UNCLASSIFIED

TECHNICAL MANUAL

for

CHANNEL FREQUENCY INDICATOR

RTIH SERIES

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

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CHANNEL FREQUENCY INDICATOR

MODEL RTIH-1

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

IN-4093 Issue Date: 19 May 1967

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

FOREWORD

Because the different Channel Frequency Indicators (RTIH-1, RTIH-2, etc.) vary only in readback function from model to model, this manual is written to encompass all units. The differences in circuit design are adequately noted in text.

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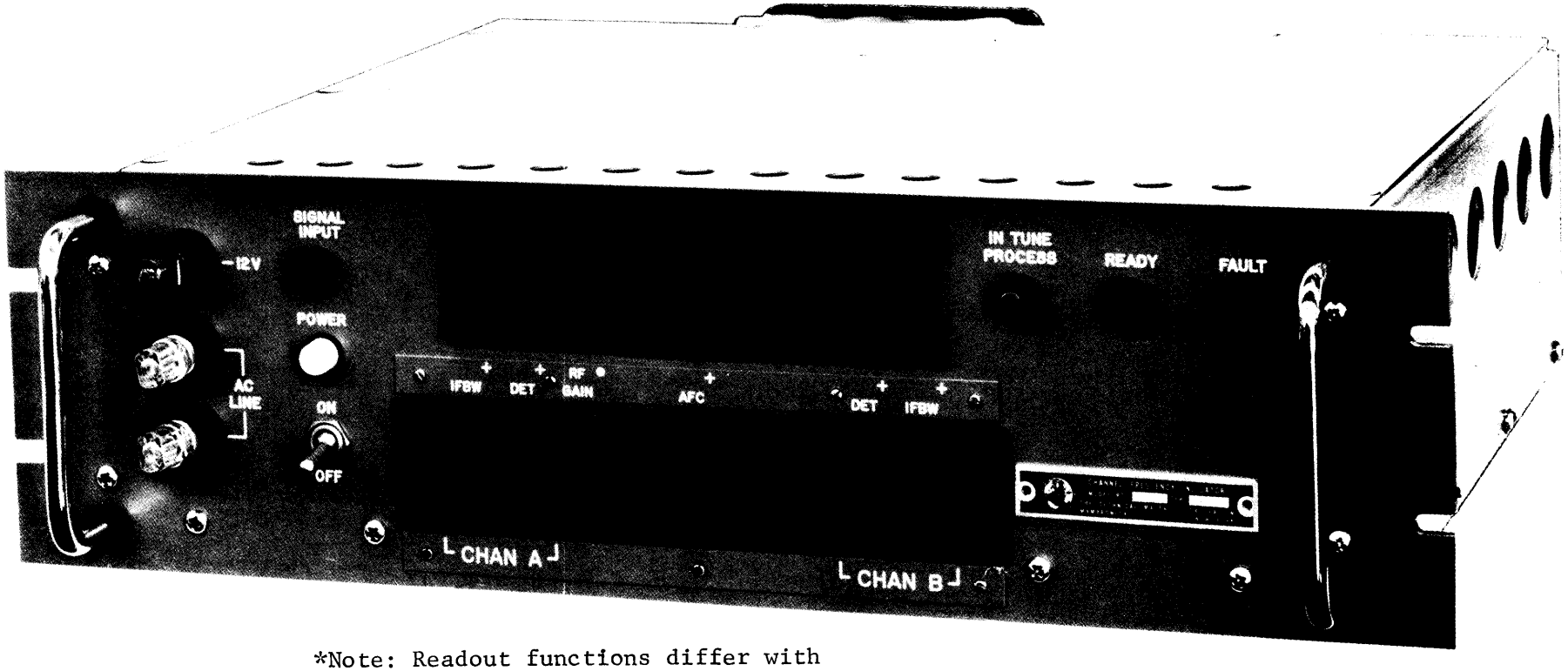


*Note: Readout functions differ with each model. RTIH-1 model shown above is typical.

4093-1

Figure 1-1. Channel Frequency Indicator, Model RTIH

667.13-8

SECTION 1

GENERAL DESCRIPTION

1-1. FUNCTIONAL DESCRIPTION

Model RTIH Channel Frequency Indicator is a monitor unit used in remote tuning of TMC's TechniMatiC* transmitters or receivers by wire or FSK radio transmission. A continuously cycling teletype input of up to fifteen codes presents lighted numerals and letters indicating a readback of transmitter or receiver control positions. Additional lights inform the operator on the state of the equipment tuning, i.e., if the controls are moving, if they have stopped moving, or if the equipment has failed to transmit the monitor signal back. One RTIH may be used, with an associated TMC equipment indicator panel, to read back an array of up to 16 transmitters or receivers. In this arrangement, the RTIH receives the equipment identification code as the last code in the readout cycle and processes it into a signal to energize the equipment indicator panel.

1-2. VARIATIONS IN MODELS

Variations of the RTIH Indicator (RTIH-1, -2, etc.) exist in some front-panel display identifications and readings. The variations (functions) are dependent on whether the RTIH is used for readback of transmitter or receiver controls; more variations exist within these two categories, depending on type and amount of readback. The pattern of the RTIH front panel is shown in figure 1-2 and remains the same throughout all models; the variations exist only in the lower row of readout displays, as indicated. This row is capable of housing 9 functional readouts; each function has a permanent location in the row as shown. Number of displays, panel lettering and specific read-

*Trademark applied for.

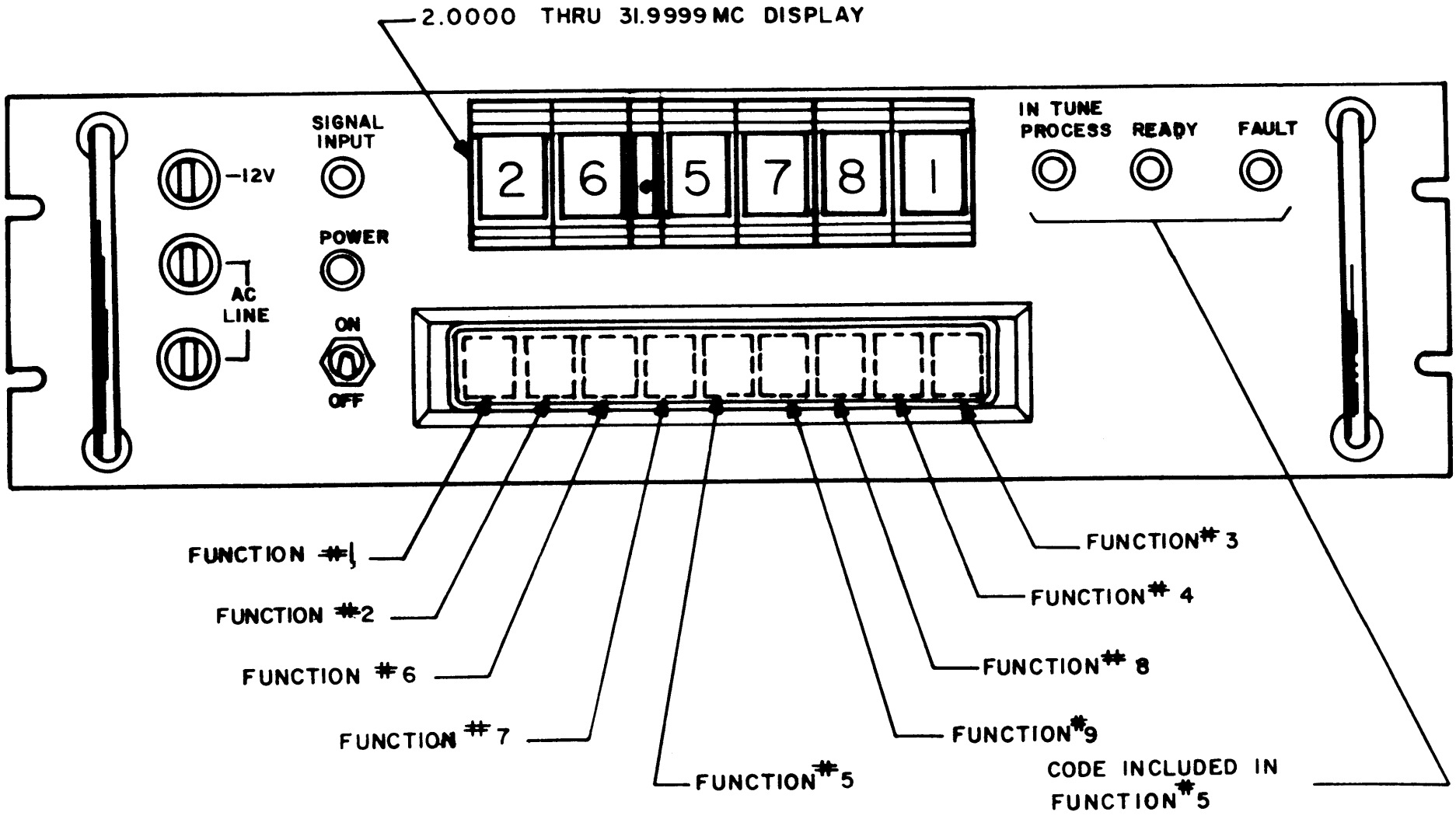


Figure 1-2. Panel Indicator Pattern, RTIH

outs vary from model to model. Code input per function location is always the same throughout the entire panel, however, on all models. The 2.0000- to 31.9999-mc frequency display is on all models and represents the frequency to which the transmitter or receiver has been tuned. IN TUNE PROCESS, READY and FAULT lamps, representing tuning status, are also on all models. The input codes and displays vs. RTIH model number are listed in tables 1-1 and 1-2.

Another variation is a printed circuit card (A4396 in J2009 receptacle) enabling the RTIH to be used with the equipment indicator. Input codes vs. equipments #1 thru #16 are listed in table 1-3.

1-3. PHYSICAL DESCRIPTION

The RTIH (see figure 1-1) is a 19-inch rack modular unit. The front panel is 19 inches wide x 5-1/4 inches high x 3/16 inch thick and is finished in grey enamel. The chassis extends 14-1/2 inches behind the panel. A blower, mounted on the chassis rear, extends another 3-1/4 inches.

The mc frequency display is in lighted filament numerals behind glass windows; control position displays, in the lower row, are projected onto their individual screens. The logic circuitry is miniature solid state, employing printed circuit plug-in cards. Encapsulated transistor/diode logic modules are mounted on the cards. The number of cards increases with the number of function readback displays through model variations.

1-4. TECHNICAL SPECIFICATIONS

SIGNAL INPUT:	A. Keying for serial pulses in 7.42 unit teletype transmission pattern with 22 millisecond (60 WPM) or 13.7 millisecond (100 WPM) pulse widths*. Continuous cycling of up to 15 codes per cycle, in sequence as listed in table 1-1.
	*B. If preferred, signal input may be through an attached Model AK-102A Isolation Keyer**. This enables operation of the RTIH from a 60ma neutral, 60ma polar or 20ma polar teletype loop.
INPUT CODES VS. DISPLAYS:	See tables 1-1 thru 1-3. Sixteen codes to be received in "reception order" shown in tables within each readback cycle.
POWER REQUIREMENT:	115/230 VAC, single phase, 50/60 cycle.

* As specified on order.

** AK-102 on RTIH containing TMC part number TF338 for transformer T2001 (see figure 5-1A); AK-102A for RTIH containing TF355 for T2001.

TABLE 1-1. INPUT CODES VS. DISPLAYS, STANDARD

RECEPTION ORDER	CODE	DISPLAY READINGS		
		RTIH-1 (receiver readback)		
1	10000	Resets flip-flops for new cycle.		
2	11001	MC frequency: 2		
	11000	3		
	10100	4		
	11100	5		
	11010	6		
	11110	7		
	11101	8		
	11111	9		
	10110	10		
	10111	11		
	11011	12		
	10011	13		
	10101	14		
	10001	15		
	10010	16		
	01001	17		
	01000	18		
	00100	19		

TABLE 1-1. INPUT CODES VS. DISPLAYS, STANDARD (CONT)

RECEPTION ORDER	CODE	DISPLAY READINGS		
		RTIH-1 (receiver readback)		
2 (cont)	01100	20		
	01010	21		
	01110	22		
	01101	23		
	01111	24		
	00110	25		
	00111	26		
	01011	27		
	00011	28		
	00101	29		
	00001	30		
	00010	31		
3	01000	.1 MC frequency: 0		
	00100	1		
	00010	2		
	01001	3		
	01100	4		
	00110	5		
	01011	6		
	01101	7		

TABLE 1-1. INPUT CODES VS. DISPLAYS STANDARD (CONT)

RECEPTION ORDER	CODE	DISPLAY READINGS		
		RTIH-1 (receiver readback)		
3 (cont)	01110	8		
	00111	9		
4	.01 MC frequency, 0-9 (same as .1 MC, 0-9)			
5	.001 MC frequency, 0-9 (same as .1 MC, 0-9)			
6	.0001 MC frequency, 0-9 (same as .1 MC, 0-9)			

TABLE 1-2. INPUT CODES VS. DISPLAYS, VARIABLE FUNCTIONS

RECEPTION ORDER	FUNCTION #	CODE	READING POSITION #	DISPLAY READINGS		
				RTIH-1 (receiver readback)		
7	1	01000	1	CHAN A IF BW: 1		
		00100	2	6		
		00010	3	15		
		01001	4	3.5U		
		01100	5	3.5L		
		00110	6	7.5U		
		01011	7	7.5L		
		01101	8	BLANK		
		01110	9			
		00111	10			
		00011	11			
		00001	12	BLANK		
8	2	01000	1	CHAN A DET: AM		
		00100	2	CW		
		00010	3	SSB		
		01001	4	BLANK		
		01100	5			
		00110	6			
		01011	7	BLANK		

TABLE 1-2. INPUT CODES VS. DISPLAYS, VARIABLE FUNCTIONS (CONT)

RECEPTION ORDER	FUNCTION #	CODE	READING POSITION #	DISPLAY READINGS		
				RTIH-1 (receiver readback)		
8 (cont)	2 (cont)	01101	8	BLANK		
		01110	9	↑		
		00111	10			
		00011	11	↓		
		00001	12	BLANK		
9	3	01000	1	CHAN B IF BW: 1		
		00100	2	6		
		00010	3	15		
		01001	4	3.5U		
		01100	5	3.5L		
		00110	6	7.5U		
		01011	7	7.5L		
		01101	8	BLANK		
		01110	9	↑		
		00111	10			
		00011	11	↓		
		00001	12	BLANK		
10	4			CHAN B DET:		

TABLE 1-2. INPUT CODES VS. DISPLAYS, VARIABLE FUNCTIONS (CONT)

RECEPTION ORDER	FUNCTION #	CODE	READING POSITION #	DISPLAY READINGS		
				RTIH-1 (receiver readback)		
10 (cont)		01000	1	AM		
		00100	2	CW		
		00010	3	SSB		
		01001	4	BLANK		
		01100	5	↕		
		00110	6			
		01011	7			
		01101	8			
		01110	9			
		00111	10			
		00011	11			
		00001	12	BLANK		
11	5	01000	1	AFC "ON" and FAULT lamp on.		
		00100	2	BLANK and IN TUNE PROCESS lamp on.		
		00010	3	AFC "OFF" and FAULT lamp on.		
		01001	4	AFC "ON" and READY lamp on.		

TABLE 1-2. INPUT CODES VS. DISPLAYS, VARIABLE FUNCTIONS (CONT)

RECEPTION ORDER	FUNCTION #	CODE	READING POSITION #	DISPLAY READINGS		
				RTIH-1 (receiver readback)		
11 (cont)	5 (cont)	01100	5	AFC "ON" and IN TUNE PROCESS lamp on.		
		00110	6	AFC "OFF" and IN TUNE PROCESS lamp on		
		01011	7	BLANK and READY lamp on		
		01101	8	AFC "ON" and IN TUNE PROCESS lamp on		
		01110	9	BLANK and all lamps on		
		00111	10	BLANK and all lamps out.		
		00011	11	AFC "OFF" and READY lamp on		
		00001	12	BLANK and READY lamp on		
12	6			RF GAIN:		
		01000	1	0		
		00100	2	1		
		00010	3	2		
		01001	4	3		
		01100	5	4		

TABLE 1-2. INPUT CODES VS. DISPLAYS, VARIABLE FUNCTIONS (CONT)

RECEPTION ORDER	FUNCTION #	CODE	READING POSITION #	DISPLAY READINGS		
				RTIH-1 (receiver readback)		
12 (cont)	6 (cont)	00110	6	5		
		01011	7	6		
		01101	8	7		
		01110	9	8		
		00111	10	9		
		00011	11	10		
		00001	12	AGC		
13	7	01000	1	NOT USED		
		00100	2			
		00010	3			
		01001	4			
		01100	5			
		00110	6			
		01011	7			
		01101	8			
		01110	9			
		00111	10			
		00011	11			
		00001	12	NOT USED		

TABLE 1-2. INPUT CODES VS. DISPLAYS, VARIABLE FUNCTIONS (CONT)

RECEPTION ORDER	FUNCTION #	CODE	READING POSITION #	DISPLAY READINGS		
				RTIH-1 (receiver readback)		
14	8	01000	1	NOT USED		
		00100	2			
		00010	3			
		01001	4			
		01100	5			
		00110	6			
		01011	7			
		01101	8			
		01110	9			
		00111	10			
		00011	11			
		00001	12	NOT USED		
15	9	01000	1	NOT USED		
		00100	2			
		00010	3			
		01001	4			
		01100	5			
		00110	6	NOT USED		

TABLE 1-2. INPUT CODES VS. DISPLAYS, VARIABLE FUNCTIONS (CONT)

RECEPTION ORDER	FUNCTION #	CODE	READING POSITION #	DISPLAY READINGS		
				RTIH-1 (receiver readback)		
15 (Cont)	9 (Cont)	01011	7	NOT USED		
		01101	8			
		01110	9			
		00111	10			
		00011	11			
		00001	12	NOT USED		

TABLE 1-3. EQUIPMENT IDENTIFICATION CODES *

RECEPTION ORDER	EQUIPMENT #	CODE	RTIH-1 (receiver readback)	MODEL USAGE
16	1	00001	NOT USED	
	2	00010		
	3	00011		
	4	00100		
	5	00101		
	6	00110		
	7	00111		
	8	01000		
	9	01001		
	10	01010		
	11	01011		
	12	01100		
	13	01101		
	14	01110		
	15	01111		
	16	00000	NOT USED	

*A4396 P/C card, in J2009 receptacle, and an associated equipment indicator are required for this readback.

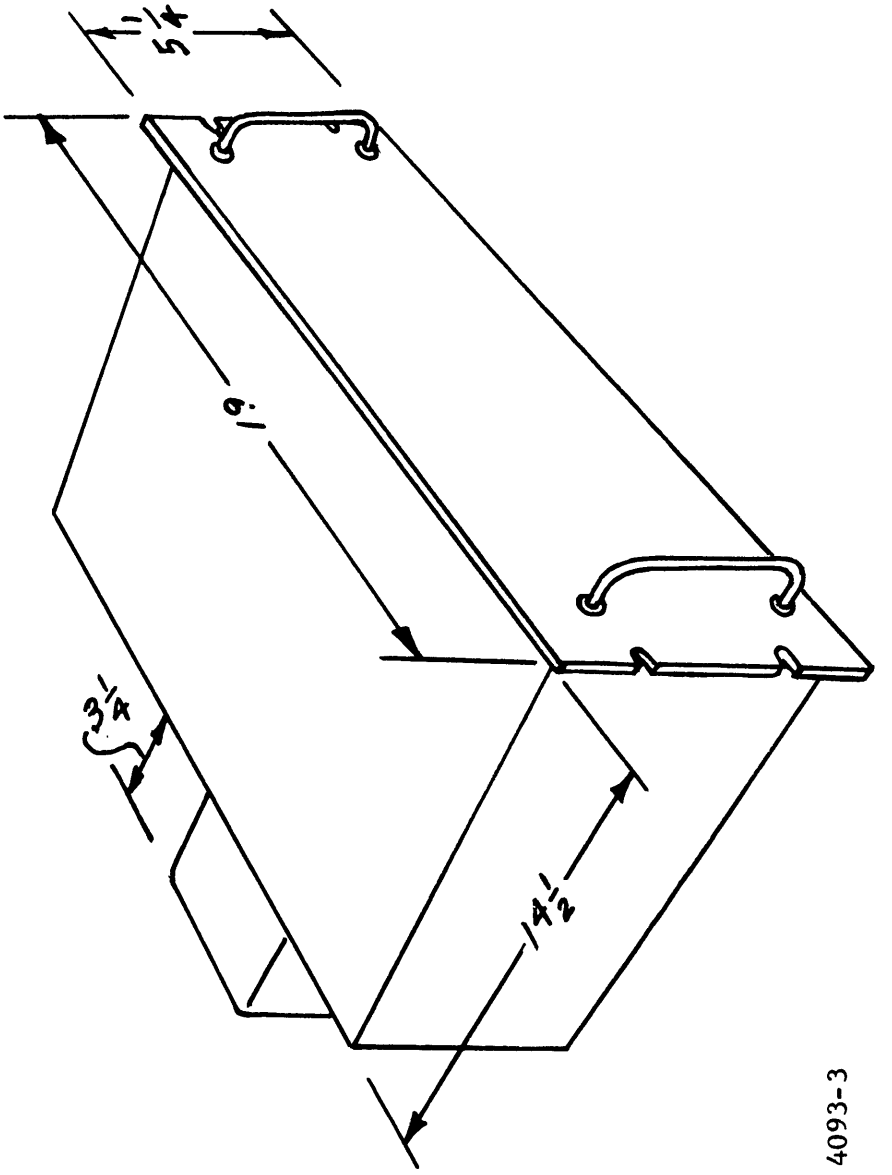


Figure 2-1. Dimensional Outline, RTIH

SECTION 2

INSTALLATION

2-1. INITIAL INSPECTION

Each RTIH 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." Card Extenders A4412 and A4448,TP128 Desoldering Tool, TP132 Connector Extractor and TP139 Cleaning Brush are included as maintenance tools.

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

2-2. MECHANICAL INSTALLATION

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

2-3. ELECTRICAL INSTALLATION

If the RTIH arrives as part of the shipment of a TMC rack system, refer to the system manual for connection of cables to associated equipment within the rack. When the RTIH is to be used separately,

however, make the following connections:

a. Line voltage input at J2019 receptacle, using CA555-3 cable supplied.

b. Signal input from remote transmitter or receiver at J2021 receptacle, as shown in figure 2-2.

c. If AK-102A Isolation Keyer is to be used (see paragraph 1-4, SIGNAL INPUT) attach Keyer to RTIH and signal input to Keyer as shown in figure 2-2*. Different TTY loop currents require different resistor installations in AK-102A. See TTY LOOP CHART in figure 7-13.

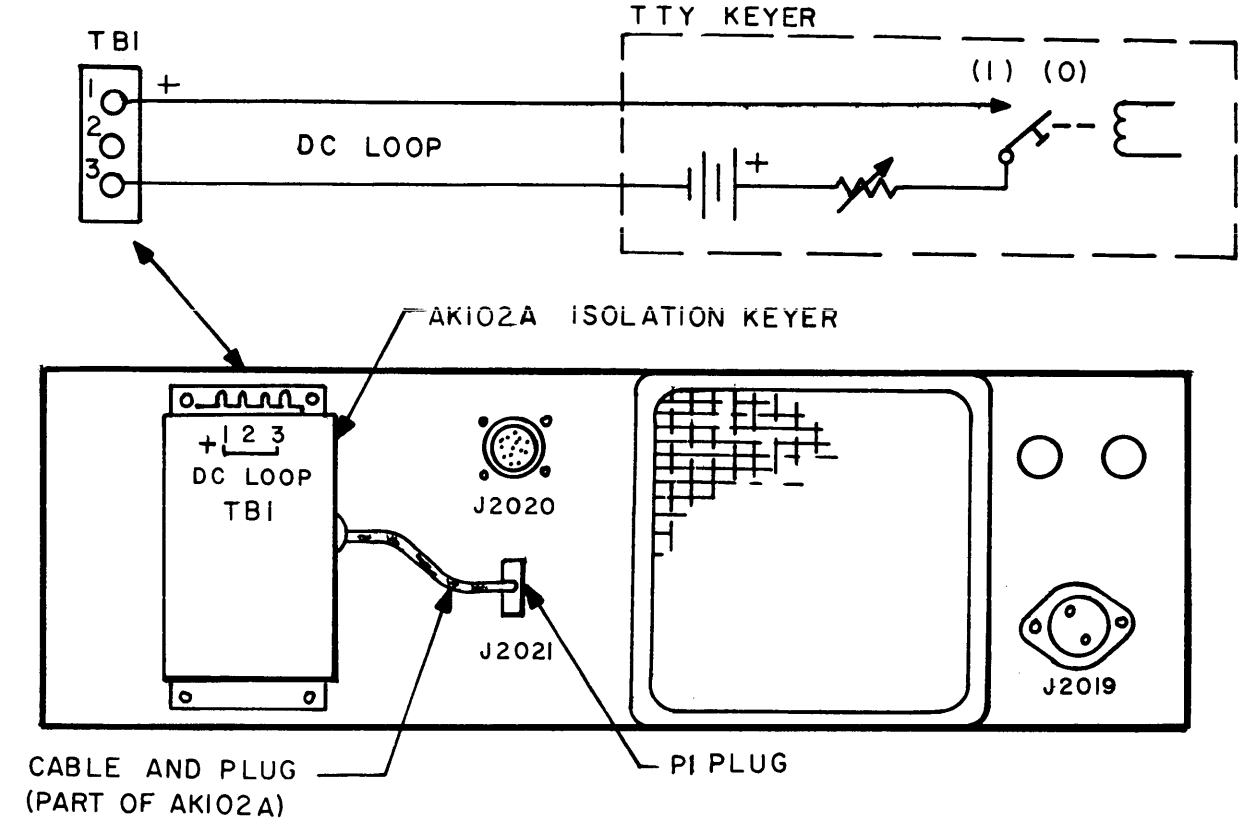
d. Output to external equipment indicator (see paragraph 1-1) at J2020 receptacle.

When the RTIH is shipped separately, mating plugs are furnished for all connections.

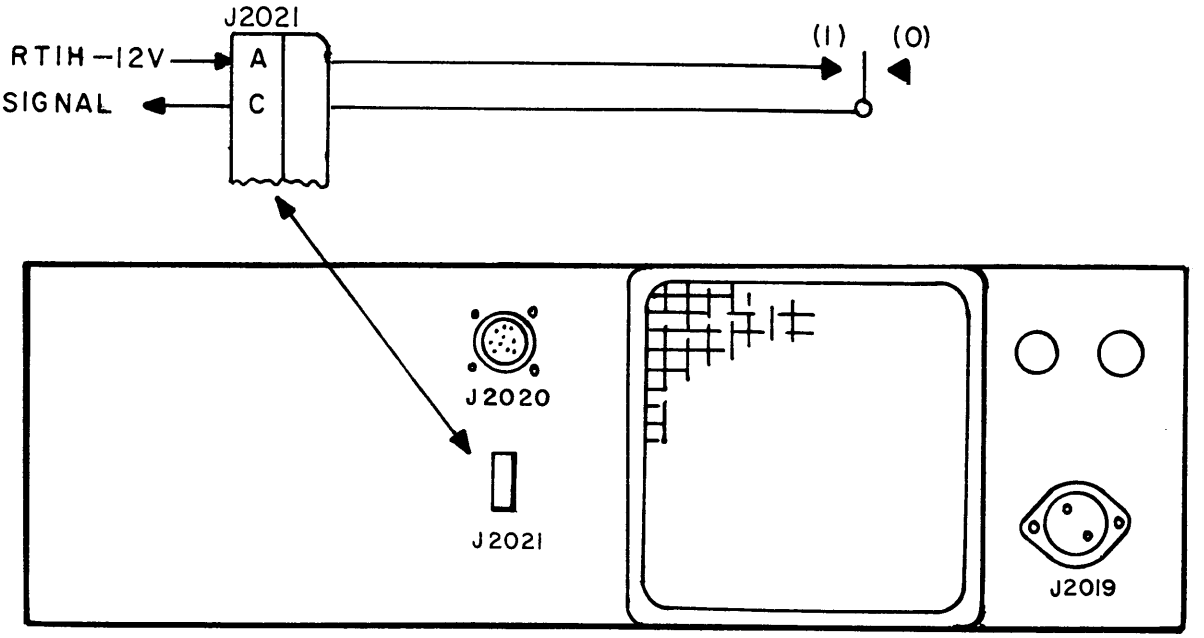
2-4. 60 VS. 100 WPM TRANSMISSIONS

The rate of speed in which the series of codes enter the signal input at J2021 can be any value and the timing may be regular or irregular, as long as the codes enter in the sequence shown in tables 1-1 thru 1-3. However, the pulse width (within the code) that the RTIH can handle depends upon the clock generator circuit in printed circuit plug-in card Z2001. Cards are available for pulse widths corresponding with 60 wpm or 100 wpm speeds, based on the standard 7.42-unit teletype transmission pattern. The RTIH is shipped with the 60 wpm card installed unless specified as otherwise on the order. The Z2001 clock generator cards are marked "60 wpm" or "100 wpm" to distinguish them.

* Use AK-102 Isolation Keyer with RTIH units containing TMC part no. TF338 for transformer T2001 (see figure 5-1A); use AK-102A Isolation Keyer when transformer T2001 part no. is TF355.



USING ISOLATION KEYER



USING DIRECT KEYING

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Figure 2-2. Connection Diagram, Signal Input, RTIH

SECTION 3

OPERATOR'S INSTRUCTIONS

3-1. OPERATION

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

To energize the display, set POWER switch to ON POWER lamp will light. When the SIGNAL INPUT lamp is on steadily, the RTIH is receiving no readback codes; when the lamp blinks steadily, the codes are being received.

Some models of the RTIH operate an associated equipment indicator (see paragraph 1-1). When this indicator is being used, check its reading to ascertain which equipment is represented on the RTIH display.

3-2. DISPLAY INTERPRETATION

a. GENERAL - For precise definitions of display readings, refer to the TMC transmitter or receiver system manual covering the remotely controlled equipment. Display readings correspond with panel markings on the front-panel equipment controls involved. Some generalizations may be made here, however.

b. SIX DIGIT MEGACYCLE - Reading indicates 2.0000- to 31.9999-mc frequency of carrier to which the transmitter or receiver is tuned, in 100-cps steps. Refer to figure 3-1.

c. IN TUNE PROCESS - Light indicates transmitter or receiver controls are still moving and that the equipment is not yet locked onto its frequency standard for synthesized operation.

d. READY - Light indicates controls have stopped moving and

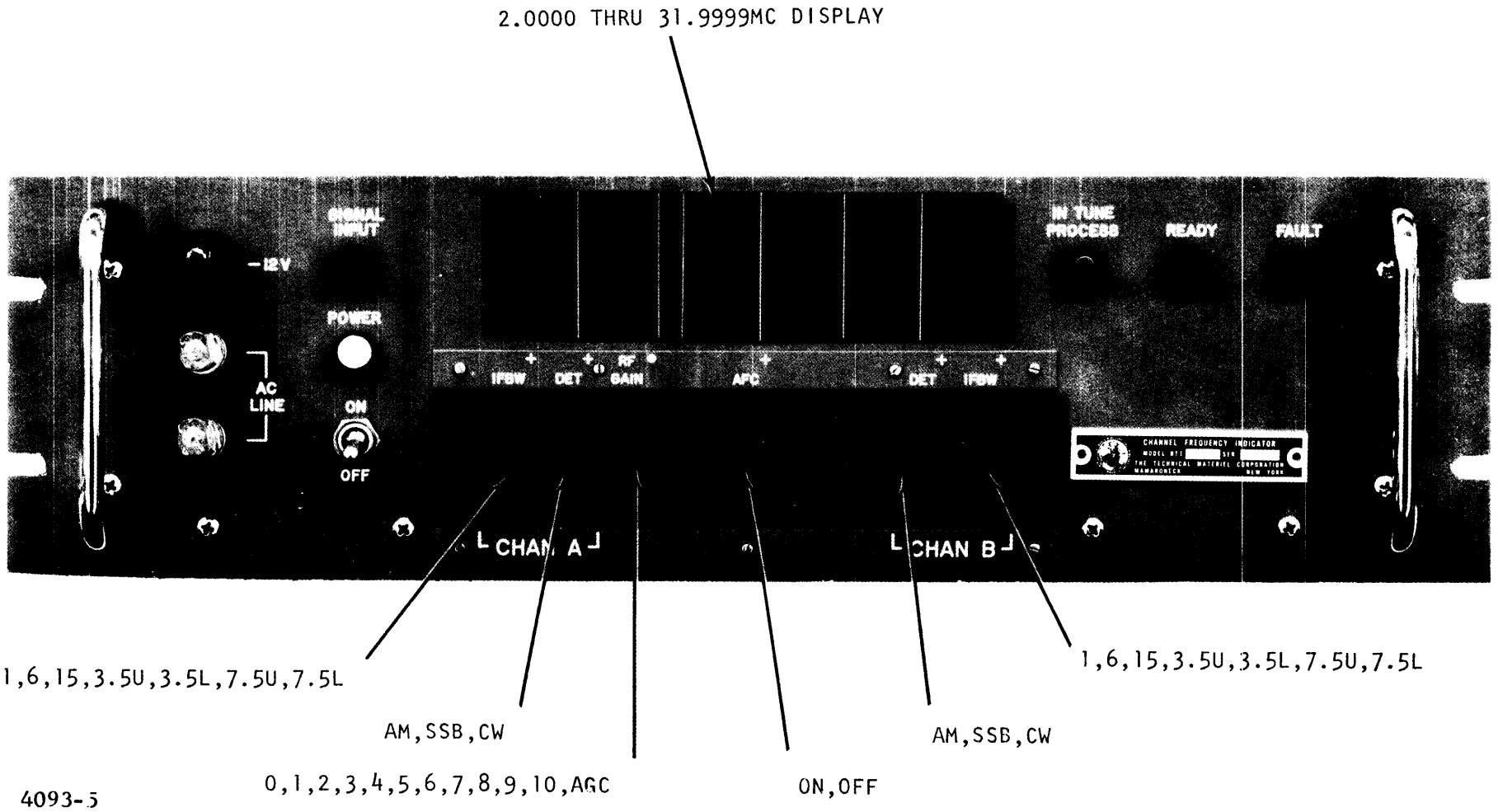


Figure 3-1A. Front Panel Displays, Model RTIH-1

equipment is locked onto its frequency standard.

e. FAULT.- Light indicates that the readback code for the IN TUNE PROCESS/READY signal is in error. This may indicate a faulty readback transmitter in the equipment.

f. FUSES.- AC LINE and -12V front panel fuses and +12V and +180V rear panel fuses are in those sections of the RTIH power supply. The AC LINE supplies the whole unit and blower, + and -12V supply the logic circuitry and the +180V supplies the MC displays. A light indicates that the fuse is blown.

g. SIGNAL INPUT. - Blinking light indicates reception of coded signal by RTIH.

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

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

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

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

l. POWER. - Light indicates RTIH is receiving a-c line voltage.

SECTION 4

PRINCIPLES OF OPERATION

4-1. INTRODUCTION

Model RTIH functions as a translator of transmitter or receiver control positions in teletype code form into the decoded lighted digital displays on its front panel, as listed in tables 1-1, 1-2 and 1-3. All circuitry is in computer-type binary logic design and mounted on printed circuit plug-in cards. The logic circuits on the cards are transistor/diode type in the form of encapsulated modules.

The logic cards are mounted in two bins (see figure 5-1), plugged into receptacles in the floor of the bin. Cards are referred to in figure 7-1 by Z2000 series circuit numbers and their "A" assembly numbers. The "A" number appears printed on the card and the "Z" and "A" numbers appear on the bottom 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 quantity of cards appearing in each RTIH depends on its model configuration (RTIH-1, -2, etc.) and, therefore, its intended readout capacity. For instance, RTIH-1 does not have Z2009, Z2016, Z2017, and Z2018 cards since these cards are needed to give the RTIH readout capabilities for functions 7, 8, and 9.

The following description covers an RTIH in its full readout capacity.

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

a. APPLICATION OF POWER. - When a-c line voltage is applied to the RTIH by the POWER switch, logic voltages are applied to all the logic cards via Z2022 power supply and B2001 blower is energized.

b. CODE INPUT. - The code input enters the RTIH at J2021

receptacle in the standard 7.42 teletype pattern, with a"start" pulse at the beginning and a "stop" pulse at the end. The first code, applied to Z2002 Input Gating circuit and Z2001 Input Timing circuit, starts a clock generator in Z2001. The clock then proceeds to energize a shift register in Z2002 and the code becomes shifted out of Z2002.

c. READOUT ENERGIZATION. - As each code leaves Z2002, it is stored in a temporary memory shift-register in cards Z2004, Z2006, Z2010, Z2011 thru Z2018 and Z2009. Readout of any particular card does not occur, however, until its shift-register is energized. The order that the shift-registers are energized is planned to match the order that the significant codes are fed into the RTIH so that the right code brings a reading on the right readout "DS" display window. TMC readback transmitting equipment is designed to send the codes in this order.

The first code to arrive in each readback cycle is the E (10000). This has the effect of starting the readout sequence in the RTIH by setting its code gates to open for the first tuning code (the next code to arrive). When this first tuning code arrives, it can pass only through Z2004, since none of the other shift-registers are energized at this time.

As each code comes through, Z2001 Input Timing circuit acts to trigger Z2003 Timing and Reset circuit. Z2003 puts out three sets of pulses at different time instances designated here as the successive instances of T1, T2 and T3. These 3 outputs have the effect of pacing the bits of each code properly through the RTIH. After the first tuning code clears through Z2004, Z2003 acts on Z2004 to produce an energizing pulse for Z2006 Shift-Register.

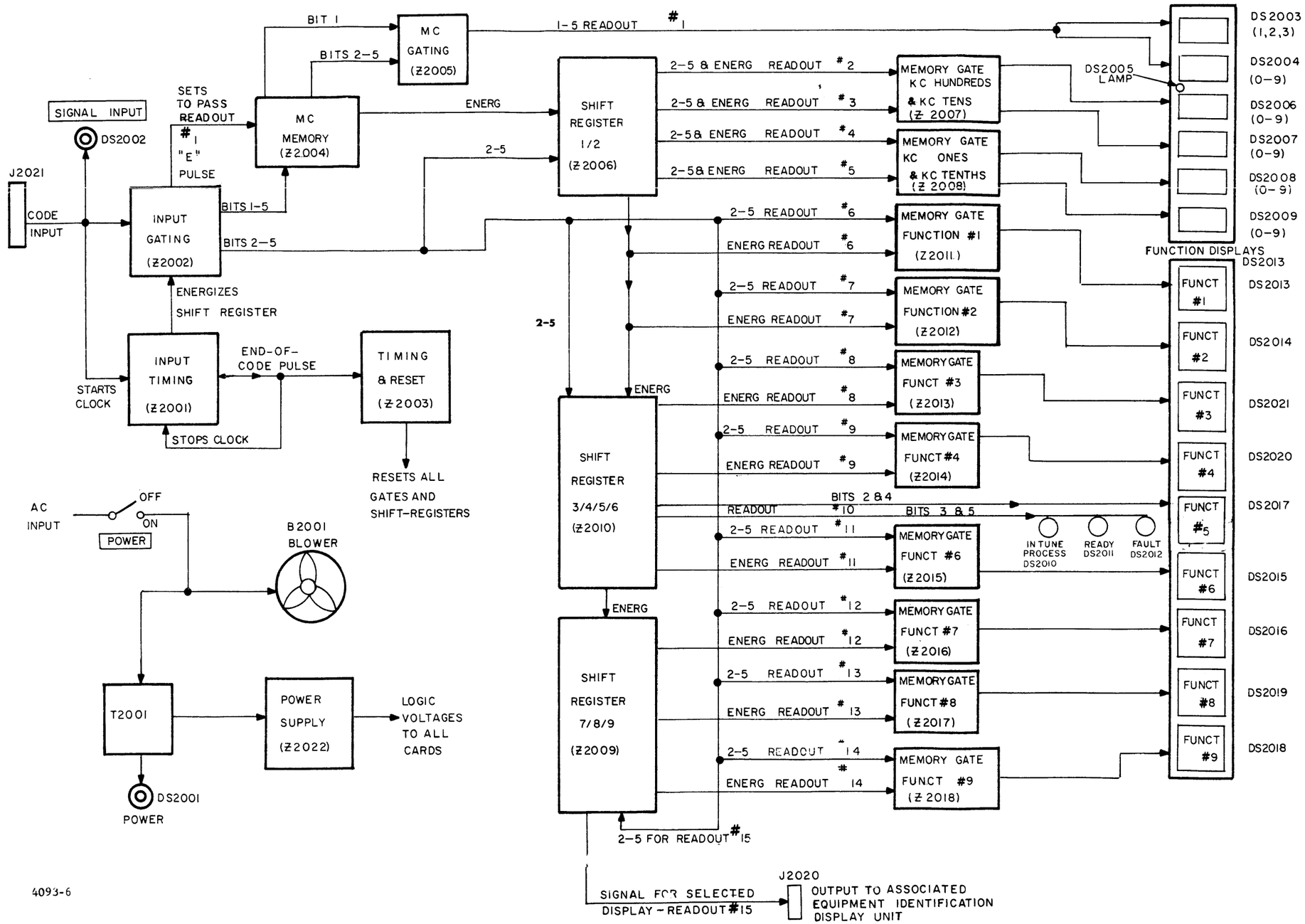


Figure 4-1. Functional Block Diagram, RTIH

Z2006 contains a shift-register that operates to read out the 2nd, 3rd, 4th and 5th codes as they arrive. Each readout completion energizes the next. Upon completion of the 5th code readout, Z2006 sends the energizing pulse for Z2011 Memory Gate and then the pulse for Z2012, readouts #6 and #7. When readout #7 has been accomplished, Z2006 sends the pulse for Z2010 Shift-Register, and its sequence is energized.

Z2010 then proceeds to energize Z2013 and Z2014 for readouts #8 and #9. It energizes readout #10 from an internally-stored code and then energizes readout #11 from Z2015 card. After #11 it energizes Z2009 Shift-Register. Z2009 then proceeds to read out #12, 13 and 14 from Z2016, Z2017 and Z2018 cards. Upon completion of #14, #15 is read out from an internally-stored code.

When the "E" again occurs in the new readback cycle, the readout energization process starts again.

d. DECODING PROCESS. -

(1) Readouts #2 thru 9 and #11 thru 14. - The bit information from the energized readout #2 is placed on ten code gates in Z2007 Memory Gate. The code, representing one of the 0-9 displays in DS2006, passes through only one gate and this gate energizes that numeral in the display. This also applies through readout #5 and DS2009. In readout #6, Z2011 Memory Gate card contains 12 code gates for a possible 12 codes that may be processed for function #1 display, DS2013. Which reading comes up on this display for a given code depends on the RTIH configuration (RTIH-1, -2, etc.) and may be found in table 1-2. This also applies through readout #9 and DS2017 and readouts #11 thru #14, (DS2015, 16, 19 and 18). In all these displays only bits #2 thru #5 of the code contain the significant information (see tables 1-1 and 1-2).

(2) Readout #1. - The code for readout #1 represents a selection from 2 to 31 for the mc figure to be displayed on DS2003 and DS2004 and, as such, all 5 bits of the code are significant. This range is divided into two parts: 2-16 and 17-31. Bits #2 thru 5 are the same set of codes for both parts; bit #1 indicates which part is being sent (see table 1-1). Z2004 Mc Memory card sorts out this information and passes it onto Z2005 Mc Gating card. Z2005 then goes through some logic stages before presenting the code at its code gates to bring the 2-31 display simultaneously on DS2003 and DS2004 windows.

(3) Readout #10. - The code that comes through on readout #10 always contains two types of information. One is for the function #5 display, DS2017, and one is for the trio of lights identified as IN TUNE PROCESS, READY and FAULT. Each type of information is binary by nature (i.e.: affording only two possible indications rather than twelve) and, as such, utilizes only two bits of the 5-bit code. Bits 2 and 4 control the DS2017 display and bits 3 and 5 control the IN TUNE PROCESS and READY lights. These lights indicate a readback of the status of the transmitter (or receiver) as to whether it is locked into synchronization with its frequency standard and also whether or not it has finished processing its codes from an associated remote tuning programmer. The FAULT light is lit when the code indicates neither status is being read back.

(4) Readout #15. - The code that comes through for readout #15 is designed to light up a display in equipment external to the RTIH. This code identifies which transmitter (or receiver) is sending the readback of its controls. The information contained in bits 2-5 of the code affords a possible selection of

16 different displays, generally the numerals "1" to "16" in the associated indicator, indicating which of a group of up to 16 transmitters (or receivers) is sending the readback cycle. The 16 code gates are contained in Z2009 card.

4-3. LOGIC DIAGRAM ANALYSIS

a. INTRODUCTION. - Figure 7-1 shows the overall schematic wiring for the RTIH and includes wiring up to the logic card receptacles. This wiring is in all configurations of the RTIH, whether or not all cards are included in its makeup. Figures 7-2 through 7-11 are individual logic diagrams of the cards.

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. Figures 7-2 through 7-11 show the logic module, its Z number, and indicates by symbol and/or logic function letters its particular function in the card circuit. The symbol  indicates an andgate and  an orgate. Other logic functions are indicated by the following function letters:

CF complimentary emitter-follower

EF emitter-follower

FF flip-flop

NA non-inverting amplifier

PF positive emitter-follower

SS single-shot (or delay circuit)

TG timing generator (or clock)

To see the equivalent transistor/diode logic circuit of an encapsulated logic module, refer to its Z number, in Section 6, Parts List, for its TMC part number. Then refer to the schematic shown for its part number in figure 7-13.

The parentheses ( ) in the following logic analysis refer to schematic or logic card figure numbers in the group of 7-1 through 7-11 diagrams. For example, (7-2) indicates a reference to figure 7-2, Logic Diagram, A4375 Memory Gating Circuit, typical for Z2011 through Z2018 cards.

b. CODE INPUT. - The 5-bit teletype code of each character enters the RTIH as keying across pins A and C of J2021 receptacle (7-1). Pin A is getting -12V from the RTIH power supply and, in this way, -12V pulses are formed into pin 19 of Z2002 (7-10). A "1" in the code forms a -12V pulse; a "0" returns the signal to OV (or ground potential). The "start"pulse in the teletype pattern creates OV and the "stop" pulse creates -12V here. Reference to -12V and OV in this text, and to other two-condition inputs and outputs, are referred to in a relative manner as negative and positive, respectively. (see also Isolation Keyer paragraph 4-3k)

DS2002 SIGNAL INPUT lamp (7-1) is connected to the code input and the -12 V supply so as to light on a "1" and extingush on a "0".

The positive start pulse works through Z10 NA in Z2002 (7-10) to set Z1 FF in Z2001 (7-9). The set Z1 starts Z7 TG clock and Z7 pin 6 commences to issue a series of regularly timed pulses to SS Z2. Z2 is triggered to issue one positive pulse from pin 6 on the positive excursion of each pulse from Z7. Each pulse from Z2 works through NA Z4 to set FF Z3 and reset FF Z5 through Z12. The timing, determined by TG Z7, is gated to match the duration of bit pulses in either a 60 WPM or 100 WPM transmission. Repitition rate of pulses from the clock are determined by the value of C2 capacitor and the setting of R1 potentiometer. Duration of pulses issuing from each SS (single-shot) is determined by the value of the resistor across pins 1 and 2 and capacitor across pins 6 and 9.

Pin 11 of Z7 clock issues, at the same time, pulses to pin 3 of SS Z8. On the positive excursion of each pulse, Z8 issues a negative pulse to pin 3 of the code input andgate in Z8 in Z2002 (7-10). Each pulse is timed by the clock to arrive with the bit pulse arrival at pin 7 of the andgate. If bit #1=0, the combination of negative and positive inputs causes the andgate output to remain positive and this charge sits simultaneously on the remaining 5 andgates in Z7 and Z8. If bit #1=1, the andgate output goes negative and negative charges sit at the 5 andgates.

When FF Z3 in Z2001 (7-9) becomes set from the first clock pulse, Z3 sets Z5 and Z5 output goes negative. On the next clock pulse, Z5 becomes reset, setting Z6. Z6 issues a negative output and this charge is placed on pin 1 of Z7 (the bit #1 andgate) in Z2002 (7-10). It is at this instance that the charge from bit #1 has arrived at pin 9. If bit #1=0, this charge is positive and the andgate output remains positive, leaving FF Z1 reset; if bit #1=1, the andgate output produces a negative pulse, the end of which sets FF Z1.

This occurs to FF Z2 through Z5 down the line for bits 2 through 5, respectively. The set FF (from a 1) issues a negative output at pin 6 and a positive one at pin 11; the reset FF (from a 0) issues a positive output at pin 6 and a negative one from pin 11. The necessary negative pulses to the andgates are issued to each gate, one-by-one, by the series of flip-flops of Z9 through Z12 in Z2001 (7-9). In this series, each pulse from the clock resets all the flip-flops. The one that was previously set, upon becoming reset, sets the next one in line by its positive output. When bit #5 shifts out of FF Z5 in Z2002 (7-10), a pulse from Z2003 Timing Circuit resets all the flip-flops via pin F of Z2002 (7-10).

c. E CODE. - The E code (10000) sets FF Z1 in Z2002 (7-10) and resets FF Z2 thru Z5. This produces 5 negative inputs at Z6 andgate. A 6th negative pulse from SS Z1 in Z2003 Timing and Reset card (7-11) causes Z6 (7-10) output to go negative for the duration of the pulse. On the positive uprise, Z6 fires SS Z9 and Z9 produces a negative pulse. At the end of this pulse, the positive uprise resets FF Z8 in Z2004 Mc Memory card (7-3). Z8 then issues a negative charge and this presents negative charges sitting on andgates in Z6 and Z9, thereby setting these gates to respond to the next code (the 2-31 mc code).

d. 2-31 MC CODE. - The 2-31 mc code arrives at FF Z1 thru Z5 in Z2002 (7-10) in the same manner as the "E" code. If bit #1=1, FF Z1 places a negative charge on pin 1 of Z9 andgate in Z2004 (7-3); if bit #1=0, a positive charge is placed there. A negative charge exists at pin 5 from the E code and another negative pulse occurs at pin 3 from Z2003 via pin V of Z2004. This causes Z9 pin 6 output to remain positive from a 0 or to pass the negative pulse from a 1. Previous to this a positive change from Z2004 at pin J and the negative output of Z8 has caused pin 11 of Z9 to go positive, resetting FF Z1. Now, if bit #1=1, the end of the negative pulse from pin 6 of Z9 output sets FF Z1; if bit #1=0, the steady positive output from pin 6 of Z9 allows Z1 to remain reset. Therefore, if bit #1=1, FF Z1 pin 6 is negative and pin 11 is positive; if bit #1=0, pin 6 is positive and pin 11 is negative. Pin 6 output is routed to pins 5 and 16 of Z2005 MC Gating card (7-7) and Z2004 FF Z1 pin 11 output (7-3) is routed to pins 6 and 15 of Z2005 (7-7).

Bits 2-5 from Z2002 FF Z2 thru Z5 (7-10) place charges on the four andgates in Z6 in Z2004 (7-3). These charges are negative for a 1

and positive for a 0. Z8 FF is keeping a second gate input negative at each gate and the third gate input is a negative pulse from Z2003. Upon this last pulse, if the bit = 1, the gate passes a negative pulse and, if the bit = 0, the gate produces a steady positive output. Therefore, the flip-flop (in the Z2 thru Z4 group) receiving the "0" information remains reset and the flip-flop receiving the "1" becomes set. The set flip-flop issues a negative charge from pin 6 and a positive one from pin 11; the reset flip-flop reverses these polarities. These flip-flops are connected to andgates in Z12 thru Z14 in such a way that the bit 2-5 information presents all negative inputs at one gate for either one of a pair of codes: 2 or 17, 3 or 18, etc. This gate then produces a negative output and the charge is sent to Z2005 Mc Gating card (7-7).

Mc Gating card Z2005 contains more andgates which assimilate this bit #2-5 information with the aforementioned bit #1 information and, working with a series of orgates in Z10, Z15, Z6, Z7, Z3, Z2, Z8 and Z4 to light up the proper numeral displays in DS2003 and DS2004 windows for the 2-31 mc code. A negative charge is necessary to light up a numeral. An andgate output goes negative only when both inputs are negative; an orgate output goes negative whenever at least one input is negative.

e. READOUT OF CODES #2 thru #5. - From the second code on, bits 2-5 are the only significant bits in the code and the only ones processed. As bits 2-5 arrive from Z2002 to Z2006 Shift-Register (7-5), they arrive at pins 11, V, 9 and 12 of this card. These inputs are connected to the inputs of 4 sets of bit gates, each set for one of the KC displays (100 KC, 10 KC, 1 KC and .1 KC). The set that will open a gate or gates depends on the set that receives a "1" bit and a negative charge at that moment from one of the flip-flops in the Z1 thru Z6 group. All gates receive a negative pulse for each code from Z2003 via

pin 6 of Z2006. An opened gate produces a negative pulse.

Z1 thru Z6 shift-register is started by Z1 pin 8 receiving a positive charge from the set FF Z8 in Z4004 (7-3). Z8 becomes set from a positive pulse from Z2003 from the preceding (mc) code. The set Z1 in Z2006 (7-5) produces a negative output to the gates in Z13 only, allowing a "1" bit gate to open and pass the negative pulse from pin 6 of Z2006. The 4 outputs (negative or positive) are then placed at the set inputs (pin 8) of 4 bit flip-flops Z6, Z5, Z2, and Z1 in Z2007 (7-4). These become either set or remain reset and their outputs are connected to andgates in Z9, Z10, Z13 and Z14 in such a way as to present all negative charges at the proper gate for the 0-9 display in DS2006, 100 KC window. This same processing occurs for the next 3 codes, with Z2006 working through Z2007 and Z2008 to bring 0-9 displays in DS2007, DS2008 and DS2009 10 KC, 1 KC and .1KC windows.

f. READOUT OF CODES #6 and #7. - The shift-register in Z2006 continues to shift two more times to trigger readouts from codes stored in Z2011 and Z2012 Memory Gate cards (7-2). Pins U, 16, 18 and X receive the bit 2-5 information from Z2002 flip-flops and pin V receives a negative pulse from Z2003, Timing and Reset card. Pin T is the pin that receives its negative charge from the Z2006 shift-register FF Z5 (7-5). The Z15 gates in Z2011 (7-2) then set up the code on flip-flops Z7, Z3, Z2 and Z1. The outputs of these flip-flops are connected to andgates in Z8, 4, 6 and 5 in such a way as to present all negative inputs at the proper gate to light up one of the 12 displays in DS2013, function #1 window. Readout of code #7 occurs in the same way with a negative charge from FF Z6 in Z2006 (7-5) working on Z2012 card (7-2) and DS2014 function #2 display.

The displays for functions #1 thru #9 are mechanically different from the digital mc displays. These are a "projection readout" type.

There is a lamp for each reading mounted in the back of the display unit with a film negative of the reading in front of the lamp and one projection screen in the front. When the negative voltage is applied to the lamp circuit, the lamp lights, shines through its film negative and the image of the reading is projected by lenses onto the screen.

g. READOUT OF CODES #8, 9, 11, 12, 13 and 14. - The readout of these codes is a processing similar to that of #6 and 7, except that Z2010 and Z2009 shift-registers serve to trigger the readouts out of Memory Gate cards Z2013 thru 18. First Z2010 shift-register starts, triggered by the last pulse of set flip-flop Z6 in Z2006 (7-5). Then flip-flops Z1, 2, 3 and 4 in Z2010 (7-6) proceed to trigger readouts out of Z2013, Z2014 function #5 shift-register in Z2010 (described in paragraph 4-3 h) and Z2015. The set FF Z4 in Z2010 (7-6) then sets FF Z5 in Z2009 (7-8) and the process is repeated with FF Z5, 6 and 7 triggering readouts from Memory Gates Z2016, 17 and 18 for function #7, 8 and 9 displays.

h. READOUT OF CODE #10. - Readout of this code (function #5 and IN TUNE PROCESS, READY, FAULT indicators) is triggered by the shift-register in Z2010 (7-6) acting on 4 bit gates in Z12. The set FF Z3 issues a negative charge to the gates in Z12 and these set up the code of all 4 bits on FF Z7, 8, 9 and 10. Bits 2 and 4 (FF Z7 and 9) are connected to gates in Z13 to activate the binary display in DS2017 function #5 window. At the same time, Z8 and Z10 are connected with Z14 gates to process bits #3 and 5 information. If bit #3 is a "1", FF Z8 becomes set and a negative output at pin 6 lights the IN TUNE PROCESS lamp, DS2010. If bit #5 is a "1", a negative output from pin 11 of Z8 and another negative output from pin 6 of Z10 cause Z14 output at pin 6 to go negative, lighting the READY lamp, DS2011. If neither bits #3 or 5 are a "1", this presents 2 negative inputs at pins 7 and 10 of Z14,

producing a negative output at pin 11 to light the FAULT lamp, DS2012.

i. READOUT OF CODE #15. - The readout of code #15 is accomplished in Z2009 card (7-8). Bits 2-5 of this code are fed to the andgates in Z12 directly from Z2002. When the last shift is made by the FF Z5, 6, 7 and 8 shift-register, Z8 becomes set by Z7 and Z8 output goes negative, placing a negative charge at the middle pin of each andgate. The releasing negative pulse then comes from Z2003 and FF Z1, 2, 3 and 4 are set up with the code. Their outputs are connected with 16 code andgates in Z13 thru Z16 in such a way as to present all negative charges at the correct gate.

j. Z2003 TIMING-SET/RESET CIRCUIT. - Z2003 (7-11) functions to clear shift-registers and set up gates for each new code through the RTIH; it operates in a cycle for each code, triggered by the code entry into Z2002. As described before, the start pulse in the code triggers the clock and shift-register in Z2001 (7-9) to set up the serial code in parallel on FF Z1 thru Z5 in Z2002 (7-10). In the last shift of Z2001 shift-register (7-9), FF Z12, besides stopping the clock, also sends a positive-going change from card pin X to pin V of Z2003 (7-11). This is the only input to this card. Z2003 then proceeds to issue three types of output, referred to here as A, B and C. "A" output is the positive change repeated at pins N, T, 2 and Y of Z2003, occurring at time instance T1. The positive swing from pin 6 of Z10 positive emitter-follower also fires SS Z1 and Z1 emits a negative pulse, "B", appearing at pins 18, C, B, K, 8, S, 14, X and 19. The beginning of this pulse occurs at time instance T1 and extends to T2. The positive swing from pin 11 of Z10 fires SS Z2 at T1 and this begins a relatively longer negative pulse, also started at T1. At the end of the pulse duration (T3) the positive upswing fires SS Z3 and this issues a positive pulse, started at T3. This pulse, the "C" out-

put issues from Z2003 pins U, 3 and H.

Duration of a pulse from an SS depends on the resistor across pins 1 and 2 and the capacitor across pins 6 and 9.

k. ISOLATION KEYER - If it is elected to use the AK102A Isolation Keyer at the Indicator code input, the code input to the AK102A is in the form of a keyed TTY (teletype) current loop across terminals 1 and 3 of terminal block TB1 (7-13). A "1" bit or a "stop" pulse creates a closure across terminals 1 and 3; a "0" bit or a "start" pulse opens the closure. Terminal 1 is the positive side of the loop and terminal 3 forms the return for the loop.

On a closure, transistor Q1 conducts and its collector current energizes the "mark" coil of polar relay K1. This results in a closure of pins A and C of P1 plug (and of J2021 on the Indicator) thereby connecting the -12v supply in the Indicator to its code input. K1 relay is normally biased in its "space" position by +12v at the wiper of potentiometer R3. When the closure at TB1 terminals 1 and 3 are opened, Q1 does not conduct, there is no current through the "mark" coil of K1 and K1 reverts into its "space" position, opening pins A and C of J2021. The +12v at R3 wiper is obtained via a rectifier circuit (C1, C2, R1 and CR4) from a 15 VAC source from the RTIH across pins D and F of plug P1.

The above description applies to later RTIH units, (using TMC #TF355 as transformer T2001). Earlier units (using TMC #TF338 transformer) use an AK102 Isolation Keyer. This keyer (7-12) is the same as AK102A except that the relay-biasing +12V is obtained directly from the RTIH +12V supply and there is, therefore, no rectifier circuit in the Keyer.

4-4. POWER SUPPLY SECTION

The power supply section of the RTIH supplies voltages for the logic

circuitry and relays. This section is comprised of transformer T2001, Power Supply card Z2009, receptacle J2019, POWER switch S2001, transistors Q2001 through Q2004, associated components and fuses (see figure 7-1). Power supply design is a conventional transistorized type, supplying d-c outputs from a line voltage input. +12v and -12v are supplied for the logic cards and relay operation. +180v supplies the 2.0000 through 31.9999 mc display units DS2003, 4, 6, 7, 8 and 9.

Blower B2001 operates directly from the line voltage input, via POWER switch S2001.

SECTION 5

MAINTENANCE

5-1. COMPONENT LOCATIONS

The logic circuits in the Indicator are contained in printed circuit plug-in cards mounted in two bins on the top side of the chassis (see figure 5-1). The card Z2000 numbers are the circuit reference symbol numbers; "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 floor along with its "Z" number. The plug end of each card contains keying notches and its receptacle, in the bin floor, contains matching blocks to prevent inserting a card into the wrong receptacle. Some cards in the Indicator and in other TMC logic equipment, although they are assigned different "Z" numbers, have the same "A" numbers and are identical and interchangeable. These cards have similar keying at their plug ends and in their receptacles.

The larger power supply components are mounted on the top side of the Indicator chassis; smaller components are contained in printed circuit plug-in card Z2022, located against the left wall of the chassis. Intake blower B2001 is mounted on the chassis rear panel, with transistors Q2002 and Q2003 mounted directly on the blower cowling, for cooling purposes.

The individual display units, DS2003 through DS2009, for the 2.0000 to 31.9999 megacycle display are mounted on the front panel separately; display units DS2013 through DS2021 (see figure 5-2) are contained in a single housing, mounted to the front panel.

5-2. SPECIAL TOOLS AND TEST EQUIPMENT

Special tools included in the shipment* and required for RTIH

*Shipment of system in which Indicator is used.

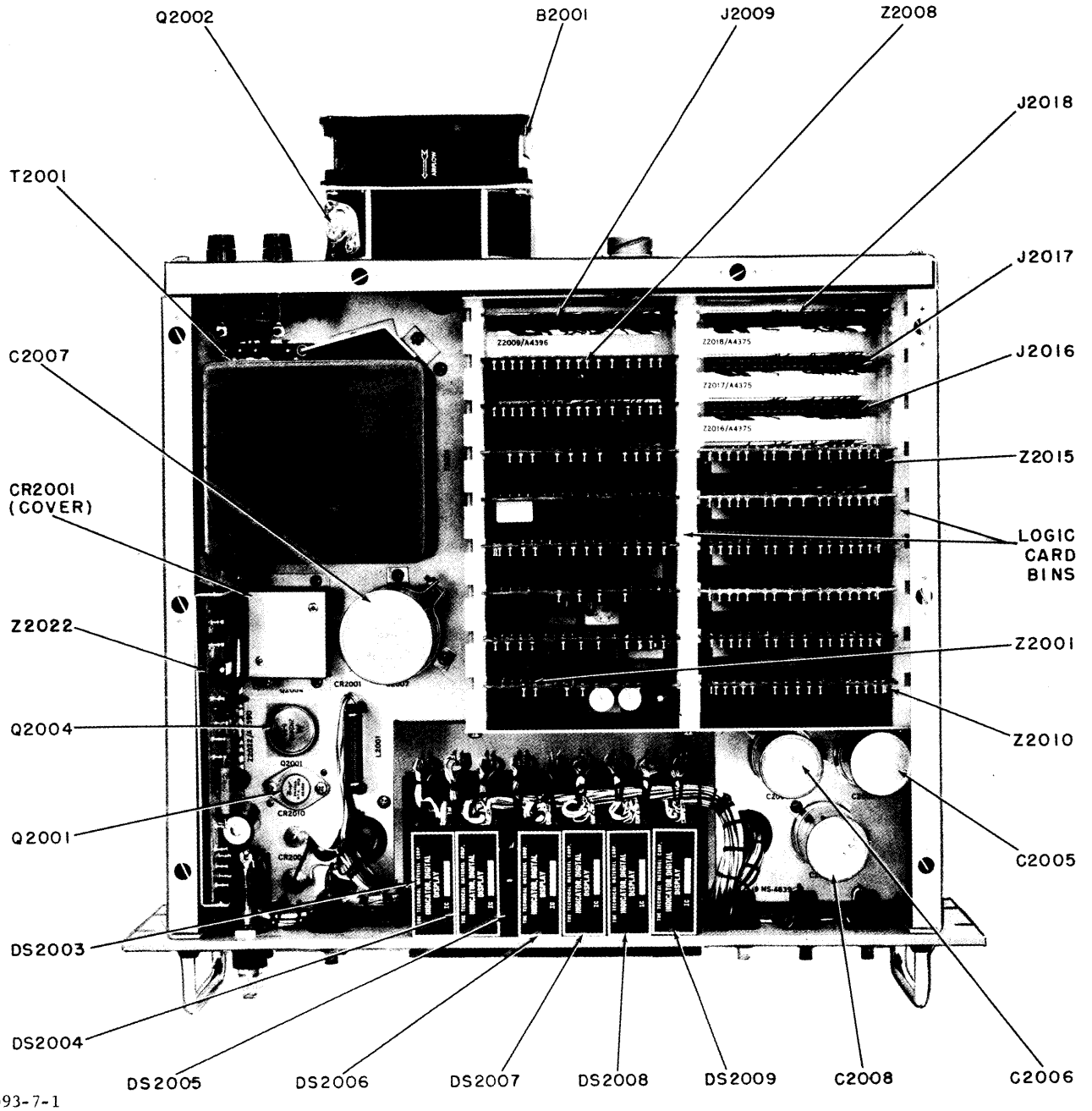


Figure 5-1A. Top View, RTIH-1

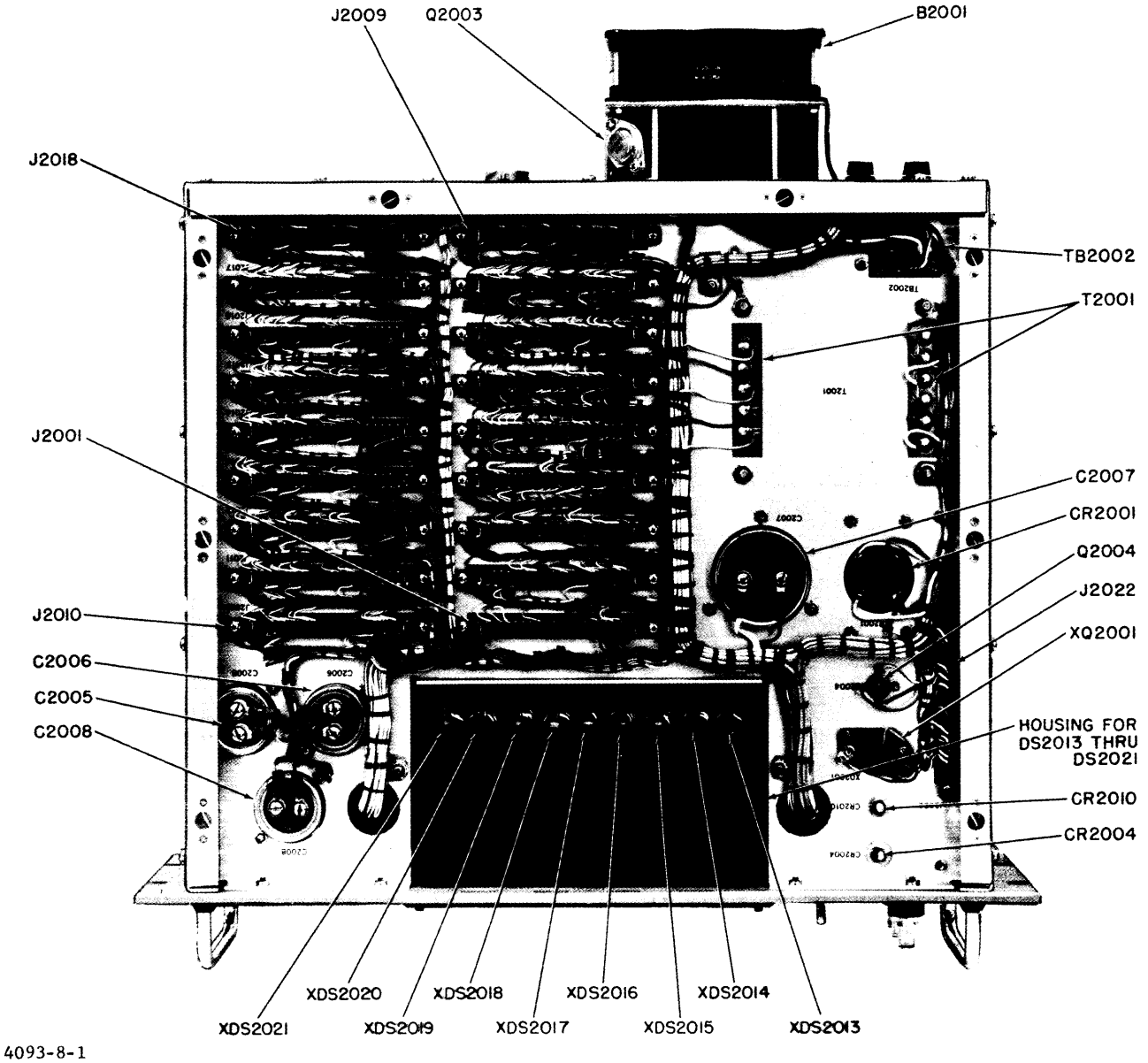
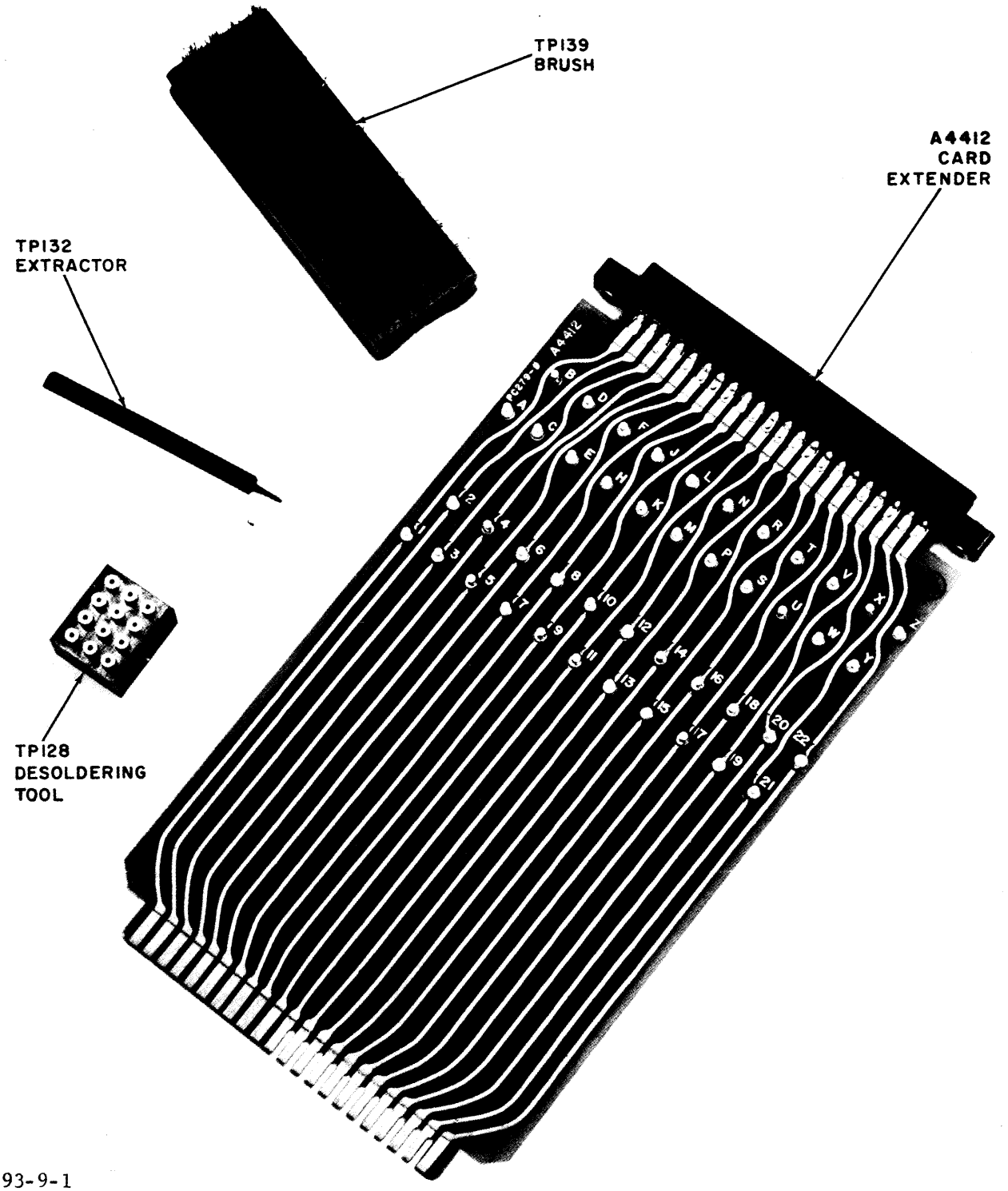


Figure 5-2. Bottom View, RTIH



NOTE: A4448 Card Extender (not shown) also included in shipment.

Figure 5-3. Maintenance Tools, Logic Circuits

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.

TABLE 5-1. TEST EQUIPMENT

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 - This section includes a voltage table and timing charts for checking normal voltages and pulse patterns in the Indicator. Before proceeding to take any readings, however, the technician is advised to read this section, with particular reference to paragraph 5-4b (following) describing techniques to be used in order to prevent damage to the miniaturized circuits.

b. CARD SETUP FOR TEST READINGS - To bring the test points on a card or on its receptacle pins up for accessibility, remove the card and insert an A-4412 Card Extender (see figure 5-3)* in the card receptacle. Then plug the card into the top of the Card Extender.

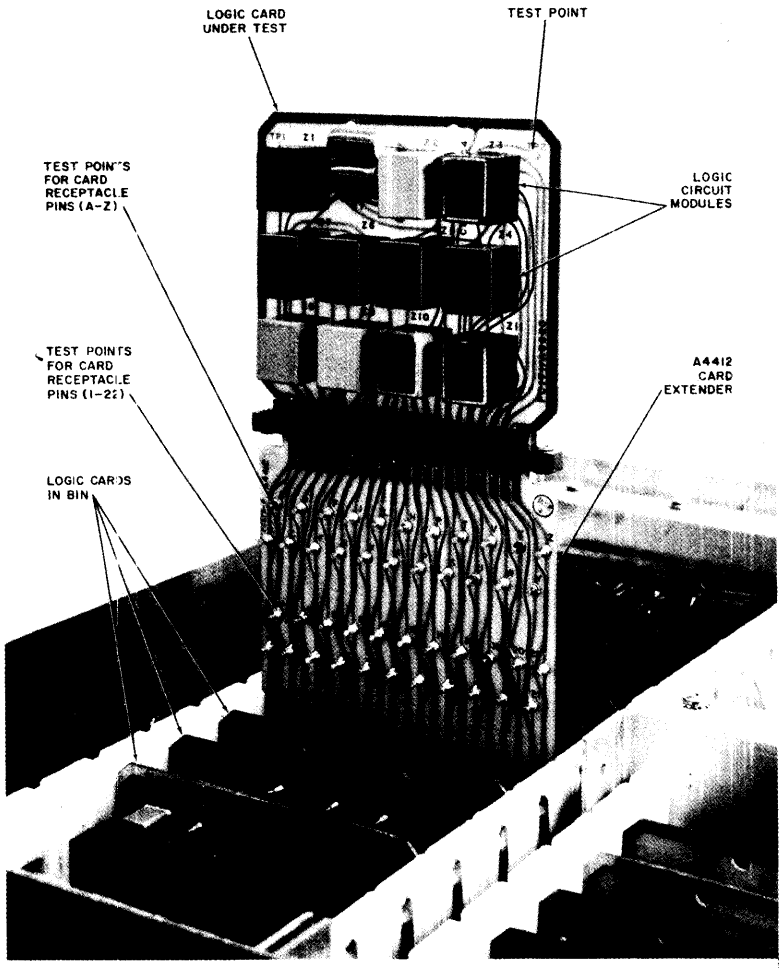
NOTE

Check to ensure that "A" number on card matches "A" number printed on side of bin adjacent to bin receptacle. Because the Card Extender is keyed to fit into all receptacles, it is possible to connect a card to the wrong receptacle.

Figure 5-4 shows a typical card in test position. For each test point listed in figures 5-7 through 5-15 there is a numbered "TP" test point terminal on the card or a card receptacle pin test point on

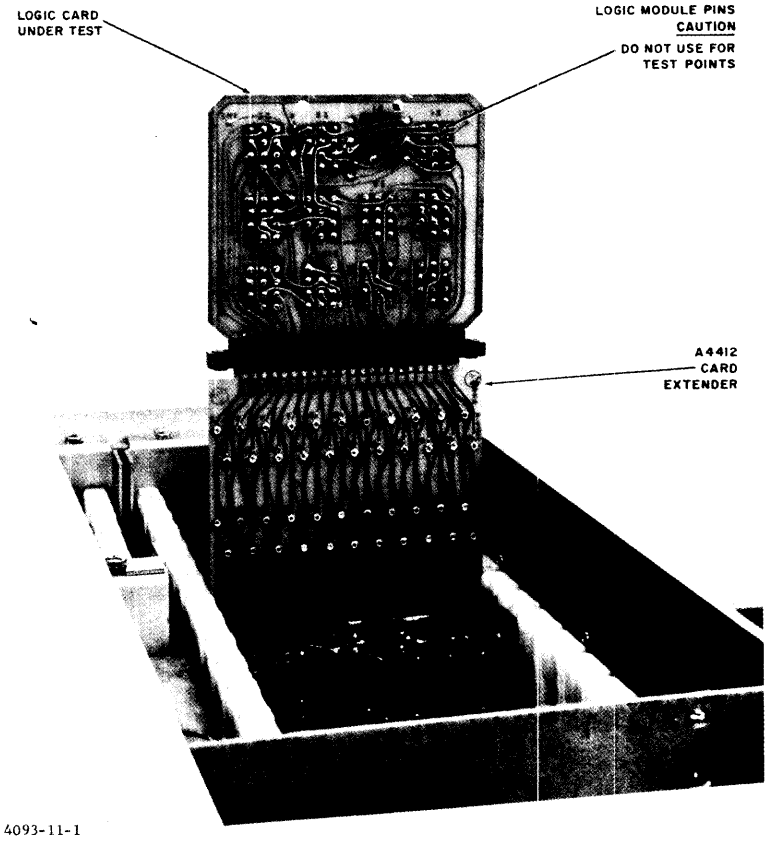
*A-4412 is for cards Z2001 through Z2018; A-4448 is for Z2022.

67 2.14-3



Front View

67 2.14-4



Rear View

Figure 5-4. Card in Test Position

the Extender. Receptacle pins are identified by letters and numbers. Test points for the lettered pins are arranged in two rows on the Extender near the top; test points for numbered pins are located in two rows beneath the lettered rows.

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 points on the Extender. It is difficult to touch the probe to the miniature pins on the module without shorting it out and destroying the module.

c. 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. TROUBLESHOOTING PROCEDURE - Troubleshooting time is greatly shortened if a set of spare plug-in cards are available. If the trouble is located in the logic circuitry (rather than in the power supply or front panel indicators), card substitution will determine this and, also, point out the faulty card. Furthermore, subsequent checking of pulse-forms to establish the faulty component (or broken conductor) on the card is localized to that one card. To do this, refer to paragraph 5-4e, USE OF TIMING CHARTS.

If card substitution fails to locate the trouble, it may be generally assumed that a power supply voltage is missing. Set POWER switch at ON and check voltage points as indicated in table 5-2, using a VTVM.

If power supply voltages check out, check wiring continuity between card receptacles for broken or loosened wires, referring to figure 7-1.

If the specific trouble is the failure of one of the upper row (mc) indicators, check the individual memory gate card feeding the indicator. If the card checks out, the tube in the digital indicator may need a replacement. Tubes used in these indicators are Burroughs Corp. 8422 (B-5991) (or equivalent). To gain access to tube, remove bezel from panel, remove indicator mounting screws and pull indicator slightly away from panel (see figure 5-5).

If the specific trouble is the failure of one of the lower row (functions) indicators, check the individual memory gate card feeding the indicator. If, however, the indicator misses only one particular reading (of a group of possible readings), one of the lamps on a lamp grid within the indicator may be burned out. To ascertain this, remove indicator from housing and remove connector assembly section from rear

of indicator to reveal lamp contacts (see figure 5-6). Remove front projector assembly by unscrewing retaining pins. Connect lamp ground plate to ground and, observing lamp heads on opposite side, touch a -12v source to contact of each lamp. The burned-out lamp will fail to light. Lamps are TMC part number BI114-4, T-1 bayonet based type and are press-fitted into base plate from the rear. To remove a lamp, pull it out of the base plate by its base. Insert the new lamp by pushing it head first into the base plate.

NOTE

Each function indicator base plate has holes for 12 lamps. However, the number of lamps necessary for each function is the same as the number of display readings for the function and depends on the model variation (see table 1-2). It is not therefore necessary to fill all twelve holes with lamps.

If the IN TUNE PROCESS or READY lamp fails to light (and if the FAULT lamp is not lit), check the individual card feeding these lamps. If the card checks out, a lamp may be burned out. Check by applying a -12v source at lamp contact. If a lamp is burned out, replace entire "DS" lamp assembly.

e. USE OF TIMING CHARTS - Figures 5-7 through 5-15 are timing charts depicting necessary coincident pulses in a properly performing Indicator. Voltage changes (between -12v and 0v) are plotted for each test point in a chart against a common time base. The nine charts are arranged to systematically check four performances of the RTIH, in that order: -

1. Code input and MC logic (figure 5-7)
2. Shift-register cycling (figure 5-8)
3. Binary functions (figure 5-9 thru 5-11)
4. Code gates (figures 5-12 thru 5-15)

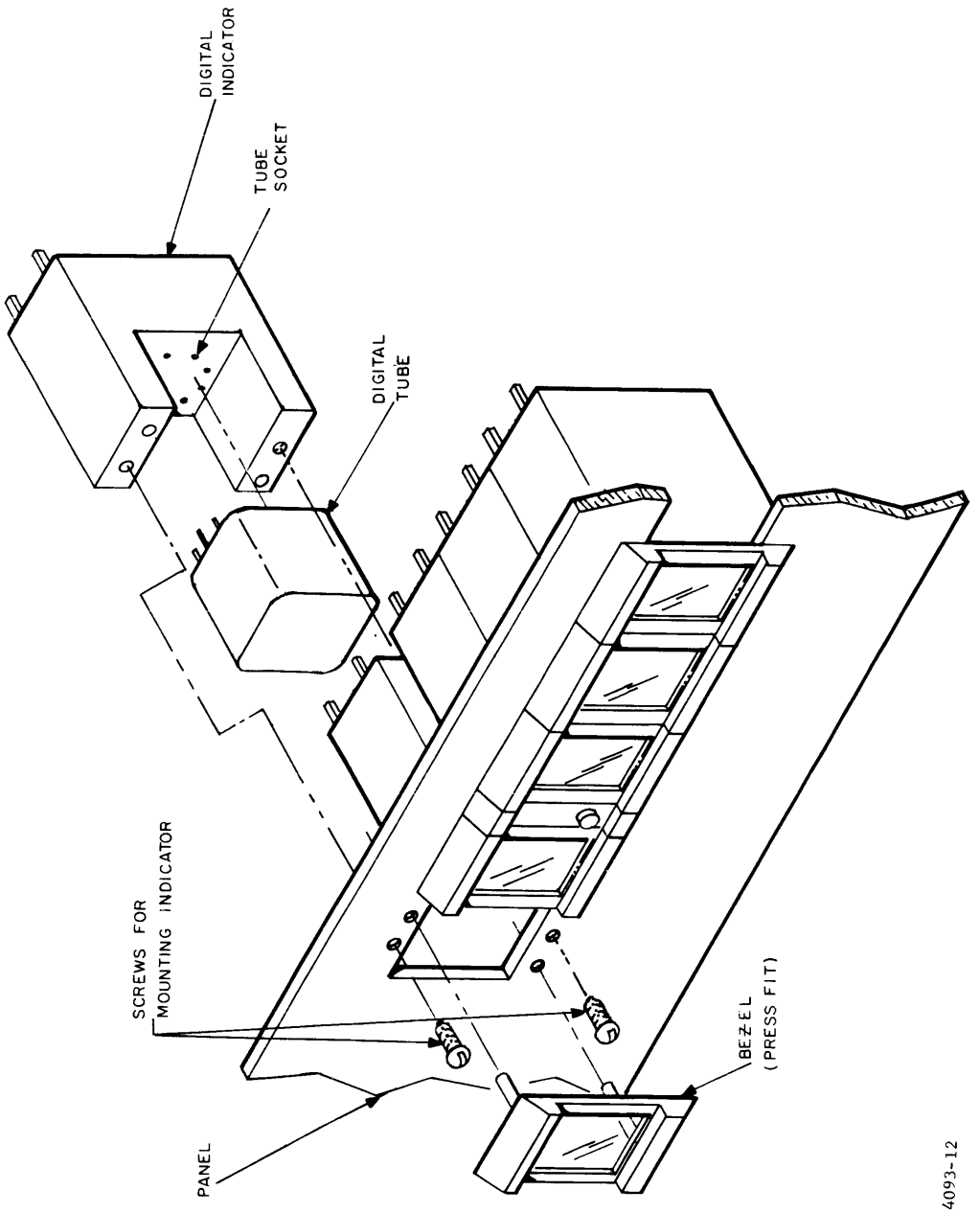


Figure 5-5. Tube Replacement in Digital Readout Indicator

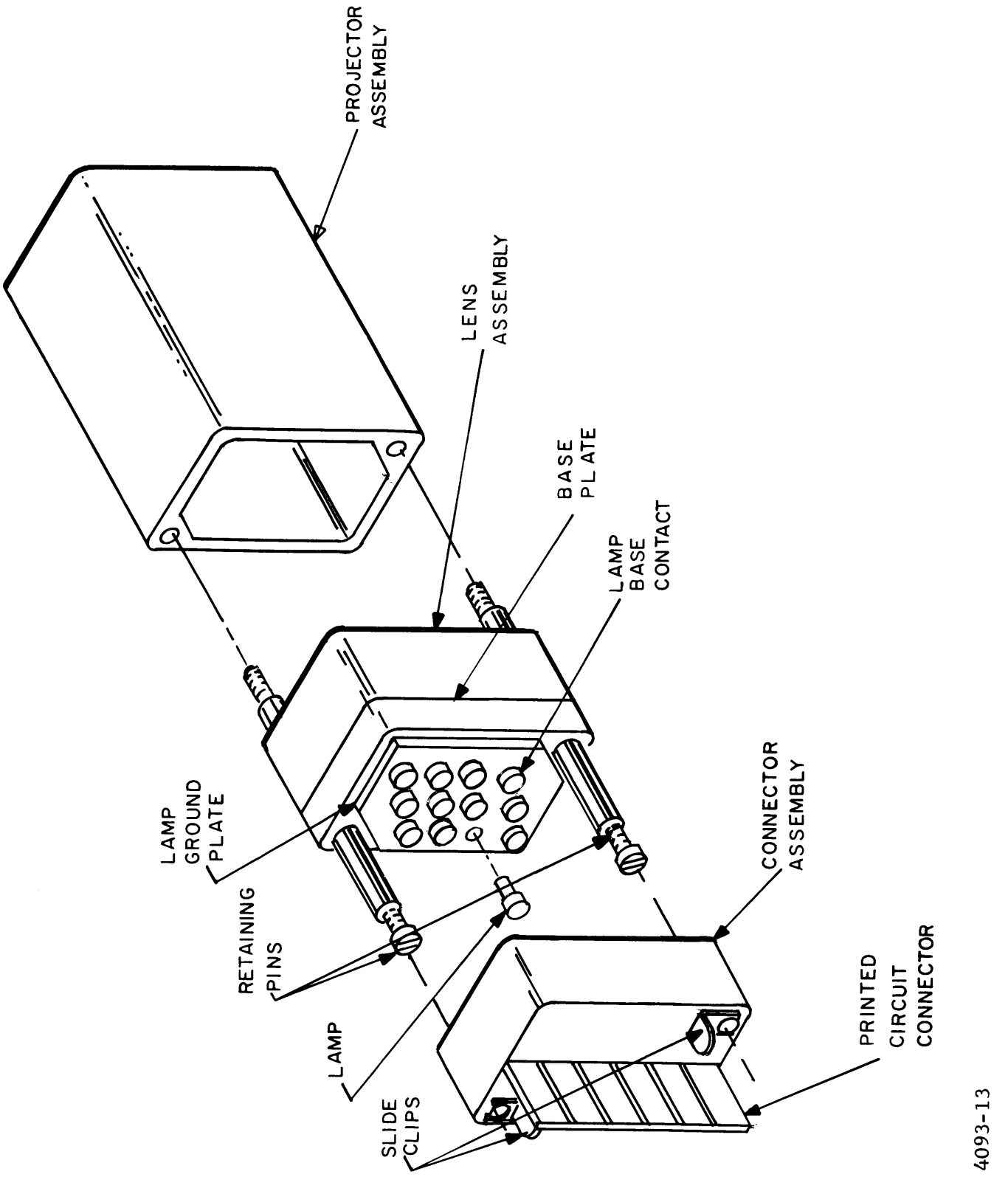
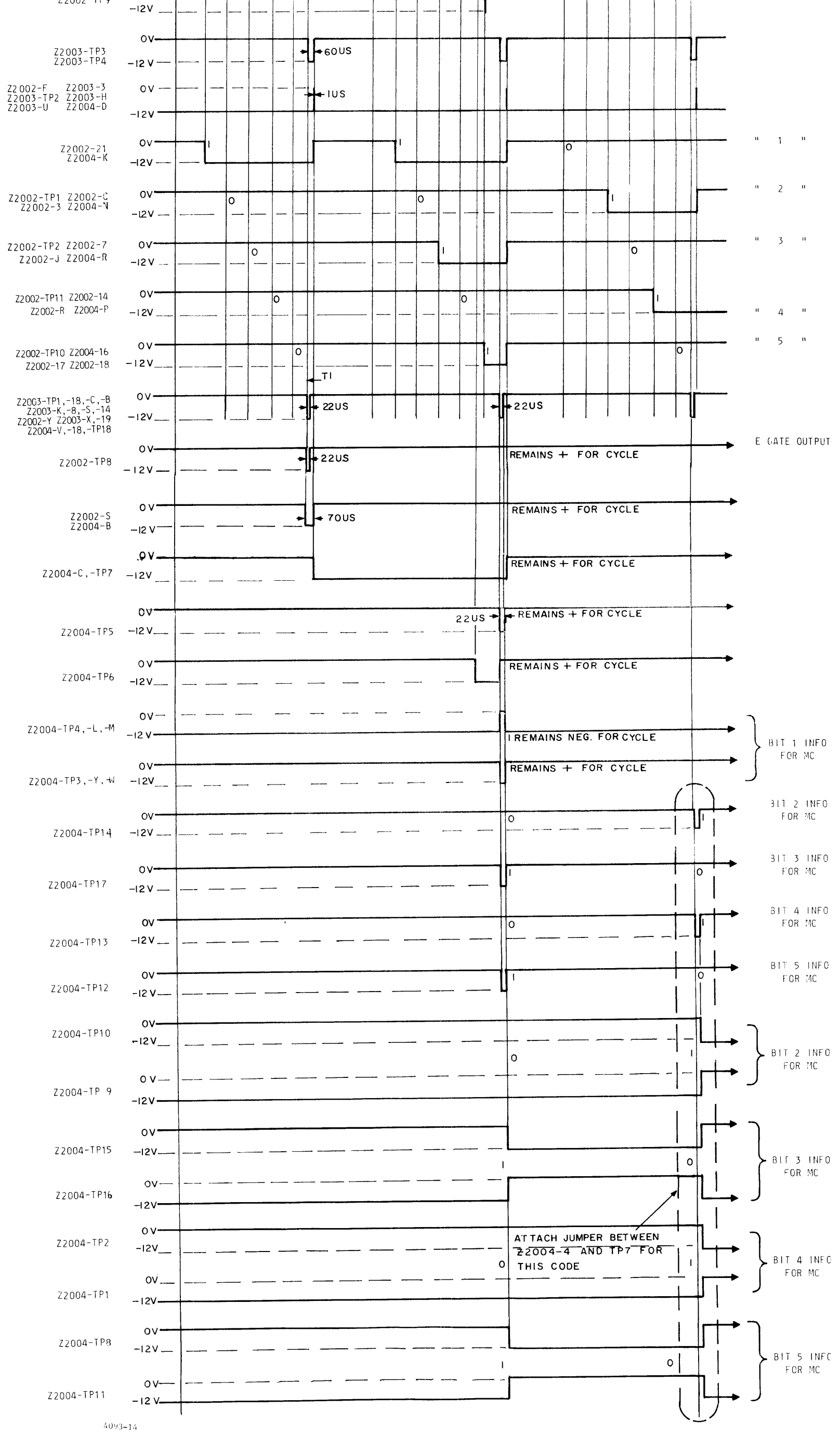
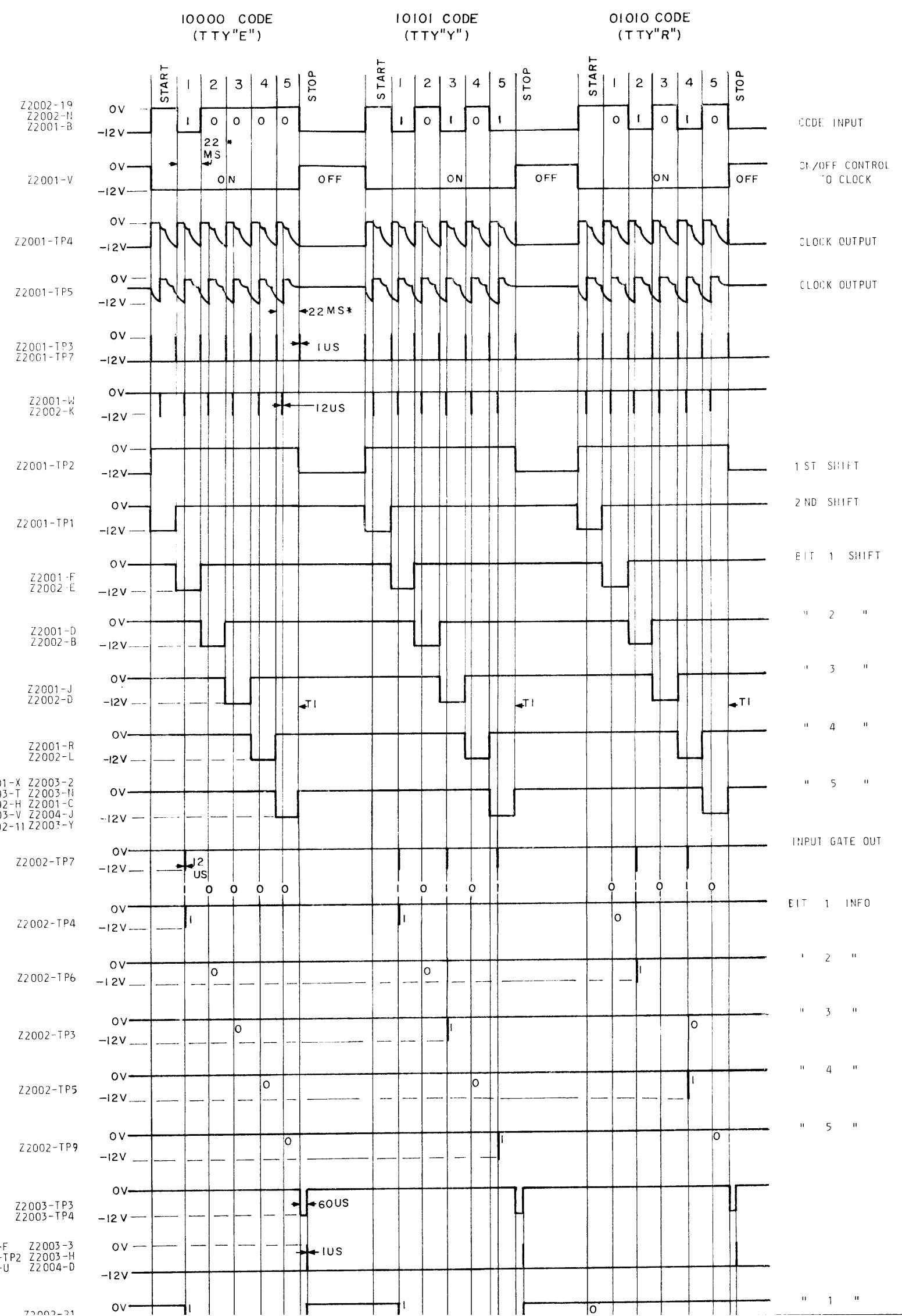


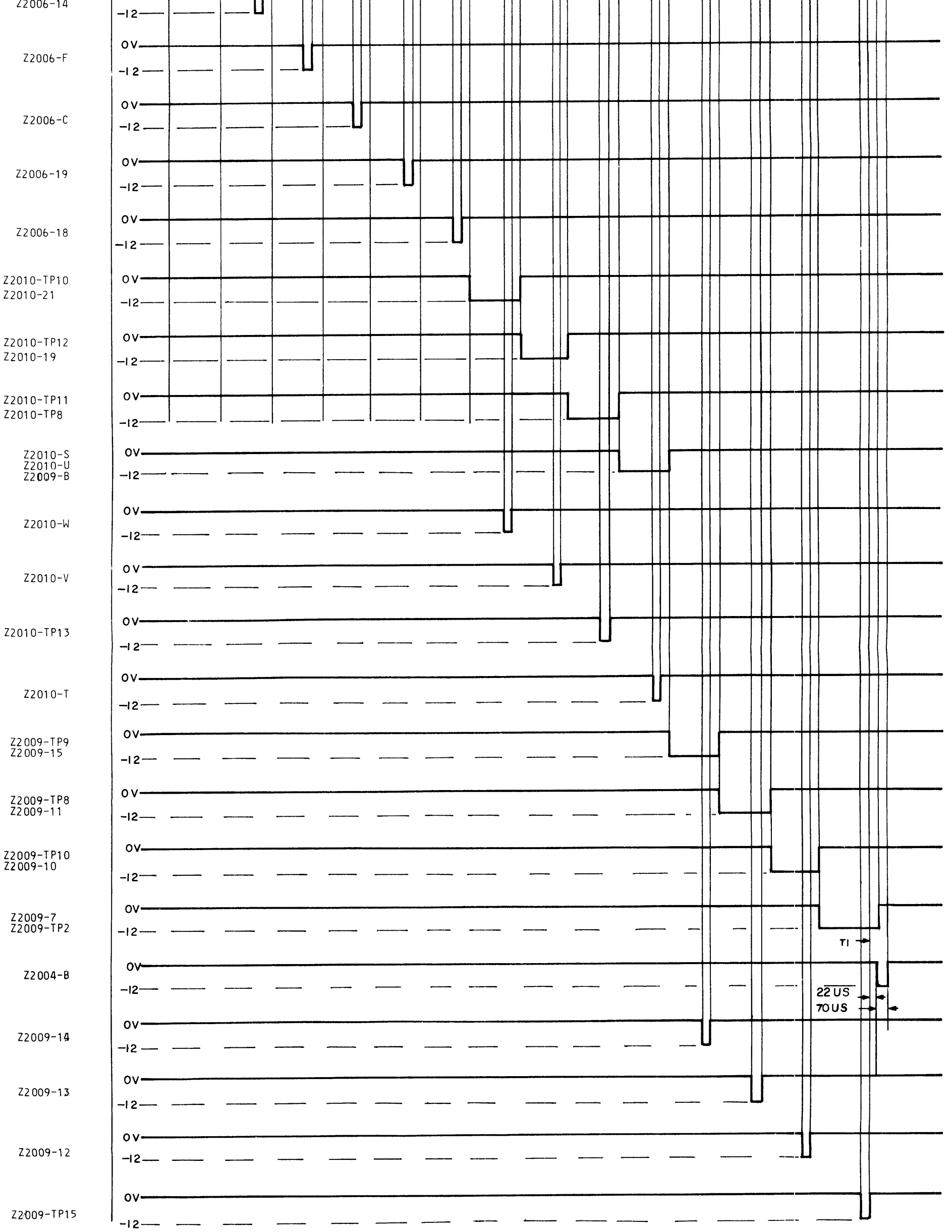
Figure 5-6. Lamp Replacement in Projection Readout Indicator



1. BEFORE INSERTING E CODE (10000), SET POWER SWITCH AT OFF AND ON.
2. FOR 10101 CODE TEST, FIRST INSERT E (10000) CODE.
3. FOR 01010 CODE TEST, FIRST INSERT 10101 CODE.
4. * 22 ms FOR 60WPM; 13.5 ms FOR 100 WPM.

Figure 5-7 Timing Chart (Z2001,2,3,4)


10000 CODE
(TTY"E")
10101 CODE
(TTY"Y")
01010 CODE
(TTY"R")
START
1
2
3
4
5
STOP
Z2002-19
Z2002-N
Z2001-B
0V
-12V
1 0 0 0 0
1 0 1 0 1
0 1 0 1 0
CODE INPUT
22 MS*
Z2001-V
ON
OFF
ON
OFF
ON
OFF
ON/OFF CONTROL TO CLOCK
Z2001-TP4
CLOCK OUTPUT
Z2001-TP5
22MS*
CLOCK OUTPUT
Z2001-TP3
Z2001-TP7
1US
Z2001-W
Z2002-K
12US
Z2001-TP2
1 ST SHIFT
Z2001-TP1
2 ND SHIFT
Z2001-F
Z2002-E
BIT 1 SHIFT
Z2001-D
Z2002-B
" 2 "
Z2001-J
Z2002-D
TI
" 3 "
Z2001-R
Z2002-L
" 4 "
Z2001-X Z2003-2
Z2003-T Z2003-N
Z2002-H Z2001-C
Z2003-V Z2004-J
Z2002-11 Z2003-Y
" 5 "
Z2002-TP7
12 US
INPUT GATE OUT
0 0 0 0 0 0 0 0 0
Z2002-TP4
BIT 1 INFO
Z2002-TP6
" 2 "
Z2002-TP3
" 3 "
Z2002-TP5
" 4 "
Z2002-TP9
" 5 "
Z2003-TP3
Z2003-TP4
60US
Z2002-F Z2003-3
Z2003-TP2 Z2003-H
Z2003-U Z2004-D
1US
Z2002-21
" 1 "



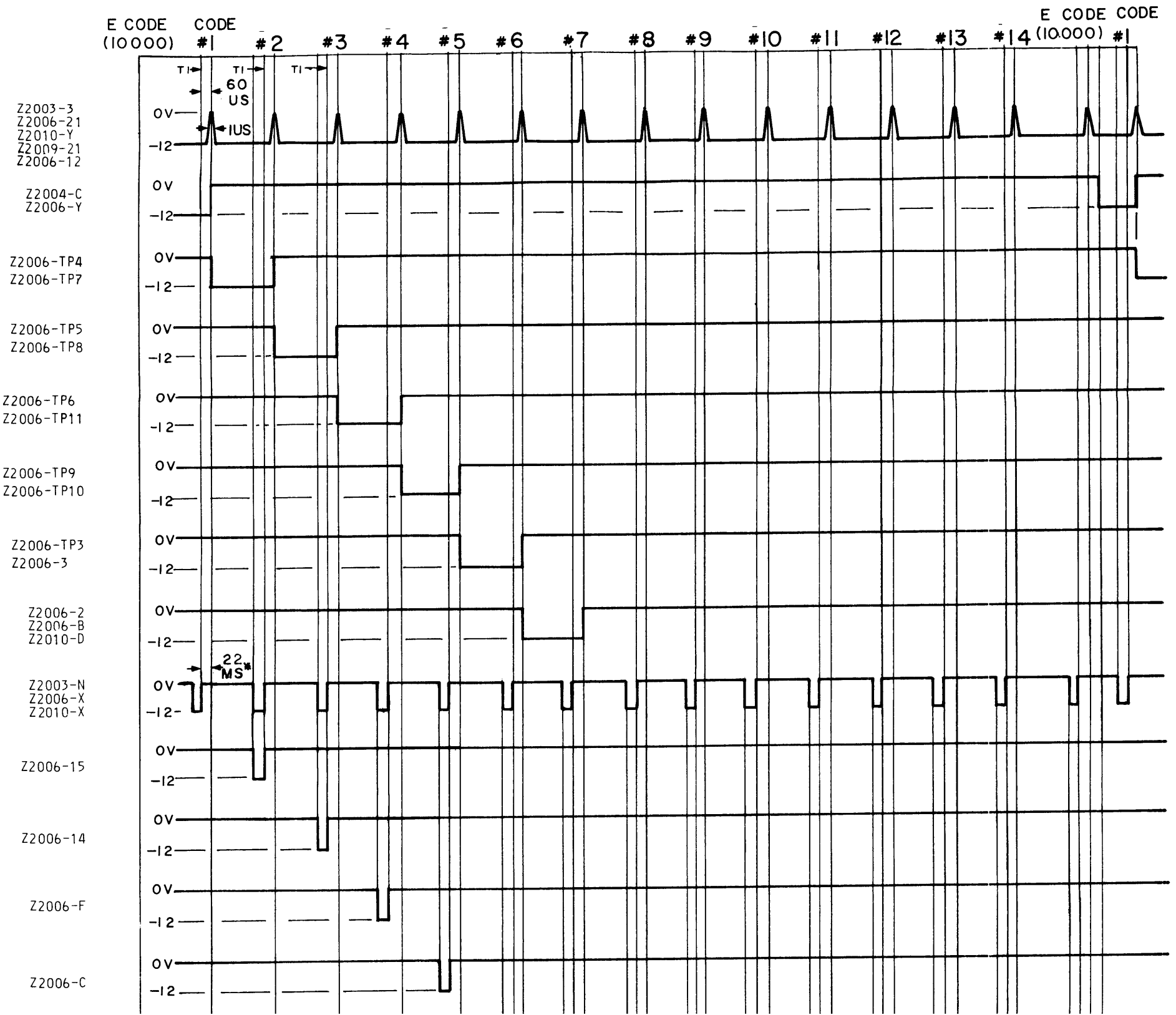
4093-15

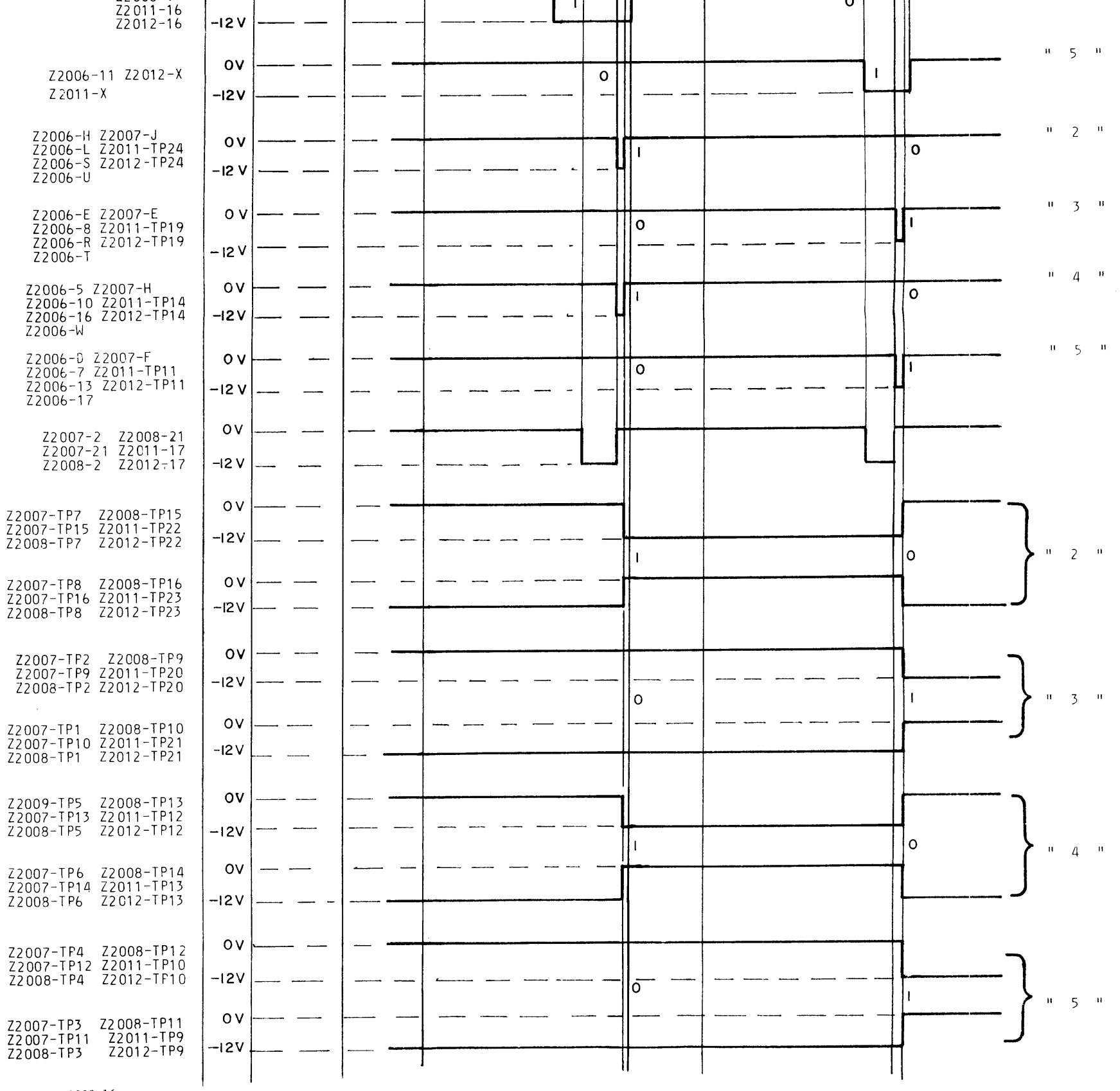
NOTES: -

1. INSERT "E" CODE, FOLLOWED BY 14 TEST CODES AND A TEST "E" CODE. 14 TEST CODES MAY BE ANY 5-BIT CODES.
2. * 22ms FOR 60 WPM; 13.5 FOR 100 WPM.

Figure 5-8 Timing Chart for Shift-Reg. (Z2006,10,9)

005674093


E CODE (10000)
CODE #1
#2
#3
#4
#5
#6
#7
#8
#9
#10
#11
#12
#13
#14
E CODE (10000)
CODE #1
T1
60 US
1US
22 MS*
0V
-12
Z2003-3
Z2006-21
Z2010-Y
Z2009-21
Z2006-12
Z2004-C
Z2006-Y
Z2006-TP4
Z2006-TP7
Z2006-TP5
Z2006-TP8
Z2006-TP6
Z2006-TP11
Z2006-TP9
Z2006-TP10
Z2006-TP3
Z2006-3
Z2006-2
Z2006-B
Z2010-D
Z2003-N
Z2006-X
Z2010-X
Z2006-15
Z2006-14
Z2006-F
Z2006-C



4093-16

005674093

NOTES

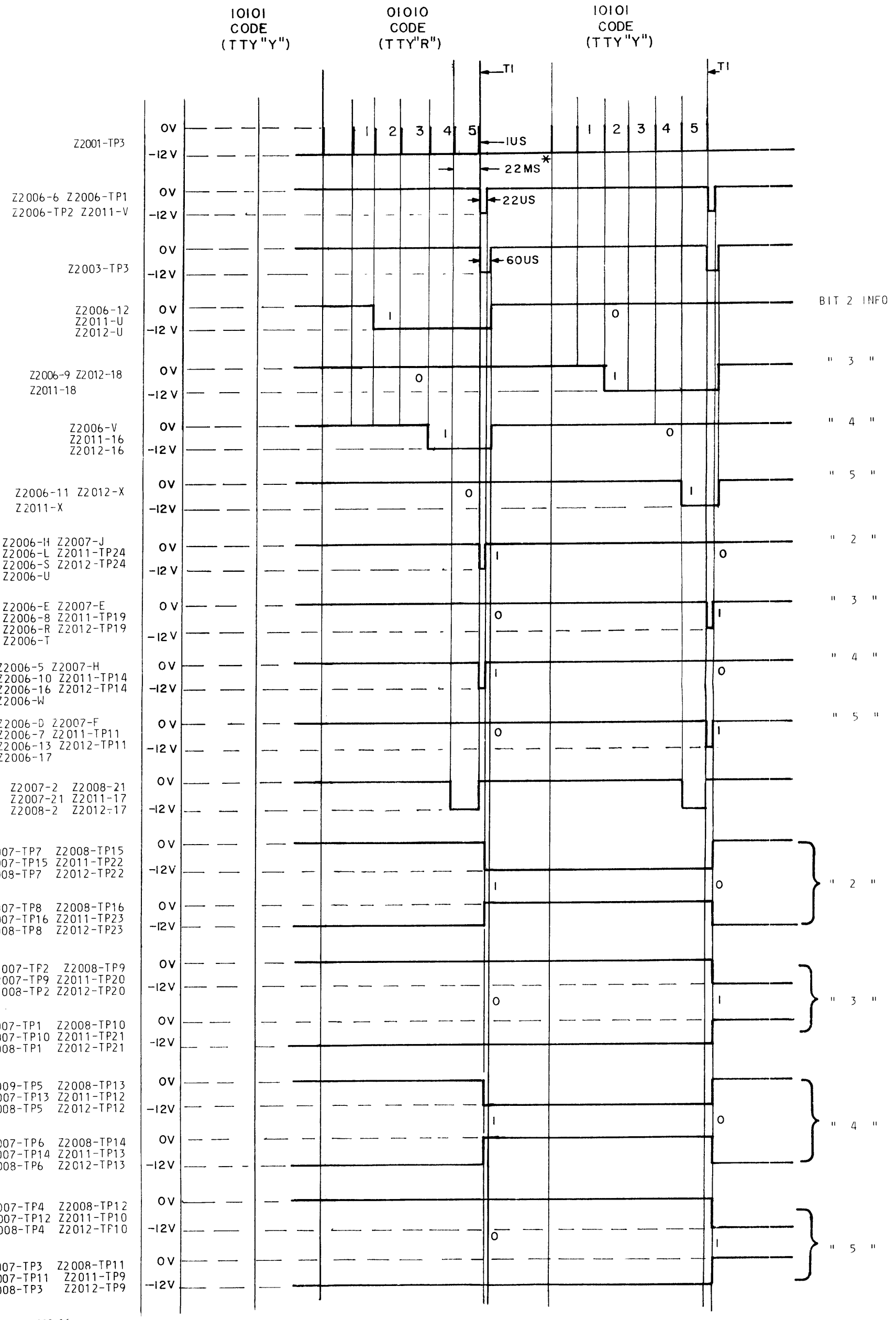
1. FOR 01010 CODE TEST, FIRST INSERT 10101 CODE.
2. FOR 10101 CODE TEST, FIRST INSERT 01010 CODE.
3. SHIFT REGISTER CYCLE MUST BE DISABLED TO OBTAIN ABOVE RESULTS. TO DO THIS, INSTALL JUMPERS AS SHOWN BELOW:

CARD UNDER TEST	JUMPER FROM	JUMPER TO
Z2006	Z2006-4	Z2006-TP7
	Z2006-TP7	Z2006-TP8
	Z2006-TP8	Z2006-TP11
	Z2006-TP11	Z2006-TP10
Z2007	Z2006-4	Z2006-TP7
	Z2006-TP7	Z2006-TP8
Z2008	Z2006-4	Z2006-TP11
	Z2006-TP11	Z2006-TP10
Z2011	Z2006-4	Z2006-3
Z2012	Z2006-4	Z2006-B

NOTE

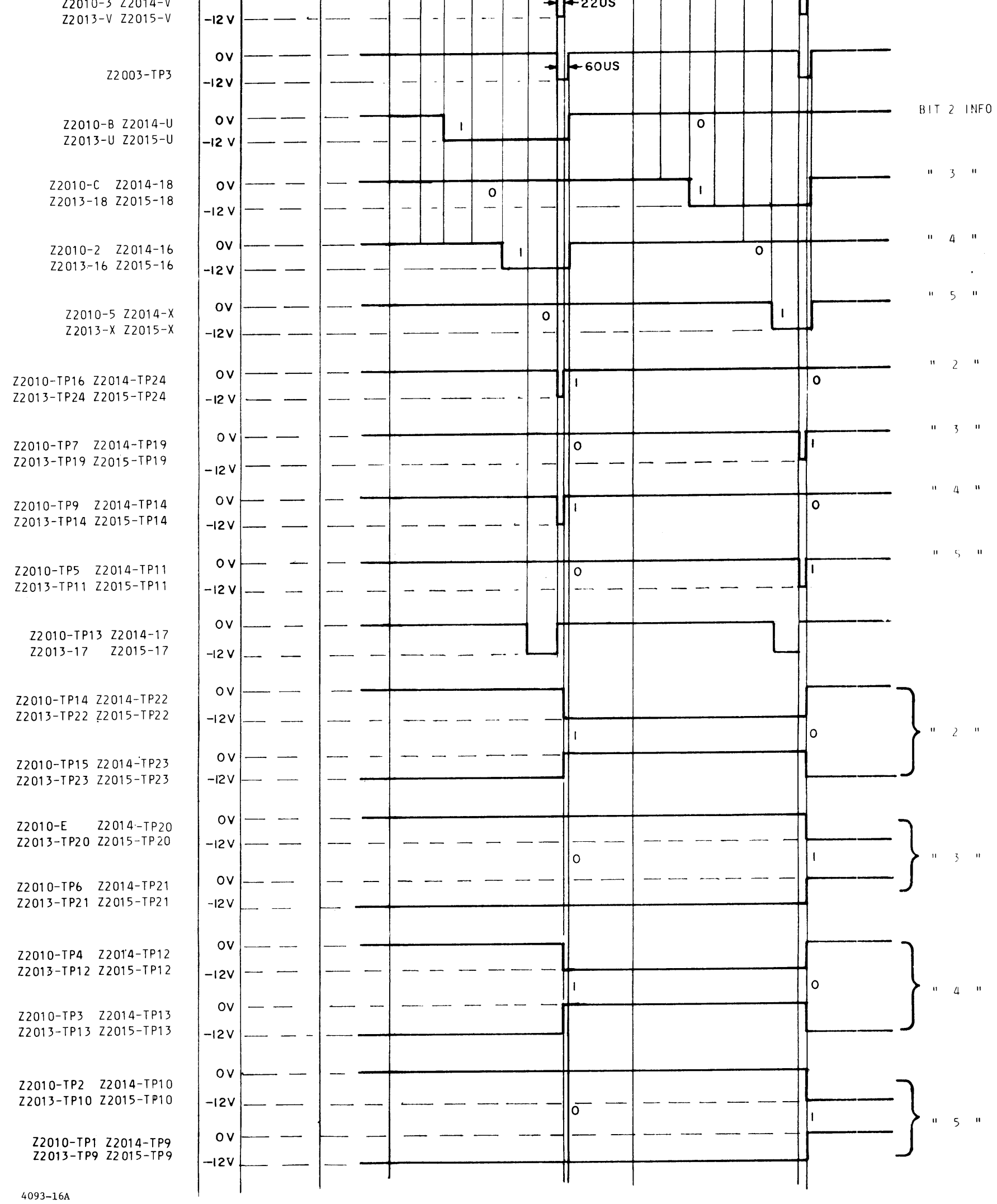
CHECK TO ENSURE THAT ABOVE JUMPERS ARE REMOVED AFTER TEST.

Figure 5-9 Timing Chart For Binary Circuits. (Z2006,7,8,11 and 12)



4093-16

NOTES



NOTES:

1. FOR 01010 CODE TEST, FIRST INSERT 10101 CODE.
2. FOR 10101 CODE TEST, FIRST INSERT 01010 CODE.
3. SHIFT REGISTER CYCLE MUST BE DISABLED TO OBTAIN ABOVE RESULTS. TO DO THIS, INSTALL JUMPERS AS SHOWN BELOW:

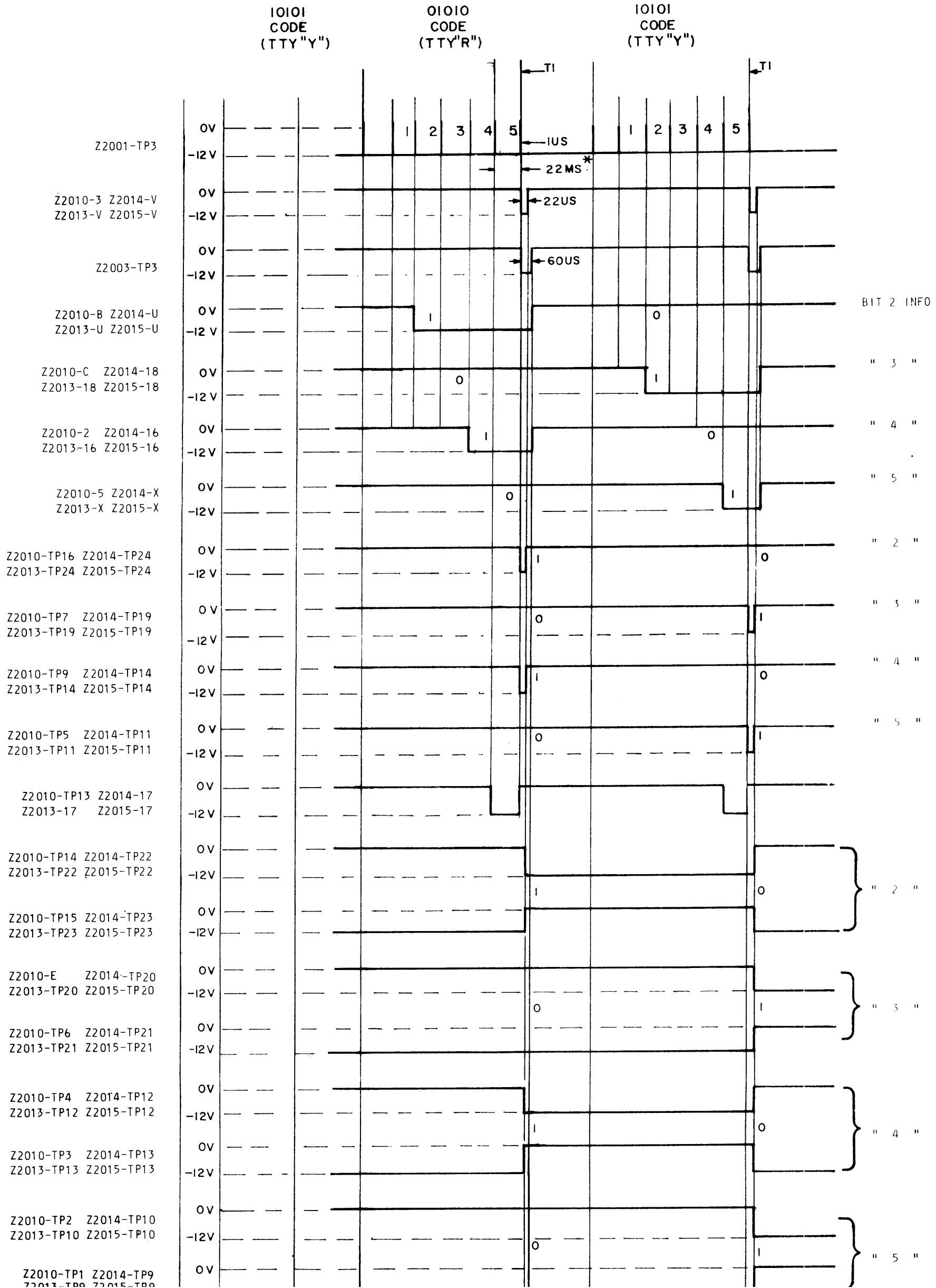
CARD UNDER TEST	JUMPER FROM	JUMPER TO
Z2010	Z2010-4	Z2010-TP8
Z2013	Z2010-4	Z2010-21
Z2014	Z2010-4	Z2010-19
Z2015	Z2010-4	Z2010-U

NOTE

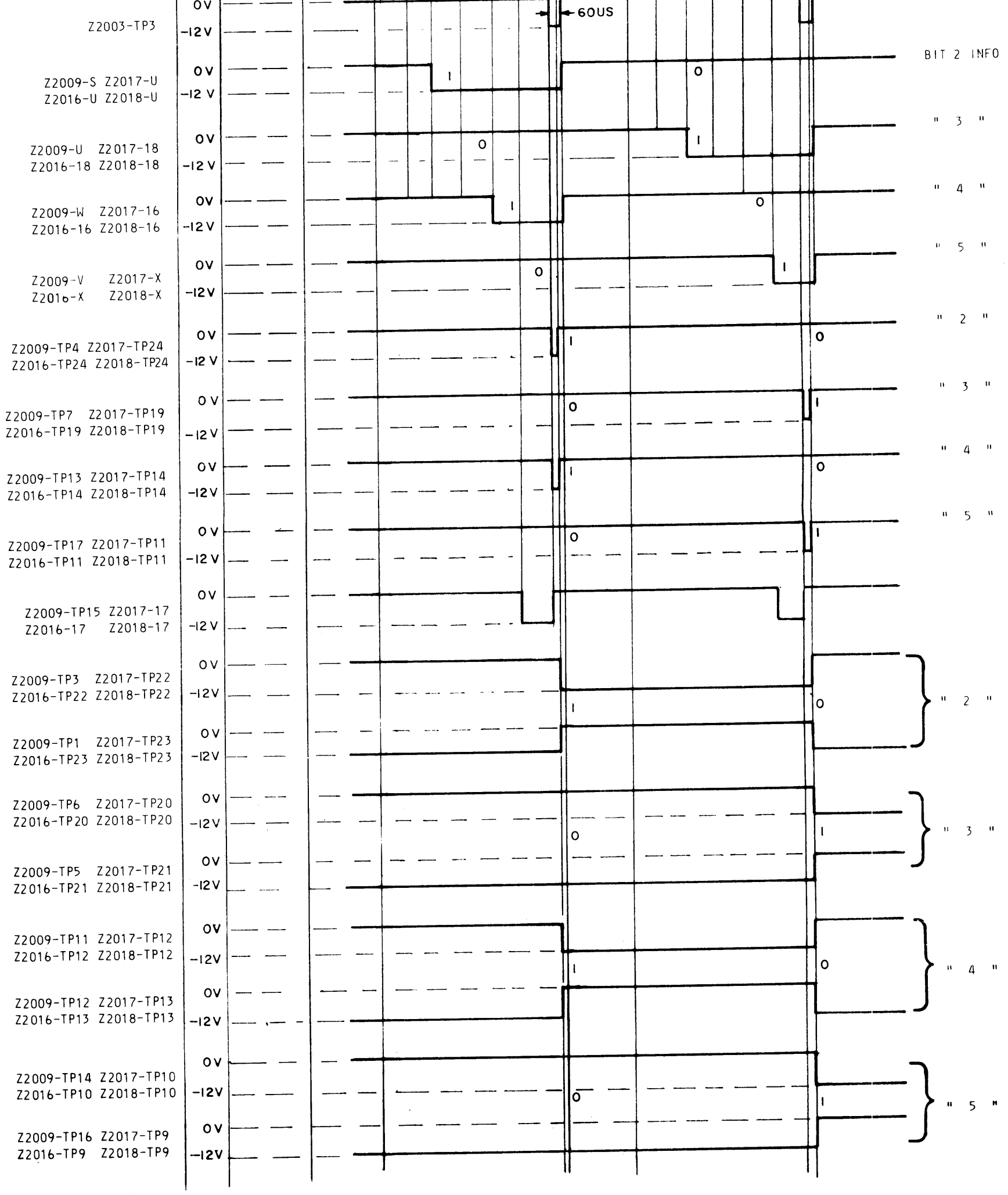
CHECK TO ENSURE THAT ABOVE JUMPERS ARE REMOVED AFTER TEST.

4. *22MS FOR 60WPM; 13.5MS FOR 100WPM.

Figure 5-10 TIMING CHART FOR BINARY CIRCUITS (Z2010,13,14,15)


10101 CODE (TTY "Y")
01010 CODE (TTY "R")
10101 CODE (TTY "Y")
T1
T1
1US
22MS*
22US
60US
Z2001-TP3
Z2010-3 Z2014-V
Z2013-V Z2015-V
Z2003-TP3
Z2010-B Z2014-U
Z2013-U Z2015-U
Z2010-C Z2014-18
Z2013-18 Z2015-18
Z2010-2 Z2014-16
Z2013-16 Z2015-16
Z2010-5 Z2014-X
Z2013-X Z2015-X
Z2010-TP16 Z2014-TP24
Z2013-TP24 Z2015-TP24
Z2010-TP7 Z2014-TP19
Z2013-TP19 Z2015-TP19
Z2010-TP9 Z2014-TP14
Z2013-TP14 Z2015-TP14
Z2010-TP5 Z2014-TP11
Z2013-TP11 Z2015-TP11
Z2010-TP13 Z2014-17
Z2013-17 Z2015-17
Z2010-TP14 Z2014-TP22
Z2013-TP22 Z2015-TP22
Z2010-TP15 Z2014-TP23
Z2013-TP23 Z2015-TP23
Z2010-E Z2014-TP20
Z2013-TP20 Z2015-TP20
Z2010-TP6 Z2014-TP21
Z2013-TP21 Z2015-TP21
Z2010-TP4 Z2014-TP12
Z2013-TP12 Z2015-TP12
Z2010-TP3 Z2014-TP13
Z2013-TP13 Z2015-TP13
Z2010-TP2 Z2014-TP10
Z2013-TP10 Z2015-TP10
Z2010-TP1 Z2014-TP9
0V
-12V
1 2 3 4 5
BIT 2 INFO
" 3 "
" 4 "
" 5 "
" 2 "
" 3 "
" 4 "
" 5 "

00567409 3



4093-16B

005674093

Figure 5-11 Timing Chart for
Binary Circuits (Z2009,16,17,18)

NOTES:

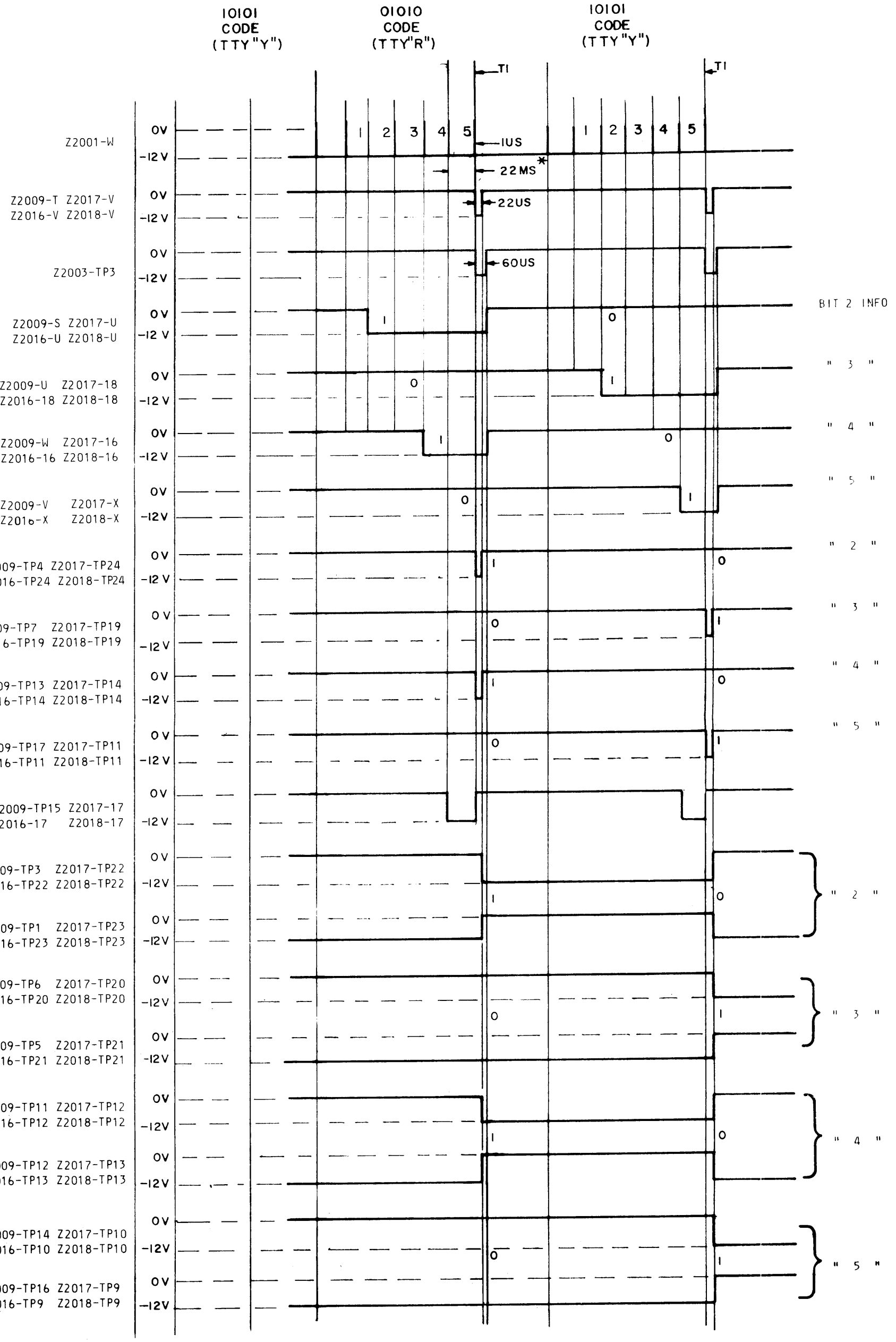
1. FOR 01010 CODE TEST, FIRST INSERT 10101 CODE.
2. FOR 10101 CODE TEST, FIRST INSERT 01010 CODE.
3. SHIFT REGISTER CYCLE MUST BE DISABLED TO OBTAIN ABOVE RESULTS. TO DO THIS, INSTALL JUMPERS AS SHOWN BELOW:

CARD UNDER TEST	JUMPERS FROM	JUMPERS TO
Z2009	Z2009-4	Z2009-TP2
Z2016	Z2009-4	Z2009-15
Z2017	Z2009-4	Z2009-11
Z2018	Z2009-4	Z2009-10

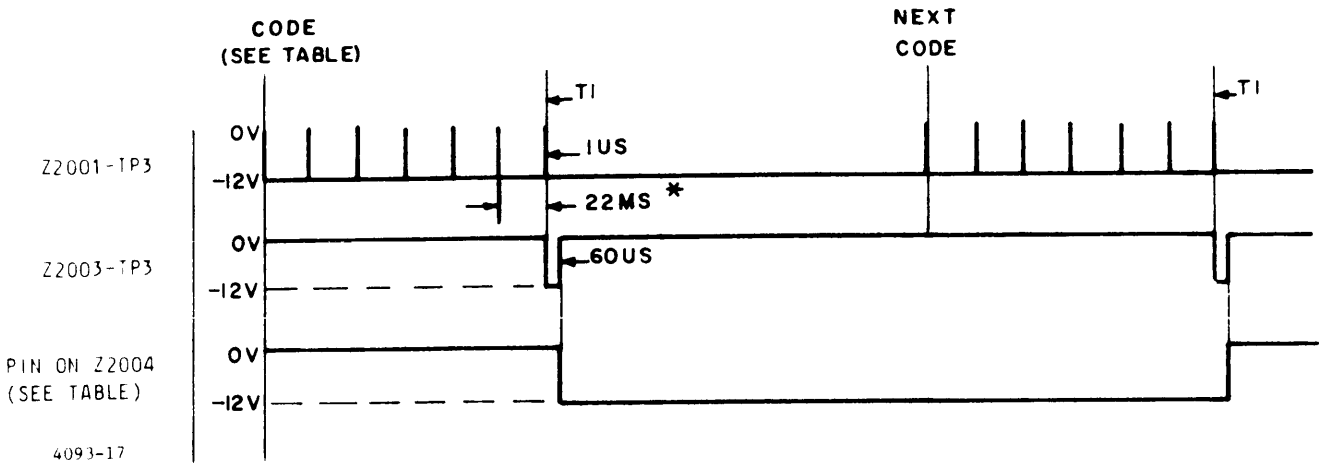
NOTE

CHECK TO ENSURE THAT ABOVE JUMPERS ARE REMOVED AFTER TEST.

4. *22MS FOR 60WPM; 13.5MS FOR 100WPM.


10101 CODE (TTY "Y")
01010 CODE (TTY "R")
10101 CODE (TTY "Y")
T1
T1
1 2 3 4 5
1 2 3 4 5
1US
22MS *
22US
60US
Z2001-W
Z2009-T Z2017-V Z2016-V Z2018-V
Z2003-TP3
Z2009-S Z2017-U Z2016-U Z2018-U
Z2009-U Z2017-18 Z2016-18 Z2018-18
Z2009-W Z2017-16 Z2016-16 Z2018-16
Z2009-V Z2017-X Z2016-X Z2018-X
Z2009-TP4 Z2017-TP24 Z2016-TP24 Z2018-TP24
Z2009-TP7 Z2017-TP19 Z2016-TP19 Z2018-TP19
Z2009-TP13 Z2017-TP14 Z2016-TP14 Z2018-TP14
Z2009-TP17 Z2017-TP11 Z2016-TP11 Z2018-TP11
Z2009-TP15 Z2017-17 Z2016-17 Z2018-17
Z2009-TP3 Z2017-TP22 Z2016-TP22 Z2018-TP22
Z2009-TP1 Z2017-TP23 Z2016-TP23 Z2018-TP23
Z2009-TP6 Z2017-TP20 Z2016-TP20 Z2018-TP20
Z2009-TP5 Z2017-TP21 Z2016-TP21 Z2018-TP21
Z2009-TP11 Z2017-TP12 Z2016-TP12 Z2018-TP12
Z2009-TP12 Z2017-TP13 Z2016-TP13 Z2018-TP13
Z2009-TP14 Z2017-TP10 Z2016-TP10 Z2018-TP10
Z2009-TP16 Z2017-TP9 Z2016-TP9 Z2018-TP9
0V
-12V
BIT 2 INFO
" 3 "
" 4 "
" 5 "
" 2 "
" 3 "
" 4 "
" 5 "

00567093



CODE	TTY KEY REF	Z2004 PIN	CODE	TTY KEY REF	Z2004 PIN
11001	W	11	10110	F	H
11000	A	13	10111	X	9
10100	S	8	11011	Figures	6
11100	U	19	10011	B	5
11010	J	12	10101	Y	F
11110	K	18	10001	Z	2
11101	Q	17	10010	D	3
11111	Letters	X			

NOTES:

1. EACH CODE SHOULD PRODUCE A NEGATIVE VOLTAGE AT PIN OF Z2004 CARD AS INDICATED IN TABLE. AT APPLICATION OF NEXT CODE (FOR NEXT PIN) VOLTAGE AT FORMER PIN SHOULD GO POSITIVE.

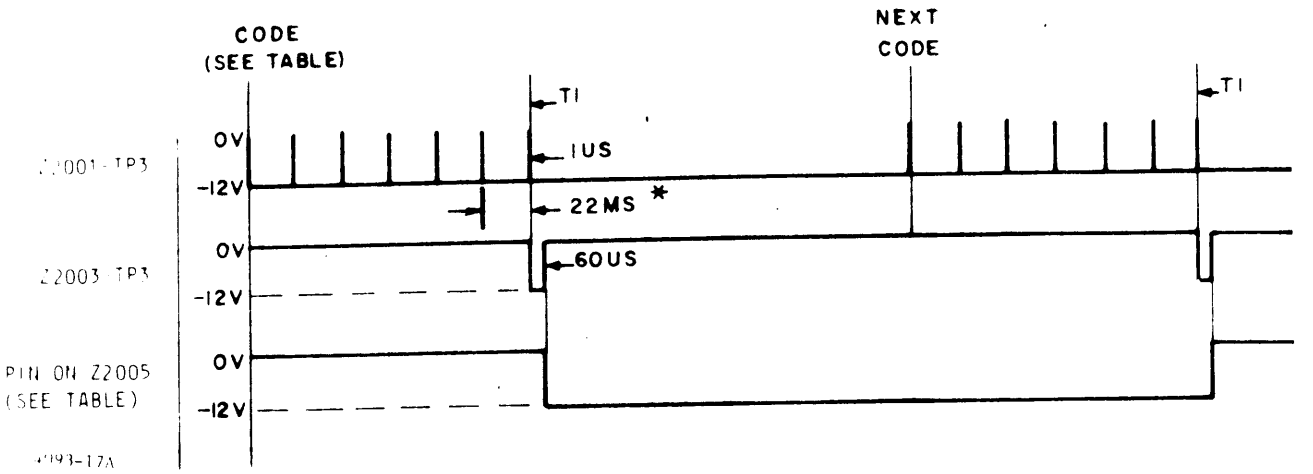
2. SHIFT REGISTER CYCLE MUST BE DISABLED TO OBTAIN ABOVE RESULTS. TO DO THIS, INSTALL JUMPER BETWEEN PINS 4 AND C OF Z2004 CARD.

NOTE

CHECK TO ENSURE THAT JUMPER IS REMOVED AFTER TEST.

3. 22ms for 60 WPM; 13.5ms for 100 WPM.

Figure 5-12. Timing Chart for Code Gates Z2004.



MC	CODE	TTY KEY REF	SHOULD PRODUCE -12V AT Z2005 PIN	MC DIGIT LEFT	MC DIGIT RIGHT	POSSIBLE FAULTY MODULES	CHECK 2nd CODE	FAULTY MODULE IF 2nd CODE: CHECKS	FAULTY MODULE IF 2nd CODE: FAILS
2	11001	W	L		2	Z1,2	12MC	Z1	Z2
3	11000	A	21		3	Z11,4	13MC	Z11	Z4
4	10100	S	V		4	Z16,8	14MC	Z16	Z8
5	11100	U	R		5	Z5,6	15MC	Z5	Z6
6	11010	J	P		6	Z14,10	16MC	Z14	Z10
7	11110	K	2		7	Z1,2	27MC	Z1	Z2
8	11101	Q	19		8	Z11,4	28MC	Z11	Z4
9	11111	Letters	U		9	Z12,8	19MC	Z12	Z8

NOTES:

1. EACH CODE SHOULD PRODUCE A NEGATIVE VOLTAGE AT A PIN OR PINS OF Z2005 CARD AS INDICATED IN TABLE. AT APPLICATION OF NEXT CODE (FOR NEXT PIN/S) VOLTAGE AT FORMER PIN/S SHOULD GO POSITIVE.

2. SHIFT REGISTER CYCLE MUST BE DISABLED TO OBTAIN ABOVE RESULTS. TO DO THIS, INSTALL JUMPER BETWEEN PINS 4 AND C OF Z2005 CARD. REMOVE JUMPER AFTER TEST.

3. 2 THROUGH 9MC CODES -- EACH CODE TRAVELS THROUGH 2 MODULES. TO REVEAL THE FAULTY ONE, TEST FOR "2nd CODE" AS INDICATED IN TABLE.

4. 10 THROUGH 31MC CODES -- EACH CODE TRAVELS THROUGH 3 MODULES. TO REVEAL THE FAULTY ONE CHECK THE 3 TROUBLE CONDITIONS AS LISTED IN TABLE.
EXAMPLE: WHEN 10MC CODE IS INTRODUCED, NEGATIVE VOLTAGE APPEARS AT PIN 13 BUT NOT AT PIN S. THE FAULTY MODULE IS Z6. IF NEITHER PIN 13 OR PIN S REGISTER A NEGATIVE VOLTAGE, Z9 MODULE IS AT FAULT.

Figure 5-13 (Sheet 1 of 3) Timing Chart for Code Gates (Z2005)

5. IF NEGATIVE VOLTAGE APPEARS AT PIN/S BUT MC INDICATOR DOES NOT REGISTER DIGIT/S, INDICATOR IS AT FAULT.

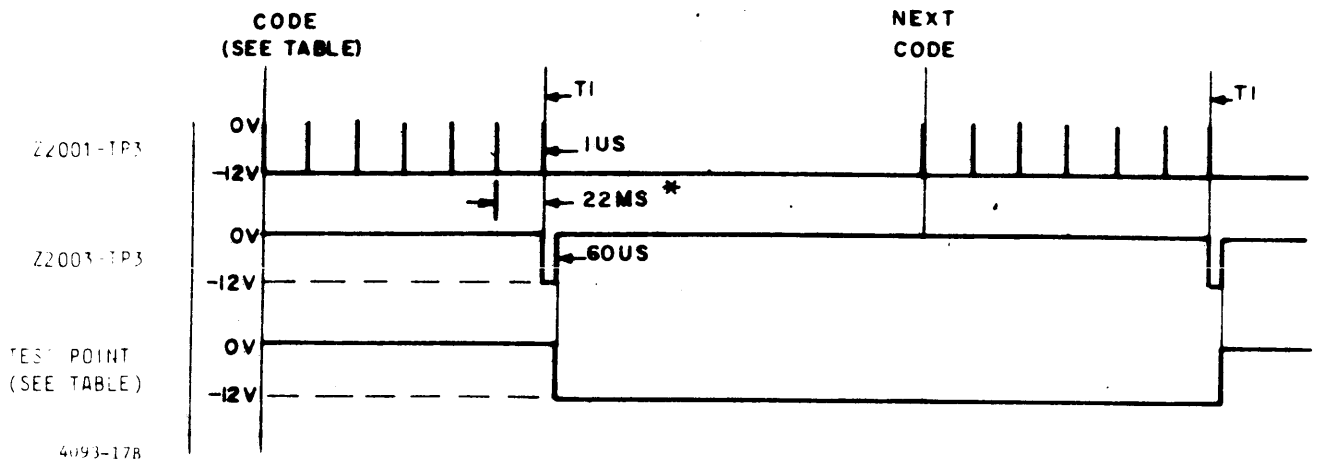
6. * 22ms FOR 60 WPM; 13.5ms FOR 100 WPM.

MC	CODE	TTY KEY REF	SHOULD PRODUCE -12V AT Z2005 PIN	MC DIGIT LEFT	MC DIGIT RIGHT	IF NOT, FAULTY MODULE IS:
			13	1		Z3
10	10110	F	S		0	Z6
			13&S	1	0	Z9
			13	1		Z15
11	10111	X	M		1	Z10
			13&M	1	1	Z14
			13	1		Z3
12	11011	Figures	L		2	Z2
			13&L	1	2	Z5
			13	1		Z3
13	10011	B	21		3	Z4
			13&21	1	3	Z12
			13	1		Z3
14	10101	Y	V		4	Z8
			13&V	1	4	Z16
			13	1		Z3
15	10001	Z	R		5	Z6
			13&R	1	5	Z9
			13	1		Z15
16	10010	D	P		6	Z10
			13&P	1	6	Z13
			13	1		Z3
17	01001	L	2		7	Z2
			13&2	1	7	Z1
			13	1		Z3
18	01000	Line Feed	19		8	Z4
			13&19	1	8	Z11
			13	1		Z3
19	00100	Space	U		9	Z8
			13&U	1	9	Z16
			14	2		Z7
20	01100	I	S		0	Z6
			14&S	2	0	Z1
			14	2		Z15
21	01010	R	M		1	Z10
			14&M	2	1	Z14
			14	2		Z7
22	01110	C	2		2	Z2
			14&2	2	2	Z1
			14	2		Z7
23	01101	P	21		3	Z4
			14&21	2	3	Z11
			14	2		Z7
24	01111	V	V		4	Z8
			14&V	2	4	Z12
			14	2		Z7
25	00110	N	R		5	Z6
			14&R	2	5	Z9

Figure 5-13 (Sheet 2 of 3) Timing Chart for Code Gates (Z2005)

MC	CODE	TTY REF REF	SHOULD PRODUCE -12V AT Z2005 PIN	MC DIGIT LEFT	MC DIGIT RIGHT	IF NOT, FAULTY MODULE IS:
			14	2		Z15
26	00111	M	10		6	Z10
			14&10	2	6	Z14
			14	2		Z7
27	01011	G	2		7	Z2
			14&2	2	7	Z5
			14	2		Z7
28	00011	O	19		8	Z4
			14&19	2	8	Z12
			14	2		Z7
29	00101	H	U		9	Z8
			14&U	2	9	Z16
			12	3		Z15
30	00001	T	S		0	Z6
			12&S	3	0	Z9
			12	3		Z15
31	00010	Carriage Return	M		1	Z10
			12&M	3	1	Z13

Figure 5-13 (Sheet 3 of 3) Timing Chart for Code Gates (Z2005)



NOTE:

1. EACH CODE SHOULD PRODUCE A NEGATIVE VOLTAGE AT THE TEST POINT AS INDICATED IN TABLES. AT APPLICATION OF NEXT CODE (FOR NEXT TEST POINT) VOLTAGE AT FORMER TEST POINT SHOULD GO POSITIVE.

2. SHIFT REGISTER CYCLE MUST BE DISABLED TO OBTAIN THESE RESULTS. TO DO THIS, INSTALL JUMPERS AS INDICATED FOR CARD UNDER TEST AS LISTED BELOW: -

CARD UNDER TEST	JUMPER FROM	JUMPER TO
Z2007	Z2006-4 Z2006-TP7	Z2006-TP7 Z2006-TP8
Z2008	Z2006-4 Z2006-TP11	Z2006-TP11 Z2006-TP10
Z2010	Z2010-4	Z2010-TP8
Z2011	Z2006-4	Z2006-3
Z2012	Z2006-4	Z2006-B
Z2013	Z2010-4	Z2010-21
Z2014	Z2010-4	Z2010-19
Z2015	Z2010-4	Z2010-U
Z2016	Z2009-4	Z2009-15
Z2017	Z2009-4	Z2009-11
Z2018	Z2009-4	Z2009-10

Figure 5-14 (Sheet 1 of 5) Timing Chart for Code Gates (Z2007,8,10,18)

NOTE

CHECK TO ENSURE THAT ABOVE JUMPERS ARE REMOVED AFTER TEST.

3. IF NEGATIVE VOLTAGE APPEARS AT PIN BUT INDICATOR DOES NOT REGISTER EXPECTED READING, INDICATOR IS AT FAULT.

4 * 22 ms for 60 WPM; 13.5 ms for 100 WPM.

MC DISPLAY (.0000-.9999)

CODE	TTY KEY REF	SHOULD PRODUCE -12V AT TEST PT.	DIGIT	PLACES RIGHT OF DECIMAL
01000	Line Feed	Z2007-D	0	1
00100	Space	-C	1	
00010	Carriage Return	-L	2	
01001	L	-8	3	
01100	I	-B	4	
00110	N	-3	5	
01011	G	-9	6	
01101	P	-10	7	
01110	C	-6	8	
00111	M	-7	9	1
01000	Line Feed	-R	0	2
00100	Space	-P	1	
00010	Carriage Return	-X	2	
01001	L	-18	3	
01100	I	-N	4	
00110	N	-14	5	
01011	G	Z2007-17	6	2

CODE	TTY KEY REF	SHOULD PRODUCE -12V AT TEST PT.	DIGIT	PLACES RIGHT OF DECIMAL
01101	P	Z2007-19	7	2
01110	C	-15	8	
00111	M	Z2007-16	9	2
01000	Line Feed	Z2008-D	0	3
00100	Space	-C	1	
00010	Carriage Return	-L	2	
01001	L	-8	3	
01100	I	-B	4	
00110	N	-3	5	
01011	G	-9	6	
01101	P	-10	7	
01110	C	-6	8	
00111	M	-7	9	3
01000	Line Feed	-R	0	4
00100	Space	-P	1	
00010	Carriage Return	-X	2	
01001	L	Z2008-18	3	4

Figure 5-14 (Sheet 2 of 5) Timing Chart for Code Gates (Z2007,8,10,18)

CODE	TTY KEY REF	SHOULD PRODUCE -12V AT TEST PT.	DIGIT	PLACES RIGHT OF DECIMAL
01100	!	Z2008-N	4	4
00110	N	-14	5	
01011	G	-17	6	
01101	P	-19	7	
01110	C	-15	8	
00111	M	Z2008-16	9	4

FUNCTION DISPLAY #1 - #4

CODE	TTY KEY REF	SHOULD PRODUCE -12V AT TEST PT.	FUNCTION#	DISPLAY (SEE TABLE 1-2) READING POSITION
01000	Line Feed	Z2011-TP3,-P	1	1
00100	Space	-TP2,-Y		2
00010	Carriage Return	-TP5,-R		3
01001	L	-TP7,-15		4
01100	I	-TP1,-W		5
00110	N	-TP16,-3		6
01011	G	-TP8,-8		7
01101	P	-TP15,14		8
01110	C	-TP17,-2		9
00111	M	-TP18,-J		10
00011	O	-TP4,-L		11
00001	T	Z2011-TP6,-H	1	12
01000	Line Feed	Z2012-TP3,-P	2	1
00100	Space	Z2012-TP2,-Y	2	2

CODE	TTY KEY REF	SHOULD PRODUCE -12V AT TEST PT.	FUNCTION#	DISPLAY (SEE TABLE 1-2) READING POSITION
00010	Carriage Return	Z2012-TP5,-R	2	3
01001	L	-TP7,-15		4
01100	I	-TP1,-W		5
00110	N	-TP16,-3		6
01011	G	-TP8,-8		7
01101	P	-TP15,-14		8
01110	C	-TP17,-2		9
00111	M	-TP18,-J		10
00011	O	-TP4,-L		11
00001	T	Z2012-TP6,-H	2	12
01000	Line Feed	Z2013-TP3,-P	3	1
00100	Space	-TP2,-Y		2
00010	Carriage Return	-TP5,-R		3
01001	L	-TP7,-15		4
01100	I	Z2013-TP1,-W	3	5

Figure 5-14 (Sheet 3 of 5) Timing Chart Code Gates (Z2007,8,10,18)

CODE	TTY KEY REF	-12V AT TEST PT.	FUNCTION#	READING POSITION
00110	N	Z2013-TP16,-3	3	6
01011	G	-TP8,-8		7
01101	P	-TP15,-14		8
01110	C	-TP17,-2		9
00111	M	-TP18,-J		10
00011	O	-TP4,-L		11
00001	T	Z2013-TP6,-H	3	12
01000	Line Feed	Z2014-TP3,-P	4	1
00100	Space	-TP2,-Y		2
00010	Carriage Return	Z2014-TP5,-R	4	3

CODE	TTY KEY REF	-12V AT TEST PT.	FUNCTION#	READING POSITION
01001	L	Z2014-TP7,-15	4	4
01100	I	-TP1,-W		5
00110	N	-TP16,-3		6
01011	G	-TP8,-8		7
01101	P	-TP15,-14		8
01110	C	-TP17,-2		9
00111	M	-TP18,-J		10
00011	O	-TP4,-L		11
00001	T	Z2014-TP6,-H	4	12

FUNCTION DISPLAY #5

CODE	TTY KEY REF	-12V AT TEST PT.	SHOULD PRODUCE FUNCT #5 WINDOW READING POSITION*	IN TUNE PROCESS/ READY/FAULT LIGHT
01000	Line Feed	Z2010-16,-R	1	FAULT
00100	Space	-E	2	IN TUNE PROCESS
00010	Carriage Return	-17,-R	3	FAULT
00001	L	Z2010-P	12	READY

* See table 1-2.

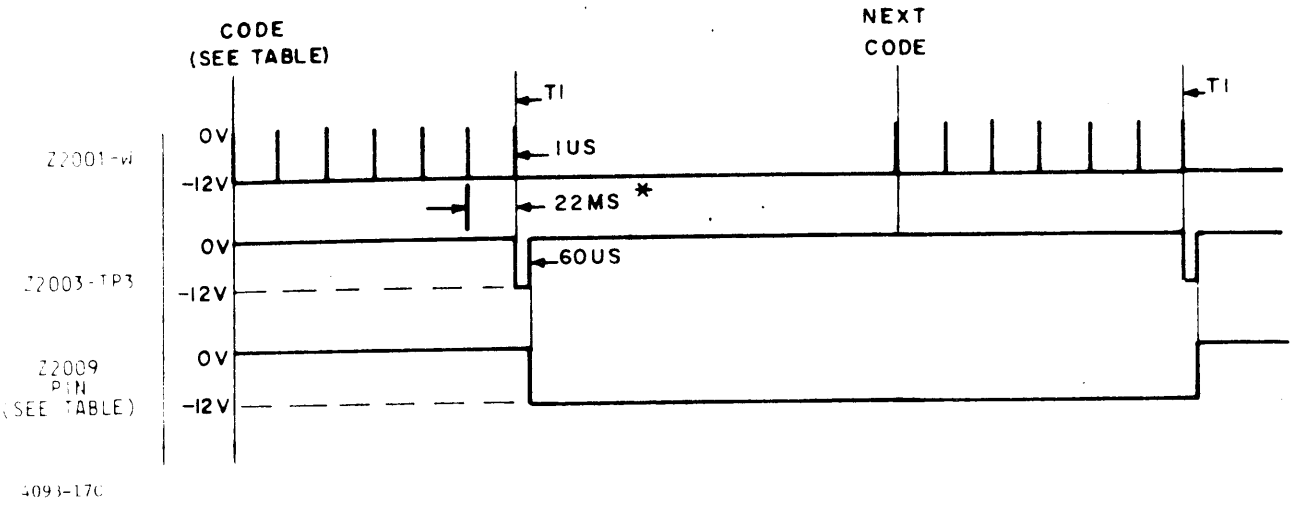
Figure 5-14 (Sheet 4 of 5) Timing Chart for Code Gates (Z2007,8,10,18)

FUNCTION DISPLAY #6 - #9

CODE	TTY KEY REF	SHOULD PRODUCE: -12V AT TEST PT.	FUNCTION	DISPLAY (SEE TABLE 1-2) READING POSITION
01000	Line Feed	Z2015-TP3,-P	6	1
00100	Space	-TP2,-Y		2
00010	Carriage Return	-TP5,-R		3
01001	L	-TP7,-15		4
01100	I	-TP1,-W		5
00110	N	-TP16,-3		6
01011	G	-TP8,-8		7
01101	P	-TP15,-14		8
01110	C	-TP17,-2		9
00111	M	-TP18,-J		10
00011	O	-TP4,-L		11
00001	T	Z2015-TP6,-H	6	12
01000	Line Feed	Z2016-TP3,-P	7	1
00100	Space	-TP2,-Y		2
00010	Carriage Return	-TP5,-R		3
01001	L	-TP7,-15		4
01100	I	-TP1,-W		5
00110	N	-TP16,-3		6
01011	G	-TP8,-8		7
01101	P	-TP15,-14		8
01110	C	-TP17,-2		9
00111	M	-TP18,-J		10
00011	O	-TP4,-L		11
00001	T	Z2016-TP6,-H	7	12

CODE	TTY KEY REF	SHOULD PRODUCE: -12V AT TEST PT.	FUNCTION	DISPLAY (SEE TABLE 1-2) READING POSITION
01000	Line Feed	Z2017-TP-3,-P	8	1
00100	Space	-TP2,-Y		2
00010	Carriage Return	-TP5,-R		3
01001	L	-TP7,-15		4
01100	I	-TP1,-W		5
00110	N	-TP16,-3		6
01011	G	-TP8,-8		7
01101	P	-TP15,-14		8
01110	C	-TP17,-2		9
00111	M	-TP18,-J		10
00011	O	-TP4,-L		11
00001	T	Z2017-TP6,-H	8	12
01000	Line Feed	Z2018-TP3,-P	9	1
00100	Space	-TP2,-Y		2
00010	Carriage Return	-TP5,-R		3
01001	L	-TP7,-15		4
01100	I	-TP1,-W		5
00110	N	-TP16,-3		6
01011	G	-TP8,-8		7
01101	P	-TP15,-14		8
01110	C	-TP17,-2		9
00111	M	-TP18,-J		10
00011	O	-TP4,-L		11
00001	T	Z2018-TP6,-H	9	12

Figure 5-14 (Sheet 5 of 5) Timing Chart for Code Gates (Z2007,8,10,18)



CODE	TTY KEY REF	SHOULD PRODUCE: -12V AT PIN	SHOULD PRODUCE: DISPLAY ON ASSOCIATED EQUIPMENT INDICATOR
00001	T	C	1
00010	Carriage Return	D	2
00011	O	F	3
00100	Space	K	4
00101	H	H	5
00110	N	J	6
00111	M	8	7
01000	Line Feed	P	8
01001	L	M	9
01010	Y	N	10
01011	G	R	11
01100	I	X	12
01101	P	18	13
01110	C	19	14
01111	V	Y	15
00000	BLANK	E	16

NOTES:

1. EACH CODE SHOULD PRODUCE A NEGATIVE VOLTAGE AT THE Z2009 CARD PIN AS INDICATED IN TABLES. AT APPLICATION OF NEXT CODE (FOR NEXT PIN) VOLTAGE AT FORMER PIN SHOULD GO POSITIVE.
2. SHIFT REGISTER CYCLE MUST BE DISABLED TO OBTAIN THESE RESULTS. TO DO THIS, INSTALL A JUMPER BETWEEN PIN 4 AND PIN 7 OF Z2009 CARD. REMOVE JUMPER AFTER TEST.
3. IF NEGATIVE VOLTAGE APPEARS AT PIN BUT DISPLAY FAILS TO APPEAR ON ASSOCIATED EQUIPMENT INDICATOR, INDICATOR MAY BE AT FAULT.
4. * 22ms for 60 WPM, 13.5ms for 100 WPM.

Figure 5-15 Timing Chart for Code Gates (Z2009)

When using charts in figures 5-7 through 5-15 (whether for checking the entire Indicator or only one card) proceed in the order as presented by the numbered sequence of the charts. For example, when checking card Z2006, check those pulse patterns presented for card Z2006 in chart figure 5-8, then chart figure 5-9.

It is seldom necessary to check more than two or three cards. The quickest way to reveal the one malfunctioning card is the card substitution method. However, if spare cards are not available for this method, observations may be made on the specific nature of the trouble in order to narrow down the search. For instance, a complete failure of any readings would indicate input and gating cards Z2001, 2 or 3 and these may be checked in the chart in figure 5-7. Shift-register cycling trouble would be indicated by partial or incomplete readouts at the front panel. Erroneous readouts indicate possible binary circuit trouble in some particular card. A blank reading for a specific code in a display indicates a specific code gate malfunctioning. In all cases, observation of the specific "DS" front panel display indicator involved and reference to figure 4-1, Block Diagram, should narrow down the search to one or two cards.

Check coinciding pulse edges (voltage changes) for pairs of test points, starting at the top of the listing for that card in the chart. Use time bases A and B on the oscilloscope to do this. In the top section of each chart there are pacing (clock) pulses (from other cards) that set the timing for most of the other voltage changes; therefore the first pairs of test points to be checked should include these where they coincide with particular voltage changes on the card being checked. Set the oscilloscope for an external triggering mode, with a n gative triggering slope and level for the negative-going changes and a positive triggering slope and level for the positive-going

changes. The exact shape of a pulse is not an important factor in troubleshooting the Indicator. Very often, different attenuator lines into the oscilloscope will produce pulse shape distortions that are not present in the Indicator. The critical fact is whether or not the expected voltage changes occur in the polarities and patterns as indicated.

When checking code input and MC logic (figure 5-7), three test codes are used: the "E" (10000) to set up the consequent MC readout, the 10101 and 01010 codes for testing the binary circuitry in cards Z2002 and Z2004, with the whole tied into pacing pulses from timing circuits in cards Z2001 and Z2003. After measurements have been made for the E code and before each measurement for the 10101 code, insert the E code first, in order to set up the circuitry for the MC readout. Similarly, the E and 10101 codes must be inserted before each measurement for the 01010 code, in order to set up the binary circuits to register the change upon receiving the 01010 code.

When checking the shift-register cycling action (figure 5-8), a complete set of codes are inserted for a normal cycle of input. Any 5-bit codes may be used for this as long as the first is an E (10000).

In checking the binary function circuits (figures 5-9 through 5-11), two codes (01010 and 10101) are used to check each circuit for its two possible input-vs.-output conditions. Before measuring for a 01010 code, however, a 10101 code must be inserted to set up the flip-flops for the 01010 code; similarly the 01010 code is inserted before measuring for the 10101 code. The shift-register cycle is disabled in this test in order to facilitate the procedure; without this measure it would be necessary to insert a complete cycle of codes before each measurement in order to come up with the energizing pulse for that readout.

In checking code gate performance (figures 5-12 through 5-15) the correct code for each gate is inserted. With the correct code, the gate output should go negative and remain so until the next code (for the next gate) is inserted. Again, the shift-register cycle is disabled, in this test, in order to expedite procedure.

If readings remain normal through the code gate checks, it may be assumed that the panel indicator itself is at fault, rather than the logic circuitry. Cross-references to panel displays are included in figures 5-12 through 5-15 for that purpose.

Because MC Gating Card Z2005 contains no "TP" test points for intermediate readings among the "Z" logic modules, the output pins of the card are checked against each code. According to results indicated, the faulty "Z" module is revealed in the table. In the single digit range (2- thru 9-mc), two possible modules are involved and it is necessary to check an alternate code to discover the faulty one. In the two-digit range (10- thru 31-mc), there are 3 possible modules involved for each code. The faulty one is revealed by the 3 possible output failures (a missing output for the left digit, a missing output for the right, or both outputs missing).

5-5. REPAIR AND REPLACEMENT.

a. INTRODUCTION. - Repair of the Indicator chassis-mounted power supply circuitry follows standard lab procedures. Repair of printed circuit cards and card receptacle wiring, however, require the special tools and techniques as outlined here. Section 6, Parts List, lists all replaceable parts by their circuit symbol numbers. Encapsulated logic circuit modules (mounted on the cards) are non-repairable items and are replaced with new ones when damaged.

b. REPLACEMENT OF LOGIC MODULES. - When replacing a logic circuit

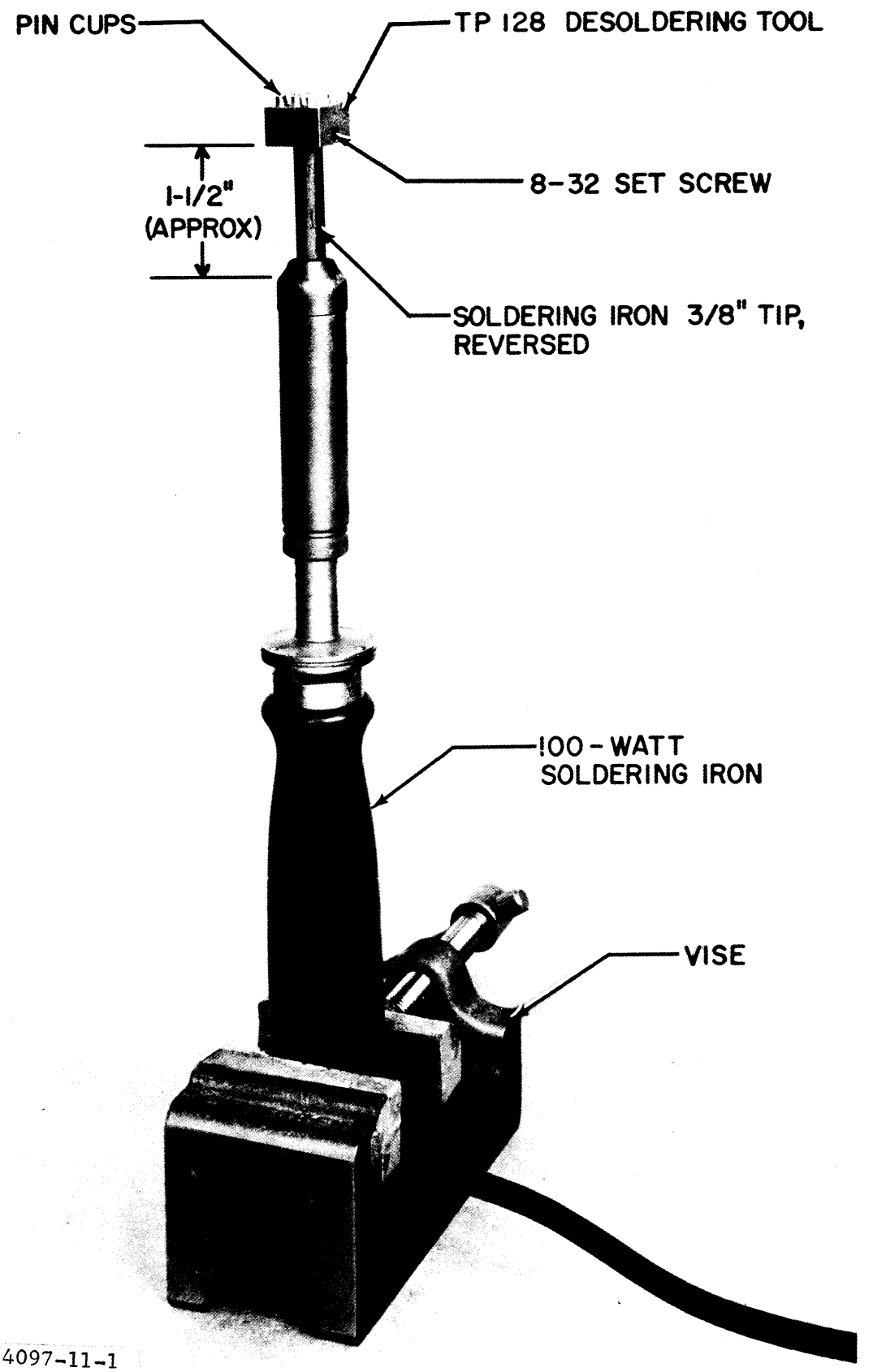


Figure 5-16. TP128 in Position

66 4.18-9

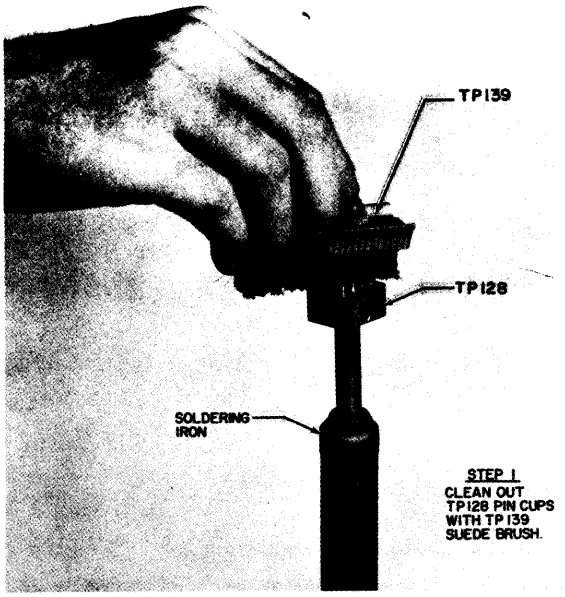
module on a card, it is necessary to remove the old module from the card by a simultaneous melting of the solder on all the logic pins. TP128 Desoldering Tool (see figure 5-3) is included in the Indicator shipment* for this purpose. Soldering the new module to the card is done pin-by-pin with conventional 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 5-16. 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 5-16) and secure with an 8-32 set screw.

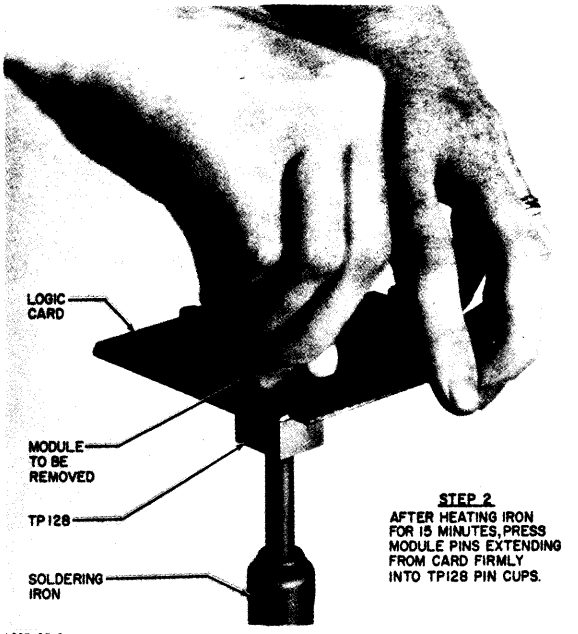
Refer to figure 5-17. Clean old solder out of TP128 cups with TP139 suede brush included in shipment* (figure 5-3). Plug iron extension cord into power outlet and allow to heat for 15 minutes. Lower card onto TP128 with pins of module to be removed nesting into TP128 solder cups. Press firmly on module to insert pins into cups while solder melts. When solder has melted sufficiently, it will be possible to pull the module straight up out of the card easily. Usually, about 2 seconds are enough. Do not try to pull module out forcibly before this point is reached. To do so may dislodge eyelets from pin holes in card. If it is possible to rock the module slightly, this is an indication that the solder has softened enough. This motion also helps to separate the pins from the eyelets. As 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

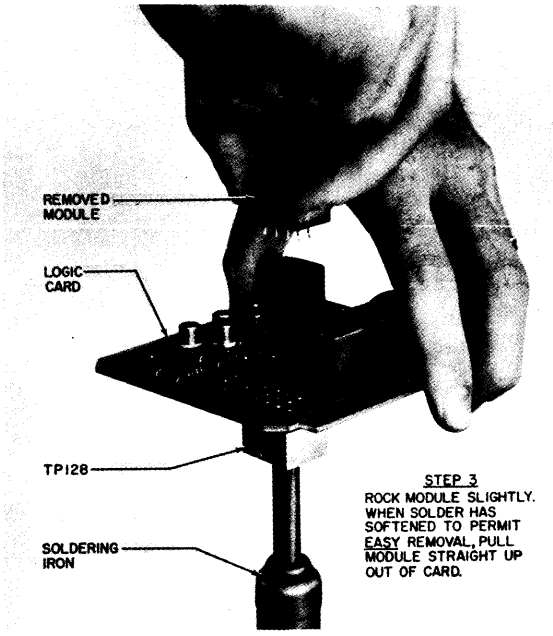
* Shipment of system in which RTIH is included.



4097-12-1A



4097-13-1



4097-14-1

4097-15-1

66 4.18-10,-11,-12,-13

Figure 5-17. Removing Logic Module from Card

the conducting strip to be repaired. Clean the area with a firm-bristle brush and approved solvent. Then repair the cracked or broken area of the conducting strip by flowing solder over the break. Considerable care must be exercised to keep the solder from flowing onto an adjacent strip.

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

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

CAUTION

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

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

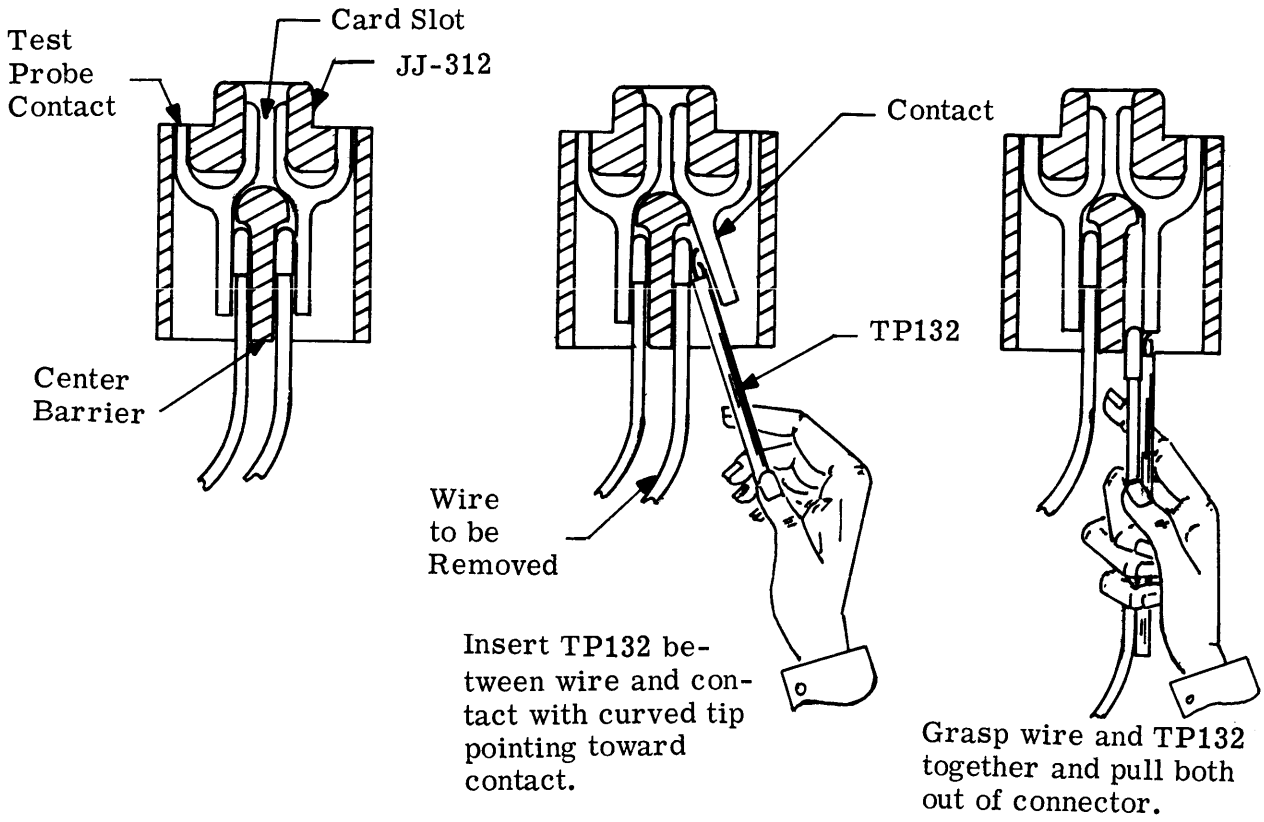
mounted on the other side.

d. REPLACEMENT OF WIRE IN CARD RECEPTACLES. - TP132 Conductor Extractor is included in the shipment* (see figure 5-3) for removing and installing wire in J2001 through J2018 and J2022 card receptacles. These receptacles take an insertion type of wire connection, rather than solder type. Figure 5-18 shows methods of wire removal and insertion using TP132. It will be noticed that TP132 serves to (a) give added rigidity to the wire as it is inserted or removed and (b) spring back the retention finger on the wire contact.

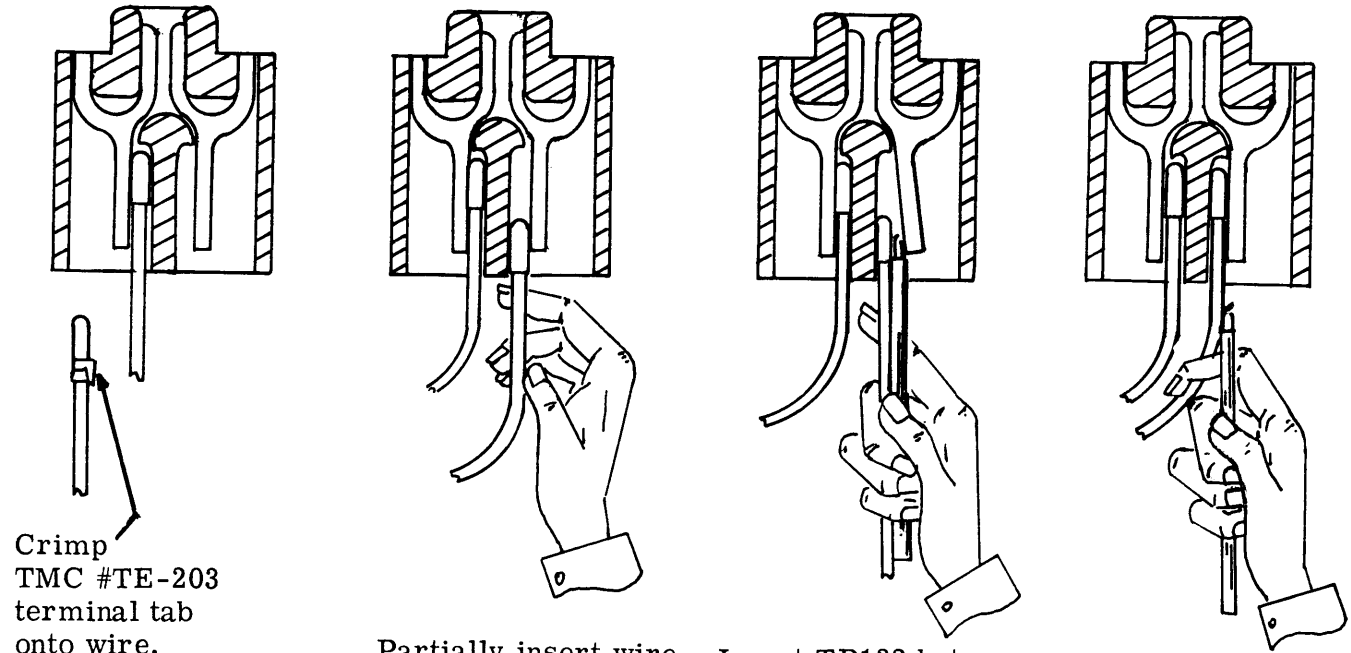
e. REPLACEMENT OF WIRE IN SYSTEM RECEPTACLES. - J2021 receptacle also takes an insertion type of wire connection. A TMC #PN119-2** terminal tab is crimped on with an Amphenol #294-91** contact crimping tool. The wire is then inserted by means of Amphenol #294-92** insertion and removal tool. This tool is also used for removing the wire.

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

REMOVAL



INSERTION



4097-16

Figure 5-18. Using TP132 Conductor Extractor

TABLE 5-2. POWER SUPPLY VOLTAGES

NOMINAL VOLTAGE AND FUNCTION	LOCATIONS OF TEST POINTS
-12V Logic reference	Z2022 - TP2004 Pin 4 of Z2001 thru Z2018
+12V Logic reference	Z2022 - TP2002 Pin 20 of Z2001 thru Z2004 and Z2006 thru Z2018
Ground	Pins 1, 21 and 22 of Z2022 Pins 1, 22, A and Z of Z2001 thru Z2018
+180V for 2.0000 to 31.9999 mc display	Z2022 - TP2003 Pin 12 of DS2003, 4, 6, 7, 8 and 9

SECTION 6

PARTS LIST

6-1. INTRODUCTION

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

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

a. Generic name.

b. Reference designation.

c. TMC part number.

d. Model and serial numbers of the equipment containing the part being replaced; this can be obtained from the equipment nameplate.

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

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

PARTS LIST
for
REMOTE TUNING INDICATOR, MODEL RTIH-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
B2001	FAN, VENTILATING: 115 VAC, 50/60 cps, single phase; power rating 14 watts; 100 CFM free delivery; black phenolic or die cast zinc with black finish.	BL106-5
C2001	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 2 x 10,000 uuf, GMV; 1,000 WVDC.	CC100-23
C2002 thru C2004	NOT USED	
C2005	CAPACITOR, FIXED, ELECTROLYTIC: 2,600 uf, 50 WVDC; polarized; clear plastic insulated case.	CE112-6
C2006	CAPACITOR, FIXED, ELECTROLYTIC: 9,200 uf, 15 WVDC; polarized; clear plastic insulated case.	CE112-10
C2007	CAPACITOR, FIXED, ELECTROLYTIC: 14,000 uf, 25 WVDC; polarized; clear plastic insulated case.	CE112-9
C2008	Same as C2006.	
CR2001	SEMICONDUCTOR DEVICE, DIODE: rectifier bridge; peak reverse voltage 200 volts; forward current 10 amps at 55°C; input voltage 140 V RMS; polarized; molded plastic case.	DD131-200-10
CR2002	NOT USED	
CR2003	NOT USED	
CR2004	SEMICONDUCTOR DEVICE, DIODE: silicon; nominal ref. voltage 9.1 volts; max. dynamic impedance 2.0 ohms; max. power dissipation 10 watts at 25°C; storage temperature 175°C; JEDEC type DO-4 case.	1N2973B
CR2005 thru CR2009	NOT USED	
CR2010	SEMICONDUCTOR DEVICE, DIODE: silicon; nominal ref. voltage 180 volts; max. dynamic impedance 115 ohms; max. power dissipation 10 watts at 25°C; ambient temperature 175°C; hermetically sealed metal case.	1N1814A
DS2001	LAMP, INCANDESCENT: 28 volts AC/DC; 0.20 amps; single contact, T-1-3/4 bulb.	BI110-7

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
DS2002	INDICATOR, DIGITAL	IC102-1-6
DS2003	INDICATOR, DIGITAL	IC101-1
DS2004	Same as DS2003.	
DS2005	LAMPHOLDER, PUNCTUATION DISPLAY: operating voltage 180 V; two solder lug type terminals, cadmium plated; center assembly bezel style; black plastic body.	TS176-1
DS2006 thru DS2009	Same as DS2003.	
DS2010	INDICATOR, DIGITAL	IC102-1-4
DS2011	INDICATOR, DIGITAL	IC102-1-5
DS2012	INDICATOR, DIGITAL	IC102-1-2
DS2013	INDICATOR, DIGITAL	IC103-1
DS2014	INDICATOR, DIGITAL	IC103-4
DS2015	INDICATOR, DIGITAL	IC103-2
DS2016	NOT USED	
DS2017	INDICATOR, DIGITAL	IC103-5
DS2018	NOT USED	
DS2019	NOT USED	
DS2020	Same as DS2014.	
DS2021	Same as DS2013.	
DS2022	NON-REPLACEABLE ITEM. (Part of XF2001)	
DS2023	NON-REPLACEABLE ITEM. (Part of XF2002)	
DS2024	NON-REPLACEABLE ITEM. (Part of XF2003)	
F2001	FUSE, CARTRIDGE: 10 amps; time lag; 1-1/4" lg. x 1/4" dia.; slow-blow.	FU102-10

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
F2002	FUSE, CARTRIDGE: 2-1/2 amps; time lag; 1-1/4" lg. x 1/4" dia.; slow-blow.	FU102-2.5
F2003	Same as F2002.	
F2004	FUSE, CARTRIDGE: 1/2 amp; 1-1/4" lg. x 1/4" dia.; quick acting.	FU100-.500
F2005	FUSE, CARTRIDGE: 1/8 amp; 1-1/4" lg. x 1/4" dia.; quick acting.	FU100-.125
J2001	CONNECTOR, RECEPTACLE, ELECTRICAL: 44 female, flat bifurcated contacts; for double sided 1/16" printed circuit board; current rating 5 amps at 1800 V RMS; floating bushing, dipped solder terminals.	JJ319-22DFE
J2002 thru J2018	Same as J2001.	
J2019	CONNECTOR, RECEPTACLE, ELECTRICAL: AC power; 2 male contacts rated for 10 amps, 250 V or 15 amps, 125 V; polarized; twist lock type; black bakelite.	JJ175
J2020	CONNECTOR, RECEPTACLE, ELECTRICAL: 24 number 20 socket type contacts; nominal current rating 7.5 amps, 500 V RMS.	JJ200-3
J2021	CONNECTOR, RECEPTACLE, ELECTRICAL: 11 round female contacts, rated at 3 amps, 1800 V RMS; key polarization; micro miniature type.	JJ311-1S
J2022	CONNECTOR, RECEPTACLE, ELECTRICAL: 22 female, flat bifurcated contacts; for single sided 1/16" printed circuit board; current rating 5 amps at 1800 V RMS; floating bushing, dipped solder terminals.	JJ319-22SFE
L2001	COIL, RADIO FREQUENCY: fixed; operating frequency 2.5 mcs; inductance rating 30 to 40 uh; o/a dim. 2" lg. x 23/64" dia.	CL292
MP2001	HEAT SINK: heat dissipating element.	HD104
Q2001	TRANSISTOR: germanium; hi-current; collector to base voltage 40 V; collector to emitter and emitter	2N456A

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Q2001 (cont)	to base voltage 20 V; collector current 7 amps; base current 3 amps; power dissipation 85 watts at 25°C; storage and junction temperature range -65°C to +110°C; JEDEC type TO-3 case.	
Q2002	TRANSISTOR: silicon; hi-current; collector to base and collector to emitter voltage 2.0 V; collector current 10 amps at 25°C; max. power dissipation 150 watts at 25°C; JEDEC type TO-3 case.	2N3790
Q2003	Same as Q2002.	
Q2004	TRANSISTOR: germanium, hi-current; collector to base voltage 100 V; emitter to base voltage 80 V; collector current 15 amps at 25°C; junction temperature 170°C; JEDEC type TO-36 case.	2N2493
R2001 thru R2019	NOT USED	
R2020	NON-REPLACEABLE ITEM. (Part of XF2001)	
R2021	NON-REPLACEABLE ITEM. (Part of XF2002)	
R2022	NON-REPLACEABLE ITEM. (Part of XF2003)	
S2001	SWITCH, TOGGLE: DPST: 28° angle of throw; bat type handle.	ST22K
T2001	TRANSFORMER, POWER, STEP-DOWN: primary 115/230VAC, 50/60 cps, single phase; secondary terminals 5 and 6, 20 V at 6ADC, terminals 7 and 8, 20 V at 600 MADC, terminals 9, 10 and 11, 280 V CT at 25 MADC; stud mounted; hermetically sealed rectangular metal case.	TF338
TB2001	NOT USED	
TB2002	TERMINAL STRIP, BARRIER: 4 double right angle solder lug type terminals; o/a dim. 2-3/8" lg. x 5/16" wide; bakelite body.	TM127-4
XDS2001	LIGHT, INDICATOR: white translucent lens, sub-miniature type.	TS153-5
XF2001	FUSEHOLDER, LAMP INDICATING: accommodates cart-ridge fuse 1-1/4" lg. x 1/4" dia.; 4 to 6V, 20 amps;	FH104-11

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
XF2001 (cont)	incandescent lamp type with a 15 ohm lamp resistor; transparent red flat sided knob; brown body. (consists of DS2022, R2020)	
XF2002	FUSEHOLDER, LAMP INDICATING: accommodates cartridge fuse 1-1/4" lg. x 1/4" dia.; 90 to 300 V, 20 amps; neon lamp type with a 220K ohm lamp resistor; transparent clear flat sided knob; black body. (consists of DS2023, R2021)	FH104-3
XF2003	Same as XF2002. (consists of DS2024, R2022)	
XF2004	FUSEHOLDER: extractor post type; accommodates cartridge fuse; o/a length 2-17/64"; bushing mounted, tapped 1/2" dia. 24 thd. per in. with removeable end terminals.	FH100-1
XF2005	Same as XF2004.	
XQ2001	SOCKET, TRANSISTOR: 7 pin contact accommodation; 0.040 or 0.050 dia.; polarized; 1 terminal lug grounding strap; o/a dim. 1-37/64" x 1" max.	TS166-1
Z2001	TIMING CIRCUIT, INPUT MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4397
Z2002	GATING CIRCUIT, INPUT MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4398
Z2003	TIMING/SET-RESET MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4399
Z2004	MEMORY CIRCUIT, MC MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4376
Z2005	GATING CIRCUIT, MC MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4395
Z2006	SHIFT REGISTER/1-2 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4379
Z2007	MEMORY GATE CIRCUIT, KC MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4377
Z2008	Same as Z2007. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2009	NOT USED	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z2010	SHIFT REGISTER/3456 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4381
Z2011	MEMORY GATE CIRCUIT MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4375
Z2012 thru Z2015	Same as Z2011. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2016 thru Z2021	NOT USED	
Z2022	POWER SUPPLY MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4390
	AUXILIARY KEYER, MODEL AK102 (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	

PARTS LIST
for
TIMING CIRCUIT INPUT MODULE

Z2001 A4397

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, METALIZED PLASTIC: 3.0 uf, ±5%; 50 WVDC; operating temperature range -55°C to +130°C; epoxy encapsulated.	CN114-3R0-5J
C2	Same as C1.	
C3	CAPACITOR, FIXED, MILA DIELECTRIC: 1,500 uuf, ±1%; 500 WVDC; straight wire leads.	CM112F152F5S
R1	RESISTOR, VARIABLE, WIREWOUND	RV121-1-103
R2	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
Z1	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z2	NETWORK, ONE SHOT GENERATOR: operating frequency 100 Kc; operating temperature range -35° to +65°; 12 male contacts, epoxy case.	NW111-1
Z3	Same as Z1.	
Z4	NETWORK, BUFFER AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z5	Same as Z1.	
Z6	Same as Z1.	
Z7	NETWORK, CLOCK GENERATOR: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW113-2X
Z8	Same as Z2.	
Z9 thru Z12	Same as Z1.	
TP1	TERMINAL, STUD	TE127-2
TP2 thru TP77	Same as TP1.	

PARTS LIST
for
GATING CIRCUIT INPUT MODULE

Z2002 A4398

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, MICA DIELECTRIC: 7,500 uuf, ±1%; 100 WVDC; straight wire leads.	CM112F752J1S
R1	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±5%; 1/2 watt.	RC20GF103J
R2	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±5%; 1 watt.	RC32GF471J
Z1	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z2 thru Z5	Same as Z1.	
Z6	NETWORK, AND GATE AMPLIFIER	NW108-23
Z7	NETWORK, AND GATE AMPLIFIER	NW108-26
Z8	Same as Z7.	
Z9	NETWORK, ONE SHOT GENERATOR: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW111-1
Z10	NETWORK, BUFFER AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z11	NETWORK, POSITIVE EMITTER FOLLOWER	NW112-11
Z12 thru Z14	Same as Z11.	
TP1	TERMINAL, STUD	TE127-2
TP2 thru TP11	Same as TP1.	

PARTS LIST
for
TIMING SET/RESET MODULE

Z2003 A4399

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, MICA DIELECTRIC: 3,900 uuf, ±1%; 300 WVDC; straight wire leads.	CM112F392F3S
C2	CAPACITOR, FIXED, MICA DIELECTRIC: 6,200 uuf, ±2%; 300 WVDC; straight wire leads.	CM112F622G3S
C3	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 10,000 uuf, GMV; 500 WVDC.	CC100-16
R1	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
R2	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±5%; 1/2 watt.	RC20GF103J
TP1	TERMINAL, STUD	TE127-2
TP2 thru TP4	Same as TP1.	
Z1	NETWORK, ONE SHOT GENERATOR: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW111-1
Z2	Same as Z1.	
Z3	Same as Z1.	
Z4	NETWORK, EMITTER FOLLOWER	NW118-11
Z5	NETWORK, BUFFER AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z6 thru Z8	Same as Z4.	
Z9	NETWORK, POSITIVE EMITTER FOLLOWER	NW112-11
Z10 thru Z14	Same as Z9.	

PARTS LIST
for
MEMORY CIRCUIT, MC MODULE

Z2004 A4376

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 0.1 uf, +80% -20%; max. peak voltage 100 VDC; radial type leads.	CC112R104Z
C2	Same as C1.	
TP1	TERMINAL, STUD	TE127-2
TP2 thru TP18	Same as TP1.	
Z1	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z2 thru Z5	Same as Z1.	
Z6	NETWORK, AND GATE AMPLIFIER	NW108-29
Z7	NETWORK, POSITIVE EMITTER FOLLOWER	NW112-11
Z8	Same as Z1.	
Z9	NETWORK, AND GATE AMPLIFIER	NW108-25
Z10	Same as Z7.	
Z11	Same as Z7.	
Z12	NETWORK, AND GATE AMPLIFIER	NW108-30
Z13 thru Z15	Same as Z12.	

PARTS LIST
for
GATING CIRCUIT, MC MODULE

Z2005 A4395

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z1	NETWORK, AND GATE AMPLIFIER	NW108-27
Z2	NETWORK, OR GATE AMPLIFIER	NW121-25
Z3	NETWORK, OR GATE AMPLIFIER	NW121-23
Z4	Same as Z2.	
Z5	Same as Z1.	
Z6	Same as Z2.	
Z7	Same as Z3.	
Z8	Same as Z2.	
Z9	Same as Z1.	
Z10	Same as Z2.	
Z11 thru Z14	Same as Z1.	
Z15	NETWORK, OR GATE AMPLIFIER	NW121-26
Z16	Same as Z1.	

PARTS LIST
for
SHIFT REGISTER 1-2 MODULE

Z2006 A4379

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD	TE127-2
TP2 thru TP11	Same as TP1.	
Z1	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z2 thru Z6	Same as Z1.	
Z7	NETWORK, POSITIVE EMITTER FOLLOWER	NW112-11
Z8 thru Z10	Same as Z7.	
Z11	NETWORK, AND GATE AMPLIFIER	NW108-27
Z12	Same as Z11.	
Z13	NETWORK, AND GATE AMPLIFIER	NW108-29
Z14 thru Z16	Same as Z13.	

PARTS LIST
for
MEMORY GATING CIRCUIT, KC MODULE

Z2007,8 A4377

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 2,200 uuf, GMV; 500 WVDC.	CC100-11
C2 thru C8	Same as C1.	
TP1	TERMINAL, STUD	TE127-2
TP2 thru TP16	Same as TP1.	
Z1	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z2 thru Z8	Same as Z1.	
Z9	NETWORK, AND GATE AMPLIFIER	NW108-28
Z10 thru Z16	Same as Z9.	

PARTS LIST
for
SHIFT REGISTER/3456 MODULE

Z2010 A4381

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD	TE127-2
TP2 thru TP18	Same as TP1.	
Z1	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z2 thru Z4	Same as Z1.	
Z5	NETWORK, POSITIVE EMITTER FOLLOWER	NW112-11
Z6	Same as Z5.	
Z7 thru Z10	Same as Z1.	
Z11	NETWORK, AND GATE AMPLIFIER	NW108-27
Z12	NETWORK, AND GATE AMPLIFIER	NW108-29
Z13	NETWORK, AND GATE AMPLIFIER	NW108-25
Z14	Same as Z13.	
Z15	NETWORK, EMITTER FOLLOWER	NW120-11

PARTS LIST
for
MEMORY GATING CIRCUIT MODULE

Z2011, 12, 13, 14, 15 A4375

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD	TE127-2
TP2 thru TP24	Same as TP1.	
Z1	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 Kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z2	Same as Z1.	
Z3	Same as Z1.	
Z4	NETWORK, AND GATE AMPLIFIER	NW108-28
Z5	Same as Z4.	
Z6	Same as Z4.	
Z7	Same as Z1.	
Z8	Same as Z4.	
Z9	NETWORK, EMITTER FOLLOWER	NW120-11
Z10 thru Z14	Same as Z9.	
Z15	NETWORK, AND GATE AMPLIFIER	NW108-29

PARTS LIST
for
POWER SUPPLY MODULE

Z2022 A4390

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C2001	NOT USED	
C2002	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 10,000 uuf, GMV; 500 WVDC	CC100-16
C2003	CAPACITOR, FIXED, ELECTROLYTIC: polarized; 20 uf; 250 WVDC; hermetically sealed aluminum case with black vinyl sleeve.	CE116-4VN
C2004	Same as C2002.	
C2005 thru C2008	NOT USED	
C2009	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100,000 uuf, +80% -20%; 100 WVDC	CC100-28
C2010	CAPACITOR, FIXED, ELECTROLYTIC: 100 uf, -10% +150% at 120 cps at 25°C; 25 WVDC; polarized; insulated tubular case.	CE105-100-25
CR2001	NOT USED	
CR2002	SEMICONDUCTOR DEVICE, DIODE: silicon; nominal ref. voltage 600 V; max. forward voltage drop 1.0 V; max. continuous DC current 0.50 amps at 100°C; peak surge current 75 amps; max. reverse current 1,000 ua; max. operating temperature 150°C; hermetically sealed glass case.	1N2484
CR2003	Same as CR2002.	
CR2004	NOT USED	
CR2005 thru CR2008	Same as CR2002.	
CR2009	SEMICONDUCTOR DEVICE, DIODE: silicon; nominal ref. voltage 13 V; max. dynamic impedance 10 ohms; Zener test current 19 ma; max. power dissipation 1.0 watts at 25°C; max. operating temperature 200°C; hermetically sealed metal case.	1N4743A
R2001	RESISTOR, FIXED, WIREWOUND: 1 ohm, ±5%; 5 watts; non-inductive.	RR114-1W

Z2022 A4390

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R2002	Same as R2001.	
R2003	RESISTOR, FIXED, WIREWOUND: 200 ohms, ±5%; 5 watts; non-inductive.	RR114-200W
R2004	RESISTOR, FIXED, COMPOSITION: 510 ohms, ±5%; 1 watt.	RC32GF511J
R2005	RESISTOR, FIXED, COMPOSITION: 82,000 ohms, ±5%; 1 watt.	RC32GF823J
R2006	RESISTOR, FIXED, WIREWOUND: 10 ohms, ±5%; 5 watts; non-inductive.	RR114-10W
R2007	Same as R2006.	
R2008	RESISTOR, FIXED, COMPOSITION: 270 ohms, ±5%; 1 watt.	RC32GF271J
R2009	RESISTOR, FIXED, COMPOSITION: 330 ohms, ±5%; 1 watt.	RC32GF331J
R2010	RESISTOR, FIXED, WIREWOUND: 75 ohms, ±5%; 5 watts; non-inductive.	RR114-75W
R2011	Same as R2010.	
R2012	Same as R2010.	
R2013	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±5%; 1/2 watt.	RC20GF470J
R2014	RESISTOR, VARIABLE, WIREWOUND	RV121-1-101
R2015	RESISTOR, FIXED, COMPOSITION: 120 ohms, ±5%; 1 watt.	RC32GF121J
R2016	RESISTOR, FIXED, WIREWOUND: 50 ohms, ±5%; 5 watts; non-inductive.	RR114-50W
R2017	RESISTOR, FIXED, COMPOSITION: 1,200 ohms, ±5%; 1/2 watt.	RC20GF122J
R2018	RESISTOR, FIXED, COMPOSITION: 2,700 ohms, ±5%; 1/2 watt.	RC20GF272J

Z2022 A4390

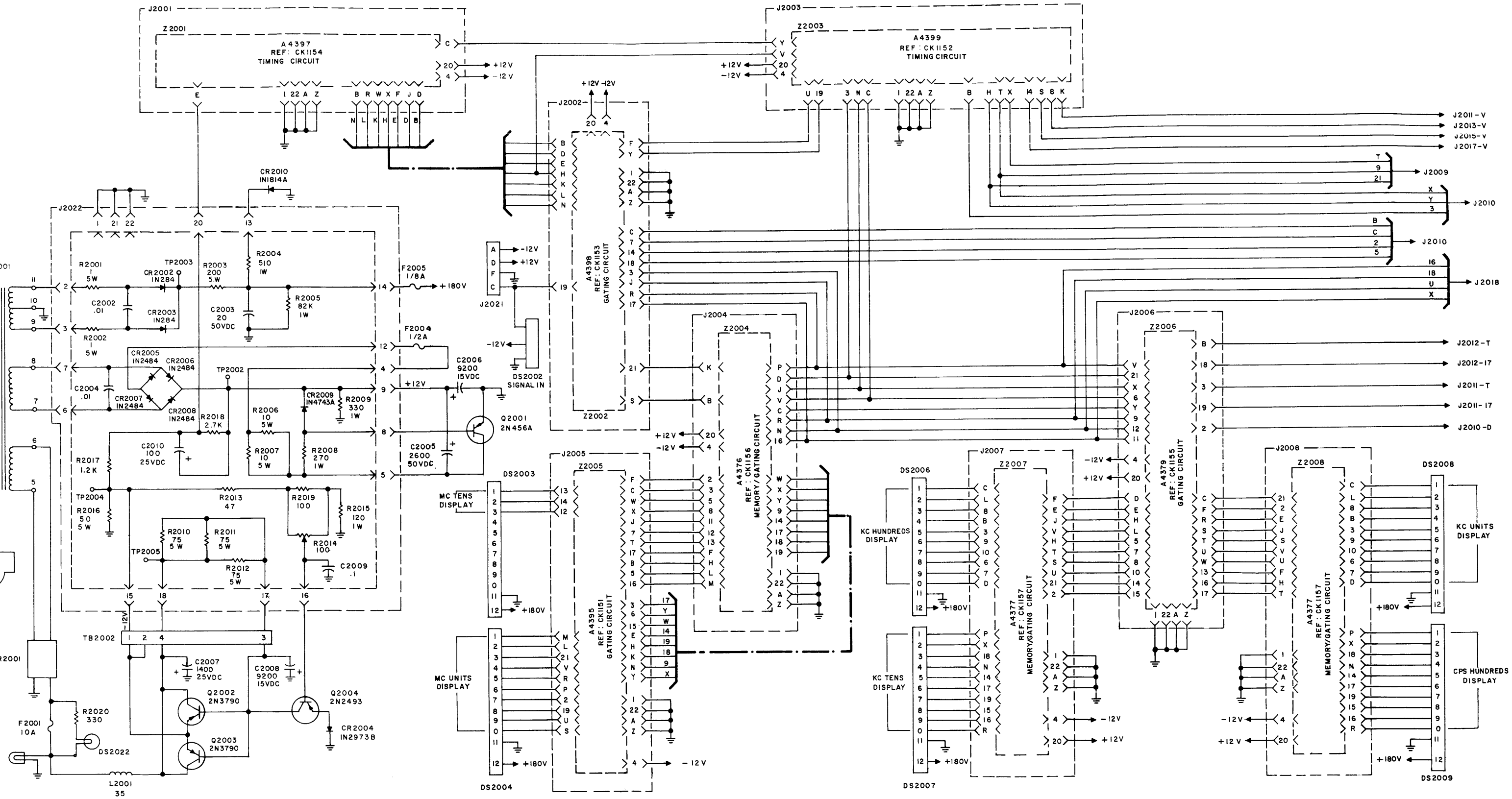
REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R2019	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%; 1/2 watt.	RC20GF100J
TP2001	TERMINAL, STUD	TE127-6
TP2002 thru TP2005	Same as TP2001.	

PARTS LIST
for
AUXILIARY KEYER, AK102

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C9501	CAPACITOR, FIXED, MICA DIELECTRIC: 1,000 uuf, ±5%; 100 WVDC; straight wire leads.	CM111F102J1S
CR9501	SEMICONDUCTOR DEVICE, DIODE: germanium; peak inverse voltage 100 V; min. forward current 200 ma at 1.0 V; max. reverse current 100 ua at 25°C; power dissipation 80 mw at 25°C; max. operating temperature 90°C; JEDEC type DO-7 case.	1N270
CR9502	Same as CR9501.	
CR9503	SEMICONDUCTOR DEVICE, DIODE: silicon; nominal ref. voltage 600 V; max. forward voltage drop 1.0 V; max. continuous DC current 0.50 amps at 100°C; peak surge current 75 amps; max. reverse current 1,000 ua; max. operating temperature 150°C; hermetically sealed glass case.	1N2484
K9501	RELAY, MERCURY-WETTED CONTACT: SPDT; windings number 1 and 2 rated for 250 ohms, ±10%; 7 contacts rated for 2 amps, 500 V max.; polarized; relay adjusted for 1% max. unbalance at 60 cps, AC, 120 V, 4,000 ohms in series with coil.	RL167-1
P9501	CONNECTOR, PLUG, ELECTRICAL: 11 male contacts, rated at 2 amps max.; 1,800 V RMS at sea level; phosphor bronze, gold over silver plate; key polarization; aluminum anodized green case.	PL247-2P
Q9501	TRANSISTOR: silicon, NPN; collector to base voltage 40 V; collector to emitter voltage 15 V; emitter to base voltage 5.0 V; collector current 200 ma at 25°C; max. power dissipation 200 mw at 25°C; hermetically sealed case.	2N3646
R9501	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
R9502	RESISTOR, VARIABLE, COMPOSITION: 1,000 ohms, ±10%; 0.25 watt at 70°C; linear taper.	RV111U102A
R9503	RESISTOR, FIXED, COMPOSITION: 27,000 ohms, ±5%; 1/2 watt.	RC20GF273J
R9504	RESISTOR, FIXED, COMPOSITION: 220 ohms, ±5%; 1 watt.	RC32GF221J
TB2001	TERMINAL BOARD, BARRIER: 3 terminals; 6-32 thd. x 1/4" long binder head screws, black bakelite.	TM100-3

SECTION 7

WIRING SCHEMATICS



UNLESS OTHERWISE SPECIFIED

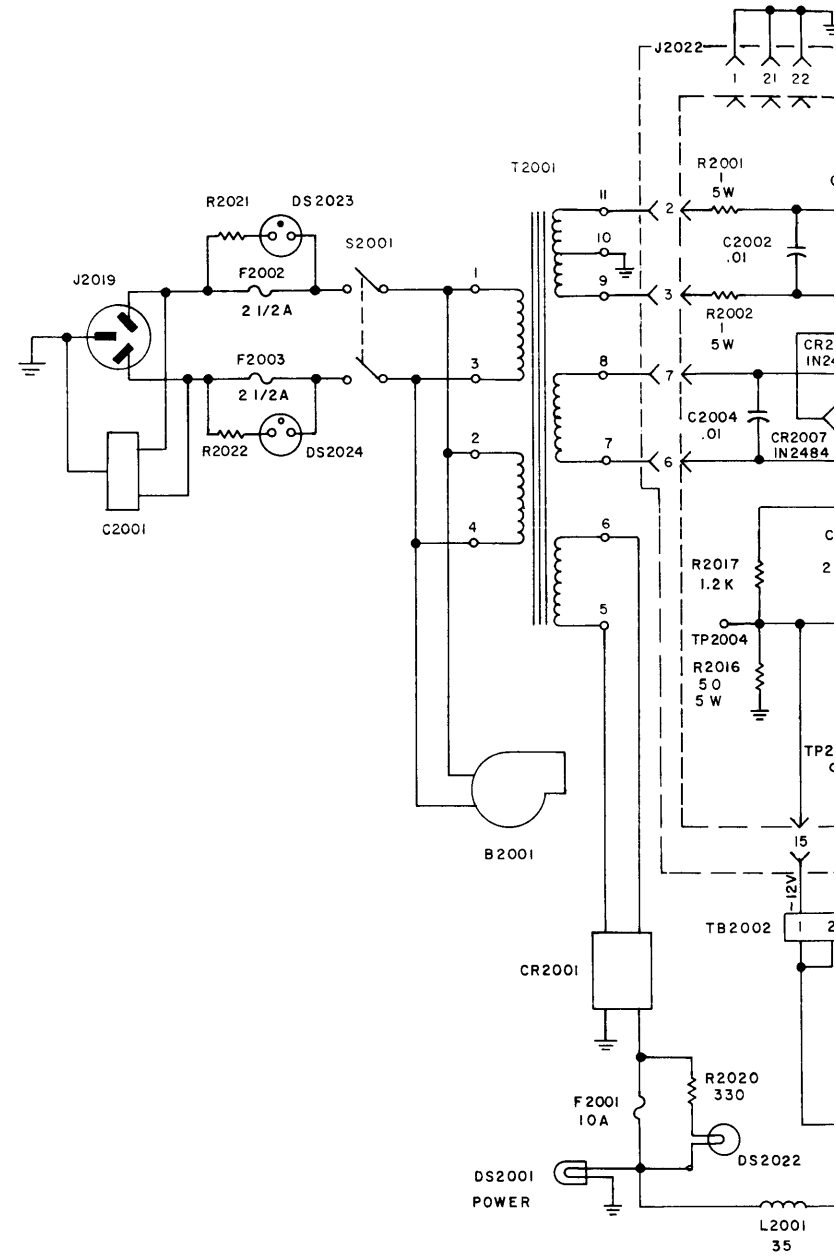
1- ALL RESISTORS ARE IN OHMS & 1/2 WATT.
2- ALL CAPACITORS ARE IN MICROFARADS.
3- ALL COILS ARE IN MICROHENRIES.
4- ALL SWITCHES ARE SHOWN IN NON OPERATING POSITION.

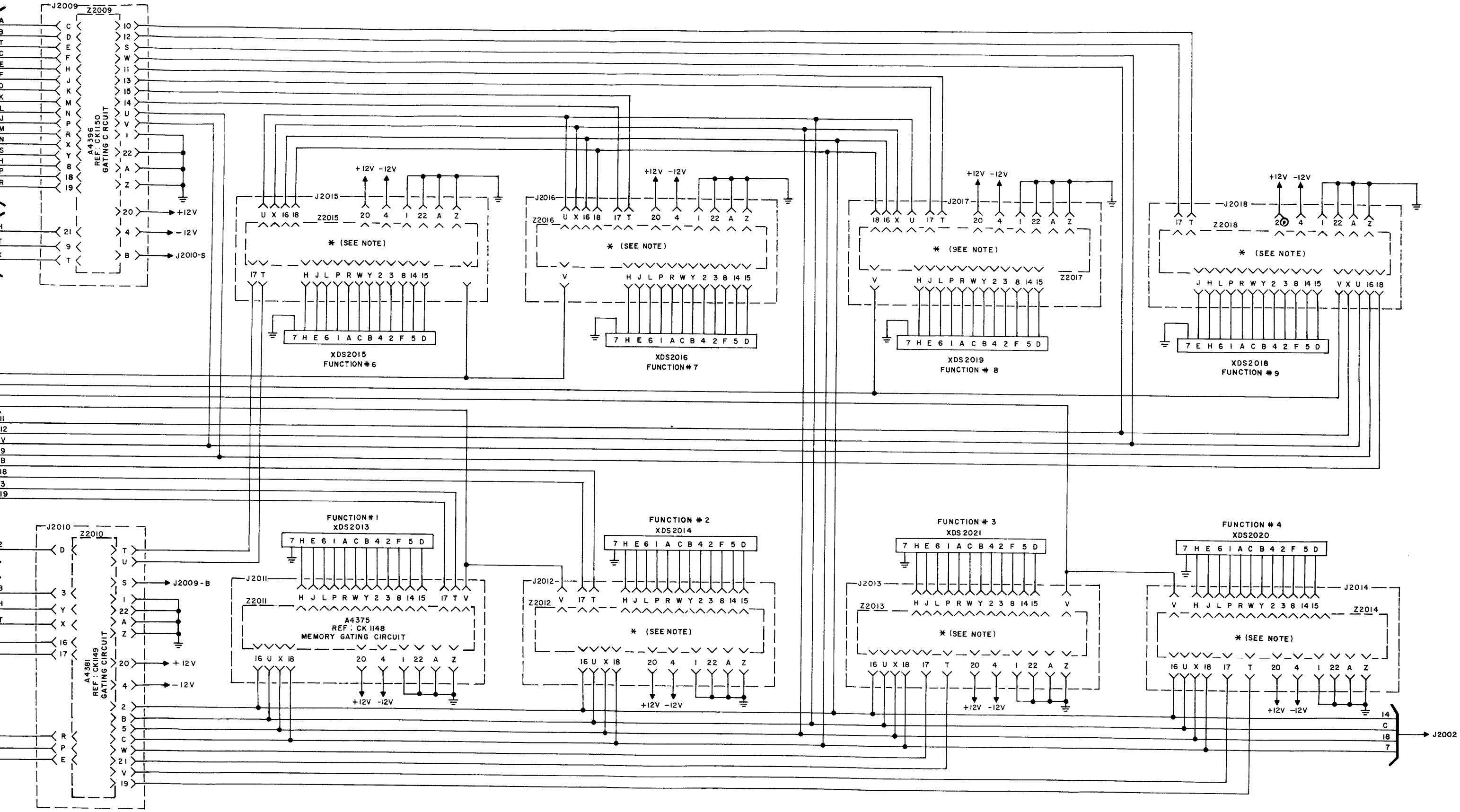
Figure 7-1. Overall Wiring Schematic, RTIH (Sheet 1 of 2)

FUNCTION NO'S 1-4 & 6-9												
LAMP POSITION	1	2	3	4	5	6	7	8	9	10	11	12
CONNECTOR PIN NO'S	P	Y	R	3	W	15	2	J	8	14	L	H
I.F. B.W. IC103-1	1	6	15	3.5U	3.5L	7.5U	7.5L					
DET IC103-4	A.M.	CW	SSB									
RF GAIN IC103-2	0	1	2	3	4	5	6	7	8	9	10	AGC

FUNCTION NO. 5												
LAMP POSITION	1	2	3	4	5	6	7	8	9	10	11	12
CONNECTOR PIN NO'S	16		17									
AFC IC103-5	ON		OFF									

UNIT	RTIH-1			
FUNCTION 1	I.F B.W. (CH. A) IC103-1			
2	DET (CH. A) IC103-4			
3	I.F B.W. (CH. B) IC103-1			
4	DET (CH. B) IC103-4			
5	AFC IC103-5			
6	RF GAIN IC103-2			
7				
8				
FUNCTION 9				

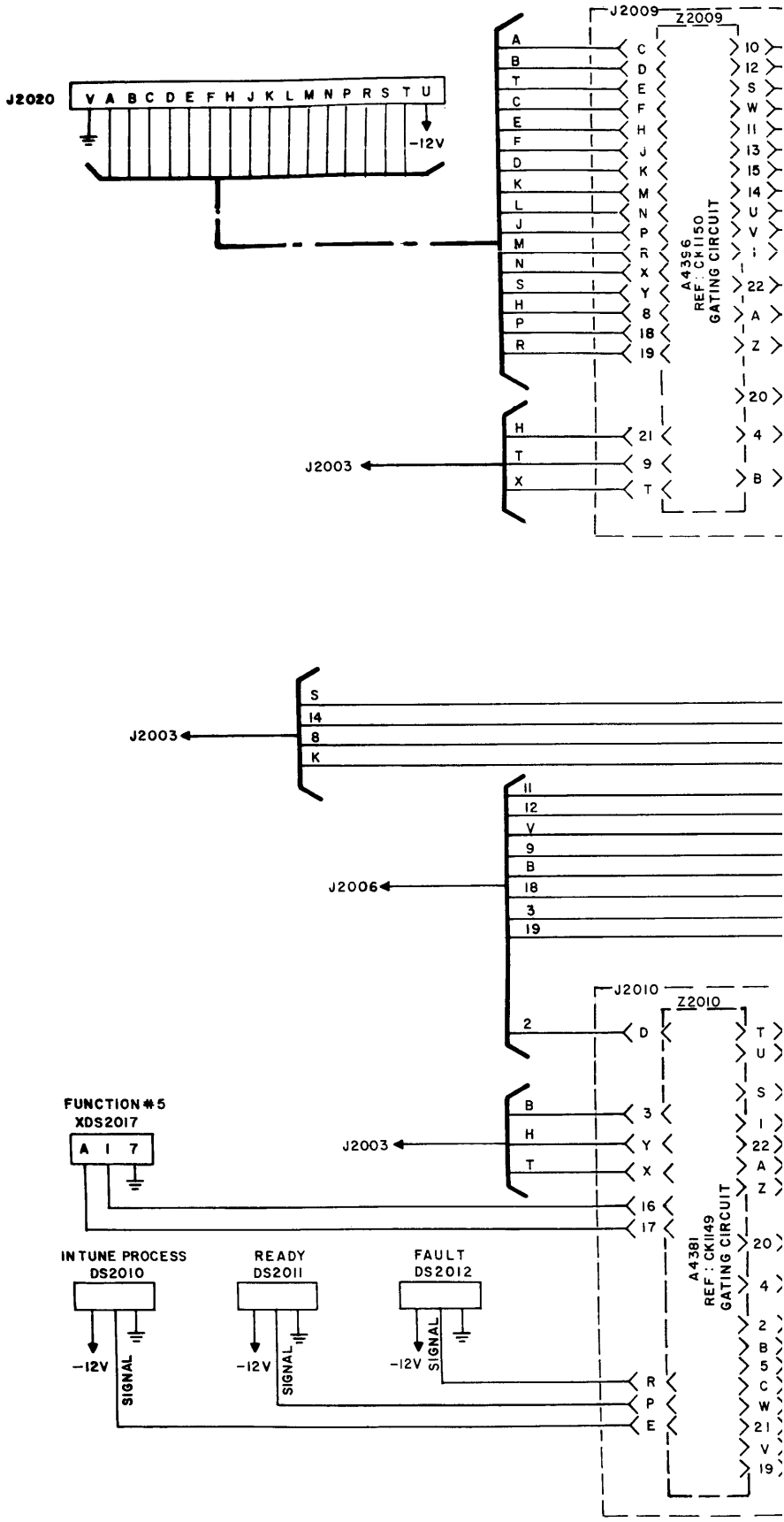




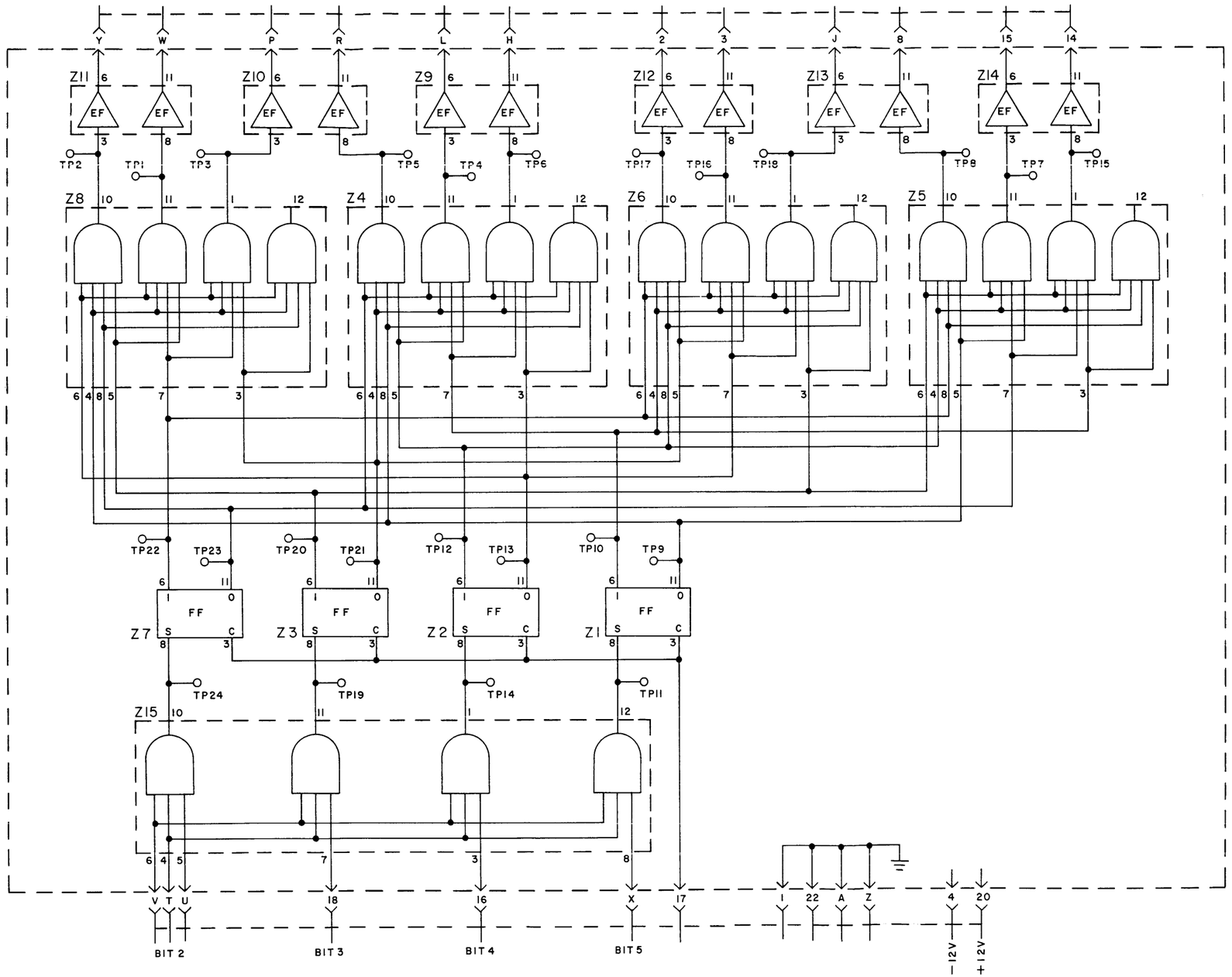
NOTE :

* = SAME INFORMATION AS Z2011.

Figure 7-1. Overall Wiring Schematic, RTIH (Sheet 2 of 2)


J2020
V A B C D E F H J K L M N P R S T U
-12V
J2009
Z2009
A4356
REF: CK1150
GATING CIRCUIT
J2003
J2003
J2006
J2010
Z2010
FUNCTION #5
XDS2017
A I 7
J2003
IN TUNE PROCESS
DS2010
READY
DS2011
FAULT
DS2012
-12V
SIGNAL
A4381
REF: CK1149
GATING CIRCUIT

CK-1113 A



MODULE VOLTAGE & GRD CHART

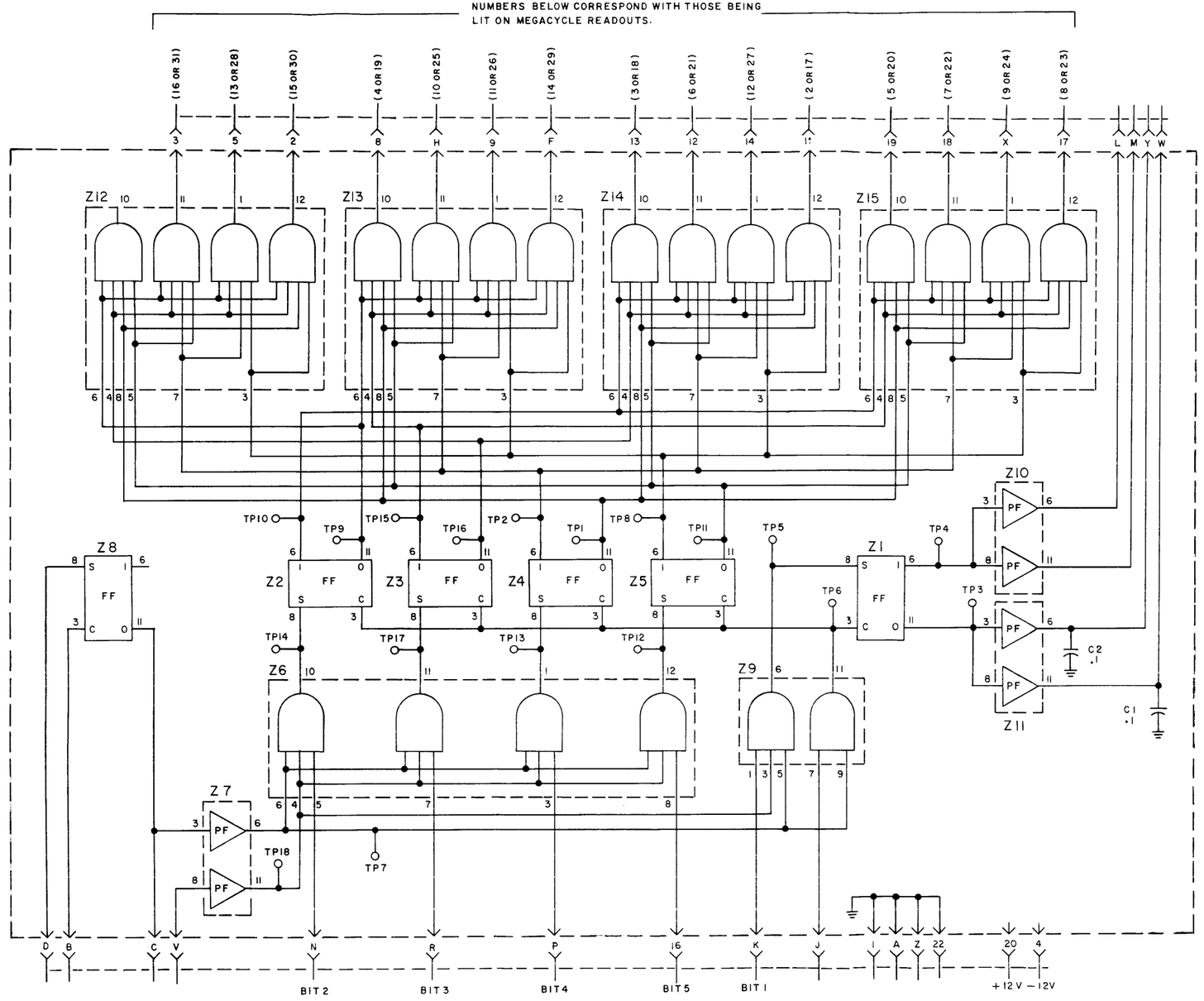
SYMBOL	PIN CONNECTION		
	+12V	-12V	GRD
Z1,2,3 & Z7	10	2	5
Z4 THRU Z6,8 & Z15		2	
Z9 THRU Z14		2 & 7	5 & 12

- UNLESS OTHERWISE SPECIFIED -

1- ON EACH FLIP FLOP (FF) PIN 6 IS THE "1" OUTPUT & PIN 11 IS THE "0" OUTPUT.

Figure 7-2. Logic Diagram, A 4375 Memory Gating Circuit

CK-1148 Ø



MODULE VOLTAGE & GRD CHART

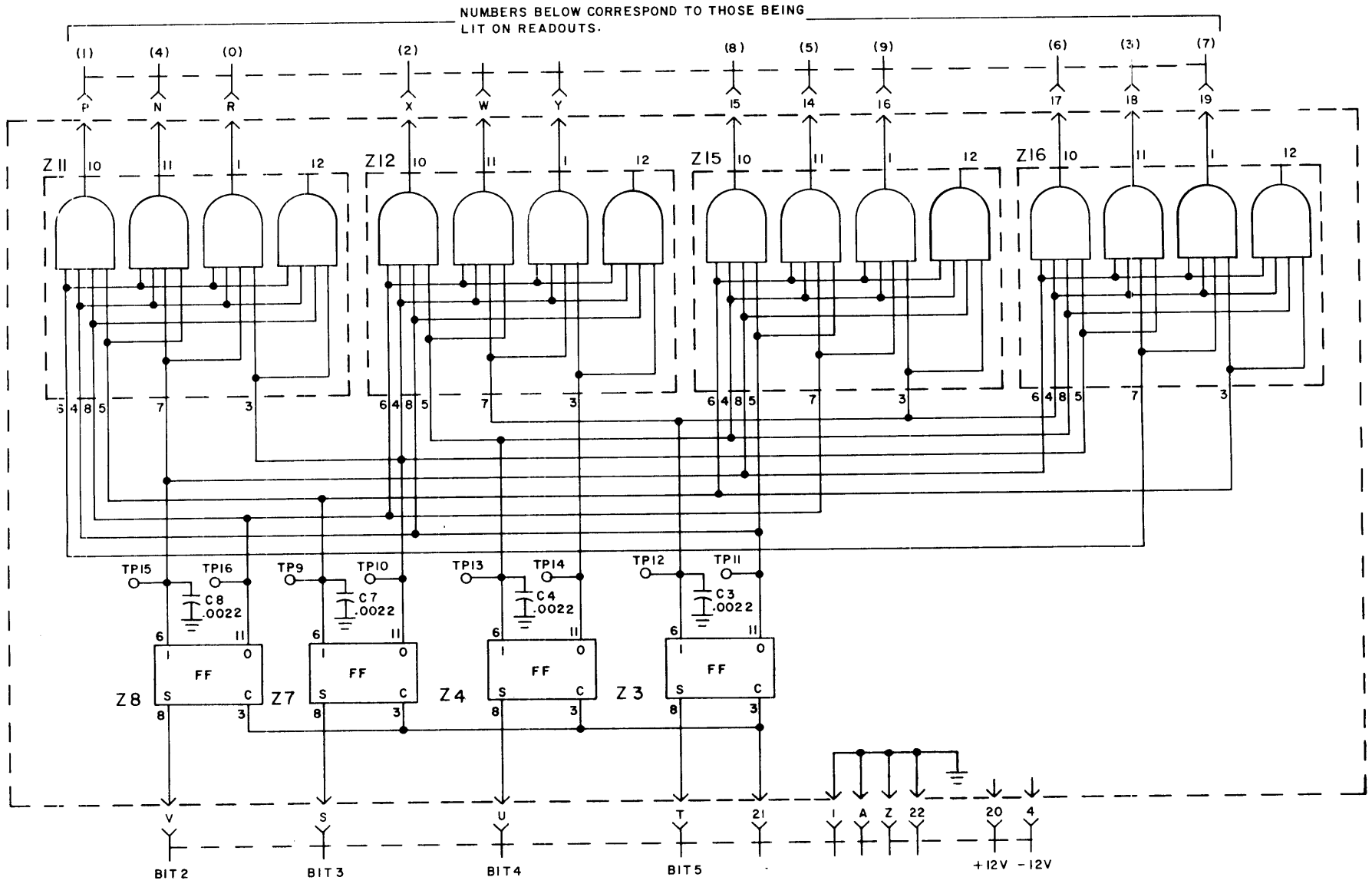
SYMBOL	PIN CONNECTIONS		
	+12V	−12V	GRD
Z1 THRU Z5, Z8	10	2	5
Z7, Z10, Z11		2	5
Z12 THRU Z15 Z6, Z9		2	

UNLESS OTHERWISE SPECIFIED

1- ALL CAPACITOR VALUES ARE IN MICROFARADS.
2 ON FLIP FLOPS Z1-Z5 PIN 6 IS THE "1" OUTPUT & PIN 11 IS THE "0" OUTPUT.

CK-1156 ø

Figure 7-3. Logic Diagram, A 4376 Memory Circuit, MC



MODULE VOLTAGE & GRD CHART

SYMBOL	PIN CONNECTIONS		
	+12 V	-12 V	GRD
Z1 THRU Z8	10	2	5
Z9 THRU Z16		2	

UNLESS OTHERWISE SPECIFIED

1- ALL CAPACITOR VALUES ARE IN MICROFARADS. REF.: PC258

2- ON EACH FLIP FLOP (FF) PIN 6 IS THE "1" OUTPUT & PIN 11 IS THE "0" OUTPUT.

Figure 7-4. Logic Diagram
A4377 Memory/Gating Circuit, KC (Sheet 1 of 2)

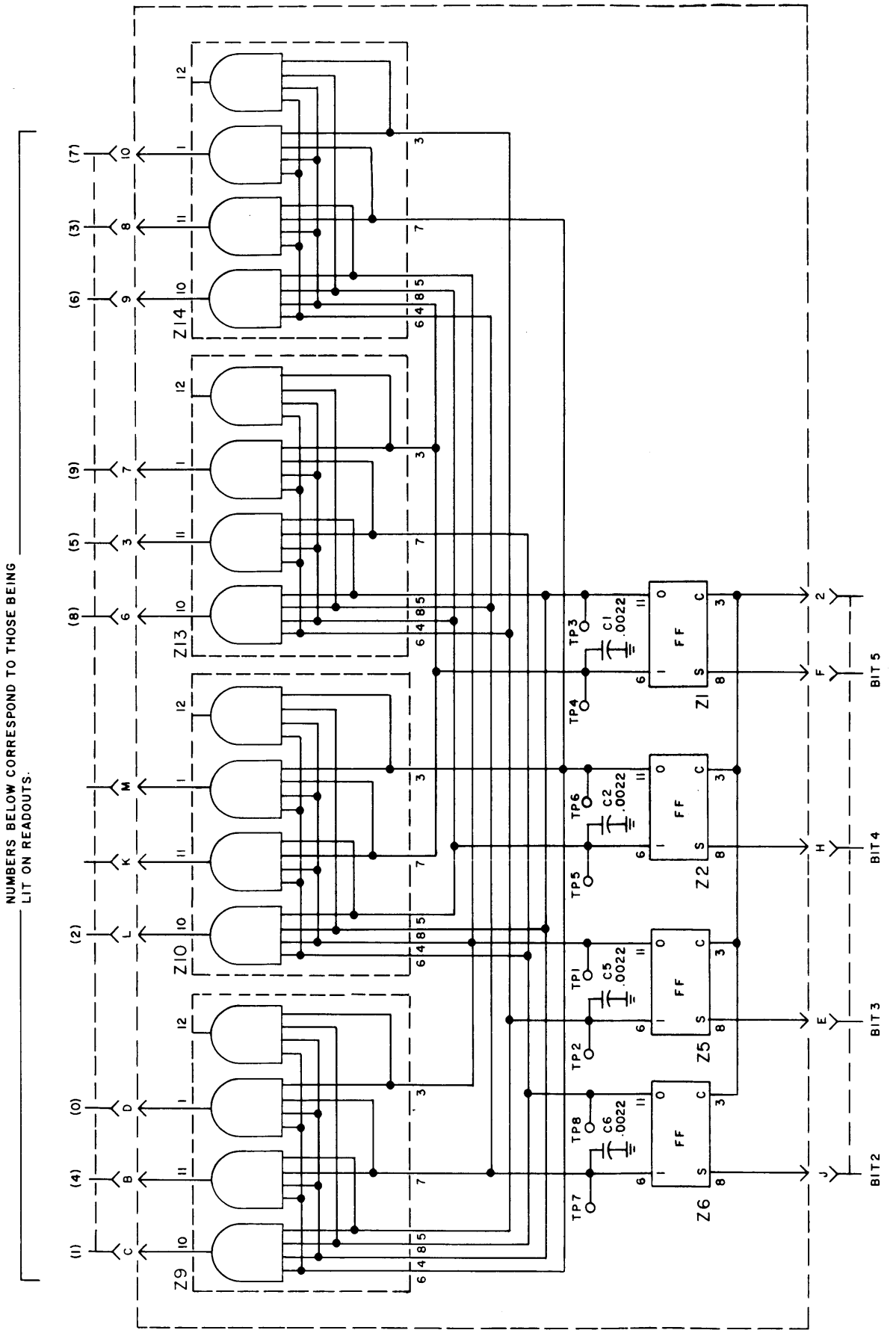


Figure 7-4. Logic Diagram
A4377 Memory/Gating Circuit, KC (Sheet 2 of 2)

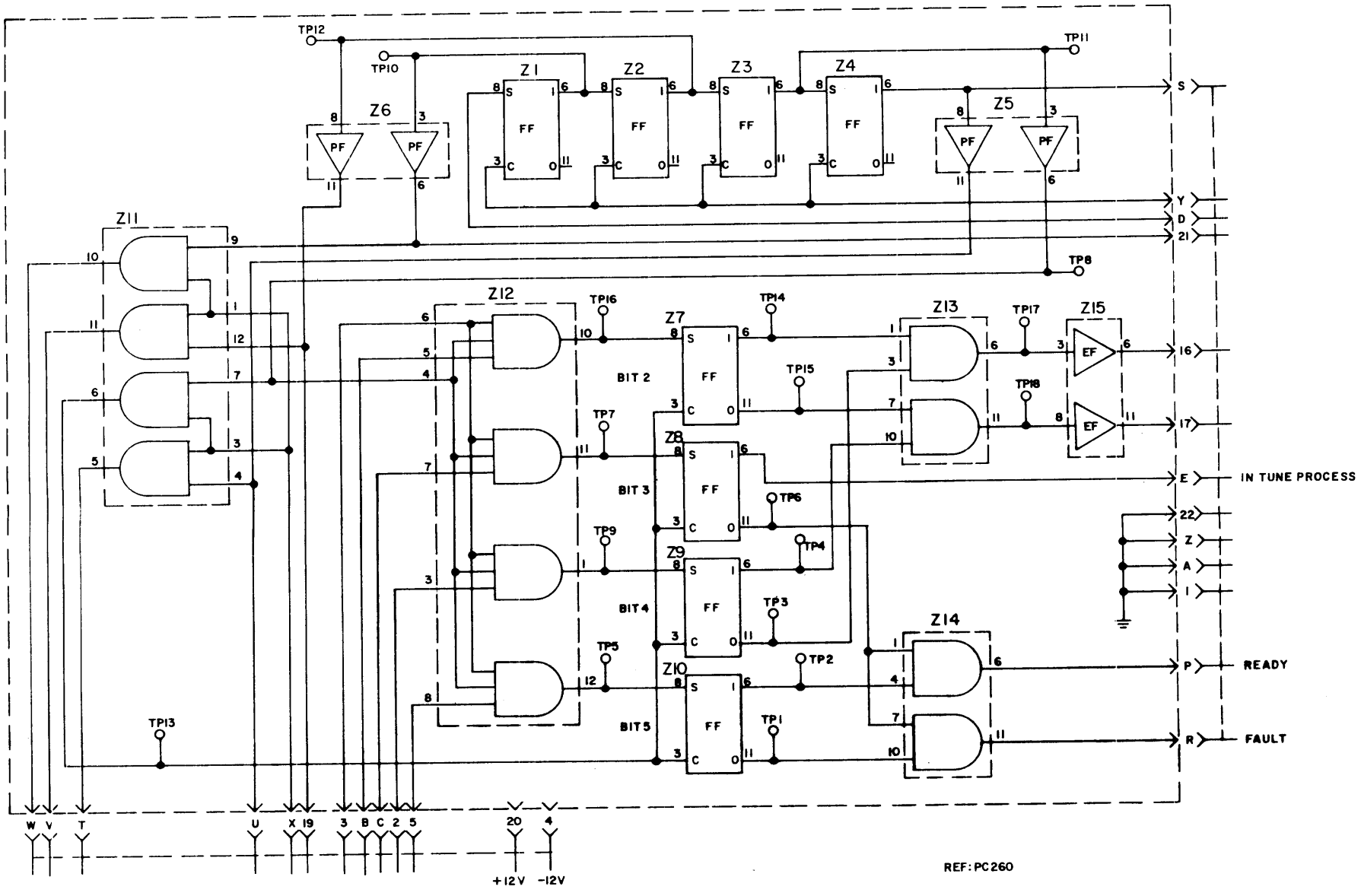
CK 1157 0

MODULE VOLTAGE & GRD CHART

SYMBOL	PIN CONNECTION		
	+12V	−12V	GRD
Z1 THRU Z6	10	2	5
Z7 THRU Z10		2	5
Z11 THRU Z16		2	

CK-1155 ø

Figure 7-5. Logic Diagram, A 4379 Shift-Register/1-2



MODULE VOLTAGE & GRD CHART

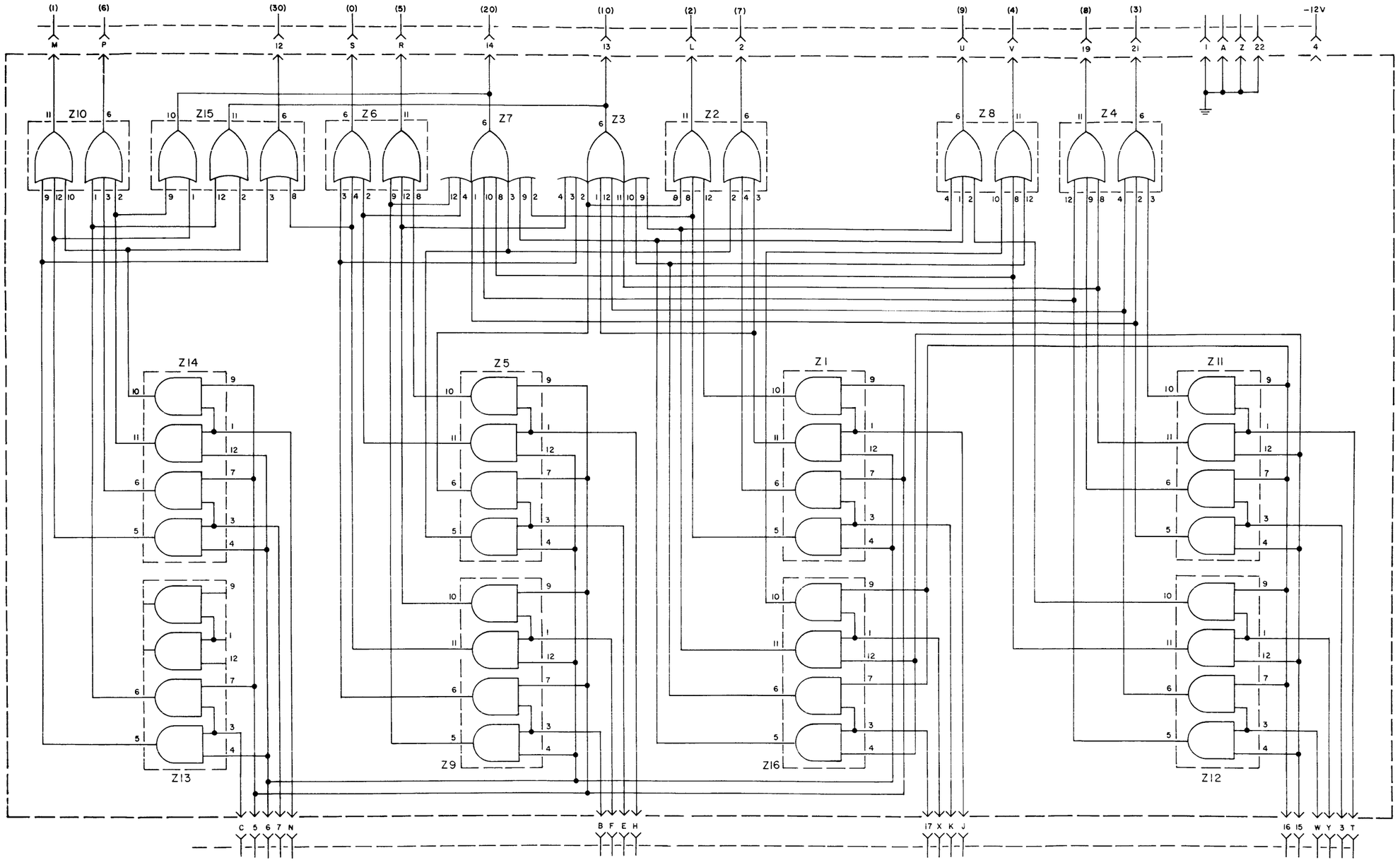
SYMBOL	PIN CONNECTIONS		
	+12 V	-12 V	GRD
Z1 THRU Z4 Z7 THRU Z10	10	2	5
Z5, Z6		2	5
Z15		2 & 7	5 & 12
Z11 THRU Z14		2	

— UNLESS OTHERWISE SPECIFIED —

1 — ON FLIP FLOPS Z7 — Z9, PIN 6 IS THE "1" OUTPUT & PIN 11 IS THE "0" OUTPUT.

CK 11<9 6

Figure 7-6. Logic Diagram, A4381 Shift-Register/3456



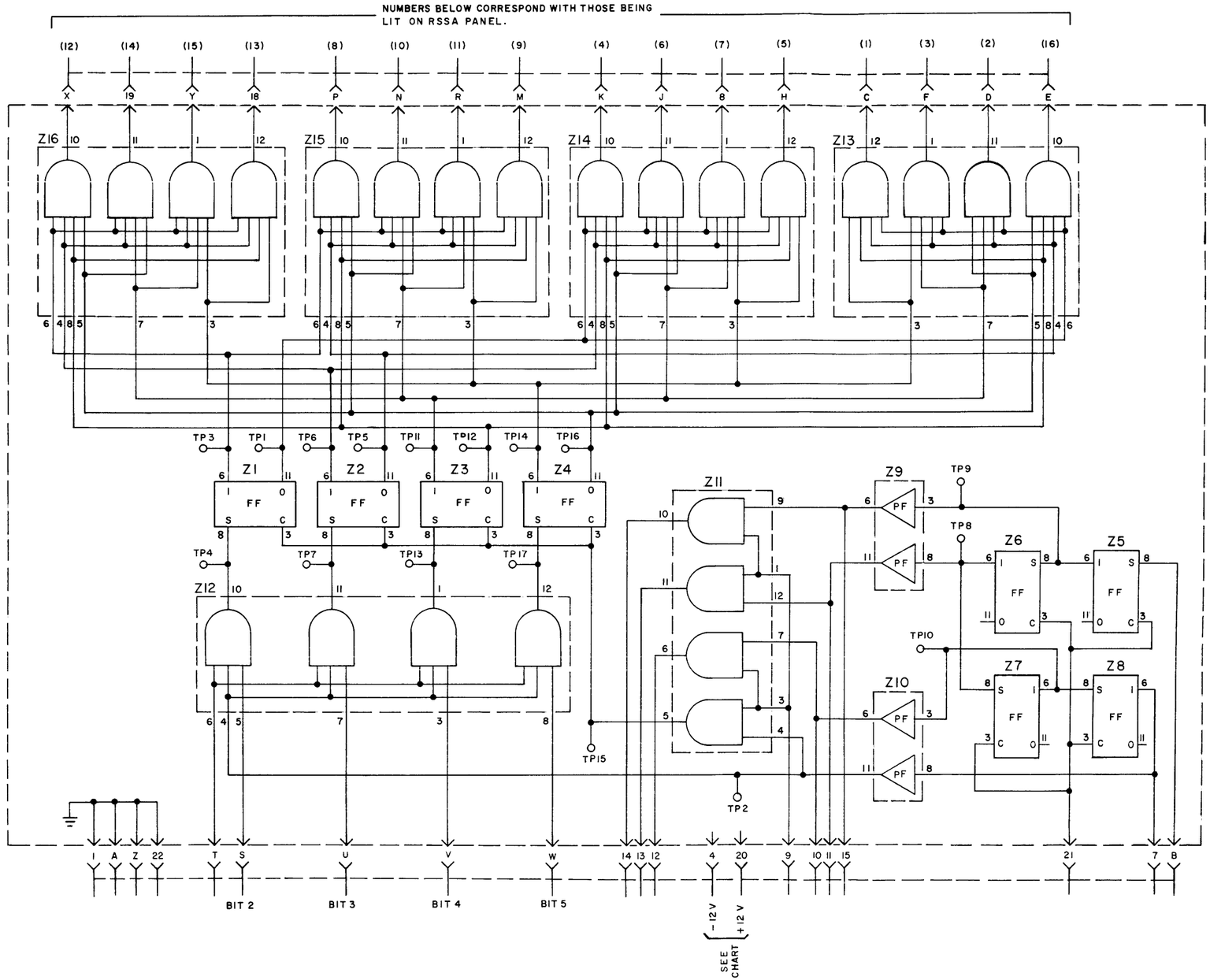
MODULE VOLTAGE & GRD CHART

SYMBOL	PIN CONNECTIONS	
	-12V	GRD
Z1, Z5, Z9, Z11, Z12, Z13, Z14, Z16	2	
Z2, Z3, Z4, Z6, Z7, Z8, Z10, Z15		5

NOTE:
10 THRU 20 & 30 REFER TO THE FIRST DIGIT OF THE MEGACYCLE READOUT 0 THRU 9 REFER TO THE SECOND DIGIT OF THE MEGACYCLE READOUT.

CK-1151 Ø

Figure 7-7. Logic Diagram, A 4395 Gating Circuit, MC



MODULE VOLTAGE & GRD CHART

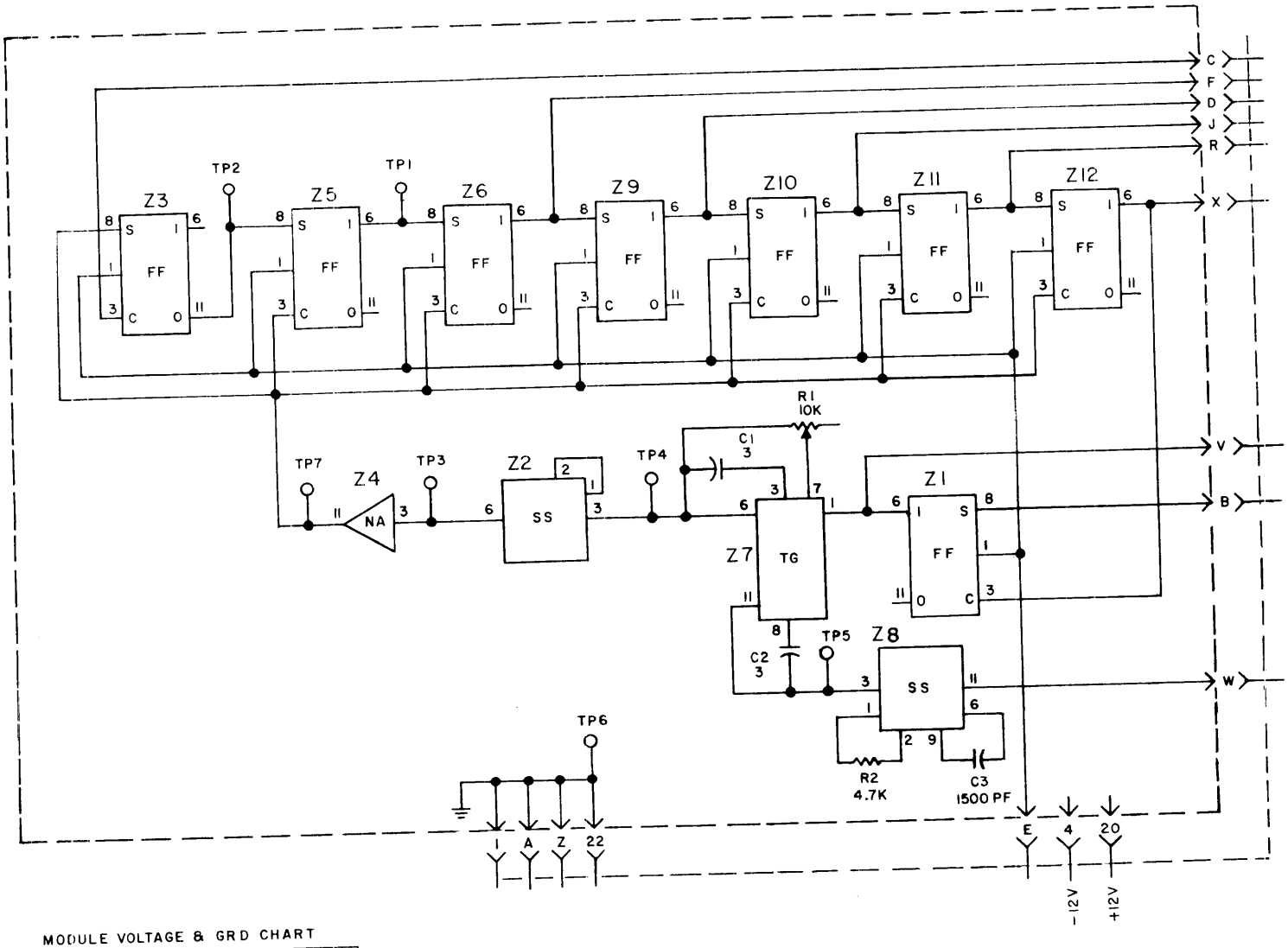
SYMBOL	PIN CONNECTIONS		
	+12V	-12V	GRD
Z1 THRU Z8	10	2	5
Z9, Z10		2	5
Z11 THRU Z16		2	

— UNLESS OTHERWISE SPECIFIED —

1 - ON EACH FLIP FLOP (FF) PIN 6 IS THE "1" OUTPUT & PIN 11 IS THE "0" OUTPUT.

CK-1150 Ø

Figure 7-8. Logic Diagram, A 4396 Gating Circuit, Equipment Identification



MODULE VOLTAGE & GRD CHART

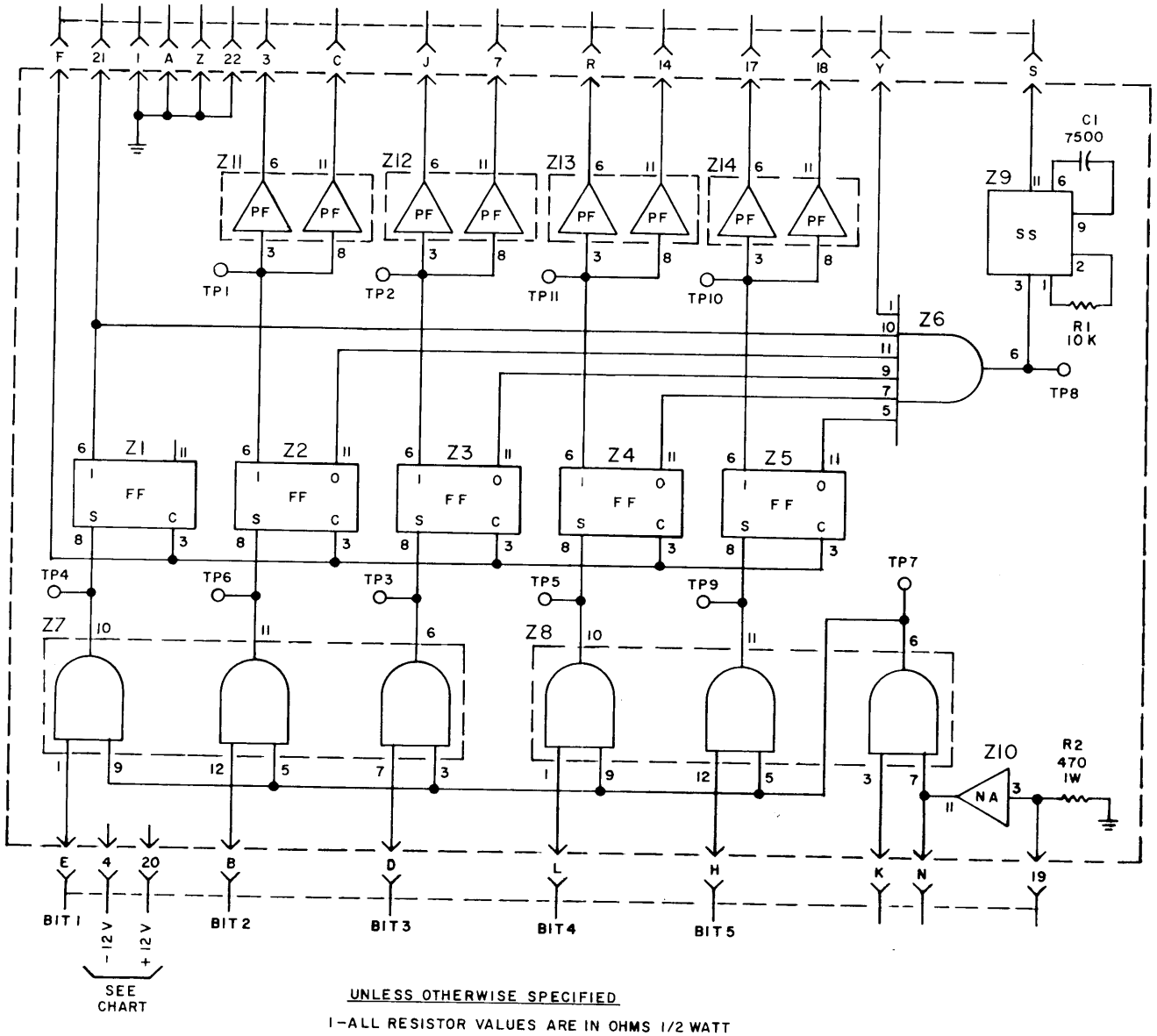
SYMBOL	PIN CONNECTION		
	+12 V	-12 V	GRD
Z1 THRU Z12	10	2	5

UNLESS OTHERWISE SPECIFIED
1-ALL RESISTOR VALUES ARE IN OHMS 1/2 WATT
2-ALL CAPACITOR VALUES ARE IN UF

REF: PC 263

CK 1154 0

Figure 7-9. Logic Diagram, A4397 Timing Circuit, Input



UNLESS OTHERWISE SPECIFIED

1-ALL RESISTOR VALUES ARE IN OHMS 1/2 WATT

2-ALL CAPACITOR VALUES ARE IN PF.

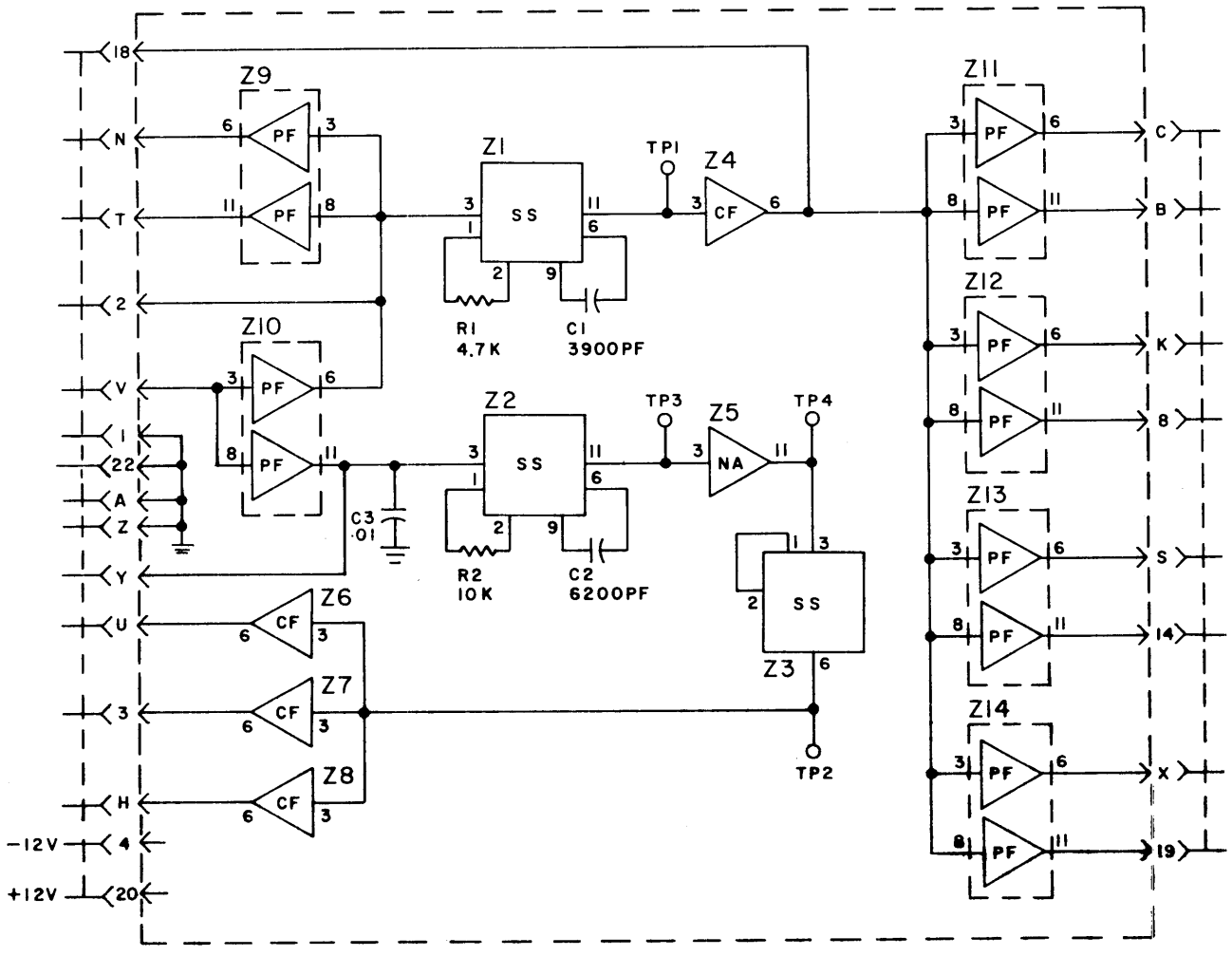
3-ON ALL FLIP FLOPS (FF) PIN 6 IS THE "1" OUTPUT & PIN 11 IS THE "0" OUTPUT.

CK 1153 Ø

MODULE VOLTAGE & GRD CHART

SYMBOL	PIN CONNECTIONS		
	+12V	-12 V	GRD
Z1 THRU Z5, Z9, 10	10	2	5
Z6, 7 & Z8		2	
Z11 THRU Z14		2	5

Figure 7-10. Logic Diagram, A4398 Gating Circuit, Input



MODULE VOLTAGE & GRD CHART

SYMBOL	PIN CONNECTION		
	+12V	-12V	GRD
Z1,2,3 & Z5	10	2	5
Z4,6 THRU Z14		2	5

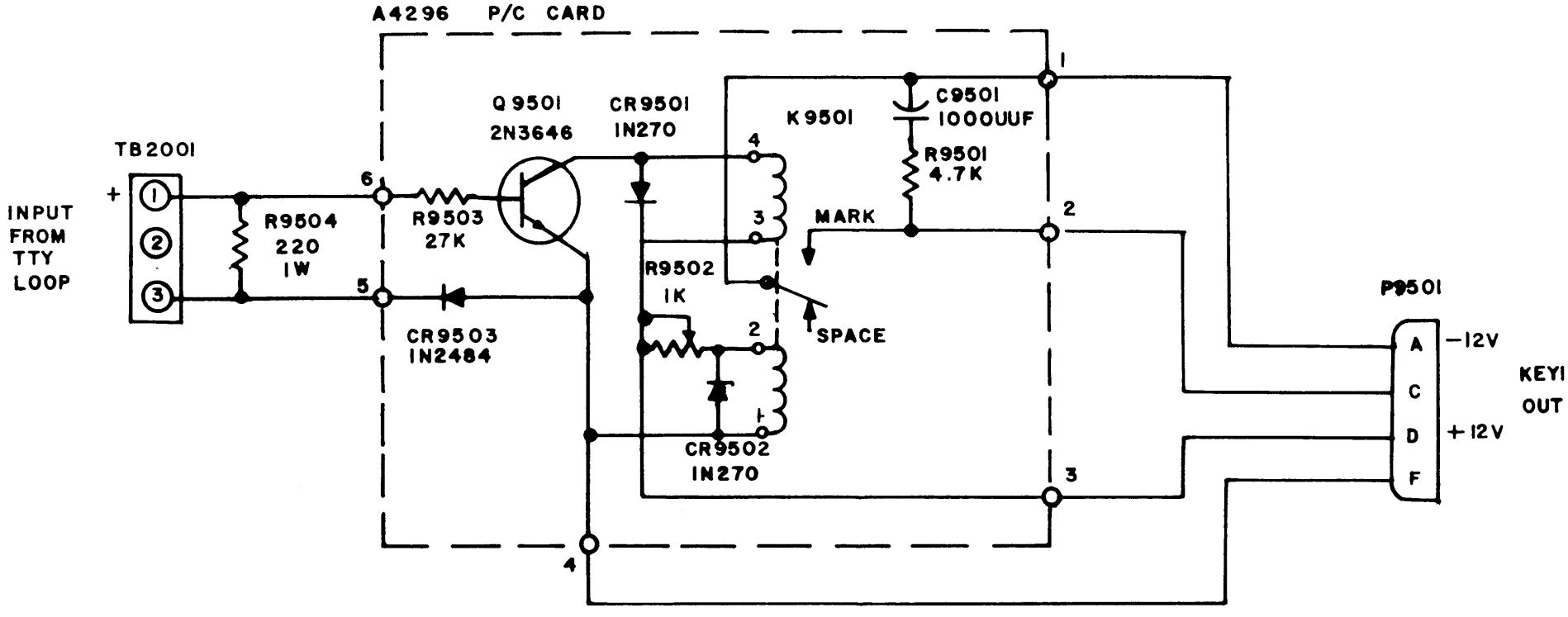
— UNLESS OTHERWISE SPECIFIED —

1 - ALL RESISTOR VALUES ARE IN OHMS, 1/ WATT.

2 - ALL CAPACITOR VALUES ARE IN MICROFARADS.

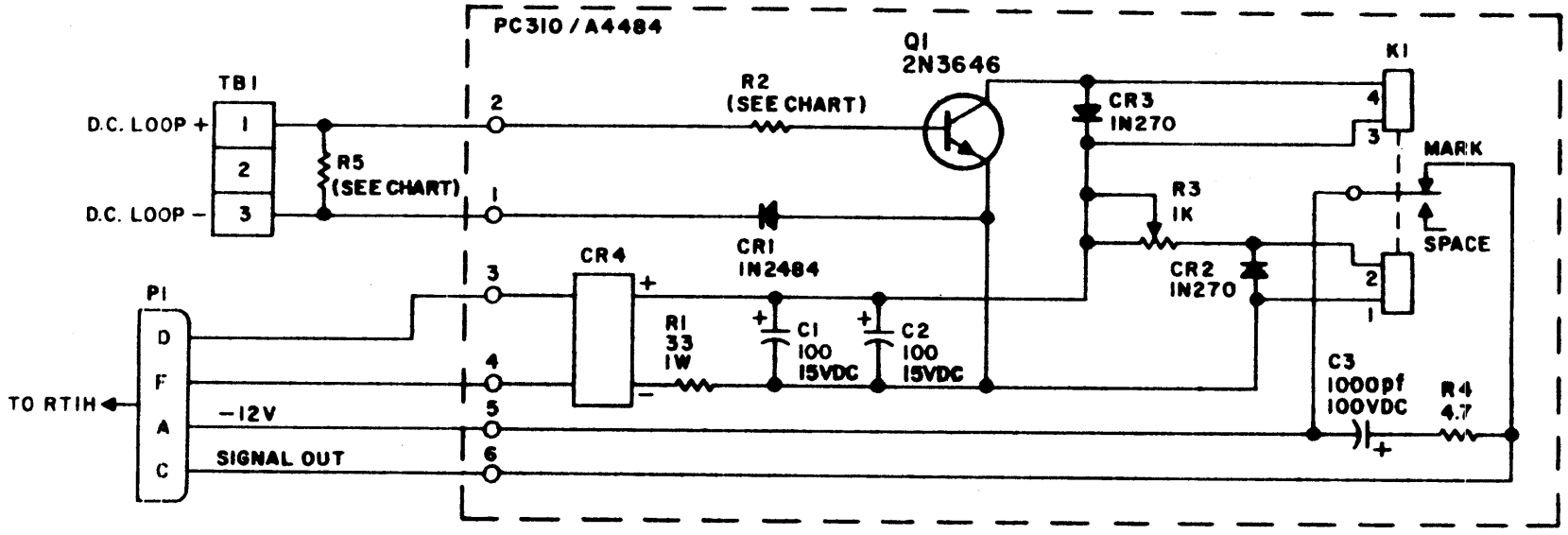
CK 1152 Ø

Figure 7-11. Logic Diagram, A4399 Timing-Set/Reset Circuit



REF: CK1042A
CA1234Ø

Figure 7-12. Schematic Wiring, AK102 Isolation Keyer



— UNLESS OTHERWISE SPECIFIED —

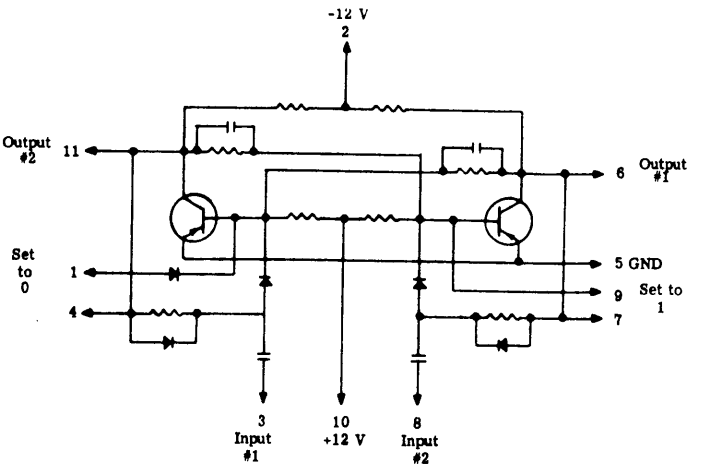
1—ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT.

2—ALL CAPACITOR VALUES ARE IN MICROFARADS.

TTY LOOP CHART		
LOOP CURRENT	RESISTANCE VALUE	
	R2	R5
60MA	27K, 1/2W	220, 1W
20MA	27K, 1/2W	680, 1W
6V, 1MA (SPECIAL)	4.7K, 1/2W	DELETE

SYMBOLS	
LAST	MISSING
R5	
C3	
CR4	
Q1	
K1	
P1	
TB1	

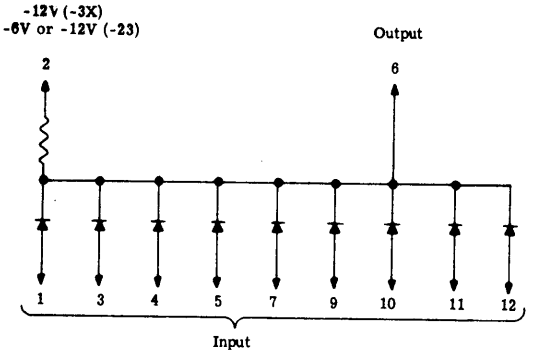
Figure 7-13. Schematic Wiring, AK102A Isolation Keyer



Polarizing Pin = #12

4097-17C

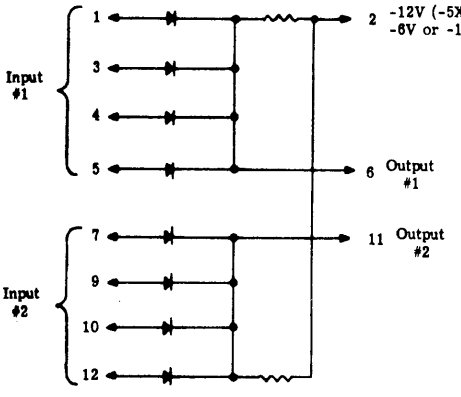
FLIP-FLOPS NW107-4X, -14, -24



Polarizing pin = #8

4093-19A

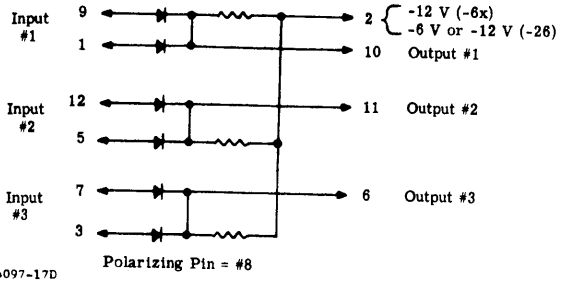
ANDGATES NW108-3X, -23



Polarizing Pin = #8

4012A-10A

DUAL ANDGATES NW108-5X, -25

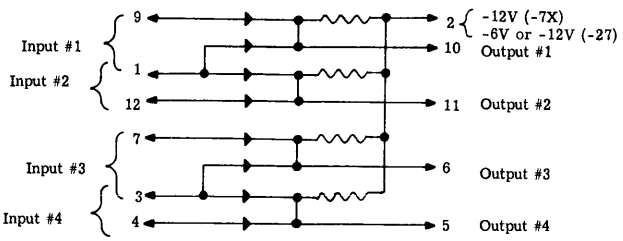


Polarizing Pin = #8

4097-17D

TRIPLE ANDGATES NW108-6X, -26

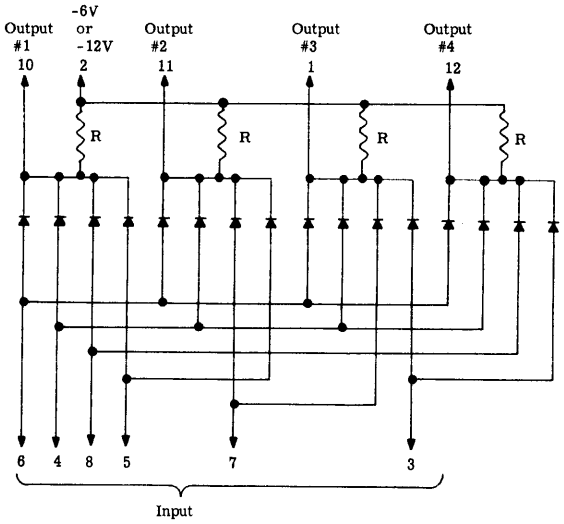
Figure 7-14. Wiring Schematics, Encapsulated Logic Modules (Sheet 1 of 4)



Polarizing pin = #8

4093-19B

QUADRUPLE ANDGATES NW108-7X, -27

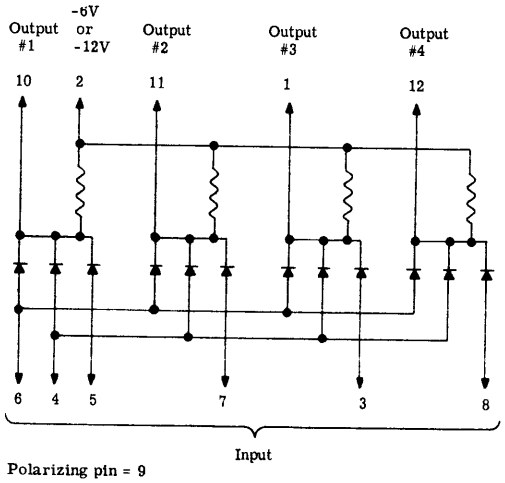


Polarizing pin = #9

R = 1.5 K (-28), 1 MEG (-30)

4093-19C

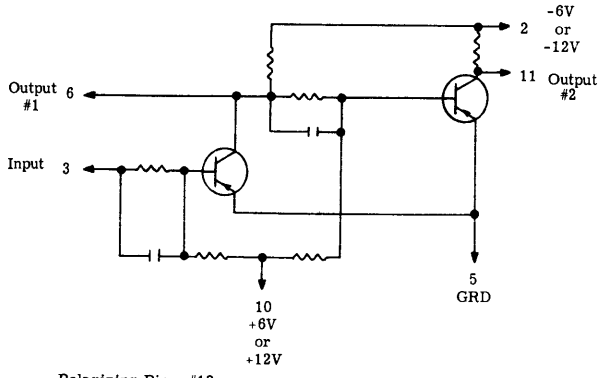
QUADRUPLE ANDGATES NW108-28, -30



Polarizing pin = 9

4093-19D

QUADRUPLE ANDGATE NW108-29

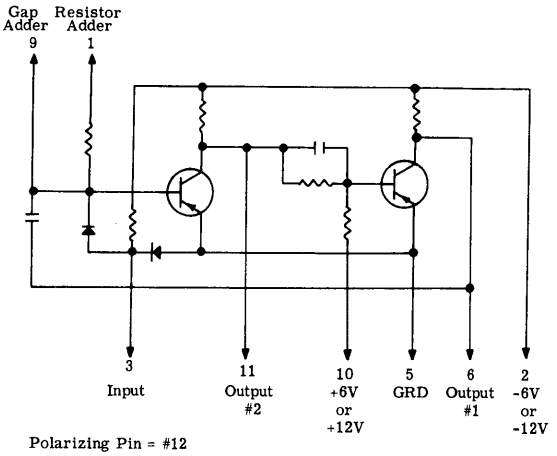


Polarizing Pin = #12

4097-17E

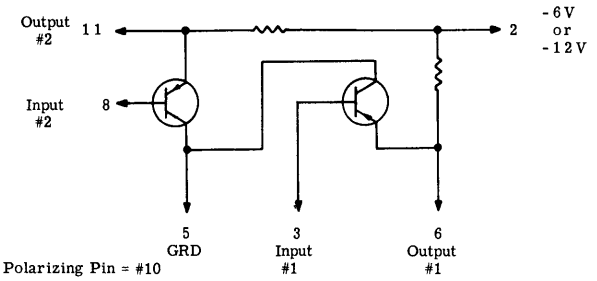
BUFFER AMPLIFIERS NW109, 109-11, -21

Figure 7-14. Wiring Schematics, Encapsulated Logic Modules (Sheet 2 of 4)



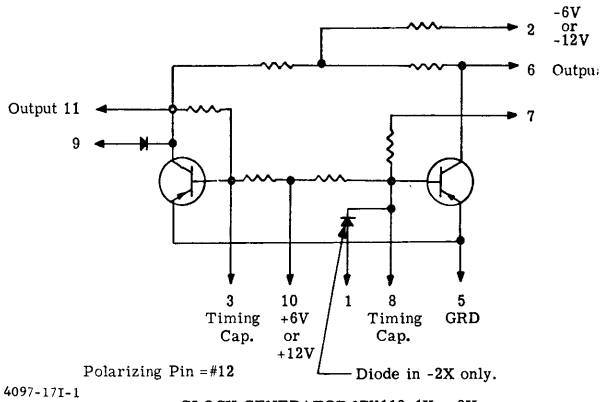
4097-17G

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



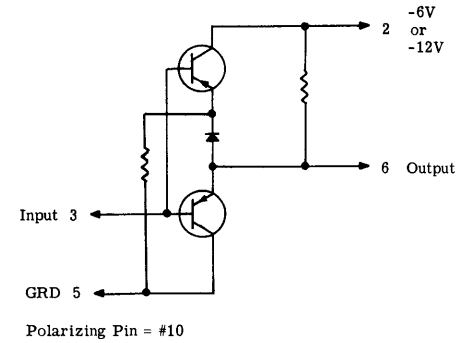
4097-17H

POSITIVE EMITTER FOLLOWERS NW112, NW112-11,-21



4097-17I-1

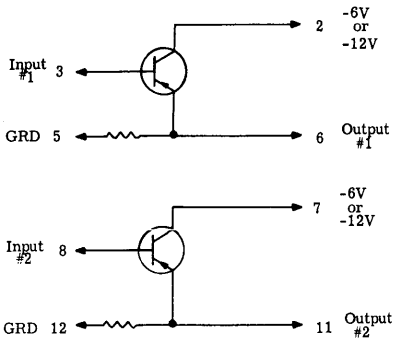
CLOCK GENERATOR NW113-1X, -2X



4097-17K

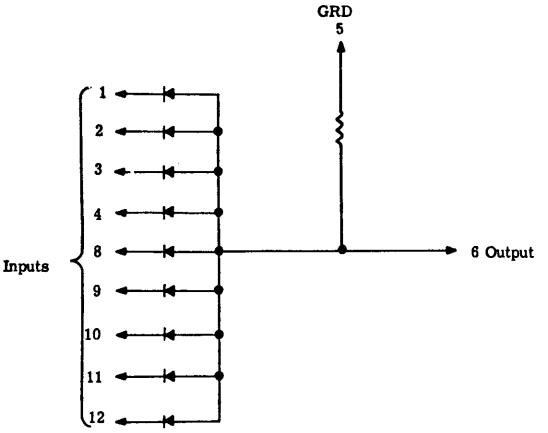
COMPLIMENTARY EMITTER FOLLOWERS NW118, NW118-11, NW118-21

Figure 7-14. Wiring Schematics, Encapsulated Logic Modules (Sheet 3 of 4)



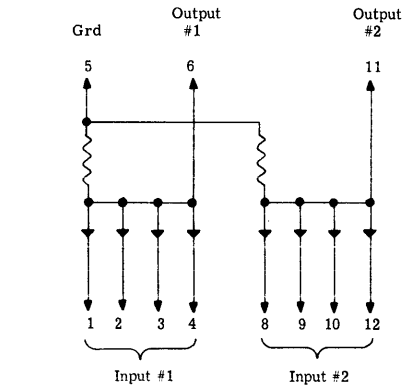
4012A-10C

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



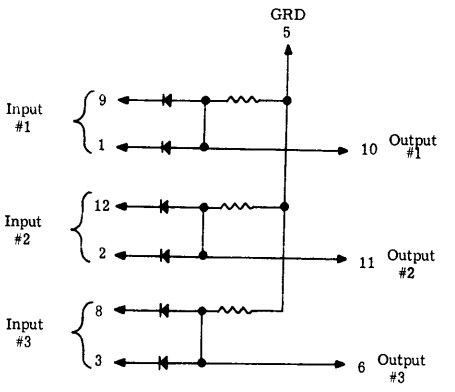
4097-17M

ORGATES NW 121-3, -23



4093-19E

DUAL ORGATES NW121-5, -25



4012A-10D

TRIPLE ORGATES NW121-6, -26

Figure 7-14. Wiring Schematics, Encapsulated Logic Modules (Sheet 4 of 4)