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TECHNICAL MANUAL

for

ELECTRONIC PROGRAMMER

MODEL RTPA-1

(MX-6758/FRR-72)

WORLD WIDE SUPPLIERS OF ELECTRONIC COMMUNICATIONS EQUIPMENT

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

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NOTICE

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

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By

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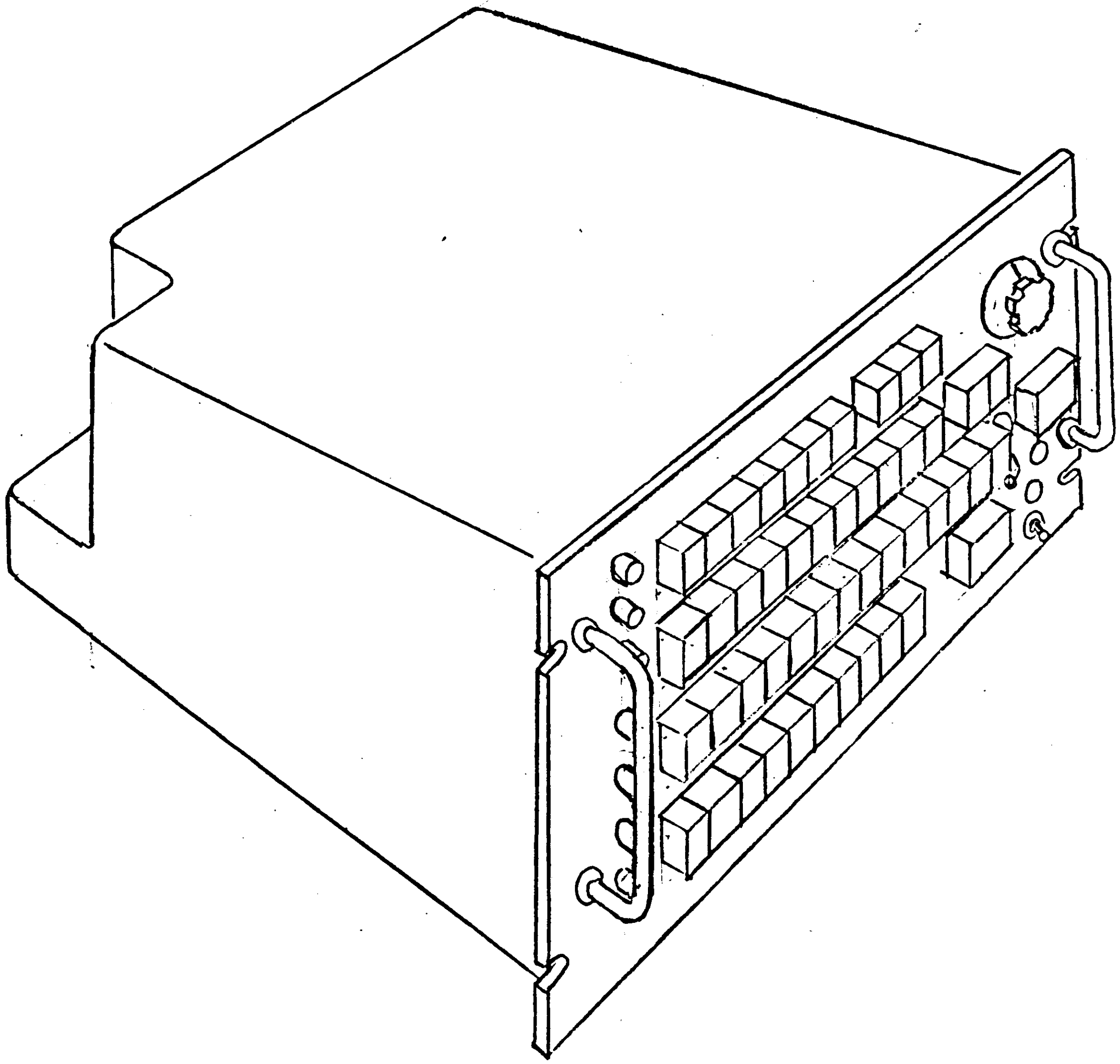

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Figure 1-1. Electronic Programmer, Model RTPA

SECTION 1

GENERAL DESCRIPTION

1-1. FUNCTIONAL DESCRIPTION

Model RTPA-1 Electronic Programmer is a teletype code generator with a keyboard for the remote tuning of TMC's TechniMatiC* receivers by wire or FSK radio transmission. Features include keying output for teletype transmission, a pulse output for a card/tape puncher, and a pulse input from a card/tape reader. Four operations are possible with the RTPA. These are:

a. Manual remote tuning of the receiver push-button keyboard.

b. Pre-programming of tuning message on card or tape through associated puncher.

c. Rapid remote tuning of the receiver by the pre-programmed punched card or tape from the associated card/tape reader.

d. A simultaneous remote receiver tuning by push-button with a recording made on tape or card by associated puncher.

1-2. PHYSICAL DESCRIPTION

The RTPA (see figure 1-1) is a 19-inch rack modular unit. The front panel is 19 inches wide x 9 inches high x 3/16 inch thick and is finished in gray enamel. The chassis extends 21 inches behind the panel.

The push-button keyboard employs switches for coding. Binary logic circuitry is made up of plug-in printed circuit cards with encapsulated transistor/diode logic modules mounted on them.

1-3. TECHNICAL SPECIFICATIONS

SIGNAL OUTPUT:	Dry contact keying for serial pulses in 7.42-unit teletype transmission pattern with 22

*Trademark applied for.

millisecond (60 WPM) or 13.7 millisecond (100 WPM) pulse widths.

CARD/TAPE PUNCH OUTPUT: 0 to -10V parallel pulses in 5-bit code. See table 1-1 for code vs. push-buttons.

CARD/TAPE READER INPUT: 0 to -10V parallel pulses in 5-bit code. See table 1-1 for adaptibility to ASCII 7-bit codes.

TABLE 1-1. CODE VS. PUSH-BUTTONS

PUSH-BUTTON	5-BIT CODE	TELETYPE CHARACTERS	
		CCIT	ASCII*
IF BANDWIDTH:			
1	01000	Line Feed	H
6	00100	Space	D
15	00010	Carriage Return	B
3.5U	01001	L	I
3.5L	01100	I	L
7.5U	00110	N	F
7.5L	01011	G	K
DETECTION:			
AM	01000	Line Feed	H
CW	00100	Space	D

* With first 5 bits of 7-bit code transmitted in reverse.

TABLE 1-1. CODE VS. PUSH-BUTTONS (CONT)

PUSH-BUTTON	5-BIT CODE	TELETYPE CHARACTERS	
		CCIT	ASCII*
DETECTION (cont)			
SSB	00010	Carriage Return	B
KILOCYCLES/RF GAIN:			
0	01000	Line Feed	H
1	00100	Space	D
2	00010	Carriage Return	B
3	01001	L	I
4	01100	I	L
5	00110	N	F
6	01011	G	K
7	01101	P	M
8	01110	C	N
9	00111	M	G
10	00011	O	C

* With first 5 bits of 7-bit code transmitted in reverse.

TABLE 1-1. CODE VS. PUSH-BUTTONS (CONT)

PUSH-BUTTON	5-BIT CODE	TELETYPE CHARACTERS	
		CCIT	ASCII*
KILOCYCLES/RF GAIN (cont)			
AGC	00001	T	A
AFC:			
ON	01000	Line Feed	H
OFF	00010	Carriage Return	B
MEGACYCLES:			
17 MC 2	01001	L	I
18 MC 3	01000	Line Feed	H
19 MC 4	00100	Space	D
20 MC 5	01100	I	L
21 MC 6	01010	R	J
22 MC 7	01110	C	N
23 MC 8	01101	P	M
24 MC 9	01111	V	O
25 MC 10	00110	N	F

* With first 5 bits of 7-bit code transmitted in reverse.

TABLE 1-1. CODE VS. PUSH-BUTTONS (CONT)

PUSH-BUTTON	5-BIT CODE	TELETYPE CHARACTERS	
----		CCIT	ASCII*
MEGACYCLES (cont)			
26 MC 11	00111	M	G
27 MC 12	01011	G	K
28 MC 13	00011	O	C
29 MC 14	00101	H	E
30 MC 15	00001	T	A
31 MC 16	00010	Carriage Return	B
FUNCTION:			
MC 2-16	11001	W	Y
MC 17-31	10001	Z	Q
100 KC	10011	B	S
10 KC	10010	D	R
1 KC	10111	X	W
.1 KC	10101	Y	U
CH A IFBW	11111	None	←
CH A DET	11011	None	[

* With first 5 bits of 7-bit code transmitted in reverse.

TABLE 1-1. CODE VS. PUSH-BUTTONS (CONT)

PUSH-BUTTON	5-BIT CODE	TELETYPE CHARACTERS	
		CCIT	ASCII*
FUNCTION (cont)			
CH B IFBW	10110	F	V
CH B DET	11110	K	↑
AFC	11100	U	\
RF GAIN	11101	Q	]
TUNE	10000	E	P

* With first 5 bits of 7-bit code transmitted in reverse.

SECTION 2

INSTALLATION

2-1 INITIAL INSPECTION

Each RTPA 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 RTPA 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 premounted in the rack. When the RTPA 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

If the RTPA arrives as part of the shipment of a TMC rack system, refer to the system manual for connection of cables to associated equipment within the rack. When the RTPA is to be used separately, however, make the following connections:-

a. Line voltage input at J1010 receptacle.

b. Signal output to remote receiver at J1009 receptacle.

c. Connection to card/tape puncher at J1007 receptacle (refer to figure 7-1 for details).

d. Connection to card/tape reader at J1007 receptacle (refer to figure 7-1 for details).

e. Connection to recognition code generator (see paragraph 2-6) at J1008 receptacle (refer to figure 7-1 for details).

When the RTPA is shipped separately, mating plugs are furnished for these connections.

2-4 60 WPM VS. 100 WPM OPERATION

Codes may be generated from the RTPA at any rate of speed at regular or irregular intervals. The pulse widths of bits within the codes, however, depend upon the clock generator circuit in printed circuit plug-in card Z1005. Cards are available for pulse widths corresponding with 60 wpm or 100 wpm speeds, based on the standard 7.42-unit teletype transmissions pattern. The RTPA is shipped with the 60 wpm card installed unless specified as otherwise on the order. The Z1005 cards are marked "60 wpm" or "100 wpm" to distinguish them.

2-5 CCIT AND ASCII CODES

Although the RTPA is generally operated with a TMC card/type puncher-reader, it can be operated to send a message punched by CCIT or ASCII teletype equipment. As long as the codes correspond with those shown in table 1-1, a message may be sent that has been previously punched by CCIT 5-bit code equipment. Reference is included in table 1-1 to the CCIT character for each code. In using ASCII 7-bit code equipment however, the characters are punched as shown in table 1-1 and the tape is then flipped over as it is fed into a 5-bit reader in order that the first 5 bits of the 7-bit code may be transmitted in reverse, with the sprocket holes properly aligned. Manuals on TMC's 5-bit readers contain more detailed information on this method.

2-6 RECOGNITION CODE GENERATOR

In all operations in which the message is sent to TMC receivers, an external recognition code generator is required. The recognition code, sent as the first code in the message, selects a specific receiver by opening the code storage input gate in that receiver. TMC code generators are made with a code capacity to select up to 100 receivers. For a list of TMC receiver recognition codes, see table 2-1. The table includes references to letters and numerals appearing on TMC code generator push-buttons, and equivalent CCIT and ASCII characters. To open a receiver it is required to send a letter followed by a numeral.

TABLE 2-1. RECEIVER RECOGNITION CODES

TMC GENERATOR PUSH-BUTTON	5-BIT CODE	TELETYPE CHARACTERS	
		CCIT	ASCII*
A	10101	Y	U
B	10110	F	V
C	11010	J	Z
D	11001	W	Y
E	10011	B	S
F	11100	U	\
G	10100	S	K
H	10010	D	R
I	10001	Z	Q
J	11000	A	X

*With first 5-bits of 7-bit code transmitted in reverse. See paragraph 2-6.

TABLE 2-1. RECEIVER RECOGNITION CODES (cont'd)

TMC GENERATOR PUSH-BUTTON	5-BIT CODE	TELETYPE CHARACTERS CCIT	ASCII*
1	01010	R	J
2	01001	L	I
3	00101	H	E
4	00110	N	F
5	01100	I	L
6	00011	O	C
7	01011	G	K
8	01101	P	M
9	01110	C	N
10	00111	M	G

*With first 5-bits of 7-bit code transmitted in reverse. See paragraph 2-6.

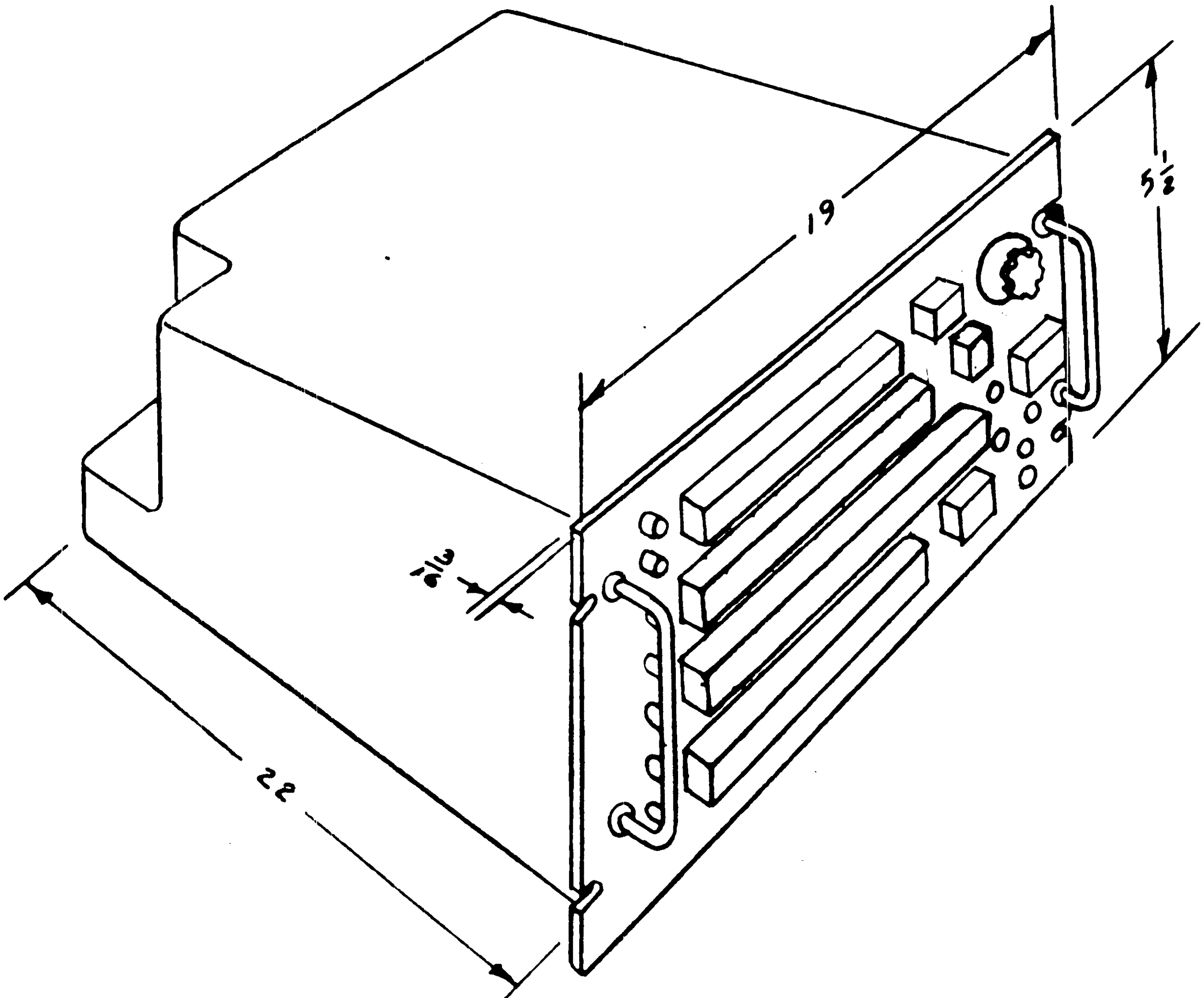

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Figure 2-1. Overall and Mounting Dimensions, RTPA

SECTION 3

OPERATOR'S INSTRUCTIONS

3-1. GENERAL

There are four operations possible with the RTPA. These operations are selected by the mode selector switch in the upper right-hand corner of the control panel (see figure 3-1). Description of the operations is as follows:-

Switch Position	Operation
MANUAL PROGRAM	Manual remote tuning of the receiver by pushbuttons.
TAPE PUNCH	Pre-programming a receiver tuning on punched card or tape by push-buttons.
TAPE READER	Rapid remote tuning of the receiver from the pre-programmed punched card or tape.
MANUAL PROGRAM/ TAPE PUNCH	Manual remote tuning of the receiver by push-buttons with simultaneous recording on punched card or tape.

The last three card/tape operations require an associated card/ tape puncher or reader. The MANUAL PROGRAM operation requires no puncher or reader. All remote tuning operations of TMC receivers require an associated recognition code generator (see paragraph 2-6).

3-2. MANUAL PROGRAM OPERATION

Set mode selector switch at MANUAL PROGRAM. Set PROGRAMMER POWER ON/OFF switch to ON. PROGRAMMER POWER lamp will light. The keyboard buttons are marked to correspond with TMC's TechniMatiC receivers. Specific sequence of remote tuning is spelled out in the TMC manual for the receiver system in which the RTPA is employed.

However, some generalizations may be made on procedure here.

Refer to figure 3-1. Buttons in the FUNCTION row represent controls on the receiver. Buttons in the IF BANDWIDTH, DETECTION, KILOCYCLES/RF GAIN, AFC and MEGACYCLES rows represent control positions. The TUNE button is pushed at the end of the message. When a button is pushed in, it stays in momentarily until the next button is pushed, releasing it. When a FUNCTION button is pushed in, the appropriate row of control position buttons light up to indicate that one button in that row must be selected. When one button is selected and pushed in, the lights in that control position row are extinguished and the FUNCTION row lights up again, to indicate that the next FUNCTION button must be pressed. When the next FUNCTION button is pressed, the FUNCTION row extinguishes and the appropriate control position row lights up again. The FUNCTION buttons and the corresponding rows of control positions that light up are as follows:-

FUNCTION button	Control position row
MC 2-16	MEGACYCLES
MC 17-31	MEGACYCLES
100 KC	KILOCYCLES (0-9)
10 KC	KILOCYCLES (0-9)
1 KC	KILOCYCLES (0-9)
.1 KC	KILOCYCLES (0-9)
CH A IFBW	IF BANDWIDTH
CH A DET	DETECTION
CH B IFBW	IF BANDWIDTH
CH B DET	DETECTION
AFC	AFC (ON/OFF)
RF GAIN	RF GAIN (0-10,AGC)

A coded character appears at the RTPA output each time a button is pushed. Pushing the TUNE button, at the end of the message, presents the "E" code at the output. The TUNE button is momentary contact and acts to release the last previous button and extinguish all button lights. The "E" character is generally used in the receiver to energize the tuning mechanisms, the receiver having previously stored the message in its memory section. The first two codes in the message, however, must be generated by the recognition code generator.

Example: To tune the receiver for a 26.5781 megacycles carrier (suppressed or partial), SSB transmission, with an upper sideband 3.5-kc wide, to be routed to audio channel A, with the AFC (automatic frequency control) feature and an r-f gain setting of 8, after sending the recognition code, press the following buttons:-

MC 17-31, 26 MC11; 100 KC, 5; 10 KC, 7; 1 KC, 8; .1 KC, 1; CH A IF BW, 3.5 U; CH A DET, SSB; AFC, ON; RF GAIN, 8; TUNE.

3-3. TAPE PUNCH OPERATION

Set mode selector switch at TAPE PUNCH. Set PROGRAMMER POWER and PUNCH READER POWER switches to ON; their corresponding lamps will light. Push buttons in the same manner as that described for MANUAL PROGRAM operation, including the TUNE button at the end. Each button punches the 5-bit code (see Table 1-1) on the card or tape. A hole represents a "1"; no hole represents "0". When finished, set the two POWER switches to OFF.

3-4. TAPE READER OPERATION

Set mode selector switch at TAPE READER. Set PROGRAMMER POWER and PUNCH-READER POWER switches to ON; their corresponding lamps will light. If the card/tape reader does not have an automatic starter, press TAPE READ button to start message transmission from pre-programmed punched tape. If a series of messages are to be sent, employing a timer, plug timer into TIMER jack on front panel and switch off the timer automatic starter. The timer will then control the message transmission.

3-5. MANUAL PROGRAM/TAPE PUNCH OPERATION

Set mode selector switch at MANUAL PROGRAM/TAPE PUNCH. Set PROGRAMMER POWER and PUNCH READER POWER switches to ON. Then proceed to send message in the same manner as for MANUAL PROGRAM. Message will be recorded on the punched card or tape at the same time. The punched card or tape may then be used at some future date to tune the receiver in a TAPE READER operation.

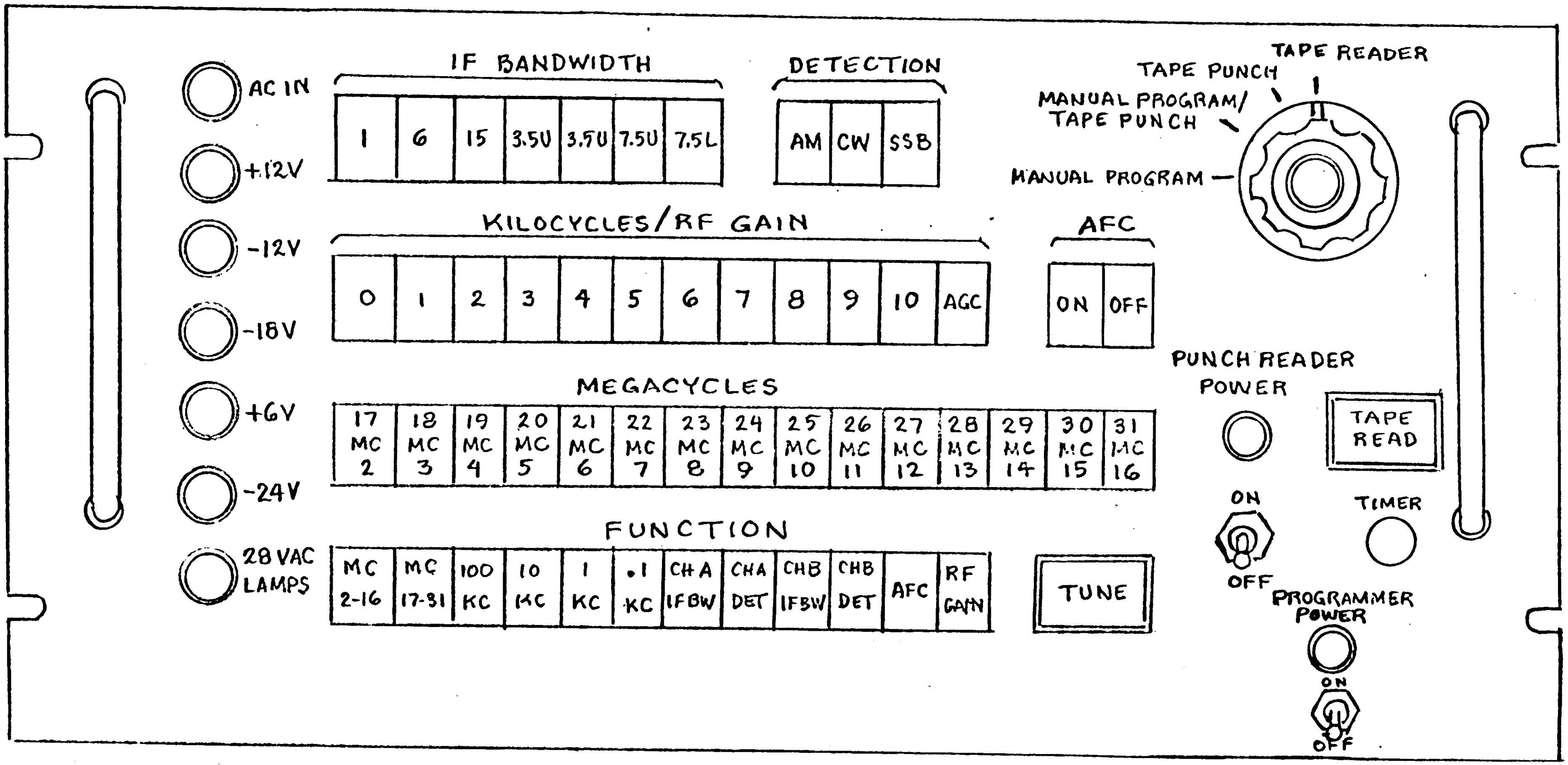

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Figure 3-1. RTPA Control Panel

SECTION 4

PRINCIPLES OF OPERATION

4-1. INTRODUCTION

Model RTPA Electronic Programmer operates through a push-button keyboard and binary logic circuitry. A 4-position mode selector switch makes the necessary connections between components for the 4 modes of operation, i.e., MANUAL PROGRAM, MANUAL PROGRAM/TAPE PUNCH, TAPE PUNCH and TAPE READER. The logic circuitry is seven plug-in printed circuit cards. The logic circuits on the cards are transistor/diode type in the form of encapsulated modules mounted on the cards. Cards are mounted in a bin (see figure 5-1), the cards plugged into receptacles in the floor of the bin. Cards are referred to in figure 7-1 by Z1000* 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. MANUAL PROGRAM OPERATION. - Each depressed push-button on the keyboard generates a 5-bit code in the form of parallel pulses. With the mode selector switch in the MANUAL PROGRAM position, these pulses proceed into Z1001 Amplifier Circuit. Z1001, upon reception of each code, sends a series of pulses to Z1002 Shift-Register via Z1005 Timing Circuit. The signal energizes the shift-register and the 5 bits are pulled one-by-one out of Z1002 and, in serial pulse form,

* Receptacles identified by J1000 series numbers to match Z1000 numbers.

these proceed over to a polar relay in Z1006 Keying Circuit. The polar relay presents J1009 output receptacle with dry-contact keying to be used with an external power supply for transmission to the remote receiver. After the code has been shifted out in this way, Z1005 Timing Circuit sends a second pulse to Z1002 Shift-Register; this pulse resets the register for the next code.

The external recognition code generator (see paragraph 2-6) generates the letter and numeral codes in parallel pulse form at J1008 receptacle. These codes, the first ones to be sent in the message, follow the same route and processing as those issuing from the keyboard.

b. MANUAL PROGRAM/TAPE PUNCH OPERATION. - With the mode selector switch set to MANUAL PROGRAM/TAPE PUNCH, codes generated from the keyboard push-buttons follow the same route and processing as described for MANUAL OPERATION (see paragraph 4-2a). In addition, each code, issuing from Z1001 Amplifier Circuit in parallel pulse form, is routed to the associated puncher. As Z1001 receives each code, it releases a "start process" pulse to the tape puncher. This pulse is used by the puncher to energize the punching mechanism for one code.

c. TAPE PUNCH OPERATION. - With the mode selector switch set to TAPE PUNCH, codes generated from keyboard push-buttons become routed, in parallel pulse form, through the Z1001 Amplifier Circuit and out to the puncher only. The pulse normally sent to Z1005 Timing Circuit is cut off and Z1002 Shift-Register receives no energizing pulse from Z1005. As a result, there is no issue from Z1002 to Z1006. As in MANUAL PROGRAM/TAPE PUNCH operation, a "start process" pulse issues from Z1001 for each code, energizing the puncher.

d. TAPE READER OPERATION. - With the mode selector switch set to TAPE READER, the input to Z1001 Amplifier Circuit is disconnected from the keyboard and connected to the reader through memory circuit, Z1000. The codes, in the form of parallel pulses from the reader, are routed to Z1001. As in the TAPE PUNCH operation, the pulse normally sent to Z1005 Timing Circuit is cut off. The energizing pulse to trigger Z1005 Timing Circuit pulses to Z1002 will now be supplied to Z1005 by Z1004 Gating Circuit.

Upon the reception of a-c power, via the RTPA PUNCHER/READER POWER switch, if the reader has an automatic starter, it will proceed to scan the first code on its tape and send the code to Z5000 Memory Circuit. At the end of the scan, the reader also sends a "search complete" pulse back to Z1004 Gating Circuit. This pulse sets a gate in Z1004 to open upon the reception of a pulse from Z1001. When Z1001 then receives the first code from the reader, it releases the first pulse to momentarily open the gate. The resulting "start search" pulse from the Z1004 gate to the reader causes the reader to scan the second code on the tape, send it to Z1001 Amplifier Circuit, and send the second "search complete" pulse back to Z1004 Gating Circuit. From this point on, the reciprocal action continues, with each code and "search complete" pulse from the reader generating the next "start search" pulse from the RTPA.

If the reader does not have an automatic starter, the operator depresses the RTPA TAPE READ momentary contact button and this generates the first energizing "start search" pulse to the reader. From that point on, the reciprocal action takes place as described before.

4-2. FUNCTIONAL ANALYSIS (figure 4-1) (cont'd)

As each "search complete" pulse comes back from the reader, besides resetting the gate in Z1004, it also causes Z1005 Timing Circuit to send one set of bit-energizing pulses to the shift-register in Z1002. The Z1005 then follows it with a pulse to reset the shift-register for the next code.

If an automatic timer is employed to send out a series of tuning messages at timed intervals, the timer (connected at the RTPA front panel TIMER jack) will generate the initial "start search" pulse to the reader for each message.

4-3. LOGIC DIAGRAM ANALYSIS

a. INTRODUCTION - Each printed circuit (PC) card is identified by a Z1000 series to match its bin receptacle J1000 series number. 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 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 entire RTPA logic circuitry. 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

CF complimentary emitter follower

EF emitter follower

FF flip-flop

OS one-shot (or delay circuit)

PF positive emitter follower

OG orgate

IV inverter

NA non-inverting amplifier

NAG nandgate

RD relay drive

TG timing generator (or clock)

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 7-5.

The following analysis is based on negative logic as depicted in figure 7-1. Two versions of figure 7-1 are included and described: figure 7-1A, reflecting the present design, and figure 7-1B, reflecting details of the circuit differing in an earlier design. Both versions of the RTPA are physically and functionally interchangeable.

b. INITIAL RESET - Upon application of a-c line power at J1010 (figure 7-3) through S1001 POWER switch, besides furnishing the necessary logic voltages (-12V and +12V) and relay voltages (-18V and -12V), +12V and -12V are supplied to Z1003 Initial Reset card (figure 7-1B) at pins 5 and 37, respectively. This results in a positive output at pins 4 and 6 of Z1003. The output at pin 6 resets flip-flop FF-11 in Z1005 card and flip-flop FF-6 through FF-13 in Z1002. The output from pin 4 resets FF-14 in Z1006 and FF-15 through FF-19 in Z1000.

In the earlier version of the RTPA, upon application of a-c line power at J1010 (figure 7-3) through S1001 POWER switch, besides furnishing the necessary logic voltages (-12V and +12V) and relay voltages (-18V and -12V), +12V and -12V are supplied to Z1003 Initial Reset card (figure 7-1B) at pins 16 and 37, respectively. The +12V becomes inverted through IV-8 and, together with the -12V from pin 37, opens nandgate NAG. NAG triggers OS-10 via NA-12 to produce a pair of positive pulses from PF-2 and PF-3. The pulse from PF-2 resets flip-flop FF-11 in Z1005 card and flip-flops FF-6 through FF-13 in Z1002. The pulse from PF-3 resets FF-14 in Z1006 and FF-15 through FF-19 in Z1000.

c. MANUAL PROGRAM OPERATION - Referring to figure 7-1A or B, the S6001 5-bit code switch depicted represents the connections made by depression of the associated recognition code generator button. A more detailed wiring is shown in figure 7-4. S1003 (in figure 7-1A) represents the connections made by one of the RTPA keyboard buttons (see figure 7-2 for keyboard schematic). When the recognition code button is depressed, the -12V available at terminal 4 of TB1001 terminal board either is connected (1 bit) or is not connected (0 bit) to pin 3 of each non-inverting amplifier of the group composed of NA-18 through NA-21 in Z1001 card, depending upon the code. This operation of RTPA relays together with the recognition code generator switches make these connections; this is described in paragraph 4-4. The non-inverting amplifiers have two inverters and two outputs: an inverted polarity output at pin 6 and a re-inverted (or non-inverted) output at pin 11. The NA receiving the -12V (1 bit) at pin 3 presents a positive-going output (0V) at pin 6 and the 0V appears at one of the pair of inputs at each andgate of the AG-4 through AG-8 group in Z1002 card. These inputs are pin 1 of AG-4, pin 3 of AG-5, pin 1 of AG-6, pin 12 of AG-7 and pin 3 of AG-8. The output at pin 6 of the NA that has not received the -12V (0 bit) remains at -12V and this negative charge is placed on its AG. The pin 11 outputs of the NA modules go to orgate OG-1 in Z1001. If one or more of the bits in the code is a "1", this will produce a negative output from the NA to the orgate, causing OG-1 to produce a negative output.

Since all codes contain at least one "1" bit, OG-1 output goes negative for each code. The negative output at pin 6 of OG-1 then gets inverted through the first inverter in NA-14 in Z1005 card and the resulting positive output at pin 6 of NA-14 fires one-shot OS-1 in Z1000 card. OS-1 produces a positive 3 us pulse and, when the mode selector switch is in the MANUAL position, this pulse is routed to pin 3 of NA-16 in Z1005. The non-inverted output at pin 11 of NA-16 sets flip-flop FF-11 causing pin 6 of FF-11 to swing negative. The negative swing triggers clock generator TG-1 and TG-1 proceeds to produce regular saw-tooth pulses, spaced at 22 ms each, to the pin 3 input of one-shot OS-5 in Z1002 card. Each pulse fires OS-5 and OS-5 produces a positive 6 us pulse at each 22 ms interval (13.2 ms for a 100 wpm transmission).

The first 6 us pulse travels via NA-11 pin 11 to reset FF-6 thru FF-10 and FF-13 and to set FF-12. The set FF-12 emits a positive voltage that sets FF-13. The resulting negative voltage from FF-13 travels directly to orgate OG-2 in Z1006 and enters the double inverter in NA-17. NA-17 has a negative output pin 11, and a positive output pin 6, each output connected to a polar relay (K1) driver, RD-1 and RD-2, respectively. The voltage swing, being negative, leaves pin 11 of NA-17 and works through RD-1 to bring K1 to connect pins E and A of J1009. This is the relay's space condition and it now transmits a "0" bit. This is for the "start" pulse in the 5-bit character to be transmitted.

The second pulse from TG-1 clock, in Z1005, again resets FF-6 through FF-10 and FF-13 in Z1002. FF-12 remains in its set condition. FF-13 going from set to reset, sets FF-6. The resulting output of

FF-6 is a negative voltage and this travels to AG-4 andgate, pin 9. If the information from pin 6 of NA-18 in Z1001 is a "1" bit, a positive charge is now sitting on pin 1 of AG-4. AG-4 gate does not open and the output of AG-4 swings to positive. The positive voltage travels through NA-4 in Z1006, OG-2, pin 6 of NA-17 and RD-2 to cause K1 to go into "mark" position, connecting pins E and C of J1009, for the transmission of bit #1 in the code.

The third pulse from TG-1 clock in Z1005 resets FF-13 and FF-6 through FF-10 in Z1002. FF-6, going from set to reset, sets FF-7. The output from FF-7 becomes a negative voltage and travels to pin 7 of AG-5. The #2 bit information from pin of NA-19 now either opens or does not open AG-5 and bit #2 is transmitted through K-1. This procedure continues until bit #5 is transmitted by the setting of FF-10 by FF-9 in Z1002. When FF-10 becomes reset, by the final pulse from TG-1, its positive output also fires one-shot OS-6 in Z1004 which produces a pulse to reset flip-flops FF-15 through FF-19 in Z1000 card for the next code. Its set output, before this, resets FF-12 thus resetting the shift-register in Z1002 for the next code and (c) resets FF-11 in Z1005. FF-11 output swings back to positive, stopping TG-1 clock generator. The timing is such that the final (7th) pulse from the clock occurs before its stops and the beginning of the positive pulse from OS-5 in Z1002 resets FF-10 causing its output to go positive. This causes AG-8 output to go positive and, before the next code arrives, OG-2 output remains positive. The resulting negative output of pin 6 of NA-17 goes negative and acts on RD-2 to keep K1 in the "mark" condition for transmission of the "stop" pulse at the end of the code. This completes the transmission of the code originated from the recognition code generator.

The next code to be sent is one generated by an RTPA keyboard button. When an S1003 button is depressed, each of the 5 bit connections are made or not made, depending on the button and its code, between the RTPA -12V supply at TB1001 pin 4 and the inputs of NA-18 through NA-22 in Z1001. This connection is made via the mode selector switch in the MANUAL PROGRAM position and K1002 relay energized. K1002 is energized whenever any RTPA button is pressed, as indicated by connection S1003 ( ) 2, and as long as K1001 relay remains energized. K1001 is initially energized by the pressing of a receiver selector button in the recognition code generator (see paragraph 4-4).

The code, at NA-18 through NA-22 inputs, proceeds to become transmitted in the same manner as the recognition code. This continues for the rest of the codes in the message. When the TUNE button is pushed, however, transmitting the final "E" code, a connection to the button breaks the +12V supply to all the relays, de-energizing them and disconnecting the -12V from the RTPA keyboard.

d. MANUAL PROGRAM/TAPE PUNCH OPERATION - Setting the mode selector switch to MANUAL PROGRAM/TAPE PUNCH makes all the same connections as for MANUAL PROGRAM with the additional connection of the code bits output from Z1001 card to the RTPA tape puncher output, pins 28 through 32 of receptacle J1007. With this connection, as the codes are transmitted to the remote receiver from J1009, parallel bits of each code appear at the same time at these bit pins of J1007 from emitter-followers EF-1 through EF-5 in Z1001 card. A "1" bit produces a negative output (or -10V) at an EF; a "0" bit produces a positive output (or 0V).

As before, the end of the first code produces a .6 ms delay pulse from OS-6 in Z1004 to reset FF-15 through FF-19 in Z1000. The pulse end also fires OS-2 in Z1000 (via S1004-4C wafer as shown in figure 7-1B for earlier models) and the 3 ms pulse from OS-2 is sent to the puncher via pin 27 of J1007 (and via S1004-4C wafer as shown in figure 7-1A for later models) and closed contacts of de-energized relay K1009. K1009 is de-energized by a button on the recognition code generator (see paragraph 4-4). This 3 ms pulse is the "start process" energizing pulse to the puncher.

e. TAPE PUNCH OPERATION - The mode selector switch in TAPE PUNCH position makes all the same connections as in the MANUAL PROGRAM/TAPE PUNCH position, with two exceptions as shown at S1004-3D and S1004-4B wafers. At S1004-D the end-of-code output at AG-2 to the clock generator via NA-16 and FF-11 is broken and the clock is not started, resulting in no action at the shift-register in Z1002 card. At S1004-B wafer the connection is broken from the swinger of K1 to pin E of J1009, resulting in no code output from the relay, should it happen that some charge is still sitting in Z1002. This results in a parallel pulse output to the tape puncher only.

f. TAPE READER OPERATION - With the mode selector switch in the TAPE READER position, their are some similarities to connections made with the switch in the MANUAL PROGRAM position; the outputs to the tape puncher are disconnected (at S1004-4C,-3B,-3A,-2D,-2C, and -2A wafers) and the output to J1009 is reconnected (at S1004-4B wafer). Wafers S1004-2A,-1D, -10C, -1B, and -1A, however, connect the code input from pins 8 through 12 of J1007 to Z1001 card via Z1000 card, rather than from the RTPA keyboard. Also, wafer S1004-3D selects a different source for triggering the clock generator.

Each bit from the reader appears in the form of either a ground connection (1) or no-ground connection (0) at each pin of the 8 to 12 group in J1007. FF-15 through FF-19 in Z1000 card, initially reset, receive bits 1 through 5 of the code, respectively, at their "set" inputs (terminal 8). The flip-flop that receives the ground connection becomes set and the one that receives the no-ground connection receives the -12V supply, remaining reset. The output at pin 6 of the set flip-flop swings negative, to -10V; the output of the reset flip-flop remains at 0V. The bit outputs, connected to NA-18 through NA-22 in Z1001, proceed from pin 6 of each NA to the andgates in Z1002, with "1" bits now inverted to + charges (0V) and "0" bits appearing as minus charges. The negative end-of-code swing is produced from OG-1, in Z1001, and travels to pin 12 of andgate AG-2 in Z1005. In the reader, meanwhile, a negative "search complete" pulse has been generated at the end of the first code scanning. This pulse has fired OS-3 in Z1005 via pin 6 of J1007 and OS-3 has produced a negative 3 ms pulse at pin 5 of AG-2 and at pin 3 of AG-3. The two negative inputs at AG-2 produce a negative output from AG-2 until the end of the 3 ms pulse from OS-3. At the end of this pulse, the positive output from OS-3 causes AG-2 output to swing positive setting FF-11 via S1004-3D wafer and NA-16. FF-11 then triggers TG-1 clock generator and the code bits are shifted out of Z1002 flip-flops and transmitted from the RTPA in the same manner as for the MANUAL PROGRAM operation. At the same time, the negative 3 ms pulse from OS-3 in Z1005 on pin 3 of AG-3 causes AG-3 output to swing negative for 3 ms. This negative charge is routed, via NA-2, to pin 1 of OG-4 in Z1004. Since pin 9 of OG-4, at this instance, is receiving a steady positive charge from OS-7, OG-4 output swings negative for 3 ms and at the end of the pulse the positive upswing travels through NA-15 to reset FF-14.

After the pulses from TG-1 transfer the code out of the shift-register in Z1002, the positive output of the reset FF-10 (upon shifting bit #5 of the code) besides accomplishing functions already described, fires OS-7 in Z1004. The resulting negative 3 us pulse from OS-7 places a negative charge at pin 9 of OG-4 or-gate via NA-10. At this instance, pin 1 of OG-4 is getting a positive charge from AG-3 and, as a result, OG-4 output swings negative for 3 us. The positive rise of this pulse then resets FF-14. This arrangement provides for a reader in which there is no "search complete" pulse to reset FF-14, as previously described.

The negative pulse from OS-7 also travels to pin 1 of NAG-2. Since pin 3 of NAG-2, at this instance, is receiving a positive charge from NAG-1 output in Z1001, this causes NAG-2 output to swing positive for 3 us, firing OS-8 in Z1005 via NA-11. OS-8 then starts a 30 ms negative delay pulse, routed to pin 12 of OG-3 in Z1004. OG-3, during this time, is receiving a normally positive input at pin 2 from OS-4 in Z1005 and OG-3 output remains negative. At the end of the pulse, however, the two positive inputs cause OG-3 output to swing positive, setting FF-14 via NA-9 and wafer S1004-4A. The set FF-14 produces a positive (or 0V) output at pin 11 and pin 5 of J1007 receptacle. This is the "start search" signal to the reader for the next code.

On some readers, there is no self-energizer in the reader, upon application of reader power, to scan the first code in the tape. To provide for this event, the RTPA includes a TAPE READ button, S1005. Depression of this button connects the RTPA -12V supply to pin 8 of Z-5 inverter in Z1000. The inverter switches the -12V to +12V and this voltage travels to OS-9 in Z1004. When the TAPE READ button is released the input at OS-9 changes back to 0V and the positive swing fires OS-9. OS-9 then produces a negative .6 ms pulse and, at the end (or positive upswing) of the pulse, it sets FF-14 via NA-15, producing the "start search" signal from FF-14 to the reader. As the first code moves through the RTPA, the next "start search" pulse is produced by the RTPA in the method described in the previous paragraph.

4-4. RELAY OPERATION (figure 7-4)

RTPA relay operation is tied in with the associated recognition code generator. Figure 7-4A depicts the RTPA relays operating from a typical recognition code generator, capable of generating a "J" (11010) for REC 1 and an "S" (10100) for REC 2. The generator is a passive device and is essentially made up of many-sectioned push button switches and indicator lamps, connecting the RTPA +12V back into the RTPA relays for their energization and the RTPA 26 VAC across the generator lamps. Figure 7-4A depicts an earlier design of the RTPA; a later design of K1002 relay is depicted in figure 7-4B.

Referring to figure 7-4A, one side of K1001, K1002, K1003 and K1008 relay coil is permanently connected to the RTPA -12V supply. In order for each relay to energize, the other side of the coil must receive +12V. The +12V for this purpose is connected across contact S1003-52C of the TUNE button while the TUNE button is not activated and to the generator at pin 7 of J1008 via S1004-3C wafer of the mode selector switch in its first 3 positions.

Both receiver code buttons on the generator are the momentary-contact type and spring back when released. If receiver #1 button is pushed, contact 2 connects +12V to K1001 relay coil and contact 1 connects +12V to K1003 coil. Closed contacts 9 and 10 of each energized relay lock the relay. Closed contacts 6 and 7 of K1001 present +12V to one side of S1003 ( ) 2 and closed contacts 6 and 7 of K1003 connect the RTPA 26 VAC across the generator receiver #1 lamp, lighting it. Contacts 3, 4 and 5 connect the -12V to bits 1, 2 and 4 for the 11010 code input into the RTPA Z1001 card.

If receiver #2 button is pushed, contact 2 connects +12V to K1001 relay coil and contact 1 connects +12V to K1008 coil. Closed contacts 9 and 10 of each energized relay lock the relay. Closed contacts 6 and 7 present +12V to one side of S1003 ( ) 2 and closed contacts 6 and 7 of K1003 connect the RTPA 26 VAC across the generator receiver #2 lamp, lighting it. Contacts 3 and 4 connect the -12V to bits 1 and 3 for the 10100 code input into the RTPA Z1001 card.

After the recognition code has been sent in this way and any RTPA keyboard button is consequently pushed, S1003 ( ) 2 contact closes, connecting the +12V, placed there by the generator receiver button, to pin 4 of K1002 relay coil. K1002 energizes, closing contacts 6 and 7, and connecting the required -12V to one side of the code button contacts.

The generator also contains a means for energizing or de-energizing the associated puncher. Besides placing the RTPA mode selector switch in one of the PUNCH positions (2 or 3), it is necessary to depress the generator PUNCH button. (This button will stay depressed until the NO PUNCH button is pushed). Pushing the PUNCH button mechanically releases the NO PUNCH button. A contact on the NO PUNCH button opens, cutting off the -12V to pin 4 of K1009 relay coil. K1009 de-energizes and contacts 8 and 9 close, connecting the 26 VAC across the PUNCH lamp, lighting it, and disconnecting the 26 VAC across the NO PUNCH lamp. Contacts 5 and 6 of K1009 close, connecting the "start process" signal from Z1000 card to the puncher via pin 27 or J1007.
If the puncher is to be de-energized, the generator NO PUNCH button is depressed. This mechanically releases the PUNCH button and the closed contacts of the NO PUNCH button reconnects -12V to K1009 relay coil pin 4. The energized relay then closes contacts 9 and 10, connecting the 26 VAC across the NO PUNCH lamp and removing it from the PUNCH

lamp. Contacts 5 and 6 of K1009 open, disconnecting the "start process" signal to the puncher.

K1010 relay (see figure 7-3) is for the purpose of sending two types of -18V power to the associated puncher/reader. When the RTPA POWER switch is set at ON, -18V is immediately sent out at pin 14 of J1007; after K1010 relay energizes, an additional -18V is presented from pin 15 of J1007. This enables a sequence for the puncher/reader energization, in some equipments.

In later models of the RTPA, K1002 relay is replaced with a polarized version (see figure 7-4B). When the RTPA power switch is set at ON, the lower coil (pins 1 to 2) of K1002 energizes. In this position the -12V is disconnected from the programmer keyboard buttons. When K1001 is energized, in the manner described previously, and when one of the RTPA buttons is pushed, S1003 ( )-2 contact closes and K1001 contacts 5 and 6 close, connecting +12V to pin 3 of K1002 upper coil. K1002 reverses, connecting the -12V to the keyboard buttons.

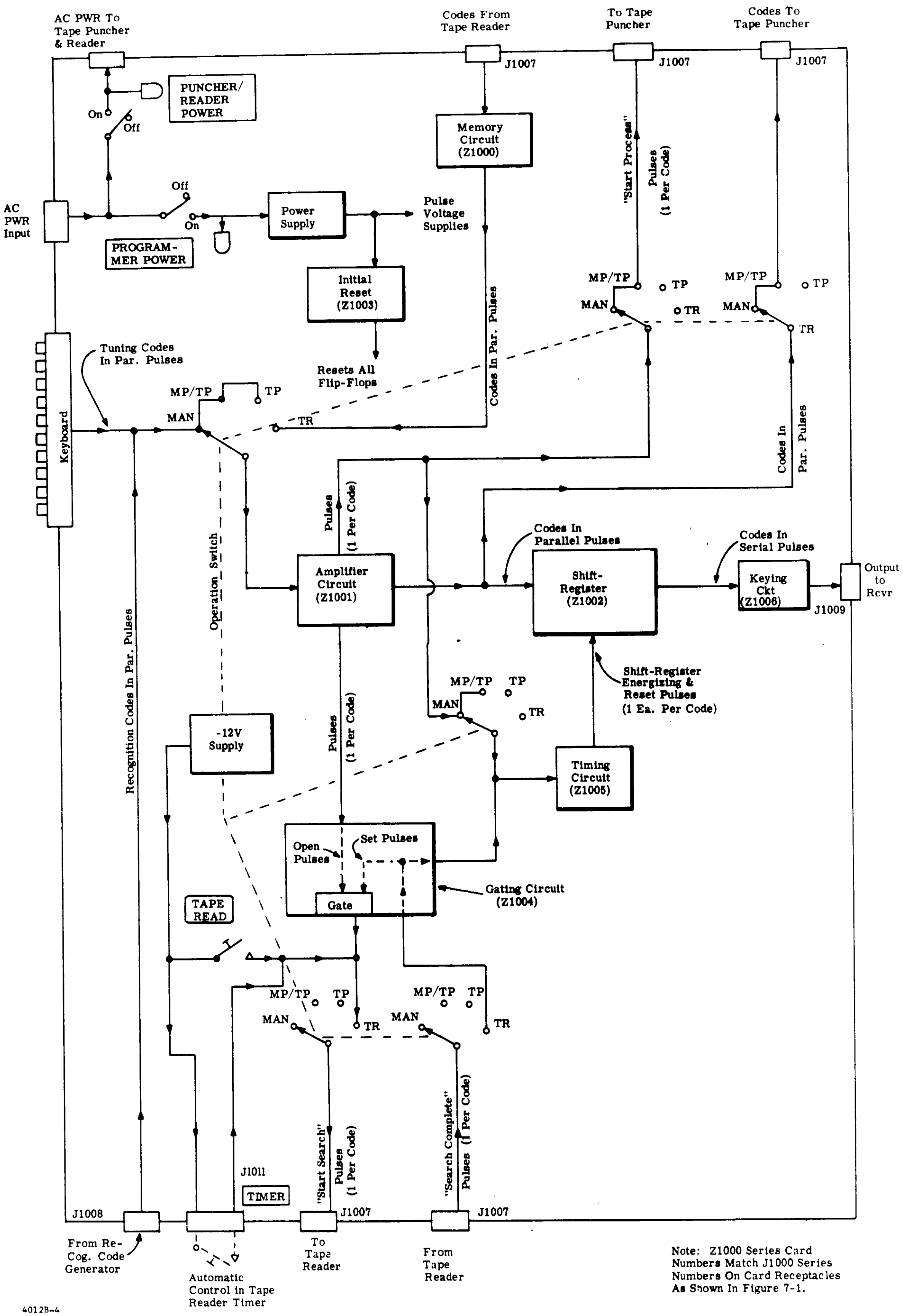

Figure 4-1. Functional Block Diagram, RTPA

SECTION 5

MAINTENANCE

5-1. INTRODUCTION

The logic circuits in the RTPA are contained on Z1000 series printed circuit plug-in cards mounted in a bin 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 keyboard and relay section. The card Z1000 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 in the RTPA 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.

5-2. SPECIAL TOOLS AND TEST EQUIPMENT

Special tools included in the shipment* and required for RTPA 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 in a set of spare logic cards for card-substitution procedures.

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*Shipment of system in which RTPA is used.

TABLE 5-1. TEST EQUIPMENT, RTPA

ITEM	MANUFACTURER
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, figures 7-1A and 7-1B furnish normal pulse patterns at test points (TP) on the RTMU printed circuit cards. Also included are figures 5-1 and 5-2, locating cards and major components.

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

When it has been determined, in a system troubleshooting procedure, that the RTPA component is at fault, the faulty card and/or component on the card can be detected by leaving the RTPA connected in the system and checking test patterns at test points, indicated on figures 7-1A or 7-1B, with an oscilloscope, referring to section 4 of this manual. If, however, it is necessary to immediately substitute in a spare RTPA to resume operation of the system, the subsequent bench check of the faulty RTPA will require the teletypewriter set, listed in table 5-1, as an output check. 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 figures 7-1A or 7-1B for that card, against the description furnished in section 4 of this manual. 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 figures 7-1A or 7-1B, 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 RTPA. Very often, different attenuator lines into the oscilloscope will produce pulse shape distortions that are not present in the RTPA. The critical fact is whether or not the expected pulse is there, its width and polarity.

In interpreting the pulse forms and patterns shown in figures 7-1A and 7-1B it should be kept in mind that they are readings under load conditions of the RTPA connected normally to a card/tape puncher.

5-5. REPAIR AND REPLACEMENT

a. Introduction. - Repair of the RTPA 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 replaceable 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 RTPA 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

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*Shipment of system in which RTPA is included.

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 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 rapaired 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 the 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 J1000 through J1006 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. - J1007 and J1008 receptacles also take 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.

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*Shipment of system in which RTPA is included.
** Or equivalent.

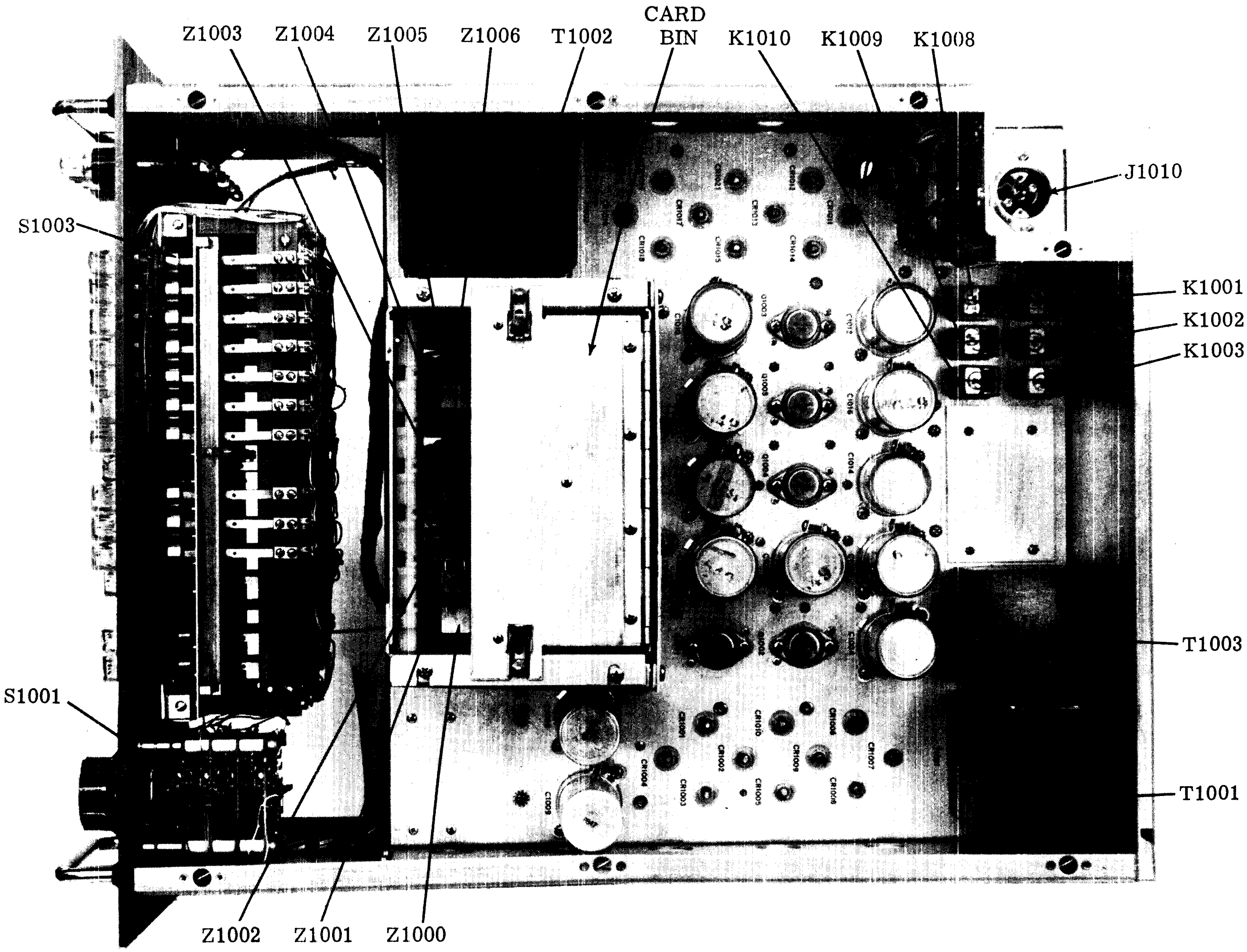

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Figure 5-1. Top View, RTPA

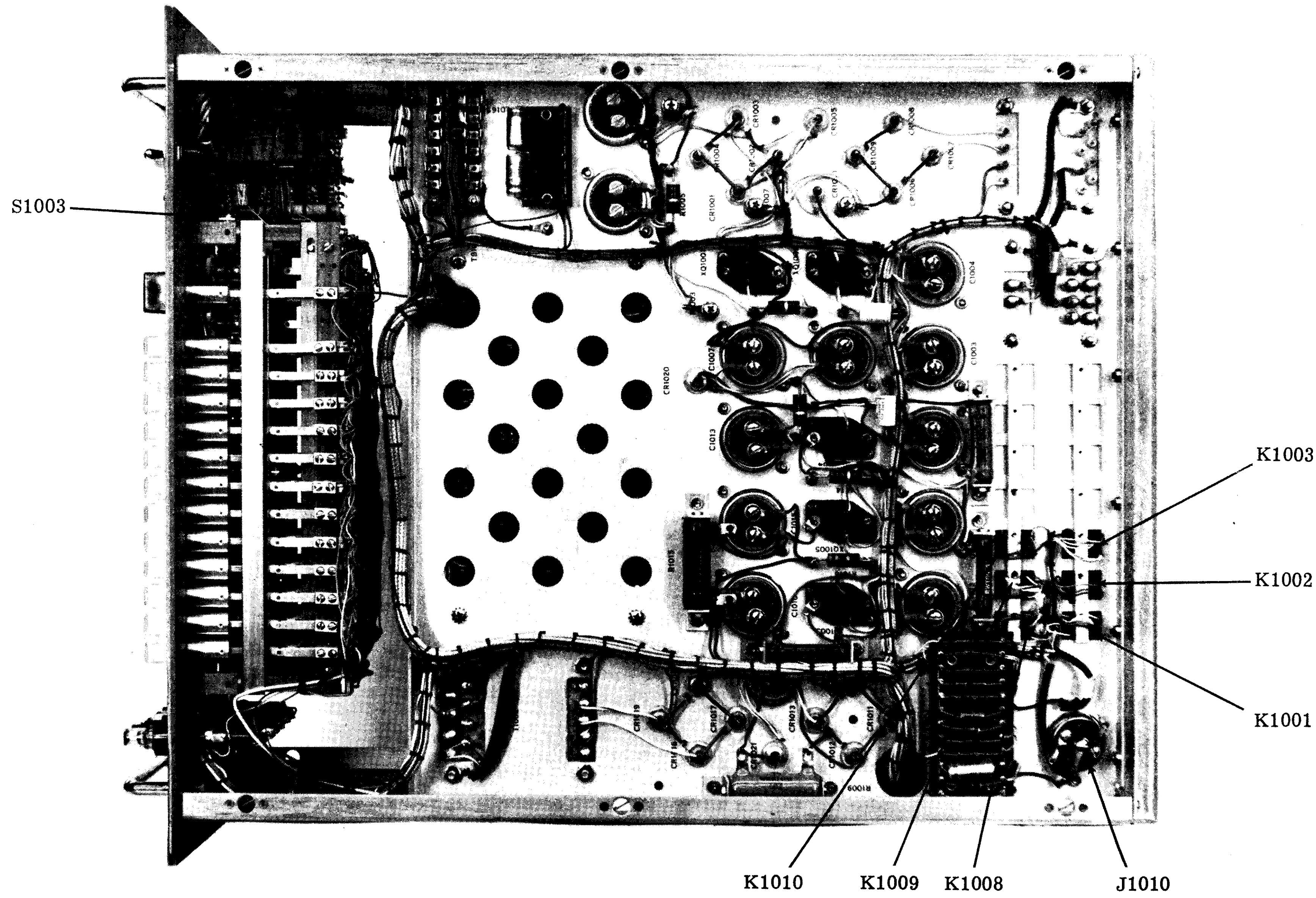

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Figure 5-2. Bottom View, RTPA

653.11-7

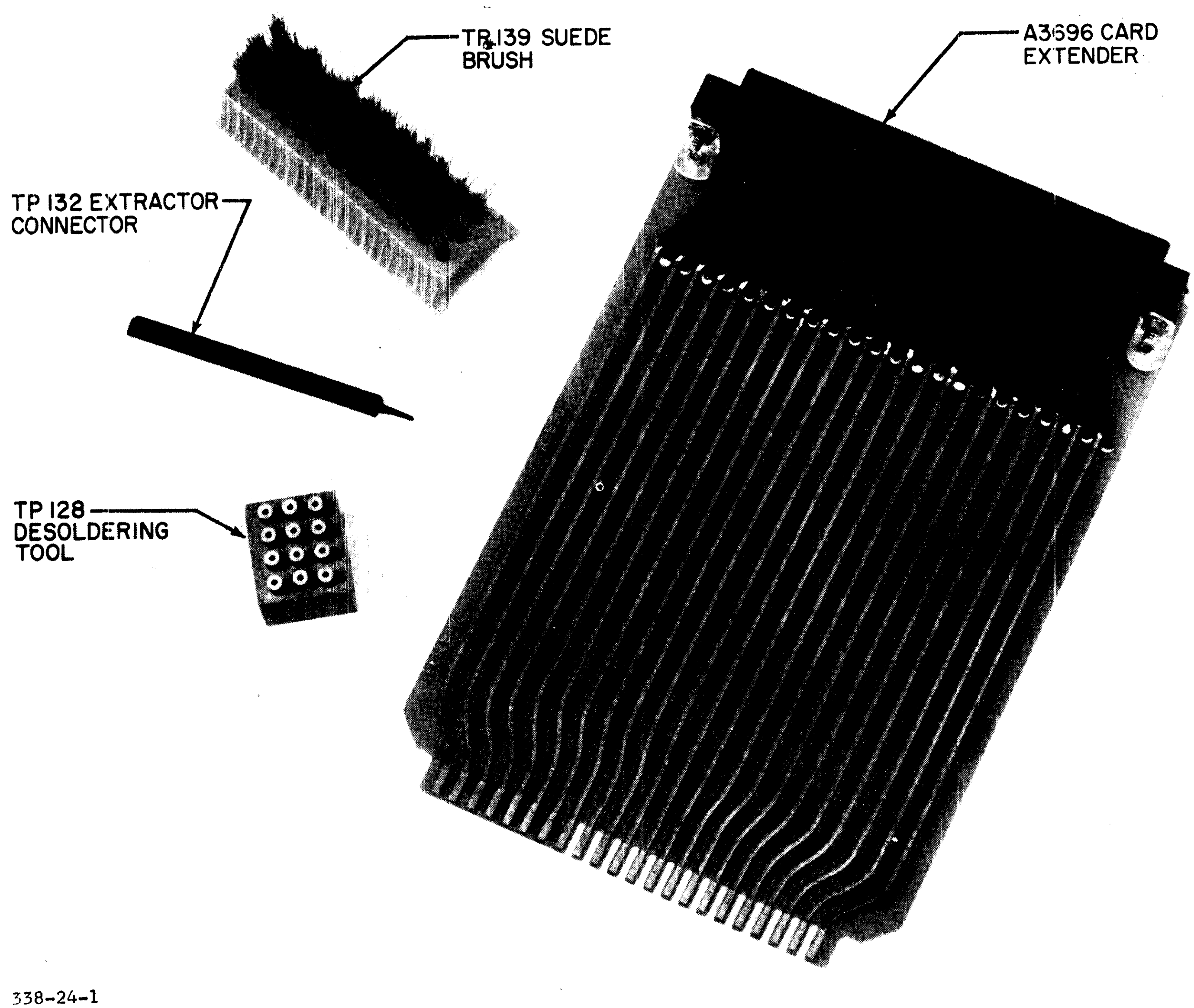
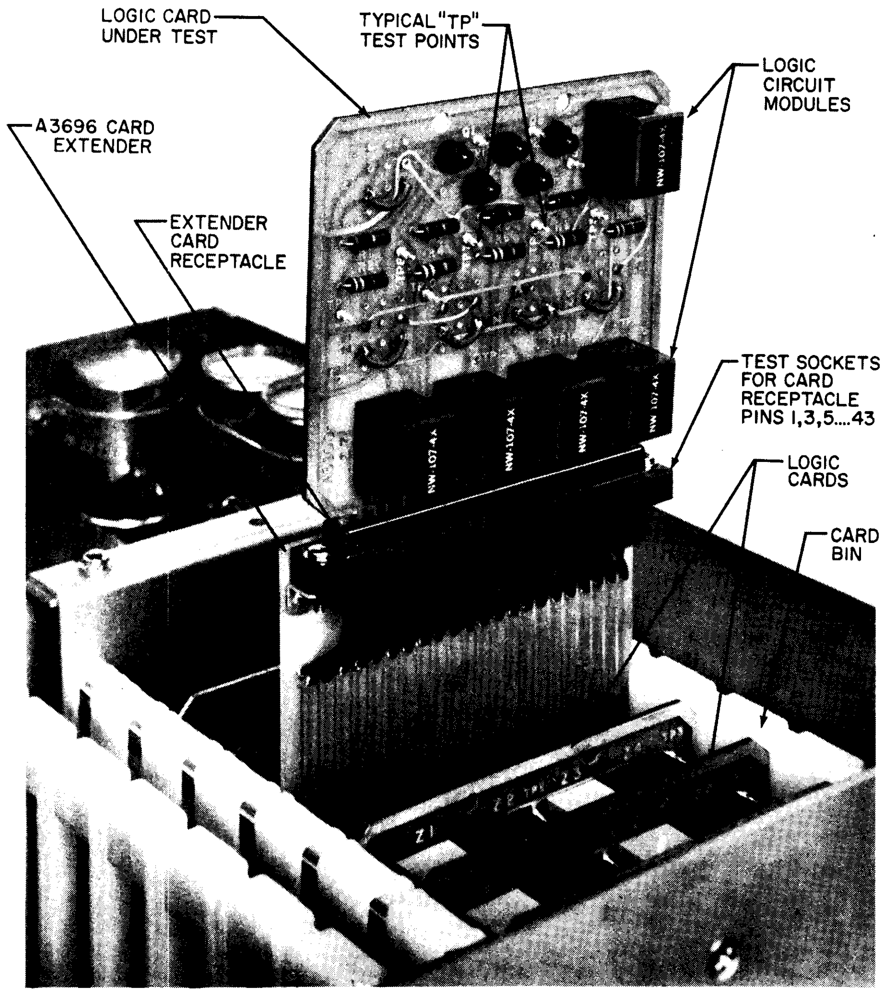


Figure 5-3. Maintenance Tools, Logic Circuit



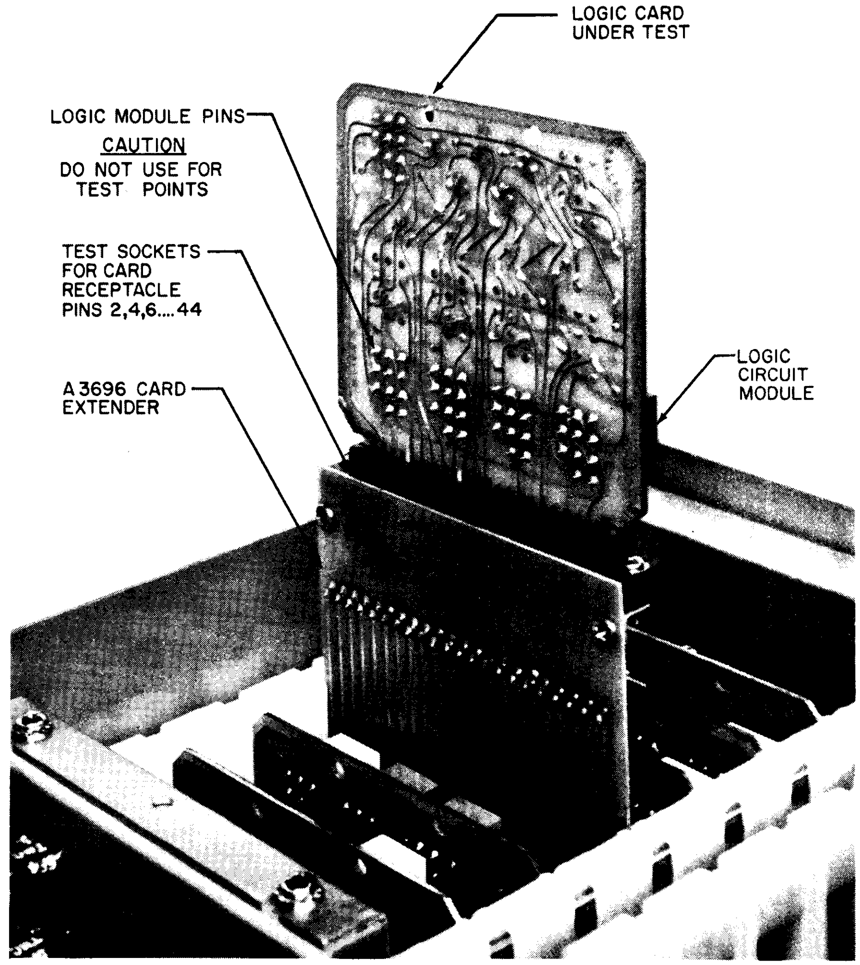


Figure 5-4. Card in Test Position

664.18-7

664.18-6

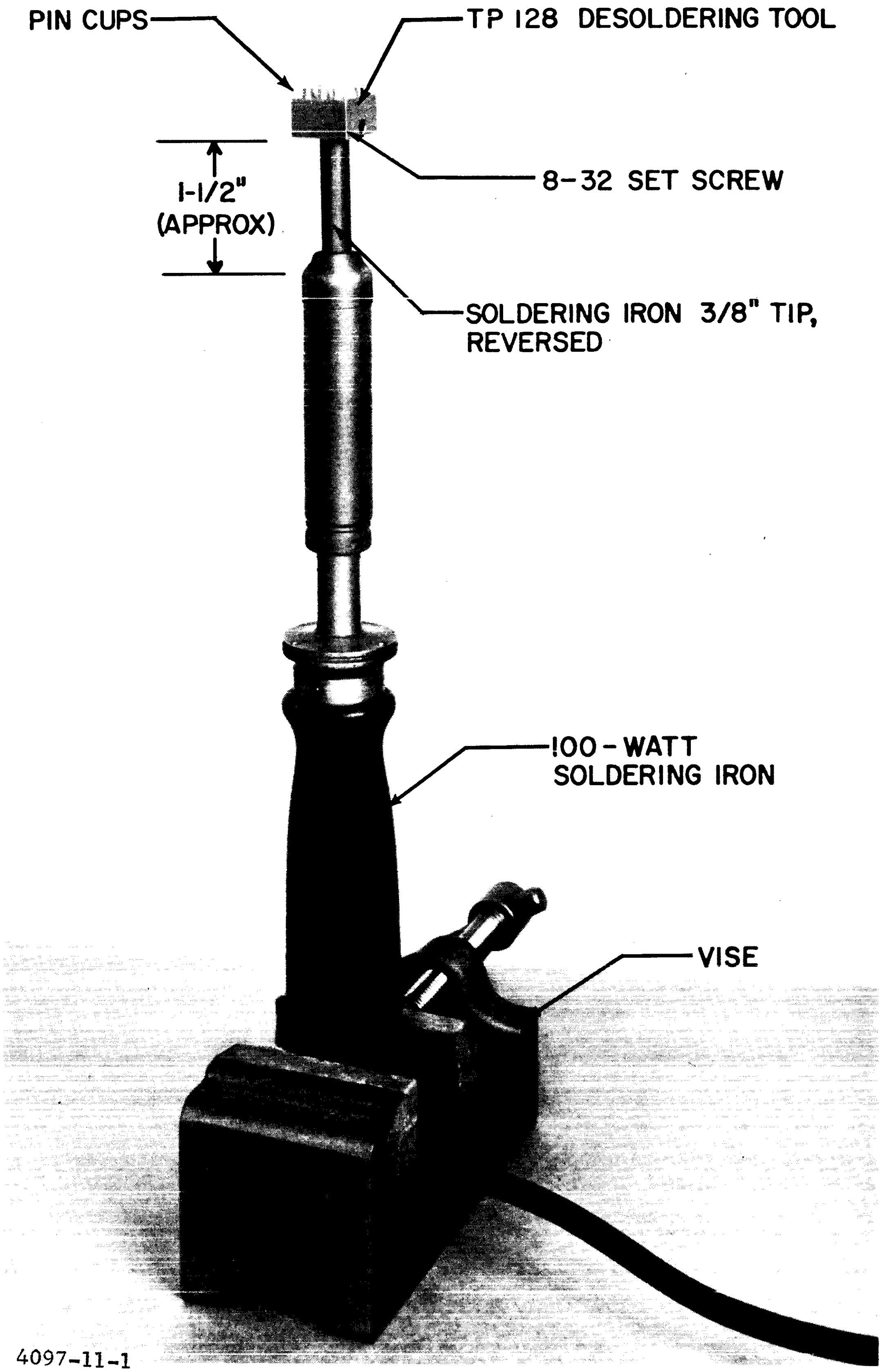
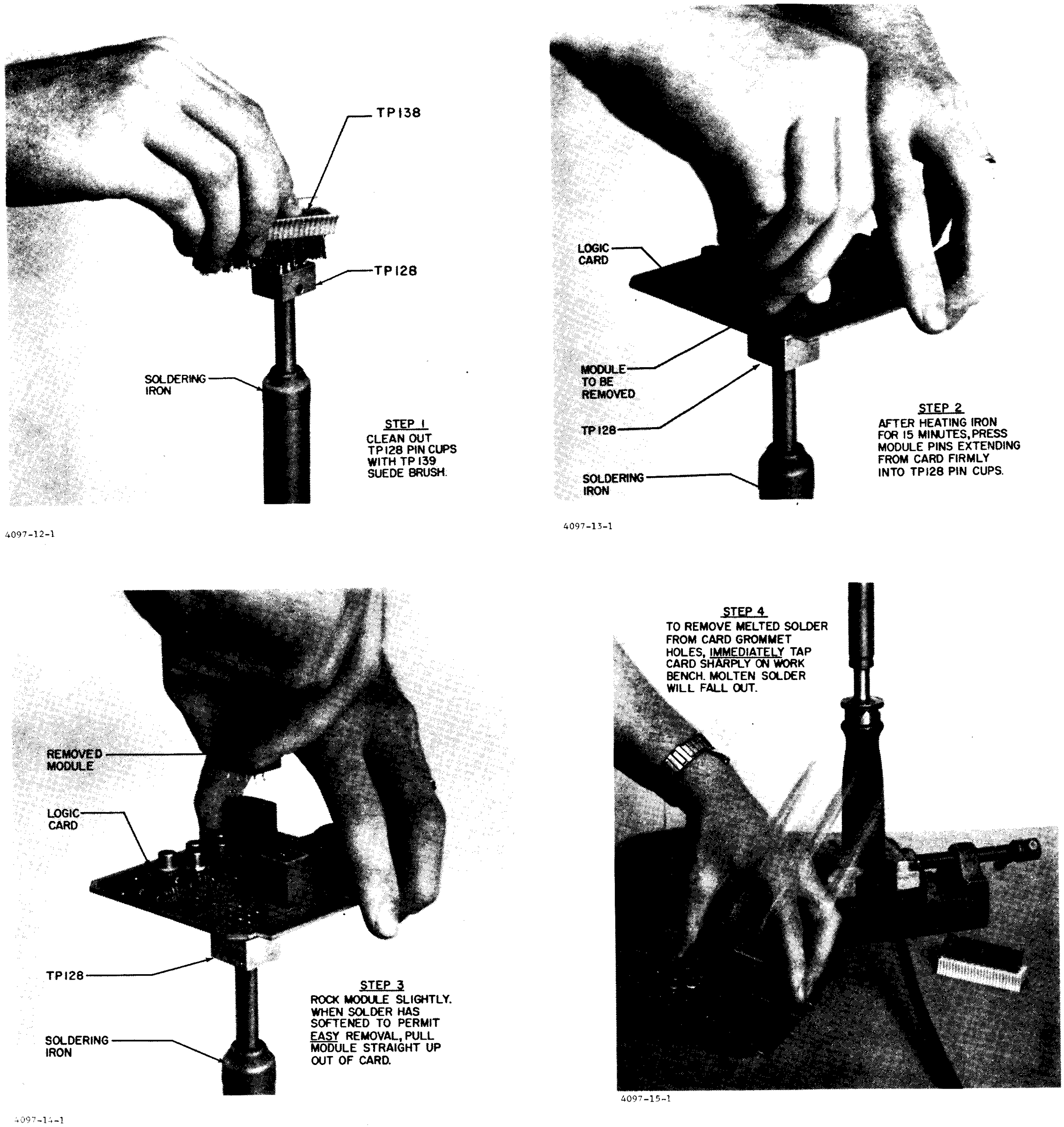


Figure 5-5. TP128 in Position

664.18-9



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

Figure 5-6. Removing Logic Module from Card

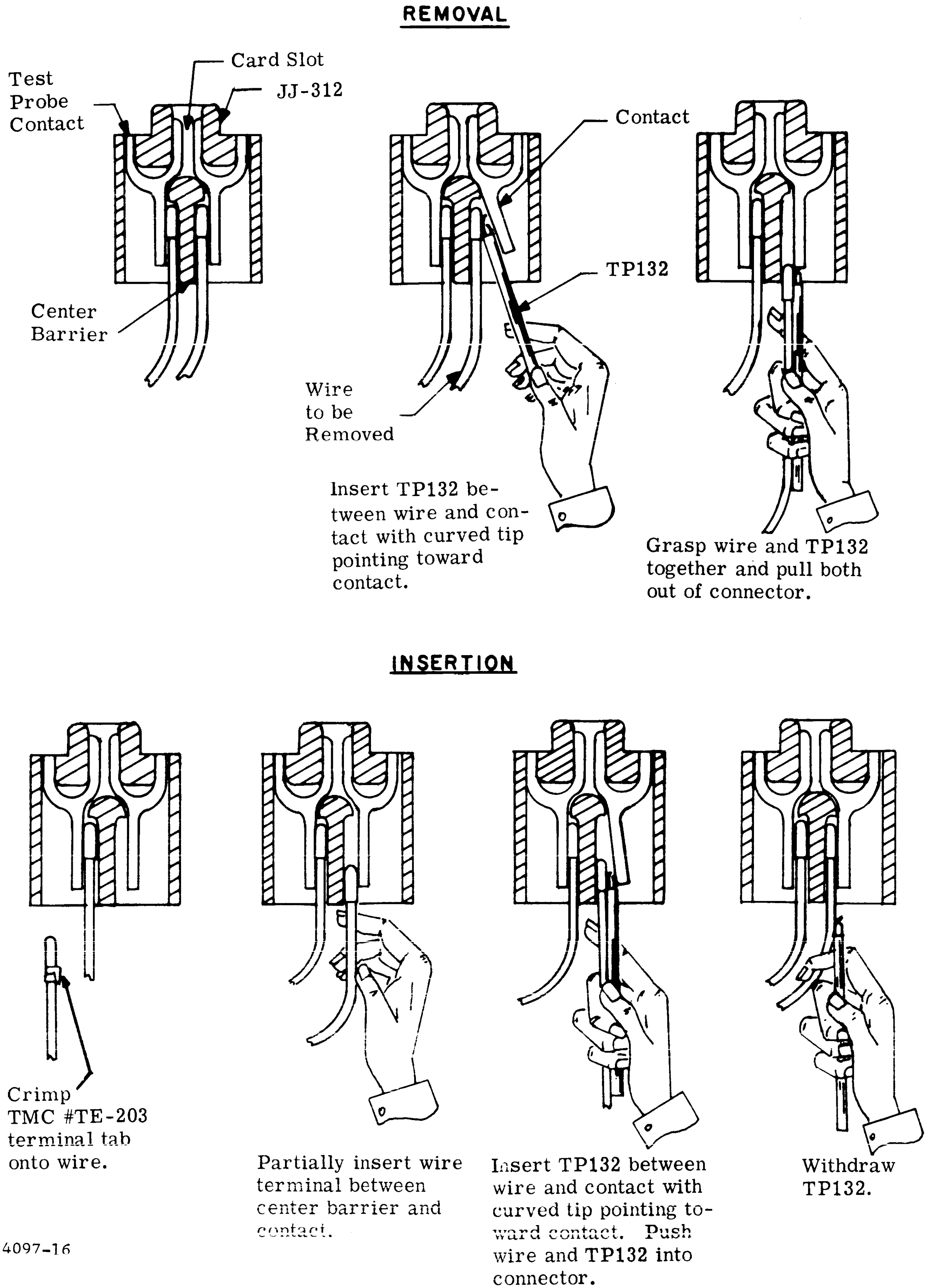


Figure 5-7. Using TP132 Connector Extractor

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

PARTS LIST

for

ELECTRONIC PROGRAMMER, RTPA-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1001	CAPACITOR, FIXED, ELECTROLYTIC: 20 uf, -10% +150% at 120 cps at 25°C; 50 WVDC; polarized; insulated tubular case.	CE105-20-50
C1002	Same as C1001.	
C1003	CAPACITOR, FIXED, ELECTROLYTIC: polarized; 2,600 uf, 50 WVDC; insulated clear plastic case.	CE112-6
C1004	Same as C1003.	
C1005	CAPACITOR, FIXED, ELECTROLYTIC: polarized; 9,200 uf, 15 WVDC; insulated clear plastic case.	CE112-10
C1006	Same as C1003.	
C1007	Same as C1003.	
C1008	CAPACITOR, FIXED, CERAMIC DIELECTRIC: rated at 470,000 uuf, +80% -20%; radial lead type terminals.	CC112R474Z
C1009	Same as C1005.	
C1010	Same as C1003.	
C1011	Same as C1008.	
C1012	Same as C1003.	
C1013	CAPACITOR, FIXED, ELECTROLYTIC: polarized; 1,500 uf, 25 WVDC; insulated clear plastic case.	CE112-7
C1014	Same as C1013.	
C1015	Same as C1003.	
C1016	Same as C1003.	
CR1001	SEMICONDUCTOR DEVICE, DIODE: silicon; max. peak inverse voltage 100 volts; continuous forward current 300 ma at 150°C; hermetically sealed metal and glass case.	1N1582
CR1002 thru CR1004	Same as CR1001.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR1005	SEMICONDUCTOR DEVICE, DIODE: silicon; nominal ref. voltage 13 volts; max. power dissipation 10 watts at 25°C; max. operating temperature 100°C; hermetically sealed case.	1N2977B
CR1006 thru CR1009	Same as CR1001.	
CR1010	Same as CR1005.	
CR1011	SEMICONDUCTOR DEVICE, DIODE: silicon; max. peak reverse voltage 100 volts; average forward current 12 amps at 150°C; operating and storage temperature range -65°C to +200°C; hermetically sealed case.	1N1200A
CR1012 thru CR1014	Same as CR1011.	
CR1015	SEMICONDUCTOR DEVICE, DIODE: silicon; nominal voltage 24 V, ±5%; power dissipation 10 watts at 25°C; current rating 105 ma; max. impedance 5 ohms; max. operating temperature 150°C; hermetically sealed metal case.	1N2986B
CR1016 thru CR1019	Same as CR1001.	
CR1020	SEMICONDUCTOR DEVICE, DIODE: silicon; nominal ref. voltage 6.2 volts; power dissipation 10 watts at 25°C; max. operating temperature 175°C.	1N1804A
CR1021	SEMICONDUCTOR DEVICE, DIODE: nominal ref. voltage 18 volts; max. power dissipation 10 watts at 25°C; max. operating temperature 175°C; JEDEC type DO-4 case.	1N2982B
CR1022	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; power dissipation 80 ma at 25°C; JEDEC type DO-7 case.	1N270
CR1023 thru CR1032	Same as CR1022.	

ELECTRONIC PROGRAMMER, RTPA-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
DS1001	LAMP, NEON: 110/125 VAC/VDC; nominal current rating 0.6 ma, 1/15 watt; midget flange base T-2 bulb.	BI111-1
DS1002	Same as DS1001.	
DS1003	Non-replaceable item. Part of XF1001.	
DS1004	Non-replaceable item. Part of XF1007.	
DS1005	Non-replaceable item. Part of XF1005.	
DS1006	Non-replaceable item. Part of XF1004.	
DS1007	Non-replaceable item. Part of XF1003.	
DS1008	Non-replaceable item. Part of XF1002.	
DS1009	Non-replaceable item. Part of XF1006.	
DS1010	LAMP, INCANDESCENT: 28.0 volts AC/DC; 0.04 amp; single contact, T-1-3/4 bulb.	BI110-7
DS1011 thru DS1061	Same as DS1010.	
F1001	FUSE, CARTRIDGE: 2-1/2 amps; time lag; 1-1/4" long x 1/4" dia.; slo-blo.	FU102-2.5
F1002	FUSE, CARTRIDGE: 3/8 amp; 1-1/4" long x 1/4" dia.; quick acting.	FU100-.375
F1003	FUSE, CARTRIDGE: 2 amps; 1-1/4" long x 1/4" dia.; quick acting.	FU100-2
F1004	FUSE, CARTRIDGE: 1-1/2 amps; 1-1/4" long x 1/4" dia.; quick acting.	FU100-1.5
F1005	Same as F1002.	
F1006	FUSE, CARTRIDGE: 1 amp; 1-1/4" long x 1/4" dia; quick acting.	FU100-1
F1007	Same as F1006.	
J1000	CONNECTOR RECEPTACLE, ELECTRICAL: 22 female contacts; accommodates 1/16" printed circuit board.	JJ312-44

ELECTRONIC PROGRAMMER, RTPA-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
J1001 thru J1006	Same as J1000.	
J1007	CONNECTOR, RECEPTACLE, ELECTRICAL: 37 number 20 female contacts, rated for 5 amps, 500 V RMS.	JJ310-3
J1008	CONNECTOR, RECEPTACLE, ELECTRICAL: 25 number 20 female contacts, rated for 5 amps, 500 V RMS.	JJ310-2
J1009	CONNECTOR, RECEPTACLE, ELECTRICAL: 11 round female contacts, rated for 3 amps, 1800 V RMS; key polarization; micro miniature type.	JJ311-1S
J1010	CONNECTOR, RECEPTACLE, ELECTRICAL: AC power; 2 male contacts, rated for 250 volts at 10 amps or 125 volts at 15 amps; polarized; twist lock type.	JJ175
J1011	JACK, TELEPHONE	JJ033
K1001	RELAY, ARMATURE: DPDT; 5,000 ohms, $\pm$10% DC resistance; operating voltage 20.5 VDC; current rating 4.1 ma, 85 mu at 25°C; 8 contacts rated for 1 amp at 29 VDC resistive; clear high impact styrene dust cover case.	RL156-4
K1002	Same as K1001.	
K1003	Same as K1001.	
K1004 thru K1007	NOT USED	
K1008 thru K1010	Same as K1001.	
Q1001	TRANSISTOR: germanium; hi current; collector to base voltage 40 V; collector to emitter and emitter to base voltage 20 V; collector current 7 amps; base current 3 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
Q1002 thru Q1005	Same as Q1001.	

ELECTRONIC PROGRAMMER, RTPA-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R1001	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±5%; 1/2 watt.	RC20GF102J
R1002	Same as R1001.	
R1003	RESISTOR, FIXED, WIREWOUND: 50 ohms, 5 watts.	RW107-54
R1004	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±5%; 2 watts.	RC42GF102J
R1005	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±5%; 2 watts.	RC42GF471J
R1006	Same as R1003.	
R1007	RESISTOR, FIXED, WIREWOUND: 1,000 ohms, current rating 70 ma; 5 watts.	RW107-34
R1008	RESISTOR, FIXED, WIREWOUND: 100 ohms, current rating 223 ma; 5 watts.	RW107-18
R1009	RESISTOR, FIXED, WIREWOUND: 1 ohm, current rating 5,000 ma; 25 watts.	RW111-1
R1010	RESISTOR, FIXED, WIREWOUND: 300 ohms, current rating 180 ma; 10 watts.	RW109-15
R1011	RESISTOR, FIXED, WIREWOUND: 150 ohms, current rating 258 ma; 10 watts.	RW109-11
R1012	RESISTOR, FIXED, WIREWOUND: 100 ohms, current rating 315 ma; 10 watts.	RW109-9
R1013	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%; 2 watts.	RC42GF101J
R1014	RESISTOR, FIXED, COMPOSITION: 680 ohms, ±5%; 2 watts.	RC42GF681J
R1015	RESISTOR, FIXED, WIREWOUND: 25 ohms, current rating 1,000 ma; 25 watts.	RW111-6
R1016	RESISTOR, FIXED, COMPOSITION: 330 ohms, ±5%; 2 watts.	RC42GF331J
R1017	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, ±5%; 1/2 watt.	RC20GF473J
R1018	Same as R1017.	
R1019	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±5%; 1/2 watt.	RC20GF471J

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R1020	Same as R1001.	
R1021	Same as R1001.	
R1022	RESISTOR, FIXED, COMPOSITION: 18,000 ohms, ±5%; 1/2 watt.	RC20GF183J
R1023 thru R1026	Same as R1022.	
R1027 thru R1031	NOT USED	
R1032	Non-replaceable item. Part of XF1001.	
R1033	Non-replaceable item. Part of XF1007.	
R1034	Non-replaceable item. Part of XF1005.	
R1035	Non-replaceable item. Part of XF1004.	
R1036	Non-replaceable item. Part of XF1003.	
R1037	Non-replaceable item. Part of XF1002.	
S1001	SWITCH, TOGGLE: SPST; bat type handle.	ST103-1-62
S1002	Same as S1001.	
S1003-1	SWITCH, PUSHBUTTON	SW361
S1003-2 thru S1003-52	Same as S1003-1.	
S1004	SWITCH, ROTARY: 4 sections, 5 positions; 15° angle of throw; stud mounted.	SW359
S1005	SWITCH, PUSHBUTTON: SPDT; illuminated; current rating 6 amps at 220 VAC or 0.25 amps at 220 VDC; operating voltage 2,000 V; green button; black plastic case.	SW371-1
T1001	TRANSFORMER, POWER, STEP-DOWN: primary- 105, 115, 125 V, 50/60 cps, single phase; secondary- 20.3 V RMS at 1.5 ADC, 20.3 V RMS at 300 MADC; stud mounted; hermetically sealed rectangular steel case.	TF294

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
T1002	TRANSFORMER, POWER, STEP-DOWN: primary- 105, 115, 125 V, 50/60 cps, single phase; secondary- 33 V RMS no load at 225 ADC, 20 V RMS no load at 120 MADC; hermetically sealed rectangular steel case.	TF290
T1003	TRANSFORMER, POWER, STEP-DOWN: primary- 105, 115, 125 V, 50/60 cps, single phase; secondary- 27.9 V RMS no load at 0.016 amp; stud mounted; hermetically sealed rectangular steel case.	TF291
TB1001	TERMINAL STRIP, BARRIER: 6 double right angle solder type terminals; o/a dim. 3-1/8" lg. x 5/16" wide; bakelite body.	TM127-6
TB1002	Same as TB1001.	
XDS1001	LIGHT, INDICATOR: with white lens; accepts T-3-1/4 single contact, midget flange lamp.	TS154-5
XDS1002	Same as XDS1001.	
XF1001	FUSEHOLDER, LAMP INDICATING: accommodates cartridge 1-1/4" long x 1/4" dia; 90 to 300 V, 20 amps; neon lamp type with 220K ohm lamp resistor; transparent clear flat sided knob; black body. Consists of DS1003, R1032.	FH104-3
XF1002	FUSEHOLDER, LAMP INDICATING: accommodated 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 DS1008, R1037.	FH104-9
XF1003	Same as XF1002. Consists of DS1007, R1036.	
XF1004	FUSEHOLDER, LAMP INDICATING: accommodates cartridge fuse 1-1/4" long x 1/4" dia.; 22 to 33 V, 20 amps; incandescent lamp type with a 330 ohm lamp resistor; transparent amber flat sided knob; brown body. Consists of DS1006, R1035.	FH104-11
XF1005	FUSEHOLDER, LAMP INDICATING: accommodates cartridge fuse 1-1/4" long x 1/4" dia.; 4 to 6 V, 20 amps; incandescent lap type with a 15 ohm lamp resistor; transparent red flat sided knob; brown body. Consists of DS1005, R1034.	FH104-8

ELECTRONIC PROGRAMMER, RTPA-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
XF1006	FUSEHOLDER, LAMP INDICATING: accommodates cartridge fuse 1-1/4" long x 1/4" dia.; 13 to 22 V, 20 amps; incandescent lamp type with no lamp resistor; transparent amber flat sided knob; brown body. Consists of DS1009.	FH104-10
XF1007	Same as XF1004. Consists of DS1004, R1033.	
XK1001	SOCKET, RELAY: with retainer; 12 beryllium copper gold plated contacts; black phenolic base.	TS171-1
XK1002	Same as XK1001.	
XK1003	Same as XK1001.	
XK1004 thru XK1007	NOT USED	
XK1008 thru XK1010	Same as XK1001.	
XQ1001	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
XQ1002 thru XQ1005	Same as XQ1001.	
Z1000	INPUT CIRCUIT NO. 2 MODULE (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3793
Z1001	INPUT CIRCUIT NO. 1 MODULE (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3686
Z1002	CONVERTER CIRCUIT NO 1 MODULE (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3695
Z1003	RESET CIRCUIT NO. 1 MODULE (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3694
Z1004	RTPA-1 CONTROL BOARD (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3804
Z1005	TIMING CIRCUIT NO. 3 MODULE (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3803

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z1006	RELAY DRIVE CIRCUIT NO. 2 MODULE (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3795

Z1000

INPUT CIRCUIT NO. 2, A3793

C1	CAPACITOR, FIXED, METALIZED PLASTIC: 0.47 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy encapsulated.	CN114R47-5J
C2	CAPACITOR, FIXED, ELECTROLYTIC: 5 uf, -10% +150% at 120 cps at 25°C; 15 WVDC; polarized; insulated tubular case.	CE105-5-15
R1	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
R2	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±5%; 1/2 watt.	RC20GF102J
R3	Same as R1.	
Z1	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z2 thru Z4	Same as Z1.	
Z5	NETWORK, DIGITAL INVERTER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW105-11
Z6	NETWORK, ONE SHOT GENERATOR: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW111-1
Z7	Same as Z6.	
Z8	Same as Z1.	

PARTS LIST (CONT)

Z1001

INPUT CIRCUIT NO. 1, A3686

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R1	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±5%; 1/2 watt.	RC20GF102J
R2	RESISTOR, FIXED, COMPOSITION: 22,000 ohms, ±5%; 1/2 watt.	RC20GF223J
R3	Same as R1.	
R4	Same as R2.	
R5	Same as R1.	
R6	Same as R2.	
R7	Same as R1.	
R8	Same as R2.	
R9	Same as R1.	
R10	Same as R2.	
TP1	TERMINAL STUD: feed-thru.	TE168-2C
TP2 thru TP6	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 thru Z4	Same as Z1.	
Z5	NETWORK, EMITTER FOLLOWER	NW120-11
Z6	Same as Z5.	
Z7	Same as Z5.	
Z8	Same as Z1.	
Z9	NETWORK, GATE AMPLIFIER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW121-23
Z10	NETWORK, NAND GATE AMPLIFIER	NW104-22

PARTS LIST (CONT)

Z1002

CONVERTER CIRCUIT NO. 1, A3695

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	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
TP1	TERMINAL STUD: feed-thru.	TE168-2C
TP2 thru TP8	Same as TP1.	
Z1	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z2 thru Z4	Same as Z1.	
Z5	NETWORK, BUFFER AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z6 thru Z8	Same as Z1.	
Z9	NETWORK, EMITTER FOLLOWER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW118-11
Z10	NETWORK, GATE AMPLIFIER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW108-26
Z11	Same as Z10.	
Z12	NETWORK, ONE SHOT GENERATOR: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW111-1

PARTS LIST (CONT)

Z1003

RESET CIRCUIT NO. 1, A3594

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, PLASTIC DIELECTRIC: 0.10 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy encapsulated case.	CN114R10-5J
C2	Same as C1.	
R1	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
R2	RESISTOR, FIXED, COMPOSITION: 390,000 ohms, ±5%; 1/2 watt.	RC20GF394J
R3	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, ±5%; 1/2 watt.	RC20GF104J
TP1	TERMINAL STUD: feed-thru.	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	Same as Z6.	
Z8	NETWORK, POSITIVE EMITTER FOLLOWER: operating temperature rnage -35°C to +85°C; 12 male contacts, epoxy case.	NW112-11
Z9 thru Z11	Same as Z8.	

Z1004

CONTROL BOARD, RTPA-1, A3804

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, METALIZED PLASTIC: 0.10 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy encapsulated case.	CN114R10-5J
C2	CAPACITOR, FIXED, MICA DIELECTRIC: 220 uuf, ±5%; 500 WVDC; straight wire leads.	CM111E221J5S
C3	Same as C1.	
CR1	SEMICONDUCTOR DEVICE, DIODE: peak inverse voltage 100 V; max. forward current 200 ma at 1.0 V; max. reverse current 100 ua at 25°C; power dissiaption 80 ma at 25°C; max. operating temperature 90°C; DO-7 case.	1N270
R1	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
R2	Same as R1.	
R3	Same as R1.	
TP1	TERMINAL STUD: feed-thru.	TE168-2C
TP2 thru TP6	Same as TP1.	
Z1	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z2	NETWORK, BUFFER AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z3	NETWORK, OR GATE AMPLIFIER	NW121-26
Z4	NETWORK, ONE SHOT GENERATOR: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW111-1
Z5	NETWORK, NAND GATE AMPLIFIER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW104-21
Z6	Same as Z4.	
Z7	NETWORK, EMITTER FOLLOWER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW118-11
Z8	Same as Z4.	
Z9	Same as Z2.	
Z10	Same as Z2.	

PARTS LIST (CONT)

Z1005

TIMING CIRCUIT NO. 3, A3803

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, METALIZED PLASTIC: 47 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy encapsulated case.	CN114R47-5J
C2	CAPACITOR, FIXED, METALIZED PLASTIC: 3.0 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy encapsulated case.	CN114-3R0-5J
C3	CAPACITOR, FIXED, METALIZED PLASTIC: 2.0 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy encapsulated case.	CN114-2R0-5J
C4	CAPACITOR, FIXED, METALIZED PLASTIC: 10 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy encapsulated case.	CN114R10-5J
C5	CAPACITOR, FIXED, ELECTROLYTIC: 3 uf, -10% +150% at 120 cps at 25°C; 15 WVDC; polarized; insulated tubular case.	CE105-3-15
C6	CAPACITOR, FIXED, METALIZED PLASTIC: 68 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy encapsulated case.	CN114R68-5J
R1	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
R2	RESISTOR, VARIABLE, COMPOSITION: miniature; 100 ohms, ±10%; rated for 0.5 watt at 50°C; transistor type case, TO-9.	RV116-201-8-3
R3	Same as R1.	
R4	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±5%; 1/2 watt.	RC20GF103J
TP1	TERMINAL STUD: feed-thru.	TE168-2C
TP2 thru TP6	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, GATE AMPLIFIER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW108-26

Z1005

TIMING CIRCUIT NO. 3, A3803

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z3	Same as Z1.	
Z4	NETWORK, ONE SHOT GENERATOR: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW111-1
Z5	Same as Z1.	
Z6	NETWORK, CLOCK GENERATOR: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW113-1X
Z7	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z8	Same as Z4.	
Z9	Same as Z4.	
Z10	Same as Z1.	

Z1006

RELAY DRIVE CIRCUIT NO. 2, A3795

K1	RELAY, ARMATURE: SPDT; contact rating 2 amps, 500 V max., 60 cps AC, 120 V unbalanced.	RL167-1
TP1	TERMINAL STUD: feed-thru.	TE168-2C
TP2 thru TP10	Same as TP1.	
Z1	NETWORK, RELAY DRIVER: operating voltage 28 V max.; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW110-1
Z2	Same as Z1.	
Z3	NETWORK, BUFFER AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z4	Same as Z3.	
Z5	NETWORK, GATE AMPLIFIER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW121-23
Z6 thru Z9	Same as Z3.	

SECTION 7

WIRING SCHEMATICS

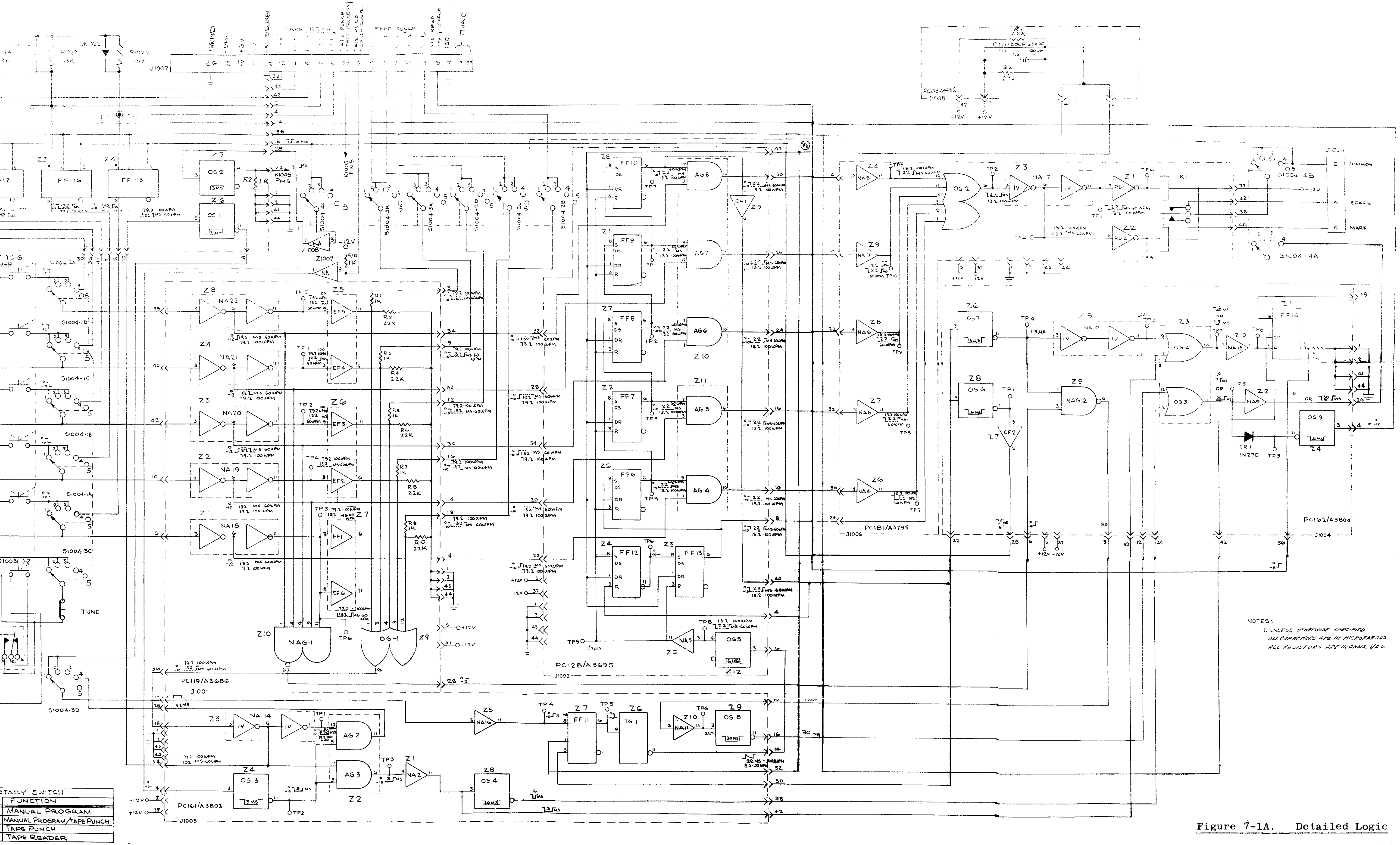
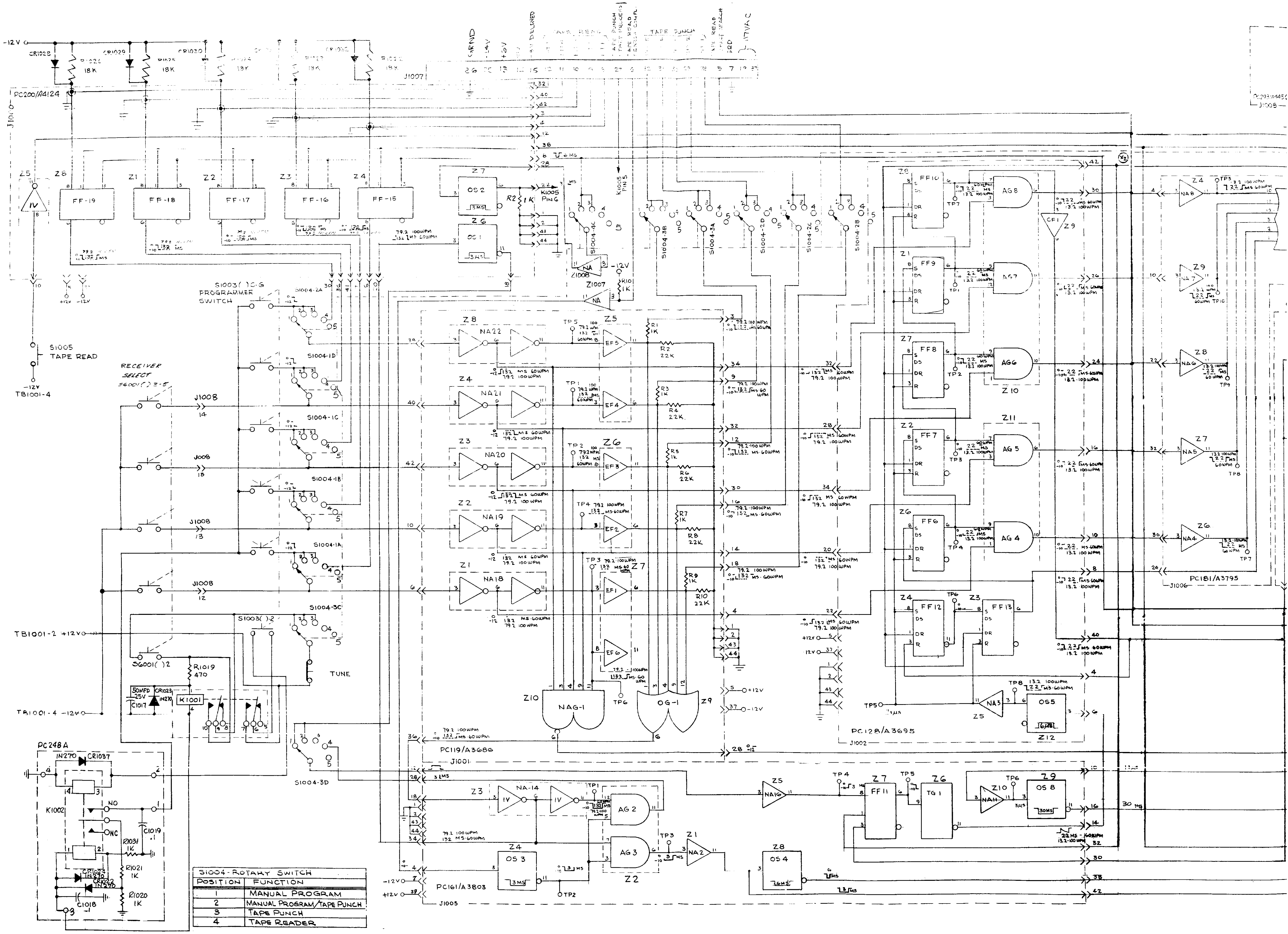


Figure 7-1A. Detailed Logic Diagram, RTPA-1



S1004-ROTARY SWITCH	
POSITION	FUNCTION
1	MANUAL PROGRAM
2	MANUAL PROGRAM/TAPE PUNCH
3	TAPE PUNCH
4	TAPE READER

CK-808D

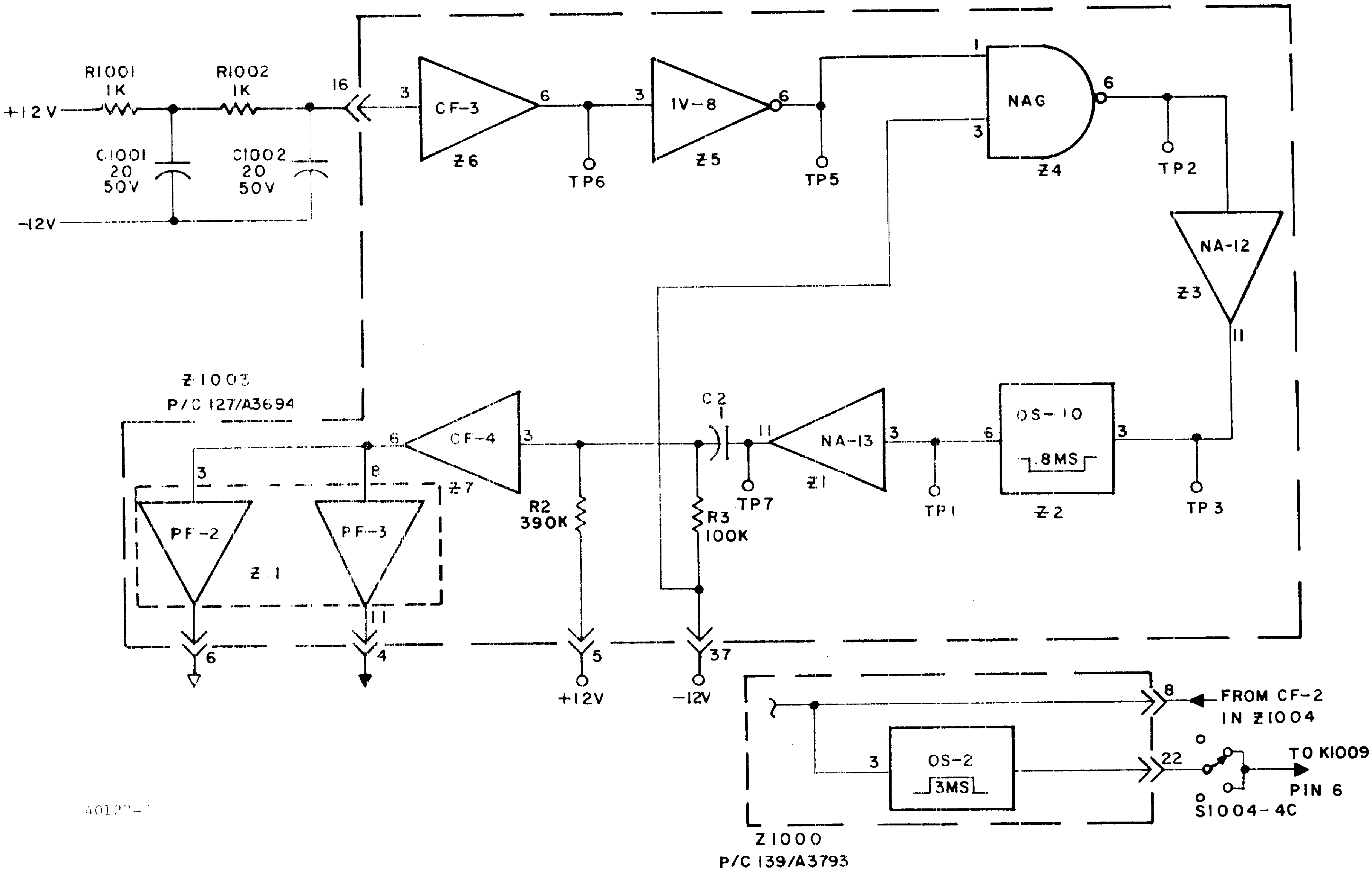


Figure 7-1B. Logic Diagram Variations, RTPA, Earlier Models

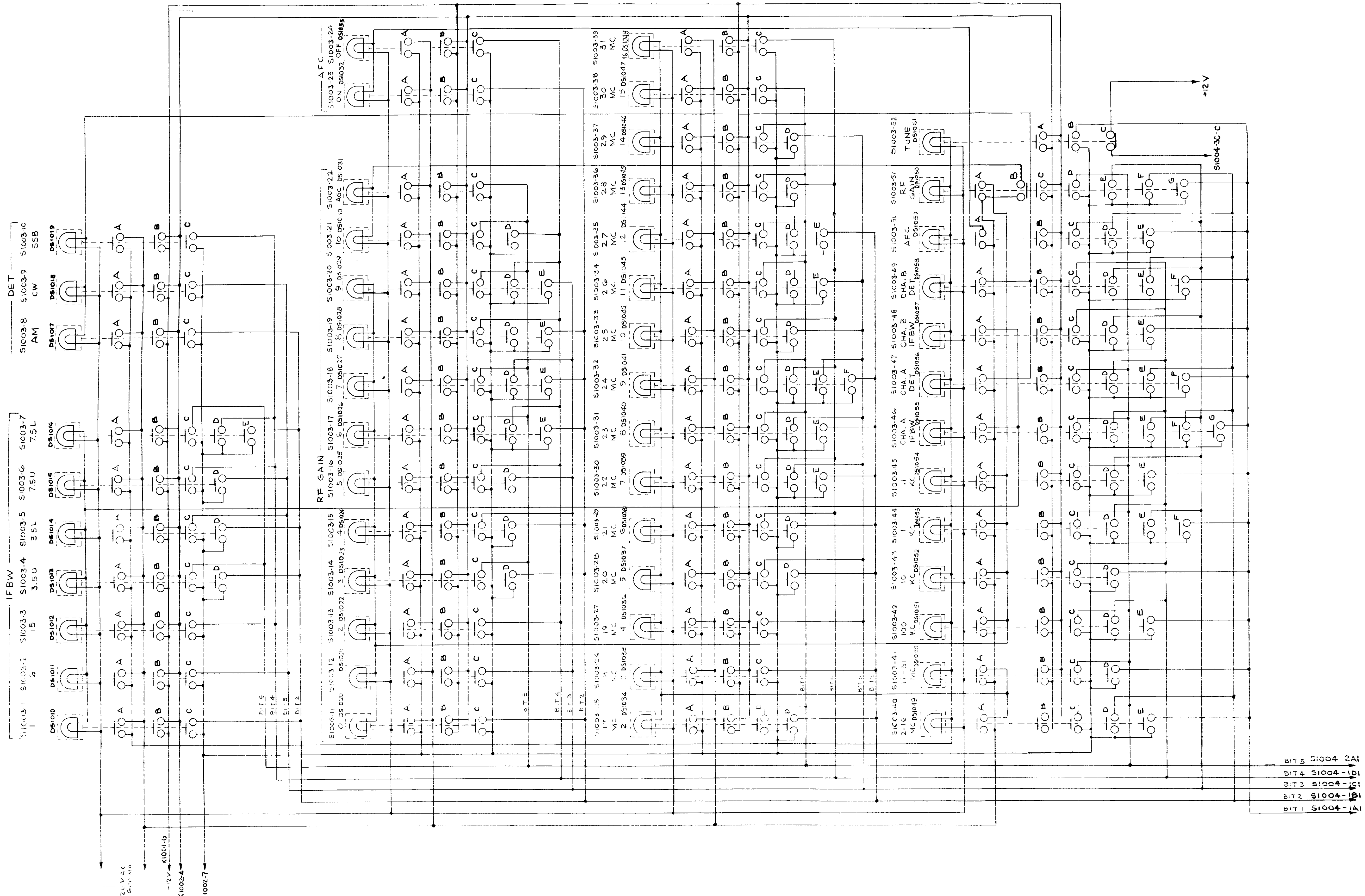


Figure 7-2. Wiring Schematic, RTPA-1 Keyboard

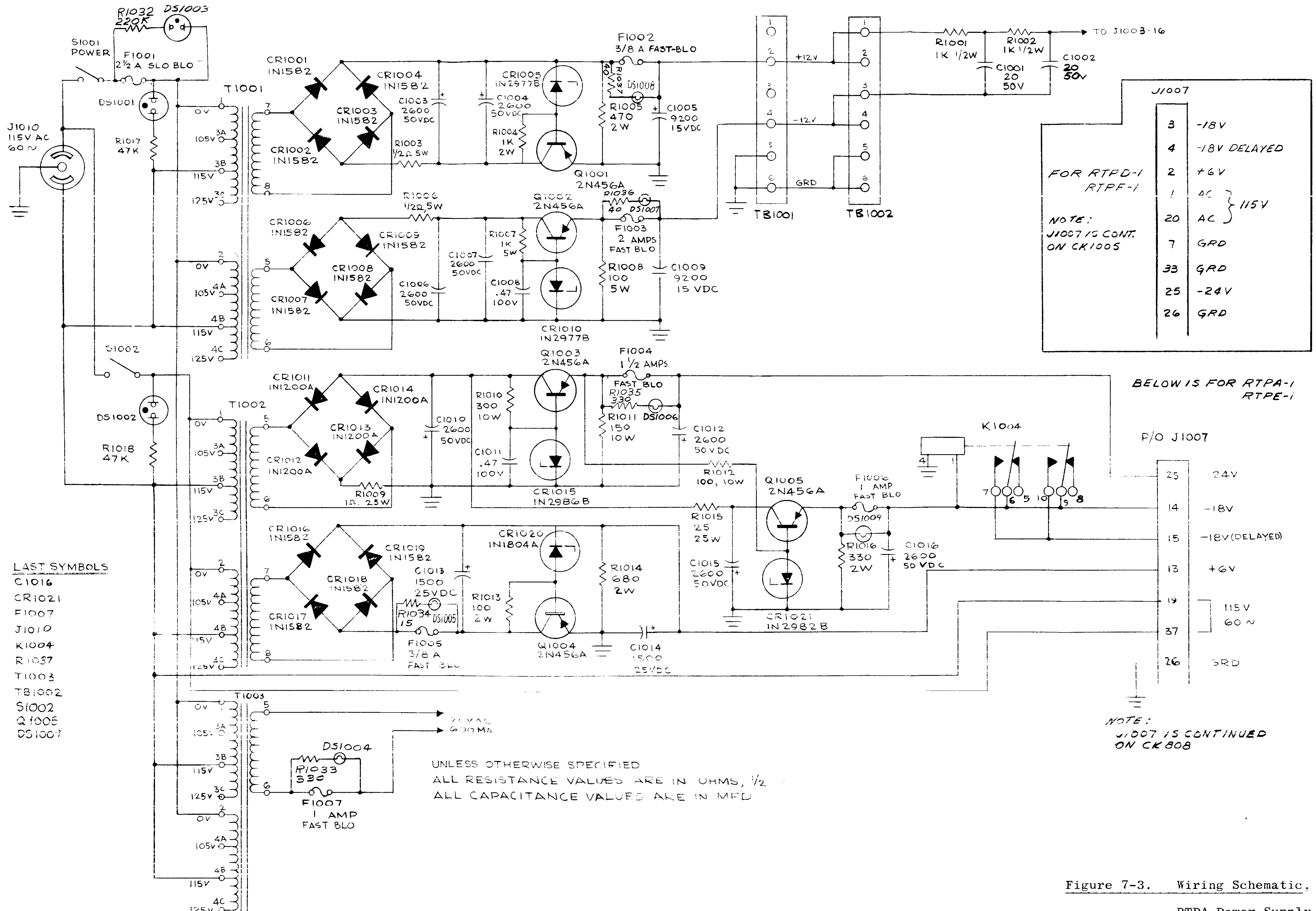
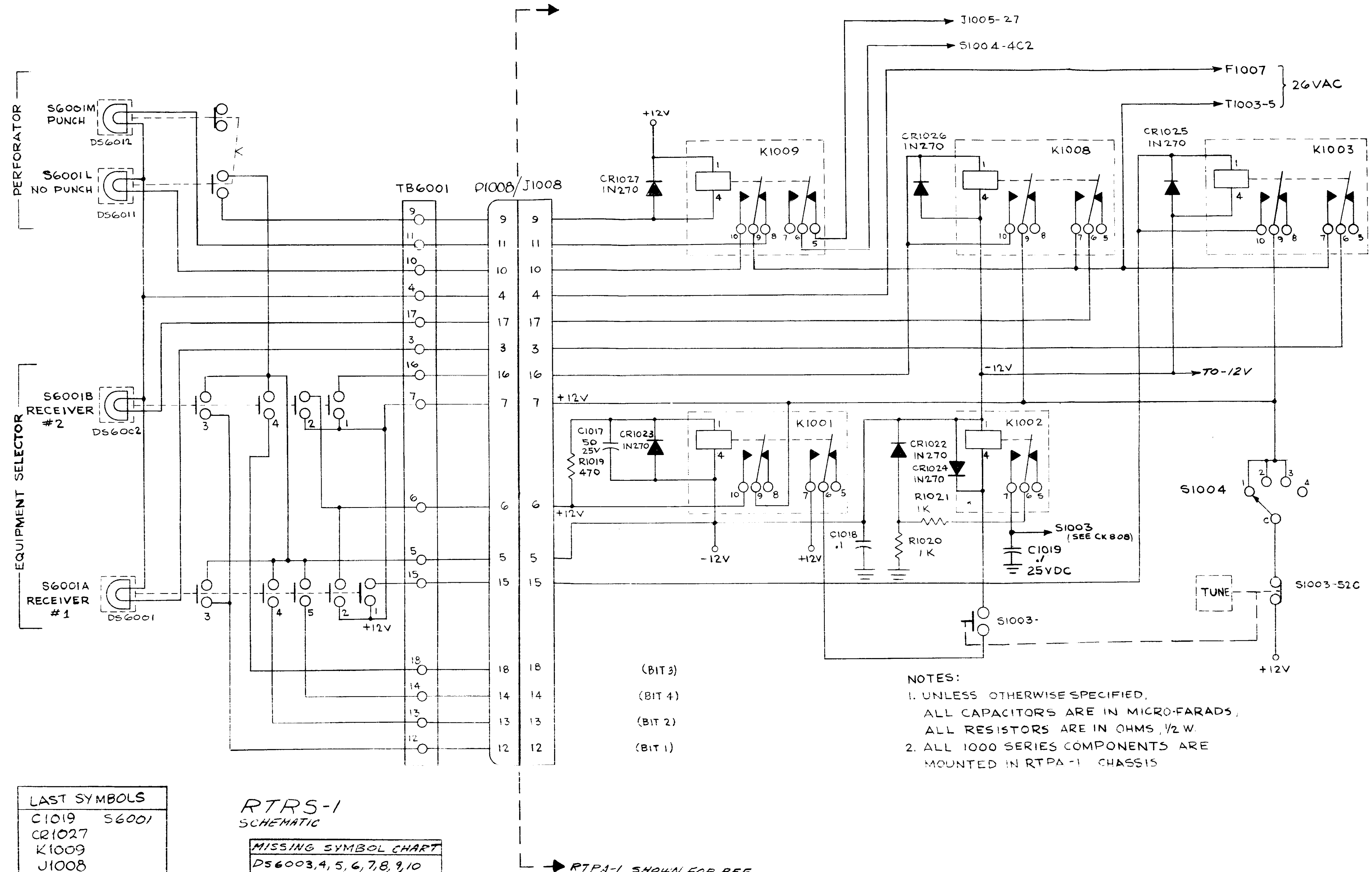


Figure 7-3. Wiring Schematic, RTPA Power Supply



NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL CAPACITORS ARE IN MICRO-FARADS, ALL RESISTORS ARE IN OHMS, 1/2 W.
2. ALL 1000 SERIES COMPONENTS ARE MOUNTED IN RTPA-1 CHASSIS

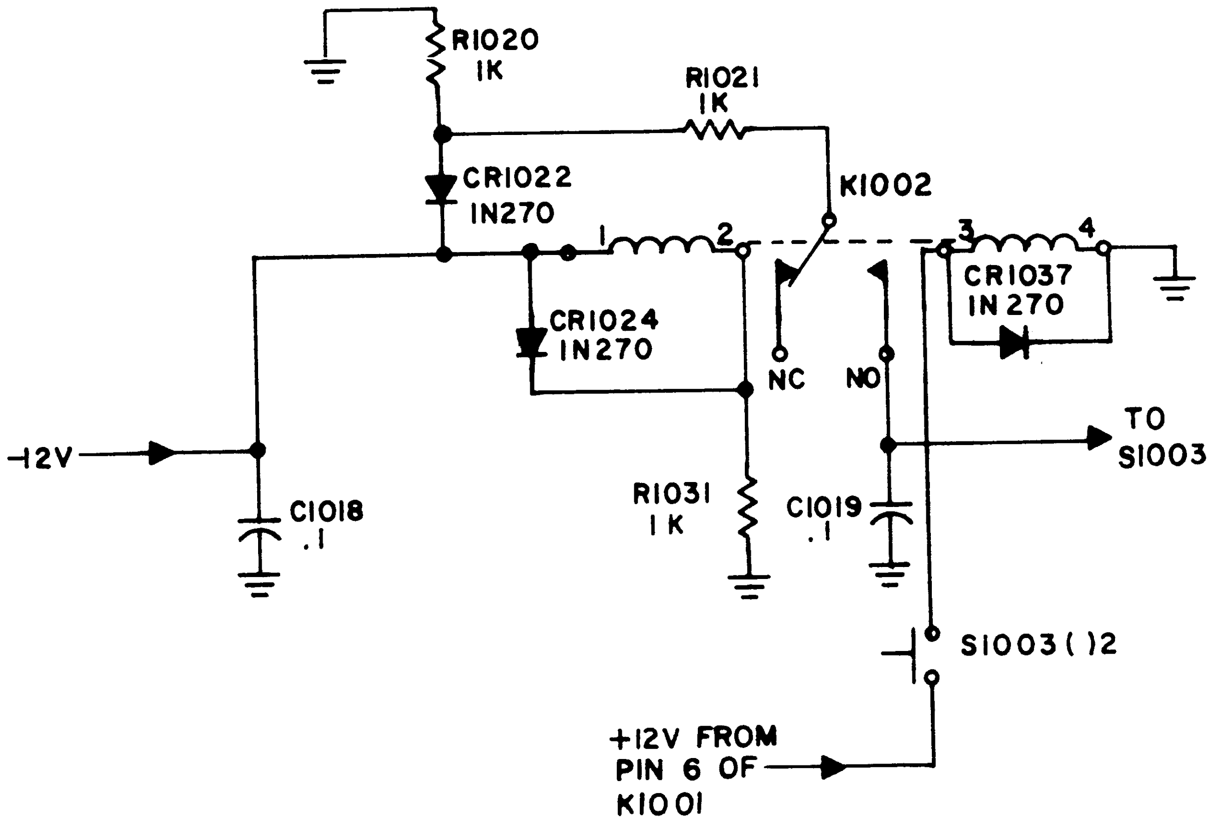
LAST SYMBOLS	
C1019	S6001
CR1027	
K1009	
J1008	
S1004	
TB6001	
DS6012	
P1008	

RTRS-1
SCHEMATIC

MISSING SYMBOL CHART
DS6003,4,5,6,7,8,9,10
K1004,5,6,7

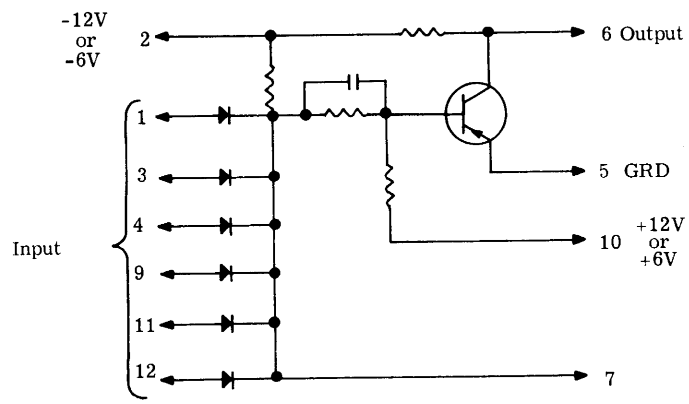
Figure 7-4A. Relay Circuitry, RTPA-1, Earlier Models

CK-809A



4012B-8

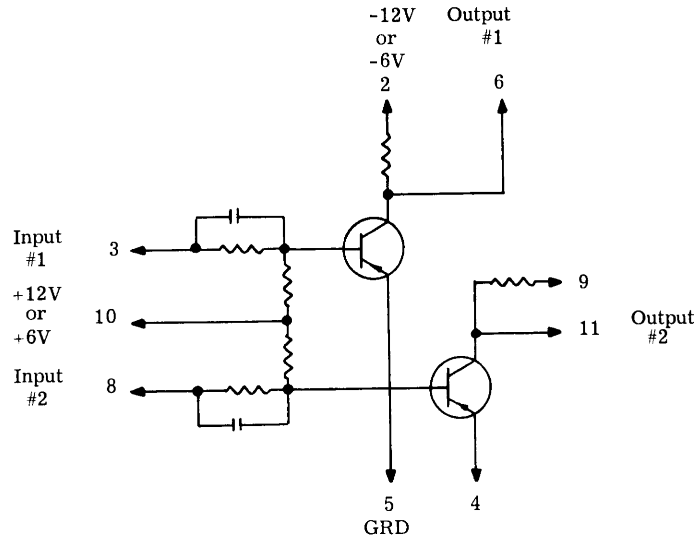
Figure 7-4B. Relay Circuitry Variation, RTPA-1, Later Models



Polarizing Pin = #8

4097-17A

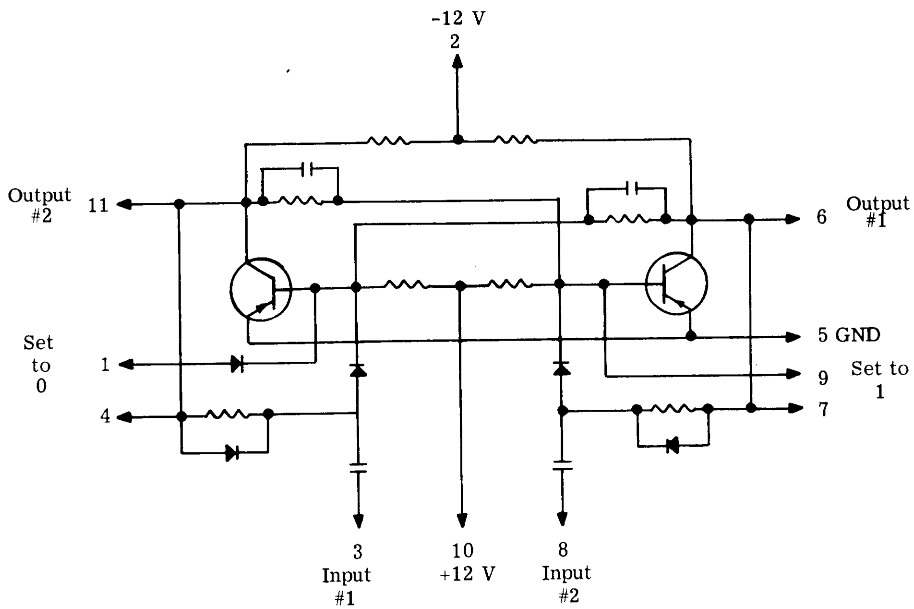
NANDGATES NW104-2, -21, -22



Polarizing Pin = #12

4097-17B

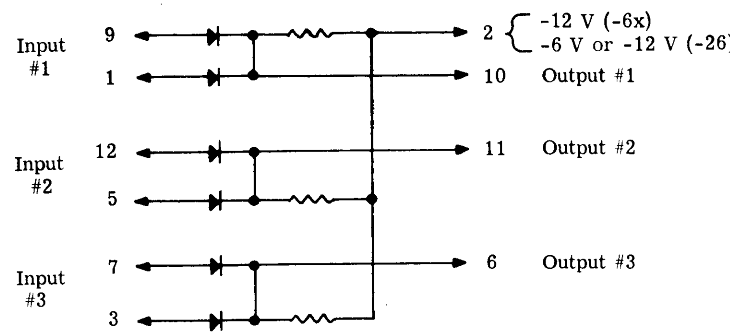
INVERTERS NW105-1, -11, -21



Polarizing Pin = #12

4097-17C

FLIP-FLOPS NW107-4X, -14, -24

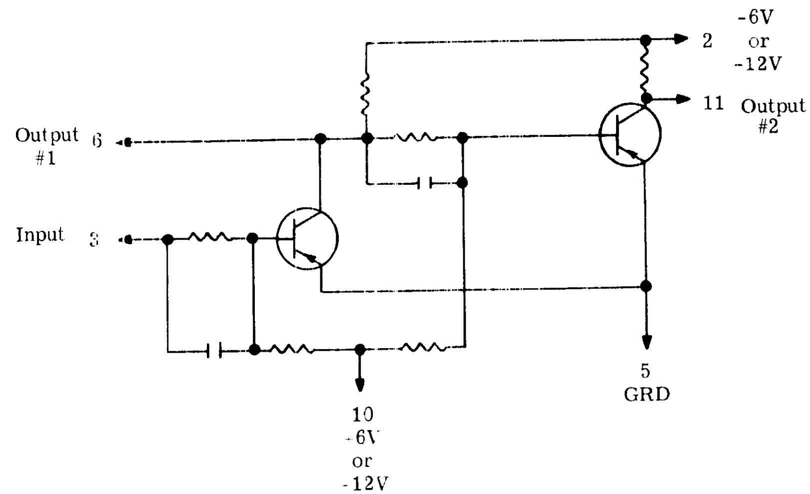


Polarizing Pin = #8

4097-17D

TRIPLE ANDGATES NW108-6X, -26

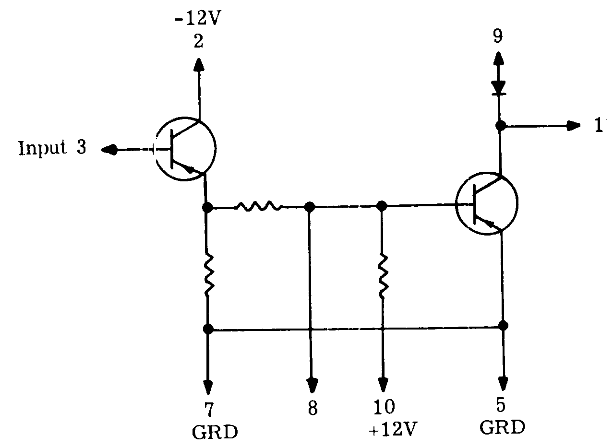
Figure 7-5. Schematic Wiring, Encapsulated Logic Modules (Sheet 1 of 4)



Polarizing Pin = #12

4097-17E

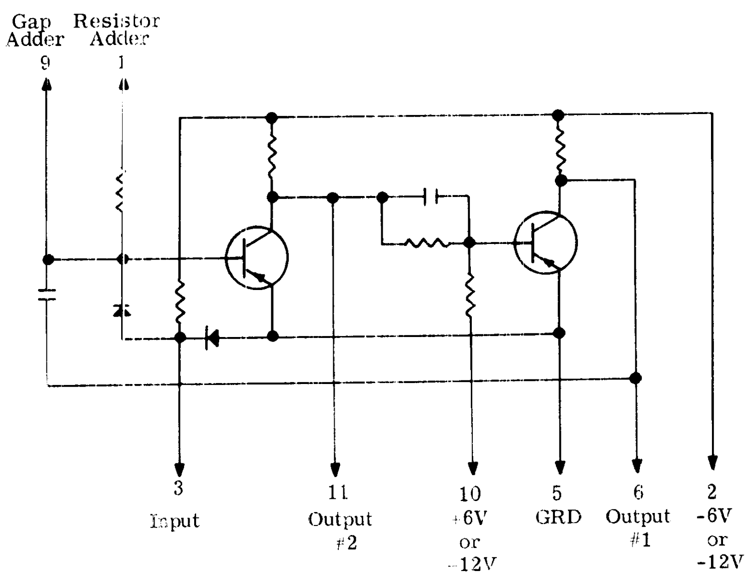
BUFFER AMPLIFIERS NW109, 109-11, -21



Polarizing Pin = #12

4097-17F

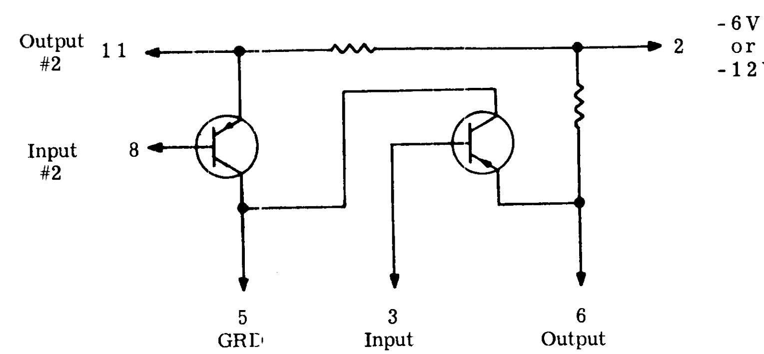
RELAY DRIVER NW110-1



Polarizing Pin = #12

4097-17G

ONE-SHOTS NW111-1, -11, -21

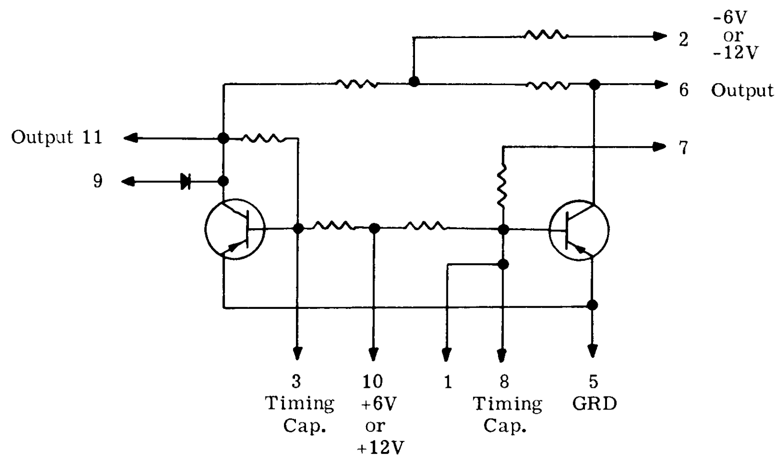


Polarizing Pin = #10

4097-17H

POSITIVE EMITTER FOLLOWERS NW112, NW112-11, -21

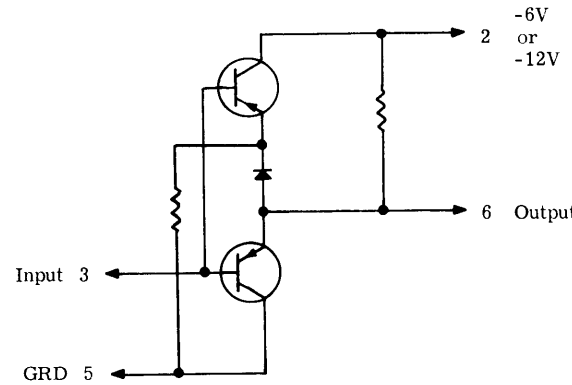
Figure 7-5. Schematic Wiring, Encapsulated Logic Modules (Sheet 2 of 4)



Polarizing Pin =#12

4097-17I

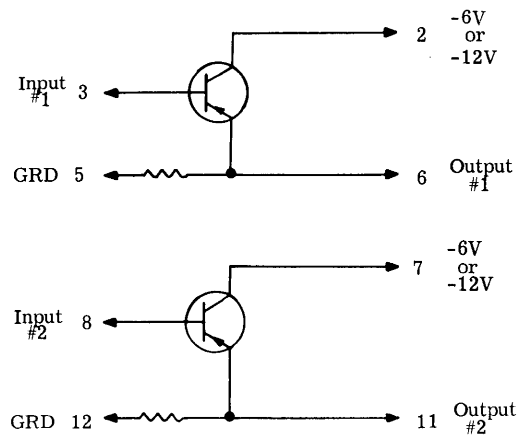
CLOCK GENERATOR NW113-1X



Polarizing Pin = #10

4097-17K

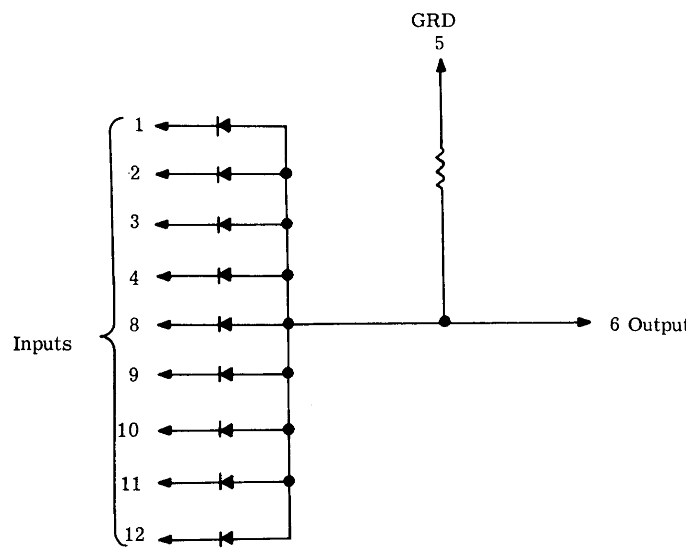
COMPLIMENTARY EMITTER FOLLOWERS
NW118, NW118-11, NW118-21



Polarizing Pin = #10

4012A-10C

DOUBLE EMITTER FOLLOWERS NW120-1, -11, -21

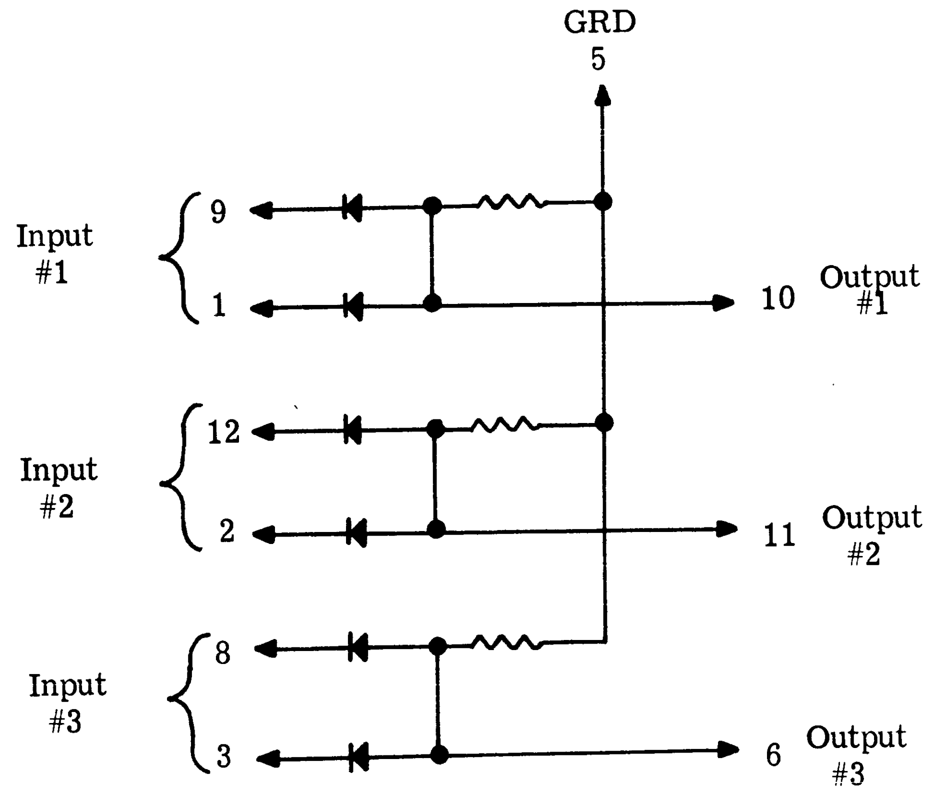


Polarizing Pin = #7

4097-17M

ORGATES NW 121-3, -23

Figure 7-5. Schematic Wiring, Encapsulated Logic Modules (Sheet 3 of 4)



Polarizing Pin = #7

4012A-10D

TRIPLE ORGATES NW121-6, -26

Figure 7-5. Schematic Wiring, Encapsulated Logic Modules (Sheet 4 of 4)