INTRO TRAFFIC 101

What is the purpose of a traffic signal?

What are the parts that make it work?

How do we time a traffic signal?

How do we maintain a traffic signal?

- **What is the purpose of a traffic signal?**

- **Ensure safe and orderly flow of traffic**
- **Protect pedestrians and vehicles at busy intersections**
- **Reduce the severity and frequency of accidents between vehicles entering intersections**

- **Safely and efficiently move traffic!**

When Properly Designed and Located:

- Allow for orderly traffic (vehicle and non-motorized) flow.
- Can increase the amount of traffic an intersection is able to handle.
- Can reduce the crash frequency, particularly right-angle crashes.
- Can be coordinated for nearly continuous traffic flow along a given route.
- Can be used to interrupt heavy traffic to permit side traffic to enter or cross a major roadway

What makes a traffic signal work?

Parts

- **Cabinet & Controller Unit (CU) – Controllers run timings programmed by the agency**
- **Malfunction Management Unit (MMU) – Also called the conflict monitor it is the device used to detect and respond to improper and conflicting signals and improper operating voltages in a traffic control system.**
- **Load Switch (LS) – Takes the DC signal from the controller and switches it to AC outputs to be sent to the field.**
- **Flasher (FL) – Similar to a LS in look it simply provides a AC flashing output that can be transferred to the field.**
- **Flash Transfer Relay (FTR) – Transfers the field indications between either the Load Switch or Flasher. Controlled by the MMU**

Traffic Signal Heads & Hardware

- Housing
- Mounting Hardware
- Pedestrian Pushbuttons

Housing

- Vehicle and Pedestrian Signals
  - Aluminum vs. Polycarbonate (MoDOT)
  - LED's (Light Emitting Diode's)
  - Visors and Backplates

Aluminum / Polycarbonate

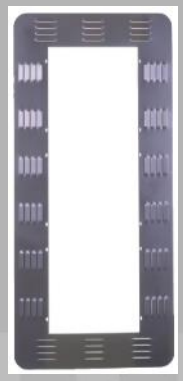
- **Aluminum**
  - **More expensive**
  - **Heavier**
  - **Requires Painting**
- **Polycarbonate**
  - **Less expensive**
  - **Weighs Less**
  - **No painting required (standard colors black , green, yellow)**

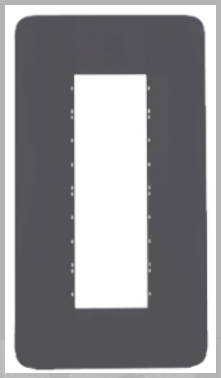
LED Indications

- 90% power savings over incandescent
- Long life (5 year warranty)
- Fits in standard 8”and 12” Vehicle housing and 9”, 12” and 16” Pedestrian housing
- ITE Specifications (GT1)

Visors and backplates

- **Visors**
  - **Reduces sun phantom**
  - **Cuts off side view**
  - **Available in Aluminum and Polycarbonate**
  - **Scoop Visor**





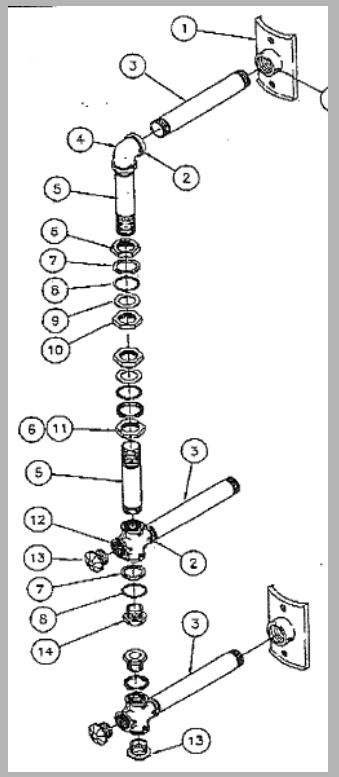
- **Backplates**
  - **Provides a solid background**
  - **Available in Aluminum and Polycarbonate**
  - **Available Louvered (reduces wind load)**

Mounting hardware

- Pipe Bracketing
- Span Wire
- Other Mounting Methods

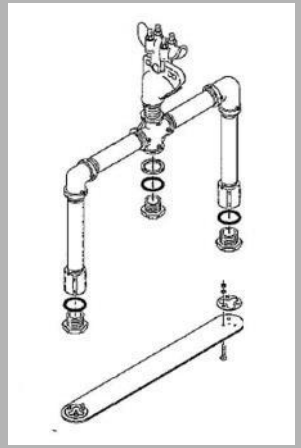
Pipe bracketing

- MoDOT Signal Bracketing
- Side of Post/Pole mount
- 1-1/2” pipe fittings
- Connects to the top and bottom of signal housing
- Bands or bolts with pole plate or hub

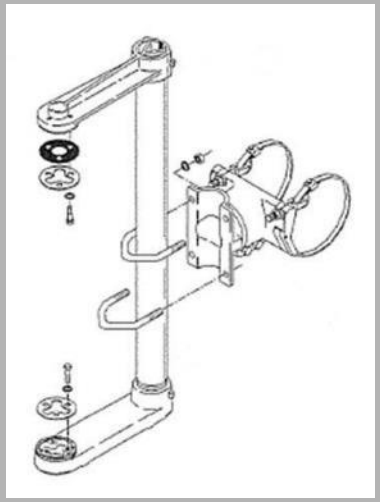


Span wire

- Used on temporary signal systems
- Iron or Aluminum
- Hangs from cable over intersection
- Top has wire entrance and balance adjuster
- Bottom connects to a tether for stabilization



Other mounting methods



- "Astro Brac" from Pelco
  - Connects to top and bottom of signal
  - Attached to mast arm by clamp assembly
  - Allows signal raising, lowering or rotation
- CPI Poly Bracketing
  - Yellow or Black

Pedestrian pushbutton

- Campbell Pushbutton
  - Solid State
    - Piezo, LED and Audible Tone
  - Round or Rectangle
  - Advisor APS
    - Visual, Tactile and Audible information

- Teeco Pushbutton
  - Mechanical

Other Parts

- **Pedestrian Poles**
- **Mast Arm Structures**
- **Conduit**
- **Pull boxes**
- **Wire**
- **Lighting at Intersection**
- **Traffic Signal signing**

Methods of Detection

Today's Options

- **Preformed Loops & LCD Detectors**
- **Cut in Place loops**
- **Video**
- **Radar**
- **In Pavement Wireless**

Preformed Loop & LCD Detectors

Why Preformed Loops?

- Long term reliability
- Five layers of protection
- The most accurate sensor
- Maintains integrity for the life of the pavement
- Stronger than standard loops
- Manufactured in a controlled environment
- Easy to handle, ship, and install
- Cost effective

Manufacture Tested

- **Before that loop leaves Reno it is soaked in Salt Water for three days. The loop is then megged and must exceed 1000 megs.**

Why an LCD Detector?

Why an LCD Detector?

Eliminates guess work

- **Provides critical information required for proper detector setup**

Direct feedback on display

- **Allows the accurate setting of frequency and sensitivity**
  - **Frequency**
    - Actual frequency is displayed
    - Optimizes frequency separation
    - Minimizes crosstalk of adjacent loops connected to different detectors
  - **Sensitivity**
    - Bar Graph allows quick determination of correct sensitivity setting

Why an LCD Detector?

Advanced diagnostics

- Like having a built-in loop analyzer
- Displays inductance and $-\Delta L/L$ of inductance
- Monitors and logs loop failures
- Audible detect signal

Push button programming

- Long term reliability by eliminating switch contacts
- All programming stored in non-volatile memory

Flexibility

- User specific options can be added with firmware changes
- Easy to upgrade

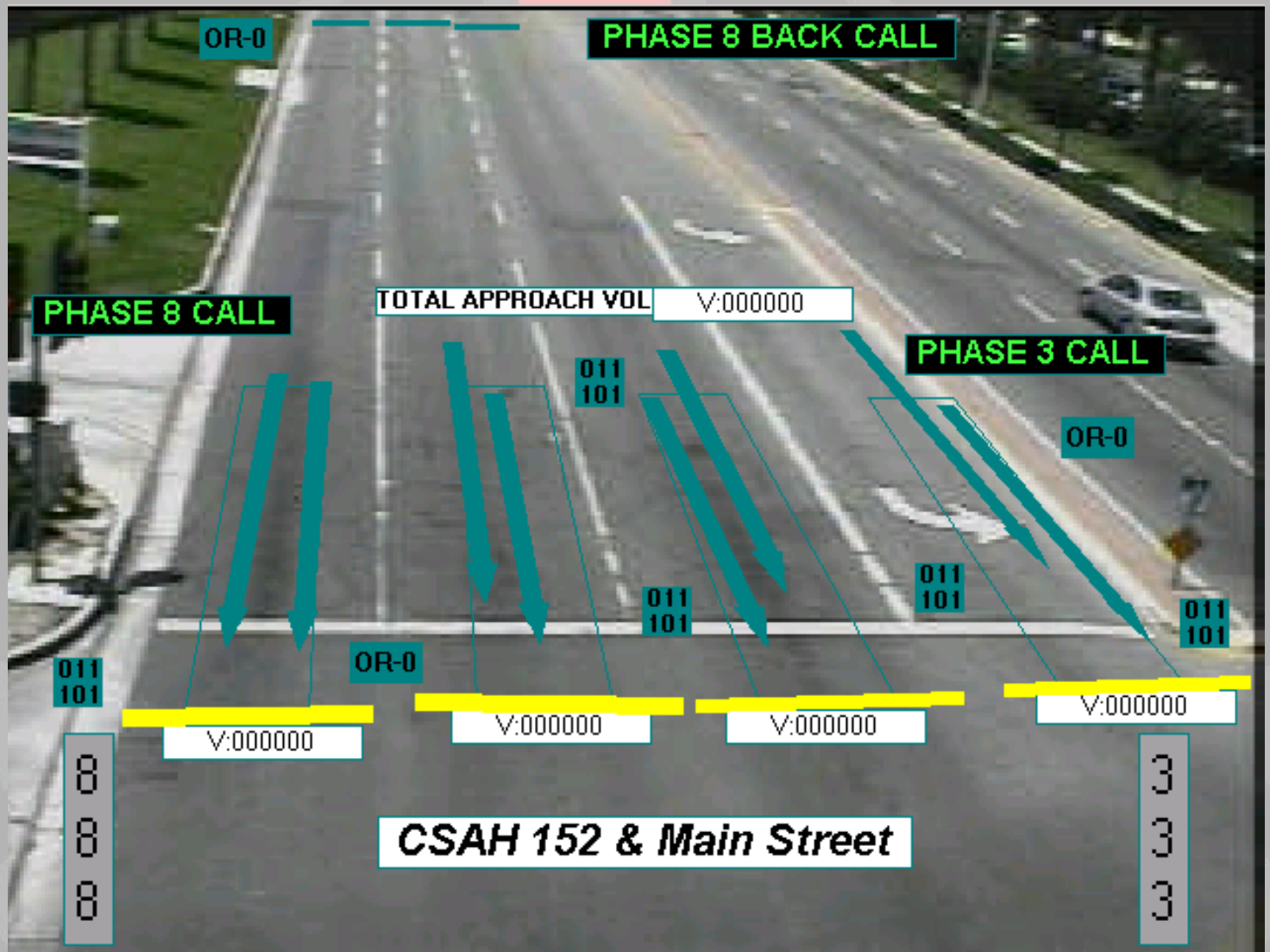
Video Detection

- **The most possible applications**
- **Easy to install.**
  - **If conduit is open to the closest pole to the cabinet we can install Terra in one working day.**
- **Easy maintenance.**
  - **Only a laptop is required to change detection.**

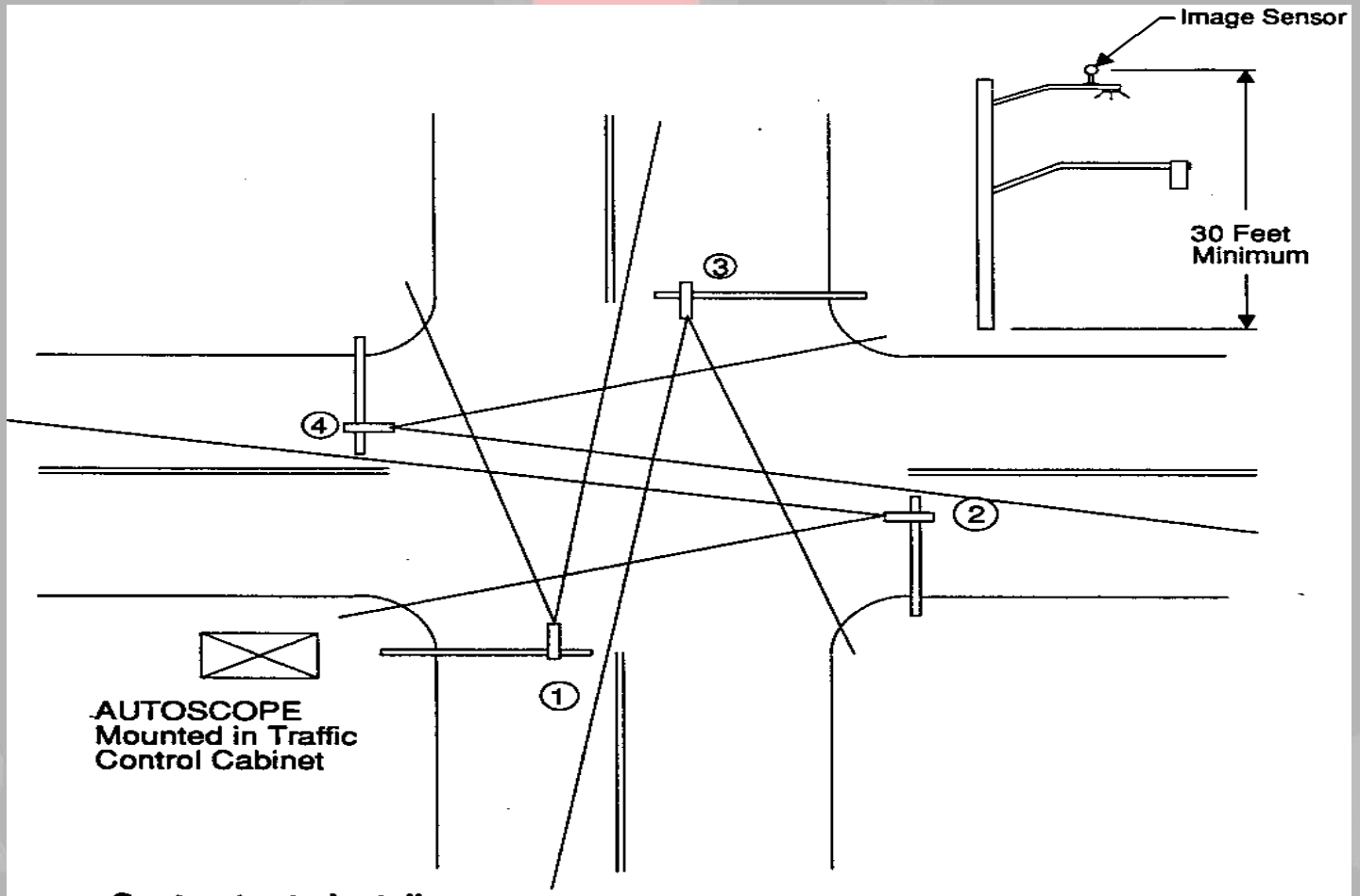
Terra Technology is…

- Integrated Camera
  - State-of-the-art dual-core processor
  - Adaptive lighting control
- Embedded web server access for setup & monitoring via standard Internet web browsers
- Streaming MPEG-4 digital video anywhere, anyhow
- “3-wires only” installation
  - Reduced cabling costs
  - Faster, easier installation
- ClearVision™ faceplate for low maintenance
- Now with HD in the Vision Product

Most Common (Intersection)...



Typical Installation



Contractor to Install

(4) Image Sensors & Brackets ① ② ③ ④
Power Cable to Each Image Sensor (115VAC)
Belden 8281 from Image Sensor to Cabinet
Coaxial and Power Cable Terminations

Radar Detection

- **Freeway / Arterial Management**
- **Stop Bar / Presence Detection**
- **Advanced Intersection Detection / Queue Management**

Radar is consistently accurate

in all weather conditions

Radar is <u>unaffected</u> by:

- ✓ Rain
- ✓ Snow
- ✓ Fog
- ✓ Wind
- ✓ Ice Storms
- ✓ Dust Storms
- ✓ Changes in Lighting
- ✓ Sun Glare
- ✓ Shadowing

In-Pavement Wireless

- Detects Vehicle Presence and movement accurately
- Flexible and reliable wireless technology
- Virtually maintenance free
- Stop bar and advance detection

Traffic Signal Cabinets

NEMA

- National Electrical Manufacturers Association
- First Traffic Standard in 1975 (TS1)
- Defines:
  - Definitions
  - Environmental
  - Controller
  - Monitoring
  - Cabinet Architecture
  - Auxiliary Devices
  - Enclosures

Background of TS1

- First cabinet standard issued in 1975
- TS1 set the MINIMUM requirements for safe and effective traffic equipment.
- Defined items such as:
  - Controller Operations (MIN GRN)
  - Controller I/O (Ph. Next, Ph. On)
  - Hardware (Connectors, pin outs, ect.)

Background of TS2

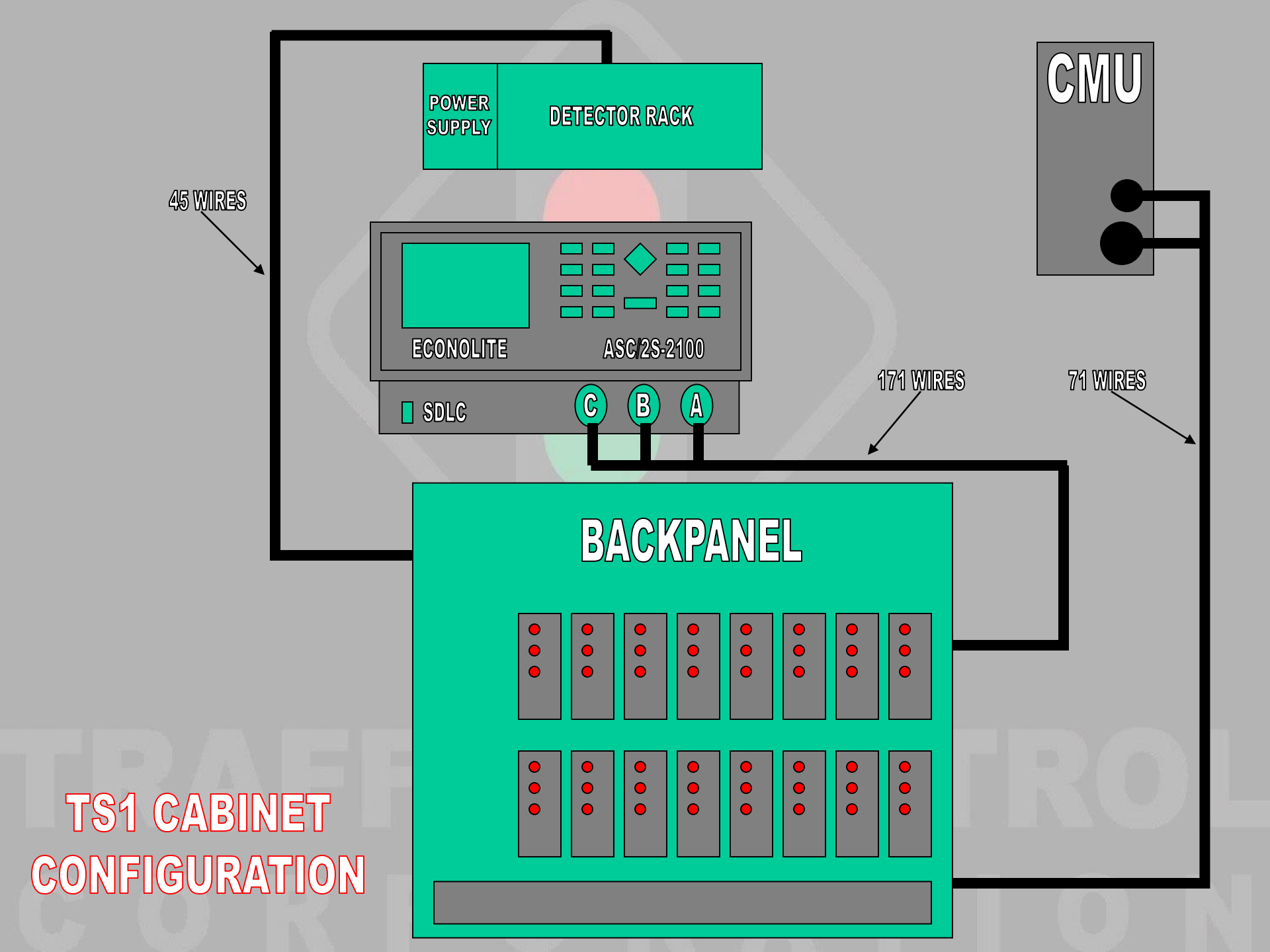
- **Approved by NEMA in March 1992**
- **First major update of the TS1 standard issued in 1975.**
- **TS2 goes above and beyond TS1 by defining controllers, cabinets, and systems more completely.**

Defined by TS2

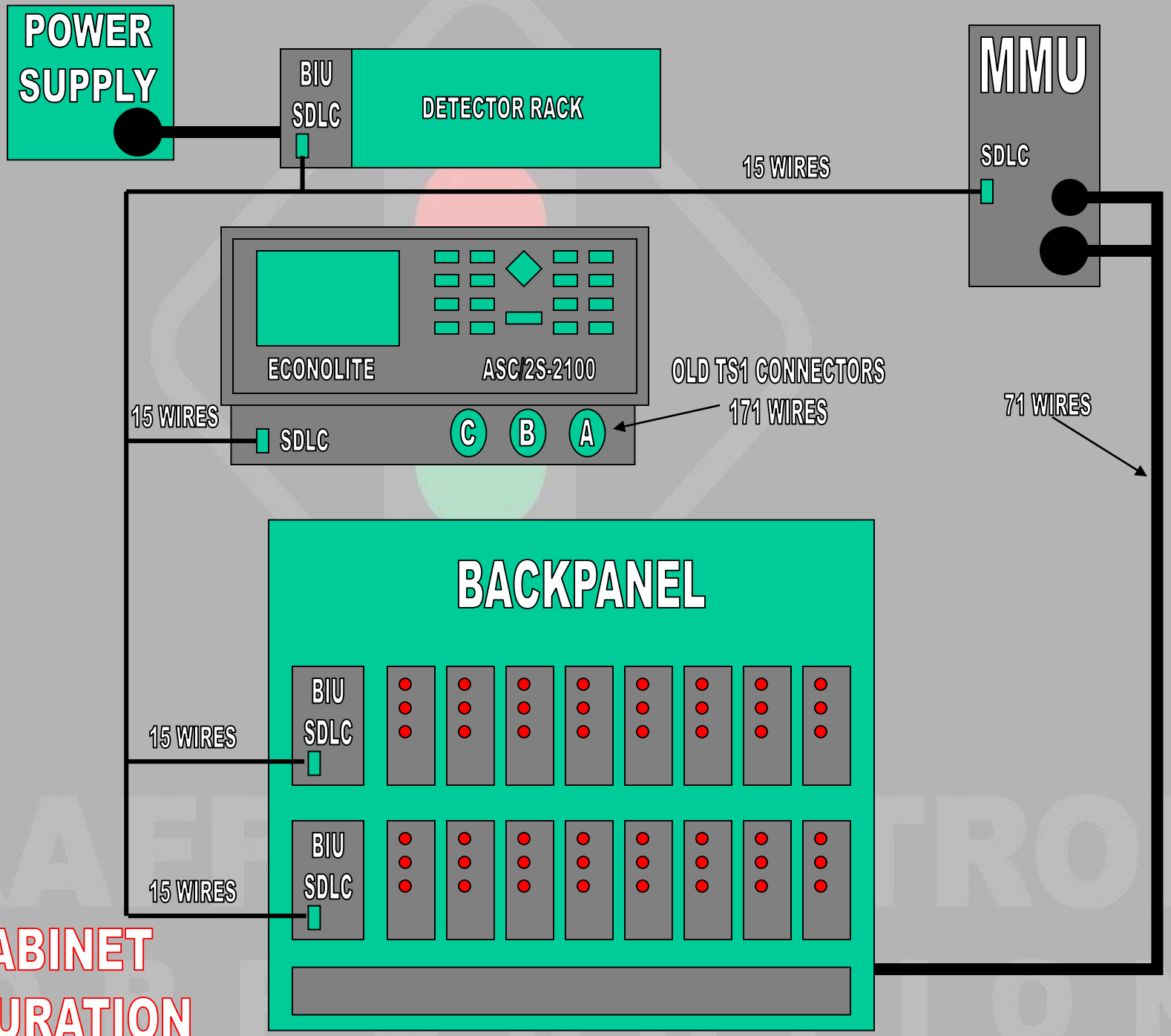
- Coordination
- Preemption
- Time Base Control
- Automatic Flash Operation
- Cabinet Hardware
- Telemetry Signals
- Detection
- Controller Logging
- Output Monitoring
- AC Power Monitoring

Cabinet Layout

- TS1
- TS2 – Type 1
- TS2 – Type 2

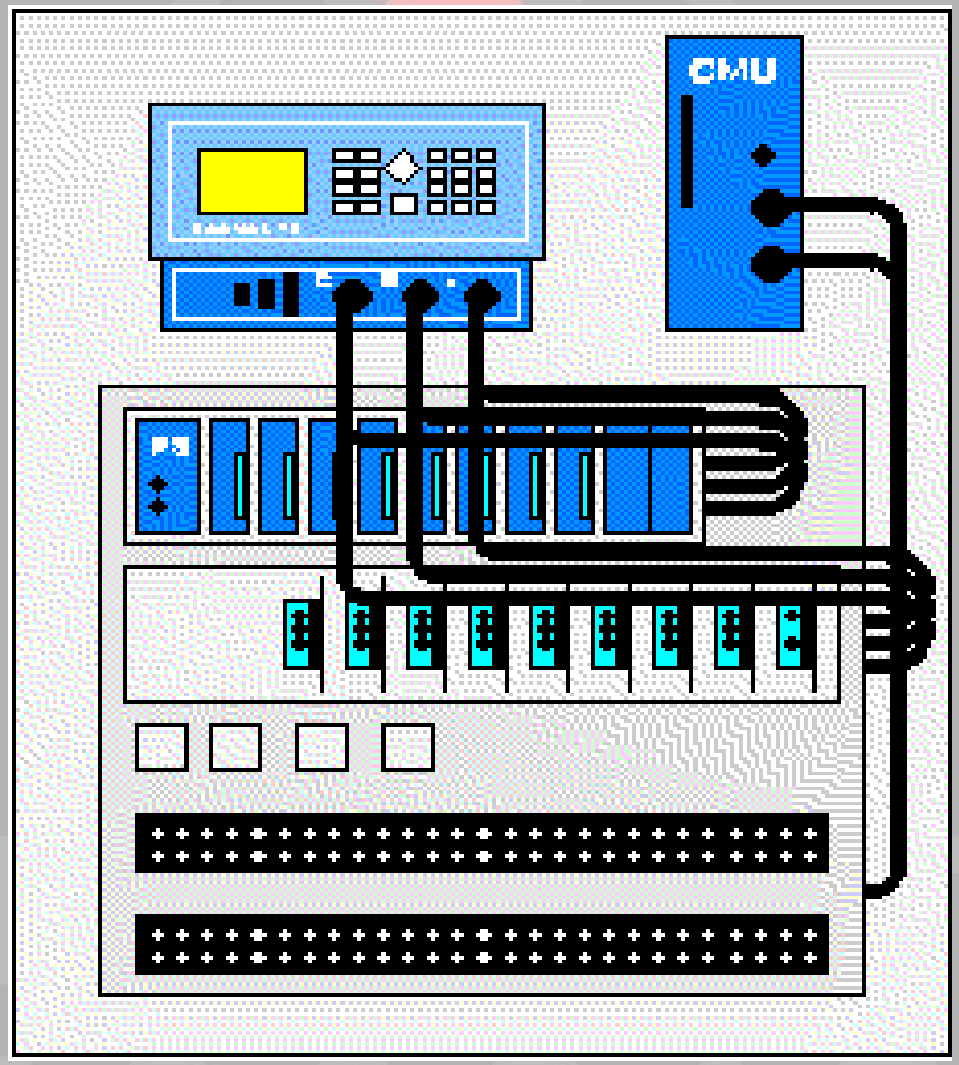


TS1 CABINET CONFIGURATION



TS2 CABINET CONFIGURATION

TS1

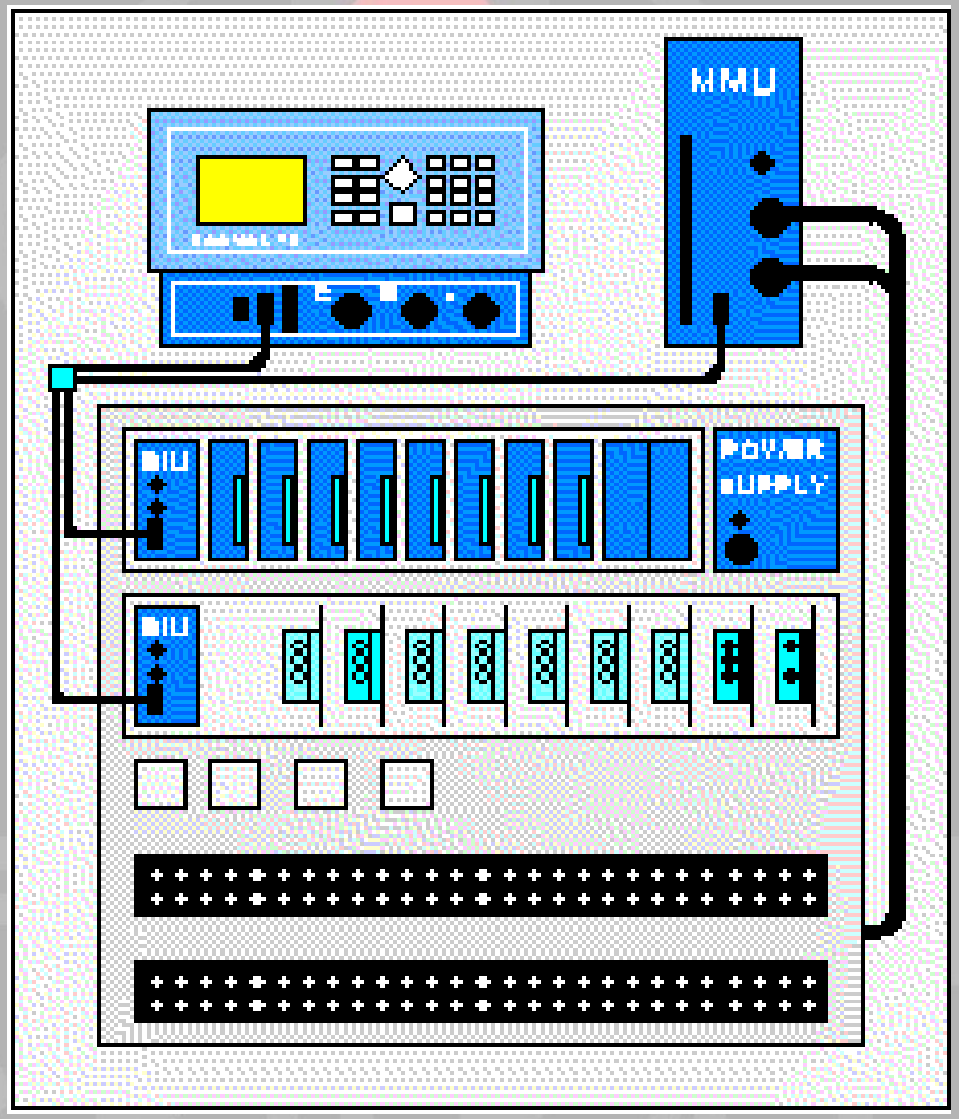


TS1

- **Alarm Inputs & Flash In[illegible] wired to TIO,FOI board “D” connector.**
- **No CMU data available**

the controller

TS2 Type 1



TS2

- **Alarm Inputs & Flash Inputs come in through BIU's**
- **MMU is connected to controller to pass flash data**

What if I want MMU data and I have a TS1 cabinet???

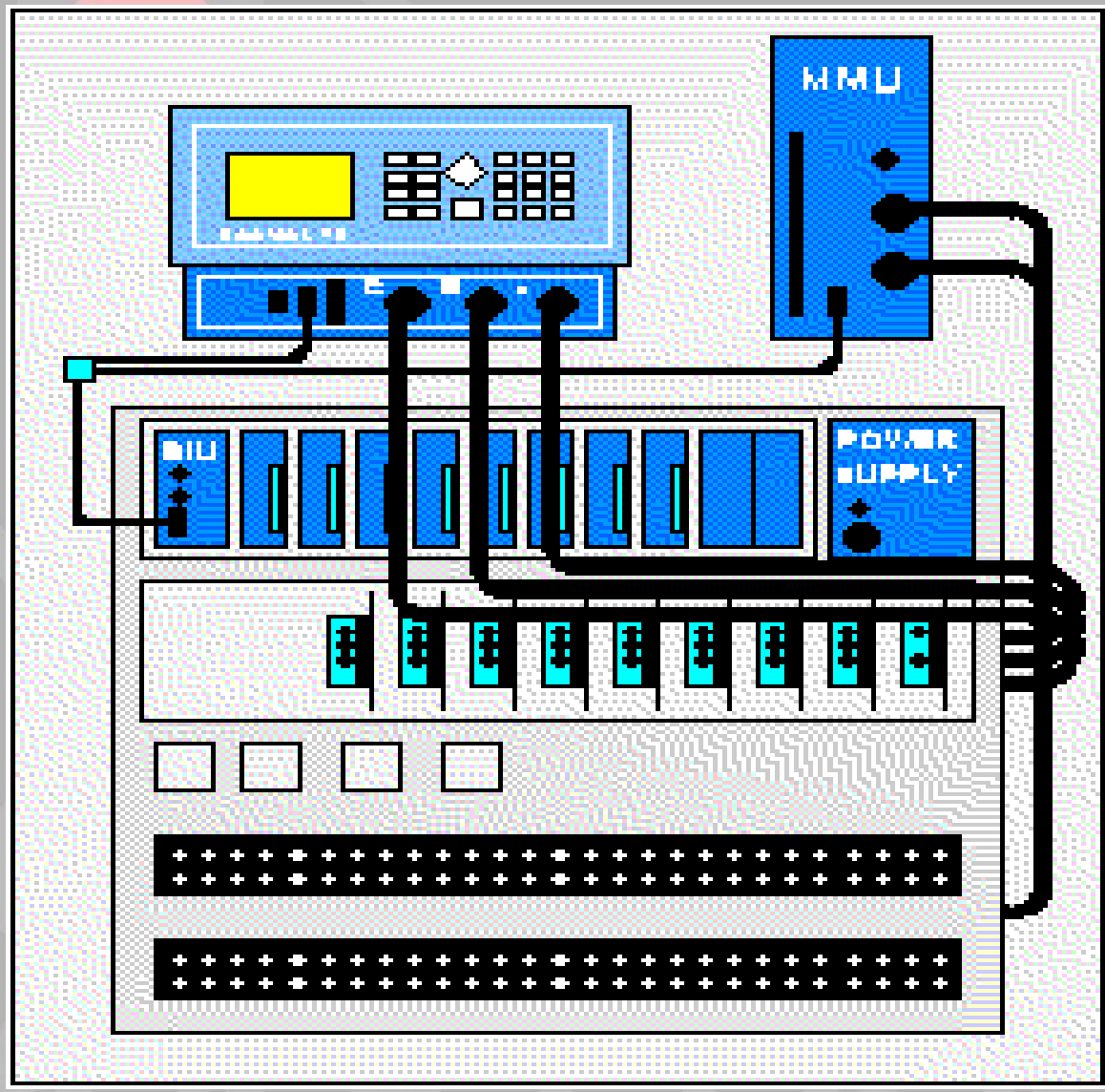
- **Buy a TS2 cabinet!!!**
- **How about a TS2 – Type 2 cabinet modify???**

TS2 Type 2

-Remove CMU and install a MMU

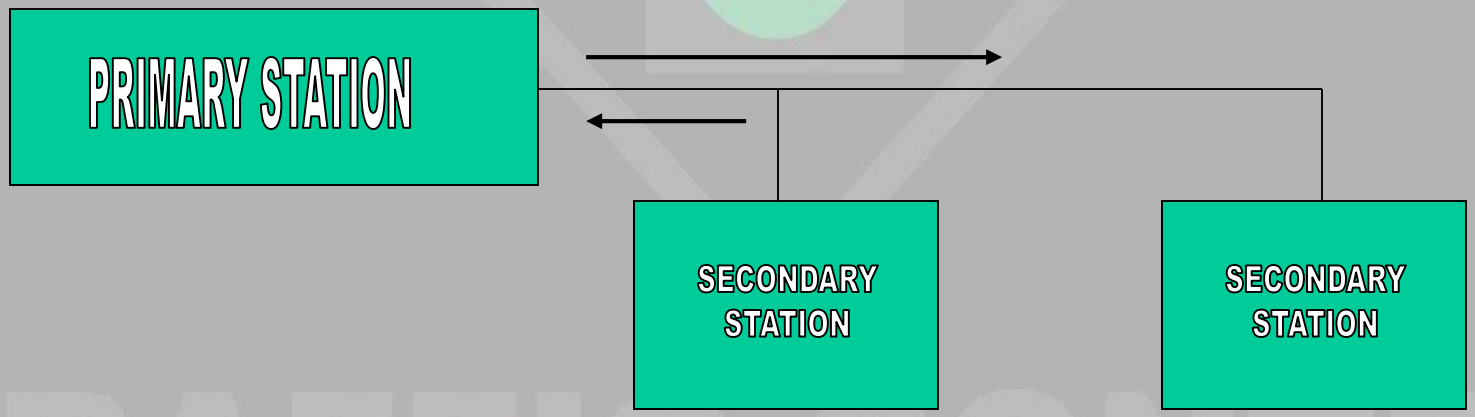
-Add an SDLC cable between Controller and MMU

-Option to add a TS2 Detector Rack for full TS2 detectors.



SDLC TECHNOLOGY

- Synchronous Data Link Control
- Unbalanced/Full Duplex
- Point to Point or Multipoint
- 153,600 bps



But what does all this mean?

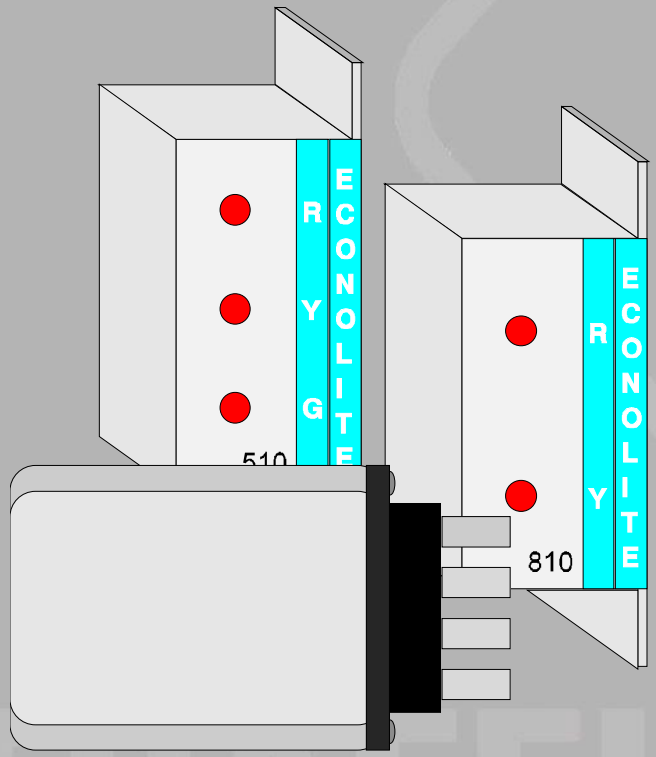
- **Simplified Cabinet Wiring**
  - **15 wire SDLC bus replaces 171 wire A, B, and C cables**
- **Program Verification**
  - **Controller and MMU verify each others program every 100msec**
- **Redundant MMU Function**
  - **A TS2 controller can put the intersection into flash if the MMU fails**

- **Clearance Time Monitoring**
  - **The MMU times the interval between conflicting greens and yellow clearance time**
- **AC Power Monitoring**
  - **The MMU monitors incoming power for low voltage and brownout conditions**
- **Logging By Controller**
  - **Detector Report**
  - **Events Report**
  - **MMU Report**

TS2 DETECTION UPGRADES

- **Makes provisions for 64 detectors**
  - **The TS1 standard only has 8**
- **Detector Health Monitoring**
  - **Normal Operation**
  - **Watchdog Failure**
  - **Open Loop**
  - **Shorted Loop**
  - **Excessive Change in Inductance**
- **Failed Detectors**
  - **TS2 detectors ALWAYS fail on and report failure to the controller**

TS2 cabinet components:
Load Switches, Flasher & Flash Transfer Relays



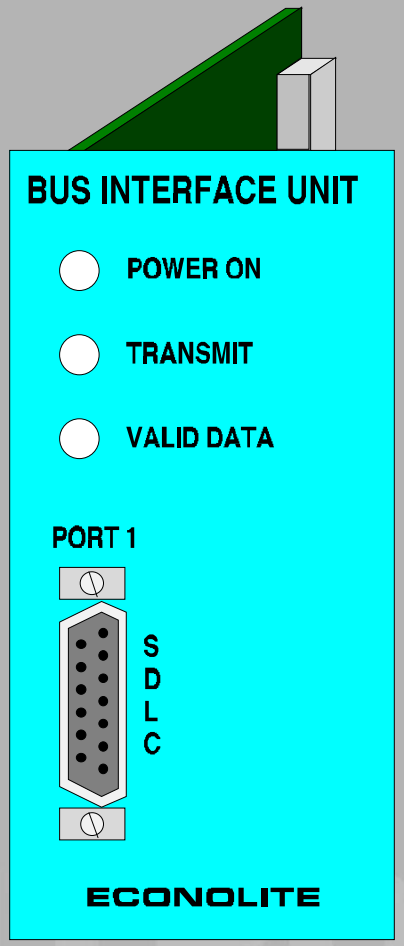
- Downward-compatible with TS1
- TS2 load switch has peak leakage of 10 mA
- TS2 flasher & flash transfer relay operate at 89 VAC

TS2 cabinet components: Bus Interface Unit (BIU)

- Interfaces detector racks & terminals & facilities to SDLC bus in Type 1 mode
- 15-pin D connector on front panel to SDLC bus
- 64-pin DIN connector to backplane

I/O includes:

- 8 inputs
- 4 opto-isolated inputs
- 24 remappable input/outputs
- 15 outputs
- 4 address select inputs



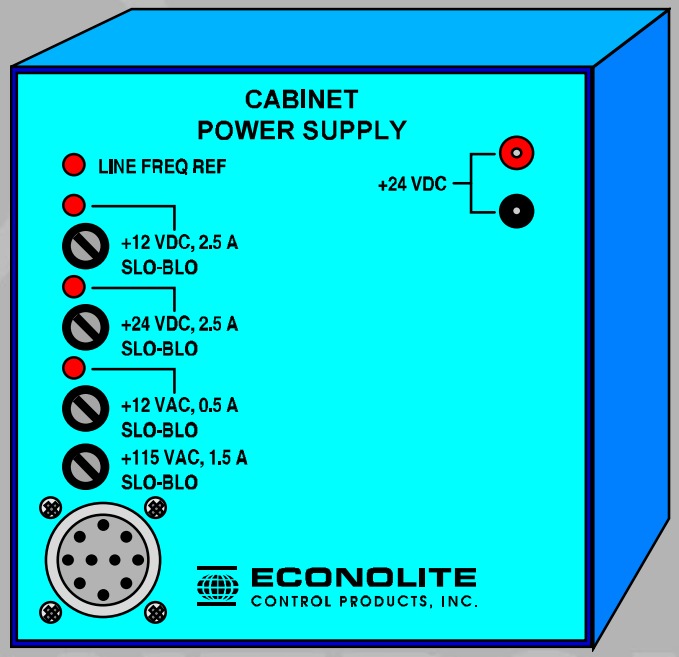
TS2 cabinet components: Understanding BIUs

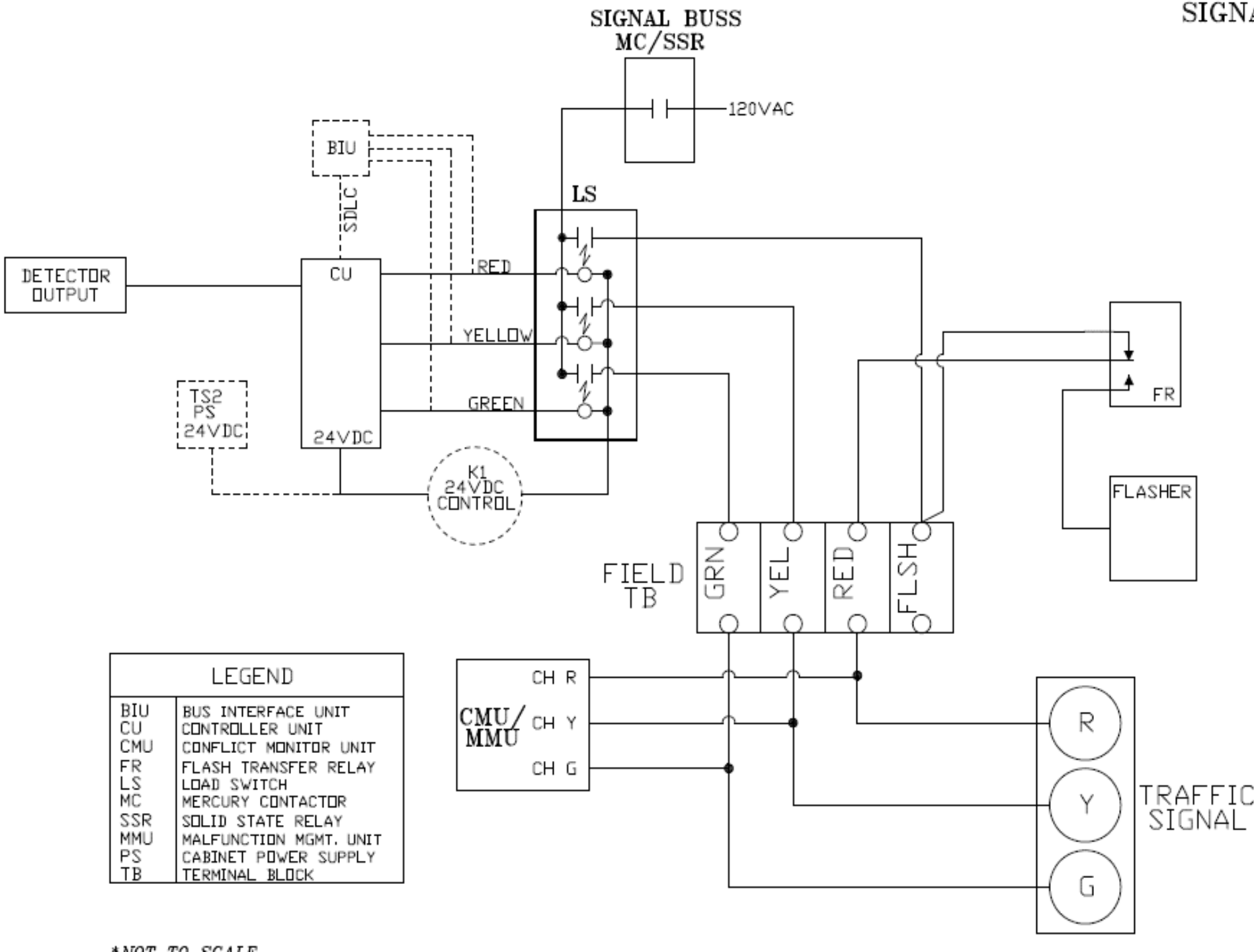
- **BIU 1: I/O for most 4-phase intersections: 8 load switches, 4 ped pushbuttons, 2 preempt channels...**
- **BIU 2: Augments BIU 1 with I/O for most 8-phase intersections**
- **BIU 3: Signals used in system applications with remote communication units (RCUs)**
- **BIU 4: Seldom-used I/O signals**
- **BIUs 9-12: 16 detector channels per BIU, for up to 64 detectors per cabinet**
- **BIUs 5-8 & 13-16: Reserved for TS2 & manufacturer use**

TS2 cabinet components:

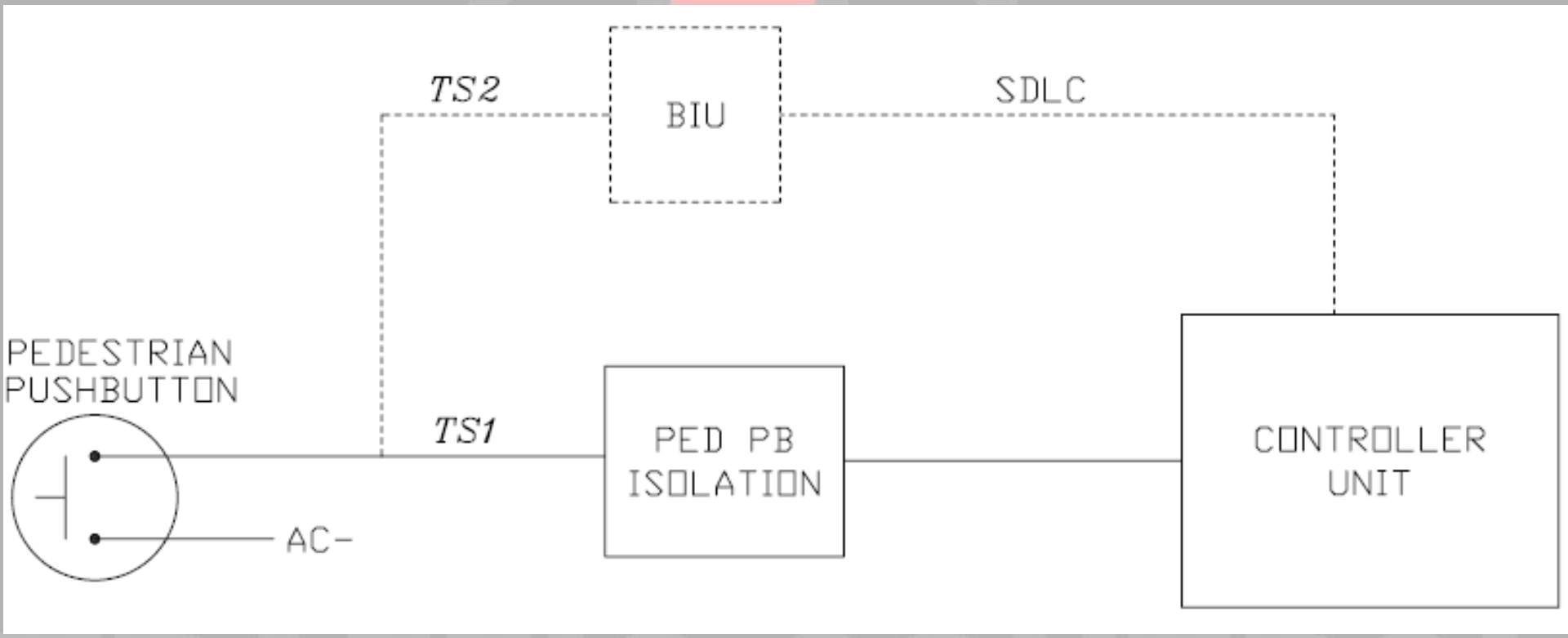
TS2 Cabinet Power Supply

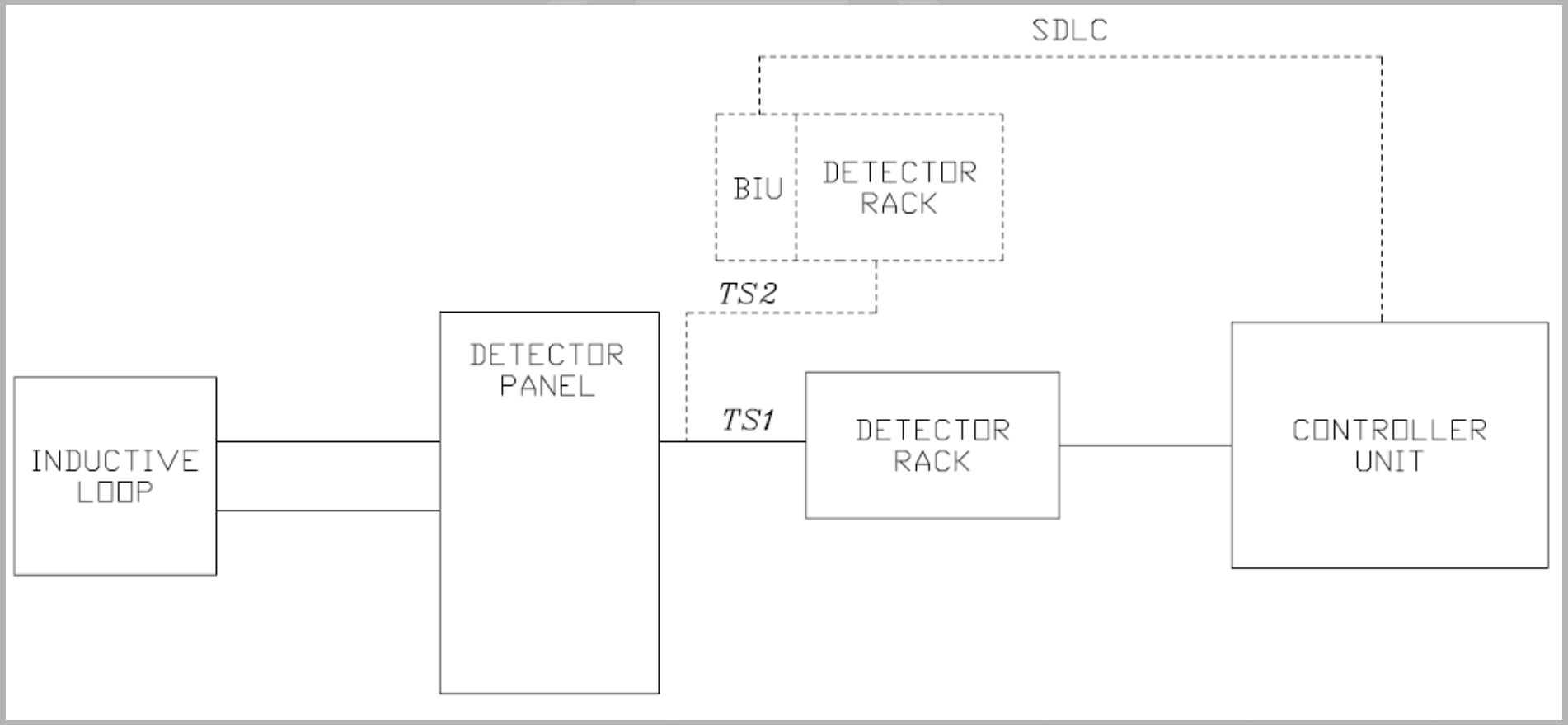
- One required per TS2 cabinet with a BIU.
- Four outputs:
  - 24 VDC to drive load switches & BIUs.
  - 12 VDC to drive TS2 detectors.
  - 12 VAC for isolated inputs.
  - 60 Hz timing reference for BIUs.
- LED lamp for each output.
- Fuses for AC power input & power outputs.

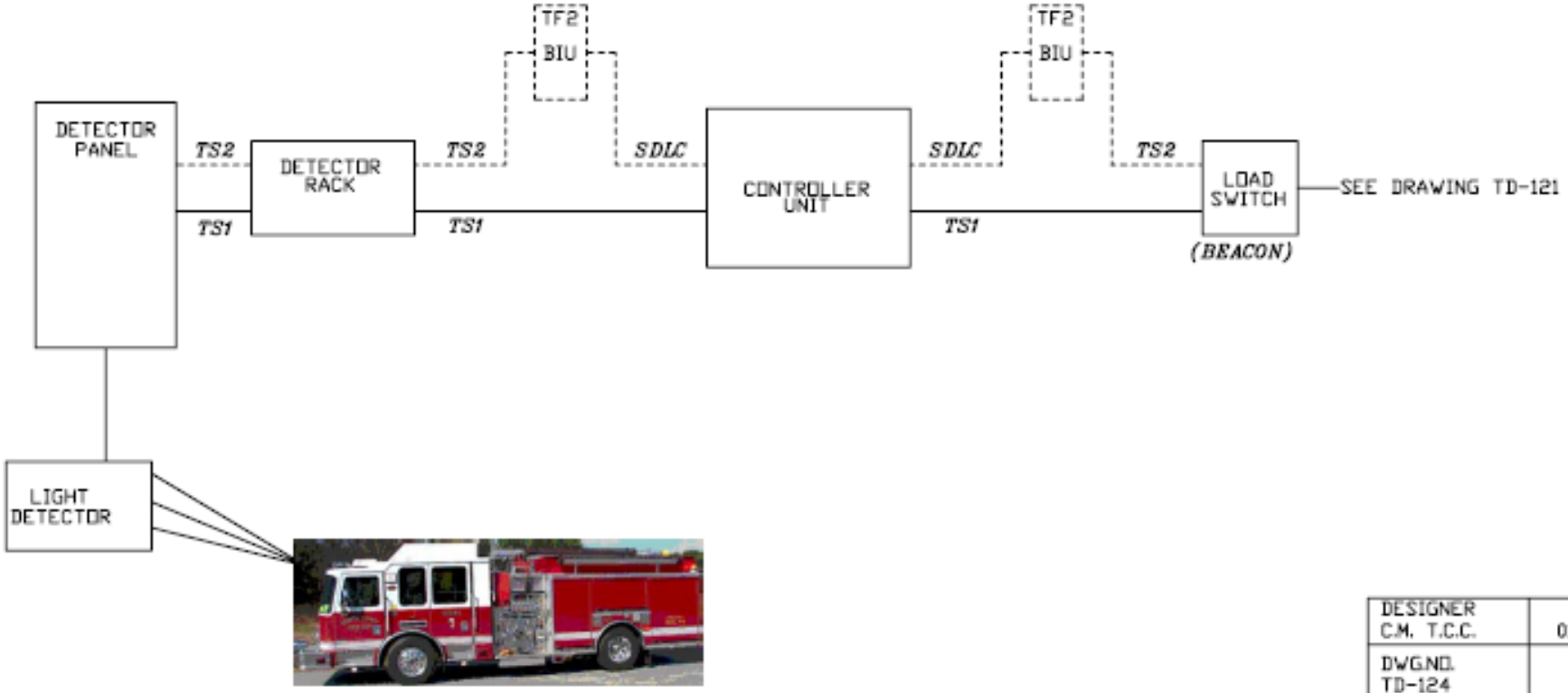



SIGNAL BUSS
MC/SSR
SIGNA
120VAC
BIU
SDLC
LS
DETECTOR
OUTPUT
CU
RED
YELLOW
GREEN
TS2
PS
24VDC
24VDC
K1
24VDC
CONTROL
FR
FLASHER
FIELD
TB
GRN
YEL
RED
FLSH
CMU/
MMU
CH R
CH Y
CH G
R
Y
G
TRAFFIC
SIGNAL
LEGEND
BIU BUS INTERFACE UNIT
CU CONTROLLER UNIT
CMU CONFLICT MONITOR UNIT
FR FLASH TRANSFER RELAY
LS LOAD SWITCH
MC MERCURY CONTACTOR
SSR SOLID STATE RELAY
MMU MALFUNCTION MGMT. UNIT
PS CABINET POWER SUPPLY
TB TERMINAL BLOCK

*NOT TO SCALE


TS2
BIU
SDLC
PEDESTRIAN
PUSHBUTTON
TS1
PED PB
ISOLATION
CONTROLLER
UNIT
AC-

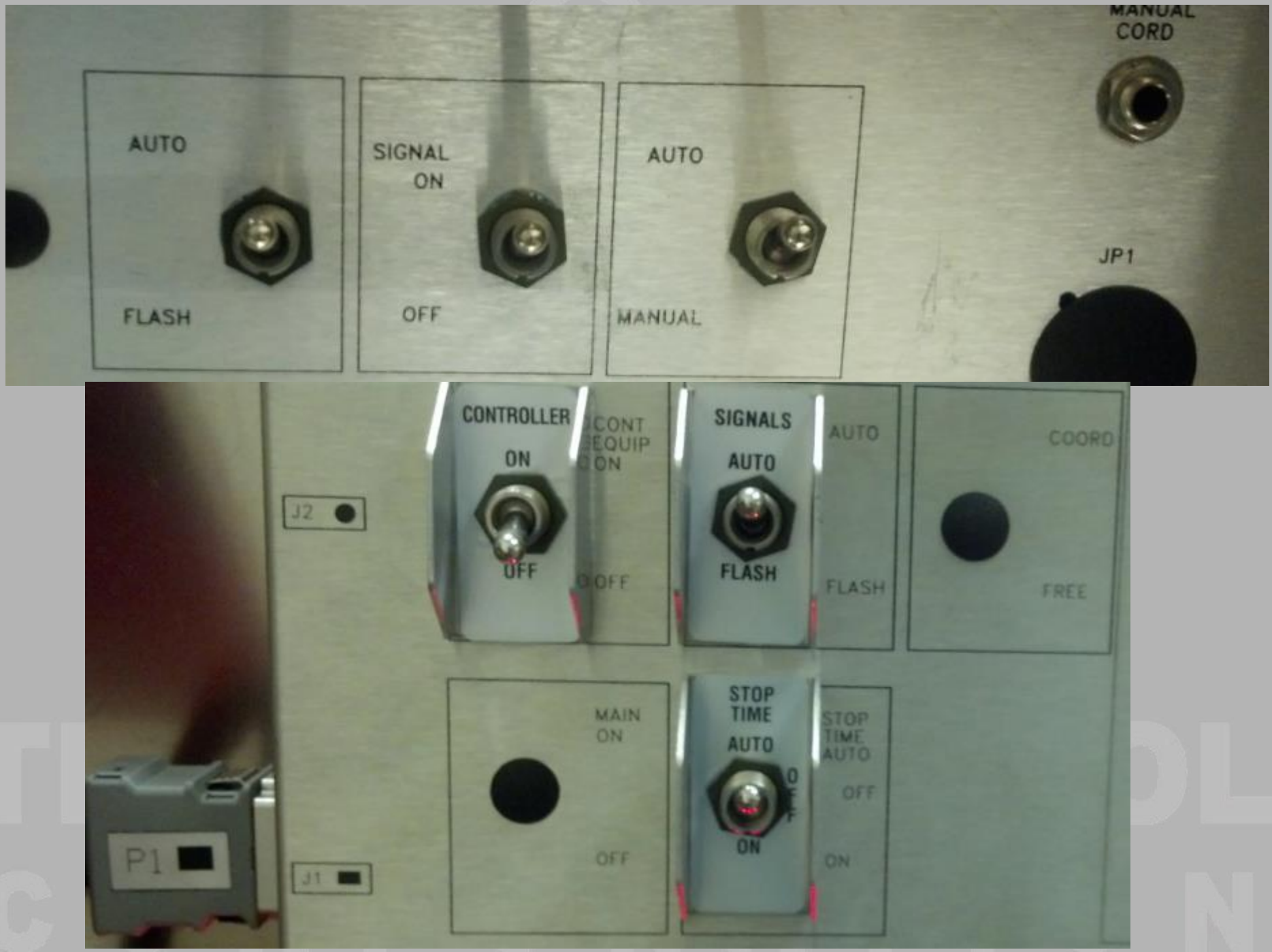




DESIGNER C.M. T.C.C.	DATE 01/02/04
DWG.NO. TD-124	
REV. B	DATE 01/07/10

MP:FL1-11
(MAIN HOT)
MP:LS3-1
MP:LS7-1
MP:LS15-1
SIGNAL BUS)
MC
RC
CB2
40A
LOAD
OUT
LINE
IN
RIS
50A
GND.
CB3
10A
SA:TB2-1
SA-AC+
CB1
50A
J2-4 (AC+ LTS. CONTROL)
SA:TB2-4
P2 J2
PB-8 4 MC-2
PB-9 2 SA:TB2-3
PB-12 3 SA:TB2-2
PB-10 1 SA:TB2-4
GB2
MP:FL1-9
GL
(MAIN NEUT)
MP:FL1-10
SA- AC-
GB1
501
502
GB2
GL
LINE NEUT ERTH
115 V., 60 HZ.
AC SERVICE
F1
15 AMP
SA-GND
GFI-G
GB2
J1
3
1
2
GB1
G
B
W
GFI

PWR PNL TO PB P2 C/C 34842G8		
PIN	FUNCTION	TO
1	AC NEUTRAL	PB-10

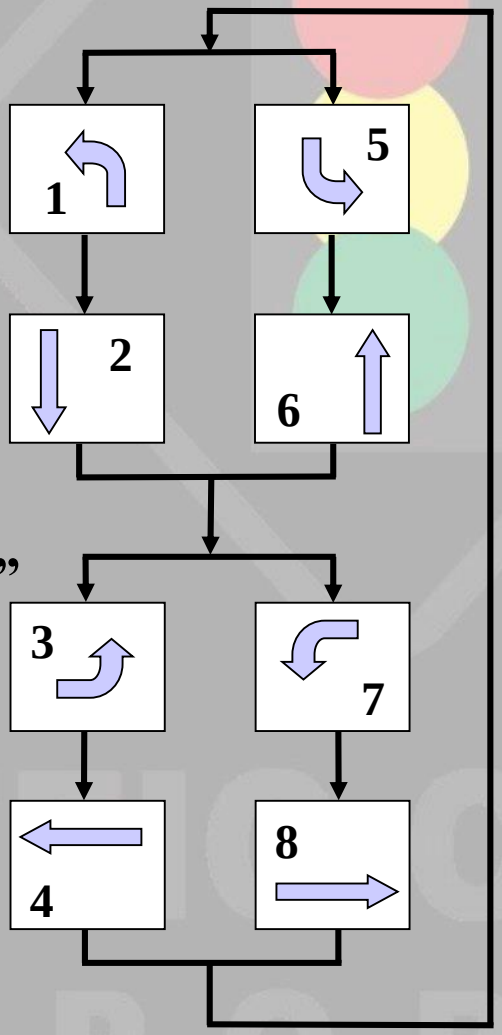

MANUAL
CORD
AUTO
FLASH
SIGNAL
ON
OFF
AUTO
MANUAL
JP1
CONTROLLER
ON
OFF
CONT
EQUIP
ON
OFF
SIGNALS
AUTO
FLASH
AUTO
FLASH
COORD
FREE
J2
MAIN
ON
OFF
STOP
TIME
AUTO
ON
OFF
STOP
TIME
AUTO
OFF
ON
P1
J1

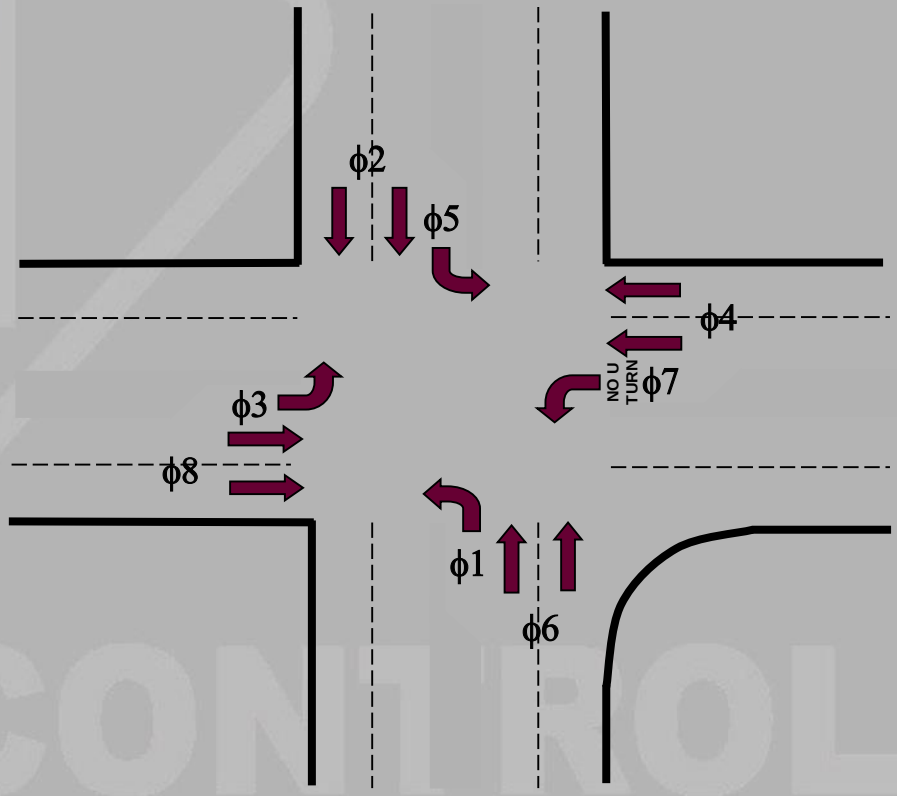
CONTROLLER PROGRAMMING

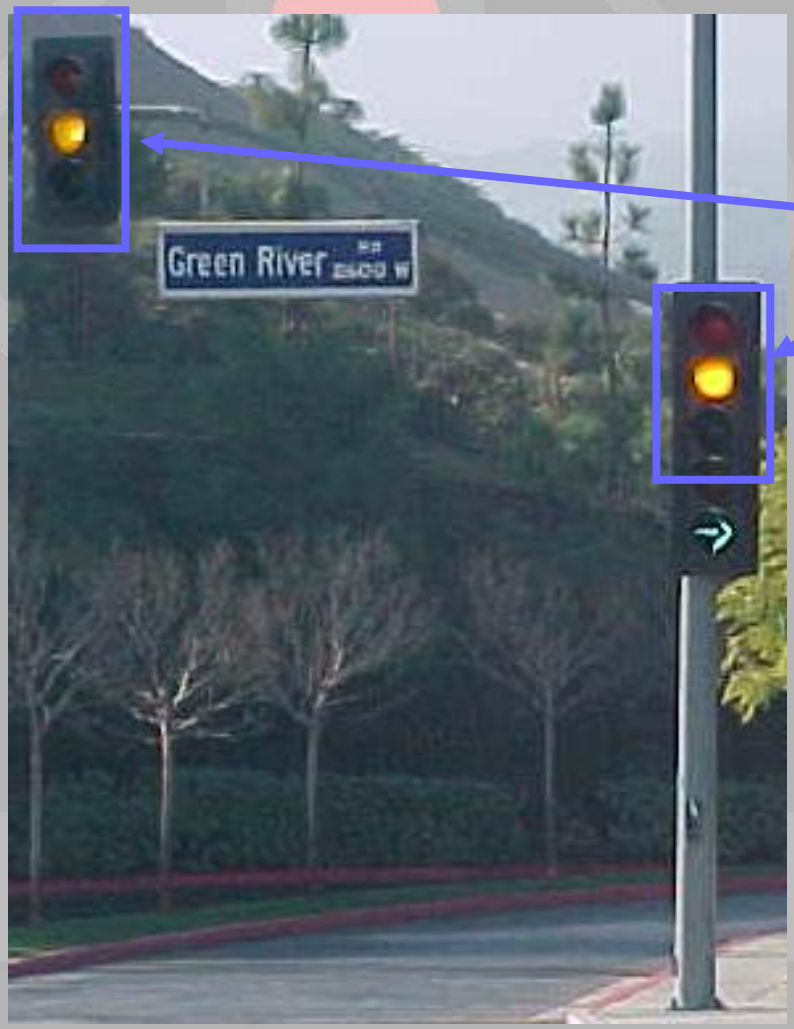
PHASE: Any combination of traffic movements receiving right-of-way simultaneously during one or more intervals

- Vehicular Phases
- Pedestrian Phases

STANDARD NEMA PHASING "QUAD CONFIGURATION"



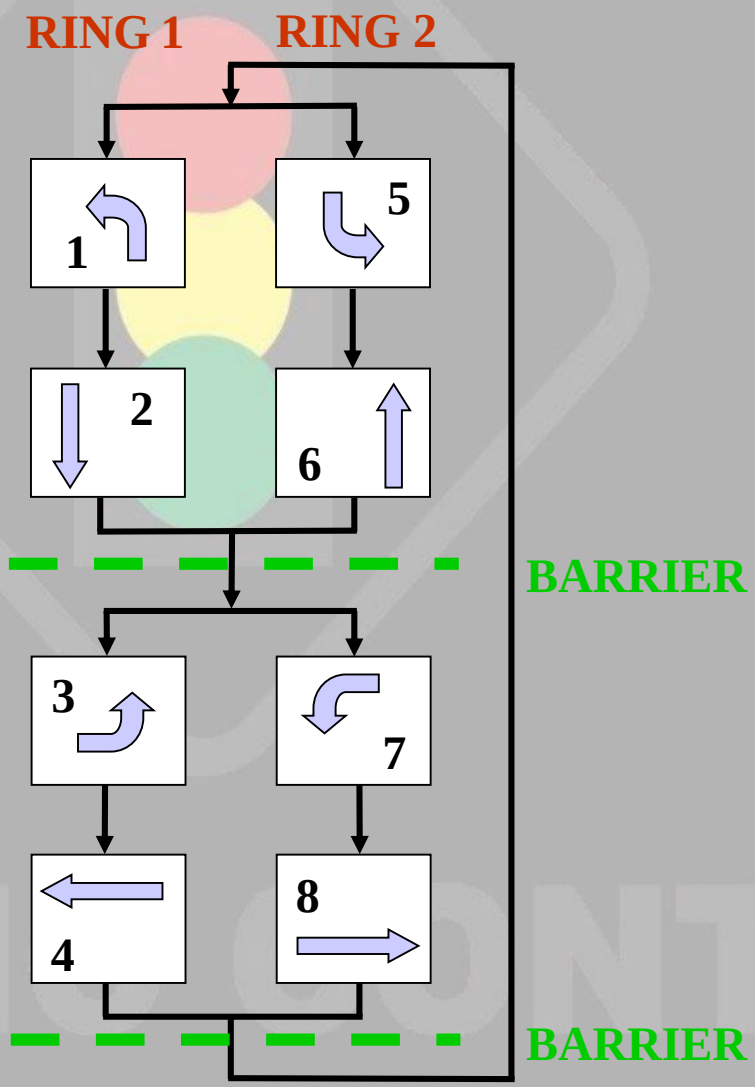



Green River
VEHICLE PHASE 6

RING: Consists of one or more sequentially timed, conflicting phases, arranged to time in a pre-established order.

BARRIER: A reference point in the preferred sequence of a multi-ring controller at which all rings are interlocked. Barriers assure there will be no concurrent selection and timing of conflicting phases for traffic movements in different rings. All rings cross the barrier simultaneously to select and time phases on the other side.

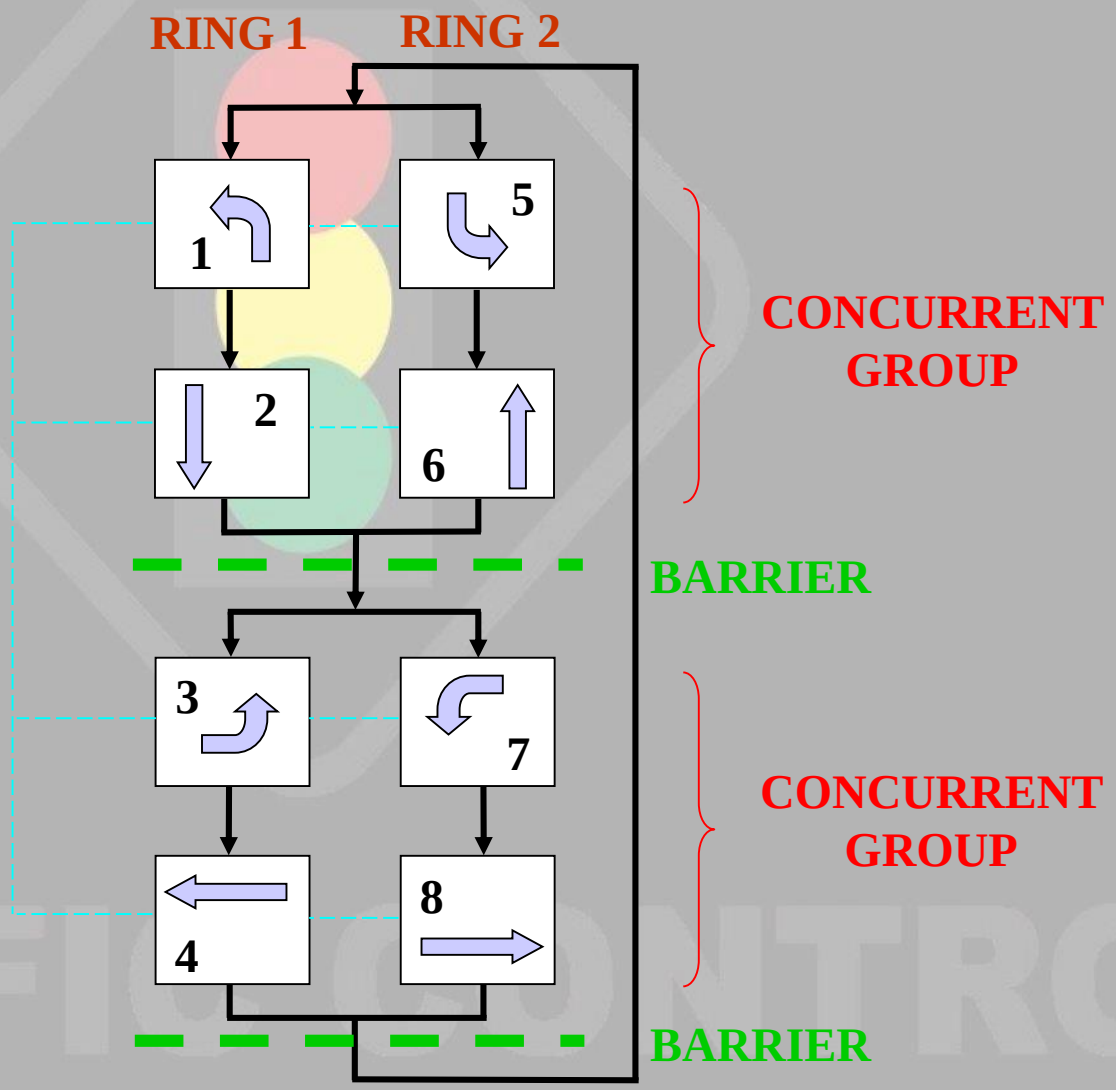
STANDARD NEMA PHASING "QUAD CONFIGURATION"



CONCURRENT GROUPS: All of the phases between two barriers. Typically, they are the left turn and through movements on a single street.

PRIORITY GROUPS: Phase Priority assignment which determines the sequence the controller will follow to service calls.

STANDARD NEMA PHASING "QUAD CONFIGURATION"



INTERVAL: Portions of the time Cycle

- VEHICLE MINIMUM GREEN
- PEDESTRIAN WALK
- PEDESTRIAN CLEARANCE
- VEHICLE EXTENSION (PASSAGE)
- MAX GREEN (1, 2, OPTIONAL 3)
- GREEN REST / GREEN TRANSFER
- YELLOW CLEARANCE
- RED CLEARANCE

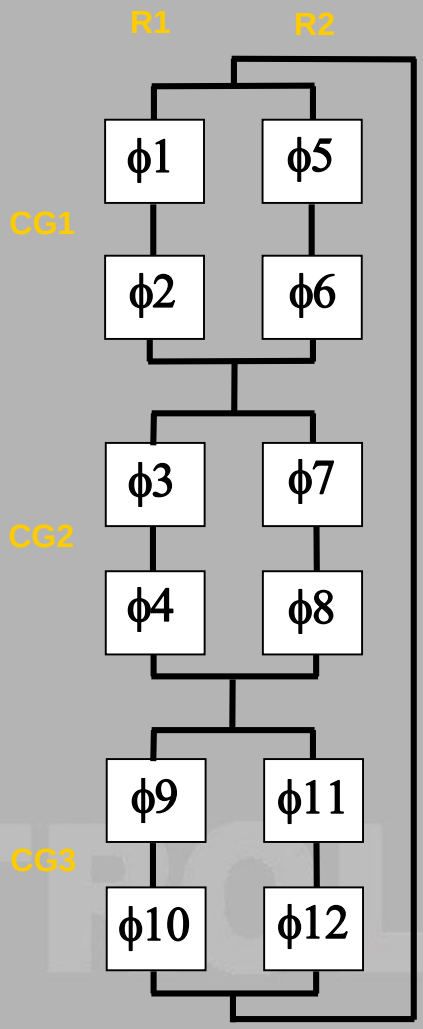
CONFIGURATION SUBMENU (MAIN MENU - 1)

- RING STRUCTURE
- PHASES IN USE
- EVENT LOGGING

```
            CONTROLLER SEQUENCE

     ------------ PRIORITY ------------
                                    1  1  1
     1..2..3..4..5..6..7..8..9..0..1..2
R1   1  2| 3  4| 9 10| 0  0  0  0  0  0
R2   5  6| 7  8|11 12| 0  0  0  0  0  0
CG    .  ^  .  ^  .  ^  .  .  .  .  .  .


R1,R2 = RING 1 AND 2 PHASE ASSIGNMENT.

CG    = BARRIER LOCATION BETWEEN
        CONCURRENT PHASE TIMING GROUPS

END OF SUBMENU
```

Defines the standard phase sequence

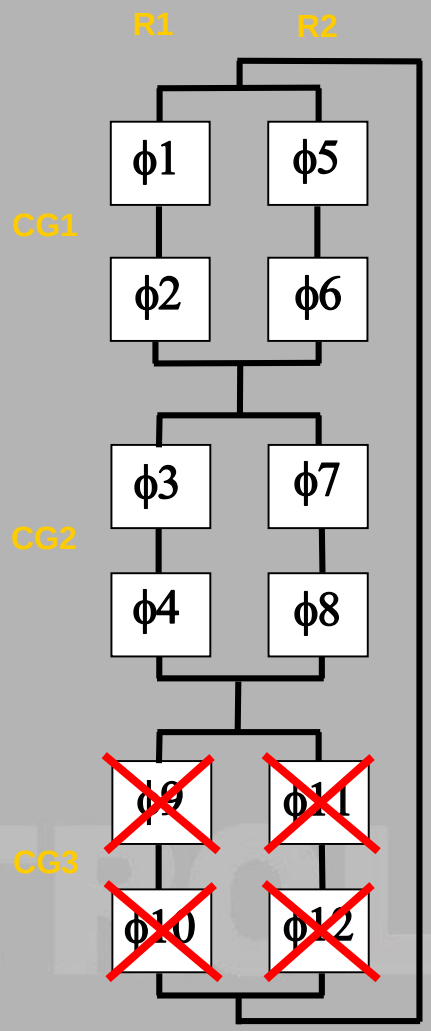
```
CONTROLLER SEQUENCE [ 1]                >
SEQUENCE COMMANDS    . HW ALT SEQ ENA.YES
    01 02 03 04 05 06 07 08 09 10 11 12
BC-   C  C  C  C  C  C  C  C  C  C  C  C
R1-  1  2  3  4  9 10 13 14  .  .  .  .
R2-  5  6  7  8 11 12 15 16  .  .  .  .
R3-  .  .  .  .  .  .  .  .  .  .  .  .
R4-  .  .  .  .  .  .  .  .  .  .  .  .

R1-R4=RING 1-4, DATA ENTRY, PHASES 1-16
BC=BARRIER CONTROL, VALUES: B,C
B=BARRIER MODE
C=COMPATIBILITY MODE
```



Defines which phases are active in the sequence

```
                PHASES IN USE

                    ----- PHASE NUMBER ----
                                        1 1 1
                    1 2 3 4 5 6 7 8 9 0 1 2
PHASES IN USE       X X X X X X X X . . . .
EXCLUSIVE PED       . . . . . . . . . . . .




END OF SUBMENU
```

```
PHASES IN USE / EXCLUSIVE PED
              PHASE  1  2  3  4  5  6  7  8
IN USE.......       X  X  X  X  X  X  X  X
EXCLUSIVE PED       .  .  .  .  .  .  .  .

              PHASE  9 10 11 12 13 14 15 16
IN USE.......       .  .  .  .  .  .  .  .
EXCLUSIVE PED       .  .  .  .  .  .  .  .
```



```
                ENABLE EVENT LOGS

CRITICAL RFE'S (MMU/TF) . . . . . .
NON-CRITICAL RFE'S (DET/TEST) . . .
DETECTOR ERRORS . . . . . .
COORDINATION ERRORS . . . . . .   X
MMU FLASH FAULTS  . . . . . .
LOCAL FLASH FAULTS  . . . . . .
PREEMPT . . . . . .   X
POWER ON/OFF  . . . . . .   X
LOW BATTERY . . . . . .
SPARE . . . . . .
ALARM 1 . . . . . .
ALARM 2 . . . . . .
ALARM 3 . . . . . .
ADDITIONAL SCREEN(S)
```

Specifies which controller events will be logged. As the event occurs, a descriptive message is logged along with the date and time of the occurrence.

```
EVENT LOGGING                                   v
RFEs (MMU/TF).. YES 3 RFEs >24 H.... YES
MMU FL FAULTS.. YES LOCAL FLASH..... YES
RFEs (DET/TEST) YES DETECTOR ERRORS. YES
COORD ERRORS... YES CTR DOWNLOAD.... YES
PREEMPT........ YES TSP............. YES
POWER ON/OFF... YES LOW BATTERY..... YES
ACCESS......... YES DATA CHANGE..... YES
ALARM 1........ YES ALARM 2......... YES
ALARM 3........ YES ALARM 4......... YES
ALARM 5........ YES ALARM 6......... YES
ALARM 7........ YES ALARM 8......... YES
ALARM 9........ YES ALARM 10........ YES
ALARM 11....... YES ALARM 12........ YES
ALARM 13....... YES ALARM 14........ YES
ALARM 15....... YES ALARM 16........ YES
```

CONTROLLER SUBMENU (MAIN MENU - 2)

- TIMING DATA
- RECALL DATA
- OVERLAP DATA

CONTROLLER TIMING DATA

PHASE...	1	2	3	4	5	6	7	8
MIN GRN.	2	2	2	2	2	2	2	2
BIKE GRN	0	0	0	0	0	0	0	0
CS MGRN.	0	0	0	0	0	0	0	0
WALK....	0	5	0	5	0	5	0	5
PED CLR.	0	7	0	7	0	7	0	7
VEH EXT.	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
VEH EXT2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAX EXT.	0	0	0	0	0	0	0	0
MAX1....	35	35	35	35	35	35	35	35
MAX2....	40	40	40	40	40	40	40	40
MAX3....	0	0	0	0	0	0	0	0
DET MAX.	0	0	0	0	0	0	0	0

ADDITIONAL SCREEN(S) MORE->

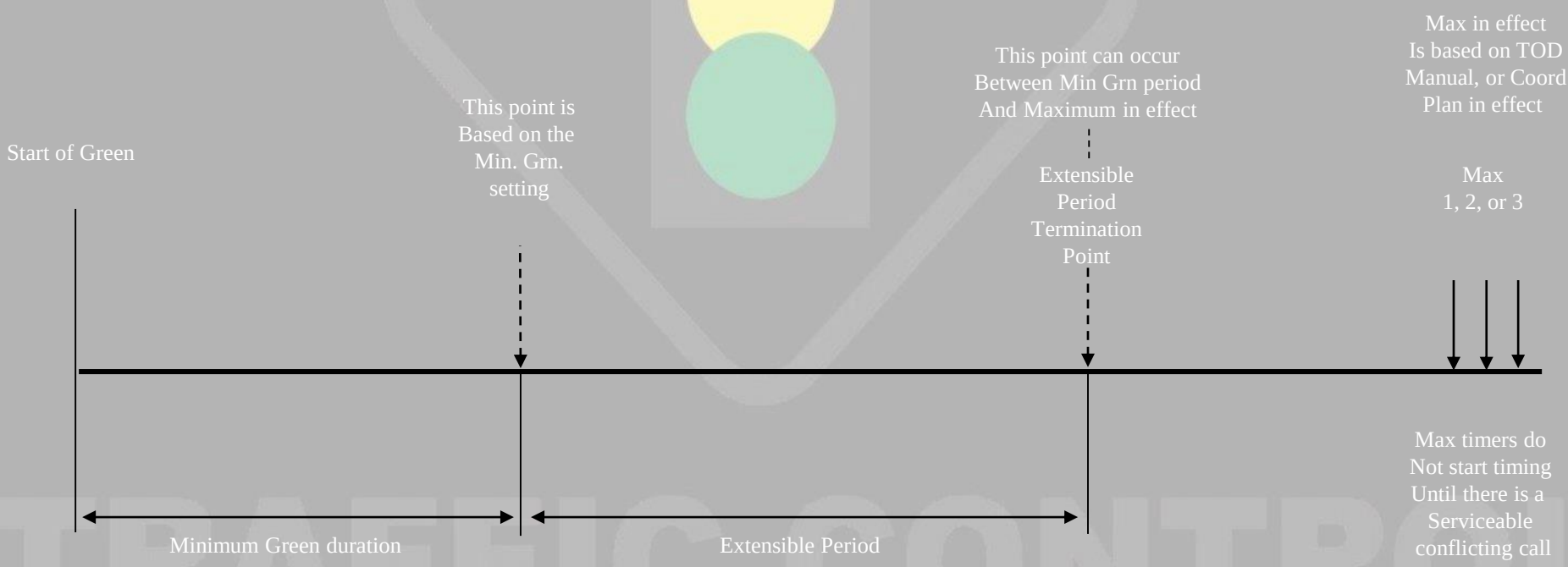
CONTROLLER TIMING DATA

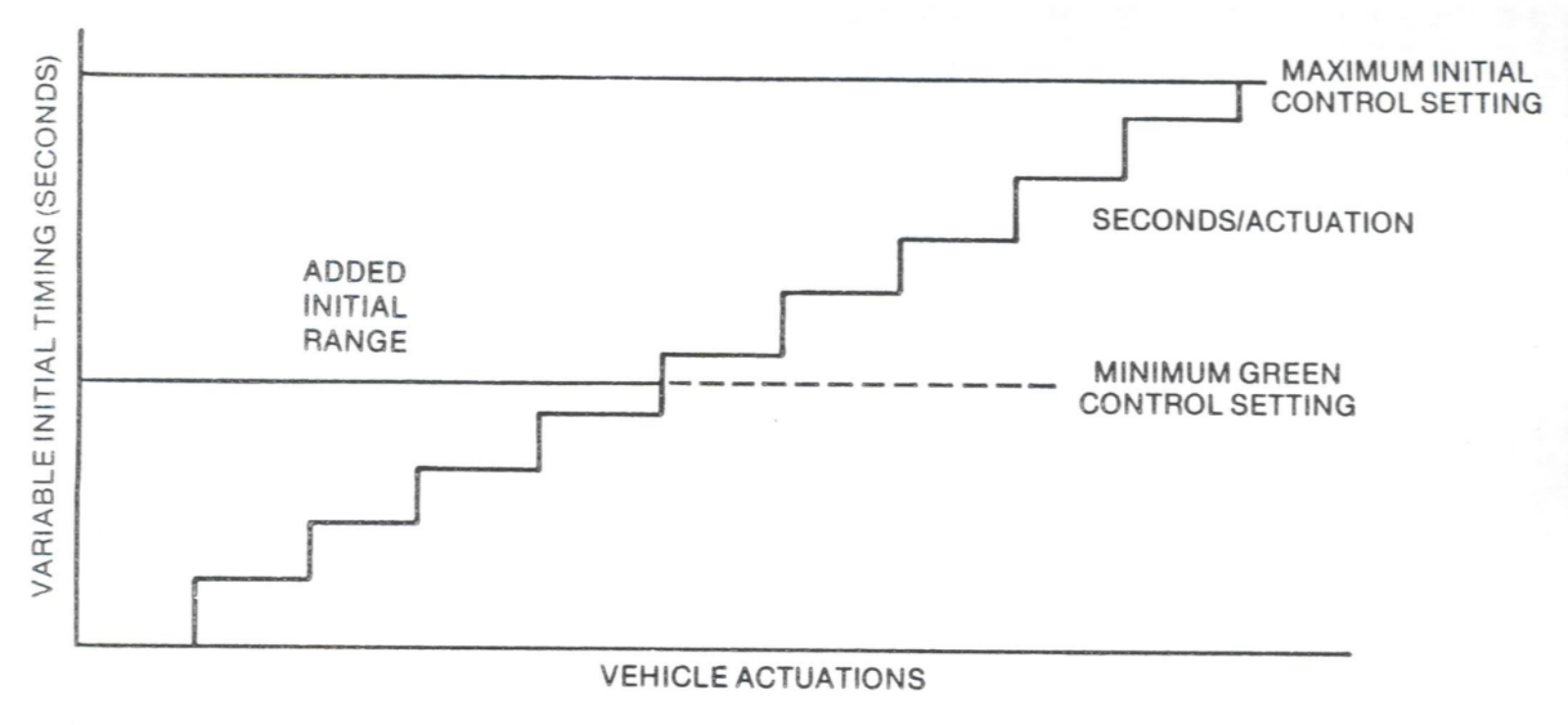
PHASE...	1	2	3	4	5	6	7	8
YELLOW..	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
RED CLR.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
RED RVT.	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
ACT B4..	0	0	0	0	0	0	0	0
SEC/ACT.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAX INI.	30	30	30	30	30	30	30	30
TIME B4.	0	0	0	0	0	0	0	0
CARS WT.	0	0	0	0	0	0	0	0
TTREDUC.	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

END OF SUBMENU MORE->

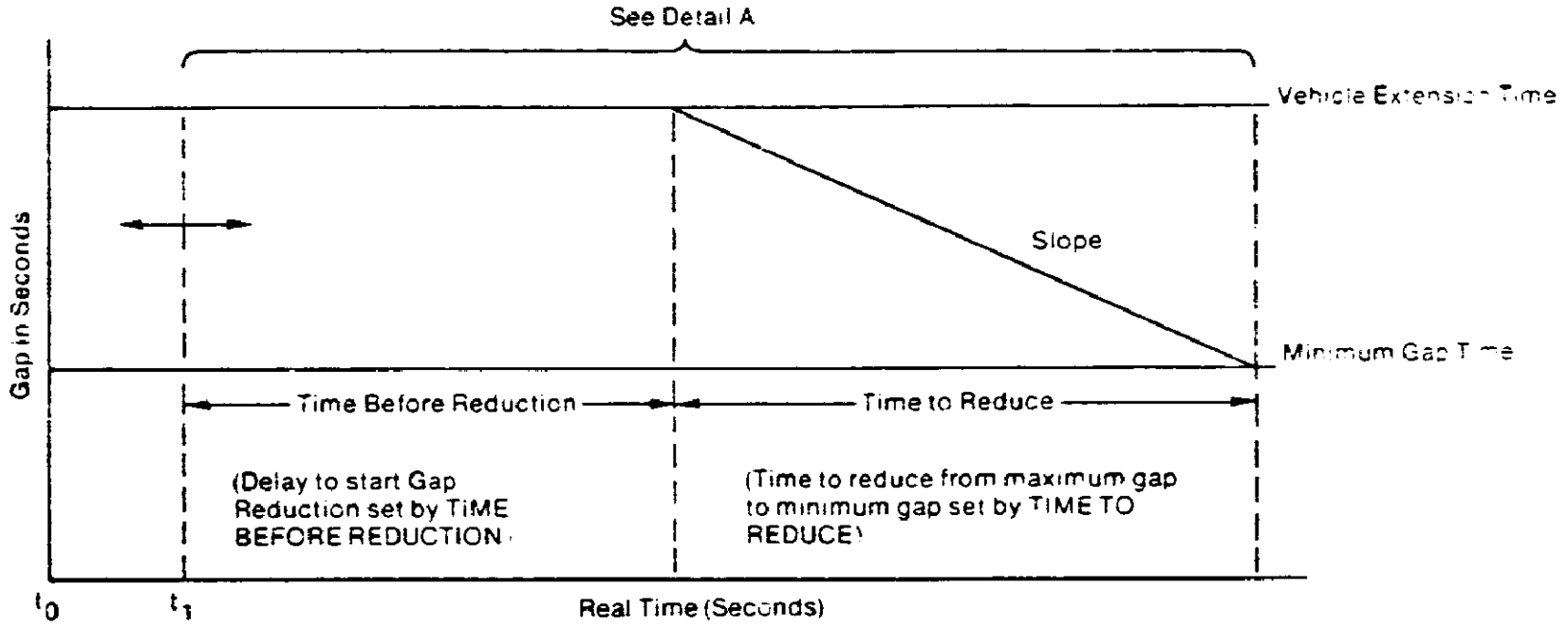
Defines the timing for all basic phase intervals

GREEN INTERVAL OF AN ACTUATED PHASE WITHOUT VOLUME DENSITY





Volume Density: Variable Initial = seconds per actuation X number of actuations.
Actuations Before = number of actuations before time is added to min. green
Seconds/Actuation = how much time is added when you start adding
Max. Initial = how high the Max initial green is allowed to build



t_0 = Start of phase Green

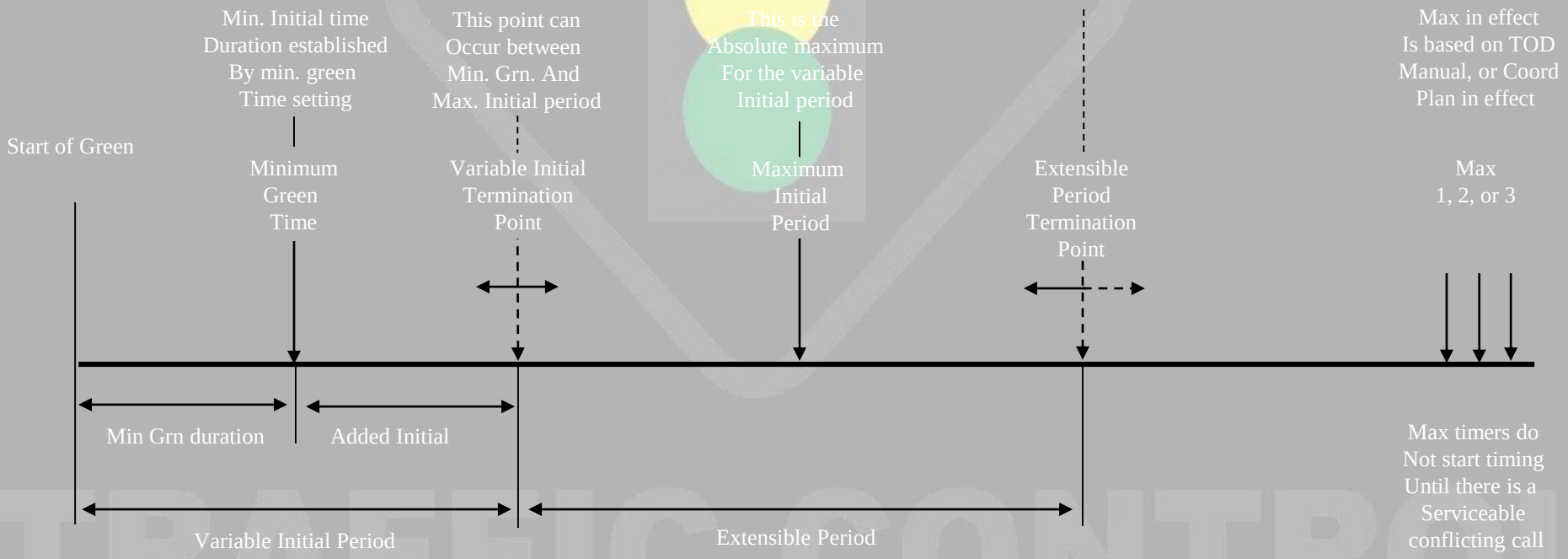
t_1 = Start of Max Timer

t_0 and t_1 may start simultaneously.

Max Timer start is dependent upon phase being in the Green interval and the registration of an opposing vehicle or pedestrian call.

Vehicle Extension Time (Pre-set Gap) portion of Green interval times concurrently with Initial subject to vehicle actuations.

GREEN INTERVAL OF AN ACTUATED PHASE WITH VOLUME DENSITY



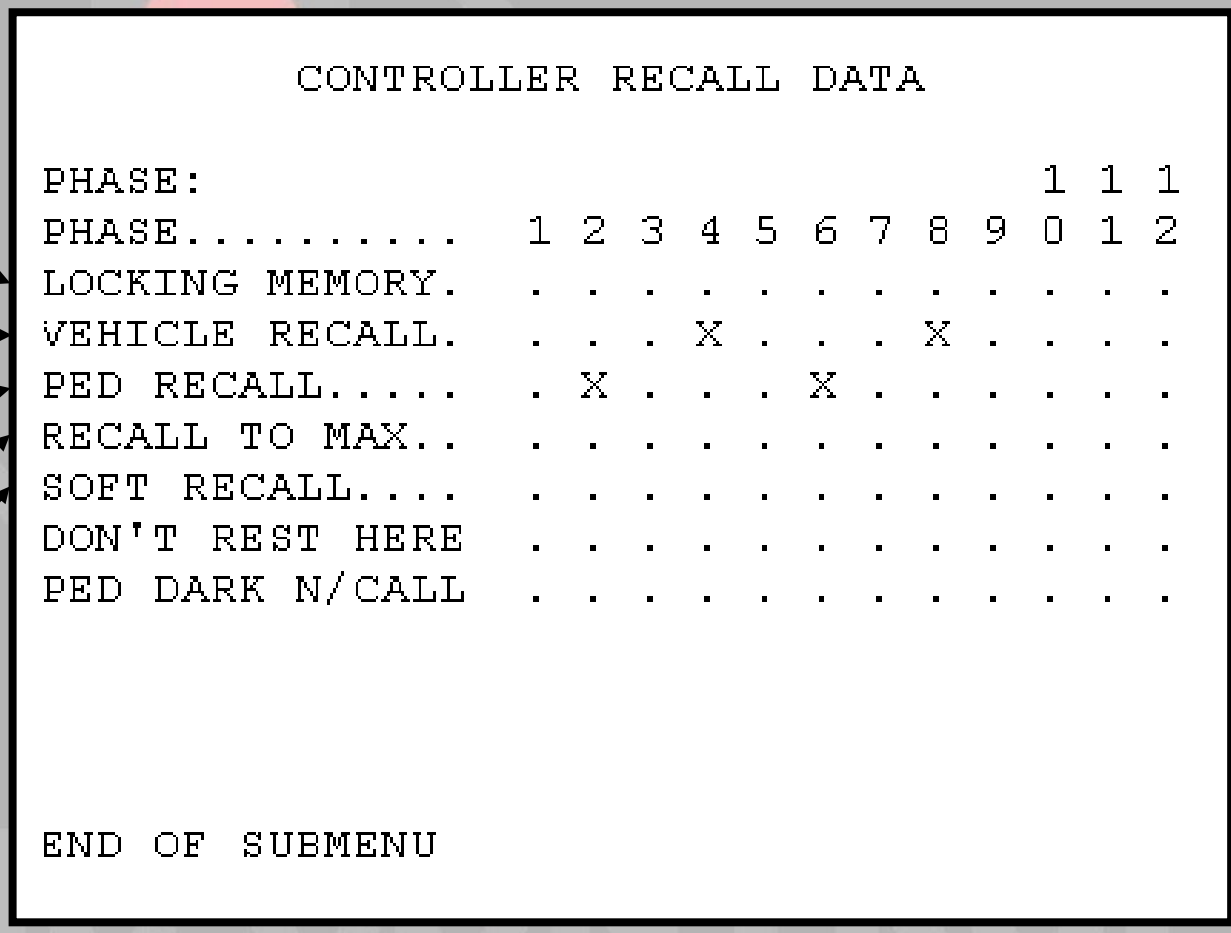
Remembers a vehicle call
Even after the vehicle has
Left the detection zone

Places a call when the
phase is not GREEN

Places a ped call when the
phase is not in WALK

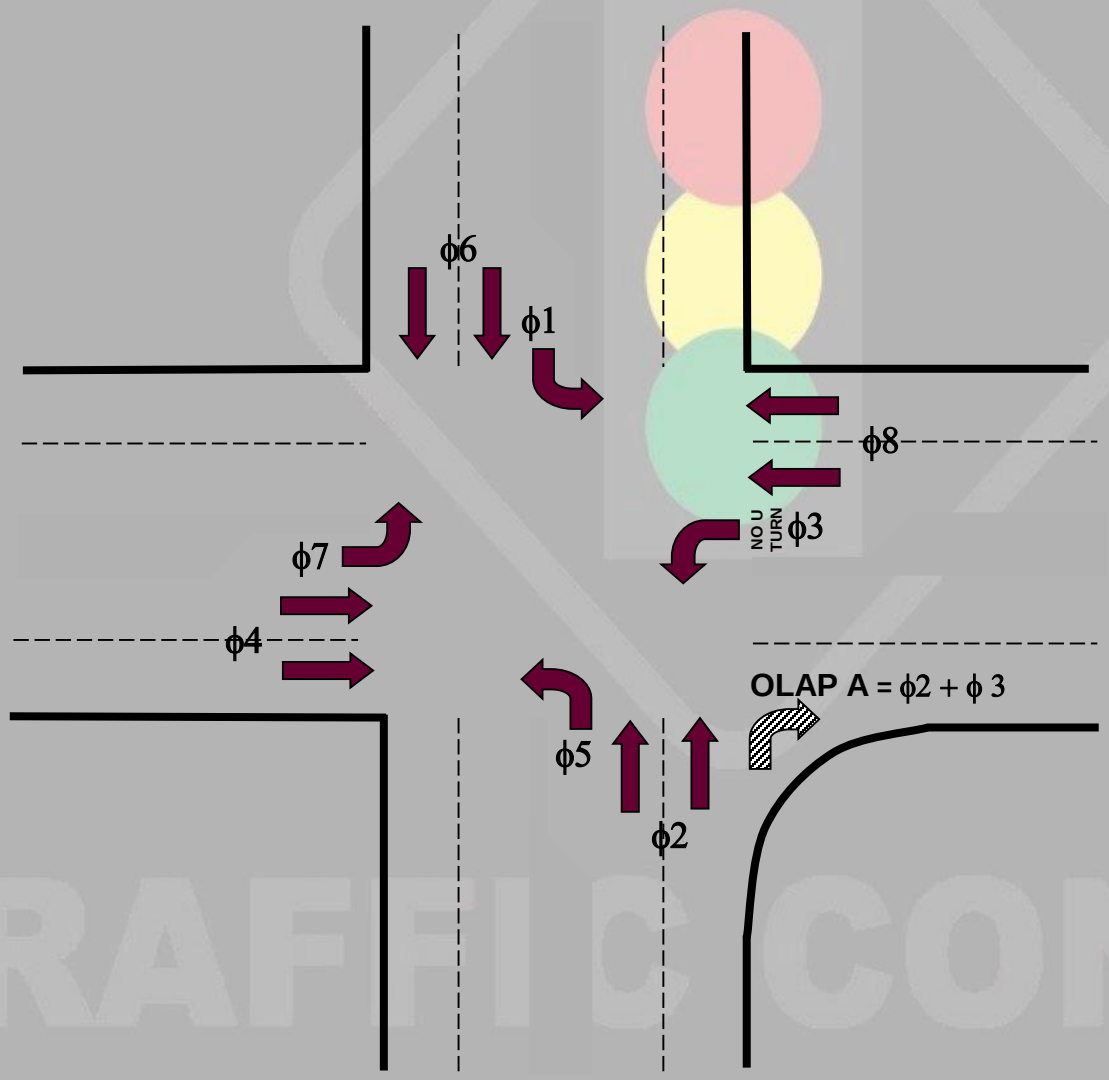
Same as VEHICLE RECALL
+ keeps the phase
GREEN for the MAX time

Places a call on the phase
in the absence of any calls



Defines calls that the controller will place internally (in addition to or in place of calls placed by vehicle / pedestrian detectors)

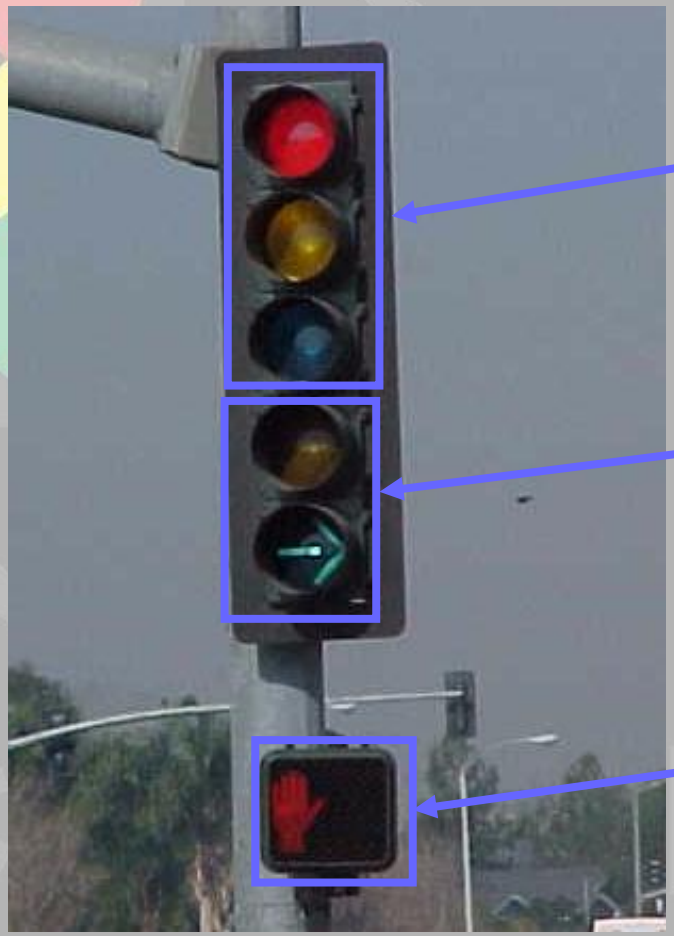
OVERLAP: A traffic movement timed concurrently with one or more phases (parent phases). Typically the yellow and red clearance timing of the overlap is equal to that of the phase terminating the overlap.



ASC/2S Features:

- 12 Phases
- 2 Rings
- 4 Overlaps ***

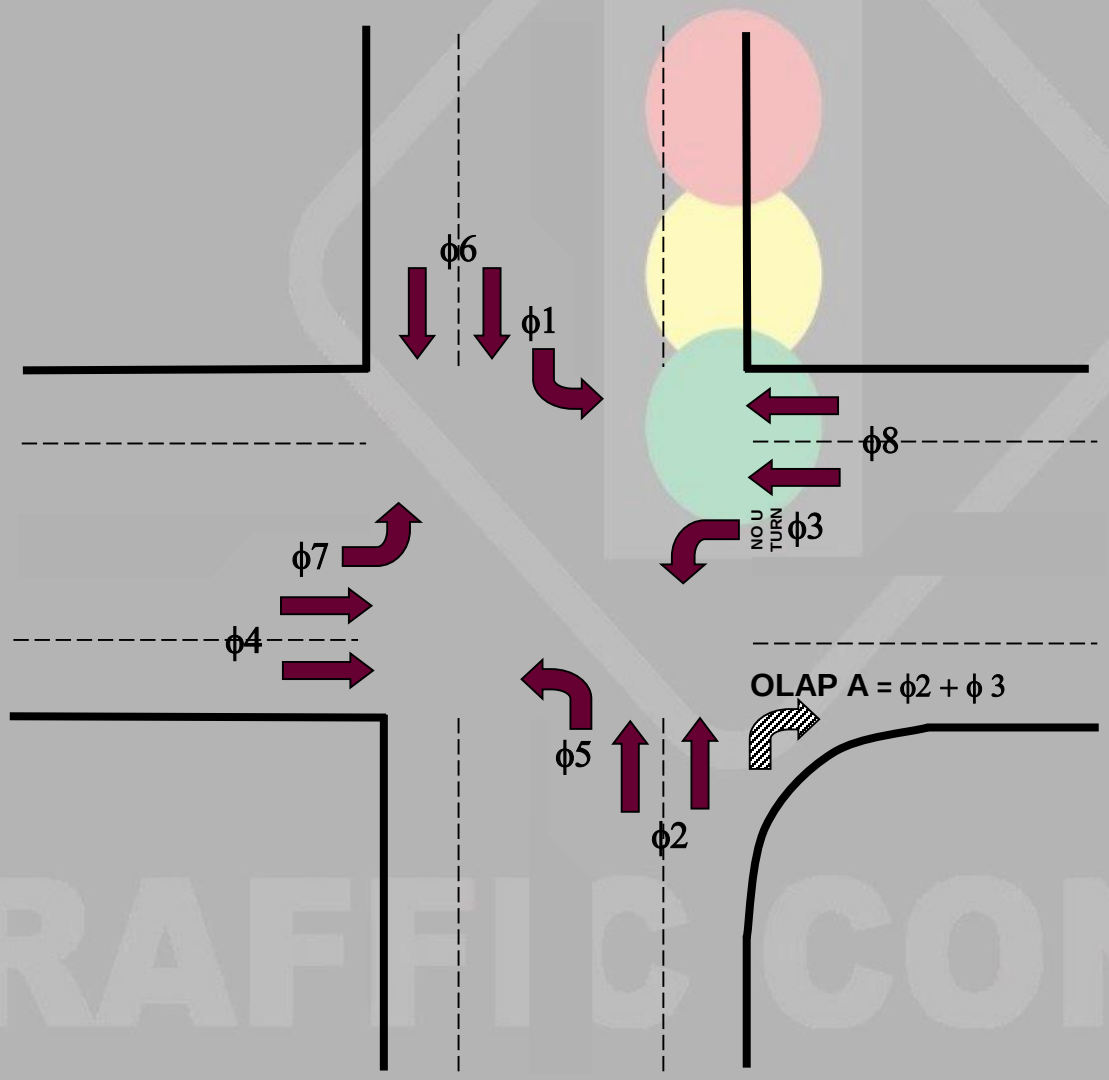
*** The 12 phases can also be programmed as basic overlaps



VEHICLE PHASE 2

OLAP A ϕ2 + ϕ3

PEDESTRIAN
PHASE 2

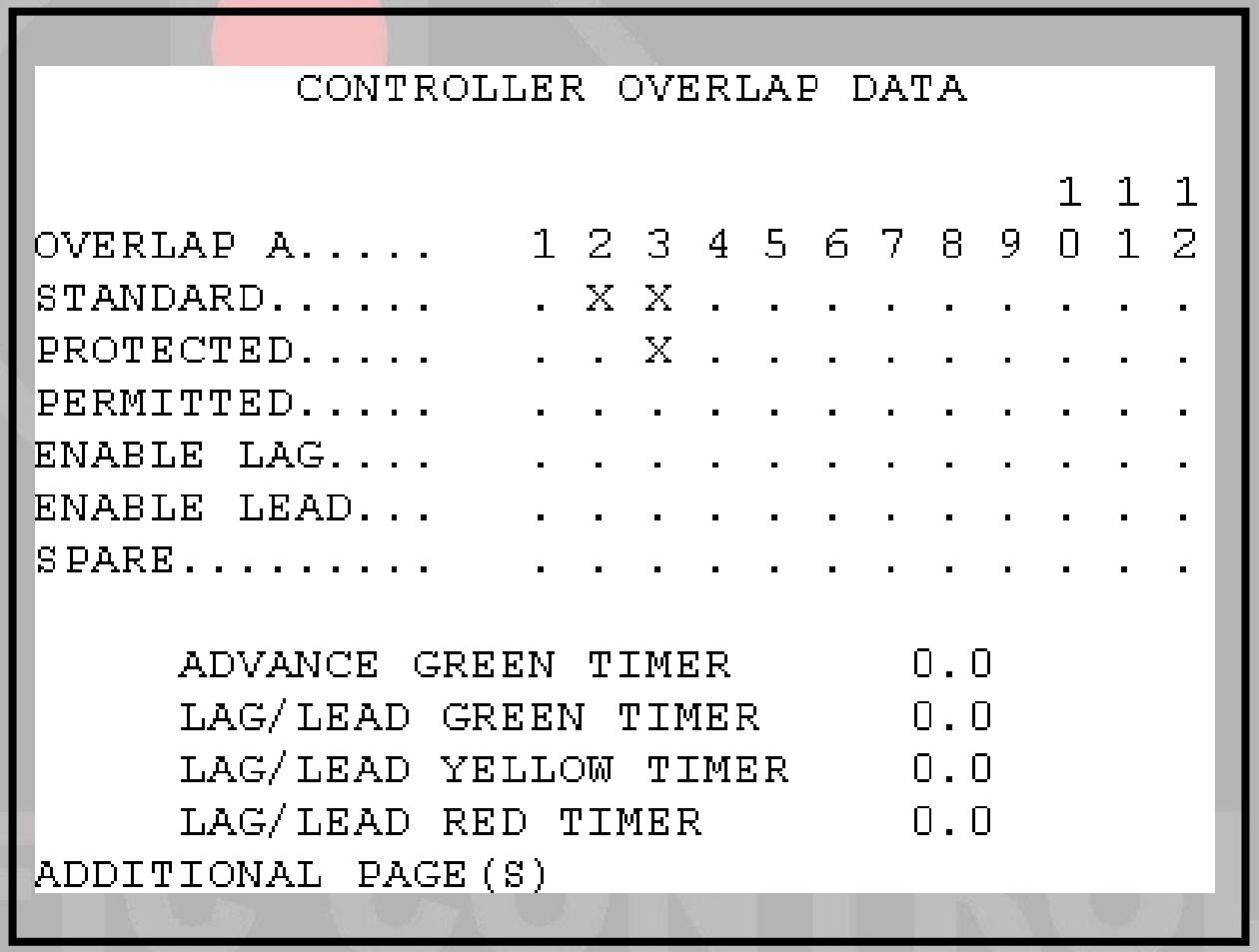


ASC/2S Features:

- 12 Phases
- 2 Rings
- 4 Overlaps ***

*** The 12 phases can also be programmed as basic overlaps

Defines phases that overlaps can time with and any modified overlap operation (e.g. protected/permissive, lag)



CONTROLLER OVERLAP DATA

OVERLAP A.....	1	2	3	4	5	6	7	8	9	10	11	12
STANDARD.....	.	X	X	.	.	.	.	.	.	.	.	.
PROTECTED.....	.	.	X	.	.	.	.	.	.	.	.	.
PERMITTED.....	.	.	.	.	.	.	.	.	.	.	.	.
ENABLE LAG....	.	.	.	.	.	.	.	.	.	.	.	.
ENABLE LEAD...	.	.	.	.	.	.	.	.	.	.	.	.
SPARE.....	.	.	.	.	.	.	.	.	.	.	.	.

ADVANCE GREEN TIMER	0.0
LAG/LEAD GREEN TIMER	0.0
LAG/LEAD YELLOW TIMER	0.0
LAG/LEAD RED TIMER	0.0

ADDITIONAL PAGE(S)

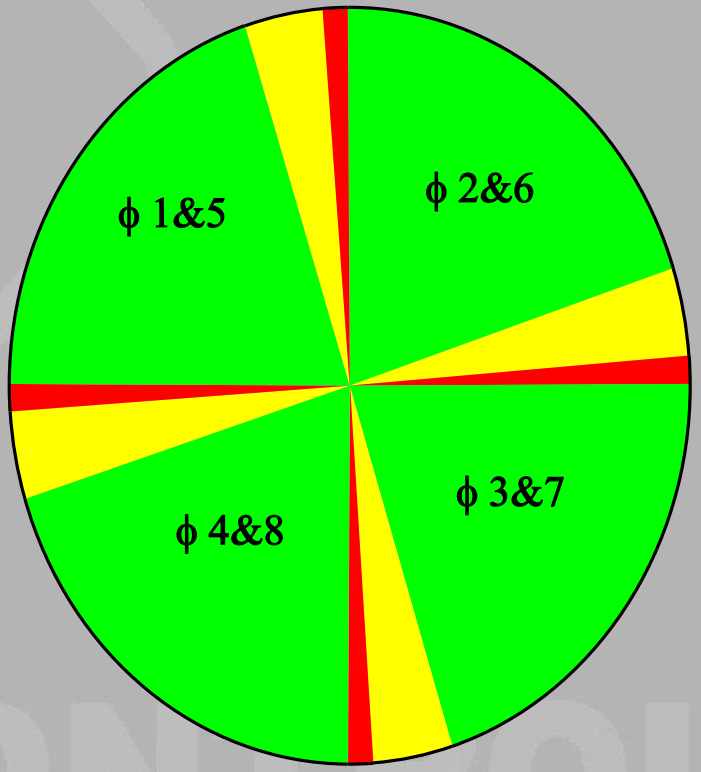
COORDINATION

COORDINATION: The control or platooning of traffic to permit a continuous flow of vehicles along a street at a designed speed.

COORDINATION (MM- 3)

Establishes a timing plan for the intersection which results in some form of progression in an arterial system.

CYCLE: The time required for one complete revolution of the timing dial or one complete sequence of signal indications.

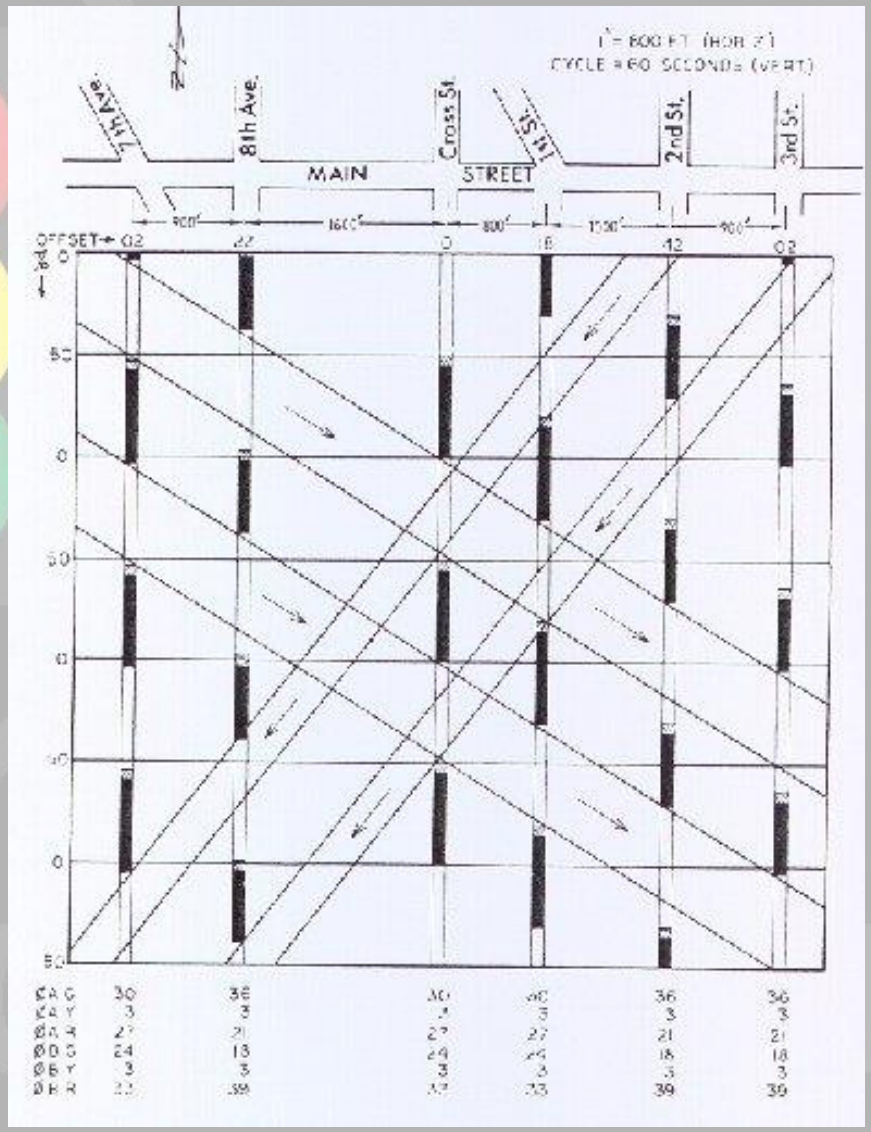


100 SEC CYCLE LENGTH

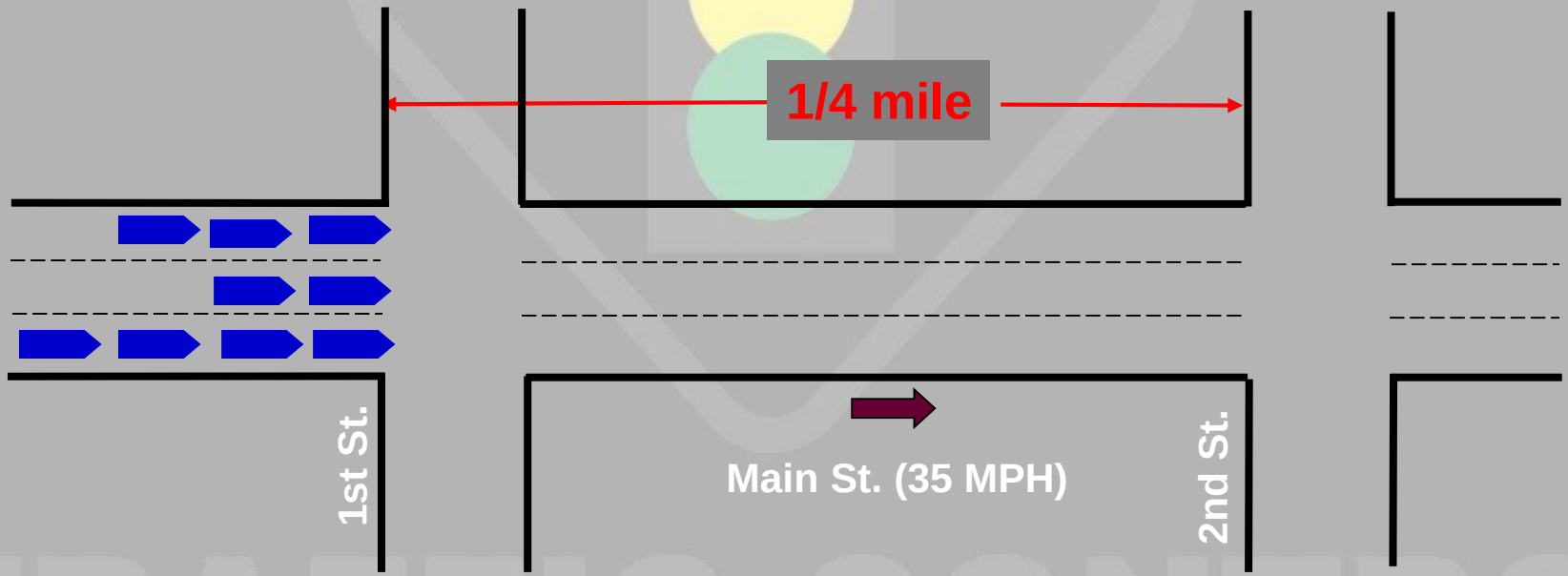
Offset = **A value calculated for vehicle travel time from a reference intersection**

Offset = **distance between intersections / travel speed**

Offset Reference Point = **typically start of coordinated phase green interval (user programmable)**

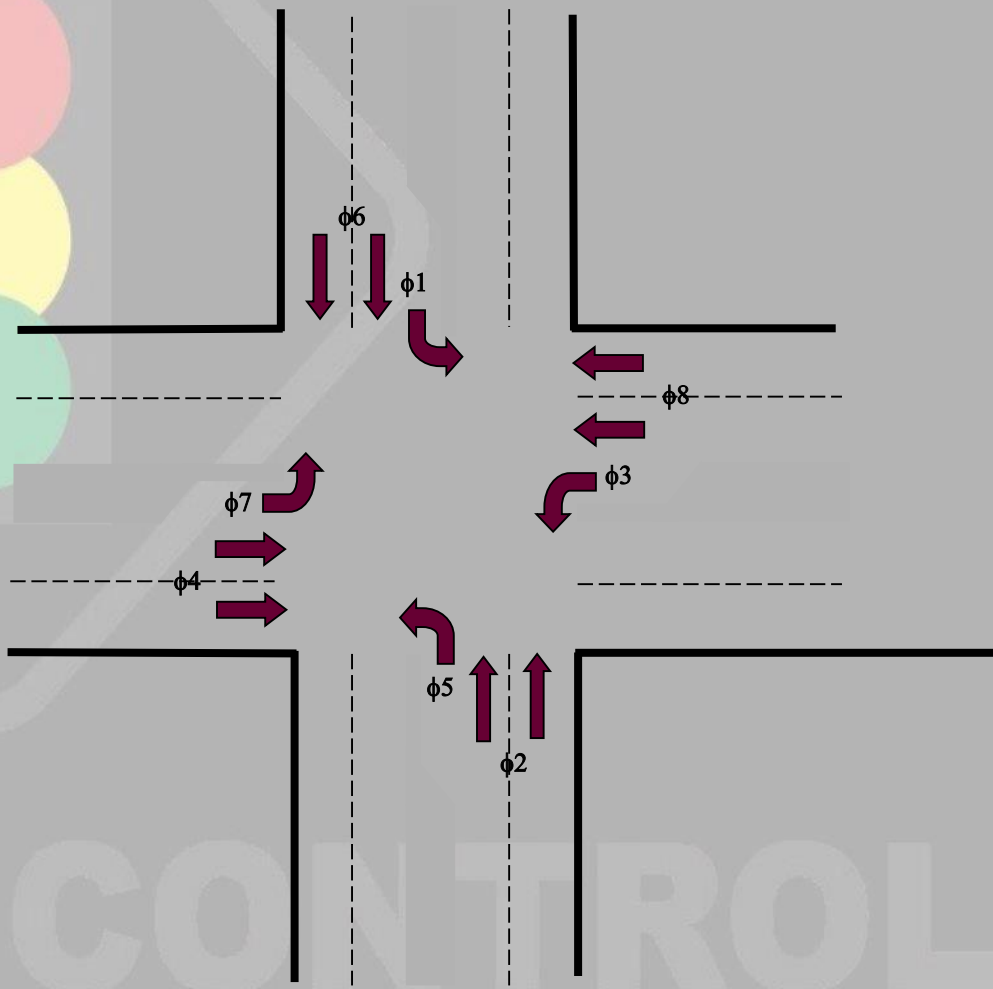


TRAVEL TIME = DISTANCE / SPEED
= ((.25 MILES) / (35 MPH)) X (3600 SEC/HR) =
25.71 SEC (round up to 26 SEC)

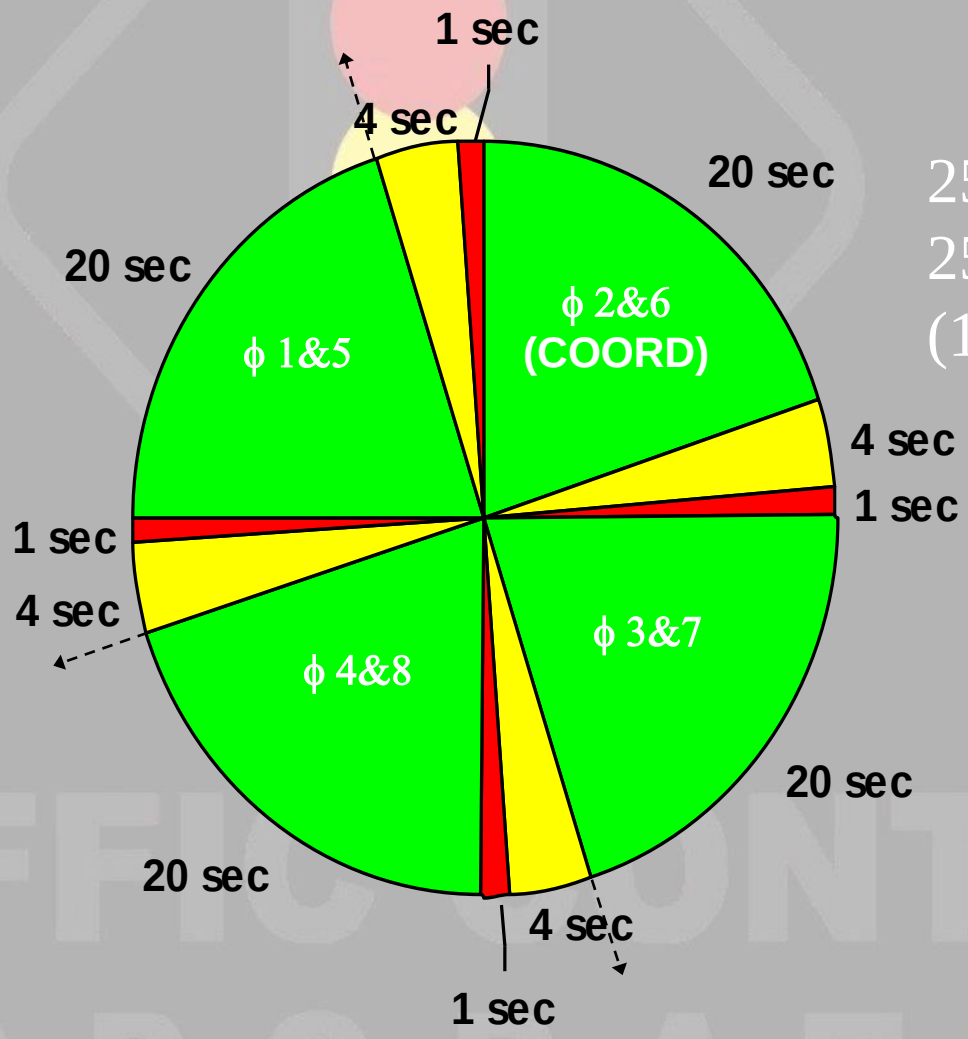


SPLIT: The portion of the cycle length allocated to each phase in the intersection (green + yellow + red).

Split times can be expressed in percent (%) or seconds (‘).

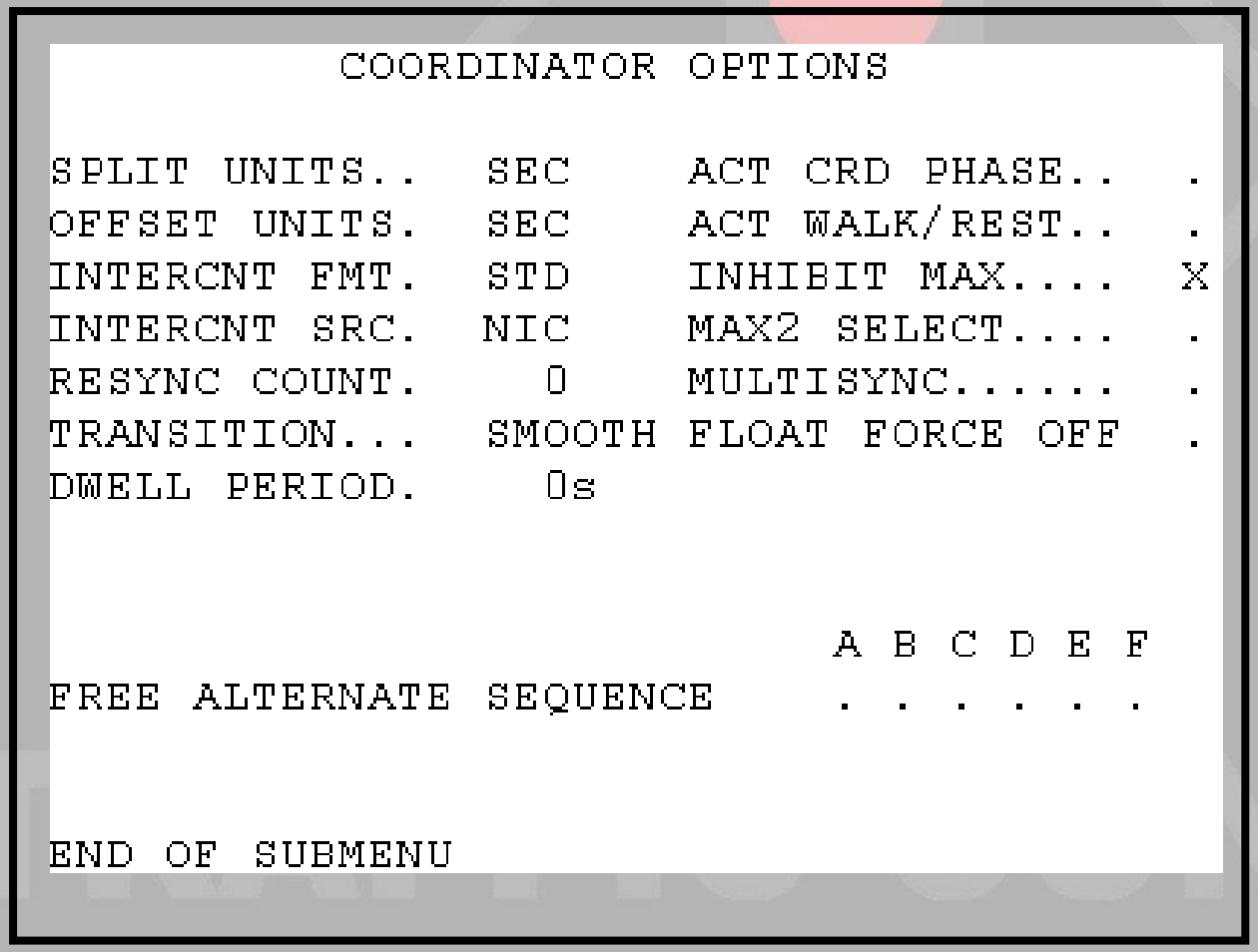


100 SEC
CYCLE
LENGTH

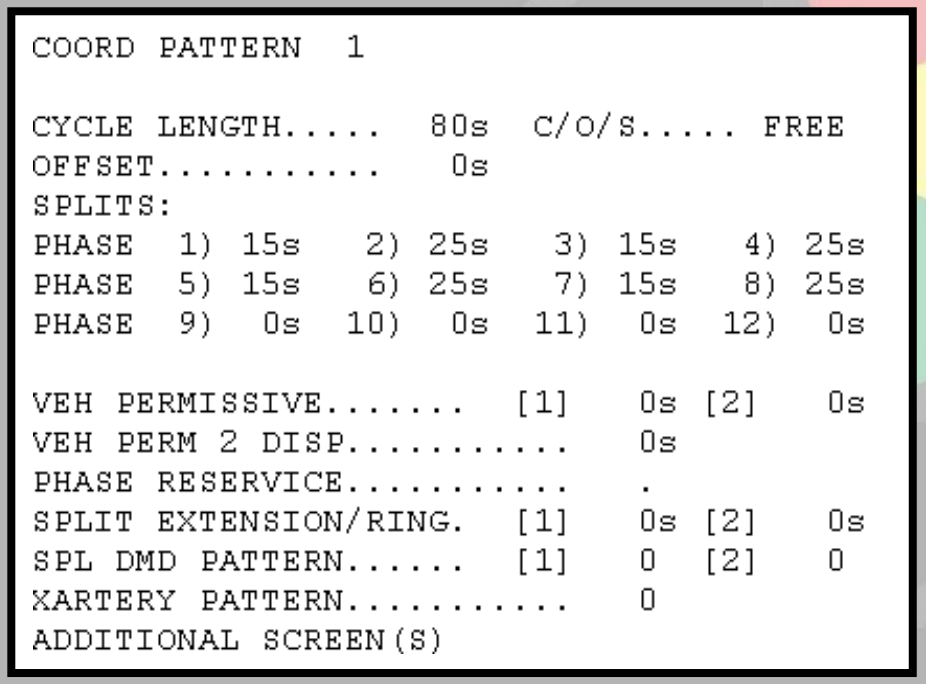


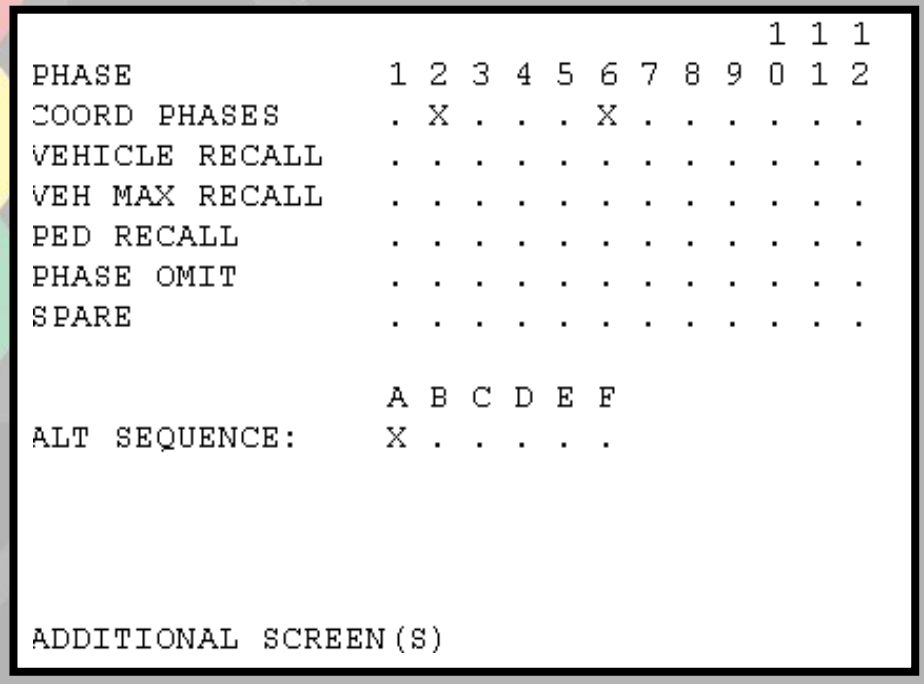
25 second or
25% split
(100 second cycle)

COORDINATED PHASES: The traffic movements that will remain green until a fixed point in the cycle in order to maintain an arterial progression or other predictable signal sequence (normally through movement on the main street).



Defines standard options used for ALL coordination patterns





Defines specific pattern data for each coordination pattern, including cycle length, phase splits, permissive periods, coordination phases, recalls, and alternate sequence

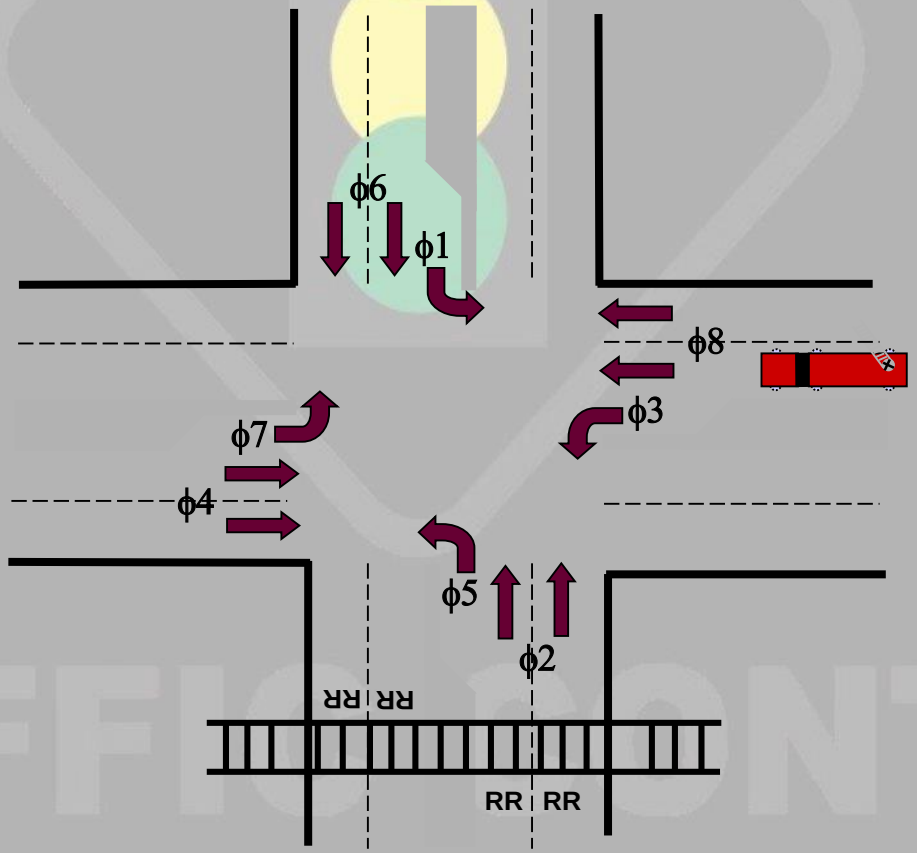
PREEMPTION

PREEMPTOR (MAIN MENU - 4)

Railroad / Emergency Preempt sequences “preempt” the normal operation of the controller in order to run a priority sequence.

Bus Preempt sequences also “preempt” the normal operation of the controller, but with a lower priority than a railroad or emergency vehicle preempt.

PREEMPTION: A SPECIAL SIGNAL SEQUENCE FOR THE PURPOSE OF SERVICING SPECIAL TASKS, EMERGENCY VEHICLES AND TRAINS ARE THE MOST WIDELY USED



EMERGENCY PREEMPTION:

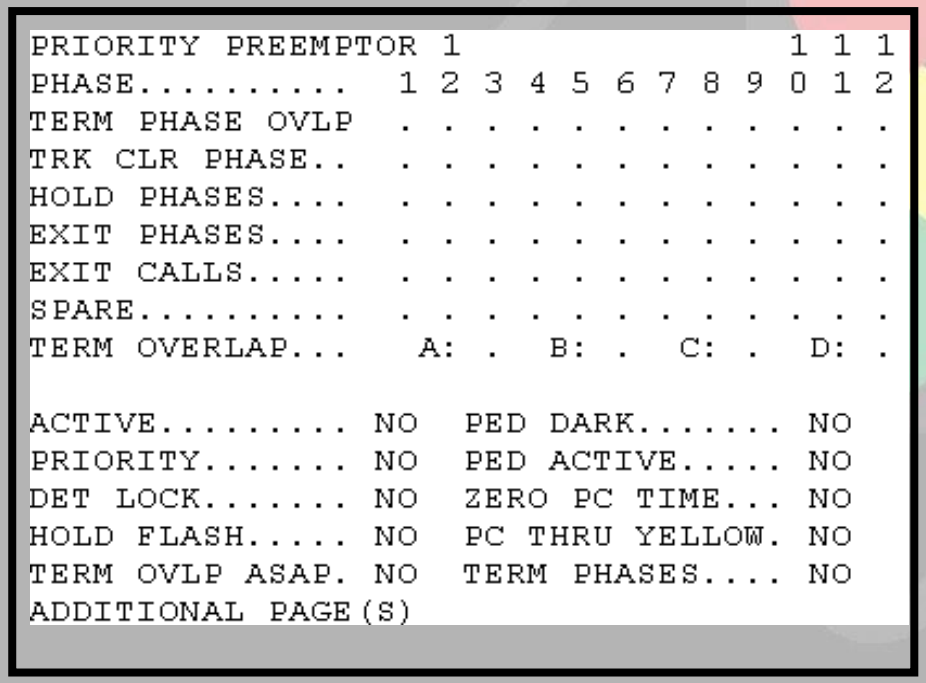
Optical sensors, such as the one shown next to the signal head above, allow emergency vehicles to activate an emergency vehicle preempt by strobing a special light on top of their vehicles.

TRAIN PREEMPTION:

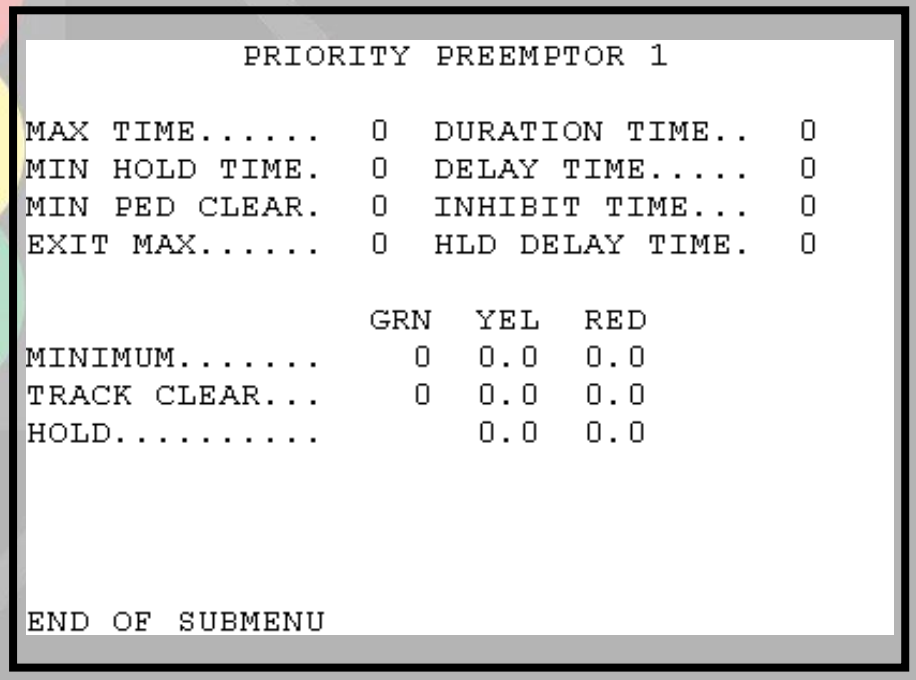
Intersections in close proximity to railroad crossings, such as the one shown in the picture above, go into a railroad preemption sequence when the grade crossing is activated. The most safety crucial interval of railroad preemption (TRACK CLEARANCE) is changing the lights green so motorists can quickly clear the tracks.

TRANSIT SIGNAL PRIORITY

- No interruption of coordination
- No omission of phases
- Minimal time required because of "check-in", "check-out" operation
- One transit vehicle movement during a cycle
- Re-service prohibited during next cycle
- Modification of phase splits to accommodate transit vehicles



```
PRIORITY PREEMPTOR 1                          1 1 1
PHASE.....  1 2 3 4 5 6 7 8 9 0 1 2
TERM PHASE OVLP  . . . . . . . . . . . .
TRK CLR PHASE..  . . . . . . . . . . . .
HOLD PHASES....  . . . . . . . . . . . .
EXIT PHASES....  . . . . . . . . . . . .
EXIT CALLS.....  . . . . . . . . . . . .
SPARE..........  . . . . . . . . . . . .
TERM OVERLAP...   A: .  B: .  C: .  D: .

ACTIVE..... NO  PED DARK..... NO
PRIORITY.... NO  PED ACTIVE.... NO
DET LOCK.... NO  ZERO PC TIME... NO
HOLD FLASH.. NO  PC THRU YELLOW. NO
TERM OVLP ASAP. NO  TERM PHASES.... NO
ADDITIONAL PAGE(S)
```



```
          PRIORITY PREEMPTOR 1

MAX TIME.....  0  DURATION TIME..  0
MIN HOLD TIME.  0  DELAY TIME.....  0
MIN PED CLEAR.  0  INHIBIT TIME...  0
EXIT MAX.....  0  HLD DELAY TIME.  0

                GRN  YEL  RED
MINIMUM.....     0  0.0  0.0
TRACK CLEAR...   0  0.0  0.0
HOLD.........       0.0  0.0



END OF SUBMENU
```

Screen 1 of 3: Defines preempt phases and general options

BUS PREEMPTOR

	- BUS PREEMPTOR -			
	1	2	3	4
PREEMPTOR ACTIVE.	X	.	.	.
DETECTOR LOCK....	.	.	.	.
MAXIMUM TIME.....	0	0	0	0
RESERVICE TIME...	0	0	0	0
DELAY TIME.....	0	0	0	0
INHIBIT TIME.....	0	0	0	0
ENTRANCE GREEN...	0	0	0	0
ENTRANCE PED CLR.	0	0	0	0
ENTRANCE YELLOW..	0.0	0.0	0.0	0.0
ENTRANCE RED.....	0.0	0.0	0.0	0.0
MIN HOLD TIME....	0	0	0	0

ADDITIONAL PAGE(S)

BUS PREEMPTOR

	------ HOLD PHASE -----											
										1	1	1
	1	2	3	4	5	6	7	8	9	0	1	2
PREEMPTOR 1....	.	X	.	.	X	.	.	.	.	.	.	.
PREEMPTOR 2....	.	.	.	.	.	.	.	.	.	.	.	.
PREEMPTOR 3....	.	.	.	.	.	.	.	.	.	.	.	.
PREEMPTOR 4....	.	.	.	.	.	.	.	.	.	.	.	.

END OF SUBMENU

Defines the active phases and timing for bus preemptors

NIC/TOD

NON-INTERCONNECTED COORDINATION / TIME – OF – DAY

THE NIC/TOD OPERATION ON THE ASC/2 CONTROLLER IS DIVIDED INTO 2 SEPARATE PROGRAMMING AREAS FOR THE EASE OF USER OPERATION.

THE NIC DATA AREA CONTROLS ONLY THE COORDINATION PLAN.

THE TOD DATA AREA CONTROLS ALL OTHER TOD PROGRAMMING ITEMS (E.G. FLASH, MAX 2-3, RECALL, PHASE OMITS, ALT. VEH. EXT., TYPE 0 DET. DELAY, ALT. SEQUENCE, DET. DIAGNOSTICS, ETC…)

NIC/TOD OPERATION (MAIN MENU - 5)

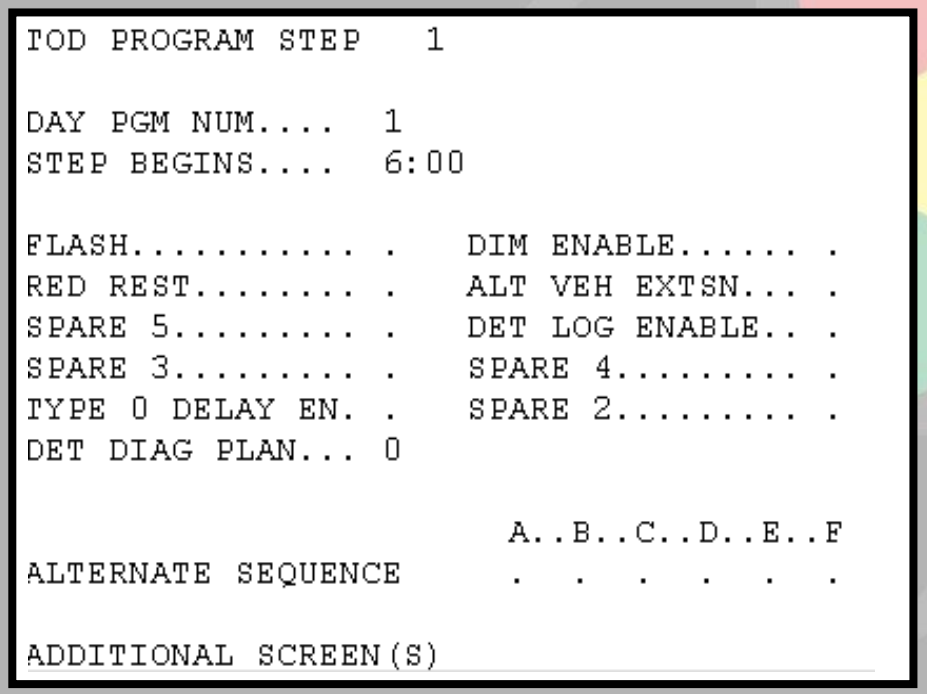
ALLOWS THE CONTROLLER TO PROGRAM THE TIME AND DATE, WEEK PLANS, YEAR PLANS, HOLIDAYS, COORDINATION PATTERNS AND PHASE OPERATIONS BY TIME OF DAY AND DATE.

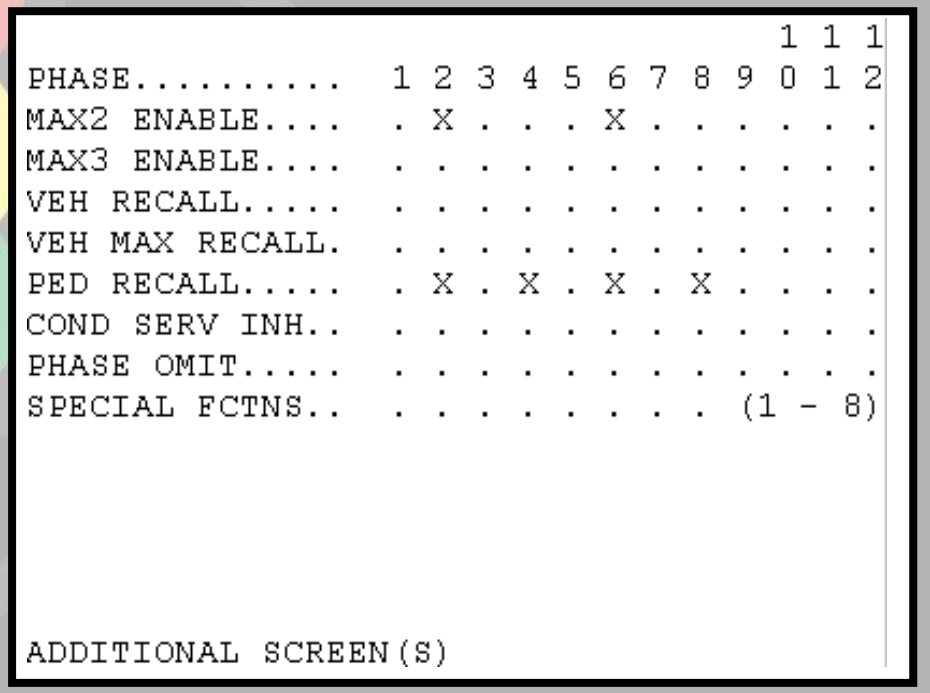
Defines the schedule for selecting coordination patterns by time of day

NIC PROGRAM STEP

STEP	PGM	TIME	PATTERN	OVERRIDE
1	1	6:00	1	.
2	1	9:00	2	.
3	1	16:00	3	.
4	1	18:00	2	.
5	1	20:00	0	.
6	0	0:00	0	.
7	0	0:00	0	.
8	0	0:00	0	.
9	0	0:00	0	.
10	0	0:00	0	.
11	0	0:00	0	.
12	0	0:00	0	.

ADDITIONAL SCREEN(S)





Defines the schedule for selecting alternate controller operation by time of day

(additional steps are on additional screens)

DETECTORS

DETECTOR SUBMENU (MAIN MENU - 6)

- TYPE/TIMERS
- PHASE ASSIGNMENT
- CROSS SWITCHING

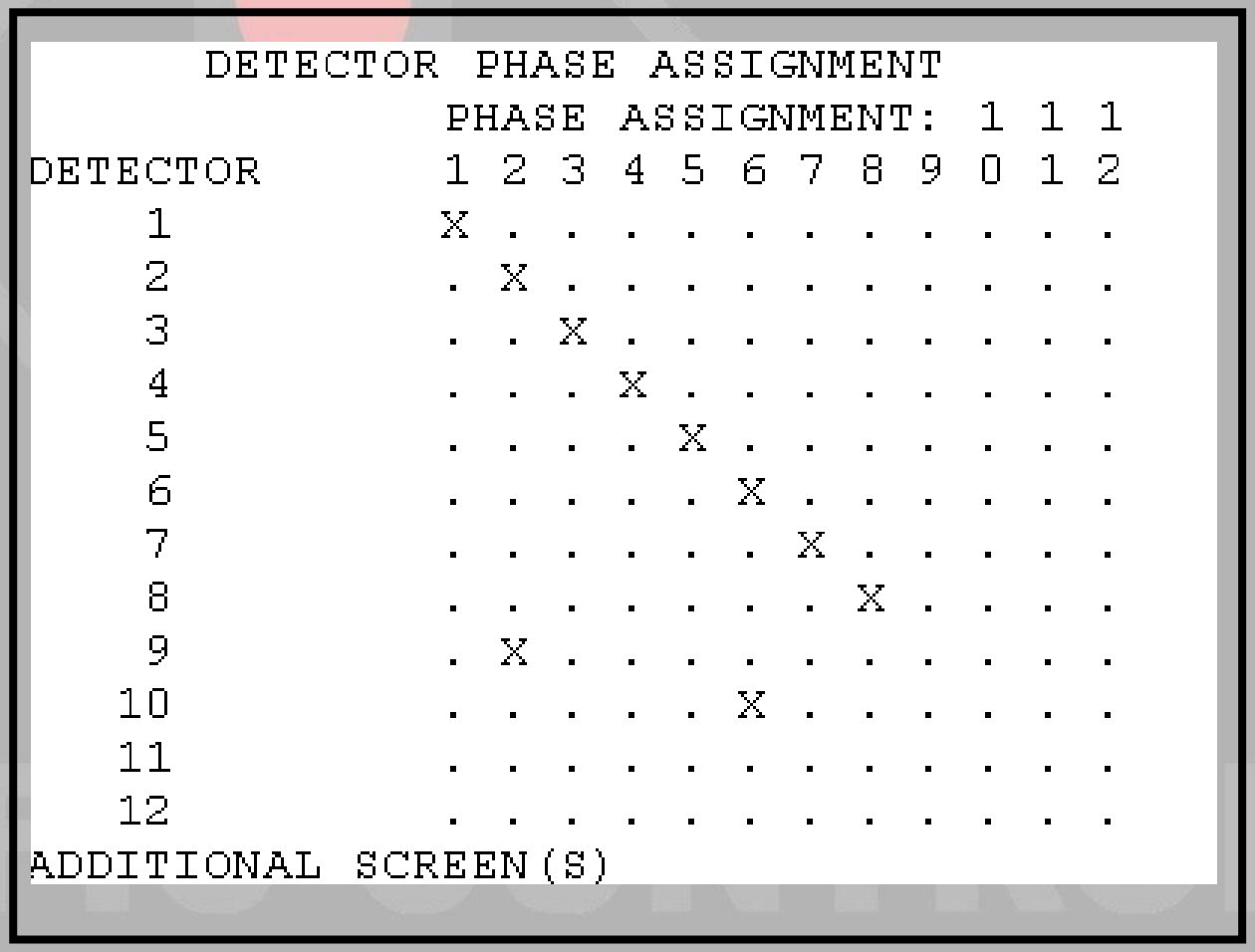
DETECTOR TYPE/TIMERS

DET	TYPE	LOCK	EXTEND	DELAY	NO RESET	LOG ENABLE
1	0	.	0.0	0	.	.
2	0	X	0.0	0	.	.
3	0	.	0.0	0	.	.
4	1	.	0.0	5	.	.
5	0	.	0.0	0	.	.
6	0	X	0.0	0	.	.
7	0	.	0.0	0	.	.
8	1	.	0.0	5	.	.
9	5	.	2.0	0	.	.
10	5	.	2.0	0	.	.
11	0	.	0.0	0	.	.
12	0	.	0.0	0	.	.

ADDITIONAL SCREEN(S)

Defines detector characteristics, timing (delays and extensions), locking detector, and log enable

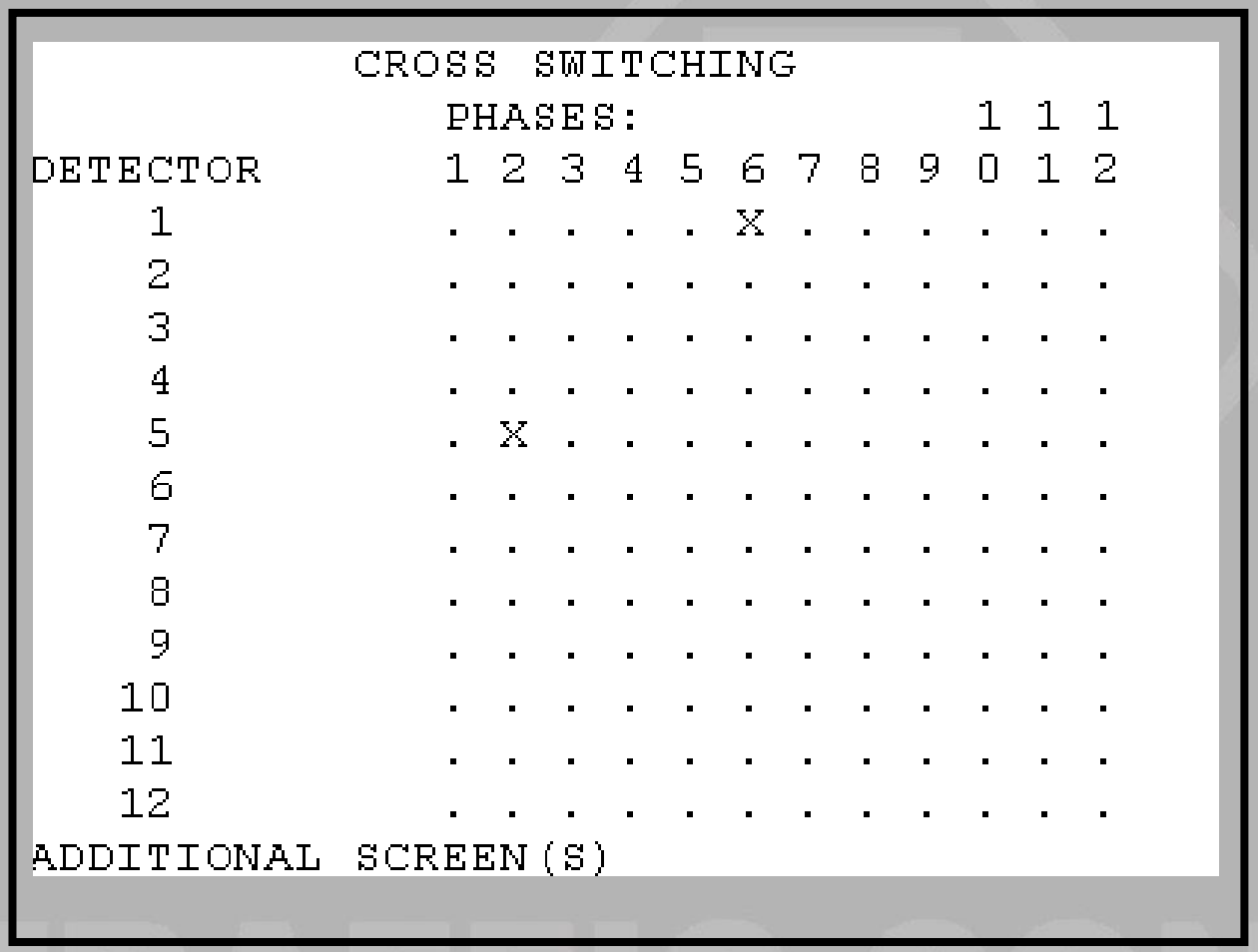
Defines which phases are called by each detector



DETECTOR PHASE ASSIGNMENT

DETECTOR	PHASE ASSIGNMENT: 1 2 3 4 5 6 7 8 9 10 11 12
1	X . . . .
2	. X . . . .
3	. . X . . . .
4	. . . X . . . .
5	. . . . X . . . .
6	. . . . . X . . . . . .
7	. . . . . . X . . . . .
8	. . . . X . . . .
9	. X . . . .
10	. . . . . X . . . . . .
11	. . . .
12	. . . .

ADDITIONAL SCREEN(S)



Phases are called if:

1) The primary assigned phases are not green and the cross switched phase is green.

2) The primary assigned phase is omitted and the cross switched phase is not omitted.

Defines phases that are called by each detector under the conditions listed on this page

STATUS DISPLAYS

Monitor in controller, coordinator, preemptor status from the display.

Place vehicle, pedestrian, preempt calls through the front panel.

Monitor telemetry communications status.

Monitor detector presence.

View intersection flash conditions.

How do we maintain a traffic signal?

IMSA PM Check List

- Vacuum cabinet
- Vermin Control
- Sealing Cabinet
- Replace Cabinet Light Bulb
- Test Cabinet Ventilation
- Inspect Suppression Devices
- Test Cabinet Voltage
- Check all Toggle Switches
- Check Controller Timings
- Update Holiday Plans
- Check Back-Up Battery
- Check PED Buttons
- Loops
- Inspect Loop Sealant
- Visual Check of all Overhead Devices
- Replace Air Filter
- Remove Overgrown Vegetation
- Replace Duct Seal
- Lubricating Locks & Hinges
- Test Electrical Outlets
- Check Tightness of Connections
- Test Cabinet Grounding
- Verify Flash Rate
- Watch Controller Operation
- Check Date & Time on Controller
- Conflict Monitor / MMU Test
- Check Vehicle Detectors & Inductive
- Check Pull Boxes & Splice Locations
- Inspect Mast Arm Terminals

Questions???