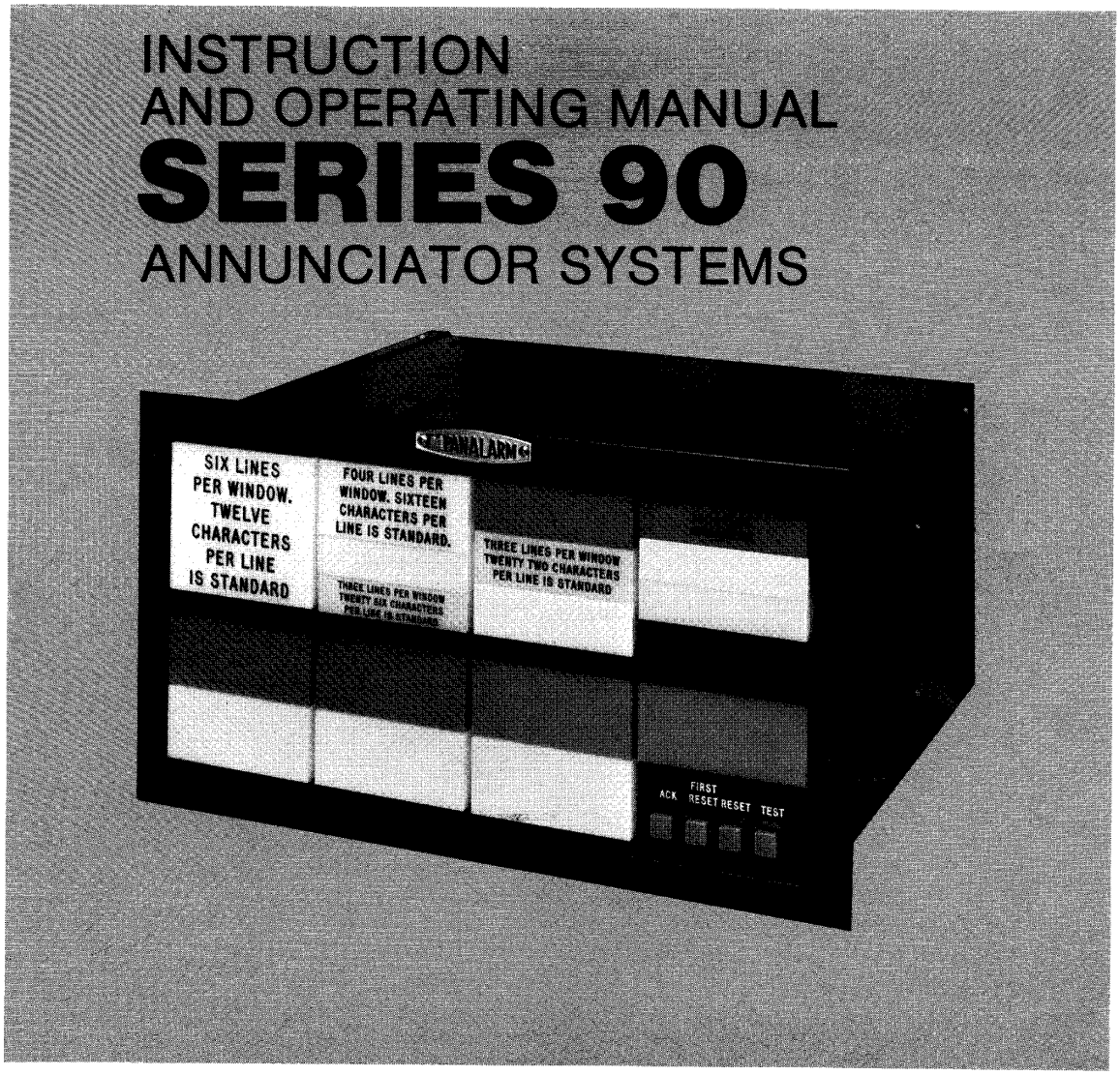
DOCUMENT #900250

INSTRUCTION AND OPERATING MANUAL

SERIES 90

ANNUNCIATOR SYSTEMS



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REV.	ECN NO.	DATE	REV.	ECN NO.	DATE
0	8300-3	3-1-82	7	10903	1-20-92
1	8700-5	4-183	8	11105	8-21-92
2	9090-63	2-1-85	9	11380	11-30-93
3	9300-9	10-1-86	10	7071-01	09-01-97
4	9751	4-1-88			
5	10341	5-1-90			
6	10341-1	3-1-91			

TABLE OF CONTENTS

Part 4 - SPECIFICATIONS (Continued)

PART 1
SYSTEM DESCRIPTION

1.1 INTRODUCTION

1.2 SCOPE OF MANUAL

This manual describes the features and sequences of the Series 90 annunciator system. With supplementary drawings and wiring diagrams, complete information for installation and operation is provided.

1.3 GENERAL

The Series 90 annunciator system is a monitoring system designed to (1) provide status information of discrete signal contacts and (2) provide interface and monitoring of commonly used analog devices. (See separate in-struction manual for analog annunciation, document 900252).

The Series 90 system is designed for optium versatility. The salient features of Series 90 are modular design and a universal busing and interconnect system which allows for virtually unrestricted arrangements and intermixing of electronic modules in any cabinet style.

1.4 SYSTEM DESCRIPTION (PHYSICAL)

A basic annunciator system comprises a chassis or cabinet, point cards, light boxes, flasher card, push-buttons, audible device, and power supply.

1.4.1 MODULAR CONSTRUCTION

The annunciator system is assembled using modular card cages with four card positions per module. Model 94 style cabinets have four active card positions per module with four rear terminal blocks and may be used with up to eight windows per module.

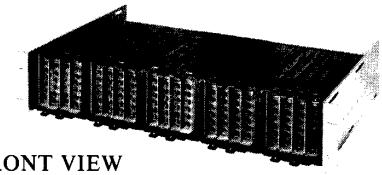
1.4.2 CABINET/CHASSIS STYLES

1.4.2.1. FLUSH MOUNT CABINET

Flush mount cabinets are made in sizes from 1 high by 2 wide modules to 10 high by 10 wide modules. Flush mount cabinets are intended for integral lamps but remote lamps may also be used.

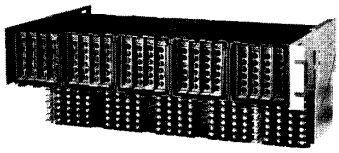
1.4.2.2 RACK MOUNT CHASSIS

Rack mount chassis are made in 1 high by 5 wide modules for 19″ wide racks. Integral lamps may be used but this style is generally used with remote lamps. Rear access terminal blocks or front access terminal blocks may be specified. With rear access terminal blocks, only 3-1/2″ of vertical rack space is required. With front access, 7″ of rack space is required.



FRONT VIEW
RACK MOUNT CHASSIS 5 WIDE SHOWN

REAR VIEW
RACK MOUNT CHASSIS 5 WIDE SHOWN

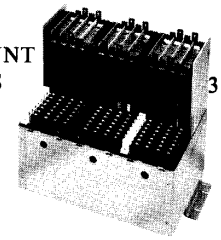


RACK MOUNT CHASSIS WITH
FRONT ACCESS TERMINALS

1.4.2.3 WALL MOUNT CABINET/CHASSIS

Wall mount chassis are made in 1 high by 1 thru 5 wide modules per chassis. 1 high by 5 wide chassis may be enclosed in wall mount cabinets. Integral and/or remote lamps may be used. Terminal blocks are front access.

WALL MOUNT
CHASSIS

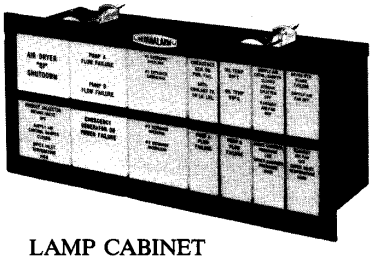


3 WIDE SHOWN

1.4.2.4. LAMP CABINETS

Remote lamp cabinets are identical in appearance to flush mounted integral annunciator cabinets, but are less than six inches deep. They are made in sizes from 1 high by 2 wide modules to 10 high by 10 wide modules per

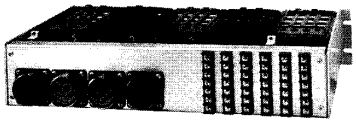
cabinet. Terminal blocks are rear access. Optional rear access cable connectors are available.



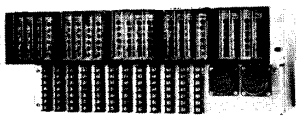
LAMP CABINET

1.4.2.5 MS TYPE CONNECTORS

As an option rack mount or wall mount chassis are made with a connector panel so that remote lamps and/or signal wiring may be cabled using MS type connectors.



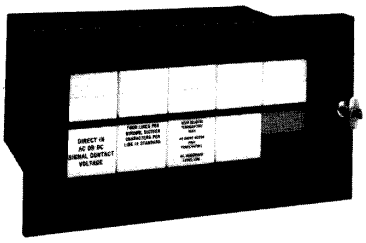
RACK MOUNT WITH REAR ACCESS
MS CONNECTORS FOR REMOTE LAMP
AND SIGNAL WIRING



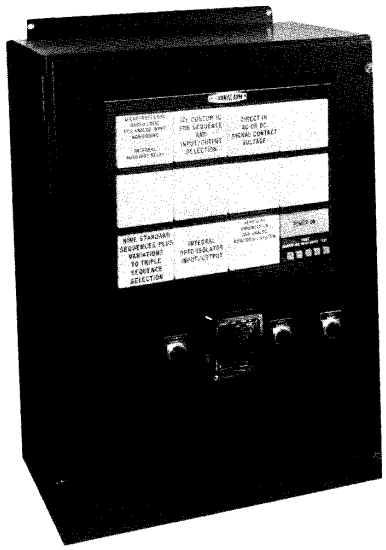
RACK MOUNT WITH FRONT ACCESS
MS CONNECTORS FOR REMOTE LAMPS

1.4.2.6 OTHER CONFIGURATIONS

Totally enclosed non-ventilated (TENV) and NEMA cabinets, are available for surface or flush mounting applications. Annunciator chassis may also be mounted in custom free-standing cabinets. Consult your local representative or the factory for details.



TENV CABINET WITH
VIEWING WINDOW



NEMA 4 OR 12
SURFACE MOUNT CABINET

1.5 SYSTEM DESCRIPTION (ELECTRICAL)

1.5.1 BUSING (See Figure 1)

In any cabinet or chassis, each active card position utilizes a 27 pin connector. Fourteen pins are bused in each row. Eleven of these pins are dedicated system buses and the remaining three are option buses. The dedicated buses allow for intermix of most sequence cards without special wiring.

1.5.2 MAIN BUS BLOCKS (See Figure 1)

The fourteen buses are connected to main bus terminal blocks. There are seven terminals per block, coded white, and are mounted on the modules at each end of each horizontal row. In a cabinet of several rows, these blocks are factory wired row to row. For convenience, a separate pair of main bus blocks are mounted near each end of the cabinet. These blocks are used for customer field wiring and may also be used to connect two or more cabinets together. Several cabinets may be interconnected with common pushbuttons, flasher, horns, and power supply.

These extra terminal blocks are added to the 1 high by 5 wide rack mount chassis. When chassis are mounted in a rack, user must connect the main bus block terminal of one chassis to the respective main bus terminals of all other chassis in a common system. Consult the system wiring diagrams for proper connections.

Note: The horn enable bus terminals are connected directly to the point card electronics and essentially comprise the output of an "OR" gate. External horns or horn relays should NEVER be connected to these terminals. Horn drive is provided on the flasher card. Wiring for audible devices is shown on the sequence wiring diagram.

CHASSIS CARD SLOT PIN IDENTIFICATION CHART

CARD SLOT CONN. PIN #	SCREW TERM. ID	SCREW TERM. LOCATION
1	FF	RMB
2	1	CT
3	P1	LMB
4		
5	SF	RMB
6	2	CT
7	FO	LMB
8		
9	FT	RMB
10	3	CT
11	AK	LMB
12		
13	FR	RMB
14	4	CT
15	P2	LMB
16		
17	MR	RMB
18	5	CT
19	P3	LMB
20		
21	SH	RMB
22	6	CT
23	0V	LMB
24		
25	FH	RMB
26	7	CT
27	+24	LMB

INTERNAL CROSSOVER LINK

INTERNAL CROSSOVER LINK

INTERNAL CROSSOVER LINK

INTERNAL CROSSOVER LINK

INTERNAL CROSSOVER LINK

SCREW TERMINAL LOCATION ID EXPLANATION:

RMB = RIGHT MAIN BUS
CT = CUSTOMER TERMINAL
LMB = LEFT MAIN BUS

BUS DESIGNATIONS

LEFT MAIN BUS

- P1 - OPTION BUS
- FO - FIRST OUT RESET BUS
- AK - ACKNOWLEDGE BUS
- P2 - OPTION BUS
- P3 - OPTION BUS
- 0V - SYSTEM COMMON BUS
- +24 - SYSTEM POWER BUS

RIGHT MAIN BUS

- FF - FAST FLASH BUS
- SF - SLOW FLASH BUS
- FT - FUNCTIONAL TEST BUS
- FR - FLASH RESET BUS
- MR - MANUAL RESET BUS
- SH - HORN 2 ENABLE BUS (RINGBACK)
- FH - HORN 1 ENABLE BUS (ALARM)

BUSING AND INTERCONNECT SYSTEM FOR 94 STYLE CABINET (SHOWN FOR FIVE WIDE)

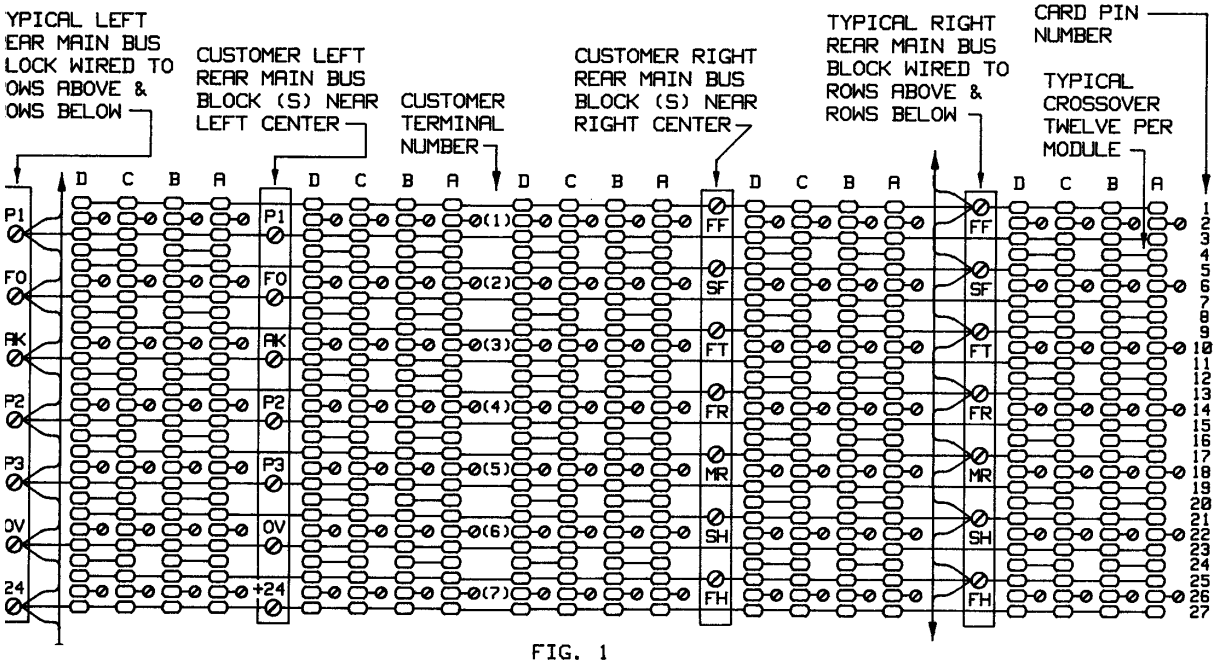


FIG. 1

TYPICAL CUSTOMER TERMINAL ASSIGNMENT					
CUST. TERM. NO.	SINGLE POINT SEQUENCE CARD	TWINPOINT SEQUENCE CARD		SEQUENCE/ANALOG PAIR	
		NL INPUT	KN INPUT	SEQUENCE CARD POSITION A (OR C)	ANALOG CARD POSITION B (OR D)
1	SIGNAL INPUT FROM FIELD CONTACT	UPPER SIGNAL INPUT	UPPER SIGNAL INPUT	OPTION TERMINAL	FIELD INPUT TERMINAL
2	"T" INPUT-FC VOLTAGE "KN" INPUT-FC COMMON	LOWER SIGNAL INPUT	FC COMMON INPUT	OPTION TERMINAL	REQUIRED FIELD INPUT
3	GROUP TERMINAL OR OPTION TERMINAL	GROUP TERMINAL OR OPTION TERMINAL		GROUP TERMINAL OR OPTION TERM.	CURRENT OR VOLTAGE OR COMPENSATION NETWORK
4	OPTION TERMINAL	OPTION TERMINAL	LOWER SIGNAL INPUT	OPTION TERMINAL	
5	OPTION TERMINAL	OPTION TERMINAL	FC COMMON INPUT	OPTION TERMINAL	RESERVED FOR OPTIONAL ANALOG OUTPUT (METER SET ONLY)
6	OPTION TERMINAL	LAMP OUTPUT FROM LOWER POINT OR OPTION		LAMP OUTPUT FROM SET POINT B/D OR OPTION	
7	LAMP OUTPUT OR OPTION TERMINAL	LAMP OUTPUT FROM UPPER POINT OR OPTION		LAMP OUTPUT FROM SET POINT A/C OR OPTION	COLUMN SELECT (METER SET ONLY)

FIG. 2

1.5.3. CUSTOMER TERMINALS (See Figures 1 and 2)

Seven of the remaining thirteen pins per card position are connected directly to customer terminals. Typical input and output connections are shown in Figure 2. Wiring diagrams for the system should be consulted for use and wiring of these terminals.

1.5.4 CROSSOVER TERMINALS (See Figure 1)

The remaining six pins of each connector are not available externally, but are used for inter-card communication. Card positions are connected in pairs. There are six interconnects between positions A and B and six between positions C and D. The primary use for these crossover terminals is for signal transmission between analog cards and sequence cards, or between optional output card and sequence cards.

PART 2
SEQUENCE DESCRIPTION

2.1 GENERAL

All operational sequences are generated by programming a custom integrated circuit (IC) which is the heart of the Series 90 annunciator system. The custom integrated circuit is made in two package sizes, 28 pin and 16 pin. All sequences and variations may be generated by programming the 28 pin integrated circuit. The 16 pin package has similar internal logic but reduced programming capability and output functions.

2.2 SEQUENCES

The sequences described in subsequent paragraphs are basic Series 90 sequences.

2.2.1 MP (multi-programmable sequence card)

MP* card allows field change of sequences via switches located on the card. The MP2 utilizes a sixteen pin custom integrated circuit, can be programmed for sequences: AF, AM, FR, FRM, TFS, and TFSR. The MP1 utilizes a twenty-eight pin custom integrated circuit adding TFSM and TFSRM sequences to the above list. Switch positions are provided for the lock-in/non-lock-in function (AF sequence) and N.O./N.C. signal contact input selection.

2.2.2 AF (AF1) (ISA SEQUENCES A, A-4, OR A-13) Ref. Dwg. No. 90450-AF1-1

AF is a basic flashing sequence in alarm. Only an ACKNOWLEDGE (ACK) pushbutton is required which silences the horn and changes lamps from flashing to steady-on. Reset is automatic when the input returns to normal. AF is always provided with optional non-lock-in which allows the point to clear without operator action. Lock-in or non-lock-in is selected via a field changeable switch.

2.2.3 FR (AF2) (ISA SEQUENCE A-1-2) Ref. Dwg. No. 90450-AF2-1

FR is a basic flashing sequence with two pushbuttons. ACK silences the horn, and the FLASH RESET pushbutton changes lamps from flashing to steady-on and sets the logic to clear when the input returns to normal.

2.2.4 AM (AF3) (ISA SEQUENCE M) Ref. Dwg. No. 90450-AF3-1

AM is similar to AF but with manual RESET. After the input has returned to normal the RESET pushbutton must be used to clear the point.

2.2.5 FRM (AF4) (ISA SEQUENCE M-1-2) Ref. Dwg. No. 90450-AF4-1

FRM is FR with manual RESET and requires three pushbuttons. ACK silences the horn; FLASH RESET changes lamps from flashing to steady-on; and RESET clears the point after the input has returned to normal.

2.2.6 TFS (TF1) (ISA SEQUENCE F3A-3) Ref. Dwg. No. 90450-TF1-1

TFS is the basic tri-flash First Out sequence. The first alarm will intermittently fast flash and all subsequent alarms within the group will fast flash. ACK silences the horn and changes the first alarm to slow flash or subsequent alarms to steady-on lamps. Subsequent alarms will then clear automatically when their inputs return to normal but the first alarm will remain in slow flash until FIRST RESET pushbutton is pressed. FIRST RESET always converts the first alarm to the same status as a subsequent alarm and allows for a new First Out point within the group.

2.2.7 TFSFR (TF2) ISA Sequence F3A-1-2-3) Ref. Dwg. No. 90450-TF2-1

TFSFR is similar to TFS but with the addition of a flash reset pushbutton to change all subsequent alarms to steady-on and the first alarm to slow flash, same as above.

2.2.8 TFSM (TF3) (ISA SEQUENCE F3M-3) Ref. Dwg. No. 90450-TF3-1

TFSM is similar to TFS but with the addition of a manual RESET pushbutton to clear the point after its input has returned to normal. RESET will not clear the first alarm until after FIRST RESET even though its input may have returned to normal.

2.2.9 TFSFRM (TF4) (ISA Sequence F3M-1-2) Ref. Dwg. No. 90450-TF4-1

TFSFRM is similar to TFSM but with the addition of a flash reset pushbutton to change all subsequent alarms to steady-on and the first alarm to fast flash, same as above.

2.2.10 ARR (AR1) (ISA SEQUENCE R OR R-8) Ref. Dwg. No. 90450-AR1-1

ARR is a basic flashing sequence with ringback (or second audible) when the input returns to normal. ACK silences the alarm horn and changes lamps from fast flash to steady-on. When the input returns to normal the ringback horn turns on and the lamps slow flash. The RESET pushbutton will silence the ringback horn and clear the point. The sequence card is the same whether a single horn is used for alarm and ringback, or two separate horns are used since the system always has two horn drivers on the flasher card which can be used with separate horns or can be connected together to drive a single horn.

2.2.11 VS (VA1) (not defined by ISA)
Ref. Dwg. No. 90450-VA1-1

VS is a two-color First Out sequence. The First Out alarm is indicated by flashing red lamps with the alarm audible and subsequent alarms within the group by flashing white lamps with the alarm audible. ACK silences the audible and changes lamps to steady-on. Red lamps remain on until FIRST RESET pushbutton is pressed even though the point has returned to normal. If point is in alarm at time of FIRST RESET, red lamps revert to white or subsequent point status. White lamps will go off on return to normal.

2.2.12 VSRR (VR1) (not defined by ISA)
Ref. Dwg. No. 90450-VR1-1

VSRR is a combination of First Out and ringback. The First Out alarm is indicated by red lamps fast flashing and the alarm audible. Subsequent alarms within the group are indicated by white lamps fast flashing and the alarm audible. ACK silences the alarm audible and changes lamps to steady-on. Return to normal is indicated by slow flash with the ringback audible. RESET silences the ringback horn and clears the point. The first alarm will revert to subsequent status when the FIRST RESET pushbutton is used. One or two audible devices may be used similar to ARR.

2.2.13 MC (MC1) (not defined by ISA)
Ref. Dwg. No. 90450-MC1-1

The MC sequence is designed specifically for motor control operation. Normal run is indicated by steady-on lamp state. An abnormal stop causes fast flash and audible signal. ACK silences the audible and changes lamps to slow flash. STOP causes lamps to go out. Each MC point card must have an input from the STOP button and an overload contact from the motor starter. See sequence wiring diagram for wiring details.

2.2.14 (LN1) (not defined by ISA)
Ref. Dwg. No. 90450-LN1-1

The LN sequence is a field contact follower. An alarm is indicated by steady-on lamps but no audible. No pushbuttons are required since the point will clear automatically when its input returns to normal.

2.2.15 SEQUENCE VARIATIONS

Sequence variations, in addition to the common sequences described in preceding paragraphs, are available. In general, these variations add steps to the basic sequences in order to allow the operator to silence the audibles while still distinguishing a new alarm from alarms previously recorded. The following is a partial list of additional sequences. For complete information, consult the factory.

Partial List of Additional Sequences		ISA Reference	Ref. Dwg. No.
AO	(AF5)	A-5 or A-4-5	90450-AF5-1
FRA	(AF10)	N/D	90450-AF10-1
AFS	(AF11)	N/D	90450-AF11-1
ASM	(AS3)	N/D	90450-AS3-1
FRR	(AR2)	R-1-2	90450-AR2-1
ARRS	(AR6)	N/D	90450-AR6-1
FRRS	(AR7)	N/D	90450-AR7-1
VSFRR	(VR2)	N/D	90450-VR2-1
VSRRS	(VR6)	N/D	90450-VR6-1
VSFRRS	(VR7)	N/D	90450-VR7-1
VSFR	(VA2)	N/D	90450-VA2-1
VSM	(VA3)	N/D	90450-VA3-1
VSFRM	(VA4)	N/D	90450-VA4-1
VSO	(VA5)	N/D	90450-VA5-1
VSA	(VA8)	N/D	90450-VA8-1
VSAR	(VA9)	N/D	90450-VA9-1

2.2.16 EXPLANATION OF SEQUENCE CODES
(N/D = not defined by ISA)
(suffix number, e.g. AF2)

Code 1 includes the basic pushbuttons required for the sequence. e.g., VR1 requires ACK, FIRST RESET, and RESET.

Code 2 always adds flash RESET. ACK silences horn only, and FLASH RESET changes flash rate.

Code 3 adds manual RESET to basic pushbutton group. RESET clears point after input has returned to normal.

Code 4 adds both FLASH RESET and manual RESET.

Code 5 signifies sequences which do not flash.

Code 6 adds RETURN ACK to ringback sequences. RETURN ACK silences horn, point remains in slow flash until RESET is pressed to clear point.

Code 7 adds FLASH RESET to Code 6.

Note: Pushbuttons are interlocked by internal logic of the custom integrated circuit, and can only be operated in the correct order.

2.3 NORMAL (FUNCTIONAL) TEST

Full functional test is standard with all sequences and, in effect, is an alarm pulse. With a point in normal, TEST causes an initial alarm condition. Since the test is a pulse, the sequence may be completed by pressing the required pushbuttons and the point will clear according to its sequence chart. With first-out sequences, all points will come up First Out if there is no existing First Out Alarm prior to test.

2.3.1 TEST DURING ALARM

The internal logic of the integrated circuit will allow a test of points in alarm if the sequence has been advanced to the state where the lamps are steady-on. The point will revert to its initial alarm state and the sequence may be advanced. Points in alarm will not clear but advance to

their prior alarm state, and will remain in off-normal until their inputs have returned to normal.

If the sequence requires manual RESET, points in alarm may be retested when the sequence is advanced to the steady-on lamp state, but normal points will not accept retest until the sequence has been completed by pressing RESET.

If a First Out alarm exists, all points in the group will test as subsequent alarms; but if the First Out point had been FIRST RESET, all points will indicate First Out.

2.3.2 ALARM DURING TEST

If an alarm occurs while in a test sequence, the point which alarms will cause an initial alarm state when the sequence is advanced. The initial alarm state will occur after ACK except in sequences which require FLASH RESET. Those points will alarm after FLASH RESET. For example, with AF sequence, if TEST is pressed, then a point alarms, ACK will silence the audible and change lamps to steady-on. As soon as the ACK button is released, the audible will come back on, and lamps will flash on the point that went into alarm during test. If the sequence was FR, the initial alarm state would not be indicated until FLASH RESET is pressed.

Note: If any of the auxiliary modes (Ref. Para. 3.8) are used for output options, the outputs will become active at the time the field contact input goes into the alarm state, but the operator may not be aware of the alarm until ACK or FLASH RESET are pressed.

2.3.3 ACK DURING TEST

The ACK pushbutton input and TEST pushbutton input are internally interlocked in the 16 pin custom IC so that TEST is inoperative if the ACK pushbutton is held down. This interlock is not built into the 28 pin IC and it may be tested with ACK pushbutton held. However, this procedure should be used with caution. Auxiliary Operational Mode outputs 4 and 5, normally inhibited during test, will momentarily turn on if TEST is initiated with the ACK pushbutton held. The on period is equal to the length of the standard time delay (normally 20 ms.). This is of no consequence for normal annunciation and won't affect the sequence, but may create problems if the Auxiliary Operational Mode outputs are used for output options. For example, a relay output for either of these modes would momentarily be active.

For long time delays (one second or longer), the test cycle is shortened. The TEST pushbutton should be held firmly for at least one second for time delays from 5 seconds to 50 seconds, and should be held for at least 5 seconds for time delays from 100 seconds to 500 seconds.

If the ACK pushbutton is operated before the internal test cycle is complete, operational modes 4 and 5 will come on until the internal timer has timed out. Therefore, to prevent an anomaly in the auxiliary outputs, (1) TEST should never be initiated while holding the ACK pushbutton, and (2) for long time delays, the ACK pushbutton should not be operated until the TEST pushbutton is released.

2.4 LAMP TEST OPTION

1LT = Lamp test in addition to functional test (P1 bus) (28 pin, only)
2LT = Lamp test instead of functional test (FT bus) (28 pin, only)
3LT = Lamp test instead of functional test (P1 bus) (28 pin, only)
4LT = Sequence card will not respond to test function
NOTE: When lamp dim in normal is required, use 1LT option on point card and 1DN option on flasher.

PART 3
ELECTRICAL DESCRIPTION

3.1 SYSTEM POWER

All power for the 90 system is supplied via the system power bus "+24" and system common "OV". The voltage on the bus is a nominal 25.5VDC. If the power supply is a PANALARM AC input type, the voltage is rectified but unfiltered and is defined as V effective or the RMS value of the unfiltered voltage. If the power supply is a DC input type, the voltage is regulated to 25.5VDC +5%. All plug-in cards in the system are designed to operate from either of these voltage forms, or from a customer supplied DC source between 20 and 32VDC with a proper PANALARM filter.

3.2 FIELD CONTACT VOLTAGE

Standard FC voltages from AC input power supplies are 24VDC or 125VDC. With 125VDC input, 125 or 24VDC FC is available, with 48VDC input 48 or 24VDC FC is available. With 24VDC input, only 24VDC FC is available.

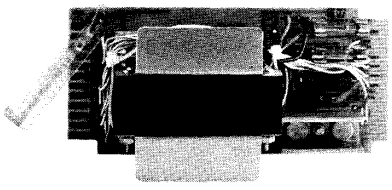
FC voltages are isolated from the system voltage so that opto-isolated inputs may be used, but for direct field contact inputs, it is necessary to connect the field contact voltage common "FCC" to system common "OV" (+24 is unfiltered and may not be used as FC power.)

3.3 POWER SUPPLY MODELS

3.3.1 AC INPUT INTEGRAL SUPPLIES (90P1X***AC*)

3.3.1.1 AC input integral supplies occupy one full module and are normally installed in the lower right corner of the cabinet (viewed from the front). Integral supplies are necessarily of limited capacity (see specifications section) but several may be used in the same cabinet. When more than one is used, the +24 system power bus is split by rows so that each supply powers part of the system. All other buses in the cabinet are common. Paralleling power supplies could result in overload of remaining supplies if one is removed or fails. Paralleling should not be attempted.

3.3.1.2 Integral supplies plug into the system, but must be connected from power supply terminals (coded yellow) to main bus blocks. Integral systems will normally be factory wired so the user need only connect the input line to the power supply module input terminals.



3.3.2 DC INPUT INTEGRAL SUPPLIES (90P1X***DC*)

DC input integral supplies also occupy one full module and are installed in the same manner as AC input models. These supplies are switching types, regulated by using pulse width modulation techniques for high efficiency. Since the system is capable of operating over a wide range of input voltages, regulation is for the purpose of maintaining uniform lamp illumination and extending lamp life. DC input supplies are fused only in the primary side. Outputs are protected by automatic shutdown and automatic restart, and will operate with a continuous short circuit without damage.

3.3.3 POWER TRANSFER SYSTEM (INTEGRAL)

3.3.3.1 A power transfer system may be used when a backup supply is necessary. The system requires the use of a 90P3X***AC* integral supply with a 90PT* power transfer card and a DC backup source. The backup source may be a PANALARM DC input supply, or a customer furnished source of approximately 25VDC with appropriate field contact voltage supply. The 90PT* mounts in the same module with the Model 90P3*.

3.3.3.2 The Model 90P3 power supply is an AC input type similar to the Model 90P1 power supply but with added features. Sense diodes and a power diode to couple the backup DC source in the system are added.

3.3.3.3 The power transfer module senses the loss of AC power and transfers to the backup source. The transfer is instantaneous and occurs before any loss of data to the annunciator system. FC voltage is transferred at the same time through an isolated circuit, so that isolated field contact supply voltage is dependent on external wiring connections. The power transfer module includes transient supression and an overvoltage "crowbar" on the backup source to protect the system against transients and misapplication of voltages.

3.3.4 PUSHBUTTONS AND POWER-ON LIGHTS

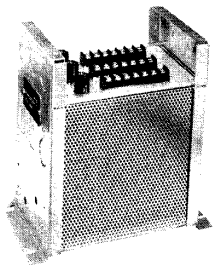
Pushbuttons and power-on lights may be mounted in the front of the module containing an AC or DC inputs integral power supply.

3.3.5 REMOTE SUPPLIES

3.3.5.1 Integral supplies may be mounted remote by inserting the power supply in a 90WM*P1 or 90WM*P3. The 90WM* is a single module designed for wall mounting. 90WM1* has rear access terminals. A 90WM2* has front access terminals.

3.3.5.2 90P2 and 90P18 models are large capacity remote supplies designed for remote mounting, Two AC (90P2) supplies or two DC (90P18) supplies may be mounted on

one standard 19" wide by 5-1/4" high rack panel. All electrical characteristics are similar to integral supplies except for greater capacity on each output. See also Doc. 900383, 90P18 instruction manual.



MODEL 90P2
AC POWER SUPPLY

3.3.6 FILTERS FOR 24VDC POWER SOURCE

A filter must be used when a customer supplies the 24VDC source. It provides transient suppression as well as capacitive filtering. Inputs are reverse polarity protected. Input and FC output are fused.

The 90FT3 integral filter has status LED's to monitor +24 and FC.

The 90FT2 remote filter is identical in appearance to the 90P2 power supply pictured above.

3.3.7 POWER SUPPLY RATINGS

All Series 90 power supplies are rated in watts. Power consumption per system is given in the specification section. Power consumption is calculated by multiplying the watts per element by the number of each in the system. The sum of the products is the total power consumption in watts and must not exceed the rating of the power supply.

3.4 FLASHER CARD

3.4.1 FLASHER

The flasher card generates fast and slow flash rates and feeds the system buses directly. The flasher is designed for systems up to 300 points. For larger systems, slave flashers, each capable of driving an additional 300 points, may be added to provide synchronized flashing.

The top LED on the flasher card indicates that the first horn circuit is active. The middle LED indicates that the second horn circuit is active. The bottom LED monitors both FF (fast flash) and SF (slow flash) outputs and flashes in intermittent fast flash mode to indicate both outputs are functional.

3.4.2 DIM IN NORMAL OPTION

The flasher card (with DN option) generates a dim signal for use with sequence cards (with 1LT options). This option will cause the lamp display to be dim in normal. A jumper option on the flasher cards selects a fixed dim rate ("F" position) or the user may connect a remote potentiometer ("R" position) to provide adjustable dim. The fixed dim feature is also used with meter set analog cards to verify point selection so these systems require a flasher with "1DN" option (901X1DN).

3.4.3 HORN DRIVER

The flasher card monitors the system horn buses and provides a higher current logic level output (up to 250mA and 24VDC) to drive or control audible devices. This output may be used to drive a Novatone (NT2-24D) directly, or to drive an interposing auxiliary relay (90AX* or similar type) if other types of audible devices are required. Since the 90AX* require only about 1mA of drive from the flasher, both output devices may be used simultaneously. An LED on the flasher card monitors the output driver.

3.4.4 RINGBACK HORN DRIVER

The flasher card includes a second identical driver for use with ringback sequences with an LED to monitor its output. On a standard flasher card, the alarm horn inhibits the ringback horn, should a new alarm occur while a point is in ringback. In order to have both horns on simultaneously under these conditions, a flasher with "2H" option should be specified. If a single horn is to be used for both alarm and ringback, the two horn driver outputs are connected together at the rear terminal block to drive a single horn or relay.

3.4.5 ELECTRICAL CONNECTIONS

The flasher card occupies one card slot and may be plugged into any spare active position in the system. The flasher buses and horn input buses are connected when the flasher is plugged in. The user must connect the alarm horn to rear terminal 7 and ringback horn to terminal 6. Terminal 6 must be connected to terminal 7 if a single horn is used for ringback sequences. Terminals 4 and 5 are used only for remote dim control. Terminals 2 and 3 are inputs when the flasher is a slave. Terminal 1 is dim output and should be connected to "P1" on the left main bus block only if dim (1DN option) is used.

3.4.6 FLASHER CARD PROTECTIVE CIRCUITRY

All inputs to the flasher card are protected by clamp diodes and current limiting resistors to prevent damage through accidental application of up to 30 volts. The flasher outputs, "FF", "SF", and DIM when used, are intended for use only within the system. These outputs are open-collector NPN transistors and are connected within the system to pullup resistors returned to +12 volts on the sequence cards. Application of voltage greater than 18 volts to an output will cause the output to shut down until the over-voltage is removed. The horn driver outputs on terminal 6 and 7 of the flasher card position are similarly protected but since they are intended to operate with pull-up resistors to the main bus voltage, shutdown will not occur until a voltage greater than +30 volts is applied.

All outputs are protected by current limiting set at approximately 500mA. A short-circuit or overload which exceeds 500mA will cause all outputs to shut down for about three seconds. Restart is automatic, but if the

abnormal condition persists, the outputs will again be shut down for three seconds. Shutdown is indicated by the flasher LED. It will be steady-on instead of intermittent fast flash. The horn LEDs will not come on during this time.

The shutdown circuit will respond to current or voltage spikes as short as 10 microseconds long. Loads should be resistive pull-ups to +30VDC or less. PANALARM NT2-24D horn or PANALARM interposing relays fulfill this requirement. Shutdown will not affect the alarm status of point modules in the system but will cause steady-on lamps instead of flashing. When the circuit recovers, all point modules will return to their respective states.

3.5 SEQUENCE CARDS

3.5.1 SINGLE POINT CARDS

Single point cards utilize a universal printed circuit board such that any sequence described in Part 2 and designated input and output options and miscellaneous features described in Part 3 can be manufactured on a single card layout.

3.5.2 TWINPOINT CARDS

Twinpoint cards are also made on a universal board. The two points are independent except for bused signals which are common to the system. Two color First Out sequences (VA* and VR*) are not available on twinpoint cards. Twinpoint cards are intended primarily for use with dual set analog cards, but may be used as contact input annunciator point cards with options restricted by input/output terminal availability. They are ideally suited for high density remote logic rack mounting. Up to 40 points (20 cards) may be mounted in a single 19″ rack chassis (4 cards per module, 5 modules wide).

3.5 TRIPOINT CARDS

The tripoint card contains three independent circuits on a common card. It is a "multi-sequence" card, with field-selectable sequences and output options. Sequences available are AF1, AF2, AF3, AF4, TF1, and TF2.

If aux. relay output is desired, a 93AXC1* aux. relay card containing three independent relay circuits may be plugged into the system in the adjacent card slot. Interconnection is automatic, via the "crossover" busses.

3.6 SEQUENCE CARD CIRCUIT DESCRIPTION (see Figure 3)

3.6.1 GENERAL

The simplified schematic illustrates the essential features of the sequence card. The custom integrated circuit performs all logic functions and determines sequence action. External circuitry on the card is for noise immunity, additional protective circuitry, and to provide additional drive when required. An LED on the card is connected to an auxiliary output of the integrated circuit and monitors the alarm status of the input. Each point of a twinpoint card is similarly monitored.

3.6.2 FIELD CONTACT INPUT

A signal input from a field contact is processed by a selected input option circuit (Para. 3.7) and connected to the input of the IC through a large value current limiting resistor. Clamp diodes at the input, with the current limiting resistor, protect the IC against very large voltage transients which might be induced in field contact wiring. Inputs operating with FC voltages of 24V or greater have been tested to meet or exceed the requirements of IEEE-472-1974, (SWC).

3.6.3 NORMAL OPEN-NORMAL CLOSED OPERATION

The logic level required for alarm or normal is determined by an internal logic circuit analogous to an "Exclusive-OR" circuit steered by the NO-NC input selection jumper.

3.6.4 RESPONSE TIME OF DISCRETE INPUTS (TIME DELAY)

When a signal input is received, a time delay is initiated internally. The time delay is a precision circuit within the intergrated circuit controlled by a selected external charging circuit. If the input signal returns to normal before the time delay has completed its cycle, no further changes occur. If the alarm signal is still present at the end of the time delay, the alarm is entered and the annunciator sequence begins. When the signal input returns to normal, the time delay is again triggered and the alarm will not clear until after the time delay cycle is complete. This feature eliminates dropout and realarm on momentary loss of input signal which might be caused by noise.

The time delay accuracy depends principally on the tolerance of the charging capacitor (normally +10%). Other variables add only about 2.5% so that overall accuracy of ±12.5% is standard. (Ref. Para. 4.9.1)

3.6.5 RESPONSE TIME OF OPTO-ISOLATED INPUTS

When opto-isolated inputs are used, the overall response time will be increased due to the filtering required to allow operation on AC input signals. This will also increase the resolution time on first out sequences. Actual time delay will be the sum of the standard time delay selected PLUS the additional delay due to the opto-coupler, which varies depending on whether the input is being energized or de-energized. See paragraph 4.9.3 for the standard time delay options available, and paragraphs 4.9.1 and 4.9.2 for the time delays and resolution times with opto-coupled inputs.

3.6.6 LAMP CIRCUIT (See Fig. #3)

The lamp logic, with inputs from fast flash, slow flash, internal alarm signal, and internal sequence logic, will cause the lamp circuit to respond according to the sequence requirement. The IC output is an emitter follower which pulls high when the lamps are on, and must source current to the external lamp driver. The lamps are connected to the collector of the lamp driver and returned to +24 volts. A keep-alive resistor is connected across the transistor. When the lamps are normal off, current through the resistor causes the lamp filaments to stay

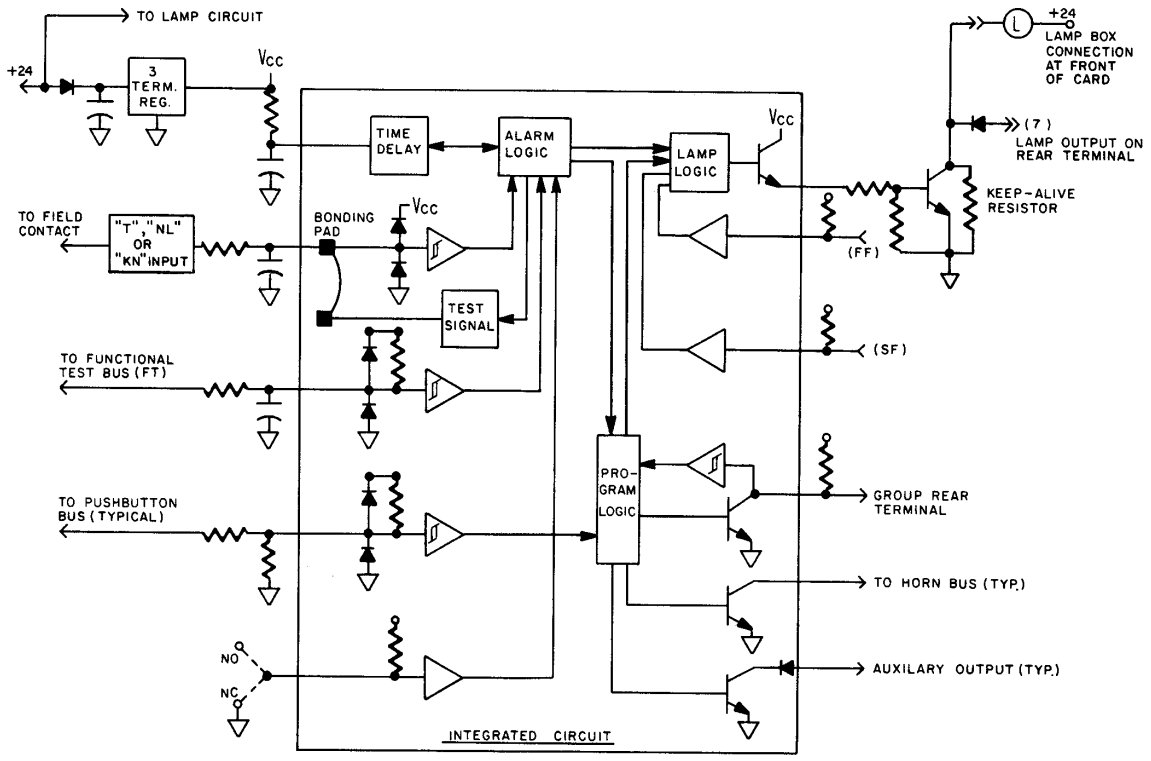


FIG. 3

warm and reduces the current surge at turn-on caused by the cold-filament resistance. As a result, lamp life is extended and system noise is reduced. If this feature is not desired (such as when the lamp output terminal is used to power an external device or if LED light boxes are used), order option "INR".

Sequences VA* and VR* have a second identical lamp output which is active only for First Out lamps on two-color First Out sequences and an identical lamp driver circuit is added to the card for those sequences.

A special card has been designed with a protection circuit for the lamp drivers. If the lamp output shorts, this circuit will protect the card against damage. Consult factory for this card.

3.6.7 ALARM HORN OUTPUT

When the alarm is entered, the alarm horn output transistor is turned on (low). The output is an open collector NPN stage and is connected directly from the integrated circuit to the system horn bus "FH". Horn outputs from all other cards in the system are similarly connected to the horn bus and to the horn input of the flasher card. The flasher card has a common pull-up resistor for all sequence card horn ouputs.

3.6.8 RINGBACK HORN OUTPUT

Sequences ARR* and VSRR* have a second horn output for the ringback horn which turns on when the signal input returns to normal on ringback. The output is connected directly to the ringback horn bus "SH" and to the common pull-up on the flasher card.

3.6.9 PUSHBUTTONS

Pushbuttons are used to advance the sequence through various states. Pushbuttons are interlocked internally in the integrated circuit so all pushbutton inputs are active on all sequences. The inputs to the IC are either connected to corresponding pushbutton buses or connected to system common on the sequence card enabling the logic to automatically advance through unused sequence steps. The basic inputs are ACKNOWLEDGE, FLASH RESET, and RESET. The ACK input to the IC turns off the alarm horn, FLASH RESET modifies the lamp flashing rate according to the internal logic, and RESET clears the point after the input has returned to normal.

FIRST RESET is used on First Out sequences, (TF*, VA* and VR*) and is not interlocked but is inoperative if either horn is on. RETURN ACK input, when not used for the sequence, is connected on the card to system common since it is also interlocked by internal logic. All pushbutton inputs are steered high by an internal pull-up resistor (to 12VDC on each card). This resistor is of relatively low value for noise immunity and the input stage includes hysteresis for additional noise immunity. The inputs are protected by internal

clamp diodes, a series current limiting resistor, and isolating diode are added on the card. All pushbuttons are normally open contacts to system common and are active low. Sequences may be converted by wiring a pushbutton bus to "OV". For example, FR (AF2) may be converted to AF (AF1) by connecting the FR bus to "OV", or FRM (AF4) may be converted to AF (AF1) by connecting both the FR and MR buses to "OV". This conversion may be done by horizontal row, by splitting the buses at the main bus terminal blocks.

3.6.10 TEST INPUT

The test input to the IC is identical to all pushbutton inputs and is similarly protected with a series current limiting resistor and isolating diode on the card. The test pushbutton is connected to the functional test bus (FT) and all points are tested simultaneously. The internal test signal is logically connected to the time delay circuit and to the NO-NC so that a test pulse of proper polarity is generated. The test pulse is equal in length to the time delay used on the card. The test pulse, when generated, is connected to its own bonding pad internally. This bonding pad is wire bonded to the signal input bonding pad. Therefore, if the point accepts a test input, there is a very high degree of probability that the point is functional. Time delay functions on test, therefore the test pulse is delayed by the length of the time delay. For convenience when testing cards with long time delays, the delay and the test pulse are made shorter by adding external circuitry.

3.6.11 GROUP BUS INPUT/OUTPUT (FIRST OUT SEQUENCES)

The group terminal circuitry comprises an output similar to the horn output (active low) and an input similar to the pushbutton inputs. Group terminals may be connected in groups up to 100 points and a system may have multiple groups. When an alarm is first of a group, the group terminal on the point which alarmed pulls low. All other points in the group accept the low as an input and the internal logic of those points cause a subsequent state if any should alarm while the group bus is low. FIRST RESET releases the group bus and changes the status of the First Out point.

The next point to alarm within the group will then indicate First Out status. A pull-up resistor is connected to the group terminal of each card to steer the input circuit high and the parallel combination of all resistors in the group functions as a collector resistor for the output circuit.

The group terminal of the IC is connected directly to a rear customer terminal of each First Out sequence card so that the user may form groups as required. For First Out sequences, the rear terminal must never be connected to anything but a group terminal of another First Out sequence point, (or see NOTE below).

NOTE: The group terminal may be connected to system common (OV). This connection converts the First Out sequence to subsequent sequence, e.g., TFS becomes AF.

3.6.12 AUXILIARY OUTPUTS (OPERATIONAL MODES)

The 28 pin IC includes four auxiliary output circuits which are dependent on internal logic. The 16 pin IC includes only one auxiliary output (signal input follower). These outputs are described in detail in Para. 3.8.1.

The output stage in the IC is an open-collector circuit identical to the horn output circuits. When used, an external collector pull-up is required. These outputs may be connected directly to rear customer terminals or used to drive isolated relay or opto-isolator output options (discussed in subsequent paragraphs).

3.6.13 ADDITIONAL FEATURES

The 28 pin IC includes four program inputs which are used to establish the operational sequence. These inputs are programmed on the card at time of manufacture and are not accessible externally. The 28 pin IC includes a lamp test pushbutton input which is functional only when the lamp circuit is in normal (non-alarm). By applying a variable duty cycle signal, generated by a flasher with 1DN option, lamps may be operated dim in normal. This input is logically inhibited when an alarm is entered.

3.6.14 CIRCUIT POWER SUPPLY

The power input (+24V bus) to the card may be either unfiltered DC or pure DC. A diode and filter capacitor on each card allow the use of an unfiltered source. A three terminal voltage regulator on each card supplies the integrated circuit and other low-level external circuitry, thus making these circuits insensitive to variations in bus voltage. Lamps are connected directly to the +24 volt bus.

3.7 SEQUENCE CARD INPUT OPTIONS

3.7.1 GENERAL

All inputs described are available with all sequences on single point sequence cards and, except where noted, are also available on twinpoint cards.

3.7.2 "T" INPUT (See Figure 4a)

A standard single point card is made so that voltage is removed from the field contact when the card is removed from its connector. The field contact voltage is bused on each card via P3, and connected on the card to customer terminal 2 of each card position. Terminal 1 is wired out to the field contact and the return wire is connected to terminal 2. Utilization of this interlocking feature requires running two wires to each field contact. A "T" input may be wired the same as an "NL" input but the interlocking feature is lost. "T" inputs cannot be used if RS422 communication option is used.

3.7.3 "TA" OR "TB" INPUTS (TWINPOINT CARDS)

Standard twinpoint cards have "NL" inputs (see 3.7.5). "TA" or "TB" options cause voltage to be removed from the signal contacts when the card is pulled from its socket. "TA" requires the use of four customer terminals (see Figure 4b), "TB" three terminals (see Figure 4c). Either may be wired as "NL" inputs but the interlocking feature will be lost.

3.7.4 "TWM" INPUT (See Figure 4d)

This option allows monitoring the field wiring circuits

for opens or breaks whether using normally open or normally closed field contacts. The option can not be used to monitor 'FC' voltage. When an open occurs in the field wiring, the alarm window will flash and the horn will sound. After acknowledge, the horn will silence, however, the window will continue to flash at a distinct slow rate and remain flashing until the open has been corrected. An LED on the input module also signals an open. Normal change of state of the NO/NC field contact will result in the sequence card alarming in its normal sequence of operation. A power failure monitor or a "T" input card is required to monitor 'FC' voltage when TWM input is used in a system.

3.7.5 "NL" INPUT (see Figure 5)

The "NL" input requires a single wire to terminal 1 of a single point card terminal block from the field contact, or wires to terminals 1 and 2 from each field contact for a twinpoint card. One wire from the "FC" output of the power supply may then supply a number of field contacts. Using this method, one side of each field contact is "HOT" whenever the system is powered up.

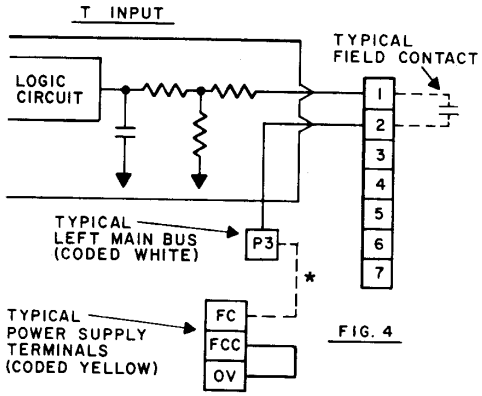


FIG. 4

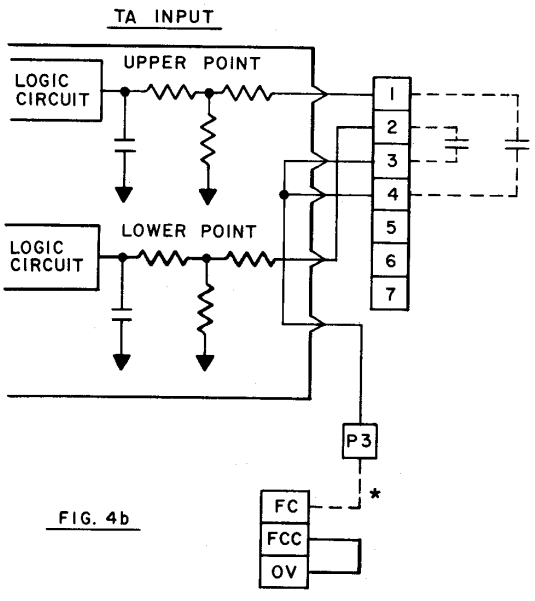


FIG. 4b

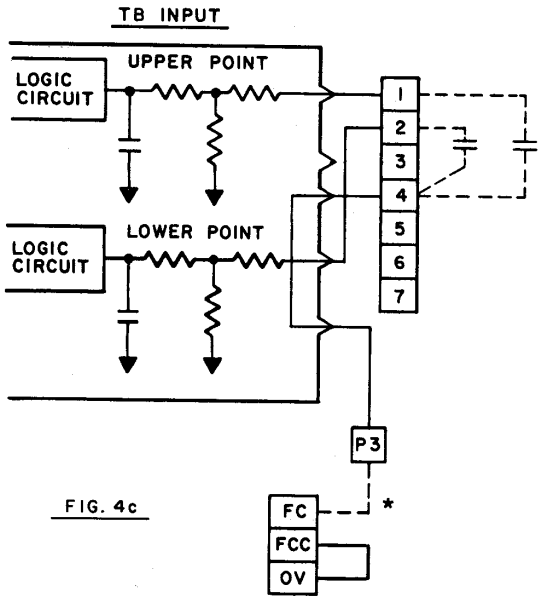


FIG. 4c

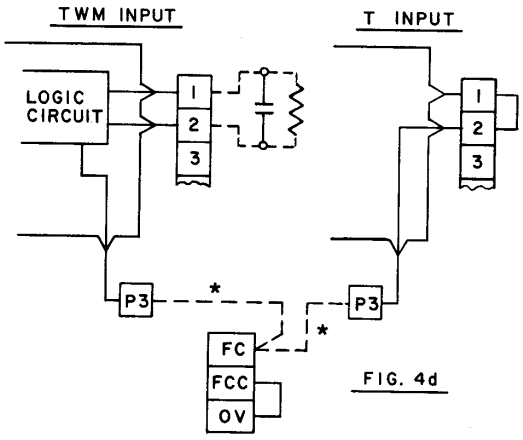


FIG. 4d

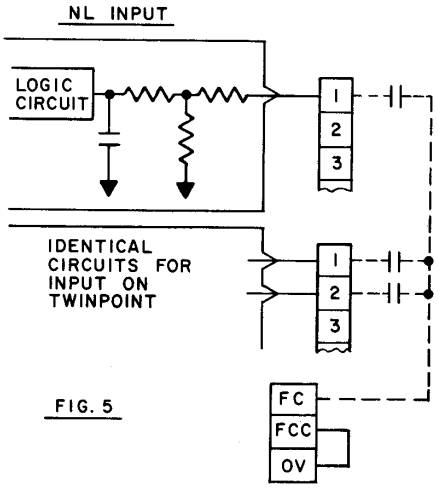


FIG. 5

*Systems with integral power supplies and "T" type input will have FC to P3 jumpers factory installed.

3.7.6 "KN" "KP" INPUTS (See Figure 6) (KP not available on twinpont cards)

Opto-isolated inputs are available for use with various voltages. The supply voltage must be isolated from the system. The input is a bridge and filter so that either AC or DC field contact voltages may be used (see Part 4 Specification Section). If the power supply (FC) is used, do not connect the FC common, (FCC) to system common (OV), or isolation will be lost.

For single point cards, one side of the field contact supply is connected to terminal 2 of each card. The other side is connected to the individual field contacts and a return wire is connected to terminal 1 of each point. For a twinpoint "KN" input, terminals 4 and 5 are the second input and are wired the same as 1 and 2, respectively.

KP is the same as KN except isolated power source is connected to P1 and P2.

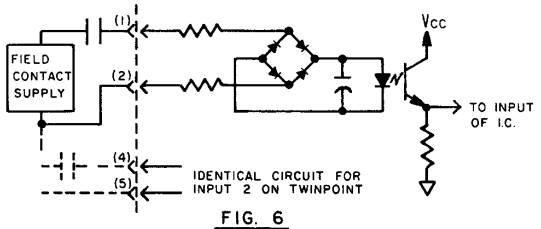


FIG. 6

3.7.7 "DM" INPUT

The DM input is designed to interface with all meter set analog cards (91AD*).

3.7.8 "1ND OPTION

Designed to be used with the "DM" input. This option deletes the dim feature on the sequence card monitoring a meter set analog card (91AD*).

3.8 SEQUENCE CARD OUTPUT OPTIONS

3.8.1. OPERATIONAL MODE CODES (AUXILIARY OUTPUT) (Ref. Para. 3.6.12)

The output options discussed in subsequent paragraphs are time dependent on electronic signals generated internally by the logic of the integrated circuit. These auxiliary modes are specified as follows:

Mode 1 - follows field signal input, and test pushbutton
Mode 3 - steady-on whenever lamps are active from alarm or test.
Mode 4 - follows field signal input, but not test.
Mode 5 - steady-on if lamps are active from alarm, but not test.
Mode 6 - Steady horn follower with test.
Mode 7 - Follows lamp flashing or steady on (Form 'A' only)
Mode 9 - Contact follower, no test (92 style card only)

The output for each mode from the integrated circuit is an open-collector , active low. Each output can sink 15 mA and will current limit at about 25 mA if overloaded. These outputs may be used directly or may be used to drive on-board relays or opto-isolators. When one more output option is used, it will always be specified by Mode number followed by the desired output. For example; if the requirement is for a form BE relay contact operating in Mode 5, the option code 5 BE will be a part of the model number of the sequence card. The form BE relay contact will then operate at initial alarm and remain active until the point clears to the lamps off state. It will never operate if the test pushbutton is used.

3.8.2 RELAY OUTPUT OPTION (A, B, or C)

One of the operational Modes is selected to drive a relay on the sequence card. The relay contacts, Form AE, BE, or CE are connected on the card to output pins connected to customer terminals. The input to the relay driver is a comparator and requires less than one mA from the electronic output of the integrated circuit. By a movable jumper change on the sequence or normally de-energized relay operation.

AAE, BBE, or CCE used for single point operation only. Two independent relays are supplied. Each relay has its own output pins.

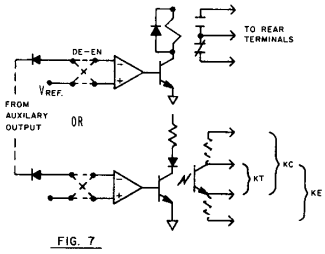


FIG. 7

3.8.3 OPTO-ISOLATED OUTPUT OPTION (KT, KC, KE (KC and KE AVAILABLE ON TWINPOINT CARDS WITH DM INPUT ONLY) (See Figure 7)

The sequence card is made so an opto-isolator may be used as an output device instead of a relay. The drive circuitry for the opto-isolator input is the same as used for the relay. The opto-isolator may therefore be operated with the output transistor normally on or normally off by placing the normally energized (on) or normally de-energized (off) jumpers in the selected position.

One of three output configurations may be selected. When KT is specified, the emitter and collector of the

output transistor are connected to customer terminals. When KC is specified, a collector pull-up resistor (1Kohm) as well as the collector and emitter are connected to customer terminals. KE is similar except the resistor is connected to the emitter. The opto-isolator is a single stage output so that a low VCE sat is available for driving one standard TTL load. The optoisolated output is specified by selecting the Mode and output configuration. For example, a field signal input follower (Mode 4) with collector pull-up (KC) in the output is specified as 4KC. This designation is added to the model number of the sequence card.

3.8.4 ELECTRONIC OUTPUT OPTIONS

The electronic Operational Mode output may be brought out directly to customer terminals through an isolating diode. The terminal choice is determined by use of customer terminals. For example, a relay output, Form AE, on a single point card uses customer terminal 4 and 5. Terminal 6 would normally be available for the electronic output. Since the electronic outputs are directly from the integrated circuit, some care should be taken in using these outputs. The output is rated 20V (24 max). It should normally be used with a 12V supply. Because of the internal circuit limiting circuitry of the integrated circuit, the VCE sat is guaranteed at 2.0 volts and at 10mA.

This may not be suitable for driving some logic directly. An external pullup resistor is always required. This output is not isolated from the system.

3.9 MISCELLANEOUS OPTIONS

3.9.1 RELAY LOCKOUT OPTION

The *RL option, or relay lockout is intended for use with relays but can also be used with the opto-isolator output option. Its purpose is to prevent the relay from changing state at certain times. A remote SPST switch, furnished by the user, is wired from the relay lockout terminal to system common. When the switch is open, the system functions normally, but when the switch is closed, the relay WILL NOT CHANGE STATE, despite the status of the point(s) or any changes in the point(s) input(s) or status. Any number of points may be grouped to a single switch, or individual switches may be desirable in some cases.

3.9.2 CARD REMOVED

The *CR (card removed) option is intended to indicate that a card is in place, or has been removed. The option consists in providing a return to system common through one of the customer terminals when the card is in place. It is up to the user to install the indicator as required to indicate that the card is in place or has been removed.

3.9.3 FTD and ATD

3.9.3.1 FIXED TIME DELAY

All sequence cards are provided with a time delay prior to alarm. The delay is also active when the input returns to normal. The sequence card logic and output functions are therefore displaced in time by the length of the delay. Standard time delay is 20ms, sufficient to eliminate false alarms on many noise pulses which might be picked up by field contact wiring. If time delay other than 20ms is required, the selected delay code group is added to the model number. Delays from 2ms to 500 seconds are available for single point cards and delays from 2ms to five seconds are available for twin point cards. (See Part 4 Specifications Section).

This delay also functions on test. In order to avoid long delays on test and return to normal, for delays of one second or longer the test and return delays are shortened. For example, if 50 seconds were selected, delay on alarm will be 50 seconds, but delay on return to normal would be about 3 ms and delay on test about 3ms. Twin point cards do not have shortened time delay.

3.9.3.2 ADJUSTABLE TIME DELAY (NOT AVAILABLE ON TWINPOINT CARDS)

Adjustable time delay is similar to FTD but a potentiometer is mounted on the sequence card so that the user may set the delay on each sequence card to a specific value. ATD is made in five overlapping ranges.

3.9.4 PR AND PC (PR NOT AVAILABLE ON TWINPOINT CARDS) (REF. DWG 91450-*PC-1, 91450-*PC-2, 92450-*PC1 AND 91450-*PR-1.

Provisions have been made on the sequence card for mounting a resistor for user convenience in the event that the input to the point card is an electronic device, (transistor, SCR, etc.). The PR option connects the resistor across customer terminals 1 and 2 and is intended for use with an emitter follower. The PC option connects the resistor between terminal 1 and the P3 bus and is intended as a collector pull-up. These options may be used with an "NL" or "KN" type input. The user must specify the supply voltage and select a resistor value from the option table. It is best suited for use with 12 or 24 volt external circuitry but may be used for higher voltages. Care must be exercised in selecting the resistor value. The leakage of the external semiconductor device must be taken into account when selecting a resistor value. If the resistor is used as a collector pull-up, the value selected should be as small as possible with respect to other circuit constraints since, in this case, the resistor is in series with the input to the circuit card and must not exceed the maximum series resistance listed in Para. 4.7.1 and 4.7.2.

3.9.5 LAMP TEST (*LT)

Full functional test is standard on all sequence cards. The *LT options add lamp test or eliminate test entirely. This option designation is also used when dim or normal is required. A flasher with 1DN option is required for dim in normal. The flasher dim output is factory wired to the P1 bus.

3.9.6 HORN ENABLE OUTPUT OPTION *FHC

1FHC on customer terminal 1 5FHC on customer terminal 5
2FHC on customer terminal 2 6FHC on customer terminal 6*
3FHC on customer terminal 3 7FHC on customer terminal 7*
4FHC on customer terminal 4
*Options not available when remote lamp option is also required. (Terminal 6 and 7 for twinpoint, 7 for single point.)

3.10 LAMP OPTIONS

3.10.1 INTEGRAL LAMPS or LED's

The iamp driver output is connected to P.C. card fingers on the front edge of the sequence card. For integral systems, the lamps are connected automatically when the lamp box is snapped in place. Because of this feature, lamp boxes are made in different configurations to properly connect to the number of cards used in the module.

3.10.2 REMOTE LAMPS

The lamp driver output is also diode-connected to a customer terminal. For single point cards with two color sequence VA* or VR* with option '1VT', the white lamp is connected to terminal 7 and the red lamp is connected to terminal 6. On twinpoint cards, the point 1 lamp is connected to terminal 7, and the point 2 lamp is connected to terminal 6. In some cases when a flush-mounted cabinet with integral lamp boxes is used, and a remote lamp connection is unnecessary, these terminals may be used for other options. The system wiring diagrams should always be consulted for proper connections. (If RS422 communications interface is used, terminal 7 is not available for remote lamps).

3.11 ANALOG INPUT SYSTEMS

Separate instruction manuals give detailed information for installation, calibration, setup, and maintenance of analog input cards. A brief general description is given in subsequent paragraphs. (Ref. instruction manual 900252 for meter set analog).

3.11.1 ANALOG CARDS

Meter set analog cards are available for use with inputs from thermocouples, RTD's, thermistors, voltage or current inputs, and load cells. All cards are made with a transformer isolated power supply on each card, and all signal outputs and test inputs are connected to the annunciator system through opto-isolators so that isolation between the field input and the annunciator logic is maintained

An analog card is always paired with a sequence card. The sequence card is always in position A(and C) with its analog card in B (and D). The sequence card requires a "DM" input for meter set systems. All interconnections between the card pair is by the crossover links (see Figure 1). Inputs are connected to the analog card rear terminal block. Because of the crossover links, all rear terminals of the sequence card position may be used for output options. No external wiring between cards is required. Analog cards may be single or dual set and, by field option, may be selected for high-high, high-low or low-low operation.

3.11.2 DIGITAL DISPLAY

A digital display module is required for the meter set, and RS422 communications option systems. This module selects the point to be displayed, and on command will display input value, set points, and status information of the selected input. The P1, P2 and P3 buses are used for communications between the digital display and the meter set analog cards.

3.11.3 RESTRICTIONS WITH ANALOG CARDS

When meter set cards are used in a mixed system, sequences or options requiring the use of the P1, P2, or P3 bus cannot be used in the same row with digital display or meter set cards. Specifically, (1) the "T", TWM, KP and PC input (interlocked field contacts) cannot be used; (2) ring-back sequences requiring both return horn acknowledge (RETURN ACK) and point reset (RESET) cannot be used, and (3) lamp test or dim in normal cannot be used. (4) and output option 4RL (RELAY LOCKOUT), (5) two color sequence (VA* and VR*) also cannot be used with meter set analog.

3.12 ACCESSORY CARDS

3.12.1 AUXILIARY RELAY CARDS (90AXC*)

A series of auxiliary relay cards are available for use with Series 90 sequence cards. The inputs to these cards are designed to be driven from electronic outputs described in Para. 3.8.1 and 3.8.4, and some models may be connected to the lamp output, (terminal 7 on most card positions). Models are available for mounting in any available card position and additional models can be mounted adjacent to a sequence card so that inputs are connected via the crossover buses described in Para. 1.5.4. One model includes an opto-isolated triac output stage capable of driving 150 watts at 120V AC.

3.12.2 INPUT REFLASH CARDS (90RF*)

A series of input reflash cards are designed to monitor up to 160 field contacts in a single group. Inputs are either "NL" inputs, or "KN" inputs. Outputs are electronic tri-state stages designed to function with a sequence card at a remote location. Models with relay outputs are also available. One model is available with contact follower relays independent of the reflash function.

3.12.3 REFLASH RELAY CARDS (90RFR*)

A reflash card to monitor the output of standard sequence cards is also available. It monitors operational mode 4 of a group of sequence cards. Up to 100 mode 4 outputs may be OR'd into one reflash card. The output of the reflash card is an isolated relay.

3.12.4 GROUND DETECTION

Both integral (90GD* models) and remote (50-DCF3-* models) ground detectors are available. Grounds may be detected on logic and/or field contact wiring, depending on model. The 50-DCF3-* models allow independent adjustment of logic and FC wiring ground detection sensitivity.

PART 4
SPECIFICATIONS

4.1 SYSTEM VOLTAGE REQUIREMENT

4.1.1 25.5VDC rectified but unfiltered DC from all PANALARM AC input power supplies. Defined as effective voltage (RMS value) Range ±15%.

4.1.2 25.5VDC when using PANALARM DC/DC power supplies regulated to ±5%.

4.1.3 Customer may use backup supply with 90PT* power transfer module or may power system from a DC source through 90FT* filter network. Input range 20 to 32VDC.

4.2 POWER CONSUMPTION

4.2.1 Single Point Sequence Card (28 pin) .. 1.3 watts
(16 pin) ..... 0.9 watts

4.2.2 Twinpoint Sequence Card (28 pin) .... 2.6 watts
(16 pin) ..... 1.8 watts

4.2.3 Lamp Box 91L** ..... 4.0 watts
92L** ..... 4.0 watts
93L** ..... 6.0 watts
94L**..... 8.0 watts
96L** ..... 6.0 watts
98L** ..... 8.0 watts

LED Lamp Box 91L*01R..... 2.0 watts
92L*01R..... 2.0 watts
93L*01R..... 3.0 watts
94L*01R..... 40 watts
96L*01R..... 3.0 watts
96L*01R..... 4.0 watts

4.2.4 Flasher Card..... 1.5 watts
(1DN option) ..... .5 watts

4.2.5 Slave Flasher Card..... 1.5 watts

4.2.6 Add for Options or Accessories
For Two Extra Lamps/Point ..... 2 watts
For KT, KC, or KE Output Option . 0.40 watts
For A, B, or C Output Option ..... 0.50 watts
For 90AX* Auxiliary Relay ..... 1.5 watts
For NT2-24D Novatone Horn ..... 1.5 watts
For Pushbuttons (Per Button) ..... 2 watts

4.3 SERIES 90 POWER SUPPLY SPECIFICATIONS

MODEL NUMBER	INPUT VOLTAGE RANGE	FRE-QUENCY	MAX. ALLOWED RIPPLE	NOMINAL SYSTEM BUS VOLTAGE	NOMINAL FIELD CONTACT VOLTAGE	REGU-LATION LINE & LOAD
90P1X120AC24FC80W	105-130	48-62	NA	25.5VDC*	24VDC	±15%
90P1X120AC125FC80W	105-130	48-62	NA	25.5VDC*	125VDC	±15%
90P1X240AC24FC80W	210-260	48-62	NA	25.5VDC*	24VDC	±15%
90P1X240AC125FC80W	210-260	48-62	NA	25.5VDC*	125VDC	±15%
90P1X24DC24FC90W	20-32	DC	20%	25.5VDC	24VDC	±5%
90P1X48DC48FC100W	40-64	DC	20%	25.5VDC	48VDC	±5%
90P1X48DC24FC100W	40-64	DC	20%	25.5VDC	24VDC	±5%
90P1X125DC24FC80W	105-140	DC	20%	25.5VDC	24VDC	±5%
90P1X125DC125FC80W	105-140	DC	20%	25.5VDC	125VDC	±5%
90P2X120AC24FC450W	105-130	48-62	NA	25.5VDC*	24VDC	±15%
90P2X120AC48FC450W	105-130	48-62	NA	25.5VDC*	48VDC	±15%
90P2X120AC125FC450W	105-130	48-62	NA	25.5VDC*	125VDC	±15%
90P2X240AC24FC450W	210-260	48-62	NA	25.5VDC*	24VDC	±15%
90P2X240AC48FC450W	210-260	48-62	NA	25.5VDC*	48VDC	±15%
90P2X240AC125FC450W	210-260	48-62	NA	25.5VDC*	125VDC	±15%

*System voltage: input is AC, full wave-rectified with no filter.
V effective is 25.5V RMS. DC voltage (AVE) is approximately 23 volts.

MODEL NUMBER	INPUT VOLTAGE RANGE	FRE-QUENCY	MAX. ALLOWED RIPPLE	NOMINAL SYSTEM BUS VOLTAGE	NOMINAL FIELD CONTACT VOLTAGE	REGU-LATION LINE & LOAD
90P3X120AC24FC80W**	105-130	48-62	NA	25.5VDC*	24VDC	±15%
90P3X120AC125FC80W**	105-130	48-62	NA	25.5VDC*	125VDC	±15%
90P3X220AC24FC80W**	210-234	48-62	NA	25.5VDC*	24VDC	±15%
90P3X220AC125FC80W**	210-234	48-62	NA	25.5VDC*	125VDC	±15%
90P18X*	SEE DOCUMENT 900383					

**90P3* for use with Power Transfer card, 90PT1.

4.4 SERIES 90 POWER FILTER SPECIFICATIONS

MODEL NUMBER	INPUT VOLTAGE RANGE	CURRENT (A) MAX	OUTPUT VOLTAGE RANGE	CURRENT (A) MAX	FC VOLTAGE	CURRENT (A) MAX
90FT2X24DC24FC500W (REMOTE MOUNTING)	24-32 VDC	20	24-32 VDC	19	24-32 VDC	1.0

MODEL NUMBER	FC VOLTAGE	CURRENT (A) MAX	OUTPUT WATTS	VOLTAGE TO SIGNAL CONTACTS IS NOT ISOLATED FROM SYSTEM SUPPLY BUT IS FUSED SEPARATELY.
90FT3X24FC125W (INTEGRAL MOUNTING)	24 VDC	5	125	
90FT3X1LT24FC125W	1LT (OPTION) REQUIRED FOR PUSHBUTTON ASSY. WITH LAMP TEST PUSHBUTTON			
90FT3X1PB24FC125W	1PB (OPTION) WIRED FOR PUSHBUTTON ASSEMBLY			
90FT3X1PL24FC125W	1PL (OPTION) WIRED FOR "POWER ON" LAMPS			

4.5 SERIES 90BT* BUMPLESS POWER TRANSFER SPECIFICATIONS (REMOTE MOUNTING)

90BT1X24DC*FC . . . . . NON-ISOLATED FC VOLTAGE, 24VDC LOGIC VOLTAGE, 24VDC OR 125 VDC FC VOLTAGE.

90BT2X24DC24FC . . . ISOLATED FC VOLTAGE, 24VDC LOGIC VOLTAGE, 24VDC FC VOLTAGE.

4.6 SERIES 90 POWER TRANSFER SPECIFICATIONS (REMOTE MOUNTING)

MODEL NUMBER	INPUT VOLTAGE		INPUT CURRENT (A) MAX	OUTPUT VOLTAGE		OUTPUT CURRENT	
	LOGIC	FC		LOGIC	FC	LOGIC	FC
90PT2X24FC450W	24	24	20	24	24	19.6A	0.4A
90PT2X125FC450W	24	125	20	24	125	19.6A	0.4A

4.7 SIGNAL INPUT SPECIFICATIONS

Surge Withstand Capability: Signal contact voltages of 24V or higher tested and passed per IEEE 472-1974 (SWC).

Radio Frequency Interference Susceptibility: Systems with K, NL and T type signal inputs and 120 VAC power input (all external wiring shielded) tested and passed SAMA PMC 33.1-1978, Class 1, Bands b & c (10 volts per meter from 50 MHz to 1000 MHz).

4.7.1 TYPE T AND NL INPUTS

Nominal Input Voltage	Minimum Maximum Signal Input Voltage	Maximum Input Voltage* Component Damage	Maximum Current	Maximum Series Resistance	Minimum Leakage Resistance	Minimum Switching Threshold	Maximum Switching Threshold
12VDC	10-14	24V	3mA	6.5K	60K	4.6V	7.5V
24VDC	20-28	48V	3mA	6.5K	45K	6.6V	10.8V
48VDC	40-56	96V	3mA	5.0K	65K	16.9V	27.6V
125VDC	105-140	140V	3mA	5.0K	150K	46.9V	76.5V

4.7.2 TYPE KN INPUTS

5VAC/DC	4-6	10V	2.5mA	.5K	20 K
12VAC/DC	10-14	24V	3.5mA	5 K	50 K
24VAC/DC	20-28	48V	3.5mA	10 K	75 K
48VAC/DC	40-56	96V	2.5mA	10 K	125 K
120VAC	100-130	138V	3mA	10 K	110 K
125DC	105-140	187V	1.5mA	10 K	200 K

*without component damage or false operation

NOTES:

1. Signal contact series resistance (maximum resistance of wiring and contacts to be recognized as a closed contact).

Signal input leakage resistance (minimum resistance in parallel to input terminals to be recognized as an open contact).

Maximum series resistance and minimum leakage resistance values are valid if field contact voltage is ±15% of nominal.

2. Inputs of 24V or higher have been tested to meet or exceed the requirements of IEEE-472-1974 and ANSI c.37.90-1978 without damage or false indication.

3. Isolation voltage rating for KN input opto-isolator is 1066VRMS continuous and 1770VRMS surge.

4. Above switching thresholds are the minimum and maximum voltages at the input terminals between which all cards are guaranteed to recognize a change of state.

4.7.3 TYPE "KNA" INPUT

The type "KNA" input is designed for series contact monitoring only. A maximum of (9) 120VAC contacts may be monitored. See DWG 91450-KNA-1A.

4.7.4 SPECIAL MODEL "KNB" (Narrow Switching Range)

Nominal V.	Min. V. - Max. V.	Max. Current
120VAC	105 to 130	3mA

Distributed capacitance along field contact wires may cause residual AC voltage of sufficient magnitude to prevent the opto-isolator input from de-energizing even though the field contact is open.

By careful selection of component values, the special "B" version card will de-energize at a higher point terminal input voltage (approx. 90VAC). In most applications, this will compensate for the negative effects of residual voltage.

This phenomenon does not occur when using D.C. source voltage.

4.8 OUTPUT SPECIFICATIONS

4.8.1 RELAY - FORM A, B, or C

Contact Rating - 3A at 28VDC or 120VAC resistive

Isolation - 750VAC RMS across open contacts, 2000 VAC RMS from contact to coil (system logic)

While the relay contact outputs are designed and tested to meet the requirements of IEEE472, field experience has shown that transients from some inductive loads can be more disruptive than IEEE472. Panalarm P/N "90ATB14" is recommended across the active relay contacts when switching inductive loads, if transient problems are experienced or expected.

4.8.2 OPTO-ISOLATED OUTPUTS (KT, KC, KE)

Output Transistor Ratings

Max Voltage - 30 VDC

Max Current - 10mA

VCE Sat - less than 0.3 volts at 5mA

Dark Current - 50nA @ 10VDC, 25° C

10uA @ 10VDC, 75° C

Isolation - 1750V RMS between output transistor and system logic

4.8.3 ELECTRONIC OUTPUTS (EA, EB, EC, ED, EE, EF, EG, EH, EJ, EL)

Output Transistor Rating

Max Voltage - 20VDC (24 max)

Max Current - 10mA

VCE Sat - less than 2.0V @ 10mA

Leakage Current - 5 μA

Current Limiting - approximately 25mA

Note: These outputs are open-collector NPN transistors internal to the integrated circuit and an external pull-up resistor is always required. Outputs are NOT isolated from the system.

4.8.4 LAMP OUTPUT

Driver Transistor Rating
Max Voltage - 45VDC
Max Current - 320mA (up to 8-#85 lamps)
Configuration - open collector NPN transistor, active low. Integral lamps connect directly, remote lamp outputs are diode coupled from collector to customer terminal.

Note: A keep-alive resistor on the sequence cards shunts the transistor and heats filaments when lamps are off.

4.9 TIME DELAY (RESPONSE TIME AND RESOLUTION)

4.9.1. RESPONSE TIME

Response time is defined as the time between application of a step voltage at the input and the sequence logic activation. With the exception of opto-coupled inputs, cards will not respond to signals shorter than the response time. Standard response time is 20mS±3mS. (Ref. para. 3.6.4).

When opto-coupled inputs are used, the input circuit affects the response time to steady-state and momentary events. The actual response time is the stated response time **plus** the effect from the chart below. Note that in some cases, the response time is **shortened.**

Opto-coupled input response time

	Steady State		Momentary	
	N/O	N/C	N/O	N/C
DC	+3mS	+7mS	-7mS	+7mS
AC	+(3mS+½Cyc)	+(7mS+½Cyc)	-(3mS+½Cyc)	+(3mS+½Cyc)

4.9.2 RESOLUTION

Resolution time is defined as minimum time between the start of two signals in a First Out group required by the system to recognize only the first occurring signal as First Out. Resolution time is 6mS for standard time delay, and 25% of specified delay for other delay options. when opto-isolated inputs are used, resolution time for first out sequences will be stated above PLUS either 10mS (DC signals) or 1 cycle (AC signals).

4.9.3 TIME DELAY OPTIONS (Ref. Para. 3.9.3)

		Time Delay on Alarm			Delay on Return or Test**
1	ATD	5	to	50ms	
2	ATD	20	to	500ms	
3	ATD *	0.2	to	5 sec.	Less than 3ms
4	ATD	2	to	50 sec.	Less than 3ms
5	ATD	20	to	500 sec.	Less than 3ms
1	FTD	1	sec		Less than 3ms
2	FTD	2	sec		Less than 3ms
3	FTD	5	sec		Less than 3ms
4	FTD	10	sec		Less than 3ms
5	FTD	20	sec		Less than 3ms
6	FTD *	50	sec		Less than 3ms
7	FTD	100	sec		Less than 3ms
8	FTD	200	sec		Less than 3ms
9	FTD	500	sec		Less than 3ms
12	FTD	2ms			
13	FTD	5ms			
14	FTD	10ms			
Standard		20ms			
16	FTD	50ms			
17	FTD	100ms			
18	FTD	200ms			
19	FTD	500ms			
FTD Tolerance		+12.5%			

***Note:** Not available on twinpoint cards.

****Note:** Hold TEST pushbutton for twice the time specified above when testing long time delays. Time delays not specified are the same as "ALARM".

Note: Single point cards 12FTD through 19FTD and 1ATD & 2ATD equal time delay occurs on alarm, test and return to normal. 1FTD through 9FTD and 3ATD through 5ATD time delay occurs on alarm only. Twin point cards 1FTD through 19FTD time delay on return to normal and test are the same time delay as alarm.

4.10 PUSHBUTTON INPUTS

Pushbuttons required for any sequence are always connected to main bus terminal blocks and system common (OV).

Contact: N.O. (Normally open)
Load Rating: 12 volts at 1.4mA/point
Signal Level: Active, 0 to 3 VDC
Inactive, 6.8 to 12VDC

Pushbuttons are interlocking by internal logic on all sequences. Operating a pushbutton out of its proper order will not affect the sequence cards.

4.11 ENVIRONMENTAL SPECIFICATION

4.11.1 OPERATING TEMPERATURE RANGE

0 to 50° C Ambient

Temperature: Power Supply, CSA Certifications (Canadian production only) based on rated load at 0 to 25°C ambient, with brief excursions to 40°C permitted — For operation to 50°C consult factory.

4.11.2 STORAGE TEMPERATURE RANGE

-40° C to +85° C

4.11.3 HUMIDITY

5% to 95% Non-condensing

PART 5
INSTALLATION

5.1 INSTALLATION LAYOUT

The installation layout for the equipment is determined by the facilities available. When planning an installation layout, sufficient clearance for wiring and cabling, and for servicing, should be considered.

5.2 UNPACKING AND HANDLING

5.2.1 Reasonable care should be taken in unpacking the equipment. Remove the cabinet and place on a flat surface. Never place cabinet with nameplates down.

5.2.2 Inspect all packing material before discarding. Clamps and auxiliary hardware are normally packed with the main chassis.

5.2.3 Inspect all equipment for dents or scratches.

5.2.4 Inspect nameplate windows for cracks or scratches.

5.3 PRE-INSTALLATION CHECK

5.3.1 System operational testing has been performed at the factory prior to shipment. If pre-installation testing is deemed necessary, the procedure outlined in subsequent paragraphs should be followed.

5.3.2 Place equipment on a work bench and connect power supplies, pushbuttons and audible devices according to the wiring diagrams supplied with the equipment. Check wiring carefully before connecting power.

5.3.3 If it is required to set contact for NO or NC field contact operation, lock-in or non-lock-in, or relay outputs for normally energized or de-energized operation at this time, refer to Part 7 for setup procedure.

5.3.4 Turn on power and clear the points by operating the pushbuttons for the sequence. Because of random logic states at power up, it is sometimes necessary to operate the pushbutton sequences twice. Refer to the sequence wiring diagram supplied with the equipment for sequence operation. If points are set for N.O. operation, all lamps will be off. If points are set for N.C. operation, they will remain in alarm but the sequence may be advanced until all lamps are steady-on.

5.3.5 Push TEST pushbutton. All points will revert to the initial alarm state, even though some may be in alarm. Complete the sequence to off or steady lamps.

5.3.6 If further testing is required, it will be necessary to simulate field operation. This can be done by connecting a SPST switch from FC of the power supply to the input of the sequence card according to the input wiring diagram supplied with the equipment.

5.3.7 With the simulated field contact connected, the complete sequence can be tested. Alarm the card and check all steps of the sequence for proper operation. Return the input to normal and complete the sequence.

5.3.8 Push TEST and then alarm the card. After ACK or FLASH RESET, the point will re-alarm.

5.3.9 Relay outputs may be tested with a continuity tester across the output terminals. Check for proper operation according to the Operational Mode, contact form, and normally energized or de-energized mode. It may be necessary to pull the card to make certain the normally de-energized or energized (DE-EN) jumpers are in the proper position.

5.3.10 To test relay lockout, connect a switch from the lockout terminal to OV. When the switch is closed, the relay will remain in its state at time of lockout, despite the point status.

5.3.11 To test opto-isolator outputs, an external circuit must be connected (see figure 8). For KT, a resistor, (2.5K), to 12VDC may be used. It may be connected as either a collector pull-up or as an emitter follower. Connect a voltmeter across the collector and emitter to determine that the opto-isolator is functioning according to its operational mode. For KE and KC, the resistor is on the sequence card. Connect the power supply to the proper terminals and the voltmeter across the transistor.

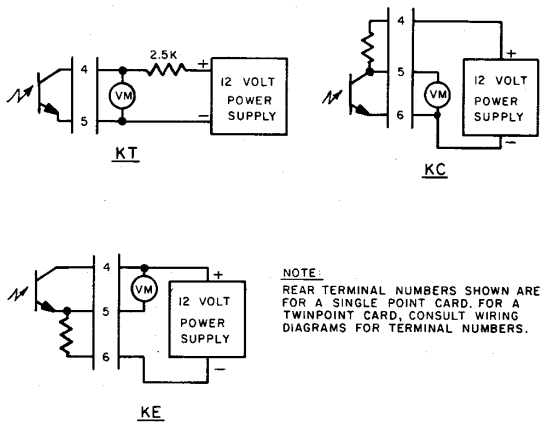
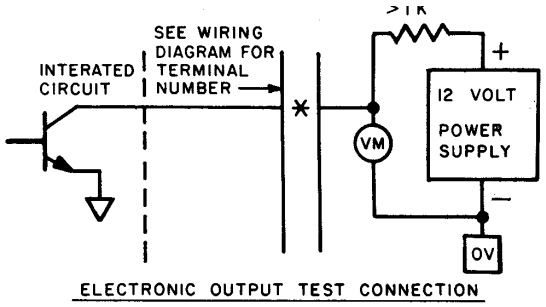


FIG. 8

5.3.12 To test electronic outputs, connect a voltmeter from the proper output terminal to OV, and connect a pull-up resistor, 1K or larger from the same terminal to a 12V supply. (see figure 9). The negative of the external supply must be connected to the system OV terminal. The meter will read 12 volts in normal and approximately one volt when the point is in alarm. Check for proper operation according to its operational Mode.



ELECTRONIC OUTPUT TEST CONNECTION

FIG. 9

PART 6
FINAL INSTALLATION AND WIRING

6.1 WIRING

6.1.1 Install and wire the annunciator in accordance with drawings furnished with the equipment, and in accordance with prevailing electrical codes and standards.

6.1.2 The use of shielded or twisted wires is not required for signal contact wiring. However, the wires should not be run in cable trays with other wiring carrying 440 volts or higher.

6.1.3 When remote power supplies are used, consult the power supply wiring diagram for recommended wire sizes for connecting the power supply.

6.1.4. The annunciator is furnished with insulation piercing screw assemblies for factory wiring. All other terminals will have #6 binder head screws. If making changes to factory wiring, make certain that the insulation piercing collar has bottomed out but do not force. In most installations, 16 AWG (1.5mm^2) is adequate for all wiring except power wiring. One 14 AWG (2.5mm^2 per terminal is the largest size which can be used with the insulation piercing terminal. If it is necessary to use ring tongue or spade lug; the lug may be placed under the piercing assembly or the assembly may be replaced with a 6 - 32 screw no more than one-half inch long.

6.1.5 When installing remote lamp cabinets which may be considerable distance from the power supply and the annunciator system, the +24V lamp feed may require more than one wire. Since all lamps will normally be on only when testing, one 14 AWG (2.5mm^2) wire will be sufficient for up to 100 points for distances up to 100 feet. For larger systems or greater distances, additional wires should be added. For individual lamp control wires, 16 AWG (1.5^2) may be used up to 1050 feet, 18 AWG (0.75mm^2) up to 700 feet, 20 AWG (0.5mm^2) or 22 AWG (0.4mm^2) up to 300 feet.

6.1.6 Connect all power wiring, input wiring, output wiring and auxiliary devices according to the set of wiring diagrams supplied with the equipment. For First Out sequences, connect group terminals as required. Wire bundles should be dressed and tied following standard industry practices and procedures. Heavy wire bundles may require clamps and/or supports for strain relief.

6.2 HIGH POTENTIAL TESTING INSTRUCTIONS

6.2.1 Carefully check all wiring. If hi-potting is required it should be done before power is turned on in accordance with the following procedure:

CAUTION

Any assembly containing semiconductor devices can be permanently damaged by application of high voltages. Before hi-potting, complete the following steps:

6.2.2 Remove lamp boxes and disengage or remove all printed circuit cards. If cards are left in guides make certain that electrical connection is broken. Pull out at least one inch.

6.2.3 Disconnect all wiring at the remote power supply. If integral supplies are used, disengage from connector. If a power transfer card is used, make certain it is disengaged.

6.2.4 Disconnect any other equipment from the system which may have semiconductor assemblies, (e.g., 90AX* relays, Novatone horns, 90 ATB), etc. If other devices are connected to annunciator terminal blocks or outgoing terminal blocks, they should be disconnected.

6.2.5 The wiring may now be hi-potted at 1500VAC maximum for one minute to be sure that the system has no ground faults or wiring shorts.

6.2.6 After completion, carefully reconnect the disconnected wiring and reinstall cards and assemblies.

PART 7
SETUP INSTRUCTIONS

7.1 GENERAL

To achieve desired system operation, the user may be required to set USER CHANGEABLE options by moving jumpers on various cards.

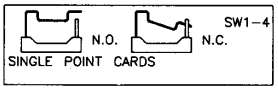
7.2 ACCESS AND ADJUSTMENT

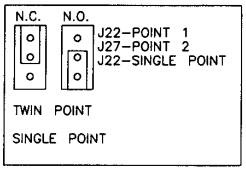
To check or change any jumper options, first remove lamp box (see Figure 10), and then remove sequence card (see Figure 11). Check position of all jumper blocks or dip-fix switches on the card (see Figures 12 thru 18 for location). To change, pull jumper block straight up and place over the center pin and either end pin of the three terminal header according to the marking on the card. For explanation of various settings see sections below.

7.2.1 NO/NC SELECTION

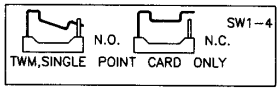
All input types should be set for N.O. or N.C. operation as required before the system is placed in operation. On twinpoint cards each input can be independently selected for N.O. or N.C. operation. Selection for N.O. contacts indicates that the point will indicate NORMAL until a voltage appears at its input.† In general this selection should be made only when the point is not considered critical, (e.g., when loss of alarm indication due to a cable break would be tolerable). Selection for N.C. contacts indicates that the point will indicate NORMAL until the voltage is removed from its input. Cable breaks or other causes for loss of this input voltage will indicate an ALERT condition. (Factory set for N.O.).

Sequence cards with "DM" inputs (for use with meter set analog cards) will be sent for N.O. operation at the factory and is not field selectable.



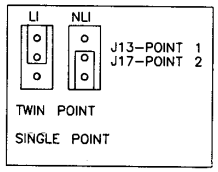


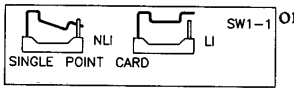
† TWM input option will monitor field wiring for open or shorts whether using N.O. or N.C. field contacts.



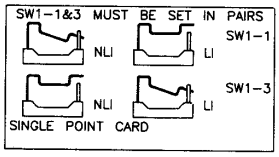
7.2.2 LOCK-IN (LI)/NON-LOCK-IN (NLI) SELECTION

Sequence cards for AF1 or AF5 sequences include the option of lock-in (LI) or non-lock-in (NLI), and are factory set for lock-in unless specified by the user. For description of this feature, see Part 2. On the twinpoint cards, each input can be independently selected for NLI or LI operation.



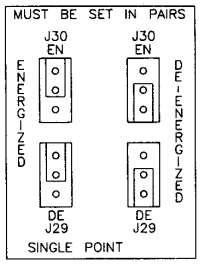


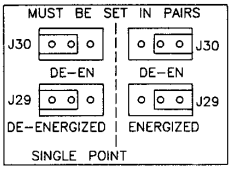
or

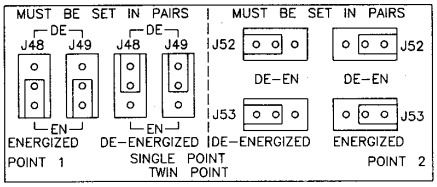


7.2.3 NORMALLY ENERGIZED/NORMALLY DE-ENERGIZED SELECTION

Cards with relay or opto-isolated output options must be selected for normally energized (EN) or normally de-energized (DE) operation. Normally de-energized operation indicates that the relay (or opto-isolator) will be de-energized or off in the normal condition. Under this condition, no indication is given if a component or system power should fail. In normally energized mode, the relay is powered in the NORMAL condition and will drop out or turn off if an ALERT or power failure condition occurs. On twinpoint cards each relay or opto-isolated output can be independently set for EN or DE operation, (factory set for EN).

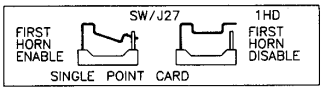


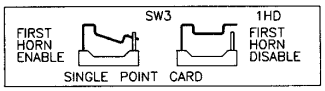


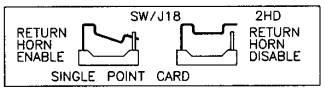


7.2.4 HORN DISABLE

Sequence cards with horn disable option can be set to have the horn enabled (switch closed) or disabled (switch open). Horn disable may be selected on an individual card, and horn basis.

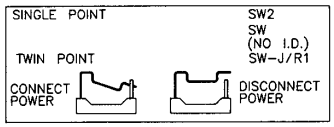






7.2.5 POWER DISCONNECT

Power disconnect switches are used to disable sequence cards on a point by point basis. Power disconnect should be used ONLY when the intent is to remove a point from service.

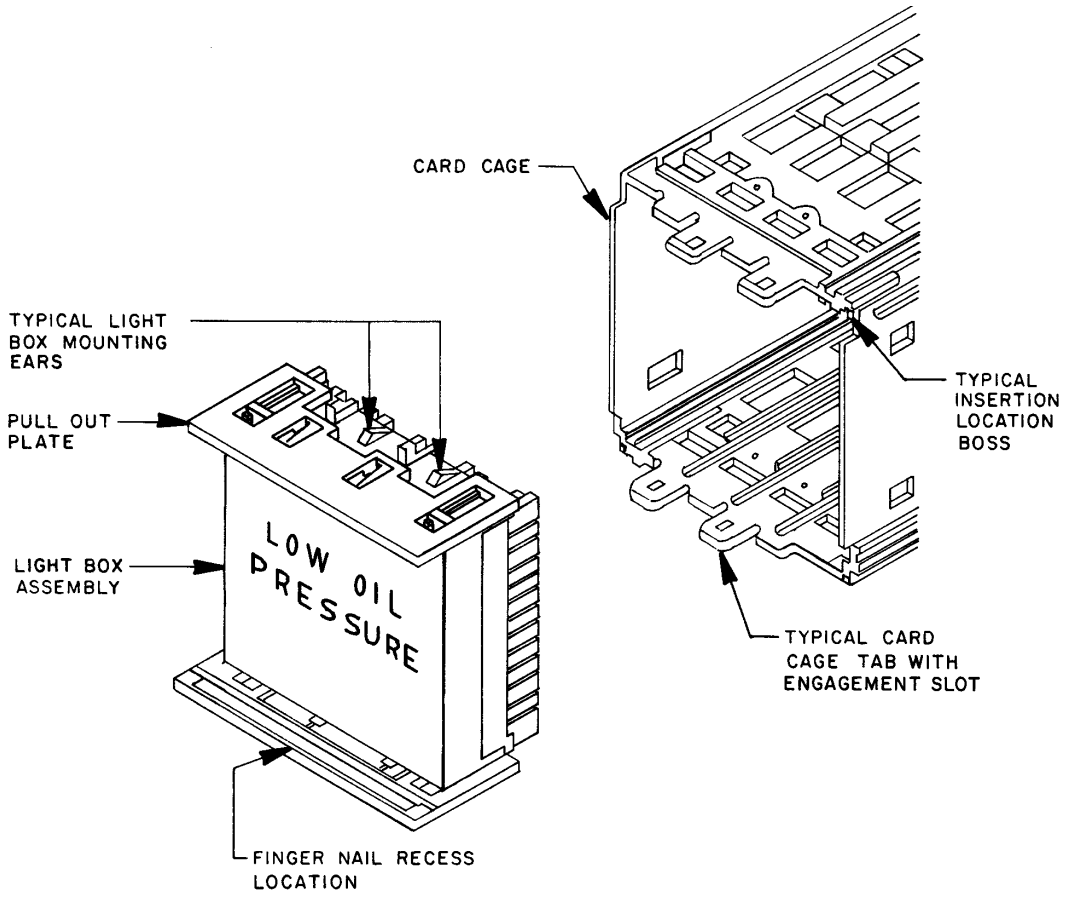


7.3 REASSEMBLY

After all jumpers are placed in their proper position, re-insert sequence cards and replace lamp boxes. If all point cards are not to be set for the same operation, it is important that cards are inserted into the proper customer selected position.

7.4 SPARE CARDS

If spare cards are inserted into the system (without signal contact wiring), they should be set for NO operation on the input. These cards will then be tested with the active cards and will clear to the OFF condition. To minimize power consumption of spare cards, select the DE operation if these cards have relay or opto-isolator output options.



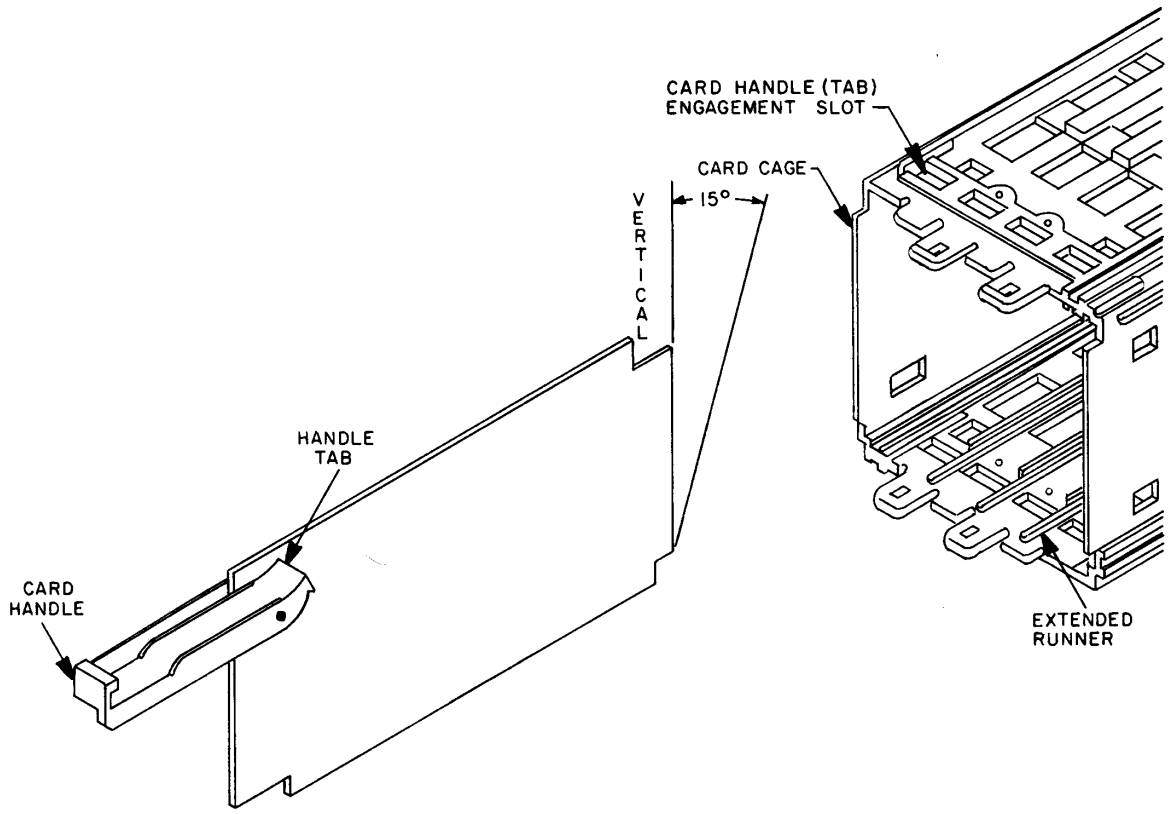
LIGHT BOX INSTALLATION OR REMOVAL FIG. 10

To Install

Step 1. Make sure light box assembly is right side up (see orientation arrows inside light box behind nameplate).
Step 2. Hold light box assembly with front nameplate surface as parallel to front panel surface as possible and slowly insert assembly into associated card cage.
Step 3. Each rear corner of the assembly should fit into the card cage corners and be guided by the insertion location bosses on the front of the card cage.
Step 4. As insertion resistance is met, increase insertion pressure (while maintaining nameplate parallel to the front panel surface) until the assembly snaps into place and is retained by card cage tabs holding light box mounting ears.
Step 5. Push in on each end of pullout plates until they are almost flush with nameplate surface and fit up against the card cage location bosses.

To Remove

Step 1. Slide out both pullout plates of light box to be removed by engaging finger nail into front recess of pullout plate and pulling plate out about 1/2" until resistance is met.
Step 2. Grasp both upper and lower pullout plates and give a sharp pull on light box assembly which will disengage from card cage.



CARD INSERTION OR REMOVAL FIG. 11

To Insert

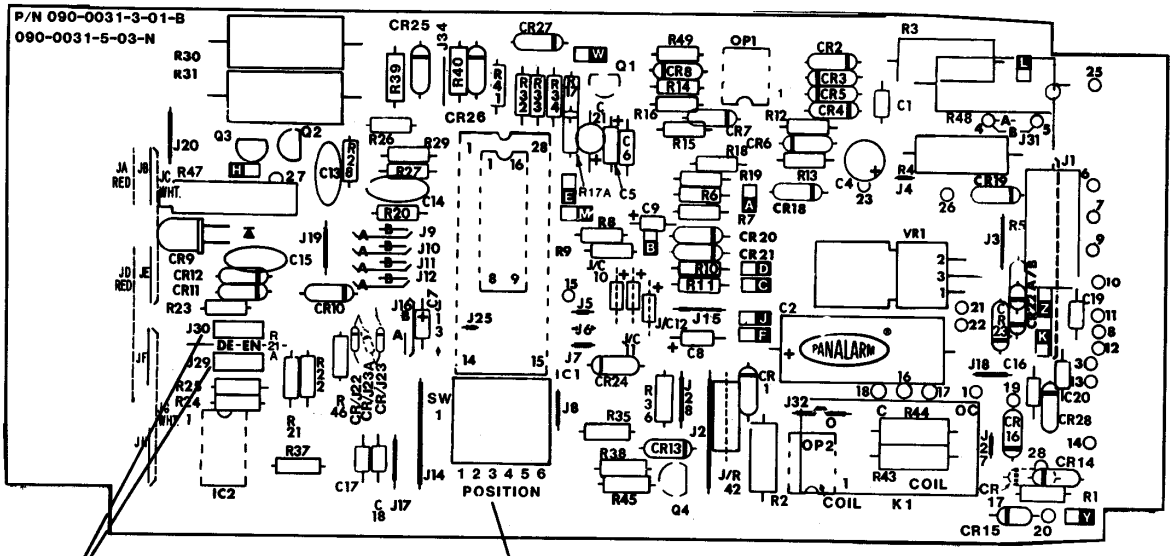
Step 1. Note that each pair of top or bottom card slots has one runner that extends further forward in the card cage.
Step 2. Hold card to be inserted so that it is rotated about 15° from vertical (as shown) and insert about 1-1/2" into card cage at correct slot location.
Step 3. Rotate card to vertical and it will stop in place against the extended top and bottom runners.
Step 4. With card handle parallel to top edge of card (as shown) push card deeply into card cage until notch on card handle strikes front edge of the extended runner.
Step 5. Swing handle slowly down to engage handle tab in engagement slot which will force card into socket connector at rear of card cage.
Step 6. To ensure complete connector engagement check that card is deep enough in card cage so that handle hangs loosely and remains flat and parallel to front edge of card after insertion pressure is relaxed.

To Withdraw

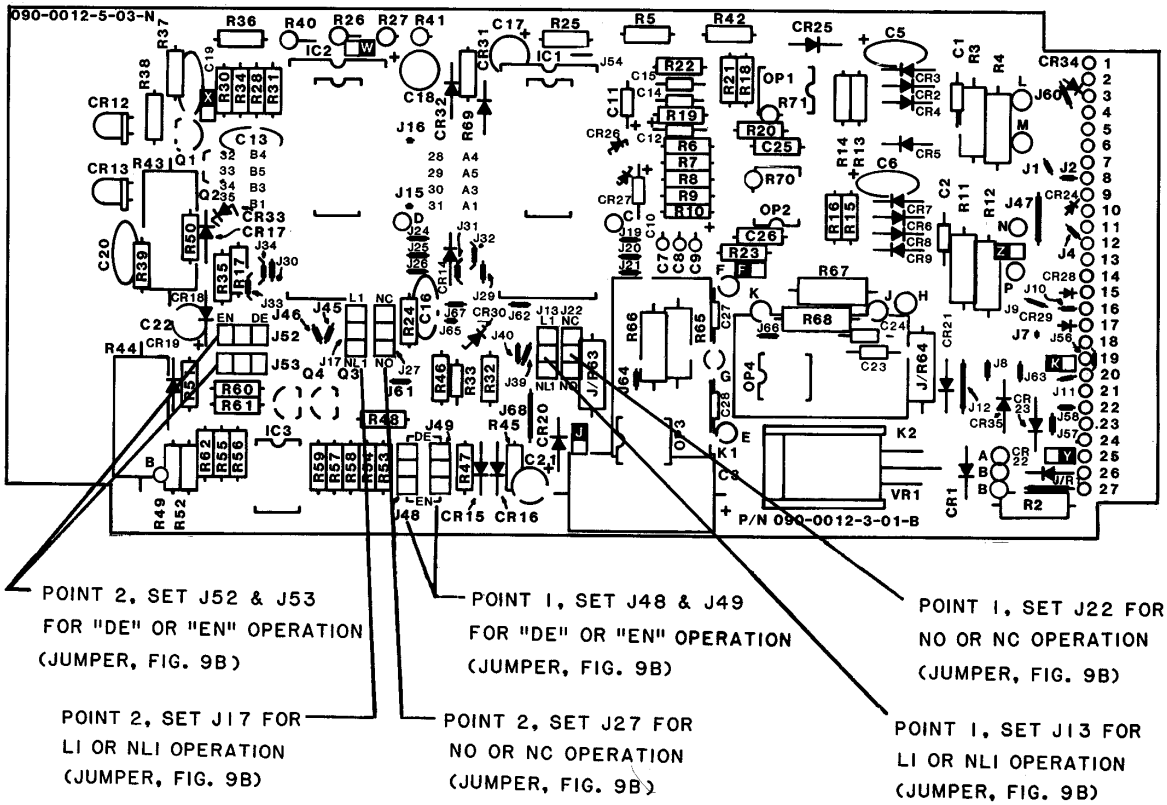
Step 1. Grasp handle of card to be withdrawn and swing slowly up until parallel with top edge of card thus engaging handle tab in engagement slot and forcing card out of connector at rear of card cage.
Step 2. Withdraw card fully from card cage by pulling on card handle while holding handle parallel to top edge of card.

JUMPER LOCATION

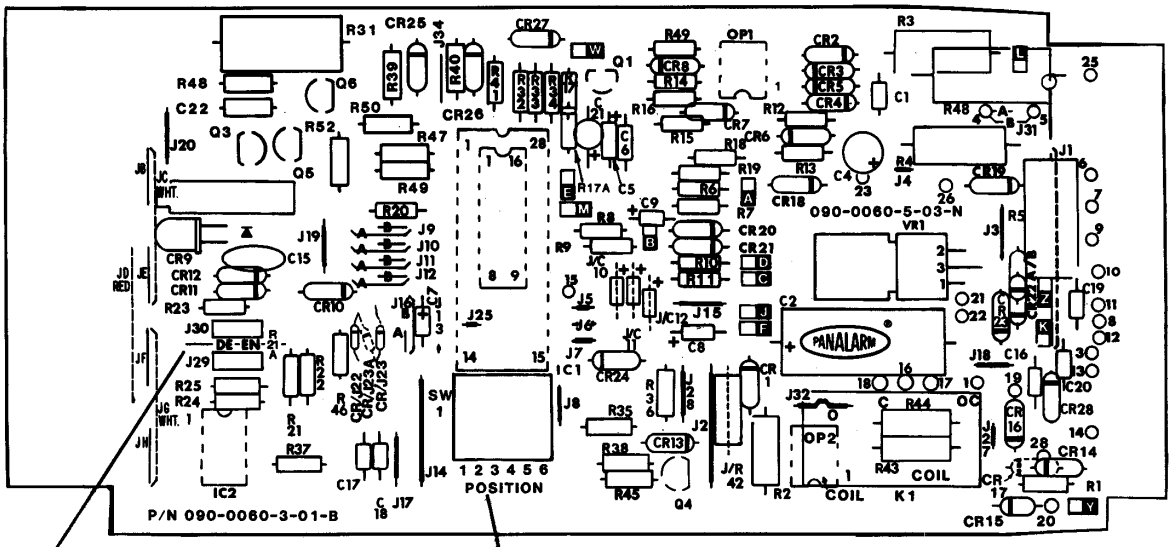
SINGLE POINT SEQUENCE CARD (0031 BOARD) FIG. 12



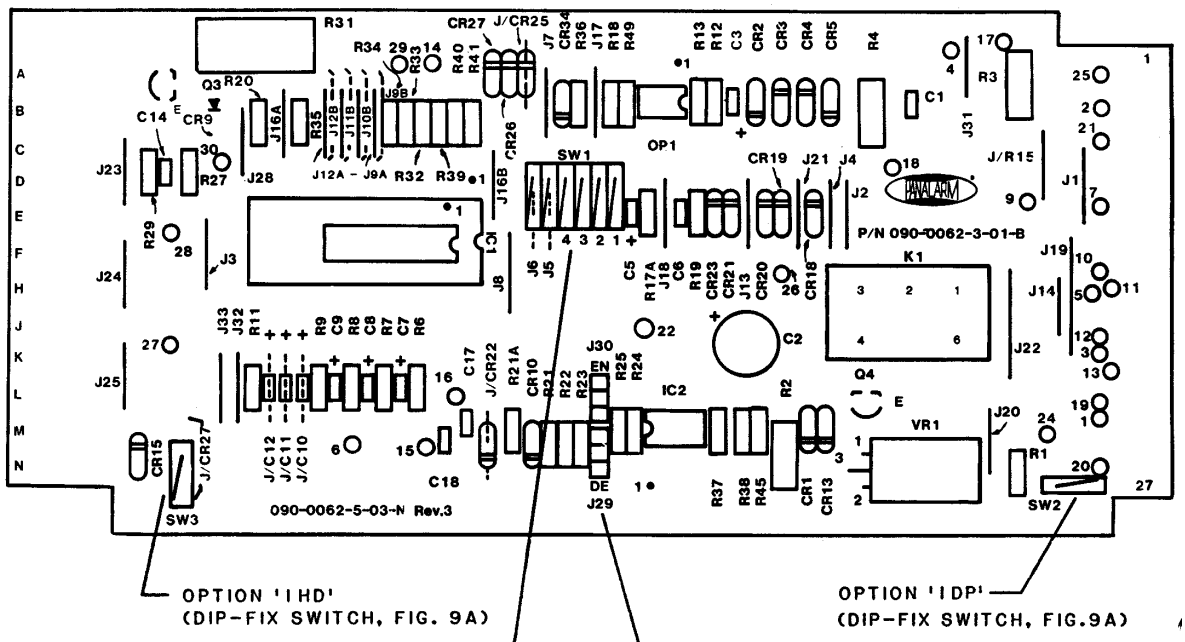
TWINPOINT SEQUENCE CARD (0012 BOARD) FIG. 13



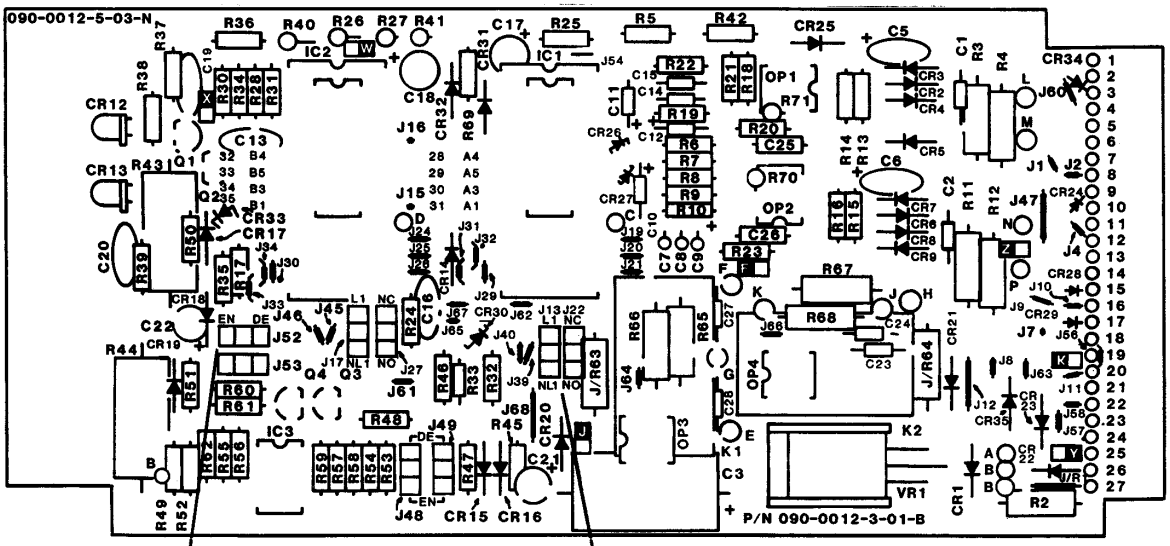
SINGLE POINT SEQUENCE CARD (0060 BOARD) FIG. 15



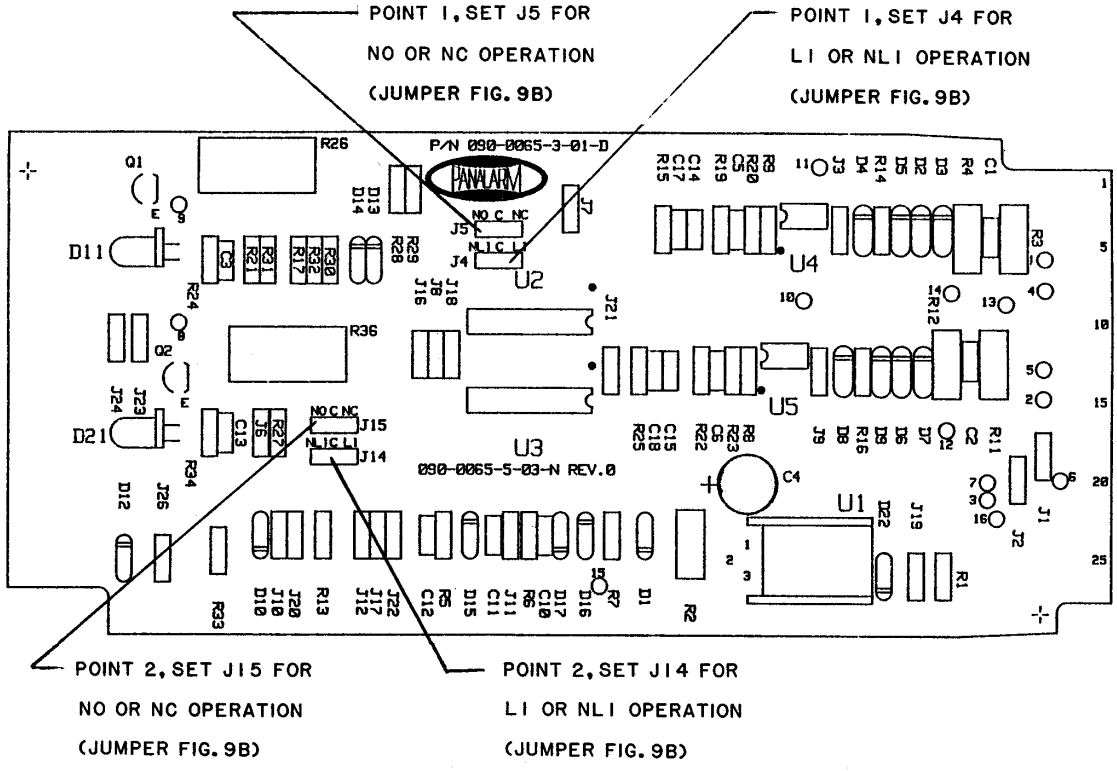
SINGLE POINT SEQUENCE CARD (0062 BOARD) FIG. 16



SINGLE POINT SEQUENCE CARD (0012 BOARD) FIG. 17



TWINPOINT SEQUENCE CARD (0065 BOARD) FIG. 18



PART 8
OPERATION

8.1 When power is first applied to the annunciator system, the sequence points can come up arbitrarily in different states of the sequence. In order to clear all latches in the internal logic of the system, it is sometimes necessary to operate the pushbutton sequence twice to bring the system to normal. This occurs because the internal test latch may have come up set, and when the lamps reach steady state, the point will realarm because of internal test. The second pushbutton operation will always clear the system and reset all internal latches. (Check document 900252 if analog cards are used).

8.2 The sequence wiring diagrams supplied with the equipment contain complete sequence information. The operator should refer to these drawings to determine the proper steps of the sequence. Pushbuttons can only be operated in order unless the sequence is a First Out sequence. The First Out reset pushbutton affects only the First Out point in a group and can be reset when desired as long as the First Out point has been silenced. Subsequent points may be cleared while retaining the First Out indication.

8.3 The system TEST pushbutton can be used to test all points in the system simultaneously. All normal points will test and any points in alarm will test provided the sequence has been advanced to a steady lamp state. Any point with flashing lamps will not accept the test input. When the test sequence has been completed, points that were in alarm will remain in alarm. For First Out sequences, all points will come up first out in test mode unless there is a First Out alarm within the group. In this event, all points in the group will test as subsequent alarms.

8.4 If an alarm occurs while in a test sequence, the point will indicate alarm after ACK or FLASH RESET of the test sequence. However, any of the output options will respond to the alarm immediately.

PART 9
MAINTENANCE

9.1 SERVICE

Solid state circuitry is used throughout Series 90 annunciator systems to ensure long life and trouble-free operation. No maintenance is necessary except for lamp replacement. Equipment may be returned to the factory for service or repair. Consult the factory or your local representative for instructions.

9.2 LAMP REPLACEMENT

All windows are illuminated by two lamps in parallel except for single windows where four lamps are utilized because of the large window areas. It is recommended that test should be preformed periodically to determine that lamps are good. If the window appears shaded during test, a lamp needs replacing. Each nameplate has a coin or screwdriver slot along each vertical edge. Snap the name plate off and replace the lamp. A keep-alive current is supplied to all lamps to reduce turn on current surges. It will be noted that the filaments of good lamps will glow in the normally off state. A defective lamp will cause its mate to glow brighter. The defective lamp should be pulled straight out. Do not turn. The replacement lamp is pushed in while holding the wide part of the base horizontal. Lamps should be replaced only with all glass wedge base, type 1 3/4, PANALARM pP/N 430039. Use lamp removal tool P/N 430037 for removal and insertion of lamps

CAUTION!

BEFORE RECLAMPING, REMOVE POWER FROM SYSTEM OR REMOVE LIGHTBOX FROM CABINET. Alternatively, if lamp outputs are from sequence cards (Power-On lamps excluded), relamp only when point is in "NORMAL" (not flashing or steady-on).

9.3 FUSE REPLACEMENT

9.3.1 Integral power supplies must be removed from the module to replace a fuse. See illustration of card replacement. Remove the power supply according to these instructions and replace the fuse with the size and type on the fuse label. Integral power supplies with AC inputs are fused in the primary and the FC voltage output. Integral DC input power supplies are fused only in the input since outputs are protected by automatic shutdown. Remote AC power supplies are fused in the primary and both outputs, +24 and FC. The fuses are accessible by removing the protective cover. Push in and turn the fuse cap one-quarter turn counter clockwise to remove. Replace by aligning the tabs on the fuse cap, then push in and turn one-quarter turn clockwise to lock in place.

9.4 CARD REPLACEMENT

See illustrations for instructions for removing lamp box and replacing cards.

9.5 CALIBRATION

9.5.1 No calibration is required for the annunciator system unless analog input modules are included. For setup procedure for meter set analog cards with digital display, see Instruction Manual #900252.

9.6 ADJUSTABLE TIME DELAY (ATD) CALIBRATION (SINGLE POINT ONLY)

If adjustable time delay sequence cards have been ordered, setting to the desired time delay is required. Method of setting is dependent on the degree of precision required. A counter or EPUT meter may be used. For long time delays, a stop watch may be suitable. An oscilloscope may also be used if the time base is sufficiently accurate.

A switch connected between the FC and the signal input of the card may be used to alarm the module and trigger the timer or oscilloscope. Connect the off trigger (or oscilloscope vertical input) to the first horn bus terminal (FH on left main bus block). The start trigger will be positive if the card is set for NO operation and negative going if set for NC operation. The magnitude will be dependent on FC voltage. Use CAUTION if FC voltage higher than 24V is used. The off trigger from the horn bus will be negative going from 12VDC to OV. It is usually necessary to make several dry runs to determine that the instrument trigger is properly adjusted. Readings should be repeatable. Remove the lamp box and with a small screwdriver, adjust to required value by rotating potentiometer clockwise to increase or counter clockwise to decrease. If a stopwatch is used, start at switch closure and stop when the audible turns on. This procedure must be repeated for each point with adjustable time delay.

PART 10
TROUBLESHOOTING

10.1 GENERAL

At start-up, malfunctions will generally be caused by wiring errors. The annunciator has been designed to withstand reverse polarities, misapplication of voltages, etc., insofar as possible. In general, voltages below 30 volts should not cause failures. Misapplication of line voltage or high contact voltages may result in component damage. Wiring should be carefully checked before power-up.

Note: When the power supply operates from AC input voltage, the voltage on the +24 volt bus is rectified but unfiltered. This voltage should be nominally 25.5VRMS, but most voltmeters will read low when measuring this voltage. A reading of approximately 23 volts is typical unless the meter reads TRUE RMS. DC.

10.2 TROUBLESHOOTING GUIDE

The following information is presented as an aid to troubleshooting a malfunctioning Series 90 system. The only equipment required is a volt meter capable of reading 0-30 volts AC or DC. True RMS digital meters are preferred but not absolutely necessary.

This guide is in 4 sections; section 1 is a general operational description of the major aspects of the Series 90 annunciator, section 2 is a table of voltages listed by main bus terminal and sequence condition, section 3 is a simplified block diagram of the annunciator and section 4 consists of 3 Flow charts outlining troubleshooting suggestions for the more common problems. Problems not covered in section 4 can be tracked down in most cases by applying the information covered in section 1.

Section 1 - General Operational Description

Power Supplies

Power supplies and associated wiring must be the first items to be checked when troubleshooting. Pay particular attention to "OV" wiring - "OV" must be commoned to all chassis that share a common flasher and/or pushbuttons. Fuses that continue to blow after replacement are an indication of either short circuits or overloads. Check all bus wiring and if bus wiring and loading is correct and the fuse(s) continue to blow, remove any aux devices connected to "OV" and "+24". If this still does not locate the short, disconnect "+24" from each chassis separately to locate the chassis containing the short.

Signal Inputs

Customer terminal #1 (some options also require #2 - see applicable wiring drawing) is the signal input terminal. The logic card senses voltage or the lack of voltage at this terminal and interprets it as either a normal or alarm condition. In order for the logic to correctly interpret the input signal, the N.O./N.C. selector must be in the proper position - N.O. for signals that are present in the alarm state and N.C. for signals that are present in the normal state. Problems with cards that cannot be reset to normal or have other abnormalities in their sequence can be caused by incorrect positioning of the NO/NC selector.

Auxiliary Outputs

Refer to the appropriate customer wiring drawing for the particular output concerned for sequence of operation, ratings, output schematic and terminal location, etc.

Flasher Inputs ("FH" and "SH"):

"FH" and "SH" are **inputs** from the logic cards to the flasher. They activate the flasher output terminals #7 and 6, respectively. A low on "FH" for example, will produce a low on flasher output terminal #7. Incorrect voltage readings on "FH" and "SH" will, in most cases, be due to wiring problems on these busses, or to logic cards holding the bus low. If there are no wiring problems on the busses and all points are operating normally, removing all cards and replacing them one at a time will pinpoint the problem to the defective card.

Flasher Outputs ("FF", "SF", and flasher position terminals #6 and #7)

These terminals are outputs and are current limited at approximately 400 MA. Loads over this level will cause the entire flasher to shut down for approximately 3 seconds. While the flasher is shut down, points that would normally be flashing will be steady on, and the horn will not sound. At the end of this period, the flasher will attempt to re-start. If the overload is still present, it will shut down again, and so on. For this reason, incorrect voltage readings on the flasher outputs can usually be traced to wiring problems or overloads at the outputs, assuming that the voltage at "FH" and "SH" are correct.

NOTE:
Capacitive inputs and lamp loads will cause shut down if inrush exceeds 400 MA.

The following information is presented as an aid to trouble shooting a malfunctioning Series 90 systems. The only equipment required is a volt meter capable of reading 0-30 volts AC or DC. True RMS digital meters are preferred but not absolutely necessary.

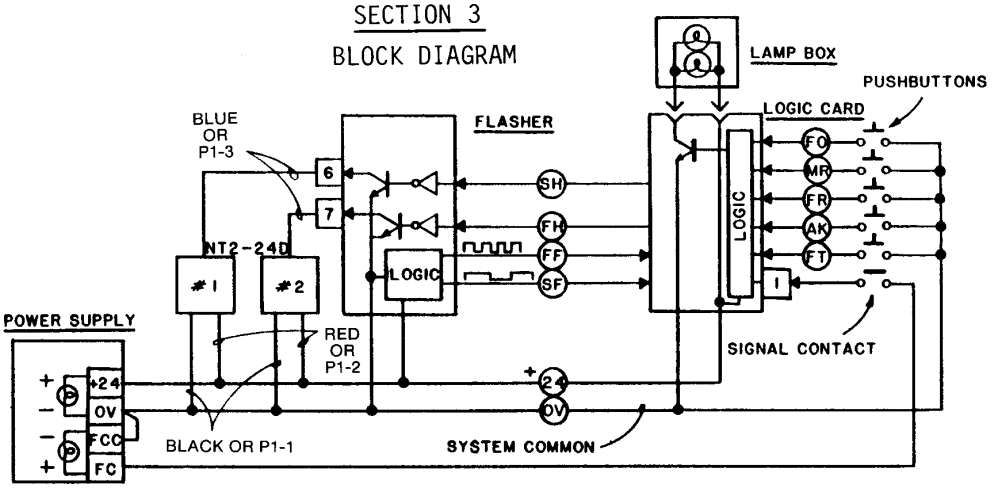
SECTION 2 SYSTEM VOLTAGES

MAIN BUS TERMINAL	CONDITION					COMMENTS (SEE NOTE 1)
	NORMAL	ALERT	ACK	RETURN ALERT	RESET	
FF FAST FLASH	6V PULSING FAST (4 HZ.)					
SF SLOW FLASH	10V PULSING SLOW (1 HZ.)					
FH FIRST HORN	12V	0V	12V	12V	12V	
2 SH SECOND HORN	12V	12V	12V	0V	12V	
FLASHER POS. TERM. 7 FIRST HORN	12V	0V	12V	12V	12V	VOLTAGES SHOWN ARE MEASURED WITH LOAD ATTACHED.
2 FLASHER POS. TERM. 6 SECOND HORN	12V	12V	12V	0V	12V	SEE NOTE 5
FT TEST	< 4V. WITH BUTTON PRESSED (0V. TYPICAL) > 8V. WITH BUTTON RELEASED (12V. TYPICAL)					CONSULT APPLICABLE FIELD WIRING DRAWING FOR PUSH-BUTTON USAGE AND CORRECT SEQUENCE OF OPERATION.
FR FLASH RESET						
MR RESET						
FO FIRST RESET						
AK ACKNOWLEDGE						
+24	24V. NOMINAL					SEE NOTE 6

1. Voltages measured with Simpson 260 and are nominal depending on power supply loading.
2. "Ringback" sequences or separate horn groups.
3. All voltages are measured referenced to "OV".
4. All voltages measured with flasher and at least one sequence card installed.
5. Horns outputs from flasher (terminals 6 & 7) require a pullup to "+24" to produce correct voltage measurements. This is normally provided by the audible device for aux relay, but if neither are wired, a 1K to 10K OHM resistor from terminal 6 or 7 to +24 will provide sufficient pullup to allow measurement between "OV" and terminal 6 or 7.
6. Any type meter may be used to measure _24 if DC input supply is being used. However, AC input supplies do not produce filtered DC output, and meters other than *TRUE RMS DC* types will not indicate correctly Generally, readings above 20 volts with AC supplies are considered normal. Typical readings will be 22-23V.

SECTION 3

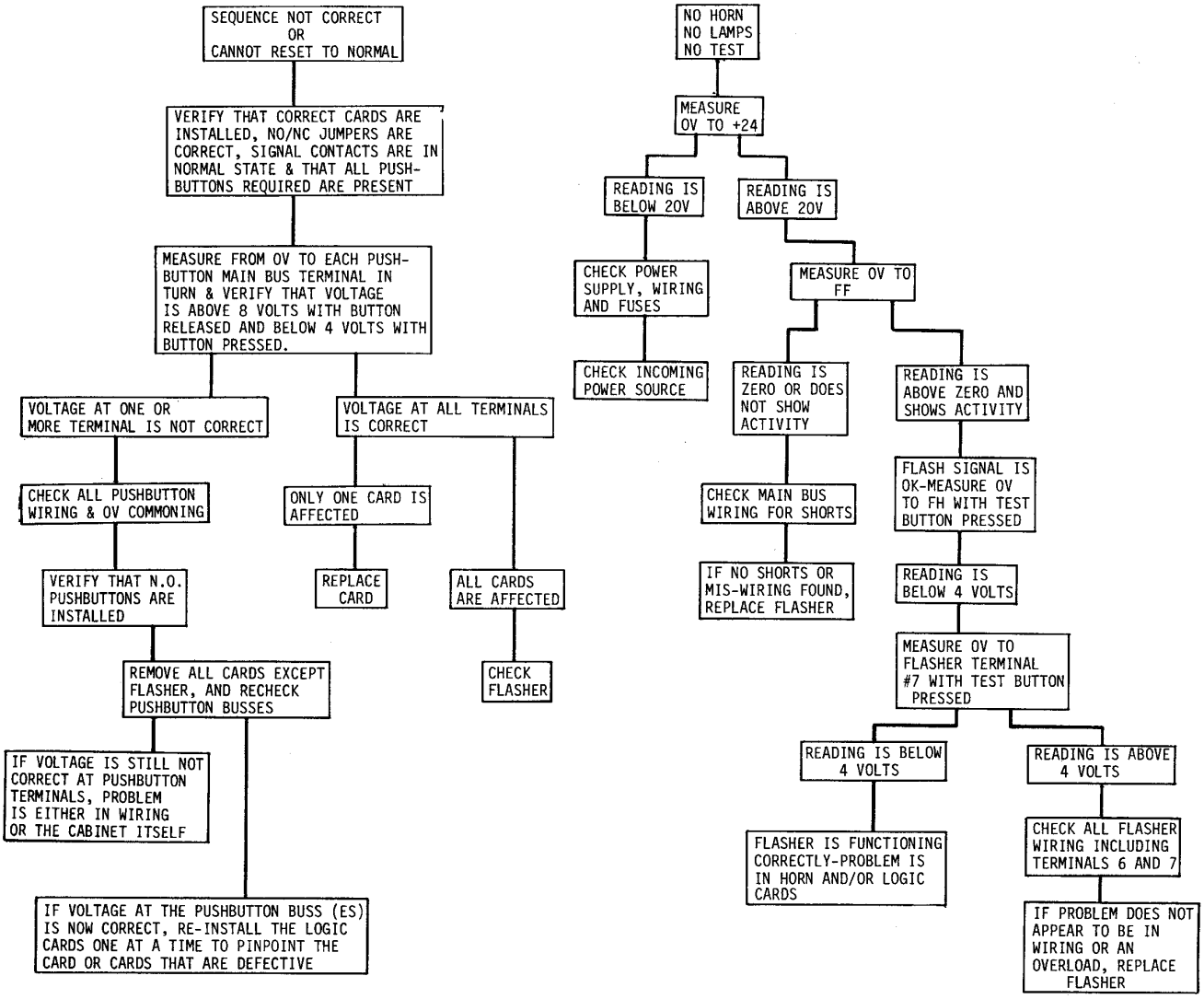
BLOCK DIAGRAM

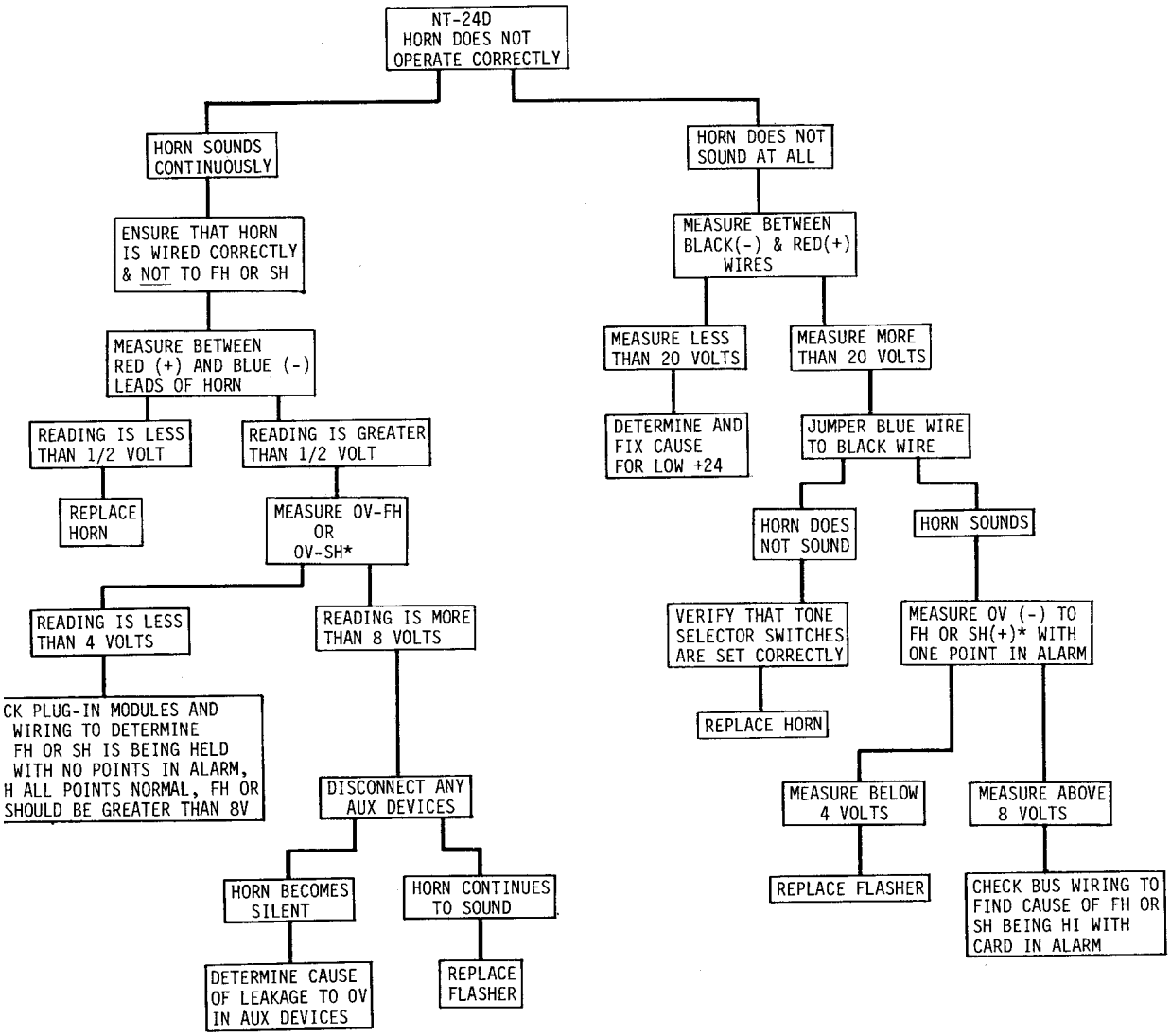


NOTE: **THE ABOVE IS A SIMPLIFIED REPRESENTATION OF THE SERIES 90 ANNUNCIATOR. FOR ACTUAL WIRING, SEE APPLICABLE CUSTOMER WIRING DRAWINGS.**

SECTION 4

FLOW CHARTS





*MEASURE OV(-) TO FH(+) IF HORN IS USED AS FIRST AUDIBLE DEVICE OR THE SOLE AUDIBLE.

MEASURE OV(-) TO SH(+) IF HORN IS THE SECOND (RING BACK) AUDIBLE.

WARRANTY
Three year warranty in accordance with terms and conditions of sale, Form AP85.

Specifications and designs subject to change without notice.