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FREEWAY OPERATIONS MANUAL
DALLAS CORRIDOR STUDY

Project Report 953-11

September 1974

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Abstract

This report documents information and instructions necessary for operation of the freeway computer control system for the Dallas Corridor Study. The report includes chapters on control strategy, hardware design, software design, and routine operating procedures. The report is intended as a guide for developing other systems and as an operations manual for personnel assigned to the Dallas North Central Expressway Corridor Project.

Acknowledgments

This report brings together several documents prepared in regard to the Dallas Corridor Study for the purposes of providing a comprehensive operation manual for the freeway control system. Contributing to this report were:

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City of Dallas Traffic Control

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Disclaimer

The contents of this report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration. This report does not constitute a standard, specification or regulation.

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1.0 INTRODUCTION

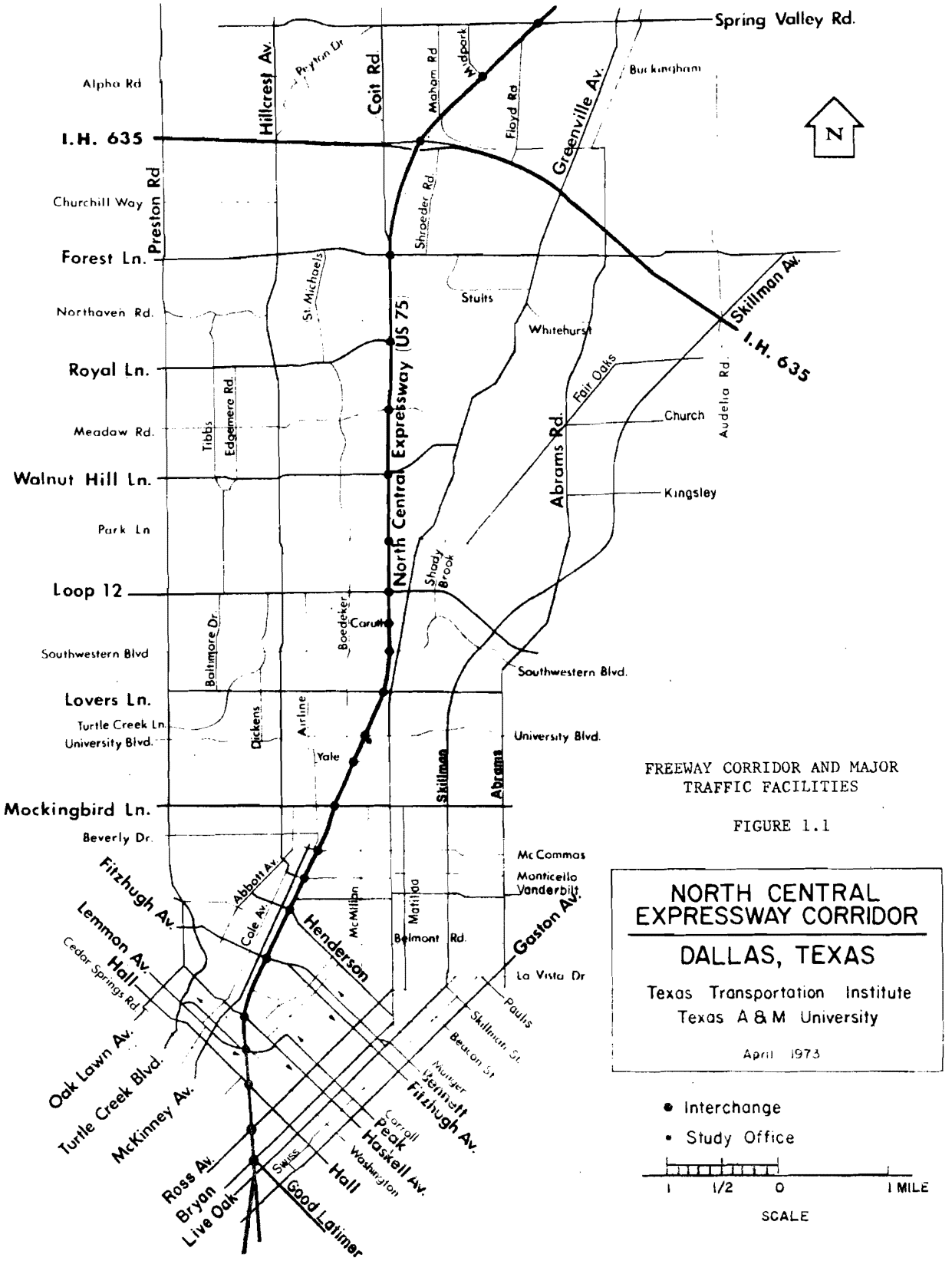
1.1 Background and Project Objectives

In July of 1968 a research/implementation project was initiated in the City of Dallas, Texas. The project, originally called "Optimization of Flow in an Urban Freeway Corridor," is a joint effort of the Federal Highway Administration (FHWA), Texas Highway Department (THD), City of Dallas, and Texas Transportation Institute (TTI). The research effort is funded by FHWA with TTI as the research contractor; hardware installation funds are being provided by FHWA and THD through the TOPICS Program; and maintenance, operation, and other support are provided by the City of Dallas. The study site is the North Central Expressway Corridor. Figure 1.1 shows the freeway corridor and major traffic facilities.

The overall objective of the project is the optimization of traffic flow in an urban freeway corridor through innovative corridor control strategies using a digital computing hardware system.

1.2 Corridor Implementation Phasing

The installation of the hardware system has been segmented into four major phases. Phase 1 is the freeway ramp control system. Phase 2 is designated the frontage road control system, although the majority of computing hardware for corridor control is a part of this phase. Phase 3 consists of various networks and subnetworks to be installed for arterial intersection control. A fourth phase, which is interrelated to the three phases described above, encompasses motor information subsystems for communication with drivers in the corridor.


Spring Valley Rd.
Alpha Rd
I.H. 635
Churchill Way
Forest Ln.
Northaven Rd.
Royal Ln.
Meadow Rd.
Walnut Hill Ln.
Park Ln
Loop 12
Southwestern Blvd
Lovers Ln.
Turtle Creek Ln.
University Blvd.
Mockingbird Ln.
Beverly Dr.
Hillcrest Av.
Preston Rd
Coit Rd.
Peyton Dr
Maham Rd
Floyd Rd
Greenville Av.
Buckingham
Shroeder Rd.
St. Michaels
Stults
Whitehurst
North Central Expressway (US 75
Skillman Av.
I.H. 635
Fair Oaks
Church
Audelia Rd.
Abrams Rd.
Kingsley
Tibbs
Edgemere Rd.
Baltimore Dr.
Boedeker
Caruth
Shady Brook
Southwestern Blvd.
Dickens
Airline
Yale
University Blvd.
Skillman
Abrams
McCommas
Monticello
Vanderbilt
Abbott Av.
Cole Av.
McMillan
Matilda
Belmont Rd.
Gaston Av.
La Vista Dr
Fitzhugh Av.
Lemmon Av.
Hall
Cedar Springs Rd.
Henderson
Oak Lawn Av.
Turtle Creek Blvd.
McKinney Av.
Pauls
Skillman St.
Beacon St.
Munger
Vermett
Fitzhugh Av.
Carroll
Peak
Haskell Av.
Ross Av.
Bryan
Live Oak
Swiss
Washington
Hall
Good Latimer
N
FREEWAY CORRIDOR AND MAJOR TRAFFIC FACILITIES
FIGURE 1.1
NORTH CENTRAL EXPRESSWAY CORRIDOR
DALLAS, TEXAS
Texas Transportation Institute
Texas A&M University
April 1973
Interchange
Study Office
1
1/2
0
1 MILE
SCALE

1.3 Scope and Purpose of Report

The purpose of this report is to document procedures for operating the present freeway ramp control system. The scope of this report includes a hardware description; theory of operation; routine operational procedures; and steps to be taken in extraordinary situations.

It is beyond the scope of this report to outline detailed computer operational procedures. These would be available in the computer manufacturer's documentation. Further, it is assumed that detailed knowledge of the control programming is not necessary for operation of the system.

It is also beyond the scope of this report to provide specific instructions for electronic hardware repair and adjustment. Instead, this type of problem will be handled by module replacement. For example, a malfunctioning tone transmitter would be replaced with a spare transmitter of the same frequency rather than repair or adjustment. Then actual repair and adjustment would take place at another level.

Although the IBM 1800 is the control computer in this particular application, the report could be adapted to other systems using similar hardware and control techniques. This operations manual will be adapted to the digital computer system being installed in Phase 2 as that system becomes operational.

2.0 FREEWAY RAMP CONTROL THEORY OF OPERATION

2.1 Basic Theory

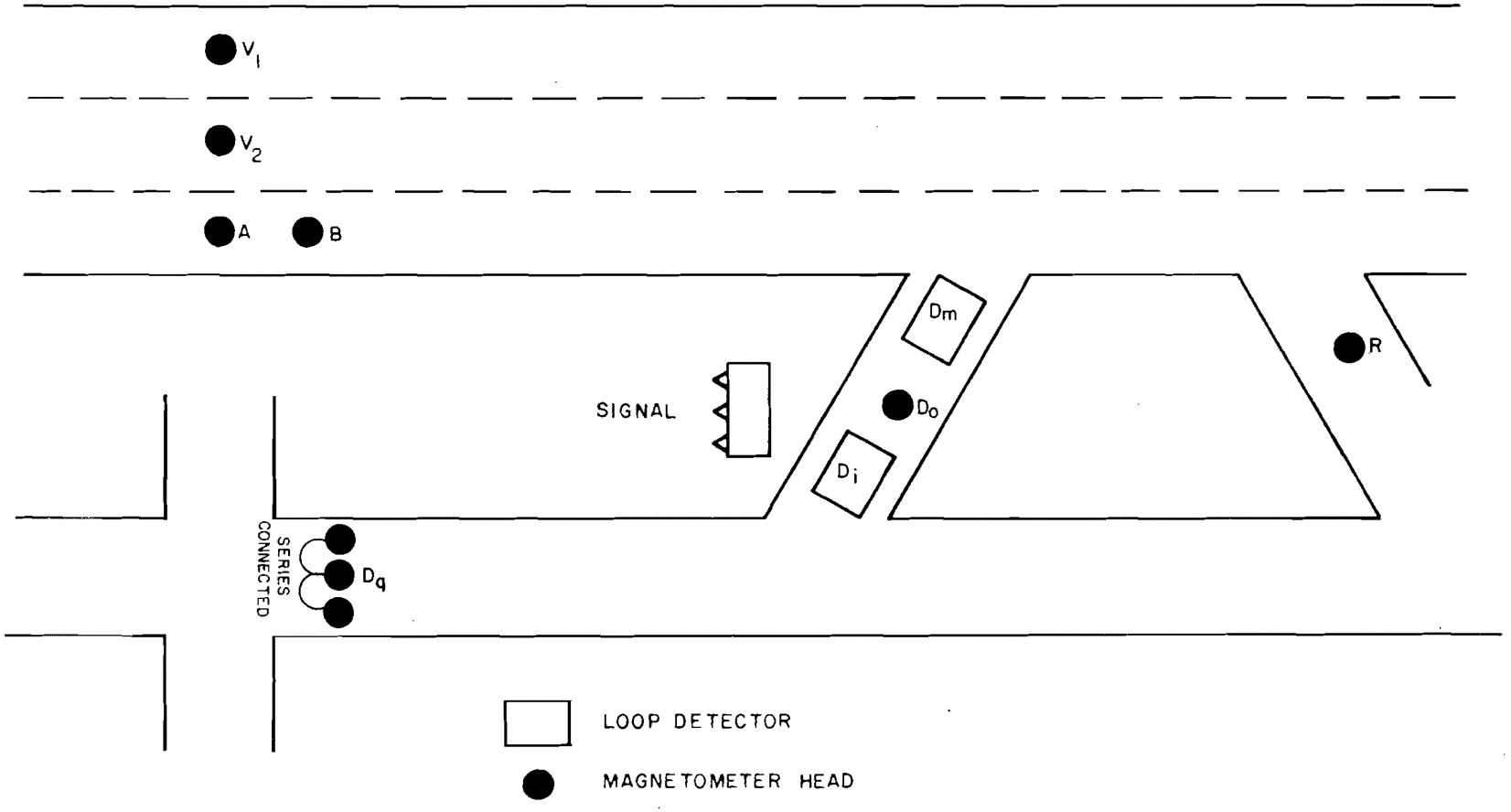
The basic theory of entrance ramp control is to change the rate of flow on the ramps, according to some relationship based on the traffic flow conditions on the freeway. Most freeway control systems use a one minute base for adjusting the rates of flow on the ramps, and once a rate has been established, attempt to release the vehicles at uniform intervals.

One of the unique features of the Dallas Control System is that after the rates have been established, the control program attempts to release the ramp vehicles at intervals that will improve merging operations. This is done by sensing and projecting vehicle gaps in the merging lane and adjusting the release time of ramp vehicles to coincide with the arrival of the gaps. The adjustment of release time produces some irregular intervals between ramp vehicles, but generally adheres to the predetermined minute metering flow rate. This gap projection function is possible at all but two entrance ramps where geometrics do not allow sufficient distance upstream for gap detectors.

The North Central Expressway Ramp Metering System has a relatively large number of detectors. There are 122 detectors on the freeway lanes; 115 detectors on entrance ramps; 50 detectors on exit ramps; and 33 detectors on frontage roads. The basic detection design is shown in Figure 2.1, which references the several detectors discussed in the following sections. Information supplied to the control computer comes from locations that have different degrees of sensitivity or priority in the control program.

2.2 Determination of Metering Rates

For each ramp, there are three or more metering rates calculated each minute from locations as described below.



TYPICAL RAMP SUBSYSTEM DETECTOR AND SIGNAL LAYOUT

FIGURE 2.1

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TEXAS A&M UNIVERSITY

2.2.1 System Indicators

There are three system operation indicators used in the control system: flow rates upstream of each ramp, flow rates downstream of each ramp, and speeds through a bottleneck section downstream of each ramp. These indicators detect changes in operation in the overall system and appropriate adjustments are made at affected ramps.

Five levels of flow and two levels of speed are set up with predetermined metering rates for each level. Typical parameters for a controlled ramp in a three-lane section are as follows:

	SYSTEM INDICATORS			
	Upstream Flow (Veh./Min.)	Downstream Flow (Veh./Min.)	Bottleneck Speed (MPH)	Ramp Metering Rate (Veh./Min.)
Level 1	>90	>95	25-30	3
Level 2	84-89	89-94	30-35	4
Level 3	80-83	85-88	-	6
Level 4	74-79	79-84	-	8
Level 5	<74	<79	-	10

2.2.2 Critical Speed

Since the bottleneck section may be located several thousand feet from some ramps, detectors near the merge area of the ramp are used to adjust the metering rates if congestion develops between the ramp and the bottleneck section. Generally, the first downstream speed station is used for local monitoring, and the metering rate schedule is set forth in the same manner as for the bottleneck speed shown below. Typical procedure for this critical speed indication would be to establish the ramp metering at 3 veh./min. when the speed drops to less than 24 MPH and maintain that rate until such time as the speed increases to more than 30 MPH.

2.2.3 Ramp Indicators

Functions of ramp detectors are discussed in Section 2.6. However, three of these detectors may influence selection of the metering rate. Their influence is described below.

2.2.3.1 Queue Indicator

Entrance ramps are generally located near an arterial cross-street with some located just downstream of a freeway exit ramp. In these situations, the queue of vehicles at the ramp signal may become so long that it adversely affects operation on these facilities. If the queue detector is occupied longer than a certain time, usually 5 seconds, a high ramp metering rate (10-12 veh./min.) is set to reduce the queue length.

2.2.3.2 Merge Indicator

A loop detector is placed on the ramp in the area where vehicles normally merge into freeway traffic. If this detector is continuously occupied for some preset time, say 2 seconds, a metering rate of 0 veh./min. is established. If at the end of 60 seconds the merge detector is still occupied, a metering rate of 1 veh./min. is set until such time as the merge is unoccupied.

2.2.3.3 Slow Vehicle Indicator

The magnetometer designate D_o is used to detect the presence of a slow-moving vehicle. If, after a green indication is given, the D_o detection is not activated by the time some predetermined period has elapsed, say 5 seconds, a false call is put on the merge detector to activate the merge override. When the merge is occupied and then cleared, operation returns to normal.

2.3 Gap Projection

The freeway control system employs gap acceptance in the ramp metering

program in conjunction with capacity/demand metering rates. This combination of two operating techniques allows satisfying system demands while aiding in the merging operation.

After metering rates have been established, time limits are set for the gap projection "windows." The projection windows are segments of time during which acceptable gaps are utilized in the control process. The time segments are spaced at the regular intervals as determined by the metering rate. The length of the time segments will vary for different rates. The segments are established by a percent, typically 40 percent, of the metering rate. For example, a 4 vehicle per minute metering rate allows vehicles to be released in 15 second intervals. A 40 percent window could be 6 seconds. Thus, under fixed rate metering, a vehicle would be released every 15 seconds. With the window, a vehicle could be released for an acceptable gap for 3 seconds on either side of the 15 second point, i.e., from 12 to 18 seconds. A vehicle released for an acceptable gap in that range is therefore considered to have satisfied the rate. If no acceptable gap is detected in the window range, the vehicle is released on the 15 second interval point.

2.4 Speed and Gap Determination

Upstream detectors A and B measure gaps between vehicles and the speeds of the gaps. In essence, the lead vehicle of all gaps is projected, but only those with accompanying acceptable gaps may call for the release of a ramp vehicle.

Gap speeds are measured by detector traps and the speed of the lead vehicle of a gap is used in the projection rate calculation. The arrival times of the lead vehicles for the acceptable gaps are calculated in real-time, and compared to the projection window times to determine if they coincide. An accumulating average speed is calculated by weighting the difference between the vehicle

speed and the preceding average speed.

2.5 Ramp Detector Functions

The ramp metering system is traffic actuated and highly responsive to ramp conditions, as well as freeway conditions. The following detectors associated with the ramps and frontage roads are used in metering control (see Figure 2.1).

2.5.1 D_I

The input or calling detector must be occupied for the ramp signal to cycle.

2.5.2 D_M

The merge detector's function was previously described. If the merge detector is occupied for 5 continuous minutes, the detector is deleted from further control functions. This negates the influence of a malfunctioning detector or stalled vehicle.

2.5.3 D_O

The output detector is utilized for ramp volume tabulation, monitoring signal violations, and detection of slow vehicles.

2.5.4 D_Q

The queue detector was discussed previously as a ramp indicator. It is also used in a back-up function for the D_i. If the D_i is not occupied but the D_q override is on, a false D_i input to the computer is made. As with the merge detector, if the D_q is continuously occupied for 5 minutes, the D_q is removed from further consideration in the control.

2.6 Signal Operation

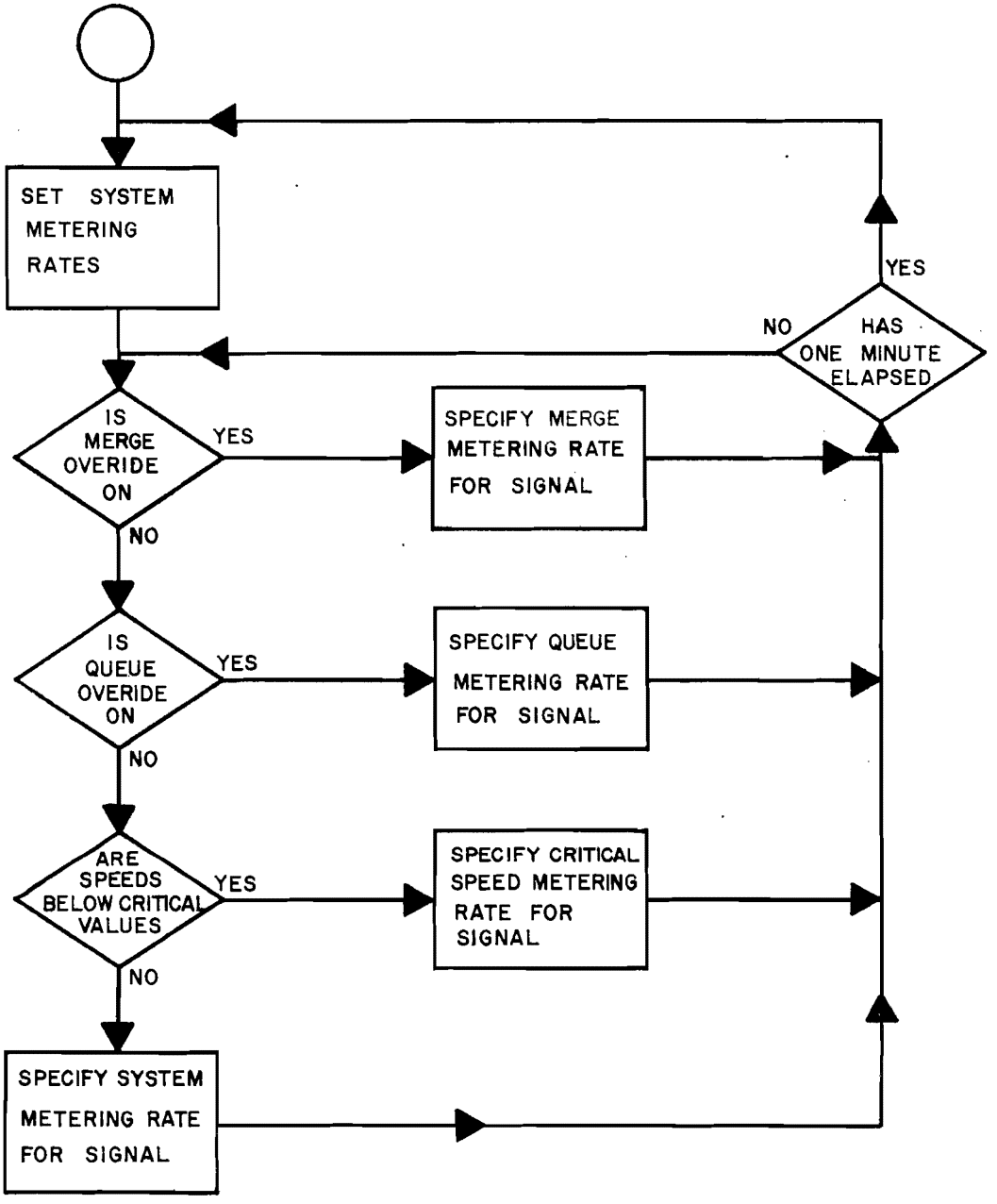
The change in state of the ramp traffic signal to release a vehicle is the result of the several conditions outlined previously. The following sections summarize these processes and explain some variations to the procedure.

2.6.1 Priority

Because of the many conditions and traffic indicators that are available in the decision-making procedure, priorities must be established when there are conflicting requirements. For example, if the queue override called for a high metering rate at the same time the critical speed indicator called for a low metering rate, some computer program logic would have to decide which takes precedence over the other. The usual priority is as follows: (1) merge, (2) queue, (3) critical speeds, and (4) system indicators (bottleneck speeds, upstream and downstream flow rates). Merge is listed in the priorities since the merge override results in a zero metering rate. Often, the decision is to switch queue override with local speed override if cross-streets are not critical. A priority of operation is set for each ramp depending on its unique characteristics.

2.6.2 Selection of Metering Rate

At the end of each minute, a metering rate is determined for each ramp. The lowest metering rate associated with the three system indicators is selected for the system metering rate. Referring to the typical parameters in Section 2.2.1, an upstream flow of 81 veh./min., a downstream flow of 94 veh./min., and bottleneck speed of 20 MPH would result in a system metering rate of 3 veh./min. Figure 2.2 shows the logic for metering rate selection.



RAMP METERING RATE SELECTION

(PRIORITY: 1.Merge 2.Queue 3.Critical Speed 4.System)

FIGURE 2.2

2.6.3 Release Time

After the metering rate has been established for each ramp, the gap window times (Section 2.3) are determined. If there is to be no gap acceptance operation, a zero percentage is assigned.

When the gap window times are established, the acceptable gap table is scanned to determine if there are times that fall within the projection window. The acceptable gap table is a list of times at which acceptable gaps arrive at a decision point. This decision point is the point in time equal to the average travel time for a vehicle from the ramp signal to the merge area.

If an acceptable gap time coincides with a gap window, then this is the release time for this window. If there are no acceptable gap times that coincide with the gap window, the release time is at the end of the gap window.

Finally, when the release time arrives, the two detectors on the ramp are scanned to determine if a vehicle is waiting for a green and to determine if the merge area is clear. If both of these conditions are positive, the signal is given the command to cycle.

2.7 Freeway Data Collection and Evaluation

An extensive data collection system, both for operation and evaluation, has been implemented as part of the freeway control program. Most freeway detectors then serve a dual purpose. A complete record of each day's operation is logged on disk for evaluation after the control period. Principle parameters are volume over each counting detector and average speed, each over one-minute intervals. Other data available include: signal violations, detector malfunction, and number of vehicles released for a gap.

A real-time evaluation of designated control points presents flow speeds and calculated density on a one minute basis. Further real-time variables may be requested from the input/output typewriter.

At the end of each control period, an input/output analysis of freeway operation is compiled. Information provided by the I/O study includes: flow over each counting detector, average speed over gap detectors, overall system speed, peak flow, density, and kinetic energy. These data provide both an evaluation of the day's operation and a check for detector malfunction.

3.0 FREEWAY SURVEILLANCE AND CONTROL HARDWARE DESCRIPTION

3.1 General System Description

The freeway control system for the North Central Expressway consists of 39 entrance ramp metering signals and associated detectors, signs, data transmission system, and an IBM 1800 digital computer. A typical ramp installation (Figure 3.1) has the following items of equipment:

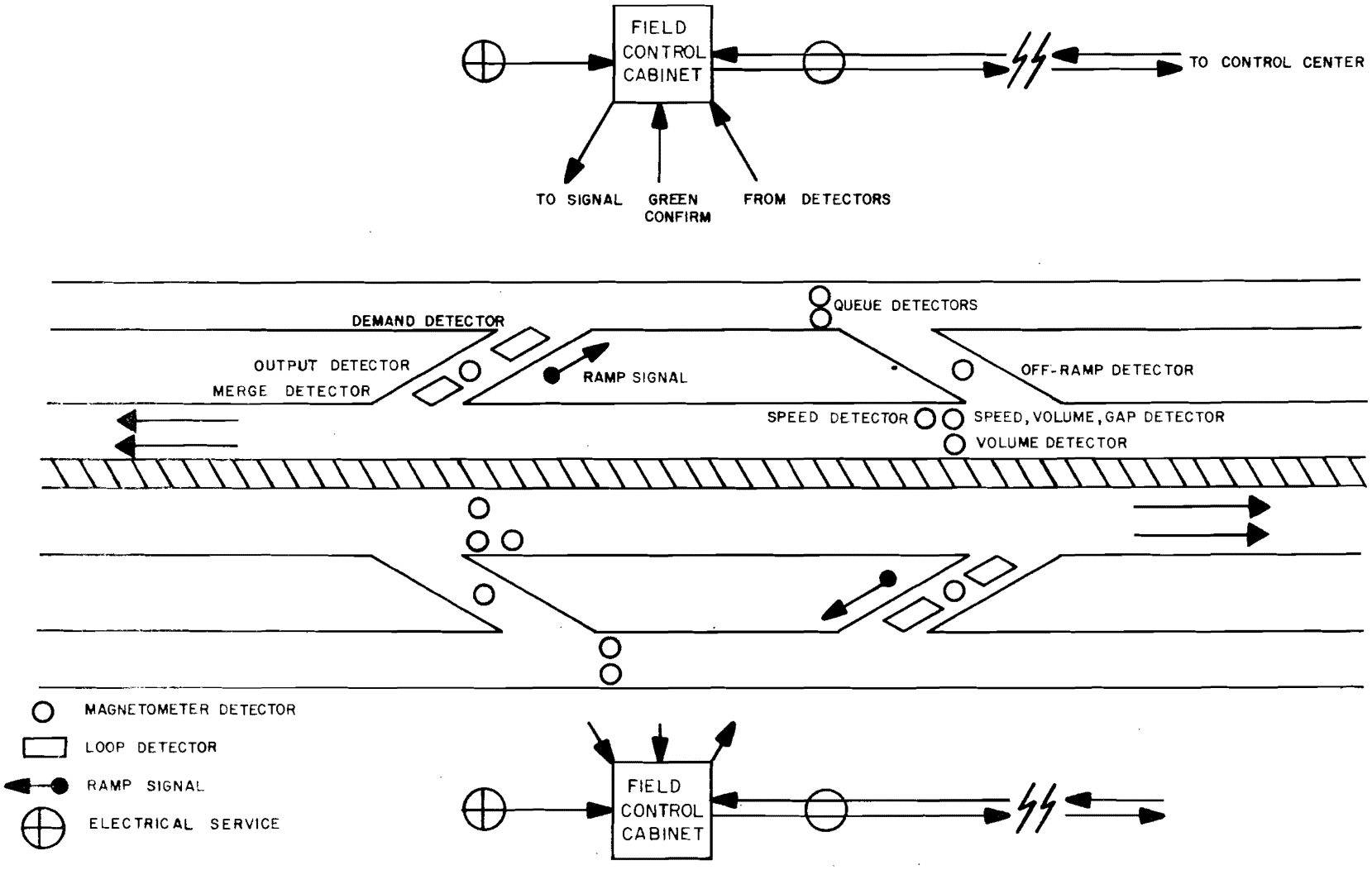
1 three head traffic signal
1 advanced warning sign and flasher
1 6' x 20' loop detector at the signal
1 6' x 40' loop detector in the merge area
1 Magnetometer detector with 2 or 3 heads on the frontage road for queue detection
1 Magnetometer detector with 1 head on the ramp downstream of the signal
2 Magnetometer detectors with 2 heads in outside lane upstream of merge area to measure speeds and gaps
2 Magnetometer detectors with 2 heads in middle and inside lane upstream of merge area to decrease demand
1 Traffic Signal Cabinet equipped with tone transmitters, tone receivers, detector amplifiers and associated power supplies

The transmission system consists of a telemetry system utilizing the frequency division multiplexing principle with three state FSK (Frequency Shift Keyed) tone channels operating on a leased, voice grade, telephone circuit using a passband of 300 to 2800 Hz.

A schematic of freeway system components is shown in Figure 3.2.

There are exceptions and additions to the typical design:

1. Approximately every other entrance ramp has no freeway detectors in the middle and inside lanes. Speed and gap detectors are present at all ramps except two, where geometrics do not allow.
2. Not all ramps are equipped with merge or queue detectors due to geometrics.



TYPICAL FREEWAY INSTALLATION

FIGURE 3.1

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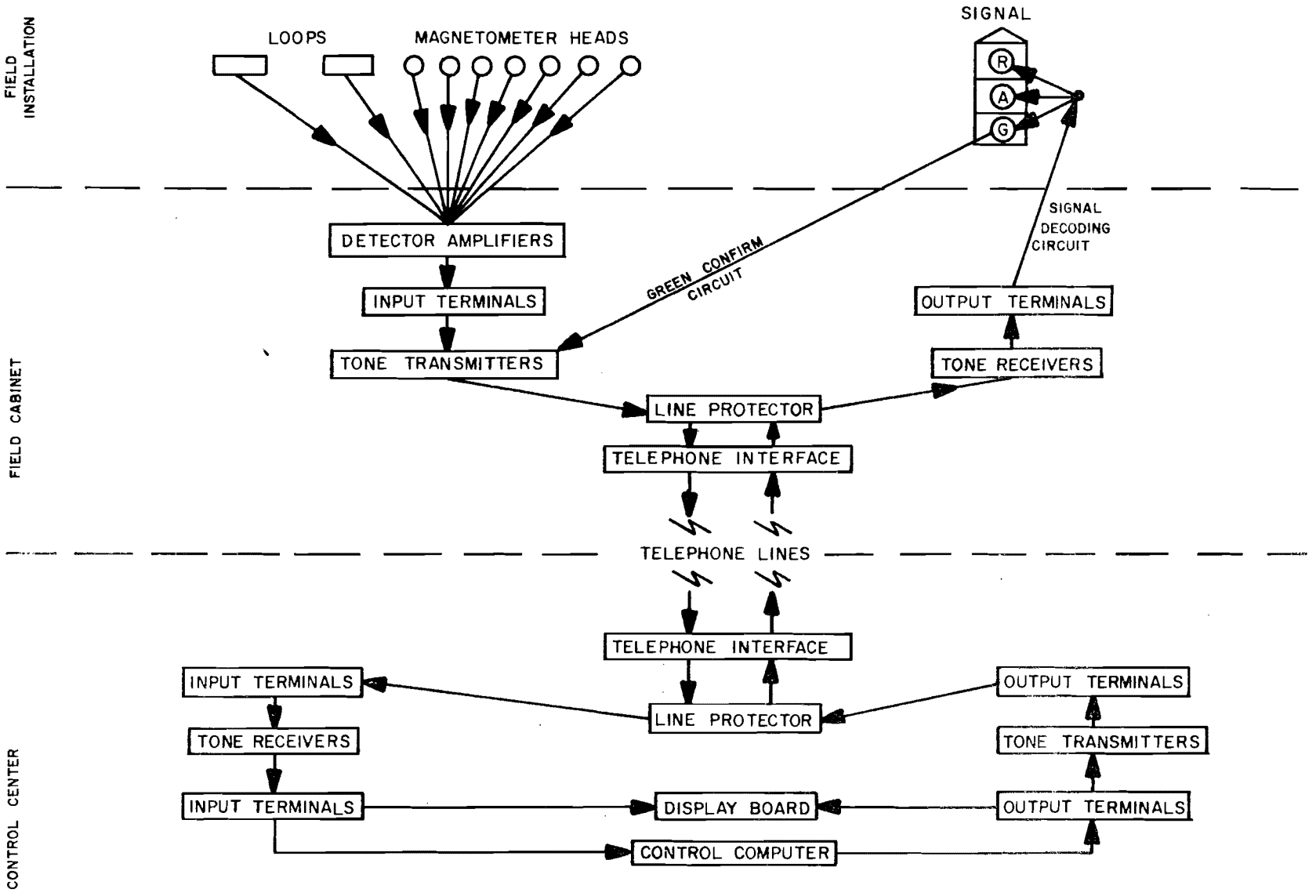


FREEWAY SYSTEM COMPONENTS

FIGURE 3.2

TEXAS TRANSPORTATION INSTITUTE
TEXAS A&M UNIVERSITY

3. Both the frontage road and freeway have two and three lane sections.
4. All exit ramps have magnetometer detectors with one head.
5. The I-635/Central Expressway Interchange has detectors on all roadways for the measurement of traffic demand.

3.2 Freeway Hardware Subsystems

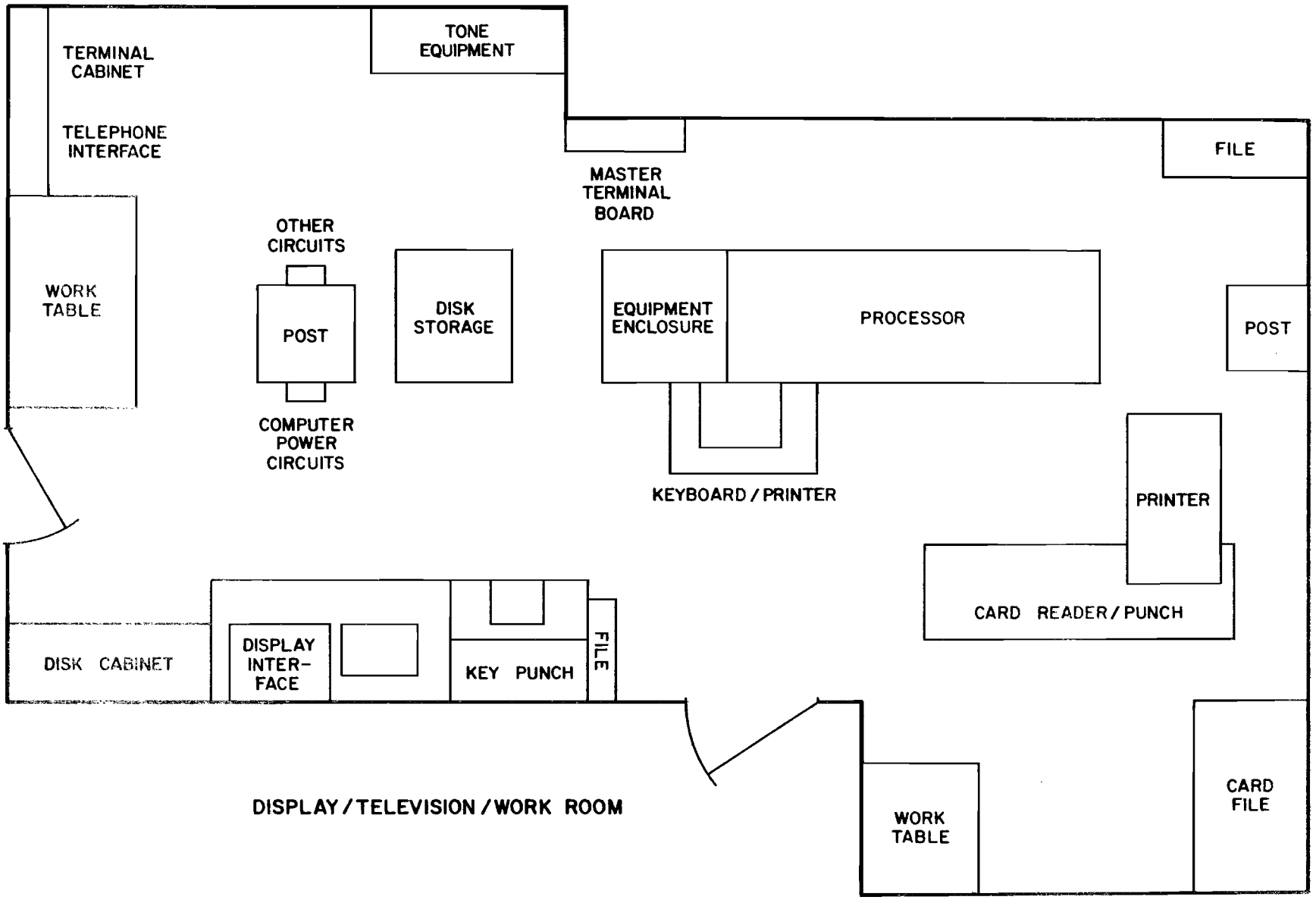
3.2.1 Surveillance Subsystem

A schematic of the freeway detection system is shown in Figure 3.1. The system is designed for presence detection at all detection locations with the exception of the speed measuring stations. Speed is measured by a speed trap consisting of two detectors which give a "pulse" output when activated. Functions of individual detectors are shown in Figure 3.1.

One other item of field data which is associated with the surveillance subsystem is a "green confirm" input. Wired into the green circuit, this line provides positive confirmation that the green phase is operating in the prescribed manner.

3.2.2 Control Subsystem

The central digital computer is the essential element in both control and surveillance. It receives inputs from the detectors in the field, acts on the information, effects the control strategy, and sends control commands to field locations. The IBM 1800 process control computer is presently used to perform these functions, as well as data analyses on a time sharing basis. After installation of the corridor control hardware system, the IBM 1800 will be phased out as the prime control unit, this function being handled by a minicomputer in the new system. Figure 3.3 shows the existing computer room configuration.



COMPUTER ROOM LAYOUT
DALLAS CORRIDOR STUDY
FIGURE 3.3

Scale 1" = 3.4'

The existing computer configuration is set up to control 39 entrance ramp signals while receiving inputs from 320 detectors and 39 green confirms. Speed traps, each with two detectors, are installed at 39 locations. Two ramps of the 39 mentioned have no freeway speed stations due to geometrics. Two speed stations serve as system indicators and are not used for gap measurement, one located northbound where one freeway lane is dropped (A41) and one northbound at the end of the system (A40). These 78 detectors are monitored on a process interrupt basis while other detectors are scanned at regular intervals of 100 milliseconds (0.1 seconds).

The control subsystem outputs operate the entrance ramp signals. Converted by the computer into a binary code, two outputs (lines) operate the four states of the signal:

Binary Code	State
00	Dark
01	Red
10	Amber
11	Green

3.2.3 Freeway Control Telemetry System

The telemetry system consists of audio tone equipment located at a master station at the central office, and at 38 remote stations (field control cabinets) throughout the control area. The remote stations transmit data derived from traffic detectors in their respective areas to the master station, and receive and execute commands from the master station. The master station receives the transmitted data from the remote stations and presents these data to the control computer through the computer data receiving interface. The master station also receives commands at the computer data transmitting interface, and transmits these commands to the appropriate remote stations for execution. The execution of commands by the remote stations serve to control the status of the ramp traffic signals.

3.2.3.1 Functional Description

The control and telemetry system operates on a frequency division multiplexing principle utilizing three state FSK (Frequency Shift Keyed) tone channels. The system is capable of being submultiplexed on a normal voice grade, two wire telephone circuit using a passband of 300 to 2800 Hz.

The three state FSK tone channels operate in a return-to-center frequency mode. The center carrier frequency of each tone channel is transmitted at all times when a keying voltage is absent to provide for fail safe operation. When a keying voltage is present, the tone frequency is shifted upward from the center (carrier) frequency. When another keying voltage is present, the tone frequency is shifted downward from the center frequency. A distant tone receiver senses the presence or absence of all three tone frequencies. The equipment is capable of transmitting and receiving both keying operations when the keying voltages are presented simultaneously. This capability is achievable by utilizing a special oscillator circuit which causes the maximum rate of alternate mark/space shifts to be generated while simultaneous keying is present. On the receiving end, sufficient delay is incorporated in the mark/space receiver outputs to cause mark and space to be simultaneously active.

3.2.3.2 Tone Transmitters

The transmitters are frequency-shift keyed, band-limited tone generators designed for mutually non-interfering services in groups when bridged across in common on a voice grade telephone circuit. The FS (Frequency Shift) transmitter includes the necessary circuitry for the keying, generation and amplification of FS audio tones. In the three frequency channels utilized, three frequencies are generated, namely, MARK, SPACE and CENTER frequency. A plug-in filter is included to reject harmonics and prevent channel loading. Test jacks are

available on the front panel which provide access to critical measuring points. A control is included on the front panel to adjust individual tone levels. The transmitter is keyed by a threshold voltage. Each transmitter utilizes a specific audio frequency band not exceeding 120 Hz in width, and operates without interference to receivers and other transmitters on the same line operating in adjacent or other frequency bands. The transmitters accept short duration voltage pulse signals from the traffic sensing equipment and computer interfaces and convert them to frequency shift keyed energy on the telephone lines. This energy is maintained at a fixed power level. The power level is adjustable so that any desired level from 0 to -30 dbm can be obtained on the telephone line from as many transmitters as are operating simultaneously in separate frequency bands on the same line.

3.2.3.3 Tone Receivers

The receivers are of a type which demodulate frequency shift keyed tone signals, designed for mutually non-interfering service in groups when bridged across in common on a voice grade telephone circuit. Each receiver utilizes a specific audio-frequency band not to exceed 120 Hz in width and operates without interference to other receivers or transmitters operating in adjacent or other frequency bands. The receivers accept frequency-shift signals transmitted via a telephone line and demodulate these, and present pulse voltages to the computer interfaces and traffic control equipment.

The FS receiver includes a band-pass filter, limiting amplifiers, discriminator and DC amplifier. The output of the receiver provides a DC output compatible with the computer's voltage-sense-digital-input. In the frequency receiving unit, two separate output circuits are provided. One circuit operates on CENTER to SPACE signal keying and the other operates on CENTER to MARK

signal keying. Neither circuit is energized in CENTER frequency condition. The design of the output and discriminator circuits is such that in the event of no signal due to transmitter or communication circuit failure, the receiver's output circuit remains de-energized. Circuitry is provided to flatten out the discriminator at the CENTER frequency to maintain a zero output over a wide range. This is important since a receiver operated CENTER frequency should not be subject to operation in either MARK or SPACE condition with a drift in frequency due to transmitter variation or to communication circuit frequency translation.

3.2.3.4 Communication Channel Compatibility

The communication channels utilized are leased, voice grade telephone lines. Twenty-six telephone pairs are used, although tone channel spacing is such that if a higher grade (conditioned) line were used, 13 pairs would be sufficient.

Channel in-band receiver input and transmitter output impedances are 600 ohms ±10 percent. Channel filtering is such that submultiplexing of channels up to the capacity of the voice channel does not degrade either per channel or composite channel impedances beyond this specified range.

Channel transmitter output levels are adjustable within the unit over a minimum range of 0 to -30 dbm. The dynamic level range of the receiver unit shall be such that a ±10 db change in the input level does not cause a bias shift greater than ±5 percent.

Channel frequency stability provides no more than 0.1 percent ±2 cycle drift over the allowable voltage temperature range. Frequency control adjustments and test points are readily accessible and plainly marked on all units to permit compensation and adjustment for component aging and/or component substitutions during periodic maintenance.

All transmitters and receivers are equipped with channel filters to minimize distortion and intermodulation when two or more channels are sub-multiplexed on the same composite channel. Rejections of adjacent channel mark/space carrier frequencies are a minimum of 15 db for transmitter filters and a 20 db minimum for receiver filters. The signal-to-noise ratio or interfering tone ratio (the point at which erroneous receiver output is observed) is between -11 db and -18 db with the signal being keyed at 20 Hz from MARK (high) to SPACE (low).

Telephone service is supplied to a terminal point within the field control cabinet and to a terminal point in the central office. Space and mounting provisions are provided in the field control cabinet for mounting of a Bell Telephone System 261-A interface connector and carbon block protectors in the circuit between the telephone lines and the tone equipment.

3.2.3.5 Computer Interface

The master station tone equipment is interfaced with an IBM 1800 control computer. Digital inputs to the computer are voltage sense as opposed to contact closure. Outputs of the central office tone receivers supply -10 to 4.5 volts for binary '0' condition and +6 to +10 volts for binary '1' condition. Central office tone receivers which are linked with the traffic speed detectors are connected to the process interrupt voltage sense points at the computer.

The computer outputs (inputs to the central office tone transmitters) are register outputs. The register outputs provide the following output voltages during operation:

binary '1' (mark/space) = +3 VDC nominal

binary '0' (center) = 0 VDC nominal

Solid state circuitry is provided to key the office tone transmitters at the above voltages.

The central office tone receivers have carrier monitor circuits wired in parallel to connect to a computer input. This arrangement is such that if a tone channel becomes inoperative a binary '1' condition will result, and if all tone channels are operative a binary '0' condition will result.

The tone equipment is so arranged in the office cabinets such that AC power for all tone transmitter power supplies is derived from one pole of the power source breaker box, and AC power for all tone receiver power supplies is derived from another pole of power source breaker box. This provides separate power sources for receivers and transmitters. A relay and necessary equipment and associated circuitry is mounted in the tone equipment cabinet to switch power on and off to the office tone transmitter according to the status of a register output terminal at the computer interface. The circuit is arranged so that if the output is a binary '1' (+3 VDC nominal), the relay contacts are closed and the power is switched on to the office transmitter tone equipment tone transmitter power supplier.

3.3 Display Board

The display board consists of a photographic negative film sandwiched between a layer of safety glass of 3/8-inch thickness and a layer of white translucent plastic of 1/4-inch thickness. The glass is encased in a wooden box frame. The film is taped to the glass and supported by the plastic and series of support rods and steel wire. Back lighting is provided by 40-watt fluorescent lights attached to the wall.

Drawings of the major road network were made at a scale of 1" = 250 ±50 feet, the variability being due to the physical space available for the board. A film

negative of the drawing made in 4 feet x 8 feet sheets presents roadways in clear transparence. These roadways were color coded by the application of ink to the backside of the negative. Figure 3.4 shows arrangement of the control room with the display board position indicated.

3.3.1 Indicator Lights

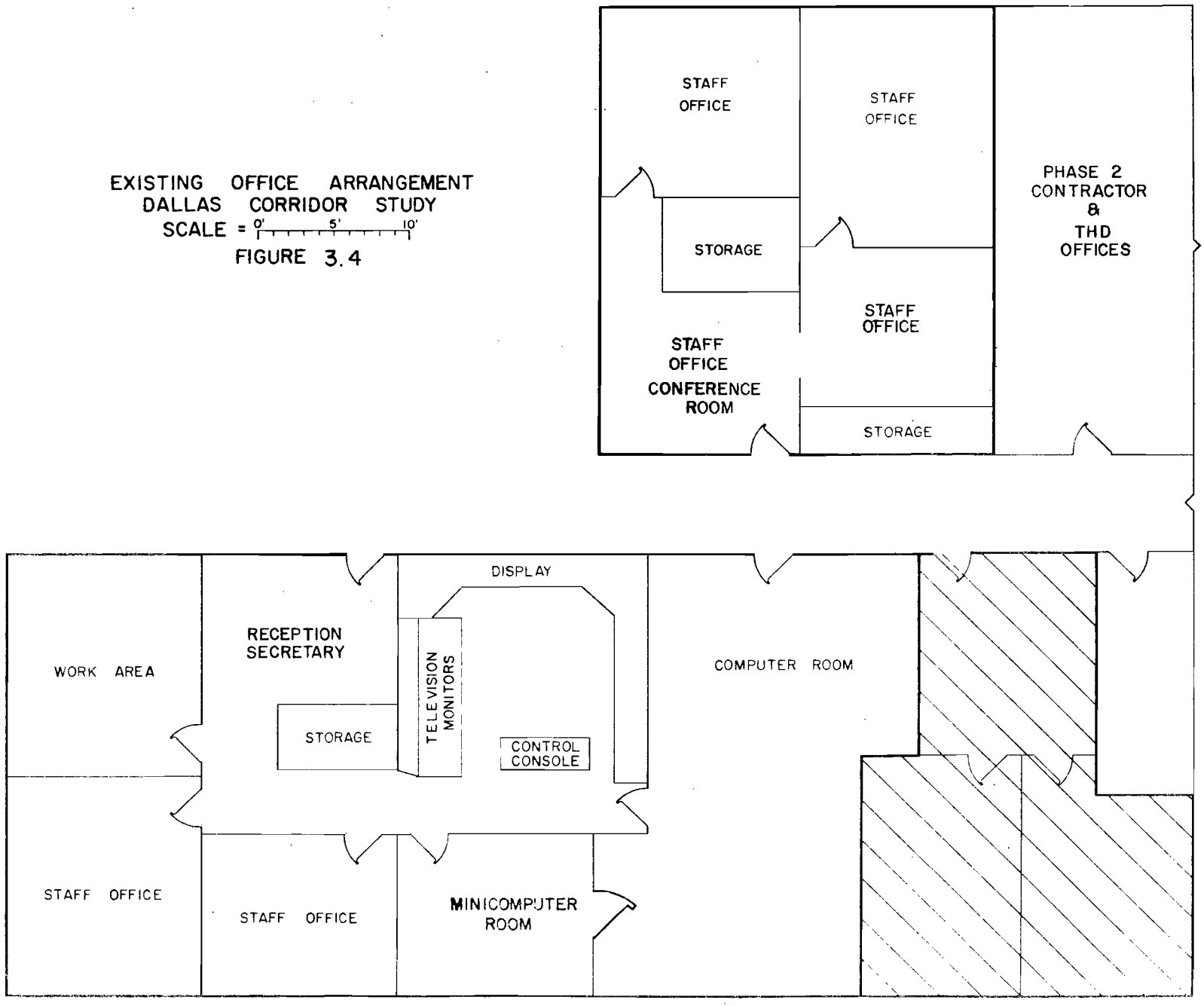
Ultra-miniature indicator lights with 100,000 hours of expected life are installed in the plexiglass support panels. Holes drilled at a close tolerance were sufficient to support the lights. The sides of the lights are painted to reduce brightness and to eliminate a halo effect.

3.3.2 Driving Mechanism

A specially designed and built mechanism drives the signal and detector display lamps. Whenever a vehicle detector is activated, the detector lamp is activated for the same length of time. The signal display shows green for the length of time green is presented in the field. Since there is no "amber confirm" line, the drive mechanism places a constant amber time which is not necessarily that which is in the field. The signal then rests in red until such time as another green confirm signal is sensed.

3.4 Closed Circuit Television System

A nine-camera closed circuit television system is installed along the Central Expressway. The system is used to monitor operations, detect accidents and incidents, to evaluate operation, evaluate new strategies, and to check out and verify field equipment hardware malfunctions. Figure 3.5 shows CCTV locations.



EXISTING OFFICE ARRANGEMENT
DALLAS CORRIDOR STUDY
SCALE = 0' 5' 10'

FIGURE 3.4

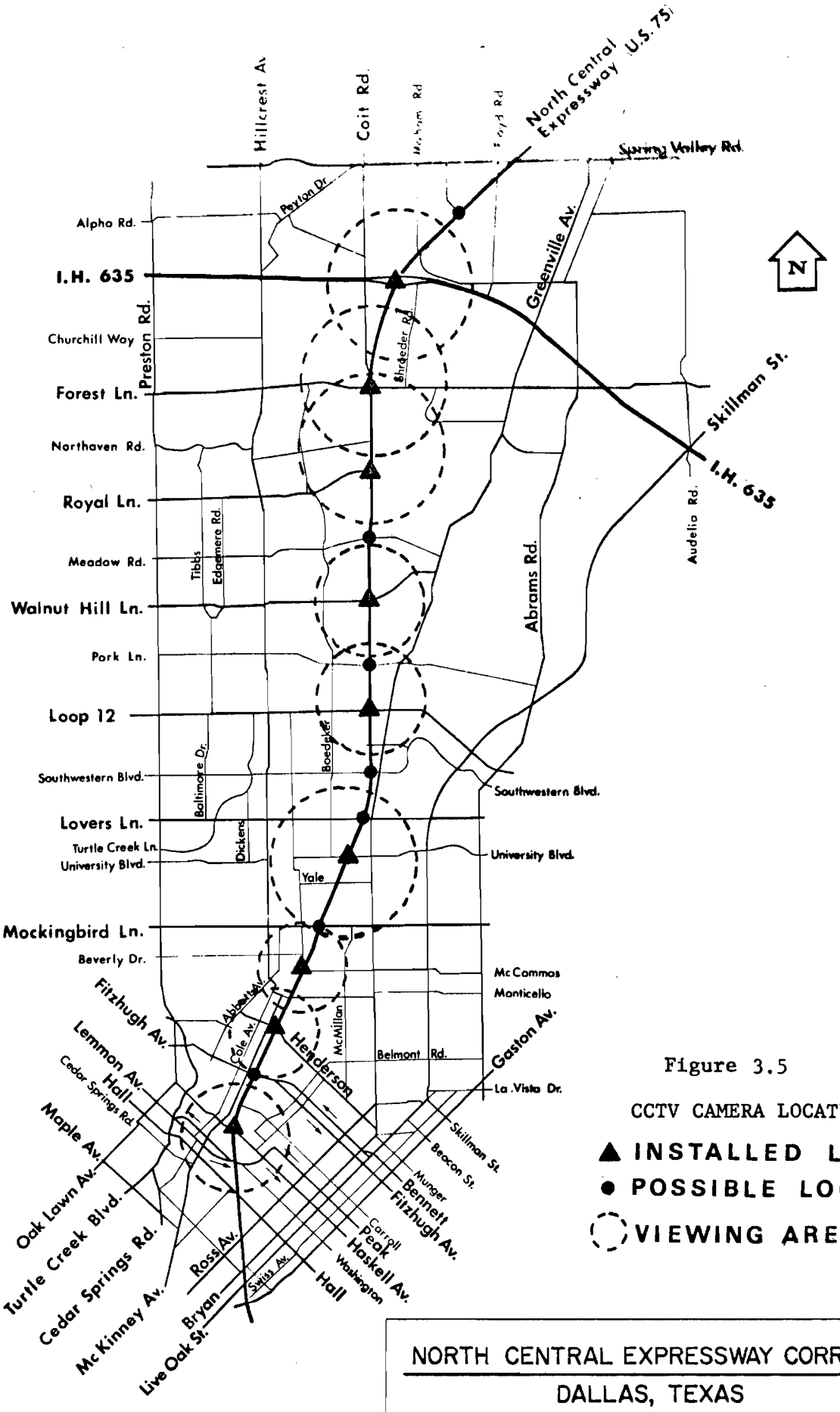


Figure 3.5

CCTV CAMERA LOCATIONS

▲ INSTALLED LOCATION

● POSSIBLE LOCATION

VIEWING AREA

NORTH CENTRAL EXPRESSWAY CORRIDOR

DALLAS, TEXAS

Texas Transportation Institute
Texas A & M University

3.14 SCALE: 3/4" = 1 mile

3.4.1 RF CCTV System

Eight cameras are installed on luminaire poles at major crossover points on the freeway. One cable pair is installed in the median of the expressway to the north of the control center and one pair in the median to the south. The cable pair consists of one 0.5 shielded aluminum cable (VHF transmission) and one shielded RG-59 cable (camera function control). If required, an additional camera could be added to the cable for Channel 7 for the cost of the camera, low band amplifier, and modulator.

The control cable presently handles 80 functions (8 cameras with 10 functions/camera). A total of 256 functions could be accommodated on this cable if additional pulse code modulation is provided.

A camera can be moved to one of the alternate locations in approximately four hours. Expense for such a move would involve the labor for physically moving the camera and control box, and making various level settings and adjustments. Any camera locations may be selected as long as no more than five are on either the north or south cable.

The following is a summary of major equipment components for the RF Freeway CCTV System:

Camera - Diamond ST-2, horizontal resolution greater than 800 lines.
Pan and Tilt Units - Pelco PT-550M.
Camera Housings - Taft Broadcasting Custom Design - EHX-2.
Zoom Lenses - Pelco TV-5 (20mm to 100mm with 2 to 1 extender with f4.0). Effective Range 40 to 200mm.
Mounting Bracket - Custom design to fit top of Luminaire Standards.
Function Control Units - Taft Broadcasting Custom Design
Field Unit - 4 Pan-tilt functions
6 Lens functions
4 Camera functions
Office Unit - Camera Location (10)
4 Pan-tilt functions
6 Lens functions

Transmission System - Time Division Multiplexing
with 80 functions carried on RG-59 Cable laid
in freeway median.
Transmission System - Low Band V.H.F.
Modulators - CAS TVM-213 (Special) Using Channels
2,3,4,5,6 with 6 megahertz band width.
Demodulators - Included in the T5900 Magnavox
Receivers
Amplifiers - CAS Low band units, TRA 110.
Cable - 0.5 Superior AL-500J laid in freeway median.
Monitors - Magnavox 23" receivers rated for greater
than 400 lines resolution.

3.4.2 Video System

A one-camera system (Camera 4) is mounted on the Noel Page Building. Control functions are similar to those described above. Camera signals are transmitted over direct coaxial cable and are video as opposed to RF.

4.0 FREEWAY CONTROL PROGRAM DESCRIPTION

4.1 General

As previously noted, it is beyond the scope of this report to deal with details of the computer control program. However, it is deemed helpful to have a broad knowledge of the function of various programs in order to adequately operate the freeway system. Details of the control program are documented in Research Report 836-2.

4.2 Purpose of Programs

The primary task of the control programs is to collect and store data for the operation of the control system in real-time. However, many other functions are necessary for a freeway control system. The surveillance and control system is monitored to determine if hardware failures exist. Data for the general evaluation of the control system in real-time and for the detailed evaluation by off-line processing are collected. These data are also used to calibrate the system.

4.3 Description of Computer System

The Dallas North Central Expressway Ramp Control Program uses a 32K, 4 microsecond memory, IBM 1800 computer. The control program is principally core resident. Operating memory is structured as follows: 21,528 words allocated to the MPX operating system (which includes a 1118-word executive-included user routine and a 3750-word INSKEL common section); 6100 words are allocated to the special area (SPAR); and 5140 words are allocated to variable core (VCORE). Further information on the role of the various areas within the framework of the MPX system can be found by referring to the appropriate IBM publications.

4.4 General Control Program Description

The control program consists of several computer routines for calculating traffic parameters, assigning priorities to decision options, and applying the control function as dictated by the control logic.

4.4.1 Theory of Operation

The freeway control program uses freeway system operation as the basis of determining metering rates for the controlled inputs. After the metering rates have been established, the gap acceptance window concept is applied in determining the times to change the signal indication.

4.4.2 System Operation Indicators

The following traffic parameters and conditions are determined by the surveillance and control system and are used in the control program for establishing rates:

1. Five minute flow rates, updated each minute, for upstream and downstream locations.
2. Average speed of freeway traffic through bottleneck sections.
3. Length (greater than a preset value) of a queue of vehicles at the ramp signal.
4. Travel time of a ramp vehicle after leaving the ramp signal.
5. Occupancy (longer than a preset value) of the merge area on the entrance ramps.

4.4.3 Gap Acceptance Operation

The measurement of vehicle headways (gaps) and speeds are made from a speed trap formed by two detectors located in the outside lane upstream of the merge area (See Figure 3.1). The calculated travel times of the gaps to the merge area and estimated travel time of the ramp vehicle, from the signal to the merge area, are used to determine when the ramp signal should change. If this time is not in conflict with one of the system operation indicators, gap acceptance operation is used.

4.5 Organization of Control Programs

The in-core portion of the freeway control program consists of programs EXECI, SC100, MINIX, DETOM, and LOGER. EXECI is included in the MPX executive built at system generation time and remains a permanent portion of the real-time system. SC100, MINIX, DETOM, and LOGER are part of the SPAR (Special Area) core-load and are resident when the control program is operating. The following is a brief description of the program functions performed by each of the above routines.

4.5.1 EXECI

EXECI is the interrupt handling routine for speed stations. This includes the following tasks.

1. Tabulates non-alternating 'A' and 'B' detector actuations.
2. Updates 'A' and 'B' detector volume counters.
3. Measures speed trap times.
4. Puts valid gaps in gap table.
5. Tabulates full gap table errors.
6. Edits trap time.

7. Updates average speeds.

8. Processes instrumented vehicle distance channel.

4.5.2 SC100

SC100 is the main control program which executes once each 100 milliseconds. The tasks performed are as follows:

1. Tabulates 'V', 'R', 'O', 'Q', 'I', and 'M' detector volume counters. The latter three volumes are used for outage identification only.
2. Processes D_i to D_o trap times and initiates applicable overrides.
3. Tabulates ramp violations and slow and fast vehicle error counters.
4. Handles queue overrides.
5. Handles merge overrides.
6. Reads all digital inputs.
7. Updates green confirm status bits.
8. Checks for green confirm 'off' errors.
9. Updates D_i status bits.
10. Updates 'stick-on' detectors mask array.
11. Handles changes in ramp operating priority.
12. Decrements all times in gap tables.
13. Schedules vehicle launches according to current metering code.
14. Handles on-line/off-line ramp signal transitions.
15. Commands red, amber, or green color as scheduled.
16. Checks for green confirm 'on' errors.
17. Handles tone transmitter power on sequence.

18. Processes instrumented vehicle digital inputs (not part of freeway control).

4.5.3 MINIX

MINIX is executed once each minute. The tasks performed are as follows:

1. Updates the current minute counter for the control program.
2. Initiates I/O study each 15 minutes.
3. Checks control data and time for on-line/off-line master control.
4. Initiates critical speed overrides where applicable.
5. Calculates system indicators metering rate.

4.5.4 DETOM

DETOM is primarily the detector outage monitor but handles several other auxiliary functions. The functions are as follows:

1. Honors keyboard requests and queues the MANIN core-load for execution.
2. Handles the operations monitor alarm.
3. Monitors detector status once each minute and supplies inactivity messages when appropriate.
4. Handles the green 'blip' test feature during noncontrol periods.
5. Handles carrier monitor circuit error checking.
6. Supplies green confirm messages.
7. Handles tone transmitter power off sequence.
8. Supplies tone transmitter power status messages.
9. Handles on-line/off-line ramp status reporting.
10. Handles I/O study calculations.

4.5.5 LOGER

LOGER formats and logs data on the disks and is executed once each minute. The tasks performed are:

1. Data parameters are formatted and logged on disk:
   - 'A' and 'B' detector volumes
   - 'V' and 'R' detector volumes
   - 'O' and 'Q' detector volumes
   - Trap and gap time error counters
   - 'B' detector error counters
   - Ramp violation counters
   - Total vehicles launched counters
   - Null release counters
   - Average speeds
   - D_o fast vehicle error counters
   - D_o slow vehicle error counters
   - 'A' detector error counters
   - Fast vehicle error counters
   - Gap table full error counters
   - 'On' detector error counters
2. The 'on' detectors' monitor mask is updated to all 'ones.'

4.5.6 MANIN

The MANIN (for MANual INteraction) program is the means by which freeway control static and dynamic parameters may be monitored, updates performed, and other necessary manual control procedures initiated, usually through the #2 1816 typewriter. This is the primary means for the operator to interact with the control program. Details on MANIN are outlined later in this report.

5.0 MANIN OPERATING PROCEDURES

5.1 Monitoring Procedures

The MANual INteraction Program (MANIN) operates through the #2 1816 typewriter as the primary communicator with the freeway control program. MANIN operates in VCORE at the mainline or basic level of execution which is at a higher priority than batch processing (BP). Therefore, any job currently in execution at the batch processing level when MANIN is called in will cause the BP job to be suspended for the duration that MANIN is in execution. This is accomplished by saving the BP core-load on disk and restoring it when all higher level jobs have been processed. The interruption of a BP program does not affect its execution or results in any way except for time delays. Time dependent programs should not be interrupted as, for example, the instrumented vehicle tape processing program. Always check with the computer operator as to the status of the program currently in execution.

MANIN is called into execution by depressing the REST KBD (Restore Keyboard, which unlocks the keyboard) followed by KBD REQ (Keyboard Request). This will be followed by a pause of approximately 5 seconds during which time a dictionary of mnemonics, locations of control parameters in INSKEL common and appropriate bit masks are read. MANIN may be requested at any time when MPX is running and the freeway control program is in SPAR (SPecial ARea). After MANIN is in execution, the keyboard 'PROCEED' green light will come on. This is the signal to input a control statement. MANIN control statements are, in general, of the form

NNNNXX-YY (EOF)

where NNNN is a 4 character mnemonic

XX is a 1 or 2 character numeric index (optional if YY not given)

YY is a 1 or 2 character numeric index (optional).

XX and YY may be considered the initial value and the test value, respectively, of a FORTRAN-type DO index. For example, AVOL1-41 will call for 'A' detector volumes for detector number 1 through detector number 41 to be printed out. The values will be current at the time of printing. In the preceding example, 'AVOL' is a 4-character mnemonic which represents an 'A' detector volume. The character 1 is the starting detector number and the characters 41 represent the ending detector number. Note that a minus (or dash) is required when using the DO type indexing.

The reading of MANIN control statements is on a character-by-character basis and, thus, no FORTRAN type input errors can result. Editing and interpretation of the character string is done within the program, and illegal inputs cause a reject of the control statement with an immediate proceed light for input of another control statement. In other words, if no output results from the control statement, then an unrecognizable input was submitted and rejected internally. The keyboard request button should not be depressed when the proceed light is on.

Referring again to the sample control statement

AVOL1-41,

an equivalent control statement could have been simply

AVOL.

If no index parameters follow the 4-character mnemonic, then a default DO-type output is obtained in which the appropriate index values are supplied by the

program according to the number of quantities referred to by the mnemonic. Thus, AVOL would have 1-41 supplied, VVOL would have 1-44 supplied, RVOL would have 1-50 supplied, etc. Most mnemonics have default index values of 1-39 since there are 39 controlled entrance ramps in the system.

In the example cited thus far, the proceed light will be turned on after the last indexed value is printed, indicating a request for a new control statement to MANIN. If, however, a starting index only is supplied as, for example,

AVOL21

then MANIN continually monitors that parameter for change after it is first printed. In this example, the content of the 'A' detector number 21 would be printed each time that it incremented as representative of a vehicle passing over. Incidentally, MANIN interprets detector and ramp numbers as the TTI designation, not THD numbers.

When a cell is being continuously monitored as in the above example, it will eventually be desirable to discontinue the monitoring and supply a new control statement. This is done by depressing REST KBD followed by KBD REQ, which will signal MANIN to discontinue monitoring and read a new control statement.

Embedded blanks will cause an improper interpretation of the control statements. A list of acceptable mnemonics and description of arrays to which they refer are given in the freeway operation manual INSKEL common description section (Appendix A).

5.2 Updating Procedures

Thus far, control statement functions have dealt with only a monitoring capability. It is possible to update many of the parameters that can be

monitored. The general form of the update statement is

NNNNXX*

where NNNN is a 4-character mnemonic

and XX is a 1 or 2 character numeric index.

The asterisk is required, and embedded blanks will cause improper interpretation of the control statement.

As an example, suppose it is desired to update the green length for window or gap acceptance metering. Suppose the current green length for ramp #1 is 1.5 seconds and it is desired to change it to 1.2 seconds. Referring to the word format section of the freeway control manual, it is noted that green lengths are contained in an array called GNLEN and are expressed in tenths of seconds. On the same page, it is noted that the MANIN mnemonic is 'GLEN' and this mnemonic refers to bits 0 through 15 of the word.

To begin the update, type in GLEN1* and

GLEN+ 0 = 15 ENTER UPDATE

will be typed. This is a general response of the form

XXXX+YYYY = ZZZZZZ ENTER UPDATE

where XXXX is the MANIN mnemonic

YYYY is one less than the numeric index

and ZZZZZZ is the value of the designed cell.

At this point an update is ready to be entered. This is a 5-character decimal input and right justified. The keyboard must be in numeric mode for an update. When input is complete, press the EOF (end of file) key. The input quantity is then edited for upper limit and if out of range

XXXXX TOO HIGH NNNN+YYYY

is printed

where XXXXX is the quantity entered

NNNN is the mnemonic

and YYYY is one less than the specified index.

At this point MANIN would abort the update and call for new input.

Assuming a valid update,

XXXXX PENDING, EC =

is printed where XXXXX is the quantity entered. EC is for Entry Code, which is always 6101 which is the date of freeway control initiation. This must be entered to complete the update. If the wrong EC is entered, the update is aborted and control is passed to the beginning of MANIN for new input. If the EC is correct

NNNN+XXXXXYYYYY**********

will be printed

where NNNN is the mnemonic

XXXXX is one less than the specified index

YYYYY is the updated value.

The string of asterisks aids in identification of update points when these values are permanently incorporated in the control program.

If an index greater than the upper limit of the array is specified, the message

YYYYYY INVALID INDEX NNNN

where YYYYYY is the invalid index

and NNNN is the mnemonic

MANIN then aborts the update and calls for new input.

If the variable specified cannot be updated externally as, for example, the time of day or a detector volume, then the message

NNNN CANNOT BE UPDATED BY PROG YYYYY

will be printed

where NNNN is the mnemonic

and YYYYY is an internal index number.

The update is aborted and MANIN calls for new input.

5.3 Exit Procedure

Type the 4 character mnemonic 'EXIT' to exit MANIN and return control to batch processing (if active).

6.0 MANIN SPECIAL MONITOR FUNCTIONS

Several MANIN special monitoring functions are available which perform more complex tasks than monitoring cells in INSKEL Common. These include the use of special purpose auxiliary calculations. The following is a list of the special functions available. Appendix A defines INSKEL common variables.

6.1 MONT1-XX

Prints speed station XX measured speed and average speed in MPH each time 'B' detector volume increments.

6.2 MONT2-XX

Prints computed versus measured gap size in centiseconds at station XX each time 'B' detector volume increments. The computed gap is the projected gap, whereas the measured gap is the gap size at the 'B' detector.

6.3 MONT3

Prints the status of the system detector 'AND' tables. This is a 25-word mask array for the 19 groups of digital inputs and 6 groups of process interrupts. Each input whose corresponding 'AND' table mask bit is a '1' will be recognized normally according to the status received from the field. Each input whose corresponding 'AND' table mask bit is a '0' will remain in a dormant state, and actuations will not be recognized. The 'AND' table thus provides a means of logically removing a detector from the system.

6.4 MONT4

Prints the status of the system detector 'OR' tables. This is a 25-word mask array for the 19 groups of digital inputs and 6 groups of process inter-

rupts. Each input whose corresponding 'OR' table mask bit is a '0' will be recognized normally according to the status received from the field. Each input whose corresponding 'OR' table mask bit is a '1' will remain in a continuous "on" state for as long as the OR'ed bit is a '1'. The 'OR' table thus provides a means of logically actuating a detector.

6.5 MONT5-XX

Monitors all dynamic parameters for ramp XX under control. All program output combinations are printed when the program is initially executed to force output of some parameters which may be static. Program output mnemonics and their interpretations are given below:

ACPGAPYYY - The current acceptable gap size for release is YYY centiseconds.

NOA - Successive 'B' detector actuations with no intermediate 'A' detector actuation at the speed station for this ramp.

AVSPYYY - Average speed at the speed station for this ramp. Note that an updated output is made only when the speed changes ±3 MPH from the last time reported.

NOB - Successive 'A' detector actuations with no intermediate 'B' detector actuation at the speed station for this ramp.

V10 - The D_o detector was actuated when no release was made.

CURMNYYYY - YYYY is the current minute of the day (1-1440).

MRTEYY - Current metering rate is YY vehicles per minute.

DFLOYYYY - Downstream flow in vehicles per minute.

DOFAS - The D_o detector was actuated in less than half the time specified by the slow vehicle time parameter. This time is the 'trap time' from time of launch to time of D_o actuation.

DODIS - The D_O detector has been actuated after a vehicle launch.

DOSLO - The D_O detector was not actuated in the time specified by the slow vehicle time parameter after vehicle launch.

FASVH - Attempt was made to project a vehicle ahead of previous vehicle in gap table.

GTFUL - Maximum of 8 gaps already in gap table when new gap was formed.

IOENB - I/O study openings have commenced at a 15 minute boundary.

IODIS - The last I/O study subsystem has opened and data transferred to disk.

MRGQN - An entry has been made in the one level merge override queue stack.

MRGQF - Merge override queue stack entry has been transferred to merge override decrementing counter.

SYSMRYY - System indicators metering code YY.

VHLCH - Waiting vehicle has been launched.

NULL - Vehicle was launched without gap.

MANLCYY - Manual override metering code YY.

MERGCYY - Merge override metering code YY.

QUECYY - Queue override metering code YY.

CRITCYY - Critical speed metering code YY.

CSORDE - Critical speed override on.

QUORDE - Queue override on.

QOROFF - Queue override off.

MGORDE - Merge override on.

MGOROF - Merge override off.

MNORDE - Manual override on.

MNOROF - Manual override off.

CNTLPRIY - Current operating priority Y (See Table 6.1).

CURMRYY - Current metering code (See Table 6.2).

STRP - Trap time less than 200 milliseconds noted at speed station.

DION - D_i detector is on.

DIOF - D_i detector is off.

LTRP - Trap time greater than 4.000 seconds noted at speed station.

SGAP - Gap shorter than 0.50 seconds noted at 'B' detector.

LGAP - Gap longer than 32.767 seconds noted at 'B' detector.

UFLOYYYY - Upstream flow in vehicles per minute.

UNSUL - Unsuccessful launch indicator by failure to receive D_o actuation after vehicle launch.

6.6 MONT6-XX

Outputs to 1443 printer all fixed parameters for ramp XX. If XX > 39, all ramps are output.

6.7 MONT7

Reassigns MANIN output device. If output device is 1816, change to 1443. If output device is 1443, change to 1816.

6.8 MONT8

1443 printer page eject.

6.9 MONT9-XX

Prints entries in gap table for ramp XX on 1443 printer. If sense switch 2 is up, auxiliary checkout data is printed.

6.10 MONT10

Translates detector outage number to TTI/THD equivalent by table look-up. Reads input in 3-column field. Initially, program types 'TYPE DET CODE 13, .GTR.332 to EXIT'. After each detector number is translated, a new input may be typed. A detector number greater than 332 will cause control to be passed to MANIN.

6.11 MONT11

Resets operation monitor alarm cell. Operations monitor console switch must then be turned off and on to reset the audio alarm.

6.12 MONT12

Disk log data retrieval program. Initially types 'DISKR DATA RETRIEVAL PROGRAM/ENTER ROUTINE + PARMS'. An input of the form NNNNXX-YY is expected, where NNNN is a 4-character mnemonic, XX is a detector number and YY is the time period either in minutes or quarter hours as explained below. The mnemonic list is

AVOL - 'A' detector volume during specified minute.

BVOL - 'B' detector volume during specified minute.

VVOL - 'V' detector volume during specified minute.

RVOL - 'R' detector volume during specified minute.

OVOL - 'O' detector volume during specified minute.

QVOL - 'Q' detector volume during specified minute.

SGAP - Short gap counter during specified minute.

HITP - High speed trap time during specified minute.

BERC - 'B' detector error counter during specified minute.

VIOL - Ramp violations during specified minute.

RELC - Vehicles launched counter during specified minute.

NULR - Non gap releases during specified minute.

DOFA - Ramp fast vehicle counter during specified minute.

DOSL - Ramp slow vehicle counter during specified minute.

AERC - 'A' detector error counter during specified minute.

FASV - Speed station fast vehicle counter during specified minute.

GTFL - Gap table full error during specified minute.

ONMN - Stick-on detector mask array during specified minute.

AVSP - Average speed in fps during specified minute.

LGAP - Long gap counter during specified minute.

LOTP - Low speed trap during specified minute.

VOPA, VOPV, VOPR, VOPO - Number of vehicles which passed over detector after opening and during minute of opening. Time period specified is quarter hour number after midnight, 1 through 96.

MOPA, MOPV, MOPR, MOPO - Minute during which the detector opened, 1 through 1440. A "-1" indicates the detector did not open during the 15-minute period. Time period specified is quarter hour number.

After each data retrieval, the DISKR program selects the 1816 keyboard for another entry. When through, type in 'EXIT' to return to MANIN. Appendix B presents the log sector description.

6.13 MONT13-XX

D_i turn on entry. This program is used to logically turn on a D_i detector at ramp XX by setting its system OR mask bit to a '1'. This condition lasts

for approximately 2 seconds which is equivalent to the time that it takes for the 1816 proceed light to come on again. Only the bit associated with the D_i detector at ramp XX is forced on in the OR mask and all other bits remain unchanged. At the end of the 2-second delay, the designated D_i OR mask bit is returned to its original state. If it was already on, this program performs a "no-op" function.

6.14 MONT14-XX

Updates ramp XX operating priority. This entry is used to manually change the ramp operating priority to one of the priorities shown in the Ramp Operation Priority Codes Table (Table 6.1) at the end of this section. Initially, the message

'TYPE RAMP PRIORITY (I1)'

is typed. The proceed light will then come on. Type in a one character priority number in numeric mode. This input will be edited for a number greater than zero or less than 7. If out of range, the same request for input message will be typed. When a number in the correct range 1-6 is input, the ramp operating priority is updated accordingly and the message

'RAMP XX OPERATING PRIORITY NOW YY**********'

is typed, where XX is the ramp number and YY is the new operating priority as input manually.

6.15 MONT15

Prints speeds at any two-speed stations. When this entry is made the message

'TYPE SPEED STATIONS I2, I3'

will be printed. After two ramp numbers are input in the specified format,

speeds over the two speed stations will be printed in real-time with the first specified station on the left.

6.16 UPDT3

Updates status of system inputs 'AND' mask (ANTBL). Initially types 'ANTBL UPDATE/TYPE GRP+BIT NO. +BIT 2I2, I1'. Group number is a 2-character field (1-25), bit number is a 2-character field (0-15), and bit is either a '0' or a '1' (1-character field). A description of the input bits and group number correspondence is given in Appendix B. The update procedure may be terminated by a keyboard request followed by an end of file. Setting a particular bit (e.g.: detector) as '0' sets the bit in a constant 'OFF' condition.

6.17 UPDT4

Same as above except the system inputs 'OR' table is updated. Setting a particular bit (e.g.: detector) as '1' places the bit in a constant 'ON' condition.

6.18 UPDT5-XX

Speed station XX trap length manual update program. Accepts new trap length in tenths of feet and calculates gap projection multiplication constant.

6.19 UPDT6

Speed station automatic trap length update program. Types 'TPLEN = XXX, DCON = XXXXXX, KBREQ NEW TPLEN' upon entry. Thereafter, the trap time cell is monitored for change. Each time it changes, the trap time and speed in MPH is typed. When test vehicle passes over speed station, press the keyboard request button and enter the calibrated speed at the keyboard in a 2-character numeric field. A zero will return control to MANIN.

If sense switch 0 is down, particular speed station numbers are selected according to a preprogrammed sequence which begins with station number 16 northbound, proceeds to the end of the control area, back through the inbound section, and outbound through station 14. If sense switch 0 is up, the MANIN control statement must be entered in the form UPDT6-XX, where XX is a speed station number. The procedure otherwise is essentially the same with the exception that control is returned to MANIN as soon as speed station XX is updated.

6.20 UPDT7-XX

Gap projection distance update program. The gap projection distance for ramp XX is updated. Initially XX is edited to determine that it is in the valid range 1-39. If invalid, control is returned to MANIN. Otherwise, the message

'DIST = YYYYYY NEW DIST(14) ='

is typed, where YYYYYY is the current projection distance. The proceed light will then come on to indicate that a new 4-character distance is to be typed in numeric mode. The distance must be positive nonzero in order for the update to be completed. When update is complete, the above message is retyped. A zero or negative number can then be entered to return control to MANIN.

7.0 FREEWAY SYSTEM OPERATING PROCEDURES

7.1 General

Previous sections have covered theory of operation, hardware and software design, and procedures for interacting with the freeway surveillance and control program. This section concerns specific operating procedures for the North Central Expressway Control System.

7.2 Freeway Hardware System Overview

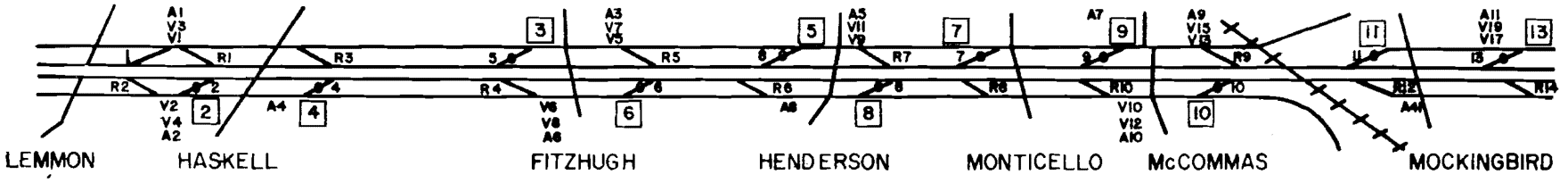
Specific details on detector and control cabinet locations, conduit runs, power sources, etc., are contained in the installation plans which are on file in the control center. Figure 7.1 shows general field locations of detector and control cabinets and detector identification numbering system.

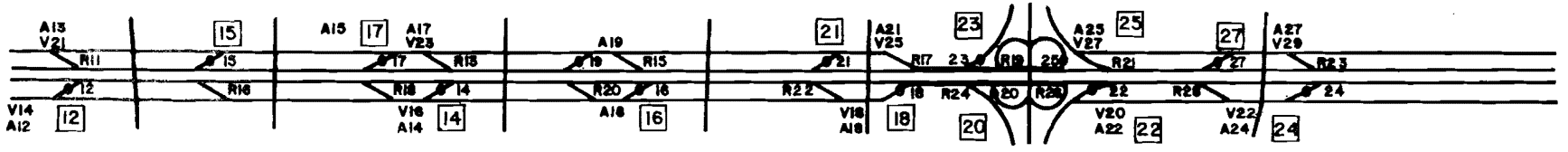
Table 7.1 lists cabinets by number and the associated detectors contained in each cabinet. Also shown are telephone line identification numbers associated with each set of cabinet hardware. Table 7.2 lists detectors numerically by function and the cabinet in which each is located.

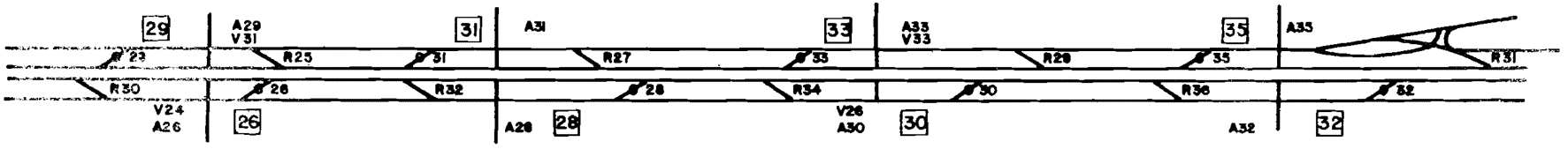
7.3 Control Logic Overview

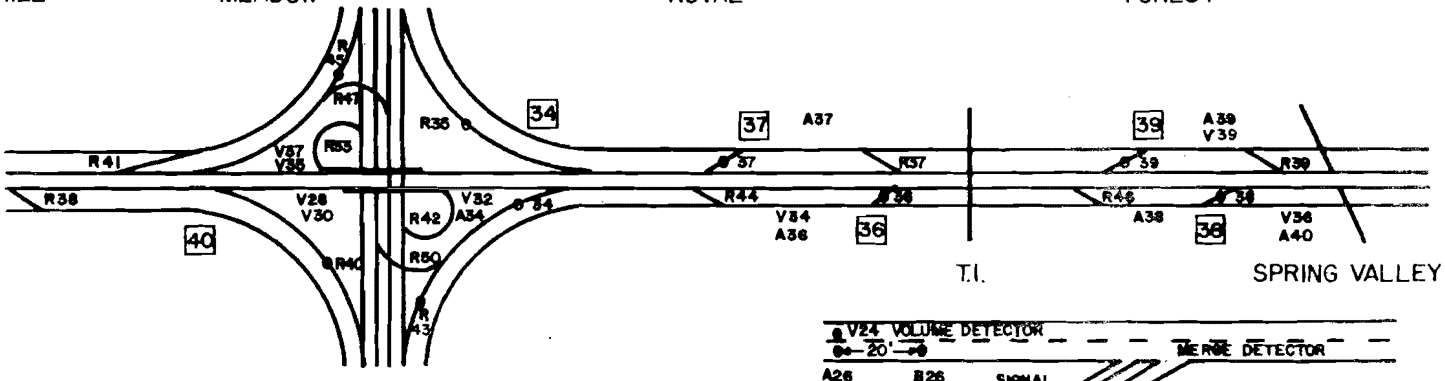
Freeway control and surveillance parameters as described in Section 2.0 are shown for each ramp in Appendix D. These parameters may be changed through the typewriter as described in previous sections. Should the freeway program be taken off-line and then placed on-line for any reason, the parameters will revert to the original values. Only by a change in the control program deck and reload of the program will a change become permanent.

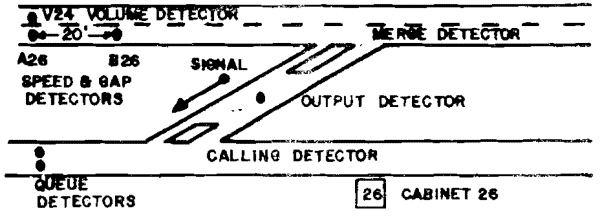
Each ramp has detectors associated with it for measurement of gaps, system parameters, bottleneck speeds, and local speeds. Table 7.3 is a tabulation of the detectors associated with each ramp in the control system.











TYPICAL RAMP INSTALLATION

DETECTOR AND CABINET LOCATIONS

DALLAS NORTH CENTRAL EXPRESSWAY

APPROXIMATE HORIZONTAL SCALE : 1" = 1/3 MILE

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TABLE 7.1
TELEPHONE PAIR AND DETECTOR LOCATION BY CABINETS

CABINET NUMBER	TELEPHONE PAIR	DETECTOR NUMBERS							
		I/O	A/B	M	Q	R	R	V	V
2	1DM3113	1	1	1	1	1	2	1	3
2	1DM3113	2	2	2	2	-	-	2	4
3	1DM3107	3	6	3	3	4	-	6	8
4	1DM3102	4	4	4	4	3	-	-	-
5	1DM3105	5	8	5	5	6	-	-	-
6	1DM3113	6	3	6	6	5	-	5	7
7	1DM3110	7	-	7	7	8	-	-	-
8	1DM3102	8	5	8	8	7	-	9	11
9	1DM3107	9	7	9	9	10	-	10	12
9	1DM3107	-	10	-	-	-	-	-	-
10	1DM3102	10	9	10	10	9	-	13	15
11	1DM3110	11	41	11	11	12	-	-	-
12	1DM3112	12	13	12	12	11	-	21	-
13	1DM3106	13	11	-	13	14	-	14	17
13	1DM3106	-	12	-	-	-	-	19	-
14	1DM3105	14	17	14	14	13	-	23	-
15	1DM3108	15	-	15	15	16	-	-	-
16	1DM3106	16	16	16	16	15	20	-	-
16	1DM3106	19	19	19	19	-	-	-	-
17	1DM3105	17	14	17	17	18	-	16	-
17	1DM3105	-	15	-	-	-	-	-	-
18	1DM3110	18	21	-	-	17	-	25	-
20	1DM3106	20	-	20	20	24	-	-	-
21	1DM3105	21	18	21	21	22	-	18	-
22	1DM3108	22	22	22	-	26	-	20	-
23	1DM3111	23	-	23	-	19	-	-	-
24	1DM3101	24	27	24	24	23	-	29	-
25	1DM3112	25	25	25	25	21	-	27	-
26	1DM3110	26	29	26	26	25	-	31	-
27	1DM3101	27	24	27	27	28	-	22	-
28	1DM3103	28	28	28	-	27	-	-	-
28	1DM3103	-	31	-	-	-	-	-	-
29	1DM3101	29	26	29	29	30	-	24	-
30	1DM3104	30	33	30	30	29	-	33	-
31	1DM3110	31	-	31	-	32	-	-	-
32	1DM3109	32	35	32	32	31	38	-	-
33	1DM3103	33	30	33	33	34	-	26	-
34	1DM3111	34	34	34	-	35	42	32	41
34	1DM3111	-	-	-	-	43	-	43	44
35	1DM3111	35	32	35	35	36	-	-	-
36	1DM3111	36	37	36	36	37	-	-	-
37	1DM3109	37	36	37	37	44	-	34	-
38	1DM3104	38	39	38	38	39	-	36	39
38	1DM3104	-	40	-	-	-	-	-	-
39	1DM3104	39	38	39	39	46	-	-	-
40	1DM3109	-	-	-	-	33	40	28	30
40	1DM3109	-	-	-	-	41	45	35	37
40	1DM3109	-	-	-	-	47	-	38	42
40	1DM3109	-	-	-	-	-	-	40	-

NOTE: Cabinets are numbered according to nearest entrance ramp.
Cabinet numbers 1 or 19 do not exist

TABLE 7.2
NUMERICAL LISTING OF FREEWAY DETECTORS

DET	CAB	COM	DET	CAB	COM	DET	CAB	COM	DET	CAB	COM	DET	CAB	COM	DET	CAB	COM	DET	CAB	COM
B 1	2	1	A 2	2	43	V 3	2	85	R 1	2	127	R43	34	169	035	35	211	Q38	38	253	M 2	2	295
B 2	2	2	A 3	6	44	V 4	2	86	R 2	2	128	R44	37	170	036	36	212	Q39	39	254	M 3	3	296
B 3	6	3	A 4	4	45	V 5	6	87	R 3	4	129	R45	40	171	037	37	213	I 1	2	255	M 4	4	297
B 4	4	4	A 5	8	46	V 6	3	88	R 4	3	130	R46	39	172	038	38	214	I 2	2	256	M 5	5	298
B 5	8	5	A 6	3	47	V 7	6	89	R 5	6	131	R47	40	173	039	39	215	I 3	3	257	M 6	6	299
B 6	3	6	A 7	9	48	V 8	3	90	R 6	5	132	R48	40	174	Q 1	2	216	I 4	4	258	M 7	7	300
B 7	9	7	A 8	5	49	V 9	8	91	R 7	8	133	R49	34	175	Q 2	2	217	I 5	5	259	M 8	8	301
B 8	5	8	A 9	10	50	V10	9	92	R 8	7	134	R50	34	176	Q 3	3	218	I 6	6	260	M 9	9	302
B 9	10	9	A10	9	51	V11	8	93	R 9	10	135	Q 1	2	177	Q 4	4	219	I 7	7	261	M10	10	303
B10	9	10	A11	13	52	V12	9	94	R10	9	136	Q 2	2	178	Q 5	5	220	I 8	8	262	M11	11	304
B11	13	11	A12	13	53	V13	10	95	R11	12	137	Q 3	3	179	Q 6	6	221	I 9	9	263	M12	12	305
B12	13	12	A13	12	54	V14	13	96	R12	11	138	Q 4	4	180	Q 7	7	222	I10	10	264			306
B13	12	13	A14	17	55	V15	10	97	R13	14	139	Q 5	5	181	Q 8	8	223	I11	11	265	M14	14	307
B14	17	14	A15	17	56	V16	17	98	R14	13	140	Q 6	6	182	Q 9	9	224	I12	12	266	M15	15	308
B15	17	15	A16	16	57	V17	13	99	R15	16	141	Q 7	7	183	Q10	10	225	I13	13	267	M16	16	309
B16	16	16	A17	14	58	V18	21	100	R16	15	142	Q 8	8	184	Q11	11	226	I14	14	268	M17	17	310
B17	14	17	A18	21	59	V19	13	101	R17	18	143	Q 9	9	185	Q12	12	227	I15	15	269			311
B18	21	18	A19	16	60	V20	22	102	R18	17	144	Q10	10	186	Q13	13	228	I16	16	270	M19	16	312
B19	16	19			61	V21	12	103	R19	23	145	Q11	11	187	Q14	14	229	I17	17	271	M20	20	313
		20	A21	18	62	V22	27	104	R20	16	146	Q12	12	188	Q15	15	230	I18	18	272	M21	21	314
B21	18	21	A22	22	63	V23	14	105	R21	25	147	Q13	13	189	Q16	16	231	I19	16	273	M22	22	315
B22	22	22			64	V24	29	106	R22	21	148	Q14	14	190	Q17	17	232	I20	20	274	M23	23	316
		23	A24	27	65	V25	18	107	R23	24	149	Q15	15	191			233	I21	21	275	M24	24	317
B24	27	24	A25	25	66	V26	33	108	R24	20	150	Q16	16	192	Q19	16	234	I22	22	276	M25	25	318
B25	25	25	A26	29	67	V27	25	109	R25	26	151	Q17	17	193	Q20	20	235	I23	23	277	M26	26	319
B26	29	26	A27	24	68	V28	40	110	R26	22	152	Q18	18	194	Q21	21	236	I24	24	278	M27	27	320
B27	24	27	A28	28	69	V29	24	111	R27	28	153	Q19	16	195			237	I25	25	279	M28	28	321
B28	28	28	A29	26	70	V30	40	112	R28	27	154	Q20	20	196			238	I26	26	280	M29	29	322
B29	26	29	A30	33	71	V31	26	113	R29	30	155	Q21	21	197	Q24	24	239	I27	27	281	M30	30	323
B30	33	30	A31	28	72	V32	34	114	R30	29	156	Q22	22	198	Q25	25	240	I28	28	282	M31	31	324
B31	28	31	A32	35	73	V33	30	115	R31	32	157	Q23	23	199	Q26	26	241	I29	29	283	M32	32	325
B32	35	32	A33	30	74	V34	37	116	R32	31	158	Q24	24	200	Q27	27	242	I30	30	284	M33	33	326
B33	30	33	A34	34	75	V35	40	117	R33	40	159	Q25	25	201			243	I31	31	285	M34	34	327
B34	34	34	A35	32	76	V36	38	118	R34	33	160	Q26	26	202	Q29	29	244	I32	32	286	M35	35	328
B35	32	35	A36	37	77	V37	40	119	R35	34	161	Q27	27	203	Q30	30	245	I33	33	287	M36	36	329
B36	37	36	A37	36	78	V38	40	120	R36	35	162	Q28	28	204			246	I34	34	288	M37	37	330
B37	36	37	A38	39	79	V39	38	121	R37	36	163	Q29	29	205	Q32	32	247	I35	35	289	M38	38	331
B38	39	38	A39	38	80	V40	40	122	R38	32	164	Q30	30	206	Q33	33	248	I36	36	290	M39	39	332
B39	38	39	A40	38	81	V41	34	123	R39	38	165	Q31	31	207			249	I37	37	291			
B40	38	40	A41	11	82	V42	40	124	R40	40	166	Q32	32	208	Q35	35	250	I38	38	292			
B41	11	41	V 1	2	83	V43	34	125	R41	40	167	Q33	33	209	Q36	36	251	I39	39	293			
A 1	2	42	V 2	2	84	V44	34	126	R42	34	168	Q34	34	210	Q37	37	252	M 1	2	294			

TABLE 7.3

CRITICAL SPEED, BOTTLENECK AND SYSTEM DETECTORS

RAMP NUMBERS	SYSTEM DETECTORS UPSTREAM	SYSTEM DETECTORS DOWNSTREAM	CRITICAL SPEED DETECTOR	BOTTLE NECK DETECTOR	ALTERNATE BNECK DETECTOR	ALTERNATE SPEED DETECTOR
RAMP 1	A1 V1 V3	A1 V1 V3 O1	1	1	3	3
RAMP 2	A2 V2 V4	A6 V6 V8 R4	4	4	2	2
RAMP 3	A3 V5 V7	A1 V1 V3 R1 R3	3	1	1	3
RAMP 4	A2 V2 V4 O2	A6 V6 V8 R4	6	41	4	12
RAMP 5	A5 V9 V11	A3 V5 V7 R5	3	1	5	3
RAMP 6	A6 V6 V8	A10 V10 V12 R6 R8 O8	8	41	6	12
RAMP 7	A9 V13 V15 O9	A5 V9 V11 R7	5	3	7	5
RAMP 8	A6 V6 V8 R6 O6	A10 V10 V12 R8 R10	10	41	8	12
RAMP 9	A9 V13 V15	A5 V9 V11 R7	7	3	9	5
RAMP 10	A10 V10 V12	A12 V14 R12 R14	41	41	10	12
RAMP 11	A11 V17 V19	A9 V13 V15 R9	9	3	11	5
RAMP 12	A12 V14	A14 V16 R16 R18	12	14	41	16
RAMP 13	A13 V21	A11 V17 V19	9	9	11	11
RAMP 14	V14 V16	A18 V18 R20 R22 O16	14	16	12	18
RAMP 15	A17 V23 O17	A13 V21 R11	15	13	17	11
RAMP 16	A14 V16 R20 O14	A18 V18 R22	16	18	14	22
RAMP 17	A17 V23 R13	A13 V21 R11	15	13	17	11
RAMP 18	A18 V18	A22 V20 R24 R26 O20	18	22	16	24
RAMP 19	A21 V25 R15 O21	A17 V23 R13	19	15	21	13
RAMP 20	A18 V18 R24 O18	A22 V20 R26	22	22	18	24
RAMP 21	A21 V25	A17 V23 R13 R15	19	15	21	13
RAMP 22	A22 V20 R26	A24 V22 R28	22	22	18	24
RAMP 23	A25 V27 R19 O25	A21 V25 R17	21	15	25	17
RAMP 24	A24 V22	A26 V24 R30	26	26	24	28
RAMP 25	A25 V27	A21 V25 R17 R19	25	21	27	19
RAMP 26	A26 V24	A30 V26 R32 R34 O28	28	28	26	30
RAMP 27	A27 V29 R23	A25 V27 R21	25	25	27	21
RAMP 28	A26 V24 R32 O26	A30 V26 R34	30	30	28	32
RAMP 29	A29 V31	A27 V29 R23	27	27	29	25
RAMP 30	A30 V26	V28 V30 R36 R38 O32	32	32	30	34
RAMP 31	A33 V33 R27 O33	A29 V31 R25	29	29	31	27
RAMP 32	A30 V26 R36 O30	V28 V30 R33 R40	32	32	30	34
RAMP 33	A33 V33	A29 V31 R25 R27 O31	31	31	29	29
RAMP 34	A34 V32	A36 V34 R44	36	36	34	38
RAMP 35	V35 V37 R31 R45 R47	A33 V33 R29	33	33	36	36
RAMP 36	A36 V34	A40 V36 R46	38	38	36	36
RAMP 37	A39 V39 R37 O39	V35 V37 R33 R35	37	37	37	37
RAMP 38	A36 V34 R46 O36	A40 V36	40	40	40	40
RAMP 39	A39 V39	V39 V43 O39	37	37	37	37

The freeway control program routinely is on-line in the 1800 system. Only in the event of a power loss, or the intentional deletion of the program for maintenance or other purposes, will the freeway control program be off-line. Specific procedures for placing the freeway control program on-line in these events are outlined in subsequent sections.

Normal control operation times are 7:00 to 9:00 a.m. and 4:15 to 6:15 p.m. on non-holiday weekdays. These times may be changed as outlined in previous sections. Determination of the freeway control calendar will be covered subsequently.

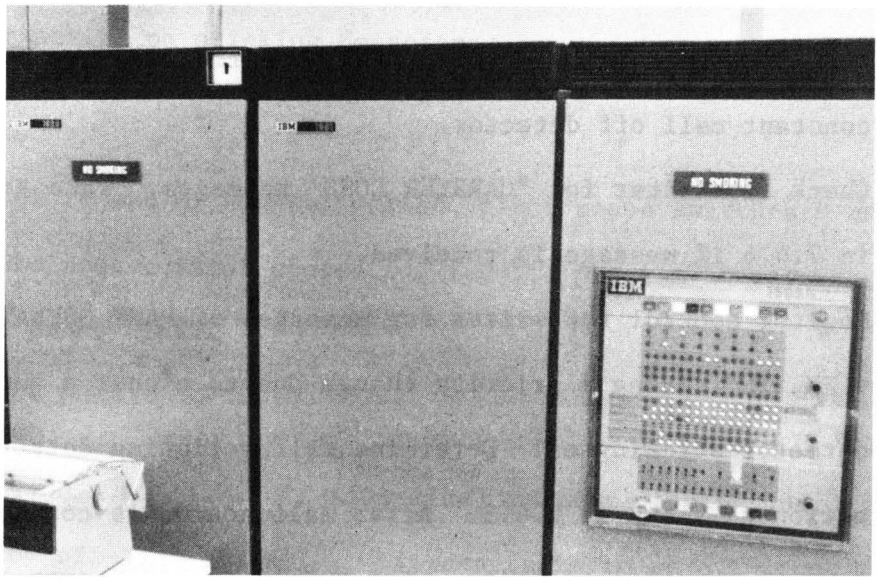
7.4 Basic Freeway Control System Operating Procedures

The following procedures assume that the freeway control program has been input to the computer, and appropriate real-time and post processing programs have been loaded. Specific steps to be taken to effect these actions are outlined below should this not be the case.

7.4.1 A.M. Control Period (Normally 7:00-9:00 A.M.)

7.4.1.1 - If the IBM 1800 computer is not functioning (as indicated by dark or partially dark indicator lights on console (Figure 7.2)), restart freeway control program as outlined in Section 7.4.8.

7.4.1.2 - Prior to 6:50 a.m., insure that Real-Time Print (RTPRT) program has been read into card reader. If not, place RTPRT program in card reader, press 'START' on card reader, and press 'CONSOLE INTR' on computer. Should clock time be less than 5 minutes until the freeway is scheduled to come on-line, RTPRT will not execute. Place 'DATA ENTRY SWITCH' #6 up and RTPRT



IBM 1800 CONSOLE

FIGURE 7.2

will execute regardless of time. Check typewriter for inactive detectors ('NO ACTIVITY IN 30 MIN') and follow steps in 7.4.3 if any are found.

7.4.1.3 - At 7:00 a.m. (ramp control turn-on time), check typewriter and display board for ramps not coming on-line properly. If any controlled ramp fails to come on-line, take action as shown in Section 7.4.4.

7.4.1.4 Action During A.M. Control Period

A. Check typewriter for additional detectors shown to be inactive. If an 'I' detector shows inactive on a controlled ramp, place a constant call on that detector using UPDT4 function as shown in previous section. After detector malfunction is corrected, use UPDT4 to take constant call off detector.

B. Check typewriter for 'CARRIER LOSS' messages. Take action as shown in 7.4.6 if message is received.

C. Monitor control typewriter for messages of RAMP OPERATING PRIORITY = XX, indicating a priority change due to either a queue or merge detector sticking on. Determine malfunctioning detector and take action as shown in 7.4.5. After malfunction is corrected, restore ramp to original priority using MONT14 in MANIN operating procedures.

D. Monitor display board for any detectors not operating properly. Take action shown in 7.4.3 or 7.4.5.

E. Periodically monitor controlled ramps to insure that signals cycle properly when 'I' detector is occupied. To place a 2 second 'false call' on an 'I' detector, use MONT13 function as described in MANIN. This may be used to test a signal where no demand is present or to give a green to a vehicle which stops short of loop.

F. Monitor console typewriter error messages for detector malfunctions, carrier losses, priority changes, and green confirm errors. See Sections 7.4.2 through 7.4.7 for specific action in the event of such malfunctions.

G. Record detector malfunctions in hardware log book.

H. Record on-line time, weather, and unusual occurrences such as accidents, stalls, ramps off-line, etc., in Freeway Operations Record Book.

I. Review 'STIKY' printout for detectors stuck-on. See Section 7.4.5 for action on sticking detectors.

7.4.1.5

A. Prior to end of control period, place sense switches 0 and 1 down.

B. Place post control evaluation (POSTC) program in card reader hopper and press START.

7.4.1.6

A. At 9:00 a.m. (A.M. off-line time) monitor display board for ramps going off-line properly. If ramp fails to go off-line, take action shown in Section 7.4.4.

B. Remove Input/Output Analysis Program (I/O) from stacker. Remove punched summary cards behind two pink cards at end of program and interpret summary cards. Punch new pink header cards with current day's date and place pink cards in I/O deck with at least 30 blank cards behind each pink card. Insure that last blank card in I/O deck has an END card behind it. File old pink cards and interpreted summary cards.

7.4.2 P.M. Control Period (Normally 4:15-6:15 P.M.)

7.4.2.1 - If the IBM 1800 computer is not functioning (as indicated by dark or partially dark indicator lights on console (Figure 7.2)), restart freeway control program as outlined in Section 7.4.7.

7.4.2.2 - Prior to 4:05 p.m., place Real-Time Print (RTPRT) into card reader, press 'START', and 'CONSOLE INTR'. Should clock time be less than 5 minutes until the freeway is scheduled to come on-line, RTPRT will not execute. Place 'DATA ENTRY SWITCH' #6 up and RTPRT will execute regardless of time. Check console typewriter for inactive detectors ('NO ACTIVITY IN 30 MIN') and follow steps in Section 7.4.3 if any are found.

7.4.2.3 - At 4:15 p.m. (ramp control turn-on time), check typewriter and display board for ramps not coming on-line properly. If any controlled ramp fails to come on-line, take action as shown in Section 7.4.4. Ramp 13, south-bound University ramp, does not normally operate during P.M. control.

7.4.2.4 Action During P.M. Control Period

Follow instructions shown in items A through H of Section 7.4.1.4.

7.4.2.5

A. Prior to end of control period, place the following card decks in the card reader and press 'START': (1) POSTC, (2) I/O, (3) STIKY, and (4) RTPRT. Insure the decks are in the order specified and no //bEND cards are in the decks.

B. Place sense switches 0 and 1 up.

7.4.2.6 - At 6:15 p.m. (P.M. off-line time) monitor display board for ramps going off-line properly. If ramp fails to go off-line, take action shown in Section 7.4.4.

7.4.3 Inactive Detectors

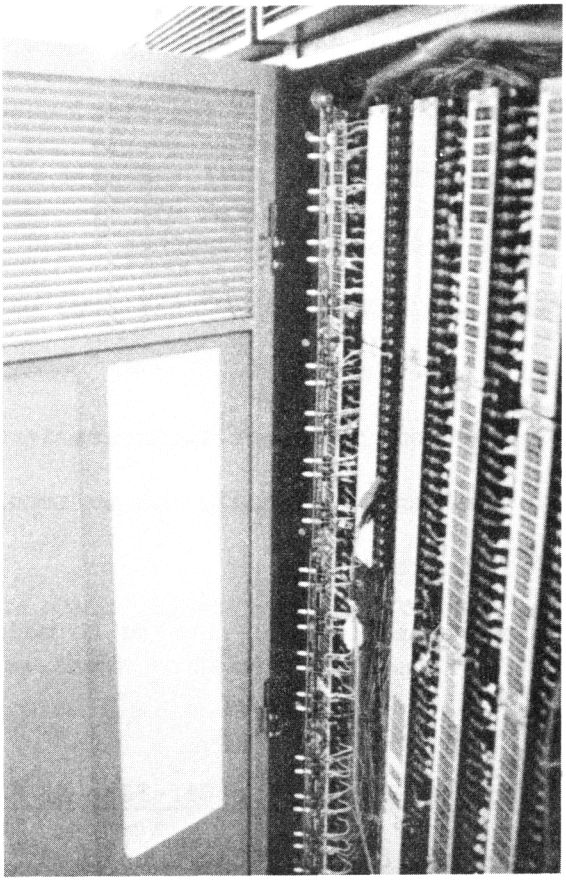
If the message 'NO INPUT ACTIVITY IN 30 MIN XXX' is received, check detector equivalency in Table 7.2 to determine which detector is inactive. If an 'I' detector is not functioning during a control period, a constant "call" should be placed on that detector using UPDT4, or the ramp may be taken off-line. If a speed detector is inactive, check the critical speed detector and bottleneck in Table 7.1. If the malfunctioning detector is a bottleneck or critical speed detector, another speed station should be substituted for that ramp with MANIN and 'DEPCXX' or 'DEPDXX' for critical speed and bottleneck speed, respectively.

Check the associated tone receiver to insure it has not failed. If carrier loss light is on, the problem is probably due to transmitter failure, phone line loss, or power loss at the cabinet.

Give detector numbers and cabinet numbers to maintenance technicians for repair.

7.4.4 Ramp Does Not Come On-line Or Go Off-line At The Proper Time

If a ramp fails to come on-line when scheduled, check to see that switches on back-up controller (Figure 7.3) are in the off (left) position. If switches are in the on (right) position, place them in the opposite direction. If this fails to bring ramp on-line, report to technician.



BACK UP CONTROLLER SWITCHES

FIGURE 7.3

If ramp fails to go off-line, check to see if back-up switches are in the OFF (left) position. If any switches are to the left, place them to the right and attempt to take ramp off-line manually using ONLN function as described in MANIN sections. If ramp fails to go off-line, report to technician.

7.4.5 Sticking Detector Report

This program is run at 5:00 a.m. for the previous 24 hour period. It tabulates all detectors in system that remain on for one minute or more. The readout on the 1443 printer is in two segments. The summary lists the detectors that have stuck-on and total number of minutes. The second section lists the detector number, number of minutes stuck-on and time period it was on.

Any detector that is stuck-on for more than 3 minutes should be checked. 'A', 'B', 'V', 'R', and '0' detectors should be assigned to maintenance technician to check for out of tune amplifiers if stuck-on for over 3 minutes. 'I', 'M' and 'Q' detectors, due to placement on ramps, will appear to be stuck-on when occupied for long periods of time during peak periods. These detectors should be checked against the times logged in the second section of the printout. If the period they are stuck-on corresponds with high volume on a ramp, where detector might actually be continuously occupied, they need not be reported to the maintenance technician.

7.4.6 Carrier Loss

'CARRIER STATE CHANGE ***' will be the first message on the console typewriter that a channel has failed. Replace the receiver with a spare receiver of the same frequency. If that does not correct problem, report malfunction to maintenance technician.

7.4.7 Green Confirm 'ON' Or 'OFF' Errors

The message 'GREEN CONFIRM OFF ERROR XX' indicates ramp signal XX was on when it should have been off. Conversely, 'GREEN CONFIRM ON ERROR XX' indicates ramp signal XX was off when it should have been on. Off errors often indicate a "flicker" in the green lamp or "noise" on the phone line feeding green confirm messages.

Use TV monitor, if possible, to monitor ramp operation. If ramp is operating satisfactorily, leave ramp on-line. If operation is impeded by flickers or a signal light not coming on, place ramp on the back-up system or remove ramp from control. Report problem to maintenance technician.

7.4.8 Restarting Freeway System After Power Loss

A. If 'POWER ON' light on computer console is dark, press green 'POWER ON' button on the computer.

B. Press 'START' button on the printer and on both disk units.

C. Press 'NPRO' on the card reader and clear all cards out of the hopper.

D. Press 'STOP', 'IMMEDIATE STOP', and 'RESET' buttons on the computer. While holding 'CLEAR STOR' button down, press 'START'. After about 2 seconds again press 'STOP', 'IMMEDIATE STOP', and 'RESET'.

E. Place COLD START deck in the card reader and press 'START' on the card reader.

F. After both disk ready lights are on, place all sense and data switches down and press 'PROGRAM LOAD'.

G. Three messages will be typed on the system typewriter requesting time, data, etc., to be entered by data switches. Ignore them by pressing 'START' on the computer after each message.

H. Place sense switch 3 up and press 'CONSOLE INTR'. Type current 6-digit date on system typewriter (e.g., 020373 = Feb. 3, 1973). Press 'EOF'. Type 6-digit time (e.g., 140600 = 2:06 PM). Press 'EOF'.

I. Place freeway on-line by putting sense switch 3 down, and 5 up, and pressing 'CONSOLE INTR'. Then put sense switch 5 down and 7 up.

J. If step I was not performed before the scheduled ramp on time, it will be necessary to update the A.M. turn-on time (AMON) or P.M. turn-on time (PMON) with a later time as follows:

```
type AMON1*  eof
     AMON+   0 = 420 ENTER UPDATE
type bbXXX   eof
     bbXXX   PENDING, ETC.
type b6101   eof
type EXIT    eof
```

Where 'b' is a blank and XXX is the new time. After making such an update and after the ramps have come on-line, always change the AMON and PMON to the normal values of 420 and 975, respectively.

7.4.9 Emergency Procedures

The back-up controller was designed and built to cycle a ramp signal, or signals, on a fixed metering rate (4 veh./min.) in the event of computer malfunction. Emergency procedures should be involved when computer has gone "not ready" due to power loss or when computer is otherwise malfunctioning and causing erratic operation at ramp signals.

7.4.9.1 To Place Selected Ramps On-line With Back-up Controller

A. Place 'TONE XMTR POWER' switch to left into back-up controller position.

B. Place ramp switches (Figure 7.3) for ramps to be put on-line to left. Do not at any time put Ramp 13 on-line with back-up controller.

C. Plug back-up controller and power supply into wall outlet.

7.4.9.2 To Take All Ramps Off-line

A. Place the 'TONE XMTR POWER' switch to the left into back-up controller.

B. Insure that back-up controller and power supply are unplugged.

7.4.10 Miscellaneous Operating Procedures

Several operating procedures related to freeway control system not previously documented are presented in this section.

7.4.10.1 Post Control Evaluation Program

This program, run at the end of each control period, provides a summary of several operating parameters. Some of these parameters are indicators of hardware malfunctions. Table 7.4 gives a typical day's operation summary.

7.4.10.1.1 - AV SP, LO SP, AND HI SP. These values indicate average, low, and high speeds measured over the speed detector associated with the indicated ramp. Inordinately low or high values may indicate speed detector problems. There are no speed or gap detectors for ramps 20 and 23.

7.4.10.1.2 - PCT VIO. This value indicates the percent of entering vehicles which violated the signal on each ramp. Unusually high percentage may indicate that the ramp was off-line during the control period or hardware malfunctions such as an "I" detector not working have occurred. Excessive violation rates without hardware causation should be called to the attention of the operations engineer who will coordinate with police authorities.

TABLE 7.4
TYPICAL OPERATIONS SUMMARY

DALLAS NORTH CENTRAL EXPRESSWAY CONTROL OPERATION SUMMARY — DATE 6/14/1973 FROM 420 TO 540 MINUTES

RP	AV SP	LO SP	HI SP	SH TP	LG TP	SH GP	LG GP	VEH REL	NUL REL	GAP REL	PCT GRL	VIO	PCT VIO	'A' VOL	'A' ERR	PCT AER	'B' VOL	'A' ERR	PCT AER	DO FA	DO SL	GTB FUL	EA VH
1	40	22	47	1	3	9	0	278	80	198	71	66	23	2523	14	0	2523	19	0	24	42	0	36
2	50	41	57	20	5	9	4	576	0	576	100	118	20	1020	15	1	1015	10	0	53	41	0	0
3	39	15	51	3	4	22	0	363	174	189	52	61	16	2913	25	0	2924	42	1	7	51	75	56
4	41	32	49	3	22	38	2	302	1	301	99	58	19	1562	51	3	1553	44	2	27	27	0	60
5	41	15	53	4	0	37	0	257	120	137	53	46	17	2984	6	0	3057	33	2	3	29	131	16
6	47	39	53	15	3	31	0	754	15	739	98	84	11	1139	9	0	1169	42	3	26	39	0	0
7	42	16	51	7	3	19	0	264	104	160	60	52	19	2989	24	0	2996	32	1	12	33	67	6
8	48	34	56	11	22	15	7	507	2	505	99	78	15	1186	49	4	1151	14	1	22	179	0	0
9	47	37	55	6	3	11	0	385	173	212	55	31	8	2630	19	0	2622	11	0	4	93	0	4
10	47	38	53	52	1	18	3	354	0	354	100	48	13	1167	9	0	1186	27	2	27	22	0	0
11	41	32	51	1	3	5	1	693	212	481	69	113	16	2241	24	1	2243	27	1	37	83	13	54
12	43	26	51	23	6	41	0	285	36	249	87	93	32	2588	36	1	2603	52	1	13	55	30	25
14	41	29	51	13	27	35	0	300	47	253	84	74	24	2062	107	5	1980	25	1	21	55	0	22
15	41	14	54	2	2	27	0	341	152	189	55	60	17	3493	6	0	3554	67	1	6	48	232	18
16	45	35	54	2	4	39	30	372	5	367	98	90	24	2134	11	0	2179	56	2	45	42	0	0
17	40	17	53	37	0	28	0	396	157	239	60	60	15	3070	13	0	3108	55	1	6	44	18	26
18	47	36	56	14	5	24	0	350	3	347	99	79	22	2427	31	1	2419	25	1	92	13	0	0
19	36	16	55	31	1	24	1	541	185	356	65	38	7	3072	52	1	3073	54	1	4	80	15	23
20	0	0	0	0	0	0	0	145	0	145	100	19	13	0	0	0	0	0	0	13	18	0	118
21	26	7	50	5	13	86	2	351	97	254	72	39	11	3006	41	1	3145	182	5	12	67	414	23
22	46	29	54	25	2	62	06	558	0	558	100	108	19	2199	20	0	2207	28	1	48	72	0	0
23	0	0	0	0	0	0	0	273	0	273	100	88	32	0	0	0	0	0	0	10	58	0	118
24	48	38	57	19	7	16	0	368	16	352	95	65	17	2314	20	0	2315	22	0	15	41	0	0
25	25	6	47	4	10	9	208	351	0	351	100	35	9	2810	5	0	2906	103	3	2	146	0	41
26	49	39	58	15	9	19	0	248	6	242	97	36	14	2169	36	1	2147	14	0	12	44	0	0
27	29	6	56	9	8	10	3	385	102	283	73	34	8	2794	136	4	2705	47	1	2	108	455	88
28	51	43	57	33	3	24	0	341	4	337	98	59	17	2153	23	1	2259	139	6	32	37	0	0
29	27	6	53	19	10	33	9	381	60	321	84	41	10	2639	61	2	2683	105	3	5	111	569	76
30	54	44	59	33	2	1	18	3	169	3	166	98	0	0	2189	3	0	2259	78	3	0	0	0	0
31	28	6	53	2	21	45	5	345	44	301	87	53	15	2596	62	2	2730	196	7	6	135	701	108
32	55	46	61	24	5	1	17	8	236	0	236	100	43	18	1855	6	0	1877	28	1	24	25	0	0
33	36	7	56	3	8	29	1	234	27	207	88	52	22	2611	24	0	2653	67	2	15	66	238	61
35	47	12	62	63	5	27	0	331	70	261	78	58	17	2757	13	0	2732	38	1	7	47	96	14

NOTE: No speed or freeway volume detectors at Ramps 20 and 23.

7.4.10.1.3 - 'A' VOL, 'B' ERR, and PCT BER. These values indicate respectively: The number of vehicles passing over the 'A' detector, the number of times there was not a corresponding 'B' detection, and the percent of 'A' actuations not detected by the 'B' detector. A high percentage error indicates detector malfunction as the space between the detectors is only 20 feet. High error percentage should be reported to maintenance technician.

7.4.10.1.4 - 'B' VOL, 'A' ERR, and PCT A ERR. Similar tabulations as those described above except the number of times no 'A' actuation was received preceding a 'B' actuation. High error percentage should be reported to maintenance technician.

7.4.10.2 Volume Discrepancies

Periodic checks of volume counting detectors may be made through the control typewriter. Entering 'AVOL' will give cumulative volume over each 'A' detector. Entering 'BVOL' gives similar values for each 'B' detector. Comparing volumes over corresponding 'A' and 'B' detectors may give indication of detector problems. Comparing volumes over a specific detector with volume over the next downstream detector may give an indication of malfunction. Similarly, VVOL will give cumulative volumes over each 'V' detector. Comparing values of adjacent detectors and successive downstream/upstream detectors may reveal detector problems. The above checks should be made near the beginning of each control period.

7.4.10.3 Speed Station Calibration

Instructions for calibration of speed stations were outlined in the MANIN operating procedures. This should be accomplished on a monthly basis. Furthermore, if a detector amplifier for an 'A' or 'B' detector is replaced, the associated trap should be calibrated.

7.4.10.4 Freeway Control Calendar

Part of the freeway control system is the freeway control calendar which specifies on which days the control system will operate. Weekends and holidays are usually non-control days. This deck must be updated and read into the system after P.M. control on December 31 of each year.

7.4.10.5 Computer Time Clock

Computer time (MINC) should be compared periodically with an accurate time indication. Should a difference of more than 2 minutes be found, the computer time should be corrected by following steps II and I of Section 7.4.8. Computer time should also be updated following P.M. control on the day before a change to or from daylight savings time.

7.4.10.6 Input/Output Study

This program is run off-line as an evaluation of each control period. This is in addition to the POSTC previously described. Volumes over each detector and speed over speed stations are tabulated for each 5 minute period during control. Unusual values and variations may be evident when this report is reviewed. This should be done during each A.M. control period.

7.4.11 Display Board Operation

The display board's operation was explained previously and requires no special operating techniques other than to insure that the power switch on the driving mechanism is ON. Malfunction or burned out bulbs should be reported to maintenance personnel.

7.4.12 Closed Circuit Television System Operation

The CCTV system may be used for various functions during control or non-control hours. The following paragraphs briefly describe its operation. The

cameras are numbered from 1 to 9 (from south to north) according to the map mounted over the monitors.

7.4.12.1 Control Functions

Five remote control functions are associated with each camera: Pan, Tilt, Iris, Zoom, and Focus. To use any one of these controls, dial the desired camera number on the control panel (Figure 7.4) and carry out the function. Camera 4 is controlled by a separate panel, the lower of the two shown.

7.4.12.2 Video Tape Recorder Operations

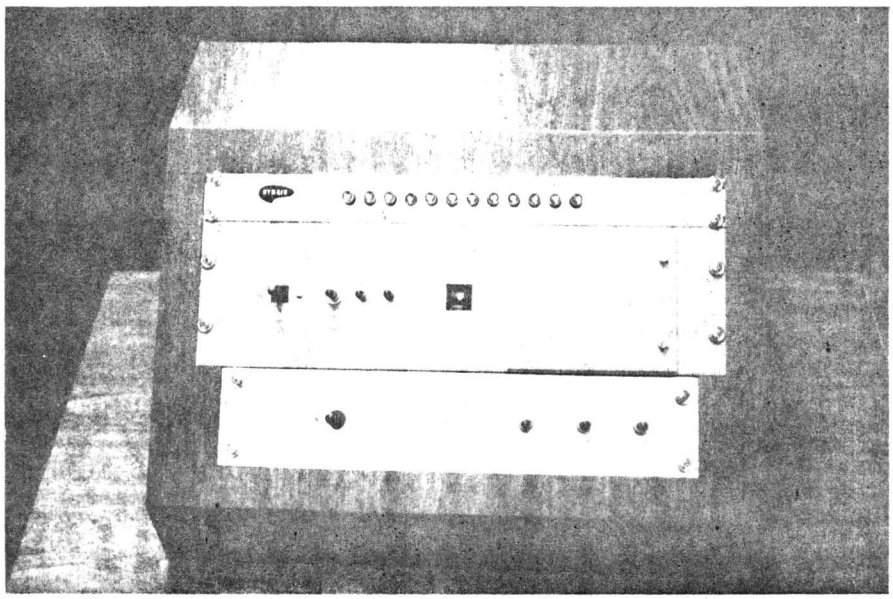
Mounted over the control panels is a video tape recorder (VTR) switching device. To tape any of the nine cameras, punch in the appropriate numbered button and operate recorder according to instruction book. The VTR normally has the record button depressed with the record level in center position and the motor rocker switch "OFF", so that the camera keyed through the switcher can be viewed through VTR monitor. To record or play, the rocker switch must be "ON".

7.4.12.3 Malfunction Reporting

Malfunctions in the control or video systems should be reported to Dallas Communications Services.

7.4.12.4 Vidicon Protection Procedures

Following P.M. control, cameras should be pointed downward at some non-light giving or reflecting source (such as a grassy area) to protect the vidicon from headlights or luminaires. During daylight hours, cameras should not be directed toward intense light sources, particularly the sun.



CCTV CONTROL PANEL
FIGURE 7.4

APPENDIX A

INSKEL COMMON VARIABLE DEFINITIONS

EQUATED VARIABLES

RANGS=DISTS

MNSTK=MGSTK

QUSTK=CSSTK

GTFUL=FASVH=GNCNF

DOERR=DOENB

BERCT=VIOLT

UNSUL=OVRUN=GOFFL

SPDCM=ONLIN=SHDQB

BERCT=LONLN

WINDP=OPRTN=ONOFL

SGCNT=GONFL

. ARRAY NAME ACEPG SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	ACCEPTABLE GAP SIZE (CS) FOR LAUNCH
MANIN MNEMONIC(S)	AGAP

DESCRIPTION:

. ARRAY NAME ACPGR SIZE: 39

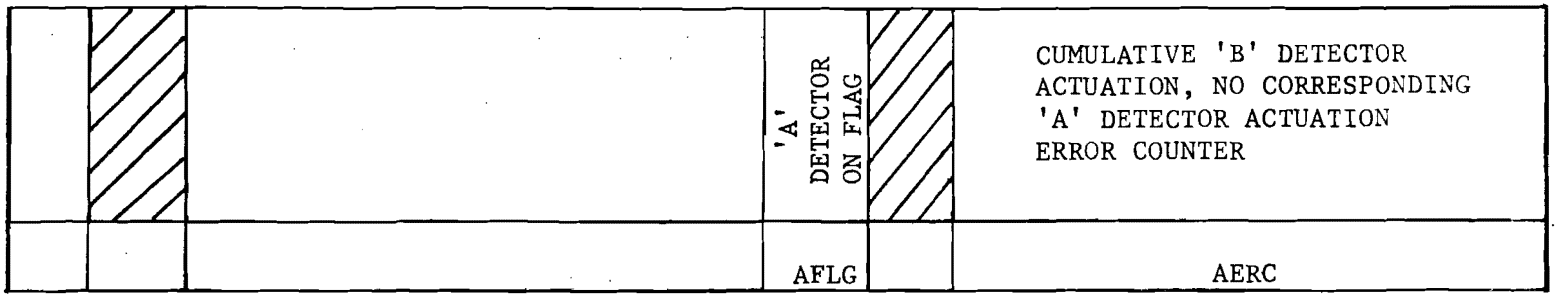
Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	LOW RANGE ACCEPTABLE GAP SIZE (TENTHS). IF ≠0, DIMINISHED BY 2.0 SECONDS	MIDDLE RANGE ACCEPTABLE GAP SIZE (TENTHS). IF ≠0, DIMINISHED BY 2.0 SECONDS.	HIGH RANGE ACCEPTABLE GAP SIZE (TENTHS). IF ≠0, DIMINISHED BY 2.0 SECONDS.
MANIN MNEMONIC(S)	ACGL	ACGM	ACGH

DESCRIPTION: ACCEPTABLE GAP SIZES CORRESPONDING TO SPEED RANGES GIVEN IN 'SPDCM.' ALL GAP SIZES (EXCEPT 0) ARE BIASED BY 2.0 SECONDS, I.E., THE PARAMETER IS 2.0 SECONDS LESS THAN USED BY THE LAUNCH SCHEDULER.

. ARRAY NAME AERCT SIZE: 41

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

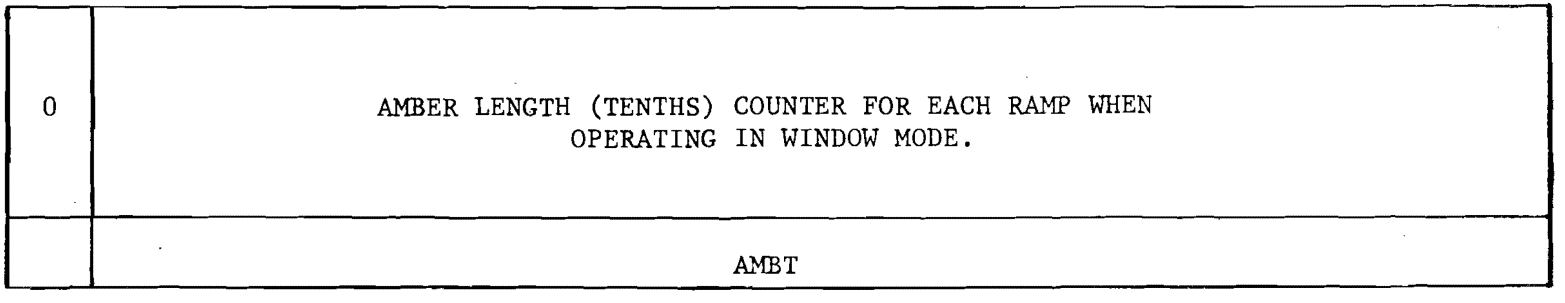


MANIN MNEMONIC(S)				AFLG		AERC

DESCRIPTION: CMLA (SEE MNEMONICS BELOW) INCREMENTS ONCE FOR EACH VEHICLE ARRIVING AT 'B' DETECTOR WITHOUT CORRESPONDING 'A' DETECTOR ACTUATION. CMLA INCREMENTS MODULO 2^6 (64). NOTE THAT BIT 0 CANNOT BE SET, OVERFLOW DOES OCCUR INTO BIT 1.

. ARRAY NAME AMBTM SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...



MANIN MNEMONIC(S)		AMBT

DESCRIPTION:

- ARRAY NAME: AMLEN SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

0	AMBER LENGTH (TENTHS) PARAMETER FOR EACH RAMP WHEN OPERATING IN WINDOW MODE.
MANIN MNEMONIC(S)	ALEN

- ARRAY NAME: AMOF SIZE: 1

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

LINEAR MINUTE (OF DAY) OF AM CONTROL PERIOD TURN OFF TIME
AMOF

MANIN MNEMONIC(S)

- ARRAY NAME: AMON SIZE: 1

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

LINEAR MINUTE (OF DAY) OF AM CONTROL PERIOD TURN ON TIME.
AMON

MANIN MNEMONIC(S)

. ARRAY NAME ANTBL SIZE: 25

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

MANIN MNEMONIC(S)	ANTB

DESCRIPTION: A BIT MATCHING ARRAY FOR THE 25 INPUT (PROCESS & DIGITAL) GROUPS. BIT 'ON' WILL CAUSE NORMAL INPUT '0' OR '1' STATES TO BE RECOGNIZED, AND BIT 'OFF' WILL CAUSE PERMANENT '0' STATE FOR THAT DISCRETE INPUT. SEE ALSO DESCRIPTION OF 'ORTBL.'

. ARRAY NAME AVOL SIZE: 41

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	'A' DETECTOR VOLUME COUNTER
MANIN MNEMONIC(S)	AVOL

DESCRIPTION:

- ARRAY NAME: AVTRP SIZE: 41

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	0	AVERAGE SPEED TRAP TIME (MS), CUMULATIVE
MANIN MNEMONIC(S)		AVTR

- ARRAY NAME: BEGNW SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

		TIME (TENTHS) AT WHICH NEXT LAUNCH WINDOW BEGINS
MANIN MNEMONIC(S)		BGNW

- ARRAY NAME: BODSA SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	BOTTLENECK DETECTOR LEVEL A LOWER SPEED (MPH).	BOTTLENECK DETECTOR LEVEL A UPPER SPEED (MPH).
MANIN MNEMONIC(S)	BSAL	BSAH

. ARRAY NAME BODSB SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	BOTTLENECK DETECTOR LEVEL B LOWER SPEED (MPH).	BOTTLENECK DETECTOR LEVEL B UPPER SPEED (MPH).
MANIN MNEMONIC(S)	BSBL	BSBH

DESCRIPTION:

. ARRAY NAME BULKA SIZE: 16

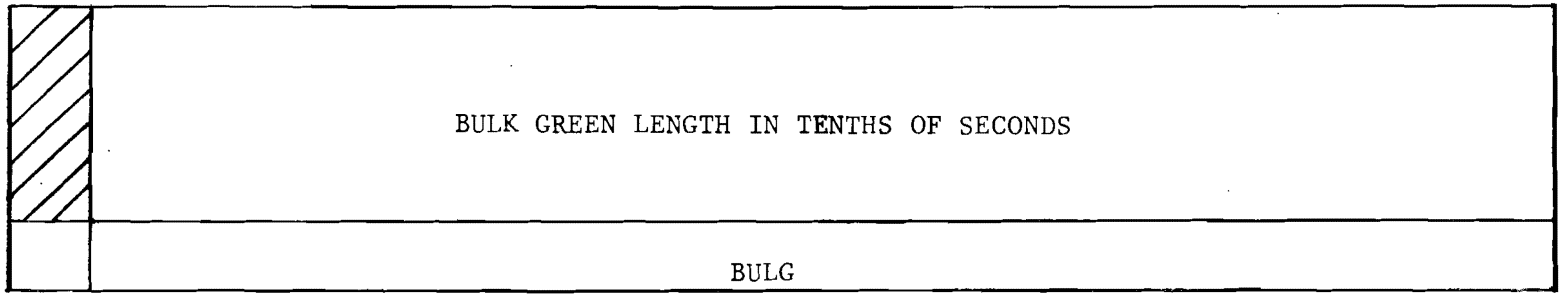
Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

		BULK AMBER LENGTH IN TENTHS OF SECONDS
MANIN MNEMONIC(S)		BULA

DESCRIPTION: AMBER LENGTH IN TENTHS OF SECONDS FOR BULK METERING RATES 1 THRU 16. NOTE THE SUM OF BULKG(I) + BULKA(I) + BULKR(I) MUST NOT EXCEED 2^{15}-1 (3276.7 SECONDS).

. ARRAY NAME BULKG SIZE: 16

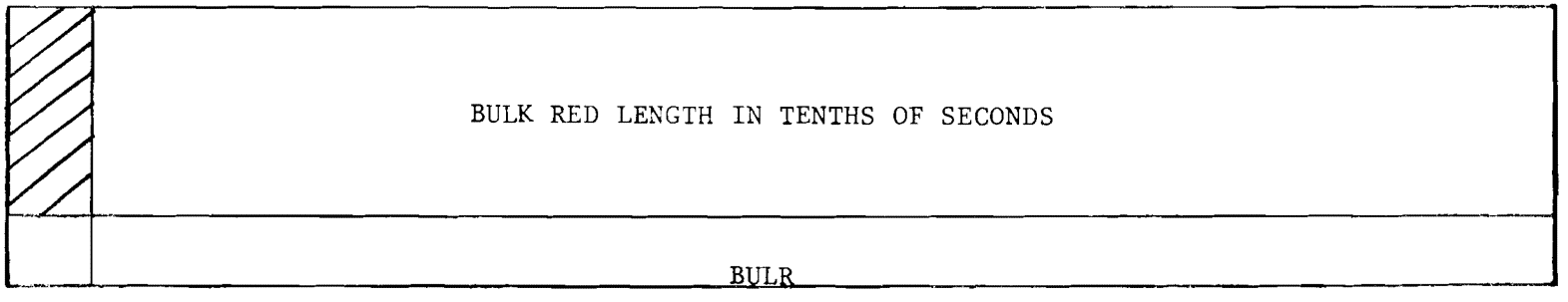
Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...



DESCRIPTION: GREEN LENGTH IN TENTHS OF SECONDS FOR BULK METERING RATES 1 THRU 16. NOTE THE SUM OF BULKG(I) + BULKA(I) + BULKR(I) MUST NOT EXCEED 2^{15}-1 (3276.6 SECONDS).

. ARRAY NAME BULKR SIZE: 16

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...



DESCRIPTION: RED LENGTH IN TENTHS OF SECONDS FOR BULK METERING RATES 1 THRU 16. NOTE THE SUM OF BULKG(I) + BULKA(I) + BULKR(I) MUST NOT EXCEED 2^{15}-1 (3276.7 SECONDS).

. ARRAY NAME CMGAP SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	0	COMPUTED GAP SIZE (CS) AS ADJUSTED FOR SPEEDS
MANIN MNEMONIC(S)		COMP

DESCRIPTION: GAP SIZES (MS) AS ADJUSTED FOR SPEED VARIATIONS TO INSURE NO OVERLAP OR 'GAPS' BETWEEN GAP (VEHICLE) ARRIVAL TIMES.

. ARRAY NAME CRITS SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	CRITICAL SPEED METERING CODE: (NOTE 1)	CRITICAL SPEED METERING PARAMETER INTERPRETED ACCORDING TO METERING CODE.	CRITICAL SPEED LOWER THRESHOLD ($MPH/_2$)	CRITICAL SPEED UPPER THRESHOLD ($MPH/_2$)
MANIN MNEMONIC(S)		CSMC	CTSL	CTSU

DESCRIPTION: NOTE 1: 00 = WINDOW
01 = PRI. CHG.
10 = BULK/FIXED
11 = GAP ACCEPT.

. ARRAY NAME CURMN SIZE: 1

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	0 0 0 0 0	CURRENT MINUTE (0-1439)
MANIN MNEMONIC(S)		MINC

DESCRIPTION:

. ARRAY NAME CURMR SIZE: 39

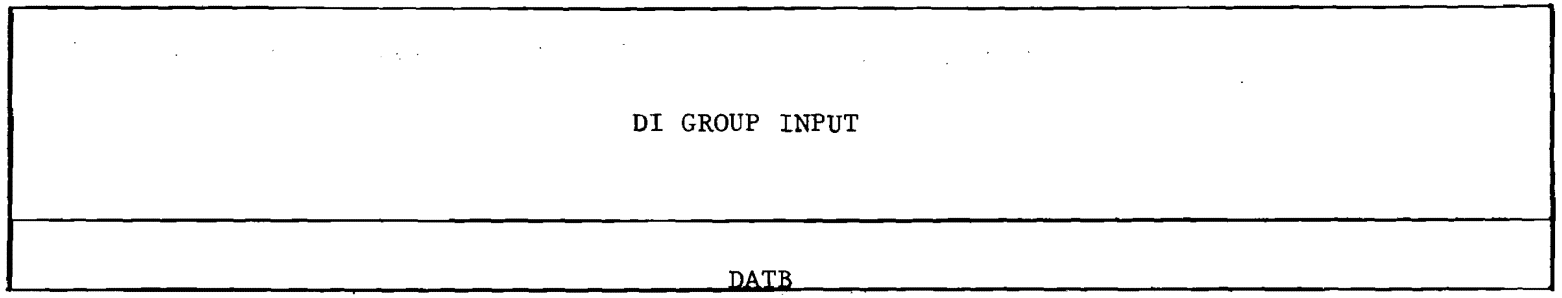
Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	0		CURRENT METERING CODE: (NOTE 1)	CURRENT METERING PARAMETER INTERPRETED ACCORDING TO METERING CODE
MANIN MNEMONIC(S)			CURM	

DESCRIPTION: NOTE 1: 00 = WINDOW
01 = PRI. CHG.
10 = BULK/FIXED
11 = GAP ACCEPT.

- ARRAY NAME DATBL SIZE: 25

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

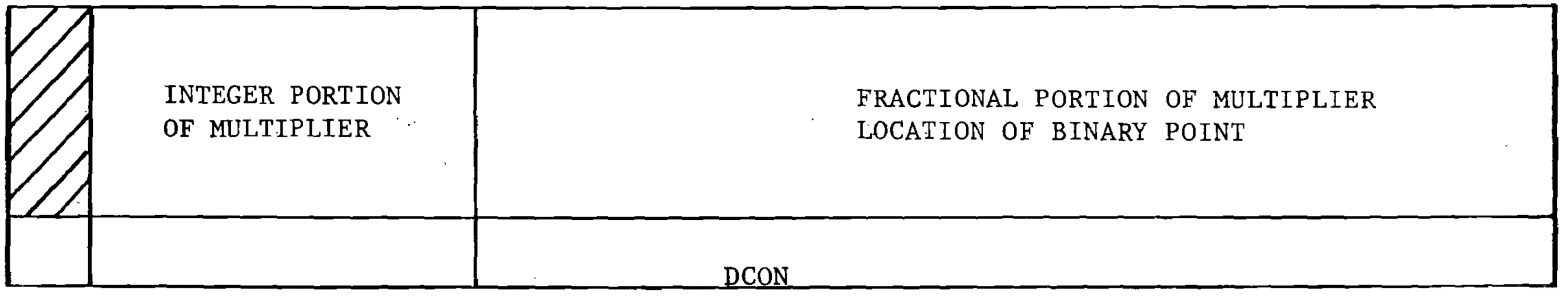


MANIN MNEMONIC(S)

DESCRIPTION: STATUS ARRAY OF BITS INPUT FROM DIGITAL INPUT GROUP. NOTE THAT DATBL +19 THRU DATBL +24 ARE THE 'OR' OF PISW BITS OF PI GROUPS 02 → 07. AN INTERROGATION PROGRAM MUST RESET THESE BITS TO MONITOR DISCRETE INPUTS.

- ARRAY NAME DCON SIZE: 41

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...



MANIN MNEMONIC(S)

DESCRIPTION: GAP PROJECTION CONSTANT, USED AS MULTIPLICATION FACTOR IN 'B' INTERRUPT SECTION. THIS CONSTANT IS SCALED 2^{-4} AND REPRESENTS THE QUANTITY $\frac{\text{PROJECTION DISTANCE}}{\text{TRAP LENGTH X 1000}}$ WHICH, WHEN MULTIPLIED BY THE TRAP TIME IN MILLISECONDS WILL GIVE THE TRAVEL TIME IN CENTISECONDS.

- ARRAY NAME: DDVOL SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	DOWNSTREAM DETECTORS 1 MINUTE FLOWS
MANIN MNEMONIC(S)	DVOL

- ARRAY NAME: DEPNT SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	BOTTLENECK DETECTOR NUMBER FOR THIS RAMP.	CRITICAL SPEED DETECTOR NUMBER FOR THIS RAMP.
MANIN MNEMONIC(S)	DEPB	DEPC

- ARRAY NAME: DETIM SIZE: 1

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	'LOOK BACK' TIME FOR DETECTOR MONITOR OUTAGE (MINUTES)
MANIN MNEMONIC(S)	DETI

. ARRAY NAME DIST SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	GAP PROJECTION DISTANCE (FEET)
MANIN MNEMONIC(S)	DIST

DESCRIPTION:

. ARRAY NAME DOCNT SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	0	DO TIME OUT COUNTER (TENTHS)
MANIN MNEMONIC(S)		DOCT

DESCRIPTION: DO DETECTOR TIME OUT COUNTER, ENABLED BY VEHICLE LAUNCH, STOPPED BY DO ACTUATION.

. ARRAY NAME DOERR SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	0		DO FAST VEHICLE ERROR COUNTER	DO DET TIME OUT ENABLE BIT		DO SLOW VEHICLE ERROR COUNTER
MANIN MNEMONIC(S)			DOFA	DOEN		DOSL

DESCRIPTION: THE DO FAST VEHICLE ERROR COUNTER IS INCREMENTED WHEN THE CORRESPONDING 'DOENB' BIT IS ON AND THE DO DETECTOR IS ACTUATED BY $\frac{\text{'DOMAX'}}{2}$ TIME INTERVAL. THE DO SLOW VEHICLE ERROR COUNTER IS INCREMENTED WHEN THE CORRESPONDING 'DOENB' BIT IS ON AND THE DO DETECTOR IS NOT ACTUATED BY 'DOMAX' TIME. WHEN DOENB BIT IS ON, THE DO DETECTOR TIME OUT COUNTER, 'DOCNT' IS ENABLED.

. ARRAY NAME DOMAX SIZE: 39

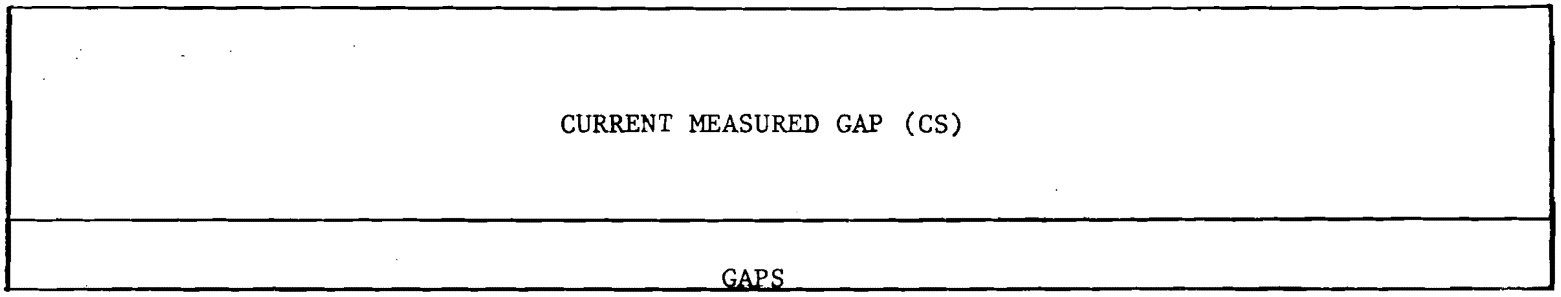
Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	0	DO DETECTOR SLOW VEHICLE TIME OUT COUNT PARAMETER (TENTHS)
MANIN MNEMONIC(S)		DOMX

DESCRIPTION:

. ARRAY NAME GAP SIZE: 41

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

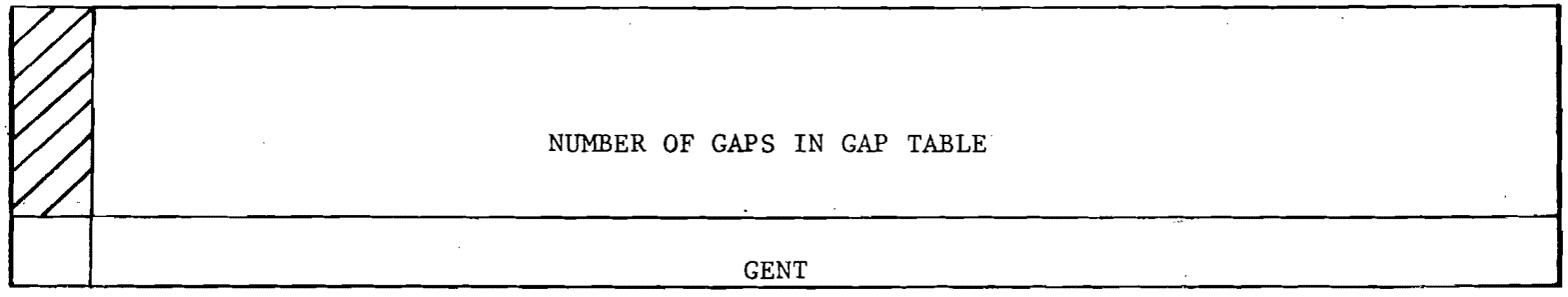


MANIN MNEMONIC(S)

DESCRIPTION: TIME DIFFERENCE BETWEEN 'B' DETECTOR ACTUATIONS.

. ARRAY NAME GENTC SIZE: 41

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...



MANIN MNEMONIC(S)

DESCRIPTION: NOTE GENTC +39 AND GENTC +40 SHOULD REMAIN ZERO.

- ARRAY NAME GNLEN SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

0	GREEN LENGTH (TENTHS) PARAMETER FOR EACH RAMP WHEN OPERATING IN WINDOW MODE.
MANIN MNEMONIC(S)	GLEN

DESCRIPTION:

- ARRAY NAME GRNTM SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

0	GREEN LENGTH (TENTHS) COUNTER FOR EACH RAMP WHEN OPERATING IN WINDOW MODE.
MANIN MNEMONIC(S)	GRNT

DESCRIPTION:

. ARRAY NAME GTFUL/FASVH/GNCNF SIZE: 41

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	0		FAST VEHICLE ERROR COUNTER.	GREEN CONFIRM STATUS BIT		GAP TABLE FULL ERROR COUNTER.
MANIN MNEMONIC(S)			FASV	GRNB		GTFL

DESCRIPTION: THE FAST VEHICLE ERROR COUNTER INCREMENTS ONCE FOR EACH VEHICLE WHICH HAS A PROJECTED ARRIVAL TIME AT MERGE AREA $\leq$ RAMP TRAVEL TIME. THE GAP TABLE FULL ERROR COUNTER INCREMENTS ONCE FOR EACH 'B' DETECTOR ACTUATION WHICH OCCURS WHEN A MAXIMUM NUMBER OF GAPS ARE ALREADY PRESENT IN THE GAP TABLE. NOTE 'FASV' NOT USED IN GTFUL +39 AND GTFUL +40.

. ARRAY NAME IOENB SIZE: 1

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	ANY NONZERO QUANTITY INDICATES I/O STUDY CURRENTLY IN PROCESS OF BEING RESTARTED.
MANIN MNEMONIC(S)	IOEN

DESCRIPTION:

- ARRAY NAME KBREQ SIZE: 1

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	ANYTHING NONZERO IN THIS CELL INDICATES REQUEST FROM KEYBOARD.
MANIN MNEMONIC(S)	KEYB

DESCRIPTION: KEYBOARD REQUEST FLAG.

- ARRAY NAME LASIN SIZE: 25

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	DIGIT INPUT STATUS LAST SCAN
MANIN MNEMONIC(S)	LASN

DESCRIPTION: STATUS ARRAY OF BITS INPUT FROM DIGITAL INPUT GROUPS DURING LAST SCAN FRAME (USUALLY 100 MS).

. ARRAY NAME: LINDT SIZE: 1

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	CURRENT LINEAR DATE (1-365)
MANIN MNEMONIC(S)	LIND

. ARRAY NAME: LONTM SIZE: 41

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	'B' DETECTOR ARRIVAL TIME (MS) MODULO 2^{16} (65536)
MANIN MNEMONIC(S)	LNTM

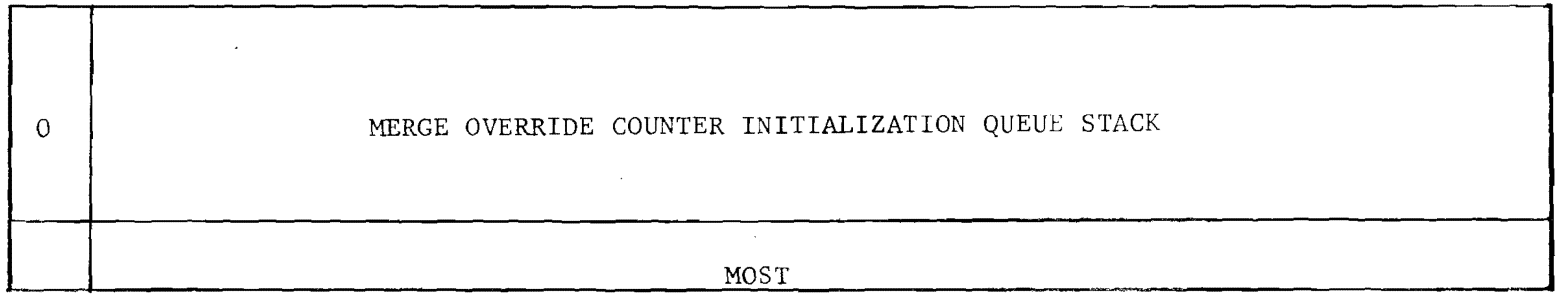
. ARRAY NAME: LSTMC SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	MERGE OVERRIDE PREVIOUS TIME COUNT USED FOR MONITORING A STATIC MERGE OVERRIDE COUNTER (MORCT)
MANIN MNEMONIC(S)	LSTM

- ARRAY NAME MGSTM SIZE: 39

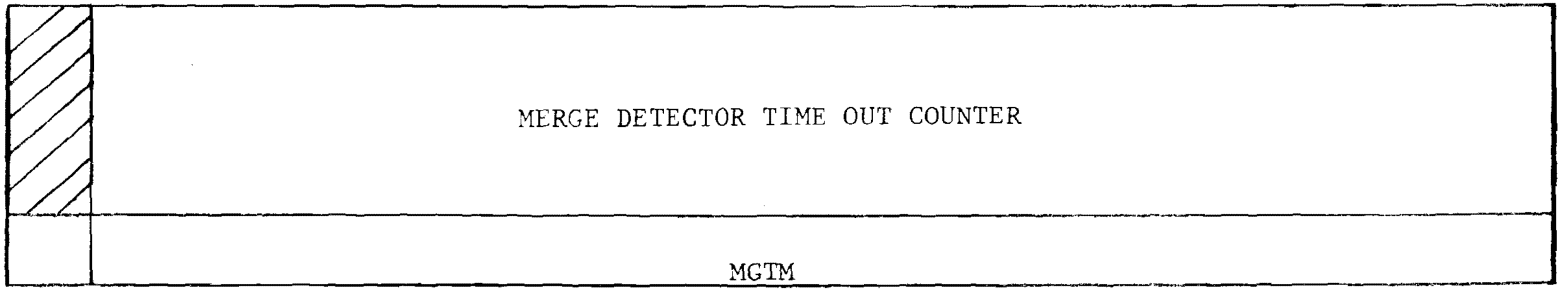
Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...



DESCRIPTION:

- ARRAY NAME MGTMC SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...



DESCRIPTION: MERGE DETECTOR TIME OUT COUNTER. ENABLED FOR DECREMENTING, IS DISABLED BY NORMAL RAMP SPEED VEHICLE. FUNCTIONS AS RESET FOR FALSE MERGE OVERRIDE CAUSED BY SLOW MOVING VEHICLE WHICH DOES NOT ACTUATE DM.

. ARRAY NAME MGTOP SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

		MERGE DETECTOR TIME OUT PARAMETER
MANIN MNEMONIC(S)		MGTO

DESCRIPTION: MERGE DETECTOR TIME OUT PARAMETER. THIS VALUE IS PLACED IN 'MGTMC' AND DECREMENTED WHEN VEHICLE IS RELEASED.

. ARRAY NAME MNSTK/MGSTK SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	MANUAL OVERRIDE METERING CODE (NOTE 1)	MANUAL OVERRIDE METERING PARAMETER INTERPRETED ACCORDING TO METERING CODE		MERGE OVERRIDE METERING CODE (NOTE 2)	MERGE OVERRIDE METERING PARAMETER INTERPRETED ACCORDING TO METERING CODE.
MANIN MNEMONIC(S)	MNMC			MOMC	

DESCRIPTION: NOTES 1 AND 2: 00 = WINDOW
01 = PRI. CHG.
10 = BULK/FIXED
11 = GAP ACCEPT.

- ARRAY NAME: MOCTA SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	NORMAL = 0 BULK = 1	NORMAL = 0 PRI. CHG. = 1	METERING RATE/ BULK CODE/ PRIORITY CHANGE CODE/	MERGE OVERRIDE LEVEL A THRESHOLD OCCUPANCY TIME (TENTHS OF SECONDS) / 4
MANIN MNEMONIC(S)	MLAM		MLAR	MLAO

- ARRAY NAME: MOCTB SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	NORMAL = 0 BULK = 1	NORMAL = 0 PRI. CHG.=1	METERING RATE/ BULK CODE/ PRIORITY CHANGE CODE/	MERGE OVERRIDE LEVEL B THRESHOLD OCCUPANCY TIME (TENTHS OF SECONDS) / 4
MANIN MNEMONIC(S)	MLBM	MLBC	MLBR	MLBO

- ARRAY NAME: MOCTC SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	NORMAL = 0 BULK = 1	NORMAL = 0 PRI. CHG.=1	METERING RATE/ BULK CODE/ PRIORITY CHANGE CODE/	MERGE OVERRIDE LEVEL C THRESHOLD OCCUPANCY TIME (TENTHS OF SECONDS) / 4
MANIN MNEMONIC(S)	MLCM	MLCC	MLCR	MLCO

. ARRAY NAME MORCT SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	0	MERGE LOOP OCCUPANCY COUNTER (TENTHS)/2
MANIN MNEMONIC(S)	MORC	

DESCRIPTION: MERGE OVERRIDE COUNTER. ENABLED WHEN MERGE LOOP IS OCCUPIED. CAN ALSO BE INCREMENTED BY DETECTION OR SLOW VEHICLE, OR INITIALIZED BY COUNT FROM 'MGSTM.' RESET BY MERGE LOOP '1' TO '0' TRANSITION OR WHEN LOOP IS UNOCCUPIED, BY 'MGTMC' DECREMENTING TO ZERO.

. ARRAY NAME MRATE SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

		SYSTEM INDICATORS METERING CODE (NOTE 1)	SYSTEM INDICATORS METERING PARAMETER INTERPRETED ACCORDING TO METERING CODE.
MANIN MNEMONIC(S)		MRAT	

DESCRIPTION: NOTE 1: 00 = WINDOW
01 = PRI. CHG.
10 = BULK/FIXED
11 = GAP ACCEPT.

- ARRAY NAME MXMES SIZE: 1

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	MAXIMUM COUNT OF TYPEWRITER ERROR MESSAGES DURING 24 HOUR PERIOD
MANIN MNEMONIC(S)	MXMS

DESCRIPTION:

- ARRAY NAME NULLC SIZE: 39

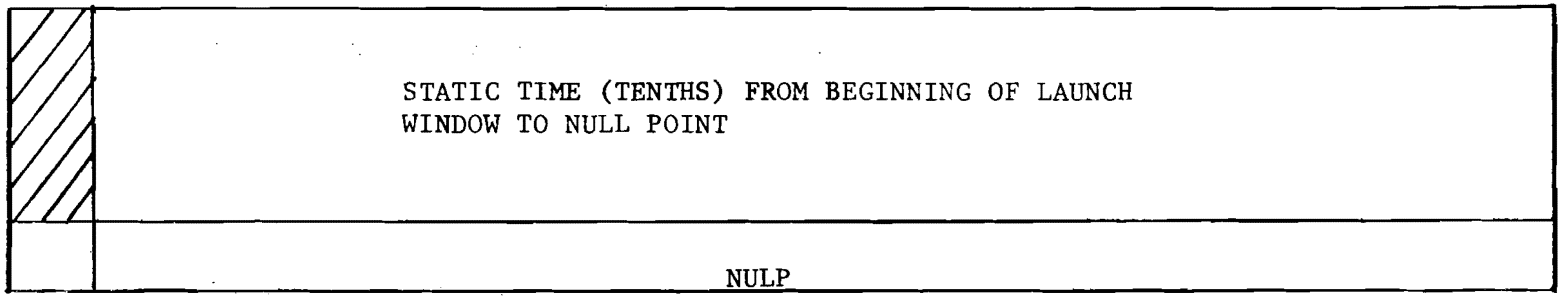
Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	ACTIVE TIME (TENTHS) FROM BEGINNING OF LAUNCH WINDOW TO NULL POINT.
MANIN MNEMONIC(S)	NULC

DESCRIPTION: ACTIVE TIME (TENTHS) FROM BEGINNING OF LAUNCH WINDOW TO NULL POINT.

- ARRAY NAME NULLP SIZE: 39

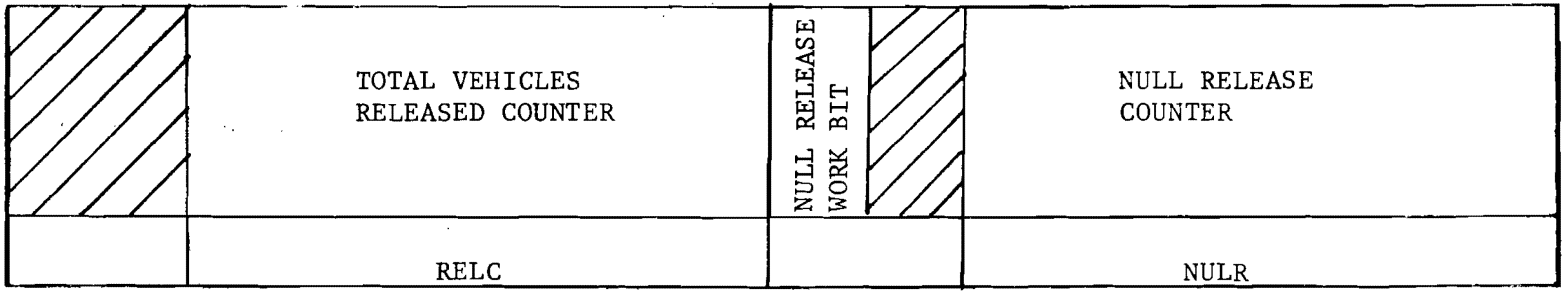
Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...



DESCRIPTION: STATIC TIME (TENTHS) FROM BEGINNING OF LAUNCH WINDOW TO NULL POINT. THIS TIME HAS TO BE RETAINED IN CASE OF NO VEHICLE AT DI WITH RESULTANT RESCHEDULING OF LAUNCH WINDOW BEGINNING AT THAT POINT. 'NULLC' IS THE ACTIVE COUNTER WHICH RECEIVES A VALUE FROM 'NULLP.'

- ARRAY NAME NULRL SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...



DESCRIPTION: 'RELC' INCREMENTS ONCE FOR EACH VEHICLE METERED. 'NULR' IS INCREMENTED BY 1 WHEN A RELEASE IS NOT MADE FOR GAP. NEITHER COUNTER IS MEANINGFUL DURING PERIODS OF BULK METERING. NOTE THAT BIT 0 CANNOT BE SET; OVERFLOW OCCURS INTO BITS 1 AND 9. THE NULL RELEASE WORK BIT COMES ON WHEN NULL RELEASE SCHEDULED.

- ARRAY NAME ONMON SIZE: 19

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	PERMANENT DETECTOR 'ON' CONDITION MONITOR MASK
MANIN MNEMONIC(S)	ONMO

DESCRIPTION: MONITOR MASK FOR DIGITAL INPUT GROUPS. SET TO ALL ONES AT BEGINNING OF EACH MINUTE, AND THEN AND'ED WITH INPUTS EACH SCAN TO AUDIT PERMANENT '1' STATES.

- ARRAY NAME ONTIM SIZE: 41

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	'A' DETECTOR ARRIVAL TIME (MS)
MANIN MNEMONIC(S)	ONTM

DESCRIPTION: TIME (MS) THAT THE LAST VEHICLE ARRIVED AT THE 'A' DETECTOR, MODULO 2^{16} (65536).

. ARRAY NAME: ORTBL SIZE: 25

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	A BIT INSERTION ARRAY FOR THE 25 INPUT (PROCESS & DIGITAL) GROUPS. BIT 'ON' WILL CAUSE PERMANENT '1' STATE, AND BIT 'OFF' WILL CAUSE NORMAL INPUT '0' OR '1' STATES TO BE RECOGNIZED FOR THAT DISCRETE INPUT. SEE ALSO DESCRIPTION OF 'ANTBL.'
MANIN MNEMONIC(S)	ORTB

. ARRAY NAME: OUTP SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

		CURRENT GAP POINTER (MODULO 16)
MANIN MNEMONIC(S)		OUTP

. ARRAY NAME: OUTBT SIZE: 5

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	ARRAY OF OUTPUT BITS FOR SIGNAL CONTROL. COMPRISED OF 8 - 2 BIT GROUPS IN OUTBT → OUTBT+3, AND 7 GROUPS IN OUTBT+4, THE INTERPRETATIONS ARE: 00 = DARK, 01 = RED, 10 = AMBER AND 11 = GREEN.
MANIN MNEMONIC(S)	OUTB

. ARRAY NAME: PMOF SIZE: 1

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	LINEAR MINUTE (OF DAY) OF PM CONTROL PERIOD TURN OFF TIME
MANIN MNEMONIC(S)	PMOF

. ARRAY NAME: PMON SIZE: 1

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	LINEAR MINUTE (OF DAY) OF PM CONTROL PERIOD TURN ON TIME
MANIN MNEMONIC(S)	PMON

. ARRAY NAME: POWER SIZE: 1

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

UNUSED, BUT MUST BE MASKED	TONE XMTRS POWER BIT	UNUSED, BUT MUST BE MASKED
	POWR	

MANIN MNEMONIC(S)

. ARRAY NAME PRISM SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

RAMP OPERATING CONTROL PRIORITY #1	RAMP OPERATING CONTROL PRIORITY #2	RAMP OPERATING CONTROL PRIORITY #3	RAMP OPERATING CONTROL PRIORITY #4
RAPH	RAPM	RAPI	RAPL

MANIN MNEMONIC(S)

DESCRIPTION: PRIORITY STACK MAP - 1 WORD FOR EACH RAMP, DIVIDED INTO 4 NYBBLES. PROGRAM WORKS FROM LEFT TO RIGHT, AND THE VALUE IN EACH NYBBLE IS A POINTER TO INDICATE WHICH OVERRIDE BIT IN RAMP STATUS WORD TO EXAMINE. VALUE CAN BE 0 (SYSTEM), 1 (CRITICAL SPEED), 2 (QUEUE), 3 (MERGE) and 4 (MANUAL). HENCE A 'PRISM' WORD =/4321 DENOTES MANUAL, MERGE, QUEUE, C.S. AND SYSTEM (BY DEFAULT) OVERRIDES IN DESCENDING PRIORITIES.

. ARRAY NAME _____ SIZE: _____

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

MANIN MNEMONIC(S)

DESCRIPTION:

ARRAY NAME: QOCTA SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

NORMAL = 0 BULK = 1	NORMAL = 0 PRI. CHG.=1	METERING RATE/ BULK CODE/ PRIORITY CHANGE CODE/	QUEUE LEVEL A THRESHOLD OCCUPANCY TIME (TENTHS OF SECONDS) / 4
MANIN MNEMONIC(S)		QLAC	QLAO

ARRAY NAME: QOCTB SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

NORMAL = 0 BULK = 1	NORMAL = 0 PRI. CHG.=1	METERING RATE/ BULK CODE/ PRIORITY CHANGE CODE/	QUEUE LEVEL B THRESHOLD OCCUPANCY TIME (TENTHS OF SECONDS) / 4
MANIN MNEMONIC(S)		QLBC	QLBO

ARRAY NAME: QOCTC SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

NORMAL = 0 BULK = 1	NORMAL = 0 PRI. CHG.=1	METERING RATE/ BULK CODE/ PRIORITY CHANGE CODE/	QUEUE LEVEL C THRESHOLD OCCUPANCY TIME (TENTHS OF SECONDS) / 4
MANIN MNEMONIC(S)		QLCC	QLCO

. ARRAY NAME QSHDC SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	'Q' DETECTOR EXTENSION TIME (IN TENTHS) DECREMENTING COUNTER
MANIN MNEMONIC(S)	QSDC

DESCRIPTION: 'Q' DETECTOR DECREMENTING COUNTER WHICH, WHEN ACTIVE, COUNTS DOWN THE EXTENSION TIME (IN TENTHS) FOLLOWING A '1' TO '0' TRANSITION OF THE 'Q' DETECTOR INPUT. DURING THIS TIME, THE QUEUE OVERRIDE OCCUPANCY COUNTER CONTINUES TO INCREMENT.

. ARRAY NAME QUORC SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	0	QUEUE DETECTOR OCCUPANCY COUNTER (TENTHS)/2
MANIN MNEMONIC(S)		QORC

DESCRIPTION:

. ARRAY NAME QUSTK/CSSTK SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	QUEUE OVERRIDE METERING CODE: NOTE 1	QUEUE OVERRIDE METERING PARAMETER INTERPRETED ACCORDING TO METERING CODE		CRITICAL SPEED METERING CODE: NOTE 2	CRITICAL SPEED OVERRIDE METERING PARAMETER INTERPRETED ACCORDING TO METERING CODE.		
MANIN MNEMONIC(S)		QUMC		CSMC			

DESCRIPTION: NOTE 1 AND 2: 00 = WINDOW
01 = PRI. CHG.
10 = BULK/FIXED
11 = GAP ACCEPT.

. ARRAY NAME RAMST SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	PRIORITY CHANGE BIT	LAST VEHICLE METERED BY: NOTE 1	CURRENT METERING MODE: NOTE 2	CURRENT METERING PARAMETER	OPERATING PRIORITY	MANUAL OVERRIDE	MERGE OVERRIDE	QUEUE OVERRIDE	CRITICAL SPEED OVERRIDE
MANIN MNEMONIC(S)		LVMB	CUMC		RAOP	RAMN	RAMM	RAMQ	RAMC

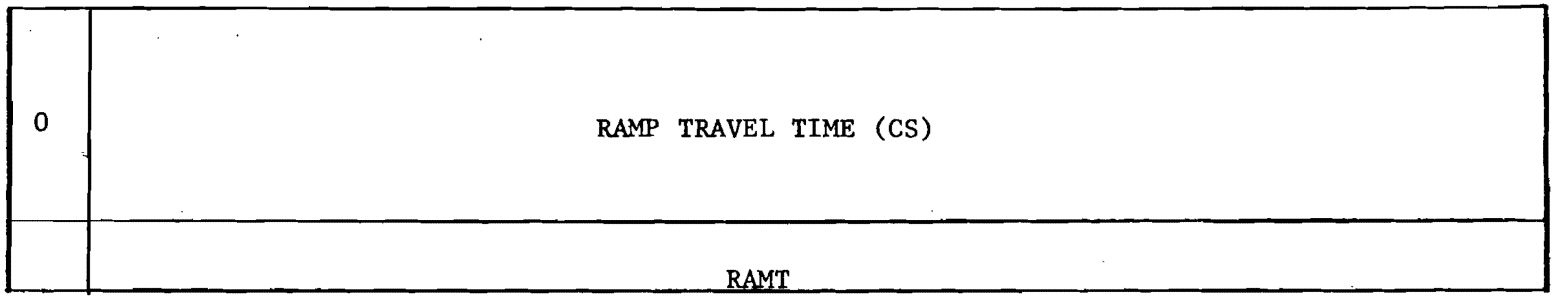
DESCRIPTION: RAMP STATUS WORD - NOTE: BIT 0 IS SET BY SC100 WHENEVER THE RAMP OPERATING PRIORITY CHANGES. IT IS RESET BY DETOM. NO MANIN ACCESS IS PROVIDED.

NOTE 1: 00 = SYSIND
01 = CRITSPD
10 = QUEUE
11 = MERGE

NOTE 2: 00 = WINDOW
01 = PRI. CHG.
10 = BULK/FIXED
11 = GAP ACCEPT.

. ARRAY NAME RAMTT SIZE: 39

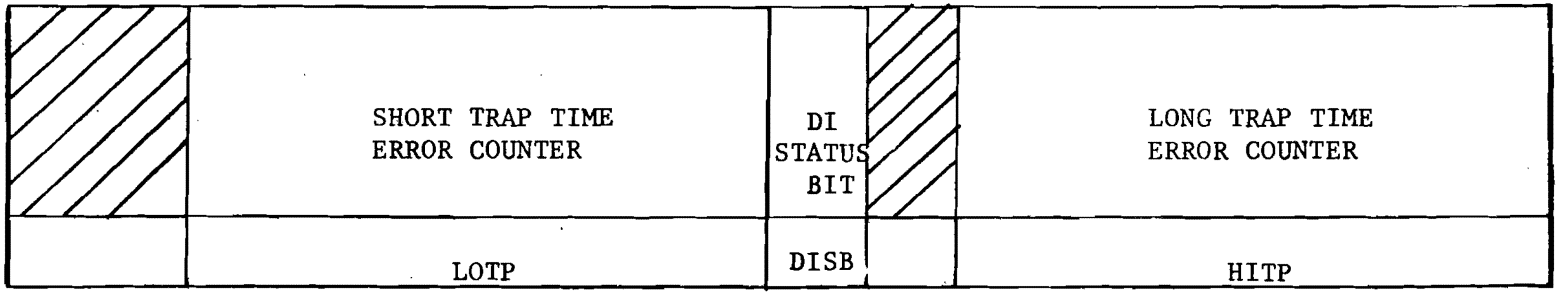
Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...



DESCRIPTION:

. ARRAY NAME RANGS SIZE: 41

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...



DESCRIPTION: LOTP (SEE MNEMONICS BELOW) INCREMENTS ONCE FOR EACH MEASURED SPEED TRAP TIME LESS THAN PROGRAM VARIABLES MNTP4, MNTP5 OR MNTP6. HITP DOES SAME FOR TRAP TIMES EXCEEDING PROGRAM VARIABLES MXTM4, MXTM5, OR MXTM6. BOTH INCREMENT MODULO 2^6 (64). NOTE THAT BIT 0 CANNOT BE SET; OVERFLOW OCCURS INTO BITS 1 AND 9. DISB IS SET ACCORDING TO THE BINARY INPUT STATUS OF THE CORRESPONDING DI DETECTOR. NOTE DISB USES FIRST 39 LOCATIONS OF 'RANGS' ONLY.

. ARRAY NAME: RELTM SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	TIME (CS) TO INITIATION OF NEXT GREEN PHASE
MANIN MNEMONIC(S)	RELT

. ARRAY NAME: SFLOA SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	SYSTEM INDICATOR LEVEL A 1 MINUTE UPSTREAM FLOW	SYSTEM INDICATOR LEVEL A 1 MINUTE DOWNSTREAM FLOW
MANIN MNEMONIC(S)	SIAU	SIAD

. ARRAY NAME: SFLOB SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	SYSTEM INDICATOR LEVEL B 1 MINUTE UPSTREAM FLOW	SYSTEM INDICATOR LEVEL B 1 MINUTE DOWNSTREAM FLOW
MANIN MNEMONIC(S)	SIBU	SIBD

. ARRAY NAME SFLOC SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	SYSTEM INDICATOR LEVEL C 1 MINUTE UPSTREAM FLOW	SYSTEM INDICATOR LEVEL C 1 MINUTE DOWNSTREAM FLOW
MANIN MNEMONIC(S)	SICU	SICD

DESCRIPTION:

. ARRAY NAME SFLOD SIZE: 39

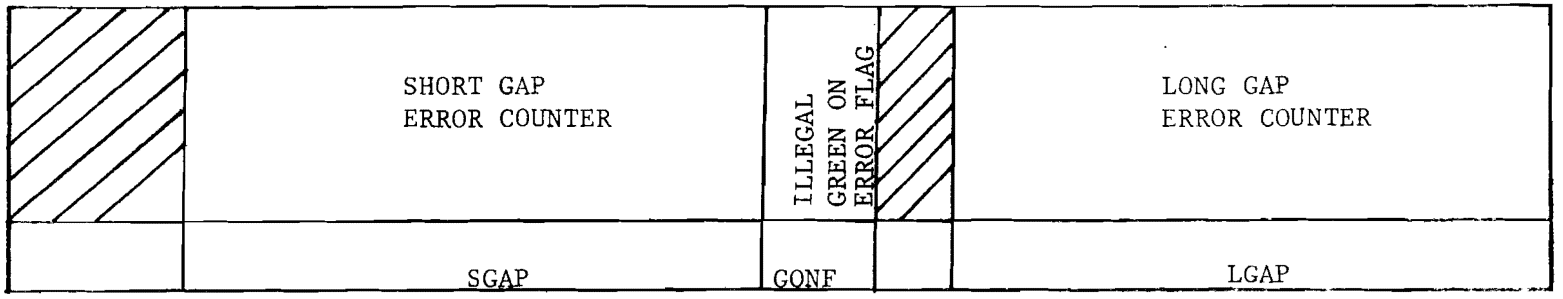
Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	SYSTEM INDICATOR LEVEL D 1 MINUTE UPSTREAM FLOW	SYSTEM INDICATOR LEVEL D 1 MINUTE DOWNSTREAM FLOW
MANIN MNEMONIC(S)	SIDU	SIDD

DESCRIPTION: NOTE LEVEL E FLOWS OBTAINED BY DEFAULT.

ARRAY NAME SGCNT SIZE: 41

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

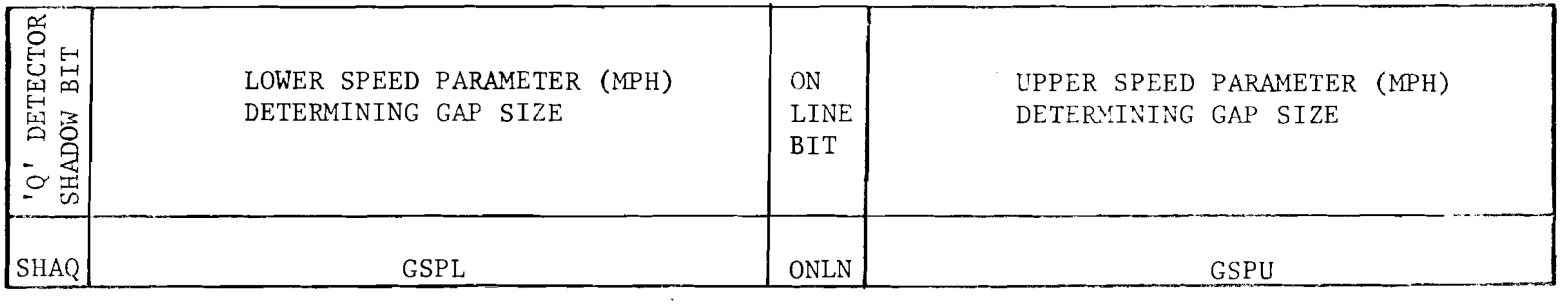


MANIN MNEMONIC(S)		SGAP	CONF		LGAP

DESCRIPTION: SGAP (SEE MNEMONICS BELOW) INCREMENTS ONCE FOR EACH MEASURED GAP LESS THAN PROGRAM VARIABLES SGAP4, SGAP5 OR SGAP6. LGAP DOES LIKEWISE FOR GAPS EXCEEDING PROGRAM VARIABLES LGAP4, LGAP5, OR LGAP6. BOTH INCREMENT MODULO 2^6 (64). NOTE THAT BIT 0 CANNOT BE SET AND OVERFLOW OCCURS INTO BITS 1 AND 9.

ARRAY NAME SPDCM/ONLIN SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...



MANIN MNEMONIC(S)	SHAQ	GSPL	ONLN	GSPU

DESCRIPTION: UPPER AND LOWER SPEED RANGES USED IN DETERMINING ACCEPTABLE GAP SIZES LOCATED IN 'ACPGR.' THE ON LINE BIT IS USED TO DENOTE IF A RAMP IS ON LINE. THE 'Q' DETECTOR SHADOW BIT IS USED AS AN INDICATOR TO EXTEND THE 'Q' DETECTOR OCCUPANCY TIME BY THE AMOUNT SPECIFIED IN 'SHADQ.'

. ARRAY NAME: SYMR1 SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	SYSTEM INDICATORS LEVEL A METERING RATE	SYSTEM INDICATORS LEVEL B METERING RATE	FIRST 4 BITS OF SYSTEM INDICATORS LEVEL C METERING RATE
MANIN MNEMONIC(S)	SMRA	SMRB	SMRC

. ARRAY NAME: SYMR2 SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	LAST 2 BITS OF SYSTEM INDICATORS LEVEL C METERING RATE	SYSTEM INDICATORS LEVEL D METERING RATE	SYSTEM INDICATORS LEVEL E METERING RATE	
MANIN MNEMONIC(S)	SMCC	SMRD	SMRE	

. ARRAY NAME: TPLEN SIZE: 41

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	0	SPEED TRAP CALIBRATED LENGTH (TENTHS OF FEET)
MANIN MNEMONIC(S)		TLEN

. ARRAY NAME: TPTIM SIZE: 41

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	CURRENT MEASURED TRAP TIME (MS) BETWEEN 'A' AND 'B' DETECTORS OF SPEED STATION.
MANIN MNEMONIC(S)	TPTM

. ARRAY NAME: TRAIL SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	0	TIME (CS) FROM NULL POINT TO END OF LAUNCH WINDOW NULLP + TRAIL = LAUNCH WINDOW LENGTH
MANIN MNEMONIC(S)		TRAL

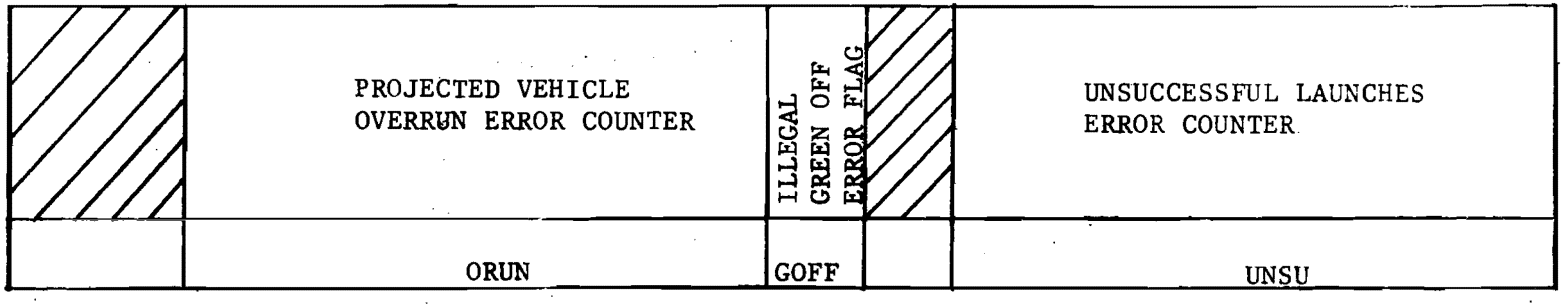
. ARRAY NAME: UDVOL SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	UPSTREAM DETECTORS 1 MINUTE FLOWS
MANIN MNEMONIC(S)	UVOL

- ARRAY NAME UNSUL/OVRUN SIZE: 39

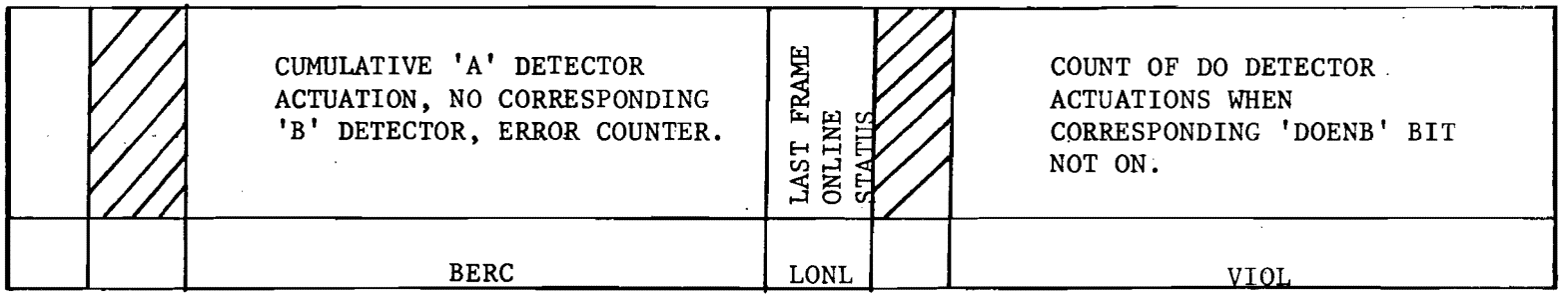
Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...



DESCRIPTION: UNSUCCESSFUL LAUNCHES ERROR COUNTER. INCREMENTED WHEN 'DOENB' BIT IS ON AND NO DO ACTUATION OCCURS WITHIN TWICE THE VALUE OF THE DO MAXIMUM TIME OUT PARAMETER ('DOMAX').

- ARRAY NAME VIOLT/BERCT/LONLN SIZE: 41

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...



DESCRIPTION: NOTE: 'VIOLT' REQUIRES 39 LOCATIONS, 'BERCT' 41.

ARRAY NAME VOL SIZE: 172

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	V, R, O AND Q DETECTOR VOLUMES
MANIN MNEMONIC(S)	VVOL VOL→VOL+43; RVOL VOL+44→VOL+93; OVOL VOL+94→VOL+132; QVOL VOL+133→VOL+171

DESCRIPTION: V, R, O, Q VOLUME DETECTORS AS FOLLOWS: VOL → VOL+43 = 'V' DETECTORS 1-44; VOL+44 → VOL+93 = 'R' DETECTORS; VOL+94 → VOL+132 = 'O' DETECTORS; VOL+133 → VOL+171 = 'Q' DETECTORS. NOTE THAT 'Q' DETECTORS 18, 22, 23, 28, 31 AND 34 ARE UNDEFINED.

ARRAY NAME WINDP SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

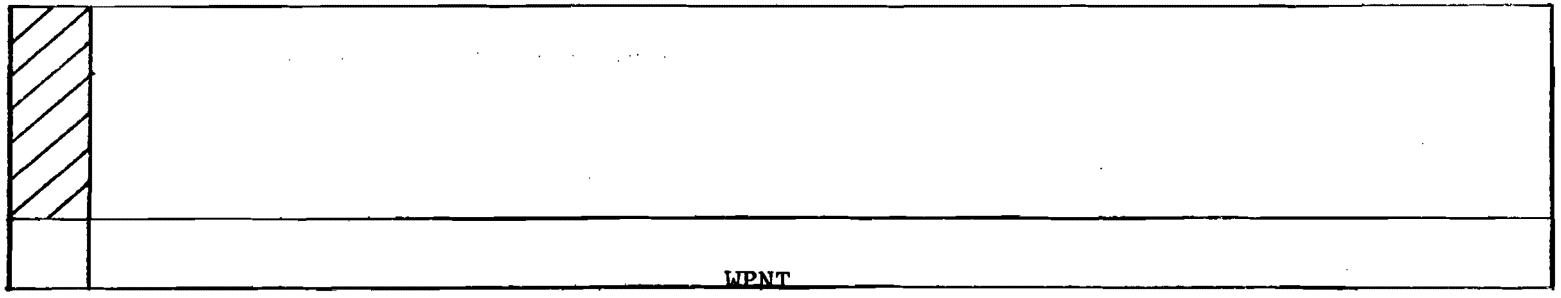
	NOTE 1	LAUNCH WINDOW NULL POINT PERCENTAGE DISPLACEMENT FROM LEADING EDGE OF WINDOW	NOTE 2	LAUNCH WINDOW SIZE PERCENTAGE OF METERING RATE.
MANIN MNEMONIC(S)	SDEF	LWNP	OMOS	LWSP

DESCRIPTION: LAUNCH WINDOW SIZE AND NULL POINT LOCATION PARAMETERS.

NOTE 1: NORMAL SYSTEM RAMP OPERATING DEFINITION.
NOTE 2: ONE MINUTE ONLINE STATUS BIT.

ARRAY NAME WPNT SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

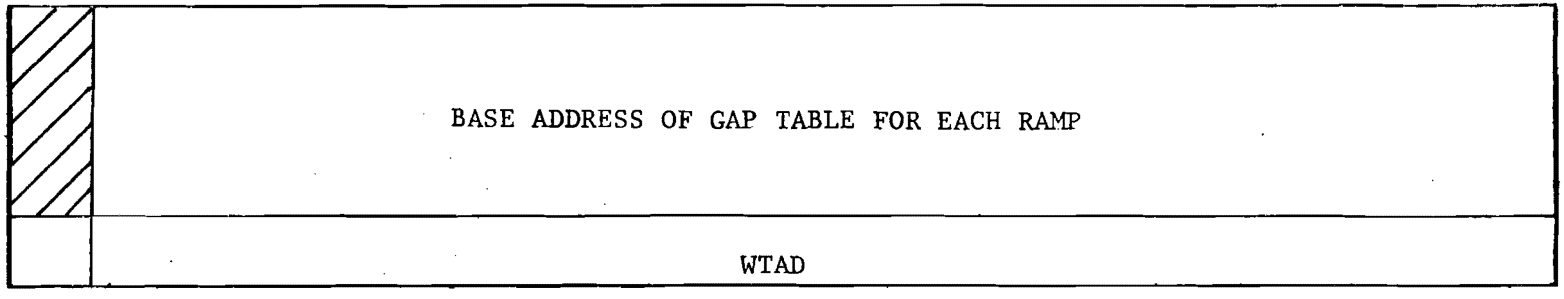


MANIN MNEMONIC(S) WPNT

DESCRIPTION: LAST GAP IN POINTER, POINTS TO LAST CELL OF WTBL WHERE LAST GAP-IN WAS PLACED, MODULO 8, INCREMENTED BY 1 EACH NEW GAP.

ARRAY NAME WTAD SIZE: 39

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...



MANIN MNEMONIC(S) WTAD

DESCRIPTION:

. ARRAY NAME WTBL SIZE: 1184

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	GAP WORKING TABLE
MANIN MNEMONIC(S)	WTBL

DESCRIPTION: GAP WORKING TABLE. 32 WORDS PER GAP ACCEPTANCE RAMP, 37 TOTAL. TIME TO DECISION POINT IN EVEN CELLS (CS); GAP SIZE IN ODD CELLS (CS).

. ARRAY NAME _____ SIZE: _____

Bit Number.....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

MANIN MNEMONIC(S)	

DESCRIPTION:

APPENDIX B

LOG SECTOR DESCRIPTION

. ARRAY NAME: LOG SECTOR .→.+40 SIZE: 41

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	'A' DETECTOR VOLUME	'B' DETECTOR VOLUME
MANIN MNEMONIC(S)	AVOL	BVOL

. ARRAY NAME: LOG SECTOR .+41→.+90 SIZE: 50

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	'V' DETECTOR VOLUME	'R' DETECTOR VOLUME
MANIN MNEMONIC(S)	VVOL	RVOL

. ARRAY NAME: LOG SECTOR .+91→.+129 SIZE: 39

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	'Q' DETECTOR VOLUME	'Q' DETECTOR VOLUME
MANIN MNEMONIC(S)	QVOL	QVOL

. ARRAY NAME: LOG SECTOR .+130→.+170 SIZE: 41

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	SHORT GAP ERROR COUNTER	LONG GAP ERROR COUNTER	SHORT TRAP TIME ERROR COUNTER	LONG TRAP TIME ERROR COUNTER
MANIN MNEMONIC(S)	SGAP	LGAP	LOTP	HITP

. ARRAY NAME: LOG SECTOR .+171→.+211 SIZE: 41

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	'B' DETECTOR ERROR COUNTER	RAMP VIOLATION COUNTER	TOTAL NUMBER VEHICLES LAUNCHED COUNTER	NULL RELEASE COUNTER
MANIN MNEMONIC(S)	BERC	VIOL	RELC	NULR

. ARRAY NAME: LOG SECTOR .+212→.+252 SIZE: 41

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

	DO FAST VEHICLE ERROR COUNTER	DO SLOW VEHICLE ERROR COUNTER	AVERAGE SPEED (FDS)
MANIN MNEMONIC(S)	DOFA	DOSL	AVSP

. ARRAY NAME: LOG SECTOR .+253→.+293 SIZE: 41

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

'A' DETECTOR ERROR COUNTER	FAST VEHICLE ERROR COUNTER		GAP TABLE FULL ERROR COUNTER
CMLA	FASV		GTFL

MANIN MNEMONIC(S)

. ARRAY NAME: LOG SECTOR .+294→.+312 SIZE: 19

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

ANDED DIGITAL INPUTS	CONSECUTIVE 'ON' TESTS
ONMO	

MANIN MNEMONIC(S)

. ARRAY NAME: _____ SIZE: _____

Bit Number....0.....1.....2.....3.....4.....5.....6.....7.....8.....9....10....11....12....13....14....15...

MANIN MNEMONIC(S)

APPENDIX C

DIGITAL I/O ASSIGNMENTS

- ADDRESS: DI76/4C LABEL: DATBL

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	V16/19	V15/14	V14/17	V13/13	V12/12	V11/10	V10/11	V9/9	V8/8	V7/6	V6/7	V5/5	V4/3	V3/4	V2/1	V1/2

- ADDRESS: DI77/4D LABEL: DATBL+1

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	V32/41	V31/28	V30/32	V29/26	V28/31	V27/23	V26/29	V25/22	V24/27	V23/20	V22/25	V21/18	V20/24	V19/16	V18/21	V17/15

- ADDRESS: DI 78/4E LABEL: DATBL+2

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	R4/4	R3/3	R2/1	R1/2	V44/38	V43/40	V42/35	V41/39	V40/36	V39/43	V38/37	V37/33	V36/44	V35/34	V34/42	V33/30

- ADDRESS: DI 79/4F LABEL: DATBL+3

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	R20/17	R19/21	R18/15	R17/20	R16/14	R15/18	R14/12	R13/16	R12/11	R11/13	R10/9	R9/10	R8/8	R7/7	R6/6	R5/5

- ADDRESS: DI 80/50 LABEL: DATBL+4

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	R36/33	R35/47	R34/31	R33/46	R32/29	R31/34	R30/27	R29/32	R28/25	R27/30	R26/23	R25/28	R24/22	R23/26	R22/19	R21/24

- ADDRESS: DI 81/51 LABEL: DATBL+5

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	R50/49	R49/48	R48/44	R47/43	R46/38	R45/42	R44/36	R43/50	R42/51	R41/41	R40/45	R39/39	R38/40	R37/37		

- ADDRESS: DI 82/52 LABEL: DATBL+6

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	O16/18	O15/14	O14/16	O13/12	O12/13	O11/11	O10/10	09/9	08/7	07/8	06/5	05/6	04/3	03/4	02/1	01/2

- ADDRESS: DI 83/53 LABEL: DATBL+7

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	032/34	031/29	030/32	029/27	028/30	027/25	026/28	025/23	024/26	023/22	022/24	021/19	020/21	019/17	018/20	017/15

- ADDRESS: DI 84/54 LABEL: DATBL+8

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	039/38	038/39	037/36	036/37	035/33	034/35	033/31	Q39/38	Q38/39	Q37/36	Q36/37	Q35/33		Q33/31		CARR MON

- ADDRESS: DI 88/58 LABEL: DATBL+9

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Q16/18	Q15/14	Q14/16	Q13/12	Q12/13	Q11/11	Q10/10	Q9/9	Q8/7	Q7/8	Q6/5	Q5/6	Q4/3	Q3/4	Q2/1	Q1/2

- ADDRESS: DI 89/59 LABEL: DATBL+10

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Q32/34		Q30/32	Q29/27		Q27/25	Q26/28	Q25/23	Q24/26			Q21/19	Q20/21	Q19/17		Q17/15

- ADDRESS: DI 90/5A LABEL: DATBL+11

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	M16/18	M15/14	M14/16		M12/13	M11/11	M10/10	M9/9	M8/7	M7/8	M6/5	M5/6	M4/3	M3/4	M2/1	M1/2

. ADDRESS: DI 91/5B LABEL: DATBL+12

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	M32/34	M31/29	M30/32	M29/27	M28/30	M27/25	M26/28	M25/23	M24/26	M23/22	M22/24	M21/19	M20/21	M19/17		M17/15

. ADDRESS: DI 92/5C LABEL: DATBL+13

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	M39/38	M38/39	M37/36	M36/37	M35/33	M34/35	M33/31	I39/38	I38/39	I37/36	I36/37	I35/33	I34/35	I33/31		

. ADDRESS: DI 93/5D LABEL: DATBL+14

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	I16/18	I15/14	I14/16	I13/12	I12/13	I11/11	I10/10	I9/9	I8/7	I7/8	I6/5	I5/6	I4/3	I3/4	I2/1	I1/2

. ADDRESS: DI 94/5E LABEL: DATBL+15

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	I32/34	I31/29	I30/32	I29/27	I28/30	I27/25	I26/28	I25/23	I24/26	I23/22	I22/24	I21/19	I20/21	I19/17	I18/20	I17/15

- ADDRESS: DI 95/5F LABEL: DATBL+16

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	G16/18	G15/14	G14/16	G13/12	G12/13	G11/11	G10/10	G9/9	G8/7	G7/8	G6/5	G5/6	G4/3	G3/4	G2/1	G1/2

- ADDRESS: DI 64/40 LABEL: DATBL+17

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	G32/34	G31/29	G30/32	G29/27	G28/30	G27/25	G26/28	G25/23	G24/26	G23/22	G22/24	G21/19	G20/21	G19/17	G18/20	G17/15

- ADDRESS: DI 65/41 LABEL: DATBL+18

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	G39/38	G38/39	G37/36	G36/37	G35/33	G34/35	G33/31		IV 1	IV 2	IV 3	IV 4	IV 5	IV 6	IV 7	

- ADDRESS: DI 66/42 LABEL:

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	AMU6/1	MAU6/32	AMU5/19	MAU5/2	MAO4/8	MAO6/6	MAO8/4	SMU26/1	SMU24/3	SMU16/5	SMU14/7	SMU6/9	SMU4/11	MSU8/40	MSU6/42	MSU4/44

. ADDRESS: DI 67/43 LABEL:

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	SMU3/37	SMU5/39	SMU13/41	SMU15/43	SMU23/45	SMU25/47	MSU7/6	MSU5/4	MSU3/2	GMU4/1	MGU6/26	GMU3/11	MGU5/2	MWU2/2	WMU2/3	MEU1/24

. ADDRESS: DI 68/44 LABEL:

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	MAU8/38	MAU4/40	AMU7/29	AMU3/25	MAU7/36	MAU3/34	SMO3/15	MSO3/32	MSO5/34	MSO7/36	SMU4/33	MSO4/14	MSO8/10	MGU7/36	MGU3/34	MAO5/28

. ADDRESS: DI 69/45 LABEL:

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	AME6/21	AME2/23	SME6/49	SME2/51	SME1/53	SME5/55	GME6/13	GME5/15	WME4/19	EME5/21	MGO5/28	MGO6/12	EMU3/13	MSO6/12	MGU8/38	MGU4/40

. ADDRESS: DI 70/46 LABEL:

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	FGCE1	FGCE2	FGCE3	FGCE4	FGCE5	FGCE6	MEU3/22	MWU4/4	FGCG1	FGCG3	FGCG4	FGCG5	FGCG7	FGCG8	FGCSU	FGCSMC

. ADDRESS: DI 71/47 LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	FGCS1	FGCS2	FGCS3	FGCS4	FGCS5	FGCS6	FGCS7	FGCS8	FGCA1	FGCA2	FGCA3	FGCA4	FGCA5	FGCA6	FGCA7	FGCA8

. ADDRESS: DI 72/48 LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	AMD6/5	MAD6/18	AMD5/11	MAD5/12	SMD6/19	SMD4/21	SMD5/29	SMD3/27	MSD7/22	MSD5/20	GMD6/3	GMD4/5	MGD6/20	GMD5/9	GMD3/7	MGD5/6

. ADDRESS: DI 73/49 LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	WMD6/7	WMD4/9	WMD2/11	MED3/18	MED1/20	MWD4/10	MWD2/8	MSD4/28	MSD6/26	MSD8/24	MAO3/26	WMU4/1	MAO7/30	SMO5/17	SMO6/31	MSD3/18

. ADDRESS: DI 74/4A LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	AMU2/3	MAD2/24	MAL2/44	AMU1/17	AML1/27	MAD1/10	MAL1/42	SMU2/13	SMD2/23	MSD2/30	MSU2/38	SMU1/35	SMD1/25	MSU1/8	MSD1/16	MGD2/18

. ADDRESS: DI 75/4B LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	MGL2/44	MGD1/4	MGL1/42	PPBE1	PPBE2	PPBG1	PPBG2	PPBS1	PPBS2	PPBA1	PPBA2	WMB2/5	MED5/16	MED2/14	MWD1/12	MWD6/6

. ADDRESS: DO 78/16 LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	T1 M	/2 S	T2 M	/1 S	T3 M	/4 S	T4 M	/3 S	T5 M	/6 S	T6 M	/5 S	T7 M	/8 S	T8 M	/7 S

. ADDRESS: DO 79/16 LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	T9 M	/9 S	T10 M	/10 S	T11 M	/11 S	T12 M	/13 S	T13 M	/12 S	T14 M	/16 S	T15 M	/14 S	T16 M	/18 S

. ADDRESS: DO 125/7D LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	T17 M	/15 S	T18 M	/20 S	T19 M	/17 S	T20 M	/21 S	T21 M	/19 S	T22 M	/24 S	T23 M	/22 S	T24 M	/26 S

. ADDRESS: DO 126/7E LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	T25 M	/23 S	T26 M	/28 S	T27 M	/25 S	T28 M	/30 S	T29 M	/27 S	T30 M	/32 S	T31 M	/29 S	T32 M	/34 S

. ADDRESS: DO 127/7F LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	T33 M	/31 S	T34 M	/35 S	T35 M	/33 S	T36 M	/37 S	T37 M	/36 S	T38 M	/39 S	T39 M	/38 S		XMTR PWR

. ADDRESS: DO 123/7B LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		MEOL/F	MEC1/A	MEC2/B	MEC3/C	MEC4/AA	MEC5/BB	MEC6/CC			MGOL/F	MGC1/A	MGC2/B	MGC3/C	MGC4/D	MGC5/E

. ADDRESS: DO 122/7A LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			MSOL/F	MSC1/A	MSC2/B	MSC3/C	MSC4/D	MSC5/E			MAOL/F	MAC1/A	MAC2/B	MAC3/C	MAC4/D	MAC5/E

. ADDRESS: PI 2/03 LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	A32/34	A31/29	A30/32	A29/27	A28/30	A27/25	A26/28	A25/22	A24/26	INST VEH DIST CHAN 5	A22/24	A21/19	INST VEH TIME CHAN 6	A19/17	A18/20	A17/15

. ADDRESS: PI 3/04 LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	A41/41	A40/40	A39/38	A38/39	A37/36	A36/37	A35/33	A34/35	A33/31							

. ADDRESS: PI 4/05 LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	B16/18	B15/14	B14/16	B13/12	B12/13	B11/11	B10/10	B9/9	B8/7	B7/8	B6/5	B5/6	B4/3	B3/4	B2/1	B1/2

. ADDRESS: PI 5/06 LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	B32/34	B31/29	B30/32	B29/27	B28/30	B27/25	B26/28	B25/22	B24/26		B22/24	B21/19		B19/17	B18/20	B17/15

. ADDRESS: PI 6/07 LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	B41/41	B40/40	B39/38	B38/39	B37/36	B36/37	B35/33	B34/35	B33/31							

. ADDRESS: PI 1/02 LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	A16/18	A15/14	A14/16	A13/12	A12/13	A11/11	A10/10	A9/9	A8/7	A7/8	A6/5	A5/6	A4/3	A3/4	A2/1	A1/2

. ADDRESS: _____ LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

. ADDRESS: _____ LABEL: _____

Bit Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

APPENDIX D

INDIVIDUAL RAMP PARAMETERS

```
RMP  1  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
      OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     )       48     6       24    30     3      90+   95+  25-30   3          .GTR.45   30
LEVB= 600     1      600     6                           84+   89+  30-35   4            35-45   30
LEVC=3000    21     3000    20                           80+   85+   --     6          .LT.35    30
LEVD= --      --      --     --                           74+   79+   --     8
LEVE= --      --      --     --                        LTEQ74LTEQ79   --    48
PROJ DIST=  650    RMP TVL TME=  800    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   2)    GRN LENG=   15    BNK DET=  1    CRIT SPD DET=  1    DO TIME OUT=   50
SPD TRP LENG=  185    MERGE RESET=   50    CNTL PRI= 1


RMP  2  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
      OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     )       48    48       24    30    48      90+   95+  25-30  48          .GTR.45   30
LEVB= 600     1      600    48                           84+   89+  30-35  48            35-45   30
LEVC=3000    21     3000    48                           80+   85+   --    48          .LT.35    30
LEVD= --      --      --    --                           74+   79+   --    48
LEVE= --      --      --    --                        LTEQ74LTEQ79   --    48
PROJ DIST=  700    RMP TVL TME=  700    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   2)    GRN LENG=   15    BNK DET=  4    CRIT SPD DET=  4    DO TIME OUT=   50
SPD TRP LENG=  195    MERGE RESET=   50    CNTL PRI= 1


RMP  3  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
      OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     )       48     6       24    30     3      90+   95+  25-30   3          .GTR.45   30
LEVB= 600     1      600     6                           84+   89+  30-35   4            35-45   30
LEVC=3000    21     3000    20                           80+   85+   --     6          .LT.35    30
LEVD= --      --      --     --                           74+   79+   --     8
LEVE= --      --      --     --                        LTEQ74LTEQ79   --    48
PROJ DIST= 1000    RMP TVL TME=  800    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   2)    GRN LENG=   15    BNK DET=  1    CRIT SPD DET=  3    DO TIME OUT=   50
SPD TRP LENG=  192    MERGE RESET=   50    CNTL PRI= 1


RMP  4  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
      OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     )       48     6       20    24     3      90+   95+  25-30   3          .GTR.45   30
LEVB= 600     1      600     6                           84+   89+  30-35   4            35-45   30
LEVC=3000    21     3000    20                           80+   85+   --     6          .LT.35    30
LEVD= --      --      --     --                           74+   79+   --     8
LEVE= --      --      --     --                        LTEQ74LTEQ79   --    48
PROJ DIST=  810    RMP TVL TME=  700    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   2)    GRN LENG=   15    BNK DET= 41    CRIT SPD DET=  6    DO TIME OUT=   50
SPD TRP LENG=  189    MERGE RESET=   50    CNTL PRI= 1
```

```
RMP  5  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
     OCCUP MODE     OCCUP MODE     LSPD USPD MODE     UPFLD DNFLD BNKSP MODE          GAPSPD GAPSIZ
LEVA=  20    0        48    8        20   24    3       90+   95+  25-30   3          .GTR.45   30
LEVB= 600    1       600    8                           84+   89+  30-35   4           35-45    30
LEVC=3000   21      3000   20                           80+   85+   --     6          .LT.35    30
LEVD= --     --       --    --                          74+   79+   --     8
LEVE= --     --       --    --                       LTEQ74LTEQ79  --    48
PROJ DIST=  920    RMP TVL TME=  700    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET=  1    CRIT SPD DET=  3    DO TIME OUT=   50
SPD TRP LENG=  203    MERGE RESET=   50    CNTL PRI= 1

RMP  6  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
     OCCUP MODE     OCCUP MODE     LSPD USPD MODE     UPFLD DNFLD BNKSP MODE          GAPSPD GAPSIZ
LEVA=  20    0        48    8        24   30    3       90+   95+  25-30   3          .GTR.45   30
LEVB= 600    1       600    8                           84+   89+  30-35   4           35-45    30
LEVC=3000   21      3000   20                           80+   85+   --     6          .LT.35    30
LEVD= --     --       --    --                          74+   79+   --     8
LEVE= --     --       --    --                       LTEQ74LTEQ79  --    48
PROJ DIST=  910    RMP TVL TME=  800    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 41    CRIT SPD DET=  8    DO TIME OUT=   50
SPD TRP LENG=  193    MERGE RESET=   50    CNTL PRI= 1

RMP  7  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
     OCCUP MODE     OCCUP MODE     LSPD USPD MODE     UPFLD DNFLD BNKSP MODE          GAPSPD GAPSIZ
LEVA=  20    0        48    8        24   30    3       90+   95+  25-30   3          .GTR.45   30
LEVB= 600    1       600    8                           84+   89+  30-35   4           35-45    30
LEVC=3000   21      3000   20                           80+   85+   --     6          .LT.35    30
LEVD= --     --       --    --                          74+   79+   --     8
LEVE= --     --       --    --                       LTEQ74LTEQ79  --    48
PROJ DIST=  900    RMP TVL TME=  800    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET=  3    CRIT SPD DET=  5    DO TIME OUT=   50
SPD TRP LENG=  194    MERGE RESET=   50    CNTL PRI= 1

RMP  8  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
     OCCUP MODE     OCCUP MODE     LSPD USPD MODE     UPFLD DNFLD BNKSP MODE          GAPSPD GAPSIZ
LEVA=  20    0        48    8        20   24    3       90+   95+  25-30   3          .GTR.45   30
LEVB= 600    1       600    8                           84+   89+  30-35   4           35-45    30
LEVC=3000   21      3000   20                           80+   85+   --     6          .LT.35    30
LEVD= --     --       --    --                          74+   79+   --     8
LEVE= --     --       --    --                       LTEQ74LTEQ79  --    48
PROJ DIST=  930    RMP TVL TME=  700    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 41    CRIT SPD DET= 10    DO TIME OUT=   40
SPD TRP LENG=  201    MERGE RESET=   30    CNTL PRI= 1
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RMP  9  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
      OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     )       48     8       20   24     3       90+   95+  25-30   3          .GT.45   30
LEVB= 600     1      600     8                           84+   89+  30-35   4            35-45  30
LEVC=3000    21     3000    20                           80+   85+   --     5          .LT.35   30
LEVD= --     --      --     --                           74+   79+   --     8
LEVE= --     --      --     --                        LTEQ74LTEQ79   --    43
PROJ DIST= 1000    RMP TVL TME=  800    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET=  3    CRIT SPD DET=  7    DO TIME OUT=   50
SPD TRP LENG=  199    MERGE RESET=   50    CNTL PRI= 2

RMP 10  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
      OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     )       48     8       20   24     3       90+   95+  25-30   3          .GT.45   30
LEVB= 600     1      600     8                           84+   89+  30-35   4            35-45  30
LEVC=3000    21     3000    20                           80+   85+   --     6          .LT.35   30
LEVD= --     --      --     --                           74+   79+   --     8
LEVE= --     --      --     --                        LTEQ74LTEQ79   --    48
PROJ DIST= 1000    RMP TVL TME=  700    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 41    CRIT SPD DET= 41    DO TIME OUT=   50
SPD TRP LENG=  181    MERGE RESET=   50    CNTL PRI= 2

RMP 11  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
      OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     )       48    10       24   30     3       90+   95+  25-30   4          .GT.45   30
LEVB= 600     1      600    10                           84+   89+  30-35   5            35-45  30
LEVC=3000    21     3000    10                           80+   85+   --     3          .LT.35   30
LEVD= --     --      --     --                           74+   79+   --    48
LEVE= --     --      --     --                        LTEQ74LTEQ79   --    43
PROJ DIST= 1100    RMP TVL TME=  900    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET=  3    CRIT SPD DET=  9    DO TIME OUT=   50
SPD TRP LENG=  205    MERGE RESET=   50    CNTL PRI= 2

RMP 12  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
      OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     )       48     6       20   24     3       64+   70+  25-30   2          .GT.45   30
LEVB= 600     1      600     6                           59+   64+  30-35   3            35-45  30
LEVC=3000    21     3000    20                           55+   60+   --     5          .LT.35   30
LEVD= --     --      --     --                           50+   54+   --     6
LEVE= --     --      --     --                        LTEQ50LTEQ54   --    43
PROJ DIST= 1000    RMP TVL TME=  700    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 14    CRIT SPD DET= 12    DO TIME OUT=   50
SPD TRP LENG=  204    MERGE RESET=   50    CNTL PRI= 1
```

```
RMP 13  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
     OCCUP MODE    OCCUP MODE    LSPD USPD MODE    UPFLO DNFLO BNKSP MODE          GAPSPD GAPSIZ
LEVA=  20    33       48    33      24    30    33      64+    70+  25-30  33        .GTR.45   30
LEVB= 600    33      600    33                          59+    64+  30-35  33          35-45   30
LEVC=3000    33     3000    33                          55+    60+   --    33        .LT.35    30
LEVD= --     --      --     --                          50+    54+   --    33
LEVE= --     --      --     --                       LTE050LTE054  --    33
PROJ DIST= 1050    RMP TVL TME=    0    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET=  9    CRIT SPD DET=  9    DO TIME OUT=   50
SPD TRP LENG=  193    MERGE RESET=    0    CNTL PRI= 6

RMP 14  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
     OCCUP MODE    OCCUP MODE    LSPD USPD MODE    UPFLO DNFLO BNKSP MODE          GAPSPD GAPSIZ
LEVA=  20     0       48     6      24    30     3      64+    70+  25-30   2        .GTR.45   30
LEVB= 600     1      600     8                          59+    64+  30-35   3          35-45   30
LEVC=3000    21     3000    20                          55+    60+   --     5        .LT.35    30
LEVD= --     --      --     --                          50+    54+   --     6
LEVE= --     --      --     --                       LTE050LTE054  --    48
PROJ DIST=  800    RMP TVL TME=  700    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 16    CRIT SPD DET= 14    DO TIME OUT=   50
SPD TRP LENG=  212    MERGE RESET=   50    CNTL PRI= 1

RMP 15  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
     OCCUP MODE    OCCUP MODE    LSPD USPD MODE    UPFLO DNFLO BNKSP MODE          GAPSPD GAPSIZ
LEVA=  20     0       48     6      24    30     2      64+    70+  25-30   2        .GTR.45   30
LEVB= 600     1      600     8                          59+    64+  30-35   4          35-45   30
LEVC=3000    22     3000    20                          55+    60+   --     5        .LT.35    30
LEVD= --     --      --     --                          50+    54+   --     6
LEVE= --     --      --     --                       LTE050LTE054  --    48
PROJ DIST= 1100    RMP TVL TME=  800    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 13    CRIT SPD DET= 15    DO TIME OUT=   50
SPD TRP LENG=  200    MERGE RESET=   50    CNTL PRI= 2

RMP 16  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
     OCCUP MODE    OCCUP MODE    LSPD USPD MODE    UPFLO DNFLO BNKSP MODE          GAPSPD GAPSIZ
LEVA=  20     0       48     6      24    30     3      64+    70+  25-30   2        .GTR.45   30
LEVB= 600     1      600     6                          59+    64+  30-35   3          35-45   30
LEVC=3000    21     3000    20                          55+    60+   --     5        .LT.35    30
LEVD= --     --      --     --                          50+    54+   --     6
LEVE= --     --      --     --                       LTE050LTE054  --    48
PROJ DIST=  600    RMP TVL TME=  900    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 18    CRIT SPD DET= 16    DO TIME OUT=   50
SPD TRP LENG=  188    MERGE RESET=   50    CNTL PRI= 1
```

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RMP 17  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
      OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     0       48     6       24    30     2      64+   70+  25-30   2         .GTR.45    30
LEVB= 600     1      600     8                           59+   64+  30-35   4           35-45    30
LEVC=3000    22     3000    20                           55+   60+   --     5         .LT.35     30
LEVD= --     --      --     --                           50+   54+   --     6
LEVE= --     --      --     --                         LTEQ50LTEQ54  --    48
PROJ DIST=  840    RMP TVL TME=  800    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 13    CRIT SPD DET= 15    DO TIME OUT=   50
SPD TRP LENG=  193    MERGE RESET=   50    CNTL PRI= 2


RMP 18  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
      OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     0       48    48       20    24    48      64+   70+  25-30  48         .GTR.45    30
LEVB= 600     1      600    48                           59+   64+  30-35  48           35-45    30
LEVC=3000    20     3000    48                           55+   60+   --    48         .LT.35     30
LEVD= --     --      --     --                           50+   54+   --    48
LEVE= --     --      --     --                         LTEQ50LTEQ54  --    48
PROJ DIST= 1000    RMP TVL TME=  800    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 22    CRIT SPD DET= 18    DO TIME OUT=   40
SPD TRP LENG=  200    MERGE RESET=   80    CNTL PRI= 4


RMP 19  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
      OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     0       48     6       24    30     2      64+   70+  25-30   2         .GTR.45    30
LEVB= 600     1      600     8                           59+   64+  30-35   4           35-45    30
LEVC=3000    21     3000    20                           55+   60+   --     5         .LT.35     30
LEVD= --     --      --     --                           50+   54+   --     6
LEVE= --     --      --     --                         LTEQ50LTEQ54  --    48
PROJ DIST=  790    RMP TVL TME= 1100    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 15    CRIT SPD DET= 19    DO TIME OUT=   50
SPD TRP LENG=  190    MERGE RESET=   50    CNTL PRI= 1


RMP 20  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
      OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     0       48     6       20    24     3      64+   70+  25-30   3         .GTR. 0      0
LEVB= 600     1      600     6                           59+   64+  30-35   4           0- 0       0
LEVC=3000    22     3000    20                           55+   60+   --     6         .LT. 0       0
LEVD= --     --      --     --                           50+   54+   --     8
LEVE= --     --      --     --                         LTEQ50LTEQ54  --    10
PROJ DIST=    0    RMP TVL TME=    0    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 22    CRIT SPD DET= 22    DO TIME OUT=   50
SPD TRP LENG=    0    MERGE RESET=   50    CNTL PRI= 2
```

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RMP 21  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
      OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     0       48     6       24   30     3       64+   70+   25-30   2        .GTR. 45    30
LEVB= 600     1      600     8                            59+   64+   30-35   3          35-45     30
LEVC=3000    22     3000    20                            55+   60+    --     5        .LT.35      30
LEVD= --      --      --     --                            50+   54+    --     6
LEVE= --      --      --     --                          LTEQ50LTEQ54   --     43
PROJ DIST=  850    RMP TVL TME=  900    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 15    CRIT SPD DET= 19    DO TIME OUT=   50
SPD TRP LENG=  195    MERGE RESET=   50    CNTL PRI= 2

RMP 22  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
      OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     0        0     0       24   30     3       64+   70+   25-30   3        .GTR.  0      0
LEVB= 600     1        0     0                            59+   64+   30-35   4          0-  0      0
LEVC=3000    19        0    20                            55+   60+    --     6        .LT.  0      0
LEVD= --      --      --     --                            50+   54+    --     8
LEVE= --      --      --     --                          LTEQ50LTEQ54   --     10
PROJ DIST=    0    RMP TVL TME=    0    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 22    CRIT SPD DET= 22    DO TIME OUT=   50
SPD TRP LENG=  186    MERGE RESET=   50    CNTL PRI= 4

RMP 23  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
      OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     0        0     0       20   24     3       65+   70+   30-35   2        .GTR.  0      0
LEVB= 600     1        0     0                            59+   64+   35-40   3          0-  0      0
LEVC=3000    19        0    20                            54+   59+    --     5        .LT.  0      0
LEVD= --      --      --     --                            50+   54+    --     6
LEVE= --      --      --     --                          LTEQ50LTEQ54   --     8
PROJ DIST=    0    RMP TVL TME=    0    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 15    CRIT SPD DET= 21    DO TIME OUT=   50
SPD TRP LENG=    0    MERGE RESET=   50    CNTL PRI= 4

RMP 24  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
      OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     0       48     8       30   34     3       64+   69+   30-35   3        .GTR.50     30
LEVB= 600     1      600     8                            59+   64+   35-40   4          40-50     30
LEVC=3000    22     3000    20                            54+   59+    --     43       .LT.40      30
LEVD= --      --      --     --                            50+   54+    --     48
LEVE= --      --      --     --                          LTEQ50LTEQ54   --     43
PROJ DIST= 1060    RMP TVL TME= 1000    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 25    CRIT SPD DET= 25    DO TIME OUT=   50
SPD TRP LENG=  169    MERGE RESET=   50    CNTL PRI= 2
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RMP 25  MERGE          QUEUE          CRITICAL SPEED       SYSTEM INDICATORS
     OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE        GAPSPD GAPSIZ
LEVA=  20     0       48     6       20   24     2      64+   70+  30-35   2        .GTR. 0     0
LEVB= 600     1      600     6                          59+   64+  35-40   4          0- 0      0
LEVC=3000    22     3000     6                          54+   59+   --     6        .LT. 0      0
LEVD= --     --       --    --                          50+   54+   --     8
LEVE= --     --       --    --                       LTEQ50LTEQ54   --    10
PROJ DIST=     )    RMP TVL TME=    0    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 21    CRIT SPD DET= 25    DO TIME OUT=   50
SPD TRP LENG=  194   MERGE RESET=   50    CNTL PRI= 2

RMP 26  MERGE          QUEUE          CRITICAL SPEED       SYSTEM INDICATORS
     OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE        GAPSPD GAPSIZ
LEVA=  20     0       48     8       30   34     3      64+   69+  30-35   3        .GTR.50    30
LEVB= 600     1      600     8                          59+   64+  35-40   4          40-50    30
LEVC=3000    21     3000    20                          54+   59+   --    48        .LT.40     30
LEVD= --     --       --    --                          50+   54+   --    48
LEVE= --     --       --    --                       LTEQ50LTEQ54   --    48
PROJ DIST= 1100    RMP TVL TME= 1000    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 28    CRIT SPD DET= 28    DO TIME OUT=   50
SPD TRP LENG=  193   MERGE RESET=   50    CNTL PRI= 1

RMP 27  MERGE          QUEUE          CRITICAL SPEED       SYSTEM INDICATORS
     OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE        GAPSPD GAPSIZ
LEVA=  20     0       48     8       20   24     3      64+   70+  30-35   3        .GTR.50    30
LEVB= 600     1      600     8                          59+   64+  35-40   4          40-50    30
LEVC=3000    21     3000    20                          54+   59+   --    48        .LT.40     30
LEVD= --     --       --    --                          50+   55+   --    48
LEVE= --     --       --    --                       LTEQ50LTEQ55   --    48
PROJ DIST= 1040    RMP TVL TME= 1000    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 25    CRIT SPD DET= 25    DO TIME OUT=   50
SPD TRP LENG=  199   MERGE RESET=   50    CNTL PRI= 1

RMP 28  MERGE          QUEUE          CRITICAL SPEED       SYSTEM INDICATORS
     OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE        GAPSPD GAPSIZ
LEVA=  20     0        0     0       30   34     3      64+   69+  30-35   3        .GTR.50    30
LEVB= 600     1        0     0                          59+   64+  35-40   4          40-50    30
LEVC=3000    19        0    20                          54+   59+   --    48        .LT.40     30
LEVD= --     --       --    --                          50+   55+   --    48
LEVE= --     --       --    --                       LTEQ50LTEQ55   --    48
PROJ DIST= 1010    RMP TVL TME= 1000    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 30    CRIT SPD DET= 30    DO TIME OUT=   50
SPD TRP LENG=  [illegible]   MERGE RESET=   50    CNTL PRI= 4
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RMP 29  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
     OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE        GAPSPD GAPSIZ
LEVA=  20     )       48     8       30   34     3      64+   70+  30-35   3        .GTR.50   30
LEVB= 600     1      600     8                          59+   64+  35-40   4          40-50   30
LEVC=3000    21     3000    20                          54+   59+   --     48         .LT.40   30
LEVD= --      --      --     --                          50+   55+   --     48
LEVE= --      --      --     --                       LTEQ50LTEQ55   --     48
PROJ DIST= 1100    RMP TVL TME= 1000    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 27    CRIT SPD DET= 27    DO TIME OUT=   50
SPD TRP LENG=  184    MERGE RESET=   50    CNTL PRI= 1

RMP 30  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
     OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE        GAPSPD GAPSIZ
LEVA=  20     )       48     6       30   34     3      64+   70+  30-35   3        .GTR.50   30
LEVB= 600     1      600     6                          59+   64+  35-40   4          40-50   30
LEVC=3000    21     3000    20                          54+   59+   --     48         .LT.40   30
LEVD= --      --      --     --                          50+   55+   --     48
LEVE= --      --      --     --                       LTEQ50LTEQ55   --     48
PROJ DIST= 1200    RMP TVL TME= 1100    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 32    CRIT SPD DET= 32    DO TIME OUT=   50
SPD TRP LENG=  194    MERGE RESET=   50    CNTL PRI= 2

RMP 31  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
     OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE        GAPSPD GAPSIZ
LEVA=  20     )        0     0       30   34     3      64+   70+  30-35   3        .GTR.50   30
LEVB= 600     1        0     0                          59+   64+  35-40   4          40-50   30
LEVC=3000    19        0    20                          54+   59+   --     48         .LT.40   30
LEVD= --      --      --     --                          50+   54+   --     48
LEVE= --      --      --     --                       LTEQ50LTEQ54   --     48
PROJ DIST= 1100    RMP TVL TME=  900    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 29    CRIT SPD DET= 29    DO TIME OUT=   50
SPD TRP LENG=  200    MERGE RESET=   50    CNTL PRI= 4

RMP 32  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
     OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE        GAPSPD GAPSIZ
LEVA=  20     )       48     8       30   34     3      64+   70+  30-35   3        .GTR.50   30
LEVB= 600     1      600     8                          59+   64+  35-40   4          40-50   30
LEVC=3000    21     3000    20                          54+   59+   --     48         .LT.40   30
LEVD= --      --      --     --                          50+   54+   --     48
LEVE= --      --      --     --                       LTEQ50LTEQ54   --     48
PROJ DIST= 1080    RMP TVL TME= 1200    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 32    CRIT SPD DET= 32    DO TIME OUT=   50
SPD TRP LENG=  200    MERGE RESET=   50    CNTL PRI= 1
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RMP 33  MERGE          QUEUE          CRITICAL SPEED       SYSTEM INDICATORS
     OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     0       48     6       30   34     3      64+   70+  30-35   3          .GTR.50   30
LEVB= 600     1      600     6                          59+   64+  35-40   4           40-50    30
LEVC=3000    22     3000    20                          54+   59+   --    48          .LT.40    30
LEVD= --     --      --     --                          50+   54+   --    48
LEVE= --     --      --     --                       LTEQ50LTEQ54  --    48
PROJ DIST= 1210    RMP TVL TME= 1000    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 31    CRIT SPD DET= 31    DO TIME OUT=   50
SPD TRP LENG=  199    MERGE RESET=   50    CNTL PRI= 2

RMP 34  MERGE          QUEUE          CRITICAL SPEED       SYSTEM INDICATORS
     OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     0       48    10       30   34     3      64+   70+  30-35   3          .GTR.50   30
LEVB= 600     1      600    10                          59+   64+  35-40   4           40-50    30
LEVC=3000    21     3000    20                          54+   59+   --     6          .LT.40    30
LEVD= --     --      --     --                          50+   54+   --     8
LEVE= --     --      --     --                       LTEQ50LTEQ54  --    10
PROJ DIST= 1200    RMP TVL TME= 1100    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 36    CRIT SPD DET= 36    DO TIME OUT=   50
SPD TRP LENG=  200    MERGE RESET=   50    CNTL PRI= 1

RMP 35  MERGE          QUEUE          CRITICAL SPEED       SYSTEM INDICATORS
     OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     0       48     8       30   34     3      64+   70+  30-35   3          .GTR.50   30
LEVB= 600     1      600     8                          59+   64+  35-40   4           40-50    30
LEVC=3000    21     3000    20                          54+   59+   --    48          .LT.40    30
LEVD= --     --      --     --                          50+   54+   --    48
LEVE= --     --      --     --                       LTEQ50LTEQ54  --    48
PROJ DIST= 1100    RMP TVL TME= 1000    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 33    CRIT SPD DET= 33    DO TIME OUT=   50
SPD TRP LENG=  199    MERGE RESET=   50    CNTL PRI= 1

RMP 36  MERGE          QUEUE          CRITICAL SPEED       SYSTEM INDICATORS
     OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE          GAPSPD GAPSIZ
LEVA=  20     0       48     8       30   34     3      64+   70+  30-35   3          .GTR.50   30
LEVB= 600     1      600     8                          59+   64+  35-40   4           40-50    30
LEVC=3000    21     3000    20                          54+   59+   --     6          .LT.40    30
LEVD= --     --      --     --                          50+   54+   --     8
LEVE= --     --      --     --                       LTEQ50LTEQ54  --    10
PROJ DIST= 1100    RMP TVL TME= 1000    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 38    CRIT SPD DET= 38    DO TIME OUT=   50
SPD TRP LENG=  182    MERGE RESET=   50    CNTL PRI= 2
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RMP 37  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
     OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE        GAPSPD GAPSIZ
LEVA=  20     0       48     8       30   34     3      64+   70+  30-35   3        .GTR.50   30
LEVB= 600     1      600     8                          59+   64+  35-40   4         40-50    30
LEVC=3000    22     3000    20                          54+   59+   --     6        .LT.40    35
LEVD= --     --       --    --                          50+   54+   --     8
LEVE= --     --       --    --                       LTEQ50LTEQ54  --    10
PROJ DIST= 1200    RMP TVL TME= 1100    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 37    CRIT SPD DET= 37    DO TIME OUT=   50
SPD TRP LENG=  192    MERGE RESET=   50    CNTL PRI= 2


RMP 38  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
     OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE        GAPSPD GAPSIZ
LEVA=  20     0       48     8       30   34     3      70+   70+  30-35   3        .GTR.50   30
LEVB= 600     1      600     8                          64+   67+  35-40   4         45-50    30
LEVC=3000    21     3000    20                          59+   63+   --     6        .LT.45    30
LEVD= --     --       --    --                          55+   59+   --     8
LEVE= --     --       --    --                       LTEQ55LTEQ59  --    10
PROJ DIST= 1200    RMP TVL TME= 1100    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 40    CRIT SPD DET= 40    DO TIME OUT=   50
SPD TRP LENG=  190    MERGE RESET=   50    CNTL PRI= 1


RMP 39  MERGE          QUEUE          CRITICAL SPEED        SYSTEM INDICATORS
     OCCUP MCODE    OCCUP MCODE    LSPD USPD MCODE    UPFLO DNFLO BNKSP MCODE        GAPSPD GAPSIZ
LEVA=  20     0       48     8       30   34     3      64+   70+  30-35   3        .GTR.50   30
LEVB= 600     1      600     8                          59+   64+  35-40   4         40-50    30
LEVC=3000    21     3000    20                          54+   59+   --     6        .LT.40    35
LEVD= --     --       --    --                          50+   55+   --     8
LEVE= --     --       --    --                       LTEQ50LTEQ55  --    10
PROJ DIST= 1200    RMP TVL TME= 1000    LCH WIND PCTG=   40    LCH WIND NULL PCTG=   50
AMBR LENG=   20    GRN LENG=   15    BNK DET= 37    CRIT SPD DET= 37    DO TIME OUT=   50
SPD TRP LENG=  202    MERGE RESET=   50    CNTL PRI= 1
```