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UNCLASSIFIED

TECHNICAL MANUAL

for

SIGNAL DATA CONVERTER-STORER

MODEL RTMU-2

WORLD WIDE SUPPLIERS • OF ELECTRONIC COMMUNICATIONS EQUIPMENT •

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

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IN-4097

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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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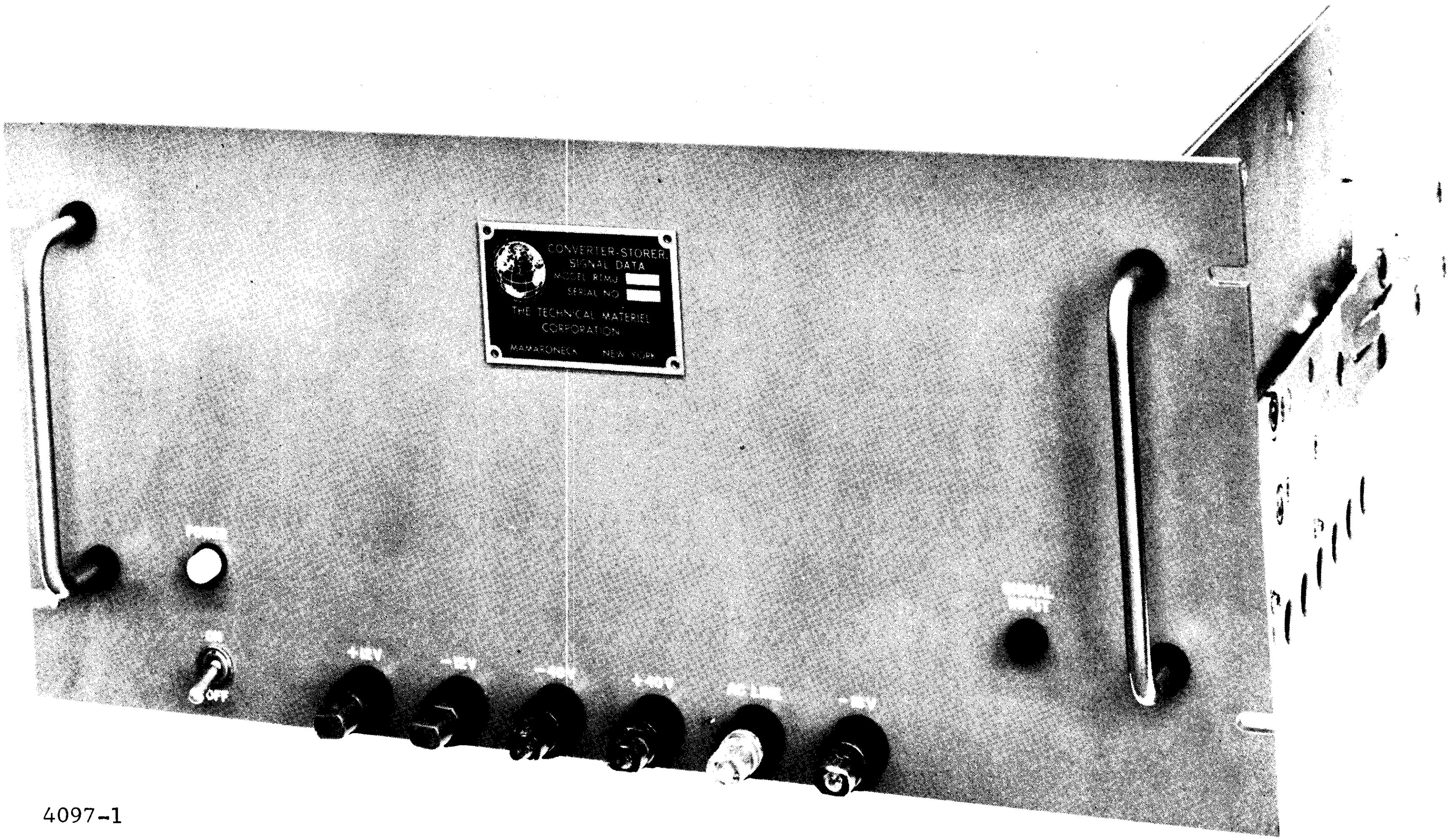

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Figure 1-1. Signal Data Converter-Storer, Model RTMU-2

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SECTION 1
GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION.

Signal Data Converter-Storer Model RTMU-2 (Figure 1-1) is a combination of a serial-to-parallel converter, temporary data storage and readback device for information transmitted in the standard CCIT 7.42-baudot code. It is used in TMC's remote-control automatic tuning systems along with an associated decoder for tuning transmitters or receivers.

The unit contains two independently operating functional sections: the memory section and the readback section.

The memory section receives and temporarily stores 28 characters (representing tuning information) in serial pulse form. Upon receiving the last character ("E" code), the RTMU proceeds to feed the information into associated decoder equipment in the form of parallel pulses for each character. In systems containing more than one transmitter and/or receiver, there is an RTMU for each transmitter and for each receiver; each unit is wired to accept or reject the entire message according to the coding of the first code (character-recognition code).

The readback section functions as a check to the remote control center to indicate when the transmitter (or receiver) has been tuned. A scanning circuit reads the "1 or 0" conditions on a diode matrix connected to rotary switches on the transmitter (or receiver) tuning mechanisms. The resulting series of characters are shifted out of the RTMU, in serial pulse form, to be transmitted back to the remote control center. The scanning cycle is continuously repeated and each cycle accommodates up to 12 characters.

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*Adaptable to ASCII 7-bit code. See paragraph 2-5.

1-2 PHYSICAL DESCRIPTION.

The RTMU (see figure 1-1) is a 19-inch rack modular unit. The front panel is 19 inches wide, 8-23/32 inches high, and 3/16 inch thick and is finished in TMC gray enamel. The chassis extends 11-5/8 inches behind the panel. The unit is equipped with drawer slides when specified or when shipped as part of a TMC rack system.

All circuitry is miniature solid state, employing plug-in printed circuit cards. Encapsulated transistor/diode logic modules are mounted on the cards.

1-3 TECHNICAL SPECIFICATIONS.

Signal Input:	Dry contact keying into a -12 V supply for serial pulses in 7.42-unit teletype transmission pattern with 22 milli-second (60 wpm) or 13.7 milli-second (100 wpm) pulse widths. 1 = -12 V; 0 = 0 V.
Tuning Output:	Parallel keying in 5-bit character form. Transistor switching output.
Readback Input:	Closed or open contact keying for 44-terminal storage matrix. Represents eleven 4-bit codes (or 11 control positions). Closed contacts = 1; open = 0.
Readback Output:	Dry contact keying through polar relay for serial pulses in 7.42-unit teletype transmission pattern with 60 WPM or 100 WPM transmission speed. Relay normally closed in mark (1) position; momentarily opened in space (0) condition. Constant cycling of 12 position codes.
Power Requirement:	105, 115, 125, 210, 230 or 250 VAC, 60 cps, single phase. 70 watts, average.
Recognition Code:	See letter and numeral on Z5003 printed circuit card and table 1-1.

TABLE 1-1. RTMU RECOGNITION CODES

TMC EQUIPMENT SELECTOR PUSH-BUTTON	5-BIT CODE	CCIT TELETYPE CHARACTER	ASCII* TELETYPE CHARACTER
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
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 2-5.

SECTION 2
INSTALLATION

2-1. INITIAL INSPECTION.

Each RTMU 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.

If the RTMU arrives as part of the shipment of a TMC rack system (i.e., receiver or transmitter), refer to the installation section of the system manual for detailed instructions as to location and installation of the unit. If the RTMU was ordered seperately, to be installed in a system other than TMC's, refer to figure 2-1 for dimensions pertinent to mounting. The unit is designed to mount in a standard 19-inch wide rack with chassis drawer slides, TMC series TK-115. When shipped as part of a system, the drawer slides are shipped pre-mounted in the rack. When the RTMU is shipped alone, no slides are included unless specified on order; however, the chassis sides contain threaded mounting holes for TK-115 slides, if required.

2-3. ELECTRICAL INSTALLATION.

If the RTMU arrives as part of the shipment of a TMC rack system, refer to the installation section of the system manual for detailed instructions as to interconnecting cabling installation.

If the RTMU was ordered separately, to be used in a system other than TMC's, refer to figure 2-1 for connector identification and locations; in this case, the mating connectors will be supplied in the shipment. Figure 2-2 identifies connector pin functions and Section 4 of this manual includes connection details.

NOTE

If more than one RTMU is being installed, check Z5003 Stunting printed circuit card in the memory bin of each unit for the "recognition" code letter and numeral stenciled onto the card. Check code to ensure that it matches that planned for the equipment site (see paragraph 1-1).

2-4 60 WPM VS. 100 WPM OPERATION.

The rate of speed in which the characters enter the tuning signal input can be any value and the timing may be regular or irregular. However, the pulse widths that the RTMU can handle depends upon the clock generator circuit. Clock generator printed circuit cards are available for pulse widths corresponding with 60 wpm or 100 wpm speeds, based on the standard 7.42-baudot code. The RTMU is shipped with the 60 wpm card installed unless specified as otherwise on the order. The Z5001 clock generator card number is marked A-4295 with "60 wpm" or "100 wpm" stenciled on it.

A choice of two speeds is also offered in the RTMU readback output. The readback signal is a continuous cycling of 13 characters in serial pulse form and the speed can be 60 wpm or 100 wpm, based

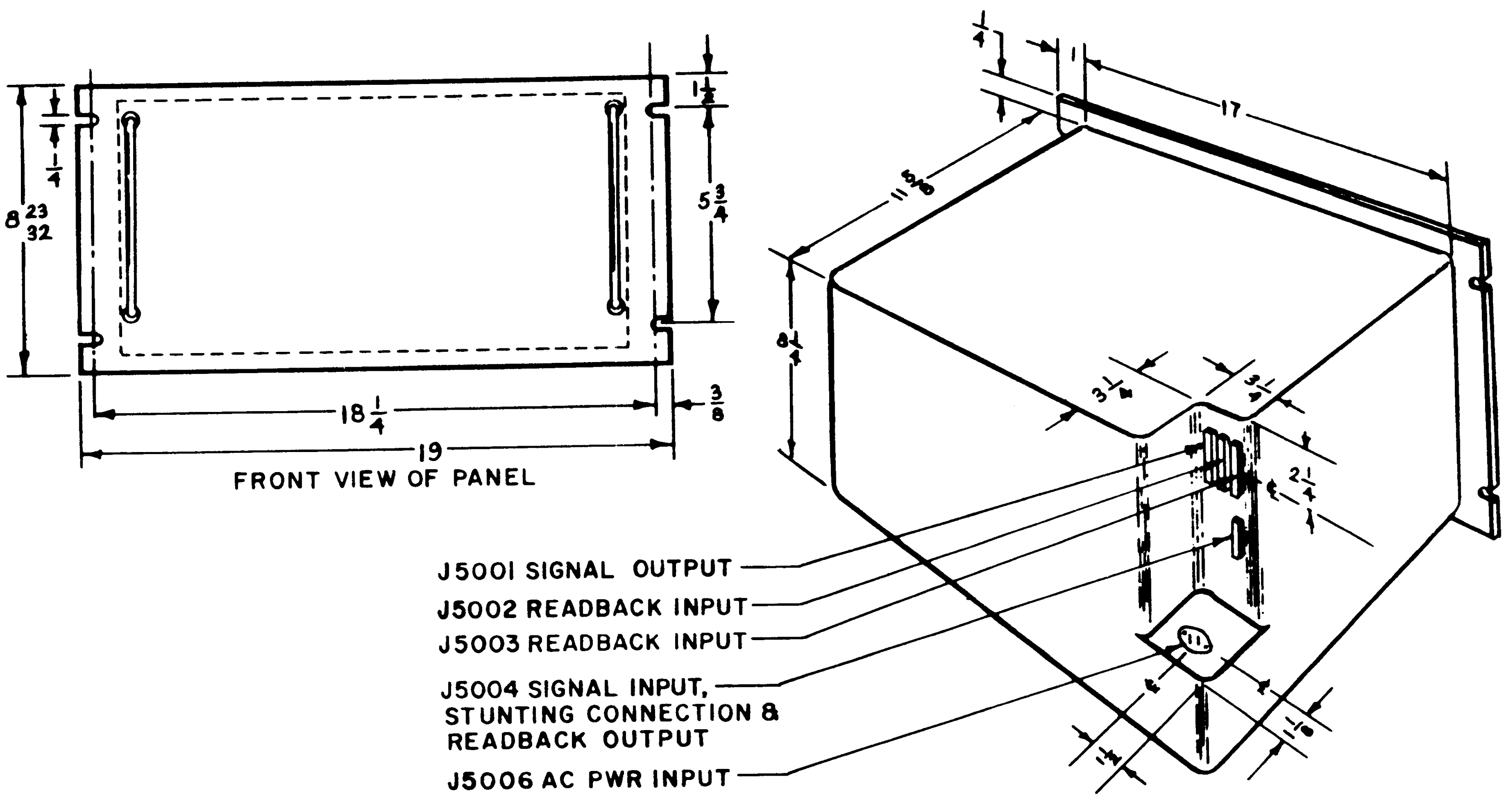

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Figure 2-1. Dimensional Outline & Connector Locations, Model RTMU

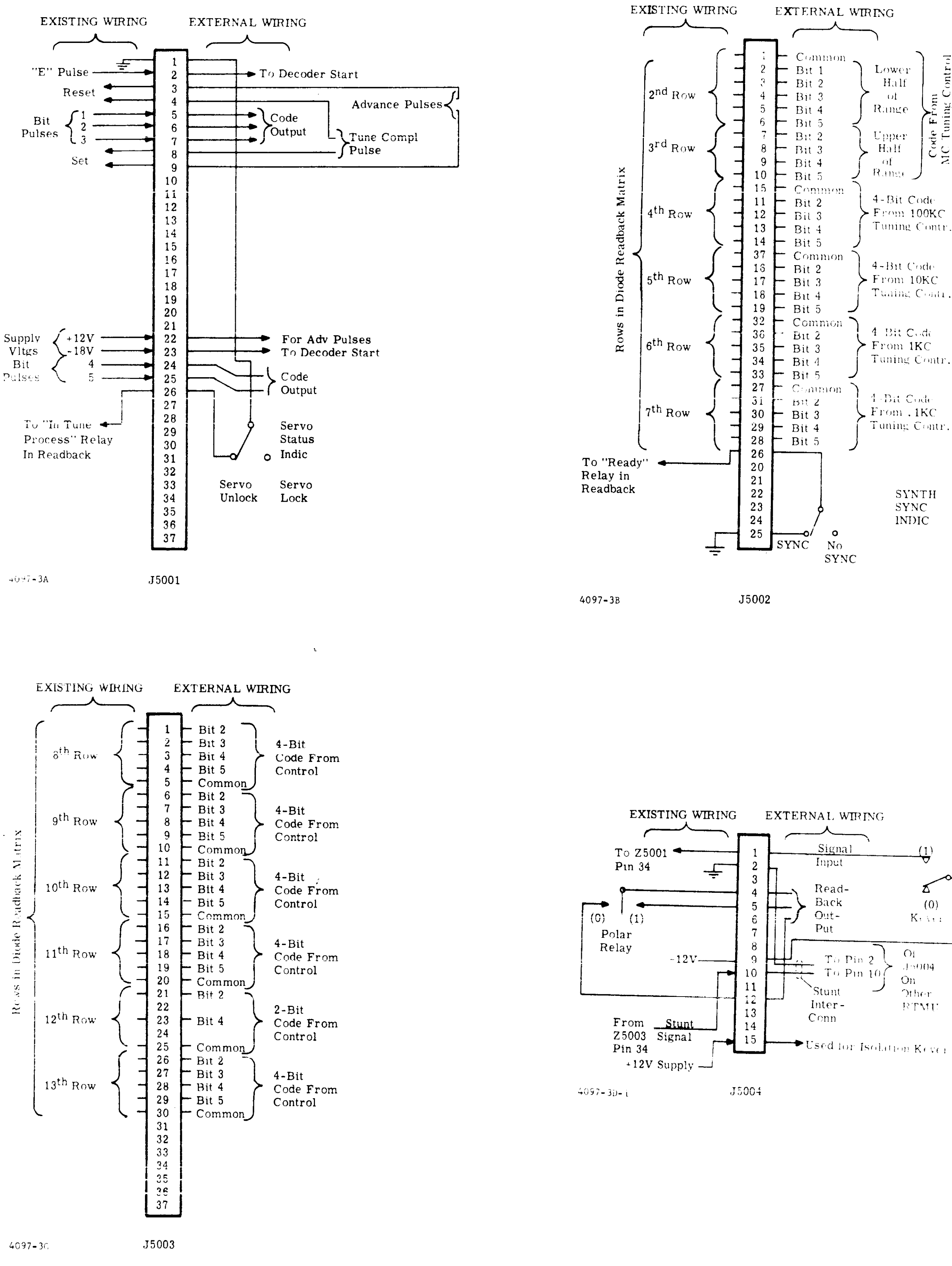

Figure 2-2. Connection Diagram, External Equipment

on the same 7.42-unit teletype transmission pattern. The Z5015 clock generator cards for the readback section are marked A3805 with either "60 wpm" or "100 wpm" added. The RTMU is shipped with the 60 wpm card installed unless specified as otherwise on the order.

2-5 CCIT AND ASCII CODES.

Although the RTMU is generally operated by TMC 5-bit code generators with code patterns designed to operate specific TMC transmitter (or receiver) controls, standard teletype transmitter equipment may also be used. Providing that the code patterns for the recognition letter/numeral combination match those shown in table 1-1, that the "E" code pattern is 10000, and that tuning code patterns match those of the remote transmitter (or receiver) controls, CCIT or ASCII teletypewriters may be used. ASCII 7-bit code generating equipment may be used for recognition and E codes if the message is first pre-programmed on punched tape and if the tape is then turned over before feeding it into the tape reader. This will transmit the first 5 bits of the 7-bit code in reverse, with the sprocket holes matching those in the TMC 5-bit tape readers. Specific tuning codes for TMC TechniMatiC* transmitter and receiver systems are found in the system manuals.

*Trademark applied for.

SECTION 3
OPERATOR'S SECTION

3-1 INTRODUCTION.

The RTMU, once it is connected to its associated equipment, operates automatically from its tuning input signal and feedback signals from its associated decoder. The following instructions, therefore, are divided into code-feeding procedure for the remote operator and set-up and maintenance notes for the local operator.

3-2 LOCAL OPERATOR, PANEL CONTROL FUNCTIONS.

The RTMU has 3 main functions: (1) to receive and store the tuning message, (2) to give the message to the associated decoder and (3) to supply a constant readback of control positions. The connection of the RTMU to its line voltage through J5006 receptacle and its POWER ON/OFF switch immediately starts its readback output to cycling. The input tuning message causes the unit to store the characters (up to 28 tuning codes followed by the "E" code). When it receives the "E" code, it energizes the decoder.

When the SIGNAL INPUT light is lit steadily, the RTMU is receiving no tuning message; when the light blinks, it is receiving a message. If the light blinks briefly and then remains lit, the character recognition code was not correct for that RTMU and did not open it to store the tuning message.

The POWER ON/OFF switch controls the a-c line voltage into the RTMU with the POWER light indicating that the voltage is connected. The AC LINE fuse is in this line. The +40 V, -40 V, -12 V, +12 V and -18 V fuses are for RTMU logic circuitry. A lighted fuse cover indicates a blown fuse.

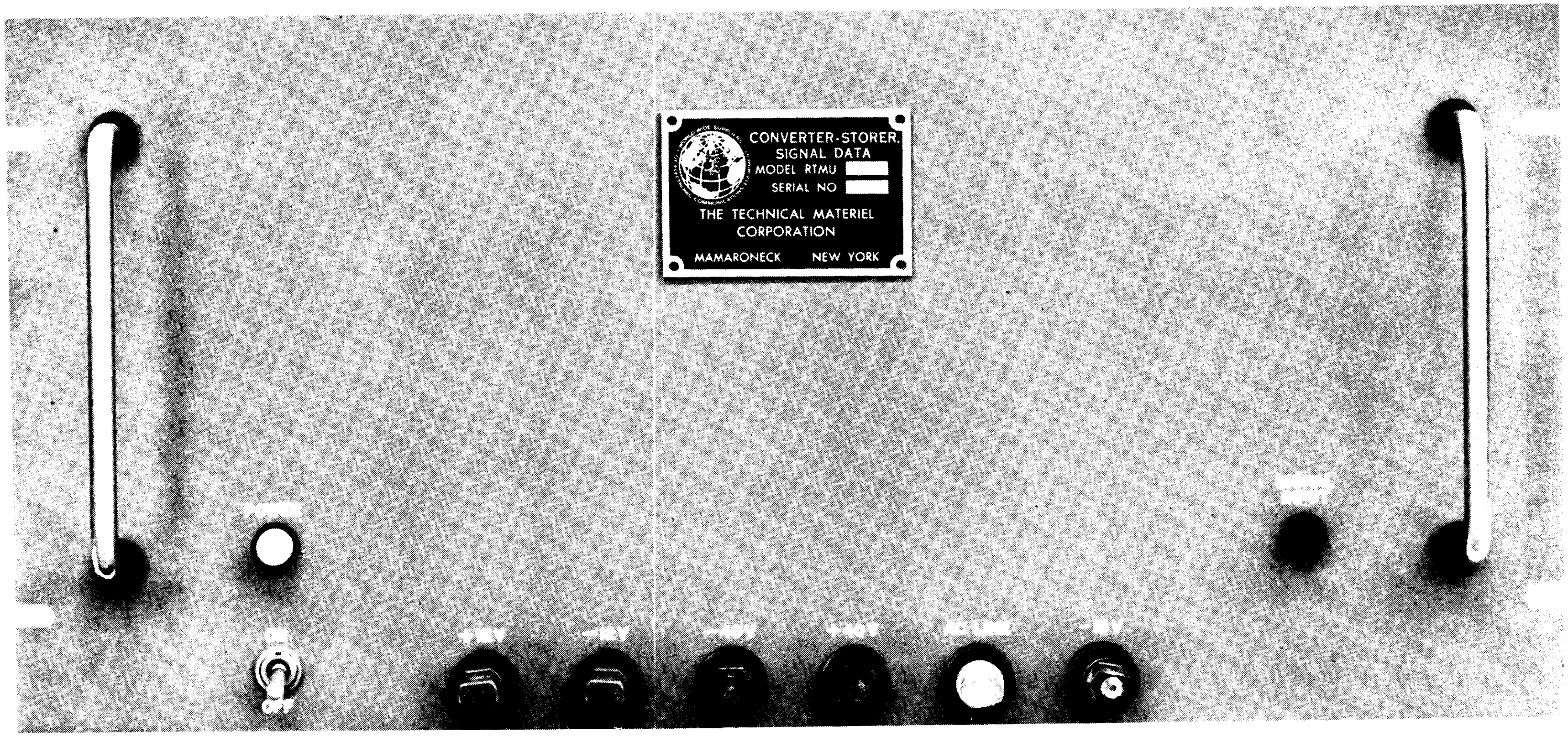

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Figure 3-1. RTMU Control Panel

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To set the RTMU for remote operation, set the POWER switch to ON.

3-3 REMOTE OPERATOR.

To open the RTMU for tuning code storage and processing, a double code consisting of a letter followed by a numeral (see table 1-1) is required. The combination for each RTMU is pre-determined by the wiring of its Z5003 Stunting card. After these codes have been sent, start the tuning code transmission. There may be as many as 28 tuning codes included in one message, followed by the "E" code (10000). Start the first tuning code with a "1" for bit #1. If the first code has a "0" for bit #1, that code will be discarded by the RTMU when the decoder starts to draw out the codes. Refer to transmitter or receiver system manual for codes vs. controls. Sending the "E" at the end of the message energizes the decoder to draw out each code and position the control.

The readback of control positions from the RTMU is a continual cycling of codes. Refer to transmitter or receiver systems manual for codes vs. controls. The IN TUNE PROCESS code indicates that the decoder is still processing the codes into the equipment and that the RTMU will reject a tuning message. The READY code indicates that the decoder has finished tuning the equipment and the RTMU is ready for the next tuning message transmission.

SECTION 4
PRINCIPLES OF OPERATION

4-1. INTRODUCTION

Model RTMU is composed of two main functional sections, operating independently of one another. The first is the memory and series-to-parallel converter section. Its function is to (1) receive the teletype message in serial pulses, (2) temporarily store the coded characters and (3) release them to an associated decoder. The basic function of the associated decoder is to route the codes to the proper equipment and tune the transmitter (or receiver) by means of a servo loop. The second RTMU section is the readback transmitter. Its function is the continuous readback transmission, in serial pulse form, of a teletype signal representing the associated transmitter (or receiver) control positions and tuning phase conditions.

All circuitry is in computer-type binary logic design and (except for the power supply and readback diode matrix) is located on printed circuit plug-in cards. The logic circuits on the cards are transistor/diode type and are encapsulated modules mounted on the cards. The memory and series-to-parallel converter section is made up of 15 cards mounted in the "memory" bin (see figure 5-1), with cards plugged into receptacles in the floor of the bin. The readback transmitter section consists of 6 cards mounted in the "readback" bin (see figure 5-1), with a diode matrix card mounted on standoffs under the bin (see figure 5-2).

Cards are referred to in figures 7-1 and 7-2 by Z5000 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.

The following description of the RTMU operation is divided into the two main functional sections (bins). Each description is further divided into a functional block diagram analysis of the "Z" cards and detailed logic diagram analysis.

4-2. MEMORY AND SERIES-TO-PARALLEL CONVERTER

a. BLOCK DIAGRAM ANALYSIS. (Figure 4-1). - When the POWER switch is set to ON, a-c line voltage is connected to the RTMU power supply circuit (see figure 7-3). The power supply furnishes logic voltages to all the cards and energizes Z5000 Initial Reset card. Z5000 then resets the logic circuitry in all the cards for the first tuning code input.

The tuning message is usually applied simultaneously to 2 or more RTMU in a system, each controlling a separate transmitter (or receiver). The 5-bit codes, in the tuning message, enter each RTMU in serial pulses in the standard 7.42 teletype pattern, with a "start" pulse in the beginning and a "stop" pulse at the end. This signal enters through J5004 receptacle and travels to the input gate (opened) of Z5001 Serial-to-Parallel Clock card. The "start" pulse of each code starts a clock in Z5001 which serves to shift the 5 code bits over to Z5002 Serial-to-Parallel Shift Register card. As bit #5 enters Z5002, Z5002 sends back a pulse to stop the clock in Z5001. Meanwhile the code is shifted over to the input gate of Z5006 Memory Core Input Shift-Register card.

The first code to enter the RTMU is the "recognition" code.* If this is the correct code for that RTMU, it will open Z5006 input gate for passage of the remaining codes into 5 memory Core Register cards (Z5009 thru Z5013). The recognition code is sent to Z5003 Stunting card. If the code is correct, this card (a) opens Z5006 input gate,

*A double code. See table 1-1.

(b) closes the Z5006 input gates in the other RTMU units and (c) sets up an "in tune process" code in the RTMU readback section (see paragraph 4-3 a). If the code is incorrect, the Stunting card (a) closes the Z5006 input gate, (b) opens the Z5006 input gate in the correct RTMU unit and (c) leaves the "ready" code set up in the RTMU readback section.

If the Z5006 input gate has become opened, Z5006 sends the next code, to come through, over to the five (Z5009 thru Z5013) Core Register Cards in the form of parallel pulses. There is one card to store each bit of each code; the bits are stored in a column of 30 cores in each card. The shift-register in Z5006 acts to set each code in the first core in each column in the input end of the column.

Meanwhile, the last bit from the second code has caused Z5002 to send one energizing pulse to Z5005 Advance Prime Timing card. Z5005 responds by sending one set of energizing pulses to Z5008 Advance "0" & "E" card and to Z5007 Prime Circuit card. Z5008 and Z5007 respond by sending one set of OPEP (O, prime, E, prime) pulses simultaneously to all five Core Register cards. This set of OPEP pulses simultaneously moves each bit of the second code to the second core in each column in the Core Register card leaving the first core empty. This process is repeated for the third code with the bits in the second code moved to the third cores and the bits in the third code moved to the second cores, again leaving the first cores empty. The rest of the codes move into the magnetic cores in the same way, at a rate governed by the input rate of codes into the RTMU. The information remains in the cores until the "E" (end of message) code enters the RTMU.

When the "E" code (10000) comes through and arrives at the Z5006 input, Z5006 sends the code to Z5003 Stunting card which (a) closes the code input gate at Z5006, (b) opens the Z5006 input gates in the other RTMU units, (c) energizes a clock in Z5006, (d) sends an energizing pulse to the associated decoder, via Z5004 Advance, Tune Complete, Boy Relay Circuit card and J5001*, and (e) sends a setting pulse to the "ready" readback transmitter (see paragraph 4-3a) in preparation for the "sync" signal from the transmitter (or receiver). When the Z5006 clock goes into action, it sends regularly timed energizing pulses to Z5005. Each energizing pulse causes Z5005 to work through Z5008 and Z5007 to produce a set of OPEP pulses to the 5 Core Register cards. In this way the bits of each code are moved in a tamping action towards the output end of each column.

When bit #1 thus passes through the 29th core of its column, Z5009 produces a "monitor" pulse. The monitor pulse (a) works thru Z5003 Stunting card to stop the clock in Z5006 (and the tamping action) and (b) travels to Z5004 to set a gate to open for the "advance" pulses from the associated decoder.

The first advance pulse is the result of the "E" energizing pulse into the decoder. From that point on, each succeeding advance pulse from the decoder is triggered by the entry of the previous code entering the decoder, in a reciprocating action. Z5004 sends an energizing pulse to Z5005 for every advance pulse it receives from the decoder. Z5005 works, as before, to move the bits in the core column towards and out of the output end of the core columns in the five Core Register cards. As the first code moves out of the Core Register cards, it moves into Decoder Relay Drive Circuit card, in parallel pulses. Z5014 then issues the code, in parallel bits, to

---

*When the decoder receives the energization pulse, it sends back a "decoder energized" signal via J5001 to Z5004; Z5004 then closes the input gate at Z5001.

the associated decoder via J5001. The decoder moves the transmitter (or receiver) control to the coded position and then sends the next advance pulse. All the remaining codes are thus pulled out of the RTMU by the decoder in this way (one code for each decoder "advance" pulse). When the "E" code, the last code in the cores, moves out of the RTMU and into the decoder, the decoder responds by sending back a "tune complete" signal into Z5004. Z5004 then re-opens the signal input gate in Z5001 Serial-to-Parallel clock card.

As a local monitor, the SIGNAL INPUT lamp serves to indicate that a signal is being applied to the RTMU input. When there is no signal applied, the lamp remains lit steadily; when a signal is applied, the lamp blinks in response to each "1" bit in the code.

b. LOGIC ANALYSIS (figure 7-1)

(1) 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 mumbers and an alpha-numerical logic function number along with each logic module Z number. The logic function numbers are numbered in series within the memory and series-to-parallel 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	OS one-shot (or delay circuit
FF flip-flop	PF positive emitter follower

IV inverter

NA non-inverting amplifier

NAG nandgate

OG orgate

RD relay drive

TG timing generator (or clock)

To see the equivalant 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 7-4.*

Figure 7-1 is made up of 4 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:

```
          3  D8  J5010 - 33
         /   |     \      \
sheet #      |      \      Receptacle pin #
             |    Bin receptacle #
             |
        Zone #
          on sheet
```

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.

(2) INITIAL RESET - Upon application of a-c line power at J5006 (figure 7-3) through S5001 POWER switch, besides furnishing the necessary logic voltages, (-12v, +12v, -40v, and +40v) and relay voltage (-18v), +12v and -12v are supplied to Z5000 Initial Reset card (2) through R5002 and J5007, pins 16 and 37 respectively. The +12v becomes inverted through IV-1 and, together with the -12v from pin 37, opens nandgate NAG-1. NAG-1 triggers OS-4 via NA-1 to produce a set of parallel pulses from PF-3 thru PF-10. The pulses from PF-7 thru

*Sheet 1 of Figure 7-1 also shows typical OS and TG circuits, depicting component values that change in accordance with usage throughout the RTMU.

PF-10 reset flip-flops throughout the memory and series-to-parallel converter section of the RTMU. Pulses from PF-4, PF-5 and PF-6 also reset flip-flops in the readback section (described in paragraph 4-3b (3) A.

(3) CODE INPUT - The 5-bit teletype code of the first character enters the Serial-to-Parallel Clock card Z5001 (2) via pin 1 of J5004 and pin 34 of J5008, with pulse widths and polarities as shown in the illustration, for 60 WPM of 100 WPM transmission (see paragraph 2-4). 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-3 and travels to nandgate NAG-2. NAG-2 has received a -12v charge from the "tune complete" signal from the associated decoder after the previous coded message (see paragraph 4-2b (10), or from the initially reset FF-1 in Z5004 (1), and opens to set flip-flop FF-4 in Z5001 (2). FF-4 produces a negative voltage that triggers clock generator TG-1. TG-1 produces regularly timed pulses, alternating from pins 6 and 11, with widths appropriate for 60 WPM (or 100 WPM). Each pulse from pin 6 works through NA-4 to set flip-flop FF-23 and to reset flip-flops FF-5 through FF-10 in Z5002 Serial-to-Parallel Shift Register card, with 22 ms (or 13.5 ms) pulse widths to match those in the code input at pin 1 of J5004. Each pulse from pin 11 of TG-1 fires OS-10. This causes OS-10 to produce regularly timed negative pulses of 5us (spaced at 22ms) into an andgate formed by diodes CR-1 and CR-2. As the first bit arrives at CR-1, if it is negative (a "1"), it will open the andgate and the resulting pulse will travel to and sit on nandgates NAG-3 thru NAG-7 in Z5002; if it is positive (a"0"), CR 1/2 andgate in Z5001 will not open and no pulse will be produced at NAG-3 thru NAG-7 in Z5002. The initial resetting of FF-23, from PF-10 in Z5000, has caused the output of FF-23 to go negative. The first clock pulse, from the series via NA-4 in Z5001 sets

FF-23, causing FF-23 output to go positive. This positive charge sets FF-5 for 22ms. After 22ms, the next pulse from pin 6 of TG-1 resets FF-5 and its output goes positive setting FF-6. FF-6 then sends a negative output to NAG-3 pin 1 until the next pulse from NA-4 resets it and the voltage swings to positive. This forms a negative pulse of 22 ms (or 13.5ms) width at NAG-3, pin 1. At the end of the negative pulse from FF-6, when the voltage swings positive, it sets FF-7. FF-7 responds by issuing a negative voltage until reset by NA-4 and, as with FF-6, FF-7 places a negative pulse on NAG-4. This is repeated down the line, with consecutive pulses placed, one by one on nandgates NAG-3 thru NAG-7. At the same time the coded bits previously described from the CR 1/2 andgate in Z5001 are being placed one-by-one simultaneously on pins 3 of NAG-3 thru NAG-7. Since they are also timed by TG-1 and delayed by OS-10, the first bit arrives at NAG-3 at the same time that FF-6 has placed a negative pulse on it. If bit #1 is also a negative pulse, NAG-3 opens, producing a positive 5us pulse. If bit #1 is a positive pulse, NAG-3 does not open and no pulse is produced. Bits #2, 3, 4, and 5 then arrive at NAG-4 thru NAG-7 at 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-10 is reset after sending its negative pulse to NAG-7, its positive upswing resets FF-4 in Z5001 (2) and FF-4 output swings positive, stopping TG-1 clock. The positive swing from FF-10 also enters Z5005 (2) at pin 6 and works through PF-1 to fire OS-6. OS-6 fires OS-7, through PF-2, and OS-7 places a positive 5us pulse on pin 3 of FF-23 in Z5002, resetting FF-23. The output at pin 11 of FF-23 then swings negative again and remains that way until the first pulse from NA-4 (from the next code) sets FF-23 and sends it positive.

(4) RECOGNITION CODE - The first two code characters to enter the RTMU make up the recognition code. This dual code represents a letter (A-J) followed by a numeral (1-10). The letters and numerals appear on push-buttons on TMC equipment selector code generators at the remote control site (see table 1-1). The function of this dual code is to open a gate in order that the rest of the tuning codes may proceed into the RTMU memory cores. If it is coded correctly for that RTMU, it will open the gate; if not, the gate remains closed and it opens the gate of another RTMU, for which it is correctly coded.

When the A-J code leaves NAG-3 thru NAG-7, it travels over to FF-12 thru FF-16 in Z5006 (4). Each of these flip-flops are set where the bit has produced a pulse; where there is no pulse, the flip-flop remains reset. The FF that is set produces a negative pulse at the andgate opposite it, of the group formed by AG-1 thru AG-4 and AG-6. These andgates that receive negative pulses will not open, however, until they receive a negative pulse from NA-9.

Pulses from the set and reset flip-flops FF-12 thru FF-16 also travel to the code gate AG-8 in Z5003 Stunting card (3). Each card in each RTMU is wired for a particular alpha-numerical code by means of jumper wiring between terminals A-H and 1-8, as depicted in table 4-1. The correct letter opens AG-8 by placing all negative charges at its input. A numeral (see table 4-1) will not open AG-8 since a numeral bit #1 is always a "0", placing a positive charge at pin 10 of the gate. The end of the negative pulse from the opened AG-8 sets FF-22 and the resulting negative charge from FF-22 sets AG-7 to open from the consequent 1-10 numeral code. The correct numeral then opens AG-7 by placing all negative charges at its input. A letter will not open AG-7 since a letter bit #1 is always a "1", placing a positive charge at pin 1 of the gate. Both gates, AG-7 and -8, are set to open from the end-of-code negative 5us pulse from OS-6 and OS-5 in Z5005 card (2).

The opened AG-7 sets FF-3. The output of FF-3 then goes negative and (a) working through relay drive RD-2, energizes K1 relay and (b) produces a negative voltage charge at pin 12 of AG-5 in Z5006 (4). When AG-5 then receives the 5us negative pulse, as the result of the second code (see next paragraph), it opens and produces the required negative pulse, via NA-9 to simultaneously release all the bit 1 and-gates of AG-1, 2, 3, 4, and 6 group for the second code.

Meanwhile, the energized K1 in Z5003 (3) has (a) connected the RTMU stunt line output at pin 10 of J5004 (2) and CR4 in Z5003 (3) to ground, thus reclosing its AG-7 and -8 gates, in Z5003 (3) and these gates in the other RTMU units and (b) energized an "in tune process" relay (K5002) in the readback transmitter section (see paragraph 4-3b (2) E).

(5) TUNING CODES AND SERIAL-TO-PARALLEL CONVERSION - The next code to enter the RTMU is the first tuning code. This code, and the tuning codes following it, are processed in the same manner as the first up to andgates AG-1,2,3,4 and 6 in Z5006(4), with the difference being that AG-5 will now open to produce the 5 us release pulse at the AG-1,2,3,4 and 6 gates to release all the "1" bit gates simultaneously. This simultaneous releasing action creates the series-to-parallel conversion in the RTMU and is described in the following paragraph.

As each "1" bit leaves FF-6 thru FF-10 in Z5002 (2), it immediately sets the opposite flip-flop in FF-12 thru FF-16 in Z5006 (4); the resulting negative outputs from the latter flip-flops are placed, one-by-one, on AG-1, 2, 3, 4 and 6 andgates. By the time a "1 bit from bit #5 in the code has settled on AG-6 pin 1, the "1" bit negative charge from #1 bit is still sitting on AG-1, pin 12. Then, what is required to simultaneously release all the "1" bit pulses to Z5009 thru Z5013 Core Registers (4) is the required 5us negative pulse from NA-9 in Z5006. This pulse is obtained as described in the following paragraph.

As the second code moves through flip-flops FF-6 thru FF-10 in Z5002 (2), the end of the pulse from FF-10 pin 6 travels, as in the first code, to OS-6 in Z5005 (2). The resulting pulse from pin 6 of OS-6 fires OS-5 which produces a negative 5us pulse at pin 5 of AG-5 in Z5006 (4). Since pin 12 of AG-5 has a negative charge sitting on it as a result of the correct recognition character (previously described) it opens and produces the 5us negative pulse to simultaneously release all the bit "1" gates of AG-1, 2, 3, 4 and 6. This is the point at which the serial-to-parallel conversion takes place in the RTMU.

(6) TUNING CODE STORAGE - Each opened gate, of the AG-1, 2, 3, 4, and 6 series in Z5006 (4) produces a 5us negative pulse to the trigger input of the Core Register card (Z5009, 10, 11, 12, 13) (4) opposite it. Each "1" bit enters the first core of a row of 30 magnetic cores connected in series (not shown). For the detailed schematic of a Core Register, see Figure 7-5. Where there is no pulse forthcoming (for an unopened gate resulting from a "0" bit) the first core in each column remains uncharged and this is taken for a "0" bit core.

At this point, each Core Register must receive one set of OPEP pulses, (0, prime, E, and prime) in order to move the first bit in each row of cores to the second core to make room for the bit in the next code. The end-of-code pulse from FF-10 in Z5002 (2) serves to trigger them off. This pulse fires OS-6 in Z5005 (2) and the output at pin 11 works through PF-2 to fire OS-7. The negative 5us output from OS-7 pin 11 works through norgate NG-1 to (a) start the prime circuit in Z5007 (3) via NA-11 and NG-2 in Z5005 (2), (b) start the advance 0 and E circuit Z5008 (3) via OS-8 in Z5005 (2) and (c) reset decoder relay drive flip-flops FF-17 thru FF-21 in Z5014 (4). The end of the .5ms pulse from OS-8 in Z5005 (2) fires OS-15 in Z5008 (3) in the advance 0 and E circuit. OS-15 produces a negative 3ms pulse entering NA-5 double inverter. NA-5 has two outputs, one producing the inverted pulse and the other producing the re-inverted pulse with the same polarity as the input. The inverted (positive) pulse acts on OS-11 first and the end of the re-inverted (negative) pulse acts on OS-9 afterwards. OS-11 then produces the "advance O" 1.5us negative pulse and this is followed by the negative 1.5us "advance E" pulse, via NA-7 and NA-6 to transistors Q2 and Q1, respectively. Q2 and Q1 have positive outputs and the 2us pulses issuing from them are further heightened by the +40v supply through dropping resistors to a +22v minimum. Timed by delay circuits to arrive at the Core Register cards Z5009 thru Z5013 (4) between the 0 and E pulses is the first prime pulse. This works from NG-1 in Z5005 (2) thru NA-11 and NG-2 and fires OS-14 in Z5007 Prime Circuit Card (3). OS-14 issues a 150us positive pulse which works through NA-8, CF-5, and Q1, Q2, Q3, Q4 and Q5 to simultaneously place prime pulses on the 5 Core Registers (4). Then, after the register has received its advance E pulse, delay circuits OS-16 and OS-12 in Z5008 (3) have produced a negative 5us pulse which travels through norgate NG-2 in Z5005 (2) to again fire OS-14 in Z5007 (3) producing the second prime pulse. The spacing between the first and second prime pulses is 850us.

In this manner, each succeeding code is moved into the 5 columns of magnetic memory cores, with the last bit of each succeeding code serving to move the previous code to the next bank of cores in the columns. There are 30 cores in each column, with the capacity for storing 29 codes (including the "E" code) at any one time.

(7) E CODE - When the "E" (end of tuning message) character comes through, it is processed in the same manner as the other codes and becomes stored in the first core of each Core Register (4). However, an assortment of actions also takes place from the "E". The end-of-code pulse from the "E", orginating in FF-10 in Z5002 (2) ultimately winds up at pin 5 of andgate AG-5 in Z5006 (4) as in the other codes. AG-5 is still kept open, at this point, by the negative going output from FF-3 in Z5003 (3) stunting card routed to pin 12 of AG-5. Besides producing the usual pulse that opens andgates AG-1, 2, 3, 4, and 6, AG-5 also sends the negative 5us pulse (for each code) to OS-13 in Z5003 (3). OS-13 places a pulse on NAG-8 which sets it to open for the "E" (10000) code from the set output of FF-12 in Z5006 (4) and the 4 reset outputs of FF-13, 14, 15 and 16. When NAG-8 in Z5003 (3) opens, it produces a 5us positive pulse that (a) resets FF-3, (b) fires OS-1 in Z5004 (1) and (c) sets FF-11 in Z5006 (4).

The set FF-11 triggers clock generator TG-2 which works through OS-3 to produce regularly timed pulses (negative 5us at 8ms) to enter norgate NG-1 in Z5005 (2). Each resulting pulse from NG-1 sets off an "0, prime, E, prime" set of pulses to the Core Registers (4) as did the end-of-code pulse through NG-1, formerly. This serves to tamp down the bits through the cores to the end of the columns.

OS-1 in Z5004 (1) produces a 450ms negative delay pulse that travels over to sit on an andgate formed by CR-3 and CR-6 in Z5003 (3). CR 3/6 andgate output remains negative as long as there are two negative inputs: from OS-1 in Z5004 (1) and from IV-2 inverter in Z5003 (3). Since the negative output from CR 3/6 andgate acting on pin 3 of FF-11 occured before the 5us pulse setting FF-11, FF-11 remains set and TG-2 continues to issue pulses. When the positive "monitor" pulse arrives from IV-2 inverter (see paragraph 4-2b (8), CR 3/6 andgate closes, and its output swings positive for 1 us resetting FF-11. FF-11 pin 6 output then goes positive and stops TG-2 clock, stopping the core tamping action. Pin 11 output of FF-11, at the same time, goes negative, placing a negative charge at CR1 input to the andgate formed by CR1 and CR2 in Z5004.(1). This sets CR 1/2 andgate to open for the first negative "advance" pulse from the associated decoder (see paragraph 4-2b (8)).

OS-1 output also works to energize the associated decoder. The -18v supply from the RTMU, available at pin 23 of J5001 (see figure 7-3), is routed through system cabling to the coil of the decoder energizing relay and the other side of the coil back (via pin 2 of J5001) to the output of RD-1 relay driver in Z5004 (1). The positive 450ms pulse from RD-1 creates zero volts (or ground) for 450ms duration on the other side of the coil, energizing a relay sequence in the decoder that ultimately locks up its power supply. The energized decoder then works to close the RTMU code input gate as follows. A +12v from the RTMU (at pin 22 of J5001, see figure 7-3) is connected through system cabling to the swinger of one of the decoder power lock-up relays. When this relay locks, the swinger connects the +12v back to pin 8 of J5001 and pin 12 of Z5004 (1). This voltage sets FF-1 and FF-1 pin 11 output goes positive. The positive charge is placed on pin 3 of NAG-2 nandgate in Z5001 (2) closing that gate to the entry of further codes.

The output at pin 6 of the reset FF-3 in Z5003 (3) swings positive and, placing the positive charge on pin 12 of AG-5 in Z5006 (4), closes that gate, preventing further entry of codes into the memory cores, via AG-1, 2, 3, 4, and 6. The positive output from FF-3 in Z5003 (3) also de-energizes K1 relay. K1 relay then (a) removes the ground from the stunt line output at pin 10 of J5004 (2) resetting the AG-7 and AG-8 recognition code gates in the other RTMU units, (b) removes the ground from the "in tune process" relay (K5002) coil in the readback transmitter (see paragraph 4-3b(2) E), and (c) removes the ground at CR4 in Z5003 (3) that was previously connected by the recognition code (see paragraph 4-2b(4), setting AG-7 and AG-8 gates to re-open for the next correct recognition character.

(8) MONITOR AND DECODER ADVANCE PULSES - The tamping action triggered by the E code, moves the bits down the core rows to the ends of the rows. When bit #1 passes through the next to the last core (29th) in Core Register #1, Z5009 (4), if bit #1 is a "1", a monitor pulse is produced from Z5009 pin 22. Since this code is the first code in the tuning message and since the first tuning code is always programmed by the remote operator to contain a "1" in bit #1, a monitor pulse is ordinarily produced. Although the monitor pulse is a double pulse (a negative followed by a positive) only the negative one is utilized and, inverted through CR5 and IV-2 in Z5003 (3), becomes the positive monitor pulse necessary to close CR 3/6 andgate, as previously described, resetting FF-11 in Z5006 (4) and shutting off the core tamping action. The reset flip-flop FF-11 also produces a negative voltage at pin 11 and places this charge at CR1 diode in the andgate formed by CR1 and CR2 in Z5004 (1). This negative charge sets the andgate to open upon the arrival of the first negative 0.4ms "advance" pulse at CR2.

The E code entering the RTMU, as previously described, has caused OS-1 in Z5004 to fire, energizing the associated decoder. The energized decoder results in the connection (by the "advance" relay contacts in the decoder) of the +12v available at pin 22 of J5001 (see figure 7-3) from the RTMU back to pin 9 of J5001. This places a positive charge on FF-2 in Z5004 (1) and the set FF-2 produces a positive charge at OS-2. The fired OS-2 produces a negative 0.4ms pulse at CR2 in the CR1/2 andgate.

The andgate, previously set by a negative voltage at CR1, produces a negative 0.4ms pulse at NG-1 norgate at Z5005(2). NG-1 works to produce one set of OPEP pulses, at the Core Registers, moving the bits of the first code out of the RTMU and into the decoder. The decoder routes the codes to the proper transmitter (or receiver) control stepping switch. As the stepping switch moves, the decoder advance relay transfers the +12v from pin 9 of J5001 to pin 3, resetting FF-2 in Z5004(1). When the stepping switch homes, it causes the decoder advance relay to swing back, transferring the +12v again to pin 9 of J5001. This completes one cycle (or one code output). The +12v at J5001 pin 9 again sets FF-2 and FF-2 works again through OS-2 to produce the next 0.4ms negative pulse for the next code output. It can be seen that the widths of the advance +12v pulses from the decoder are not regular and will depend on how long it takes for the stepping switch to home.

(9) CODE OUTPUT TO DECODER - Z5014 card (4) forms the output connection with the associated decoder bit-sensitive relays. The coils of the relays (not shown) are connected through system cabling to pins 5, 6, 7, 24 and 25 of J5001. The other sides of the coils are connected to a +28v supply available in the decoder as a result of decoder energization by the RTMU. Z5014 circuitry causes the decoder bit relay coil to see ground on a "1" bit (energizing the relay) and an infinite resistance on a "O" bit (leaving the relay deenergized).

As the Core Registers (4) receive each set of OPEP pulses, the bits of the codes are transferred over to flip-flops FF-17 thru FF-21 in Z5014. The output of the flip-flops control the operation of Q1 thru Q5 transistors. If the bit from the Core Register is a "1", a positive pulse* sets the flip-flop; if the bit is a "O", no pulse is

*Although a pair of pulses is issued, due to load connections, only one is used.

produced and the flip-flop remains reset. The set flip-flop issues a positive voltage to the base of the transistor and the reset flip-flop issues a negative voltage to the transistor base. The positive voltage at the transistor base causes it to conduct, and the decoder relay coil sees the ground at pins 1, 2, 43 and 44 of Z5014. The negative voltage at the base disables the transistor and the decoder coil sees an infinite resistance to ground. In this phase, FF-17 thru FF-21 are reset after each code by the end of a positive 0.4ms pulse from NG-1 in Z5005(2) as a result of the next decoder advance pulse.

(10) DECODER TUNE COMPLETE SIGNAL - When all the codes have been drawn out of the RTMU cores into the decoder, the last code is the E (10000) code. This code de-energizes the decoder power lockup relays. One of the de-energized relays sends a "tune complete" signal back to the RTMU that results in re-opening the code input gate, as follows. The +12v previously connected to pin 8 of J5001 and pin 12 of Z5004(1) (by the E code moving into the RTMU) now becomes transferred by the de-energized decoder power lock-up relay swinger to pin 4 of J5001 and pin 20 of Z5004. This positive voltage resets FF-1 and FF-1 issues a negative voltage to pin 3 of NAG-2 in Z5001 (2), resetting the RTMU code input gate to open to the first code of the next message.

At this point, the RTMU is ready to receive a new tuning message. Its memory cores are cleared of information, the code input gate and the recognition code input gate are set to open.

(11) FIRST CODE CORRECTION - CR 3/6 andgate in Z5003 (3) has the function of correcting a remote programming error in the first code. In order for some associated decoders to function correctly, the first code to enter the decoder from the RTMU must contain a "1" in bit #1. As stated in paragraph 4-2b(8), in order for there to be a monitor pulse from Z5009(4) bit #1 must be a "1". If bit #1 is a

"0", no monitor pulse issues and CR3/6 andgate remains open from the negative 450ms pulse generated by the E code. TG-2 in Z5006 (4) issues another pulse and one set of OPEP pulses is generated, activating FF-17 thru FF-21 in Z5014(4). Since bit #1=0, the decoder does not bring this code to any one of the transmitter (or receiver) stepping switches and there is no stepping switch movement to activate the decoder advance relay or form the advance pulses in the decoder. This causes the first code to become ineffective in the decoder. Since there is no advance pulse generated from the decoder into the RTMU, the reciprocating action (between the RTMU and the decoder) is not started. This process will continue until a code containing a "1" for bit #1 arrives, producing the monitor pulse. Then the action becomes the same as described in paragraph 4-2b(8) and that code becomes effective in the decoder.

(12) SIGNAL INPUT LAMP - As an aid to system checks, the RTMU contains a SIGNAL INPUT lamp on its front panel. This lamp, DS-5002(2), is connected to the -12v supply and the code signal input from J5004, pin 1. The lamp remains lit from the -12v until there is a positive swing in the signal input (from a "0" or "space" pulse); a negative ("1" or "mark") pulse relights it. The indication for a coded signal applied to that RTMU, therefore, is a blinking lamp; a continuously lit lamp indicates no signal applied.

(13) 60 WPM AND 100 WPM CARDS - Z5001 Serial-to-Parallel Clock Circuit card (2) comes in two versions-- for 60 WPM or 100 WPM reception. The circuitry for both cards is the same; the variation is in resistance and capacitance values added to the TG-1 clock generator module. In the 60 WPM card, TG-1 issues pulses spaced at 22ms; in the 100 WPM card it issues 13.7ms-spaced pulses. The cards are marked "60 WPM" or "100 WPM" to distinguish them.

4-3. READBACK TRANSMITTER

a. BLOCK DIAGRAM ANALYSIS - (Figure 4-2). The input of readout codes, representing equipment control positions, is applied by switch connections to pins of J5002 and J5003 receptacles. Connections made between pins of the receptacles and the A-3914-4 Diode Matrix result in a 5-bit code set up on each of the eleven control position readouts.

There are two shift-registers in the readback circuit: two PC cards, Z5016 and Z5017, making up the Code Shift Register and one Z5018 Bit Shift Register card. The Z5018 card functions to read out each code, bit-by-bit and shift it out, in serial pulse form, to the Z5019 Output Relay Circuit card. The Z5016 and Z5017 cards shift the readout to the next code on the Diode Matrix.

When the RTMU POWER switch is set to ON, the power supply circuit (see figure 7-3) (a) furnishes logic voltages, (b) energizes the Z5000 Initial Reset card in the Memory bin (see paragraph 4-2a) and (c) turns on the clock in Z5015 Clock Circuit card. Timed pulses from the clock (timed to match a 60 WPM or 100 WPM transmission) proceed to (a) create the required "start" pulse for the 7.42 transmission pattern and (b) shift the readout action of Z5018 bit-by-bit until the 5 bits are read out. As the 5th bit is shifted out of Z5018, it (a) causes Z5015 clock to stop for the required interval to create the "stop" pulse in the 7.42 pattern and (b) starts a recycle of the bit shift register. At the end of the stop pulse the clock resumes its evenly spaced pulses for the next code readout.

Z5016/17 shift register is timed to then shift the readout to the next code diode group in the matrix. The timing corresponds with the length of one code transmission. The same process is repeated again by Z5018 to shift out the bits to Z5019. This is repeated all the way down to the twelfth code readout. When the last bit is read out in the twelfth code, Z5017 card sends a feedback signal to Z5020 Recycle Reset card and Z5020 responds by resetting both Z5016 and Z5017 cards, thereby starting the recycle of the Code Shift Register (previously started by Z5000 Initial Reset card). From that point on, Z5020 restarts the readout cycle each time. When the POWER switch is set to OFF, the readback ceases; when it is set to ON again, Z5000 starts the first cycle with Z5020 starting each recycle.

The first code to be read out in each cycle is the "E" code (10000). This, code permanently set up on the Diode Matrix, marks off each new cycle and is generally used to mark off each new cycle in the remote readback indicator. With the eleven control position readouts that follow, the total cycle of readout codes is twelve.

The tenth control position readout (eleventh code) also contains, in the same code, information on the transmitter (or receiver) tuning phase. Relays K5001 and K5002, connected to the diode matrix, cause either a "ready" code or an "in tune process" code to be sent out. These relays are controlled by a variety and combinations of signals: a "sync" indication from the transmitter (or receiver) tuner, an "E" code pulse from the tuning message input (see paragraph 4-2a) Stunting card, and an "in tune process" signal from the associated decoder via J5001. The exact sequences and conditions for relay control are discussed in paragraph 4-3b(2) E.

b. LOGIC ANALYSIS (Figure 7-2)

(1) INTRODUCTION - Cards, bin receptacles, and logic modules in the readback transmitter are presented in the same manner in figure 7-2 as in figure 7-1 with the same logic function identification system as outlined in paragraph 4-2b(1).

(2) CODE SETUP-

A. GENERAL - There are twelve codes set up to be read out of the RTMU. With the execption of the "E" code and information from K5001 and K5002 relays, each code input, at J5002 or J5003, appears across "bit" pins and a "common" pin. A connection in the equipment being read, of any bit pin with the common pin makes that pin a "1"; no connection makes it a "0". As each flip-flop in Z5016 and Z5017 Code Shift Register is energized in turn, it places a positive charge on the "1" bit diodes in the group of diodes opposite it (of the CR1, CR3 thru CR14, CR18 thru CR29, CR33 thru CR44, and CR48 thru CR59 group in A3914-4 Diode Matrix). The charge then awaits the readout action of Z5018 Bit Shift Register. A detailed description of Z5016, Z5017 and Z5018 shift register action is in paragraph 4-3b(3).

B. FIRST CODE - The first code to be read out is the "E" code; this code (10000) is premanently set up inside the RTMU by the presence of CR2 diode. FF-9 generates the positive charge for the readout with CR2 forming the "1" bit for bit #1, followed by 4 negative charges, for the 4 "0" bits, from R4 thru R1.

C. SECOND CODE - The second code setup is across pins 1 thru 10 of J5002. The 5-bit code is read out of this combination, with pin 1 acting as the common pin and the positive charge placed by FF-10. The code originating equipment divides the code source into two halves: source A and source B, each with the same 4-bit code in bits #2 thru #5. This equipment either connects source A or source B to J5002. If source A is connected, it is across pins 1 thru 6; if source B is connected, it is across pins 1 and 7 thru 10. Bit #1 contains the information, in the code, as to the source. In source A of the equipment, permanent connection is made between pins 1 and 2, and this always forms a "1" bit for bit #1 through

CR1. In source B, no such connection is made, and bit #1 always forms a "0" bit in readout. This arrangement enables a maximum of 31* different code combinations to be set up in one code readout and is generally used to read out a control with a large number of positions.

D. <u>THIRD THRU TENTH AND TWELFTH CODES</u> - The third through tenth, and twelfth code setups are all similar: a common pin and 4 bit pins. Bit #1 is permanently set up as a "0" and bits #2 thru #5 contain the coded information. This enables a maximum of 16 different code combinations.

E. <u>ELEVENTH CODE</u> - The eleventh code is also in the form of a "0" for bit #1 followed by a 4-bit code but there are separate sources for the setup. Bits #2 and #4 are obtained by connections across pins 21, 23, and 25 (common) on J5003. Bit #3 is obtained from K5002 "in tune process" relay and bit #5 is from K5001 "ready" relay. Bits #2 and #4 present four possible codes for control positions. Because this leaves bits #3 and #5 free for additional information, they are utilized for reading back the tuning condition of the transmitter (or receiver) (i.e.: either "in tune process" or "ready"). The "ready" indication usually signifies that the equipment has been tuned and locked onto a frequency standard by action of the servo loop. The "in tune process" indicates that this point has not yet been reached. In each case, the energized relay presents a "1" bit to signify the condition.

When the transmitter (or receiver)has become synchronized and locked onto a frequency standard as the final phase of its tuning, associated equipment connects pins 26 and 25 of J5002, grounding K5001

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* E(10000) would make this number 32, but cannot be used here.

coil through the contacts of the de-energized K5002. The energized K5001 connects the positive charge from NA-23 in Z5017 to CR13 in A3914-4 and a "1" bit is presented to the readout, signifying that the transmitter (or receiver) is "ready" to transmit (or receive). When the RTMU receives its next coded tuning message, however, the correctly coded recognition character energizes K1 (see paragraph 4-2b(4)) in the Z5003 Stunt card circuit. The energized K1 connects pin 3 of K5002 coil to ground, energizing K5002. K5002 the (1) de-energizes K5001 by opening contacts 4 and 2 of K5002 and (2) connects the positive charge from NA-23(in Z5017 card) to CR43, producing the "1" bit in the bit 3 readout signifying "in tune process". The de-energized K5001 disconnects the positive charge, from NA-23 in Z5017, from CR13 and "0" is read out for bit 5. This condition will remain until the ground connection is removed from pin 3 of K5002. At this point, after the associated tuning servo has been energized by the new tuning codes, K5002 coil has another ground connection * through pins 26 and 1 of J5001. This ground connection remains until the tuning servo has locked the transmitter (or receiver) onto the frequency standard and the decoder has received the "E" code. The former ground connection, through the energized K1, will remain until the "E" code moves into the RTMU (see paragraph 4-2b(6)). When both ground connections are removed, K5002 becomes de-energized and, if pins 26 and 25 of J5002 are connected by the previously described sync indication, K5001 becomes again energized, sending out the "ready" code. It can be seen, therefore, that the "ready" code indicates four conditions: (1) a "sync" signal is issuing from the transmitter (or receiver,) (2) the tuning servo has zeroed-in and stopped, (3) the RTMU has received the "E" (end of message) char-

* From the decoder.

acter and (4) the decoder has received the "E" character.

(3) SHIFT REGISTER ACTION

A. INITIAL RESET AND ENERGIZATION - The entire readback action is energized by connecting the RTMU to the a-c line voltage source and setting the POWER switch (figure 7-3) to ON. This, in turn, energizes the Initial Reset circuit Z5000 used in the memory and serial-to-parallel converter section (described in paragraph 4-2b (2)) and, besides supplying logic voltages, also produces initial reset pulses from PF-4, PF-5 and PF-6 for the readback circuitry. The pulse from PF-4 in Z5000 resets flip-flops FF-2 thru FF-8. PF-5 in Z5000 resets flip-flops FF-15 thru FF-20. PF-6 in Z5000 resets flip-flops FF-9 thru FF-14. At the same time, the application of logic voltages from the power supply (figure 7-3) causes the output of OS-3 in Z5015 to go negative. The negative output of OS-3 thru NA-5 turns on clock generator TG-1. Pulses from the clock generator energize the entire readback transmission circuit.

B. FIRST CODE - The output of TG-1 in Z5015 is in 22ms pulses (for 60 WPM transmission) or 13.7ms pulses (for a 100 WPM transmission) (see paragraph 4-2b(3)F). Each pulse fires OS-5 in Z5018. OS-5 responds with 4us pulses spaced at 22ms (or 13.7ms). The first 4us pulse resets FF-3 thru FF-8 and sets FF-2. When FF-2 goes from reset to set condition, it emits a positive voltage that sets FF-3. The resulting negative voltage from FF-3 travels directly through orgate OG-1 in Z5019 and enters a double inverter amplifier NA-26. NA-26 has a negative output pin 11, and a positive output pin 6, each output connected to a polar relay (K1) driver, RD-2 and RD-1, respectively. The voltage swing, being negative, leaves pin 11 of NA-26 and works through RD-2 to bring K1 to connect pins 4 and 12 of J5004. 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 Z5015, again resets FF-3 through FF-8 in Z5018. FF-2 remains in its set condition. FF-3 going from set to reset, sets FF-4. The resulting output of FF-4 is a negative voltage and this travels to AG-1 andgate, pin 9. A positive charge is sitting on pin 1 of AG-1 from the normally positive output of FF-9, pin 1, in Z5016 through NA-13 in Z5016 and CR2 in A3914-4. AG-1 gate does not open and the output of AG-1 remains positive. The positive voltage travels through NA-8 in Z5019, OG-1, pin 6 of NA-26 and RD-1 to cause K1 to go into "mark" position, producing a "1" bit as the first code bit. This is the "1" bit in the "E" code (10000).

The third pulse from TG-1 clock in Z5015 resets FF-3 through FF-8 in Z5018. FF-4, going from set to reset, sets FF-5. The output from FF-5 becomes a negative voltage and travels to pin 7 of AG-2. Pin 3 of AG-2 is always connected to the -12v power supply through R4 resistor in A3914-4. The two negative charges cause AG-2 gate to open, producing a negative voltage. The negative charge travels through NA-9 in Z5019, OG-1, pin 11 of NA-26 and RD-2 to bring K1 to its space position, producing a "0" bit for the second bit in the "E" code.

The fourth and fifth pulses from TG-1 clock produce the next to "0" bits in the same manner as from the third clock pulse. The positive reset output issuing from FF-8 in Z5018, after producing the final "0", also (a) re-sets FF-2, (b) fires OS-4 in Z5015 and (c) fires OS-3 in Z5015. OS-3 puts out a 33ms (or 23ms) positive pulse through NA-5 to stop clock generator TG-1 for a period of 33ms (or 23ms). OS-4 issues a 4us pulse which branches through NA-6 and NA-7 to set FF-9 in Z5016 card and reset FF-10 through FF-20 in Z5016 and Z5017 cards.

During the 33ms (or 23ms) that TG-1 clock is stopped, the output of reset FF-8 in Z5018 is positive. AG-5 gate does not open and its output remains positive for the 33ms (or 23ms) interval. This pulse travels through OG-1 in Z5019, pin 6 of NA7, and RD-1 to bring K1 to its mark condition for transmission of the 33ms (or 23ms) "stop" pulse at the end of the code.

C. SECOND CODE - At this point, the first code (E code) has been read out and transmitted, complete with start pulse and stop pulse. The next action reads out the information from pins 2 through 10 of J5002, (see paragraph 4-3b(2) C).

The next "start" pulse is created in the same way as before, with the first clock pulse resetting FF-3 thru FF-8 and setting FF-2. Meanwhile, the last shift of FF-8 in Z5018 from the first code has set FF-9 and reset FF-10 thru FF-20 in Z5016 and 17 cards, via OS-4 in Z5015. The set FF-9 in Z5016 produces a positive output at pin 11. The positive output sets FF-10. FF-10 responds by issuing a positive output from pin 11 which travels through NA14 to pin 1 of J5002. If source A (see paragraph 4-3b(2) C) is connected at J5002, pin 1 is connected, through this source, to pin 2 to present a "1" bit. The positive charge from Z5016 NA-14, in that case, travels through CR1 down to AG-1 in Z5018. As in the first code, the second pulse from TG-1 in Z5015 resets FF-3 through FF-8 in Z5018, with FF-2 remaining in its set condition. FF-3, going from set to reset, sets FF-4 and FF-4 presents pin 9 of AG-1 with a negative charge. Since the polarities do not match, AG-1 gate does not open and its output swings to positive. The positive output travels through NA-8 in Z5019, OG-1, pin 6 of NA-26 and RD-2 to bring K1 into its mark position for a "1" bit. If, on the other hand, source B has been connected at J5002, the positive charge from NA14 in Z5016 is blocked at pin 1 of J5002, and the negative voltage from R5 in A3914-4 is presented at pin 1 of AG-1 in Z5018. This voltage would match the negative one at pin 9 of AG-1, the gate would open, presenting a negative swing and resulting in a "0" bit at K1 in Z5019 for bit #1.

The third, fourth, fifth and sixth pulses from TG-1 shift out the remaining 4 bits of information from diodes CR48, CR33, CR18, CR3 (or CR49, CR34, CR19 and CR4), respectively, with the shift register, made up of FF-3 thru FF-8 in Z5018, operating in the same manner as in the previous "E" code and the "stop" pulse formed in the same way.

D. <u>THIRD CODE</u> - FF-11 in Z5016, having been again reset at the end of the last code from OS-4 in Z5015, becomes set by FF-10 in Z5016 as FF-10 becomes reset and pin 6 output swings positive. The pin 11 output of FF-11 then goes positive; this charge travels through NA-15 to pin 15 of J5002. Meanwhile, the "start" pulse has been recreated and FF-2 thru FF-8 shift-register in Z5018 has gone into action again. FF-4 sets a negative pulse on pin 9 of AG-1 for bit #1. Since bit #1 line from R5 in A3914-4 is negative to pin 1 of AG-1, polarities match and AG-1 opens, presenting a negative swing and producing a "0" bit from K1 in Z5019. The third, fourth, fifth and sixth pulses from TG-1 shift out the "0" or "1" information for bits 2 through 5 appearing at diodes CR50, CR35, CR20 and CR5, respectively. The stop pulse is again recreated.

E. <u>FOURTH THRU TWELFTH CODES AND RECYCLE</u> - FF-11 then sets FF-12 in Z5016 and the process is repeated all the way down to FF-20 in Z5017 and the readout of CR14 in A3914-4. At the end of its 170ms (or 115ms) interval (as a result of the final reset from OS-4) FF-20 pin 6 output swings positive and fires OS-1 in

Z5020. OS-1 issues, via NA1, CF1, PF2, and PF3, positive pulses to reset FF-9 thru FF-20 in Z5016 and Z5017 for the next readout cycle.

F. 60 WPM AND 100 WPM CARDS Z5015 Clock Circuit card comes in two versions: for 60 WPM or 100 WPM readback transmission. The circuitry for both cards is the same: the variation is in added resistance and capacitance to the TG-1 Clock generator module. In the 60 WPM card, TG-1 issues pulses spaced at 22ms; in the 100 WPM card it issues 13.7ms spaced pulses. The cards are marked "60 WPM" or "100 WPM" to distinguish them.

TABLE 4-1. Z5003 STUNTING CARD JUMPER WIRING

TMC Equipment Selector Push-Button	Jumper Connections (See Figure 7-1, Sheet 3)
A	3 to E; 4 to F; 7 to G; 5 to H
B	3 to E; 4 to F; 2 to G; 8 to H
C	1 to E; 6 to F; 2 to G; 8 to H
D	1 to E; 6 to F; 7 to G; 5 to H
E	3 to E; 6 to F; 2 to G; 5 to H
F	1 to E; 4 to F; 7 to G; 8 to H
G	3 to E; 4 to F; 7 to G; 8 to H
H	3 to E; 6 to F; 2 to G; 8 to H
I	3 to E; 6 to F; 7 to G; 5 to H
J	1 to E; 6 to F; 7 to G; 8 to H
1	1 to A; 6 to B; 2 to C; 8 to D
2	1 to A; 6 to B; 7 to C; 5 to D
3	3 to A; 4 to B; 7 to C; 5 to D
4	3 to A; 4 to B; 2 to C; 8 to D
5	1 to A; 4 to B; 7 to C; 8 to D
6	3 to A; 6 to B; 2 to C; 5 to D
7	1 to A; 6 to B; 2 to C; 5 to D
8	1 to A; 4 to B; 7 to C; 5 to D
9	1 to A; 4 to B; 2 to C; 8 to D
10	3 to A; 4 to B; 2 to C; 5 to D

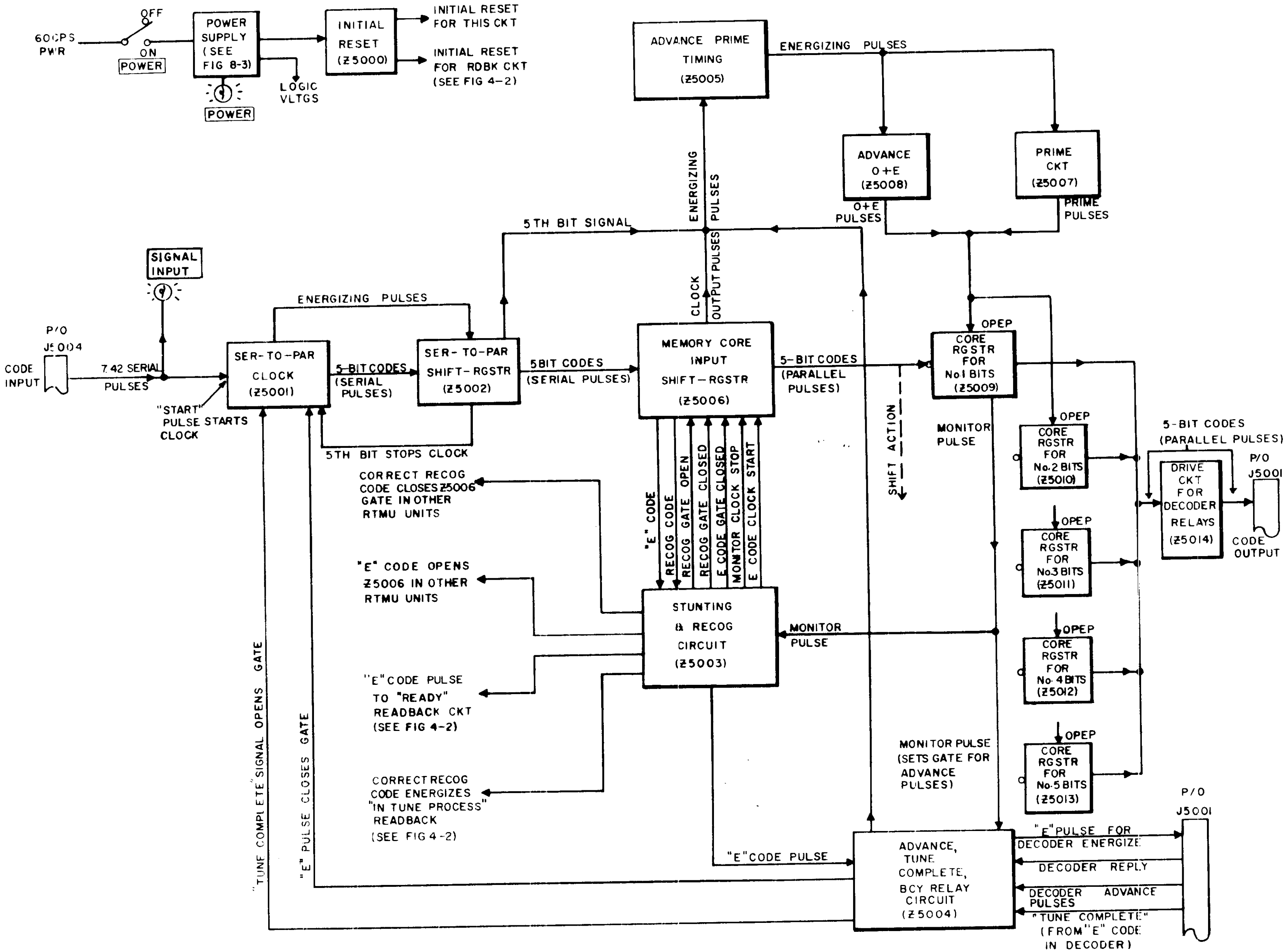

Figure 4-1. Functional Block Diagram, Memory and Series-to-Parallel Converter, RTMU

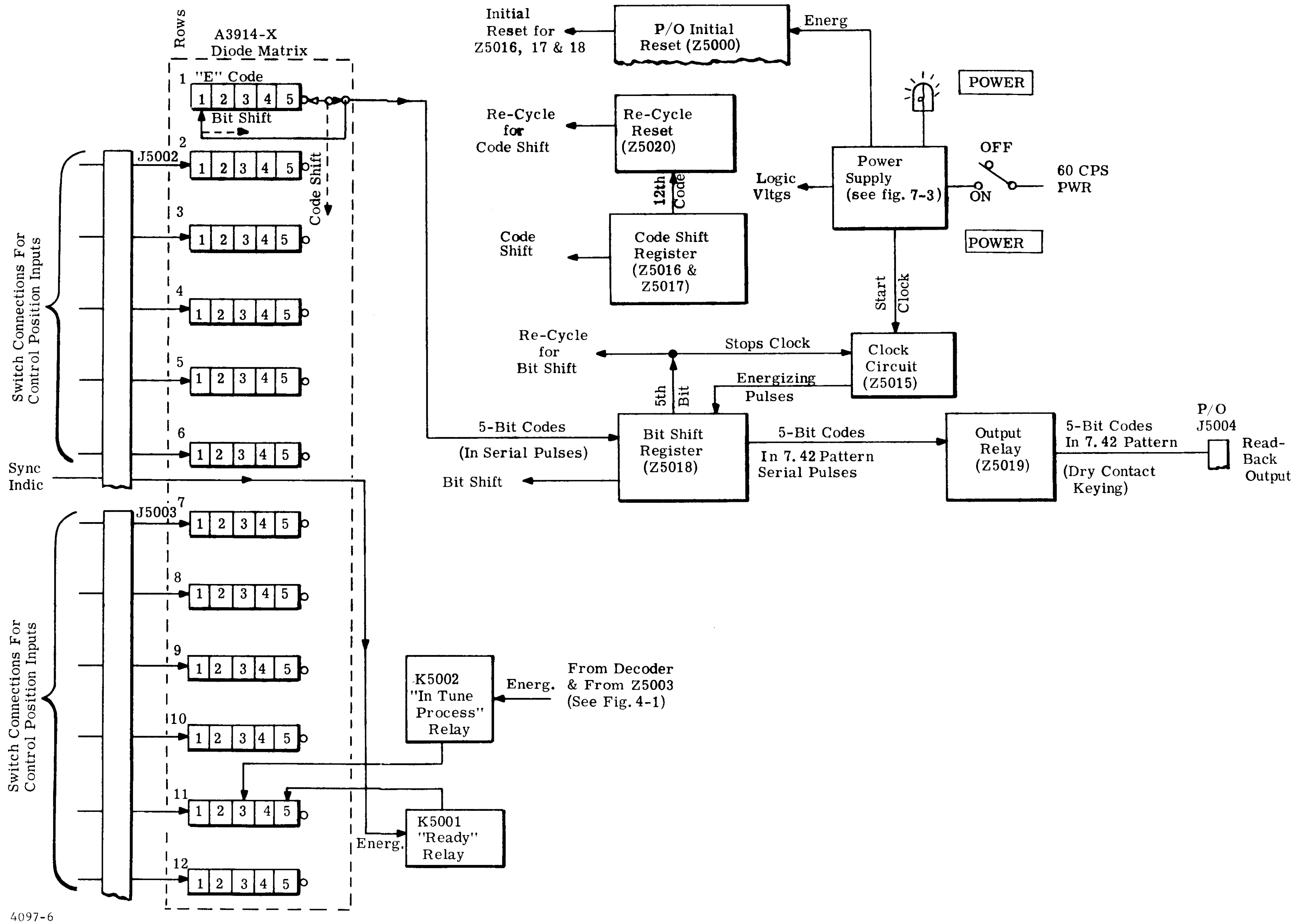

Figure 4-2. Functional Block Diagram, Readback Transmitter, RTMU

SECTION 5
MAINTENANCE

5-1. INTRODUCTION

The logic circuits in the RTMU are contained on Z5000 series printed circuit plug-in cards mounted in two bins (see figure 5-1). The A-3914 readback diode matrix is a printed circuit card mounted on standoffs under the readback bin on the bottom side of the chassis (see figure 5-2). The rest of the circuit components make up the power supply section. The card Z5000 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, 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 RTMU 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 RTMU is used.

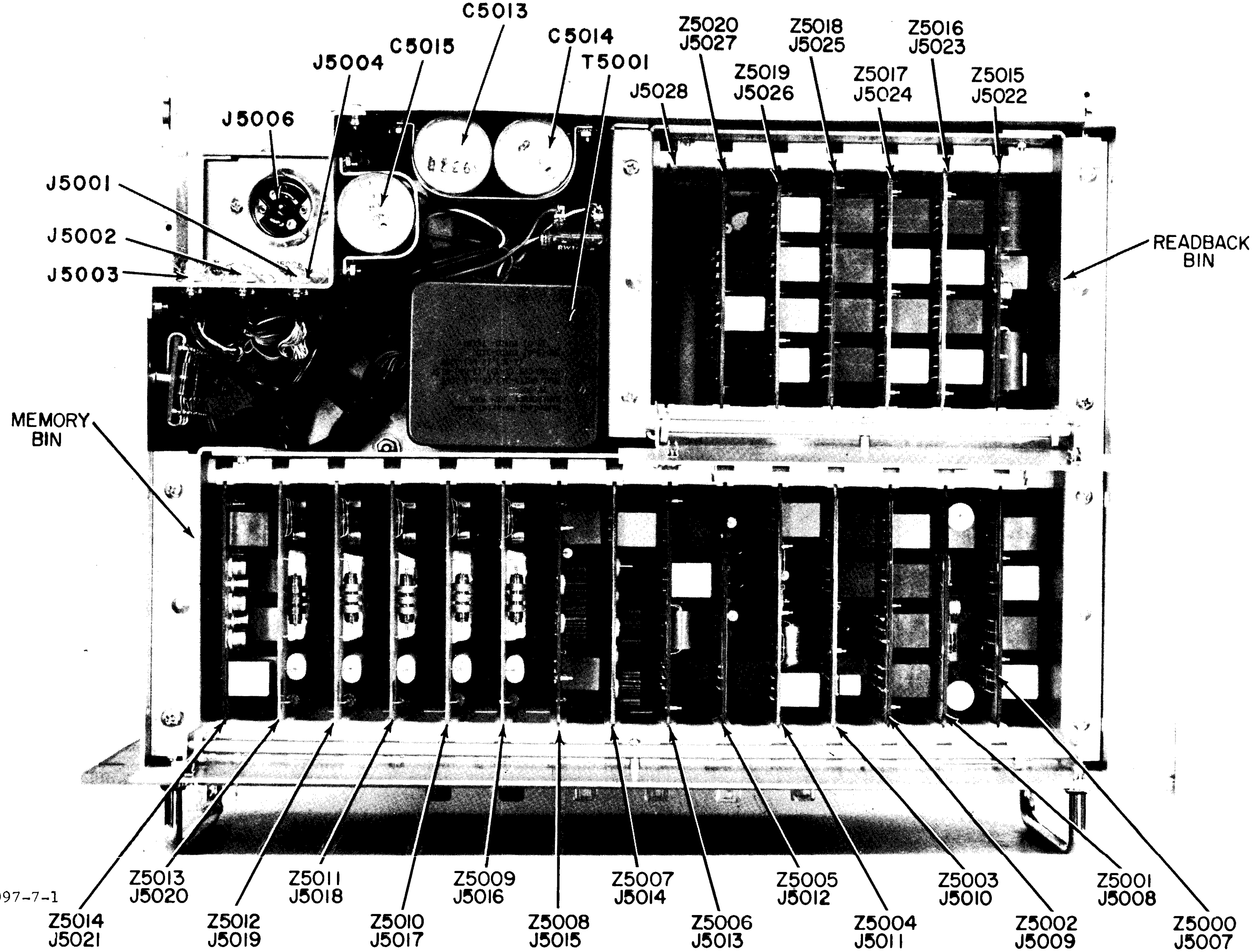

Figure 5-1. Top View, RTMU

65 3.11-9

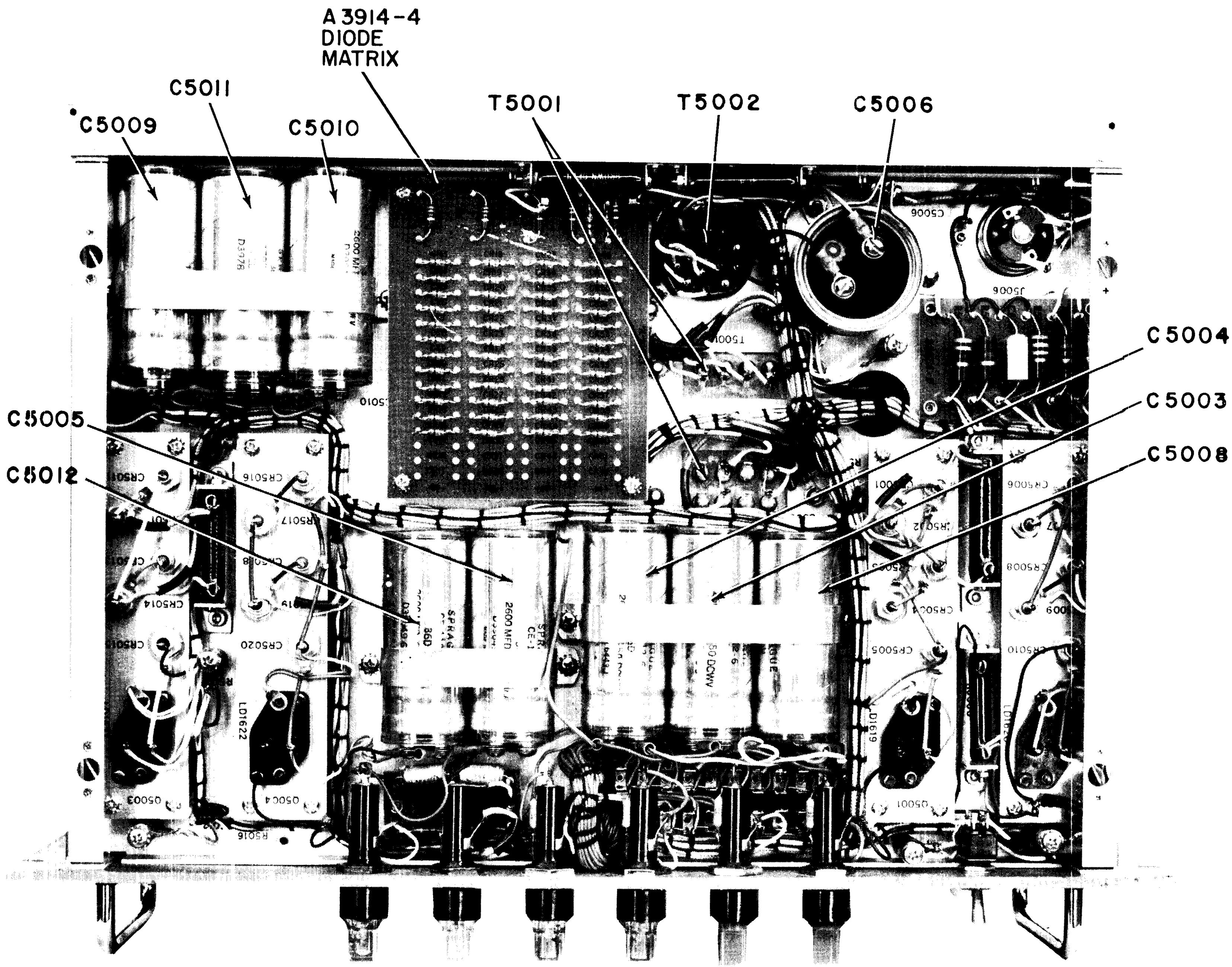

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Figure 5-2. Bottom View, RTMU

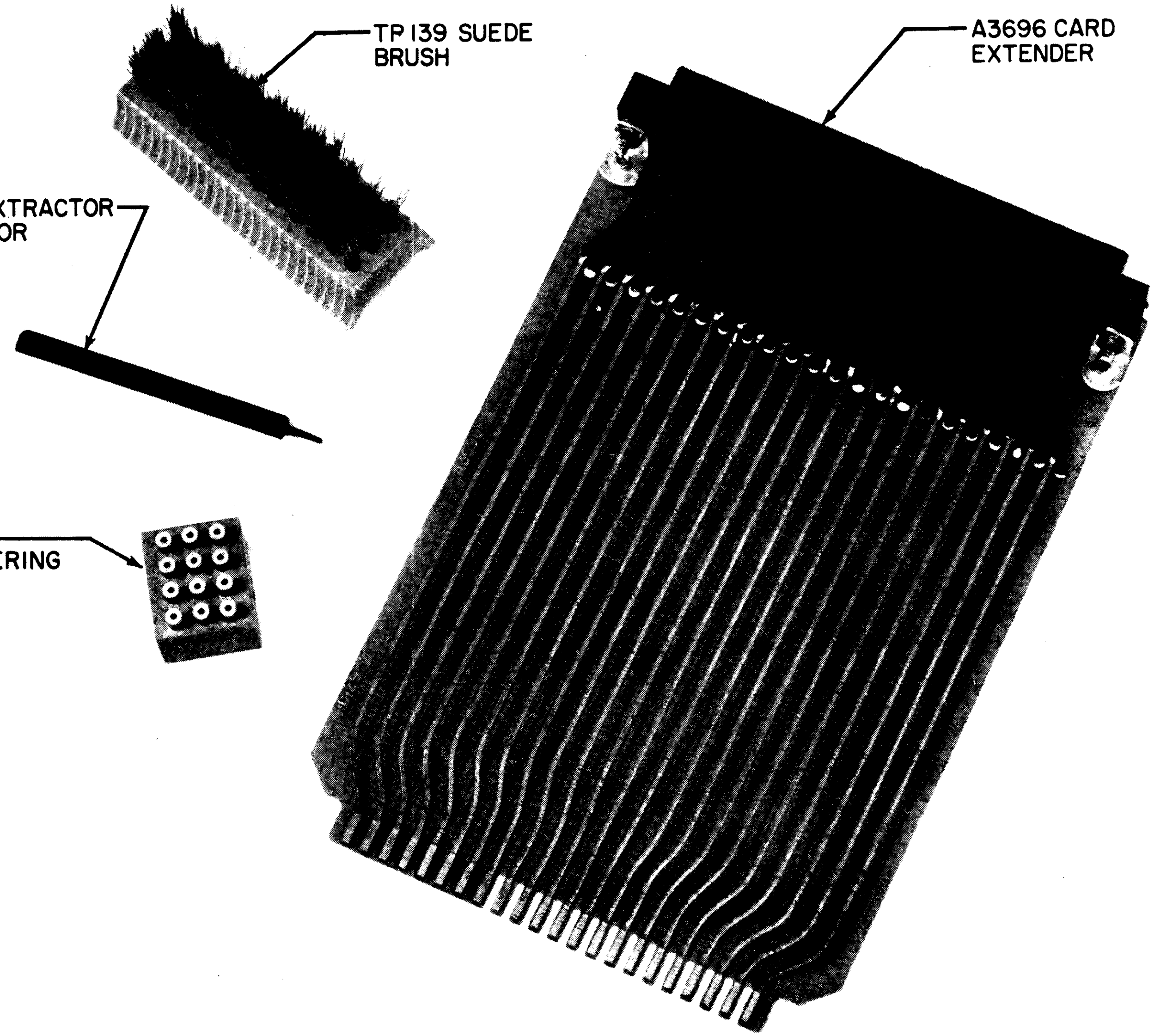

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Figure 5-3. Maintenance Tools, Logic Circuit

TABLE 5-1. TEST EQUIPMENT, RTMU

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 7-1 and 7-2 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 and figure 5-4 and table 5-2 showing power supply voltage check points and normal voltages.

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

When it has been determined, in a system troubleshooting procedure, that the RTMU component is at fault, the faulty card and/or component on the card can be detected by leaving the RTMU connected in the system and using the remote code input, checking test patterns at test points, indicated on figures 7-1 and 7-2, with an oscilloscope. If, however, it is necessary to immediately substitute in a spare RTMU to resume operation of the system, the subsequent bench check of the RTMU will require the teletypewriter set listed in table 5-1. 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 7-1 and 7-2 for that card.

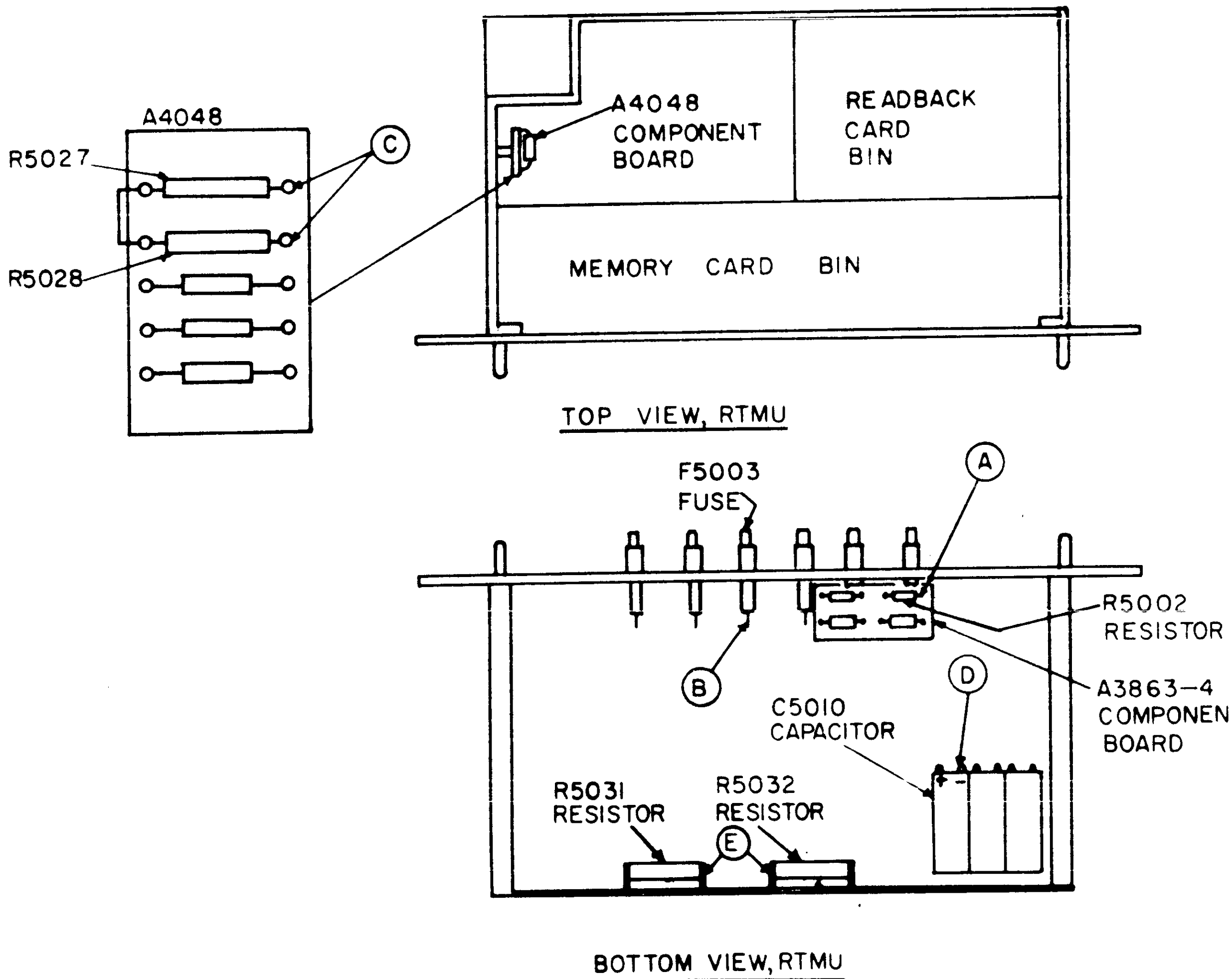

TABLE 5-2 POWER VOLTAGES, RTMU

LOCATION	NOMINAL DC VLTG
A	+ 12
B	− 12
C	− 18
D	−40
E	+40

4097-9

Figure 5-4. Power Supply Voltage Test Points

The test set-ups and procedures for both methods (in-system and bench) are described in this section (paragraph 5-4). 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. IN-SYSTEM CHECK

(1) Test Set-up.- Pull the RTMU unit out of the system rack on its drawer slides to reveal the components. Leave all connections installed (at J5001 thru J5004 and J5006). Set RTMU POWER switch to OFF. Connect into the system the normal transmitter (or receiver) remote code input and readback indicator. Have available the oscilloscope, voltmeter and two or three #A3639 Card Extenders (see figure 5-3) supplied with the RTMU.

(2) Procedure. - First refer to paragraph 5-4 d for technique in measuring card test points and adjustments of the oscilloscope. Then set RTMU POWER switch to ON and check power supply voltages with the voltmeter, referring to figure 5-4 for test point locations and table 5-2 for nominal voltages.

If the power supply voltages are normal, check Z5000 Initial Reset card by setting the POWER switch to OFF and then setting it to ON for each measurement on the card.

If the normal patterns have been indicated, determine next if the memory section or the readback section is at fault.

To do this, check the signal input and output patterns of each, using a complete tuning message input for the memory section and rotating the transmitter (or receiver) controls for the readback section. After the faulty section (memory or readback) has been established, repeat the tuning messages and procede to locate the faulty card, either by card substitution against a check of the output pattern or by strategic spot checks in the bin. The latter is best performed by starting at a test point approximately midway between input and output and continuing to bisect each faulty area until the card is found. After this, a point-by-point check of the card should reveal the faulty component. If the card checks out properly, the trouble may be caused by broken wiring between bin receptacles; a visual or continuity check should reveal this.

c. BENCH CHECK

(1) Test Set-up.- Connect the RTMU to the line voltage source, teletypewriter* equipment and dummy load as shown in figure 5-5. Have the VTVM and oscilloscope available for measurements. Set RTMU POWER switch to OFF.

(2) Procedure, Preliminary Check.- First refer to paragraph 5-4d for technique in measuring card test points and adjustments of the oscilloscope. Then set RTMU POWER switch to ON and check power supply voltages with the voltmeter, referring to figure 5-4 for test point locations and table 5-2 for normal voltages.

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*Check to ensure teletypewriter equipment transmits and reads 60WPM (or 100WPM) to match the RTMU(see paragraph 2-4).

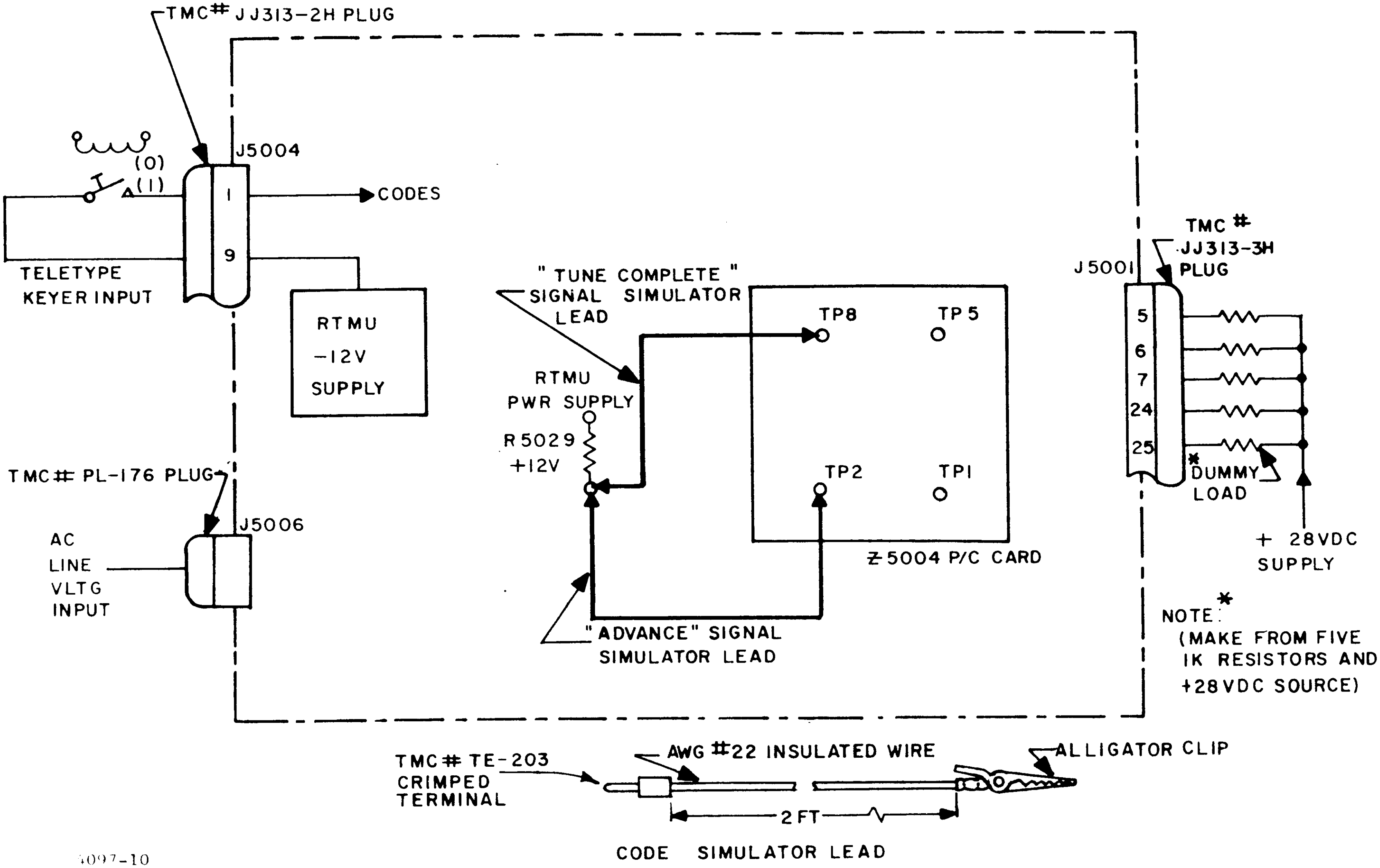


Figure 5-5. Test Setup, RTMU

If the power supply voltages are normal, check Z5000 Initial Reset card by setting the POWER switch to OFF and then setting it to ON for each measurement on the card.

If the proper patterns have been indicated, determine next if the memory section or the readback section is at fault, if this has not been already established in the system check.

To check the readback section, connect the readback keying output to the teletypewriter tape puncher input as shown in figure 5-5. Setting the RTMU POWER switch to ON will start the readback scanning action and the RTMU will transmit the "E" code (10000) to the puncher on each scan cycle. If this code appears punched on the tape every 2 seconds, for a 60 WPM Z5015 card (or 1-3/8 seconds for a 100 WPM card), the basic readback action is functioning correctly. To check individual readback circuity (diode matrix wiring), simulate codes by shorting the common pin with a bit pin for a "1" bit in each code group throughout J5002 and J5003 receptacles (refer to figure 7-2). Check resulting codes on the punched tape.

To check the memory section, set up cards Z5001, Z5004 and Z5014 on A3696 card extenders. Connect the teletypewriter serial pulse output to a polar relay keyer and the keyer to pins 34 of Z5001 and terminal 11 of TB5001 as shown in figure 5-5. Connect RTMU to line voltage at J5006 receptacle. Connect one end of a jumper to R5029 resistor at its +12V output end (end opposite to connection at terminal 1 of TB5001) and keep other end of jumper available for the simulated "advance" pulse. Set RTMU POWER switch first to OFF and then to ON. Send the alpha/numerical recognition code for the RTMU by the teletypewriter keyboard; then send the 5-bit code 11000 ("A" on CCIT equipment), followed by the "E" code (10000). Attach oscilloscope probe to TP1 test point on Z5014 and touch free end of +12V "advance" simulator lead to TP1 test point on Z5004 card. Reading on oscilloscope should swing positive, indicating the "1" bit for bit #1 in the "A". Attach scope probe to TP9 on Z5004, set POWER switch OFF and ON, and send recognition codes, A and E again. Touch "advance" lead **again** to TP1 on Z5004. Scope reading should again swing positive for the "1" bit for bit #2 in the "A". For bit #3, attach scope probe to TP3 on Z5004; set POWER switch to OFF and ON, send same codes and touch "advance" lead to TP1 on Z5004. Scope reading should remain negative for the "0" bit for bit #3 in the "A". This reading should also result for bits #4 and #5 with scope probe at TP2 and TP10, respectively, using the same method. This effectively checks the RTMU memory section input vs. output.

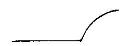
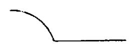
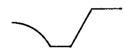
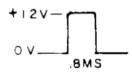
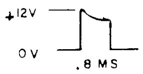
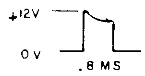
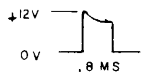
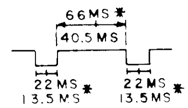
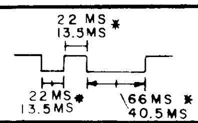
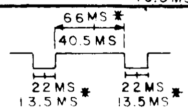
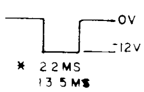
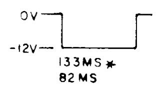
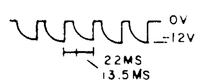
Assuming that the power supply section is working properly, once it has been determined which section (i.e.: memory or readback) is faulty, a point-by-point check can be made to trace down the faulty card and component or wiring. This procedure is described in the following paragraphs.

(3) Procedure, Detailed Check, Memory Section. - This procedure simulates events in the sequence in which they normally occur in the memory section. Some events are produced by the functioning of associated equipment in the transmitter (or receiver) system. To simulate the signals from the associated equipment, a teletypewriter and jumper leads are used, as shown in figure 5-5.

Connect the RTMU to the teletypewriter as shown in figure 5-5. Connect the "advance", and "tune complete" signal simulator leads as shown in figure 5-5, using alligator clip connections. Connect line voltage and a dummy load to the RTMU as shown in figure 5-5. Have oscilloscope available for pulse measurements (see paragraph 5-4d).

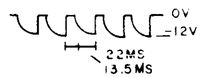
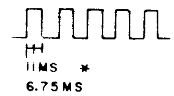
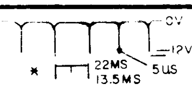
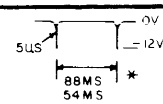
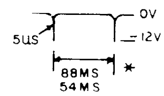
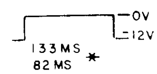
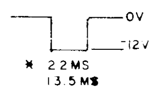
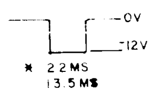
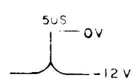
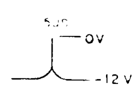
Perform events and steps shown in table 5-3. Events coincide with event sub-paragraph headings in paragraph 4-2b. When indication in "normal reading" column is not forthcoming, reference to figure 7-1 and appropriate event paragraph in 4-2b should indicate faulty component or area.

TABLE 5-3. MEMORY SECTION CHECK PROCEDURE

EVENT	STEP	OPERATION	NORMAL READING
1 Initial Reset	1	Set RTMU POWER switch to OFF. Connect scope probe to Z5000 TP6. Set POWER switch to ON.	
	2	Repeat step 1 with probe at Z5000 TP5.	
	3	Repeat step 1 with probe at Z5000 TP2 and TP3, in turn.	
	4	Repeat step 1 with probe at Z5000 TP1 and TP7 in turn.	
	5	Repeat step 1 with probe at Z5000 TP4 and TP8, in turn.	
	6	Repeat step 1 with probe, in turn, at pins 18, 14, 6, and 4 of Z5000 receptacle.	
	7	Repeat step 1 with probe at pin 20 of Z5014, pin 4 of Z5006, pin 30 of Z5003, pin 42 of Z5004, pin 8 of Z5002, and pin 12 of Z5001 receptacles, in turn.	
2 Code Input	1	Set RTMU POWER switch to ON. Turn teletypewriter (TTY) power on. Place scope probe at Z5001 TP3. Punch "Z" (10001) on TTY keyboard.	
	2	Place probe at Z5001 TP7. Punch "Z" (10001) on TTY keyboard.	
	3	Place probe at Z5001 TP8. Punch "Z" (10001) on TTY keyboard.	
	4	Place probe at pin 10 of Z5001 receptacle. Punch any key on TTY keyboard.	
	5	Place probe at Z5001 TP9. Punch any key on TTY keyboard.	
	6	Place probe at Z5001 TP2. Punch any key on TTY keyboard.	

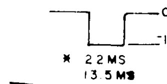
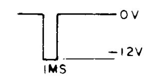
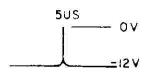
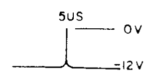
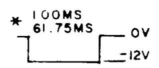
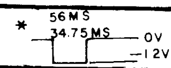
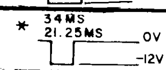
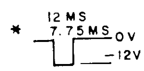
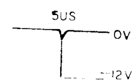
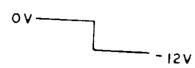
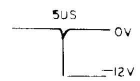
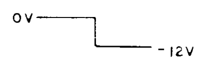
*Top figure is for 60 WPM; bottom figure is for 100 WPM.

TABLE 5-3. MEMORY SECTION CHECK PROCEDURE (CONT)

EVENT	STEP	OPERATION	NORMAL READING
2 (cont)	7	Place probe at Z5001 TP6. Punch any key on TTY keyboard.	
	8	Place probe at pin 36 of Z5001 receptacle. Punch any key on TTY keyboard.	
	9	Place probe at Z5001 TP5. Punch any key on TTY keyboard.	
	10	Place probe at Z5001 TP1. Punch "Z" (10001) on TTY keyboard.	
	11	Place probe at pin 6 of Z5001 receptacle. Punch "Z" (10001) on TTY keyboard.	
	12	Place probe at Z5002 TP3. Punch any key on TTY keyboard.	
	13	Place probe at Z5002 TP2, TP1, TP6, TP5, and TP4, in turn, punching any key on TTY keyboard each time.	
	14	Place probe at pin 40 of Z5002 receptacle. Punch any key on TTY keyboard.	
	15	Place probe at pin 42 of Z5002 receptacle. Punch "Y" (10101) on TTY keyboard. Place probe, in turn, at pins 16 and 36, punching the "Y" each time.	
	16	Repeat step 15, punching the "R" (01010) on the keyboard.	no pulse
	17	Place probe at pin 10 of Z5002 receptacle. Punch "R" (01010) on the keyboard. Place probe at pin 28 and punch "R".	
	18	Repeat step 17, punching the "Y" (10101) on the keyboard.	no pulse

*Top figure is for 60WPM; bottom figure is for 100WPM.

TABLE 5-3. MEMORY SECTION CHECK PROCEDURE (CONT)

EVENT	STEP	OPERATION	NORMAL READING
2 (cont)	19	Place probe at Z5005 TP 5. Punch any key on TTY keyboard.	
	20	Place probe at Z5005 TP 6 and TP 7, in turn. Punch any key on TTY keyboard.	
	21	Place probe at Z5005 TP 4. Punch any key on TTY keyboard.	
	22	Place probe at pin 14 of Z5005 receptacle. Punch any key on TTY keyboard.	
	23	Place probe at pin 14 of Z5006. Punch "K" (11110) on TTY keyboard.	
	24	Place probe at pin 20 and punch "K".	
	25	Place probe at pin 22 and punch "K".	
	26	Place probe at pin 34 and punch "K".	
	27	Place probe at pin 38 of Z5006. Punch "Z" (10001) on keyboard.	
3 Recognition Code	1	Refer to table 1-1 for CCIT equivalent characters corresponding with recognition A-J letter and 1-10 numeral for RTMU unit. Place scope probe at Z5003, TP 1. Punch equivalent key for recognition letter.	
	2	Leave probe at TP 1 and punch keys other** than key punched in step 1.	no pulse
	3	Place probe at Z5003 TP 3. Punch key punched in step 1.	
	4	Place probe at Z5003 TP 8. Punch equivalent key for recognition numeral	
		Punch any key** on TTY keyboard. Then place probe at pin 26 of Z5003 receptacle. Punch equivalent of recognition letter followed by equivalent for numeral.	

* Top figure is for 60 WPM; bottom figure is for 100WPM.
** Do not punch "E".

TABLE 5-3. MEMORY SECTION CHECK PROCEDURE (CONT)

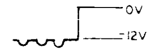
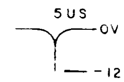
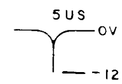
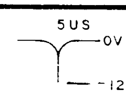
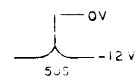
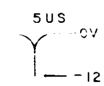
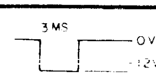
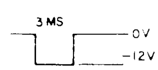
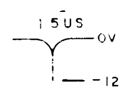
EVENT	STEP	OPERATION	NORMAL READING
3 (cont)	6	Repeat step 5 with probe at Z5003 TP 9.	
	7	Repeat step 5 observing K1 relay on Z5003 card.	Relay energizes
4 Serial-to -Parallel Conversion	1	Set RTMU POWER switch to OFF, then ON. Place probe at pin 33 of Z5006 receptacle. Punch equivalent of recognition letter followed by equivalent for numeral. Then punch "K" (11110) on keyboard.	
	2	With probe, in turn, at pin 16, 18, 15 and 32 of Z5006 receptacle, punch "K" each time on keyboard.	
	3	With probe at pin 28 of Z5006 receptacle, punch "K" once.	no pulse
5 Tuning Code Storage	1	With probe at Z5005 TP3, punch "T" (00001) on TTY keyboard.	
	2	With probe at pin 34 of Z5005 receptacle, punch "T" on keyboard.	
	3	With probe at Z5005 TP 2, punch "T" on keyboard.	
	4	With probe at pin 38 of Z5005 receptacle, punch "T" on keyboard.	
	5	With probe at pin 42 of Z5C05 receptacle, punch "T" on keyboard.	
	6	With probe at Z5008 TP 8, punch "T" on keyboard.	
	7	With probe at Z5008 TP 7, punch "T" on keyboard.	
	8	With probe at Z5008 TP 9, punch "T" on keyboard.	
	9	With probe at Z5008 TP 6, TP 10, and TP 5, in turn, punch "T" on keyboard.	

TABLE 5-3. MEMORY SECTION CHECK PROCEDURE (CONT)

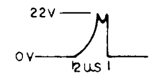
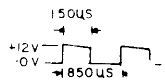
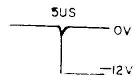
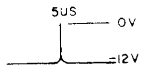
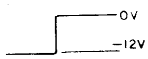
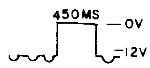
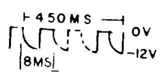
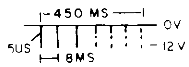
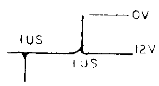
EVENT	STEP	OPERATION	NORMAL READING
5 (cont)	10	With probe at pin 36 and pin 42 of Z5008 receptacle, in turn, punch "T" on keyboard.	
	11	With probe at Z5007 TP 7, TP 1, TP 2, TP 3, TP 4 and TP 5, in turn, punch "T" on keyboard each time.	
6 E Code	1	With probe at Z5003 TP 7, punch "E" on keyboard.	
	2	Set RTMU POWER switch to OFF, then ON. Punch equivalent of recognition letter and equivalent of recognition numeral on keyboard. Then, with probe at pin 10 of Z5003 receptacle, punch the "E".	
	3	Repeat step 2 with probe at pin 26 of Z5003.	
	4	Repeat step 2 with probe at Z5003 TP 9.	
	5	Repeat step 2, removing probe and observing K1 relay on Z5003.	K1 de-energizes
	6	Repeat step 2, with probe at pin 39 of Z5004 receptacle.	
	7	Repeat step 2, with probe at pin 22 of Z5004 receptacle.	
	8	Repeat step 2, with probe at Z5006 TP 2.	
	9	Repeat step 2, with probe at Z5006 TP 1.	
	10	Repeat step 2, with probe at pin 41 of Z5006 receptacle.	
7 Monitor Pulse	1	Set RTMU POWER switch to OFF, then ON. Punch equivalent of recognition letter and equivalent of recognition numeral on keyboard. Then, with probe at pin 22 of Z5009 receptacle, punch the "E".	

TABLE 5-3. MEMORY SECTION CHECK PROCEDURE (CONT)

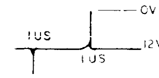
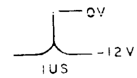
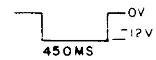
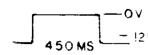
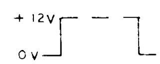
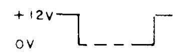
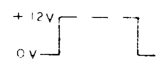
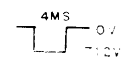
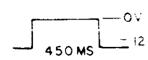
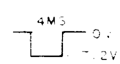
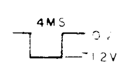
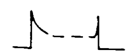
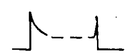
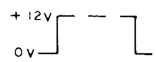
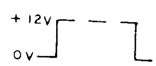
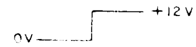
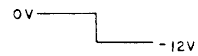
EVENT	STEP	OPERATION	NORMAL READING
7 (cont)	2	Repeat step 1 with probe at Z5003 TP 4.	
	3	Repeat step 1 with probe at Z5003 TP 5.	
	4	Repeat step 1 with probe at pin 15 of Z5003 receptacle.	
	5	Repeat step 1 with probe at pin 8 of Z5006 receptacle.	
8 Advance Pulse	1	Take previously installed end of "advance" lead from Z5004 TP 2 and, with probe at Z5004 TP 1, touch it to pin 8 of Z5004 receptacle and back to TP 2.	
	2	Repeat with probe at pin 10 of Z5004 receptacle.	
	3	With probe at Z5004 TP 9, touch "advance" lead to TP 2 then TP 1 and back to TP 2.	
	4	Connect "advance" lead to Z5004 TP 2. Then, with probe at Z5004 TP 7, move lead to Z5004 TP 1.	
	5	Attach "advance" lead to Z5004 TP 2. Set RTMU POWER switch to OFF, then ON. Punch equivalent of recognition letter and equivalent of recognition numeral on keyboard. Then, with probe at pin 6 of Z5004 receptacle, punch the "E".	
	6	Set RTMU POWER switch to OFF, then ON. Punch equivalents of recognition letter and numeral, and then the "E". Then with probe at Z5004 TP 3, switch advance lead from Z5004 TP 2 to TP 1.	
	7	Replacing advance lead back to Z5004 TP 2, repeat step 6, with probe at pin 4 of Z5004.	

TABLE 5-3. MEMORY SECTION CHECK PROCEDURE (CONT)

EVENT	STEP	OPERATION	NORMAL READING
9 Code Output	1	Re-connect free end of "advance" lead back at Z5004 TP 2. Set RTMU POWER switch to ON. Punch equivalents of recognition letter and numeral on keyboard. Then punch 5"K's" 5 "T's", 5 "K's", and 5 "T's", followed by an "E". With probe at pin 10 of Z5009, switch end of "advance" lead to Z5004 TP 1 and back to TP 2.	
	2	With probe at pin 10, in turn, of Z5010 11 and 12 receptacles, switch end of "advance" lead to Z5004 TP 1 and back to TP 2.	"
	3	With probe at pin 10 of Z5013 receptacle, switch end of "advance" lead to Z5004 TP 1 and back to TP 2.	no pulse
	4	With probe at pin 10, in turn, of Z5009, Z5010, Z5011 and Z5012, switch end of "advance" lead to Z5004 TP 1 and back to TP 2.	no pulse
	5	With probe at pin 10 of Z5013, switch end of "advance" lead to Z5004 TP 1 and back to TP 2.	
	6	With probe at Z5014 TP 1, TP 9, TP 3 and TP 2, in turn, switch end of "advance" lead to Z5004 TP 1 and back to TP 2.	
	7	With probe at Z5014 TP 10 switch end of "advance" lead to Z5004 TP 1 and back to TP 2.	no pulse
	8	With probe at Z5014 TP 1, TP 9, TP 3, and TP 2, in turn, switch end of "advance" lead to Z5004 TP 1 and back to TP 2.	no pulse
	9	With probe at Z5014 TP 10, switch end of "advance" lead to Z5004 TP 1 and back to TP 2.	

EVENT	STEP	OPERATION	NORMAL READING
10 Decoder Tune Complete	1	Set RTMU POWER switch to OFF, then ON. With probe at pin 12 of Z5004, switch end of "tune complete" lead from Z5004 TP 8 to Z5004 TP 5.	
	2	Reconnect "tune complete" lead to Z5004 TP 8. With probe at Z5004 pin 20, switch lead from TP 8 to TP 5.	
	3	Reconnect "tune complete" lead to Z5004 TP 8. With probe at pin 38 of Z5004 receptacle, switch lead from Z5004 TP 8 to TP 5.	

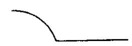
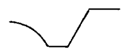
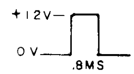
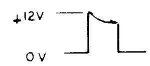
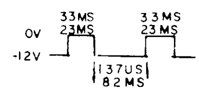
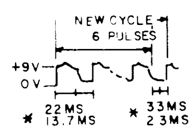
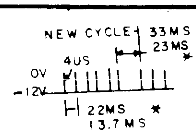
(4) Procedure, Detailed Check, Readback Section

This procedure checks functioning sections of the readback circuitry.

Connect line voltage to the RTMU. Have two 2-ft. long code simulator leads (see figure 5-5) and an oscilloscope available for pulse measurements (see paragraph 5-4d).

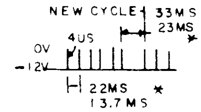
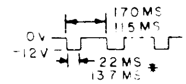
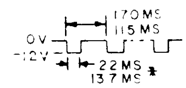
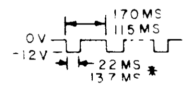
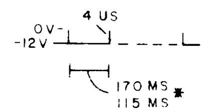
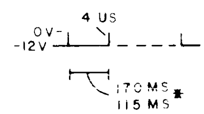
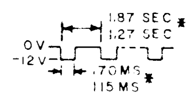
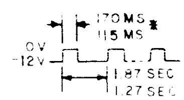
Perform checks on each section as shown in table 5-4, in the order shown. When indication in "normal reading" column is not forthcoming, reference to figure 7-2 and appropriate subparagraph in 4-3b should indicate faulty component or area.

TABLE 5-4. READBACK SECTION CHECK PROCEDURE

SECTION	STEP	OPERATION	NORMAL READING
1 Initial Reset	1	Set RTMU POWER switch to OFF. Connect scope probe to Z5000 TP 6. Set POWER switch to ON.	
	2	Repeat step 1 with probe at Z5000 TP 5.	
	3	Repeat step 1 with probe at Z5000 TP 2 and TP 3, in turn.	
	4	Repeat step 1 with probe at Z5000 TP 1 and TP 7, in turn.	
	5	Repeat step 1 with probe at Z5000 TP 4 and TP 8, in turn.	
	6	Repeat step 1 with probe, in turn, at pins 28, 40 and 42 of Z5000 receptacle.	"
2 Bit Shift-Register	1	Set RTMU POWER switch to OFF. With probe at Z5015 TP 2, set POWER switch to ON.	
	2	Repeat step 1, with probe at Z5015 TP 1.	"
	3	Repeat step 1, with probe at pin 36 of Z5015 receptacle.	
	4	Repeat step 1, with probe at Z5018 TP 8.	

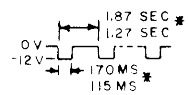
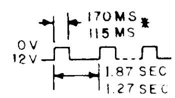
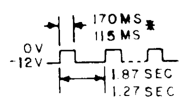
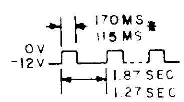
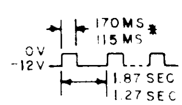
* Upper figure for 60 WPM, lower figure for 100 WPM.

TABLE 5-4. READBACK SECTION CHECK PROCEDURE (CONT)

SECTION	STEP	OPERATION	NORMAL READING
2 (cont)	5	Repeat step 1, with probe at Z5018 TP 5.	
	6	Leave RTMU POWER switch in ON position. Place scope probe at Z5018 TP 6 and observe regular pulse pattern.	
	7	Observe regular pulse pattern with probe at Z5018 TP 4, TP 3, TP 2, TP 1 and TP 7, in turn.	
3 Row Shift-Register	1	Observe regular pulse pattern with probe at pin 12 of Z5015 receptacle.	
	2	Observe regular pulse pattern with probe at Z5015 TP 3.	
	3	Observe regular pulse pattern with probe at pins 14 and 4 of Z5015 receptacle, in turn.	
	4	Observe regular pulse pattern with probe at pin 10 of Z5016 receptacle.	
	5	Observe regular pulse pattern with probe at Z5016 TP 7, TP 4, TP 1, TP 6 and TP 8, in turn.	
	6	Observe regular pulse pattern with probe at Z5016 TP 3, TP 2, TP 5 and TP 9, in turn.	Same as step 4
	7	Observe regular pulse pattern with probe at pin 28 of Z5016 receptacle.	Same as step 4

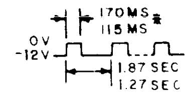
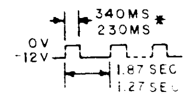
* Upper figure for 60 WPM, lower figure for 100 WPM.

TABLE 5-4. READBACK SECTION CHECK PROCEDURE (CONT)

SECTION	STEP	OPERATION	NORMAL READING
3 (cont)	8	Observe regular pulse pattern with probe at pin 20 of Z5017 receptacle.	Same as step 5
	9	Observe regular pulse pattern with probe at Z5017 TP 7, TP 4, TP 1, TP 6 and TP 8, in turn.	Same as step 5
	10	Observe regular pulse pattern with probe at pin 10 of Z5017 receptacle.	Same as step 4
	11	Observe regular pulse pattern with probe at Z5017 TP 3, TP 2, TP 5, and TP 9, in turn.	Same as step 4
	12	Observe regular pulse pattern with probe at pin 28 of Z5017 receptacle.	Same as step 4
4 Recycle Reset	1	Observe regular pulse pattern with probe at Z5020 TP 5.	
	2	Observe regular pulse pattern with probe at Z5020 TP 4.	
	3	Observe regular pulse pattern with probe at Z5020 TP 1.	
	4	Observe regular pulse pattern with probe at Z5020 TP 2.	
	5	Observe regular pulse pattern with probe at pins 40 and 42 of Z5020 receptacle, in turn.	

* Upper figure for 60 WPM, lower figure for 100 WPM.

TABLE 5-4. READBACK SECTION CHECK PROCEDURE (CONT)

SECTION	STEP	OPERATION	NORMAL READING
5 Code Matrix	1	Observe regular pulse pattern with probe at pin 22 of Z5018 receptacle.	
	2	Set RTMU on its front panel handles. Insert one end of code simulator lead into pin 26 of Z5016 receptacle. Attach other free end of lead to + side of CR 1 diode on A3914-4 diode matrix (see figure 5-2). Place scope probe at pin 22 of Z5018 and observe regular pulse pattern.	
	3	Attach free end of simulator lead to + side of the following diodes in turn on the matrix with scope probe in the indicated pins of Z5018 receptacle. Observe regular pulse patterns. Diode — Pin # of Z5018 CR48 . . . . 20 CR33 . . . . 34 CR18 . . . . 28 CR3 . . . . 32 CR49 . . . . 20 CR34 . . . . 34 CR19 . . . . 28 CR4 32	Same as step 1
	4	Installing simulator lead between the following points, in turn and with the scope probe at the indicated points, observe regular pulse patterns. Lead from: Card, Pin — to: Diode** — Probe at: Card, Pin Z5016 16 CR50 Z5018 20 16 CR35 34 16 CR20 28 16 CR5 32 42 CR51 20 42 CR36 34 42 CR21 28 Z5016 42 CR6 Z5018 32	Same as step 1

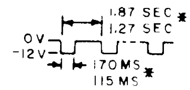
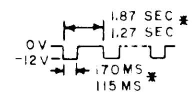
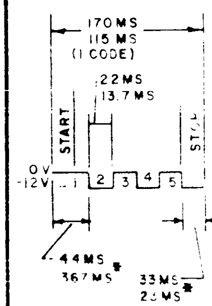
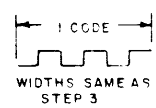
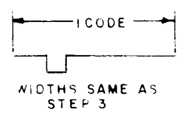
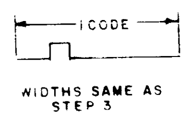
* Upper figure for 60 WPM, lower figure for 100 WPM

TABLE 5-4. READBACK SECTION CHECK PROCEDURE (CONT)

SECTION	STEP	OPERATION: Lead from: Card	Pin	to: Diode**	Probe at: Card	Pin	NORMAL READING
5 (cont)	4 (cont)	Z5016	34	CR52	Z5018	20	
			34	CR37		34	
			34	CR22		28	
			34	CR7		32	
			38	CR53		20	
			38	CR38		34	
			38	CR23		28	
		Z5016	38	CR8		32	
		Z5017	18	CR54		20	
			18	CR39		34	
			18	CR24		28	
			18	CR9		32	
			26	CR55		20	
			26	CR40		34	
			26	CR25		28	
			26	CR10		32	
			16	CR56		20	
			16	CR41		34	
			16	CR26		28	
			16	CR11		32	
			42	CR57		20	
			42	CR42		34	
			42	CR27		28	
			42	CR12		32	
			34	CR58		20	
			34	CR43		34	
			34	CR28		28	
			34	CR13		32	
			38	CR59		20	
			38	CR44		34	
			38	CR29		28	
		Z5017	38	CR14	Z5018	32	
6 Serial Output	1	Installing simulator lead between the following points, in turn, and with the scope probe at indicated points, observe regular pulse patterns.					

* Upper figure for 60 WPM, lower figure for 100 WPM.
** To + side of diode.

TABLE 5-4. READBACK SECTION CHECK PROCEDURE (CONT)

<table>
<tr><th>SECTION</th><th>STEP</th><th>OPERATION</th><th>NORMAL READING</th></tr>
<tr><td>6
(cont)</td><td>1
(cont)</td><td>
<table>
<tr><th colspan="2">Lead from:</th><th>to:</th><th colspan="2">Probe at:</th></tr>
<tr><th>Card</th><th>pin</th><th>Diode</th><th>Card</th><th>Point</th></tr>
<tr><td>Z5016</td><td>34</td><td>CR52</td><td>Z5018</td><td>pin 16</td></tr>
<tr><td>↑</td><td>↑</td><td>CR37</td><td>↕</td><td>24</td></tr>
<tr><td></td><td></td><td>CR22</td><td></td><td>26</td></tr>
<tr><td></td><td></td><td>CR7</td><td>Z5018</td><td>pin 30</td></tr>
<tr><td></td><td></td><td>CR52</td><td>Z5019</td><td>TP 10</td></tr>
<tr><td></td><td></td><td>CR37</td><td>↕</td><td>TP 9</td></tr>
<tr><td>↓</td><td>↓</td><td>CR22</td><td></td><td>TP 8</td></tr>
<tr><td>Z5016</td><td>34</td><td>CR7</td><td>Z5019</td><td>TP 7</td></tr>
</table>
</td><td>
</td></tr>
<tr><td></td><td>2</td><td>Remove simulator lead. With scope probe at pin 10 of Z5018 receptacle and Z5019 TP 3, in turn, observe regular pulse patterns.</td><td>
</td></tr>
<tr><td></td><td>3</td><td>Install two simulator leads between points as follows:
<table>
<tr><th>Lead #</th><th>From</th><th>To</th></tr>
<tr><td>1</td><td>Z5017 pin 34</td><td>+ side of CR58</td></tr>
<tr><td>2</td><td>K5002 pin 6</td><td>+ side of CR28</td></tr>
</table>
Place scope probe at Z5019 TP 2, TP 1 and TP 6, in turn. Observe typical pulse pattern for code.</td><td>
</td></tr>
<tr><td></td><td>4</td><td>Repeat step 3 with probe at Z5019 TP 4 and TP 5, in turn. Observe typical pulse pattern for code.</td><td>
</td></tr>
<tr><td></td><td>5</td><td>Remove simulator leads. With probe at Z5019 TP 2, TP1 and TP 6, in turn, Observe typical pulse pattern of "E".</td><td>
</td></tr>
<tr><td></td><td>6</td><td>With probe at Z5019 TP 4 and TP 5, observe typical pulse pattern of "E".</td><td>
</td></tr>
<tr><td></td><td>7</td><td>Observe K1 relay action (on Z5019). On each readout cycle, K1 should energize in the "mark" (or 1) position for the "E".</td><td>—</td></tr>
</table>

* Upper figure for 60 WPM, lower figure for 100 WPM.

TABLE 5-4. READBACK SECTION CHECK PROCEDURE (CONT)

SECTION	STEP	OPERATION	NORMAL READING
7 "In Tune Process" and "Ready" relays	1	Observing K5001 relay, ground pin 2 of K5002 relay. K5001 relay should energize.	—
	2	Leave ground connection on pin 2 of K5002. Observing K5001 and K5002, ground pin 3 of K5002. K5002 relay should energize and K5001 should de-energize.	—
	3	Leave ground connection on pins 2 and 3 of K5002. Observing K5001 and K5002, remove the ground from pin 3 of K5002. K5002 should de-energize and K5001 should energize.	—
	4	Observing K5001, remove the ground from pin 2 of K5002. K5001 should de-energize.	—

(5) 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.

d. MEASURING TECHNIQUES.

(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.

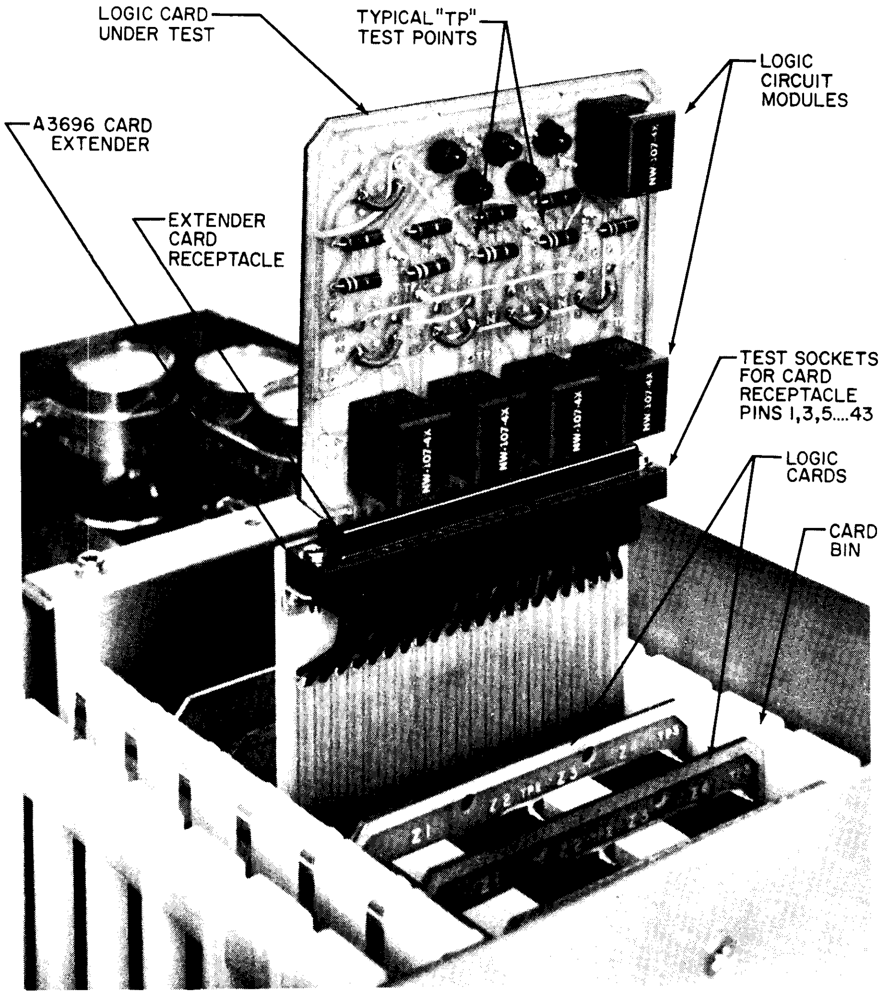
CAUTION

> 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 5-6 shows a typical card in test position. For each pulse pattern shown in figures 7-1 and 7-2, 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



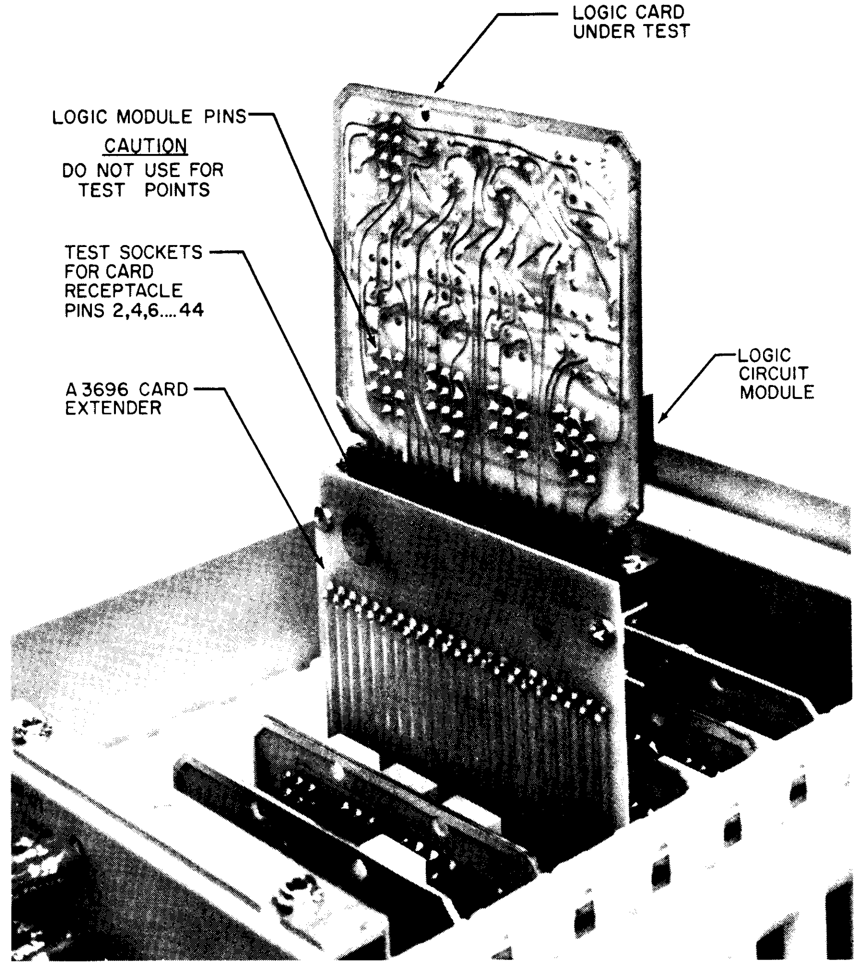


Figure 5-6. Card in Test Position

66 4.18-7

66 4.18-6

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. Set time base control appropiately for pulse widths and so that one cycle may be observed when measuring clock generator outputs.

(3) Interpretation of Pulses. - The exact shape of the pulse is, in most cases, not an important factor in trouble-shooting the RTMU. Very often, different attenuator lines into the oscilloscope will produce pulse shape distortions that are not present in the RTMU. 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 7-1 and 7-2 (or tables 5-3 and 5-4) it should be kept in mind that they are readings under load conditions of the RTMU connected normally into the transmitter (or receiver) system.

5-5. REPAIR AND REPLACEMENT

a. Introduction. - Repair of the RTMU 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. Encap-sulated logic circuit modules (mounted on the cards) are non-repairable items and are replaced with new ones when damaged.

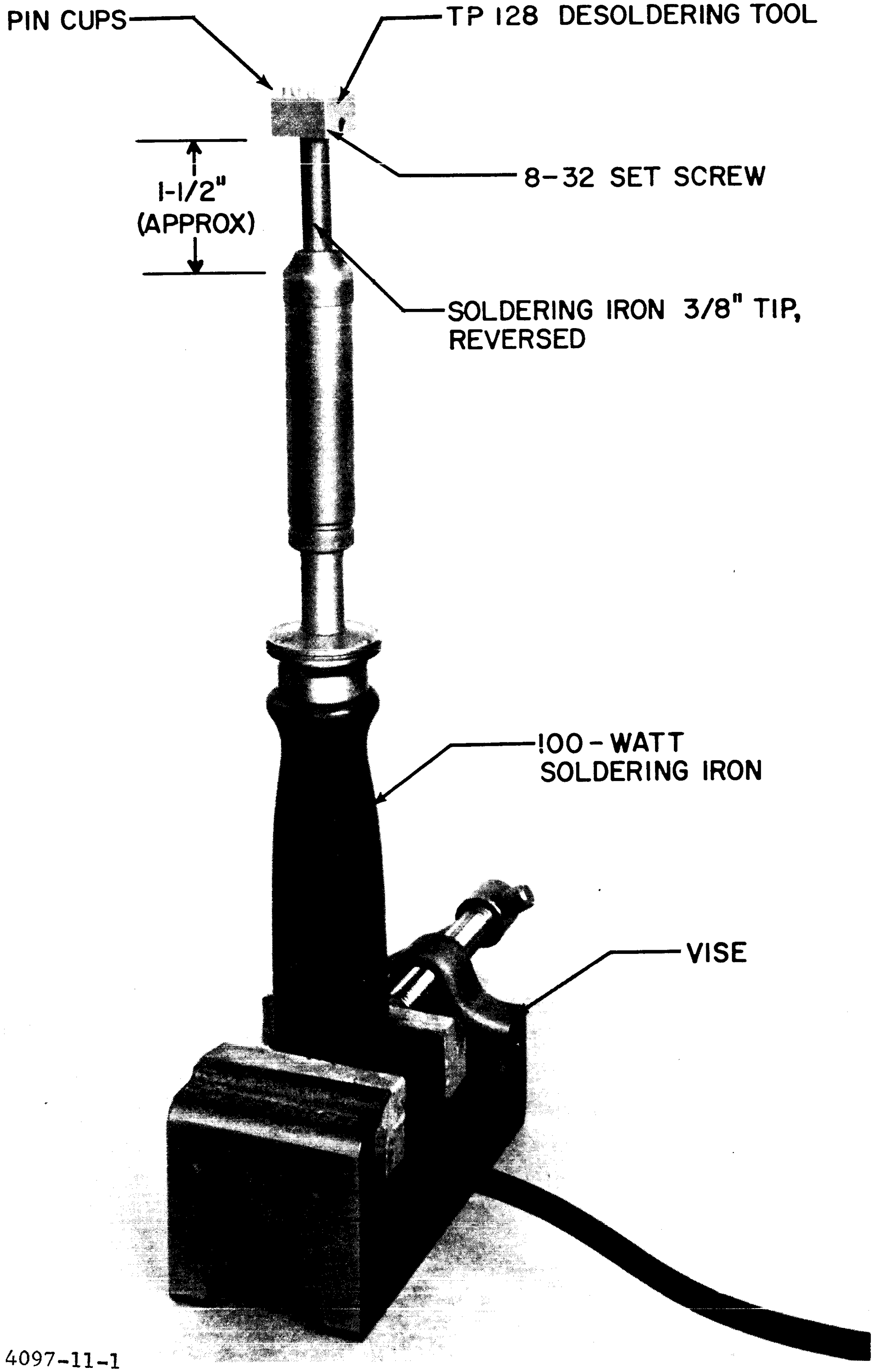
Potted core assemblies on Z5009 through Z5013 cards are also non-repairable items (see figure 7-5) and cannot be replaced on the cards. If trouble develops in the potted core assembly, replace the entire P/C card.

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 RTMU 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 5-7. 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 5-7) and secure with an 8-32 set screw.

Refer to figure 5-8. 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

*Shipment of system in which RTMU is included.



4097-11-1

Figure 5-7. TP128 in Position

66 4.18-9

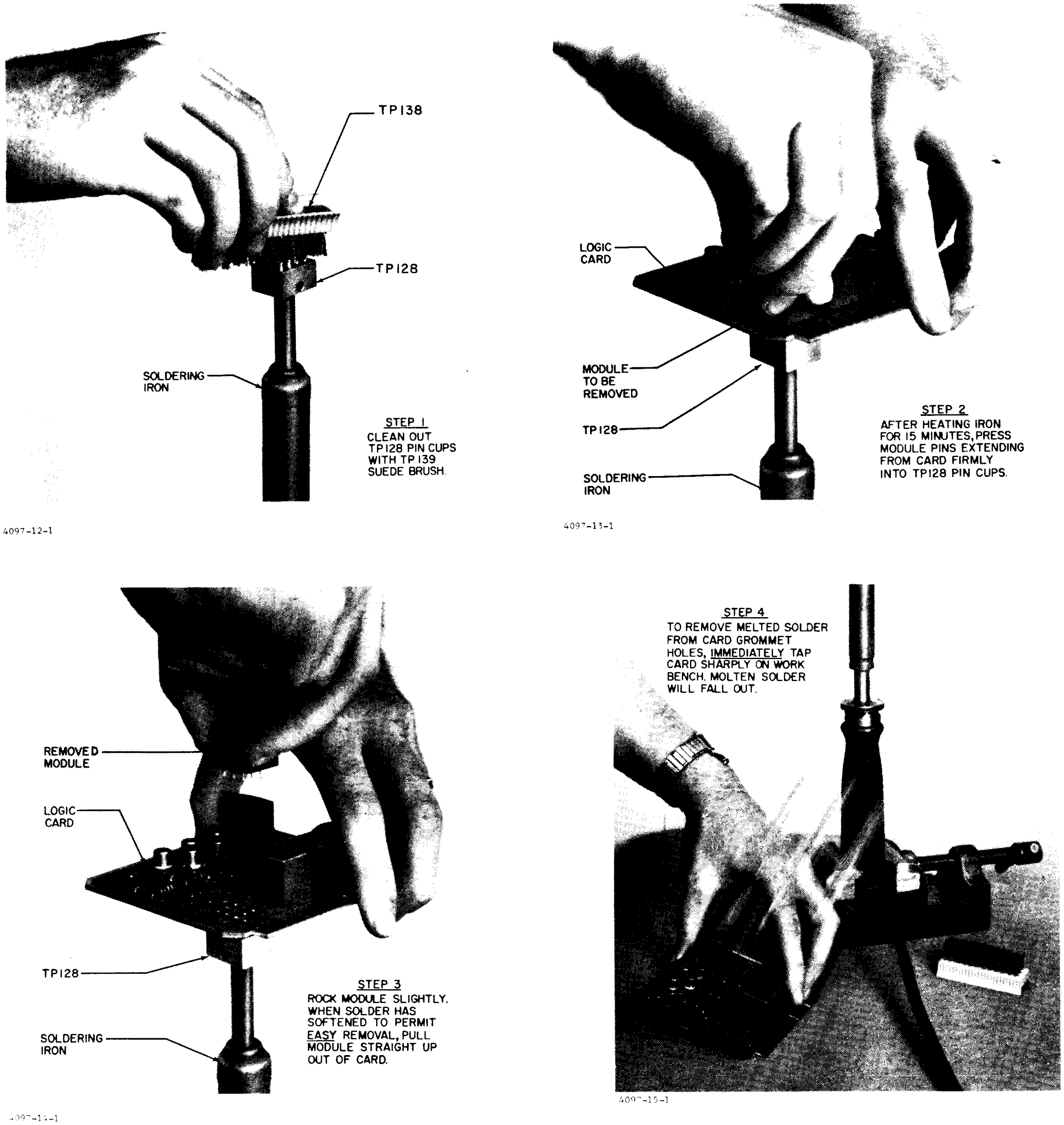


Figure 5-8. Removing Logic Module from Card

66 4.18-10,11,12,13

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 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 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 J5007 through J5028 card receptacles. These receptacles take an insertion type of wire connection, rather than solder type. Figure 5-9 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 ot Wire in System Receptacles. - J5001 through J5004 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 RTMU is included.
**Or equivalent.

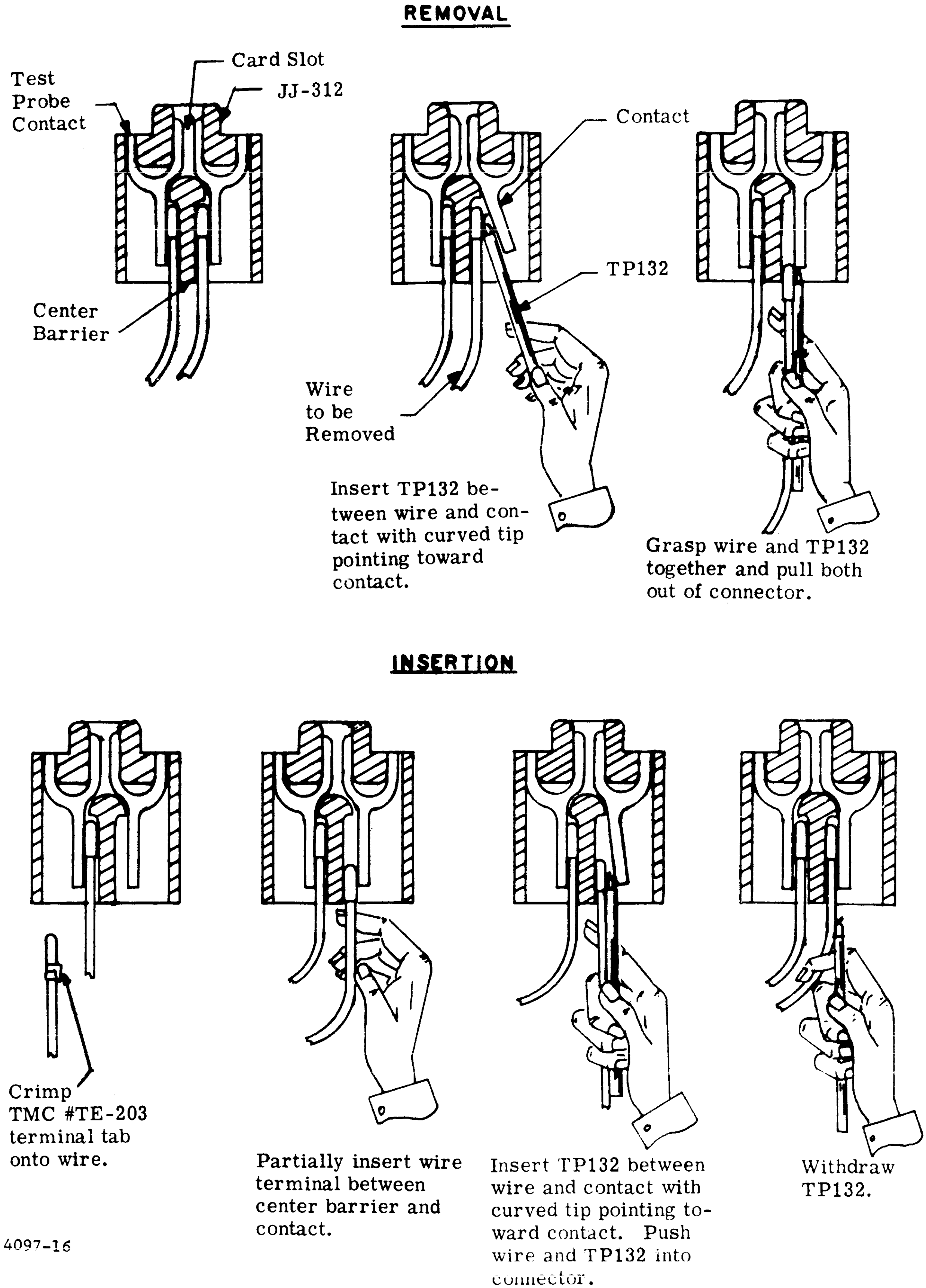


Figure 5-9. Using TP132 Connector Extractor

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. Reference symbol.

b. Description as indicated in parts list.

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

CONVERTER-STORER, SIGNAL DATA RTMU-2

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C5001	CAPACITOR, FIXED, ELECTROLYTIC: 20 uf, -10% +150% at 120 cps at 25°C; 50 WVDC; polarized	CE105-20-50
C5002	Same as C5001.	
C5003	CAPACITOR, FIXED, ELECTROLYTIC: 2,600 uf, 50 WVDC; polarized.	CE112-6
C5004	Same as C5003.	
C5005	CAPACITOR, FIXED, ELECTROLYTIC: 9,200 uf, 15 WVDC; polarized.	CE112-10
C5006	CAPACITOR, FIXED, ELECTROLYTIC: 14,000 uf, 25 WVDC; polarized.	CE112-9
C5007	CAPACITOR, FIXED, PLASTIC DIELECTRIC: 0.47 uf, ±10%; 100 volts; operating temperature range -55°C to +100°C; straight wire leads.	CN112A474K1
C5008	Same as C5005.	
C5009	CAPACITOR,FIXED, ELECTROLYTIC: 1,700 uf, 75 WVDC; polarized.	CE112-8
C5010	Same as C5003.	
C5011	Same as C5009.	
C5012	Same as C5003.	
C5013	CAPACITOR, FIXED, ELECTROLYTIC: 1,500 uf, 25 WVDC; polarized.	CE112-7
C5014	Same as C5013.	
C5015	Same as C5013.	
CR5001	SEMICONDUCTOR DEVICE, DIODE: silicon; max. peak inverse vltg. 100; max. cont. fwd. current 300 ma at 150°C; solder type term.	1N1582A
CR5002 thru CR5004	Same as CR5001.	
CR5005	SEMICONDUCTOR DEVICE, DIODE	1N2977B

CONVERTER-STORER, SIGNAL DATA RTMU-2

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR5006 thru CR5009	Same as CR5001.	
CR5010	Same as CR5005.	
CR5011 thru CR5014	Same as CR5001.	
CR5015	SEMICONDUCTOR DEVICE, DIODE	1N1827A
CR5016 thru CR5019	Same as CR5001.	
CR5020	Same as CR5015.	
CR5021	SEMICONDUCTOR DEVICE, DIODE	1N270
CR5022 thru CR5027	Same as CR5021.	
CR5028	NOT USED	
CR5029	Same as CR5021.	
CR5030	Same as CR5021.	
DS5001	LAMP, INCANDESCENT: 28.0 volts; 0.04 amp; single contact midget flange base; T-1-3/4 bulb.	BI110-7
DS5002	INDICATOR, DIGITAL: blue.	IC102-1-6
DS5003	Non-replaceable item. (Part of XF5001)	
DS5004	Non-replaceable item. (Part of XF5002)	
DS5005	Non-replaceable item. (Part of XF5003)	
DS5006	Non-replaceable item. (Part of XF5004)	
DS5007	Non-replaceable item. (Part of XF5005)	
DS5008	Non-replaceable item. (Part of XF5006)	

PARTS LIST (CONT)

CONVERTER-STORER, SIGNAL DATA RTMU-2

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
F5001	FUSE, CARTRIDGE: 1-1/2 amps; time lag; 1-1/4" long x 1/4" dia.; slo-blo.	FU102-1.5
F5002	FUSE, CARTRIDGE: 1-1/2 amps; quick acting; 250 volts; 1-1/4" long x 1/4" dia.	FU100-1.5
F5003	FUSE, CARTRIDGE: 4 amps; quick acting; 250 volts; 1-1/4" long x 1/4" dia.	FU100-4
F5004	FUSE, CARTRIDGE: 3/10 amp; time lag; 1-1/4" long x 1/4" dia.; slo-blo.	FU102-.3
F5005	Same as F5004.	
F5006	FUSE, CARTRIDGE: 1/4 amp; quick acting; 250 volts; 1-1/4" long x 1/4" dia.	FU100-.250
J5001	CONNECTOR, RECEPTACLE, ELECTRICAL: 37 number 20 female contacts; 5 amps, 500 V. RMS.	JJ310-3
J5001-2	DELETED	
J5002	Same as J5001.	
J5002-3	DELETED	
J5003	Same as J5001.	
J5003-2	DELETED	
J5004	CONNECTOR, RECEPTACLE, ELECTRICAL: 15 number 20 female contacts; 5 amps, 500 V RMS.	JJ310-1
J5005	NOT USED	
J5006	CONNECTOR, RECEPTACLE, ELECTRICAL: AC power; 2 male contacts rated for 250 volts at 10 amps or 125 volts at 15 amps; polarized, twist lock.	JJ175
J5007	CONNECTOR, RECEPTACLE, ELECTRICAL: 22 female contacts; accommodates 1/16" printed circuit board.	JJ312-44

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
J5008 thru J5028	Same as J5007.	
K5001	RELAY, ELECTROMAGNETIC: DPDT; operating temperature range -65°C to +125°C ambient; sub-miniature type; hermetically sealed.	RL160-2
K5002	Same as K5001.	
Q5001	TRANSISTOR: PNP high current germanium; collector to base voltage 40 V; collector to emitter voltage 20 V; emitter to base voltages 20 V; collector current 7 amps, base current 3 amps; operating temperature range -65°C to +110°C; power dissipation 85 watts at 25°C; T03 case.	2N456A
Q5002 thru Q5004	Same as Q5001.	
R5001	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±5%; 1/2 watt.	RC20GF10-2J
R5002	Same as R5001.	
R5003	RESISTOR, FIXED, WIREWOUND: 0.5 ohm, current not rated; 5 watts.	RW107-54
R5004	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±5%; 2 watts.	RC42GF102J
R5005	RESISTOR, FIXED, COMPOSITION: 220 ohms, ±5%; 2 watts.	RC42GF221J
R5006	RESISTOR, FIXED, WIREWOUND: 0.5 ohm, current rating 6,300 ma; 20 watts.	RW110-47
R5007	RESISTOR, FIXED, WIREWOUND: 25 ohms, current rating 450 ma; 5 watts.	RW107-12
R5008	RESISTOR, FIXED, WIREWOUND: 500 ohms, current rating 142 ma; 10 watt.	RW109-19
R5009	RESISTOR, FIXED, WIREWOUND: 1 ohm, current 3,160 ma; 10 watts.	RW109-1

PARTS LIST (CONT)

CONVERTER-STORER, SIGNAL DATA RTMU-2

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R5010	RESISTOR, FIXED, COMPOSITION: 560 ohms, ±5%; 2 watts.	RR114-500W
R5011	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±5%; 2 watts.	RC42GF332J
R5012	Same as R5003.	
R5013	Same as R5010.	
R5014	RESISTOR, FIXED, WIREWOUND: 1,500 ohms, current rating 57 ma; 5 watts.	RW107-38
R5015	RESISTOR, FIXED, WIREWOUND: 3 ohms, current rating 1,290 ma; 5 watts.	RW107-4
R5016	NOT USED	
R5017	RESISTOR, FIXED, WIREWOUND: 4 ohms, current rating 1,117 ma; 5 watts.	RW107-5
R5018	Same as R5017.	
R5019	RESISTOR, FIXED, COMPOSITION: 10 ohms, ±5%; 1/2 watt.	RC20GF100J
R5020 thru R5025	Same as R5019.	
R5026	NOT USED	
R5027	TESISTOR, FIXED, COMPOSITION: 82 ohms, ±5%; 1 watt.	RC32GF820J
R5028	Same as R5027.	
R5029	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%; 1/2 watt.	RC20GF101J
R5030	Same as R5003.	
R5031	Same as R5008.	
R5032	Same as R5008.	
R5033	NOT USED	

PARTS LIST (CONT)

CONVERTER-STORER, SIGNAL DATA RTMU-2

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R5034	Non-replaceable item. (Part of XF5004)	
R5035	Non-replaceable item. (Part of XF5005)	
R5036	Non-replaceable item. (Part of XF5001)	
R5037	Non-replaceable item. (Part of XF5002)	
R5038	Non-replaceable item. (Part of XF5003)	
S5001	SWITCH, TOGGLE: SPST; 5 amps, 115 VAC; 28° angle of throw; solder lug terminals.	ST22N
T5001	TRANSFORMER, POWER, STEP-DOWN: primary-105, 115, 125 volts 50/60 cps, single phase; secondary- 17.5 V RMS (no load) at 3 amps DC, 17.5 V RMS (no load) at 0.75 amps DC; 12 solder lug type terminals; fully enclosed hermetically sealed grey steel case.	TF305
T5002	TRANSFORMER, POWER, STEP-DOWN: primary-105, 115, 125 volts 50/60 cps, single phase; secondary- 56 volts RMS (no load) at 0.25 amps DC, 55.5 volts RMS (no load) at 0.030 amps DC; 12 solder lug type terminals; fully enclosed hermetically sealed grey steel case.	TF306
XCR5001 thru XCR5014	NOT USED	
XCR5015	SOCKET, SEMICONDUCTOR DEVICE: polarized; 2 pin contact accommodation; 1-37/64" x 1" max. dim. o/a.	TS166-1
XCR5016 thru XCR5019	NOT USED	
XCR5020	Same as XCR5015.	
XDS5001	LIGHT, INDICATOR: with white translucent lens; 2 hot tinned brass terminals; sub-miniature type.	TS153-5

CONVERTER-STORER, SIGNAL DATA RTMU-2

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
XF5001	FUSEHOLDER: lamp indicating; accommodates cartridge fuse 1-1/4" long x 1/4" dia.; 80 - 90 volts, 20 amps; incandescent lamp type with 220K ohm lamp resistor; clear transparent flat sided knob; black body.	RH104-3
XF5002	FUSEHOLDER: lamp indicating; accommodates cartridge fuse 1-1/4" long x 1/4" dia.; 22 - 33 volts, 20 amps; incandescent lamp type with 330 ohm lamp resistor; transparent amber flat sided knob; brown body.	FH104-7
XF5003	Same as XF5002.	
XF5004	FUSEHOLDER: lamp indicating; accommodates cartridge fuse 1-1/4" long x 1/4" dia.; 33 - 45 volts, 20 amps; incandescent lamp type with 700 ohm lamp resistor; transparent amber flat sided knob; brown body.	FH104-12
XF5005	Same as XF5004.	
XF5006	FUSEHOLDER: lamp indicating; accommodates cartridge fuse 1-1/4" long x 1/4" dial; 13 - 22 volts, 20 amps; incandescent lamp type with no lamp resistor; transparent amber flat sided knob; brown body.	FH104-10
XK5001	SOCKET, RELAY: 8 female type contacts, bronze gold plate over silver plate; 0.200" center to center; melamine body.	TS173-3
XK5002	Same as XK5001.	
XQ5001 thru XQ5004	Same as XCR5015.	
Z5000	RESET CIRCUIT NO. 1 (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3694
Z5001	CLOCK TIMING CIRCUIT (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4295
Z5002	SHIFT REGISTER (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4294
Z5003	EQUIPMENT RECOGNITION MODULE (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4254

CONVERTER-STORER, SIGNAL DATA RTMU-2

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z5004	ADVANCE CIRCUIT NO. 1 (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3812
Z5005	ADVANCE CIRCUIT NO.2 (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3823
Z5006	SHIFT REGISTER NO.6 (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3820
Z5007	PRIME CIRCUIT MODULE (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3821
Z5008	ADVANCE CIRCUIT NO.3 (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3824
Z5009	MEMORY CORES MODULE (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3639
Z5010 thru Z5013	Same as Z5009. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z5014	RELAY DRIVE CIRCUIT NO. 1 (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3800
Z5015	TIMING CIRCUIT NO. 1 (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3805
Z5016	SHIFT REGISTER NO. 1 (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3689
Z5017	Same as Z5016. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3695
Z5018	CONVERTER CIRCUIT NO. 1 (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3695
Z5019	RELAY DRIVE CIRCUIT NO. 2 (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3795
Z5020	SHIFT REGISTER NO.7 (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3985

PARTS LIST

Z5000

RESET CIRCUIT NO. 1, A3694

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, METALLIZED 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	RESITOR, 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
Z1	NETWORK, BUFFER AMPLIFIER: 100 kc operating range; operating temperature range -35 to +85°C; 12 male contacts, epoxy case.	NW109-11
Z2	NETWORK, ONE SHOT GENERATOR: 100 kc operating range; operating temperature range -35 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 to +85°C; 12 male contacts, epoxy case.	NW105-11
Z6	NETWORK, EMITTER FOLLOWER: operating temperature range -35 to +85°C; 12 male contacts, epoxy case.	NW118-11
Z7	NETWORK, EMITTER FOLLOWER: operating temperature range -35 to +65°C; 12 male contacts, epoxy case.	NW118
Z8	NETWORK, POSITIVE EMITTER FOLLOWER: operating temperature range -35 to +85°C; 12 male contacts, epoxy case.	NW112-11
Z9 thru Z11	Same as Z8.	

PARTS LIST

Z5001

CLOCK TIMING CIRCUIT, A4295

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, METALIZED PLASTIC DIELECTRIC: 3.0 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy case.	CN114-3R0-5J
C2	CAPACITOR, FIXED, MICA DIELECTRIC: 470 uuf, ±5%; 500 WVDC; straight wire leads.	CM111E471J5S
C3	CAPACITOR, FIXED, METALIZED PLASTIC DIELECTRIC: 2.0 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy case.	CN114-2R0-5J
C4	CAPACITOR, FIXED, METALIZED PLASTIC DIELECTRIC: 0.68 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy case.	CN114R68-5J
CR1	SEMICONDUCTOR DEVICE, DIODE: peak inverse voltage 100 V; max. reverse current 100 ua at 25°C; power dissipation 80 mw at 25°C; max. operating temperature 90°C; DO-7 case.	1N270
CR2	Same as CR1.	
R1	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±5%; 1 watt.	RC32GF471J
R2	RESISTOR, FIXED, COMPOSITION: 1,200 ohms, ±5%; 1/2 watt.	RC20GF122J
R3	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
R4	RESISTOR, VARIABLE, COMPOSITION: 200 ohms, ±10%; 5 watts.	RV116-201-8-3
Z1	NETWORK, EMITTER FOLLOWER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW118-11
Z2	NETWORK, ONE SHOT GENERATOR: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW111-1
Z3	NETWORK, CLOCK GENERATOR: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW113-1X

Z5001

CLOCK TIMING CIRCUIT, A4295

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z4	NETWORK, FLIP-FLOP AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z5	NETWORK, NAND GATE AMPLIFIER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW104-21
Z6	NETWORK, BUFFER AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z7	NETWORK, BUFFER AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW109

Z5002

SHIFT REGISTER, A4294

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: 100 Kc operating range; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW107-14
Z3 thru Z8	Same as Z2.'	
Z9 thru Z12	Same as Z1.	

Z5003

EQUIPMENT RECOGNITION MODULE, A4254

C1	CAPACITOR, FIXED, MICA DIELECTRIC: 1,000 uuf, ±5%; 500 WVDC; straight wire leads.	CM111E102-J5S

PARTS LIST (CONT)

Z5003

EQUIPMENT RECOGNITION MODULE, A4254

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C2	Same as C1.	
CR1	SEMICONDUCTOR DEVICE, DIODE: peak inverse voltage 100 V; max. reverse current 100 ua at 25°C; power dissipation 80 mw at 25°C; max. operating temperature 90°C; DO-7 case.	1N270
CR2 thru CR4	Same as CR1.	
K1	RELAY, ELECTROMAGNETIC: DPDT; operating temperature range -65°C to +125°C ambient; sub-miniature type; hermetically sealed.	RL160-2
R1	RESISTOR, FIXED, COMPOSITION: 6,800 ohms, ±5%; 1/2 watt.	RC20GF682J
R2	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
R3	Same as R2.	
Z1	NETWORK, RELAY DRIVER: max. operating voltage 28 V; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW110-1
Z2	NETWORK, FLIP-FLOP AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z3	NETWORK, NAND GATE AMPLIFIER: operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW104-2
Z4	Same as Z3.	
Z5	NETWORK, ONE SHOT GENERATOR: 100 Kc operating range; operating temperature range -35°C to +65°C; epoxy case.	NW111-1
Z6	Same as Z5.	
Z7	NETWORK, DIGITAL INVERTER: operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW105-1

PARTS LIST

Z5004

ADVANCE CIRCUIT NO. 1, A3812

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, ELECTROLYTIC: 50 uf, -10% +150% at 120 cps at 25°C; 15 WVDC; polarized; insulated tubular case.	CE105-50-15
C2	CAPACITOR, FIXED, METALIZED PLASTIC DIELECTRIC: 0.10 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy case.	CN114R10-5J
CR1	SEMICONDUCTOR DEVICE, DIODE	1N270
CR2 thru CR8	Same as CR1.	
R1	RESISTOR, FIXED, COMPOSITION: 5,600 ohms, ±5%; 1/2 watt.	RC20GF562J
R2	RESISTOR, FIXED, COMPOSITION: 1,200 ohms, ±5%; 1/2 watt.	RC20GF122J
R3	Same as R2.	
R4	Same as R2.	
R5	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, ±5%; 1/2 watt.	RC20GF222J
Z1	NETWORK, RELAY DRIVER: operating temperature range -35°C to +65°C; 28 volts max. operating voltage; 12 male contacts, epoxy case.	NW110-1
Z2	NETWORK, COMPLIMENTARY EMITTER FOLLOWER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW118-11
Z3	NETWORK, ONE SHOT GENERATOR: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW111-1
Z4	Same as Z3.	
Z5	NETWORK, FLIP-FLOP AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z6	Same as Z5.	

PARTS LIST

Z5005

ADVANCE CIRCUIT NO. 2, A3823

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, METALIZED PLASTIC DIELECTRIC: 0.10 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy case.	CN114R10-5J
C2	CAPACITOR, FIXED, MICA DIELECTRIC: 1,000 uuf, ±5%; 500 WVDC; straight wire leads.	CM111E102J5S
C3	Same as C2.	
C4	Same as C1.	
R1	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±5%; 1/2 watt.	RC20GF332J
R2	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
R3	Same as R2.	
R4	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±5%; 1/2 watt.	RC20GF103J
Z1	NETWORK, ONE SHOT GENERATOR: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW111-1
Z2	NETWORK, BUFFER AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z3 thru Z5	Same as Z1.	
Z6	NETWORK, POSITIVE EMITTER FOLLOWER: operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW112-11
Z7	Same as Z2.	
Z8	NETWORK, NOR GATE AMPLIFIER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW119-21
Z9	Same as Z8.	

PARTS LIST

Z5006

SHIFT REGISTER NO. 6, A3820

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, METALIZED PLASTIC DIELECTRIC: 1.0 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy case.	CN114-1RO-5J
C2	Same as C1.	
C3	CAPACITOR, FIXED, MICA DIELECTRIC: 1,000 uuf, ±5%; 500 WVDC; straight wire leads.	CM111E102J5S
C4	NOT USED	
C5	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1,000 uuf, ±10%; 500 WVDC.	CC100-9
R1	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
Z1	NETWORK, ONE SHOT GENERATOR: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW111-1
Z2	NETWORK, CLOCK GENERATOR: operating temperature range -35°C to +65°C.	NW116-1
Z3	NETWORK, FLIP-FLOP AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z4 thru Z7	Same as Z3.	
Z8	NETWORK, BUFFER AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z9	NETWORK, GATE AMPLIFIER: operating temperature range -35°C to +85°C; 12 male contact, epoxy case.	NW108-26
Z10	Same as Z9.	
Z11	Same as Z3.	

PARTS LIST

Z5007

PRIME CIRCUIT MODULE, A3821

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, METALIZED PLASTIC DIELECTRIC: 0.10 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy encapsulated.	CN114R10-5J
C2	CAPACITOR, FIXED, METALIZED PLASTIC DIELECTRIC: 0.033 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy encapsulated.	CN114R033-5J
EQ1	HEAT SINK: transistor heat dissipating element.	HD101-1
EQ2	Same as EQ1.	
Q1	TRANSISTOR: germanium, NPN alloy-junction; collector to base and emitter to base voltage 25 V; collector current 300 ma; power dissipation 150 mw at 25°C; storage temperature range -65°C to +100°C; operating temperature range -65°C to +85°C; hermetically sealed metal case.	2N1308
Q2	Same as Q1.	
R1	RESISTOR, FIXED, COMPOSITION: 68 ohms, ±5%; 1/2 watt.	RC20GF680J
R2 thru R5	Same as R1.	
R6	RESISTOR, FIXED, COMPOSITION: 390,000 ohms, ±5%; 1/2 watt.	RC20GF394J
R7	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, ±5%; 1/2 watt.	RC20GF104J
R8	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
Z1	NETWORK, EMITTER FOLLOWER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW118-11
Z2	NETWORK, BUFFER AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z3	NETWORK, ONE SHOT GENERATOR: 100 Kc operating range; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW111-11

PARTS LIST

Z5008

ADVANCE CIRCUIT NO. 3, A3824

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, METALIZED PLASTIC DIELECTRIC: 0.10 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy encapsulated.	CN114R10-5J
C2	CAPACITOR, FIXED, MICA DIELECTRIC: 1,000 uuf, ±5%; 500 WVDC; straight wire leads.	CM111E102J5S
C3	Same as C1.	
EQ1	HEAT SINK: transistor heat dissipating element.	HD101-1
EQ2	Same as EQ1.	
Q1	TRANSISTOR: germanium, NPN alloy-junction; collector to base and emitter to base voltage 25 V; collector current 300 ma; power dissipation 150 mw at 25°C; storage temperature range -65°C to +100°C; operating temperature range -65°C to +85°C; hermetically sealed metal case.	2N1308
Q2	Same as Q1.	
R1	RESISTOR, FIXED, COMPOSITION: 1,200 ohms, ±5%; 1/2 watt.	RC20GF122J
R2	RESISTOR, FIXED, COMPOSITION: 8,200 ohms, ±5%; 1/2 watt.	RC20GF822J
R3	Same as R2.	
R4	Same as R1.	
R5	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±5%; 1/2 watt.	RC20GF332J
R6	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
R7	RESISTOR, FIXED, COMPOSITION: 33,000 ohms, ±5%; 1/2 watt.	RC20GF333J
Z1	NETWORK, BUFFER AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW109-11
Z2	NETWORK, ONE SHOT GENERATOR: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW111-1

PARTS LIST (CONT)

Z5008

ADVANCE CIRCUIT NO. 3, A3824

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z3	Same as Z2.	
Z4	Same as Z1.	
Z5	Same as Z2.	
Z6	Same as Z2.	
Z7	Same as Z1.	
Z8	Same as Z2.	

Z5009,10,11,12,13

MEMORY CORE MODULE, A3639

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, PLASTIC DIELECTRIC: 22,000 uuf, ±10%; 200 WVDC.	CN112B223K2
C2	CAPACITOR, FIXED, MICA DIELECTRIC: 620 uuf, ±5%; 500 WVDC; straight wire leads.	CM111E621J5S
C3	CAPACITOR, FIXED, PLASTIC DIELECTRIC: 470,000 uuf, ±10%; 100 WVDC.	CN112A474K1
C4	Same as C2.	
C5	CAPACITOR, FIXED, MICA DIELECTRIC: 300 uuf, ±5%; 500 WVDC; straight wire leads.	CM111E301J5S
C6	Same as C5.	
C7	CAPACITOR, FIXED, PLASTIC DIELECTRIC: 10,000 uuf, ±10%; 200 WVDC.	CN112B103K2
CR1	SEMICONDUCTOR DEVICE, DIODE: germanium; max. peak inverse voltage 60 V; continuous average forward current 50 ma; max. peak forward current 150 ma; max. surge current 500 ma; max. inverse current 500 ua at 50 volts or 30 ua at 10 volts.	1N34A
CR2	Same as CR1.	

Z5009,10,11,12,13

MEMORY CORE MODULE, A3639

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR3	SEMICONDUCTOR DEVICE, DIODE: silicon; peak inverse voltage 200 V; max. continuous DC current 1.5 amps at 50°C; surge current peak 50 amps at 1 ohm; max. operating temperature 150°C; max. forward voltage drop 0.90 volt at 1 amp at 25°C; max. reverse current 0.20 ma at 100°C at 200 test volts; A147 type case.	DD126-2
CR4	SEMICONDUCTOR DEVICE, DIODE	DD123-3
CR5	Same as CR3.	
CR6	Same as CR4.	
CR7	Same as CR1.	
L1	COIL, RADIO FREQUENCY: fixed; 15.0 uhy, ±10%; approx. DC resistance 0.144 ohms; current rating 1,000 ma for 20°C; molded mica filled phenolic form.	CL105-5
L2	COIL, RADIO FREQUENCY: fixed; 1.0 uh, ±5%; 84 ohms DC resistance; current rating 125 ma; molded case.	CL226-6
Q1	TRANSISTOR: germanium, PNP; collector to base voltage 30 V; emitter to base voltage 25 V; collector current 300 ma; power dissipation 150 mw at 25°C; operating temperature range -65°C to +85°C; storage temperature range -65°C to +100°C; JEDEC type TO5 case.	2N1303
Q2	TRANSISTOR: silicon, PNP; collector to base and collector to emitter voltage 25 volts; emitter to base voltage 4 volts; collector current 500 ma; max. power dissipation 0.7 watt at 25°C; operating junction temperature 125°C; storage temperature range -55°C to +125°C; hermetically sealed case.	2N3638
Q3	TRANSISTOR: PNP, alloy-junction germanium; collector to base voltage 25 V; emitter to base voltage 10 V; collector to emitter voltage 25 V; collector current 150 ma; power dissipation 150 mw at 25°C; collector junction temperature 85°C; storage temperature range -55°C to +85°C; hermetically sealed glass to metal case.	2N1370
R1	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, ±5%; 1/2 watt.	RC20GF222J
R2	RESISTOR, FIXED, COMPOSITION: 5,600 ohms, ±5%; 1/2 watt.	RC20GF562J

PARTS LIST (CONT)

Z5009,10,11,12,13

MEMORY CORE MODULE, A3639

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R3	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±5%; 1/2 watt.	RC20GF103J
R4	RESISTOR, FIXED, COMPOSITION: 56 ohms, ±5%; 1 watt.	RC32GF560J
R5	RESISTOR, FIXED, COMPOSITION: 1,500 ohms, ±5%; 1/2 watt.	RC20GF152J
R6	RESISTOR, FIXED, COMPOSITION: 2,700 ohms, ±5%; 1/4 watt.	RC07GF272J
R7	Same as R3.	
R8	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, ±5%; 1/2 watt.	RC20GF104J
R9	RESISTOR, FIXED, COMPOSITION: 12,000 ohms, ±5%; 1/2 watt.	RC20GF123J
R10	RESISTOR, FIXED, COMPOSITION: 39 ohms, ±5%; 1/2 watt.	RC20GF390J
R11	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±5%; 1/2 watt.	RC20GF332J
R12	Same as R6.	
Z1	CORE ASSEMBLY: Potted assembly, consists of 30 odd and even cores on terminal board. (NON-REPLACEABLE ITEM)*	
	* In the event that Z1 core assembly requires replacement, replace entire A3639 card.	

PARTS LIST

Z5014

RELAY DRIVE CIRCUIT NO. 1, A3800

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Q1	TRANSISTOR: germanium, NPN alloy-junction; collector to base and emitter to base voltage 25 V; collector current 300 ma; power dissipation 150 mw at 25°C; storage temperature range -65°C to +100°C; operating temperature range -65°C to +85°C; hermetically sealed metal case.	2N1308
Q2 thru Q5	Same as Q1.	
R1	RESISTOR, FIXED, COMPOSITION: 8,200 ohms, ±5%; 1/2 watt.	RC20GF822J
R2	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±5%; 1/2 watt.	RC20GF332J
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.	
Z1	NETWORK, BUFFER AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW109
Z2	NETWORK, FLIP-FLOP AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z3 thru Z6	Same as Z1.	
Z7 thru Z10	Same as Z2.	

PARTS LIST

Z5015

TIMING CIRCUIT NO. 1, A3805

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, METALIZED PLASTIC DIELECTRIC: 2.0 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy encapsulated.	CN114-2RO-5J
C2	CAPACITOR, FIXED, METALIZED PLASTIC DIELECTRIC: 3.0 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy encapsulated.	CN114-3RO-5J
C3	CAPACITOR, FIXED, ELECTROLYTIC: 3 uf, -10% +150% at 120 cps at 25°C; 15 WVDC; polarized; insulated tubular case.	CE105-3-15
C4	CAPACITOR, FIXED, MICA DIELECTRIC: 220 uuf, ±5%; 500 WVDC; straight wire leads.	CM111E221J5S
C5	CAPACITOR, FIXED, METALIZED PLASTIC DIELECTRIC: 0.68 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy encapsulated.	CN114R68-5J
R1	RESISTOR, VARIABLE, COMPOSITION: 200 ohms, ±10%; 5 watts.	RV116-201-8-3
R2	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
R3	Same as R2.	
Z1	NETWORK, CLOCK GENERATOR: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW113-1X
Z2	NETWORK, BUFFER AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z3	NETWORK, ONE SHOT GENERATOR: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW111-1
Z4	Same as Z3.	
Z5	Same as Z2.	
Z6	Same as Z2.	

PARTS LIST

Z5016,17

SHIFT REGISTER NO. 1, A3689

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z1	NETWORK, BUFFER AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z2	NETWORK, FLIP-FLOP AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW107-4X
Z3	Same as Z1.	
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.	

Z5018

CONVERTER CIRCUIT NO. 1, A3695

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
Z1	NETWORK, FLIP-FLOP AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X

PARTS LIST (CONT)

Z5018

CONVERTER CIRCUIT NO. 1, A3695

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z2 thru Z4	Same as Z1.	
Z5	NETWORK, BUFFER AMPLIFIER: 100 Kc operating range; 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: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW111-1

Z5019

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
Z1	NETWORK, RELAY DRIVER: 28 volts max. operating voltage; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW110-1
Z2	Same as Z1.	
Z3	NETWORK, BUFFER AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z4	Same as Z3.	

Z5019

RELAY DRIVE CIRCUIT NO. 2, A3795

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
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.	

Z5020

SHIFT REGISTER NO. 7, A3985

C1	CAPACITOR, FIXED, METALIZED PLASTIC DIELECTRIC: 0.10 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy encapsulated.	CN114R10-5J
C2	Same as C1.	
CR1	SEMICONDUCTOR DEVICE, DIODE	1N270
CR2	Same as CR1.	
R1	RESISTOR, FIXED, COMPOSITION: 10 ohms, ±5%; 1/2 watt.	RC20GF100J
R2	Same as R1.	
R3	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±5%; 1/2 watt.	RC20GF104J
R4	RESISTOR, FIXED, COMPOSITION: 39,000 ohms, ±5%; 1/2 watt.	RC20GF394J
R5	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
Z1	NETWORK, BUFFER AMPLIFIER: 100 Kc operating range; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z2	NETWORK, ONE SHOT GENERATOR: 100 Kc operating range; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW111-1

Z5020

SHIFT REGISTER NO. 7, A3985

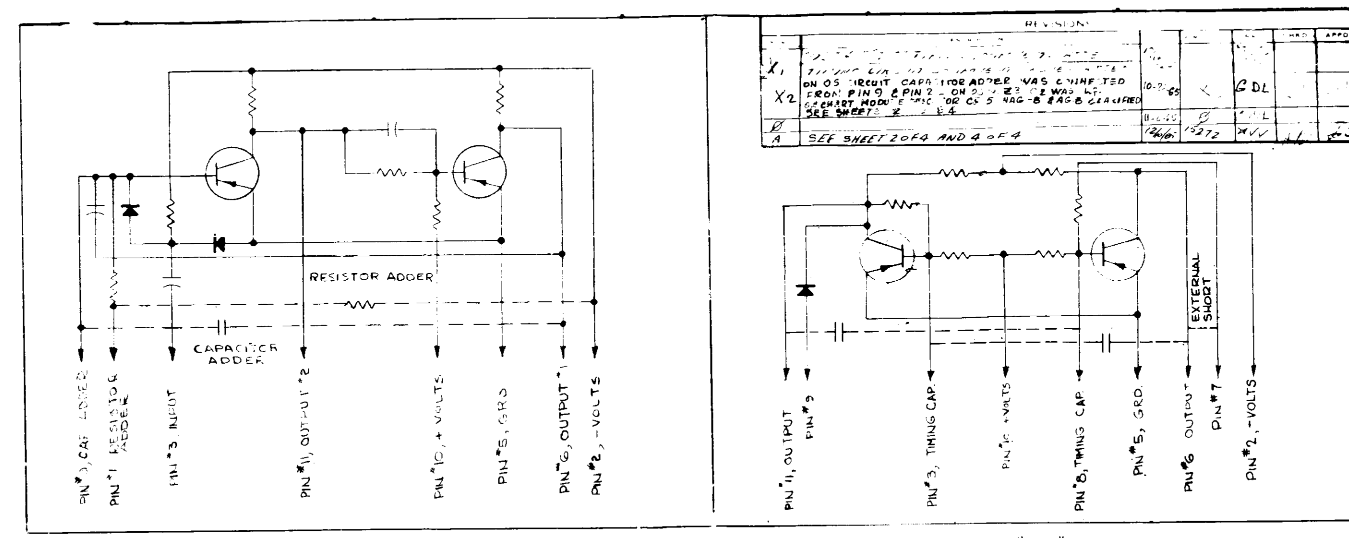
REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z3	NETWORK, EMITTER FOLLOWER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW118-11
Z4	NETWORK, POSITIVE EMITTER FOLLOWER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW112-11
Z5	Same as Z4.	

DIODE MATRIX ASSEMBLY, A3914

CR1	SEMICONDUCTOR DEVICE, DIODE	1N270
CR2 thru CR62	Same as CR1.	
R1	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±5%; 1/2 watt.	RC20GF332J
R2 thru R5	Same as R1.	

SECTION 7

SCHEMATIC WIRING

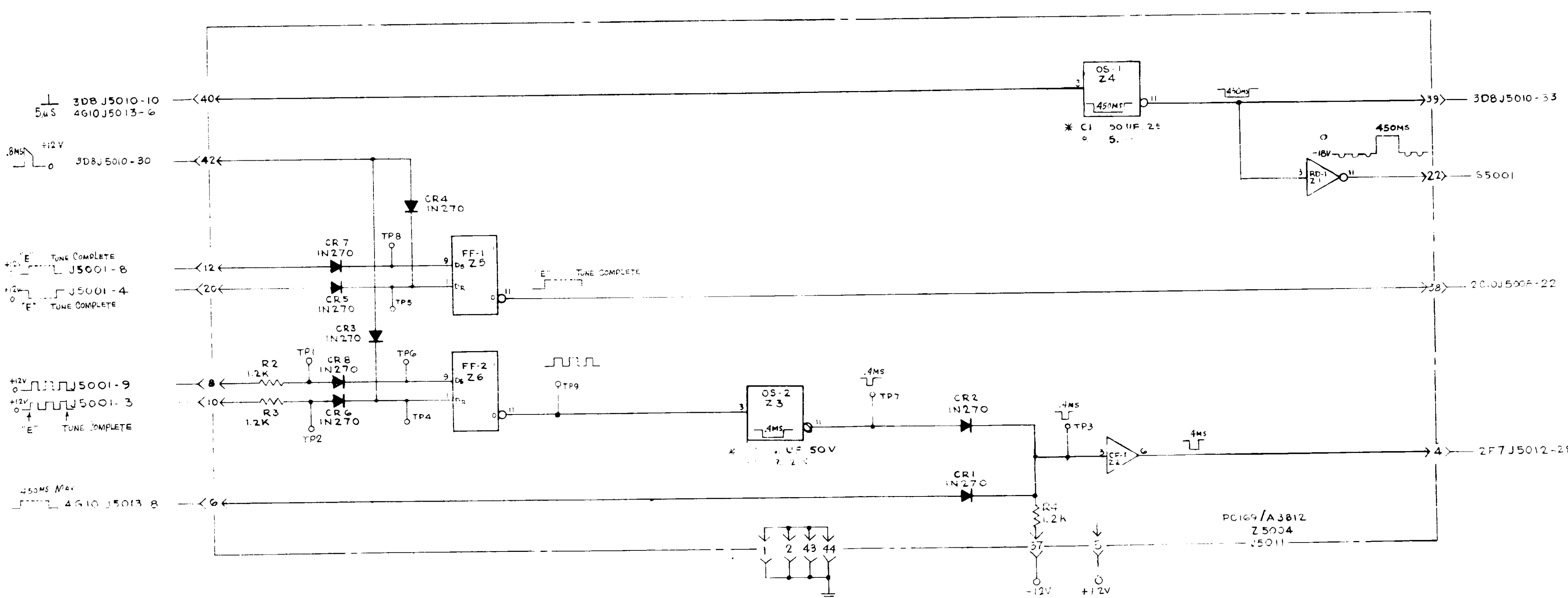


TYPICAL "OS" CIRCUIT

NOTE: * INDICATES VALUES OF RESISTOR & CAPACITOR USED WHEN CALLED FOR BENEATH RESPECTIVE "OS" MODULES IN DIAGRAM

TYPICAL "TG" CIRCUIT

NOTE: ** INDICATES VALUES OF CAPACITORS USED WHEN CALLED FOR BENEATH RESPECTIVE "TG" MODULE IN DIAGRAM. QTY OF CAPACITORS MAY VARY WHEN IT BECOMES NECESSARY TO PARALLEL TO ARRIVE AT DESIRED VALUE.



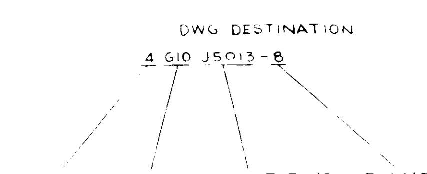


Figure 7-1. Detailed Logic Diagram, RTMU-2 (Memory and Series-to-Parallel Converter) (Sheet 1 of 4)

CK-1044A

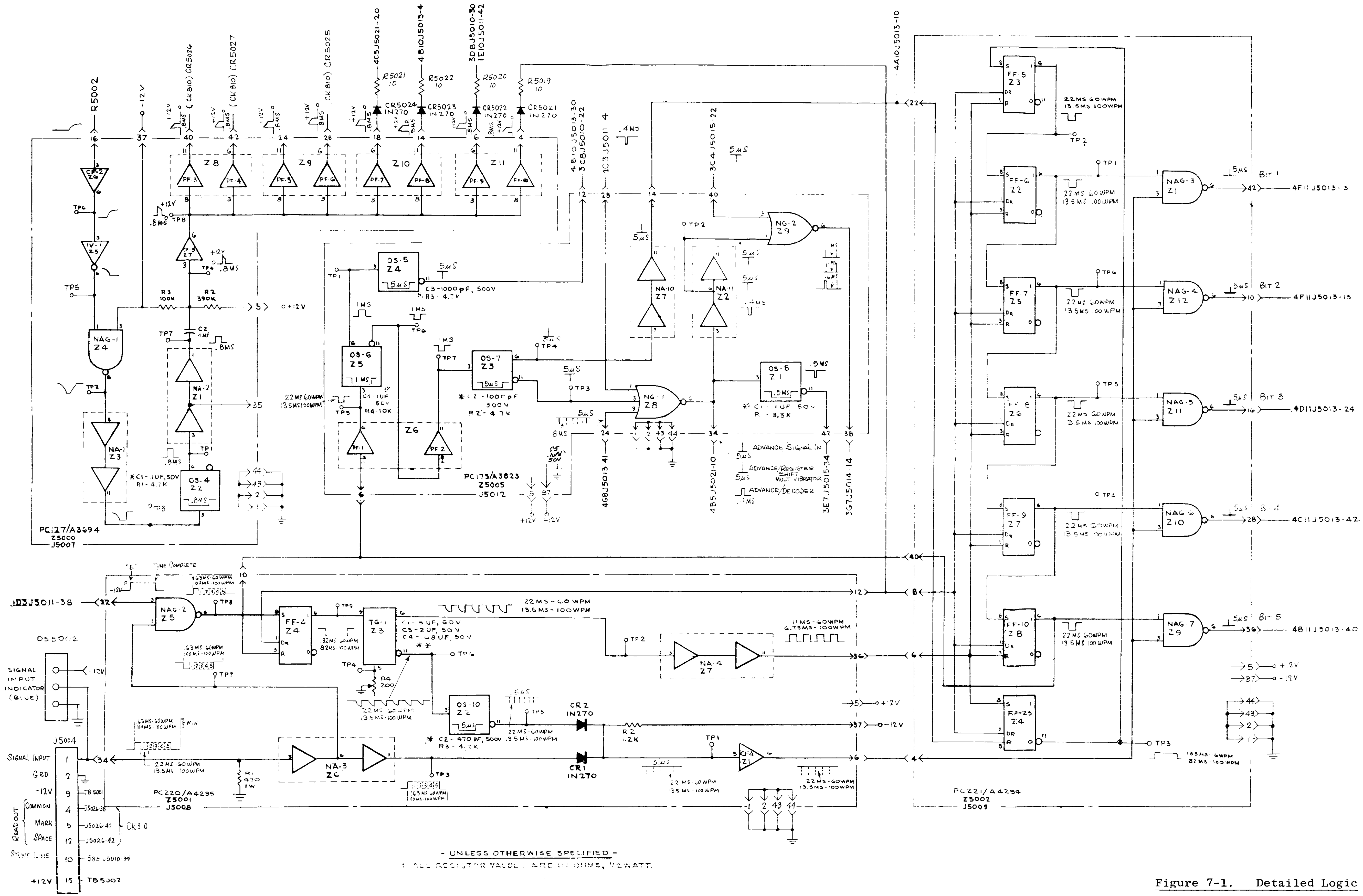


Figure 7-1. Detailed Logic Diagram, RTMU-2 (Memory and Series-to-Parallel Converter) (Sheet 2 of 4)

CK-1044A

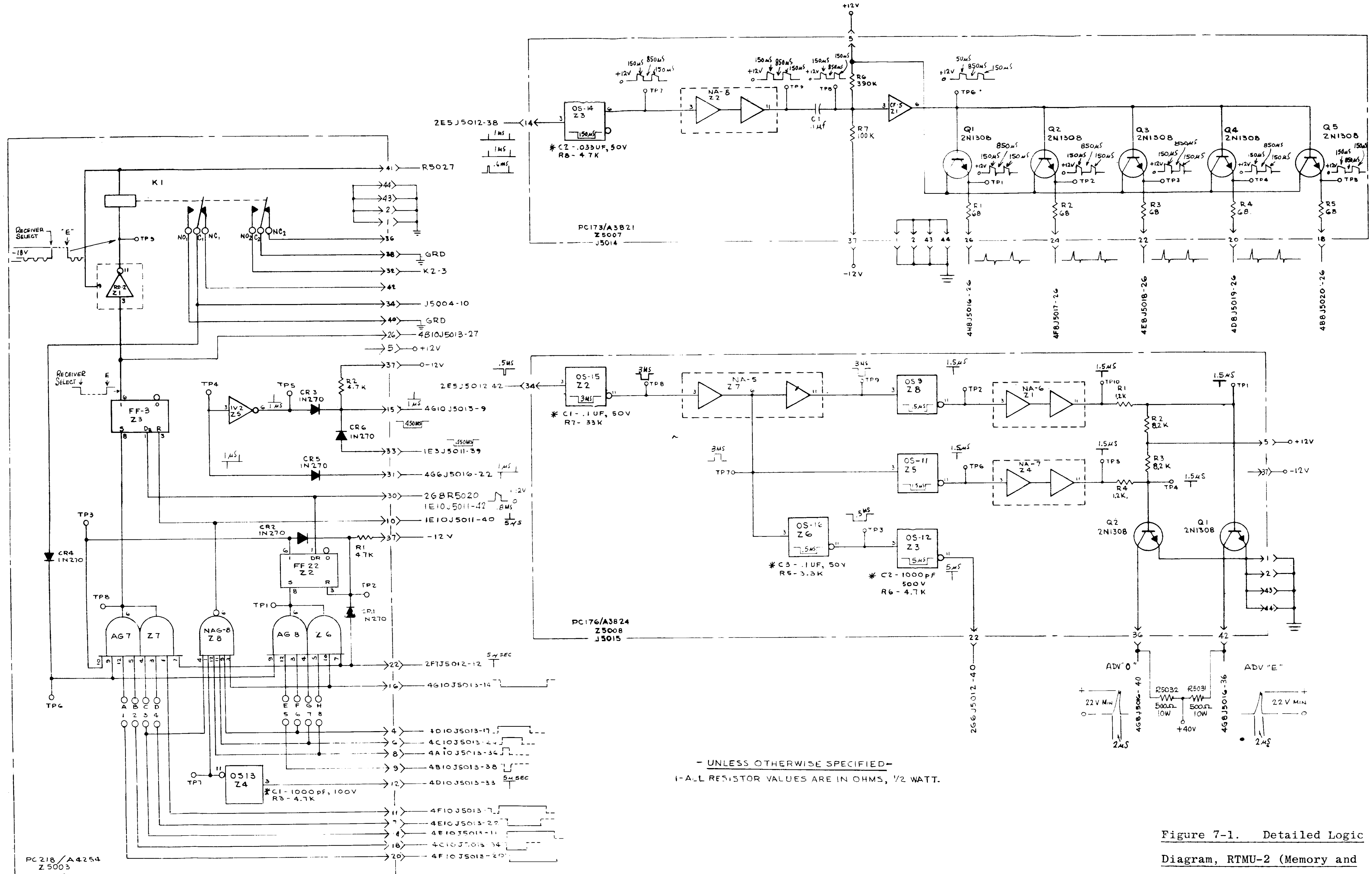


Figure 7-1. Detailed Logic Diagram, RTMU-2 (Memory and Series-to-Parallel Converter) (Sheet 3 of 4)

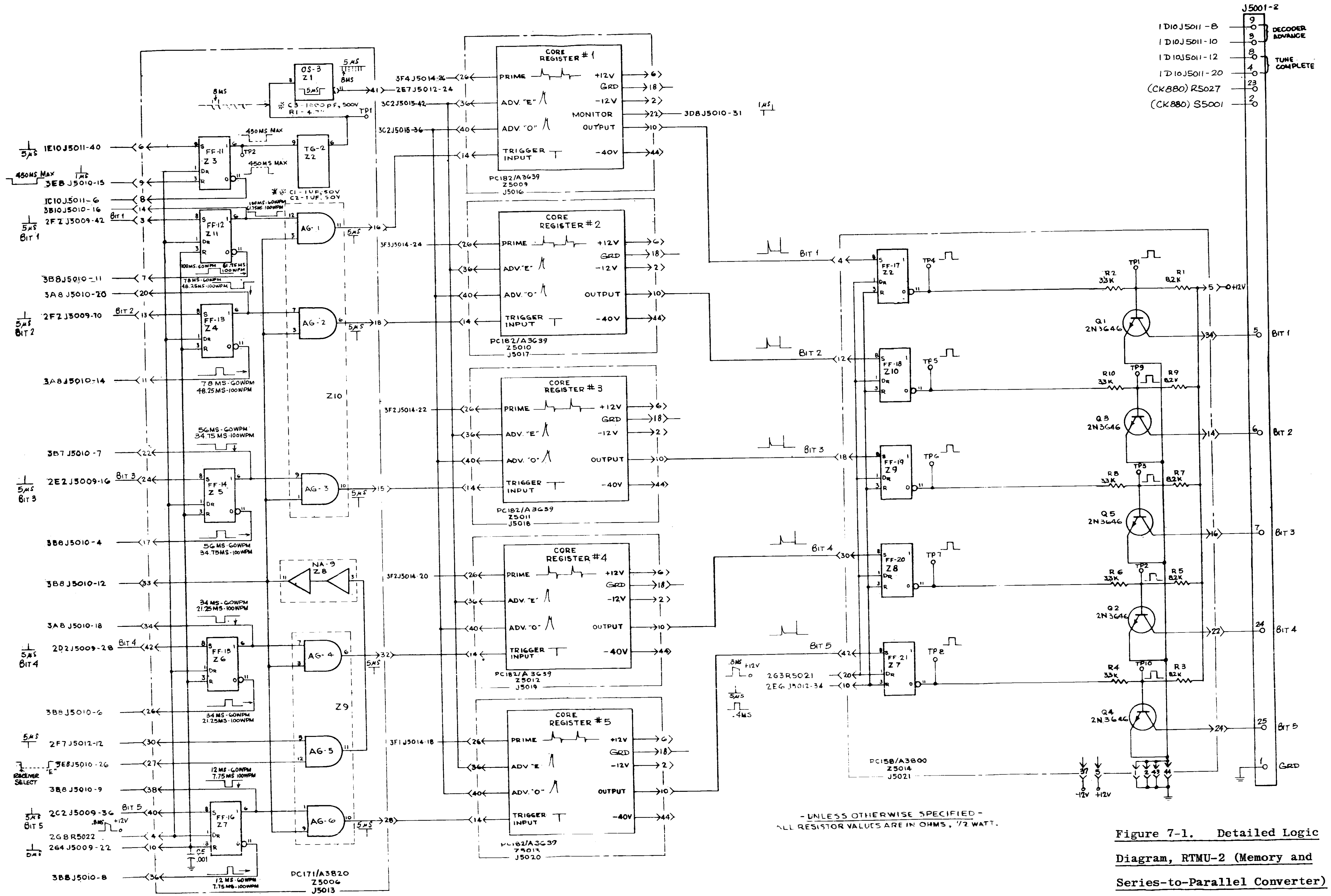


Figure 7-1. Detailed Logic Diagram, RTMU-2 (Memory and Series-to-Parallel Converter) (Sheet 4 of 4)

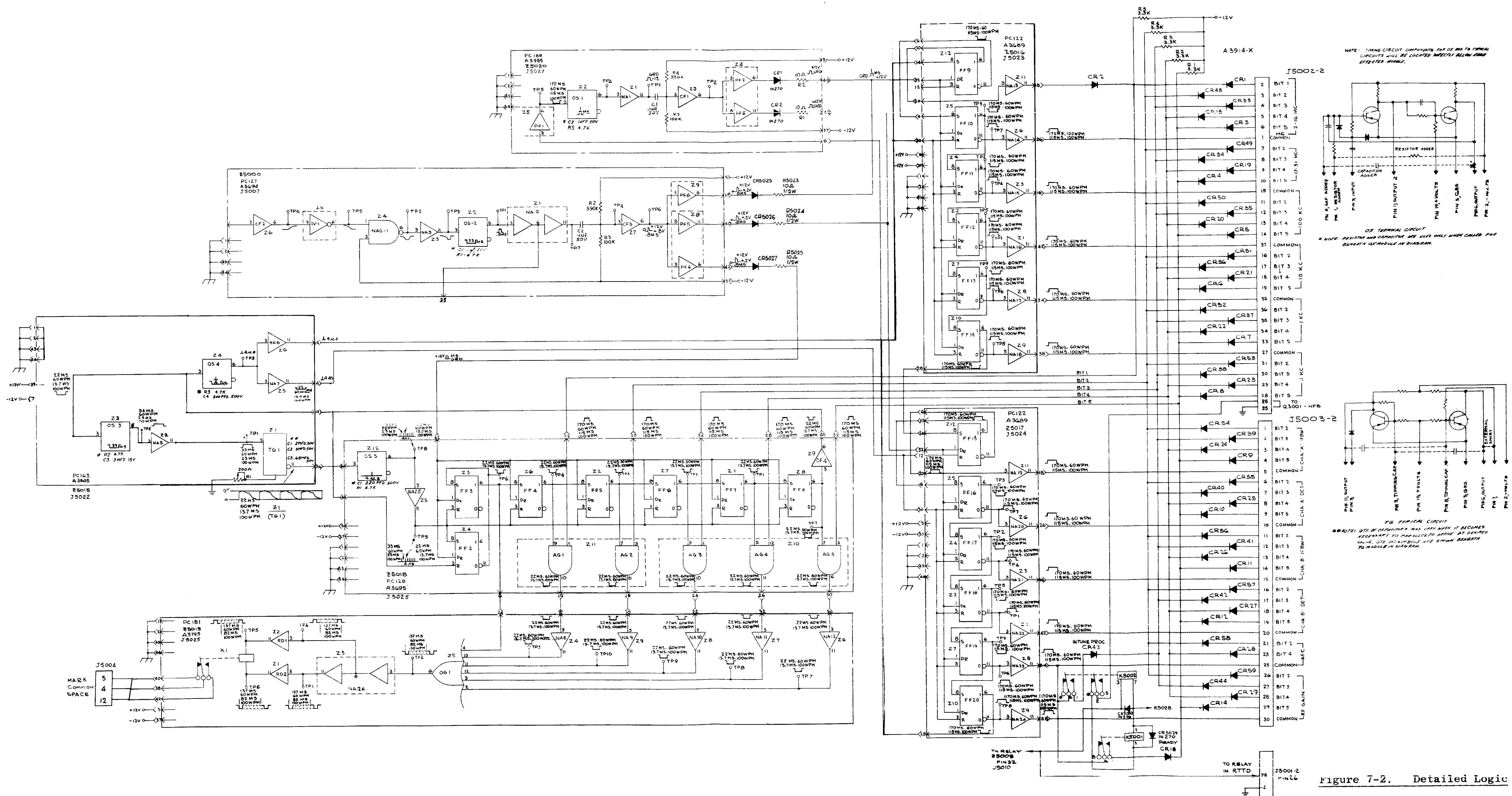
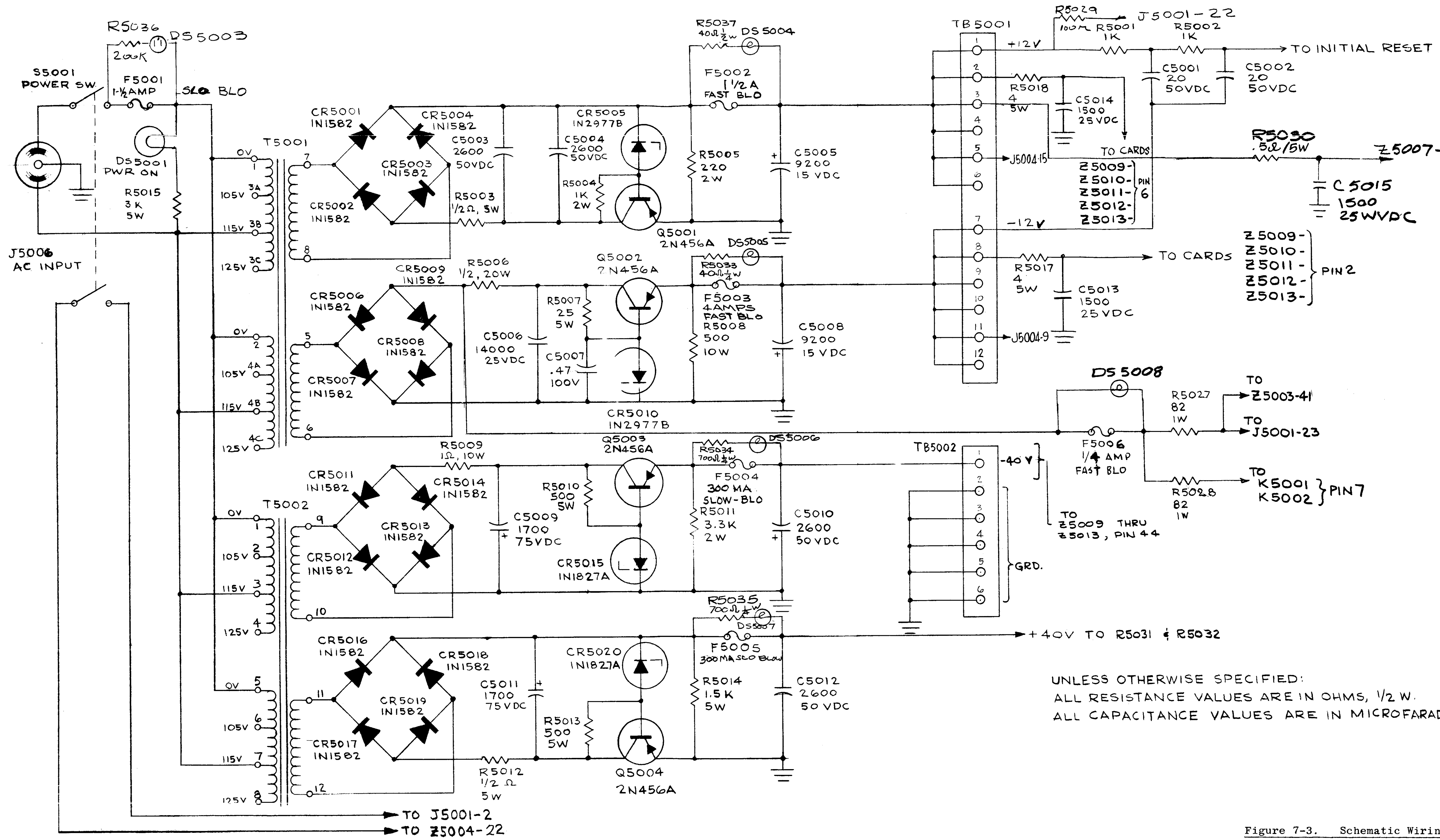
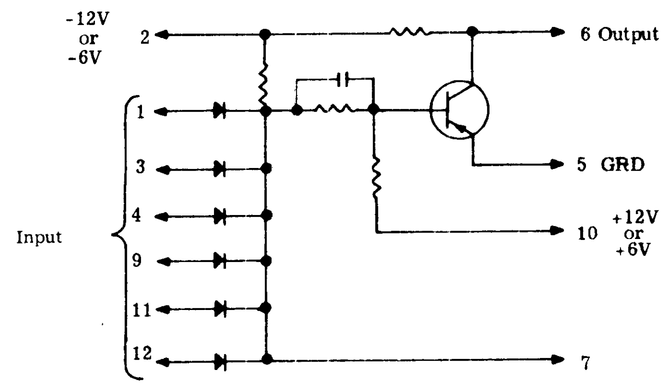


Figure 7-2. Detailed Logic Diagram, RTMU-2 (Readback Transmitter)



UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCE VALUES ARE IN OHMS, ½ W.
ALL CAPACITANCE VALUES ARE IN MICROFARADS.

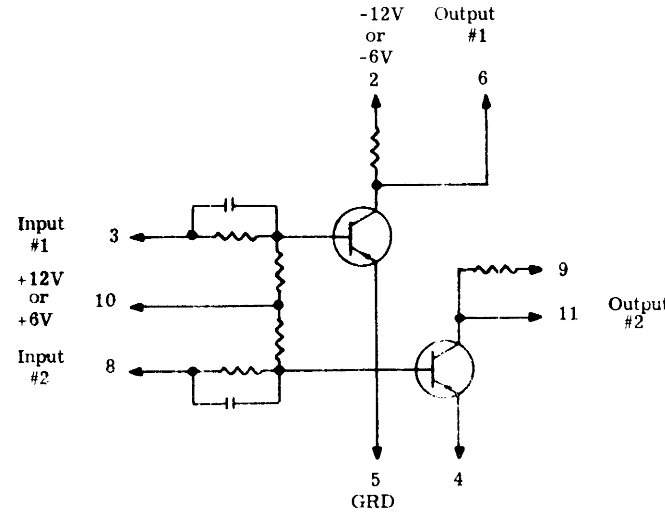
Figure 7-3. Schematic Wiring, Power Supply, RTMU



Polarizing Pin = #8

4097-17A

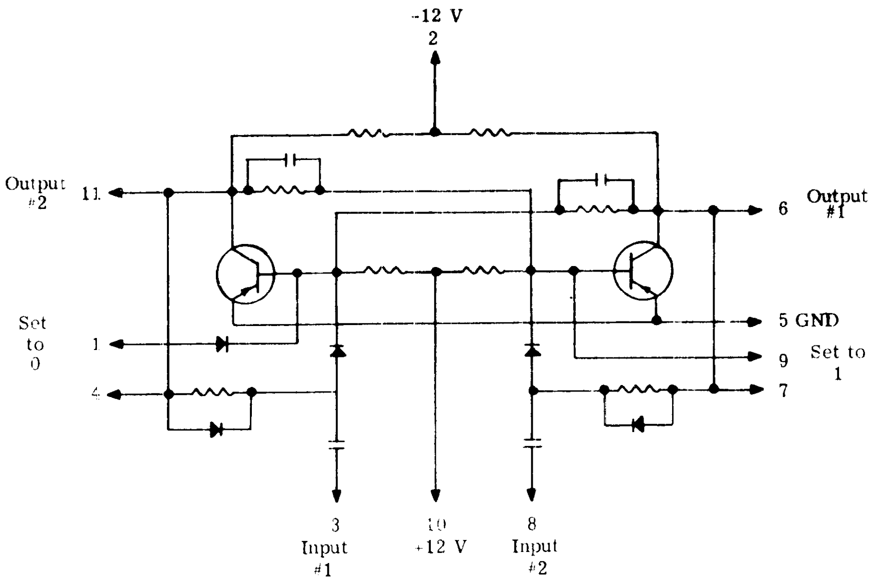
NANDGATES NW104-2, -21, -22



Polarizing Pin = #12

4097-17B

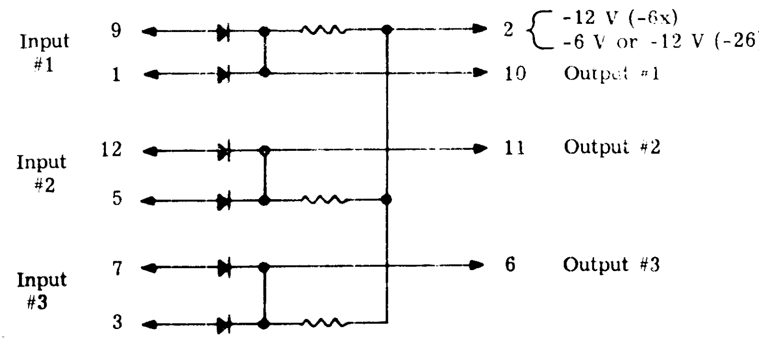
INVERTERS NW105-1, -11, -21



Polarizing Pin = #12

4097-17C

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

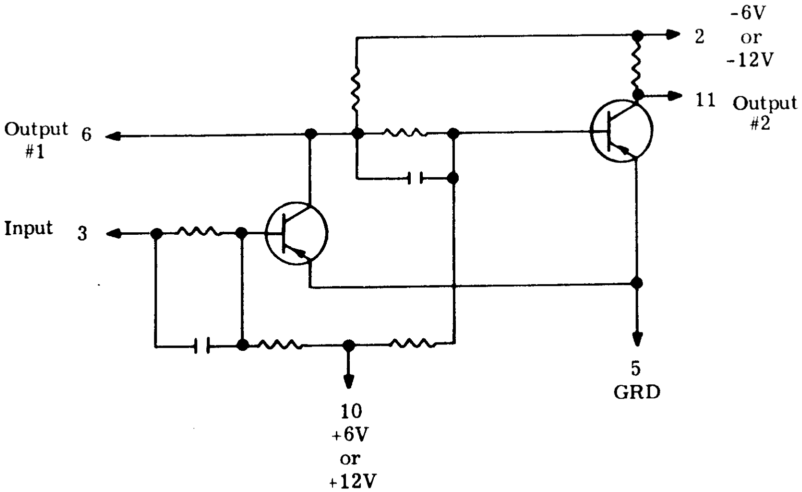


Polarizing Pin = #8

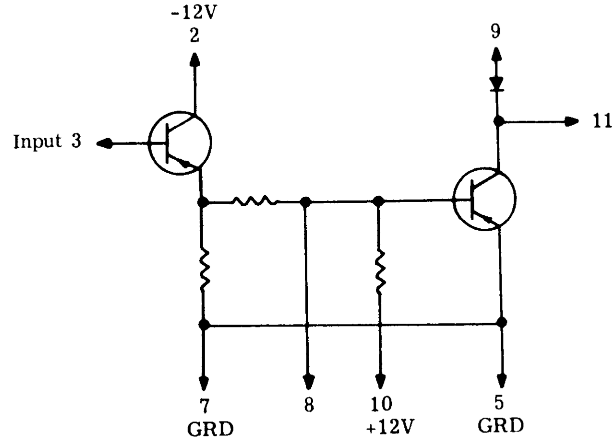
4097-17D

TRIPLE ANDGATES NW108-6X, -26

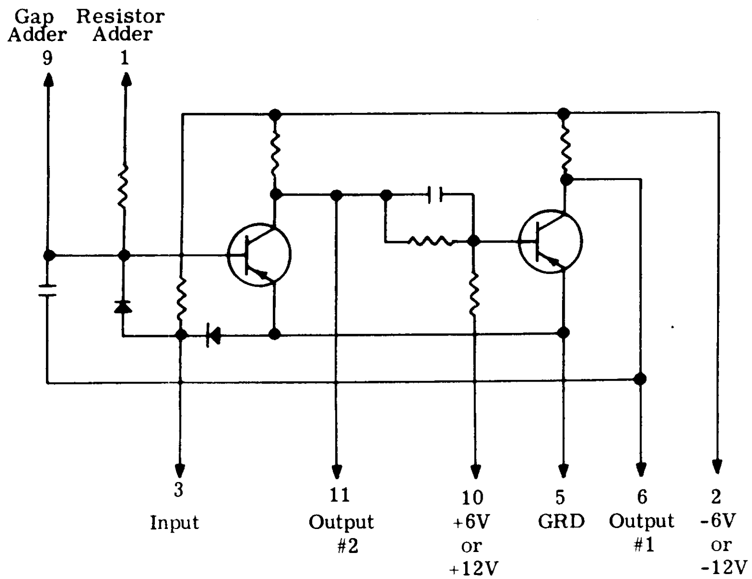
Figure 7-4. Schematic Wiring, Encapsulated Logic Modules (Sheet 1 of 4)



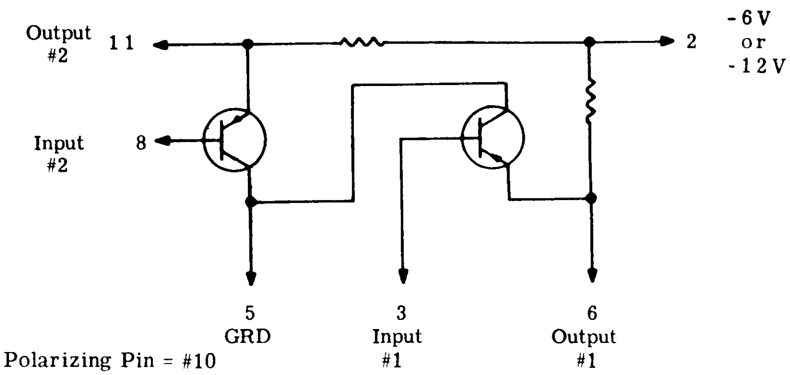
Polarizing Pin = #12
4097-17E
BUFFER AMPLIFIERS NW109, 109-11, -21



Polarizing Pin = #12
4097-17F
RELAY DRIVER NW110-1

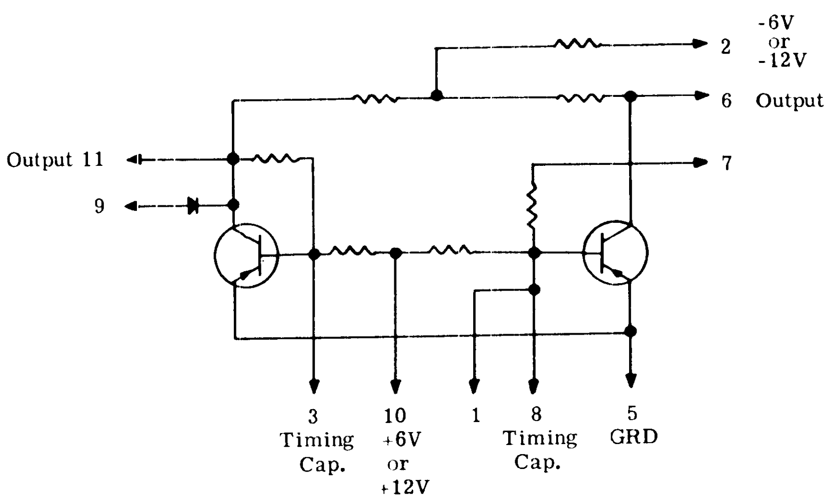


Polarizing Pin = #12
4097-17G
ONE-SHOTS NW111-1, -11, -21



Polarizing Pin = #10
4097-17H
POSITIVE EMITTER FOLLOWERS NW112, NW112-11, -21

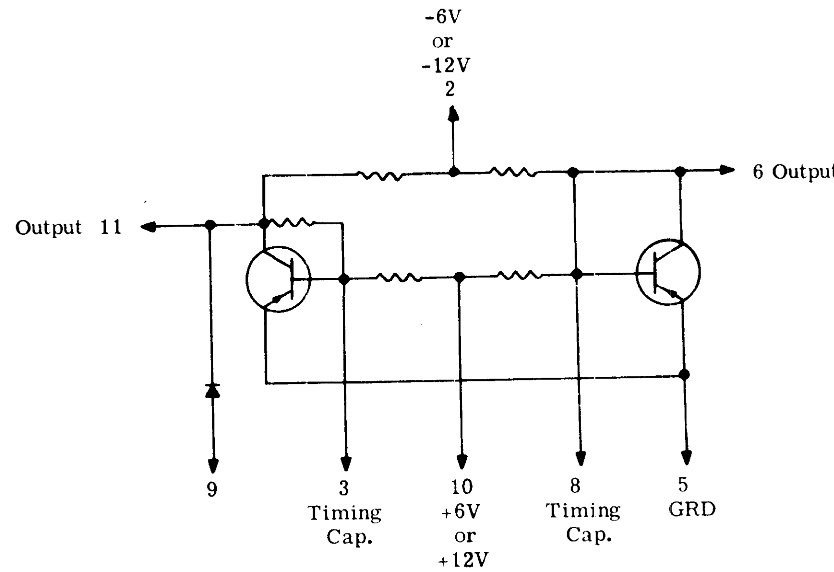
Figure 7-4. Schematic Wiring, Encapsulated Logic Modules (Sheet 2 of 4)



Polarizing Pin = #12

4097-17I

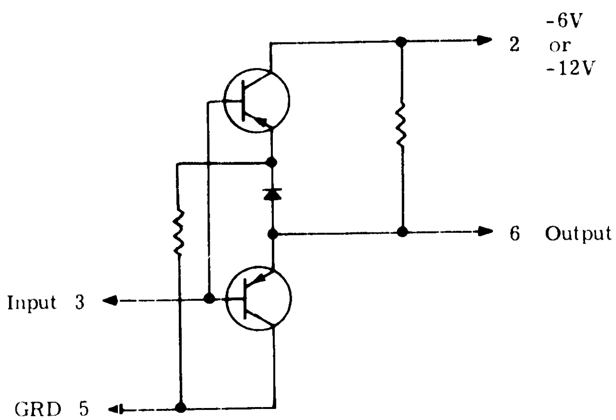
CLOCK GENERATOR NW113-1X



Polarizing Pin = #12

4097-17J

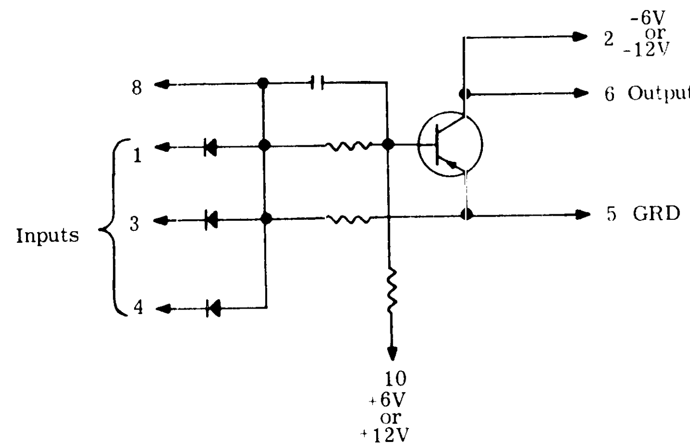
CLOCK GENERATORS NW116, NW116-11, -21



Polarizing Pin = #10

4097-17K

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



Polarizing Pin = #7

4097-17L

NORGATES NW119-1, -21

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

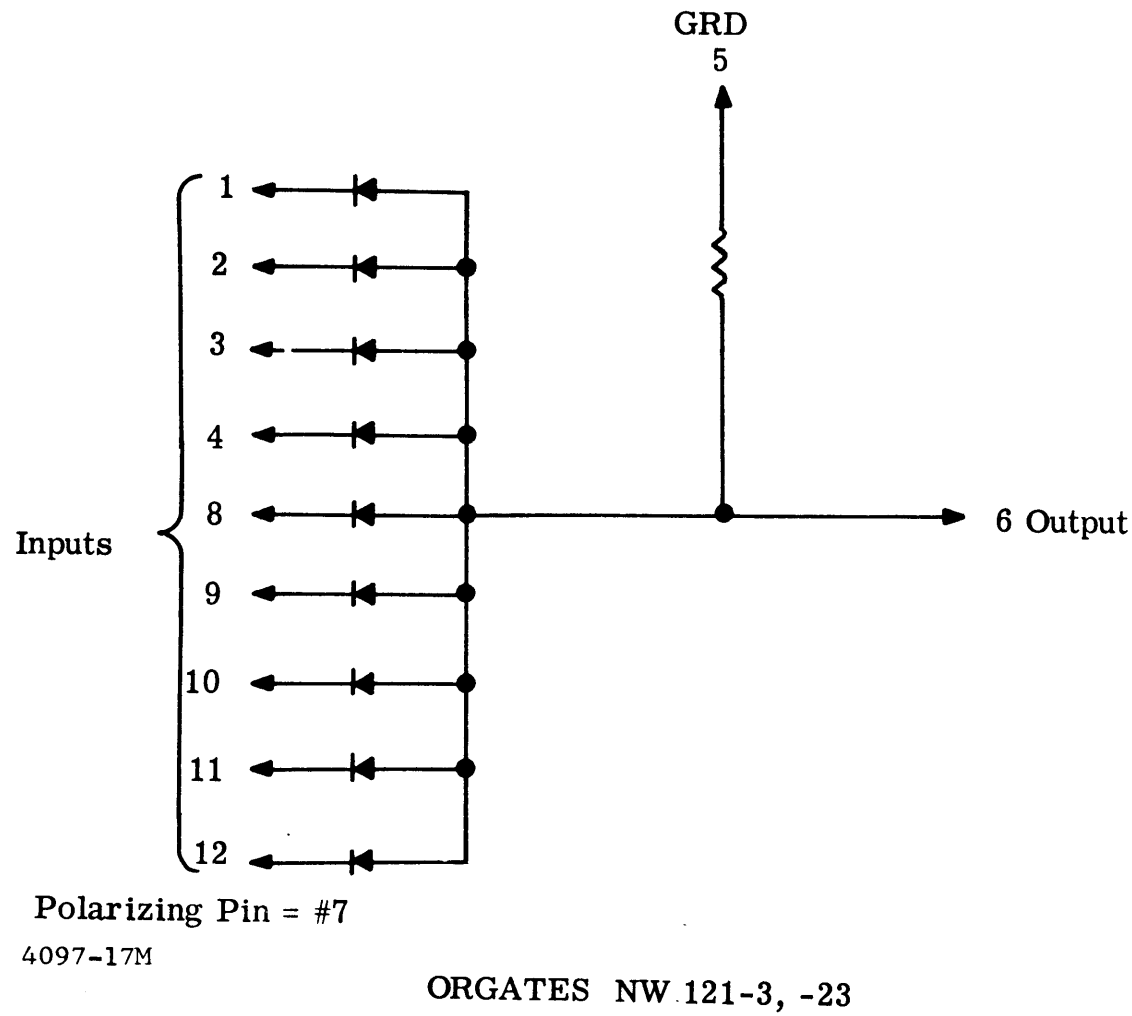
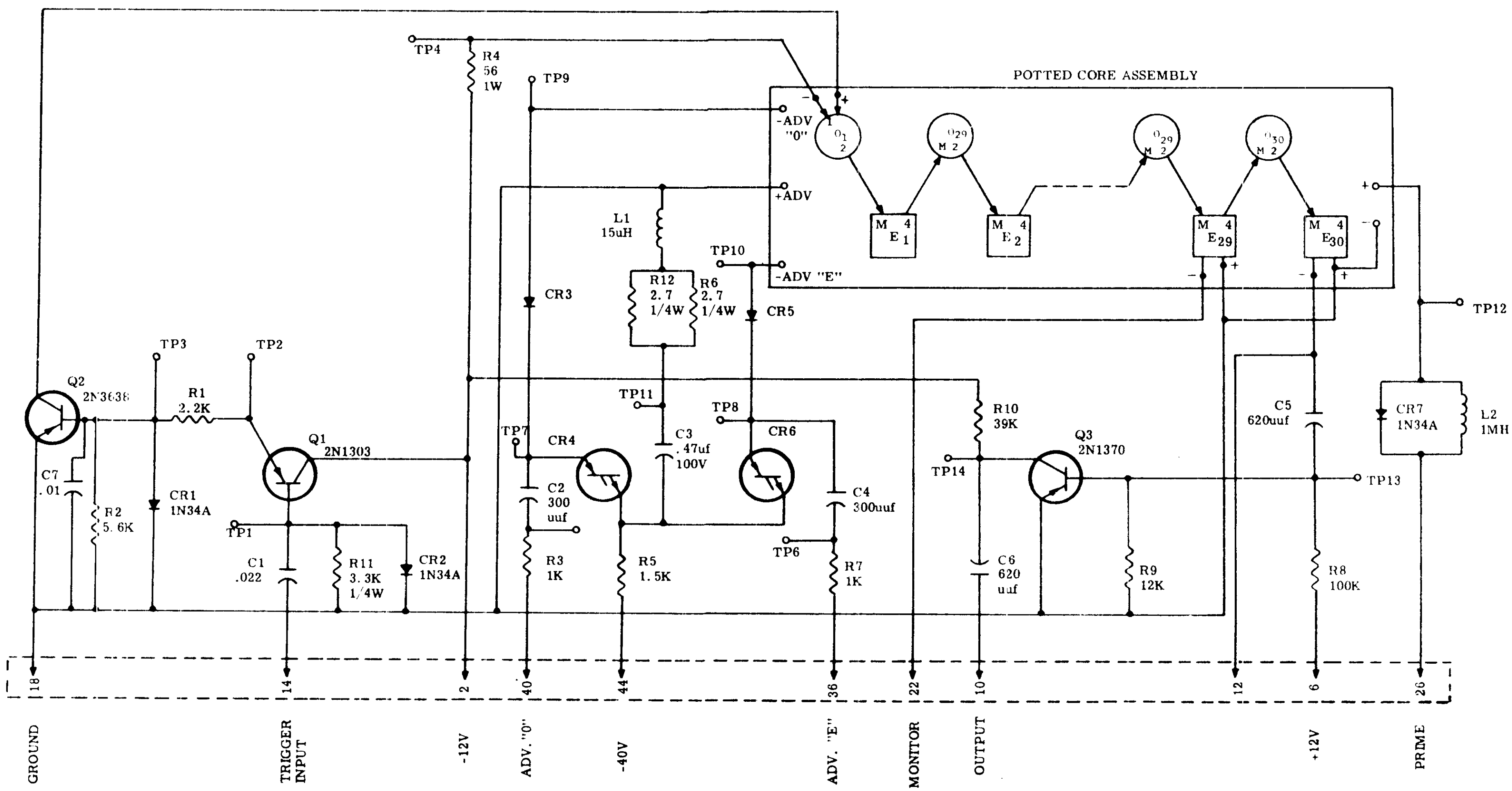


Figure 7-4. Schematic Wiring, Encapsulated Logic Modules (Sheet 4 of 4)



OPERATIONAL REQUIREMENTS:
VOLTAGE SUPPLIES:
+12±0.5 Volts W.R.T.G.
-12±0.5 Volts W.R.T.G.
-40±3.0 Volts W.R.T.G.
ADVANCE "0" & "E":
+22.5 Min. Volts
Duration ≥ 2 u Sec.
TRIGGER INPUT:
-7±Volts
Duration 5± 1 u Sec.
PRIME (PULSE):
150 ±10 MA
Duration 120 ±10 u Sec.
SPEED ("0" TO "0")
200 CPS Max.
TEMP. RANGE:
0°C to +50°C.

4097-18

Figure 7-5. Wiring Schematic, A3639 Memory Core Module