RAMP METERING

PROCEDURE MANUAL

STATE OF CALIFORNIA
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DISTRICT 7
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OFFICE OF FREEWAY OPERATIONS

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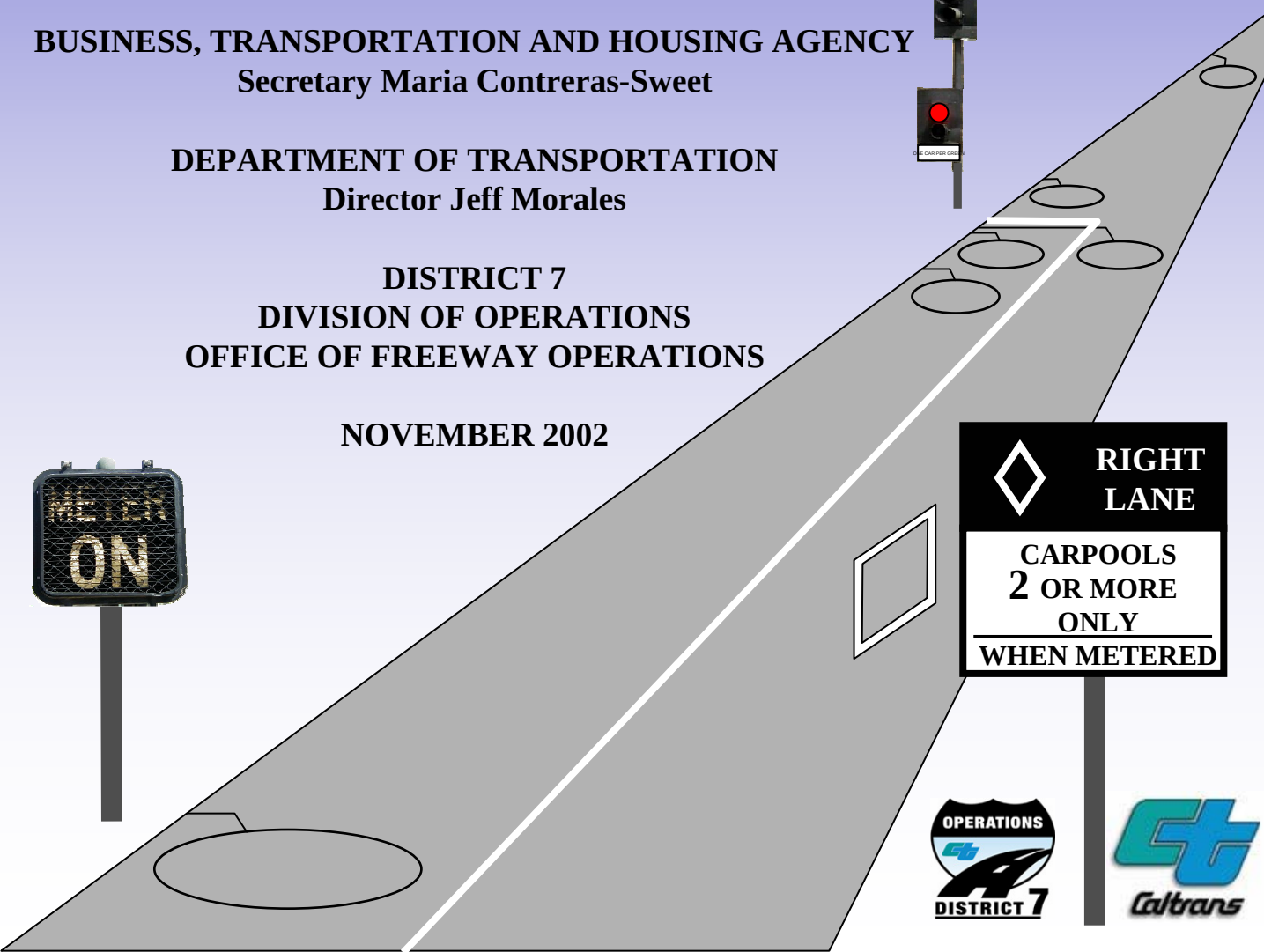

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RAMP METERING

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M A N U A L

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This Ramp Metering Procedure Manual has been prepared under the direction of the following registered civil engineer. The registered civil engineer attests to the technical information contained therein and has judged the qualifications of any technical specialists providing engineering data upon which recommendations, conclusions, and decisions are based.

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The following Ramp Metering Branch personnel provided their comments which improve the quality of this Manual:

- ***Wahib Jreij***
- ***Tim Nguyen***
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PURPOSE OF THIS MANUAL

The purpose of this Manual is to provide a guide to CALTRANS Ramp Metering Branch personnel. In order to establish consistency and accuracy, the Manual provides written guidelines and general field procedures.

This Manual is divided into three chapters:

- **CHAPTER 1- Transportation Management Center (TMC) and Advanced Transportation Management System (ATMS)**
  Describes the functions and duties of District 7 TMC. Explains and describes the computer system (ATMS) used in the TMC by Ramp Metering Branch and other CALTRANS personnel.

- **CHAPTER 2- Ramp Metering Branch Responsibilities**
  Describes the responsibilities of the Ramp Metering Branch. The guidelines are continuously being improved by new ideas and technologies.

- **CHAPTER 3- Ramp Metering Branch Field Procedure**
  Describes the field procedure for ramp metering field personnel and explains how the ramp meter software operates.

INTRODUCTION TO RAMP METERING

Ramp metering is a traffic management tool used to increase the efficiency and safety of the traffic operations on freeways. It is one of the most cost effective ways of managing traffic flow. It improves traffic flow on congested freeways and often significantly delays the necessity of undertaking major freeway improvement projects.

Freeway ramp meters are traffic signals installed on the freeway on-ramps to regulate the traffic entering the freeway system. Ramp meters allow the traffic to enter the freeway at a rate dependent on the conditions of freeway mainline traffic. They generally operate during the traffic peak periods. The main objective of ramp meters is to maintain the freeway traffic volumes below the freeway capacity, and to provide an acceptable level of service. In highly populated metropolitan areas, this objective is difficult to maintain for long periods of time due to high freeway and on-ramps traffic demand. Stop and go traffic conditions are normally delayed and/or shortened and congestion related traffic accidents are highly reduced.

Freeway ramp meters are often used in conjunction with preferential High Occupancy Vehicles (HOV) non-metered lanes in District 7, to provide time saving incentives for use of carpool, vanpools and public transit.

There are three different modes of freeway ramp metering:

- *Non-traffic responsive (fixed rate) mode*-the ramp meter is programmed to operate at designated time intervals ("time of day") with fixed metering rates (vehicles per minutes). Using historical traffic data, traffic engineers determine the time periods and metering rates in advance. The parameters are then entered into the ramp meter controller (microprocessor) either by remote connection or directly at the field location.

- *Traffic responsive mode*-the local ramp meter controller adjusts ramp metering rates based on real time mainline traffic flow parameters (occupancy and volume) and on programmed parameters (minimum metering rates, queue loop threshold, etc.) selected by the traffic engineer. Vehicle detectors collect the real time traffic flow parameters. The vehicle detectors, usually inductive loops embedded into the pavement, are located upstream from the on ramp. Local ramp vehicle detection is used by the controller to provide an effective and safe operation under a wide variety of traffic conditions.

- *Central control mode*-the central system, in conjunction with the local ramp controllers determine, ramp meter rates based on freeway mainline real time traffic flow parameters (speed, saturation density, volumes). The central computer may modify the local controller metering rate by generating more/less restrictive rates from downstream ramp meter locations. The central control system also permits,

- monitoring of an entire series of ramp meter locations from a remote central location
- convenient reprogramming of the local controllers from a remote central location
- manual intervention to override the program for any given ramp in the event of unusual conditions.

At the present, District 7 is testing and evaluating a central control system called **S**ystem **W**ide **A**rea **R**amp **M**etering (**SWARM**). The goal is to implement this central ramp metering control throughout the District.

Note: Most of the writings on this section are excerpts from the Internet articles titled: TMS Baseline Inventory –June 30, 2001 FREEWAY RAMP METERS and RAMP METERS CENTRAL SYSTEM

CHAPTER 1

TRANSPORTATION MANAGEMENT CENTER (TMC)

The District 7 Transportation Management Center (TMC) is located in the Caltrans District Office Building in Downtown Los Angeles. It is a state-of-the-art technologically advanced focal point for maximizing traffic flow on the vast Los Angeles and Ventura County freeway system. Caltrans and the California Highway Patrol (CHP) jointly operate the Center.

The TMC is used to manage the freeway transportation system. Functions of the TMC include:

- Ramp metering system - control the entry of vehicles onto freeways via traffic signals, thereby limiting freeway volumes. This in turn optimizes vehicle density and speed, and reduces traffic congestion. Ramp metering system is the responsibility of the Ramp Metering Branch, along with TMC Support and Electrical Maintenance.

- Freeway surveillance equipment - provides essential traffic data to the TMC for early detection of incidents and locates areas of congestion. The primary means of obtaining traffic flow data is through wire loops embedded in freeway lanes and ramps. These include Vehicle Detection Stations (VDS) for mainline surveillance and Ramp Metering Stations (RMS) for on/off ramp surveillance. Freeway surveillance equipment is the responsibility of the Ramp Metering Branch, along with TMC Support and Electrical Maintenance.

- Closed circuit television (CCTV) cameras - with zoom capabilities are used to confirm the exact location, nature and severity of freeway incidents.

- Changeable message signs (CMS) - are TMC controlled signs located at key points on the freeway system. The TMC updates the display of the CMS messages to provide motorists with real-time traffic information and amber alerts.

- Highway Advisory Radio (HAR) - is a short-range broadcast radio with transmitters located within the freeway right of way to provide motorists with advanced informational messages. HAR messages are remotely activated from TMC.

- CHP computer-aided dispatch (CAD) - is a computer database of freeway incidents. The TMC has direct access to the California Highway Patrol's CAD system so staff can check on existing incidents or enter new information as it becomes available.

- Freeway Service Patrol (FSP) - is a fleet of tow trucks co-managed by Caltrans and the CHP, in partnership with the Metropolitan Transportation Authority (MTA). The trucks patrol the freeways continuously during rush-hour traffic and provide rapid removal of disabled vehicles. Services provided at no charge include: changing flat tires, jump starting a vehicle, refilling a radiator and patching leaky hoses, placing a gallon of fuel in an empty gas tank, and towing disabled vehicles to designated drop zones.

- Freeway call boxes - are located on freeways in both Los Angeles and Ventura Counties. Motorists use the call boxes to report car problems, i.e., flat tires, leaking radiators, no gas, traffic accidents, stalled cars, etc. Calls can then be directed to the FSP.

ADVANCED TRANSPORTATION MANAGEMENT SYSTEM (ATMS)

The Advanced Transportation Management System (ATMS) is a computer workstation designed to assist in collection and disseminating of traffic information in order to effectively manage the existing Caltrans District 7 transportation system. There are several ATMS workstations in the TMC, four of which are used exclusively by the Ramp Metering Branch.

The ATMS provides access to the field RMS and VDS. It provides data showing freeway mainline, and on/off ramp volumes, speed and occupancies. Meter rates and other ramp meter configurations can be changed through ATMS. Historical data can be obtained to analyze the efficiency of the freeway system.

The ATMS provides speed data for most of District 7 freeways. This data can be displayed on the ATMS workstations or placed on the TMC Freeway Operations Status display. This display is a large wall projection screen inside of the TMC, which shows District 7 freeway system and the real time operational speed (by color) at each VDS location.

Each field RMS and VDS is operated by a “170” controller (microprocessor) inside a cabinet. The controller program is called RAM MAP, which is provided by the Ramp Metering Branch personnel. See Attachment A.

The ATMS works on RAM MAPS. The RAM MAPS tell the “170” controllers how and when to operate. Changes to the RAM MAPS can be done in the field or through the ATMS workstation.

In order for the RMS, VDS and ATMS to operate properly, the following two items are required.

1.The “170” controller program (RAM MAPS): Needs to have the correct ramp configuration (number of freeway lanes, number of ramp lanes, identify the type of freeway and ramp loops, etc.).

- The RAMP MAPS should be updated when a construction project or any change affects the ramp/freeway configuration (freeway widening, adding mainline or ramp carpool lanes, etc.).

- In addition, when a mainline or on-ramp loop is not working properly, the area engineer should evaluate if the loop needs to be disabled in the "170" controller program. Occasionally, a malfunctioning loop will affect the correct operation of the ramp meter and/or the TMC Freeway Operations Status display.

2. Loop detector sensitivity: Loop detector sensitivity needs to be set correctly, since TMC/ATMS data are affected by this item, particularly freeway speed calculations. Electrical Maintenance should set the sensor sensitivity per the sensor manufacturer recommendations. See APPENDIX A.

CHAPTER 2

RAMP METERING BRANCH RESPONSIBILITIES

- Periodically, conduct High Occupancy Vehicles (HOV) lane occupancy counts to obtain the violation rate. High violation rates shall be reported to the CHP for enforcement purposes. Should be done at least once a year at those locations where a high HOV lane violation rate has been observed.

- Obtain data from ATMS and develop an operational study for each freeway. The results from the operational study shall be used to develop plans for operational improvement projects where needed, and to revise ramp meter rates and turn on/off times. These studies should be conducted every year, if possible.

- Review Project Study Reports (PSR), Project Reports (PR) and Plans Specifications and Estimate (PS & E) to ensure that metering equipment will be installed properly in the project. This includes HOV bypass lanes, safe locations for the controller cabinet, and all the proper equipment necessary for the ramp meter system. Loops are in the correct lanes and properly placed. Ramp storage is adequate to handle demands.

- Conduct a yearly inventory of missing or defective equipment (loop detectors, freeway and ramp loops, etc.), at each RMS and VDS locations and submit this inventory to TMC Support and/or Electrical Maintenance. The collected information is included in the Ramp Metering Development Plan developed by District 7 Ramp Metering Branch, per Caltrans Ramp Metering Policy Procedures. See Attachment B.

- Periodically conduct Queue and Demand (Q and D) counts to monitor and/or make adjustments to the existing ramp meter operations. These counts should be done on a continuous basis. The area engineer should set the frequency of the Q and D counts (at least once a year, if possible; before and after construction projects). Some ramp meter traffic complaint investigation should include a Q and D count.

- Investigate ramp meter complaints and inquiries generated in-house and by private citizens by checking ATMS data, field review, Q&D counts, HOV occupancy counts, etc., as needed. Answers should be responded to in a timely manner.

- Provide at each RMS and VDS cabinet location, a copy of the latest RAM MAP, Loop Detector Sensor Layout Sheet and As Built Plans. This allows any authorized personnel working at the Ramp Meter cabinet to do the work efficiently. See Attachment A.

- Conduct field "ramp meter surveillance".

1. Office Work (Before going to the field)

Ramp Metering personnel should periodically use the ATMS to check the following:

- Loops operation/malfunction
- Communication (phone lines) between the "170" controller and the ATMS/TMC
- Freeway operations (bottleneck, speed, etc.)

If the ATMS shows that there is an equipment malfunction in the field, Ramp Metering personnel should use the ATMS and immediately check:

- "170" Controller program (RAM MAP)
- Status of the loops (failed hard failed, etc.)
- Status of the location (location was turned off by TMC personnel, under construction, etc.)
- Other (use the ATMS* features to try to solve the problem)

*ATMS has many features that give clues of what the problem maybe, possibly avoiding a trip to the field.

2. Field Surveillance

While in the field conducting ramp meter/freeway surveillance, if the location seems to be operating properly, Ramp Metering personnel should use the guidelines below. Otherwise refer to Chapter 3, Ramp Metering Branch Field Procedure.

- Time the ramp meter cycle with a stopwatch and check it against the scheduled time of day (TOD) table cycle. If the location is in traffic responsive mode, the cycle shall be equal or less than the TOD cycle.

- Observe the queue length and the ramp meter operation during different traffic conditions to evaluate if the existing ramp meter program (RAM MAP) needs any changes. See Attachment C.

- Look for damaged/malfunctioning equipment, missing signs, stripping, etc.

3. Office work (After Field Surveillance)

- Report to Electrical Maintenance any equipment malfunction (burned out lights, knocked down ramp meter heads/meter on signs, etc.). See Attachment C.

- Report to Maintenance Department any knocked down traffic signs, graffiti on signs/structures, overgrown trees blocking ramp meters or signs, etc. that are located within the State right of way.

- Report to the Traffic Investigation Department unsafe traffic conditions that they need to be aware, like off ramp traffic backing up to the freeway mainline lanes, etc.

- Report to Maintenance Special Crews of any worn out or missing stripping, signs, etc.

Notes:

- Telephone line (communication) problems should be brought to the attention of TMC Support.
- Whenever Ramp Metering personnel cannot "fix" the ramp meter malfunction, TMC Support or Electrical Maintenance should be immediately informed.
- Every time a RMS or a VDS is found to be malfunctioning, it should be "Logged", in the Freeway Surveillance Form book. See Attachment C.

CHAPTER 3

RAMP METERING BRANCH FIELD PROCEDURE

General Note: Please, refer to the pictures of the "170" controller cabinet on page 21 and to APPENDIX A and B, while reading this chapter.

"170" CONTROLLER BASE DISPLAY

The LCD display of the "170" controller **must be turned "on"** to access the ramp meter program. The display is turned on by pressing any one of the following controller's keys, **"A", "B", "C", "D", "4", "5" or "6"**. The display will show what is known as the **"Base Display"**. See Appendix B.

Pressing **"E" (when the display is off),** will turn the LCD display on, showing the "date" (version) of the software installed in the controller. To switch the LCD display from the "date" (version) mode to the Base Display, the **"stop timing"** toggle switch has to be reset. This switch is located on the faceplate of the controller.

INPUTTING TIME AND DATE
(KEY "8" PROCEDURE)

Note: This procedure is used to input the correct time of day, date and day of week in the "170" controller program.

Suppose the correct time is 13:05 and the correct date is 07-27-02, Thursday.

1. Press "**8**" to change time of day and date and day of week. Time of day is going to display. If correct go to 3. If not go to 2.

2. Press "**1**", "**3**", "**0**", and "**5**" to input **13:05**.

3. Press "**E**" to enter. Date is going to display. If correct, go to 5. If not, go to 4.

4. Press "**0**","**7**", "**2**", "**7**", "**0**", and "**2**" to input **07-27-02**.

5. Press "**E**" to enter. The controller is going to display the day of the week.

6. If the day of week is correct, go to the next step. Otherwise, press "**1**" for Monday, "**2**" for Tuesday, "**3**" for Wednesday, "**4**" for Thursday, "**5**" for Friday, "**6**" for Saturday and "**7**" for Sunday. (Example: Press **"4"** for Thursday).

7. Press "**E**" to enter and to get back to the Base Display.

INPUTTING TIME OF DAY (TOD) TABLE
(KEY "9" PROCEDURE)

Note: This procedure is used to input in the "170" controller, the TOD Table which consist of the days and time of day of ramp meter operations and the metering rates.

1. Press **"9"** to get to the **Time of Day** (**TOD**) **Table.** Display is going to show the 1st time of day interval (starting time of metering) entry. If the time is correct, press **"E"**. Go to 3 or 4.

2. If not, input the correct metering time (military time) and then press **"E"**. Go to 3 or 4.

3. Press **"A"** to advance to the next time of day interval (2, 3, 4…) at which the TOD is going to be changed. If the time is not correct, input the right time then press **"E"**.

4. The display moves to the **metering rate (total number of vehicles/minute)** for that time of day interval. If the rate is correct, press **"E"**. Otherwise, input the rate **"00"** = to turn off the meter, **"01"**= steady green light, any other number= metering rate (from **03** to **15** for single metered lane, 1 vehicle per cycle) then press **"E"**. Go to 3 or 5.

5. Display is going to show the **days of week when metering** is programmed for that particular time of day interval. If the entries are not correct go to 6, otherwise go to 3.

6. Controller **lights (bits) 1 to 7** indicate the **day of week** that the meter should be in operation (**"1"** for Monday, **"2"** for Tuesday, **"3"** for Wednesday, **"4"** for Thursday, **"5"** for Friday, **"6"** for Saturday and **"7"** for Sunday). By pressing the controller numbered keypad (on/off), the correct metering day is enabled. Once the entries are correct go to 3 or press **"E"**.

7. Display is going to show **"FFFF",** indicating special features (**"1"** for External Device1, **"2"**for External Device2, **"3"** for Number of vehicles per cycle plan B, **"4"** for critical volume plan B). By pressing the controller numbered keypad (on/off), the correct feature is enabled. Once the entries are correct go to 3 or press **"E"** to get out of the TOD table mode and back to the base display.

NOTES:

- If **"F"** is pressed at any time during this procedure, the last entry made will not be recorded and the program will get out of the TOD table mode and back to the base display. **"E"** must be pressed for the program to accept any new entry.

The last entry on the TOD Table must be **"3333"** (a terminator), which indicates to the program that this is the end of the TOD table.

RAMP METER IS OPERATING ON A STEADY GREEN
(WITH FREEWAY MAINLINE CONGESTION)

1. Check if the **mainline loops' detector sensor** lights are blinking as vehicles pass over the mainline loops. This indicates that the sensor is detecting mainline traffic. If the sensor is working, go to 2.
   If the loop detector sensor's lights are off, check if the sensor is turned **"On"**. If it is **"On"**, then try to reset it and/or check that the sensor sensitivity setting is correct. See APPENDIX A.
   As a last resort, pull the loop detector sensor out and plug it back in. Sometimes the sensor connection is bad or dirty and this will correct this problem. If the sensor starts to work, go to 7. If the sensor does not work, go to 8.

2. Go to address **"0D4"**, to check the status of the mainline loops in the controller (mainline loops **must be enabled** at address **"0F6"**). The controller's LCD display should show (blink) the number of the lane as the vehicles pass over the mainline loops. If address **"0D4"** does not show the lane number, go to 8.

3. Check if address **"090"** (manual ramp metering) have a **"255"** entry (normal metering). If the entry is correct, go to 4. If the entry is **"1"** (steady green), then most likely, that is the reason of the problem. Input **"255"** in this address. Go to 7.

4. Check the values of addresses **"088"** and **"08A".** Values should be per **RAM MAP** placed inside the cabinet. If not, input the correct values. Go to 7.

5. Check the value of address **"3B4"** (3 minutes average mainline traffic volume). The software updates this value every 30 seconds. If the value does not change, go to 8.

6. As the last resource, go to address **"3E0"**. Zero out this address, to reinitialize the program. Then, you **must input the RAM MAP** information including the **Time of Day (TOD) Table**. If the problem is fixed, go to 7. If the ramp meter is still operating on steady green, go to 8

7. **Observe the ramp meter operation for enough time**, **to ensure that it is operating per the RAM MAP**. If the meter does not operate properly, go to 8.

8. **Report** this and any other ramp meter operational problem to **Electrical Maintenance and/or TMC Support.**

RAMP METER IS OFF (BLACK)

1. Open **Police/Light Switch Door** on the side of the "170" controller cabinet. Check the status of the **Signal Light Toggle Switch**. This switch turn on /off the ramp meter signal lights. Check if this switch is on the **"On"** or **"Off"** position. If the switch is on the **"Off"** position, turn it **"On"** (for safety reasons, the on ramp should be clear of any traffic when the light switch is turned on). If the meter signal lights turn on, go to 12. Otherwise go to 2.

2. For safety reasons, position the **Signal Light Toggle Switch** to the **"Off"** position before proceeding with any other work on the "170" controller.

3. Open the cabinet.

   REMINDER: For safety reasons, on step **2**, the signal lights were turned **"Off".** The meter signal lights **must be** turned **"On"**, after each step (from **4** to **11)** is performed, to check if the lights are working. First, verify that the ramp is clear of traffic, then position the **Signal Light Toggle Switch** to **"On"** position and wait for at least 1 cycle or 30 seconds.

4. Check if the **controller has power** by observing if the loop detector sensor lights are blinking, or by turning on the controller's LCD display (Refer to **"170" Controller Base Display Instructions**). If there is no power in the cabinet, go to 13. If the controller has power, go to 5.

5. Check if the **Watch Dog Switch (WDS)** light (lower rack) is on. If this light is on, the **WDS** need to be reset. Reset it by pressing the reset button if equipped with one or by flipping the toggle switch on and off. If the meter signals lights turn on, go to 12. If the **WDS** cannot be reset (light keeps turning on), go to 13. If the **WDS** light was not on, go to 6.

6. Go to address "**0F4**" and check if bit **"1"** is enabled (on). This bit turns on the controller program. If, bit **"1"** was already enabled, go to7. If it was not on, press key **"1"** to enable it. If the meter signal lights turn on, go to12. Otherwise, go to7.

7. Check the controller's calendar (**Time of Day**, **Date**, and **Day of the Week)** using **Key "8" Procedure**. If the calendar information is correct, go to 8. If the meter signal lights turn on after the calendar is corrected, go to12. If the lights do not turn on, go to 8.

8. Check **Time of the Day (TOD) Table**, using **Key "9" Procedure**. Follow the **RAM MAP** information to check: time of day of metering, meter rates, day of the week of metering, etc. If the information in the TOD table is correct, go to 9. If the meter signals

lights turn on, after the TOD table is corrected, go to12. If the lights do not turn on, go to 9.

9. Check if the **Holiday Table**, the **"A"** column (addresses from **"0A0"** to **"0AF"**) of the program has the correct entries per **RAM MAP**. If the meter location operates on traffic responsive mode, the entries at these addresses should be **zeroes** (meter will be on during holidays). If the meter location does not operate on traffic responsive mode, the current year holidays should be in (meter will be off during the programmed holidays). If the information in the **Holiday Table** is correct, go to10. If the meter signal lights turn on, after the **Holiday Table** is corrected, go to 12. If the lights do not turn on, go to 10.

10. Check addresses from "**0E8**" to "**0EF"**. These addresses contain active error flags after the program performs different internal tests. On occasions, by clearing the storage entries in these addresses, the meter will start to operate per the **RAM MAP**. To clear the entries in any of these addresses, input a **"0"**. If these addresses were already cleared, go to 11. If the meter signals lights turn on, after the addresses are cleared, go to 12. If the lights do not turn on, go to11.

11. As the last resource, go to address **"3E0"**. Zero out this address, to reinitialize the program. Then, you **must input the RAM MAP** information including the **TOD Table**. If the problem is fixed, go to 12. If the ramp meter signals lights are still off, go to 13.

12. **Observe the ramp meter operation for enough time, to ensure that it is operating per the RAM MAP**. If the meter does not operate properly, go to the next step.

13. **Report** this and any other ramp meter operational problem to **Electrical Maintenance and/or TMC Support.**

RAMP METER IS OPERATING ON "PRE-TIME" MODE
(CYCLING WITHOUT ANY VEHICLE AT THE DEMAND LOOP)

NOTE: Most likely, the Pre-time condition is due to the demand loop detector "locking up".

1. Check if the **Demand (D**) loop detector sensor light blinks as vehicles pass over the D loop. This indicates that the sensor is detecting the presence of vehicles. If the detector is working, go to 2 (Reminder: Loop detector sensor needs to be turned **"On"**).
   If the D loop detector sensor's light is steady on ("locked up"), then try to reset the loop detector sensor and/or check is the sensor's sensitivity setting is correct. See APPENDIX A. If the detector starts to work and the ramp meter go off the pre-time mode, go to 5. If the meter stays operating in "pre-time" mode, go to 2.
   As a last resort, pull the loop detector sensor out and plug it back in. Sometimes the loop detector sensor connection is bad or dirty and this will correct this problem. If the sensor does not work, go to 6. If the sensor starts to work and the ramp meter go off the "pre-time" mode, go to 5. If the meter stays operating in "pre-time" mode, go to 2.

2. Go to address **"0D6"** to check the status of the D loop in the controller. The controller's LCD display shows when the D loop detects a vehicle by displaying **(blinking)** a number (D loop **must be enabled** at address **"0F8"**). The D loop is represented by a number **"1".** Simultaneously, the controller bits (lights) located on the controller's faceplate will blink. If address **"0D6"** does not show a number **"1"**, go to 6. If the LCD display shows a solid number **"1"**, that means that the D loop detector is "locked up", go to 1. If the display shows a blinking number **"1"**, but the location is still operating in "pre-time" mode, go to 3.

3. Check address **"0F5"** and verify that bits **"5"**("pre-time" red) and **"6"** ("pre-time" green) are not enabled. Enabling these bits trigger the controller to operate on a "pre-time" mode (that is, the ramp meter will cycle red and green with or without traffic on the ramp). This mode is used only when Ramp Meter personnel is aware of a D and/or P loop malfunction and wants to operate the meter.
   If bit **"5"** and/or **"6"** are set (and they are not wanted on), then **zero out** these bits (on/off). If the ramp meter go off the "pre-time" mode, go to 5. If the meter is still operating on "pre-time" go to 4.

4. As a last resort, go to address **"3E0"**. **Zero out** this address, to reinitialize the program. Then, you **must input the RAM MAP** information including the **Time of Day (TOD) Table**. If the problem is fixed, go to 5. If the ramp meter is still operating on "pre-time" mode, go to 6.

5. **Observe the ramp meter operation for enough time, to ensure that it is operating per the RAM MAP**. If the meter does not operate properly, go to the next step.

6. **Report** this and any other ramp meter operational problem to **Electrical Maintenance and/or TMC Support.**

Be aware that if the D and P loops are "locked up" at the same time, the ramp meter will operate on "pre-time" mode, too. The D loop "locking up" will trigger the green light without any vehicles at the demand loop.

RAMP METER IS STUCK ON RED

(RAMP METER DOES NOT TURN GREEN WHEN VEHICLES ARRIVE AT THE DEMAND LOOP)

NOTE: Most likely, this condition is due to the demand loop failing to detect the presence of the vehicles.

1. Check if the **Demand (D**) loop detector sensor light blinks as vehicles pass over the D loop. This indicates that the sensor is detecting the presence of vehicles. If the sensor is working, go to 2.
   If the D loop detector sensor's light is off, check if the sensor is turned **"On"**. If it is **"On"**, then try to reset the sensor and/or check if the sensor's sensitivity setting is correct. See APPENDIX A. If the sensor starts to work and the ramp meter starts to meter, go to 4. If the meter stays stuck on red, go to 2.
   As a last resort, pull the loop detector sensor out and plug it back in. Sometimes the sensor connection is bad or dirty and this will correct this problem. If the sensor does not work, go to 5. If the detector starts to work and the ramp meter starts to meter, go to 4. If the ramp meter stays stuck on red, go to 2.

2. Go to address **"0D6"** to check the status of the D loop in the controller. The controller's LCD display shows when the D loop detects a vehicle by displaying **(blinking)** a number (D loop **must be enabled** at address **"0F8"**). The D loop is represented by a number **"1".** Simultaneously, the controller bits (lights) located on the controller's faceplate will blink.
   If address **"0D6"** does not show a number **"1"**, go to 5. If the LCD display shows a blinking number **"1",** but the ramp meter is stuck on red, go to the next step.

3. As a last resort, go to address **"3E0"**. Zero out this address, to reinitialize the program. Then, you **must input the RAM MAP** information including the **Time of Day (TOD) Table**. If the problem is fixed, go to 4. If the ramp meter is still stuck on red, go to 5.

4. **Observe the ramp meter operation for enough time, to ensure that it is operating per the RAM MAP**. If the meter does not operate properly, go to the next step.

5. **Report** this and any other ramp meter operational problem to **Electrical Maintenance and/or TMC Support.**

Be aware that if the D and P loops fail at the same time, the ramp meter will get stuck on red, too. The D loop failing to detect the presence of vehicles will not trigger the beginning of a cycle (green light).

MAXIMUM GREEN TIME ON EVERY CYCLE
(EVEN THOUGH VEHICLES ALREADY PASSED OVER THE PASSAGE LOOP)

NOTE: Most likely, this condition is due to the passage loop failing to detect the presence of the vehicles.
Before you start this procedure, be aware of the RAM MAP programmed values for the maximum and minimum green light time at addresses "086" and "09B", respectively.

1. Check if the **Passage (P**) loop detector sensor light blinks as vehicles pass over the P loop. This indicates that the sensor is detecting the presence of vehicles. If the sensor is working, go to 2.
   If the P loop detector sensor's light is off, check if the sensor is turned **"On"**. If it is **"On"**, then try to reset the sensor and/or check if the sensor's sensitivity setting is correct. See APPENDIX A. If the detector starts to work and the ramp meter starts to meter properly, go to 4. If the green light time is still the maximum, go to 2.
   As a last resort, pull the loop detector sensor out and plug it back in. Sometimes the sensor connection is bad or dirty and this will correct this problem. If the sensor does not work, go to 5. If the sensor starts to work and the ramp meter starts to meter properly, go to 4. If the green light time is still the maximum, go to 2.

2. Go to address **"0D6"** to check the status of the P loop in the controller. The controller's LCD display shows when the P loop detects a vehicle by displaying **(blinking)** a number (P loop **must be enabled** at address **"0F8"**). The P loop is represented by a number **"2".** Simultaneously, the controller bits (lights) located on the controller's faceplate will blink. If address **"0D6"** does not show a number **"2"**, go to 5. If the LCD display shows a blinking number **"2",** but the green light time is still the maximum, go to the next step.

3. As a last resort, go to address **"3E0"**. Zero out this address, to reinitialize the program. Then, you **must input the RAM MAP** information including the **Time of Day (TOD) Table**. If the problem is fixed, go to 4. If the green light time is still the maximum, go to 5.

4. **Observe the ramp meter operation for enough time, to ensure that it is operating per the RAM MAP**. If the meter does not operate properly, go to the next step.

5. **Report** this and any other ramp meter operational problem to **Electrical Maintenance and/or TMC Support.**

Be aware that if the D and P loops fail at the same time, the ramp meter will get stuck on red. The D loop failing to detect the presence of vehicles will not trigger the beginning of a cycle (green light).

MINIMUM GREEN TIME ON EVERY CYCLE
(EVEN THOUGH VEHICLES HAVE NOT PASSED OVER THE PASSAGE LOOP TO TERMINATE THE GREEN TIME)

NOTE: Most likely, this condition is due to the passage loop detector "locking up". Before you start this procedure, be aware of the RAM MAP programmed values for the maximum and minimum green light time at addresses "086" and "09B", respectively.

1. Check if the **Passage (P**) loop detector sensor light blinks as vehicles pass over the P loop. This indicates that the sensor is detecting the presence of vehicles. If the detector is working, go to 2 (Reminder: Loop detector sensor needs to be turned **"On"**).
   If the P loop detector sensor's light is steady on ("locked up"), then try to reset the detector and/or check if the sensor's sensitivity setting is correct. See APPENDIX A. If the sensor starts to work and the ramp meter starts to meter properly, go to 4. If the green light time is still the minimum, go to 2.
   As a last resort, pull the loop detector sensor out and plug it back in. Sometimes the sensor connection is bad or dirty and this will correct this problem. If the sensor does not work, go to 5. If the sensor starts to work and the ramp meter starts to meter properly, go to 4. If the green time is still the minimum, go to 2.

2. Go to address **"0D6"** to check the status of the P loop in the controller. The controller's LCD display shows when the P loop detects a vehicle by displaying **(blinking)** a number (P loop **must be enabled** at address **"0F8"**). The P loop is represented by a number **"2"**. Simultaneously, the controller bits (lights) located on the controller's faceplate will blink. If address **"0D6"** does not show a number **"2"**, go to 5. If the LCD display shows a solid number **"2"**, that means that the loop detector is "locked up", go to 1. If the display shows a blinking number **"2"**, but green light time is still the minimum, go to 3.

3. As a last resort, go to address **"3E0"**. Zero out this address, to reinitialize the program. Then, you **must input the RAM MAP** information including the **Time of Day (TOD) Table**. If the problem is fixed, go to 4. If green time is still the minimum, go to 5.

4. **Observe the ramp meter operation for enough time, to ensure that it is operating per the RAM MAP**. If the meter does not operate properly, go to the next step.

5. **Report** this and any other ramp meter operational problem to **Electrical Maintenance and/or TMC Support.**

Be aware that if the D and P loops are "locked up" at the same time, the ramp meter will operate on "pre-time" mode. The D loop "locking up" will trigger the green light without the presence of any vehicles at the demand loop.

RAMP METER CONTROLLER CABINET

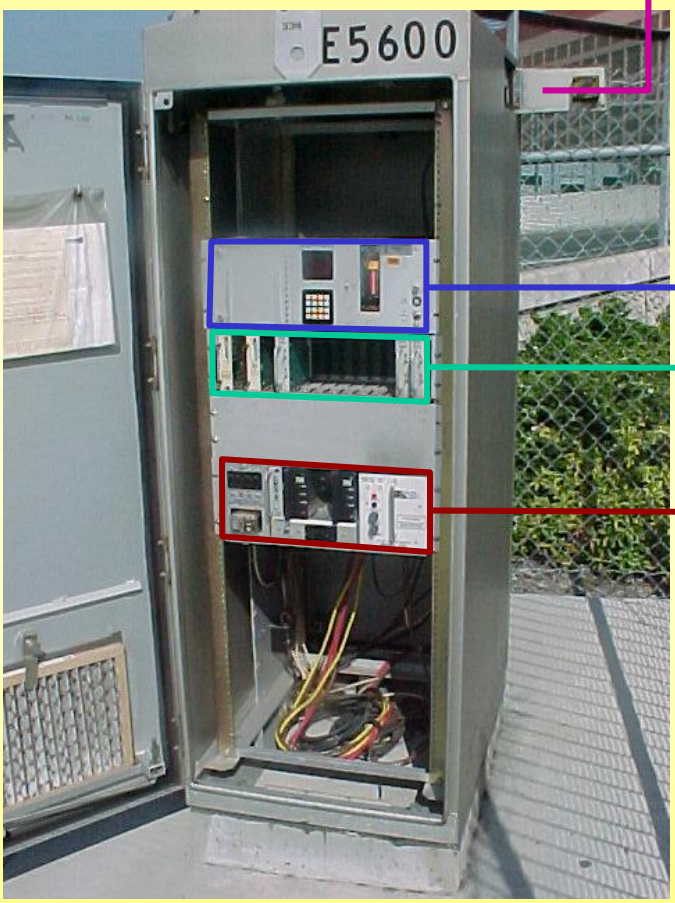
Police\Light Switch Panel

Light Switch

“170” Controller

Stop/Timing Toggle Switch

Key Pad & LCD Display



Loop Detector Sensors Input File

Loop Detector Sensors

“170” Controller Cabinet

Power Distribution Assembly

Watchdog Switch

ATTACHMENT A

- **RAM MAP**
  (Page "00XY" & TOD Table)
- **LOOP DETECTOR SENSOR LAYOUT SHEET**
- **AS-BUILTS PLAN**

Notes:

- Ramp Metering personnel are **responsible** for the creation, placement and up-keep of these documents (RAM MAP, Loop Detector Sensor Layout Sheet and As-Built plans).

- These documents **must be placed inside every** RMS and VDS cabinet in the District.

SATMS 2.3 RAM MAP Page "00XY"

Date 10/6/2005

Route	105	Direction	WB	P.M.	3.3	Location	IMPERIAL/PRAIRIE
E. No	4808	Loc. No.	1808	Line No.	33	Controller No.	3	Engineer	RAFAEL BENITEZ

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F		"BITS" or "FLAGS"
0	GETADD		DATA	CHARCT	SCTML1	TEMP00	CYLEN	RXSTST	FIRGR **60**	FMNL **255**	HOLTBL **00**	CFTRR	TBCNT2	DATA0A	DATA1A	STATUS	0	
1	"+1"		BLKOUT	SPCOUT	SCTML2	TEMP01	DCNTR	TXSTAT	FYELL **3.0**	FLSHR **00**		Q1CYTMR	ACKFLG	DATA0B	DATA1B	SIGMSK **0 0**	1	
2	PUTADD		PGADD	MODE	SCTML3	TEMP02	PCNTR	TXINIT	PLTYEL **0.0**	LASTGR **60**			ETBFLG	DATA0C	DATA1C	QFLAG	2	
3	"+1"		WDADD	CHARIN	SCTML4	TEMP03	YCNTR	INCTR	LNGYEL **3.0**	PHYSML **03**		GOODML	PADFLG	DATA0D	DATA1D	QSTAT	3	
4	EXINDX		D1	LASTCB	SCTML5	TEMP04	DLETM	BTCK	**0.0**	PHYSOP **00**		GOODOS	CARCT1	DETINA	STCHGA	COMM1 **0 ##**	4	1 2 3
5	"+1"		D2	TIMEFX	SCTML6	TEMP05	PLETM	TRCODE	QTHRS **2.0**	Q2THRS **0.0**		RLPSEL	SPRCNT	DETINB	STCHGB	COMM2 **0 ##**	5	3
6	HZ30		D3	HR	SCTOS1	TEMP06	GRNTMR	CCHK	MXGRNA **5.0**	QON **0.0**		MAXRATE	ACKMEM	DETINC	STCHGC	DTCTRA **## ##**	6	1 2 3 7
7	HZ30+1		D4	MIN	SCTOS2	TEMP07	QTMR	XCCHK	MXGRNB **0.0**	Q2ON **0.0**		QMAXRAT	"+1"	DETIND	STCHGD	DTCTRB **0 0**	7	
8	HZ30+2		D5	SEC	SCTOS3	TEMP08	CNTR	GRFLAG	CROCCA **17.0**	QOFF **0.0**			ENDFG1	BLKTMR	ERRORA **00**	DTCTRC **## ##**	8	1 2 3 4 5 6
9	HZ30+3		D6	YEAR	SCTOS4	TEMP09	TIME	RBPNTR	CROCCB **0.0**	Q2OFF **0.0**			ENDFG2	GRNFLG	ERRORB	DTCTRD **## ##**	9	1 5
A	HZ30+4		H1	MONTH	SCTOS5	TEMP0A	SOURCE	"+1"	CRVOLA **90**				XMITFG	EXFLAG	ERRORC	ALTDES	A	
B	HZ30+5		H2	DAOFMO	SCTOS6	TEMP0B	RATE	TBPNT1	CRVOLB **00**	MINGRN **2.0**			SEND1	TXFLGS	ERRORD	LNDSML **0 0**	B	
C	TMFLAG		H3	DAOFWK	DWNCNT	BITSTR	MXGRN	"+1"	PSELA **01**	CRSPEED **35**			TSTFLG		ERSETA	LNDSOS **0 0**	C	
D	BFTMR		H4	DIM	TLANES	CYCLY	PSEL	TBCNT1	PSELB **00**	Q1CYGRN **255**				DEFLAG	ERSETB	ENBLR **0F**	D	1 2 3 4
E	"+1"		H5	SSEC	LNCNT	PCC	CRVOL	TBPNT2	RLANES **01**	Q1MAXSET **15**				STSC	ERSETC	SIGFLG	E	
F	MONITR		H6	DAYPTR	WDTGGL	VLTN	CROCC	"+1"	GRNHLD **60**	RATESTP **02**	**00**			REFLAG	ERSETD **00**	DPERR	F	
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F		

SATMS 2.3 Time-of-Day (TOD) Table

Date 10/18/2005

Route	105	**Direction**	WB	**P.M.**	3.3	**Location**	IMPERIAL/PRAIRIE
E. No.	4808	**Location No.**	1808	**Line No.**	33	**Controller No.**	3

Engineer RAFAEL BENITEZ

No. of Metered Lane(s) 1

HOV Lane YES

Platooning Plans

(Column A CLR)

PSELA($8C) = 01 MAXGRNA ($86) = 5.0

(Column A SET)

PSELB($8D) = 00 MAXGRNB ($87) = 0.0

Critical Volume/Occupancy Plans

(Column B CLR)

CRVOLA ($8A) = 90 CROCCA ($88) = 17.0

(Column B SET)

CRVOLB ($8B) = 00 CROCCB ($89) = 0.0

INTV	Time of Day (Hrs.)	Rates (Veh/Min)	Days of the Week							DEV 1 On	DEV 2 On	(A) Platn	(B) Crvol
			M	T	W	Th	F	Sa	Su				
01	0530	08	X	X	X	X	X						
02	1400	10	X	X	X	X	X						
03	1930	00	X	X	X	X	X						
04	3333												
05													
06													
07													
08													
09													
10													
11													
12													
13													
14													

SATMS 2.3 Loop Detector Sensor Layout Sheet

Date 10/18/2005

Route	105	Direction	WB	P.M.	3.3	Location	IMPERIAL/PRAIRIE
E. No.	4808	Location No.	1808	Line No.	33	Controller No.	3	Engineer	RAFAEL BENITEZ

SLOT #1	SLOT #2	SLOT #3	SLOT #4	SLOT #5	SLOT #6	SLOT #7	SLOT #8	SLOT #9	SLOT #10	SLOT #11	SLOT #12	SLOT #13	SLOT #14
D1 0F8-1 X	SD1 0F9-1 X	Q1 0F8-3 X	HOV 0F8-6 X	ON1 0F8-4 X	SD4 0F9-4	CD ON OF8-8	CD1 0F8-7	OS1 OF7-1	OS3 OF7-3	OS5 0F7-5	ML5 0F6-5	ML3 0F6-3 X	ML1 0F6-1 X
P1 0F8-2 X	SD2 0F9-2	SD3 0F9-3	Q2 0F9-6	OFF1 0F8-5 X	SD5 0F9-5 X	CD OFF 0F7-8	CD2 0F7-7	OS2 OF7-2	OS4 OF7-4	OS6 0F7-6	ML6 0F6-6	ML4 0F6-4	ML2 0F6-2 X
		Descrp	Descrp RAMP HOV	Descrp PRAIRIE OFF	Descrp HAWTHORNE OFF	Descrp	Descrp						

0F1 (0 0)

1		Enable Device 1
2		Enable Device 2

0F4 (0 #) — *0D2*

1	X	Enable Metering
2	X	Enable Local Responsive
3	X	Enable Q1 Override
4		Enable Q2 or Super Q1 Override
5		Enable Independent Q2
6		Check ML Speed Before Q-override
7		Enable Mag. D & P Lock-in

0F5 (0 #) — *0D3*

1		Device 1 Flash
2		Device 2 Flash
3	X	"Meter On" Sign Flash
4		Enable Load Switch Monitoring
5		Pre-time Red (if no Demand Det)
6		Pre-time Green (if no Passage Det)
7		Enable Shutdown Top EMS Failure
8		Enable Shutdown Bot. EMS Failure

0F6 (## #) — *0D4*

1	X	Main Line 1
2	X	Main Line 2
3	X	Main Line 3
4		Main Line 4
5		Main Line 5
6		Main Line 6
7	X	ML HOV Flag
8		Fwy Conn Flag

0F7 (0 0) — *0D5*

1		Opp Side 1
2		Opp Side 2
3		Opp Side 3
4		Opp Side 4
5		Opp Side 5
6		Opp Side 6
7		CD2
8		CD OFF

0F8 (# #) — *0D6*

1	X	Demand
2	X	Passage
3	X	Queue 1
4	X	ON1
5	X	OFF1
6	X	Ramp HOV
7		CD1
8		CD ON

0F9 — *0D7*

1	X	SD1 ML HOV
2		SD2
3		SD3
4		SD4
5	X	SD5 HAWTHORNE OFF
6		Queue 2
7		Pass Vol Count
8		(Not Used)

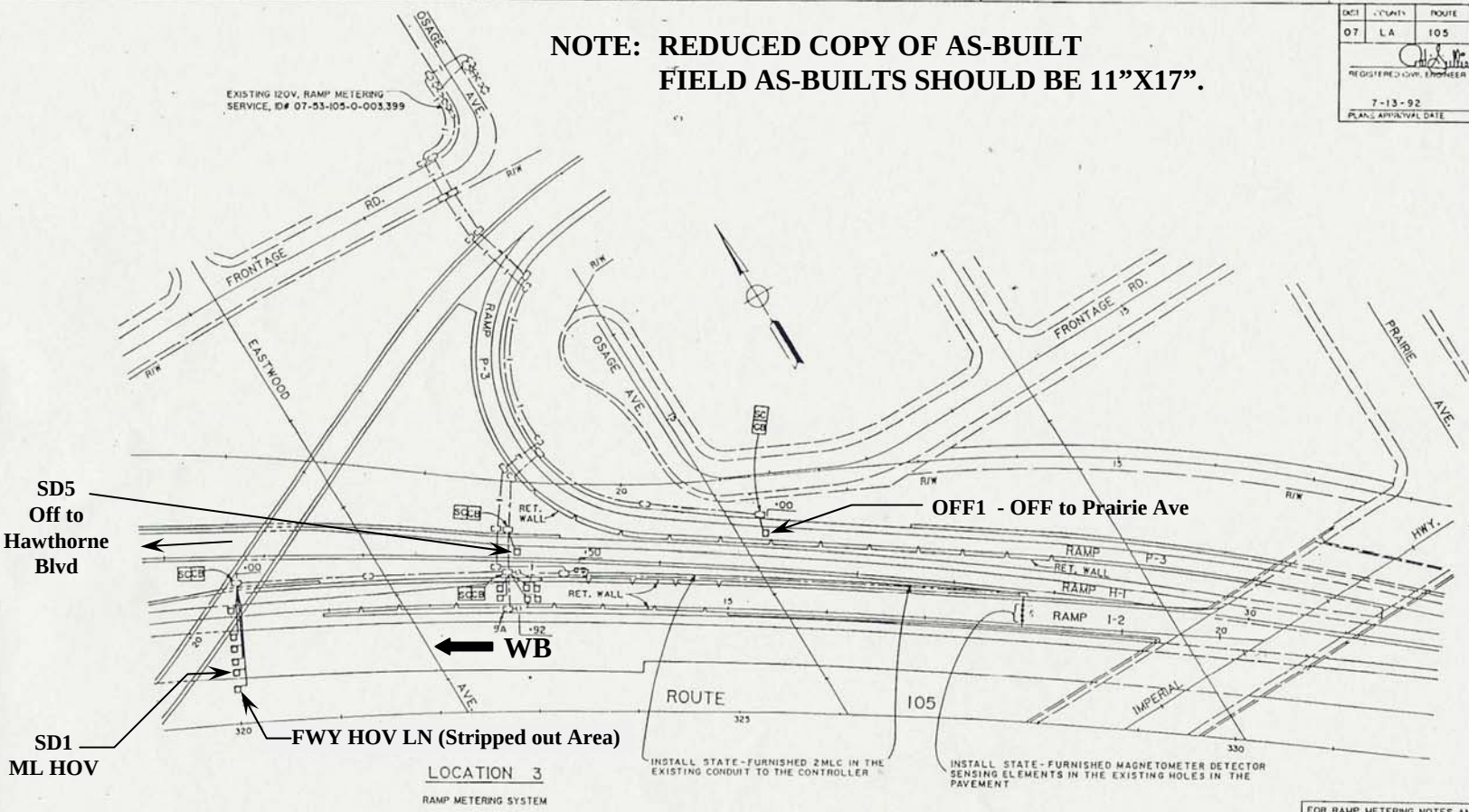
0FB (0 0)

1		ML1 Disabler
2		ML2 Disabler
3		ML3 Disabler
4		ML4 Disabler
5		ML5 Disabler
6		ML6 Disabler
7		(Not Used)
8		(Not Used)

0FC (0 0)

1		OS1 Disabler
2		OS2 Disabler
3		OS3 Disabler
4		OS4 Disabler
5		OS5 Disabler
6		OS6 Disabler
7		(Not Used)
8		(Not Used)

NOTE: REDUCED COPY OF AS-BUILT
FIELD AS-BUILTS SHOULD BE 11”X17”.



DIST	COUNTY	ROUTE	EXIST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
07	LA	105	R2.5/R5.5	58	75

REGISTERED CIVIL ENGINEER — PAT WILIVAN — 3-31-96
7-13-92 PLANS APPROVAL DATE

FOR RAMP METERING NOTES AND LEGEND SEE SHEET E-1

FOR PROJECT NOTES & LEGEND SEE SHEET E-4

LA-105-WB PM 3.30
AT PRAIRIE/IMPERIAL

FWY OPS
Traffic Engineer: Rafael Benitez
(213) 897-1666

RAMP METERING SYSTEM
(LOCATION 3)
SCALE: 1"=50'

E-3

NOTE: THIS PLAN ACCURATE FOR ELECTRICAL ONLY.

I - 105 CENTURY PROJECT 61 | CU 07202 | EA 115001

DESIGNED BY WJ | CHECKED BY J. KAWAMOTO | REVISED BY | DATE REVISED

Caltrans TRAFFIC DESIGN

ATTACHMENT B

RAMP METER INVENTORY FIELD FORM

RAMP METER INVENTORY FIELD FORM

DIST.	CO.	RTE	DIR.	PM	E #	LOCATION
07	LA					

OPERATION OF METERED LANE(S)

RAMP TYPE					M - F	AM METERING	FROM		TO	
NO. OF LANES AT ENTRANCE						PM METERING	FROM		TO	
NO. OF LANES AT METER					SA	AM METERING	FROM		TO	
RAMP STORAGE (VEH.)					SU	PM METERING	FROM		TO	
"METER ON" SIGN (LOC.)	NO	YES	LT	RT	MAX. RATE		MIN. RATE			
FLASHING BEACON (LOC.)	NO	YES	LT	RT	PLATOON METERING	NO		YES	VEH/CY.	

HOV & PULLOUT INFORMATION

RAMP HOV LANE	YES		NO	
HOV LANE LOCATION	LT		RT	
MAINTENANCE PULLOUT	YES		NO	
CHP PULLOUT AREA	YES		NO	

LOOPS INVENTORY

DMD		ML 1		SD 1		OS 1	
PAS		ML 2		SD 2		OS 2	
QUE		ML 3		SD 3		OS 3	
ON		ML 4		SD 4		OS 4	
OFF		ML 5		SD 5		OS 5	
HOV		ML 6		QUE 2		OS 6	
CD 1						CD 2	
CD ON						CD OFF	

W: WORKING NW: NOT WORKING ?: UNCERTAIN

FIELD REVIEW AND COMMENTS

SIGNING

STRIPING

COMMENTS

RECOMMENDATIONS

INVESTIGATOR	DATE	SUPERVISOR	DATE

ATTACHMENT C

FREEWAY SURVEILLANCE FORM

The Freeway Surveillance Form (see next page) provides a log of:

- When the ramp meter malfunction was detected.
- The type of malfunction.
- If Ramp Metering personnel fixed the malfunction or it was “Called in” to the Electrical Maintenance and/or TMC Support.
- A malfunction / repair history by location.

FREEWAY SURVEILLANCE FORM

WESTBOUND ROUTE 10 (SANTA MONICA FWY)

DATE:_____ DAY:_____ NAME(S):_____

LOCATION	LNS	TIME	METER	QUEUE	COMMENTS
1- HOOVER ST	2				
2- VERMONT AVE	2				
3- NORMANDIE AVE	2				
4- WESTERN AVE	HOV+1				
5- ARLINGTON AVE	2				
6- CRENSHAW AVE	HOV+1				
7- NB-LA BREA AVE	1				
8- SB-LA BREA AVE	2				
9- FAIRFAX AVE	1+HOV				
10- LA CIENEGA AVE	2				
11-ROBERTSON AVE	2				
12- OVERLAND AVE	2				
13-CENTINELA AVE	2				
14- 20TH ST	HOV+1				

APPENDIX A

LOOP DETECTOR SENSORS RECOMMENDED SETTINGS

LOOP DETECTOR SENSORS NOTES

- Be aware that not all of the loop detector sensors used in the ramp meter cabinets are represented in this Appendix. Included are the most common ones used in District 7. Ramp Metering personnel should contact TMC Support and/or Electrical Maintenance Dept. if they encounter a loop detector sensor in the field that is not included in this Appendix. TMC Support and/or Electrical Maintenance personnel should be able to provide the manufacturer recommended sensor setting.

- One of the many Electrical Maintenance personnel responsibilities is to maintain the ramp meter loop detector sensors in good operating conditions and to set their sensitivity to the correct recommended manufacturer setting.

- Ramp Metering personnel should have the basic understanding of how the loop detector sensors work. This will allow Ramp Metering personnel to solve basic sensor malfunctions and/or problems, like:

    - Sensor “locking up”
    - Recognize wrong sensor ’s setting
    - Recognize when a sensor is “bad” (malfunctioning)
    - Set the correct sensor’s sensitivity, etc.

Introduction to Loop Detector Sensor's Settings

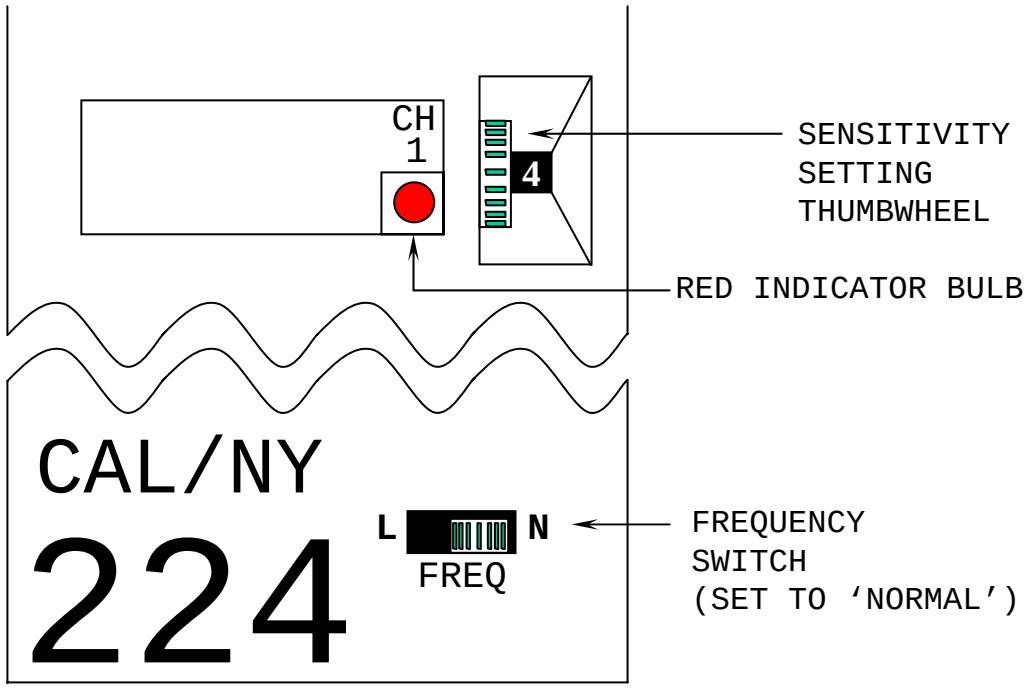
The generation of speed values from volume/occupancy measurement is highly dependent on the sensitivity switch settings found on inductive loop sensors. The sensors contain; on/off switches, pulse/presence switches, frequency switches, sensitivity switches and sometimes reset switches. To obtain occupancy values, the on position and the presence position are essential. The frequency switch has not shown to influence occupancy, however the frequency switch can be used to prevent sensor lockups. The sensitivity switches or dial however have a range of settings. This range of settings can be used to obtain various occupancy values for the same real-world vehicle/speed combination. As a direct consequence of these settings, a real-world free flow average speed of say 58 MPH can be changed into 120 MPH or 30 MPH or various values in between. To obtain the estimated (calculated) 58 MPH value from the computer, the sensitivity switch settings must be set in predetermined positions so the correct occupancy can be generated. This report determines the sensitivity switch settings for various manufacturers' sensors.

It is critical that the sensitivity switches be set correctly because if they are not, the ATMS computer will show speeds that are too high (over 100 MPH) or too low (below 30 MPH) in supposedly free flow traffic. This data will be invalid for public dissemination (internet, etc.), traffic studies or say for a court case.

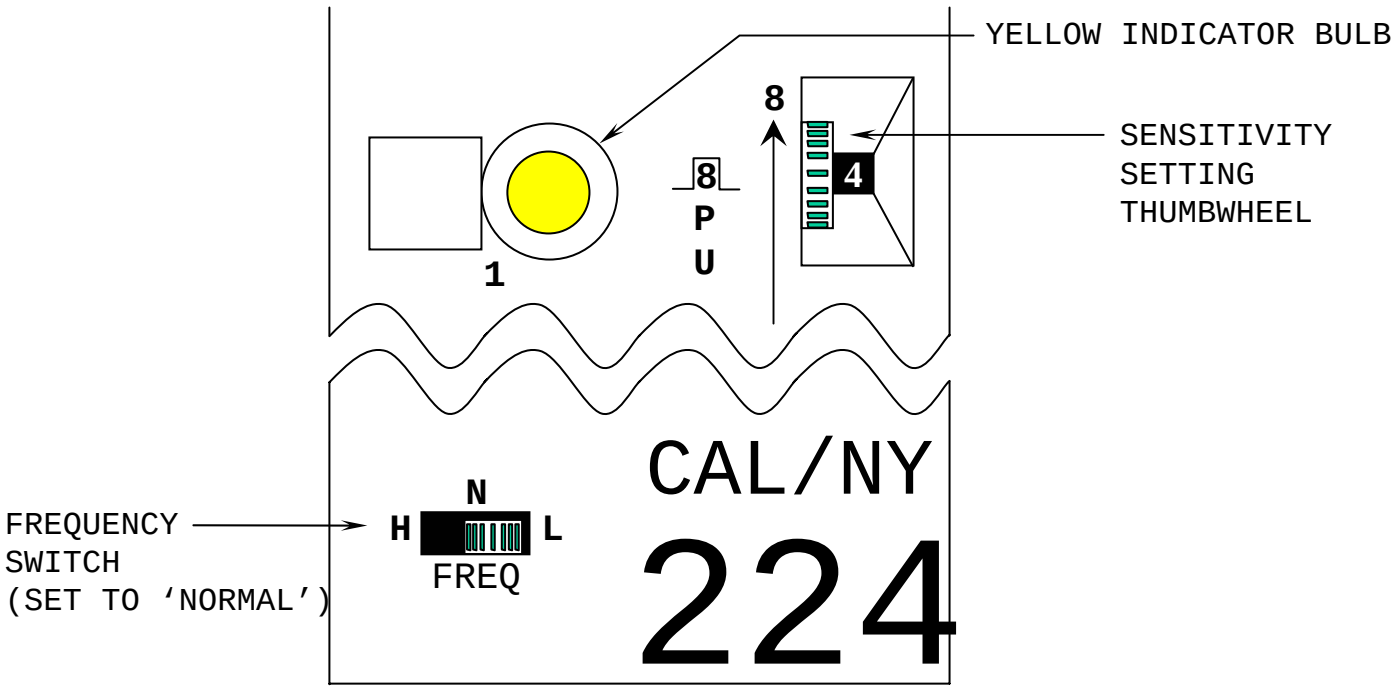
Additionally, and no less importantly, the speeds are used by the Transportation Management Center to determine if incidents are occurring in "real time" by using the Freeway Operations Status Map Display and or the ATMS computer station. False speed can lead to false Response Team callouts and will also erode the Operator's confidence in their use of the data from the field.

One of the objectives of the Office of Freeway Operations is to track the quantity and quality of the freeway system. That is not only how many vehicles used the system, but also how well the system operates in terms of speed.

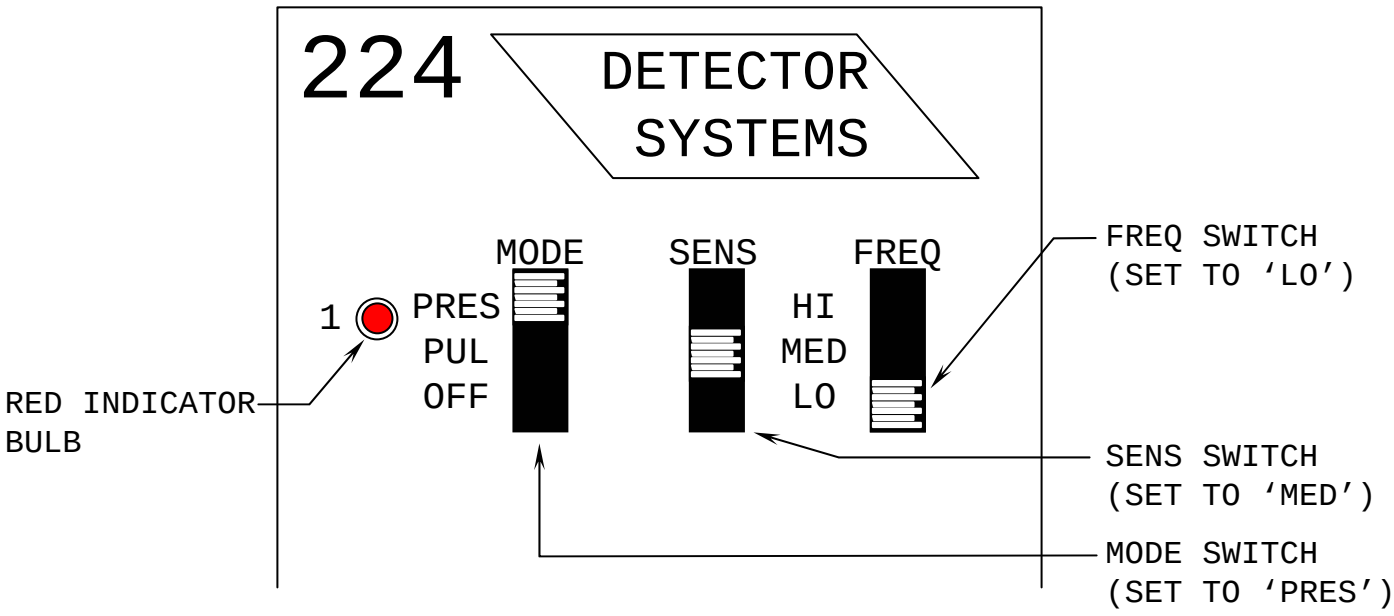
The sensitivity switches must thus be set at or as near to the values recommended. This Appendix defines those switch settings.



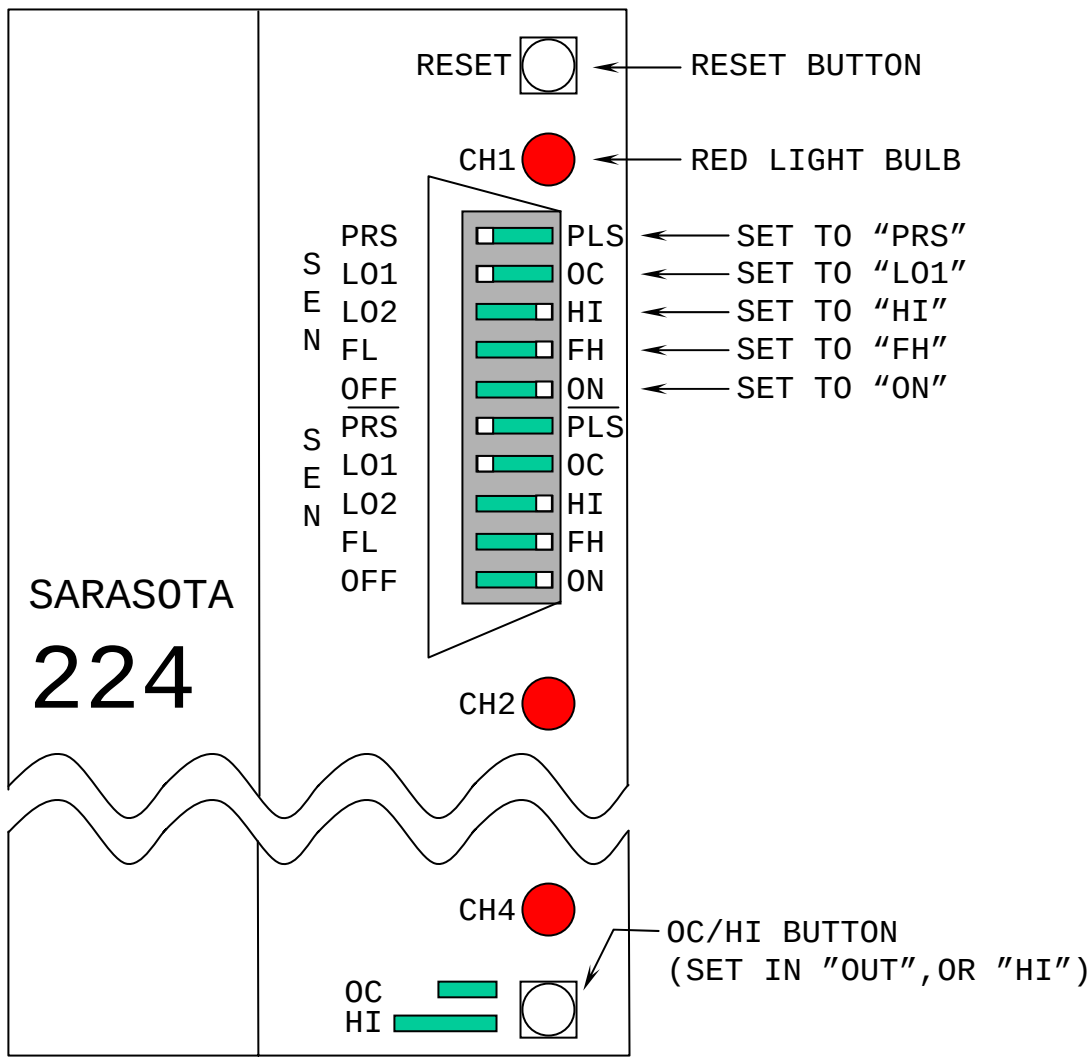
CANOGA CONTROLS MODEL P224



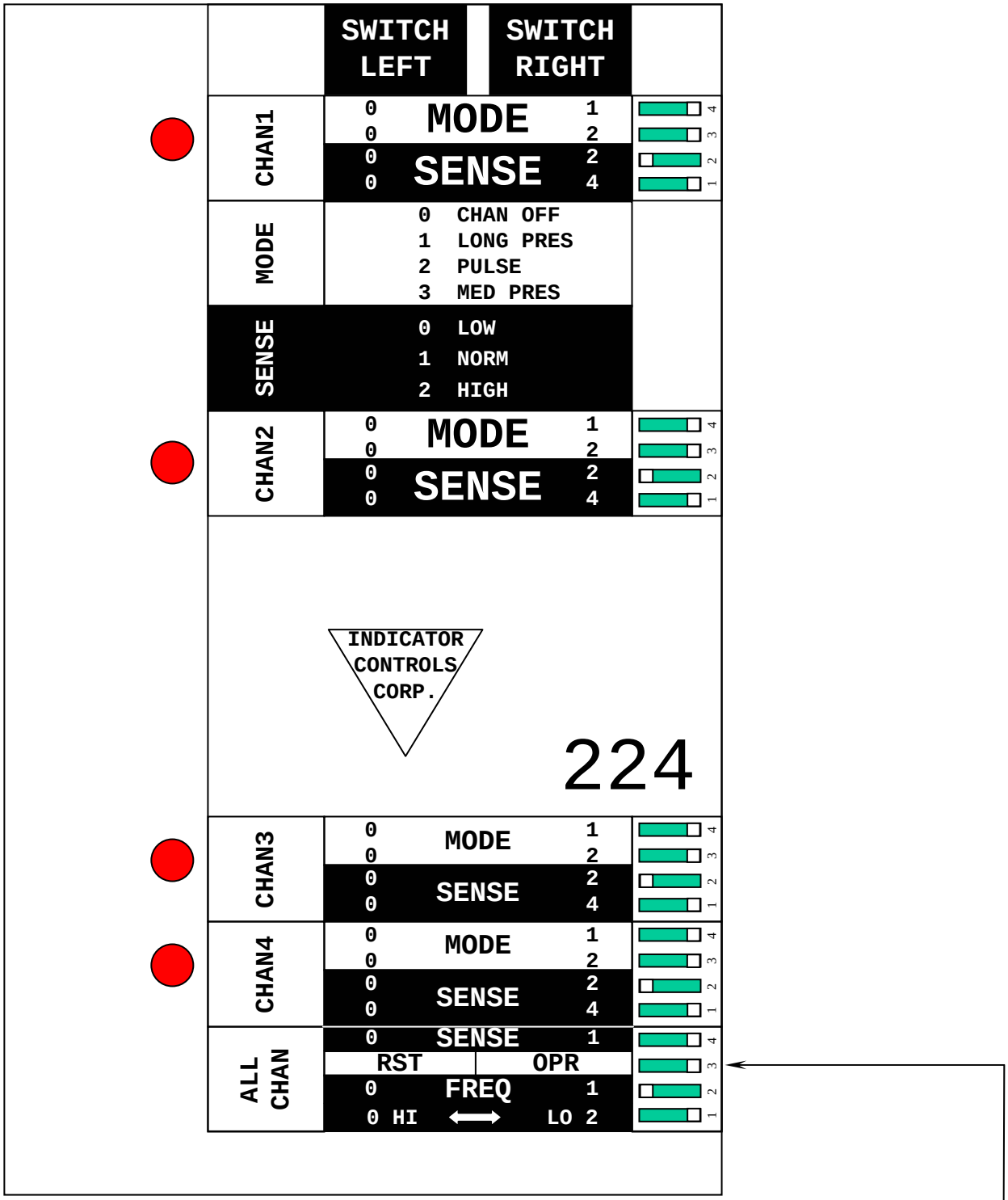
CANOGA CONTROLS PROXIMITOR 224

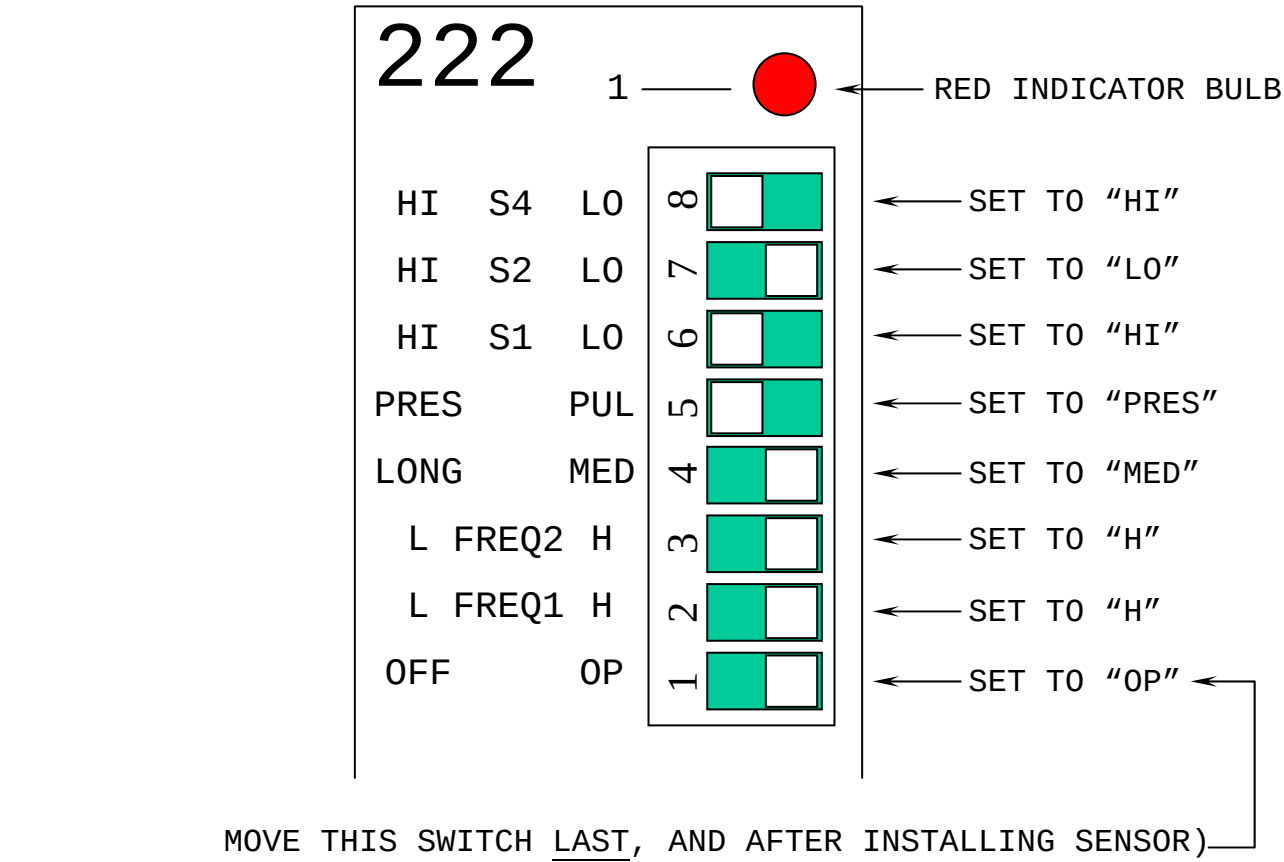


DETECTOR SYSTEMS 224

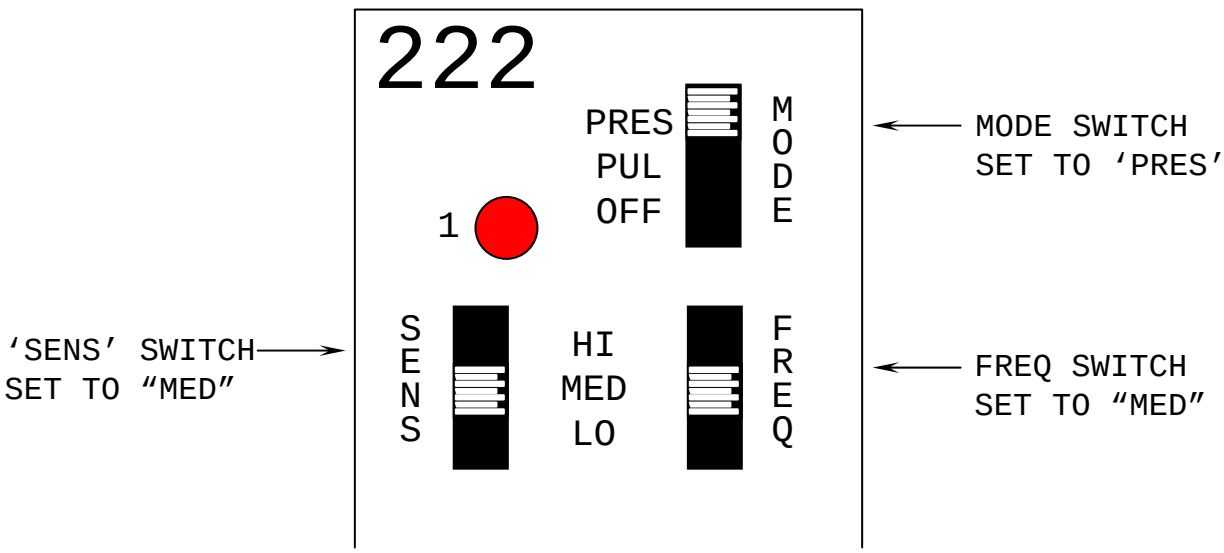


SARASOTA 224

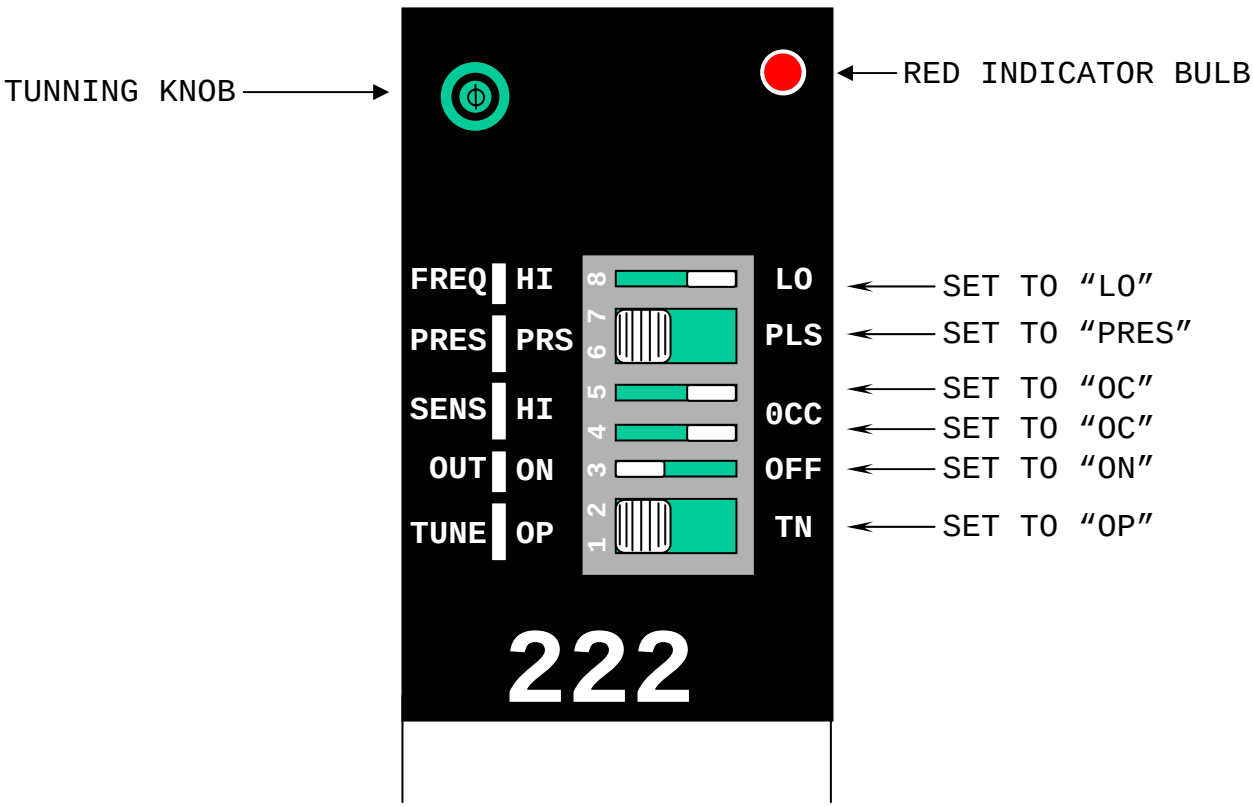

SWITCH LEFT
SWITCH RIGHT
CHAN1
MODE
SENSE
0 MODE 1
0 2
0 SENSE 2
0 4
MODE
0 CHAN OFF
1 LONG PRES
2 PULSE
3 MED PRES
SENSE
0 LOW
1 NORM
2 HIGH
CHAN2
MODE
SENSE
INDICATOR CONTROLS CORP.
224
CHAN3
MODE
SENSE
CHAN4
MODE
SENSE
ALL CHAN
SENSE
RST
OPR
FREQ
0 HI
LO 2
MOVE THIS SWITCH LAST, AND AFTER INSTALLING SENSOR.



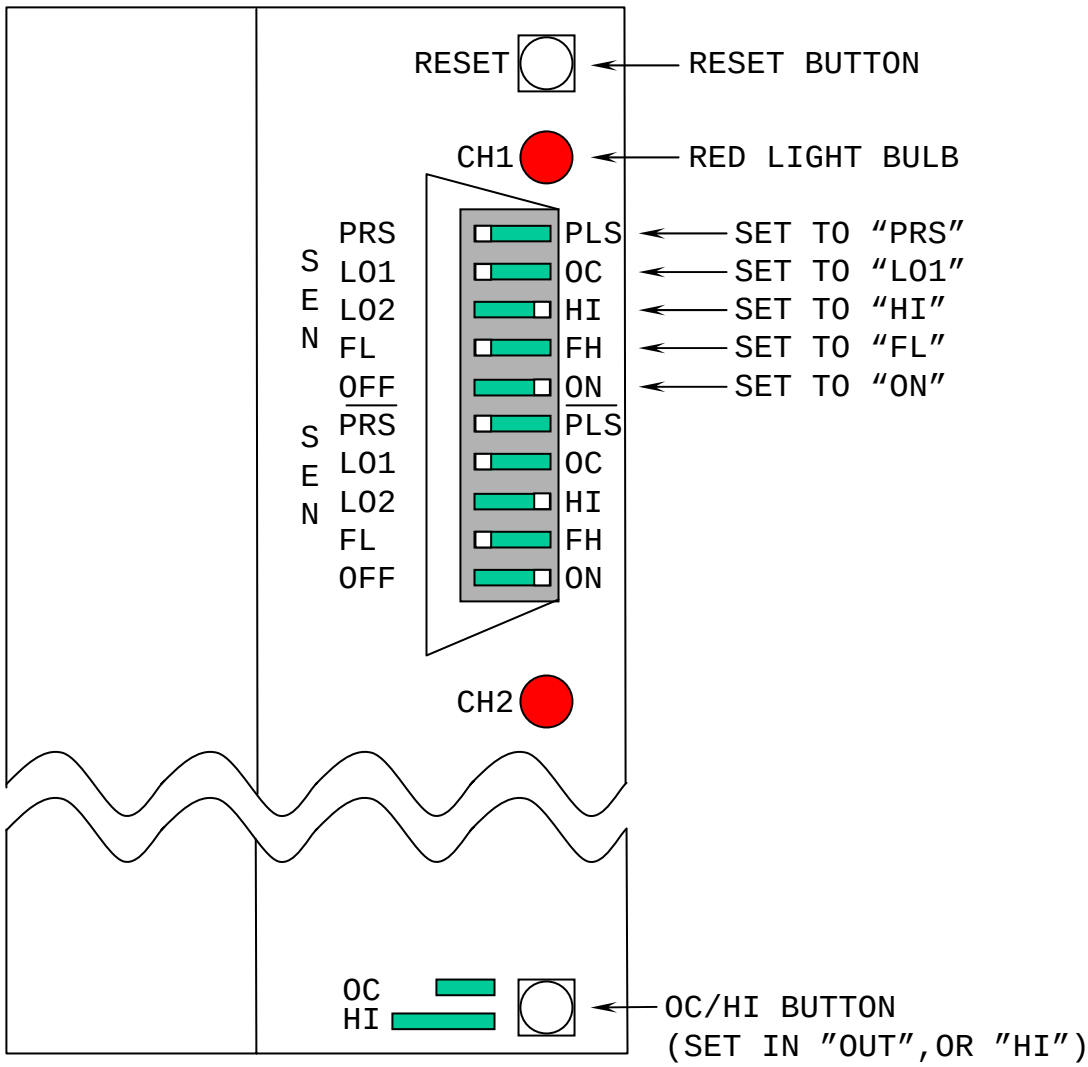
DETECTOR SYSTEMS 222



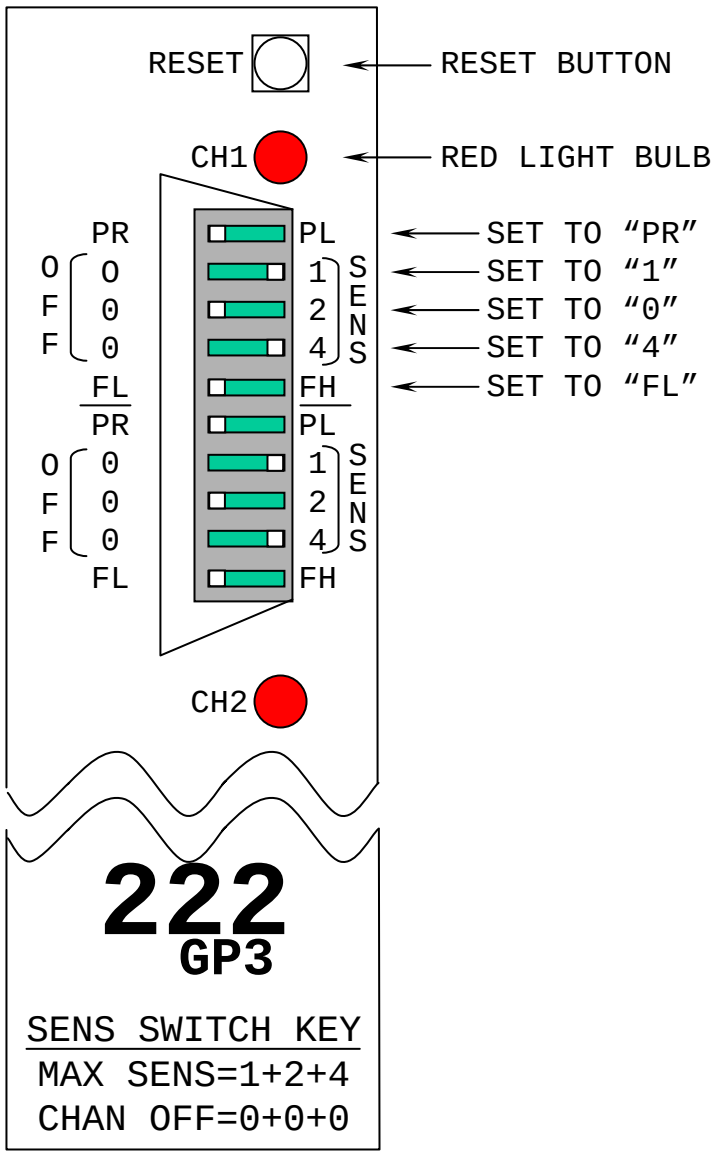
DETECTOR SYSTEMS 222



SARASOTA 222 “BLACK”

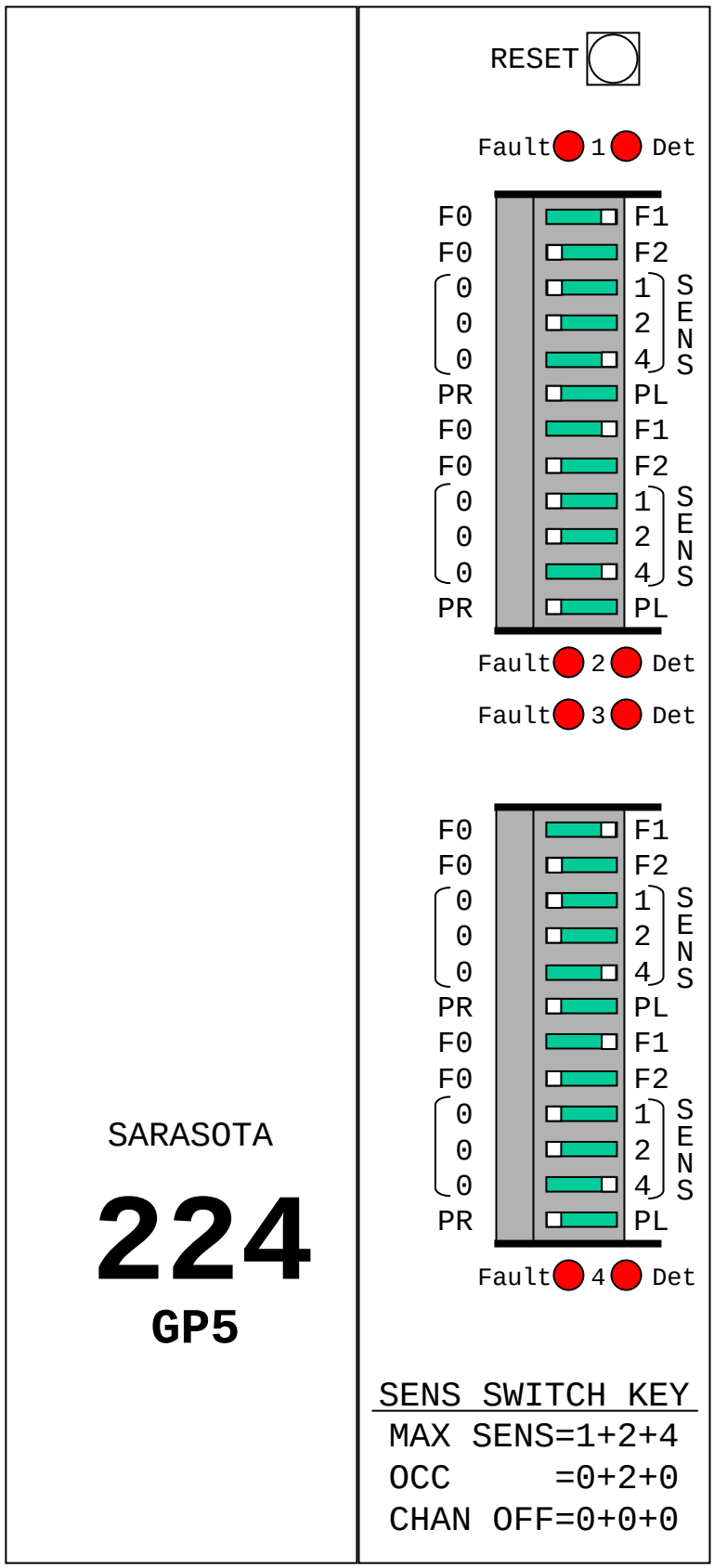


SARASOTA 222



SARASOTA 222 GP3

FREQ SWITCH
CAN BE CHANGED
TO STOP
CROSS TALKING



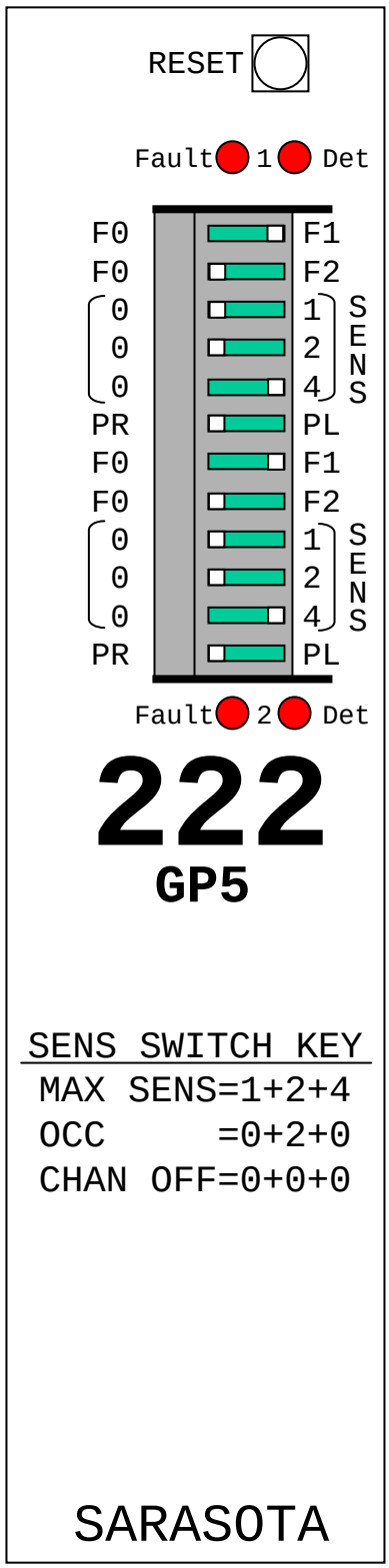
SENS
SWITCH
1 LT.
2 LT.
4 RT.
PR LT.

SARASOTA

224

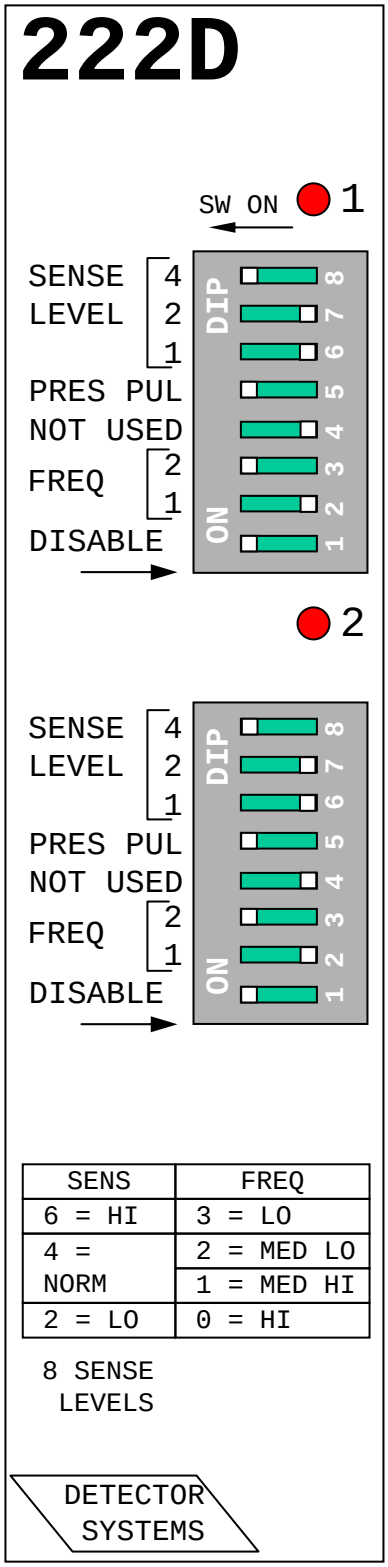
GP5

FREQ SWITCH
CAN BE CHANGED
TO STOP CROSS TALKING



SENS SWITCH	
1	LT.
2	LT.
4	RT.
PR	LT.

FREQ SWITCH
CAN BE CHANGED
TO STOP CROSS TALKING



SENS
SWITCH
1 RT.
2 RT.
4 LT.
PR LT.

DISABLE SWITCH
LT.

YOU CAN CHANGE FREQ'S TO STOP CROSS TALKING

SARASOTA 222

APPENDIX B

SATMS (ver. 2.3) SOFTWARE
WORKSHOP NOTES*

*** This Appendix is the workshop notes of Mr. Liem Phan, TMC Support.**

SATMS* VERSION 2.3
(INTERIM SOFTWARE)

- This section explains in detail how the ramp meter software operates and how the user input in the program affect the operation of ramp meters. ***Field personnel must fully understand the software*** in order to operate it and be able to detect and trouble shoot ramp meter malfunctions in the field.

- The software description included in this Manual is the SATMS ver. 2.3, which is an interim version program developed in CALTRANS District 7. The final version (ver. 3.0) will be released by the end of year 2002. This section will be updated once the final software (ver. 3.0) is released and field-tested.

*** SATMS** is an acronym for **S**emi **A**utomatic **T**raffic **M**anagement **S**ystem

SATMS Version 2.3 Workshop

October 17, 2001

About This Workshop

- For Maintenance and Operations (new and experienced) personnel to gain updates on hardware and software

About This Workshop (cont'd)

- For Maintenance people who want to:
  - know more on the operation of ramp meters
  - Understand how the program basic functions work
- For Operations people who need to:
  - know more about hardware
  - understand the concept and limits of the program

About This Workshop (cont'd)

- Not for Design Engineers
- Active participation and sharing of knowledge and experience is highly encouraged

SATMS-3

- 2 Versions:
  - Interim Version – v.2.3
  - Final Version – v.3.0

SATMS-3 Interim version

- Immediately accommodate SWARM operation
- Was installed on I-210 WB at twenty ramps on 8/13/2001

SATMS-3 Final version

- Will be put in service – Late January 2002
- More features as discussed in earlier brain-storming meetings
- More enhancements and bugs fixed
- Will gradually phase in to replace SATMS and all other versions of SATMS-C

SATMS-3 - Enhancements

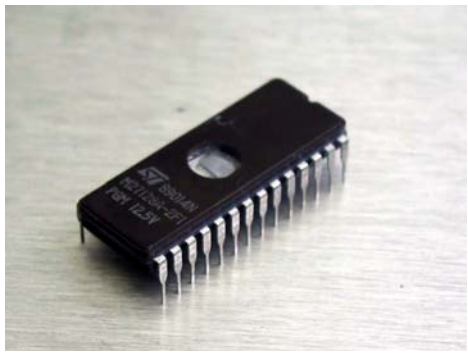
- Auto Re-initialization when software version changes
- Prevents controller from resetting after short power-down
- Reduces to 8 holiday entries
- New default values with safety protection range

SATMS-3 – Enhancements (cont'd)

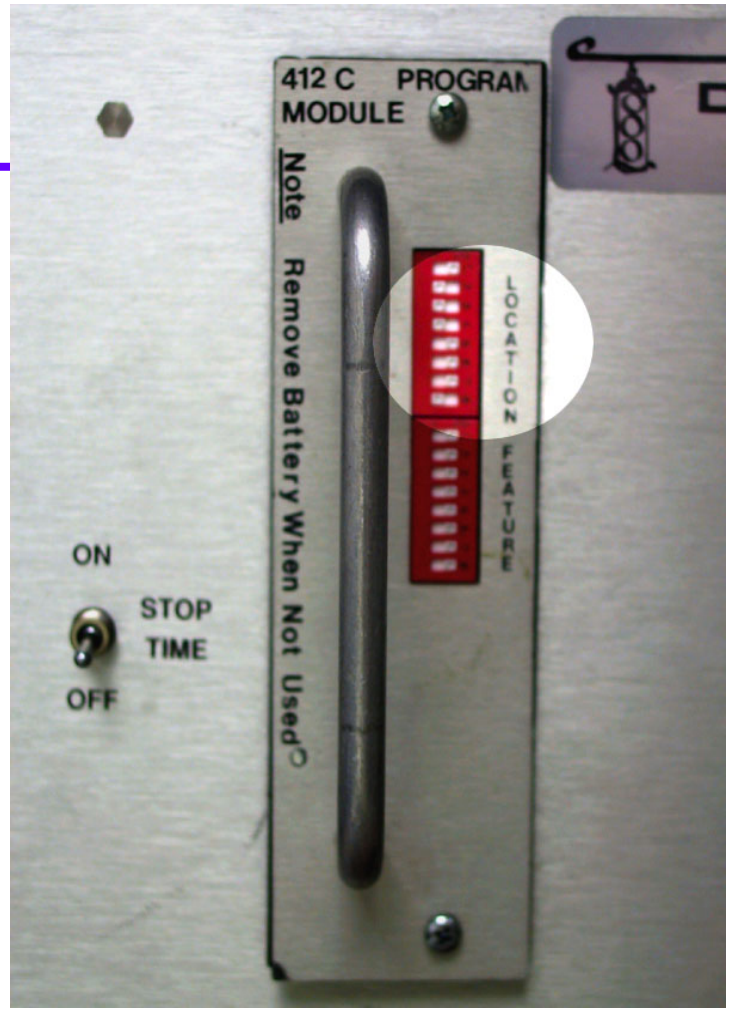
- Maintain SWARM operation for 10 cycles after loss of TMC communication
  - Hard coded
  - Need higher number of cycles?

New Chip

- New chip 27256



- Uses Location DIP switch on 412C EPROM board for controller ID



How To Identify SW Version

- Power off the controller for longer than 2 seconds
- Turn the controller back on
- The software version will be shown on the top row of the display for couple of seconds
- Also displayed at memory locations $3E0 and $3E1

Base Display & Stop-Time Switch

Front Panel Display & L.E.D.

How to Set and Verify Controller ID

- Uses Location DIP switch on the front of the 412C EPROM board
- Switch settings are in binary
- Controller ID (also called Controller Number) is displayed at location $280

SATMS-3
Controller Number Guide

Controller Number	Location DIP Switch Settings
1	1
2	2
3	1, 2
4	3
5	1, 3
6	2, 4
7	1, 2, 3
8	4
9	1, 4
10	2, 4

Controller Number	Location DIP Switch Settings
11	1, 2, 4
12	3, 4
13	1, 3, 4
14	2, 3, 4
15	1, 2, 3, 4
16	5
17	1, 5
18	2, 5
19	1, 2, 5
20	3, 5

Metering Rate

- Rate = Total number of Vehicles Per Minute (VPM)
- Determined and input into the 170 controller by different means - Traffic Ops, TMC, ATMS, Local Mainline Responsive, etc.
- SATMS-3 reads the Rate, then calculates the best possible waiting time, called Cycle Length
- Actual Rate used is determined once every 30 seconds by the controller, and is stored at address $06B

Rate Hierarchy - 6 Levels

- Highest Level 1: Field Manual
- 2nd Level : SWARM rate
- 3rd : PSO :
- 4th : CORM (no longer available)
- 5th : Traffic Responsive Rate
- 6th : T.O.D. Rate

Level 6 – Time-Of-Day Rate

- This is the “default” rate for the ramp
- T.O.D. Rate is entered into the T.O.D. Table in the controller

Traffic Responsive Metering

- The basic principle of Traffic Responsive Metering is to increase the metering rate as otherwise determined by T.O.D. rate
- TR Metering takes place when the mainline volume and occupancy are both less than the Critical Volume and Critical Occupancy

Critical Occupancy

- Occupancy is the percentage of time a loop is occupied
- Critical Occupancy (CROCC) is a threshold level input by Traffic Ops at address $088

Critical Volume

- Critical Volume (CRVOL) - is defined as Vehicles per 3 Minutes per Lane. This value is input at address $08A by Traffic Ops as the maximum volume desired downstream of the freeway
- When upstream mainline volume is less than CRVOL (provided occupancy is also less than Critical Occupancy), SATMS-3 will generate TRRATE

Level 5 - Traffic Responsive Rate (TRRATE) or Lane Metering Rate (LMRATE)

- If the feature is selected, TRRATE is calculated every 30 seconds by SATMS
- TRRATE or LMRATE is displayed at $3D7

TRRATE - Activation

- Activated only if enabled at $0F4, bit2
- And the calculated TRRATE > TOD Rate

- Not activated if TRRATE < T.O.D. Rate
- Not activated outside T.O.D.
- Not activated during Holidays

TRRATE Rest-in-Green

- When TRRATE > Max Rate (cycle length , 4.0 seconds): Green Ball or Rest-in-Green occurs
- Green Hold (GRNHLD) at $08F is activated

Level 4 – CORM Rate

- This is a rate generated and sent out to 170 controllers from the TMC
- CORM rate is displayed at $3D6
- Default Value = 255 means CORM is not activated

- No longer used

Level 3 – PSO Rate (PMNL)

- This is a rate generated and sent out to 170 controllers by Traffic Ops engineers at the TMC
- PMNL Rate is displayed at $3D5
- Default Value = 255 means PMNL is not activated

Level 2 – SWARM Rate (TMNL)

- System Wide Adaptive Ramp Metering
- This rate is sent out to 170 Controller from the TMC by Traffic Ops or ATMS
- This rate is displayed at $3D4
- Value = 255 means SWARM not in use

SWARM Communication Disconnected

- If communication is disconnected during SWARM operation, SATMS-3 will continue to keep SWARM rate for 10 more communication cycles (5 minutes)
- After 5 minutes, SATMS-3 will revert to the next lower level available

Level 1 - Field Manual (FMNL)

- FMNL is activated by entering a rate at address $090
- Default value 255: FMNL is not activated
- Rate = 0: Turn off metering
- Rate = 1: Turn meter to Green Ball

Holidays, Flasher, Q1, Q2, Green Hold ... Affect Rates

- Selected Rate is affected by:
  - Holidays
  - Flasher
  - Queue Override
  - Green Hold

Holidays

- There are 8 holidays that can be programmed into the RAM Map
- They are stored at Column A
- During holidays, TRRATE and TDRATE do not function

Flashing RED – Stop Rates

- Flashing RED: stops all type of rates
- Signal Heads now function as a STOP sign
- Flashing RED is set by enter any non-zero at address $091

Q-Overrides - Change Rates

- Q1
  - Can override Rate level 5 and 6 only
  - Gradually increases RATE until it reaches Max Rate
  - Increment is set at Rate Step (RATESTP) $09F
- Super Q1
  - Same as Q1
  - But overrides all rates, except top level – Field Manual
- Q2
  - Overrides all rates, except top level – Field Manual
  - Turns meter to Green Ball or “Rest-in-Green”

Q1 Overrides ... Activation

- Q1 is activated if :
  - Enabled at $0F4, bit 3
  - Time-Over-Loop ($067) is more than the threshold level (QTHRS at $085) set by Traffic Ops
- Super Q1 is activated if :
  - Enabled at $0F4, bit 4
  - Time-Over-Loop ($067) is more than the threshold level (QTHRS at $085)

Q2 Overrides ... Activation

- Q2 is activated if :
  - Enabled at $0F4, bit 4
  - Time-Over-Loop ($3CC) is more than the threshold level (Q2THRS at $095) set by Traffic Ops
  - Q1 must be already activated*

* Final SATMS-3 will have provisions for independent Q1 and Q2

Rate Hierarchy with Q-Overrides

- Highest Level 1: Field Manual

- Q2 or Super Q1-Override
  - 2nd Level : SWARM rate
  - 3rd : PSO
  - 4th : CORM
- Q1-Override
  - 5th : Traffic Responsive Rate
  - 6th : T.O.D. Rate

GREEN HOLD

- When Rate = 1 vpm, or Rest-in-Green, SATMS-3 will display Green for at least X seconds, called Green Hold
- GRNHLD is stored at $08F
- Not activated by
  - First green
  - Last Green

Effective Rate

- The program updates RATE every 30 seconds
- The selected RATE is called Effective Rate

Metering Cycle

- The program reads the Effective Rate, then calculates the number of Cycles per minute
- A Cycle consists of Green, Red, and sometimes Yellow

Cycle Length

- Length of each Cycle (Cylen) is displayed at address $060
- Shortest CL is 4.0 sec
- Longest CL is 20.0 sec

GREEN

- Green time varies
- It terminates when Passage Loop is activated
- Minimum Green (MINGRN) at $09B
- Maximum Green (MXGRNA) at $086

RED

- Red Ball also varies
- Minimum Red is hard-coded for 2 seconds

Platoon Yellow

- Yellow is recommended when Metering Plan calls for more than one vehicle per cycle per lane
- This yellow is called Platoon Yellow (PLTYEL) and is set at $082
- Yellow is bypassed when PLTYEL is zero

Long Yellow

- For safety reason, whenever Green terminates after displayed for more than 7 seconds, Yellow is used automatically before Red
- This type of yellow is called Long Yellow (LNGYEL) and is set at $083

Cylen Calculation

$$\textbf{Cylen} = \left(\frac{60}{\text{Effective Rate}}\right)(\#\text{ of Lanes})(\#\text{ of Platoon})$$

Cylen = Red + Platoon Yellow + Actual Green

Or

Red = Cylen – Actual Green – Platoon Yellow

Maximum RATE

- When calculated CL = 4 sec, the Rate is at maximum value (Max Rate)
- When Rate > Max Rate, meter turns to Green Ball
- When Rate = 1 vpm, it also means Green Ball

Minimum RATE

- When calculated CL = 20 sec, the Rate is at minimum value (Min Rate)
- When Rate < Min Rate, warning will show in the display

Pre-Timed Red

- Automatically used if Passage is activated 11 times or more without a Demand call
- Can also be set manually at bit 5 of $0F5 in cases where there are no demand loops, or demand loops known for not working
- Green time used is fixed at Maximum Green (MXGRN)
- Yellow used is Platoon Yellow (PLTYEL)
- Red = Cylen - MXGRN - PLTYEL

Pre-Timed Green

- Automatically used if Demand is activated 11 times or more without a Passage call
- Can also be set manually at bit 6 of $0F5 in cases where there are no passage loops, or passage loops known for not working
- Green time used is fixed at Minimum Green (MINGRN)
- Yellow used is Platoon Yellow (PLTYEL)
- Red = Cylen - MINGRN - PLTYEL

Pre-Timed Red and Green set Simultaneously

- When both Pre-Timed Red and Pre-Timed Green are selected, Pre-Timed Green will take precedent

Start Up Sequence

- Meter is off: Black ball
- First Green (FIRGR) at $080
- First Yellow (FYELL) at $081
- Red

Shutdown Sequence

- Meter is On: Color Ball
- Last Green (LASTGR) at $092
- Black Ball

Lock-Up Magnetometer

- Magnetometers sometimes provide only a ‘spike’ reading when a vehicle is present
- Magnetometers also may provide a continuous reading or ‘lock up’ high
- When the physical limitations of freeway connectors or ramps require the use of magnetometers as Demand and Passage sensors, SATMS-C and SATMS-3 can help solved these two problems
- By setting bit 5 of COMM1 ($0F4)

Device 1 and 2

- In addition to Signal Heads and the Meter-On sign, there are Device 1 and Device 2
- Seldom used for ramp metering. For connector metering, Device 2 is not currently used, and Device 1 is used as a flashing beacon for W41 sign
- Device 1 is turned on/off by setting/clearing bit 1 of COMM1, address $0F1
- Device 2 is turned on/off by setting/clearing bit 2 of COMM1, address $0F1

Meter-On Sign, Device 1, and 2 Flashing

- When turned on, they can be made flashing by setting:
  - Bit 1 of $0F5 for Device 1
  - Bit 2 of $0F5 for Device 2
  - Bit 3 of $0F5 for Meter-On sign

EMS Failure Detection

- Light bulbs for EMS are continuously monitored during metering. Shutdown sequences will start immediately upon detection of bulb failure
  - To monitor Top part of EMS, set bit 7 of $0F5
  - To monitor Bottom part of EMS, set bit 8 of $0F5
- All entries at $0F4 are cleared. The only way to resume metering is to reprogram $0F4

Load Switch Failure Detection

- In the absence of 120 VAC to power the EMS, Shutdown Sequences will start immediately
- All entries at $0F4 are cleared. The only way to resume metering is to reprogram $0F4
- To activate this feature, just set bit 4 of COMM2 ($0F5)
- Make sure this bit is CLEAR for normal ramp metering.

Local Speeds Reading

- Estimated speed on Mainline, opposite side, and HOV Ramp are available:
  - $357 ;Average 3 Min per lane (MPH) at Mainline
  - $358 ;Average 3 Min per lane (MPH) at Opposite Side
  - $359 ;Average 3 Min per lane (MPH) at HOV Ramp
- Estimate Occupancy can also be read (in %):
  - $354 ;Average 1 minute occ mainline in percent (%)
  - $355 ;Average 1 minute occ opposite side (%)
  - $356 ;Average 1 minute occ HOV metering lane (%)

More on Queues

- Q1 ON delay
- Q1 OFF delay
- Q2 ON delay
- Q2 OFF delay

Mainline and Opposite Side Disablers

- Tells SATMS which lane(s) to ignore in determining Local Responsive Rate
- ML Disablers - $0FB (LNDSML) Bits 1-6
- OS Disablers - $0FC (LNDSOS) Bits 1-6
- $0F6 (DTCTRA) & $0F7 (DTCTRB) should show actual detector settings, whether detectors are good or bad
- Enter physical number of ML and OS lanes at $093 and $094

Procedure
For Changing to New CHIP

- Read existing controller ID (controller number) at $280
- Read & record actual settings:
  - T.O.D. Table
  - Holiday Table
  - Columns 8, 9, and F
- Power down and install new EPROM board with New CHIP
- Power up and set ID at DIP switch
- Verify ID at $280
- Setup real time clock and calendar
- Setup T.O.D and Holiday Tables
- Enter values at column 8, 9, and F
- RESET Watch Dog