NTCIP Based Advanced Transportation Controller (ATC) User Manual

Based on the National Transportation Communications for ITS Protocol (NTCIP)

Version 80.x – Cubic | Trafficware ATC Controllers

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522 Gillingham
Sugar Land, Texas 77478
Phone: (281) 240-7233
Fax: (281) 240-7238

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1 Introduction

This manual fully describes software release Version 80.x for the Cubic | Trafficware ATC controller that complies with the NEMA NTCIP 1202 versions 1 and 2. The foundation of this version is an NTCIP compliant database that is cross compatible between controllers in this version and older versions of NTCIP compliant software.

V80.x software is installed on Linux platforms and allows utilization of up to 32 vehicle phases, 32 pedestrian phases, 32 overlaps, 8 timing rings, 32 channel outputs, 100 logic lines and 128 vehicle detectors. This software can be installed on the 2070 ATC with a 2070-1C CPU and the Cubic | Trafficware Commander platforms.

2070 ATC with Linux 2070-1C module

Cubic | Trafficware Commander

2 Getting Started

2.1 ATC Operating Modes for NEMA Cabinets

The ATC controller operates in two basic NEMA cabinet configurations:

- TS2 (Type-1) – controller I/O passed as data on a high speed SDLC interface
- TS2 (Type-2) – controller I/O supplied over the SDLC and as point-to-point cabinet wiring (like TS1)

The NEMA TS2 Type-1 specification is based on an SDLC serial data link which transmits I/O messages on a high speed data path between devices in the cabinet. NEMA TS2 Type-2 supports older NEMA TS1 cabinet facilities where all I/O to the controller is point-to-point wiring to a back-panel.

Type-2 controllers operate in either TS1 or TS2 Type-1 cabinets whereas Type-1 controllers operate only in Type-1 cabinets. The I/O in TS2 Type-2 controllers (ABCD connectors) is always active regardless of the state of any SDLC interface present. However, the TS2 Type-1 SDLC interface is only active if a NEMA *Bus Interface Unit (BIU)* is programmed as active.

"Hybrid" combinations are possible that allow a TS2 controller to operate in a TS1 cabinet with all cabinet I/O from the ABCD connectors (Type-2) and detector inputs provided from a Type-1 SDLC detector rack in the same cabinet. Another "Hybrid" approach supports TS1 conflict monitors or TS2 MMU (Malfunction Management Units) in TS1 or TS cabinets.

2.2 ATC Operating Modes for 2070 Type Cabinets

The ATC controller operates in four basic 2070 type cabinet configurations:

- 2070 FIO – TEES Field I/O supports C1 connectors in 170/179 cabinets
- 2070 TS2 – Software supports TS2 Type-1 in NEMA cabinet facilities using the TEES C12S connector
- 2070N – TEES specification supports TS2 Type-2 cabinet facilities (ABCD connectors)
- 2070 ATC – TEES specification that supports the ATC cabinet currently under development

"Hybrid" combinations are possible combining these modes in the same cabinet configuration. Our company takes a unique position in the 2070 cabinet and controller market by supporting NEMA TS2 Type-1 devices using the TEES C12S connector. Because the electrical specifications for the TEES C12S and NEMA SDLC interfaces are equivalent, the 2070 can support both NEMA and TEES cabinets as a controller software option.

2.3 ATC Operating Modes for Model 340 ITS Cabinets

Cubic | Trafficware also provides Model 340 ITS Cabinets based on national and specific agency specifications. These "plug and play" cabinets provide agencies with endless configurations. The ATC controller will operate in these cabinets by communicating via a SDLC serial data link which transmits I/O messages on a high speed data path between devices in the cabinet via a specified bus system.

2.4 Hardware I/O Differences between NEMA TS2, TEES 2070, ITS Cabinet ATC Controllers

Uniformity is provided between software versions to support NTCIP for NEMA TS2, 2070 and ITS Cabinet systems using the ATC controller specifications. To the developer, this uniformity promotes a common code base that minimizes software maintenance costs and support. To the end user, this uniformity provides a common user interface and documentation base which minimizes training and support requirements. The primary differences between the cabinets is the hardware IO. Thus, separate chapters are provided which are dedicated to the Data Communications (Chapter 10), SDLC Programming (Chapter 11) and Channel and I/O Programming (Chapter 12).

2.5 Differences Between NEMA TS2 and 2070 I/O Ports

TS2, 2070 and ATC controllers support an Ethernet interface that allows the user to assign one or more IP addresses to the controller. In addition to the Ethernet interface, NEMA TS2 and 2070 I/O ports can be categorized as one of the following:

1) Asynchronous (ASYNC) – EIA RS-232 compliant devices that use hardware and software handshaking protocols

2) Synchronous (SYNC) – SDLC compliant devices that use a "synchronous clock" line to strobe data between devices

3) FIO Ports – separate inputs and outputs for NEMA Type-2, 2070N or ATC connectors (ABCD) or 170/179 C1 connectors

The NEMA platform provides a *Mode* setting for each hardware RS-232 *Com Port* that allows different software functions and protocols to be assigned to the port. For example, the *System-Up* port on a TS2 controller may be assigned a DEFAULT or NTCIP protocol to communicate with the central system. The *PC/Print* hardware port may be assigned to different software functions to communicate with a GPS, Opticom (Model 752/754) or MMU device.

As discussed in section 2.2, certain ATC controllers can provides the flexibility of operating in any NEMA, TEES or ATC cabinet configuration using a concept called "port binding". This allows a software function (system up, system down, GPS, etc) to be assigned to a software port (such as ASYNC1 or ASYNCH2) which is in turn "bound" to a physical hardware port (such as SP1 or SP2) defined by the equipment specifications. In addition, the TEES C12S connector may be bound to different software ports (such as SYNC1 or SYNC2) that support the various SDLC protocols in NEMA and ATC cabinets.

Another concept to understand fully is the difference between "port binding" and "port mapping". ***Port Binding*** associates a controller software function with a physical hardware port defined by the TS2 or TEES standard. ***Port Mapping*** allows the individual pins of an FIO port to be re-mapped to conform to specific cabinet requirements required by the user.

NEMA defines different *Port Maps* for the ABC connectors which are hardware or software selectable. We also support *Port Maps* for the D connector as a controller software feature. Custom *Port Maps* may be provided to respond to user needs.

2070 type cabinets also require different *Port Maps* for the C1 connector. We allow each pin to be customized in software through the keyboard and can provide custom *Port Maps* for specific user applications.

2.6 Database Initialization and Phase Mode Selection

TheV80.x database may be initialized with one of the following factory defaults*:*

- NO ACTION – No Initialization will occur
- FULL-CLEAR – Initializes each value in the controller database to zero
- FULL-STD8 – Initializes the controller database to *Standard 8 Phase* operations (dual-quad operation)
- FULL-DIAMD – Initializes the controller database to the TS2 Texas *Diamond Phase Mode*
- Specific user modes – reserved for a special application required by various agencies

The ***Clear & Init All*** **utility (MM->8->4->1)** allows the user to initialize the controller to a default database after turning the **Run Timer to OFF (MM->1->7)**. The run timer disables all outputs from the controller and insures that the cabinet is in flash when the database is initialized. Use caution when initializing the controller database because all existing program data will be erased and overwritten. When the **MM->8->4->1** screen indicates that the initialization is complete, the user should turn the **Run Timer to ON (MM->1->7)** to finalize the initialization (i.e. finalizing phase sequence and concurrency based on phase mode programming, latching output mapping, binding communications, etc.) and activate the unit.

After the controller is initialized, the following *Phase Modes* selected under *Unit Parameters* (**MM->1->2->1**) determine the phase structure and barriers for the unit.

- STD8 – Standard 8 Phase
- QSeq – Quad Sequential
- 8Seq – 8 Phase Sequential
- DIAM – Diamond Phase Mode
- USER – User Programmable Mode

Note: The Phase Modes are used in for standard TS2 four ring, sixteen phase operation. If using more phases or more rings, this must be set to USER.

STD8 Phase Mode is the best practice for all applications unless intersection geometry and sequencing are too complex.

When considering coordination, using STD8 mode will take advantage of the most coordination diagnostic checks to catch common data entry mistakes, and if detected, times the intersection in FREE. In USER mode, most of these coordination diagnostics are removed, and the onus is on the agency verify and test the programming to ensure that coordination pattern(s) run as expected.

3 Interface & Navigation

3.1 Keyboard and Display

Keyboard sequences in this manual are referenced to the *Main Menu* using the "Main Menu" key on the Series 900 ATC or the "*" key on the 2070 ATC controller. For example, sequence MM->1 indicates that the "1.Controller" option is selected from the *Main Menu* shown to the right.

```
               Main Menu
1.Controller 4.Scheduler 7.Status
2.Coordinate 5.Detectors 8.Login,Utils
3.Preempts   6.Comm
```

3.1.1 "Plus" Features

The controller database provides a one-to-one match with object definitions in the National Transportation and Communications for ITS Protocol (NTCIP) specification. NTCIP provides guidelines to extend the base NTCIP feature set using MIB extensions (Manufacturer Information Blocks). We refer to these MIB extensions as "Plus" Features which are identified on separate menus with the "+" character. For example, the following menu groups NTCIP based phase options under menu selection 2 and "plus" phase options under menu selection 3. Menu item 6 is also an example of a MIB extensions provided as "plus" features.

```
              Controller
1.Phases      4.Flash     7.Enable Run
2.Unit,Ring   5.Overlaps  8.Channel,I/O
3.SDLC        6.Alarms    9.I/O
```

3.1.2 Left and Right Menu Indicators and Cursor Movement

Four cursor keys provide navigation between user editable fields. If the user leaves a field that has been changed, then an implied **ENTR** key is issued. This feature eliminates an extra **ENTR** (**or ENT**) keystroke when a data field is changed.

Many menu screens display the symbol "< >". This is an indication that there are screens to the Left or Right of the current screen. Move the cursor beyond the left or right boundary to display the next screen. These menus are similar to the left and right pages of an open book. The left and right arrow keys navigate between these displays by moving the cursor past the left or right boundary of the current screen.

For example, the *Left Menu* used to program phases 1-8 is accessed using keyboard sequence MM->1->1->1. Moving to the right, you will navigate to the next screen which provides access to phases 9-16.

MM->1->1->1, Left Menu

```
Times< >..1...2...3...4...5...6...7...8
Min Grn     5   5   5   5   5   5   5   5
Gap,Ext   1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
Max 1      25  25  25  25  25  25  25  25
Max 2      50  50  50  50  50  50  50  50
Yel Clr   3.5 3.5 3.5 3.5 3.5 3.5 3.5 3.5
Red Clr   1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5
Walk     +  0   5   0   5   0   5   0   5
```

MM->1->1->1, Right Menu

```
Times< >.9..10..11..12..13..14..15..16
Min Grn     0   0   0   0   0   0   0   0
Gap,Ext   0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
Max 1       0   0   0   0   0   0   0   0
Max 2       0   0   0   0   0   0   0   0
Yel Clr   3.5 3.5 3.5 3.5 3.5 3.5 3.5 3.5
Red Clr   1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5
Walk     +  0   0   0   0   0   0   0   0
```

The "<" symbol indicates that there is a Menu to the left and a ">" indicates a Menu to the right

Scroll past the left or right boundary of with the left or right arrow keys to "wrap" the cursor to the next column in the adjacent menu.

In V80.x software, the number of phases has increased from 16 phases to 32 Phases. To accommodate the extra phases, we now have extra screens which you can navigate through. As an example, the Phase timing screens as shown below:

```
Times < >..1...2...3...4...5...6...7...8
Min Grn     5   5   5   5   5   5   5   5
Gap,Ext   1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
Max 1      25  25  25  25  25  25  25  25
Max 2      50  50  50  50  50  50  50  50
Yel Clr   3.5 3.5 3.5 3.5 3.5 3.5 3.5 3.5
Red Clr   1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5
Walk    +   0   5   0   5   0   5   0   5
```

```
Times < >..9..10..11..12..13..14..15..16
Min Grn     0   0   0   0   0   0   0   0
Gap,Ext   0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
Max 1       0   0   0   0   0   0   0   0
Max 2       0   0   0   0   0   0   0   0
Yel Clr   3.5 3.5 3.5 3.5 3.5 3.5 3.5 3.5
Red Clr   1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5
Walk    +   0   0   0   0   0   0   0   0
```

```
Times < >.17..18..19..20..21..22..23..24
Min Grn     0   0   0   0   0   0   0   0
Gap,Ext   0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
Max 1       0   0   0   0   0   0   0   0
Max 2       0   0   0   0   0   0   0   0
Yel Clr   3.5 3.5 3.5 3.5 3.5 3.5 3.5 3.5
Red Clr   1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5
Walk    +   0   0   0   0   0   0   0   0
```

```
Times < >.25..26..27..28..29..30..31..32
Min Grn     0   0   0   0   0   0   0   0
Gap,Ext   0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
Max 1       0   0   0   0   0   0   0   0
Max 2       0   0   0   0   0   0   0   0
Yel Clr   3.5 3.5 3.5 3.5 3.5 3.5 3.5 3.5
Red Clr   1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5
Walk    +   0   0   0   0   0   0   0   0
```

Depending on the type of ATC controller, the user will view a 4-line display or an 8-line display of 40 characters per line. Additional lines are accessed using the up arrow ("↑") and down arrow ("↓") keyboard keys to move the cursor past the top and bottom boundaries of the screen. The TS2 menu indicates that additional lines are available off screen with an arrow symbol. The cursor may also be moved one page at a time using the Page Up ("▲Page" or "+") and Page Down ("Page▼" or "-") keys on the controller keyboard.

Data that is edited is entered into the controller's RAM immediately and will be stored in the controllers EEPROM. Thus after a power down/up the edited data will saved until edited again. As an example, this includes the Run Timer (MM->1->7). If the Run Timer is in the OFF state when the controller is shut off, then the Run Timer will remain in the OFF state upon reboot until manually turned ON.

3.1.3 Audible Tone

An audible tones are produced to indicate the result of each keystroke. Set *Tone Disable* to ON under *Unit Parameters* (MM->1->2->1) to turn off all audible tone indications. This is a Legacy feature and is available based on specific controller types.

Error Tone

A single long tone (approximately 1/3 second) indicates that an operation is unsuccessful, when a value entered is out of range or as a warning message.

3.1.4 Entry Field Types

Toggle Fields

Toggle fields are on/off entries that are toggled with any number key on the keyboard. A toggle field is enabled (or true) if the value shown is the 'X' character. A toggle field is disabled (or false) if the value shown is a '.' character.

Numeric Fields

Numeric data fields accept entries as whole numbers, decimal numbers, dates or time-of-day. Pressing a numeric key corresponding to a desired digit makes an entry to the numeric field. For multi-digit fields, the left-most or most-significant digit is entered first. As each subsequent digit is entered, the left-most digit is shifted left so that the entire number is right justified in the field. This entry/sequence is similar to the data entry used with most calculators.

Selection Fields

Selection fields are multiple choice entries toggled by any numeric keys. Examples of selection fields are day-of-week entries and flash settings.

Selection Field Groups

Selection field groups consist of two to eight fields on the same row that are updated as a group. Programming these fields can be done without moving the cursor. With the cursor on the row that you wish to edit, place it so that it rests between the first entry and the row label. Next, to cycle any entry of the group, press the numeric key that correlates with the field in the column you wish to edit.

Select/Proceed Fields

Select/proceed fields are places where the cursor stops to allow the operator to issue a command to the controller. The two main occurrences of these fields are inside menus and on warning screens. Menu screens allow the user to move the cursor to the number of the menu item, and then press **ENTR** or **ENT** to make the selection. The user may also press the number that correlates to the menu option of choice. Warning screens prompt the user with instructions to cancel or to proceed with the command that created the warning.

3.1.5 Function Keys

BACK or Escape Key

The **BACK** or **ESC** key causes the controller to exit the active screen and display the previous screen. Each previous screen will be accessed until the main menu is reached. If **BACK** or **ESC** is pressed prior to saving (pressing enter) data that has been entered in an edit field, then the controller will display a warning screen allowing the user to abort the escape operation, thus giving the user an opportunity to save the data.

Enter Key

The **ENTR (ENT)** key instructs the controller to process the current field. In the case of data entry fields, this instructs the controller to store the new value in memory. If the screen is a select field, then the controller will load the specified screen or take the desired action. In the case of proceed fields, an enter correlates to a 'yes'.

Display Control Key

The display control key offers the user a quick way to move to the *Main Menu*, and turn on display backlighting. If the **MAIN MENU** ("*****") key is pressed in any location other than the main menu, then the controller will immediately return the user to the main menu.

Alternate Function Key

The alternate function key provides access to various features such as help and the default status screen. The **ALT** (or '**F**') is used in combination with other keystrokes defined in the next section.

3.1.6 Alternate Functions

Alternate function key sequences require two keystrokes. First press and release the **ALT** key (TS2) or the '**F**' key (2070), then immediately press and release the key that corresponds to the desired function.

Help Screen (ALT, ALT , HELP , 'F' 'F' or 'E')

The Help command causes the controller to load context sensitive help. When the help function is executed, the controller displays help information that corresponds to the screen or fields where the cursor is located.

Restore/Clear Field (ALT, BACK or 'F' ESC)

The restore command restores the original contents of a data entry field. Once the value in a field has been changed, if the user wants to revert back to the original contents of the field prior to having pressed **ENTR (ENT)**, they may select this alternate function and the original contents will be placed in the active field.

Back-Light Control (ALT, MAIN/DISP)

The backlight alternate function allows the user to toggle the back lighting on/off without having to be in the main menu. On the series 900 ATC you also have 2 other backlight control keys, the brightness key and the contrast key .

Clear Data (ALT, 7 or 'F' 7)

The communications status screen (**MM->6->7**) and the clear MMU Permissives screen (**MM->1->3->4**) feature a way to clear data using the 'C" key on a 2070 ATC or **ALT,7** keystrokes on a series 900 ATC.

Show Phase Inhibit Status (ALT,8, 'D')

When viewing the Controller Status screen (**MM->7->1**), the user can view Phase inhibits (**I**) by depressing the **ALT,8** or '**D'** key as shown below:

```
R1 Pclr   5   P.12345678 90123456 seq 01
P4 Ext  0.0 A/N ...A...A ........ STD8
R2 Pclr   5 Veh CRI.CRI. 00000000 Loc011
P8 Ext  0.0 Ped ICI.ICI. IIIIIIII CoLong
R3 -ALL RED
P0 RRev 0.0
R4 -ALL RED
P0 RRev 0.0
```

Overview Status Screen (ALT, 9 or : 'F' 9)

```
Controller Monitor     Cabinet    System
 TIMING    | OK        | OK       | OFFLIN
 FREE      |           |          |
           |           |          |
```

The ***Controller*** section in the overview status screen reports:

- OFF – controller *Run Timer* is OFF
- TIMING - FREE or COORD also displayed with TIMING
- FLASH-LS or FLASH-CVM - controller initiated flash through load switches (LS) or dropping CVM to the monitor The cause of flash is also displayed as STARTUP, AUTOMATIC, PREEMPT SDLC or **FAULT** If **FAULT** is displayed, the cause is also displayed as CRIT SDLC, MMU PERM or MMU FIELD
- STOP-TIME **-** If STOP-TIME is displayed, then INPUT or MAN-CNTRL is also displayed
- SEQ TRANS – if there is an error transitioning to a new sequence that places a phase in a different ring.
- INIT-ERR – Displayed when the controller fails to start running due to an initial ring/phase error. Although the screen only shows INIT ERR, the following are the List of errors codes provide general information about the reason for failure that will assist the user if diagnosing the initialization issues:
    - INIT Err1 – Two phases in one ring are set to be active at startup
    - INIT Err2 – One phase does not have a proper initial entry
    - INIT Err3 – "Yellow Next" phase is not in ring sequence
    - INIT Err4 – Initialization phases are not compatible with "yellow next" phase
    - INIT Err5 – Compatible phases in a group do not reference each other
    - INIT Err6 – Ring sequence does not agree with ring assignment in phase programming
- PROCESSOR – is displayed if the controller has a CPU fault has multiple power failures in a 24 hour period.
- RESTART – is displayed if the controller restarts unexpectedly.
- START-UP – is displayed when the controller is timing the Startup Flash interval
- T&F BIU or MON – This is displayed for any enabled T&F BIU or MON that does not respond upon power-up. If they do not respond, it will causes the controller to remain in flash but it does not accumulate errors on the SDLC status screen, which occurs only after a device has been successfully communicated with.
- DBASE – Occurs when the controller cannot write the Database to the hardware drive.

The ***Monitor*** status displays OK, FAULT, RESET (if monitor reset button is pressed) or NO DATA (if the controller is programmed to communicate with a Monitor and the SDLC to the Monitor is not active). If the *Monitor* is in a FAULT, an additional status message is displayed to show the cause of the fault (CVM/FltMon, 24V-1, CONFLICT, RED-FAIL, etc.).

```
Controller Monitor     Cabinet    System
 FLASH LS | FAULT     | OK       | OFFLIN
 FAULT    | CONFLICT  |          |
 MMU PERM |           |          |
```

The controller performs redundant conflict monitoring on its output. The monitoring uses the Permissive configuration for either the MMU or the CMU, whichever is present. If a conflict is discovered, the controller will go into flash. The screen to the right is a sample of the status screen when such an error is triggered:

The ***Cabinet*** status displays OK, FLASH or NO DATA (if the controller is programmed to communicate with a Terminal Facility BIU and the SDLC to the cabinet is not active). If the *Cabinet* is in FLASH, then the cause is also displayed as LOCAL (from a cabinet switch) or Monitor.

The ***System*** status displays OFFLINE if the controller is not programmed to operate in a closed-loop system. If the controller is programmed for closed-loop, the System will displays ON-LINE if the controller is communicating with a master or FALLBACK if the fallback timer has expired indicating communications is disrupted.

Any Keystroke after this screen is displayed will result in the screen below which will indicate controller hardware/software information. This screen in particular will display, the MAC address, Controller software version/ Build number, and the Hardware / Operating system type.

```
Naztec Int Ctrl    74:46:a0:92:6c:d4
Version: 80.3A Build 5876 ---> Linux

(c) Naztec, Inc. 06/10/17 21:37:47
```

4 Basic Controller Operation

The *Controller Main Menu* (MM->1) accesses the basic operating features of the controller.

```
              Main Menu
1.Controller 4.Scheduler 7.Status
2.Coordinate 5.Detectors 8.Login,Utils
3.Preempts   6.Comm
```

```
               Phases
1.Times    4.Ring,Start,Concur 7.Times+
2.Options  5.Call,Inh,Redirect 8.Copy
3.Options+ 6.Alt Progs+        9.AdvWarn
```

4.1.1 Phases Modes of Operation (MM->1->1)

A controller services competing demands for right-of-way from vehicle and pedestrian *phases*. A *phase* is composed of vehicle and pedestrian intervals assigned to each traffic movement at an intersection. Thirty-two separate vehicle/pedestrian phases are provided that may be serviced sequentially (in a common ring) or concurrently (in separate rings). The *phase sequence* defines the order of the phases in each ring and *concurrency* defines which phases may be active in separate rings at the same time.

Vehicle detectors and pedestrian detectors (push-buttons) call phases during the red / don't walk interval to request service from the controller and *extend* the phase after a call from a competing phase is received. The controller provides a set of base phase timings (min green, walk, vehicle and pedestrian clearances) and a series of detector settings to control the extension of green when a competing call is received from another phase. The three modes of operation that extend a phase are the *Vehicle Actuated Mode, Volume Density Mode* and *Pedestrian Actuated Mode*.

Vehicle and Pedestrian Detectors Place a Service Demand on the Phase

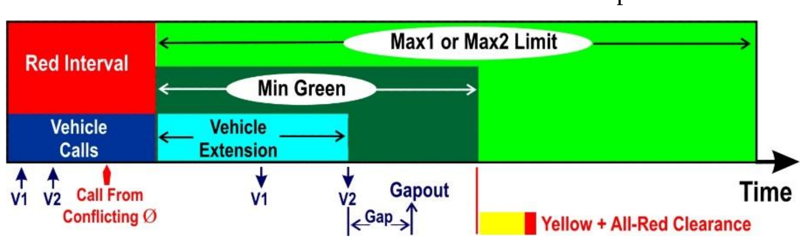
4.1.2 Vehicle Actuated Mode

The *Vehicle actuated mode* guarantees a m*inimum green* period to service vehicle calls received during the red interval. Vehicle detectors may extend the *minimum green* up to a *Max1* or *Max2* limit unless a *Gap,extension* timer expires. Vehicle actuated mode applies a fixed *Gap,extension* timer to limit the extension of phase green.

The *Minimum Green* and *Vehicle extension* timers begin counting down at the onset of green. *Vehicle extension* allows detector actuations to extend the phase as long as the *Gap,extension* timer has not expired between actuations. The *max* timers limit vehicle extension and begin during the green interval after a conflicting vehicle or pedestrian call is received on another phase. The *max* setting (either *Max1* or *Max2)* is selectable by time-of-day.

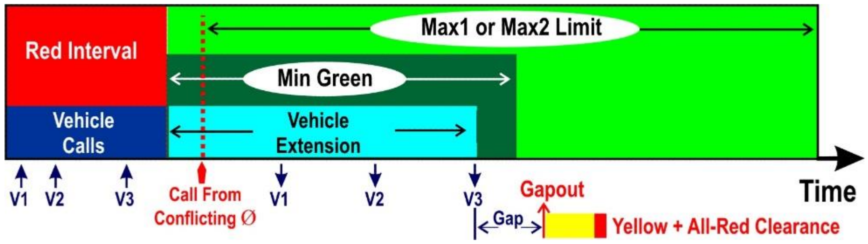
In the example below, two vehicles call the phase during the red interval from a presence detector located at the stop bar. When the phase turns green, these two vehicles leave the presence detector before the *Minimum Green* time expires and a "gap-out" occurs after the *Gap,extension* timer expires. In this case, the *minimum green* time is guaranteed even though the gap timer has expired. The phase will terminate after timing yellow and all-red clearance because a conflicting phase has requested service. During red clearance, all phases display a red indication.

A phase will dwell (or rest) in the green interval in the absence of a conflicting call unless *Red Rest* is programmed for that phase. *Red Rest* will cause the phases to remain in red until another call is received. *Red Revert* controls how quickly a phase may be reserviced once it has entered red rest and another call is received for that phase.



Minimum Green is Guaranteed When Gap-out Condition Occurs

In the example below, a third vehicle actuation extends *vehicle extension* past the end of minimum green. Vehicle detectors may continue to extend the phase green up to the *Max1* or *Max-2* limit after a conflicting phase is called. However, once a "gap-out" occurs, the phase will terminate with a yellow and all-red clearance so that a conflicting phase may be serviced during the phase red interval.



Vehicle Detectors May Extend the Green to the Max1 or Max2 limit

In summary, vehicle actuated mode arbitrates demand for service from competing phases by:

- Limiting the *minimum green* guaranteed to the phase
- Limiting the *extension of green* based on the *Gap,extension* (or gap separation) between vehicles
- Limiting the *maximum green* after a call for service is received from a competing phase

4.1.3 Volume Density Mode

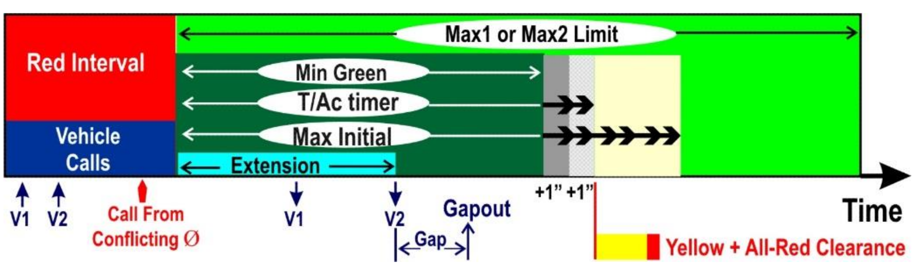
Volume Density Mode extends vehicle-actuated operation by:

- Extending *Minimum Green* based on the number of vehicle calls during the yellow and red intervals
- Reducing *Gap,extension* over a specified period to a specified minimum gap setting

The variable initial time is essentially the sum of the *Minimum Green* and the accumulated *Added Initial* time. The *Added Initial* parameter specifies the number of seconds accumulated per actuation during the yellow and red interval of the phase. Variable initial time may not be increased beyond the limits of the *Max Initial* parameter. The accumulated *Added Initial* time is reset after the phase green has been serviced. If the *Added Initial* time is calculated to be less that the Minimum green, *Minimum Green* time is guaranteed.

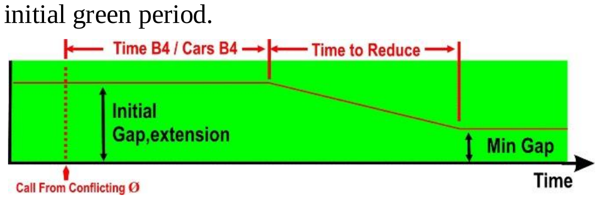
In the example below, *Added Initial* is set to 1" and "times per actuation" (*T/Ac*) is set initially to the *Minimum Green*. *T/Ac* is extended by 2 vehicle calls each adding 1" of *Added Initial* to the *T/Ac* timer. During *Min Green*, the *Gap,extension* timer "gaps-out" sending the phase to *Yellow + All-Red Clearance* after the *T/Ac* timer expires.

The *T/Ac* timer guarantees the *Min Green* plus *Added Initial* (2" in this example). Additional calls received during the *Yellow* and *Red* interval may increase the *T/Ac* timer up to the *Max Initial* setting.



Added Initial Features Provided by Volume Density Operation

Gap reduction may be delayed using *Time Before Reduction* (TBR) or *Cars Before Reduction* (CBR). TBR delay begins after the start of green when a conflicting phase is received and continues to countdown as long as there is a serviceable conflicting call. TBR is reset if the conflicting call goes away. The *Cars Before Reduction* (CBR) delay expires when the sum of the vehicles counted on the associated phase detector is greater than the CBR value specified. Both approaches delay the reduction of the gap while the initial queue dissipates during the initial green period.



After the TBR or CBR delay expires, the initial *Gap,extension* will be reduced to the *Min Gap* value over the *Time to Reduce* (TTR) period. The *Min Gap* value limits the reduction of the *Gap,extension* time as illustrated to the right. If all serviceable conflicting calls are removed, *Gap,extension* , TBR and TTR will reset and gap reduction will not take place until the next serviceable conflicting call is received. The *Min Gap* value is the limiting headway (of separation between vehicles) needed to extend the green interval to the *Max1* or *Max2* setting.

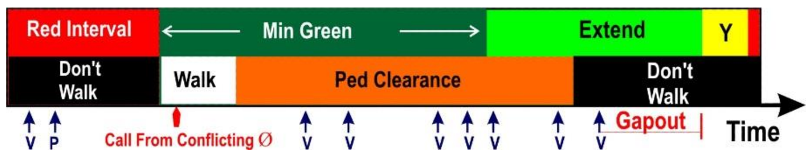
4.1.4 Pedestrian Actuated Mode

Pedestrian displays always time concurrently with the vehicle displays of a phase. During free operation, if a pedestrian call is being serviced and no vehicle calls are present to extend the phase, the pedestrian clearance interval will end at the onset of yellow as shown below. The "Don't Walk" indication flashes during the *pedestrian clearance* interval and changes to a steady "Don't Walk" indication at the end of *ped clearance*. If the associated phase is resting in green, a subsequent pedestrian call will reinitiate (or recycle) pedestrian sequence if there is not a call (or check) on a conflicting phase. The phase cannot enter its yellow clearance until the pedestrian clearance ceases, unless *PedClr-Through-Yellow* is enabled as a *Phase Option*. *PedClr-Through-Yellow* allows flashing "Don't Walk" to time concurrently with yellow clearance.

Ped Clearances Ends Prior to Vehicle Clearance if *PedClr-Thru-Yellow* is Not Enabled

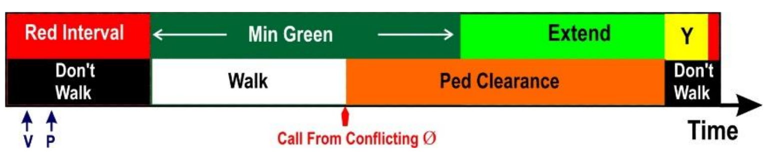
Ped Clearances Times With Vehicle Clearance if *PedClr-Thru-Yellow* is Enabled

Enabling *PedClr-Thru-Yellow* reduces the total time provided to the pedestrian by the yellow clearance time if the walk time and ped clearance time remain constant. Therefore, if *PedClr-Thru-Yellow* is enabled, do not add the yellow clearance interval to ped clearance when calculating the ped crossing time. Vehicle detection may extend the green beyond the end of the pedestrian clearance interval as shown below and is by *Max-1* or *Max-2* after a call is received from a competing phase.



In Free Operation, Vehicle Calls May Extend the Green Beyond Ped Clearance

If *Rest-in-Walk* is enabled for the phase, the controller will rest in the walk interval in free operation until a conflicting call is received. During coordination, this feature insures that the end of ped clearance occurs at the force-off point of the phase.



In Free Operation, Rest-In-Walk Extends Walk Until a Conflicting Phase is Received

[*Grn/Ped Delay*] allows the beginning of the green interval or the beginning of the walk to be delayed by a programmed amount as illustrated below: This feature is fully discussed under *Phase+ Options*.

Green Delay Used to Suppress the Start of Green When a Ped Call is Serviced

Ped Delay Used to Suppress the Start of Walk When a Ped Call is Serviced

4.1.5 Phase Times (MM->1->1->1)

Minimum Green (Min Grn)

```
Times < >..1...2...3...4...5...6...7...8
Min Grn    5   5   5   5   5   5   5   5
Gap,Ext  1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
Max 1     25  25  25  25  25  25  25  25
Max 2     50  50  50  50  50  50  50  50
Yel Clr  3.5 3.5 3.5 3.5 3.5 3.5 3.5 3.5
Red Clr  1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5
Walk   +   0   5   0   5   0   5   0   5
```

The *Minimum Green* parameter (0-255 sec) determines the minimum duration of the green interval for each phase. When setting this time, consider the storage of vehicles between the detector and the stop-bar for the associated approach.

Gap, Extension (Gap, Ext)

Gap,extension (also known as *Passage* time) determines the extensible portion of the green interval (0-25.5 sec). The phase remains in the extensible portion as long as an actuation is present and the passage timer has not expired. The timer is reset with each subsequent actuation and does not start timing again until the actuation is removed.

Max-1 Green (Max 1)

Max-1 (0-999 sec) limits the maximum time of the green interval after a serviceable conflicting call is received. The maximum green timer does not begin timing until a serviceable conflicting call is received. *Max-1* is set as the default max setting but may be overridden *Max-2.*

Max-2 Green (Max 2)

Max-2 (0-999 sec) also limits the maximum time of the green interval after receiving a serviceable conflicting call. *Max-2* may be selected by ring from an external controller input or as a pattern option. *Max-2* may also be selected by-phase under *Phase Options+* (next section). This last method allows *Max-1* to be enabled for some phases and *Max-2* for others.

Yellow Clearance (Yel Clr)

The *Yellow Clearance* parameter (0-25.5 sec) determines the yellow clearance interval of the associated phase.

Red Clearance (Red Clr)

The *Red Clearance* parameter (0-25.5 sec) determines the all-red clearance interval of the associated phase.

Walk (Walk)

The Walk time parameter provides the length of the walk indication (0-255 sec).

```
Times < >..1...2...3...4...5...6...7...8
Ped Clr -   0  10   0  10   0  10   0  10
Red Revt 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
Add Init 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
Max Init    0   0   0   0   0   0   0   0
Gap Reduce
 Time B4    0   0   0   0   0   0   0   0
 Cars B4+   0   0   0   0   0   0   0   0
```

Pedestrian Clearance (Ped Clr)

Pedestrian Clearance (0-255 sec) is the duration of the flashing pedestrian clearance ("Don't Walk") output.

Red Revert Time (Red Revt)

The *Red-Revert* Time parameter determines the minimum time (0-25.5 sec) that the phase must remain in red rest before it is recycled to green. The controller uses the greater of the phase *Red-Revert Time* or the *Unit Parameter, Red-Revert*, to limit how quickly each phase green is recycled.

Added Initial (Add Init)

Added-Initial (0-25.5 sec) is an optional volume-density feature that extends after the *Minimum Green* timer expires. *The T/Ac* (time per actuation) timer is set initially to *Min Green*. Each detector actuation during the yellow and red interval extends the *T/Ac* timer by the *Added Initial* value if the detector option *Added-Initial* is enabled. Detector actuations received during the red interval continue to extend *T/Ac* by the *Added Initial* value until the *Max Initial* limit is reached. In this way, the *T/Ac* timer behaves as a parallel timer with *Min-Green*. The greater of *Min-Green* or *T/Ac* defines the minimum green time period.

Maximum Initial (Max Init)

Maximum-Initial (0-255 sec) is an optional volume density feature that limits the extension of *Min Green* using *Added Initial*. The minimum or guaranteed green period cannot be greater than the *Max Initial* value specified. Note, that added-initial operation is defeated if one of the three following conditions is satisfied. If any of these conditions are true, then *Min Green* guarantees the initial green of the phase.

- *Max Initial* is equal to of less than the *Min Green* value assigned to the phase.
- The *Added Initial* value assigned to the phase is zero.
- The *Added.Initial* detector option is not enabled for the detectors calling the phase.

Time Before Reduction (Time B4)

Times < >	1	2	3	4	5	6	7	8
Time B4-	0	0	0	0	0	0	0	0
Cars B4	0	0	0	0	0	0	0	0
Time To	0	0	0	0	0	0	0	0
ReducBy	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Min Gap	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DyMaxLim	0	0	0	0	0	0	0	0
Max Step	0	0	0	0	0	0	0	0

Time-Before-Reduction (0-255 sec) delays gap reduction after receiving a conflicting call. After *Time-B4* expires, the unit begins reducing *Gap,extension* over the specified *Time-to-Reduce (TTR)* period. Gap reduction is an optional volume density feature that is limited by the *Min Gap* value specified for the phase.

Cars Before Reduction (Cars B4)

Cars-Before-Reduction (0-255 vehicles) is an alternate method to delay gap reduction after a serviceable conflicting call. This feature applies the total number of detector actuations received during the yellow and all-red intervals to calculate the delay. Gap reduction begins when the total detector actuations exceeds the *Cars-B4* value or after the *Time-B4* timer expires (whichever comes first). After the *Cars-B4* or *Time-B4* delay, passage time is reduced to the *Min Gap* in a linear fashion during the *Time-to-Reduce (TTR)* period.

Cars-Before-Reduction does not replace *Time-Before-Reduction* and both are active at the same time. Therefore, set *Time-Before-Reduction* greater than *Max-1* to force the controller to use *Cars-Before-Reduction*. The detector option, *Added.Initial* must also be enabled for calling detector to enable *Cars-Before-Reduction*.

Time To Reduce (TTR)

Time-to-Reduce (0-255 sec) is an optional volume-density parameter used reduce *Gap,extension* to the *Min Gap*. The linear rate of change applied to gap reduction is the difference between *Gap,extension* and *Min Gap* divided by *TTR*. For example, assume that *Gap,extension* is initially set to 4.5 seconds, *Min Gap* is set to 3.2 seconds and *Time-to-Reduce (TTR)* is set to 40”. The gap reduction rate over the TTR period is (4.5” – 3.2”) / 40” or 0.033” of gap reduction per second. Therefore, the first reduced passage time is 4.5” – (4.5” * 0.03”) = 4.4”. The second passage time is 4.4” – (4.4” * 0.03”) = 4.3”. Gap reduction continues in a linear fashion over the *Time-to-Reduce* period to reduce passage to the *Min Gap.*

Reduce By (ReducBy)

The *Reduce-By* parameter (0-25.5 sec) provides an NTCIP alternative to linear gap reduction. *Time-To-Reduce* specifies the period over which the *Gap,extension* time is reduced. However, instead of reducing *Gap,extension* in a linear fashion , the extension time is reduced by the *Reduce By* time equally over the *TTR* period.

Minimum Gap Time (MinGap)

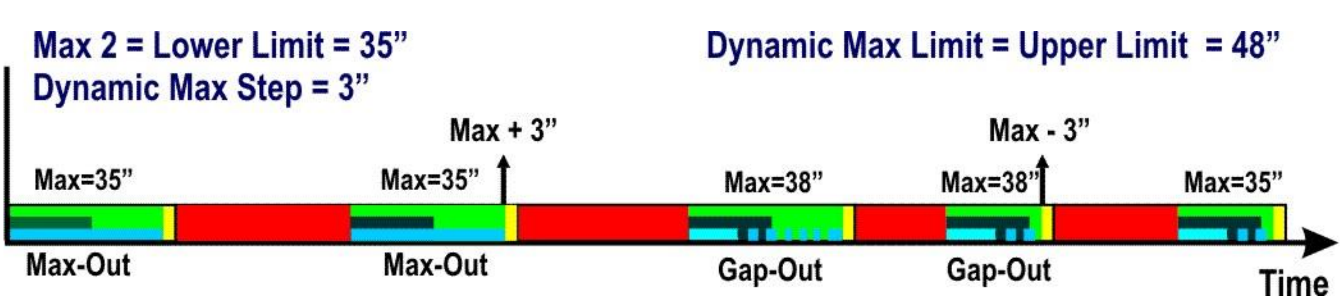
The *Minimum-Gap Time* specifies the lowest allowable time (0-25.5 sec) to which the gap time can be reduced.

Dynamic Max Limit (DyMaxLim)

Dynamic-Max-Limit (*0-999 sec*) and active maximum (MAX1, MAX2) determine the upper and lower limit during dynamic max operation. If the *dynamic max limit* is greater than the active Max-1 or Max-2, then it becomes an upper limit. If the *dynamic max limit* is less than the active Max-1 or Max-2, then it becomes a lower limit. Maximum recall or a failed detector that is assigned to the associated phase disables dynamic max operation for the phase.

Dynamic Max Step (Max Step)

Dynamic-Max-Step (0-25.5 sec) determines the stepwise adjustment to the max time. When a phase maxes out twice in a row **and on each successive max out thereafter**, one dynamic max step value shall be added to the running max until such addition would mean the running max was greater than the larger of normal max or dynamic max limit. When a phase gaps out twice in a row, **and on each successive gap out thereafter**, one dynamic max step value shall be subtracted from the running max until such subtraction would mean the running max was less than the smaller of the normal max or the dynamic max limit. If a phase gaps out in one cycle and maxes out in the next cycle, or vice versa, the running max will not change.



4.1.6 Phase Options (MM->1->1->2)

```
< Options      ..1..2..3..4..5..6..7..8>
      Enable P X  X  X  X  X  X  X  X
    Min Recall .  .  .  .  .  .  .  .
    Max Recall .  .  .  .  .  .  .  .
    Ped Recall .  .  .  .  .  .  .  .
   Soft Recall .  .  .  .  .  .  .  .
    Lock Calls .  .  .  .  .  .  .  .
Auto Flash Entry+.  .  .  .  .  .  .  .
```

Enable Phase (Enable)

Enable is the most important phase option because unless a phase is e*nabled* it can never be serviced. When a controller is initialized, phases 1-8 are *enabled* and phases 9-32 are *not enabled* by default.

Minimum Vehicle Recall (Min Recall)

Minimum-Recall places a call on the associated phase when the phase is not timing the green interval. *Minimum Recall* only "calls" the phase and does not "extend" the phase during the *Minimum Green* interval. **NOTE: Programming any Coordination Split Mode (MM->2->7->1) other than NON, will override this selection.**

Maximum Vehicle Recall (Max Recall)

Maximum-Recall places a call on the associated phase while the phase is timing the red and yellow intervals, and extends the associated phase to the *Maximum Green* time. **NOTE: Programming any Coordination Split Mode (MM->2->7->1) other than NON, will override this selection.**

Pedestrian Recall (Ped Recall)

When enabled, *Pedestrian-Recall* causes a recurring call similar to an external call. However, it will not recycle pedestrian service until a conflicting phase has been served. **NOTE: Programming any Coordination Split Mode (MM->2->7->1) other than NON, will override this selection.**

Soft Vehicle Recall (Soft Recall)

Soft-Vehicle-Recall generates a call on the associated phase when all conflicting phases are in Green Dwell or Red Dwell, and there is no serviceable conflicting call. **NOTE: Programming any Coordination Split Mode (MM->2->7->1) other than NON, will override this selection.**

Lock Calls (Lock Calls)

When *Lock-Calls* (also known as "memory on") is enabled, any call during the yellow or red interval places a constant call for service on the phase and sets the NEMA "check" output for that phase. *Lock-Calls* ensures that the call remains in effect until the phase is serviced, even if the detector call is removed. If *Lock-Calls* is not enabled, the *Yellow.Lock* and *Red.Lock* detector options (**MM->5->2**, right menu) determine the locking options for each detector calling the phase.

Detector placement usually determines whether the phase is locked or not locked. Phases called by stop-bar detectors are typically not locked to allow permitted left-turn and right-turn-on-red movements to remove the call on the phase. Phases called by approach detectors set back more than one car length from the stop-bar are generally locked.

Automatic Flash Entry Phase (Auto Flash Entry)

```
< Options      ..1..2..3..4..5..6..7..8>
Auto Flash Exit -.  .  .  .  .  .  .  .
      Dual Entry .  X  .  X  .  X  .  X
Enable Simul Gap X  X  X  X  X  X  X  X
Guarantd Passage .  .  .  .  .  .  .  .
    Rest In Walk .  .  .  .  .  .  .  .
Condit'l Service .  .  .  .  .  .  .  .
  Non-Actuated 1+.  .  .  .  .  .  .  .
```

When *Automatic-Flash* is activated, the controller continues to service the phases in the current sequence. After the programmed *Automatic-Flash Entry Phases* are serviced, the controller will clear to all-red, then proceed to the programmed flashing operation until the *Automatic-Flash* input is deactivated.

Automatic Flash Exit Phase (Auto Flash Exit)

After the *Automatic-Flash* input is deactivated, the controller will exit programmed flash and proceed to the beginning of the *Automatic-Flash Exit Phases.*

Dual Entry (Dual Entry)

Dual-Entry phases are called into service when a concurrent phase in another ring is serviced. This insures that a phase in each ring is always being serviced even when there is only a demand for service in one ring. The through phases are usually programmed for *Dual-Entry* to allow the ring without the call to rest in the through movement. Dual Entry should **NOT** be set on any phases that are a part of a barrier which is not fully concurrent. The reason is because the Dual Entry programming checks to see if the phase that is next is compatible with the dual-entry phase using the assumption that the software is crossing a barrier.

Enable Simultaneous Gap (Enable Simul Gap)

Enable-Simultaneous-Gap allows the *Gap,extension* timer to reset if the phase(s) in the other ring(s) have not gapped out. When *Enable-Simultaneous-Gap* is not set and the phase is at a barrier, it will remain gapped out and be ready to cross the barrier when the phases in the other ring(s) gap out. *Enable-Simultaneous-Gap* is typically set for the "main street" phases to allow *Gap,extension* to reset in free operation.

Guaranteed Passage (Guarantd Passage)

```
< Options      ..1..2..3..4..5..6..7..8>
Guarantd Passage-.  .  .  .  .  .  .  .
    Rest In Walk .  .  .  .  .  .  .  .
Condit'l Service .  .  .  .  .  .  .  .
  Non-Actuated 1 .  .  .  .  .  .  .  .
  Non-Actuated 2 .  .  .  .  .  .  .  .
 Added Init Calc S  S  S  S  S  S  S  S
 Hold To Max     .  .  .  .  .  .  .  .
```

Guaranteed-Passage-Time is an optional volume-density feature used with gap reduction. Enabling *Guaranteed- Passage-Time* insures that one full *Gap,extension* time is provided to the last vehicle after a gap-out condition. This insures that the actuated phase retains the right-of-way for a period equal to the difference between the *Gap,extension* time and the reduced gap before the green interval terminates.

Rest In Walk (Rest in Walk)

In free operation, *Rest-In-Walk* causes a phase to rest in walk until there is a serviceable conflicting call. *Rest-In-Walk* may be used under coordination to time the end of ped clearance at the beginning of yellow clearance. The walk should always be recycled when using *Rest-In-Walk* in coordination (see chapter 6).

Conditional Service (Condit'l Service)

Conditional Service causes a gapped/maxed phase to conditionally service a preceding actuated phase in the same ring if sufficient time remains in the phase prior to being maxed out. To set this, program the phase that gaps or maxes out, not the preceding phase. For example, phases 2 and 6 are straight through phases and phases 1and 5 are leading left turns. If you desire to serve phases 1 and 5 again, program phases 2 and 6 as conditional service phases.

Non-Actuated 1 and Non-Actuated 2 (Non-Actuated 1, Non-Actuated 2)

Non-Actuated 1 allows the programmed phase(s) to respond (be called) to external hardware input CNA1. *Non-Actuated 2* allows the programmed phase(s) to respond (be called) to external hardware input CNA2.

Added Initial Calculation (Added Init Calc)

The *Added-Initial-Calculation* controls added initial is applied under volume-density operation and may be set to:

- 'S' - Sum of the added initial from all of the detectors calling the phase during the yellow and red interval
- "L" - use the Largest value from the group of added initial detectors calling the phase

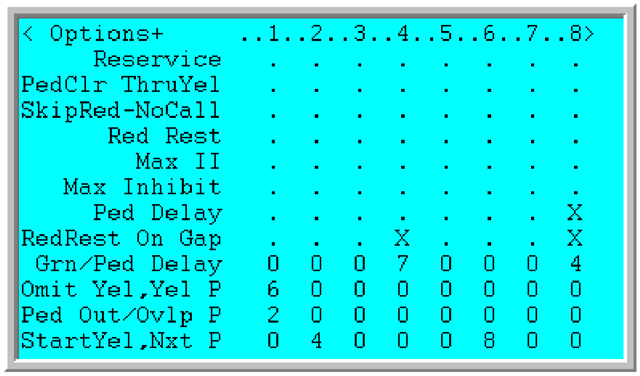
Hold to Max (Hold to Max)

This feature runs during coordination. It is a way to select a hold on any non-coordinated phases for the entire programmed split time, if the phase is actuated (receives a call). If the phase is not actuated, then the split will run as normal.

4.1.7 Phase Options+ (MM->1->1->3)

Reservice (Reservice)

Reservice works in conjunction with *Conditional Service* (discussed in the last section). Once a phase leaves to conditionally service a previous phase, it cannot be serviced again until the next cycle unless *Reservice* is enabled for that phase and there is enough time left in the phase (prior to being maxed out) to service the original phase. Program the phase that was conditionally serviced to allow the original phase to be reserviced. For example, phases 2 and 6 are straight through phases and phases 1and 5 are leading left turns. If you desire to reservice phases 2 and 6 again, program phases 1 and 5 as reservice phases.



PedClr Thru Yellow (PedClr ThruYel)

When *PedClr-Thru-Yellow* is enabled, the end of the pedestrian clearance interval times concurrently with the yellow clearance interval. When *PedClr-Thru-Yellow* is not enabled, ped clearance always ends before the yellow vehicle clearance begins.

SkipRed-NoCall (SkipRed-NoCall)

SkipRed-NoCall allows the red clearance interval to be skipped if there is not call on a terminating phase during the yellow clearance interval. *SkipRed-NoCall* is enabled on a per-phase basis

Red Rest (Red Rest)

Red-Rest allows a phase to rest in red instead of green dwell in the absence of any calls. If *Red-Rest* is enabled and no other phases are called, the phase will terminate the green after a "gap-out" condition and move to the red rest state. The phase will remain in red rest in the absence of calls and can return to service after the *Red-Revert* timer has expired. An external *Red-Rest* inputs will override this software feature for the associated ring.

Red Rest on Gap (RedRest on Gap)

When enabled, *Red Rest on Gap* allows a phase to gap-out and remain in red-rest in the absence of calls on other concurrent phases in the same ring.

Max II (Max II)

When *Max II* is enabled for a phase, *Max II* is applied with or without and external Max II controller input or pattern entry calling for *Max II*. Note that a mixture of *Max I* and *Max II* settings may be accomplished with this feature because Max II may be enabled for some phases and not others.

Max Inhibit (Max Inhibit)

This feature allows the selection of *Max Inhibit* by phase under coordination rather than a *Coord Mode* option (MM->2->1) which applied inhibit max to all phases

Ped Delay (Ped Delay)

Ped-Delay works together with *Grn/Ped Delay* described below to either delay the start of the green or the walk interval when a pedestrian call is **first** serviced. **Note that if the phase is currently active, this feature has no effect.**

< Options+	..1	..2	..3	..4	..5	..6	..7	..8>
Reservice	.	.	.	.	.	.	.	.
PedClr ThruYel	.	.	.	.	.	.	.	.
SkipRed-NoCall	.	.	.	.	.	.	.	.
Red Rest	.	.	.	.	.	.	.	.
Max II	.	.	.	.	.	.	.	.
Max Inhibit	.	.	.	.	.	.	.	.
Ped Delay	.	.	.	.	.	.	.	X
RedRest On Gap	.	.	.	X	.	.	.	X
Grn/Ped Delay	0	0	0	7	0	0	0	4
Omit Yel,Yel P	6	0	0	0	0	0	0	0
Ped Out/Ovlp P	2	0	0	0	0	0	0	0
StartYel,Nxt P	0	4	0	0	0	8	0	0

If *Ped-Delay* is enabled with an "X", the walk interval is delayed by the *Grn/Ped Delay* time. In the screen to the right, *Ped-Delay* is enabled for phase 8 and the *Grn/Ped Delay* is 4". When a pedestrian call is first serviced, the pedestrian walk period is delayed 4" after the start of green on phase 8. During this delay period, you will observe "DlyW" displayed in the status screen under **MM->7->1**.

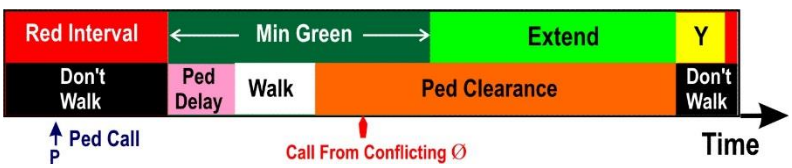
If *Ped-Delay* is disabled, the start of green is delayed by the *Grn/Ped Delay* time. This leading pedestrian interval (**LPI**) feature allows the pedestrian to enter the crosswalk while the vehicle indication is red. In the above screen, *Ped-Delay* is not enabled for phase 4 and *Grn/Ped Delay* is 7". When a ped call is serviced, the start of green is delayed 7" after Walk begins on phase 4.

Grn/Ped Delay (Grn/Ped Delay)

Grn/Ped Delay works together with *Ped/Delay* described above. This value can delay the beginning of the walk interval (*Ped Delay* enabled) or delay the beginning of green (*Ped Delay* disabled) when a pedestrian call is **first** serviced. *Grn/Ped Delay* programming is not applied when there is no pedestrian call for service. **Note that if the phase is currently active, this feature has no effect.**

Grn/Ped Delay is included in the coordination diagnostic check **MM->2->8->5** to insure that the sum of *Grn/Ped Delay* + *Walk* + *Ped Clearance* + *Yellow* + *All Red* is satisfied by the split time. Ped times are checked by the coord diagnostic if STOP-IN-WALK is OFF or if STOP-IN-WALK is ON and "Rest-In-Walk" is enabled for the phase.

Grn/Ped Delay is omitted during preemption and the controller will time the appropriate walk and ped clearance times assigned to each preempt. *Grn/Ped Delay* is also omitted during manual control enable when the phase is terminated by interval advance.



Enable *Ped Delay* to delay the Walk interval by the programmed *Grn/Ped Delay* value

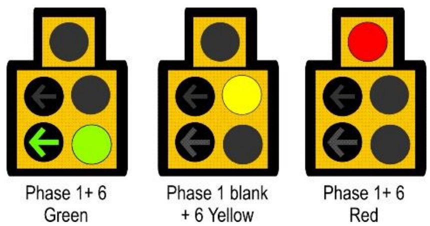
Disable *Ped Delay* to delay the Green interval by the programmed *Grn/Ped Delay* value

Grn/Ped Delay may also be used to program a leading Green interval for an overlap (**MM->1->5->2->3**) by programming the **Leading Green** parameter. If **Leading Green** is turned **ON**, the overlap will start (display green) while the green of the included phase is being delayed for the time programmed in the *Grn/Ped Delay* feature. If Leading Green is turned **OFF**, the overlap will follow the delay of the included phase before it starts.

Omit Yel, Yel Ø (Omt Yel/Yel P)

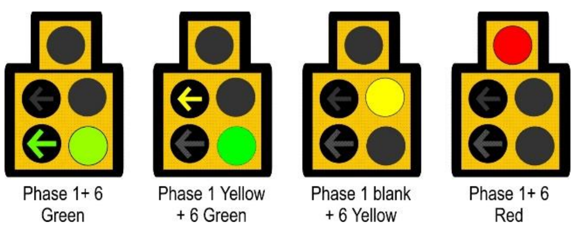
Omit Yel allows the yellow output of a phase to go dark when a specified phase is also timing yellow clearance. "*Allow Skip Yel*" must be enabled under Unit Parameters to enable this option.

In the example below, *Omit Yel, Yel Ø* is used to prevent the left-turn yellow arrow and yellow ball from being simultaneously illuminated in a 5-section left-turn display. Whenever both phases terminate simultaneously, only the solid yellow indication is displayed during the clearance interval. In this example, phase 6 is programmed as the *Omit Yel, Yel Ø* under phase 1 in the Options+ menu below.




```
< Options+       ..1..2..3..4..5..6..7..8>
      Reservice    .  .  .  .  .  .  .  .
PedClr ThruYel     .  .  .  .  .  .  .  .
SkipRed-NoCall     .  .  .  .  .  .  .  .
       Red Rest    .  .  .  .  .  .  .  .
         Max II    .  .  .  .  .  .  .  .
    Max Inhibit    .  .  .  .  .  .  .  .
      Ped Delay    .  .  .  .  .  .  .  X
RedRest On Gap     .  .  .  X  .  .  .  X
 Grn/Ped Delay     0  0  0  7  0  0  0  4
Omit Yel,Yel P     6  0  0  0  0  0  0  0
Ped Out/Ovlp P     2  0  0  0  0  0  0  0
StartYel,Nxt P     0  4  0  0  0  8  0  0
```

MM->1->1->3: Phase Plus Options



When the yellow clearance of the phase specified in the column of the table (in this example *Ø1)* and the *Omit Yel Ø* (in this example Ø 6) are both timing, only the *Omit Yel Ø* will display an output. This insures that a single clearance indication is displayed from the *Omit Yel Ø* shown in the left figure when Ø 6 displays a solid yellow indication.

Ped Out/Ovrlap Ø (Ped Out/Ovlp P)

```
< Options+      ..1..2..3..4..5..6..7..8>
      Reservice   .  .  .  .  .  .  .  .
PedClr ThruYel    .  .  .  .  .  .  .  .
SkipRed-NoCall    .  .  .  .  .  .  .  .
       Red Rest   .  .  .  .  .  .  .  .
         Max II   .  .  .  .  .  .  .  .
    Max Inhibit   .  .  .  .  .  .  .  .
      Ped Delay   .  .  .  .  .  .  .  X
RedRest On Gap    .  .  .  X  .  .  .  X
 Grn/Ped Delay    0  0  0  7  0  0  0  4
Omit Yel,Yel P    6  0  0  0  0  0  0  0
Ped Out/Ovlp P    2  0  0  0  0  0  0  0
StartYel,Nxt P    0  4  0  0  0  8  0  0
```

The *Ped Out/OverlapØ* feature allows one phase to share the pedestrian outputs of another phase within the same ring. This allows pedestrian outputs for an active phase to be redirected to the pedestrian outputs of a non-active phase. A similar operation may also be accomplished using the PED_1 overlap type to provide a separate set of outputs for pedestrian phases assigned to the overlap.

The *Ped Out/OverlapØ* feature allows the user to steer (or redirect) the pedestrian outputs of a phase to another phase. In the example menu above, the pedestrian outputs for phase 1 are directed to the pedestrian outputs of phase 2. When ped call is serviced on phase 1, the walk and ped clearance indications are driven on phase 2. In this case, a ped call serviced during phase 2 will also drive the walk and ped clearance indications assigned to phase 2.

Ped Out/OverlapØ programming may also be used to service a pedestrian movement that overlaps two sequential phases. The designated pedestrian movement must be entered under both phases as shown to the right. If phase 1 and 2 are consecutive phases in the sequence, the walk indication serviced during phase 1 will be redirected to the walk output on phase 2. This walk indication will hold until the end of the walk interval programmed for phase 2. Pedestrian clearance programmed for phase 2 will terminate the pedestrian movement which overlaps phase 1 and 2.

Operation of the pedestrian overlap is according to the following rules:

- The overlapping phases must be adjacent in the ring sequence, i.e., 1&2, 3&4, 4&1 for a STD8
- If the first sequential phase has a ped call, it will begin timing the Walk interval upon entry.
- At the end of the walk interval, if there is a ped call on the second sequential phase, the first phase will remain in walk while timing normal green and through yellow and red clearances.
- Upon entering the second sequential phase, the pedestrian timing of that phase will apply. The pedestrian movement must terminate prior to termination of the second overlap phase.

The *Ped Out/OverlapØ* feature was provided before the *PED_1 Overlap* type was added. The *PED_1 Overlap* type is a more flexible method to achieve the same operation described above. The *PED_1 Overlap* type allows walk and pedestrian clearance to overlap two or more consecutive phases; however, the outputs are not confined to the walk and ped clearance outputs of the parent phase. The walk output of the *PED_1 Overlap* type is driven by the green output of the overlap and the ped clearance output is driven by the red output.

StartYel, Next Ø (Start Yel, Nxt P)

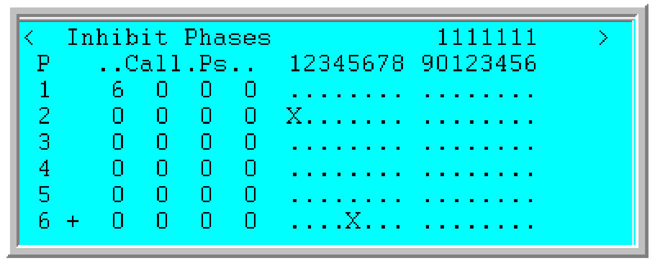
When the controller is programmed to start in yellow, it will normally progress to the next sequential phase in the sequence. *StartYel, Next* Ø designates the next phase to be serviced after startup in yellow. If phase 2 is programmed with a value of 4 and the startup programming for phase 2 is yellow, then phases 4 and 8 will be serviced next instead of 3 and 7.

4.1.8 Call Inhibit, Redirect Phases (MM->1->1->5)

The *Call, Inhibit, Redirect* menu provides access to three independent features in the controller for all 32 Phases.

Call, Inhibit (MM->1>1->5->1)

The *Call* feature allows a phase green to indirectly call another phase. Each controller phase can be assigned up to 4 Call Ø's. In the menu above, ø6 is a called when ø1 is green and ø1 is receiving a detector call, min or max recall.

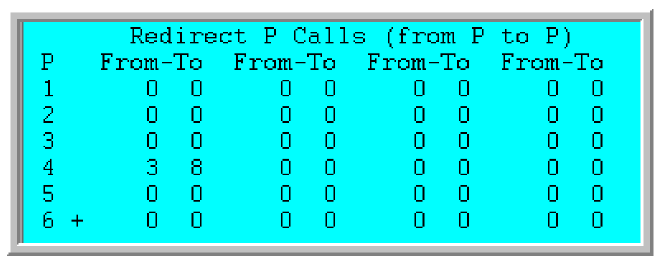


The *Inhibit Ø's* feature places omits on inhibited phases while a phase is ON. This option can be used to prevent the controller from "backing into the previous phase" without crossing the barrier. For example, in the menu above, phase 2 inhibits phase 1 and phase 6 inhibits phase 5. This programming is useful with protected/permitted left-turn displays when you do not want to create a yellow trap condition by allowing phase 2 to "back into" phase 1 or phase 6 to "back" into phase 5 without crossing the barrier.

Redirect (MM->1>1->5->2)

The *Redirect Ø Calls* feature (**MM->1->1->5**, right menu) redirects a phase call from one phase to another phase. The redirected call is only issued when the programmed phase is green and the phase called is red. . Please note that *Redirect Ø Calls* **CALLS** the redirect phase when it is red, where Detector Switching **EXTENDS** the switch phase when it is green. Therefore if you try to extend a programmed phase by redirecting another phase call to it, it will not extend the phase. Also note, do not redirect a call from the programmed phase to itself.

For example, in the right menu, when phase 4 is green, detector calls on phase 3 are directed to phase 8. This is useful when 3+7 are leading and calls are serviced on 4+7 prior to a later call on phase 3. Redirecting calls from phase 3 to phase 8 will allow a late turn to be serviced if the left-turn display is protected/permitted.



4.1.9 Alternate Phase Programs (MM->1->1->6)

```
      Alternate Phase Programs
1.Times                    4. Times+
2.Options
3.Call/Inh/Redirect
```

Alternate Phase Programs (or alternate *maps*) allow the phase timings, phase options and call/inhibit/redirect programming to be changed by time-of-day using timing patterns.

Alternate Phase Programs may be assigned to any of the 48 patterns under Alt Tables+ (**MM->2->6**) as shown in the menu to the right.

```
Pat#  Alt: POpt PTime DetGrp Call/Inh  >
 1          0    0     0        0
 2          8    3     3        2
 3          0    0     0        0
```

Alternate Interval Times (MM->1->1->6->1)

Eight separate Alternate Interval Times tables are provided to modify the base phase options programmed under controller menu **MM->1->1->1**. *Alternate Interval Times* may be "attached" to patterns to vary phase times by time-of-day. Entries in this table are made by <u>column</u> and not by phase. In the screen to the right, column 4 is being used to give alternate times to Phase 2. There are 32 columns so that all phases can be modified, if needed.

```
Alt-1<>Col.1...2...3...4...5...6...7...8
Assign P   1   0   0   2   0   0   0   0
Min Grn    5   0   0   5   0   0   0   0
Gap,Ext  0.0 0.0 0.0 3.5 0.0 0.0 0.0 0.0
Max 1      0   0   0  27   0   0   0   0
Max 2      0   0   0  50   0   0   0   0
Yel Clr  3.5 3.5 3.5 3.0 3.5 3.5 3.5 3.5
Red Clr+ 1.5 1.5 1.5 1.0 1.5 1.5 1.5 1.5
```

Keep in mind, that if you wish to override only one phase time in a column, you **must** provide all entries for that phase or else zero values will be substituted for that phase. For example, column 1 sets *MinGrn* for Ø1 to 5 seconds. However, all entries for Ø 1 (except Yel Clr and Red Clr) will be set to zero values when this alternate phase timing is called. In summary, the entries shown in column 4 represent the correct way to program alternate phase times.

Alternate Phase Options (MM->1->1->6->2)

Eight separate alternate phase option tables are provided to modify the base phase options programmed under controller menu **MM->1->1->2**. Again, remember to program all options for the phase you assign to each column even if you only want to vary one value. There are 32 columns so that all phases can be modified, if needed.

```
Alt-8 <    > Col..1..2..3..4..5..6..7..8
     Assigned P  0  0  0  0  0  0  0  0
      Lock Calls X  X  X  X  X  X  X  X
     Soft Recall .  .  .  .  .  .  .  .
      Dual Entry .  .  .  .  .  .  .  .
Enable Simul Gap X  X  X  X  X  X  X  X
Guarantd Passage .  .  .  .  .  .  .  .
   Rest In Walk + .  .  .  .  .  .  .  .
```

Special Note: the function in this table labeled '*Grn/Ped Delay Inh*' inhibits advance pedestrian or delayed pedestrian phases if set.

Alternate Call/Inhibit (MM->1->1->6->3->1)

Eight separate alternate tables are provided to modify Call/Inhibit features. These alternate tables may also be assigned to a coordination pattern that called by time-of-day through the TBC scheduler. Up to eight phases can have an alternate Call/Inhibit features.

```
Alt-2 <> Inhibit Ps             1111111
#  P     ..Call.Ps..   12345678 90123456
1  0      0  0  0  0   ........ ........
2  0      0  0  0  0   ........ ........
3  0      0  0  0  0   ........ ........
4  0      0  0  0  0   ........ ........
5  0      0  0  0  0   ........ ........
6  0 +    0  0  0  0   ........ ........
```

Alternate Redirect (MM->1->1->6->3->2)

Eight separate alternate tables are provided to modify Redirect features. These alternate tables may also be assigned to a coordination pattern that called by time-of-day through the TBC scheduler. Up to eight phases can have an alternate Redirect feature.

```
Alt-1  Redirect P Calls (from P to P)
#  P From-To   From-To   From-To   From-To
1  0    0  0      0  0      0  0      0  0
2  0    0  0      0  0      0  0      0  0
3  0    0  0      0  0      0  0      0  0
4  0    0  0      0  0      0  0      0  0
5  0    0  0      0  0      0  0      0  0
6  0 +  0  0      0  0      0  0      0  0
```

Alternate Interval Times+ (MM->1->1->6->4)

Eight separate Alternate Interval Times+ tables are provided to modify the base phase options programmed under controller menu **MM->1->1->t**.Alternate Interval Times+ features may be "attached" to patterns to vary additional phase times by time-of-day. Entries in this table are also made by <u>column</u> and not by phase. There are 32 columns so that all phases can be modified, if needed.

```
Alt-3<>Col.1...2...3...4...5...6...7...8
Phase      0   0   0   0   0   0   0   0
Walk2      0   0   0   0   0   0   0   0
BikeClr  0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
Max III    .   .   .   .   .   .   .   .
```

4.1.10 Times+ (MM->1->1->7)

Times+ **(MM->1->1->7)** provides enhanced features that extend the basic NTCIP *Times* features under **MM->1->1->1**.

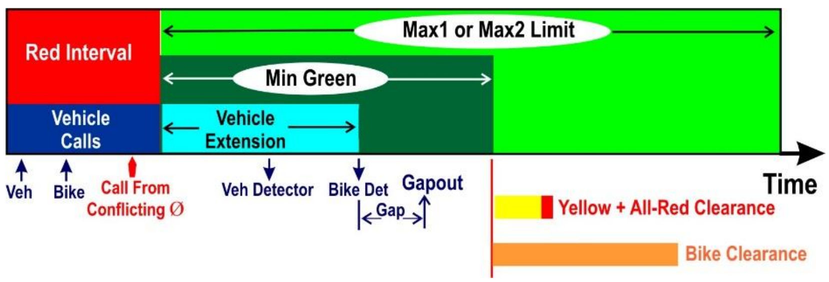
Times+ < >	1	2	3	4	5	6	7	8
Walk2	0	0	0	0	0	0	0	0
BikeClr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GrnFlash	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GrnInYel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SfClrMin	0	0	0	0	0	0	0	0
SfClrNoFl	.	.	.	.	.	.	.	.
Max III	.	.	.	.	.	.	.	.

Walk 2 (Walk2)

The Walk2 clearance time is used in place of the Walk time if the pedestrian button is depressed longer than 2 seconds. This feature can be used to provide a "longer" clearance time to those with disabilities. However, it will be necessary to work with local grounds assisting the blind and disabled to educate those who can benefit from the longer pedestrian (clearance) times. This longer time is displayed during the walk period (i.e. longer walk time) and not during the flashing don't walk period.

BikeClr (BikeClr)

A new *Times+* feature called *Bike Clearance* insures that the yellow + all-red clearance terminating a phase is at least as long as the *BikeClr* value specified in the *Times+* menu if the last detection prior to gap-out is from a BIKE detector (**MM->5->3**). Note that *BikeClr* times concurrently with the yellow + all-red interval of the phase as shown below. If the last detection prior to gap-out is received from a BIKE detector, the controller will extend the red-clearance of the phase to insure the total bike clearance specified for the phase.



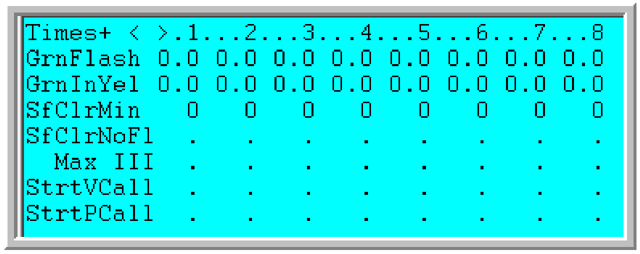
***BikeClr* Extends All-red Clearance If the Last Detection is From a BIKE Detector**

The following outlines the operation and programming of a BIKE Detector using the Bike Clearance time.

1) Program the BikeClr time as stated above. Next program the detector as TYPE= BIKE (**MM->5->3**) enable the detector to extend by turning on the EXTEND value under **MM->5->2**. Under MM->5->1, program the extension time as a 10x value. Normal NTCIP extension values are from 0.0 – 25.0 seconds. When the detector is a bicycle detector, that value is multiplied by 10, causing the extension time to be 0 – 255 seconds. The extension behavior on a bike detector is the same as extension on any detector. It will apply an extension to the green until its extension expires, or the phase maxes out.
2) Any time during green that the detector is activated, the bike clear timer is also loaded. The phase will time normally, but if the bike clear time has not counted down by the time red clearance has terminated, then the phase will hold in red until the remaining bike clearance time has expired. (This is to protect the bike due to non-typical terminations of the phase, i.e. force-offs)
3) If you have normal extension enabled, and the bike detector is extending when the phase goes to yellow, then the bike clear time will be loaded, and always time its full value. (This is to protect the bikes that were extending the phase, but could have potentially run up against the max time for the phase.) Thus, this will ensure a bike that entered intersection just prior to gap out, will clear the intersection (especially at wide intersections), before the conflicting traffic enters the intersection.

GrnFlash (Grn Flash) Error! Bookmark not defined.

This parameter was added for signals in Mexico. In Mexico, a typical clearance is GREEN, GREEN FLASH, YELLOW, RED. An extra interval for the green flashing interval has been created. This parameter is where a user will set the time interval for the Green Flashing period. When programming this parameter the user must consider the green flash as part of a clearance interval. Therefore the parameter is programmed by calculating “how much of the first X seconds of the yellow interval will the indication be flashing green as opposed to showing yellow”.



The following describes the operation of the ***GrnFlash*** parameter as it applies to each channel type.

Phase Operation and Programming

The ‘yellow clearance’ time must include time for both the ‘yellow’ and the ‘flashing green’ interval. If you want 10 seconds of ‘flashing green’ and 5 seconds of ‘yellow’, then you must enter 15.0 seconds for the ‘yellow clearance’ in the phase times (MM→1→1→1), and then enter the 10.0 seconds that you want the channel it to flash on the channel mapping screen under ‘FlshGrn’.

In other words, the formula that determines the yellow clearance time is:

“**yel clr**” = yellow interval time + green flash interval time

which means…

yellow interval time = yellow clearance time – green flash time

As you can see, it is possible to enter a ‘green flash time’ that would reduce the ‘yellow interval time’ down to zero, or even negative. If the ‘3 second yellow disable’ is not active, then the ‘green flash time’ will be limited such that it can not reduce the ‘yellow interval’ to less than three seconds.

If the ‘disable 3 second yellow’ is active, then the yellow interval may be reduced to zero.

In no case will entering a green flash time larger than the yellow clearance time allow the green flashing interval to exceed the yellow clearance time.

In summary, the ‘yellow clearance’ entered in the phase times is the clearance interval regardless of other values. The ‘green flash time’ simply designates what portion of the clearance time will be used to flash green.

Overlap Operation and Programming

To use Green Flash with overlaps, set the Parent Phase Clearances parameter on the General Overlap Parameters screen to OFF. This will cause the controller will use the yellow clearance time programmed for the overlap Additionally, the overlap must have a yellow time entered in the overlap parameters that will be used as the clearance interval in the same manner the yellow clearance time is used with the phases. All of the same rules apply to the yellow clearance interval of an overlap as a phase in regards to ‘3 second yellow disable’.

Pedestrian Operation:

The green flash time acts as a flag. If there is a green flash time entered for a channel that is providing a PED output, then that output will flash walk, as opposed to flashing don’t walk during the pedestrian clearance. The amount of time has no effect on flashing walk operation. Any amount of time will cause this operation.

GrnInYel

Parameter definition to be added at future date.

Safe Clr Ped Min, Safe Clr No Flash (SfClrMin, SfClrNoFl)Error! Bookmark not defined.

A new feature known as the Safety Clear (Ped Extend) feature has been added. It is used to extend the pedestrian clearance interval, up to a programmed maximum by reassigning an existing Ped detector to be a Ped Extension detector. The Ped Extension detector is typically a Microwave or ultra-sonic detector that detects the presence of pedestrians in the cross-walk. It works as follows:

1. Program the existing *Pedestrian Clearance* time (**MM->1->1->1**) as a **Maximum** Ped Clearance time.

2. Program the new entry *Safe Clr Ped Min* as a **Minimum** Ped Clearance time.

3. Optionally program the new entry *Safe Clr No Flash* if you want the Don't Walk signal to be dark instead of flashing while the Ped clearance interval is extending.

4. A new pedestrian detector feature allows the Ped detectors to be specified as a Pedestrian Extend input rather than a Ped Call input. There are 8 Ped Extension Input Functions shown in the Table below:

```
Times+ < >.1...2...3...4...5...6...7...8
GrnFlash 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
GrnInYel 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
SfClrMin   0   0   0   0   0   0   0   0
SfClrNoFl  .   .   .   .   .   .   .   .
  Max III  .   .   .   .   .   .   .   .
StrtVCall  .   .   .   .   .   .   .   .
StrtPCall  .   .   .   .   .   .   .   .
```

Function	Name	Ped Input Extended
298	Ped Ext 1	Ped Detector 1
299	Ped Ext 2	Ped Detector 2
300	Ped Ext 3	Ped Detector 3
301	Ped Ext 4	Ped Detector 4
302	Ped Ext 5	Ped Detector 5
303	Ped Ext 6	Ped Detector 6
304	Ped Ext 7	Ped Detector 7
305	Ped Ext 8	Ped Detector 8

As an example, program Ped detector 2 to call Phase 2. Next, choose any detector input, in our case we will choose Detector 21. To specify Detector 21 to extend during Ped clearance for phase 2, Map Detector 21 with Function 299, as shown in the table above. When Ped detector 2's pushbutton is depressed, a call for Ped 2 will occur. When the Pedestrian interval times, it will time for the Walk time entered. If detector 21 is actuated during the Ped interval, it will tie the Ped Clearance using the time programmed under *Safe Clr Ped Min*. This will be the the minimum time used for Ped clearance. As long as Detector 21 (Ped Extend detector) is active or until the Maximum Ped Clearance time expires. The Timing Status Screen (**MM-7-1**) shows "***Pext***" instead of "***Pclr***" while the Ped clearance is extending.

Max III (Max III)

When *Max III* is enabled for a phase, the DyMaxLim time is applied. Note that a mixture of *Max I, Max II* and *Max III* settings may be accomplished with this feature because Max II may be enabled for some phases and not others. Also Not if both *Max II* and *Max III* are set, *Max II* is the higher priority Max time.

StartupVehCall (StrtVCall)

When the controller is powered up, the user can program if specific vehicle phases will receive calls upon startup. The user must set the parameter **StartupCalls** under **MM→1-→2→1** to ***UsePrg***. Then program **StartupVehCall** with the phases that you choose to have calls, and those phases will be run upon startup.

```
Times+ < >.1...2...3...4...5...6...7...8
GrnFlash 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
GrnInYel 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
SfClrMin   0   0   0   0   0   0   0   0
SfClrNoFl  .   .   .   .   .   .   .   .
  Max III  .   .   .   .   .   .   .   .
StrtVCall  .   .   .   .   .   .   .   .
StrtPCall  .   .   .   .   .   .   .   .
```

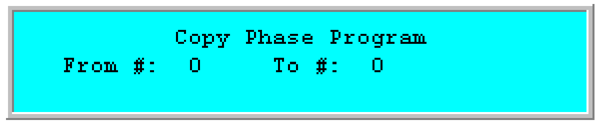
StartupPedCall (StrtPCall)

When the controller is powered up, the user can program if specific pedestrian phases will receive calls upon startup. The user must set the parameter **StartupCalls** under **MM→1-→2→1** to ***UsePrg***. Then program **StartupPedCall** with the pedestrian phases that you choose to have calls, and those pedestrian phases will be run upon startup.

NoPedReserv (NoPedReserv)Error! Bookmark not defined.

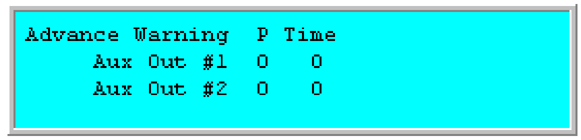
NoPedReserv is used in conjunction with Conditional Service Reservice Phases. (**MM->1->1->3**). If the phase has Reservice enabled (**MM->1->1->3**, Phase Options+ screen) and this is parameter enabled, then it will reservice, but the ped on the phase being reserviced will be omitted. Program the phase that was conditionally serviced to omit the pedestrian movement on the Reservice phase.

4.1.11 Copy Phase Utility (MM->1->1->8)



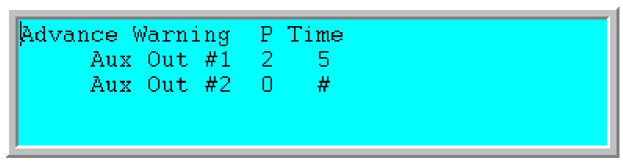
The *Copy Phase Utility* allows the user to copy phase programming from one phase to another phase. This can speed up data entry and reduce errors if complementary phases in each ring have similar programming values. This utility copies all phase times, options, and phase options+ programming from menus **MM->1->1->1**, **MM->1->1->2** and **MM->1->1->3**.

4.1.12 Advance Warning Beacon (MM->1->1->9)



This feature is used to illuminate a warning beacon in advance of a traffic signal to alert the driver a specified number of seconds before the phase begins yellow clearance. The warning beacon is activated by an auxiliary output via a selected action that is associated with a coordination pattern. The beacon is activated for the specified number of seconds after the phase is forced off.

To activate this feature the user typically sets up a coordination pattern and associated split table. When setting up cycle lengths and split times, make sure you accommodate the length of time that the phase will remain on while the sign is illuminated for the particular split phase (normally chosen as the coord phase). The time in the cycle length needed to output the advanced warning sign and clear out the associated phase must be accommodated so that all other splits still have enough time to guarantee their minimums and clearances.



Consider the example of outputting a five second advanced warning sign with phase 2, the coordinated phase. If using ENDGRN coordination with phase 2, the following will occur at the zero point in the cycle. Normally phases 2 and 6 run together therefore phase 6 will terminate at the zero point and phase 2 will be extended by five seconds, while the sign is being outputted. Then phase 2 will begin its clearances. Thus split 1 **must additionally accommodate** the time programmed under this menu item plus the clearance of the coord phase. If this is the case, please insure that the split time for these phases have enough time to guarantee its minimum. Early yields may be considered so that the sign is actuated prior to the zero point in the cycle. Also keep in mind that if another phase is associated with the coord phase (as phase 6 in this example), it will be terminated while the sign is being outputted.

In summary, the beacons will always be on, except during green of the phase that the sign is associated with, in which case they turn off, and will stay off until that phase terminates. When the phase terminates, it times an additional interval prior to termination, during which the beacons turn on and stay on, until the phase becomes green again. Keep in mind that this feature can be run in Free or Coordinated operation.

4.2 Rings, Sequences and Concurrency

Version 80 supports thirty-two phases assigned to eight rings and 32 phases. Phases may time concurrently with phases in other rings that are defined as concurrent phases. Any phase not defined as a concurrent phase is considered to be a conflicting phase. The controller uses ring sequence and concurrency definitions to determine the order that the phases are serviced and to insure that conflicting phases never time concurrently. Phase concurrency establishes “barriers” between non-concurrent phases.

Phase Mode defines the sequence and concurrency relationship of the phases assigned to each ring. P*hase Modes* is programmed under *Unit Parameters* and illustrated below. The most common mode, *STD8* is comprised of 8 phases operating in two rings. Phases on either side of the barrier (concurrency group) may time together in separate rings.

Eight Phase Sequential (8Seq) mode has no concurrency relationship and all eight phases time sequentially. *Quad Sequential (QSeq)* mode is a combination of *STD8* and *8Seq* and is typically used to provide dual ring operation for the major street and sequential (or split) phasing for the cross street.

USER phase mode applies to phase sequences that require more than 8 phases or more than two rings. *USER* mode also allows up to 32 phases to be serviced sequentially by assigning the sequences to a single ring.

Phase Mode	Ring Sequence / Concurrency
STD8 – Standard 8 Phase	Ring 1: 1 2 3 4 Ring 2: 5 6 7 8
QSeq – Quad Sequential	Ring 1: 1 2 3 4 7 8 Ring 2: 5 6
8Seq – 8 Phase Sequential	1 2 3 4 5 6 7 8
DIA – Texas Diamond	USER sequence based on the *Texas Diamond Specification*
USER – User defined phase mode	Ring 1: 1 2 3 4 5 6 7 8 Ring 2: 11 12 13 14 0 0 0 0 Ring 3: 15 0 0 0 0 0 0 0 Ring 4: 16 0 0 0 0 0 0 0

The matrix below depicts the Ring/Phase layout that is available via USER mode. All fields are defaulted to zero and can be modified at the user’s discretion.

		Concurrent Phase #																															
Phase #	Ring # (1-8)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1																																	
2																																	
3																																	
4																																	
5																																	
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30																																	
31																																	
32																																	
	Ring # (1-8)																																

4.2.1 Ring Sequence (MM->1->2->4->1, MM->1->2->4->2)

Sequence Number (Seq#)

Sixteen sequence number combinations are provided in the sequence table

Ring Number (Ring #)

Eight rings are provided for each of the sixteen sequences.

```
             Ring Sequences
1.Phases 1-16            2.Phases 17-32
```

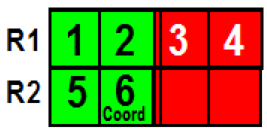
Sequence Data

A maximum of thirty-two consecutive phases may be programmed for each ring. STD-8ø initializes the controller with 16 default sequences that providing every lead/lag combination possible for eight-phase operation, dual ring operation.

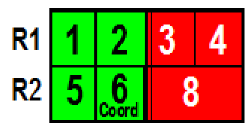
```
             Sequence of Phases
 Seq# Ring#<..1..2..3..4..5..6..7..8>
   1     1    1  2  3  4  0  0  0  0
   1     2    5  6  7  8  0  0  0  0
   1     3    0  0  0  0  0  0  0  0
   1     4    0  0  0  0  0  0  0  0
   1     5    0  0  0  0  0  0  0  0
   1 +   6    0  0  0  0  0  0  0  0
```

Each sequence must contain the same phases assigned to the same ring. Do not assign a phase to different rings in different sequences or you will generate a SEQ TRANS fault under **MM->7->9->5**) and send the controller to flash.

In addition, a phase must be provided in the coordinated ring for each concurrency (or barrier) group. For example, consider the USER sequence below in coordination with ø 6 selected as the coordinated phase. A "dummy phase" must be included in ring 2 because a phase must be assigned to each side of the barrier in the coordinated ring.



Wrong! No phase provided in coord ring right of barrier



Correct! Dummy Phase 8 provided in coord ring on the right of barrier

4.2.2 Ring, Concurrency, Startup (MM->1->1->4->1, MM->1->1->4->2)

Phase ø (P)

Phase ø identifies the phase of the entries in the row.

```
        Ring, Start, Concurence
1.Phases 1-16            2.Phases 17-32
```

Ring (Rg)

The Ring value assigns each phase to a ring.

```
<          Concurrent Phases              >
 P Ring StartUp ..1..2..3..4..5..6..7..8
 1   1  RED        5  6  0  0  0  0  0  0
 2   1  RED        5  6  0  0  0  0  0  0
 3   1  RED        7  8  0  0  0  0  0  0
 4   1  RED        7  8  0  0  0  0  0  0
 5   2  RED        1  2  0  0  0  0  0  0
 6   2  RED        1  2  0  0  0  0  0  0
 7   2  RED        3  4  0  0  0  0  0  0
 8   2  RED        3  4  0  0  0  0  0  0
 9   0  RED        0  0  0  0  0  0  0  0
10   0  RED        0  0  0  0  0  0  0  0
11   0  RED        0  0  0  0  0  0  0  0
```

Start Up Phases (StartUp)

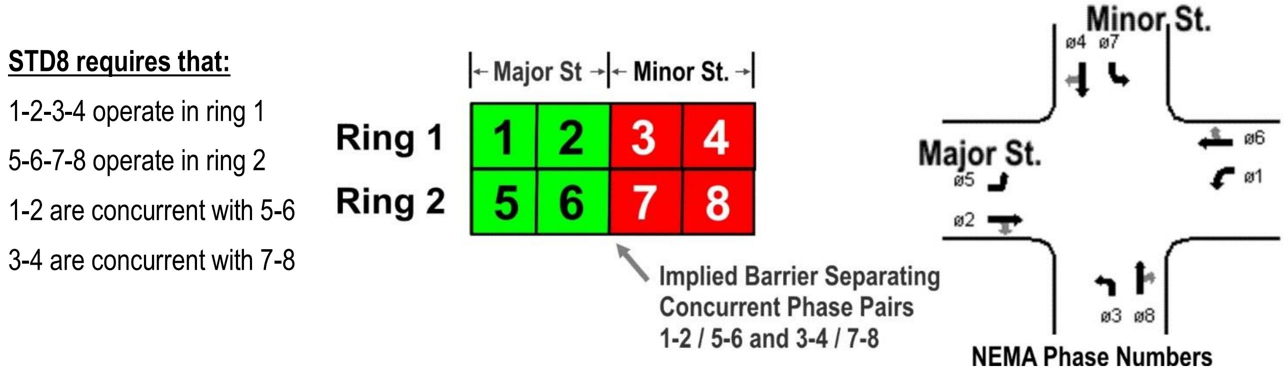
- RED – phase startup in the red interval
- WALK - startup in the green and walk interval
- GREEN - startup in the green interval (pedestrian calls are removed for the startup phase)
- YELLOW - startup in the yellow interval
- RedCl - startup in the red interval (applies the *Start Red Time* defined under *Unit Parameters*)
- OTHER- reserved NTCIP value
  Note: You can also control which phases are serviced next using the *StartYel, Next Ø* option under **MM->1->1->3**.

Concurrent Phases

Concurrent Phases define which phases may time together in each ring. The *Phase ø* itself does not need to be included in the concurrency group. However, any phase that is allowed to time with the *Phase ø* in another ring must be listed as a concurrent phase. Phases that are assigned to a sequence and do not belong to a concurrency group time sequentially while are other phases in the sequence are resting in red.

4.2.3 Phase Assignments and Sequences for STD8 Operation

Most traffic signals apply STD8 operation even if all eight phases are not enabled. NEMA assigns the left-turn movements to the odd-numbered phases and the through movements to the even numbered phases. It is easy to remember this convention if you recall that the even numbered through phases are assigned in a clockwise manner (2-4-6-8) and the left-turn phases opposing each thru are numbered in pairs 1-2, 3-4, 5-6 and 7-8. Many agencies assign phase 1-2-5-6 to the major (coordinated) street and 3-4-7-8 to the cross street as shown below. Other agencies assign phases to a direction (north, south, east or west) if the non-intersecting streets in the network are parallel.



When a controller is initialized for STD8 under **MM->8->4->1**, the following phase sequence table is automatically programmed in the sequence table. These defaults provide 16 combinations of leading and lagging left-turn sequences for the 8 phase, dual-ring operation illustrated above. The user may customize this table as desired under **MM->1->2->4**.

Seq #	Phase Seq.
1	1 2 3 4 5 6 7 8
2	1 2 3 4 6 5 7 8
3	2 1 3 4 5 6 7 8
4	2 1 3 4 6 5 7 8
5	1 2 3 4 5 6 8 7
6	1 2 3 4 6 5 8 7
7	2 1 3 4 5 6 8 7
8	2 1 3 4 6 5 8 7

Seq #	Phase Seq.
9	1 2 4 3 5 6 7 8
10	1 2 4 3 6 5 7 8
11	2 1 4 3 5 6 7 8
12	2 1 4 3 6 5 7 8
13	1 2 4 3 5 6 8 7
14	1 2 4 3 6 5 8 7
15	2 1 4 3 5 6 8 7
16	2 1 4 3 6 5 8 7

16 Default Phase Sequences for STD8 (Every Combination of Lead/Lag Left-turns)

STD8 Phase Mode is the best practice for all applications unless intersection geometry and sequencing are too complex.

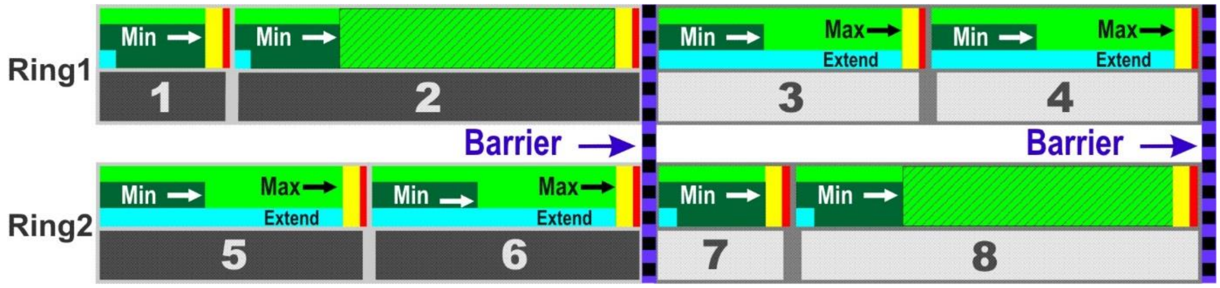
When considering coordination, using STD8 mode will take advantage of the most coordination diagnostic checks to catch common data entry mistakes, and if detected, times the intersection in FREE. In USER mode, most of these coordination diagnostics are removed, and the onus is on the agency verify and test the programming to ensure that coordination pattern(s) run as expected.

4.2.4 How Barriers Affect the Phase Timing in Each Ring under STD8

This chapter began with a discussion of basic actuated and volume density features as related to a single phase. Individual phase timing and options determine how a phase services vehicle and pedestrian calls and transfers the right-of-way to a competing phase. Barriers also affect how phases terminate because a phase may be extended by a phase in another ring that is timing concurrently. Phases in each ring cross the barrier at the same time.

In the example below, *Min Recall* calls phases 1, 2, 7 and 8 but does not extend these phases. Without a vehicle call to extend phases 1, 2, 7 and 8, a gap-out occurs after one *Gap,extension* and the phase will terminate and move to the next phase in the sequence. In this example, phases 1, 2, 7 and 8 must dwell in green until the phases in the other ring are also ready to cross the barrier. If the phase setting, *Enable Simultaneous Gap* is not enabled on phases 1, 2, 7 and 8, their respective *Gap,extension* timers will not reset once gap-out is reached.

Max Recalls on phases 3, 4, 5 and 6 not only call these phases during their red intervals, but also extend the phases during the green interval as shown below. A *Max Recall* acts like a constant vehicle call on the phase that extends the phase to the maximum setting currently in effect (either Max-1 or Max-2). The *Gap, Extension* timer is never reset during *Max Recall*.



STD8 Operation - Min Recalls on Phases 1, 2, 7 and 8 and Max Recalls on Phases 3, 4, 5 and 6

It is important to note that a phase cannot cross a barrier until the concurrent phase in the other ring are also ready to cross the barrier. In this example, ø2 extends until ø6 has timed its maximum because the phase concurrency for STD8 allows phase 1-2 to time concurrently with ø5-6, but never with 3-4 or 7-8. Similarly, ø 8 extends until ø 4 "maxes" out to cross the second barrier with simultaneously with ø4.

Coordinated operation is similar to the free operation example shown above except that the maximum times allocated to each phase are typically governed by *Split Times.* The same "barrier rules" rules apply during coordinated operation as during free operation and unused split time from both rings must be available before it can transfer across the barrier.

4.2.5 USER Mode - Phase Sequential Operation

Sequence of Phases

Seq#	Ring#	1	2	3	4	5	6	7	8
1	1	7	9	15	4	2	3	12	5
1	2	0	0	0	0	0	0	0	0
1	3	0	0	0	0	0	0	0	0
1	4	0	0	0	0	0	0	0	0
1	5	0	0	0	0	0	0	0	0
1	6	0	0	0	0	0	0	0	0
1	7	0	0	0	0	0	0	0	0
1 +	8	0	0	0	0	0	0	0	0

Sequence of Phases

Seq#	Ring#	9	10	11	12	13	14	15	16
1	1	1	6	11	14	32	17	0	0
1	2	0	0	0	0	0	0	0	0
1	3	0	0	0	0	0	0	0	0
1	4	0	0	0	0	0	0	0	0
1	5	0	0	0	0	0	0	0	0
1	6	0	0	0	0	0	0	0	0
1	7	0	0	0	0	0	0	0	0
1	8	0	0	0	0	0	0	0	0

The *Sequence Table* provides a maximum of 32 phases in each ring sequence. USER mode can provide a maximum of 32 sequential phases by programming **MM→1→1→2→4** as shown above. The example above illustrates 14 sequential phases assigned in the order 7-9-15-4-2-3-12-5-1-6-11-14-32-17.

To program this sequential operation, the *Concurrent Phase* programming (**MM→1→1→4**) for each sequential phase must be set to zero. Programming the same phase in different rings or repeating a Phase in the same sequence will result in generating a SEQ TRANS fault under **MM->7->9->5** sending the controller to flash.

Sequential Operation may also be combined with overlaps to define complex display sequences. The sequence order may be changed by defining a new phase sequence in the sequence table. However, each phase sequence in the table must contain the same number of phases and the ring assignment in the sequence table and the *Ring/StartUp/Concurrency* table must agree. You may omit (OMT) phases in the sequence through the *Mode* setting in the *Split Table*; however, you should never omit a phase in the sequence table if the phase is enabled under phase options (**MM->1->1->2**).

4.2.6 V80.x Ring and Concurrency Programming Considerations

When modifying phase sequences and concurrencies, V80 was updated to accommodate various iterations of sequencing and concurrency needs. Its programming has been modified and will act differently than prior versions of Cubic | Trafficware controller software (V61.x, V65,x and V76.x) . For V80.x the following rules must be adhered when programming the sequence and concurrency structure to properly run the controller for the desired operation declared by the agency.

- The goal of the V80.x ring logic is to never skip a phase. To achieve this operation, **the precedent of a phase is first by it ring and second by its position in the sequence.**
- There must always be a phase concurrent at the first barrier (add dummy phase “0” if necessary).
- There must always be a phase assigned in ring 1 for each concurrency barrier.
- Use dummy phase “0’s” to align the barriers.

Phases assigned to each column in the sequence table must be concurrent with each other. Therefore with V80.x the position of the phase in the sequence is needed to give the controller some information about how to prioritize. In versions prior to V80.x this was not necessary.

These rules will address the prioritization aspects of V80.x sequence concurrency algorithm, which implies you need to place dummy phase “0” in front of a phase, if you want the one in the other ring to service it first in sequence when the concurrent phases are part of two different barrier groups.

To understand this new algorithm, consider the following structure that is required by the agency:
Here’s the problem. Imagine the following ring & barrier structure:

Ring 1	Φ 1	Φ2	Φ 10	Φ11	Φ 20	Φ 21	Φ 3	Φ 4
Ring 2	Φ 5	Φ 6					Φ 7	Φ 8

In controller software versions prior to V80.x, the sequence table would have been programmed as shown below

Sequence of Phases

Seq#	Ring#	1	2	3	4	5	6	7	8
1	1	1	2	10	11	20	21	3	4
1	2	5	6	7	8	0	0	0	0
1	3	0	0	0	0	0	0	0	0
1	4	0	0	0	0	0	0	0	0

Now imagine that the controller is crossing the barrier at the end of phases 2 and 6. The controller software must decide if it is going to service phase 10 or phase 7, because they’re not compatible. If there is a call on both phase 10 and 7, it will serve phase 10 because it is in ring 1. If there are calls on phases 11 and 7 (no call on 10), the controller will service phase 7 because it is before 11 in the sequence. As you can see, this could lead to skipping phases 11, 20, and 21. In version 80 we added the ability to eliminate this issue by adding place holders (“0”) to mimic the concurrency in the sequence table
The correct implementation for V80.x of the example above is:

Sequence of Phases

Seq#	Ring#	1	2	3	4	5	6	7	8
1	1	1	2	10	11	20	21	3	4
1	2	5	6	0	0	0	0	7	8
1	3	0	0	0	0	0	0	0	0
1	4	0	0	0	0	0	0	0	0

The requirement about having a phase in every barrier for ring 1 may not be immediately obvious from the example above, but if you do not follow this rule there may be problems with coordination. Specifically, there may be problems with determining force-off points correctly.

As another example consider the sequence and concurrency requirements shown below:

Ring 1	Φ 2		Φ4		Φ 3	Φ 1
Ring 2	Φ 7	Φ 5	Φ 15	Φ 6	Φ 16	Φ 18

In controller software versions prior to V80.x, the sequence table would have been programmed as shown below

```
          Sequence of Phases
 Seq# Ring#<..1..2..3..4..5..6..7..8>
   1     1    2  4  3  1  0  0  0  0
   1     2    7  5 15  6 16 18  7  8
   1     3    0  0  0  0  0  0  0  0
   1     4    0  0  0  0  0  0  0  0
```

Software prior to V80.x, when running phases 2 and 5 with demand on Phases 3 and 6, phase 6 could be skipped. This was because phase 3 in the ring sequence has a higher "priority" than phase 6 because not only is in in a lower number ring, but it is also earlier in sequence.

In V80.x to get the desired operation, please program the Ring sequence table as shown below:

```
          Sequence of Phases
 Seq# Ring#<..1..2..3..4..5..6..7..8>
   1     1    2  0  4  0  3  1  0  0
   1     2    7  5 15  6 16 18  7  8
   1     3    0  0  0  0  0  0  0  0
   1     4    0  0  0  0  0  0  0  0
```

This way, in the event that phase 4 does not have a call, but phase 3 does and phase 6 has a call, the controller software will service 6 before 3.

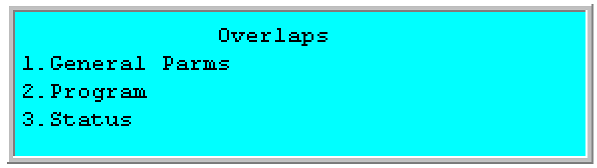
NOTE: Dual Entry (**MM->1->1->2**) should **NOT** be set on any phases that are a part of a barrier which is not fully concurrent. The reason is because the Dual Entry programming checks to see if the phase that is next is compatible with the dual-entry phase using the assumption that the software is crossing a barrier.

4.2.7 Ring Parameters+ (MM->1->2->5)

NEMA TS2 only defines ring inputs (like Stop Time 1) for rings 1 and 2. The *Ring Parameters+* screen allows the user to map the ring I/O for ring 1 and 2 to any of the 8 rings available in the controller. The default assumes that ring inputs for rings 1, 3, 5, 6, 7, 8 use TS2 Ring 1 inputs and that rings 2 and 4 use TS2 Ring 2 inputs.

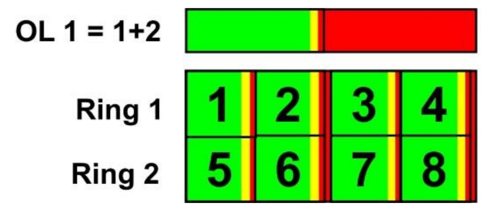
```
Input Map Ring#..1..2..3..4..5..6..7..8
Use Ring Inputs  1  2  1  2  1  1  1  1
```

4.3 Overlaps (MM->1->5)

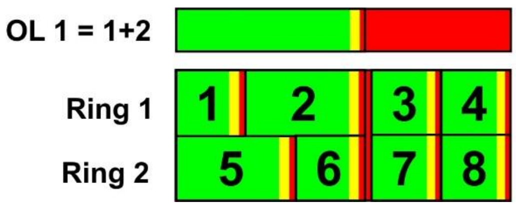


Thirty-two fully programmable overlaps may be assigned to any load switch channel in the terminal facility (cabinet) on Linux platforms.

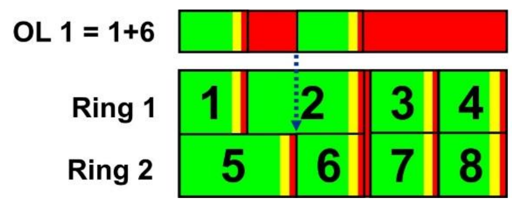
Overlaps are customized channel outputs driven by one or more *included phases* that are typically consecutive phases in the ring sequence.



In the illustration to the right, OL1 is defined as an overlap of two included phases (Ø 1+ Ø 2). OL1 turns green when the first included phase turns green and clears with the last *included phase* in the sequence. Because Ø 1 and Ø 5 time together in this example, it does not matter if the *included phases* are defined as 1+2 or 1+6. The overlap extends from the beginning of Ø1 until the end of Ø2 or Ø6 green in either case. However, if Ø 5 extends past the end of Ø 1, the overlap operation varies significantly depending on whether the included phases are 1+2 or 1+6 as shown below.

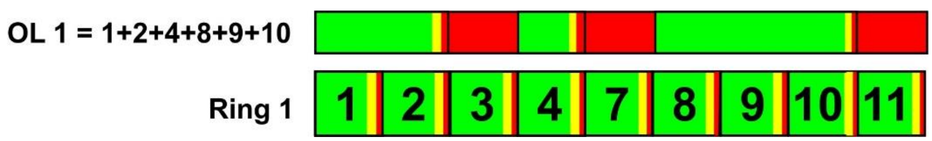


Consecutive Included Ø 1+ Ø 2 in the Same Ring



Non-consecutive Included Ø 1+6 in Separate Rings

Overlaps may be defined with any number of phases in the same ring as shown below. This feature is useful in sequential phase operation (8SEQ or USER phase mode) to create signal displays that overlap any number of phases in the sequence.



When Included Phases Are Not Consecutive, the Overlap Will Time Multiple Clearances during the Sequence

Note: Although Overlaps use phasing to control their outputs, they preform independently. Therefore if your agency uses specific features which may have an effect on included phases, modifier phases or various overlap types, you should thoroughly bench test the overlap to insure proper operation. For example, a feature such as the unit parameter Clearance Decide, affects phase next decision making which will have ramifications on overlap behavior.

4.3.1 General Overlap Parameters (MM->1->5->1)

The following *General Overlap Parameters* apply to overlaps 1-32.

Lock Inhibit

```
    General Overlap Parameters
         Lock Inhibit OFF
    Confl Lock Enable OFF
      Parent P Clrncs OFF
  InhibitLockInterval ALWAYS
```

If *Lock Inhibit* is OFF, the controller will not proceed to the next phase following the last included phase until the overlap has completed timing the overlap green extension and clearance intervals. If *Lock Inhibit* is ON, the controller will time the next phase in the sequence during the overlap green extension and clearance intervals.

Conflict Lock Enable

Conflict Lock Enable is used together with the *Lock Inhibit* feature. If *Conflict Lock Enable* is ON, the controller suppresses all conflicting vehicle and pedestrian phases and conflicting overlaps until the end of overlap green extension, yellow and all-red clearance. If *Conflict Lock Enable* is OFF, then the conflicting vehicle and pedestrian phases and conflicting overlaps may proceed while the overlap is timing its clearances. The table below summarizes how the parameters *Lock Inhibit* and *Conflicting Lock Enable* work together to determine how the overlaps are terminated.

Lock Inhibit	***Conflicting Lock Enable***	**Effect on overlap clearance timing**
OFF	OFF	The controller will not proceed to the next phase following the last included phase until the overlap has completed timing the overlap green extension and clearance intervals. It also insures that the overlap green extension, yellow and all-red clearances are finished before the next phase is serviced
OFF	ON	Same as above.
ON	OFF	Allows the next phase (including any conflicting phase or overlap) to begin while the overlap completes timing green extension and clearances
ON	ON	Allows the next phase to begin with the overlap green extension and clearances, but suppresses any conflicting phases or overlaps programmed for the overlap

Effect of Lock Inhibit and Conflicting Lock Enable on Overlap Termination

FYA Considerations: **Lock Inhibit** and **Conflict Lock Enable** can be programmed **ON** or **OFF** when running FYA-4 overlaps. However, **Lock Inhibit** will not be applied to the FYA yellow clearance (either after a protected arrow, or flashing arrow), if we are moving to (phase next is) an included/modifier phase. Also note that, the user should program **Conflict Lock Enable** to **ON** when programming conflicting phases(s) when using a FYA overlap (**MM->1->5->2->2**).

InhibitLockInterval

Users may also select when or if they would like to disable the *Lock Inhibit* and *Conflict Lock Enable* parameters. This entry has the following selections:

ALWAYS = The inhibit lock parameters are always obeyed including preemptions.
COORD = The inhibit lock parameters are only obeyed during coordination.
COORD+FREE = The inhibit lock parameters are only obeyed during either coordination or free.

One purpose of this parameter is to insure that during preemptions, the overlaps fully clear before moving to the next phase.

Parent Phase Clearance

Parent Ø Clearances determines whether the overlap times its clearances with the included phases or uses the clearance times programmed for each individual overlap. If *Parent Ø Clearances* is ON, the clearance times of the included phase terminating the overlap are used. If *Parent Ø Clearances* is OFF, the yellow and all-red clearances as programmed in each overlap are used.

```
     General Overlap Parameters
          Lock Inhibit OFF
     Confl Lock Enable OFF
       Parent P Clrncs OFF
   InhibitLockInterval ALWAYS
```

Please Note: Under Flashing Yellow Arrow (FYA) operation, the following clearance decision table is used by the software.

Parent Clearance Selection	Yellow Arrow After Green Arrow	Red Arrow After Green Arrow	Yellow Arrow After FYA	Red Arrow After FYA
OFF	Uses Included phase yellow time	Uses Included phase red time	Uses Overlap yellow time	Uses Included phase red time
ON	Uses Included phase yellow time	Uses Included phase red time	Uses Modifier phase yellow time	Uses Included phase red time

4.3.2 Overlap Program Selection and Configuration (MM->1->5->2)

Each overlap is selected separately from **MM->1->5->2**.

```
                 Overlap   1
1.Program Parms
2.Confl Prog+
3.Program Parms+
```

Included Phases

A maximum of 32 *Included Phases* (or parent phases) may be assigned to each overlap. The user should enter (program) the phases in order from the leftmost position to rightmost position.

```
Olp  1 .............Phases............
Inc    0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Mod    0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Type:NORMAL  Grn:  0  Yel: 3.5  Red: 1.5
```

Modifier Phases

A maximum of 32 *Modifier Phases* may be assigned to the overlap to alter the operation based on the *Overlap Type*. The user should enter (program) the phases in order from the leftmost position to rightmost position.

Overlap Type

The *Overlap Type* parameter (NORMAL, -Grn/Yel or other sets the overlap operation as described in the next section

Overlap “Trailing” Green Extension

The overlap Green parameter extends the overlap green for 0-255 sec after an included phase terminates and the controller moves to the non-included phases. This overlap parameter is called “trailing green” in some controllers.

When running a Green Extension during an Overlap, the controller overlap software has a special case added to its termination logic as shown below. If the overlap is terminating:

AND NO green extension is programmed

AND there is a preempt in the begin phase

AND the preempt is NOT configured for All Red Before Preempt (**PreRedClr**)

then the software will provide a "dummy" 1 second green extension time.

The intention of this code is to ensure that an overlap that is currently green does not go green->red->green as it terminates the overlap to enter the preempt, but then re-enables the overlap because one of the included phases of the overlap are used by the preempt.

This code provides an extension to **ANY** overlap being terminated by a preemption that does not have a green extension configured regardless of whether or not this overlap has an included phase that is going to be serviced "next" by the preempt. This can lead to a situation where the current overlap is extending and can be in conflict with the phases becoming active as part of the preemption. To mitigate this issue, program the parameter **PreRedClr to ON** under **MM->3->1->8**. In addition the use can consider programming the green extend inhibit parameter (**ExtInh**) under **MM->1->5->2->3** to not allow certain phases to extend

Overlap “Trailing” Yellow and Red Clearance

Parent Phase Clearance determines whether the overlap times yellow and all-red clearance with the included phases or uses the separate yellow and all-red clearances programmed in the menu above. If *Parent Ø Clearances* is OFF, the yellow and all-red clearances as programmed in each overlap are used.

Please note that these timers are always used when exiting overlaps when a pre-emption is called.

4.4 Overlap Types

The operation of each of the 32 overlaps is governed by the *Overlap Type* and the *ModifierPhase(s).* Examples are presented below to illustrate the operation available with each overlap type. We provide overlap features based on customer requirements and does not endorse any particular mode of operation provided in these examples. The user should develop applications from these features that comply with local policies and with the Manual of Traffic Control Devices.

- **Normal** (NTCIP) – modifier phase causes the overlap to go dark
- **–GrnYel** (NTCIP) – modifier phase used to suppress the overlap green
- **OTHER** (Proprietary MIB) – selects one of the following Types+ under overlap *Program Parms+:*
  - **L-Perm** – suppresses the solid green in a protected/permitted left-turn while the opposing left-turn (modifier phase) is green (this left-turn display is used by some agencies to resolve the "yellow-trap).
  - **Fl Red** – Flashing red arrow used by some agencies for the permitted left-turn indication (another left-turn display designed to address the "yellow trap" safety issue.
  - **FAST-FL -** Fast FL is used in Canada. It flashes the GREEN signal at the rate specified in the Fast-Fl Rate parameter (see **MM→1→5→1**). It is used for protected-permissive left turns. An overlap set to this type will flash green when the user programs both the included phase and modifier phase and that phase is active
  - **R-Turn** – used to drive a right-turn green arrow when a non-conflicting left-turn is being serviced and move immediately to a solid green indication of the through movement associated with the right turn
  - **Ped_1** – used to drive a walk indication timed with the first included phase and pedestrian clearance which overlaps the following included phases defined for the overlap
  - **MinGrn** – identical to the NORMAL overlap type, except that the overlap green extension is timed as a min green period when the overlap green period begins
  - **FlYel-4** – this is used to Flash a yellow arrow during permissive left turns.
  - **GoBAR** – This overlap was developed to meet specific requirements for the City of Houston light rail system. The go indication (vertical bar) is output to the overlap green and the stop indication (horizontal bar) is output to the overlap red. The overlap displays a flashing prepare-top-stop and prepare-to-go based on requirements for the City of Houston.
  - **IndPed** – The IndPed overlap is intended for applications that bridge pedestrian clearance over two or more sequential included phases assigned to the overlap. The pedestrian clearance time is programmed using the parameter called **PedClrTime** under the overlap parameter+ screen.

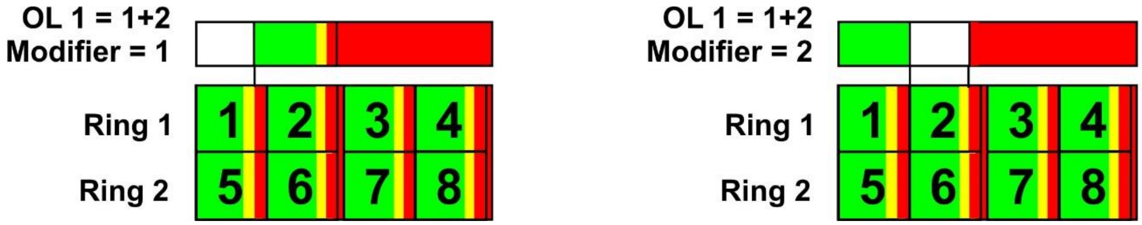
    Note: The **Ped_1** overlap is intended for applications that time phase walk and pedestrian clearance for included phases that do not follow each other in the sequence. The **Ped_1** overlap may also bridge the walk indication time over one or more included phases. If the application requires bridging pedestrian clearance, then use the **IndPed** overlap.

4.4.1 NTCIP Overlap Type: Normal (NORMAL)

The Included Phases and the modifier phases control the *Normal* overlap type as follows:

- The overlap is green when an included phase is green, or an included phase is timing yellow/red clearance and an included phase is next
- The overlap is yellow when an included phase is yellow and an included phase is not next
- The overlap is red when the overlap green and yellow are not on
- The overlap is dark (all outputs off) when a modifier phase is on during its green or yellow interval

The examples below illustrate a NORMAL overlap type with included phases Ø1 and Ø2. The Ø1 modifier blanks out the overlap outputs as long as the Ø1 outputs are green or yellow. The Ø2 modifier blanks out the overlap as long as the Ø2 outputs are green or yellow. If the modifier selected is the last included phase in the sequence (in this case Ø2), the yellow clearance will be omitted as shown.



NORMAL Type: Modifier Phases Blanks Out the Overlap When the Modifier is Green or Yellow

Note: if you specify a modifier phase for a NORMAL overlap type, be sure that your conflict monitor is programmed to allow the overlap output channel to go blank when the modifier phase is timing. It also may be necessary to adjust the monitor to accept an output sequence that omits yellow clearance such as the example above. The user is responsible to configure the phase sequence, phase concurrency and overlap programming to comply with the MUTCD.

4.4.2 NTCIP Overlap Type: Minus Green Yellow (-GrnYel)

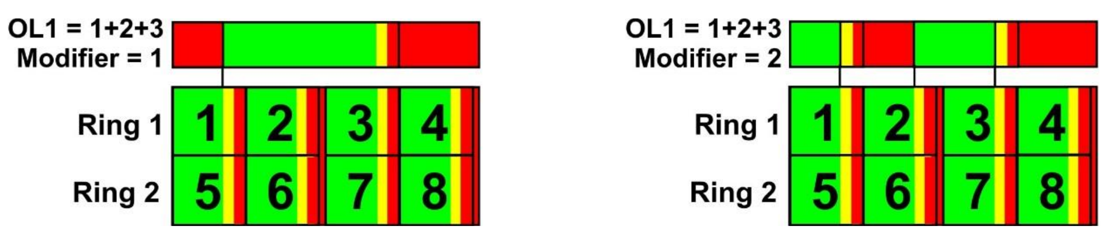
Both the *Included Phases* and the *Modifier Phases* control this overlap type as follows:

- The overlap is green when an included phase is green, or an included phase is timing yellow/red clearance and an included phase is next. In both of these cases, the modifier phase is not green.
- The overlap is yellow when an included phase is yellow, an included phase is not next, and a modifier phase is not green
- The overlap is red when the overlap green or yellow is not on

The *–GrnYel* overlap type uses the green output of the modifier phase to suppress the overlap. If the overlap is red when the modifier turns green, the overlap will be suppressed until the yellow clearance of the modifier phase (see example below with the modifier set to Ø1).

In the second example (modifier set to Ø2), the overlap will terminate at the point when the modifier phase is NEXT and remain suppressed until the end of the modifier green. This is the same configuration used in our last example for the NORMAL overlap type; however, in this case, the overlap displays a solid red indication when Ø1 is green instead of a "blank" indication used with the NORMAL type.

Please insure that all –GrnYel overlaps are included as preempt dwell overlaps in preempt Overlaps+ (**MM->3->1->5**).

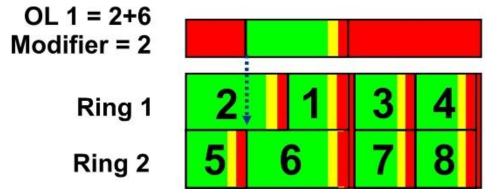


-GrnYel Type: Modifier Phases Suppresses the Overlap During When the Modifier Phase is Green

4.4.3 Overlap Type: Left Turn Permissive (L-PERM)

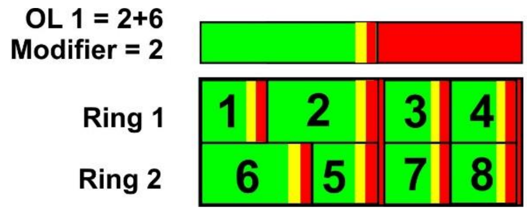
Both the Included Phases and the Modifier Phases control this overlap type as follows:

- The overlap turns green when an included phase, that is not a modifier phase, turns green (this is true even if a modifier phase is already displaying a green indication)
- The overlap remains green as long as one of the included phases remain green
- The overlap is yellow when an included phase is yellow and an included phase is not on or next
- The overlap is red when it is not green or yellow



These overlap outputs can provide the permissive green, yellow, and red indications for a 5-section left-turn display. The protected left-turn phase provides the green and yellow arrow indications. The *modifier phase* is used with the L-PERM type to suppress the overlap display when the protected movement is lagging but not leading. The *included phases* are entered as the two through movements for the barrier, and the modifier phase is entered as the conflicting through movement for the left turn. The example to the right defines an overlap used to drive the permitted indications in a left-turn display where Ø1 is the protected left-turn movement. This overlap is defined with Ø2 & Ø6 as the included phases, and Ø2 as the modifier phase.

The L-PERM overlap type suppresses the overlap green indication until the adjacent through phase turns green in the lagging left-turn display. This prevents the driver in the through direction (Ø6 in this case) from seeing a green indication in the left-turn display while the through indications are solid red. Once the adjacent through phase (in this case Ø6) turns green, the overlap remains green until the barrier is reached.



If the phase sequence is reversed (Ø1 leading instead of lagging), the overlap does not need to be suppressed, so the L-PERM overlap displays a solid green indication as shown to the right. During a dual-lead sequence (Ø1 and Ø5 leading), the overlap is suppressed with a solid read indication until the end of Ø1.

4.4.4 Overlap Type: Flashing Red (FL-RED)

Both the Included Phases and the Modifier Phases control this overlap type as follows:

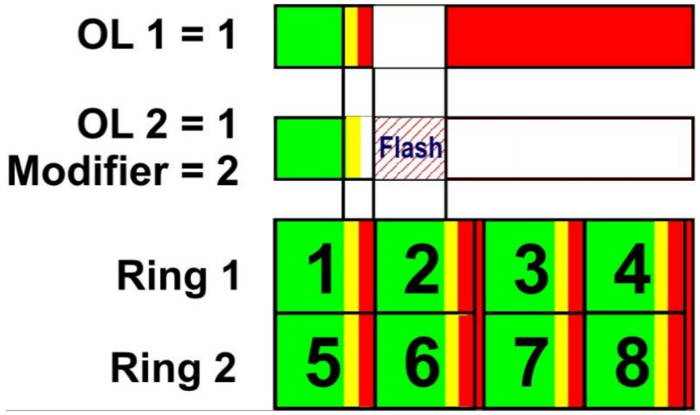
- The overlap is green when an included phase is green, or an included phase is timing yellow/red clearance and an included phase is next
- The overlap is yellow when an included phase is yellow and an included phase is not next
- The overlap is flashing red when the overlap green or yellow are not active, the modifier phase is green, and the modifier phase is not in ped clearance, or walk.
- The overlap is dark when the overlap is not green, yellow, or flashing red

This overlap type was developed to drive a flashing red indication in a 4-section left-turn signal display in place of the solid green permitted indication.

This overlap type requires two consecutive overlaps. The solid red indication in the display is driven from the first overlap and the flashing red display is driven from the second overlap red output. Never set Overlap A (1) to type FL-RED because it will be used to also clear the red of the previous overlap (i.e. overlap A (1) cannot used this feature). For example, if the protected movement (green and yellow arrow is assigned to phase 1, the solid red indication should be driven from overlap A (1) red and the flashing red indication should be driven from overlap B (2) red.

FL RED Overlap Type - Ø1 Protected / Permitted Display

The overlaps for this configuration are shown to the right for a dual-lead sequence. Since the overlap is gated with the adjacent through movement's green, the overlap will go back to green when the adjacent turn goes to yellow, and the included left turn is next. This means that this feature should not be used if the adjacent through phase is utilizing the "walk through yellow" feature. The FL RED overlap type flashes at a rate of 60 flash cycles per minute (or once per second). This rate flashes the overlap red output at 500ms on, followed by 500ms off.



4.4.5 Overlap Type: FAST FL

The flash rate may be programmed within a range of values (OFF, 60, 120, 150 or 180 cycles per minute) from **MM→1→5→1**, *General Overlap Parameters.* Fast FL is used in Canada. It flashes the GREEN signal at the rate specified in the Fast-Fl Rate parameter. It is used for protected-permissive left turns. An overlap set to this type will flash green when the user programs both the included phase and modifier phase and that phase is active.

4.4.6 Overlap Type: Right Turn (R-TURN)

The Included Phases and Modifier Phases are used to program this overlap type as follows:

- The overlap turns green when an included phase is green that is not also a modifier phase
- The overlap remains green if the next phase is also an included phase
- The overlap goes from green to red, without yellow, when the included next phase that is also a modifier phase turns green
- The overlap is yellow when an included phase is yellow, and an included phase is not next
- The overlap is red when the overlap is not green or yellow, or modifier phase is green

This overlap type provides a green right-turn arrow when a non-conflicting left turn is active. The overlap was designed to allow the right-turn arrow to remain illuminated through the compatible left turn clearances and move to red when the through movement becomes active.

4.4.7 Overlap Type: Min Green

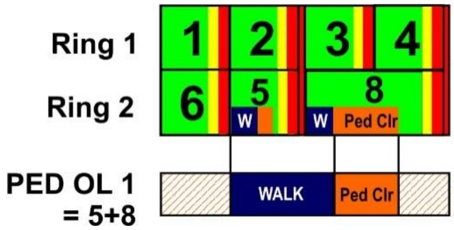
This overlap type is identical to the NORMAL overlap type with the exception that the overlap green extension is used to insure the minimum period that the overlap is green.

4.4.8 Overlap Type: Ped Overlap (Ped-1)

Ped Overlaps are useful where there is a large median to store pedestrians midway in the crosswalk and the crossing can be broken into two sequential portions. The order of the included phases assigned to the overlap affects the mode of operation. This is the only overlap type where the order of the included phases is significant.

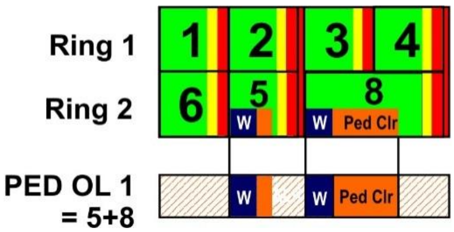
If each included phases is consecutive in the phase sequence, the ped overlap walk interval will begin timing with the first parent phase. Ped Clearance begins with the first included phase and ends with the ped clearance programmed for the last included phase assigned to the overlap.

```
Olp  1 ..............Phases.............
Inc    5  8  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Mod    0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Type:PED 1   Grn:  0  Yel: 3.5  Red: 1.5
```



Ped 1 Overlap Type with Included Phases 5 + 8 (note the order of the included phases)

Note how the operation of the PED 1 overlap changes when the order of the included phases is reversed. This operation is useful only if the pedestrian indication needs to be serviced more than once per cycle. The PED 1 overlap type will also service multiple pedestrian movements if the included phases assigned to the overlap are not consecutive.




```
Olp  1 ..............Phases.............
Inc    8  5  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Mod    0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Type:PED 1   Grn:  0  Yel: 3.5  Red: 1.5
```

The following rules must be followed to select included phases for Ped Overlaps.

- The included phases must be in the same ring
- The included phases must be sequential in the ring sequence, in order for the ped output to stay active between phase transitions. For instance, if you are overlapping 1+2 ped, then phases 1&2 must appear in order in the ring sequence. If they do not, then the ped will clear, and reactivate when the next included phase becomes active.
- For overlapping to occur, the following must happen: The walk must go active in the current included phase, and a ped call must be active in a subsequent included phase before the end of walk of the current phase.

4.4.9 Overlap Type: Independent Ped (IndPed)

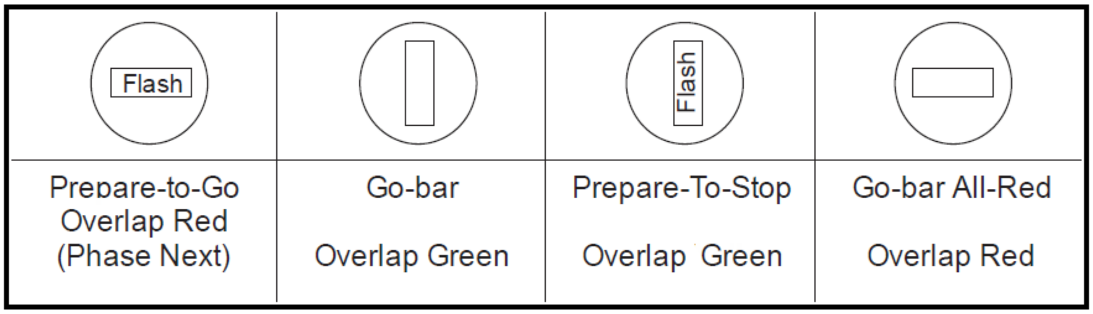
This overlap is intended for applications that bridge pedestrian clearance over two or more sequential included phases assigned to the overlap. The Walk time is programmed under the overlap **Grn** parameter. Independent Ped overlaps use the overlap **Red** time as a red/solid-don't-walk clearance interval. The overlap **Yel** time is not used. The Pedestrian Clearance time is programmed using the parameter called **PedClrTime** under the overlap parameter+ screen. This overlap will use existing phase ped calls or the call can be specifically programmed via setting ***Ped Enh+ (MM->5->9->4)***.

```
Olp  1 ..............Phases.............
Inc    2  3  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Mod    0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Type:IndPed   Grn:  7  Yel: 3.5  Red: 1.5
```

Note: When operating under coordination, the independent ped overlap will only start operation on the first phase in the included phase row with ped recall, and not begin walk if the parent phase has a force off applied.

4.4.10 Overlap Type: GOBAR

A new overlap type was developed for the City of Houston to provide a go-bar for light rail operations. Each go-bar can be assigned a detector to activate the go-bar using the *Transit Input* under *Program Parameters+* for the overlap. In addition, the **GoBarNoNext** parameter may be set **ON** to allow the go-bar to be activated by its parent phases. The go-bar intervals shown below are set using the Green and Red times of the overlap.



GoBar Overlap Programming

GoBar Overlap Type – the GoBar overlap is a two physical indication overlap that is used in BRT/LRT applications. The overlap has four states – steady horizontal (channel red indication), flashing horizontal prepare to go (channel red indication), steady vertical (channel green indication), and flashing vertical prepare to stop (channel green indication). There is no yellow output for this overlap type.

GoBar Included Phases (Parents) – the GoBar can have up to 32 included phases associated with it. If an included phase is next, the overlap will flash prepare to go. If an included phase is on, it will be green. If an included phase is terminating it will flash prepare to stop. If no parent is active it will be red.

GoBar Modifier Phase(s) – modifiers have no effect on a GoBar overlap's operation

GoBar Advanced Programming

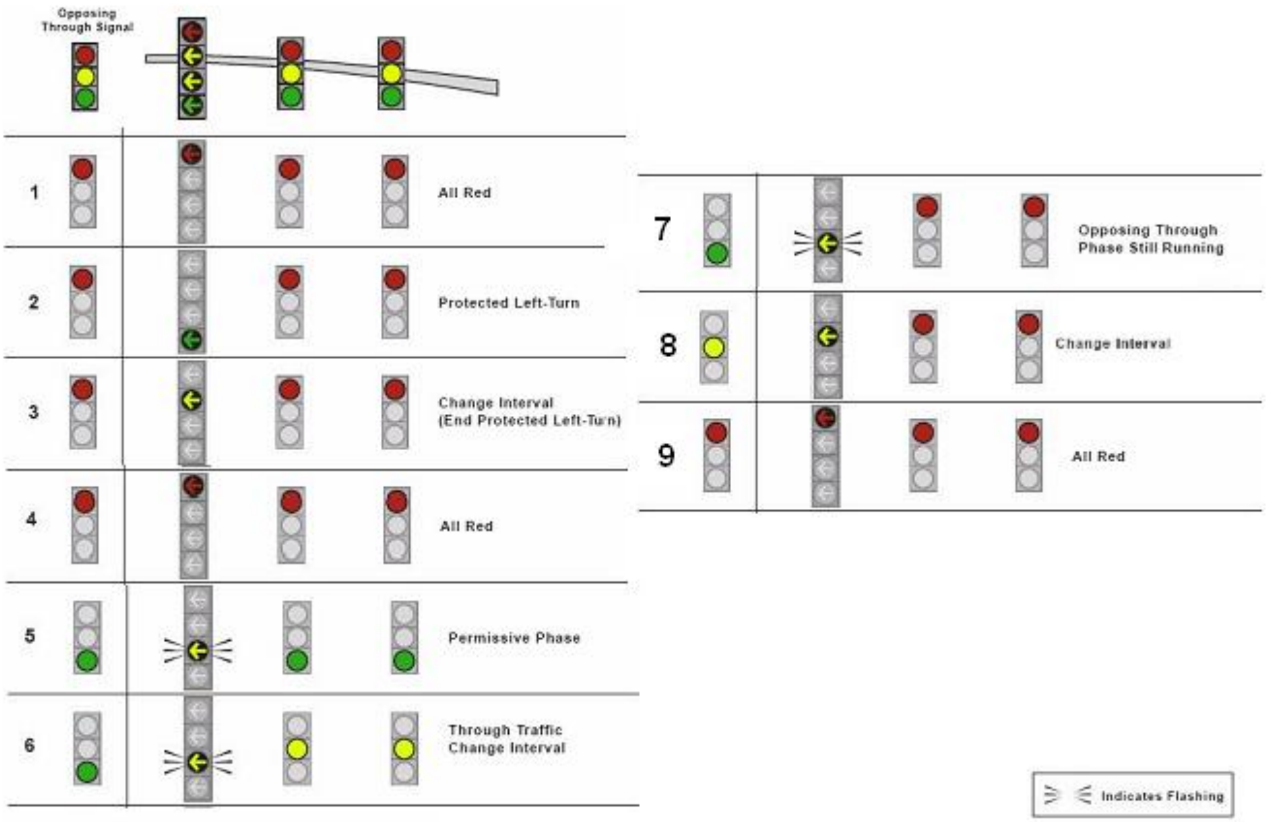
GoBar Conflicting Phases/Overlaps – GoBar overlaps are not compatible with conflicting phase or overlap programming **(MM->1->5->2->2**)

GoBar No Next – under **MM->1->5->2->3** there is a feature called GoBarNoNext. The default value is OFF and will cause the GoBar overlap to display a prepare to go indication when a parent phase is next. Setting this value to ON will prevent the prepare to go indication from displaying and the GoBar will go directly from stop to go. Typical usage of this setting is for locations where there is no need to inform the vehicle operator that the signal is about to change (locations where displaying prepare to go would delay the go indication from being displayed). The default value is typically used at station platforms where the vehicle has stopped and the prepare to go informs the vehicle operator that the signal is about to change.

GoBar Minimum Flash – the user setting GoBarMinFlash is used to force a display of prepare to go for a minimum amount of time regardless of whether a parent phase is already in service. A typical application would be when the GoBar overlap is being used in conjunction with preempt service. As a parent might already be on, programming a value in this field will force the overlap to display prepare to go and not drop directly from red (STOP) to green (GO).

4.5 Flashing Yellow Arrows using Overlaps

Agencies may choose to use the flashing yellow arrow method for permissive left turns (see below). This is the implementation discussed in NCHRP Report 493. The Flashing Yellow Arrow was approved as the recommended signal indication for protected/permitted left-turn operation in the 2009 version of the MUTCD (Manual of Uniform Traffic Control Devices).



4.5.1 Flashing Yellow Overlap Programming – Unused Ped Yellows

One way to accomplish a Flashing Yellow Overlap is using existing pedestrian yellows outputs that are not normally used by the Walk and Don't Walk intervals. This feature allows the Flashing Yellow Arrow (FYA) output from an overlap to be mapped to the yellow output of a pedestrian channel. The yellow output is typically not used and therefore available for FYA use. In other words, the Overlap, during the modified phase period of that overlap, drives the pedestrian channel that is mapped to it, to flash the yellow arrow. This feature allows an FYA signal to be implemented without using a second full load switch position or cumbersome cabinet re-wiring. For example, we will change a protected only Phase 1 Left-turn to a Protect-Permissive using a 4-head signal with Flashing Yellow. You may also accomplish a Flashing Yellow Overlap by using an existing overlap yellow or pedestrian yellows outputs. We will change a protected only Phase 1 Left-turn to a Protect-Permissive using a 4-head signal with Flashing Yellow. We will program Overlap A (Overlap 1) that will utilize the Yellow Flash output from Phase 2 Ped Yellow which programmed to be displayed via channel 13 (**MM->1->8->1**).

First set up the overlap via **MM→1→5→2→(olp#)→1**. Make sure you program the type as FYA-4 and set up the included phase as the protected/permitted phase and the modifier phase as the conflicting through movement.

```
Olp  1 ..............Phases............
Inc    1  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Mod    2  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Type:FYA-4   Grn: 10  Yel: 3.5  Red: 1.5
```

Use the Output Channels+ screen (**MM→1→8→4**) to tell channel 13 that it is having an overlap override applied, whose source is via Overlap A(Overlap 1) and that it is to flash the yellow output. Assume that Phase 2 Ped is programmed as the default Ped 2 channel, Channel 13.

```
<    Chan.9..10..11..12..13..14..15..16
Flash Red .   .   .   .   .   .   .   .
Flash Yel .   .   .   .   X   .   .   .
Flash Grn .   .   .   .   .   .   .   .
Inhibit Red Flash in
  Preempt .   .   .   .   .   .   .   .
Olap Ovrd 0   0   0   0   1   0   0   0
```

The Final Programming step that is necessary is to **set OverrideYellow ON** for each FYA overlap (**MM→1→5→2→(olp #)→3**) to override the Pedestrian Yellow output with the Auxilliary output. Below is this screen for Overlap 1.

```
  Ovrlp    1
Leading Green  OFF  FYA MCE Disable OFF
Transit Input    0  FYA Skip Red    OFF
FYA Delay Time   0  FYA AfterPrempt OFF
PedCallClear   OFF  FYA Ext Overlap   0
PedClearTime     0  FYA ImmedReturn ON
GoBarNoNext    OFF  AuxGreenSwap    OFF
OverrideExcl   OFF  OverrideGreen   OFF
OverrideYellow ON   OverrideRed     OFF
RestInWalk     OFF  PedRecall       OFF
PedRecycle     OFF  GoBarMinFlash     0
ExInh........ ........ ........ ........
```

In summary, you may consider that the Flashing Yellow Arrow overlaps have 4 outputs. They have RED, YELLOW, GREEN, and AUX. In the channel+ screen, you tell which channel's yellow output is going to be overridden by the overlap AUX output. Keep in mind that you do not have to use a ped channel, but can use any channel. Therefore, you can elect to utilize a whole channel for the FYA output, or an existing pedestrian channel.

FYA Inhibit and Other Considerations

The FYA will be inhibited only when the FYA overlap is not active and is not flashing yellow. This satisfies various state MUTCDs that do not allow Yellow Clearance for flashing yellow to be active while the Modifier phase (which normally conflicts with the left turn movement) is still green. The controller will begin a FYA inhibit only when the FYA overlap is Red and not flashing in three cases:

1) Inhibit by Time-of-day
2) Inhibit due to preemption and the "**PreRedClear**" parameter in preemption is set to ON.
3) Inhibit if a conflicting Pedestrian, Phase or NORMAL Overlap is programmed under **MM->1->5->2**.

This prevents an FYA clearance from occurring asynchronously with the overlap's parent phases. If the FYA is inhibited by time-of-day, inhibits will take affect the next time the overlap is Red. When the FYA is inhibited by preemption with "**PreRedClear**" set, preemption will cause all rings to clear through All Red if any FYA is flashing yellow. This provides an opportunity for the FYA to clear while the conflicting thru phase (FYA modifier phase) is also timing yellow. If "**PreRedClear**" is not set, then the FYA overlap will terminate immediately upon inhibit while the conflicting thru movement may remain green. When a conflicting Pedestrian or Phase is programmed, the Overlap will terminate immediately upon inhibit and then run the pedestrian Phase.

Note the following nuances with the FYA software. The yellow arrow will flash for a minimum of 2.0 seconds to insure proper clearances for the cabinet's conflict monitor. Also note, when the time of day pattern or preempt disables an overlap that is an FYA overlap, the software will finish out the yellow before dropping the overlap. If FYA overlaps are inhibited during preemption, when the preemption is completed, the controller must cross the barrier before displaying the flashing yellow arrow. When time of day or preempt allows an omitted FYA overlap to be reestablished, it will not wait until the overlap is timing green or red. When FYA overlaps are inhibited during pedestrian timing, when the pedestrian phase concludes, the controller must leave the FYA phase before displaying the flashing yellow arrow. Finally, when programming Flashing Yellow arrow, upon controller startup (i.e. controller power up, NEMA Ext. Startup, startup after Flash, etc.), the FYA outputs can be programmed to be inhibited or allowed to run immediately by programming **InhFYARedSt** under MM→1→2→1.

Another consideration is that FYA operation requires some synchronization before operation can begin, for safety reasons. For example, if the controller starts in the FYA modifier phases, you would then instantly startup in FYA operation – that is not always desirable. Additionally, the proper operation of FYA requires that the controller go from specific states to other specific states – you must pass through solid yellow, and for the monitor must see that yellow (or flashing yellow for a minimum time) and so forth. In order to achieve this synchronization requirement, the original implementation of FYA required that the controller cross the barrier before any FYA operation was allowed. If you program all the phases on a ring in one barrier, there is no barrier to cross into, and operation is never allowed. In this case simply set the Unit parameter Inhibit FYA Red Start to ON so the FYA will not be inhibited.

The unit parameter **Clearance Decide** should be set to **OFF** when programming Flashing Yellow Arrows that use multiple modifier and/or included phases.

A new feature under **MM->1->5->2->3** called **FYA ImmedReturn** has been added. When set to **OFF,** inhibits work as discussed above. When set to **ON**, as soon as inhibits are lifted, the Yellow arrow(s) will start. The agency is cautioned that an immediate start of a Yellow arrow could result in less than 2 seconds of FYA time depending on how much time is left in the permissive phase and when the inhibit is lifted.

Finally, When the FYA is inhibited by time-of-day, inhibits will only occur on the Modifier (Permissive Phase) so that the included Phase (protected Phase) will still output Green Yellow and red Left turn arrows.

4.5.2 Flashing Yellow Overlap Programming – Using Auxiliary Green Swap

The programming example below is for Model 332 cabinets that use Caltrans I/O Mode 0 initialization and drive the Flashing Yellow Arrows via Green indications. Cubic | Trafficware has provided an Auxiliary Green Swap feature to interface with this method.

The FYA overlaps for a STD8 configuration are programmed as follows.

Approach	WB (OL 1)	EB (OL 3)	NB (OL2)	SB (OL4)
Included Phase	1	5	3	7
Modifier Phase	2	6	4	8
Channel	1	7	4	10

These 332 cabinet channel assignments shown below provide FYA overlaps 1-4 in channels 1, 4, 7 and 10 and green arrow outputs from 1, 3, 5 and 7 VEH in channels 13-16.

```
   Chan..1...2...3...4...5...6...7...8>
P/Olp#    1   2   2   2   4   4   3   6
 Type    OLP VEH PED OLP VEH PED OLP VEH
 Flash   RED RED DRK RED RED DRK RED RED
Alt Hz    .   .   .   .   .   .   .   .
Dim Grn   .   .   .   .   .   .   .   .
Dim Yel   .   .   .   .   .   .   .   .
Dim Red   .   .   .   .   .   .   .   .
Dim Cyc   +   +   +   +   +   +   +   +
```

```
<    Chan.9..10..11..12..13..14..15..16
P/Olp#    6   4   8   8   1   3   5   7
 Type    PED OLP VEH PED VEH VEH VEH VEH
 Flash   DRK RED RED DRK RED RED RED RED
Alt Hz    .   .   .   .   .   .   .   .
Dim Grn   .   .   .   .   .   .   .   .
Dim Yel   .   .   .   .   .   .   .   .
Dim Red   .   .   .   .   .   .   .   .
Dim Cyc   +   +   +   +   +   +   +   +
```

Set up Overlaps 1-4 by program the overlap via **MM→1→5→2→(olp#) →1**. Make sure you program the type as FYA-4 and set up the included phase as the protected/permitted phase and the modifier phase as the conflicting through movement.

```
Olp  1 .............Phases............
Inc    1  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Mod    2  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Type:FYA-4   Grn:  0  Yel: 3.5   Red: 1.5
```

```
Olp  2 .............Phases............
Inc    3  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Mod    4  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Type:FYA-4   Grn:  0  Yel: 3.5   Red: 1.5
```

```
Olp  3 .............Phases............
Inc    5  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Mod    6  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Type:FYA-4   Grn:  0  Yel: 3.5   Red: 1.5
```

```
Olp  4 .............Phases............
Inc    7  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Mod    8  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Type:FYA-4   Grn:  0  Yel: 3.5   Red: 1.5
```

Use the Output Channels+ screen (**MM→1→8→4**) to tell channels 13-16 that it is having an overlap override applied, whose source is via Overlap 1-4 and that it is to flash the green output.

To accomplish this, the Channels+ menu (**MM→1→8→4**) must be programmed as follows:

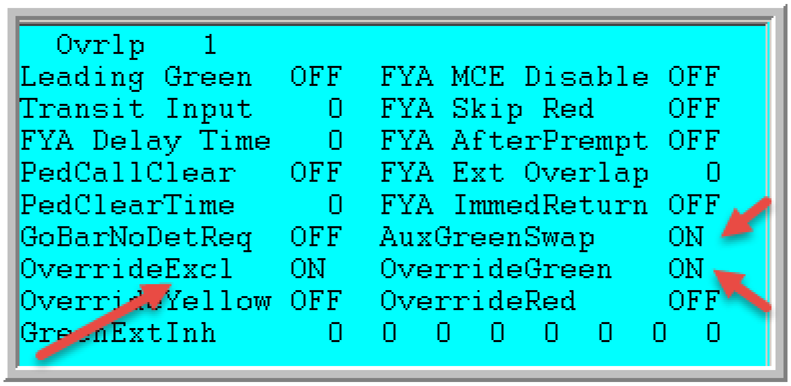
```
   Chan..1...2...3...4...5...6...7...8>
Flash Red .   .   .   .   .   .   .   .
Flash Yel .   .   .   .   .   .   .   .
Flash Grn X   .   .   X   .   .   X   .
Inhibit Red Flash in
  Preempt .   .   .   .   .   .   .   .
Olap Ovrd 0   0   0   0   0   0   0   0
```

```
<   Chan..9..10..11..12..13..14..15..16
Flash Red .   .   .   .   .   .   .   .
Flash Yel .   .   .   .   .   .   .   .
Flash Grn .   X   .   .   .   .   .   .
Inhibit Red Flash in
  Preempt .   .   .   .   .   .   .   .
Olap Ovrd 0   0   0   0   1   2   3   4
```

The FYA-4 overlap provides 4 outputs (green, yellow, red and aux). In this method, under **MM→1→5→2(Olp #)→3**, use the **AuxGreenSwap** feature to drive the Aux output with the the FYA or green arrow (**AuxGreenSwap** = **ON**).

AuxGreenSwap = OFF	AuxGreenSwap = ON
Green – green arrow	Green – FYA (flashing yellow arrow)
Yellow – yellow arrow	Yellow – yellow arrow
Red – red arrow/ball	Red – red arrow/ball
Aux – FYA (flashing yellow arrow)	Aux – green arrow

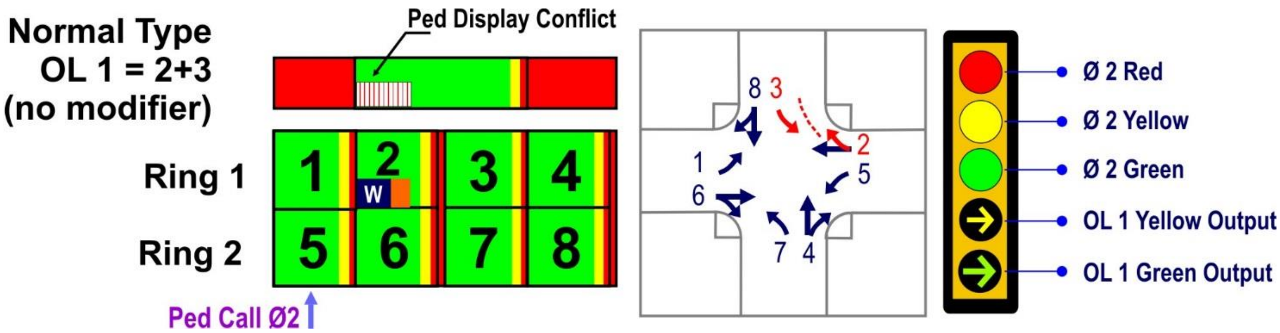
The Final Programming that is necessary is to **set OverrideGreen ON** and **AuxGreenSwap ON** for each FYA overlaps(MM→1→5→(olp #)→2→3) to override the green arrow outputs with the Auxilliary output as shown below on the Overlap 1 screen. Setting **OverrideExcl** to **ON** will only output the Auxillary green output on channels 13-16.



4.6 Overlap Conflict Program+ Menu (MM->1->5->2->2)

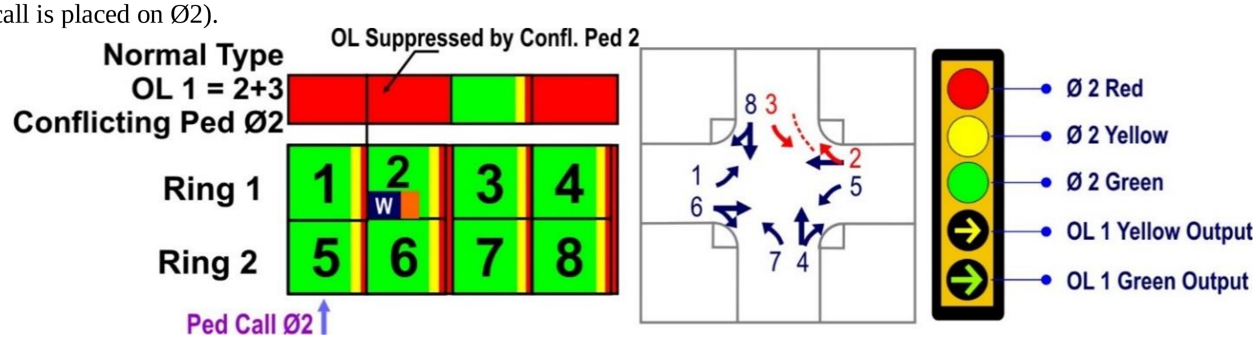
Up to 32 conflicting phases, pedestrian and overlaps terminate an overlap when the conflicting phase, pedestrian movement or overlap is next and continue to suppress the overlap while the conflicting phase, pedestrian movement or conflicting overlap is timing green and yellow clearance. *Conflicting Peds* may be used to omit a right-turn indication when a pedestrian movement is serviced. The example below shows the right-turn arrow (overlap 1) conflicting with the ped signals during phase 2.

```
Olp  1 ..........Conflicting..........
Phs    0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Olp    0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
Ped    2  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0  0  0  0  0
       0  0  0  0  0  0  0  0
```



In this example, a right-turn indication (overlap 1 green) conflicts with the pedestrian signals during phase 2

The conflict between the right arrow and the walk indication may be avoided by programming the pedestrian phase as a *Conflicting Ped* to suppress the overlap whenever a ped call is placed on Ø2. The overlap will continue to be suppressed during Ø2 until the pedestrian call is serviced. The overlap will also be suppressed if the ped call is issued continuously (ped recall is placed on Ø2).



Here, a Conflicting Ped parameter is used to prevent the right-turn arrow conflict with the pedestrian signals

Note: the user should program **Conflict Lock Enable** to **ON** when programming conflicting phases(s) when using a FYA overlap.

4.7 Program Parameters + Menu (MM->1->5->2->3)

The following screen is specific to the ATC Version 80.x software and is found at **MM→1→5→2→3**. These additional features are explained below.

4.7.1 Leading Green Feature

```
  Ovrlp   1
Leading Green  OFF  FYA MCE Disable OFF
Transit Input    0  FYA Skip Red    OFF
FYA Delay Time   0  FYA AfterPrempt OFF
PedCallClear   OFF  FYA Ext Overlap   0
PedClearTime     0  FYA ImmedReturn OFF
GoBarNoNext    OFF  AuxGreenSwap    OFF
OverrideExcl   OFF  OverrideGreen   OFF
OverrideYellow OFF  OverrideRed     OFF
RestInWalk     OFF  PedRecall       OFF
PedRecycle     OFF  GoBarMinFlash     0
ExInh........ ....... ....... .......
```

The *Leading Green* parameter (ON/OFF) delays the start of the overlap green much like *the Green/Ped Delay* which delays the start of a phase green or walk indication. This parameter is used in combination with the **Green/Ped Delay (MM->1->1->3)** which delays the start of a phase green or walk indication. If **Leading Green** is turned **ON**, the overlap will start (display green) while the green of the included phase is being delayed for the time programmed in the **Grn/Ped Delay** feature. If *Leading Green* is turned **OFF**, the overlap will follow the delay of the included phase before it starts.

4.7.2 Green Extension Inhibit (ExtInh)

Green Extension Inhibit phases overrides the green extension setting in the overlap. For instance, if included phases are 1+2, and the overlap times a green extension/trailing time of 10 seconds, setting phase 1 as a ExtInh phase will inhibit the extension if the overlap terminates at the end of phase 1 instead of phase 2. Simply select the specific phase (1-32) or phases for ExtInh.

4.7.3 Transit Input

Used with our additional Transit Priority controller software . If the overlap is providing the right-of-way to the transit vehicle (i.e. a train on a dedicated path), the transit value is the value of the transit input # that it is linked to. Currently the Transit software has 4 transit inputs so the valid programming values would be 0, 1,2,3 or 4 where the value of "0" indicates no transit input.

4.7.4 FYA Delay Time

This is used in association with the flashing yellow arrow (FYA-4) overlap type. This programmable period (0-255 seconds) delays the flashing yellow arrow from immediately starting when the through phase turns green. When this timer is programmed the controller insures that the delay time that it uses is the lesser of "modifier min green - 2 seconds" or "FYA delay time".

4.7.5 FYA Skip Red

This feature is used when going from a protected movement to a permissive movement that brings up the Flashing Yellow Arrow. MUTCD allows the signal to go from steady yellow arrow of the protected movement directly to a Flashing yellow arrow on the permitted movement, without display any red on the protected movement. By setting this parameter to "**ON**", this allowed behavior will occur. Please be aware that this behavior will occur even if the protected movement has RedClr time programmed under **MM→1→1→1**. In this case the Flashing Yellow Arrow for the permissive movement will be displayed during the Red Clearance period of the protected phase.

4.7.6 FYA AfterPreempt

Normally after any preemptions, FYA operation is suspended until the controller crosses a barrier. By setting this parameter to "**ON**", the FYA will immediately begin after the preemption is concluded, without crossing a barrier.

4.7.7 FYA Ext Overlap

This parameter specifies the NORMAL overlap (1-32) that the FYA will extend with during that overlap's green extension interval. Since the FYA follows the green extension of the NORMAL overlap specified, it can extend across a barrier if Lock Inhibit is ON.

4.7.8 PedCallClear

When the overlap type is **PED1**, and this feature is ON, then the locked Pedestrian calls will be cleared from all included phases any time any of the included phases is servicing a Pedestrian.

```
 Ovrlp   1
Leading Green  OFF  FYA MCE Disable OFF
Transit Input    0  FYA Skip Red    OFF
FYA Delay Time   0  FYA AfterPrempt OFF
PedCallClear   OFF  FYA Ext Overlap   0
PedClearTime     0  FYA ImmedReturn OFF
GoBarNoNext    OFF  AuxGreenSwap    OFF
OverrideExcl   OFF  OverrideGreen   OFF
OverrideYellow OFF  OverrideRed     OFF
RestInWalk     OFF  PedRecall       OFF
PedRecycle     OFF  GoBarMinFlash     0
ExInh........ ........ ........ ........
```

4.7.9 PedClrTime (0-255 seconds)

If the Overlap Type is **IndPed** then this time will be used as the Ped Clearance time for the Overlap. A default of 0 seconds will follow the Ped Clearance of the pedestrian phase that is currently running.

4.7.10 FYA ImmedReturn

"FYA Immediate Return" is used if the agency programs either conflicting Phases or Overlaps (Type= NORMAL) via **MM->1->5->2->2**. Typically, the default behavior (OFF) is for FYA not to "pop back up" once it has been inhibited. However, when the conflicting phase or overlap goes away, an agency may want the FYA to reappear. This feature, when set to ON will immediately begin the FYA after the conflict Phase/Overlap ends, without interfering with FYA's default behavior. Conflicting overlaps and phases still work if the feature is OFF or ON, so to be clear, this feature was added only to allow FYA to come back immediately. The agency is cautioned that an immediate start of a FYA could result in less than 2 seconds of FYA time depending on how much time is left in the permissive phase and when the inhibit is lifted.

Note: If using InhFYARedSt (MM->1->2->1), FYA ImmedReturn should be set to ON. Setting this option OFF disables the InhFYARedSt feature from being used.

4.7.11 GoBarNoNext

Normally, the GoBar overlap is called by a check-in detector. .Setting this parameter to **ON** insures that the GoBar overlap follows the parents and no detector is required. The GoBar overlap type is also driven by the included phases assigned to the overlap if **GoBarNoNext** is OFF but needs the check-in detector to activate.

4.7.12 GoBarMinFlash

The GoBarMinFlash setting is the time in seconds that the go bar must flash. The GoBar overlap will normally start flashing when the go bar phase is next. However, it is possible for a preemption to come in when the rings are all red, and then there is no phase next for the go bar phase to select. Due to this instance, this parameter should be programmed to a value other than "0", which will solve this issue by starting timing for go bar overlap flashing, and it cannot proceed to solid until is flashes a minimum prepare to go time.

4.7.13 AuxGreenSwap

The FYA-4 overlap provides 4 outputs (green, yellow, red and aux). Use the chart below to drive the phase's three colors as well as the auxiliary flashing yellow arrow.

AuxGreenSwap = OFF	AuxGreenSwap = ON
Green – green arrow	Green – FYA (flashing yellow arrow)
Yellow – yellow arrow	Yellow – yellow arrow
Red – red arrow/ball	Red – red arrow/ball
Aux – FYA (flashing yellow arrow)	Aux – green arrow

4.7.14 OverrideGreen

```
  Ovrlp    1
Leading Green  OFF  FYA MCE Disable OFF
Transit Input    0  FYA Skip Red    OFF
FYA Delay Time   0  FYA AfterPrempt OFF
PedCallClear   OFF  FYA Ext Overlap   0
PedClearTime     0  FYA ImmedReturn OFF
GoBarNoNext    OFF  AuxGreenSwap    OFF
OverrideExcl   OFF  OverrideGreen   OFF
OverrideYellow OFF  OverrideRed     OFF
RestInWalk     OFF  PedRecall       OFF
PedRecycle     OFF  GoBarMinFlash     0
ExInh........ ........ ........ ........
```

When **AuxGreenSwap** is set to **ON**, Setting **OverrideGreen** to **ON** will override the green output of a channel with the Aux output of a FYA-4 overlap. The specific overlap number (**Overlap Ovrd**) must be specified for the channel under the Chan+ menu (**MM->1->8->4**).

4.7.15 OverrideYellow

When When **AuxGreenSwap** is set to **ON**, Setting **OverrideYellow** to **ON** will override the yellow output of a channel with the Aux output of a FYA-4 overlap. The specific overlap number (**Overlap Ovrd**) must be specified for the channel under the Chan+ menu (**MM->1->8->4**).

4.7.16 OverrideRed

When **AuxGreenSwap** is set to **ON**, Setting **OverrideRed** to **ON** will override the red output of a channel with the Aux output of a FYA-4 overlap. The specific overlap number (**Overlap Ovrd**) must be specified for the channel under the Chan+ menu (**MM->1->8->4**).

4.7.17 OverrideExcl

Setting **OverrideExcl** (override exclusive mode) to **ON** will insure that all the non-overridden colors for the overridden channel will stay dark. This setting has been added to assist users that may have MMU/CMU dual indication issues. As a practical example, consider the following. Some agencies bring out the protected green arrow using the phase output channel. This feature will provide an overlap override setting, which will basically determine which colors are overridden. The issue is that typically in a standard FYA operation the software only allows the selection of one color. Because the phase output is being used the agency wants to only override green, but this allows yellow and red to appear Turning this feature to **ON**, will result in the desired behavior in that when we override the green the yellow and red outputs do not appear at all.

4.7.18 RestInWalk

This parameter only applies if the Overlap Type = **INDPED**. Setting this to "**ON**" will rest in walk during an Independent Ped Overlap.

4.7.19 PedRecall

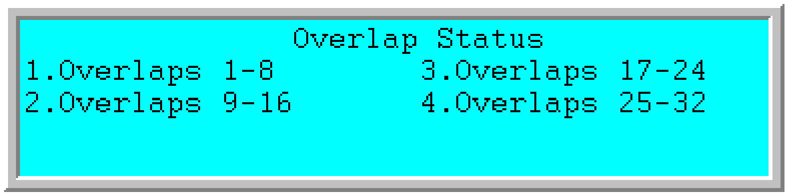
This parameter only applies if the Overlap Type = **INDPED**. Setting this to "**ON**" will recall the Independent Ped Overlap.

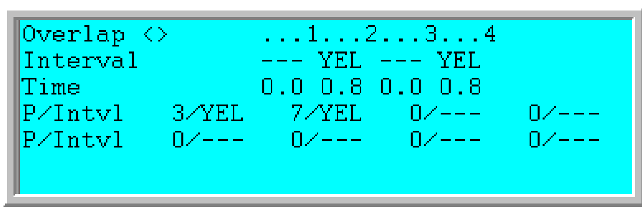
4.7.20 PedRecycle

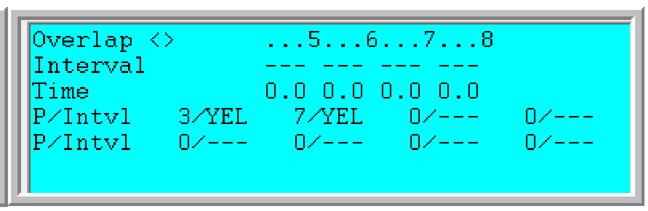
This parameter only applies if the Overlap Type = **INDPED**. Setting this to "**ON**" will allow the Independent Ped Overlap to be recycled.

4.8 Overlap Status Display (MM->1->5->3->1, MM->1->5->3->2)

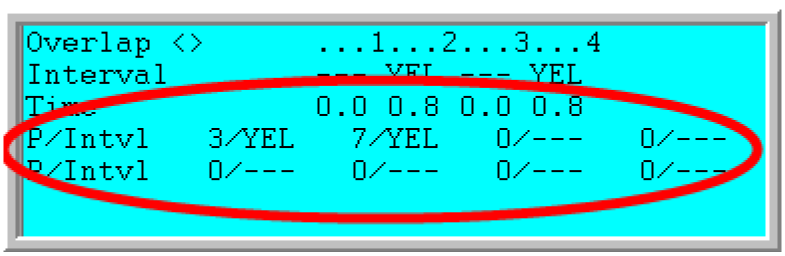
Overlap Status is shown for each of the overlaps in the controller. Intervals and timing show the individual clearance and extension timers for each overlap as shown below for selection 1: Overlaps 1-8.







In addition the ring status for all eight rings are also shown as highlighted below.



4.9 Automatic Flash (MM->1->4)

```
        Automatic Flash
1.Parameters
2.Phases/Overlaps
```

"Cabinet Flash" is a fallback mode of operation after an equipment failure, conflicting signal indication or local/internal conflict checks are detected by the Monitoring device (MMU/CMU). During "Cabinet Flash", the transfer relays disable all channel outputs from the controller and flash the load switches though a separate flasher device.

Automatic Flash (or programmed flash) provides two alternate means of flashing the load switch channels through the controller instead of the cabinet flasher. This operation is controlled through the *Flash Mode* setting found in the *parameters* section of the *Automatic Flash* menu.

4.9.1 Flash Parameters (MM->1->4->1)

```
       Auto Flash Parameters

Flash Mode           : CHANNEL
Input Source (Type 2): D-CONN
```

The *Flash Parameters* determine the:

- *Flash Mode* used to flash the signal displays during automatic (or programmed) flash
- Source of the input triggering automatic flash
- Clearance times when the controller leaves automatic flash and returns to stop-and-go operation

Flash Mode

This entry determines the source of the flash data when the controller goes into flash. Three modes are available.

- **CHANNEL** – *Channel* settings are applied during *Automatic Flash*
- **Ø/Olap** – Phase/overlap flash settings (discussed in the next section) are applied during *Automatic Flash*
- **CVM/WDOG** – the controller voltage-monitor and the fault-monitor signals are de-asserted during automatic flash causing the Monitoring device to disengage the transfer relays and flash the cabinet through the flasher

Input Src

The *Input Source* defines the external input for *Automatic Flash*. This allows the controller to be easily adapted to TS1 cabinets without rewiring the external input. Valid values are D-CONN (D-connector input), TEST-A or TEST-B.

Yellow Clearance

If a channel is selected to flash yellow, then this parameter determines its yellow clearance time when it leaves flash.

Red Clearance

If a channel is selected to flash red, then this parameter determines its red clearance time when it leaves flash.

4.9.2 Ø / Overlap Flash Settings (MM->1->4->2)

Ø/Overlap Flash Settings provide an alternative to the CHANNEL flash settings and allow the user to specify which phases and/or overlaps flash yellow when *Automatic Flash* is activated. All undefined phases and overlaps will flash red unless programmed to flash yellow in this menu.

```
    Phase/Overlap Automatic Flash
Yellow Clearance: 3.5
Red Clearance   : 1.5
  -----------Flash Yellow------------
Phs:  0  0  0  0  0  0  0  0
Phs:  0  0  0  0  0  0  0  0
Phs:  0  0  0  0  0  0  0  0
Phs:  0  0  0  0  0  0  0  0
Olp:  0  0  0  0  0  0  0  0
Olp:  0  0  0  0  0  0  0  0
Olp:  0  0  0  0  0  0  0  0
Olp:  0  0  0  0  0  0  0  0
```

4.10 Events and Alarms (MM->1->6)

```
  Events      |    Alarms     |  Evts/Alrms
1.Enable Evts 4.Enable Alrm 7.Enables
2.Show Evts   5.Show Alarms 8.Status
3.Clear Buffr 6.Clear Buffr 9.Show Det
```

The software logs and time stamps events. Events can optionally be flagged as Alarms. Events are intended to be uploaded periodically by the central management system (perhaps only once per day) for historical purposes, whereas Alarms are typically relayed to the central management system as soon as possible.

There are 128 types of Events and Alarms that can be individually enabled or disabled. Events and Alarms are referenced by number; each Event number corresponds to the same Alarm number. An Alarm is enabled if and only if its corresponding Event is enabled; however, an Event does not necessarily need its corresponding Alarm to be enabled. This lets the user choose which Events should be deemed high priority and reported immediately to the central management system.

4.10.1 Enabling Events (MM->1->6->1) and Alarms (MM->1->6->4)

```
Alarm Enable      Column.1.2.3.4.5.6.7.8
      Alarm #s 1-8      X X X . . . . .
               9-16     . . . X X X X X
              17-24     X X X . . . . .
              25-32     . . . . . . . .
              33-40     . . . . . . . .
              41-48     . . . . . . . .
              49-56  +  . . . . . . . .
```

```
Event Enable      Column.1.2.3.4.5.6.7.8
    Event #s   1-8      X X X X X X X X
               9-16     . X . . . . . .
              17-24     . . . . . . . .
              25-32     . . . . . . . .
              33-40     . . . . . . . .
              41-48     . . . . . . . .
              49-56  +  . . . . . . . .
```

A maximum of 128 events and alarms may be enabled through separate controller menus; however, each numbered events refers to the same numbered alarm. If an alarm is to be enabled, it must first be enabled as an event. However, an event may be enabled as an event without being enabled as an alarm. This scheme allows user defined high-priority alarm to be reported immediately to central while low-priority events are stored for record purposes.

4.10.2 Pattern / Preempt Events (MM->1->6->7->1)

Pattern changes and *Preempt Events* are stored in the events log and enabled separately from *Event / Alarm Parameters*.

```
        Event/Alarm Parameters
Pattern Events ON   Preempt Events ON
Loc Txmt Alrms OFF
Re-Assign User Alarm In #1 (5):    0
Re-Assign User Alarm In #2 (6):    0
Mon/Flash Alarm Delay (31)(secs) 15
```

Pattern Events

A *Pattern Event* and time-stamp is generated whenever there is a change in the active coordination pattern.

Preempt Events

A *Preempt Event* and time-stamp is generated whenever preemption begins or ends. In the Alarm or Event Buffer valid preemption numbers 1-12 will be displayed for High Priority Preemptions 1-12 and preemption numbers 13-16 will be displayed for Low Priority Preemptions 1-4.

Local Transmit Alarms

Do not enable *Local Transmit Alarms* if a closed loop master or the central software is polling the local controller. This feature should only be enabled if the local controller is programmed to forward alarms over a dialup modem.

Re-Assign User Alarm IN

These two entries allow the general-purpose NEMA Inputs, Alarm Input 1 and Alarm In 2 to be mapped to the alarm # that is entered. If this entry is 0, then the Alarm inputs are mapped to their default alarm numbers that are shown in parenthesis. The alarm input flexibility that this provides allows users to mimic other manufacturer's controllers when replacing them in existing non-standard NEMA cabinets.

Mon/Flash Alarm Delay (31) (secs)

Alarm # 31 is a alarm with a built-in Delay Feature. It may be used to filter for non-routine cabinet flash conditions, such as controller faults and Monitor (CMU/MMU) faults. It does not activate for intended or temporary flash periods such as time-of-day flash, startup flash, etc. This alarm is intended to be used to notify technical personnel when a fault condition exists that requires a technician's attention. This alarm becomes active after the user-programmed delay expires if the monitor, or a controller fault, causes the cabinet to flash. Specifically, the alarm is activated by:

1) A controller fault
2) A non-critical SDLC fault, including non-response after power-up
3) NEMA input "MMU Flash In" if the Local Flash Input is not active
4) NEMA input "Stop Time In" if the Local Flash Input is not active

This alarm will issue a pulse when three power-ups occur without sufficient time between them. The user should enter the seconds that the flash alarm may exist without setting the alarm. This allows momentary flashing due to MMU startup flash to NOT generate this alarm. If short flashes occur three times without meeting the delay, and these occur with less than 12 hours in between occurrences, then this alarm is asserted momentarily. The user may also clear the power up counter by clearing Controller Faults via **MM->8->7**.

This alarm can be avoided for Monitor Startup Flash periods by setting a time (in seconds) in the delay parameter that is greater than the monitor's startup flash time. This alarm is not intended for use with CVM Auto-Flash Mode in TS2 cabinets, as this mode of auto-flash causes the Monitor to flash the cabinet and it is indistinguishable from a monitor fault flash. Also note that this alarm times a delay that is dependent upon how your controller and cabinet powers up. It should be programmed to accommodate both. Short delay times may result in Alarm 31 coming up due to hardware faults that haven't cleared before the timer expires.

4.10.3 The Events Buffer (MM->1->6->2)

The *Events Buffer* stores event data so it can be uploaded to a closed loop master and/or the central system. On the example event screen is date and time stamped with the "Stn" (controller Station ID address). This example is for a controller with the Station ID of 121

- Event # 10 records Alarm# 61 when the controller was last in SYNC during Coordination on 12/20 at 15:11
- Event #9 (Alarm # 47) records that Coordination is not Active (OFF)
- Event # 8 records that Preemption 1 was called
- Event # 7 records that Preemption Active Alarm 48 (PR1) was set ON
- Event # 6 records that Alarm 49 (PR1) was called ON
- Event # 5 records that Alarm 48 (PR1) was completed (OFF)
- Event # 4 records that Alarm 49 (PR1) was completed (OFF)
- Event # 3 records that Preemption 1 was completed (OFF)
- Event #2 (Alarm # 47) records that Coordination is active
- Event #1 records Alarm #61 that Coordination is transitioning (ON)

```
#  Date  Time     Stn Typ Data ---------
 1 12-20 15:11    121 AL# 61   ON 02
 2 12-20 15:11    121 AL# 47   ON 0F
 3 12-20 15:11    121 PR#  0    0  0
 4 12-20 15:11    121 AL# 49 OFF 00
 5 12-20 15:11    121 AL# 48 OFF 00
 6 12-20 15:11    121 AL# 49   ON 00
 7 12-20 15:11    121 AL# 48   ON 01
 8 12-20 15:11    121 PR#  1    0  2
 9 12-20 15:11    121 AL# 47 OFF 00
10 12-20 15:11    121 AL# 61 OFF 00
11 00-00 00:00      0    00 00 00 00 00 0
```

The *Event Buffer* (internal buffer) holds 100 events and a separate *Event Display Buffer* (shown above) displays the first 100 events logged until the central software can poll the information from the local controller (via the Local Events Scheduler option). It is good practice, if you want to keep the event buffer up-to-date, to poll *Local Events* from the central software frequently enough to avoid losing any event information stored in the controller's event buffer. The central software interprets these event codes to generate query reports at the central office, so you don't have to view them from the controller.

4.10.4 The Alarms Buffer (MM->1-6->5)

The internal *Alarms Buffer* and *Event Buffer* are very similar; however, only events that are enabled as alarms under menu **MM->1->6->4** will be logged to the *Alarm Buffer*. Alarms enabled under menu **MM->1->6->4** MUST also be enabled as events under menu **MM->1->6->2** to be stored in the *Alarm Buffer*. Note that local pattern events (LPT) and preempt events (PRE) are stored only in the *Event Buffer*, not in the *Alarm Buffer*. However, if preempts are required as alarms, the preempt inputs may be wired to external alarm inputs in the cabinet as shown in the table.

```
 #  Date  Time     Stn Typ Data ---------
  1 12-20 15:15    121 AL# 61 OFF 00
  2 12-20 15:11    121 AL# 61  ON 02
  3 12-20 15:11    121 AL# 47  ON 0F
  4 12-20 15:11    121 AL# 49 OFF 00
  5 12-20 15:11    121 AL# 48 OFF 00
  6 12-20 15:11    121 AL# 49  ON 00
  7 12-20 15:11    121 AL# 48  ON 01
  8 12-20 15:11    121 AL# 47 OFF 00
  9 12-20 15:11    121 AL# 61 OFF 00
 10 00-00 00:00      0    00 00 00 00 00 0
 11 00-00 00:00      0    00 00 00 00 00 0
```

The *Alarm Buffer* has a capacity of 20 alarms. If the Alarm Buffer has 20 alarms, any subsequent alarms are discarded until the Alarm Buffer is manually cleared (see next section) or uploaded to the central system.

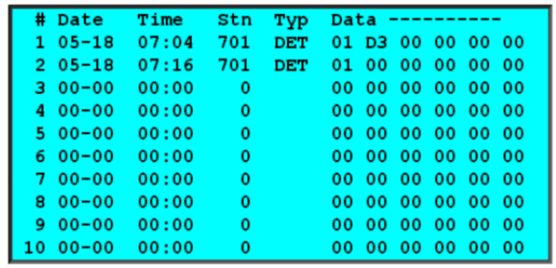
4.10.5 Clear Event and Alarm Buffers.

MM->1->6->3 clears the *Event Buffer* and **MM->1->6->6** allows the user to manually clear the *Alarm Buffer*.

```
CAUTION: This function clears all Events
       press Enter to begin...

       press ESC/BAK to go back
```

```
CAUTION:  This function clears all Alarm
       press Enter to begin...

       press ESC/BAK to go back
```

4.10.6 The Detector Events Buffer (MM->1->6->9)



```
 # Date   Time   Stn  Typ  Data ----------
 1 05-18  07:04  701  DET  01 D3 00 00 00 00
 2 05-18  07:16  701  DET  01 00 00 00 00 00
 3 00-00  00:00    0       00 00 00 00 00 00
 4 00-00  00:00    0       00 00 00 00 00 00
 5 00-00  00:00    0       00 00 00 00 00 00
 6 00-00  00:00    0       00 00 00 00 00 00
 7 00-00  00:00    0       00 00 00 00 00 00
 8 00-00  00:00    0       00 00 00 00 00 00
 9 00-00  00:00    0       00 00 00 00 00 00
10 00-00  00:00    0       00 00 00 00 00 00
```

Detector Events are stored in a separate 50 record buffer and uploaded to ATMS.now with the *Local Event* buffer. In the display to the right, Detector 1 at Station ID 701 failed at 07:04 with a fault code "D3" and became active again at 07:16. ***Please Note that Detector Numbers will and error codes will be displayed in hexadecimal notation***.

NTCIP 2.3.5.4.2 OCCUPANCY DATA calls for detector faults to be stored as occupancy data using the following values. These codes are interpreted by ATMS.now and converted to “friendly” text messages.

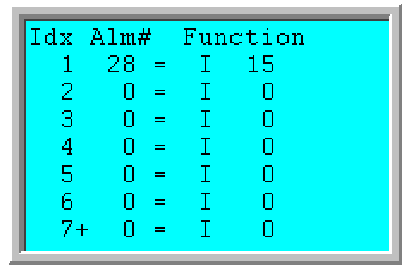
The following table documents the occupancy values for each NEMA detector faults.

Fault (decimal)	Fault (Hexadecimal)	Fault (Stored as Occupancy Data)
210	D2	Max Presence Fault
211	D3	No Activity Fault
212	D4	Open Loop Fault
213	D5	Shorted Loop Fault
214	D6	Excessive Inductance Change
215	D7	Reserved
216	D8	Watchdog Fault
217	D9	Erratic Output Fault

The following table documents the occupancy values for each NEMA Pedestrian detector faults.

Fault (decimal)	Fault (Hexadecimal)	Fault (Stored as Occupancy Data)
1	01	No Activity Fault
2	02	Max Presence Fault
4	04	Erratic Output Fault
5	05	Erratic Output/No Activity
6	06	Erratic Output/ Max Presence

4.10.7 Alarm Overrides (MM->1->6->7->2)



Alarm Overrides give users the ability to tie any input or output to an alarm input. The screen programming allows the user to choose any IO function (input or output), to drive or override any alarm (up to 16 of them). In general any IO function can drive any alarm. It is no different than if you simply re-mapped the alarm input in the IO mapping or IO logic. Using the detector to drive an alarm will OVERRIDE any other source of alarm. It will take the highest priority in setting the state. Please refer to the Programmable IO Logic Section for function codes.

In the example above, a set-back detector (detector #15) will drive alarm 28, the Queue detector alarm, thus instigating Queue Detector programming. Another purpose for this function is video detectors that have the ability to drive their own internal alarms to detector outputs (i.e. no video, inverse directions, etc...). The user can program up to 16 rows the following information:

Alarm
Program this column with the alarm number to override.

Function
The user sets this field to either an **I** (for Input) or **O** (for Output). This selection determines if you are assigning the result of the statement to an input or an output. The user can optionally set a **!** prior to the **I** or **O** result. The exclamation point indicates that the term is inverted during evaluation of the statement.

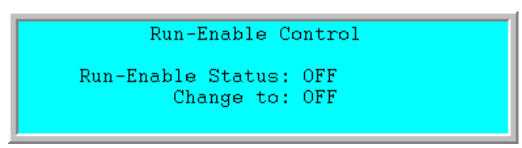
Function Number
The Function is followed by the IO Function Number as described in Chapter 12.

4.11 Predefined Event / Alarm Functions

See chapter 13 for a complete alarm listing with definitions for each alarm.

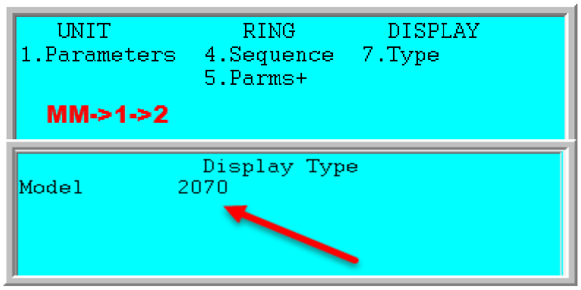
4.12 Enable Run Timer (MM→1→7)

Enable Run shows the current status of the ***Run Timer*** programmed under menu **MM->1->7**. As discussed in chapter 2, the Run Timer is used with the ***Clear & Init All*** **utility (MM->8->4->1).** This utility allows the user to initialize the controller to a default database after turning the **Run Timer to OFF (MM->1->7)**. The run timer disables all outputs from the controller and insures that the cabinet is in flash when the database is initialized. The user should use caution when initializing the controller database because all existing program data will be erased and overwritten. When the initialization is complete, the user should turn the **Run Timer to ON (MM->1->7)** to finalize the initialization (i.e. finalizing phase sequence and concurrency based on phase mode programming, latching output mapping, binding communications, etc.) and activate the unit. Note: when the run timer is first activated, calls are placed for all phases not omitted and for pedestrians that have walk and Ped clearance times that are programmed under **MM→1→1→1**. If the Run Timer is in the OFF state when the controller is shut off, then the Run Timer will remain in the OFF state upon reboot until manually turned ON.



4.13 Display Type (MM→1→2→7)

This screen allows the user to choose the type of hardware screen that the V76 software utilizes. This selection is used in association with the unit parameter **Screen Size** under MM->1->2->1 as discussed in the next section. The following is the list of parameters that the user may select along with the default screen size and hardware type that should be chosen as the maximum to properly display the screens. Any screen size up to the Maximum allowed size can be programmed under MM->1->2->1.



Note: for proper display, **do not** program a screen size greater than the maximum.

Parameter	Maximum Screen Size	Associated Hardware
2070	8 lines	2070-1B, 2070-1E, 2070-1C with 2070-3B Front panel
ATC	16 lines	National Standard ATC
980ATC	8 Lines	Cubic | Trafficware 980 ATC Type 1 or Type 2
4 Lines	4 lines	2070-1B, 2070-1E, 2070-1C with 2070-3A Front panel
8 Lines	8 Lines	2070-1B, 2070-1E, 2070-1C with 2070-3B Front panel, 980 ATC
16 Lines	16 Lines	National Standard ATC
VirtCtrl	13 Lines	Virtual controller

4.14 Unit Parameters (MM->1->2->1)

```
                Unit Parameters
Screen Size         13  Metric         OFF
 StartUp Flash(s)    0  Red Revert     3.0
  MCE Timeout        0  Auto Ped Clr   OFF
Local Flash Start OFF   Display Time   255
 Allow <3 sec Yel OFF   Tone Disable   OFF
   Allow Skip Yel OFF   AudioPedTime     0
   Start Red Time 0.0     Phase Mode  STD8
  StartupCalls   Norm   CNA FreeTime     0
 TOD Dimming Enbl OFF   Diamond Mode    4P
StopTm Over Prmpt OFF   Free Ring Seq    1
  Feature Profile    1       IO Mode VIRCTL
Max Seek Trak Tim    0 + Max Cycle Tm    0
```

Screen Size (Screen Size)

This parameter allows the use to adjust the numbers of lines on the screen to accommodate various controller screen sizes. It is used in association with the **Display Type** parameter described in the section above. Valid data entries are from 4-16. This number should match the maximum allowed screen size for the hardware selected under the **Display Type** parameter. Any screen size up to the maximum allowed size can be programmed under MM->1->2->1.

Metric (Metric)

This setting is for use with the DCS (Detector Control System) module only. Wen set to ***ON*** all inputted distances and internal calculations will be in Metric instead of English units. Default is ***OFF*** which will be English units.

Start Up Flash (StartUP Flash(s))

Start-up Flash (0-255 sec) determines how long a controller will remain in flash following a power interruption. During *Start-up Flash*, the Fault Monitor and CVM (Controller Voltage Monitor) outputs are inactive. The *Start Red Time* can be used to time an all-red interval immediately after the Start-up Flash interval.

Red Revert (Red Revert)

Red Revert (0-25.5 sec) applies to all phases that are programmed as red rest phases. This parameter insures that the phase will remain in red rest for the minimum period specified before the phase is reserviced. Each phase may override this value under *Phase Times* **(MM->1->1->1**).

MCE (Manual Control Enable) Timeout (0 -255)

If MCE programmed to 0, MCE is always enabled. If MCE is programmed between 1 and 254 (minutes) and MCE is applied and no interval advance is issued for this amount of time (in minutes), then MCE is disabled. In this case, to re-enable MCE, the MCE input must be cycled OFF and then back ON. The Manual Control Enable function is always disabled if there is a programmed value of 255.

AudioPedTime (AudioPedTime) (0-255 seconds)

Pedestrian phases 2, 4, 6, and 8 have a dedicated output function (pin) called the "Audible Ped Output". If the amount of Walk time left in the associated Ped is greater than the time specified by this parameter, then the output is asserted. It will also activate the Special Function Outputs 1-8, which will turn on alarms 121-128 if enabled.

Auto Pedestrian Clear (Auto Ped Clr)

The *Automatic Pedestrian Clear* parameter may be either enabled or disabled. This option determines the behavior of the pedestrian clearance interval for the controller when manual control is enabled. When enabled, it prevents the pedestrian clearance interval from being terminated by the Interval Advance input.

Phase Mode (Phase Mode)

Phase Mode sets the operating mode and automatically programs the default phase sequence and concurrencies for the specified mode. The *Run Timer* must be turned OFF under MM->1->7 to change *Phase Mode*. This insures that the controller outputs are off and not driving any channel outputs. Once *Phase Mode* is modified and the *Run Timer* is set to ON, diagnostics will occur that will verify if *Ring Sequences* and *Phase Concurrencies* make sense to the software. If not, the diagnostics will result in an INIT Err and the controller will be set to flashing operation. *Phase Mode* diagnostics will vary based on the selected mode with STD8 utilizing the most and USER the least. Please note that the user should test the controller operation after modifying the *Phase Mode* prior to field operation.

STD8 Phase Mode is the best practice for all applications unless intersection geometry and sequencing are too complex.

NOTE: If Phase mode is reset by the user to STD8 any changes in the sequence table (MM-1-2-4) or the concurrency table (MM-1-1-4) will be overwritten by the STD8 defaults upon the Run Timer going from OFF to ON or a power cycle!

Display Time (Display Time)

Display Time sets the timeout (0-99 minutes) that reverts the display to its default screen and logs off the user. If security is set under **MM->8->2**, the user must “log in” with a security access code after the *Display Time* expires. If the *Display Time* is set to zero, a value of one minute is used to insure that the screen does not timeout.

Tone Disable (Tone Disable)

Set *Tone Disable* to ON to disable audible tones for keyboard operations.

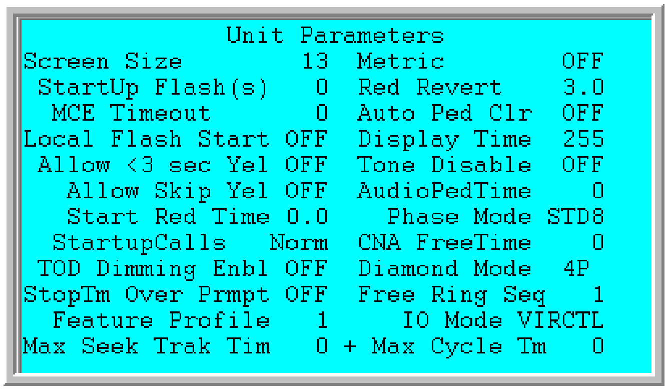
Diamond Mode (Diamond Mode)

Diamond Mode only applies if the Phase Mode is set to DIAMOND. The three Diamond Modes are 4-Phase, 3-Phase, and Separate Intersection. Please refer to the Operations Manual for Texas Diamond Controllers for a description of the various diamond operations.

Call to Non-Actuated Free Time (CNA FreeTime) (0-254 seconds, 255 disables CNA)

CNA FreeTime is the amount of time that CNA can be applied before it is automatically disabled. CNA must be de-asserted, then re-asserted for CNA to be active. If the value is 0, then CNA does not time out. If the value is 255, CNA is ignored

Local Flash Start (Local Flash Start)



Local Flash Start is a feature that will be instigated by the toggling of a flash input. When a Flash input is toggled to the "ON" state, there are 4 types of flash inputs that can be programmed via IO mapping as described in chapter 12. The first is Local Flash (input function 208) which will enable the Cabinet Flash input to be activated. The second is 33x Flash Sense (input function 228) which will enable the Cabinet Flash input to be activated as well as stop time the controller. The third is Auto Flash (input function 211) which will initiate the software programmed (Automatic) flashing operation. The fourth is Flash In (input function 191) which will also initiate the software programmed (Automatic) flashing operation.

When the Flash input is toggled to the "***ON***" state, *Local Flash Start* goes into effect. The following table describes the programmed features available for *Local Flash Start*.

Local Flash Start State	Operational Feature when the Flash input is Deactivated
OFF	The software will continue to run without going through a restart. Please select this setting if implementing V80.x on City of Houston ITS Cabinets.
ON	Forces the controller to perform an "External Start" which in effect restarts the controller.. This feature was originally used in NEMA cabinets that were built prior to TS2-98 and that didn't have a diode/capacitor network installed in the cabinet on the EXT START input. The Local Flash Start parameter essentially replaced a diode/cap circuit with a software feature.
DRK	Upon Activation of a Flash input, all Load switches will be placed in a dark state. This feature is used by some Type 170 cabinets that use 2070 controllers. When the Flash input is deactivated, the controller will go through a restart.
RED	This feature is used by some Type 170 cabinets that use 2070 controllers. When the Flash input is deactivated, the controller will go through a restart. In addition it will time the *Start Red Timer* when the restart is initiated.
RSt	Upon Activation of a Flash input, all Load switches will be placed in an All-Red state. This feature is used by some Type 170 cabinets that use 2070 controllers. When the Flash input is deactivated, the controller will go through a restart. In addition it will time the *Start Red Timer* when the restart is initiated.

Start Red Time (Start Red Time)

Start Red Time (0-25.5 seconds) is an all-red period at the end of *Startup Flash* when the controller is reset (power-up or an SDLC fault is cleared). *Startup* values (**MM->1->1->4**) must be set to ***RED*** or ***RED CLR*** before *Start Red Time* can be applied.

```
            Unit Parameters
Screen Size          13  Metric        OFF
 StartUp Flash(s)     0  Red Revert    3.0
  MCE Timeout         0  Auto Ped Clr  OFF
Local Flash Start OFF  Display Time  255
 Allow <3 sec Yel OFF  Tone Disable  OFF
   Allow Skip Yel OFF  AudioPedTime    0
   Start Red Time 0.0    Phase Mode STD8
  StartupCalls   Norm  CNA FreeTime    0
 TOD Dimming Enbl OFF  Diamond Mode   4P
StopTm Over Prmpt OFF  Free Ring Seq   1
  Feature Profile   1      IO Mode VIRCTL
Max Seek Trak Tim   0 + Max Cycle Tm   0
```

Allow Less than 3 Sec Yellow (Allow <3 Sec Yel)

The controller enforces the minimum yellow clearance time of 3" specified in the MUTCD unless *Allow <3 Sec Yel* is ON. Turn this value ON when a yellow clearance less than 3 seconds is required on a phase (such as a clearance driving an overlap and not a vehicle display).

Allow Skip Yellow (Allow Skip Yel)

Allow Skip Yellow must be enabled in order to use the OMIT YEL, YEL Ø discussed in the last section under options plus.

Startup Calls (StartupCalls)

This setting allows the user to program which phases that they would like to call upon startup. The settings are as follows:

Setting	
Norm	All vehicle and pedestrian phases that are enabled will be called on startup
SkipPed	Disables pedestrian calls during the first cycle after a controller reset. This is a temporary value that is not part of the controller database and is always set to OFF after the controller powers up.
UsePrg	The user can program which vehicle or pedestrian phases that will be called on startup. Phase and pedestrian phases are programmed under **MM→1→1→7**, the Phase Times+ menu.

Free Ring Sequence (Free Ring Seq)

The default phase sequence for FREE operation is Seq # 1 (dual-ring, left-turns first sequence). *Free Ring Seq* is initialized to "0" when you initialize the controller to STD8 operation that does not override the default Seq # 1. Any other value (2-16) for *Free Ring Sequence* overrides Seq# 1 as the default phase sequence for FREE operation.

Stop-Time Over Preempt Priority (StopTm Over Prmpt)

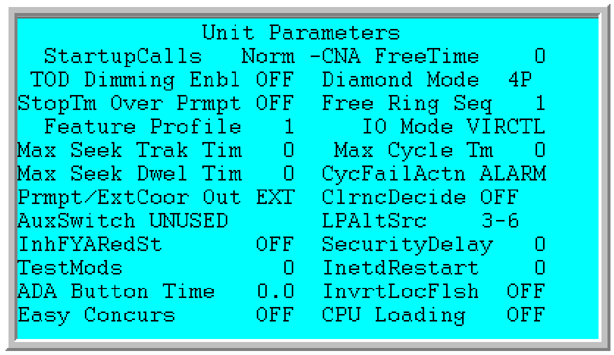
Stop-Time Over Preempt causes the *Stop-Time* inputs to have priority over *Preempt* inputs. *Stop-Time* is often wired to the output of a Monitoring device unit (MMU/CMU) so that in the event of a Monitor fault, the controller is halted to help diagnose the fault. Since preemption has priority over stop-time, a preempt will cause the controller to begin timing again and the diagnostic information will be lost. Setting *Stop-Time Over Preempt* to ON prevents a preempt from overriding stop timing and preserves this diagnostic information. However, be aware that preempts will be ignored if the *Stop-Time* switch on the maintenance panel is activated.

Feature Profile (Feature Profile)

This parameter allows predefined selections to be removed from the menu screens. The default value, 0, allows all menu selections to be visible and accessed according to security definitions. This normally includes the Master Menu if that module is allowed. A value of 1 removes selection 9 from the main menu screen on the 981 TS2 master controller and the 2070 controllers with this version. If Feature Profile is set to 3, then a database download will not block any database parameters from being overwritten. A value of 3 can be used when the user wants to initiate a "Full" download from the field using ***MM->6->4->1, Request Download***. If the user sets Select Data to **LOCAL** on this menu, it will initiate a "full" download. After completion, all settings will be present from the downloaded database. The user should use caution when setting Feature Profile to 3 because all communication parameters may be overridden (changed) including the Station ID.

IMPORTANT: If the database that is stored in ATMS is saved with MM-1-2-1 Feature Profile set to 1 (the normal value), then the act of performing the download will change that field back from 3 to 1, effectively making the manual action at the controller a one-time override.

Max Cycle Tm



Maximum-Cycle-Time is a manual override value used to check that the controller is cycling properly. If no value is entered, the controller will calculate a value based on the controller phase and coordination programming. A different value is calculated for free and for coordinated operation. The user can enter a value (in seconds) to override the calculated value that the controller uses to perform this check, **for FREE operation only**. Please note that the calculated time under coordination is calculated as three times the cycle length. Under the USER phase mode, in Free operation, it is defaulted to 420 seconds. The Cycle Fault Action parameter determines the controller response to Max Cycle Time as described below.

Cycle Failure Action (CycFailActn)

A Cycle Failure Action is declared when the Max Cycle Time or the preemption seek times (Max Seek Track Time or Max Seek Dwell Time) are exceeded while the controller is operating free. The Cycle Failure Action setting determines whether the controller generates an ALARM or enters FLASH when the cycle failure occurs. A cycle failure occurs due to the following scenarios:

1. While operating in free mode, the controller does not service valid demand within the allotted time.
2. The controller has already failed coordination due to a cycle fault, and is now running free. If the controller still does not service valid demand within the allotted time, a cycle failure occurs.

Maximum Seek Preemption Track Clearance Time (Max Seek Trak Tim)

Maximum-Seek-Track-Clearance-Time is used to check if the track phases become active as quickly as expected when a railroad preempt is received. Enter a value at least one second greater than the maximum time anticipated for the controller will take to achieve track clearance. A zero entry disables the feature.

Max Seek Preemption Dwell Time (Max Seek Dwel Tim)

Maximum-Seek-Preempt-Dwell-Time is used to check if the preempt dwell phases become active within the maximum expected time following the beginning of track clearance during railroad preemption or from the beginning of an emergency preempt. Enter a value at least one second greater than the maximum time anticipated to achieve preempt dwell. A zero entry disables the feature.

Clearance Decide (ClrncDecide)

The default phase next decision is made at the beginning of yellow clearance when a phase terminates.

ON forces the controller to re-evaluate phase next at the end of all-red clearance. When the controller finishes its red clear, it looks at the all phase next selections and verifies if phases still have calls **(if any calls have been dropped)**. If they don't, then it makes the phase next decision again. In other words, it only makes a phase next decision if the original decision does not warrant service, NOT if there was a different decision to be made. This prevents the phase from moving to another phase if the call is lost during the clearance intervals.

ALWAYS waits for the controller to finish its red clear, it then makes the phase next decision. This will allow phases that are earlier in the sequence to be serviced if they did not have calls at the time the original decision was made.

OFF uses the default phase next decision making

Note: Clearance Decide was developed for specific user applications, and not advised for general use. Use of this feature will have various ramifications on overlap functionality – specifically overlaps with multiple included or modifier phases, as the "next" decision affects their operation. If this feature is used, then the user must take care to carefully bench test the application to ensure that the overlaps will operate as expected. This note specifically applies to flashing yellow arrow (FYA) operation, which is implemented via special overlap functionality.

Prmpt/ExtCoor Out

Setting this parameter to “ON” will remap the NEMA “D” connector when using Texas 2, V14 (TX2-V14) Alternate 820A Mapping. The 820A function is enabled by setting this selection to ON. When this is selected, the new Preempt interval status for intervals 1-7 is output on pins 14, 22, 35, 39-42, and 48. Also, the standard Preempt Status for Preempts 1-6 is output on pins 43, 44, 49-51, and 56 is output. Please see Chapter 14 for more details.

Low Priority Preemption Inputs Alternate Sourcing (LPAltSrc)

Setting this parameter allows low-priority preempts 7-10 to be assigned to oscillating inputs on preempts 1-4 instead of 3-6.

```
             Unit Parameters
  StartupCalls   Norm -CNA FreeTime     0
 TOD Dimming Enbl OFF  Diamond Mode   4P
StopTm Over Prmpt OFF  Free Ring Seq    1
  Feature Profile   1      IO Mode VIRCTL
Max Seek Trak Tim   0   Max Cycle Tm    0
Max Seek Dwel Tim   0  CycFailActn ALARM
Prmpt/ExtCoor Out EXT  ClrncDecide OFF
AuxSwitch UNUSED       LPAltSrc     3-6
InhFYARedSt       OFF  SecurityDelay    0
TestMods            0  InetdRestart     0
ADA Button Time   0.0  InvrtLocFlsh   OFF
Easy Concurs      OFF  CPU Loading    OFF
```

Auxillary Switch Input (AuxSwitch)

Setting this parameter to “**<u>STOPTIME</u>**” allows the user to toggle the 2070 Front Panel Auxiliary Switch to the “ON” position and stop the Patriot software from advancing any Phase timer. Toggling the switch to the “OFF” position will continue controller’s phase timing from the point it was halted. Setting this Parameter to “**<u>UNUSED</u>**” will ignore the toggling of the 2070 Front Panel Auxiliary Switch.

Inhibit Flashing Yellow Arrow on Startup (InhFYARedSt)

When programming Flashing Yellow arrow, upon controller startup (i.e. controller power up, NEMA Ext. Startup, startup after Flash, etc.), the FYA outputs will be inhibited until all phases are cycled and serviced once when this parameter is programmed to *OFF*. By programming this parameter to *ON* the FYA outputs will not be inhibited.

Note: FYA ImmedReturn (MM->1->5->2->3) must be set to ON in order to use this feature. In other words, FYA ImmedReturn must be programmed as OFF in order to inhibit the FYA for the first cycle after startup.

Security Delay (SecurityDelay)

This feature is used with TS1 Cabinets to sound an audible alarm if a cabinet door is opened without authorization. It is programmed in seconds from 1-255.

InetdRestart (InetdRestart)

This selection allows the user to set a reset time (1-255 minutes) to force a reset of the FTP communications engine used by the Linux operating system. The typical setting is 1 minute. If the agency is using an FTP to gather Purdue data, this feature will allow a way to restart the FTP application if it gets hung up.

TestMods

This is used by Cubic | Trafficware for internal usage. This should be kept at the default programming of “0”.

ADA Button Time (ADA Button Time)

This parameter (0.0 to 25.5 seconds) will allow the Pedestrian button to extend its call for use by pedestrians needing ADA assistance.

Invert Local Flash (InvrtLocFlsh)

This parameter will Invert the Local flash outputs if set to **ON**.

Easy Concurs

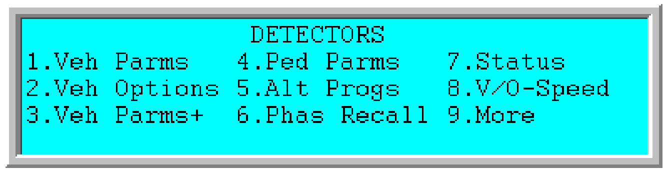
This is used by Cubic | Trafficware for internal usage. This should be kept at the default programming of “**OFF**”.

CPU Loading

This is used by Cubic | Trafficware for internal usage. This should be kept at the default programming of “**OFF**”.

5 Detection

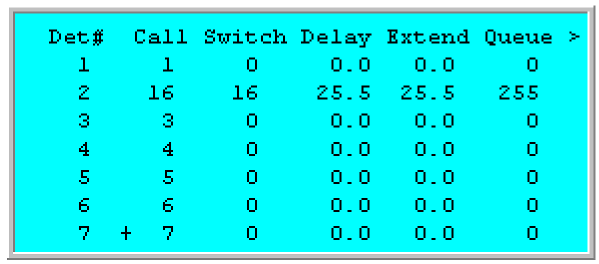
5.1 Detector Programming (MM->5)



Cubic | Trafficware controllers provide all NTCIP objects related to detection with additional "plus" features to enhance functionality. NEMA TS 1 provides one detector input per phase to call and extend the phase (each phase has one source or channel of detection). TS2 and Model 332/336 cabinets provide separate detector inputs that can be individually programmed to call and/or extend any phase. Each of its 64 "logical" detectors in the controller can be visualized as an input channel assigned to a call phase. These "logical" detectors may be sourced from "physical" detectors in the detector rack or from another "logical" detector (1-64). ITS Cabinets also provide separate detector inputs that can be individually programmed to call and/or extend any phase. Each of its 128 "logical" detectors in the controller can be visualized as an input channel assigned to a call phase. These "logical" detectors may be sourced from "physical" detectors in the detector rack or from another "logical" detector (1-128).

NOTE: Currently the highest detector number that can be mapped is 128.

5.1.1 Vehicle Parameters (MM->5->1, Left Menu)



Det#		Call	Switch	Delay	Extend	Queue >
1		1	0	0.0	0.0	0
2		16	16	25.5	25.5	255
3		3	0	0.0	0.0	0
4		4	0	0.0	0.0	0
5		5	0	0.0	0.0	0
6		6	0	0.0	0.0	0
7	+	7	0	0.0	0.0	0

Detectors may be assigned to an active phase to drive the actuated features of the controller or may be used as system detectors to collect volume and occupancy or detect queue failures. The *Call* phase parameter defines an input channel for the phase that will receive the call when a detector has been actuated. The *Switch* phase allows a detector to call and extend the call phase, while also providing extends to a secondary phase.

Delay, *Extend* and *Queue* times modify the phase input. The *Delay* timer inhibits the detector input until the *Delay* timer expires. The *Extend* timer "stretches" the detector call for a user specified extend time. The *Queue* timer inhibits a detector after a delay time based on the start of the green interval.

Call Phase (Call)

The *Call Phase* receives detector actuations when the phase is red if *Call* option is enabled for the detector (**MM->5->2**). The *Call Phase* also receives detector actuations when the phase is green if the *Extend* or *Queue* option for the detector is enabled. If *Call Phase* is set to zero, the call and extend features of the detector are disabled, but volume and occupancy may still be sampled. Occupancy measured during the green, yellow or red interval requires a *Call Phase* other than zero.

Switch Phase (Switch)

The *Switch Phase* is extended when the assigned *Call Phase* is red or yellow, and the *Switch Phase* is green. Note that the *Call Phase* is not called when the *Switch Phase* is green. This feature is typically used for protected/permitted left-turn applications to call and extend a protected left-turn phase after the cross street is serviced and extend the permitted indication by programming a *Switch Phase* corresponding with the adjacent through movement.

Delay (Delay)

The *Delay* parameter is the amount of time in tenths of seconds (0-255.0 sec) that the actuation from the detector is delayed when the assigned phase is not green.

Extend (Extend)

The *Extend* parameter is the amount of time in tenths of seconds (0-25.5 sec) that the actuation is extended after the point of termination, when the phase is green. *Extend* is only effective when the *Extend* option is enabled for the detector under *Vehicle Options* (MM->5->2).

Queue Limit (Queue)

Queue Limit (0-255 sec) determines how long a detector actuation is active after the start of the green interval. After the timer expires, actuations from the detector are ignored. *Queue Limit* is only effective when the *Queue* option is enabled and the *Extend* option is disabled for the detector under *Vehicle Options* (**MM->5->2**).

5.1.2 Detector Diagnostic Vehicle Parameters (MM->5->1, Right Menu)

< Det#	NoAct	MaxPres	ErrCnt	FailTime
1	0	0	0	2
2	255	255	255	255
3	0	0	0	2
4	15	10	0	2
5	0	0	0	2
6	0	0	30	2
7 +	0	0	0	2

Vehicle Parameters include detector diagnostics programmed from the right menu of **MM->5->1**. The *No Activity* time insures that the detector has received a call within the specified period. The *Max Presence* time fails the detector if a constant call exceeds the specified period (both of these values are expressed in minutes). *Erratic Counts* (expressed in actuations per minute) isolates a chattering detector that is issuing false calls.

If any of these diagnostics fail, the controller will place a recall on the phase called by the detector. This recall insures the greater of *Min Green* or the *Fail Time* programmed under *Vehicle Parameters*. The recall generated is not a traditional recall but instead acts as though a continuous call is present until such time as the detector is classified as working. In addition, real-time vehicle alarm status is provided under **MM->5->7->1** and **MM->5->7->2**. Real-time vehicle alarm status is provided under **MM->5->7->1** and **MM->5->7->2**.

Vehicle Detector - No Activity (NoAct)

No Activity (0-255 min) fails the detector if it has not issued a call within the specified period of time. The failed detector will continue to place a call on the assigned *Call Phase* and extend the *Call Phase* until the detector receives a call and resets the *No Activity* failure. The *No Activity* failure will continue to service the *Call Phase* for the greater of *Min Green* or the specified *Fail Time* for the detector. NEMA requires that *No Activity* logs a value of 211 in the current occupancy sample for the detector. A value of 0 disables this feature and a common practice is to call an alternate detector map through a pattern to disable *No Activity* diagnostics late at night when traffic volumes are light.

Vehicle Detector - Max Presence (MaxPres)

Max Presence (0-255 min) fails the detector if it has issued a constant call after the specified period of time. The failed detector will continue to place a call on the assigned *Call Phase* and extend the *Call Phase* until the constant call on the detector is reset. The *Max Presence* failure will continue to service the *Call Phase* for the greater of *Min Green* or the specified *Fail Time* for the detector until the detector is reset. NEMA requires that *Max Presence* logs a value of 210 in the current occupancy sample for the detector. A value of 0 disables this feature; however, it is not necessary to disable *Max Presence* during light traffic conditions because a *Max Presence* failure will provide a min recall on the phase instead of driving the phase to max with a constant call.

Vehicle Detector - Erratic Counts (ErrCnt)

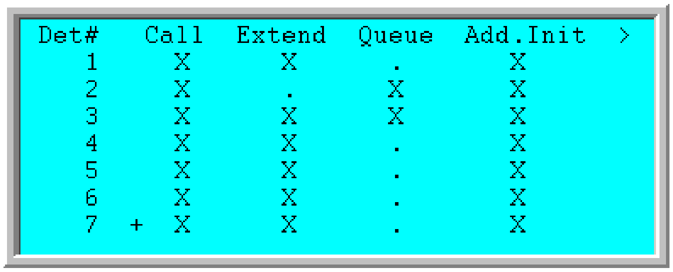
Erratic Counts is expressed in counts-per-minute (0-255 cpm) instead of seconds. This detector diagnostic isolates a "chattering" detector that is issuing false calls to the controller. Typical values for *Erratic Counts* range from 40-70. The *Erratic Counts* failure will continue to service the *Call Phase* for the greater of *Min Green* or the specified *Fail Time* until the number of counts per minute drops below the specified threshold. NEMA requires that *Erratic Counts* logs a value of 217 in the current occupancy sample for the detector. A value of 0 disables this feature; however, it is not necessary to disable *Erratic Counts* during light traffic conditions.

Vehicle Detector - Fail Time (FailTime)

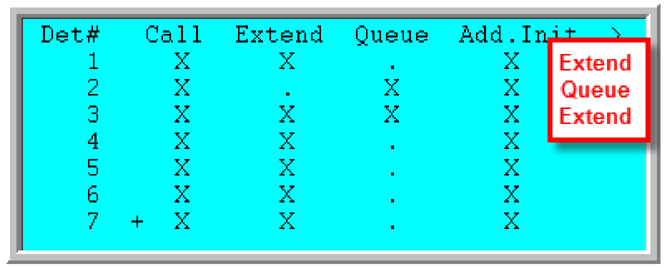
When a detector diagnostic fails, a call is issued to the *Call Phase* of the failed detector and the *Call Phase* is extended by the greater of *Min Green* or the specified *Fail Time* (1-254 seconds). If the *Fail Time* exceeds the *Max Green* time for the *Call Phase*, the issued call will go to *Max Green*. Note that a 0" *Fail Time* disables this call and extend feature when a detector fails. A 0" *Fail Time* will always prevent a failed detector from placing a call, so the default Fail *Time* for STD8 is set to 2 seconds. This insures that the greater of *Fail Time* or *Min Green* is applied to recall the phase when the detector fails. A *Fail Time* equal to 255" insures that a constant call extends the phase when a detector fails.

5.1.3 Vehicle Options (MM->5->2, Left Menu)

Each of the 128 “logical” detectors may be programmed to *Call* and/or *Extend* the *Call Phase* specified under *Vehicle Parameters*. *Extend* overrides the *Queue* option as shown in the example to the right. Therefore, do not enable *Extend* if the *Queue* time under *Vehicle Parameters* (**MM->5->1**) is to be applied. *Extend* and *Queue* are mutually exclusive.



Det#	Call	Extend	Queue	Add.Init >
1	X	X	.	X
2	X	.	X	X
3	X	X	X	X
4	X	X	.	X
5	X	X	.	X
6	X	X	.	X
7 +	X	X	.	X



Det#	Call	Extend	Queue	Add.Init >
1	X	X	.	X
2	X	.	X	X
3	X	X	X	X
4	X	X	.	X
5	X	X	.	X
6	X	X	.	X
7 +	X	X	.	X

Vehicle Option - Call (Call)

The *Call* option enables a detector to call the *Call Phase* when the *Call Phase* is not green and any assigned *Switch* phase is also not green. If the assigned *Switch* phase is zero, then a call is issued to the *Call Phase* whenever the *Call Phase* is not green. Therefore, if a *Switch* phase is not assigned, the detector will call the *Call Phase* whenever it is in yellow or red.

Vehicle Option – Extend (Extend)

The *Extend* option resets *Extension* timer of the assigned phase to extend the green interval. The *Extend* option overrides the *Queue* option as described below.

Vehicle Option – Queue (Queue)

The *Queue* option allows the detector to extend the assigned phase until either a gap occurs (no actuation) or the green has been active longer than *Queue* limit specified under Vehicle Parameters (**MM->5->1**). This feature is useful for detectors located at or close to the stop-bar that call and extend the phase during the initial green but drop out after the queue clears to allow setback detectors to gap out the phase farther upstream. For this feature to operate, the *Extend* Vehicle Option for this detector must be disabled and the *Extend time* under Vehicle Parameters should be programmed**.**

Vehicle Option - Added Initial (Add.Init)

This option enables the detector to accumulate vehicle volumes during the yellow and red intervals that are used with added initial calculations. *Added Initial* must be enabled for the detector before volume density parameters become effective. Providing timing for *Added Initial* and *Max Initial* under menu **MM->1->1->1** does not imply that *Added Initial* will extend the *Min Green* time. You must enable *Added Initial* for the detector calling the phase before these volume density settings become effective.

5.1.4 Vehicle Options (MM->5->2, Right Menu)

< Det#	Red.Lock	Yel.Lock	Occup	Volum
1	.	.	X	X
2	.	.	X	X
3	.	.	X	X
4	.	.	X	X
5	.	.	X	X
6	.	.	X	X
7 +	.	.	X	X

The phase option, *Lock Calls* (**MM->1->1->2**) applies a constant call on the phase even if the call is reset before the phase is serviced. *Red Lock Calls* and *Yellow Lock Calls* are NTCIP features that apply locking to each detector rather than lock all calls to the phase. This provides individual control over each detector assigned to a *Call Phase* allowing some detectors to lock the call and others to reset the call prior to the phase being serviced.

Vehicle Option - Red Lock Calls (Red.Lock)

Red Lock Calls lock a call to the assigned phase if the actuation occurs during the red interval.

Vehicle Option - Yellow Lock Calls (Yel.Lock)

Yellow Lock Calls allows the detector to lock a call to the assigned phase if the actuation occurs during the yellow interval.

Vehicle Option – Occupancy (Occup)

Set *Occupancy* to log the occupancy of the detector. *Occupancy* is expressed as the ratio of the accumulated vehicle actuations during the sample period divided by the *Volume/Occupancy Period.* This ratio is expressed as a percentage in half-percent's over the range (0-200). The *Volume/Occupancy Period* is set in the *Report Parameters* (**MM->5->8->1**). Up to 90 continuous days of Occupancy data can be stored in the controller's memory buffers before being overwritten.

Vehicle Option – Volume (Volum)

The *Volume Detector* option enables the detector to collect volume data. Volume is the accumulated number of actuations during the *Volume/Occupancy Period.* The *Volume/Occupancy Period* is set in the *Report Parameters* (**MM->5->8->1**). Up to 90 continuous days of Volume data can be stored in the controller's memory buffers before being overwritten.

5.1.5 Vehicle Parameters+ (MM->5->3)

These plus features extend NTCIP by providing additional *Modes* of detector operation. *Delay Phases* allow the delay assigned to a detector to be inhibited only when the assigned *Delay Phase(s)* are active. Detector occupancy may be measured only during the green, yellow, and/or red intervals of the *Call Phase* assigned to the detector.

```
Det# Occ:GYR Dly/Q-Alm Mode    Src Olp
  1      XX.   0     0 NORMAL   0   0
  2      XX.   0     0 STOP_A   0   0
  3      XX.   0     0 STOP_B   0   0
  4      XX.   0     0 NRM_RR   0   0
  5      XX.   0     0 BIKE     0   0
  6      XX.   0     0 Q-ALRM   0   0
  7      XX.   0     0 ADAPT    0   0
  8      XX.   0     0 VU_COM   0   0
  9      XX.   0     0 NORMAL   0   1
 10      ...   0     0 NORMAL   0   0
 11  +   ...   0     0 NORMAL   0   0
```

Vehicle Parms+ - Occ: G Y R (Occ: G Y R)

Occupancy may be measured during any combination of the Green, Yellow and/or Red interval of the *Call Phase*. If G, Y and R are not selected, occupancy will be sampled continuously. Occupancy during G+Y can be used when detectors are located at or near the stop-bar. Be sure to select "Occ" for the detector under **MM->5->2** as discussed in the last section.

Vehicle Parms+ - Dly/Q-Alm

There are two delay phases that can be programmed, under the column heading **Dly/Q-Alm**. If the *Delay Phases* are programmed to zero, the associated detector will time the delay specified for that detector under *Vehicles Parameters* (MM->5->1). If either *Delay Phase* entry is not zero, the detector delay is **<u>only</u>** timed when either programmed *Delay Phases* on this screen are being serviced. Please note that the first column can alternately be programmed as a Queue Alarm number (1-16) instead of a delay phase if the agency programs the detector mode as a Q-Alrm as described in the next section

Queue Alarm (Q-Alm)

Selecting Q-Alm for a detector is intended to be a system only detector to generate *Alarm # 28*. Once this field is set to **ON** and the detector mode is set to **Q-Alrm** (see modes below) set this detector will generates alarm 28 when a specified QUEUE timer expires. See **Queue Detection Programming** section below for operational details.

Vehicle Parms+ - Mode

The *Mode* parameter defines the following operating modes of the detector:

- **NORMAL** – Normal operating mode is determined by the NTCIP detector options and parameters.
- **Stopbar A -** The assigned phase may be extended by the detector for the amount of time specified in the Extend parameter or until a gap occurs. Once a gap occurs, the programmed detector channel will ignore any future actuations during the green interval. Assigning the value of 0 to the Extend parameter will allow a phase to be extended until a gap occurs.
- **Stopbar B -** During the green interval, the detector will receive actuations as long as the detector has not been vacant for the specified amount of time in the Extend parameter. Once the Extend timer has expired, that detector will be disabled for the remainder of the green interval. If an actuation occurs before the Extend timer expires, the timer is reset to its programmed value. An Extend timer value of 0 will allow the detector to receive actuations only as long as there is a constant detection on that detector.
- **NRM_RR** – *Normal Red Rest* mode allows the delay assigned to a detector to force the controller to red rest instead of calling a phase. This application was developed for left-turn applications where inhibit phases prohibit a through movement from backing into a turn phase and a feature was needed to service the turn phase after moving to red rest to prevent the "yellow trap". The delay timed by the NRM_RR detector before red rest is applied is programmed in the delay setting under *Detector Parms*, **MM->5->1**.
- **BIKE** – When this mode is enabled, the detector will be used to generate any additional *Bike Clearance* time programmed for the phase called by the detector (**MM->1->1->7**). In addition, an actuation of the BIKE detector will time the Bike Extension value programmed for the detector under **MM->5->1** (*Extend* parameter). **Please note that the values programmed under the Extend parameter are in one second increments not 0.1 second increments. For example programming an Extend value of 0.5 for a Bike detector will result in a 5 second extension.**
- **Q-Alrm** – A *Queue* detector generates alarm 28 when a specified QUEUE timer expires. The additional programming required for this operation is documented in the next section.
- **Adapt** – An *Adaptive* detector measures the degree-of-saturation of the phase called by the detector based on occupancy measured during green + yellow clearance.

- **VU_COM** – This mode is used when interfacing to the Cubic | Trafficware/Traficon VU COM communications module through the 2070 Serial communications port.

Vehicle Parms+ - Src (Source)

Each of the 128 “logical” detectors in the controller may receive their source directly from a “physical” detector channel or indirectly from another “logical” detector using the *Source* feature. The default *Source (Src)* setting is zero that implies that the detector is sourced from the same “physical” detector in the detector rack. A *Source (Src)* setting in the range of 1-128 implies that the detector is sourced indirectly from any of the first 128 physical detectors that are currently active in the controller.

NOTE: Currently the highest detector Number that can be physically sourced is 128.

```
Det# Occ:GYR Dly/Q-Alm Mode    Src Olp
  1      XX.   0     0 NORMAL    0   0
  2      XX.   0     0 STOP_A    0   0
  3      XX.   0     0 STOP_B    0   0
  4      XX.   0     0 NRM_RR    0   0
  5      XX.   0     0 BIKE      0   0
  6      XX.   0     0 Q-ALRM    0   0
  7      XX.   0     0 ADAPT     0   0
  8      XX.   0     0 VU_COM    0   0
  9      XX.   0     0 NORMAL    0   1
 10      ...   0     0 NORMAL    0   0
 11   +  ...   0     0 NORMAL    0   0
```

Vehicle Parms+ - Olp (Overlap Source Detector)

The ability to set a vehicle detector to a specific overlap has been added in V80.x. When you program an Overlap number (1-32) for a specific detector, the software will place a call on **all** included phases in the overlap and when those phases are running, it will extend them.

5.1.6 Queue Detector Programming

The **Q-Alrm** detector mode was defined in the last section. Keep in mind that a *Q-Alrm* detector is intended to be a system only detector to generate *Alarm # 28* and cannot be used to call a phase. Therefore, you must source a separate detector used to call a phase if you want this detector to also serve as a Queue Alarm detector (see the Src feature in the last section). However, detector diagnostics (max presence, no activity and erratic count) may be programmed for a queue detector and used to trap error conditions when they occur.

This detector feature requires that:

1) *Queue* parameter is enabled for the detector under MM->5->2 (section 5.1.5)
2) *Queue* time is programmed under MM->5->1. This is the number of minutes (0-255) used to test a constant call on the detector and generate *Alarm # 28*.
3) *Extend* time under MM->5->1 is set to the number of seconds (0-25.5) required to detect an OFF condition over the detector. This resets the *Queue* timer and *Alarm # 28*.
4) *Queue* is enabled and *Extend* is disabled for the queue detector under MM->5->2.
5) A *Queue Alarm Number* (1-16) is assigned to the first *Dly/Q-Alm Phase* under MM->5->3

A maximum of 16 queue alarms may be reported by returning a *Queue Alarm Number* (1-16) associated with each queue detector. The *Queue Alarm Number* (1-16) is assigned to the first column of ***Dly/Q-Alm*** under MM->5->3 for each detector using the **Q-Alrm** detector mode. This value is returned with Alarm #28 and allows multiple detectors to share the same *Queue Alarm Number*. The central system is capable can distinguish which queue detector(s) have activated *Alarm # 28* using the number assigned to the first column of ***Dly/Q-Alm*** associated with each detector.

5.1.7 Pedestrian Parameters (MM->5->4)

Det#	Call	NoAct	MaxPres	ErrCnt
1	14	255	255	255
2	2	0	0	0
3	0	0	0	0
4	4	0	0	0
5	0	0	0	0
6	6	0	0	0
7 +	0	0	0	0

The *Pedestrian Parameters* allow for mapping of pedestrian inputs to call the pedestrian service for a phase. Detector diagnostics are also provided to isolate pedestrian detector failures like those provided to isolate vehicle detector failures. The real-time pedestrian alarm failures are shown under the *Pedestrian Detector Alarm Status* (**MM->5->7->5**) section of this chapter.

Ped Parameter - Call Phase (Call)

The *Call Phase* parameter sets the phase called by the pedestrian detector. A zero value disables the pedestrian input.

Note: When programming the Safety Clear (Ped Extend) feature under **MM->1->1->7** the user may specify an extend detector by entering 17-32 for the Call phase. This number entered is the walk phase to extend, plus 16. Entries of 1-16 function as before to specify the Ped phase to call. As an example, to specify Ped detector 1 as an extend detector for walk phase 2, enter 18 in the Call column for Ped detector 1. If Ped detector 2 is to be the calling detector for walk phase 2, then enter 2 in the call column as you usually would.

Ped Parameter - No Activity (NoAct)

The *No Activity* parameter (0-255 min) fails the diagnostic if a pedestrian actuation is not received before the *No Activity* timer expires. A zero value disables the pedestrian input.

Ped Parameter - Maximum Presence (MaxPres)

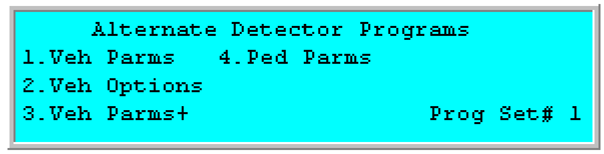
The *Maximum Presence* parameter (0-255 min) is a diagnostic feature. If the detector exhibits a constant actuation for the specified amount of time (0-255 min), then the detector is considered to have failed. The *Pedestrian Detector Alarm Status* (**MM->5->7->3**) shows the detector's failure mode. A zero value disables the pedestrian input.

Ped Parameter - Erratic Counts (ErrCnt)

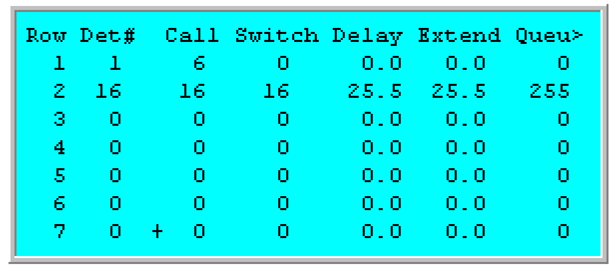
The *Erratic Counts* parameter is a diagnostic feature. The detector is considered to have failed if it exhibits too many actuations per minute. The Pedestrian Detector Alarm Status shows the detector's failure mode. Enter the data as the number of counts per minute (0-255 cpm). A zero value disables the pedestrian input.

5.2 Alternate Detector Programs (MM->5->5)

Alternate Detector Programs provide a method of changing detector parameters through the pattern. This is similar to *Alternate Phase Programs* discussed in chapter 4. Three *Alternate Detector Programs* provide 16 rows used to modify a specified detector (Det#).



The left menu for the *Vehicle Parameters* selection is shown to the right. The other *Alternate Detector Programs* are summarized below.



Row	Det#	Call	Switch	Delay	Extend	Queu>
1	1	6	0	0.0	0.0	0
2	16	16	16	25.5	25.5	255
3	0	0	0	0.0	0.0	0
4	0	0	0	0.0	0.0	0
5	0	0	0	0.0	0.0	0
6	0	0	0	0.0	0.0	0
7	0 +	0	0	0.0	0.0	0

- Alternate Vehicle Parameters
  - Call Phase
  - Switch Phase
  - Delay
  - Extend
  - Queue Time
  - No Activity Diagnostic
  - Maximum Presence Diagnostic
  - Erratic Count Diagnostic
  - Fail Time Parameter

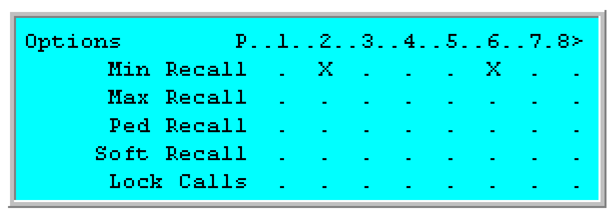
- Detector Options
  - Enable Call
  - Enable Extend
  - Enable Queue
  - Enable Added.Initial
  - Enable Red.Lock
  - Enable Yellow Lock
  - Enable Occupancy Sampling
  - Enable Volume Sampling

- Vehicle Parameters+
  - Occupancy on Green / Yellow / Red Interval
  - Delay Phases
  - Detector Mode

- Ped Parameters
  - Phase called by the ped detector
  - No Activity Diagnostic
  - Maximum Presence Diagnostic
  - Erratic Count Diagnostic

5.3 Phase Recall Menu (MM->5->6)

This menu consolidates all phase recall options on a common screen accessed under the *Detection* menu. These are the same options accessed under *Phase Options* (**MM->1->1->2**).



Options	P..1	2	3	4	5	6	7	8>
Min Recall	.	X	.	.	.	X	.	.
Max Recall	.	.	.	.	.	.	.	.
Ped Recall	.	.	.	.	.	.	.	.
Soft Recall	.	.	.	.	.	.	.	.
Lock Calls	.	.	.	.	.	.	.	.

5.4 Detector Status Screens (MM->5->7)

```
          DETECTOR STATUS
1.Det  1-32 4.Det 97-128   7.V/O Sample
2.Det 33-64 5.Ped Dets     8.Spd Sample
3.Det 65-96 6.Delay,Extend 9.Audible
```

The *Detector Status Screens* include separate real-time indication for each vehicle and pedestrian detector along with current alarm status from the detector diagnostics. Accumulated V/O (volume and occupancy) data is displayed for the current *Sample Period*. Speed trap measurements are also displayed.

5.4.1 Vehicle Detection Status (MM->5->7->1, MM->5->7->2, MM->5->7->3, MM->5->7->4)

```
   (1-16)  Det #  1.......   9.......  >
Veh Field Call    --------   --------
Veh Call          --------   --------
Veh Alarm         --------   --------
```

The *Vehicle Detection Status* screen displays real-time vehicle calls and alarms. This is a post-processed status, that is, calls are displayed after modification due to mapping, alarms, delays, and extends. These are the actual calls passed to the controller phase logic.

Vehicle Call

Vehicle Call status indicates the presence of a call for each detector channel. The source of the channel is selected in the *Vehicle Parameters+* screen. It is important to note that the screen status displays the calls after they have been modified by extend and delay settings for the channel. A detector diagnostic alarm will place a constant call when the *Call Phase* is not green and will extend the phase in accordance with the *Fail Time* setting of the detector when the *Call Phase* is green.

Vehicle Alarm

The *Vehicle Alarm* field shows the results of the detector diagnostics programmed under the *Vehicle Parameter* screen. When an alarm is indicated, a call will be placed on the corresponding channel's detection input.

Veh Field Call

```
   (1-16)  Det #  1.......   9.......  >
Veh Field Call    -*-*-*--   --------
Veh Call          -*-*-*--   --------
Veh Alarm         --------   --------
```

Veh Field Call is the raw input as seen from the actual inputs. This shows the raw state of the input with no conditioning. This will help users in debugging whether or not a detector is coming in or not. If "Veh Call" and "Veh Field Call" don't match... you know a detector option is causing it to be different. If you have no "field call", then nothing is coming in from the detector input itself. An easy way to see this screen work is to put calls on detector channels 1-8 via the IO, and turn off the extend option on all 8 detector channels. You can then see the difference between the field and current call status.

5.4.2 Pedestrian Detection Status (MM->5->7->5)

```
     Det  #         1 1       2 2       3
Ped  1......8 9......6 7......4 5......2
Call -*-*-*-* -------- -------- --------
Alrm -------- -------- -------- --------
```

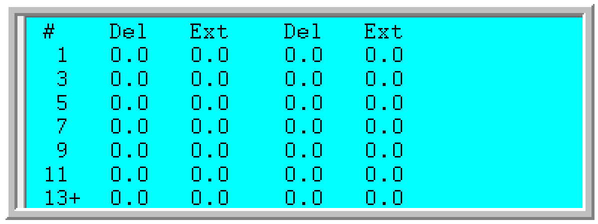
Ped Call

Ped Call indicates the raw inputs from the pedestrian detectors for pedestrian channels 1-8.

Ped Alarm

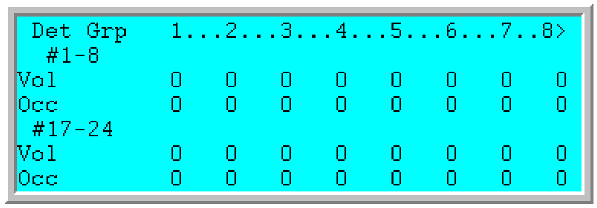
The *Pedestrian Alarm* indicates the real-time status of pedestrian channel alarms 1-8. When an alarm is present, a constant pedestrian call will be placed on the pedestrian *Call Phase* until the diagnostic error is corrected. The parameters for these alarms are set in the *Pedestrian Parameters* options (**MM->5->4**)

5.4.3 Detector Delay, Extend Status (MM->5->7->6)



This real-time status screen displays any active delay and/or extension timing for each detector. Notice that row 1 corresponds to two detectors: Row 1 to detectors 1 – 2, row 2 to detectors 3 – 4, etc.

5.4.4 Vol/Occ Real-Time Sample (MM->5->7->7)



The *Volume/Occupancy Real-Time Sample* status screen allows the user to view the real-time sample as volume and occupancy is being accumulated. The sample is stored and reset at the conclusion of each *Vol/Occ Period* specified in under **MM->5->8->1**.

Volume

The *Volume* field shows the accumulated vehicle actuations for the channel during the current *Vol/Occ Period*. Volume is recorded as zero when a detector diagnostic failure occurs and a detector alarm is generated.

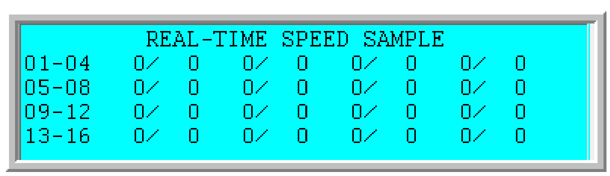
Occupancy

The *Occupancy* field indicates a measure of vehicle presence over the detector or a NEMA specified error code when the detector fails a detector diagnostic. If a detector alarm is not active, the occupancy values indicates the percentage of the *Vol/Occ Period* that a vehicle is present over the detector. This value ranges from 0-200 with each increment representing 0.5%. The total detector "on time" may be calculated by multiplying the occupancy measure by the *Vol/Occ Period* and dividing this product by 200.

When a detector alarm is active, the occupancy value represents a NEMA specified error code for the failed detector diagnostic in the range of 200 – 255 as shown below. The active alarm code may be viewed in the detector buffer found under **MM->1->6->9**. These codes are interpreted by the central software and converted to "friendly" text messages in the Local Detector Event query.

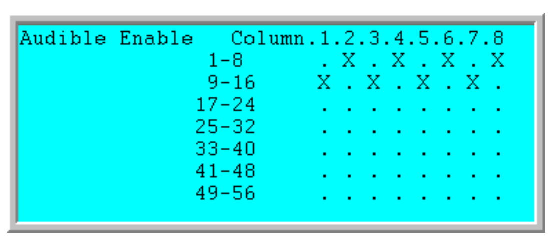
Fault (decimal)	Fault (Hexadecimal)	Fault (Stored as Occupancy Data)
210	D2	Max Presence Fault
211	D3	No Activity Fault
212	D4	Open Loop Fault
213	D5	Shorted Loop Fault
214	D6	Excessive Inductance Change
215	D7	Reserved
216	D8	Watchdog Fault
217	D9	Erratic Output Fault

5.4.5 Speed Sample (MM->5->7->8)



The controller provides 16 speed traps consisting of two detectors, a specified *Zone Length* and *Car Length* (see section below). The *Real-Time Speed/Length Sample* displays the average speed for each speed trap during the active *Vol/Occ Period.* Note: Speed samples will work only with TS2 Type 1 cabinets and Detector BIU's

5.4.6 Audible Enable (MM->5->7->9)



This parameter is used to output an audible tone whenever a detector actuation occurs. This can be helpful for users who can't view vehicles, while working in a cabinet, but want to know if a call was placed. The tone lasts approximately 1 second. For each detector, the user will toggle an "**X**" if the audible to is to be enabled or a "**.**" to disable the audible tone.

5.5 Volume / Occupancy Parameters

5.5.1 Volume and Occupancy Period (MM->5->8->1)

Detector volumes and/or occupancy are sampled at a rate determined by the *Volume/Occupancy Period*. Enter the *Volume/Occupancy Period* in minutes (0-99) or seconds (0-255). The actual period is the sum of the minutes and seconds, so you can enter values of seconds greater than 60, using a combination of minutes and seconds.

```
Vol/Occ Period:      0   Seconds
                    15   Minutes
```

5.5.2 Speed Detectors (MM->5->8->2)

The *Speed Detectors* screen defines the speed trap detectors for each of the 16 speed stations. The *Up* detector number is the upstream detector which first detects the vehicle in the travel lane. The *Dn* detector number is the downstream detector that is detected next.

```
  Up Det   Dn Det   Zone Len   Car Len
 1   1          2        6.0      18.0
 2  12         14        6.0      18.0
 3   0          0        0.0       0.0
```

The *Zone Len* is the separation between the detectors in feet. Use the distance between the leading edge of the upstream detector and the leading edge of the downstream detector. The *Veh Length* is the average vehicle length (in feet) specified for the calculation. Note: Speed traps will work only with TS2 Type 1 cabinets and Detector BIU's..

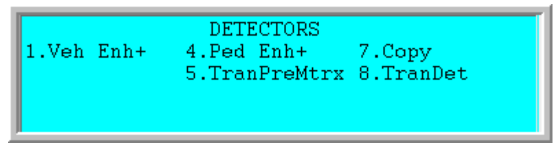
5.5.3 Speed Thresholds (MM->5->8->3)

The *Speed Thresholds* screen allows the user to view detector volumes and occupancies based on the analysis period as programmed under **MM->5->8->1**.

```
Det Grp    1...2...3...4...5...6...7..8>
  #1-8
Vol       13   0   1  45  10   0   1  39
Occ        2   0  16  16   0   0  16  13
 #17-24
Vol        0   0   0   0   0   0   0   0
Occ        0   0   0   0   0   0   0   0
 #33-40 +
```

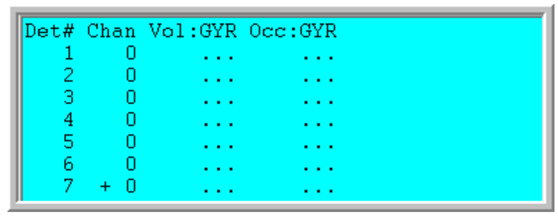
5.6 Enhanced Detection Screens (MM->5->9)

The following screens are accessed via MM->5->9.



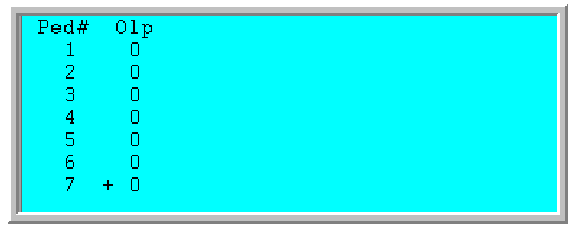
5.6.1 Veh Enh+ (MM->5->9->1)

All detectors have a Vehicle Enhanced option programmed via this screen. When you program a Channel number for a specific detector, you can set each detector to collect volume or occupancies based on specific channel colors.



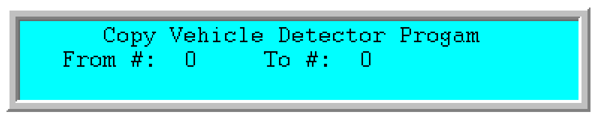
5.6.2 Ped Enh+ (MM->5->9->4)

Programming entries on this screen only pertains to two specific Overlap Types: IndPed and GOBar. All pedestrian detectors have a Pedestrian Enhanced Overlap option programmed via this screen. When you program an overlap number for a specific ped detector, the software will place a ped call on **all** included phases in the overlap (type **IndPed** or **GoBar** only).



5.6.3 Copy Detector Utility (MM->5->9->7)

The *Copy Detector Utility* allows the user to copy detector programming from one detector to another detector. This can speed up data entry and reduce errors if detectors have similar programming values. This utility copies all Veh Parms, Options, and Parms+ programming from menus **MM->5->1**, **MM->5->2** and **MM->5->3**.



5.6.4 TranDet (MM->5->9->8)

NOTE: This section describes the features of Transit Light Rail functionality that was modified as of version V80.5F. Please refer to TecNote 1204 for programing of this functionality prior to version 80.5F.

Up to eight Light Rail or Transit Priority **LRV** detection selections can be programmed to check the light rail or transit vehicle in and out. **NOTE: This feature will only work if Preemption Type is set to LRV under MM->3->1->6.**

Transit Light Rail Detectors

LRV Det	..1	...2	...3	...4	...5	...6	...7	...8
AdvDet	0	0	15	17	0	0	0	0
ChkInDet	9	11	0	18	25	0	0	0
ChkOutDet	10	12	16	19	26	0	0	0
MaxDur	30	30	30	30	0	0	0	0
ChkInDly	0	20	0	5	0	0	0	0
TLRMode	X	X	.	.	X	.	.	.
L/OTime	0	0	6	6	0	0	0	0
OvrTime	0	0	0	0	0	0	0	0
Reserved	0	0	0	0	0	0	0	0
Preempt	9	10	0	0	0	0	0	0
UseHold	.	.	.	.	.	.	.	.

TLRMode is the key field to program when using this screen.

When **TLRMode** is set to **ON** (**X**) the intersection is running in the Transit Light Rail (**TLR**) Mode. In this mode, a Transit vehicle is running over specified detectors to create the preemption.

When **TLRMode** is set to **OFF** (**.**) the intersection is running in the Preemption Service Delay (**PSD**) Mode. The Preemption Service Delay (**PSD**) Mode is intended for use with an input coming from external source like a rail cabinet or GPS. It is automatically calculated by the software. The user must verify (calculate) the **PSD** time and give it to the agency that is providing the **PSD** input so they can adjust as needed to reduce impact of the Transit.Time. Please note that the **PSD** time is calculated to be equal to the longest programmed **walk + pedestrian clearance + yellow clearance + red clearance times.**

The rest of the fields on this screen are based on the TLRMode setting that the user programs.

AdvDet (Advanced Detector) – This is the detector number that will place the initial call to the Transit Phase. It will initiate the TSD (Time-of-Service-Desired) counter to the Light Rail Transit Priority service phase.

ChkInDet (Check-In Detector) – This is the detector number that tells the controller that the train has arrived for service. This detector will place a call to the Transit Phase if there is not one existing from the Advanced Detector.

ChkOutDet (Check-Out Detector) – This is the detector number that tells the controller that the train has cleared the intersection.

MaxDur (Max Duration) – The maximum amount of time, in seconds, that the Check-In detector will apply an input before it is automatically checked out. This is to avoid “Stuck Detection” from holding the Green.

ChkInDly (Check-In Delay) – This parameter acts like the Preemption Delay timer in FREE mode. This is the delay time, in seconds, for the Advanced Detector Input while in FREE operation, because in FREE mode the Light Rail Vehicle (LRV) is serviced with Transit Preempt service. This parameter may be set and should be the same value as the Time of Service Desired (TSD) value in coordination.

L/OTime (Lockout Time) – The amount of time, in **minutes**, that must elapse between requests to be serviced for that direction. It prevents another Check in Detector input calling a preemption. The user has this option to prevent multiple preemption's coming in for the same direction back to back.

OvrTime (Override Time) – is a fail-safe timer for a stuck cabinet override input. It is used in association with any of Cabinet Input functions that can override the PSD Mode. **OvrTime** is a fail-safe timer if any of these cabinet override inputs is stuck ON. Refer to the following page for further information.

Preempt – This is the associated high priority preemption number (1-12)

UseHold – Use the programmed Hold Phases selected on the **MM->5->9->5** screen and hold them for the selected **LRV** preemption. These Hold phases are selected prior to the high priority preemption being run. This provides the user option to hold phases green until preemption causes phases to terminate clearing traffic prior to Transit vehicle arriving at intersection.

In addition, **Output Function #138 (LRV Warning Status Output)** can be mapped to drive any cabinet output. For instance, this output could be wired to a “Train Coming” sign. When any Transit Light Rail detector is activated, and the **TLR** or **PSD** commences, this output will come on. It will remain on until the **TSD** or **PSD** is completed.

Typical Logic programming under **MM->1->8->7** for flashing (O113) and driving Special Function Output 1 (O103) from the LRV Warning Status Output (O138) is as follows: **O 103 = O138 AND O113**

Each LRV detector depends on the above programming and the programming will utilize software to select the LRV input that will be used for high priority Preemption detection described in the **TranPreMatxDet** section.

Operational considerations based on the TLRMode settings

With **TLRMode** set to **ON:**

The Transit Light Rail (**TLR**) Mode is intended for use with Raw Detector inputs from the intersection. The Transit vehicle runs over detectors in the intersection bringing inputs into controller like normal vehicle inputs.

- The Check-In detector should call the preemption immediately and stay in the preemption until the Check-Out Detector input is received or until the Max Duration timer expires.
- The Advance Detector should become the Check-In Detector after the programmed Check-in Delay times expires. This input will call the preemption until Check-Out Detector input is received or the Max Duration timer expires. If the Check-in Delay timer is set to "**0**" the software will call the preemption immediately. Further note: if a Check-Out Detector **is not** programmed, check-out will occur at the trailing edge of the Advance Detector call (i.e. the Advanced Detector call is dropped).
- The L/O Time is a timer (in minutes) that user can program to prevent another Check in Detector input calling a preemption. The user has this option to prevent multiple preemption's from coming in for the same direction back to back.

With **TLRMode** set to **OFF**:

The Preemption Service Delay (**PSD**) Mode is intended for use with an input coming from external source like a rail cabinet or GPS. It is automatically calculated by the software. The user must verify (calculate) the **PSD** time and give it to the agency that is providing the **PSD** input so they can adjust as needed to reduce impact of the TransitTime. Please note that the **PSD** time is calculated to be equal to the longest programmed **walk + pedestrian clearance + yellow clearance + red clearance times.**

- The Advance Detector should put intersection in Free, place Inhibits on all PEDS immediately, use the **PSD** time as a delay, then calls the preemption until the Check-Out Detector input is received or Max Duration time expires.
- NOTE: The **Check-In** Detector, **Check-in Delay** and the **L/O Time** are not used under **PSD** Mode.

Override input functions 205, 532-539 and **OvrTime** (**PSD only**):
Nine Cabinet Inputs can be assigned a function numbers to override the calculated **PSD** time described in the above section

Input #205:	Apply inhibit phases for all Rail Dets immediately
Input #532:	Apply all inhibit phases for Rail Det 1 immediately
Input #533:	Apply all inhibit phases for Rail Det 2 immediately
Input #534:	Apply all inhibit phases for Rail Det 3 immediately
Input #535:	Apply all inhibit phases for Rail Det 4 immediately
Input #536:	Apply all inhibit phases for Rail Det 5 immediately
Input #537:	Apply all inhibit phases for Rail Det 6 immediately
Input #538:	Apply all inhibit phases for Rail Det 7 immediately
Input #539:	Apply all inhibit phases for Rail Det 8 immediately

If the external source that the **PSD** Mode is using is not working correctly, a technician can physically turn on a cabinet input to override and turn off the **PSD** calculation. This will cause the software to revert back to the **TLR** Mode. This provides the user flexibility to have programmed Check-In Delay times (which are ignored when in **PSD**). If the Override input is activated, then **OvrTime** will be used. The **OvrTime** is a fail-safe timer for a stuck cabinet override input.

This timer shall start to countdown once override input comes in and if time expires before input drops, the intersection will go to a programmed failed preemption selected on **MM->5->9->5**.

Advance Detectors
If advance detectors are programmed, the Transit Light Rail preemption will be delayed automatically by the longest delay (i.e. this delay accounts for the worse case movement). The worse case movement is the one that takes the longest to clear and is typically the pedestrian movement. So, if you have an advance detector go active, the controller looks to see what the longest delay is and delays the input. As the wait is timed down, inhibits are applied to phases that cannot serve anymore due to not enough time being left.

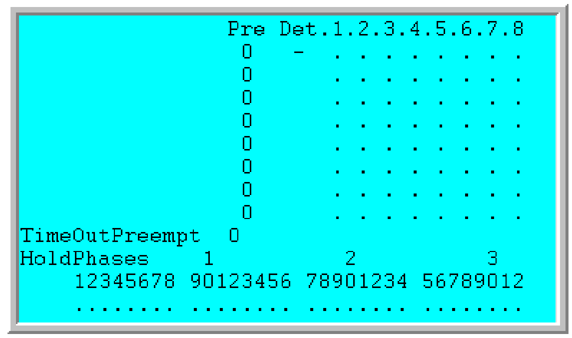
Max Check In – This time is based on the input being active, not necessarily the preemption being in service. This timer is different that the **Max Duration** (**MM->3->1->7**).

Check In / Check Out detectors - the check in and check out detectors can be the same or different detectors. If they are the same, the rising edge actuation checks it in and the falling edge actuation checks it out

5.6.5 TranPreMtrxDet (MM->5->9->5)

NOTE: This section describes the features of Transit Light Rail functionality that was modified as of version V80.5F. Please refer to TecNote 1204 for programing of this functionality prior to version 80.5F.

This matrix allows the user to select a particular LRV detection selection (**MM->5->9->8**) that may be used for each preemption. Each of the first twelve rows row represents a user programmed High Priority Preemption (1-12) and each column represents the **LRV** detection selected for that preemption. See the above section for a discussion on the programming of the **LRV** detection.

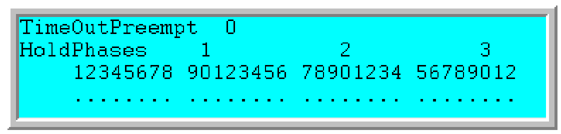


NOTE: This feature will only work if Preemption Type is set to LRV under MM->3->1->6.

Pre: The user will program the High priority Preemption (1-12). A value of "**0**" will disable the row,

Det: The user can select any combination of LRV detection (columns 1-8). The selected columns are used by the software to evaluate if the particular programmed Transit detector **(MM->5->9->8**) will be used based upon the preemption priority hierarchy. This matrix is subject to the preemption priority hierarchy programmed under **MM->3->3 and MM->3->8 34** described earlier in chapter 8.

TimeOutPreempt (0-12) – The user can choose a fail-safe preemption (1-12) that will be run if the LRV detector check-in timer has expired. This check-in timer is calculated by the specific user program settings. Setting **TimeOutPreempt** to 0 will remain in the selected High priority preemption chosen via the matrix programed above.

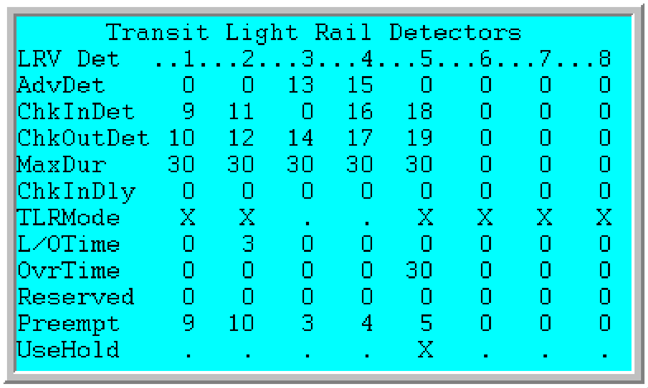


Hold Phases - Any Phases (1-32) can be selected as a Hold Phase. Hold phases are phases that are held till the selected preemption, via the above matrix, becomes active. These phases will be held if the **UseHold** Parameter under **MM_>5->9->8** is set for the specific LRV preemption. If there is a hold phase programmed, and if that phase is active, the controller will not process any other movement until the LRV preempt longest delay time expires. The purpose of this is to keep the controller in the phase that is currently holding if it is already in service. However, if the Hold Phase is not in service, the intersection will continue to cycle until it reaches the hold phase or the preempt delay timer expires.

The **TranPreMtrxDet** screen is used when the agency requires combinatorial logic to call a preemption, using a programmed matrix. The purpose that this was specified and created was to save entering data in the matrix and slots for programming. This is also why the preemption is able to be specified in the preempt matrix. For example, the Transit Light Rail Detector # 1 could call preempt 1, but entry 1 in this matrix does not need to reference preempt 1. The software algorithm uses the first line of matching logic to see what preemption it will run with the combination of inputs.

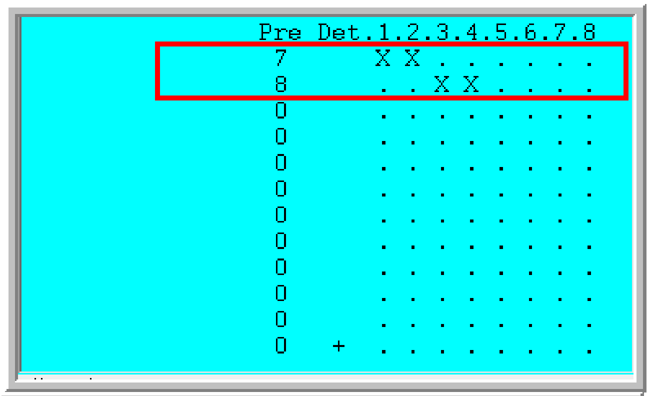
The following example will discuss the programming of both the TranDet (**MM->5->9->8**) and TranPreMtrxDet (**MM->5->9->5**) screens.

As an example, the user has programed the standard preemption hierarchy where HP1 overrides HP2, overrides HP3, etc. Below are screens for **MM->5->9->8**, the Transit Check-in detectors, and **MM->5->9->5** the Transit Preemption detector Matrix:

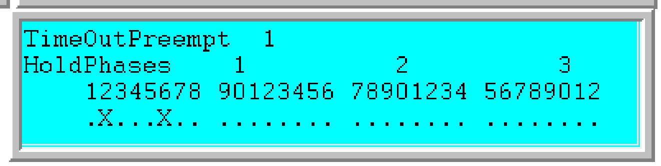


Transit Light Rail Detectors

LRV Det	1	2	3	4	5	6	7	8
AdvDet	0	0	13	15	0	0	0	0
ChkInDet	9	11	0	16	18	0	0	0
ChkOutDet	10	12	14	17	19	0	0	0
MaxDur	30	30	30	30	30	0	0	0
ChkInDly	0	0	0	0	0	0	0	0
TLRMode	X	X	.	.	X	X	X	X
L/OTime	0	3	0	0	0	0	0	0
OvrTime	0	0	0	0	30	0	0	0
Reserved	0	0	0	0	0	0	0	0
Preempt	9	10	3	4	5	0	0	0
UseHold	.	.	.	.	X	.	.	.



Pre	Det.	1	2	3	4	5	6	7	8
7		X	X	.	.	.	.	.	.
8		.	.	X	X	.	.	.	.
0		.	.	.	.	.	.	.	.
0		.	.	.	.	.	.	.	.
0		.	.	.	.	.	.	.	.
0		.	.	.	.	.	.	.	.
0		.	.	.	.	.	.	.	.
0		.	.	.	.	.	.	.	.
0		.	.	.	.	.	.	.	.
0		.	.	.	.	.	.	.	.
0		.	.	.	.	.	.	.	.
0	+	.	.	.	.	.	.	.	.



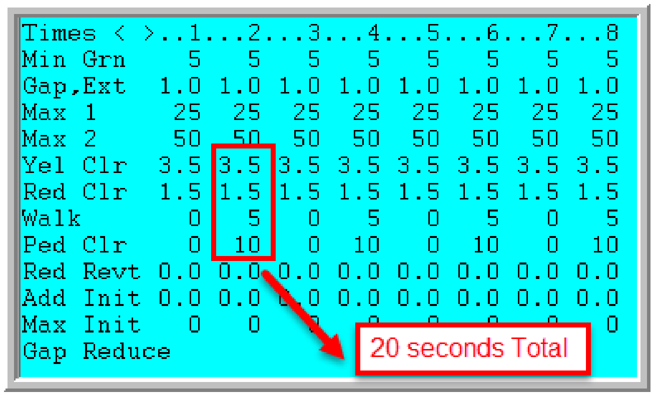
```
TimeOutPreempt   1
HoldPhases     1           2           3
    12345678 90123456 78901234 56789012
    .X...X.. ........ ........ ........
```

For each Transit Light Rail Detector (**TLRD**) (**MM->5->9->8**), the software first looks at the **TLRMode** to determine if the **TLRD** Detector is running **TLR** or **PSD**. For each **TLRD**, the software will attempt to run the programmed preemption associated with it based on the selected mode. If there is no preemption programmed, then a preemption is **not** selected to run.

If multiple **TLRD**'s are actuated at the same time, the software will instead match the **TLRD** detection selection to the matrix (**MM->5->9->5**) and chooses the programmed preemption based on exactly matching the **TLRD** Detection Selection along with preemption priority hierarchy. If there is no match, then a preemption is **not** selected.

Below are different scenarios based on the programming screens above.

1) Scenario 1: **TLRD** #1 using **TLR**. Check-in Detector 9 is activated to ON. It will result Preemption 9 being run. Detector 9 is then actuated to an OFF state. Preempt 9 will run until Check-out Detector 10 is actuated ON then OFF or the **MaxDUR** timer of 30 seconds is reached.
2) Scenario 2: **TLRD #2** using **TLR**. Check-in Detector 11 is activated to ON. It will result Preemption 10 being run. Detector 11 is then actuated to an OFF state. Preempt 10 will run until Check-out Detector 12 is actuated ON then OFF or the **MaxDUR** timer of 30 seconds is reached. In addition, **TLRD** #2 cannot run for 3 minutes due to the **L/O Time** setting.
3) Scenario 3: Both **TLRD #1** and **TLRD #2** are called at the same time. Check-in detectors 9 (**LRV 1**) and 11 (**LRV 2)** are activated then Preemption 7 will be run.



Times < >	1	2	3	4	5	6	7	8
Min Grn	5	5	5	5	5	5	5	5
Gap,Ext	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Max 1	25	25	25	25	25	25	25	25
Max 2	50	50	50	50	50	50	50	50
Yel Clr	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Red Clr	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Walk	0	5	0	5	0	5	0	5
Ped Clr	0	10	0	10	0	10	0	10
Red Revt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Add Init	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Max Init	0	0	0	[illegible]	[illegible]	[illegible]	[illegible]	0
Gap Reduce								

4) Scenario 4: **TLRD #3** using **PSD**. The Preemption Service Delay (**PSD**) Mode is intended for use with an input coming from external source like a rail cabinet or GPS. It is automatically calculated by the software. Please note that the **PSD** time is calculated to be equal to the longest programmed **walk + pedestrian clearance + yellow clearance + red clearance times.** In this case, as derived from the phase timing screen above, it will be calculated as 20 seconds. Advanced Detector 13 is activated to ON. This will put intersection in **Free and** places inhibits on all pedestrian phases immediately. It will then use the calculated **PSD** time to delay the operation of the preemption, then call Preemption 3 until the Check-Out Detector 14 is actuated ON then OFF or the 30 second **MaxDur** time expires.
5) Scenario 5: **TLRD #4** using **PSD**. Using the Timing screen above, the **PSD** time will be calculated as 20 seconds. Advanced Detector 15 is activated to ON. This will put intersection in **Free and** places inhibits on all pedestrian phases immediately. It will then use the calculated **PSD** time to delay the operation of the preemption, It is expecting a call from Check-in Detector # 16 to call Preemption 4. If Check-in detector #16 does not receive a call, then Preemption 4 will still be run after the calculated **PSD** time. The software will remain in Preemption 4 until the Check-Out Detector 17 is actuated ON then OFF or the 30 second **MaxDur** time expires.
6) Scenario 6: Both **TLRD #3** and **TLRD #4** are called at the same time. Using the Timing screen above, the **PSD** time will be calculated as 20 seconds. Advanced Detectors 13 and 15 are activated to ON. This will put intersection in **Free and** places inhibits on all pedestrian phases immediately. It will then use the calculated **PSD** time to delay the operation of the preemption, Preemption 8 will still be run after the calculated **PSD** time. The software will remain in Preemption 8 until the Check-Out Detector 14 and 17 are actuated ON then OFF or the 30 second **MaxDur** time expires.
7) Scenario 7: **TLRD #5** using **TLR.** Check-in Detector 18 is activated to ON. It will result Preemption 5 being called and run. If the controller is running phases 2 & 6, those phases will be held ON until the preemption is run. Detector 18 is then actuated to an OFF state. Preempt 5 will run until Check-out Detector 19 is actuated ON then OFF or the **MaxDUR** timer of 30 seconds is reached.
8) Scenario 8: Scenario 1: **TLRD** #1 using **TLR**. Check-in Detector 9 is activated to ON. It will result Preemption 9 being run. Detector 9 is then actuated to an OFF state. Preempt 9 will run until Check-out Detector 10 is actuated ON then OFF or the **MaxDUR** timer of 30 seconds is reached. If the **MaxDUR** timer of 30 seconds is reached and the Check-in detector 9 call remains constantly on, then Preemption 1 will be run based on the **TimeOutPreempt** programming under **MM->5->9->5**.

6 Basic Coordination

6.1 Overview of the Coordination Module

The *Coordination Module* or "Coordinator" is always active in an NTCIP based controller, even during free and flash operation. NTCIP defines the *Coord Status* and *Free Status* objects that describe the active state of the controller as show below. This status information is displayed under **MM->2->8->5** in the controller.

```
Coord Parms |    Pattern      |
1.Modes,+    4.Pattern Tbl  7.Splits
2.Ext. I/O   5.Tran,CoorPhs 8.Status
3.Pattern+   6.Alt Tables+  9.More
```

Pattern#	Coord	FreeStat	Active State of the Coordinator
0	FREE	PATTERN	Coordinator has selected default free pattern# 0 by time-of-day
1 - 48	ACTIVE	CoorActv	Coordinator is running one of the 48 patterns under coordination
1 - 48	FREE	COMMAND	Coordinator is running one of the 48 patterns in free operation
254	FREE	COMMAND	Coordinator is running the NTCIP Free Pattern# 254
255	FREE	COMMAND	Coordinator is running the NTCIP Flash Pattern# 255

The *Free Status* also reflects other conditions such as plan, cycle, split and offset errors and external overrides such as preemption and manual control enable. However, it is important to note that patterns 1-48 can be activated as either *Coord Patterns* or *Free Patterns*. A *Free Pattern* can be created using a zero second cycle length to use any of the pattern features shown below during free operation.

Note: When considering coordination, using the STD8 phase mode will take advantage of the most coordination diagnostic checks to catch common data entry mistakes, and if detected, times the intersection in FREE. In USER mode, most of these coordination diagnostics are removed, and the onus is on the agency verify and test the programming to ensure that coordination pattern(s) run as expected.

6.2 Coordination Modes

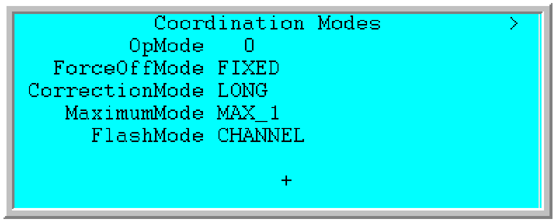
This section describes coordination parameters accessed from the Main Menu using keystroke **MM->2**. The first menu item provides access to *Coordination Modes* and *Coordination Modes+* menus. The *Coordination Modes* (**MM->2->1**, left menu) provide basic NTCIP features related to coordination. *Coordination Modes+* (**MM->2->1**, right menu) provides enhancements to NTCIP coordination.

Coordination Modes determine the force-off method (FIXED, FLOAT or OTHER), the offset correction method used during transition and which maximum settings are applied (or inhibited) during coordination. *Coordination Modes+* select OTHER force-off+ methods and determine if a controller is operating as a secondary in a closed loop system or using external coordination. Pedestrian features related to coordination are also modified through the *Modes+* settings.

Coordination Modes apply to all coordination patterns and may not be modified by time-of-day. The only exception is the Force-off method FIXED may be overridden by the *Flt* option. The *Flt* option is specified by pattern under Trans,CoorØ+ (**MM->2->5**, right menu).

6.2.1 Coordination Modes (MM->2->1, Left Menu)

Test OpMode (Operational Mode)



The *Test OpMode* parameter allows the operator to manually override the active pattern in the *Coordination Module* The "Test" mode parameter selects the active pattern (1-48) or reverts to a standby mode (Test 0). The standby mode allows the controller to receive the active pattern from another source such as a closed-loop master or the local time-of-day schedule. Be aware that *Test Mode* (1-48) overrides all other software related operational modes including the time base scheduler, closed loop and central control. Therefore, any pattern updates from these other operational modes will be ignored unless the *Test Mode* has been set to *Automatic (Standby)* mode (Test 0).

The following are valid entries for the *Test OpMode* parameter.

0 Automatic (Standby) – TestOpMode 0, or standby mode allows the controller to receive the active pattern from the internal time base scheduler, external interconnect, a closed loop master or central control system. TestOpMode 0 is the typical default operation.

1-48 Manual Pattern Override – Test OpMode can be used to select one of the 48 patterns from the pattern table, and overrides all other pattern commands. It is common practice to force the controller to a desired pattern for testing purposes and to check coordination diagnostics as discussed later in this chapter.

254 Manual Free – selects free operation defined by NEMA as pattern 254

255 Manual Flash – selects auto flash operation defined by NEMA as pattern 255

Note: Startup-flash and conflict fault flash override the current *Test Mode* setting; however, *Test Mode* has a higher priority than any of the other of the software operational modes and is typically only used for test applications.

Correction Mode

The *Correction Mode* parameter controls whether *Long-way* or a combination of *Short-way/Long-way* transition is used to synchronize offsets during coordination. The correction mode is also selected on a pattern by pattern basis through the short-way, long-way and dwell settings in the *Trans,CoorØ+* menu described later in this chapter. The Dwell transition method is selected under the *Trans,CoorØ+* menu when the Long% and Short% values for the pattern are coded as zero.

LONG The *Coordination Module* transitions to a new offset reference by increasing the split times by the long-way% value programmed in the *Trans,CoorØ+* menu.

SHORT/LONG The *Coordination Module* selects the quickest transition method by either lengthening split times using the long-way% value or by shortening split times using the short-way% value programmed in the *Trans,CoorØ+* menu.

Maximum Mode

The *Maximum Mode* parameter determines which maximum green time is active, or if maximum green time is inhibited during coordination. These settings do not apply to floating force-offs because FLOAT sets the max timer equal to the split time to insure that slack time developed in the non-coordinated phases is passed to the coord phase.

MAX_1 Selecting the MAX_1 mode allows *Maximum 1* phase timing to terminate a phase when FIXED or OTHER force-off methods are in effect. If MAX_1 is selected, then *Maximum 1* timing may be overridden by the *Max2* setting on a pattern by pattern basis as discussed in the *Alt Tables+* section.

MAX_2 Selecting the MAX_2 mode allows *Maximum 2* phase timing to terminate a phase when FIXED or OTHER force-off methods are in effect. This setting is equivalent to the *Max2* setting discussed in the *Alt Tables+* section.

MAX_INH Selecting MAX_INH inhibits *Maximum 1* and *Maximum 2* timing from terminating a phase when FIXED or OTHER force-off methods. When MAX_INH is in effect and a max call is placed on a phase, the max timer will decrement to zero (**MM->7->1**); however, the phase will not terminate under coordination until it is forced-off. This version now insures that MAX_INH does not inhibit the floating max timer under FLOAT, that is, the Maximum Mode setting has no effect under floating force-offs).

Flash Mode (FlshMode)

This setting is defined in chapter 4 and is duplicated on the *Coordination Modes* screen for convenience.

Force-Off Mode

Force-offs are predefined points in the signal cycle used to terminate the active phase and limit the time allocated to each active phase. NTCIP specifies FIXED and FLOAT force-off methods. A third NTCIP method, defined as OTHER, activates one of the seven additional *Force-Off+ Modes* under the *Coordination Modes+* menu. The NTCIP based *Force-Off* modes are defined as follows:

FLOAT Phases other than the coordinated phase(s) are active for their assigned split time only. This causes unused split time to revert to the coordinated phase.

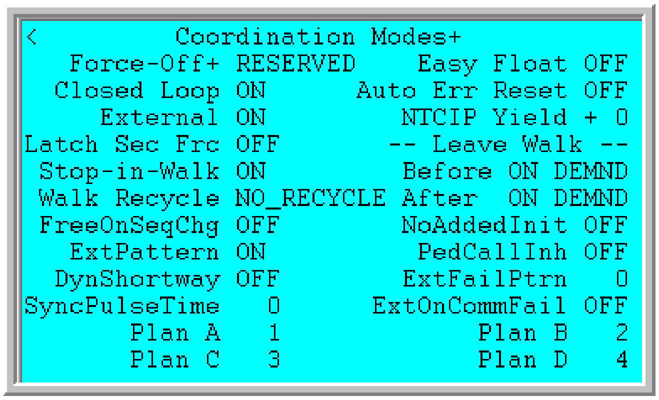
FIXED Phases are forced-off at fixed points in the cycle. This allows unused split time of a phase to revert to the phases served next in the sequence.

OTHER The coordination mode is determined by the *Force-Off+* and *Easy Float* parameters and is not specified by NTCIP. It is available for those agencies that need to interface with legacy equipment or have special needs.

6.2.2 Coordination Modes+ (MM->2->1, Right Menu)

Force-Off +

The *Force-Off+ Mode* entry is only active if the *Force-Off Mode* under *Coordination Modes* is set to **OTHER**. This entry allows for two additional coordination modes: ***PermFrc*** and ***EASY***.



Easy Float

Easy Float only applies if OTHER is selected as the force-off mode and EASY is selected as the force-off+ mode.

OFF The maximum allocated to each phase is allowed to exceed the programmed split time (like FIXED).

ON A floating max time is used to insure that the time allocated to each phase does not exceed the programmed split This insures that all slack time from the non-coordinated phases is passed to the beginning of the coord phase.

Closed Loop

The *Closed Loop* entry enables the *System Operational Mode* and allows the coordination pattern to originate from an on-street master or from the central control system.

OFF The controller does not respond to pattern commands from an on-street master or the central system.

ON *System Operational Modes* are based on the hierarchy of control system. The central system and closed loop masters provide the highest level of control followed by the local time based scheduler in each secondary controller. The local TEST Operational Mode overrides commands from the external closed-loop system and the internal time-of-day scheduler.

Auto Error Reset

Coordination failures may occur under the coord diagnostic, if a vehicle or pedestrian call is not serviced for three cycles or if the maximum cycle counter is exceeded. A coordination failure is not reset by the next pattern change issued to the controller if *Auto Error Reset* is OFF. If *Auto Error Reset* is ON, the next system or time-of-day pattern change issued to the controller will reset the failure when the new pattern goes into effect.

External

External coordination enables the *External Operational Mode* and allows the pattern selection based on the external offset, cycle, and split inputs from the D-connector..

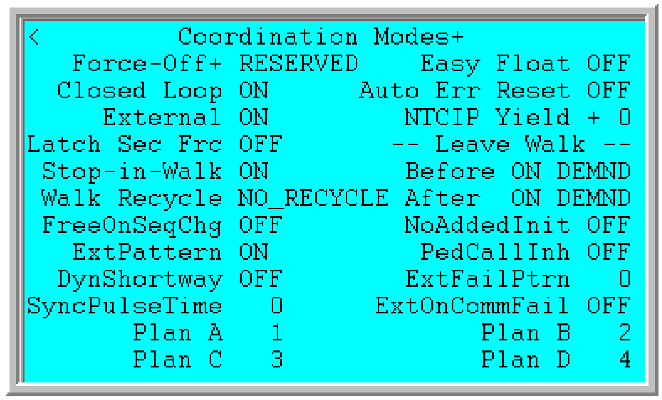
OFF Disables external (hardwire interconnect) coordination inputs and outputs.

ON Enables external coordination inputs and outputs

Latch Secondary Force Offs

This setting **ONLY** applies to the OTHER Force-off+ methods of coordination and insures that secondary force-offs are applied at the same point as primary force-offs.

Stop-in Walk



Stop-In-Walk is a very important feature that allows the split time of a phase less than the minimum pedestrian requirements (sum of the walk + ped clearance + yellow + all-red clearance).

Stop-In-Walk causes the local cycle counter to "stop" during coordination if a force-off is applied to the phase and it is still timing walk or pedestrian clearance. This feature should only be used when pedestrian actuations are infrequent. Stop-In-Walk is enhanced by short-way offset correction because the coordinator can usually re-synchronize the offset within one cycle when ped clearance only extends 5 – 10" beyond the force-off.

OFF *Stop-in-Walk* OFF forces the user to provide adequate split time to service the walk and ped clearance intervals assigned to the phase. The coordination diagnostic will fail the pattern if the split times do not adequately meet the pedestrian requirements.

ON *Stop-in-Walk* ON disables the coord diagnostic that insures that the split time is adequate to service the minimum pedestrian times. The local counter will "STOP" at the force-off and "**suspended**" until the end of ped clearance. At the end of ped clearance, the local cycle counter will begin incrementing and the coordinator will immediately begin correcting the offset using short-way transition if specified and if the splits have enough time to utilize short way for the pattern.

Note: *Rest-in-Walk* programmed for a coord phase defeats *Stop-in-Walk* and requires that pedestrian times be serviced within the programmed split time.

Stop-In-Walk may affect arterial phases that are push button actuated when there is no side road demand. If a late arterial Ped call comes in, the coordinator may utilize *Stop-in Walk* to finish processing the arterial Ped clearance times during the first split, thus correcting during the side road splits. If this is not desired, program the arterial phases as *Rest-in-Walk* and program the *Walk Recycle*, *Leave Walk Before* and *Leave Walk After* parameters as described below.

Walk Recycle

This parameter is used in association with arterial phases. The Options under this parameter will take effect only when *Rest-In-Walk* is set for the arterial phase(s). **If *Rest-In-Walk* is not set, this parameter is ignored.** When *Rest-In-Walk* is not set, the arterial pedestrians are subject to *PedLeav* and *Ped Yld* parameters as well as opposing phase demand.

Walk Recycle and the two *Leave Walk* settings described below, determine how walk intervals are terminated and recycled during coordination when the controller is resting in a phase and there is time available to re-service the pedestrian movement before the phase is forced off.

***Walk Recycle* only recycles the walk interval if a ped call has been placed on the phase or if the phase is programmed for *Rest-In-Walk*. A ped recall set through the phase options or through the *Split Table Mode* setting (PED or MxP) will not recycle the walk unless a ped detector has also called the phase or *Rest-In-Walk* is set**. If you want to rest-in-walk on the arterial phases, then program *Rest-In-Walk* for those phases under menu **MM->1->1->2**. Below are the programmed settings for *Walk Recycle*.

NO_RECYCLE After servicing walk and ped clearance, the controller will continue to rest in the coordinated phase until the next cycle (Local counter = 0) before deciding to recycle the walk. Walk Recycling is now dependent upon getting a demand from any conflicting phase ***AND*** a pedestrian actuation or recall on the rest-in-walk phase.

IMMEDIATE If *Rest-In-Walk* is set, the controller will recycle the walk immediately (without a pedestrian actuation or recall on the rest-in-walk phase) at the end of ped clearance **if a serviceable (i.e. not inhibited) conflicting call does not exist**. This setting locks out any new conflicting calls until the end of pedestrian clearance in the next cycle. Caution should be used if IMMEDIATE is programmed. One consequence of setting *Walk Recycle* to IMMEDIATE is that side road phases may not be serviced if the recycled ped finishes past the side road phase(s) apply points. There are two ways to solve the above consequence.

If IMMEDIATE recycling is desired, set the *Leave Walk After* parameter to ON DEMAND. This option ignores the PedLeave point and allows the controller to leave walk immediately when a conflicting call is received

Set the *Walk Recycle* parameter to INHIBIT_1256 or INHIBIT_3478 as discussed below.

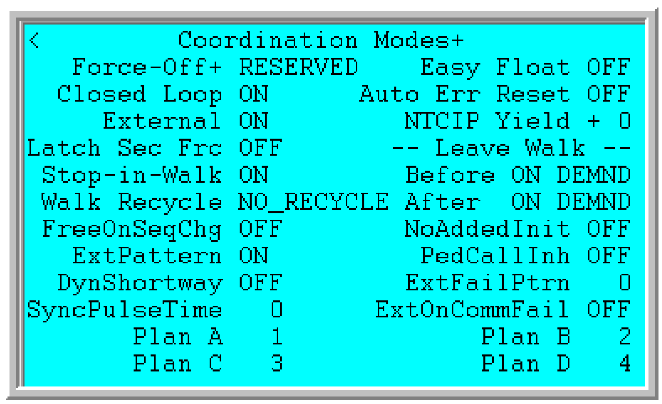
Ø1256_INH This option is useful when the coord phase is Ø4 or Ø8. The coord phase walk is not recycled until the permissive window for the cross street (Ø1256) has had an opportunity to service conflicting pedestrian and vehicle calls.

Ø3478_INH This option is useful when the coord phase is Ø2 or Ø6. The coord phase walk is not recycled until the permissive window for the cross street (Ø3478) has had an opportunity to service conflicting pedestrian and vehicle calls

NO_PED_INH This option allows the walk of the coord phase to recycle when the pedestrian omits are lifted on the coordinated phase (i.e. the earliest point in the cycle when the coordinator will allow a walk interval to be serviced. If a ped call is issued during or after ped clearance, the walk will be recycled immediately after the ped clearance is timed and after or at the Ped Yield point of the phase if the controller continues to rest in that phase.

Leave Walk Before

This parameter is used in association with arterial phases. The Options under this parameter will take effect only when *Rest-In-Walk* is set for the arterial phase(s). **If *Rest-In-Walk* is not set, this parameter is ignored.** The following entries determines when a phase will leave walk if it is resting in walk but has not been recycled:



TIMED The *PedLeav* point is the latest point in the cycle that allows the controller to begin Ped clearance and have end it at the force-off of the phase. The TIMED option allows the controller to rest-in-walk until the *PedLeav* point if a conflicting call is received on another phase.

ON DEMAND This option ignores the *PedLeav* point during coordination and allows the controller to leave walk immediately when a conflicting call is received.

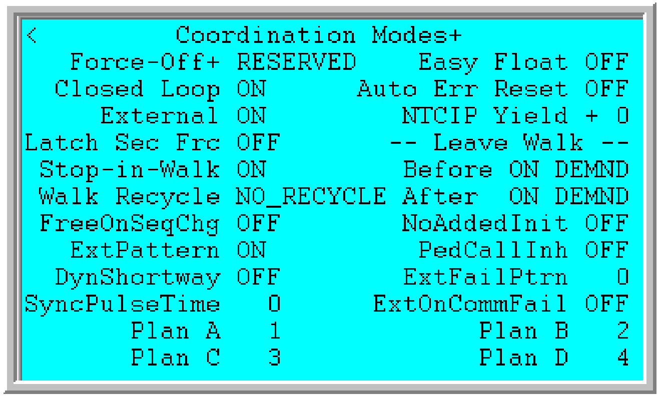
Leave Walk After

These entries are the same as *Leave Walk Before* except they apply to phases resting in walk after being recycled. This parameter is used in association with arterial phases. The Options under this parameter will take effect only when *Rest-In-Walk* is set for the arterial phase(s). **If *Rest-In-Walk* is not set, this parameter is ignored.**

NTCIP Yield

The *Coord Yield* parameter is expressed as a positive and negative number (- 15 to +15”). This parameter is used to adjust the default yield point of the coord phase under NTCIP coordination (FIXED and FLOAT modes). This adjustment is applied to only the coordinated phases, where the *Early Yield* adjustment is applied to all of the non-coordinated phases.

FreeOnSeqChg



Transitioning from one pattern to another is dependent on many decisions such as cycle length changes, coordination phase changes, split time changes and phase sequence changes. Phase Sequence changes can especially influence a transition. This parameter gives the user flexibility to determine when phase sequence changes will occur during coordination pattern changes. Turning this parameter to ***ON*** will briefly (approximately 1 second) force the coordinator to run free when a sequence change occurs thus insuring that the coordinator will reset itself. Setting this parameter to ***OFF*** will run sequence changes when the coordinator deems it is appropriate.

No Added Initial

This Feature allows Added Initial Timing to be disabled whenever coordination is active (i.e. Not Free). Set this parameter to ON if you want Added Initial Timing to be disabled during coordination. Set to OFF if you want to continue to use Added Initial Timing during coordination.

PedCallInh

Setting this variable to "ON" will disable pedestrian inhibits during coordination.

DynShortway

Dynamic Shortway is an alternative way to vary the **Shortway** percentage (**MM->2->5**) so make the best use of split time in order to speed up transitions.

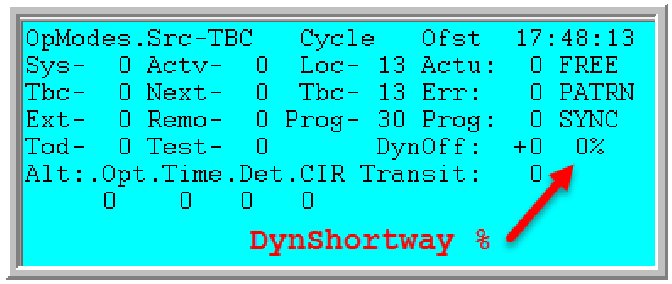
Setting *DynShortway* to **OFF** will use the programmed transition percentage (time).

Setting *DynShortway* to **ON** will result in a **Dynamic Shortway** transition. Then the software does the following:

1) It will wait for the controller to be in coordination transition.
2) It looks at all the phases that are **ON**
3) For **<u>each</u>** phase **ON**, it will calculate the largest **Shortway** percentage that the phase can run and **not** violate its minimums. Note: The controller transition will be based upon the minimum phase times and the amount of time that the phase (split) used in the last cycle.
    a. It will choose the larger of these values (so, if a phase was skipped, it will choose the min time, else it will use the actual split used).
    b. If either of these numbers are smaller than the user programmed transition time, the user programmed transition will be used.
4) For **<u>all</u>** phases **ON**, it calculates the largest **Shortway** percentage that the phase can run and **not** violate its minimums.
    a. It chooses the ***SMALLEST*** **Shortway** percentage that is calculated for each phase **ON,** because otherwise a larger one would violate the smaller one.
5) Once *DynShortway* is set to **ON**, a **Shortway** percentage must be programmed in each pattern. Setting the **Shortway** percentage to a low value such as 1% will allow the algorithm to process.
6) Since this is a **Dynamic Shortway** transition, keep in mind that your ability to transition is controlled by which phases are running. Therefore, if a phase that is running that has the standard **Shortway** disabled (i.e. set to "0") or the **Correction Mode** is **LONG**, then obviously no transition will occur. Likewise, if you are running a left turn with a through phase, and the left turn does not have a lot of slop time, then the through phase will be constrained until the left turn terminates.

As an example, assume there is a split that is programmed at 50 seconds. During the last cycle, that split only used 25 seconds. Setting *DynShortway* = **ON** would allow a transition at the speed of 50% during this phase while **not** shortening the time relative to the prior cycle. (50% = ((50 – 25)/50)).

To view DynShortway in action, go to the Coord status screen (**MM->2->8->1** or **MM->7-> 2**).



ExtFailPtrn

The External Coordination Failure Default Pattern is a pattern number (0-48). Typically if External coordination enabled, and the controller does not get a sync pulse within 3 cycles then External coordination is considered failed, and the software will drop back to time of day. By programming a pattern, the software will put the programmed pattern into action instead of going back to time of day.

ExtOnCommFail

This parameter will cause the External Pattern parameter, described above, to be run based on a communications failure.

SyncPulseTime

This parameter will allow the suse to set the “width” of the Sync Pulse when using External coordination. Theis is programmed in seconds.

ExtPattern / PlanA / PlanB / Planc / PlanD

Setting the **ExtPattern** parameter to “ON” allows the user to program up to four External Patterns that can override scheduled coordination patterns, To run the External patterns, the user may assign Plan A (function 216), Plan B (function 217), Plan C (function 218), and/or Plan D (function 219) to input channels via I/O mapping.

In addition the user must program the appropriate pattern that matches the Plan input using the **Plan** parameter on this screen. The **Plan** entries are the pattern number that is called in when those inputs are active. These entries have to call in a pattern – it cannot call in the NTCIP free (254) or flash (255) patterns. This selection cannot override free or flash operation that has been called in by another plan.

When the Plan input is triggered, the **Plan** pattern will become the external sourced pattern that will override the scheduled pattern. Input priority is Plan A then Plan B then Plan C and finally Plan D.

6.3 Pattern Table (MM->2->4)

Coordinated *Patterns* are defined by a *Cycle* length (normally 1-255 sec.). *Free patterns* are specified in the *Pattern Table* with a zero second Cycle length. The 48 patterns in the *Pattern Table* along with Pattern# 254 (free) and Pattern# 255 (flash) provide a total of 50 patterns. Only one pattern may be active at a time.

Pat#	Cycle	Offset	Split	Seqnc
1	100	50	1	1
2	225	200	24	16
3	0	0	0	1
4	0	0	0	1
5	0	0	0	1
6	0	0	0	1
7 +	0	0	0	1

Cycle Time (Cycle)

Cycle Time specifies the cycle length and ranges from 0-255 seconds if *Expanded Splits* is OFF, or 0-999 if *Expanded Splits* is ON. Cycle Time is typically set to the sum of the split times in each ring during coordination. However, a *Cycle Time* of 0" implies a *free pattern*. Many features available to patterns under coordination are also available to a *free pattern* programmed with a zero second cycle length. This allows different *free patterns* to be called by time-of-day or through the system that vary the operation of the controller during free operation. Note in Version 65.x, if Expanded Splits is set to "ON cycle lengths can vary from 1-999 seconds.

Offset Time (Offset)

Offset Time defines the length of time that the local counter (Loc) lags behind the system time base (TBC). Offset ranges from 0-255 seconds if *Expanded Splits* is OFF, or 0-999 if *Expanded Splits* is ON. Each controller in a coordinated system references the system time base to midnight to synchronize the offset time for each active pattern in the system. The system maintains coordination as long as each controller in the system maintains the same midnight time reference. Note: if the offset value is greater than or equal to the cycle time, then the controller is forced into free mode by the coordination diagnostic.

Split Number (Split)

Split Number is used to reference one of the 32 *Split Tables* associated with the pattern. The *Split Tables* are interpreted differently based on the force-off method. Most of these modes require split times for each phase programmed through the Split Table. However, some of the OTHER force-off methods require the setting the force-off and yield points for each phase. This chapter on Basic Coordination discusses the FIXED and FLOAT force-off methods that simplify coordination under NTCIP coordination. The OTHER methods of coordination are discussed in Chapter 13 under Advanced Coordination.

Sequence Number (Seqnc)

The *Sequence Number* selects one of the 16 phase sequences to use with the pattern. Each phase sequence provides eight (8) entries per ring for each of the 8 rings. Phase sequences are fully discussed in chapter 4 of this manual. A sequence number of 0 in the database defaults to sequence number 1. Only entries between 1 and 16 are valid if entered through the keyboard.

6.4 Split Tables for NTCIP Modes FIXED and FLOAT (MM->2->7)

This section discusses how to program the *Split Table* when the NTCIP force-off modes (FIXED and FLOAT) are specified. The NTCIP coordination modes allow you to specify a split time in seconds to each phase and let the controller calculate all of the internal force-off and yield points for the pattern. NTCIP provides the OTHER coord mode to let the manufacturer provide additional methods of coordination.

6.4.1 Accessing the Split Tables (MM->2->7)

```
      Split Menu            Coord.Modes
1.Split Table           Force  OTHER
2.Plus Features                PERM_FRC
```

The *Split Table* allocates the cycle time (in seconds) to each of the phases enabled in the controller. One of these phases is set as the *Coordinated Phase* to reference the *Offset* of the pattern. The recall *Mode* of each phase can also be set in the *Split Table* and overrides the recalls set in phase options when the *Split Table* is called by the active pattern. A maximum of 32 split tables may be individually assigned to any of the 48 patterns in the *Pattern Table*. Each split table (1-32) is selected individually from menu **MM->2->7**.

The following *Split Menu* will appears after the split number has been selected from **MM->2->7**. Selection 1 is used to modify the *Split Table.* Selection 2, "Plus Features" is only available with the OTHER force-off methods. *Plus Features* are not needed for FIXED and FLOAT because these modes automatically calculate the permissive period and simplify additional programming required for the OTHER non-NTCIP modes.

6.4.2 Programming Each NTCIP Split Tables for Fixed & Float

Split Time

```
Spl- 1<>P..1...2...3...4...5...6...7...8
Time      25  25  25  25  25  25  25  25
Coor-P     .   X   .   .   .   .   .   .
Mode     NON MAX NON NON NON MAX NON NON
```

Split Time sets the maximum time allocated to each phase during the signal cycle. *Split Time* ranges from 0-255 seconds if *Expanded Splits* is OFF, or 0-999 if *Expanded Splits* is ON. The FIXED force-off method allows unused split time, or "slack time" to be used by the next phase in the sequence. The FLOAT method guarantees that "slack time" from the non-coordinated phases is used by the coordinated phase.

The controller diagnostic (discussed later in this chapter) insures that each split meets or exceeds the minimum times programmed for the phase. Each split time must be sufficient to service the minimum green, vehicle clearance and all-red clearance to prevent the min times from extending the phase past force-off point. In addition, if *Stop-In-Walk* is set to OFF, the diagnostic insures that each split is long enough to service the minimum pedestrian times (walk and ped clearance) prior to the force-off. The coordination diagnostic is always run prior to the pattern becoming active. If diagnostic errors are detected, the pattern is fails and the controller is placed into the free mode.

Coordinated Phase

The *Coordinated Phase* designates one phase in the split table as the offset reference. The offset may be referenced to the beginning or the end of the *Coordinated Phase* using the programming features from **MM->2->5** (right menu).

Only one phase should be designated as the *Coordinated Phase*. If multiple coord phases are specified in different rings, the coordinator will not be able to reference the offset if the phases do not begin (or end) at the same point in the cycle. Therefore, specify one *Coordinated Phase* for the offset reference and apply a MAX mode setting (discussed in the next section) if you want to guarantee split time allocated to the coordinated movements. Consider, for example, when a lead left-turn sequence is used, and there is only one designated lead left (Phase 1) as pictured. In this case the *Coordinated Phase* should be the first "standalone" through phase (Phase 2) in the sequence after crossing the barrier. The same will apply to lag left turn sequences.

Setting *Return Hold* (**MM->2->5**) insures that the controller holds in the coordinated phase once it returns to the phase. Applying a MAX *Mode* setting to the coord phase in the *Split Table* also "holds" the coord phase with a max call. It is recommended that you set *Return Hold* for all lead/lag left-turn sequences, because this guarantees that the *Coordinated Phase* is held to its force-off even if the max timer expires.

It is possible to gap out of the *Coordinated Phase* if *Return Hold* and the MAX *Mode* parameters are not set. This allows the controller to leave the *Coordinated Phase* and re-service a preceding left turn phase if there is enough time in the cycle to service the phase before forcing off the coord phase and crossing the barrier. The *Early Yield* adjustment may also be used to yield to the cross street phases before the barrier to service the cross street early.

Split Table Mode Setting

The *Mode* settings **override** recalls programmed in *Phase Options* (**MM->1->1->2**) whenever the split table is active.

NON The *None* setting applies the base recall settings programmed under **MM->1->1->2**

MIN The *Min* setting applies a minimum recall to the phase when the split table is active

MAX The *Max* setting applies a maximum recall to the phase when the split table is active. Note that when the Force-off mode is set to **Float** mode, a *Max* setting on any non-coordinated phase will utilize the calculated Max Float time and have an opportunity to leave that phase depending on phase rotation and the calculated apply points.

PED The *Ped* setting applies a pedestrian recall to the phase when the split table is active

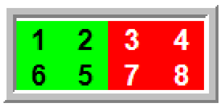
MxP The *Max + Ped* setting applies maximum and pedestrian recalls to the phase when the split is active

OMT The *Omit* setting omits the phase when the split table is active

Enb The *Enable* setting enables a phase that is not enabled in the phase options (**MM->1->1->2**) with ***NON*** selected.

NOTE: If a phase is disabled and the user programs a split time and a recall time other than NON, the phase is enabled.

Lead/Lag Considerations with the Coordinated Phase- First coordinated Phase

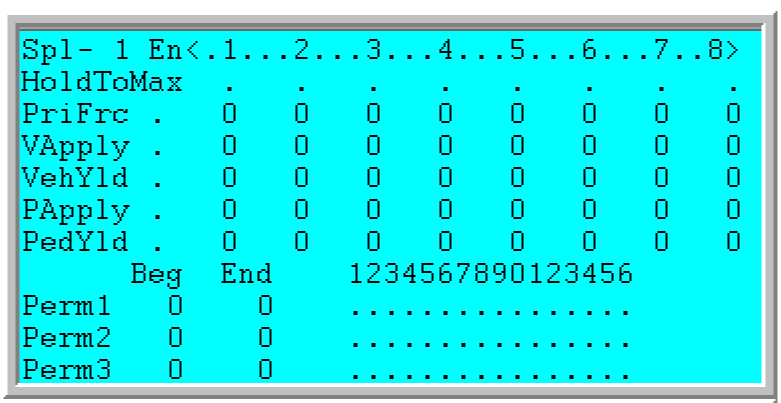


Many agencies switch lead lefts to lag lefts (and vice-versa) throughout the day to meet their traffic needs by calling different Phase Sequence tables by pattern. Choosing the coordinated phase may vary based on switching the phase sequence or the offset reference point. In the example to the left Phase 1 is a lead left, phase 2 and 6 are the straight through movements and phase 5 is a lag left. NTCIP specifies that the user must choose the first through phase as the coordinated phase for ***BegGrn*** offsets.. The coordinated phase which occurs first within the concurrent group of phases containing the coordinated phase(s), when there are constant calls on all phases, is known as the **First Coordinated Phase**, in this case phase 6. In this case the user should choose Phase 6 as the Coord phase in the split table because it is the first through. If a lead/lag left-turn sequence is used and ***BegGrn*** offset reference point is used, the Coordinated Phase should be the first through phase in the sequence after crossing the barrier.

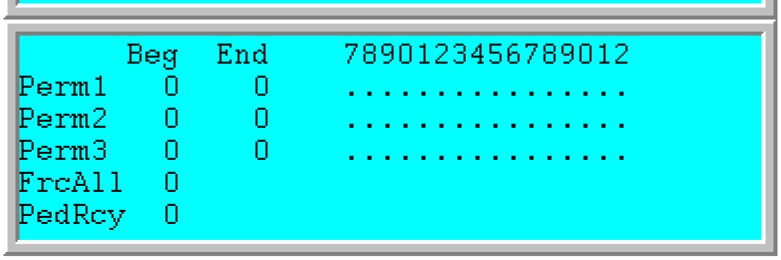
Using the ***EndGrn*** offset reference point, the user should choose Phase 2 as the Coordinated phase in the split table because it is the last through before crossing the barrier at the "0" point in the cycle.

6.4.3 Split Plus + Table

If **OTHER** modes is selected, this table is used to program the specific information for the type of coordination desired. Please refer to the Coord+ OTHER Modes section later in this chapter for detailed information about this screen.



```
Spl- 1 En<.1...2...3...4...5...6...7..8>
HoldToMax  .   .   .   .   .   .   .   .
PriFrc .   0   0   0   0   0   0   0   0
VApply .   0   0   0   0   0   0   0   0
VehYld .   0   0   0   0   0   0   0   0
PApply .   0   0   0   0   0   0   0   0
PedYld .   0   0   0   0   0   0   0   0
      Beg  End    1234567890123456
Perm1   0    0    ................
Perm2   0    0    ................
Perm3   0    0    ................
```



```
      Beg  End    7890123456789012
Perm1   0    0    ................
Perm2   0    0    ................
Perm3   0    0    ................
FrcAll  0
PedRcy  0
```

6.5 Easy Calcs Generated For NTCIP Modes FIXED and FLOAT

Spl- 1<>P	..1	...2	...3	...4	...5	...6	...7	...8
Time	25	25	25	25	25	25	25	25
Coor-P	.	X	.	.	.	.	.	.
Mode	NON	MAX	NON	NON	NON	MAX	NON	NON

All that is required to allocate cycle time using FIXED and FLOAT are the *Split Times* (in seconds) for each phase. The controller automatically calculates the internal force-off and yield points (called Easy Calcs) given the split times and sequence of the pattern. The OTHER coordination methods provide greater control over the yield point settings, but at the expense of additional complexity. The NTCIP yield point adjustments, *Coord Yield* and *Early Yield* allow the user to fine-tune the default yield points if desired (this topic is discussed in the chapter on *Advanced Coordination*). However, for most users, the *Easy Calcs* (force-off and yield points calculated under FIXED and FLOAT) are "hidden from view" and all the user is concerned about is insuring that the split times provided pass the coord diagnostic. The *Split Table* above assigns phase 2 as the *Coordinated Phase* with 20" S*plit Times* allocated to each phase.

Easy <> P	..1	...2	...3	...4	...5	...6	...7	...8
PrimFrc	65	0	20	45	65	0	20	45
SecdFrc	65	0	20	45	65	0	20	45
Veh Yld	0	10	0	0	0	10	0	0
VehAply	56	91	11	36	56	91	11	36
Ped Yld	0	10	0	0	0	10	0	0
PedAply	65	91	20	36	65	91	20	36
FloatMx	15	30	15	20	15	30	15	20
PedLeav	65	90	20	35	65	90	20	35
PedCall	60	85	15	30	60	85	15	30
SpltRem	0	0	0	0	0	0	0	0

The pattern example to the right represents a 100" cycle with the offset referenced to *Begin-of-Green* (BegGRN) coord Ø2. All splits are 25" as shown in the *Split Table#* above and the clearance times for each phase are 4". The zero point of the cycle (Loc = 0) coincides with the beginning of the coordinated phase (in this case, phase 2). The green interval for Ø2 and Ø6 is applied at Loc=21 to provide a 25" *Split Time* Each phase in the sequence is forced off 25" after the force-off for the previous phase starting at the coord phase and proceeding across the barriers.

The *Easy Calcs* status screen (**MM->2->8->2**) displays the internal calculations for this example under FIXED or FLOAT NTCIP modes. *Secondary Force-offs* only apply to the OTHER modes, so under FIXED and FLOAT, the *Primary* and *Secondary Force-offs* are the same. The *Yield* points opens the *Permissive Periods* to service vehicle and pedestrian calls for each phase. The *Apply* points close the *Permissive Periods* as discussed in the next section. Specifics concerning the Easy Calcs screen are discussed at the end of this chapter. **Keep in mind that whenever the user changes any coordination parameter that the Easy Calcs may be affected.**

6.5.1 Permissive Periods for NTCIP FIXED and FLOAT

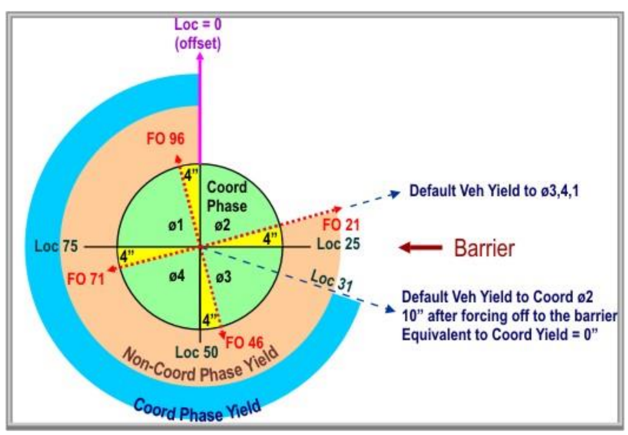
The vehicle permissive period is defined as the portion of the cycle during which vehicle calls can be serviced if there is a vehicle call on the phase. The permissive period begins at the *VehYield* point and ends at the *VehApply* point that inhibits vehicle calls from being serviced until the next signal cycle.

The pedestrian permissive period is defined as the portion of the cycle during which pedestrian calls can be serviced if there is a pedestrian call on the phase. The permissive period begins at the *PedYield* point and ends at the *PedApply* point that inhibits pedestrian calls from being serviced until the next signal cycle.

The vehicle and pedestrian *Yield* points open "windows of opportunity" to service calls for each phase. The vehicle and pedestrian *Apply* points close the permissive windows for each phase.

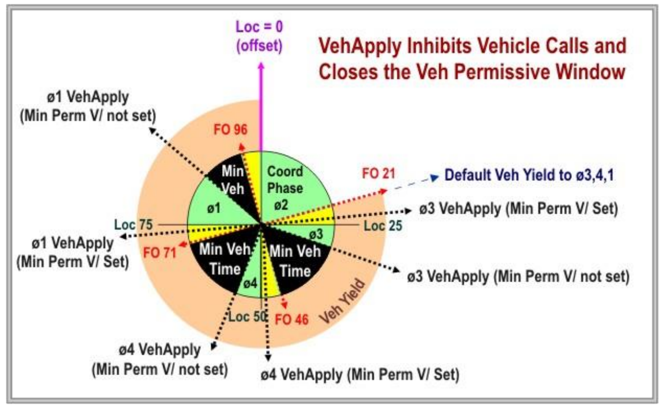
Default Yield Points for FIXED and FLOAT

The default *VehYield* points for the 100" cycle example are illustrated to the right. The FIXED and FLOAT coord modes set the Y*ield* points for all non-coordinated phases at the force-off of the coord phase. The default *Yield* point of the coord phase and the "pseudo" coord phase is set 10" later. This allows the controller to service the non-coordinated phases immediately at the end of the coordinated phase. However, if no calls exist on the non-coordinated phases at the barrier, the controller will dwell in the coord phase for 10" before it is reserviced. The default yield points delay the permissive period for the coord phase to allow "late" side street to be serviced after the barrier.



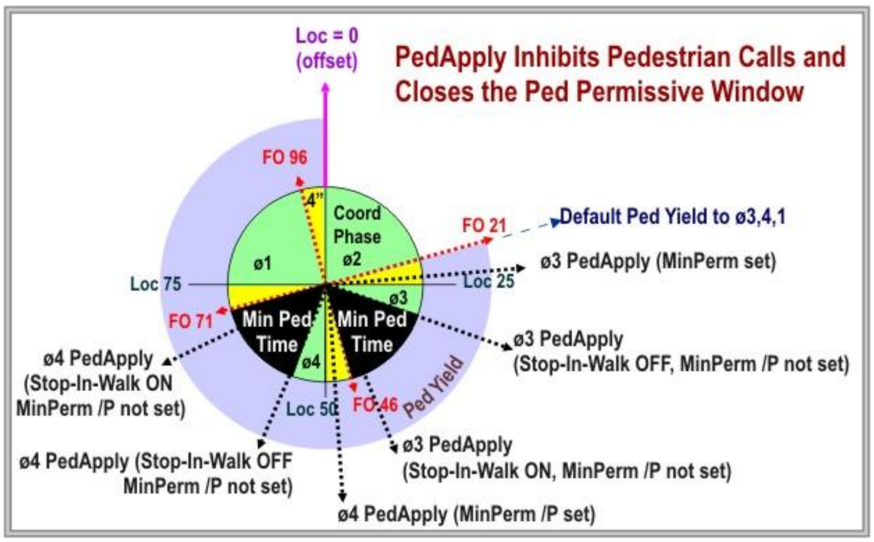
VehApply Points

The controller automatically calculates vehicle *Apply* points for FIXED and FLOAT to close the permissive period to veh calls on each phase. Each *VehApply* point is calculated by subtracting the minimum vehicle times (min green or max initial + yellow + all-red) from the force-off point of the phase. This insures that minimum veh times are serviced without overrunning the force-off. This default *VehApply* point is applied as late in the cycle as possible to maximize the permissive period for "late" vehicle calls. A *Min Perm* setting for vehicle calls is provided to minimize the veh permissive window as shown to the right.



PedApply Points

The controller automatically calculates pedestrian *Apply* points for FIXED and FLOAT to close the permissive period for ped calls on each phase. If *Stop-In-Walk* is OFF, the *PedApply* point is calculated by subtracting the minimum pedestrian times (walk + ped clearance + yellow + all-red) from the force-off point of the phase. This insures the minimum ped times are serviced without overrunning the force-off. If *Stop-In-Walk* is ON, the default *PedApply* point is applied 5" prior to the force-off to allow late ped calls to overrun the force-off. The *Min Perm /P* setting minimizes the ped permissive window as shown below.



6.6 Transition, Coord Ø+ (MM->2->5)

6.6.1 Transition Parameters (Left Menu)

Pat#	Trans:	Short	Long	Dwell	No.Short.P>			
1		0	17	0	1	5	0	0
2		12	22	0	0	0	0	0
3		0	0	60	0	0	0	0
4		0	17	0	0	0	0	0

Offset *Correction* may be set to LONG (long-way) or SHORT/LONG (short/long-way) under **MM->2->1**. *Transition,CoordØ+* specifies the amount of short, long or dwell for each pattern.

Short (Short-way Transition %)

This field sets the percent reduction applied to each split time in the *Split Table* during short-way transition. Valid values for this parameter are 0-24%. *Short-way* is disabled when the parameter is set to zero. The controller diagnostic (discussed later in this chapter) insures that minimum phase times are satisfied for each programmed split with *short-way* applied and insure that the phase minimums do not extend beyond a force-off. *Short-way* transition is very effective when used with the *Stop-In-Walk* feature discussed in the last section. It should also be noted that Rest-In-Walk does not operate for uncoordinated phases during short way transitioning. The ***No Short*** option (**MM->2->5**) can be turned on, if it desired for Rest-In-Walk to operate for a specific phase, even while in short way transition.

Long (Long-way Transition %)

This field sets the percent extension applied to each split time in the *Split Table* during *long-way* transition. Valid values for this parameter are 0-50%. *Long-way* is disabled when the parameter is set to zero. You may force the controller to use *long-way* only by coding a zero *Short* value for the pattern. Many users do this as a means to avoid the additional constraints imposed by the coord diagnostic for short-way transition. However, selecting SHORT/LONG as the *Correction* and providing short and long-way transition % values greater than zero allows the controller to select the quickest way to transition and synchronize the offset for the active pattern.

Dwell (Dwell in coord phase)

Dwell transition is enabled for a pattern if both *Short* and *Long* values are set to zero and *Dwell* is set to 1-99 seconds. The *Dwell* method corrects the offset by resting at the end of the coordinated phase until the desired offset is reached or until the *Dwell* time expires. The controller will continue to dwell in the coordinated phase each cycle until the desired offset is reached. Increasing the *Dwell* time reduces the number of cycles to achieve coordination, but increases delay for drivers waiting on the non-coordinated phases. *Dwell* offset correction is not as popular as the short-way/long-way method for this reason. When using *EndGrn* transitions, the controller dwells at the end of the cycle (or after the coordinated phase green) which could be whatever phase is running next after the coordinated phase. When using *BegGrn* transitions, the controller dwells at the beginning of the coordinated phase green.

No Short Ø's

This feature allows four phases to be excluded from short-way transition as "no short-way phases". Split times that are not long enough to service the minimum phase times with short-way applied will fail the coordination diagnostic. Occasionally, it is more convenient to exclude a phase from short-way as a "no short-way phases" than to increase the split time to pass the coord diagnostic or to reduce the short-way percent applied to all of the phases. This feature promotes the use to short-way transition to reduce the time need to get the offset in sync.

6.6.2 Yield Point Adjustments, Return Hold and Offset Reference (Right Menu)

<Pat	EYld	Offst	RtHld	Flt	MinVP	%	MI
1	0	EndGr	X	.	..	.	.
2	0	EndGr	X	.	..	.	.
3	0	EndGr	X	.	..	.	.
4	0	EndGr	X	.	..	.	.
5	0	EndGr	X	.	..	.	.
6	0	EndGr	X	.	..	.	.
7 +	0	EndGr	X	.	..	.	.

These entries relate to the *Coord Phase* selected in the *Split Table* and referenced by each *Pattern*. The *Coord Phase* provides the "sync" point during coordination. The pattern *Offset* is referenced to either the beginning or end of the coord phase as specified by in this table. This menu provides the ability to return and hold the coord phase active until it's force-off and the also the ability to modify the yield points of the non-coordinated phases.

Early Yield (EarlyYld)

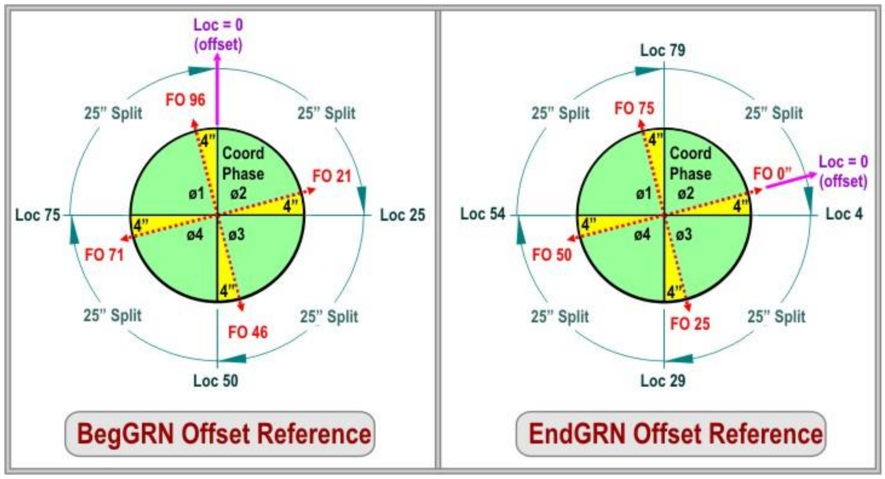
The *Early Yield* parameter (0-25 seconds) modifies the yield calculations under NTCIP coordination (FIXED and FLOAT force-off modes). This adjustment is applied to all the non-coordinated phases, where the *Coord Yield* adjustment is applied to the coordinated phases.

Return Hold (RetHold)

Return Hold only applies to NTCIP FIXED and FLOAT modes. Enabling *RetHold* causes a hold to be placed on the coordinated phase until it is forced-off. Disabling *RetHold* allows the controller to gap-out of the coordinated phase to service a competing vehicle or pedestrian call on another phase.

The MAX *Mode* setting in the *Split Table* can also be used to extend the coord phase. However, it is recommended that unless you wish to gap out of the coord phase, that you set Return Hold as a default. This insures that if the max timer expires during a lead/lag sequence, that you will never leave the coord phase until its force-off point. This feature is typically used in End of Green scenarios.

Offset Reference



The *Offset Reference* synchronizes the offset to either the beginning of the coord phase (BegGRN) or the end of the coord phase green (EndGRN). The 100" cycle example to the right shows how force-off points change when the *Offset Reference* is changed.

You must insure the *Offset Reference* agrees with the offset reference in the computer model used to develop the pattern. For BegGRN corresponds with the Synchro "TS2 1st Green" offset method. EndGrn corresponds with "Begin Yellow" in Synchro.

Flt

The *Flt* pattern option is provided to override the FIXED force-off method programmed under *Coord Modes*. If FIXED is selected as the default under **MM->2->1**, you can use this pattern option to override the force-off method as FLOAT on a pattern-by-pattern basis. This allows one pattern to guarantee slack time to either the next phase in the sequence or to the coord phase as a pattern or time-of-day feature.

MinPermV/P

These two parameters allow the minimum permissive window for vehicles (V/) and for pedestrians (/P) to be selected on a pattern-by-pattern basis. Enabling this feature prevents a "late" vehicle and/or pedestrian call from being serviced if the call received after the force-off of the preceding phase. The *MinPermV/P* adjustments are illustrated in the next section.

%

Setting this parameter to **ON** (**X**) will reinterpret the split times as percentages of cycle length, and not seconds. The user must insure that all phase splits add up to 100 percent. There is limited diagnostics when using this feature.

MI

This parameter only works under NTCIP ***Float*** mode and the user must set *Max Inhibit* per Phase under MM→1→3 or MM→1→1→6→2. By programming these parameters the controller will allow max inhibit during float mode.

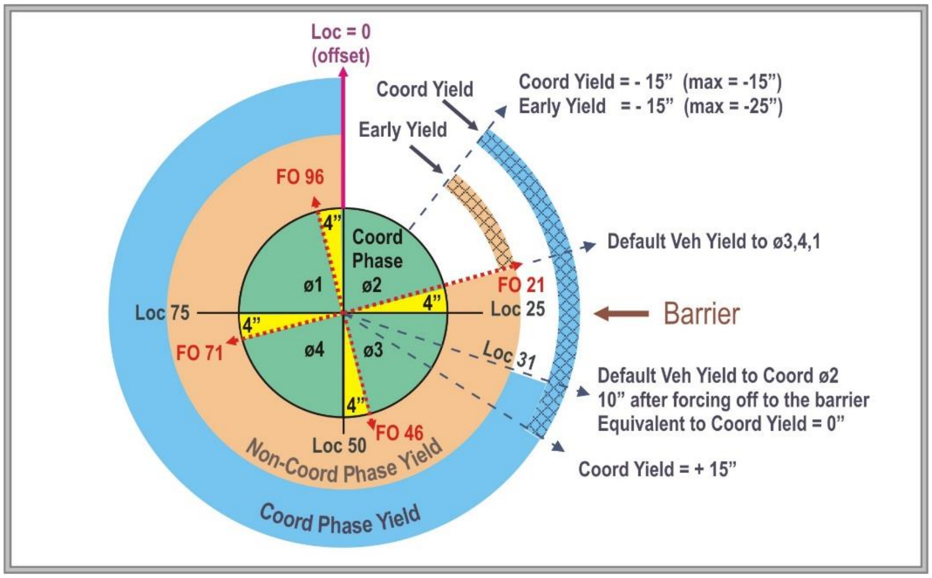
As an example an intersection is using STD8, utilizes ENDGRN coordination and has phase 2 as the coord phase. Under normal (FLOAT mode) operation all unused time on Phases 1, 3 4, 5, 7 and 8 will be given to the artery phases 2 and 6. If the user programs the MI parameter for the current running pattern and has Phases 4 and 8 set as Max Inhibit phases **(MM→1→1-→3** or **MM→1→1→6→2)**, then any unused time left in the Phase 3 and 7 split will be given to Phases 4 and 8 (up to phase 4 and 8 Force Off Times). Any unused time left in the Phases 1 and 5 split will be given to arterial Phases 2 and 6.

6.6.3 Coord Yield and Early Yield Adjustments

The default yield points calculated by *Easy Calcs* are acceptable without modification for most applications. In fact most users continue to run coordination for years and never question the default yield point calculations. This section discusses how to adjust the default yield points calculated under FIXED and FLOAT without having to delve into the OTHER coordination modes.

The default *VehYield* points for the coord phase(s) may be adjusted using *Coord Yield*. The default *VehYield* points for the non-coordinated phases may be adjusted using *Early Yield*.

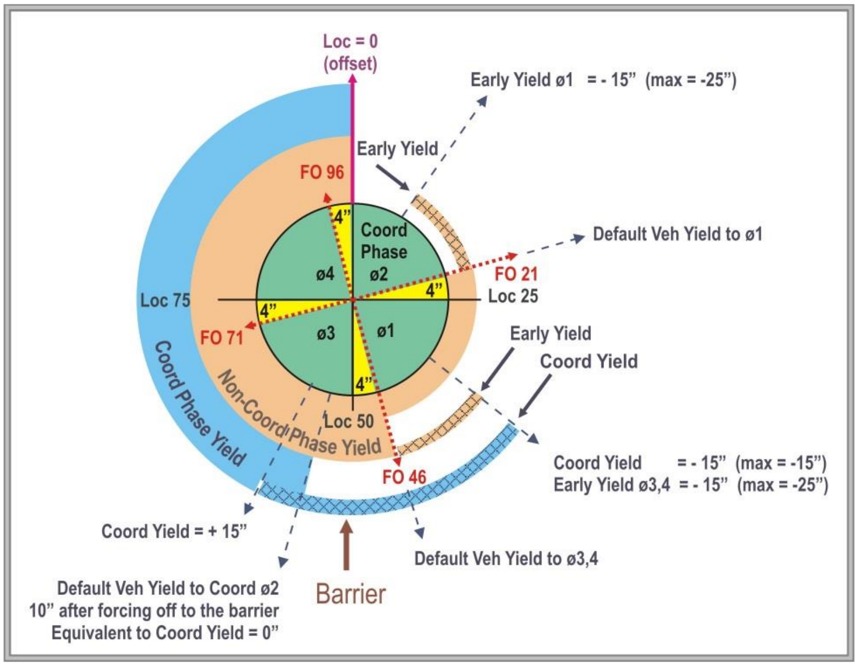
The *VehYield* point of the non-coordinated phases may be adjusted using *Early Yield* (**MM->2->5**). This parameter moves the *VehYield* point of the non-coordinated phases as much as 25" prior to the barrier change. Typically, this value is not changed because the user does not want to leave the coordinated phases early in a progressed signal system. However, there are unique applications when adjusting these default yield points is desirable.



The diagram to the right illustrates the *Coord Yield* and *Early Yield* adjustments when ø 1 is leading and the barrier is crossed at the end of ø2

The *VehYield* points are slightly different when the coordinated phase begins at the barrier, as in the case of a lagging left-turn sequence (see figure to the right).

The non-coordinated phases (other than the lagging turn phase) still yield at the barrier. The coord phases still yield 10" later. However, the yield point for the lagging left turn is placed at the force-off of the coord phase.

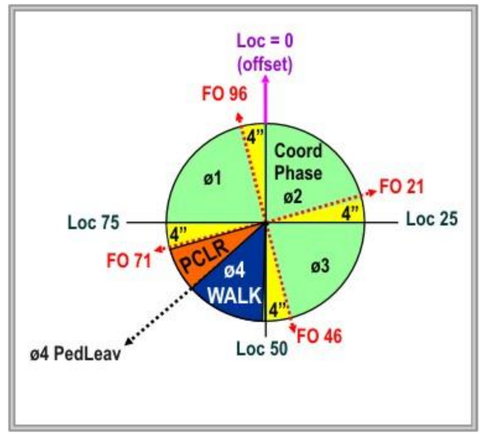


Programming Min Perm V or Min Perm P will result in the vehicle phase inhibit being set as follows:

Min Perm V:	Vehicle inhibit = Force Off minus the green portion of the Split under Fixed mode.
	Vehicle inhibit = Force Off (FloatMax) minus the green portion of Split under Float mode.
Min Perm P:	Ped inhibit = Force Off minus the green portion of the Split plus 5 seconds under Fixed mode.
	Ped inhibit = Force Off (FloatMax) minus the green portion of the Split plus 5 seconds under Float mode.

Note: If the user programs both the Min Perm V and Min Perm P, Min Perm V takes precedence.

6.7 Recalling Peds With Rest-In-Walk



Pedestrian recalls may be placed on any phase during coordination through the *Mode* setting in the split table, but any setting other than **NON** (none) overrides the phase recall settings programmed under **MM->1->1->2** or **MM->5->6**. Pedestrian recalls can be applied through the *Mode* setting by selecting PED to apply a ped recall MxP to place a MAX and PED recall on the phase. The PED and MxP mode settings do not recycle the walk indications if the controller is resting in the phase and the walk interval has timed out. This operation is accomplished using the walk recycle feature.

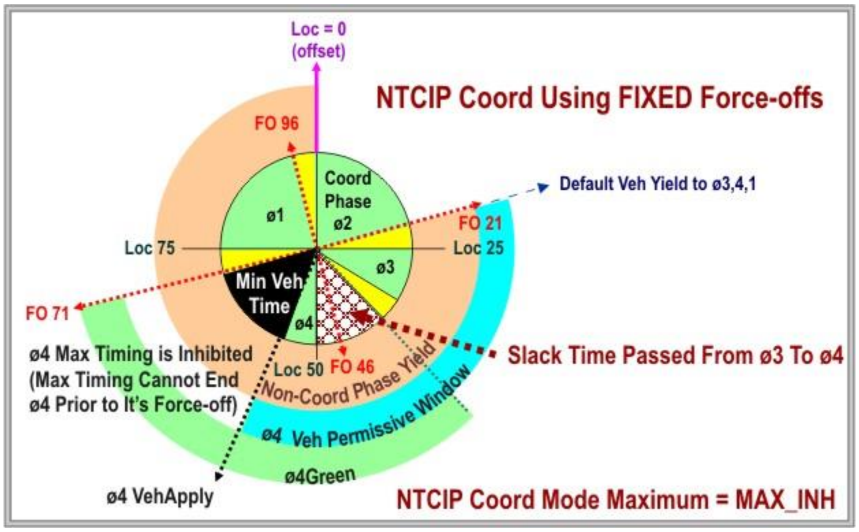
Agencies often want the controller to rest-in-walk in the coordinated phase to provide the maximum opportunity for pedestrians to begin crossing the street. *Rest-In-Walk* under **MM->1->1->2** must be set for each phase to rest in the walk interval and time the end of ped clearance at the force-off point (beginning of yellow). The controller calculates an *Easy Calc* point, called *PedLeav* that defines the end of the end of the *Rest-In-Walk* period. This coordination feature replaces the walk-rest-modifier method used in TS1controllers to achieve rest-in-walk operation.

The *PedLeav* point is calculated by subtracting ped clearance time from the force-off point of the phase as shown above. If *Walk* Recycle is set to NO_RECYLE or NEVER, then *Rest-In-Walk* feature will not operate properly. Therefore, set *Walk_Recycle* under Coord Modes+ (**MM->2->1**, right menu) to recycle the walk indication if *Rest-In-Walk* is used.

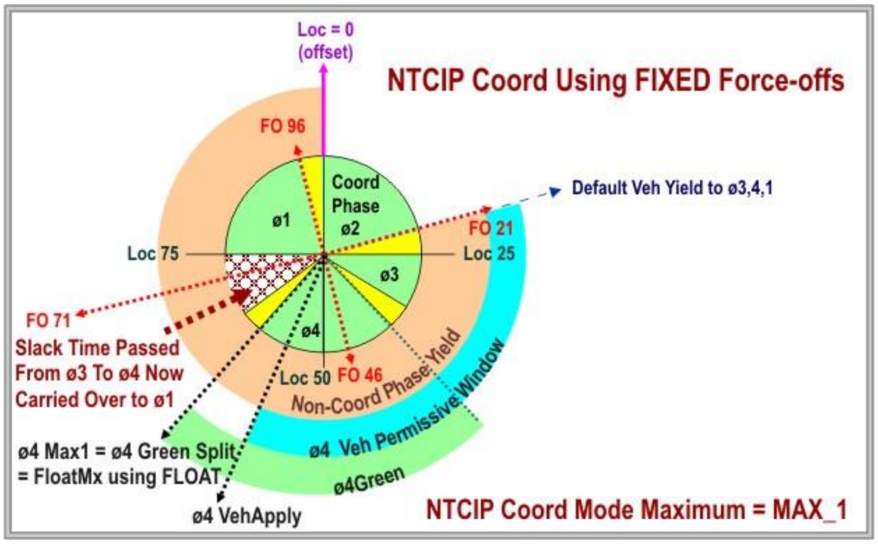
6.8 Maximum Phase Timing Using FIXED Force-offs

Force-offs calculated for FIXED and FLOAT are fixed points in the cycle that do not change even though phases may skip, gap-out early and transfer slack time to the next phase in the sequence. FIXED force-offs allow slack time to be used by the next phase in the sequence. Max phase timing under FIXED may be inhibited (MAX_INH) or set to MAX_1 or MAX2. FLOAT force-offs insure that all slack time is transferred from the coordinated FLOAT apples a floating max time (*FloatMx*) equal to the green portion of the split to terminate the phase prior to the force-off if the time allocated to the phase exceeds programmed split time. This insures slack time transfers to the coord phase in the sequence.

The example to the right applies FIXED force-offs with the *Maximum* mode set to MAX_INH. ø 3 gaps out early and moves to ø4 because the vehicle permissive window for ø4 is open. Because max timing is inhibited, slack time from ø3 is transferred and used by ø4 if veh calls exist extending ø 4 to the force-off for ø4.



The next example illustrates FIXED force-offs with the *Maximum* mode set to MAX_1. In this case, the active max1 phase time for ø4 is set equal to the green portion of the split assigned to ø4 which is equivalent to the *FloatMx* automatically set using FLOAT. Setting the active max1 value greater than *FloatMx* allows ø4 to use a portion of the slack time from ø3. Setting max1 to a "large" value allows the max timer to extend the phase to the force-off of ø4 and achieves the same effect as setting the *Maximum* mode to MAX_INH.



6.9 Alternate Tables+ (MM->2->6)

The *Alternate Tables+* menu attaches any of the *Alternate Phase Programs* or the *Alternate Detector Programs* to any of the 48 patterns. There are a total of 8 *Alternate Phase Option Programs*, 3 *Alternate Phase Time Programs*, 3 *Alternate Detector Group Programs* and 2 *Call/Inhibit Programs* assignable to each patterns in *Alternate Tables+* in the left menu of **MM->2->6.**

Pat#	Alt:	POpt	PTime	DetGrp	Call/Inh	>
1		0	0	0	0	
2		8	3	3	2	
3		0	0	0	0	
4		0	0	0	0	

The ASC plan (1-4) for *Adaptive Split Control* may also be enabled or disabled for each pattern. ASC provides an adaptive split feature when using Cubic | Trafficware Adaptive module and Adaptive Central Master.

< Pat#	ASC	CNA1	Max2	Dia
1	0	.	.	DFT
2	0	.	.	DFT
3	0	.	.	DFT
4	0	.	.	DFT
5	0	.	.	DFT
6	0	.	.	DFT
7	0	.	.	DFT
8	0	.	.	DFT
9	0	.	.	DFT
10	0	.	.	DFT
11	0	.	.	DFT
12 +	0	.	.	DFT

Enabling *CNA1* when a pattern is active applies a hold during coordination on any phases programmed for "Non-actuated 1". *CNA1* provides an external method of coordination commonly used with older UTCS type systems. However, external coordination has been replaced with internal time base methods described in this chapter.

Max2 may be selected for each pattern from Alternate Tables+ and overrides the *Maximum* setting in *Coord Modes* MM->2->1. *Max2* has no effect under coordination if the floating force-offs (FLOAT) is active. This feature is also used to call a free pattern (0" cycle length) by time-of-day and change the current max timing in effect from Max1 to Max2.

6.10 External I/O (MM->2->2)

External I/O allows an external source to select the active pattern using *Offset* and *Plan* inputs provided on the D-connector. External coordination schemes date back to early TS1 days when an on-street master selected the active pattern of all secondary controllers in the system through an AC current based hardwire interconnect *External I/O* programming is provided in for backward compatibility with these older systems. The *External I/O* programming shown to the right associates the *Offset / Plan* inputs with the NTCIP pattern provided in the pattern table.

Pat#	Offset	Plan	Pat#	Offset	Plan
1	1	1	2	1	1
3	1	1	4	1	1
5	1	1	6	1	1
7	1	1	8	1	1

6.11 Pattern+ (MM->2->3)

The Pattern Plus screen allows the user modify/Inhibit the Yield Points (YI) as well as create ring offset times (**R1 R2, ….R8)** for users that are coordinating multiple independent rings.

Pat	YI	R1	R2	R3	R4	R5	R6	R7	R8>
1	.	0	0	0	0	0	0	0	0
2	.	0	0	0	0	0	0	0	0
3	.	0	0	0	0	0	0	0	0
4	.	0	0	0	0	0	0	0	0
5	.	0	0	0	0	0	0	0	0
6	.	0	0	0	0	0	0	0	0
7	.	0	0	0	0	0	0	0	0
8	.	0	0	0	0	0	0	0	0
9	.	0	0	0	0	0	0	0	0
10	.	0	0	0	0	0	0	0	0
11	.	0	0	0	0	0	0	0	0
12+	.	0	0	0	0	0	0	0	0

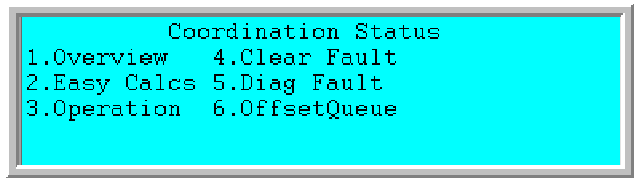
<Pat	OlpInh 1-32			
1	....	....	....	....
2	....	....	....	....
3	....	....	....	....
4	....	....	....	....
5	....	....	....	....
6	....	....	....	....
7	....	....	....	....
8	....	....	....	....
9	....	....	....	....
10	....	....	....	....
11	....	....	....	....
12+	....	....	....	....

The right menu of *Patterns +* allows overlaps 1-32 to be individually enabled or disabled by pattern. One application of this feature is to convert a protected/permitted left-turn signal to protected-only through a pattern that disables an overlap driving the permissive indications. ***Please note overlap Types PED1 and FASTFL do not get turned off by time of day.***

Note further that when an overlap is disabled by time of day, it stays disabled; the overlap won't turn on. For example, if a preemption comes up that allows the overlap to be run, the user should **not** expect the overlap to operate.

6.12 Coordination Status Displays (MM->2->8)

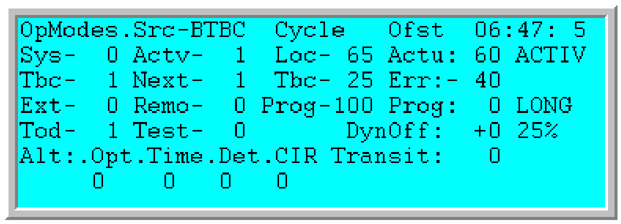
The *Coordination Status Displays*:



- Show the current state of the *Coordination Module* and it's various *Operation Modes* (the active pattern and it's source along with the timers that relate to the active pattern)
- List the internal force-off and yield points driving the active pattern (Easy Calcs).
- List the dynamic operation of the pattern including remaining split times including the phases being called and inhibited.
- Display phases that were skipped if the active pattern fails and allow the user to clear the fault
- Diagnose the *Next* pattern to isolate faults before they occur.

6.12.1 Coordination Overview Status Screen (MM->2->8->1)

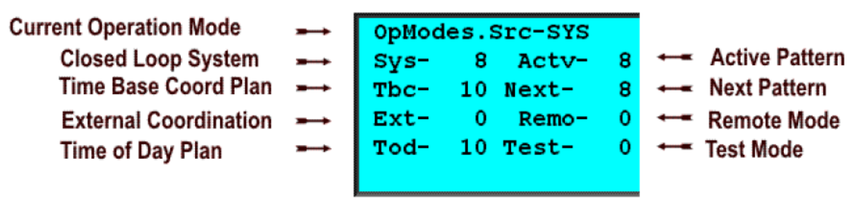
The *Coordination Overview Status Screen* is grouped into the following three distinct areas. These three areas are combined on one status display to avoid changing menus to display the current status of the coordinator:



- The current *Operation Modes* and source (*Src*) of the *Active* pattern
- The real-time status of the *Active* pattern and offset synchronization
- Alternate phase times and options, detector group and Call/Inhibit/Redirects assigned to the *Active* pattern (bottom line of the *Coordination Overview Status Screen* above)

Operational Modes and Active Pattern

The left-hand area of the *Coordination Overview Status Screen* provides the current p*attern #* generated by each of the Coordination Modes and the, *Next* p*attern #* and the *Active pattern #* in effect.



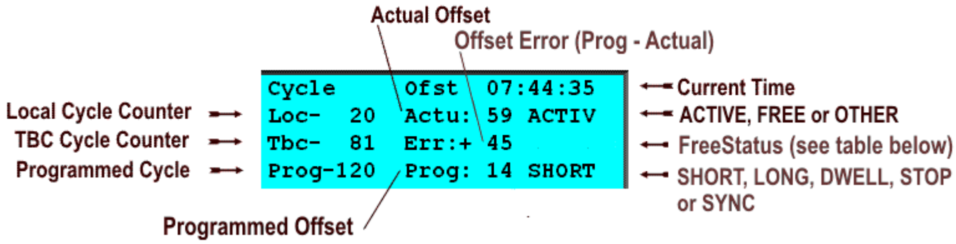
The controller may receive a pattern change from any of the *Coordination Modes* discussed in this chapter. These modes generate the *Source (Src)* of the *Active* pattern based on the following hierarchy of control:

- *Test* patterns have the highest priority and can only be overridden by modifying the *Test OpMode* value in the database (see **MM->2->1**)
- *Remote (Remo)* patterns downloaded from ATMS.now have the next highest level of priority.
- *System (Sys)* generated patterns downloaded from a closed loop master becomes active if the *Closed Loop* parameter in *Coordination Modes+* is ON (see **MM->2->1**).
- *External (Ext)* generated patterns are selected using D-connector plan/offset inputs rather than data communication to a central based or master based system
- *TBC* generated patterns are selected by any manual override of the Time Base Scheduler, see chapter 7. (*TBC* is usually in stand-by and therefore defaults to the current *Tod* pattern from the *Time Base Scheduler*)
- *Tod* generated patterns are selected by the *Time Base Scheduler*.

During a pattern change, the *Next* pattern becomes *Active* when the *Local (Loc)* cycle counter reaches zero. This assures a smooth transition between pattern changes that may affect active cycle, splits, offsets or sequence.

Active Pattern Real-time Status

The right-hand area of the *Coordination Overview Status Screen* provides the status of the *Active* pattern and the cycle counters related to offset synchronization.



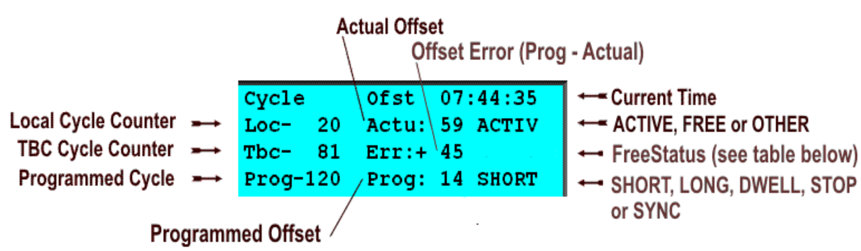
Coordination may be ACTIVE, FREE or OTHER as indicated in the right corner of this display. ACTIVE implies that coordination is active and that the *Cycle* and *Offset* values displayed and all *Easy Calcs* are in effect. FREE implies that coordination is not active and that cycle length, offset and *Easy Calcs* are ignored. OTHER is displayed when coordination is ACTIVE and a valid preempt call is received.

FreeStatus is defined in NTCIP 1210, section 2.5.11 and is summarized in the table below:

FreeStatus Display	Definition
<blank>	Coordinator is not running free (Coordination is active)
COMND	a) The current pattern (0, 254 or 255) is calling for FREE operation b) The current pattern (1-48) is calling for FREE (Cycle = 0)
PATRN	The controller is running FREE under Pattern 0
PlnER	a) the pattern called is invalid (48 < pat# < 254 is not valid) b) the sum of the splits in a ring does not equal the cycle length c) the splits in one ring do not cross a barrier with another ring d) no coord phase or two coord phases assigned to the same ring e) coord phase are in separate rings, but are not concurrent
CycER	Cycle length is less than 30”
SplER	a) Split time is not sufficient to service minimum phase times b) Split time is zero for an enabled phase
OftER	The offset is greater than or equal to the Cycle length
FAIL	Coordination failure - a valid vehicle or ped call has not been serviced for 3 consecutive cycles
OTHER	a) A railroad or light rail preemption input has been activated b) MCE (Manual Control Enable) has been activated
INPUT	The external FREE input has been activated and the FREE pattern is Active
TRANS	Diamond operation is in transition

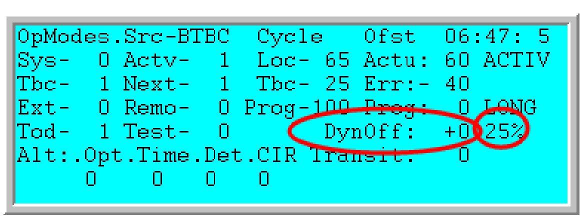
Tbc and Local Cycle Counters

The *Tbc* cycle counter for the *Active pattern* is a midnight time reference. Imagine that the *Tbc* counter is set to zero at midnight (00:00:00) and allowed to count up to the active *Cycle* length over and over again until the current time (now) is displayed on this screen. Every time the *Tbc* counter rolls over to zero, you have a sync point for the *Active pattern* that synchronizes the system *Time Base* at midnight.



The *Programmed Offset* is added to the zero point of the Tbc counter to provide the “synch” point for the coord phase (either BegGRN or EndGRN) at Loc = 0. *Time Base Coordination* provides a way to synchronize the coord phases of all the controllers in a system running a common cycle length because the Tbc counter in each controller shares the same *Time Base* (midnight) reference. The controller is in SYNCH when the *Coord Phase* (*Loc* = 0) is lined up with *the Programmed Offset* applied to the *Tbc* counter.

In addition the Dynamic Offset and Shortway Transition percentage is displayed as shown below:

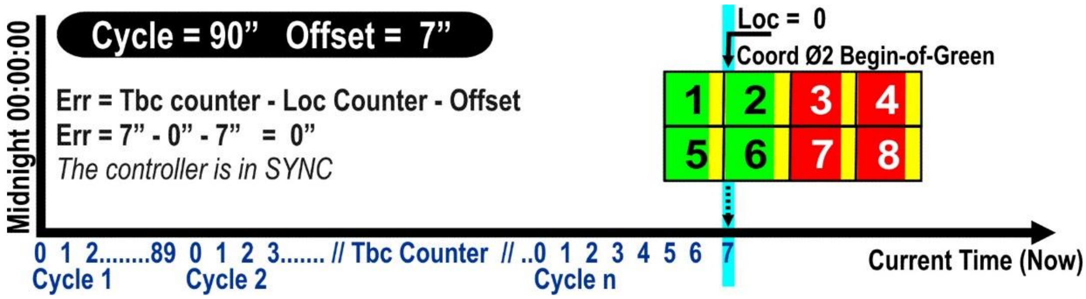


Understanding Offset Errors and SHORT, LONG, SYNC and STOP

The controller is in SYNC when the *Error (Err)* display above is zero. If the controller is not in SYNC, it is in transition (SHORT, LONG or DWELL), or the Local counter is has stopped because pedestrian service has just overrun a force-off applying STOP-IN-WALK. The *Error (Err)* display shows how far the *Local* counter is "out of step" with the *Programmed Offset* and *Tbc* counter and is calculated as:

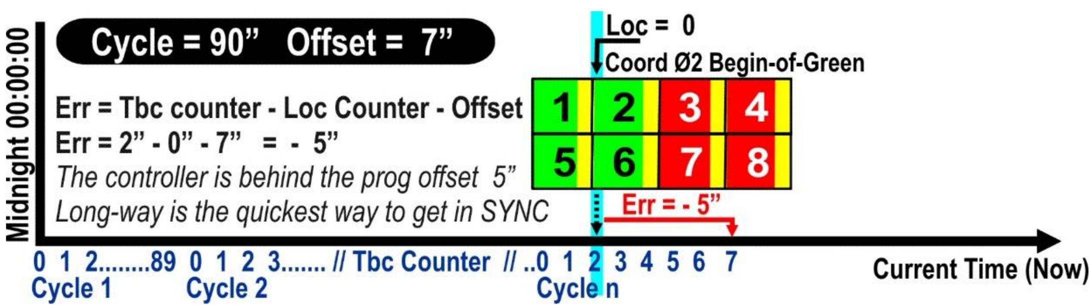
Err = Tbc counter – Loc counter - Programmed Offset

The controller applies short-way, long-way or dwell transition to bring the Local counter (beginning or end of the coord phase green) into sync with the *Programmed Offset.* When the *Programmed Offset* is zero and the controller is in SYNC (Err = 0), the *Loc* counter and *Tbc* counter are equal. In summary, *Loc=0* is referenced to either the beginning or end of coord phase green (controller offset reference). This point in the cycle need to line up with the current offset relative to the system time reference (*Tbc* counter plus the *Prog* offset) to insure synchronization across the network.



The Controller is in SYNC When the Local Zero Counter (Loc = 0) is Aligned With the Programmed Offset

The above illustration shows the Tbc counter referenced to midnight for a 90" *Cycle* with a 7" *Programmed Offset*. The controller is in SYNC because *Local 0* is aligned with the *Programmed Offset* and the offset reference of coord phase 2 is begin-of-green.



LONG-way Transition Moves the Offset "Forward in Time" by <u>Increasing Split Times</u> the Long-way%

In the above case, the synch point (*Local 0*) begins 5" before the *Programmed Offset* of 7*"*. Five seconds is only 6% of the current 90" cycle, so if at least 6% *Long-way* transition is programmed (**MM->2->5**), the controller can easily correct *Local 0* to the current offset within one cycle. The controller accomplishes this transition by running the *Local* cycle counter "slow" by the *Long-way%* specified during the transition. This avoids recalculating the *Easy Calcs* and also insures that the programmed phase times (min greens, clearances, etc.) are all timed correctly. The user should understand that during *Long-way*, each *Split Time* is lengthened by the *Long-way%* value programmed for the pattern.

SHORT-way Transition Moves the Offset "Back in Time" by <u>Decreasing Split Times</u> the Short-way%

In the example above, the synch point (*Local 0*) is ahead of the *Programmed Offset* by 5". If SHORT/LONG is selected under *Coord Modes* (**MM->2->1**) and at least 6% *Short-way* is programmed for this pattern, the controller will shorten the *Split Times* by the *Short-way%* value programmed under **MM->2->5**. During *Short-way* transition, the reduced *Split Times* must be adequate to service the minimum phase times or else the controller diagnostic will fail and the controller will be placed into free operation. *Short-way* is very effective with the *Stop-In-Walk* feature and allows the controller to transition quickly when an occasional pedestrian service extends a phase past its force-off.

6.12.2 Easy Calcs Status Screen (MM->2->8->2)

Easy Calcs show the current force-offs and yield calculations for the active pattern under FIXED, FLOAT or one of the OTHER coordination modes. *Easy Calcs* are identical for the FIXED and FLOAT modes except that "*FloatMx"* is used to limit each non-coordinated phase to its programmed split and move any "slack time" to the coordinated phase. Most users find these default *Easy Calc* calculations acceptable for their application and do not have to review these values with every pattern change. **Keep in mind that whenever the user changes any coordination parameter that the Easy Calcs may be affected.**

```
Easy <> P..1...2...3...4...5...6...7...8
PrimFrc    65   0  20  45  65   0  20  45
SecdFrc    65   0  20  45  65   0  20  45
Veh Yld     0  10   0   0   0  10   0   0
VehAply    56  91  11  36  56  91  11  36
Ped Yld     0  10   0   0   0  10   0   0
PedAply    65  91  20  36  65  91  20  36
FloatMx    15  30  15  20  15  30  15  20
PedLeav    65  90  20  35  65  90  20  35
PedCall    60  85  15  30  60  85  15  30
SpltRem     0   0   0   0   0   0   0   0
```

Primary Force-Off

The Primary Force-Off is the point in the local cycle that a force-off is applied to a phase causing that phase to terminate and begin timing yellow clearance. A Primary Force-off will remain applied until the phase terminates.

Secondary Force-Off

The Secondary Force-Off is a momentary force-off applied prior to the Primary Force-off. Secondary Force-offs are useful when conditionally servicing phases or when a phase is to be forced off twice per cycle. The Secondary Force-off normally default to the value of Primary Force-off. **NOTE: This feature is not used in NTCIP Coordination.**

Vehicle Yield

The Vehicle Yield is that point in the cycle that a vehicle call on a phase will be serviced, i.e. that the phase's inhibit is removed. Note that the phase inhibit is automatically applied by the controller at a calculated time in advance of the primary force-off.

Vehicle Apply

The Vehicle Apply point defines the point in the cycle when the phase inhibit is applied. A phase may begin anytime between the Vehicle Yield point and the Vehicle Apply point. The Vehicle Apply point (VehAply) for each phase is calculated as:

Vehicle Apply Point (VehAply) = Primary Force-off – ((Max Yellow + All Red) + Minimum Green)

The yield point must be earlier than the automatic application point for the phase to be serviced. If short-cycle offset correction is enabled, the yield point must be earlier still to allow for the effective reduction in split time that occurs when the local cycle timer corrects by running fast.

Pedestrian Yield

The Pedestrian Yield is that point in the cycle that a pedestrian call on a phase will be serviced, i.e. that the phases pedestrian inhibit is removed. The phase inhibit is automatically applied by the controller at a calculated time in advance of the primary force-off.

Ped Apply

The Ped Apply point defines the point in the cycle when the pedestrian phase inhibit is applied. A pedestrian phase may begin anytime between the Ped Yield point and the Ped Apply point. The PedApply point for each pedestrian phase is calculated as:

Ped Apply Point (PedAply) = Primary Force-off – ((Max Yellow + All Red) + Pedestrian Clear)

The same considerations described above for selecting vehicle yield points apply to determining pedestrian yield points except when the STOP-IN-WALK is enabled. Refer to the explanation of Stop-In-Walk.

FloatMx

Floating max time (*FloatMx*) is equal to the green portion of the split needed to terminate the phase prior to the force-off if the time allocated to the phase exceeds programmed split time. This is used as the max green time with floating force-offs.

PedLeav

The Pedestrian Leave Point is used when Rest-In-Walk is active. This is the point in time when the Pedestrian Clearance begins after the phase has been resting in walk.

PedCall

Ped Call displays the last time a call can be placed in the cycle so a pedestrian can be serviced in that cycle. Ped Call is only used when MinP is active, otherwise Ped Call = Ped Apply. The Ped Call point for each pedestrian phase is calculated as:

PedCall = Ped Apply - Max (red+yellow)

SplitRem

This is the remaining time in the split before the next cycle begins.

6.12.3 Coord Operation Status (MM-2-8-3)

This screen displays the operational status of the coordination pattern that is currently running.

```
18:56:48   TBC:  8  LOC: 29         LONG

        P..1...2...3...4...5...6...7..8>
SplTRem    0   0   0 102   0   0   0  86
PhCall     0   0   0   0   0   0   0   0
PhInh      0  15   0   0  15   0  15   0
```

6.13 Free Patterns and Multiple Maximum Greens

Patterns 1-48 can be activated as either *Coord Patterns* or *Free Patterns*. A *Free Pattern* can be created using a zero second cycle length to use any of the coord features listed in this chapter. The most consistent way to program a Free pattern is follow the following steps.

1) Under **MM->2->4** (Patterns), choose an unused pattern and program a zero second cycle length, zero second offset and an unused split table number.
2) Under **MM->2->7** (Split Table), go to the unused split table that you chose under step 1, and program each phase's split time with the max green that you want to use for that phase. These green times will be used under Free operation. In this way a user can run multiple maxes.
3) **DO NOT** program a coord phase in the split table. You can optionally program the phase modes at your discretion.

6.14 Coord Diagnostics

This section documents why coord patterns fail and how to use Coord Diagnostics to isolate problems in a pattern. The *Coord Diagnostics* check patterns before they become Active to insure that phases do not skip or run past their intended force-off point under traffic conditions. Coord Diagnostics check to make sure that the sum of the splits in each ring equals the programmed cycle length and that the phases in each ring cross the barrier at the same point in the cycle. When a *Coord Diagnostic* fails, the controller provides text messages to allow you to isolate the problem with the programmed cycle, offset, split or sequence that has failed the diagnostic.

Note: When considering coordination, using the STD8 phase mode will take advantage of the most coordination diagnostic checks to catch common data entry mistakes, and if detected, times the intersection in FREE. In USER mode, most of these coordination diagnostics are removed, and the onus is on the agency verify and test the programming to ensure that coordination pattern(s) run as expected.

6.14.1 Why Coord Patterns Fail

NEMA requires that the controller monitor vehicle and pedestrian calls during coordination and detect phases that are skipped. If a vehicle or pedestrian call is not serviced for more than two consecutive cycles, the controller fails the pattern and runs FREE. NEMA also requires that split times are adequate to service the minimum phase times. When coordination fails and the controller goes to FREE, the FreeStatus display is set to one of the following values. *FreeStatus* was defined in the section on the *Coordination Status Display*:

FreeStatus Display	Status During Coordination or During a Coord Fail
<blank>	Coordinator is not running free (Coordination is active)
PlnER	a) the pattern called is invalid (48 < pat# < 254 is not valid in version 80) b) the sum of the splits in a ring does not equal the cycle length c) the splits in one ring do not cross a barrier with another ring d) no coord phase or two coord phases assigned to the same ring e) coord phase are in separate rings, but are not concurrent
CycER	Cycle length is less than 30”
SplER	a) Split time is not sufficient to service minimum phase times b) Split time is zero for an enabled phase
OftER	The offset is greater than or equal to the Cycle length
FAIL	Coordination failure - a valid vehicle or ped call has not been serviced for 3 consecutive cycles. Coord diagnostics insure that this failure does not occur in STD8 operation with FIXED and FLOAT force-off methods. However, USER mode operation and OTHER modes of coordination do not perform the same diagnostic checks and it is quite possible to skip a phase if force-off and yield points are not specified correctly.

6.14.2 Coordination Clear Fault Status Display (MM->2->8->4)

```
Coord Fault     P 1.......   9.......  >
       Skipped Ps --------   --------
       Pattern #    0
Press ENTR to Clear Fault
```

The *Clear Fault Status Display* records any phase skipped for more than two consecutive cycles and the pattern number in effect at the time coordination failed.

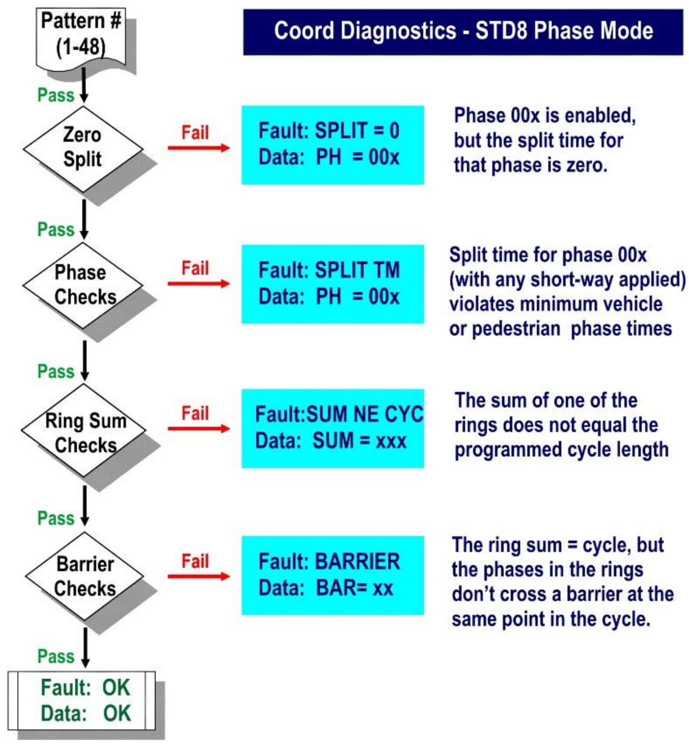
The *Coord Fault* can be cleared from this screen to reset coordination; however, the proper way to recover from coord failure is to run the *Coord Diagnostics* discussed in the next section because resetting the failure does not fix the problem. A *Coord Fault* will also be cleared when a new *Tod* pattern is called by the *Time Base Scheduler* if *Auto Err Reset* is set ON (see *Coordination Modes+*, **MM->2->1**, right menu).

6.14.3 Coordination Diagnostic Status Display (MM->2->8->5)

```
    Coordination Diagnostic Status
Cycle 100   Pattrn   1  Fault: OK
Offst  50   Source TEST Data :OK
Coord   1 FreeStat CoorActv
```

The *Coord Diagnostic* was designed to isolate coordination errors and identify the cause of the failure. All patterns should be checked with *diagnostic* or from ATMS.now utilities that emulate these diagnostics. This will help you eliminate pattern errors before they are placed in operation under traffic.

The *Coord Diagnostic* displays the active *Pattern #* and the *Cycle* length and *Offset* programmed in the *Pattern Table* (**MM->2->4**). The *Coord* status may be FREE (0), ACTIV (1) or OTHER (2) and corresponds with the coord status screen described in the Coordination Status Display section above.



The *Coord Diagnostic* is typically used in conjunction with the *Test* mode to test coord patterns before placing them in service. The controller must be manually forced into each pattern under TEST (**MM->2->1**) and then checked with **MM->2->8->5** to insure that the Fault: and Data: fields in the above menu display OK.

ATMS.now provides coord diagnostics that emulate the coord diagnostics in the controller and allows you to test patterns without downloading the database to the controller. The same rules used in the controller are applied in the ATMS.now diagnostics because the controller's diagnostics are the final checks on the pattern and determine if the coord plan passes (CoordActv) or fails (Failed).

During a pattern change, the new pattern # becomes the *Next* pattern in menu **MM->7->2** and does not become the *Active* pattern until the *Local* counter of the current *Active* pattern reaches zero. The *Coordination Diagnostics* status display above shows the current *Active* pattern and a full cycle may elapse before a TEST pattern becomes Active. However, the *Coord Diagnostics* are run immediately on the *Next* pattern entered under **MM->2->**1, so it is not necessary to wait until the TEST pattern becomes *Active* in this display to check the Fault: and Data: fields for errors.

The *Coord Diagnostic* will stop on the first error encountered with the TEST pattern. Therefore, if a problem is isolated and corrected, the *Coord Diagnostics* must be checked again for additional errors. When the Fault: and Data: fields each display OK, the pattern has been fully tested and can be placed into service.

Diagnostic Check	STD8	QSeq	8Seq	USER	DIAMOND
Zero Split Check	■	■	■	■	■
Phase Checks	■	■	■	■	■
Ring Sum Checks	■	■	■		
Barrier Checks	■	■	**N/A**		

Coord Diagnostic - Phase Time Checks

The *Coord Diagnostics* perform extensive checks to insure that each *Split Time* is long enough to service the minimum phase times of each phase. This insures that a force-off is not issued to a phase while it is servicing a minimum phase time. The diagnostics take into account the following to insure minimum phase times are guaranteed for each split.

1) **Short-way Offset Correction**
   The programmed split time for each phase is reduced by the amount of short-way programmed for the pattern under **MM->2->5**. This insures that the minimum phase times are satisfied during short-way transition when the split times are reduced to align the coord phase with the programmed offset. You can easily calculate the split adjustment performed by the *Coord Diagnostic* as follows:

   Short-way Split = Split * (100 – Shortway%) / 100

   This adjustment is not made if the phase is assigned as a *No Short Phase* under **MM->2->5**. Split times for "*No Short Phases*" are not reduced by short-way transition.

2) **Minimum Phase Times**
   There are actually two minimum phase times checked by the Coord Diagnostic. Note that these minimums times are checked using the current phase times and options associated with the coord pattern. If any alternate phase times or phase options are associated with the pattern, the alternate values will be used to perform these checks.

   a) Vehicle Min Phase Time - This minimum is calculated by taking the greater of the "Min Green" or "Max Initial" and adding the "Yellow Clearance" and "All-Red" time of each phase.

   Veh Min = Min Green + Yellow + All-Red

   or if volume density is used,

   Veh Min = Max Initial + Yellow + All-Red

   b) Pedestrian Min Phase Time - If STOP-IN-WALK is OFF (**MM->2->1**), then the coord diagnostic will also insure the split times are long enough to service all pedestrian times. Setting STOP-IN-WALK to ON allows an occasional pedestrian call to violate the programmed split. The pedestrian times will always be guaranteed if "Rest-in-Walk" is enabled, even if the STOP-IN-WALK parameter is ON.

   If *PedClr-Thru-Yellow* is not enabled for the phase, the pedestrian min phase time is:

   Ped Min = Walk + Ped Clearance + Yellow + All-Red

   If *PedClr Thru Yellow* is enabled, the pedestrian and vehicle clearances time together and the ped min is:

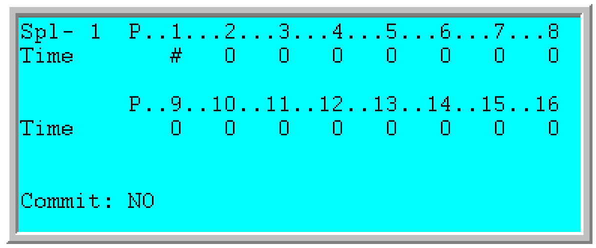
   Ped Min = Walk + Ped Clearance + All-Red

6.14.4 OffsetQueue (MM->2->8->6)

This screen is used to assist the user in monitoring transition and offset timing.

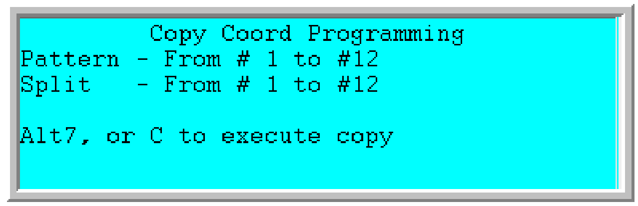
```
07:34:22  Pat:  1 Tran:LONG  OffAdj:  +0
          Loc: 71            OffErr:  -9
Timer  Adj Pat      Timer  Adj Pat
   --   --  --         --   --  --
   --   --  --         --   --  --
   --   --  --         --   --  --
   --   --  --         --   --  --
   --   --  --         --   --  --
```

6.14.5 Split Edit (MM->2->9->1)



The Split Edit screen allows the user to specifically edit split times for splits 1-24. Users can use this screen to modify the splits of the phases while the controller is currently running a coordination pattern. It is helpful when users take too long in modifying (editing) the split, and the controller begins to make the editing changes to the database, thus generating a coordination failure. Programming this screen allows all changes to be made without modifying the current running pattern until the users commit to it.

6.14.6 CopySplit/Pat (MM->2->9->4)



This screen allows the user to copy Pattern and Split table information to simplify and speed up programming via the keyboard.

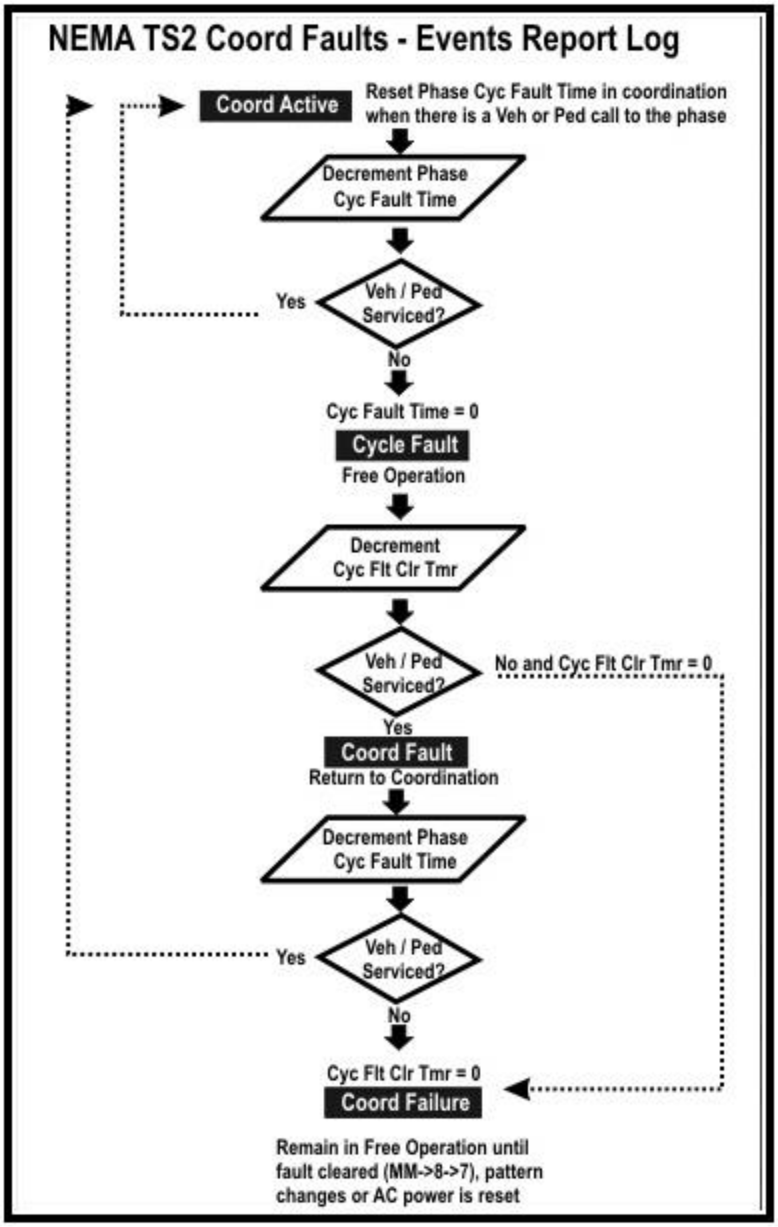
6.15 Coordination Alarm Considerations

There are specific alarms that assist the user when programming coordination. They are listed below.

Alarm #	Alarm Name	Description
4	Coordination Failure	This alarm indicates that coordination is failed. There are two ways in which coordination may fail: 1) The TS2 method in which two cycle faults have occurred during coordination, but not when coordination is inactive. 2) A serviceable call has not be serviced in 3 cycles. This is the traditional method, which predates the NEMA TS2 method.
9	Closed Loop Disabled	This alarm, when active, indicates that the Closed-loop Enable parameter is set to OFF.
13	Coordination Free Switch Input	Alarm active when System/Free Switch is FREE
17	Cycle Fault	TS2 Alarm. It indicates that a serviceable call has not been serviced in approximately two cycle times and coordination was active at the time. If the controller is operating in free mode, a Cycle Fault alarm is also logged at the same time as a Cycle Failure alarm.
18	Cycle Failure	TS2 Alarm. It indicates that a serviceable call has not been serviced in approximately two cycle times and that coordination was not active at the time.
19	Coordination Fault	Indicates that a cycle fault occurred during coordination.
30	Pattern Error / Coord Diagnostic Fault	Active when coord diagnostic has failed.
38	Pattern Change	Coordination Pattern changes are logged to the event and alarm buffers using this alarm number. The data byte stores the new pattern number.
47	Coord Active	Set when coordination is active (not free)
60	Coordination Failure	Alarm is ON when Coordination has failed
61	Coordination in (Sync) Transition	Alarm is ON when coord is active and in transition for times over 3 seconds. Alarm is OFF when coord is active and in SYNC.

6.15.1 Algorithmic details of various coordination alarms

In particular, Cycle Fault (Alarm #17) and Cycle Failure (Alarm # 18) alarms may occur if the user does not program the coordination parameters correctly. Prior to declaring a specific coordination alarm, the controller software will run as per the following flowchart.



1) The controller software will first establish the amount of time that must expire without a phase being serviced in order to declare a fault ("cycle fault time"). That amount of time is dependent upon a few settings – the phase mode (STD8, USER, etc), whether the controller is in free or coord, and whether or not the user entered a max cycle time in the unit parameters.

Phase Mode	Coord State	Max Cycle Time	Cycle Fault Time
STD8/QSEQ/DIA	Free	0	calculated from maxes
STD8/QSEQ/DIA	Free	>30	user settable time (MM-1-2-1)
STD8/QSEQ/DIA	Coord	n/a	3 x pattern cycle
USER	Free	0	420"
USER	Free	>60	user settable time (MM-1-2-1)
USER	Coord	n/a	3 x pattern cycle

2) Secondly, the controller monitors the phases to see if any phase, that had demand, was not serviced for the cycle fault time. If a fault occurs, the action is based upon user settings as follows:

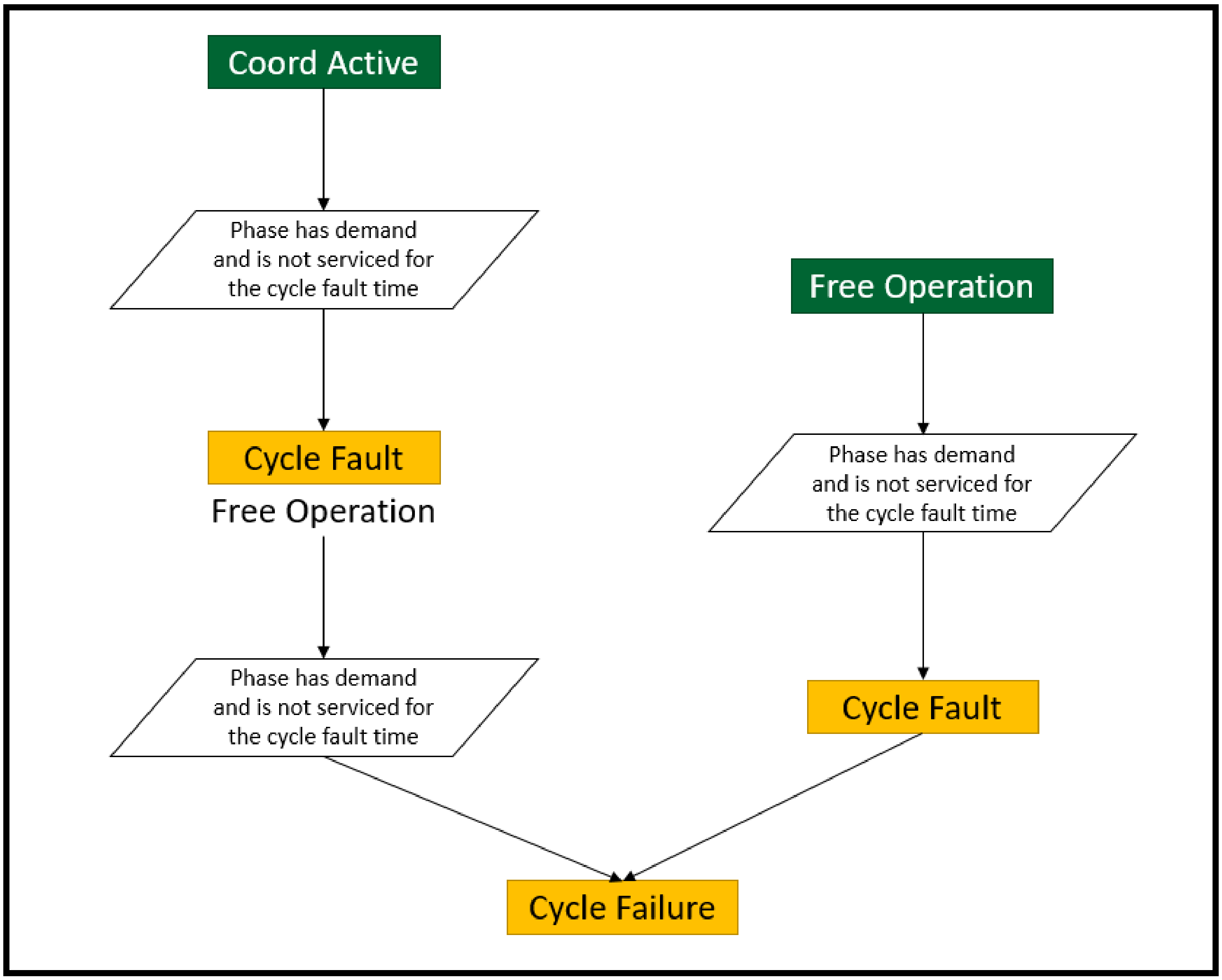
a) In all cases a "***cycle fault***" is declared.

b) If the controller is running free then a "***cycle failure***" occurs

c) If the controller is running coordination then a "***coord cycle fault***" will occurs on the first occurrence of a cycle fault.

d) Once a fault occurs while running coordination, if the fault clears but occurs again before 4x the cycle fault time, then a "***coord cycle fail***" will occur, and the controller will latch in a free state.

e) Once a fault occurs for any reason or any amount of times, a timer is set to the cycle fault time. If the timer expires before the fault is cleared, then a "***cycle failure***" will occur. (The user can cause the controller to go to flash in this case). Although the algorithm is programmed for this event, **THIS SHOULD NEVER HAPPEN.**



In particular, below are further details on how the software relates to the coordination alarms.

Alarm #17 Cycle Fault
Any time a cycle fault occurs during coordination (a phase is not service for the fault timer amount of time) for any reason, the Cycle Fault is alarm is set. If it occurs during coordination or preemption the data element of the event will tell you if it was caused during coordination or preempt. If it was during preemption, the data will also tell you which preemption interval. A cycle fault is like a "first time forgiven" skipped phase.

Alarm #18 Cycle Failure
Any time a cycle fault occurs during free operation, a Cycle Failure alarm occurs. Anytime during coordination that a cycle fault occurred and did not clear for the "***cycle fault clear time***", a Cycle Failure occurs. Another way to view the Cycle Failure alarm is a way for the software to indicate an issue with the cycle. This failure occurred because it happened during free and/or the coord/preempt fault did not clear itself when the controller went free. A Cycle Failure is a critical coordination alarm that should normally not occur.

Alarm #19 Coord Cycle Fault
Any time a cycle fault occurs during coordination, the Coord Cycle Fault alarm is set.

Alarm #4 Coord Cycle Failure

Any time a cycle fault occurs a second time **BEFORE** the "***cycle fault clear time***" expires after the prior cycle fault, a Coord Cycle Failure alarm is set. If you enable this alarm, then the failure is latched, and the controller will stay free until the fault is cleared. If you do not enable this alarm, then the failure is not latched, and the controller will run coordination once the fault is cleared.

The following programming parameters should be considered:

Auto Err Reset (MM->2->1)

If the auto error reset feature is enabled in the coordination Mode parameters, then this will allow a new pattern to clear a cycle fault that was latched.

Max Cycle Tm (MM-1-2-1)

Maximum-Cycle-Time is a manual override value used to check that the controller is cycling properly. If no value is entered, the controller will calculate a value based on the controller phase and coordination programming as shown in the section above.

Cycle Failure Action (MM-1-2-1)

As explained above, a cycle failure is considered a critical problem, because it means that a phase was skipped in free or that once coordination went free, the phase that was skipped never ran. The controller gives you the option to report it as an alarm, and keep running – or, send the cabinet into flash.

For emphasis, this should simply never happen. The controller software is **NOT DESIGNED TO SKIP PHASES.** For this reason, the user can send the controller to flash when this does occur.

6.15.2 Alarm 17: Cycle Fault

Fault #	Fault Description
0	Other cycle fault
1	Non-preempt cycle fault (not servicing phases)
2	Preempt cycle fault (timed out while seeking **track** phases)
3	Preempt cycle fault (timed out while seeking **dwell** phases)
4	4 Preempt cycle fault (timed out while seeking **return/end of preempt**)

6.15.3 Alarm 30: Pattern Error Faults

Fault #	Fault Description
0	No Error
1	In diamond mode, sum of major phases (splits) adds to zero
2	In diamond mode, sum of splits did not equal cycle length
3	Sum of splits exceeded max cycle length (max length currently 999 in ATC/2070, 255 in 980/v65 or older)
4	Invalid split number called out in pattern
5	Ring 1 / 2 sum of splits not equal (when applicable)
6	Split time is shorter than sum of min time for a phase
7	Coordinated phases are not compatible
8	No coordinated phase assigned
9	More than one coord phase was designated for a single ring
10	Undefined
11	Fastway/Shortway transition time greater than 25% (out of range)
12	Undefined
13	Stop-time active
14	Manual-control active
15	Error in cycle length when calculating reference point (Cycle time is greater than calculated coord max cycle length)
16	In diamond mode, error in phase split value (typically phase 12)
17	Active split had a zero split value programmed

6.16 Coord+ Other Modes (MM-2->7->2)

6.16.1 Perm,Frc

Primary Force-Off

The *Primary Force-Off* is the point in the local cycle that a force-off is applied to a phase causing that phase to terminate and begin timing yellow clearance. A *Primary Force-off* will remain applied until the phase terminates. It is up to the user to insure that *Primary Force-Offs* are applied after the minimum phase times of each phase.

The coordination diagnostics does not check minimum phase when force-offs are programmed directly like the FIXED and FLOAT coordination methods. **Therefore, it is possible to program force-offs incorrectly and skip phases**. Care must be taken to insure that each force-off needs to accommodate the split times including any pedestrians that are programmed. If the phase is skipped for three cycles in a row, the coordinator will fail the pattern. Coord diagnostics provided with FIXED and FLOAT detect these errors before the pattern is run and place the controller in a FREE fail condition.

```
Spl- 1 En<.1...2...3...4...5...6...7..8>
HoldToMax   .   .   .   .   .   .   .   .
PriFrc .    0   0   0   0   0   0   0   0
VApply .    0   0   0   0   0   0   0   0
VehYld .    0   0   0   0   0   0   0   0
PApply .    0   0   0   0   0   0   0   0
PedYld .    0   0   0   0   0   0   0   0
      Beg   End     1234567890123456
Perm1   0     0     ................
Perm2   0     0     ................
Perm3   0     0     ................
```

```
      Beg   End     7890123456789012
Perm1   0     0     ................
Perm2   0     0     ................
Perm3   0     0     ................
FrcAll  0
PedRcy  0
```

HoldToMax

This parameter will force a phase to be held to its programmed maximum time or the calculated force off if it has a call. This is used for side road phases to insure that when there is a call, they stay on and are not subject to gapping out.

VApply

This parameter allows the user to modify the vehicle apply point for each phase. Please take under consideration when modifying each phases apply point.

The Vehicle Apply point (VehAply) for each phase is typically calculated as:

Vehicle Apply Point (VehAply) = Primary Force-off – ((Max Yellow + All Red) + Minimum Green)

The yield point must be earlier than the automatic application point for the phase to be serviced. If short-cycle offset correction is enabled, the yield point must be earlier still to allow for the effective reduction in split time that occurs when the local cycle timer corrects by running fast.

VehYld

The *Vehicle Yield* is that point in the cycle that a vehicle call on a phase will be serviced, i.e. that the phase's inhibit is removed. Note that the phase inhibit is automatically applied by the controller at a calculated time in advance of the primary force-off. The *Vehicle Apply* point (*VehApply* value under *Easy Calcs*) is calculated as:

Vehicle Apply Point (VehAply) = Primary Force-off – ((Max Yellow+All Red) + Minimum Green)

The yield point must be earlier than the automatic application point for the phase to be serviced. If short-cycle offset correction is enabled, the yield point must be earlier still to allow for the effective reduction in split time that occurs when the local cycle timer corrects by running fast.

PApply

This parameter allows the user to modify the pedestrian apply point for each phase. Please take under consideration when modifying each phases apply point.

The PedApply point for each pedestrian phase is calculated as:

Ped Apply Point (PedAply) = Primary Force-off – ((Max Yellow + All Red) + Pedestrian Clear + Walk)

The same considerations described above for selecting vehicle yield points apply to determining pedestrian yield points except when the STOP-IN-WALK is enabled. Refer to the explanation of Stop-In-Walk.

Pedestrian Yield

The *Pedestrian Yield* is that point in the cycle that a pedestrian call on a phase will be serviced, i.e. that the phases pedestrian inhibit is removed. The phase inhibit is automatically applied by the controller at a calculated time in advance of the primary force-off per the *PedApply* point which is calculated as:

Ped Apply Point (PedAply) = Primary Force-off – ((Max Yellow + All Red) + Pedestrian Clear + Walk)

The same considerations described above for selecting vehicle yield points apply to determining pedestrian yield points except when the STOP-IN-WALK is enabled. Refer to the explanation of Stop-In-Walk.

Permissives

The Permissive method allows you to specify up to three permissive “windows of opportunity” to service the yield phases programmed in the *Split Plus Features.* Programming these periods where you allow phases these windows can assist the user in complicated intersections.

FrcAll

This is an entry which allows selection of a point along the coordinated cycle that will cause a force-off on any phase which is green. Tis is programmed in seconds from 0-255.

```
       Beg  End     7890123456789012
Perm1   0    10     ................
Perm2   0     0     ................
Perm3   0     0     ................
FrcAll 40
PedRcy 30
```

PedRcy

This entry activated when timing the permissive mode in seconds as the point along the coordinated cycle when the coordinated phase(s) recycles to walk

6.16.2 Easy

This mode activates the EASY programming coordination mode as specified by the State of Texas. EASY mode must be used when the agency uses standard Cubic | Trafficware Diamond coordination.

This mode uses the standard Split table (**MM->2->7-1**) to program the Easy Split entries and Coordinated Phases. It also causes the internal coordination firmware to begin an automatic calculation of permissive periods and force-offs.

The *Easy Coordination Mode* has two variations depending if *Easy Float* under *Coordination Modes+* (**MM->2->1**) is set ON or OFF. This mode with *Easy Float* OFF is very similar to the NTCIP FIXED force-off method discussed in the last section. *Easy Mode* with *Easy Float* ON is very similar to the NTCIP FLOAT method.

The differences between the NTCIP modes and the *Easy Mode* of coordination are as follows:

- The offset is always referenced to ***Begin-of-Green*** of the *Coordinated Phase* (the NTCIP offset reference under **MM->2->5**, right menu, does not apply in *Easy Mode*)
- Yield points are more constrained. That is, the “windows of opportunity” to service the non-coordinated phases are opened later in the cycle than the NTCIP methods which yield to the non-coordinated phases when the coordinated phase is forced off

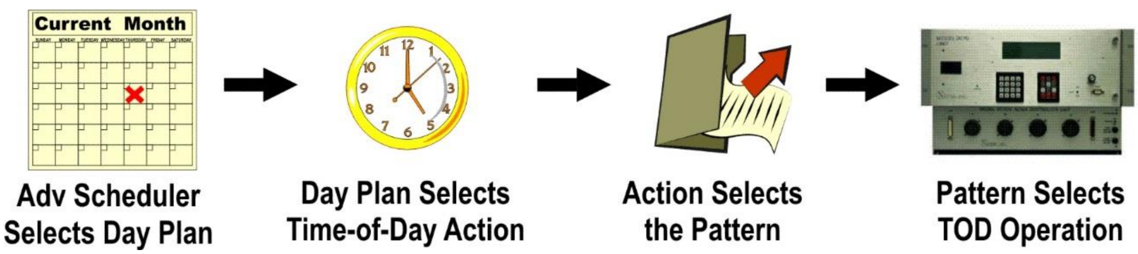
.

7 Time Base Scheduler

7.1 Theory of Operation

The *Advanced Schedule* is a fully compliant NTCIP based time-of-day schedule. NTCIP defines an annual schedule in terms of day-of-week, month and day-of-month. This implies that the schedule applies to the current year. An *Easy Schedule* is provided to facilitate programming the NTCIP *Advanced Schedule*; however, there is only one schedule in the controller database because *Easy Schedule* is provided as an alternative method of programming the *Advanced Schedule*.

The *Advanced Schedule* selects the *Day Plan* for the current day. The *Day Plan* contains the time-of-day events for the current day used to select actions from the *Action Table*. The controller updates the current TBC pattern once per minute based on the scheduled events from the *Action Table*.



Each day the controller checks the *Scheduler* to determine the most applicable *Day Plan*. If the current day is not specified in the *Advanced Schedule*, the controller will run "free" in Pattern# 0. The controller checks the current *Day Plan* once per minute to retrieve the current time-of-day action. The controller then performs a lookup in the *Action Table* to determine the active *TBC Pattern*. The *TBC Pattern* determines the current time-of-day operation of the controller.

All programming related to the Scheduler is accessed from **MM->4** shown to the right.

```
            Time Based Scheduler
1.Set Date/Time 4.Day Plan       7.Status
2.Easy Schedule 5.Action Table 8.Resrvd
3.Adv Schedule  6.Parameters    9.More
```

7.2 Controller Time Base (MM->4->1)

The *Set Date/Time* entry screen allows the user to set the current time and date also referred to as the controller's time base.

```
Set Date & Time
              Date     Day    Time   Secs
 Current    08-29-04   SUN   03:54     9
  Set To    00-00-00         00:00    00
```

Date

The *Date* parameter is entered in MM-DD-YY format. All six numeric digits must be entered, including leading zeroes. Setting the date automatically updates the *Day* field.

Day

The *Day* parameter specifies the day of week (SUN-SAT). Setting the date automatically updates the *Day* field. Therefore, it is not necessary to update this field after the date has been set.

Time

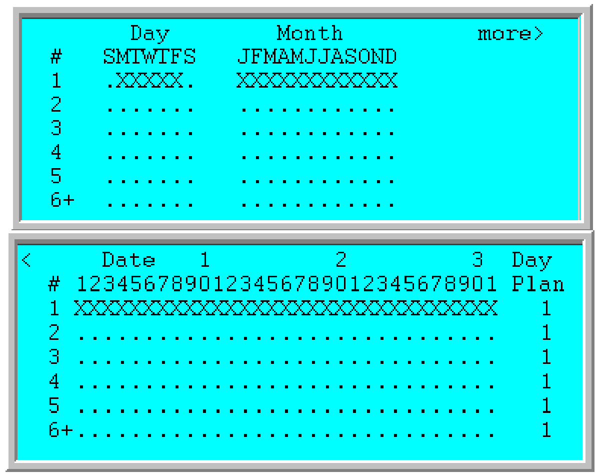
The *Time* parameter is entered as HH:MM in 24-hour military format. All four numeric digits must be entered including any leading zeros. Pressing the Enter key after entering the 4 time digits will automatically zero out the *Seconds* field

Secs

The *Seconds* parameter will update the "seconds" portion of the real time clock seconds. The second entry is provided separately from the hour and minute fields to facilitate setting the time base to a known reference.

NOTE: Whenever making time changes to the clock using the Front Panel keyboard you must always reprogram seconds and that the reprogramming of seconds should be the last thing that is done.

7.3 Advanced Schedule (MM->4->3)



The NTCIP based *Advanced Schedule* is an annual calendar for the current year used to select the *Day Plan* for the current day. Each entry of the scheduler specifies a day-of-week, month, day-of-month, and the *Day Plan* assigned to the entry. Each entry identifies the day or range of days during which the *Day Plan* is in effect.

It is possible for two or more schedule entries to specify the same day of the year. In this situation, the scheduler will always select the most specific entry. An entry is defined as more specific if the range of days defined by that entry is narrower in scope than another entry. For example, the user may assign *Day Plan* 1 for the entire month of March in one entry and *Day Plan* 2 for March 7 in a separate entry. This would appear to be a duplicate entry because two different day plans are programmed for March 7. However, in this situation, the *Advanced Schedule* would select *Day Plan* 2, because it more specific to the current day. The priority order of day plan selection is based upon month, day-of-week, then day of month. If no *Day Plan* is assigned to the current date (based on the time base of the unit), the controller will run free in *Pattern # 0.*

The user may select multiple entries for *Day*, *Month*, and *Date*. For example, selecting all fields under *Day* implies that this entry applies to every day of the week. If a *Day* field is not selected, then the schedule is not considered valid for that particular day. Therefore, when entering a schedule event for a specific date, such as March 7, it is good practice to make that event applicable to every day of the week. This will prevent the user from having to change the day-of-week for the entry when the calendar year changes.

Day

The *Day* parameter defines the day-of-week or multiple days for the entry.

Month

The *Month* parameter defines the month or range of months for the entry based on *Begin Month–End Month*.

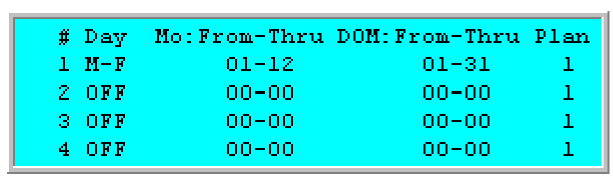
Date

The *Date* parameter indicates which days of the month that the entry will be allowed. More than one day of month may be selected.

Day Plan

The *Day Plan* number selects the Day Plan (1-32) placed in effect when the scheduled entry becomes active.

7.4 Easy Schedule (MM->4->2)



Easy Schedule is an alternative method of coding the NTCIP based *Advanced Schedule*. The *Day* entry provides a separate entry for each day-of-week or range of days (M-F or ALL). Setting the *Day* selection to OFF disables the event #.

The *Month* and *DOM* (Day-Of-Month) entries specify begin and end values for each range. Four digits must be provided for each entry (including zero place holders). The range specified will automatically be transferred to the *Advanced Schedule* as a range of “X” values for the individual month and day entries. This “easy” method allows each entry to be specified as a range instead of having to code each individual “X” field in the *Advanced Schedule.*

Note that each entry provided in *Easy Schedule* applies to a consecutive range of days, months or days of month. It is possible to specify a non-consecutive range in the *Advanced Schedule* (such as a DOM entry including 1-4, 7, 20-25, 30 in the same event#). This complex *DOM* entry will display in *Easy Schedule* as “**-**” because it is not defined as a consecutive series of days. Complex events are programmed in the *Advanced Schedule* and less complex entries are programmed in *Easy Schedule* as a shortcut method.

7.5 Day Plan Table (MM->4->4)

Plan- 1	Evt	Time	Actn	Evt	Time	Actn
Link: 0	1	00:00	99	2	06:00	1
	3	09:00	99	4	11:30	1
	5	14:45	2	6	18:00	1
	7	23:45	99	8	00:00	0
	9	00:00	0	10	00:00	0
	11	00:00	0	12	00:00	0
+	13	00:00	0	14	00:00	0

The *Scheduler* reads the active *Day Plan* for the current date once per minute to update the current *Action*. The *Action* drives the active *Pattern* and controls the state of the special function outputs from the *Action Table*.

Time

The *Time* parameter in 24-hour military format (HH:MM) defines the time-of-day that the associated *Action* will become active. All four numeric digits must be entered, including any leading zeroes.

Action

The *Action* parameter (1-100) is associated with the *Action* in the *Action Table*. **NTCIP defines <u>Action 0</u> as the "do-nothing" action.** Therefore, do not be misled into thinking that <u>Action 0</u> places the intersection into "free" operation. It is good practice to assign an event and *Action* at 00:00 for every *Day Plan* called by the *Advanced Schedule*. This insures that even if the controller date is changed and a new *Day Plan* is referenced that at least the first *Action* at specified for 00:00 will be selected.

Link

The Link parameter joins (or links) two or more *Day Plans* to increase the number event entries from 16 to 32. The link parameter contains the *Day Plan* number the *Day Plan* is linked to. Multiple *Day Plans* may link to the same *Day Plan* by specifying the same *Link* entry in each plan; however, linking more than two *Day Plans* in a chain is not supported.

7.6 Action Table (MM->4->5)

Actn	Patrn	Aux-123	Spec-12345678	Pre.1.2
1	255	...	....	0 0
2	0	...	....	0 0
3	0	...	....	0 0
4	0	...	....	0 0
5	254	...	....	0 0

The *Action* selected by the current *Day Plan* controls the state of *Auxiliary* and *Special Function* hardware outputs. In addition, the source of the source of preempt 1 and 2 may be selected by the current *Action* table. The time-of-day *Scheduler* allows the Day Plan to call different *Actions* to turn outputs ON and OFF and share the same pattern between actions. This scheme minimizes the number of patterns required to cycle outputs ON and OFF.

Pattern

The *Pattern* parameter (1-48) defines the *TBC Pattern* selected by the current *Action*. A value of zero or 254 will cause the controller to run free. It is very easy to confuse Action 0 and Pattern 0. Just remember that <u>a zero Action is no action</u> and <u>Pattern 0 may not always runs free.</u> However, keep in mind that to insure free operation in an NTCIP controller, one should program Pattern 254 instead of Pattern 0.

Aux Outputs

The *Auxiliary* settings define the state of each auxiliary output when the associated action is active. These outputs are activated by *Day Plan Actions* or are manually controlled from the central system. The 2070 and older TS2 controllers provide 3 *Aux* outputs and newer TS2 and some ATC controllers provide 8 *Aux* outputs per action.

Special Function Outputs

The *Special-Function* settings defines the state of each special function output when the associated action is active. These outputs are activated by *Day Plan Actions* or manually controlled from the central system. The 2070 and older TS2 controllers provide 8 *Special Function* outputs and newer TS2 and some ATC controllers provide 24 *Special Function* outputs per action.

Preempt Outputs

This setting allows the source of the inputs for preempt 1 and 2 to be remapped by time of day through the *Action Table*. The source for Pre.1 may be set to a value of "3" or "4"and Pre.2 may be set to a value of "5" or "6". Programming zero ("0") calls for the default input for each preempt. For example, setting Pre.1 to "3" would source the preempt 3 input when the time of day action is active instead of the preempt 1 input.

7.7 Time Base Parameters (MM->4->6)

Time Base Parameters provide additional NTCIP features to modify the behavior of the controller's Time Base.

Daylight Savings

The *Daylight Savings* parameter determines specifies if daylight savings is active, and which method is be used. The ENABLE US mode references daylight savings for the United States.

```
         Time Base Parameters
Daylight Savings  : ENABLE US
Time Base Sync Ref:    0
GMT Offset        : +  0
Daylight Saving   Month   Week
           Spring    0      1
             Fall    0      1
Clock Source      : LINESYNC
Time Set         :   0:00:00
```

Time Base Sync Ref

The *Time Base Synchronization Reference* defines the number of minutes after midnight to synchronize the time base. This reference provides the zero point for the TBC counter uses to synchronize the offset called in the pattern.

GMT Offset

The *GMT (Greenwich Mean Time) Offset* adjusts the system time base for Universal Standard Time (see chapter 10).

Daylight Savings Time

The user is allowed to override the default Daylight Saving time schedule with parameters that they can program**. As of 2007, you will not have to program the default values of Daylight Savings time, which are currently set to begin the second Sunday in March and end on the first Sunday in November**. If Congress mandates another change don't forget to enter the leading '0' for the Month, if necessary. If the last Sunday of the month is designated (week 4 or 5) please program a 5 under the Week parameter.

Clock Source

The Clock source allows the user to set a source for the controller clock. Valid Choices are **LINESYNC** or **CRYSTAL**. The default is **LINESYNC** which will use the 60Hz (60 Cycles per seconds) to generate the clock. Select **CRYSTAL** if your clock source is via an external source that will be attached to Input Function # 252 (***SetTime***)

Time Set

This is the time that will be immediately set when you select **CRYSTAL** as your clock source and toggle Input Function # 252 (***SetTime***).

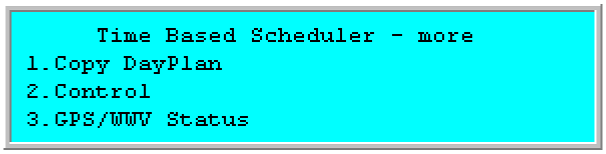
7.8 Time Base Status (MM->4->7)

Interpreting *Time Base Status* requires a thorough understanding of the relationship between the *Advanced Schedule*, day plans and actions. Compare these four status fields with the graphic provided in section 7.1. If you visualize these status fields as four steps used to select the current TBC pattern based on the current date and time, then you will understand the NTCIP time-of-day scheduler.

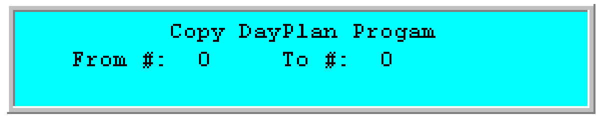
```
            TBC Current Status
   Sched Event #:  1    Action #:  1
      Day Plan #:  1
Day Plan Event #:  1
```

1. The *Schedule Event #* is the active event selected by the scheduler based on the current day-of-week, month and day-of-month. This event # is useful to determine which event is more specific if more than one entry in the scheduler references the current day.
2. The *Day Plan #* is the active day plan specified by the scheduler for the current Schedule Event #. The *Day Plan #* is programmed for each event in the *Advanced Schedule* and *Easy Schedule*.
3. The *Day Plan Event #* is the active day plan entry selected by the scheduler for the current time-of-day. The *Day Plan* Event # references the event selected in the active Day Plan #.
4. The *Action #* is the active action selected by the scheduler for the current *Day Plan*. The controller reads the current Day Plan entries once every minute to update the current *Action#*. This value is used to reference the *Pattern #* and the special function output status specified in the *Action Table*.

7.9 Time Base Scheduler – More Features (MM->4->9)

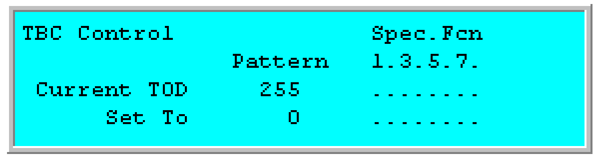


7.9.1 Copy Day Plan Utility (MM->4->9->1)



The Copy Day Plan Utility copies the 16 Event # entries from one Day Plan # to another Day Plan #. The Link field specified in the From #: Day Plan is not copied.

7.9.2 TBC Manual Control Screen (MM->4->9->2)



The TBC Manual Control Screen allows the user to manually select the active Pattern and special function outputs as a keyboard entry. These selections override the Pattern and special function outputs specified for the current Action called from the Time Base Scheduler. Therefore, this screen provides the ability to override the actions of the scheduler.

The controller also allows the active Pattern to be manually controlled from the Test Mode under **MM->2->1**. However, patterns selected from the Test Mode cannot be overridden by future events in the scheduler, whereas patterns entered from the TBC Manual Control Screen are replaced by the next scheduled event.

7.9.3 GPS/WWV Status (MM->4->9->3)

Refer to Chapter 10 for further details.

8 Preemption

8.1 Preempt (MM->3)

```
         Preemption Menu
1.HiPriority  4.LowPriority
2.Events
3.Sequences
```

Preemption is accessed by selecting **MM->3**. This version of software allows the user to select standard preemptions 1-12 (**MM->3->1**), low priority preemptions 1-4 **(MM->3->1**) or user selectable events and sequences (**MM->3->2**, **MM->3->3**) which are settable and timed by the user.

8.2 High Priority Preempt Selection (MM->3->1)

```
 Enter Preempt #

     then press ENTER
```

High Priority Preempts 1-12 are selected using item 1 from the MM-3 menu shown above. This will display the following input screen allowing you to enter a value from 1 to 12. Upon pressing the ENTR key, a submenu will be displayed for the preemption that you selected.

8.3 High Priority Preempts 1 – 12

```
#12          Preemption
1.Times    4.Times+     7.Diagnostics
2.Phases   5.Overlaps+  8.AdvTime/InitDwll
3.Options  6.Options+   9.EnhancedTimes
```

High priority preempts 1 through 12 may be programmed as RAIL or EMERG (emergency) high priority preempts. Each input is activated by a separate ground true input provided from the terminal facility. TS2 maps each input to a terminal facility BIU (type 1 cabinet). In addition, TS2 (type 2) allows preempts to be mapped to D-connector inputs as specified by the end user. Programming for low priority preempts is provided in the next section, 8.4.

Note: High Priority Preemptions will run "FREE" as long as the physical input remains "ON" or until the input terminates and the associated programmed timers expire. At that point, the preemption will go back to normal operations. Further note that normally omitted phases can be run during a High Priority Preemption. Finally note that phases which run during preemption are subject to vehicle calls (or recalls) being present.

8.3.1 Preempt Times (MM->3->1->1)

```
#12  Times    |     Begin      |     Other
  Delay     0    MinGrn    0   Track Grn    0
MinDura     0    MinWlk    0   Min Dwell    0
MaxPres     0    PedClr    0   InitDwell    0
```

This screen provides entries for various time parameters defined in NTCIP. The entries in the first column relate to the preempt input or call. The second column groups the minimum times provided to the phase in service when the preempt call is received. The third column lists the track and dwell intervals. Each of these parameters is described below.

Delay

The preempt *Delay* parameter (0-600 sec) is timed prior to the track clearance interval and dwell intervals. If the *Lock Input* associated with the preempt input is enabled (set to ON), the *Minimum Duration* and *Minimum Dwell* periods are guaranteed even if the preempt call is removed. However, if the *Lock Input* is not enabled (set to OFF), and the preempt call is removed during the preempt *Delay* period, the request for service is dropped and the preempt sequence is not activated.

Minimum Duration (MinDura)

The *Minimum Duration* parameter (0-9999 sec) determines the shortest period that a preempt call is active. The *Minimum Duration* time begins at the end of the preempt *Delay* period, and prevents an exit from the dwell state until the set amount of time has elapsed.

Maximum Presence (MaxPres)

Maximum Presence (0-9999 sec) limits the period of time a preempt input is considered valid. When a preempt call exceeds this limit, the controller stops recognizing the call and returns to normal operation. Once a call becomes invalid, it will remain invalid until the input resets and becomes inactive. This feature is useful to limit the call from an emergency vehicle that has stopped upstream of the detector with the emitter locked on. A setting of 0 disables this feature.

Minimum Green (MinGrn)

The preempt *Minimum Green* parameter (0-255 sec) insures that a preempt call will not terminate an active phase green indication before the lesser of *preempt Minimum Green* or the active *phase Minimum Gre*en. MinGrn can also be used to insure that an associated Flashing Yellow Arrow output occurs before preemption occurs. Some manufacturer's monitors need one to two seconds to establish the existence of a Flashing yellow arrow. If a preemption comes in before that time, the monitor may detect a Red failure. By programming MinGrn to 2 seconds, this issue can be avoided.

Minimum Walk (MinWlk)

```
#12  Times  |    Begin     |     Other
  Delay    0   MinGrn    0  Track Grn    0
MinDura    0   MinWlk    0  Min Dwell    0
MaxPres    0   PedClr    0  InitDwell    0
```

The preempt *Minimum Walk* parameter (0-255 sec) insures that a preempt call will not terminate an active phase walk interval before the lesser of the preempt *Minimum Walk* time or the active phase *Walk* time. When an active walk indication is driven by a phase output, the walk will continue to be illuminated while the walk interval times on the active phase. However, if the active walk indication is driven by a Ped_1 overlap, the walk display will terminate immediately and move to pedestrian clearance when preempted even though walk continues to time on the included phase defining the overlap.

Enter Pedestrian Clear (PedClr)

The preempt *Pedestrian Clear* time (0-255 sec) insures that a preempt call will not terminate an active phase pedestrian clearance before the lesser of the preempt *Pedestrian Clear* time or the active phase *Pedestrian Clearance* time.

Track Green (Track Grn)

The *Track Green* parameter (0-255 sec) determines the green interval of the *Track Vehicle Phases* serviced during the track clearance movement. The track clearance movement is typically used only rail type preempts rather than high-priority or low-priority emergency vehicle preempts.

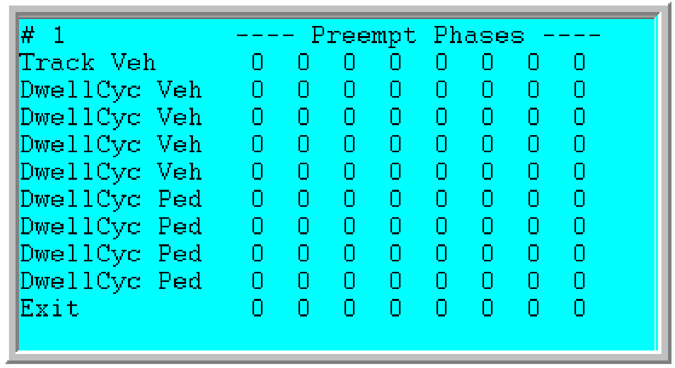
Minimum Dwell (Min Dwell)

The *Minimum Dwell* parameter (1-255 sec) determines the minimum time guaranteed to the dwell phases listed under the *Dwell Phase* parameters. The dwell state will not terminate prior to the expiration of the *Minimum Dwell* time and the *Minimum Duration* time, nor will it terminate if the preempt call is still present. **Note: If the preemption has exit phases programmed, the minimum dwell time should be programmed to be at least as large as the minimum green time of the preempt dwell phases to ensure the exit phases are always selected upon exiting the preempt.**

Initial Dwell (InitDwell)

The *Initial Dwell* parameter (1-255 sec) determines the minimum time guaranteed to the Initial dwell phases/pedestrians/overlaps programmed under MM-3-1-8. The Initial dwell state will not terminate prior to the expiration of the *InitDwell* time and the *Minimum Duration* time, nor will it terminate if the preempt call is still present.

8.3.2 Preempt Phases (MM->3->1->2)



Track Vehicle Phases (Track Veh)

The *Track Phase* parameters allow a maximum of 8 track clearance phases to be serviced during the track green interval of the preemption sequence. Only one phase per ring should be entered for the track interval. All track phases selected must be concurrent and serviced simultaneously to insure adequate track clearance before the train arrives. The user may specify track phases that are only enabled during preemption (phases that are normally omitted can be enabled during this period).

Dwell Vehicle (Dwell Cyc Veh) Phases

The *Dwell Phase* parameters allow a maximum of 32 dwell phases to be serviced during the dwell interval of the preemption sequence. It is not required that the dwell phases be concurrent. If more than one dwell phase is specified per ring, the controller will service the dwell phases based on the current phase sequence or the optional preempt *Pattern* selected. Care must be exercised to insure that no dwell phase conflicts with the priority vehicle that issues the preemption. This version allows you to specify dwell phases that are enabled only during preemption (phases that are normally omitted can be enabled during this period). The preemption software calls all dwell phases to insure that the dwell period is run. Once a phase in each ring is running then other preemption phase calls are dropped and those phases are subject to normal actuation.

Dwell Pedestrian (Dwell CycPed) Movements

The *Dwell Ped* parameters allow a maximum of 32 pedestrian movements to be serviced during the dwell interval of the preemption sequence. *Dwell Ped Movements* must always be defined as *Dwell Vehicle Phases*.

Exit Phases (Exit)

Exit Phases (also called *Return* phases) determine how the controller leaves preemption and returns to normal stop-and-go operation. The controller returns to the *Exit Phases* at the end of the preempt dwell interval unless *Coord+Preempt* is enabled as explained below. Only one *Exit Phase* is allowed in each active ring and all *Exit Phases* must be concurrent.

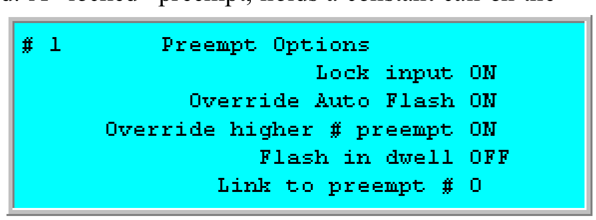
The user should avoid programming any *Exit* phases when *Coord+Preempt* is turned ON. When running coordination with *Coord+Preempt* = OFF and no exit phases programmed, there is no certainty on where the Exit Phases will go nor where in the coordinator you will be. Therefore, please program exit phases or *Coord+Preempt* to properly exit coordination.

Certain considerations should be taken when programming Exit phases. For example, the user should **NOT** return to exit phases that have a potential to inhibit each other. Another consideration, as stated in the section above, is when the exit phases are programmed In this case, the minimum dwell time (**MM->3->1->1**) should be programmed to be at least as large as the minimum green time of the preempt dwell phases to ensure the exit phases are always selected upon exiting the preempt.

8.3.3 Preempt Options (MM->3->1->3)

Lock Input

Enabling the *Lock Input* parameter (to ON), locks the preempt call and guarantees that the preempt *Delay*, *Minimum Dwell* and *Minimum Duration* are serviced even if the preempt call is removed. A "locked" preempt, holds a constant call on the preempt input during the *Minimum Dwell* and *Minimum Duration* periods. Once these minimum times have been met, the preempt call reflects the actual state of the preempt input



If the *Lock Input* is disabled (set to OFF) the preempt call reflects the state of the actual input. Therefore, if the preempt call drops before the preempt *Delay* time has elapsed, the preempt sequence does not occur. However, once the preemption begins timing *Minimum Dwell* and *Minimum Duration*, these minimum times will be guaranteed.

Override Auto Flash

Enabling the *Override Auto Flash* parameter (to ON) allows preempt calls to have priority over automatic flash. Stated another way, if automatic flash is active when a preempt call is recognized, auto flash is terminated, including appropriate clearances, and the preempt sequence is executed. After the preemption is finished, the controller returns to automatic flash. If *Override Auto Flash* is set to OFF, the preemption does not override automatic flash. If auto flash is active when a preempt call is received, the call is ignored as long as auto flash is active.

Override higher # preempt

Preempts possess an implied priority order with the lowest numbered Preempt (#1) having the highest priority and the highest numbered Preempt (#10) having the lowest priority. *Override higher # preempt* is used to override this priority order based on the preempt number.

If *Override higher # preempt* is set to ON, then the specified preempt has priority over higher numbered ones and allows the preemption to interrupt any higher numbered preempts that are active. If this parameter is set to OFF, then this preempt cannot interrupt higher numbered preempts. Note that higher numbered preempts cannot interrupt lower numbered ones regardless of the settings of their respective *Override higher # preempt parameters*.

Note: This feature is disabled if the user programs

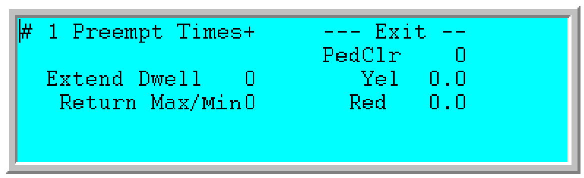
Flash in Dwell

Flash in Dwell allows the controller flash during preempt dwell instead of displaying phases or running a limited sequence of phases. If set to ON, phases in the Dwell Vehicle Phase list flash yellow during the preempt dwell. All other phases flash red.

Link to preempt

The *Link to preempt #* parameter allows the specified preempt to initiate a higher priority preempt. At the termination of the current preemption, the linked preempt automatically receives a call, which is maintained as long as the demand for this, the original, preempt are active. Linking provides a method of implementing dual track clearance intervals and other complex preemption sequences.

8.3.4 Preempt Times+ (MM->3->1->4)



The *Preempt Times+* screen includes fields for interval and call times that are not defined in the NTCIP standards.

Extend Dwell

The *Extend Dwell* parameter (0-255 seconds) extends the preempt call much like the vehicle detector extension parameter extends a vehicle call. This feature is useful, to extend a preempt call in an optical preemption system when an optical sensor is installed at the leading edge of a large intersection. In this situation, the sensor stops receiving the signal from the emergency vehicle before it clears the intersection and *Extend Dwell* can be used to stretch the preempt call input to allow the emergency vehicles to clear the intersection.

Return Max/Min

The *Return Max* parameter (0-255 seconds) insures that the *Exit* phases service the current maximum (Max-1 or Max-2) or minimum programmed for the phase based on the selection chosen under MM→3→6.

Exit (Return) Clearances

The *Exit (Return) Clearances* are pedestrian clearance (PedClr, 0-255 seconds) and yellow/all-red vehicle clearance (0-25.5 seconds). These exit clearances are timed for the *Vehicle Dwell Phases* as the controller exits the preempt dwell state. The three clearance times provided are Pedestrian Clearance, Yellow Clearance, and Red Clearance.

8.3.5 Preempt Overlaps+ (MM->3->1->5)

Users have the choice to allow overlap indications to be displayed or not displayed during preemption track clearance and dwell intervals.

By default, all overlaps are disabled (i.e. displayed as all red indications) during preemption. Therefore, during the track clearance interval and the dwell interval, all overlaps are turned off (i.e. displayed as all red indications) even if the included phases defining these overlaps are assigned as track clearance and dwell phases.

```
# 1           -- Preempt Overlaps+ --
    Track       0  0  0  0  0  0  0  0
     (more)     0  0  0  0  0  0  0  0
     (more)     0  0  0  0  0  0  0  0
     (more)     0  0  0  0  0  0  0  0
    DwellCyc    0  0  0  0  0  0  0  0
     (more)     0  0  0  0  0  0  0  0
     (more)     0  0  0  0  0  0  0  0
     (more)     0  0  0  0  0  0  0  0
```

The *Preempt Overlaps+* screen allows up to 32 overlaps to be programmed (i.e. turned on and allowed to display green and yellow indications) with the track clearance phases and / or the vehicle dwell phases. For each group, eight overlap entries are provided on the first row, and four additional overlaps are provided on the following row.

If any –GrnYel overlaps are programmed and used as dwell phases, the user should also include (program) them in preempt Overlaps+ (**MM->3->1->1->5**).

This version allows you to specify track and dwell phases that are enabled only during preemption. These phases can be used to drive an overlap assigned as a track clear or dwell indication only during preemption.

8.3.6 Preempt Options+ (MM->3->1->6)

Preempt Enable

Preempt Enable must be set to ON to enable the preempt input and allow the preemption to take place.

Type

The preempt *Type* may be identified as a railroad (LRV) or an emergency vehicle (EMERG) preempt.

```
# 1      Preempt Options +
Enable ON                  Pattern    0
  Type EMERG   Skip Track if Overide OFF
Output TS-2             Coord+Preempt  OFF
                         MCE Override  OFF
Lnk Aft Dwel OFF       Return Max/Min  MAX
```

The setting LRV will turn on the Light Rail features detection described under **MM->5->9->6 (TransPreMtrx)** and **MM->5->9->6 (TranDet)**. Please refer to chapter 5 for more details.

The setting EMERG is only used to identify the preemption and is included on preempt event log entries.

Output

Each preempt has an *Output* signal that represents the preemption active status. The setting determines when the output becomes active during the preempt cycle as follows:

- **TS2 -** The output is active from the time the preemption is recognized until it is complete. The output is not active while the call delay period is timing.
- **DELAY -** The output becomes active when the call is received and includes the call delay period. The output remains active while the preemption is active.
- **DWELL -** The output becomes active when the preempt dwell state is reached. It is not active during the call delay period, begin clearances, or track interval.

Pattern

The *Pattern* parameter (0-24) associates any programming assigned to a pattern with a preemption. If *Coord+Preempt* (described below) is enabled, the *Pattern* parameter is disabled, preventing a preemption from changing a coordination pattern in effect when the preempt call is received. If *Coord+Preempt* is not enabled, the specified *Pattern* (1-24) will be invoked after the preempt *Delay* expires and the preemption becomes active.

When a Pattern is implemented during preemption, coordination is not active (because *Coord+Preempt* is OFF), but any other features attached to the pattern will be in effect. These features include phase recall mode assigned to the active split table, and alternate phase and detector programming attached to the pattern.

Skip Track if Override

```
# 1      Preempt Options +
Enable ON                  Pattern   0
  Type EMERG   Skip Track if Overide OFF
Output TS-2            Coord+Preempt OFF
                        MCE Override OFF
Lnk Aft Dwel OFF      Return Max/Min MAX
```

This ON/OFF toggle field allows the track clearance interval to be skipped if the current preempt is overriding a lower priority preempt. Set this entry to ON to cause the track interval not to be serviced.

CAUTION: Use this feature carefully, it is only appropriate for complex, multi-track clearance situations. Inappropriate use can cause the track clearance interval to be skipped when it should not be.

The Exit Phases parameter is a list of up to 8 phases that are active following the termination of a preemption sequence.

Coord+Preempt

The *Coord+Preempt* parameter allows coordination to proceed in the background **during** the preempt sequences. This allows the controller to return to the phase(s) currently active in the background cycle rather than specific *Exit* phases discussed in this chapter. This option typically allows the controller to return from the preemption dwell phases to coordination in SYNC without going through a transition period to correct the offset. Many agencies utilize the *Coor+Pre* option when coordination is interrupted frequently by preemption. The user should avoid programming any *Exit* phases when *Coord+Preempt* is turned ON.

Please note that because preemption is an emergency operation, there are times that the coordinator must go FREE to insure the safety of the motoring public. One example is during railroad preemption track clearance phase timing. If Track Clearance phases and timing are programmed, the coordinator will go free to insure that the vehicles will move off the track. Once the dwell phases begin timing, the coordinator will begin to transition back to being in SYNC.

The software process when setting Coord+Preempt to ON follows. Once a preemption call occurs and the preemption Delay timer expires, Track Clearance Phases are run under non-coordinated **FREE** mode during the Track Clear time. Next the preemption will cycle to the dwell phases. While in dwell the coordinator starts again and the software runs the dwell phases as per coordination requirements. When exiting preemption (the preemption Return Interval) the software goes free momentarily until it gets to the exit phase(s) and again starts the coordinator. It is recommended that if the user sets Coord+Preempt to ON, the user should not program exit phases.

Lnk Aft Dwell

This parameter is used with the ***Link to preempt #*** parameter found under the Preemption Options+ menu (**MM→3→3**). When this parameter is set to ***OFF***, the preemption that is programmed under MM→3→3 will be run after the current preemption is completed. If this parameter is set to ***ON,*** the preemption will not link to the other preemption programmed under MM→3→3 until the current preemption call is released and its dwell time has expired.

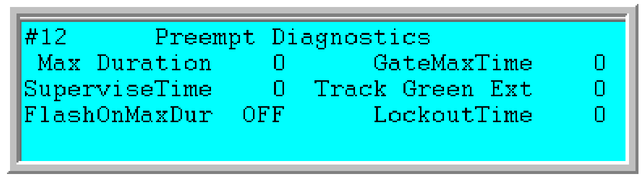
Return Min/Max

This parameter is used with the ***Return Max*** parameter found under the Preemption Times+ menu (**MM→3→4**). If this parameter is set to ***MAX***, the time programmed under MM→3→4 will be used as the Maximum Green timer for the Exit Phases. If this parameter is set to ***MIN***, the time programmed under MM→3→4 will be used as the Minimum Green timer for the Exit Phases.

MCE Override

Setting this parameter to "ON" will allow the preemption to override Manual Control (MCE) operations. If it is OFF, MCE remains active. **Please note that this feature will not work if the preemption input is set using controller logic.**

8.3.7 Preemption Diagnostics (MM->3->1->7)



This screen has been added to diagnose the preemption inputs to insure that they are working correctly. In addition, Railroad gates are monitored for proper functionality.

V80.x has added new input functions that are associated with the Preempt Diagnostics screen. In particular Functions 541-552 monitor gate down signals for each of the twelve preemptions and Functions 561-572 are the preemption Supervisory inputs for each of the twelve preemptions. The supervisory input is considered to be the inverse of the preemption input. If the input is no longer than the SuperviseTime, then a CVM fault is set after the preemption times the minim track clearance.

Max Duration (0-9999 sec)

Max Duration is the maximum duration that preemption will use. It is different than the Max Presence timer (**MM->3->1**) which times once the preemption input is set to on. Max Duration is timed from the start of the preemption actually being serviced. This time is typically used by agencies that have mutiple preemptions to insure service for each registered preemption. This timer alieviates the possibility for a preemption call that is waiting, while another preemption is currently timing, that it may not be served.

SuperviseTime (0-255 sec)

The Supervise Time is the amount of time that the supervised inputs will have to be in the fault condition before a fault is declared. Zero (0) has the special meaning that the supervised mode is disabled. A non-zero value will enable supervised mode.

FlashOnMaxDur (On/Off)

Selecting **ON** for this field will cause the signal to flash all outputs to RED when the Max duration time has expired.

GateMaxTime (0-255 sec)

This is the maximum amount of time allowed from the beginning of the track clearance interval until the gate is down. Failure to receive a gate down after this amount of time will generate a fault condition. The clearance phases will hold green, beyond their minimum, until a gate down signal is received. Zero (0) has a special meaning that gate monitoring is disabled.

Track Green Ext (0-255 sec)

This is the programmed amount of time that the track clearance phase green can be extended once the gate goes down. Zero (0) has a special meaning that gate monitoring is disabled.

LockoutTime (0-255 sec)

This is the minimum amount of time that must pass before the preempt inputs are re-enabled. Zero (0) has a special meaning that Lockout Time is disabled.

8.3.8 Advanced Preemption timers (MM->3->1->8)

These times are used by the phases that are currently running prior to starting the preemption dwell interval and are used to **shorten** clearance times from their default programming. They are defined as follows:

EnterYellowChange (0-25.5 sec)

This parameter controls the yellow change timing for a normal Yellow Change signal terminated by a preemption initiated transition. A preemption initiated transition shall not cause the termination of a Yellow Change prior to its display for the **lesser** of the phase's Yellow Change time or this period.

```
# 1 AdvTimes
  FYA Clear      OFF      EnterYelChg 25.5
  ResetExtDwell  OFF      EnterRedClr 25.5
ReservicePrempt  OFF      TrackYelChg 25.5
       EndDwell  OFF      TrackRedClr 25.5
 Priority Level    1      PreRedClear OFF
 DsblDwellCalls  OFF
  DynExitThresh      0  DynExitMode NORMAL
  ExitVehCall
    ........ ........ ........ ........
  ExitPedCall
    ........ ........ ........ ........

InitPhase 0  0  0  0  0  0  0  0
InitPeds  0  0  0  0  0  0  0  0
InitOlaps 0  0  0  0  0  0  0  0
  (more)  0  0  0  0  0  0  0  0
  (more)  0  0  0  0  0  0  0  0
  (more)  0  0  0  0  0  0  0  0
```

CAUTION -- if this value is zero, the current phase Yellow Change is terminated immediately. If less than 3 seconds of Yellow time is needed for a phase, the user must allow the programming of this by turning **Allow <3 Sec Yel** parameter under the Unit parameters menu at MM→1→2→1 to "ON". If not, the yellow time programmed for the phase in MM→1→1→1 will be used.

EnterRedClear (0-25.5 sec)

This parameter controls the red clearance timing for a normal Red Clear signal terminated by a preemption initiated transition. A preemption initiated transition shall not cause the termination of a Red Clear prior to its display for the **lesser** of the phase's Red Clear time or this period**.**

CAUTION -- if this value is zero, the current phase Red Clear is terminated immediately.

TrackYellowChange (0-25.5 sec)

The **lesser** of the phase's Yellow Change time or this parameter controls the yellow timing for the track clearance movement. Track clear phase(s) are enabled at MM→3→2.

CAUTION -- if this value is zero, the current phase Yellow Change is terminated immediately. If less than 3 seconds of Yellow time is needed for a phase, the user must allow the programming of this by turning **Allow <3 Sec Yel** parameter under the Unit parameters menu at MM→1→2→1 to "ON". If not, the yellow time programmed for the phase in MM→1→1→1 will be used.

TrackRedClear (0-25.5 sec)

The **lesser** of the phase's Red Clear time or this parameter controls the Red Clear timing for the track clearance movement. Track clear phase(s) are enabled at MM→3→2.

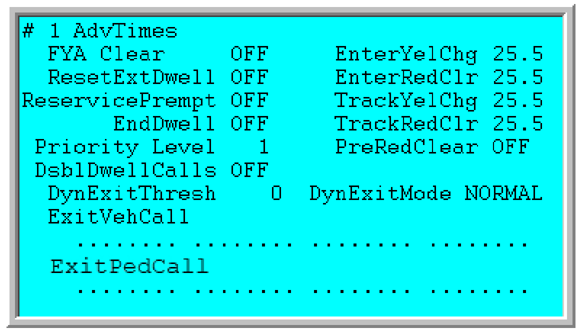
CAUTION -- if this value is zero, the current phase Red Clear is terminated immediately.

NOTE: The default programming of 25.5 seconds for these timers will insure that Yellow Clearance and Red Clearance timers programmed under MM->1->1-> 1 are adhered to during preemption.

PreRedClear

The Preempt Red Clear feature will cause **ALL** Phases, Pedestrians and Overlaps to go to an all red state prior to the preemption, **even if you are already in the preempt phases**.

FYA Clear



This feature is specific to FYA overlaps and prevents the controller going directly into the FYA preemption begin interval (dwell interval or track clearance interval) if the preempt happens to begin when the preemption begin interval phases are active. If the user needs to time an all red interval prior to serving the preemption phases, this parameter should be programmed to "**ON**". If set to "**ON**", the feature requires that the controller clear to all red before entering the dwell interval. Therefore, the phase red clear time for the terminating phase(s) or red-revert times would apply.

FYA Clear is also used in protected/permissive left turns to avoid the "yellow trap" situation. It does so by causing a conflicting through movement to terminate so that a permissive left turn interval can time yellow clearance simultaneously with the conflicting through movement.

For the description below please note that "target phases" are the phases that are programmed for the interval that follows the preemption begin phases. They are track clearance phases if defined, otherwise they are dwell phases.

1. **FYA Clear** applies to both emergency preemptions without track clearance and to rail preempts. In both cases, the all-red interval occurs at the end of the preempt Begin interval.

2. The all-red clearance occurs if:

a. Some, but not all, rings are in their target phases

b. Any Flashing Yellow Overlap is flashing yellow

c. No target phases are defined (i.e. a programming or setup error)

In summary, this feature is used by some agencies to prevent yellow trap situations. By clearing to all red, all phases must terminate together. These agencies use this feature in association with 4 channel preemptions and protected/permissive turning situations. The agencies want the intersection to clear to red, then go back to the dwell phases (or simply go all red before the dwell phases), so the on-coming emergency vehicle will know that the conflicting permissive movement is green and that they are truly in a preemption situation. This option will use the Red Revert time, if appropriate, as the time to remain all red.

ResetExtDwell

Typically, when a controller is in preemption running extended dwell and the same preemption call occurs, the preemption will finish out. If the call still exists at the end of preemption, the preemption will restart. If the user is in Extended Dwell and this parameter is ON, when a preemption call occurs the controller will go back to its dwell timer and will run extended dwell again, thus not restarting preemption.

Reservice Preempt

Typically, when a controller is in preemption running extended dwell and the same preemption call occurs, the preemption will finish out. If the call still exists at the end of preemption, the preemption will restart. If the user is in Extended Dwell and this parameter is ON, when a preemption call occurs the controller will immediately restart the preemption from the beginning.

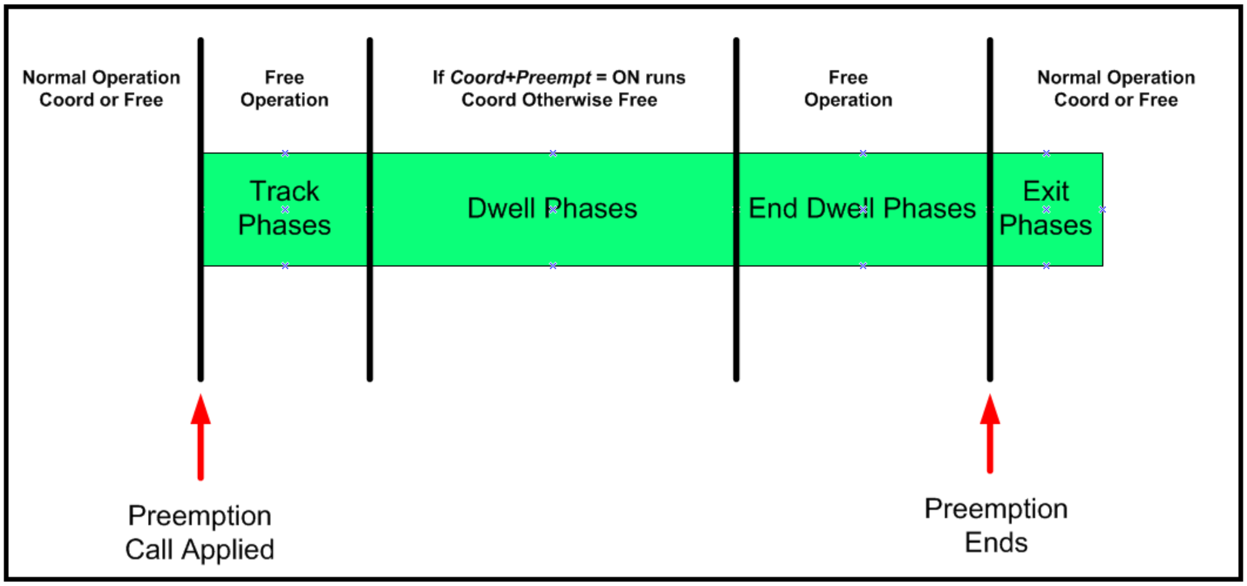
DsblDwellCalls

When set to **OFF** this feature will insure that dwell phases in each ring are recalled so that preemption will go to the Dwell period. When set to **ON**, preemption will wait for phases to be called prior to going to the dwell phases. Note: when setting this to ON, the agency should place at least one Dwell Phase **per ring** on recall to avoid resting in the Track Clearance Phase(s) until a call on the dwell phases occur.

End Dwell

This variable is used **prior** to exiting preemption. When the dwell period expires, and it is set to **ON,** it will look at which phases, that currently have a call (demand), that have not been served (including unserved dwell phases) during the preemption dwell period. It will cycles thru those under normal actuated free mode **prior** to the running Exit Phases, when the dwell period expires. Once this period begins, demand for any phase not selected must wait until the preemption exits.

```
# 1 AdvTimes
  FYA Clear      OFF      EnterYelChg 25.5
  ResetExtDwell  OFF      EnterRedClr 25.5
ReservicePrempt  OFF      TrackYelChg 25.5
       EndDwell  OFF      TrackRedClr 25.5
 Priority Level    1      PreRedClear OFF
 DsblDwellCalls  OFF
  DynExitThresh      0  DynExitMode NORMAL
  ExitVehCall
    ........ ........ ........ ........
  ExitPedCall
    ........ ........ ........ ........
```



Note: End Dwell is not available when running a flashing preemption.

Dynamic Exit Phases Threshold (0-999 sec), Dynamic Exit Mode

These two programmable features work together to dynamically select the preemption exit phases. For the dynamic selection of Exit phases, the **Dynamic Exit Phases Threshold** must be programmed to a value other than “0”. In other words, an entry of “0” indicates that programmed exit phases will be used.

If upon termination of preemption, any phases that have not been served for longer than the **Dynamic Exit Phases Threshold** time (in seconds), new exit phases will be selected; otherwise, the programmed exit phases will be used. The selected exit phases are dependent on the programmed values for the Dynamic Exit Mode as follows.

The dynamic exit phases are selected by finding the phase that has not been serviced for the longest period of time, and using that as the primary exit phase. Once the primary exit phases are selected, for all other rings, an exit phase is selected by choosing the phase that has not been served for the longest period of time that is compatible with the primary exit phase. An entry of “0” indicates that programmed exit phases will be used.

Please note the following decision tree that is used for this feature. When preemption dwell ends and the software is making the exit phases decision:

A. The software checks to see if any phase has been waiting longer than the threshold

If No, then we use the normally assigned exit phases and the preemption exits to those phases.

If yes, then the software proceeds to step B

B. The software selects which phase has waited the longest, and that becomes the primary exit phase

C. Next the software selects for each ring, the longest waiting phase that is compatible with the primary exit phase

D. Finally the software selects the primary exit phase and its subsequently selected compatible phases as the exit phases.

Dynamic Exit Mode = NORMAL

In NORMAL mode, only phases with demand (either physical input or recall) is considered for the decision in step A noted above.

Dynamic Exit Mode = ALWAYS

In this case, an exit phase is selected by choosing the phase that has not been served for the longest period of time, regardless of demand.

NOTE: The User should not program End Dwell with Dynamic Exit Phases Threshold timer. Further Note that all phases are eligible for dynamic exit phases unless the user chooses specific phases via MM-3-1-9 as discussed below.

```
# 1 AdvTimes
  FYA Clear     OFF     EnterYelChg 25.5
  ResetExtDwell OFF     EnterRedClr 25.5
ReservicePrempt OFF     TrackYelChg 25.5
       EndDwell OFF     TrackRedClr 25.5
 Priority Level   1     PreRedClear OFF
 DsblDwellCalls OFF
  DynExitThresh    0  DynExitMode NORMAL
  ExitVehCall
    ........ ........ ........ ........
  ExitPedCall
    ........ ........ ........ ........
```

```
InitPhase 0  0  0  0  0  0  0  0
InitPeds  0  0  0  0  0  0  0  0
InitOlaps 0  0  0  0  0  0  0  0
  (more)  0  0  0  0  0  0  0  0
  (more)  0  0  0  0  0  0  0  0
  (more)  0  0  0  0  0  0  0  0
```

Priority Level

This is the Priority Level for those phases that have the parameter **Override Higher # Preempt** (**MM->3->3**) set to **ON**. Valid Priority Numbers are 1-12, where 1 is the highest priority and 12 is the lowest. Preemptions with the same priority number will be run on a first come first served basis.

ExitVehCall

When exiting preemption, the user can select which phases will be run immediately after the Exit phases are run. Setting this parameter will guarantee a call on those phases selected.

ExitPedCall

When exiting preemption, the user can select which phases will be run immediately after the Exit phases are run. Setting this parameter will guarantee a call on those phases selected.

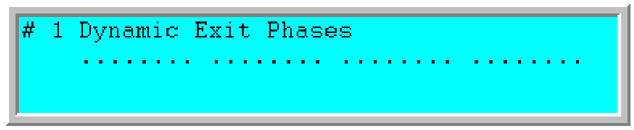
InitDwell selection

Consider the programming of the parameters as entry phases, pedestrians or overlaps prior to running the limited service preemption phases. The user can program any combination of phases, pedestrians or Overlaps to be run one time prior to running the Dwell phases as programmed at MM→3→2. The minimum amount of time that these phases, pedestrians or overlaps will run is based on the timing programmed under MM→1→1→1.

- **InitPhase -** These are the initial phases to be run once the preemption goes to the dwell period.
- **InitPeds -** These are the initial pedestrians to be run once the preemption goes to the dwell period.
- **InitOlaps -** These are the initial overlaps to be run once the preemption goes to the dwell period.

8.3.9 Preemption Enhanced Times (MM->3->1->9)

This screen allows the user to pick the allowable dynamic Exit Phases that may be selected. All thirty-two Phases are shown. Simply choose the phase(s) that are allowed to be chosen for Dynamic exit where the first column repersents phase 1 and the thirty-second column represents Phase 32.

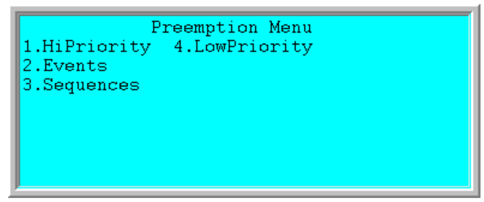


NOTE: The user should not choose any phase(s) that are programmed in the preemption.

Selecting no phases on this screen will allow the dynamic exit feature to pick any phase that has waited the longest. Some agencies that have more complicated intersections, such as a diamond setup may want to use dynamic exit but they don't want to exit preemption to certain phases that may cause them to skip the internal clearances. This screen wiil allow them to to identify which phases can be used for dynamic exit.

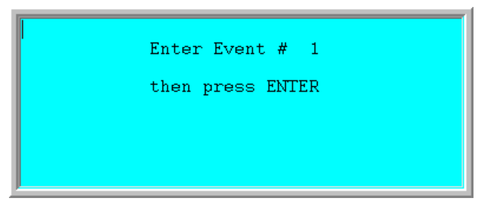
8.4 Special Events and Sequence Intervals (MM-3->2, MM->3->3)

There are four Special Event sequences that the user can select to run user selectable sequence intervals. These inputs can be mapped and when actuated the user defined sequences will be run user timed intervals.



8.4.1 Events (MM->3->2)

The user may select up to 4 events which will occur when a special event input is toggled. The user must select the event number as shown on the screen to the right. Once chosen the screen below is displayed and the user can program up to 16 events that will run for a specified time.

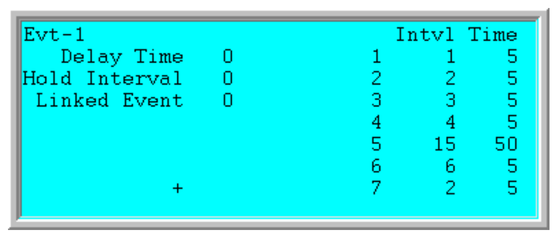


Intvl (1-32)

The event sequence is programmed under the Intvl column. All sequence intervals will be run in order from Interval 1 to Interval 16. If the Intvl column is "0", then it will be skipped. Interval sequences can be programmed and run multiple times during an event.

Time (0-255)

Programming this value in seconds (1- 255) will insure that the sequence selected will be run for the period of time that the user desires. A zero value will skip this interval.



Delay Time (0-255)

This value, programmed in seconds, will delay the special event sequence from occuring until this timer expires.

Hold Interval (1-16)

Programming a particular interval as a Hold Interval will "freeze" the sequences until the special event input is toggled to an "OFF" state.

Linked Event (1-4)

At the termination of the special event intervals, the linked event automatically receives a call, which is maintained as long as the demand for this, the original, special event input is active.

8.4.2 Sequences (MM->3->3)

```
Enter Sequence #  1
then press ENTER
```

Each sequence is programmed by the user to control the following controller inputs and outputs.

Start Phase

The interval selected will not start timing until the the phases selected by the user are running. At that point the interval will be run. Care should be made to insure that the phases selected are correct (not omitted and/or concurrent).

```
Seq- 1  <..>                      1111111
                       12345678  90123456
     StartPhase        .X......  ........
     Phase Omit        ..X...X.  ........
       Ped Omit        ........  ........
   Overlap Omit        ........  ........
      Veh Calls        ...X...X  ........
      Ped Calls        ........  ........
    Hold Phases        ........  ........
     Adv Phases        ........  ........
      Force Off        ........  ........
      Spec Func        ........  ........
```

Phase Omit
The user has the option to omit phases during the sequence interval.

Ped Omit
The user has the option to omit pedestrian phases during the sequence interval.

Overlap Omit
The user has the option to omit overlaps during the sequence interval.

Vehicle calls
The user has the option to call phases during the sequence interval.

Ped calls
The user has the option to call pedestrian phases during the sequence interval.

Hold Phases
The user has the option to hold and stay in phases during the sequence interval.

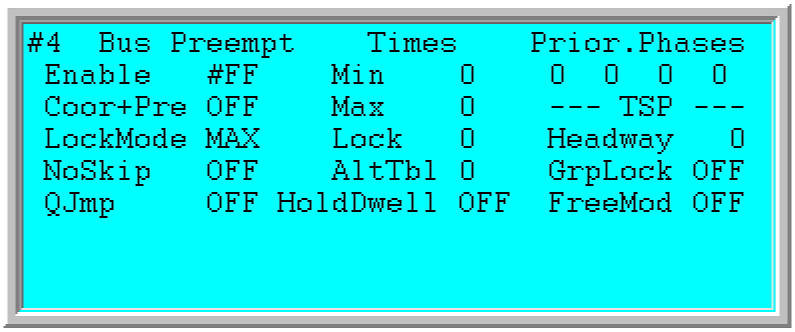
Advance Phases
The user has the option to advance to phases during the sequence interval.

Force Off
The user has the option to force off and leave phases during the sequence interval.

Spec Func
The user has the option to run special function outputs during the sequence interval.

8.5 Low-Priority Preempts LowPrior 1 – LowPrior 4

Low-priority preempts can be used for Low-Priority (Bus), Transit and emergency vehicle preemption. The Low Priority Preempts may be enabled as Low-Priority or Transit preempts by setting the *Enable* parameter either to **ON** or **TRANS** in menu **MM->3->4** (below). Low Priority Preempts 1 – 4 may also be enabled as high-priority emergency vehicle preempts 3-6 by setting the *Enable* parameter to **EMERG**. The following screen is used for programming:



The same physical inputs are shared for high-priority preempts 3 – 6 and low-priority inputs 7 – 10 if desired by the agency. The controller distinguishes between a high-priority and low priority input by recognizing a steady ground-true input as high-priority and a 6.25Hz oscillating signal as a low-priority input. The oscillating input is also recognized in a Type-1 cabinet facility when interfaced to a BIU through the SDLC port.

All programming required for low priority preemption is provided from menu **MM->3->4** for Low Priority preempts 1 – 4. However, low-priority EMERG preempts share programming with high-priority preempts as shown in the table below.

Preempt #	Preempt Input	Type (typical)	Programming Shared With Other Preempt
HP 1	HP 1 (steady low)	RAIL	No
HP 2	HP 2 (steady low)	RAIL	No
HP 3	HP 3 (steady low)	RAIL or EMERG – H Prior	No
HP 4	HP 4 (steady low)	RAIL or EMERG – H Prior	No
HP 5	HP 5 (steady low)	RAIL or EMERG – H Prior	No
HP 6	HP 6 (steady low)	RAIL or EMERG – H Prior	No
HP 7	HP 7 (steady low)	RAIL or EMERG – H Prior	No
HP 8	HP 8 (steady low)	RAIL or EMERG – H Prior	No
HP 9	HP 9 (steady low)	RAIL or EMERG – H Prior	No
HP 10	HP 10 (steady low)	RAIL or EMERG – H Prior	No
HP 11	HP 11 (steady low)	RAIL or EMERG – H Prior	No
HP 12	HP 12 (steady low)	RAIL or EMERG – H Prior	No
LP 1	LP 1 (steady low) or 3 (oscillating)	ON, EMERG, TRANS	EMERG shares programming with preempt 3
LP 2	LP 2 (steady low) or 4 (oscillating	ON,EMERG, TRANS	EMERG shares programming with preempt 4
LP 3	LP 3 (steady low) or 5 (oscillating)	ON,EMERG, TRANS	EMERG shares programming with preempt 5
LP 4	LP 4 (steady low) or 6 (oscillating	ON, EMERG, TRANS	EMERG shares programming with preempt 6

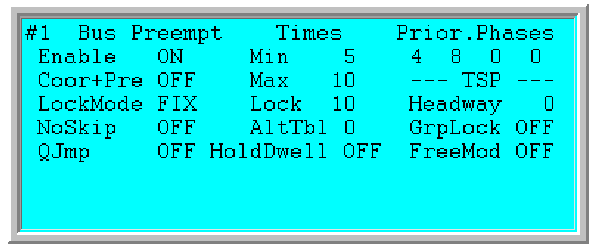
A Low-Priority (Bus) preempt responds differently from a low-priority EMERG vehicle preempt when activated. When a low-priority EMERG vehicle preempts is activated, the controller will apply programming associated with the high-priority preempt to transfer control to the high-priority dwell phase. When a Low-Priority preempt is activated, the controller will continue to service the current phase until it gaps out or maxes out (free operation) or is forced off (under coordination). The Low-Priority preempt will then move immediately to the bus phase specified in the menu above.

Under Unit parameters there is also a selection called LPAltSrc. Setting this parameter allows low-priority preempts 7-10 to be assigned to oscillating inputs on preempts 1-4 instead of 3-6.

8.5.1 Low-Priority Features

Enable (ON/OFF/EMERG/TRANS)

The Enable parameter must be set to ON to enable bus preemption or OFF to disable the preemption. The parameter may also be set to EMERG to enable a low-priority emergency vehicle preemption or TRANS for a Transit preemption variable.



The primary difference between the ON (bus preempt) option and the EMERG (low-priority emergency vehicle) or TRANS options lies in the preempt response during coordination. If the agency has purchased the Transit Signal Priority (TSP) module, the user will select the TRANS option.

Please ensure if **Enable** is set to ON, EMERG or TRANS that at least one non-zero priority phase is programmed.

Coor+Preempt

The Coord+Preempt parameter allows coordination to proceed in the background during the preempt sequences. This allows the controller to return to the phase(s) currently active in the background cycle rather than the next phases in rotation. This option allows the controller to return from preemption to coordination in SYNC without going through a transition period to correct the offset. Many agencies utilize the Coor+Preempt option when coordination is interrupted frequently by preemption.

Please note that because preemption is an emergency operation, there are times that the coordinator must go FREE to insure the safety of the motoring public. One example is during railroad preemption track clearance phase timing. If Track Clearance phases and timing are programmed, the coordinator will go free to insure that the vehicles will move off the track. Once the dwell phases begin timing, the coordinator will begin to transition back to being in SYNC.

Lock Mode (Max Lockout Type) Parameter (MAX/FIX)

The LockMode parameter only applies to low-priority requests. This locks out any other low pre call. The LockMode will tell how the controller uses the Lock (lockout) timer. Selecting FIX will lock out all low priority requests for the duration of the Lock time. Selecting MAX will lock out low priority requests based on the Lock time and demand. With LockMode set to MAX, a Lock time greater than zero will inhibit a new service request until the lock out period expires or all phases with demand when the lockout period begins have been serviced. In other words, a LockMode set to MAX is provided to insure that all demand phases have been serviced before a new request is serviced.

NoSkip (ON/OFF)

Setting **NoSkip** to **ON** services only the minimum times for all phases with calls prior to serving the transit phase(s). Think of it as “a poor man’s transit” because in effect, it reduces each phase to the phase minimum prior to serving the transit phase(s). Based on when the call occurs, as well as the sequence and concurrency that is currently running, the algorithm will move to the LP phases as soon as it can. This setting does **not** guarantee that all phases run prior to rotating to the LP preemption phase(s). Setting **NoSkip** to **OFF** will time out (gap out, max out or force off) the phase it is currently in and immediately move to the LP preemption phase(s).

QJmp (ON / OFF)

It enables a Low-priority transit overlap output (sign or indication) to display a Queue Jump signal (output) to the public.

Transit Priority Min and Max Times

The Min time (0-255 sec) insures that the priority request is active for the minimum period specified even if the oscillating input drops before the end of the period. This feature is useful to mask calls from an emitter that drops in and out when the phase selector is set to maximum sensitivity.

The Max time (0-255 sec) limits the time that a transit service can be active. If Max is zero, then no maximum limit is applied. The priority service will end after the Max time and will not re-service until the max lockout period ends to insure all phases with demand have been serviced.

Lock (Max Lockout Time)

The Lock time period (0-999 seconds) limits the duration of the lockout period following any preempt or priority service. A value of zero disables the lockout, thereby allowing a new priority request to be serviced 3” after another preemption or priority service ends. This inherent 3” lockout insures that the last service is complete and all affected values, including status screens have been updated before initiating the new service request. This timer is used in association with the LockMode parameter.

```
#1  Bus Preempt    Times     Prior.Phases
 Enable    ON     Min     5    4  8  0  0
 Coor+Pre  OFF    Max    10    --- TSP ---
 LockMode  FIX    Lock   10    Headway   0
 NoSkip    OFF    AltTbl 0     GrpLock OFF
 QJmp      OFF HoldDwell OFF   FreeMod OFF
```

Hold Dwell

When set to ON, Hold Dwell causes the controller to maintain the dwell interval while the preempt call is active. This feature may be used to cause a low-priority preempt to operate similar to an emergency vehicle (high-priority) preempt.

Prior Phases

For low priority preemption types EMERG or ON, whenever a 6.25 Hz oscillating signal is applied to high priority inputs 3-6 (PR7-10), the controller will either dwell in the Prior Phases specified if these phases are active, or move immediately to the Prior Phases without violating the min times and pedestrian times of the phases currently being serviced.

Please ensure if **Enable** is set to ON, EMERG or TRANS that at least one non-zero priority phase is programmed.

Headway (Maximum headway Time) (0-255 minutes)

Each low priority transit (Type= **TRANS** only) preemption has an independent internal headway timer which counts up from zero whenever a low priority preempt input occurs. While this time is running, the low priority preempt in question is "locked out" until the headway timer exceeds the time programmed under the Headway parameter. It is used in association with the GrpLock parameter.

GrpLock (ON / OFF)

The GrpLock parameter is used in association with the headway timer. When GrpLock is OFF, the specific headway timer for the existing low priority preemption will be run and not allow any new preemption call for the current running low priority preemption to occur until the maximum headway time is reached. When GrpLock is ON the specific headway timer for the existing low priority preemption will be run and will not allow a new preemption call for any low priority preemption to occur until the maximum headway time is reached for the current running preemption.

FreeMod (ON/OFF)

When running transit preemption (Enable=TRANS) some agencies do not want to program a “Free” pattern and associated transit split and strategy tables. Instead they want the preemption to act like a standard low priority preemption (Enable= ON). Setting the FreeMod parameter to ON will ignore any transit split and strategy programming and treat the preemption call as a standard low priority call. Make sure that in this case that the priority phases are programmed under the associated low priority preemption screen.

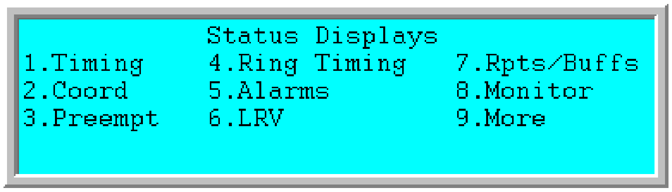
AltTbl

This feature allows the low priority preemption to change the min and Max times during the preemption by calling an alternate timing table.

9 Status Displays, Login & Utils

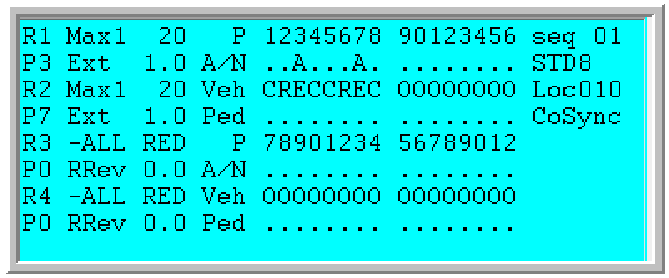
9.1 Status Displays (MM->7)

This chapter documents the *Status Displays* found under **MM->7**. Several of these displays were discussed in other sections of this manual where appropriate. For example, the *Coord Status Display* was discussed in depth in Chapter 6 – Coordination. Cross-references to previous sections in this manual are provided in this chapter to insure that every status display is thoroughly documented.



9.1.1 Phase Timing Status Display (MM->7->1)

The *Phase Timing* status display indicates whether the controller is running coordination, FREE or is in flash. This status display also shows which of the 32 phases are active, calls on each phase and the phase timing in each ring.

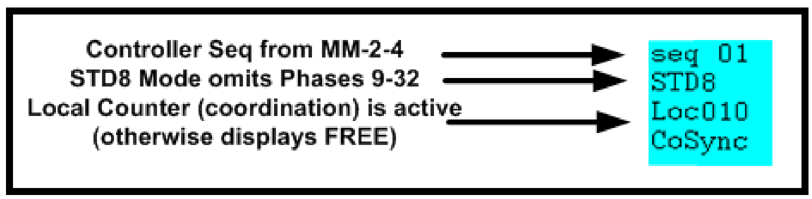


The *Phase Timing* status screen is divided into 3 separate areas to display:

- The current operation and sequence
- Ring status and phase timing
- Active phases and *Veh* / *Ped* calls and *Veh* extension for each phase

Current Sequence and Operation

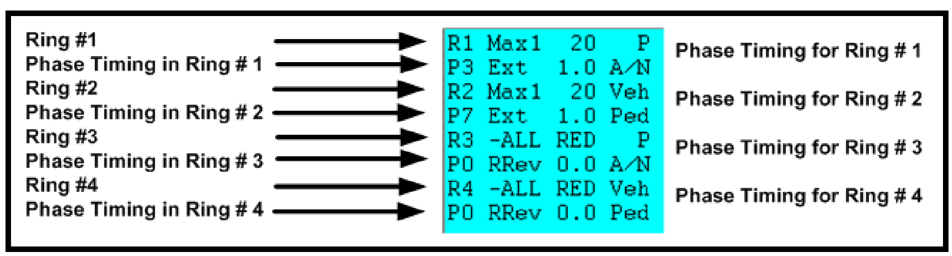
The current sequence and phase mode is displayed in the top right corner (the default is Seq 01, STD8 dual-ring). The second line will display FREE or the active Local timer if coordination is active.



Ring Status and Phase Timing

The left area of this status screen shows the active phase timing in each ring. The *Min* green, *Added Initial*, *Max* green, *Gap,extension*, *Yel* and *Red* intervals of the active phases are shown in each ring. The pedestrian intervals *Walk* and *Pclr* are displayed concurrently with the vehicle phase timing for each ring.

During FREE operation, *Term Gap* is displayed whenever the *Gap,extension* timer expires and the phase gaps-out. Otherwise, the *Gap,extension* timer will continue to reset and until the *Max1* or *Max2* timer expires and the *Term Max* message is displayed.



During coordination, *Term Fof* is displayed whenever a phase terminates due to a force-off. The example menu to the right is a "snapshot" taken of a controller during coordination with active phases 4 and 8 forced-off. The effect of max timing can also be observed from this display during coordination. If FLOATing force-offs are in effect, you will see a FloatMx time down in the ring as each phase is serviced. If FIXED force-offs are in effect, you will see Max1 or Max2 timing corresponding with the *Maximum* setting in *Coord Modes* (**MM->2->1**). If FIXED is in effect and the *Maximum* setting is MAX_INH, you will not see the max timer count down because the max timer is inhibited and cannot terminate the phase prior to its force-off (see chapter 6).

If *Guaranteed Passage Time* is enabled for the phase, the message LCAR is displayed while the phase times the difference between initial *Gap,extension* and the final extension at the time of gap-out

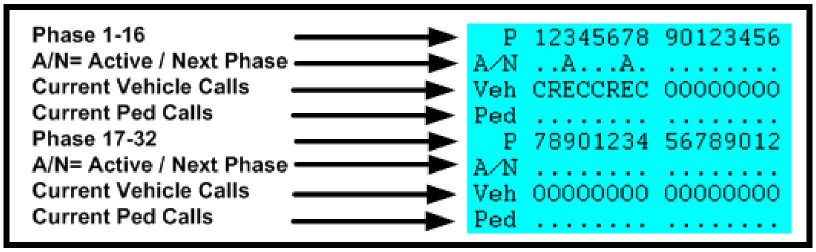
“AdIn”, “MxIn” or “T/Act” ring statuses will be displayed as appropriate after minimum green has expired and while added initial or max initial are timing.

Active / Next Phases and Veh / Calls on Each Phase

In the screen to the right, phase 4 and 8 are *Active* (**A**) and are being forced-off to phase 1 and 5 that are *Next* (**N**).

This is a STD8 controller (dual-ring 8-phase), so phases 9 - 32 are Omitted as shown with the "**O**" symbol.

Veh and *Ped* calls and *Veh* extension for all phases are shown using the following symbols:



.	The phase is enabled, but there is no call on this phase
R or **r**	Max "**R**"ecall or min "**r**"ecall has been programmed for the non-active phase
C	A vehicle "**C**"all has been placed on a non-active phase
S	A vehicle call has been placed on an active phase via detector "**S**"witching
K	A "K"eyboard call has been placed on a non-active phase. Also displayed if you make a call using the Screen Calls via **MM->7->9->9**.
E	A vehicle is "**E**"xtending an active phase
P or **p**	A "**P"**edestrian push-button call or a "**p**"ed recall has been placed on a non-active phase
F	A "**F**"orce-off has been issued to terminate an active phase (under coordination)

9.1.2 Coord Status Display (MM->7->2)

Please refer to chapter 6 for a discussion of the *Coord Status Display*.

9.1.3 Preempt Status (MM->7->3)

This screen shows the preemption status for each of the 12 High Priority preemptions as they occur.

```
Pre  Input  Age Interval   Time
 1     .      0 ---------     0
 2     .      0 ---------     0
 3     .      0 ---------     0
 4     X      0 DWELL         0
 5     .      0 ---------     0
 6     .      0 ---------     0
 7     .      0 ---------     0
 8     .      0 ---------     0
 9     .      0 ---------     0
10     .      0 ---------     0
11     .      0 ---------     0
12     .      0 ---------     0
```

9.1.4 Ring Timing Status (MM->7->4)

Ring timing is a dynamic status display that shows live timing status as the rings time. In particular the following items are displayed as columns on this screen:

R – Ring Number

Ps – Phase running

Tim - Current running timer

Int - Timing Interval (Min, Max1, Max2, Yel, Red, RRev, etc.)

Tim - Gap Timer

Ext - Extension timer

Max - Max green timer

Trm - Reason for Phase termination

Nxt - Phase Next

R	Ps	Tim	Int	Tim	Ext	Max	Trm	Nxt
1	2	32.1	Yel	1.3	1.3	0	3	3
2	6	32.1	Yel	1.3	1.3	0	3	7
3	0	0.0	RRev	0.0	0.0	0	0	0
4	0	0.0	RRev	0.0	0.0	0	0	0
5	0	0.0	RRev	0.0	0.0	0	0	0
6	0	0.0	RRev	0.0	0.0	0	0	0
7	0	0.0	RRev	0.0	0.0	0	0	0
8	0	0.0	RRev	0.0	0.0	0	0	0

9.1.5 Alarm Status Display (MM->7->5)

Events and *Alarms* are discussed in chapter 4. The *Alarm Status* for alarms 1-128 are provided in this status display. Note that alarms 129-255 are reserved for the closed loop master and are documented in the *Closed Loop Master Manual*.

9.1.6 LRV Status (MM->7->6)

This status screen shows the LRV (Transit) detector status. These detectors are programmed via the TranDet menu (MM->5->9->8) and typically are mapped to high priority preemptions1-12 via the TranPreMtrx selection (MM->5->9->5). For each transit call the user can program separate detectors to trigger the transit. This screen will show the calls when they are received. Below is an explanition of the calls:

Transit	AdvCall	ChkIn	ChkOut
1	X	X	.
2	.	.	.
3	.	.	.
4	.	.	.
5	.	.	.
6	.	.	.
7	.	.	.
8	.	.	.

AdvCall (Advanced Detector) – This is the detector that has placed the initial call to the LRV preemption

ChkInDet (Check-In Detector) – This is the detector that tells the controller that the LRV has arrived for service.

ChkOutDet (Check-Out Detector) – This is the detector that tells the controller that the LRV has cleared the intersection.

9.1.7 Reports and Buffers (MM->7->7)

The Volume and Occupancy Reports and Buffers menu is equivalent to **MM->5->8** and is documented in Chapter 5.

9.1.8 Monitor Status (MM->7->8)

Monitor status is provided for field testing purposes so that the field technician can monitor the controller in relationship with the cabinet and its monitoring devices. In particular the agency can get monitoring data from an MMU, CMU.

```
        Monitor Status Displays
1.MMU                        7.CMU Status
                             8.CMUCtrlStat
                             9.CMUVolt/Amp
```

MMU Status (MM->7->8->1)

MMU status screen.

CMU Status (MM->7->8->7)

CMU status screen is used with ITS Cabinets to display channel Faults and Field check faults.

```
              CMU STATUS
Time   0:00:00
Fault  0
Chn  < 1..8 > < 9.16 > <17..24> <25..32>
Flt  ........ ........ ........ ........
Red  ........ ........ ........ ........
Yel  ........ ........ ........ ........
Grn  ........ ........ ........ ........
Field Check
Red  ........ ........ ........ ........
Yel  ........ ........ ........ ........
Grn  ........ ........ ........ ........
```

CMU CtrlStat (MM->7->8->8)

CMUCtrlStat status screen is used with ITS cabinets and shows various control status as reported by the CMU to the controller.

```
          CMU CONTROL STATUS
Start Up Call  NO      Cfg Change NO
Out Relay Xfer OK
FTR Coil Drive OFF
Main Cont Coil OFF     Secondary  OFF
FRONT Door     Close   REAR Door Close
FLASHER Output OK
CMU OUTPUT    VAC    0 24VDC 00 12VDC   0
TEMPERATURE+  0F
ASSEMBLY(1-4)VAC   0    0    0    0
ASSEMBLY1 F1 OK    F2 OK
ASSEMBLY2 F1 OK    F2 OK                +
```

CMU Volt/Amp (MM->7->8->9)

CMUVolt/Amp status screen shows thw CMU Output Voltage/Amperage as well as the Current Sense outputs.

```
          CMU OUTPUT VOLTS/AMPS
Chn < 1..8 > < 9.16 > <17..24> <25..32>
Red
Red
Red
Yel
Yel
Yel
Grn
Grn
Grn
                                        +
```

```
Current Sense
    ........ ........ ........ ........
Amps
```

9.1.9 Overlaps Status Displays (MM->7->9->1)

The *Overlap Status* screen is equivalent to **MM->5->8** and is documented in chapter 4.

9.1.10 Easy Calcs (MM->7>9->2)

The *Easy Calcs* are documented in chapter 6. This menu is equivalent to menu **MM->2->8->2**.

9.1.11 Overview Status Screen (MM->7>9->5)

The *Overview Status Screen* is documented at the end of Chapter 3.

9.1.12 Phase Input / Inhibits (MM->7>9->6)

The *Phase Input / Inhibit Status Screen* is useful to study the effect of inhibits applied during coordination. These inhibits become active at the *Veh Apply* points and *Ped Apply* points discussed in Chapter 6.

```
Input/Inh Status      P1......8  9......6
    Coord Inhibit      --------  --------
  Preempt Inhibit      --------  --------
  Ped Inh(0 time)      *-*-*-*-  ********
   NTCIP Ped Omit      --------  --------
       Hold Input      --------
 Phase Omit Input      --------
   Ped Omit Input      --------
```

9.1.13 Fault Timers (MM->7>9->7)

The *Fault Timer Status* provides status displays to the errors and detector faults specified by NEMA.

```
Faults  P..1...2...3...4...5...6...7...8
P 1-8     244 279 299 224 244 279 299 224
P 9-16    300 300 300 300 300 300 300 300
P 17-24   300 300 300 300 300 300 300 300
P 25-32   299 299 299 299 299 299 299 299
Preempt Flt Tmr    0   Cyc Fault Time 300
Pre Seek Tk Clr    0   Pre Seek Dwell  10
Pre Seek Return    0          Fault Fail
                       Cycle       0   0
Cyc Flt Clr Tmr    0   Pre Cyc     0
                       Coord       0   0
```

Cycle Faults and Cycle failures occur when phases with demand are not serviced within an appropriate time. A cycle fault occurs when a phase is not serviced and coordination is active. A cycle failure occurs when a phase is not serviced during FREE operation. If a controller experiences a cycle fault (coordination active) it will kick the timer free. If the phase still isn't serviced, then a cycle failure is declared. Note that these TS2 features became defined long after the controller software had its own three-strike coordination failure feature. In order to continue to provide what our customers were already used to, we support both of these features simultaneously.

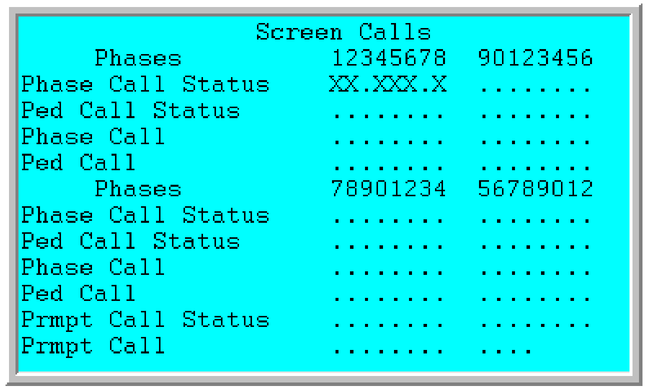
To accomplish the TS2 cycle fault/failure logic, a number of "cycle fault" timers are implemented. These down-timers are loaded when a phase is serviced with a value that is either entered by the user or calculated by the controller. If the controller calculates it, it provides liberal margin so that false alarms are not generated. The calculation is based upon either the cycle time or else accumulated individual phase times when operating free. If you observe the counters on the top two rows (phases 1-8 and 9-16), you will see them being pre-loaded as the phases are serviced and then count down as other phases are serviced. If they time to zero before being reloaded (i.e. serviced), then a fault or failure occurs.

The preemption timers are our own enhancement. The timers work similarly to the phase timers except that they represent the times expected to achieve interval states during preemption. The "seek" timers are loaded when the controller has begun moving to the appropriate interval (track clear, dwell, and return phases). Maximum seek times may be entered by the user on the Controller Parameters screen. When programming these, it is important to include any possible clearance times and then add a little margin. For times such as "seek track clear", the margin programmed in is generally pretty small, so it is important that the user or engineer knows what the times are supposed to be. Of course, this is true of track clearance times and in general, it is important to get right. This feature is a way to double-check that the controller is clearing the track in the expected amount of time. Using the alarm feature, the customer can get notified of a problem before taking the added step of causing the controller to go to flash during preemption.

Action to be taken upon cycle fault/failure is programmed by the "Cycl Flt Actn" parameter on the Controller Parameters screen. It can set an Alarm or else cause a controller fault and Flash the controller.

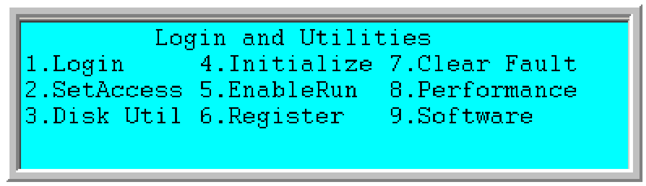
9.1.14 Screen Calls (MM->7>9->9)

This screen provides the user a method to places temporary Phase Calls, Pedestrian Calls and Preemption Calls for each phase using the controller's keyboard. Simply toggle the Phase Call that you want called to the on state ("X") and the call will be placed in the controller until you toggle the Phase Call to the off state ("."). Any calls that are toggled on will remain in the controller until your session is logged off. The real-time call status is also displayed on this screen. The timing status screen (MM→7→1) will display a "K" whenever these keyboard calls are made.



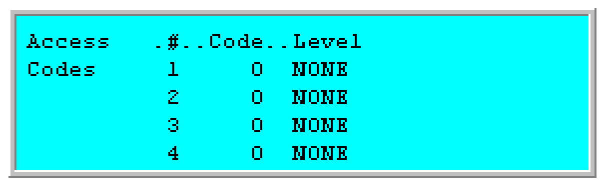
9.2 Login and Utilities

Up to 64 separate password logins are provided to control keyboard access to the controller database. The level of security can also be assigned to each user to control the ability to edit the database, load software and assign passwords. Various utilities are also provided from this menu to load the controller software (flash the EEPROMS), initialize the controller's database, print the database and perform diagnostic tests that interrogate the memory, ports and hardware associated with the controller.



9.2.1 Login Utilities (MM->8->1 & MM->8->2)

If any *Access Codes* are programmed under **MM->8->2**, the user will be required to provide a valid user number and access code to enable editing via the keyboard. Programming all access codes under **MM->8->2** to zero and setting the Level to NONE, disables all login procedures in the controller.

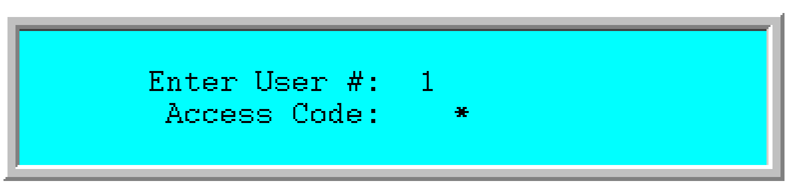


A maximum of 64 individual users and 4-digit access codes may be programmed by a SECUR user. Therefore, if access security is used, at least one access # should have *SECUR Level* access.

The security Level (from highest to lowest) is assigned as follows:

- **SECURE** User has full access to the database including the ability to assign passwords
- **SW LD** User has full access to the database and the ability to run diagnostics and load the controller software. The user may not assign passwords.
- **DIAG** User has edit access to the database plus the ability to run diagnostic utilities. The user cannot load controller software (reflash the controller) or assign security passwords
- **ENTRY** User has edit access to the database but cannot run diagnostics, load software or assign passwords
- **NONE** View only access to the database

Once established, the user can log in via **MM->8->1** as shown on the screen below:



9.2.2 Initialize Controller Database (MM->8->4)

Initialization screens

The screen for the initialization is shown.

```
            Initialize
1.Database
2.Run Options
3.Restart Controller
```

Initialize the Database (MM->8->4->1)

Initialize Database should be executed whenever new controller software is loaded in the 2070 controller (discussed in the next section). The controller may be initialized to one of the following default databases:

- **NO ACTION**: this default will ignore initialization
- **FULL-CLEAR**: this Clear EEPROM utility erases the EEPROM completely. A separate command is provided to erase only the initial part of EEPROM. These utilities are primarily used for hardware testing.
- **FULL-STD8**: this is the most appropriate default database and initializes the controller to 8 phase dual ring operation, often called quad-left operation
- **FULL-DIAMOND**: this default should only be used to initialize the controller to the operation defined in the *Operations Manual for Texas Diamond Controllers* that conforms with the TxDOT Diamond Controller Specification.

Normally the user will choose Full-STD8 to initialize the controller and do all the I/O mapping the traditional way as outlined in Chapter 12. For those agencies that would like to utilize simple input mapping an extra step after initialization will have to be done. It is accessed through this menu and is described below.

- **FULL NYSDOT-0 and NYSDOT-8** These are custom modes defined by the State of New York. NYSDOT-8 is intended for testing purposes and NYSDOT-0 is intended as a template for creating new controller databases. Phase timing and channel outputs are not defined in NYSDOT-0 and all phases are disabled. The phase mode in NYSDOT-0 is STD8 and the IO Mode for the C1 connector is USER. The intent of these defaults is to require the user to program the inputs to the C1 connector from the 33.x INPUT FILE.
- **FULL MODE 7** This custom mode is used by Broward County for their customized cabinets.
- **FULL CALTRANS** This custom mode is used by agencies that utilize CALTRANS 332 and 336 cabinets.

Run Options (MM->8->4->2)

Run options allows the user to active specific licensed software modules. To access this menu the user must turn off the Run Timer (MM→1→7) and select, by toggling the data to **YES**, the appropriate module as listed below. Once selected the user must power off the unit to implement and activate the software module. Then turn on the Run time to run the unit. The modules are:

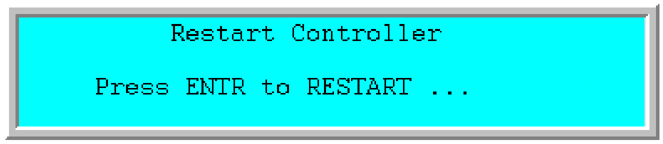
```
        Module Run-Time Enables
             Sel    Avail
Master       NO     YES
Transit      YES    YES
D-CS         NO     YES
NazAdapt     NO     YES
SynGrn       YES    YES
Emrgncy      NO     YES
WebAccess    NO     YES
```

- **Master:** Activate System Master software with Traffic Responsive on the Local Controller
- **DC-S:** Activate the Detector Control System software on the Local Controller
- **Transit:** Activate Transit Priority software on the Local Controller
- **Emrgncy:** Activate Emergency Priority software on the Local Controller
- **NazAdapt:** Activate System Master software with Traffic Adaptive on the Local Controller
- **SynGrn:** Activate Synchro Green Adaptive software on the Local Controller
- **WebAccess:** Allow web access to controller screens

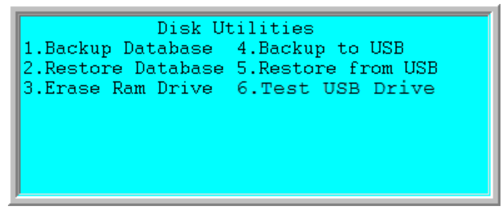
Contact your Cubic | Trafficware representative for further information on these modules and their availability based on various controller hardware platforms that they are installed on.

Restart Controller (MM->8->4->3)

This feature will allow the user to restart the controller without having to disable/enable the Run Timer. Therefore when making changes to features like I/O mapping, Phase concurrency/Sequence changes, Hardware Binding, etc. the user can do it while the controller is running. For those changes to occur the unit must be restarted (powered Off/On). Instead of bringing the intersection to a Flash State to accomplish this, the user can restart the controller using this feature. This feature will do a "software" restart when the controller is processing all-red. Keep in mind that this is a restart so all start-up options programmed will take effect. The user is cautioned when using this feature and should be present in the field when using this feature.



9.2.3 Disk Utilities (MM->8->3)



Disk Utilities are provided to back up or restore the user programmable features to either the Flash drive or a USB drive.

When a user programs the ATC or a 2070 with intersection control data, it is stored on the high speed Ram drive. This drive has a built-in capacitor back-up that will hold stored data for up to two weeks before clearing.

These important utilities will insure that the user backs up their intersection control data to the internal flash memory or to a USB drive.

NOTE: All disk utilities, except Backup to USB, require that the user turn off the Run Timer.

Command	Name	Function
MM-8-3-1	Backup Database	Backup data to Flash Memory
MM-8-3-2	Restore Database	Restore data from Flash Memory
MM-8-3-3	Erase Ram drive	This is used to erase the /r0 drive (2070 only)
MM-8-3-4	Backup to USB	Backup data to USB drive (ATC)
MM-8-3-5	Restore from USB	Restore data from USB Drive (ATC)
MM-8-3-6	Test USB Drive	Tests the USB for ATC compatibility. Users should run this first before backing up or restoring data to guarantee compatibility.

USB Drive considerations

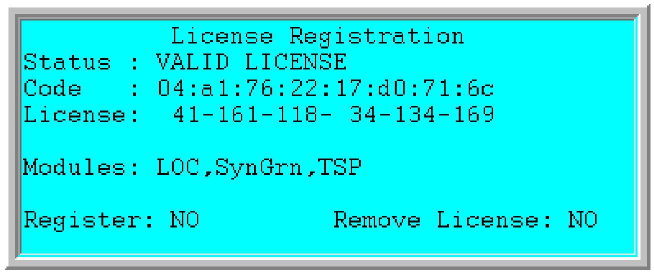
Users are cautioned to wait a few seconds after mounting the USB device to give it time to mount in the ATC.

In addition, the user must set up a directory named **naztec** (lowercase) on the USB root directory. Under the **naztec** directory the user must also create a directory called **databases** (lowercase). The USB drive should be a dedicated drive and only contain the directory **naztec** and its subdirectory **databases**.

9.2.4 EnableRun (MM->8->5, MM->1->7)

Enable Run shows the current status of the ***Run Timer*** programmed under menu **MM->1->7**. As discussed in a previous section of this chapter, the Run Timer is used with the ***Clear & Init All*** **utility (MM->8->4->1).** This utility allows the user to initialize the controller to a default database after turning the **Run Timer to OFF (MM->1->7)**. The run timer disables all outputs from the controller and insures that the cabinet is in flash when the database is initialized. The user should use caution when initializing the controller database because all existing program data will be erased and overwritten. When the initialization is complete, the user should turn the **Run Timer to ON (MM->1->7)** to finalize the initialization (i.e. finalizing phase sequence and concurrency based on phase mode programming, latching output mapping, binding communications, etc.) and activate the unit. If the Run Timer is in the OFF state when the controller is shut off, then the Run Timer will remain in the OFF state upon reboot until manually turned ON.

9.2.5 Register (MM->8->6)



A license or product key generator is a computer program that generates a licensing key, serial number, or some other registration information necessary to activate for use a software application. A software license is a legal instrument that governs the usage and distribution of computer software. Licenses are enforced by implementing in the software, a product activation or digital rights management (DRM) mechanism seeking to prevent unauthorized use of the software by issuing a code sequence that must be entered into the application when prompted or stored in its configuration.

All licenses will be centrally granted and managed via the Cubic | Trafficware website. The user must license the software on the controller before the Run Timer is allowed to be turned on.

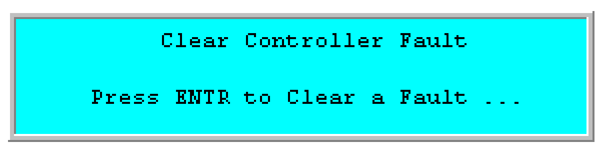
Registering a new License

1) Go to **MM->8->6** and get the code that is generated by the controller.
2) Send the controller code to your Cubic | Trafficware representative. This code will produce a License number that your representative will give to you.
3) Enter the generated License number.
4) Go to Register and select **YES** and hit the enter key.
5) The Status should change from **UNREGISTERED** to **VALID LICENSE**.
6) The user should power off/on the unit. The user is allowed to now turn on the Run Timer at **MM->1->7**.

Untegistering an existing License

1) GO to **MM->8->6** and navigate to Remove License and select **YES** and hit the enter key.
2) Hit the Esc Key and a new code will be generated. **DO NOT POWER OFF THE UNIT.**
3) Send the controller code to your Cubic | Trafficware representative. This code will produce a License number that your representative will give to you.
4) Enter the generated License number.
5) Go to Register and select **YES** and hit the enter key.
6) The Status should change from **UNREGISTERED** to **VALID LICENSE**.
7) The user should power off/on the unit. The user is allowed to now turn on the Run Timer at **MM->1->7**.

9.2.6 Clearing Controller Faults (MM->8->7)



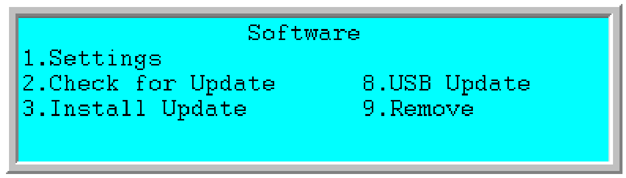
"Critical SDLC Faults" isolate errors defined by the NEMA TS2 specification. A controller fault is generated when communication is lost to an SDLC device (BIU) defined in **MM->1->3->7**. "Critical SDLC Faults" are cleared from menu **MM->8->7** by pressing the **ENTR** key. This entry will also clear any Cycle Faults or Cycle failures that may occur. Cycle Faults and Cycle failures are displayed via the Fault Timer screen at **MM->7->9->7**.

9.2.7 Performance (MM->8->8)

This screen is used to investigate OS-9 operating issues on 2070 CPU's only. It is intended for Cubic | Trafficware usage only. The user should proceed with caution when selecting this option and should contact Cubic | Trafficware support personnel for further information.

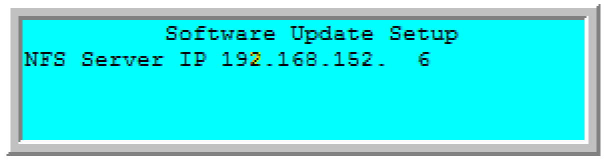
9.2.8 Software (MM->8->9)

This menu allows the agency to update its controller software by various means including utilizing a Network File Server (NFS), via a USB 2.0 Drive using the Validation suite (Valsuite) program that is built in the Linux operating system. Please note that the Run Timer must be off prior to updating software.

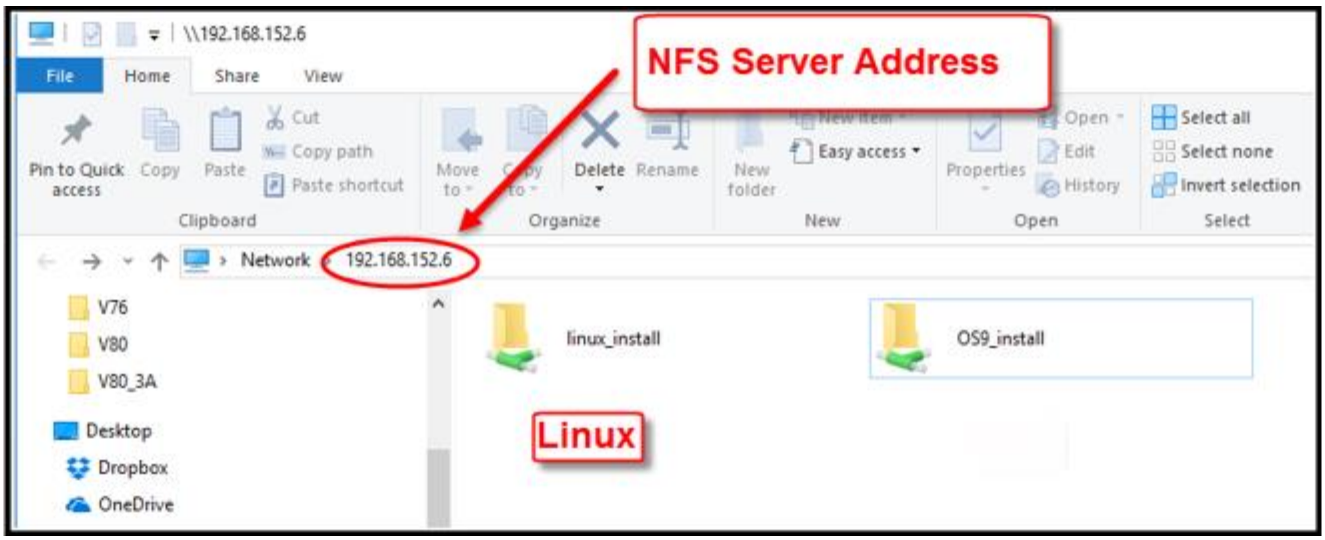


Settings (MM->8->9->1)

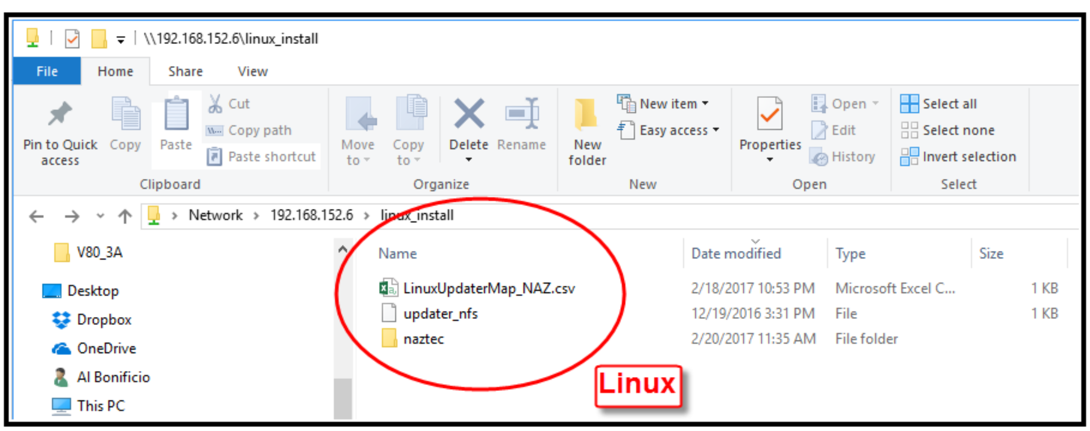
Settings is used for agencies that can access a centralized NFS server to access controller software updates. The agency IT department is responsible for setting up the NFS server. This screen expects that the NFS server is set up centrally and expects the IP address of the NFS server be programed on this screen. This data is needed prior to using this update method.



Based on the types of controllers that the agency has, it should set up the NFS server's root directory with the directory named linux _install.

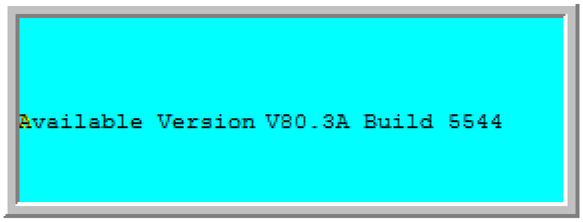


Under that directory, the agency should place the update files. Thes files are available from your Cubic | Trafficware representative. Below is an example of the update files for the linux installation that have been place under the Linux directory.



Check for Update (MM->8->9->2)

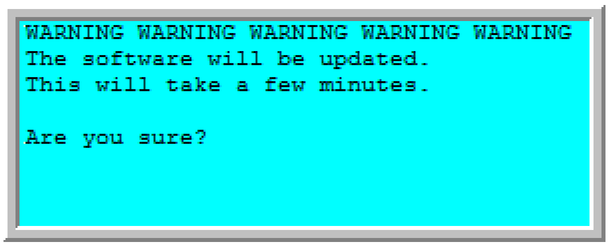
This selection will check the NFS server to verify that an update is available or if your software is up-to-date.



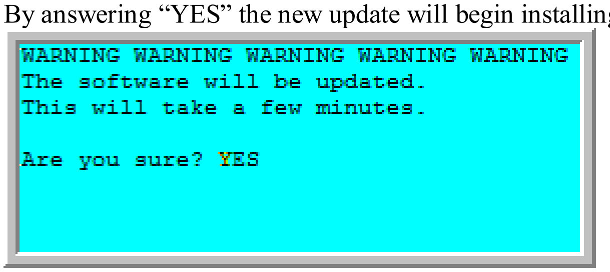
NOTE: Check for update must be done prior to Install Update.

Install Update (MM->8->9->3)

This will install the updated software on the controller. This feature requires that the Run-Timer (**MM->1->7**) is set to OFF. When entering this screen the following warning screen will be displayed.



By answering “YES” the new update will begin installing.

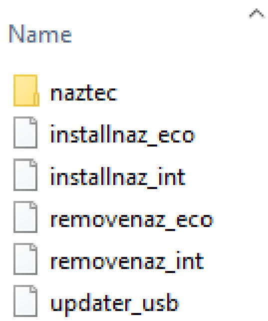


A screen will come up and say that the” **update was successful**”.

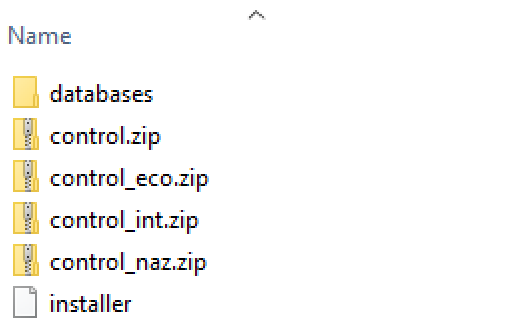
USB Update (MM-8->9->8)

This screen will update all control software on the ATC controller with an USB drive. The USB drive must be compatible with USB 2.x or 3.x. A USB Flash drive version 1.x will not work. In addition, The USB drive must have a "FAT32" format.

On the root of the USB drive create the **naztec** folder and place the files shown below, which are available from your Cubic | Trafficware representative:



Below is an example of the **naztec** folder setup:



The files shown in the root directory and in the **naztec** folder are <u>required</u> for the controller software update of Cubic | Trafficware and Econolite controllers.

<u>If any of the files are missing or out of place, the controller software update will fail.</u>

Be aware that the folder and files generated for the backup of the controller database can coexist on the same flash drive with the controller update folder and files.

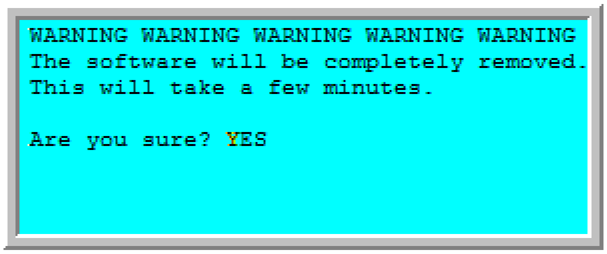
NOTE: control_eco.zip is used to update the controller software on Econolite hardware
control_naz.zip is used to update the controller software on Cubic | Trafficware hardware

An optional file named control.zip can also be placed in the **naztec** directory. It is used to install controller software on Cubic | Trafficware hardware which is running ValSuite.

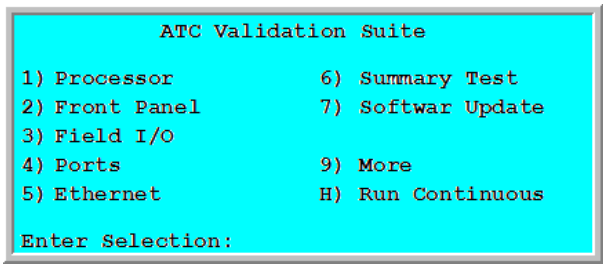
Once placed on the USB, Install the USB Drive. Then go to MM->9->8 which will automatically install the software

Remove (MM-8->9->9)

This screen will remove all control software from the ATC controller. The user should proceed with caution when selecting this option. Contact Cubic | Trafficware support personnel for further information.



A "**Yes**" answer will bring you to the Validation suite screen and the software will be removed.



10 Data Communications

10.1 Communication Menu (MM->6)

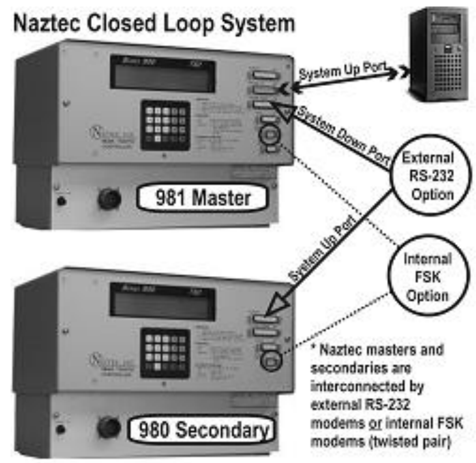
MM->6 configures the controller communications ports. The following sections describe the proper setup, observation, and use of the RS-232 communication ports and the Ethernet port provided with the 2070 or ATC.

```
          Communication Menu
1.General Parms    4.Req Downld 7.Status
2.Port Parms       5.IP Setup   8.Ping
3.Reserved         6.Binding
```

10.2 Central Communications

ATMS.now provides either direct communication to each controller in the system (master-less), or communicates with closed loop masters that serve as communication buffers for the secondary controllers in the system.

A TS2 or ATC master controller interconnects up to 32 secondary controllers using RS-232 modems communicating at 600 - 38.4 Kbaud. Internal FSK modems can also be used to provide data communication rates up to 9600 baud over twisted pair. Full and half-duplex asynchronous communication is fully supported.



10.3 General Communication Parameters (MM->6->1)

```
          General Comm Parms
StationID    :11121
GroupID      :    0
MasterID     :    0
BackupTime   :  900
FailTime     :    0
```

Station ID (Range 1 - 65,535 – see Note below)

The Station ID is a unique identification number (or address) assigned to every master and secondary controller in the system. When ATMS.now initiates a communication poll to a *Station ID*, all controllers on the same communication path (including the controllers in the master's subsystem) receive the same poll request. However, the only controller responding to this request is the *Station ID* matching the ID contained in the poll request. This unique controller addressing provides the poll/response system typically found in point-to-point traffic control systems.

Note: The Cubic | Trafficware **DEFAULT** protocol supports controller addresses in the range of 1-65,535; however, the valid range under the NTCIP protocol is 1-8192.

Master Station ID (1 - 65535)

The Master Station ID is the ID of the master controller when the secondary is operating in a system under a master. Valid Master IDs are in the range of 1-65535 under the Cubic | Trafficware DEFAULT protocol and 1-8192 under NTCIP.

Group ID

The Group ID is reserved for future under NTCIP using a broadcast message to all secondary controllers programmed with the same group address. Currently, the secondary controllers a response message is received by the central or master when a secondary controller is polled within a system. A group broadcast does not expect a reply message and provides no status that the message was actually received.

Backup Time

Backup Time is an NTCIP object used to revert a secondary controller to local time base control if system communication is lost. The *Backup Time* (specified in seconds) is a countdown timer that is reset by any valid poll received from a closed loop master or from the central office. Therefore, it is possible for a secondary operating under closed loop to receive polls that set the clock or gather status or detector information without receiving an updated Sys pattern. This timer ranges from 0-9999 seconds.

FailTime

This parameter is programmed in minutes. If the controller has received NO COMM for this amount of time, then alarm #84 (**Comm Fail**) is set. The Comm Fail alarm is used to drive other functionality, aside from reporting Comm failures (i.e. the External coord on comm fail feature above)

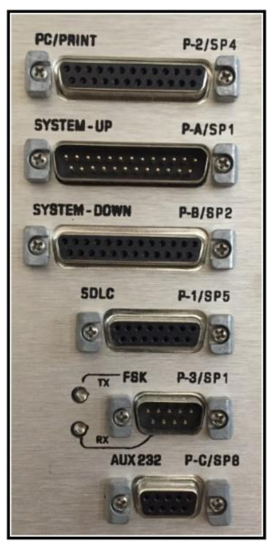
10.4 2070/ATC Communications Port Parameters (MM->6->2)

After a system reset (SYSRESET), the 2070 serial ports are initialized as follows. The board label and slot position of each SP port are also provided as a reference. Note that the port must be assigned to the correct slot position in the 2070. Slot positions are read left to right with A1 at the far left when viewed from the back of the controller.

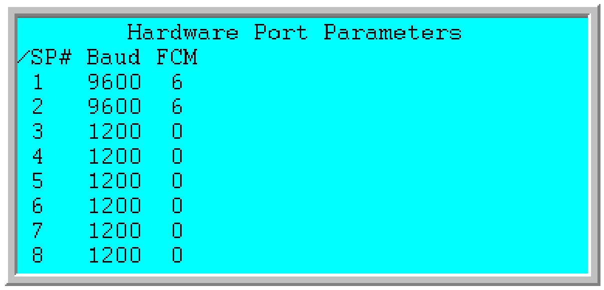
Serial Port	Board	Slot	Connector	Default Settings When the 2070 is Reset
SP1	2070-7A	A2	C21S	1.2 Kbps, 8-bit, 1 stop, no parity, no pause, no echo
SP1S	2070-7B	A2	TBD	1.2 Kbps, 8-bit, 1 stop, no parity, no pause, no echo
SP2	2070-7A	A2	C22S	
SP2S	2070-7B	A2	TBD	
SP3	2070-7A	A1	C21S	
SP3S	2070-2A/2B	A3	C12S	614.4 Kbps
SP4	FPA		C50S	9.6 Kbps, 8-bit, 1 stop, no parity, no pause, XDR off, xoff
SP5S	2070-2A/2B	A3	C12S	614.4 Kbps
SP8	2070-1B	A5	C13S	
SP8S	2070-1B	A5	C13S	

Similar Ports are available on the ATC as shown below:

Serial Port	Connector
SP1	SYSTEM UP
SP1	FSK
SP2	SYSTEM DOWN
SP3	C21S
SP4	PC PRINT
SP5	SDLC
SP8	AUX 232



The *Communications Port Parameters* under menu **MM->6->2** (menu to the right) allow you to change the default baud rate settings and the FCM (Flow Control Mode) of the eight 2070/ATC serial ports. This programming overrides the default baud rate settings shown to the right when the unit is initialized.

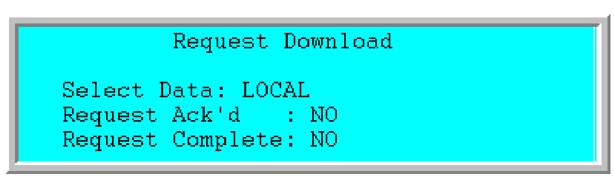


FCM	Description of FCM (Flow Control Mode)
0	**No Flow Control Mode:** The CTS and CD signals are set asserted internally, so the serial device driver can receive data at all times. Upon a write command, the serial device driver asserts RTS to start data transmission, and de-asserts RTS when data transmission is completed. When user programs issue the first RTS related command, the driver switches to Manual Flow Control Mode.
1	**Manual Flow Control Mode:** The serial device driver transmits and receives data regardless of the RTS, CTS, and CD states. The user program has absolute control of the RTS state and can inquire of the states of CTS and CD. The states of CTS and CD are set externally by a DCE. The device driver doesn't assert or de-assert the RTS.
2	**Auto-CTS Flow Control Mode:** The serial device driver transmits data when CTS is asserted. The CTS state is controlled externally by a DCE. The user program has absolute control of the RTS state. The CD is set asserted internally. The device driver doesn't assert or de-assert the RTS.
3	**Auto-RTS Flow Control Mode:** The CTS and CD are set asserted internally. The serial device driver receives and transmits data at all times. Upon a write command, the serial device driver asserts RTS to start data transmission, and de-asserts RTS when data transmission is completed. If the user program asserts the RTS, the RTS remains to be on until user program de-asserts RTS. If user program de-asserts RTS before the transmitting buffer is empty, the driver holds RTS on until the transmitting buffer is empty. Parameters related to delays of the RTS turn-off after last character are user configurable.
4	**Fully Automatic Flow Control Mode:** The serial device driver receives data when CD is asserted. Upon a write command, the serial device driver asserts RTS and wait for CTS, starts data transmission when CTS is asserted, and de-asserts RTS when data transmission is completed. Parameters related to delays of RTS turn-off after last character are user configurable. If user program asserts the RTS, RTS remains to be on until user program de-asserts RTS. If user program de-asserts RTS before the transmitting buffer is empty, the driver holds RTS on until the transmitting buffer is empty.
5	**Dynamic Flow Control Mode:** The Serial device driver maintains a transmit buffer and a receive buffer with fixed sizes, controls the state of RTS and monitors the state of CTS. The transmission and reception of data are managed automatically by the serial device driver. The serial device driver transmits data when CTS is asserted. The serial device driver asserts RTS when its receiving buffer is filled below certain level (low watermark), and de-asserts RTS when its receiving buffer is filled above certain level (high watermark).
6	**Cubic | Trafficware Enhanced Flow Control Mode**: This is the recommended flow control mode for all RS-232 applications using the 2070. This mode combines the features of modes 0 and 2 and provides a hardware RTS/CTS handshake with any device connected to the serial port. However, request-to-send and clear-to-send are controlled directly from the control program rather than through the OS-9 operating system. This method allows the control program to communicate with some devices that cannot be interfaced through OS-9.

FCM definitions above were taken from Section 9.2.7.2.5, CALTRANS TEES Specification dated November 19, 1999

10.5 Request Download (MM->6->4)

The *Request Download* screen allows an operator in the field to request a download of the permanent file in the ATMS.now database by selecting LOCAL or MASTER from the menu shown in the menu to the right. In addition, this screen will show if the download was acknowledged by the field controller and when it is completed.



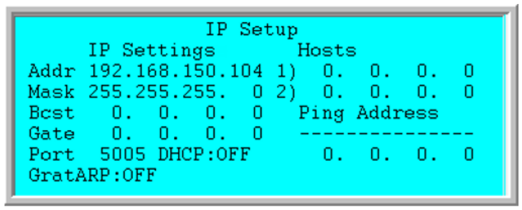
10.6 IP General Setup (MM->6->5)

The IP Setup menu configures the IP (Internet Protocol) port for an ATC controller. There should not be an upload-download cable installed in the *System-Up* port because jumper pins 24 and 25 on this cable disable the TS2 Ethernet interface.

Depending on the controller hardware platform, any time that you change the IP settings from menu **MM->6->5**, you may have to toggle controller power to cause changes in the IP settings to take effect.

Later in this chapter, a basic test procedure to check connectivity for a controller Ethernet interface is provided.

10.6.1 IP Setup (MM->6->5)



The *IP Setup* menu configures the IP (Internet Protocol) ports implemented through the controller's Ethernet interface. The IP settings are used to identify an ATC residing on a TCP/IP network like the Station ID is used to identify a controller residing on a serial data link.

You must provide separate IP address (***Addr***) and ***Mask*** settings for the *Device* (local controller) and *Host* (central system). Please note that a second host computer can also be addressed via this screen. The ***Bcast*** (Broadcast) address and ***Gate*** (Gateway) address settings are optional, but may be required for your network configuration. You must also provide an IP ***Port*** number which will match the port # in the particular Drop that you are communicating with as specified in ATMS. Ask your network administrator or the one who configured your network to explain how these additional settings are used if you need additional information.

The *IP Address* and *Mask* must be configured correctly for the local network. IP 1 is assigned to the local controller. The *Broadcast* and Gateway addresses are allowed be set to 0.0.0.0 if the subnet addressing or routing is not called for. Changes to *IP Setup* should take effect when the user leaves menu **MM->6->5**. As noted above, depending on the controller hardware platform, any time that you change the IP settings from menu **MM->6->5**, you may have to toggle controller power to cause changes in the IP settings to take effect.

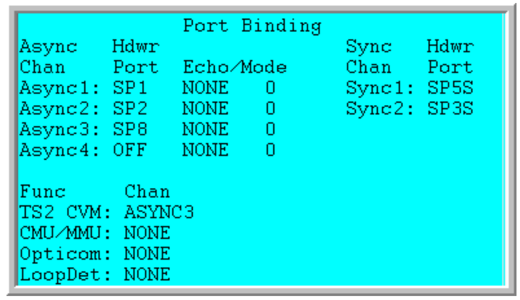
DHCP (Dynamic Host Configuration Protocol) can be turned on if the agency requires it. In this case do not program the IP address of the local unit because one will be provided automatically by DHCP. The IP port Number must be programmed. In addition the user must program the *Host* IP address of the central Server when communicating to ATMS.

Gratuitous ARP is used when hosts need to update other local host ARP tables, and to check for duplicate IP address. If ***GratARP*** is set to **ON**, every minute a request is made to the Host (typically the ATMS server or the address programmed under the ***Host1*** address) to re-establish its ARP tables. Using this feature will allow Hosts to discovered newly added controllers to the system.

A ***Ping Address*** can be programmed to allow the controller to see if it can communicate to the system. The user can ping the specified address via **MM->6->8**.

NOTE: Peer to Peer programming (**MM-1->9->3**) will **ONLY** work if the user **DOES NOT** program any Host IP address under **MM->6->5**.

10.7 2070 Binding (MM->6->6)



The *Binding* menu associates the physical hardware ports of the 2070 controller with the logical ports assigned through software. Please refer to chapter 14 if you are not familiar with the 2070 I/O modules.

For most applications, "Software Ports" SP1 and SP2 correspond with the 9-pin serial connectors, C21S and C22S on the 2070-7A card. Recall from the table in chapter 9 that the 2070-7A card must reside in slot A2 to support these two ports.

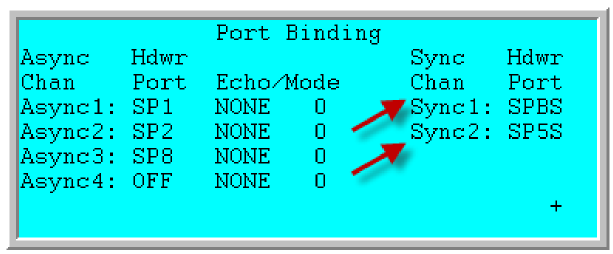
The FIO 20 interface supports the ATC cabinet and the 2070N expansion chassis. This interface requires that "Software Port" SP5 correspond with the FIO 20 interface. The hardware connector for FIO 20 is identified as the C12S connector on the 2070-2A and 2070-2B Field I/O Modules. These parameters are set by hardware and cannot be changed from their defaults: FIO20 = SYNC1 and TS2IO = SYNC2.

The FIO 20 interface must also be assigned to SP5 to interface the Cubic | Trafficware Test Box with the C12S connector. The Cubic | Trafficware Test Box essentially emulates the operation of the 2070N expansion chassis. **The user must power cycle the controller to ensure that the port changes have been bound. The modified binding will then run once the Run Timer (MM->1->7) is enabled.**

Please note: The only binding selection available for Opticom or CMU/MMU functions is ASYNC1.

10.8 Series 900 ATC Binding (MM->6->6)

The binding for the series 900 ATC is the same as the 2070 binding, except that the user must set Sync1 to SPBS and Sync2 to SP5S.



10.9 Basic IP Interface Connectivity Test

The following guidelines should be used to test basic connectivity between a TS2, 2070 or other ATC controllers and a laptop computer. It assumes typical setups that many agencies use. Be sure to set the TS2 communications protocol under *General Parameters* (**MM->6->1**) to NTCIP. The communication protocol for the 2070 and the Series 900 ATC is NTCIP by default.

The network should be properly configured by your network administrator. As a minimum, the controller settings under **MM->6->5** must provide the local IP address and mask settings for the network (typically the IP 1 address for the 2070). These settings are discussed in chapter 9 for the TS2 Ethernet option and 9.9 for the 2070 controller.

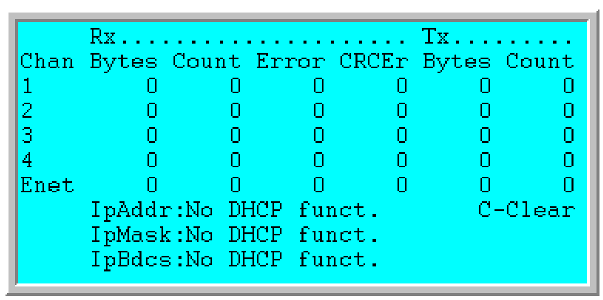
The first three octets of the IP address are typically be shared by all devices on the network (including the central computer). The last 3-digit octet must be unique for all devices on the network (like the unique *Station ID* used with serial communications). For example, the central computer might be assigned an IP address xxx.yyy.zzz.001 and the local controller xxx.yyy.zzz.002. Every device on this network would share the same "network" address xxx.yyy.zzz. However, each device, including the central computer (.001) would be required to have a unique address on the network.

You can test connectivity using a "cross-over" Ethernet cable to interface the controller directly with the Ethernet port of your computer. A "cross-over" cable is similar to a null-modem cable that switches transmit and receive pairs between two RS-232 devices. You cannot directly connect the controller to a computer using the same RJ45 Ethernet cable that you use to connect to your local computer network. Your computer must also be configured with a "static" IP address instead of the "dynamic" address typically used with LAN and dial-up Internet connections. Changing your network settings is not advised unless you know what you are doing because this will disrupt your LAN and Internet connection.

For this test, assume that the computer is configured with "fixed" IP address 192.168.001 and the controller is configured with 192.168.100.002 under **MM->6->5**. The network interface of the computer and local controller share the same *Mask* address 255.255.255.0. Basic connectivity of the Ethernet circuit may be confirmed by running a command line program, called *Ping* from Windows. Select *Run* from the *Start Menu*, enter "command" and press OK. This launches a command window where you can execute the ping command. Enter the command "ping 192.168.100.002" and press return. If the Ethernet circuit is functional, you should see a several replies from the controller each time the computer "pings" it's local IP address. If the controller does not respond, you will see a timeout message indicating that the Ethernet interface is not connected. If this basic "ping test" passes from the ATMS.now communication server, but you cannot communicate with the same controller in ATMS.now, then you have an error in your com server software configuration.

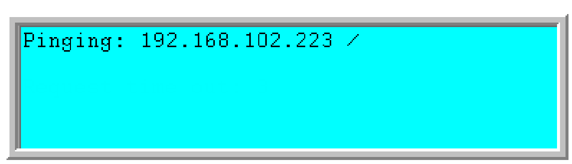
10.10 Com Status

The TS2 *Communication Status Screen* monitors the activity of each communication port and shows transmitting (TX) or receiving (Rx) bytes. In addition, this screen will also indicate if the DHCP connection has been established.



10.11 Ping Status (MM->6->8)

When a Ping address is selected under **MM->6->5** for a unit connected to the controller, this selection will allow the user to see if the controller can reach out to the addressed unit.

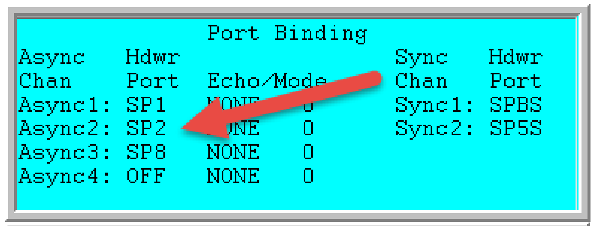


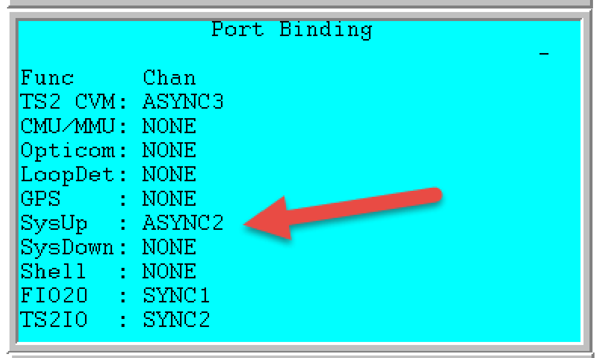
10.12 ATC GPS Interface Setup

ATC controllers can be used to update the time sync from various GPS receivers. Units such as the Garmin GPS 16x device (shown to the right) can be connected externally to the controller serial ports. Cubic | Trafficware has also created software to support Garmin, Intelight, ASI (Adaptive Solutions, Inc), and McCain GPS devices.

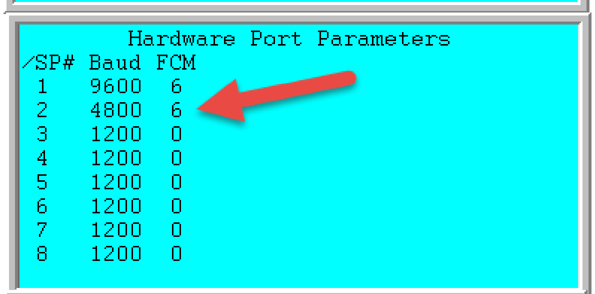
The following steps are required to setup the GPS interface.

1) Set the com port mode under the Binding screen (MM->6->6) to "GPS" for the com port (SP1, SP2 SP3 or SP4) that is interfaced to the GPS. In the example screens on the right, SP2 Is set to ASYNC2 which is mapped to the Garmin GPS.

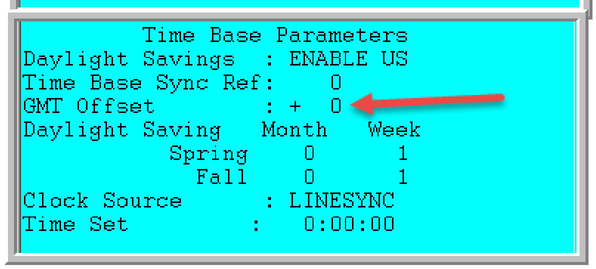




2) Set the baud rate of GPS com port to "4800" under MM->6->2.

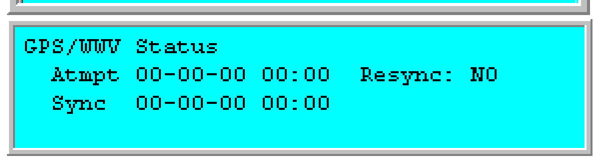


3) Select the GMT offset (MM-4-6) for you location based upon your time zone (EST = -5, CST = -6, PST = -8). Be sure to select the proper +/- sign.



4) Resync the GPS

The controller will automatically resync the time from the GPS twice per hour at approximately 13 and 43 minutes past the hour, every hour. The MM->4->9->3 screen provides the last date/time stamp when the controller attempted to communicate with the GPS device. The status also shows the time returned by the GPS and a text message indicating if the attempt was successful. The menu also allows the used to manually force the controller to resync the GPS. Toggle the *Resync* setting to "YES" and press <ENTR> under MM->4->9->3.



The following status messages are displayed after the controller attempts to communicate with the GPS.

"OK Reply" **-** the received message was correct and implemented

"No Reply" **-** the controller did not receive a reply from the GPS module

"No Signal" **-** the GPS module has not acquired a signal from the satellite

"Bad Reply" **-** the receive message had a data error

NOTE: The Run Timer (MM-1-7) Must be set to ON for controller to update the date/time from the Garmin GPS device.

10.13 2070 ATC GPS Interface

The GPS interface for the 2070 is identical to the operation for the ATC discussed in the last section with the exception of the com port settings.

In addition the GPS can be connected internally via 2070-7T or 2070-7G card modules like the ASI, Intelight, and McCain GPS units

The 2070 also provides 4 hardware serial ports (SP1, SP2, SP3 and SP8) which may be assigned to the 4 logical ports (ASYNCH 1-4) under the port binding menu. The default programming assumes that SP1 and SP2 located on the 2070-7A card are assigned to ASYNCH1 and ASYNCH2 respectively. SP8 is typically assigned to ASYNCH3 and dedicated for the internal hardware of the controller.

```
                 Port Binding
Async    Hdwr                      Sync     Hdwr
Chan     Port  Echo/Mode           Chan     Port
Async1:  SP1   NONE     0          Sync1:   SP5S
Async2:  SP2   NONE     0          Sync2:   SP3S
Async3:  SP8   NONE     0
Async4:  OFF   NONE     0
                                               +
```

```
                 Port Binding
Func       Chan                                -
TS2 CVM:   NONE
CMU/MMU:   NONE
Opticom:   NONE
LoopDet:   NONE
GPS     :  ASYNC2
SysUp   :  ASYNC1                              +
```

In the example to the right, SP1 on a 2070-7A card is assigned to the system and SP2 is assigned to the GPS unit. The baud rate of SP2 must be set to 4800 under MM->6->2 as shown below.

The configuration of the GPS device for the 2070 is identical with the TS2 discussed in the last section. You must set the GMT offset under *Time Base Parameters* (MM->4-6) for your time zone (EST = -5, CST = -6, PST = -8). Be sure to select the proper +/- sign. Use the MM->4->9->3 status screen to display the last date/time stamp the controller attempted a resync with the GPS device. The MM->4->9->3 screen can also be used to manually resync the GPS unit.

```
        Hardware Port Parameters
/SP# Baud FCM
 1   9600  6
 2   4800  6
 3   1200  0
 4   1200  0
 5   1200  0
 6   1200  0        +
```

If a function port is not assigned, then the GPS status screen at MM->4->9->3 displays "NO PORT" at all times.

NOTE: The Garmin GPS unit, described above, is the preferred unit that Cubic | Trafficware interfaces with. Contact your Cubic | Trafficware representative about the availability of interfacing with other GPS units such as the ASI, Intelight, and McCain GPS units.

11 TS2, ITS & FIO SDLC Programming

V80.x software can be used on various cabinet platforms including NEMA TS1, TS2 Type 1, TS2 Type 2, Model 330/332/336 cabinets and ITS Cabinets. This chapter will discuss specifically the TS2 Type 1 cabinet interface (SDLC) and the ITS Cabinet Interface. Both use a 2070/ATC hardware concept called FIO (Field Inputs/Outputs) that will be set to properly communicate to agency's specific cabinet (s).

```
          TS2, ITS & FIO SDLC
1.TS2 Devices 4.SDLC Parms 7.ITS Devices
2.TS2 Status  5.MMU Map    8.ITS Status
3.MMU Perms                9 CMU Perms
```

11.1 SDLC for TS2 Devices

Channel and *SDLC* features are programmed from **MM->1->3**. Refer to Chapter 2 of this manual for an overview of the differences between TS2 and 2070 SDLC programming, The SDLC interface is a high-speed (153.6 Kbps) serial data bus that transmits Type-1 messages between the SDLC devices between the controller, terminal facility (or back-panel), detector rack and MMU. The BIU (Bus Interface Unit) is the primary SDLC device responsible for transmitting and receiving standard messages defined in the NEMA TS2 specification. Any BIU enabled in the controller will immediately begin communicating through the SDLC interface as long as the *Run-Timer* is ON.

11.1.1 Activating TS2 Devices (MM->1->3->1)

```
SDLC Device: Term/Fac  Detector MMU Diag
       BIU #: 12345678  12345678
Dev. Present XX......  X.......  X    .
Peer-to-Peer ........  ........  .    .
```

Individual BIU devices are enabled by selecting an "X" under the device on this screen. The first eight BIUs support the terminal facility (cabinet) followed by eight BIUs for detection and one BIU for the MMU. NEMA only defines the first four terminal facility (TF) BIUs. Detector Facility BIUs 1-4 are used for standard NEMA detectors 1-64. Peer-to-peer BIU functions are reserved for future implementation. The Diagnostic selection is reserved for manufacturer's testing purposes. Detector Facility BIUs 5-8 are ONLY used for Cubic | Trafficware Pods. When used with Pods, avoid detector overlap between SIUs and BIUs. For example, do not use detectors 65-72 on BIU 5 if SIU 3 is in use because SIU 3 includes detectors 49-72.

11.1.2 SDLC Parameters (MM->1->3->4)

The following SDLC parameters modify the default operation of the SDLC interface for the TS2 and 2070 controller versions.

SDLC Retry Time

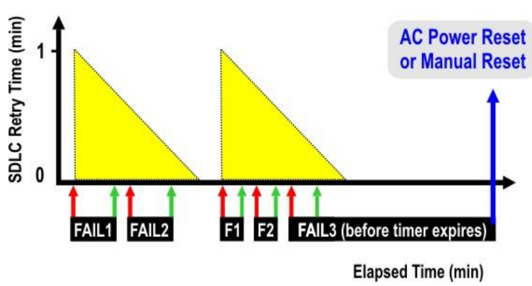
```
             SDLC Parameters

RetryTime    :   0    Enable Msg0: OFF
Ts2DetFaults: ON      Enable TOD : OFF
SlowMsgOvrd : OFF
```

SDLC Retry Time (0- 255 minutes) is a countdown timer initiated by a critical SDLC fault that determines how the controller recovers from SDLC communication errors.

1) If the *SDLC Retry Time* is zero, a critical SDLC fault is latched by the controller until AC power is cycled or the fault is cleared manually by an operator using keystrokes **MM->8->7**.

2) If the *SDLC Retry Time* is not zero, a critical SDLC fault holds the controller in the fault mode until proper SDLC communication is restored. Once SDLC communication is restored, the SDLC Retry Time continues to count down and test successive faults as shown below. The first two SDLC communication faults allow the controller to recover once the communications is restored. However, if a third fault occurs before the *SDLC Retry Time* expires, a critical SDLC fault is latched by the controller until AC power is cycled or the fault is cleared manually by an operator using keystrokes **MM->8->7**.

You can test this feature by connecting a TS2 Test Box to the unit. Set the *SDLC Retry Time* to 1 minute (**MM->1->3->4**). Now, manually disconnect the SDLC interface cable on the front of the unit and note that the controller registers a critical SDLC fault. If you re-insert the SDLC cable before the *SDLC Retry Time* expires, the SDLC communication will be restored. However, if you wait longer than the *SDLC Retry Time* or create more than two faults before the timer has expired, the controller will not recover and you will need to reset AC power or manually clear the fault from **MM->8->7**.



Changing the *SDLC Retry Time* to 1 minute helps troubleshoot intermittent SDLC problems to verify a marginal BIU in the system. We have seen cases where a BIU from a different manufacturer creates random SDLC errors that the controller traps properly as required by NEMA. This problem can sometimes be corrected by setting *SDLC Retry Time* to 1; however, we recommends that *SDLC Retry Time* should be set to zero as a default to trap all SDLC errors at the first failure.

This timer is also used for SIU communications. When using SIU's the SDLC messages are received and processed at a higher speed versus the BIU communication messages. Therefore, setting this parameter to 1 (minute) will allow the SIU to establish its messages without going to a Flash State. If the messages are still failing after 1 minute, the signal will go to a flash state as intended by this setting.

TS2 Detector Faults

```
               SDLC Parameters

RetryTime    :    0   Enable Msg0: OFF
Ts2DetFaults: ON      Enable TOD : OFF
SlowMsgOvrd : OFF
```

Set *TS2 Detector Faults* to ON to allow faults reported by detector BIUs to generate detector events. Set this entry to OFF to prevent BIU generated detector faults from recording events. This parameter is useful in cases where a TS2 detector rack is not fully populated with loop detectors. In such cases, this parameter may be set to OFF, thereby preventing numerous unwanted detector events from being reported upon power-up. If TS2 Detector Fault is set to ON-RST, when the controller receives a watchdog fault from the detector BIU, it will automatically issue a detector reset to try to clear the fault. Please note that a reset pulse won't be issued more than once every 20 seconds while the watchdog fault is being reported.

SlowMsgOvrd

This parameter will override (ON) or enable (OFF) the transmission of slow SDLC messages. The default is OFF,

EnableMsg0

This parameter turns ON or OFF the SDLC transmission of the MMU Message 0. The *Msg 0 Enable* parameter was originally added to provide compatibility with Autoscope vehicle detection. Turn this parameter ON if Autoscope is used in a terminal facility without a SDLC interface. This causes the controller to generate Msg 0 frames required by Autoscope if an MMU is not present in the cabinet.

SDLC Msg 0 will include any remapped MMU-to-Controller channels. This allows signal output channels in the cabinet to be wired differently for the controller and the MMU, and for the field check feature to still be used.

Enable TOD

This parameter turns ON or OFF the SDLC transmission of time of day. The time of day will be sent once per second.

11.1.3 MMU Permissives (MM->1->3->3)

```
        ALT7 or C CpyPrm from MMU
Chan 16..14..12..10.9.8.7.6.5.4.3.2
 1      . . X X . . . . . X . . . . .
 2      . . X X . . . . . X . X . .
 3     X X . . . . . . X . . . .
 4     X X . . . . . . X . X .
 5      . . . . . . . . . . .
 6      . . . . . . . . . X
 7      . . . . . . . . .
 8      . . . . . . . .
 9      . . . . . . .
10    + . . . . . .
```

MMU Permissives are only required in a TS2 type-1 configuration. When an MMU (Malfunction Management Unit) is present, the values programmed in this table must reflect the jumper settings on the MMU programming card or the controller will declare an MMU Permissive fault and go to flash.

The screen is laid out to form a diagonal matrix with channels 1-16 assigned to the rows and columns as shown to the right. This configuration is very similar to the layout of the jumper settings of MMU programming card. Compatible (or permissive) channels are indicated by a 'X' at the intersection of each channel number within the matrix. Compatible channels may display simultaneous green, yellow and/or walk indications without generating an MMU conflict fault. In addition, some users use this screen to automatically program the permissive typing a C or ALT 7 on the keyboard.

11.1.4 Channel MMU Map (MM->1->3->5)

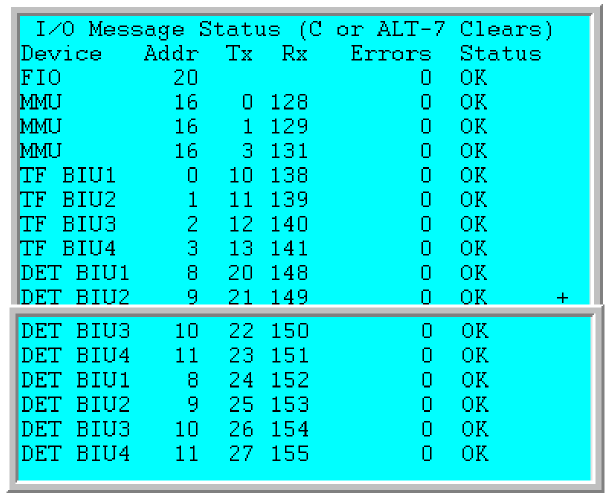
```
  MMU-to-Controller Channel Map
MMU Chan    Col.1..2..3..4..5..6..7..8
    1-8         1  2  3  4  5  6  7  8
    9-16        9 10 11 12 13 14 15 16
```

The *MMU Map* entries are used to map each of the 16 MMU channels to the 24 output channels provided in the TS2 terminal facility (cabinet). The first row correlates to MMU channels 1-8, and the second row correlates to MMU channels 9-16. A '0' entry defaults to the standard one to one mapping.

Note: Certain detector devices (like GRIDSMART video detection) that use SDLC require channel telemetry messages from output channels. MM->1->3->5 must **not** have "0" entries when this occurs but instead should be mapped. Typically, the default mapping shown above should be used.

11.1.5 TS2 SDLC Status Display (MM->1->3->2)

The *TS2 SDLC Status Display* summarizes random frame errors for each BIU enabled under **MM->1->3->2** and reports the status of each device. This display is useful to isolate a BIU failure in a TS2 or 2070 type-1 cabinet facility after checking the *Overview Status Screen* discussed in Chapter 3.



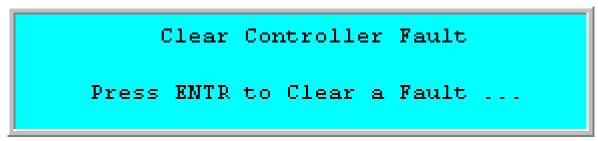
I/O Message Status (C or ALT-7 Clears)

Device	Addr	Tx	Rx	Errors	Status
FIO	20			0	OK
MMU	16	0	128	0	OK
MMU	16	1	129	0	OK
MMU	16	3	131	0	OK
TF BIU1	0	10	138	0	OK
TF BIU2	1	11	139	0	OK
TF BIU3	2	12	140	0	OK
TF BIU4	3	13	141	0	OK
DET BIU1	8	20	148	0	OK
DET BIU2	9	21	149	0	OK +
DET BIU3	10	22	150	0	OK
DET BIU4	11	23	151	0	OK
DET BIU1	8	24	152	0	OK
DET BIU2	9	25	153	0	OK
DET BIU3	10	26	154	0	OK
DET BIU4	11	27	155	0	OK

\

11.1.6 Clearing Critical SDLC Faults (MM->8->7)

"Critical SDLC Faults" isolate errors defined by the NEMA TS2 specification. A controller fault is generated when communication is lost to an SDLC device (BIU) defined in **MM->1->3->7**. "Critical SDLC Faults" are cleared from menu **MM->8->7** by pressing the **ENTR** key.



11.2 SDLC for ITS Devices

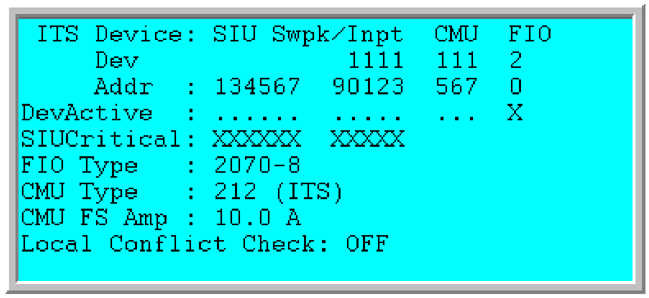
This section will describe the communication setup for ITS Cabinet Devices.

11.2.1 Features of a Typical Model 340 cabinet

Cubic | Trafficware's Model 340 ITS Cabinet is designed using advanced technology and modularity to provide state-of-the-art transportation control. This cabinet meets and exceeds v1.02.17b of the Joint AASHTO/ITE/NEMA specifications for ITS Cabinets. The cabinet's modular design exemplifies interchangeability with its ability to conform to present and future assemblies and applications. Cubic | Trafficware's 340 Cabinet features three 24-channel input files, a 6 pack, and a 14 pack output file assembly. Each of these assemblies contains a Serial Interface Unit socket for an SIU card. This card makes system expansion easier with a 614K baud rate. Along with the Serial Interface Unit, the output files also contain an Auxiliary Monitor Unit socket. The 340 Cabinet provides a facility for configurations by conveniently placing a variety of power buses and serial connectors throughout. Each cabinet contains a standard Power Distribution Assembly, and rack mount 12/24VDC switch power supply unit.

To set up communications with cabinets such as this, the software communications must be programmed as discussed in the sections below.

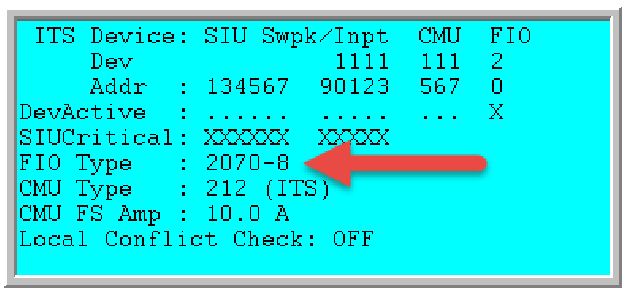
11.2.2 ITS Devices (MM->1->3->7)



This screen is used to set up the various I/O bindings for all cabinets. Note that FIO 2 must be set for all cabinets except ITS Model Cabinets 340 and 344.

FIO Type

The FIO Type parameter selects the built-in hardware interface to the cabinet that the controller uses. Selections include:



2070-2A The cabinet I/O is connected to a 2070-2A

2070-8 The cabinet I/O is connected to a 2070-8 or NEMA TS1 type cabinet

2070-2N The cabinet I/O is connected to a 2070-2N or NEMA TS2 type cabinet

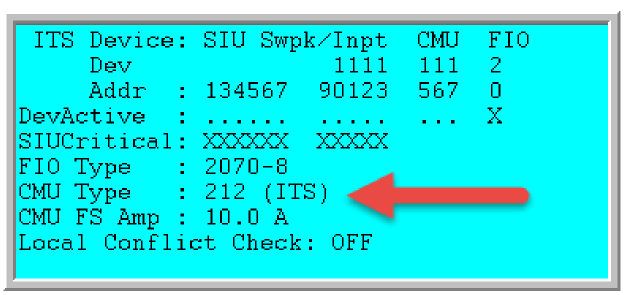
980-ATC The cabinet I/O is connected to a 980-ATC

970-ATC The cabinet I/O is connected to a 970-ATC

2070-8D The cabinet I/O is connected to an ATCC cabinet and/or any cabinet using Trafficware "D" connector mapping.

Selecting this in association with the FIO Device described in the next section will bind the I/O in the controller and begin communications to the cabinet hardware.

NOTE: Based on the Hardware type chosen, various functions may be enabled or disabled. For example the 170 watchdog output (Output Function 114) will only toggle (at a rate of 100ms on/off) when the FIO type is a 2070-2A or a 970-ATC.



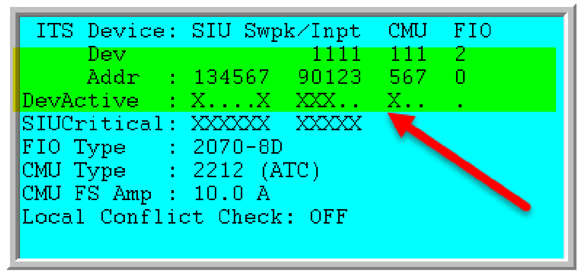
CMU Type

The CMU Type selects the specific Cabinet Monitor Unit based on the type of ATC cabinet that the agency uses.

212 (ITS): The controller is communicating with an ITS cabinet (such as a Model 340) that uses a model 212 CMU

2212 (ATC): The controller is communicating with an ATC cabinet that uses a model 2212 CMU

DevActive



Each ITS Cabinet can be customized based on intersection and agency requirements. The controller must be able to communicate to each SIU, CMU or FIO device. The user can activate a particular SIU, CMU or FIO via this selection area. The first six SIUs support the terminal facility outputs (**Swpk**) followed by five SIUs for detection (**Inpt**) and three CMUs for monitoring purposes. The FIO 20 device binds particular cabinet hardware interfaces to the physical cabinet as described above.

The following Table is provided to assist the user in activating devices in an ITS Cabinet.

SIU Output Assembly	SIU Address	Cabinet Address Jumpers	SIU Input Assembly	SIU Address	Cab Address Jumpers
14 Pack Pos 1	1	1-2	Detector Rack 1	9	1-2; 7-8
14 Pack Pos 3	3	1-2; 3-4	Detector Rack 2	10	1-2; 5-6
6 Pack Pos 4	4	5-6	Detector Rack 3	11	1-2; 5-6; 7-8
6 Pack Pos 1	5	1-2; 5-6	Detector Rack 4	12	1-2; 3-4
6 Pack Pos 2	6	3-4; 5-6	Detector Rack 5	13	1-2; 3-4; 7-8
6 Pack Pos 3	7	1-2; 3-4; 5-6			

This selection selects the SIU's devices that will be monitored. Not all SDLC failures should put the cabinet into flash. For example, if an SIU that only has detectors assigned to it fails, the cabinet should not go into flash. Instead, the controller should apply recalls on those detectors.

By default, all SIU's are treated as critical. Any related SDLC failure will result in the cabinet going into flash. In the ITS Devices menu (**MM->1->3->7**), there is an SIU Critical record listed under the Dev Active record. For each Dev Active field which corresponds to an SIU, there is a related SIU Critical field. Clearing out the "X" from this field indicates that the related SIU is not critical.

If a failure occurs on an SIU that is configured as "not critical", the controller will not go into flash. The failure can be observed in the ITS Status screen (**MM->1->3->8**)

Any failure detected on an input SIU (critical or not) will result in the controller issuing recall's on the connected detectors.

CMU FS Amp

CMU amperage monitoring selection. The valid entries for the CMU FS Amp are: 10.0, 5.0, 3.3, and 2.5 amps. This value is used to calculate the channel amperage reported by the CMU (Monitor Status screen **MM->7->8->9**)

Local Conflict Check

This parameter can be turned ON/OFF and is used to monitor conflicts. The ATC can provide redundant conflict monitoring which is independent of the CMU. This function helps protect against mechanical relay failure.

If the Local Conflict Check is enabled (ON), then the ATC will perform conflict monitoring. The same permissives which apply to the CMU will apply to this conflict monitoring. If a conflict is detected, then the ATC will go into flash. If selected, this conflict checking will happen on cabinets with the MMU or the CMU, whichever are present.

11.2.3 ITS Status (MM->1->3->8)

The *ITS Status Display* summarizes random frame errors for each SIU/CMU enabled under **MM->1->3->**7 and reports the status of each device. This display is useful to isolate failures in ITS cabinets after checking the *Overview Status Screen* discussed in Chapter 3. SIU's defined as non-critical will show a FAIL status even if the non-critical SIU has not put the cabinet in flash.

```
 I/O Message Status (C or ALT-7 Clears)
Device    Addr            Errors  Status
FIO        20                  0  OK
CMU1       15              21545  FAIL
CMU2       16                  0  OK
CMU3       17                  0  OK
OUT SIU1    1              21682  FAIL
OUT SIU2    3                  0  OK
OUT SIU3    4                  0  OK
OUT SIU4    5                  0  OK
OUT SIU5    6                  0  OK
OUT SIU6    7              21662  FAIL    +
```

```
IN SIU1     9              21622  FAIL
IN SIU2    10              21614  FAIL
IN SIU3    11              21580  FAIL
IN SIU4    12                  0  OK
IN SIU5    13                  0  OK
```

11.2.4 CMU Permissives (MM1->3->9)

CMU Permissives are only required in an ITS cabinet configuration. When a CMU is present, the values programmed in this table must reflect the jumper settings on the CMU programming card (Flash RAM) or the controller will declare an CMU Permissive fault and go to flash.

The screen is laid out to form a diagonal matrix with channels 1-32 assigned to the rows and columns as shown to the right. This configuration is very similar to the layout of the jumper settings of MMU programming card. Compatible (or permissive) channels are indicated by a 'X' at the intersection of each channel number within the matrix. Compatible channels may display simultaneous green, yellow and/or walk indications without generating an CMU conflict fault. In addition, some users use this screen to automatically program the permissive typing a C or ALT 7 on the keyboard.

```
        ALT7 or C CpyPrm from CMU
Chn  32<-->25 24<-->17 16<--->9 8<--->2
 1   ........ ........ ........ .......
 2   ........ ........ ........ ......
 3   ........ ........ ........ .....
 4   ........ ........ ........ ....
 5   ........ ........ ........ ...
 6   ........ ........ ........ ..
 7   ........ ........ ........ .
 8   ........ ........ ........
 9   ........ ........ .......
10  +........ ........ ......
```

12 Channel and I/O Programming

```
            Channel & I/O
1.Chan   1-16  4.Chan+  1-16 7.IO Logic
2.Chan 17-32  5.Chan+ 17-32 8.IO Viewer
3.Chan Parms  6.IO Parms    9.IO UserMap
```

```
                   I/O
1.Parameters  4.User Maps   7.Status
2.Logic       5.Logging     8.ClrInputs
3.Peer
```

MM->1->8: Channel/IO menu (left menu) and MM->1->9 I/O menu (right menu)

12.1 Channel Assignments (MM->1->8->1, MM->1->8->2)

A *Channel* is an output driver (or load switch) used to switch AC power to a signal display. A channel is simply an output path composed of three signals - red, yellow, and green. All of the controller's main outputs (vehicle phases, overlaps, or pedestrian outputs) consist of these three signals. Channel assignment allows these outputs to be applied to any of the available load switch channels. Therefore, a particular phase output or overlap output is not dedicated to a fixed channel as in the TS1 specification. This provides more flexibility to the assignment of hardware outputs.

Output mapping is accomplished by selecting a source number (1-32 for phase/pedestrian or overlap 1-32) followed by the source type (OLP, VEH, PED). The associated output channel will then display indications based upon the state of the assigned source. The example screens below show the channel assignments for a USER mode using 32 phases, each assigned to a separate channel in an ITS type cabinet.

```
    Chan..1...2...3...4...5...6...7...8>
P/Olp#    1   2   3   4   5   6   7   8
  Type   VEH VEH VEH VEH VEH VEH VEH VEH
Flash Red X   X   X   X   X   X   X   X
Flash Yel .   .   .   .   .   .   .   .
Flash Grn .   .   .   .   .   .   .   .
Alt Hz    .   .   .   .   .   .   .   .
Dim Grn   .   .   .   .   .   .   .   .
Dim Yel   .   .   .   .   .   .   .   .
Dim Red   .   .   .   .   .   .   .   .
Dim Cyc   +   +   +   +   +   +   +   +
```

```
<    Chan.9..10..11..12..13..14..15..16
P/Olp#    9  10  11  12  13  14  15  16
  Type   VEH VEH VEH VEH VEH VEH VEH VEH
Flash Red X   X   X   X   X   X   X   X
Flash Yel .   .   .   .   .   .   .   .
Flash Grn .   .   .   .   .   .   .   .
Alt Hz    .   .   .   .   .   .   .   .
Dim Grn   .   .   .   .   .   .   .   .
Dim Yel   .   .   .   .   .   .   .   .
Dim Red   .   .   .   .   .   .   .   .
Dim Cyc   +   +   +   +   +   +   +   +
```

MM->1->8->1: Channel Assignments for Channels 1-8 (left menu) and Channels 9-16 (right menu)

```
    Chan.17..18..19..20..21..22..23..24>
P/Olp#   17  18  19  20  21  22  23  24
  Type   VEH VEH VEH VEH VEH VEH VEH VEH
Flash Red X   X   X   X   X   X   X   X
Flash Yel .   .   .   .   .   .   .   .
Flash Grn .   .   .   .   .   .   .   .
Alt Hz    .   .   .   .   .   .   .   .
Dim Grn   .   .   .   .   .   .   .   .
Dim Yel   .   .   .   .   .   .   .   .
Dim Red   .   .   .   .   .   .   .   .
Dim Cyc   +   +   +   +   +   +   +   +
```

```
<    Chan.25..26..27..28..29..30..31..32
P/Olp#   25  26  27  28  29  30  31  32
  Type   VEH VEH VEH VEH VEH VEH VEH VEH
Flash Red X   X   X   X   X   X   X   X
Flash Yel .   .   .   .   .   .   .   .
Flash Grn .   .   .   .   .   .   .   .
Alt Hz    .   .   .   .   .   .   .   .
Dim Grn   .   .   .   .   .   .   .   .
Dim Yel   .   .   .   .   .   .   .   .
Dim Red   .   .   .   .   .   .   .   .
Dim Cyc   +   +   +   +   +   +   +   +
```

MM->1->8->2: Channel Assignments for Channels 1-8 (left menu) and Channels 9-16 (right menu)

12.1.1 Ø/Olp# and Type

The channel source (*Ø/Olp#)* directs one of the phase or overlap outputs to each load switch channel. The channel *Type* (VEH, PED or OLP) programs the channel as either a vehicle, pedestrian or overlap output. A channel may be programmed as inactive (dark) by entering a zero value for the channel source *(Ø/Olp#).*

12.1.2 Flash

Automatic-Flash may be programmed from the channel settings shown in the menus above or the *Phase/Overlap* flash settings under **MM->1->4->2**. The channel *Flash* settings above only apply if the *Flash Mode* is set to CHAN. The channel *Flash* settings may be set to RED or YEL to control the flashing displays when the *Flash Mode* is set to CHAN and *Automatic Flash* is driven by the channel settings.

12.1.3 Alt Hz

The *Alternate Hertz* entries assign the channel flash outputs to either the first half or second half of the one second flash duty-cycle. If *Alternate Hertz* is not enabled, the flash indication will be illuminated during the first half second of the flash cycle. If *Alternate Hertz* *is enabled*, the flash indication will be displayed during the second half of the one second flash duty cycle. If *Alternate Hertz* is enabled for the yellow flash channels and disabled for the red flash channels, this programming will create a "bobbing" effect that alternates between flashing yellow and flashing red every half second.

12.1.4 Dim Parameters

Dimming reduces power consumption of incandescent signal displays by trimming the AC current wave. *Dimming* should not be used with LED indications because cycling the LED on an off greatly reduces the life of the LED indication. Replacing incandescent lamps with LED's is a more effective method of reducing power consumption.

Dimming is activated by an external input typically grounded by a photocell device or a special function output. The menu to the right allows each phase to be dimmed independently and controls which half of the AC wave dimming is applied. Dimming should be assigned to concurrent phases in each ring to equalize the loading of the AC source and balance both halves of the AC cycle. This is typically accomplished by assigning the phases in one ring to the "+" side and the phases in the other ring to the "**-**" side of the AC cycle.

12.2 Chan+ Flash Settings (MM->1->8->4, MM->1->8->5)

The Chan+ settings allow the user to flash any combination of outputs for channels 1-24. In addition, the user can turn off flashing red outputs for a particular channel during all flashing preemptions (i.e. **Flash in Dwell** = **ON**). The user can also have an Overlap override control of the channel via the "**Olap Ovrd"** selection. This feature is used with Flashing Yellow Arrow Overlaps.

```
    Chan..1...2...3...4...5...6...7...8>
Flash Red .   .   .   .   .   .   .   .
Flash Yel .   .   .   .   .   .   .   .
Flash Grn .   .   .   .   .   .   .   .
Inhibit Red Flash in
  Preempt .   .   .   .   .   .   .   .
Olap Ovrd 0   0   0   0   0   0   0   0
```

12.3 Channel Parameters (MM->1->8->3)

The *Channel I/O Parameters* allow the user to customize I/O assignments for 2070 and ATC controllers.

```
          Channel Parameters
Chan 17-24 Mapping: DEFAULT
    D Conn Mapping: NONE
Invert Rail Inputs: OFF
C1-C11-ABC IO Mode: AUTO
```

Channel 17-24 Mapping

NEMA does not define more than 16 output channels, so the DEFAULT setting defines channels 17-24. These additional outputs are provided in a Type-1 terminal facility using additional BIU devices to extend the channel outputs.

D-connector Mapping

D-connector Mapping defines the inputs and outputs of the D-connector for one of the following cabinet configurations. Chapter 14 lists the pin-out assignments for the D-connector for each of these settings.

NONE	no D-connector inputs or outputs (required for TS2 Type-2 I/O Modes 0, 1, 2 or 6) If TS2 I/O Mode is not Mode 0, the *D-connector Mapping* MUST be set to NONE.
TX2-V14	pin assignment compatible with Cubic | Trafficware Model 900-TX2CL, version 14
DIAMOND	pin assignment compatible with Cubic | Trafficware Model 900-DIA6CL, version 6
LIGHT RAIL	pin assignment compatible with the light-rail definitions
820-VMS	pin assignment compatible with 820-VMS mapping
MODE 7	pin assignment compatible with Mode 7 mapping
CID	pin assignment compatible with CID
SCC	pin assignment compatible with SCC mapping
VIRCTL	pin assignment compatible with the virtual controller test software

Invert Rail Inputs

A preemption input normally is open and when a contact closure is made, that input is recognized by the controller. Some railroads use a normally closed input and when it is open, that indicates that a railroad is preempting the controller. Agencies in the past had to create electrical relays to accommodate these rail preemption inputs. Setting this parameter to "ON" will eliminate the need for that additional cabinet relay wiring.

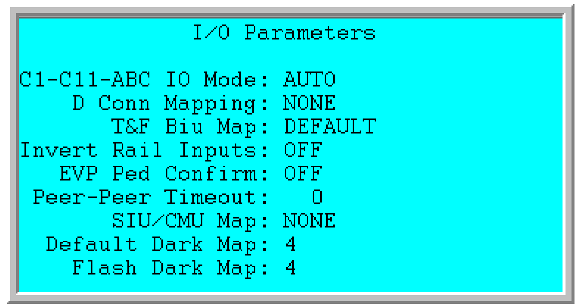
C1-C11-ABC IO Mode (2070 or ATC Only)

This setting remaps the C1-C11 connector of the 2070 or ATC controllers and the A-B-C connectors of the TS2, 2070N or ATC controller.

NONE	Disables the I/O for the 2070 and 2070N controllers
AUTO	Applies the I/O standard published in the CALTRANS TEES Specification
Mode 0	Reserved
Mode 1	Applies the New York DOT I/O mode settings
Mode 2	Applies the Dade County, Florida I/O mode settings
Mode 3-7	Reserved
USER	Applies USER I/O mapping programmed through **MM->1->3->6** discussed in the next section.
VIRCTL	Applies with the virtual controller test software

12.4 IO Parameters (MM->1->8->6) or (MM->1->9->1)

The TS2 *IO Parameter* allows the user to customize the IO Modes defined by NEMA for the ABC connectors and custom modes supported in the controller firmware. The 2070 and ATC *IO Parameter* supports custom modes for the C1 connector. In addition, the 2070 and ATC provides a USER mode that allows the user to redefine any input or output provided on the C1 connector.



TS2 IO Modes

The TS2 IO Modes are defined as follows:

- AUTO uses the NEMA IO Mode selected by the NEMA IO Mode inputs A, B, and C on connector A to select the appropriate TS2 IO mapping on ATC controller and 2070 controller with NEMA interface
- Mode 0 - Mode 2 correspond with the TS2 IO Modes defined in TS2-1992
- Modes 3-5 are reserved by NEMA for future use
- Modes 6-7 are reserved for the manufacturer's use
- USER mode is required to redefine the IO pins in the 2070 and 2070N version 80 software
- VIRCTL – this applies to the virtual controller test software
- NONE - this is a 2070 specific mode that disable the IO mapping (Note that these I/O Modes for the 2070 are programmed under **MM->1->3->6->3**

Note: When the TS2 IO Mode is not Mode 0, the D-connector mapping (refer to chapter 12) MUST be set to NONE.

C1-C11-ABC IO Mode (2070 or ATC Only)

This setting remaps the C1-C11 connector of the 2070 or ATC controllers and the A-B-C connectors of the TS2, 2070N or ATC controller.

NONE	Disables the I/O for the 2070 and 2070N controllers
AUTO	Applies the I/O standard published in the CALTRANS TEES Specification
Mode 0	Reserved
Mode 1	Applies the New York DOT I/O mode settings
Mode 2	Applies the Dade County, Florida I/O mode settings
Mode 3-7	Reserved
USER	Applies USER I/O mapping programmed through **MM->1->3->6** discussed in the next section.
VIRCTL	This applies to the virtual controller test software

D-connector Mapping

D-connector Mapping defines the inputs and outputs of the D-connector for one of the following cabinet configurations. Chapter 14 lists the pin-out assignments for the D-connector for each of these settings.

NONE	no D-connector inputs or outputs (required for TS2 Type-2 I/O Modes 0, 1, 2 or 6) If TS2 I/O Mode is not Mode 0, the *D-connector Mapping* MUST be set to NONE.
TX2-V14	pin assignment compatible with Cubic | Trafficware Model 900-TX2CL, version 14
DIAMOND	pin assignment compatible with Cubic | Trafficware Model 900-DIA6CL, version 6
LIGHT RAIL	pin assignment compatible with the light-rail definitions
820-VMS	pin assignment compatible with 820-VMS mapping
MODE 7	pin assignment compatible with Mode 7 mapping
CID	pin assignment compatible with CID
SCC	pin assignment compatible with SCC mapping
VIRCTL	pin assignment compatible with the virtual controller test software

T&F BIU Map

The Terminal and Facilities BIU inputs and Outputs can be mapped using this parameter. The mapping selections are:

DEFAULT , **SOLO TF BIU1, 24 OUT CHAN, USER**

Please refer to Chapter 14 to see the various BIU mapping. If the user wants to modify this mapping, please program these changes at **MM->1->8->9->1->9** for BIU inputs and **MM->1->8->9->2->9** for BIU outputs.

```
             I/O Parameters

C1-C11-ABC IO Mode: AUTO
    D Conn Mapping: NONE
       T&F Biu Map: DEFAULT
Invert Rail Inputs: OFF
   EVP Ped Confirm: OFF
 Peer-Peer Timeout:   0
       SIU/CMU Map: NONE
  Default Dark Map: 4
    Flash Dark Map: 4
```

Invert Rail Inputs

A railroad preemption input (Preemptions 1 or 2) normally is open and when a contact closure is made, that input is recognized by the controller. Some railroads use a normally closed input and when it is open, that indicates that a railroad is preempting the controller. Agencies in the past had to create electrical relays to accommodate these rail preemption inputs. Setting this parameter to "ON" will eliminate the need for that additional cabinet relay wiring for Preemptions 1 or 2.

EVP Ped Confirm

If this parameter is "ON", then the pedestrian clearances outputs (Yellows) are used for Preemption confirmations in the following manner:

a. If the preemption is a rail, then all the pedestrian clearance outputs (yellows) flash

b. If the preemption is low priority, then all the pedestrian clearance outputs flash

c. If the preemption is high priority, then all the dwell phases and the initial dwell phases for the given preempt will be solid yellow to act as confirmations, while all other pedestrian clearance outputs will flash yellow.

NOTE: The EVP Ped Confirm outputs may be affected if you set a Ped output to control a Flashing Yellow Arrow overlap as discussed in the overlap section of Chapter 4.

Peer-Peer TimeOut (seconds)

V80.x provides Peer to Peer I/O to field controllers. Each of the possible fifteen peers that are allowed to communicate try to do so. If communications fails, this parameter will insure that I/O is not overridden by the Peer units until communications is restored. In addition this timer has the ability keep or override the peer generated input or output. If you do not get a response from the peer within the "peer to peer timeout" time, then the inputs / output for that peer all default to an **Off (FALSE)** state. If you program that timer as zero seconds, then the inputs/outputs from that device remain in their last known state

SIU/CMU Map

This setting sets up the ITS cabinet Output SIUs with default Mapping.

NONE	Disables the I/O for ITS cabinet controllers
28 Chan	Applies 28 Channel ITS Cabinet mapping
20 Chan	Applies 20 Channel ITS Cabinet mapping
28B Chan	Applies 28B Channel ITS Cabinet mapping
18 Chan	Applies 18 Channel ITS Cabinet mapping
USER	Applies USER Channel ITS Cabinet mapping

Dark Maps

In the CMU configuration, there are four Lack of Signal (LOS) Dark Maps. These are used for disabling the LOS monitor function on a real-time per channel basis.
The ATC selects which of four maps the CMU should use. The CMU will override the LOS Enable programming with the Dark Map specified by the ATC.

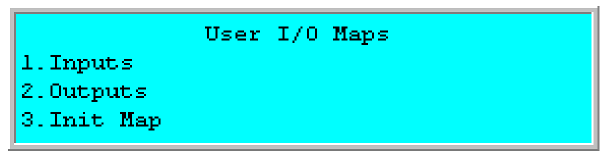
Default Dark Map - this is the Dark Map the CMU should use under normal operations
Flash Map - this is the Dark Map the CMU should use when in flash

By convention, Dark Map 4 should be selected as the Flash Map. Both Dark Map selections can have the same value. If there are no special considerations, set both Dark Maps to 4.

The Dark Map selection can range from "NO SEL" or 1 - 4. "NO SEL" means that No Selection has been made.

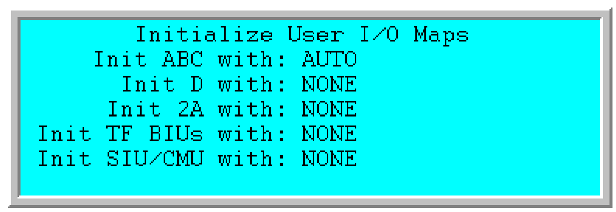
12.5 IO User Maps (MM->1->8->9 or MM->1->9->4)

IO User Maps are used to customize the I/O pin assignments for the 2070 C1-C11, the NEMA A-B-C and ITS Cabinet connectors.



Customizing the I/O maps for the 2070 involves three steps:

- Step 1 – Set *C1-C11-ABC IO Mode to* **USER** under menu **MM->1->8->6**
- Step 2 **-** Initialize the User I/O Maps from **MM->1->8->9->3** (menu shown to the right)
- Step 3 – Customize the I/O Maps under **MM->1->2** with selection *1.Inputs* and *2.Outputs*



Selecting *3.Init Map*, from the menu above allows NEMA A-B-C, D-connector and 2A (C1) connector to be initialized with several factory default settings as shown below

Initializing the 2070 ABC, D and 2A Connectors (MM->1->8->9->3, MM->1->9->4->3)

The **ABC connector configurations** for the 2070N are:

- **NONE** – A-B-C inputs and outputs deactivated
- **AUTO** – default NEMA TS1 A-B-C I/O (Mode 0)
- **Mode 0–7** – Modes 0-5 (defined by NEMA) and Modes 6 and 7 (defined by the manufacturer) are listed in Chapter 14. The 2070 I/O mode is selected by initializing ABC from the above menu. The TS2 I/O modes are specified as a *Unit Parameter* (see chapter 4). These modes only apply to the TS2 and not to the 2070.
- **USER** – allows the user to configure each pin various cabinet connectors
- **VIRCTL –** allows the user to configure the pin assignment compatible with the virtual controller test software

The **D connector configurations** for the 2070N controller are:

- **NONE** no D-connector inputs or outputs (required for TS2 Type-2 I/O Modes 0, 1, 2 or 6)
- **TX2-V14** pin assignment compatible with Cubic | Trafficware Model 900-TX2CL, version 14
- **DIAMOND** pin assignment compatible with Cubic | Trafficware Model 900-DIA6CL, version 6
- **LIGHT RAIL** pin assignment compatible with the light-rail definitions
- **820-VMS** pin assignment compatible with 820-VMS mapping
- **MODE 7** pin assignment compatible with Mode 7 mapping
- **CID** pin assignment compatible with CID
- **SCC** pin assignment compatible with SCC mapping
- **VIRCTL** pin assignment compatible with the virtual controller test software

The **2A (C1) connector configurations** are:

- **NONE** All C1-connector inputs and outputs are deactivated.
- **Mode 0** C1 inputs and outputs conform to the latest Caltrans / SCDOT 2070 TEES specification. This will be used with Model 332/336 cabinets.
- **Mode 1** C1 inputs and outputs conform to 179 controller defaults defined by the New York DOT. This will be used with Model 330 cabinets.
- **Mode 2-7** Reserved

The **TF BIUs connector configurations** are used for NEMA TS2 Type 1 cabinets. The selections are:

- **NONE** No TF BIUs are used
- **DEFAULT** Default TF BIU mapping is used
- **SOLO TF BIU1** Solo TF BIU1 mapping is used
- **24 OUT CHAN** 24 Output Channel Mapping is used

The **SIU/CMU configurations** are used for ITS Cabinets. The selections are:

- **NONE** No SIU/CMUs are used
- **28 CHAN** The ITS Cabinet is set up using 28 Channel Outputs
- **20 CHAN** The ITS Cabinet is set up using 20 Channel Outputs
- **28B CHAN** The ITS Cabinet is set up using 28B Channel Outputs
- **18 Chan** The ITS Cabinet is set up using 18 Channel Outputs

12.6 Customizing Inputs (MM->1->8->9->1 or MM->1->9->4->1)

After initializing the default I/O, you may customize the input maps selecting this menu. Each input pin on the NEMA (A-B-C,D), 2A (C1) connector may be redefined using the function numbers provided in the chart below. Mapping of TS2 terminal facilities (BIU1 – BIU4) and SIU Input channels may also be mapped using these functions.

```
          User Input Maps
1.NEMA A   4.NEMA D       7.SIU OUTFILE
2.NEMA B   5.FIO 2A       8.SIU INFILE
3.NEMA C   6.33x INFILE   9.TS2 IO
```

Func	Input	Func	Input	Func	Input	Func	Input	Func	Input
0	Unused	50	Veh Call 50	100	Veh Chng 36	150	Ped Omit 6	200	Pre 3 In
1	Veh Call 1	51	Veh Call 51	101	Veh Chng 37	151	Ped Omit 7	201	Pre 4 In
2	Veh Call 2	52	Veh Call 52	102	Veh Chng 38	152	Ped Omit 8	202	Pre 5 In
3	Veh Call 3	53	Veh Call 53	103	Veh Chng 39	153	Ph Omit 1	203	Pre 6 In
4	Veh Call 4	54	Veh Call 54	104	Veh Chng 40	154	Ph Omit 2	204	Unused
5	Veh Call 5	55	Veh Call 55	105	Veh Chng 41	155	Ph Omit 3	205	Inh All LRV Ph
6	Veh Call 6	56	Veh Call 56	106	Veh Chng 42	156	Ph Omit 4	206	Cab Flash
7	Veh Call 7	57	Veh Call 57	107	Veh Chng 43	157	Ph Omit 5	207	Comp StopTm
8	Veh Call 8	58	Veh Call 58	108	Veh Chng 44	158	Ph Omit 6	208	Local Flash
9	Veh Call 9	59	Veh Call 59	109	Veh Chng 45	159	Ph Omit 7	209	TBC Input
10	Veh Call 10	60	Veh Call 60	110	Veh Chng 46	160	Ph Omit 8	210	Dim Enable
11	Veh Call 11	61	Veh Call 61	111	Veh Chng 47	161	R1 Frc Off	211	Auto Flash
12	Veh Call 12	62	Veh Call 62	112	Veh Chng 48	162	R1 Stop Tim	212	Alt Seq A
13	Veh Call 13	63	Veh Call 63	113	Veh Chng 49	163	R1 Inh Max	213	Alt Seq B
14	Veh Call 14	64	Veh Call 64	114	Veh Chng 50	164	R1 Red Rest	214	Alt Seq C
15	Veh Call 15	65	Veh Chng 1	115	Veh Chng 51	165	R1 PedRecyc	215	Alt Seq D
16	Veh Call 16	66	Veh Chng 2	116	Veh Chng 52	166	R1 Max II	216	Plan A
17	Veh Call 17	67	Veh Chng 3	117	Veh Chng 53	167	R1 OmtRdClr	217	Plan B
18	Veh Call 18	68	Veh Chng 4	118	Veh Chng 54	168	Non-Act I	218	Plan C
19	Veh Call 19	69	Veh Chng 5	119	Veh Chng 55	169	R2 Frc Off	219	Plan D
20	Veh Call 20	70	Veh Chng 6	120	Veh Chng 56	170	R2 Stop Tim	220	Addr Bit 0
21	Veh Call 21	71	Veh Chng 7	121	Veh Chng 57	171	R2 Inh Max	221	Addr Bit 1
22	Veh Call 22	72	Veh Chng 8	122	Veh Chng 58	172	R2 Red Rest	222	Addr Bit 2
23	Veh Call 23	73	Veh Chng 9	123	Veh Chng 59	173	R2 PedRecyc	223	Addr Bit 3
24	Veh Call 24	74	Veh Chng 10	124	Veh Chng 60	174	R2 Max II	224	Addr Bit 4
25	Veh Call 25	75	Veh Chng 11	125	Veh Chng 61	175	R2 OmtRdClr	225	Offset 1
26	Veh Call 26	76	Veh Chng 12	126	Veh Chng 62	176	Non-Act II	226	Offset 2
27	Veh Call 27	77	Veh Chng 13	127	Veh Chng 63	177	Ext Start	227	Offset 3
28	Veh Call 28	78	Veh Chng 14	128	Veh Chng 64	178	Int Advance	228	33x Flash Sense
29	Veh Call 29	79	Veh Chng 15	129	Ped Call 1	179	IndLampCtrl	229	33x CMU Stop
30	Veh Call 30	80	Veh Chng 16	130	Ped Call 2	180	Min Recall	230	Conditional
31	Veh Call 31	81	Veh Chng 17	131	Ped Call 3	181	ManCtrlEnbl	231	Input/ Output
32	Veh Call 32	82	Veh Chng 18	132	Ped Call 4	182	Mode Bit A	232	
33	Veh Call 33	83	Veh Chng 19	133	Ped Call 5	183	Mode Bit B	233	Based on
34	Veh Call 34	84	Veh Chng 20	134	Ped Call 6	184	Mode Bit C	234	CNF_GATE
35	Veh Call 35	85	Veh Chng 21	135	Ped Call 7	185	Test A	235	
36	Veh Call 36	86	Veh Chng 22	136	Ped Call 8	186	Test B	236	Refer to
37	Veh Call 37	87	Veh Chng 23	137	Hold 1	187	Test C	237	CFG_Gate
38	Veh Call 38	88	Veh Chng 24	138	Hold 2	188	WalkRestMod	238	Table end of
39	Veh Call 39	89	Veh Chng 25	139	Hold 3	189	Unused	239	Sect 12.7
40	Veh Call 40	90	Veh Chng 26	140	Hold 4	190	Free	240	Logic11
41	Veh Call 41	91	Veh Chng 27	141	Hold 5	191	Flash In	241	Logic12
42	Veh Call 42	92	Veh Chng 28	142	Hold 6	192	Alarm 1	242	Logic13
43	Veh Call 43	93	Veh Chng 29	143	Hold 7	193	Alarm 2	243	Logic14
44	Veh Call 44	94	Veh Chng 30	144	Hold 8	194	Alarm 3	244	Logic15
45	Veh Call 45	95	Veh Chng 31	145	Ped Omit 1	195	Alarm 4	245	Logic16
46	Veh Call 46	96	Veh Chng 32	146	Ped Omit 2	196	Alarm 5	246	Logic17
47	Veh Call 47	97	Veh Chng 33	147	Ped Omit 3	197	Alarm 6	247	Logic18
48	Veh Call 48	98	Veh Chng 34	148	Ped Omit 4	198	Pre 1 In	248	Logic19
49	Veh Call 49	99	Veh Chng 35	149	Ped Omit 5	199	Pre 2 In	249	Logic20

Func	Input	Func	Input	Func	Input	Func	Input	Func	Input
250	UPS on Battery	318	Seq Event 1	386	Veh Call 121	454	Veh Chng 125	522	Ph Omit 23
251	UPS Flash	319	Seq Event 2	387	Veh Call 122	455	Veh Chng 126	523	Ph Omit 24
252	Set Time In	320	Seq Event 3	388	Veh Call 123	456	Veh Chng 127	524	Ph Omit 25
253	ImgDumpTrig	321	Seq Event 4	389	Veh Call 124	457	Veh Chng 128	525	Ph Omit 26
254	Logic False	322	Pre 7 In	390	Veh Call 125	458	Logic 21	526	Ph Omit 27
255	Logic True	323	Pre 8 In	391	Veh Call 126	459	Logic 22	527	Ph Omit 28
256	Ped Call 9	324	Pre 9 In	392	Veh Call 127	460	Logic 23	528	Ph Omit 29
257	Ped Call 10	325	Pre 10 In	393	Veh Call 128	461	Logic 24	529	Ph Omit 30
258	Ped Call 11	326	Pre 11 In	394	Veh Chng 65	462	Logic 25	530	Ph Omit 31
259	Ped Call 12	327	Pre 12 In	395	Veh Chng 66	463	Logic 26	531	Ph Omit 32
260	Ped Call 13	328	Reserved	396	Veh Chng 67	464	Logic 27	532	Inh LRV D1 Ph
261	Ped Call 14	329	Reserved	397	Veh Chng 68	465	Logic 28	533	Inh LRV D2 Ph
262	Ped Call 15	330	Veh Call 65	398	Veh Chng 69	466	Logic 29	534	Inh LRV D3 Ph
263	Ped Call 16	331	Veh Call 66	399	Veh Chng 70	467	Logic 30	535	Inh LRV D4 Ph
264	Hold 9	332	Veh Call 67	400	Veh Chng 71	468	Hold 17	536	Inh LRV D5 Ph
265	Hold 10	333	Veh Call 68	401	Veh Chng 72	469	Hold 18	537	Inh LRV D6 Ph
266	Hold 11	334	Veh Call 69	402	Veh Chng 73	470	Hold 19	538	Inh LRV D7 Ph
267	Hold 12	335	Veh Call 70	403	Veh Chng 74	471	Hold 20	539	Inh LRV D8 Ph
268	Hold 13	336	Veh Call 71	404	Veh Chng 75	472	Hold 21	540	Reserved
269	Hold 14	337	Veh Call 72	405	Veh Chng 76	473	Hold 22	541	PR1 GateDn
270	Hold 15	338	Veh Call 73	406	Veh Chng 77	474	Hold 23	542	PR2 GateDn
271	Hold 16	339	Veh Call 74	407	Veh Chng 78	475	Hold 24	543	PR3 GateDn
272	Ped Omit 9	340	Veh Call 75	408	Veh Chng 79	476	Hold 25	544	PR4 GateDn
273	Ped Omit 10	341	Veh Call 76	409	Veh Chng 80	477	Hold 26	545	PR5 GateDn
274	Ped Omit 11	342	Veh Call 77	410	Veh Chng 81	478	Hold 27	546	PR6 GateDn
275	Ped Omit 12	343	Veh Call 78	411	Veh Chng 82	479	Hold 28	547	PR7 GateDn
276	Ped Omit 13	344	Veh Call 79	412	Veh Chng 83	480	Hold 29	548	PR8 GateDn
277	Ped Omit 14	345	Veh Call 80	413	Veh Chng 84	481	Hold 30	549	PR9 GateDn
278	Ped Omit 15	346	Veh Call 81	414	Veh Chng 85	482	Hold 31	550	PR10 GateDn
279	Ped Omit 16	347	Veh Call 82	415	Veh Chng 86	483	Hold 32	551	PR11 GateDn
280	Ph Omit 9	349	Veh Call 83	416	Veh Chng 87	484	Ped Call 17	552	PR12 GateDn
281	Ph Omit 10	349	Veh Call 84	417	Veh Chng 88	485	Ped Call 18	553	Reserved
282	Ph Omit 11	350	Veh Call 85	418	Veh Chng 89	486	Ped Call 19	554	Reserved
283	Ph Omit 12	351	Veh Call 86	419	Veh Chng 90	487	Ped Call 20	555	Reserved
284	Ph Omit 13	352	Veh Call 87	420	Veh Chng 91	488	Ped Call 21	556	Reserved
285	Ph Omit 14	353	Veh Call 88	421	Veh Chng 92	489	Ped Call 22	557	Reserved
286	Ph Omit 15	354	Veh Call 89	422	Veh Chng 93	490	Ped Call 23	558	Reserved
287	Ph Omit 16	355	Veh Call 90	423	Veh Chng 94	491	Ped Call 24	559	Reserved
288	Alarm 7	356	Veh Call 91	424	Veh Chng 95	492	Ped Call 25	560	Reserved
289	Alarm 8	357	Veh Call 92	425	Veh Chng 96	493	Ped Call 26	561	PR1 Supervise
290	Alarm 9	368	Veh Call 93	426	Veh Chng 97	494	Ped Call 27	562	PR2 Supervise
291	Alarm 10	359	Veh Call 94	427	Veh Chng 98	495	Ped Call 28	563	PR3 Supervise
292	Alarm 11	360	Veh Call 95	428	Veh Chng 99	496	Ped Call 29	564	PR4 Supervise
293	Alarm 12	361	Veh Call 96	429	Veh Chng 100	497	Ped Call 30	565	PR5 Supervise
294	Alarm 13	362	Veh Call 97	430	Veh Chng 101	498	Ped Call 31	566	PR6 Supervise
295	Alarm 14	363	Veh Call 98	431	Veh Chng 102	499	Ped Call 32	567	PR7 Supervise
296	Alarm 15	364	Veh Call 99	432	Veh Chng 103	500	Ped Omit 17	568	PR8 Supervise
297	Alarm 16	365	Veh Call 100	433	Veh Chng 104	501	Ped Omit 18	569	PR9 Supervise
298	Ped Ext 1	366	Veh Call 101	434	Veh Chng 105	502	Ped Omit 19	570	PR10 Supervise
299	Ped Ext 2	367	Veh Call 102	435	Veh Chng 106	503	Ped Omit 20	571	PR11 Supervise
300	Ped Ext 3	368	Veh Call 103	436	Veh Chng 107	504	Ped Omit 21	572	PR12 Supervise
301	Ped Ext 4	369	Veh Call 104	437	Veh Chng 108	505	Ped Omit 22	573	Reserved
302	Ped Ext 5	370	Veh Call 105	438	Veh Chng 109	506	Ped Omit 23	574	Reserved
303	Ped Ext 6	371	Veh Call 106	439	Veh Chng 110	507	Ped Omit 24	575	Reserved
304	Ped Ext 7	372	Veh Call 107	440	Veh Chng 111	508	Ped Omit 25	576	Reserved
305	Ped Ext 8	373	Veh Call 108	441	Veh Chng 112	509	Ped Omit 26	577	Reserved
306	LCU Auto	374	Veh Call 109	442	Veh Chng 113	510	Ped Omit 27	578	Reserved
307	LCU Normal	375	Veh Call 110	443	Veh Chng 114	511	Ped Omit 28	579	Reserved
308	LCUPreGame	376	Veh Call 111	444	Veh Chng 115	512	Ped Omit 29	580	Reserved
309	LCUPostGame	377	Veh Call 112	445	Veh Chng 116	513	Ped Omit 30	581	Reserved
310	LowPriPre 1 *	378	Veh Call 113	446	Veh Chng 117	514	Ped Omit 31	582	Reserved
311	LowPriPre 2 *	379	Veh Call 114	447	Veh Chng 118	515	Ped Omit 32	583	Reserved
312	LowPriPre 3 *	380	Veh Call 115	448	Veh Chng 119	516	Ph Omit 17	584	Reserved
313	LowPriPre 4 *	381	Veh Call 116	449	Veh Chng 120	517	Ph Omit 18	585	Reserved
314	LowPreInh 1 *	382	Veh Call 117	450	Veh Chng 121	518	Ph Omit 19	586	Reserved
315	LowPreInh 2 *	383	Veh Call 118	451	Veh Chng 122	519	Ph Omit 20	587	Reserved
316	LowPreInh 3 *	384	Veh Call 119	452	Veh Chng 123	520	Ph Omit 21	588	Reserved
317	LowPreInh 4 *	385	Veh Call120	453	Veh Chng 124	521	Ph Omit 22	589	Reserved

***** indicates this function is only available with the Transit Priority Module enabled

UPS Functions

Input #250 "UPS On Battery" is a basic status input. Any time this input changes state, it will be logged in alarm/event #82. When using IO mapping, use this input to tie the UPS status line with the enable alarm/event #82

Input #251 "UPS Flash In" is an input that will allow the UPS to call the cabinet into "Auto Flash". This should be tied to the UPS low battery status output on the UPS unit. This input is also tied to alarm/event #83. When the UPS unit sets the cabinet to flash, or out of flash, the event is logged. If the controller starts up and the input is asserted, the controller will not leave startup flash. Once the input is removed, the controller will start as normal.

Preempt Diagnostics Functions

V80.x has added new input functions that are associated with the Preempt Diagnostics screen (MM->3->1->7). In particular Functions 541-552 monitor gate down signals for each of the twelve preemptions and Functions 561-572 are the preemption Supervisory inputs for each of the twelve preemptions. The supervisory input is considered to be the inverse of the preemption input. If the input is not longer than the SuperviseTime, then a CVM fault is set after the preemption times the minim track clearance.

LRV Functions

Up to eight Light Rail or Transit Priority LRV detection selections can be programmed to check the light rail or transit vehicle in and out using parameters programmed under **MM->5->9->7**. The following input functions listed below, defeat the advance detector countdown timer logic.

Input #205: Apply inhibit phases for all Rail Dets immediately
Input #532: Apply all inhibit phases for Rail Det 1 immediately
Input #533: Apply all inhibit phases for Rail Det 2 immediately
Input #534: Apply all inhibit phases for Rail Det 3 immediately
Input #535: Apply all inhibit phases for Rail Det 4 immediately
Input #536: Apply all inhibit phases for Rail Det 5 immediately
Input #537: Apply all inhibit phases for Rail Det 6 immediately
Input #538: Apply all inhibit phases for Rail Det 7 immediately
Input #539: Apply all inhibit phases for Rail Det 8 immediately

12.6.1 33x Input File (MM->1->8->9->1->6)

The 33.X INPUT FILE is used in conjunction with USER IO Mode to allow the user to customize the input pins of the C1.

Inputs 1-64 on this menu correspond with I1-1 through I8-8

```
IO Bank 33xInp Category Idx  Description
 1 (1-1)    1   DETECTOR   2  Detector 2
 2 (1-2)    2   PEDCALL    6  PedDetect 6
 3 (1-3)    3   HOLD       8  Ph 8 Hold
 4 (1-4)    4   OMIT       1  Ph 1 Omit
 5 (1-5)    5   PEDOMIT    2  Ped 2 Omit
 6 (1-6)    6   RING       2  R1 StopTime
 7 (1-7)    7   CABINET    2  CNA 1
 8 (1-8)    8   PREEMPT    1  Preempt 1
 9 (2-1)    9   UNUSED     1  Unused
```

DETECTOR: Indexes 1-64 assign any vehicle detector to any input pin

PEDCALL: Index 1-8 assigns the input to one of the 8 *Ped Detectors* programmed under **MM->5->4**

HOLD: Indexes 1-16 apply a hold on phases 1-16 if CNA operation is in effect

OMIT: Indexes 1-16 apply an omit on phases 1-16

PEDOMIT: Indexes 1-16 apply a ped omit on phases 1-16

RING: The indexes below apply the following ring features

Index	Description	Index	Description
1	R1 Frc Off	8	R1 Frc Off
2	R1 Stop Time	9	R1 Stop Time
3	R1 Inh Max	10	R1 Inh Max
4	R1 Red Rest	11	R1 Red Rest
5	R1 Ped Recycle	12	R1 Ped Recycle
6	R1 Max II	13	R1 Max II
7	R1 Omit Red Clearance	14	R1 Omit Red Clearance

CABINET: The indexes below apply the following cabinet features

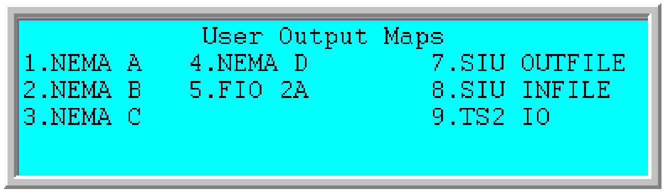
Index	Description	Index	Description
1	CNA2	11	Cab Flash
2	CNA1	12	33x Stop Time
3	External Start	13	Local Flash
4	Interval Advance	14	TBC Input
5	Door Open	15	Dim Enable
6	Min Recall	16	Auto Flash
07	Manual Control Enable	17	33xFlash Sense
8	Walk Rest Modifier	18	33xCMUStop
9	Free Command	19	Unused
10	Flash Input	20	Unused

PREEMPT: Indexes 1-10 apply a call to preempts 1-10

UNUSED: The input pin is unused

12.7 Customizing Outputs (MM->1->8->9->2 or MM->1->9->4->2)

After initializing the default I/O, you may customize the outputs maps selecting this menu. Each output pin on the NEMA (A-B-C,D), 2A (C1) connector may be redefined using the function numbers provided in the chart below. Mapping of TS2 terminal facilities (BIU1 – BIU4) and SIU Output channels may also be mapped using these functions



Func	Output	Func	Output	Func	Output	Func	Output	Func	Output
0	Unused	50	Ch2 Green	100	R2 Status A	150	Ph 9 Check	200	UCF Flash
1	Ch1 Red	51	Ch3 Green	101	R2 Status B	151	Ph 10 Check	201	Pr-Int_Stat1
2	Ch2 Red	52	Ch4 Green	102	R2 Status C	152	Ph 11 Check	202	Pr-Int_Stat2
3	Ch3 Red	53	Ch5 Green	103	Special 1	153	Ph 12 Check	203	Pr-Int_Stat3
4	Ch4 Red	54	Ch6 Green	104	Special 2	154	Ph 13 Check	204	Pr-Int_Stat4
5	Ch5 Red	55	Ch7 Green	105	Special 3	155	Ph 14 Check	205	Pr-Int_Stat5
6	Ch6 Red	56	Ch8 Green	106	Special 4	156	Ph 15 Check	206	Pr-Int_Stat6
7	Ch7 Red	57	Ch9 Green	107	Special 5	157	Ph 16 Check	207	Pr-Int_Stat7
8	Ch8 Red	58	Ch10 Green	108	Special 6	158	Ph 9 Next	208	Reserved
9	Ch9 Red	59	Ch11 Green	109	Special 7	159	Ph 10 Next	209	Reserved
10	Ch10 Red	60	Ch12 Green	110	Special 8	160	Ph 11 Next	210	Reserved
11	Ch11 Red	61	Ch13 Green	111	Fault Mon	161	Ph 12 Next	211	TrainOnWy1
12	Ch12 Red	62	Ch14 Green	112	Voltage Mon	162	Ph 13 Next	212	TrainOnWy2
13	Ch13 Red	63	Ch15 Green	113	Flash Logic-1 Hz	163	Ph 14 Next	213	TrainOnWy3
14	Ch14 Red	64	Ch16 Green	114	Watchdog	164	Ph 15 Next	214	TrainOnWy4
15	Ch15 Red	65	Ch17 Green	115	Not Used	165	Ph 16 Next	215	TrainOnWy5
16	Ch16 Red	66	Ch18 Green	116	Pre Stat 1	166	Phase 9 On	216	TrainOnWy6
17	Ch17 Red	67	Ch19 Green	117	Pre Stat 2	167	Phase 10 On	217	TrainOnWy7
18	Ch18 Red	68	Ch20 Green	118	Pre Stat 3	168	Phase 11 On	218	TrainOnWy8
19	Ch19 Red	69	Ch21 Green	119	Pre Stat 4	169	Phase 12 On	219	Reserved
20	Ch20 Red	70	Ch22 Green	120	Pre Stat 5	170	Phase 13 On	220	Reserved
21	Ch21 Red	71	Ch23 Green	121	Pre Stat 6	171	Phase 14 On	221	LRVCkOut1
22	Ch22 Red	72	Ch24 Green	122	TBCAux/Pre1	172	Phase 15 On	222	LRVCkOut2
23	Ch23 Red	73	Ph 1 Check	123	TBCAux/Pre2	173	Phase 16 On	223	LRVCkOut3
24	Ch24 Red	74	Ph 2 Check	124	LdSwtchFlsh	174	Flash Logic- 2.5 Hz	224	LRVCkOut4
25	Ch1 Yellow	75	Ph 3 Check	125	TBC Aux 1	175	Flash Logic- 5 Hz	225	LRVCkOut5
26	Ch2 Yellow	76	Ph 4 Check	126	TBC Aux 2	176	Reserved	226	LRVCkOut6
27	Ch3 Yellow	77	Ph 5 Check	127	TBC Aux 3	177	Reserved	227	LRVCkOut7
28	Ch4 Yellow	78	Ph 6 Check	128	Free/Coord	178	Reserved	228	LRVCkOut8
29	Ch5 Yellow	79	Ph 7 Check	129	Time plan A	179	Set Time	229	Reserved
30	Ch6 Yellow	80	Ph 8 Check	130	Time plan B	180	QJmpPend 1	230	Conditional
31	Ch7 Yellow	81	Ph 1 Next	131	Time plan C	181	QJmpPend 2	231	Input/ Output
32	Ch8 Yellow	82	Ph 2 Next	132	Time plan D	182	QJmpPend 3	232	
33	Ch9 Yellow	83	Ph 3 Next	133	Offset Out1	183	QJmpPend 4	233	Based on
34	Ch10 Yellow	84	Ph 4 Next	134	Offset Out2	184	QJmpAct 1	234	CNF_GATE
35	Ch11 Yellow	85	Ph 5 Next	135	Offset Out3	185	QJmpAct 2	235	
36	Ch12 Yellow	86	Ph 6 Next	136	Auto Flash	186	QJmpAct 3	236	Refer to
37	Ch13 Yellow	87	Ph 7 Next	137	PreemptActv	187	QJmpAct 4	237	CFG_Gate
38	Ch14 Yellow	88	Ph 8 Next	138	LRV Warning	188	Pre Stat 7	238	Table end of
39	Ch15 Yellow	89	Phase 1 On	139	Reserved	189	Pre Stat 8	239	Sect 12.7
40	Ch16 Yellow	90	Phase 2 On	140	Audible Ped 2	190	Pre Stat 9	240	Logic11
41	Ch17 Yellow	91	Phase 3 On	141	Audible Ped 4	191	Pre Stat 10	241	Logic12
42	Ch18 Yellow	92	Phase 4 On	142	Audible Ped 6	192	Pre Stat 11	242	Logic13
43	Ch19 Yellow	93	Phase 5 On	143	Audible Ped 8	193	Pre Stat 12	243	Logic14
44	Ch20 Yellow	94	Phase 6 On	144	Coord Sync	194	Reserved	244	Logic15
45	Ch21 Yellow	95	Phase 7 On	145	Coord Shortway	195	Reserved	245	Logic16
46	Ch22 Yellow	96	Phase 8 On	146	Coord Longway	196	Reserved	246	Logic17
47	Ch23 Yellow	97	R1 Status A	147	Reserved	197	Reserved	247	Logic18
48	Ch24 Yellow	98	R1 Status B	148	Reserved	198	Reserved	248	Logic19
49	Ch1 Green	99	R1 Status C	149	ENow Active	199	Reserved	249	Logic20

Func	Output	Func	Output	Func	Output	Func	Output	Func	Output
250	LCU NormOut	280	Ph 17 Check	310	Ph 31 Next	340	Logic 29	370	Reserved
251	LCU PreOut	281	Ph 18 Check	311	Ph 32 Next	341	Logic 30	371	Reserved
252	LCU PostOut	282	Ph 19 Check	312	LPStat 1	342	Ph 17 On	372	Reserved
253	Reserved	283	Ph 20 Check	313	LPStat 2	343	Ph 18 On	373	Reserved
254	Logic False	284	Ph 21 Check	314	LPStat 3	344	Ph 19 On	374	Reserved
255	Logic True	285	Ph 22 Check	315	LPStat 4	345	Ph 20 On	375	Reserved
256	Ch25 Red	286	Ph 23 Check	316	Reserved	346	Ph 21 On	376	Reserved
257	Ch26 Red	287	Ph 24 Check	317	Reserved	347	Ph 22 On	377	Reserved
258	Ch27 Red	288	Ph 25 Check	318	Reserved	348	Ph 23 On	378	Reserved
259	Ch28 Red	289	Ph 26 Check	319	Reserved	349	Ph 24 On	379	Reserved
260	Ch29 Red	290	Ph 27 Check	320	Reserved	350	Ph 25 On	380	Reserved
261	Ch30 Red	291	Ph 28 Check	321	LRchkIn1	351	Ph 26 On	381	Reserved
262	Ch31 Red	292	Ph 29 Check	322	LRchkIn2	352	Ph 27 On	382	Reserved
263	Ch32 Red	293	Ph 30 Check	323	LRchkIn3	353	Ph 28 On	383	Reserved
264	Ch25 Yellow	294	Ph 31 Check	324	LRchkIn4	354	Ph 29 On	384	Reserved
265	Ch26 Yellow	295	Ph 32 Check	325	LRchkIn5	355	Ph 30 On	385	Reserved
266	Ch27 Yellow	296	Ph 17 Next	326	LRchkIn6	356	Ph 31 On	386	Reserved
267	Ch28 Yellow	297	Ph 18 Next	327	LRchkIn7	357	Ph 32 On	387	Reserved
268	Ch29 Yellow	298	Ph 19 Next	328	LRchkIn8	368	Reserved	388	Reserved
269	Ch30 Yellow	299	Ph 20 Next	329	Reserved	359	Reserved	389	Reserved
270	Ch31 Yellow	300	Ph 21 Next	330	Reserved	360	Reserved	390	Reserved
271	Ch32 Yellow	301	Ph 22 Next	331	Reserved	361	Reserved	391	Reserved
272	Ch25 Green	302	Ph 23 Next	332	Logic 21	362	Reserved	392	Reserved
273	Ch26 Green	303	Ph 24 Next	333	Logic 22	363	Reserved	393	Reserved
274	Ch27 Green	304	Ph 25 Next	334	Logic 23	364	Reserved	394	Reserved
275	Ch28 Green	305	Ph 26 Next	335	Logic 24	365	Reserved	395	Reserved
276	Ch29 Green	306	Ph 27 Next	336	Logic 25	366	Reserved	396	Reserved
277	Ch30 Green	307	Ph 28 Next	337	Logic 26	367	Reserved	397	Reserved
278	Ch31 Green	308	Ph 29 Next	338	Logic 27	368	Reserved	398	Reserved
279	Ch32 Green	309	Ph 30 Next	339	Logic 28	369	Reserved	399	Reserved

Below are the Preemption Interval Status outputs that can be monitored.

Func	Output	Description
201	Pr-Int_Stat1	Preempt delay
202	Pr-Int_Stat2	Begin Yellow / Red Clearances
203	Pr-Int_Stat3	Track Clearance Green
204	Pr-Int_Stat4	Track Clearance Red / Yellow
205	Pr-Int_Stat5	Dwell
206	Pr-Int_Stat6	Dwell Yellow Clearance (i.e. Exiting Dwell)
207	Pr-Int_Stat7	Flashing Preempt

The following Table is used in association with the parameter CNF_Gate found on MM-x-x-x.

Func	Input if CNF_Gate=0	Input if CNF_Gate=1	Output if CNF_Gate=0	Output if CNF_Gate=0
230	Logic 1	GateMode0	Logic 1	GateOpen1
231	Logic 2	GateMode 1	Logic 2	GateClose1
232	Logic 3	GateMode 2	Logic 3	GateOpen2
233	Logic 4	GateMode 3	Logic 4	GateClose2
234	Logic 5	GateOpen 1	Logic 5	Reserved
235	Logic 6	GateClose 1	Logic 6	Reserved
236	Logic 7	GateOpen 2	Logic 7	Reserved
237	Logic 8	GateClose 2	Logic 8	Reserved
238	Logic 9	Reserved	Logic 9	Reserved
239	Logic 10	Reserved	Logic 10	Reserved

12.8 Programmable IO Logic (MM->1->8->7 or MM->1->9->2)

```
R#  Result Src.Fcn Op Src.Fcn Op Src.Fn>
  1 I   1 &=  0I   2 &     0I   3 +   ! 00113
  2 I   0  =  0I   0       0I   0       0I   0
  3 I   0  =  0I   0       0I   0       0I   0
  4 I   0  =  0I   0       0I   0       0I   0
  5 I   0  =  0I   0       0I   0       0I   0
  6 I   0  =  0I   0       0I   0       0I   0
  7 I   0  =  0I   0       0I   0       0I   0
```

```
<R#    TimeOp       Time
  1    EXTEND         5
  2    DELAY          0
  3    DELAY          0
  4    DELAY          0
  5    DELAY          0
  6    DELAY          0
  7    DELAY          0
```

The *IO Logic* feature allows the user to “logically” combine IO to create new inputs and outputs that extend the functionality of the controller. On Linux platforms, up to 100 lines of Logic programming is available to the user. The following are descriptions of each field

R#
This is the logic **R**ecord (Line) number.

Result Value and Resulting Statement
The user sets the **Result** value to either an **I** (for Input) or **O** (for Output). This selection determines if you are assigning the result of the statement to an input or an output.

Normally the resulting statement (**Result** value) equals (=) the logic statement that the user creates. However, with this version there is a feature where the user can also set the final **Result** value to be:

&=	Equal to the *Result value* **AND** the Logic on the right	**!&=**	Not equal to the *Result value* **AND** the Logic on the right
+=	Equal to the *Result value* **OR** the Logic on the right	**!+=**	Not equal to the *Result value* **OR** the Logic on the right
x=	Equal to the *Result value* **XOR** the Logic on the right	**!x=**	Not equal to the *Result value* **XOR** the Logic on the right

Note: Once the user programs Logic lines, the resultant (*Result)* input or output **will** replace the original physical input or output.

Src
This is the source controller number that is generating the logic function. The source ID will match the Peer ID number programmed on the “Peer tp Peer” menu under MM→1→93. Valid Source ID numbers are 0-15. Only program “**0**” as the source ID when the logic function remains within the same controller or when “Peer to Peer” programming is not used.

Fcn
This is the IO Function Number as described in Chapter 14 of the NTCIP Controller Training Manual.

The software utilizes 20 Logic Function variables numbered 230-249, where Functions 230-249 are functions "Logic 1" - "Logic 20".In addition output Logic Functions 21-30 are available and are function numbers 332-341. Whether they are denoted as input or output, they point to the same location. Think of these functions as temporary storage locations. If you want to feed the output of one statement into the next, you can make an assignment of the first statement to one of these logic variables, and then use it as a term in the next statement.

The user can optionally set a **!** prior to the **I** or **O** function. The exclamation point indicates that the term is inverted during evaluation of the statement.

Operator
This is the Logical Operation (Boolean Logic) displayed in symbols. Among the choices are: **&** (AND), **!&** (NAND), **+** (OR), **!+** (NOR), **x** (XOR), **!x** (XNOR)

The logic will follow the following truth tables-- Where '0' represents OFF or False and "1" represents ON or True

& (AND) !& (NAND)

0	0	0		0	0	1
0	1	0		0	1	1
1	0	0		1	0	1
1	1	1		1	1	0

+ (OR) !+ (NOR)

0	0	0		0	0	1
0	1	1		0	1	0
1	0	1		1	0	0
1	1	1		1	1	0

x (XOR) !x (XNOR)

0	0	0		0	0	1
0	1	1		0	1	0
1	0	1		1	0	0
1	1	0		1	1	1

Timer

The timer can optionally be specified to SHIFT, DELAY, or EXTEND the result of the logic statement for the number of seconds specified by the user.

SHIFT - Shift logic by the programmed number of seconds (0-255)

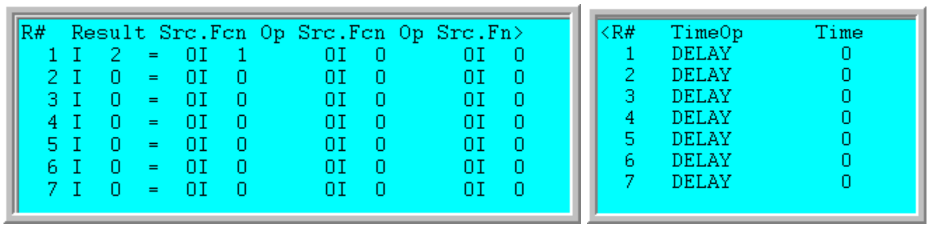
DELAY - Delay logic by the programmed number of seconds (0-255)

EXTEND – Extend logic by the programmed number of seconds (0-255)

SMALL DELAY – Delay logic by the programmed number of tenths seconds (0.0-25.5)

This timer operates similar to detection delay and extend.

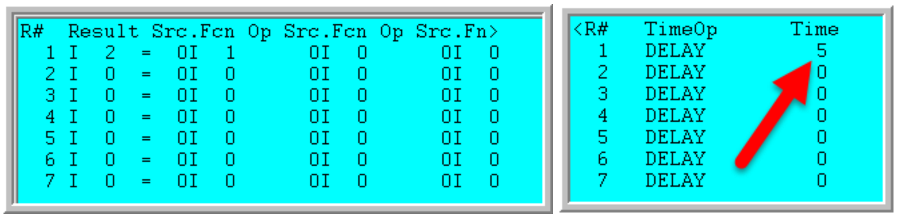
To illustrate the timers, program the logic such that a physical call on detector 1 will also call detector #2 as shown below.



```
R#  Result Src.Fcn Op Src.Fcn Op Src.Fn>
 1 I  2  =  OI  1      OI  0      OI  0
 2 I  0  =  OI  0      OI  0      OI  0
 3 I  0  =  OI  0      OI  0      OI  0
 4 I  0  =  OI  0      OI  0      OI  0
 5 I  0  =  OI  0      OI  0      OI  0
 6 I  0  =  OI  0      OI  0      OI  0
 7 I  0  =  OI  0      OI  0      OI  0
```

```
<R#   TimeOp       Time
 1    DELAY         0
 2    DELAY         0
 3    DELAY         0
 4    DELAY         0
 5    DELAY         0
 6    DELAY         0
 7    DELAY         0
```

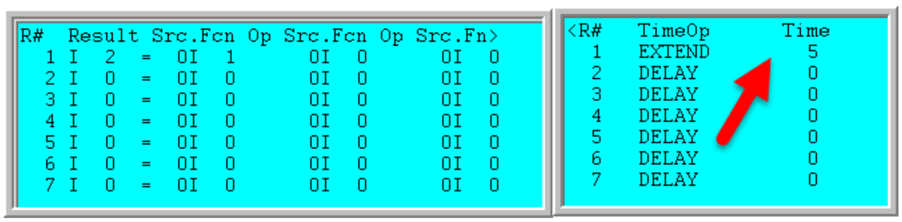
Program the timer with a DELAY 5



```
R#  Result Src.Fcn Op Src.Fcn Op Src.Fn>
 1 I  2  =  OI  1      OI  0      OI  0
 2 I  0  =  OI  0      OI  0      OI  0
 3 I  0  =  OI  0      OI  0      OI  0
 4 I  0  =  OI  0      OI  0      OI  0
 5 I  0  =  OI  0      OI  0      OI  0
 6 I  0  =  OI  0      OI  0      OI  0
 7 I  0  =  OI  0      OI  0      OI  0
```

```
<R#   TimeOp       Time
 1    DELAY         5
 2    DELAY         0
 3    DELAY         0
 4    DELAY         0
 5    DELAY         0
 6    DELAY         0
 7    DELAY         0
```

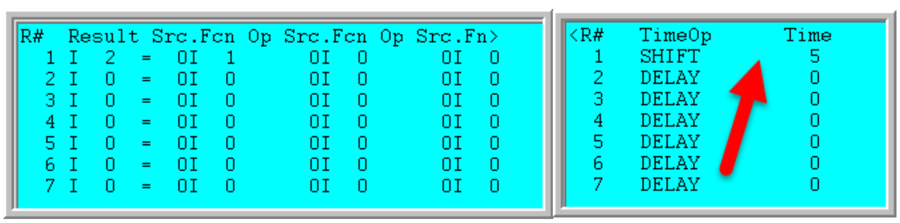
Veh Call #2 will come on 5 seconds after Veh Call 1 is active, as long as Call #1 is still on (active). Now program the timer with a EXTEND 5



```
R#  Result Src.Fcn Op Src.Fcn Op Src.Fn>
 1 I  2  =  OI  1      OI  0      OI  0
 2 I  0  =  OI  0      OI  0      OI  0
 3 I  0  =  OI  0      OI  0      OI  0
 4 I  0  =  OI  0      OI  0      OI  0
 5 I  0  =  OI  0      OI  0      OI  0
 6 I  0  =  OI  0      OI  0      OI  0
 7 I  0  =  OI  0      OI  0      OI  0
```

```
<R#   TimeOp       Time
 1    EXTEND        5
 2    DELAY         0
 3    DELAY         0
 4    DELAY         0
 5    DELAY         0
 6    DELAY         0
 7    DELAY         0
```

Veh Call #2 will come on as soon as Veh Call 1 is activated. When Veh Call 1 is deactivated, Veh Call # 2 will remain on for an additional 5 seconds. Now program the timer with a SHIFT 5



```
R#  Result Src.Fcn Op Src.Fcn Op Src.Fn>
 1 I  2  =  OI  1      OI  0      OI  0
 2 I  0  =  OI  0      OI  0      OI  0
 3 I  0  =  OI  0      OI  0      OI  0
 4 I  0  =  OI  0      OI  0      OI  0
 5 I  0  =  OI  0      OI  0      OI  0
 6 I  0  =  OI  0      OI  0      OI  0
 7 I  0  =  OI  0      OI  0      OI  0
```

```
<R#   TimeOp       Time
 1    SHIFT         5
 2    DELAY         0
 3    DELAY         0
 4    DELAY         0
 5    DELAY         0
 6    DELAY         0
 7    DELAY         0
```

Veh Call #2 will come on 5 seconds after Veh Call 1 is activated, even if Veh Call 1 is then deactivated during the interim time. Veh Call # 2 will remain on for as long as Veh Call 1 was active.

Summary

The logic statement is performed from **left to right**. The result of each statement is accumulated. For example, "1 AND 2 AND 3" is processed as follows " (RESULT OF 1 AND 2) AND 3".

12.8.1 I/O Logic Considerations and Best Practices

The controller I/O logic has the ability to store temporary states in a place holder I/O locations (variable) regardless if it is an input or output function, i.e. Function 230 (Logic 1), Function 231 (Logic2)…..Function 249 (logic 20). Controller I/O logic can also override inputs and outputs.

The algorithmic process for I/O logic follows the following steps:

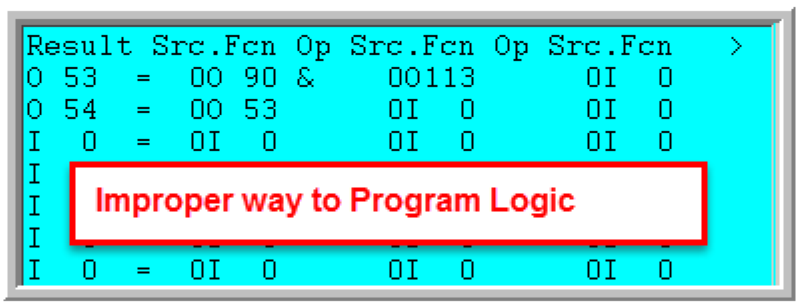
1. The controller polls all of the inputs from the I/O hardware.
2. The I/O logic executes each programmed line left to right and executes the top row to the bottom row.
3. The controller performs normal operation
4. The I/O logic stores the logic result overridden OUTPUTS for hardware processing.
5. The controller then pushes the outputs to the physical I/O hardware.

There is a nuanced detail that must be noted based on the above algorithm: **Any logic statement that stores its results to an output, then the logic is evaluated after the inputs are polled, but the assignment of the result of the output bit does not happen until right before the controller pushes the output to the hardware.**

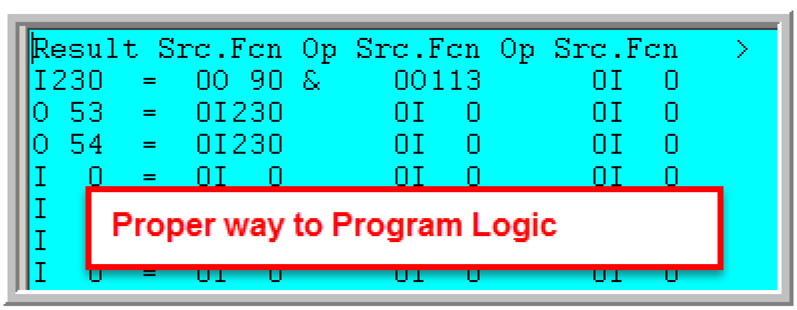
This nuance impacts the way to write a logic statement. If you are feeding forward a result, and that result is stored in an output, then it **WILL NOT WORK**.

Consider the example below. When phase 2 is ON, the user wants to turn on and flash the Channel 5 Green output. The user also wants to flash the Channel 6 Green output whenever Phase 2 is ON. The functions to do this are O53 (Channel 5 Green), O54 (Channel 6 Green), O90 (Phase 2 ON) and O113 (Flashing logic).

Logic programming on the screen below will FAIL based on the above algorithmic process. The second statement would fail because Channel 5 will not receive its value after the first statement is executed.



The way to work around this is to assign the result of the first statement to one of the LOGIC variables as a place-holder, and use the LOGIC variable to feed the state forward to other statements. We will use I230 (Logic1) to be this placeholder variable. **Remember to store and this variable as an INPUT**. The proper way to program the desired result is below:



This works because you can feed forward results assigned to INPUTS, but not the results assigned to OUTPUTS

As a general rule, you should only designate the place holder I/O locations as INPUTS. So, if you are storing something in LOGIC1 it should be "I 230", and not "O 230".

12.9 IO Viewer (MM->1->8->8 or MM->1->9->7)

12.9.1 Viewing Inputs/Outputs (MM->1->8->8->1, MM->1->9->7->1, MM->1->8->8->2, MM->1->9->7-2)

An *IO Viewer* provides a real-time status monitor of all available inputs and outputs to the controller.

```
                           Status
1.In/Out 1-531     4.PeerStatus
2.Reserved         5.DeviceBuffer
```

```
  1  Inputs             Outputs
Fcn Description Stat   Description Stat
  1 Veh Call 1  ----   Ch1 Red     Actv
  2 Veh Call 2  ----   Ch2 Red     ----
  3 Veh Call 3  ----   Ch3 Red     Actv
  4 Veh Call 4  ----   Ch4 Red     Actv
  5 Veh Call 5  ----   Ch5 Red     ----
  6 Veh Call 6  ----   Ch6 Red     Actv
```

The screens will display Input functions on the left side and output functions on the right side, using the function numbers as described in the previous sections. The user can simply type in a function number and the screen will kip to the IO area that begins with that function number. Valid entries are 1-531. Below is a screen shot after editing the function number 342.

```
342  Inputs             Outputs
Fcn Description Stat   Description Stat
342 Veh Call 77 ----   Phase 17 On ----
343 Veh Call 78 ----   Phase 18 On Actv
344 Veh Call 79 ----   Phase 19 On ----
345 Veh Call 80 ----   Phase 20 On ----
346 Veh Call 81 ----   Phase 21 On ----
347 Veh Call 82 ----   Phase 22 On Actv
```

12.9.2 FIO Device Buffer (MM->1->8->8->5, MM->1->9->7->5)

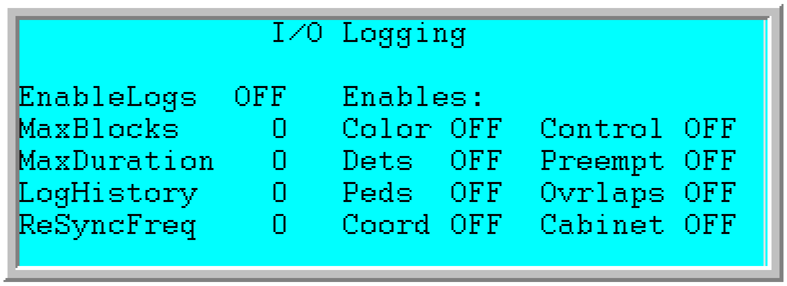
This selection allows the user to monitor the FIO device Buffer Status.

```
Device:FIO  In 1 --------  Out 1 --------
Addr  : 0      2 --------      2 --------
               3 --------      3 --------
               4 --------      4 --------
               5 --------      5 --------
               6 --------      6 --------
               7 --------      7 --------
               8 --------      8 --------
```

12.10 Traffic Signal Performance Logging (MM→1→9→5)

Automated Traffic Signal Performance Measures are a series of aids that display the high-resolution data from traffic signal controllers. They are a valuable asset management tool, aiding technicians and managers in the control of both traffic signal hardware and traffic signal timing and coordination. They allow analysis of data collected 24 hours a day, 7 days a week, improving the accuracy, flexibility, and performance of signal equipment and the system as a whole. Cubic | Trafficware provides the Purdue logging facilities that will gather this data and report it to the **ATMS.now** central system. This screen allows the user to turn this logging on and set which detailed traffic data that the agency desires to gather.

Note: This feature is only available utilizing the ATC platform due to RAM storage requirements for high resolution data. Further note that the agency MUST retrieve the logs within 24 hours because the log buffer is overwritten.



Enable Logs
Turns logging on/off

Max Blocks
The number of 100KB blocks to limit the log file size (a selection of "0 "= 512 K Bytes)

Max Duration
The number of minutes before the log file rolls to the next logs file (a selection of "0"=99 minutes)

Log History
The number of hours to store the logs file (a selection of "0 " = 24 hours)

ReSyncFreq
The number of hours between re-syncing of data. The Purdue spec logs transitions in data, this will reset all states to 0, allowing the data user to establish actual states for low frequency transitions (a selection of "0"= 24 hours)

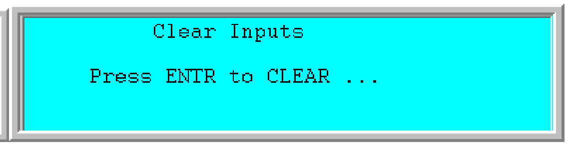
Enumeration Category (Data Types) Enables
Allows enabling or disabling of the specific Enumeration data categories (such as Colors, Dets, Peds, etc.) in order to limit the size of the log files. Once you turn an Enumeration Category to ON, the log file will only record that category.

The default value for each Enumeration Category is set to OFF. If you simply turn the feature to ON, then the controller will begin to gather the data for that particular category. Each of the Enable Items can be turned on/off or on depending on agency needs.

Please note that by default, all Enumeration Categories are set to OFF. This default setting will collect the data for ALL Enumeration Categories.

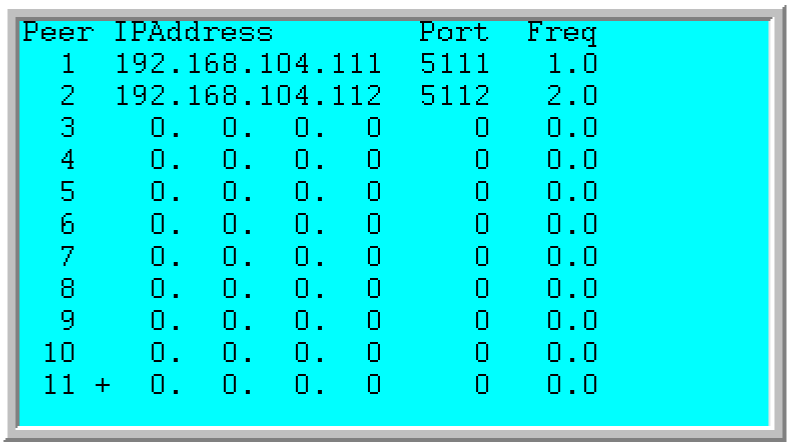
12.11 ClrInputs (MM->1->9->8)

This selection will allow the user to clear “stuck” inputs. This can occur if the user has added inputs via the I/O mapping or I/O logic mechanisms and then decides to remove them from the I/O mapping or I/O Logic. In this case if they were set then they could remain set so this screen will simply reset them from an undesired state to a normal state.



12.12 Peer to Peer Programming (MM→1→9→3)

Peer to Peer programming is a way to have one controller’s inputs or outputs drive another controller’s inputs or outputs. It is used in conjunction with IO logic programming describe earlier in this chapter. Peer to Peer programming can be accomplished using any Ethernet IP connection via the programming screen shown below.



Peer	IPAddress	Port	Freq
1	192.168.104.111	5111	1.0
2	192.168.104.112	5112	2.0
3	0. 0. 0. 0	0	0.0
4	0. 0. 0. 0	0	0.0
5	0. 0. 0. 0	0	0.0
6	0. 0. 0. 0	0	0.0
7	0. 0. 0. 0	0	0.0
8	0. 0. 0. 0	0	0.0
9	0. 0. 0. 0	0	0.0
10	0. 0. 0. 0	0	0.0
11 +	0. 0. 0. 0	0	0.0

Peer: This is the Peer number assigned by the user and is programmed as ***Src*** on the IO Logic screen. The user can assign up to 15 Peers to any controller.

IPAddress: This is the Ethernet IP address of the assigned Peer controller.

Port: This is the Port number of the assigned Peer controller.

Freq: This is how often the Peer will be polled for information. It is programmed in tenths of seconds. Valid vales are 0-25.5 seconds.   Typically, agencies use 1.0 for second by second polling.

NOTE: Cubic | Trafficware recommends that Peer to Peer programming (**MM-1->9->3**) will work if the user **DOES NOT** program any Host IP address under **MM->6->5** for communication setups that **do not use DHCP**.

12.13 Peer to Peer Comm Status (MM→1→8→8→4 or MM→1→9→7→4)

The communications status of each peer can be viewed via this screen selection. Each of the possible fifteen peers that are allowed to communicate will display the Transmit and receive block count along with any missing blocks. In addition, a Timeout value will be displayed and reset to zero each time the peer message is being transmitted and received. This will insure that each peer is actually communicating within the frequency that was programmed as per the section above.

```
     Tx.... Rx...................
Peer Count  Count  Missed   TimeOut
  1      0      0       0       0.0
  2      0      0       0       0.0
  3      0      0       0       0.0
  4      0      0       0       0.0
  5      0      0       0       0.0
  6      0      0   +   0       0.0
```

Under **MM->1->8->6** or **MM->1-9->1** the user can program the parameter called **Peer-Peer Timeout (0-25.5 sec)**. If communications fails, this parameter will insure that I/O is not overridden by the Peer units until communications is restored. In addition this timer has the ability keep or override the peer generated input or output. If you do not get a response from the peer within the “peer to peer timeout” time, then the inputs / output for that peer all default to an **Off (FALSE)** state. If you program that timer as zero seconds, then the inputs/outputs from that device remain in their last known state.

13 Controller Event/Alarm Descriptions

Event / Alarm #	Alarm Name	Comments	Hardware Specific
1	Power Up / Long Power Outage	Always active when power is applied to the controller. Transitions between power-up and power-downs of 500 ms or greater are logged and the controller will reset when power is restored.	
2	Stop Timing	Indicates that one of the stop time inputs is active.	
3	Cabinet Door Activation	This is brought into the NEMA input called "lamps" or "indicator". This input is typically used for the cabinet door switch in TS1 cabinets.	
4	Coordination Failure	This alarm indicates that coordination is failed. There are two ways in which coordination may fail: 1) The TS2 method in which two cycle faults have occurred during coordination, but not when coordination is inactive. 2) A serviceable call has not be serviced in 3 cycles. This is the traditional method, which predates the NEMA TS2 method.	
5	External Alarm # 1		
6	External Alarm # 2		
7	External Alarm # 3		
8	External Alarm # 4		
9	Closed Loop Disabled	This alarm, when active, indicates that the Closed-loop Enable parameter is set to OFF.	
10	External Alarm # 5		
11	External Alarm # 6		
12	Manual Control Enable	Alarm active when *Police Push Button* is ON	
13	Coordination Free Switch Input	Alarm active when System/Free Switch is FREE	
14	Local Flash Input	Asserted by monitor or cabinet switch when in flash	SDLC or I/O Mode
15	CMU or MMU Flash Input	Alarm is active when the controller receives an SDLC message from the MMU that it is in flash. Alarm is active when the controller receives a SDLC message from the CMU hardware that it is in flash. Please note that the CMU/MMU must be properly wired in the cabinet to receive this alarm	SDLC or I/O Mode

16	MMU Fault	Indicates a Conflict Monitor Hardware Fault has occurred when CVM is NOT asserted by the controller and Stop-Time is applied.	
17	Cycle Fault	TS2 Alarm. It indicates that a serviceable call has not been serviced in approximately two cycle times and coordination was active at the time. If the controller is operating in free mode, a Cycle Fault alarm is also logged at the same time as a Cycle Failure alarm.	
18	Cycle Failure	TS2 Alarm. It indicates that a serviceable call has not been serviced in approximately two cycle times and that coordination was not active at the time.	
19	Coordination Fault	Indicates that a cycle fault occurred during coordination.	
20	Controller Fault	Intersection is in Flash due to a critical controller fault. This fault includes Field Check, Response Frames, and Processor Diagnostics.	
21	Detector SDLC Fault	Indicates SDLC communication with at least one of the Detector BIUs are faulted. This is a non-critical fault and will not cause the intersection to flash.	SDLC
22	MMU SDLC Fault	SDLC communication with the MMU has experienced a Response Frame Fault. This is a critical fault and will cause the controller to flash.	SDLC
23	Terminal Facility (cabinet) SDLC Fault	SDLC communication with one or more of the Terminal and Facilities BIUs are faulted. This is a critical fault and will cause the controller to Flash.	SDLC
24	SDLC Response Frame Fault	Report from SDLC interface of faulty messages	TS2 SDLC
25	EEPROM CRC Fault	The background EEPROM diagnostic has detected an unexplained change in the CRC of the user-programmed database.	
26	Detector Diagnostic Fault	One of the controller detector diagnostics (No Activity, Max Presence or Erratic Count) has failed. Refer to section 13.1 for further details.	
27	Detector Fault From SDLC	One or more local detectors have been reported to be faulted by detector hardware and/or BIU hardware. These faults include open loop, shorted loop, excessive inductance change, and watch-dog time-out.	SDLC
28	Queue Detector alarm	Associated with the queue detector feature. Data indicates which queue detector is generating the alarm.	
29	Ped Detector Fault	A ped detector is faulted due to user program limits being exceeded. These include *No Activity*, *Max Presence* and *Erratic Count* on screen **MM->5->4**.	

30	Pattern Error / Coord Diagnostic Fault	Active when coord diagnostic has failed. Refer to section 13.1 for further details	
31	Cabinet Flash Alarm	Active after a programmed delay timer expires if the monitor, or a controller fault, causes the cabinet to flash. Refer to Alarms section for further details.	TS2 (newer hardware)
32	Reserved		
33	Street Lamp Failure	Street Lamp Failure (Channel A)	
34	Street Lamp Failure	Street Lamp Failure (Channel B)	
35	Reserved	Reserved	
36	Reserved	Reserved	
37	Download Request	Requests Download from central system (see **MM->6->4**	
38	Pattern Change	Coordination Pattern changes are logged to the event and alarm buffers using this alarm number. The data byte stores the new pattern number.	
39	Reserved	Reserved	
40	Reserved	Reserved	
41	Temperature Alert #1	Temp Alert 1 – High Temp	Temp Alert
42	Temperature Alert #1	Temp Alert 1 – Low Temp	Temp Alert
43	Temperature Alert #1	Temp Alert 1 – Status Alarm	Temp Alert
44	Temperature Alert #2	Temp Alert 2 – High Temp	Temp Alert
45	Temperature Alert #2	Temp Alert 2 – Low Temp	Temp Alert
46	Temperature Alert #2	Temp Alert 2 – Status Alarm	Temp Alert
47	Coord Active	Set when coordination is active (not free)	
48	Preempt Active	Set when any preempt is active	
49	HP Preempt 1	High-Priority Preempt 1 (Rail Preempt 1)	
50	HP Preempt 2	High-Priority Preempt 2 (Rail Preempt 2)	

51	HP Preempt 3	High-Priority Preempt 3	
52	HP Preempt 4	High-Priority Preempt 4	
53	HP Preempt 5	High-Priority Preempt 5	
54	HP Preempt 6	High-Priority Preempt 6	
55	LP Preempt 1	Low-Priority or Transit Priority Preempt 1	
56	LP Preempt 2	Low-Priority or Transit Priority Preempt 2	
57	LP Preempt 3	Low-Priority or Transit Priority Preempt 3	
58	LP Preempt 4	Low-Priority or Transit Priority Preempt 4	
59	EEPROM Compare Fault	The checksum of firmware memory has changed	
60	Coordination Failure	Alarm is ON when Coordination has failed	2070 / ATC
61	Coordination in (Sync) Transition	Alarm is ON when coord is active and in transition for times over 3 seconds. Alarm is OFF when coord is active and in SYNC.	
62	Light Rail / Transit	Alarm Rail Check: One of the following detector conditions exist: • Train activates Check-In detector without activating Advanced Detector • Train waited too long (MaxCheckIn value expired) • Train activated Check-Out detector without activating the Check-In Detector	
63	TSP Active Trigger	Used with ATMS to initiate download of TSP Data	
64	SynchroGreen Adaptive Active	Indicates that the agency has the Synchro Green Central Module and it is currently sending a Pattern to the local controller.	
65	Light Rail / Transit	Advance/Check-in/Check-out Detector Stuck	
66	Light Rail / Transit	Advance/Check-in/Check-out detector inputs are out of sequence	
67	Light Rail / Transit	Failed to arrive at the Check-in Detector in the proper amount of time	
68	Light Rail / Transit	Failure to arrive at the Check-out Detector	
69	Reserved		
70	Internal Clock Jump	Occurs when the clock jumps by +/- 2 seconds	
71	SIU Input SDLC error	Indicates SDLC communication fault with at least one of the Input file Detector SIUs	SDLC
72	SIU Output SDLC error	SDLC communication fault with one or more of the Output file SIUs.	SDLC
73	Controller Access	Active when a key is pressed until the *Display Time* expires (see Unit Parameters, **MM->1->2->1**)	

74	User Key Login	Active when user enters security key – records the User # in the data byte	
75	"Disk" File Access Error	The software could not access the files on "disk" devices such as Flash RAM, RAM, SD card or USB device	
76	Database Change Notification	Database is edited in a controller by a Logged in User and is reported to ATMS.now	2070 / ATC
77	Emergency Priority	Emergency Priority Activation (ON/OFF)	
78	SIU CMU SDLC Fault error	SDLC communication with the CMU has indicated a Fault condition.	SDLC
79	SIU CMU SDLC error	SDLC communication with the CMU has failed. This is a critical fault and will cause the controller to flash.	SDLC
80	CMU Channel Conflict	Conflict detected between SIU CMU channels	SDLC
81	FIO Changed Status	FIO Status has changed	2070 / ATC
82	UPS On Battery	Indicates that the cabinet is running under UPS Power (Input function 250 is set to ON)	
83	UPS Flash Input	Indicates the controller is in Flash due to the UPS Battery low power (Input function 251 is set to ON)	
84	Communications Failure	This alarm is set when the parameter FailTime (MM->6->1) expires (Controller received no communications)	
85	Short Power Outage	Transitions between power-up and power-downs of less than 500 ms are logged and the controller will not reset. Used to track power brownouts	
86	Reserved		
87	External Alarm # 7		2070 / ATC
88	External Alarm # 8		2070 / ATC
89	External Alarm # 9		2070 / ATC
90	External Alarm # 10		2070 / ATC
91	External Alarm # 11		2070 / ATC
92	External Alarm # 12		2070 / ATC
93	External Alarm # 13		2070 / ATC
94	External Alarm # 14		2070 / ATC
95	External Alarm # 15		2070
96	External Alarm # 16		2070

97-113	Reserved		
114	HP Preempt 7	High-Priority Preempt 7	
115	HP Preempt 8	High-Priority Preempt 8	
116	HP Preempt 9	High-Priority Preempt 9	
117	HP Preempt 10	High-Priority Preempt 10	
118	HP Preempt 11	High-Priority Preempt 11	
119	HP Preempt 12	High-Priority Preempt 12	
120	Reserved		
121	Special Function Output	Special Function #1	
122	Special Function Output	Special Function #2	
123	Special Function Output	Special Function #3	
124	Special Function Output	Special Function #4	
125	Special Function Output	Special Function #5	
126	Special Function Output	Special Function #6	
127	Special Function Output	Special Function #7	
128	Special Function Output	Special Function #8	

13.1 Error Data

13.1.1 Alarm 17 Cycle Fault

Fault #	Fault Description
0	Other cycle fault
1	Non-preempt cycle fault (not servicing phases)
2	Preempt cycle fault (timed out while seeking **track** phases)
3	Preempt cycle fault (timed out while seeking **dwell** phases)
4	4 Preempt cycle fault (timed out while seeking **return/end of preempt**)

13.1.2 Alarm 21 Detector SDLC Diagnostic Fault Data

Fault Description	Det BIU Out Fault Data	Det BIU In Fault Data
Detector BIU # 1	1	29
Detector BIU # 2	2	45
Detector BIU # 3	3	61
Detector BIU # 4	4	77

13.1.3 Alarm 22 MMU SDLC Diagnostic Fault Data

Fault #	Fault Description
129	MMU SDLC fault

13.1.4 Alarm 23 Terminal Facilities SDLC Diagnostic Fault Data

Fault Description	Det BIU Out Fault Data
Terminal Facilities BIU # 1	138
Terminal Facilities BIU # 2	139
Terminal Facilities BIU # 3	140
Terminal Facilities BIU # 4	141

13.1.5 Alarm 26 Detector Diagnostic Fault

Fault (decimal)	Fault (Hexadecimal)	Fault (Stored as Occupancy Data)
210	D2	Max Presence Fault
211	D3	No Activity Fault
212	D4	Open Loop Fault
213	D5	Shorted Loop Fault
214	D6	Excessive Inductance Change
215	D7	Reserved
216	D8	Watchdog Fault
217	D9	Erratic Output Fault

13.1.6 Alarm 30 Pattern Error

Fault #	Fault Description
0	No Error
1	In diamond mode, sum of major phases (splits) adds to zero
2	In diamond mode, sum of splits did not equal cycle length
3	Sum of splits exceeded max cycle length (max length currently 999 in ATC/2070, 255 in 980/v65 or older)
4	Invalid split number called out in pattern
5	Ring 1 / 2 sum of splits not equal (when applicable)
6	Split time is shorter than sum of min time for a phase
7	Coordinated phases are not compatible
8	No coordinated phase assigned
9	More than one coord phase was designated for a single ring
10	Undefined
11	Fastway/Shortway transition time greater than 25% (out of range)
12	Undefined
13	Stop-time active
14	Manual-control active
15	Error in cycle length when calculating reference point (Cycle time is greater than calculated coord max cycle length)
16	In diamond mode, error in phase split value (typically phase 12)
17	Active split had a zero split value programmed

13.1.7 Power Down/Up Events and Alarms

Events and Alarms 1 and 85 track controller (and cabinet) power outages. They are used to distinguish between long power outages (Alarm 1) and short power outages (Alarm 85). The difference between Alarm 1 and Alarm 85 is noted below.

- **Alarm 1 (long power out) will show OFF when power is lower than 92 VAC +/- 2 VAC (Caltrans) or 89 VAC +/- 2 VAC (NEMA) for "GREATER" than 500 ms and *WILL* cause a controller reset.**
- **Alarm 1 (long power out) will show ON when power is restored.**
- **Alarm 85 (short power out) will show OFF when power is lower than 92 VAC +/- 2VAC (Caltrans) or 89 VAC +/- 2 VAC (NEMA) for "LESS" than 500 ms and *WILL NOT* cause a controller reset.**
- **Alarm 85 (short power out) will show ON when power is restored.**

14 Hardware I/O and Interfaces

14.1 TS2 and 2070(N) I/O Maps

14.1.1 A-Connector - TS2 (type-2) and 2070N

Note: Refer to the TS2 I/O Mode chart (section 14.1.4) to reference Inputs 1-24 and Outputs 1-24. These inputs and outputs may be reassigned using the *I/O Mode* setting under Unit Parameters (**MM->1->2->1**). Mode 0 is the default mode.

Pin	Function	I/O	Pin	Function	I/O
A	Fault Monitor	O	f	Det Ch 1	I
B	+24 VDC	O	g	Ped Det 1	I
C	Voltage Monitor	O	h	Input 1	I
D	Ch 1 Red	O	i	Force Off (1)	I
E	Ch 17 Red	O	j	External Recall (min)	I
F	Ch 2 Red	O	k	Man Control Enable	I
G	Ch 13 Red (ø 2 Don't Walk)	O	m	Call to Non-Actuated **I**	I
H	Ch 13 Yel (ø 2 Ped Clear)	O	n	Test A	I
J	Ch 13 Grn (ø 2 Walk)	O	p	AC Line	I
K	Det Ch 2	I	q	I/O Mode Bit A	I
L	Ped Det Ch 2	I	r	Status Bit B (1)	O
M	Input 2	I	s	Ch 1 Grn	O
N	Stop Time (1)	I	t	Ch 17 Grn (ø 1 Walk)	O
P	Inh Max (1)	I	u	Output 17	O
R	External Start	I	v	Input 18	I
S	Internal Advance	I	w	Omit Red Clr (1)	I
T	Ind. Lamp Control	I	x	Red Rest (1)	I
U	AC Neutral	I	y	I/O Mode Bit B	I
V	Earth Ground	I	z	Call to Non-Actuated **II**	I
W	Logic Ground	O	AA	Test B	I
X	Flashing Logic	O	BB	Walk Rest Modifier	I
Y	Status Bit C (1)	O	CC	Status Bit A	O
Z	Ch 1 Yel	O	DD	Output 1	O
a	Ch 17 Yel (ø 1 Ped Clear)	O	EE	Input 9	I
b	Ch 2 Yel	O	FF	Ped Recycle (1)	I
c	Ch 2 Grn	O	GG	Max **II** (1)	I
d	Output 18	O	HH	I/O Mode bit C	I
e	Output 2	O			

TS2 (type-2) and 2070N: A-Connector

14.1.2 B-Connector - TS2 (type-2) and 2070N

Note: Refer to the TS2 I/O Mode chart (section 14.1.4) to reference Inputs 1-24 and Outputs 1-24. These inputs and outputs may be reassigned using the *I/O Mode* setting under Unit Parameters (**MM->1->2->1**). Mode 0 is the default mode.

Pin	Function	I/O	Pin	Function	I/O
A	Output 9	O	f	Output 12	O
B	Preempt 2	I	g	Input 12	I
C	Output 10	O	h	Input 4	I
D	Ch 3 Grn	O	i	Input 3	I
E	Ch 3 Yel	O	j	Input 19	I
F	Ch 3 Red	O	k	Input 22	I
G	Ch 4 Red	O	m	Input 23	I
H	Ch 14 Yel (ø 4 Ped Clear)	O	n	Input 24	I
J	Ch 14 Red (ø 4 Don't Walk)	O	p	Ch 9 Yel (OL A)	O
K	Output 20	O	q	Ch 9 Red (OL A)	O
L	Det Ch 4	I	r	Output 19	O
M	Ped Det Ch 4	I	s	Output 3	O
N	Det Ch 3	I	t	Output 11	O
P	Ped Det Ch 3	I	u	Ch 12 Red (OL D)	O
R	Input 11	I	v	Preempt 6	I
S	Input 10	I	w	Ch 12 Grn (OL D)	O
T	Input 21	I	x	Input 20	I
U	Input 9	I	y	Free	I
V	Ped Recycle (Ring 2)	I	z	Max II select (Ring 2)	I
W	Preempt 4	I	AA	CH 9 Grn (OL A)	O
X	Preempt 5	I	BB	Ch 10 Yel (OL B)	O
Y	Ch 18 Grn (ø 3 Walk)	O	CC	Ch 10 Red (OL B)	O
Z	Ch 18 Yel (ø 3 Ped Clear)	O	DD	Ch 11 Red (OL C)	O
a	Ch 18 Red (ø 3 Don't Walk)	O	EE	Ch 12 Yel (OL D)	O
b	Ch 4 Grn	O	FF	Ch 11 Grn (OL C)	O
c	Ch 4 Yel	O	GG	Ch 10 Grn (OL B)	O
d	Ch 14 Grn (ø 4 Walk)	O	HH	Ch 11 Yel (OL C)	O
e	Output 4	O			

TS2 (type-2) and 2070N: B-Connector

14.1.3 C-Connector - TS2 (type-2) and 2070N

Note: Refer to the TS2 I/O Mode chart (section 14.1.4) to reference Inputs 1-24 and Outputs 1-24. These inputs and outputs may be reassigned using the *I/O Mode* setting under Unit Parameters (**MM->1->2->1**). Mode 0 is the default mode.

Pin	Function	I/O	Pin	Function	I/O
A	Status A Bit (2)	O	i	Ch 5 Grn	O
B	Status B Bit (2)	O	j	Ch 18 Grn (ø 5 Walk)	O
C	Ch 16 Red (ø8 Don't Walk)	O	k	Output 21	O
D	Ch 8 Red	O	m	Input 5	I
E	Ch 7 Yel	O	n	Input 13	I
F	Ch 7 Red	O	p	Input 6	I
G	Ch 6 Red	O	q	Input 14	I
H	Ch 5 Red	O	r	Input 15	I
J	Ch 5 Yel	O	s	Input 16	I
K	Ch 19 Yel (ø 5 Ped Clear)	O	t	Det Ch 8	I
L	Ch 19 Red (ø 5 Don't Walk)	O	u	Red Rest (2)	I
M	Output 13	O	v	Omit Red (2)	I
N	Output 5	O	w	Ch 16 Yel (ø 8 Ped Clear)	O
P	Det Ch 5	I	x	Ch 8 Grn	O
R	Ped Det Ch 5	I	y	Ch 20 Red (ø 7 Don't Walk)	O
S	Det Ch 6	I	z	Ch 15 Red (ø 6 Don't Walk)	O
T	Ped Det Ch 6	I	AA	Ch 15 Yel (ø 6 Ped Clear)	O
U	Ped Det Ch 7	I	BB	Output 22	O
V	Det Ch 7	I	CC	Output 6	O
W	Ped Det Ch 8	I	DD	Output 14	O
X	Input 8	I	EE	Input 7	I
Y	Force Off (2)	I	FF	Output 24	O
Z	Stop Time (2)	I	GG	Output 8	O
a	Inh Max (2)	I	HH	Output 16	O
b	Test C	I	JJ	Ch 20 Grn (ø 7 Walk)	O
c	Status C Bit (2)	O	KK	Ch 20 Yel (ø 7 Ped Clear)	O
d	Ch 16 Grn (ø 8 Walk)	O	LL	Ch 15 Grn (ø 6 Walk)	O
e	Ch 8 Yel	O	MM	Output 23	O
f	Ch 7 Grn	O	NN	Output 7	O
g	Ch 6 Grn	O	PP	Output 15	O
h	Ch 6 Yel	O			

TS2 (type-2) and 2070N: C-Connector

14.1.4 TS2 and 2070(N) - I/O Modes 0 – 3

Input	Mode 0	Mode 1	Mode 2	Mode 3
1	Ph1 Hold	Prmpt 1	Prmpt 1	Prmpt 1
2	Ph2 Hold	Prmpt 3	Prmpt 3	Prmpt 3
3	Ph3 Hold	Det Ch 9	Det Ch 9	
4	Ph4 Hold	Det Ch 10	Det Ch 10	
5	Ph5 Hold	Det Ch 13	Det Ch 13	
6	Ph6 Hold	Det Ch 14	Det Ch 14	
7	Ph7 Hold	Det Ch 15	Det Ch 15	
8	Ph8 Hold	Det Ch 16	Det Ch 16	
9	Ph1 Phase Omit	Det Ch 11	Det Ch 11	
10	Ph2 Phase Omit	Det Ch 12	Det Ch 12	
11	Ph3 Phase Omit	Timing Plan C	Det Ch 17	Timing Plan C
12	Ph4 Phase Omit	Timing Plan D	Det Ch 18	Timing Plan D
13	Ph5 Phase Omit	Alt Seq A	Det Ch 19	Alt Seq A
14	Ph6 Phase Omit	Alt Seq B	Det Ch 20	Alt Seq B
15	Ph7 Phase Omit	Alt Seq C	Alarm 1	Alt Seq C
16	Ph8 Phase Omit	Alt Seq D	Alarm 2	Alt Seq D
17	Ph1 Ped Omit	Dimming Enabled	Dimming Enabled	Dimming Enabled
18	Ph2 Ped Omit	Auto Flash	Local Flash Status	Auto Flash
19	Ph3 Ped Omit	Timing Plan A	Addr Bit 0	Timing Plan A
20	Ph4 Ped Omit	Timing Plan B	Addr Bit 1	Timing Plan B
21	Ph5 Ped Omit	Offset 1	Addr Bit 2	Offset 1
22	Ph6 Ped Omit	Offset 2	Addr Bit 3	Offset 2
23	Ph7 Ped Omit	Offset 3	Addr Bit 4	Offset 3
24	Ph8 Ped Omit	TBC On Line	MMU Flash Status	TBC On Line
Output	**Mode 0**	**Mode 1**	**Mode 2**	**Mode 3**
1	Ph1 On	Prmpt Stat 1	Prmpt Stat 1	
2	Ph2 On	Prmpt Stat 3	Prmpt Stat 3	
3	Ph3 On	TBC Aux 1	TBC Aux 1	TBC Aux 1
4	Ph4 On	TBC Aux 2	TBC Aux 2	TBC Aux 2
5	Ph5 On	Timing Plan A	Timing Plan A	Timing Plan A
6	Ph6 On	Timing Plan B	Timing Plan B	Timing Plan B
7	Ph7 On	Offset 1	Offset 1	Offset 1
8	Ph8 On	Offset 2	Offset 2	Offset 2
9	Ph1 Next	Prmpt Stat 2	Prmpt Stat 2	
10	Ph2 Next	Prmpt Stat 4	Prmpt Stat 4	
11	Ph3 Next	Prmpt Stat 5	Prmpt Stat 5	
12	Ph4 Next	Prmpt Stat 6	Prmpt Stat 6	
13	Ph5 Next	Offset 3	Offset 3	Offset 3
14	Ph6 Next	Timing Plan C	Timing Plan C	Timing Plan C
15	Ph7 Next	Timing Plan D	Timing Plan D	Timing Plan D
16	Ph8 Next	Reserved	Reserved	
17	Ph1 Check	Free/Coord	Free/Coord	
18	Ph2 Check	Auto Flash	Auto Flash	Auto Flash
19	Ph3 Check	TBC Aux 3	TBC Aux 3	
20	Ph4 Check	Reserved	Reserved	
21	Ph5 Check	Reserved	Spec Func 1	
22	Ph6 Check	Reserved	Spec Func 2	
23	Ph7 Check	Reserved	Spec Func 3	
24	Ph8 Check	Reserved	Spec Func 4	

TS2 and 2070(N) I/O Modes 0 – 3: Selected under Channel/IO Parameters

14.1.5 TS2 and 2070(N) - I/O Modes 4 – 7

Input	Mode 4	Mode 5	Mode 6	Mode 7
1	Reserved by NEMA	Reserved by NEMA		
2	Reserved by NEMA	Reserved by NEMA		
3	Reserved by NEMA	Reserved by NEMA		
4	Reserved by NEMA	Reserved by NEMA		
5	Reserved by NEMA	Reserved by NEMA		
6	Reserved by NEMA	Reserved by NEMA		
7	Reserved by NEMA	Reserved by NEMA		
8	Reserved by NEMA	Reserved by NEMA		
9	Reserved by NEMA	Reserved by NEMA		
10	Reserved by NEMA	Reserved by NEMA		
11	Reserved by NEMA	Reserved by NEMA		
12	Reserved by NEMA	Reserved by NEMA		
13	Reserved by NEMA	Reserved by NEMA		
14	Reserved by NEMA	Reserved by NEMA		
15	Reserved by NEMA	Reserved by NEMA		
16	Reserved by NEMA	Reserved by NEMA		
17	Reserved by NEMA	Reserved by NEMA		
18	Reserved by NEMA	Reserved by NEMA		
19	Reserved by NEMA	Reserved by NEMA		
20	Reserved by NEMA	Reserved by NEMA		
21	Reserved by NEMA	Reserved by NEMA		
22	Reserved by NEMA	Reserved by NEMA		
23	Reserved by NEMA	Reserved by NEMA		
24	Reserved by NEMA	Reserved by NEMA		
Output	**Mode 4**	**Mode 5**	**Mode 6**	**Mode 7**
1	Reserved by NEMA	Reserved by NEMA		
2	Reserved by NEMA	Reserved by NEMA		
3	Reserved by NEMA	Reserved by NEMA		
4	Reserved by NEMA	Reserved by NEMA		
5	Reserved by NEMA	Reserved by NEMA		
6	Reserved by NEMA	Reserved by NEMA		
7	Reserved by NEMA	Reserved by NEMA		
8	Reserved by NEMA	Reserved by NEMA		
9	Reserved by NEMA	Reserved by NEMA		
10	Reserved by NEMA	Reserved by NEMA		
11	Reserved by NEMA	Reserved by NEMA		
12	Reserved by NEMA	Reserved by NEMA		
13	Reserved by NEMA	Reserved by NEMA		
14	Reserved by NEMA	Reserved by NEMA		
15	Reserved by NEMA	Reserved by NEMA		
16	Reserved by NEMA	Reserved by NEMA		
17	Reserved by NEMA	Reserved by NEMA		
18	Reserved by NEMA	Reserved by NEMA		
19	Reserved by NEMA	Reserved by NEMA		
20	Reserved by NEMA	Reserved by NEMA		
21	Reserved by NEMA	Reserved by NEMA		
22	Reserved by NEMA	Reserved by NEMA		
23	Reserved by NEMA	Reserved by NEMA		
24	Reserved by NEMA	Reserved by NEMA		

14.1.6 TS2 D-Connector - DIAMOND Mapping

Pin	Function	I/O		Pin	Function	I/O
10	Special Function 2	O		9	System Det 6 / Veh Det 22	I
14	Special Function 6	O		11	Free	I
22	Special Function 5	O		12	Not Assigned	I
23	Ext. Coord Active	O		13	Not Assigned	I
24	Flash Active	O		14	Not Assigned	I
35	Offset 1	O		15	Reserved	I
39*	I/O Spare	O		16	Reserved	I
42	Not Assigned	O		17	N/A	I
43	Special Function 1	O		18	Reserved	I
44	Split 3, Preempt 2	O		19	Preempt 1	I
45	Split 2, Preempt 1	O		20	Preempt 2	I
46	Offset 4, Preempt 5	O		21	Preempt 3	I
47	Offset 3, Preempt 6	O		22	Preempt 4	I
48	Offset 2	O		23	Preempt 5	I
49	Flash	O		24	Preempt 6	I
50	Cycle 3, Preempt 4	O		25	Detector 45P / Veh Det 9	I
51	Cycle 2, Preempt 3	O		26	Detector 25S / Veh Det 10	I
52	Offset 1	O		27	Detector 18P / Veh Det 11	I
53	+24 VDC	O		28	Detector 16S / Veh Det 12	I
54	Logic Ground	O		29	Det. Cir. 2b/1P / Veh Det 13	I
55	Chassis Ground	O		30	Det. Cir. 2a / Veh Det 14	I
56	Not Assigned	O		31	Det. Cir. 1b/5P / Veh Det 15	I
57	Not Assigned	O		32	Det. Cir. 1a / Veh Det 16	I
				33	External Alarm 1	I
1	System Detector 2 / Veh Det 18	I		34	External Alarm 2	I
2	System Detector 7 /Veh Det 23	I		35	Not Assigned	I
3	System Detector 8 / Veh Det 24	I		36	Not Assigned	I
4	Flash	I		37	Not Assigned	I
5	System Detector 3 / Veh Det 19	I		38	Not Assigned	I
6	System Detector 4 / Veh Det 20	I		39	External Alarm 3	I
7	System Detector 1 / Veh Det 17	I		40	External Alarm 4	I
8	System Detector 1 / Veh Det 21	I		41	Alarm 5	I

TS2 D-Connector DIAMOND Mapping

14.1.7 TS2 D-Connector - Texas 2, V14 (TX2-V14) Standard Mapping

Pin	Function	I/O		Pin	Function	I/O
10	Prmpt Active	O		6	Offset 3	I
14	Special Function 6	O		7	Flash In	I
22	Special Function 5	O		8	Prmpt 5	I
23	Ext. Coord Active	O		9	Prmpt 3	I
24	Flash Active	O		11	Split 2	I
35	Offset 1	O		12	Cycle 3	I
39*	I/O Spare	O		13	Offset 1	I
40	Special Function 8	O		15	Prmpt 2	I
41	Special Function 7	O		16	Prmpt 1	I
42	Offset 2	O		17	Veh16	I
43	Offset 3 / Preempt 6	O		18	Alarm1	I
44	Split 3 / Preempt 2	O		19	Split 3	I
45	Special Function 1	O		20	Offset 4	I
46	Special Function 3	O		21	Veh15	I
47	Special Function 4/Pulse	O		25	Veh14	I
48	Spare			26	Alarm 3	I
49	Offset 4 / Preempt 5	O		27	Alarm 4	I
50	Split 2 / Preempt 1	O		28	Dimming/Alarm 5	I
51	Cycle 3 / Preempt 4	O		29	Alarm 2	I
52	Special Function 2	O		30	Veh13	I
53	+24 VDC	O		31	Veh10	I
54	Logic Ground	O		32	Veh11	I
55	Chassis Ground	O		33	Veh12	I
56	Cycle 2 / Preempt 3	O		34	Prmpt 6	I
1	Offset 2	I		36	Alarm 6	I
2	Free	I		37	Enable Prmpt	I
3	System/TOD Resync	I		38*	Spare	I
4	Prmpt 4	I		39*	Spare	I
5	Cycle 2	I		57	Veh9	I

TS2 D-Connector TX-2 V14 Mapping

14.1.8 TS2 D-Connector - Texas 2, V14 (TX2-V14) Alternate 820A Mapping

The 820A function is enabled by setting the Prmpt/ExtCoor Output parameter to "**ON**", which is on the Channel and I/0 Parameters entry screen. When this is selected, the new Preempt interval status for intervals 1-7 is output on pins 14, 22, 35, 39-42, and 48. Also, the standard Preempt Status for Preempts 1-6 is output on pins 43, 44, 49-51, and 56 is output

Pin	Function	I/O	Pin	Function	I/O
10	Prmpt Active	O	6	Offset 3	I
14	Spec Func 6 / Prmpt Interval 1	O	7	Flash In	I
22	Spec Func 5 / Prmpt Interval 2	O	8	Prmpt 5	I
23	Ext. Coord Active	O	9	Prmpt 3	I
24	Flash Active	O	11	Split 2	I
35	Offset 1 / Prmpt Interval 3	O	12	Cycle 3	I
39*	I/O Spare / Prmpt Interval 4	O	13	Offset 1	I
40	Spec Func 8 / Prmpt Interval 5	O	15	Prmpt 2	I
41	Spec Func 7 / Prmpt Interval 6	O	16	Prmpt 1	I
42	Offset 2 / Prmpt Interval 7	O	17	Veh16	I
43	Offset 3 / Preempt Status 6	O	18	Alarm1	I
44	Split 3 / Preempt Status 2	O	19	Split 3	I
45	Special Function 1	O	20	Offset 4	I
46	Special Function 3	O	21	Veh15	I
47	Special Function 4/Pulse	O	25	Veh14	I
48	UCF Soft Flash		26	Alarm 3	I
49	Offset 4 / Preempt Status 5	O	27	Alarm 4	I
50	Split 2 / Preempt Status 1	O	28	Dimming/Alarm 5	I
51	Cycle 3 / Preempt Status 4	O	29	Alarm 2	I
52	Special Function 2	O	30	Veh13	I
53	+24 VDC	O	31	Veh10	I
54	Logic Ground	O	32	Veh11	I
55	Chassis Ground	O	33	Veh12	I
56	Cycle 2 / Preempt Status 3	O	34	Prmpt 6	I
1	Offset 2	I	36	Alarm 6	I
2	Free	I	37	Enable Prmpt	I
3	System/TOD Resync	I	38*	Spare	I
4	Prmpt 4	I	39*	Spare	I
5	Cycle 2	I	57	Veh9	I

TS2 D-Connector TX-2 V14 Alternate 820A Mapping

14.1.9 TS2 D-Connector – 40 Detector Mapping

10	Special Function 5	O	Pin	Function	I/O
10	Special Function 5	O	6	Veh Det 19	I
14	Veh Det 39	I	7	Veh Det 32	I
22	Veh Det 40	I	8	Preempt In 5	I
23	Veh Det 29	I	9	Preempt In 3	I
24	Veh Det 28	I	11	Veh Det 23	I
35	Special Function 6	O	12	Veh Det 22	I
39	Spare	O	13	Veh Det 17	I
40	Veh Det 37	I	15	Veh Det 30	I
41	Veh Det 38	I	16	Preempt In 1	I
42	Special Function 7	O	17	Veh Det 16	I
43	Preempt 6 Out	O	18	alarm 1	I
44	Special Function 8	O	19	Veh Det 24	I
45	Spec Func 1	O	20	Veh Det 20	I
46	Special Function 3	O	21	Veh Det 15	I
47	Special Function 4	O	25	Veh Det 14	I
48	Aux Out 1	O	26	Veh Det 25	I
49	Preempt 5 Out	O	27	Veh Det 26	I
50	Preempt 1 Out	O	28	Veh Det 27	I
51	Preempt 4 Out	O	29	Alarm 2	I
52	Special Function 2	O	30	Veh Det 13	I
53	+24 VDC	O	31	Veh Det 10	I
54	Logic Ground	O	32	Veh Det 11	I
55	Chassis Ground	O	33	Veh Det 12	I
56	Preempt 3 Out	O	34	Preempt In 6	I
1	Veh Det 18	I	36	Veh Det 33	I
2	Free Input	I	37	Veh Det 34	I
3	Veh Det 31	I	38	Veh Det 35	I
4	Preempt In 4	I	39	Veh Det 36	I
5	Veh Det 21	I	57	Veh Det 9	I

TS2 D-Connector 40 Detector Mapping

14.1.10 TS2 D-Connector – Santa Clara County (SCC) Mapping

Pin	Function	I/O		Pin	Function	I/O
10	Special Function 7	O		6	Unused (Platoon Rx 3)	I
14	Special Function 2	O		7	Spare 1	I
22	Special Function 1	O		8	Preempt 6 In	I
23	Veh Det 24/ Bike 8	I		9	Preempt 4 In	I
24	Veh Det 23 / Bike 7/ Alarm 8 (User Alarm 4)	I		11	Low Priority Preempt Inhibit 3	I
35	Offset 4 Out / Preempt 5 Out	O		12	Low Priority Preempt Inhibit 2	I
39	Spare	O		13	Unused (Platoon Rx 1)	I
40	Special Function 4	O		15	Preempt 3 In	I
41	Special Function 3	O		16	Preempt 1 In	I
42	Offset 3 Out / Preempt 6 Out	O		17	Veh Det 16	I
43	Offset 2 Out	O		18	Veh Det 17 / Bike 1 / Alarm 5 (User Alarm 1)	I
44	Split 2 Out / Preempt 1 Out	O		19	Low Priority Preempt Inhibit 4	I
45	Spare 2	O		20	Unused (Platoon Rx 4)	I
46	Spare 4	O		21	Veh Det 15	I
47	Spare 5	O		25	Veh Det 14	I
48	Special Function 8	O		26	Veh Det 19 / Bike 3 / Alarm 6 (User Alarm 2)	I
49	Offset 1 Out	O		27	Veh Det 20 / Bike 4	I
50	Split 3 Out / Preempt 2 Out	O		28	Veh Det 22 / Bike 6	I
51	Cycle 2 Out / Preempt 3 Out	O		29	Veh Det 18 / Bike 2	I
52	Spare 3	O		30	Veh Det 13	I
53	+24 VDC	O		31	Veh Det 10	I
54	Logic Ground	O		32	Veh Det 11	I
55	Chassis Ground	O		33	Veh Det 12	I
56	Cycle 3 Out / Preempt 4 Out	O		34	Veh Det 21 / Bike 5 / Alarm 7 (User Alarm 3)	I
1	Unused (Platoon Rx 2)	I		36	Special Function 5	O
2	Local Flash In	I		37	Special Function 6	O
3	Free Input	I		38	Det Fail / Alarm 10 (User Alarm 5)	I
4	Preempt 5 In	I		39	Alarm 11 (User Alarm 6)	I
5	Low Priority Preempt Inhibit 1	I		57	Veh Det 9	I

TS2 D-Connector SCC Mapping

14.2 2070 Specific I/O Maps

The following maps are based on the 2070 hardware mapping as specified in the tables below:

C1S PIN ASSIGNMENT											
PIN	FUNCTION		PIN	FUNCTION		PIN	FUNCTION		PIN	FUNCTION	
	NAME	PORT		NAME	PORT		NAME	PORT		NAME	PORT
1	DC GROUND		27	O24	O4-1	53	I14	I2-7	79	I44	I6-5
2	O0	O1-1	28	O25	O4-2	54	I15	I2-8	80	I45	I6-6
3	O1	O1-2	29	O26	O4-3	55	I16	I3-1	81	I46	I6-7
4	O2	O1-3	30	O27	O4-4	56	I17	I3-2	82	I47	I6-8
5	O3	O1-4	31	O28	O4-5	57	I18	I3-3	83	O40	O6-1
6	O4	O1-5	32	O29	O4-6	58	I19	I3-4	84	O41	O6-2
7	O5	O1-6	33	O30	O4-7	59	I20	I3-5	85	O42	O6-3
8	O6	O1-7	34	O31	O4-8	60	I21	I3-6	86	O43	O6-4
9	O7	O1-8	35	O32	O5-1	61	I22	I3-7	87	O44	O6-5
10	O8	O2-1	36	O33	O5-2	62	I23	I3-8	88	O45	O6-6
11	O9	O2-2	37	O34	O5-3	63	I28	I4-5	89	O46	O6-7
12	O10	O2-3	38	O35	O5-4	64	I29	I4-6	90	O47	O6-8
13	O11	O2-4	39	I0	I1-1	65	I30	I4-7	91	O48	O7-1
14	DC GROUND		40	I1	I1-2	66	I31	I4-8	92	DC GROUND	
15	O12	O2-5	41	I2	I1-3	67	I32	I5-1	93	O49	O7-2
16	O13	O2-6	42	I3	I1-4	68	I33	I5-2	94	O50	O7-3
17	O14	O2-7	43	I4	I1-5	69	I34	I5-3	95	O51	O7-4
18	O15	O2-8	44	I5	I1-6	70	I35	I5-4	96	O52	O7-5
19	O16	O3-1	45	I6	I1-7	71	I36	I5-5	97	O53	O7-6
20	O17	O3-2	46	I7	I1-8	72	I37	I5-6	98	O54	O7-7
21	O18	O3-3	47	I8	I2-1	73	I38	I5-7	99	O55	O7-8
22	O19	O3-4	48	I9	I2-2	74	I39	I5-8	100	O36	O5-5
23	O20	O3-5	49	I10	I2-3	75	I40	I6-1	101	O37	O5-6
24	O21	O3-6	50	I11	I2-4	76	I41	I6-2	102	O38 DET RES	O5-7
25	O22	O3-7	51	I12	I2-5	77	I42	I6-3	103	O39 WDT	O5-8
26	O23	O3-8	52	I13	I2-6	78	I43	I6-4	104	DC GROUND	

C11S PIN ASSIGNMENT											
PIN	FUNCTION		PIN	FUNCTION		PIN	FUNCTION		PIN	FUNCTION	
	NAME	PORT		NAME	PORT		NAME	PORT		NAME	PORT
1	O56	O8-1	11	I25	I4-2	21	I54	I7-7	31	DC GROUND	
2	O57	O8-2	12	I26	I4-3	22	I55	I7-8	32	NA	- - -
3	O58	O8-3	13	I27	I4-4	23	I56	I8-1	33	NA	- - -
4	O59	O8-4	14	DC GROUND		24	I57	I8-2	34	NA	- - -
5	O60	O8-5	15	I48	I7-1	25	I58	I8-3	35	NA	- - -
6	O61	O8-6	16	I49	I7-2	26	I59	I8-4	36	NA	- - -
7	O62	O8-7	17	I50	I7-3	27	I60	I8-5	37	DC GROUND	
8	O63	O8-8	18	I51	I7-4	28	I61	I8-6			
9	DC GROUND		19	I52	I7-5	29	I62	I8-7			
10	I24	I4-1	20	I53	I7-6	30	I63	I8-8			

The following are commonly used modes standardized by a specific agency and used by multiple agencies:

MODE 0: **CALTRANS TEES Standard**
MODE 1: **NY DOT Standard**
MODE 2: **DADE County**
MODE 3: **Plano Texas**
MODE 6: **HOV Gate**
MODE 7: **Broward County**

14.2.1 2070 2A (C1 Connector) Mapping – Caltrans TEES Option (Mode 0)

*** Next to the Pin Number indicates the Pin is on the C11S rather than the C1**

C1/C11S* Pin	Source	Func	Output Description		C1/C11S* Pin	Source	Func	Input Description
2	O1-1	14	Ch14 Red		39	I1-1	2	Veh Call 2
3	O1-2	62	Ch14 Green		40	I1-2	16	Veh Call 16
4	O1-3	4	Ch4 Red		41	I1-3	8	Veh Call 8
5	O1-4	28	Ch4 Yellow		42	I1-4	22	Veh Call 22
6	O1-5	52	Ch4 Green		43	I1-5	3	Veh Call 3
7	O1-6	3	Ch3 Red		44	I1-6	17	Veh Call 17
8	O1-7	27	Ch3 Yellow		45	I1-7	9	Veh Call 9
9	O1-8	51	Ch3 Green		46	I1-8	23	Veh Call 23
10	O2-1	13	Ch13 Red		47	I2-1	6	Veh Call 6
11	O2-2	61	Ch13 Green		48	I2-2	20	Veh Call 20
12	O2-3	2	Ch2 Red		49	I2-3	12	Veh Call 12
13	O2-4	26	Ch2 Yellow		50	I2-4	26	Veh Call 26
15	O2-5	50	Ch2 Green		51	I2-5	198	Pre 1 In
16	O2-6	1	Ch1 Red		52	I2-6	199	Pre 2 In
17	O2-7	25	Ch1 Yellow		53	I2-7	189	Unused
18	O2-8	49	Ch1 Green		54	I2-8	189	Unused
19	O3-1	16	Ch16 Red		55	I3-1	15	Veh Call 15
20	O3-2	64	Ch16 Green		56	I3-2	1	Veh Call 1
21	O3-3	8	Ch8 Red		57	I3-3	21	Veh Call 21
22	O3-4	32	Ch8 Yellow		58	I3-4	7	Veh Call 7
23	O3-5	56	Ch8 Green		59	I3-5	27	Veh Call 27
24	O3-6	7	Ch7 Red		60	I3-6	13	Veh Call 13
25	O3-7	31	Ch7 Yellow		61	I3-7	28	Veh Call 28
26	O3-8	55	Ch7 Green		62	I3-8	14	Veh Call 14
27	O4-1	15	Ch15 Red		10*	I4-1	189	Unused
28	O4-2	63	Ch15 Green		11*	I4-2	189	Unused
29	O4-3	6	Ch6 Red		12*	I4-3	189	Unused
30	O4-4	30	Ch6 Yellow		13*	I4-4	189	Unused
31	O4-5	54	Ch6 Green		63	I4-5	4	Veh Call 4
32	O4-6	5	Ch5 Red		64	I4-6	18	Veh Call 18
33	O4-7	29	Ch5 Yellow		65	I4-7	10	Veh Call 10
34	O4-8	53	Ch5 Green		66	I4-8	24	Veh Call 24

C1/C11S* Pin	Source	Func	Output Description		C1/C11S* Pin	Source	Func	Input Description
35	O5-1	37	Ch13 Yellow		67	I5-1	130	Ped Call 2
36	O5-2	39	Ch15 Yellow		68	I5-2	134	Ped Call 6
37	O5-3	38	Ch14 Yellow		69	I5-3	132	Ped Call 4
38	O5-4	40	Ch16 Yellow		70	I5-4	136	Ped Call 8
100	O5-5	42	Ch18 Yellow		71	I5-5	200	Pre 3 In
101	O5-6	41	Ch17 Yellow		72	I5-6	201	Pre 4 In
102	O5-7	115	Not Used		73	I5-7	202	Pre 5 In
103	O5-8	114	Watchdog		74	I5-8	203	Pre 6 In
83	O6-1	18	Ch18 Red		75	I6-1	189	Unused
84	O6-2	66	Ch18 Green		76	I6-2	5	Veh Call 5
85	O6-3	12	Ch12 Red		77	I6-3	19	Veh Call 19
86	O6-4	36	Ch12 Yellow		78	I6-4	11	Veh Call 11
87	O6-5	60	Ch12 Green		79	I6-5	25	Veh Call 25
88	O6-6	11	Ch11 Red		80	I6-6	178	Int Advance
89	O6-7	35	Ch11 Yellow		81	I6-7	208	Local Flash
90	O6-8	59	Ch11 Green		82	I6-8	207	Comp StopTm
91	O7-1	17	Ch17 Red		15*	I7-1	189	Unused
93	O7-2	65	Ch17 Green		16*	I7-2	189	Unused
94	O7-3	10	Ch10 Red		17*	I7-3	189	Unused
95	O7-4	34	Ch10 Yellow		18*	I7-4	189	Unused
96	O7-5	58	Ch10 Green		19*	I7-5	189	Unused
97	O7-6	9	Ch9 Red		20*	I7-6	189	Unused
98	O7-7	33	Ch9 Yellow		21*	I7-7	189	Unused
99	O7-8	57	Ch9 Green		22*	I7-8	189	Unused
1*	O8-1	115	Not Used		23*	I8-1	189	Unused
2*	O8-2	115	Not Used		24*	I8-2	189	Unused
3*	O8-3	115	Not Used		25*	I8-3	189	Unused
4*	O8-4	115	Not Used		26*	I8-4	189	Unused
5*	O8-5	115	Not Used		27*	I8-5	189	Unused
6*	O8-6	115	Not Used		28*	I8-6	189	Unused
7*	O8-7	115	Not Used		29*	I8-7	189	Unused
8*	O8-8	115	Not Used		30*	I8-8	189	Unused

2070 2A Mapping - Caltrans TEES option
*** Next to the Pin Number indicates the Pin is on the C11S rather than the C1**

14.2.2 2070 2A (C1 Connector) Mapping – NY DOT Mode 1

C1 Pin	Source	Func	Output Description	C1 Pin	Source	Func	Input Description
2	O1-1	1	Ch1 Red	39	I1-1	1	Veh Call 1
3	O1-2	49	Ch1 Green	40	I1-2	2	Veh Call 2
4	O1-3	2	Ch2 Red	41	I1-3	3	Veh Call 3
5	O1-4	26	Ch2 Yellow	42	I1-4	4	Veh Call 4
6	O1-5	50	Ch2 Green	43	I1-5	5	Veh Call 5
7	O1-6	3	Ch3 Red	44	I1-6	6	Veh Call 6
8	O1-7	27	Ch3 Yellow	45	I1-7	7	Veh Call 7
9	O1-8	51	Ch3 Green	46	I1-8	8	Veh Call 8
10	O2-1	4	Ch4 Red	47	I2-1	130	Ped Call 2
11	O2-2	52	Ch4 Green	48	I2-2	132	Ped Call 4
12	O2-3	5	Ch5 Red	49	I2-3	134	Ped Call 6
13	O2-4	29	Ch5 Yellow	50	I2-4	136	Ped Call 8
15	O2-5	53	Ch5 Green	51	I2-5	189	Unused
16	O2-6	6	Ch6 Red	52	I2-6	189	Unused
17	O2-7	30	Ch6 Yellow	53	I2-7	189	Unused
18	O2-8	54	Ch6 Green	54	I2-8	189	Unused
19	O3-1	7	Ch7 Red	55	I3-1	189	Unused
20	O3-2	55	Ch7 Green	56	I3-2	189	Unused
21	O3-3	8	Ch8 Red	57	I3-3	189	Unused
22	O3-4	32	Ch8 Yellow	58	I3-4	189	Unused
23	O3-5	56	Ch8 Green	59	I3-5	189	Unused
24	O3-6	9	Ch9 Red	60	I3-6	189	Unused
25	O3-7	33	Ch9 Yellow	61	I3-7	189	Unused
26	O3-8	57	Ch9 Green	62	I3-8	189	Unused
27	O4-1	10	Ch10 Red		I4-1	189	Unused
28	O4-2	58	Ch10 Green		I4-2	189	Unused
29	O4-3	11	Ch11 Red		I4-3	189	Unused
30	O4-4	35	Ch11 Yellow		I4-4	189	Unused
31	O4-5	59	Ch11 Green	63	I4-5	189	Unused
32	O4-6	12	Ch12 Red	64	I4-6	189	Unused
33	O4-7	36	Ch12 Yellow	65	I4-7	229	33xCMUStop
34	O4-8	60	Ch12 Green	66	I4-8	228	33xFlashSns

C1 Pin	Source	Func	Output Description		C1 Pin	Source	Func	Input Description
35	O5-1	28	Ch4 Yellow		67	I5-1	189	Unused
36	O5-2	34	Ch10 Yellow		68	I5-2	189	Unused
37	O5-3	25	Ch1 Yellow		69	I5-3	189	Unused
38	O5-4	31	Ch7 Yellow		70	I5-4	189	Unused
100	O5-5	39	Ch15 Yellow		71	I5-5	189	Unused
101	O5-6	63	Ch15 Green		72	I5-6	189	Unused
102	O5-7	115	Not Used		73	I5-7	207	Comp StopTm
103	O5-8	114	Watchdog		74	I5-8	208	Local Flash
83	O6-1	115	Not Used		75	I6-1	130	Ped Call 2
84	O6-2	115	Not Used		76	I6-2	132	Ped Call 4
85	O6-3	13	Ch13 Red		77	I6-3	134	Ped Call 6
86	O6-4	37	Ch13 Yellow		78	I6-4	136	Ped Call 8
87	O6-5	61	Ch13 Green		79	I6-5	189	Unused
88	O6-6	14	Ch14 Red		80	I6-6	189	Unused
89	O6-7	38	Ch14 Yellow		81	I6-7	189	Unused
90	O6-8	62	Ch14 Green		82	I6-8	189	Unused
91	O7-1	40	Ch16 Yellow			I7-1	189	Unused
93	O7-2	16	Ch16 Red			I7-2	189	Unused
94	O7-3	64	Ch16 Green			I7-3	189	Unused
95	O7-4	115	Not Used			I7-4	189	Unused
96	O7-5	115	Not Used			I7-5	189	Unused
97	O7-6	115	Not Used			I7-6	189	Unused
98	O7-7	115	Not Used			I7-7	189	Unused
99	O7-8	15	Ch15 Red			I7-8	189	Unused
	O8-1	115	Not Used			I8-1	189	Unused
	O8-2	115	Not Used			I8-2	189	Unused
	O8-3	115	Not Used			I8-3	189	Unused
	O8-4	115	Not Used			I8-4	189	Unused
	O8-5	115	Not Used			I8-5	189	Unused
	O8-6	115	Not Used			I8-6	189	Unused
	O8-7	115	Not Used			I8-7	189	Unused
	O8-8	115	Not Used			I8-8	189	Unused

2070 2A (C1 Connector) Mapping – NY DOT Mode 1 Option

14.2.3 2070 2A (C1 Connector) Mapping – Mode 2

C1 Pin	Source	Func	Output Description	C1 Pin	Source	Func	Input Description
2	O1-1	14	Ch14 Red	39	I1-1	1	Veh Call 1
3	O1-2	62	Ch14 Green	40	I1-2	2	Veh Call 2
4	O1-3	4	Ch4 Red	41	I1-3	3	Veh Call 3
5	O1-4	28	Ch4 Yellow	42	I1-4	4	Veh Call 4
6	O1-5	52	Ch4 Green	43	I1-5	5	Veh Call 5
7	O1-6	3	Ch3 Red	44	I1-6	6	Veh Call 6
8	O1-7	27	Ch3 Yellow	45	I1-7	7	Veh Call 7
9	O1-8	51	Ch3 Green	46	I1-8	8	Veh Call 8
10	O2-1	13	Ch13 Red	47	I2-1	9	Veh Call 9
11	O2-2	61	Ch13 Green	48	I2-2	10	Veh Call 10
12	O2-3	2	Ch2 Red	49	I2-3	189	Unused
13	O2-4	26	Ch2 Yellow	50	I2-4	169	R2 Frc Off
15	O2-5	50	Ch2 Green	51	I2-5	198	Pre 1 In
16	O2-6	1	Ch1 Red	52	I2-6	199	Pre 2 In
17	O2-7	25	Ch1 Yellow	53	I2-7	227	Offset 3
18	O2-8	49	Ch1 Green	54	I2-8	226	Offset 2
19	O3-1	16	Ch16 Red	55	I3-1	189	Unused
20	O3-2	64	Ch16 Green	56	I3-2	11	Veh Call 11
21	O3-3	8	Ch8 Red	57	I3-3	12	Veh Call 12
22	O3-4	32	Ch8 Yellow	58	I3-4	13	Veh Call 13
23	O3-5	56	Ch8 Green	59	I3-5	14	Veh Call 14
24	O3-6	7	Ch7 Red	60	I3-6	15	Veh Call 15
25	O3-7	31	Ch7 Yellow	61	I3-7	16	Veh Call 16
26	O3-8	55	Ch7 Green	62	I3-8	17	Veh Call 17
27	O4-1	15	Ch15 Red		I4-1	189	Unused
28	O4-2	63	Ch15 Green		I4-2	189	Unused
29	O4-3	6	Ch6 Red		I4-3	189	Unused
30	O4-4	30	Ch6 Yellow		I4-4	189	Unused
31	O4-5	54	Ch6 Green	63	I4-5	18	Veh Call 18
32	O4-6	5	Ch5 Red	64	I4-6	189	Unused
33	O4-7	29	Ch5 Yellow	65	I4-7	179	Door Open
34	O4-8	53	Ch5 Green	66	I4-8	189	Unused

C1 Pin	Source	Func	Output Description		C1 Pin	Source	Func	Input Description
35	O5-1	115	Not Used		67	I5-1	181	Man Ctrl Enbl
36	O5-2	115	Not Used		68	I5-2	189	Unused
37	O5-3	115	Not Used		69	I5-3	178	Int Advance
38	O5-4	103	Special 1		70	I5-4	191	Flash In
100	O5-5	115	Not Used		71	I5-5	200	Pre 3 In
101	O5-6	115	Not Used		72	I5-6	201	Pre 4 In
102	O5-7	115	Not Used		73	I5-7	202	Pre 5 In
103	O5-8	114	Watchdog		74	I5-8	203	Pre 6 In
83	O6-1	115	Not Used		75	I6-1	130	Ped Call 2
84	O6-2	115	Not Used		76	I6-2	134	Ped Call 6
85	O6-3	12	Ch12 Red		77	I6-3	132	Ped Call 4
86	O6-4	36	Ch12 Yellow		78	I6-4	136	Ped Call 8
87	O6-5	60	Ch12 Green		79	I6-5	189	Unused
88	O6-6	11	Ch11 Red		80	I6-6	189	Unused
89	O6-7	35	Ch11 Yellow		81	I6-7	208	Local Flash
90	O6-8	59	Ch11 Green		82	I6-8	207	Comp Stop Tm
91	O7-1	115	Not Used			I7-1	189	Unused
93	O7-2	115	Not Used			I7-2	189	Unused
94	O7-3	10	Ch10 Red			I7-3	189	Unused
95	O7-4	34	Ch10 Yellow			I7-4	189	Unused
96	O7-5	58	Ch10 Green			I7-5	189	Unused
97	O7-6	9	Ch9 Red			I7-6	189	Unused
98	O7-7	33	Ch9 Yellow			I7-7	189	Unused
99	O7-8	57	Ch9 Green			I7-8	189	Unused
	O8-1	115	Not Used			I8-1	189	Unused
	O8-2	115	Not Used			I8-2	189	Unused
	O8-3	115	Not Used			I8-3	189	Unused
	O8-4	115	Not Used			I8-4	189	Unused
	O8-5	115	Not Used			I8-5	189	Unused
	O8-6	115	Not Used			I8-6	189	Unused
	O8-7	115	Not Used			I8-7	189	Unused
	O8-8	115	Not Used			I8-8	189	Unused

2070 2A (C1 Connector) Mapping – Mode 2 Option

14.2.4 2070 2A (C1 Connector) Mapping – Mode 3

C1 Pin	Source	Func	Output Description	C1 Pin	Source	Func	Input Description
2	O1-1	1	Ch1 Red	39	I1-1	1	Veh Call 1
3	O1-2	49	Ch1 Green	40	I1-2	2	Veh Call 2
4	O1-3	2	Ch2 Red	41	I1-3	3	Veh Call 3
5	O1-4	26	Ch2 Yellow	42	I1-4	4	Veh Call 4
6	O1-5	50	Ch2 Green	43	I1-5	5	Veh Call 5
7	O1-6	3	Ch3 Red	44	I1-6	6	Veh Call 6
8	O1-7	27	Ch3 Yellow	45	I1-7	7	Veh Call 7
9	O1-8	51	Ch3 Green	46	I1-8	8	Veh Call 8
10	O2-1	4	Ch4 Red	47	I2-1	9	Veh Call 9
11	O2-2	52	Ch4 Green	48	I2-2	10	Veh Call 10
12	O2-3	5	Ch5 Red	49	I2-3	11	Veh Call 11
13	O2-4	29	Ch5 Yellow	50	I2-4	12	Veh Call 12
15	O2-5	53	Ch5 Green	51	I2-5	13	Veh Call 13
16	O2-6	6	Ch6 Red	52	I2-6	14	Veh Call 14
17	O2-7	30	Ch6 Yellow	53	I2-7	15	Veh Call 15
18	O2-8	54	Ch6 Green	54	I2-8	16	Veh Call 16
19	O3-1	7	Ch7 Red	55	I3-1	130	Ped Call 2
20	O3-2	55	Ch7 Green	56	I3-2	132	Ped Call 4
21	O3-3	8	Ch8 Red	57	I3-3	134	Ped Call 6
22	O3-4	32	Ch8 Yellow	58	I3-4	136	Ped Call 8
23	O3-5	56	Ch8 Green	59	I3-5	17	Veh Call 17
24	O3-6	9	Ch9 Red	60	I3-6	18	Veh Call 18
25	O3-7	33	Ch9 Yellow	61	I3-7	19	Veh Call 19
26	O3-8	57	Ch9 Green	62	I3-8	20	Veh Call 20
27	O4-1	10	Ch10 Red		I4-1	189	Unused
28	O4-2	58	Ch10 Green		I4-2	189	Unused
29	O4-3	11	Ch11 Red		I4-3	189	Unused
30	O4-4	35	Ch11 Yellow		I4-4	189	Unused
31	O4-5	59	Ch11 Green	63	I4-5	189	Unused
32	O4-6	12	Ch12 Red	64	I4-6	208	Local Flash
33	O4-7	38	Ch14 Yellow	65	I4-7	229	Comp Stop Time
34	O4-8	60	Ch12 Green	66	I4-8	189	Unused

C1 Pin	Source	Func	Output Description		C1 Pin	Source	Func	Input Description
35	O5-1	28	Ch4 Yellow		67	I5-1	200	Pre 3 input
36	O5-2	34	Ch10 Yellow		68	I5-2	201	Pre 4 input
37	O5-3	25	Ch1 Yellow		69	I5-3	202	Pre 5 input
38	O5-4	31	Ch7 Yellow		70	I5-4	203	Pre 6 input
100	O5-5	40	Ch16 Yellow		71	I5-5	189	Unused
101	O5-6	39	Ch15 Yellow		72	I5-6	189	Unused
102	O5-7	115	Not Used		73	I5-7	189	Unused
103	O5-8	114	Watchdog		74	I5-8	189	Unused
83	O6-1	15	Ch15 Red		75	I6-1	189	Unused
84	O6-2	63	Ch15 Green		76	I6-2	189	Unused
85	O6-3	13	Ch13 Red		77	I6-3	189	Unused
86	O6-4	37	Ch13 Yellow		78	I6-4	189	Unused
87	O6-5	61	Ch13 Green		79	I6-5	189	Unused
88	O6-6	14	Ch14 Red		80	I6-6	189	Unused
89	O6-7	38	Ch14 Yellow		81	I6-7	189	Unused
90	O6-8	62	Ch14 Green		82	I6-8	189	Unused
91	O7-1	16	Ch16 Red			I7-1	189	Unused
93	O7-2	64	Ch16 Green			I7-2	189	Unused
94	O7-3	115	Not Used			I7-3	189	Unused
95	O7-4	115	Not Used			I7-4	189	Unused
96	O7-5	115	Not Used			I7-5	189	Unused
97	O7-6	115	Not Used			I7-6	189	Unused
98	O7-7	115	Not Used			I7-7	189	Unused
99	O7-8	115	Not Used			I7-8	189	Unused
	O8-1	115	Not Used			I8-1	189	Unused
	O8-2	115	Not Used			I8-2	189	Unused
	O8-3	115	Not Used			I8-3	189	Unused
	O8-4	115	Not Used			I8-4	189	Unused
	O8-5	115	Not Used			I8-5	189	Unused
	O8-6	115	Not Used			I8-6	189	Unused
	O8-7	115	Not Used			I8-7	189	Unused
	O8-8	115	Not Used			I8-8	189	Unused

2070 2A (C1 Connector) Mapping – Mode 3 Option

14.2.5 2070 2A (C1 Connector) Mapping – Mode 5

C1 Pin	Source	Func	Output Description	C1 Pin	Source	Func	Input Description
2	O1-1	14	Ch14 Red	39	I1-1	2	Veh Call 2
3	O1-2	62	Ch14 Green	40	I1-2	16	Veh Call 16
4	O1-3	4	Ch4 Red	41	I1-3	8	Veh Call 8
5	O1-4	28	Ch4 Yellow	42	I1-4	22	Veh Call 22
6	O1-5	52	Ch4 Green	43	I1-5	3	Veh Call 3
7	O1-6	3	Ch3 Red	44	I1-6	17	Veh Call 17
8	O1-7	27	Ch3 Yellow	45	I1-7	9	Veh Call 9
9	O1-8	51	Ch3 Green	46	I1-8	23	Veh Call 23
10	O2-1	13	Ch13 Red	47	I2-1	6	Veh Call 6
11	O2-2	61	Ch13 Green	48	I2-2	20	Veh Call 20
12	O2-3	2	Ch2 Red	49	I2-3	12	Veh Call 12
13	O2-4	26	Ch2 Yellow	50	I2-4	26	Veh Call 26
15	O2-5	50	Ch2 Green	51	I2-5	198	Pre 1 In
16	O2-6	1	Ch1 Red	52	I2-6	199	Pre 2 In
17	O2-7	25	Ch1 Yellow	53	I2-7	181	ManCtrlEnbl
18	O2-8	49	Ch1 Green	54	I2-8	189	Unused
19	O3-1	16	Ch16 Red	55	I3-1	15	Veh Call 15
20	O3-2	64	Ch16 Green	56	I3-2	1	Veh Call 1
21	O3-3	8	Ch8 Red	57	I3-3	21	Veh Call 21
22	O3-4	32	Ch8 Yellow	58	I3-4	7	Veh Call 7
23	O3-5	56	Ch8 Green	59	I3-5	27	Veh Call 27
24	O3-6	7	Ch7 Red	60	I3-6	13	Veh Call 13
25	O3-7	31	Ch7 Yellow	61	I3-7	28	Veh Call 28
26	O3-8	55	Ch7 Green	62	I3-8	14	Veh Call 14
27	O4-1	15	Ch15 Red		I4-1	189	Unused
28	O4-2	63	Ch15 Green		I4-2	189	Unused
29	O4-3	6	Ch6 Red		I4-3	189	Unused
30	O4-4	30	Ch6 Yellow		I4-4	199	Unused
31	O4-5	54	Ch6 Green	63	I4-5	4	Veh Call 4
32	O4-6	5	Ch5 Red	64	I4-6	18	Veh Call 18
33	O4-7	29	Ch5 Yellow	65	I4-7	10	Veh Call 10
34	O4-8	53	Ch5 Green	66	I4-8	24	Veh Call 24

C1 Pin	Source	Func	Output Description		C1 Pin	Source	Func	Input Description
35	O5-1	37	Ch13 Yellow		67	I5-1	130	Ped Call 2
36	O5-2	39	Ch15 Yellow		68	I5-2	134	Ped Call 6
37	O5-3	38	Ch14 Yellow		69	I5-3	132	Ped Call 4
38	O5-4	40	Ch16 Yellow		70	I5-4	136	Ped Call 8
100	O5-5	115	Not Used		71	I5-5	200	Pre 3 In
101	O5-6	124	LdSwtchFlsh		72	I5-6	201	Pre 4 In
102	O5-7	115	Not Used		73	I5-7	202	Pre 5 In
103	O5-8	114	Watchdog		74	I5-8	203	Pre 6 In
83	O6-1	115	Not Used		75	I6-1	179	Door Open
84	O6-2	115	Not Used		76	I6-2	5	Veh Call 5
85	O6-3	12	Ch12 Red		77	I6-3	19	Veh Call 19
86	O6-4	36	Ch12 Yellow		78	I6-4	11	Veh Call 11
87	O6-5	60	Ch12 Green		79	I6-5	25	Veh Call 25
88	O6-6	11	Ch11 Red		80	I6-6	178	Int Advance
89	O6-7	35	Ch11 Yellow		81	I6-7	208	Local Flash
90	O6-8	59	Ch11 Green		82	I6-8	207	Comp StopTm
91	O7-1	115	Not Used			I7-1	192	Alarm 1
93	O7-2	115	Not Used			I7-2	193	Alarm 2
94	O7-3	10	Ch10 Red			I7-3	194	Alarm 3
95	O7-4	34	Ch10 Yellow			I7-4	195	Alarm 4
96	O7-5	58	Ch10 Green			I7-5	196	Alarm 5
97	O7-6	9	Ch9 Red			I7-6	197	Alarm 6
98	O7-7	33	Ch9 Yellow			I7-7	189	Unused
99	O7-8	57	Ch9 Green			I7-8	189	Unused
	O8-1	115	Not Used			I8-1	189	Unused
	O8-2	115	Not Used			I8-2	189	Unused
	O8-3	115	Not Used			I8-3	189	Unused
	O8-4	115	Not Used			I8-4	189	Unused
	O8-5	115	Not Used			I8-5	189	Unused
	O8-6	115	Not Used			I8-6	189	Unused
	O8-7	115	Not Used			I8-7	189	Unused
	O8-8	115	Not Used			I8-8	189	Unused

2070 2A (C1 Connector) Mapping – North Carolina Mode 5 Option

14.2.6 2070 2A (C1 Connector) Mapping – Mode 6

C1 Pin	Source	Func	Output Description		C1 Pin	Source	Func	Input Description
2	O1-1	115	Not Used		39	I1-1	1	Veh Call 1
3	O1-2	115	Not Used		40	I1-2	3	Veh Call 3
4	O1-3	115	Not Used		41	I1-3	5	Veh Call 5
5	O1-4	115	Not Used		42	I1-4	6	Veh Call 6
6	O1-5	115	Not Used		43	I1-5	2	Veh Call 2
7	O1-6	115	Not Used		44	I1-6	4	Veh Call 4
8	O1-7	115	Not Used		45	I1-7	7	Veh Call 7
9	O1-8	115	Not Used		46	I1-8	8	Veh Call 8
10	O2-1	115	Not Used		47	I2-1	189	Unused
11	O2-2	115	Not Used		48	I2-2	189	Unused
12	O2-3	232	Logic 3		49	I2-3	189	Unused
13	O2-4	233	Logic 4		50	I2-4	189	Unused
15	O2-5	115	Not Used		51	I2-5	189	Unused
16	O2-6	230	Logic 1		52	I2-6	189	Unused
17	O2-7	231	Logic 2		53	I2-7	189	Unused
18	O2-8	115	Not Used		54	I2-8	189	Unused
19	O3-1	115	Not Used		55	I3-1	189	Unused
20	O3-2	115	Not Used		56	I3-2	189	Unused
21	O3-3	115	Not Used		57	I3-3	189	Unused
22	O3-4	115	Not Used		58	I3-4	189	Unused
23	O3-5	115	Not Used		59	I3-5	189	Unused
24	O3-6	115	Not Used		60	I3-6	189	Unused
25	O3-7	115	Not Used		61	I3-7	189	Unused
26	O3-8	115	Not Used		62	I3-8	189	Unused
27	O4-1	115	Not Used			I4-1	189	Unused
28	O4-2	115	Not Used			I4-2	189	Unused
29	O4-3	115	Not Used			I4-3	189	Unused
30	O4-4	115	Not Used			I4-4	189	Unused
31	O4-5	115	Not Used		63	I4-5	1	Veh Call 1
32	O4-6	115	Not Used		64	I4-6	3	Veh Call 3
33	O4-7	115	Not Used		65	I4-7	5	Veh Call 5
34	O4-8	115	Not Used		66	I4-8	6	Veh Call 6

C1 Pin	Source	Func	Output Description		C1 Pin	Source	Func	Input Description
35	O5-1	115	Not Used		67	I5-1	234	Logic 5
36	O5-2	115	Not Used		68	I5-2	230	Logic 1
37	O5-3	115	Not Used		69	I5-3	235	Logic 6
38	O5-4	115	Not Used		70	I5-4	231	Logic 2
100	O5-5	115	Not Used		71	I5-5	236	Logic 7
101	O5-6	115	Not Used		72	I5-6	232	Logic 3
102	O5-7	115	Not Used		73	I5-7	237	Logic 8
103	O5-8	114	Watchdog		74	I5-8	233	Logic 4
83	O6-1	115	Not Used		75	I6-1	179	Door Open
84	O6-2	115	Not Used		76	I6-2	2	Veh Call 2
85	O6-3	115	Not Used		77	I6-3	4	Veh Call 4
86	O6-4	115	Not Used		78	I6-4	7	Veh Call 7
87	O6-5	115	Not Used		79	I6-5	8	Veh Call 8
88	O6-6	115	Not Used		80	I6-6	189	Unused
89	O6-7	115	Not Used		81	I6-7	208	Local Flash
90	O6-8	115	Not Used		82	I6-8	207	Comp Stop Time
91	O7-1	115	Not Used			I7-1	189	Unused
93	O7-2	115	Not Used			I7-2	189	Unused
94	O7-3	115	Not Used			I7-3	189	Unused
95	O7-4	115	Not Used			I7-4	189	Unused
96	O7-5	115	Not Used			I7-5	189	Unused
97	O7-6	115	Not Used			I7-6	189	Unused
98	O7-7	115	Not Used			I7-7	189	Unused
99	O7-8	115	Not Used			I7-8	189	Unused
	O8-1	115	Not Used			I8-1	189	Unused
	O8-2	115	Not Used			I8-2	189	Unused
	O8-3	115	Not Used			I8-3	189	Unused
	O8-4	115	Not Used			I8-4	189	Unused
	O8-5	115	Not Used			I8-5	189	Unused
	O8-6	115	Not Used			I8-6	189	Unused
	O8-7	115	Not Used			I8-7	189	Unused
	O8-8	115	Not Used			I8-8	189	Unused

2070 2A (C1 Connector) Mapping – HOV Gate Mode 6 Option

14.2.7 2070 2A (C1 Connector) Mapping – Mode 7

C1 Pin	Source	Func	Output Description	C1 Pin	Source	Func	Input Description
2	O1-1	14	Ch14 Red	39	I1-1	2	Veh Call 2
3	O1-2	62	Ch14 Green	40	I1-2	6	Veh Call 6
4	O1-3	4	Ch4 Red	41	I1-3	4	Veh Call 4
5	O1-4	28	Ch4 Yellow	42	I1-4	8	Veh Call 8
6	O1-5	52	Ch4 Green	43	I1-5	10	Veh Call 10
7	O1-6	3	Ch3 Red	44	I1-6	12	Veh Call 12
8	O1-7	27	Ch3 Yellow	45	I1-7	14	Veh Call 14
9	O1-8	51	Ch3 Green	46	I1-8	16	Veh Call 16
10	O2-1	13	Ch13 Red	47	I2-1	18	Veh Call 18
11	O2-2	61	Ch13 Green	48	I2-2	22	Veh Call 22
12	O2-3	2	Ch2 Red	49	I2-3	20	Veh Call 20
13	O2-4	26	Ch2 Yellow	50	I2-4	24	Veh Call 24
15	O2-5	50	Ch2 Green	51	I2-5	198	Pre 1 In
16	O2-6	1	Ch1 Red	52	I2-6	199	Pre 2 In
17	O2-7	25	Ch1 Yellow	53	I2-7	181	Man Ctrl Enbl
18	O2-8	49	Ch1 Green	54	I2-8	205	Pre 8 In
19	O3-1	16	Ch16 Red	55	I3-1	5	Veh Call 5
20	O3-2	64	Ch16 Green	56	I3-2	1	Veh Call 1
21	O3-3	8	Ch8 Red	57	I3-3	7	Veh Call 7
22	O3-4	32	Ch8 Yellow	58	I3-4	3	Veh Call 3
23	O3-5	56	Ch8 Green	59	I3-5	133	Ped Call 5
24	O3-6	7	Ch7 Red	60	I3-6	129	Ped Call 1
25	O3-7	31	Ch7 Yellow	61	I3-7	135	Ped Call 7
26	O3-8	55	Ch7 Green	62	I3-8	131	Ped Call 3
27	O4-1	15	Ch15 Red		I4-1	188	Walk Rest Mod
28	O4-2	63	Ch15 Green		I4-2	191	Flash In
29	O4-3	6	Ch6 Red		I4-3	189	Unused
30	O4-4	30	Ch6 Yellow		I4-4	189	Unused
31	O4-5	54	Ch6 Green	63	I4-5	26	Veh Call 26
32	O4-6	5	Ch5 Red	64	I4-6	30	Veh Call 30
33	O4-7	29	Ch5 Yellow	65	I4-7	28	Veh Call 28
34	O4-8	53	Ch5 Green	66	I4-8	32	Veh Call 32

C1 Pin	Source	Func	Output Description		C1 Pin	Source	Func	Input Description
35	O5-1	140	AudiblePed2		67	I5-1	130	Ped Call 2
36	O5-2	141	AudiblePed4		68	I5-2	134	Ped Call 6
37	O5-3	142	AudiblePed6		69	I5-3	132	Ped Call 4
38	O5-4	143	AudiblePed8		70	I5-4	136	Ped Call 8
100	O5-5	115	Not Used		71	I5-5	200	Pre 3 In
101	O5-6	101	R2 Status B		72	I5-6	201	Pre 4 In
102	O5-7	115	Not Used		73	I5-7	202	Pre 5 In
103	O5-8	114	Watchdog		74	I5-8	203	Pre 6 In
83	O6-1	115	Not Used		75	I6-1	189	Unused
84	O6-2	115	Not Used		76	I6-2	34	Veh Call 34
85	O6-3	12	Ch12 Red		77	I6-3	38	Veh Call 38
86	O6-4	36	Ch12 Yellow		78	I6-4	36	Veh Call 36
87	O6-5	60	Ch12 Green		79	I6-5	40	Veh Call 40
88	O6-6	11	Ch11 Red		80	I6-6	178	Int Advance
89	O6-7	35	Ch11 Yellow		81	I6-7	208	Local Flash
90	O6-8	59	Ch11 Green		82	I6-8	207	Comp Stop Tm
91	O7-1	115	Not Used			I7-1	138	Hold 2
93	O7-2	115	Not Used			I7-2	140	Hold 4
94	O7-3	10	Ch10 Red			I7-3	142	Hold 6
95	O7-4	34	Ch10 Yellow			I7-4	144	Hold 8
96	O7-5	58	Ch10 Green			I7-5	161	R1 Frc Off
97	O7-6	9	Ch9 Red			I7-6	163	R1 Inh Max
98	O7-7	33	Ch9 Yellow			I7-7	166	R1 Max II
99	O7-8	57	Ch9 Green			I7-8	168	Non-Act I
	O8-1	103	Special 1			I8-1	169	R2 Frc Off
	O8-2	115	Not Used			I8-2	171	R2 Inh Max
	O8-3	115	Not Used			I8-3	174	R2 Max II
	O8-4	128	Free/Coord			I8-4	176	Non-Act II
	O8-5	115	Not Used			I8-5	137	Hold 1
	O8-6	137	PreemptActv			I8-6	139	Hold 3
	O8-7	115	Not Used			I8-7	141	Hold 5
	O8-8	115	Not Used			I8-8	143	Hold 7

2070 2A (C1 Connector) Mapping – Mode 7 Option

14.2.8 2070(N) D-Connector – TEES Mapping

Pin	Function	I/O		Pin	Function	I/O
A	Detector 9	I		i	Door Ajar	I
B	Detector 10	I		j	Special Function 1	I
C	Detector 11	I		k	Special Function 2	I
D	Detector 12	I		m	Special Function 3	I
E	Detector 13	I		n	Special Function 4	I
F	Detector 14	I		p	Special Function 5	I
G	Detector 15	I		q	Special Function 6	I
H	Detector 16	I		r	Special Function 7	I
J	Detector 17	I		s	Special Function 8	I
K	Detector 18	I		t	Preempt 1 In	I
L	Detector 19	I		u	Preempt 2 In	I
M	Detector 20	I		v	Preempt 3 In	I
N	Detector 21	I		w	Preempt 4 In	I
P	Detector 22	I		x	Preempt 5 In	I
R	Detector 23	I		y	Preempt 6 In	I
S	Detector 24	I		z	Alarm 1 Out	O
T	***** Clock Update	I		AA	Alarm 2 Out	O
U	Hardware Control	I		BB	Special Function 1 Out	O
V	Cycle Advance	I		CC	Special Function 2	O
W	Max 3 Selection	I		DD	Special Function 3	O
X	Max 4 Selection	I		EE	Special Function 4	O
Y	Free	I		FF	Special Function 5	O
Z	Not assigned	-		GG	Special Function 6	O
a	Not assigned	-		HH	Special Function 7	O
b	Alarm 1	I		JJ	Special Function 8	O
c	Alarm 2	I		KK	Not assigned	-
d	Alarm 3	I		LL	Detector Reset	O
e	Alarm 4	I		MM	Not assigned	-
f	Alarm 5	I		NN	+24VDC	-
g	Flash In	I		PP	2070N DC Gnd	-
h	Conflict Monitor Status	I				

2070(N) D-Connector – TEES Mapping

***Not Implemented**

14.2.9 2070(N) D-Connector – 820A-VMS Mapping

Warning: Identify pin M (Local Flash input), and install a 120 VAC relay to isolate the high voltage cabinet flash status signal used for the 820A flash input. Verify this AC input is not present on pin M before connecting the D harness to prevent damage to the 2070. Failure to deactivate the 120 V flash input on pin M will void the warranty of the 2070(N) expansion chassis.

Pin	Function	I/O		Pin	Function	I/O
A	N/A	I		i	Detector 16	I
B	Detector 15	I		j	N/A	-
C	Detector 17	I		k	N/A	-
D	Detector 18	I		m	N/A	-
E	Detector 19	I		n	N/A	-
F	Detector 20	I		p	Alarm 3	I
G	Detector 21	I		q	N/A	-
H	Detector 22	I		r	N/A	-
J	Detector 23	I		s	N/A	-
K	Detector 24	I		t	N/A	-
L	N/A	-		u	N/A	-
M!!!	**Local Flash In (See warning)**	I		v	N/A	-
N	Alarm 4	I		w	Alarm 1	I
P	N/A	-		x	N/A	-
R	N/A	-		y	Alarm 5	I
S	Detector 9	I		z	N/A	O
T	Detector 10	I		AA	Special Function 1 Out	O
U	Detector 11	I		BB	Special Function 2 Out	O
V	Detector 12	I		CC	Special Function 3 Out	O
W	Detector 13	I		DD	Special Function 4 Out	O
X	Detector 14	I		EE	Special Function 5 Out	O
Y	Alarm 2	I		FF	Special Function 6 Out	O
Z	N/A	-		GG	Special Function 7 Out	O
a	Preempt 1	I		HH	Special Function 8 Out	O
b	Preempt 2	I		JJ	N/A	O
c	Preempt 3	I		KK	External 24 VDC	-
d	Preempt 4	I		LL	N/A	O
e	N/A	-		MM	N/A	-
f	N/A	-		NN	N/A	-
g	N/A	-		PP	N/A	-
h	N/A	-				

2070(N) D-Connector – 820A-VMS Mapping

14.3 Model 970 (C1 Connector) Mapping

C1 Pin	Source	Func	Output Description	C1 Pin	Source	Func	Input Description
2	O1-1	14	Ch14 Red	39	I1-1	2	Veh Call 2
3	O1-2	62	Ch14 Green	40	I1-2	16	Veh Call 16
4	O1-3	4	Ch4 Red	41	I1-3	8	Veh Call 8
5	O1-4	28	Ch4 Yellow	42	I1-4	22	Veh Call 22
6	O1-5	52	Ch4 Green	43	I1-5	3	Veh Call 3
7	O1-6	3	Ch3 Red	44	I1-6	17	Veh Call 17
8	O1-7	27	Ch3 Yellow	45	I1-7	9	Veh Call 9
9	O1-8	51	Ch3 Green	46	I1-8	23	Veh Call 23
10	O2-1	13	Ch13 Red	47	I2-1	6	Veh Call 6
11	O2-2	61	Ch13 Green	48	I2-2	20	Veh Call 20
12	O2-3	2	Ch2 Red	49	I2-3	12	Veh Call 12
13	O2-4	26	Ch2 Yellow	50	I2-4	26	Veh Call 26
15	O2-5	50	Ch2 Green	51	I2-5	198	Pre 1 In
16	O2-6	1	Ch1 Red	52	I2-6	199	Pre 2 In
17	O2-7	25	Ch1 Yellow	53	I2-7	189	Manual Ctrl Enable
18	O2-8	49	Ch1 Green	54	I2-8	189	Unused
19	O3-1	16	Ch16 Red	55	I3-1	15	Veh Call 15
20	O3-2	64	Ch16 Green	56	I3-2	1	Veh Call 1
21	O3-3	8	Ch8 Red	57	I3-3	21	Veh Call 21
22	O3-4	32	Ch8 Yellow	58	I3-4	7	Veh Call 7
23	O3-5	56	Ch8 Green	59	I3-5	27	Veh Call 27
24	O3-6	7	Ch7 Red	60	I3-6	13	Veh Call 13
25	O3-7	31	Ch7 Yellow	61	I3-7	28	Veh Call 28
26	O3-8	55	Ch7 Green	62	I3-8	14	Veh Call 14
27	O4-1	15	Ch15 Red		I4-1	189	Unused
28	O4-2	63	Ch15 Green		I4-2	189	Unused
29	O4-3	6	Ch6 Red		I4-3	189	Unused
30	O4-4	30	Ch6 Yellow		I4-4	189	Unused
31	O4-5	54	Ch6 Green	63	I4-5	4	Veh Call 4
32	O4-6	5	Ch5 Red	64	I4-6	18	Veh Call 18
33	O4-7	29	Ch5 Yellow	65	I4-7	10	Veh Call 10
34	O4-8	53	Ch5 Green	66	I4-8	24	Veh Call 24

C1 Pin	Source	Func	Output Description		C1 Pin	Source	Func	Input Description
35	O5-1	37	Ch13 Yellow		67	I5-1	130	Ped Call 2
36	O5-2	39	Ch15 Yellow		68	I5-2	134	Ped Call 6
37	O5-3	38	Ch14 Yellow		69	I5-3	132	Ped Call 4
38	O5-4	40	Ch16 Yellow		70	I5-4	136	Ped Call 8
100	O5-5	42	Ch18 Yellow		71	I5-5	200	Pre 3 In
101	O5-6	35	Ch11 Yellow		72	I5-6	201	Pre 4 In
102	O5-7	115	Not Used		73	I5-7	202	Pre 5 In
103	O5-8	114	Watchdog		74	I5-8	203	Pre 6 In
83	O6-1	14	Ch18 Red		75	I6-1	189	Unused
84	O6-2	62	Ch18 Green		76	I6-2	5	Veh Call 5
85	O6-3	17	Ch17 Red		77	I6-3	19	Veh Call 19
86	O6-4	41	Ch17 Yellow		78	I6-4	11	Veh Call 11
87	O6-5	65	Ch17 Green		79	I6-5	25	Veh Call 25
88	O6-6	12	Ch12 Red		80	I6-6	178	Int Advance
89	O6-7	36	Ch12 Yellow		81	I6-7	208	Local Flash
90	O6-8	60	Ch12 Green		82	I6-8	207	Comp StopTm
91	O7-1	11	Ch11 Red			I7-1	189	Unused
93	O7-2	59	Ch11 Green			I7-2	189	Unused
94	O7-3	10	Ch10 Red			I7-3	189	Unused
95	O7-4	34	Ch10 Yellow			I7-4	189	Unused
96	O7-5	58	Ch10 Green			I7-5	189	Unused
97	O7-6	9	Ch9 Red			I7-6	189	Unused
98	O7-7	33	Ch9 Yellow			I7-7	189	Unused
99	O7-8	57	Ch9 Green			I7-8	189	Unused
	O8-1	115	Unused			I8-1	189	Unused
	O8-2	115	Unused			I8-2	189	Unused
	O8-3	115	Unused			I8-3	189	Unused
	O8-4	115	Unused			I8-4	189	Unused
	O8-5	115	Unused			I8-5	189	Unused
	O8-6	115	Unused			I8-6	189	Unused
	O8-7	115	Unused			I8-7	189	Unused
	O8-8	115	Unused			I8-8	189	Unused

970 C1 Connector Mapping

14.4 Terminal & Facilities BIU Mapping

14.4.1 Default BIU Input Map (MM->1->8->9->3)

BIU #1

Pin	Fcn	Description	Pin	Fcn	Description
B01	189	Unused	B02	189	Unused
B03	189	Unused	B04	189	Unused
B05	189	Unused	B06	189	Unused
B07	189	Unused	B08	189	Unused
B09	189	Unused	B10	189	Unused
B11	189	Unused	B12	189	Unused
B13	189	Unused	B14	198	Pre1In
B15	199	Pre 2 In	B16	185	Test A
B17	186	Test B	B18	211	Auto Flash
B19	210	Dim Enable	B20	181	Man Ctrl Enbl
B21	178	Int Advance	B22	180	Min Recall
B23	177	Ext Start	B24	209	TBC Input
I01	162	R1 Stop Tim	I02	170	R2 Stop Tim
I03	166	R1 Max II	I04	174	R2 Max II
I05	161	R1 Frc Off	I06	169	R2 Frc Off
I07	168	Non-Act	I08	I88	WalkRestMod
Op1	129	Ped Call 1	Op2	130	Ped Call 2
Op3	131	Ped Call 3	Op4	132	Ped Call 4
***	189	Unused	***	189	Unused
***	189	Unused	***	189	Unused

BIU #2

Pin	Fcn	Description	Pin	Fcn	Description
B01	189	Unused	B02	189	Unused
B03	189	Unused	B04	189	Unused
B05	189	Unused	B06	189	Unused
B07	189	Unused	B08	189	Unused
B09	189	Unused	B10	189	Unused
B11	189	Unused	B12	189	Unused
B13	189	Unused	B14	189	Unused
B15	189	Unused	B16	200	Pre3 In
B17	201	Pre 4 In	B18	202	Pre5 In
B19	203	Pre 6 In	B20	176	Non-Act II
B21	189	Unused	B22	189	Unused
B23	189	Unused	B24	189	Unused
I01	163	R1 Inh Max	I02	171	R2 Inh Max
I03	208	Local Flash	I04	206	Cab Flash
I05	192	Alarm 1	I06	193	Alarm 2
I07	190	Free	I08	187	Test C
Op1	133	Ped Call 5	Op2	134	Ped Call 6
Op3	135	Ped Call 7	Op4	136	Ped Call 8
***	189	Unused	***	189	Unused
***	189	Unused	***	189	Unused

BIU #3

Pin	Fcn	Description	Pin	Fcn	Description
B01	189	Unused	B02	189	Unused
B03	189	Unused	B04	189	Unused
B05	189	Unused	B06	189	Unused
B07	164	R1RedRest	B08	172	R2RedRest
B09	167	R1OmtRdClr	B10	175	R2OmtRdClr
B11	165	R1PedRecyc	B12	173	R2PedRecyc
B13	212	AltSeqA	B14	213	AltSeqB
B15	214	AltSeqC	B16	215	AltSeqD
B17	153	PhOmit1	B18	154	PhOmit2
B19	155	PhOmit3	B20	156	PhOmit4
B21	157	PhOmit5	B22	158	PhOmit6
B23	159	PhOmit7	B24	160	PhOmit8
I01	137	Hold1	I02	138	Hold2
I03	139	Hold3	I04	140	Hold4
I05	141	Hold5	I06	142	Hold6
I07	143	Hold7	I08	144	Hold8
Op1	216	PlanA	Op2	217	PlanB
Op3	218	PlanC	Op4	219	PlanD
***	189	Unused	***	189	Unused
***	189	Unused	***	189	Unused

BIU #4

Pin	Fcn	Description	Pin	Fcn	Description
B01	189	Unused	B02	189	Unused
B03	189	Unused	B04	189	Unused
B05	189	Unused	B06	189	Unused
B07	189	Unused	B08	189	Unused
B09	189	Unused	B10	220	Addr Bit 0
B11	221	Addr Bit 1	B12	222	Addr Bit 2
B13	223	Addr Bit 3	B14	224	Addr Bit 4
B15	189	Unused	B16	189	Unused
B17	189	Unused	B18	189	Unused
B19	189	Unused	B20	189	Unused
B21	189	Unused	B22	189	Unused
B23	189	Unused	B24	189	Unused
I01	145	Ped Omit 1	I02	146	Ped Omit 2
I03	147	Ped Omit 3	I04	148	Ped Omit 4
I05	149	Ped Omit 5	I06	150	Ped Omit 6
I07	151	Ped Omit 7	I08	152	Ped Omit 8
Op1	225	Offset 1	Op2	226	Offset 2
Op3	227	Offset 3	Op4	189	Unused
***	189	Unused	***	189	Unused
***	189	Unused	***	189	Unused

14.4.2 Default BIU Output Map (MM->1->8->9->3)

BIU #1

Pin	Fcn	Description	Pin	Fcn	Description
O01	1	Ch1 Red	O02	25	Ch1 Yellow
O03	49	Ch1 Green	O04	2	Ch2 Red
O05	26	Ch2 Yellow	O06	50	Ch2 Green
O07	3	Ch3 Red	O08	27	Ch3 Yellow
O09	51	Ch3 Green	O10	4	Ch4 Red
O11	28	Ch4 Yellow	O12	52	Ch4 Green
O13	5	Ch5 Red	O14	29	Ch5 Yellow
O15	53	Ch5 Green	B01	6	Ch6 Red
B02	30	Ch6 Yellow	B03	54	Ch6 Green
B04	7	Ch7 Red	B05	31	Ch7 Yellow
B06	55	Ch7 Green	B07	8	Ch8 Red
B08	32	Ch8 Yellow	B09	56	Ch8 Green
B10	122	TB CAux/Pre1	B11	123	TBC Aux/Pre2
B12	116	Pre Stat 1	B13	117	Pre Stat 2
B14	115	Not Used	B15	115	Not Used
B16	115	Not Used	B17	115	Not Used
B18	115	Not Used	B19	115	Not Used
B20	115	Not Used	B21	115	Not Used
B22	115	Not Used	B23	115	Not Used
B24	115	Not Used	***	115	Not Used

BIU #2

Pin	Fcn	Description	Pin	Fcn	Description
O01	9	Ch9 Red	O02	33	Ch9 Yellow
O03	57	Ch9 Green	O04	10	Ch10 Red
O05	34	Ch10 Yellow	O06	58	Ch10 Green
O07	11	Ch11 Red	O08	35	Ch11 Yellow
O09	59	Ch11 Green	O10	12	Ch12 Red
O11	36	Ch12 Yellow	O12	60	Ch12 Green
O13	13	Ch13 Red	O14	37	Ch13 Yellow
O15	61	Ch13 Green	B01	14	Ch14 Red
B02	38	Ch14 Yellow	B03	62	Ch14 Green
B04	15	Ch15 Red	B05	39	Ch15 Yellow
B06	63	Ch15 Green	B07	16	Ch16 Red
B08	40	Ch16 Yellow	B09	64	Ch16 Green
B10	127	TBC Aux 3	B11	128	Free/Coord
B12	118	Pre Stat 3	B13	119	Pre Stat 4
B14	120	Pre Stat 5	B15	121	Pre Stat 6
B16	115	Not Used	B17	115	Not Used
B18	115	Not Used	B19	115	Not Used
B20	115	Not Used	B21	115	Not Used
B22	115	Not Used	B23	115	Not Used
B24	115	Not Used	***	115	Not Used

BIU #3

Pin	Fcn	Description	Pin	Fcn	Description
O01	129	Time plan A	O02	130	Time plan B
O03	131	Time plan C	O04	132	Time plan D
O05	133	Offset Out 1	O06	134	Offset Out 2
O07	135	Offset Out 3	O08	136	Auto Flash
O09	103	Special 1	O10	104	Special 2
O11	105	Special 3	O12	106	Special 4
O13	115	Not Used	O14	115	Not Used
O15	115	Not Used	B01	115	Not Used
B02	97	R1 Status A	B03	98	R1 Status B
B04	99	R1 Status C	B05	100	R2 Status A
B06	101	R2 Status B	B07	102	R2 Status C
B08	115	Not Used	B09	115	Not Used
B10	115	Not Used	B11	115	Not Used
B12	115	Not Used	B13	115	Not Used
B14	115	Not Used	B15	115	Not Used
B16	115	Not Used	B17	115	Not Used
B18	115	Not Used	B19	115	Not Used
B20	115	Not Used	B21	115	Not Used
B22	115	Not Used	B23	115	Not Used
B24	115	Not Used	***	115	Not Used

BIU #4

Pin	Fcn	Description	Pin	Fcn	Description
O01	89	Phase 1 On	O02	90	Phase 2 On
O03	91	Phase 3 On	O04	92	Phase 4 On
O05	93	Phase 5 On	O06	94	Phase 6 On
O07	95	Phase 7 On	O08	96	Phase 8 On
O09	81	Ph1 Next	O10	82	Ph2 Next
O11	83	Ph3 Next	O12	84	Ph4 Next
O13	85	Ph5 Next	O14	86	Ph6 Next
O15	87	Ph7 Next	B01	115	Not Used
B02	88	Ph8 Next	B03	73	Ph1 Check
B04	74	Ph2 Check	B05	75	Ph3 Check
B06	76	Ph4 Check	B07	77	Ph5 Check
B08	78	Ph6 Check	B09	79	Ph7 Check
B10	80	Ph8 Check	B11	115	Not Used
B12	115	Not Used	B13	115	Not Used
B14	115	Not Used	B15	115	Not Used
B16	115	Not Used	B17	115	Not Used
B18	115	Not Used	B19	115	Not Used
B20	115	Not Used	B21	115	Not Used
B22	115	Not Used	B23	115	Not Used
B24	115	Not Used	***	115	Not Used

14.4.3 Solo TF BIU1 Input Map (Note: output map same as Default output map)

BIU #1

Pin	Fcn	Description	Pin	Fcn	Description
B01	189	Unused	B02	189	Unused
B03	189	Unused	B04	189	Unused
B05	189	Unused	B06	189	Unused
B07	189	Unused	B08	189	Unused
B09	189	Unused	B10	189	Unused
B11	189	Unused	B12	189	Unused
B13	189	Unused	B14	198	Pre 1 In
B15	199	Pre2 In	B16	206	Cab Flash
B17	191	Flash In	B18	211	Auto Flash
B19	210	Dim Enable	B20	181	Man Ctrl Enbl
B21	178	Int Advance	B22	190	Free
B23	177	Ext Start	B24	209	TBC Input
I01	162	R1 Stop Tim	I02	170	R2 Stop Tim
I03	192	Alarm1	I04	193	Alarm 2
I05	200	Pre 3 In	I06	201	Pre 4 In
I07	202	Pre 5 In	I08	203	Pre 6 In
Op1	129	Ped Call 1	Op2	130	Ped Call 2
Op3	131	Ped Call 3	Op4	132	Ped Call 4
***	189	Unused	***	189	Unused
***	189	Unused	***	189	Unused

BIU #2

Pin	Fcn	Description	Pin	Fcn	Description
B01	189	Unused	B02	189	Unused
B03	189	Unused	B04	189	Unused
B05	189	Unused	B06	189	Unused
B07	189	Unused	B08	189	Unused
B09	189	Unused	B10	189	Unused
B11	189	Unused	B12	189	Unused
B13	189	Unused	B14	189	Unused
B15	189	Unused	B16	200	Pre 3 In
B17	201	Pre 4 In	B18	202	Pre 5 In
B19	203	Pre 6 In	B20	176	Non-Act II
B21	189	Unused	B22	189	Unused
B23	189	Unused	B24	189	Unused
I01	163	R1 Inh Max	I02	171	R2 Inh Max
I03	208	Local Flash	I04	206	Cab Flash
I05	192	Alarm 1	I06	193	Alarm 2
I07	190	Free	I08	187	Test C
Op1	133	Ped Call 5	Op2	134	Ped Call 6
Op3	135	Ped Call 7	Op4	136	Ped Call 8
***	189	Unused	***	189	Unused
***	189	Unused	***	189	Unused

BIU #3

Pin	Fcn	Description	Pin	Fcn	Description
B01	189	Unused	B02	189	Unused
B03	189	Unused	B04	189	Unused
B05	189	Unused	B06	189	Unused
B07	164	R1 Red Rest	B08	172	R2 Red Rest
B09	167	R1 Omt Rd Clr	B10	175	R2 Omt Rd Clr
B11	165	R1 Ped Recyc	B12	173	R2 Ped Recyc
B13	212	Alt Seq A	B14	213	Alt Seq B
B15	214	Alt Seq C	B16	215	Alt Seq D
B17	153	Ph Omit 1	B18	154	Ph Omit 2
B19	155	Ph Omit 3	B20	156	Ph Omit 4
B21	157	Ph Omit 5	B22	158	Ph Omit 6
B23	159	Ph Omit 7	B24	160	Ph Omit 8
I01	137	Hold 1	I02	138	Hold 2
I03	139	Hold 3	I04	140	Hold 4
I05	141	Hold 5	I06	142	Hold 6
I07	143	Hold 7	I08	144	Hold 8
Op1	216	Plan A	Op2	217	PlanB
Op3	218	Plan C	Op4	219	PlanD
***	189	Unused	***	189	Unused
***	189	Unused	***	189	Unused

BIU #4

Pin	Fcn	Description	Pin	Fcn	Description
B01	189	Unused	B02	189	Unused
B03	189	Unused	B04	189	Unused
B05	189	Unused	B06	189	Unused
B07	189	Unused	B08	189	Unused
B09	189	Unused	B10	220	Addr Bit 0
B11	221	Addr Bit 1	B12	222	Addr Bit 2
B13	223	Addr Bit 3	B14	224	Addr Bit 4
B15	189	Unused	B16	189	Unused
B17	189	Unused	B18	189	Unused
B19	189	Unused	B20	189	Unused
B21	189	Unused	B22	189	Unused
B23	189	Unused	B24	189	Unused
I01	145	Ped Omit 1	I02	146	Ped Omit 2
I03	147	Ped Omit 3	I04	148	Ped Omit 4
I05	149	Ped Omit 5	I06	150	Ped Omit 6
I07	151	Ped Omit 7	I08	152	Ped Omit 8
Op1	225	Offset 1	Op2	226	Offset 2
Op3	227	Offset 3	Op4	189	Unused
***	189	Unused	***	189	Unused
***	189	Unused	***	189	Unused

14.4.4 24 Out Chan Output Map (output map same as Default output map)

BIU #1

Pin	Fcn	Description	Pin	Fcn	Description
O01	1	Ch1 Red	O02	25	Ch1 Yellow
O03	49	Ch1 Green	O04	2	Ch2 Red
O05	26	Ch2 Yellow	O06	50	Ch2 Green
O07	3	Ch3 Red	O08	27	Ch3 Yellow
O09	51	Ch3 Green	O10	4	Ch4 Red
O11	28	Ch4 Yellow	O12	52	Ch4 Green
O13	5	Ch5 Red	O14	29	Ch5 Yellow
O15	53	Ch5 Green	B01	6	Ch6 Red
B02	30	Ch6 Yellow	B03	54	Ch6 Green
B04	7	Ch7 Red	B05	31	Ch7 Yellow
B06	55	Ch7 Green	B07	8	Ch8 Red
B08	32	Ch8 Yellow	B09	56	Ch8 Green
B10	122	TBC Aux/Pre1	B11	123	TBC Aux/Pre2
B12	116	Pre Stat 1	B13	117	Pre Stat 2
B14	115	Not Used	B15	115	Not Used
B16	115	Not Used	B17	115	Not Used
B18	115	Not Used	B19	115	Not Used
B20	115	Not Used	B21	115	Not Used
B22	115	Not Used	B23	115	Not Used
B24	115	Not Used	***	115	Not Used

BIU #2

Pin	Fcn	Description	Pin	Fcn	Description
O01	9	Ch9 Red	O02	33	Ch9 Yellow
O03	57	Ch9 Green	O04	10	Ch10 Red
O05	34	Ch10 Yellow	O06	58	Ch10 Green
O07	11	Ch11 Red	O08	35	Ch11 Yellow
O09	59	Ch11 Green	O10	12	Ch12 Red
O11	36	Ch12 Yellow	O12	60	Ch12 Green
O13	13	Ch13 Red	O14	37	Ch13 Yellow
O15	61	Ch13 Green	B01	14	Ch14 Red
B02	38	Ch14 Yellow	B03	62	Ch14 Green
B04	15	Ch15 Red	B05	39	Ch15 Yellow
B06	63	Ch15 Green	B07	16	Ch16 Red
B08	40	Ch16 Yellow	B09	64	Ch16 Green
B10	127	TBC Aux 3	B11	128	Free/Coord
B12	118	Pre Stat 3	B13	119	Pre Stat 4
B14	120	Pre Stat 5	B15	121	Pre Stat 6
B16	115	Not Used	B17	115	Not Used
B18	115	Not Used	B19	115	Not Used
B20	115	Not Used	B21	115	Not Used
B22	115	Not Used	B23	115	Not Used
B24	115	Not Used	***	115	Not Used

BIU #3

Pin	Fcn	Description	Pin	Fcn	Description
O01	129	Time plan A	O02	130	Time plan B
O03	131	Time plan C	O04	132	Time plan D
O05	133	Offset Out 1	O06	134	Offset Out 2
O07	135	Offset Out 3	O08	136	Auto Flash
O09	103	Special 1	O10	104	Special 2
O11	105	Special 3	O12	106	Special 4
O13	115	Not Used	O14	115	Not Used
O15	115	Not Used	B01	115	Not Used
B02	97	R1 Status A	B03	98	R1 Status B
B04	99	R1 Status C	B05	100	R2 Status A
B06	101	R2 Status B	B07	102	R2 Status C
B08	115	Not Used	B09	115	Not Used
B10	115	Not Used	B11	115	Not Used
B12	115	Not Used	B13	115	Not Used
B14	115	Not Used	B15	115	Not Used
B16	115	Not Used	B17	115	Not Used
B18	115	Not Used	B19	115	Not Used
B20	115	Not Used	B21	115	Not Used
B22	115	Not Used	B23	115	Not Used
B24	115	Not Used	***	115	Not Used

BIU #4

Pin	Fcn	Description	Pin	Fcn	Description
O01	17	Ch17 Red	O02	41	Ch17 Yellow
O03	65	Ch17 Green	O04	18	Ch18 Red
O05	42	Ch18 Yellow	O06	66	Ch18 Green
O07	19	Ch19 Red	O08	43	Ch19 Yellow
O09	67	Ch19 Green	O10	20	Ch20 Red
O11	44	Ch20 Yellow	O12	68	Ch20 Green
O13	21	Ch21 Red	O14	45	Ch21 Yellow
O15	69	Ch21 Green	B01	115	Not Used
B02	22	Ch22 Red	B03	46	Ch22 Yellow
B04	70	Ch22 Green	B05	23	Ch23 Red
B06	47	Ch23 Yellow	B07	71	Ch23 Green
B08	24	Ch24 Red	B09	48	Ch24 Yellow
B10	72	Ch24 Green	B11	115	Not Used
B12	115	Not Used	B13	115	Not Used
B14	115	Not Used	B15	115	Not Used
B16	115	Not Used	B17	115	Not Used
B18	115	Not Used	B19	115	Not Used
B20	115	Not Used	B21	115	Not Used
B22	115	Not Used	B23	115	Not Used
B24	115	Not Used	***	115	Not Used

14.5 ITS ATCC Cabinet SIU Mapping

This section outlines the pinouts for various cabinets that follow ITS Cabinet Version 2 specs associated with the ATC 5301 Advanced Transportation Controller Cabinet (ATCC) standard.

14.5.1 ITS ATCC Cabinet mapping (City of Houston Specifications)

Please reference the following chart to program the pin banks for the SIU's present in the Model 340/346 cabinets used in the city of Houston. These pinouts are also used with other ATC cabinets developed by Cubic | Trafficware.

SIU	Desc	PinBank	I/F1	Func	I/F2	Func	I/F3	Func	O/F1	Func	O/F3	Func
A1	+24VDC											
B1	+24VDC											
A2	IO 0	1-1		115		115		115	Ch1 Red	1	Ch15 Red	15
B2	IO 1	1-2		115		115		115	Ch1 Yel	25	Ch15 Yel	39
A3	IO 2	1-3		115		115		115	Ch1 Grn	49	Ch15 Grn	63
B3	IO 3	1-4		115		115		115	Ch2 Red	2	Ch16 Red	16
A4	IO 4	1-5		115		115		115	Ch2 Yel	26	Ch16 Yel	40
B4	IO 5	1-6		115		115		115	Ch2 Grn	50	Ch16 Grn	64
A5	IO 6	1-7	veh 1	1	veh 17	17	veh 35	35	Ch3 Red	3	Ch17 Red	17
B5	IO 7	1-8	veh 2	2	veh 18	18	veh 36	36	Ch3 Yel	27	Ch17 Yel	41
A6	IO 8	2-1	veh 3	3	veh 19	19	veh 37	37	Ch3 Grn	51	Ch17 Grn	65
B6	IO 9	2-2	veh 4	4	veh 20	20	veh 38	38	Ch4 Red	4	Ch18 Red	18
A7	IO 10	2-3	veh 5	5	veh 21	21	veh 39	39	Ch4 Yel	28	Ch18 Yel	42
B7	IO 11	2-4	veh 6	6	veh 22	22	veh 40	40	Ch4 Grn	52	Ch18 Grn	66
A8	IO 12	2-5	veh 7	7	veh 23	23	veh 41	41	Ch5 Red	5	Ch19 Red	19
B8	IO 13	2-6	veh 8	8	veh 24	24	veh 42	42	Ch5 Yel	29	Ch19 Yel	43
A9	IO 14	2-7	veh 9	9	veh 25	25	veh 43	43	Ch5 Grn	53	Ch19 Grn	67
B9	IO 15	2-8	veh 10	10	veh 26	26	veh 44	44	Ch6 Red	6	Ch20 Red	20
A10	IO 16	3-1	veh 11	11	veh 27	27	veh 45	45	Ch6 Yel	30	Ch20 Yel	44
B10	IO 17	3-2	veh 12	12	veh 28	28	veh 46	46	Ch6 Grn	54	Ch20 Grn	68
A11	IO 18	3-3	veh 13	13	veh 29	29	veh 47	47	Ch7 Red	7		115
B11	IO 19	3-4	veh 14	14	veh 30	30	veh 48	48	Ch7 Yel	31		115
A12	IO 20	3-5	veh 15	15	veh 31	31	veh 49	49	Ch7 Grn	55		115
B12	IO 21	3-6	veh 16	16	veh 32	32	veh 50	50	Ch8 Red	8		115
A13	IO 22	3-7	Plan-A	216	veh 33	33	veh 51	51	Ch8 Yel	32		115
B13	IO 23	3-8	Plan-B	217	veh 34	34	veh 52	52	Ch8 Grn	56		115
A14	IO 24	4-1	Plan-C	218	Pre 2	199	LPrior 2	199	Ch9 Red	9		115
B14	IO 25	4-2	Plan-D	219	Pre 3	200	LPrior 3	200	Ch9 Yel	33		115
A15	IO 26	4-3	ped 2	130	Pre 4	201	LPrior 4	201	Ch9 Grn	57		115
B15	IO 27	4-4	ped 4	132	Pre 5	202	LPrior 5	202	Ch10 Red	10		115
A16	IO 28	4-5	ped 6	133	Pre 1	198	Alarm 3	194	Ch10 Yel	34		115
B16	IO 29	4-6	ped 8	134	Pre 6	203	Alarm 4	195	Ch10 Grn	58		115
A17	IO 30	4-7		115		115		115	Ch11 Red	11		115
B17	IO 31	4-8		115		115		115	Ch11 Yel	35		115
A18	IO 32	5-1		115		115		115	Ch11 Grn	59		115
B18	IO 33	5-2		115		115		115	Ch12 Red	12		115
A19	IO 34	5-3		115		115		115	Ch12 Yel	36		115
B19	IO 35	5-4		115		115		115	Ch12 Grn	60		115
A20	IO 36	5-5		115		115		115	Ch13 Red	13		115
B20	IO 37	5-6		115		115		115	Ch13 Yel	37		115
A21	IO 38	5-7		115		115		115	Ch13 Grn	61		115
B21	IO 39	5-8		115		115		115	Ch14 Red	144		115
A22	IO 40	6-1		115		115		115	Ch14 Yel	38		115
B22	IO 41	6-2		115		115		115	Ch14 Grn	62		115

SIU	Desc	PinBank	I/F1	Func	I/F2	Func	I/F3	Func	O/F1	Func	O/F3	Func
A23	IO 42	6-3		115		115		115		115		115
B23	IO 43	6-4		115		115		115		115		115
A24	IO 44	6-5		115		115		115		115		115
B24	IO 45	6-6		115		115		115		115		115
A25	IO 46	6-7		115		115		115		115		115
B25	Opto 1	8-1		115		115		115	MCE	181		115
A26	Opto 2	8-2		115		115		115	Advanc	178		115
B26	Opto 3	8-3		115		115		115	StopTim	207		115
A27	Opto 4	8-4		115		115		115	Flash	191		115
B27	Opto Gnd			115		115		115		115		115
A28	Addr-0			115		115		115		115		115
B28	Addr-1			115		115		115		115		115
A29	Addr-2			115		115		115		115		115
B29	Addr-3			115		115		115		115		115
A30	INBUS Tx			115		115		115		115		115
B30	INBUS Rc			115		115		115		115		115
A31	Chas Gnd			115		115		115		115		115
B31	AC Line			115		115		115		115		115
A32	24V Gnd			115		115		115		115		115
B32	24V Gnd			115		115		115		115		115

14.6 TS2, ATC and 2070 Communications Ports

14.6.1 TS2 Communication Ports

System (P-A)

Pin	Function	Pin	Function
1	Earth Ground	7	Signal Ground
2	TX	8	DCD
3	RX	20	DTR
4	RTS	24	Enable
5	CTS	25	Logic Ground

System Up (P-A)

Pin	Function	Pin	Function
1	Earth Ground	7	Signal Ground
2	TX	8	DCD
3	RX	20	DTR
4	RTS	24	Enable
5	CTS	25	Logic Ground

System Down (P-B)

Pin	Function	Pin	Function
1	Earth Ground	5	CTS
2	TX	7	Signal Ground
3	RX	8	DCD
4	RTS	20	DTR

14.6.2 2070 Communication Ports

2070-7A (DB-9S) Async Serial Com Module

C21 & C22 Connector Pinouts (DB-9S)			
Pin	Function	Pin	Function
1	DCD	6	N/A
2	RXD	7	RTS
3	TXD	8	CTS
4	N/A	9	N/A
5	ISO DC GND		

2070-7B (DB-15S) High Speed Serial Com Module

C21 & C22 Connector Pinouts (DB-15S)			
Pin	Function	Pin	Function
1	TX DATA +	9	TX DATA -
2	ISO DC GND	10	ISO DC GND
3	TX CLOCK +	11	TX CLOCK -
4	ISO DC GND	12	ISO DC GND
5	RX DATA +	13	RX DATA -
6	ISO DC GND	14	ISO DC GND
7	RX CLOCK +	15	RX CLOCK -
8	N/A		

2070-6A and 6B Async/Modem Serial Com Module

C2 & C20 Connector Pin-outs			
Pin	Function	Pin	Function
A	Audio In	J	RTS
B	Audio In	K	Data In
C	Audio Out	L	Data Out
D	ISO +5 VDC	M	CTS
E	Audio Out	N	ISO DC Ground
F	N/A	P	N/A
H	CD	R	N/A

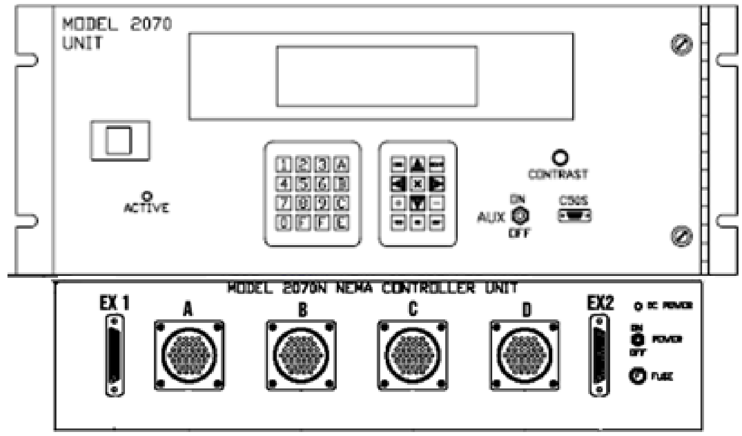
14.6.3 External Communication Ports Provided on the 2070N Expansion Chassis

The EX1 and EX2 communication ports reside on the front of the 2070N expansion chassis as shown in the figure to the right.

The EX1 port provides an EIA RS-232 serial port. The baud rate of the EX1 port is selected by hardware jumpers to provide 300, 1200, 2400, 4800, 9600, 19,200 and 38,400 baud operation.

The EX2 port is connected to a Model 2070-6 Serial Comm Module in the 2070 unit using a 22 line HAR 2 harness. This connector provides two modems or RS-232 connections from the 2070-6 Serial Comm Module.

The pinouts for the EX1 and EX2 ports below comply with the Caltrans TEES specification.



2070N EX1 Com Port

Pin	Function	Pin	Function
1	EQ Gnd	14	2070-8 DC GND
2	TxD FCU	15	485 RX Data +
3	RXD FCU	16	485 RX Data -
4	RTS FCU	17	2070-8 DC GND
5	CTS FCU	18	485 RC Clock +
6	N/A	19	485 RC Clock -
7	2070-8 DC GND	20	
8	DCD FCU	21	
9	2070-8 DC GND	22	
10	485 TX Data +	23	
11	485 TX Data -	24	
12	485 TX Clock +	25	
13	485 TX Clock -		

2070N EX2 Com Port

Pin	Function	Pin	Function
1	EQ Gnd	14	EQ Gnd
2	TxD 1	15	TxD 2
3	RxD 1	16	RxD 2
4	RTS 1	17	RTS 2
5	CTS 1	18	CTS 2
6	N/A	19	N/A
7	DC GND #1	20	DC GND #1
8	DCD 1	21	DCD 2
9	Audio In 1	22	Audio In 2
10	Audio In 1	23	Audio In 2
11	Audio Out 1	24	Audio Out 2
12	Audio Out 1	25	Audio Out 2
13	N/A		

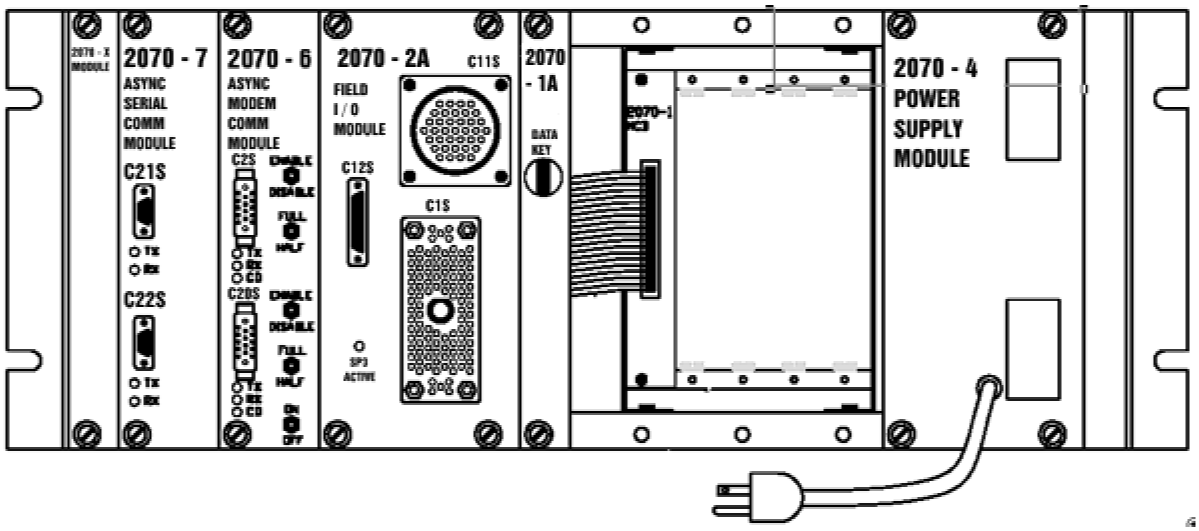
14.7 2070 / 2070N Modules

The 2070 is supplied with either full VME support or as a VME “light” configuration. The full VME version provides dual-processor support and VME expansion while the “light” version supports a single processor to reduce unit costs. The full VME version is supplied with a 2070-1A module as shown in the figure below. The VME “light” version is supplied with the 2070-1B module which also provides an Ethernet port (C14S) and an additional serial port (C13S).

Two field I/O modules are supported with either the full VME or VME “light” version. Both modules provide a C12S connector designed to interface the ATC cabinet. In addition to the C12S connector, the 2070-2A module provides a C1S and C11s connector to interface existing 170 and 179 cabinets. The 2070-2B module only provides the C12S connector to interface a 2070N expansion chassis and provide NEMA I/O support.

The LCD (Liquid Crystal Display) comes in 2 versions (a 4 line x 40 character display with ½” characters or an 8 line x40 character display with ¼” characters). The 2070 may also be supplied without the LCD and keyboard to reduce costs; however, a laptop or palm pilot must be supplied for the user interface using the C60P connector.

The 2070 modules used with these various configurations are listed below.



Rear View of 2070 Controller – VME Version, 170 Compatible I/O, 2 Async Serial Ports and 2 Modem Ports

Module #	Module Description
2070 – 1A	Full VME CPU – dual board module with VME master and slave capability
2070 – 1B	VME "Light" CPU – single board module with Ethernet and serial port 8 support
2070 – 1C	Future API support – processor and operating system independent
2070 – 2A	170/179 Compatible Field I/O Module with ATC support (C12S connector)
2070 - 2N	ATC Compatible Field I/O Module (SDLC cabinet communications)
2070 – 2B	ATC Compatible Field I/O Module (used to interface the 2070N expansion chassis)
2070 – 3A	Front Panel with 4 line x 40 character LCD (1/2 inch letter height) – full VME only
2070 – 3B	Front Panel with 8 line x 40 character LCD (1/4 inch letter height)
2070 – 3C	Front panel without LCD or keyboard
2070 – 4A	10 amp, +5VDC Power Supply (used with the full VME version)
2070 – 4B	3.5 amp, +5VDC Power Supply (used with the VME "light" version)
2070 – 5	VME Assembly
2070 – 6A	Two modems and/or 1200 baud RS-232 serial ports – interfaces with either voice grade telephone or direct connection
2070 – 6B	Two modems and/or 9600 baud RS-232 serial ports – interfaces with either voice grade telephone or direct connection
2070 – 6C	1 channel auto-dial and 1 channel 400 modem
2070 – 6D	2 channel – fiber communication
2070 – 7A	2 Asynch Serial RS-232 Comm Channels
2070 – 7B	2 Asynch Serial RS-485 Comm Channels
2070 – 8	NEMA expansion module used with the 2070-2B module

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