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TECHNICAL MANUAL

for

CHANNEL FREQUENCY INDICATOR

MODEL RTIF-1



THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N. Y.

OTTAWA, CANADA

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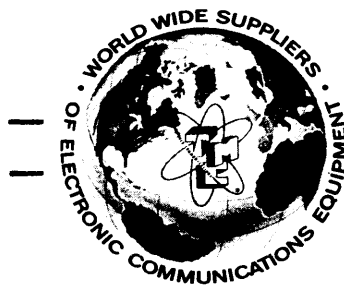


THE TECHNICAL MATERIEL CORPORATION  
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# THE TECHNICAL MATERIEL CORPORATION

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MAMARONECK, N. Y.

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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.

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\*Electron tubes also include semi-conductor devices.

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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.

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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.

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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



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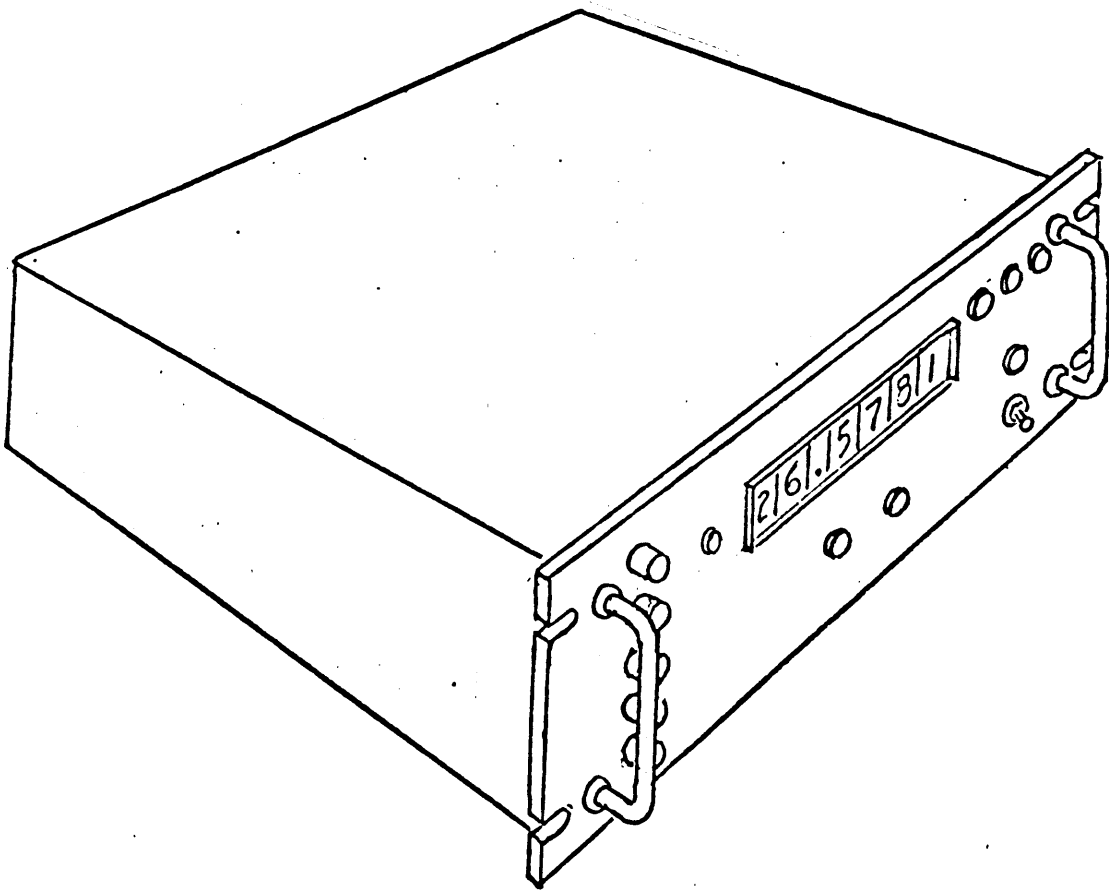


Figure 1-1. Channel Frequency Indicator, Model RTIF-1

# SECTION 1

## GENERAL INFORMATION

### 1-1. FUNCTIONAL DESCRIPTION

Model RTIF-1 Channel Frequency Indicator is a monitor unit used in remote tuning of TMC's TechniMatiC\* receivers by wire or FSK radio transmission. A continuously cycling teletype input of 7 codes presents lighted numerals indicating the frequency to which the receiver is tuned. Signal lights indicate source of receiver injection frequencies, i.e., automatic frequency control or synthesizer. Additional lights inform the operator on the state of the receiver tuning, i.e., if the controls are moving, if they have stopped moving, or if the receiver has failed to transmit the monitor signal back.

### 1-2. PHYSICAL DESCRIPTION

The RTIF-1 (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 gray enamel. The chassis extends 22 inches behind the panel.

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

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\* Trademark applied for.

### 1-3. TECHNICAL SPECIFICATIONS

SIGNAL INPUT:

Keying for serial pulses in 7.42-unit teletype transmission pattern with 22 millisecond (60 WPM) or 13.7 millisecond (100 WPM) pulse widths. Continuous cycling of 11 codes per cycle, in sequence as listed in Table 1-1.

INPUT CODE &  
CHARACTER  
SEQUENCE

See Table 1-1.

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

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

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

CHARACTER RECEPTION ORDER	DISPLAY	READING	CODE
2 (Cont)	MC	15	10001
		16	10010
		17	01001
		18	01000
		19	00100
		20	01100
		21	01010
		22	01110
		23	01101
		24	01111
		25	00110
		26	00111
		27	01011
		28	00011
		29	00101
		30	00001
31	00010		
3	. 1 MC	0	01000
		1	00100
		2	00010
		3	01001
		4	01100
		5	00110
		6	01011

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

CHARACTER RECEPTION ORDER	DISPLAY	READING	CODE
3 (cont)	.1 MC	7	01101
		8	01110
		9	00111
4	.01 MC	0-9	Same as .1 MC
5	.001 MC	0-9	Same as .1 MC
6	.0001 MC	0-9	Same as .1 MC
7	AFC and IN TUNE PROCESS lamps	on	01100
	AFC and READY lamps	on	01001
	AFC and FAULT lamps	on	01000 or 01101
	SYN and IN TUNE PROCESS lamps	on	00110
	SYN and READY lamps	on	00011
	SYN and FAULT lamps	on	00010 or 00111

## **SECTION 2**

### **INSTALLATION**

#### 2-1. INITIAL INSPECTION

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

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

#### 2-2. MECHANICAL INSTALLATION

Overall dimensions and mounting data are shown in figure 2-1. If the RTIF 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 RTIF is shipped alone, no slides are included unless specified on the order; however, the chassis sides contain threaded mounting holes for TMC TK-115 slides, if required.

#### 2-3. ELECTRICAL INSTALLATION

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

cluded when the RTIF is shipped alone.

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

#### 2-4. 60 VS. 100 WPM TRANSMISSIONS

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



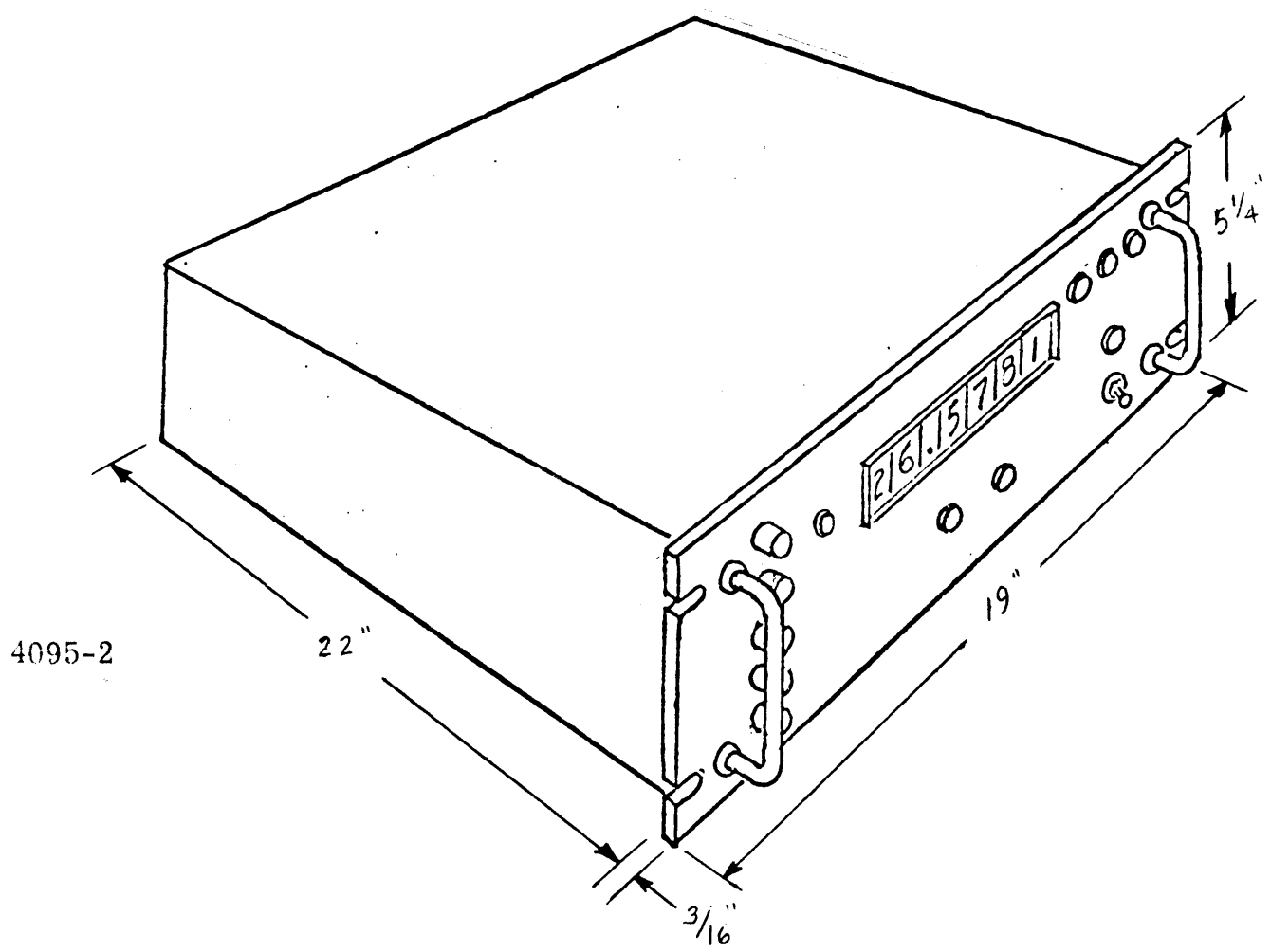


Figure 2-1. Overall and Mounting Dimensions

# SECTION 3

## OPERATOR'S SECTION

### 3-1. GENERAL

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

To energize RTIF display, set POWER switch to ON. POWER lamp will light.

The following definitions are based on the receivers generally associated with the RTIF in TMC TechniMatic systems.

### 3-2. DEFINITION OF INDICATIONS

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

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

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

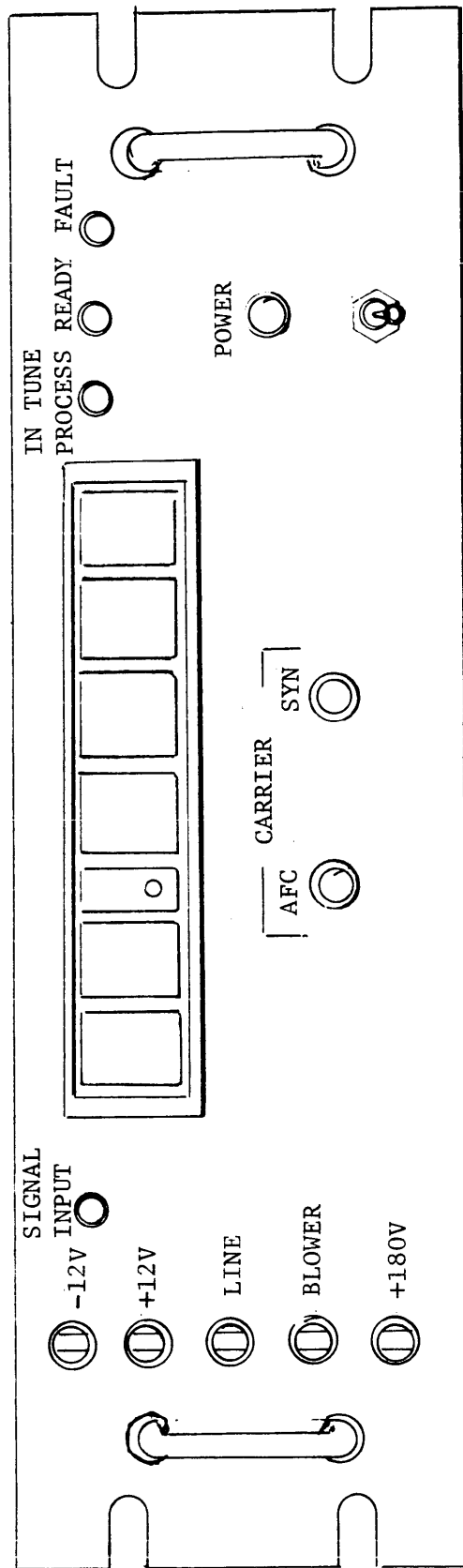
d. FAULT. - Light indicates that receiver has not been tuned as display indicates.

e. CARRIER, AFC. - Light indicates that receiver's i-f and product detector injection frequencies are originating from receiver automatic frequency control unit.

f. CARRIER, SYN. - Light indicates that receiver's i-f and product detector injection frequencies are originating from receiver synthesizer unit.

g. POWER. - Light indicates that RTIF is receiving a-c power.

h. SIGNAL INPUT. - Light indicates reception of coded signal by RTIF



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Figure 3-1. RTIF Control Panel

# SECTION 4

## PRINCIPLES OF OPERATION

### 4-1. INTRODUCTION

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

### 4-2. FUNCTIONAL ANALYSIS (Figure 4-1)

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

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

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

c. TIMING RESET. - As bit #5 enters Z2027, Z2027 sends an end-of-code pulse to Z2026 Timing and Reset card. Z2026 then sends reset pulses to the shift registers in Z2027 and Z2029 and flip-flop circuits (via Z001 Reset card) to clear the last code from the circuitry. This arrangement enables the RTIF to receive codes at any input rate.

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

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

Referring to the codes in table 1-1, it will be seen that, in all codes other than the 2 to 31 MC code, only the last 4 bits (2 thru 5) contain the significant information, with bit #1 always a "0". In the 2 to 31 MC code, however, all 5 bits are used. In the 2 to 16 MC range, the first bit is always a "1" followed by the coded bits #2 thru #5. In the 17 to 31 MC range, the first bit is always a "0" followed by a repetition of the same 4-bit code used in the 2 to 16 MC range. Bit #1 is routed to Z2024 Read-

out Memory Flip-flop card for the MC display via Z2025 MC Shift Register; bits #2 thru #5 are routed directly to Z2024. The flip-flops (energized by the MC shift register) then pass the bit #2-5 information on to Z2023 First Logic Stage card together with the "0" or "1" bit #1. The first logic stage then works with the 3 additional logic stages (Z2019 thru Z2022) to set up the proper indications on DS2011 and DS2010.

f. SHIFT REGISTER AND READOUT. There are 5 shift-registers and 6 Readout Memory cards (Z2024, Z2018, Z2003, Z2004, and Z2012) in the RTIF. Z2029 shift register shifts to start the conversion of serial pulses into parallel pulses. Z2027 shifts to store all the readout memory card. It will be noticed that each code is fed to all 6 Readout Memory cards simultaneously. However, readout of a card will not occur until it has been energized by one of the 3 remaining shift-registers (Z2025, Z2002 or Z2009). These 3 shift-registers function to energize the readouts for each display, one-by-one. The Z2026 Timing and Reset card acts to reset and energize all the code energized flip-flops in the Readout Memory Flip-flop cards, via Z2001, at the end of each code, as previously described.

The third code (.1 MC code) is for the 0-9 numeral display in DS2009 window. It enters Z2030 and travels through Z2029 and into the Z2027 Code Storage Input Shift Register Card, in the same manner as the MC code. In the .1 MC code (and the rest of the codes in the cycle) only the last 4 bits (2-5) are significant. These 4 bits are sent directly to the Readout Memory cards in parallel pulses. The Z2025 MC Shift Register, energized by the .1 MC code via Z2026 Timing and Reset card, shifts to the next position to energize the readout of the Z2018 Readout Memory card. The output of Z2018 goes to the Z2016 Readout Drive

Circuit card. Z2018 housed independent drive circuits for both the .1MC and .01MC displays (DS2009 and DS2007).

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

The next 2 codes (.001 MC and .0001 MC) are read out by the Z2002 Shift-Register card as they come through, acting on DS2006 and DS2005, respectively. After the .0001 MC code, Z2002 shift-register becomes de-activated and sets Z2009 shift-register to read out the AFC/SYN and IN TUNE PROCESS/READY/FAULT codes. The readout of these codes completes the cycle. Re-energization of Z2025 MC Shift-Register for the new cycle is again accomplished by bit #1 (a "1") in the first E code.

All these codes are processed in the same way with the exception of the last code (readout #6). This code contains information for all 5 lights (AFC, SYN, IN TUNE PROCESS, READY and FAULT). Refer to table 1-1. It will be seen that a "1" bit in bits #2 through #5 light each of the first four lamps, as follows:

<u>Lamp</u>	<u>Bit #</u>
AFC	2
SYN	4
IN TUNE PROCESS	3
READY	5

If bits #3 and #5 are both "1's" or "0's" in the same code, the FAULT lamp only will light, indicating that the IN TUNE PROCESS/READY readback is in error.

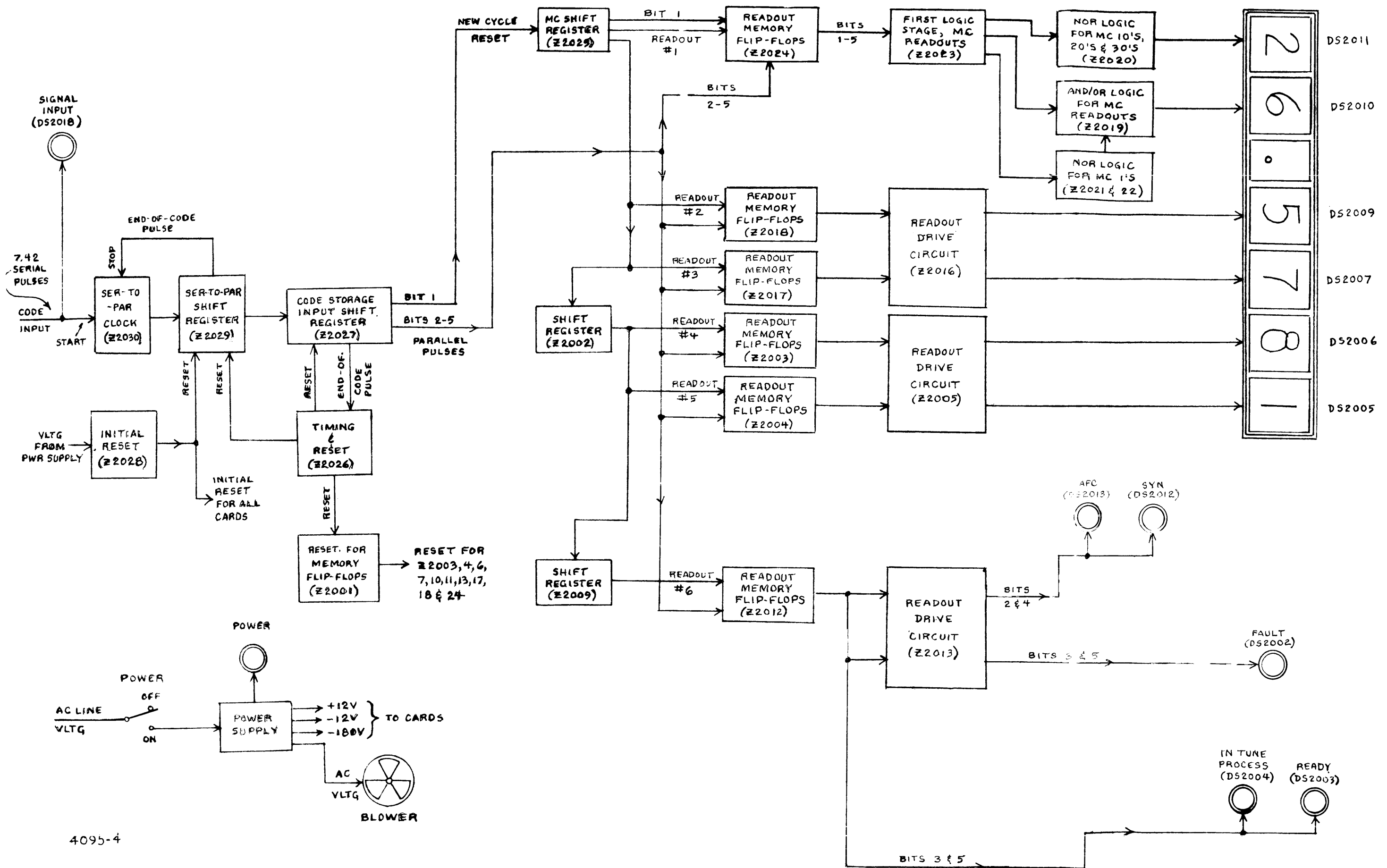


Figure 4-1. Functional Block Diagram

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## **SECTION 5**

### **MAINTENANCE**

#### 5-1. PREVENTIVE MAINTENANCE.

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

At periodic intervals, the equipment should be removed from its mounting for cleaning and inspection. The wiring and all components should be inspected for dirt, dust, corrosion, grease or other harmful conditions. Remove dust with a soft brush or vacuum cleaner. Remove dirt or grease with any suitable cleaning solvent. Use of carbon tetrachloride should be avoided due to its highly toxic effects. Trichlorethylene or methyl chloroform 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.

## 5-2. TROUBLESHOOTING

When a piece of equipment has been operating satisfactorily and suddenly fails, the cause of failure may be due to symptoms of past failures or due to component aging.

The first step in troubleshooting is to ascertain that proper equipment voltages are present, interconnecting cables are secure, and that all fuses are in functional condition.

### NOTE

Never replace a fuse with one of a high rating unless brief continued operation is more important than probable equipment damage. If a fuse burns out immediately after replacement, do not replace it a second time until the cause has been located and corrected.

Visual troubleshooting of the modular unit chassis components may also help localize the fault.

## 5-3. REPAIR AND REPLACEMENT

Maintenance will consist mainly of component replacement. It should be noted that when replacing components having many wires connected, such as switches, relays, etc., the wires should be tagged and marked for accurate identification when replacing.

When replacing components, the technician should observe for exact or equivalent replacements by referring to the parts list in section 6.

Polarity and positioning of certain components should be observed before removing so that the replacement component will fit and operate correctly.

## 5-4. OPERATIONAL CHECKS

The following checks are derived from factory test procedures, modified

for field service use. Refer to table 5-1 for test equipment required.

a. POWER SUPPLY VOLTAGE CHECK. - Before placing any cards in the unit, set a-c power switch at ON using VOM, check for -12 volts (blue wires), +12 volts (red wires), and +180 volts (yellow wires).

b. KEYING PINS. - Before placing any cards in unit, check each connector for proper keying to receive appropriate PC card.

c. INITIAL RESET. -

(1) Insert card extender PC129/A3696 into Z-2028 and insert PC127/A3694 into the card extender.

(2) Connect oscilloscope to pin 40 of PC137/A3694 and set power switch at ON and OFF slowly.

(3) Connect oscilloscope to pin 42 and repeat procedure.

(4) With power switch set at OFF, remove extender card and insert PC127/A3694 into Z-2028.

d. PERIOD ADJUST. -

(1) Insert card extender PC129/A3696 into Z-2030 and insert PC220/4295.

(2) Feed intelligence from an operating RTMU-1 into the input connector at the rear of the unit.

(3) Connect oscilloscope, set at 50 mil-sec. cm, 1-volt range, probe to CLOCK test point 2 in front of unit.

(4) Set power switch at ON and observe for a continuous line of positive pulses.

(5) Remove oscilloscope probe and connect frequency counter (set for 3- volts sensitivity),

(6) Using potentiometer R5 on PC220/A4295, adjust the period of the clock to 22 mil-sec. , observed on the frequency counter.

(7) Set power switch at OFF; do not remove card or extender card from Z-2030.

e. TEST PROCEDURE. -

(1) Insert another extender card PC129/A3696 into Z-2029, and insert PC221/A4294.

(2) Connect oscilloscope, set at .1 sec./cm, 1-volt range, probe to pin 10 of PC220/A4295.

(3) Set power switch at ON and observe for at least one -12 volts square wave pulse.

(4) Connect oscilloscope probe to pin 6 of PC220/A4295 and observe for a continuous string of negative pulses of random length.

(5) Connect oscilloscope probe to TP2 of PC220/A4295. Setting power switch at OFF and ON, observe for six pulses, a break, and then a continuous string of pulses.

(6) Set power switch at OFF. Disconnect oscilloscope probe, remove card extender PC129/A3696 from Z-2029, and insert PC221/A4294 into Z-2029

(7) Insert PC160/A3794 into Z-2026.

(8) Connect oscilloscope probe to test point 2 at the front of the unit, and upon setting the power switch at ON, observe for a continuous string of positive pulses.

(9) Connect oscilloscope probe to the SHIFT test point at the front of the unit, and observe for positive pulses, approximately 160 mil-sec. apart.

(10) Set power switch at OFF. Remove card extender PC129/A3696 from Z-2030, and insert PC220/A4295 into Z-2030.

(11) Insert PC139/A3756 into Z-2027. Connect oscilloscope probe to the SYNC test point at the front of the unit. Set power switch at ON and observe for positive-going pulses at approximately every two (2) seconds.

(12) Set power switch at OFF; disconnect oscilloscope probe.

(13) Insert PC144/A3761 into Z-2001 and set power switch at ON.

(14) Connect oscilloscope probe to the RESET test point and observe for a negative-going pulse at approximately every 160 mil-sec.

(15) Connect oscilloscope probe to the SET test point, observe for a negative-going pulse at approximately every 160 mil-sec.

(16) Set power switch at OFF; disconnect oscilloscope probe.

(17) Insert three (3) extender cards PC129/A3696 into Z-2025, Z-2002 and Z-2009. Insert PC142/A3759 into Z-2025, and insert two (2) PC141/Z3758's into Z-2002 and Z2009.

(18) Set power switch at ON. On oscilloscope observe for a negative square wave every two to three seconds on pin 10 of Z-2025, and pin 20 of Z-2002 and Z2009.

(19) Set power switch at OFF. Remove the three (3) extender cards and insert PC142/A3759, and the two (2) PC 141/A3758's into the bins.

(20) Insert all six (6) of the megacycle cards as follows: PC121/A3688 into Z-2024, PC143/A3760 into Z-2023, PC140/A3757 into Z-2022, PC140/A3756 into Z-2021, PC145/A3764 into Z-2020, PC138/A3755 into Z-2019, and set power switch at ON.

(21) Rotate the megacycle control on the associated system synthesizer unit (HFSR), and observe the megacycle readback indicators on the RTIF; both readings must match.

(22) Set power switch at OFF.

(23) Insert 100KC and 10KC PC boards as follows: PC121/A3688 into Z-2018, PC121/A3688 into Z-2017, PC124/A3691 into Z-2016, and set power switch at ON.

(24) Rotate the 100 KC and 10 KC controls on the associated system synthesizer unit (HFSR), and observe the readback indicators on the RTIF; both readings must match.

(25) Insert 1KC and .1KC PC boards as follows: PC121/A3688 into Z-2003, PC121/A3688 into Z-2004, PC124/A3691 into Z-2005, and set power switch at ON.

(26) Rotate the 1KC and .1KC controls on the associated system synthesizer unit (HFSR), and observe the readings must match.

(27) Set power switch at OFF.

(28) Insert READY, IN TUNE, FAULT, AFC, and SYN PC cards as follows: PC121/A3688 into Z-2012, PC123/A3690 into Z-2013.

(29) Set the selector switch control on the associated system mux-carrier generator unit (MCG) at SYN position and observe that the SYN indicator on the RTIF lights.

(30) Set the selector switch control on the associated system mux-carrier generator unit (MCG) at AFC position; the AFC indicator on the RTIF should light.

(31) Detune the associated system receiver tuner (HFRR-2) from the associated synthesizer until the SYN lamp on the receiver tuner is out; the RTIF FAULT indicator should light.

(32) Retune the associated system receiver tuner until it is in SYN with the associated synthesizer; the RTIF FAULT indicator should go out, and the READY indicator should light.

(33) Slide the RTIF out from its equipment rack. Set power switch at ON and depress the BOY relay (at the rear of the unit) so that the unit is placed in the operate condition.

(34) Observe that the RTIF READY indicator lamp is out, and the IN TUNE PROCESS lamp is lit.

(35) After approximately thirty (30) seconds, the RTIF should automatically switch OFF, at which time observe that the IN TUNE PROCESS indicator lamp goes out, and the READY indicator lamp lights.

(36) Set power switch at OFF.

Table 5-1. Test Equipment Required

DESCRIPTION	MANUFACTURER
Volt-Ohmmeter (VOM)	Simpson, Model 260 or equivalent.
Oscilloscope	Tektronix, Model 545 or equivalent.
Electronic Counter	Hewlett-Packard, Model 5244 or equivalent.

# 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 elector-mechnaical 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

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## PARTS LIST

For

## CHANNEL FREQUENCY INDICATOR, RTIF-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
BL2001	FAN, VENTILATING; 115 VAC, 50/60 cps; single phase; 14 watts; 100 cfm free delivery; venture block, black phenolic case.	BL106-2
C2001	CAPACITOR, FIXED, ELECTROLYTIC: 20uf, -10% +150% at 120 cps at 25 <sup>0</sup> c; 50 WVDC; polarized; insulated tubular case.	CE105-20-50
C2002	Same as C2001.	
C2003	CAPACITOR, FIXED, ELECTROLYTIC: polarized; 2,600 uf, 50 WVDC; insulated clear plastic case.	CE112-6
C2004	Same as C2003.	
C2005	CAPACITOR, FIXED, ELECTROLYTIC: polarized; 9,200 uf, 15 WVDC; insulated clear plastic case.	CE112-10
C2006	CAPACITOR, FIXED, ELECTROLYTIC: polarized; 14,000 uf, 30 WVDC; insulated clear plastic case.	CE112-9
C2007	CAPACITOR, FIXED, METALLIZED PLASTIC: 0.47 uf, +10%; 100 WVDC; epoxy encapsulated.	CN112A474-K1
C2008	Same as C2005.	
C2009	CAPACITOR, FIXED ELECTROLYTIC: polarized; 20 uf; 250 WVDC; hermetically sealed aluminum case, black vinyl plastic sleeve.	CE116-4VS
CR2001	SEMICONDUCTOR DEVICE, DIODE: silicon; max. peak inverse voltage 100 volts; continuous forward current 300 ma at 150 <sup>0</sup> c; hermetically sealed metal and glass case.	1N1582
CR2002 thru CR2004	Same as CR2001.	

PARTS LIST (CONT)  
CHANNEL FREQUENCY INDICATOR, RTIF-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR2005	SEMICONDUCTOR DEVICE, DIODE: silicon; nom. ref. voltage 13 volts; max. power dissipation 10 watts at 25 <sup>0</sup> c; max. operating temperature 100 <sup>0</sup> c; hermetically sealed case.	1N2977B
CR2006	SEMICONDUCTOR DEVICE, DIODE: silicon; max. peak reverse voltage 100 volts; average forward current 12 amps at 150 <sup>0</sup> c; operating and storage temperature range -65 <sup>0</sup> c to +200 <sup>0</sup> c; hermetically sealed case.	1N1200A
CR2007 thru CR2009	Same as CR2006	
CR2010	SEMICONDUCTOR DEVICE, DIODE: silicon; nom. ref. voltage 39 volts; max. power dissipation 10 watts at 25 <sup>0</sup> c; max. operating temperature 150 <sup>0</sup> c; hermetically sealed case.	1N1827A
CR2011	SEMICONDUCTOR DEVICE, DIODE: silicon; nominal ref. voltage 12 volts; max. power dissipation 50 watts at 25 <sup>0</sup> c; max. operating temperature 150 <sup>0</sup> c; hermetically sealed case.	1N2810B
CR2012	SEMICONDUCTOR DEVICE, DIODE: silicon; nominal voltage 600 volts; max. forward voltage drop 1.0 volts; max. continuous DC current 0.50 amps at 100 <sup>0</sup> c; peak surge current 75amps; max. reverse current 1,000 ua; max. operating temperature 150 <sup>0</sup> c; hermetically sealed case.	1N2484
CR2013	Same as CR2012.	
CR2014	SEMICONDUCTOR DEVICE, DIODE: silicon; nominal ref. voltage 180 volts at 25 <sup>0</sup> c; max. power dissipation 10 watts at 25 <sup>0</sup> c; max. operating temperature 175 <sup>0</sup> c; hermetically sealed case.	1N1814A

## PARTS LIST (CONT)

## CHANNEL FREQUENCY INDICATOR, RTIF-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR2015	SEMICONDUCTOR DEVICE, DIODE: peak inverse voltage 100 volts; max. forward current 200 ma at 1.0 volts; max. reverse current 100 ua at 25 <sup>0</sup> c; max. power dissipation 80 mw at 25 <sup>0</sup> c; max. operating temperature 90 <sup>0</sup> c; DO-7 case.	1N270
CR2016	Same as CR2015.	
CR2017	Same as CR2015.	
DS2001	LAMP, NEON: 110/125 volts, 1/15 watts; midget flange base; T-2 bulb.	BI111-1
DS2002	INDICATOR, DIGITAL	IC102-1-2
DS2003	INDICATOR, DIGITAL	IC102-1-5
DS2004	INDICATOR, DIGITAL	IC102-1-4
DS2005	INDICATOR, DIGITAL	IC101-1
DS2006 thru DS2008	Same as DS2005.	
DS2009	LAMPHOLDER, PUNCTUATION DISPLAY: operating voltage 180 volts; 2 solder type terminals; black plastic body.	TS176-1
DS2010	Same as DS2005.	
DS2011	Same as DS2005.	
DS2012	Same as DS2003.	
DS2013	INDICATOR, DIGITAL	IC102-1-6
DS2014 thru DS2017	NOT USED	
DS2018	Same as DS2013.	
DS2019	NON-REPLACEABLE ITEM. (Part of XF2001)	
DS2020	NON-REPLACEABLE ITEM. (Part of XF2005)	

## PARTS LIST (CONT)

## CHANNEL FREQUENCY INDICATOR, RTIF-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
DS2021	NON-REPLACEABLE ITEM. (Part of XF2004)	
DS2022	NON-REPLACEABLE ITEM. (Part of XF2003)	
F2001	FUSE, CARTRIDGE: 1-1/2 amps; time lag; 1-1/4" long x 1/4" dia. ; slow blow.	FU102-1.5
F2002	FUSE, CARTRIDGE: 1 amp; 1-1/4" long x 1/4" dia. ; quick acting.	FU100-1
F2003	FUSE, CARTRIDGE: 6 amps; 1-1/4" long x 1/4" dia. ; quick acting.	FU100-6
F2004	FUSE, CARTRIDGE: 1/4 amp; 1-1/4" long x 1/4" dia. ; quick acting.	FU100-.250
F2005	FUSE, CARTRIDGE: 1/4 amp; 1-1/4" long x 1/4" dia. ; slow blow.	FU102-.250
J2001	CONNECTOR, RECEPTACLE, ELECTRICAL: 22 female contacts; accomodates 1/16" printed circuit board.	JJ312-44
J2002 thru J2014	Same as J2001.	
J2015	NOT USED	
J2016 thru J2030	Same as J2001.	
J2031	NOT USED	
J2032	NOT USED	
J2033	CONNECTOR, RECEPTACLE, ELECTRICAL: 11 round female contacts, rated at 3 amps 1,800V RMS; key polarization; micro miniature type.	JJ311-1S
MP2001	FILTER, AIR CONDITIONING: replaceable type; galvanized steel frame, aluminum mesh; o/a dim. 4-11/16" long x 4-11/16" high x 1/2" wide.	AD103-19

## PARTS LIST (CONT)

## CHANNEL FREQUENCY INDICATOR, RTIF-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
P2001 thru P2006	NOT USED	
P2007	CONNECTOR, PLUG, ELECTRICAL: AC; 3 prong polarized plug with removeable ground connection. (Part of W2001)	PL218
Q2001	TRANSISTOR: germanium, hi-current; collector to base voltage 40 V; collector to emitter and emitter to base voltage 20 V; collector current 7 amps; base current 3 amps; power dissipation 85 watts at 25°C; operating storage and junction temperature range -65°C to +110°C; JEDEC type TO-3 case.	2N456A
Q2002	TRANSISTOR: PNP, germanium; collector to base voltage -50 V; emitter to base voltage -30 V; collector current -15 amps; power dissipation 150watts at 25°C; operating storage temperature range -65°C to +100°C; JEDEC type TO-36 case.	2N278
R2001	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±5%; 1/2 watt.	RC20GF102J
R2002	Same as R2001.	
R2003	RESISTOR, FIXED, WIREWOUND: 0.5 ohms, 5 watts.	RW107-54
R2004	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±5%; 2 watts.	RC42GF102J
R2005	RESISTOR, FIXED, WIREWOUND: 250 ohms, current rating 141 ma; 5 watts.	RW107-23
R2006	RESISTOR, FIXED, WIREWOUND: 0.5 ohms, current rating 6,300 ma; 20 watts.	RW110-47
R2007	RESISTOR, FIXED, WIERWOUND: 25 ohms, current rating 630 ma; 10 watts.	RW109-6
R2008	RESISTOR, FIXED, WIREWOUND: 100 ohms, current rating 315 ma; 10 watts.	RW109-9

## PARTS LIST (CONT)

## CHANNEL FREQUENCY INDICATOR, RTIF-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R2008	RESISTOR, FIXED, WIREWOUND: 100 ohms current rating 315 ma; 10 watts.	RW109-9
R2009	Same as R2003.	
R2010	RESISTOR, FIXED COMPOSITION: 33,000 ohms, +5%; 2 watts.	RC42GF333J
R2011	NOT USED.	
R2012	RESISTOR, FIXED, COMPOSITION: 10 ohms, +5%; 1/2 watt.	RC20GF100J
R2013	Same as R2012.	
R2014	Same as R2012.	
R2015 thru R2020	NOT USED.	
R2021	NON-REPLACEABLE ITEM. (Part of XF2001)	
R2022	NON-REPLACEABLE ITEM. (Part of XF2005)	
R2023	NON-REPLACEABLE ITEM. (Part of XF2004)	
R2024	NON-REPLACEABLE ITEM. (Part of XF2003)	
R2025	NON-REPLACEABLE ITEM. (Part of XF2002)	
S2001	SWITCH, TOGGLE: SPST; bat type handle.	ST103-1-62
T2001	TRANSFORMER, POWER, STEP-DOWN: primary (#1, #2) 125V, 250 VAC tapped at 105, 115, 50/60 cps; secondary 20.4 V RMS at 6ADC, 20.4 V RMS at 600 MADC, 290 V at 25 MADC center tapped; 15 solder lug type terminals; hermetically sealed steel rectangular case.	TF323
TB2001	TERMINAL STRIP, BARRIER: 6 double right angle solder lug type terminals; o/a dim. 3-1/8" lg. x 5/16" wide; bakelite body.	TM127-6
TB2002	Same as TB2001.	
TB2003	Same as TB2001.	

## PARTS LIST (CONT)

## CHANNEL FREQUENCY INDICATOR, RTIF-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TB2004	TERMINAL BOARD, BARRIER: two 6-32 thd x 1/4" long binder head machine screws; black phenolic body.	TM102-2
W2001	CABLE ASSEMBLY, POWER: consists of one 3 conductor coiled power cord, one AC connector P2007; 3 spade type terminal lugs.	CA575-5
XCR2001 thru XCR2010	NOT USED.	
XCR2011	SOCKET, TRANSISTOR: 7 pin contact accommodation; 0.040 or 0.050 dia. ; polarized; 1 terminal lug grounding strap; o/a dim. 1-37/64" x 1" max.	TS166-1
XDS2001	LIGHT, INDICATOR: with white lens; accepts T-3-1/4 single contact, midget flange lamp.	TS154-5
XF2001	FUSEHOLDER, LAMP INDICATING: accommodates cartridge fuse 1-1/4" long x 1/4" dia. ; 90 to 300 V 20 amps; neon lamp type with a 220K ohm lamp resistor; clear transparent flat sided knob; black body. (Consists of DS2019, R2021)	FH104-3
XF2002	FUSEHOLDER, LAMP INDICATING: accomodates cartridge fuse 1-1/4" long x 1/4" dia. ; 6.4 to 13 V, 20 amps; incandescent lamp type with a 40 ohm lamp resistor; red transparent flat sided knob; brown body. (consists of DS2023, R2025)	FH104-9
XF2003	Same as XF2002. (Consists of DS2022, R2024)	
XF2004	Same as XF2001. (Consists of DS2021, R2023)	
XF2005	Same as XF2001. (Consists of DS2020, R2022)	
XQ2001	Same as XCR2011.	
XQ2002	HEAT SINK: non-insulated; black anodize finish TO-36 case.	HD102-1A

## PARTS LIST (CONT)

## CHANNEL FREQUENCY INDICATOR, RTIF-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z2001	RESET CIRCUIT NO.2 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3761
Z2002	SHIFT REGISTER NO.4 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3758
Z2003	READOUT CIRCUIT NO.1 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3688
Z2004	Same as Z2003. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2005	READOUT CIRCUIT NO.3 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3691
Z2006 thru Z2008	NOT USED	
Z2009	Same as Z2002. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2010	NOT USED	
Z2011	NOT USED	
Z2012	Same as Z2003. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2013	READOUT CIRCUIT NO.2 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3690-2
Z2014	NOT USED	
Z2015	NOT USED	
Z2016	Same as Z2005. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2017	Same as Z2003. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2018	Same as Z2003. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2019	READOUT CIRCUIT NO.5 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3755



PARTS LIST (CONT)  
CHANNEL FREQUENCY INDICATOR, RTIF-1

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z2020	READOUT CIRCUIT NO.7 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3764
Z2021	NOR LOGIC/MC-1 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3757
Z2022	Same as Z2021. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2023	READOUT CIRCUIT NO.6 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3760
Z2024	Same as Z2003. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	
Z2025	SHIFT REGISTER NO.5 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3759
Z2026	READOUT CIRCUIT NO.8 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3794
Z2027	SHIFT REGISTER NO.3 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3756
Z2028	RESET CIRCUIT NO.2 MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A3694
Z2029	SHIFT REGISTER MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4294
Z2030	CLOCK TIMING CIRCUIT MODULE. (SEE SEPARATE PARTS LIST FOR BREAKDOWN)	A4295

PARTS LIST  
For  
RESET CIRCUIT NO.2

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, METALLIZED PLASTIC: 0.10 uf, <u>+5%</u> ; 50 WVDC; epoxy case.	CN114R10-5J
C2	Same as C1.	
R1	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, <u>+5%</u> ; 1/2 watt.	RC2OGF472J
R2	RESISTOR, FIXED, COMPOSITION: 390,000 ohms, <u>+5%</u> ; 1/2 watt.	RC2OGF394J
R3	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, <u>+5%</u> ; 1/2 watt.	RC2OGF104J
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP8	Same as TP1.	
Z1	NETWORK, BUFFER AMPLIFIER: operating frequency 100 kc; operating temperature range -35 <sup>o</sup> c to +85 <sup>o</sup> c; 12 male contacts, epoxy case.	NW109-11
Z2	NETWORK, ONE SHOT GENERATOR: operating frequency 100 kc; operating temperature range -35 <sup>o</sup> c to +85 <sup>o</sup> c; 12 male contacts, epoxy case.	NW111-11
Z3	Same as Z1.	
Z4	NETWORK, NAND GATE AMPLIFIER: operating temperature range -35 <sup>o</sup> c to +85 <sup>o</sup> c; 12 male contacts, epoxy case.	NW104-21
Z5	NETWORK, DIGITAL INVERTER: operating temperature range -35 <sup>o</sup> c to +85 <sup>o</sup> c; 12 male contacts, epoxy case.	NW105-11
Z6	NETWORK, EMITTER FOLLOWER: operating temperature range -35 <sup>o</sup> c to +85 <sup>o</sup> c; 12 male contacts, epoxy case.	NW118-11

PARTS LIST (CONT)  
RESET CIRCUIT NO.2

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z7	NETWORK, EMITTER FOLLOWER: operating temperature range $-35^{\circ}\text{c}$ to $+85^{\circ}\text{c}$ ; 12 male contacts, epoxy case.	NW118
Z8	NETWORK, POSITIVE EMITTER FOLLOWER: operating temperature range $-35^{\circ}\text{c}$ to $+85^{\circ}\text{c}$ ; 12 male contacts, epoxy case.	NW112-11
Z9 thru Z11	Same as Z8.	

PARTS LIST  
For  
SHIFT REGISTER NO. 4 MODULE

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2	Same as TP1.	
TP3	Same as TP1.	
Z1	NETWORK, NAND GATE AMPLIFIER: operating temperature range $-35^{\circ}\text{c}$ to $+85^{\circ}\text{c}$ ; 12 male contacts, epoxy case.	NW104-21
Z2 thru Z4	Same as Z1.	
Z5	NETWORK, POSITIVE EMITTER FOLLOWER: operating temperature range $-35^{\circ}\text{c}$ to $+85^{\circ}\text{c}$ ; 12 male contacts, epoxy case.	NW112-11
Z6	Same as Z5.	
Z7	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 kc; operating temperature range $-35^{\circ}\text{c}$ to $+65^{\circ}\text{c}$ ; 12 male contacts, epoxy case.	NW107-4X
Z8 thru Z10	Same as Z7.	

PARTS LIST  
For  
READOUT CIRCUIT NO.1 MODULE

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP12	Same as TP1.	
Z1	NETWORK, POSITIVE EMITTER FOLLOWER: operating temperature range $-35^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW112-11
Z2 thru Z4	Same as Z1.	
Z5	NETWORK, FLIP - FLOP AMPLIFIER: operating frequency 100 kc; operating temperature range $-35^{\circ}\text{C}$ to $+65^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW107-4X
Z6 thru Z8	Same as Z5.	
Z9	NETWORK, NAND GATE AMPLIFIER: operating temperature range $-35^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW104-21
Z10 thru Z12	Same as Z9.	



PARTS LIST  
For  
READOUT CIRCUIT NO.2 MODULE

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP12	Same as TP1.	
Z1 thru Z8	NOT USED	
Z9	NETWORK, EMITTER FOLLOWER: operating temperature range $-35^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW120-11
Z10	NETWORK, GATE AMPLIFIER: operating temperature range $-35^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW108-26

PARTS LIST  
For  
READOUT CIRCUIT NO.5 MODULE

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP13	Same as TP1.	
Z1	NETWORK, DIGITAL INVERTER: operating temperature range -35 <sup>o</sup> c to +85 <sup>o</sup> c; 12 male contacts, epoxy case.	NW105-11
Z2	NETWORK, GATE AMPLIFIER: operating temperature range -35 <sup>o</sup> c to +85 <sup>o</sup> c; 12 male contacts, epoxy case.	NW108-26
Z3	Same as Z2.	
Z4	NETWORK, OR GATE AMPLIFIER	NW121-26
Z5	Same as Z2.	
Z6	NETWORK, AND GATE AMPLIFIER: dual; operating temperature +85 <sup>o</sup> c; 12 male contacts, epoxy case.	NW108-25
Z7 thru Z9	Same as Z4.	



PARTS LIST  
For

READOUT CIRCUIT NO. 7

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR1	SEMICONDUCTOR DEVICE, DIODE: peak inverse voltage 100 volts; max. forward current 200 ma at 1.0 volts; max. reverse current 100 ua at 25 <sup>o</sup> c; power dissipation 80 mw at 25 <sup>o</sup> c; max. operating temperature 90 <sup>o</sup> c; JEDEC type DO-7 case.	1N270
CR2 thru CR5	Same as CR1.	
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP4	Same as TP1.	
Z1	NETWORK, NOR GATE AMPLIFIER: operating temperature range -35 <sup>o</sup> c to +85 <sup>o</sup> c; 12 male contacts, epoxy case.	NW119-21
Z2 thru Z5	Same as Z1.	
Z6	NETWORK, EMITTER FOLLOWER: operating temperature range -35 <sup>o</sup> c to +85 <sup>o</sup> c; 12 male contacts, epoxy case.	NW120-11
Z7	Same as Z1.	
Z8	NETWORK, NOR GATE AMPLIFIER: operating temperature range -35 <sup>o</sup> c to +85 <sup>o</sup> c; 12 male contacts, epoxy case.	NW119-22
Z9	Same as Z8.	

PARTS LIST  
For  
NOR LOGIC/MC-1 MODULE

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP5	Same as TP1.	
Z1	NETWORK, NOR GATE AMPLIFIER: operating temperature range -35 <sup>o</sup> c to +85 <sup>o</sup> c; 12 male contacts, epoxy case.	NW119-21
Z2 thru Z10	Same as Z1.	

## PARTS LIST

for

## READOUT CIRCUIT NO. 6 MODULE

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP10	Same as TP1.	
Z1	NETWORK, EMITTER FOLLOWER: operating temperature range $-35^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW120-11
Z2	NETWORK, GATE AMPLIFIER: dual; operating temperature $+85^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW108-25
Z3	Same as Z2.	
Z4	Same as Z1.	
Z5	Same as Z1.	
Z6	Same as Z2.	
Z7	Same as Z2.	
Z8	Same as Z1.	
Z9 thru Z11	Same as Z2.	
Z12	Same as Z1.	

PARTS LIST  
For  
SHIFT REGISTER NO.5 MODULE

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP4	Same as TP1.	
Z1	NETWORK, NAND GATE AMPLIFIER: operating temperature range $-35^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW104-21
Z2 thru Z4	Same as Z1.	
Z5	NETWORK, POSITIVE EMITTER FOLLOWER: operating temperature range $-35^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW112-11
Z6	Same as Z5.	
Z7	NETWORK, FLIP - FLOP AMPLIFIER: operating frequency 100 kc; operating temperature range $-35^{\circ}\text{C}$ to $+65^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW107-4X
Z8 thru Z10	Same as Z7.	

PARTS LIST  
For  
READOUT CIRCUIT NO.8 MODULE

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, MICA DIELECTRIC: 470 uuf, $\pm 5\%$ ; 500 WVDC; straight wire leads.	CM111E471J-5S
C2	CAPACITOR, FIXED, METALLIZED PLASTIC: 0.10 uf, $\pm 5\%$ ; 50 WVDC; epoxy encapsulated.	CN114R10-5J
C3	CAPACITOR, FIXED, METALLIZED PLASTIC: 1.0 uf, $\pm 5\%$ ; 50 WVDC; epoxy encapsulated.	CN114-1R0-5J
C4	Same as C2.	
R1	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, $\pm 5\%$ ; 1/2 watt.	RC20GF472J
R2	Same as R1.	
R3	Same as R1.	
R4	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, $\pm 5\%$ ; 1/2 watt.	RC20GF104J
R5	RESISTOR, FIXED, COMPOSITION: 390,000 ohms, $\pm 5\%$ ; 1/2 watt.	RC20GF394J
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP6	Same as TP1.	
Z1	NETWORK, BUFFER AMPLIFIER: operating frequency 100 kc; operating temperature range $-35^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW109-11
Z2	NETWORK, ONE SHOT GENERATOR: operating frequency 100 kc; operating temperature range $-35^{\circ}\text{C}$ to $+65^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW111-1
Z3	Same as Z2.	
Z4	NETWORK, POSITIVE EMITTER FOLLOWER: operating temperature range $-35^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW112-11
Z5	Same as Z2.	

PARTS LIST (CONT)  
 READOUT CIRCUIT NO. 8 MODULE

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z6	Same as Z1.	
Z7	Same as Z1.	
Z8	NETWORK, EMITTER FOLLOWER: operating temperature range -35 <sup>o</sup> c to +85 <sup>o</sup> c; 12 male contacts, epoxy case.	NW118
Z9	Same as Z4.	
Z10	Same as Z1.	

PARTS LIST  
For  
SHIFT REGISTER NO.3 MODULE

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, METALLIZED PLASTIC: 0.10 uf, $\pm 5\%$ ; 50 WVDC; epoxy encapsulated.	CN114R10-5J
R1	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, $\pm 5\%$ ; 1/2 watt.	RC20GF472J
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP9	Same as TP1.	
Z1	NETWORK, POSITIVE EMITTER FOLLOWER: operating temperature range $-35^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW112-11
Z2 thru Z4	Same as Z1.	
Z5	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 kc; operating temperature range $-35^{\circ}\text{C}$ to $+65^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW107-4X
Z6 thru Z9	Same as Z5.	
Z10	NETWORK, NAND GATE AMPLIFIER: operating temperature range $-35^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW104-22
Z11	NETWORK, ONE SHOT GENERATOR: operating frequency 100 kc; operating temperature range $-35^{\circ}\text{C}$ to $+65^{\circ}\text{C}$ ; 12 male contacts, epoxy case.	NW111-1

# PARTS LIST

For

## RESET CIRCUIT NO. 2 MODULE

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, MICA DIELECTRIC: 620 uuf, $\pm 5\%$ ; 500 WVDC; straight wire leads.	CM112E621J-5S
C2	CAPACITOR, FIXED, MICA DIELECTRIC: 220 uuf, $\pm 5\%$ ; 500 WVDC; straight wire leads.	CM111E221J-5S
R1	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, $\pm 5\%$ ; 1/2 watt.	RC20GF472J
R2	Same as R1.	
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP4	Same as TP1.	
Z1	NETWORK, BUFFER AMPLIFIER: operating frequency 100 kc; operating temperature range $-35^{\circ}\text{c}$ to $+85^{\circ}\text{c}$ ; 12 male contacts, epoxy case.	NW109-11
Z2 thru Z8	Same as Z1	
Z9	NETWORK, ONE SHOT GENERATOR: operating frequency 100 kc; operating temperature range $-35^{\circ}\text{c}$ to $+65^{\circ}\text{c}$ ; 12 male contacts, epoxy case.	NW111-1
Z10	NETWORK, EMITTER FOLLOWER: operating temperature range $-35^{\circ}\text{c}$ to $+85^{\circ}\text{c}$ ; 12 male contacts, epoxy case.	NW118-11
Z11	Same as Z9.	
Z12	Same as Z10.	



PARTS LIST  
For  
SHIFT REGISTOR MODULE

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP1	TERMINAL, STUD: feedthru.	TE168-2C
TP2 thru TP6	Same as TP1.	
Z1	NETWORK, NAND GATE AMPLIFIER: operating temperature range $-35^{\circ}\text{c}$ to $+85^{\circ}\text{c}$ ; 12 male contacts, epoxy case.	NW104-21
Z2	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency range 100 kc; operating temperature range $-35^{\circ}\text{c}$ to $+85^{\circ}\text{c}$ ; 12 male contacts, epoxy case.	NW107-14
Z3 thru Z8	Same as Z2.	
Z9 thru Z12	Same as Z1.	

PARTS LIST (CONT)

for

TIMING CIRCUIT, CLOCK MODULE		
REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z3	NETWORK, CLOCK GENERATOR: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW113-1X
Z4	NETWORK, FLIP-FLOP AMPLIFIER: operating frequency 100 kc; operating temperature range -35°C to +65°C; 12 male contacts, epoxy case.	NW107-4X
Z5	NETWORK, NAND GATE AMPLIFIER: operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW104-2X
Z6	NETWORK, BUFFER AMPLIFIER: operating frequency 100 kc; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW109-11
Z7	NETWORK, BUFFER AMPLIFIER: operating frequency 100 kc; operating temperature range -35°C to +85°C; 12 male contacts, epoxy case.	NW101
	NOT USED	R1
	Same as CRI.	CR2
	SEMICONDUCTOR DEVICE, DIODE: peak inverse voltage 100 volts; max. reverse current 100 ua at 25°C; power dissipation 80 mu at 25°C; max. operating temperature 90°C; JEDEC type DO-7 case.	CRI
	CAPACITOR, FIXED, METALLIZED PLASTIC: 0.68 uf, ±5%; 50 WVDC; epoxy encapsulated.	C4
	CAPACITOR, FIXED, METALLIZED PLASTIC: 2.0 uf, ±5%; 50 WVDC; epoxy encapsulated.	C3
	CAPACITOR, FIXED, MICA DIELECTRIC: 470uuf, ±5%; 500 WVDC; straight wire leads.	C2
	CAPACITOR, FIXED, METALLIZED PLASTIC: 3.0 uf, ±5%; 50 WVDC; epoxy encapsulated.	C1
TMC PART NUMBER	DESCRIPTION	REF SYMBOL

TIMING CIRCUIT, CLOCK MODULE

For

PARTS LIST

**SECTION 7**  
**SCHEMATIC DIAGRAMS**

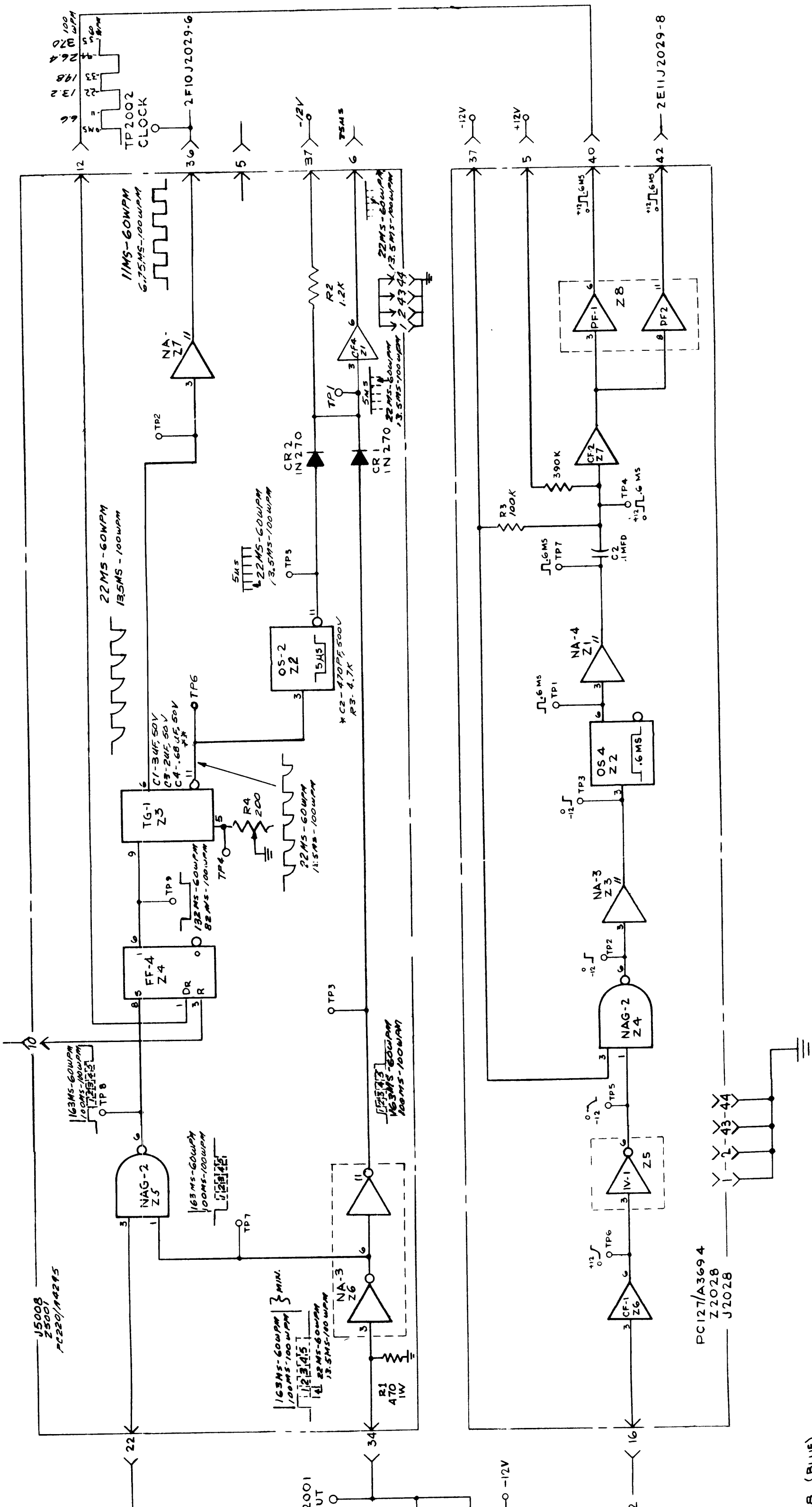


Figure 7-1. Detailed Logic Diagram RTIF-1 (Sheet 1 of 7)

CK1014

7-3/7-4

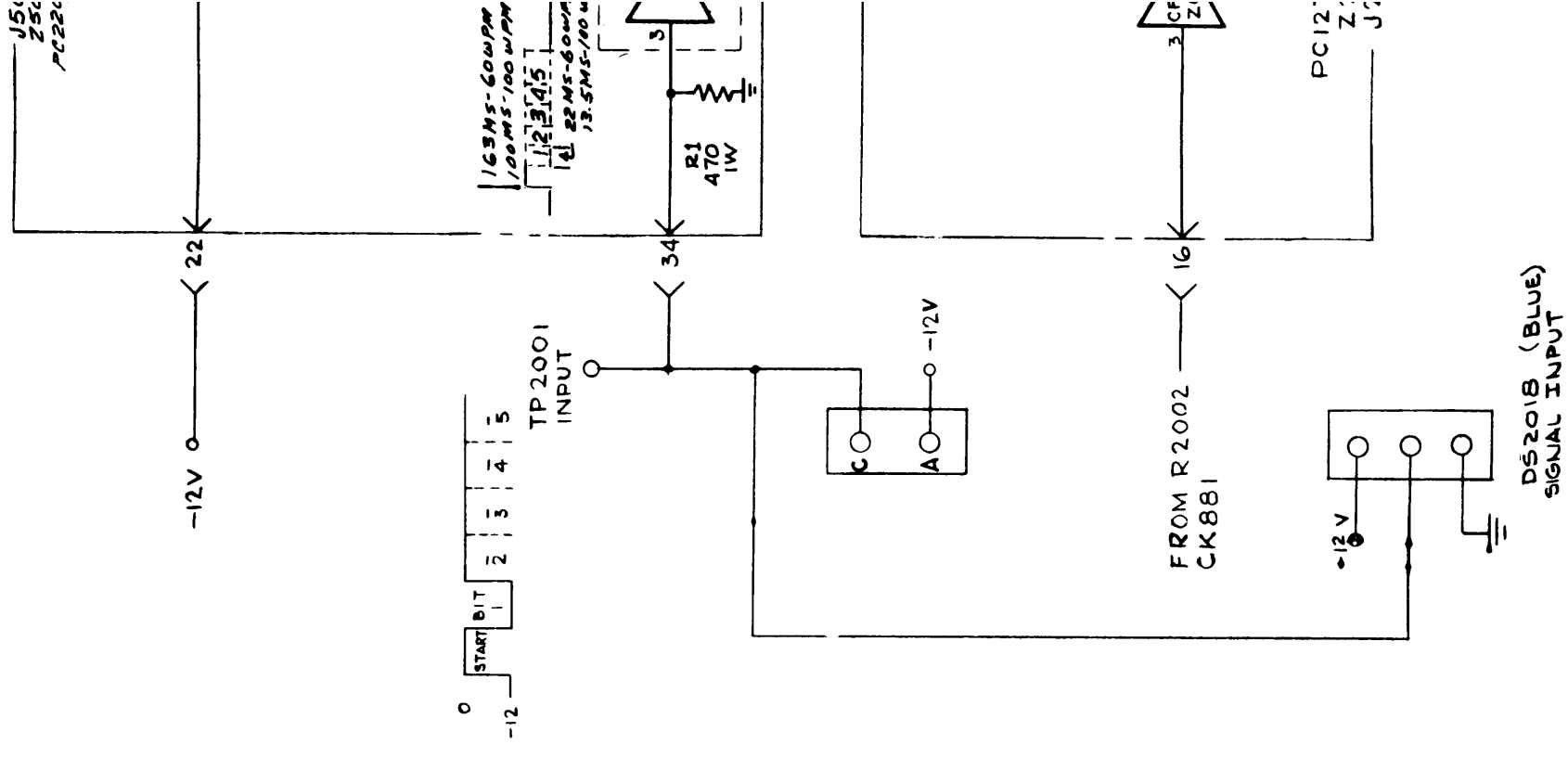
NOTES:  
 1 - GROUND CONNECTION THRU  
 PINS 1, 2, 43 & 44 FOR  
 ALL CARDS.

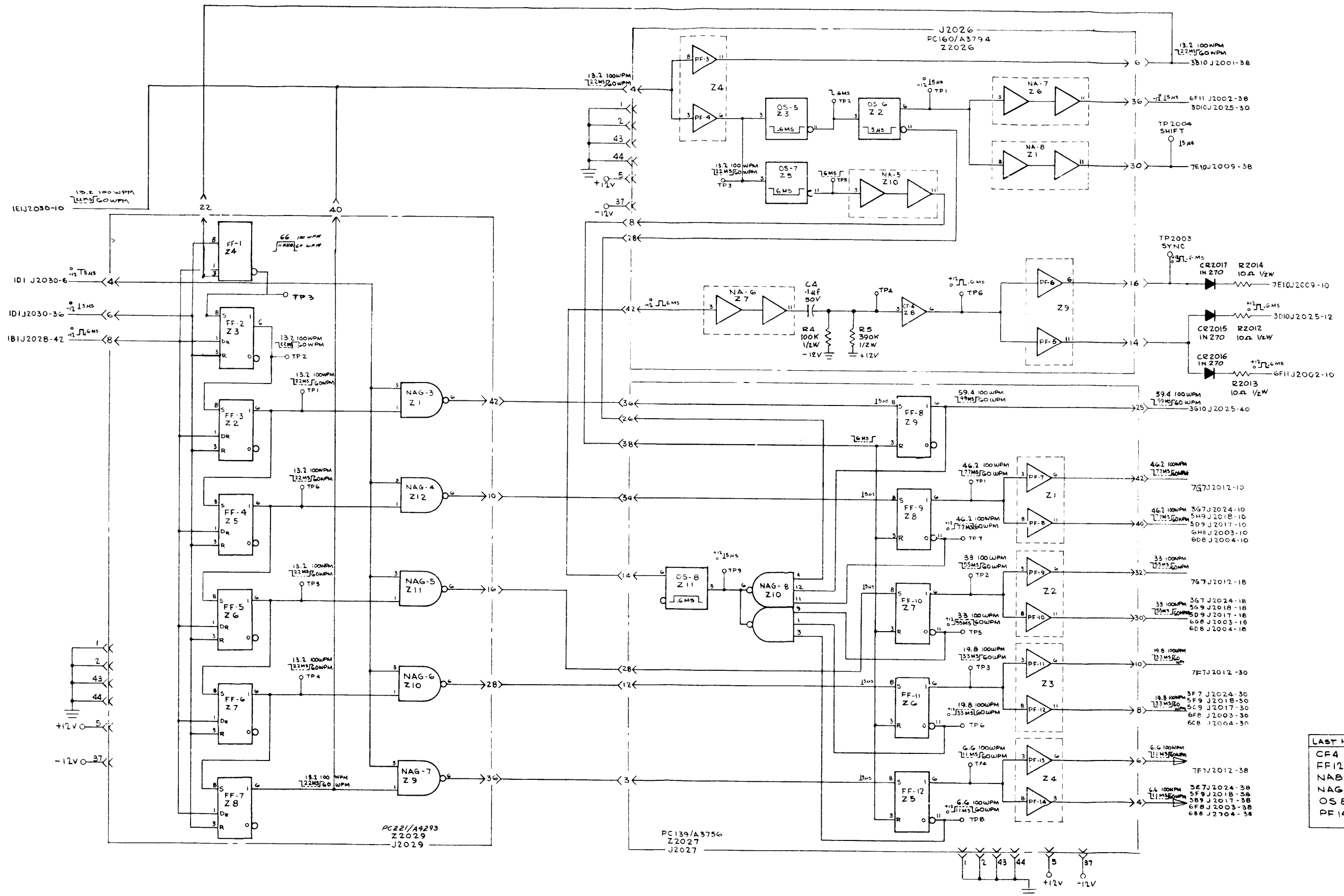
DWG DESTINATION

2 F11 J2029 - 40

SHT NO. ZONE CONNECTOR PIN NO.

LAST NUMBER USED
CF2
FF1
IV1
NA4
NAG2
OS4
PF2
TG1



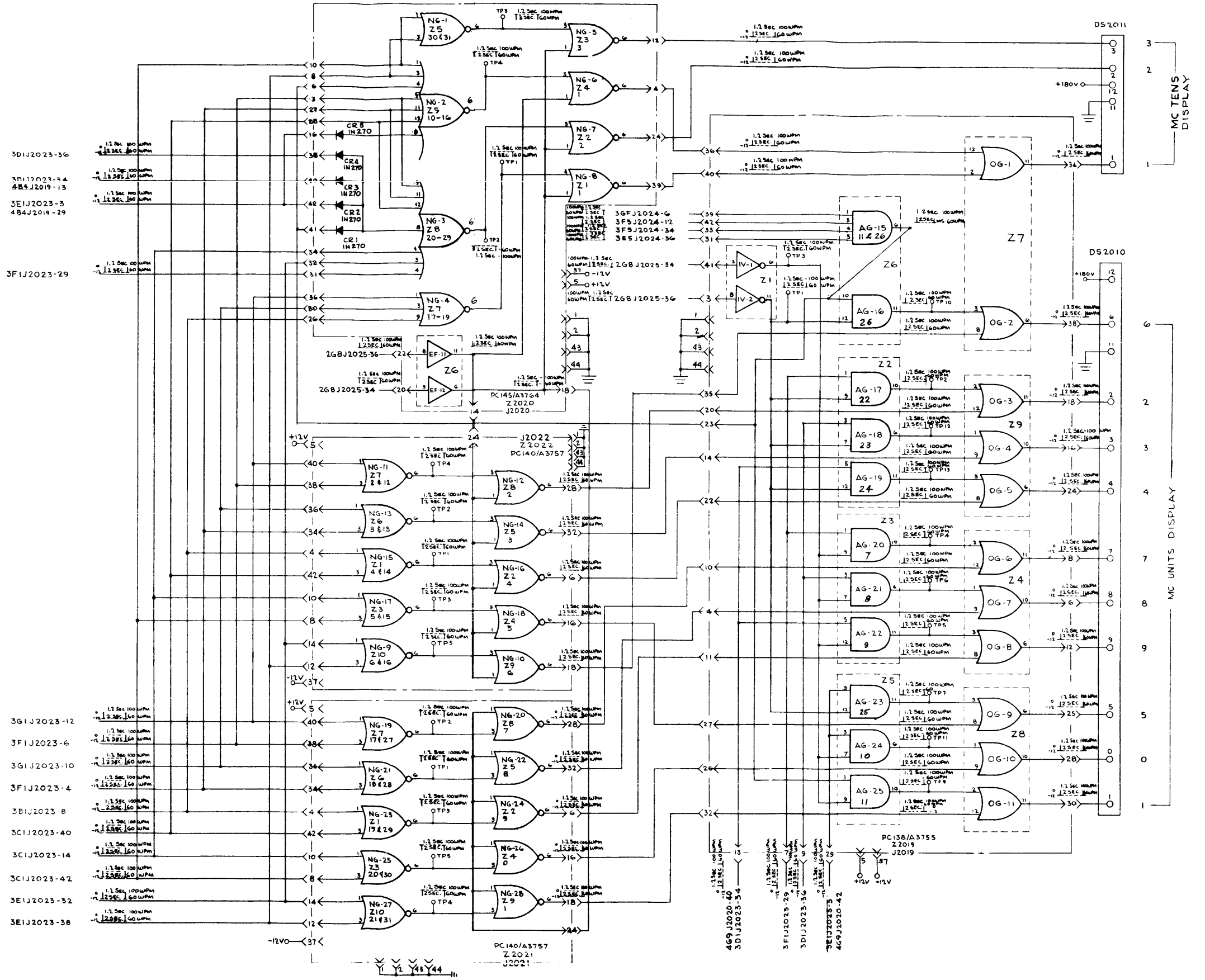


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Figure 7-1. Detailed Logic Diagram  
RTIF-1 (Sheet 2 of 7)



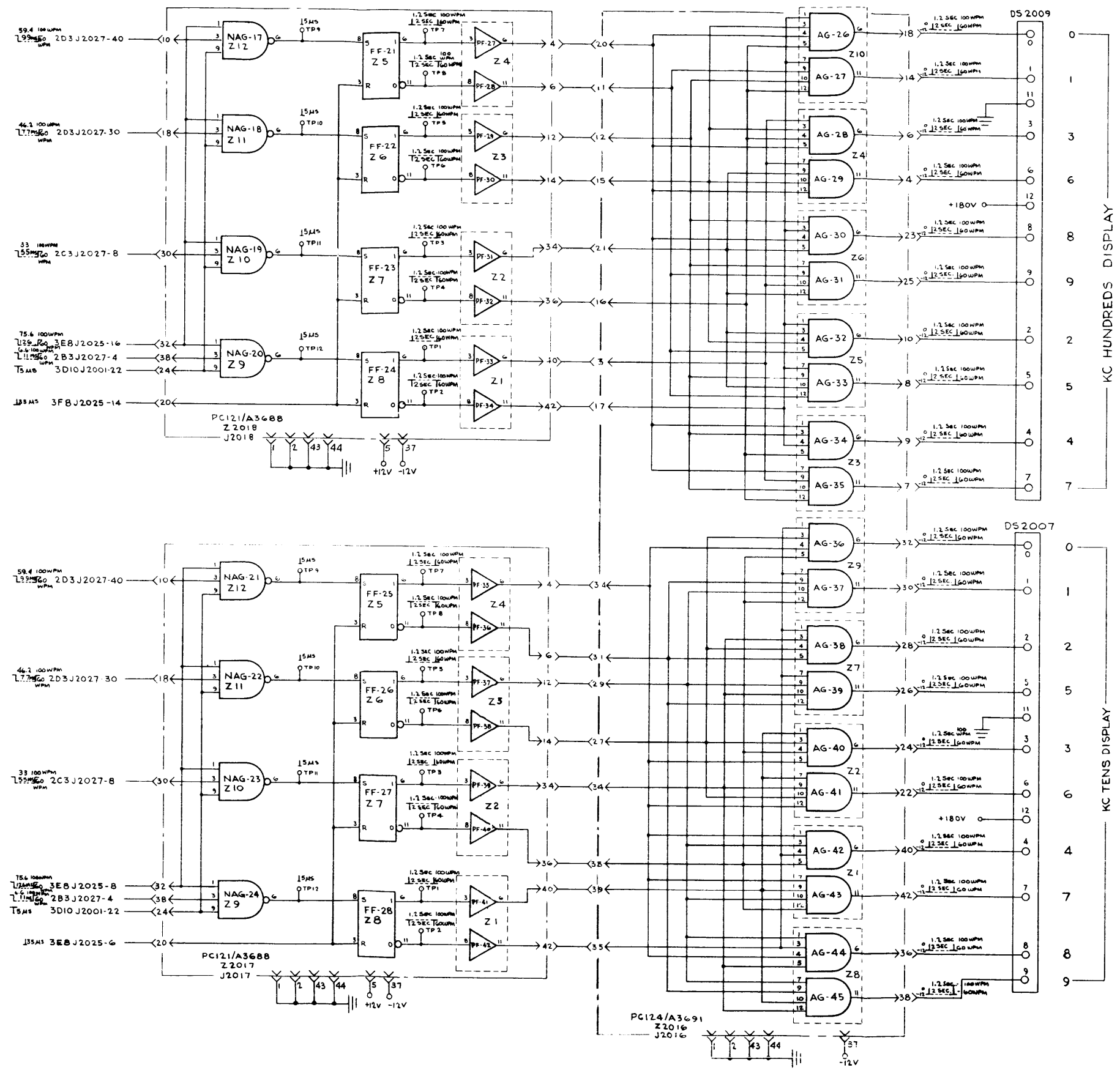
LAST NUMBER USED
AG 15
EF 12
IV 2
NG 28
OG 11



CK-1014

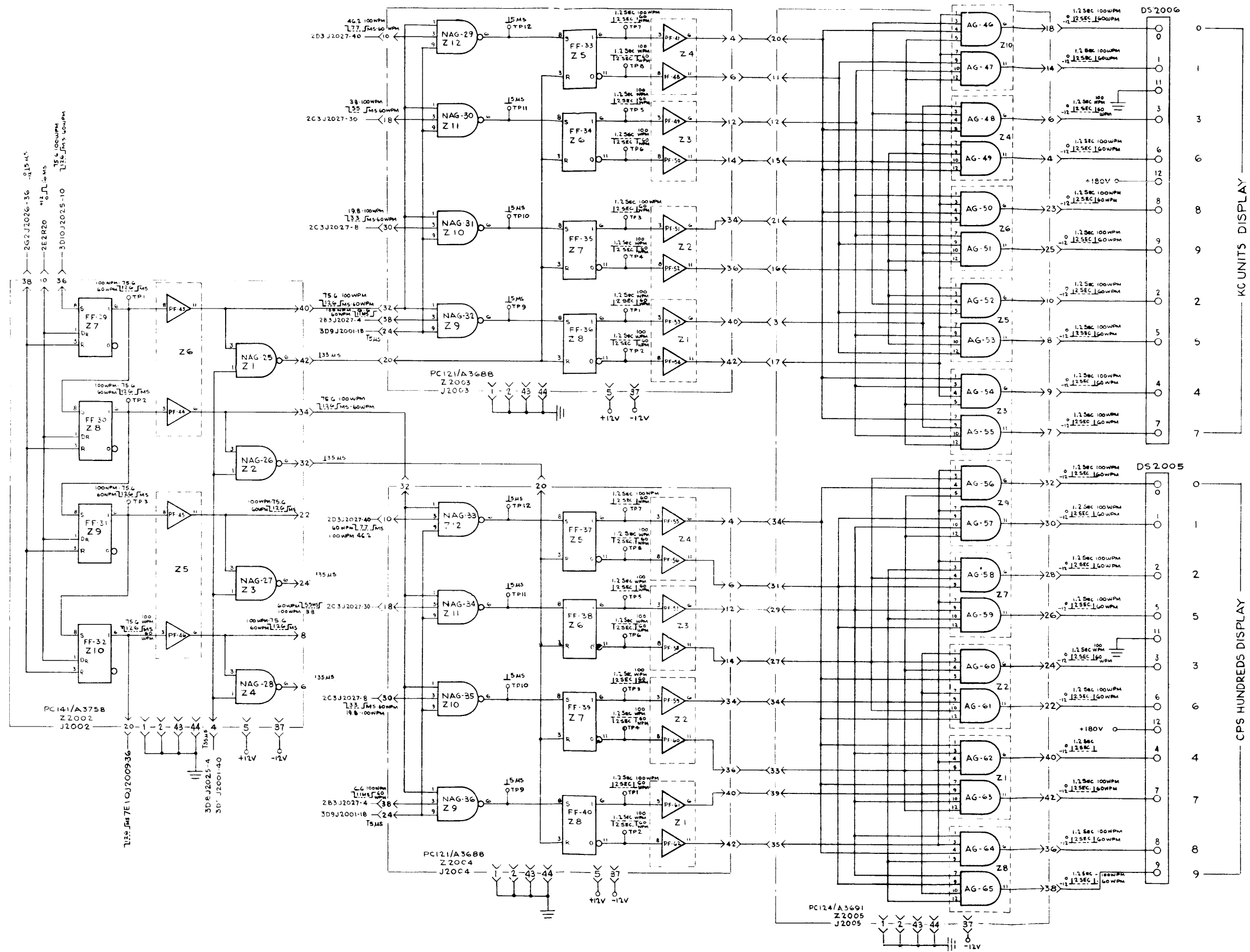
Figure 7-1. Detailed Logic Diagram, RTIF-1 (Sheet 4 of 7)





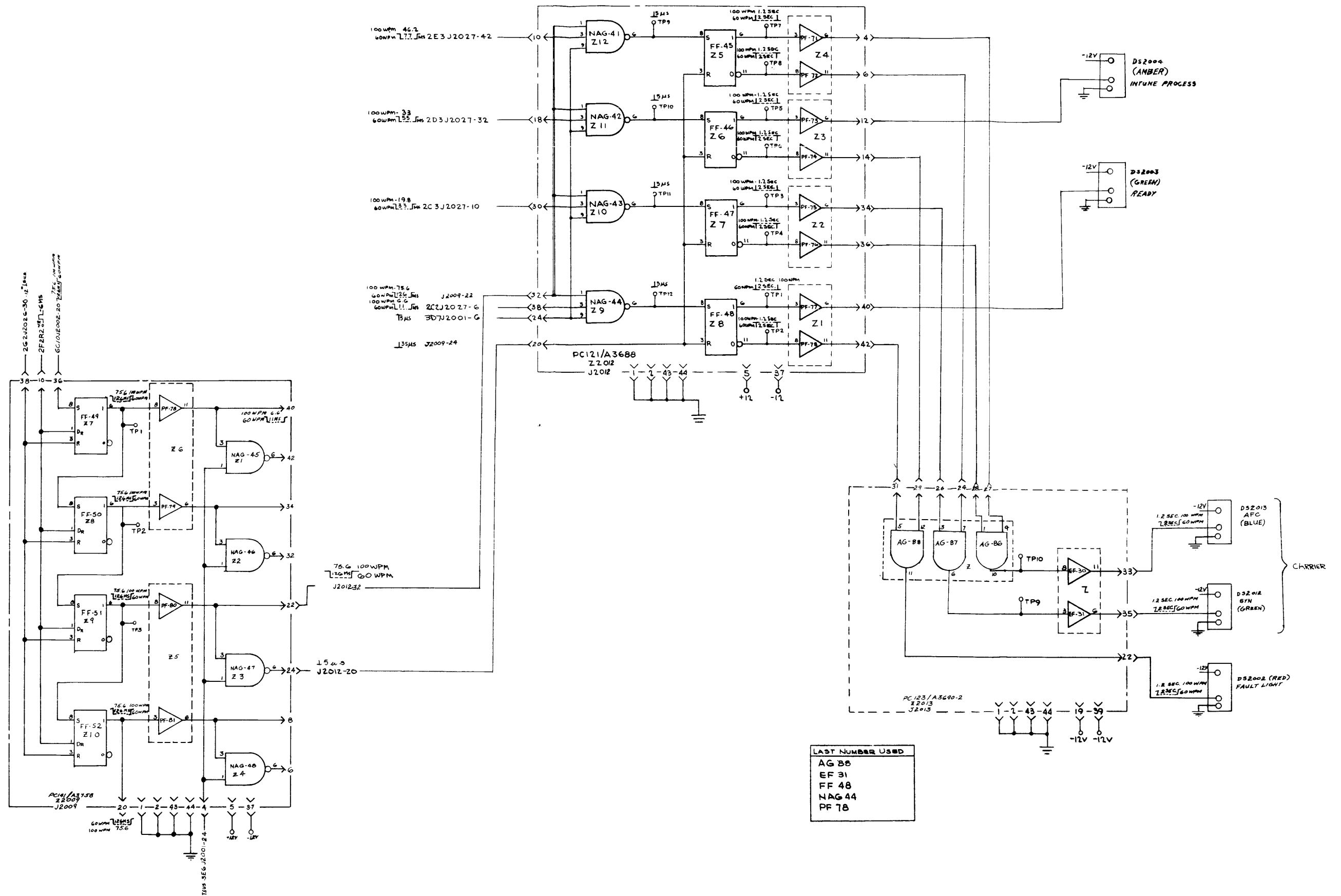
CK-1014

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



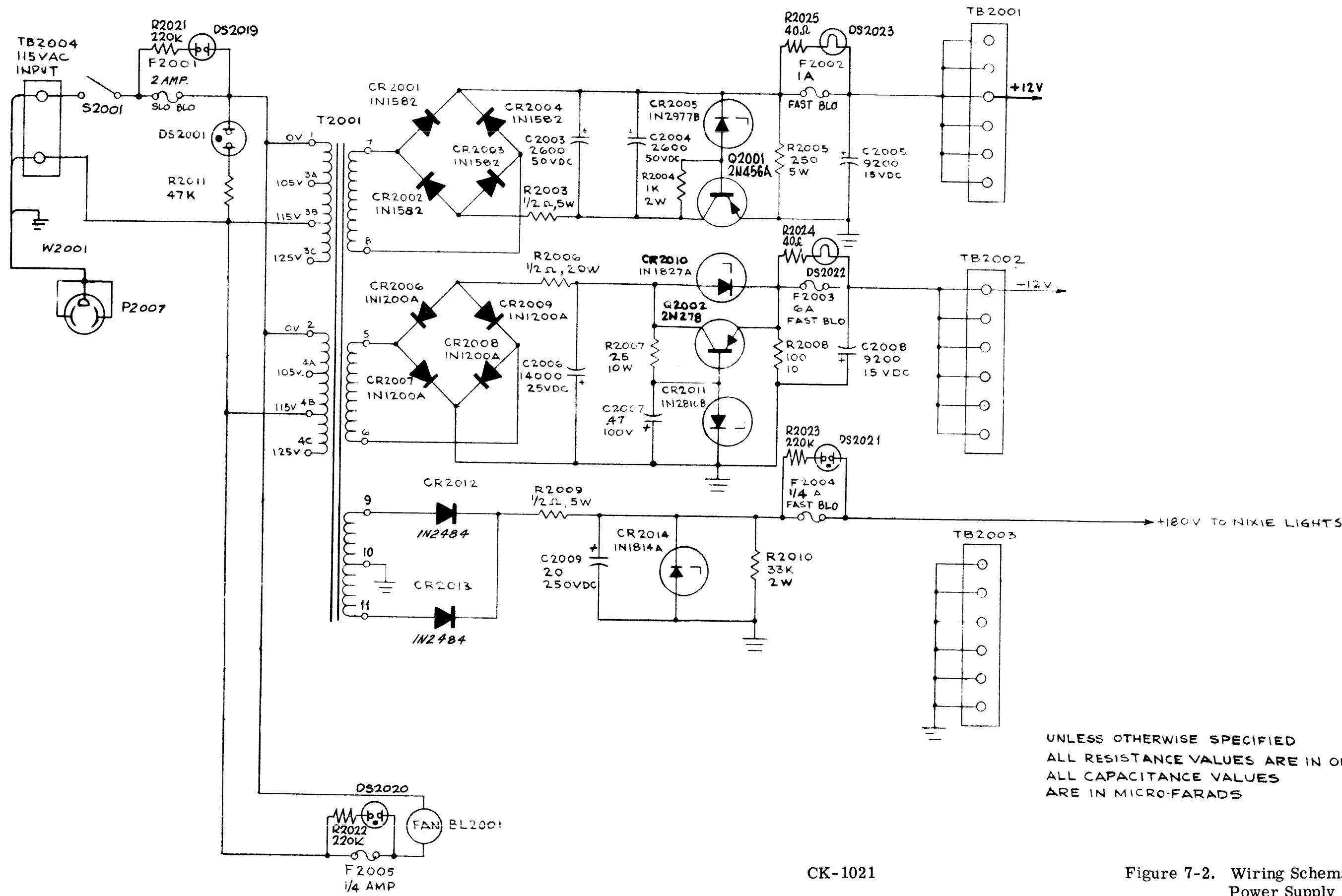
CK-1014

Figure 7-1. Detailed Logic Diagram, RTIF-1 (Sheet 6 of 7)



CK-1014

Figure 7-1. Detailed Logic Diagram RTIF-1 (Sheet 7 of 7)



UNLESS OTHERWISE SPECIFIED  
 ALL RESISTANCE VALUES ARE IN OHMS, 1/2 W  
 ALL CAPACITANCE VALUES  
 ARE IN MICRO-FARADS

CK-1021

Figure 7-2. Wiring Schematic, RTIF Power Supply