

★
MASTER COPY
UNCLASSIFIED
DO NOT DESTROY

TECHNICAL MANUAL

for

CHANNEL FREQUENCY INDICATOR

MODEL RTIA-1

(ID-1277/FRR-72)



A3794
Labw time
5 hrs.
only if we
have NW

THE TECHNICAL MATERIEL CORPORATION
MAMARONECK, N.Y. OTTAWA, ONTARIO

★

★
UNCLASSIFIED

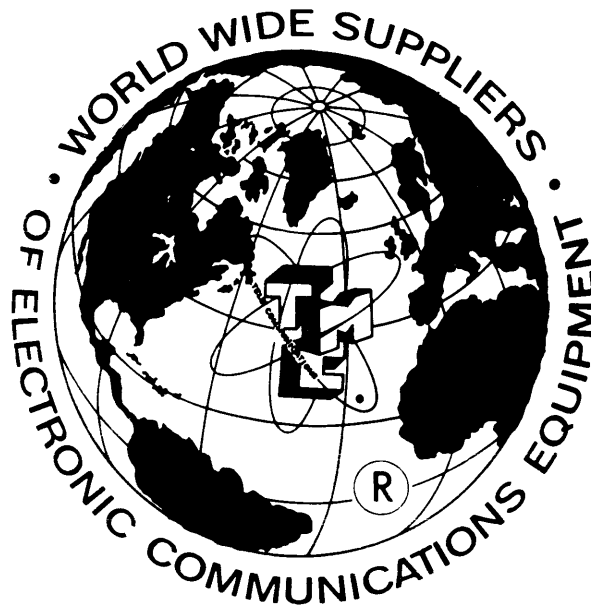
TECHNICAL MANUAL

for

CHANNEL FREQUENCY INDICATOR

MODEL RTIA-1

(ID-1277/FRR-72)



THE TECHNICAL MATERIEL CORPORATION
MAMARONECK, N.Y.

OTTAWA, ONTARIO

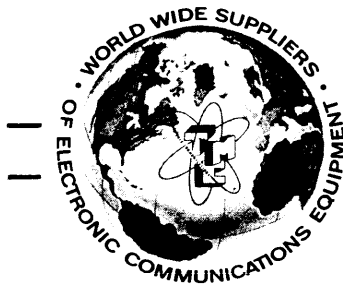
COPYRIGHT 1966
THE TECHNICAL MATERIEL CORPORATION

★
IN-4012A

ISSUE DATE: 15 September 1966

NOTICE

THE CONTENTS AND INFORMATION CONTAINED IN THIS INSTRUCTION MANUAL IS PROPRIETARY TO THE TECHNICAL MATERIEL CORPORATION TO BE USED AS A GUIDE TO THE OPERATION AND MAINTENANCE OF THE EQUIPMENT FOR WHICH THE MANUAL IS ISSUED AND MAY NOT BE DUPLICATED EITHER IN WHOLE OR IN PART BY ANY MEANS WHATSOEVER WITHOUT THE WRITTEN CONSENT OF THE TECHNICAL MATERIEL CORPORATION.



THE TECHNICAL MATERIEL CORPORATION

COMMUNICATIONS ENGINEERS

700 FENIMORE ROAD

MAMARONECK, N. Y.

Warranty

The Technical Materiel Corporation, hereinafter referred to as TMC, warrants the equipment (except electron tubes,*fuses, lamps, batteries and articles made of glass or other fragile or other expendable materials) purchased hereunder to be free from defect in materials and workmanship under normal use and service, when used for the purposes for which the same is designed, for a period of one year from the date of delivery F.O.B. factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

TMC will replace or repair any such defective items, F.O.B. factory, which may fail within the stated warranty period, PROVIDED:

1. That any claim of defect under this warranty is made within sixty (60) days after discovery thereof and that inspection by TMC, if required, indicates the validity of such claim to TMC's satisfaction.
2. That the defect is not the result of damage incurred in shipment from or to the factory.
3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise.
4. That any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

Electron tubes*furnished by TMC, but manufactured by others, bear only the warranty given by such other manufacturers. Electron tube warranty claims should be made directly to the manufacturer of such tubes.

TMC's obligation under this warranty is limited to the repair or replacement of defective parts with the exceptions noted above.

At TMC's option any defective part or equipment which fails within the warranty period shall be returned to TMC's factory for inspection, properly packed with shipping charges prepaid. No parts or equipment shall be returned to TMC, unless a return authorization is issued by TMC.

No warranties, express or implied, other than those specifically set forth herein shall be applicable to any equipment manufactured or furnished by TMC and the foregoing warranty shall constitute the Buyers sole right and remedy. In no event does TMC assume any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of TMC Products, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

*Electron tubes also include semi-conductor devices.

PROCEDURE FOR RETURN OF MATERIAL OR EQUIPMENT

Should it be necessary to return equipment or material for repair or replacement, whether within warranty or otherwise, a return authorization must be obtained from TMC prior to shipment. The request for return authorization should include the following information:

1. Model Number of Equipment.
2. Serial Number of Equipment.
3. TMC Part Number.
4. Nature of defect or cause of failure.
5. The contract or purchase order under which equipment was delivered.

PROCEDURE FOR ORDERING REPLACEMENT PARTS

When ordering replacement parts, the following information must be included in the order as applicable:

1. Quantity Required.
2. TMC Part Number.
3. Equipment in which used by TMC or Military Model Number.
4. Brief Description of the Item.
5. The *Crystal Frequency* if the order includes crystals.

PROCEDURE IN THE EVENT OF DAMAGE INCURRED IN SHIPMENT

TMC's Warranty specifically excludes damage incurred in shipment to or from the factory. In the event equipment is received in damaged condition, the carrier should be notified immediately. Claims for such damage should be filed with the carrier involved and not with TMC.

All correspondence pertaining to Warranty Claims, return, repair, or replacement and all material or equipment returned for repair or replacement, within Warranty or otherwise, should be addressed as follows:

THE TECHNICAL MATERIEL CORPORATION
Engineering Services Department
700 Fenimore Road
Mamaroneck, New York

TABLE OF CONTENTS

<u>Paragraph</u>		<u>Page</u>
<u>SECTION 1 - GENERAL DESCRIPTION</u>		
1-1	Functional Description	1-1
1-2	Physical Description	1-1
1-3	Technical Specifications	1-2
<u>SECTION 2 - INSTALLATION</u>		
2-1	Initial Inspection	2-1
2-2	Mechanical Installation	2-1
2-3	Electrical Installation	2-1
2-4	60 Vs. 100 WPM Transmissions	2-2
<u>SECTION 3 - OPERATOR'S INSTRUCTIONS</u>		
3-1	General	3-1
3-2	Definitions of Indications	3-1
	<u>a.</u> Six Digit Megacycle	3-1
	<u>b.</u> IFBW, CHAN A (or B)	3-1
	<u>c.</u> DET, CHAN A (or B)	3-1
	<u>d.</u> AFC	3-3
	<u>e.</u> RF GAIN	3-3
	<u>f.</u> IN TUNE PROCESS	3-3
	<u>g.</u> READY	3-3
	<u>h.</u> FAULT	3-3
	<u>j.</u> POWER	3-3
	<u>k.</u> SIGNAL INPUT	3-3
	<u>l.</u> Fuses	3-3

TABLE OF CONTENTS (CONT)

Paragraph

Page

SECTION 4 - PRINCIPLES OF OPERATION

4-1	Introduction	4-1
4-2	Functional Analysis	4-1
	<u>a.</u> Initial Reset	4-1
	<u>b.</u> Code Input	4-1
	<u>c.</u> Timing and Reset	4-2
	<u>d.</u> "E" Code Reset	4-2
	<u>e.</u> MC Code	4-2
	<u>f.</u> Shift Register and Readout	4-4
4-3	Logic Diagram Analysis	4-6
	<u>a.</u> Introduction	4-6
	<u>b.</u> Initial Reset	4-7
	<u>c.</u> Code Input	4-7
	<u>d.</u> First Code	4-9
	<u>e.</u> Second Code	4-10
	<u>f.</u> Third Code	4-18
	<u>g.</u> Fourth thru Tenth Codes and Twelfth Codes	4-19
	<u>h.</u> Eleventh Code	4-19
	<u>i.</u> Timing and Reset Action	4-21

SECTION 5 - MAINTENANCE

5-1	Introduction	5-1
5-2	Special Tools and Test Equipment	5-1

TABLE OF CONTENTS (CONT)

<u>Paragraph</u>		<u>Page</u>
<u>SECTION 5 - MAINTENANCE (CONT)</u>		
5-3	Preventive Maintenance	5-2
5-4	Troubleshooting	5-3
	<u>a.</u> Introduction	5-3
	<u>b.</u> Checking Printed Circuit Conductors	5-4
	<u>c.</u> Logic Card Checking	5-4
5-5	Repair and Replacement	5-6
	<u>a.</u> Introduction	5-6
	<u>b.</u> Replacement of Logic Modules	5-7
	<u>c.</u> Repair of Printed Conductors	5-9
	<u>d.</u> Replacement of Wire in Card Receptacles	5-10
	<u>e.</u> Replacement of Wire in System Receptacles	5-10

SECTION 6 - PARTS LIST

6-1	Introduction	6-1
-----	--------------------	-----

SECTION 7 - SCHEMATIC WIRING

LIST OF ILLUSTRATIONS

<u>Figure</u>		<u>Page</u>
<u>SECTION 1 - GENERAL DESCRIPTION</u>		
1-1	Channel Frequency Indicator, Model RTIA	1-0
<u>SECTION 2 - INSTALLATION</u>		
2-1	Overall and Mounting Dimensions, Model RTIA	2-3

LIST OF ILLUSTRATION (CONT)

<u>Figure</u>		<u>Page</u>
<u>SECTION 3 - OPERATOR'S INSTRUCTIONS</u>		
3-1	RTIA Control Panel	3-2
<u>SECTION 4 - PRINCIPLES OF OPERATION</u>		
4-1	Functional Block Diagram, RTIA	4-3
4-2	Inputs Vs. Outputs, Negative Logic	4-14
<u>SECTION 5 - MAINTENANCE</u>		
5-1A	Top View, RTIA	5-5
5-1B	Top View with Card Bins Rotated into Servicing Position, RTIA	5-8
5-2	Bottom View, RTIA	5-11
5-3	Maintenance Tools, Logic Circuits	5-12
5-4	Card in Test Position	5-13
5-5	TP128 in Position	5-14
5-6	Removing Logic Module from Card	5-15
5-7	Using TP132 Connector Extractor	5-16
<u>SECTION 7 - SCHEMATIC WIRING</u>		
7-1	Detailed Logic Diagram, RTIA-1 (9 sheets)	7-1/7-9
7-1A	Earlier Model Variations, Detailed Logic, RTIA-1	7-10
7-2	Wiring Schematic, RTIA Power Supply	7-11
7-3	Wiring Schematics, Encapsulated Logic Modules (4 sheets)	7-12/7-15

LIST OF TABLES

Table

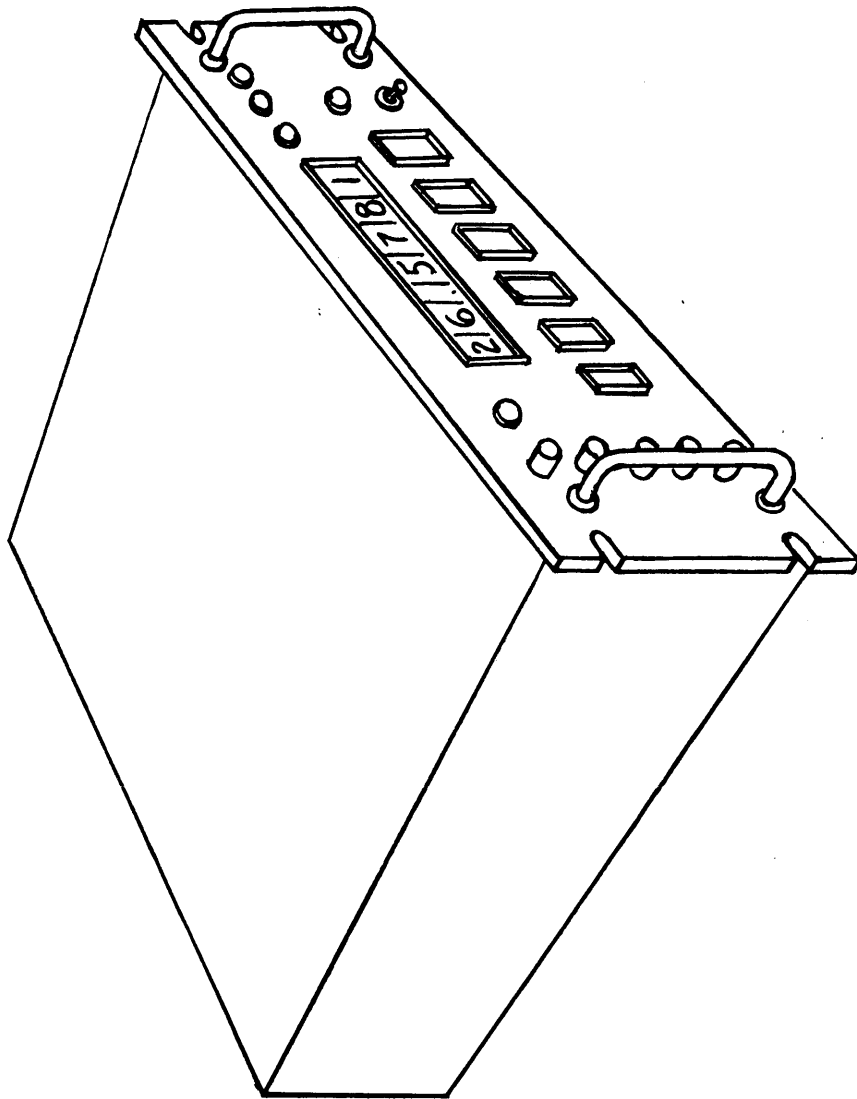
Page

SECTION 1 - GENERAL DESCRIPTION

1-1 Indication Vs. Code, Signal Input 1-2

SECTION 5 - MAINTENANCE

5-1 Test Equipment, RTIA 5-2



4012A-1

Figure 1-1. Channel Frequency Indicator, Model RTIA

SECTION 1
GENERAL DESCRIPTION

1-1. FUNCTIONAL DESCRIPTION

Model RTIA-1 Channel Frequency Indicator is a monitor unit used in remote tuning of TMC's TechniMatic* receivers by wire or FSK radio transmission. A continuously cycling teletype input of 11 codes presents lighted numerals and letters indicating receiver control positions. Additional lights inform the operator on the state of the receiver tuning, i.e, if the controls are moving, if they have stopped moving, or if the receiver has failed to transmit the monitor signal back.

1-2. PHYSICAL DESCRIPTION

The RTIA-1 (see figure 1-1) is a 19-inch rack modular unit. The front panel is 19 inches wide x 5-1/2 inches high x 3/16 inch thick and is finished in gray enamel. The chassis extends 22 inches behind the panel.

The display of control positions are in lighted numerals and letters through glass windows. Logic circuitry is miniature solid state, employing removable printed circuit cards. Encapsulated transistor/diode logic modules are mounted on the cards.

*Trademark applied for.

1-3. TECHNICAL SPECIFICATIONS

SIGNAL INPUT: Keying for serial pulses in 7.42-unit teletype transmission pattern with 22 millisecond (60 WPM) or 13.7 millisecond (100 WPM) pulse widths. Continuous cycling of 12 codes per cycle, in sequence as listed in Table 1-1.

INPUT CODE & CHARACTER SEQUENCE See Table 1-1.

TABLE 1-1. INDICATION VS. CODE, SIGNAL INPUT

CHARACTER RECEPTION ORDER	DISPLAY	READING	CODE
1	Resets flip-flop circuits for new cycle		10000
2	MC	2	11001
		3	11000
		4	10100
		5	11100
		6	11010
		7	11110
		8	11101
		9	11111
		10	10110
		11	10111
		12	11011
		13	10011
		14	10101
		15	10001
		16	10010

TABLE 1-1. INDICATION VS. CODE, SIGNAL INPUT (CONT)

CHARACTER RECEPTION ORDER	DISPLAY	READING	CODE
2 (cont)	MC	17	01001
		18	01000
		19	00100
		20	01100
		21	01010
		22	01110
		23	01101
		24	01111
		25	00110
		26	00111
		27	01011
		28	00011
		29	00101
		30	00001
		31	00010
3	.1 MC	0	01000
		1	00100
		2	00010
		3	01001
		4	01100
		5	00110
		6	01011

TABLE 1-1. INDICATION VS. CODE, SIGNAL INPUT (CONT)

CHARACTER RECEPTION ORDER	DISPLAY	READING	CODE
3 (cont)	.1 MC	7	01101
		8	01110
		9	00111
4	.01 MC	0-9	Same as .1 MC
5	.001 MC	0-9	Same as .1 MC
6	.0001 MC	0-9	Same as .1 MC
7	CHAN A IFBW	1	01000
		6	00100
		15	00010
		3.5 U	01001
		3.5 L	01100
		7.5 U	00110
		7.5 L	01011
8	CHAN A DET	AM	01000
		CW	00100
		SSB	00010

TABLE 1-1. INDICATION VS. CODE, SIGNAL INPUT (CONT)

CHARACTER RECEPTION ORDER	DISPLAY	READING	CODE
9	CHAN B IFBW	1 to 7.5 L	Same as CHAN A IFBW
10	CHAN B DET	AM to SSB	Same as CHAN A DET
11	AFC and Receiver status lamps.	AFC "ON" and IN TUNE PROCESS lamp on.	01100
		AFC "ON" and READY lamp on.	01001
		AFC "ON" and FAULT lamp on.	01000
		AFC "OFF" and IN TUNE PROCESS lamp on.	00110
		AFC "OFF" and READY lamp on.	00011
		AFC "OFF" and FAULT lamp on.	00010
12	RF GAIN	0-9	Same as .1 MC
		10	00011
		AGC	00001

SECTION 2
INSTALLATION

2-1. INITIAL INSPECTION

Each RTIA has been thoroughly checked and tested at the factory before shipment. Upon arrival at the operating site, inspect case and its contents immediately for possible damage. Unpack the equipment carefully. Inspect all packing material for parts which may have been shipped as "loose items."

With respect to damage to the equipment for which the carrier is liable, The Technical Materiel Corporation will assist in describing methods of repair and the furnishing of replacement parts.

2-2. MECHANICAL INSTALLATION

Overall dimensions and mounting data are shown in figure 2-1. If the RTIA is to be used in a TMC rack system, refer to system manual for location and mounting instructions. The unit is designed to be mounted by its front panel, with or without chassis drawer slides. When shipped as part of a system, the drawer slides are shipped pre-mounted in the rack. When the RTIA is shipped alone, no slides are included unless specified on the order; however, the chassis sides contain threaded mounting holes for TMC TK-115 slides, if required.

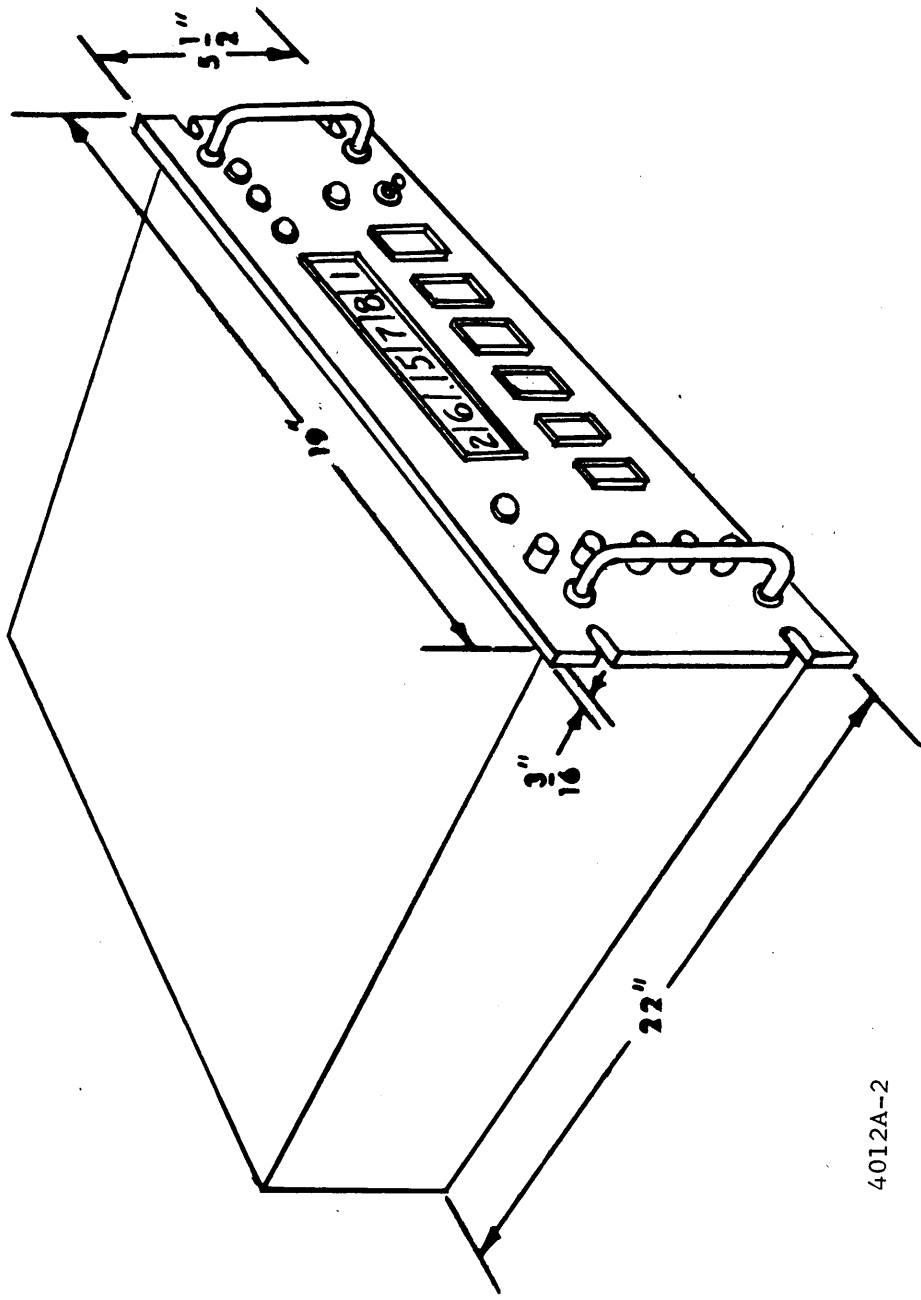
2-3. ELECTRICAL INSTALLATION

The RTIA has an a-c power input for line voltage and a serial pulse teletype signal input. The line voltage input is made by plugging the cable extension on the rear of the RTIA into a 115 VAC, 60 cps, single phase source. Signal input connection is made at J2033 receptacle on the rear of the chassis. A mating plug is included when the RTIA is shipped alone.

Refer to TMC systems manual for connection of cables to associated equipment when the RTIA is shipped as part of a system.

2-4. 60 VS. 100 WPM TRANSMISSIONS

The rate of speed in which the series of codes enter the signal input at J2033 can be any value and the timing may be regular or irregular, as long as the codes enter in the sequence shown in table 1-1. However, the pulse width (within the code) that the RTIA can handle depends upon the clock generator circuit in printed circuit plug-in card Z2030. Cards are available for pulse widths corresponding with 60 wpm or 100 wpm speeds, based on the standard 7.42-unit teletype transmission pattern. The RTIA is shipped with the 60 wpm card installed unless specified as otherwise on the order. The Z2030 clock generator cards are marked "60 wpm" or "100 wpm" to distinguish them.



4012A-2

Figure 2-1. Overall and Mounting Dimensions, Model RTIA

SECTION 3
OPERATOR'S INSTRUCTIONS

3-1. GENERAL

In remote receiver tuning systems, the RTIA Channel Frequency Indicator serves as a continuous monitor of the receiver control positions whether moving or stationary.

To energize RTIA display, set POWER switch at ON. POWER lamp will light.

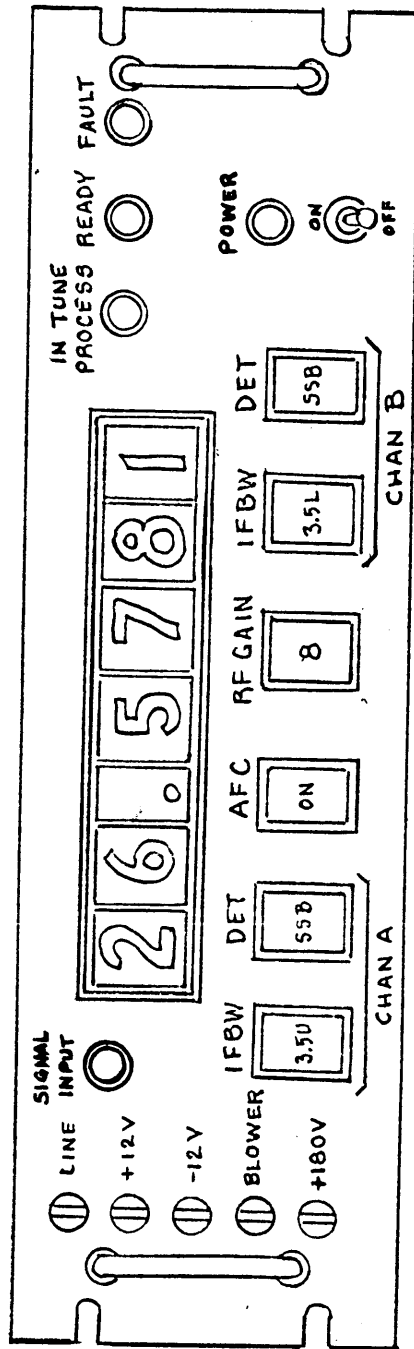
The following definitions are based on the receivers generally associated with the RTIA in TMC TechniMatiC systems.

3-2. DEFINITION OF INDICATIONS

a. SIX DIGIT MEGACYCLE. - Reading indicates frequency of carrier in a 2 to 32 mc range to which receiver has been tuned, in 100 cps steps.

b. IFBW, CHAN A (or B). - Reading indicates width in kilocycles of i-f bands filtered out of the signal and routed to the detectors in audio channel A (or B). The 1, 6 and 15 readings indicate 1-kc, 6-kc and 15-kc widths centered on the carrier frequency. The 3.5 U and 3.5 L readings indicate upper and lower sidebands of 3.5-kc each; the 7.5 U and 7.5 L indicate upper and lower sidebands of 7.5-kc each.

c. DET, CHAN A (or B). - Reading indicates mode of reception (AM, CW, or SSB) for which receiver is tuned.



4012A-3

Figure 3-1. RTIA Control Panel

d. AFC. - ON or OFF reading indicates AFC (automatic frequency control) circuitry has been switched in or out, respectively.

e. RF GAIN. - 0 to 10 reading indicates relative levels of r-f gain setting. AGC indicates r-f gain is controlled by the automatic gain control circuit at some fixed value.

f. IN TUNE PROCESS. - Light indicates receiver tuning controls are moving and receiver is not yet synchronized.

g. READY. - Light indicates receiver controls have stopped moving and receiver is synchronized.

h. FAULT. - Light indicates that receiver has not been tuned as display indicates.

j. POWER. - Light indicates that RTIA is receiving a-c power.

k. SIGNAL INPUT. - Light indicates reception of coded signal by RTIA.

l. FUSES. - LINE, +12V, -12V, BLOWER and +180V panel fuses are in those sections of the RTIA power supply. A light indicates that the fuse is blown.

SECTION 4

PRINCIPLES OF OPERATION

4-1. INTRODUCTION

Model RTIA functions as a translator of receiver control positions in teletype code form into the decoded lighted digital displays on its front panel, as indicated in table 1-1. All circuitry (except for the power supply) is in computer-type binary logic design and mounted on printed circuit plug-in cards. The logic circuits on the cards are transistor/diode type in the form of encapsulated modules mounted on the cards. The cards are mounted in two bins (see figure 5-1), plugged into receptacles in the floor of the bin. Cards are referred to in figure 7-1 by Z2000 series circuit numbers and their "A" assembly numbers. The "A" number appears printed on the card and the "Z" and "A" numbers appear on one side of the bin adjacent to its receptacle. The encapsulated logic modules are identified by Z1-and-up series of circuit numbers and these numbers appear printed on the card adjacent to the modules.

4-2. FUNCTIONAL ANALYSIS (figure 4-1)

a. INITIAL RESET. - When the POWER switch is set to ON, a-c line voltage is connected to the RTIA power supply circuit (see figure 7-2). The power supply furnishes logic voltages to all the cards and energizes Z2028 Initial Reset card. Z2028 then resets the logic circuitry in all the cards for the first tuning code input.

b. CODE INPUT. - The 5-bit codes enter the RTIA in serial pulses in the standard 7.42 teletype pattern, with a "start" pulse in the beginning and a "stop" pulse at the end. The first code, applied to

Z2030 Serial-to-Parallel Clock card, starts the clock with its "start" pulse. The clock then proceeds to shift the 5 bits of the code over to Z2029 Serial-to-Parallel Shift Register card. As bit #5 enters Z2029, Z2029 sends an end-of-code pulse back to Z2030 to stop the clock. Meanwhile, the code is shifted over to Z2027 Code Storage Input Shift Register card.

c. TIMING AND RESET. - The same end-of-code pulse that stopped the clock in Z2030 is also sent to Z2026 Timing and Reset card. Z2026 then sends reset pulses to the shift registers in Z2027 and Z2029 and flip-flop circuits (via Z001 Reset card) to clear the last code from the circuitry. This arrangement enables the RTIA to receive codes at any input rate.

d. "E" CODE RESET. - The first code to enter the RTIA on each read-back cycle is the "E" (10000) code. Bit #1 of this code generates a reset pulse from Z2027 for shift registers in Z2025, Z2002 and Z2009, clearing the last cycle of codes from this circuitry.

e. MC CODE. - The second code to enter the RTIA is the 2-31 MC code. This code is for the 2-digit megacycle display formed by DS2011 and DS2010. DS2011 will display a blank, 1, 2 or 3; DS2010 will display a numeral in the 0-to-9 range.

Referring to the codes in table 1-1, it will be seen that, in all codes other than the 2 to 31 MC code, only the last 4 bits (2 thru 5) contain the significant information, with bit #1 always a "0". In the 2 to 31 MC code, however, all 5 bits are used. In the 2 to 16 MC range, the first bit is always a "1" followed by the coded bits #2 thru #5. In the 17 to 31 MC range, the first bit is always a "0" followed by a repetition of the same 4-bit code used in the 2 to 16 MC range. Bit #1 is routed to Z2019 And/Or Logic for MC Readouts card and Z2020 Nor Logic for MC 10's, 20's and 30's, via Z2025 MC

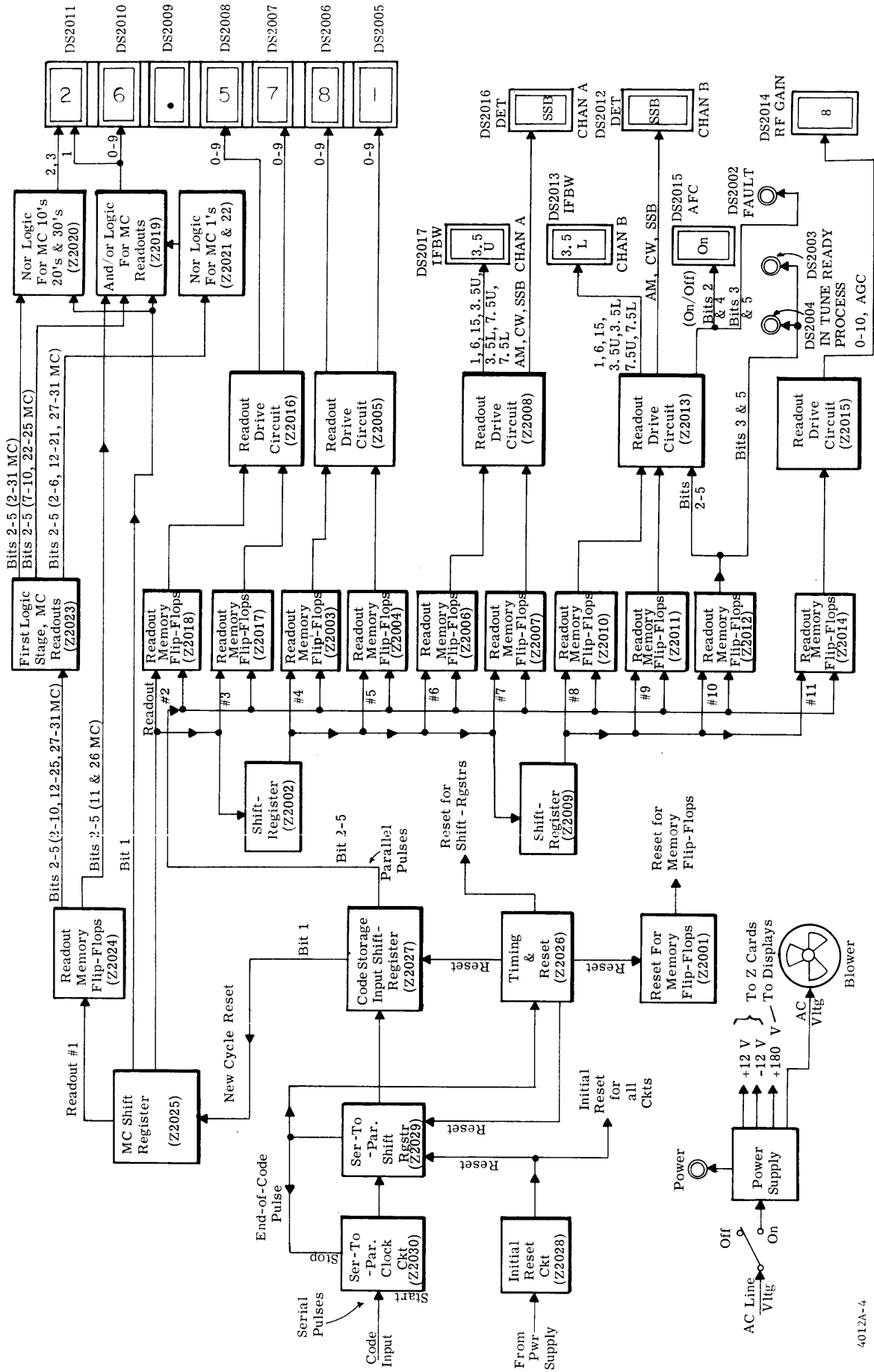


Figure 4-1. Functional Block Diagram, RTIA

Shift Register; bits #2 thru #5 routed directly to Z2024. The flip-flops (energized by the MC shift register) then pass the bit #2-5 information on to Z2023 First Logic Stage card. The first logic stage then works with the 3 additional logic stages (Z2019 thru Z2022) to set up the proper indications on DS2011 and DS2010.

f. SHIFT REGISTER AND READOUT. - There are 5 shift-registers and 11 Readout Memory cards (Z2024,18,17,03,04,06,07,10,11,12 and 14) in the RTIA. Z2029 shift-register shifts to start the conversion of serial pulses into parallel pulses. Z2027 shifts to store all the bits of one code before releasing them in parallel to the readout memory card. It will be noticed that each code is fed to all 11 Readout Memory cards simultaneously. However, readout of a card will not occur until it has been energized by one of the 3 remaining shift-registers (Z2025, Z2002 or Z2009). These 3 shift-registers function to energize the readouts for each display, one-by-one. The Z2026 Timing and Reset card acts to reset and energize all the code energized flip-flops in the Readout Memory Flip-flop cards, via Z2001, at the end of each code, as previously described.

The third code (.1 MC code) is for the 0-9 numeral display in DS-2008 window. It enters Z2030 and travels through Z2029 and into the Z2027 Code Storage Input Shift Register card, in the same manner as the MC code. In the .1 MC code (and the rest of the codes in the cycle) only the last 4 bits (2-5) are significant. These 4 bits are sent directly to the Readout Memory cards in parallel pulses. The Z2025 MC Shift Register, energized by the .1 MC code via Z2026 Timing and Reset card, shifts to the next position to energize the readout of the Z2018 Readout Memory card. The output of Z2018 goes to the

Z2016 Readout Drive Circuit card. Z2018 houses independent drive circuits for both the .1 MC and .01 MC displays (DS2008 and DS2007).

The same processing occurs for the .01 MC code as for the .1 MC code. The .01 MC code is for the 0-9 display in the DS2007 window. When the Z2025 shift-register has shifted to the .01 MC position, it becomes de-activated and sets the next shift-register in Z2002 to receive the next code.

The next 4 codes (.001MC, .0001 MC, CHA IFBW and CHA DET) are read out by the Z2002 Shift-Register card as they come through, acting on DS2006, DS2005, DS2017 and DS2016, respectively. After the CHA DET code, Z2002 shift-register becomes de-activated and sets Z2009 shift-register to read out the CHB IFBW, CH B DET, AFC/IN TUNE PROCESS/READY/FAULT and RF GAIN codes. The readout of these codes completes the cycle. Re-energization of Z2025 MC Shift-Register for the new cycle is again accomplished by bit #1 (a "1") in the first E code.

All these codes are processed in the same way with the exception of readout #10. This code contains information for the AFC ON/OFF display and the receiver status (IN TUNE PROCESS/READY/FAULT) lamps. Refer to table 1-1. It will be seen that a "1" bit in bits #2 through #5 controls each display, as follows:

<u>Display</u>	<u>Bit #</u>
AFC ON	2
AFC OFF	4
IN TUNE PROCESS	3
READY	5

If bits #3 and #5 are both "0's" in the same code, the FAULT lamp only will light, indicating that the IN TUNE PROCESS/READY readback is in error.

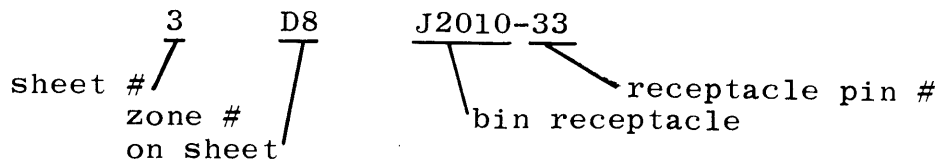
4-3. LOGIC DIAGRAM ANALYSIS

a. INTRODUCTION. - On each card, each encapsulated logic module is identified by a Z number, numbered in series within the card. The TMC part numbers of the modules are listed in Section 6 Parts List under their Z numbers which, in turn, are listed under the Z number of the card. Figure 7-1 shows card Z numbers, card TMC part numbers, mating bin receptacle "J" numbers and pins, logic module Z numbers and an alphanumerical logic function number along with each logic module Z number. The logic function numbers are numbered in series within the RTIA logic circuit. The letter portion of this number indicates logic function and the numerical portion indicates the number in the series. Logic function letters indicate the following functions:

AG andgate	NG norgate
CF complimentary emitter follower	OG orgate
FF flip-flop	OS one-shot (or delay circuit)
IV inverter	PF positive emitter follower
NA non-inverting amplifier	RD relay drive
NAG nandgate	TG timing generator

To see the equivalent transistor/diode logic circuit of an encapsulated logic module, refer to its Z number, in Section 6 Parts List, for the TMC part number. Then refer to the schematic shown for the part number in Figure 7-3.

Figure 7-1 is made up of 9 sheets. When wiring, between cards, on one sheet extends to another sheet, a destination code reference is made at the receptacle pin number. The code is read as follows:



The parentheses () in the following logic analysis refer to sheet numbers of figure 7-1. Cards are referred to by their Z numbers and logic modules by their logic function numbers.

b. INITIAL RESET - Upon application of a-c line power at P2007 (see figure 7-2) via S2001 POWER switch, besides furnishing the logic voltages (+12V and -12V) and +180V digital display voltage, +12V and -12V are supplied to Z2028 Initial Reset card, as shown in figure 7-1 (1). A variation of design occurs between Initial Reset cards of earlier and later models of the RTIA. The later design is depicted in figure 7-1 (1); the earlier variation is shown in figure 7-1A.

In the later design, the +12V and -12V are introduced at pins 5 and 37, respectively, of Z2028 Initial Reset card. This results in a positive output from pin 40 and 42 of Z2028. The output from pin 40 resets flip-flop FF-1 in Z2030 Serial-to-Parallel Clock card, setting TG-1 clock to trigger on the first code; the output from pin 42 resets flip-flops FF-2 through FF-7 in Z2029 Serial-to-Parallel Shift-Register (2).

In the earlier design (see figure 7-1A), the +12V and -12V inputs appear at pins 16 and 37, respectively, of Z2028 card. The +12V becomes inverted through IV-1 and, together with the -12V from pin 37, opens nandgate NAG-2. NAG-2 triggers OS-4 to produce a pair of parallel pulses from PF-1 and PF-2. The pulse from PF-1 resets FF-1 in Z2030 and the pulse from PF-2 resets FF-2 through FF-7 in Z2029.

c. CODE INPUT - The 5-bit teletype code of the first character

enters the Serial-to-Parallel Clock card Z2030 (1) via pin C of J2033 and pin 34 of Z2030, with pulse polarities as shown in the illustration. The positive "start" pulse enters first, followed by the 5 coded bits which are negative (1) or positive (0) and these are followed by the negative "stop" pulse. The start pulse becomes inverted through one half of NA-1 and travels to nandgate NAG-1. NAG-1 has received a -12V charge from the power supply section (when S2001 switch is closed) and opens to produce a positive pulse to set flip-flop FF-1 in Z2030 (1). FF-1, having become reset by Z2028 Initial Reset card, produces a negative voltage that triggers clock generator TG-1. TG-1 produces regularly timed pulses from pin 11 with widths appropriate for 60 WPM (or 100 WPM). Each pulse fires OS-1 and OS-2. OS-1 works through OS-3 and NA-2 to set flip-flop FF-2 and to reset FF-3 through FF-7 in Z2029 Serial-to-Parallel Shift Register (2) with 22ms (or 13.5 ms) pulse widths to match those in the code input at pin C of J2033. OS-2 in Z2030 (1), meanwhile, produces regularly timed negative pulses of 5 us (spaced at 22 ms) into an andgate formed by CR-1 and CR-2. As the first bit arrives at CR-1, if it is a negative bit (a "1"), it will open the andgate and the resulting negative 5 us pulse will travel to nandgates NAG-3 through NAG-7 in Z2029 (2); if it is positive (a "0"), CR1/2 andgate in Z2030 (1) will not open and no pulse will be produced at NAG-3 through NAG-7 in Z2029 (2).

The initial resetting of FF-2, in Z2029 (2), from PF-2, in Z2028 (1), has caused the output of FF-2 to go negative. The first clock pulse, from the series via NA-2 in Z2030 (1), sets FF-2 causing FF-2 output to go positive. This positive charge sets FF-3. FF-3 then sends a negative output to NAG-3, pin 1, until the next pulse from

NA-2, in Z2030 (1), resets it and the voltage swings to positive. This forms a negative pulse of 22 ms (or 13.5 ms) width at NAG-3, pin 1. At the end of the negative pulse from FF-3, when the voltage swings positive, it sets FF-4. FF-4 responds by issuing a negative voltage until reset by NA-2 and, as with FF-3, FF-4 places a negative pulse on NAG-4. This is repeated down the line, with consecutive negative pulses placed, one by one on nandgates NAG-3 through NAG-7.

At the same time, the coded bits previously described from the CR1/2 andgate in Z2030 (1) are being placed one-by-one simultaneously on pins 3 of NAG-3 through NAG-7. Since they are also timed by TG-1 in Z2030 (1) and delayed by OS-3, the first bit arrives at NAG-3 inside the time duration that FF-3 has placed a negative pulse on it. If bit #1 is also a negative pulse (a "1"), NAG-3 opens, producing a positive 5 us pulse. If bit #1 is a positive pulse (a "0"), NAG-3 does not open and no pulse is produced. Bits #2,3,4, and 5 then arrive at NAG-4 through NAG-7 during the same time that the opposite flip-flops place negative pulses on them and the gates open or do not open according to the polarity of the bits. As FF-7 (for bit #5) is set, it also sends its negative pulse back to FF-1 in Z2030 (1). The pulse end resets FF-1 and FF-1 output swings positive, stopping the TG-1 clock. The negative "end-of-code" pulse from FF-7 also enters Z2026 Timing and Reset card (2). The total effect of this is described in paragraph 4-3*i*, Timing and Reset.

d. FIRST CODE. - The first code in each cycle of input codes is the "E" (10000) code. This code serves to set one readout cycle in motion so that the pre-arranged sequence of codes in the input are properly routed to the correct display windows. When nandgates NAG-3 through NAG-7 produce the "E" for the Z2027 Code Storage card,

FF-8 is set by the positive pulse issuing from NAG-3, since bit #1 is a "1". Bits #2-5 being 0's, produce no pulses from NAG-4 through NAG-7 and FF-9 through FF-12 in Z2027 remain in their reset conditions. The output of the set FF-8 is negative at pin 6. The outputs of the reset FF-9 through FF-12 are negative at pin 11 in each flip-flop. These five outputs are connected to nandgate NAG-8. One more negative charge is needed, at pin 4 of NAG-8, to open the gate. This arrives from pin 28 of Z2026 Timing and Reset card (2) through two delay circuits (see paragraph 4-3i).

When NAG-8 opens, it produces a positive 5 us pulse that fires OS-8 one-shot. OS-8 produces a positive 0.6 ms pulse that travels to Z2026 Timing and Reset card. Z2026 uses this signal to reset the Z2025 MC Shift Register card.

e. SECOND CODE. - The second code arrives at NAG-3 through NAG-7 in Z2029 (2) in the same manner as the first one. The first and second codes (see table 1-1) are the only codes in which bit #1 is significant. In the second code (if bit #1=1) NAG-3 produces the 5 us pulse to set FF-8 in Z2027 (2). FF-9 through FF-12 are set or remain reset, according to the particular code. The output of FF-8 swings negative and the negative charge arrives at pin 1 of NAG-9 nandgate in Z2025 MC Shift Register (3). Meanwhile FF-13 in Z2025 has become reset by the positive pulse at pin 1 from Z2026, as a result of the "E" code (see paragraph 4-3i) and is producing a negative voltage at pin 11. This negative charge sits on pin 3 of NAG-9, setting NAG-9 to open from the forthcoming negative 5 us pulse at pin 9 from Z2001 (see paragraph 4-3i). When NAG-9 is then opened in this way, it produces a positive 5 us pulse setting FF-16. If, on the other hand, bit #1=0, NAG-3 in Z2029 (2) does not produce the positive pulse, FF-8 in Z2027 remains reset and does not produce

the negative swing to open NAG-9 in Z2025 (3). In this case FF-16 remains reset.

The function of FF-16 is to send the bit #1 (1 or 0) information to Z2019 through Z2022 Nor and And/Or Logic cards. If bit #1 is a "1", FF-16 produces a negative swing from pin 6 and a positive swing from pin 11. If bit #1 is a "0", a positive swing appears at pin 6 and a negative one at pin 11.

The same 5 us negative pulse from Z2001 (3) that arrives at NAG-9 in Z2025 (3) for bit #1 also arrives at NAG-13 through NAG-16 in Z2024 (3) for bits #2 through #5, respectively. The bit #2-5 outputs from FF-9 through FF-12 in Z2027 (2) are connected, via PF-8 PF-10, PF-12, and PF-14, to pins 3 of NAG-13 through NAG-16. Of FF-9 through FF-12, the "1" bits produce negative swings and the "0" bits produce positive swings. Meanwhile the positive 0.6 ms pulse from Z2026 (see paragraph 4-3i) has reset FF-13 and the output of FF-13 at pin 11 is negative. With 3 negative charges on it, the "1 bit" nandgate (of the NAG-13 through -16 group) opens and produces a positive 5 us pulse; the "0 bit" nandgate remains closed and its output remains negative. The opened nandgate sets the flip-flop opposite it (of FF-17 through FF-20). The unopened nandgate leaves its flip-flop reset.

The set flip-flop, of FF-17 through FF-20, produces a negative swing at pin 6 and a positive swing at pin 11. The reset flip-flop produces a positive output at pin 6 and a negative output at pin 11. These outputs, via PF-19 through PF-26 positive emitter-followers, are connected to AG-1 through AG-14 andgates in Z2023 MC First Logic Stage card in such a way as to provide a gate for bits #2-5 of each code in the 2-31 mc range. Since bits #2-5 in the 2-16 mc range of

codes are repeated again for the 17-31 mc range, one gate is utilized for 2 codes. The andgate opens to produce a negative voltage when all the inputs are negative. If all inputs are not negative, the gate does not open and its output is positive. Of this group, AG-15 (for the 11 mc and 26 mc codes) is located on Z2019 And/Or Logic card (4).

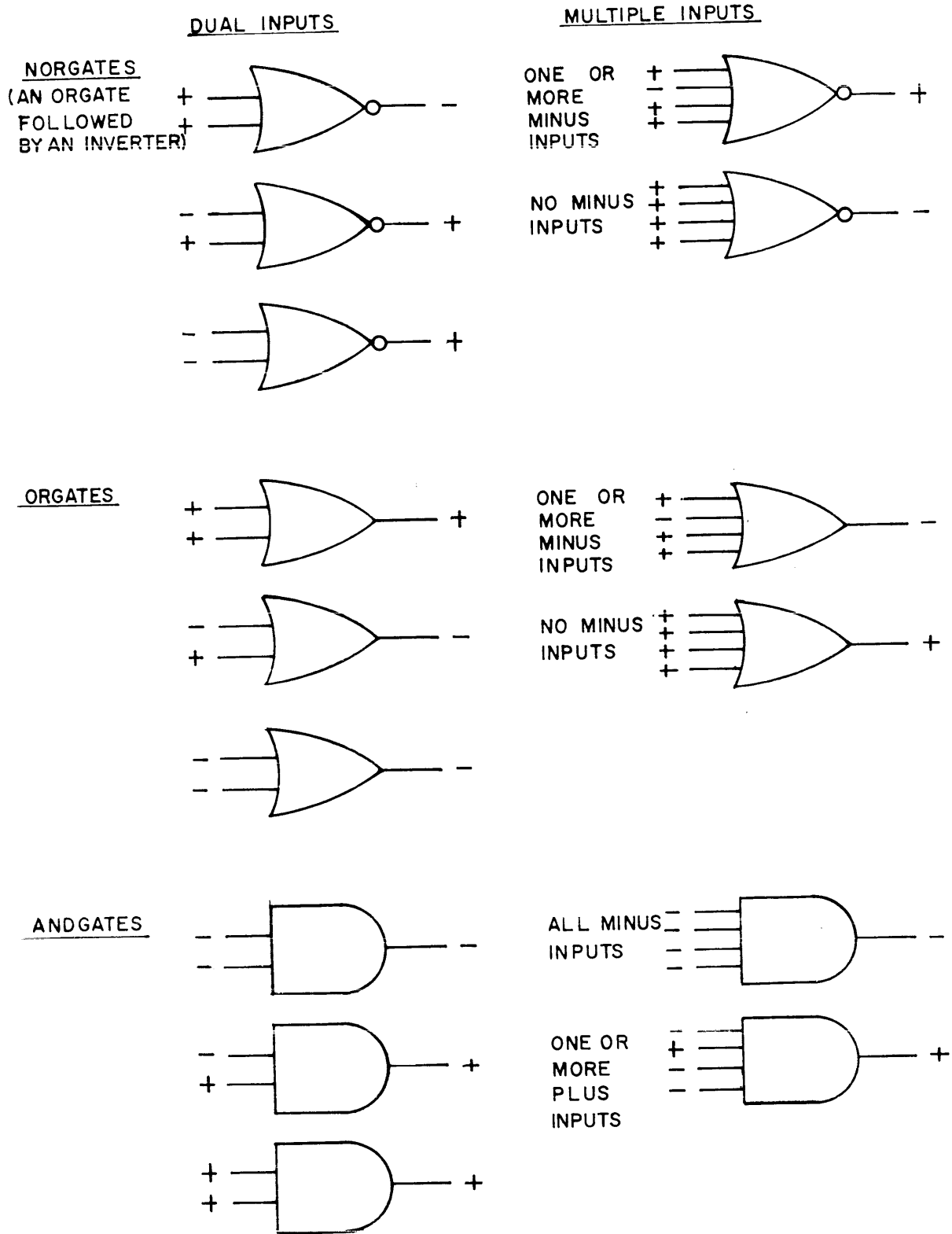
Some of the outputs of AG-1 through AG-15 gates are connected directly to Z2019 And/Or Logic card (4) and some to Z2021 and Z2022 Nor Logic cards (4) to be later processed through Z2019 And/Or Logic card. This is due to the pattern of codes vs. 2-31 mc numerals, shown as follows:-

	<u>BIT #1 = 1</u>		<u>BIT #1 = 0</u>		
	<u>MC</u>	<u>CODE</u>	<u>MC</u>	<u>CODE</u>	
Requires Nor Logic	2 - - -	11001	17 - - -	01001	Requires Nor Logic
	3 - - -	11000	18 - - -	01000	
	4 - - -	10100	19 - - -	00100	
	5 - - -	11100	20 - - -	01100	
	6 - - -	11010	21 - - -	01010	
	7 - - -	11110	22 - - -	01110	
	8 - - -	11101	23 - - -	01101	
	9 - - -	11111	24 - - -	01111	
	10 - - -	10110	25 - - -	00110	
	11 - - -	10111	26 - - -	00111	
Requires Nor Logic	12 - - -	11011	27 - - -	01011	Requires Nor Logic
	13 - - -	10011	28 - - -	00011	
	14 - - -	10101	29 - - -	00101	
	15 - - -	10001	30 - - -	00001	
	16 - - -	10010	31 - - -	00010	

It can be seen that within each of the two bit-columns, a group of second digits (to be displayed in DS2010 window) is repeated. These groups require the additional nor logic processing to differentiate the codes.

Using the 2mc code as an example, bits 2 through 5 produce all negative inputs at AG-1 andgate in Z2023 (3); AG-1 then produces a negative output to pin 1 of norgate NG-19 in Z2021 (4) and NG-11 in Z2022 (4). Pin 3 of each norgate is connected to the output of AG-3 andgate, in Z2023 (3). AG-3, since it is unopened, has a positive output and each norgate then has a + and a - input. The RTIA circuitry uses "negative logic" (responding to negative inputs) as shown in figure 4-2. Therefore, both NG-19 and NG-11 have + outputs, and these are connected to pins 3 of NG-20 norgate in Z2021 and NG-12 in Z2022, respectively. Meanwhile EF-11 and EF-12 emitter-followers in Z2020 (4) have received the bit #1 information from FF-16 in Z2025 (3) for the 2 mc code. Since bit #1 is a "1" in this case, EF-11 has received a + signal and EF-12 has received a -. EF-11 transmits the + signal to pin 1 of NG-12 and EF-12 transmits the - signal to pin 1 of NG-20. With two + inputs, NG-12 issues a negative output to pin 12 of orgate OG-3 in Z2019 (4). OG-3 then issues a negative voltage to the "2" numeral in DS2010 display window, and lights it up. NG-20, receiving a + and - input, issues a + output to pin 12 of OG-6 orgate. Pin 2 of OG-6 is connected to the output of AG-20 andgate (for the 7mc code). Since AG-20 output is +, OG-6 receives two + inputs and issues a + (or ground potential) output to the "7" numeral in DS2010. The "7" (and all the other numerals in the display) remains dark.

In Z2020 card (4), diodes CR1 through CR5 have been added to



401 Figure 4-2. Inputs Vs. Outputs, Negative Logic

provide extra inputs to NG-2 and NG-3 norgates. CR1 through CR4 add 4 additional inputs to NG-3 and CR-5 adds one input to NG-2.

The same code gate output, from AG-1 in Z2023 (3), that goes to NG-19 and NG-11 in Z2021 and 22 (4) is also connected to pin 1 of NG-4 norgate in Z2020 (4). This single minus input at NG-4 causes its output to go +, placing a + input at pin 3 of NG-8. NG-8 pin 1 is receiving the minus output of EF-12 and issues a + output to pin 2 of OG-1 orgate in Z2019 (4). The output of NG-2, in Z2020, receiving all + inputs, issues a - input to pin 3 of NG-6. Since pin 1 of NG-6 is receiving a + signal from EF-11, it issues a + output to pin 12 of OG-1. OG-1, receiving two + inputs, presents ground (or +) at its output and the "1" numeral in DS2011 remains out. Since NG-3 and NG-1 are receiving no minus inputs, these norgates are also issuing minus outputs to pin 3 of NG-7 and NG-5 respectively. Pin 1 of NG-7 and NG-5 receives the + output of EF-11. This causes NG-7 and NG-5 outputs to go positive (or ground) and the "2" and "3" numerals in DS2011 remain out, leaving this display dark. This leaves only the "2" displayed in DS2010 window.

The 7- through 11-mc codes do not require nor logic and the code gate outputs in Z2023 (3) are connected directly to Z2019 And/Or Logic card inputs (4). The 7- through 9-mc codes are processed directly through Z2019 to the numeral displays, with aid from the bit #1 (1 or 0) information from IV-1 and IV-2 inverters. Outputs from the 10 mc and 11 mc code gates are also connected to Z2020 to light the "1" numeral on the DS2011 display.

The 7- through 9-mc codes may be described by using the 7 mc code as an example. AG-5 in Z2023 (3) opens for the 7 mc code to produce a minus input at pin 1 of AG-20 and AG-17 andgates in Z2019 (4). When bit #1 =1, IV-1 inverter issues a minus output and IV-2 issues a plus.

This places two minus inputs at AG-20 and AG-20 places a minus input at pin 2 of orgate OG-6. The single minus input causes OG-6 output to go negative and light the "7" numeral in DS2010. AG-17, receiving a + and a - input, issues a + output to pin 2 of OG-3. Since pin 12 of OG-3 is normally at + (from the deactivated outputs of AG-1, AG-3, NG-11 and NG-12) the two + inputs at OG-3 keep its output at ground and the "2" numeral remains out. The 1, 2 and 3 numerals in DS2011 remain out by the same action as described for the 2- through 6-mc codes.

The 10-mc and 11-mc codes light up the "0" and "1" numerals in DS2010 in the same manner as for the 7-, 8- and 9-mc codes. The "1" numeral in DS2011 is ignited as follows, using the 10-mc code as an example. AG-8, besides placing a negative charge on AG-24 and AG-23, places the charge on the additional CR2 diode input to NG-3 norgate and the additional CR5 diode input to NG-2, in Z2020 (4). This causes both norgate outputs to go +, placing the + charge on pin 3 of norgates NG-7 and NG-6, respectively. Pin 1 of NG-6 is receiving a + charge from EF-11 as a result of bit #1 =1. With two + inputs, NG-6 places its minus output on pin 12 input of OG-1 orgate. As a result of the deactivated AG-14, AG-1 and AG-2 gates in Z2023 (3) and deactivated NG-4 norgate in Z2020 (4), NG-8 keeps its normal + output at OG-1 pin 2. With a + and a - input, OG-1 output goes negative and the numeral "1" in DS2011 lights up.

Codes for 12mc through 16mc again use the nor logic circuitry for the 2-6 digit in the same manner as for the 2mc through 6mc codes. The "1" is brought up on the DS2011 display in the same logic pattern as for the 10- and 11-mc codes.

In codes for 17mc through 31mc, bit #1 =0. This causes EF-11 output, in Z2020 (4), to go + and EF-12 to go -. It also causes IV-1

inverter output in Z2019 to go - and IV-2 to go +. This results in slightly different logic patterns, compared to the 2- through 16-mc codes. However, the same general processing is used (i.e.: nor logic added for 17- through 21-mc and 27- through 31-mc codes and straight and/or logic used for the 22- through 26-mc codes).

Using the 17-mc code as an example, AG-1 in Z2023 (3) opens and (as for the 2mc code) places a minus signal on NG-4, NG-19 and NG-11. As in the 2-mc code, AG-3 keeps a + charge on the other inputs of NG-19 and NG-11 and their outputs are both +. However, since bit #1=0, EF-11 now places a minus input at pin 1 of NG-12 causing its output to OG-3 pin 12 to go +. Since the deactivated AG-5 and AG-17 andgates keep a + on OG-3 orgate's other input, the output of OG-3 is a ground and the "2" in DS2010 remains out. On the other hand, the + output of NG-19 to pin 3 of NG-20 is matched by another + output from EF-11. The two + inputs cause NG-20 output to go negative and this single minus input into OG-6 orgate causes its output to go negative, lighting the "7" in DS2010. The single minus input at NG-4 in Z2020 causes its output to go + and place this charge on pin 3 of NG-8. Another + at pin 1 is produced by EF-12 and NG-8 issues a negative voltage through OG-1 to light the "1" in DS2011.

The "2" and "3" on the DS2011 display for the 20- through 31-mc codes are brought up by a simple norgate pattern in Z2020 (4), involving NG-3 and NG-7 for the "2" and NG-1 and NG-5 for the "3". Taking the 27-mc code as an example, the negative charge from AG-3 in Z2023(3) goes to pin 9 of NG-2 and NG-3, causing NG-3 to place a + charge on pin 3 of NG-7. Since EF-12 is placing another + charge on pin 1, NG-7 issues the negative voltage to light the "2" in the display. Although NG-2 goes positive, OG-1 output remains at ground, since NG-4 and NG-8 remain deactivated and EF-11 is issuing a minus

charge. Using the 30-mc code as an example for the "3", AG-12 places a negative charge on pin 1 of NG-2 and NG-1 causing NG-1 to place a + on pin 3 of NG-5. EF-12, placing another + on pin 1, causes NG-5 output to go negative, lighting the "3". Although NG-2 has gone positive, there is no action through NG-6 and OG-1 on the "1", due to the negative output of EF-11 and the deactivated state of NG-4 and NG-8.

f. THIRD CODE. - It will be noticed, by referring to the output destinations on Z2027 Code Storage card (2), that bits #2-5 of each code are sent simultaneously to Readout Memory Flip-flop cards Z2003, 4,6,7,10,11,12,14,17,18 and 24. These cards serve as temporary storage for each code and await readout action energized by Shift-Registers Z2025, Z2002 and Z2009 (see figure 4-1). Since the sequence of codes coming into the RTIA is pre-programmed for each "DS" display, the shift registers function to read out the correct memory card for its associated display.

The second code (2-31) readout is energized by the negative pulse from pin 40 of Z2001 opening NAG-10, already set up by the reset FF-13. The third code (0-.9mc) readout is energized by the next 5 us positive pulse from Z2026 setting FF-13 at pin 8. The output of FF-13, going from reset to set, swings positive, setting FF-14. The output at pin 6 of FF-14 swings negative, placing a negative charge on pin 3 of NAG-11 nandgate. As result of action by Z2026 (see paragraph 4-3i), NAG-11 pin 1 receives a negative 35 us pulse at that point, causing the output of NAG-11 to go positive for 35 us. This pulse resets FF-21 through FF-24 flip-flops in Z2018 Readout Memory card (5). At the same time the negative output from FF-14 in Z2025 (3) sits on pins 1 of nandgates NAG-17 through NAG-20 in Z2018 and the positive or negative charges from bits #2-5 of the third code have arrived from Z2027 (2) and sit on pins 3 of NAG-17 through NAG-20. At this point the next negative 5 us pulse from Z2001 (3) arrives at pin 9 of each

nandgate. As a result, the nandgate with the negative charge on pin 3 (from a "1" in the code) opens to produce a positive 5us pulse and the nandgate with a positive bit charge at pin 3 remains closed, with its output negative. The positive pulse sets the flip-flop (of FF-21 through FF-24) opposite the nandgate; the negative charge leaves the flip-flop reset. The set (1) flip-flops issue a negative charge at pin 6 and a positive at pin 11. Reset (0) flip-flops issue a positive charge at pin 6 and a negative charge at pin 11.

The outputs of FF-21 through FF-24 are connected to andgates AG-26 through AG-35 in Z2016 Readout Drive Circuit (5) in such a way as to provide a gate for bits #2-5 of each code in the 0-.9mc range. When the andgate receives all negative charges, from the correct code, it opens, presenting a negative swing at its output. The negative voltage causes the numeral in the 0-9 group in DS2008 display to light up. The other numerals, receiving ground potential from the unopened andgates, remain dark.

g. FOURTH THRU TENTH CODES AND TWELFTH CODES. - Codes #4 thru 10 and 12 proceed to their displays, DS2007, 6,5,17,16,13,12 and 14, respectively, in the same manner as code #3 proceeds to DS2008. Displays DS2017, 16,13,12 and 14 are mechanically different from the mc displays. Instead of numerals arranged in a column, one behind the other, these are a "projection readout" type. There is a bulb for each reading mounted in the back of the display unit with a film negative of the reading in front of the bulb and one projection screen in the front. When the negative voltage is applied to the bulb circuit, the bulb lights, shines through its film negative and the image of the reading is projected by lenses onto the screen.

h. ELEVENTH CODE. - The eleventh code carries two types of information, unrelated to one another. Since each type of information

can be expressed in a binary code, only two bits of the 4-bit code are used for each. Bits #2 and #4 control the on/off reading in the AFC, projection readout display (DS2015). Bits #3 and #5 control three lamps: DS2004 IN TUNE PROCESS, DS2003 READY and DS2002 FAULT.

In the sequence of the 11th code readout, flip-flops FF-61 thru FF-64 in Z2012 (9) are set or reset from the 4-bit code in the same manner as for the other codes. If the code contains an "ON" signal for the AFC display, bit #2 will be a "1" and bit #4 will be a "0". In this case, FF-61 will be set and FF-63 will remain reset. This will produce two negative charges at andgate AG-86 in Z2013 Readout Drive Circuit (8). AG-86 then produces the required negative voltage to bring "ON" up on the DS2015 display screen. The same action occurs with the "OFF" code, using FF-61, FF-63 and AG-87.

At the same time, bits #3 and #5 are acting on the IN TUNE PROCESS, READY and FAULT lamps by action of FF-62 and FF-64. If the IN TUNE PROCESS code has been sent, bit #3 is a "1" and bit #5 is a "0". This causes FF-62 to become set and FF-64 to remain reset, placing a negative voltage on DS2004 IN TUNE PROCESS bulb circuit and a ground on DS2003 READY bulb circuit. FF-62 pin 11 also places a positive charge at pin 9 of AG-88 andgate in Z2013 (8) and FF-64 pin 11 places a negative charge. This causes the output of AG-88 to the DS2002 FAULT bulb circuit to remain positive (or at ground potential). Since DS2004 is the only lamp receiving negative voltage, it lights. The same procedure applies, in reverse polarities, for the READY lamp. The FAULT lamp (DS2002) will light only when AG-88 andgate issues a negative voltage as the result of having received two negative inputs. This will happen when, due to some error in the IN TUNE PROCESS/READY readback code originating in the receiver, neither bit #3 nor bit #5 is a "1".

i. TIMING AND RESET ACTION. - The Timing and Reset circuit (Z2026) is energized for each code by an end-of-code pulse from the code as it passes through Z2029 Serial-to-Parallel Shift-Register.

As each code comes through, FF-7 in Z2029 (2) becomes set (on bit #5) and, besides transferring the bit over to NAG-7, sends the end of its negative "end-of-code" pulse (a) back to stop the clock in Z2030 (2), (b) through PF-3 in Z2026 (2) and back to FF-2 in Z2029 (2), resetting it, (c) to OS-9 in Z2001 (3) and (d) through PF-4 to OS-5 and OS-7 in Z2026 (2). At the end of the negative pulse, upon its positive rise, assume the time instant = T. At T+0, OS-5 starts a negative 0.6 ms pulse and sends it to OS-6. At T+0.6ms, OS-6 starts a positive 5us pulse from pin 6 and a negative 5us pulse from pin 11. At T+.6ms the pulse from pin 6 resets all the flip-flops in Z2025 (3), Z2002 (6) and Z2009 (8) shift-registers. The negative pulse from pin 11 goes to pin 4 of NAG-8 "E" code NANDgate in Z2027 (2). Also at T+0, the end of the negative pulse from PF-4 in Z2026 (2) starts a negative .6 ms pulse from OS-7, resetting FF-8 through FF-12 in Z2027 (2) at T+.6ms.

In the "E" code (10000), resetting FF-8 through FF-12 places five negative charges, at T+.6ms, on NAG-8 NANDgate. The consequent negative 5us pulse at T+0.6ms from pin 11 of OS-6 in Z2026 (2) opens the NANDgate and places a positive 5us pulse on pin 3 of OS-8 at T+.6ms. OS-8 starts a 0.6ms positive pulse, via NA-6, CF-4, PF-6 and PF-5 in Z2026 (2), to reset all the flip-flops in Z2025 (3), Z2002 (6) and Z2009 (8) for the new input cycle at pin 1 of each flip-flop. Also at T+.6ms, OS-6 in Z2026 (2) has started a positive 5us pulse from pin 6. This pulse travels to pin 8 of FF-13 in Z2025 (3) to set it. The positive .6ms pulse from OS-8, however, arrives at pin 1 of FF-13 slightly after T+.6ms, due to fall and rise time of OS-6 and OS-8. In this way, FF-13 becomes set from the "E" code and its output at

pin 11 goes negative, placing the necessary negative charges on pin 3 of NAG-9 nandgate and pin 3 of NAG-10 nandgate for the second code (2-31 mc code).

When the second code consequently arrives from Z2027 (2) flip-flops FF-8 through FF-12, bit #1 information is placed on pin 1 of NAG-9 in Z2025 (3) and bits #2-5 information is placed on pins 3 of NAG-13 through NAG-16 in Z2024 Readout Memory card (3). The "end-of-code" negative pulse again occurs, from the second code, and the positive swing fires OS-9 in Z2001 (3) at T+0. The negative 35us pulse from OS-9 opens NAG-10 in Z2025 (3) and NAG-10 produces a positive 35us pulse. This results in resetting FF-17 through FF-20 in Z2024 (3) at T+0. Also (at T+35us), the positive upswing from OS-9 fires OS-10 in Z2001 (3). The negative 5us pulse from OS-10 travels to pin 9 of NAG-9 in Z2025 and pins 9 of NAG-13 through NAG-16 in Z2024, completing the required total of negative pulses for those nandgates with the negative "1" bit charges from code #2, and opening them. The opened gates then set the flip-flops opposite them, as previously described.

The rest of the codes in the cycle are sent through the RTIA by the Z2026 Timing and Reset circuit and the Z2001 Reset for Memory Flip-flops circuit in the same manner as the second code.

SECTION 5
MAINTENANCE

5-1. INTRODUCTION

The logic circuits in the RTIA are contained on Z2000 series printed circuit plug-in cards mounted in two bins on the top side of the chassis (see figure 5-1). Terminals to the power supply section are accessible from the bottom side (see figure 5-2). The rest of the circuit components make up the front panel digital and projection read-out displays. The card Z2000 numbers are the circuit reference symbol numbers; the card "A" numbers are the card assembly part numbers by which they are identified and ordered. The "A" number appears printed on the card and again on the bin wall adjacent to its receptacle along with its "Z" number and its receptacle "J" circuit symbol number. The plug end of each card contains keying notches and its receptacle in the bin floor contains matching blocks to prevent inserting a card into the wrong receptacle. Some cards within the RTIA and in other TMC logic equipment, although they are assigned different "Z" numbers, have the same "A" numbers and are identical and interchangeable. These cards have similar keying at their plug ends and in their receptacles.

Figure 5-1A shows the two card bins in their normal installed positions. In order to gain access to the cards, rotate the card bins 90° into the positions shown in figure 5-1B.

5-2. SPECIAL TOOLS AND TEST EQUIPMENT

Special tools included in the shipment* and required for RTIA testing and repair are shown in figure 5-3. Table 5-1 lists standard laboratory equipment required but not supplied. Also, of particular value in speedy troubleshooting is a set of spare logic cards for card-substitution procedures.

*Shipment of system in which RTIA is used.

TABLE 5-1. TEST EQUIPMENT, RTIA

<u>ITEM</u>	<u>MANUFACTURER</u>
Vacuum Tube Voltmeter	Hewlett Packard, Model 524C, or equivalent
Oscilloscope	Tecktronic Model 545, or equivalent
Teletypewriter Set (with keyboard, tape puncher, tape reader and 7.42 serial CCIT 5-level code electrical output)	Smith-Corona Marchant (Kleinschmidt Div.) AN/FGC-25 or equivalent

5-3. PREVENTIVE MAINTENANCE

a. In order to prevent equipment failure due to dust, dirt and other destructive elements, it is suggested that a schedule of preventive maintenance be set up and adhered to.

b. At periodic intervals, the equipment should be removed from its mounting for cleaning and inspection. All accessible covers should be removed and the wiring and all components inspected for dirt, corrosion, charring, discoloring or grease. Remove dust with a soft brush or vacuum cleaner. Remove dirt or grease from other parts with any suitable cleaning solvent. Use of carbon tetrachloride should be avoided due to its highly toxic effects. Trichlorethylene or methylchloroform may be used, providing the necessary precautions are observed.

WARNING

When using toxic solvents, make certain that adequate ventilation exists. Avoid prolonged or repeated breathing of the vapor. Avoid prolonged or repeated contact with skin. Flammable solvents shall not be used on energized equipment or near any equipment from which a spark may be received. Smoking, "hot work", etc. is prohibited in the immediate area.

CAUTION

When using trichlorethylene, avoid contact with painted surfaces, due to its paint removing effects.

5-4. TROUBLESHOOTING

a. INTRODUCTION. - As an aid to troubleshooting, figure 7-1 furnishes normal pulse patterns at test points (TP) on the RTIA printed circuit cards. Also included are figures 5-1 and 5-2, locating cards and major components.

There are several methods for troubleshooting the RTIA; the method to use depends on spare parts and test equipment available.

When it has been determined, in a system troubleshooting procedure, that the RTIA component is at fault, the faulty card and/or component on the card can be detected by leaving the RTIA connected in the system and using the remote code input, checking test patterns at test points, indicated on figure 7-1, with an oscilloscope. If, however, it is necessary to immediately substitute in a spare RTIA to resume operation of the system, the subsequent bench check of the faulty RTIA will require the teletypewriter set listed in table 5-1, as an input substitute. In either case, spare printed circuit cards, if available, can be used to save time in a card-substitution procedure to determine the faulty card. Further detection of the faulty component on the card can then be made by checking the pulse patterns furnished in figure 7-1 for that card. Repair and replacement of components and modules on printed circuit cards is described in paragraph 5-5, Repair and Replacement.

CAUTION

Replacement of logic modules on the printed circuit cards requires the special tools and technique described in paragraph 5-5b.

b. CHECKING PRINTED CIRCUIT CONDUCTORS - Breaks in the conducting strip (foil) on a printed circuit card can cause permanent or intermittent trouble. In many instances, these breaks will be so small that they cannot be detected by the naked eye. These almost invisible cracks (breaks) can be located only with the aid of a powerful magnifying glass.

To check out and locate trouble in the conducting strips of a printed circuit board, set up a multimeter (one which does not use a current in excess of 1 ma) for making point-to-point resistance tests, using needle point probes. Insert one point into the conducting strip, close to the end of terminal, and place the other probe on the terminal or opposite end of the conducting strip. The multimeter should indicate continuity. If the multimeter indicates an open circuit, drag the probe along the strip (or if the conducting strip is coated, puncture the coating at intervals) until the multimeter indicates continuity. Mark this area; then use a magnifying glass to locate the fault in the conductor.

CAUTION

Before using an ohmmeter for testing a circuit containing transistors or other voltage-sensitive semiconductors, check the current it passes under test on all ranges. DO NOT use a range that passes more than 1 ma.

c. LOGIC CARD CHECKING

(1) Card Setup and Test Points. - To bring the test points on a card or on its receptacle pins up for accessibility, remove the card and insert an A3696 Card Extender in the card receptacle. Then plug the card into the top of the Card Extender.

CAUTION

Check to ensure that "A" number on card matches "A" number printed on side of

bin adjacent to bin receptacle. Because the Card Extender is keyed to fit into all receptacles, it is possible to connect a card to the wrong receptacle.

Figure 5-4 shows a typical card in test position. For each pulse pattern shown in figure 7-1, there is either a numbered "TP" (test point) standoff terminal on the card or a card receptacle pin accessible at the Card Extender receptacle. Odd numbered pins are accessible on one side of the card; even numbered pins appear on the other side.

CAUTION

Do not apply test probe to pins of encapsulated logic modules! Apply probe only to "TP" test points on card or receptacle pin test sockets on Card Extender. It is difficult to touch the probe to the miniature pins on the module without shorting it out and destroying the module.

(2) Oscilloscope Adjustments. - Set the scope for the external triggering mode, with a negative triggering slope and level for the negative-going outputs and negative pulses; use a positive triggering slope and level for the positive-going outputs and positive pulses.

(3) Interpretation of Pulses. - The exact shape of the pulse is, in most cases, not an important factor in troubleshooting the RTIA. Very often, different attenuator lines into the oscilloscope will produce pulse shape distortions that are not present in the RTIA. The critical fact is whether or not the expected pulse is there, its width and polarity.

5-5. REPAIR AND REPLACEMENT

a. Introduction.- Repair of the RTIA power supply circuitry follows standard lab procedures. Repair of printed circuit cards and card receptacle wiring, however, require the special tools and techniques as outlined here. Section 6, Parts List, lists all re-

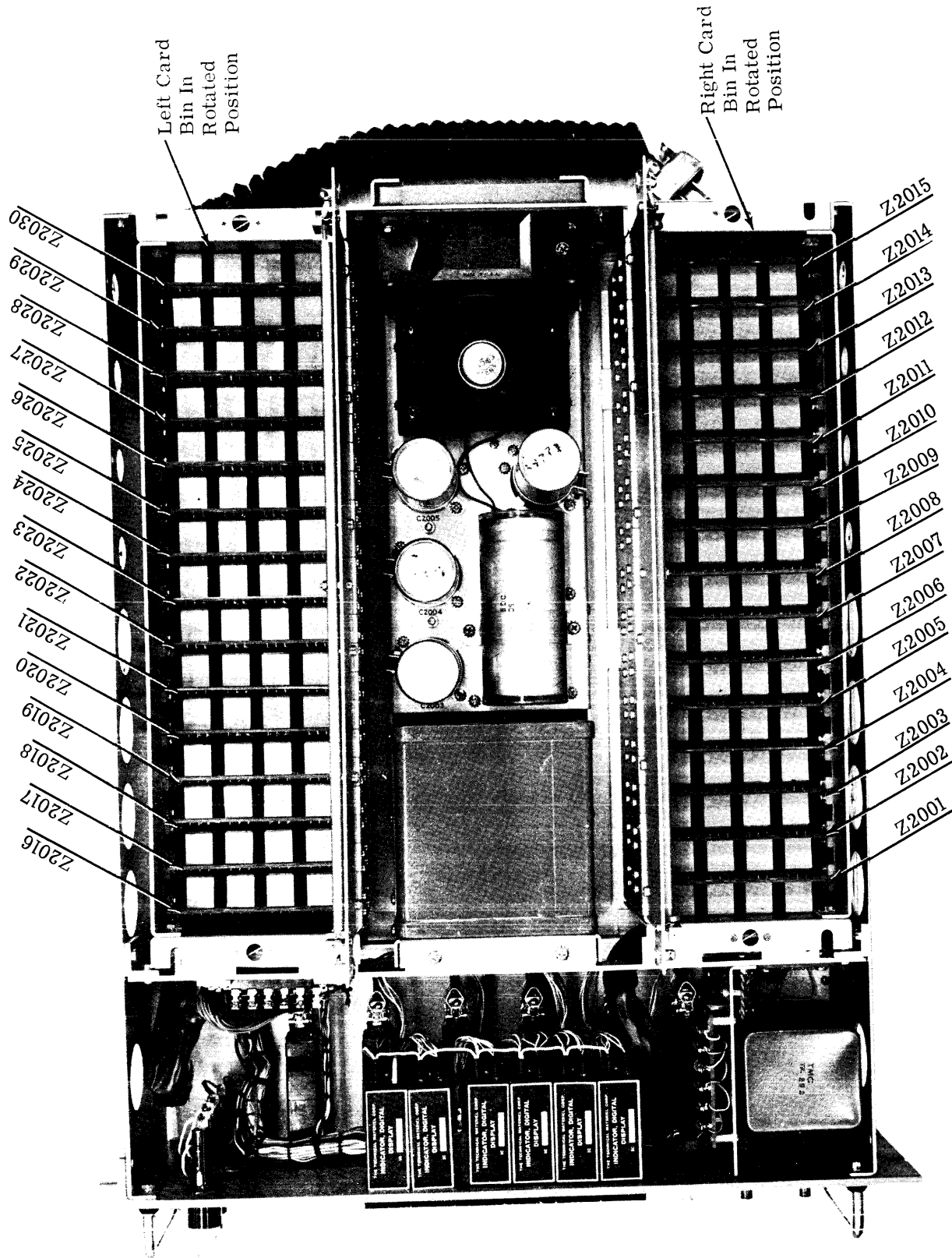
placeable parts by their circuit symbol numbers. Encapsulated logic circuit modules (mounted on the cards) are nonrepairable items and are replaced with new ones when damaged.

b. Replacement of Logic Modules. - When replacing a logic circuit module on a card, it is necessary to remove the old module from the card by a simultaneous melting of the solder on all the logic pins. TP128 Desoldering Tool (see figure 5-3) is included in the RTIA shipment* for this purpose. Soldering the new module to the card is done pin-by-pin with conventional methods.

To remove a module from a card, fasten a 100-watt soldering iron (with 3/8-inch tip) in a vertical position with a vise, as shown in figure 5-5. Remove the 3/8-inch tip and re-install it into the iron in the inverted position, with approximately 1-1/2 inches extending. Slip the TP128 Desoldering Tool onto the end of the tip (as shown in figure 5-5) and secure with an 8-32 set screw.

Refer to figure 5-6. Clean old solder out of TP128 cups with TP139 suede brush included in shipment* (figure 5-3). Plug iron extension cord into power outlet and allow to heat for 15 minutes. Lower card onto TP128 with pins of module to be removed nesting into TP128 solder cups. Press firmly on module to insert pins into cups while solder melts. When solder has melted sufficiently, it will be possible to pull the module straight up out of the card easily. Usually, about 2 seconds are enough. Do not try to pull module out forcibly before this point is reached. To do so may dislodge eyelets from pin holes in card. If it is possible to rock the module slightly, this is an indication that the solder has softened enough. This motion also helps to separate the pins from the eyelets. As

*Shipment of system in which RTIA is included.



4012A-7-1

Figure 5-lb. Top View with Card Bins Rotated into Servicing Position, RTIA

soon as the module has been drawn out, tap the card sharply, edge slightly down, on the work bench. The molten solder remnants in the eyelets will fall out on bench surface, eliminating the problem of cleaning them out to receive the new module.

c. Repair of Printed Conductors. - If the break in the conductor strip is small, lightly scrape away any coating covering the area of the conducting strip to be repaired. Clean the area with a firm-bristle brush and approved solvent. Then repair the cracked or broken area of the conducting strip by flowing solder over the break. Considerable care must be exercised to keep the solder from flowing onto an adjacent strip.

If a strip is burned out, or fused, cut and remove the damaged strip. Connect a length of insulated wire across the breach or from solder-point to solder-point.

After the repairs are completed, clean the repaired area with a stiff brush and solvent. Allow the board to dry thoroughly, and then coat the repaired area with an epoxy resin or similar compound. This coating not only will protect the repaired area, but will help to strengthen it.

CAUTION

After repairs, check the board for solder drippings; they may cause shorts.

Frequently, a low-resistance leakage path will be created by moisture and/or dirt that has carbonized onto the phenolic board. This leakage can be detected by measuring the suspected circuit with a multimeter. To overcome this condition, thoroughly clean the carbonized area with solvent and a stiff brush. If this does not remove it, use a scraping tool (spade end of a solder-aid tool or its equivalent) to remove the carbon, or drill a hole through the leakage

path to break the continuity of the leakage. When drilling method is used, be careful not to drill into a part mounted on the other side.

d. Replacement of Wire in Card Receptacles. - TP132 Connector Extractor is included in the shipment* (see figure 5-3) for removing and installing wire in J2001 through J2030 card receptacles. These receptacles take an insertion type of wire connection, rather than solder type. Figure 5-7 shows methods of wire removal and insertion using TP132. It will be noticed that TP132 serves to (a) give added rigidity to the wire as it is inserted or removed and (b) spring back the retention finger on the wire contact.

e. Replacement of Wire in System Receptacles.- J2033 receptacle also takes an insertion type of wire connection. A TMC #PN119-2** terminal tab is crimped on with an Amphenol #294-91** contact crimping tool. The wire is then inserted by means of Amphenol #294-92** insertion and removal tool. This tool is also used for removing the wire.

*Shipment of system in which RTIA is included.

**Or equivalent.

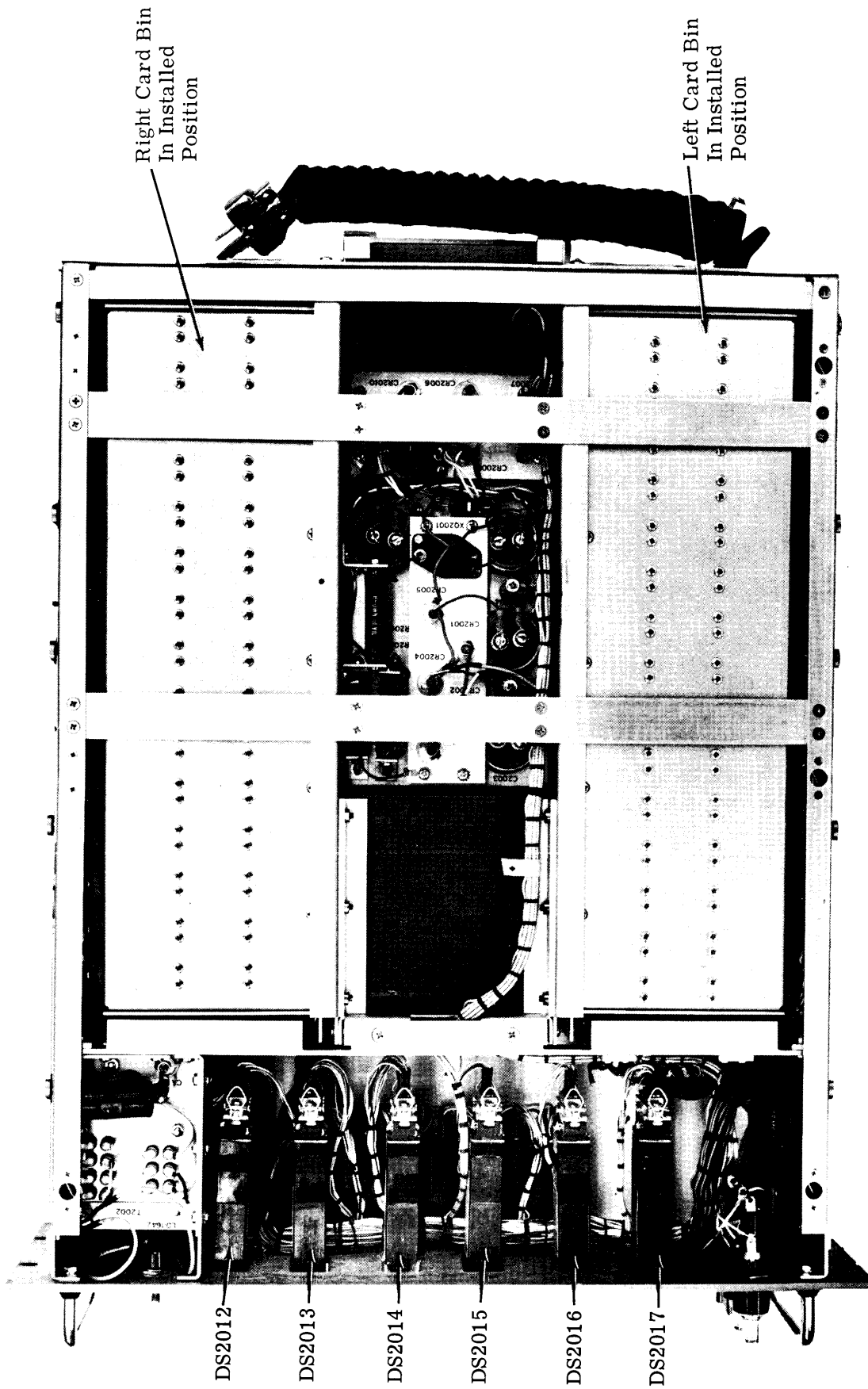


Figure 5-2. Bottom View, RTIA

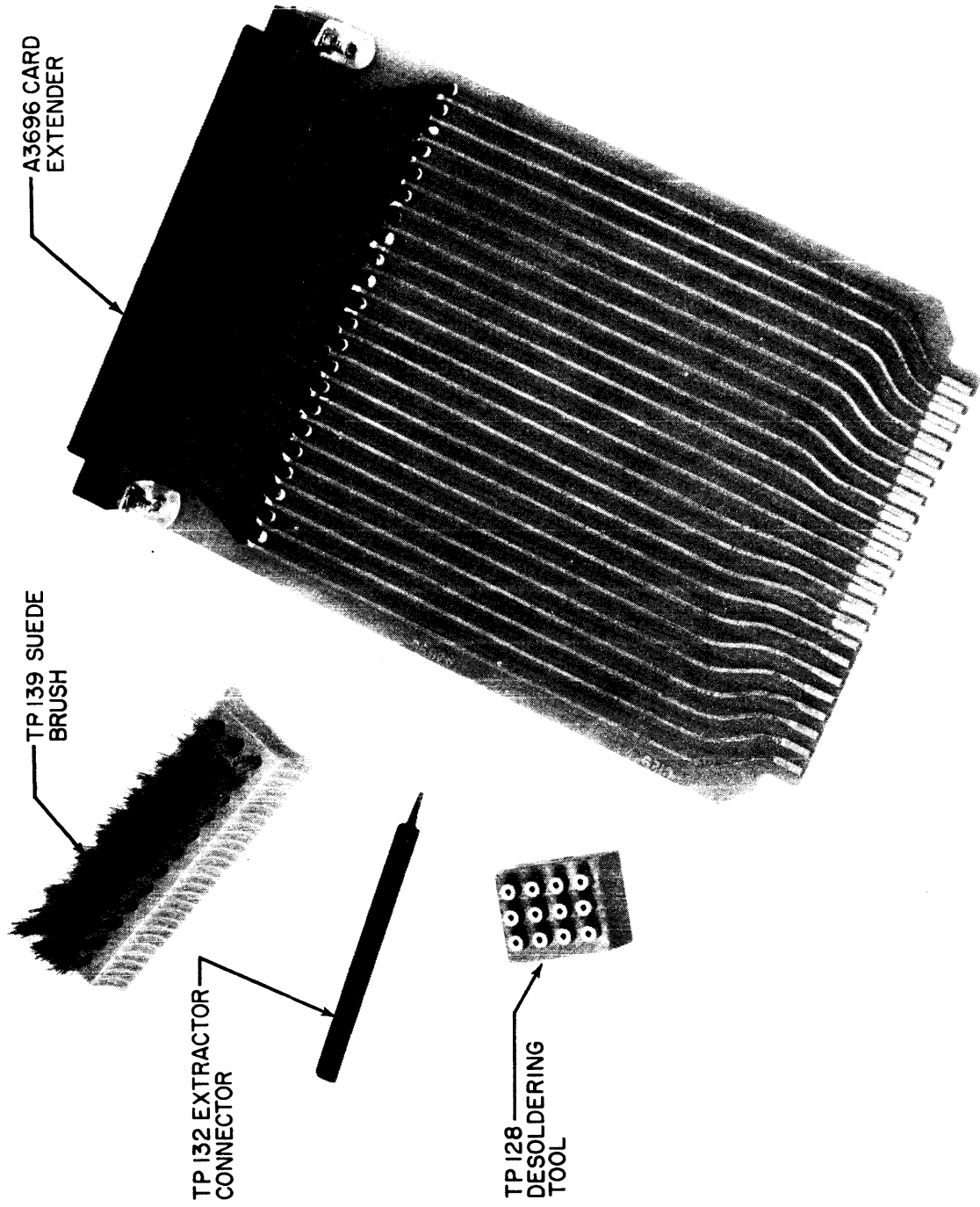
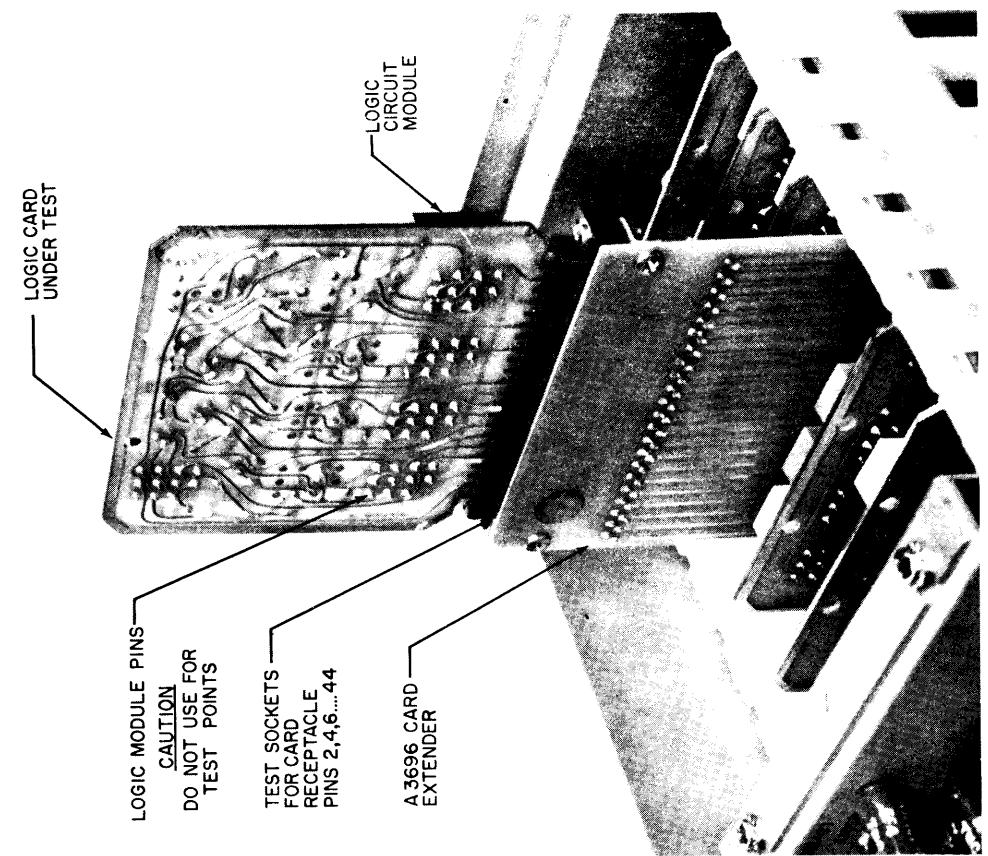
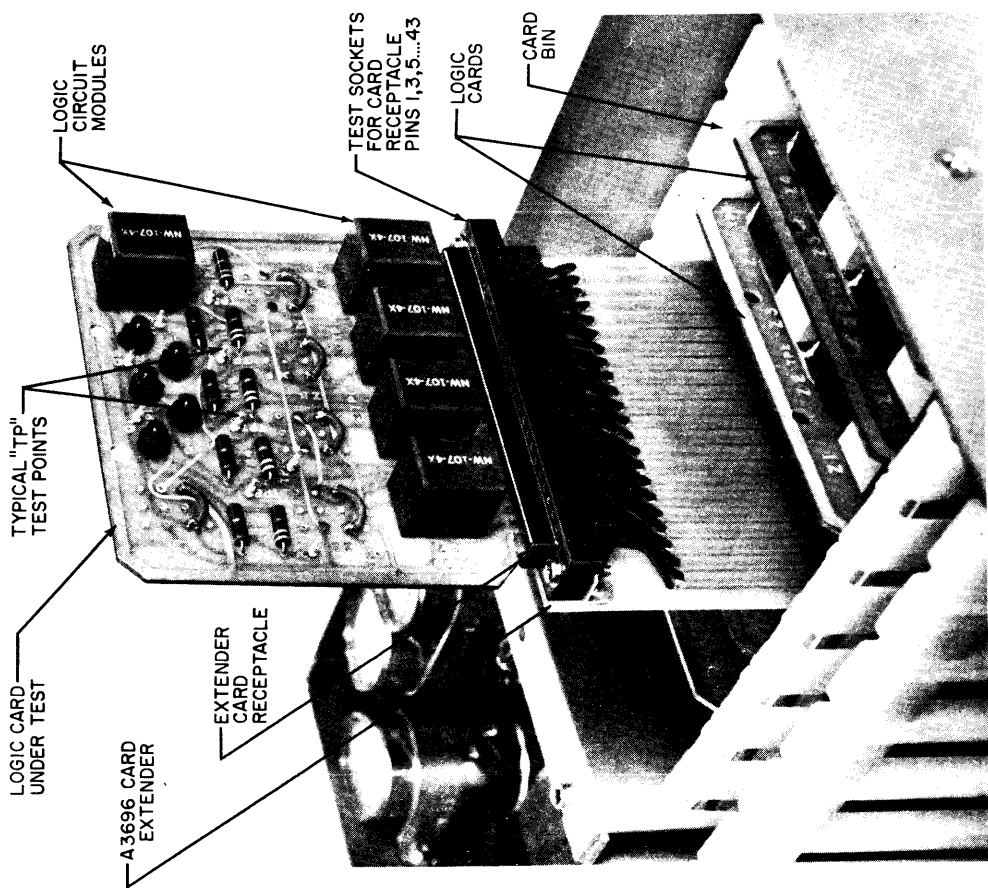


Figure 5-3. Maintenance Tools, Logic Circuit



338-26-1



338-25-1

Figure 5-4. Card in Test Position

9-81*799

7-81*799

PIN CUPS
TP 128 DESOLDERING TOOL
8-32 SET SCREW
SOLDERING IRON 3/8" TIP, REVERSED

1-1/2"
(APPROX)

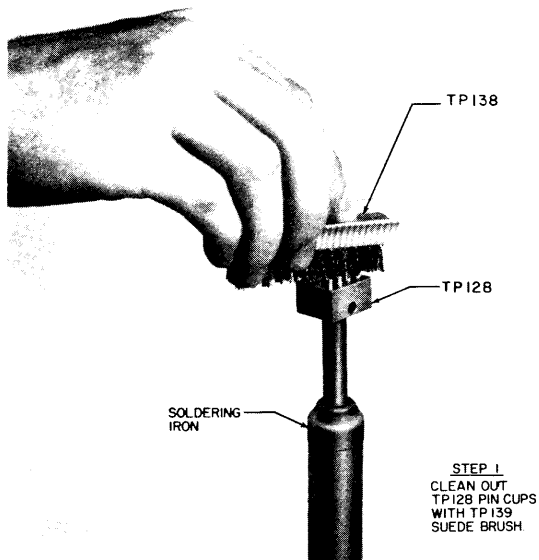
100-WATT
SOLDERING IRON

WISE

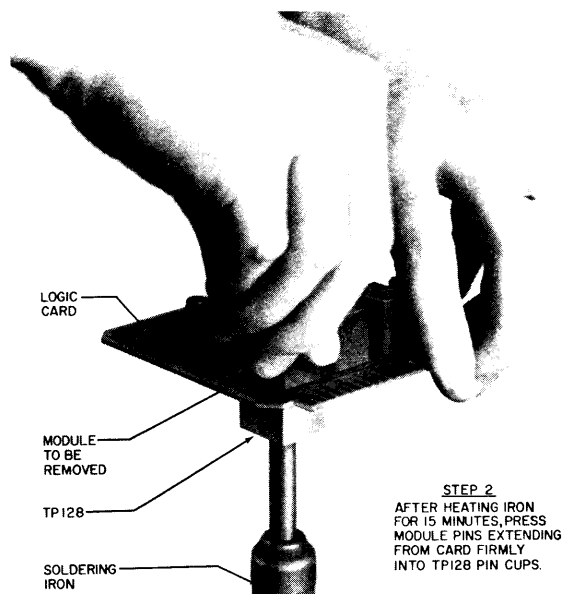
664.18-9

4097-11-1

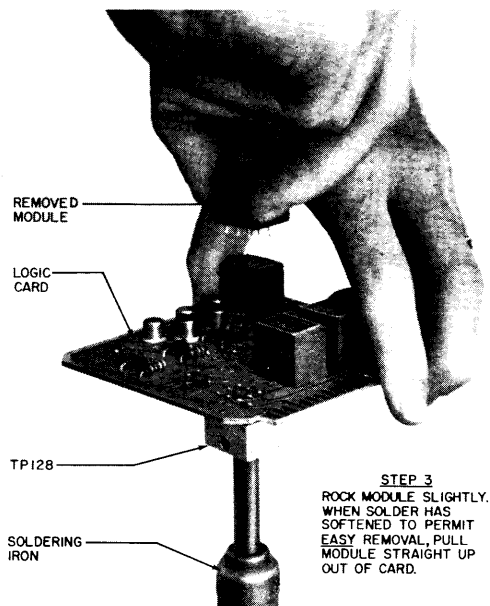
Figure 5-5. TP128 in Position



4097-12-1



4097-13-1



4097-14-1

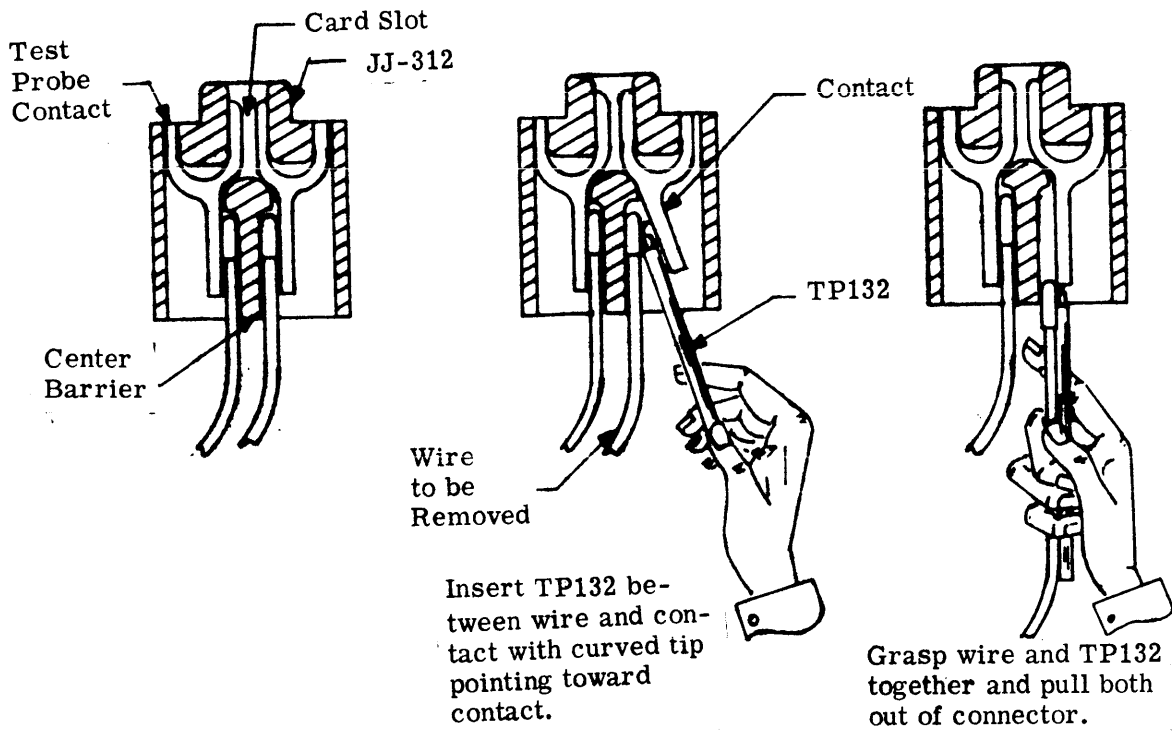


4097-15-1

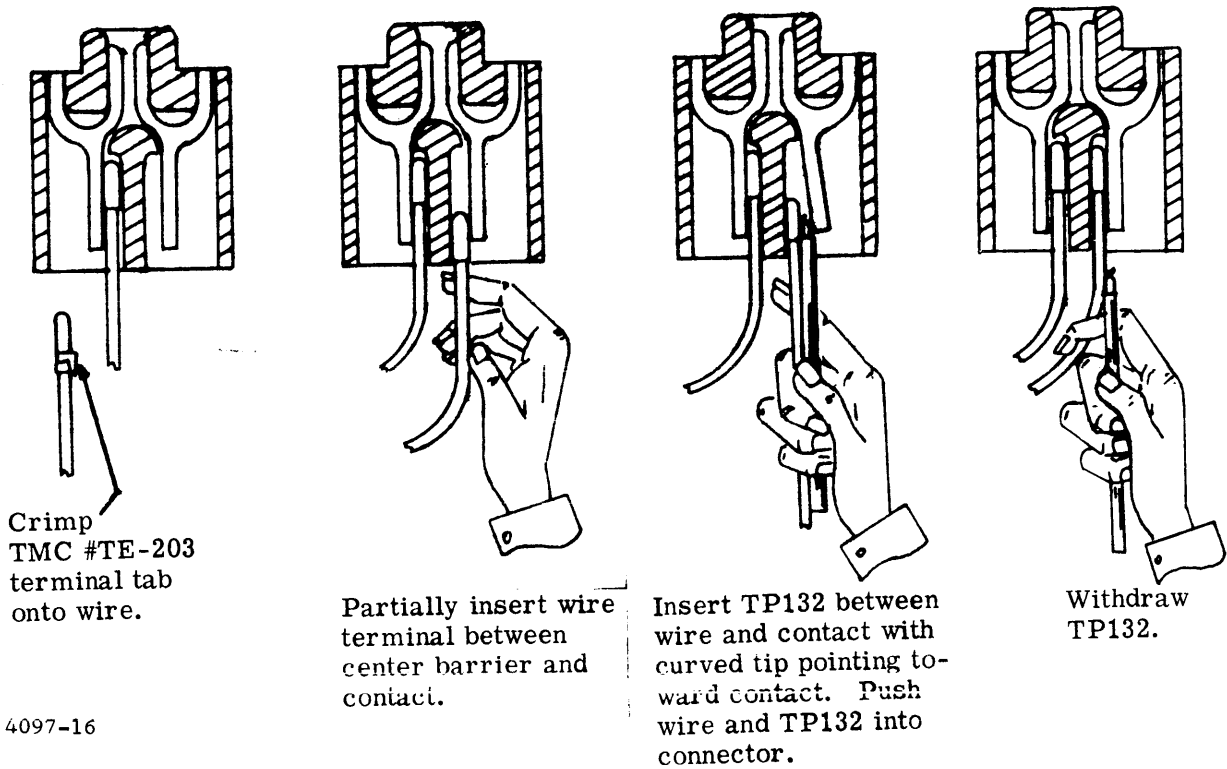
664.18-10,-11,-12,-13

Figure 5-6. Removing Logic Module from Card

REMOVAL



INSERTION



4097-16

Figure 5-7. Using TP132 Connector Extractor

SECTION 6 PARTS LIST

6-1. INTRODUCTION

The parts list presented in this section is a cross-reference list of parts identified by a reference designation and TMC part number. In most cases, parts appearing on schematic diagrams are assigned reference designations in accordance with MIL-STD-16. Wherever practicable, the reference designation is marked on the equipment, close to the part it identifies. In most cases, mechanical and electro-mechanical parts have TMC part numbers stamped on them.

To expedite delivery when ordering any part, specify the following:

- a. Generic name.
- b. Reference designation.
- c. TMC part number.
- d. Model and serial numbers of the equipment containing the part being replaced; this can be obtained from the equipment nameplate.

For replacement parts not covered by warranty (refer to warranty sheet in front of manual), address all purchase orders to:

The Technical Materiel Corporation
Attention: Sales Department
700 Fenimore Road
Mamaroneck, New York

<u>Assembly or Subassembly</u>	<u>Page</u>
CHANNEL FREQUENCY INDICATOR, RTIA-1	6-2
RESET CIRCUIT No.2 MODULE	6-10
SHIFT REGISTER No.4 MODULE	6-11
READOUT CIRCUIT No.1 MODULE	6-12
READOUT CIRCUIT No.3 MODULE	6-13
READOUT CIRCUIT No.2 MODULE	6-13
READOUT CIRCUIT No.4 MODULE	6-14
READOUT CIRCUIT No.5 MODULE	6-15
READOUT CIRCUIT No.7 MODULE	6-16
NOR LOGIC/MC-1 MODULE	6-17
READOUT CIRCUIT No.6 MODULE	6-17
SHIFT REGISTER No.5 MODULE	6-18
READOUT CIRCUIT No.8 MODULE	6-19
SHIFT REGISTER No.3 MODULE	6-20
RESET CIRCUIT No.1 MODULE	6-21
SHIFT REGISTER No.2 MODULE	6-23
TIMING CIRCUIT No.2 MODULE	6-24

PARTS LIST

for

CHANNEL FREQUENCY INDICATOR, RTIA-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
BL2001	FAN, VENTILATING: 115 VAC, 50/60 cps; single phase; 14 watts; 100 cfm free delivery; venturi block, black phenolic case.	BL106-2
C2001	CAPACITOR, FIXED, ELECTROLYTIC: 20 uf, -10% +150% at 120 cps at 25°C; 50 WVDC; polarized insulated tubular case.	CE105-20-50
C2002	Same as C2001.	
C2003	CAPACITOR, FIXED, ELECTROLYTIC: polarized; 2,600 uf, 50 WVDC; insulated clear plastic case.	CE112-6
C2004	Same as C2003.	
C2005	CAPACITOR, FIXED, ELECTROLYTIC: polarized; 9,200 uf, 15 WVDC; insulated clear plastic case.	CE112-10
C2006	CAPACITOR, FIXED, ELECTROLYTIC: polarized; 14,000 uf, 30 WVDC; insulated clear plastic case.	CE112-9
C2007	CAPACITOR, FIXED, METALIZED PLASTIC: 0.47 uf, <u>+</u> 10%; 100 WVDC; epoxy encapsulated case.	CN112A474K1
C2008	Same as C2005.	
C2009	CAPACITOR, FIXED, ELECTROLYTIC: polarized; 20 uf, 250 WVDC; hermetically sealed aluminum case, black vinyl plastic sleeve.	CE116-4VS
CR2001	SEMICONDUCTOR DEVICE, DIODE: silicon; max. peak inverse voltage 100 V; continuous forward current 300 ma at 150°C; hermetically sealed metal and glass case.	1N1582
CR2002 thru CR2004	Same as CR2001.	
CR2005	SEMICONDUCTOR DEVICE, DIODE: silicon; nominal ref. voltage 13 V; max. power dissipation 10 watts at 25°C; max. operating temperature 100°C; hermetically sealed case.	1N2977B

PARTS LIST (CONT)

CHANNEL FREQUENCY INDICATOR, RTIA-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR2006	SEMICONDUCTOR DEVICE, DIODE: silicon; max. peak reverse voltage 100 V; average forward current 12 amps at 150°C; operating and storage temperature range -65°C to +200°C; hermetically sealed case.	1N1200A
CR2007 thru CR2009	Same as CR2006.	
CR2010	SEMICONDUCTOR DEVICE, DIODE: silicon; nominal ref. voltage 39 V; max. power dissipation 10 watts at 25°C; max. operating temperature 150°C; hermetically sealed case.	1N1827A
CR2011	SEMICONDUCTOR DEVICE, DIODE: silicon; nominal ref. voltage 12 V; max. power dissipation 50 watts at 25°C; max. operating temperature 150°C; hermetically sealed case.	1N2810B
CR2012	SEMICONDUCTOR DEVICE, DIODE: silicon; nominal ref. voltage 600 V; max. forward voltage drop 1.0 volts; max. continuous DC current 0.50 amps at 100°C; peak surge current 75 amps; max. reverse current 1,000 ua; max. operating temperature 150°C; hermetically sealed case.	1N2484
CR2013	Same as CR2012.	
CR2014	SEMICONDUCTOR DEVICE, DIODE: silicon; nominal ref. voltage 180 V; max. power dissipation 10 watts at 25°C; max. operating temperature 175°C; hermetically sealed case.	1N1814A
CR2015	SEMICONDUCTOR DEVICE, DIODE: peak inverse voltage 100 V; max. forward current 200 ma at 1.0 volts; max. reverse current 100 ua at 25°C; max. operating temperature 90°C; JEDEC type DO-7 case.	1N270
CR2016	Same as CR2015.	
CR2017	Same as CR2015.	
DS2001	LAMP, NEON: 110 to 125 volts, 1/15 watts; midget flange base; T-2 bulb.	B1111-1

PARTS LIST (CONT)

CHANNEL FREQUENCY INDICATOR, RTIA-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
DS2002	INDICATOR, DIGITAL	IC102-1-2
DS2003	INDICATOR, DIGITAL	IC102-1-5
DS2004	INDICATOR, DIGITAL	IC102-1-4
DS2005	INDICATOR, DIGITAL	IC101-1
DS2006 thru DS2008	Same as DS2005.	
DS2009	LAMPHOLDER, PUNCTUATION DISPLAY: operating voltage 180 volts; 2 solder lug type terminals; black plastic body.	TS176-1
DS2010	Same as DS2005.	
DS2011	Same as DS2005.	
DS2012	INDICATOR, DIGITAL	IC100-1
DS2013	Same as DS2012	
DS2014	INDICATOR, DIGITAL	IC100-2
DS2015	Same as DS2012	
DS2016	Same as DS2012	
DS2017	Same as DS2012	
DS2018	INDICATOR, DIGITAL	IC102-1-6
DS2019	NON-REPLACEABLE ITEM. (Part of XF2001)	
DS2020	NON-REPLACEABLE ITEM. (Part of XF2005)	
DS2021	NON-REPLACEABLE ITEM. (Part of XF2004)	
DS2022	NON-REPLACEABLE ITEM. (Part of XF2003)	
DS2023	NON-REPLACEABLE ITEM. (Part of XF2002)	
F2001	FUSE, CARTRIDGE: 2 amps; time lag; 1-1/4" long x 1/4" dia.; slow blow.	FU102-2
F2002	FUSE, CARTRIDGE: 1 amp; 1-1/4" long x 1/4" dia. : quick acting.	FU100-1

PARTS LIST (CONT)

CHANNEL FREQUENCY INDICATOR, RTIA-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
F2003	FUSE, CARTRIDGE: 6 amps; 1-1/4" long x 1/4" dia.; quick acting.	FU100-6
F2004	FUSE, CARTRIDGE: 1/4 amp; 1-1/4" long x 1/4" dia.; quick acting.	FU100-.250
F2005	FUSE, CARTRIDGE: 1/4 amp; time lag; 1-1/4" long x 1/4" dia.; slow blow.	FU102-.250
J2001	CONNECTOR, RECEPTACLE, ELECTRICAL: 22 female contacts; accomodates 1/16" printed circuit board.	JJ312-44
J2002 thru J2030	Same as J2001.	
J2031	NOT USED	
J2032	NOT USED	
J2033	CONNECTOR, RECEPTACLE, ELECTRICAL: 11 round female contacts, rated for 3 amps at 1,800 V RMS; key polarization. micro miniature type.	JJ311-1S
MP2001	FILTER, AIR CONDITIONING: replaceable type; galvanized steel frame, aluminum mesh; o/a dim. 4-11/16" long x 4-11/16" high x 1/2" wide.	AD103-19
P2001 thru P2006	NOT USED	
P2007	CONNECTOR, PLUG, ELECTRICAL: AC; 3 prong polarized plug with removeable ground connection.	PL218
Q2001	TRANSISTOR: germanium, hi-current; collector to base voltage 40 V; collector to emitter and emitter to base voltage 20 V; collector current 7 amps; power dissipation 85 watts at 25°C; operating storage and junction temperature range -65°C to +110°C; JEDEC type TO-3 case.	2N456A

PARTS LIST (CONT)

CHANNEL FREQUENCY INDICATOR, RTIA-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Q2002	TRANSISTOR: PNP, germanium; collector to base voltage 50 V; emitter to base voltage 30 V; collector current 15 amps; power dissipation 150 watts at 25°C; operating storage temperature range -65°C to +100°C; JEDEC type TO-36 case.	2N278
R2001	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, <u>+5%</u> ; 1/2 watt.	RC20GF102J
R2002	Same as R2001.	
R2003	RESISTOR, FIXED, WIREWOUND: 0.5 ohms, 5 watts.	RW107-54
R2004	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, <u>+5%</u> ; 2 watts.	RC42GF102J
R2005	RESISTOR, FIXED, WIREWOUND: 250 ohms, current rating 141 ma; 5 watts.	RW107-23
R2006	RESISTOR, FIXED, WIREWOUND: 0.5 ohms, current rating 6,300 ma; 20 watts.	RW110-47
R2007	RESISTOR, FIXED, WIREWOUND: 25 ohms, current rating 630 ma; 10 watts.	RW109-6
R2008	RESISTOR, FIXED, WIREWOUND: 100 ohms, current rating 315 ma; 10 watts.	RW109-9
R2009	Same as R2003.	
R2010	RESISTOR, FIXED, COMPOSITION: 33,000 ohms, <u>+5%</u> ; 2 watts.	RC42GF333J
R2011	NOT USED	
R2012	RESISTOR, FIXED, COMPOSITION: 10 ohms, <u>+5%</u> ; 1/2 watt.	RC20GF100J
R2013	Same as R2012.	
R2014	Same as R2012.	
R2015	RESISTOR, FIXED, COMPOSITION: 22 ohms, <u>+5%</u> ; 2 watts.	RC42GF220J

PARTS LIST (CONT)

CHANNEL FREQUENCY INDICATOR, RTIA-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R2016 thru R2020	Same as R2015.	
R2021	NON-REPLACEABLE ITEM. (Part of XF2001)	
R2022	NON-REPLACEABLE ITEM. (Part of XF2005)	
R2023	NON-REPLACEABLE ITEM. (Part of XF2004)	
R2024	NON-REPLACEABLE ITEM. (Part of XF2003)	
S2001	SWITCH, TOGGLE: SPST; bat type handle.	ST103-1-62
T2001	TRANSFORMER, POWER, STEP-DOWN: primary (#1, #2) 125 V, 250 VAC tapped at 105, 115 V, 50/60 cps; secondary 20.4 V RMS at 6 ADC, 20.4 V RMS at 600 MADC, 290 V at 25 MADC center tapped; 15 solder lug type terminals; hermetically sealed steel rectangular case.	TF323
TB2001	TERMINAL STRIP, BARRIER: 6 double right angle solder lug type terminals; o/a dim. 3-1/8" long x 5/16" wide; black phenolic body.	TM127-6
TB2002	Same as TB2001.	
TB2003	Same as TB2001.	
TB2004	TERMINAL BOARD, BARRIER: two 6-32 x 1/4" binding head machine screw; black phenolic body.	TM102-2
W2001	CABLE ASSEMBLY, POWER; consists of one 3 conductor coiled power cord, 1 AC connector, P2007; 3 spade type terminal lugs.	CA575-2
XCR2001 thru XCR2010	NOT USED	
XCR2011	SOCKET, TRANSISTOR: 7 pin contact accommodation; 0.040 or 0.050 dia.; polarized; 1 terminal lug grounding strap; o/a dim. 1-37/64" x 1" max.	TS166-1
XDS2001	LIGHT, INDICATOR: with white lens; accepts T-3-1/4 single contact, midget flange lamp.	TS154-5

PARTS LIST (CONT)

CHANNEL FREQUENCY INDICATOR, RTIA-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
XF2001	FUSEHOLDER, LAMP INDICATING: accomodates cartridge fuse 1-1/4" long x 1/4" dia.; 90 to 300 V, 20 amps; neon lamp type with a 220 k ohm lamp resistor; transparent clear flat sided knob; black body. (Consists of DS2019, R2021)	FH104-3
XF2002	FUSEHOLDER, LAMP INDICATING: accomodates cartridge fuse 1-1/4" long x 1/4" dia.; 6.4 to 13 V, 20 amps; incandescent lamp type with a 40 ohm lamp resistor; transparent red flat sided knob; brown body. (Consists of DS2023, R2025)	FH104-9
XF2003	Same as XF2002. (Consists of DS2022, R2024)	
XF2004	Same as XF2002. (Consists of DS2021, R2023)	
XF2005	Same as XF2001. (Consists of DS2020, R2022)	
XQ2001	Same as XCR2011.	
XQ2002	HEAT SINK: non-insulated; black anodize finish; TO-36 case.	HD102-1A
Z2001	RESET CIRCUIT NO.2 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3761
Z2002	SHIFT REGISTER NO. 4 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3758
Z2003	READOUT CIRCUIT NO. 1 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3688
Z2004	Same as Z2003. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2005	READOUT CIRCUIT NO. 3 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3691
Z2006	Same as Z2003. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2007	Same as Z2003. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2008	READOUT CIRCUIT NO. 2 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3690

PARTS LIST (CONT)

CHANNEL FREQUENCY INDICATOR, RTIA-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z2009	Same as Z2002. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2010 thru Z2012	Same as Z2003. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2013	Same as Z2008. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2014	Same as Z2003. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2015	READOUT CIRCUIT NO. 4 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3693
Z2016	Same as Z2005. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2017	Same as Z2003. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2018	Same as Z2003. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2019	READOUT CIRCUIT NO. 5 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3755
Z2020	READOUT CIRCUIT NO. 7 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3764
Z2021	NOR LOGIC MC-1 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3757
Z2022	Same as Z2021. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2023	READOUT CIRCUIT NO. 6 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3760
Z2024	Same as Z2003. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2025	SHIFT REGISTER NO. 5 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3759

PARTS LIST (CONT)

CHANNEL FREQUENCY INDICATOR, RTIA-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z2026	READOUT CIRCUIT NO. 8 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3794
Z2027	SHIFT REGISTER NO. 3 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3756
Z2028	RESET CIRCUIT NO. 1 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4456*
Z2029	SHIFT REGISTER NO. 2 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3692
Z2030	TIMING CIRCUIT NO. 2 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3806
	* Z2028 is A3694 in earlier models.	

Z2001

RESET CIRCUIT NO. 2 MODULE, A3761

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, MICA DIELECTRIC: 620 uuf, +5%; 500 WVDC; straight wire leads.	CM112E621J5S
C2	CAPACITOR, FIXED, MICA DIELECTRIC: 220 uuf, +5%; 500 WVDC; straight wire leads.	CM111E221J5S
R1	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, +5%; 1/2 watt.	RC20GF472J
R2	Same as R1.	
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP4	Same as TP1.	

PARTS LIST (CONT)

Z2001

RESET CIRCUIT NO. 2 MODULE, A3761

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z1	NETWORK, BUFFER AMPLIFIER: operating frequency 100 kc; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z2 thru Z8	Same as Z1.	
Z9	NETWORK, ONESHOT GENERATOR: operating frequency 100 kc; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW111-1
Z10	NETWORK, EMITTER FOLLOWER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW118-11
Z11	Same as Z9.	
Z12	Same as Z10.	

Z2002

SHIFT REGISTER NO. 4 MODULE, A3758

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2	Same as TP1.	
TP3	Same as TP1.	
Z1	NETWORK, NAND GATE AMPLIFIER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW104-21
Z2 thru Z4	Same as Z1.	

PARTS LIST (CONT)

Z2002

SHIFT REGISTER NO. 4 MODULE, A3758

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z5	NETWORK, POSITIVE EMITTER FOLLOWER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW112-11
Z6	Same as Z5.	
Z7	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 kc; operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW107-4X
Z8 thru Z10	Same as Z7.	

Z2003,4,6,7,10,11,12,14,17,18,24

READOUT CIRCUIT NO. 1 MODULE, A3688

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP12	Same as TP1.	
Z1	NETWORK, POSITIVE EMITTER FOLLOWER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW112-11
Z2 thru Z4	Same as Z1.	
Z5	NETWORK, FLIP-FLOP AMPLIFIER: operating temperature range -35°C to $+85^{\circ}\text{C}$; operating frequency 100 kc; 12 male contacts, epoxy case.	NW107-4X
Z6 thru Z8	Same as Z5.	

PARTS LIST (CONT)

Z2003, 4, 6, 7, 10, 12, 14, 17, 18, 24

READOUT CIRCUIT NO. 1 MODULE, A3688

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z9	NETWORK, NAND GATE AMPLIFIER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW104-21
Z10 thru Z12	Same as Z9.	

Z2005, 16

READOUT CIRCUIT NO. 3 MODULE, A3691

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z1	NETWORK, GATE AMPLIFIER: dual; operating temperature $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW108-25
Z2 thru Z10	Same as Z1.	

Z2008

READOUT CIRCUIT NO. 2, A3690

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP12	Same as TP1.	
Z1	NETWORK, EMITTER FOLLOWER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW120-11
Z2	NETWORK, GATE AMPLIFIER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW108-25

PARTS LIST (CONT)

Z2008

READOUT CIRCUIT NO. 2, A3690

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z3	Same as Z1.	NW108-26
Z4	Same as Z2.	
Z5	Same as Z2.	
Z6	Same as Z1.	
Z7	Same as Z2.	
Z8	Same as Z1.	
Z9	Same as Z1.	
Z10	NETWORK, GATE AMPLIFIER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	
Z11	Same as Z1.	
Z12	Same as Z2.	

Z2015

READOUT CIRCUIT NO. 4 MODULE, A3693

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP12	Same as TP1.	
Z1	NETWORK, EMITTER FOLLOWER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW120-11
Z2	NETWORK, GATE AMPLIFIER: dual; operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW108-25
Z3	Same as Z1.	

PARTS LIST (CONT)

Z2015

READOUT CIRCUIT NO. 4 MODULE, A3693

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z4	Same as Z2.	
Z5	Same as Z2.	
Z6	Same as Z1.	
Z7	Same as Z2.	
Z8	Same as Z1.	
Z9	Same as Z1.	
Z10	Same as Z2.	
Z11	Same as Z1.	
Z12	Same as Z2.	

Z2019

READOUT CIRCUIT NO. 5 MODULE, A3755

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP13	Same as TP1.	
Z1	NETWORK, DIGITAL INVERTER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW105-11
Z2	NETWORK, GATE AMPLIFIER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW108-26
Z3	Same as Z2.	
Z4	NETWORK, OR GATE AMPLIFIER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW121-26

PARTS LIST (CONT)

Z2019

READOUT CIRCUIT NO. 5 MODULE, A3755

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z5	Same as Z2.	NW108-25
Z6	NETWORK, AND GATE AMPLIFIER: dual; operating temperature +85°C; 12 male contacts, epoxy case.	
Z7 thru Z9	Same as Z4.	

Z2020

READOUT CIRCUIT NO. 7 MODULE, A3764

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR1	SEMICONDUCTOR DEVICE, DIODE: peak inverse voltage 100 V; max. forward current 200 ma at 1.0 volts; max. reverse current 100 ua at 25°C; max. power dissipation 80 mw at 25°C; max. operating temperature 90°C; JEDEC type DO-7 case.	1N270
CR2 thru CR5	Same as CR1.	TE168-2C
TP1	TERMINAL, STUD: feedthru.	
TP2 thru TP4	Same as TP1.	NW119-21
Z1	NETWORK, NOR GATE AMPLIFIER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	
Z2 thru Z5	Same as Z1.	NW120-11
Z6	NETWORK, EMITTER FOLLOWER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	

PARTS LIST (CONT)

Z2020

READOUT CIRCUIT NO. 7 MODULE, A3764

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z7	Same as Z1.	NW119-22
Z8	NETWORK, NOR GATE AMPLIFIER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	
Z9	Same as Z8.	

Z2021,22

NOR LOGIC/MC-1 MODULE, A3757

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP5	Same as TP1.	
Z1	NETWORK, NOR GATE AMPLIFIER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW119-21
Z2 thru Z10	Same as Z1.	

Z2023

READOUT CIRCUIT NO. 6 MODULE, A3760

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP10	Same as TP1.	
Z1	NETWORK, EMITTER FOLLOWER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW120-11

PARTS LIST (CONT)

Z2023

READOUT CIRCUIT NO. 6 MODULE, A3760

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z2	NETWORK, GATE AMPLIFIER: dual; operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW108-25
Z3	Same as Z2.	
Z4	Same as Z1.	
Z5	Same as Z1.	
Z6	Same as Z2.	
Z7	Same as Z2.	
Z8	Same as Z1.	
Z9 thru Z11	Same as Z2.	
Z12	Same as Z1.	

Z2025

SHIFT REGISTER NO. 5 MODULE, A3759

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP4	Same as TP1.	
Z1	NETWORK, NAND GATE AMPLIFIER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW104-21
Z2 thru Z4	Same as Z1.	
Z5	NETWORK, POSITIVE EMITTER FOLLOWER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW112-11

PARTS LIST (CONT)

Z2025

SHIFT REGISTER NO. 5 MODULE, A3759

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z6	Same as Z5.	NW107-4X
Z7	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 kc; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	
Z8 thru Z10	Same as Z7.	

Z2026

READOUT CIRCUIT NO. 8 MODULE, A3794

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, MICA DIELECTRIC: 470 uuf, +5%; 500 WVDC; straight wire leads.	CM111E471J-5S
C2	CAPACITOR, FIXED, METALLIZED PLASTIC: 0.10 uf, +5%; 50 WVDC; epoxy encapsulated case.	CN114R10-5J
C3	CAPACITOR, FIXED, METALLIZED PLASTIC: 1.0 uf, +5%; 50 WVDC; epoxy encapsulated case.	CN114-1R05J
C4	Same as C2.	
R1	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, +5%; 1/2 watt.	RC20GF472J
R2	Same as R1.	
R3	Same as R1.	
R4	RESISTOR, FIXED, COMPOSITION: 100,000 ohms +5%; 1/2 watt.	RC20GF104J
R5	RESISTOR, FIXED, COMPOSITION: 390,000 ohms, +5%; 1/2 watt.	RC20GF394J
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP6	Same as TP1.	

PARTS LIST (CONT)

Z2026

READOUT CIRCUIT NO. 8 MODULE, A3794

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z1	NETWORK, BUFFER AMPLIFIER: operating frequency 100 kc; operating temperature -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z2	NETWORK, ONE SHOT GENERATOR: operating frequency 100 kc; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW111-11
Z3	Same as Z2.	
Z4	NETWORK, POSITIVE EMITTER FOLLOWER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW112-11
Z5	Same as Z2.	
Z6	Same as Z1.	
Z7	Same as Z1.	
Z8	NETWORK, EMITTER FOLLOWER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW118
Z9	Same as Z4.	
Z10	Same as Z1.	

Z2027

SHIFT REGISTER NO. 3 MODULE, A3756

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, METALLIZED PLASTIC: 0.10 uf, +5%; 50 WVDC; epoxy encapsulated case.	CN114R105J
R1	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, +5%; 1/2 watt.	RC20GF472J
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP9	Same as TP1.	

PARTS LIST (CONT)

Z2027

SHIFT REGISTER NO. 3 MODULE, A3756

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z1	NETWORK, POSITIVE EMITTER FOLLOWER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW112-11
Z2 thru Z4	Same as Z1.	
Z5	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 kc; operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW107-4X
Z6 thru Z9	Same as Z5.	
Z10	NETWORK, NAND GATE AMPLIFIER: operating temperature -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW104-22
Z11	NETWORK, ONE SHOT GENERATOR: operating frequency 100 kc; operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW111-1

Z2028 (EARLIER MODELS)

RESET CIRCUIT NO. 1 MODULE, A3694

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, METALLIZED PLASTIC: 0.10 uf, $\pm 5\%$; 50 WVDC; epoxy encapsulated case.	CN114R105J
C2	Same as C1.	
R1	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, $\pm 5\%$; 1/2 watt.	RC20GF472J
R2	RESISTOR, FIXED, COMPOSITION: 390,000 ohms, $\pm 5\%$; 1/2 watt.	RC20GF394J
R3	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, $\pm 5\%$; 1/2 watt.	RC20GF104J

PARTS LIST (CONT)

Z2028 (EARLIER MODELS)

RESET CIRCUIT NO. 1 MODULE, A3694

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP8	Same as TP1.	
Z1	NETWORK, BUFFER AMPLIFIER: operating frequency 100 kc; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z2	NETWORK, ONE SHOT GENERATOR: operating frequency 100 kc; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW111-11
Z3	Same as Z1.	
Z4	NETWORK, NAND GATE AMPLIFIER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW104-21
Z5	NETWORK, DIGITAL INVERTER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW105-11
Z6	NETWORK, EMITTER FOLLOWER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW118-11
Z7	NETWORK, EMITTER FOLLOWER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW118
Z8	NETWORK, POSITIVE EMITTER FOLLOWER: operating temperature range -35°C; 12 male contacts. epoxy case.	NW112-11
Z9 thru Z11	Same as Z8.	

PARTS LIST (CONT)

Z2028 (LATER MODELS)

RESET CIRCUIT NO. 1 MODULE, A4456

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, ELECTROLYTIC: 100 uf, -10% +150% at 120 cps at 25°C, 25 WVDC; polarized; insulated tubular case.	CE105-100-25
C2	Same as C1.	
R1	RESISTOR, FIXED, COMPOSITION: 1,200 ohms +5%; 1/2 watt.	RC20GF122J
R2	RESISTOR, FIXED, COMPOSITION: 2,700 ohms +5%; 1/2 watt.	RC20GF272J

Z2029

SHIFT REGISTER NO. 2, A3692

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP6	Same as TP1.	
Z1	NETWORK, NAND GATE AMPLIFIER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW104-21
Z2	NETWORK, FLIP-FLOP AMPLIFIER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW107-4X
Z3	Same as Z2.	
Z4	NETWORK, COMPLIMENTARY EMITTER FOLLOWER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW118-11
Z5 thru Z8	Same as Z2.	
Z9 thru Z12	Same as Z1.	

PARTS LIST

Z2030

TIMING CIRCUIT NO. 2, A3806

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, METALLIZED PLASTIC: 3.0 uf, $\pm 5\%$; 50 WVDC; epoxy encapsulated.	CN114-3RO-5J
C2	CAPACITOR, FIXED, METALLIZED PLASTIC: 1.0 uf, $\pm 5\%$; 50 WVDC; epoxy encapsulated.	CN114-1RO-5J
C3	CAPACITOR, FIXED, METALLIZED PLASTIC: 0.68 uf, $\pm 5\%$; 50 WVDC; epoxy encapsulated.	CN114R68-5J
C4	CAPACITOR, FIXED, MICA DIELECTRIC: 470 uuf $\pm 5\%$; 500 WVDC; straight wire leads.	CM111E471J-5S
C5	CAPACITOR, FIXED, METALLIZED PLASTIC: 2.0uf, $\pm 5\%$; 50 WVDC; epoxy encapsulated.	CN114-2RO-5J
CR1	SEMICONDUCTOR DEVICE, DIODE: peak inverse voltage 100 V; max. forward current 200 ma at 1.0 volts; max. reverse current 100 ua at 25 ^o c; max. power dissipation 80 mw at 25 ^o c; max. operating temperature 90 ^o c; JEDEC type DO-7 case.	1N270
CR2	Same as CR1.	
R1	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, $\pm 5\%$; 1/2 watt.	RC20GF472J
R2	RESISTOR, FIXED, COMPOSITION: 12,000 ohms, $\pm 5\%$; 1/2 watt.	RC20GF123J
R3	RESISTOR, FIXED, COMPOSITION: 1,200 ohms, $\pm 5\%$; 1/2 watt.	RC20GF122J
R4	Same as R1.	
R5	RESISTOR, VARIABLE, COMPOSITION: 200 ohms, $\pm 10\%$; 5 watts.	RV116-201-8-3
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP9	Same as TP1.	
Z1	NETWORK, ONE SHOT GENERATOR: operating frequency 100 kc; operating temperature range -35 ^o c to +65 ^o c; 12 male contacts.	NW111-1

PARTS LIST (CONT)

Z2030

TIMING CIRCUIT NO. 2, A3806

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z2	Same as Z1.	
Z3	Same as Z1.	
Z4	NETWORK, CLOCK GENERATOR: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW113-1X
Z5	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 kc; operating temperature range -35°C to $+65^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW107-4X
Z6	NETWORK, NAND GATE AMPLIFIER: operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW104-21
Z7	NETWORK, BUFFER AMPLIFIER: operating frequency 100 kc; operating temperature range -35°C to $+85^{\circ}\text{C}$; 12 male contacts, epoxy case.	NW109-11
Z8	Same as Z7.	

SECTION 7

SCHEMATIC WIRING

- NOTES:
- 1- GROUND CONNECTION THRU PINS 1, 2, 43 & 44 FOR ALL CARDS.
 - 2- FOR RTIE-1 DELETE DS 2015 AND R201B LOCATED ON SHEET 8 OF 9.

DWG DESTINATION

2 F11 J2029-40

SHT NO. ZONE CONNECTOR PIN NO.

LAST NUMBER USED

FF-1
NA-2
NAG-1
OS-3
TG-1

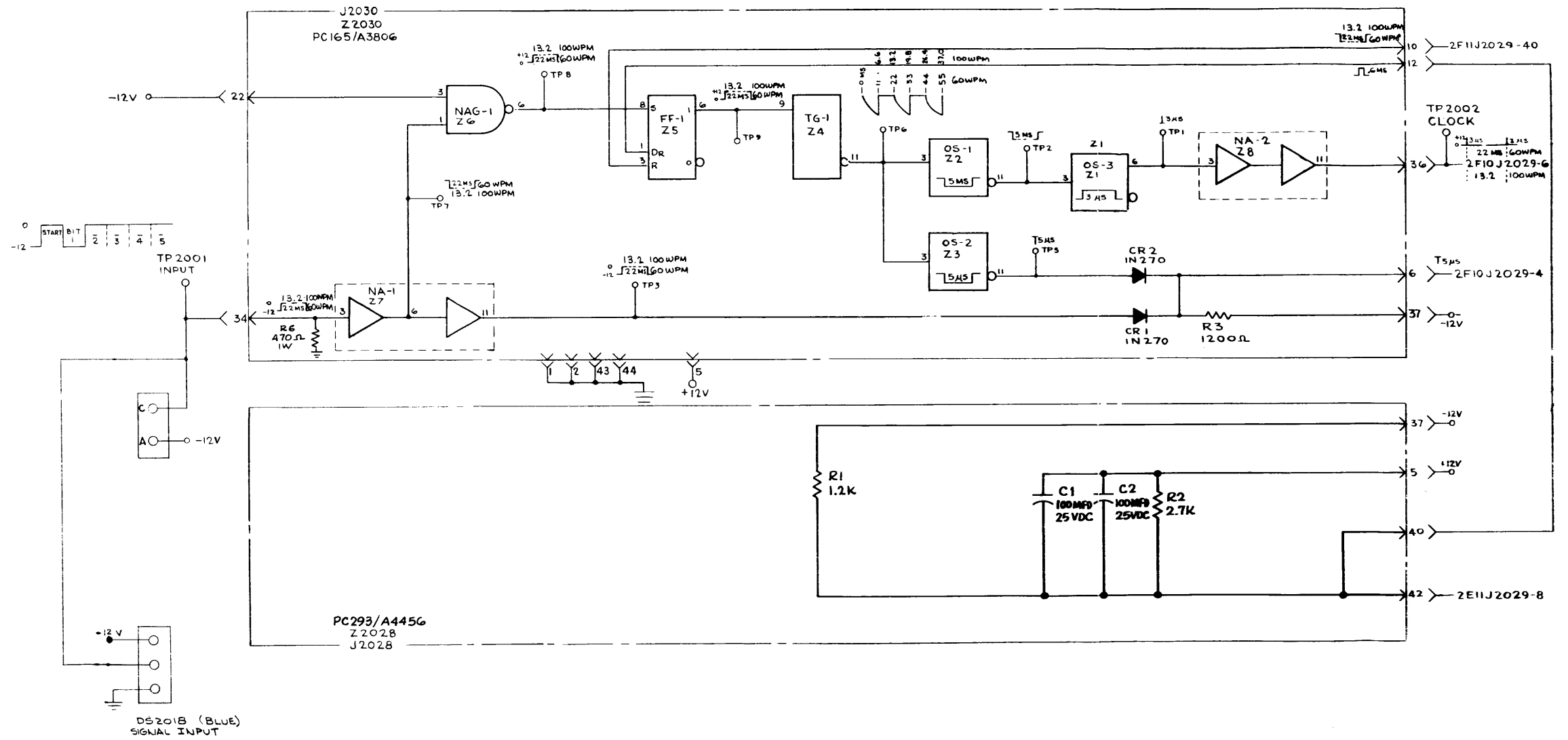


Figure 7-1. Detailed Logic Diagram, RTIA-1 (Sheet 1 of 9)

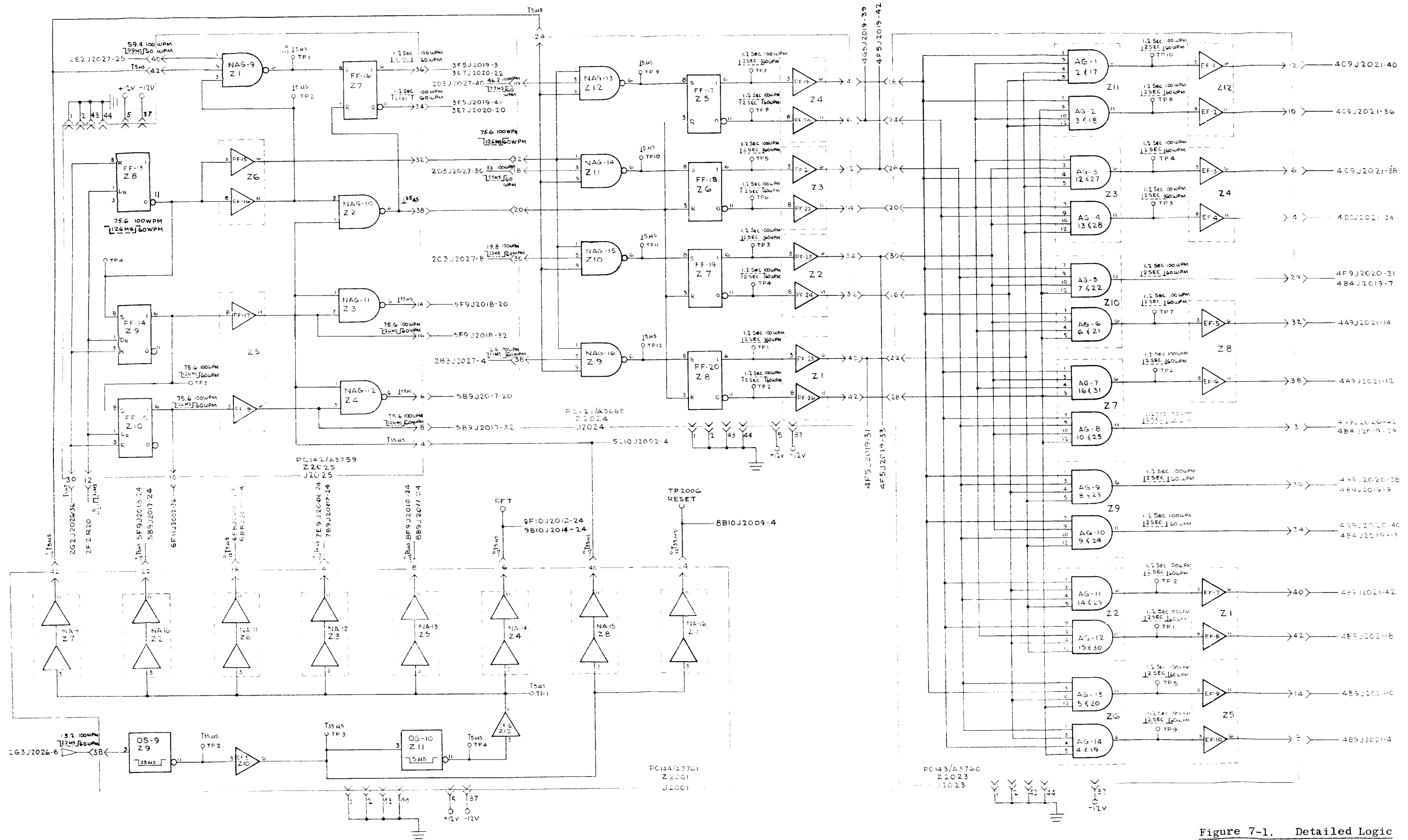


Figure 7-1. Detailed Logic Diagram, RTIA-1 (Sheet 3 of 9)

LAST NUMBER USED
AG 15
EF 12
IV 2
NG 18
OG 11

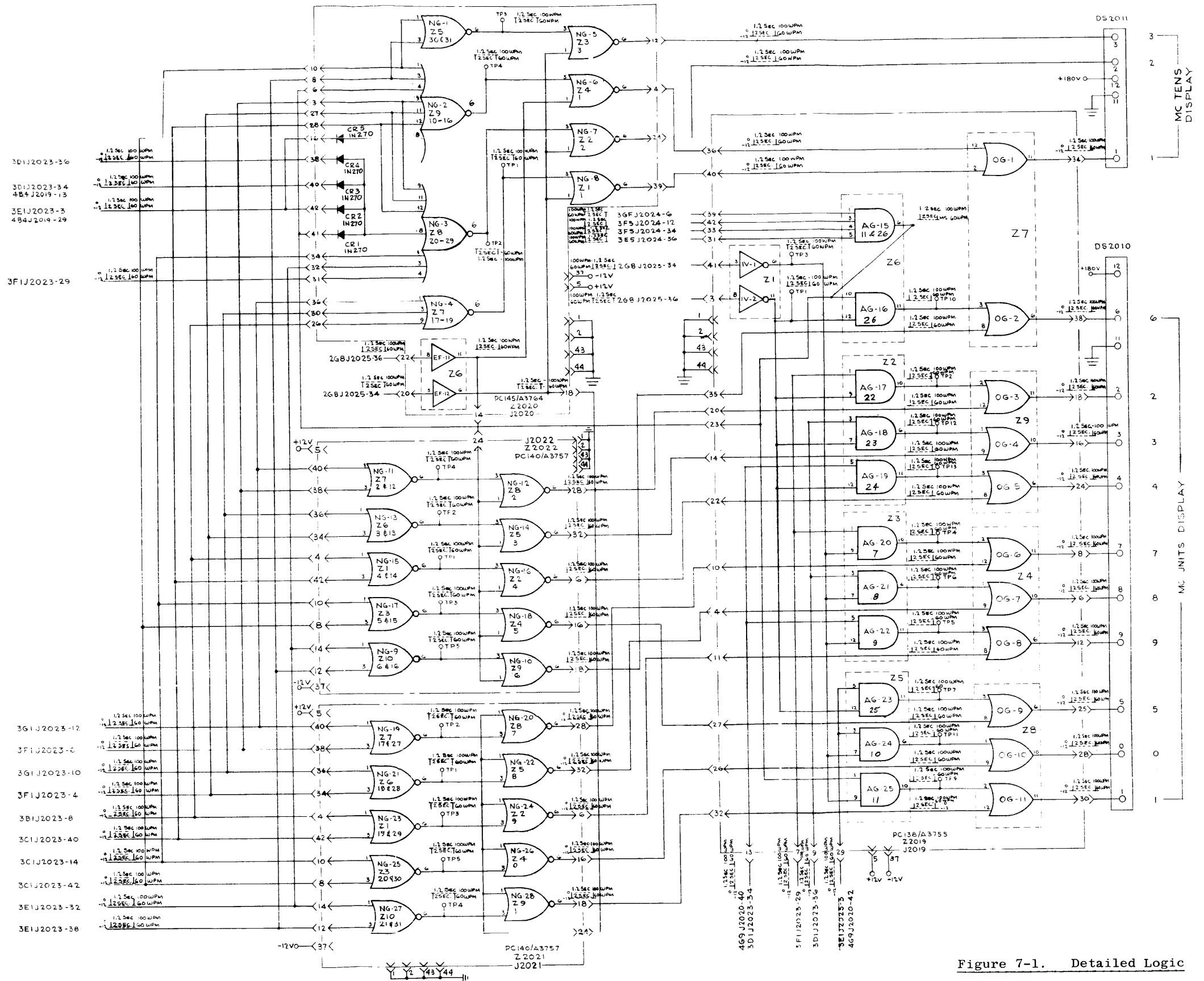
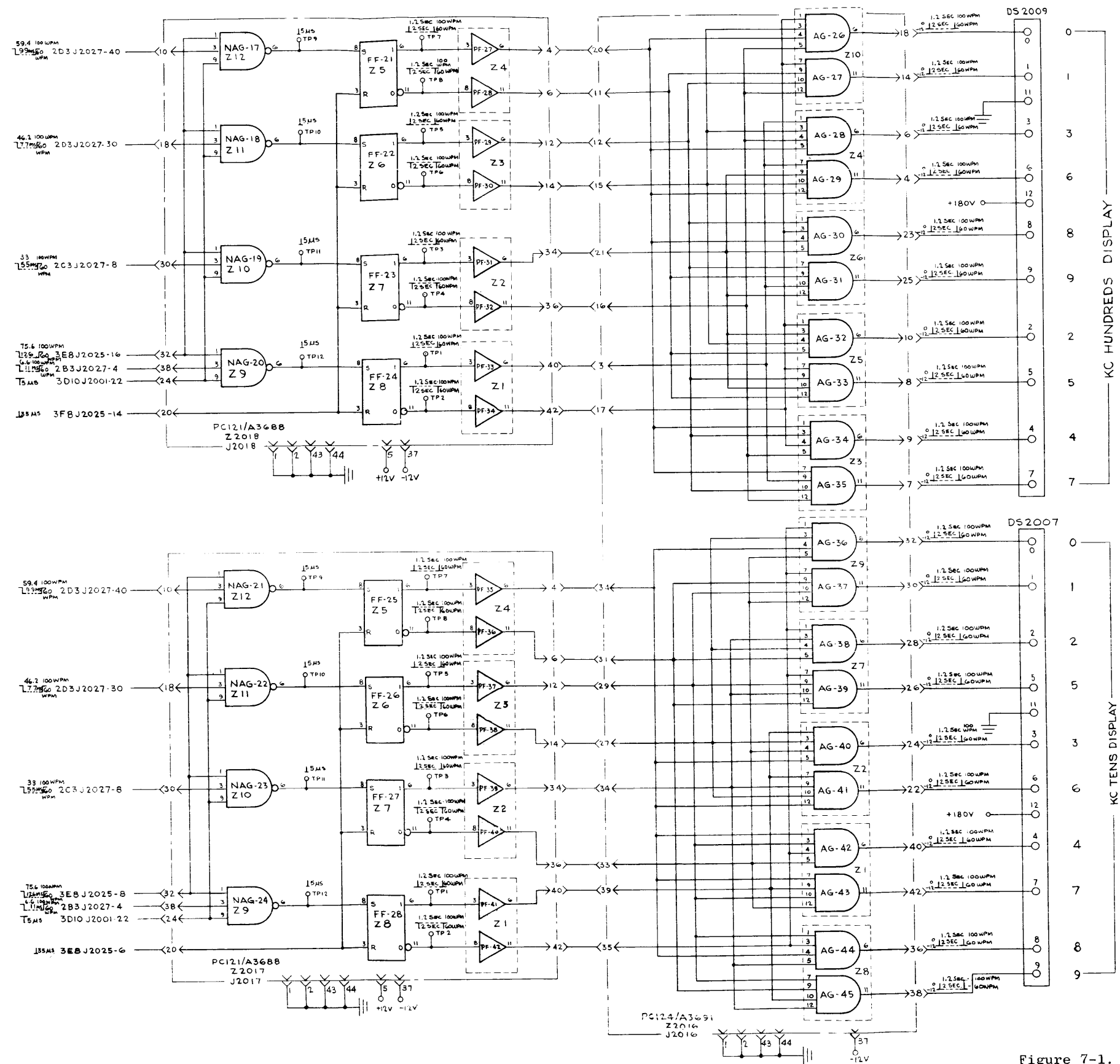
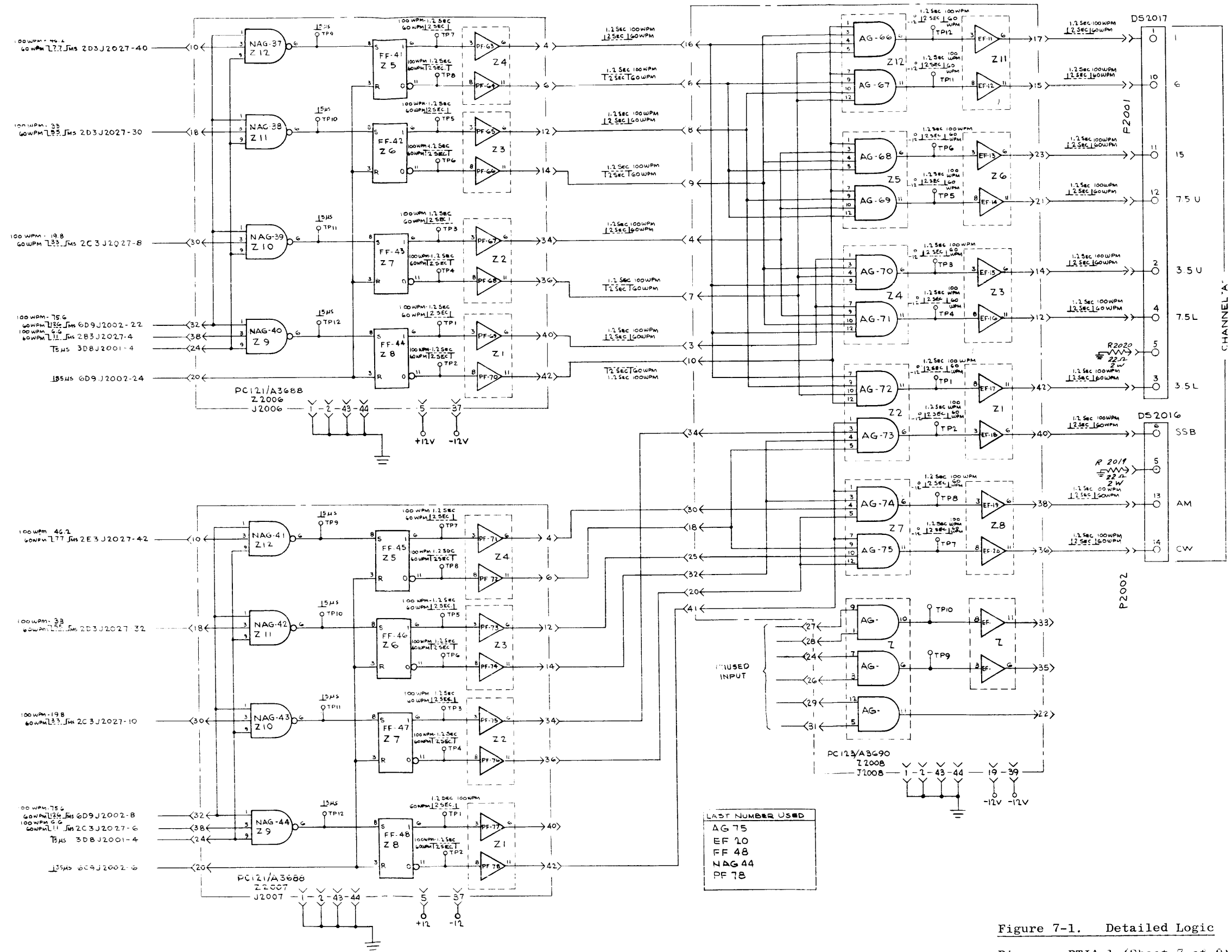


Figure 7-1. Detailed Logic Diagram, RTIA-1 (Sheet 4 of 9)



LAST NUMBER USED
 AG 45
 FF 28
 NAG 24
 PF 42

Figure 7-1. Detailed Logic Diagram, RTIA-1 (Sheet 5 of 9)



LAST NUMBER USED	
AG	75
EF	10
FF	48
NAG	44
PF	78

Figure 7-1. Detailed Logic Diagram, RTIA-1 (Sheet 7 of 9)

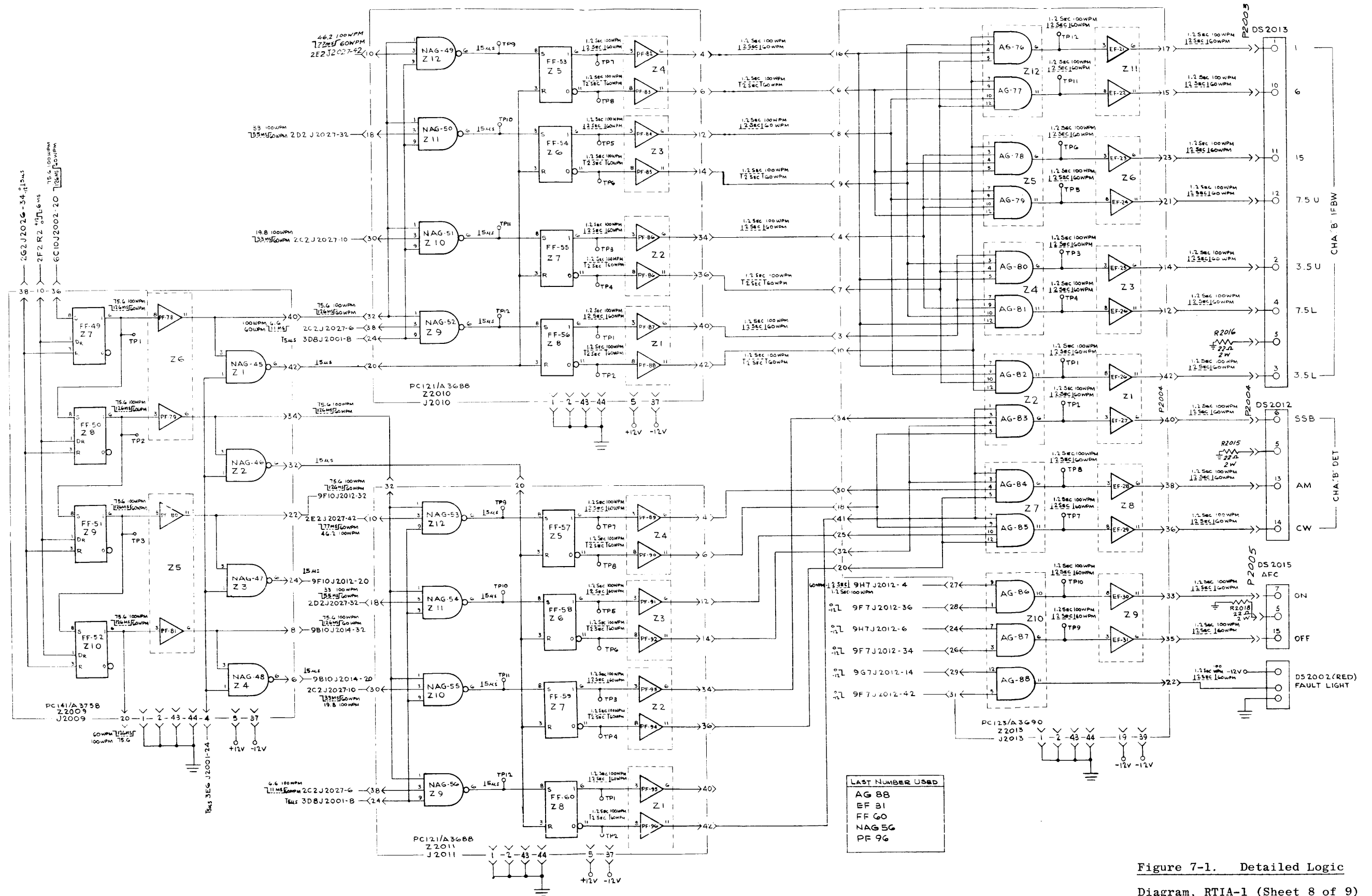


Figure 7-1. Detailed Logic Diagram, RTIA-1 (Sheet 8 of 9)

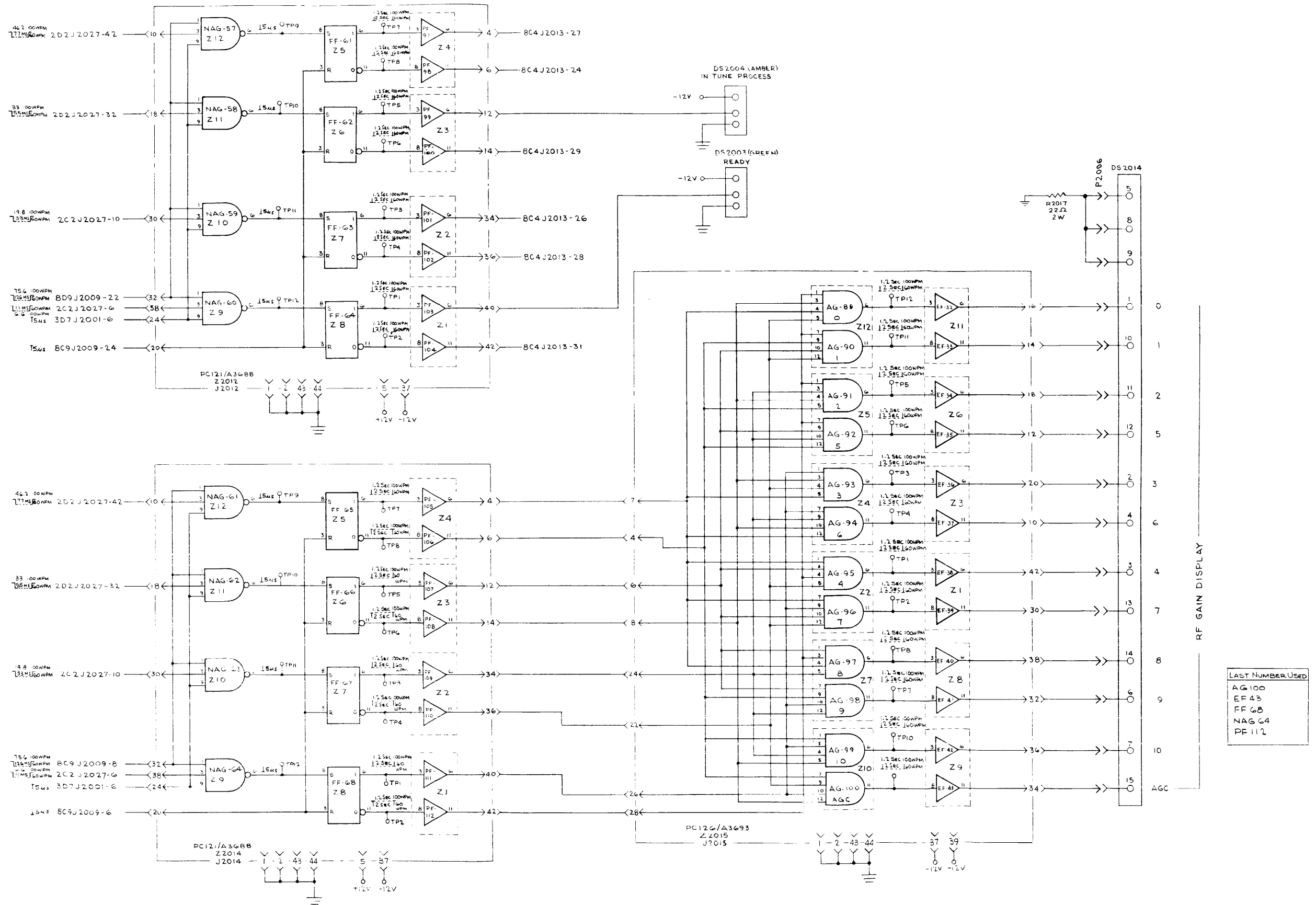


Figure 7-1. Detailed Logic Diagram, RTIA-1 (Sheet 9 of 9)

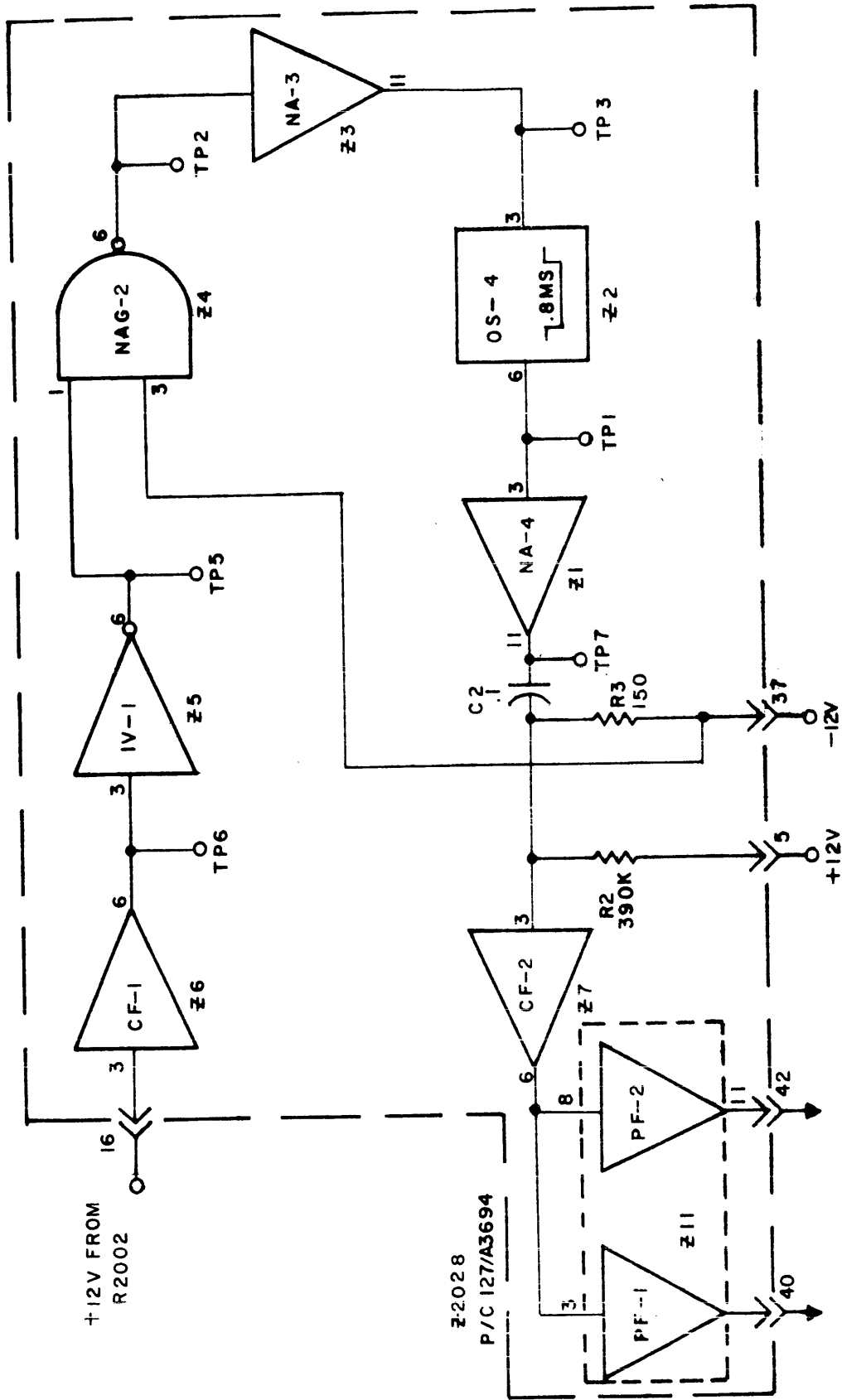


Figure 7-1A. Earlier Model Variations, Detailed Logic, RTIA-1

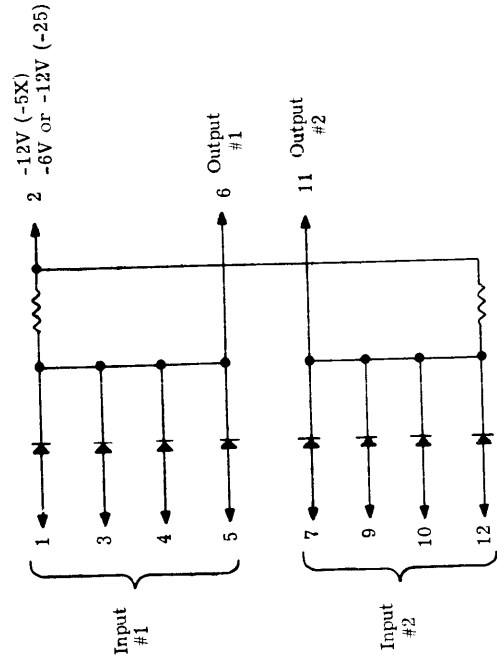
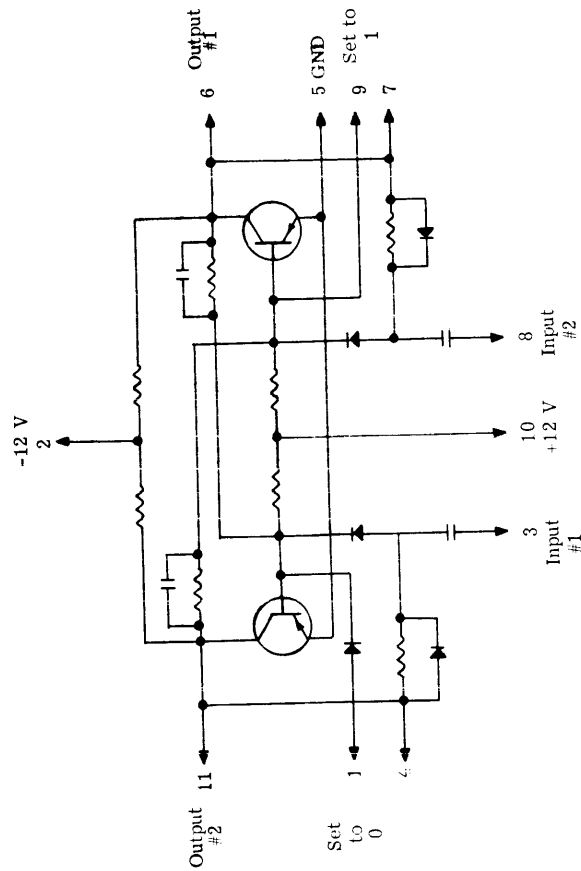
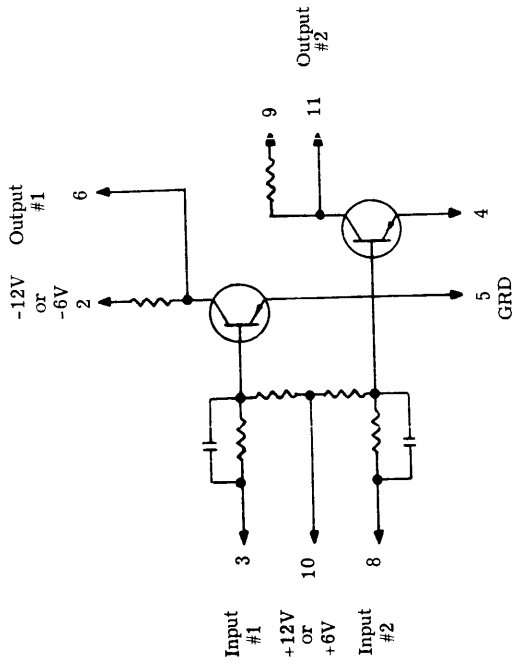
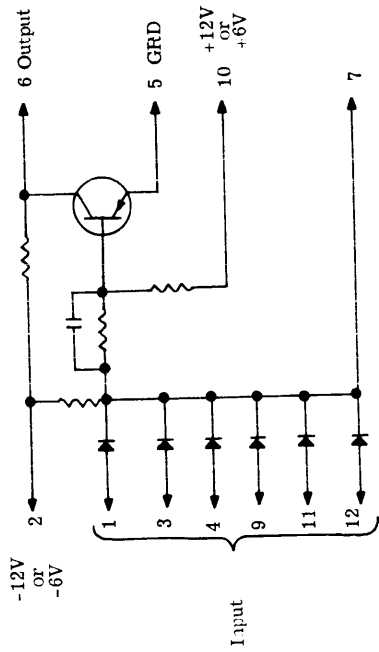
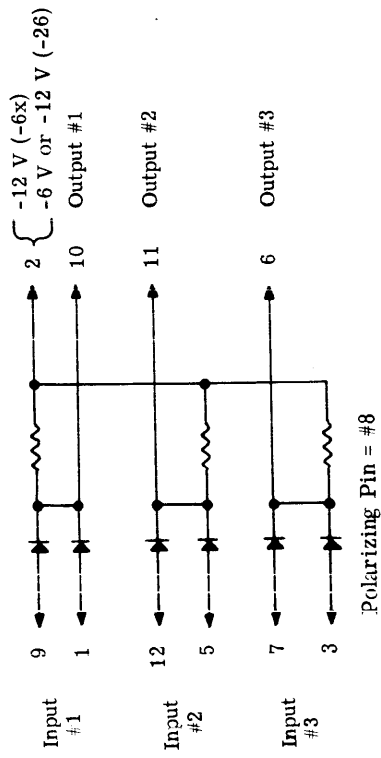
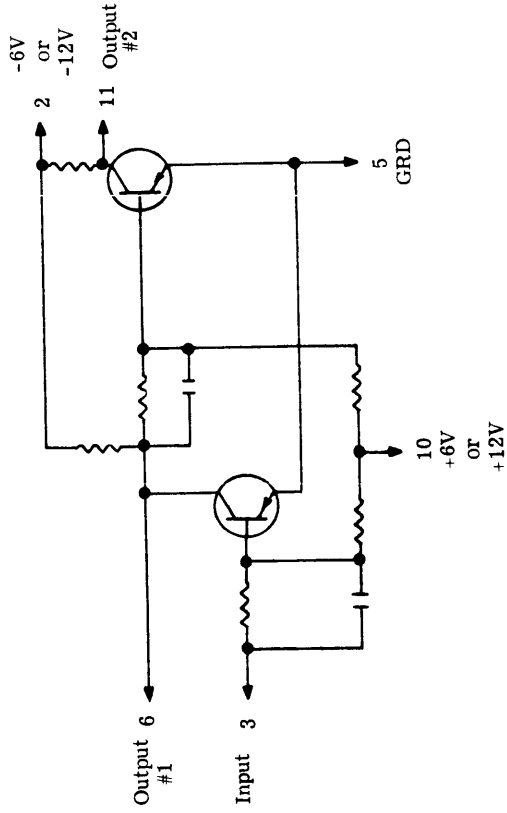


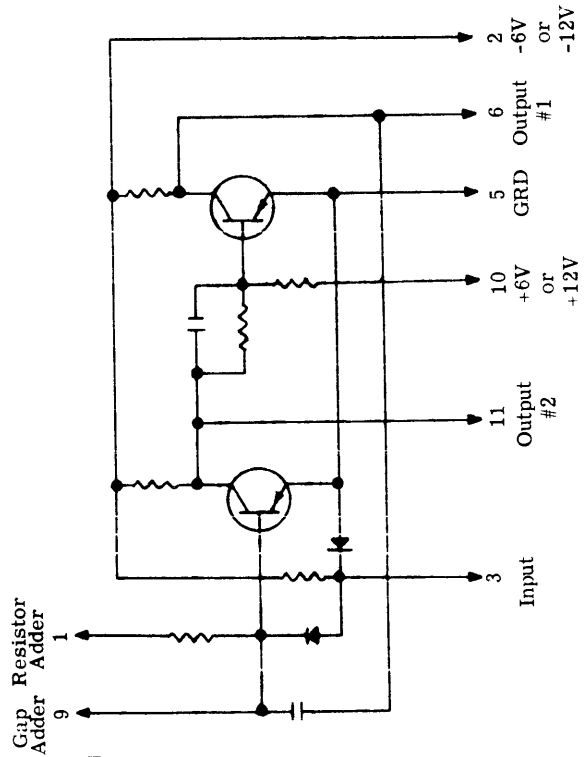
Figure 7-3. Schematic Wiring, Encapsulated Logic Modules (Sheet 1 of 4)



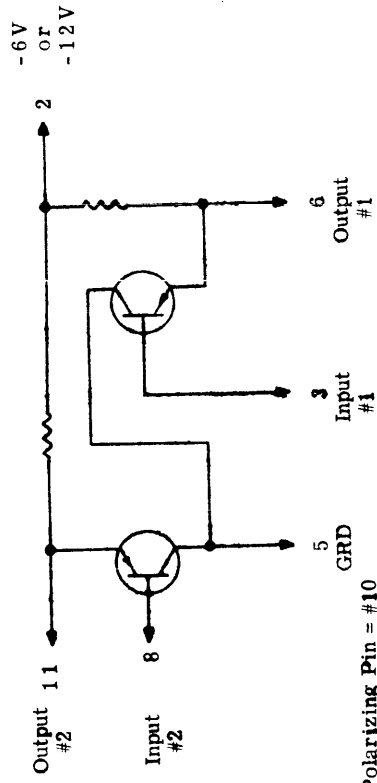
4097-17D



4097-17E

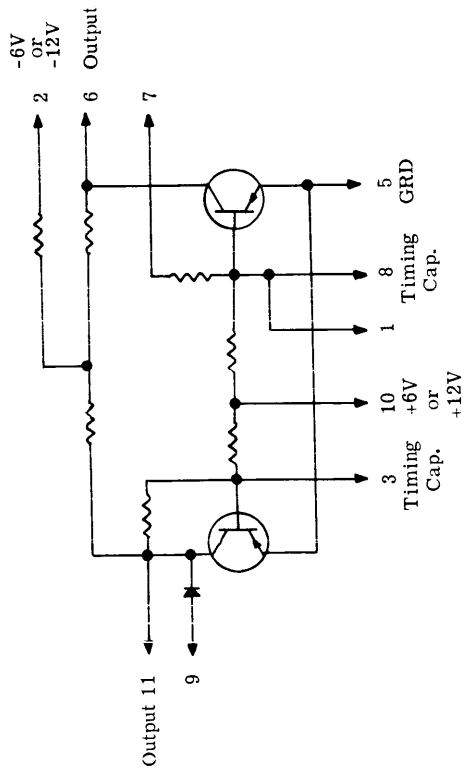


4097-17C



4097-17H

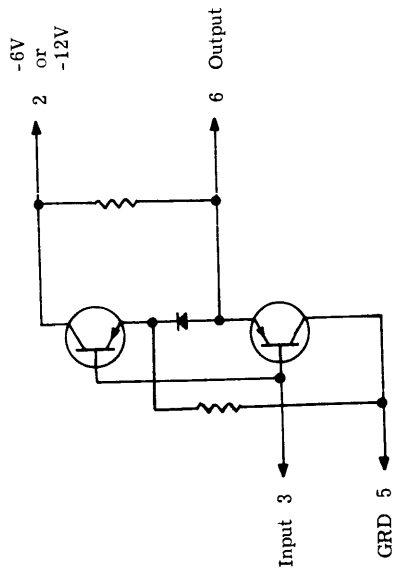
Figure 7-3. Schematic Wiring, Encapsulated Logic Modules (Sheet 2 of 4)



Polarizing Pin = #12

4097-171

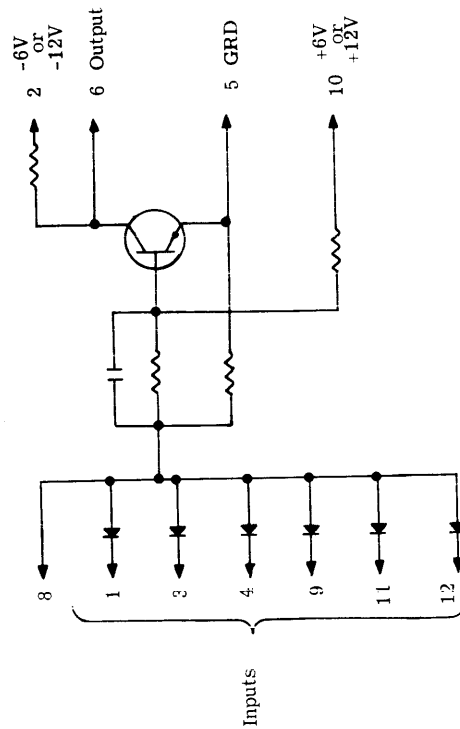
CLOCK GENERATOR NW113-1X



Polarizing Pin = #10

4097-17K

COMPLEMENTARY EMITTER FOLLOWERS
NW118, NW118-11, NW118-21



Polarizing Pin = #7

4012A-10B

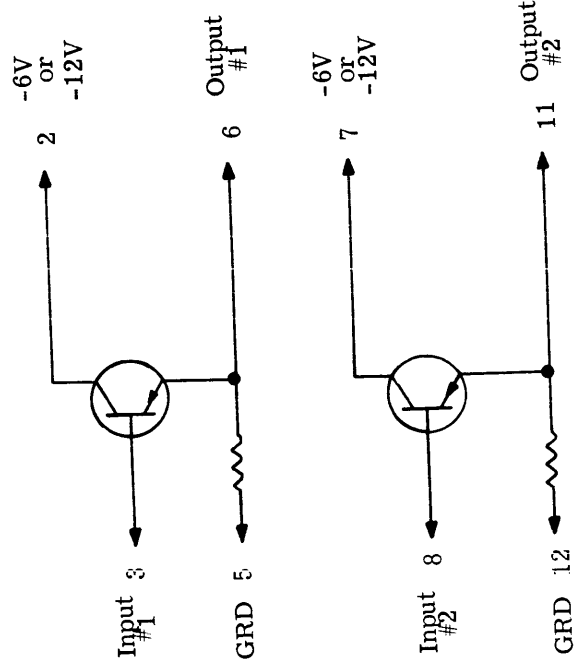
NORGATES NW119-2, -22

Polarizing Pin = #7

4097-17L

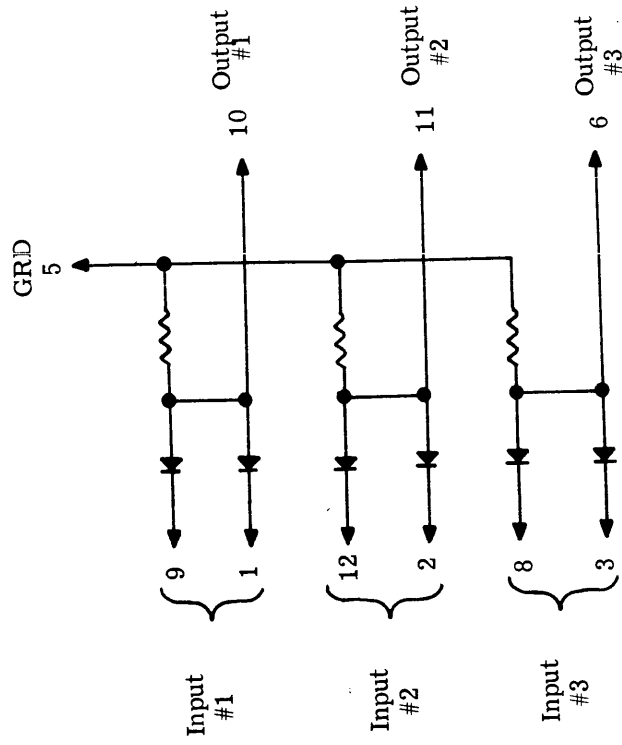
NORGATES NW119-1, -21

Figure 7-3. Schematic Wiring, Encapsulated Logic Modules (Sheet 3 of 4)



Polarizing Pin = #10

4012A-10C DOUBLE EMITTER FOLLOWERS NW120-1, -11, -21



Polarizing Pin = #7

4012A-10D

TRIPLE ORGATES NW121-6, -26