**LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS**

HARRY W. STONE, Director

LACO - 1R

TRAFFIC SIGNAL CONTROL PROGRAM

USER'S MANUAL

JANUARY 1996

LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS
TRAFFIC SIGNAL CONTROL PROGRAM

LACO - 1R

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HARRY W. STONE
Director of Public Works

THE DEPARTMENT OF PUBLIC WORKS ACKNOWLEDGES THE COMBINED
EFFORTS OF THE PROFESSIONAL STAFFS OF BOTH THE TRAFFIC SIGNAL
SYSTEMS UNIT UNDER MR. PERRY PATEL, AND THE TRAFFIC SIGNAL LAB
UNDER MR. LARRY SANDERSON IN DEVELOPING THIS PROGRAM

WE WELCOME COMMENTS CONCERNING THIS MANUAL OR SOFTWARE.
PLEASE SUBMIT TO :

TRAFFIC SIGNAL LAB
1525 ALCAZAR STREET
LOS ANGELES, CA 90033

FAX (213) 223-4152

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LACO-1R USER'S MANUAL

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LACO-1R USER'S MANUAL

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INTRODUCTION

The Los Angeles County Traffic Signal Control Program #1 was developed as a follow-on to the Q5 program written by the Federal Highway Administration (FHWA). It incorporates many added features that can be selectively used to address special situations. This program was designed to cover most of the intersection applications in the County of Los Angeles and has been a stable workhorse for many years.

TRAFFIC SIGNAL PROGRAM REVISIONS

Since its inception, the LACO-1 program has under gone several upgrades. This manual covers the latest changes and additions for the version called LACO-1R. At the time of print, the current revision date is 3-15-95. This date is burned into the program and can be observed at memory locations:

D-0-8 month

D-0-9 day

D-0-A year

All previous revisions are obsolete. Please contact the LA County Signal Test Lab or your City Services representative for free upgrade information.

GENERAL PROGRAM DESCRIPTION

LACO-1R provides the following features:

COORDINATION:
Master or Slave operation by using

7- wire direct interconnect

2 wire (Modem) Compatible with Caltrans ML2 format

Time Based, with W W V Clock support

Time Based by 2 wire (Modem) Time and Date transfer

Offset Timing by hard wire or modem

OVERLAPS:

Four 2-color right turn overlaps

One 3-color single phase overlap

One 3-color multi-phase overlap

PREEMPTS:

One Railroad Preempt input that can be configured as a Railroad Flash preempt (RR1) or a Limited Service preempt (RR2).

Four Emergency Vehicle Preempt inputs with individually selectable Clearance Phases, Clearance times and Delay times.

MISCELLANEOUS:

Programmable Lag phases for Free operation and each of 3 Dials

Ped Recall via "Rest-in-Walk" or STA mode

Selectable GREEN REST phases with programmable delay timer

Protected/Permissive Left Turn Arrow Logic

Manual Control

Associated Phase Recall

Mid-block Ped Crossing

Driveway Flash

Four Phase Programmable Detectors

Programmable Phase 8 Ped Load Switch Output

Timing Saver Routines

Phase and Dial Copy Routines

Memory Requirements

Signal Program	16k	C000h-FFFFh
RAM	1k	0000h-03FFh
T.O.D. Tables	1k	1000h-13FFh
Timing Saver	4k	7010h-7FFFh

HARDWARE INFORMATION

Figures 1 through 6 on the following pages have been included to assist both users and maintenance personnel with installation, maintenance and trouble shooting of controller cabinets that have the LACO-1R program installed.
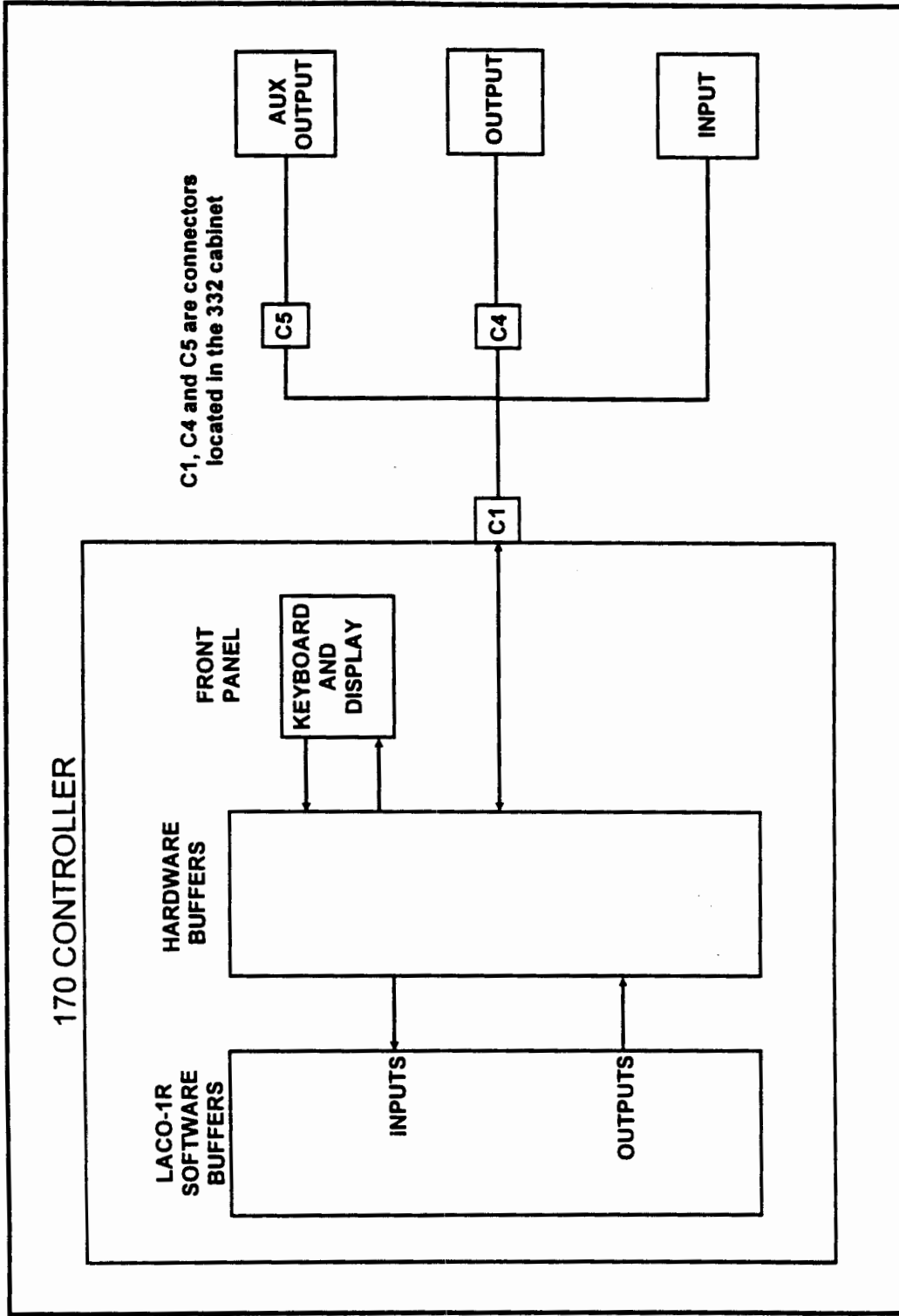
332 CABINET

FIGURE 1 - LACO-1R / 170 Controller / 332 Cabinet; I / O Diagram

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PIN	I/O	FUNCTION	PIN	I/O	FUNCTION
1	•••••	LOGIC GROUND	53	I2-7	OFFSET 1/ MANUAL ENABLE
2	O1-1	4 PED DON'T WALK	54	I2-8	OFFSET 2
3	O1-2	4 PED WALK	55	I3-1	DETECTOR 5J1U/L
4	O1-3	PHASE 4 RED	56	I3-2	DETECTOR 1I1U/L
5	O1-4	PHASE 4 YELLOW	57	I3-3	DETECTOR 7J5U/L
6	O1-5	PHASE 4 GREEN	58	I3-4	DETECTOR 3I5U/L
7	O1-6	PHASE 3 RED	59	I3-5	DETECTOR 5J9U
8	O1-7	PHASE 3 YELLOW	60	I3-6	DETECTOR 1I9U
9	O1-8	PHASE 3 GREEN	61	I3-7	DETECTOR 7J9L
10	O2-1	2 PED DON'T WALK	62	I3-8	DETECTOR 3I9L
11	O2-2	2 PED WALK	63	I4-5	DETECTOR 2I3U
12	O2-3	PHASE 2 RED	64	I4-6	DETECTOR 6J3U
13	O2-4	PHASE 2 YELLOW	65	I4-7	DETECTOR 4I7U
14	•••••	LOGIC GROUND	66	I4-8	DETECTOR 8J7U
15	O2-5	PHASE 2 GREEN	67	I5-1	2 PED PUSHBUTTON
16	O2-6	PHASE 1 RED	68	I5-2	6 PED PUSHBUTTON
17	O2-7	PHASE 1 YELLOW	69	I5-3	4 PED PUSHBUTTON
18	O2-8	PHASE 1 GREEN	70	I5-4	8 PED PUSHBUTTON
19	O3-1	8 PED DON'T WALK	71	I5-5	EV A
20	O3-2	8 PED WALK	72	I5-6	EV B
21	O3-3	PHASE 8 RED	73	I5-7	EV C
22	O3-4	PHASE 8 YELLOW	74	I5-8	EV D
23	O3-5	PHASE 8 GREEN	75	I6-1	OFFSET 3
24	O3-6	PHASE 7 RED	76	I6-2	DETECTOR 2I3L
25	O3-7	PHASE 7 YELLOW	77	I6-3	DETECTOR 6J3L
26	O3-8	PHASE 7 GREEN	78	I6-4	DETECTOR 4I7L
27	O4-1	6 PED DON'T WALK	79	I6-5	DETECTOR 8J7L
28	O4-2	6 PED WALK	80	I6-6	FUNC 6 / MANUAL ADVANCE
29	O4-3	PHASE 6 RED	81	I6-7	DIAL 2
30	O4-4	PHASE 6 YELLOW	82	I6-8	CABINET STOP TIME
31	O4-5	PHASE 6 GREEN	83	O6-1	FUNCTION 6
32	O4-6	PHASE 5 RED	84	O6-2	DIAL 3
33	O4-7	PHASE 5 YELLOW	85	O6-3	OVERLAP D RED
34	O4-8	PHASE 5 GREEN	86	O6-4	OVERLAP D YELLOW
35	O5-1	OVERLAP A GREEN	87	O6-5	OVERLAP D GREEN
36	O5-2	OVERLAP B GREEN	88	O6-6	OVERLAP C RED
37	O5-3	OVERLAP A YELLOW	89	O6-7	OVERLAP C YELLOW
38	O5-4	OVERLAP B YELLOW	90	O6-8	OVERLAP C GREEN
39	I1-1	DETECTOR 2I2U	91	O7-1	OFFSET 1
40	I1-2	DETECTOR 6J2U	92	•••••	DC GROUND
41	I1-3	DETECTOR 4I6U	93	O7-2	OFFSET 3
42	I1-4	DETECTOR 8J6U	94	O7-3	NOT USED
43	I1-5	DETECTOR 2I2L	95	O7-4	RAILROAD PREEMPT
44	I1-6	DETECTOR 6J2L	96	O7-5	EV PREEMPT
45	I1-7	DETECTOR 4I6L	97	O7-6	OVERLAP E RED
46	I1-8	DETECTOR 8J6L	98	O7-7	OVERLAP E YELLOW
47	I2-1	DETECTOR 2I4U/L	99	O7-8	OVERLAP E GREEN
48	I2-2	DETECTOR 6J4U/L	100	O5-5	DIAL 2
49	I2-3	DETECTOR 4I8U/L	101	O5-6	OFFSET 2
50	I2-4	DETECTOR 8J8U/L	102	O5-7	DETECTOR RESET
51	I2-5	DIAL 3 / OFFSET TIMING	103	O5-8	WATCHDOG
52	I2-6	RR1/RR2 PREEMPT	104	•••••	DC GROUND

FIGURE 2 - C1 Connector Pins

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LACO-1R MNEMONIC	SOFTWARE ADDRESS	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	HARDWARE ADDRESS
IN1	E80	8J6L	4I6L	6J2L	2I2L	8J6U	4I6U	6J2U	2I2U	5001
IN2	E81	OFFSET 2 / DIMMING	OFFSET 1 / MANUAL ENABLE	RAILROAD	DIAL 3 / OFFSET TIMING	8J8U/L	4I8U/L	6J4U/L	2I4U/L	5002
IN3	E82	3I9L	7J9L	1I9U	5J9U	3I5U/L	7J5U/L	1I1U/L	5J1U/L	5003
IN4	E83	8J7U	4I7U	6J3U	2I3U	UNUSED	UNUSED	UNUSED	RESTART TIMER	5004
IN5	E84	EV D	EV C	EV B	EV A	8 PED PUSH BUTTON	4 PED PUSH BUTTON	6 PED PUSH BUTTON	2 PED PUSH BUTTON	5005
IN6	E85	CABINET STOP TIME	DIAL 2 / FLASH SENSE	FUNC 6 / MANUAL ADVANCE	8J7L	4I7L	6J3L	2I3L	OFFSET 1	5006
IN7	E86	UNUSED	UNUSED	FRONT PANEL STOP TIME	MSB KEYPAD CHAR	NMSB KEYPAD CHAR	NLSB KEYPAD CHAR	LSB KEYPAD CHAR	KEYPAD KEY DOWN	5007

FIGURE 3 - Model 170 Controller Inputs

LACO-1R MNEMONIC	SOFTWARE ADDRESS	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	HARDWARE ADDRESS
OUT1	E90	Ø3 GREEN	Ø3 YELLOW	Ø3 RED	Ø4 GREEN	Ø4 YELLOW	Ø4 RED	4 PED WALK	4 PED DON'T WALK	5001
OUT2	E91	Ø1 GREEN	Ø1 YELLOW	Ø1 RED	Ø2 GREEN	Ø2 YELLOW	Ø2 RED	2 PED WALK	2 PED DON'T WALK	5002
OUT3	E92	Ø7 GREEN	Ø7 YELLOW	Ø7 RED	Ø8 GREEN	Ø8 YELLOW	Ø8 RED	8 PED WALK	8 PED DON'T WALK	5003
OUT4	E93	Ø5 GREEN	Ø5 YELLOW	Ø5 RED	Ø6 GREEN	Ø6 YELLOW	Ø6 RED	6 PED WALK	6 PED DON'T WALK	5004
OUT5	E94	WATCH DOG	DET RESET	OFFSET 2	DIAL2	O'LAP B YELLOW	O'LAP A YELLOW	O'LAP B GREEN	O'LAP A GREEN	5005
OUT6	E95	O'LAP C GREEN	O'LAP C YELLOW	O'LAP C RED	O'LAP D GREEN	O'LAP D YELLOW	O'LAP D RED	DIAL 3	FUNC 6	5006
OUT7	E96	O'LAP E GREEN	O'LAP E YELLOW	O'LAP E RED	EV (GREEN)	RR (YELLOW)	NOT USED (RED)	OFFSET3	OFFSET 1	5007

FIGURE 4 - Model 170 Controller Outputs

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I - INPUT FILE

	2I2U (39)	2I3U (63)	2I4 (47) *	3I5 (58)	4I6U (41)	4I7U (65)	4I8 (49) *	1I9U (60) UNUSED	FUNC 6 MANUAL ADVANCE (80)	2 PED PPB (67)	6 PED PPB (68)	DIAL 2 FLASH SENSE (81)
1I1	2I2U (39)	2I3U (63)	2I4 (47) *	3I5 (58)	4I6U (41)	4I7U (65)	4I8 (49) *	1I9U (60)	FUNC 6 MANUAL ADVANCE (80)	2 PED PPB (67)	6 PED PPB (68)	DIAL 2 FLASH SENSE (81)
(56)	2I2L (43)	2I3L (76)			4I6L (45)	4I7L (78)		3I9L (62)	OFFSET 1 MANUAL ENABLE (53)	4 PED PPB (69)	8 PED PPB (70)	CABINET STOP TIME (82)

J - INPUT FILE

	6J2U (40)	6J3U (64)	6J4 (48) *	7J5 (57)	8J6U (42)	8J7U (66)	8J8 (50) *	5J9U (59) UNUSED	OFFSET 2 (54)	EV - A (71)	EV - B (73)	DIAL 3 OFFSET TIMING (51)
5J1	6J2U (40)	6J3U (64)	6J4 (48) *	7J5 (57)	8J6U (42)	8J7U (66)	8J8 (50) *	5J9U (59)	OFFSET 2 (54)	EV - A (71)	EV - B (73)	DIAL 3 OFFSET TIMING (51)
(55)	6J2L (44)	6J3L (77)			8J6L (46)	8J7L (79)		7J9L (61)	OFFSET 3 (75)	EV - c (72)	EV - D (74)	RxR PREEMPT (52)

* OPTIONAL PROGRAMMABLE DETECTOR

Numbers in parentheses indicate C1 Connector pin numbers

FIGURE 5 - 332 Input File Layout

SPARE TERMINALS

1	2	3	4	5	6	7	8	9	10	11
UNUSED	UNUSED	UNUSED	UNUSED	UNUSED	EV-A (71)	RXR (52)	STOP TIME (82)	FLASH SENSE (C4-4)	A3 YEL (101)	DC FLASH

1	2	3	4	5	6	7	8	9	10	11
2I2U (39)	2I3U (63)	4I6U (41)	4I7U (65)	6J2U (40)	6J3U (64)	2 PPB (67)	6 PPB (68)	DIAL 2 (81)	FUNC 6 MANUAL ADVANCE (80)	OFFSET 2 (54)
2I2L (43)	* 2I4 (47)	4I6L (45)	* 4I8 (49)	6J2L (44)	* 6J4 (48)	4 PPB (69)	UNUSED	DIAL 3 OFFSET TIMING (51)	OFFSET 1 MANUAL ENABLE (53)	OFFSET 3 (75)

* OPTIONAL PROGRAMMABLE DETECTOR

Numbers in parentheses indicate C1 Connector pin numbers

FIGURE 6 - 337 Input File Layout

337 OUTPUT FILE

LS1	LS2	LS3	LS4	LS5	LS6
AUX1 RED (97)	Ø2 RED (12)	Ø4 RED (4)	Ø6 RED (29)	2PED D. WALK (10)	4PED D.WALK (2)
AUX1 YEL (98)	Ø2 YEL (13)	Ø4 YEL (5)	Ø6 YEL (30)	6PED D. WALK (27)	6PED WALK (28)
AUX1 GRN (99)	Ø2 GRN (14)	Ø4 GRN (6)	Ø6 GRN (31)	2PED WALK (11)	4PED WALK (3)

332 OUTPUT FILE

LS1	LS2	LS3	LS4	LS5	LS6
Ø1 RED (16)	Ø2 RED (12)	2PED D. WALK (10)	Ø3 RED (7)	Ø4 RED (4)	4PED D. WALK (2)
Ø1 YEL (17)	Ø2 YEL (13)	O'LAP "A" GRN (35)	Ø3 YEL (8)	Ø4 YEL (5)	O'LAP "A" YEL (37)
Ø1 GRN (18)	Ø2 GRN (15)	2PED WALK (11)	Ø3 GRN (9)	Ø4 GRN (6)	4PED WALK (3)

LS7	LS8	LS9	LS10	LS11	LS12
Ø5 RED (32)	Ø6 RED (29)	6PED D. WALK (27)	Ø7 RED (24)	Ø8 RED (21)	8PED D. WALK (19)
Ø5 YEL (33)	Ø6 YEL (30)	O'LAP "B" GRN (36)	Ø7 YEL (25)	Ø8 YEL (22)	O'LAP "B" YEL (38)
Ø5 GRN (34)	Ø6 GRN (31)	6PED WALK (28)	Ø7 GRN (26)	Ø8 GRN (23)	8PED WALK (20)

Numbers in Parentheses indicate C1 connector pins

"LS" = Load Switch

FIGURE 7 - 332/337 Cabinet Output File Layout

AUXILIARY OUTPUT FILE

| LS 1	LS 2	LS 3	LS 4	LS 5	LS 6
OVERLAP "E" RED	NOT USED	OFFSET 1	OVERLAP "C" RED	OVERLAP "D" RED	FUNCTION 6
OVERLAP "E" YEL	RR INDICATOR	OFFSET 2	OVERLAP "C" YEL	OVERLAP "D" YEL	DIAL 2
OVERLAP "E" GRN	EV INDICATOR	OFFSET 3	OVERLAP "C" GRN	OVERLAP "D" GRN	DIAL 3

FIGURE 8 - Auxiliary Output File Load Switch (LS) Layout

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170 CONTROLLER OPERATION

FRONT PANEL CONTROLS AND INDICATORS (see FIGURE 9)

Controls and indicators required for operation of the Model 170 Traffic Signal Controller are located on the front panel. All interval times for each phase are displayed and entered using the front panel mounted keyboard and read-out. The current phase, interval and interval timer are displayed, along with vehicle and pedestrian calls. Typical phase related functions, such as Vehicle Recall and Ped Recall are displayed and modified using the call/active lights. The front panel is illustrated in FIGURE 8. A brief description of the controls and indicators is as follows:

A. BATTERY CHARGING LIGHT - This light senses the charging current for the backup battery. Some manufacturers of the Model "170 E" which has no battery, remove the light completely. Some have assigned a new function to it: WDT (Watch Dog Timer) which echoes the 170E Watch Dog output to the CMU.

B. CALL/ACTIVE LIGHTS - These ten indicator lights are used to indicate the presence of traffic demand, Preemption status, Coordination status or error/status flags within some memory locations. An individual light is illuminated whenever there is a demand for the Phase indicated by the numbers "1" through "8". The lights will flash whenever the associated Phase has a pedestrian call. Call lights "1" through "7" are also used to indicate days of the week when in Real Time Clock or Table display modes. Call light "8" flashes when in Real Time Clock display mode. Call light "9" flashes when in Table display mode and is on continuously when a Preempt is active. Call light "0" provides Coordination status and Sync Pulse state.

C. FUNCTION DISPLAY - This LED display is used to show phase and interval timing in the base display mode and detailed ring display mode. It is also used to show timing data when accessing memory locations.

D. KEYBOARD - The keyboard is made up of 16 keys consisting of the numbers "0" through "9" and the letters "A" through "F". The keyboard is used to access memory locations, enter timing data, set operation modes and enter other operation commands into the Model 170 Controller Unit.

E. STOP TIMING SWITCH - The Stop Timing switch is used to stop the program from timing the interval in effect. The interrupted interval continues timing when the Stop Time switch is turned off. Coordination timers are not affected by this switch.

F. POWER SWITCH - The power switch is used to turn the Model 170 Controller Unit on and off.
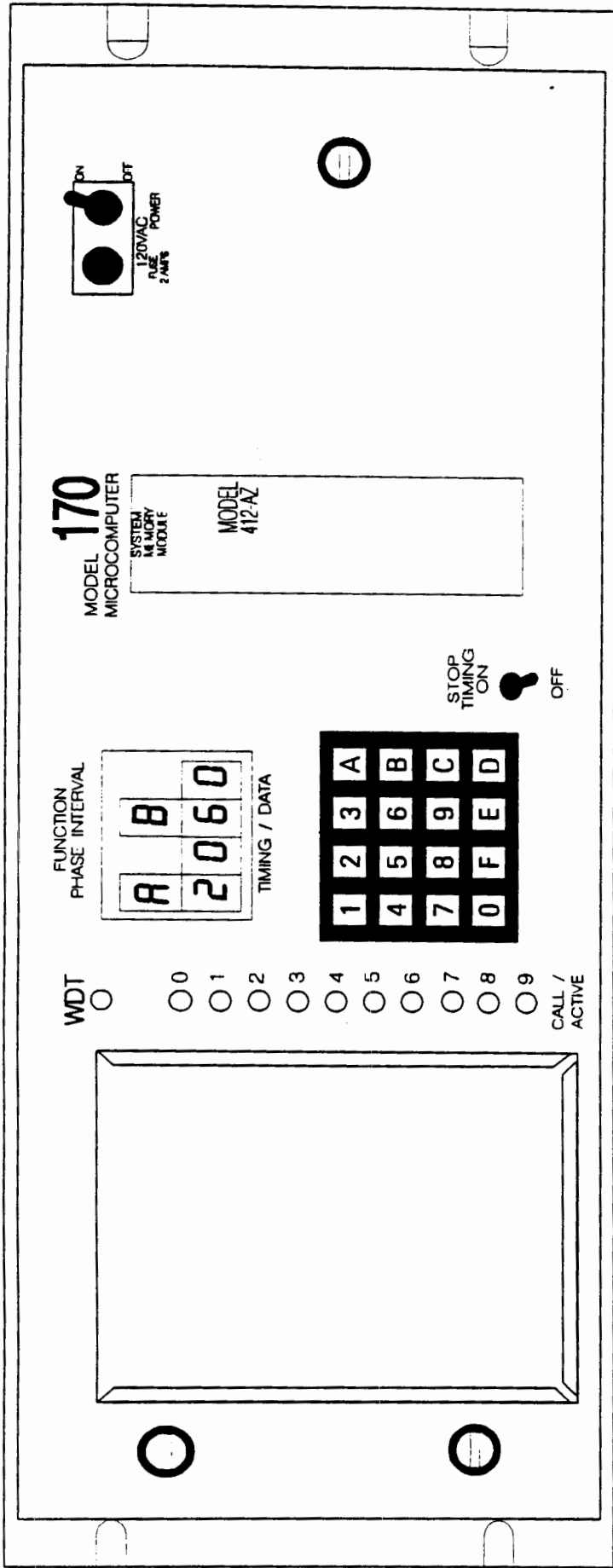
This 170 Front Panel is typical of the various manufacturers. Note that the Call / Active light labeled "WDT" is for the newer generation of 170E controllers that do not use a battery for data retention. On older models, this Call / Active light is labeled "BATTERY CHARGING"

FIGURE 9 - Type 170 Controller Front Panel

DISPLAY INTERPRETATION

The LACO-1R program uses one of four display modes to communicate data to the user as follows.

A. RING DISPLAY mode (see FIGURE 10)- This is the default display mode and is active after a long power down. It provides current Phase and interval status. The Ring Display mode includes the Base Display and the Detailed Ring displays. The Base display shows the phase and interval of both Ring A and Ring B. The Detailed Ring display shows the phase, interval and current interval timer of the selected Ring. From the Base display, press "A" to go to Ring A Detail Display, or "B" to go to Ring B Detail Display. Press any key, except "d", from the Ring B detail display, and any key, except "C" or "d", from the Ring A detail display, to return to the Base Display.

B. MEMORY DISPLAY mode- The Memory display mode is active whenever a specific location in RAM is accessed. There are two types of data shown when in the Memory display mode; timing data and Phase/flag data. When in the Memory display mode , the memory location being accessed is shown in the left hand digit of the Timing/Data window, and the Phase and Interval digits. If the memory location accessed is Phase/Flag data, then that data is reflected in call lights "1" through "8" and the Timing/Data window shows the Local Cycle Timer. If the memory location holds Timing data, it will be displayed in the Timing/Data window and the call lights will show the same data as in the Base display.

C. TABLE DISPLAY mode shows the Coordination Table data using all of the Function Display LED's and call lights "1" through "9".

D. REAL TIME CLOCK DISPLAY mode (see FIGURE 11) has two displays, the Time display and the Date display. The Time display shows the Hour, Minute and units digit of Seconds of the 170's internal clock while the Date display shows the Day-in-month, last two digits of the year and current month. Both displays indicate the Day-of-week in call lights "1" through "7".

E. CALL/ACTIVE LIGHTS indicate:
   1. Vehicle and Pedestrian calls
   2. Real Time Clock display mode when call light "8" is flashing.
   3. Preemptions/Table display mode when call light "9" is on/flashing.
   4. Active phases when setting Phase related functions.
   5. Active flags when accessing status/error types of memory.
   6. Coordination status in call light "0".

A			b	
RING A PHASE	RING A INTERVAL		RING B PHASE	RING B INTERVAL

BASE DISPLAY

A		INTERVAL	
PHASE			

RING A DETAILED DISPLAY

b		INTERVAL	
PHASE			

RING B DETAILED DISPLAY

FROM BASE DISPLAY PRESS:

"A" FOR RING A DETAILED DISPLAY

"B" FOR RING B DETAILED DISPLAY

FIGURE 10 - Ring Display Mode

Alternating "A" and "d" indicates Date Display

Current Month : "C" = December

Current Year : 1994

Current Day of Month : 14th

Date Display
Keypress (A - D)

Alternating "A" and "C" indicates Time Display

Units digit of Current Seconds
(Seconds set at d-4-F)

Current Time : 1:58 P.M.

Current Day of Week : Wednesday

Flashing Call Light "8" indicates Real
Time Clock Display Mode

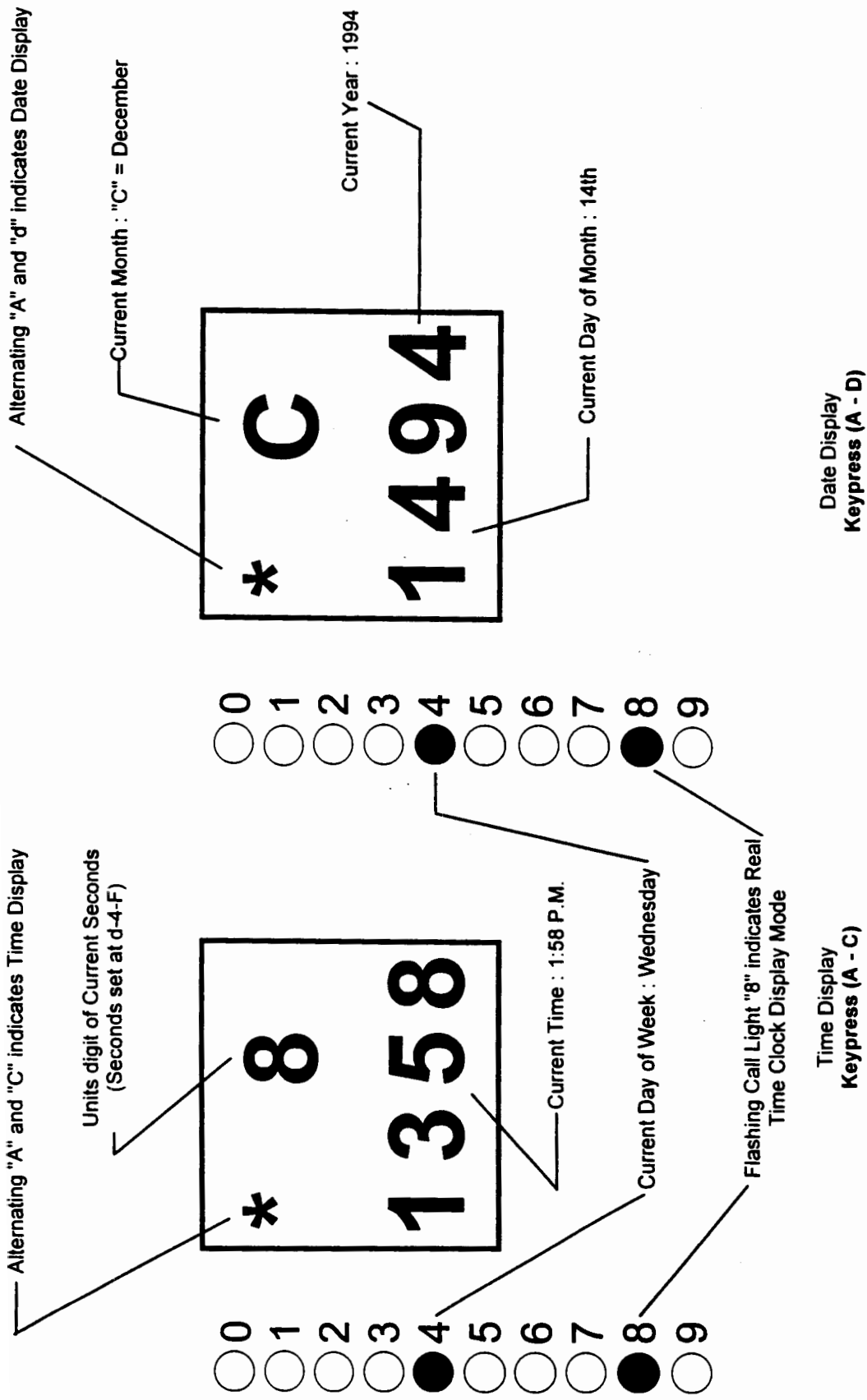Time Display
Keypress (A - C)

FIGURE 11 - Real Time Clock Displays

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CALL LIGHT INTERPRETATION

The Call / Active Lights (Call Lights) on the 170 Controller Front Panel provide a wide range of information about an intersection's timing and operation. There are 10 Call Lights, numbered "0" through "9". Call Lights "1" through "9" have different interpretations, depending on which mode the Function display is in. Call light "0", however, **always** reflects coordination status regardless of the display mode. See Page 31 for a detailed description of Call light "0" interpretation.

Call Lights "1" through "8"

In both Ring Display modes (Base and Detailed Ring displays), Call lights "1" through "8" represent the Call status of Phases 1 through 8. A steady "on" indication means there is a vehicle demand for the corresponding phase. Pedestrian demand is indicated when a Call Light flashes at a 5 Hz rate. A Call light flashing at a 1 Hz rate means the corresponding phase is flagged for Leading Left Turn operation (at F-F-b) and its demand will not be satisfied until a barrier crossing occurs. If a ped call is placed for a Leading Left Turn phase that must wait for a Barrier crossing, both flash rates are combined. The Call Light will be extinguished for .5 seconds and flash at a 5 Hz rate for the next .5 seconds.

The preceding also applies when the function display is in Memory Display mode and accessing a timing data location. When in Memory Display mode and accessing a Phase/Flag data location, Call Lights "1" through "8" indicate the data at that location. If a Call Light is "on", then the phase or flag at that location is enabled or set.

Also, Call Light "8" will flash at a 2.5 Hz rate whenever the Real Time Clock Display mode is active (key press A-C or A-d).

Call Light "9"

Call Light "9" is a status indicator only. It is used to indicate Preempt status while in Ring Display mode, Real Time Clock Display mode or Memory Display mode. It will be on from the moment the Preempt input is recognized and stay on until the end of the Preempt sequence.

Call Light "9" is also used to indicate that the Table Display mode is active when entering or observing Coordination Table data. In this case it will flash at a 2.5 Hz rate.

If the Table Display mode is accessed while a Preempt is active, Call light "9" will appear to flicker since it is only turned off for .1 second every .5 seconds.

KEYBOARD OPERATION

"A" KEY - This key is used to change from the Base Display to the Ring A Detailed Ring display. Any key pressed next, except for the "C" or "D" key, returns to the Base display. If the second key pressed is a "C", the Clock display appears. If the second key pressed is a "D", the Date display appears. In either of these displays, the "A", or "D" keys toggle between the Clock display and the Date display. Any numerical key pressed in the Time or Date displays begins data entry. The "B" "C" "E" or "F" key returns to the Base display.

"B" KEY - This key is used to change from the Base Display to the Ring B Detailed Ring display. Pressing any other key returns to the Base Display.

"C" KEY - This key is used to access the data on page C of RAM, the Coordination page. From the Base display the C key is pressed, followed by the keys defining the RAM page coordinates. The data in columns 0 through 3 is decimal and shown in the Timing/Data window. The data in columns 4 through F is phase data as indicated by the Call Lights "1" through "8".

"D" KEY - This key is used to access the data on page D of RAM, the Detector page. From the Base display the D key is pressed followed by the keys defining the RAM coordinates. The data in columns 1 through A is decimal while columns B through F contain phase data.

"E" KEY - This key is used to access the data on the E page of RAM. From the Base display the E-Key is pressed, followed by the keys defining the RAM coordinates. All data is phase data.

"F" KEY - This key is used to access the data on page F of RAM, the Phase Timing page. From the Base display, the F key is pressed, followed by the keys defining the RAM coordinates. The columns C, D and F contain phase data and the rest are decimal data.

KEYS "0" through "9". These keys are used to access the Coordination tables. From the Base display press the key corresponding to the desired table. The next key press, "0" through "F", shows the selected Interval in the Table display. These keys are also used to enter data in Memory, Table or Real Time Clock Display modes.

DISPLAY MOVEMENT KEYS

There are four keys used to move around RAM when viewing or changing data. These keys are used after a memory location has been accessed and the Function display is in Memory Display mode.

"A" (ADVANCE) KEY will move down a RAM column. This key may also be used in the Table Display mode to scan down successive table entries.

"C" (COLUMN BACK) KEY will move left to the next RAM column.

"D" (DECREASE) KEY will move up a RAM column. This key may also be used in the Table Display mode to scan up and view previous table entries .

"F" (FORWARD) KEY will move right to the next RAM column.

ENTERING DATA

TIMING DATA is entered by first entering the address in RAM to be changed, then entering the decimal value required and pressing the "E" key to enter data in RAM. The Function display will blink briefly indicating the new data has been accepted. By using the display movement keys, other RAM locations may also be viewed and changed. Pressing either the "B" or "E" key at any time while in the Timing Display mode will return the 170 controller to the Base Display mode.

PHASE DATA is entered by first accessing the desired memory location. Next press keys "1" through "8" to turn on the call light(s) that correspond(s) to the Phase(s) required. It is not necessary to press the "E" key to save phase values. If the "E" key is used, the display will return to the Base display mode. The display movement keys may be used in a phase related display to access other RAM locations. The "0" key may be used to cancel all of the phase related display lights.

COORDINATION TABLE DATA is entered by first pressing keys "0" through "9" to access the desired table and then keys "0" through "F" to access the desired interval within that table. Tables 0 through 3 contain Time-of-Day data and tables 4 through 9 contain Event data. Data entry is the same for both. When accessing the Coordination Tables, call light "9" will flash and the phase digit of the function display will alternately show the Table number and Interval number. If they are the same, for instance Table 5, Interval 5, the phase digit does not change. The following description is given for Time-of-Day tables with Event table fields in parentheses.

After accessing the desired table, the next four keystrokes provide the Hour:Min (Month/Day) data, The fifth keystroke is the Plan (Table) data, and the sixth keystroke is "E" to save the data. Next press the keys corresponding to the days of the week, where "1" through "7" represent "Sunday" through "Saturday", "8" sets all days, "9" sets week days and "0" clears all days. The days of the week data is saved immediately. The "E" or "B" key then returns to the base display, or press "A" for the next Interval or "D" for the previous Interval. Table data must be entered in the order shown. If an item needs to be changed, for example days of the week, the process has to be started from the beginning, re-entering all data even if it is unchanged.

Table 6 data is slightly different than the other Event tables although the keystroke sequence is the same. See Timing Sheet page 5 for more information.

REAL TIME CLOCK DATA is entered in the same sequence as Table data. To access the Time display, press "A" followed by "C". Keys "0" through "9" are used to enter the Hour (in 24 hour format) followed by a "0" for seconds then "E" to save the time. Next press keys "1" through "7" to indicate Day-of-Week, "Sunday" through "Saturday". Pressing "E" or "B" will return to the Base display, or pressing "A" or "D" will toggle to the Date display. In this display, enter "00" through "31" for day-in-month followed by the last two digits of the year, and then enter "1" through "C" for the months, "January" through "December". Press "E" to save the date. Next press keys "1" through "7" to indicate Day-of-Week.

EXTENDED MEMORY locations, memory above the "C" page, can also be accessed from the keyboard. At location F-9-F enter the decimal equivalent of the most significant byte of the RAM location you want to access. Return to the Base display and press "C" followed by the least significant byte of the RAM location.

The entire Function display will flash continuously (indicating an extended memory address is being displayed) to avoid confusion with data located on the "C" page. In this display mode, all data, whether phase data or timing data, is shown in the Timing/Data window of thedisplay and is the actual hexadecimal data used by the program.

This feature in conjunction with the Hardware information provided previously can be very useful for trouble shooting problems with hardware such as WWV clocks and modems. Any memory location from 0000h to FFFFh can be examined using this feature. Care must be exercised when using this feature to ensure that critical data is not changed. When finished with the extended memory feature, set location F-9-F back to "000".

PROGRAM INITIALIZATION

The first time that the 170 controller is powered up with a LACO-1R program installed, all data in the CPU base RAM is cleared. At this point the 170 will be in the following state:

All phases permitted

All phases on recall (for 1 phase cycle)

All phases set to 10 seconds minimum green

No peds enabled

No preempts enabled

No overlaps selected

The LACO-1R program continually checks for the correct program number stored in ram. If the ram gets corrupted or the program is changed, the Function display will immediately show "bAdA" as indicated below. Toggling the Front Panel Stop Timing switch will clear the bad data and restart the program.

To manually reinitialize the program, enter E-E-0-0. The program will reinitialize to its default settings and display "bAdA" as shown below.

A		b	
b	A	d	A

POWER UP SEQUENCES

The program has two power up sequences; one after a short power down (less than 2 seconds) and the other after a long power down. When power is restored after a short power down, the program continues on as if no interruption occurred. A long power down sets the program into a Start-up condition. This condition puts the controller through one of two structured start-up sequences as follows:

1. START UP ALL RED - Location F-F-E (Yellow Start Up) has no phases flagged. In this case, the 170 outputs red to all load switches both vehicle and ped. Two-color overlaps are kept dark. The intersection stays all red for 5.0 seconds (this time is fixed). At the end of this period, the program searches for the first permitted phases in each ring, starting with phase 1 in ring A and phase 5 in ring B. These phases become the default First Phases After Start Up.

Example

F-F-0 (Phases Permitted) = 1,2,3,4,6,7,8

F-F-E (Yellow Start Up Phases) = none flagged

After the 5.0 seconds of all Red, Phase 1 and Phase 6 will go Green. If Phase 6 was not Permitted either, then Phase 1 would start alone.

2. START UP IN YELLOW - Location F-F-E (Yellow Start Up) has phases set. In this case the 170 outputs yellow to the Yellow Start Up phases for a period of 5.0 seconds. Red Clearance (if any is set) is timed and then the next permitted phases in sequence are served. Note that the Yellow interval of 5.0 seconds at Start Up is not selectable and does not affect the Yellow Change times set for individual phases.

INPUTS

DETECTION

Vehicle: Twenty-eight inputs supported. Four inputs can have any phase or combination of phases assigned.

Pedestrian: Up to 4 fully actuated ped inputs. Each ped input can be programmed to time with either vehicle phase in its quadrant. Also phase 8 ped can be programed to serve with phases 1,3 or 5.

PREEMPTION

Four Emergency Vehicle inputs and one Railroad input.

COORDINATION

Accepts 7-wire direct and 2 wire inputs via Modem for Dial/Offset information or Time/Date updates.

Also accepts a two wire input for the Offset Timing mode.

DETECTION

VEHICLE DETECTION

LACO-1R supports twenty-eight vehicle inputs. All discussion in this section refers to detectors operating in "presence" mode (as opposed to "pulse" mode) of operation. All vehicle detectors include delay timers (0 to 255 seconds) and extended call timers (0 to 25.5 seconds). Both functions can be set concurrently but delay times are effective only when the detector phase is red and extended call times are effective only when the detector phase is green. Each detector has three basic functions:

    a. It places a call to its assigned phase(s) for the duration of the actuation.

    b. It causes Vehicle Extension to be timed if any extension time is set in phase timing.

    c. It counts vehicle actuations during $\emptyset$ red and yellow, incrementing the count once for each actuation and is cleared at the beginning of yellow.

1. **Yellow Disconnect** - Ignores detection calls during the yellow interval. A typical application is for a phase with a mix of advance and near (first vehicle) presence detectors. In this situation, the phase should be on Red & Yellow Lock for the advance detectors and the near detectors should be disconnected during the yellow interval to prevent unnecessary recalls from vehicles that leave the intersection on yellow.

NOTE

When both Yellow Disconnect and Red & Yellow Lock are set, the resulting operation is identical to Red Lock only operation.

2. **Queue Clearing** - Implemented when a value other than zero is set for Queue Max. Values can range from 1-255 seconds. Queue Clearing operation is as follows:

    a. During the Red interval, a demand on a Queue Clearing detector will place a CALL to its phase.

    b. A "HOLD" is placed on that phase at the beginning of green in response to the continuous actuation (including extended call) of All Queue Clearing detectors on that phase. Queue "HOLD" is indicated by a "3" displayed in Ring display and the limit timer can be observed in the detailed ring display.

    c. The "HOLD" will continue to be placed until vehicle actuation first ceases (gaps) on All flagged detectors or until the Queue Maximum limit is reached. Once "HOLD" has been released, these detectors will be ignored until the start of the next green.

d. Vehicle actuation during the yellow interval is ignored.

e. The "counting function" is inhibited when a the Queue Clearing flag is set.

Queue detectors provide a precise method of moving a Queue of traffic accumulated during RED. They also include provision to retain green with presence or extended call detection. Vehicle extension does not time from a Queue detector. "Calling" detector operation is provided when the Queue Clearing detector maximum limit is set to zero. Only calls during the RED are seen by the controller and counts remain disabled.

Programmable Detectors

Input file slots I4, I8, J4 and J8 are Phase selectable. All other Detector rules apply. If NO phases are flagged then the standard default phasing as specified by Caltrans is assumed. Please see the sample timing sheets in the back of this manual for Flag locations.

Detector Timers And Counters:

To observe the delay timers, enter the user set delay time code found on page two of the timing sheet and press the "F" key 6 times.

To observe the extension timers, enter the user set extension time code from page two and press the "F" key 6 times.

To observe the count buffers, enter the user set extension time code from page two and press the "F" key 2 times.

NOTE: For special applications, the DELAY TIMERS can be reprogrammed to count in TENTHS of a second. Setting memory location D-0-4 to a "1" will cause ALL of the detectors to time their delays in tenths (0-25.5 seconds).

COORDINATION

The LACO-1R program can be coordinated in either interconnected systems or non-interconnected systems. As a Master, this program uses its real time clock to access tables which determine the coordination plan to act on. This plan is continuously sent out on the 7-wire outputs and also sent out via Modem on Serial Port #3. As a Slave in an interconnected system, coordination commands are received via the hard wire inputs and the Modem on Serial Port #3. This serial data is compatible with the Caltrans Diamond Interchange program (ML2 format).

The coordination plan is in a 3 Dial, 3 Offset format. Time-of-Day, Annual and Holiday tables are used to change the plans. The operator can turn coordination on and off manually or force it to one of the 9 plans.

Offset Timing is an optional Slave mode operation. It provides the user with a coordination scheme which is triggered by an event rather than a sync pulse in a fixed background cycle. The basic coordination functions are maintained and programmed the same as with the conventional timing. The operation differs only by the intersection going Free after each cycle is completed.

For Master operation, the operator must set the Coordination Mode location to the Master number (D-0-0 = 170). It will then read its Time-of-Day tables to determine the plan to run. It will output this plan on the C5 connector to run a 7-wire direct interconnect system and output the data via the Modem on Serial Port #3.

For Slave Mode operation, the operator must enter a "7" at the Mode select location (D-0-0). As a Slave, it will interface to both 7-wire and the standard 2-wire modem interconnect called the "CALTRANS" Diamond Interchange program or ML2 Master. The program looks at both inputs and logically "OR's" them together so there are no additional locations to set. It then echoes this information on both the C5 connector (for a 7-wire system) and the Serial Port #3.

This program provides for the coordination of fully actuated signals within the constraints of a background cycle. The intersection is normally structured and timed the same as an isolated intersection. Coordination is achieved by implementing intervals of *Force Off, Hold, Pedestrian Restrict, Call or Phase Omit*, set and timed by the Local Cycle Timer, while servicing phases on demand. The controller maintains two cycle timers, the Master Cycle Timer and the Local Cycle Timer. The Master Cycle Timer is kept in step by a "sync" pulse which is generated internally when in the Master mode or externally from the interconnect in the Slave mode. The Local Cycle Timer times the Coordination functions and always lags the Master Cycle Timer by the offset time corresponding to the offset number selected for that plan. The Master Cycle Timer has limits which are user set to allow some control over the sync pulse reset. This allows for a minimum and a maximum cycle to be set. Each phase is provided two maximum vehicle extension values. Max Extension1 operates under Free conditions and Max Extension 2 operates under coordination. Lag phases may be set independently for "Free", Dial 1, Dial 2, and Dial 3 operations.

Master/Local Cycle Timer Limits:

Set Minimum Cycle	C-0-8
Set Maximum Cycle	C-0-9
Observe Master Cycle Timer	C-0-A
Observe Local Cycle Timer	C-0-b

Dial: A dial is the timing cycle (0 to 255 seconds) which contains the intervals used for programming the Coordination functions. There can be up to 3 dials used per system.

Set Dial 1 cycle length	C-1-0
Set Dial 2 cycle length	C-2-0
Set Dial 3 cycle length	C-3-0

Set Free Lag Phases	D-F-0
Set Dial 1 Lag Phases	D-F-1
Set Dial 2 Lag Phases	D-F-2
Set Dial 3 Lag Phases	D-F-3

Interval: An interval is a selectable time during the dial when a Coordination function is turned on or off. There can be up to 15 intervals per dial.

Set Dial 1 intervals	C-1-1 thru C-1-F
Set Dial 2 intervals	C-2-1 thru C-2-F
Set Dial 3 intervals	C-3-1 thru C-3-F

Offset: An offset is the amount of time that the local controller lags behind the System Master. There are up to three offsets per dial. The offset is timed from the Master sync pulse and is selectable from 0 to 255 seconds.

Set Offset 1 for Dial 1	F-1-A
Set Offset 1 for Dial 2	F-2-A
Set Offset 1 for Dial 3	F-3-A
Set Offset 2 for Dial 1	F-1-B
Set Offset 2 for Dial 2	F-2-B
Set Offset 2 for Dial 3	F-3-B
Set Offset 3 for Dial 1	F-1-C
Set Offset 3 for Dial 2	F-2-C
Set Offset 3 for Dial 3	F-3-C

Observe the current offset number (1-3) at C-0-4

Observe the new offset value at C-0-C

Observe the current offset time at C-0-D

COORDINATION FUNCTIONS

Coordination functions are implemented during the intervals set on the dial. These are implemented with respect to the Local Cycle Timer. Each function is selected by phase, per interval, within a dial. Coordination functions can be observed in the call lights along with the Local Cycle Timer in the Timing/Data display window.

Force Off	D-F-F
Hold	D-F-D
Ped Restrict	D-F-E
Call	D-F-C
Phase Omit	D-D-4

FORCE OFF: A *Force Off* will terminate a phase only if there is an opposing call and the minimum green and/or pedestrian timing have expired. *Force Off* will prevail over *Hold* set for the same phase. If a phase is red when the *Force Off* interval is applied, it will not prevent the start of green for that phase, however pedestrian timing will not start during a *Force Off* interval.

HOLD: When *Hold* is applied to a phase it will prevent the "gap out" or "max out" termination of that phase green. All other phase timing is unchanged. When *Hold* is released, phase timing continues from its present status.

PED RESTRICT: A *Ped Restrict* will prevent a pedestrian movement from starting but will not cut short any timing currently in progress. If pedestrian timing is in progress when the interval is applied, the timing will continue uninterrupted to completion. If a pedestrian call is placed during *Ped Restrict*, the call will not be registered (nor will it show in the phase call light) until the restriction has ended. When a pedestrian call exists prior to the vehicle phase being served, the ped call will be ignored if its vehicle phase begins timing during the Ped Restrict interval. When the Ped Restrict is removed the ped call is restored. A Ped Restrict does not prevent the ped's associated Vehicle phase from responding to vehicle detector actuations.

In general, the *Ped Restrict* interval, in conjunction with normal controller sequencing and operation, is used to limit pedestrian signal timing to those portions of the cycle where ped timing will not interfere with system coordination.

*** *Caution* ***

Care must be taken to assure a start of pedestrian timing each cycle. If the *Ped Restrict* interval is set to begin at the start of green, the ped intervals for that phase will not time because the ped must start timing with the start of its vehicle phase. If the ped movement does not start at that time, it must wait until the next time its vehicle phase is served. Provide at least 1 second of time after the start of green before the restriction is started.

CALL: The *Call* function is the same as placing a constant vehicle actuation to that Phase. All rules for gap detection and max limits still apply as in Free operation.

PHASE OMIT: The Phase Omit function is the opposite of Call. It removes all calls to the selected phase so the phase will never serve.

FUNCTION 6: When Function 6 is requested by the System, the local will select either a DIAL or FREE operation as set by the operator at C-0-6 (FUNC 6). The setting shall be 1, 2 or 3 for the dials or 14 for FREE operation. When a dial is set for Function 6 operation, the following operations occur:

    a. If Function 6 is in response to an input from the System Master, the Dial set at C-0-6 will time in response to the Master cycle length.

    b. If Function 6 is in response to loss of the Master Sync input, the Function 6 dial will time in Offset 1 and the cycle length (viewed at the Master Cycle Timer, C-0-A) will be the cycle time as preset for the selected Dial 1,2,or 3.

    c. Time of Day Dial (or Free) selection will override a System command for Function 6 (see "a." preceding). If the interconnect fails during Time of Day selection, Function 6 operation will prevail (see "b." preceding).

PHASE SEQUENCE

Each of the Dials and Free operation has a phase sequence selection available. This permits the operator to select the lead-lag sequence for each dial as desired. The operator must set the designated phase which lags each phase pair. The quad configuration contains 4 phase pairs, phases 1 and 2, 3 and 4, 5 and 6 or 7 and 8. Typical operation has the even numbered phase lagging the odd numbered phase. Consequently, phases 2, 4, 6 and 8 would be designated as the lag phases. One and only one phase of each phase pair must be set as a Lag Phase. The operator sets LAG 0 (D-F-0) through LAG 3 (D-F-3) using the CALL/ACTIVE lights as he would for setting recalls, etc. LAG 0 is used during Free operation, and LAG 1, LAG 2 and LAG 3 are utilized with Dial 1, Dial 2 and Dial 3 respectively, during coordinated operation.

MANUAL COORDINATION

There are two manual entry locations. The first one, System Manual, is at C-0-0. It can be used to override the Time of Day tables to force the entire system to a selected plan. Second is the Local Manual located at C-0-1. As its name implies, it only affects the local controller's operation. The operator can manually select a dial and offset, or free operation independent of the System operation. To select a dial and offset, set the dial required into Local Manual (C-0-1) and the offset in (C-0-4). The cycle length will be the time corresponding to the selected dial, and the offset time will be determined by the selected offset. Therefore, the operator may select a dial and offset to override the Master, and the Slave will "sync" with the Master.

To restore the 3 dial 3 offset system, both System Manual (C-0-0) and Local Manual (C-0-1) must be set to "zero". To have the local intersection operate Free set Local Manual (C-0-1) to 14.

The following is a list of functions that can be called from the manual locations:

SYSTEM MANUAL C-0-0

0 = Automatic time based mode

1-9 = Force to the selected manual plan

14 = Request the Function 6 output from Local controller

LOCAL MANUAL C-0-1

0 = Automatic time based mode

1-3 = Force local to Dials 1,2 or 3

12(C) = Offset timing mode

14(E) = Free

The letters "A" through "F" are the hexadecimal equivalents of the numbers "10" through "15" and are used when entering Plan/Functions into coordination Tables.

SYNC PULSE

The controller will look for "sync" pulses within the limits set by the operator. These sync pulses are the result of pulling low (i.e. A.C. voltage equals 0) the active offset line. The minimum amount of time the offset line must be off can be set at D-0-F (MINPUL) in tenths of a second. The maximum time is set at D-0-E (MAXPUL), also in tenths of a second. These values have been initially set at 1.0 and 4.0 seconds respectively. Therefore, the offset line has to be off for more than 1 second to be recognized as a "sync" pulse and cannot be off longer than 4 seconds. If the pulse is greater than 4 seconds, the controller will go to "FUNCTION 6" and generate a cycle for the dial selected or go "Free". If the offset line is "off" less than 1 second, the pulse will be ignored. Multiple offset inputs will be interpreted as Offset 1 and multiple dial inputs will be interpreted as Dial 1.

OFFSET TIMING

An optional Offset Timing Coordination program has been provided for use where it is not desired to have a fixed background cycle. When in either the Master or Slave modes, Offset Timing can be implemented by Time of Day or by manually setting a "12" in the Local Manual location C-0-1. This will inhibit the Local controllers 3 dial 3 offset system. Dial 3 must be reserved to run the Offset Timing functions which are set up as in normal coordination. Receiving an input from the adjacent intersection (Pin 51-C1 connector, J14U), the 170 controller will time the Dial 3 cycle length once and then go Free. During the offset period, coordinated functions will be implemented as set. Once this process is initiated, it will continue through its full cycle before acting upon another input. The input can also come from ACIA port #3 bit 8. This is an unused bit in the dial and offset Modem data. The program looks at both locations and there are no additional locations to set. To transmit the offset bit there is one location to set. To send a green select the phase at F-C-0. To send a yellow select the phase at F-C-1. This bit is added to the modem data and sent out ten times a second.

COORDINATION TIMING

This coordination program provides timing and functions to enable the user to modify the timing and operation of a fully traffic actuated controlled intersection to time in harmony with System control of a background cycle. Traffic moving through a system of signals will usually be more concentrated in the early portion of the through-Green band while the flow during the later part of the band is usually relative to the demand on the system. For example, assume a system band of 36 seconds. In off-peak periods perhaps only the first 8 to 10 seconds may have a flow of traffic that might be considered relevant to the system, but during peak periods the flow of traffic may frequently be heavy and continuous during the entire band time.

The coordination program can "guide" the controller into a condition to provide a period of assured Green during the initial portion of the band, leaving the remainder of the band to be self generated by vehicle actuations. If, after the assured Green period, traffic flow is not sufficient to continue the Green, the controller will "gap out" and transfer to a conflicting call. In the case of peak traffic demand, the Green will be held following the assured Green period by vehicle actuations until either a gap appears or the Phase *Force Off* is applied. The coordination functions can also be utilized to allow the controller to respond to conflicting phases late in the cycle and still return in time for the assured Green.

Some other points to consider:

Walk and Don't Walk intervals will not be abbreviated by maximum extension or *Force Off* . Emergency Vehicle preemption will terminate the Walk interval immediately to Flashing Don't Walk. Railroad preemption has priority over pedestrian timing and will terminate either interval to a solid Don't Walk indication.

Either type of preemption will temporarily suspend Coordination control of the intersection, although it will continue to cycle in the background. This allows a seamless return to Coordination control after preemption. The railroad preempt routine also has a Free Timer which can be used to keep the intersection free to service any backlog of traffic.

Minimum Green or Added Minimum Green will not be terminated by *Force Off* or Emergency Vehicle preemption, but will terminate to Railroad preemption, as in non-coordinated operation.

Queue Clearing *Hold* will not terminate to maximum extension, but will end at *Force Off* or any preemption.

Yellow Change, Red Clearance and Red Revert intervals time as normal.

LOCATIONS TO OBSERVE WHEN IN COORDINATION

C-0-0: System Manual (usually set to 0)

    0 = Automatic Mode

    1-9 = Plan 1, 2, 3, 4, 5, 6, 7, 8 or 9

    14 = System requesting Function 6

C-0-1: Local Manual (usually set to 0)

    0 = Automatic Mode

    1-3 = Dial 1, 2 or 3

    12 = for constant Offset Timing Mode

    14 = Free

C-0-2: the current Dial that the System Master is calling for

C-0-3: the current Dial that the Local controller is using

C-0-4: the current Offset number that the Local controller is using

C-0-5: the current plan selected by the Time Of Day tables (Tables 0 - 3)

C-0-6: the user set default dial for Free operation (Function 6)

C-0-7: the Table Number from which the plan (shown at C-0-5) was selected

C-0-8: the minimum cycle length allowable

C-0-9: the maximum cycle length allowable

C-0-A: the Master Cycle Timer

C-0-B: the Local Cycle Timer

C-0-C: the new Offset value

C-0-D: the current Offset time

C-0-E: the last Master cycle length

C-0-F: the last Local cycle length

CALL LIGHT "0"

Call light "0" reflects Coordination status, regardless of the 170 Display mode. Interpretation of Call light "0" is as follows:

Constant Off indicates that a "14" is entered at C-0-1 (Local Manual) and that the Local controller will not respond to System commands. C-0-3 will also show a "14".

Constant On indicates that the Local controller is in Coordination and operating normally. C-0-3 will show the current Dial (or C-0-6 entry if in Function 6). In this mode Call Light "0" will extinguish only for the duration of the Master Sync Pulse.

On .1 Seconds and Off .9 Seconds indicates a Coordination error condition, specifically loss of sync. If sync is restored, Call light "0" returns to a constant on condition. If "14" is entered at C-0-1, Call light "0" returns to a constant off condition.

COMMUNICATIONS PORTS

LACO-1R supports 3 Communications Ports. Port assignments are as follows:

COMM PORT 1 = WWV or Time and Date transfer

COMM PORT 2 = WWV

COMM PORT 3 = Dial and Offset data plus the Offset Timing bit

COMM PORT 4 = not used

Note: The communications routine automatically looks to see what port the WWV clock is plugged into. If it finds it on port 1, the Time and Date transfer routine is inhibited. If it finds it on port 2, the Time and Date routine is automatically enabled for port 1. Connecting the wires to the Receive or Transmit pins of the connector are all that is needed to send or receive the data. The time and date of the last WWV repoll or TOD transfer can be observed at D-E-0 through D-E-5.

The WWV protocol format is: 1 start bit, 8 data bits, no parity, 1 stop bit, IRQ on. All Other protocols are set to: 1 start bit, 8 data bits, even parity, 1 stop bit, IRQ off.

TIME OF DAY TABLES

The LACO-1R program has two modes of operation, Master and Slave. In the slave mode (D-0-0=7), there is only 1 table available for use by the local controller. This table is found on page 4 of the timing sheets and is numbered Table 9. The user may program in the times (Hrs\Mins) that he wishes to override the coordination data being received. The user may only select a Dial (1-3), Free, Flash or Offset Timing Mode to begin on the selected Days of the week. Please see the sample timing sheets (following this section) for Key Codes and examples.

In the Master Mode (D-0-0=170) there are 10 tables which can be used to select the desired operation. Tables 0 (the default table) through 3 are the PLAN tables which will be used by the coordination routine to select the desired Dial and Offset to use. Table 4 is the Floating Holiday table and is used to direct the coordination routine to change from table 0 to one of the other 3 tables for a particular day. Data entry is by Month, week of the month, table to use and day of the week. Tables 5,6 &7 are Annual tables and can be set up by entering the Month & Day, the table to use and day of week. The annual event will then select a table and remain in effect until the next annual entry turns it off or the end of the calendar year is reached. Tables 8 & 9 are special event tables. Table 8, the exception day table, selects FLAGS (not tables) to perform special coordination routines on specific days of the year. Data entry is by Month & Day, Flag # and day of the week. Table 9 uses this flag data to run a special program on that day. Note : If the Plan chosen in table 9 is "0", the default table 0 is used for that day. Enter data as you would for the 1st four tables by Hr, Min, Plan # but set the Flag corresponding to the Flags in table 8. Please see the example at the end of this section.

TABLE EXAMPLES: The example timing on the table page immediately following this text is for instruction only. In order to insure that the data is entered correctly the user should always check the operation on the bench prior to field installation.

Table 0 interval 0 shows a Free operation starting at midnight on all days of the week. The next interval, 0-1, starts Dial 2 at 6 a.m. Monday through Friday. Interval 0-2 starts Dial 1 at 9 a.m. M-F. Interval 0-3 starts Dial 3 at 3 p.m. M-F. The last interval, 0-4, ends coordination by going Free at 6 p.m. M-F.

Table 4 interval 0 is calling a special operation on the Monday of the third week in February to use table 1 which is a Free pattern all day. The next interval, 4-1, shows another special operation on Memorial day which is always the last Monday in May. Note on the timing sheet in the center of the page that Nth=99 means the last occurrence of the month. The next interval, 4-2, is Labor Day (which always falls on the first Monday in September) and it also calls table 1. The last interval, 4-3, is Thanksgiving which is calling for table 1 on Thursday and Friday of the forth week in November.

Table 5 is the annual event table. There are two entries which direct the coordination routine to use table 1 between June 1st and the 12th. This table saves the user from having to program 12 separate exception days.

Table 8 is the exception day table and calls table 9 exclusively. It is used for holidays which always fall on fixed dates. The first interval, 8-0, calls for a special operation on the First of January any time it falls on Monday through Friday. Note that instead of calling for a plan it calls for a FLAG (1). Looking at Table 9, we see that there is only one entry for Flag 1 and it calls for Free operation. Table 8 interval 1 has the Fourth of July set to call Flag 1. The next interval, 8-2, is the day before Christmas and calls for a special operation setting Flag 2. Table 9 shows us that Flag 2 has two entries (9-1 & 9-2) and calls for Dial 2 to run between 10 a.m. and 6 p.m.. The last interval, 8-3, is Christmas day and again Flag 1 is set for Free operation.

Intersection: _____ SAMPLE _____   **Date Requested:** _____ **By:** ____

T.S. No.: _____   **Date Completed:** _____ **By:** ____

TABLE 0 - DEFAULT			s	m	t	w	t	f	s
Code	Hour : Min	Plan	1	2	3	4	5	6	7
0-0	00 : 00	E	X	X	X	X	X	X	X
0-1	06 : 00	2		X	X	X	X	X	
0-2	09 : 00	1		X	X	X	X	X	
0-3	15 : 00	3		X	X	X	X	X	
0-4	18 : 00	E		X	X	X	X	X	
0-5	:								
0-6	:								
0-7	:								
0-8	:								
0-9	:								
0-A	:								
0-b	:								
0-C	:								
0-d	:								
0-E	:								
0-F	:								

TABLE 3			s	m	t	w	t	f	s
Code	Hour : Min	Plan	1	2	3	4	5	6	7
3-0	:								
3-1	:								
3-2	:								
3-3	:								
3-4	:								
3-5	:								
3-6	:								
3-7	:								
3-8	:								
3-9	:								
3-A	:								
3-b	:								
3-C	:								
3-d	:								
3-E	:								
3-F	:								

ANNUAL EVENTS			s	m	t	w	t	f	s
Code	Month / Day	Table	1	2	3	4	5	6	7
5-0	06 / 01	1		X	X	X	X	X	
5-1	06 / 12	0		X	X	X	X	X	
5-2	/								
5-3	/								
5-4	/								
5-5	/								
5-6	/								
5-7	/								
5-8	/								
5-9	/								
5-A	/								
5-b	/								
5-C	/								
5-d	/								
5-E	/								
5-F	/								

TABLE 1			s	m	t	w	t	f	s
Code	Hour : Min	Plan	1	2	3	4	5	6	7
1-0	00 : 00	E		X	X	X	X	X	
1-1	:								
1-2	:								
1-3	:								
1-4	:								
1-5	:								
1-6	:								
1-7	:								
1-8	:								
1-9	:								
1-A	:								
1-b	:								
1-C	:								
1-d	:								
1-E	:								
1-F	:								

Plan = Plan Number

	D1	D2	D3
O1 =	1	2	3
O2 =	4	5	6
O3 =	7	8	9

Plans: **Keys:**

A = Arrows On   0 = No Days

d = Arrows Off   8 = All Days

C = Offset Timing   9 = Weekdays

E = Function 6

F = Flash

Table #4, Nth = The number of the occurence in the month (1-5). 99 = Always the last occurence in the month.

I.E. Thanksgiving = 11 / 04 [Table] and Thursday.

ANNUAL EVENTS			s	m	t	w	t	f	s
Code	Month / Day	Table	1	2	3	4	5	6	7
6-0	/								
6-1	/								
6-2	/								
6-3	/								
6-4	/								
6-5	/								
6-6	/								
6-7	/								
6-8	/								
6-9	/								
6-A	/								
6-b	/								
6-C	/								
6-d	/								
6-E	/								
6-F	/								

TABLE 2			s	m	t	w	t	f	s
Code	Hour : Min	Plan	1	2	3	4	5	6	7
2-0	:								
2-1	:								
2-2	:								
2-3	:								
2-4	:								
2-5	:								
2-6	:								
2-7	:								
2-8	:								
2-9	:								
2-A	:								
2-b	:								
2-C	:								
2-d	:								
2-E	:								
2-F	:								

FLOATING HOLIDAYS			s	m	t	w	t	f	s
Code	Month/ Nth	Table	1	2	3	4	5	6	7
4-0	02 / 03	1		X					
4-1	05 / 99	1		X					
4-2	09 / 01	1		X					
4-3	11 / 04	1					X	X	
4-4	/								
4-5	/								
4-6	/								
4-7	/								
4-8	/								
4-9	/								
4-A	/								
4-b	/								
4-C	/								
4-d	/								
4-E	/								
4-F	/								

ANNUAL EVENTS			s	m	t	w	t	f	s
Code	Month / Day	Table	1	2	3	4	5	6	7
7-0	/								
7-1	/								
7-2	/								
7-3	/								
7-4	/								
7-5	/								
7-6	/								
7-7	/								
7-8	/								
7-9	/								
7-A	/								
7-b	/								
7-C	/								
7-d	/								
7-E	/								
7-F	/								

Intersection: _____ SAMPLE _____ **Date Requested:** _____ **By:__**

T.S. No.: _____ **Date Completed:** _____ **By:__**

EXCEPTION DAYS

Code	Month / Day	Flag	s 1	m 2	t 3	w 4	t 5	f 6	s 7
8-0	01 / 01	1		X	X	X	X	X	
8-1	07 / 04	1		X	X	X	X	X	
8-2	12 / 24	2		X	X	X	X	X	
8-3	12 / 25	1		X	X	X	X	X	
8-4	/								
8-5	/								
8-6	/								
8-7	/								
8-8	/								
8-9	/								
8-A	/								
8-b	/								
8-C	/								
8-d	/								
8-E	/								
8-F	/								

EXCEPTION TIMES / Table 8 Flags

Code	Hour : Min	Plan	1	2	3	4	5	6	7
9-0	00 : 00	E	X						
9-1	10 : 00	2		X					
9-2	18 : 00	E		X					
9-3	:								
9-4	:								
9-5	:								
9-6	:								
9-7	:								
9-8	:								
9-9	:								
9-A	:								
9-b	:								
9-C	:								
9-d	:								
9-E	:								
9-F	:								

NOTES ON USING TABLES:

Starting from the base display [A/b], Table access is gained with a two digit Table Code. Access is verified by the flashing of both Call Light 9 and the Phase digit* of the display (* No Flash if Table # & Event # match).

Five keypresses will be required followed by [E] to enter the data and open the flag mode. Day of Week flags can now be set.

ADDITIONAL KEY CODES:

d-0-3 = 1	Search Tables
d-0-3 = 3	Repoll WWV Clock
d-A-F = 1	Repoll WWV Clock
d-0-3 = 071	Save Timing to Prom Module
d-0-3 = 170	Download Timing into 170
d-0-3 = 999	Clear All Tables
F-0-0 =	Phase / Dial Copy - Source
F-0-1 =	Phase / Dial Copy - Destination
F-0-4 =	Program Number (66)
E-E-0-0 =	Reinitialization

SPECIAL FUNCTION TABLE

Keystrokes: F + d + Function

		Phase Flags								
		1	2	3	4	5	6	7	8
(Green) Calling Phases	0								
(Green) Call To Phases	1								
(Yellow) Calling Phases	2								
(Yellow) Call To Phases	3								
Auxiliary Ovlp A Output	4								
Mid-Block Ped Crossing	5								
Driveway Flash	6								
Green Extension	7								
Sequential Ped	8								
Not Used	9								
EV- A Clearance Phases	A								
EV- B Clearance Phases	b								
EV- C Clearance Phases	C								
EV- D Clearance Phases	d								
Track Clearance Phases	E								
Limited Service Phases	F								

When Any Flagged Phase Is Green - - -

- - - Place A Locked Call To These Phases.

When Any Flagged Phase Is Yellow - - -

- - - Place A Locked Call To These Phases.

"Three Color Single Phase Overlap" Outputs On Auxiliary File - Slot 1

Ø4P Only.   Ø2 & Ø6 Reds Flash During Ø4P Clearance

Flashes The Green Outputs Of The Selected Phases

Staggered Termination At Barrier Crossing

Allows Ø1, Ø3 or Ø5 Ped to output on the Ø8P Load Switch

Emergency Vehicle "A" Clearance Phases

Emergency Vehicle "B" Clearance Phases

Emergency Vehicle "C" Clearance Phases

Emergency Vehicle "D" Clearance Phases

Railroad Track Clearance Phases

Railroad 2 Limited Service Phases

F-9-7		Coordination Free Time (Seconds) After Railroad Preempt
F-9-d		Green Rest Delay Time (Seconds)
d-0-1		RAILROAD ROUTINE SELECT: 0 = Normal Railroad 1 = Special Two Input Railroad Routine
d-0-2		MANUAL CONTROL: 0 = Not Enabled 1 = No Recalls 2 = Vehicle Recalls 3 = Vehicle and Ped Recalls

PHASE OMIT	Keys	1	2	3	4	5	6	7	8
Phase Omit (Observe Only)	d - d - 4								
Phase Omit for Dial 1	d - d - 5								
Phase Omit for Dial 2	d - d - 6								
Phase Omit for Dial 3	d - d - 7					•			

ADDITIONAL OVERLAPS	Keys	1	2	3	4	5	6	7	8
Aux File 2 Color Ovlp C	d - d - C								
Aux File 2 Color Ovlp D	d - d - d								
Ø7 Load Sw. 3 Color Ovlp E	d - d - E								
Overlap E Green Omit	d - d - F								

PHASE OMIT is active when Coordination CALL function is active _and_ the OMIT flag is set.

Overlap E will not function if the Railroad Preempt has been selected.

OVERLAPS

Four 2 color (Overlaps A-D) - Overlaps A & B are set at F-F-A & B and use the Ped Yellows in the 332 cabinet output file for their outputs and overlaps C & D are set at D-D-C & D and use the auxiliary file slots 4 & 5.

One 3 color Auxiliary Overlap - This overlap uses slot 1 of the auxiliary file and is designed primarily for use in the LA County 337 cabinet. It is set at F-D-4 but can only be set to ONE vehicle phase.

One 3 color multi-phase (Overlap E) - This overlap is set at D-D-E and automatically uses the phase 7 vehicle output when phase 7 is not a permitted phase, and outputs on auxiliary file slot 1 if the Single Phase Overlap is not used. It has Green Omit capabilities (set at D-D-F) and uses the terminating phase's timing for its clearance times. This overlap can not be used with multiple phases if a railroad preempt is selected. The output in this case will remain red.

PREEMPTS

GENERAL PREEMPTION DESCRIPTION

As the word "preemption" indicates, a Railroad (RR) or Emergency Vehicle (EV) input causes the existing configuration at an intersection to be replaced by a special configuration. This temporary configuration allows the safe and orderly "clearance" of traffic from the path of the Emergency Vehicle or train. An EV preempt input can be serviced during normal operation or during the Limited Service portion of a RR2 preempt. A Railroad preempt input is serviced immediately, even if the input is active at power up. If a Railroad input is sensed during an EV preempt, it will cause the EV preempt to terminate in the same manner that it terminates normal operation.

LACO-1R has four Emergency Vehicle (EV) inputs and one Railroad input. The single Railroad input can be configured to provide two entirely different operations. These are referred to as Railroad 1 (RR1) Flash and Railroad 2 (RR2) Limited Service. After the clearance portion of the preempt, RR2 allows normal operation only on phases that the Engineer determines can be safely used. RR1, on the other hand, puts the intersection into software flash for as long as the Railroad input is active. At the end of the Railroad preempt, RR2 provides a smooth transition back to normal operation. RR1 resumes normal operation following flash by implementing a user set all-Red period. Then it reserves the track clearance phases first before resuming normal operation.

Emergency Vehicle

Each of the 4 programmable EV inputs (A-D) is activated by grounding the input to the controller. Each EV can be delayed from 0-255 seconds before the clearance time of 0-255 seconds starts. At the beginning of an EV, a Maximum Limit Timer will begin (the default is 255 seconds) and can be set to any value. If the timer reaches 0 before the EV ends the Max Timer will end the EV preempt and the input is ignored as long as it remains on. The Delay time, if used, will place a HOLD and a CALL to the selected EV phases. Any "walk" timing will be terminated to the flashing protection interval and a ped restrict flag will be set for all phases to keep any peds from starting. The Clearance timer will start only if two conditions are met. First, the Delay timer must be zero. Second, the preempt call must have ended. If the call still exists or is reapplied before the Clearance timer reaches zero, the Clearance timer will reset and hold at its beginning value. The Clearance timer places a HOLD and CALL to the selected clearance phases and a FORCE OFF to all other phases. All of the timers can be viewed from the front panel. Please see the sample timing sheets for the memory locations. At Memory location F-9-C there is an EV event counter. Each time the program enters the EV routine it will increment this location. There is also an "EV on" indicator in the aux file at slot 2 the green output. The user may find these two features useful for monitoring, logging or record keeping.

Railroad Preempt

The Railroad routine is activated by selecting the type of Railroad operation desired and then removing the constant ground on the Railroad input. This normally closed relay operation insures that the Railroad routine will be "on" should anything happen to the interconnect wiring.

There is one input which can be programmed to initiate either RR1 flash or RR2 limited service. Select the type of operation desired at F-E-0 (0=no RR, 1=RR1 flash, 2=RR limited service). When programmed, you may select 0-255 seconds of track clearance time. The track clearance phases need not be permitted phases.

RR1: After track clearance, if selected, the intersection will go to Flash. When the RR input clears, the intersection will time a user set "all Red" period. Then normal operation will commence, timing the track clearance phases first.

RR2: There are a number of conditions which must be met to allow a limited service operation. Track clearance phases must be set. A track clearance time must be set. The limited-service phases must be set and the RR2 maximum timer must be set. The RR2 max Timer defaults to 255 minutes but can be set to any time. The RR1 All Red Time defaults to 5 seconds in case the intersection powers up during a RR condition or one of the above user set locations was missed or the max timer reaches 0. In this case RR1 flash will be in effect until the RR input clears. There is a Railroad event counter located at F-9-B and a Railroad on indicator in the aux file at slot 2 the yellow output. There is also a Free timer that can be used to keep the intersection Free for a specified time (0-255 seconds) after either Railroad preempt to allow traffic to clear out of the intersection before coordination continues. The time is set at F-9-7 and the timer can be observed at F-9-8. During limited service operation (if coordination was running prior to the preempt), the Function flags are not set since the Railroad routines uses

them to manipulate the phases for track clearance. The intersection runs Free with the exception that the coordinated Max 2 extension time is still in effect.

SPECIAL TWO INPUT RAILROAD ROUTINE (D-0-1)

This routine was written for 1 specific location where it was necessary to have two railroad inputs. In order to accomplish this, major modifications where made to the operation of this program.

1) The 7-wire inputs where removed so only the modem data can be used for the Slave Mode. Since the inputs were removed the Manual Control inputs are active even in the Slave Mode for this special case.

2) The Offset Timing input was moved to the J file slot J11L.

3) The normal Dial 3 input at J14U is now the second railroad input.

The operation of the special routine is straight forward. Location F-E-0 (Railroad select) is now the "priority" location. The user can select which Railroad input has priority, RR1 (J14U) or RR2 (J14L). If RR1 has priority and the input is activated, all phases are terminated and the intersection will go into flash. If RR2 is selected as priority, then the rules for the normal LA County Railroad limited service routine apply.

MISCELLANEOUS FEATURES

MANUAL CONTROL: Inhibits coordination and allows the operator to manually Force-Off phases by means of a special cable hooked up to the manual enable and manual advance inputs. Use of the Force-Off ensures that the minimum green and pedestrian times are guaranteed. The Manual enable input must be "on" before the advance input will issue the Force-Off commands. All other program parameters are unchanged. The user has 4 options to choose from when selecting Manual Control. Set location D-0-2 to 0 (default) if no manual operation is allowed. A selection of 1 produces no recalls and the intersection remains fully actuated. If a 2 is selected, all permitted vehicle phases are placed on recall. A selection of 3 places both vehicle and pedestrian phases on recall. The hard wire inputs used for this feature are I11U for the Manual advance and I11L for the enable. The coordination mode must be set to Master (D-0-0 = 170) or these inputs will be assigned to 7-wire interconnect functions.

PROTECTED/PERMISSIVE LEFT TURNS (F-F-F): A feature which will prevent the lag phase from backing up to the lead phase. This guarantees that both lag phases terminate simultaneously.

GREEN CALL PHASE: To place a call to a phase when a selected phase is green, set the green phase at F-D-0 and the call phase at F-D-1.

YELLOW CALL PHASE: To place a call to a phase when a selected phase is yellow, set the yellow phase at F-D-2 and the call phase at F-D-3.

AUXILIARY OVERLAP (F-D-4): A 3 color overlap which outputs on slot 1 of the aux file. This overlap can only be set to a single phase and is primarily used in LA County wired 337 cabinets to add a phase without wiring changes.

MID BLOCK PED CROSSING (F-D-5): Phase 4 can only be set to this function. When phase 4 is timing and not in the walk interval, phases 2 and 6 will flash their reds. This allows the vehicles to proceed across the ped crossing if it is safe to do so.

DRIVEWAY FLASH (F-D-6): Flashes the green output of the selected phase during its green interval. Primarily used as warning flashers at Fire Stations and for driveways which are part of an intersection. Phase 7 has a special operation designed for flashers ouputting on 2 section heads. After timing the flashing green interval, it will skip the yellow interval and immediately output red.

GREEN EXTENSION (F-D-7): A unique feature that allows a staggered termination of a lag phase at the barrier crossing. The flagged lag phase will remain green and wait for the other ring to time its yellow and all red intervals before terminating. This is used to create an out clearance for dog-leg intersections.

SEQUENTIAL PED (F-D-8): Allows the phase 8 ped load switch to be assigned as a ped output to phase 1, 3 or 5. The phase 8 ped input will also follow this reassignment.

DIMMING (D-0-B): Setting this location to a "1" will half-wave the switch packs of the 8 vehicle outputs to dim the lamps for night-time operation. Please note that the Special Railroad Routine at D-0-1 must also be set to a "1". The input file slot J11U receives the photo cell input and enables the dimming routine to run.

TIMING SAVER: All timing is saved to RAM memory between 7010-7FFF. To save timing, enter D-0-3=071. To download the timing, enter D-0-3=170

PHASE AND DIAL COPY: Phase and dial copy requires 2 locations to be set. Enter the phase (1-8) or dial (11-13) to copy at F-0-0. Next, enter the phase or dial to receive the data at F-0-1. The display will zero itself to indicate asuccessful copy and the next phase/dial can be entered.

DOWN TIME ACCUMULATOR: The contents of the Down Time Accumulator's last power down are saved for viewing at F-0-2 (mins) and F-0-3 (seconds).

PROGRAM NUMBER: LACO-1R's Program number is "66" observe at F-0-4.

CALL SUMMARY

Calls in the LACO-1R program fall into two categories; program generated and hardware generated. Hardware calls are generated by detector or Ped pushbutton actuation. Program generated calls fall into two sub-categories; soft calls and hard calls. A hard call is one that, once generated, does not drop until serviced. A soft call, on the other hand is dependent on conditions at the intersection and may be dropped or re-established at any time as those conditions change. Below is a table of parameters that generate software calls and their classification as hard or soft calls.

HARD CALLS	SOFT CALLS
Minimum Veh Recall (F-F-3)	Green Rest (F-F-D)
Ped Recall/Rest in Walk (F-F-4)	Double Entry (F-F-8)
Semi Traffic Actuated (STA) (F-F-7)	Barrier Recall (F-F-C)
Maximum Veh Recall (F-F-9)	
Associated Phase Recall	
(F-D-0 thru F-D-3)	
Preemption	
Coordination Call	

Note that if a Soft call is generated for a Phase that has one of the following Phase Function Flags set, then it becomes a Hard call. That is, the call will not drop until serviced.

Locking Calls

There are several call "locking" mechanisms in the LACO-1R program:

Phase Function Flags

Red Lock (F-F-1)

Red and Yellow Lock (F-F-2)

Minimum Vehicle Recall (F-F-3)

Ped Recall/Rest in Walk (F-F-4)

Semi-Traffic Actuated (STA)(F-F-7)

Maximum Vehicle Recall (F-F-9)

Barrier Recall (**after** Barrier crossing) (F-F-C)

Actuation on a non-Allowed phase during preemption

Any Ped Call

Termination of an Overlap Parent Phase

Track Clearance phases once Railroad preempt sequence has begun

EV Clearance phases once EV preempt input is sensed

RECALL SUMMARY

The LACO-1R program employs a variety of Recall mechanisms. Recall is defined as a recurring demand for a vehicle or pedestrian phase set by a program flag.

MINIMUM VEHICLE RECALL (F-F-3)

A flag which places a recurring call to a Vehicle Phase during its Red and Yellow intervals, but does not act to extend Green timing beyond minimums.

GREEN REST (F-F-D)

This flag places a continuous call to Vehicle Phases **only** if there are no other hard calls present. A delay time (delays the call) can be set at F-9-D and the delay timer can be observered at F-9-E.

MAXIMUM VEHICLE RECALL (F-F-9)

A flag which places a continuous call to a Vehicle Phase and extends the Green interval to the "Max Extension" limit exactly like a constant Vehicle detector input would.

BARRIER RECALL (F-F-C)

This flag places a locked call **only** when service has crossed to the flagged phase's side of the barrier as the result of other demands.

ASSOCIATED PHASE RECALL (F-D-0 through F-D-3)

This feature assures that if a particular phase goes green or yellow, the flagged call phase will receive a locked call. This call is dropped when the flagged phase goes green.

PED RECALL/ REST IN WALK (F-F-4) and STA MODE (F-F-7)

Both of these flags place a recurring call to a pedestrian phase and its associated Vehicle Phase. Once served, they cause service to remain in the Walk interval until an opposing call is received.

The above are all software generated recalls but there is also a hardware generated Ped Recall. This generally refers to a constant pedestrian call through an external input by means of a switch on the ped isolator. Operation is the same as a software generated Ped Recall with one exception. This condition can be differentiated from a software generated Ped Recall by observing the ped indication. With a ped isolator recall, after timing down the Walk interval, the Flashing Don't Walk interval is displayed for one tenth of a second and then the Walk interval is restarted. With the software generated Ped Recall, the Walk interval times down to 1 second and remains in that interval.

PHASE FUNCTION FLAGS QUICK REFERENCE			
INTERVAL	KEYSTROKES	FUNCTION	DESCRIPTION
0	F-F-0	Phases Permitted	Phases selected for Normal operation.
1	F-F-1	Red Lock	Red Lock causes any Vehicle actuation made during the Red interval of the flagged phases to place a locked call to those phases.
2	F-F-2	Red and Yellow Lock	Red and Yellow Lock causes any Vehicle actuation made during the Red OR Yellow interval of the flagged phases to place a locked call to those phases.
3	F-F-3	Minimum Vehicle Recall	Places Vehicle call only during the Red Interval of the flagged Vehicle Phase(s). Guarantees a recurring minimum Green interval for flagged phases.
4	F-F-4	Pedestrian Recall and Rest in Walk	Places a Pedestrian AND Vehicle call during the Flashing Don't Walk Interval of the flagged Pedestrian Phase. It will "Rest" in Walk at the end of its Walk interval in the absence of an opposing call.
5	F-F-5	Ped Phases	Phases selected for pedestrian Timing.
6	F-F-6	Red Rest	Red Rest causes the termination of flagged phase(s) as if in the presence of an opposing call. The terminated Phase then "Rests" in Red (Interval 8 is displayed).
7	F-F-7	Semi-Traffic Actuated (STA)	Identical to F-F-4, except the Walk Interval can only be terminated by a Coordination Force Off (in the presence of an opposing call) or Preemption.
8	F-F-8	Double Entry	Places a call for flagged Phase(s) at the Barrier crossing if there is no demand for that Phase's Ring on the new street.
9	F-F-9	Maximum Vehicle Recall	Places a continuous Vehicle call to the flagged Phase(s). Termination of the flagged phase(s) is by Max or Force Off.
A	F-F-A	Overlap A	Right turn two color overlap.
b	F-F-B	Overlap B	Right turn two color overlap.
C	F-F-C	Barrier Recall	Barrier Recall places a locked call to the flagged phase when crossing to its side of the Barrier.
d	F-F-D	Green Rest	Green Rest causes a call to be placed to flagged phases in the absence of ANY calls. Flagged phase(s) will "Rest" in Green after timing the minimums.
E	F-F-E	Yellow Startup	Flagged phases start in Yellow interval after a long power down and always time for 5.0 seconds.
F	F-F-F	Protected/Permissive Left Turns	Prevents a Lag Phase from "backing up" to its Lead Phase.

FIGURE 12 - LACO-1R Phase Function Flags

WWV CLOCK

In order to implement Time Based Coordination an accurate time source must be used to periodically update the 170 controller's Real Time Clock. The Radio Corrected Time Base (RCTB) WWV Clock used by Los Angeles County receives and decodes the WWV/WWVH radio broadcasts transmitted by NIST (National Institute of Standards and Technology, formerly the National Bureau of Standards). It automatically corrects for Leap Year and Daylight Savings Time and, in the event of a power failure, automatically locks on to the WWV broadcast when power is restored.

The 170 controller downloads this extremely accurate time in a number of ways:

        1. It automatically polls the WWV Clock after a long or short power outage.

        2. It automatically polls the WWV Clock every hour on the hour.

        3. It can manually poll the WWV Clock via the Front Panel keypad.

The WWV Clock cable must be connected to Comm Ports one or two and the WWV Clock must be "locked on" to the WWV signal. If the WWV Clock has not "locked on" to the WWV signal, then the LACO1R program will not allow a download. This is to prevent erroneous time from being downloaded.

To manually poll the WWV Clock, at location D-A-F enter "1" followed by "E". A successful download is indicated if the display shows a "002 " for two seconds followed by a zero. If the display changes to "000" then the poll attempt was unsuccessful. If the display retains the "001" but changes to "000" briefly every 2 seconds, then the 170 is not receiving valid data or the WWV Clock is not "locked on". In this situation the 170 will continually repoll until valid data is received from the WWV Clock, or a "0" is entered at location D-A-F. Disconnecting the WWV Clock or cable while performing a repoll (not recommended) will abort the repoll process.

TIMING SHEET CONVERSIONS

Upgrading older LACO-1 programs to the LACO-1R program

Page 1: If There are no preempts involved, there is only one change to be aware of. The LACO-1 program has a separate "rest in walk" location at F-F-7. The LACO-1 WWW and LACO-1R programs incorporated this mode in the Ped Recall feature at F-F-4. The New designation for F-F-7 is a coordination function called Semi Traffic Actuated or STA mode. For preempt usage please see the end of this section.

Page 2: Detector delays in LACO-1 are in tenths of a second. LACO-1 WWV and LACO-1R time their delays in whole seconds. When converting delay times please make sure 10.0 seconds corresponds to 10 and not 100 seconds. The only other change is the 4 phase programmable detectors found only in the LACO-1R program. Since the previous programs did not have this feature, no entry needs to be made on the phase selection block.

Page 3: There are several minor changes to the coordination page. First is the coordination mode selection at D-0-0. LACO-1 uses modes 2,4 & 7. LACO-1 WWV has modes 2,7,& 170. LACO-1R has all of these modes but in different locations. When converting to LACO-1R, Mode 2 is set at memory location C-0-1=12. This is the Offset Timing mode. The input was moved from the Dial 2 input (I14U) to the Dial 3 input (J14U). The special offset timing page was deleted and the standard coordination functions for Dial 3 are now used. For more information, see the Offset Timing section under coordination.

Mode 4 is the Caltrans Diamond Interchange modem interconnect. LACO-1R has dedicated ACIA port 3 for this function. It may be necessary to upgrade the controller to a 170E version which contains four ACIA ports. Please select mode 7, the slave mode at D-0-0, when converting the timing sheets. For more information please see Slave Mode in the coordination section.

Mode 7 is still the 7-wire field inputs. There are no changes to this operation.

The 170 Master Mode is the same with no changes.

LACO-1 has 3 user set locations called dwell times at D-0-1,2,3. This function has been removed in the LACO-1 WWV and LACO-1R programs. The LACO-1 WWV program uses these locations for specific functions.

D-0-1 RS232 communication time compensation

D-0-2 WWV clock repoll hour

D-0-3 special function location

The LACO-1R program has different function assigned to these locations.

D-0-1 special railroad preempt routine

D-0-2 Manual Control

D-0-3 special function location (see section in manual)

C-0-0 System Manual location for LACO-1 WWV and LACO-1R. The LACO-1 program does not use this location.

C-0-5 Plan # from the Time-of-Day tables. LACO-1 table 9 from page 4 Dial or Free plan. LACO-1 WWV and LACO-1R plan information from tables 1-3 on page 5.

C-0-7 LACO-1 dwell timer. LACO-1 WWV and LACO-1R Table number that the plan information comes from.

Page 4: Setting the Time and Date and Slave Mode Table.

LACO-1 time is set at 8-0 and date at 8-1. LACO-1 WWV and LACO-1R set the time at A-C and the date at A-D. The Slave table is unchanged. However LACO-1R can also select Offset Timing and Flash by time of day.

Page 5: LACO-1 does not have Master Tables. LACO-1R has the same tables as LACO-1 WWV with the addition of Offset Timing and Flash by time of day.

Page 6: LACO-1 does not have Master Tables. LACO-1R has added many new features to the program. Since the older programs do not have these features they will not be used.

PREEMPTS

The LACO-1 and LACO-1 WWV preempt routine are the same. Please note that the LACO-1R preempt routines are completely different. On page 1 of the timing sheets you will notice that the user set locations are completely changed and new features have been added. The input has been modified for a normally closed relay operation and page 6 of the timing sheets have the selectable track clearance and limited service phase locations. In order to convert the older program preempt data, it is important that you read and understand the preempt section in this manual.

LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS
TRAFFIC AND LIGHTING DIVISION
TRAFFIC SIGNAL TIMING

LACO - 1R   WWV - TIME - BASED
TYPE 170 PROGRAM

Intersection: _____

T.S. No.: _____

Date Requested: _____ By: _____

Date Completed: _____ By: _____

PHASE TIMING

Keystrokes: F + Phase + Interval

PHASE TIMING		Phase # 1	2	3	4	5	6	7	8
Minimum Walk	0								
Flashing Don't Walk	1								
Minimum Green	2								
Queue Maximum	3								
Added Green/Actuation	4								
Vehicle Extension	5								
Maximum Gap	6								
Minimum Gap	7								
Max Extension 1 (Free)	8								
Max Extension 2 (Coord)	9								
Offset 1	A	Dial 1	Dial 2	Dial 3					
Offset 2	b								
Offset 3	C								
Reduce 0.1 Sec. Every...	d								
Yellow	E								
Red Clearance	F								
Max Added Green (F-0-E)									
Red Revert (F-0-F)									

Remarks:

PREEMPTION

Keystrokes: F + E + Function

PREEMPTION	
RR Select (0, 1, 2)	0
Track Clearance	1
RR Red	2
RR2 Maximum (Minutes)	3
EV- A Delay	4
EV- A Clearance	5
EV- B Delay	6
EV- B Clearance	7
EV- C Delay	8
EV- C Clearance	9
EV- D Delay	A
EV- D Clearance	b
EV Maximum (Seconds)	C
Delay Timer	d
Clearance Timer	E
Maximum Timer	F

PHASE FUNCTION FLAGS

Keystrokes: F + F + Function

PHASE FUNCTION FLAGS		1	2	3	4	5	6	7	8
Phases Permitted	0								
Red Lock	1								
Red & Yellow Lock	2								
Minimum Vehicle Recall	3								
Ped Recall / Rest In Walk	4								
Pedestrian Phases	5								
Rest In Red	6								
Semi Traffic Actuated Mode	7								
Double Entry	8								
Maximum Vehicle Recall	9								
Overlap A	A								
Overlap B	b								
Barrier Recall	C								
Rest In Green	d								
Yellow Start Up	E								
Protected / Permissive Left Turn	F								

LAG PHASE FLAGS

LAG PHASE FLAGS		1	2	3	4	5	6	7	8
Lag Free	d-F-0								
Lag Dial 1	d-F-1								
Lag Dial 2	d-F-2								
Lag Dial 3	d-F-3								

True North	Phase North	1	2	3	4
		5	6	7	8

T.S. :_____ **Intersection:**_____ **Date Req:**_____ **By:**_____

App	Lanes	Description	Phase File - Slot Channel	Delay Code	Delay Seconds	Extended Call Code	Extended Call Seconds	Remarks — Note: The four Programmable Detectors will default to normal phasing if not flagged.	Yellow Disconnect Code	Yellow Disconnect Lite	Yellow Disconnect On	Queue Clearing Code	Queue Clearing Lite	Queue Clearing On
			1I1U	d10		d30			dF4	1		dF8	1	
			1I1L											
			2I2U	d11		d31			dF4	2		dF8	2	
			2I2L	d12		d32			dF4	3		dF8	3	
			2I3U	d13		d33			dF4	4		dF8	4	
			2I3L	d14		d34			dF4	5		dF8	5	
			2I4U	d15		d35		Call Ø 1 2 3 4 5 6 7 8 / dd8	dF4	6		dF8	6	
			2I4L											
			3I5U	d16		d36			dF4	7		dF8	7	
			3I5L											
			4I6U	d17		d37			dF4	8		dF8	8	
			4I6L	d18		d38			dF5	1		dF9	1	
			4I7U	d19		d39			dF5	2		dF9	2	
			4I7L	d1A		d3A			dF5	3		dF9	3	
			4I8U	d1b		d3b		Call Ø 1 2 3 4 5 6 7 8 / dd9	dF5	4		dF9	4	
			4I8L											
			1I9U	d1C		d3C			dF5	5		dF9	5	
			3I9L	d1d		d3d			dF5	6		dF9	6	
			5J1U	d20		d40			dF6	1		dFA	1	
			5J1L											
			6J2U	d21		d41			dF6	2		dFA	2	
			6J2L	d22		d42			dF6	3		dFA	3	
			6J3U	d23		d43			dF6	4		dFA	4	
			6J3L	d24		d44			dF6	5		dFA	5	
			6J4U	d25		d45		Call Ø 1 2 3 4 5 6 7 8 / ddA	dF6	6		dFA	6	
			6J4L											
			7J5U	d26		d46			dF6	7		dFA	7	
			7J5L											
			8J6U	d27		d47			dF6	8		dFA	8	
			8J6L	d28		d48			dF7	1		dFb	1	
			8J7U	d29		d49			dF7	2		dFb	2	
			8J7L	d2A		d4A			dF7	3		dFb	3	
			8J8U	d2b		d4b		Call Ø 1 2 3 4 5 6 7 8 / ddb	dF7	4		dFb	4	
			8J8L											
			5J9U	d2C		d4C			dF7	5		dFb	5	
			7J9L	d2d		d4d			dF7	6		dFb	6	

YELLOW DISCONNECT QUICK REFERENCE

Code	Call Lights 1	2	3	4	5	6	7	8
dF4								
dF5								
dF6								
dF7								

Remarks

QUEUE CLEARING DETECTOR QUICK REFERENCE

Code	Call Lights 1	2	3	4	5	6	7	8
dF8								
dF9								
dFA								
dFb								

T.S. No.:_____ Intersection:_____

System Limits:_____

Remote Master: _____Date Requested:_____ By:_____

System No. :_____   Date Completed:_____ By:_____

TIME OF DAY OPERATION SUMMARY			
	Dial 1	Dial 2	Dial 3 / Offset Timing
Offset 1			
Offset 2			
Offset 3			
Free			
Special			

*Set Local Manual to 14 (free) before setting or changing dial intervals & functions. Setting either of the Manuals to 0 will release that Manual.

Offset Timing Mode:

A 12 at C-0-1 or by T.O.D. enables this mode and uses the Dial 3 Intervals and Functions.

Observe:

Call	d-F-C
Hold	d-F-d
Ped Restrict	d-F-E
Force - Off	d-F-F
Cycle with Field Calls	C-0-b
Master Sync Pulse Width	d-0-d

INTERCONNECT SELECT

d-0-0 [ ] 7 = Slave   [ ] 170 = Master

d-0-E Set Maximum Width _4.0_ Seconds

d-0-F Set Minimum Width _1.0_ Seconds

Remarks:

Keystrokes:
C + Column + Row

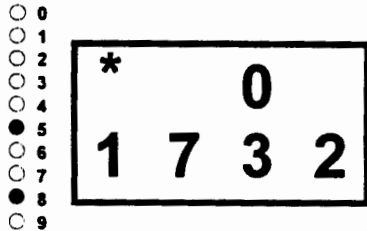| Coordination Parameters		INTERVALS (in seconds)			FUNCTION FLAGS												
					DIAL 1				DIAL 2				DIAL 3 / OFFSET TIMING				
		Dial 1	Dial 2	Dial 3	Force Off	Hold	Ped Rstrict	Call	Force Off	Hold	Ped Rstrict	Call	Force Off	Hold	Ped Rstrict	Call	
0	Int	1	2	3	4	5	6	7	8	9	A	b	C	d	E	F	Int
System Manual *	0																0
Local Manual*	1																1
Master Dial	2																2
Current Dial	3																3
Offset Number	4																4
Time of Day Plan	5																5
Function 6	6																6
Current Table	7																7
Minimum Cycle	8																8
Maximum Cycle	9																9
Master Timer	A																A
Local Timer	b																b
New Offset	c																c
Current Offset	d																d
Last Master Cycle	E																E
Last Local Cycle	F																F

LACO-1R WWV TIME BASE

CLOCK / SLAVE MODE EVENT TABLE INSTRUCTIONS

T.S. :_____   Intersection:_____   Date Req:_____   By:_____

SETTING REAL TIME CLOCK

TIME - KEY PRESS "A - C"

```
○ 0
○ 1
○ 2     * 
○ 3        0
○ 4
● 5
○ 6     1 7 3 2
○ 7
● 8
○ 9
```

DATE - KEY PRESS "A - D"

```
○ 0
○ 1
○ 2     *
○ 3        4
○ 4
● 5
○ 6     2 7 9 5
○ 7
● 8
○ 9
```
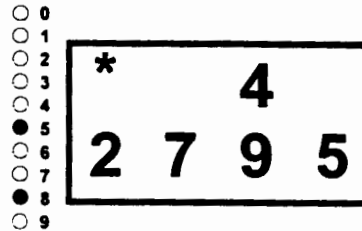
The example above shows that the time in the 170 is set to 5:32 P.M. and that the day-of-the-week is Thursday. The "*" indicates an "A" alternately displayed with a "C", representing the Time display. Call light "8" flashes, indicating that the Function display is in the Real Time Clock Display Mode.

The example above shows that the date in the 170 is set to Thursday, April 27, 1995. The "*" indicates an "A" alternately displayed with a "d", representing the Date display. Call light "8" flashes, indicating that the Function display is in the Real Time Clock Display Mode.

From Base Display, press "A - C". Enter time in 24 hour format, then enter "0" to clear seconds. Press the "E" key and turn on call light corresponding to the current day-of-the-week. Press "A" or "D" to go to the Date Display (or press "A - D" from the Base Display). Enter the "1" through "31" for the day-of-the-month, "00" through "99" for the year, and "1" through "9" for "January" through "September", "A" for "October", "B" for "November" or "C" for "December". Then press the "E" key. Turn on the call light corresponding to the current day-of-the-week. Set seconds at location d-4-F.

SETTING EVENT TABLE 9 DATA

TABLE 9, EVENT 3 - KEY PRESS "9-3"

```
○ 0
○ 1
● 2     *
● 3        2
● 4
● 5
● 6     1 5 3 0
○ 7
○ 8
● 9
```
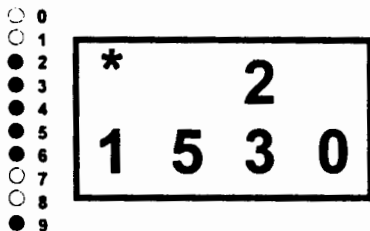
The example above shows Table 9 Event 3. It calls for Dial 2 to start at 3:30 P.M. on Monday through Friday. The "*" indicates a "9" alternately displayed with a "3", representing Table 9 Event 3. Call light "9" flashes indicating that the Function display is in Table Display Mode.

From the Base Display, press "9" and the event number to be set. Enter the time for the event to start in HH:MM format. Enter the desired Dial or Function followed by "E". Then press "1" through "7" corresponding to the days of the week that the selected plan should be implemented.

FOR TABLE 9 IN SLAVE MODE ONLY
(LOCATION D-0-0 MUST = "007")

Code	Hour:Min	Dial or Function	SUN 1	MON 2	TUE 3	WED 4	THU 5	FRI 6	SAT 7
0	:								
1	:								
2	:								
3	:								
4	:								
5	:								
6	:								
7	:								
8	:								
9	:								
A	:								
B	:								
C	:								
D	:								
E	:								
F	:								

DIAL = 1, 2 or 3	FUNCTIONS	
	"0" = OFF	"E" = FREE
	"C" = OFFSET TIMING	"F" = T.O.D. FLASH

LACO-1R WWV - TIME - BASE EVENT TABLES

Intersection:_____ Date Requested:_____ By:____

T.S. No.:_____ Date Completed:_____ By:____

TABLE 0 - DEFAULT			s	m	t	w	t	f	s
Code	Hour : Min	Plan	1	2	3	4	5	6	7
0-0	:								
0-1	:								
0-2	:								
0-3	:								
0-4	:								
0-5	:								
0-6	:								
0-7	:								
0-8	:								
0-9	:								
0-A	:								
0-b	:								
0-C	:								
0-d	:								
0-E	:								
0-F	:								

TABLE 3			s	m	t	w	t	f	s
Code	Hour : Min	Plan	1	2	3	4	5	6	7
3-0	:								
3-1	:								
3-2	:								
3-3	:								
3-4	:								
3-5	:								
3-6	:								
3-7	:								
3-8	:								
3-9	:								
3-A	:								
3-b	:								
3-C	:								
3-d	:								
3-E	:								
3-F	:								

ANNUAL EVENTS			s	m	t	w	t	f	s
Code	Month / Day	Table	1	2	3	4	5	6	7
5-0	/								
5-1	/								
5-2	/								
5-3	/								
5-4	/								
5-5	/								
5-6	/								
5-7	/								
5-8	/								
5-9	/								
5-A	/								
5-b	/								
5-C	/								
5-d	/								
5-E	/								
5-F	/								

TABLE 1			s	m	t	w	t	f	s
Code	Hour : Min	Plan	1	2	3	4	5	6	7
1-0	:								
1-1	:								
1-2	:								
1-3	:								
1-4	:								
1-5	:								
1-6	:								
1-7	:								
1-8	:								
1-9	:								
1-A	:								
1-b	:								
1-C	:								
1-d	:								
1-E	:								
1-F	:								

Plan = Plan Number

	D1	D2	D3
O1 =	1	2	3
O2 =	4	5	6
O3 =	7	8	9

Plans: **Keys:**

A = Arrows On 0 = No Days

d = Arrows Off 8 = All Days

C = Offset Timing 9 = Weekdays

E = Function 6

F = Flash

Table #4, N^{th} = The number of the occurence in the month (1-5). 99 = Always the last occurence in the month.

I.E. Thanksgiving = 11 / 04 [Table] and Thursday.

ANNUAL EVENTS			s	m	t	w	t	f	s
Code	Month / Day	Table	1	2	3	4	5	6	7
6-0	/								
6-1	/								
6-2	/								
6-3	/								
6-4	/								
6-5	/								
6-6	/								
6-7	/								
6-8	/								
6-9	/								
6-A	/								
6-b	/								
6-C	/								
6-d	/								
6-E	/								
6-F	/								

TABLE 2			s	m	t	w	t	f	s
Code	Hour : Min	Plan	1	2	3	4	5	6	7
2-0	:								
2-1	:								
2-2	:								
2-3	:								
2-4	:								
2-5	:								
2-6	:								
2-7	:								
2-8	:								
2-9	:								
2-A	:								
2-b	:								
2-C	:								
2-d	:								
2-E	:								
2-F	:								

FLOATING HOLIDAYS			s	m	t	w	t	f	s
Code	Month/	N^{th}	Table	1	2	3	4	5	6	7
4-0	/								
4-1	/								
4-2	/								
4-3	/								
4-4	/								
4-5	/								
4-6	/								
4-7	/								
4-8	/								
4-9	/								
4-A	/								
4-b	/								
4-C	/								
4-d	/								
4-E	/								
4-F	/								

ANNUAL EVENTS			s	m	t	w	t	f	s
Code	Month / Day	Table	1	2	3	4	5	6	7
7-0	/								
7-1	/								
7-2	/								
7-3	/								
7-4	/								
7-5	/								
7-6	/								
7-7	/								
7-8	/								
7-9	/								
7-A	/								
7-b	/								
7-C	/								
7-d	/								
7-E	/								
7-F	/								

Intersection:_____ Date Requested:_____ By:____

T.S. No.:_____ Date Completed:_____ By:____

EXCEPTION DAYS			s	m	t	w	t	f	s
Code	Month / Day	Flag	1	2	3	4	5	6	7
8-0	/								
8-1	/								
8-2	/								
8-3	/								
8-4	/								
8-5	/								
8-6	/								
8-7	/								
8-8	/								
8-9	/								
8-A	/								
8-b	/								
8-C	/								
8-d	/								
8-E	/								
8-F	/								

EXCEPTION TIMES		Table 8 Flags		1	2	3	4	5	6	7
Code	Hour : Min	Plan		1	2	3	4	5	6	7
9-0	:									
9-1	:									
9-2	:									
9-3	:									
9-4	:									
9-5	:									
9-6	:									
9-7	:									
9-8	:									
9-9	:									
9-A	:									
9-b	:									
9-C	:									
9-d	:									
9-E	:									
9-F	:									

NOTES ON USING TABLES:

Starting from the base display [A/b], Table access is gained with a two digit Table Code. Access is verified by the flashing of both Call Light 9 and the Phase digit* of the display (* No Flash if Table # & Event # match).

Five keypresses will be required followed by [E] to enter the data and open the flag mode. Day of Week flags can now be set.

ADDITIONAL KEY CODES:

d-0-3 = 1   Search Tables
d-0-3 = 3   Repoll WWV Clock
d-A-F = 1   Repoll WWV Clock
d-0-3 = 071   Save Timing to Prom Module
d-0-3 = 170   Download Timing into 170
d-0-3 = 999   Clear All Tables
F-0-0 = Phase / Dial Copy - Source
F-0-1 = Phase / Dial Copy - Destination
F-0-4 = Program Number (66)
E-E-0-0 = Reinitialization

SPECIAL FUNCTION TABLE									
Keystrokes: F + d + Function									
		Phase Flags							
		1	2	3	4	5	6	7	8
(Green) Calling Phases	0								
(Green) Call To Phases	1								
(Yellow) Calling Phases	2								
(Yellow) Call To Phases	3								
Auxiliary Ovlp A Output	4								
Mid-Block Ped Crossing	5								
Driveway Flash	6								
Green Extension	7								
Sequential Ped	8								
Not Used	9								
EV- A Clearance Phases	A								
EV- B Clearance Phases	b								
EV- C Clearance Phases	C								
EV- D Clearance Phases	d								
Track Clearance Phases	E								
Limited Service Phases	F								

When Any Flagged Phase Is Green - - -

- - - Place A Locked Call To These Phases.

When Any Flagged Phase Is Yellow - - -

- - - Place A Locked Call To These Phases.

"Three Color Single Phase Overlap" Outputs On Auxiliary File - Slot 1

Ø4P Only. Ø2 & Ø6 Reds Flash During Ø4P Clearance

Flashes The Green Outputs Of The Selected Phases

Staggered Termination At Barrier Crossing

Allows Ø1, Ø3 or Ø5 Ped to output on the Ø8P Load Switch

Emergency Vehicle "A" Clearance Phases

Emergency Vehicle "B" Clearance Phases

Emergency Vehicle "C" Clearance Phases

Emergency Vehicle "D" Clearance Phases

Railroad Track Clearance Phases

Railroad 2 Limited Service Phases

F-9-7		Coordination Free Time (Seconds) After Railroad Preempt
F-9-d		Green Rest Delay Time (Seconds)
d-0-1		RAILROAD ROUTINE SELECT: 0 = Normal Railroad 1 = Special Two Input Railroad Routine
d-0-2		MANUAL CONTROL: 0 = Not Enabled 1 = No Recalls 2 = Vehicle Recalls 3 = Vehicle and Ped Recalls

PHASE OMIT	Keys	1	2	3	4	5	6	7	8
Phase Omit (Observe Only)	d - d - 4								
Phase Omit for Dial 1	d - d - 5								
Phase Omit for Dial 2	d - d - 6								
Phase Omit for Dial 3	d - d - 7								

ADDITIONAL OVERLAPS	Keys	1	2	3	4	5	6	7	8
Aux File 2 Color Ovlp C	d - d - C								
Aux File 2 Color Ovlp D	d - d - d								
Ø7 Load Sw. 3 Color Ovlp E	d - d - E								
Overlap E Green Omit	d - d - F								

PHASE OMIT is active when Coordination CALL function is active *and* the OMIT flag is set.

Overlap E will not function if the Railroad Preempt has been selected.

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NOTES

LACO INTERVAL DESCRIPTIONS	
0	WALK
1	FLASHING DON'T WALK
2	MINIMUM GREEN
3	QUEUE HOLD
4	ADDED INITIAL GREEN
5	VEHICLE EXTENSION
6	COORDINATION/PREEMPT HOLD
7	GAP REDUCTION
8	RED REST (OUT OF SERVICE)
9	PREEMPT CLEARANCE
A	STOP TIME
b	RED REVERT
C	GAP OUT YELLOW
d	MAX OUT YELLOW
E	FORCE OFF YELLOW
F	RED CLEARANCE