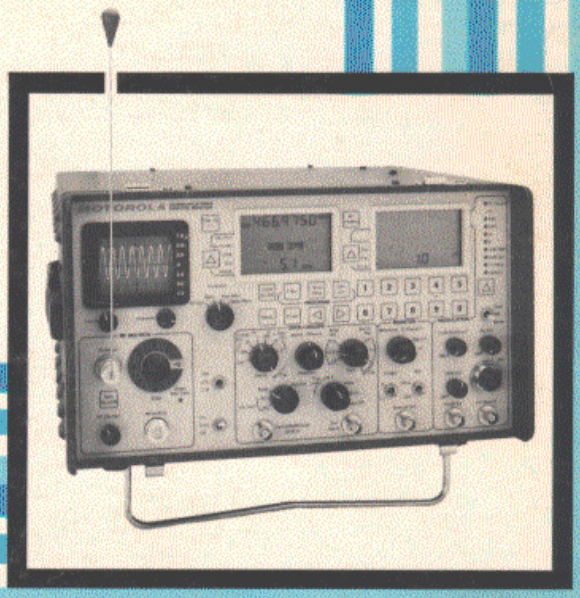
MOTOROLA INC.

test equipment

Communications Service Monitor MAINTENANCE MANUAL



R-2200A

68P81069A76-O

MOTOROLA INC.
Communications
Sector

R-2200A COMMUNICATIONS SERVICE MONITOR

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technical writing services
1301 E. Algonquin Road, Schaumburg, Il. 60196

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FOREWORD

1. SCOPE OF MANUAL

This manual is intended for use by technicians experienced with similar types of equipment. It contains all the service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date are incorporated by Instruction Manual Revisions (SMR). These SMR's are added to the manuals as engineering changes are incorporated into the equipment.

2. MODEL AND KIT IDENTIFICATION

Motorola equipments are specifically identified by an overall model number on the nameplate. In most cases, assemblies and kits which make up the equipment also have kit model numbers stamped on them. When a production or engineering change is incorporated, the applicable schematic diagrams are updated.

3. SERVICE

The Motorola Test Equipment Service Center is charged with the service responsibility for all test equipment supplied by the Motorola Communications Sector. The center maintains a stock of original equipment replacement parts and a complete library of service information for all Motorola test equipment.

Most in-warranty repairs are performed at the center. Exceptions include repairs on some equipment not manufactured by Motorola which are performed by the original supplier under the direction of the Motorola Test Equipment Service Center. Out-of-warranty service is performed on a time and materials basis at competitive rates. Customer satisfaction is continually surveyed by reply cards returned with repaired instruments.

The Motorola Test Equipment Service Center also provides a convenient telephone troubleshooting service. Frequently, a user technician can troubleshoot a piece of equipment and isolate the defective components under the direction of the Motorola Test Equipment Service Center via telephone. Required replacement parts are then immediately shipped to the user thereby reducing shipping time and servicing costs. For telephone troubleshooting, contact the Motorola Test Equipment Service Center toll free at 1-800-323-6967.

All other inquires and requests for test equipment calibration and repairs should be directed to the Motorola Area Parts Office. They will contact the Motorola Test Equipment Service Center, process the necessary paperwork and, if necessary, have the Center contact you to expedite the repair.

4. REPLACEMENT PARTS ORDERING

Motorola maintains a number of parts offices strategically located throughout the United States. These facilities are staffed to process parts orders, identify part numbers, and otherwise assist in the maintenance and repair of Motorola Communications products.

Orders for all replacement parts should be sent to the nearest area parts and service center listed below. When ordering replacement parts, the complete identification number located on the equipment should be included.

5. ADDRESSES

5.1 GENERAL OFFICES

MOTOROLA Communications and Electronics Inc.
Communications & Electronics Parts
1313 E. Algonquin Rd.,
Schaumburg, Illinois 60196
Phone: 1-312-576-3900

5.2 U.S. ORDERS

WESTERN AREA PARTS
1170 Chess Drive, Foster City
San Mateo, California 94404
Phone: 1-415-349-8621
TWX: 910-375-3877

MIDWEST AREA PARTS
1313 E. Algonquin Rd
Schaumburg, Ill. 60196
Phone: 1-312-576-7430
TWX: 910-693-0869

MID-ATLANTIC AREA PARTS
7230 Parkway Drive
Hanover, Maryland 20176
Phone: 1-301-796-8763
TWX: 710-862-1941

EAST CENTRAL AREA PARTS
12995 Snow Road
Parma, Ohio 44130
Phone: 1-216-433-1560
TWX: 810-421-8845

EASTERN AREA PARTS
85 Harristown Road
Glenrock, New Jersey 07452
Phone: 1-201-444-9662
TWX: 710-988-5602

ROCKY MOUNTAIN AREA PARTS
20 Inverness Place East
Engelwood, Colorado 80112
Phone: 1-303-790-2323
TWX: 910-935-0785

PACIFIC SOUTHWESTERN AREA PARTS
P.O. Box 85036
San Diego, California 92138
Phone: 1-714-578-8030
TWX: 910-335-1516

GULF STATES AREA PARTS
1140 Cypress Station
P.O. Box 73115
Houston, Texas 77090
Phone: 1-713-537-3636
TWX: 910-881-6392

SOUTHWESTERN AREA PARTS
P.O. Box 34290
3320 Belt Line Road
Dallas, Texas 75234
Phone: 1-214-620-8511
TWX: 910-860-5505

SOUTHEASTERN AREA PARTS
P.O. Box 368
Decatur, Georgia 30031
Phone: 1-504-987-2232
TWX: 810-766-0876

5.3 CANADIAN ORDERS

MOTOROLA LTD.
National Parts Department
3125 Steeles Avenue East
Willowdale, Ontario M2H 2H6
Phone: 416-499-1441
TWX: 610-491-1032
Telex: 06-526258

5.4 ALL COUNTRIES EXCEPT U.S. AND CANADA

MOTOROLA, INC.
International Parts Dept.
1313 E. Algonquin Road
Schaumburg, Illinois 60196 U.S.A.
Phone: 1-312-576-6482
TWX: 910-693-0869
Telex: 722443
Cable: MOTOL PARTS

MOTOROLA TEST EQUIPMENT PRODUCTS AUTHORIZED WARRANTY SERVICE CENTERS

Motorola C & E Parts
Test Equipment Service Center
1313 E. Algonquin Road
Schaumburg, IL 60196
1-800-323-6967
1-312-576-7025 (Illinois Only)
MAMS: NAGOU
TTY: 910-693-0869

Motorola C & E, Inc.
Hawaii Service Center
99-1180 Iwaena Street
Aiea, HI 96701
1-808-487-0033
TTY: 63212

Motorola Australia Pty. Ltd.
Test Equipment Service Center
666 Wellington Road
Mulgrave, VIC 3170
Melbourne
Phone: 3-561-3555
Telex: 32516 MOTOCOMA AA
Cable: MOTOCOM MELBOURNE
MAMS: FEMEL

Motorola GmbH
F and V ABT. Frachtzentrum FZF
6000 Frankfurt Main/Flughafen
West Germany
Attn: METEC
Phone: (0) 6128-702130
Telex: (0) 4182761 MOT D

Motorola France S.A.
Test Equipment Service Center
14, Allee du Cantal CE 1455
91020 Evry Cedex
Phone: (6) 077.790.25
Telex: .60043F MOTEV
MAMS: FAFEV

Motorola Canada, Ltd.
Test Equipment Service Center
3420 Pharmacy Avenue
Unit 11
Scarborough, Ontario M1W 2P7
Phone: (416) 499-1441
TTY: 610-491-1032
MAMS: NAWIL

Motorola South Africa (Pty.) Ltd.
Motorola House
5th Street
P.O. Box 39586
Wynberg
Phone: 011-786-6165
Telex: 422-070 SA
CABLE: MOTOROLA JOHANNESBURG
MAMS: FESAF

MOTOROLA INC.
Communications
Sector

SPECIFICATIONS, DESCRIPTION, AND OPERATION

The Specifications, Description, Operation, and Operating Instructions sections are contained in the R-2200A Communications Service Monitor Operators' Manual, Motorola part number 68P81069A79. Refer to the Operators' Manual as required.

8/12/83-*PHI*

technical writing services
1301 E. Algonquin Road, Schaumburg, Il. 60196

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SYSTEM MAINTENANCE AND TROUBLESHOOTING

1. GENERAL

1.1 This instruction section includes system maintenance and troubleshooting information which will assist a technician in keeping the service monitor operating properly.

1.2 If additional assistance should become necessary, the Motorola Test Equipment Service Center provides a convenient telephone troubleshooting service. Frequently, a technician can troubleshoot a piece of equipment and isolate the defective components under the direction of the Motorola Test Equipment Service Center via telephone. Required replacement parts are then immediately shipped to the user thereby reducing shipping time and servicing costs. For telephone troubleshooting, contact the Motorola Test Equipment Service Center toll free at 1-(800) 323-6967.

1.3 All other inquiries and requests for test equipment calibration and repairs should be directed to the Motorola Area Parts Office. They will contact the Motorola Test Equipment Service Center, process the necessary paperwork and, if necessary, have the Center contact you to expedite the repair. Addresses and telephone numbers of Motorola Parts Offices are shown in the Foreword of this manual.

2. LIST OF MAJOR ASSEMBLIES

A list of major assemblies, including assembly number and Motorola kit number, is given in Table 1.

3. SYSTEM THEORY OF OPERATION

(Refer to Figure 1.)

3.1 LOW VOLTAGE POWER SUPPLY

The low voltage power supply consists of two printed circuit boards: the main board and the control board. The outputs are +5 volts, −5 volts, +12 volts, −12 volts, and +33 volts. The supply operates as a switching regulator for greater efficiency and is powered by either an ac or dc source. An internal battery is also available as an option. The power supply provides for overvoltage protection, overcurrent protection, and battery charging.

Table 1. List of Major Assemblies

Assembly Number	Assembly/Subassembly Name	Motorola Kit Number
A01	Rear Panel	—
A02	Low Voltage Power Supply	RTP4018A
A03	Scope Module	RTC1004A
A03A01	High Voltage Board	RTP4019A
A03A02	High Voltage Power Supply Board	RTP4020A
A03A03	Driver Board	RTC4021A
A04	Scope Amplifier Board	RTL4022A
A05	RF Synthesizer Module	RTC1001B
A05A01	Digital Board	RTC4009B
A05A02	RF Board	RTC4010B
A06	Receiver Board	RTL4091A
A07	Analog Interface Board	RTL4092A
A08	CPU Board	RTC4023A
A09	Option	—
A10	Counter Boad	RTL4106A
A11	RF Module	RTL1014A
A11A01	Wideband Amplifier Board	RTL4093A
A11A02	Wattmeter Board	RTL4094A
A11A03	RF Interconnect Board	RTL4095A
A12	Tone Synthesizer Board	RTL4096A
A13	Reference/Audio Module	RTL4097A (TCXO)/ RTL4098A (OCXO)
A14	Front Panel Interface Board	RTL4100A
A15	Front Panel Display Board	RTL4101A
A16	Battery Pack	RTP4021A
A17	Chassis Mechanical Less Rear Panel and Main Interconnect Board	RTX1008A
A18	Main Interconnect Board	RTL4099A
A19	Front Panel	—

3.2 REAR PANEL

The rear panel contains the ac power module, ac line filter, auxiliary power transformer, system cooling fan, EXT DC/BATTERY switch, and the dc fuse. The ac power module is the main ac fuseholder and is also used to set the line operating voltage. Line selection is accomplished with a small printed circuit board located behind a clear protective panel. The position in which the card is inserted determines the line voltage, either 110 volts or 220 volts. From the switch, ac power is routed through the ac line filter to the auxiliary power transformer. The fan provides cooling when power is on. The EXT DC/BATTERY switch selects either the internal battery or an external dc source which are both routed through the dc fuse.

3.3 MAIN INTERCONNECT BOARD

The main interconnect board provides a common interface for all modules and printed circuit boards including power, data and address lines, and other necessary wiring. A delay circuit prevents voltage surges when switching from STBY to the ON mode of operation. Additional filtering of the voltage to the rf synthesizer board is also provided by the main interconnect board. The front panel wiring harness plugs into this board.

3.4 REFERENCE/AUDIO MODULE

This board provides the service monitor with a 10 MHz frequency standard and audio amplifiers for audio signals from the receivers.

3.5 RF GENERATOR

3.5.1 RF signals are generated in the rf synthesizer and then routed to the rf module. From here the signal is amplified to 1 volt rms, sent through the step attenuator to either the antenna jack or the RF IN/OUT jack, depending on whether the HI GEN or GEN mode is selected. The front panel LCD displays the generated level in either dBm or volts.

3.5.2 Modulation of the rf carrier is obtained by routing the desired modulation signal (1 kHz, code synthesizer, or external) through the front panel interface board (FPI) to the rf synthesizer. The buffered signal is used by the rf synthesizer to perform AM or FM modulation on the carrier, and the front panel display allows the operator to view the amount of FM deviation or %AM.

3.6 MONITOR

The rf signal applied to the antenna jack is routed to the rf module where it is mixed with the local oscillator frequency that results in a 10.7 MHz i-f. The receiver board filters, amplifies, and performs detection on the i-f and sends the recovered audio signal to the speaker amplifier and the analog interface board. One of the functions of the analog interface board is to detect the audio peaks to extract the FM deviation levels as well as the %AM measurements. The 10.7 MHz signal is routed to the counter board input where frequency error measurements are made. The squelch potentiometer and the signal level indicator LED located on the service monitor front panel are physically mounted on the receiver board via the main interconnect board.

3.7 RF WATTMETER AND LOAD

The 50-ohm load and wattmeter circuitry eliminate the need for an external load and wattmeter. The 125-watt load is located on the rf wattmeter board. The rf module detects the rf power applied at the RF IN/ OUT jack and sends a dc voltage proportional to the ac rms level to the analog interface board, counter, and the CPU where it is scaled and displayed on the LCD. Compensation for slight variations of the wattmeter circuitry are corrected by the custom PROM on the rf module.

3.8 DIGITAL VOLTMETER (AC, DC, SINAD, DISTORTION)

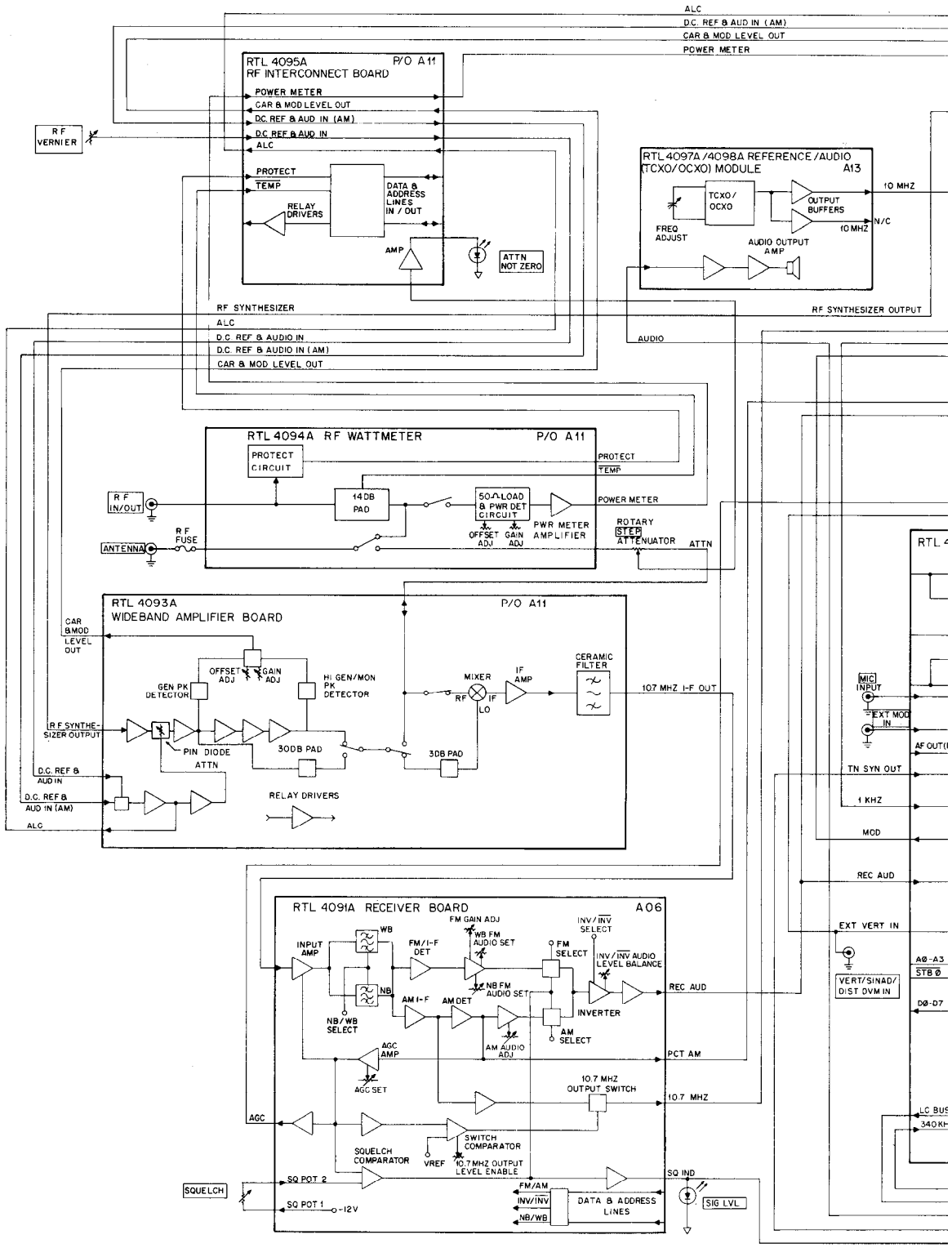
When a signal is being measured, it is applied to the VERT/SINAD/DIST/DVM IN jack on the front panel. The signal is routed to the analog interface board when it is coupled to the rms/dc converter and is passed through either the ac or dc path. The absolute dc value is sent to the counter and after passing through the A/D converter it goes to the CPU for processing and display. The SINAD and distortion measurements are processed similarly except that a 1 kHz notch is added. The DVM ranging is performed automatically by the CPU control of the relay switching on the analog interface board.

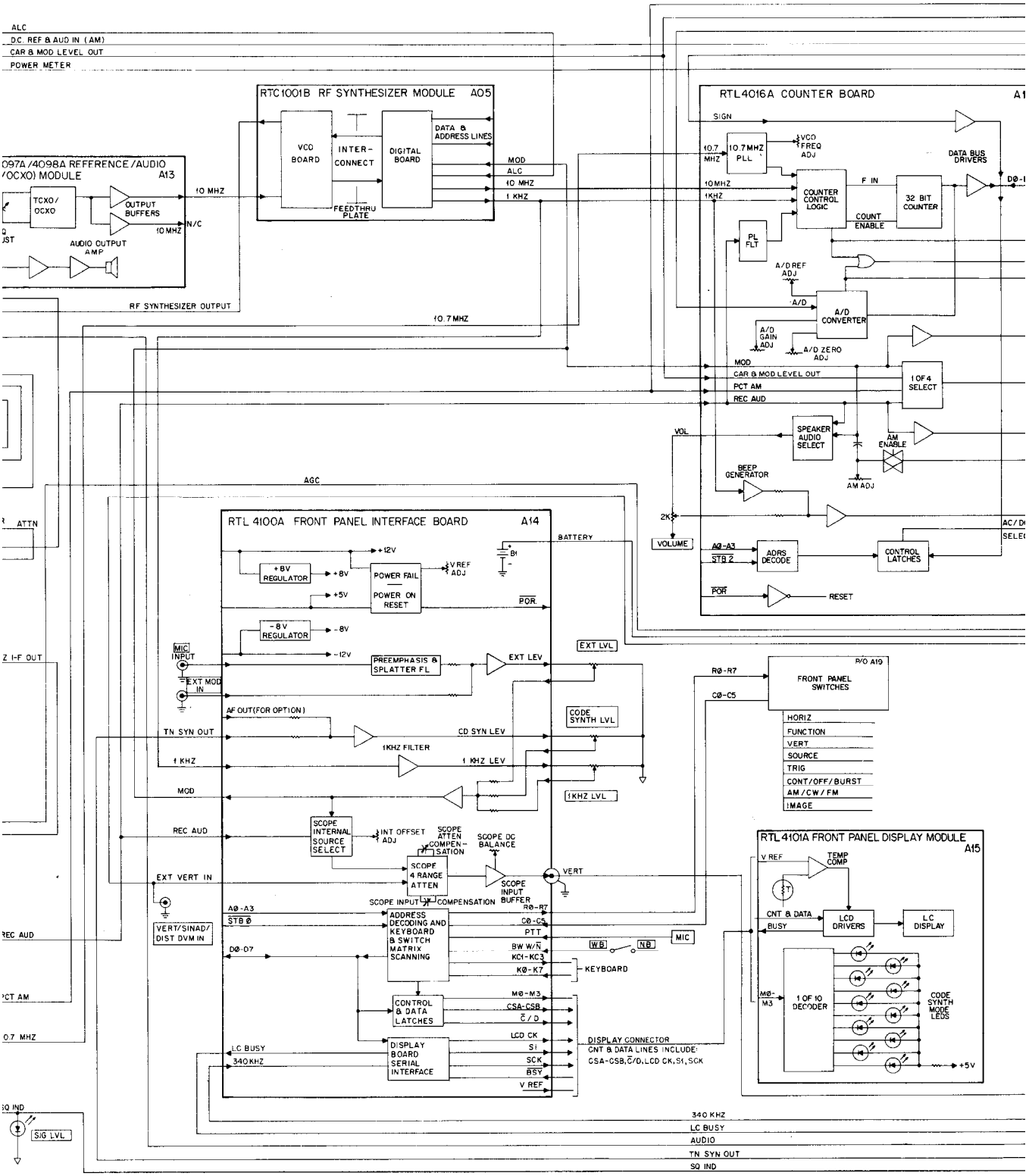
3.9 OSCILLOSCOPE

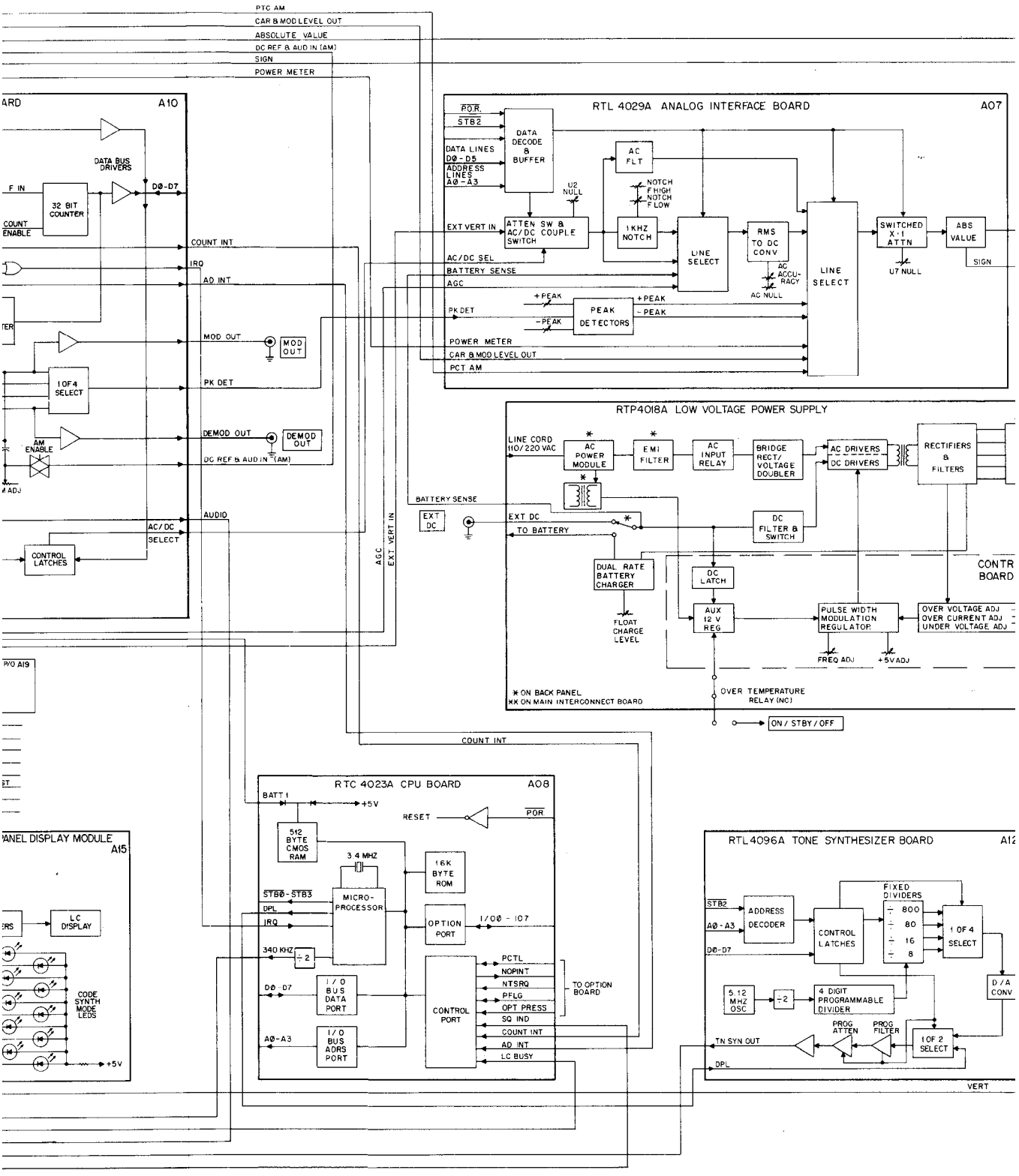
All signals displayed by the oscilloscope are routed to the scope vertical input through the front panel interface board. Depending upon the mode selected, the appropriate signals are passed through the scope amplifier and driver boards to the CRT. The oscilloscope can be used either with an external vertical input or as a modulation monitor. In the external vertical mode, ac or dc coupling is available. Horizontal sweep can be from either an external or internal source.

3.10 CODE SYNTHESIZER/AUDIO GENERATION

The code synthesizer is programmed by the CPU to generate tones and DPL (Digital Private-Line™) codes. The tones are routed to the front panel interface board and then to the rf synthesizer where a 1 kHz signal is generated for use in keyboard entry verification and modulation. The code synthesizer operates independently of the function switch setting.


ALC
D.C. REF & AUD IN (AM)
CAR & MOD LEVEL OUT
POWER METER
RTL 4095A P/O A11
RF INTERCONNECT BOARD
POWER METER
CAR & MOD LEVEL OUT
D.C. REF & AUD IN (AM)
D.C. REF & AUD IN
ALC
PROTECT
TEMP
RELAY DRIVERS
DATA & ADDRESS LINES IN / OUT
AMP
ATTN NOT ZERO
R F VERNIER
RTL 4097A /4098A REFERENCE / AUDIO (TCXO/OCXO) MODULE A13
TCXO / OCXO
OUTPUT BUFFERS
10 MHZ
N/C
10 MHZ
FREQ ADJUST
AUDIO OUTPUT AMP
RF SYNTHESIZER
ALC
D.C. REF & AUDIO IN
D.C. REF & AUDIO IN (AM)
CAR & MOD LEVEL OUT
RF SYNTHESIZER OUTPUT
AUDIO
RTL 4094A RF WATTMETER P/O A11
PROTECT CIRCUIT
PROTECT
TEMP
R F IN/OUT
14DB PAD
50Ω LOAD & PWR DET CIRCUIT
POWER METER
OFFSET ADJ
GAIN ADJ
PWR METER AMPLIFIER
ROTARY STEP ATTENUATOR
ATTN
ANTENNA
R F FUSE
RTL 4093A
WIDEBAND AMPLIFIER BOARD
P/O A11
CAR & MOD LEVEL OUT
OFFSET ADJ
GAIN ADJ
GEN PK DETECTOR
HI GEN/MON PK DETECTOR
MIXER
IF AMP
CERAMIC FILTER
RF
IF
LO
107 MHZ I-F OUT
R F SYNTHESIZER OUTPUT
PIN DIODE ATTN
30DB PAD
30DB PAD
D.C. REF & AUD IN
D.C. REF & AUD IN (AM)
ALC
RELAY DRIVERS
RTL 4091A RECEIVER BOARD A06
INPUT AMP
WB
NB
FM/I-F DET
FM GAIN ADJ
WB FM AUDIO SET
NB FM AUDIO SET
FM SELECT
INV/INV SELECT
INV/INV AUDIO LEVEL BALANCE
REC AUD
NB/WB SELECT
AM I-F
AM DET
AM AUDIO ADJ
AM SELECT
INVERTER
AGC AMP
AGC SET
PCT AM
10.7 MHZ OUTPUT SWITCH
10.7 MHZ
AGC
SQUELCH COMPARATOR
VREF
SWITCH COMPARATOR
10.7MHZ OUTPUT LEVEL ENABLE
SQUELCH
SQ POT 2
SQ POT 1
-12V
SQ IND
FM/AM
INV/INV
NB/WB
DATA & ADDRESS LINES
SIG LVL
MIC INPUT
EXT MOD IN
TN SYN OUT
1 KHZ
MOD
REC AUD
EXT VERT IN
VERT/SINAD/ DIST DVM IN
A0-A3
STB 0
D0-D7


ALC
D.C. REF & AUD IN (AM)
CAR & MOD LEVEL OUT
POWER METER
RTC1001B RF SYNTHESIZER MODULE A05
VCO BOARD
INTER-CONNECT
DIGITAL BOARD
DATA & ADDRESS LINES
FEEDTHRU PLATE
MOD
ALC
10 MHZ
1 KHZ
RTL4016A COUNTER BOARD
SIGN
10.7 MHZ
10.7MHZ PLL
VCO FREQ ADJ
DATA BUS DRIVERS
F IN
COUNTER CONTROL LOGIC
32 BIT COUNTER
COUNT ENABLE
PL FLT
A/D REF ADJ
A/D
A/D CONVERTER
A/D GAIN ADJ
A/D ZERO ADJ
CAR & MOD LEVEL OUT
PCT AM
REC AUD
1 OF 4 SELECT
VOL
SPEAKER AUDIO SELECT
AM ENABLE
AM ADJ
BEEP GENERATOR
2K
VOLUME
A0-A3
STB 2
ADRS DECODE
CONTROL LATCHES
POR
RESET
097A/4098A REFFERENCE/AUDIO /OCXO) MODULE A13
TCXO/ OCXO
OUTPUT BUFFERS
10 MHZ
N/C
AUDIO OUTPUT AMP
RF SYNTHESIZER OUTPUT
AGC
ATTN
RTL 4100A FRONT PANEL INTERFACE BOARD A14
+12V
+8V REGULATOR
+8V
+5V
POWER FAIL
POWER ON RESET
V REF ADJ
BATTERY
POR
-8V REGULATOR
-8V
-12V
MIC INPUT
EXT MOD IN
PREEMPHASIS & SPLATTER FIL
EXT LEV
EXT LVL
AF OUT(FOR OPTION)
TN SYN OUT
CD SYN LEV
CODE SYNTH LVL
1KHZ FILTER
1 KHZ
1 KHZ LEV
1KHZ LVL
MOD
REC AUD
SCOPE INTERNAL SOURCE SELECT
INT OFFSET ADJ
SCOPE ATTEN COMPEN-SATION
SCOPE DC BALANCE
SCOPE 4 RANGE ATTEN
SCOPE INPUT BUFFER
VERT
EXT VERT IN
VERT/SINAD/ DIST DVM IN
SCOPE INPUT COMPENSATION
A0-A3
STB 0
D0-D7
ADDRESS DECODING AND KEYBOARD & SWITCH MATRIX SCANNING
R0-R7
C0-C5
PTT
BW W/N
KC1-KC3
K0-K7
KEYBOARD
WB
NB
MIC
M0-M3
CSA-CSB
C/D
CONTROL & DATA LATCHES
LCD CK
SI
SCK
BSY
V REF
DISPLAY BOARD SERIAL INTERFACE
LC BUSY
340 KHZ
DISPLAY CONNECTOR
CNT & DATA LINES INCLUDE:
CSA-CSB, C/D, LCD CK, SI, SCK
P/O A19
FRONT PANEL SWITCHES
HORIZ
FUNCTION
VERT
SOURCE
TRIG
CONT/OFF/BURST
AM/CW/FM
IMAGE
RTL4101A FRONT PANEL DISPLAY MODULE A15
V REF
TEMP COMP
CNT & DATA
BUSY
LCD DRIVERS
LC DISPLAY
1 OF 10 DECODER
CODE SYNTH MODE LEDS
+5V
SIG LVL
340 KHZ
LC BUSY
AUDIO
TN SYN OUT
SQ IND

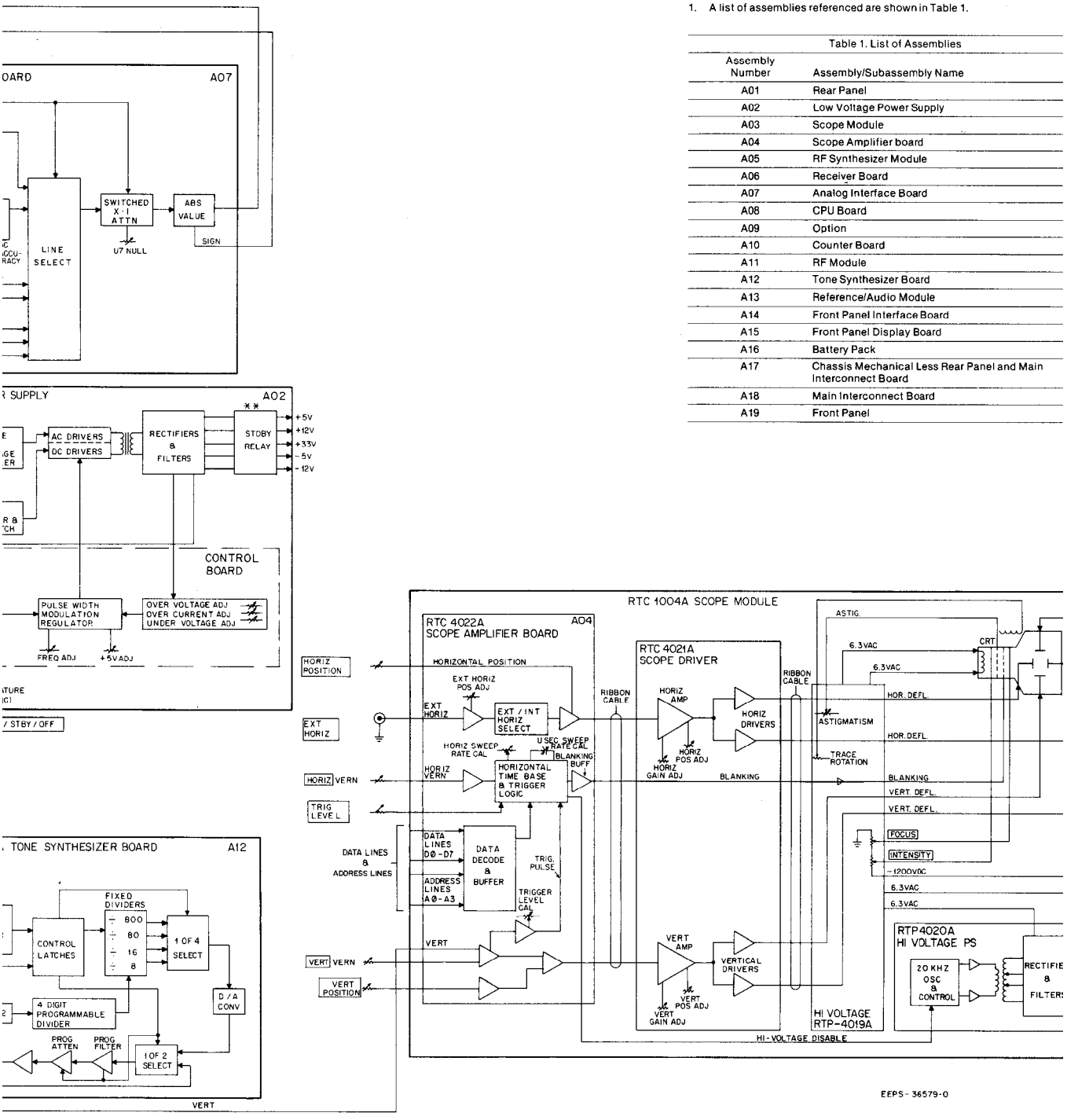

PTC AM
CAR & MOD LEVEL OUT
ABSOLUTE VALUE
DC REF & AUD IN (AM)
SIGN
POWER METER
ARD
A10
DATA BUS DRIVERS
F IN
32 BIT COUNTER
D0-D7
COUNT ENABLE
COUNT INT
IRQ
AD INT
MOD OUT
MOD OUT
1 OF 4 SELECT
PK DET
DEMOD OUT
DEMOD OUT
AM ENABLE
DC REF & AUD IN (AM)
AUDIO
AC/DC SELECT
CONTROL LATCHES
RTL 4029A ANALOG INTERFACE BOARD
A07
POR
STB2
DATA LINES D0-D5
ADDRESS LINES A0-A3
DATA DECODE & BUFFER
AC FLT
U2 NULL
NOTCH F HIGH
NOTCH F LOW
EXT VERT IN
ATTEN SW & AC/DC COUPLE SWITCH
1 KHZ NOTCH
LINE SELECT
RMS TO DC CONV
AC ACCU-RACY
AC NULL
LINE SELECT
SWITCHED X·1 ATTN
U7 NULL
ABS VALUE
SIGN
AC/DC SEL
BATTERY SENSE
AGC
+PEAK
-PEAK
PK DET
PEAK DETECTORS
+PEAK
-PEAK
POWER METER
CAR & MOD LEVEL OUT
PCT AM
RTP4018A LOW VOLTAGE POWER SUPPLY
LINE CORD 110/220 VAC
AC POWER MODULE
EMI FILTER
AC INPUT RELAY
BRIDGE RECT/ VOLTAGE DOUBLER
AC DRIVERS
DC DRIVERS
RECTIFIERS & FILTERS
BATTERY SENSE
EXT DC
EXT DC TO BATTERY
DC FILTER & SWITCH
DUAL RATE BATTERY CHARGER
FLOAT CHARGE LEVEL
DC LATCH
AUX 12 V REG
PULSE WIDTH MODULATION REGULATOR
OVER VOLTAGE ADJ
OVER CURRENT ADJ
UNDER VOLTAGE ADJ
FREQ ADJ
+5V ADJ
CONTR BOARD
* ON BACK PANEL
** ON MAIN INTERCONNECT BOARD
OVER TEMPERATURE RELAY (NC)
ON / STBY / OFF
AGC
EXT VERT IN
P/O A19
COUNT INT
RTC 4023A CPU BOARD
A08
BATT I
+5V
RESET
POR
512 BYTE CMOS RAM
3.4 MHZ
16K BYTE ROM
STB0 - STB3
DPL
IRQ
MICRO-PROCESSOR
OPTION PORT
I/00 - I07
340 KHZ
÷ 2
D0 - D7
I/O BUS DATA PORT
A0-A3
I/O BUS ADRS PORT
CONTROL PORT
PCTL
NOPINT
NTSRQ
PFLG
OPT PRESS
SQ IND
COUNT INT
AD INT
LC BUSY
TO OPTION BOARD
ANEL DISPLAY MODULE
A15
LC DISPLAY
CODE SYNTH MODE LEDS
+5V
RTL4096A TONE SYNTHESIZER BOARD
A12
STB2
A0 - A3
D0-D7
ADDRESS DECODER
CONTROL LATCHES
FIXED DIVIDERS
÷ 800
÷ 80
÷ 16
÷ 8
1 OF 4 SELECT
5.12 MHZ OSC
÷ 2
4 DIGIT PROGRAMMABLE DIVIDER
D / A CONV
PROG ATTEN
PROG FILTER
1 OF 2 SELECT
TN SYN OUT
DPL
VERT

NOTE:

1. A list of assemblies referenced are shown in Table 1.

Table 1. List of Assemblies

Assembly Number	Assembly/Subassembly Name
A01	Rear Panel
A02	Low Voltage Power Supply
A03	Scope Module
A04	Scope Amplifier board
A05	RF Synthesizer Module
A06	Receiver Board
A07	Analog Interface Board
A08	CPU Board
A09	Option
A10	Counter Board
A11	RF Module
A12	Tone Synthesizer Board
A13	Reference/Audio Module
A14	Front Panel Interface Board
A15	Front Panel Display Board
A16	Battery Pack
A17	Chassis Mechanical Less Rear Panel and Main Interconnect Board
A18	Main Interconnect Board
A19	Front Panel



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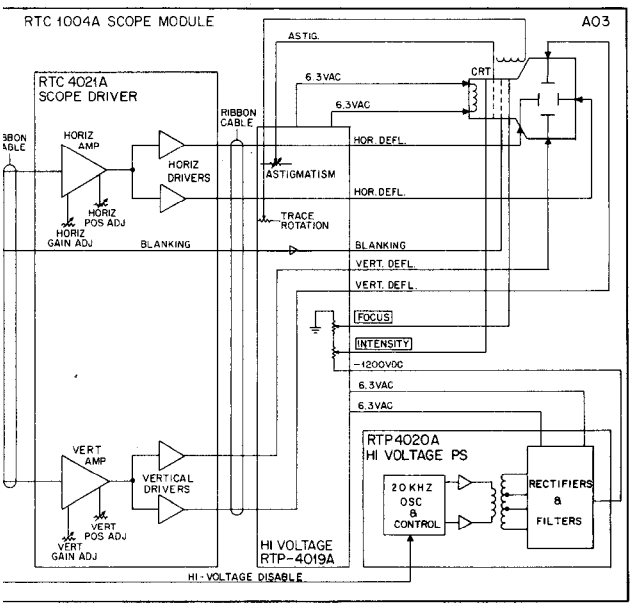
A13	Reference/Audio Module
A14	Front Panel Interface Board
A15	Front Panel Display Board
A16	Battery Pack
A17	Chassis Mechanical Less Rear Panel and Main Interconnect Board
A18	Main Interconnect Board
A19	Front Panel



EEPS-36579-0

Figure 1. R-2200 Communications Service Monitor System Signal Flow and Functional Block Diagram

Service Kit RPX-4239A

01-80350A32	L.V.P.S. Extender Board (1)
01-80350A33	C.P.U. Extender Board (1)
01-80350A34	Digital Extender Board (1)
01-80350A35	F.P.I. Extender Board (1)
01-80350A36	L.V.P.S. Control Extender Board (1)
01-80350A41	Synthesizer Extender (1)
01-80307A70	Extender Ribbon Cable (2)
01-80308A72	Extender R.F. Cable (2)
01-80356A22	Synthesizer Output Check (1)
01-80350A40	9-Conductor Extender Cable (1)
01-80351A14	Extender Cable (1)

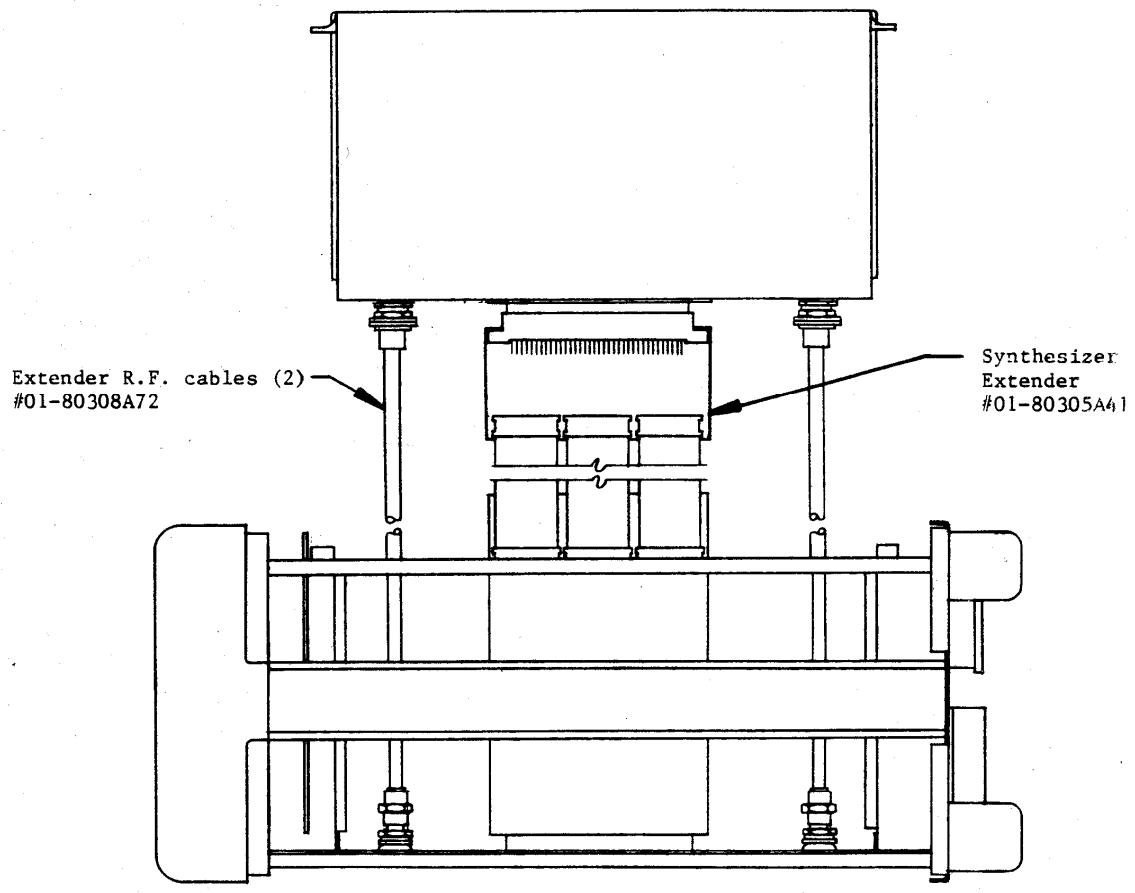


Figure 2. Serv

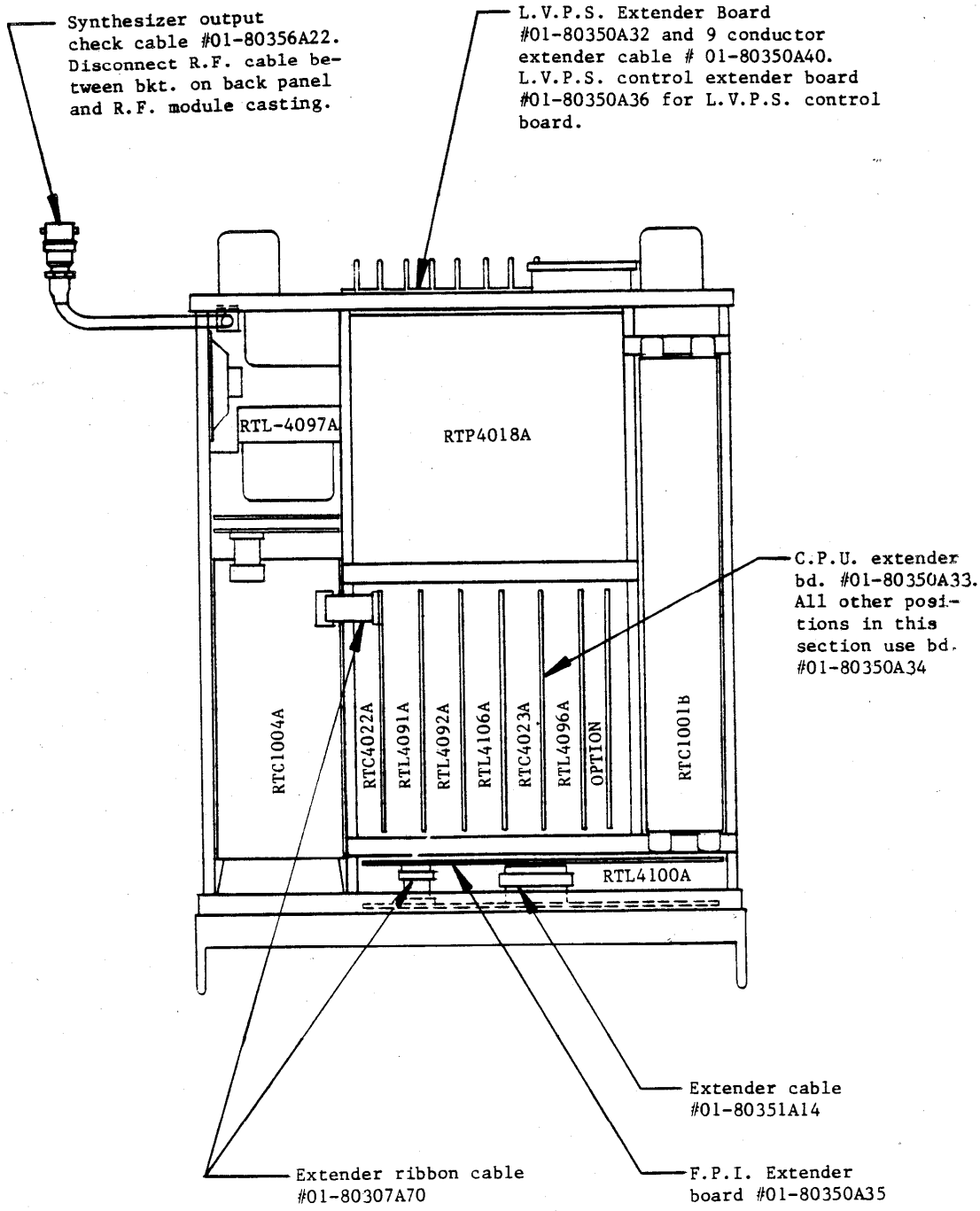


Figure 2. Service Kit RPX4239A

4. SERVICE KIT RPX4239A

An optional Service Kit RPX4239A is available which contains extender cards and cables for easier servicing. The service kit is described in Figure 2.

5. PREVENTIVE MAINTENANCE

5.1 CLEANING

The liquid crystal displays (LCDs) and oscilloscope graticule should be cleaned periodically using a damp, soft cloth with a mild detergent.

5.2 STORAGE AND OPERATING ENVIRONMENTS

The service monitor should be operated in an environment with an ambient temperature between 0 °C and +55 °C. The service monitor should be stored in an environment with an ambient temperature between −40 °C to +85 °C.

5.3 REFERENCE MODULE (TCXO/OCXO) OSCILLATOR CHECK

The reference oscillator in the reference module should be checked once a year as described in the Adjustment, Alignment, and Calibration Procedures instruction section (68P81065E08) in this manual.

5.4 RECALIBRATION

The service monitor should be recalibrated yearly to assure performance to specifications. The calibration procedure is included in the Adjustment, Alignment, and Calibration Procedures instruction section (68P81065E08) in this manual.

6. AC INPUT POWER MODULE ADJUSTMENT

The service monitor is set for 110-130 V ac operation at the factory. For operation from 100-110 V ac or 200-260 V ac, the voltage selection card must be readjusted before connection to the power source. This is accomplished by the following procedure.

Step 1. Remove the power cord from the rear panel connector.

Step 2. Slide the selector card cover door over the connector area exposing the selection card and fuse area.

Step 3. Pull outward on the fuse ejector tab and remove fuse.

Step 4. Remove the printed circuit board voltage selector card by pulling straight to the rear.

Step 5. Reinsert the card at the orientation which causes the appropriate voltage range (marked on card) to be displayed.

Step 6. Reinstall the fuse.

Step 7. Slide the cover plate back to the original position, connect power cord, and proceed with system operation.

7. REMOVAL OF SCOPE MODULE (RTC1004A)

Step 1. To gain access to the printed circuit boards and modules, turn off the power and remove the top cover. The service monitor should be unplugged for added safety.

Step 2. Using an Allen wrench, loosen the lock screws holding the INTENSITY and FOCUS knobs on the front panel and remove the knobs.

Step 3. Disconnect the 16-conductor ribbon cable from the scope amplifier board (RTC4022A).

Step 4. Loosen six screws holding the scope amplifier module to the chassis.

Step 5. Position the service monitor in the upright position and remove the six screws holding the module in place. Work the module backward until the FOCUS and INTENSITY shafts are behind the front panel, and the CRT face is behind the bezel which surrounds the front panel.

CAUTION

A spring and washer are on both the FOCUS and INTENSITY shafts. Care should be taken to avoid pointing the shafts below horizontal level so that the spring and washer do not slide off.

Step 6. Pull the module out a few inches, allowing enough room to reach inside, and disconnect the 4-pin connector from the scope high voltage power supply.

Step 7. Remove the module by pulling straight out until the entire CRT and shield are out. Tilt the rear of the module to prevent damaging the FOCUS and INTENSITY shafts.

8. TROUBLESHOOTING

Table 2 provides general system troubleshooting information.

Table 2. R-2200 Service Monitor System Troubleshooting Chart

Symptom	Probable Cause	Check
Variation of RF VERNIER control produces no change in the displayed rf level in HI GEN function.	Inadequate detected rf (dc level) at U207 input (RTL4093A).	• U203, U204, and/or U205 not functioning. • L217 and/or L218 are open. • CR217 not functioning.
Same as above except in GEN function.	Inadequate detected rf (dc level) at U207 input (RTL4093A).	• CR231 not functioning. • Broken lead on RF VERNIER control R320 (RTL4095A).
Little or no rf output in HI GEN function.	Open fuse in ANTENNA connector (J6).	• Replace fuse.
	Relay (K202) does not close (RTL4093A).	• Check relay coil (normally 300-400 ohms). • Check rf path.
	No 10 MHz reference (RTL4097A/98A).	• Check TCXO output. • Check all related hardline and connections.
	No injection from rf synthesizer (RTC1001B).	• Check rf synthesizer injection to rf module. • Check all related hardline and connections. • Check wideband amplifier (RTL4093A) and rf path.
Little or no rf output in GEN function.	Relay (K203) does not close (RTL4093A).	• Check relay coil (normally 300-400 ohms). • Check rf path.
	No 10 MHz reference (RTL4097A/98A).	• Check TCXO output. • Check all related hardline and connections.
	No injection from rf synthesizer (RTC1001B).	• Check rf synthesizer injection to rf module. • Check all related hardline and connections.
No reception in SENS MON function.	No 10 MHz reference (RTL4097A/98A).	• Check TCXO output. • Check all related hardline and connections.
	No injection from rf synthesizer (RTC1001B).	• Check rf synthesizer injection to rf module. • Check all related hardline and connection.
	No mixer injection to receiver board (RTL4091A).	• Check position of rotary STEP attenuator. • Check fuse in ANTENNA jack (J6). • Check coils of K201, 4 (RTL4093) (normally 300-400 ohms).
No HI GEN or GEN function modulation.	Modulation source not getting to rf synthesizer.	• Check MOD line on main interconnect board (RTL4099A). • Check 1 kHz or CODE SYNTHESIZER OUT or EXT MOD IN signals at front panel interface board (RTL4100A).
Unit fails to power up (ac operation).	Failure in power supply (RTP4018A).	• Check fuses. • Check output lines [voltages marked on main interconnect board (RTL4099A)] for short circuits to ground. • Check power supply.
Unit fails to power up (dc operation) (battery or external).	Failure in power supply (RTP4018A).	• Check fuses. • Check EXT DC/BATTERY switch for proper position. • Check output lines [voltages marked on main interconnect board (RTL4099A)] for short circuits to ground. • Check battery. • Check power supply.

Table 2. R-2200 Service Monitor System Troubleshooting Chart (Cont'd.)

Symptom	Probable Cause	Check
No scope trace. No spot on CRT.	No output from HV power supply (RTP4020A).	• Check for voltages; − 1200 V dc, + 140 V dc, 6.3 V ac (filament). **WARNING** The service monitor uses 1200 V high voltage in the scope module RTP4020A High Voltage Power Supply, RTP4019A High Voltage Board, and near the cathode ray tube (CRT). Handle with extreme care to avoid electrical shock.
	Bad CRT.	• Check for filament glow.
	No vertical or horizontal from scope amplifier.	• Check pin 1 with respect to pin 3 (RTC4022A) should be − 5 V variable with VERT/HORIZ POSITION controls.
Spot in center of CRT.	No drive from scope amplifier (RTC4022A).	• Check ribbon cable from scope amplifier to driver board.
No keyboard response tone and/or no 1 kHz.	10 MHz timebase not getting to rf synthesizer (RTC1001B).	• Check TCXO output (RTL4097A/98A). • Check all related hardline and connections. • Check rf synthesizer (RTC1001B). • Check for tone on FPI socket (RTL4100A) when key is depressed.
Counter does not work for PL signals.	No 10 MHz getting to counter module (RTL4106A).	• Check 10 MHz line to counter module. • Check counter module.
Unit turns on but displays are blank (PL COUNT LED on).	Power on reset signal stuck at low level.	• Check voltage at J1-9 on front panel interface board (RTL4100A), should be 7.00 V dc. Adjust R80 if necessary. • Check RTL4100A reset circuitry.
	LC BUSY signal is stuck at high level.	• Check RTL4100A. Edge connector pin 2 should be TTL low signal. • If high, disconnect display board (RTL4101A). If signal goes low — check display module.
	No 170 kHz clock to the display module.	• Check RTL4100A edge connector pin 4 for 340 kHz.
Unit turns on but all displays remain off (no response from front panel).	IRQ signal stuck low.	• Check RTL4106A edge connector pin 70 for high signal.
Over power on (unit in GEN and no rf input).	RF module disconnected.	• Seat 24-pin header securely into socket on rf interconnect board (RTL4095A). • Check output of comparator on rf I/O module (RTL4092A).
Any part of the non-volatile memory fails to retain information.	Discharged battery.	**WARNING** Lithium battery — do not mutilate or disassemble. Lithium metal is a very active metal that burns in the presence of water or high humidity. Do not put the battery in fire, attempt to charge or heat above 100 °C. Do not overdischarge the cell to a reverse voltage greater than 3 volts. The battery may burst and burn or release hazardous materials.

Table 2. R-2200 Service Monitor System Troubleshooting Chart (Cont'd.)

Symptom	Probable Cause	Check
		CAUTION Do not substitute another type lithium battery as a replacement. The battery was chosen with safety as a major consideration. Other lithium battery types may present a potential hazard when used in this system. **DISPOSAL** A. Do not dispose of the battery by placing in the everyday trash. Lithium batteries are classified as hazardous material and must be disposed of accordingly. B. Consult state and local codes for disposal procedure. C. Motorola will dispose of the battery for you if you send the battery in the shipping container and by the same method that the new battery came to you. Send to: Motorola, Inc. Return Goods Dept. 1313 E. Algonquin Rd. Schaumburg, IL 60196
		• Remove FPI (RTL4100A) from unit and place on non-conducting surface. • Measure the dc voltage across the lithium battery. If the voltage is less than 2.4 volts, the cell is discharged and should be replaced.
Code synthesizer output extremely distorted.	Tone synthesizer module (RTL4096A) D/A converter not working properly.	• Check related circuitry on tone synthesizer module (RTL4096A).
No code synthesizer modulation.		• Check for output from code synthesizer (RTL4096A) at edge connector pin 25. • Check for signal at FPI board (RTL4100A) edge connector pin 35.
No external modulation.		• Apply modulating signal to external modulation jack (EXT MOD IN). • Check for signal at FPI (RTL4100A) edge connector pin 36. • Check for signal at FPI (RTL4100A) edge connector pin 33 with the external level (EXT LVL) potentiometer fully clockwise.
Any keys on the front panel do not work.	Defective keyboard/connector.	• Ensure that the keyboard tail is securely plugged into the connector on the FPI (RTL4100A).
One or more positions on one or more switches on front panel do not operate.	Open path on switch scanning matrix.	• Check for defective switch. • Check for broken wire at switch or at connection near main interconnect board (RTL4099A).
Frequency error display reads 0.00 or 99.9 kHz with signal input and receiver unsquelched.	10.7 MHz PLL is misaligned.	• Follow counter module (RTL4106A) adjustment procedure to adjust 10.7 MHz PLL.
	Count enable signal is not being generated on the counter module (RTL4106A).	• Check counter module (RTL4106A) for count enable signal generation.
No audio output at speaker.		• Check audio feed signal at counter module (RTL4106A) edge connector pin 2. • Check audio amplifier (p/o RTL4097A/98A).
No SINAD, distortion or DVM measurements are displayed.	Signal not getting to analog interface board (RTL4092A).	• Check for signal at analog interface board (RTL4092A) edge connector pin 2. • Check analog interface board (RTL4092A).

ADJUSTMENT, ALIGNMENT, AND CALIBRATION PROCEDURES

1. INTRODUCTION

This section details procedures required to maintain the service monitor for optimum performance after replacing or repairing one of the modules or printed circuit boards. Specific adjustment, alignment, and calibration procedures are grouped under each individual subunit. A list of test equipment required to maintain the service monitor is included in paragraph 2 and the maintenance procedures are in paragraph 3.

2. TEST EQUIPMENT

The following is a list of test equipment that is required for proper maintenance and adjustment of the major assemblies of the R-2200 Service Monitor. Equivalent test equipment may be used if desired.

Assembly	Test Equipment Required
Plug-in Assemblies	Circuit Board Extender Kit RPX4239A
Scope Module RTC1004A	Tone Generator — Motorola R1100A Digital Multimeter (DMM) — Motorola R1024A
RF Module RTL1014A (less RF Wattmeter)	Digital Multimeter (DMM) — Motorola R1024A RF Signal Generator HP8640B — two required Spectrum Analyzer — HP8558B (with HP182T Display) Modulation Analyzer — HP8901A 0.1-1300 MHz, 48 dB gain amplifier — HP8447F
RF Wattmeter RTL4094A	Power Meter — HP436A with 25 W HP Power Sensor Directional Coupler — NARDA 3020A RF Millivoltmeter — S1339A 50-ohm BNC adapter for RF Millivoltmeter 450 MHz ± 5 MHz, 40 Watt RF power source with harmonic filter Digital Multimeter (DMM) — Motorola R1024A 3 dB, 50 Watt Attenuator — NARDA 765 6 dB, 20 Watt N-type Power Attenuator — NARDA 766 10 dB, 20 Watt Attenuator — NARDA 766 10 dB BNC Attenuator — NARDA 755 Miscellaneous assortment of cables and adapters (refer to test set-up diagram) (Figure 2)
Reference Module RTL4097A/RTL4098A	Frequency Counter (8 or more digits) Systron Donner 6243A Frequency Standard — 1 part in 10^9 or better — 1 MHz
Counter RTL4106A	Digital Multimeter (DMM) — Motorola R1024A Tone Generator — Motorola R1100A
Front Panel Interface RTL4100A	Digital Multimeter (DMM) — Motorola R1024A Audio Analyzer — HP8903A
Receiver RTL4091A	Digital Multimeter (DMM) — Motorola R1024A RF Signal Generator — Motorola R1201A 25-0-25 Microammeter Audio Analyzer — HP8903A
Low Voltage Power Supply RTP4018A	Oscilloscope — Motorola R1029A Digital Multimeter — Motorola R1024A
Analog Interface Board RTL4092A	Digital Multimeter (DMM) — Motorola R1024A RF Signal Generator — Motorola R1201A

3. ADJUSTMENT, ALIGNMENT, AND CALIBRATION PROCEDURES

3.1 SCOPE MODULE (RTC1004A) ADJUSTMENT PROCEDURE

Adjustments to the scope module circuit boards are made on one of three boards: scope amplifier (RTC4022A), scope driver (RTC4021A), and scope high voltage board (RTC4019A). Refer to the appropriate circuit board detail diagram for the location of specified potentiometers in the Scope Module (A03) section (68P81064E52) of this manual.

NOTE

Adjustments to the scope module ***must*** be made in the order indicated.

3.1.1 Scope High Voltage Board (R16 — Trace Rotation)

With no signal applied to VERT/SINAD/DIST/DVM IN jack and a trace displayed on the CRT, adjust R16 so that the trace is parallel with the horizontal graticule lines.

3.1.2 Scope High Voltage Board (R19 — Astigmatism)

With 1 kHz sine wave at 60 mV p-p (21.2 mV rms) applied to VERT/SINAD/DIST/DVM IN jack and VERT control set to .01 V/div., adjust R19 for the clearest trace.

NOTE

R9 located on the FPI (front panel interface) board ***must*** be adjusted before adjusting R63.

3.1.3 Scope Driver (R63 — Vertical Position)

With no input to VERT/SINAD/DIST/DVM IN jack, VERT control set to 10 V/div., and VERT control positioned at center of rotation, adjust R63 to vertically center the trace on the CRT.

3.1.4 Scope Driver (R70 — Vertical Gain Calibrate)

Apply a 1 kHz sine wave at 60 mV p-p (21.2 mV rms) to VERT/SINAD/DIST/DVM IN jack. Set VERT control at .01 V/div. and VERT vernier control to calibrate (CAL). Adjust R70 to obtain a trace that is 6 divisions peak-to-peak.

3.1.5 Scope Driver (R10 — Horizontal Position)

Adjust R10 to give the following: When the HORIZ POSITION control is fully clockwise, the *distance* from the start of the trace (to the rightmost vertical graticule line) is the same *distance* as the *distance* from the end of the trace (to the leftmost vertical graticule line) when the HORIZ POSITION control is fully counterclockwise.

3.1.6 Scope Amplifier (R7 — External Horizontal Position)

Apply a 1 kHz sine wave at 600 mV p-p (212 mV rms) to EXT HORIZ jack. Set the HORIZ switch to EXT. Adjust R7 fully counterclockwise. Set HORIZ POSITION control so that the trace starts at the second vertical graticule line (from left). Adjust R7 clockwise until the trace moves two divisions to the right.

3.1.7 Scope Amplifier (R40 — Horizontal Sweep Rate Calibrate and R11 Horizontal Gain)

Step 1. Adjust R11 fully counterclockwise. Set HORIZ to 1 mSec/div. Make sure HORIZ vernier is in CAL position (fully CW). Apply 1 kHz sine wave at 60 mV p-p (21.2 mV rms) to VERT/SINAD/DIST/DVM IN jack. Set VERT control to .01 V/div. — make sure VERT vernier is in CAL position. Adjust R40 for the display on CRT as shown in Figure 1A.

Step 2. Adjust R11 on scope driver board to expand the trace in Figure 1A to 1 peak-per-vertical division.

3.1.8 Scope Amplifier (R81 — Trigger Level Calibrate)

NOTE

The input signal, VERT, and HORIZ front panel adjustments are the same as for R40 and R11 in 3.1.7.

Adjust TRIG LEVEL control (front panel) to center of range. Center the trace vertically on the CRT using VERT POSITION control, if necessary. Adjust HORIZ POSITION on the front panel, if necessary, such that the start of trace is visible. Adjust R81 so that the beginning of the trace starts at and touches the center horizontal graticule (Figure 1B).

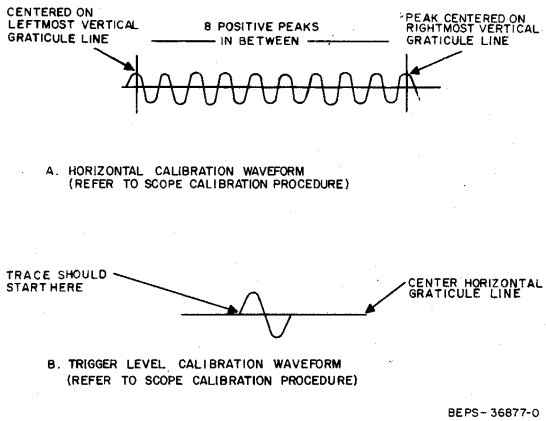


Figure 1. Scope Calibration Waveforms

3.1.9 Scope Amplifier (C3 — uSec Sweep Rate Calibration)

Apply 100 kHz sine wave at 60 mV p-p (21.2 mV rms) to VERT/SINAD/DIST/DVM IN jack. Set HORIZ control to 10 uSec/div. Ensure that HORIZ vernier is in the CAL position. Adjust C3 for 1 peak of the sine wave per vertical graticule line.

3.2 REFERENCE MODULE (RTL4097A/ RTL4098A) ADJUSTMENT PROCEDURE

Step 1. Connect external frequency standard to frequency counter external reference input. Set counter to EXT. REF.

Step 2. Connect service monitor antenna port to frequency counter input.

Step 3. Turn on service monitor and allow to warm up for 10 minutes (20 minutes for models with oven controlled crystal oscillator).

Step 4. Set service monitor frequency to 950.0000 MHz, FUNCTION switch to HI GEN, and adjust output level to 0 dBm.

Step 5. Using an appropriate non-metallic tuning tool, adjust the service monitor reference oscillator until the frequency counter reads 950.00000 MHz ±1 count (±10 Hz). Service monitor is now calibrated to better than 1/2 part in 10^7.

NOTE

If there is no reason to suspect that the receiver requires alignment, then proceed to the receiver adjustment procedure (paragraph 3.4).

3.3 RECEIVER BOARD (RTL4091A) ALIGNMENT PROCEDURE

3.3.1 Discriminator Alignment

Step 1. Remove phono plug from receiver input. Place receiver board on an extender card.

Step 2. Set service monitor for AM/FM/CW switch to FM, BW switch to WIDE, and FUNCTION switch to SENS MON.

Step 3. Connect a 25 uA-0-25 uA ammeter from TP1A to TP1B (refer to receiver schematic diagram and circuit board detail).

Step 4. Apply a 10.7000 MHz signal at a level of −30 dBm (7100 uV approximately) frequency modulated ±75 kHz with a 1000 Hz tone to the phono jack on the receiver board.

Step 5. Tune L8 for 0 uA on the meter. Disconnect meter. Reduce signal level to −47 dBm (1000 uV).

Step 6. Connect an audio distortion analyzer to the end of R19 closest to the edge connector.

Step 7. Adjust L8 for minimum distortion on the distortion analyzer. L8 should only require ±1/4 turn.

3.3.2 Narrowband Filter Alignment

Step 1. Set service monitor FUNCTION switch to SENS MON, AM/CW/FM switch to FM, and BW switch to NAR.

Step 2. Apply a 10.7 MHz signal at a level of −47 dBm (1000 uV) frequency modulated ±10 kHz with a 1000 Hz tone to the receiver board input jack.

Step 3. Connect an audio distortion analyzer to the end of R19 closest to the board edge connector.

Step 4. Adjust C82 for minimum distortion as read on the distortion analyzer.

Step 5. Adjust C44 for minimum distortion.

Step 6. Repeat Steps 4 and 5 until minimum distortion is obtained.

NOTE

Upon completion of alignment procedure, the receiver board adjustment (paragraph 3.4) ***must*** be made.

3.4 RECEIVER BOARD (RTL4091A) ADJUSTMENT PROCEDURE

3.4.1 AGC Set (R59)

NOTE

Prior to doing the receiver board adjustment, ensure that the receiver is aligned, if not, then the alignment ***must*** precede the adjustment.

Step 1. Program the receiver frequency for 11.0000 MHz.

Step 2. Set FUNCTION switch to SENS MON.

Step 3. Disconnect the antenna so there is no input to ANTENNA or RF IN/OUT jacks.

Step 4. Connect a DMM probe to pin 7 of U5. Adjust R59 for 2.00 V dc (±.05 V dc).

3.4.2 INV/$\overline{\text{INV}}$ Audio Level Balance (R104)

Step 1. Program the receiver frequency for 101.0000 MHz.

Step 2. Set service monitor FUNCTION switch to SENS MON, AM/CW/FM switch to FM, STEP (ATTEN) to 0 dB, BW switch to NAR, SQUELCH control to fully counterclockwise, IMAGE switch to HI, and VOLUME control at a comfortable level.

Step 3. Apply a 101.0000 MHz signal at a level of −67 dBm (100 V) frequency modulated ±3 kHz with a 1000 Hz tone to the ANTENNA jack input.

Step 4. Connect an audio voltmeter (DMM preferred) to DEMOD OUT jack and record level.

Step 5. Switch IMAGE switch to LO and note level. R104 should be adjusted so that the level in HI is the same as the level in LO.

3.4.3 AM Audio Set (R70)

Step 1. Disconnect phono plug from the receiver.

Step 2. Set service monitor FUNCTION switch to SENS MON, AM/CW/FM switch to AM, BW switch to NAR, and SQUELCH control fully counterclockwise.

Step 3. Apply a 10.7000 MHz signal at a level of −47 dBm (1000 uV) amplitude modulated 80% with a 1000 Hz tone to the phono jack on the receiver.

Step 4. Connect an ac voltmeter (DMM preferred) to the end of R19 closest to the board edge connector. Adjust R70 for 2.00 V rms (±.05 V rms).

3.4.4 WBFM Audio Set (R75)

Step 1. Set service monitor AM/CW/FM switch to FM, FUNCTION switch to SENS MON, BW switch to WIDE, and SQUELCH control fully counterclockwise. Remove phono plug from the receiver board.

Step 2. Apply a 10.7 MHz signal at a level of −47 dBm (1000 uV) frequency modulated ±75.0 kHz with a 1000 Hz tone to the phono jack on the receiver board.

Step 3. Connect an ac voltmeter (DMM preferred) to the end of R19 closest to the board edge connector.

Step 4. Adjust R75 for 2.121 V rms (±10 mV rms).

3.4.5 NBFM Audio Set (R77)

Step 1. Set service monitor AM/CW/FM switch to FM, FUNCTION switch to SENS MON, BW switch to NAR, and SQUELCH control fully counterclockwise. Remove phono plug from receiver board.

Step 2. Apply a 10.7 MHz signal at a level of −47 dBm (1000 uV) frequency modulated ±5.0 kHz with a 1000 Hz tone to the phono jack on the receiver board.

Step 3. Connect an ac voltmeter to the end of R19 closest to the board edge connector. Adjust R77 for 354 mV rms (±4 mV rms).

3.4.6 10.7 MHz Output Level Enable (R103)

Step 1. Set service monitor AM/CW/FM switch to FM, and FUNCTION switch to SENS MON.

Step 2. Program receiver frequency for 11.0000 MHz.

Step 3. Connect dc voltmeter (DMM preferred) to pin 6 of U16. Adjust R103 for 0.90 V dc (±.05 V dc).

3.5 LOW VOLTAGE POWER SUPPLY (RTP4018A) ADJUSTMENT PROCEDURE

3.5.1 Setup Procedure

NOTE

With service monitor off, remove power supply and reinstall using an extender card and cable.

Step 1. Preset R53 and R62 fully clockwise, R61 fully counterclockwise, and R60 to midposition.

Step 2. Turn service monitor to STBY.

3.5.2 Oscillator Frequency Adjustment

Step 1. Adjust R57 for a triangular wave with a period of 7.7 uSec (±0.2 uSec) at pin 3 of U4 as viewed on an oscilloscope (refer to schematic diagram and circuit board detail in Low Voltage Power Supply (A02) section (68P81064E51) of this manual).

Step 2. Set service monitor to OFF, then back to STBY.

3.5.3 Overvoltage Adjustment

Step 1. Adjust R60 to 5.6 V at pin 8 or pin 10 of the edge connector. Note R60 position.

Step 2. Adjust R62 until the voltage at pin 8 or pin 10 is 0 V and the supply is shut off.

Step 3. Adjust R60 to midposition.

Step 4. Switch service monitor to OFF, then back to STBY.

3.5.4 Undervoltage Adjustment

Step 1. Adjust R60 to give 4.6 V dc at pin 8 or pin 10. Note R60 position.

Step 2. Adjust R61 until the voltage goes over 0 V dc.

3.5.5 Output Voltage Adjustment

Step 1. Adjust R60 midway between the positions noted in Step 1 of the Overvoltage Adjustment and Step 1 of the Undervoltage Adjustment.

Step 2. Switch service monitor to OFF, then back to STBY.

Step 3. Adjust R60 to 5.1 V dc (±20 mV) at pin 8 or pin 10.

3.5.6 Float Voltage Adjustment

NOTE

Perform this adjustment ***only*** if the optional battery is installed.

Step 1. Turn service monitor to OFF.

Step 2. Remove top cover of service monitor. Disconnect the red lead from battery.

Step 3. Turn service monitor to ON.

Step 4. Adjust R30 for 13.8 V dc (±100 mV) measured at the red lead.

Step 5. Turn service monitor to OFF. Reconnect the battery lead and replace cover.

3.6 ANALOG INTERFACE BOARD (RTL4092A) ADJUSTMENT PROCEDURE

Switch service monitor to OFF. Remove top cover. Place analog interface board on extender card. Switch service monitor to ON.

3.6.1 U2 Null (R12)

Step 1. Set service monitor for DVM, DC volts.

Step 2. Measure voltage at U2-pin 6 (card edge pin 1 as ground) with a dc voltmeter. With no input to VERT/SINAD/DIST/DVM IN jack, adjust R12 for 0 V dc (±0.6 mV).

3.6.2 U7 Null (R8)

Adjust R8 for .000 on display.

3.6.3 AC Accuracy

Step 1. Adjust R24 to midposition and select DVM, AC volts.

Step 2. Apply a 10 mV rms ac (±0.5 mV) signal at a frequency of 1 kHz to VERT/SINAD/DIST/DVM IN jack. Adjust R30 for .010 on display.

Step 3. Apply a .997 V rms (±1 mV) 1 kHz signal to VERT/SINAD/DIST/DVM IN jack. Adjust R24 for .997 on display.

3.6.4 AC Attenuation Compensation

Step 1. Apply a 5.55 V rms (±50 mV) signal at a frequency of 10 kHz to VERT/SINAD/DIST/DVM IN jack. Adjust C2 so display reads 5.55.

Step 2. Switch service monitor to OFF. Insert board without an extender card.

Step 3. Switch service monitor to ON. Note reading on display. If reading is higher than 5.55, determine the difference. C2 must be adjusted ***on extender card*** to (5.55 minus the difference).

Step 4. If the reading in Step 3 is lower than 5.5, determine the difference. C2 must be adjusted ***on extender card*** to (5.55 plus the difference).

3.6.5 1 kHz Notch Adjustment

Step 1. Set service monitor for DMV, AC volts. Apply a 0.900 V rms (±50 mV) signal at a frequency of 1001 Hz (±0.25 Hz) to VERT/SINAD/DIST/DVM IN jack.

Step 2. Using an ac voltmeter at U3 pin 1, adjust R101 for a minimum on voltmeter.

Step 3. Change generator frequency to 999 Hz (±0.25 Hz).

Step 4. Using an ac voltmeter at U3 pin 14, adjust R119 for a minimum on voltmeter.

3.6.6 Peak Detector Adjustment

NOTE

Before proceeding with the following procedure, ensure that the receiver adjustment and alignment have been performed.

Step 1. Set service monitor AM/CW/FM switch to FM, FUNCTION switch to SENS MON, BW switch to NAR, and SQUELCH control fully counterclockwise, DEV/%AM, and STEP attenuator to 0 dB. Program for 11.0000 MHz.

Step 2. Apply a 11.0000 MHz signal at a level of −47 dBm (1000 uV) frequency.

Step 3. Select +DEV. Adjust R55 for 5.0 on display.

Step 4. Select −DEV. Adjust R62 for −5.0 on display.

3.7 COUNTER BOARD (RTL4106A) ADJUSTMENT PROCEDURE

3.7.1 A/D Converter Adjustment

Step 1. Switch service monitor to OFF. Place counter board on extender card. Switch service monitor to ON. Connect a dc voltmeter to reference integrated circuit U27. Adjust R40 for 2.490 V dc (± .01 V) on voltmeter.

NOTE

The rest of the counter board adjustment ***must*** be preceded by the analog interface adjustment (paragraph 3.6).

Step 2. Set service monitor for DVM, DC volts.

Step 3. Apply 10 mV dc (±0.5 mV) to VERT/SINAD/DIST/DVM IN jack.

Step 4. Adjust R17 until display reads .010.

Step 5. Apply 990 mV dc (±0.5 mV) to VERT/SINAD/DIST/DVM IN jack.

Step 6. Adjust R21 until the display reads .990. Repeat Steps 3 through 6 until no further adjustment of R17 and R21 is required.

3.7.2 AM Adjustment

Step 1. Set service monitor FUNCTION switch for HI GEN, AM/CW/FM switch to CW, and all modulation sources off. Program for 10.0000 MHz. Connect an oscilloscope to ANTENNA jack (greater than 10 MHz bandwidth).

Step 2. Adjust RF VERNIER control and STEP attenuator for 1 V p-p on oscilloscope.

Step 3. Set AM/CW/FM switch to AM. Adjust R42 for 0.5 V p-p on oscilloscope.

3.7.3 PLL Adjustment

Step 1. Remove receiver board. Unsolder and lift one end of C65 on receiver board and reinsert receiver board. Set SQUELCH control fully CCW.

Step 2. Adjust R102 until FREQuency ERRor display reads 0 ± 10 kHz. Reconnect receiver capacitor.

3.8 FRONT PANEL INTERFACE (RTL4100A) ADJUSTMENT PROCEDURE

3.8.1 V_{ref} Adjustment

Step 1. Turn service monitor to OFF. Place front panel interface (FPI) board on an extender card. Switch service monitor to ON.

Step 2. Adjust R80 until the voltage at J1 pin 9 is +7.00 V dc (± .01 V).

3.8.2 Internal Source Offset Adjustment

Step 1. Set scope SOURCE switch to MOD, and FUNCTION switch to SENS MON.

Step 2. Ground U18, pin 14. Adjust R66 until the voltage at U19, pin 6 is 0 V (± 1 mV). Remove ground from U18, pin 14.

3.8.3 DC Balance Adjustment

Turn service monitor to OFF. Place scope amplifier board on extender card. Switch service monitor to ON. Use dc voltmeter and measure U14-1 on scope amplifier board. Adjust R9 on the FPI until the voltage at U14-8 on the scope amplifier board equals that measured at U14-1 on the scope amplifier board.

3.8.4 Scope Attenuator Compensation

Step 1. Set service monitor SOURCE switch to EXT VERT AC, and HORIZ switch to 100 mV/div.

Step 2. Apply a 1 kHz square wave at a level of 0.6 V p-p to VERT/SINAD/DIST/DVM IN jack.

Step 3. Adjust C76 for best square wave on CRT.

3.8.5 Scope Input Compensation

Step 1. Using a ×10 oscilloscope probe connected to VERT/SINAD/DIST/DVM IN jack, connect probe to the output of a function generator at approximately 100 kHz and 0.2 V rms.

Step 2. Set service monitor to DVM, AC volts and set SOURCE switch to EXT VERT AC.

Step 3. Adjust generator output until display reads .200 (± 1 mV).

Step 4. Change SOURCE switch to MOD. Adjust C66 until DVM returns to 0.200 (± 1 mV).

3.9 WIDEBAND AMPLIFIER BOARD (RTL4093A) ADJUSTMENT PROCEDURE

3.9.1 High and Lo Generator Calibration

Step 1. Set Offset (R276) and Gain (R252) potentiometers on the wideband amplifier board to midposition.

Step 2. Connect an rf signal generator to J4 (rf synthesizer injection input port). Adjust generator output for a frequency of 500 MHz at a −10 dBm (approximately 70.7 mV) level.

Step 3. Disconnect the hardline coaxial cable from J3 (generator output port).

NOTE

Ensure that adequate attenuation is in line with the spectrum analyzer in order to avoid overload and prevent spurious signals from being generated before proceeding with the next step.

Step 4. Connect the spectrum analyzer to J3. (The maximum output of J3 is +13 dBm (1 V). Adjust the spectrum analyzer to view 0-1000 MHz full scale horizontal and 0 dBm (224 mV) full scale vertical.

Step 5. Set service monitor FUNCTION switch to GEN and AM/CW/FM switch to CW. Adjust RF VERNIER control for an rf output level of −34 dBm (±0.5 dB) (4.46 mV ±0.25 mV).

Step 6. Connect DMM (dc) to CAR & MOD LEVEL OUT (J200-15). Adjust the Gain potentiometer (R252) for 4.75 V dc (±.01 V dc) on the DMM.

Step 7. Repeat the RF VERNIER adjustment (Step 5) and Gain potentiometer (R252) adjustment (Step 6) until the correct rf output level (−34 dBm ± 0.5 dB) and dc voltage (4.75 V dc ±.01 V) are obtained.

NOTE

The amplitude modulation calibration must be performed after the High and Lo generator calibration.

3.9.2 Amplitude Modulation Calibration

Step 1. Connect the rf signal generator to J4 (rf synthesizer injection input port).

Step 2. Disconnect the hardline coaxial cable from J3 (generator output port).

Step 3. Connect the spectrum analyzer to J3.

Step 4. Set service monitor FUNCTION switch for GEN, IMAGE switch to HI, AM/CW/FM switch to CW, and connect DMM to CAR & MOD LEVEL OUT (J200-15). Adjust RF VERNIER control for an rf output level of −45 dBm (±0.5 dB). (1.26 mV ±.08 mV).

Step 5. Set AM/CW/FM switch to AM (without modulation). Adjust R42 (AM adjust) on counter board for −49 dBm (±0.5 dB) (793 uV ±44 uV) on spectrum analyzer.

Step 6. Adjust the RF VERNIER control for 0.590 V dc (±.005 V) on DMM (J220-15).

Step 7. Remove the spectrum analyzer from J3 (generator output port). Connect the 0.1-1300 MHz, 48 dB gain amplifier and modulation analyzer to J3 (generator output port).

Step 8. Connect an ac voltmeter to J200-15 CAR & MOD LEVEL OUT. Turn on the 1 kHz modulation source and adjust for 0.137 V rms (±.005 V) on the ac voltmeter.

Step 9. Adjust the Offset potentiometer (R276) for 50 ±2% AM on the modulation analyzer.

Step 10. Repeat the adjustments in Step 8 and Step 9 until the correct audio output level 0.137 V rms ±.005 V) and 50 ±2% modulation are obtained.

Step 11. Remove the 0.1-1300 MHz 48 dB gain amplifier and modulation analyzer from J3 (generator output port).

Step 12. Connect the hardline coaxial cable to J3.

3.9.3 Sensitive Monitor (Receive) 10.7 MHz I-F Alignment and Sensitivity Tests

Step 1. Remove hardline coaxial cable from J3 and coaxial cable from J4. Connect the first rf signal generator to J4 (rf synthesizer injection input port). Inject a −10 dBm, 110.7 MHz signal into this port.

Step 2. Connect the second rf signal generator to J6 (rf input port). Inject a −20 dBm (22.4 mV), 100 MHz signal into this port.

Step 3. Remove coaxial cable from J5. Connect the spectrum analyzer to J5 (10.7 MHz i-f).

Step 4. Set service monitor FUNCTION switch to SENS MON, and STEP attenuator to 0 dB.

Step 5. Alternately adjust the i-f amplifier coil (L212) and capacitor (C232) for maximum output at 10.7 MHz as viewed on the spectrum analyzer. After peaking both the coil and capacitor, the 10.7 MHz i-f output level must be 0 dBm (±2 dB) (223 mV ±58 mV).

3.10 WATTMETER (RTL4094A) CALIBRATION PROCEDURE

The wattmeter must be re-calibrated whenever any components are replaced or adjustments are made to the module. It is not practical to program a new PROM using field equipment. Therefore, calibration at the time of manufacture is likely to be invalid when components are changed. The complete module must be returned to a factory service center for certified calibration.

NOTE

The following alignment procedure assumes that calibrated laboratory standards are used to produce a known, accurate rf power source at the specified frequency and power levels.

3.10.1 Calibration Procedure

Step 1. Connect test equipment and service monitor as shown in Figure 2. Leave the rf module installed in the service monitor.

Step 2. Use the sample calibration chart provided below to prepare a calibration guide for the rf millivoltmeter at various power levels.

Sample Calibration Chart

Data Point	True Power	Equiv. Voltage
P20		
P5		
P2		
P0.5		

Step 3. Connect the HP436A 25 watt power meter directly (no coaxial cable) to the output of the directional coupler.

Step 4. With points A-B connected directly together, turn on the rf power source and record the true power reading on the HP436A meter and the equivalent rf voltage on the rf millivoltmeter as data point P20.

NOTE

Do not key the power source longer than necessary to minimize overheating the power attenuators. Excessive heat can change attenuator accuracy.

Step 5. Connect the NARDA 755 6 dB attenuator to points A-B. Turn on the rf power source and record true power and equivalent power for data point P5.

Step 6. Connect the NARDA 766 10 dB attenuator to points A-B and repeat the power readings for data point P2.

Step 7. Connect both the 10 dB and 6 dB attenuators in series as shown in Figure 2 and record the power readings for data point P0.5.

NOTE

This procedure produces an indication of true forward power into an unknown load, independent of the VSWR of the load or how the load may affect the ability of the rf power source to produce a required power.

Step 8. Plot the data in the sample calibration chart using 2-cycle, semilog graph paper such as shown in Figure 3. The voltage is plotted along the vertical scale and the true power along the horizontal scale. Draw a smooth curve through these points.

Step 9. Connect the 6 dB attenuator between points A-B, and connect the output of the directional coupler directly to the RF IN/OUT jack.

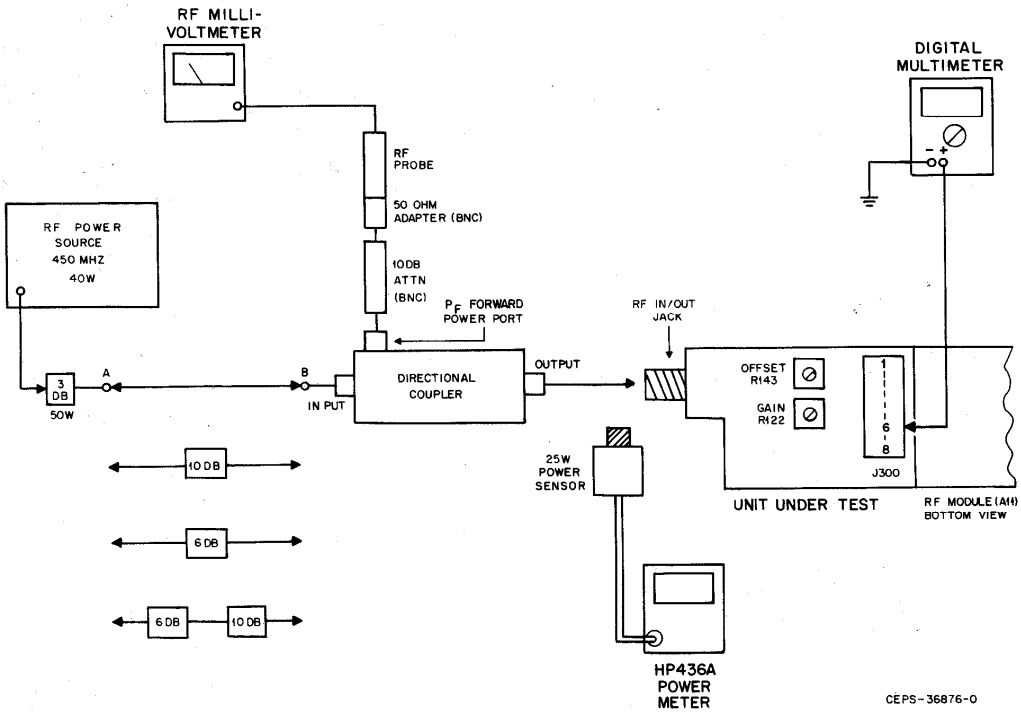


Figure 2. Wattmeter Calibration Test Set-up

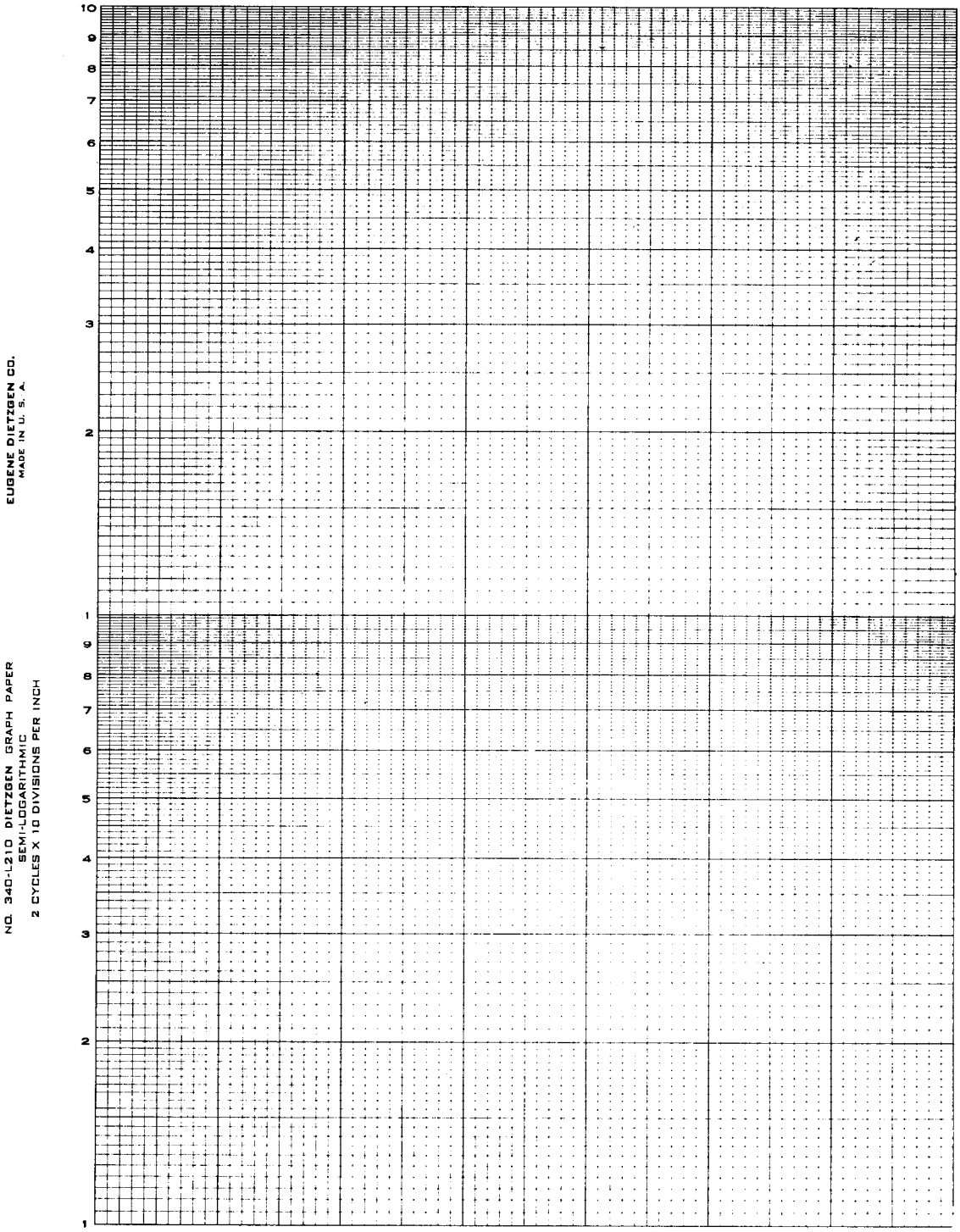


Figure 3.
2-Cycle Semilog Graph Paper for Calibration Chart

Step 10. With the rf power source fully off, turn on the service monitor. Set the FUNCTION switch to PWR MON. Enter the actual test frequency of the rf power source at the front panel keyboard.

Step 11. Turn Offset potentiometer R143 to the mid-point and then clockwise until the LCD displays 0.01 watts. Turn R143 counterclockwise just until 0.00 is displayed. Use the DVM to measure the voltage at J300-6. This should be +0.47 ±0.1 V dc.

Step 12. Turn on the rf power source and observe the equivalent rf voltage reading on the millivoltmeter. Locate this voltage on the graph to determine the true power output.

Step 13. Adjust the rf power source (if adjustable) until the true power is 5.0 watts (±0.05 watts). The voltage at J300-6 should be +1.5 V dc (±0.05 V dc).

Step 14. Adjust the Gain control (R122) until the true power is displayed on the LCD.

Step 15. Repeat Steps 9 through 14 until the true power is refined and further adjustments are not necessary.

Step 16. Connect the 10 dB and 6 dB attenuator in series as shown in Figure 2.

Step 17. Key the rf power source and observe the rf equivalent voltage on the millivoltmeter. Using the graph, determine the true power (P0.5) and compare it to the power displayed. The power displayed should be within 10% of the graphed true power.

Step 18. If the true power is not within 10%, adjust the Gain potentiometer (R122) to increase or decrease the displayed power accordingly. Recheck the (P5) measurement.

Step 19. Connect the 10 dB attenuator as shown in Figure 2 and measure the true power and equivalent voltage recorded in P2. Refine the R122 adjustment if necessary.

Step 20. Remove the attenuators and connect points A-B directly together. Measure the true power and equivalent voltage and verify it is the same as that recorded earlier at P20.

NOTE

Minor adjustment of R122 and R143 may be required to obtain the ten percent accuracy at each power level.

IMPORTANT

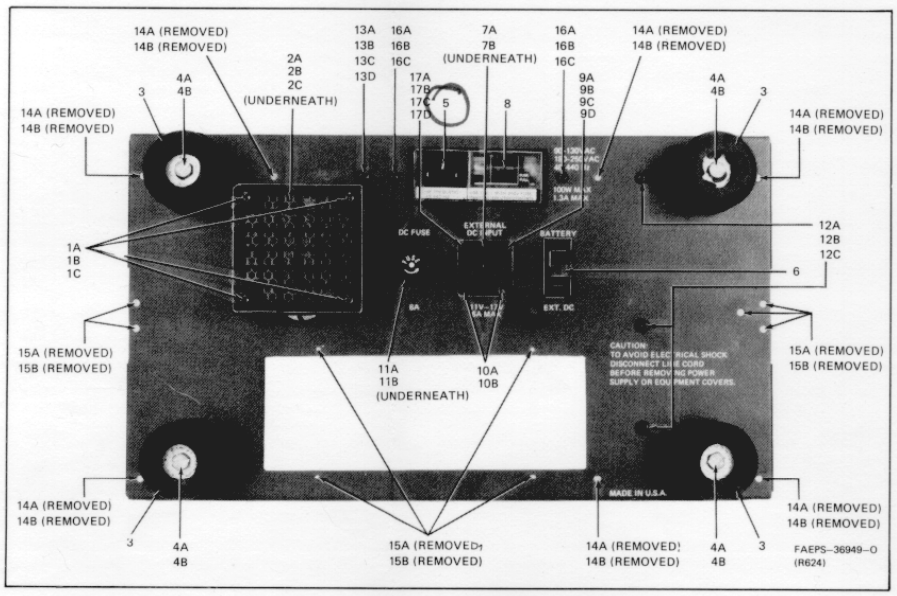
As a final caution, it should be noted that this calibration procedure does not constitute a traceable accuracy to any standard. Therefore, power measurements of transmitters cannot be certified to the user or operator of such transmitters.

parts list

Rear Panel (A01) Mechanical Parts List — PL-8589-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1A	3-80312B02	SCREW: 4-40 × 1-1/8", Phillips pan; 4 used
1B	4-140208	WASHER, lock: 4 med. split; 4 used
1C	43-80390A34	SPACER; 4 used
2A	13-80390A35	GRILLE
2B	35-80397A71	SCREEN
2C	1-80351A17	FAN ASSEMBLY
3	75-80378A91	FOOT; 4 used
4A	3-490642	SCREW: 10-32 × 1-1/2" slot hex; 4 used
4B	2-115123	NUT: 10-32 lock; 4 used
4C	28-80390A05	POWER MODULE
6	40-80390A50	SWITCH; rocker (S13)
7A	15-10811A07	CONNECTOR
7B	38-80395A08	CAPACITOR
8	65-42092	FUSE: 2 amp; 250 V (F1)
9A	3-138810	SCREW: 4-40 × 5/8" Phillips
9B	4-140208	WASHER, lock: #4 med. split
9C	2-131435	NUT; 4-40 hex lock
9D	42-82143C01	CLAMP
10A	3-80395A09	SCREW: 4-40 × 3/8" Phillips pan; 2 used
10B	4-140208	WASHER, lock: #4 med. split; 2 used
11A	9-82083C02	FUSE RECEPTACLE
11B	65-80397A22	FUSE: 8 amp; 32 V (F2)
12A	3-80335A97	SCREW: 6-32 × 5/16" Phillips pan; 3 used
12B	4-140209	WASHER, lock: #6 split; 3 used
12C	2-132616	NUT: #6-32 hex lock; 3 used
13A	3-80335A97	SCREW: 6-32 × 5/16" Phillips pan
13B	4-140209	WASHER, lock: #6 split
13C	29-5248	LUG
13D	2-132616	NUT, 6-32 hex lock
14A	3-80335A97	SCREW: 6-32 × 5/16" Phillips pan; 6 used
14B	4-140209	WASHER, lock: #6 split; 6 used
15A	3-140207	SCREW: 4-40 × 5/16" Phillips pan; 9 used
15B	4-140208	WASHER, lock: #4 split; 9 used
16A	3-80395A09	SCREW: 4-40 × 3/8" Phillips pan; 2 used
16B	4-140208	WASHER, lock: #4 split; 2 used
16C	2-131435	NUT, 4-40 hex lock; 2 used
17A	3-80395A09	SCREW: 4-40 × 3/8" Phillips pan
17B	4-140208	WASHER, lock: #4 split
17C	29-5248	LUG
17D	2-131435	NUT, 4-40 hex lock

5 → 28-80390A05
AC Socket


14A (REMOVED)
14B (REMOVED)
2A
2B
2C
(UNDERNEATH)
13A
13B
13C
13D
16A
16B
16C
17A
17B
17C
17D
7A
7B
(UNDERNEATH)
16A
16B
16C
9A
9B
9C
9D
14A (REMOVED)
14B (REMOVED)
4A
4B
3
5
8
14A (REMOVED)
14B (REMOVED)
4A
4B
3
14A (REMOVED)
14B (REMOVED)
1A
1B
1C
DC FUSE
EXTERNAL DC INPUT
BATTERY
12A
12B
12C
6
8A
11V–17V 6A MAX
EXT. DC
15A (REMOVED)
15B (REMOVED)
CAUTION:
TO AVOID ELECTRICAL SHOCK
DISCONNECT LINE CORD
BEFORE REMOVING POWER
SUPPLY OR EQUIPMENT COVERS.
15A (REMOVED)
15B (REMOVED)
11A
11B
(UNDERNEATH)
10A
10B
MADE IN U.S.A.
14A (REMOVED)
14B (REMOVED)
3
4A
4B
15A (REMOVED)
15B (REMOVED)
14A (REMOVED)
14B (REMOVED)
4A
4B
3
14A (REMOVED)
14B (REMOVED)
FAEPS–36949–O
(R624)

REAR PANEL (A01)

FUNCTION

The rear panel contains the ac power module, ac line filter, auxiliary power transformer, system cooling fan, EXT DC/BATTERY switch, and the dc fuse. The ac power module is the main ac fuse holder and is also used to set the line operating voltage. The ac line switch is a small printed circuit card located behind a clear protective panel. The position in which the card is inserted determines the line voltage, either 110 volts or 220 volts. A detailed procedure for setting the line voltage is given in the System Maintenance and Troubleshooting instruction section (68P81064E48) in this manual. From the ac line switch, ac power is routed through the ac line filter to the auxiliary power transformer. The EXT DC/BATTERY switch selects either the internal battery (optionally supplied) or an external dc source which are both routed through the dc fuse.

LOW VOLTAGE POWER SUPPLY (A02)

MODEL RTP4018A

1. DESCRIPTION

1.1 The low voltage power supply (LVPS) provides all of the dc voltages necessary to power the service monitor. The unit operates with an input of 90-130 or 180-260 V ac, 50-60 Hz, or 11-17 V dc. An internal battery pack allows the unit to be used without external voltages.

1.2 When the unit is plugged into the ac line, operation is automatically switched to the ac voltage. A battery charger is included on the power supply board. A standby mode allows the removal of power from the other modules in the service monitor except for the OCXO/TCXO and the battery charger.

2. THEORY OF OPERATION

2.1 When operating from ac line voltage, low voltage ac from T3 is applied across pins 2 and 8 of the 9-pin connector, rectified by bridge rectifier CR45 and filter C18. This voltage is sensed by Q16 which turns off the dc latch and energizes K2. When K2 opens, the dc path is interrupted and high voltage dc is sent to the ac switching transistors. This also turns on Q14 and energizes K1. K1 completes the path for the high voltage dc circuit.

2.2 The voltage on C18 is also connected to Q17, the 12-volt regulator. U3B compares a reference voltage developed by VR6 and R110 with a portion of the output, and controls the base voltage to Q17 to maintain 12 volts at the collector of Q17. Transistor Q19 is connected through R43 to the ON/OFF switch. The power supply is turned off by turning off the 12 volt regulator. If the external ac voltage is too high, VR7 conducts and turns on Q19. This then turns off the power supply.

2.3 When 220 V ac is used to power the service monitor, pins 4 and 7 of the 9-pin connector supply the voltage to bridge rectifier CR44. Filtering by C1 and C2 provides high voltage dc. If the power supply is operated from 110 V ac, the power is applied to pins 1 and 4; and CR44, C1, and C2 act as a voltage doubler. Selection of either 110 or 220 V ac is done on the back panel. VR10 and VR11 protect against voltage surges. R1 and R2 are bleeder resistors.

2.4 The bases of Q5 and Q6 are driven alternately by rectangular pulses of 65 kHz from U4. The width of these pulses are varied to provide regulation. This waveform is coupled by transformer T1 to drive high voltage switching transistors Q1 and Q2. The transistors drive current first into and then out of the high voltage primary DM pins 5 and 6 of the switching transformer. It is important that there is dead time when both Q1 and Q2 are off or there will be a short circuit across the high voltage circuit. The RC circuit of R5 and C7 is a snubber circuit to damp out oscillations when both Q1 and Q2 are off. C3 is used to eliminate any dc component of voltage through T2 which would tend to cause T2 to saturate.

2.5 The output of the secondary windings of the switching transformer are full wave rectified and filtered by LC filters. The 12-volt output (via CR23) provides drive current as soon as the 12-volt output is greater than the regulated 12-volts which supplies a drive circuit power through CR22. The +5-volt output is fed back to three potentiometers that control overvoltage and undervoltage protection and the 5-volt adjustment. The voltage at R60 is sensed by U3A and compared with a reference voltage (about 2.3 volts) from U4-10. R54, R55, C31, C32, and C33 form a compensation network to provide stability and high gain.

2.6 The error signal from U3A-1 is connected to U4-4, and controls the width of the pulses at U3A-12 and U3A-13. R57 and C26 control the switching frequency. R62 is adjusted to provide overvoltage protection. When the voltage at U4-7 rises above the reference voltage on U4-10, the power supply is shut down. R61 adjusts the undervoltage protection. When the voltage at U4-6 drops below the reference voltage the supply is shutdown. Overcurrent, 5-volt overvoltage or undervoltage fault detection causes the supply to shut down and latch off.

2.7 Because the LVPS cannot instantly provide 5 volts at the output, Q20 turns on initially for about one second until the output has time to come up to full power. Thus, there is a voltage at pin 6 and the under-voltage protection is bypassed during turn on.

2.8 Capacitor C27 is charged by a source internal to U4 and provides a soft-start. This allows the power supply to start up slowly over about one-half second to avoid large initial current surges.

2.9 DC power is supplied to U4 through Q25 to pin 11. Q25 and Q26 form a switch that is controlled by the ON/OFF switch. When the unit is in standby, relay K3 is open. Turning the service monitor on turns on Q21 which in turn pulls the base of Q26 low. This turns Q25 off which turns off the supply. The output filter capacitors discharge through the bleeder resistors. C36 begins charging through R66, and after about 2 seconds, Q22 turns on and K3 is closed. This turns off Q21. This action permits the power supply to turn on again under soft-start control. Closing K3 with the supply off avoids large surge currents through K3 contacts as the supply tries to instantly charge up all the discharged bypass capacitors on the other modules.

2.10 VR7 and Q19 shut down the power supply if the ac line voltage is higher than 132 volts at turn on, or if the voltage rises to 140 volts after being turned on.

2.11 R33, R34, and C7 insure that the ac input drivers and the dc input drivers cannot be on at the same time. If the service monitor is operating from a dc source and is then plugged into an ac line without the unit being turned off, the service monitor shuts down. To resume operation, the service monitor must be turned off and then back on in order to reset the protective circuits. The same procedure applies when going from ac to dc.

2.12 When operating from external dc or internal battery, relays K1 and K2 are in the normal position with the high voltage circuit open. Transistors Q3 and Q4 are operated as a push-pull circuit to drive the low voltage primary of the switching transformer.

2.13 Output and feedback circuits are the same as in ac operation. The power to the 12-volt regulator is now supplied through CR25 from the dc latch circuit. This circuit is started when Q9 is turned on momentarily as C13 charges through the ON/OFF switch. Q8 is turned on and Q7 saturates, turning on the latch. As long as the input voltage is above about 11 volts, VR3 conducts and the latch is kept on. If the voltage drops below this, VR3 stops conducting and the latch is turned off removing all current drain from the battery. If the input rises above 18 volts, VR4 conducts and Q10 turns on. This shuts down the latch to protect the supply.

2.14 Transistors Q23 and Q24 provide gate drive to power FET's Q3 and Q4. The resistors and diodes on the gates provide shaped drive to minimize ringing. VR1 and VR2 are there to insure that the drain-source breakdown voltage is never exceeded. L1, C9, and C10 filter the large current pulses on pin 2 of T2 from the battery input or external dc input lines.

2.15 The battery charger is a temperature compensated dual rate current limited charger. The charger operates whenever the unit is in ac operation, either ON or in STBY. Pin 4 of U1 provides a reference voltage of 7.2 V $\pm$0.2 volts that is divided by R16, R17, R30, and CR11, and is amplified by U2 to provide a temperature compensated reference voltage to U1.

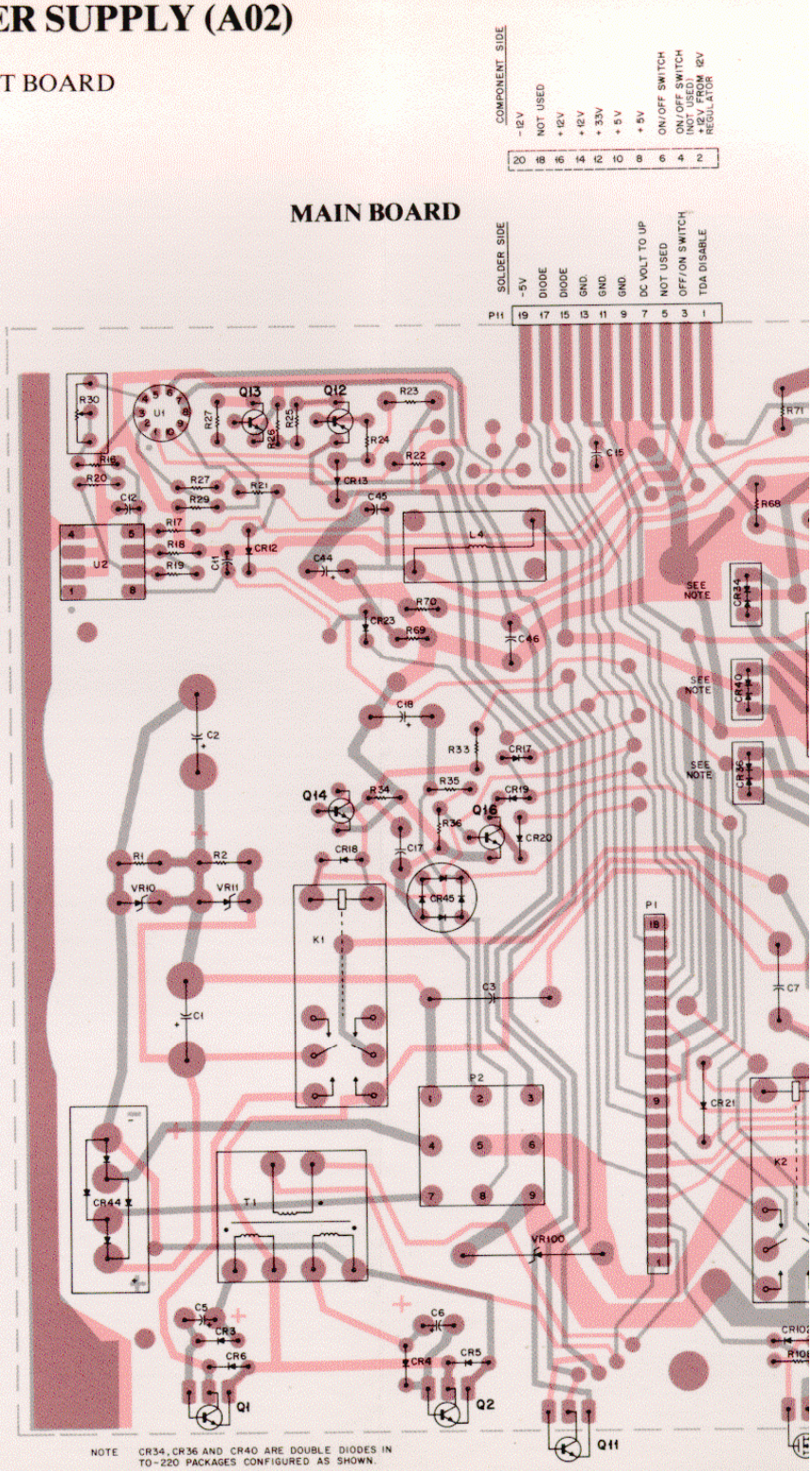
2.16 Diode CR11 has temperature characteristics that track those of the battery. R30 is used to set the battery charge voltage to 13.7 $\pm$50 mV with the battery disconnected from the charger. U1 and Q11 form a series pass regulator that is current limited by sense resistor R23. As the charging current drops below 1.2A, U1 comes out of current limit. As long as the charge current is greater than about 700 mA, Q12 remains on due to the voltage drop across R22 and R23. This keeps Q13 on which sets the charge voltage at 14.7 volts by placing R28 in parallel with R29 of the output voltage divider. As the charge current decreases to less than about 700 mA, Q12 and Q13 are cutoff and the charge voltage is at 13.7 volts. Pin 9 of U1 is the enable control. When the power supply is operated from a dc input, pin 9 is pulled low which then turns the battery charger off.

2.17 An over temperature shutdown relay is located on the main interconnect board. At 75°C $\pm$5° the relay opens causing the supply to shut down.

2.18 The rear panel contains T3, the ac line filter, dc input fuse, ac input power module, fan, battery/external dc select switch, and external dc input connector.

LOW VOLTAGE POWER SUPPLY (A02)

MODEL RTP4018A
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



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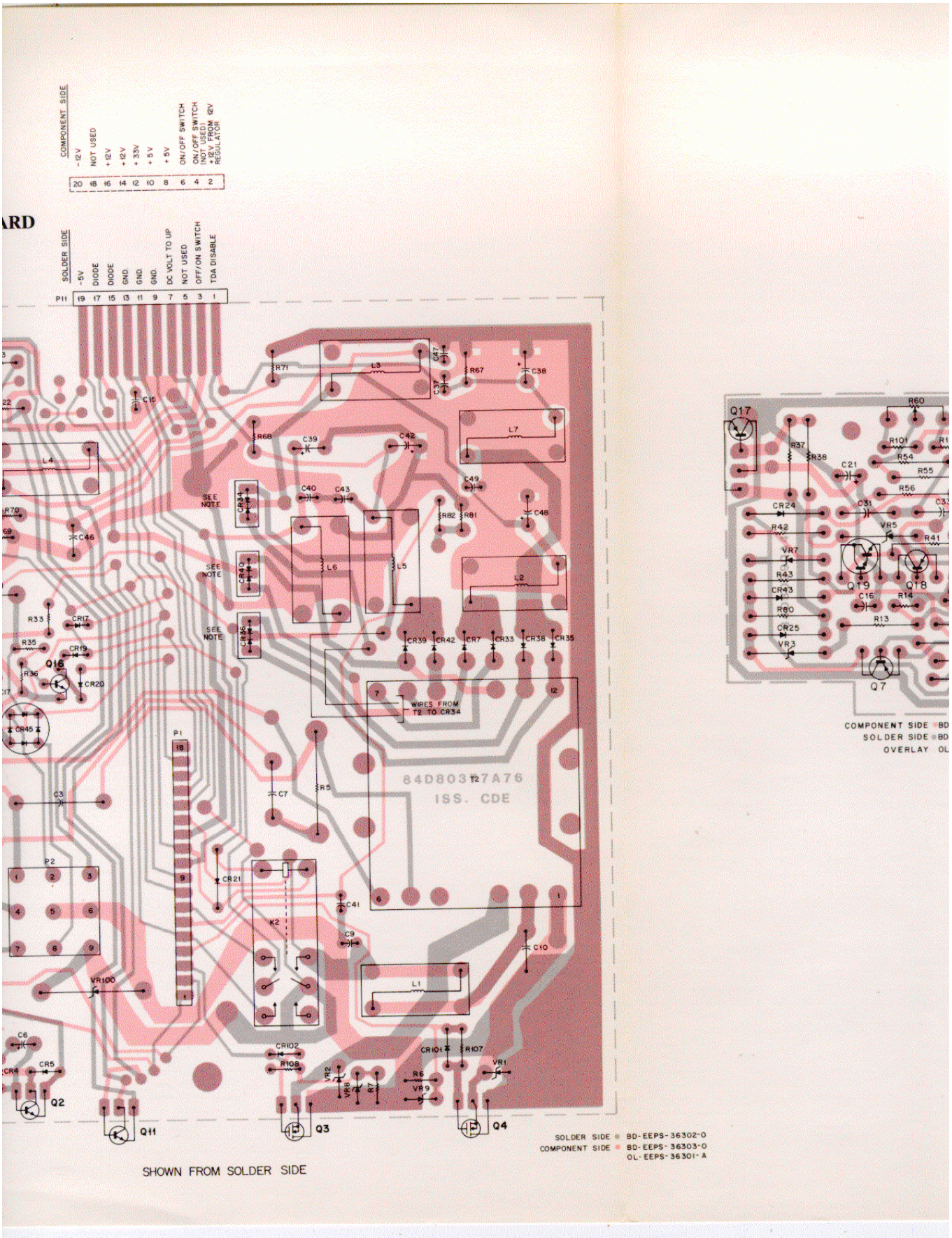
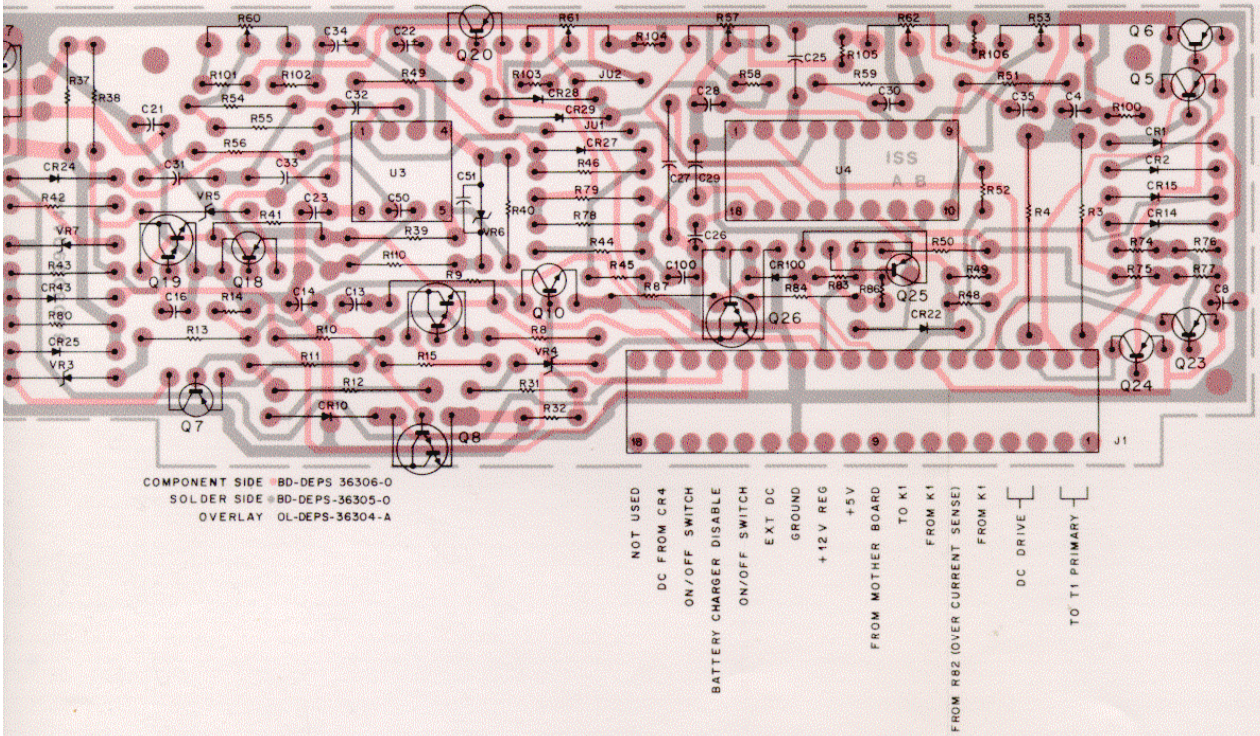
ARD


COMPONENT SIDE
-12V
NOT USED
+12V
+12V
+33V
+5V
+5V
ON/OFF SWITCH
ON/OFF SWITCH (NOT USED)
+12V FROM 12V REGULATOR
20 18 16 14 12 10 8 6 4 2
SOLDER SIDE
-5V
DIODE
DIODE
GND.
GND.
GND.
DC VOLT TO UP
NOT USED
OFF/ON SWITCH
TDA DISABLE
P11 19 17 15 13 11 9 7 5 3 1
SEE NOTE
WIRES FROM T2 TO CR34
84D803T27A76
ISS. CDE
SHOWN FROM SOLDER SIDE
SOLDER SIDE = BD-EEPS-36302-0
COMPONENT SIDE = BD-EEPS-36303-0
OL-EEPS-36301-A
COMPONENT SIDE =BD
SOLDER SIDE =BD
OVERLAY OL

CONTROL BOARD



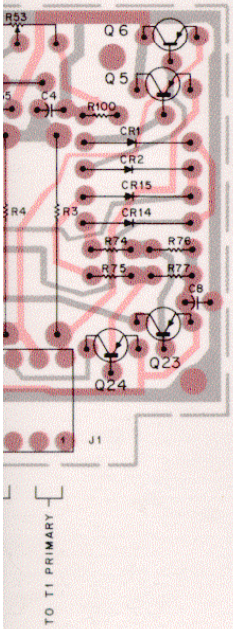
SHOWN FROM SOLDER SIDE

parts list

RTP4018A Low Voltage Power Supply — PL-8471-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF + 80 – 20%; 50 V: unless otherwise stated
C1, 2	23-80395A80	220 ± 20%; 250 V
C3	21-80378A15	0.47 ± 10%; 400 V
C4	21-84008H03	0.15
C5, 6	23-80390A76	10 ± 20%
C7	21-82187B01	.0022 ± 20%; 3000 V
C8, 9	21-84008H03	0.15
C10	8-80395A76	6 ± 10%; 35 V
C11, 12, 13	21-84008H03	0.15
C14	21-84008H08	.02 ± 20%
C15	21-84008H03	0.15
C16	21-84008H03	0.15
C17	23-80390A76	10 ± 20%
C18	23-80390A64	1000 ± 20%
C21, 22	23-80390A76	10 ± 20%
C23	21-84008H03	0.1
C25	21-84494B12	220 pF ± 5%; 500 V
C26	21-80397A12	820 pF ± 5%; NPO
C27	23-84762H14	0.47 ± 20%
C28	21-84008H03	0.15
C29	21-84008H21	0.15 ± 20%
C30	21-84008H03	0.15
C31	8-84637L30	.0022 ± 10; 630 V
C32	21-84494B85	140 pF ± 3%; 500 V
C33	8-84637L28	.018 ± 10%; 250 V
C34	23-80390A76	10 ± 20%; 50 V
C35	21-84008H03	0.15
C36	23-84665F14	220 + 150 – 10%; 16 V
C37	21-84008H03	0.15
C38, 39	23-80390A61	330 ± 20%
C40, 41	21-84008H03	0.15
C42	23-80390A61	330 ± 20%
C43	21-84008H03	0.15
C44	23-80390A61	330 ± 20%
C45	21-84008H03	0.15
C46	23-80390A62	100 ± 20%
C47	21-84008H03	0.15
C48	23-80390A62	100 ± 20%
C49	21-84008H03	0.15
C50, 51	21-84008H16	.01 ± 5%
C100	21-84008H03	0.15
		diode: (see note)
CR1, 2	48-83654H01	silicon
CR3, 4	48-82466H18	silicon
CR5, 6	48-80390A74	silicon
CR7	48-82525G20	silicon
CR10	48-83654H01	silicon
CR12	48-83654H01	silicon
CR13	48-82184K01	silicon
CR14, 15	48-83654H01	silicon
CR17, 18	48-83654H01	silicon
CR19	48-83654H02	silicon
CR20, 21	48-82466H01	silicon
CR22, 23, 24	48-82466H01	silicon
CR25	48-82525G23	silicon
CR27, 28, 29	48-83654H01	silicon
CR33	48-82525G20	fast recovery
CR34	48-80395A79	hi voltage fast recovery
CR35	48-80390A73	fast recovery
CR36	48-80390A67	dual schottky
CR38	48-80390A73	fast recovery
CR39	48-80390A70	fast recovery
CR40	48-80390A68	dual fast recovery
CR42	48-80390A70	fast recovery
CR43	48-82466H01	silicon
CR44	48-80390A69	bridge rectifier
CR45	48-84621E08	bridge rectifier; 400 V
CR100, 101, 102	48-83654H01	silicon
		connector, receptacle:
J1	9-80397A55	female; 18-contact
J2	28-80390A09	male; 9-contact
P1	28-80897A54	male; 18-contact
		relay:
K1, 2	80-80378A39	dpdt; coil res. 285 ohms
		coil, rf:
L1	24-80390A5	choke; 15 uH
L2	24-80395A66	choke; 1.9 uH
L3	24-80395A67	choke; 1.6 uH
L4, 5	24-80390A58	choke; 350 uH
L6	24-80390A57	choke; 350 uH
L7	24-80390A58	choke; 350 uH
		transistor: (see note)
Q1, 2	48-80390A65	NPN; type M90A65
Q3, 4	48-80390A66	field-effect
Q5, 6, 7	48-869649	PNP; type M9649
Q8	48-869706	Darlington; type M9756
Q9	48-869707	PNP; type M9707
Q10	48-869648	NPN; type M9648
Q11	48-869806	NPN; type M9806

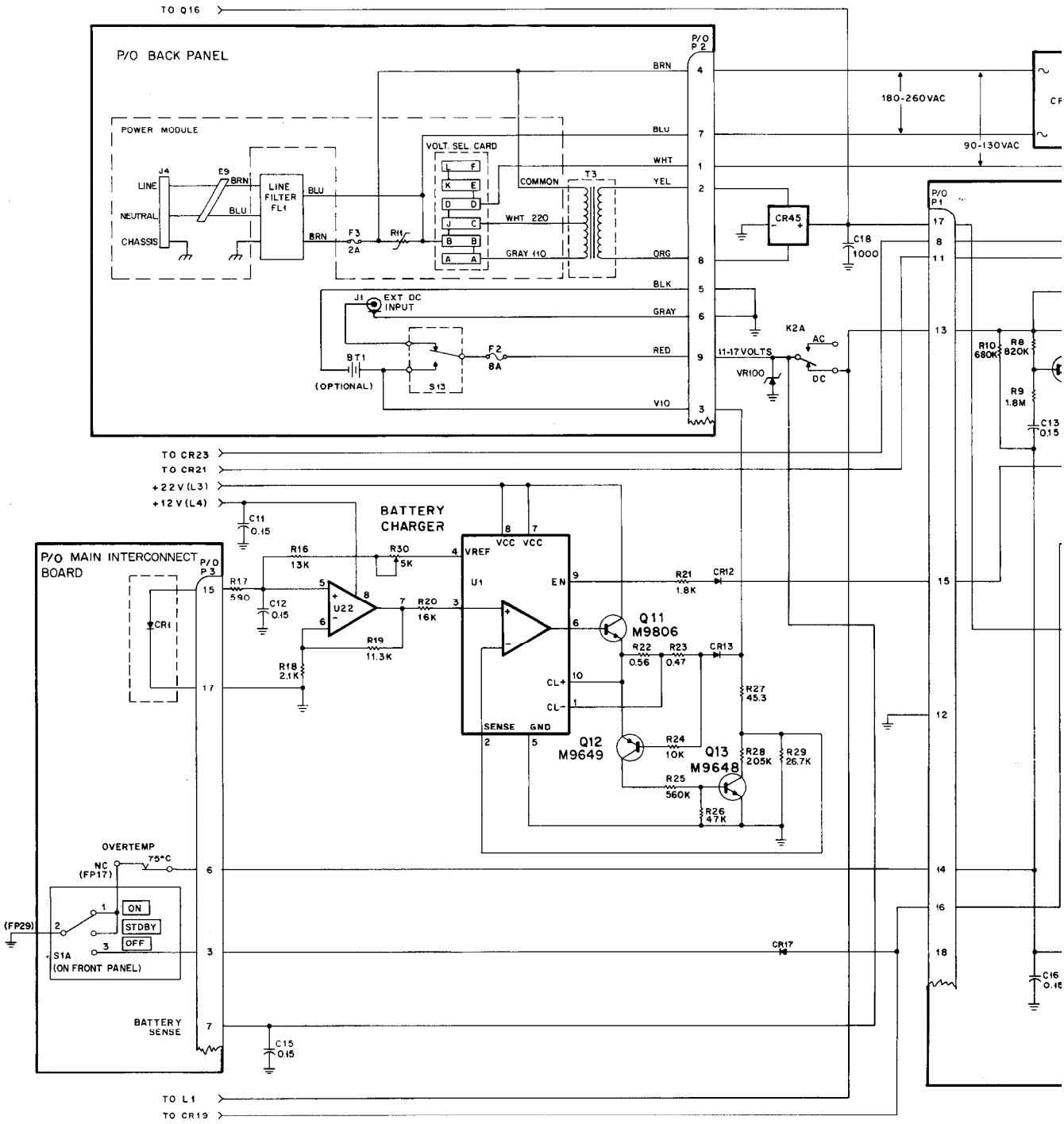
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
Q12	48-869649	PNP: type M9649
Q13	48-869648	NPN; type M9648
Q14	48-869706	Darlington; type M9706
Q16	48-869648	NPN; type M9648
Q17	48-869807	PNP; type M9807
Q18	48-869649	PNP; type M9649
Q19	48-869706	Darlington; type M9706
Q20	48-869649	PNP; type M9649
Q21	48-869706	Darlington; type M9706
Q22	48-869648	NPN; type M9648
Q23, 24	48-869713	PNP; type M9713
Q25	48-869649	PNP; type M9640
Q26	48-869706	Darlington; type M9706
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1, 2	6-126A89	47k; 1 W
R3, 4	17-82036G28	100 ± 10%; 2 W
R5	17-82036G06	2.7 ± 10%; 2 W
R6, 7	6-11009E35	270
R8	6-124B20	820k
R9	6-124B28	1.8 meg
R10	6-124B18	680k
R11	6-124A77	15k
R12	6-125A35	270; 1/2 W
R13	6-124A49	1k
R14	6-11009E81	22k
R15	6-124A71	8.2k
R16	6-11009E76	13k
R17	6-10621B72	590 ± 1%; 1/8 W
R18	6-10621C26	2.1k ± 1%; 1/8 W
R19	6-10621C96	11.3k ± 1%; 1/8 W
R20	6-11009E78	16k
R21	6-11009E55	1.8k
R22	17-82036G18	0.56; 2 W
R23	17-82036G56	0.47; 2 W
R24	6-11009E73	10k
R25	6-11009F16	560k
R26	6-11009E89	47k
R27	6-10621D55	45.3k ± 1%; 1/8 W
R28	6-10621E19	205k ± 1%; 1/8 W
R29	6-10621D33	26.7k ± 1%; 1/8 W
R30	18-83452F11	variable; 5k
R31, 32	6-11009A49	1k
R33, 34	6-11009E81	22k
R35	6-11009E47	820
R36	6-11009E57	2.2k
R37	6-124A83	27k
R38	6-124A39	390
R39	6-10621D05	13.7k ± 1%; 1/8 W
R40	6-10621D10	15.4k ± 1%; 1/8 W
R41	6-10621D05	13.7k ± 1%; 1/8 W
R42	6-124A73	10k
R43	6-124A63	3.9k
R44	6-124A32	200
R45	6-11009E41	470
R46	6-124A96	91k
R47	6-124A92	62k
R48	6-124B09	300k
R49, 50	6-11009E41	470
R51	6-124A73	10k
R52	6-11009E65	4.7k
R53	18-83452F01	variable; 2k
R54	6-124A76	13k
R55	6-124A59	2.7k
R56	6-124A98	110k
R57	18-83452F17	variable; 50k
R58	6-11009E97	100k
R59	6-124A69	6.8k
R60	18-83452F01	variable; 1k
R61, 62	18-83452F01	variable; 2k
R67	6-11009E49	1k
R68	6-125A49	1k; 1/2 W
R69	6-125A45	680; 1/2 W
R70	6-125A61	3.3k; 1/2 W
R71	6-126A57	2.2k; 1 W
R74, 75	6-11009E49	1k
R76, 77	6-11009E41	470
R78, 79	6-124A73	10k
R80	6-124A95	82k
R81	17-82036G49	4.7k
R82	6-11009E65	4.7k
R83	6-124A89	47k
R84	6-124A65	4.7k
R86	6-124A65	4.7k
R87	6-124A89	47k
R100	6-11009E73	1k
R101	6-11009E55	1.8k
R102	6-11009E56	2k
R103	6-11009E50	1.1k
R104	6-11009E55	1.8k
R105, 106	6-11009E53	1.5k
R107, 108	6-11009E31	180
R110	6-124A55	1.8k

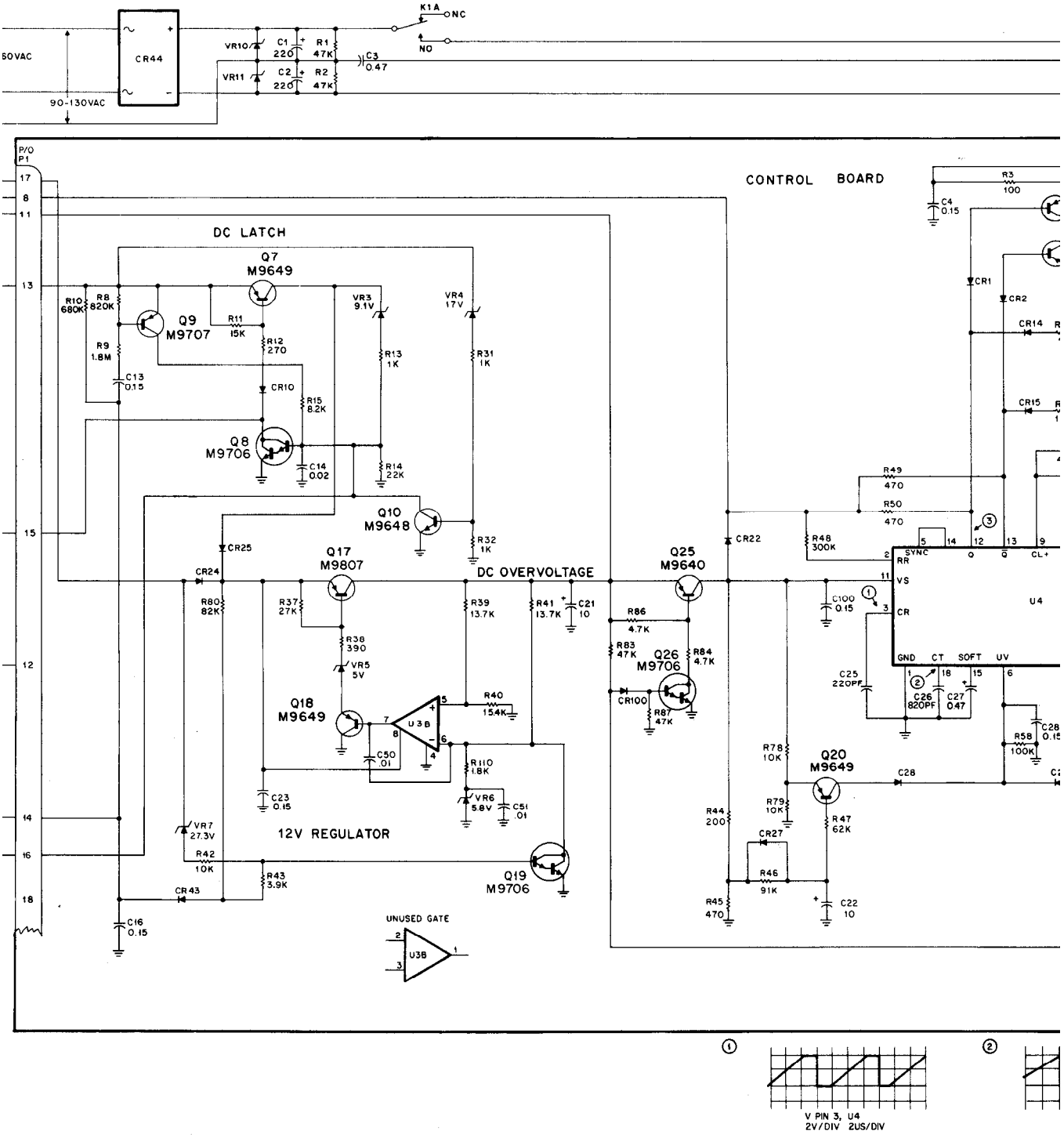


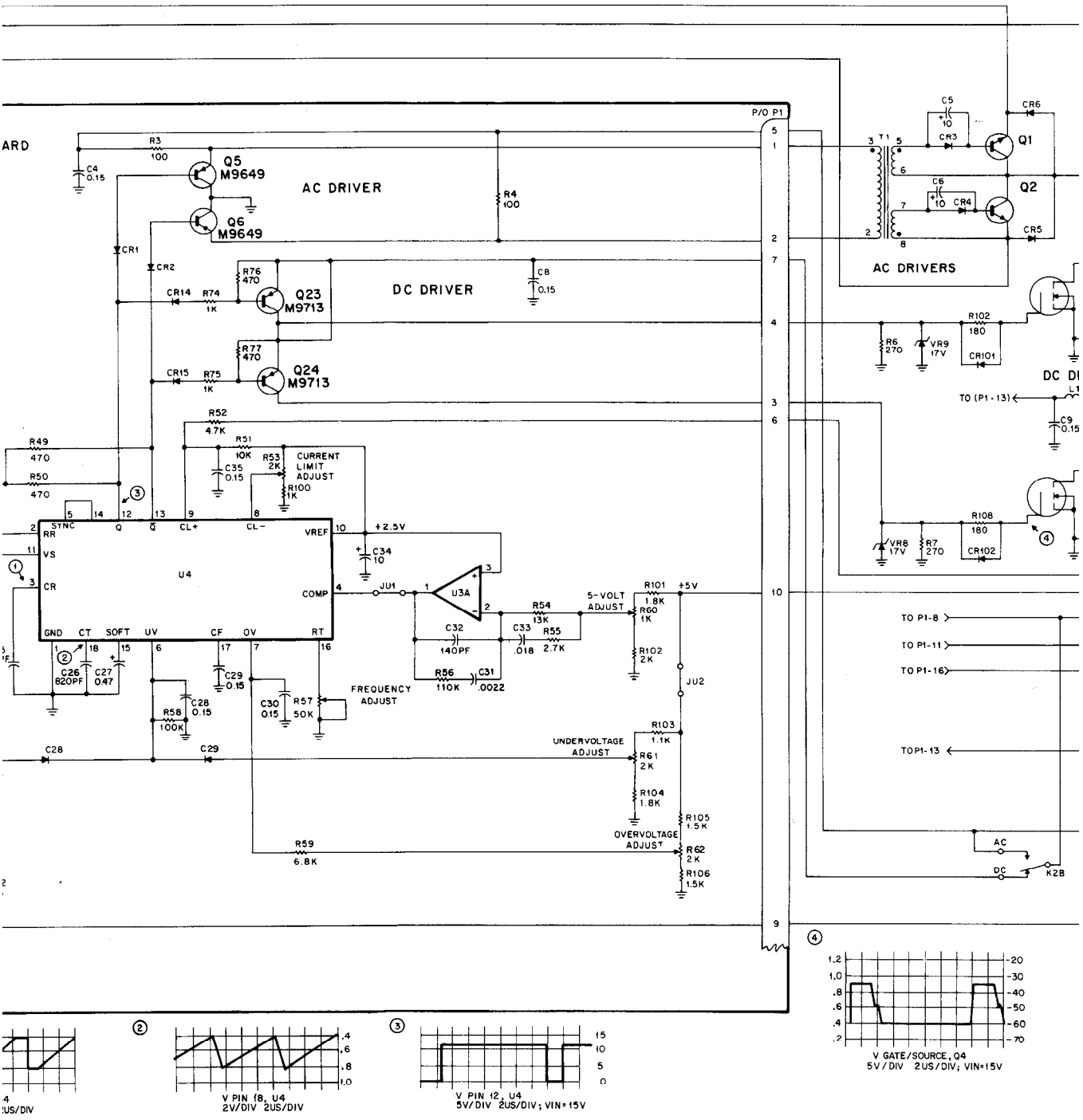
ENCE BOL	MOTOROLA PART NO.	DESCRIPTION
	48-869649	PNP; type M9649
	48-869648	NPN; type M9648
	48-869706	Darlington; type M9706
	48-869648	NPN; type M9648
	48-869807	PNP; type M9807
	48-869649	PNP; type M9649
	48-869706	Darlington; type M9706
	48-869649	PNP; type M9649
	48-869706	Darlington; type M9706
	48-869648	NPN; type M9648
	48-869713	PNP; type M9713
	48-869649	PNP; type M9640
	48-869706	Darlington; type M9706
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
	6-126A89	47k; 1 W
	17-82036G28	100 ± 10%; 2 W
	17-82036G06	2.7 ± 10%; 2 W
	6-11009E35	270
	6-124B20	820k
	6-124B28	1.8 meg
	6-124B18	680k
	6-124A77	15k
	6-125A35	270; 1/2 W
	6-124A49	1k
	6-11009E81	22k
	6-124A71	8.2k
	6-11009E76	13k
	6-10621B72	590 ± 1%; 1/8 W
	6-10621C26	2.1k ± 1%; 1/8 W
	6-10621C96	11.3k ± 1%; 1/8 W
	6-11009E78	16k
	6-11009E55	1.8k
	17-82036G18	0.56; 2 W
	17-82036G56	0.47; 2 W
	6-11009E73	10k
	6-11009F16	560k
	6-11009E89	47k
	6-10621D55	45.3k ± 1%; 1/8 W
	6-10621E19	205k ± 1%; 1/8 W
	6-10621D33	26.7k ± 1%; 1/8 W
	18-83452F11	variable; 5k
	6-11009A49	1k
	6-11009E81	22k
	6-11009E47	820
	6-11009E57	2.2k
	6-124A83	27k
	6-124A39	390
	6-10621D05	13.7k ± 1%; 1/8 W
	6-10621D10	15.4k ± 1%; 1/8 W
	6-10621D05	13.7k ± 1%; 1/8 W
	6-124A73	10k
	6-124A63	3.9k
	6-124A32	200
	6-11009E41	470
	6-124A96	91k
	6-124A92	62k
	6-124B09	300k
	6-11009E41	470
	6-124A73	10k
	6-11009E65	4.7k
	18-83452F01	variable; 2k
	6-124A76	13k
	6-124A59	2.7k
	6-124A98	110k
	18-83452F17	variable; 50k
	6-11009E97	100k
	6-124A69	6.8k
	18-83452F01	variable; 1k
	18-83452F01	variable; 2k
	6-11009E49	1k
	6-125A49	1k; 1/2 W
	6-125A45	680; 1/2 W
	6-125A61	3.3k; 1/2 W
	6-126A57	2.2k; 1 W
	6-11009E49	1k
	6-11009E41	470
	6-124A73	10k
	6-124A95	82k
	17-82036G49	4.7k
	6-11009E65	4.7k
	6-124A89	47k
	6-124A65	4.7k
	6-124A65	4.7k
	6-124A89	47k
	6-11009E73	1k
	6-11009E55	1.8k
	6-11009E56	2k
	6-11009E50	1.1k
	6-11009E55	1.8k
6	6-11009E53	1.5k
8	6-11009E31	180
	6-124A55	1.8k

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		transformer:
T1	25-80390A53	base drive
T2	25-80390A54	switching
		integrated circuit: (see note)
U1	51-84320A52	voltage regulator
U2	51-84621K67	operational amplifier
U3	51-80365A07	dual operational amplifier
U4	51-80365A23	pulse width modulator
		voltage regulator:
VR1, 2	48-80395A74	Zener type; 56 V
VR3	48-83461E15	Zener type; 9.1 V
VR4	48-82256C63	Zener type; 17 V
VR5	48-83461E47	Zener type; 5 V
VR6	48-82256C61	Zener type; 5.8 V
VR7	48-83461E20	Zener type; 27.3 V
VR8, 9	48-82256C63	Zener type; 17 V
VR10, 11	48-80312B50	Zener type; 250 V
VR100	48-80397A21	Zener type; 22 V
		mechanical parts
	2-7019	NUT, 4-40 × 1/4 × 3/32"; 7 used
	2-131435	NUT, 4-40 × 1/4 × 3/32"; 2 used
	2-132616	NUT, 6-32 × 1/4 × 1/8"
	2-10239A03	NUT, 4-40 × 0.25 × .098
	3-134027	SCREW, machine; 6-32 × 7/16"
	3-136785	SCREW, machine; 4-40 × 3/16"; 2 used
	3-139581	SCREW, machine; 4-40 × 3/16"; 8 used
	3-140207	SCREW, machine; 4-40 × 5/16"; 2 used
	3-10129A07	SCREW, machine; 4-40 × 3/8"
	3-80395A09	SCREW, pan head; 4-40 × 0.375"; 5 used
	4-114970	WASHER, flat; 0.125 × 0.250 × .020
	4-140208	WASHER lock #4 split; 4 used
	4-84180C01	WASHER shoulder; 7 used
	7-80377A36	BRACKET, mounting; 2 used
	7-80390A38	BRACKET
	14-80395A56	INSULATOR; 7 used
	14-80395A68	INSULATOR
	14-80395A69	INSULATOR
	14-80395A89	INSULATOR
	26-80377A35	HEAT SINK
	9-84881F06	SOCKET, IC; 18-contact

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.


TO Q16
P/O BACK PANEL
P/O P2
POWER MODULE
J4
LINE
NEUTRAL
CHASSIS
E9
BRN
BLU
LINE FILTER FL1
F3 2A
R11
VOLT. SEL CARD
COMMON
WHT 220
GRAY 110
T3
BRN
BLU
WHT
YEL
ORG
BLK
GRAY
RED
VIO
J1 EXT DC INPUT
BT1 (OPTIONAL)
S13
F2 8A
180-260VAC
90-130VAC
CR45
C18 1000
K2A
AC
DC
11-17 VOLTS
VR100
P/O P1
R10 680K
R8 820K
R9 1.8M
C13 0.15
TO CR23
TO CR21
+22 V (L3)
+12 V (L4)
C11 0.15
BATTERY CHARGER
P/O MAIN INTERCONNECT BOARD
P/O P3
R16 13K
R30 5K
R17 590
C12 0.15
U22
R20 16K
R19 11.3K
R18 2.1K
CR14
VCC VCC
VREF
U1
EN
CL+
CL-
SENSE GND
R21 1.8K
CR12
Q11 M9806
R22 0.56
R23 0.47
CR13
R27 45.3
Q12 M9649
R24 10K
Q13 M9648
R28 205K
R29 26.7K
R25 560K
R26 47K
OVERTEMP
NC (FP17)
75°C
(FP29)
ON
STDBY
OFF
S1A (ON FRONT PANEL)
CR17
BATTERY SENSE
C15 0.15
C16 0.15
TO L1
TO CR19


50VAC
90-130VAC
CR44
VR10
VR11
C1 220
C2 220
R1 47K
R2 47K
C3 0.47
K1A
NC
NO
P/O P1
17
8
11
13
15
12
14
16
18
CONTROL BOARD
DC LATCH
Q7 M9649
Q9 M9707
Q8 M9706
Q10 M9648
R10 680K
R8 820K
R9 1.8M
R11 15K
R12 270
R13 1K
R31 1K
R14 22K
R15 8.2K
R32 1K
VR3 9.1V
VR4 17V
C13 0.15
C14 0.02
CR10
CR25
CR24
R80 82K
Q17 M9807
DC OVERVOLTAGE
R37 27K
R38 390
VR5 5V
R39 13.7K
R41 13.7K
C21 10
Q18 M9649
U3B
R40 15.4K
C50 .01
R110 1.8K
VR6 5.8V
C51 .01
C23 0.15
12V REGULATOR
VR7 27.3V
R42 10K
R43 3.9K
CR43
C16 0.15
Q19 M9706
UNUSED GATE
U3B
Q25 M9640
CR22
R86 4.7K
R83 47K
Q26 M9706
R84 4.7K
CR100
R87 47K
R48 300K
R49 470
R50 470
C100 0.15
U4
SYNC
RR
VS
CR
GND
CT
SOFT
UV
C25 220PF
C26 820PF
C27 0.47
C28 0.15
R58 100K
R78 10K
Q20 M9649
R79 10K
R47 62K
R44 200
CR27
R46 91K
R45 470
C22 10
R3 100
C4 0.15
CR1
CR2
CR14
CR15
V PIN 3, U4
2V/DIV 2US/DIV



4
US/DIV

②

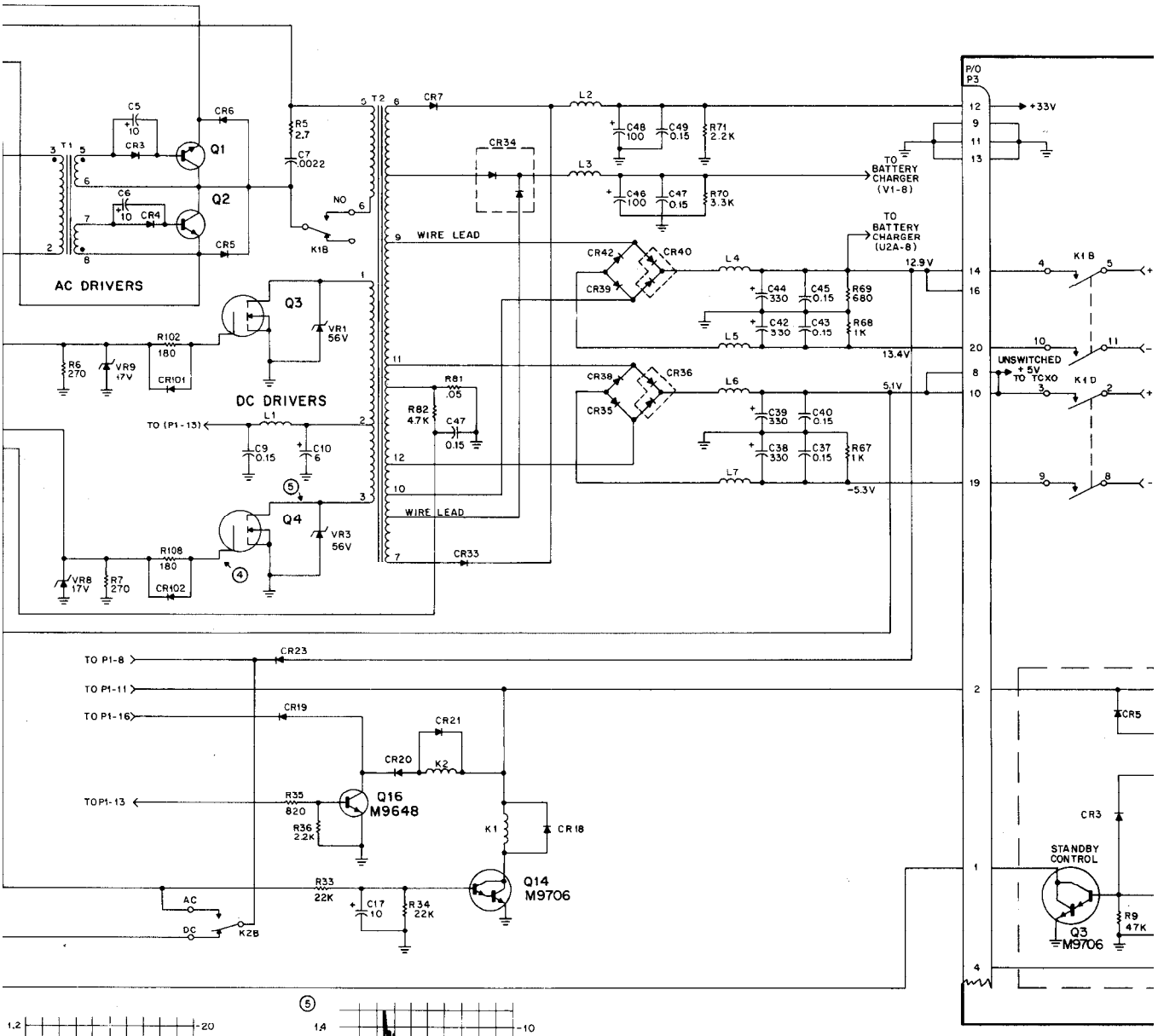
V PIN 18, U4
2V/DIV 2US/DIV

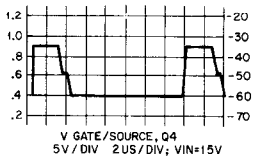
③

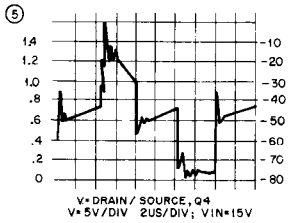
V PIN 12, U4
5V/DIV 2US/DIV; VIN=15V

④

V GATE/SOURCE, Q4
5V/DIV 2US/DIV; VIN=15V







EEPS-36300

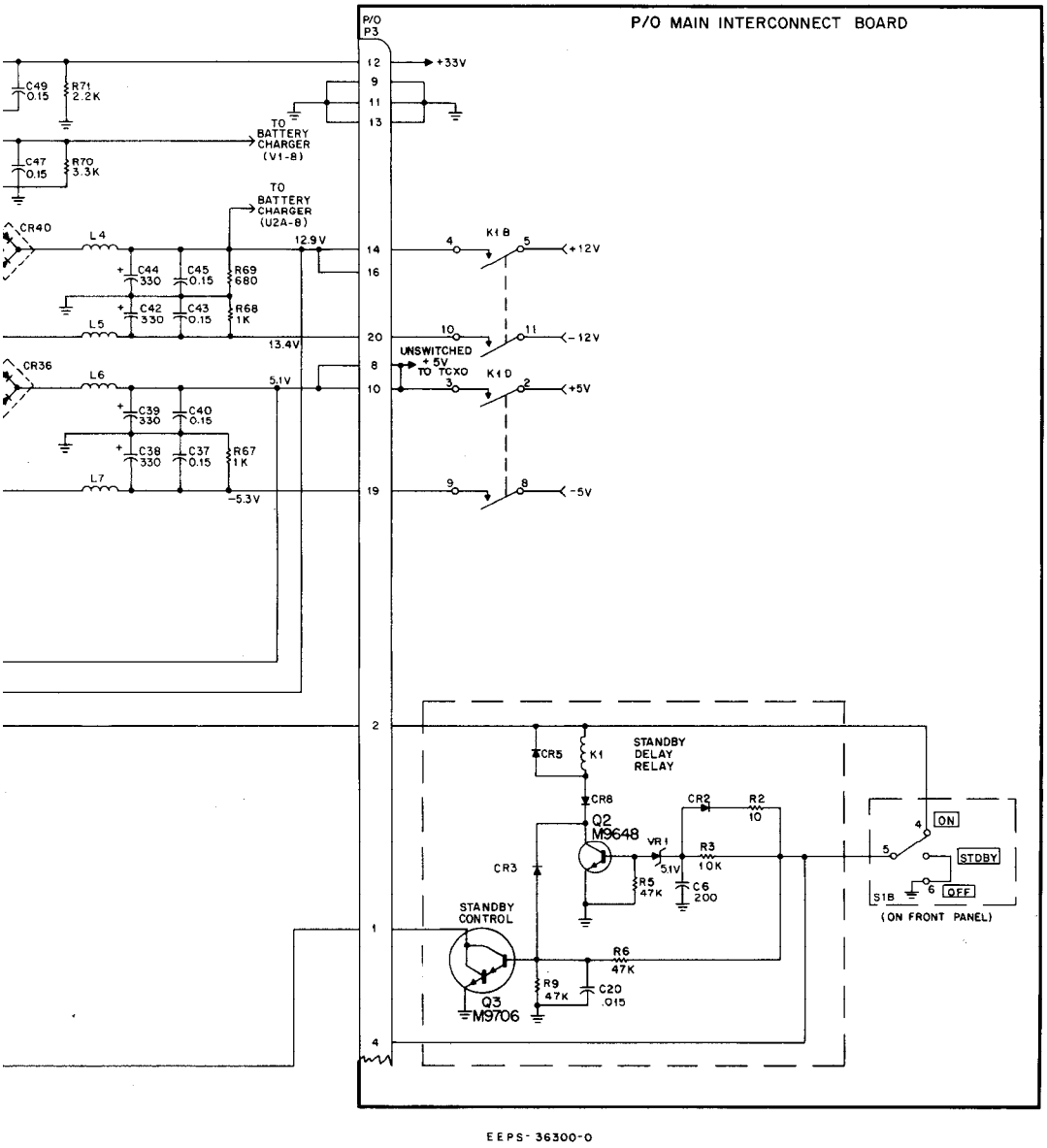
Notes:

1. Unless otherwise indicated, all resistor values are in ohms, all capacitor values are in microfarads, and all inductor values are in microhenries.
2. IC types are TTL and CMOS devices.
3 Connections for integrated circuits are as follows:

Reference Number	Mfgr's Description	VCC	GND
U1	Voltage Reg.	7, 8	5
U2	Dual Op Amp	8	4
U3	Dual Op Amp	8	4
U4	Pulse Width Mod	11	1

LOW VOLTAGE POWER SUPPLY (A02)

MODEL RTP4018A
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



EEPS-36300-O

otherwise indicated, all resistor values are in ohms, all capacitor values
nicrofarads, and all inductor values are in microhenries.

s are TTL and CMOS devices.

:tions for integrated circuits are as follows:

erence mber	Mfgr's Description	VCC	GND
U1	Voltage Reg.	7, 8	5
U2	Dual Op Amp	8	4
U3	Dual Op Amp	8	4
U4	Pulse Width Mod	11	1

Motorola No. ***PEPS-36840-O***
(Sheet 2 of 2)
8/12/83-PHI

MOTOROLA INC.
Communications
Sector

SCOPE MODULE (A03)

MODEL RTC1004A

1. DESCRIPTION

The scope module (RTC1004A) is comprised of the scope driver (RTC4021A), high voltage power supply (RTP4020A), and high voltage board (RTP4019A). The scope driver board amplifies the vertical and horizontal signals from the scope amplifier to the level necessary to drive the CRT deflection plates. CRT high voltages are developed by the high voltage power supply. The outputs are: −1200 V dc; 140 V dc; and 6.3 V ac. The inputs are +12 and +33 V dc. The scope high voltage board is an interface board which connects power, the grid blanking and deflection signals, and the astigmatism, trace rotation, FOCUS, and INTENSITY controls to the CRT.

2. THEORY OF OPERATION

2.1 SCOPE DRIVER BOARD

Three stages of amplification, the first two using differential amplifiers and current sources, and the third a class AB output, are used to boost the vertical and horizontal signals. Amplifiers U1 and U2 are the first amplification stage. Each amplifier outputs two signals that are inverted with respect to each other. Amplifier gain is varied by the control connected between the emitter resistors. The dc offset adjustment allows centering of the vertical and horizontal signals. Stages two and three include negative feedback for stability and fixed gain.

2.2 SCOPE HIGH VOLTAGE POWER SUPPLY

The scope high voltage power supply consists of a square wave generator, on delay, drive circuit, and the output voltage circuits.

2.2.1 The square wave generator is a standard timer configured for 50-percent duty cycle at approximately 22 kHz. A filtered +12 volts is provided.

2.2.2 After the square wave generator output is divided and inverted with respect to each waveform, the on (low-high) transition of the next gates is delayed. The off (high-low) transition is not delayed.

2.2.3 The NPN/PNP transistor combination provides the drive for switching transistors Q2 and Q4. The negative voltage on the base of Q2 and Q4 is limited by diodes.

2.2.4 The −1200 volt and +140 volt outputs are full wave rectified to dc and filtered. The 6.3 volt ac is used for the CRT filament heater voltage.

2.3 SCOPE HIGH VOLTAGE BOARD

Opto-isolator U1 is used to drive transistor Q3 which switches the dc level of the grid. Q1 acts to decrease transition time. Resistive ladders set the proper voltage ranges for the INTENSITY, FOCUS, astigmatism, and trace rotation controls.

technical writing services
1301 E. Algonquin Road, Schaumburg, Il. 60196

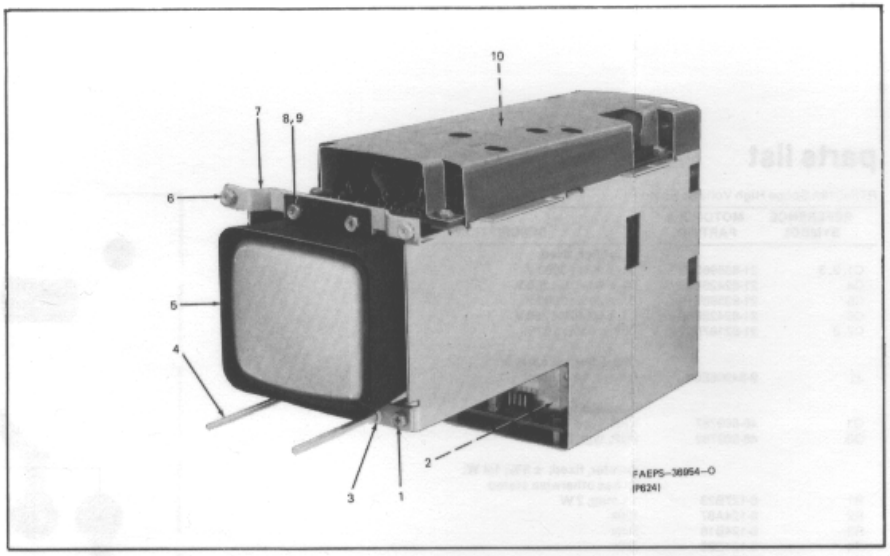
SCOPE MODULE (A03)

MODEL RTC1004A
PARTS LIST

parts list

RTC1004A Scope Module — PL-8470-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		coil; rf:
L1	24-80377A06	twist
		tube:
V1	96-80377A04	CRT; type D7-201GH or D7-231GH
		referenced mechanical parts
1	7-80378A87	BRACKET, mounting
2	RTP4020A	HIGH VOLTAGE power supply (for reference only)
3	43-80336A37	BUSHING; 2 used
4	47-80378A88	SHAFT, extension; 1/4" dia; 2 used
5	26-80377A05	SHIELD, (CRT)
6	3-139013	SCREW, machine: 4-40 × 3/16"; 2 used
7	7-80377A43	BRACKET
8, 13	2-131435	NUT, 4-40 x 1/4 x 3/32"; 7 used
9	3-138804	SCREW, machine: 4-40 × 5/16"; 3 used
10	RTC4021A	SCOPE DRIVER BOARD (for reference only)
11	RTP4019A	HIGH VOLTAGE BOARD (for reference only)
12	26-80378A69	SHIELD
14, 16	43-80397A41	STANDOFF, "hex": 1/4"; 8 used
17	3-136890	SCREW, machine: 4-40 x 9/32"; 10 used
18	14-80395A04	INSULATOR
19	3-139012	SCREW, machine: 4-40 × 1/4"; 8 used
20	64-80395A01	PLATE, back
		non-referenced mechanical parts
	5-80377A44	GROMMET
	7-80377A41	BRACKET
	7-80377A42	BRACKET
	42-84066A60	STRAP
	43-80370A69	SPACER (U/F4-40) 8 used
	58-80377A99	COUPLER; 2 used
	1-80307A72	ASSEMBLY CABLE, interconnect
	4-8434	WASHER, lock; 8 used


10
7
8, 9
6
5
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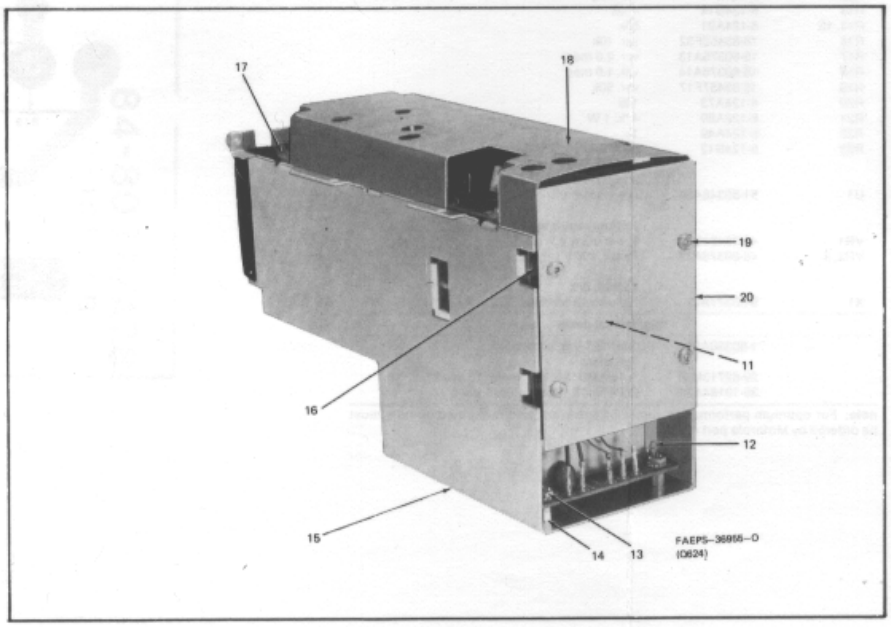
1
FAEPS–36954–O
(P624)


17
18
19
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11
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12
15
14
13
FAEPS–36955–O
(0624)

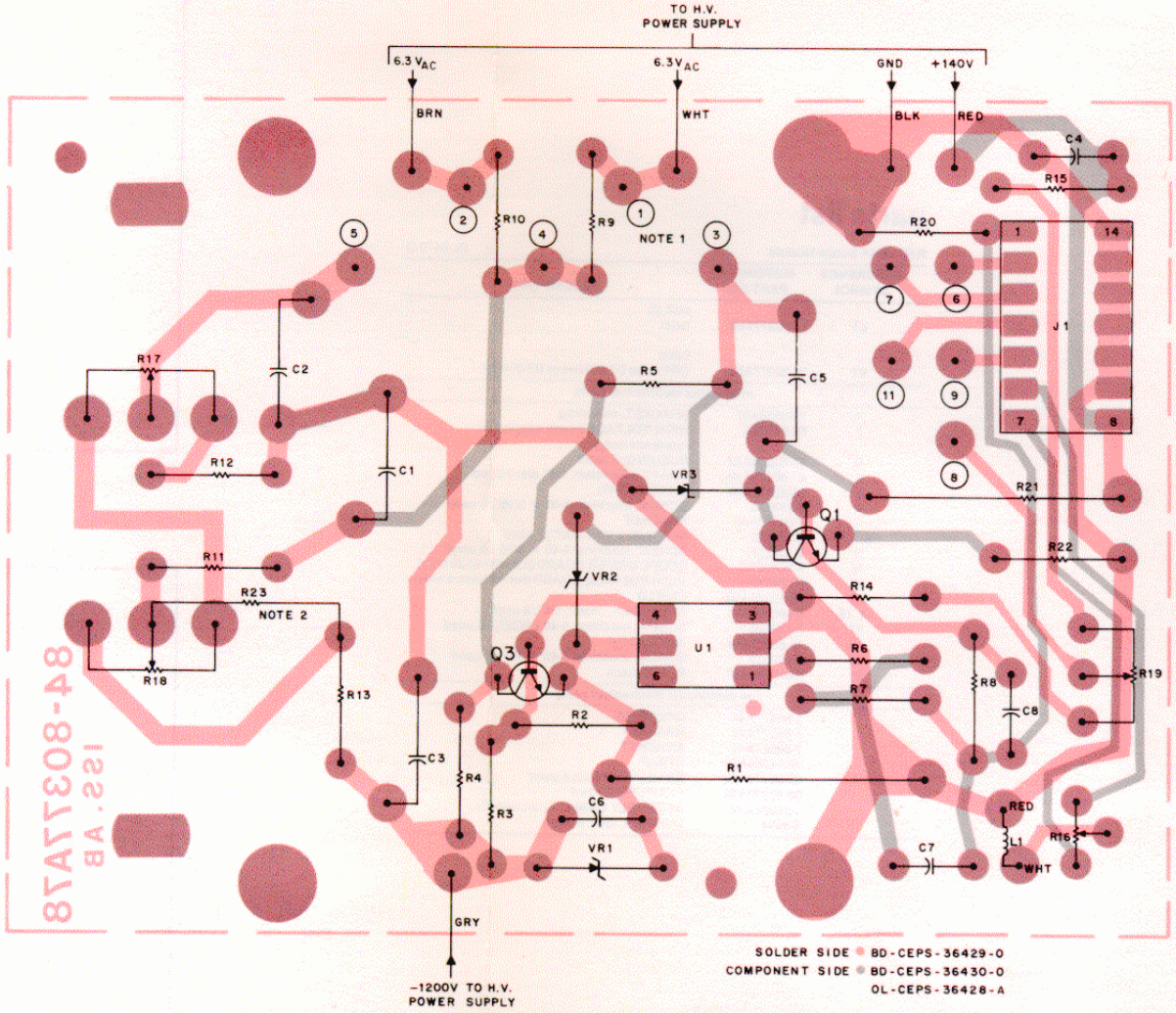
SCOPE MODULE (A03)
HIGH VOLTAGE BOARD
MODEL RTP4019A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST

parts list

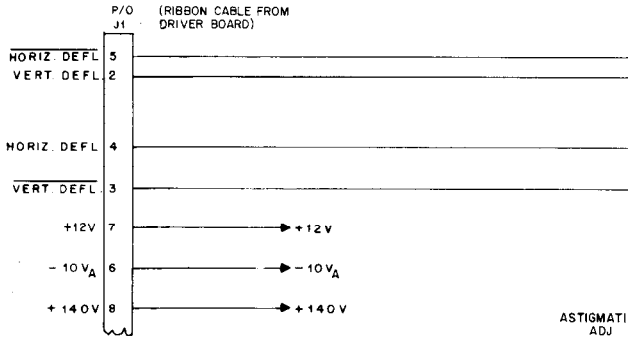
RTP4019A Scope High Voltage Board PL-8484-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1, 2, 3	21-83596E19	.01 ± 20%; 3000 V
C4	21-82428B40	.01 + 60-40%; 250 V
C5	21-83596E19	.01 ± 20%; 3000 V
C6	21-82428B40	.01 + 60-40%; 250 V
C7, 8	21-82187B27	.002 ± 40%; 100 V
		connector, receptacle:
J1	9-84906E01	female, 14 contact
		transistor: (see note)
Q1	48-869787	NPN; type M9787
Q3	48-869762	PNP; type M9762
		resistor, fixed; ± 5%; 1/4 W: unless otherwise stated
R1	6-127B23	1.1 meg; 2 W
R2	6-124A97	100k
R3	6-124B16	560k
R4	6-124B05	200k
R5	6-124B22	1.0 meg
R6	6-124A29	150
R7	6-124A61	3.3k
R8	6-124A97	100k
R9, 10	6-124B30	2.2 meg
R11	6-124A97	100k
R12	6-124B44	8.2 meg
R13	6-124B14	470k
R14, 15	6-124A91	56k
R16	18-83452F32	var. 10k
R17	18-80378A13	var. 2.0 meg
R18	18-80378A14	var. 1.0 meg
R19	18-83457F17	var. 50k
R20	6-124A73	10k
R21	6-126A89	47k; 1 W
R22	6-124A49	1k
R23	6-124B12	390k
		integrated circuit: (see note)
U1	51-80348A81	opto isolator
		voltage regulator: (see note)
VR1	48-83461E30	Zener, 53.6 V
VR2, 3	48-80378A17	Zener, 100 V
		socket, crt:
X1	9-80377A07	female; 13 contact
		mechanical parts
	1-80350A01	SOCKET, crt, assembly includes:
	29-82713M01	TERMINAL, pin, male; 10 used
	39-10184A24	CONTACT, receptacle; 5 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.



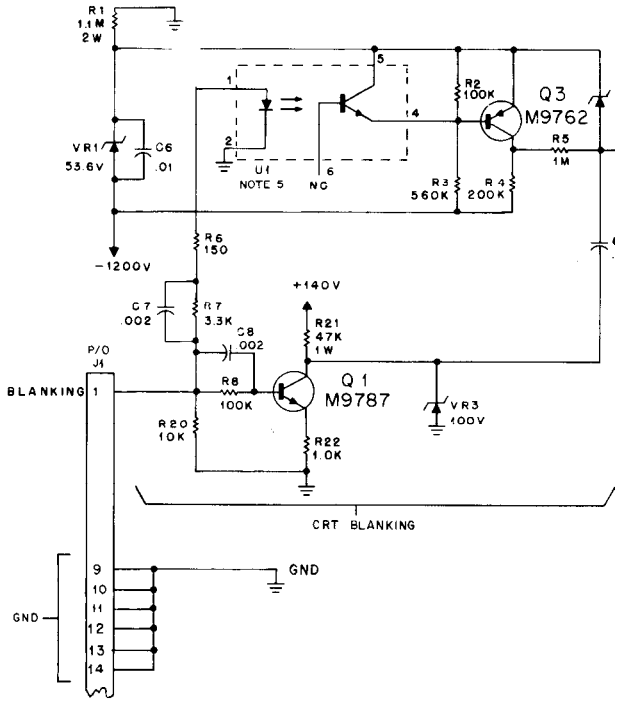
SHOWN FROM COMPONENT SIDE

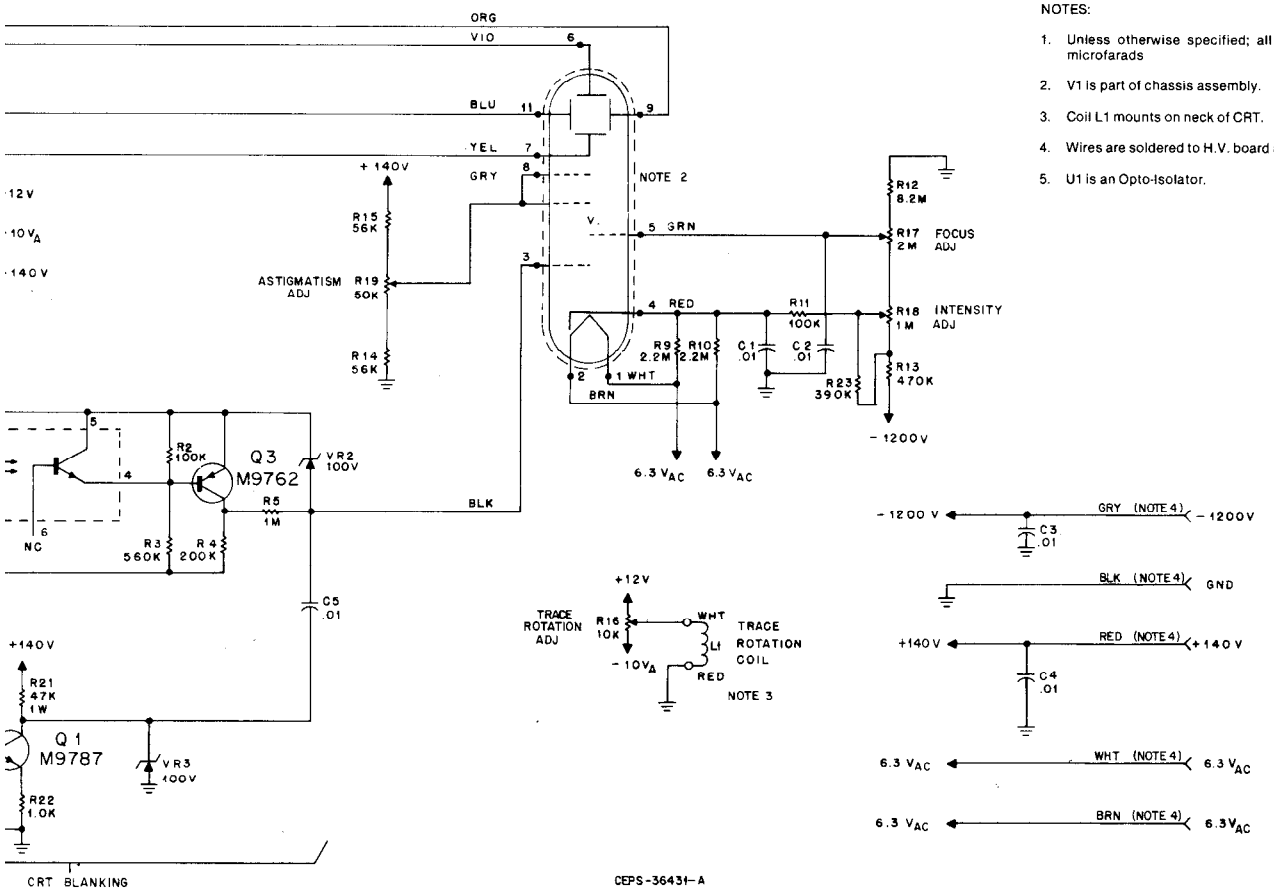


	J1 DETAIL		(TO SCOPE DRIVER BD VIA RIBBON CABLE)
BLANKING	1	14	GND
VERT. DEFL.	2	13	GND
$\overline{\text{VERT. DEFL.}}$	3	12	GND
HORIZ. DEFL.	4	11	GND
$\overline{\text{HORIZ. DEFL.}}$	5	10	GND
-10V$_A$	6	9	GND
+12V	7	8	+140V

NOTES

1. CIRCLED NUMBERS, E.G., ① INDICATE CONNECTION POINTS TO CRT SOCKET X1.
2. R23 IS LOCATED ON SOLDER SIDE ON LATER VERSIONS.
3. TRACE ROTATION COIL L1 IS MOUNTED ON THE NECK OF THE CRT.





CEPS-36431-A

NOTES:

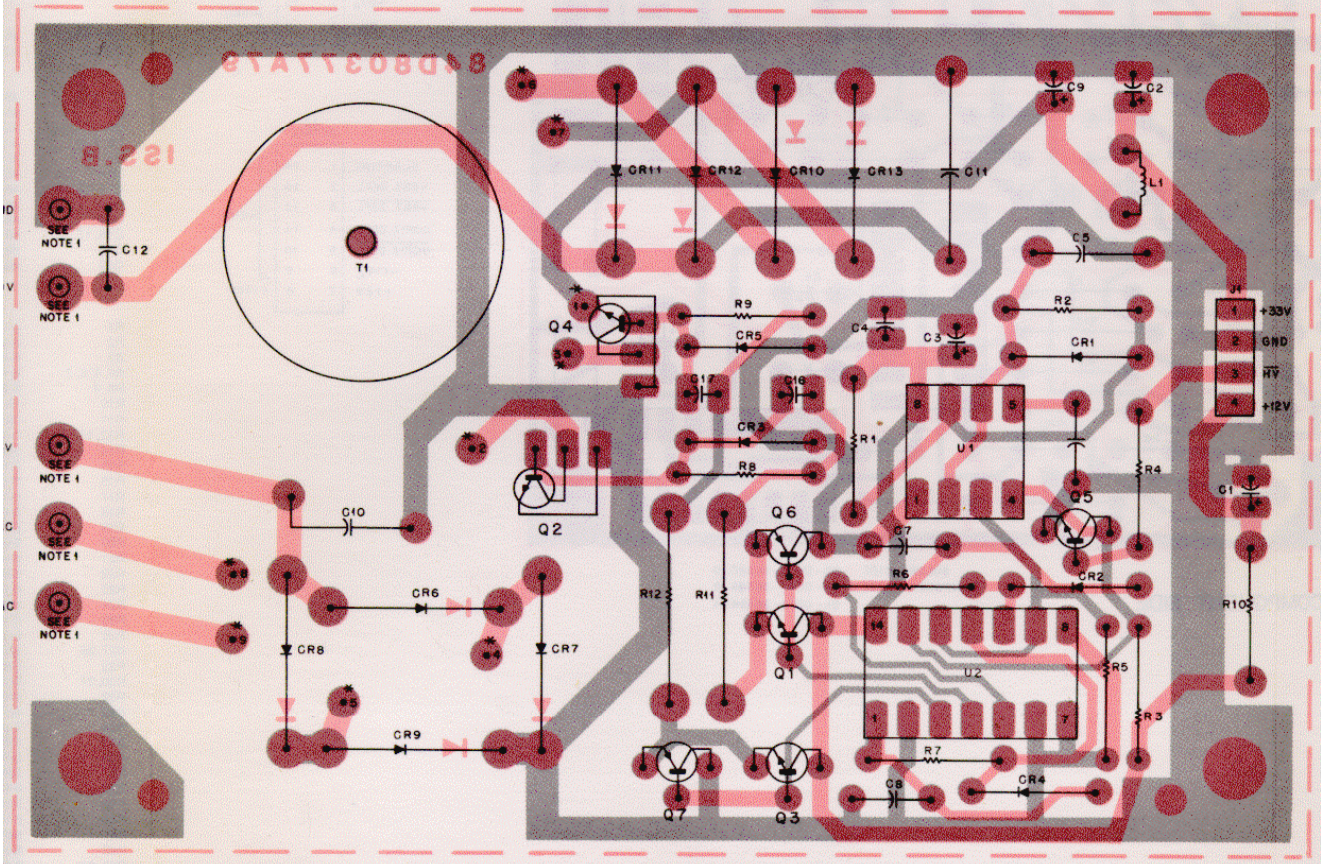
1. Unless otherwise specified; all resistors ar microfarads
2. V1 is part of chassis assembly.
3. Coil L1 mounts on neck of CRT.
4. Wires are soldered to H.V. board and plug into
5. U1 is an Opto-Isolator.

parts list

RTP4020A High Voltage Power Supply Board — PL-8458-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed ± 10%; 250 V: unless otherwise stated:
C1	23-84665F01	10 uF + 100-10%; 25 V
C2	23-84908L01	2.2 uF ± 20%; 50 V
C3	23-84665F01	10 uF + 100-10%; 25 V
C4	21-84008H03	0.15 uF + 80-20%; 50 V
C5	8-82096J02	.0047 uF
	or 8-82096J07	.0056 uF
	or 8-84326A30	.0045 ± 1%
	or 8-84326A03	.0042 ± 1%
C6	21-82428B40	.01 uF + 60-40%; 250 V
C7, 8	21-863629	330 pF ± 10%; 600 V
C9	23-84908L01	2.2 uF ± 20%; 50 V
C10	21-83596E19	.01 uF + 80-20%; 3000 V
C11	21-80378A15	0.47 uF ± 10%; 400 V
C12	21-832502	.01 uF + 60-40%; 250 V
C16, 17	21-84008H03	0.15 uF + 80-20%; 50 V
		diode: (see note)
CR1 thru 5	48-83654H01	silicon
CR6, 7, 8, 9	48-83024H01	silicon
CR10, 11, 12, 13	48-82095C02	silicon
		connector, plug:
J1	28-80390A59	male; 4-contact, right angle
		coil, rf:
L1	24-5649E01	choke; 600 uH
		transistor: (see note)
Q1	48-869706	NPN; type M9706
Q2	48-80395A95	NPN; type MJE243
Q3	48-869706	NPN; type M9706
Q4	48-80395A95	NPN; type MJE243
Q5	48-869570	NPN; M9750
Q6, 7	48-869649	PNP; M9649
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1	6-124A67	5.6k
R2	6-124A69	6.8k
R3	6-124A73	10k
R4	6-124A97	100k
R5	6-124A62	3.6k
R6, 7	6-124A83	27k
R8, 9	6-124A69	6.8k
R10	6-124A33	220
R11, 12	6-125B70	1; 1/2 W
		transformer:
T1	25-80378A16	high voltage
		integrated circuit: (see note)
U1	51-84371K65	timer
U2	51-82884L49	quad exclusive or gate
		mechanical parts
	2-115123	NUT, 10-32 x 3/8 x 1/8"
	3-118030	SCREW, machine; 10-32 x 1/8"
	4-1712	WASHER, flat
	26-80378A69	SHIELD

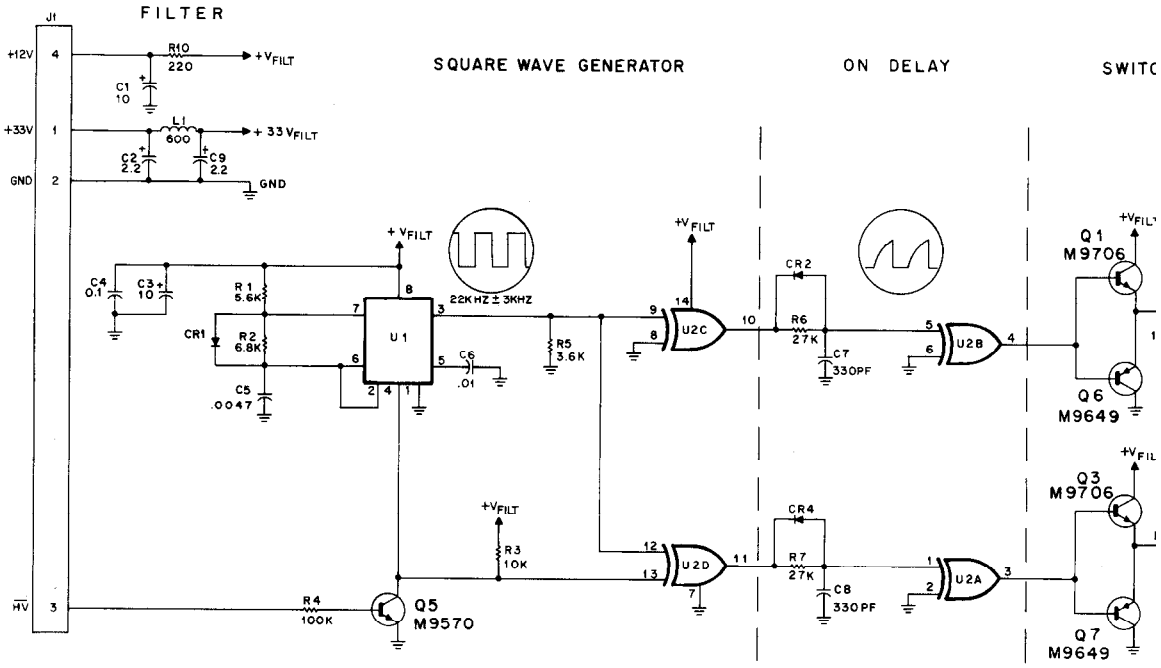
note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.



* CONNECTION POINT FOR WIRES FROM TRANSFORMER T1.

SHOWN FROM COMPONENT SIDE

SOLDER SIDE BD-CEPS-36372-0
COMPONENT SIDE BD-CEPS-36373-0
OL-CEPS-36371-A



Notes:

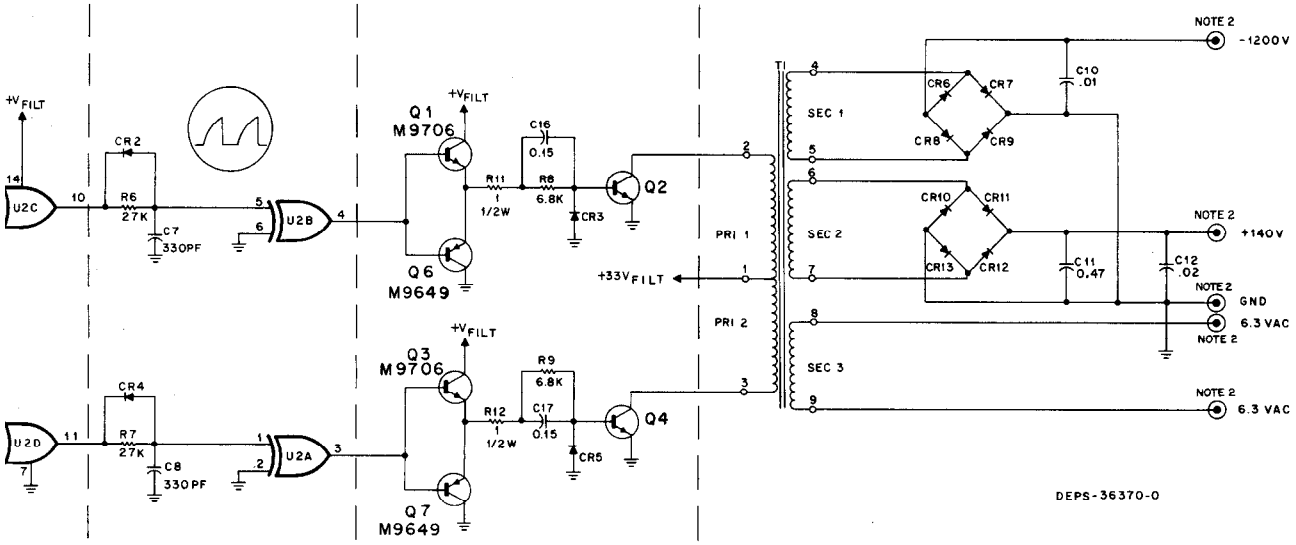
1. Unless otherwise specified; all resistors are in ohms, 1/4 capacitors are in microfarads; all inductors are in microhenries.
2. Bubble pins for wires from high voltage board.
3. Integrated circuits on this board are TTL and CMOS devices.

Reference Designation	Mfgr's Description	+V Filt.
U1	Timer	8
U2	Quad Exclusive Or Gate	14

HIGH VOL

SCHEMATIC DI

R ON DELAY SWITCHING DRIVE



Notes.

1. Unless otherwise specified; all resistors are in ohms, 1/4 watt, 5%; all capacitors are in microfarads; all inductors are in microhenries.
2. Bubble pins for wires from high voltage board.
3. Integrated circuits on this board are TTL and CMOS devices.

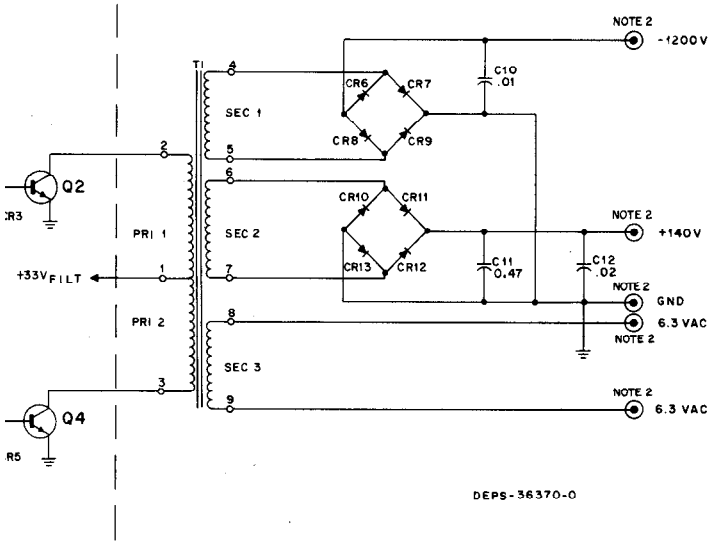
Reference Designation	Mfgr's Description	+V Filt.	Gnd
U1	Timer	8	1
U2	Quad Exclusive Or Gate	14	7

SCOPE MODULE (A03)

HIGH VOLTAGE POWER SUPPLY BOARD

MODEL RTP4020A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST

VE



DEPS-36370-O

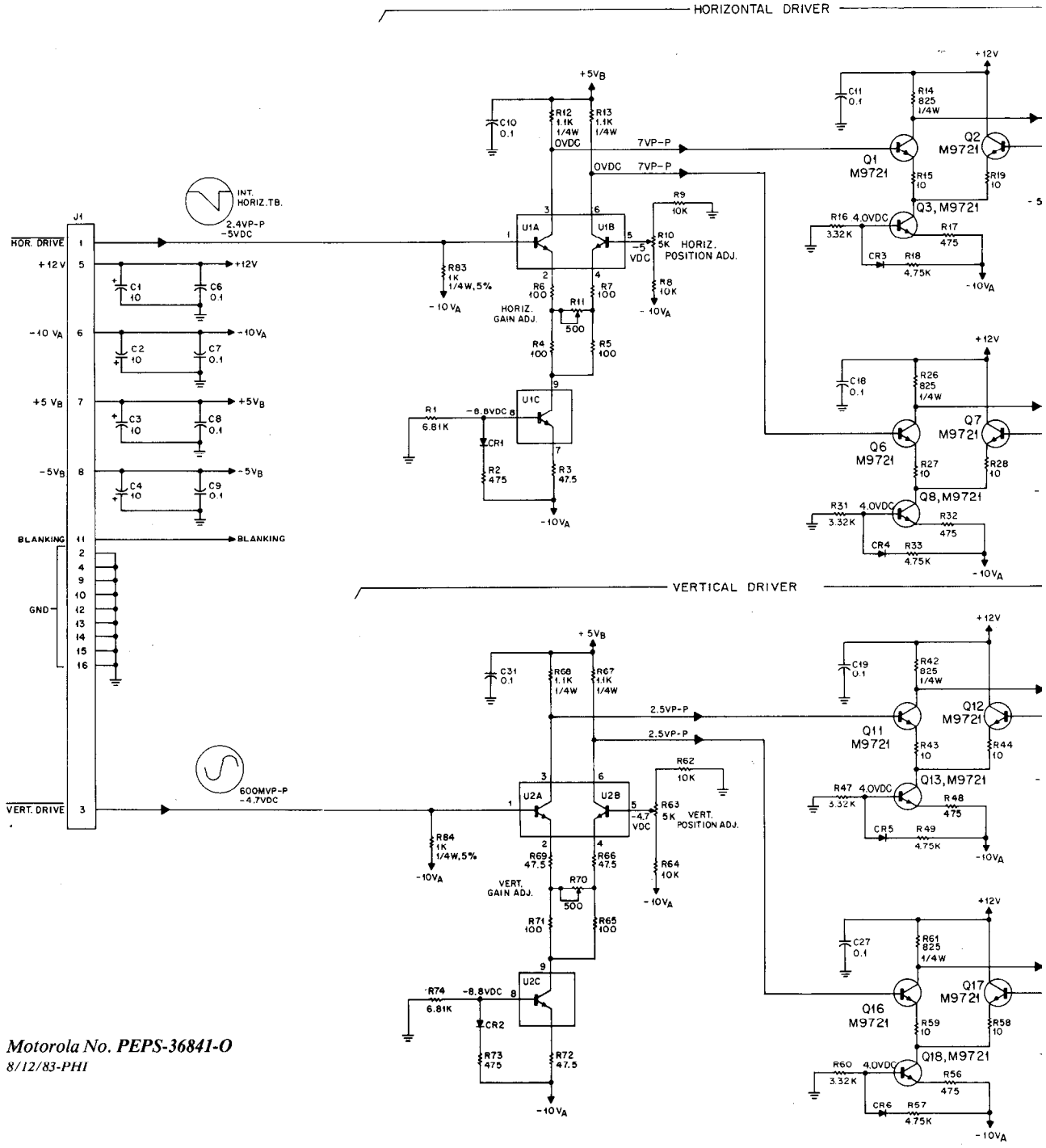
HIGH VOLTAGE POWER SUPPLY

Motorola No. PEPS-36843-O
8/12/83-PHI

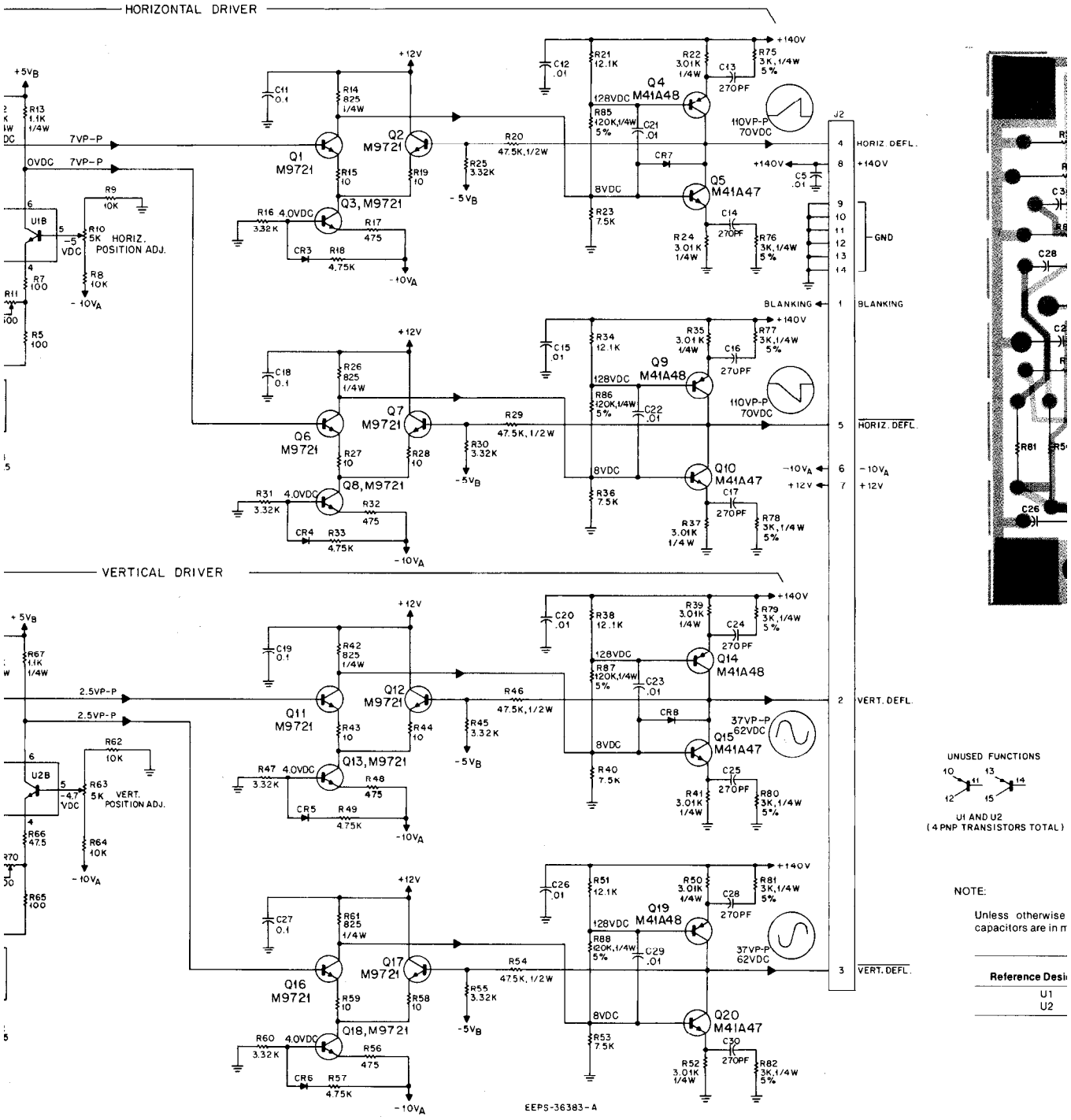
SCOPE MODULE (A03)

DRIVER BOARD

MODEL RTC4021A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



*Motorola No. **PEPS-36841-O***
8/12/83-PHI



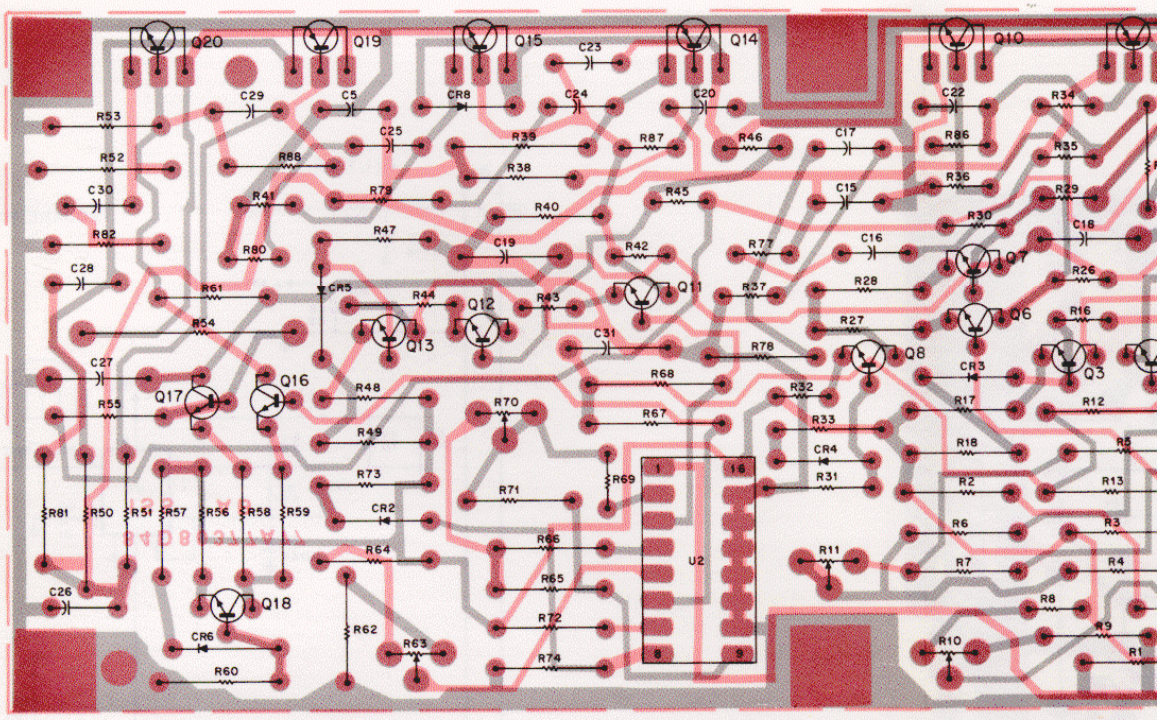
UNUSED FUNCTIONS

U1 AND U2
(4 PNP TRANSISTORS TOTAL)

NOTE:

Unless otherwise
capacitors are in m

Reference Desi
U1
U2

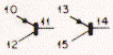


SHOWN FROM COMPONENT SIDE

J2

4	HORIZ. DEFL.
8	+140V
9, 10, 11, 12, 13, 14	GND
1	BLANKING
5	$\overline{\text{HORIZ. DEFL.}}$
6	$-10V_A$
7	+12V
2	VERT. DEFL.
3	$\overline{\text{VERT. DEFL.}}$

UNUSED FUNCTIONS

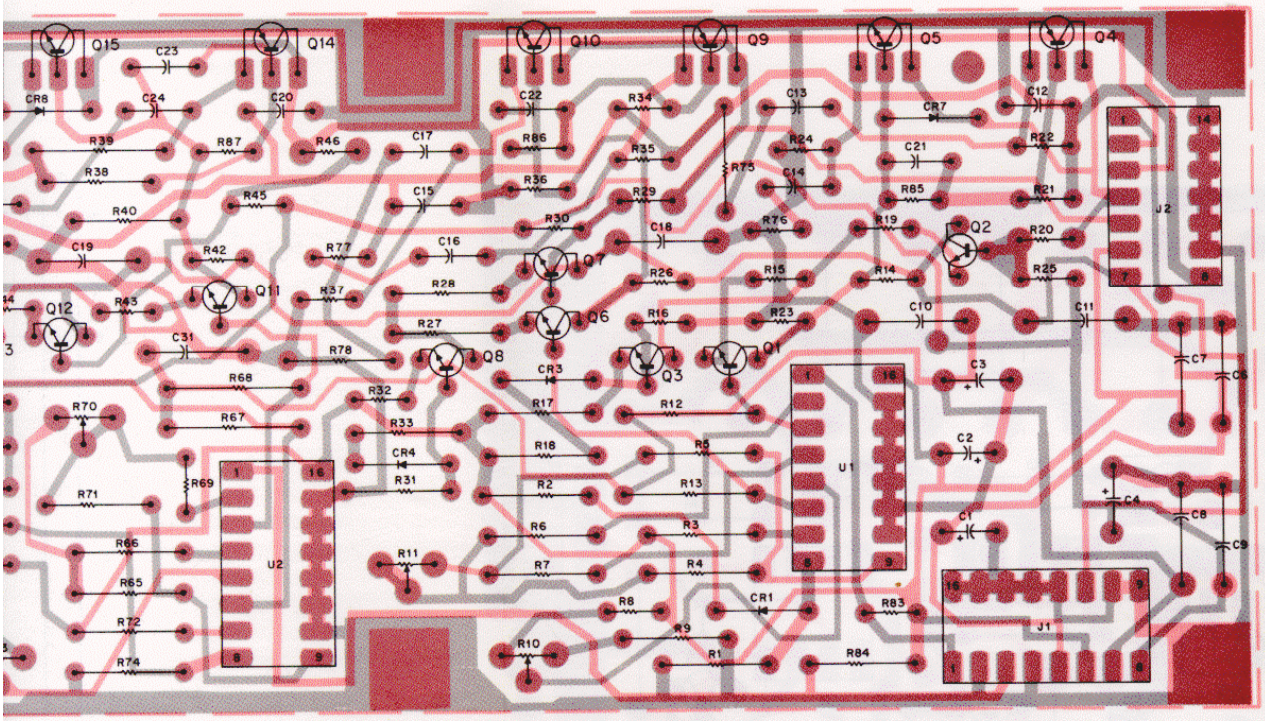


U1 AND U2
(4 PNP TRANSISTORS TOTAL)

NOTE:

Unless otherwise specified: all resistors are in ohms, 1%, 1/8 watt; all capacitors are in microfarads.

Reference Designation	Manufacturer's Description	$-10\ V_A$	GND
U1	Transistor Array	Pin 16	Pins 10-15
U2	Transistor Array	Pin 16	Pins 10-15



SOLDER SIDE ● BD-DEPS-36385-O
COMPONENT SIDE ● BD-DEPS-36386-O
OL-DEPS-36384-A

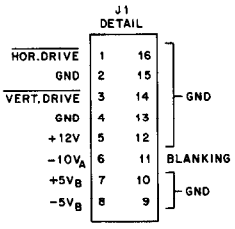
SHOWN FROM COMPONENT SIDE

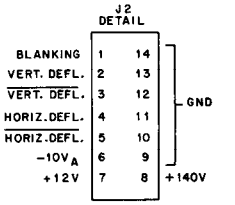
8 watt; all

GND
ns 10-15
ns 10-15

parts list

RTC4021A Scope Driver Board — PL-8457-O





REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed uF; +60-40%; 250 V: unless otherwise stated:
C1, 2, 3, 4	23-84665F01	10 uF +100-10%; 25 V
C5	21-82428B40	.01
C6 thru 11	21-82372C01	0.1 uF +80-20%; 25 V
C12	21-82428B40	.01 uF
C13, 14	21-859178	270 pF ±5%; 300 V
C15	21-82428B40	.01
C16, 17	21-859178	270 pF ±5%; 300 V
C18, 19	21-82372C01	0.1 uF +80-20%; 25 V
C20, 21, 22, 23	21-82428B40	.01
C24, 25	21-859179	270 pF ±5%; 300 V
C26	21-82428B40	.01
C27	21-82372C01	0.1 uF +80-20%; 25 V
C28	21-859179	270 pF ±5%; 300 V
C29	21-82428B40	.01
C30	21-859179	270 pF ±5%; 300 V
C31	21-82372C01	0.1 uF +80-20%; 25 V
		diode: (see note)
CR1 thru 6	48-83654H01	silicon
CR7, 8	48-82420C15	silicon
		transistor: (see note)
Q1, 2, 3	48-869721	NPN; type 2N5209
Q4	48-80341A48	PNP; type MPSU60
Q5	48-80341A47	NPN; type MPSU10
U6, 7, 8	48-869721	NPN; type 2N5209
U9	48-80341A48	PNP; type MPSU60
Q10	48-80341A47	NPN; type MPSU10
Q11, 12, 13	48-869721	NPN; type 2N5209
Q14	48-80341A48	PNP; type MPSU60
Q15	48-80341A47	NPN; type MPSU10
Q16, 17, 18	48-869721	NPN; type 2N5209
Q19	48-80341A48	PNP; type MPSU60
Q20	48-80341A47	NPN; type MPSU10
		resistor, fixed: ±1%; 1/8 W: unless otherwise stated
R1	6-10621C75	6.81k
R2	6-10621B63	475
R3	6-10621A66	47.5
R4, 5, 6, 7	6-10621A97	100
R8, 9	6-10621C91	10k
R10	18-83452F12	variable; 5k
R11	18-83452F08	variable; 500
R12, 13	6-80313A96	1.1k; 1/4 W
R14	6-84444A02	825; 1/4 W
R15	6-10621A01	10
R16	6-10621C45	3.32k
R17	6-10621B63	475
R18	6-10621C60	4.75k
R19	6-10621A01	10
R20	6-80378A20	47.5k; 1/2 W
R21	6-10621C99	12.1k
R22	6-80313A97	3.01k; 1/4 W
R23	6-10621C79	7.5k
R24	6-80313A97	3.01k; 1/4 W
R25	6-10621C45	3.32k
R26	6-84444A02	825; 1/4 W
R27, 28	6-10621A01	10
R29	6-80378A20	47.5k; 1/2 W
R30, 31	6-10621C45	3.32k
R32	6-10621B63	475
R33	6-10621C60	4.75k
R34	6-10621C99	12.1k
R35	6-80313A97	3.01k; 1/4 W
R36	6-10621C79	7.5k
R37	6-80313A97	3.01k; 1/4 W
R38	6-10621C99	12.1k
R39	6-80313A97	3.01k; 1/4 W
R40	6-10621C79	7.5k
R41	6-80313A97	3.01k; 1/4 W
R42	6-84444A02	825; 1/4 W
R43, 44	6-10621A01	10
R45	6-10621C45	3.32k
R46	6-80378A20	47.5k; 1/2 W
R47	6-10621C45	3.32k
R48	6-10621B63	475
R49	6-10621C60	4.75k
R50	6-80313A97	3.01k; 1/4 W
R51	6-10621C99	12.1k
R52	6-80313A97	3.01k; 1/4 W
R53	6-10621C79	7.5k
R54	6-80378A20	47.5k; 1/2 W
R55	6-10621C45	3.32k
R56	6-10621B63	475
R57	6-10621C60	4.75k
R58, 59	6-10621A01	10
R60	6-10621C45	3.32k
R61	6-84444A02	825; 1/4 W
R62	6-10621C91	10k
R63	18-83452F12	variable; 5k
R64	6-10621C91	10k
R65	6-10621A97	100
R66	6-10621A66	47.5

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R67, 68	6-80313A96	1.1k; 1/4 W
R69	6-10621A66	47.5
R70	18-83452F08	variable; 500
R71	6-10621A97	100
R72	6-10621A66	47.5
R73	6-10621B63	475
R74	6-10621C75	6.81k
R75 thru 82	6-124A60	3k ± 5%; 1/4 W
R83, 84	6-124A49	1k ± 5%; 1/4 W
R85 thru 88	6-124A99	120k ± 5%; 1/4 W
		integrated circuit: (see note)
U1, 2	51-83629M10	linear transistor array
		mechanical parts
	9-84906E01	SOCKET, 14 contact
	9-84906E02	SOCKET, 16 contact

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

SCOPE AMPLIFIER BOARD (A04)

MODEL RTL4022A

1. DESCRIPTION

1.1 The scope amplifier board develops the signals necessary to drive the scope module (A03). AC and dc voltages are developed for the scope driver board. In addition, vertical signal amplification and dc level shift are provided. A blanking signal is applied to the scope high voltage board.

1.2 The scope amplifier operates in auto or normal modes. When a triggerable vertical signal is present, a sweep is developed in both auto or normal modes. When a triggerable signal is not present, the sweep is blanked in the normal mode and free running in the auto mode. An external horizontal input is available at the front panel.

2. THEORY OF OPERATION

2.1 ADDRESS/DATA LATCH

When address lines AØ-A3 are low, the scope data lines DØ-D7 are clocked into latch U23. The output of U23 is buffered and level shifted by U1 and U17.

2.2 INTERNAL HORIZONTAL TIME BASE

An internal horizontal time base is generated by a ramp generator and the blanking and trigger hold off circuitry.

2.2.1 Ramp Generator

The ramp signal is developed using an integrator with a constant voltage applied. The sweep rate is determined by R44, R45, R46 and C3, C4, and C5. The combinations of the RC network produce six sweep rates over a six decade range between 1 microsecond and 100 milliseconds.

2.2.2 Blanking and Trigger Hold Off Circuitry

2.2.2.1 When the ramp voltage reaches 6 volts, the output of U8B is a blanking pulse which is used to short circuit the integrator (via switch U4C) and develop a hold off time (U9B). During this time, U8A and U10B are disabled. In the normal triggering mode, U10B is always disabled thus keeping the blanking signal high and preventing the ramp from starting until a trigger pulse is present at U12B. The output of U12B is a negative- going pulse to U10A, which resets U8B if all other inputs are low. This starts the ramp signal.

2.2.2.2 In the auto triggering mode with no trigger pulse present, U9B allows sufficient time for the retrace to occur before applying a low to U10B. When this occurs, U8B is clocked low and the ramp cycle begins. U12A delays the free-running auto triggering by disabling U10B for about 0.2 seconds following the last trigger pulse from U12B. Free-run operation begins if there are no other trigger pulses during that time.

2.3 EXTERNAL HORIZONTAL

An externally generated horizontal signal applied to the EXT HORIZ input jack on the service monitor front panel is amplified and level shifted by U19A and U19B.

2.4 VERTICAL AMPLIFIER

Amplifier U14 forms a differential amplifier and current source for amplifying the vertical signal. A VERTical vernier control on the front panel is connected between emitter resistors and is used to control gain. When in the calibrated position (fully CCW), maximum signal gain is attained.

2.5 TRIGGER LEVEL/OUTPUT

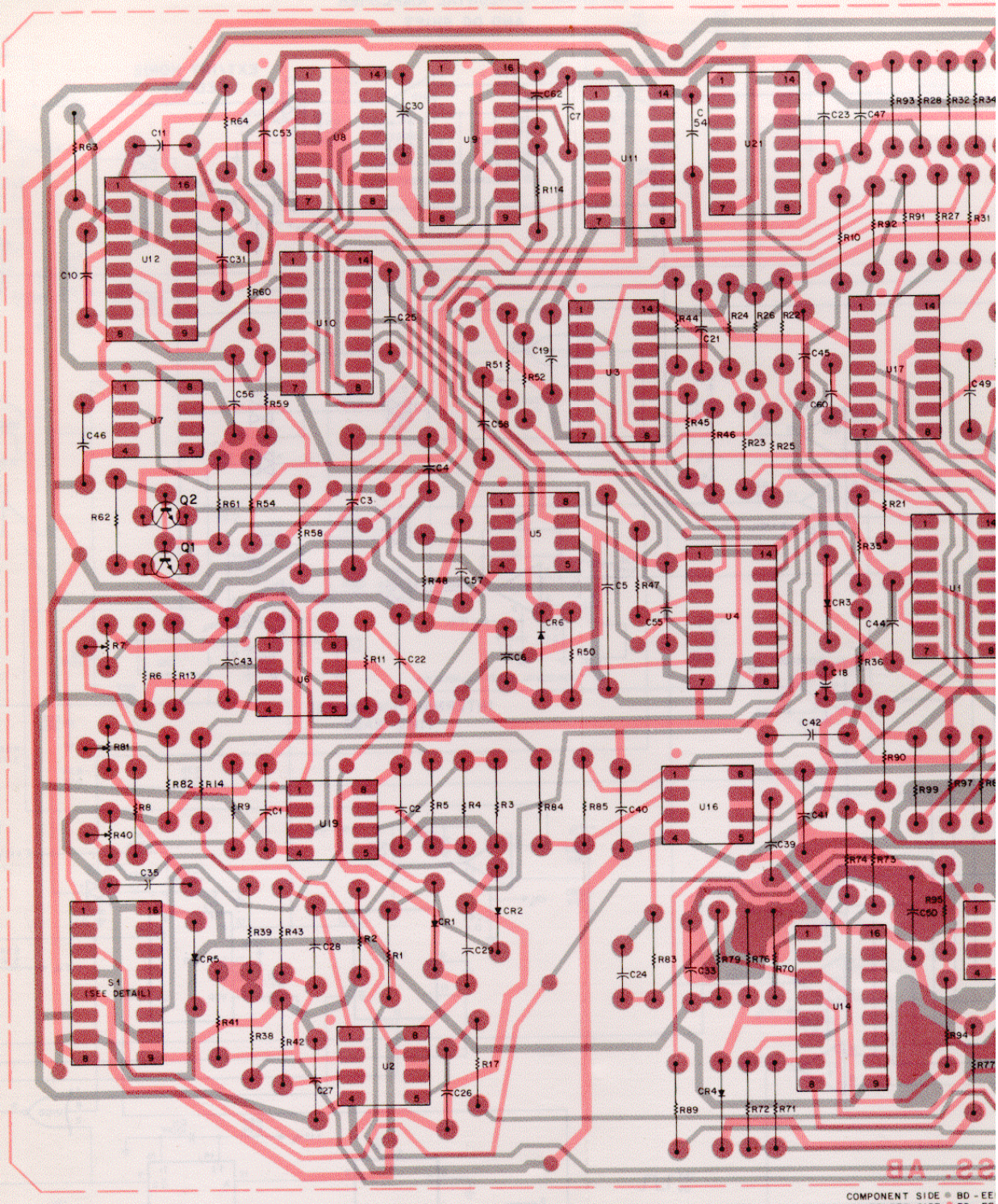
The amplified vertical signal is compared to the trigger level set by the TRIG LEVEL control. The output signal is a squarewave with the duty cycle dependent upon the control setting. The high-to-low transition coincides with a point on the rising edge of the vertical signal input from the front panel interface board.

parts list

RTC4022A Scope Amplifier Board — PL-8455-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF; ± 5%; 500 V: unless otherwise stated
C1, 2	21-82372C01	0.1 uF + 80-20%; 25 V
C3	20-83601B10	variable; 100
C4	21-840812	200
C5	8-82317B02	0.25 uF ± 10%; 100 V
C6	21-868681	47; 300 V
C7	21-847601	1000 uF
C8, 9		NOT USED
C10	8-84637L22	0.22 uF ± 10%; 100 V
C11	21-850118	100
C12, 13	23-84665F01	10 uF + 100-10%; 25 V
C14, 15	8-84637L34	0.33 uF ± 10%; 100 V
C16, 17	8-84637L31	.047 uF ± 10%; 250 V
C18	23-84665F01	10 uF + 100-10%; 25 V
C19	21-82372C01	0.1 uF + 80-20%; 25 V
C20	23-84665F01	10 uF + 100-10%; 25 V
C21, 22, 23	21-82372C01	0.1 uF + 80-20%; 25 V
C24	21-832502	.02 uF + 60-40%; 250 V
C25 thru 58	21-82372C01	0.1 uF + 80-20%; 25 V
C59	21-847091	80 ± 2%; 300 V
C60	21-863623	56
C61		NOT USED
C62	21-82187B27	.002 uF ± 10%; 200 V
		diode: (see note)
CR1, 2, 3, 4	48-83654H01	silicon
CR5	48-82466H01	silicon
CR6 thru 9	48-83654H01	silicon
		connector, receptacle:
J1	9-84231B02	female; single contact (phone)
J2	9-84906E02	female; 16 contact, IC
		transistor: (see note)
Q1	48-869571	PNP; type M9571
Q2	48-869570	NPN; type M9570
		resistor, fixed; ± 5%; 1/8 W: unless otherwise stated
R1	6-10621C75	6.81k ± 1%
R2	6-124A73	10k; 1/4 W
R3	6-10621C91	10k ± 1%
R4	6-10621D29	24.3k ± 1%
R5	6-10621C75	6.81k ± 1%
R6	6-10621D49	39.2k ± 1%
R7	18-83452F32	variable; 10k
R8	6-10621C91	10k ± 1%
R9	6-10621D29	24.3k ± 1%
R10	6-124A73	10k; 1/4 W
R11	6-10621C79	7.5k ± 1%
R12		NOT USED
R13	6-10621C41	3.01k ± 1%
R14	6-10621C63	5.11k ± 1%
R15	6-10621C67	5.62k ± 1%
R16		NOT USED
R17	6-10621C91	10k ± 1%
R18	6-10621C24	2.0k ± 1%
R19	6-124A79	18k; 1/4 W
R20	6-124A53	1.5k; 1/4 W
R21	6-124A60	3k; 1/4 W
R22	6-124A69	6.8k; 1/4 W
R23	6-124A60	3k; 1/4 W
R24	6-124A69	6.8k; 1/4 W
R25	6-124A60	3k; 1/4 W
R26	6-124A69	6.8k; 1/4 W
R27	6-124A60	3k; 1/4 W
R28	6-129A69	6.8k; 1/4 W
R29	6-124A79	18k; 1/4 W
R30	6-124A53	1.5k; 1/4 W
R31 thru 36	6-124A66	5.1k; 1/4 W
R37		NOT USED
U38	6-10621C63	5.11k ± 1%
R39	6-10621B31	221 ± 1%
R40	18-83452F09	variable; 1k
R41	6-10621C91	10k ± 1%
R42	6-10621C63	5.11k ± 1%
R43	6-10621C91	10k ± 1%
R44	6-10621C74	6.65k ± 1%
R45	6-10621D71	66.5k ± 1%
R46	6-10621E68	665k ± 1%
R47	6-1024A25	100; 1/4 W
R48	6-10621C63	5.11k ± 1%
R49		NOT USED
R50	6-124A92	62k; 1/4 W
R51	6-124B14	470k; 1/4 W
R52	6-124A73	10k; 1/4 W
R53		NOT USED
R54	6-124A65	4.7k; 1/4 W
R58	6-10621C63	5.11k ± 1%
R59, 60	6-10621C91	10k ± 1%
R61, 62	6-124A91	56k; 1/4 W
R63	6-124B21	910k; 1/4 W
R64	6-124A69	6.8k; 1/4 W
R65		NOT USED
R66	6-10621C63	5.11k ± 1%
R69, 70	6-10621B98	1.1k ± 1%
R71	6-10621A66	47.5 ± 1%
R72, 73	6-84444A10	2.74k ± 1%
R74	6-10621A66	47.5k ± 1%
R75		NOT USED
R76	6-10621D41	32.4k ± 1%
R77	6-10621C49	3.65k ± 1%
R78	6-10621B52	365 ± 1%
R79	6-10621C20	1.82k ± 1%
R80		NOT USED
R81	18-83452F30	variable; 500
R82	6-124A38	360; 1/4 W
R83	6-10621D88	100k ± 1%
R84	6-10621C91	10k ± 1%
R85	6-10621D57	47.5k ± 1%
R86	6-10621C99	12.1k ± 1%
R87		NOT USED
R88	6-10621C88	9.31k ± 1%
R89	6-10621D88	100k ± 1%
R90	6-124A73	10k; 1/4 W
R91	6-124B37	4.3 meg; 1/4 W
R92, 93	6-124A66	5.1k; 1/4 W
R94, 95	6-10621C91	10k ± 1%
R96	6-10621D96	121k ± 1%
R97	6-10621C32	2.43k ± 1%
R98		NOT USED
R99	6-10621D29	24.3k ± 1%
R100	6-10621C91	10k ± 1%
R101		NOT USED
R102	6-124A68	6.2k; 1/4 W
R114	6-124A01	10; 1/4 W
		integrated circuit: (see note)
U1	51-84371K59	quad comparator
U2	51-84371K63	dual operational amplifier
U3, 4	51-82884L48	quad analog switch
U5, 6	51-80365A09	operational amplifier
U7	51-80347A38	voltage comparator
U8	51-82884L13	dual D flip-flop
U9	51-82884L53	dual precision monostable multivibrator
U10	51-82884L17	triple 3-input NOR gate
U11	51-82884L05	quad 2-input NAND gate
U12	51-82884L53	dual precision monostable multivibrator
U13	51-80365A07	operational amplifier
U14	51-83629M10	linear transistor array
U15	51-84371K60	single operational amplifier
U16	51-80365A07	operational amplifier
U17	51-84371K59	quad comparator
U18	51-82609M20	negative voltage regulator
U19	51-80365A07	operational amplifier
U20	51-84561L76	positive voltage regulator
U21	51-82884L05	quad 2-input NAND gate
U22	51-84561L38	triple 3-input NOR gate
U23	51-82609M17	octal D-type flip-flop
U24	51-80365A29	negative voltage regulator
		mechanical parts
	9-84906E02	SOCKET, 16 pin
	45-80395A42	ACTUATOR, ejector; 2 used
	75-80378A83	PAD

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

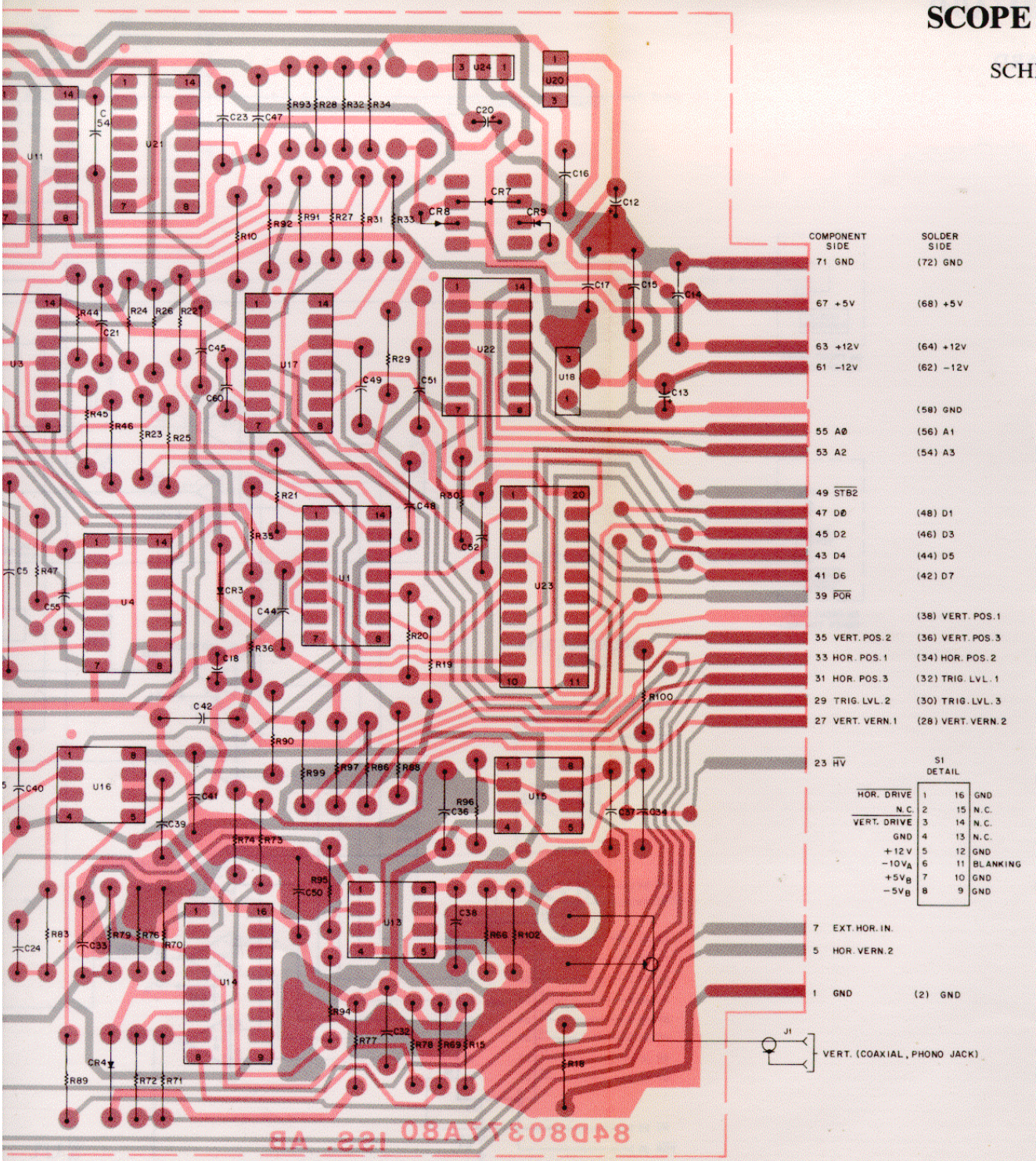


SHOWN FROM COMPONENT SIDE

COMPONENT SIDE BD - EE
SOLDER SIDE BD - EE
OVERLAY OL - EE

SCOPE A

SCHEM



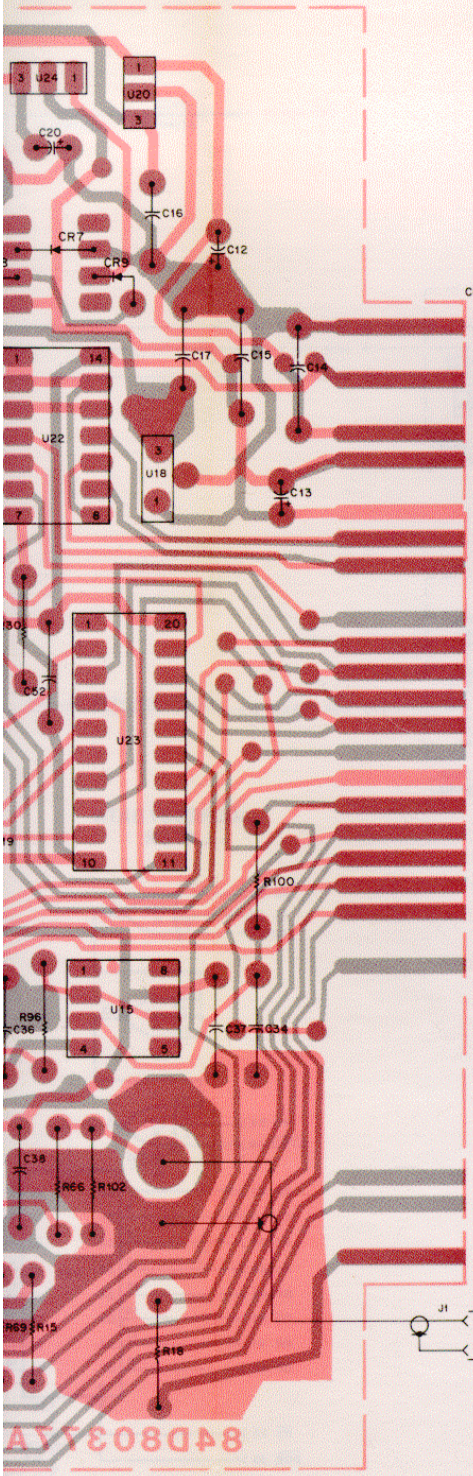
COMPONENT SIDE

COMPONENT SIDE ● BD - EEPS - 36262 - O
SOLDER SIDE ● BD - EEPS - 36263 - O
OVERLAY OL - EEPS - 36261 - A

NOTE:
PIN NUMBERS AND SIGNAL NAMES IN PARENTHESES, ( ), ARE ON SOLDER SIDE.

SCOPE AMPLIFIER BOARD (A04)

MODEL RTL4022A
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



COMPONENT SIDE	SOLDER SIDE
71 GND	(72) GND
67 +5V	(68) +5V
63 +12V	(64) +12V
61 −12V	(62) −12V
	(58) GND
55 A0	(56) A1
53 A2	(54) A3
49 $\overline{STB2}$	
47 D0	(48) D1
45 D2	(46) D3
43 D4	(44) D5
41 D6	(42) D7
39 $\overline{POR}$	
	(38) VERT. POS. 1
35 VERT. POS. 2	(36) VERT. POS. 3
33 HOR. POS. 1	(34) HOR. POS. 2
31 HOR. POS. 3	(32) TRIG. LVL. 1
29 TRIG. LVL. 2	(30) TRIG. LVL. 3
27 VERT. VERN. 1	(28) VERT. VERN. 2
23 $\overline{HV}$	

S1 DETAIL

$\overline{HOR.\ DRIVE}$	1	16	GND
N.C.	2	15	N.C.
$\overline{VERT.\ DRIVE}$	3	14	N.C.
GND	4	13	N.C.
+12V	5	12	GND
$-10V_A$	6	11	BLANKING
$+5V_B$	7	10	GND
$-5V_B$	8	9	GND

7	EXT. HOR. IN.	
5	HOR. VERN. 2	
1	GND	(2) GND

J1 — VERT. (COAXIAL, PHONO JACK)

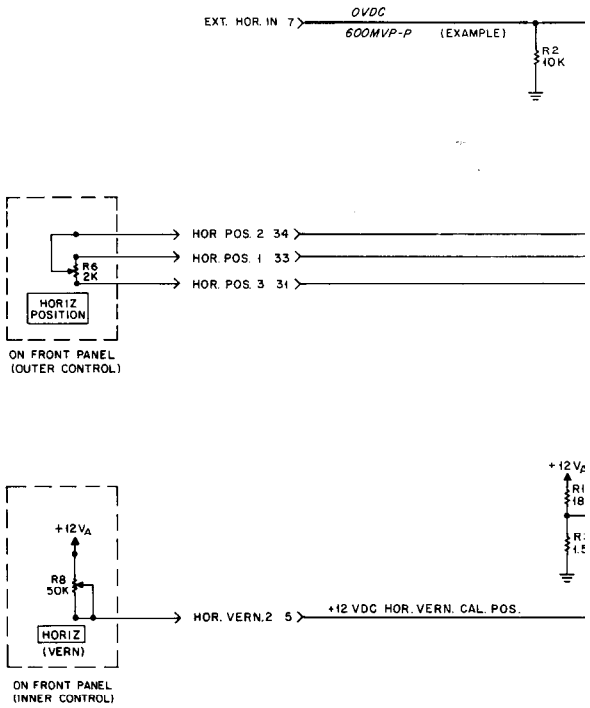
NOTE:
PIN NUMBERS AND SIGNAL NAMES IN PARENTHESES, ( ), ARE ON SOLDER SIDE.

Motorola No. PEPS-36844-O
(Sheet 1 of 3)
8/12/83- PHI

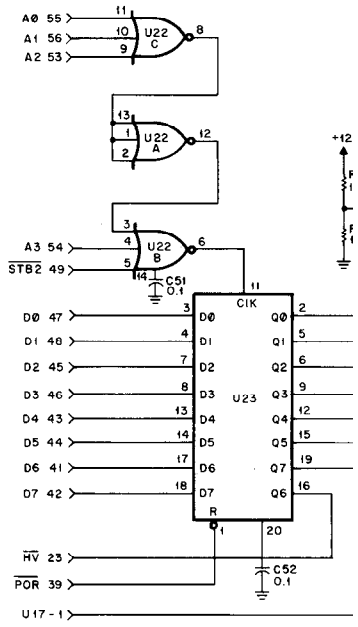
SCOPE AMPLIFIER BOARD

SCOPE AMPLIFIER BOARD (A04)

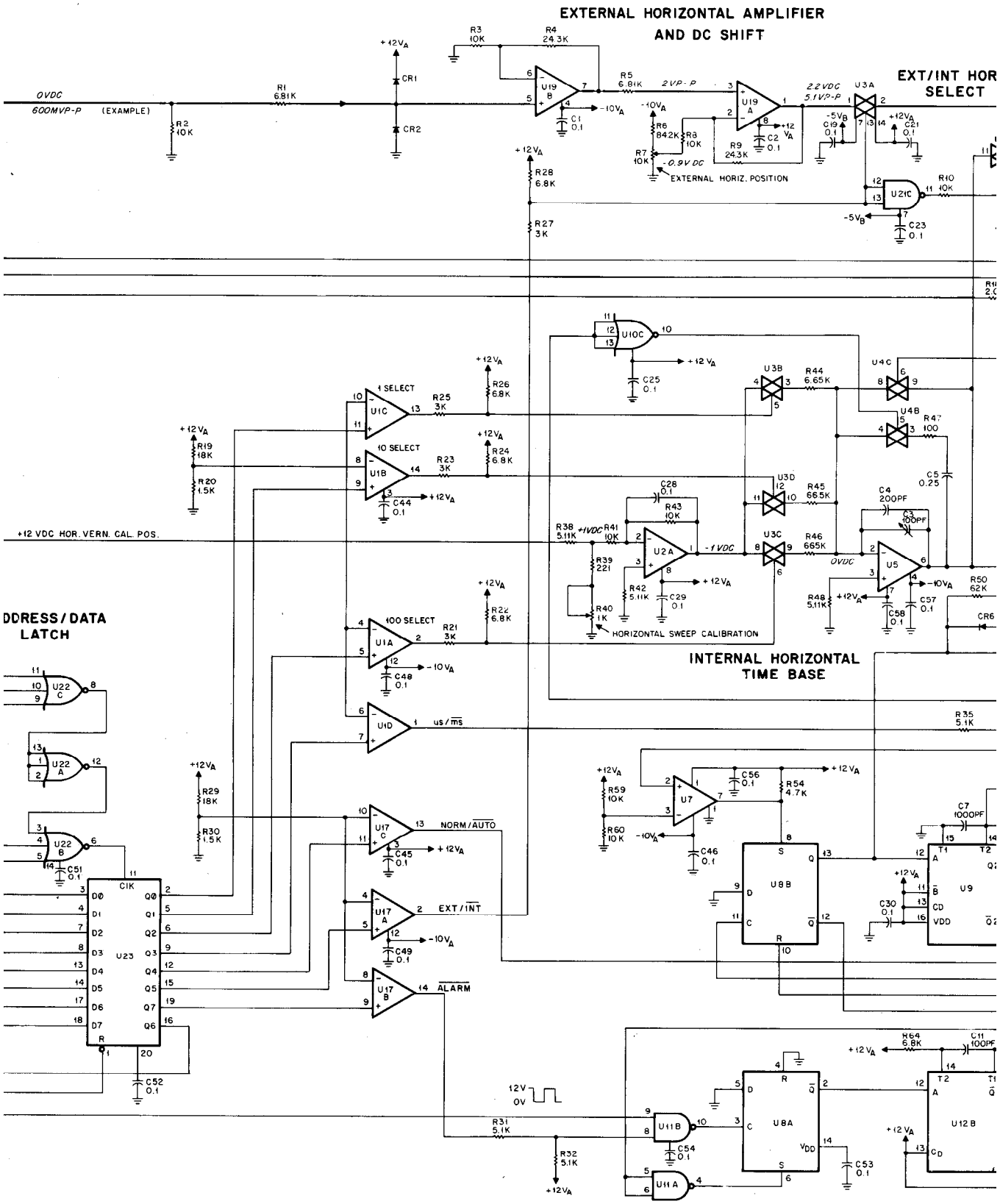
MODEL RTL4022A
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



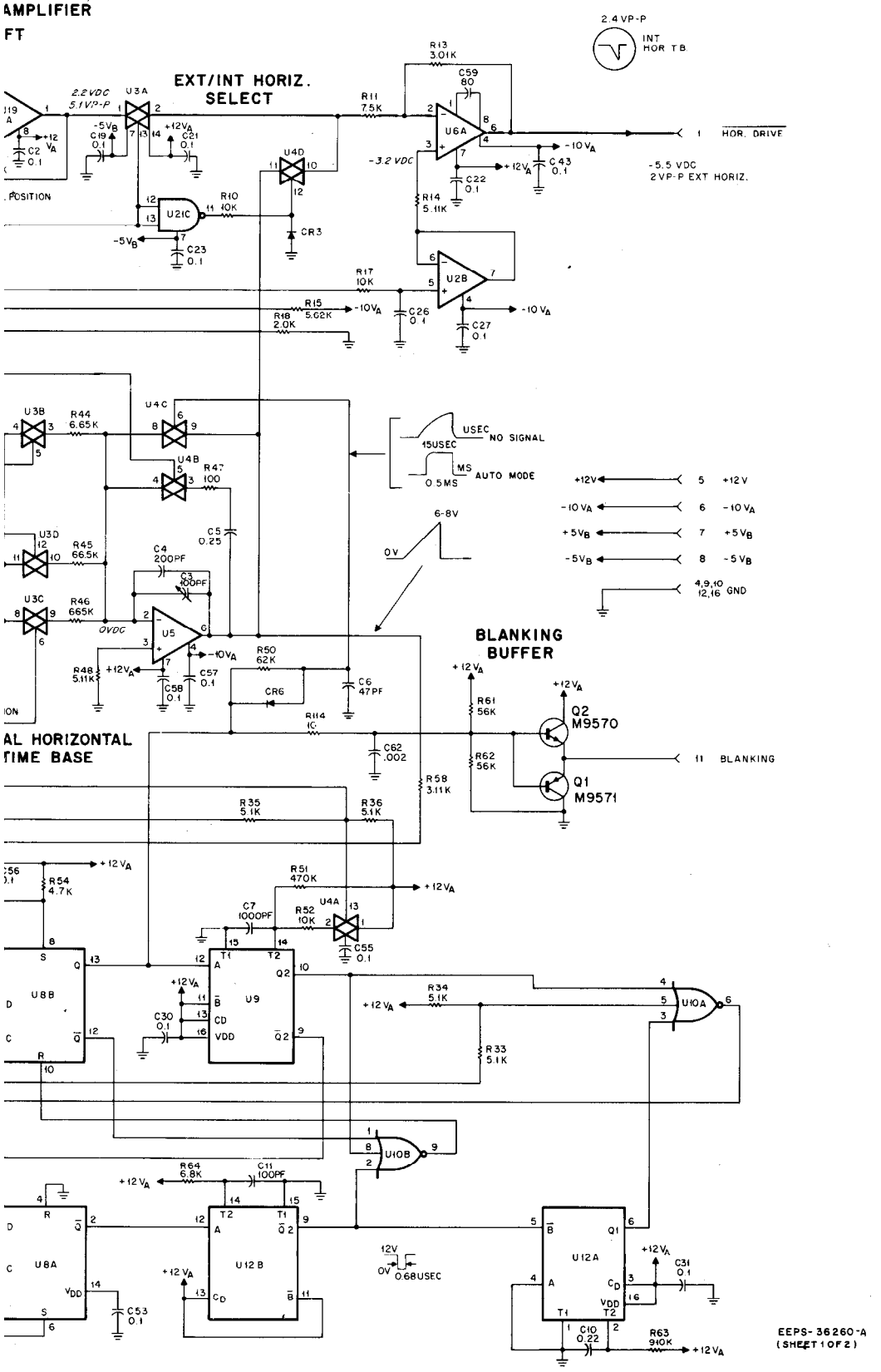
ADDRESS / DATA LATCH



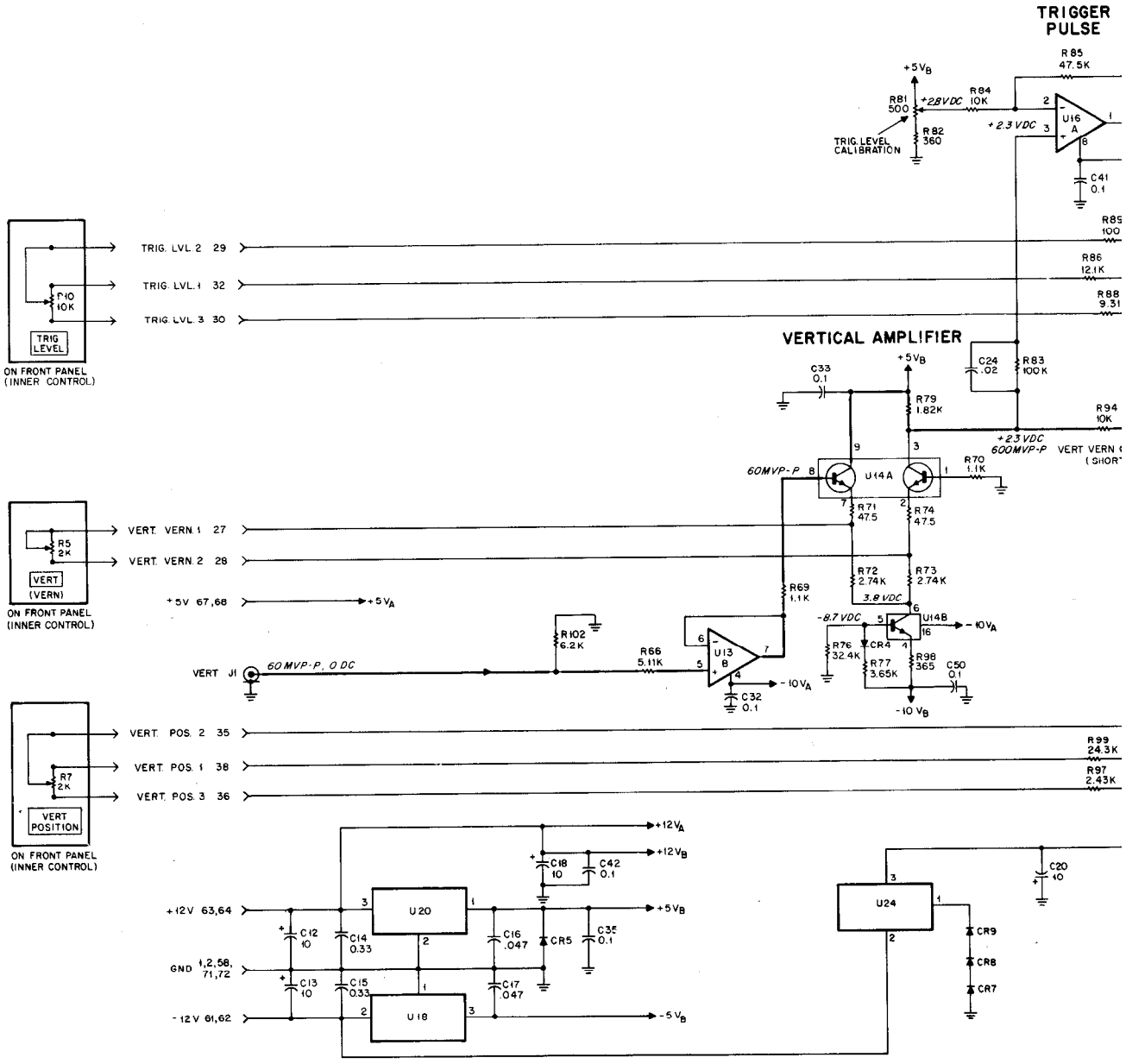
*Motorola No. **PEPS-36844-O***
(Sheet 2 of 3)
8/12/83-PHI


EXTERNAL HORIZONTAL AMPLIFIER AND DC SHIFT
EXT/INT HOR SELECT
0VDC
600MVP-P (EXAMPLE)
R1 6.81K
R2 10K
CR1
CR2
+12VA
R3 10K
R4 24.3K
U19 B
R5 6.81K
2VP-P
U19 A
2.2VDC 5.1VP-P
U3A
-10VA
R6 842K
R8 10K
R7 10K
-0.9V DC
EXTERNAL HORIZ. POSITION
R9 24.3K
C2 0.1
C1 0.1
-5VB
C19 0.1
C21 0.1
R10 10K
U21C
C23 0.1
R28 6.8K
R27 3K
+12 VDC HOR. VERN. CAL. POS.
1 SELECT
10 SELECT
100 SELECT
U1C
U1B
U1A
U1D
R25 3K
R23 3K
R21 3K
R26 6.8K
R24 6.8K
R22 6.8K
R19 18K
R20 1.5K
C44 0.1
C48 0.1
us/ms
U10C
C25 0.1
U3B
U3C
U3D
U4B
U4C
R44 6.65K
R45 665K
R46 665K
R47 100
C5 0.25
C4 200PF
C3 100PF
C28 0.1
R43 10K
R38 5.11K
+1VDC
R41 10K
U2A
-1VDC
R39 221
R42 5.11K
C29 0.1
R40 1K
HORIZONTAL SWEEP CALIBRATION
OVDC
U5
R48 5.11K
C57 0.1
C58 0.1
R50 62K
CR6
INTERNAL HORIZONTAL TIME BASE
R35 5.1K
DDRESS/DATA LATCH
U22 C
U22 A
U22 B
C51 0.1
R29 18K
R30 1.5K
U23
CIK
D0
D1
D2
D3
D4
D5
D6
D7
Q0
Q1
Q2
Q3
Q4
Q5
Q7
Q6
C52 0.1
U17 C
NORM/AUTO
C45 0.1
U17 A
EXT/INT
C49 0.1
U17 B
ALARM
R59 10K
R60 10K
U7
C56 0.1
R54 4.7K
C46 0.1
U8B
C7 1000PF
T1
T2
U9
C30 0.1
VDD
12V
0V
R31 5.1K
R32 5.1K
U11B
U11A
C54 0.1
U8A
C53 0.1
R64 6.8K
C11 100PF
U12B

AMPLIFIER
FT

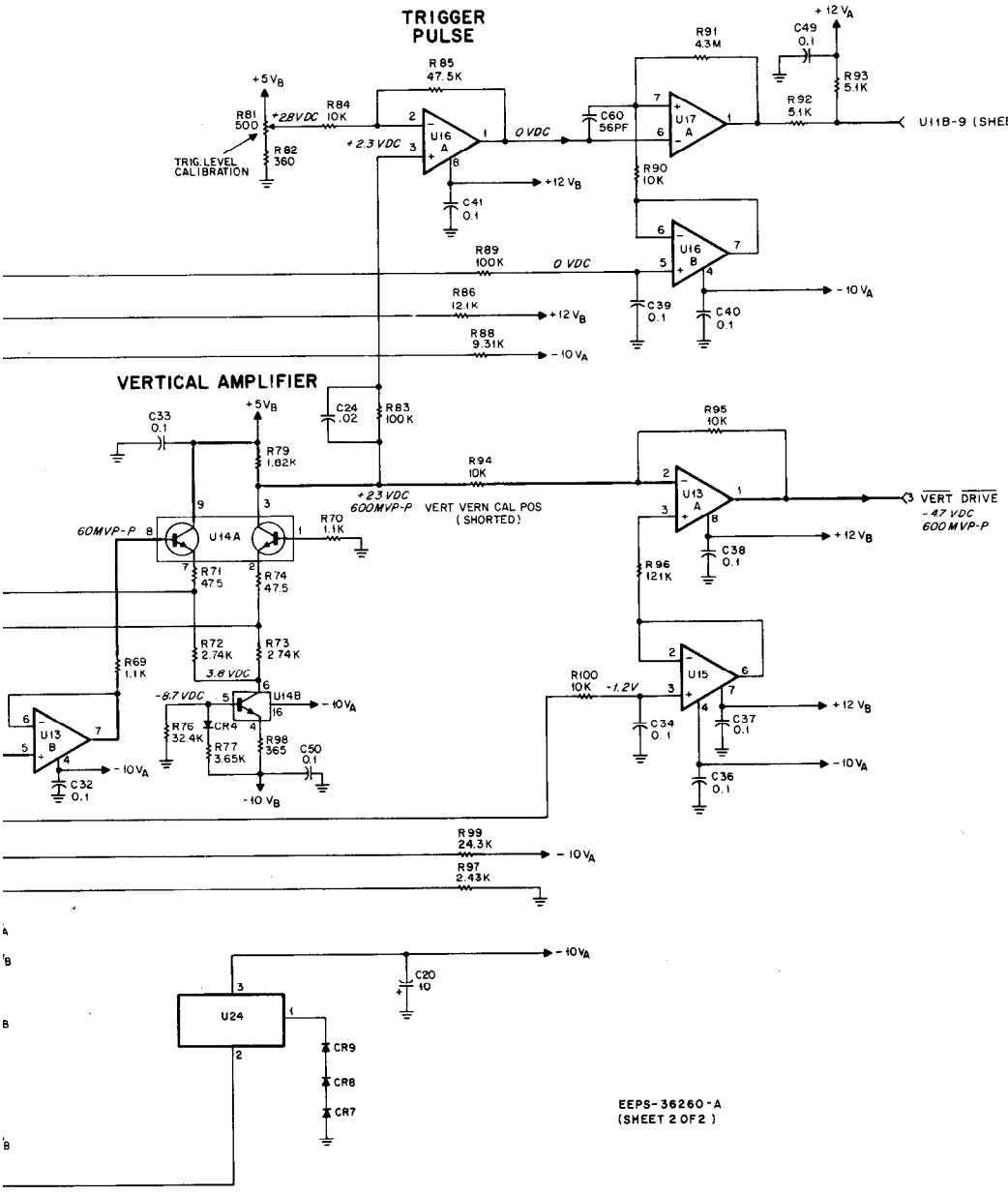


EEPS-36260-A
(SHEET 1 OF 2)


TRIGGER PULSE
+5V_B
R81 500
+2.8VDC
R84 10K
R85 47.5K
R82 360
TRIG. LEVEL CALIBRATION
+2.3 VDC
U16 A
C41 0.1
TRIG. LVL. 2 29
TRIG. LVL. 1 32
TRIG. LVL. 3 30
R10 10K
TRIG LEVEL
ON FRONT PANEL (INNER CONTROL)
R89 100
R86 12.1K
R88 9.31
VERTICAL AMPLIFIER
C33 0.1
C24 .02
R83 100K
R79 1.82K
R94 10K
+2.3 VDC
600MVP-P
VERT VERN (SHORT
60MVP-P
U14A
R70 1.1K
R71 47.5
R74 47.5
VERT. VERN. 1 27
VERT. VERN. 2 28
R5 2K
VERT (VERN)
ON FRONT PANEL (INNER CONTROL)
+5V 67,68
+5V_A
R69 1.1K
R72 2.74K
R73 2.74K
3.8 VDC
-8.7 VDC
U14B
-10V_A
R102 6.2K
VERT J1
60MVP-P, 0 DC
R66 5.11K
U13 B
C32 0.1
R76 32.4K
CR4
R77 3.65K
R98 365
C50 0.1
-10 V_B
VERT. POS. 2 35
VERT. POS. 1 38
VERT. POS. 3 36
R99 24.3K
R97 2.43K
R7 2K
VERT POSITION
ON FRONT PANEL (INNER CONTROL)
+12V_A
+12V_B
C18 10
C42 0.1
+12V 63,64
U20
C12 10
C14 0.33
C16 .047
CR5
C35 0.1
+5V_B
GND 1,2,58, 71,72
C13 10
C15 0.33
C17 .047
-12V 61,62
U18
-5V_B
U24
C20 10
CR9
CR8
CR7

SCOPE AM

SCHEMA



EEPS-36260-A
(SHEET 2 OF 2)

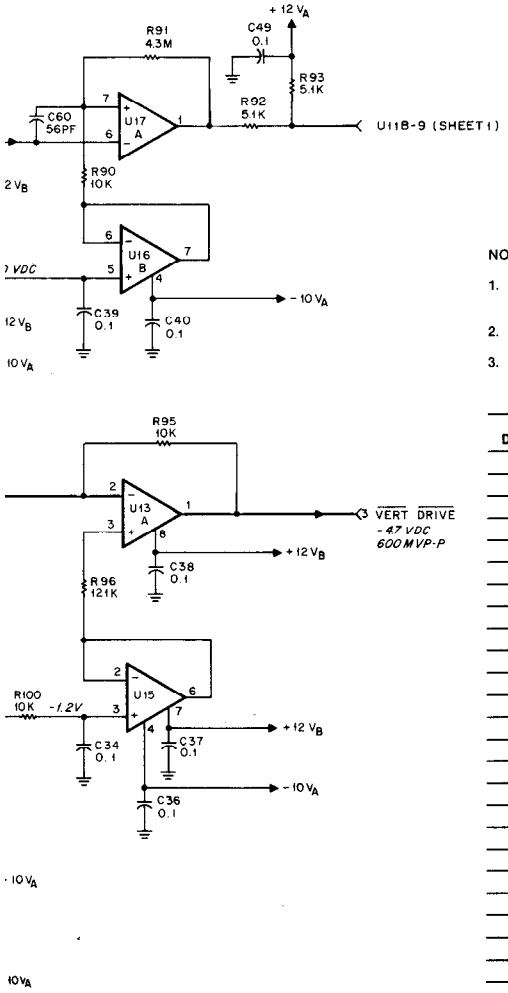
NOTES:

1. Unless otherwise indicated, all resistor v values are microfarads; and inductors are
2. IC types are TTL and CMOS devices.
3. Types and connections for the integrate follows:

Reference Designation	Mfgr's Description
U1	Quad Comparator
U2	Dual Op-Amp
U3	Quad Analog Switch
U4	Quad Analog Switch
U5	Op Amp
U6	Op Amp
U7	Voltage Comparator
U8	Dual-D Dlip-Flop
U9	Dual Retrig Monostable
U10	Triple 3-Input NOR
U11	Quad 2-Input NAND
U12	Dual Retrig Monostable
U13	Dual Op Amp
U14	NPN/PNP Trans Array
U15	Op Amp
U16	Dual Op Amp
U17	Quad Comparator
U18	Neg Voltage Reg
U19	Dual Op Amp
U20	Pos Voltage Reg
U21	Quad 2-Input NAND
U22	Triple 3-Input NOR
U23	Octal F-F Comm Clk
U24	Neg Voltage Reg

SCOPE AMPLIFIER BOARD (A04)

MODEL TRL4022A
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



NOTES:

1. Unless otherwise indicated, all resistor values are in ohms, 1%; all capacitor values are microfarads; and inductors are in microhenries.
2. IC types are TTL and CMOS devices.
3. Types and connections for the integrated circuits used on this board are as follows:

Reference Designation	Mfgr's Description	+12 V_A (+12 V_B)	−10 V_A	−5 V_B	+5 V_A	GND	−12 V
U1	Quad Comparator	3	12				
U2	Dual Op-Amp	8	4				
U3	Quad Analog Switch	14		7			
U4	Quad Analog Switch	14				7	
U5	Op Amp	7	4				
U6	Op Amp	7	4				
U7	Voltage Comparator	8	4			1	
U8	Dual-D Dlip-Flop	14				7	
U9	Dual Retrig Monostable	16				8	
U10	Triple 3-Input NOR	14				7	
U11	Quad 2-Input NAND	14				7	
U12	Dual Retrig Monostable	16				8	
U13	Dual Op Amp	(8)	4				
U14	NPN/PNP Trans Array		16				
U15	Op Amp	(7)	4				
U16	Dual Op Amp	(8)	4				
U17	Quad Comparator	3	12				
U18	Neg Voltage Reg					1	2
U19	Dual Op Amp	8	4				
U20	Pos Voltage Reg	3				2	
U21	Quad 2-Input NAND	14		7			
U22	Triple 3-Input NOR				14	7	
U23	Octal F-F Comm Clk				20	10	
U24	Neg Voltage Reg						2

EEPS-36260-A
(SHEET 2 OF 2)

SCOPE AMPLIFIER BOARD

*Motorola No. **PEPS-36844-O***
(Sheet 3 of 3)
8/12/83-PHI

RF SYNTHESIZER (A05)

MODEL RTC1001B

1. DESCRIPTION

The rf synthesizer provides an rf signal source for the frequency range from 10 kHz to 1 GHz in 100 Hz steps. The output frequency is programmed by the microprocessor through the rf control bus and is phase-locked to the 10 MHz frequency standard. A reference divider in the module produces outputs of 500 kHz, 50 kHz, 1 kHz, 100 Hz, and 50 Hz each having the same accuracy as the frequency standard.

2. THEORY OF OPERATION

2.1 GENERAL

2.1.1 Four phase-locked loops are used to generate the output frequency; a 60.5 MHz loop; a 310-440 MHz loop; the 500 MHz-1000 MHz loop; and the 550 MHz loop. Two of these loops contain programmable dividers, controlled by the microprocessor for varying the frequency. The 310-440 MHz loop is controlled by the four most significant digits of the required frequency and operates in discrete 50 kHz increments. The 60.5 MHz loop is controlled by the three least significant digits of the required frequency and operates in discrete 50 Hz increments.

2.1.2 The output is derived from three sources, covering the ranges of 10 kHz to 250 MHz, 250 MHz to 500 MHz, and 500 MHz to 1000 MHz. In the first range, 10 kHz to 250 MHz, the output is derived by mixing the fixed 550 MHz signal with 500-1000 MHz signal programmed for frequencies from 550.01 MHz to 800 MHz. For the second range, 250 to 500 MHz, the output is the result of a divide-by-two operation on the 500-1000 MHz signal. The final range is the direct output of the 500-1000 MHz loop. The appropriate frequency source is switched to the SYNTH RF output by the Output Select switch.

2.2 310-440 MHz PHASE-LOCKED LOOP

A single 310-440 MHz VCO (Voltage Controlled Oscillator) is phase-locked to the 50 kHz reference input using a loop. The VCO output is divided down to 50 kHz using a programmable two modulus prescaler and divider. Programming of the divider is controlled by the microprocessor to give output frequencies from 310 to 440 MHz in 50 kHz steps.

2.3 60.5 MHz PHASE-LOCKED LOOP

The 60.5 MHz loop is programmable over a ± 100 kHz range in 50 Hz increments. The 60.5 MHz VCO output is mixed with a 50 MHz signal from the 550 MHz loop. A programmable divider following the mixer divides the 10.5 MHz ± 100 kHz signal down to the 50 Hz reference frequency. A comparison between the divider output and the reference signal by the phase/frequency detector results in an error voltage to the VCO which maintains the phase lock.

2.4 550 MHz PHASE-LOCKED LOOP

A fixed frequency of 550 MHz is obtained by dividing the 550 MHz VCO by 55 to obtain 10 MHz. The 10 MHz from the divider is compared with the 10 MHz frequency standard in the phase/frequency detector. The resulting error signal is filtered and used to correct the 550 MHz VCO to maintain the phase lock. A voltage controlled attenuator follows the 550 MHz output to control the output level of the generator output for frequencies below 1 MHz. The leveling loop in the rf input module provides the ALC VOLT control signal to maintain the required output level at the front panel rf jack.

2.5 500-1000 MHz PHASE-LOCKED LOOP

The 500-1000 MHz output is locked to either the sum or the difference of the 310-440 MHz and 60.5 MHz loop output frequencies. In the locked condition, mixing the divide-by-two output of the 500-1000 MHz VCO with the 310-440 MHz signal gives a difference frequency equal to the 60.5 MHz output. There are two frequencies of the divide-by-two output, the 310-440 MHz frequency plus 60.5 MHz and the 310-440 MHz frequency minus the 60.5 MHz frequency. One of the signals is mixed down to the correct frequency. The sense of the loop is inverted for one signal compared to

the other. Thus, the phase switch following the phase/frequency detector determines the frequency the loop locks on.

2.6 MODULATION CONTROL

Modulation of the tuning voltage for the 60.5 MHz VCO provides the frequency modulation of the rf output. Since the modulation sensitivity changes by a factor of two when the 250-500 MHz source is selected, the modulation control provides programmable gain control to maintain constant sensitivity at the FM MOD input. Additionally, the wideband modulation mode requires a gain of four beyond that for the narrowband mode. Thus, under control of the microprocessor, the modulation control selects gains of 1, 2, 4, and 8 for the FM MOD input. Input modulation sensitivities are 5 kHz/volt and 20 kHz/volt for narrow and wideband FM input.

2.7 MODULE CONTROL

Control information is latched into four-bit control latches which are loaded by the microprocessor through the rf control bus. The four-bit RF ADD BUS Ø-3 data is decoded by the address decoder to determine into which control latch the four-bit RF DATA BUS Ø-3 data is to be stored. Synchronization of the data transfer is the function of the RF BUS EN line. One control latch output, LO/HI BAND SEL, is applied to the rf input module to control the frequency range of the output amplifier.

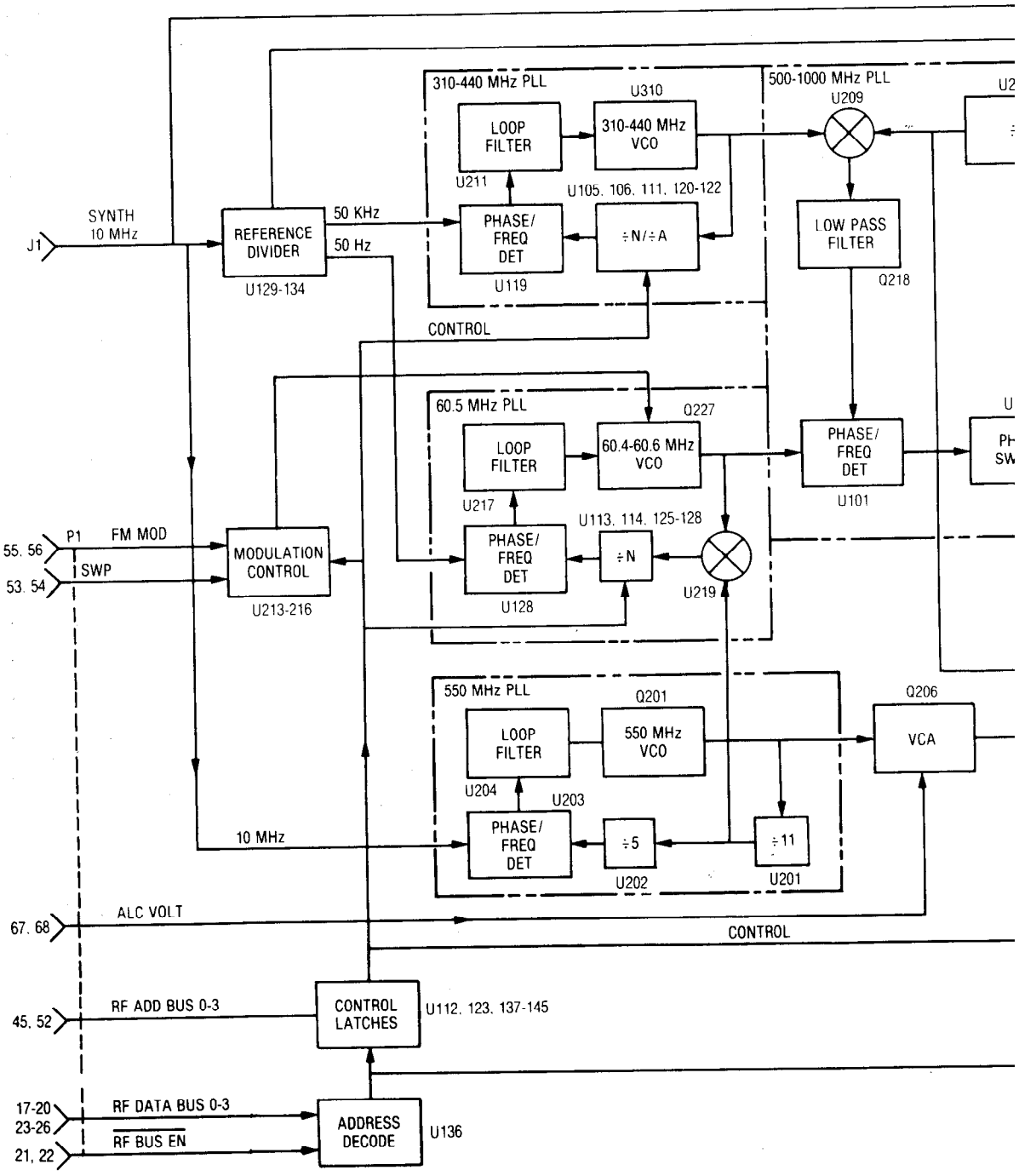
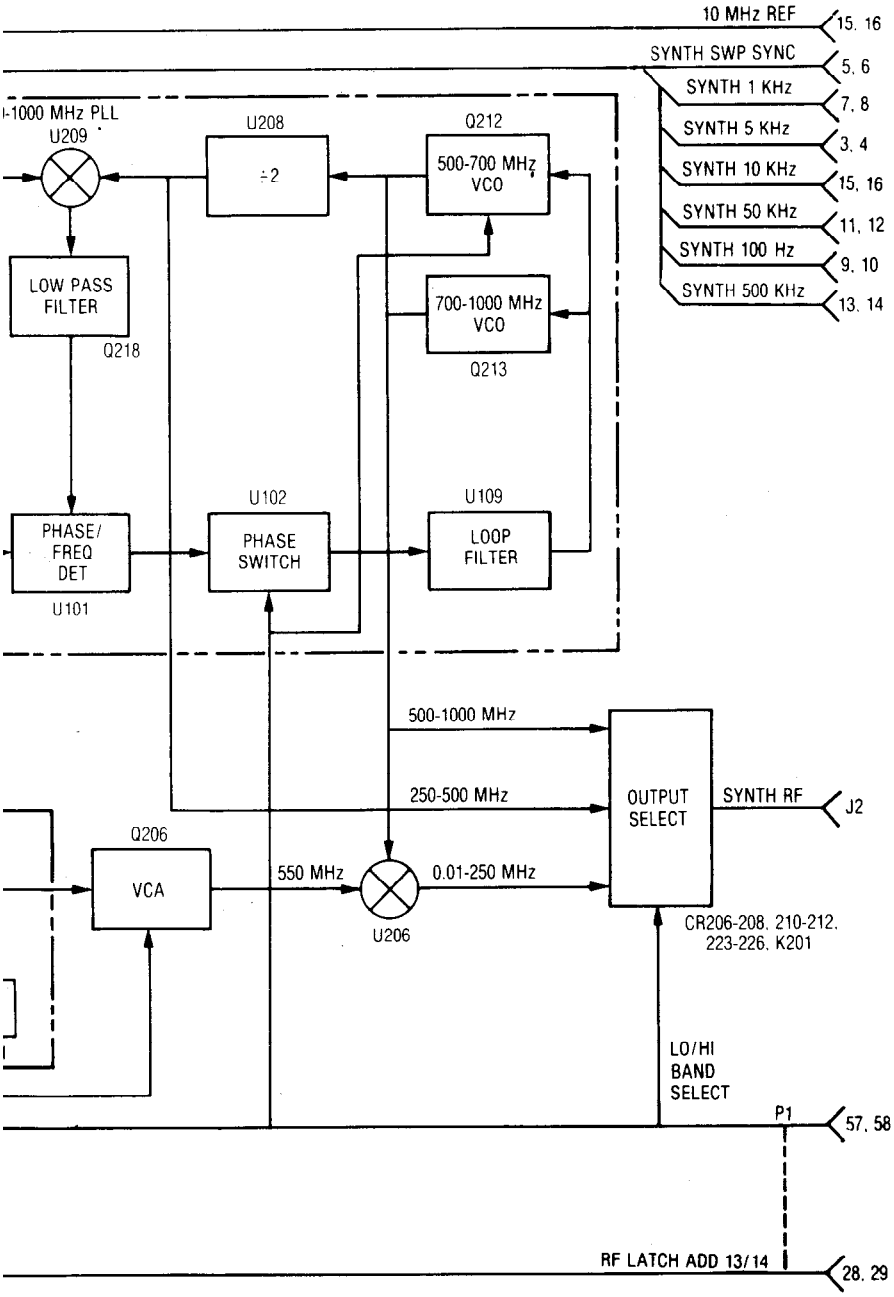


Figure 1. RF Synthesizer Functional Block Diagram



nctional Block Diagram

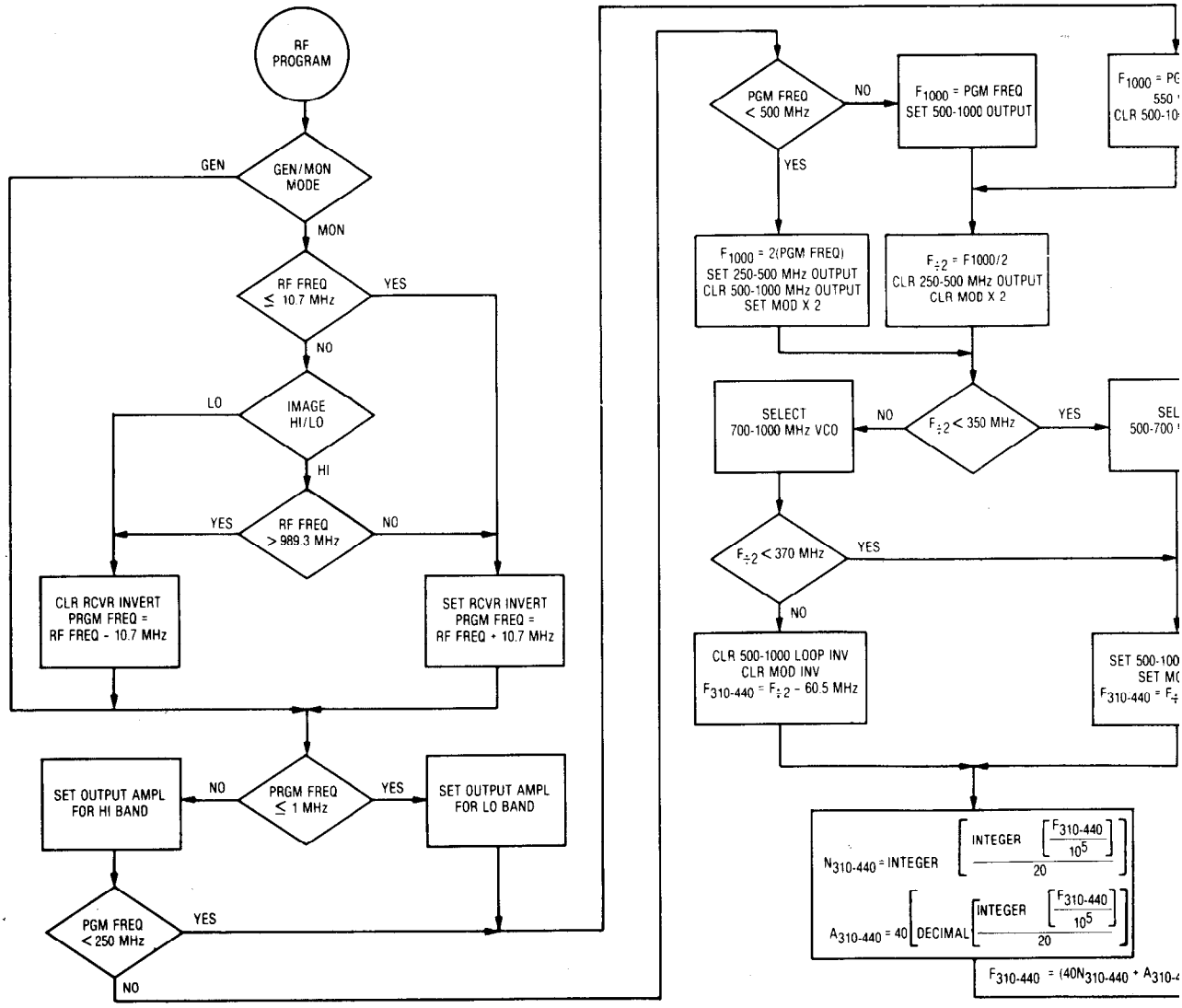
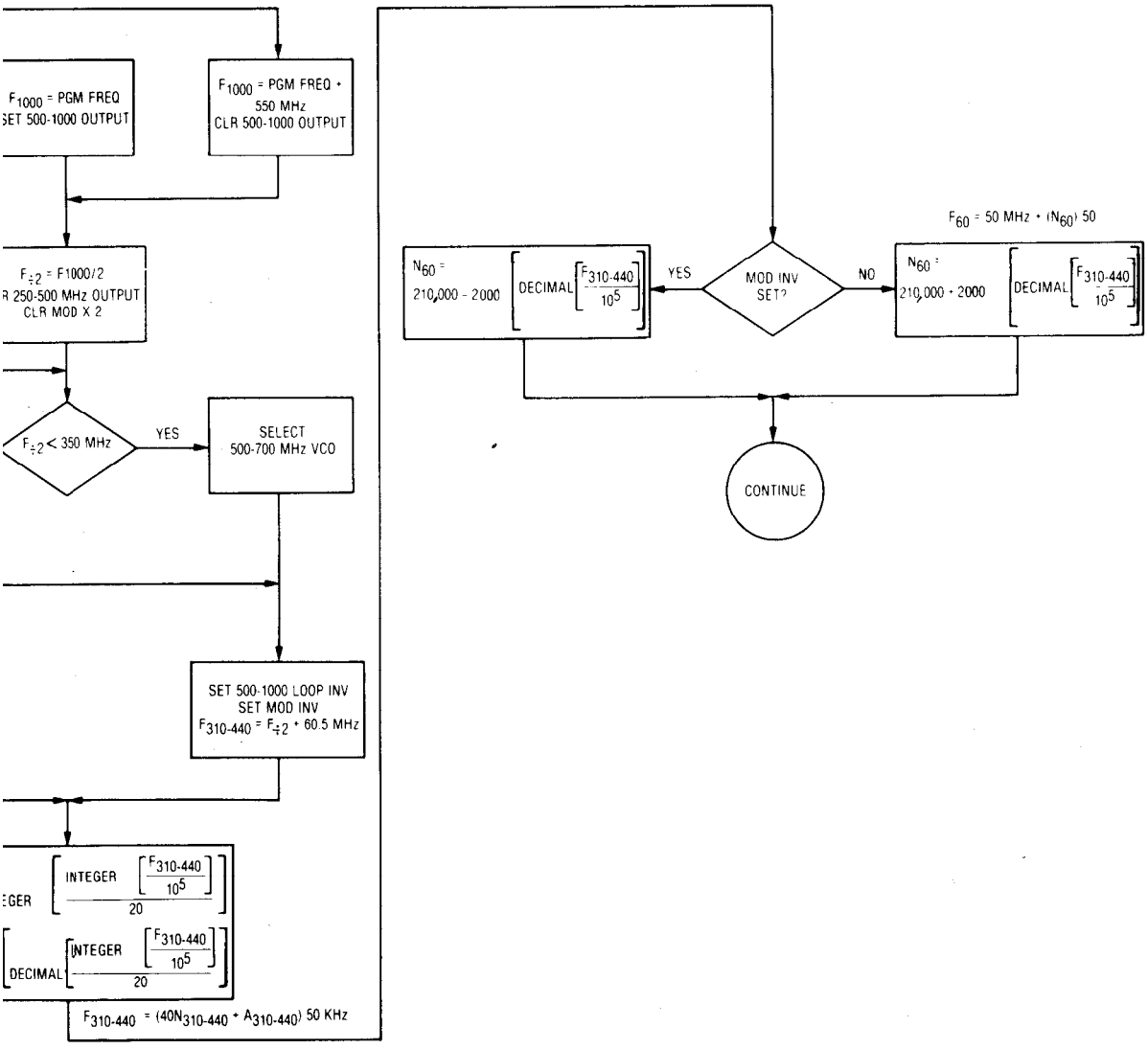
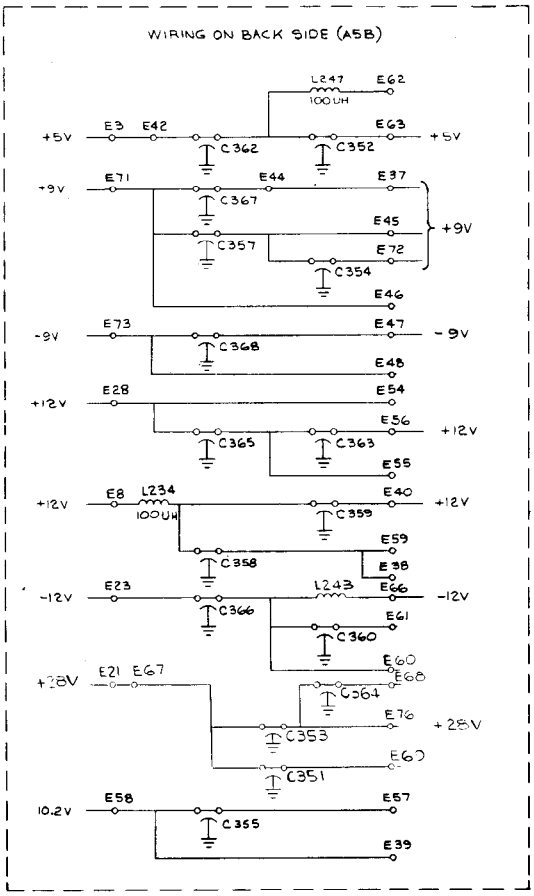
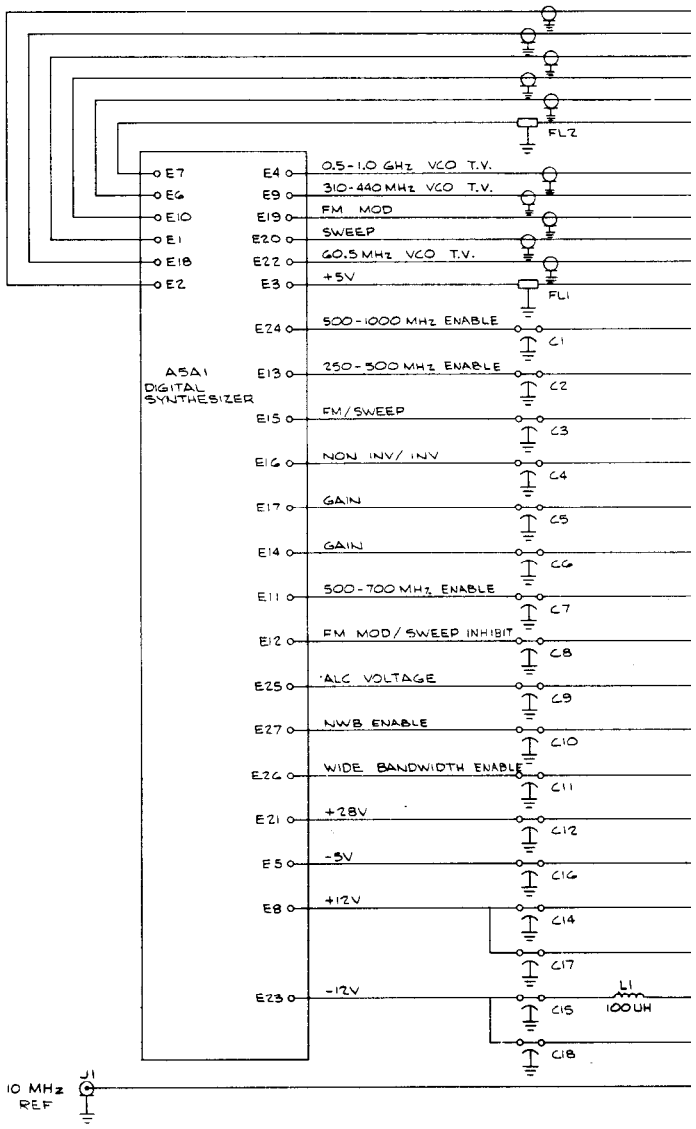


Figure 2. Frequency Programming Flow Dia



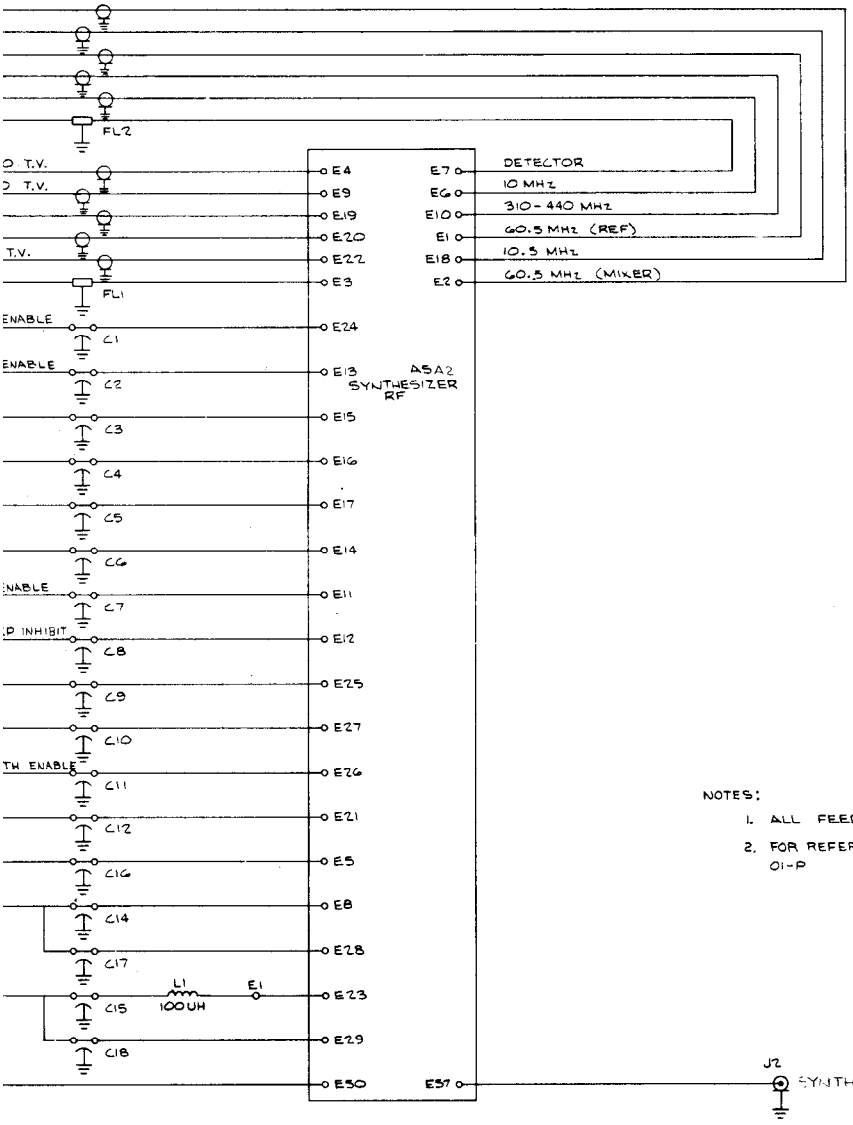
quency Programming Flow Diagram


WIRING ON BACK SIDE (A5B)
L247
100 UH
E62
+5V
E3
E42
E63
+5V
C362
C352
+9V
E71
E44
E37
C367
E45
+9V
C357
E72
C354
E46
-9V
E73
E47
-9V
C368
E48
+12V
E28
E54
E56
+12V
C365
C363
E55
+12V
E8
L234
100 UH
E40
+12V
C359
E59
C358
E38
-12V
E23
L243
E66
-12V
C366
E61
C360
E60
+28V
E21
E67
E68
C364
E76
+28V
C353
E60
C351
10.2V
E58
E57
C355
E39


FL2
E7
E6
E10
E1
E18
E2
A5A1
DIGITAL
SYNTHESIZER
E4
0.5-1.0 GHz VCO T.V.
E9
310-440 MHz VCO T.V.
E19
FM MOD
E20
SWEEP
E22
60.5 MHz VCO T.V.
E3
+5V
FL1
E24
500-1000 MHz ENABLE
C1
E13
250-500 MHz ENABLE
C2
E15
FM/SWEEP
C3
E16
NON INV/INV
C4
E17
GAIN
C5
E14
GAIN
C6
E11
500-700 MHz ENABLE
C7
E12
FM MOD/SWEEP INHIBIT
C8
E25
ALC VOLTAGE
C9
E27
NWB ENABLE
C10
E26
WIDE BANDWIDTH ENABLE
C11
E21
+28V
C12
E5
-5V
C16
E8
+12V
C14
C17
E23
-12V
C15
L1
100 UH
C18
10 MHz
REF
J1

RF SYNTHESIZER (A05)

MODEL RTC1001B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



NOTES:

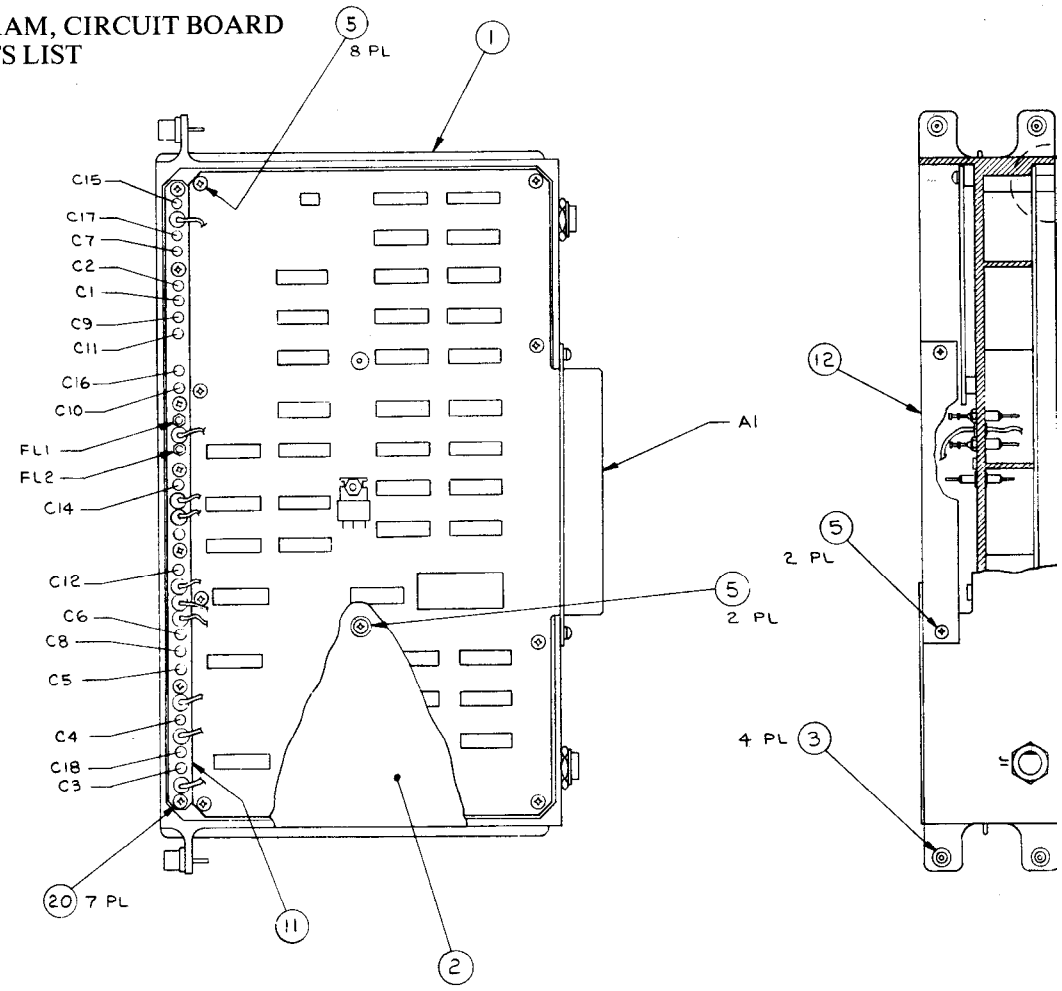
1. ALL FEED THRU CAPACITORS ARE 5000 PF
2. FOR REFERENCE DRAWINGS REFER TO:
   01-P ASSEMBLY

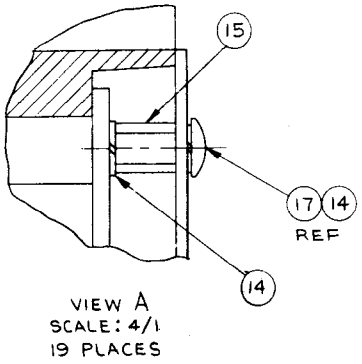
RF SYNTHESIZER

Motorola No. PEPS-37063-O
(Sheet 1 of 2)
8/12/83-PHI

RF SYNTHESIZER (A05)

MODEL RTC1001B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



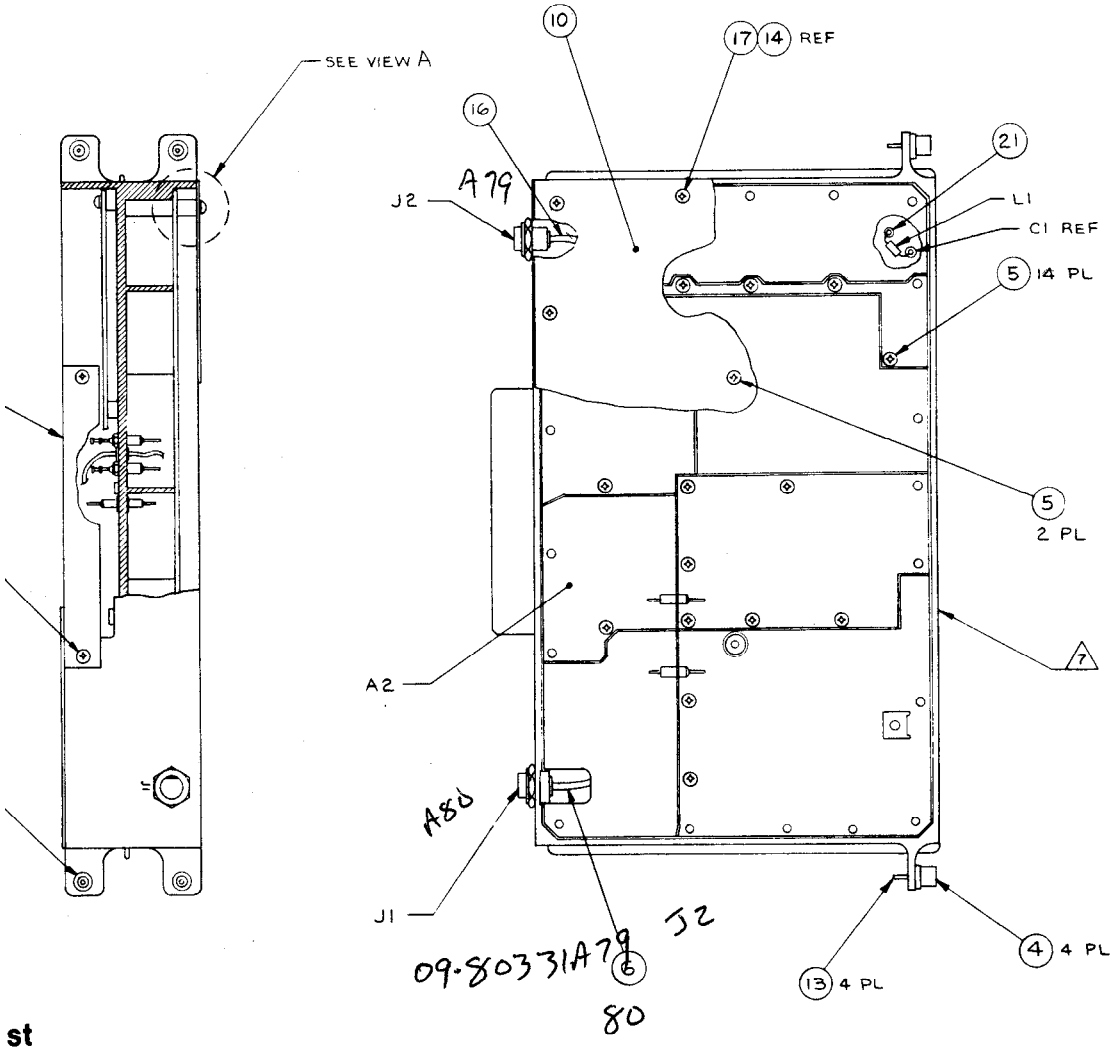


VIEW A
SCALE: 4/1
19 PLACES

parts list

RTC1001B Synthesizer Kit

REFERENCE SYMBOL	MOTOROLA PART NO.	
		capacitor
C1 thru 12	21-82543H03	5000
C14 thru 17	21-82543H03	5000
		filter:
FL1	91-87679C01	1500 pF
		coil, rf:
L1	24-80369A37	choke; 1
REF. NO.		**MECHANICAL**
2	15-80335A37	COVER,
3	5-84500B03	EYELET,
4	42-84284B01	RETAINE
5	3-138804	SCREW,
10	15-80335A36	COVER,
11	26-80370A67	SHIELD
12	64-80370A68	PLATE, c
13	3-139581	SCREW,
14	4-114583	LOCKWA
15	43-80370A69	SPACER,
16	30-80377A09	CABLE, c
17	3-136786	SCREW,
20	3-139012	SCREW,
21	29-80377A75	TERMIN



st

hesizer Kit PL-8482-O

E MOTOROLA PART NO.	DESCRIPTION
	capacitor, fixed pF: + 80-20%; 500:
21-82543H03	5000
21-82543H03	5000
	filter:
91-87679C01	1500 pF @ 25 °C
	coil, rf:
24-80369A37	choke; 100 uH
	MECHANICAL PARTS
15-80335A37	COVER, digital synthesizer
5-84500B03	EYELET, special; 4 used
42-84284B01	RETAINER; 4 used
3-138804	SCREW, machine; 4-40 × 5/16"; 28 used
15-80335A36	COVER, synthesizer RF
26-80370A67	SHIELD
64-80370A68	PLATE, connector
3-139581	SCREW, machine; 4-40 × 5/16"; 4 used
4-114583	LOCKWASHER, #4 split; 38 used
43-80370A69	SPACER, MF 4-40; 19 used
30-80377A09	CABLE, coaxial RG196A/U
3-136786	SCREW, machine; 4-40 × 1/4"; 19 used
3-139012	SCREW, machine; 4-40 × 1/4"; 7 used
29-80377A75	TERMINAL

Crimp on = ~~Loose~~ Coax

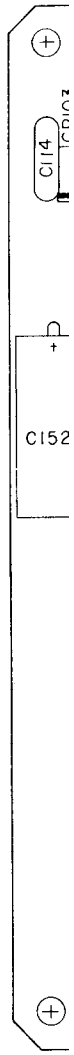
parts list

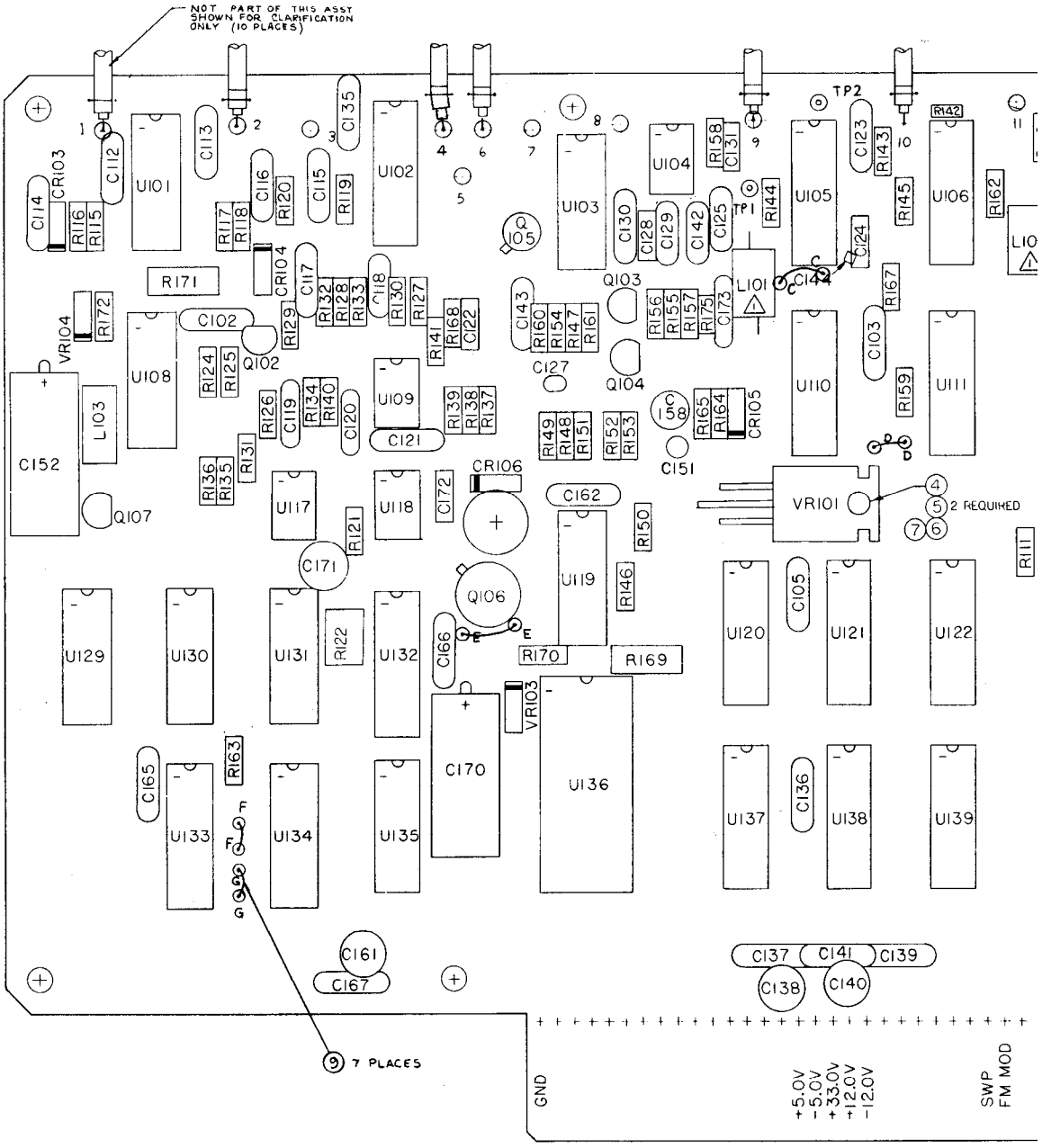
RTC4009B RF Synthesizer Digital Board — PL-8502-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, pF ± 10%; 100 V: unless otherwise stated
C101	23-80369A65	30 uF + 75-10%; 16 V
C102 thru 105	21-82187B14	1000
C106	21-84494B46	180 ± 3%; 500 V
C107	21-82372C10	.05 uF ± 20; 25 V
C108	23-84665F01	10 uF; 25 V
C109	21-82428B59	.01 uF + 80-20%; 200 V
C110	23-80369A61	10 uF ± 20%; 35 V
C111	23-82397D50	0.22 uF ± 20%; 35 V
C112 thru 114	21-82428B59	.01 uF + 80-10%; 200 V
C115, 116	21-84494B37	11 ± 5%; 500 V
C117, 118	21-84494B24	39 ± 5%; 500 V
C119, 120	21-82428B10	3300
C121	21-82428B59	.01 uF + 80-20%; 200 V
C122	21-80369A82	0.1 uF ± 20%
C123	21-82187B07	470 ± 10%; 500 V
C124	21-80369A82	0.1 uF ± 20%
C125, 126	21-82187B14	1000
C127	23-82397D04	15 pF ± 20%; 15 V
C128	21-80370A02	2200
C129	23-80369A61	10 uF ± 20%; 35 V
C130	21-82428B59	.01 uF + 80-10%; 200 V
C131	21-80369A99	.01 uF
C132	21-82187B14	1000
C133	23-84665F01	10 uF; 25 V
C134 thru 137	21-82187B14	1000
C138	23-84665F01	10 uF; 25 V
C139	21-82187B14	1000
C140	23-84665F01	10 uF; 25 V
C141	21-82187B14	1000
C142	23-80369A61	10 uF ± 20%; 35 V
C143	21-82187B04	270; 500 V
C144	21-80376A12	33 ± 5%; 50 V (chip)
C151	23-84665F04	1.0 uF ± 20%; 50 V
C152	23-84665F10	100 uF; 25 V
C158	23-84665F01	10 uF; 25 V
C161	23-84665F01	10 uF; 25 V
C162 thru 168	21-82187B14	1000
C169, 170	23-84665F10	100 uF; 25 V
C171	23-84665F01	10 uF; 25 V
C172	21-80369A99	.01 uF
C173	21-82187B14	.001 uF
		diode:
CR101	48-84616A01	hot carrier
CR102, 103, 104	48-83617C01	silicon
CR105	48-86850C47	silicon
CR106	48-82617C01	silicon
		coil:
L101, 102	24-83977B02	
L103	24-80370A39	inductor, 12 mH
		transistor:
Q101	48-84308A92	NPN
Q102	48-869570	NPN; type M9570
Q103	48-869571	PNP; type M9571
Q104	48-869570	NPN; type M9570
Q105	48-84308A92	NPN
Q106	48-86851C32	NPN
Q107	48-869570	NPN; type M9570
Q108	48-2089C01	NPN
		resistor: ± 5%; 1/4 W: unless otherwise stated
R101	6-124A73	R10k
R102	6-124A49	1k
R103 thru 106	6-124A73	10k
R107	6-124B16	560k
R108	6-124A49	1k
R109	6-124A53	1.5k
R110	6-124A90	51k
R111, 112, 113	6-124A56	2.0k
R114	6-125A45	680; 1/2 W
R115	6-124A56	2.0k
R116	6-124A41	470
R117	6-124A56	2.0k
R118, 119, 120	6-124A41	470
R121	6-124B19	750k
R122	18-83452F19	variable, 100k
R124, 125, 126	6-124A49	1k
R127, 128	6-124A41	470
R129, 130	6-124A53	1.5k
R131	6-124A73	10k
R132, 133	6-124A53	1.5k
R134	6-124A39	390
R135	6-124A56	2.0k
R136	6-124A59	2.7k
R137	6-124A25	100
R138	6-124A61	3.3k
R139	6-124A71	8.2k
R140	6-124A39	390
R141	6-124A49	1k
R142	6-185A18	51; 1/8 W
R143	6-124A49	1k

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R144, 145	6-124A41	470
R146	6-124A51	1.2k
R147	6-124A07	18
R148	6-124A53	1.5k
R149	6-124A35	270
R150, 151	6-124A41	470
R152	6-124A57	2.2k
R153	6-124A23	82
R154, 155	6-124A77	15k
R156	6-124A69	6.8k
R157, 158, 159	6-124A49	1k
R160	6-124A73	10k
R161	6-124A49	1k
R162	6-124A41	470
R163	6-124A73	10k
R164	6-124A65	4.7k
R165	6-124A41	470
R166	6-124A56	2.0k
R167, 168	6-124A41	470
R169	6-125A13	33; 1/2 W
R170	6-124A47	820
R171	6-125A43	560; 1/2 W
R172	6-124A63	3.9k
R173	6-124A73	10k
R174	6-124A27	120
R175	6-185A49	1000; 1/8 W
		integrated circuit:
U101	51-80365A01	phase frequency detector
U102	51-80365A03	quad exclusive OR gate
U103	51-82884L48	quad bilateral switch
U104	51-80365A07	op amp
U105	51-84561L53	modulus prescaler
U106	51-84561L55	dual D flip-flop
U107	51-83629M07	op amp
U108	51-82884L48	quad bilateral switch
U109	51-83629H07	op amp
U110	51-80365A05	op amp
U111	51-82609M54	4-bit binary synch up/down counter
U112	51-82884L15	quad clocked "D" latch
U113	51-80365A05	counter control logic unit
U114	51-84561L45	dual 4-input AND gate
U115	51-82884L48	quad bilateral switch
U116	51-83629M07	op amp
U117, 118	51-80365A08	op amp
U119	51-84371K99	phase-frequency detector
U120, 121, 122	51-82609M54	4-bit binary synch up/down counter
U123	51-82884L15	quad clocked "D" latch
U124 thru 127	51-82609M54	4-bit binary synch up/down counter
U128	51-83629M26	voltage regulator
U129	51-82609M02	dual JK flip-flop
U130	51-84561L03	hex inverter
U131	51-82609M02	dual JK flip-flop
U132, 133	51-82609M68	dual decade counter
U134	51-82884L12	dual 4-bit decade counter
U135	51-84561L03	hex inverter
U136	51-82884L32	4-bit latch/4-16 line decoder
U137 thru 145	51-82884L15	quad clocked "D" latch
U146	51-82884L04	quad 2-input NOR gate
		voltage regulator:
VR101	51-80365A17	3-terminal
VR102, 103	48-83193A59	Zener, 5.6 V ± 5%; 0.4 W
VR104	48-82256C50	Zener, 3.09 V ± 5%; 0.4 W

REF. NO.	MECHANICAL PARTS	
1	84-80335A22	PWB, digital synthesizer
2	SN63WRP3	SOLDER
3	11-14167A01	INK, BLACK
4	MS35206-214	SCREW, Phillips; 4-40 × 0.312"
5	4-7007	WASHER, flat; No. 4
6	4-114583	WASHER, lock; No. 4
7	2-7019	NUT, hex; 4-40
9		WIRE, 24
10	M23053/5-206-C	INSULATION SLEEVING; 0.250 CLR




NOT PART OF THIS ASST SHOWN FOR CLARIFICATION ONLY (10 PLACES)
TP1
TP2
U101
U102
U103
U104
U105
U106
U108
U109
U110
U111
U117
U118
U119
U120
U121
U122
U129
U130
U131
U132
U133
U134
U135
U136
U137
U138
U139
C102
C103
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C106
C112
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C114
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C165
C166
C167
C170
C171
C172
C173
L101
L103
Q102
Q103
Q104
Q105
Q106
Q107
R111
R116
R117
R118
R119
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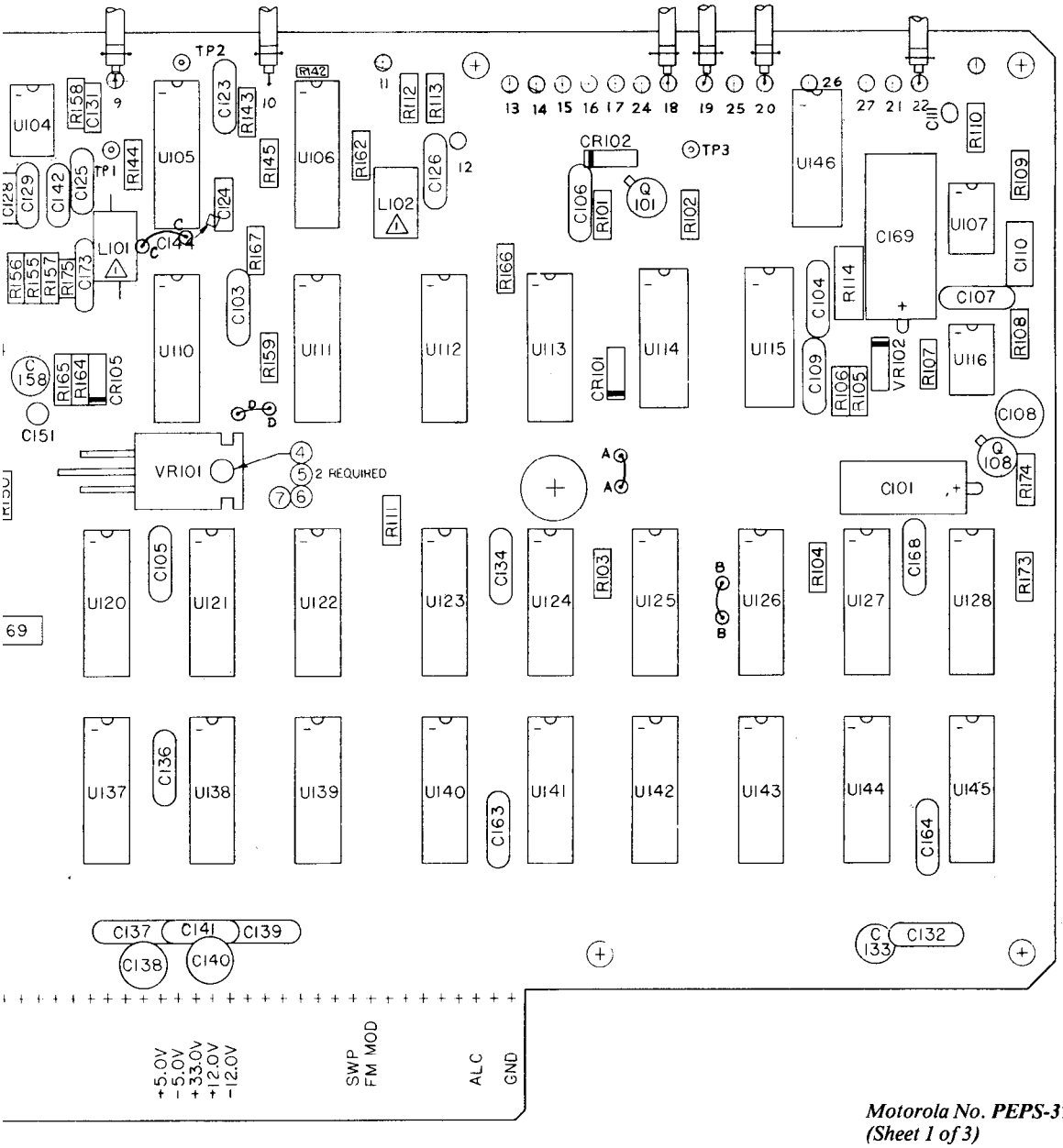
R163
R164
R165
R167
R168
R169
R170
R171
R172
VR101
VR103
VR104
CR103
CR104
CR105
2 REQUIRED
7 PLACES
GND
+5.0V
-5.0V
+33.0V
+12.0V
-12.0V
SWP
FM MOD

RF SYNTHESIZER (A05)

DIGITAL BOARD

MODEL RTC4009B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



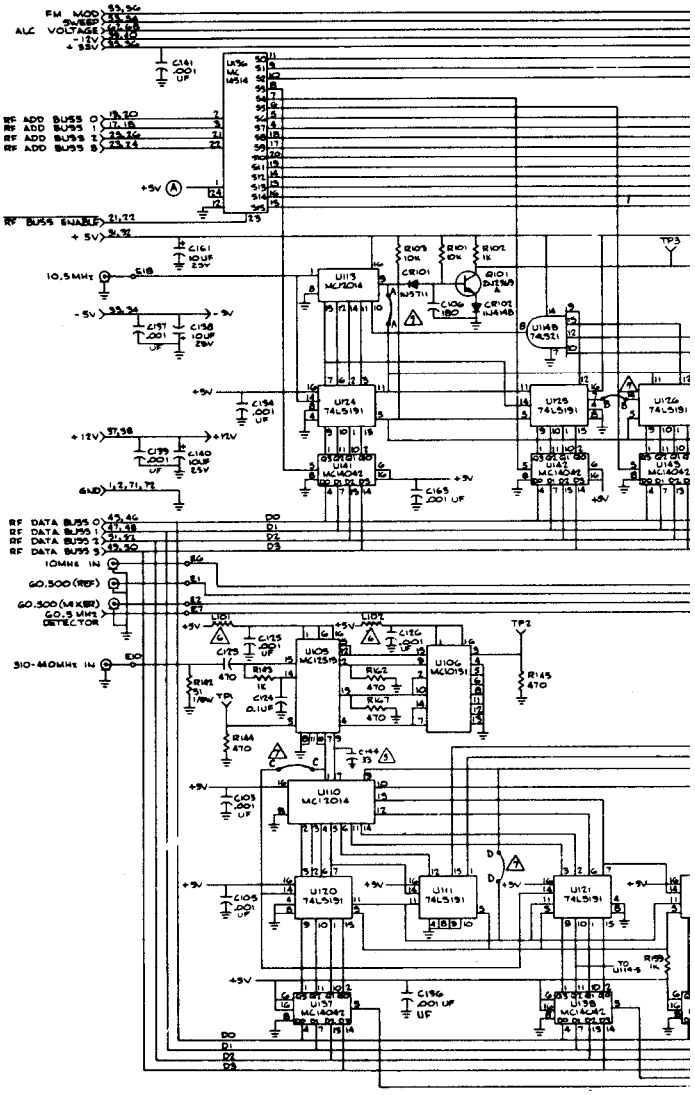
*Motorola No. **PEPS-37064-O***
(Sheet 1 of 3)
8/12/83-PHI

RF SYNTHESIZER DIGITAL BOARD

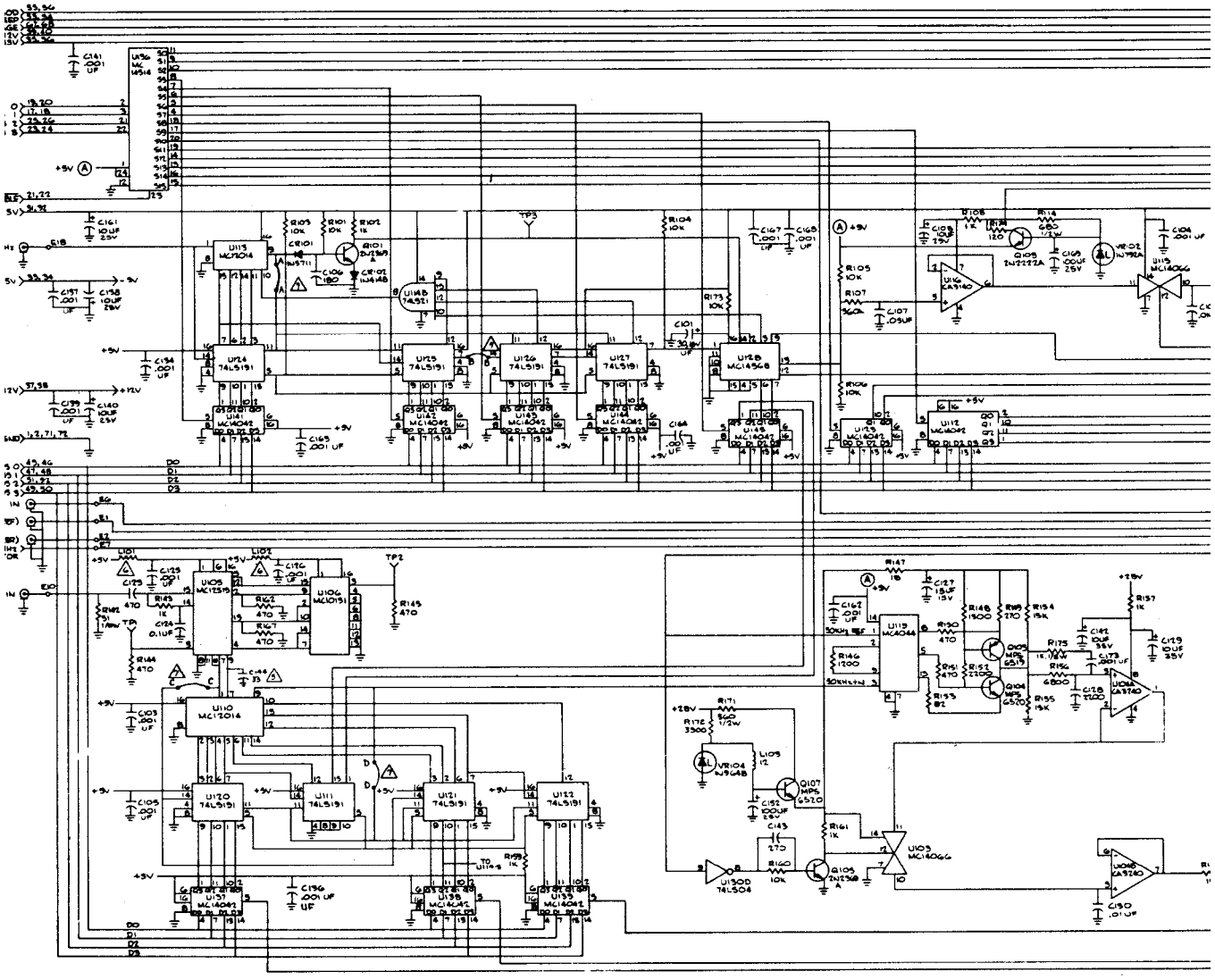
RF SYNTHESIZER (A05)

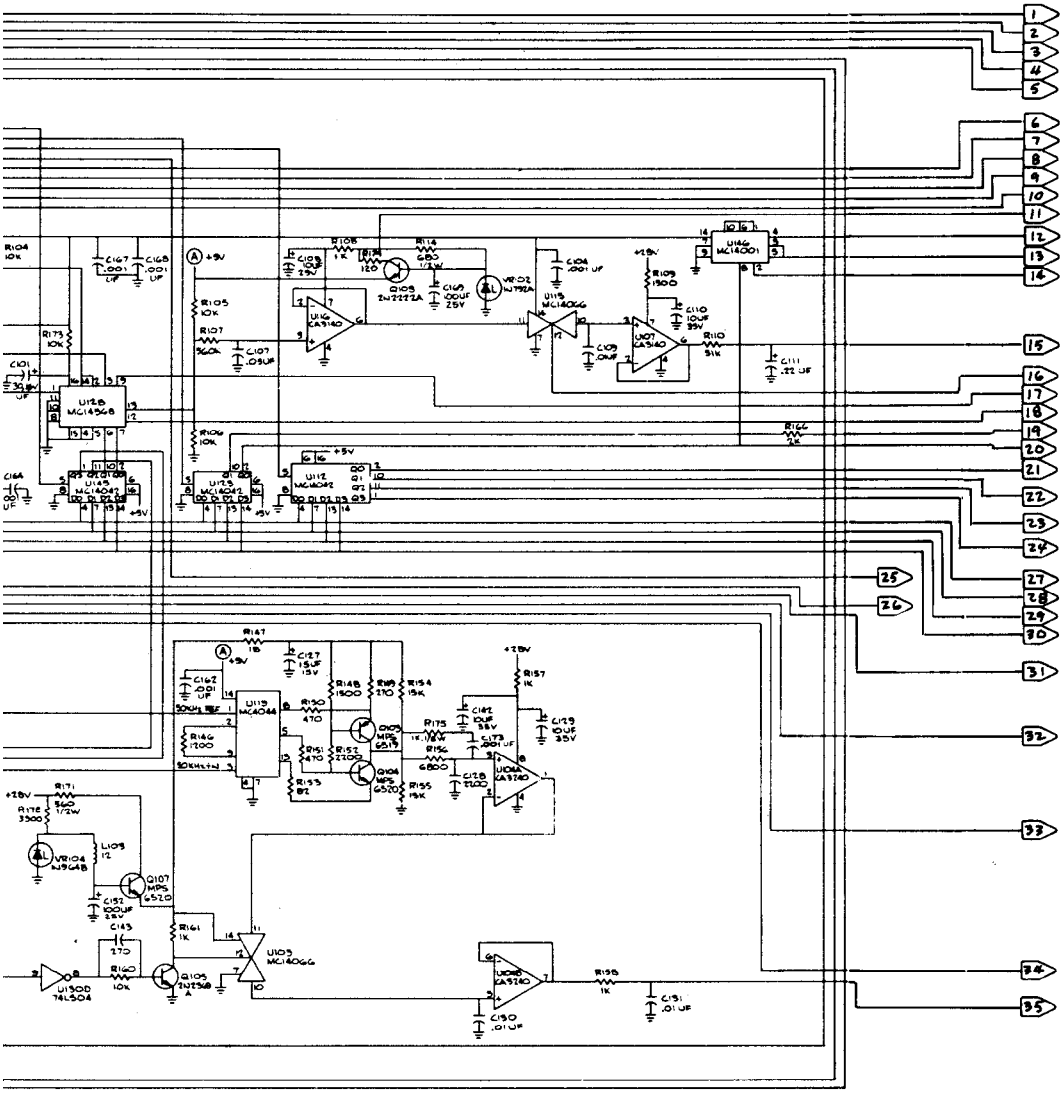
DIGITAL BOARD

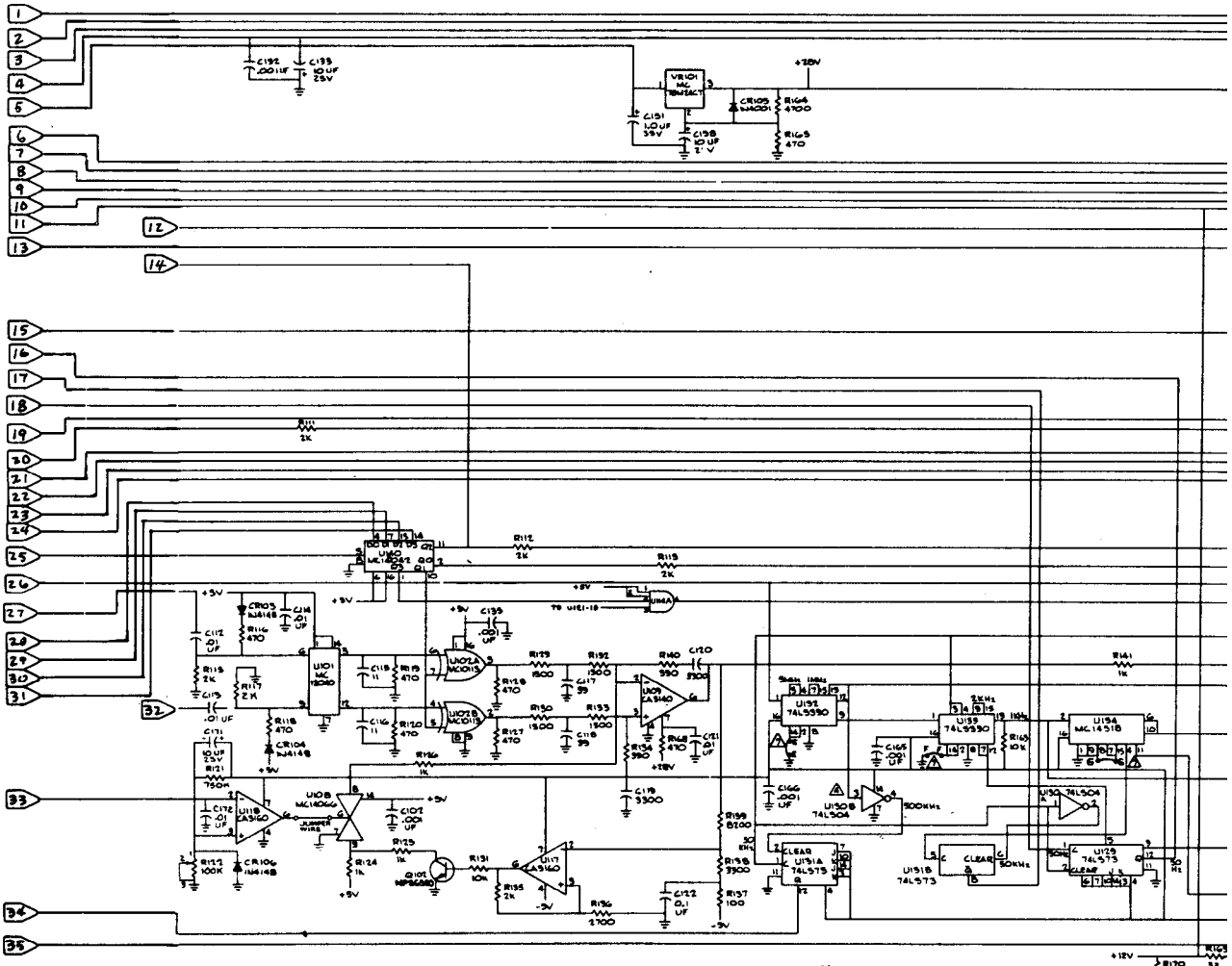
MODEL RTC4009B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



*Motorola No. **PEPS-37064-O***
(Sheet 2 of 3)
8/12/83-PHI







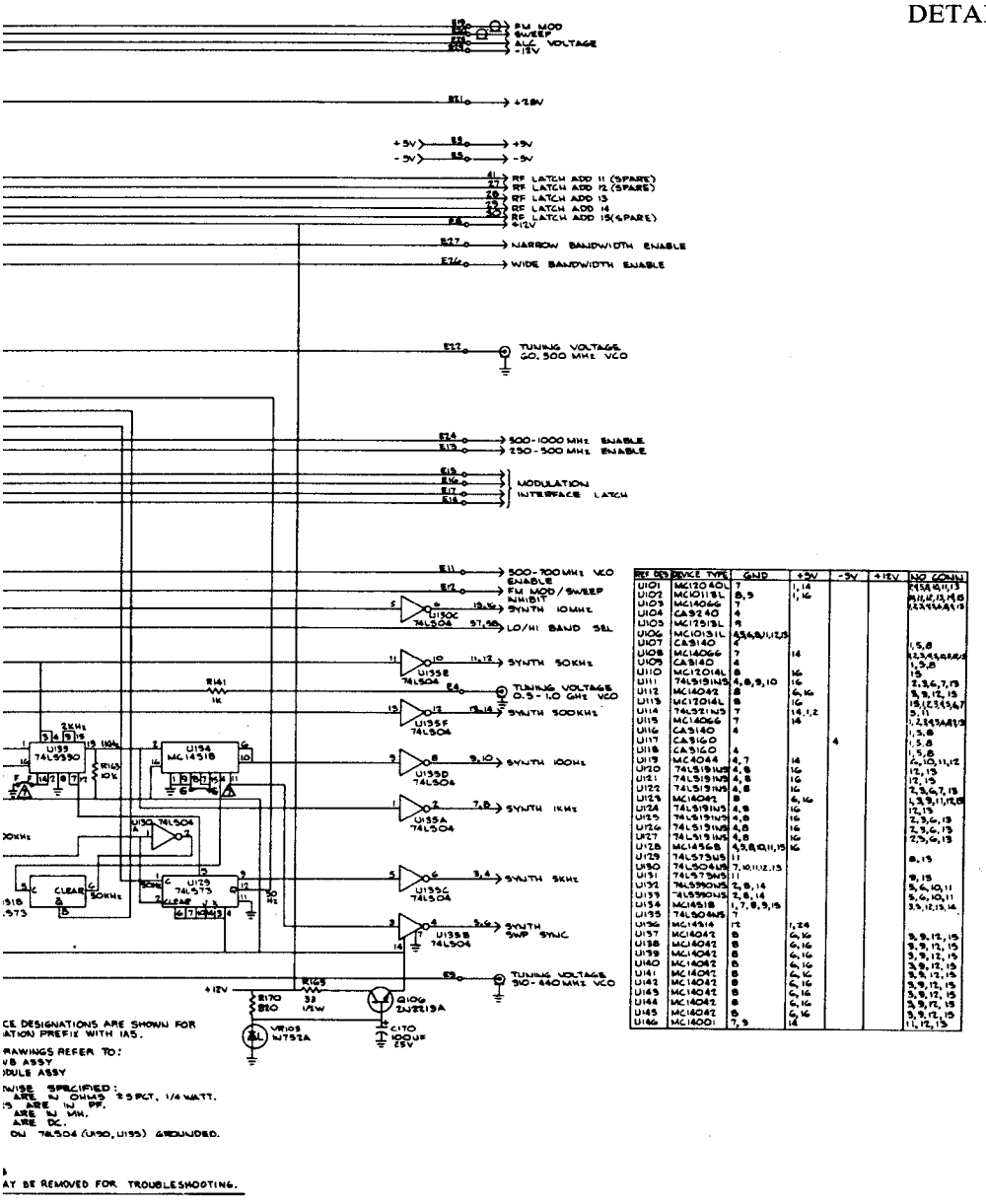
NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN FOR COMPLETE DESIGNATION PREFIX WITH 1A5.
2. FOR REFERENCE DRAWINGS REFER TO:
   01-P00358N PWB ASSY
   01-P00388N MODULE ASSY
3. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS ±5 PCT, 1/4 WATT.
   ALL CAPACITORS ARE IN PF.
   ALL INDUCTORS ARE IN MH.
   ALL VOLTAGES ARE DC.
4. EXTRA INPUTS ON 74LS04 (U150, U155) GROUNDED.
5. CHIP CAPACITOR
6. COIL, VK 200-10/3B
7. JUMPER WIRES. MAY BE REMOVED FOR TROUBLESHOOTING.

RF SYNTHESIZER (A05)

DIGITAL BOARD

MODEL RTC4009B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



REF DES	DEVICE TYPE	GND	+5V	-5V	+12V	NO CONN
U101	MC12040L	7	1,14			2,3,4,10,11,13
U102	MC10115L	8,9	1,16			2,3,4,5,6,7,10,11,12,13,14,15
U103	MC14066	7				1,2,3,4,5,8,9,10,11,12,13
U104	CA3240	4				
U105	MC12515L	8				
U106	MC10131L	4,5,6,8,9,11,12,13				
U107	CA3140	4				1,5,8
U108	MC14066	7	14			1,2,3,4,5,6,8,9,10,11,12,13
U109	CA3140	4				1,5,8
U110	MC12014L	8	16			15
U111	74LS191N5	4,8,9,10	16			2,3,6,7,13
U112	MC14042	8	6,16			1,2,9,12,15
U113	MC12014L	8	16			15
U114	74LS21N5	7	14			1,2,4,5,6,9,10,11
U115	MC14066	7	14			1,2,4,5,8,9,12,13
U116	CA3140	4				1,5,8
U117	CA3160			4		1,5,8
U118	CA3160	4				1,5,8
U119	MC4044	4,7	16			2,4,10,11,12
U120	74LS191N5	4,8	16			12,15
U121	74LS191N5	4,8	16			12,15
U122	74LS191N5	4,8	16			2,3,6,7,13
U123	MC14042	8	6,16			1,2,9,11,12,15
U124	74LS191N5	4,8	16			12,15
U125	74LS191N5	4,8	16			2,3,6,13
U126	74LS191N5	4,8	16			2,3,6,13
U127	74LS191N5	4,8	16			2,3,6,13
U128	MC14556B	4,8,9,10,11,15	16			
U129	74LS73N5	11				8,13
U130	74LS04N5	7,9,11,12,13				
U131	74LS73N5	11				10,13
U132	74LS90N5	2,8,14				5,6,10,11
U133	74LS90N5	2,8,14				5,6,10,11
U134	MC14518	1,7,8,9,15				3,5,12,13,14
U135	74LS04N5	7				
U136	MC14414	12	1,24			
U137	MC14042	8	6,16			1,9,12,15
U138	MC14042	8	6,16			1,9,12,15
U139	MC14042	8	6,16			1,9,12,15
U140	MC14042	8	6,16			1,9,12,15
U141	MC14042	8	6,16			1,9,12,15
U142	MC14042	8	6,16			1,9,12,15
U143	MC14042	8	6,16			1,9,12,15
U144	MC14042	8	6,16			1,9,12,15
U145	MC14042	8	6,16			1,9,12,15
U146	MC14001	7,9	14			11,12,13

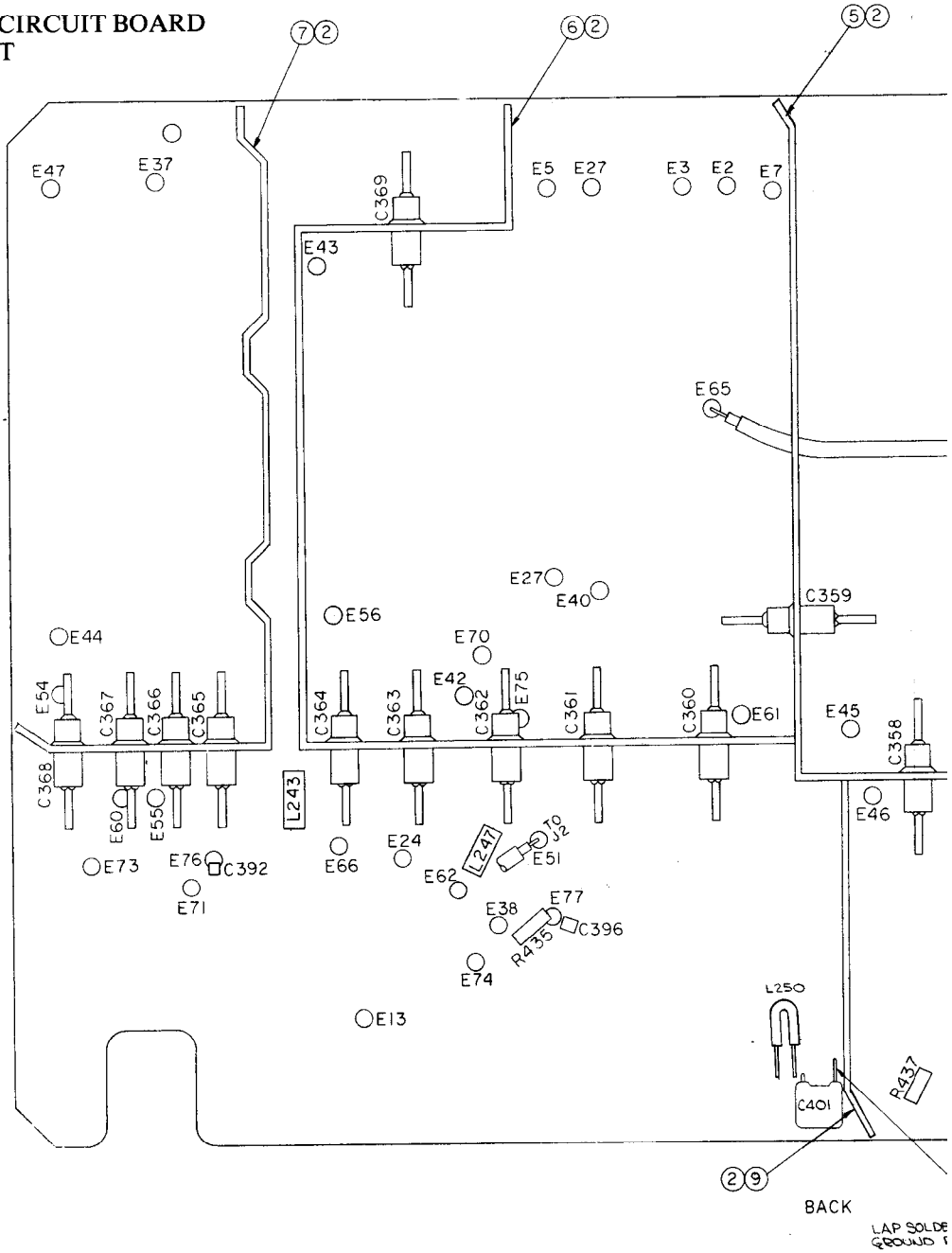
RF SYNTHESIZER DIGITAL BOARD

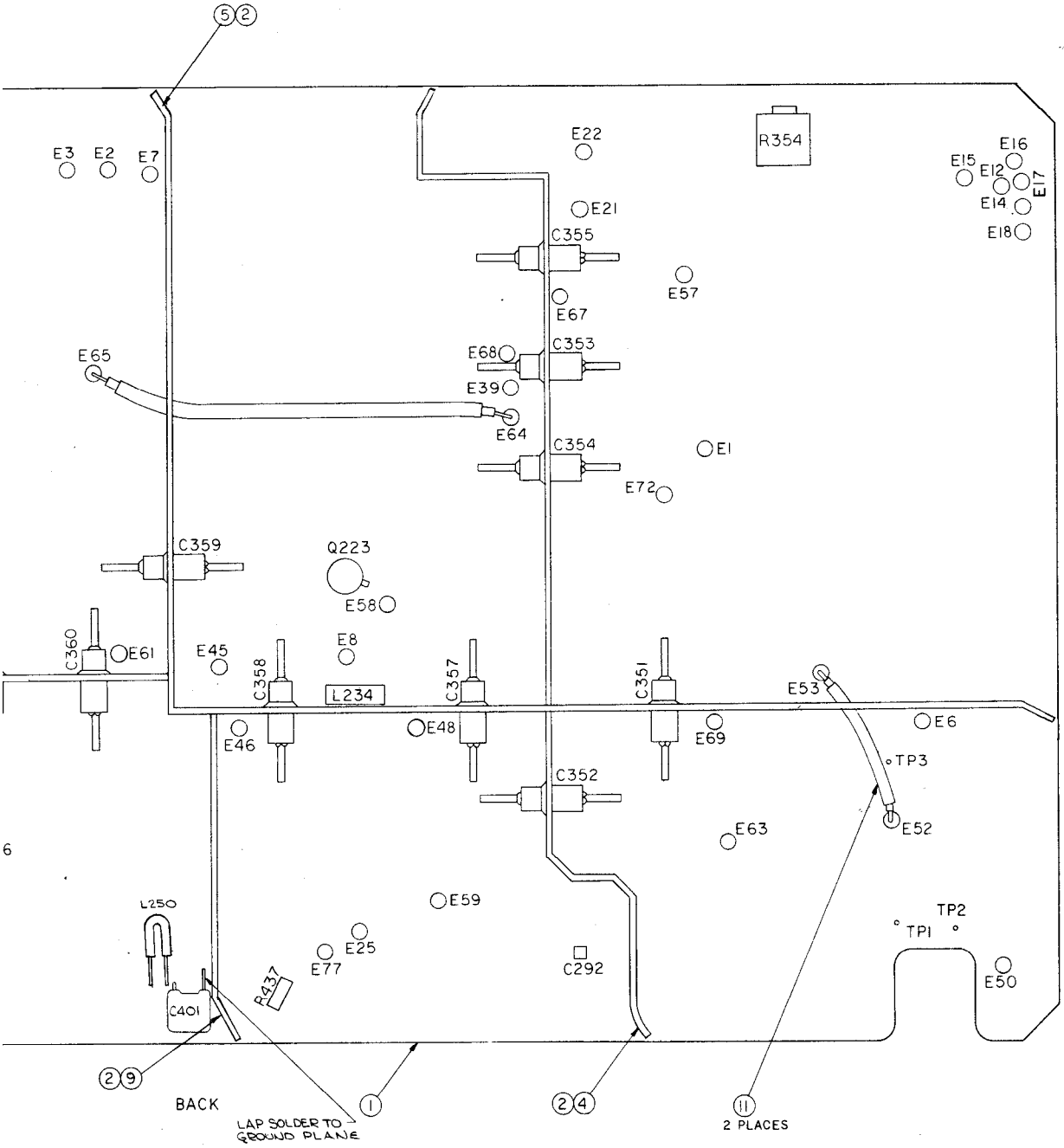
Motorola No. PEPS-37064-O
(Sheet 3 of 3)
8/12/83- PHI

RF SYNTHESIZER (A05)

RF BOARD

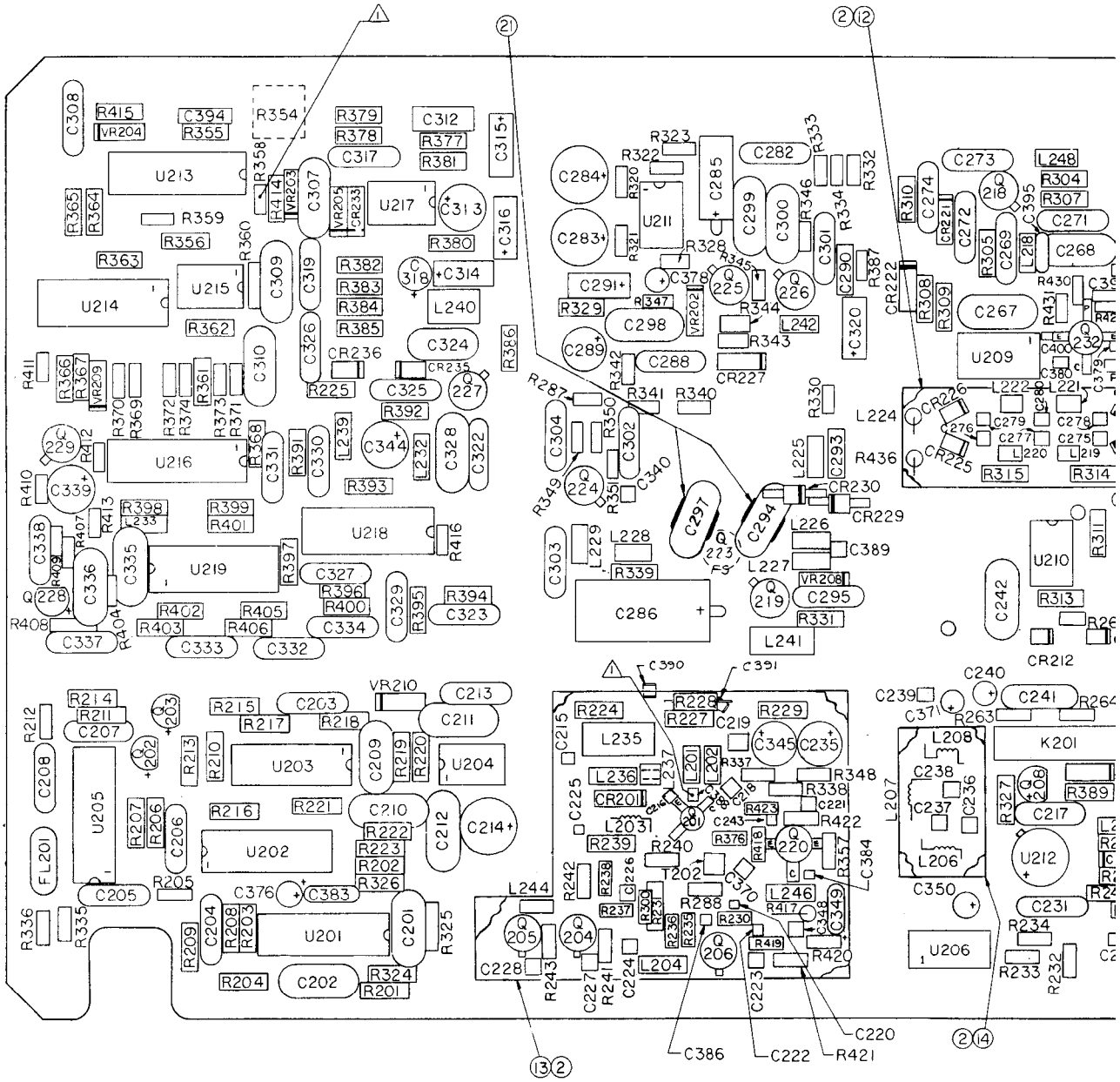
MODEL RTC4010B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



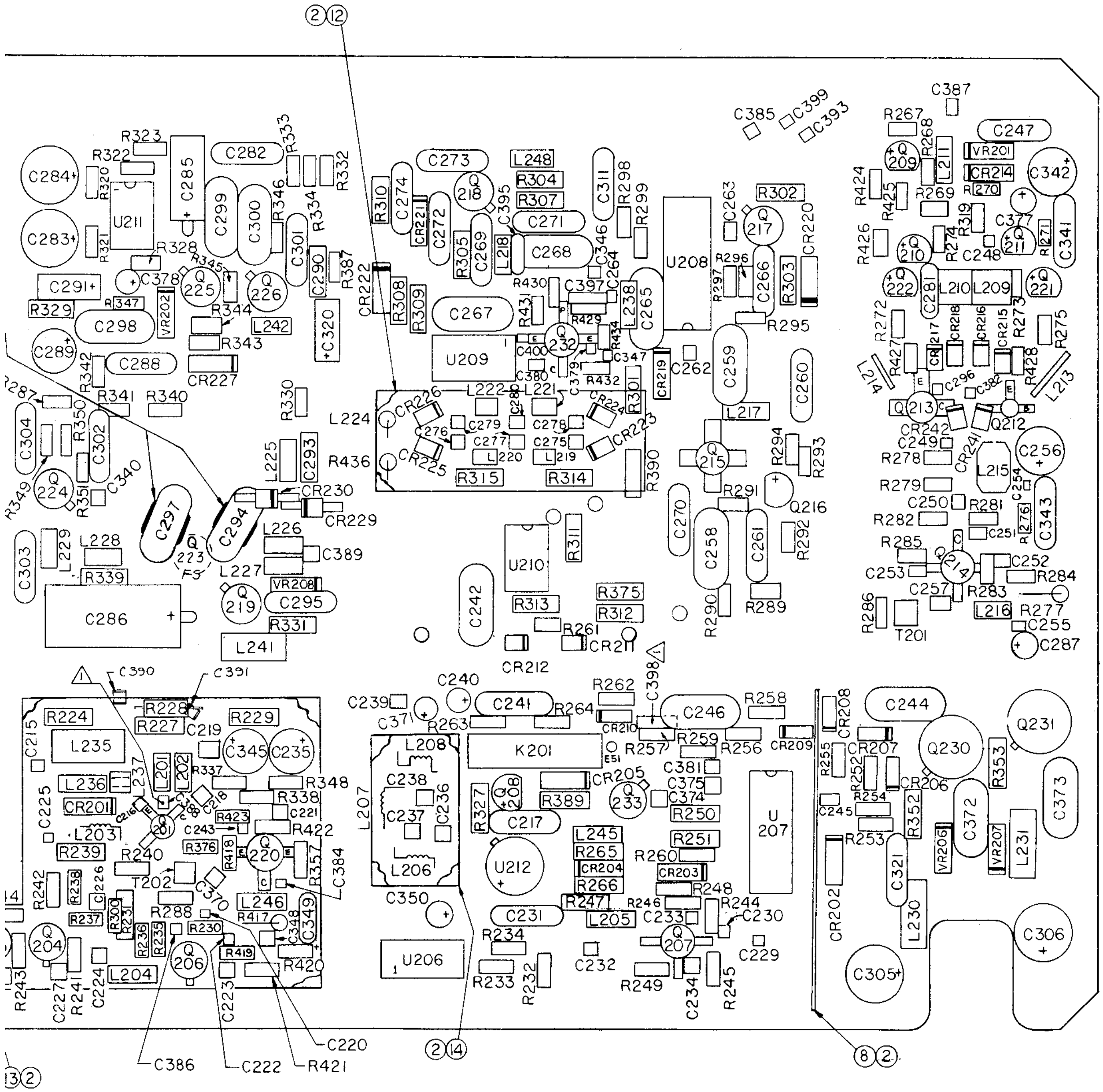

5 2
E3
E2
E7
E22
R354
E16
E15
E12
E17
E14
E18
E21
C355
E57
E67
E65
E68
C353
E39
E64
C354
E1
E72
C359
Q223
E58
C360
E61
E45
E8
C358
L234
C357
C351
E53
E46
E48
E69
E6
TP3
C352
E52
E63
6
L250
E59
TP2
TP1
E25
E77
C292
E50
R437
C401
2 9
BACK
1
LAP SOLDER TO GROUND PLANE
2 4
11
2 PLACES

NOTES:

1. VALUE OF COMPONENT TO BE SELECTED IN TEST.



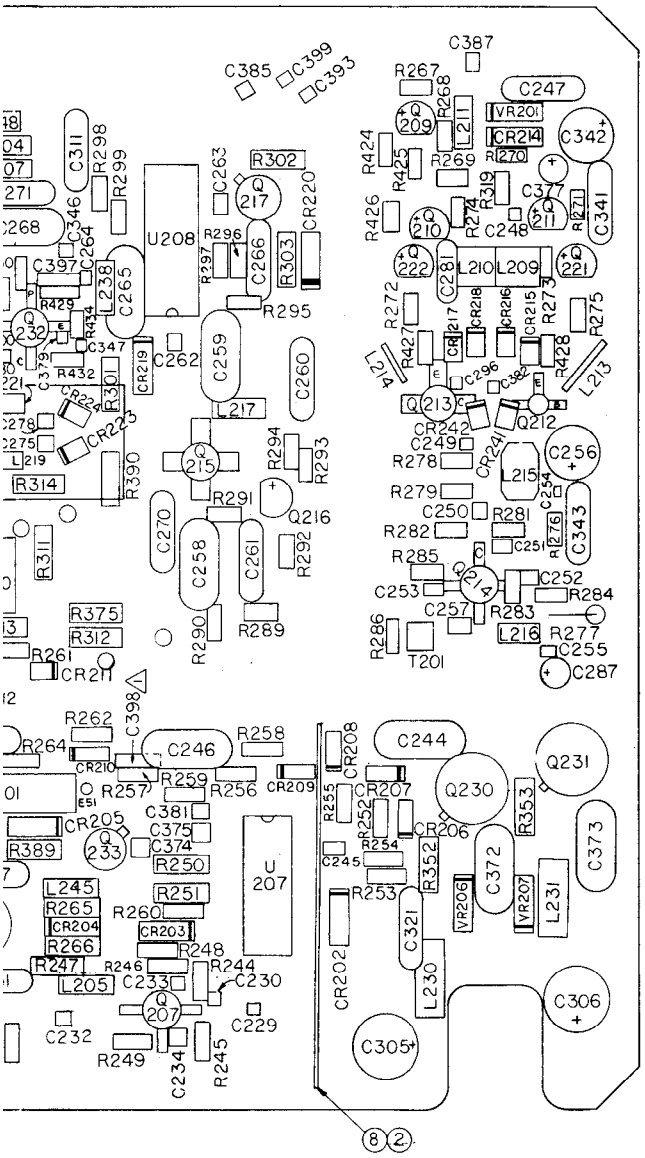
SCI



RF SYNTHESIZER (A05)

RF BOARD

MODEL RTC4010B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



RF SYNTHESIZER RF BOARD

Motorola No. PEPS-37065-O
(Sheet 2 of 6)
8/12/83- PHI

RF SYNTHESIZER (A05)

RF BOARD

MODEL RTC4010B
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST

parts list

RTC4010B RF Synthesizer RF Board — PL-8520-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION	REFERENCE SYMBOL
		capacitor: pF ± 10%; 100 V: unless otherwise stated	C329
			C330
C201, 202	21-82187B14	1000	C331 thru 33
C203 thru 208	21-82428B59	.01 uF + 80-10%; 200 V	C335
C209, 210	21-82187B08	220; 500 V	C336
C211, 212	21-84494B04	100 ± 5%; 500 V	C337, 338
C213	21-82428B59	.01 uF + 80-10%; 200 V	C339
C214	23-84665F01	10 uF; 25 V	C340
C215	21-80376A17	100; 50 V (chip)	C341
C216	21-80376A10	22 ± 5%; 50 V (chip)	C342
C217	21-82187B14	1000; 100 V	C343
C218	21-80376A10	22 ± 50%; 50 V (chip)	C344, 345
C219	21-80376A26	2200; 50 V (chip)	C346, 347
C220	21-80376A17	100; 50 V (chip)	C348
C221	21-80376A10	22 ± 5%; 50 V (chip)	C349
C222	21-80376A25	1000; 50 V (chip)	C350
C223	21-80376A17	100; 50 V (chip)	C351 thru 36
C224, 225	21-80376A25	1000; 50 V (chip)	C370
C226	21-80376A17	100; 50 V (chip)	C371
C227, 228, 229	21-80376A10	22; 50 V (chip)	C372, 373
C230	21-80376A26	2200; 50 V (chip)	C374, 375
C231	21-82187B14	1000; 100 V	C376, 377
C232	21-80376A10	22 ± 5%; 50 V (chip)	C378
C233, 234	21-80376A08	15 ± 5%; 50 V (chip)	C379
C235	23-84665F01	10; 50 V (chip)	C380
C236	21-80376A06	10 ± 5%; 50 V (chip)	C381
C237, 238	21-80376A10	22 ± 5%; 50 V (chip)	C382
C239	21-80376A06	10; 50 V (chip)	C383
C240	23-83441B15	1.0 uF ± 20%; 35 V	C384
C241	21-82428B59	.01 uF + 80-20%; 200 V	C385, 386
C242	21-84494B04	100 ± 5%; 500 V	C387
C243	21-80376A26	2200; 50 V (chip)	C388
C244	21-84494B01	51 ± 5%; 500 V	C389
C245	21-80376A10	22 ± 5%; 50 V (chip)	C390 thru 39
C246	21-84494B01	51 ± 5%; 500 V	C394, 395
C247	21-82428B59	.01 uF + 80-20%; 200 V	C396
C248	21-80376A11	27 ± 5%; 50 V (chip)	C397
C249, 250	21-80376A10	22 ± 5%; 50 V (chip)	C398
C251	21-80376A26	2200; 50 V (chip)	
C252, 253	21-80376A08	15 ± 5%; 50 V (chip)	C399, 400
C254, 255	21-80376A26	2200; 50 V (chip)	C401
C256	23-84665F01	10 uF; 25 V	C500
C257	21-80376A17	100; 50 V (chip)	C501
C258, 259	21-84494B24	39 ± 5%; 500 V	
C260, 261	21-82428B59	.01 uF + 80-20%; 200 V	
C262, 263	21-80376A25	1000; 50 V (chip)	CR201
C264	21-80376A17	100; 50 V (chip)	CR202 thru 2
C265	21-84494B04	100 ± 5%; 500 V	CR206 thru 2
C266	21-82428B59	.01 uF + 80-20%; 200 V	CR214
C267	21-84494B34	68 ± 5%; 500 V	CR215, 216
C268	21-859936	15 ± 5%; 500 V	CR217, 218
C269, 270	21-82428B59	.01 uF + 80-20%; 200 V	CR219, 220
C271	21-84494B06	120 ± 5%; 500 V	CR221, 222
C272, 273	21-82428B59	.01 uF + 80-20%; 200 V	CR223 thru 2
C274	21-865922	390; 500 V	CR227
C275, 276	21-80376A03	3.9 ± 0.25%; 50 V (chip)	CR229, 230
C277	21-80376A07	12 ± 5%; 50 V (chip)	CR233
C278, 279	21-80376A05	5.6 ± 0.25%; 50 V (chip)	CR235, 126
C280	21-80376A09	18 ± 5%; 50 V (chip)	CR241, 242
C281	23-82397D04	15 uF ± 20%; 15 V	
C282	21-80369A99	.01 uF	
C283, 284	23-84665F02	15 uF; 25 V	FL201
C285	23-80369A64	6.8 uF; 35 V	
C286	23-84665F10	100 uF; 25 V	
C287	23-83441B18	4.7 uF ± 20%; 20 V	K201
C288	21-82428B59	.01 uF + 80-20%; 200 V	
C289	23-84665F01	10 uF; 25 V	
C290	21-80370A03	6800	L201, 202
C291	23-80368A62	15 uF ± 20%; 35 V	L203
C292	21-80376A17	100 ± 20%; 50 V (chip)	L204, 205
C293	21-80370A04	.011 uF	L206, 207, 20
C294	21-859934	10 ± 5%; 500 V	L209, 210
C295	21-82428B10	3300	L211
C296	21-80376A01	1.5 ± 0.5 pF; 50 V (chip)	L213, 214
C297	21-859936	15 ± 5%; 500 V	L215
C298	21-84494B47	6 ± 0.5 pF; 500 V	L216, 217
C299, 300	21-84494B74	6 ± 0.5 pF; 500 V	L218
C301 thru 304	21-82187B14	1000	L219, 220
C305, 306	23-84665F02	15 uF; 25 V	L221, 222
C307, 308	21-82372C10	.05 uF ± 20%; 25 V	L224
C309	21-84494B45	56 ± 5%; 500 V	L225
C310	21-84494B38	15 ± 5%; 500 V	L226, 227
C311	21-82187B14	1000	L228
C312	23-82397D50	0.22 uF ± 20%; 35 V	L229
C313	23-84665F01	10 uF; 25 V	L230, 231
C314, 315, 316	23-80369A61	10 uF ± 20%; 35 V	L232
C317	22-82428B59	.01 uF + 80-20%; 200 V	L233
C318	23-83441B15	1.0 uF ± 20%; 35 V	L234, 235
C319	21-82428B59	.01 uF + 80-20%; 200 V	L236
C320	23-80369A62	15 uF ± 20%; 35 V	L237
C321	21-82187B14	1000	L238
C322, 323	21-82428B59	.01 uF + 80-20%; 200 V	L239
C324	21-80369A88	22 ± 5%; 500 V	L240
C325, 326	21-82187B08	220; 500 V	L241
C327	21-82187B14	1000	L242
C328	21-80369A83	2 ± 0.5 pF; 500 V	

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C329	21-82428B59	.01 uF + 80-20%; 200 V
C330	21-84494B74	6 ± 5%; 500 V
C331 thru 334	21-82428B59	.01 uF + 80-20%; 200 V
C335	21-84494B37	11 ± 5%; 500 V
C336	21-84494B74	6 ± 0.5 pF; 500 V
C337, 338	21-82428B59	.01 uF + 80-20%; 200 V
C339	23-84665F01	10 uF; 25 V
C340	21-80376A17	100; 50 V (chip)
C341	21-82428B10	3300
C342	23-84665F01	10 uF; 25 V
C343	21-82428B10	3300
C344, 345	23-84665F01	10 uF; 25 V
C346, 347	21-83076A18	220; 50 V (chip)
C348	21-80376A26	2200; 50 V (chip)
C349	23-82397D04	15 uF ± 20%; 15 V
C350	23-83441B15	1.0 uF ± 20%; 35 V
C351 thru 369	21-82543H03	5000 + 80-20%; 500 V
C370	21-80376A17	100; 50 V (chip)
C371	23-83441B15	1.0 uF ± 20%; 35 V
C372, 373	21-82187B14	1000
C374, 375	21-80376A25	1000; 50 V (chip)
C376, 377	23-83441B18	4.7 uF ± 20%; 20 V
C378	23-83441B15	1.0 uF ± 20%; 35 V
C379	21-80376A25	1000; 50 V (chip)
C380	21-80376A17	100; 50 V (chip)
C381	21-80376A25	1000; 50 V (chip)
C382	21-80376A01	1.5 ± 0.5 pF; 50 V (chip)
C383	23-82397D18	33 uF ± 20%; 10 V
C384	21-80376A06	10 ± 5%; 50 V (chip)
C385, 386	21-80376A25	1000; 50 V (chip)
C387	21-80376A04	4.7 ± 0.5 pF; 50 V (chip)
C388	21-80376A01	1.5 ± 0.5 pF; 50 V (chip)
C389	21-80376A14	220 ± 2%; 50 V (chip)
C390 thru 393	21-80376A18	220; 50 V (chip)
C394, 395	21-859936	15 ± 5%; 500 V
C396	21-80376A25	1000; 50 V (chip)
C397	21-80369A83	2 ± 0.5 pF; 500 V
C398	21-8711966	10; 200 V
	or 21-859934	5 ± 0.5 pF; 500 V
C399, 400	21-80376A18	220; 50 V (chip)
C401	21-871966	5; 500 V
C500	21-80376A18	22; 50 V (chip)
C501	21-80376A06	10; 50 V (chip)
		diode:
CR201	48-82190H32	varactor
CR202 thru 205	48-82617C01	silicon
CR206 thru 212	48-80345A62	silicon
CR214	48-82617C01	silicon
CR215, 216	48-82190H47	varactor
CR217, 218	48-82190H37	varactor
CR219, 220	48-82617C01	silicon
CR221, 222	48-84616A01	hot carrier
CR223 thru 226	48-80345A62	silicon
CR227	48-82617C01	silicon
CR229, 230	48-80397A25	varactor
CR233	48-82617C01	silicon
CR235, 126	48-80397A25	varactor
CR241, 242	48-80345A62	silicon
		filter, crystal:
FL201	91-80378A36	10 MHz, 2-pole
		relay:
K201	80-80346A02	
		coil:
L201, 202	24-80369A19	0.1 uH
L203	24-80369A50	air wound, 1T 20
L204, 205	24-80369A19	0.1 uH
L206, 207, 208	24-80369A49	air wound, 1T 20
L209, 210	24-83961B01	choke, rf
L211	24-80369A23	0.15 uH ± 10%
L213, 214	24-80369A50	air wound, 1T 20
L215	24-83961B01	choke, rf
L216, 217	24-80369A19	0.1 uH
L218	24-80369A24	0.18 uH
L219, 220	24-80369A48	air wound, 3T 24
L221, 222	24-80369A51	air wound, 4T 24
L224	24-80369A25	0.22 uH
L225	24-80369A26	0.33 uH
L226, 227	24-80369A19	0.1 uH
L228	24-80369A27	0.47 uH
L229	24-80369A26	0.33 uH
L230, 231	24-80370A39	inductor, 12 mH
L232	24-80369A14	0.47 uH ± 1%
L233	24-80369A29	10 uH
L234, 235	24-80369A37	100 uH
L236	24-80369A25	0.22 uH
L237	76-83960B01	bead, ferrite
L238	24-80369A23	0.15 uH ± 10%
L239	24-80369A22	1 uH ± 10%
L240	24-83961B01	choke, rf
L241	24-80370A39	inductor, 12 mH
L242	24-80369A19	0.1 uH

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
L243	24-80369A37	100 uH
L244, 245, 246	24-80369A19	0.1 uH
L247	24-80369A37	100 uH
L248	24-80369A31	22 uH
L250	24-80369A52	
		transistor:
Q201	48-80345A46	NPN
Q202, 203	48-869571	PNP; type M9571
Q204, 205	48-84309A61	NPN
Q206	48-80345A54	dual gate MOSFET
Q207	48-869870	NPN; type MRF901
Q208, 209	48-869570	NPN; type M9570
Q210 211	48-869571	PNP; type M9571
Q212	48-80345A47	NPN
Q213, 214, 215	48-869870	NPN; type MRF901
Q216	48-869571	PNP; type M9571
Q217	48-6123A22	PNP
Q218	48-80346A65	NPN
Q219	48-2089C01	NPN
Q220	48-869870	NPN; type MRF901
Q221, 222	48-869570	NPN; type M9570
Q223	48-869933	N-channel FET; type U310
Q224, 225, 226	48-84309A61	NPN
Q227	48-869933	N-channel FET; type U310
Q228	48-869571	PNP; type M9571
Q229	48-84308A92	NPN
Q230	48-86851C32	NPN
Q231	48-80378A38	PNP
Q232	48-869870	NPN; type MRF901
Q233	48-2089C01	NPN
		resistor: ± 5%; 1/4 W: unless otherwise stated
R201	6-124A18	51
R202, 203	6-124A41	470
R204	6-124A25	100
R205	6-185A25	100; 1/8 W
R206 thru 211	6-124A41	470
R212	6-185A53	1.5k; 1/8 W
R213, 214	6-124A31	180
R215	6-124A15	39
R216, 217	6-124A41	470
R218, 219	6-124A59	2.7k
R220	6-124A79	18k
R221, 222	6-124A59	2.7k
R223	6-124A79	18k
R224	6-124A49	1k
R225	6-124A79	18k
R227	6-124A43	560
R228, 229	6-124A29	150
R230	6-185A73	10k; 1/8 W
R231	6-124A25	100
R232, 233	6-185A33	220; 1/8 W
R234	6-185A09	22; 1/8 W
R235	6-185A85	33k; 1/8 W
R236	6-185A96	51k; 1/8 W
R237	6-185A47	820; 1/8 W
R238	6-185A49	1k; 1/8 W
R239	6-124A25	100
R240	6-185A18	51; 1/8 W
R241	6-185A41	470; 1/8 W
R242, 243	6-185A43	560; 1/8 W
R244	6-185A53	1.5k; 1/8 W
R245, 246	6-185A33	220; 1/8 W
R247	6-124A31	180
R248, 249	6-185A05	15; 1/8 W
R250	6-124A97	100k
R251	6-124A85	33k
R252	6-185A57	2.2k; 1/8 W
R253	6-185A49	1k; 1/8 W
R254	6-185A53	1.5k; 1/8 W
R255	6-185A45	680; 1/8 W
R256, 257	6-185A09	22; 1/8 W
R258	6-185A21	68; 1/8 W
R259 thru 264	6-185A49	1k; 1/8 W
R265	6-124A73	10k
R266	6-124A65	4.7k
R267	6-185A57	2.2k; 1/8 W
R268	6-185A65	4.7k; 1/8 W
R269	6-185A59	2.7k; 1/8 W
R270	6-185A75	12k; 1/8 W
R271	6-185A67	5.6k; 1/8 W
R272	6-185A29	150; 1/8 W
R273	6-185A71	8.2k; 1/8 W
R274	6-185A75	12k; 1/8 W
R275	6-185A37	330; 1/8 W
R276	6-185A29	150; 1/8 W
R277	6-124A31	180
R278	6-185A17	47; 1/8 W
R279	6-185A05	15; 1/8 W
R281	6-185A53	1.5k; 1/8 W
R282, 283	6-185A33	220; 1/8 W
R284, 285	6-185A05	15; 1/8 W
R286	6-185A27	120; 1/8 W

REFE SYI
R287
R288
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R290
R291, 2
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R295, 2
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R298, 2
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R302, 3
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R310 th
R314, 3
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R394, 3
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R397
R398

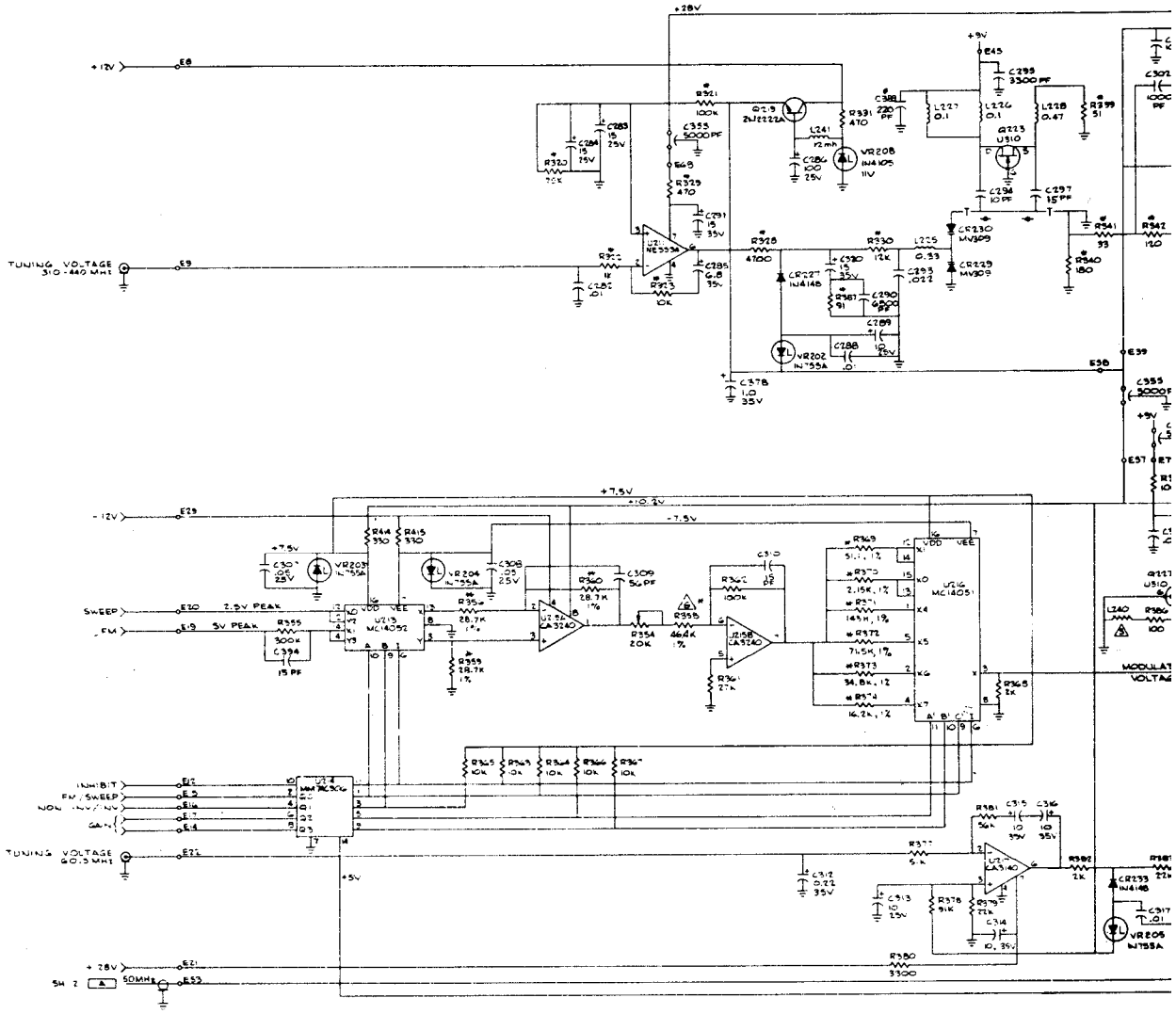
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R287	6-185A21	68; 1/8 W
R288	6-185A27	120; 1/8 W
R289	6-185A13	33; 1/8 W
R290	6-185A07	18; 1/8 W
R291, 292	6-185A69	6.8k; 1/8 W
R293	6-185A63	3.9k; 1/8 W
R294	6-185A39	390; 1/8 W
R295, 296	6-185A36	300; 1/8 W
R297	6-185A07	18; 1/8 W
R298, 299	6-185A44	620; 1/8 W
R300	6-185A18	51; 1/8 W
R301	6-124A15	39
R302, 303	6-124A33	220
R304	6-124A45	680
R305	6-124A35	270
R307	6-124A15	39
R308	6-124A49	1k
R309	6-124A59	2.7k
R310 thru 313	6-124A73	10k
R314, 315	6-124A53	1.5k
R319	6-185A57	2.2k; 1/8 W
R320	6-185A94	75k; 1/8 W
R321	6-185A97	100k; 1/8 W
R322	6-185A49	1k; 1/8 W
R323	6-185A73	10k; 1/8 W
R324	6-124A36	300
R325	6-124A07	18
R326	6-124A36	300
R327	6-124A43	560
R328	6-185A65	4.7k; 1/8 W
R329	6-185A41	470
R330	6-185A75	12k; 1/8 W
R331	6-124A41	470
R332, 333	6-185A36	300; 1/8 W
R334	6-185A07	18; 1/8 W
R335	6-185A18	51; 1/8 W
R336	6-185A53	1.5k; 1/8 W
R337, 338	6-185A05	15; 1/8 W
R339	6-185A18	51
R340	6-185A31	180; 1/8 W
R341	6-185A13	33; 1/8 W
R342	6-185A27	120; 1/8 W
R343	6-185A47	820; 1/8 W
R344	6-185A49	1k; 1/8 W
R345, 346	6-185A43	560; 1/8 W
R347	6-185A41	470; 1/8 W
R348	6-185A21	68; 1/8 W
R349	6-185A61	3.3k; 1/8 W
R350	6-185A59	2.7k; 1/8 W
R351	6-185A35	270; 1/8 W
R352	6-124A61	3.3k
R353	6-124A35	270
R354	18-83452F16	variable, 20k
R355	6-82672B33	309 ± 1%
R356	6-124A83	27k
R357	6-185A05	15; 1/8 W
R358	6-10621D56	46.4k ± 1; 1/8 W nominal
	or 6-10621D48	38.3k ± 1%; 1/8 W
	or 6-10621D52	42.2k ± 1%; 1/8 W
	or 6-10621D60	51.1k ± 1%; 1/8 W
	or 6-10621D64	56.2k ± 1%; 1/8 W
	or 6-10621D68	61.9k ± 1%; 1/8 W
R359, 360	6-10621D36	28.7k ± 1%; 1/8 W
R361	6-124A83	27k
R362	6-124A97	100k
R363 thru 367	6-124A73	10k
R368	6-124A56	2.0k
R369	6-10621D60	51.1 ± 1%; 1/8 W
R370	6-10621C27	2150 ± 1%; 1/8 W
R371	6-10621E04	143k ± 1%; 1/8 W
R372	6-10621D74	71.5k ± 1%; 1/8 W
R373	6-10621D44	34.8k ± 1%; 1/8 W
R374	6-10621D12	16.2k ± 1%; 1/8 W
R375	6-124A73	10k
R376	6-185A05	15; 1/8 W
R377	6-124A90	51k
R378	6-124A96	91k
R379	6-124A81	22k
R380	6-124A61	3.3k
R381	6-124A91	56k
R382	6-124A56	2.0k
R383	6-124A81	22k
R384	6-124A99	120k
R385	6-124A73	10k
R386	6-124A25	100
R387	6-185A24	91; 1/8 W
R389	6-124A73	10k
R390	6-124A25	100
R391	6-124A97	100k
R392	6-124A79	18k
R393	6-124A25	100
R394, 395	6-124A75	12k
R396	6-124A01	10
R397	6-124A73	10k
R398	6-124A47	820
R399	6-124A51	1.2k
R400	6-124A01	10
R401, 402, 403	6-124A49	1k
R404	6-185A49	1k; 1/8 W
R405	6-124A73	10k
R406	6-124A49	1k
R407	6-185A56	2.0k; 1/8 W
R408	6-124A25	100
R409	6-185A49	1k; 1/8 W
R410	6-185A61	3.3k; 1/8 W
R411	6-185A49	1k; 1/8 W
R412	6-185A41	470; 1/8 W
R413	6-185A45	680; 1/8 W
R414, 415	6-124A37	330
R416	6-185A65	4.7k; 1/8 W
R417	6-124A31	180
R418	6-185A33	220; 1/8 W
R419, 420	6-185A31	180; 1/8 W
R421	6-185A85	33; 1/8 W
R422	6-185A33	220; 1/8 W
R423	6-185A53	1.5k; 1/8 W
R424	6-185A51	1.2k; 1/8 W
R425	6-185A65	4.7k; 1/8 W
R426	6-185A67	5.6k; 1/8 W
R427 thru 430	6-185A37	330; 1/8 W
R431	6-185A41	470; 1/8 W
R432	6-185A21	68; 1/8 W
R434	6-185A31	180; 1/8 W
R435	6-124A56	2.0k
R436	6-185A25	100; 1/8 W
R437	6-185A23	82; 1/8 W
R500, 501	6-124A81	22k
R502	6-124A25	100
		transformer:
T201, 202	24-80369A53	2T 32 on 3B bead
		integrated circuit:
U201	51-80365A16	650 MHz prescaler
U202	51-80365A06	bi-quinary counter
U203	51-80365A01	phase frequency detector
U204	51-83629M07	operational amplifier
U205	51-80365A02	triple line receiver
U206	51-80346A05	mixer
U207	51-83629M08	operational amplifier
U208	51-80345A32	high speed 1.3 GHz divider
U209	1-84846M02	mixer
U210	51-80365A16	150 MHz prescaler
U211	51-80365A14	micro circuit; NE5534AN screened low noise operational amplifier
U212	51-80346A54	dc; 600 MHz wideband hybrid amplifier
U213	51-82884L54	dual 4-channel analog multiplexer/ demultiplexer
U214	51-84561L97	hex open drain N-channel buffer
U215	51-80365A07	operational amplifier
U216	51-82884L46	8-channel analog multiplexer/ demultiplexer
U217	51-83629H07	operational amplifier
U218	51-80365A15	differential video wideband amplifier
U219	51-83225M05	balanced modulator/demodulator
		Zener diode: ± 5%; 1/4 W: unless otherwise stated
VR201	48-83193A59	5.6 V
VR202 thru 205	48-82256C44	7.5 V
VR206, 207	48-82256C11	10 V
VR208	48-82256C34	11 V
VR209	48-86850C13	5.1 V
VR210	48-82256C34	11 V

REF. NO.	MECHANICAL PARTS	
	RTC-4010B	RF synthesizer
1	84-80335A21	PWB, rf synthesizer
2	SN63WRMAP3	SOLDER
3	11-14167A01	INK, BLK
4	26-P00210N001	SHIELD
5	26-P00210N02	SHIELD
6	26-P00210N03	SHIELD
7	26-P0021N004	SHIELD
8	26-P0021N005	SHIELD
9	26-P00210N06	SHIELD
11	1-80305A61	CABLE, semi-rigid
12	26-P00210N007	SHIELD, can
13	26-P00240N001	SHIELD, can
14	26-P00210N008	SHIELD, can
15	SN63WRP3	SOLDER
16	M23053/5-103-9	INSULATOR SLEEVING, .093 WHT
17	M23053/5-205-C	INSULATION SLEEVING, 0.187 CLR
18		INSULATION SLEEVING, 22 WHT
19		INSULATION TAPE, 1 IN YEL
20		WIRE, 24

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R399	6-124A51	1.2k
R400	6-124A01	10
R401, 402, 403	6-124A49	1k
R404	6-185A49	1k; 1/8 W
R405	6-124A73	10k
R406	6-124A49	1k
R407	6-185A56	2.0k; 1/8 W
R408	6-124A25	100
R409	6-185A49	1k; 1/8 W
R410	6-185A61	3.3k; 1/8 W
R411	6-185A49	1k; 1/8 W
R412	6-185A41	470; 1/8 W
R413	6-185A45	680; 1/8 W
R414, 415	6-124A37	330
R416	6-185A65	4.7k; 1/8 W
R417	6-124A31	180
R418	6-185A33	220; 1/8 W
R419, 420	6-185A31	180; 1/8 W
R421	6-185A85	33; 1/8 W
R422	6-185A33	220; 1/8 W
R423	6-185A53	1.5k; 1/8 W
R424	6-185A51	1.2k; 1/8 W
R425	6-185A65	4.7k; 1/8 W
R426	6-185A67	5.6k; 1/8 W
R427 thru 430	6-185A37	330; 1/8 W
R431	6-185A41	470; 1/8 W
R432	6-185A21	68; 1/8 W
R434	6-185A31	180; 1/8 W
R435	6-124A56	2.0k
R436	6-185A25	100; 1/8 W
R437	6-185A23	82; 1/8 W
R500, 501	6-124A81	22k
R502	6-124A25	100
		transformer:
T201, 202	24-80369A53	2T 32 on 3B bead
		integrated circuit:
U201	51-80365A16	650 MHz prescaler
U202	51-80365A06	bi-quinary counter
U203	51-80365A01	phase frequency detector
U204	51-83629M07	operational amplifier
U205	51-80365A02	triple line receiver
U206	51-80346A05	mixer
U207	51-83629M08	operational amplifier
U208	51-80345A32	high speed 1.3 GHz divider
U209	1-84846M02	mixer
U210	51-80365A16	150 MHz prescaler
U211	51-80365A14	micro circuit; NE5534AN screened low noise operational amplifier
U212	51-80346A54	dc; 600 MHz wideband hybrid amplifier
U213	51-82884L54	dual 4-channel analog multiplexer/ demultiplexer
U214	51-84561L97	hex open drain N-channel buffer
U215	51-80365A07	operational amplifier
U216	51-82884L46	8-channel analog multiplexer/ demultiplexer
U217	51-83629H07	operational amplifier
U218	51-80365A15	differential video wideband amplifier
U219	51-83225M05	balanced modulator/demodulator
		Zener diode: ± 5%; 1/4 W: unless otherwise stated
VR201	48-83193A59	5.6 V
VR202 thru 205	48-82256C44	7.5 V
VR206, 207	48-82256C11	10 V
VR208	48-82256C34	11 V
VR209	48-86850C13	5.1 V
VR210	48-82256C34	11 V

REF. NO.	MECHANICAL PARTS	
	RTC-4010B	RF synthesizer
1	84-80335A21	PWB, rf synthesizer
2	SN63WRMAP3	SOLDER
3	11-14167A01	INK, BLK
4	26-P00210N001	SHIELD
5	26-P00210N02	SHIELD
6	26-P00210N03	SHIELD
7	26-P0021N004	SHIELD
8	26-P0021N005	SHIELD
9	26-P00210N06	SHIELD
11	1-80305A61	CABLE, semi-rigid
12	26-P00210N007	SHIELD, can
13	26-P00240N001	SHIELD, can
14	26-P00210N008	SHIELD, can
15	SN63WRP3	SOLDER
16	M23053/5-103-9	INSULATOR SLEEVING, .093 WHT
17	M23053/5-205-C	INSULATION SLEEVING, 0.187 CLR
18		INSULATION SLEEVING, 22 WHT
19		INSULATION TAPE, 1 IN YEL
20		WIRE, 24

REF. NO.	MOTOROLA PART NO.	DESCRIPTION
21	RTV3145	ADHESIVE
22		WIRE, teflon; 22 solid WHT
23		INSULATING SLEEVING, 14 WHT
24	SN62WRMAP3	SOLDER

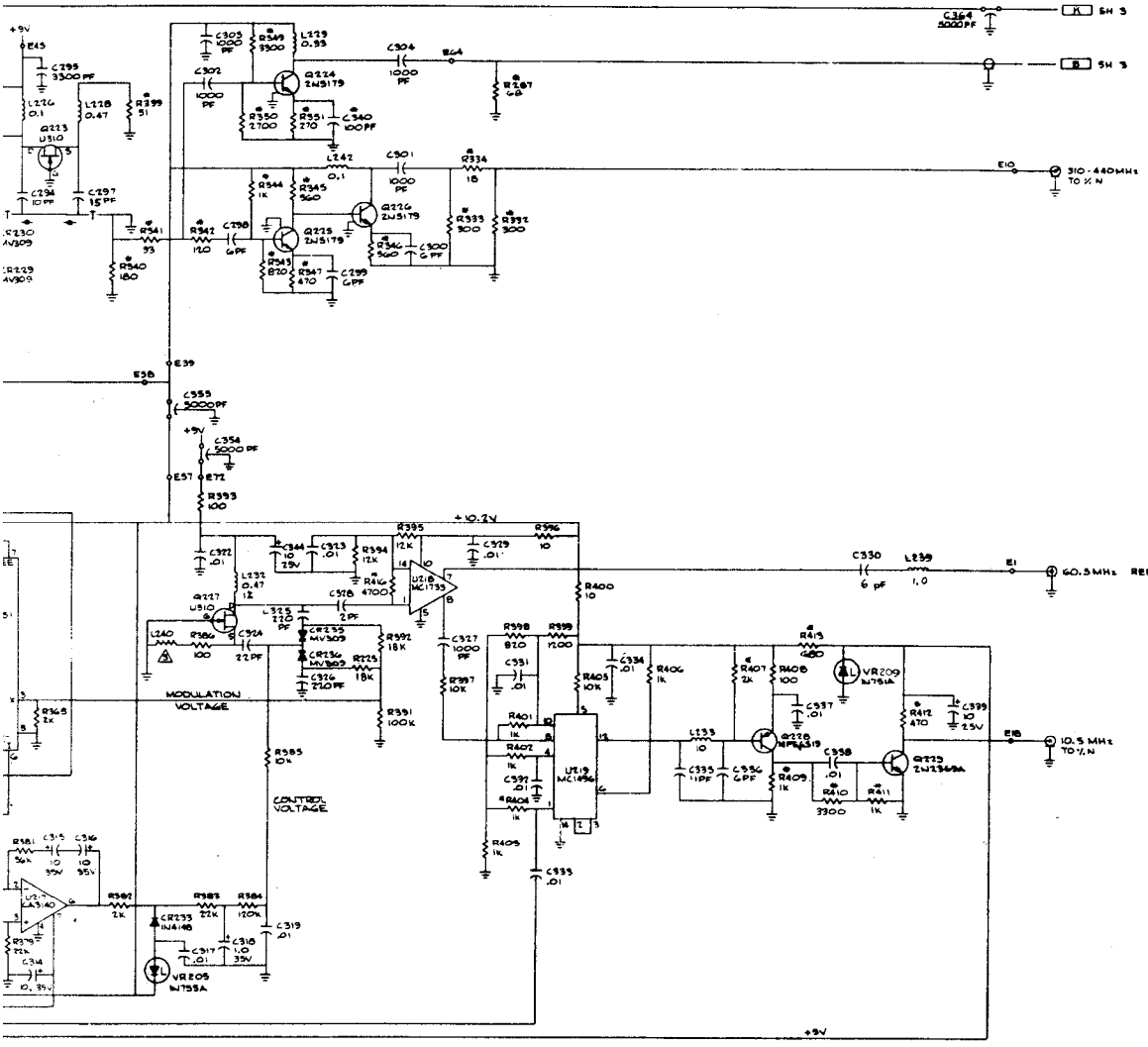


REF DES	DEVICE TYPE	SHLD	+5V
U201	HC900C	1,2,3,12,14	4,5
U202	MC10158L	8	1,16
U203	MC12008L	7	1,14
U204	CA3140E	4	
U205	MC10116	8	1,16
U206	TEM-2	3	
U207	MLM524		
U208	SP8609B	6	
U209	TEM-2	3	
U210	CA3240E		
U211	NE5534AN	4	
U212	MWA100	3	
U213	MC14052	8	
U214	MMC4504N	7	
U215	CA3240E		M
U216	MC14051	8	
U217	CA3140E	4	
U218	MC11793	5	
U219	MC1496	14	

RF SYNTHESIZER (A05)

RF BOARD

MODEL RTC4010B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATIONS PREFIX WITH 1A5.
2. FOR REFERENCE DRAWINGS REFER TO:
   01-P00385N02 MODULE ASSY
   01-P00386A02 PWB ASSY
3. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS ±5 PCT, 1/4W.
   ALL CAPACITORS ARE IN UF.
   ALL INDUCTORS ARE IN UH.
   ALL VOLTAGES ARE DC.
4. B MEANS 1/8W OR CHIP CAP.

⚠ 2AC8996180I

⚠ SELECT IN TEST

REF DES	NOMINAL	SELECT VALUES
C365	NONE	1.5 PF
C398	NONE	5 PF, 10 PF
R358	464K	38.3K, 42.2K, 51K, 56.2K, 61.9K
R437	NONE	82

REF DES	DEVICE TYPE	SHLD	+5V	-5V	+12V	+12V	NO CONNECTION
U201	HC900C	1,2,3,12,14	4,5				6,7,10,11,13
U202	MC1038L	8	1,16				4,5,6,9,10,11,12,13,14,15
U203	MC12040L	7	1,14				2,4,5,8,10,11,13
U204	CA3140E	4					1,5,8
U205	MC1016	8	1,16				14,15
U206	TEM-2	3					
U207	MLM324				4	11	
U208	SP8698B	6					1,2,3,5,8,9,12,13
U209	TEM-2	3					
U210	CA3240E				8	4	
U211	NE5536AN	4					1,5,8
U212	MWA100	3					
U213	MC14052	8					1,5,11,15
U214	MM74C906	7	14				12,13
U215	CA3240E					4	
U216	MC14051	8					
U217	CA3140E	4					1,5,8
U218	MC1733	5					2,3,4,6,9,11,12,13
U219	MC1496	14					7,9,12,13

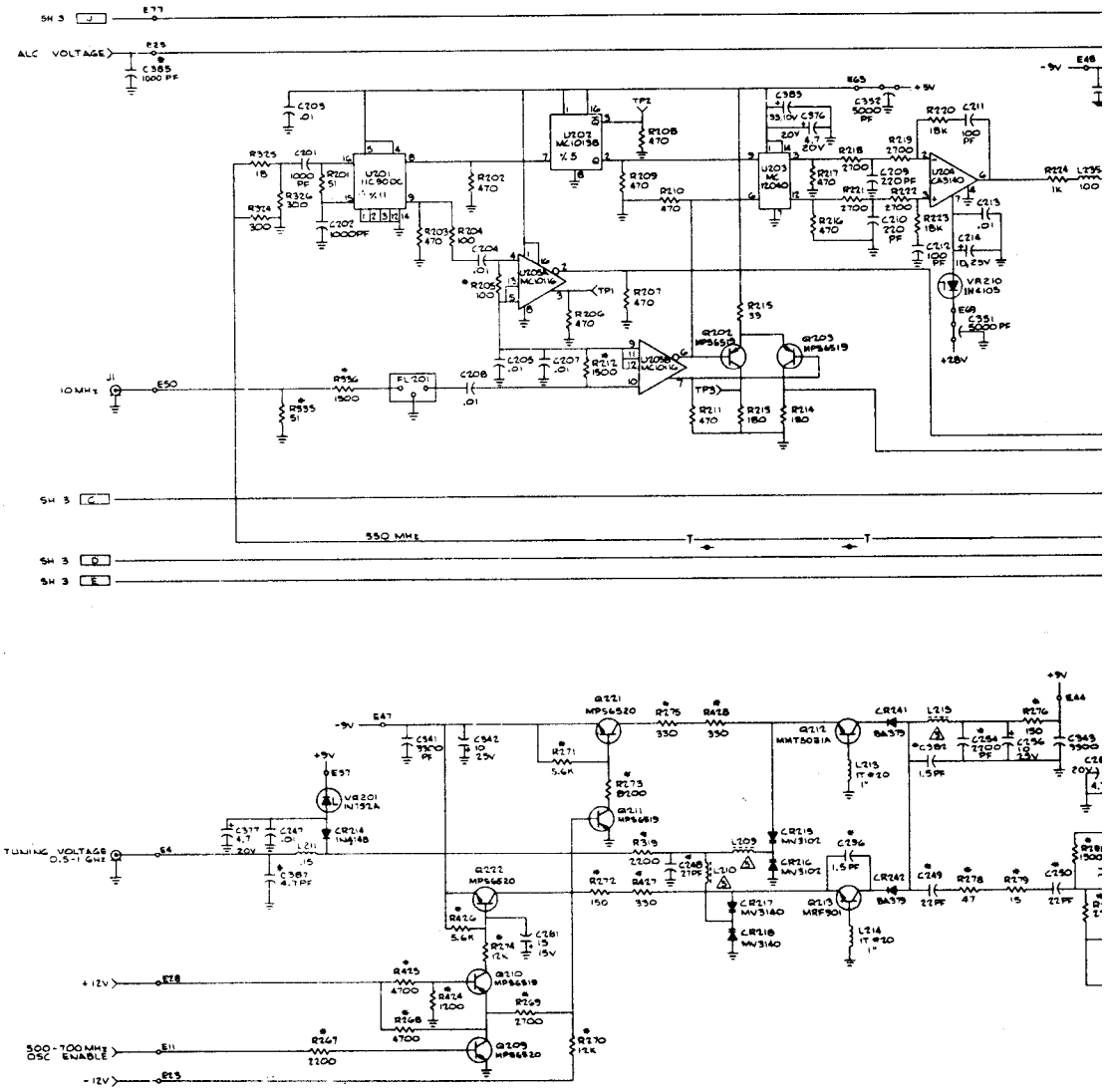
Motorola No. PEPS-37065-O
(Sheet 4 of 6)
8/12/83- PHI

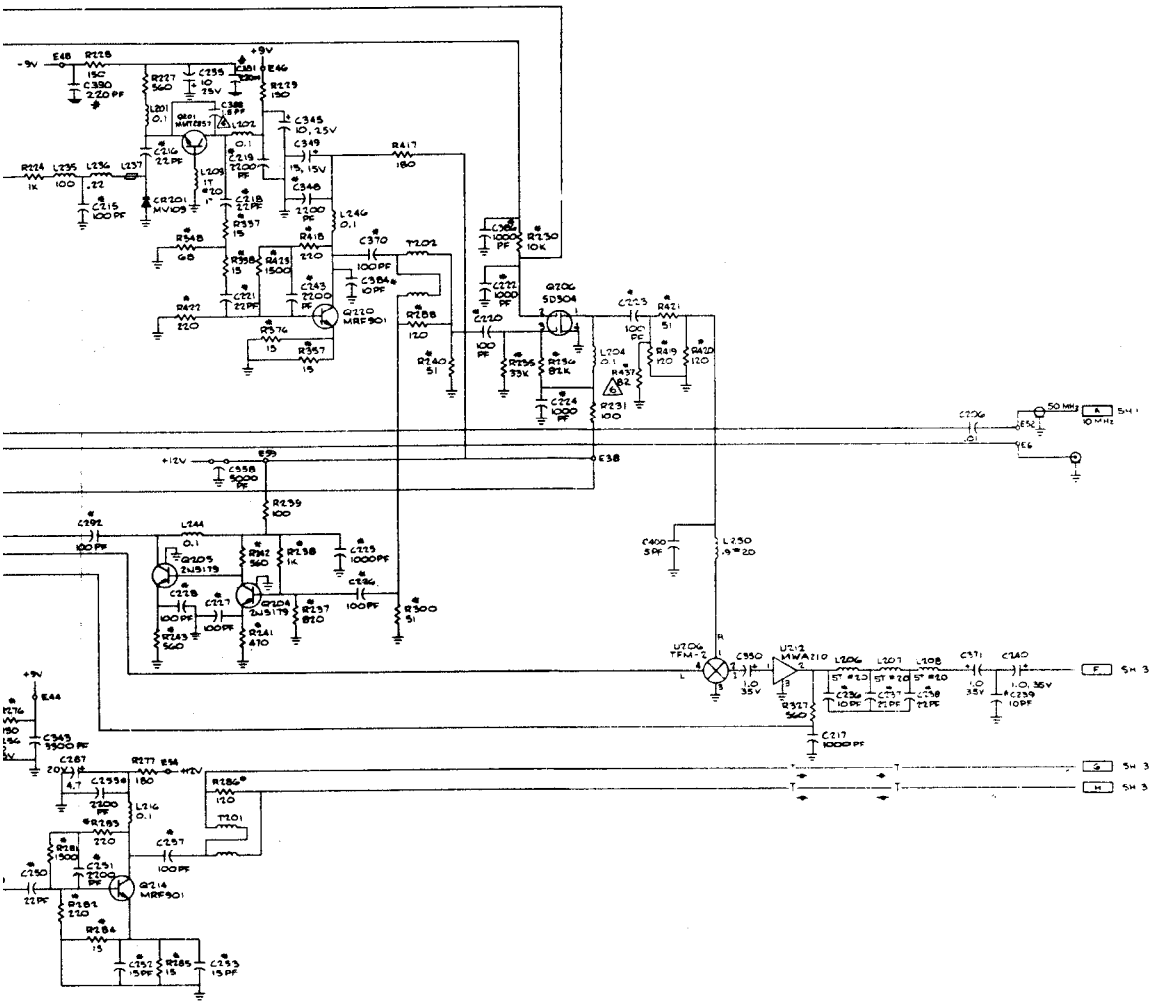
RF SYNTHESIZER RF BOARD

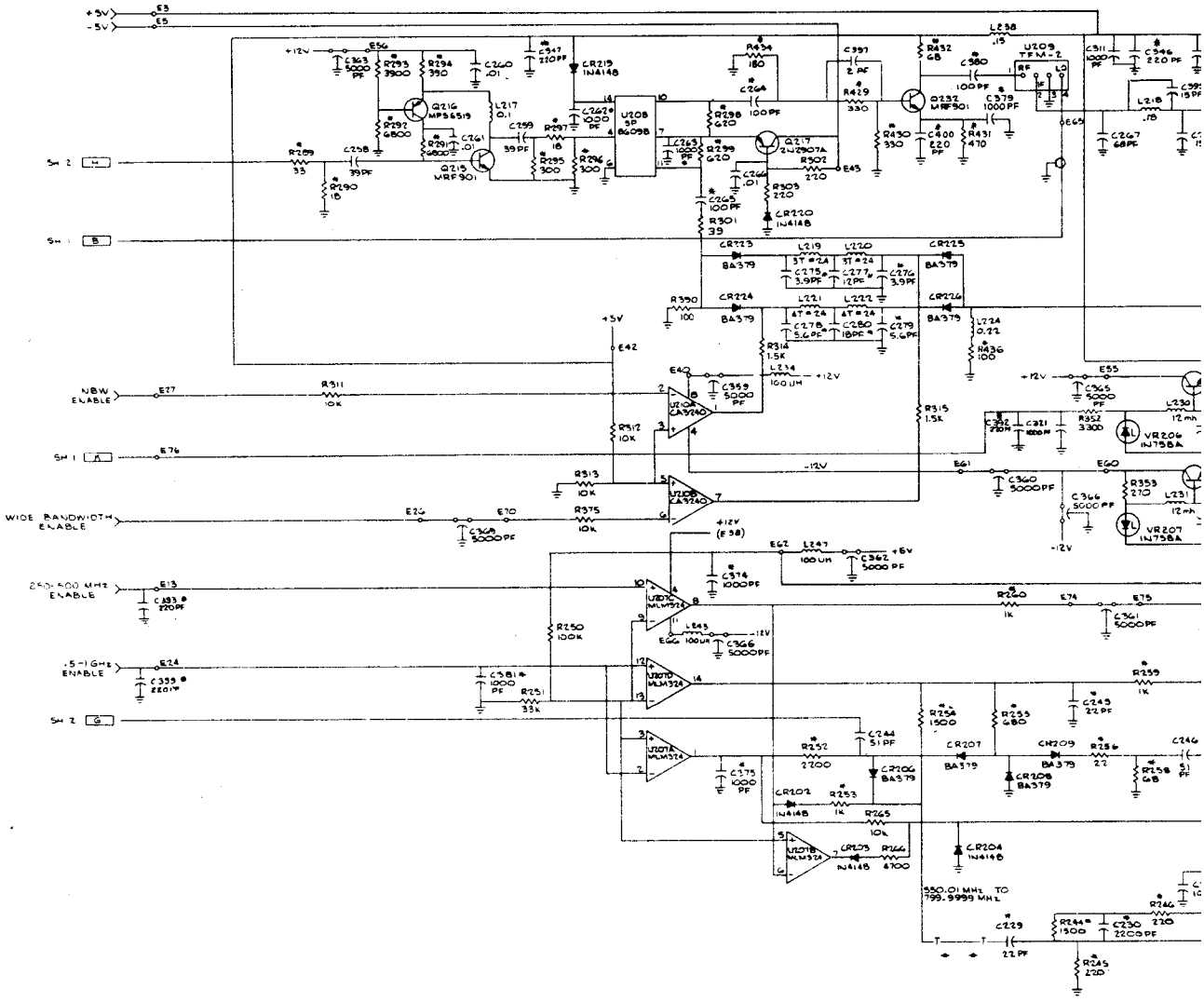
RF SYNTHESIZER (A05)

RF BOARD

MODEL RTC4010B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



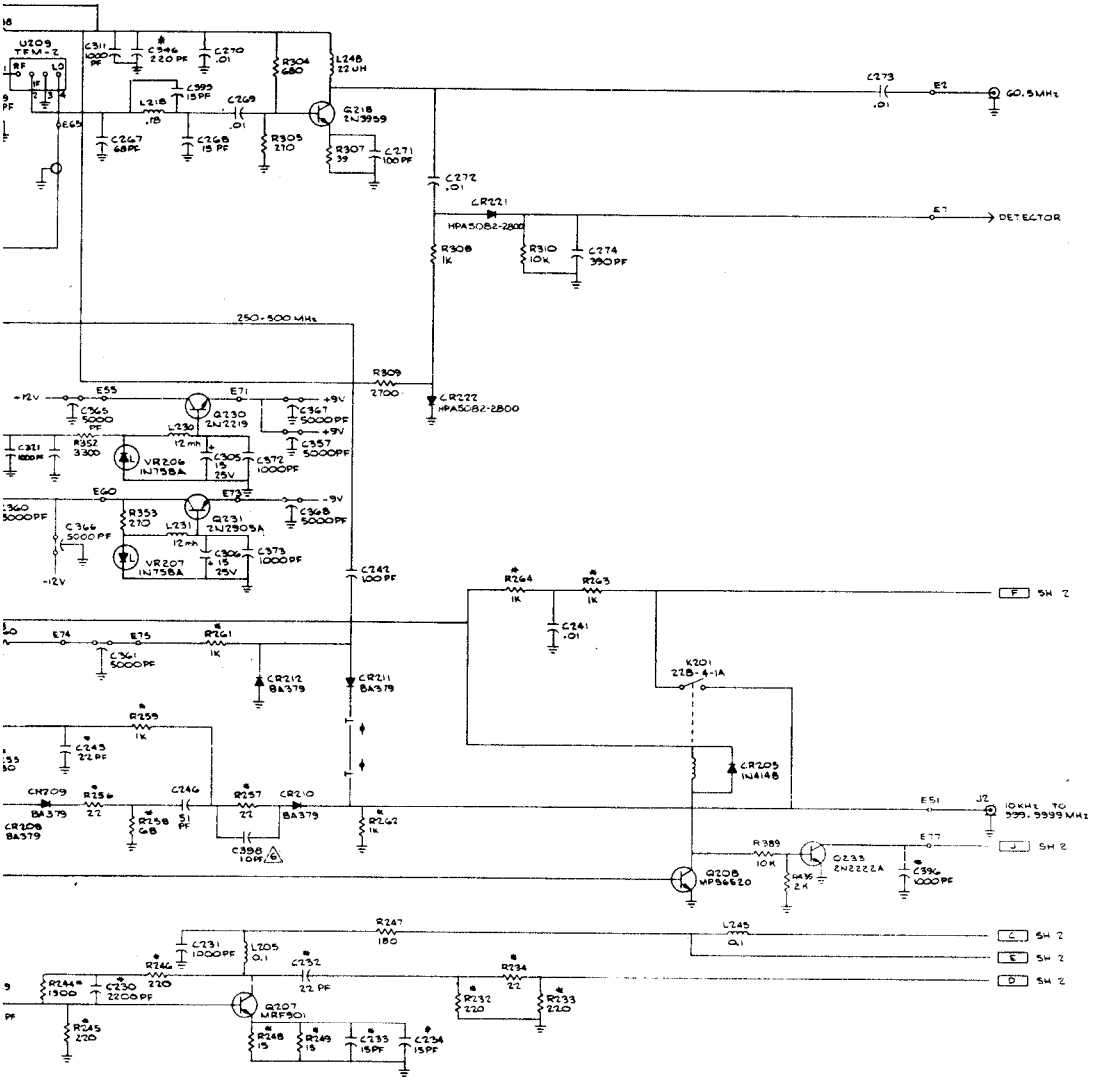

-9V
+9V
+12V
E48
E46
E44
E39
E38
R228
150
C390
220 PF
R227
560
C395
10
25V
C388
6PF
R229
150
L201
0.1
Q201
MMBT5551
L202
C345
10, 25V
C349
15, 15V
C346
2200 PF
R417
180
C216
22 PF
L208
17
#20
C219
2200 PF
C218
12 PF
L246
0.1
R224
1K
L235
100
L236
.22
L237
C215
100 PF
CR201
MV109
R357
15
R418
220
C370
100 PF
T1202
R548
68
R358
15
R425
1500
C384
10PF
C221
22PF
C243
2200 PF
Q220
MRF901
R427
220
R376
15
R357
15
R388
120
R240
51
C360
1000 PF
R230
10K
C222
1000 PF
Q206
SD304
C220
100 PF
R235
33K
R236
82K
L204
0.1
R437
82
C224
1000 PF
R231
100
C223
100 PF
R421
51
R419
120
R420
120
C706
.01
50 MHz
10 MHz
SH 1
C292
100 PF
L244
0.1
Q205
SU5179
R242
560
R238
1K
C225
1000PF
C228
100 PF
C227
100PF
Q204
SU5179
C226
100PF
R237
820
R243
560
R241
470
R300
51
R239
100
C400
5PF
L250
.9"#20
U206
TFM-2
C350
.1
35V
U212
MWA210
L206
5" #20
L207
5" #20
L208
5" #20
C371
.1
35V
C140
1.0, 35V
C236
10PF
C237
.1PF
C238
22PF
C239
10PF
F
SH 3
R327
560
C217
1000 PF
G
H
SH 3
R276
150
C343
1500 PF
C287
20V
4.7
C295
2200 PF
R277
180
R286
120
T1201
L216
0.1
R293
220
C297
100PF
R281
1500
C251
2200 PF
C250
22PF
Q214
MRF901
R282
220
R284
15
C292
15PF
R285
15
C293
15PF


+5V
-5V
+12V
SW 2 H
SW 1 B
NBW ENABLE
SW 1 A
WIDE BANDWIDTH ENABLE
250-500 MHz ENABLE
.5-1 GHz ENABLE
SW 2 G
-12V
+6V
U208 SP 8698
U209 TFM-2
Q216 MPS6519
Q215 MRF901
Q217 2N2907A
Q232 MRF901
U210 CA3240
U207C MLM324
U207D MLM324
U207A MLM324
U207B MLM324
VR206 IN758A
VR207 IN758A
CR219 IN4148
CR220 IN4148
CR204 IN4148
CR205 IN4148
CR202 IN4148
CR207 BA379
CR208 BA379
CR209 BA379
CR222 BA379
CR223 BA379
CR224 BA379
CR225 BA379
CR226 BA379
550.01 MHz TO 799.9999 MHz

RF SYNTHESIZER (A05)

RF BOARD

MODEL RTC4010B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



*Motorola No. **PEPS-37065-O***
(Sheet 6 of 6)
8/12/83- PHI

RF SYNTHESIZER RF BOARD

RECEIVER BOARD (A06)

MODEL RTL4091A

1. DESCRIPTION

1.1 The receiver demodulates and processes the 10.7 MHz i-f output from the rf module to recovered AM and FM audio signals. The receiver consists of an i-f section, an audio section, a squelch section, frequency counter output circuit, and a microprocessor interface.

1.2 Input signals are subjected to filtering, amplification, limiting, detection, and AGC control. Primary outputs from the receiver board include calibrated audio levels corresponding to deviation and percent of amplitude modulation. A gated 10.7 MHz i-f signal is output to the counter circuits to determine frequency error. The amplifiers in the i-f section are AGC controlled to establish overload alarm signals. Squelch status is applied to the front panel for monitoring. All switching on the receiver is microprocessor-controlled via the data bus.

1.3 RF from the wideband amplifier is applied via coaxial cable to J1 on the receiver board. The recovered audio is applied to the output via the main interconnect board.

2. THEORY OF OPERATION

2.1 I-F SECTION

2.1.1 General

The i-f section consists of an AGC controlled amplifier, AGC circuit, AM i-f and detector circuit, FM i-f and quadrature detector circuit, and bandpass filtering. The output from the rf module is connected via coaxial cable to J1. Amplifier U1 is an AGC controlled input amplifier that is matched to the narrow bandpass and wide bandpass filter. U1 gain is determined by the output of U6A. Narrowband or wideband filtering is selected by the i-f bandwidth control lines. The FM i-f signal is sent to the FM i-f circuit and quadrature detector U2 where it is converted into audio.

2.1.2 AGC Controlled Amplifier

I-F input amplifier U1 is an AGC controlled amplifier. The i-f cirucit is terminated through J1 by a 50 ohm load. The output of U1 is a 4000 ohm tuned circuit and matched filter.

2.1.3 AGC Circuit

The dc component of the composite AM signal is applied to amplifier U6A where it is amplified and sent to amplifier U1 as the AGC voltage. Feedback circuitry and filtering provide sufficient time for the AGC circuit to respond to changes in signal level inherent with AM signals.

2.1.4 AM I-F and Detector

AM i-f signals are routed through transistor circuits utilizing a high input impedance to avoid loading the i-f filter output. AM detection is accomplished by diode CR13 with the composite signal being developed across C48 and R54.

2.1.5 FM I-F and Quadrature Detector Circuit

The output of the i-f filter is applied to U2. The amplifier combines both amplifier, limiter, and quadrature detector on a single integrated circuit. The tuned network from pin 8 to pin 10 supplies a quadrature i-f signal. The i-f signal and quadrature component are applied to the internal detector of U2. The audio output is sent to audio amplifier U8B.

2.2 AUDIO/SQUELCH SECTION

Composite AM from the AM detector is sent through a 7 kHz low-pass filter prior to being amplified by U9B. The AM audio signal is applied to amplifier U5A where it is amplified and applied to the percent modulation output. AM audio is also applied to gate U7C and is routed through the active filter U12B. If FM select is active, the FM audio signal from amplifiers

U8B and U9A is routed through squelch gate U7C and U7D to the active filter.

2.3 AUDIO/COUNTER SECTION

The audio section consists of an audio inverter and an audio output amplifier. Audio is inverted by U12A. Switching for inversion is determined by U10A, U10B, and U10C. Audio is buffered by transistors Q8 and Q9 before being applied to the output as recovered audio. The i-f signal from amplifier Q7 is buffered by transistor Q10 before being routed off the board as a 10.7 MHz signal. U6B and U16A determine at what input level the 10.7 MHz output is to be enabled. Transistor Q11 enables CR18 to open the 10.7 MHz output line. AGC output from amplifier U6A is inverted by U4A. Squelch comparator U4B applies the squelch gate signal and the signal level voltage to light the front panel indicator.

2.4 INTERFACE SECTION

The interface section consists of an address decoder, data latch, and i-f bandwidth control line switch. The address decoder receives address input on AØ through A3 address lines and applies a data strobe to data latch U14. The data strobe gates data from data lines DØ through D3 into U14 to generate AM/FM select, audio invert, and i-f bandwidth gain signals. The i-f bandwidth control line switch applies narrow band or wideband select signals to the i-f input audio amplifier and filter circuit.

parts list

RTL4091A Receiver Board — PL-8442-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed uF; ± 5%; 500 V: unless otherwise stated
C1 thru 7	21-83596E21	.01 + 80-20%; 200 V
C8	21-83406D81	20 pF ± 5%
C9 thru 12		NOT USED
C13	21-83406D89	10 pF ± 0.5 pF
C14	21-83406D93	16 pF ± 5%
C15		NOT USED
C16, 17, 18	21-83596E21	.01 + 80-20%; 200 V
C19	21-83406D55	18 pF ± 5%
C20	21-83596E21	.01 + 80-20%; 200 V
C21	21-83406D89	10 pF ± 0.5 pF; 500 V
C22, 23	21-83596E21	.01 + 80-20%; 200 V
C24, 25	21-82372C07	.05 + 80-0%; 25 V
C26	23-84665F26	100 ± 20%; 16 V
C27	21-83596E21	.01 + 80-20%; 200 V
C28	23-84665F26	100 ± 20%; 16 V
C29	21-82372C07	.05 + 80-0%; 25 V
C30, 31, 32	21-83596E21	.01 + 80-20%; 200 V
C33	21-850118	100 pF sil mica; 300 V
C34	23-84665F26	100 ± 20%; 16 V
C35, 36	21-840895	27 pF ± 5%; 300 V
C37 thru 43	21-83596E21	.01 + 80-20%; 200 V
C44	20-82399D05	variable; 9-35 pF
C45, 46, 47	21-83596E21	.01 + 80-20%; 200 V
C48	21-84426B62	190 pF sil mica ± 3%; 300 V
C49	21-859944	300 pF sil mica ± 5%; 300 V
C50	23-84665F04	1 + 150-10%; 50 V
C51	23-84908L01	2.2 ± 20%; 50 V
C52, 53	21-83596E21	.01 + 80-20%; 200 V
C54	53-84908L01	2.2 ± 20%; 50 V
C55	8-82096J18	0.1 ± 10%; 250 V
C56		NOT USED
C57	21-84494B13	240 pF sil mica ± 5%; 300 V
C58		NOT USED
C59	21-84494B06	120 pF sil mica ± 5%; 300 V
C60 thru 68	21-83596E21	.01 + 80-20%; 200 V
C69, 70, 71	21-82372C07	.05 + 80-0%; 25 V
C72 thru 75	23-84665F01	10 + 100-10%; 25 V
C76, 77	21-83596E21	.01 + 80-20%; 200 V
C78, 79	23-84665F01	10 + 100-10%; 25 V
C80	21-83596E21	.01 + 80-20%; 200 V
C81	21-83406D86	47 pF ± 5%; 300 V
C82	20-82399D05	variable; 9-35 pF
		diode: (see note 1)
CR1	48-83654H01	silicon
CR2, 3, 4		NOT USED
CR5	48-83654H01	silicon
CR6		NOT USED
CR7, 8	48-83654H01	silicon
CR9, 10	48-83654H01	silicon
CR11		NOT USED
CR12 thru 20	48-83654H01	silicon
		connector, receptacle:
J1	9-83250M01	female; single contact (phono)
		coil, rf:
L1	24-84250D01	choke; 15 uH ± 5%
L2	24-82549D25	choke; 10 uH ± 5%
L3	24-82549D36	choke; 4.7 uH ± 10%
L4	24-84250D01	choke; 15 uH ± 5%
L5	24-82549D25	choke; 10 uH ± 5%
L6	24-82549D36	choke; 4.7 uH ± 10%
L7	24-82723H03	choke; 23 uH ± 10%
L8	24-83541L02	discriminator coil
L9, 10	24-82549D28	choke; 10 uH ± 20%
L11	24-84250D01	choke; 15 uH ± 5%
		transistor: (see note 1)
Q1 thru 4	48-869570	NPN; type M9570
Q5	48-869940	field-effect; type M9940
Q6, 7, 8	48-869570	NPN; type M9570
Q9	48-869571	PNP; type M9571
Q10	48-869940	field-effect; type M9940
Q11	48-869570	NPN; type M9570
		resistor, fixed; ± 5%; 1/4 W: unless otherwise stated
R1	6-124A18	51
R2, 3	6-124A66	5.1k
R4	6-124A05	15
R5 thru 9		NOT USED
R10	6-124A55	1.8k
R11	6-124A45	680
R12		NOT USED
R13	6-124A09	22
R14, 15	6-124A97	100k
R16	6-124A85	33k
R17	6-124A07	18
R18	6-124A77	15k
R19	6-124A13	33
R20	6-124A67	5.6k
R21	6-124A70	7.5k
R22	6-124A35	270

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R23		NOT USED
R24, 25	6-124A97	100k
R26, 27, 28, 29	6-124B02	150k
R30	6-124A45	680
R31	6-124A69	6.8k
R32	6-124A73	10k
R33	6-124A47	820
R34	6-124A89	47k
R35, 36, 37	6-124A83	27k
R38	6-124A86	36k
R39	6-124A83	27k
R40	6-124A86	36k
R41	6-124A97	100k
R42	6-124A37	330
R43	6-124A73	10k
R44	6-124A71	8.2k
R45	6-124A51	1.2k
R46	6-124A78	16k
R47	6-124A59	2.7k
R48	6-124A49	1k
R49	6-124A31	180
R50	6-124A01	10
R51	6-124A73	10k
R52*	6-124A72	9.1k (note 2)
R53	6-124A01	10
R54	6-124A77	15k
R55	6-124A94	75k
R56	6-124B14	470k
R57	6-124A81	22k
R58	6-124A97	100k
R59	18-83452F14	variable; 10k
R60	6-124A49	1k
R61	6-124A09	22
R62	6-124A61	3.3k
R63 thru 65		NOT USED
R66	6-124A82	24k
R67	6-124A90	51k
R68	6-124A81	22k
R69	6-124A93	68k
R70	18-83452F14	variable; 10k
R71	6-124A63	3.9k
R72	6-124B06	220k
R73, 74	6-124A73	10k
R75	18-83452F18	variable; 50k
R76*	6-124A87	39k (note 2)
R77	18-83452F17	variable; 50k
R78*	6-124A98	110k (note 2)
R79, 80		NOT USED
R81, 82	6-124A75	12k
R83	6-124A89	47k
R84	6-124A88	43k
R85	6-124A25	100
R86, 87	6-124A72	9.1k
R88	6-124A25	100
R89	6-124A09	22
R90	6-124A93	68k
R91	6-124A37	330
R92	6-124A01	10
R93	6-124A77	15k
R94	6-124A45	680
R95	6-124A89	47k
R96	6-124A59	2.7k
R97	6-124B14	470k
R98	6-124A44	620
R99	6-124A97	100k
R100	6-124A57	2.2k
R101, 102	6-124B06	220k
R103, 104	18-83452F13	variable; 10k
R105, 106	6-124A77	15k
R107	6-124B02	150k
R108 thru 112	6-124A71	8.2k
R113, 114	6-124A67	5.6k
R115, 116	6-124A01	10
		integrated circuit: (see note 1)
U1	51-80066C01	i-f amplifier
U2	51-84561L84	quad detector
U3	51-82884L48	quad bilateral switch
U4	51-84371K63	dual operational amplifier
U5, 6	51-80365A07	dual operational amplifier
U7	51-82884L48	quad bilateral switch
U8, 9	51-80365A07	dual operational amplifier
U10	51-82884L48	quad bilateral switch
U11		NOT USED
U12	51-80365A07	dual operational amplifier
U13		NOT USED
U14	51-82884L15	quad clocked D-latch
U15, 16	51-84371K74	quad comparator
U17	51-84561L42	dual 1 of 4 decoder/demultiplexer
		voltage regulator: (see note 1)
VR1, 2	48-82256C46	Zener type; ± 5%; 3.9 V

REFE SYI
Y1
Y2

notes:

1. For o order
2. R52, R5: R7(R7(

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R23		NOT USED
R24, 25	6-124A97	100k
R26, 27, 28, 29	6-124B02	150k
R30	6-124A45	680
R31	6-124A69	6.8k
R32	6-124A73	10k
R33	6-124A47	820
R34	6-124A89	47k
R35, 36, 37	6-124A83	27k
R38	6-124A86	36k
R39	6-124A83	27k
R40	6-124A86	36k
R41	6-124A97	100k
R42	6-124A37	330
R43	6-124A73	10k
R44	6-124A71	8.2k
R45	6-124A51	1.2k
R46	6-124A78	16k
R47	6-124A59	2.7k
R48	6-124A49	1k
R49	6-124A31	180
R50	6-124A01	10
R51	6-124A73	10k
R52*	6-124A72	9.1k (note 2)
R53	6-124A01	10
R54	6-124A77	15k
R55	6-124A94	75k
R56	6-124B14	470k
R57	6-124A81	22k
R58	6-124A97	100k
R59	18-83452F14	variable; 10k
R60	6-124A49	1k
R61	6-124A09	22
R62	6-124A61	3.3k
R63 thru 65		NOT USED
R66	6-124A82	24k
R67	6-124A90	51k
R68	6-124A81	22k
R69	6-124A93	68k
R70	18-83452F14	variable; 10k
R71	6-124A63	3.9k
R72	6-124B06	220k
R73, 74	6-124A73	10k
R75	18-83452F18	variable; 50k
R76*	6-124A87	39k (note 2)
R77	18-83452F17	variable; 50k
R78*	6-124A98	110k (note 2)
R79, 80		NOT USED
R81, 82	6-124A75	12k
R83	6-124A89	47k
R84	6-124A88	43k
R85	6-124A25	100
R86, 87	6-124A72	9.1k
R88	6-124A25	100
R89	6-124A09	22
R90	6-124A93	68k
R91	6-124A37	330
R92	6-124A01	10
R93	6-124A77	15k
R94	6-124A45	680
R95	6-124A89	47k
R96	6-124A59	2.7k
R97	6-124B14	470k
R98	6-124A44	620
R99	6-124A97	100k
R100	6-124A57	2.2k
R101, 102	6-124B06	220k
R103, 104	18-83452F13	variable; 10k
R105, 106	6-124A77	15k
R107	6-124B02	150k
R108 thru 112	6-124A71	8.2k
R113, 114	6-124A67	5.6k
R115, 116	6-124A01	10
		integrated circuit: (see note 1)
U1	51-80066C01	i-f amplifier
U2	51-84561L84	quad detector
U3	51-82884L48	quad bilateral switch
U4	51-84371K63	dual operational amplifier
U5, 6	51-80365A07	dual operational amplifier
U7	51-82884L48	quad bilateral switch
U8, 9	51-80365A07	dual operational amplifier
U10	51-82884L48	quad bilateral switch
U11		NOT USED
U12	51-80365A07	dual operational amplifier
U13		NOT USED
U14	51-82884L15	quad clocked D-latch
U15, 16	51-84371K74	quad comparator
U17	51-84561L42	dual 1 of 4 decoder/demultiplexer
		voltage regulator: (see note 1)
VR1, 2	48-82256C46	Zener type; ± 5%; 3.9 V

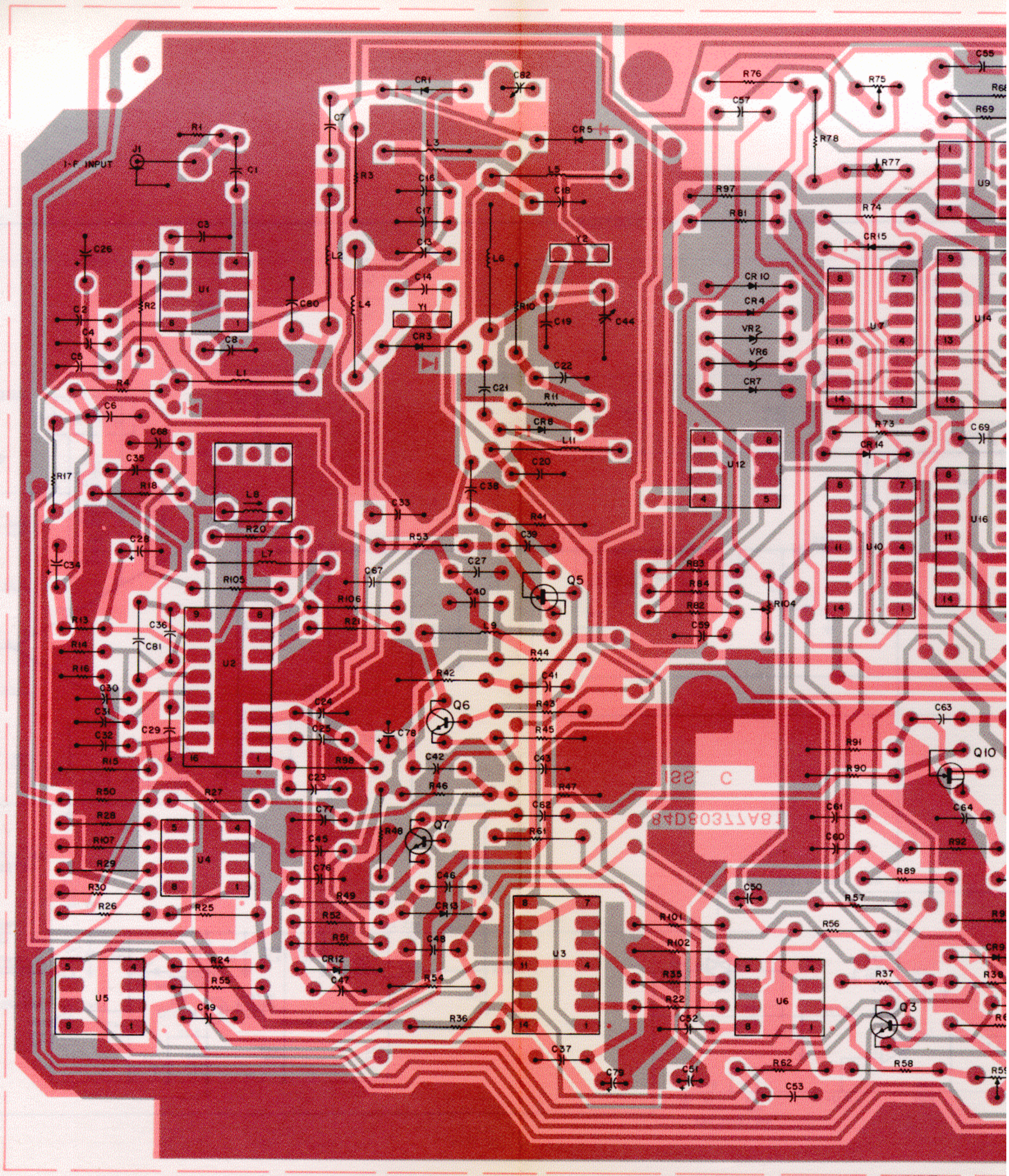
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		crystal: (see note 1)
Y1	91-80377A94	ceramic filter
Y2	91-80397A29	crystal filter
		mechanical parts
	3-139012	SCREW, machine; 4-40 × 1/4"; 7 used
	14-84602K02	INSULATOR
	26-80378A52	SHIELD
	45-80395A40	ACTUATOR, ejector; 2 used

notes:

1. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

2. R52, R76 and R78 may be selected at the factory from the values indicated.

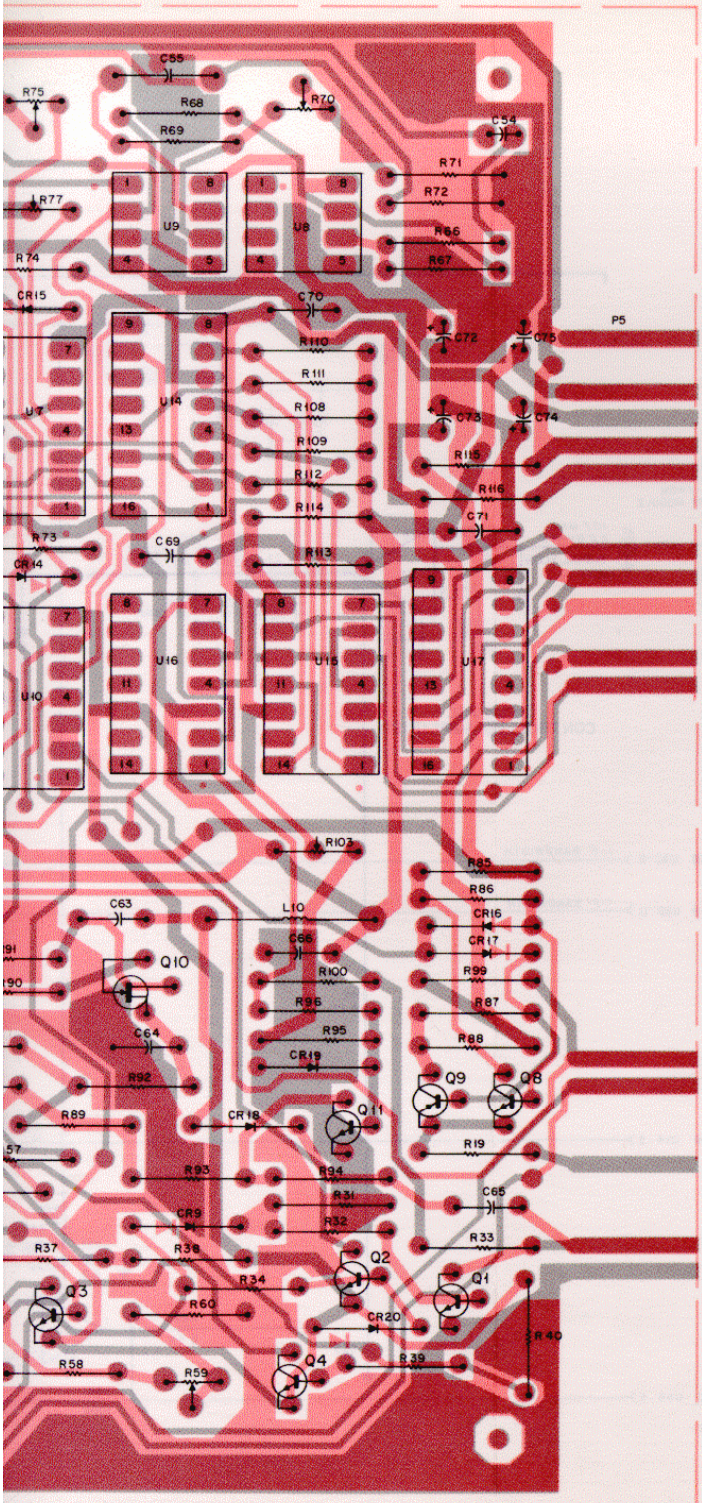
R52*	6-124A72	9.1k
	6-124A74	11k
	6-124A75	12k
R76*	6-124A85	33k
	6-124A87	39k
	6-124A89	47k
R78*	6-124A96	91k
	6-124A98	110k
	6-124B01	130k
	6-124B02	150k



SHOWN FROM COMPONENT SIDE

RECEIVER BOARD (A06)

MODEL RTL4091A
SCHEMATIC DIAGRAM, CIRCUIT
BOARD DETAIL, AND PARTS LIST



71 (72) GND (GND)

67 (68) +5V (+5V)

65 - 5V

63 (64) +12V (+12V)

61 (62) -12V (-12V)

55 (56) A0 (A1)

53 (54) A2 (A3)

(52) (STB1)

47 (48) D0 (D1)

45 (46) D2 (D3)

17 (18) SQ. POT. 1 (SQ. POT. 2)

15 (16) PCT AM (AGC)

9 REC AUD

3 (4) SQ. IND (10.7 MHZ)

1 (2) GND (GND)

NOTE: PIN NUMBERS AND SIGNAL NAMES IN PARENTHESES, ( ), ARE ON SOLDER SIDE.

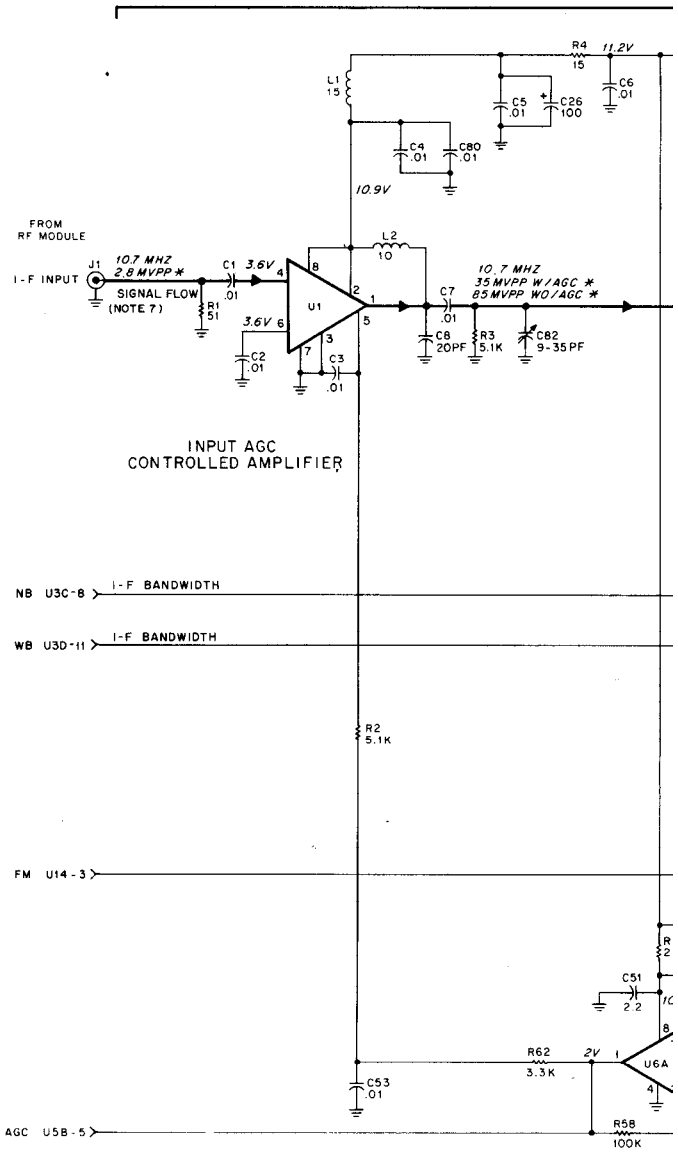
NENT SIDE

COMPONENT SIDE ● BD-EEPS-36200-O
SOLDER SIDE ● BD-EEPS-36199-O
OL-EEPS-36192-A

Motorola No. ***PEPS-36848-O***
(Sheet 1 of 5)
8/12/83- PHI

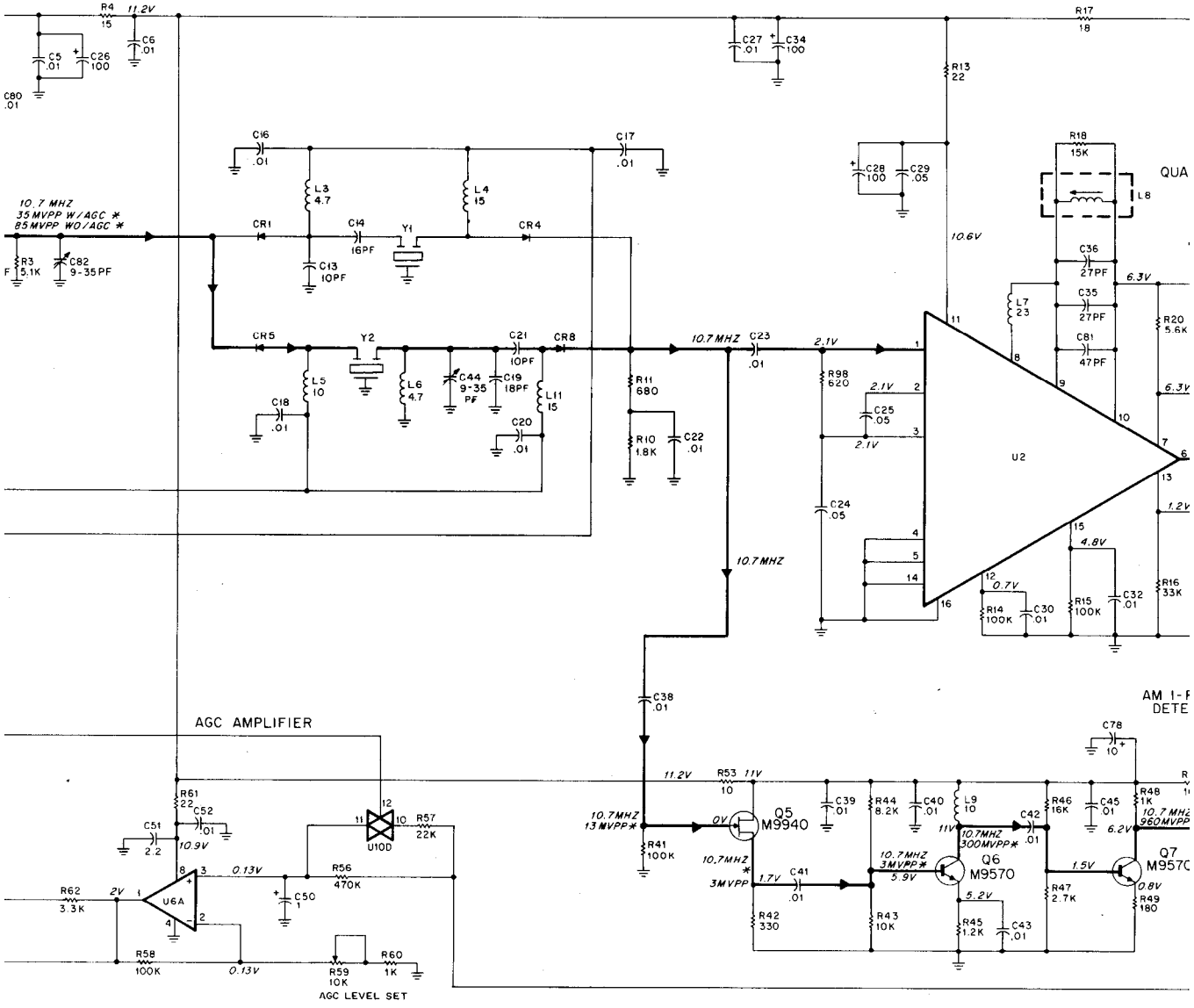
RECEIVER BOARD (A06)

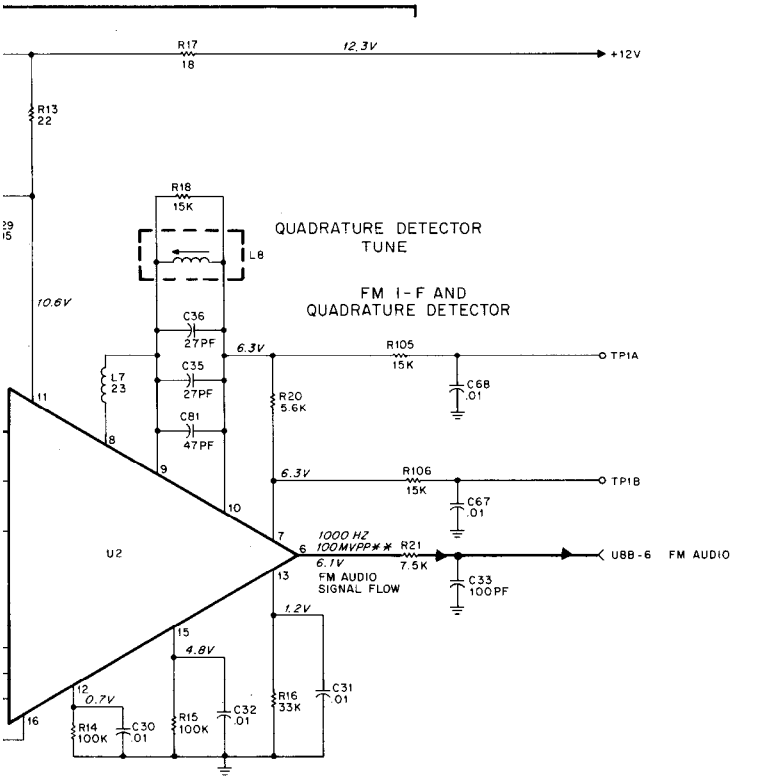
MODEL RTL4091A
SCHEMATIC DIAGRAM, CIRCUIT
BOARD DETAIL, AND PARTS LIST

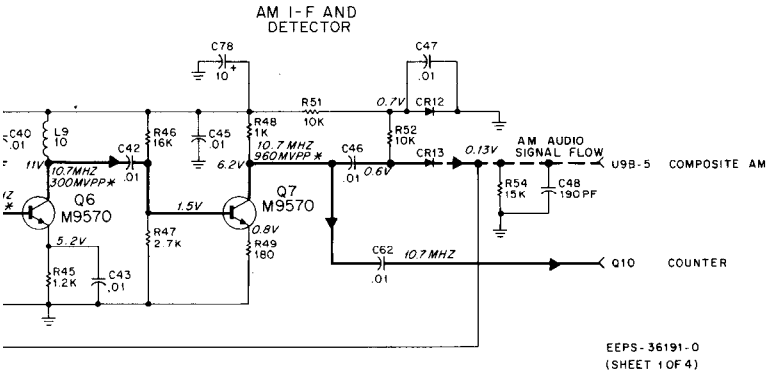


Motorola No. ***PEPS-36848-O***
(Sheet 2 of 5)
8/12/83- PHI

I - F SECTION


10.7 MHZ
35 MVPP W/AGC *
85 MVPP WO/AGC *
10.7MHZ
AGC AMPLIFIER
AGC LEVEL SET
U2
U6A
U10D
Q5
M9940
Q6
M9570
Q7
M957C
QUA
AM I-F
DETE





EEPS-36191-0
(SHEET 1 OF 4)

NOTES:

1. Unless otherwise indicated: resistor values are ohms; capacit· microfarads; and inductor values are in microhenries.
2. **DC voltages are measured with no i-f input, FM operating mo· i-f, and normal audio-squelch open.
3. *10.7 MHz PP voltages are measured at – 47.0 dBm input, narro·
4. **Audio voltages are measured at – 47.0 dBm input, narrow b· audio, 5.00 kHz deviation, 1000 Hz modulating signal.
5. Integrated circuits on this board are TTL and CMOS devices.
6. IC types and connections for this board are as follows:
7. 10.7 MHz signal flow shown for narrow band I-F.

Reference Designation	Mfgr's Description	+5 V	–
U1	I-F Amp	—	
U2	Quad Detector	—	
U3	Quad Bi-Lat SW	—	
U4	Dual Op Amp	—	
U5	Dual Op Amp	—	
U6	Dual Op Amp	—	
U7	Quad Bi-Lat SW	14	
U8	Dual Op Amp	—	
U9	Dual Op Amp	—	
U10	Quad Bi-Lat SW	14	
U12	Dual Op Amp	—	
U14	Quad Clk D-Latch	16	6
U15	Quad Comparator	3	
U16	Quad Comparator	3	
U17	Dual 1-4 Decode/Demux	16	

8. Logic states shown are for FM, narrow band I-F, normal audio.

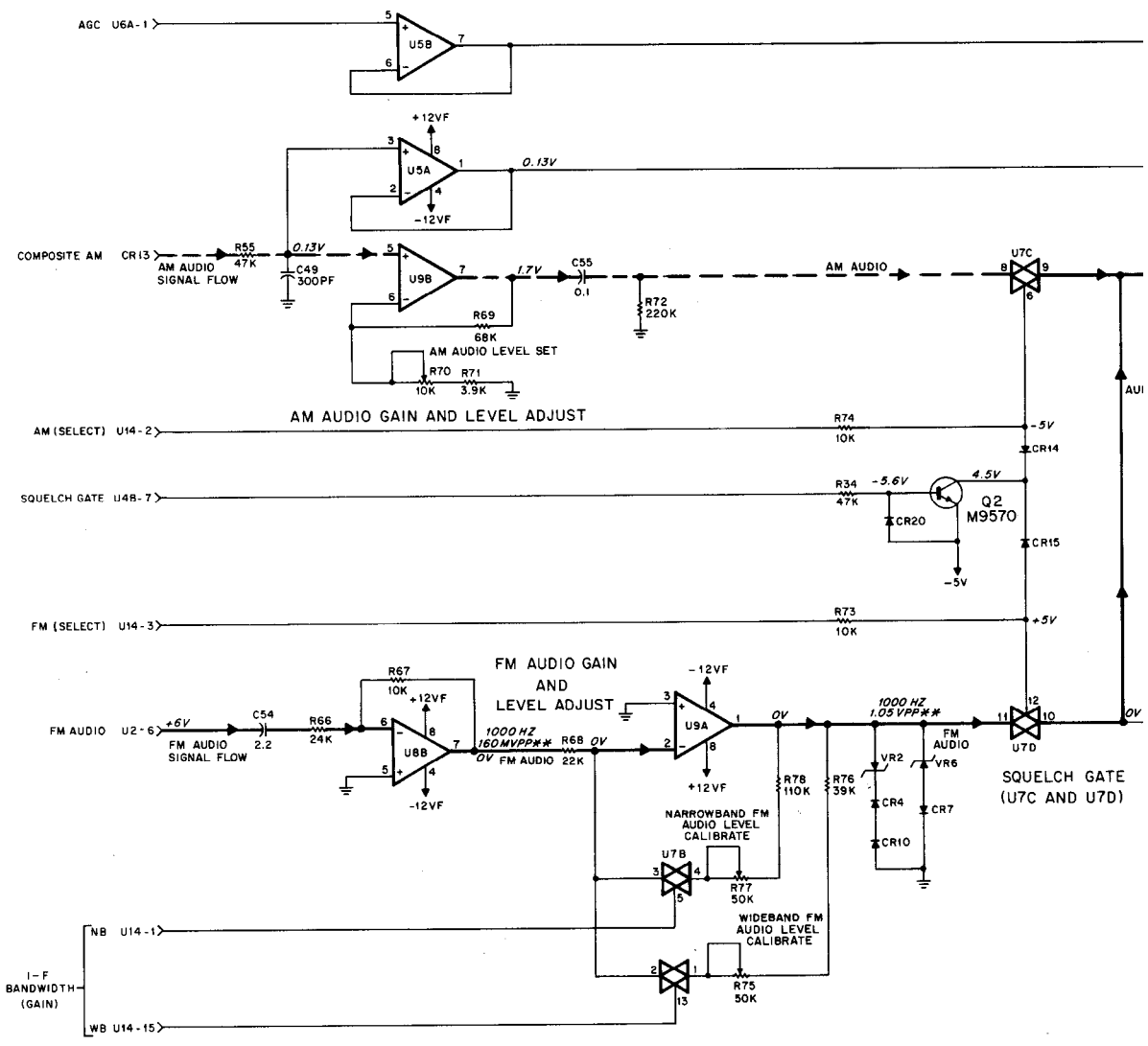
NOTES:

1. Unless otherwise indicated: resistor values are ohms; capacitor values are in microfarads; and inductor values are in microhenries.
2. **DC voltages are measured with no i-f input, FM operating mode, narrow band i-f, and normal audio-squelch open.
3. *10.7 MHz PP voltages are measured at – 47.0 dBm input, narrow band FM
4. **Audio voltages are measured at – 47.0 dBm input, narrow band FM, normal audio, 5.00 kHz deviation, 1000 Hz modulating signal.
5. Integrated circuits on this board are TTL and CMOS devices.
6. IC types and connections for this board are as follows:
7. 10.7 MHz signal flow shown for narrow band I-F.

Reference Designation	Mfgr's Description	+5 V	–5 V	+12 V	–12 V	Unused	Gnd
U1	I-F Amp	—	—	2, 8	—	—	3, 7
U2	Quad Detector	—	—	11	—	—	4, 5, 14, 16
U3	Quad Bi-Lat SW	—	7	14	—	—	—
U4	Dual Op Amp	—	—	8	4	—	3
U5	Dual Op Amp	—	—	8	4	—	—
U6	Dual Op Amp	—	—	8	—	—	4
U7	Quad Bi-Lat SW	14	7	—	—	—	—
U8	Dual Op Amp	—	—	8	4	1, 2, 3	5
U9	Dual Op Amp	—	—	8	4	—	—
U10	Quad Bi-Lat SW	14	7	—	—	—	—
U12	Dual Op Amp	—	—	8	4	—	3
U14	Quad Clk D-Latch	16	6, 8	—	—	11, 12	—
U15	Quad Comparator	3	12	—	—	—	—
U16	Quad Comparator	3	12	—	—	8, 9, 10, 11, 13, 14	—
U17	Dual 1-4 Decode/Demux	16	—	—	—	4, 5, 7, 10, 11, 12	—

8. Logic states shown are for FM, narrow band I-F, normal audio.

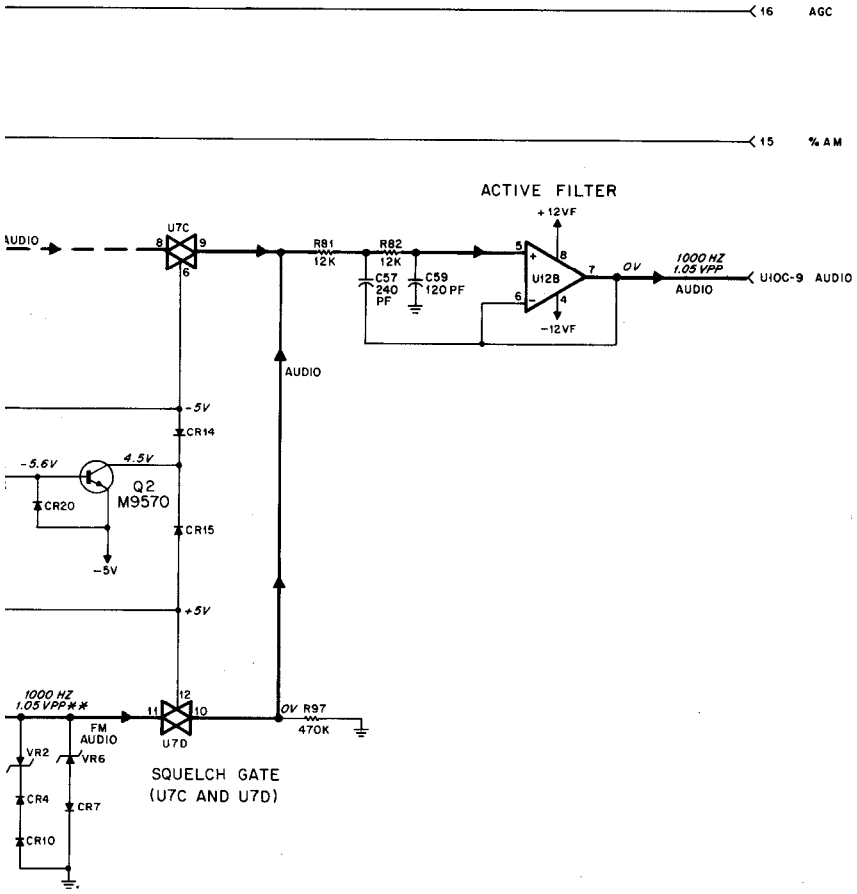
AUDIO / SQUELCH SECTION



RECEIVER BOARD (A06)

MODEL RTL4091A
SCHEMATIC DIAGRAM, CIRCUIT
BOARD DETAIL, AND PARTS LIST

I SECTION



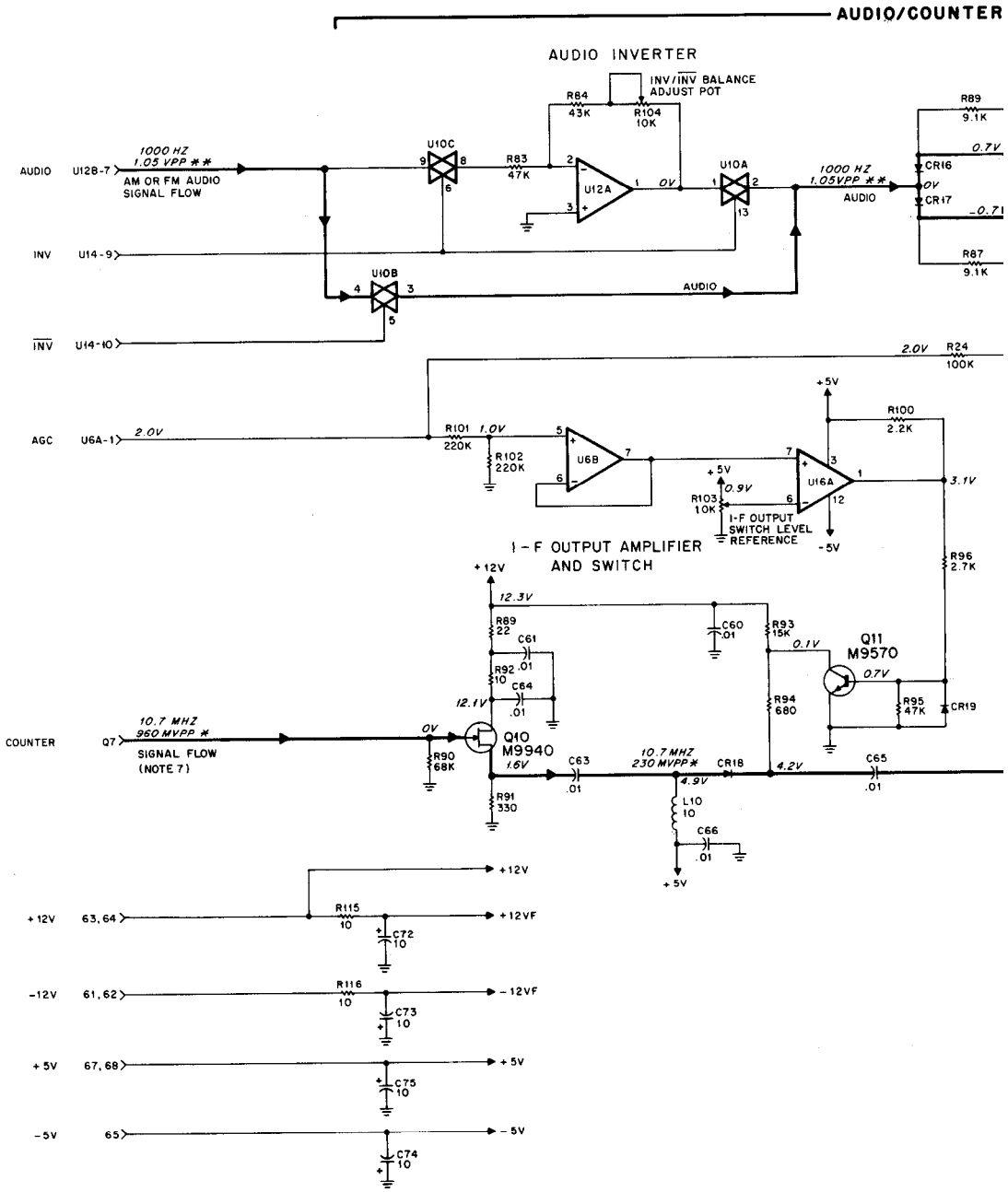
PEPS-36191-O
(SHEET 2 OF 4)

RECEIVER BOARD

Motorola No. PEPS-36848-O
(Sheet 3 of 5)
8/12/83- PHI

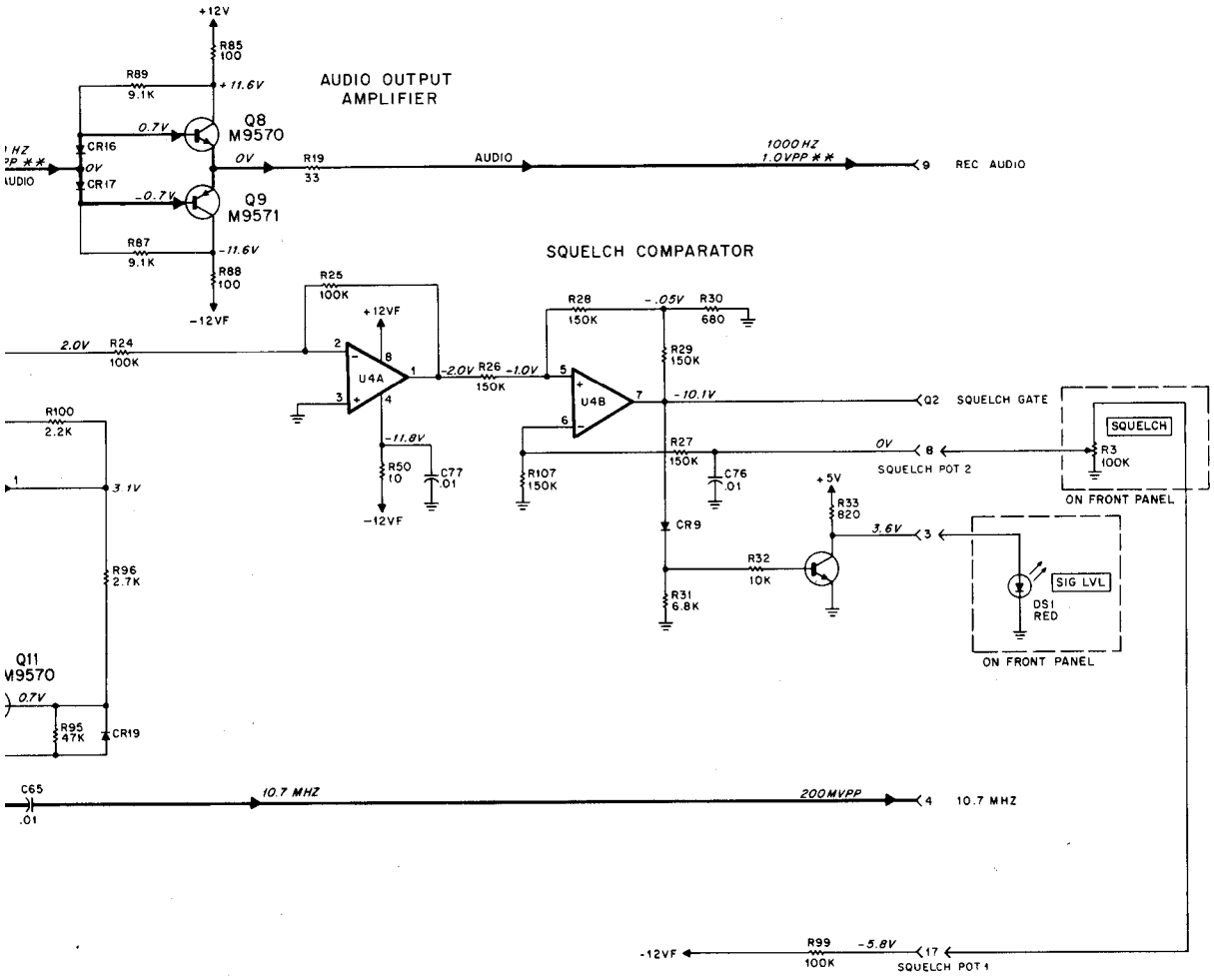
RECEIVER BOARD (A06)

MODEL RTL4091A
SCHEMATIC DIAGRAM, CIRCUIT
BOARD DETAIL, AND PARTS LIST



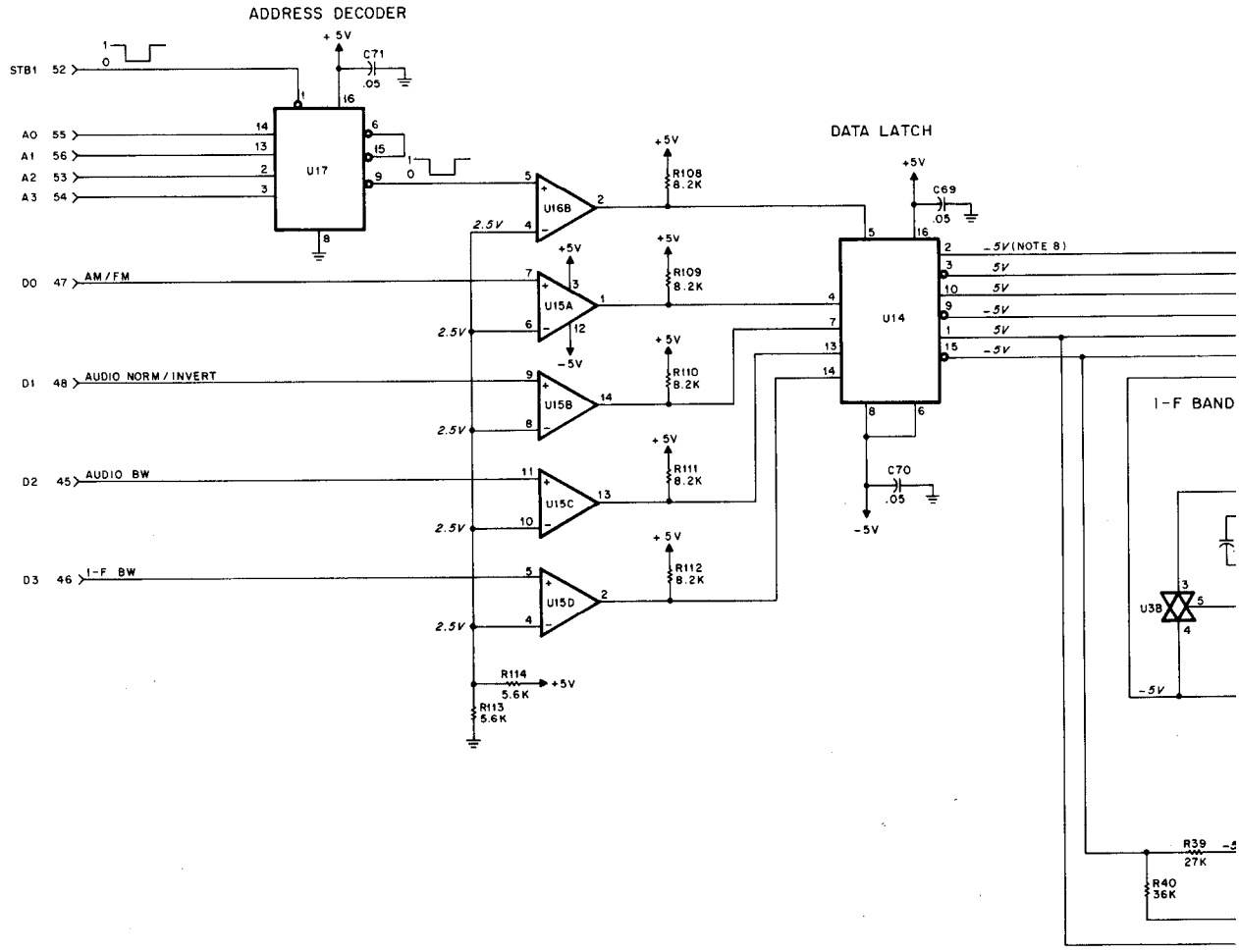
Motorola No. ***PEPS-36848-O***
(Sheet 4 of 5)
8/12/83-PHI

UDIO/COUNTER SECTION



DEPS-36191-0
(SHEET 3 OF 4)

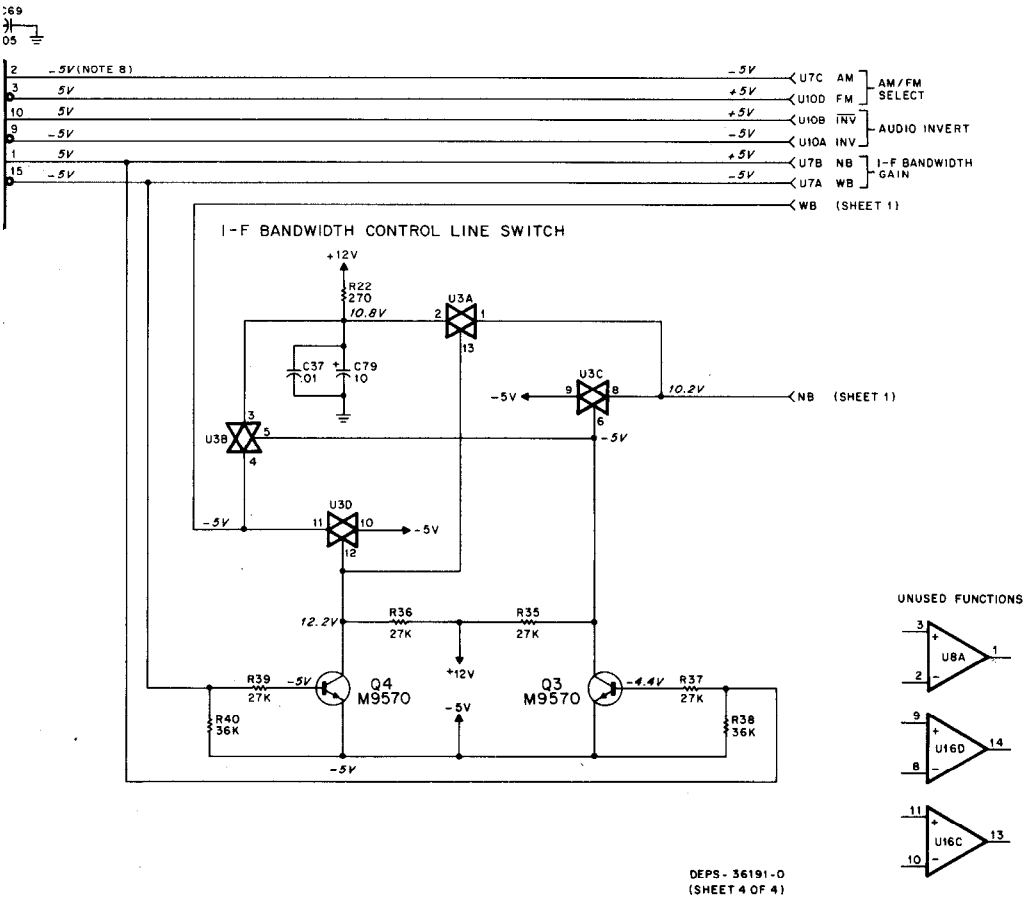
INTERFACE SECTION



RECEIVER BOARD (A06)

MODEL RTL4091A
SCHEMATIC DIAGRAM, CIRCUIT
BOARD DETAIL, AND PARTS LIST

ION



RECEIVER BOARD

Motorola No. ***PEPS-36848-O***
(Sheet 5 of 5)
8/12/83- PHI

MOTOROLA INC.
Communications
Sector

ANALOG INTERFACE BOARD (A07)

MODEL RTL4092A

1. DESCRIPTION

1.1 The analog interface board (AIB) processes analog voltages to obtain an absolute value and sign voltage for the counter board. The AIB is a microprocessor controlled signal buffer, filter, and ranging device. The external vertical input voltages are multiplexed to obtain the absolute value and sign of the voltage that is sent to the counter.

1.2 The AIB consists of the four range attenuator, rms-dc converter, 1 kHz notch filter, ×.1 attenuator, absolute value amplifier, peak detector, and attenuator driver stage. All ac, dc, AGC, and other input and output signal connections are made through the main interconnect board.

2. THEORY OF OPERATION

2.1 RANGE ATTENUATOR

External DVM inputs to the VERT/SINAD/DIST/DVM IN input jack are ranged by the microprocessor over a four-decode range before being routed to the rms-dc converter. A relay ladder driven by inputs from the attenuator driver stage selects the ranging values prior to being sent to the ac/dc coupler. An ac filter consisting of C77, C78, R124, and R125 allows an accurate dc voltage measurement to be taken when an ac voltage is also present at the input by attenuating the ac signal.

2.2 RMS-DC CONVERTER

AC voltages are applied to multiplexer U4 which selects signals either before the notch filter or after the filter for both ac voltage and SINAD measurements. Battery voltage and AGC levels are also applied to U4. When measuring SINAD, the microprocessor switches the notched and unnotched signals input to U4 at 60 millisecond intervals.

2.3 TWO-STATE 1 kHZ NOTCH FILTER

The two-stage notch filter consists of five distinct filters with two of the notch filters cascaded to obtain increased attenuation. The output of amplifier U2 is coupled across a high-pass filter made up of C79 and R80. Two low-pass filters attenuate frequencies above 19 kHz. The notch filter is designed to attenuate a 1 kHz signal by 50 dB.

2.4 ×.1 ATTENUATOR

The composite voltage output from multiplexer U6 is scaled by the ×.1 attenuator prior to being amplified by U7. Transistors Q2 and Q5 are level shifters. The ×.1 attenuator consists of Q1 and the combined impedance of R51, R38, and R36. The attenuated signal is amplified by voltage follower U7.

2.5 ABSOLUTE VALUE AMPLIFIER

The output of amplifier U7 is inverted by amplifier U8 while U9 determines the input polarity. The output of U8 and U7 is gated by U10 to the analog-to-digital converter on the counter board. Transistors Q7 and Q8 are level shifters and Q9 drives the sign polarity output.

2.6 PEAK DETECTOR CIRCUIT

The peak detector circuit provides dc outputs equal to the negative and positive peak values of the input signal relative to the average dc level of the input signal. The positive and negative signals are selected through the 1-of-8 multiplexer U6.

2.7 ATTENUATOR DRIVER STAGE

The attenuator driver stage provides the voltage to the range attenuator relays. Function data from the microprocessor is applied through buffer U15 to latches U16 and U17. The output of U16 controls the multiplexer, while U17 primarily controls the attenuator relays.

technical writing services
1301 E. Algonquin Road, Schaumburg, Il. 60196

parts list

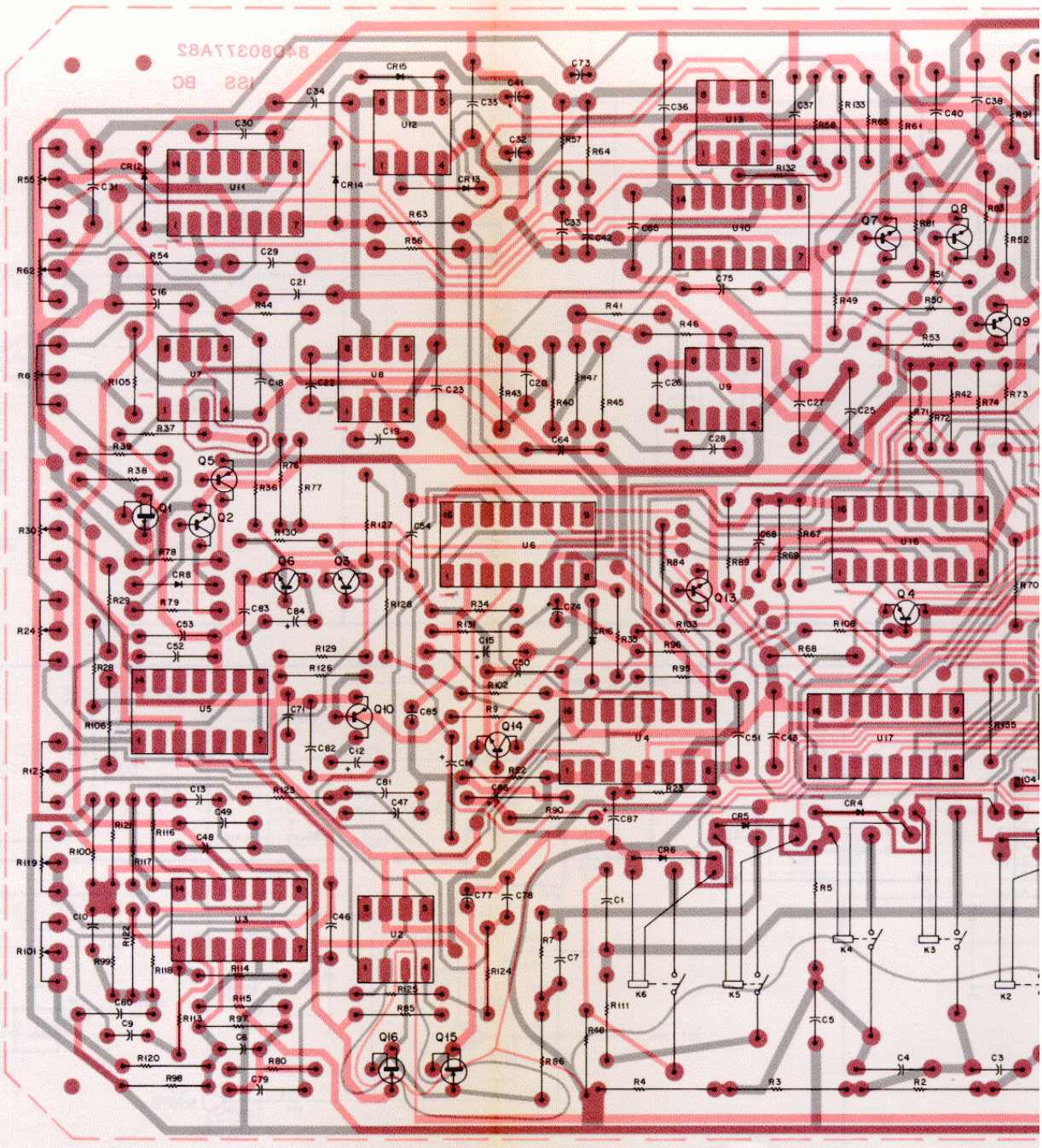
RTL4092A Analog Interface Board — PL-8499-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF + 80-20%; 25 V: unless otherwise stated
C1	8-84637L06	.0068 ± 5%; 680 V
C2	20-84307A11	var. 5.5-18 pF; NP0; 350 V
C3	21-84494B11	200 pF ± 5%; 500 V
C4	21-863296	2500 pF ± 2%; 500 V
C5	8-84637L47	.022 ± 5%; 250 V
C6	21-80397A11	.022 ± 5%; 50 V; NP0
C7	21-84494B11	200 pF ± 5%; 500 V
C8		NOT USED
C9, 10	21-80397A11	.022 ± 5%; 50 V; NP0
C11		NOT USED
C12	23-84538G24	0.56 ± 10%; 35 V
C13	21-80397A11	.022 ± 5%; 50 V; NP0
C14, 15	23-84762H14	0.47 ± 20%; 50 V
C16	21-82372C03	0.1
C17		NOT USED
C18	21-82372C03	0.1
C19	21-84494B46	180 pF ± 3%; 500 V
C20	21-82428B21	.01 + 10-30%; 100 V
C21	21-82372C03	0.1
C22	21-84494B42	27 pF ± 5%; 500 V
C23	21-82372C03	0.1
C24	23-84908L01	2.2 ± 20%; 50 V non polar
C25	21-82372C03	0.1
C26	21-84494B42	27 pF ± 5%; 500 V
C27	21-82372C03	0.1
C28	21-84494B46	180 pF ± 3%; 500 V
C29, 30	21-82372C03	0.1
C31	21-82372C03	0.1
C32	23-84665F01	10 + 100-10%; 25 V
C33	21-80397A01	0.47 ± 10%; 50 V
C34 thru 40	21-82372C03	0.1
C41	23-84665F01	10 + 100-10%; 25 V
C42	21-80397A10	0.47 ± 10%; 50 V
C43	21-82372C03	0.1
C44, 45		NOT USED
C46 thru 54	21-82372C03	0.1
C55	21-83406D93	16 pF ± 5%; 500 V; NP0
C56 thru 59	21-82372C03	0.1
C60 thru 63	23-84665F01	10 + 100-10%; 25 V
C64, 65	21-82372C03	0.1
C66		NOT USED
C67, 68, 69	21-82372C03	0.1
C70		NOT USED
C71	21-80370A04	.022 ± 10%; 100 V
C72		NOT USED
C73	23-84708L01	2.2 ± 20%; 50 V non polar
C74	21-84665F01	10 + 100-10%; 25 V
C75	21-82372C03	0.1
C76	21-84494B33	30 pF ± 5%; 500 V
C77	23-84908L01	2.2 ± 20%; 50 V non polar
C78	21-84008H23	0.22 ± 10%; 100 V
C79, 80, 81	21-82372C03	0.1
C82	21-82428B15	.005 ± 10%; 100 V
C83	8-84637L24	.068 ± 10%; 100 V
C84	23-84538G02	4.7 ± 20%; 50 V
C85	23-84908L01	2.2 ± 20%; 50 V non polar
C86	23-84762H14	0.47 ± 20%; 50 V
C87	23-84535G28	0.33 ± 10%; 35 V
		diode: (see note)
CR1 thru 6	48-83654H01	silicon
CR8	48-83654H01	silicon
CR12 thru 15	48-83654H01	silicon
CR16	48-84616A09	hot carrier
		relay, reed:
K1 thru 6	80-80346A01	12 V
		transistor: (see note)
Q1	48-84308A43	FET, N-channel; type M0843
Q2, 3	48-869570	NPN; type M9570
Q4, 5	48-869571	PNP; type M9571
Q6 thru 9	48-869570	PNP; type M9570
Q10, 11	48-869571	PNP; type M9571
Q12, 13, 14	48-869570	NPN; type M9570
Q15, 16	48-869831	FET, N-channel; type M9831
Q17	48-869571	PNP; type M9571
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1	6-80390A85	1.82 meg ± 0.25%
R2	6-80390A86	182k ± 0.25%
R3	6-80390A87	18.2k ± 0.25%
R4	6-80390A88	2.1k ± 0.25%
R5	6-80390A89	54.9k ± 0.25%
R6		NOT USED
R7	6-10621E85	1.0 meg ± 1%; 1/8 W
R8	18-83452F11	var. 5k
R9	6-124A73	10k
R10, 11		NOT USED
R12	18-83452F11	var. 5k
R22, 23	6-10621C60	4.75k ± 1%; 1/8 W
R24	18-83452F09	var. 1k
R25, 26, 27		NOT USED

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R28	6-10621B98	1.1k ± 1%; 1/8 W
R29	6-10621E85	1.0 meg ± 1%; 1/8 W
R30	18-83452F23	var.; 500k
R31, 32, 33		NOT USED
R34	6-84640C97	6.98k ± 0.5%; 1/8 W
R35	6-84640C27	2.87k ± 0.5%; 1/8 W
R36	6-84640C61	499k ± 0.5%; 1/8 W
R37	6-80390A84	54.9 ± 0.5%
R38	6-84640C20	511 ± 0.5%; 1/8 W
R39	6-124A97	100k
R40	6-84640C70	73.2k ± 0.5%; 1/8 W
R41	6-124A94	75k
R42	6-124A61	3.3k
R43	6-84640C70	73.2 ± 0.5%; 1/8 W
R44	6-84640C67	35.7k ± 0.5%; 1/8 W
R45	6-83175C72	75k ± 1%; 1/8 W
R46	6-10621E85	1.0 meg ± 1%; 1/8 W
R47	6-124A10	24
R48	6-124B50	15 meg
R49	6-124A53	1.5k
R50	6-124A72	9.1k
R51, 52	6-124A97	100k
R53	6-124A73	10k
R54	6-124B22	1.0 meg
R55	18-83452F13	var. 10k
R56	6-124A80	20k
R57	6-124B22	1.0 meg
R58	6-124B40	5.6 meg
R59, 60	6-84640C70	73.2k ± 0.5%; 1/8 W
R61	6-124B22	1.0 meg
R62	18-83452F13	var. 10k
R63	6-124A80	20k
R64	6-124B22	1.0 meg
R65	6-124B40	5.6 meg
R66	6-124A49	1k
R67	6-124A73	10k
R68 thru 74	6-124A61	3.3k
R75		NOT USED
R76 thru 79	6-124A73	10k
R80	6-124A67	5.6k
R81	6-124A73	10k
R82		NOT USED
R83	6-124A73	10k
R84	6-124A61	3.3k
R85	6-124A01	10
R86	6-124A66	5.1k
R87	6-124A58	2.4k
R88	6-124A97	100k
R89	6-124A61	3.3k
R90	6-10621D42	33.3k ± 1%; 1/8 W
R91	6-83175C72	75k ± 1%; 1/8 W
R92, 93		NOT USED
R94	6-10621D07	14.3k ± 1%; 1/8 W
R95	6-84640C97	6.98k ± 0.5; 1/8 W
R96	6-84640C27	2.87k ± 0.5%; 1/8 W
R97 thru 100	6-80390A91	158k ± 0.25%; 1/8 W
R101	18-83452F09	var. 1k
R102	6-124A76	13k
R103	6-124A61	3.3k
R104	6-124A49	1k
R105, 106	6-10621C63	5.11k ± 1%; 1/8 W
R107	6-124A61	3.3k
R108	6-124A94	75k
R109		NOT USED
R110	6-10621D88	100k ± 1%; 1/8 W
R111	6-124C25	100 ± 10%
R112		NOT USED
R113	6-84640C97	6.98k ± 0.5%; 1/8 W
R114, 115	6-80390A90	6.98k ± 0.25%; 1/8 W
R116	6-84640C97	6.98k ± 0.5%; 1/8 W
R117, 118	6-80390A90	6.98k ± 0.25%; 1/8 W
R119	18-83452F09	var. 1k
R120, 121	6-84640C97	6.98k ± 0.5%; 1/8 W
R122, 123	6-124A20	62
R124	6-124A91	56k
R125	6-124A67	5.6k
R126	6-124A61	3.3k
R127	6-124A64	4.3k
R128 thru 130	6-124A73	10k
R131	6-124A72	9.1k
R132, 133	6-124A39	390
R134, 135	6-124A97	100k
		integrated circuit: (see note)
U2	51-80365A09	operational amplifier
U3	51-84561L75	quad operational amplifier
U4	51-82884L54	4-channel analog multiplexer
U5	51-80365A13	rms ac/dc converter
U6	51-82884L46	8-channel analog multiplexer
U7	51-80365A09	operational amplifier
U8, 9	51-80365A27	operational amplifier
U10	51-82884L48	quad analog switch
U11	51-80365A12	dual operational amplifier

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
U12	51-80365A26	dual comparator
U13, 14	51-80365A07	dual op amp
U15	51-84561L03	hex inverter
U16, 17	51-82884L70	hex 'D' type flip-flop
U18	51-84561L42	dual 1-4 decoder/demultiplexer
U19		NOT USED
U20	51-83629M08	quad op amp
	mechanical part	
M1, 2	45-80395A38	EJECTOR

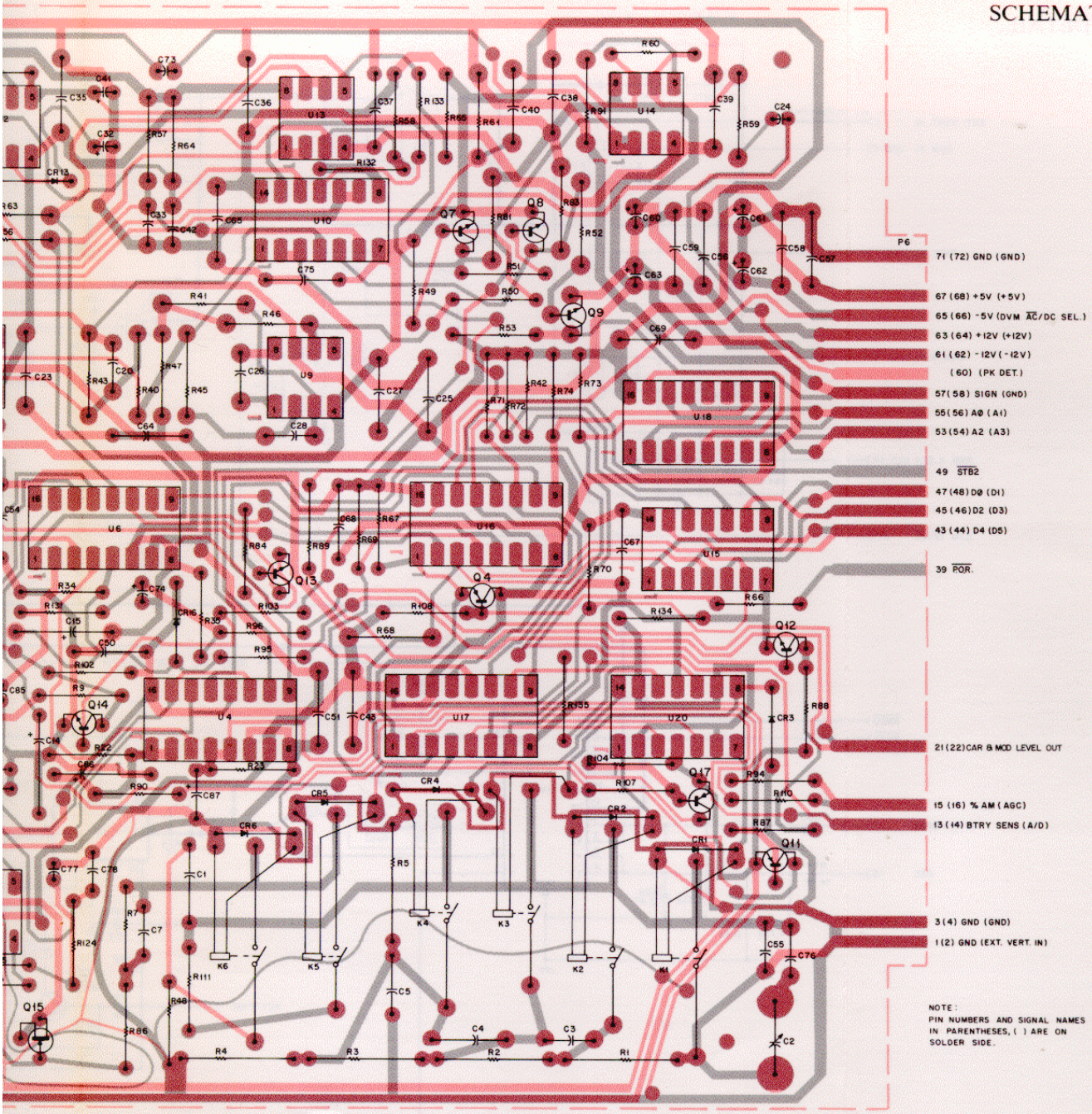
note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.



SHOWN FROM COMPONENT SIDE

ANALOG

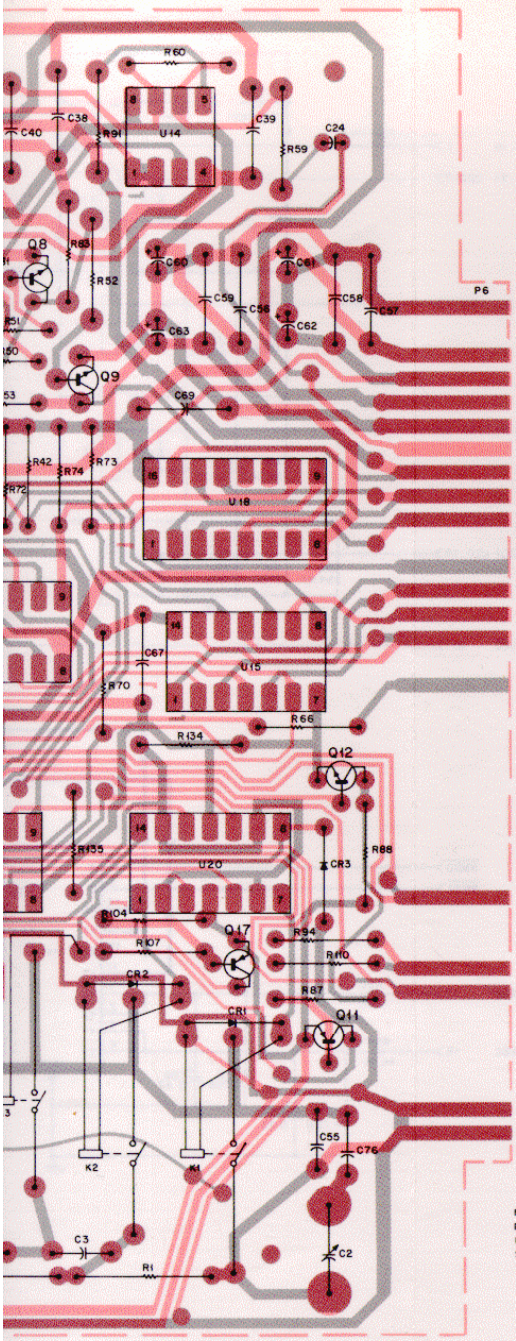
SCHEMATIC



SHOWN FROM COMPONENT SIDE

ANALOG INTERFACE BOARD (A07)

MODEL RTL4092A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



P6

71 (72) GND (GND)

67 (68) +5V (+5V)

65 (66) -5V (DVM AC/DC SEL.)

63 (64) +12V (+12V)

61 (62) -12V (-12V)

(60) (PK DET.)

57 (58) SIGN (GND)

55 (56) A0 (A1)

53 (54) A2 (A3)

49 $\overline{STB2}$

47 (48) D0 (D1)

45 (46) D2 (D3)

43 (44) D4 (D5)

39 $\overline{POR}$.

21 (22) CAR & MOD LEVEL OUT

15 (16) % AM (AGC)

13 (14) BTRY SENS (A/D)

3 (4) GND (GND)

1 (2) GND (EXT. VERT. IN)

NOTE:
PIN NUMBERS AND SIGNAL NAMES IN PARENTHESES, ( ) ARE ON SOLDER SIDE.

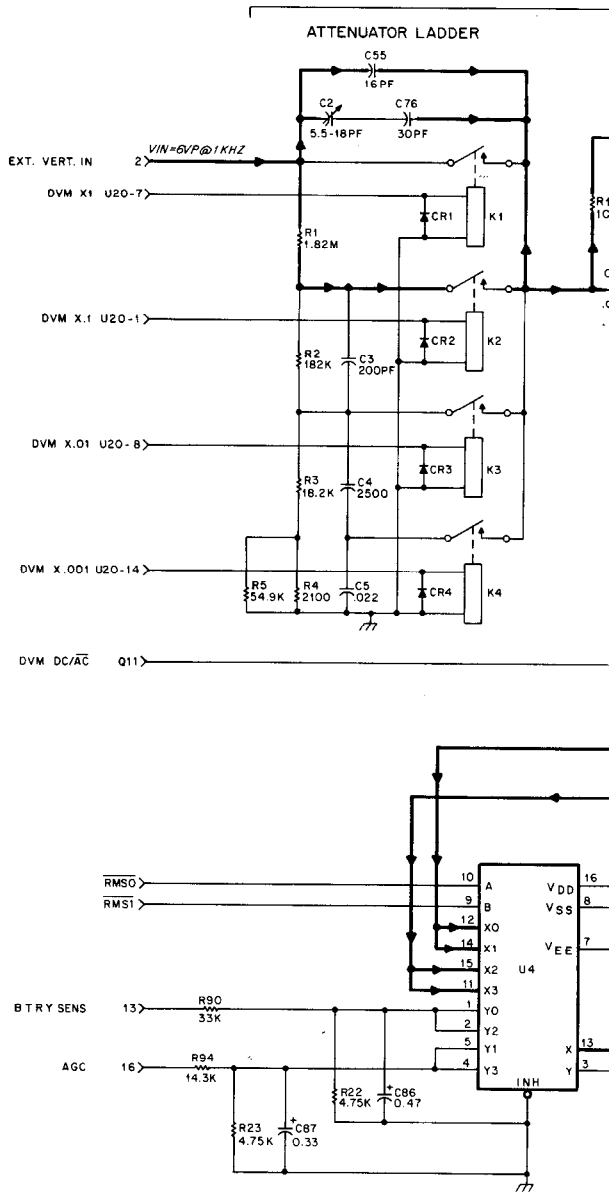
SOLDER SIDE ● BD-EEPS-36197-O
COMPONENT SIDE ● BD-EEPS-36198-O
OL-EEPS-36190-B

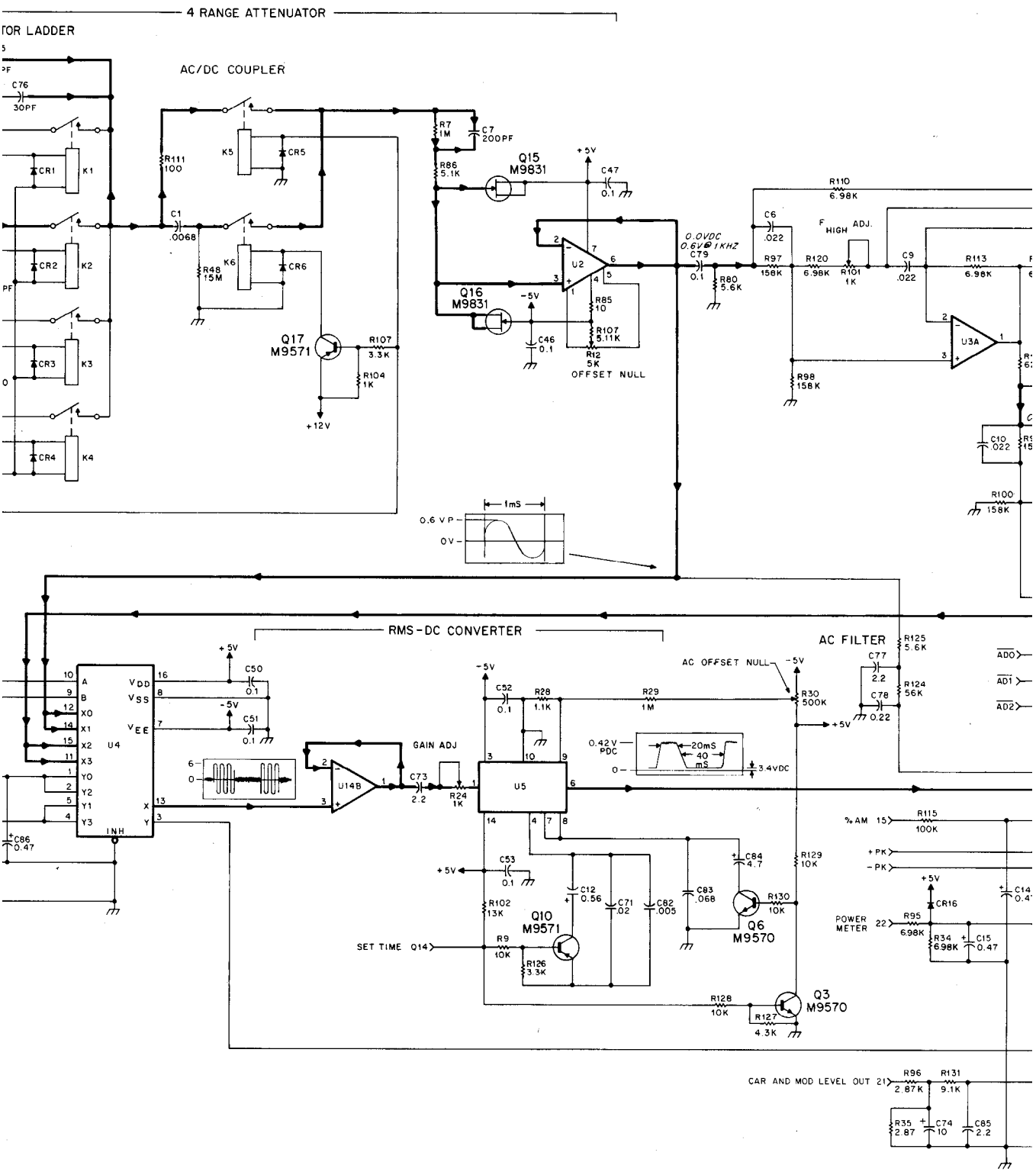
ANALOG INTERFACE BOARD

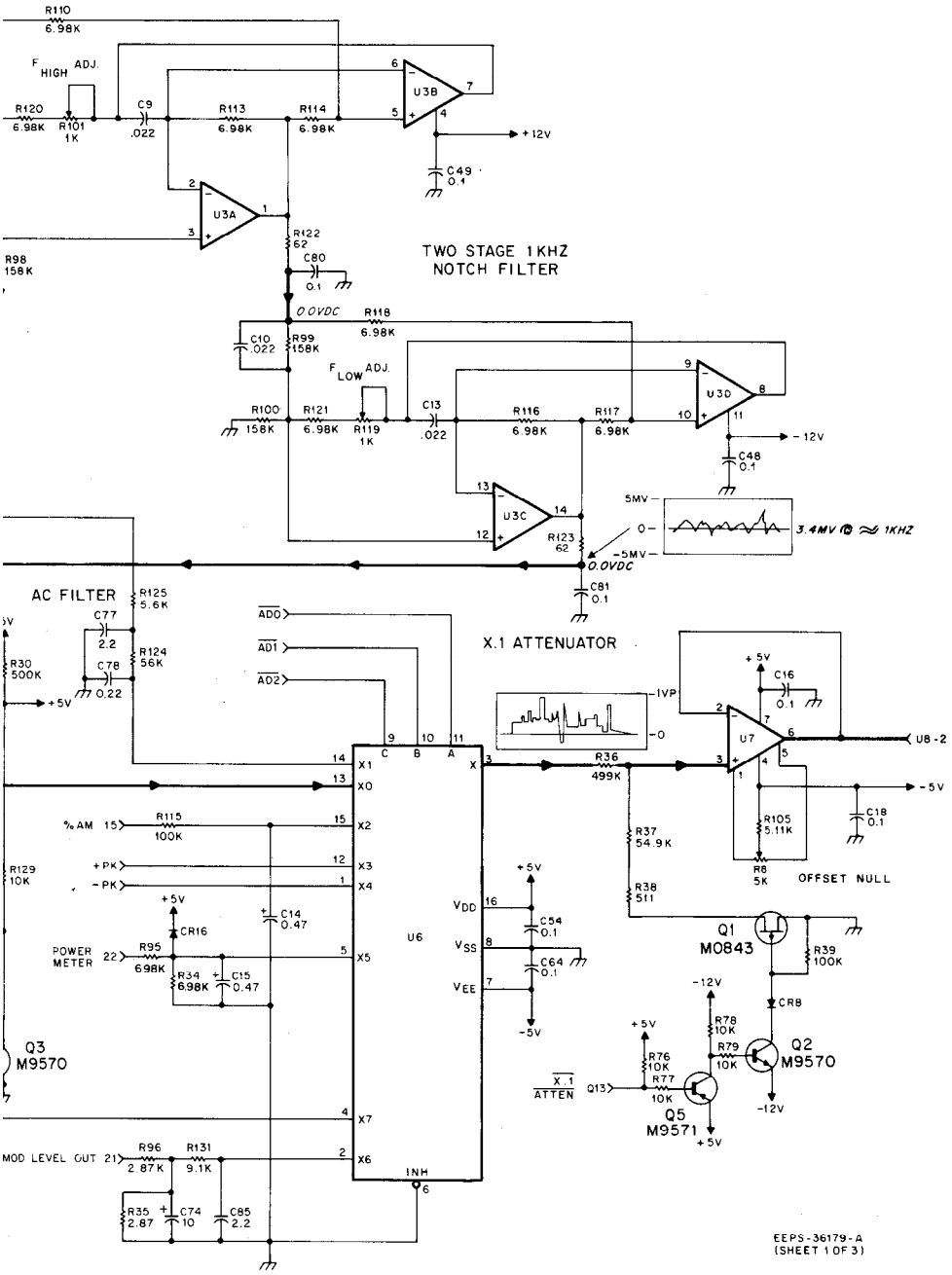
Motorola No. PEPS-36849-O
(Sheet 1 of 4)
8/12/83-PHI

ANALOG INTERFACE BOARD (A07)

MODEL RTL4092A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST




4 RANGE ATTENUATOR
TOR LADDER
AC/DC COUPLER
C76
30PF
CR1
K1
CR2
K2
CR3
K3
CR4
K4
R111
100
K5
CR5
C1
.0068
K6
CR6
R48
15M
R7
1M
C7
200PF
R86
5.1K
Q15
M9831
+5V
C47
0.1
Q16
M9831
-5V
C46
0.1
U2
R85
10
R107
5.11K
R12
5K
OFFSET NULL
Q17
M9571
R107
3.3K
R104
1K
+12V
R110
6.98K
C6
.022
F HIGH ADJ.
R97
158K
R120
6.98K
R101
1K
C9
.022
R113
6.98K
R80
5.6K
0.0VDC
0.6V@1KHZ
C79
0.1
U3A
R98
158K
C10
.022
R100
158K
1mS
0.6 V P-P
0V
RMS-DC CONVERTER
U4
INH
C86
0.47
C50
0.1
C51
0.1
GAIN ADJ
U14B
C73
2.2
R24
1K
U5
C52
0.1
R28
1.1K
R29
1M
AC OFFSET NULL
R30
500K
AC FILTER
C77
2.2
C78
0.22
R125
5.6K
R124
56K
ADO
AD1
AD2
0.42V PDC
20mS
40 mS
3.4VDC
C53
0.1
R102
13K
C12
0.56
C71
.02
C82
.005
C83
.068
C84
4.7
R129
10K
Q10
M9571
Q6
M9570
R130
10K
SET TIME Q14
R9
10K
R126
3.3K
R128
10K
Q3
M9570
R127
4.3K
% AM
R115
100K
+PK
-PK
POWER METER
CR16
R95
6.98K
R34
6.98K
C15
0.47
C14
0.47
CAR AND MOD LEVEL OUT
R96
2.87K
R131
9.1K
R35
2.87
C74
10
C85
2.2



Notes:

1. Unless otherwise indicated: resistor microfarads; and inductor values ar
2. Integrated circuits on this board are
3. IC types and connections for this bo

Reference Designation	Mfgr's Description
U2, 7	Op Amp
U3	Quad Diff. Op Amp
U4	4-Channel Analog M
U5	AC/DC Converter
U6	8 CH Analog Mux
U8	Op Amp
U9	Op Amp
U10	Quad Analog Switc
U11	Dual Op Amp
U12	Comparator
U13, 14	Dual Op Amp
U15	Hex Inverter
U16, 17	Hex D Flip/Flp
U18	Dual 1-4 Decoder/D
U20	Quad Op Amp

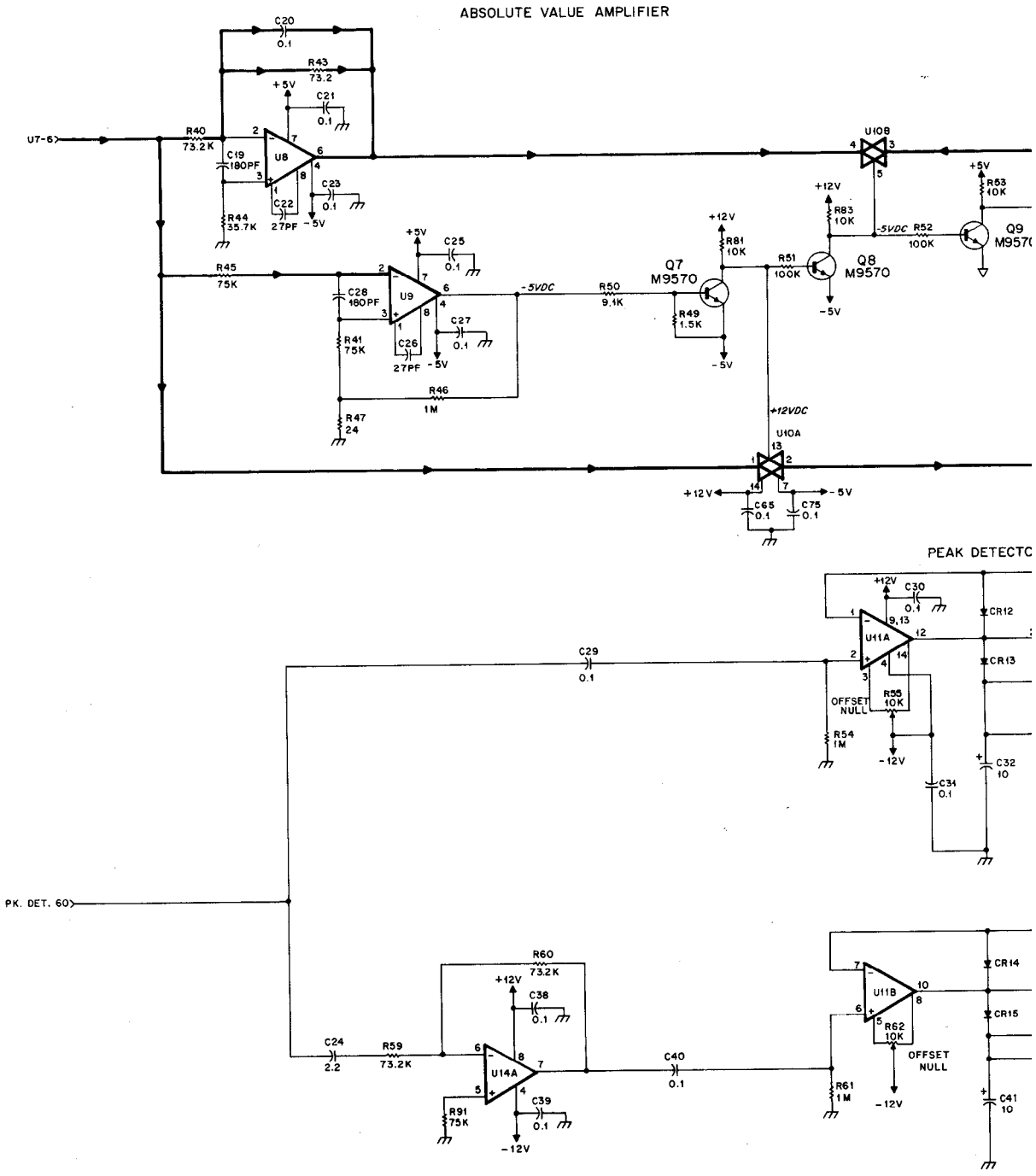
Notes:

1. Unless otherwise indicated: resistor values are in ohms; capacitor values are in microfarads; and inductor values are in millihenries.

2. Integrated circuits on this board are TTL and CMOS devices.

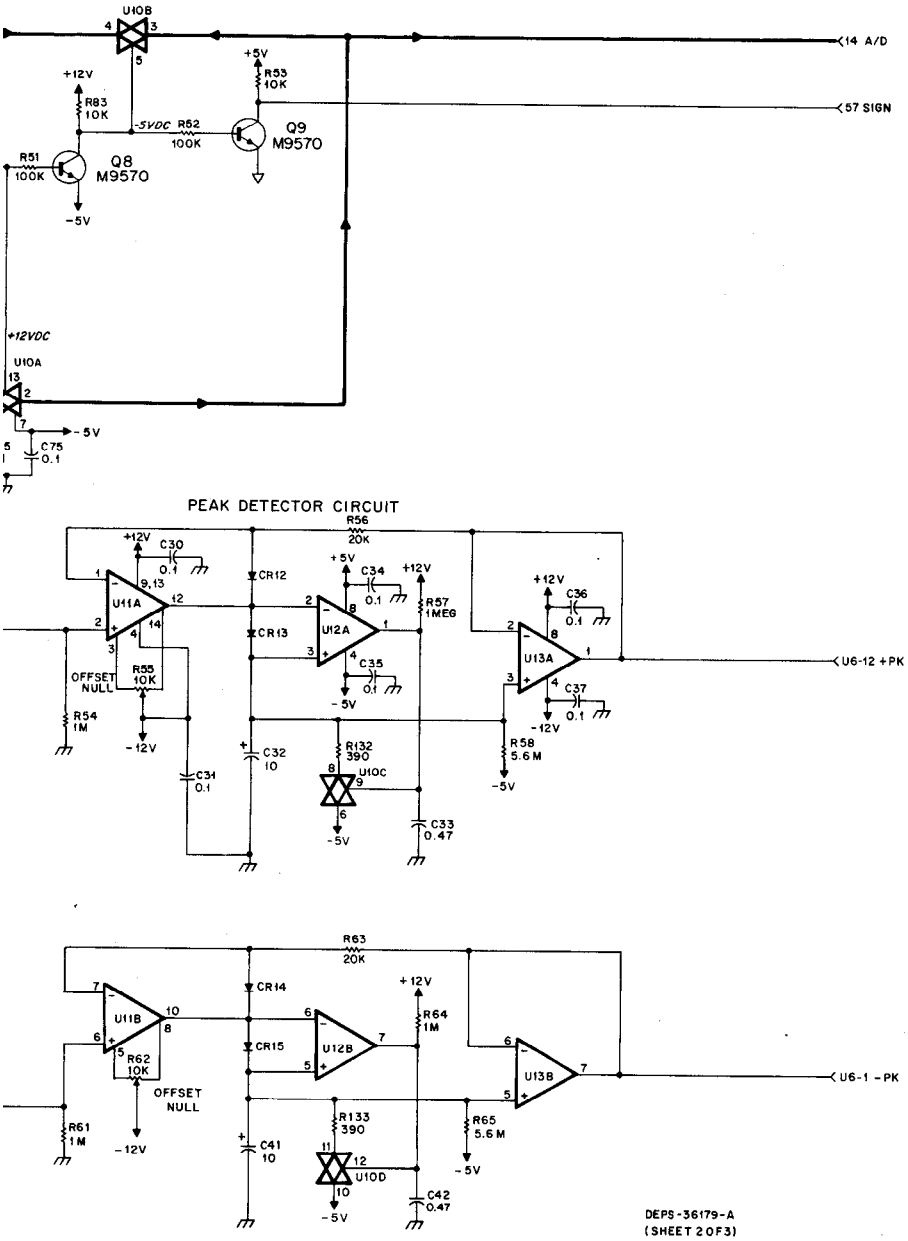
3. IC types and connections for this board are as follows:

Reference Designation	Mfgr's Description	+5 V	−5 V	+12 V	−12 V	GND
U2, 7	Op Amp	7	4	—	—	
U3	Quad Diff. Op Amp	—	—	4	11	
U4	4-Channel Analog Mux	16	7	—	—	8, 6
U5	AC/DC Converter	14	3	—	—	10
U6	8 CH Analog Mux	16	7	—	—	8, 6
U8	Op Amp	7	4	—	—	
U9	Op Amp	7	4	—	—	
U10	Quad Analog Switch	—	7, 9, 10	14	—	—
U11	Dual Op Amp	—	—	9, 13	4	
U12	Comparator	8	4	—	—	
U13, 14	Dual Op Amp	—	—	8	4	
U15	Hex Inverter	14	—	—	—	7
U16, 17	Hex D Flip/Flp	16	—	—	—	8
U18	Dual 1-4 Decoder/Demux	16	—	—	—	8
U20	Quad Op Amp	—	—	4	—	11


ABSOLUTE VALUE AMPLIFIER
PEAK DETECTO
U7-6
PK. DET. 60
C20
0.1
R43
73.2
+5V
C21
0.1
R40
73.2K
C19
180PF
U8
C22
27PF
C23
0.1
R44
35.7K
-5V
U10B
+5V
R53
10K
+12V
R83
10K
-5VDC
R52
100K
Q9
M957
+5V
C25
0.1
R45
75K
C28
180PF
U9
C27
0.1
C26
27PF
-5V
R41
75K
-5VDC
R50
9.1K
Q7
M9570
+12V
R81
10K
R49
1.5K
-5V
R51
100K
Q8
M9570
-5V
R46
1M
R47
24
+12VDC
U10A
+12V
-5V
C65
0.1
C75
0.1
+12V
C30
0.1
U11A
CR12
CR13
C29
0.1
OFFSET
NULL
R55
10K
R54
1M
-12V
C32
10
C31
0.1
R60
73.2K
+12V
C38
0.1
C24
2.2
R59
73.2K
U14A
C40
0.1
R91
75K
C39
0.1
-12V
U11B
CR14
CR15
R62
10K
OFFSET
NULL
R61
1M
-12V
C41
10

ANALOG INTERFACE BOARD (A07)

MODEL RTL4092A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST

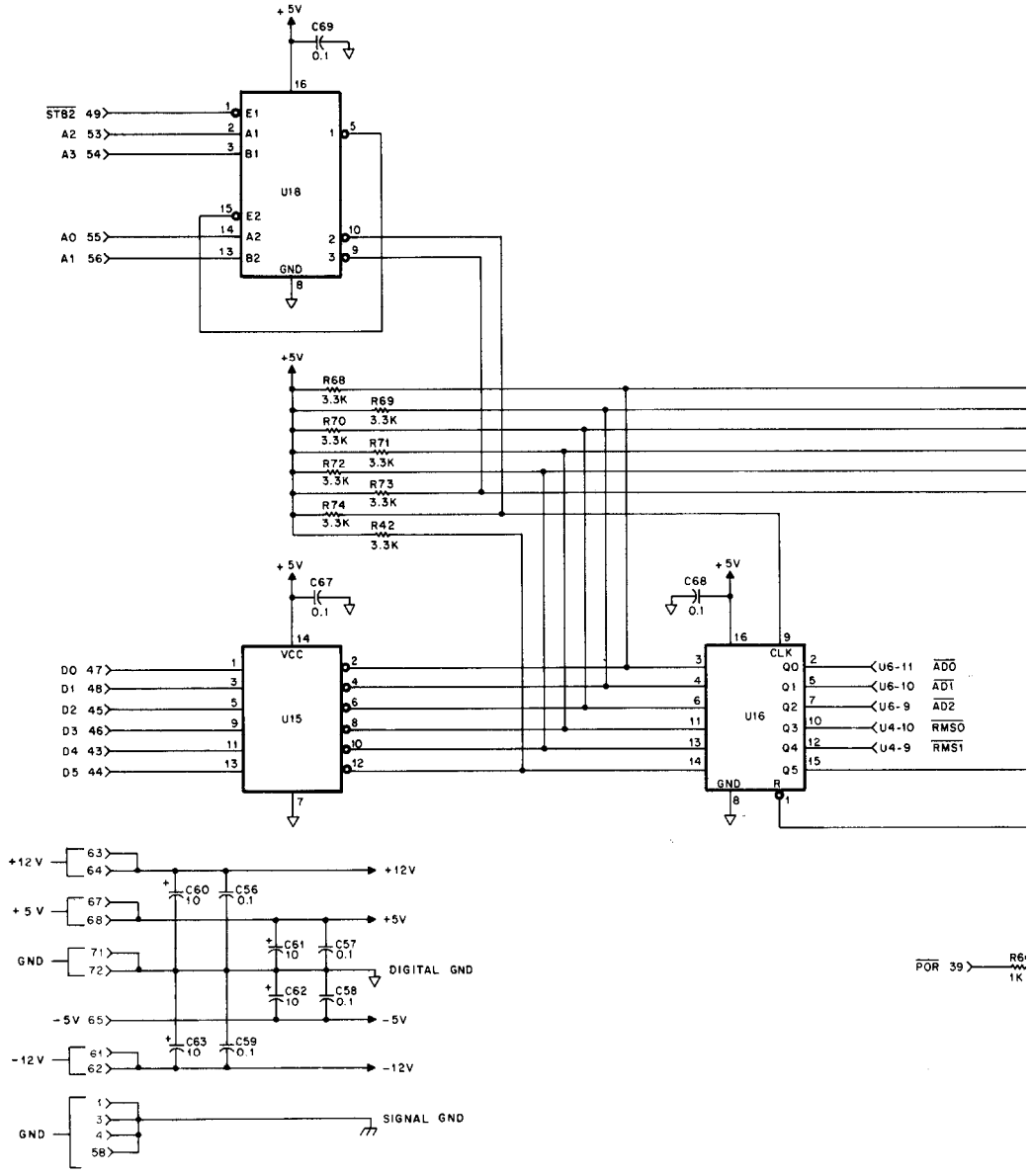


ANALOG INTERFACE BOARD

*Motorola No. **PEPS-36849-O***
(Sheet 3 of 4)
8/12/83-PHI

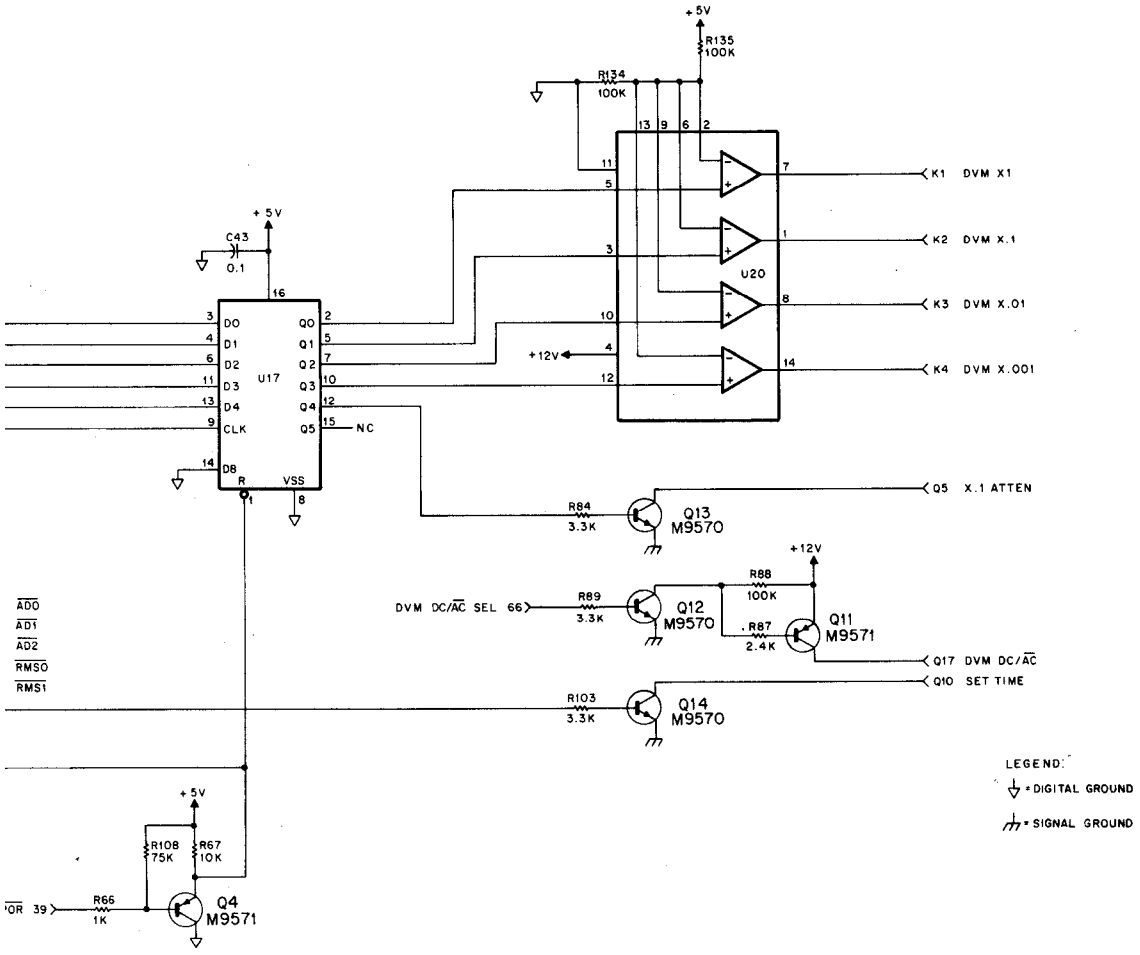
ANALOG INTERFACE BOARD (A07)

MODEL RTL4092A
SCHEMAIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



Motorola No. ***PEPS-36849-O***
(Sheet 4 of 4)
8/12/83- PHI

ATTENUATOR DRIVER STAGE



DEPS - 36179 - A
(SHEET 3 OF 3)

CENTRAL PROCESSING UNIT (CPU) BOARD (A08)

MODEL RTC4023A

1. DESCRIPTION

The central processing unit (CPU) board contains the microprocessor, program memory, read/write memory, and input/output buffers. The card uses a Motorola M6800 series microprocessor, a 16k × 8 ROM, and a 384 × 8 RAM.

2. THEORY OF OPERATION

2.1 INPUT/OUTPUT BUS

The CPU communicates with all the modules in the service monitor through the I/O bus. The bus consists of eight bidirectional data lines, four address lines, and four strobe lines. A second bus consisting of eight bidirectional data lines, two handshake lines, and two status lines is available for the optional tone signaling card. In addition to the two buses, there are six dedicated I/O lines: DPL, LC. BUSY, AD. INT., COUNT INT., $\overline{SQ\ OPN}$, and $\overline{IRQ}$.

2.2 MICROPROCESSOR

2.2.1 An M6805 microprocessor is used to control the service monitor operating modes. The device contains 16 I/O lines in two ports, 112 bytes of internal RAM, and a total addressable complement of 8192 bytes. An external RAM of 384 bytes is provided, along with two 8k × 8 programmed memories. The low order lines are BØ-B7 and the high order address and data lines are A8-A12. The low order lines are multiplexed whereas the high order lines are not. The AS and DS signals are derived from the 3.40 MHz crystal oscillator. The 680 kHz DS signal is further divided to obtain a 340 kHz signal used by the front panel interface module.

2.2.2 Memory Access

The lower address bits are latched by U5 during the high-to-low transition of AS. The selected address is routed to ROM, RAM, and the I/O decoding logic. High order address bits are routed directly to ROM and the chip select decoding logic. Addresses below $0200 are selected by PB7 (MEM SEL); and PB5 (ROM SEL) is used to select the main ROM (U4), or the auxiliary ROM (U22). Shift register U21 delays ROM SEL for four address strobe cycles to simplify ROM paging for the operating program. Data selector U9 is used to divide locations before $0200 into four 128-byte segments. U9 applies ROM, RAM, and I/O select signals. Chip selects for U4 and U22 are decoded by U7 and U8.

2.2.3 Input/Output

2.2.3.1 The two communication buses are interfaced to the CPU through several input and output ports. All input devices drive the address/data lines directly. Output ports receive data from the microprocessor PAØ-PA7 lines. Lines PBØ-PB4 and PB6 are buffered directly from the microprocessor. When PB7 is high and the selected address is between $0080 and $00FF, U9 generates an I/O select ($\overline{IOSEL}$). An $\overline{IOSEL}$ and $\overline{A3}$ enables U12 to select one of seven ports.

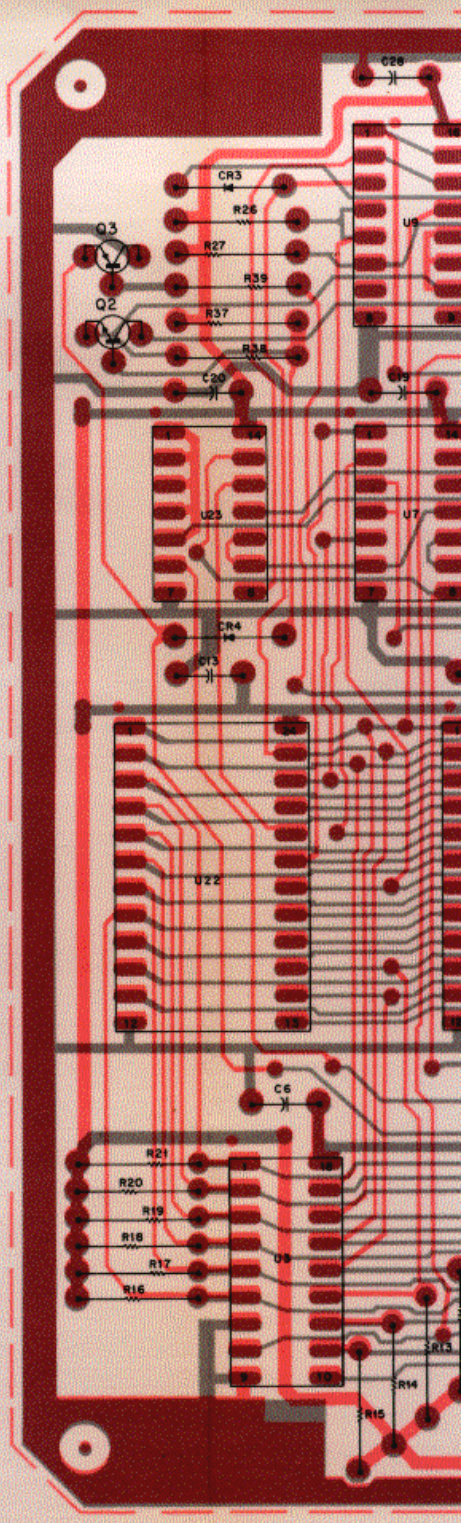
2.2.3.2 The selects enable U13, U15, and U17 to drive the multiplexed bus. The ports are read by the microprocessor with normal memory access. To alter the contents of an output latch, the microprocessor first places new data on the PA lines, and then, by referencing the memory address of the latch, clocks the information into the latch. PB4 and I/O bus drive disable signals for U16 to a high impedance during I/O bus read. U18 is in the high impedance state when the microprocessor reads the option bus.

2.2.4 CMOS RAM

Data held in RAM's U2 and U3 is preserved by voltage from the lithium battery on the front panel interface board. Diodes CR1 and CR2 switch RAM power between the +5 V supply and the battery. The $\overline{P.O.R.}$ (power-on-reset) generated by the front panel interface senses the loss of power and resets the microprocessor and U5. Line A8 is held low through U11 and CR3. Q1 and Q2 disconnect R/$\overline{W}$ and chip select from the RAM's to inhibit access during power transitions.

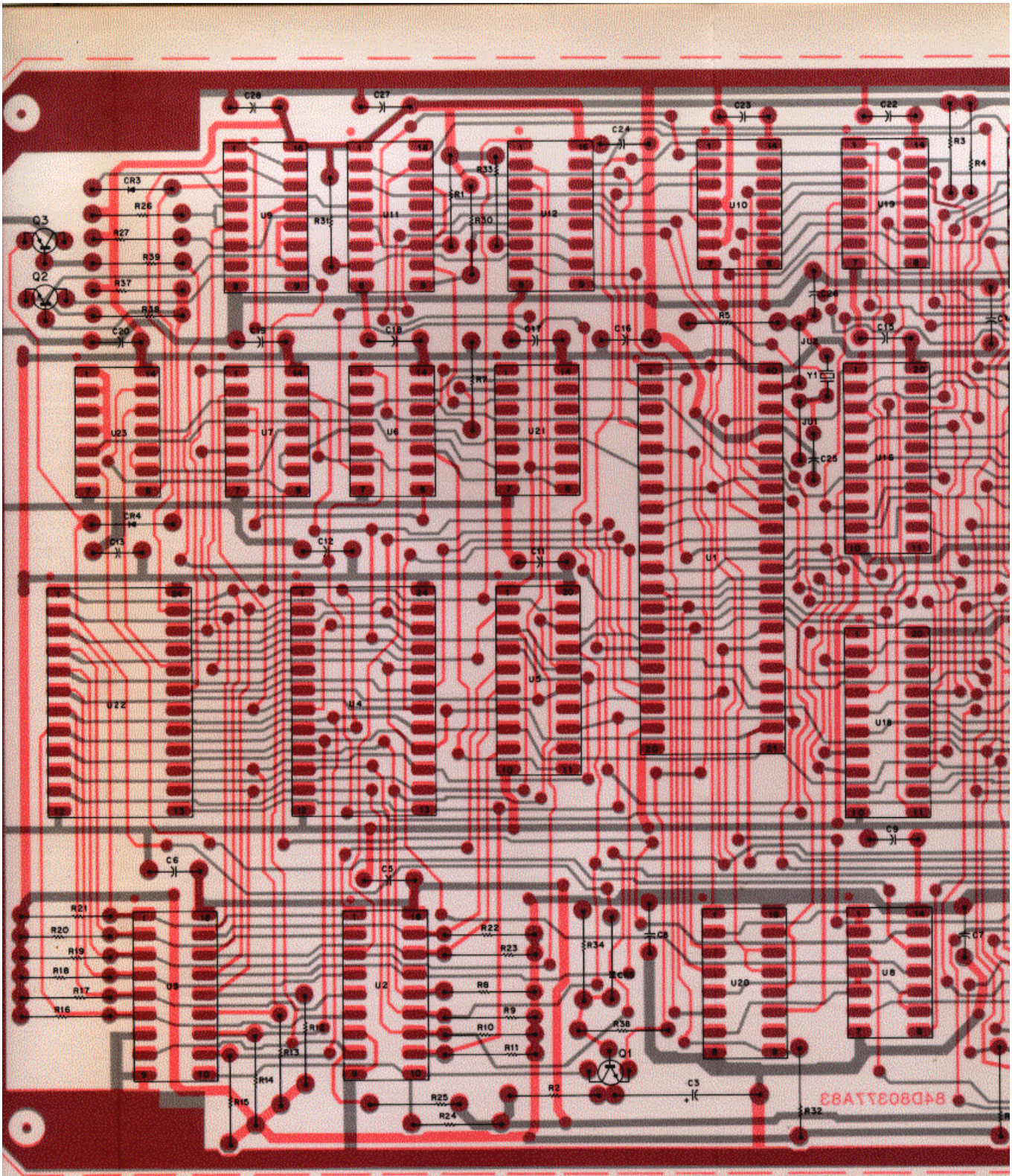
CPU BOARD (A08)

MODEL RTC4023A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST

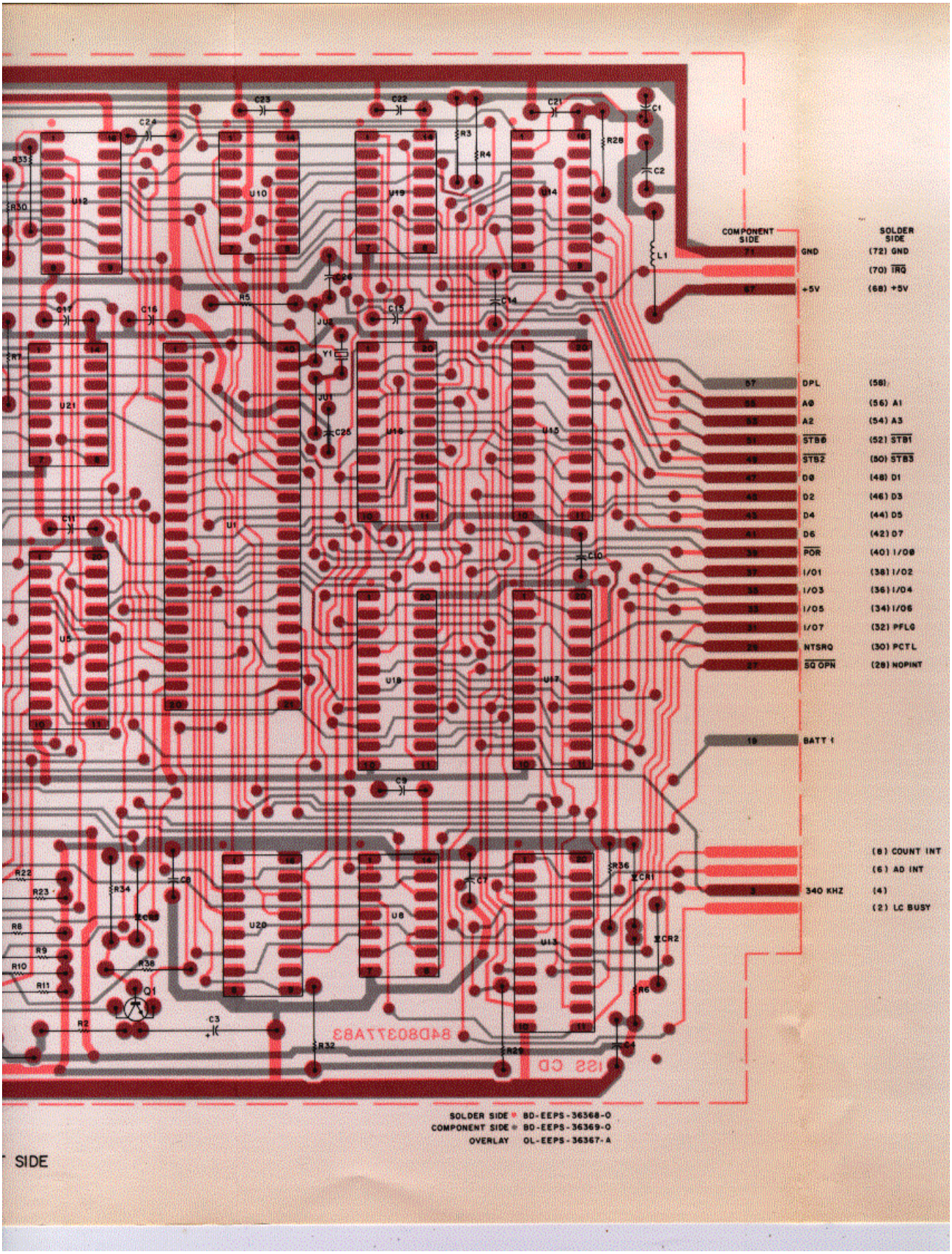


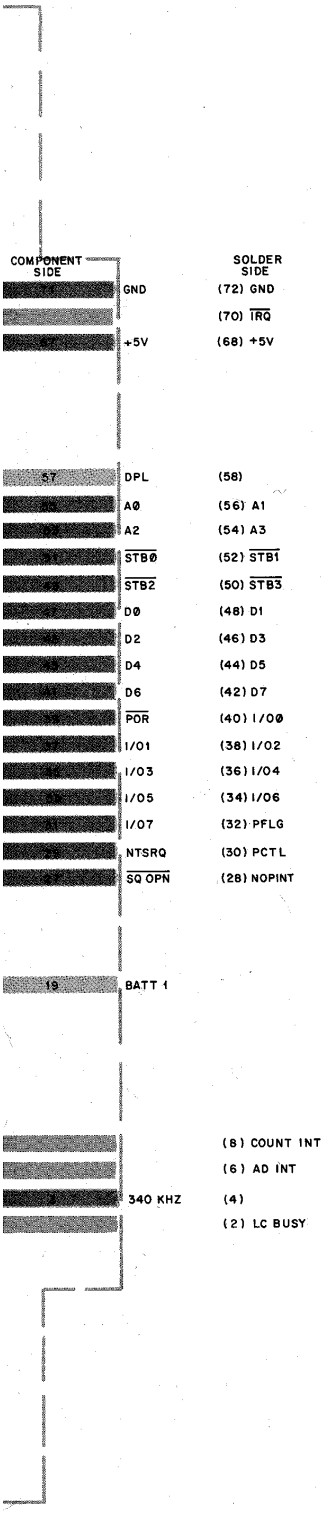
Motorola No. PEPS-36850-O
(Sheet 1 of 2)
8/12/83- PHI

SHOWI



SHOWN FROM COMPONENT SIDE


COMPONENT SIDE
SOLDER SIDE
71 GND (72) GND
(70) IRQ
67 +5V (68) +5V
57 DPL (58)
56 A0 (56) A1
55 A2 (54) A3
51 STB0 (52) STB1
49 STB2 (50) STB3
47 D0 (48) D1
45 D2 (46) D3
43 D4 (44) D5
41 D6 (42) D7
39 POR (40) I/O0
37 I/O1 (38) I/O2
35 I/O3 (36) I/O4
33 I/O5 (34) I/O6
31 I/O7 (32) PFLG
29 NTSRQ (30) PCTL
27 SQ OPN (28) NOPINT
19 BATT +
(8) COUNT INT
(6) AD INT
3 340 KHZ (4)
(2) LC BUSY
SOLDER SIDE = BD-EEPS-36368-0
COMPONENT SIDE = BD-EEPS-36369-0
OVERLAY OL-EEPS-36367-A
SIDE

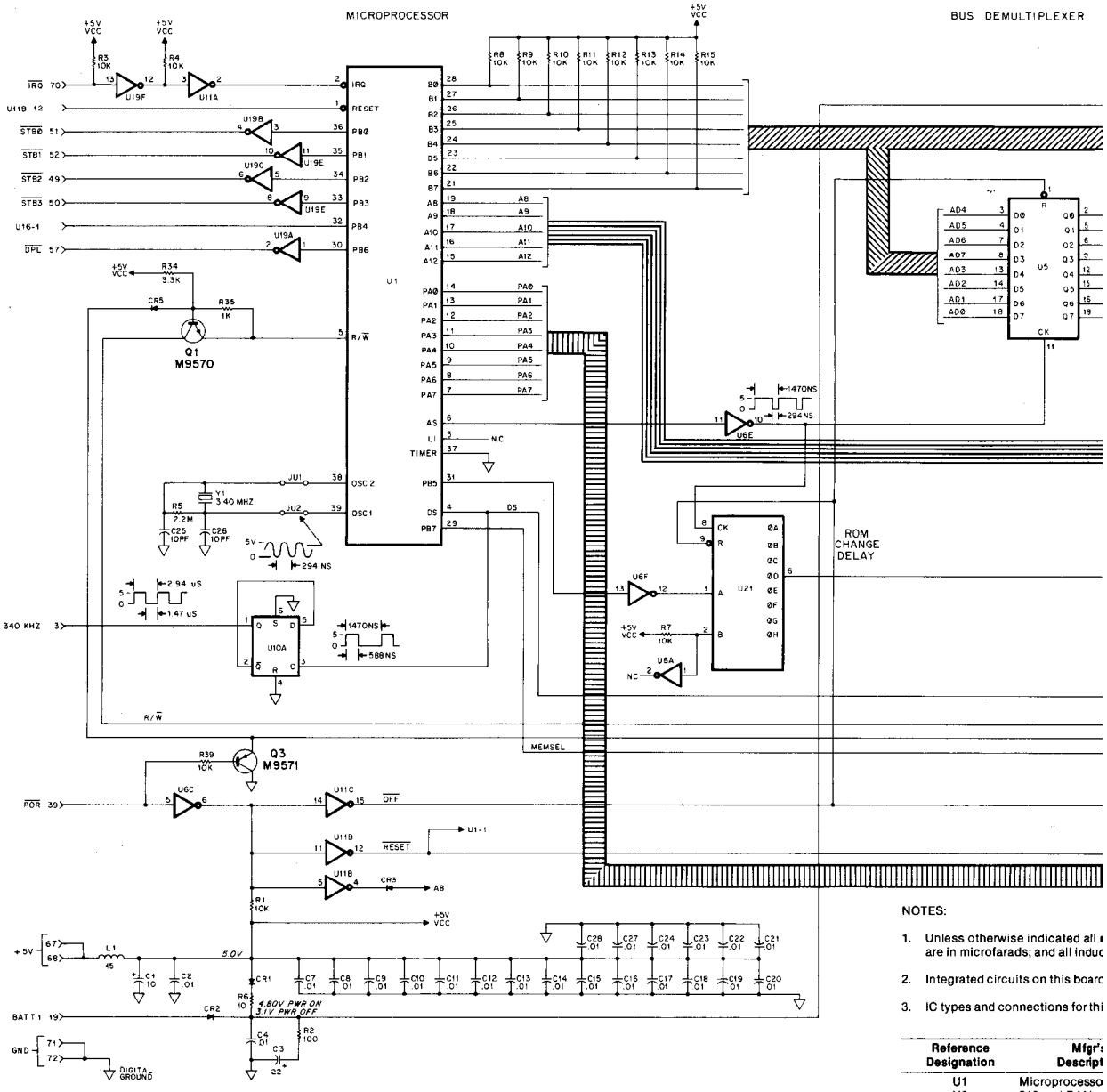


parts list

RTC4023A CPU Board — PL-8454-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed uF; + 70-30%; 100 V: unless otherwise stated
C1	23-84665F01	10 uF + 100-10%; 25 V
C2	21-82428B21	.01
C3	23-84762H10	22 uF ± 20%; 15 V
C4 thru 24	21-82428B21	.01
C25, 26	21-82355B11	30 pF ± 5%; 500 V
C27, 28	21-82428B21	.01
		diode: (see note)
CR1, 2	48-84616A01	hot carrier
CR3	48-83654H01	silicon
CR4, 5	48-84616A01	hot carrier
		coil, rf:
L1	24-83451F01	choke; 15 uH
		transistor: (see note)
Q1, 2	48-869570	NPN; type M9570
Q3	48-869571	PNP; type M9571
		resistor, fixed; ± 5%; 1/4 W: unless otherwise stated
R1	6-11009C73	10k
R2	6-11009C25	100
R3, 4	6-11009C73	10k
R5	6-124B30	2.2 meg
R6	6-11009C01	10
R7 thru 24	6-11009C73	10k
R25, 26, 27	6-11009C49	1k
R28 thru 33	6-11009C73	10k
R34	6-11009C61	3.3k
R35	6-11009C49	1k
R36	6-11009C73	10k
R37	6-11009C61	3.3k
R38	6-11009C49	1k
R39	6-11009C73	10k
		integrated circuit: (see note)
U1	51-83625M44	microprocessor
U2, 3	51-83625M55	512 × 4 RAM
U4	51-80397A23	8k × 8 ROM
U5	51-82609M17	octal D flip-flop
U6	51-84561L03	hex inverter
U7	51-84561L38	triple NOR gate
U8	51-83627M04	quad open collector NAND gate
U9	51-84561L47	dual 2 to 4 decoder
U10	51-82884L13	dual D flip-flop
U11	51-82884L02	hex inverter
U12	51-84561L41	1 of 8 decoder
U13	51-82609M56	octal buffer
U14	51-84561L51	hex D flip-flop
U15	51-82609M56	octal buffer
U16	51-82627M03	octal D latch
U17	51-82609M56	octal buffer
U18	51-83627M03	octal D latch
U19	51-84561L03	hex inverter
U20	51-82884L70	hex D flip-flop
U21	51-82609M52	8-bit serial input/parallel output shift register
U22	51-80397A24	8k × 8 ROM
U23	51-84561L08	triple NAND gate
		crystal: (see note)
Y1	48-80378A44	3.4 MHz
		mechanical parts
	45-80395A37	EJECTOR, (YEL); 2 used
	9-84881F01	SOCKET, 24 contact; 2 used
	9-83893M01	SOCKET, 40 contact
	42-10217A24	TIE, wrap
	14-84602K01	INSULATOR, crystal
	84-80377A83	PC BOARD

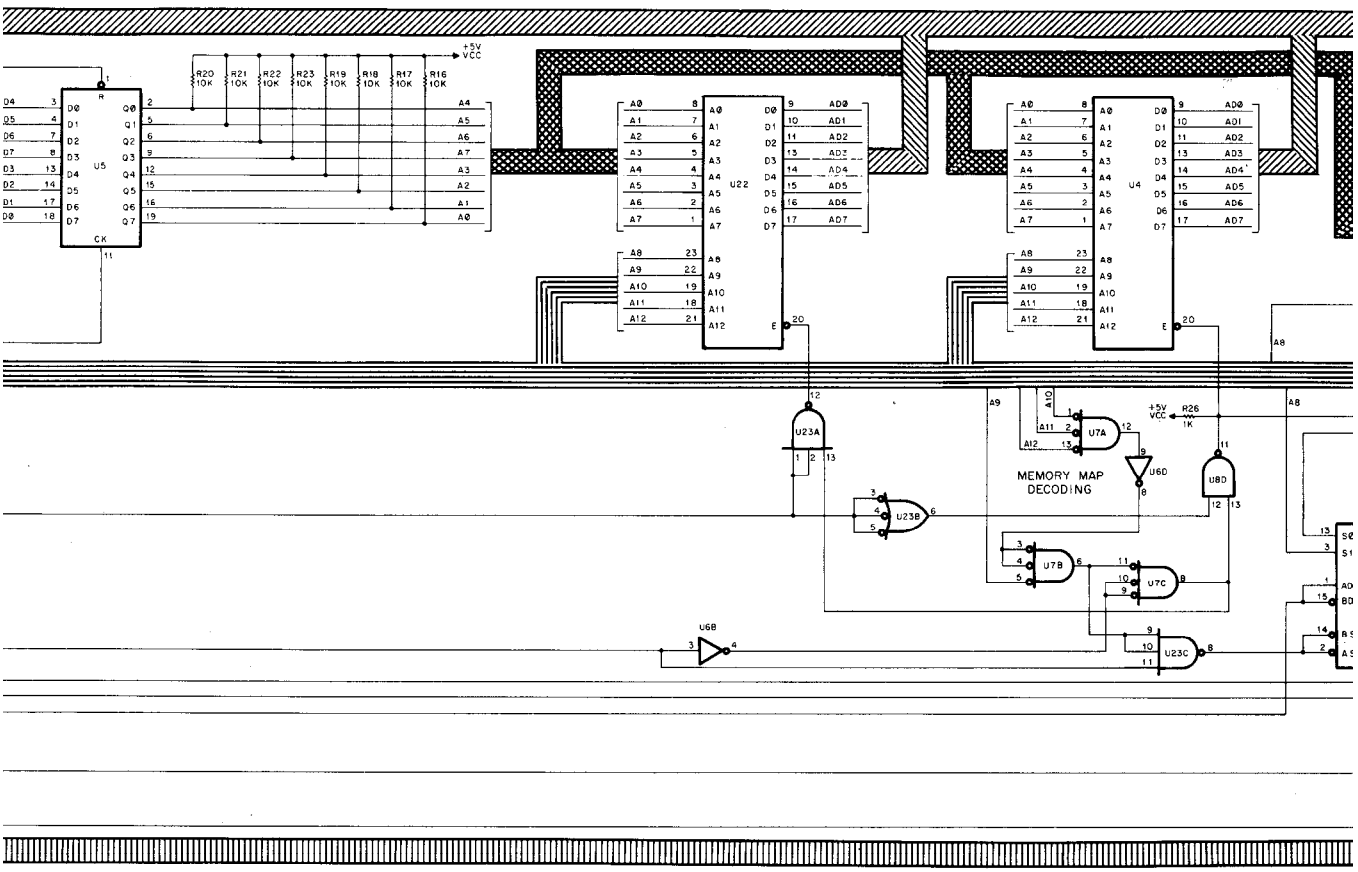
note: For optimum performance, diodes, transistors, crystals, and integrated circuits must be ordered by Motorola part numbers.



NOTES:

1. Unless otherwise indicated all r are in microfarads; and all induc
2. Integrated circuits on this boarc
3. IC types and connections for thi

Reference Designation	Mfgr's Descript
U1	Microprocesso
U2	512 × 4 RAM
U3	512 × 4 RAM
U4	8k × 8 ROM
U5	Octal D Flip-Flc
U6	Hex Inverter
U7	Triple NOR
U8	Quad Open Col
U9	Dual 2 to 4 Dec
U10	Dual D Flip-Flo
U11	Hex Inverter
U12	1 of 8 Decoder
U13	Octal Buffer
U14	Hex D Flip-Flop
U15	Octal Buffer
U16	Octal D-Latch
U17	Octal Buffer
U18	Octal D-Latch
U19	Hex Inverter
U20	Hex D Flip-Flop
U21	8 Bit Serial/Para
U22	8k × 8 ROM
U23	Triple NAND



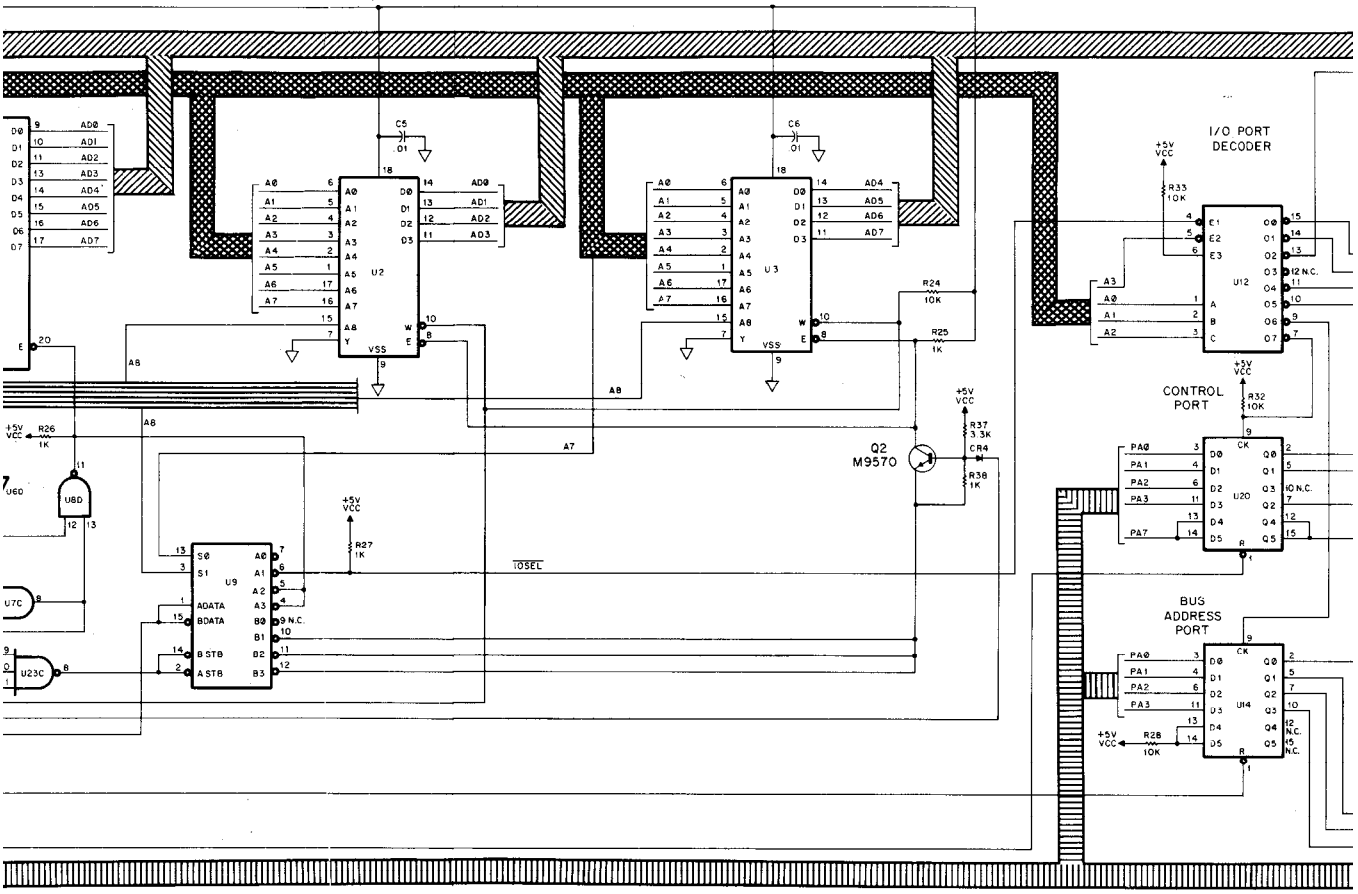
is otherwise indicated all resistor values are in ohms; all capacitor values microfarads; and all inductor values are in microhenries.

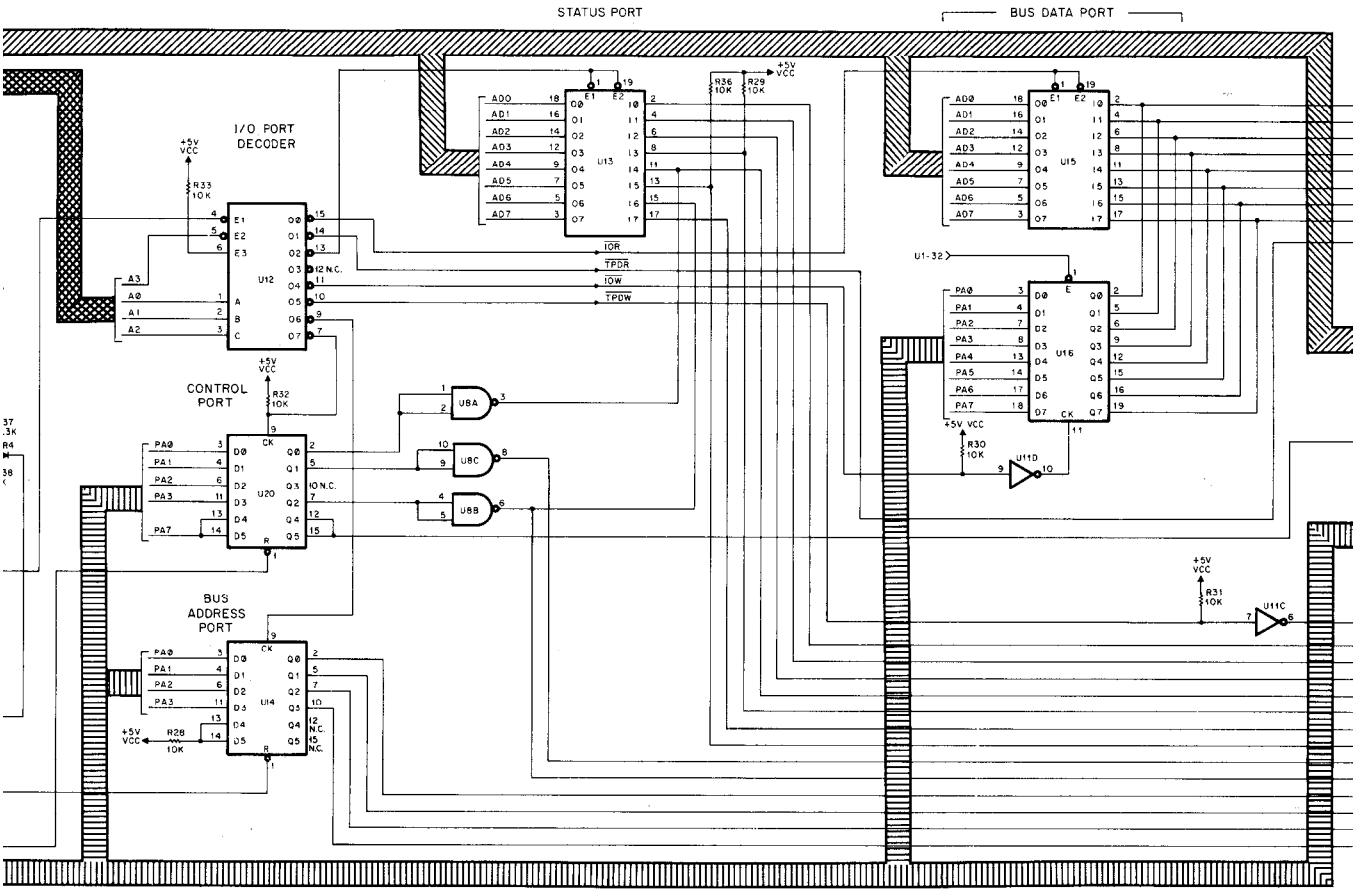
rated circuits on this board are TTL and CMOS devices.

es and connections for this board are as follows:

rence nation	Mfgr's Description	VCC	GND	Ram Pwr
J1	Microprocessor	40	20	
J2	512 x 4 RAM		9	18
J3	512 x 4 RAM		9	18
J4	8k x 8 ROM	24	12	
J5	Octal D Flip-Flop	20	10	
J6	Hex Inverter	14	7	
J7	Triple NOR	14	7	
J8	Quad Open Coll NAND	14	7	
J9	Dual 2 to 4 Decoder	16	8	
10	Dual D Flip-Flop	14	7	
11	Hex Inverter	1	8	
12	1 of 8 Decoder	16	8	
13	Octal Buffer	20	10	
14	Hex D Flip-Flop	16	8	
15	Octal Buffer	20	10	
16	Octal D-Latch	20	10	
17	Octal Buffer	20	10	
18	Octal D-Latch	20	10	
19	Hex Inverter	14	7	
20	Hex D Flip-Flop	16	8	
21	8 Bit Serial/Parallel Shift	14	7	
22	8k x 8 ROM	24	12	
23	Triple NAND	14	7	

RAM

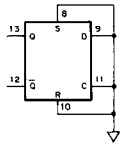

I/O PORT DECODER
CONTROL PORT
BUS ADDRESS PORT
U2
U3
U9
U12
U20
U14
U60
U23C
U7C
Q2 M9570
R24 10K
R25 1K
R26 1K
R27 1K
R28 10K
R32 10K
R33 10K
R37 3.3K
R38 1K
CR4
C5 .01
C6 .01
+5V VCC
A8
A7
IOSEL



LEGEND

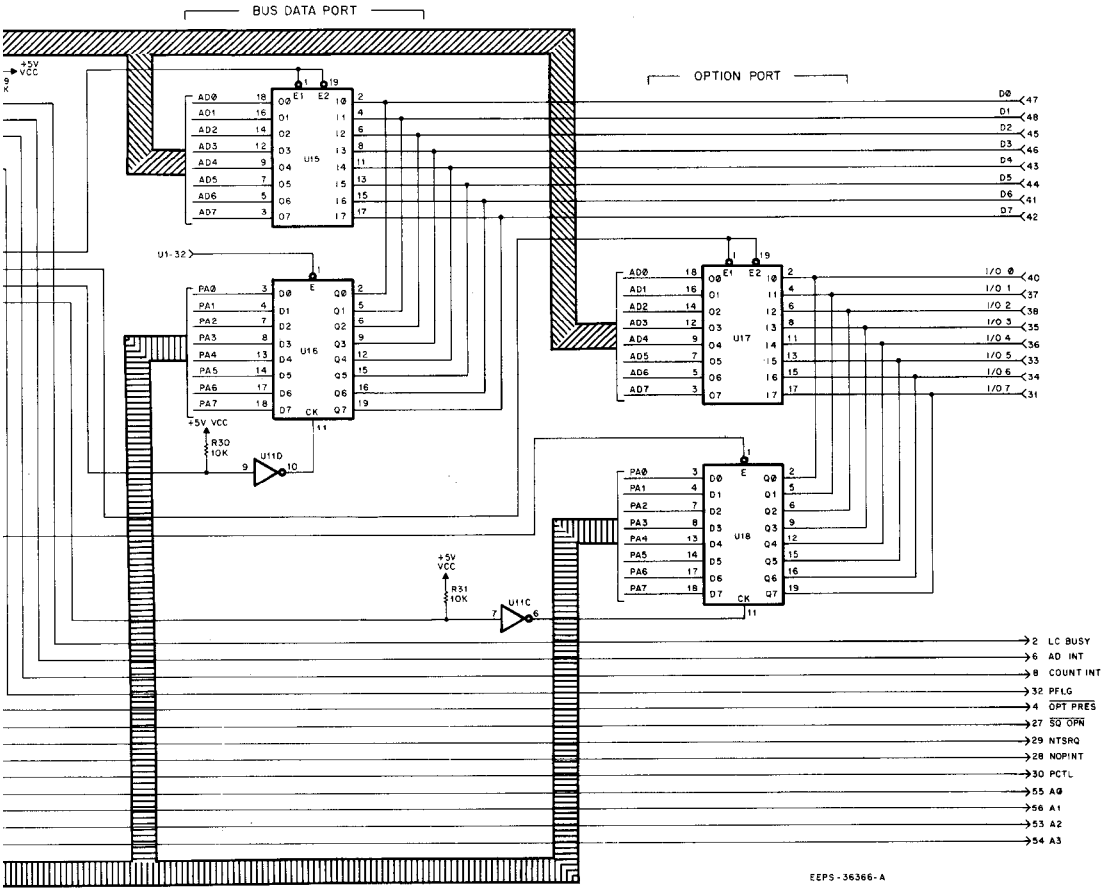
= DIGITAL GROUND

UNUSED GATE



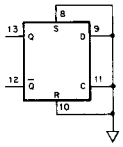
CPU BOARD (A08)

MODEL RTC4023A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



LEGEND
= DIGITAL GROUND

UNUSED GATE



Motorola No. PEPS-36850-O
(Sheet 2 of 2)
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COUNTER BOARD (A10)

MODEL RTL4106A

1. DESCRIPTION

The counter board consists of the microprocessor bus interface frequency error and PL (Private-Line™) counter, analog-to-digital converter, and audio circuitry.

2. THEORY OF OPERATION

2.1 MICROPROCESSOR INTERFACE

The counter communicates with the microprocessor via the system data and address bus. The address and strobe are decoded by address decoder U1 to obtain load commands and control pulses. The data bus, DØ-D7, is connected to control latch U14 and output drivers U10 and U11. The drivers gate data onto the data bus when enabled by the A/D and counter read commands. U14 latches the bits that control the audio routing. The AC/DC SEL command output of U14 is sent to the analog interface board (AIB) where it controls the coupling of the external input to the AIB. U24 is the counter mode latch that generates the FREQ ERROR/PL and .1/.01 SEC GATE signals that are used to control the mode of operation.

2.2 COUNTER OPERATION, FREQUENCY ERROR MODE

2.2.1 Counter mode latch U24 enables the counter to measure the receiver i-f frequency. The microprocessor reads the i-f, subtracts 10.7 MHz, and displays the result on the front panel LCD. The 10.7 MHz signal from the receiver is applied to the phase comparator input of phase-locked loop U26. The i-f is compared with that of the PLL VCO to produce an error voltage that locks the VCO frequency to that of the input i-f. Thus, the VCO output of U26 is a low noise reproduction of the i-f, and is further amplified by transistors Q5 and Q6. With U24-2 high, the B inputs to multiplexer U2 are gated to the U2 outputs. U23A divides the SYNTH 1 kHz frequency by 10. U25A and U25B select either 1 kHz or 100 Hz for the clock input of U3 providing a .01 second or 0.1 second gate time for the frequency counter. The count input to counter U8 is connected to the squared VCO signal and the enable command is sent to U6-4 via U2.

2.2.2 Counter operation begins when the counter start pulse (START COUNT) is decoded at U1. The pulse causes U5 to toggle causing preset to be removed from U3, and U8 counts the i-f frequency. $\overline{\text{COUNT ENABLE}}$ stays low until U3 rolls over from the F state to Ø. Thus, U8 is enabled for 10 cycles of the gate clock. State F is decoded internally by U3 and appears at the carry output, U3-7. The low-to-high transition of the carry toggles U5 Q output high. U3 returns to preset and the count cycle ends. The low-to-high transition of $\overline{\text{COUNT ENABLE}}$ latches an interrupt into U13B to end the microprocessor cycle. The counter interrupt latch is cleared by the $\overline{\text{CTR READ}}$ pulse. The microprocessor reads three bytes from U8 sequentially and then resets U8 by addressing U1-9.

2.3 COUNTER OPERATION, PL MODE

2.3.1 Before the sub-audible PL tone can be counted, it must be separated from the recovered audio. The PL filter comprised of U20A, U21, and U22 has a cutoff frequency of 270 Hz and this signal is squared for counting by U20B and Q4.

2.3.2 With U24-2 low, the counter is in the PL mode and the A inputs of U2 are gated to the U2 output. The count input of U8 is connected to the 10 MHz timebase and the PL tone drives the clock input of U3. The count enable of U8 is driven from the carry output of U3. PL frequency is measured by gating 10 MHz into U8 for one period of the audio tone. The microprocessor reads the number of 10 MHz pulses counted, multiplies by 100 nanoseconds per pulse and calculates the reciprocal of the time to obtain the PL frequency.

2.3.3 Counter operation is similar to that for frequency error except that U3 is preset to a different value and U23B is enabled. For normal operation in which a tone is present, reset is removed from U23B; preset is removed from U3 when U5 toggles after a counter start pulse is decoded. The carry output of U3

goes low at the first low-to-high transition of the PL tone. COUNT ENABLE is low and U8 counts the 10 MHz input. On the next low-to-high transition of the tone, COUNT ENABLE goes high, the counter interrupt is latched, and U5 toggles causing U23B to reset and U3 to be preset.

2.3.4 If the subaudible tone frequency is below 16 Hz, U23-14 goes high before U3 completes its cycle. The abort pulse generated at U7-12 drives U3 to the preset state, clears U8, and forces a counter interrupt. U23B acts as a timer to ensure that the control logic does not get hung up when PL input is absent.

2.4 ANALOG-TO-DIGITAL CONVERTER

2.4.1 The analog-to-digital (A/D) converter, U9, changes the input voltage on the AD INPUT line into a 10-bit data word. The A/D converter accepts input voltages in the range of 0-999 mV full scale. A separate sign bit from the AIB is read by the microprocessor through U11 to indicate input polarity.

2.4.2 The +2.49 V dc supplied by Zener diode VR1 is inverted by U12. The reference current developed through R20, R21, and R22 sets the full scale voltage of the A/D converter. The zero voltage offset of U9 is cancelled by adjusting R17.

2.4.3 An A/D conversion is initiated when U1 decodes the AD START command. When the conversion is completed, U9-23 goes high and clocks the A/D interrupt latch U13B. The interrupt informs the microprocessor that data is available. After the processor reads the A/D data, U13B is reset.

2.5 PEAK DETECTOR SWITCHING

The 1-of-4 select, U15, selects one of four signals for application to the peak detectors on the AIB. The signals are the MOD; REC AUD; CAR & MOD LEVEL OUT; and PCT AM.

2.6 SPEAKER AUDIO SWITCHING

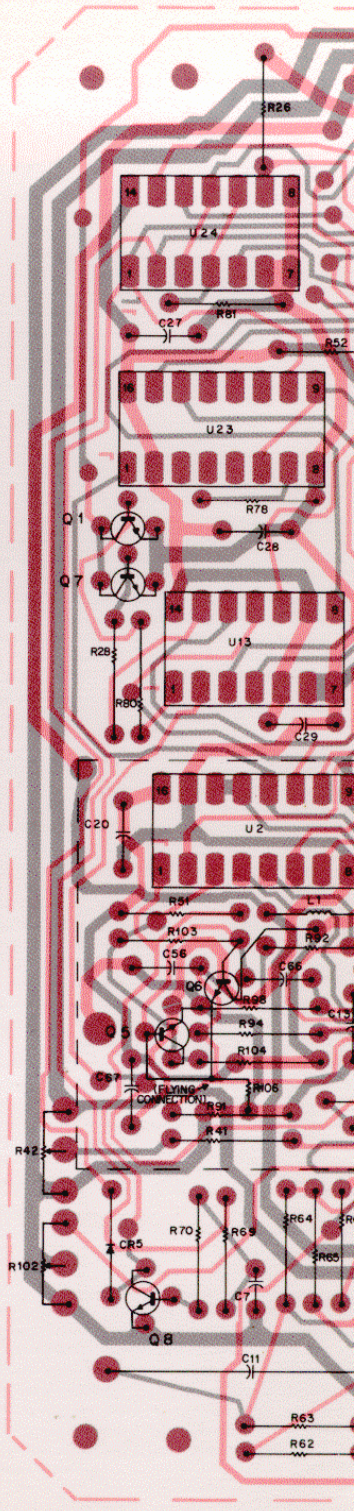
U17A switches MOD or REC AUD to the speaker volume control. U17C serves as a speaker audio mute switch. The return from the wiper of the volume control is summed by U16B with the keyboard response tone from U25C and the alarm tone from U25B. The generate modulation and recovered audio are buffered separately by U16A and U18A which drive the front panel MOD and DEMOD OUT jacks.

2.7 AM AUDIO SWITCHING

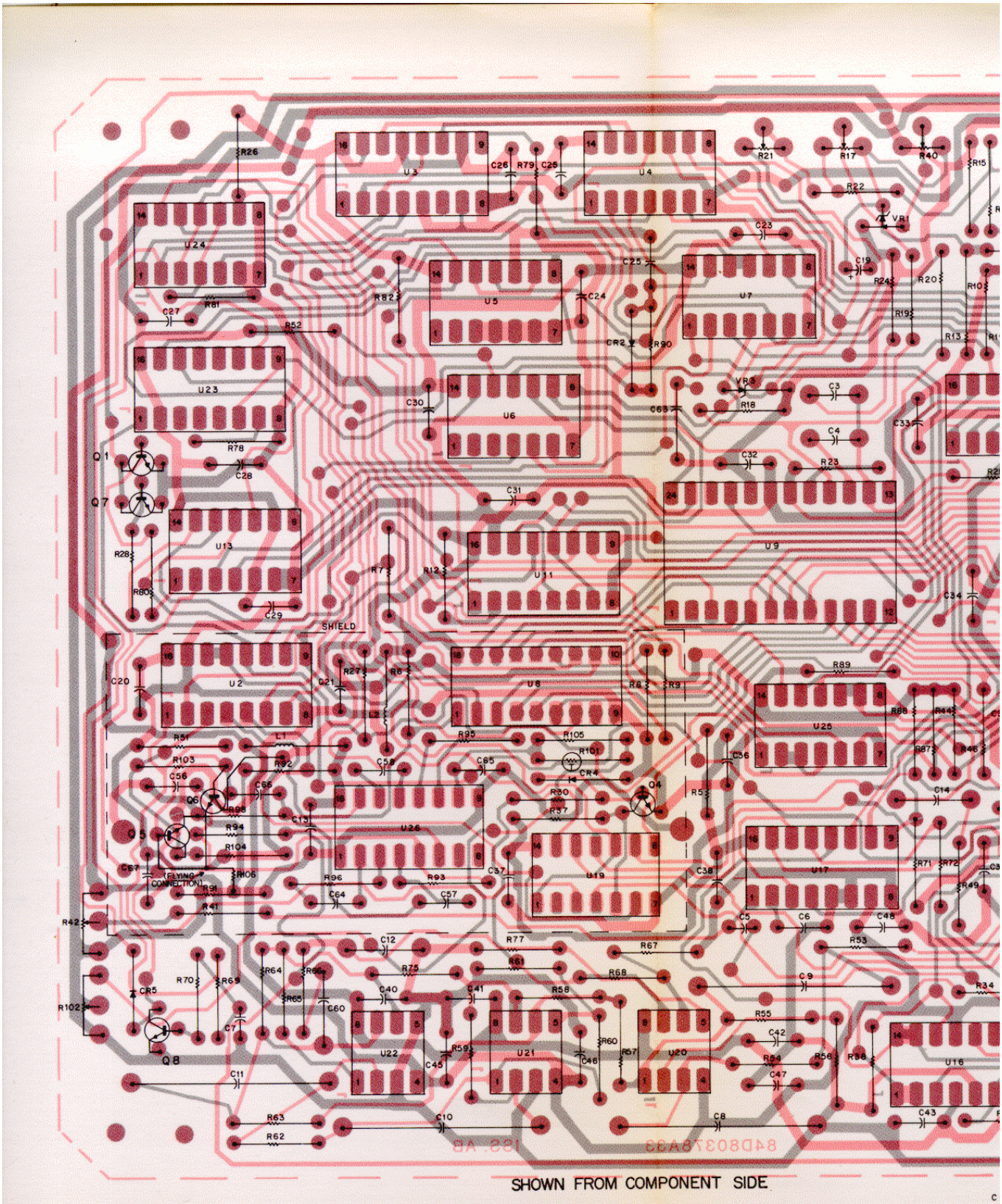
U17B gates modulation audio plus a dc bias signal onto the AM MOD line when the unit is in AM generate mode. The dc bias reduces the rf output level to provide sufficient modulation headroom for AM.

COUNTER BOARD (A10)

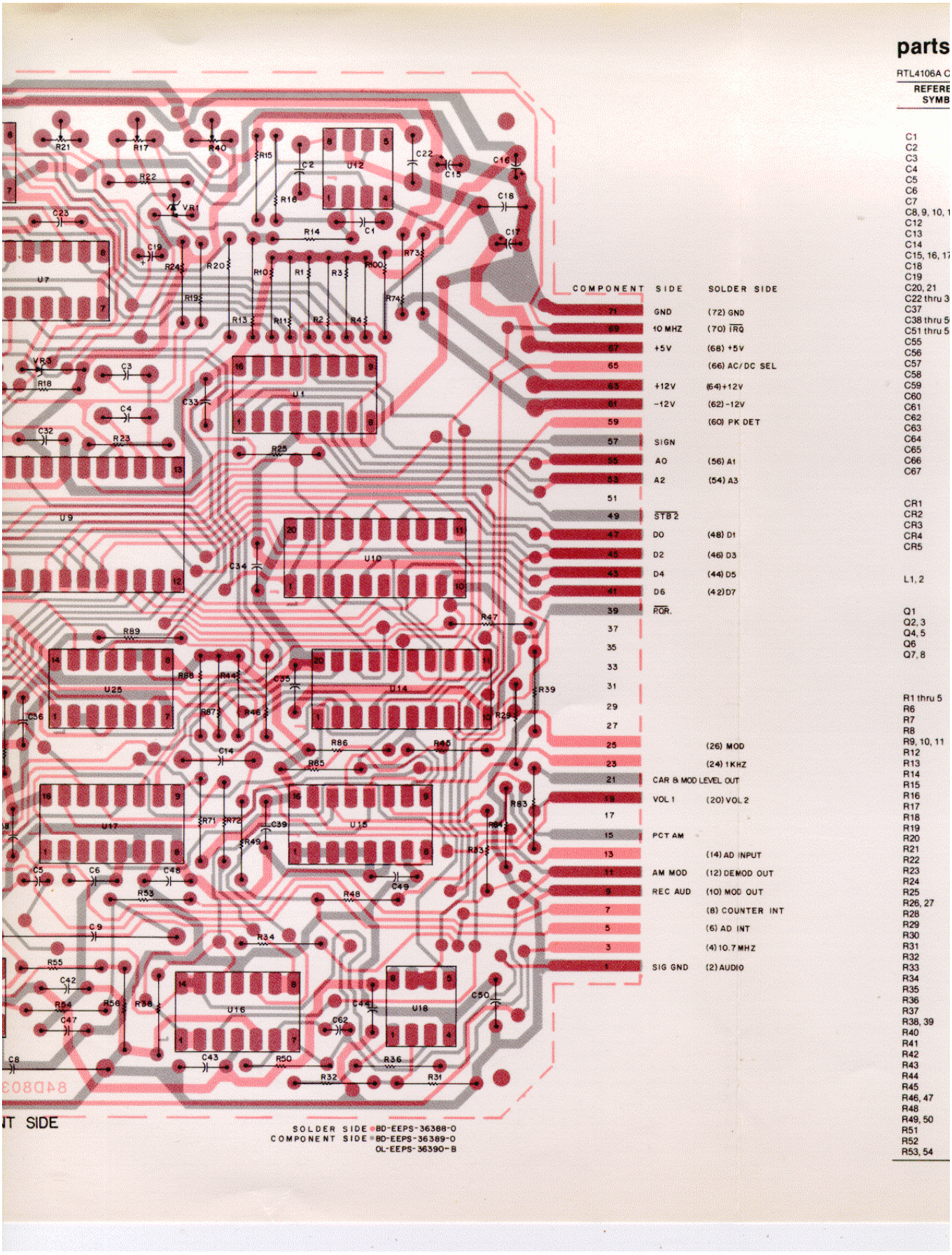
MODEL RTL4106A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



Motorola No. ***PEPS-36851-O***
(Sheet 1 of 2)
8/12/83-PHI



SHOWN FROM COMPONENT SIDE



parts

RTL4106A C

REFERE
SYMB

C1
C2
C3
C4
C5
C6
C7
C8, 9, 10, 1
C12
C13
C14
C15, 16, 17
C18
C19
C20, 21
C22 thru 3
C37
C38 thru 5
C51 thru 5
C55
C56
C57
C58
C59
C60
C61
C62
C63
C64
C65
C66
C67

CR1
CR2
CR3
CR4
CR5

L1, 2

Q1
Q2, 3
Q4, 5
Q6
Q7, 8

R1 thru 5
R6
R7
R8
R9, 10, 11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
R26, 27
R28
R29
R30
R31
R32
R33
R34
R35
R36
R37
R38, 39
R40
R41
R42
R43
R44
R45
R46, 47
R48
R49, 50
R51
R52
R53, 54

parts list

RTL4106A Counter Board — PL-8465-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed; pF ± 5%; 500 V: unless otherwise stated
C1	21-84494B46	180 ± 3%
C2	21-84494B42	27
C3	21-82187B10	270
C4	21-84494B34	68
C5	23-84908L01	2.2 uF ± 20%; 50 V
C6	21-82428B21	.01 uF + 10-30%; 100 V
C7	21-82187B27	.002 uF ± 10%; 100 V
C8, 9, 10, 11	8-84326A20	.0129 uF ± 2%; 50 V
C12	21-874352	1200 pF ± 5%; 300 V
C13	21-82372C07	.05 uF + 80-20%; 25 V
C14	21-82372C03	0.1 uF + 80-20%; 25 V
C15, 16, 17	23-84665F01	10 uF + 100-10%; 25 V
C18	21-82428B21	.01 uF + 10-30%; 100 V
C19	23-84665F01	10 uF + 100-10%; 25 V
C20, 21	21-82372C07	.05 uF + 80-20%; 25 V
C22 thru 36	21-82428B21	.01 uF + 10-30%; 100 V
C37	21-82372C07	.05 uF + 80-20%; 25 V
C38 thru 50	21-82428B21	.01 uF + 10-30%; 100 V
C51 thru 54		NOT USED
C55	21-82187B20	.001 uF ± 10%; 100 V
C56	21-82372C07	.05 uF + 80-20%; 25 V
C57	21-82187B14	.001 uF ± 10%; 100 V
C58	21-859937	24
C59		NOT USED
C60	21-82372C03	0.1 uF + 80-20%; 25 V
C61		NOT USED
C62	8-11017A03	.0022 uF ± 5%; 50 V
C63	21-82372C03	0.1 uF + 80-20%; 25 V
C64	21-82537B22	560 pF ± 5%; 100 V
C65	21-82372C07	.05 uF + 80-20%; 25 V
C66	21-82187B14	.001 uF ± 10%; 100 V
C67	21-82372C07	.05 uF + 80-20%; 25 V
		diode: (see note)
CR1		NOT USED
CR2	48-83654H01	silicon
CR3		NOT USED
CR4	48-83654H01	silicon
CR5	48-84616A01	silicon
		coil, rf:
L1, 2	24-82549D41	choke: 100 uH
		transistor: (see note)
Q1	48-869570	NPN; type M9570
Q2, 3		NOT USED
Q4, 5	48-869570	NPN; type M9570
Q6	48-869528	NPN; type M9528
Q7, 8	48-869570	NPN; type M9570
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1 thru 5	6-11009C83	27k
R6	6-11009C65	4.7k
R7	6-11009C83	27k
R8	6-11009C49	1k
R9, 10, 11	6-11009C83	27k
R12	6-11009C73	10k
R13	6-10621B94	1.00k ± 1%; 1/8 W
R14	6-83175C03	10k ± 1%
R15	6-10621C63	5.11k ± 1%; 1/8 W
R16	6-83175C03	10k ± 1%
R17	18-83452F14	variable; 10k
R18	6-10621C27	2.15k ± 1%; 1/8 W
R19	6-10621D88	100k ± 1%; 1/8 W
R20	6-84444A75	110k ± 1%; 1/8 W
R21	18-83452F14	variable; 10k
R22	6-10621C75	6.81k ± 1%; 1/8 W
R23	6-10621D88	100k ± 1%; 1/8 W
R24	6-10621A97	100 ± 1%; 1/8 W
R25	6-10621D88	100k ± 1%; 1/8 W
R26, 27	6-11009C83	27k
R28	6-11009C73	10k
R29	6-10621C70	6.04k ± 1%; 1/8 W
R30	6-11009C61	3.3k
R31	6-10621C63	5.11k ± 1%; 1/8 W
R32	6-10621D42	33.2k ± 1%; 1/8 W
R33	6-10621C70	6.04k ± 1%; 1/8 W
R34	6-11009C43	560
R35		NOT USED
R36	6-11009C43	560
R37	6-11009C73	10k
R38, 39	6-10621C53	4.02k ± 1%; 1/8 W
R40	18-83452F14	variable; 10k
R41	6-11009C75	12k
R42	18-83452F01	variable; 2k
R43		NOT USED
R44	6-11009C83	27k
R45	6-11009C67	5.6k
R46, 47	6-11009C63	3.9k
R48	6-11009C74	11k
R49, 50	6-11009C91	56k
R51	6-11009C73	10k
R52	6-11009C83	27k
R53, 54	6-10621D84	90.9k ± 1%; 1/8 W

REFERENCE SYMBOL	MOTOROLA PART NO.	
R55	6-11009C74	11k
R56	6-11009C77	15k
R57, 58, 59	6-10621D58	48.7k ± 1%; 1
R60	6-11009D14	470k
R61, 62, 63	6-10621D58	48.7k ± 1%; 1
R64, 65	6-11009C81	22k
R66	6-11009D06	220k
R67	6-11009C65	4.7k
R68	6-11009C99	120k
R69	6-11009C85	33k
R70	6-11009C60	3k
R71	6-11009C83	27k
R72	6-11009C59	2.7k
R73, 74	6-11009C01	10
R75	6-11009C98	110k
R76		NOT USED
R77	6-124B30	2.2 meg
R78, 79	6-11009C49	1k
R80	6-11009C73	10k
R81	6-11009C49	1k
R82	6-11009C83	27k
R83	6-10621C70	6.04k ± 1%; 1
R84	6-10621C53	4.02k ± 1%; 1
R85 thru 89	6-11009C83	27k
R90	6-11009C73	10k
R91, 92	6-11009C65	4.7k
R93, 94	6-11009C56	2k
R95	6-11009C66	5.1k
R96	6-11009C63	3.9k
R97		NOT USED
R98	6-11009C73	10k
R99		NOT USED
R100	6-11009C43	560
R101		NOT USED
R102	18-83452F09	variable; 1k
R103	6-11009C97	100k
R104	6-11009C60	3k
R105	6-11009C45	680
R106	6-11009C49	1k
		thermistor:
RT101	6-80378A45	20k @ 25°C
		integrated cir
U1	51-84561L41	1 of 8 decode
U2	51-84561L48	quad 1 of 2 M
U3	51-82884L26	4-bit, up/dow
U4	51-82884L51	quad AND ga
U5	51-82884L13	dual D flip-flo
U6	51-82884L04	quad NOR ga
U7	51-82884L03	hex inverter
U8	51-80365A20	32-bit counte
U9	51-80365A28	A/D converte
U10	51-82609M56	octal driver
U11	51-84561L77	hex driver
U12	51-80365A27	operational a
U13	51-82884L13	dual D flip-flo
U14	51-82609M17	octal flip-flop
U15	51-82884L54	dual 4 to 1 mu
U16	51-84561L75	quad operatic
U17	51-82884L65	triple 2 to 1 m
U18	51-80365A07	dual operatio
U19	51-82848M19	hex Schmitt t
U20, 21, 22	51-80365A07	dual operatio
U23	51-82884L12	dual decode
U24	51-82884L13	dual D flip-flo
U25	51-82884L48	quad analog
U26	51-80365A31	PLL
		voltage regul
VR1	51-80365A11	Zener
VR2		NOT USED
VR3	48-82256C15	Zener; type, 5
		mechanical parts
	45-80395A41	EJECTOR (GI
	26-80378A78	SHIELD
	9-84881F01	SOCKET, 24
	9-84881F06	SOCKET, 18
	84-80378A33	CIRCUIT BOA

note: For optimum performance, diodes, transisto be ordered by Motorola part numbers.

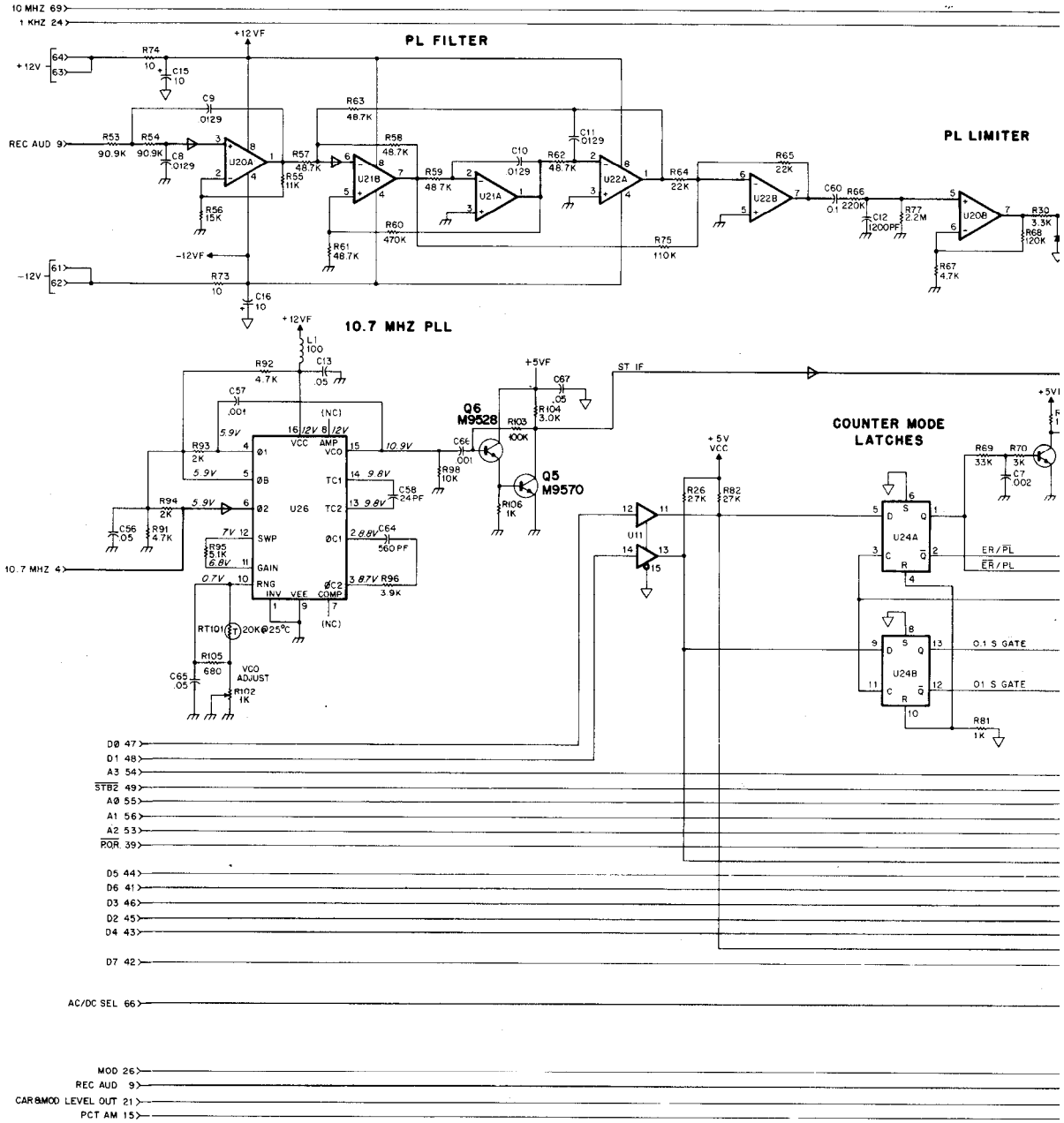
PONENT	SIDE	SOLDER SIDE
	GND	(72) GND
	10 MHZ	(70) $\overline{IRQ}$
	+5V	(68) +5V
65		(66) AC/DC SEL
	+12V	(64)+12V
	-12V	(62)-12V
59		(60) PK DET
57	SIGN	
	A0	(56) A1
	A2	(54) A3
51		
49	$\overline{STB2}$	
	D0	(48) D1
	D2	(46) D3
	D4	(44) D5
	D6	(42)D7
39	$\overline{POR}$.	
37		
35		
33		
31		
29		
27		
25		(26) MOD
23		(24) 1KHZ
21	CAR & MOD LEVEL OUT	
	VOL 1	(20) VOL 2
17		
15	PCT AM	
13		(14) AD INPUT
	AM MOD	(12) DEMOD OUT
	REC AUD	(10) MOD OUT
7		(8) COUNTER INT
5		(6) AD INT
3		(4) 10.7 MHZ
	SIG GND	(2) AUDIO
1		

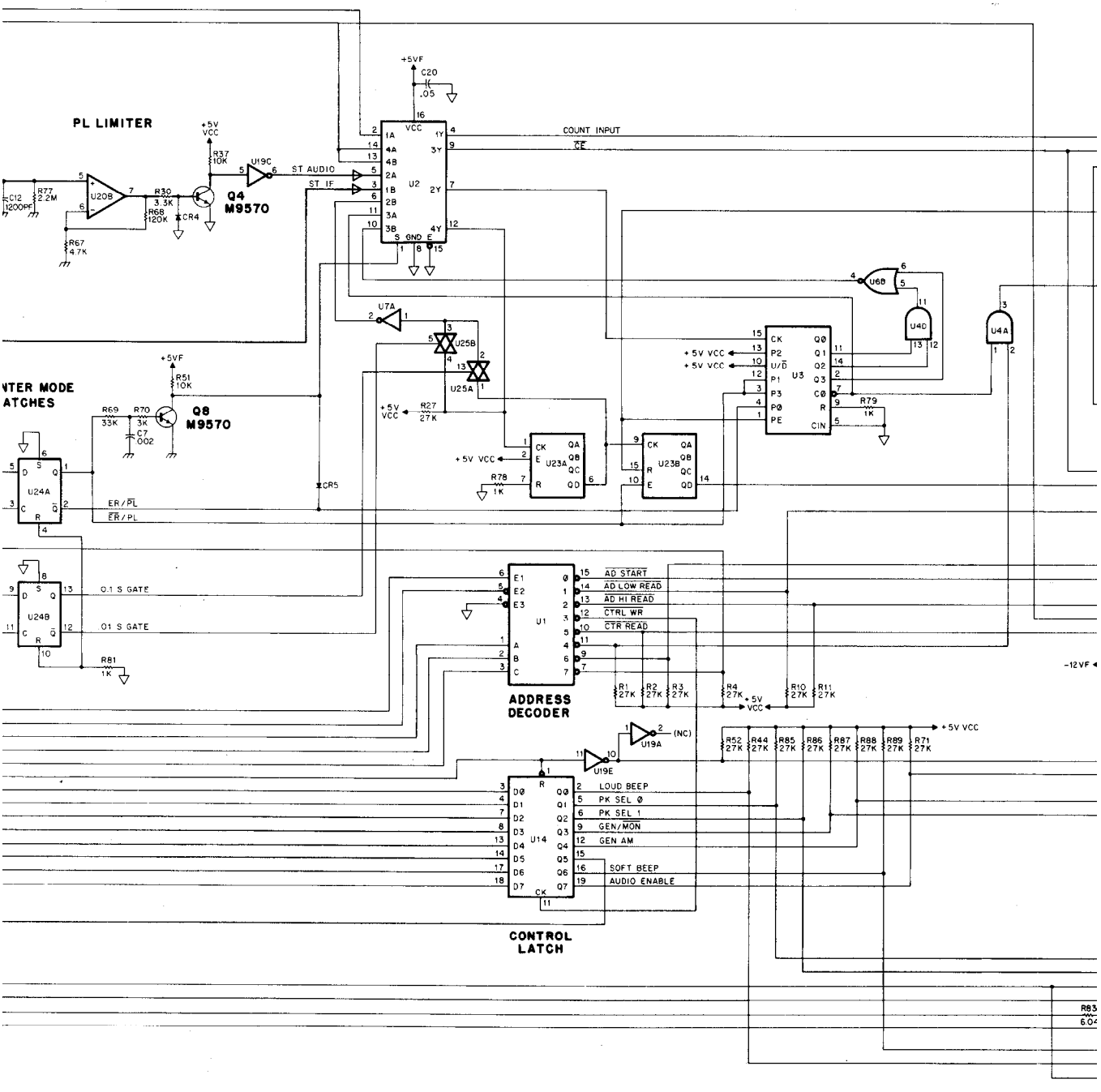
PL-8465-O

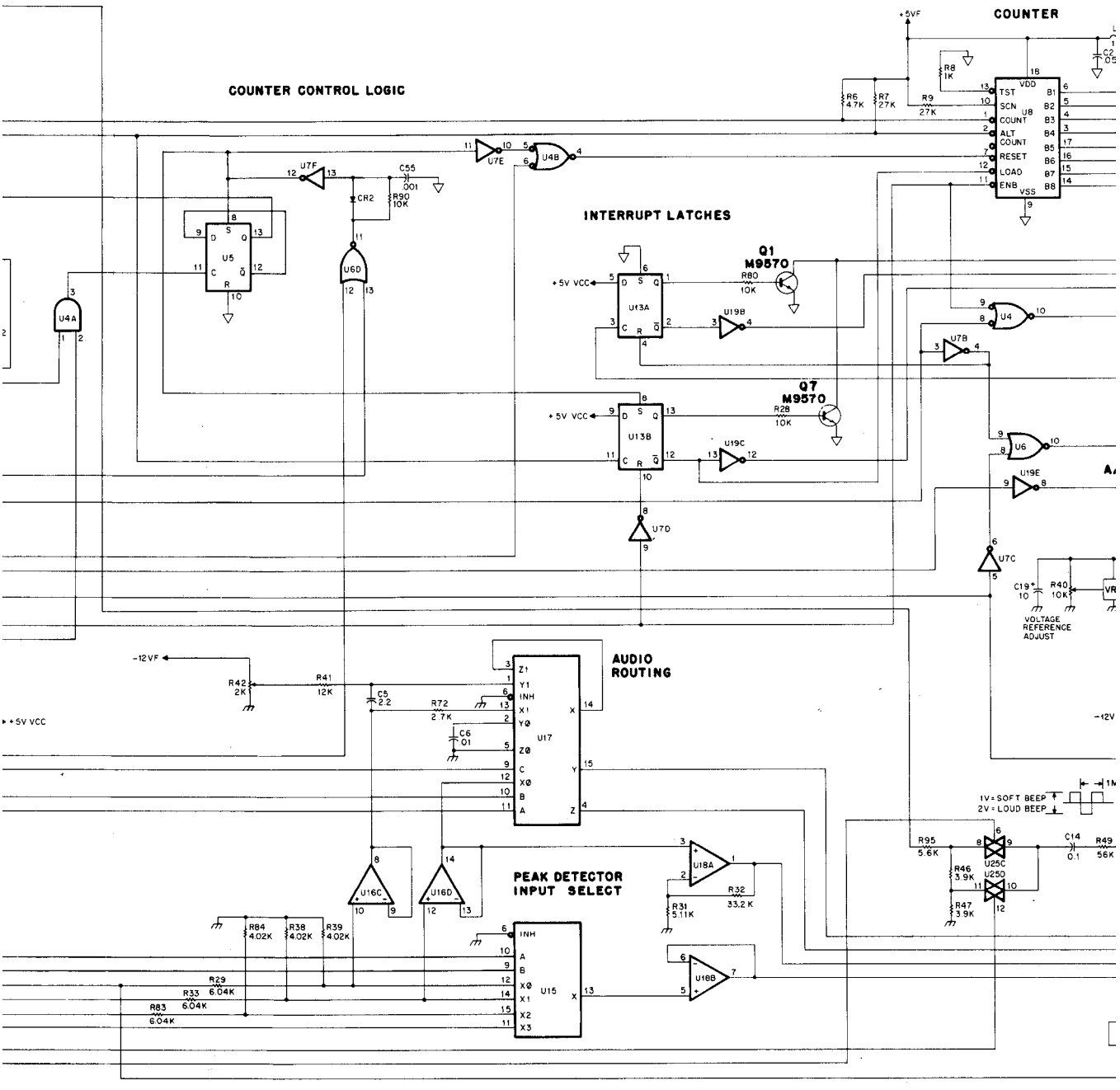
DESCRIPTION
acitor, fixed; pF ± 5%; 500 V:
ess otherwise stated
± 3%
uF ± 20%; 50 V
uF + 10-30%; 100 V
uF ± 10%; 100 V
9 uF ± 2%; 50 V
0 pF ± 5%; 300 V
uF + 80-20%; 25 V
uF + 80-20%; 25 V
F + 100-10%; 25 V
uF + 10-30%; 100 V
F + 100-10%; 25 V
uF + 80-20%; 25 V
uF + 10-30%; 100 V
uF + 80-20%; 25 V
uF + 10-30%; 100 V
T USED
uF ± 10%; 100 V
uF + 80-20%; 25 V
uF ± 10%; 100 V
T USED
uF + 80-20%; 25 V
T USED
2 uF ± 5%; 50 V
uF + 80-20%; 25 V
pF ± 5%; 100 V
uF + 80-20%; 25 V
uF ± 10%; 100 V
uF + 80-20%; 25 V
de: (see note)
T USED
con
T USED
con
con
, rf:
ke: 100 uH
sistor: (see note)
V; type M9570
T USED
V; type M9570
V; type M9528
V; type M9570
stor, fixed: ± 5%; 1/4 W:
ess otherwise stated
k ± 1%; 1/8 W
± 1%
k ± 1%; 1/8 W
± 1%
able; 10k
k ± 1%; 1/8 W
k ± 1%; 1/8 W
k ± 1%; 1/8 W
able; 10k
k ± 1%; 1/8 W
k ± 1%; 1/8 W
± 1%; 1/8 W
k ± 1%; 1/8 W
k ± 1%; 1/8 W
k ± 1%; 1/8 W
k ± 1%; 1/8 W
k ± 1%; 1/8 W
T USED
k ± 1%; 1/8 W
able; 10k
able; 2k
T USED
k ± 1%; 1/8 W

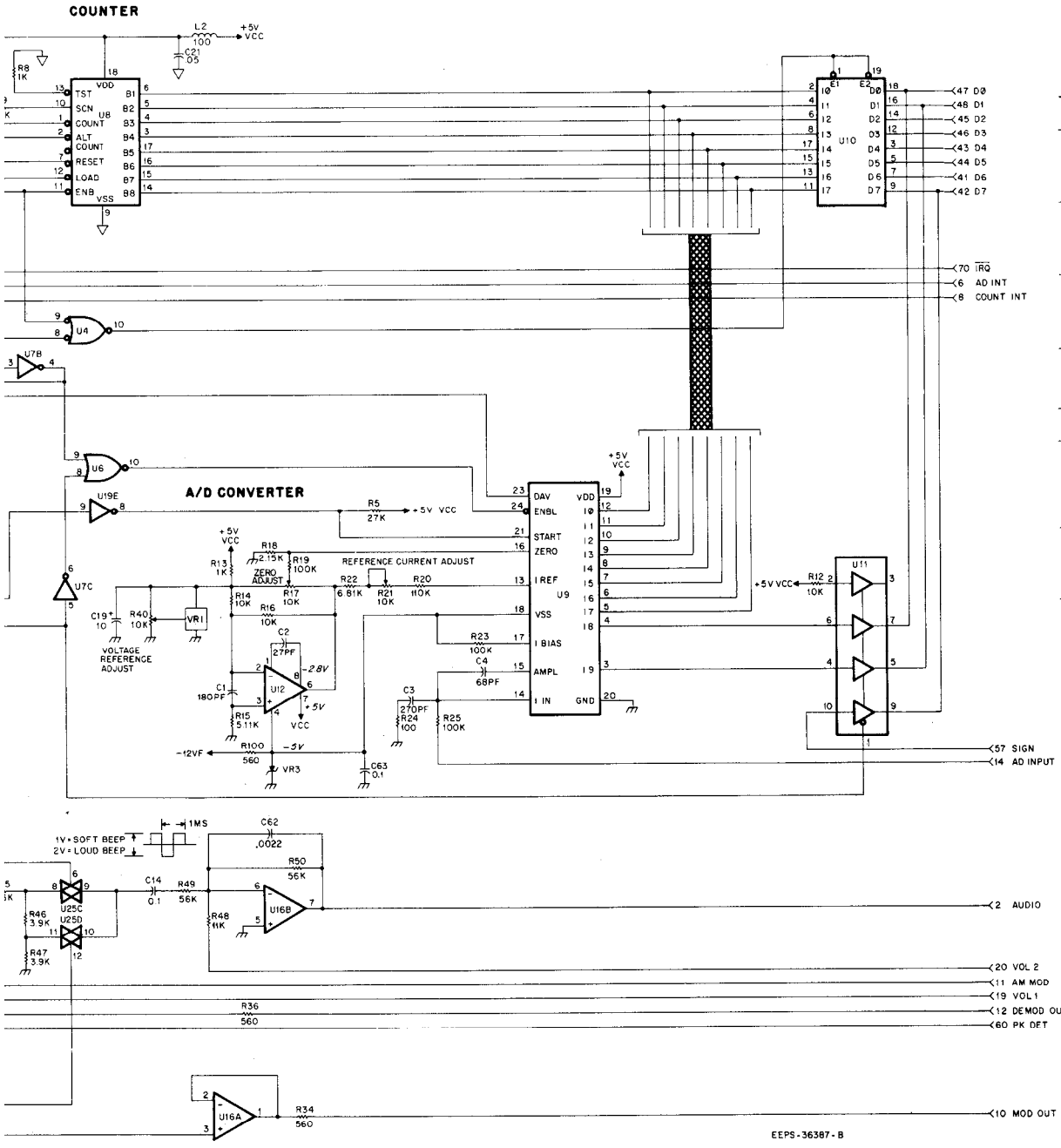
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R55	6-11009C74	11k
R56	6-11009C77	15k
R57, 58, 59	6-10621D58	48.7k ± 1%; 1/8 W
R60	6-11009D14	470k
R61, 62, 63	6-10621D58	48.7k ± 1%; 1/8 W
R64, 65	6-11009C81	22k
R66	6-11009D06	220k
R67	6-11009C65	4.7k
R68	6-11009C99	120k
R69	6-11009C85	33k
R70	6-11009C60	3k
R71	6-11009C83	27k
R72	6-11009C59	2.7k
R73, 74	6-11009C01	10
R75	6-11009C98	110k
R76		NOT USED
R77	6-124B30	2.2 meg
R78, 79	6-11009C49	1k
R80	6-11009C73	10k
R81	6-11009C49	1k
R82	6-11009C83	27k
R83	6-10621C70	6.04k ± 1%; 1/8 W
R84	6-10621C53	4.02k ± 1%; 1/8 W
R85 thru 89	6-11009C83	27k
R90	6-11009C73	10k
R91, 92	6-11009C65	4.7k
R93, 94	6-11009C56	2k
R95	6-11009C66	5.1k
R96	6-11009C63	3.9k
R97		NOT USED
R98	6-11009C73	10k
R99		NOT USED
R100	6-11009C43	560
R101		NOT USED
R102	18-83452F09	variable; 1k
R103	6-11009C97	100k
R104	6-11009C60	3k
R105	6-11009C45	680
R106	6-11009C49	1k
		thermistor:
RT101	6-80378A45	20k @ 25°C
		integrated circuit: (see note)
U1	51-84561L41	1 of 8 decoder
U2	51-84561L48	quad 1 of 2 MUX
U3	51-82884L26	4-bit, up/down counter
U4	51-82884L51	quad AND gate
U5	51-82884L13	dual D flip-flop
U6	51-82884L04	quad NOR gate
U7	51-82884L03	hex inverter
U8	51-80365A20	32-bit counter
U9	51-80365A28	A/D converter
U10	51-82609M56	octal driver
U11	51-84561L77	hex driver
U12	51-80365A27	operational amplifier
U13	51-82884L13	dual D flip-flop
U14	51-82609M17	octal flip-flop
U15	51-82884L54	dual 4 to 1 multiplexer
U16	51-84561L75	quad operational amplifier
U17	51-82884L65	triple 2 to 1 multiplexer
U18	51-80365A07	dual operational amplifier
U19	51-82848M19	hex Schmitt trigger
U20, 21, 22	51-80365A07	dual operational amplifier
U23	51-82884L12	dual decode counter
U24	51-82884L13	dual D flip-flop
U25	51-82884L48	quad analog switch
U26	51-80365A31	PLL
		voltage regulator: (see note)
VR1	51-80365A11	Zener
VR2		NOT USED
VR3	48-82256C15	Zener; type, 5.1 V
		mechanical parts
	45-80395A41	EJECTOR (GRN); 2 used
	26-80378A78	SHIELD
	9-84881F01	SOCKET, 24 contact
	9-84881F06	SOCKET, 18 contact
	84-80378A33	CIRCUIT BOARD

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.


PL FILTER
PL LIMITER
10.7 MHZ PLL
COUNTER MODE LATCHES
10 MHZ 69
1 KHZ 24
+12V
-12V
+12VF
-12VF
+5VF
+5V VCC
REC AUD 9
10.7 MHZ 4
ST IF
Q6 M9528
Q5 M9570
U20A
U21B
U21A
U22A
U22B
U20B
U26
U11
U24A
U24B
VCO ADJUST
ER/PL
ER/PL
0.1 S GATE
0.1 S GATE
D0 47
D1 48
A3 54
STBZ 49
A0 55
A1 56
A2 53
POR 39
D5 44
D6 41
D3 46
D2 45
D4 43
D7 42
AC/DC SEL 66
MOD 26
REC AUD 9
CAR&MOD LEVEL OUT 21
PCT AM 15


PL LIMITER
+5V VCC
R37 10K
U19C
ST AUDIO
ST IF
C12 1200pf
R77 2.2M
U20B
R30 3.3K
R68 120K
CR4
Q4 M9570
R67 4.7K
+5VF
C20 .05
U2
COUNT INPUT
CE
U7A
U25B
U25A
U6B
U4D
U4A
U3
+5V VCC
R79 1K
R27 27K
U23A
U23B
R78 1K
NTER MODE ATCHES
R51 10K
R69 33K
R70 3K
C7 .002
Q8 M9570
CR5
U24A
ER/PL
U24B
0.1 S GATE
01 S GATE
R81 1K
U1
AD START
AD LOW READ
AD HI READ
CTRL WR
CTR READ
ADDRESS DECODER
R1 27K
R2 27K
R3 27K
R4 27K
R10 27K
R11 27K
U19A
(NC)
U19E
R52 27K
R44 27K
R85 27K
R86 27K
R87 27K
R88 27K
R89 27K
R71 27K
U14
LOUD BEEP
PK SEL Ø
PK SEL 1
GEN/MON
GEN AM
SOFT BEEP
AUDIO ENABLE
CONTROL LATCH
-12VF

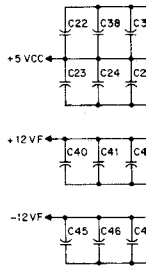

COUNTER
COUNTER CONTROL LOGIC
INTERRUPT LATCHES
AUDIO ROUTING
PEAK DETECTOR INPUT SELECT
VOLTAGE REFERENCE ADJUST
1V = SOFT BEEP
2V = LOUD BEEP
+5VF
-12VF
+5V VCC
-12V
U8
U5
U6D
U7E
U4B
U7F
U4A
U13A
U13B
U19B
U19C
U7B
U4
U6
U19E
U7D
U7C
U17
U15
U16C
U16D
U18A
U18B
U25C
U25D
Q1 M9570
Q7 M9570
R80 10K
R28 10K
R6 4.7K
R7 27K
R8 1K
R9 27K
R40 10K
R41 12K
R42 2K
R72 2.7K
R84 4.02K
R38 4.02K
R39 4.02K
R29 6.04K
R33 6.04K
R83 6.04K
R31 5.11K
R32 33.2K
R95 5.6K
R46 3.9K
R47 3.9K
R49 56K
C55 .001
C5 2.2
C6 .01
C19 10
C14 0.1



NOTES:

1. Unless otherwis microfarads, and
2. IC types are TTL a
3. Integrated circuit

Reference Designation	
U1	
U2	
U3	
U4	
U5, U13, U24	
U6	
U7	
U8	
U9	
U10	
U11	
U12	
U14	
U15	
U16	
U17	
U18, 20, 21, 22	
U19	
U23	
U25	
U26	



SIGNAL

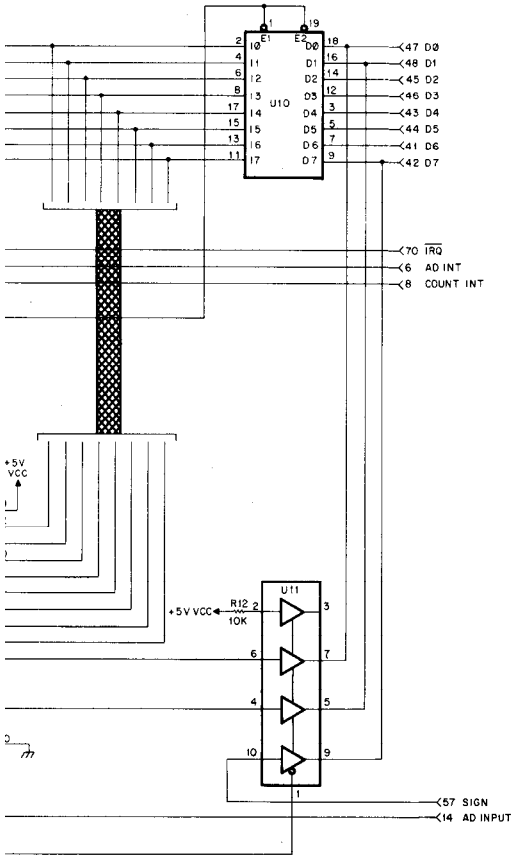
COUNTER BOARD (A10)

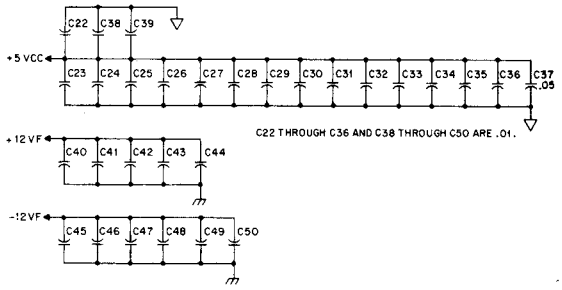
MODEL RTL4106A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST

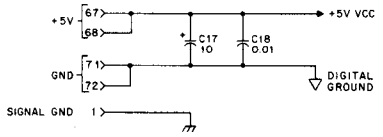
NOTES:

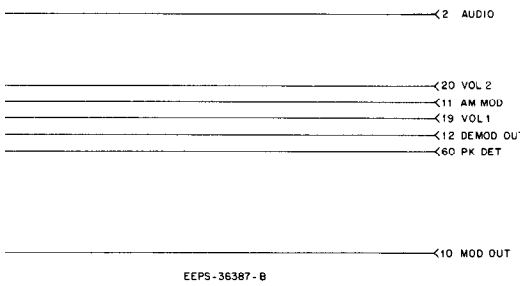
1. Unless otherwise indicated, all resistors are in ohms, all capacitors are microfarads, and all inductors are microhenries.
2. IC types are TTL and CMOS devices.
3. Integrated circuit connections for this board are as follows:

Reference Designation	Mfgr's Description	+12 F	+5 V	Pwr GND	Sig GND	−5 V	−12 F
U1	1 of 8 Decoder		16	8			
U2	Quad 2 to 1 Multiplier		16	8			
U3	4 Bit Up/Down Counter		16	8			
U4	Quad AND Gate		14	7			
U5, U13, U24	Dual D Flip-Flop		14	7			
U6	Quad NOR		14	7			
U7	Hex Inverter		14	7			
U8	32 Bit Counter		18	9			
U9	A/D Converter		19		20		
U10	Octal Buffer		20	10			
U11	Hex Buffer		16	8			
U12	Op Amp		7				
U14	Octal D Flip-Flop		20	10			
U15	Dual 4 to 1 Multiplexer		16		8, 6		7
U16	Quad Op Amp	4					11
U17	Triple 2 to 1 Multiplexer		16		8, 6		7
U18, 20, 21, 22	Dual Op Amp	8					4
U19	Hex Schmitt Trigger		14	7			
U23	Dual Decade Counter		16	8			
U25	Quad Analog Switch		14	7			
U26	PLL	16		9			









EEPS-36387-B

COUNTER BOARD

Motorola No. PEPS-36851-O
(Sheet 2 of 2)
8/12/83-PHI

RF MODULE (A11)

MODEL RTL1014A

1. DESCRIPTION

1.1 The rf module is comprised of four sections: (1) wideband amplifier board, (2) rf wattmeter board, (3) rf interconnect board, and (4) rf mechanics. The rf mechanics include a feedthrough plug assembly (P7A & B) that interconnects the three printed circuit boards on a casting; a 0-70 dB Rotary STEP Attenuator with associated coaxial cable; two bottom covers and an RF VERNIER control.

1.2 Electrically, the rf module provides four primary rf functions: (1) high level generate (HI GEN) provides an rf output signal (AM, FM, or CW; 200 kHz-1 GHz) adjustable over the +13 dBm to −75 dBm (1.0 V to 40 uV) range; (2) low level generate (GEN) provides an rf output signal, as above for HI GEN, adjustable over the −48 dBm to −134 dBm (890 uV to .045 uV) range; (3) power monitor (PWR MON) provides a means of rf power measurement (1 MHz-1 GHz; 0.5-125 W @ ±10% accuracy), and (4) sensitive monitor (SENS MON) provides a means of "off the air" reception. The rf module also provides the necessary signal routing, analog signals for system processing, the status/control signals for each of the four functions, via an interface cable to the system control bus on the main interconnect board.

2. THEORY OF OPERATION

(Refer to functional block diagram and schematic diagrams)

2.1 RTL4095A RF INTERCONNECT BOARD

2.1.1 General

This printed circuit board provides the main interface to the system bus through a 24-pin ribbon cable and plug (J302).

2.1.2 Control Functions

2.1.2.1 U301 decodes address information and selects the network to read or drive the data bus (through J302), whenever $\overline{\text{STROBE 1}}$ goes low (enabled). Address 1100 (A3-AØ) selects two-thirds of U302, 1101 selects U303 and one third of U302 and 1110 selects U304. When the first portion of U302 is selected, the $\overline{\text{TEMP}}$ status and PROTECT signals (from the rf wattmeter board) appear on DØ and D7 of the data bus, respectively. The 0 and 10 positions of the Rotary STEP Attenuator position indicator switch (S1) appear on DØ and D1, respectively, and the 20 through 70 positions appear on D2 through D7, when the second portion of U302, and U303, are selected.

2.1.2.2 Resistors R301, R302, and R305-R312 provide pull-up current for the inputs of U302 and U303. Switch S1 is mounted on the rear shaft of the Rotary STEP Attenuator. When S1 is not in the 0 dB position, transistor Q303 is biased on and DS301 provides a visual indication of this condition to the user. When U304 is enabled via U301, the system mode functions are latched in to define the configuration of the wideband amplifier board, the rf wattmeter board, and the GEN ON/OFF condition. When U304, Q4 output is low, transistors Q302 and Q301 in turn are biased on, thus providing the switched +5 volts required to power the wideband amplifier board in both HIGH and LOW LEVEL GENERATE.

2.1.3 PROM Operation

2.1.3.1 A fused-link PROM U305 is used to provide module calibration data to the system microprocessor in the power monitor (PWR MON) and both high and low level generate (HI GEN and GEN) functions. The PROM is organized as two banks of 16 8-bit words. The four address lines (A3-AØ) select one of the 16 words of memory, while one of the two banks is selected by the latched WATTMETER ENABLE line of U304. When the power monitor (PWR MON) function has been selected, the WATTMETER ENABLE line is set high, addressing one-half of the PROM.

2.1.3.2 As the computer requires data, $\overline{\text{STROBE 3}}$ goes low (enabled), turning on transistor Q304 and providing +5 volts to U305-16. When the WATTMETER ENABLE line is low, the generate (GEN) func-

tion is implied and the other half of the PROM is available to be read by the microprocessor. The PROM is factory programmed uniquely for each rf module during final test and *must always remain with that particular unit.*

2.1.4 RF Output/Modulation Control

2.1.4.1 Potentiometer R320 is the RF VERNIER control and provides a variable dc voltage to the wideband amplifier board (J301-16), resulting in a 16 dB (minimum) range of rf output level in both high and low level generate (HI GEN and GEN). In the CW or FM generate modes, pin 18 of J302 "floats" and has no effect on the operation of the control.

2.1.4.2 However, in the AM mode, both modulating audio and a dc level shift are present at J302-18, resulting in a downward shift of the rf output level by approximately 4 dB. This is required to minimize distortion at high modulation levels. Since both the dc and audio levels are controlled by this potentiometer, the percentage of modulation tends to remain constant as the rf level is varied. Capacitors C332 and C333 and resistor R319 provide audio frequency compensation.

2.1.5 DC Voltage Distribution

Each power supply line (+5 V, +12 V, & −12 V) is filtered on this board before distribution to the other boards in the module. The LO/HI BAND (J302-15), CAR & MOD LEVEL OUT (J302-16), ALC (J302-14) and POWER METER (J302-17) are all analog signals and are not processed on this board.

2.2 RTL4094A RF WATTMETER BOARD

2.2.1 Detector, Differential, and Summing Amplifiers

2.2.1.1 In the power monitor (PWR MON) function rf power from the radio under test, is applied to J101, and attenuated by a 14 dB, 125 W attenuator AT101. This reduced power level is applied to 50-ohm load AT102 through relay K101. The peak of the voltage produced across the load is detected by diode CR105 and the resulting dc level is applied to a three-stage instrumentation style amplifier U101A, C, and D.

2.2.1.2 Thermistor RT101 provides compensation for changes in the internal temperature of the compartment, while diode CR107 and operational amplifier U101A provide temperature compensation for diode CR105. The detected signal is amplified by U101C, the output of which is summed in U101D, differentially with the output of the reference amplifier U101A. The signal at the output of U101D is passed directly through the rf interconnect board to the analog interface board for additional processing. Because of the diode detector CR105, this output signal is directly proportional to the square of the power applied. Potentiometer R143 provides Offset adjustment, while R122 provides Gain adjustment. For 125 watts of input power, the 50 ohm load AT102 dissipates only 5 watts, with the balance absorbed by the 14 dB, 125 watt attenuator AT101.

2.2.2 RF Switch and Over Power Protection

2.2.2.1 Operational amplifier U102 (connected as a comparator) and transistors Q101 and Q102 are used to provide control of relays K101 and K102. Since Q101 provides an inverting signal to Q102, relay K101 is always energized when K102 is not (exclusive OR configuration). This condition is forced: (1) if the system microprocessor causes the latched WATTMETER ENABLE line to go high, or; (2) the detector network, consisting of diodes CR101 and CR109 responds (through resistor R132) to an rf voltage at the input to AT101. The dc level produced from either source is summed at pin 2 of U102; U102 output goes low and turns off transistor Q101 (and thus relay K102) and enables relay K101 via transistor Q102.

2.2.2.2 Diodes CR108 and VR101 act to speed up the opening of relay K102's contacts should condition (2) above occur. Also, under this condition, transistor Q101 causes the PROTECT line output signal to go high, which informs the system microprocessor that rf power may have been applied to J101, while the FUNCTION switch was set to other than the PWR MON position. Also, in the PWR MON function, capacitive coupling around relay K102 allows enough signal to pass through J102 to enable the receiver to monitor the modulation on the rf power source.

2.2.2.3 In the sensitive monitor (SENS MON) or high level generate (HI GEN) functions, relay K101 is set the same as for PWR MON, via the WATTMETER ENABLE line. Also, relay K103 is closed, since the system microprocessor sets the latched ANTENNA ENABLE line high, turning on transistor Q103. In the former case, signals present at the ANTENNA connector (J6 on the front panel) are routed to J106, through relay K103 to J102, through the Rotary STEP Attenuator AT3 and finally to the first mixer on the wideband amplifier board. Likewise, in the high level generate (HI GEN) function, a signal generated by the wideband amplifier board is routed to ANTENNA connector J6.

2.2.3 Over Temperature Protection

The 14 dB, 125 watt attenuator AT101 is capable of dissipating 125 watts for approximately two minutes, at which time the temperature of the device exceeds the 100° C temperature rating. Thermistor RT102, resting on the head of one of the attenuator flange mounting screws, decreases in resistance to a point that causes the output of comparator U101B to go low. This signal

causes the microprocessor to activate the service monitor audible alarm and disable certain functions until the applied rf power is removed and AT101 has had ample time to cool off.

2.3 RTL4093A WIDEBAND AMPLIFIER BOARD

2.3.1 General

The wideband amplifier board performs essentially two functions: First, in the generate (GEN and HI GEN) functions, the board amplifies a −10 dBm ±5 dB signal from the rf synthesizer module, providing an rf output signal of uniform and level response in the 200 kHz-1 GHz range. This signal in the high level generate (HI GEN) function is in the +13 dBm to −5 dBm range (using the RF VERNIER control with the Rotary STEP Attenuator AT3 set to 0 dB). This range may be extended to −75 dBm (using the Rotary STEP Attenuator AT3 set to 70 dB). Likewise, in the low level generate (GEN) function, the signal is in the −48 dBm to −64 dBm range (using the RF VERNIER control and the built-in 14 dB attenuator AT101 on the RF wattmeter board with the Rotary STEP Attenuator AT3 set to 0 dB). This range may be extended to −134 dBm (using the Rotary STEP Attenuator AT3 set to 70 dB). Second, in the sensitive monitor (SENS MON) function, this board in conjunction with the receiver board enables the reception of "off the air" AM, FM or CW signals in the 1 MHz-1 GHz spectrum.

2.3.2 Control Inputs

This section executes the desired front panel functions available on the service monitor. Comparator U209 sets up the correct circuit conditions for the low and high level generate (GEN and HI GEN), and power monitor and sensitive monitor (PWR MON and SENS MON) functions, and provides buffered inputs for all four control lines. In HI GEN, U209D-14 goes high; in GEN, U209B-7 goes high and in PWR MON/SENS MON, U209C-8 goes high. When the rf synthesizer frequency is operating below 1 MHz, the LO/HI BAND line, U209A-1 goes high. This forces U210, via diode CR205, high for maximum gain in the rf amplifier chain and also activates U208A which routes the ALC error voltage produced by U206A over to the rf synthesizer leveling circuits via the ALC line. In addition, U208D switches in additional rf bypassing for the detectors at these lower frequencies.

2.3.3 RF Amplifier, HI GEN Switch & 30 dB Attenuator

2.3.3.1 The rf amplifier chain is comprised of hybrid devices U201-U205. The overall gain (when all five devices are active) is approximately 25 dB.

2.3.3.2 Devices U201 and U202 are active in all four functions (HI GEN, GEN, PWR MON and SENS MON). The HI GEN switching transistor Q206 turns on and applies voltage to devices U203-U205 in all functions except GEN. In the GEN function, transistor Q206 turns off, thereby removing voltage from stages U203-U205. Also, the 30 dB attenuator (R229, R230, R248 and R249) is switched in series with the GEN output path to further reduce the signal.

2.3.4 HI GEN Detector, GEN Detector, & Level Control

2.3.4.1 In the HI GEN function, when all amplifier stages are active, the HI GEN detector (CR217, C222, and L220) is also active, providing a dc voltage to the automatic leveling control (ALC) circuits. Since in this case, amplifier U203 is enabled (through transistor Q206), U203-1 has approximately 1.0 volt of dc bias. This back biases GEN detector diode CR231 as it is also biased (in part) by the same network (R266, R272 and R223) as the HI GEN detector.

2.3.4.2 In the GEN function, when only amplifier stages U201-202 are active, amplifier U203 input bias drops to 0 volts. This allows the GEN detector diode CR231 to become slightly forward biased thereby producting a dc voltage to the ALC circuits. Also, an additional dc biasing network (CR232, VR205, R283 and R284) is switched in via comparator U209B-7 output going high. This improves performance at the lowest levels of rf output because of an increase of forward biased diode CR231.

2.3.4.3 The outputs of both detectors are summed together at a high gain operational amplifier U207; U207 output is varying as a function of the rf level in either HI GEN or GEN. This output is routed via the CAR & MOD LEVEL OUT line to the analog interface board. The microprocessor processes this signal, along with the Rotary STEP Attenuator switch position data from the rf interconnect board, to display the correct rf output level (in dBm or microvolts) being produced, as well as any amplitude modulation that may be present on the rf carrier. The same output signal is also one of the two signals applied to summing amplifier U206A.

2.3.4.4 The AM MOD AUDIO signal from the rf interconnect board passes through analog gate U208C (switched on in either HI GEN or GEN by U209D or U209B, respectively) to amplifier U206B, and is the second signal to be summed at U206A. The output of U206A is therefore proportional to the level set by the RF VERNIER control and the detected rf level generated. The second signal becomes the reference for the first and acts to set the desired rf level. This output of U206A (through amplifier/buffer U210 and Q207), provides bias to a PIN diode attenuator network CR206, U207, and CR208 that essentially varies the gain of the rf amplifier line up.

2.3.5 Mixer, Matching Network & I-F Amplifier

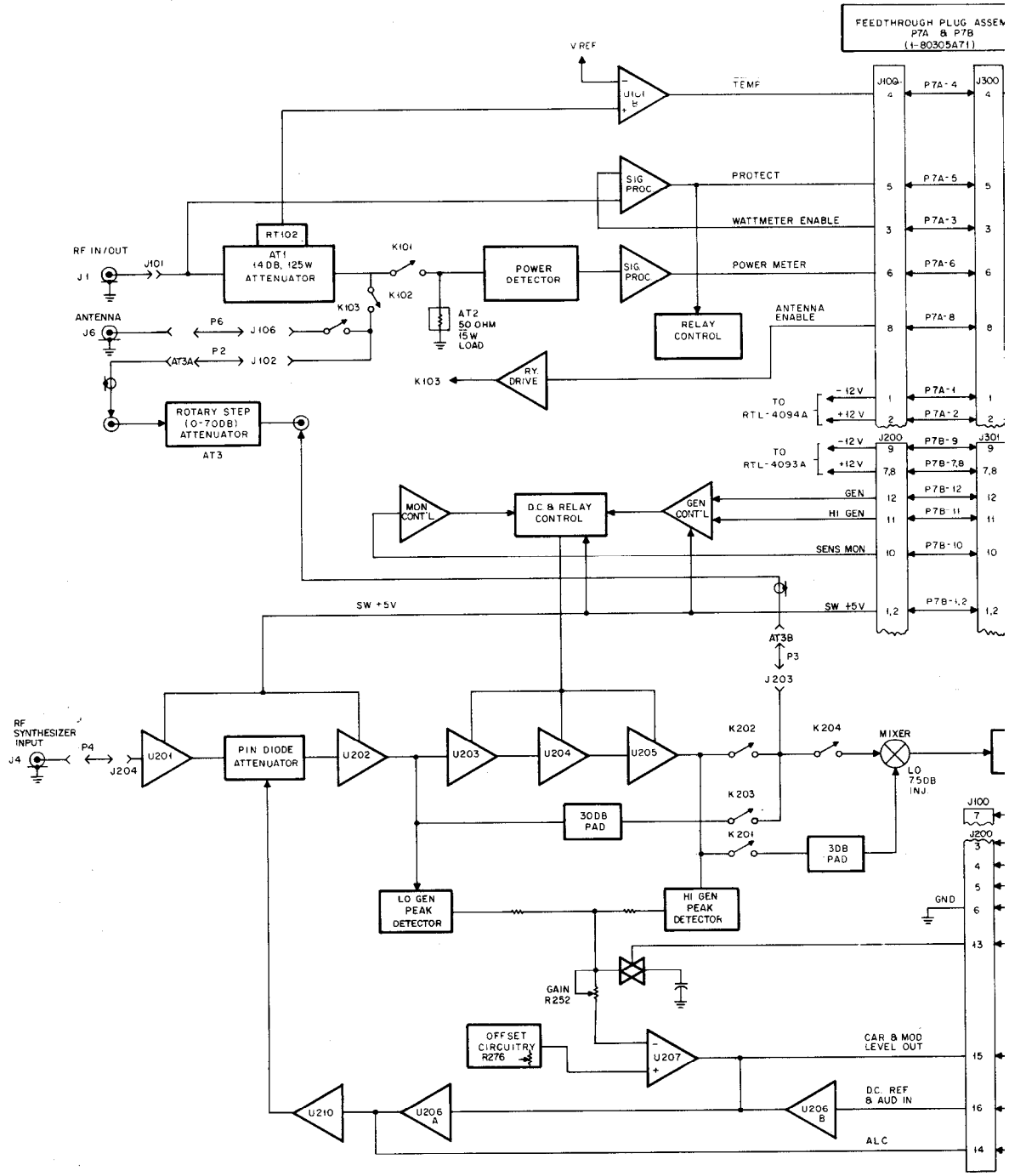
2.3.5.1 Mixer E201 is a passive, double balanced type mixer and is employed only in the PWR MON and SENS MON functions. Diodes CR222 and CR223 will clamp excessive rf levels present at the mixer rf input port. The mixer injection signal is supplied from the rf synthesizer module, amplified to + 10 dBm by devices U201-U205 and attenuated by a 3 dB pad (R277, R278 and R279) to approximately 7 dBm. The mixer injection level is fixed at + 7 dBm by resistor R211 supplying a fixed bias on the D.C. REF & AUD IN line via analog switch U208B, thereby indirectly controlling the bias on the PIN diode attenuator to provide constant rf amplifier gain. The injection frequency is *always* 10.7 MHz above or below (high or low side injection, respectively) the rf input signal such that a 10.7 MHz i-f output signal results from the mixing process.

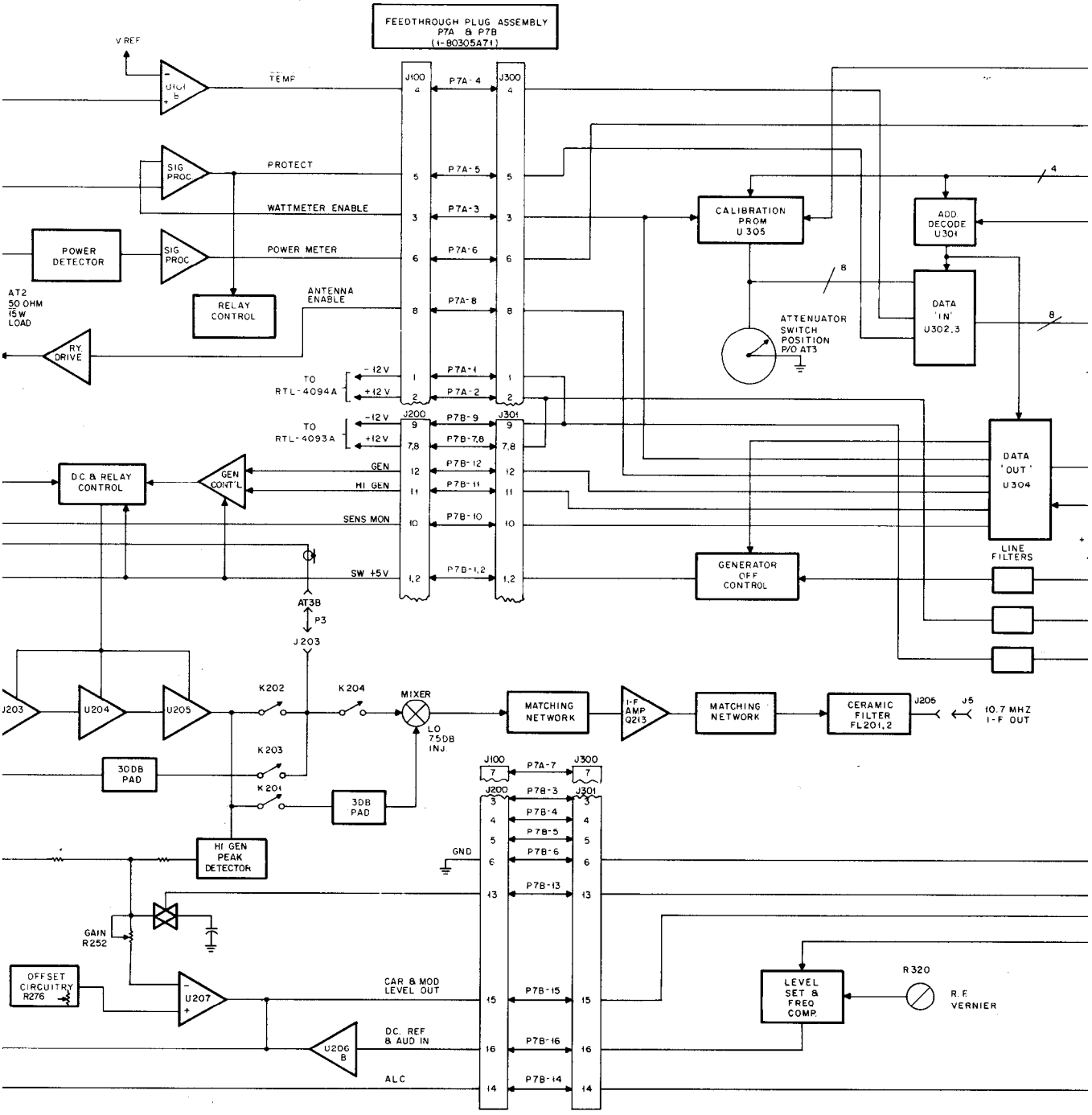
2.3.5.2 Matching network (C228, C229 and L212) is a tunable filter that matches the mixer 50 ohm output port to the high impedance presented by Q213 gate.

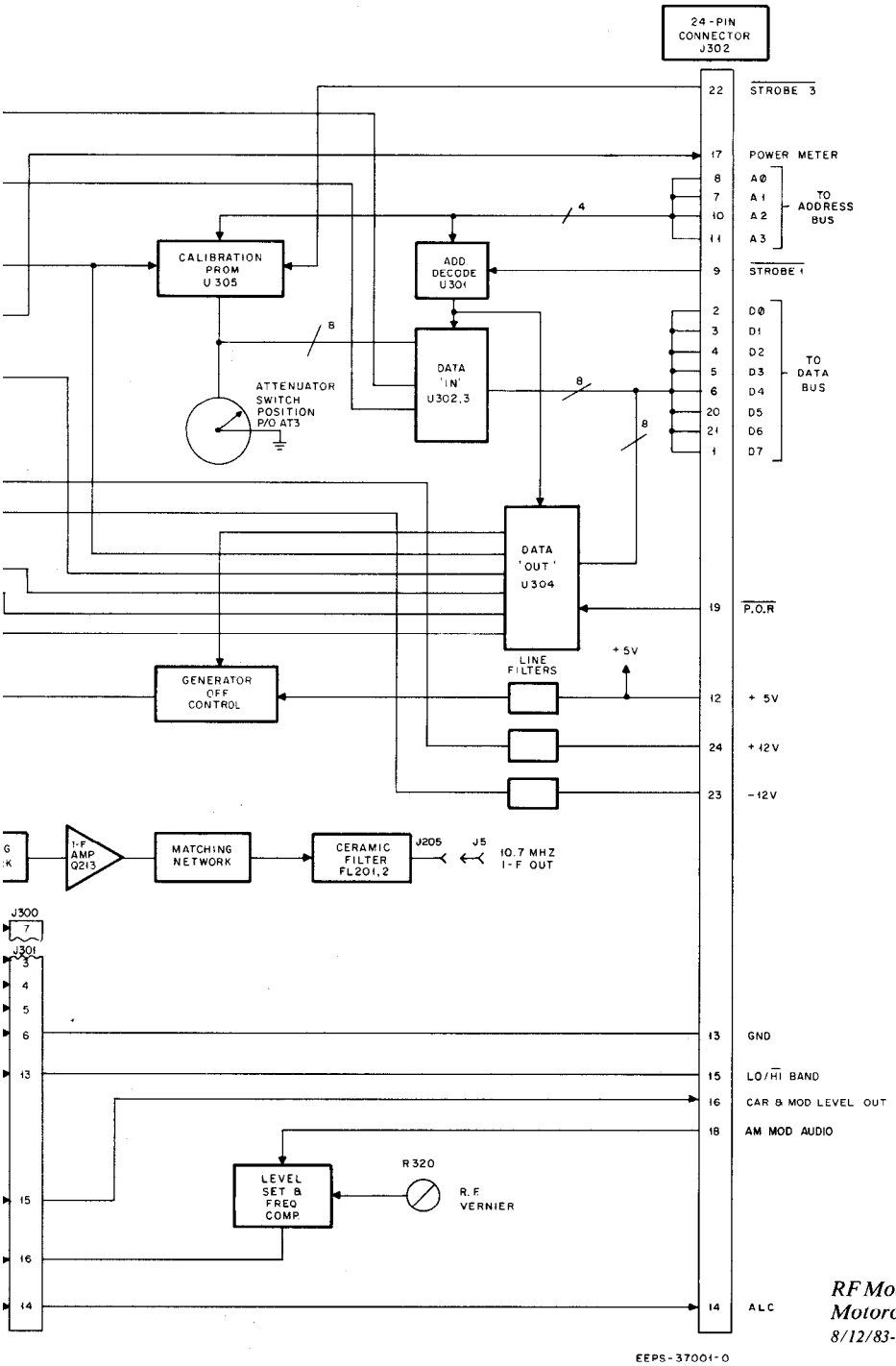
2.3.5.3 10.7 MHz i-f amplifier stage Q213 provides approximately 20 dB of gain. Capacitor C232 is variable and provides a match between the relatively high drain output impedance of Q213 and the low termination impedance required at the ceramic filter input. Ceramic filters, FL201 and FL202, provide wide-band filtering of the 10.7 MHz i-f signal.

2.3.6 RF Switching

The HI GEN and GEN signals are routed through relays K202 and K203, respectively. In HI GEN, relays K201, K203 and K204 are open. In GEN, relay K201 is closed and relays K202 and K204 are open. In PWR MON and SENS MON, relays K201 and K204 are closed while K202 and K203 are open.


FEEDTHROUGH PLUG ASSEM
P7A & P7B
(1-80305A71)
VREF
TEMP
PROTECT
WATTMETER ENABLE
POWER METER
ANTENNA ENABLE
SIG PROC
SIG PROC
RELAY CONTROL
POWER DETECTOR
RF IN/OUT
J1
J101
RT102
AT1
14DB, 125W
ATTENUATOR
K101
K102
K103
AT2
50 OHM
15W
LOAD
ANTENNA
J6
P6
J106
P2
AT3A
J102
K103
RY. DRIVE
ROTARY STEP
(0-70DB)
ATTENUATOR
AT3
TO
RTL-4094A
-12V
+12V
TO
RTL-4093A
-12V
+12V
J100
J200
J300
J301
P7A-4
P7A-5
P7A-3
P7A-6
P7A-8
P7A-1
P7A-2
P7B-9
P7B-7,8
P7B-12
P7B-11
P7B-10
P7B-1,2
MON CONT'L
D.C. & RELAY CONTROL
GEN CONT'L
GEN
HI GEN
SENS MON
SW +5V
SW +5V
AT3B
P3
J203
RF SYNTHESIZER INPUT
J4
P4
J204
U201
PIN DIODE ATTENUATOR
U202
U203
U204
U205
K202
K204
MIXER
LO
7.5DB
INJ.
K203
30DB PAD
K201
30DB PAD
LO GEN PEAK DETECTOR
HI GEN PEAK DETECTOR
GND
GAIN
R252
OFFSET CIRCUITRY
R276
U207
CAR & MOD LEVEL OUT
U210
U206 A
U206 B
D.C. REF & AUD IN
ALC


FEEDTHROUGH PLUG ASSEMBLY
P7A & P7B
(1-80305A71)
VREF
TEMP
PROTECT
WATTMETER ENABLE
POWER METER
ANTENNA ENABLE
SIG PROC
POWER DETECTOR
RELAY CONTROL
RY DRIVE
AT2
50 OHM
15W
LOAD
J100
J300
P7A-4
P7A-5
P7A-3
P7A-6
P7A-8
P7A-1
P7A-2
TO RTL-4094A
-12V
+12V
J200
J301
P7B-9
P7B-7,8
P7B-12
P7B-11
P7B-10
P7B-1,2
TO RTL-4093A
GEN
HI GEN
SENS MON
SW +5V
CALIBRATION PROM U305
ADD DECODE U301
DATA 'IN' U302,3
ATTENUATOR SWITCH POSITION P/O AT3
DATA 'OUT' U304
LINE FILTERS
GENERATOR OFF CONTROL
DC & RELAY CONTROL
GEN CONT'L
AT3B
P3
J203
U203
U204
U205
K202
K204
MIXER
LO
7.5DB
INJ.
MATCHING NETWORK
I-F AMP Q213
MATCHING NETWORK
CERAMIC FILTER FL201,2
J205
J5
10.7 MHZ I-F OUT
K203
K201
30DB PAD
30DB PAD
HI GEN PEAK DETECTOR
GND
P7A-7
P7B-3
P7B-4
P7B-5
P7B-6
P7B-13
GAIN R252
OFFSET CIRCUITRY R276
U207
U206 B
CAR & MOD LEVEL OUT
DC. REF & AUD IN
ALC
P7B-15
P7B-16
P7B-14
LEVEL SET & FREQ COMP.
R320
R.F. VERNIER

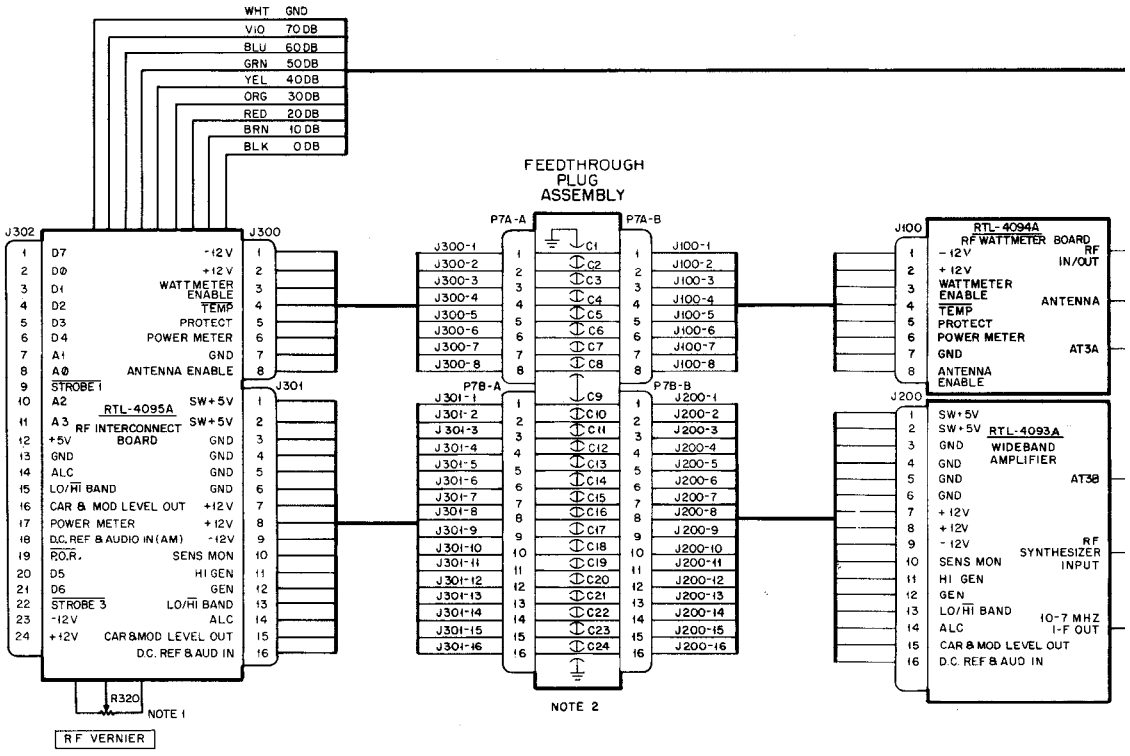


RF Module Functional Block Diagram
*Motorola No. **EEPS-37001-O***
8/12/83-PHI

RF MODULE (A11)

MODEL RTL1014A

INTERCONNECT DIAGRAM AND PARTS LIST

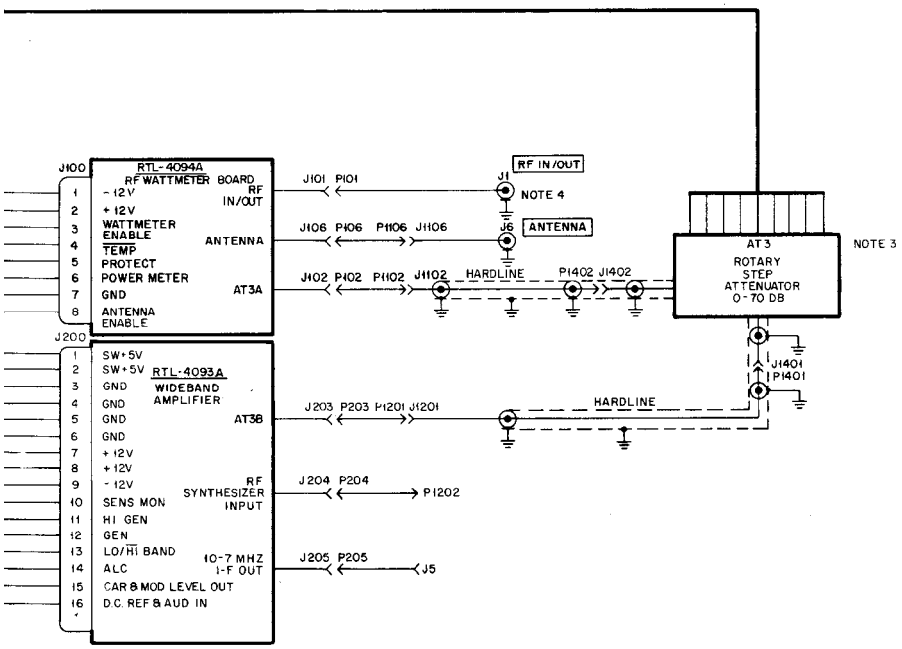


NOTES:

1. R320 is a front panel control. It is physically attached to the RTL-4095A.
2. Feedthrough capacitors C1 through C24 are 470 pF.
3. Rotary step attenuator AT3 is a front panel control. It is physically attached to the RTL-1014A RF module.
4. J1 and J6 are front panel connectors.

*Motorola No. **PEPS-37074-O***

8/12/83-PHI



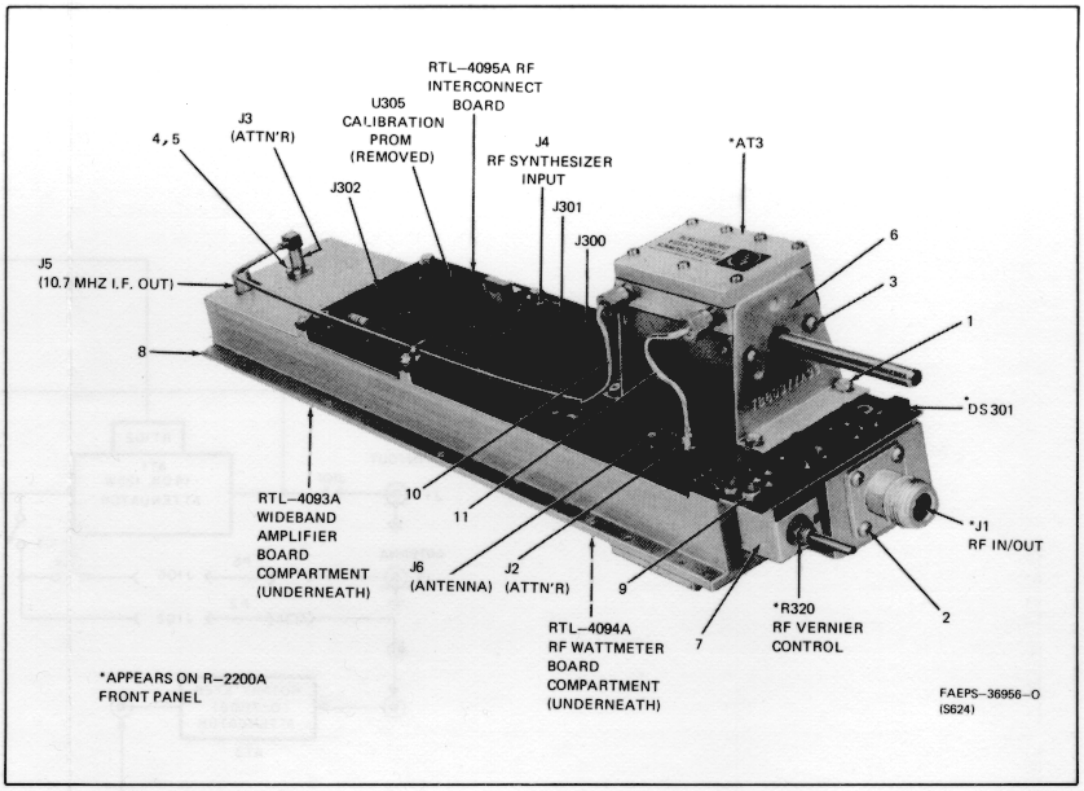
DEPS-36700-0

ıysically attached to the RTL-4095A.

ı C24 are 470 pF.

nt panel control. It is physically attached to

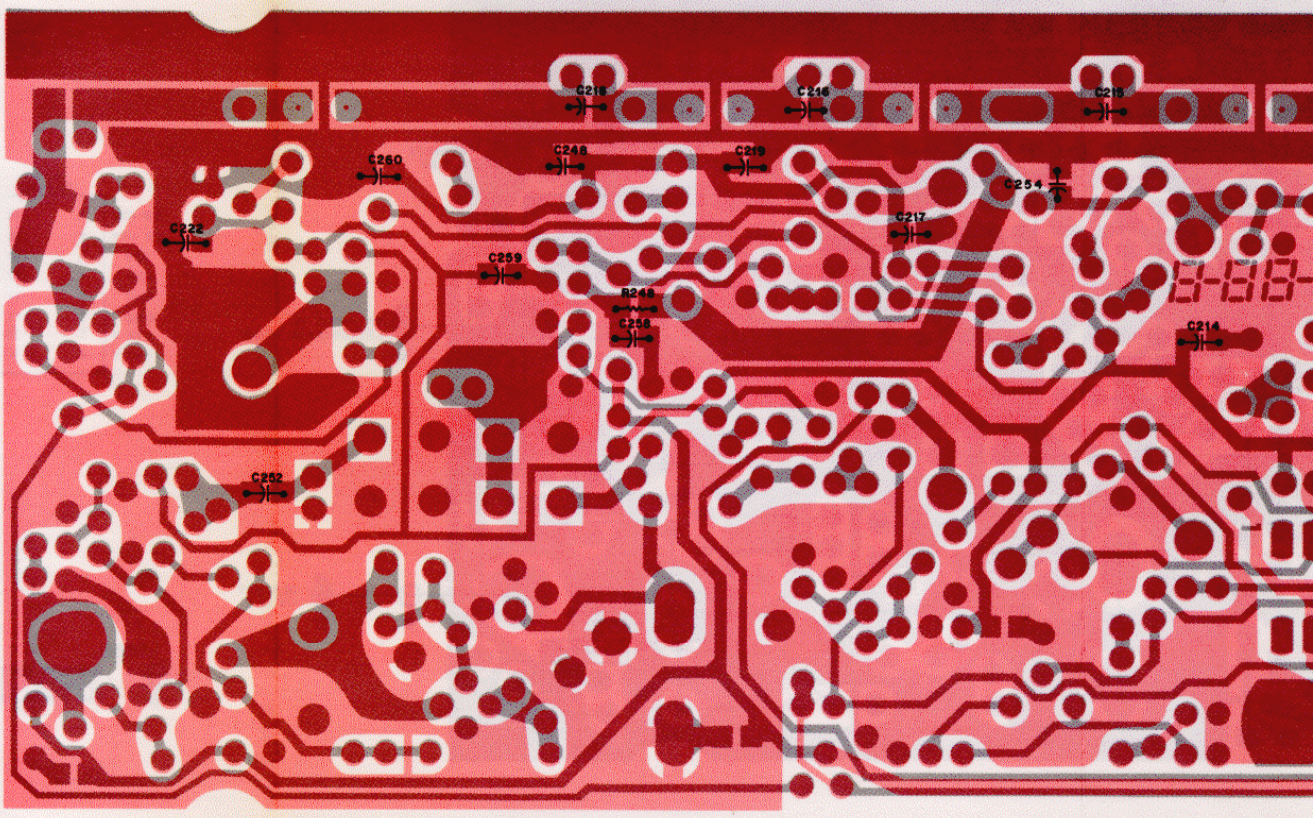
s.



parts list

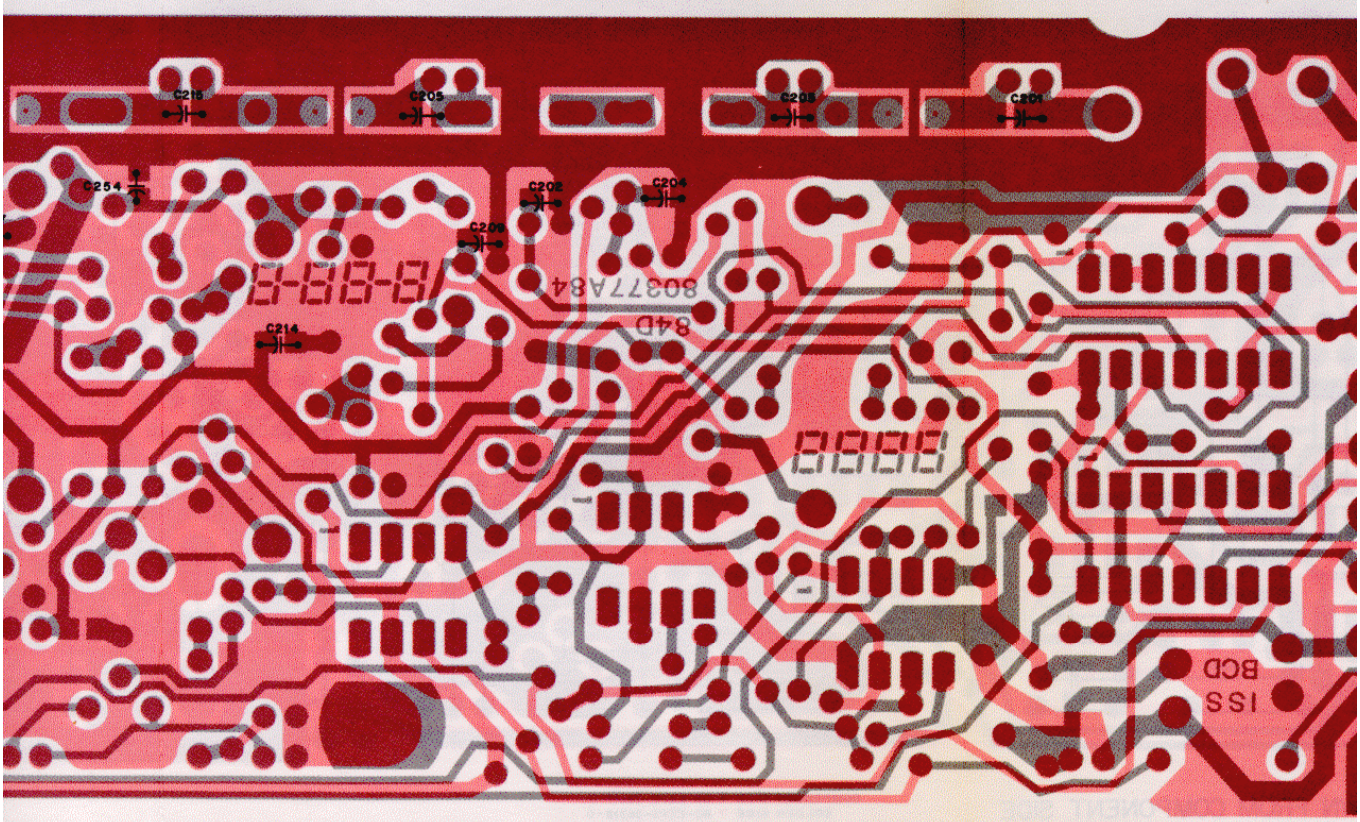
RTL1014A RF Module — PL-8480-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
P7A, P7B	1-80305A71	assembly rf feed-thru; includes:
C1 thru 24	21-84874K01	470 pF ± 20%; 250 V
	29-80377A64	PIN; 24 used
	64-80377A32	PLATE
		connector; receptacle:
J1	9-82741A01	female; single-contact
J2 thru 4	9-80377A71	female; SMB, single-contact
J5	9-84135B02	female; single-contact (phono)
J6	9-80377A71	female; SMB, single-contact
		resistor:
R320	18-80390A75	variable, 10k
		switch:
S1	1-80350A18	assembly, switch; includes:
	40-80378A28	SWITCH, rotary; 8-position
ref. no.		**mechanical parts**
AT3	1-80377A74	ATTENUATOR, pot assembly
1	3-138804	SCREW, machine; 4-40 × 5/16"; 8 used
2	3-139581	SCREW, machine; 4-40 × 5/16"; 6 used
3	3-2942	SCREW, machine; 4-40 × 3/16" Phillips round; 4 used
4	3-136782	SCREW, machine; #2-56 × 3/16" Phillips pan; 4 used
5	4-8406	LOCKWASHER #2 internal; 27 used
6	7-80377A33	BRACKET, atten; 2 used
7	7-80390A20	BRACKET
8	64-80377A29	CASTING
9	2-131435	NUT, 4-40; 2 used
10	1-80356A04	CABLE, coaxial (long hardline)
11	1-80356A06	CABLE, coaxial (short hardline)
		non-referenced items
	3-136890	SCREW, machine; 4-40 × 9/32"; 8 used
	4-140208	LOCKWASHER #4 split; 4 used
	15-80377A30	COVER (RF WM)
	15-80377A31	COVER (WBA)
	42-80395A06	CLIP
	43-80370A69	SPACER, M/F 4-40; 2 used
	43-80395A82	STANDOFF; 2 used
	55-84300B02	HANDLE; 4 used
	14-80395A02	INSULATOR
	14-80395A03	INSULATOR
	29-82713M01	TERMINAL, 9 used



SHOWN FROM SOLDER SIDE
(COMPONENTS ARE CHIP CAPACITORS)

COMPONENT SIDE BD-EEPS-3631
SOLDER SIDE BD-EEPS-3631
OL-EEPS-3631

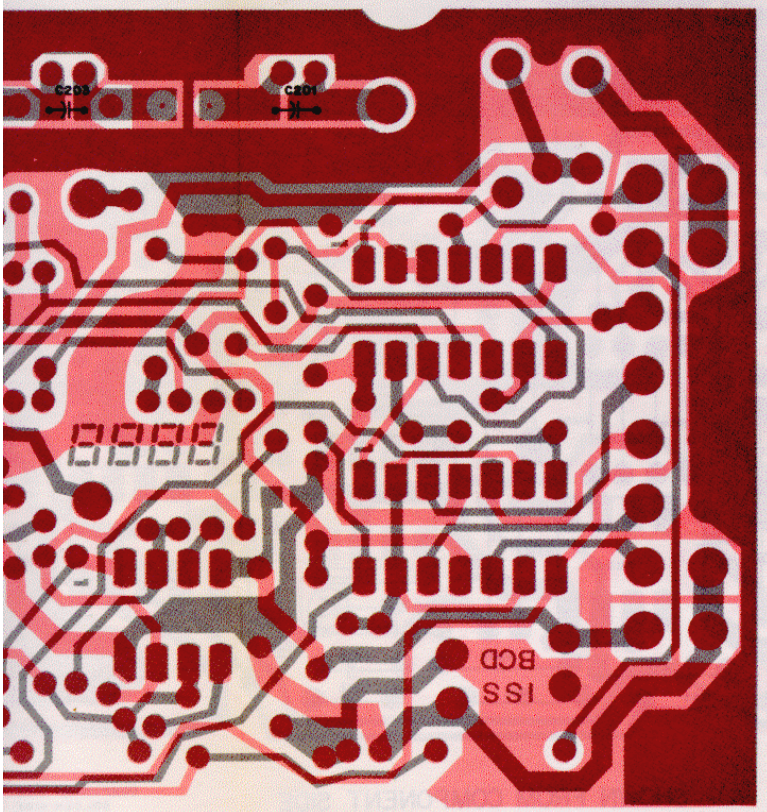


COMPONENT SIDE — BD-EEPS-36317-0 (REVERSED)
SOLDER SIDE — BD-EEPS-36316-0 (REVERSED)
OL-EEPS-36318-0

RF MODULE (A11)

WIDEBAND AMPLIFIER BOARD

MODEL RTL4093A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



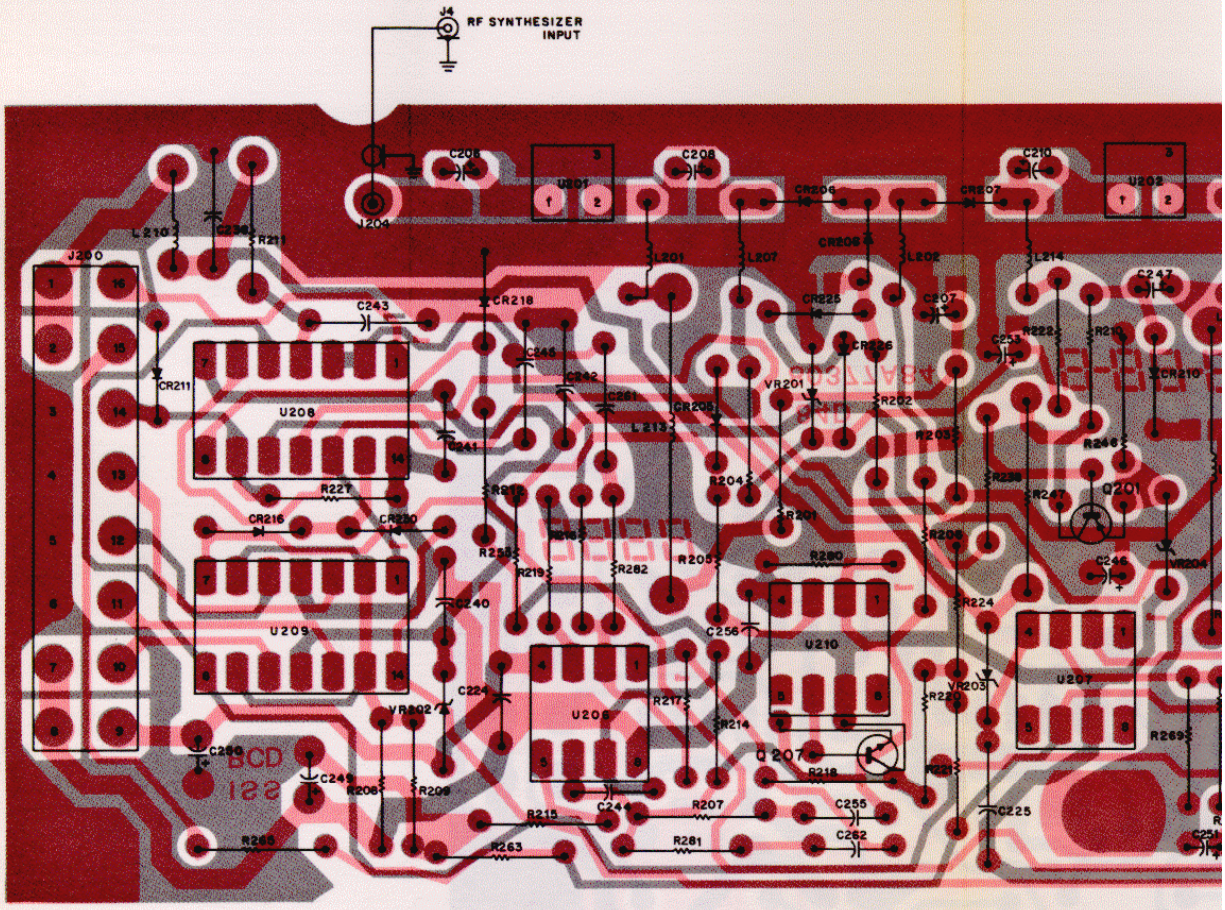
WIDEBAND AMPLIFIER BOARD

Motorola No. PEPS-36854-O
(Sheet 1 of 4)
8/12/83-PHI

RF MODULE (A11)

WIDEBAND AMPLIFIER BOARD

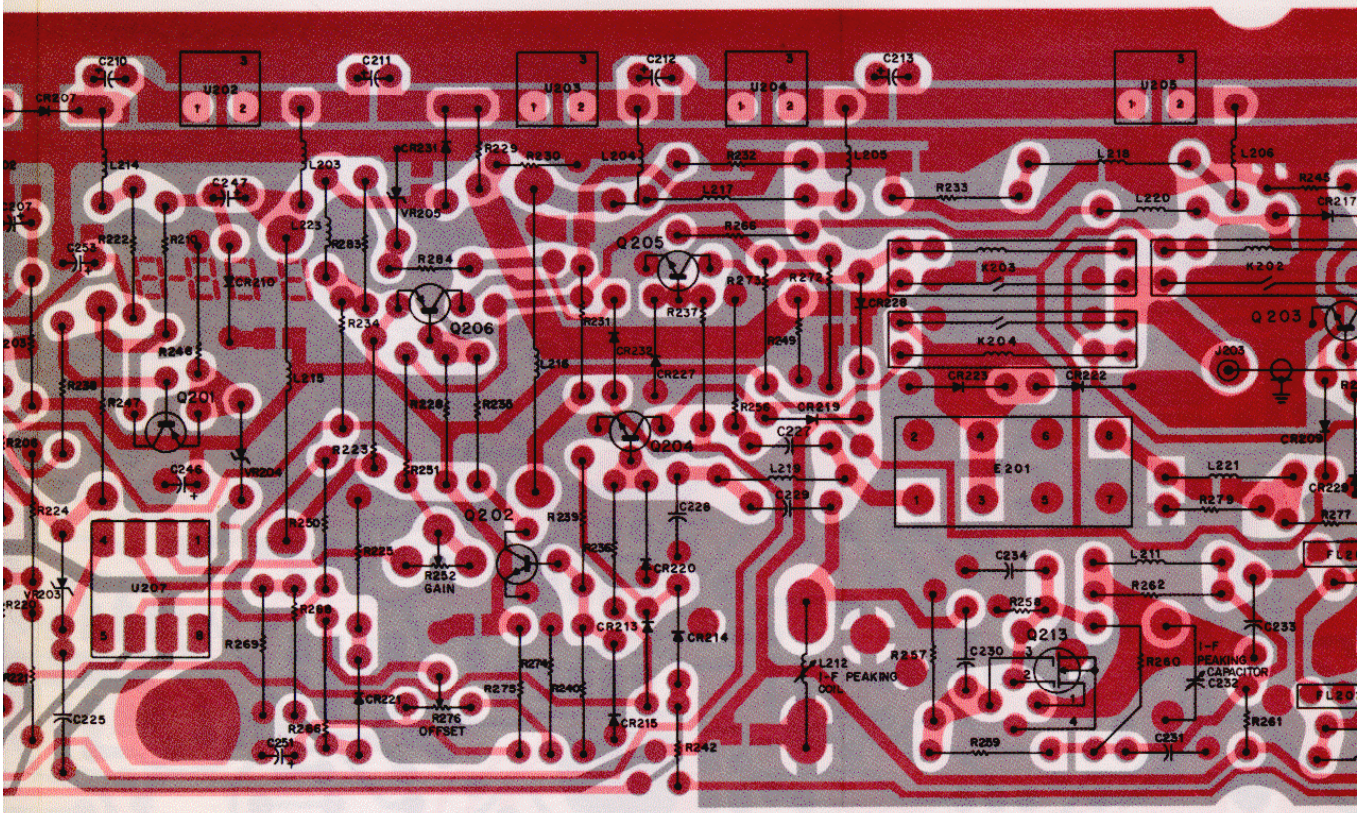
MODEL RTL4093A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



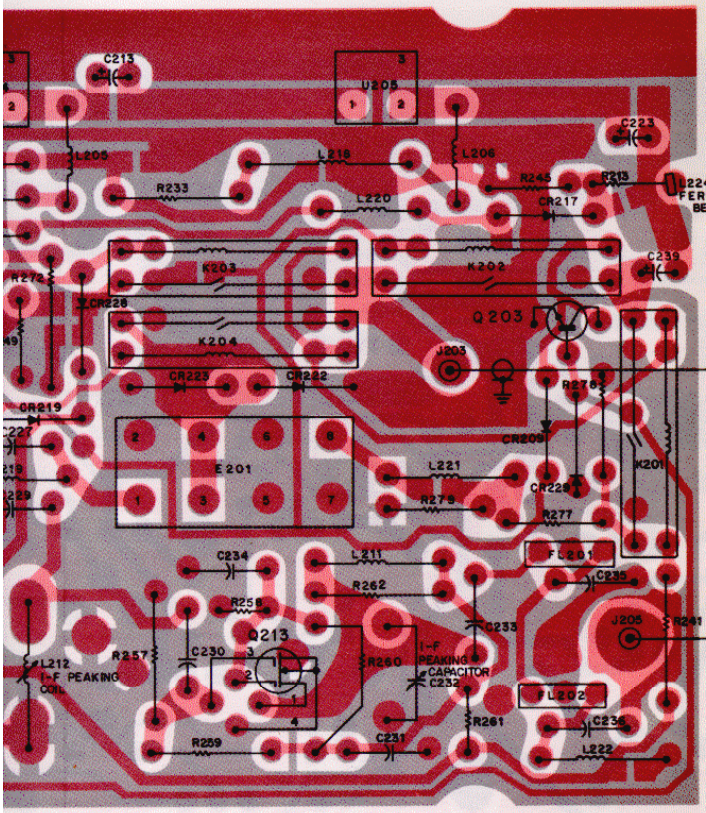
SHOWN FROM COMPONENT SIDE

COMPONENT SIDE
SOLDER SIDE

Motorola No. ***PEPS-36854-O***
(Sheet 2 of 4)
8/12/83-PHI



COMPONENT SIDE BD-EEPS-36317-0
SOLDER SIDE BD-EEPS-36316-0
OL-EEPS-36315-A

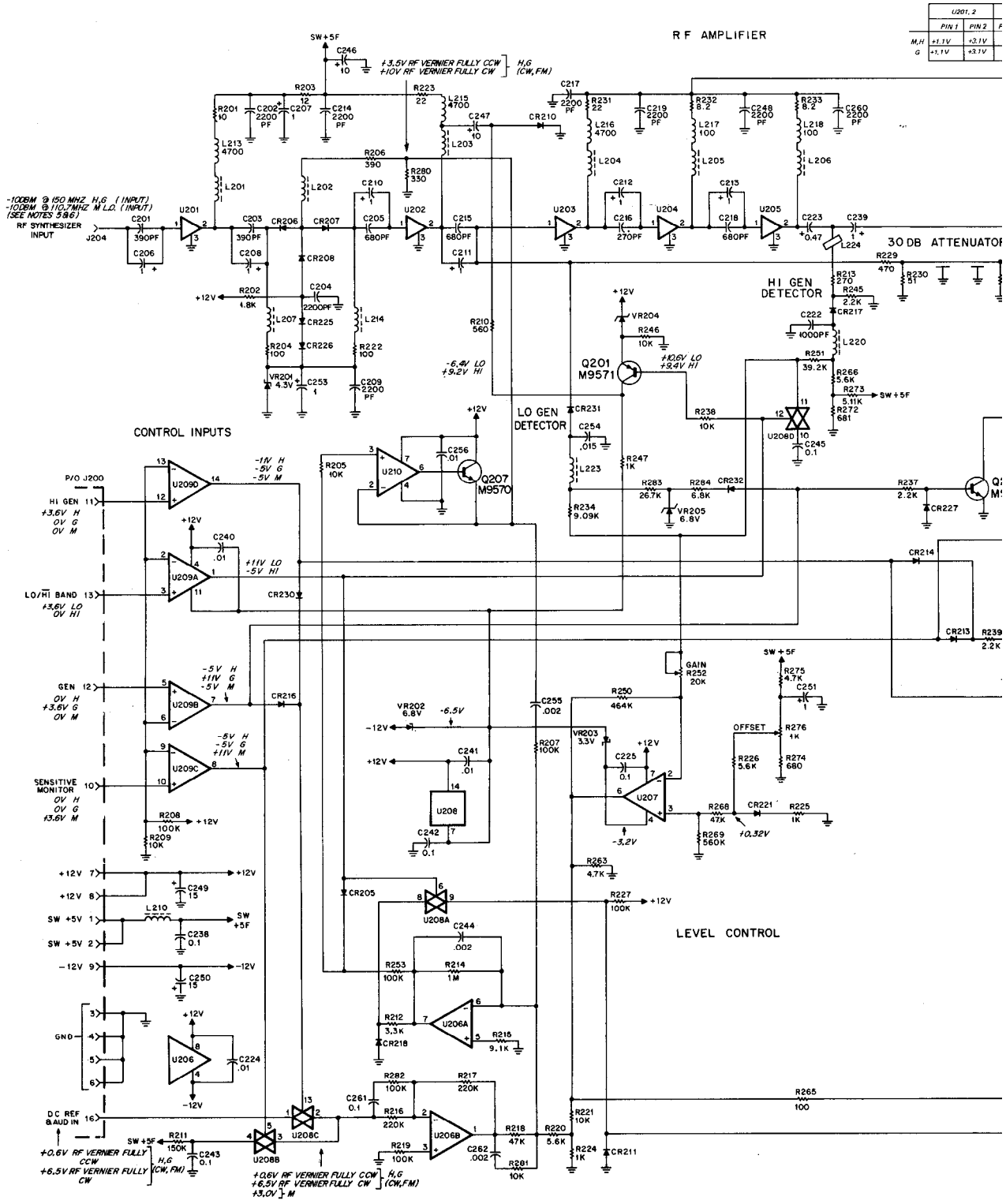


J201
DETAIL

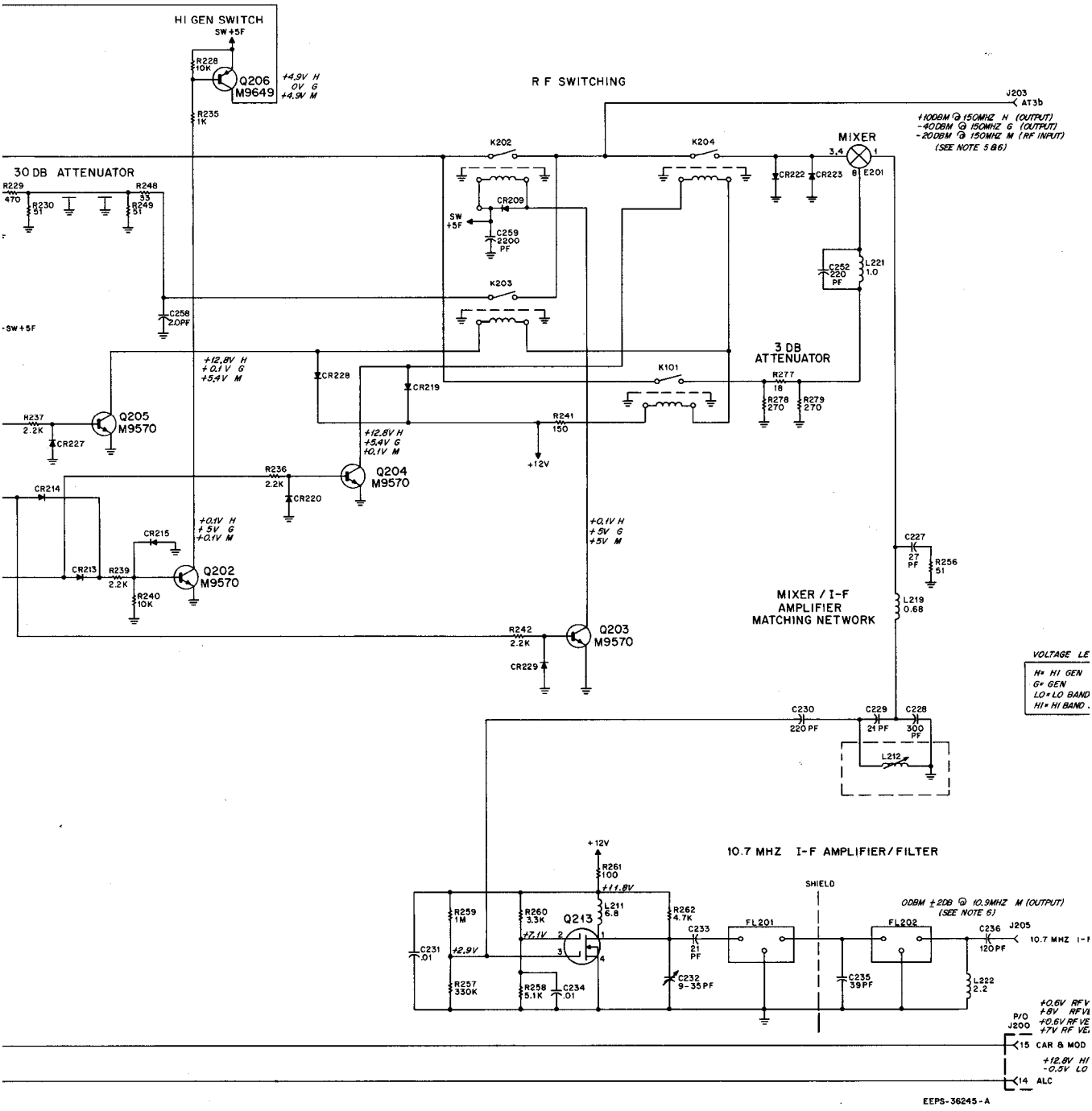
SW +5V	1	16	D.C. REF & AUD IN
SW +5V	2	15	CAR & MOD LEVEL OUT
GND	3	14	ALC
GND	4	13	LO/$\overline{\text{HI}}$ BAND
GND	5	12	GEN
GND	6	11	HI GEN
+12 V	7	10	SENSITIVE MONITOR
+12 V	8	9	−12V

LEGEND

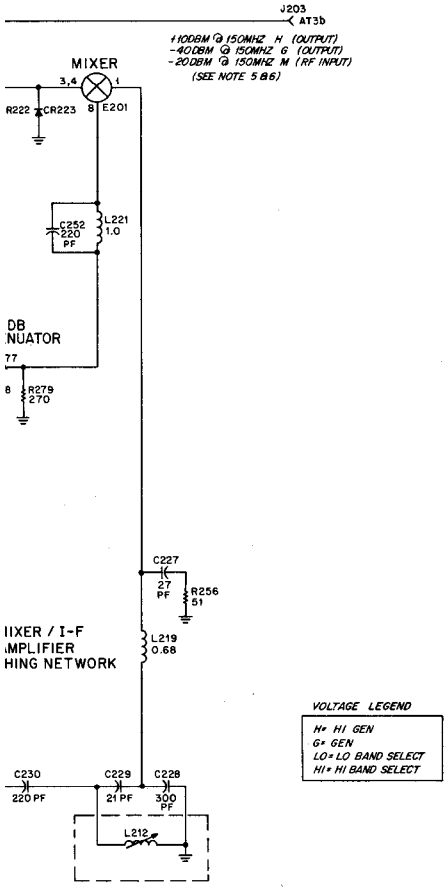
INDICATES PORTION OF CONNECTOR (J3,4,5) THAT PASSES THRU CHASSIS.


U201, 2
PIN 1
PIN 2
M,H
+1.1V
+3.1V
G
+1.1V
+3.1V
RF AMPLIFIER
SW+5F
+3.5V RF VERNIER FULLY CCW
+10V RF VERNIER FULLY CW
H,G (CW,FM)
-10DBM @ 150 MHZ H,G (INPUT)
-10DBM @ 10.7MHZ M I.F. (INPUT)
(SEE NOTES 5&6)
RF SYNTHESIZER INPUT
J204
30 DB ATTENUATOR
HI GEN DETECTOR
LO GEN DETECTOR
Q201 M9571
Q207 M9570
CONTROL INPUTS
P/O J200
HI GEN
+3.6V H
0V G
0V M
LO/HI BAND
+3.6V LO
0V HI
GEN
0V H
+3.6V G
0V M
SENSITIVE MONITOR
0V H
0V G
+3.6V M
GND
DC REF & AUD IN
+0.6V RF VERNIER FULLY CCW
+6.5V RF VERNIER FULLY CW
H,G (CW,FM)
+0.6V RF VERNIER FULLY CCW
+6.5V RF VERNIER FULLY CW
+3.0V
H,G (CW,FM)
M
LEVEL CONTROL
GAIN R252 20K
OFFSET
-6.4V LO
+9.2V HI
+10.5V LO
+9.4V HI
+11V LO
-5V HI
-1V H
-5V G
-5V M
-5V H
+11V G
-5V M
-5V H
-5V G
+11V M
+0.32V
-3.2V
-6.5V

	U201, 2		U203		U204, 5	
	PIN 1	PIN 2	PIN 1	PIN 2	PIN 1	PIN 2
M,H	+1.1V	+3.1V	+1V	+3.3V	+1.5V	+4.1 V
G	+1.1V	+3.1V	0V	0V	0V	0V



RF MODULE (A11)
WIDEBAND AMPLIFIER BOARD
MODEL RTL4093A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



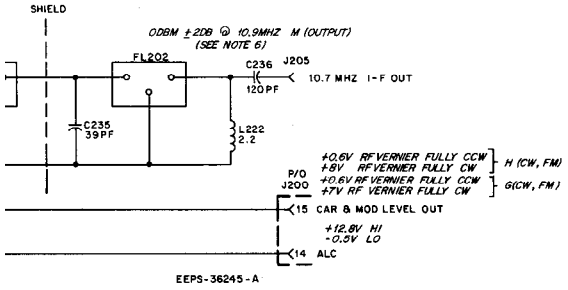
NOTES:

1. Unless otherwise indicated, all resistor values are in ohms; all capacitor values are in microfarads; and all inductors are in microhenries.
2. IC types are TTL & CMOS devices.
3. Types and connections for the integrated circuits used on this board are as follows:

Reference Designation	+5 V	+12 V	−12 V	GND	Unused Pins	Description
U201	Filt. +5 V; 2	—	—	3	—	RF Amp
U202	Filt. +5 V; 2	—	—	3	—	RF Amp
U203	Filt. SW +5 V; 2	—	—	3	—	RF Amp
U204	Filt. SW +5 V; 2	—	—	3	—	RF Amp
U205	Fil. SW +5 V; 2	—	—	3	—	RF Amp
U206	—	8	4	—	—	Dual Op-Amp
U207	—	7	—	—	1, 5, 8	Op-Amp
U208	—	14	—	—	—	Quad Analog Switch
U209	—	4	—	—	—	Quad Op-Amp (Comparator)
U210	—	7	—	4	1, 5, 8	Op-Amp

4. All dc voltages obtained with an rf synthesizer injection input (J4) being -10 dBm @ 150 MHz for HI GEN and GEN, and -10 dBM @ 110.7 MHz for MON. These voltages are typical values.
5. RF output levels in the AI GEN and GEN functions are obtained by setting the RF VERNIER control.
6. L.O injection input and rf input (@J4 and J3, respectively) yield an I-f output (@J5) as shown in the MON function.

I-F AMPLIFIER/FILTER



WIDEBAND AMPLIFIER BOARD

Motorola No. PEPS-36854-O
(Sheet 3 of 4)
8/12/83-PHI

RF MODULE (A11)

WIDEBAND AMPLIFIER BOARD

MODEL RTL4093A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST

parts list

RTL4093A Wideband Amplifier Board — PL-8462-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed pF; ± 10%; 50 V (chip): unless otherwise stated
C201	21-80376A21	390
C202	21-80376A26	2200
C203	21-80376A21	390
C204	21-80376A26	2200
C205	21-80376A24	680
C206, 207, 208	23-83441B15	1 uF ± 20%; 35 V
C209	21-80376A26	2200
C210 thru 213	23-83441B15	1 uF ± 20%; 35 V
C214	21-80376A26	2200
C215	21-80376A24	680
C216	21-80376A19	270
C217	21-80376A26	2200
C218	21-80376A24	680
C219	21-80376A26	2200
C222	21-80376A25	1000
C223	23-84762H14	0.47 uF ± 20%; 50 V
C224	21-82428B21	.01 uF + 10-30%; 100 V
C225	21-82372C03	0.1 uF + 80-20%; 25 V
C226		NOT USED
C227	21-84494B42	27 ± 5%; 500 V
C228	21-84494B15	300 ± 5%; 500 V
C229	21-84494B40	21 ± 5%; 500 V
C230	21-82187B08	220 ± 10%; 500 V
C231	21-82428B21	.01 uF + 10-30%; 100 V
C232	19-80370A35	variable; 9-35 pF
C233	21-84494B40	21 ± 5%; 500 V
C234	21-82428B21	.01 uF + 10-30%; 100 V
C235	21-84494B24	39 ± 5%; 500 V
C236	21-84494B06	120 ± 5%; 500 V
C237		NOT USED
C238	21-82372C03	0.1 uF + 80-20%; 25 V
C239	23-83441B15	1 uF ± 20%; 35 V
C240, 241	21-82428B21	.01 uF + 10-30%; 100 V
C242, 243	23-82372C03	0.1 uF + 80-20%; 25 V
C244	21-82428B47	.002 uF ± 5%; 200 V
C245	21-82872C03	0.1 uF + 80-20%; 25 V
C246, 247	23-84665F01	10 uF + 100-10%; 25 V
C248	21-80376A26	2200
C249, 250	23-84665F02	15 uF + 100-10%; 25 V
C251	23-83441B15	1 uF ± 20%; 35 V
C252	21-80376A14	220 pF ± 2%
C253	23-83441B15	1 uF ± 20%; 35 V
C254	21-80376A27	.015 uF ± 10%
C255	21-82428B47	.002 uF ± 5%; 200 V
C256	21-82428B21	.01 uF + 10-30%; 100 V
C257		NOT USED
C258	21-80376A02	2.7 ± .25 pF
C259, 260	21-80376A26	2200
C261	21-82372C03	0.1 uF + 80-20%; 100 V
C262	21-82428B47	.002 uF ± 5%; 200 V
		diode: (see note)
CR205	48-83654H01	silicon
CR206, 207, 208	48-80345A62	pin
CR209, 210, 211	48-83654H01	silicon
CR212		NOT USED
CR213 thru 216	48-83654H01	silicon
CR217	48-80394A86	hot carrier
CR218, 219, 220	48-83654H01	silicon
CR221	48-80394A86	hot carrier
CR222, 223	48-83654H01	silicon
CR224		NOT USED
CR225 thru 230	48-83654H01	silicon
CR231	48-80394A86	hot carrier
CR232	48-83654H01	silicon
		mixer:
E201	1-80377A98	assembly, double balanced mixer
		filter:
FL201, 202	91-80377A94	ceramic, 10.7 MHz
		relay:
K201 thru 204	80-80377A59	spst, coil res. 350 ohms; 5 V
		coil, rf:
L201 thru 207	24-83961B01	3 turns
L210	24-83961B01	3 turns
L211	24-80369A28	choke; 6.8 uH
L212	24-80377A97	variable
L213	24-80369A44	choke; 4700 uH
L214	24-83961B01	3 turns
L215, 216	24-80369A44	choke; 4700 uH
L217, 218	24-82549D41	choke; 100 uH
L219	24-80369A21	choke; 0.68 uH

DESCRIPTION
acitor, fixed pF; ± 10%; 50 V (chip):
ess otherwise stated
0
0
± 20%; 35 V
0
± 20%; 35 V
0
0
0
0
uF ± 20%; 50 V
uF + 10-30%; 100 V
uF + 80-20%; 25 V
T USED
± 5%; 500 V
± 5%; 500 V
± 5%; 500 V
± 10%; 500 V
uF + 10-30%; 100 V
able; 9-35 pF
± 5%; 500 V
uF + 10-30%; 100 V
± 5%; 500 V
± 5%; 500 V
T USED
uF + 80-20%; 25 V
± 20%; 35 V
uF + 10-30%; 100 V
uF + 80-20%; 25 V
uF ± 5%; 200 V
uF + 80-20%; 25 V
F + 100-10%; 25 V
)
F + 100-10%; 25 V
± 20%; 35 V
pF ± 2%
± 20%; 35 V
uF ± 10%
uF ± 5%; 200 V
uF + 10-30%; 100 V
USED
± .25 pF
)
uF + 80-20%; 100 V
uF ± 5%; 200 V
le: (see note)
on
on
USED
on
carrier
on
carrier
on
USED
on
carrier
on
r:
mbly, double balanced mixer
r:
mic, 10.7 MHz
r:
, coil res. 350 ohms; 5 V
rf:
ns
ns
e; 6.8 uH
able
e; 4700 uH
ns
e; 4700 uH
e; 100 uH
e; 0.68 uH

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
L220	24-83961B01	3 turns
L221	24-80369A22	choke; 1 uH
L222	24-80369A32	choke; 2.2 uH
L223	24-83961B01	3 turns
L224	76-83960B01	choke, bead; 3 turns
		transistor: (see note)
Q201	48-869571	PNP; type M9571
Q202 thru 205	48-869570	NPN; type M9570
Q206	48-869649	PNP; M9649
Q207	48-869570	NPN; type M9570
Q213	48-80345A42	MOS field-effect
		resistor, fixed; ± 5%; 1/4 W: unless otherwise stated
R201	6-124A01	10
R202	6-124A55	1.8k
R203	6-124A03	12
R204	6-124A25	100
R205	6-124A73	10k
R206	6-124A39	390
R207, 208	6-124A97	100k
R209	6-124A73	10k
R210	6-124A43	560
R211	6-124B02	150k
R212	6-124A61	3.3k
R213	6-185A35	270; 1/8 W
R214	6-124B22	1 meg
R215	6-124A72	9.1k
R216, 217	6-124B06	220k
R218	6-124A89	47k
R219	6-124A97	100k
R220	6-10621C67	5.6k ± 1%; 1/8 W
R221	6-10621C91	10k ± 1%; 1/8 W
R222	6-124A25	100
R223	6-124A09	22
R224, 225	6-124A49	1k
R226	6-124A67	5.6k
R227	6-124A97	100k
R228	6-124A73	10k
R229	6-185A41	470; 1/8 W
R230	6-185A18	51; 1/8 W
R231	6-124A09	22
R232, 233	6-124B67	8.2
R234	6-10621C87	9.09k ± 1%; 1/8 W
R235	6-124A49	1k
R236, 237	6-124A57	2.2k
R238	6-124A73	10k
R239	6-124A57	2.2k
R240	6-124A73	10k
R241	6-124A29	150
R242	6-185A57	2.2k; 1/8 W
R243, 244		NOT USED
R245	6-185A57	2.2k; 1/8 W
R246	6-124A73	10k
R247	6-125A49	1k; 1/2 W
R248	6-11024A13	33; 1/8 W (chip)
R249	6-185A18	51; 1/8 W
R250	6-10621E53	464k ± 1%; 1/8 W
R251	6-10621D49	39.2k ± 1%; 1/8 W
R252	18-83452F16	variable; 20k
R253	6-124A97	100k
R254, 255		NOT USED
R256	6-124A18	51
R257	6-124B10	330k
R258	6-124A66	5.1k
R259	6-124B22	1 meg
R260	6-124A61	3.3k
R261	6-185A25	100; 1/8 W
R262, 263	6-124A65	4.7k
R264		NOT USED
R265	6-124A25	100
R266	6-124A67	5.6k
R267		NOT USED
R268	6-124A89	47k
R269	6-124B16	560k
R270, 271		NOT USED
R272	6-10621B78	681 ± 1%; 1/8 W
R273	6-10621C63	5.11k ± 1%; 1/8 W
R274	6-124A45	680
R275	6-124A65	4.7k
R276	18-83452F10	variable; 1k
R277	6-185A07	18; 1/8 W
R278, 279	6-185A35	270; 1/8 W
R280	6-124A37	330
R281	6-124A73	10k
R282	6-124A97	100k
R283	6-10621D33	26.7k ± 1%; 1/8 W
R284	6-185A69	6.8k; 1/8 W
		integrated circuit: (see note)
U201, 202, 203	51-80345A34	rf amplifier
U204, 205	51-80345A35	rf amplifier
U206	51-80365A07	dual operational amplifier
U207	51-80365A08	operational amplifier
U208	51-82884L48	quad analog switch

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
U209	51-83629M08	quad operational amplifier
U210	51-83629M07	operational amplifier
		voltage regulator: (see note)
VR201	48-80378A46	Zener type; 4.3 V
VR202	48-82256C23	Zener type; 6.8 V
VR203, 204	48-83624E52	Zener type; 3.3 V
VR205	48-82256C23	Zener type; 6.8 V
		mechanical parts
	26-80378A77	SHIELD
	26-80395A49	SHIELD
J203, 204	9-5856A01	SOCKET, spring miniature; 2 used
J200	9-80377A65	RECEPTACLE, pin; 2 used

note: For optimum performance, diodes, transistors, and integrated c be ordered by Motorola part numbers.

ENCE BOL	MOTOROLA PART NO.	DESCRIPTION
	24-83961B01	3 turns
	24-80369A22	choke; 1 uH
	24-80369A32	choke; 2.2 uH
	24-83961B01	3 turns
	76-83960B01	choke, bead; 3 turns
		transistor: (see note)
	48-869571	PNP; type M9571
1205	48-869570	NPN; type M9570
	48-869649	PNP; M9649
	48-869570	NPN; type M9570
	48-80345A42	MOS field-effect
		resistor, fixed; ± 5%; 1/4 W: unless otherwise stated
	6-124A01	10
	6-124A55	1.8k
	6-124A03	12
	6-124A25	100
	6-124A73	10k
	6-124A39	390
	6-124A97	100k
	6-124A73	10k
	6-124A43	560
	6-124B02	150k
	6-124A61	3.3k
	6-185A35	270; 1/8 W
	6-124B22	1 meg
	6-124A72	9.1k
	6-124B06	220k
	6-124A89	47k
	6-124A97	100k
	6-10621C67	5.6k ± 1%; 1/8 W
	6-10621C91	10k ± 1%; 1/8 W
	6-124A25	100
	6-124A09	22
	6-124A49	1k
	6-124A67	5.6k
	6-124A97	100k
	6-124A73	10k
	6-185A41	470; 1/8 W
	6-185A18	51; 1/8 W
	6-124A09	22
	6-124B67	8.2
	6-10621C87	9.09k ± 1%; 1/8 W
	6-124A49	1k
	6-124A57	2.2k
	6-124A73	10k
	6-124A57	2.2k
	6-124A73	10k
	6-124A29	150
	6-185A57	2.2k; 1/8 W
		NOT USED
	6-185A57	2.2k; 1/8 W
	6-124A73	10k
	6-125A49	1k; 1/2 W
	6-11024A13	33; 1/8 W (chip)
	6-185A18	51; 1/8 W
	6-10621E53	464k ± 1%; 1/8 W
	6-10621D49	39.2k ± 1%; 1/8 W
	18-83452F16	variable; 20k
	6-124A97	100k
		NOT USED
	6-124A18	51
	6-124B10	330k
	6-124A66	5.1k
	6-124B22	1 meg
	6-124A61	3.3k
	6-185A25	100; 1/8 W
	6-124A65	4.7k
		NOT USED
	6-124A25	100
	6-124A67	5.6k
		NOT USED
	6-124A89	47k
	6-124B16	560k
		NOT USED
	6-10621B78	681 ± 1%; 1/8 W
	6-10621C63	5.11k ± 1%; 1/8 W
	6-124A45	680
	6-124A65	4.7k
	18-83452F10	variable; 1k
	6-185A07	18; 1/8 W
	6-185A35	270; 1/8 W
	6-124A37	330
	6-124A73	10k
	6-124A97	100k
	6-10621D33	26.7k ± 1%; 1/8 W
	6-185A69	6.8k; 1/8 W
		integrated circuit: (see note)
1203	51-80345A34	rf amplifier
	51-80345A35	rf amplifier
	51-80365A07	dual operational amplifier
	51-80365A08	operational amplifier
	51-82884L48	quad analog switch

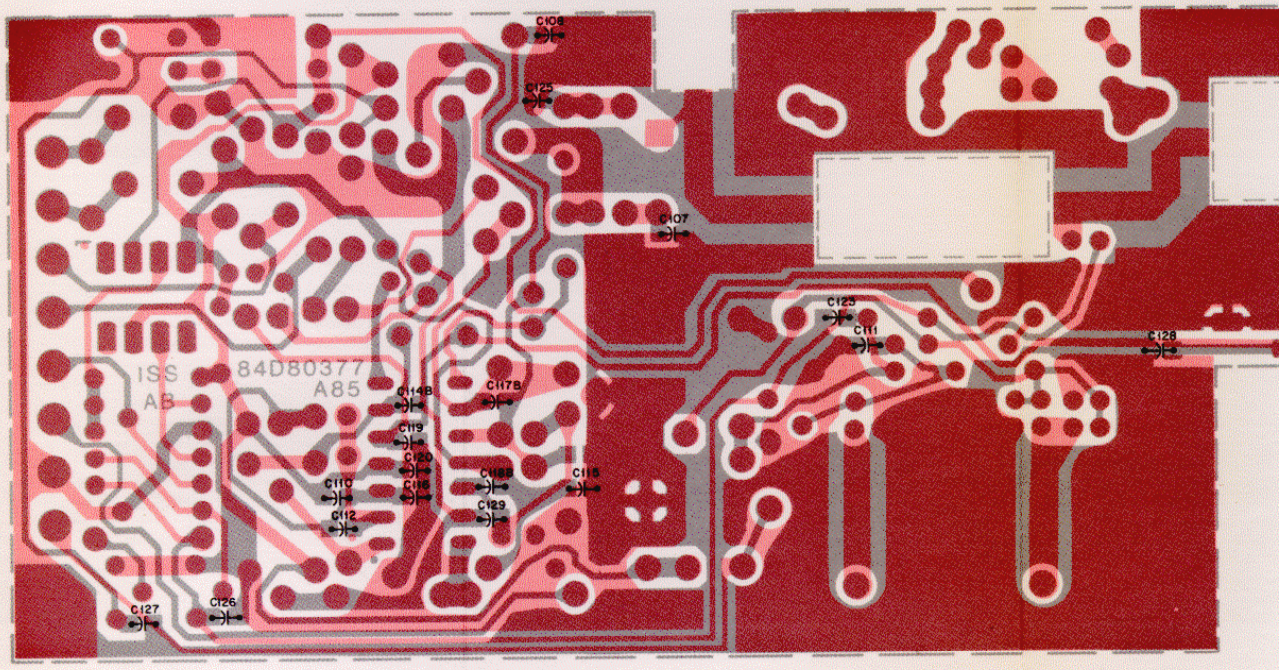
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
U209	51-83629M08	quad operational amplifier
U210	51-83629M07	operational amplifier
		voltage regulator: (see note)
VR201	48-80378A46	Zener type; 4.3 V
VR202	48-82256C23	Zener type; 6.8 V
VR203, 204	48-83624E52	Zener type; 3.3 V
VR205	48-82256C23	Zener type; 6.8 V
		mechanical parts
	26-80378A77	SHIELD
	26-80395A49	SHIELD
J203, 204	9-5856A01	SOCKET, spring miniature; 2 used
J200	9-80377A65	RECEPTACLE, pin; 2 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

RF MODULE (A11)

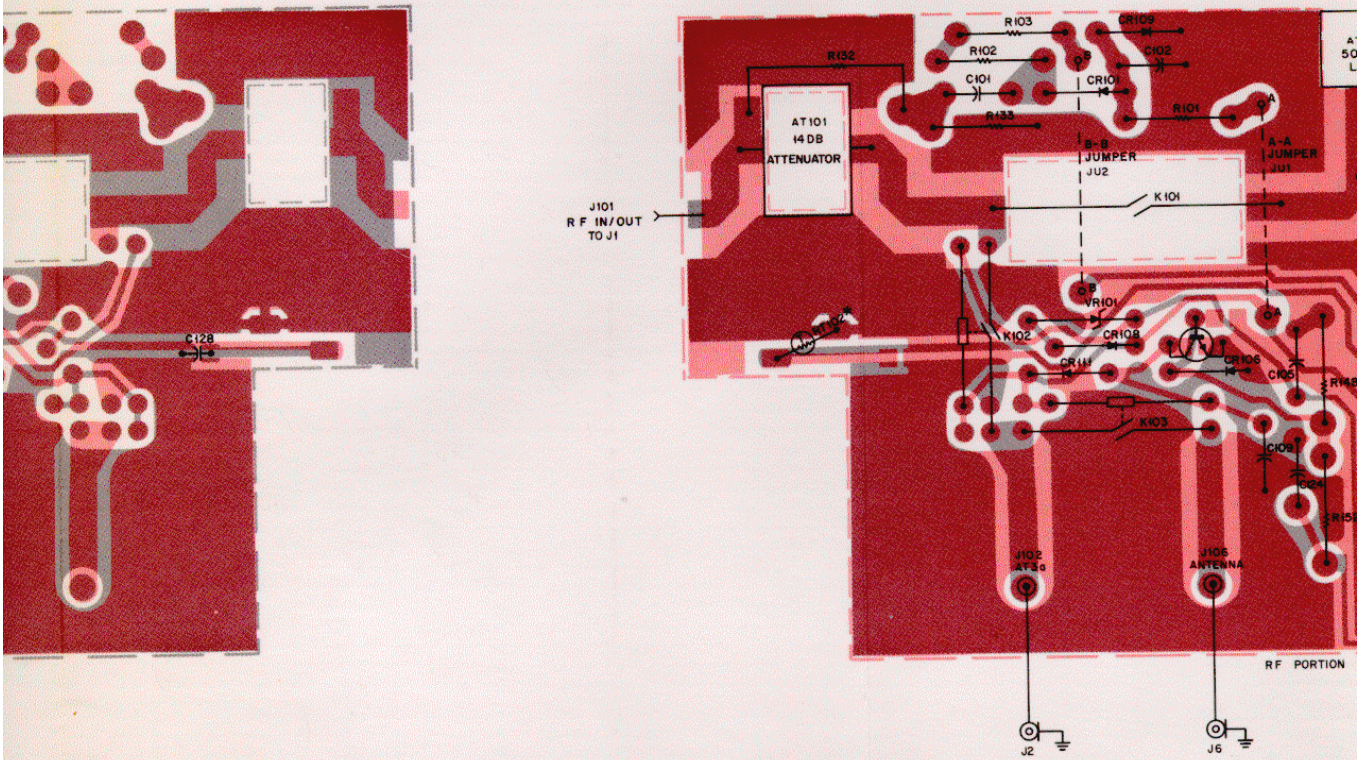
RF WATTMETER BOARD

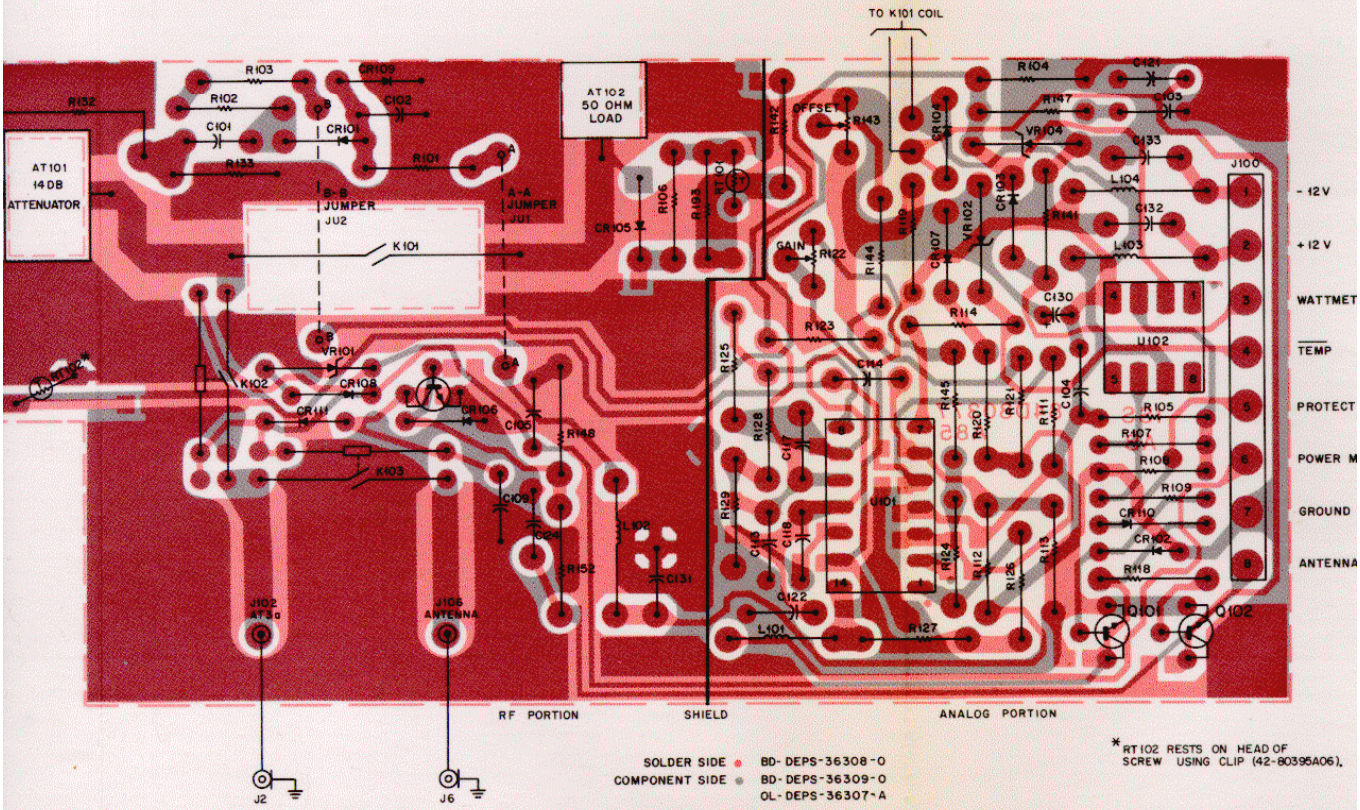
MODEL RTL4094A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



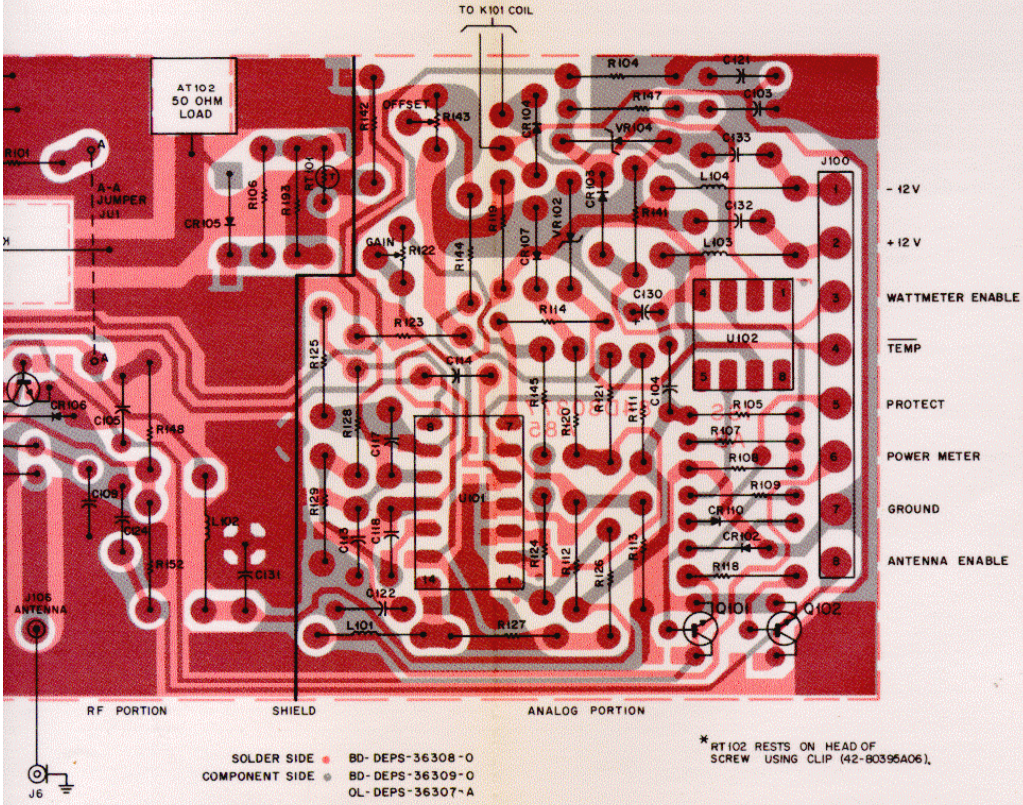
SOLDER SIDE ● BD-DEPS-36308-O (REVERSED)
COMPONENT SIDE ● BD-DEPS-36309-O (REVERSED)
OL-DEPS-36310-A

SHOWN FROM SOLDER SIDE
(COMPONENTS ARE CHIP CAPACITORS)


C128
R103
CR109
R102
C102
C101
CR101
R132
AT101
14 DB
ATTENUATOR
R133
R101
A-A
JUMPER
JU1
B-B
JUMPER
JU2
J101
R F IN/OUT
TO J1
K101
VR101
K102
CR108
CR111
CR106
C105
K103
C109
C124
J102
ANT 3a
J105
ANTENNA
RF PORTION
J2
J6



SHOWN FROM COMPONENT SIDE



SOLDER SIDE ● BD-DEPS-36308-0
COMPONENT SIDE ● BD-DEPS-36309-0
OL-DEPS-36307-A

*RT102 RESTS ON HEAD OF SCREW USING CLIP (42-80395A06).

SHOWN FROM COMPONENT SIDE

parts list

RTL4094A RF Wattmeter Board — PL-8463-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		attenuator:
AT101	17-80377A95	14 dB
AT102	17-80377A96	50 ohm termination
		capacitor, fixed pF; ± 5%; 50 V (chip):
		unless otherwise stated
C101, 102	21-83596E32	1100; 200 V
C103, 104, 105	21-832501	.01 uF + 60-40%; 500 V
C106		NOT USED
C107	21-80376A28	7.5
C108	21-80376A10	22
C109	21-832501	.01 uF + 60-40%; 500 V
C110, 111, 112	21-80376A10	22
C113, 114A	21-82428B21	.01 uF + 10-30%; 100 V
C114B, 115	21-80376A06	10
C116	21-80376A10	22
C117A	21-82428B21	.01 uF + 10-30%; 100 V
C117B	21-80376A06	10
C118A	21-82428B21	.01 uF + 10-30%; 100 V
C118B	21-80376A06	10
C119, 120	21-80376A10	22
C121	21-832501	.01 uF + 60-40%; 500 V
C122A	21-82428B21	.01 uF + 10-30%; 100 V
C123	21-80376A06	10
C124	21-832501	.01 uF + 60-40%; 500 V
C125	21-80376A27	.015 uF ± 10%
C126, 127	21-80376A10	22
C128	21-80376A27	.015 uF ± 10%
C129	21-80376A06	10
C130	23-84665F01	10 uF + 100-10%; 25 V
C131, 132, 133	21-82372C07	.05 uF + 80-20%; 25 V
		diode: (see note)
CR101	48-80345A64	hot carrier
CR102, 103, 104	48-83654H01	silicon
CR105	48-80345A64	hot carrier
CR106	48-83654H01	silicon
CR107	48-80345A64	hot carrier
CR108	48-83654H01	silicon
CR109	48-80345A64	hot carrier
CR110	48-84616A01	hot carrier
CR111	48-83654H01	silicon
		relay:
K101		includes:
	24-80369A45	solenoid
	26-80377A63	shield, reed
	40-84200B02	switch, reed, spst
K102, 103	80-80377A60	1 form A res. 1500 ohms
		coil, rf:
L101	24-80369A25	choke; 0.22 uH
L102, 103, 104	24-82549D41	choke; 100 uH
		transistor: (see note)
Q101	48-869787	NPN; type M9787
Q102, 103	48-869570	NPN; type M9570
		resistor, fixed; ± 5%; 1/4 W:
		unless otherwised stated
R101	6-124A81	22k
R102, 103	6-124A66	5.1k
R104	6-124B22	1 meg
R105	6-124A85	33k
R106	6-124A23	82
R107	6-124B06	220k
R108	6-124A49	1k
R109	6-124A53	1.5k
R110		NOT USED
R111	6-124A73	10k
R112, 113	6-124A89	47k
R114	6-124A75	12k
R118	6-124A73	10k
R119	6-124A75	12k
R120	6-124A87	39k
R121	6-124A71	8.2k
R122	18-84352F12	variable; 5k
R123	6-83175C90	8.06k ± 1%; 1/8 W
R124, 125	6-10621C19	1.78k ± 1%; 1/8 W
R126 thru 129	6-83175C03	10k ± 1%; 1/8 W
R132	6-125A83	27k; 1/2 W
R133	6-124A51	1.2k
R141	6-124A73	10k
R142	6-83175C51	37.4k ± 1%; 1/8 W
R143	18-83452F10	variable; 1k
R144	6-124A89	47k
R145	6-124A53	1.5k
R147	6-124A49	1k
R148	6-124A73	10k
R152	6-124A49	1k
R153	6-83175C88	6.98k ± 1%; 1/8 W
		thermistor:
RT101, 102	6-83600K05	100k @ 25 °C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U101	51-83629M08	quad operational amplifier
U102	51-83629M07	operational amplifier
		voltage regulator: (see note)
VR101	48-80345A84	Zener type; 68 V
VR102	48-82256C15	Zener type; 5.1 V
VR103		NOT USED
VR104	48-82256C15	Zener type; 5.1 V
		mechanical parts
J102, 106	9-05856A01	SOCKET, spring miniature; 2 used
J100	9-80377A65	RECEPTACLE, pin
	26-80378A76	SHIELD
	26-80377A63	SHIELD, reed

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

RF

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note)
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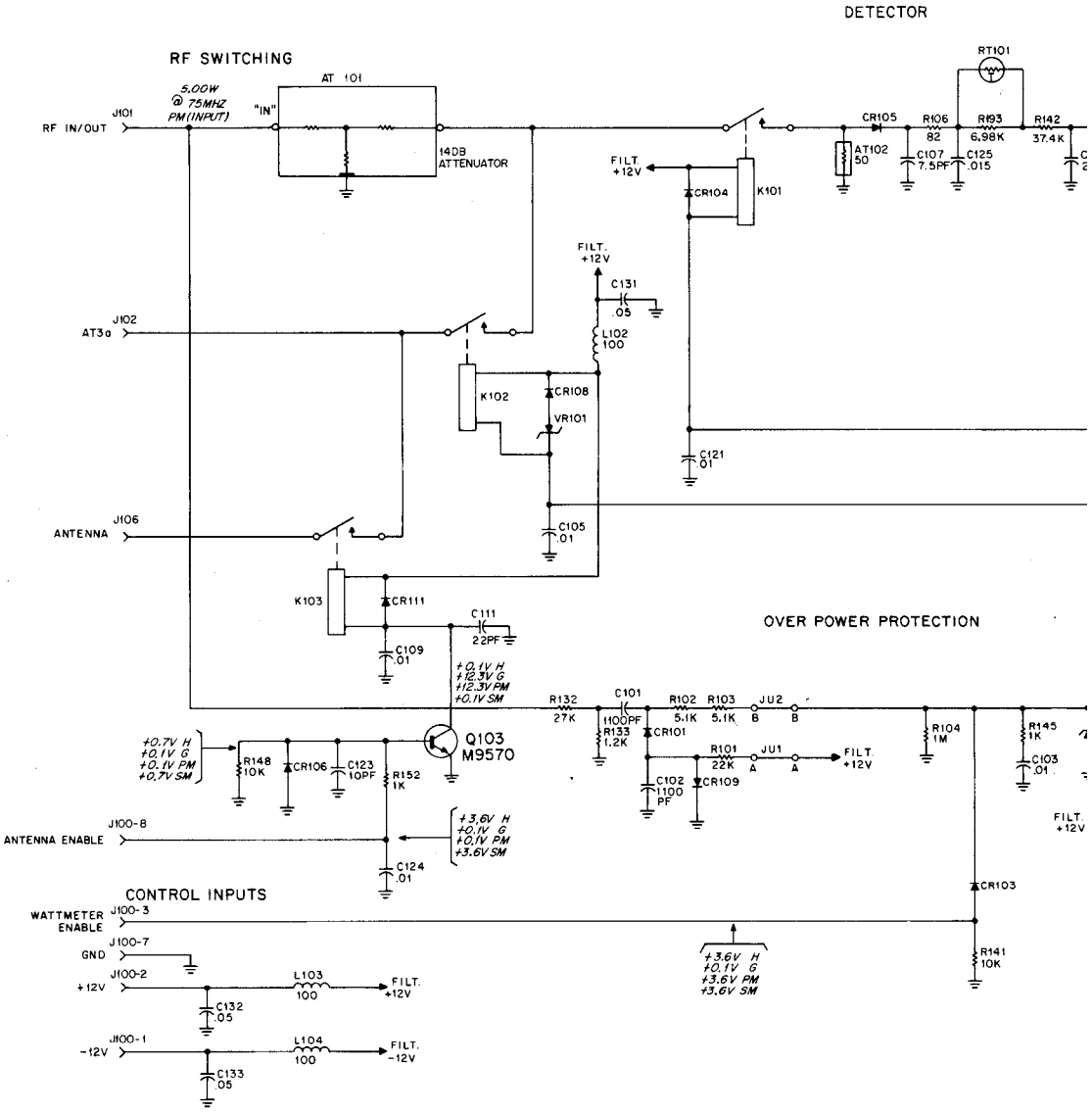
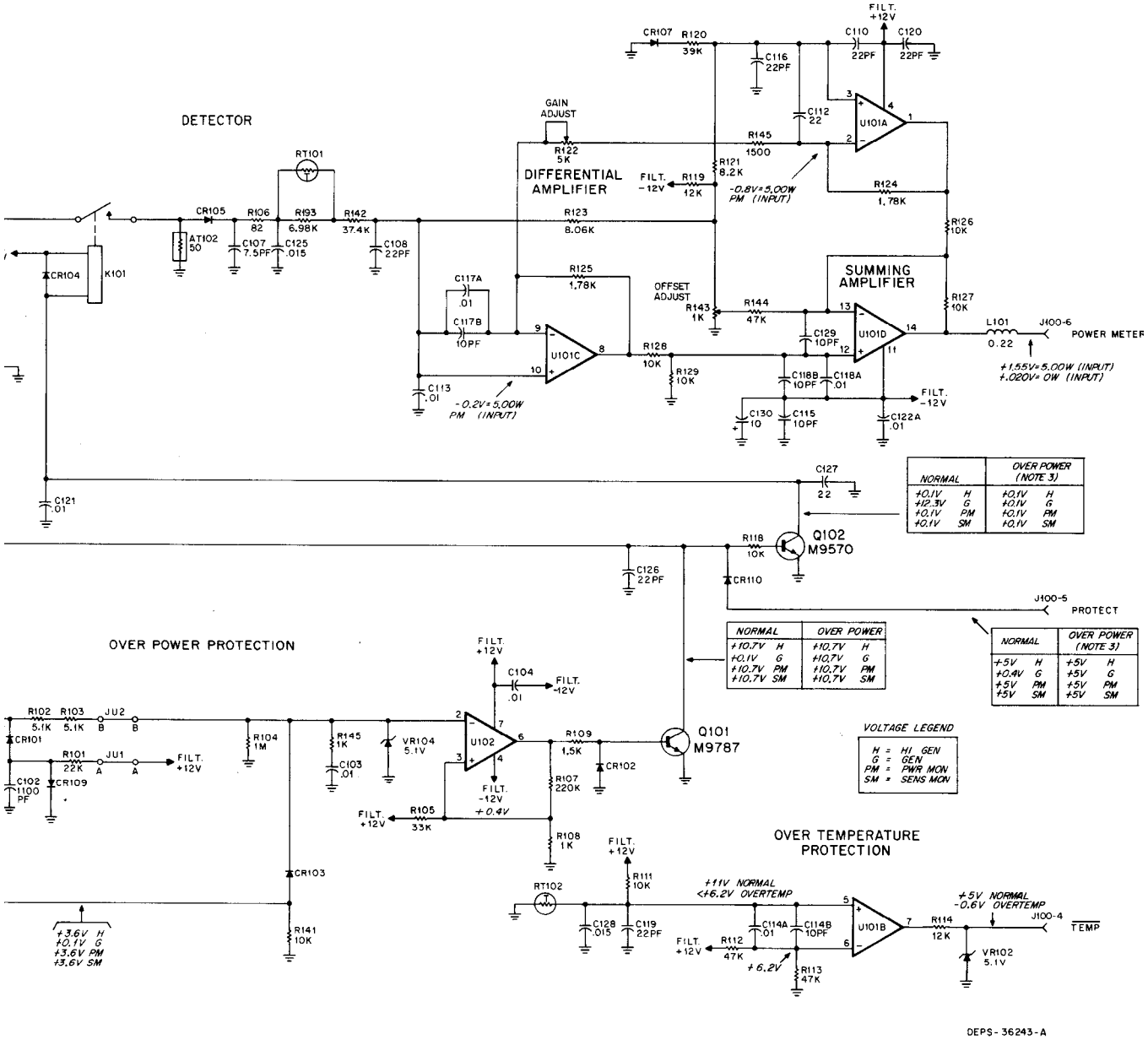
ure; 2 used

tegrated circuits must



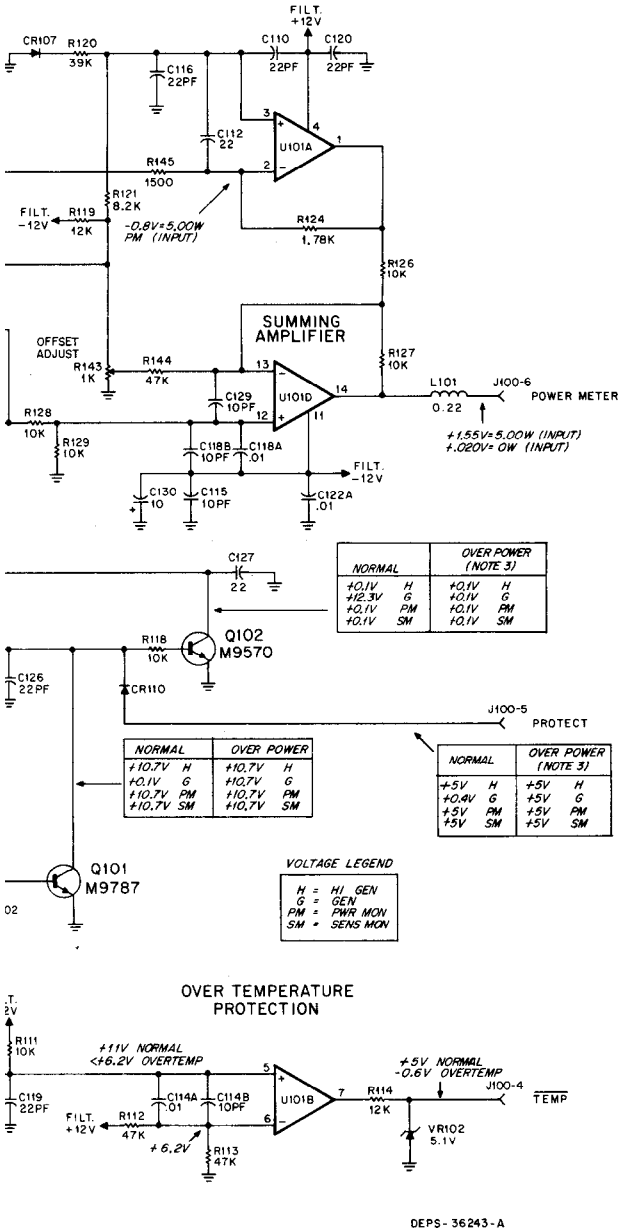

DETECTOR
DIFFERENTIAL AMPLIFIER
SUMMING AMPLIFIER
OVER POWER PROTECTION
OVER TEMPERATURE PROTECTION
GAIN ADJUST
OFFSET ADJUST
FILT. +12V
FILT. -12V
POWER METER
PROTECT
TEMP
Q102 M9570
Q101 M9787
VOLTAGE LEGEND
H = HI GEN
G = GEN
PM = PWR MON
SM = SENS MON
-0.8V=5.00W PM (INPUT)
-0.2V=5.00W PM (INPUT)
+1.55V=5.00W (INPUT)
+.020V=0W (INPUT)
+11V NORMAL
<+6.2V OVERTEMP
+5V NORMAL
-0.6V OVERTEMP
+6.2V
+3.6V H
+0.1V G
+3.6V PM
+3.6V SM
DEPS-36243-A

RF MODULE (A11)

RF WATTMETER BOARD

MODEL RTL4094A

SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST



NORMAL		OVER POWER (NOTE 3)	
+0.1V	H	+0.1V	H
+12.3V	G	+0.1V	G
+0.1V	PM	+0.1V	PM
+0.1V	SM	+0.1V	SM

NORMAL		OVER POWER	
+10.7V	H	+10.7V	H
+0.1V	G	+10.7V	G
+10.7V	PM	+10.7V	PM
+10.7V	SM	+10.7V	SM

NORMAL		OVER POWER (NOTE 3)	
+5V	H	+5V	H
+0.4V	G	+5V	G
+5V	PM	+5V	PM
+5V	SM	+5V	SM

DEPS-36243-A

NOTES:

1. Unless otherwise indicated, all resistor values are in ohms; all capacitor values are in microfarads; and all inductor values are in microhenries.
2. IC types are TTL & CMOS devices.
3. 1.25 W TRIP-POINT @ J101 for overpower condition.
4. Types and connections for the integrated circuits used on this board are as follows:

Reference Designation	Mfgr's Description	+12 V	−12 V	Gnd	Unused Pins
U101	Quad Op Amp	4	11	—	—
U102	Op Amp	7	4	—	1, 5, 8

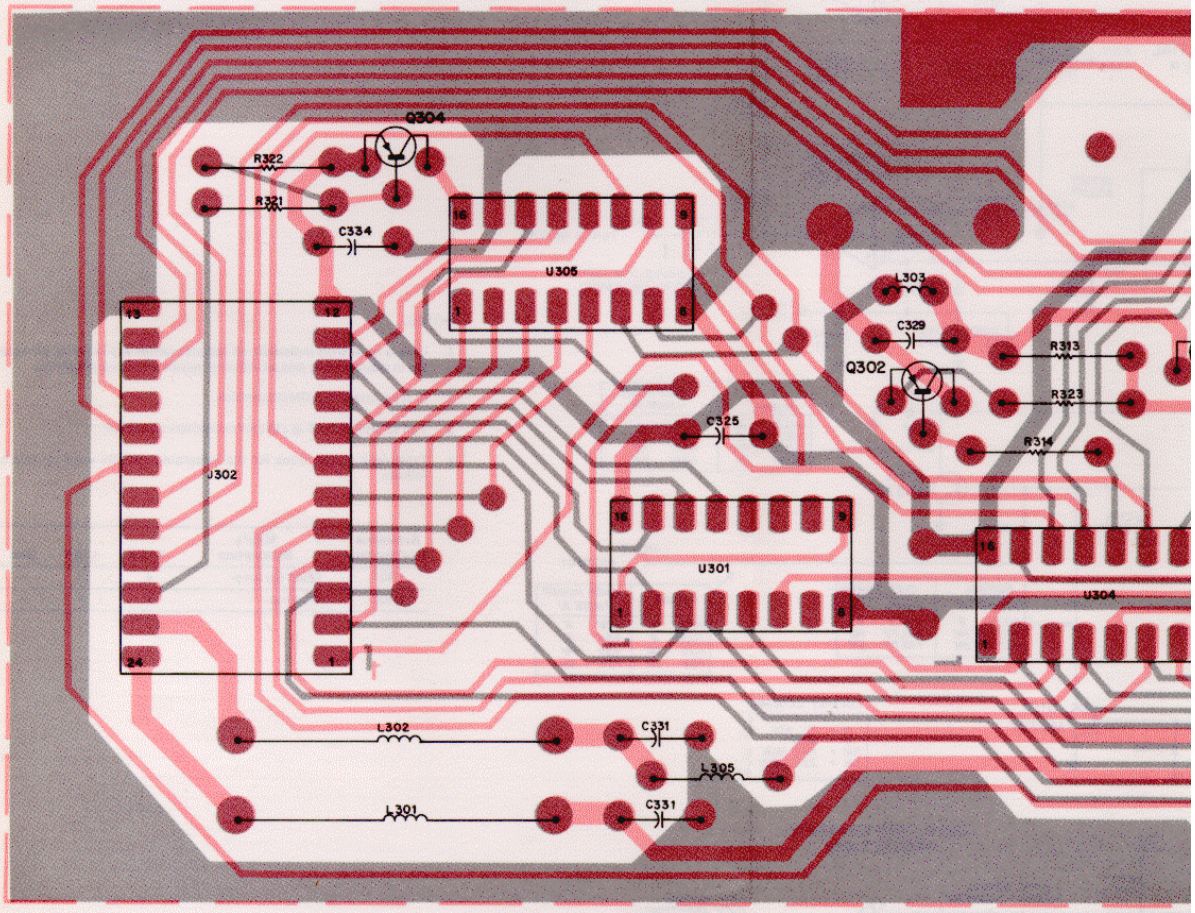
RF WATTMETER BOARD

Motorola No. PEPS-36853-O
(Sheet 2 of 2)
8/12/83-PHI

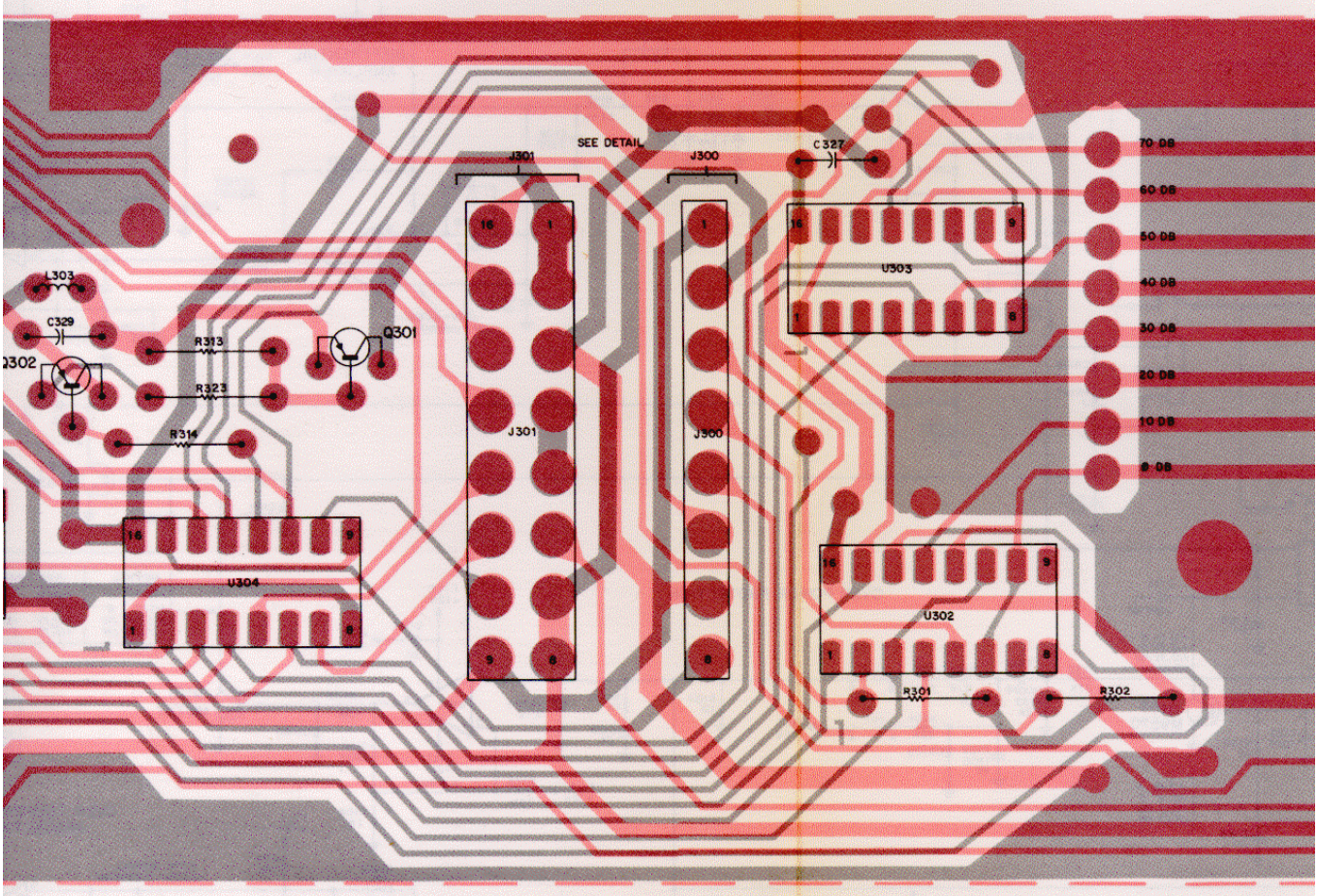
RF MODULE (A11)

RF INTERCONNECT BOARD

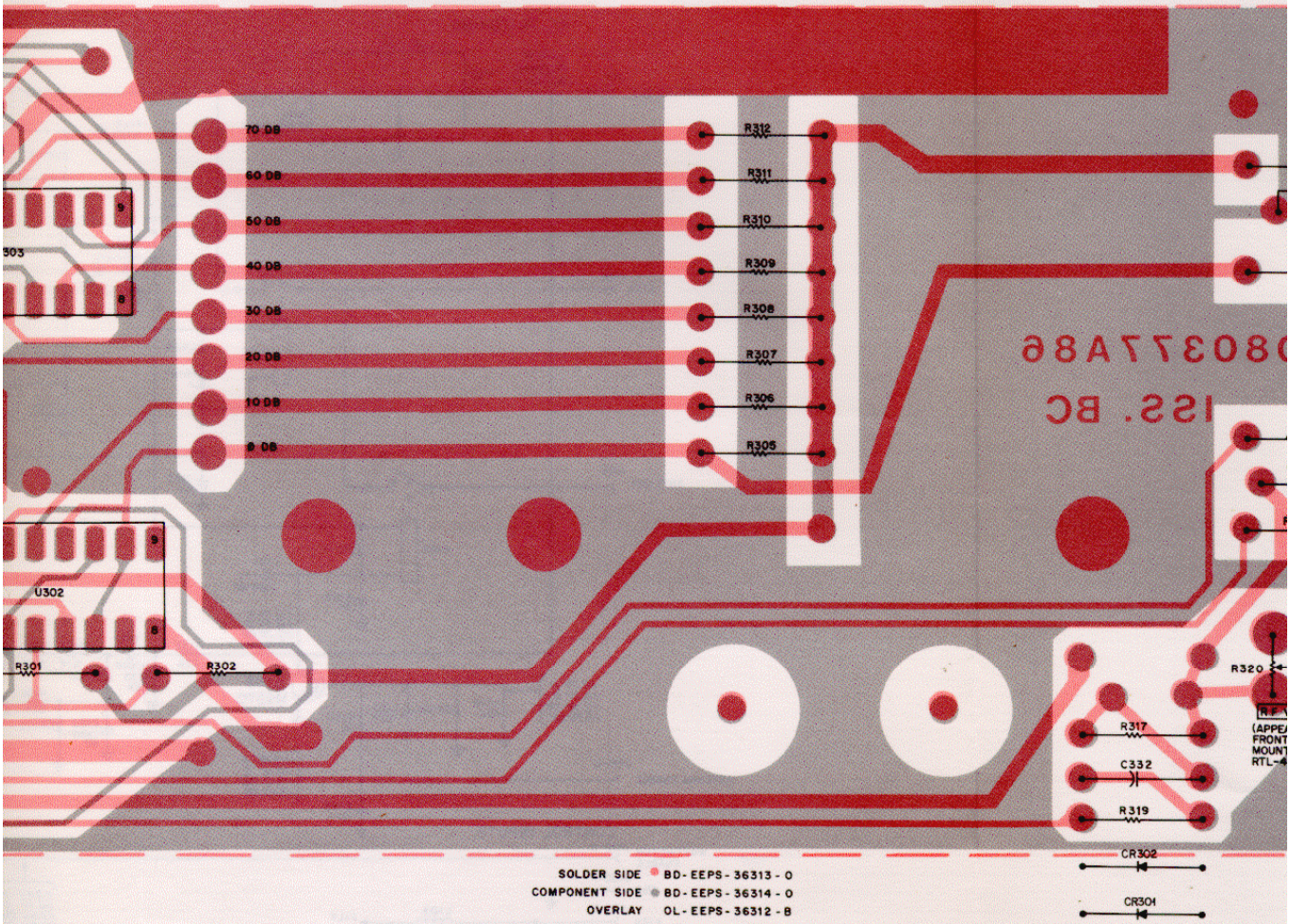
MODEL RTL4095A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



Motorola No. ***PEPS-36852-O***
(Sheet 1 of 2)
8/12/83-PHI

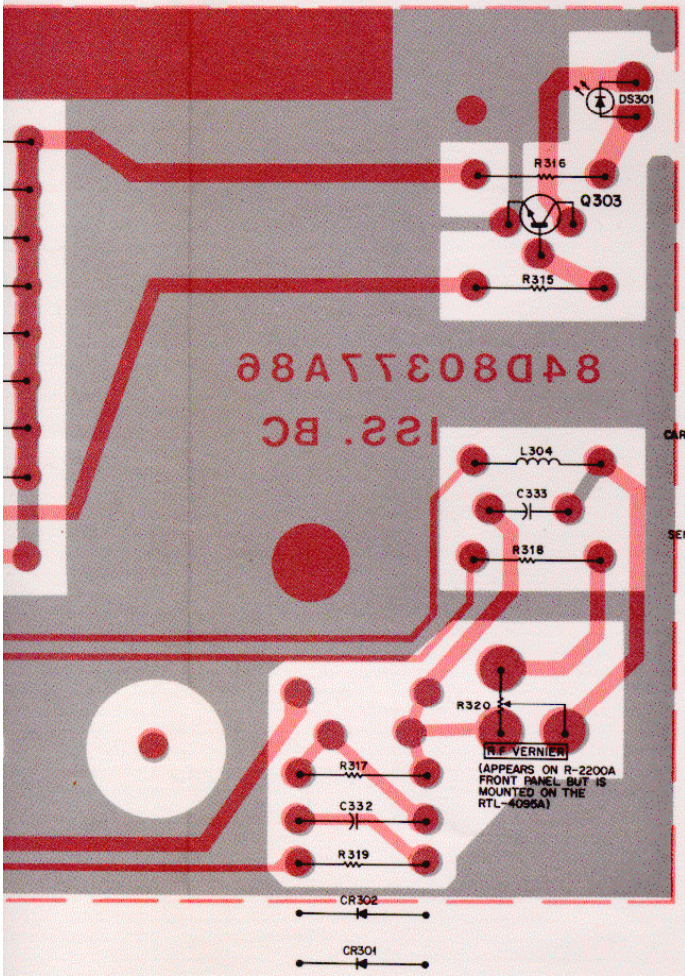


SHOWN FROM COMPONENT SIDE



SOLDER SIDE BD-EEPS-36313-0
COMPONENT SIDE BD-EEPS-36314-0
OVERLAY OL-EEPS-36312-B

SIDE



J302 DETAIL

GND	13	12	+5V
ALC	14	11	A3
LO/$\overline{\text{HI}}$ BAND	15	10	A2
CAR & MOD LEVEL OUT	16	9	$\overline{\text{STROBE 1}}$
POWER METER	17	8	AØ
AM MOD AUDIO	18	7	A1
$\overline{\text{P.O.R.}}$	19	6	D4
D5	20	5	D3
D6	21	4	D2
$\overline{\text{STROBE 3}}$	22	3	D1
-12V	23	2	DØ
+12V	24	1	D7

J301 DETAIL

D.C. REF & AUD IN	16	1	SW + 5V
CAR & MOD LEVEL OUT	15	2	SW + 5V
ALC	14	3	GND
LO/$\overline{\text{HI}}$ BAND	13	4	GND
GEN	12	5	GND
HI GEN	11	6	GND
SENSITIVE MONITOR	10	7	+12V
-12V	9	8	+12V

J300 DETAIL

1	-12V
2	+12V
3	WATTMETTER ENABLE
4	$\overline{\text{TEMP}}$
5	PROTECT
6	POWER METER
7	GND
8	ANTENNA ENABLE

parts list

RTL4095A RF Interconnect Board — PL-8461-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed uF; +60-40%; 500 V: unless otherwise stated
C325 thru 331	21-832501	.01
C332, 333	21-82428B47	.002 uF ± 5%; 200 V
C334	21-832501	.01
		diode: (see note)
CR301, 302	48-83654H01	silicon
		light emitting diode: (see note)
DS301	48-80329A53	red
		connector, receptacle:
J302	9-84881F01	female; 24 contact
J303	9-82604F02	female; 16 contact
		coil, rf:
L301	24-82549D07	choke; 56 uH
L302	24-80348A83	choke; 470 uH
L303	25-83127G01	choke filter
L304	24-80369A25	choke; 0.22 uH
L305	24-80369A23	choke; 0.15 uH
		transistor: (see note)
Q301	48-869649	PNP; type M9649
Q302	48-869571	PNP; type M9571
Q303	48-869570	NPN; type M9570
Q304	48-869571	PNP; type M9571
		resistor, fixed; ± 5%; 1/4 W: unless otherwise stated
R301	6-124A81	22k
R302 thru 312	6-124A57	2.2k
R313	6-124A73	10k
R314, 315	6-124A65	4.7k
R316	6-124A33	220
R317	6-124A73	10k
R318	6-124A49	1k
R319	6-124A47	820
R320		NOT USED
R321, 322	6-124A49	1k
R323	6-124A29	150
		integrated circuit: (see note)
U301	51-84561L42	decode/demux
U302, 303	51-84561L77	hex 3-state buffer
U304	51-84561L51	hex D flip-flop
U305	51-82848M48	PROM
		mechanical parts
J300, 301	9-80377A65	RECEPTACLE, pin; 3 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

NOTES:

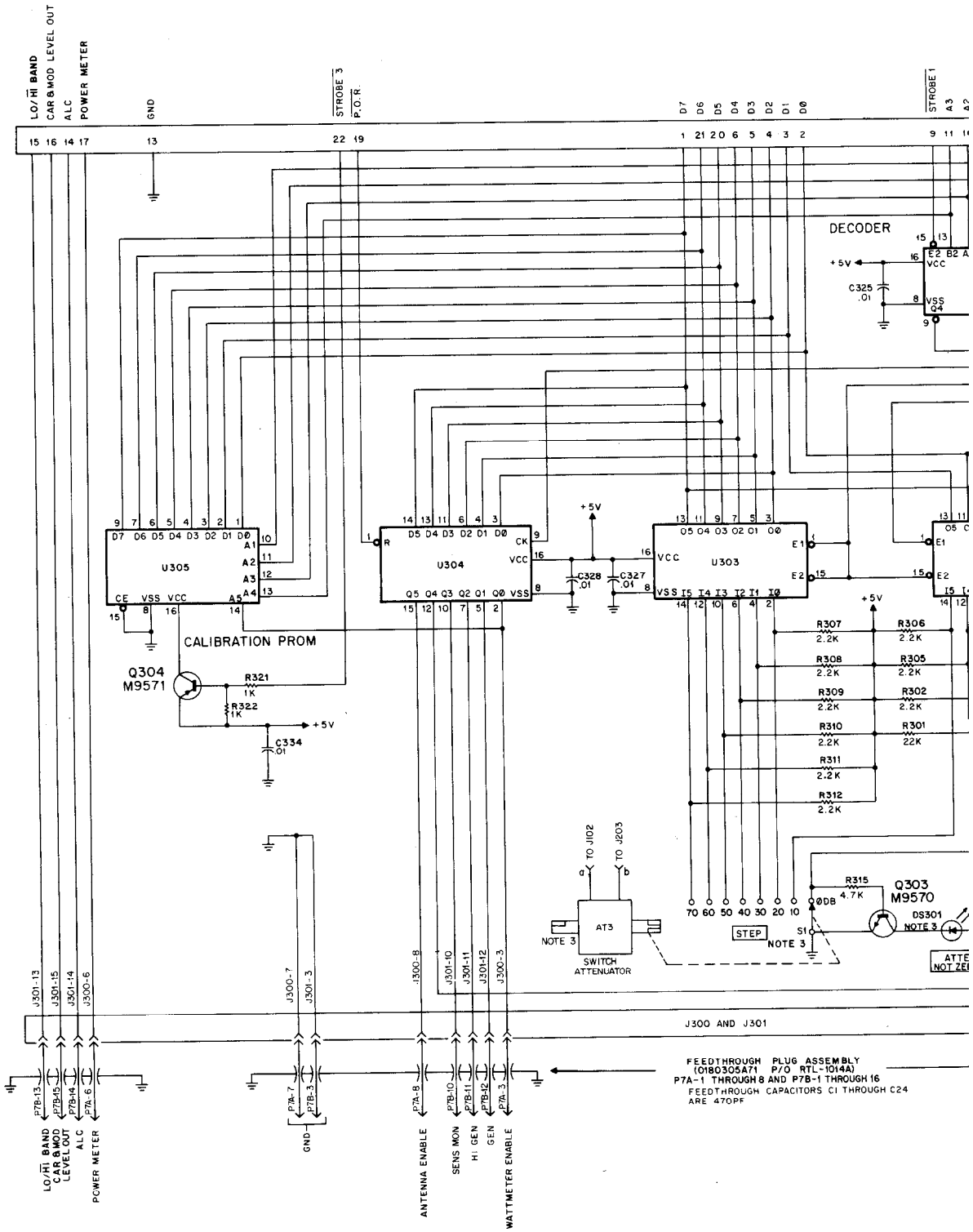
1. Unless otherwise indicated, all resistor values are in ohms; capacitor values are in microfarads; and inductor values are microhenries.
2. IC types are TTL & CMOS devices.
3. Part mounted on board, but extends thru front panel when module is installed.
4. Types and connections for the integrated circuits used on this board are as follows:

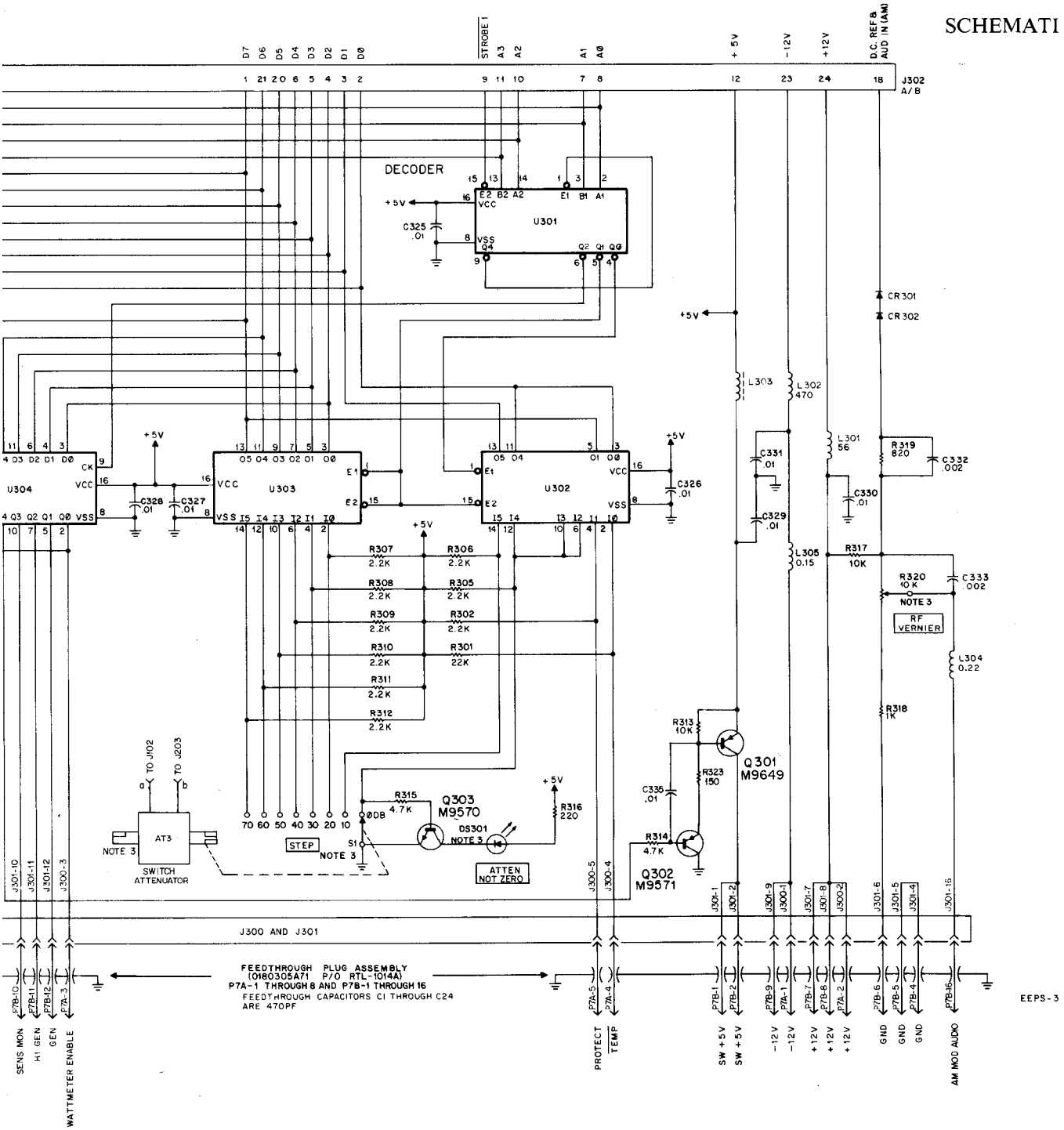
Reference Designation	Mfgr's Description	+5 V	Gnd	Unused Pins
U301	Decode/Demux	16	8	7, 10, 11, 12
U302	Hex 3-State Buffer	16	8	7, 9
U303	Hex 3-State Buffer	16	8	—
U304	Hex D-Flip-Flop	16	8	—
U305	Prom	16	8	—

Truth Table RTL-4095A

									Data							
	Module Write		Module Enable		Strobe											
Mode	A0	A1	A2	A3	S0	S1	S2	S3	D0	D1	WEN D2	GEN D3	HIGEN D4	MON D5	GENOFF D6	AEN D7
HI GEN	0	1	1	1	0	⌐	0	0	0	0	1	0	1	0	0	1
GEN	0	1	1	1	0	⌐	0	0	0	0	0	1	0	0	0	0
MON	0	1	1	1	0	⌐	0	0	0	0	1	0	0	1	1	0
SENS MON	0	1	1	1	0	⌐	0	0	0	0	1	0	0	1	0	1

	Module Read		Module Enable	
TEMP	0	0	1	1
PROTECT	0	0	1	1
ATTEN 0-70	0	0	1	1


LO/HI BAND
CAR & MOD LEVEL OUT
ALC
POWER METER
GND
STROBE 3
P.O.R.
D7 D6 D5 D4 D3 D2 D1 D0
STROBE 1
DECODER
+5V
C325 .01
U305
CALIBRATION PROM
U304
U303
C328 .01
C327 .01
C334 .01
Q304 M9571
R321 1K
R322 1K
R307 2.2K
R306 2.2K
R308 2.2K
R305 2.2K
R309 2.2K
R302 2.2K
R310 2.2K
R301 22K
R311 2.2K
R312 2.2K
R315 4.7K
Q303 M9570
DS301
NOTE 3
STEP
SWITCH ATTENUATOR
AT3
TO J102
TO J203
J300 AND J301
FEEDTHROUGH PLUG ASSEMBLY (01180305A71 P/O RTL-1014A)
P7A-1 THROUGH 8 AND P7B-1 THROUGH 16
FEEDTHROUGH CAPACITORS C1 THROUGH C24 ARE 470PF
LO/HI BAND
CAR & MOD LEVEL OUT
ALC
POWER METER
GND
ANTENNA ENABLE
SENS MON
HI GEN
GEN
WATTMETER ENABLE


J302 A/B
DECODER
U301
U302
U303
U304
+5V
-12V
+12V
D.C. REF & AUD IN (AM)
STROBE 1
CR301
CR302
L303
L302 470
L301 56
L305 0.15
L304 0.22
R317 10K
R318 1K
R319 820
R320 10K
NOTE 3
RF VERNIER
C325 .01
C326 .01
C327 .01
C328 .01
C329 .01
C330 .01
C331 .01
C332 .002
C333 .002
C335 .01
R307 2.2K
R306 2.2K
R308 2.2K
R305 2.2K
R309 2.2K
R302 2.2K
R310 2.2K
R301 22K
R311 2.2K
R312 2.2K
R313 10K
R314 4.7K
R315 4.7K
R316 220
R323 150
Q301 M9649
Q302 M9571
Q303 M9570
DS301 NOTE 3
S1
STEP
NOTE 3
ATTEN NOT ZERO
AT3
SWITCH ATTENUATOR
NOTE 3
TO J102
TO J203
J300 AND J301
FEEDTHROUGH PLUG ASSEMBLY (0180305A71 P/O RTL-1014A)
P7A-1 THROUGH 8 AND P7B-1 THROUGH 16
FEEDTHROUGH CAPACITORS C1 THROUGH C24 ARE 470PF
SENS MON
HI GEN
GEN
WATTMETER ENABLE
PROTECT
TEMP
SW +5V
SW +5V
-12V
-12V
+12V
+12V
+12V
GND
GND
GND
AM MOD AUDIO

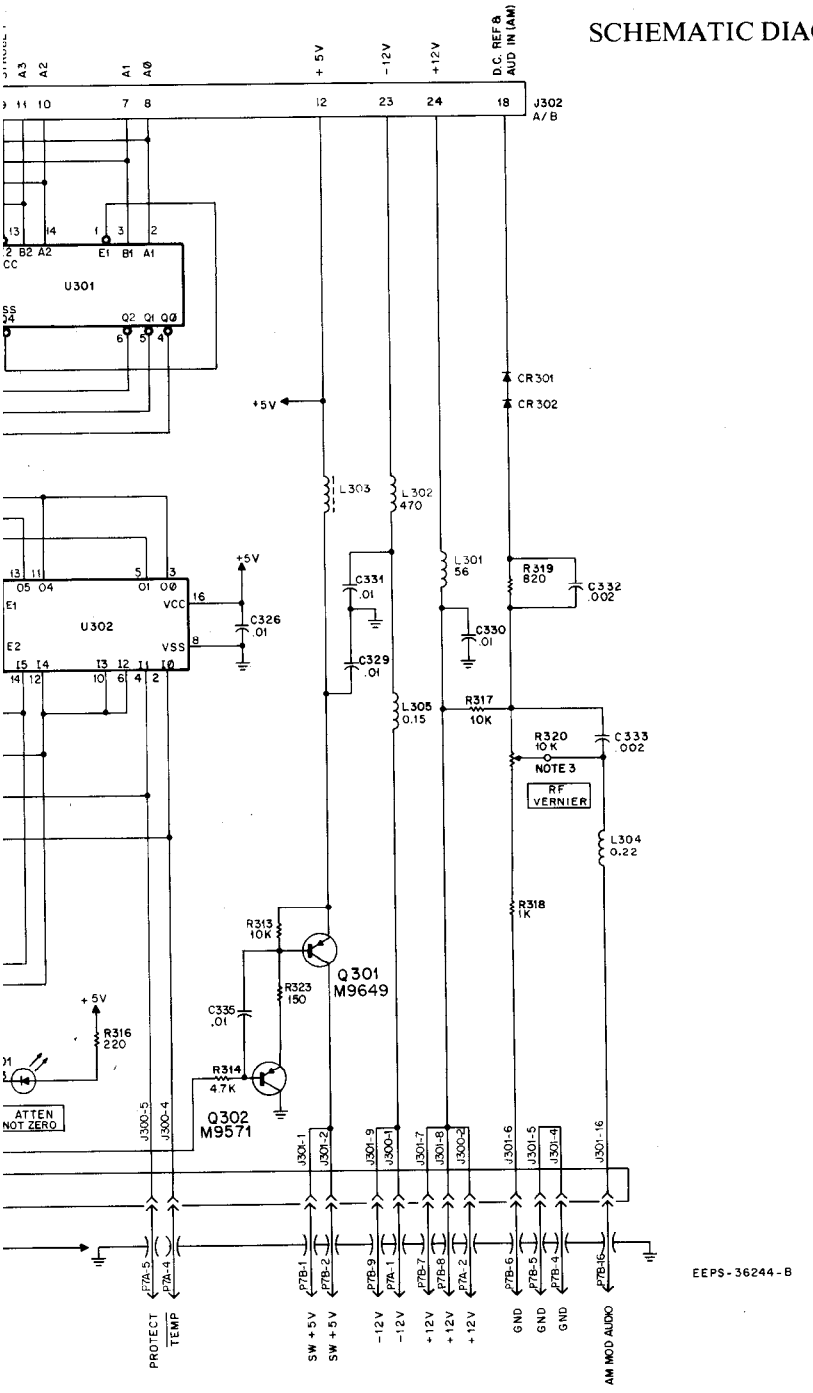
EEPS-3

RF MODULE (A11)

RF INTERCONNECT BOARD

MODEL RTL4095A

SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST



Motorola No. ***PEPS-36852-O***
(Sheet 2 of 2)
8/12/83-PHI

TONE SYNTHESIZER BOARD (A12)

MODEL RTL4096A

1. DESCRIPTION

1.1 The tone synthesizer generates audio frequencies in the 10 Hz to 9999 Hz range. Frequency selection is controlled by the service monitor's microprocessor and the output of the crystal controlled 5.12 MHz oscillator.

1.2 The tone synthesizer is comprised of an address decoder, 2.56 MHz clock generator, digital-to-analog converter, harmonic filters, and frequency multipliers.

2. THEORY OF OPERATION

2.1 ADDRESS DECODER

Input lines AØ through A3 contain the address of the upper or lower frequency registers and the control latch. The dual 2-to-4 decoder is activated by the $\overline{\text{STB2}}$ signal. Level shifters U3 and U4 convert data bus logic to +12 V logic.

2.2 CLOCK GENERATOR

The output of the 5.12 MHz crystal controlled oscillator is buffered by transistor Q3 and divided by the dual-D flip-flop U25A to obtain a symmeterical 2.56 MHz clock pulse. The upper two digits of the selected frequency are latched into U6 and U7, and the lower two digits are latched into U8 and U9. The outputs of the latches are sent to the bit rate multipliers. U14 and U15 are fixed frequency dividers. U16 selects one of the four available frequencies.

2.3 DIGITAL-TO-ANALOG CONVERTER

The actual frequency output of analog switch U16 is 32 times greater than the desired frequency. A 5-bit counter comprised of U14, U17, and Q5 applies the counter output to an exclusive OR gate tree made up of U18, U19, and U20. The decoded outputs are applied to summing amplifier U21 where the square waves are synthesized into a sine wave.

2.4 HARMONIC FILTERS

A low-pass filter formed by U16, U21, and U23 is used to suppress unwanted harmonics. The filter cutoff frequency is determined by the analog switches under microprocessor control. The output frequencies available are determined by the selected frequency range.

2.5 SIGNAL SELECTION AND OUTPUT

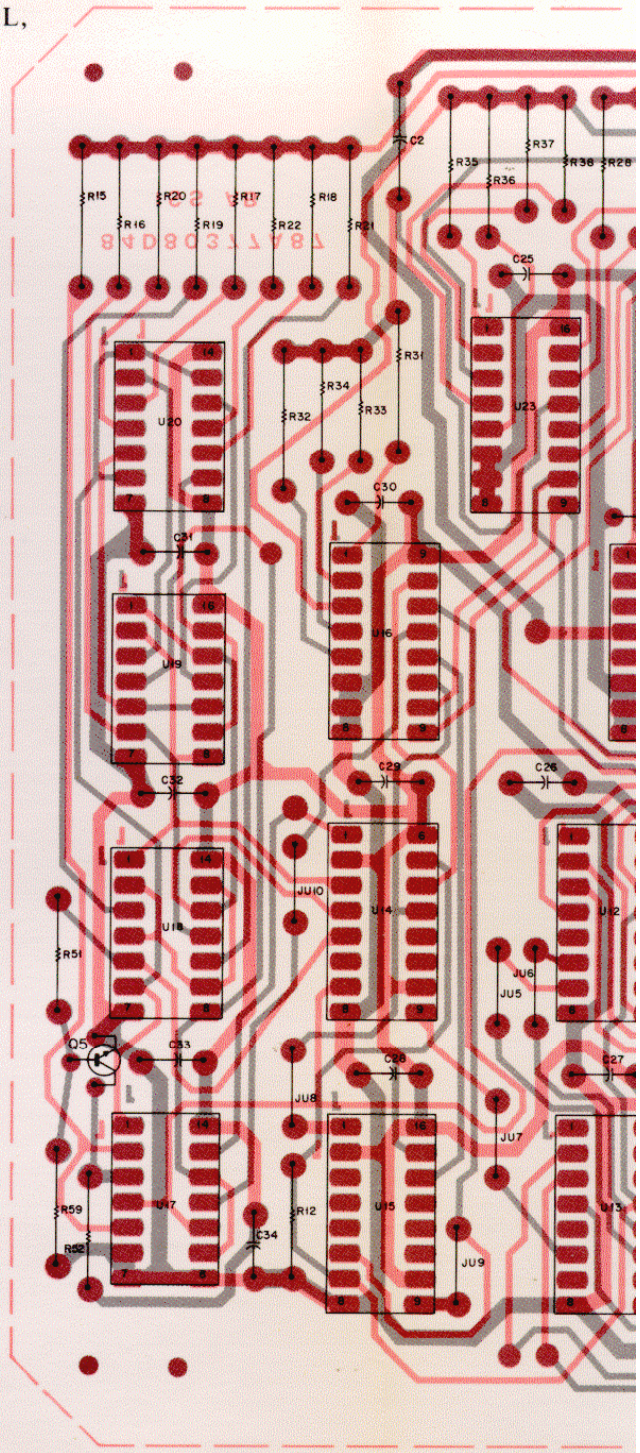
For normal tone generation, analog switch U22 selects unattenuated filter output, and for tone remote signaling the attenuated output is selected. The attenuator, formed by U21B and U22A, provides 10 dB and 30 dB attenuation. Amplifier U24 provides signal gain and buffering. A lowpass filter removes any high frequencies components of the synthesized frequency.

2.6 DPL GENERATION

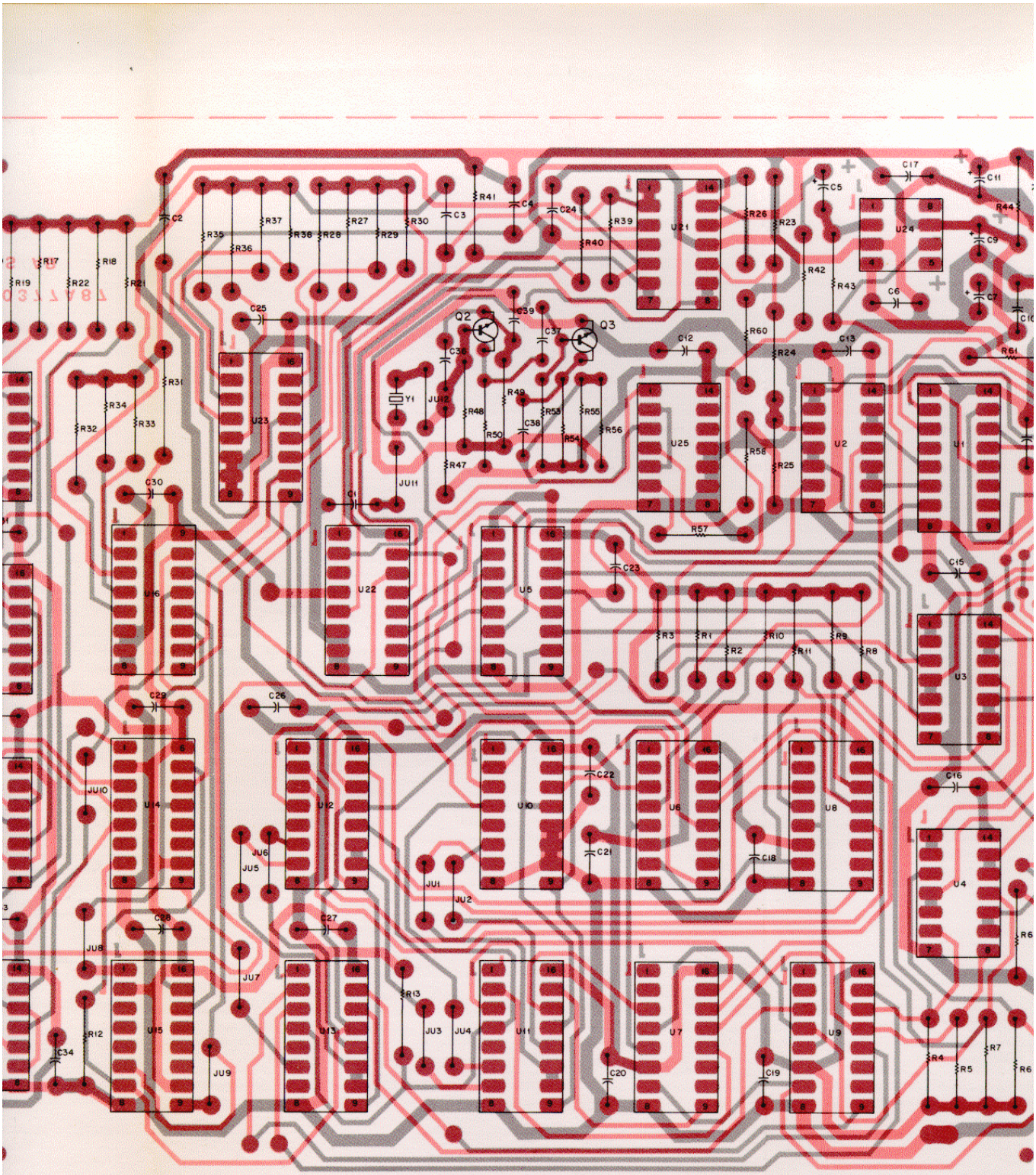
The *Digital Private-Line* (DPL) signal is generated by software and sent to the harmonic filters via U21 and switch U22.

TONE SYNTHESIZER BOARD (A12)

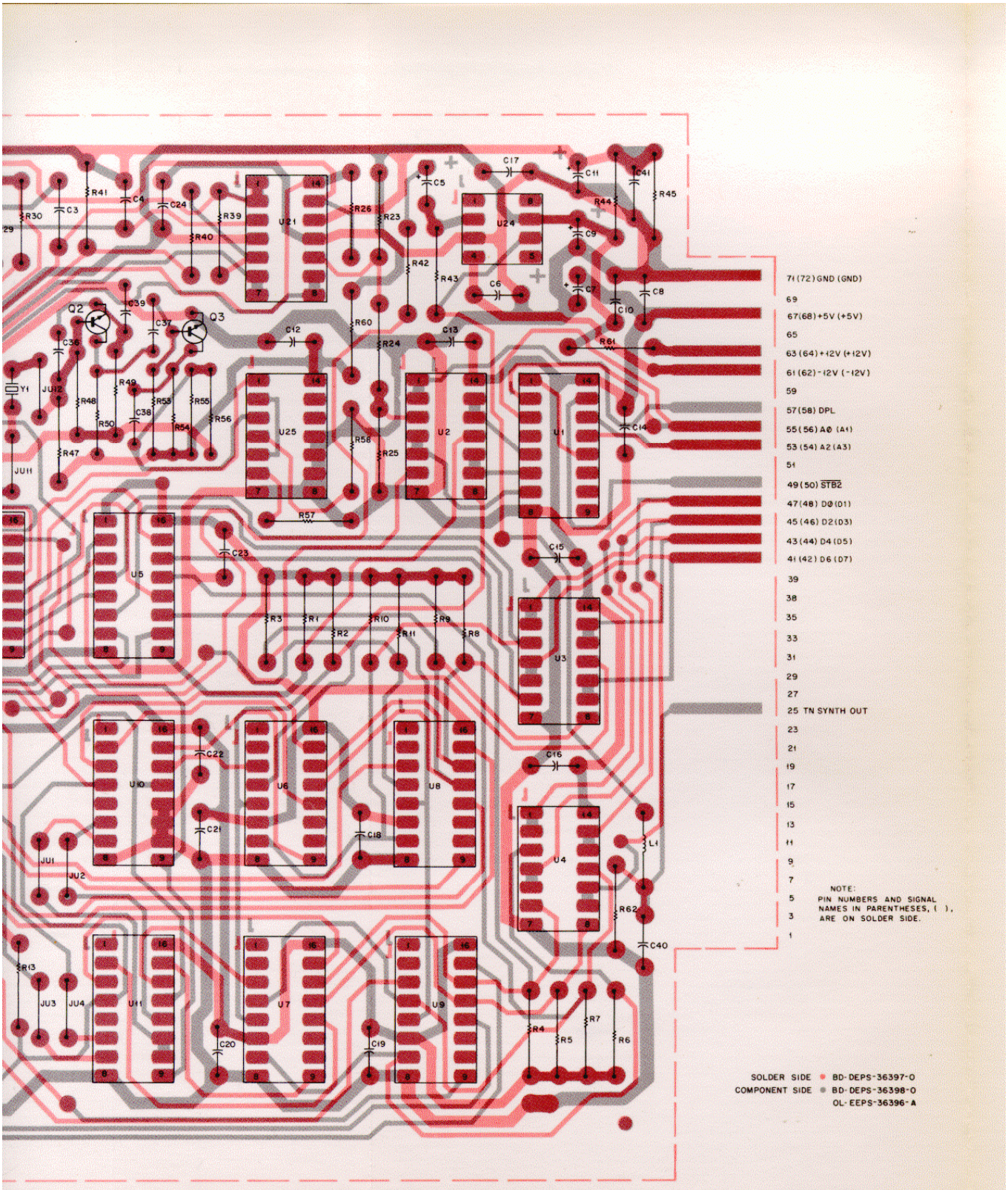
MODEL RTL4096A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



Motorola No. ***PEPS-36855-O***
(Sheet 1 of 2)
8/12/83-PHI



SHOWN FROM COMPONENT SIDE



SHOWN FROM COMPONENT SIDE

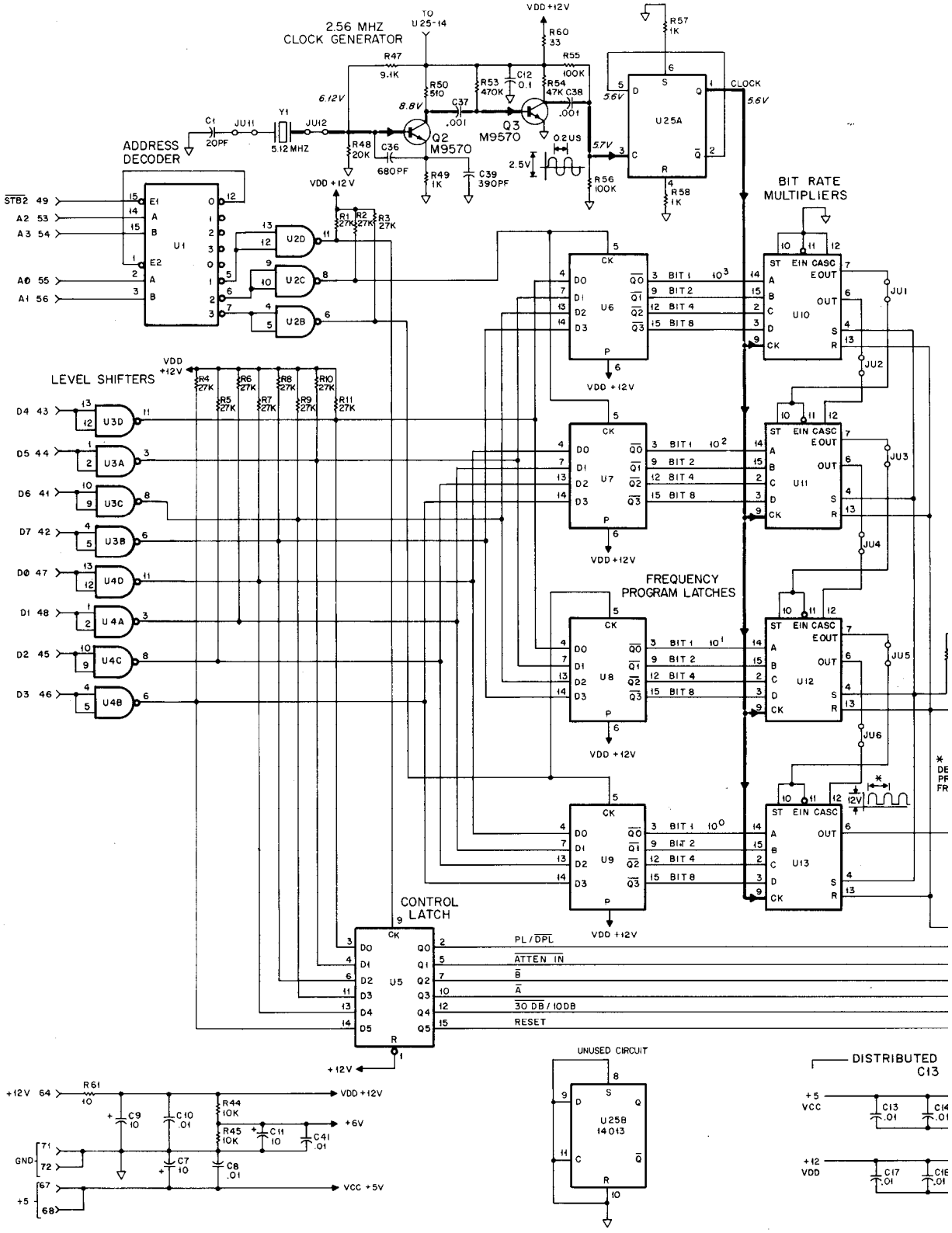
parts list

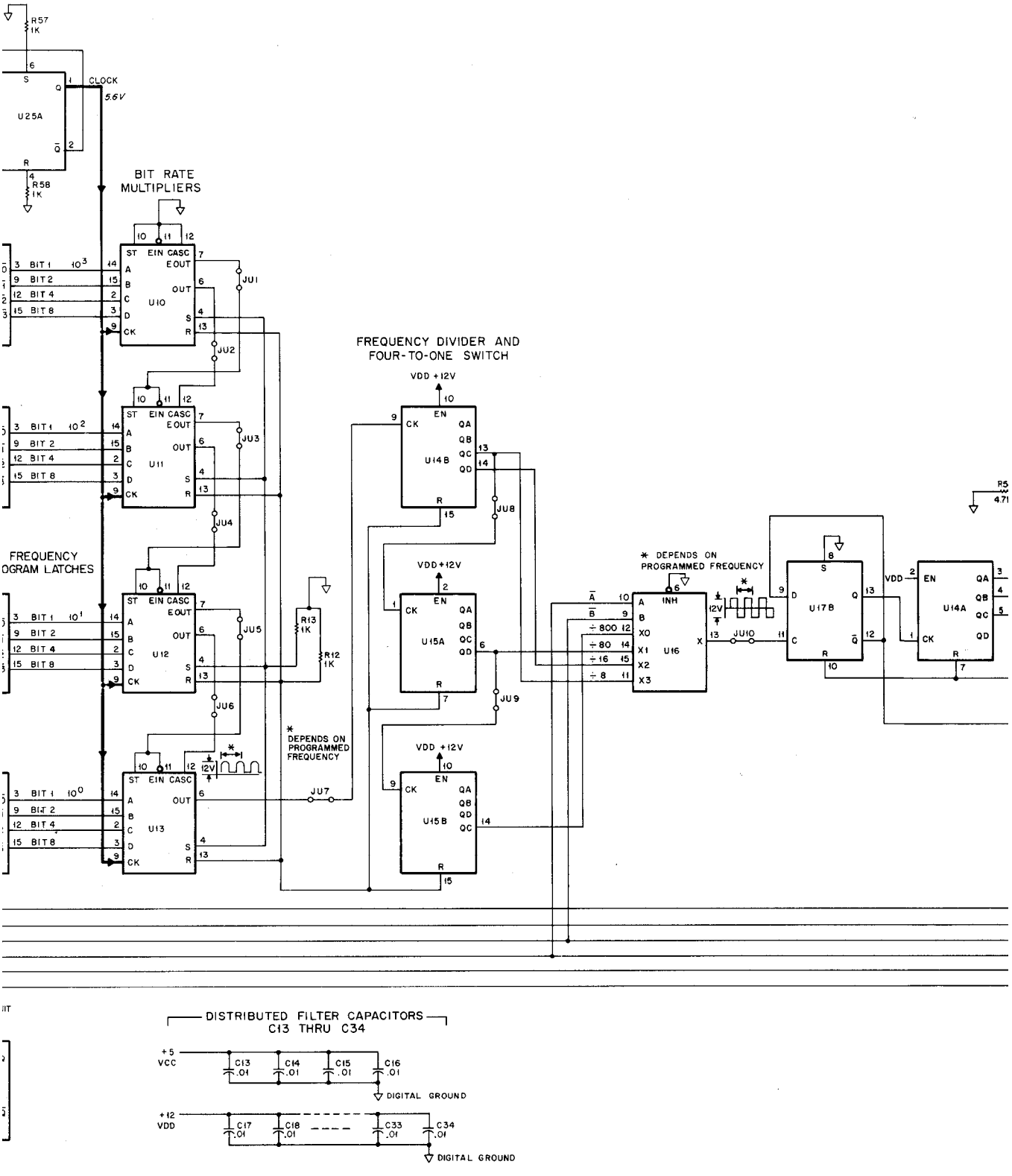
RTL4096A Tone Synthesizer Board — PL-8459-O

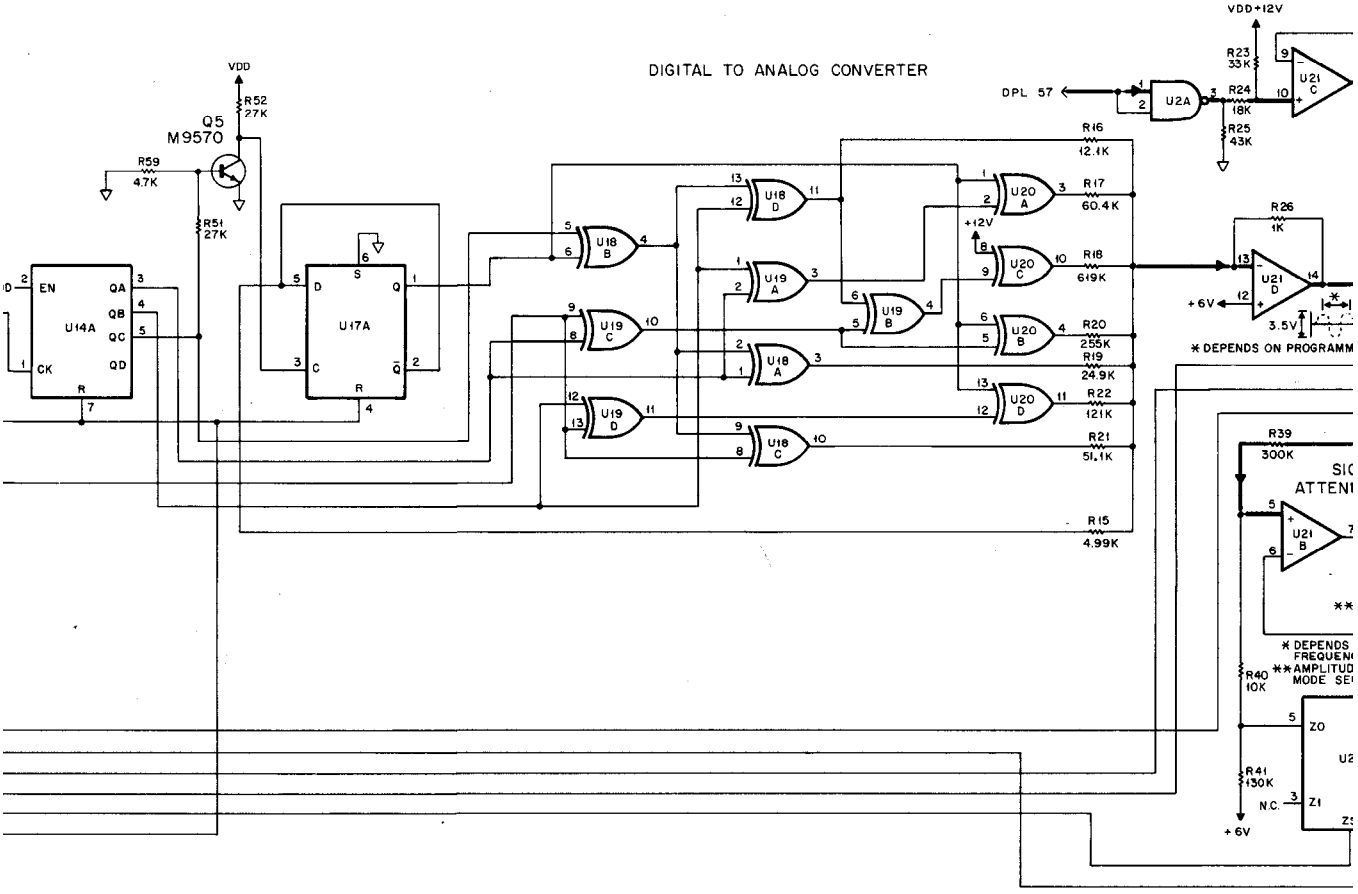
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF; + 100-10%; 25 V: unless otherwise stated
C1	21-840849	20 pF ± 5%; 500 V
C2	21-863291	1500 pF ± 2%; 500 V
C3	21-82537B49	3900 pF ± 1%; 100 V
C4	21-865956	220 pF ± 3%; 500 V
C5	23-84665F26	100; 16 V
C6	21-82428B21	.01 + 10-30%; 100 V
C7	23-84665F01	10
C8	21-82428B21	.01 + 10-30%; 100 V
C9	23-84665F01	10
C10	21-82428B21	.01 + 10-30%; 100 V
C11	23-84665F01	10
C12	21-82372C03	0.1 + 80-20%; 25 V
C13 thru 34	21-82428B21	.01 + 10-30%; 100 V
C35		NOT USED
C36	21-865452	680 pF ± 10%; 500 V
C37, 38	21-82187B20	.001 ± 10%; 100 V
C39	21-865922	390 pF ± 10%; 500 V
C40	21-82187B20	.001 ± 10%; 100 V
C41	21-82428B21	.01 + 10-30%; 100 V
		coil, rf:
L1	24-82549D03	choke; 1000 uH
		transistor: (see note)
Q1		NOT USED
Q2, 3	48-869570	NPN; type M9750
Q4		NOT USED
Q5	48-869570	NPN; type M9570
		resistor, fixed ± 5%; 1/4 W: unless otherwise stated
R1 thru 11	6-11009C83	27k
R12, 13	6-11009C49	1k
R14		NOT USED
R15	6-80334A58	4.99k ± 1%
R16	6-80334A63	12.1k ± 1%
R17	6-80334A62	60.4k ± 1%
R18	6-80334A57	619k ± 1%
R19	6-80334A61	24.9k ± 1%
R20	6-80334A56	2.55k ± 1%
R21	6-80334A60	51.1k ± 1%
R22	6-80334A55	121k ± 1%
R23	6-11009C85	33k
R24	6-11009C79	18k
R25	6-11009C88	43k
R26	6-11009C49	1k
R27	6-80334A64	715k ± 1%
R28	6-80334A59	68.1k ± 1%
R29	6-11009C73	10k
R30	6-11009C67	5.6k
R31	6-80334A64	715k ± 1%
R32	6-80334A59	68.1k ± 1%
R33	6-11009C73	10k
R34	6-11009C67	5.6k
R35	6-80334A64	715k ± 1%
R36	6-80334A59	68.1k ± 1%
R37	6-11009C73	10k
R38	6-11009C67	5.6k
R39	6-11009D09	300k
R40	6-11009C73	10k
R41	6-11009D01	130k
R42	6-11009C77	15k
R43	6-11009C82	24k
R44, 45	6-83175C03	10k ± 1%; 1/8 W
R46		NOT USED
R47	6-11009C72	9.1k
R48	6-11009C80	20k
R49	6-11009C49	1k
R50	6-11009C42	510
R51, 52	6-11009C83	27k
R53	6-11009D14	470k
R54	6-11009C65	4.7k
R55, 56	6-11009C97	100k
R57, 58	6-11009C49	1k
R59	6-11009C65	4.7k
R60	6-11009C13	33
R61	6-11009C01	10
		integrated circuit: (see note)
U1	51-84561L42	dual decoder
U2, 3, 4	51-83627M04	quad open collector NAND gate
U5	51-82884L70	hex flip-flop
U6, 7, 8, 9	51-82884L15	quad latch
U10, 11, 12, 13	51-83627M59	4-bit BCD rate multiplier
U14	51-82884L07	dual binary counter
U15	51-82884L12	dual BCD counter
U16	51-82884L54	dual 4 to 1 multiplexer
U17	51-82884L13	dual D flip-flop
U18, 19, 20	51-82884L49	quad exclusive OR gate
U21	51-84561L75	quad operational amplifier
U22	51-82884L65	triple 2 to 1 multiplexer
U23	51-82884L54	dual 4 to 1 multiplexer
U24	51-84561L80	operational amplifier
U25	51-82884L13	dual D flip-flop

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		crystal: (see note)
Y1	48-80378A43	5.12 MHz
		mechanical parts
	45-80395A36	EJECTOR (ORG); 2 used
	14-84602K01	INSULATOR
	84-80377A87	PC BOARD

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.


2.56 MHZ
CLOCK GENERATOR
TO
U25-14
VDD +12V
R60
33
R57
1K
R47
9.1K
R50
510
R53
470K
C12
0.1
R55
100K
R54
47K
C38
.001
C37
.001
6.12V
8.8V
5.6V
CLOCK
5.6V
U25A
Q3
M9570
Q2
M9570
C1
20PF
JU11
Y1
5.12 MHZ
JU12
R48
20K
C36
680PF
0.2US
2.5V
5.7V
R49
1K
C39
390PF
R56
100K
R58
1K
ADDRESS
DECODER
VDD +12V
R1
27K
R2
27K
R3
27K
STB2 49
A2 53
A3 54
A0 55
A1 56
U1
U2D
U2C
U2B
BIT RATE
MULTIPLIERS
LEVEL SHIFTERS
VDD
+12V
R4
27K
R5
27K
R6
27K
R7
27K
R8
27K
R9
27K
R10
27K
R11
27K
D4 43
D5 44
D6 41
D7 42
D0 47
D1 48
D2 45
D3 46
U3D
U3A
U3C
U3B
U4D
U4A
U4C
U4B
U6
U7
U8
U9
U10
U11
U12
U13
BIT 1
BIT 2
BIT 4
BIT 8
10^3
10^2
10^1
10^0
JU1
JU2
JU3
JU4
JU5
JU6
FREQUENCY
PROGRAM LATCHES
CONTROL
LATCH
U5
PL/DPL
ATTEN IN
B
A
30 DB/10DB
RESET
+12V
R61
10
+12V 64
GND 71 72
+5 67 68
C9
10
C10
.01
R44
10K
R45
10K
C11
10
C41
.01
C7
10
C8
.01
VDD +12V
+6V
VCC +5V
UNUSED CIRCUIT
U25B
14013
DISTRIBUTED
C13
+5
VCC
+12
VDD
C13
.01
C14
.01
C17
.01
C18
.01

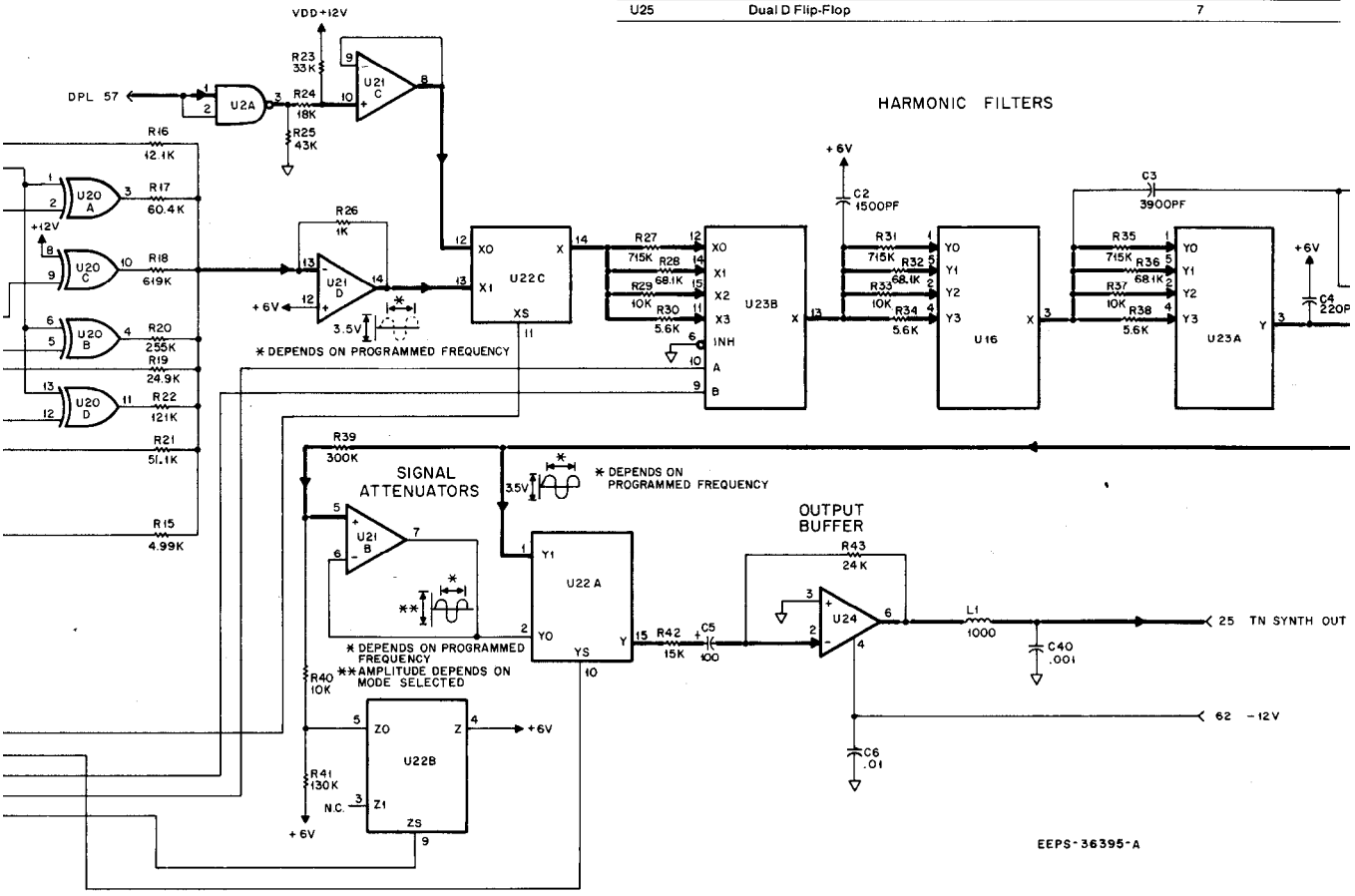

R57
1K
CLOCK
5.6V
U25A
R58
1K
BIT RATE
MULTIPLIERS
BIT 1 10^3
BIT 2
BIT 4
BIT 8
U10
JU1
JU2
BIT 1 10^2
U11
JU3
JU4
FREQUENCY
OGRAM LATCHES
BIT 1 10^1
U12
JU5
JU6
R13
1K
R12
1K
BIT 1 10^0
U13
JU7
* DEPENDS ON
PROGRAMMED
FREQUENCY
FREQUENCY DIVIDER AND
FOUR-TO-ONE SWITCH
VDD +12V
U14B
JU8
U15A
JU9
U15B
÷ 800
÷ 80
÷ 16
÷ 8
INH
U16
* DEPENDS ON
PROGRAMMED FREQUENCY
U17B
JU10
U14A
R5
4.7
DISTRIBUTED FILTER CAPACITORS
C13 THRU C34
+5
VCC
C13 .01
C14 .01
C15 .01
C16 .01
DIGITAL GROUND
+12
VDD
C17 .01
C18 .01
C33 .01
C34 .01
DIGITAL GROUND


DIGITAL TO ANALOG CONVERTER
VDD
VDD+12V
Q5
M9570
R52
27K
R59
4.7K
R51
27K
U14A
EN
CK
QA
QB
QC
QD
U17A
S
D
C
R
Q
U16 B
U16 D
U19 C
U19 D
U18 D
U19 A
U18 A
U18 C
U19 B
U20 A
U20 C
U20 B
U20 D
+12V
R16
12.4K
R17
60.4K
R18
619K
R20
255K
R19
24.9K
R22
121K
R21
51.1K
R15
4.99K
DPL 57
U2A
R23
33K
R24
18K
R25
43K
U21 C
R26
1K
U21 D
+6V
3.5V
* DEPENDS ON PROGRAMM
R39
300K
U21 B
R40
10K
R41
130K
N.C.
+6V
ZO
Z1

NOTES:

1. Unless otherwise indicated, all resistor values are in ohms, all capacitor values are in microfarads, and all inductor values are in microhenries.
2. IC types are TTL and CMOS devices.
3. Integrated circuit connections for this board are as follows:

Reference Designation	Mfgr's Description	VDD +12 V	VCC +5 V	Gnd	VBB −12 V
U1	Dual 2-to-4 Decoder		16	8	
U2, U3, U4	Quad Open Collector NAND		14	7	
U5	Hex D Flip-Flop	16		8	
U6, U7, U8, U9	Quad D Latch	16		8	
U10, U11, U12, U13	4-Bit BCD Rate Multiplier	16		8	
U14	Dual Binary Counter	16		8	
U15	Dual BCD Counter	16		8	
U16, U23	Dual 4-to-1 Multiplier	16		7, 8	
U17	Dual D Flip-Flop	14		7	
U18, U19, U20	Quad XOR	14		7	
U21	Quad Op Amp	4		11	
U22	Triple 2-to-1 Multiplier	16		6, 7, 8	
U24	Op Amp	7			4
U25	Dual D Flip-Flop			7	



TONE SYNTHESIZER BOARD (A12)

MODEL RTL4096A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST

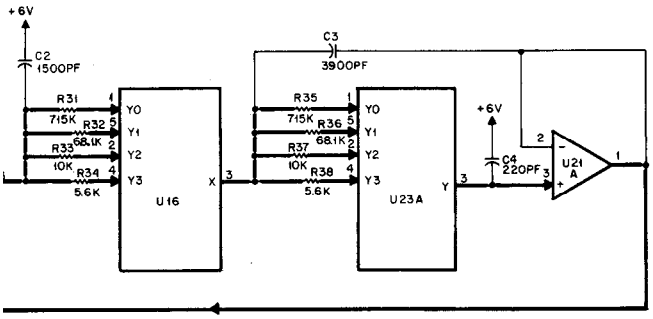
all resistor values are in ohms, all capacitor values
ductor values are in microhenries.

devices.

ns for this board are as follows:

r's Description	VDD +12 V	VCC +5 V	Gnd	VBB −12 V
Decoder		16	8	
Collector NAND		14	7	
Flop	16		8	
ch	16		8	
ate Multiplier	16		8	
Counter	16		8	
ounter	16		8	
Multiplier	16		7, 8	
Flop	14		7	
	14		7	
np	4		11	
Multiplier	16		6, 7, 8	
	7			4
Flop			7	

HARMONIC FILTERS



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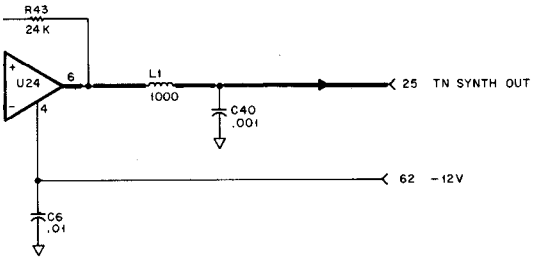
IFFER



EEPS-36395-A

TONE SYNTHESIZER BOARD

Motorola No. PEPS-36855-O
(Sheet 2 of 2)
8/12/83-PHI

MOTOROLA INC.
Communications
Sector

REFERENCE/AUDIO MODULE (A13) (TCXO/OCXO)

MODELS RTL4097A/RTL4098A

1. DESCRIPTION

The reference/audio module consists of the TCXO/OCXO board and the audio/speaker board. The reference/audio module contains: (1) the 10 MHz time base for the service monitor, (2) the audio amplifier and (3) the speaker. A standard (RTL4097A) temperature compensated crystal oscillator (TCXO) provides ±1 PPM stability. An optional (RTL4098A) oven compensated crystal oscillator (OCXO) is available which provides ±0.05 PPM stability over temperature variations.

2. THEORY OF OPERATION

2.1 TCXO/OCXO BOARD

Oscillator E1 generates a 10 MHz signal that is coupled to operational amplifier U1. The output of U1A is two 10 MHz signals 180° out-of-phase. The oscillator is driven by + 5 volts supplied through a pi-filter.

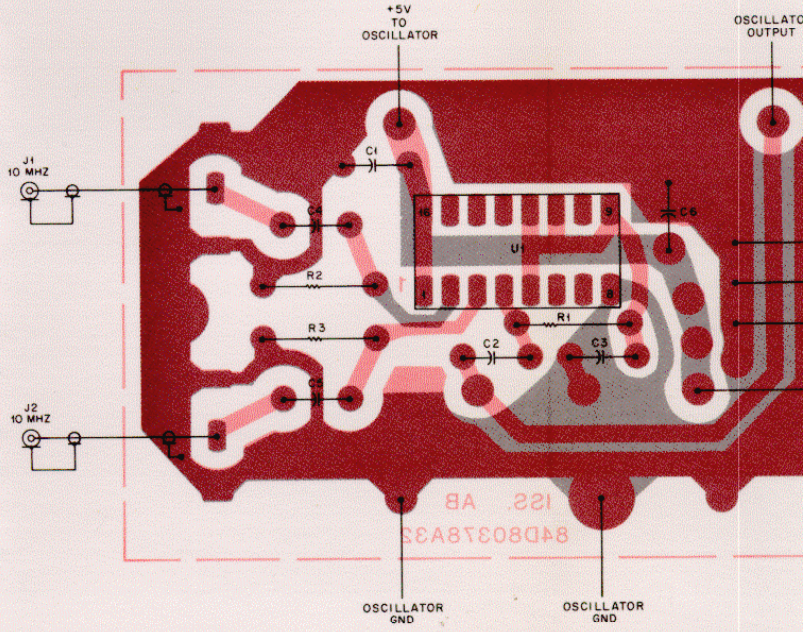
2.2 AUDIO AMPLIFIER BOARD

Audio is applied through buffer amplifier U1B and a driver circuit to the speaker. The output of U1 is buffered by transistor Q1, and the signal amplified by push-pull amplifier Q2 and Q3. The amplifier circuit is powered by a + 12 volt source.

REFERENCE/AUDIO MODULE (A13) (TCXO/OCXO)

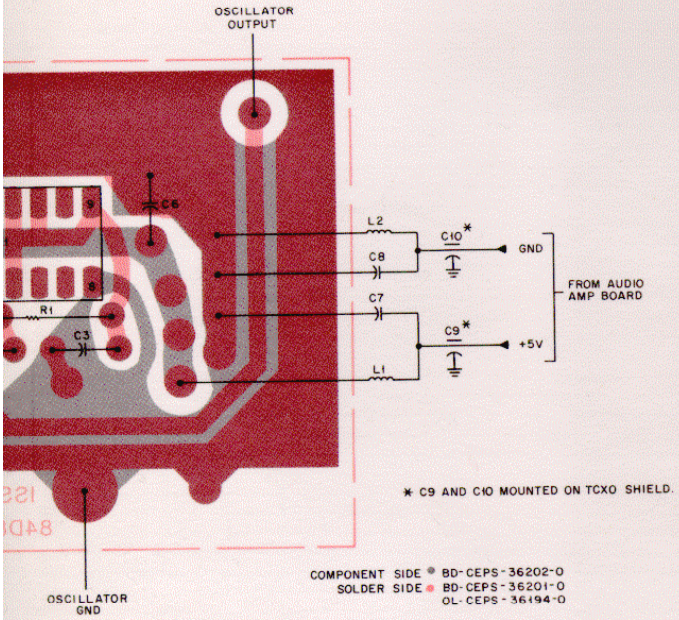
MODELS RTL4097A (TCXO)
RTL4098A (OCXO)
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST

TCXO/OCXO BOARD



SHOWN FROM COMPONENT SIDE

/OCXO BOARD

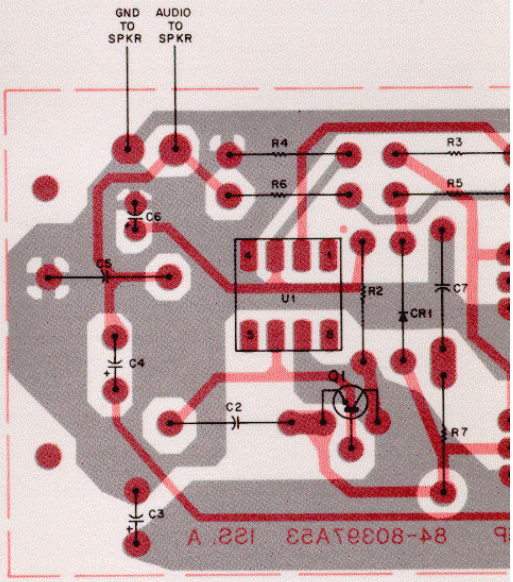


* C9 AND C10 MOUNTED ON TCXO SHIELD.

COMPONENT SIDE ● BD-CEPS-36202-0
SOLDER SIDE ● BD-CEPS-36201-0
OL-CEPS-36194-0

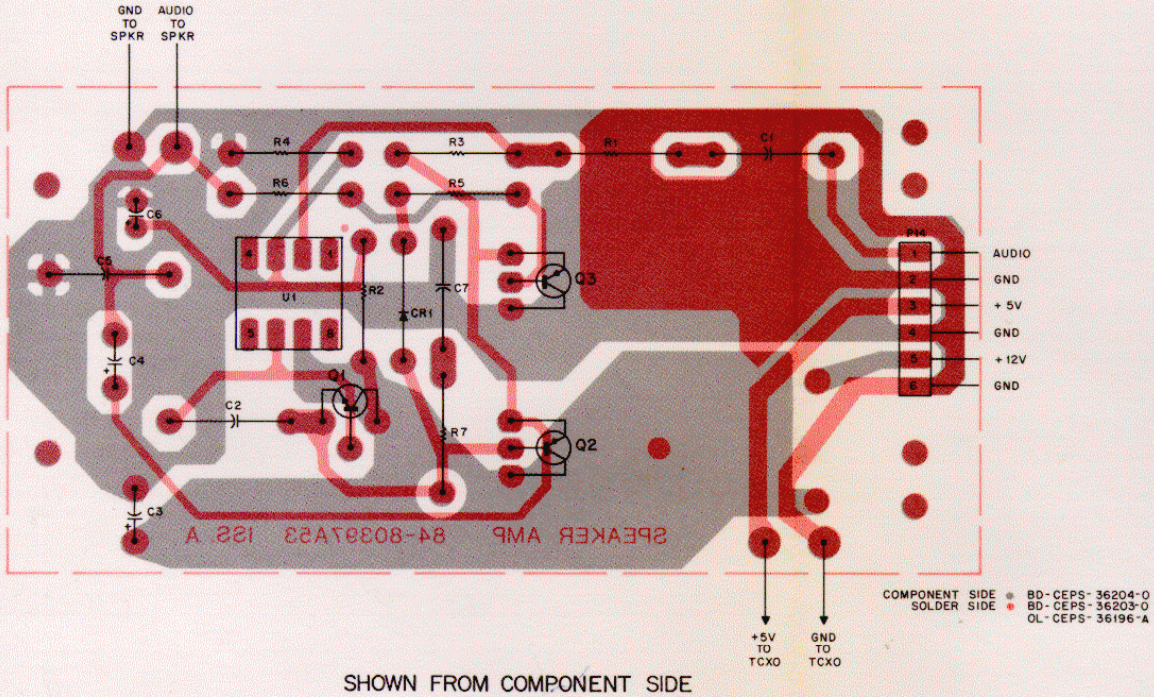
COMPONENT SIDE

AUDIO A



SHOWN FROM C

AUDIO AMPLIFIER BOARD



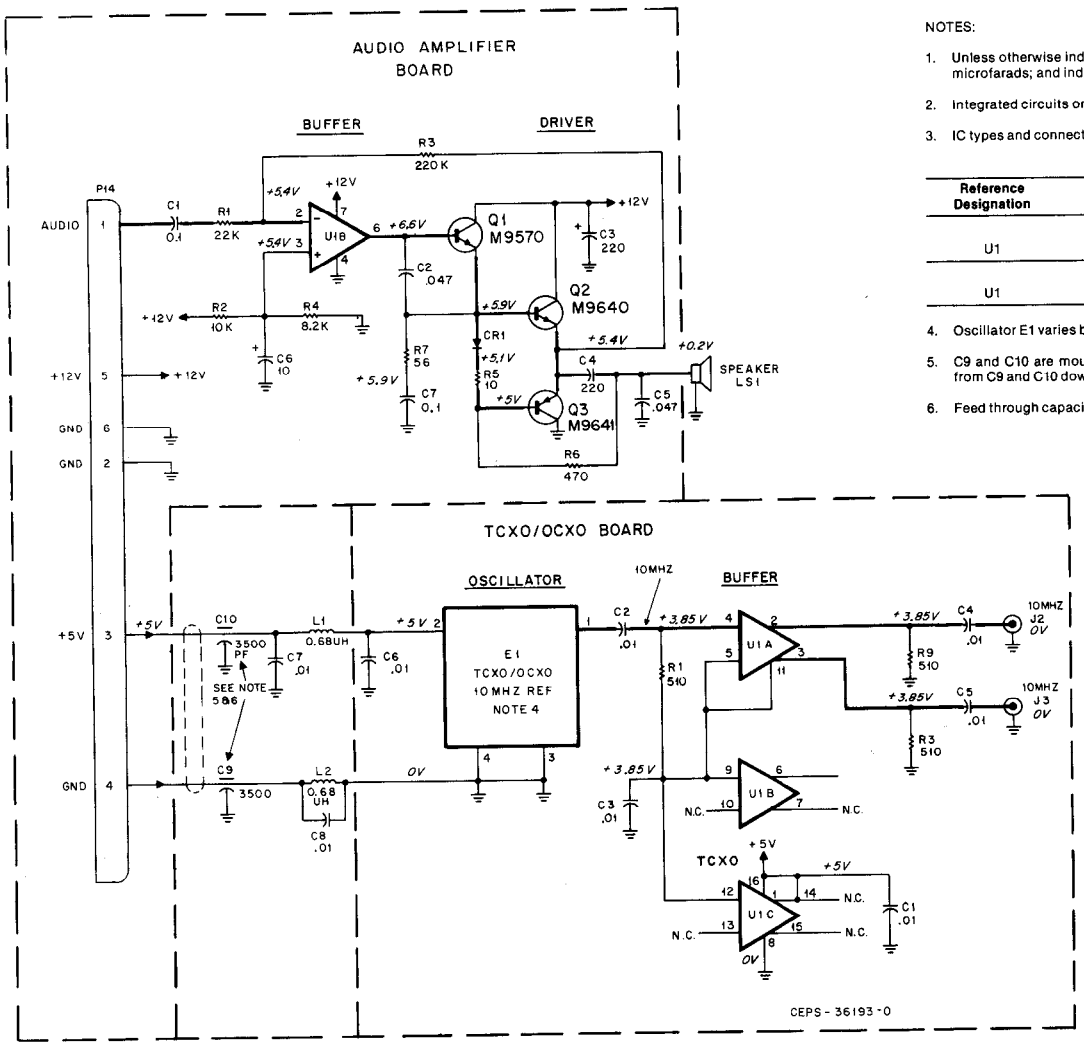
SHOWN FROM COMPONENT SIDE

parts list

RTL4097A TCXO Module
RTL4098A OCXO Module PL-8443-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Audio Amplifier Board
		capacitor, fixed: uF + 80-20%; 50 V: unless otherwise stated
C1	21-84448K03	0.1
C2	21-84448K05	.047
C3, 4	23-84665F06	220 uF + 150-10%; 25 V
C5	21-84448K05	.047
C6	23-84665F01	10 uF + 100-10%; 25 V
C7	21-84448K03	0.1
		diode: (see note)
CR1	48-83654H01	silicon
		connector:
P14	28-80397A52	male; 6-contact
		speaker:
LS1	50-83064J01	16 ohm
		transistor: (see note)
Q1	48-869570	NPN; type M9570
Q2	48-869640	NPN; type M9640
Q3	48-869641	PNP; type M9641
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1	6-124A81	22k
R2	6-124A73	10k
R3	6-124B06	220k
R4	6-124A71	8.2k
R5	6-124A01	10
R6	6-124A41	470
R7	6-124A19	56
		integrated circuit: (see note)
U1	51-84371K60	high slew-rate operational amplifier
		TCXO/OCXO Board
		capacitor, fixed:
C1 thru 8	21-832501	.01 uF + 60-40%; 250 V
C9, 10	21-84211B03	3500 pF; GMV; 500 V (feed-thru)
		oscillator:
E1	1-80308A92	10 MHz (RTL4097A only)
	1-80308A93	10 MHz (RTL4098A only)
		connector;
J2, 3	9-84231B02	female, single-contact (phono)
		coil, rf:
L1, 2	24-82549D17	choke; 0.68 uH
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1, 2, 3	6-124A42	510
		integrated circuit: (see note)
U1	51-80365A02	quad line driver
		mechanical parts
	2-7019	NUT, 4-40 × 1/4 × 3/32"; 4 used
	3-136785	SCREW, machine; 4-40 × 3/16"; 4 used
	3-139579	SCREW, machine; 4-40 × 5/16"; 2 used
	3-139581	SCREW, machine; 4-40 × 5/16"; 2 used
	3-131435	NUT, 4-40 × 1/4 × 3/32"; 5 used
	3-136886	SCREW, machine; 4-40 × 3/8"
	3-121047	SCREW, machine; 4-40 × 5/16; 2 used
	2-131865	NUT; 1/4-28 × 3/8 × 3/32"; 2 used
	7-80378A54	BRACKET
	7-80378A55	BRACKET
	26-80378A86	SHIELD
	29-82713M01	TERMINAL; 4 used
	32-80397A59	GASKET, 2 used
	35-80313A21	GRILLE, felt
	43-80370A69	SPACER, 4 used
	43-80397A61	SPACER, 2 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.



NOTES:

1. Unless otherwise indicated: resistor values i microfarads; and inductor values are in milli
2. Integrated circuits on this board are CMOS c
3. IC types and connections for this board are a

Reference Designation	Mfgr's Description
	Audio Amplifier Boa
U1	Operational Amplif
	TCXO/OCXO Boar
U1	Quad Line Driver 3-S

4. Oscillator E1 varies between TCXO and OCX
5. C9 and C10 are mounted on TCXO/OCXO s from C9 and C10 down to the PC board.
6. Feed through capacitors C9 and C10 are wir

REFERENCE/AUDIO MODULE (A13) (TCXO/OCXO)

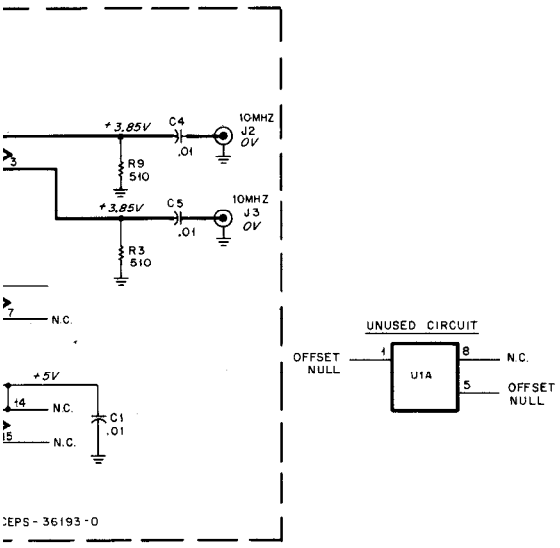
MODELS RTL4097A (TCXO)
RTL4098A (OCXO)
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST

NOTES:

1. Unless otherwise indicated: resistor values are in ohms; capacitor values are in microfarads; and inductor values are in millihenries.
2. Integrated circuits on this board are CMOS devices.
3. IC types and connections for this board are as follows:

Reference Designation	Mfgr's Description	+5 V	Gnd
	Audio Amplifier Board		
U1	Operational Amplifier	7	4
	TCXO/OCXO Board		
U1	Quad Line Driver 3-State	16, 1	8

4. Oscillator E1 varies between TCXO and OCXO. See Parts List.
5. C9 and C10 are mounted on TCXO/OCXO shield. L1, L2, C7 and C8 are wired from C9 and C10 down to the PC board.
6. Feed through capacitors C9 and C10 are wired to audio amp board.



REFERENCE/AUDIO MODULE

Motorola No. ***PEPS-36856-O***
(Sheet 2 of 2)
8/12/83-PHI

FRONT PANEL INTERFACE BOARD (A14)

MODEL RTL4100A

1. DESCRIPTION

The front panel interface (FPI) board provides the electrical interface between the front panel controls and displays and internal circuits. The keyboard, display module, and front panel switches are controlled via the FPI. Additional circuits on the FPI include buffering and ranging circuits for the oscilloscope input, modulation audio circuits, and the master reset.

2. THEORY OF OPERATION

2.1 KEYBOARD AND SWITCH MATRIX SCANNING

2.1.1 The front panel switch contacts (except the bandwidth switch) and the membrane keyboard contacts are arranged in a row and column matrix that is scanned by the microprocessor. The center pole of each switch is connected to the RØ-R7 lines from U1, and individual contacts on each switch are wired to lines CØ-C5. These lines are connected to +5 volts through resistors and also to the input bus of multiplexers U5 and U6.

2.1.2 Keyboard column lines KC1-KC3 are connected to the output of U2 and row lines KØ-K7 are connected to pull-up resistors and routed to the B port of U6. Four of the output lines from U2 are connected to pull-up resistors and used as load signals for output latches.

2.1.3 The microprocessor reads each row by setting address lines AØ-A3. The $\overline{\text{STBØ}}$ pulse sets the row line low and enables U5 and U6 on the data bus. Address A3 determines whether the multiplexers gate the keyboard or switch matrix data onto the bus. A low on the C- or K-lines indicates switch closure at the particular crosspoint. U5 and U6 invert the data in order to send a high to the microprocessor.

2.1.4 The microphone PTT line and the bandwidth switch are wired directly to U6. These lines are read anytime the switch matrix is addressed.

2.2 DISPLAY INTERFACE

The display interface consists of the LCD control latch, CD synthesizer mode indicator latch, and the LCD serial interface. Control lines CSA, CSB, and $\overline{\text{C}}$/D originate at the LCD control latch. Code synthesizer mode indication lines MØ-M3 are latched by U8. The parallel-to-serial converter is formed by five devices, U12, U13, U14, U15, and U31. This circuit applies the LCD CK, SCK, and SI signals. The LCD CK signal frequency is 170 kHz and is sent to both the display module and the LCD serial interface.

2.3 POWER DISTRIBUTION

Regulators U16 and U32 produce regulated ±8 volts to power the analog devices. Separate ground runners are used to minimize noise. U20B is a +7 volt reference source that is supplied to the display module and the master reset circuit.

2.4 MASTER RESET

2.4.1 The master reset circuit produces the signal that is used to initialize the service monitor on power-up. When power supplies drop below predetermined limits, the reset signal stops the microprocessor and serves to protect the battery-backed CMOS memory contents.

2.4.2 When power is first applied to the service monitor, capacitor C9 is discharged and transistor Q1 is turned on holding the $\overline{\text{P.O.R.}}$ (Power-On-Reset) low. As C9 charges, U17B switches and Q1 is turned off.

2.4.3 Comparators U17C and U17D monitor the +12 volt and +5 volt power supplies. When either voltage drops below predetermined values (+10.8 V dc or +4.7 V dc), Q6 is turned off and Q8 pulls $\overline{\text{P.O.R.}}$ low. When power is restored, Q7 discharges C9 to ensure that the proper delay occurs during reinitialization.

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1301 E. Algonquin Road, Schaumburg, Il. 60196

2.5 MODULATION AUDIO

Three sources are provided for simultaneous modulation of the rf output signal. The code synthesizer output is combined with the option card output (when installed); a filtered 1 kHz squarewave provides the fixed 1 kHz modulation source, and external modulation is provided by connecting a microphone to the front panel jack (MIC). The three level adjusted sources are combined by U23A and the composite signal is routed to the modulation display selector and the MOD line for internal distribution.

2.6 SCOPE INPUT

2.6.1 The oscilloscope step attenuator can be switched between internal audio sources and the external input. Analog switch U18 selects: (1) recovered audio when the monitor mode is selected, and (2) modulation when the GEN mode is selected. U18 is disabled when the step attenuator is connected to the external input.

2.6.2 Relays K8 and K3 are energized when the internal source is selected. K8 switches a load onto the external input when the step attenuator is being used to display modulation. K2 is energized when viewing the external input.

2.6.3 The step attenuator provides attenuation ranges of 1, .1, .01, and .001. The input impedance is 1 megohm with a 500 kHz bandwidth. A unity gain buffer amplifier drives the scope amplifier board. Signals controlling the modulation display selector and the scope input are latched by U8, U9, and U11. U10 and U33 drive the relays.

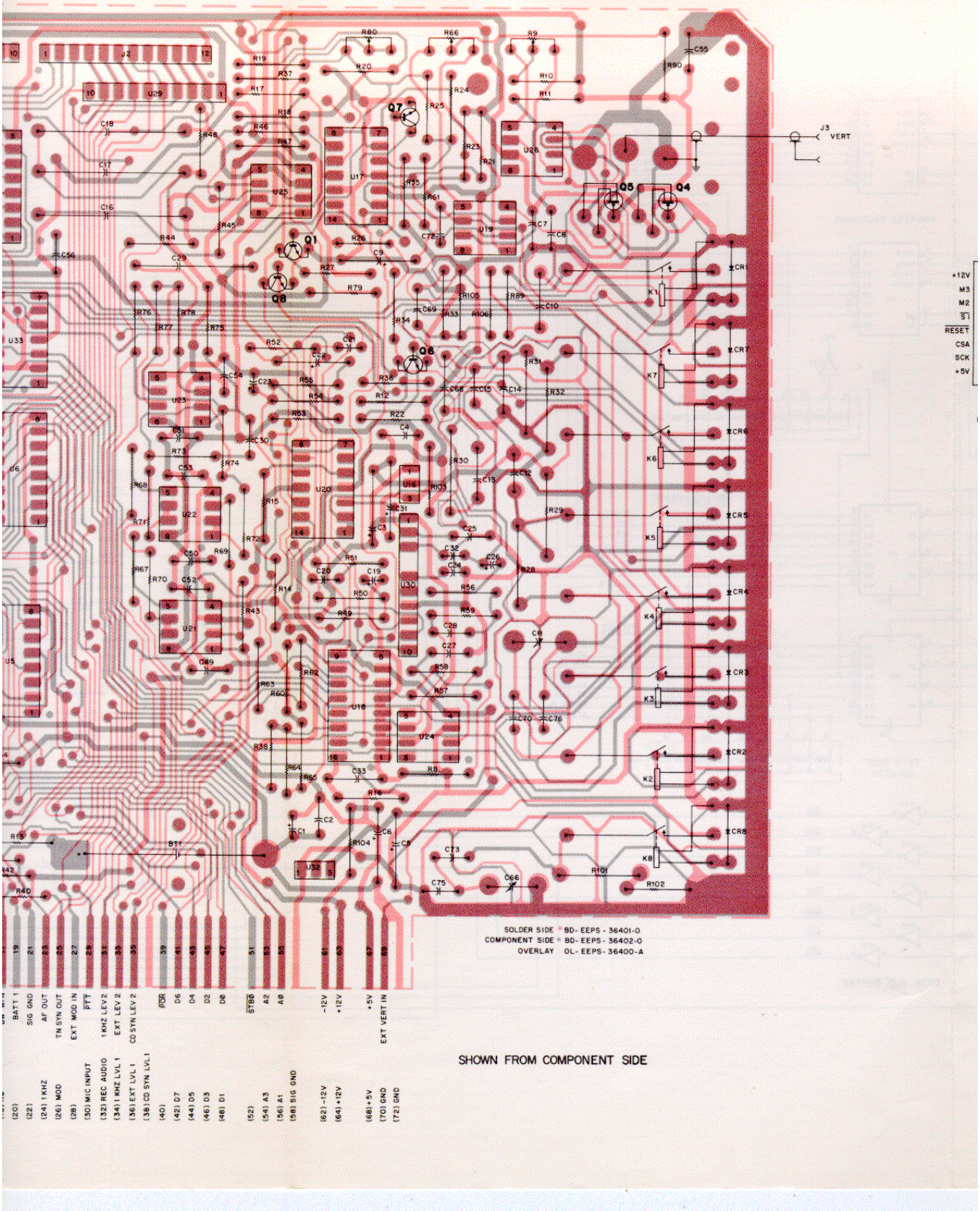
parts list

RTL4100A Front Panel Interface Board — PL-8460-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		battery:
BT1	RPX4258A	BATTERY; 3 V lithium
		capacitor, fixed:
C1	23-84665F01	10 uF + 100-10%; 25 V
C2	21-82428B21	.01 uF + 10-30%; 100 V
C3	23-84762H06	1 uF ± 20%; 35 V
C4	21-82428B21	.01 uF + 10-30%; 100 V
C5, 6	23-84762H06	1 uF ± 20%; 35 V
C7	21-82372C03	0.1 uF + 80-20%; 25 V
C8	21-82428B21	.01 uF + 10-30%; 100 V
C9	23-84762H06	1 uF ± 20%; 35 V
C10	8-84637L06	6800 pF + 5%; 630 V
C11	20-34307A11	variable; 5.5, 18 pF
C12	21-84494B11	200 pF ± 5%; 500 V
C13	21-859773	2500 pF ± 5%; 500 V
C14	8-84637L09	.023 uF ± 5%; 400 V
C15	21-840047	150 pF ± 5%; 500 V
C16, 17, 18	8-84326A48	.022 uF ± 1%; 50 V
C19	23-84665F01	10 uF + 100-10%; 25 V
C20	8-11017A02	.0015 uF ± 5%; 50 V
C21	21-11014B47	82 pF ± 5%; 100 V
C22	23-84762H06	1 uF ± 20%; 35 V
C23	23-84665F01	10 uF + 100-10%; 25 V
C24	8-11017A02	.0015 uF ± 5%; 50 V
C25	21-11014B47	82 pF ± 5%; 100 V
C26	23-84665F01	10 uF + 100-10%; 25 V
C27	21-82187B14	100 pF ± 10%; 100 V
C28	21-84494B24	39 pF ± 5%; 500 V
C29	8-82096J21	.33 uF ± 10%; 250 V
C30	21-84494B16	330 pF ± 5%; 500 V
C31	23-84762H06	1 uF ± 20%; 35 V
C32	8-11017A03	.0022 uF ± 5%; 50 V
C33	21-82372C03	0.1 uF + 80-20%; 25 V
C34 thru 56	21-82428B21	.01 uF + 10-30%; 100 V
C66	20-34307A11	variable; 5.5-15 pF
C67		NOT USED
C68	8-84637L04	3300 pF ± 10%; 630 V
C69	21-865923	.001 uF ± 10%; 500 V
C70	21-859938	75 pF ± 5%; 500 V
C71		NOT USED
C72	21-82187B08	220 pF ± 10%; 500 V
C73	21-859938	75 pF ± 5%; 500 V
C74		NOT USED
C75	21-84494B24	39 pF ± 5%; 500 V
C76	21-859940	20 pF ± 5%; 500 V
		diode: (see note)
CR1 thru 8	48-83654H01	silicon
		relay:
K1 thru 8	80-80346A01	1 form "A"; coil res: 1k
		transistor: (see note)
Q1, 2, 3	48-869570	NPN; type M9750
Q4, 5	48-869831	field-effect; M9831
Q6, 7, 8	48-869570	NPN; type M9750
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1, 2, 3	6-11009C97	100k
R4	6-11009C25	100
R5	6-11009C83	27k
R6, 7	6-11009C73	10k
R8	6-11009C44	620
R9	18-83452F13	variable; 10k
R10	6-11009C57	2.2k
R11	6-11009C01	10
R12	6-11009C57	2.2k
R13	6-11009C35	270
R14, 15	6-11009C73	10k
R16	6-11009C49	1k
R17	6-10621D17	18.2k ± 1%; 1/8 W
R18	6-10621D42	33.2k ± 1%; 1/8 W
R19	6-10621D13	16.5k ± 1%; 1/8 W
R20	6-10621D42	33.2k ± 1%; 1/8 W
R21	6-11009C97	100k
R22	6-11009C81	22k
R23, 24	6-11009C83	27k
R25	6-11009C60	3k
R26	6-11009C59	2.7k
R27	6-11009C49	1k
R28	6-80390A80	1.82 meg ± .5%; 1/8 W
R29	6-80390A81	182k ± .5%
R30	6-80390A82	18.2k ± .5%
R31	6-80390A83	2.1k ± .5%
R32	6-80390A84	54.9k ± .5%
R33	6-11009D22	1 meg
R34	6-11009C59	2.7k
R35	6-83175C03	10k ± 1%; 1/8 W
R36	6-11009C59	2.7k
R37	6-11009C67	5.6k
R38	6-10621C72	6.34k + 1%; 1/8 W
R39		NOT USED
R40, 41	6-11009C73	10k
R42	6-11009C44	620
R43	6-11009C73	10k
R44	6-11009C70	7.5k
R45	6-11009C69	6.8k
R46	6-10621D48	38.3k ± 1%; 1/8 W
R47	6-10621B50	348 ± 1%; 1/8 W
R48	6-10621E05	147k ± 1%; 1/8 W
R49	6-11009C47	820
R50	6-11009C43	560
R51	6-10621C62	4.99k ± 1%; 1/8 W
R52	6-11009D02	150k
R53	6-10621C12	1.5k ± 1%; 1/8 W
R54	6-10621C17	1.69k ± 1%; 1/8 W
R55	6-11009D06	220k
R56	6-11009C91	56k
R57, 58	6-11009C66	5.1k
R59	6-11009C91	56k
R60	6-10621C15	1.62k ± 1%; 1/8 W
R61	6-10621D09	15k ± 1%; 1/8 W
R62	6-10621C61	4.87k ± 1%; 1/8 W
R63	6-10621D05	13.7k ± 1%; 1/8 W
R64	6-10621C34	2.55k ± 1%; 1/8 W
R65	6-10621C17	1.69k ± 1%; 1/8 W
R66	18-83452F13	variable; 10k
R67, 68, 69	6-11009C73	10k
R70	6-11009C53	1.5k
R71, 72	6-11009C62	3.6k
R73	6-11009C29	150
R74	6-11009C69	6.8k
R75	6-11009C67	5.6k
R76, 77	6-11009C73	10k
R78	6-124D38	4.7 meg ± 10%
R79	6-11009C73	10k
R80	18-83452F13	variable; 10k
R81		NOT USED
R82	6-11009C73	10k
R83	6-11009C83	27k
R84	6-11009C73	10k
R85, 86	6-11009C83	27k
R87, 88	6-11009C97	100k
R89	6-11009C43	560
R90	6-11009C71	8.2k
R91 thru 99	6-11009C83	27k
R100	6-11009C65	4.7k
R101	6-80390A80	1.82 meg ± .5%
R102	6-10621E18	200k ± 1%; 1/8 W
R103, 104	6-11009C01	10
R105	6-124B54	22 meg
R106	6-11009C57	2.2k
		integrated circuit: (see note)
U1, 2	51-84561L47	dual 1 of 4 decoder
U3, 4	51-84561L03	hex inverter
U5, 6	51-82609M60	quad 2 to 1 multiplexer w/inverter; three-state output
U7	51-82884L05	quad NAND gate
U8, 9	51-82884L70	hex D flip-flop
U10	51-83629M08	quad operational amplifier
U11	51-82884L15	quad latch
U12	51-82884L33	8 bit parallel in/serial out shift register
U13	51-82884L13	dual D flip-flop
U14	51-82884L17	triple NOR gate
U15	51-82884L35	decade counter
U16	51-80365A30	voltage regulator
U17	51-84371K74	quad comparator
U18	51-82884L54	dual 1 of 4 multiplexer
U19	51-80365A09	operational amplifier
U20	51-84561L75	quad operational amplifier
U21, 22, 23	51-80365A07	dual operational amplifier
U24	51-80365A09	operational amplifier
U25	51-80365A07	dual operational amplifier
U26	51-80365A09	operational amplifier
U27, 28, 29	51-82142K06	resistor network
U30	51-82142K14	resistor network
U31	51-84561L03	hex inverter
U32	51-80365A29	voltage regulator
U33	51-83629M08	quad operational amplifier
		mechanical parts
	7-80395A57	BRACKET, (right hand)
	7-80395A58	BRACKET, (left hand)
	42-80313A70	TIE WRAP
	45-80395A35	EJECTOR (BLK); 2 used
	75-80378A90	FOOT, rubber; 2 used
	84-80377A81	CIRCUIT BOARD
	28-84729L03	CONNECTOR, male, keyboard
	9-80330A49	CONNECTOR, 16-pin
	9-83250M01	CONNECTOR, female, phono-type

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

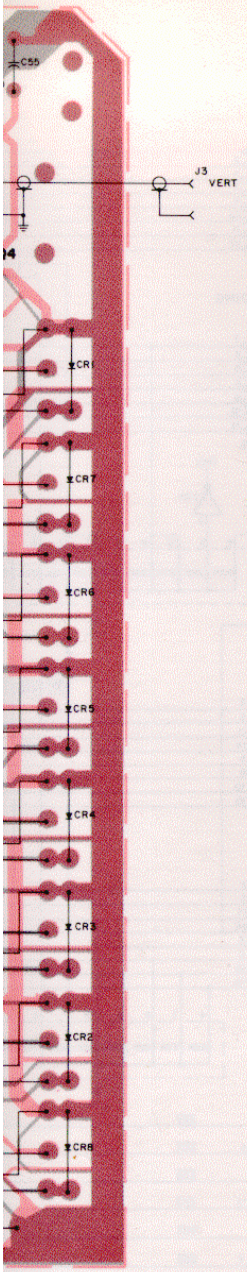
84D8037A88
152.48
COMPONENT SIDE
SOLDER SIDE
(2) LC BUSY
(4) 340 KHZ
(6) C4
(8) C2
(10) C0
(12) R6
(14) R4
(16) R2
(18) R0
(20)
(22)
(24) 1 KHZ
(26) MOD
(28)
(30) MIC INPUT
(32) REC AUDIO
(34) 1 KHZ LVL 1
(36) EXT LVL 1
(38) CD SYN LVL 1
(40)
(42) D7
(44) D5
(46) D3
(48) D1
(52)
(54) A3
(56) A1
(58) SIG GND
(62) -12V
(64) +12V
(68) +5V
(70) GND
(72) GND
C5
C3
C1
R7
R5
R3
R1
BW W/R
BATT 1
SIG GND
AF OUT
TN SYN OUT
EXT MOD IN
PTT
1 KHZ LEV 2
EXT LEV 2
CD SYN LEV 2
POR
D6
D4
D2
D0
STBB
A2
A0
-12V
+12V
+5V
EXT VERT IN



SHOWN FROM COMPONENT SIDE

FRONT PANEL INTERFACE BOARD (A14)

MODEL RTL4100A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



J1
DETAIL

+12V	1	16	GND
M3	2	15	M1
M2	3	14	MØ
$\overline{S1}$	4	13	CSB
$\overline{RESET}$	5	12	$\overline{C/D}$
CSA	6	11	$\overline{BSY}$
SCK	7	10	LCD CK
+5V	8	9	VREF

J2
DETAIL

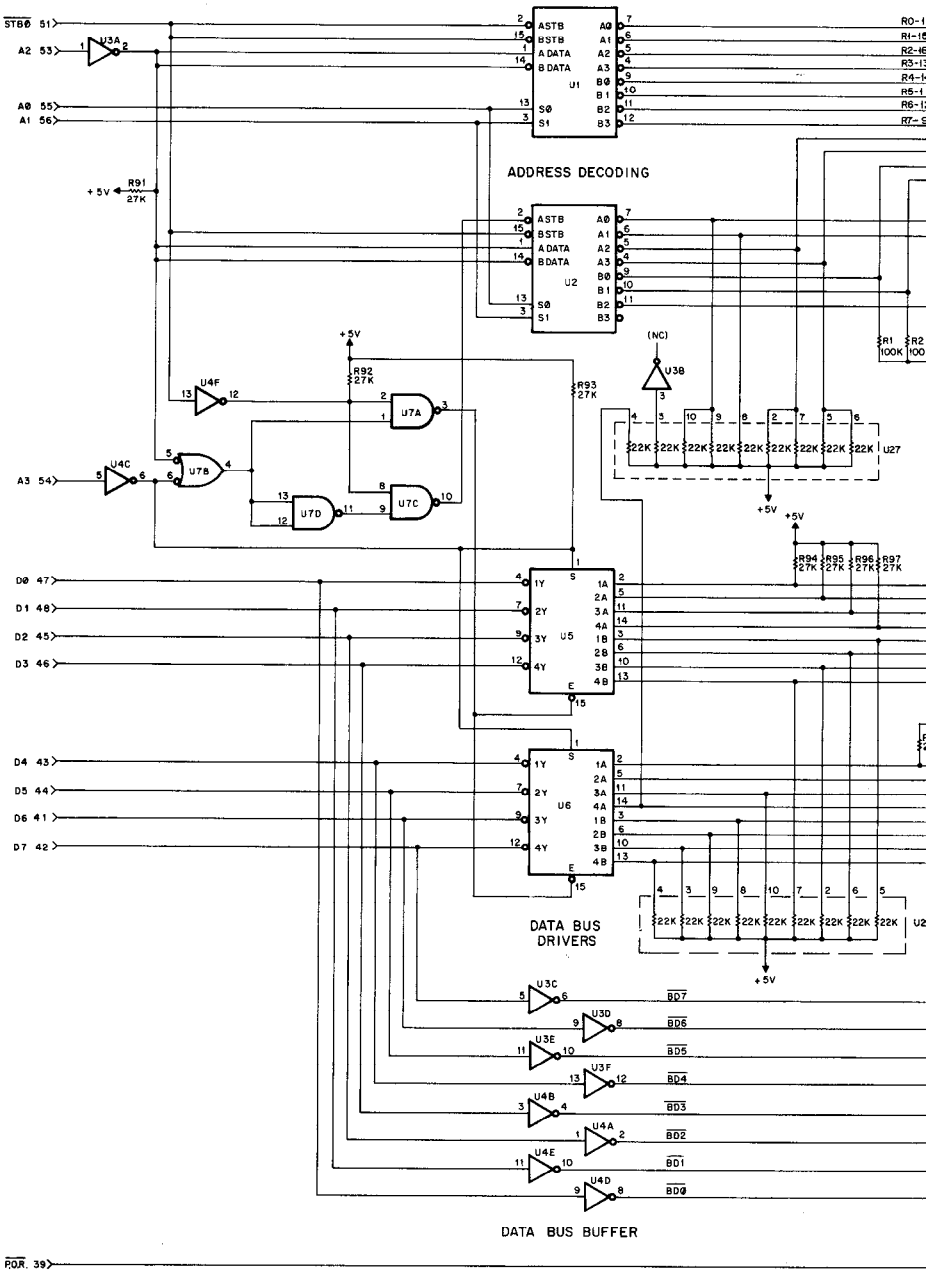
1	KC3
2	KC2
3	KC1
4	K5
5	K4
6	K3
7	KØ
8	K1
9	K7
10	K6
11	K2
12	GND

FRONT PANEL INTERFACE BOARD

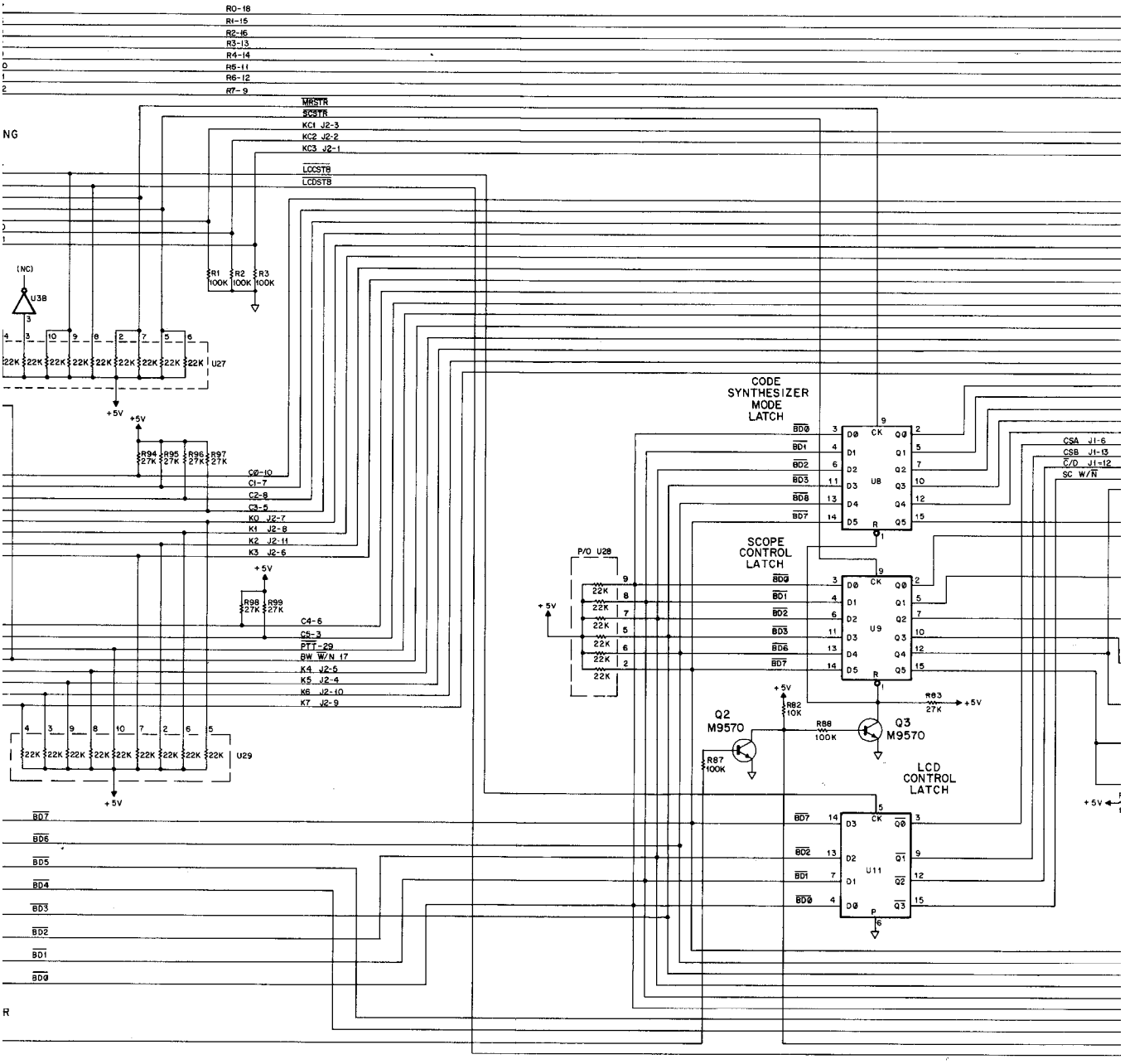
Motorola No. ***PEPS-36857-O***
(Sheet 1 of 3)
8/12/83-PHI

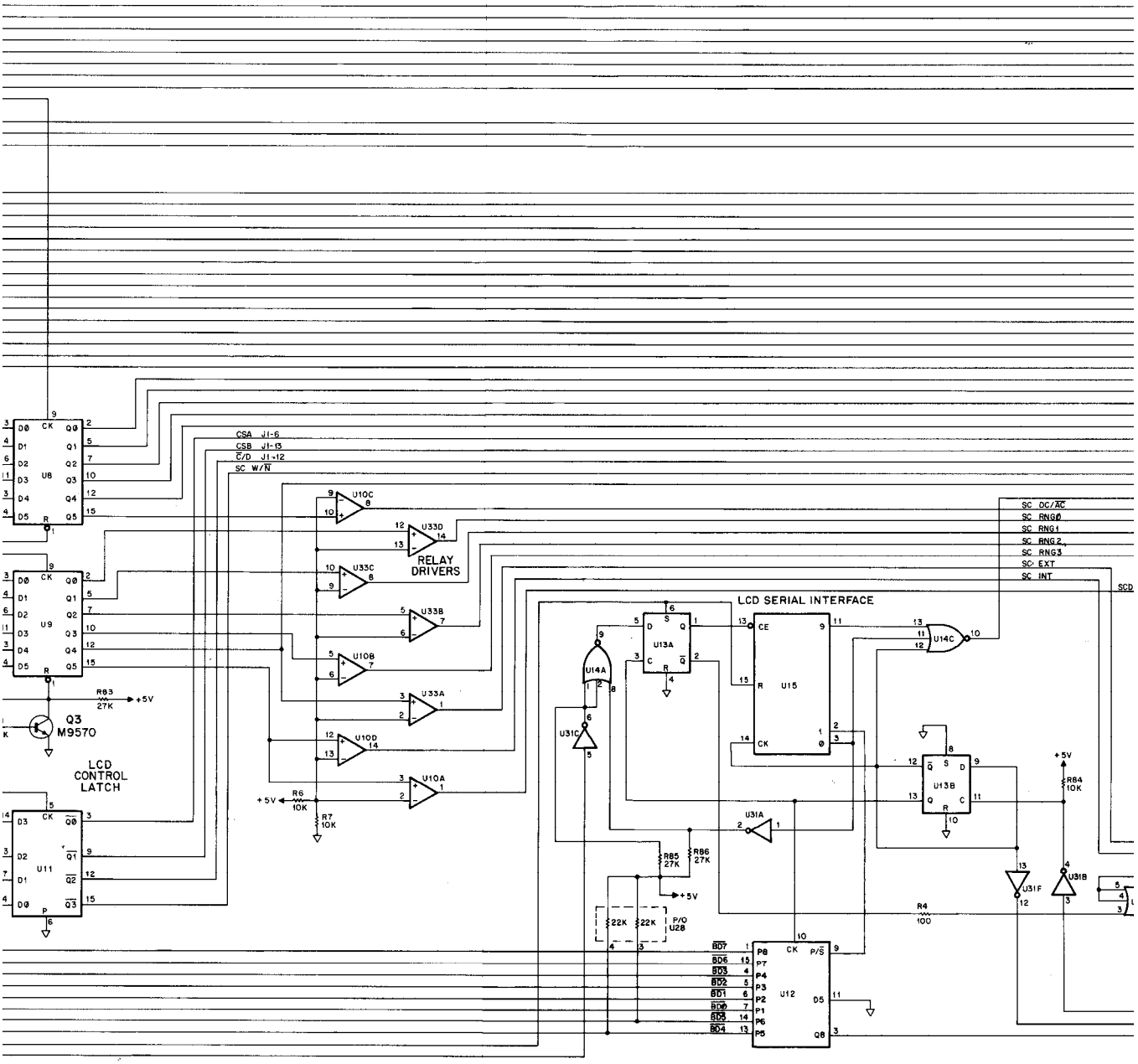
FRONT PANEL INTERFACE BOARD (A14)

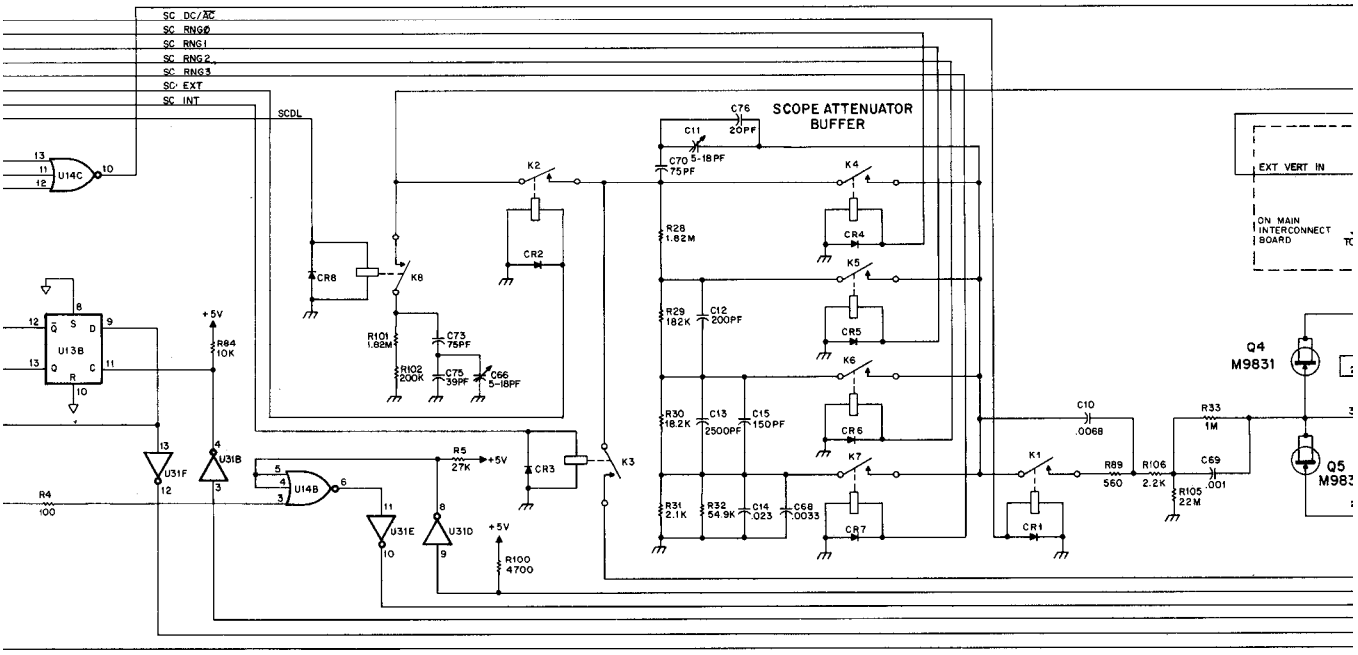
MODEL RTL4100A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST

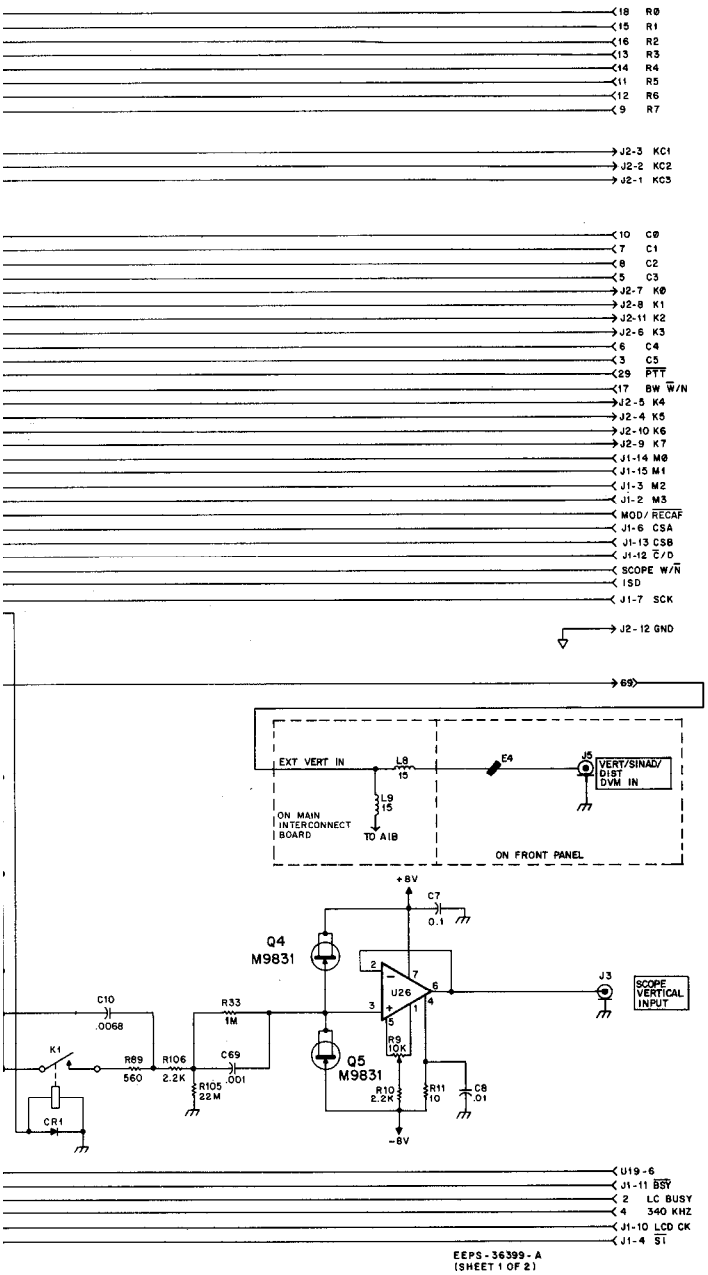


*Motorola No. **PEPS-36857-O***
(Sheet 2 of 3)
8/12/83-PHI

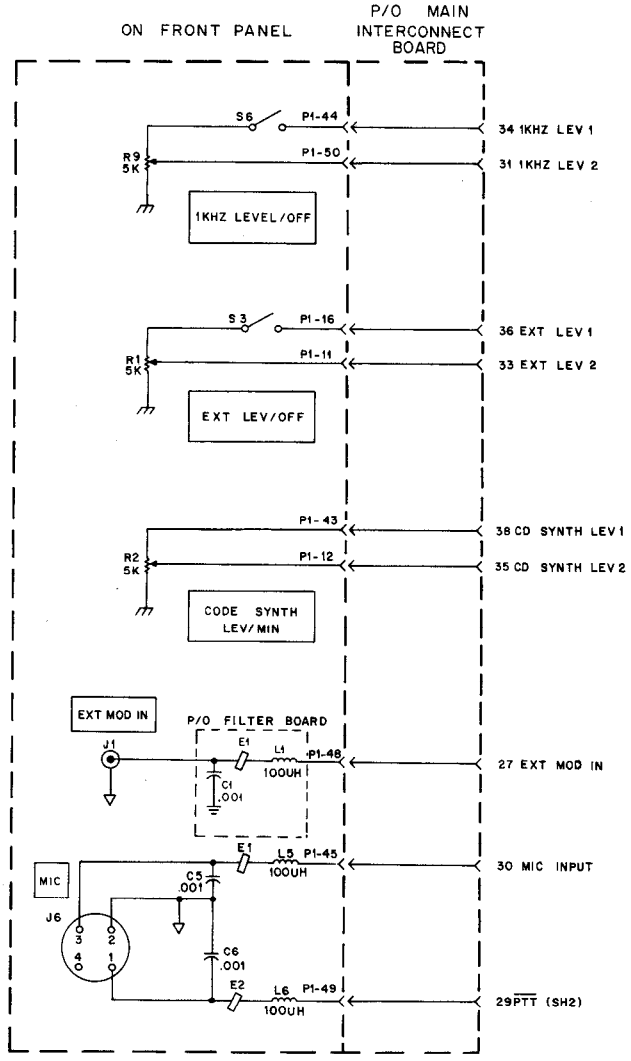

R0-18
R1-15
R2-16
R3-13
R4-14
R5-11
R6-12
R7-9
MRSTR
SCSTR
KC1 J2-3
KC2 J2-2
KC3 J2-1
LCDSTB
LCDSTB
R1 100K
R2 100K
R3 100K
(NC)
U38
22K
U27
+5V
R94 27K
R95 27K
R96 27K
R97 27K
C0-10
C1-7
C2-8
C3-5
K0 J2-7
K1 J2-8
K2 J2-11
K3 J2-6
R98 27K
R99 27K
C4-6
C5-3
PTT-29
SW W/N 17
K4 J2-5
K5 J2-4
K6 J2-10
K7 J2-9
U29
BD7
BD6
BD5
BD4
BD3
BD2
BD1
BD0
CODE SYNTHESIZER MODE LATCH
U8
SCOPE CONTROL LATCH
U9
P/O U28
22K
CSA J1-6
CSB J1-13
C/D J1-12
SC W/N
Q2 M9570
Q3 M9570
R87 100K
R88 100K
R82 10K
R83 27K
LCD CONTROL LATCH
U11

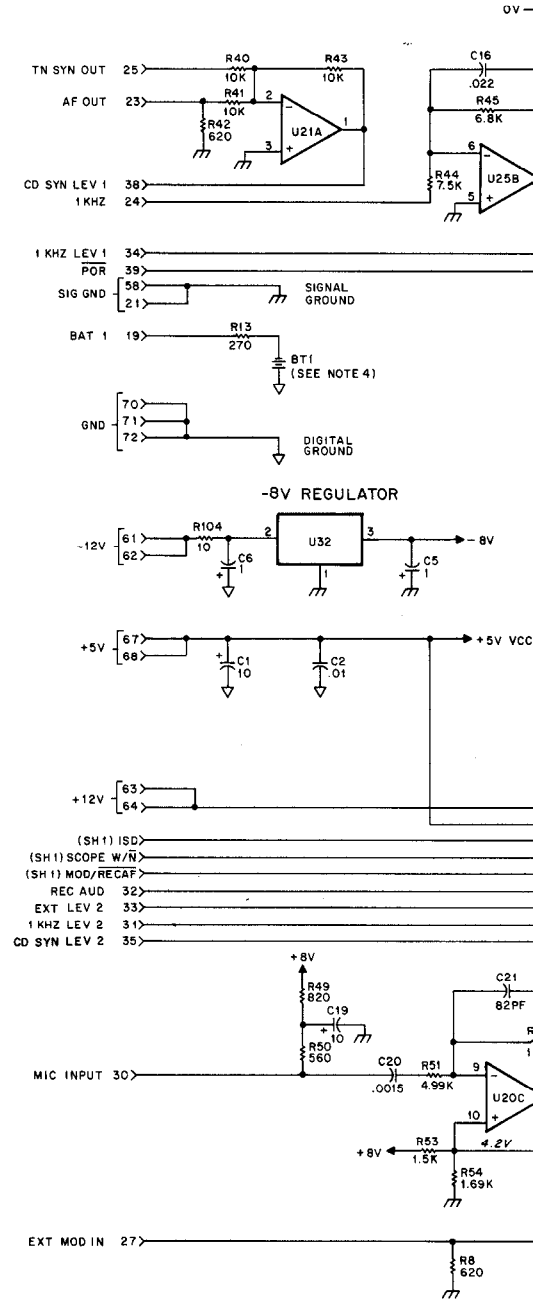

LCD CONTROL LATCH
RELAY DRIVERS
LCD SERIAL INTERFACE
U8
U9
U11
U12
U13A
U13B
U14A
U14C
U15
U10A
U10B
U10C
U10D
U33A
U33B
U33C
U33D
U31A
U31B
U31C
U31F
Q3
M9570
R63
27K
+5V
R6
10K
R7
10K
R85
27K
R86
27K
R84
10K
R4
100
22K
22K
P/O
U28
CSA J1-6
CSB J1-13
C/D J1-12
SC W/R
SC DC/AC
SC RNG0
SC RNG1
SC RNG2
SC RNG3
SC EXT
SC INT
SCD

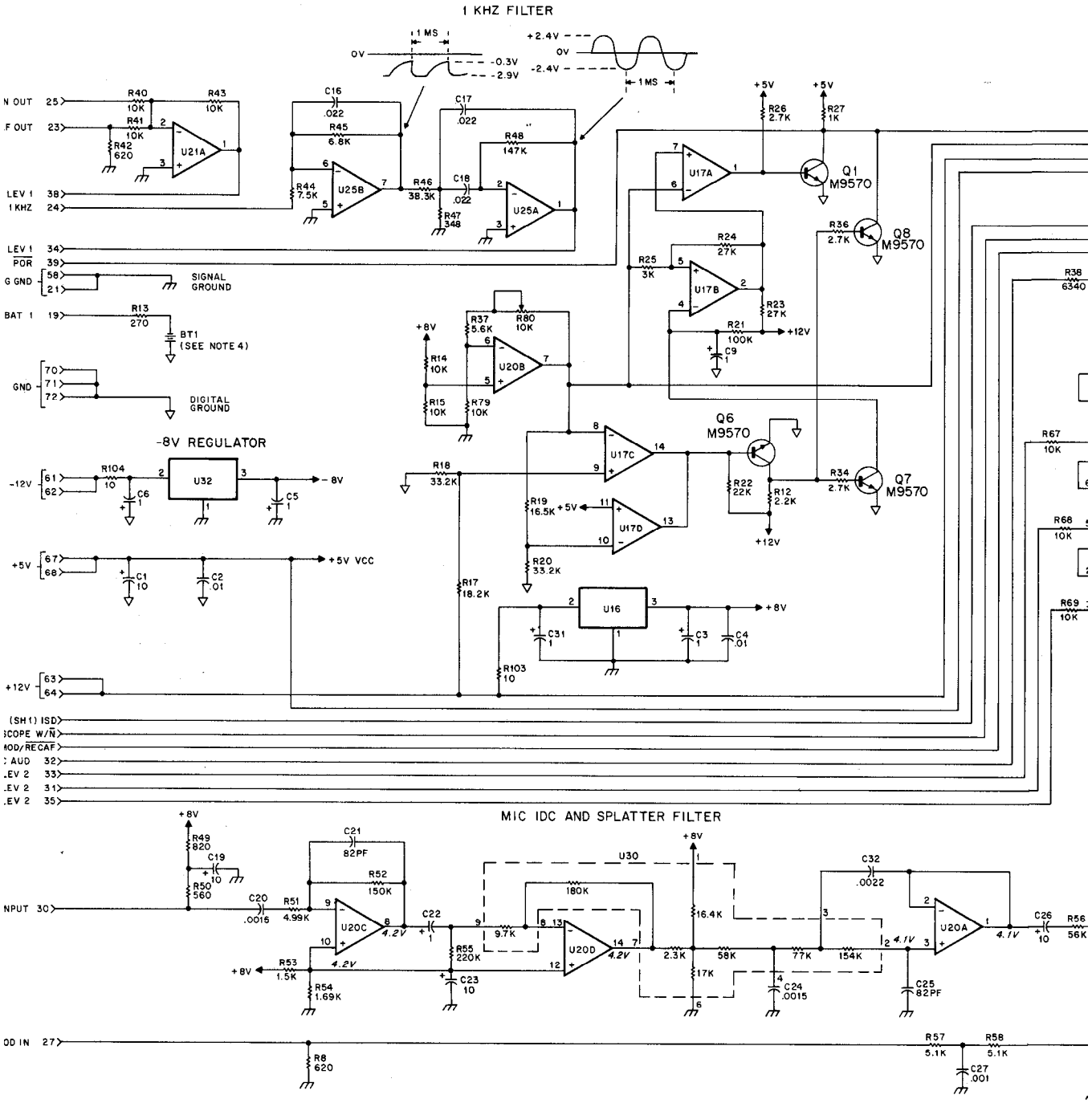

SC DC/AC
SC RNGØ
SC RNG1
SC RNG2
SC RNG3
SC EXT
SC INT
SCDL
SCOPE ATTENUATOR BUFFER
U14C
U13B
U31F
U31B
U14B
U31E
U31D
K1
K2
K3
K4
K5
K6
K7
K8
CR1
CR2
CR3
CR4
CR5
CR6
CR7
C76 20PF
C11
C70 5-18PF 75PF
R28 1.82M
R29 182K
C12 200PF
R30 18.2K
C13 2500PF
C15 150PF
R31 2.1K
R32 54.9K
C14 .023
C68 .0033
R101 1.82M
C73 75PF
R102 200K
C75 39PF
C66 5-18PF
R64 10K
R4 100
R5 27K
R100 4700
+5V
C10 .0068
R89 560
R106 2.2K
R105 22M
C69 .001
R33 1M
EXT VERT IN
ON MAIN INTERCONNECT BOARD
Q4 M9831
Q5 M983

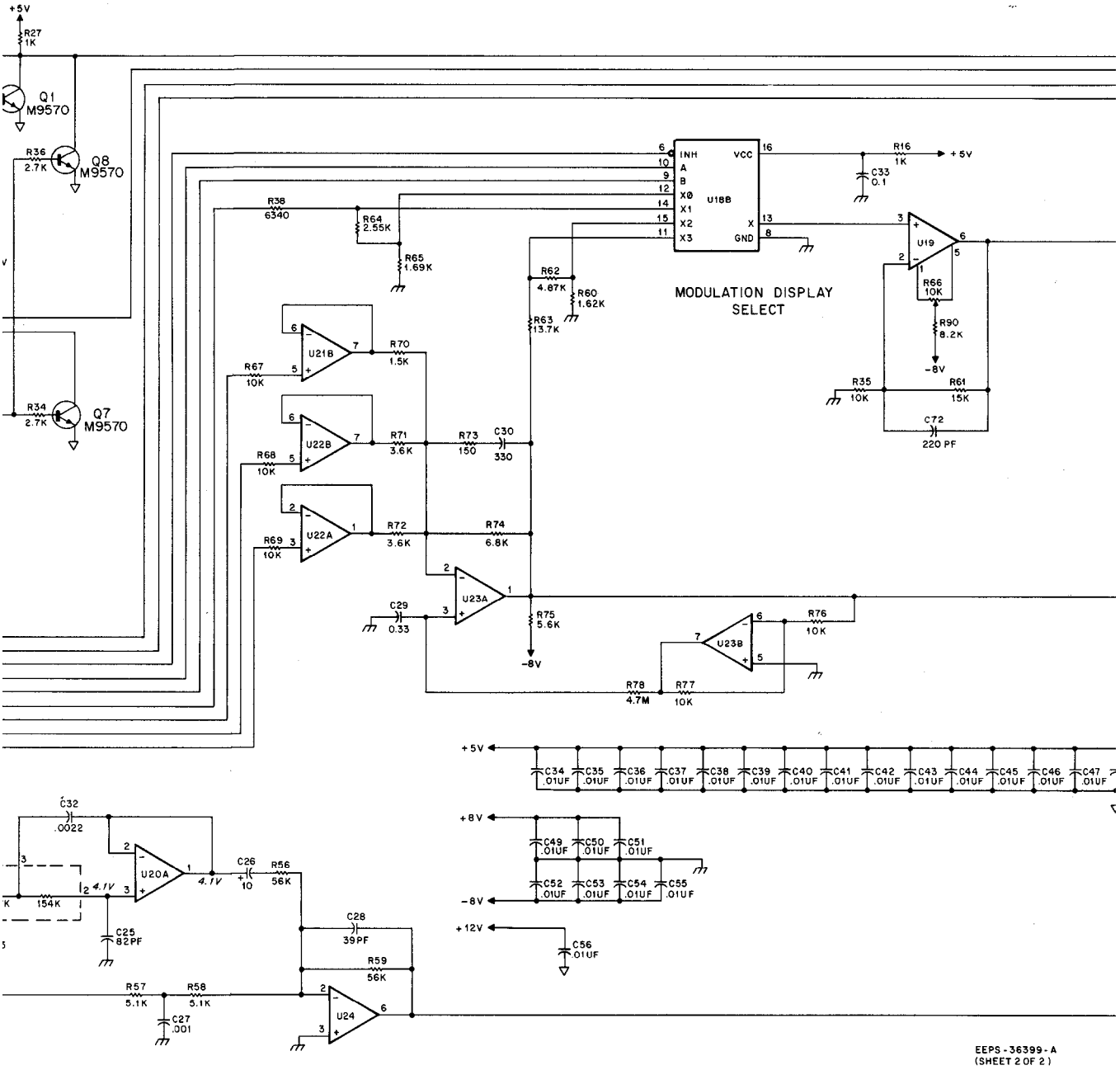


EEPS-36399-A
(SHEET 1 OF 2)

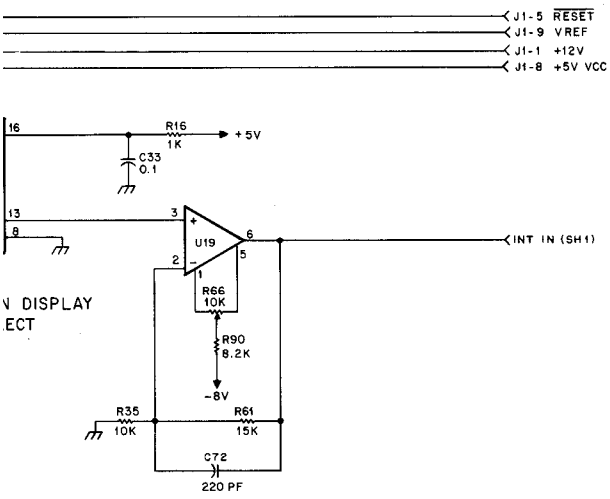

ON FRONT PANEL
P/O MAIN INTERCONNECT BOARD
S6
P1-44
34 1KHZ LEV 1
R9 5K
P1-50
31 1KHZ LEV 2
1KHZ LEVEL/OFF
S3
P1-16
36 EXT LEV 1
R1 5K
P1-11
33 EXT LEV 2
EXT LEV/OFF
P1-43
38 CD SYNTH LEV 1
R2 5K
P1-12
35 CD SYNTH LEV 2
CODE SYNTH LEV/MIN
EXT MOD IN
P/O FILTER BOARD
J1
E1
L1
P1-46
100UH
C1 .001
27 EXT MOD IN
MIC
E1
L5
P1-45
100UH
30 MIC INPUT
C5 .001
J6
C6 .001
E2
L6
P1-49
100UH
29 PTT (SH2)


0V
TN SYN OUT 25
AF OUT 23
R40 10K
R43 10K
R41 10K
R42 620
U21A
C16 .022
R45 6.8K
U25B
R44 7.5K
CD SYN LEV 1 38
1 KHZ 24
1 KHZ LEV 1 34
POR 39
SIG GND 58 21
SIGNAL GROUND
BAT 1 19
R13 270
BT1 (SEE NOTE 4)
GND 70 71 72
DIGITAL GROUND
-8V REGULATOR
-12V 61 62
R104 10
U32
C6 1
C5 1
-8V
+5V 67 68
C1 10
C2 .01
+5V VCC
+12V 63 64
(SH1) ISD
(SH1) SCOPE W/N
(SH1) MOD/RECAF
REC AUD 32
EXT LEV 2 33
1 KHZ LEV 2 31
CD SYN LEV 2 35
+8V
R49 820
C19 10
R50 560
C21 82PF
MIC INPUT 30
C20 .0015
R51 4.99K
U20C
4.2V
R53 1.5K
R54 1.69K
EXT MOD IN 27
R8 620

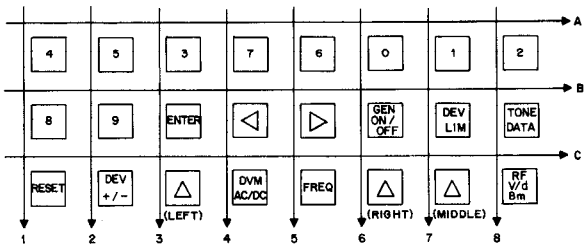

1 KHZ FILTER
1 MS
0V
-0.3V
-2.9V
+2.4V
0V
-2.4V
1 MS
N OUT 25
F OUT 23
LEV 1 38
1 KHZ 24
LEV 1 34
POR 39
G GND 58
21
SIGNAL GROUND
BAT 1 19
BT1 (SEE NOTE 4)
GND 70
71
72
DIGITAL GROUND
-8V REGULATOR
-12V 61
62
+5V 67
68
+5V VCC
+12V 63
64
(SH1) ISD
SCOPE W/N
MOD/RECAF
AUD 32
LEV 2 33
LEV 2 31
LEV 2 35
R40 10K
R41 10K
R42 620
R43 10K
U21A
C16 .022
R45 6.8K
U25B
R44 7.5K
R46 38.3K
C17 .022
R48 147K
C18 .022
U25A
R47 348
R13 270
R104 10
C6 1
U32
C5 1
C1 10
C2 .01
R37 5.6K
R80 10K
+8V
R14 10K
R15 10K
U20B
R79 10K
R18 33.2K
U17C
R19 16.5K
+5V
U17D
R20 33.2K
R17 18.2K
U16
C31 1
C3 1
C4 .01
R103 10
+8V
+5V
R26 2.7K
R27 1K
U17A
Q1 M9570
R36 2.7K
Q8 M9570
R24 27K
R25 3K
U17B
R23 27K
R21 100K
+12V
C9 1
Q6 M9570
R22 22K
R12 2.2K
R34 2.7K
Q7 M9570
+12V
R38 6340
R67 10K
R68 10K
R69 10K
MIC IDC AND SPLATTER FILTER
+8V
R49 820
C19 10
R50 560
INPUT 30
C20 .0016
R51 4.99K
C21 82PF
R52 150K
U20C
4.2V
C22 1
R55 220K
R53 1.5K
R54 1.69K
C23 10
U30
180K
9.7K
U20D
4.2V
+8V
16.4K
2.3K
58K
17K
C24 .0015
77K
154K
C32 .0022
U20A
4.1V
C25 82PF
C26 10
R56 56K
ODIN 27
R8 620
R57 5.1K
R58 5.1K
C27 .001

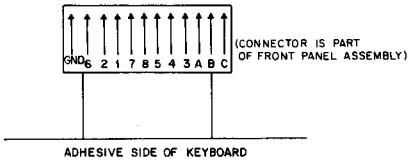


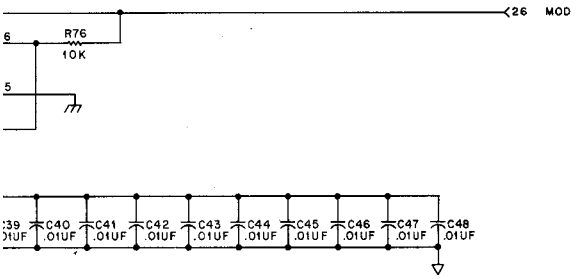
EEPS-36399-A
(SHEET 2 OF 2)



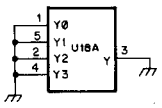
KEYBOARD MATRIX DETAIL







UNUSED GATE



LEGEND:

⏚ = DIGITAL GROUND

⏚ = SIGNAL GROUND

EEPS-36399-A
(SHEET 2 OF 2)

NOTES:

1. Unle milli
2. IC ty
3. Inte

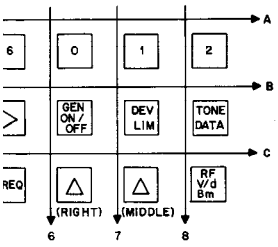
Re Des
U1, U2
U3, U4
U5, U6
U7
U8, U9
U10, U
U11
U12
U13
U14
U15
U16
U17
U18
U19
U20
U21, U
U23, U
U24, U
U32

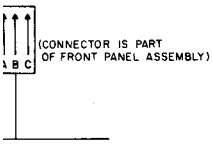
4. Rea

FRONT PANEL INTERFACE BOARD (A14)

MODEL RTL4100A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST

)ETAIL





:YBOARD

NOTES:

1. Unless otherwise indicated, all resistor values are in ohms, all capacitor values are in microfarads, and all inductors are in millihenries.
2. IC types are TTL and CMOS devices.
3. Integrated circuit connections for this board are as follows:

Reference Designation	Mfgr's. Description	−12 V	+12 V	+8 V	+5 V	Dig Gnd	Sig Gnd	−8 V
U1, U2	Dual 1 of 4 Decoder				16	8		
U3, U4, U31	Hex Inverter				14	7		
U5, U6	Quad 2 to 1 Multiplexer				16	8		
U7	Quad NAND				14	7		
U8, U9	Hex D Flip-Flop				16	8		
U10, U33	Quad Op Amp		4			11		
U11	Quad Latch				16	8		
U12	8-Bit Shift Register				16	8		
U13	Dual D Flip-Flop				14	7		
U14	Triple NOR				14	7		
U15	Decade Counter				16	8		
U16	Voltage Regulator		1	3			2	
U17	Quad Comparator		3			12		
U18	Dual 1 of 4 Multiplexer						8	7
U19	Op Amp			7				4
U20	Quad Op Amp		4				11	
U21, U22	Dual Op Amp			8				4
U23, U25	Dual Op Amp			8				4
U24, U26	Op Amp			7				4
U32	Voltage Regulator	2					1	3

4. Read the following WARNING and CAUTION regarding lithium batteries.

WARNING
Lithium Battery

The processor module within this system utilizes a lithium battery as a memory keep-alive voltage source. Do not mutilate or disassemble the battery cell. The lithium metal is a very active material that burns in the presence of water or high humidity. Do not put the battery in fire, attempt to charge, or heat above 100°C. Do not overdischarge the cell to a reverse voltage greater than 3 volts. The battery may burst and burn or release hazardous materials.

CAUTION
Lithium Battery

Lithium batteries are classified as hazardous materials and must be disposed of accordingly. Do not dispose of the battery by placing it in with the everyday trash. Consult state and local codes for the appropriate disposal procedure. Motorola will dispose of the battery if the expended battery is returned in the replacement battery container and by the same method that the new battery came to you, send to: Motorola Inc., Return Goods Department, 1313 East Algonquin Road, Schaumburg, IL 60196.

MOTOROLA INC.
Communications
Sector

FRONT PANEL DISPLAY BOARD (A15)

MODEL RTL4101A

1. DESCRIPTION

1.1 The front panel display board contains two liquid crystal displays (LCD) that present service data in both alphanumeric and graphic form. The front panel display board is a plug-in unit with power and data line connections to the front panel interface board.

1.2 The front panel display consists of two LCD's, 1-of-10 decoder, level shifters, display drivers, and a temperature compensating voltage regulator.

2. THEORY OF OPERATION

2.1 LIQUID CRYSTAL DISPLAY (LCD)

Each LCD is a segmented display with each of the 125 segments being multiplexed by voltage level drivers. The 125 segments are organized in a 32 × 4 matrix.

2.2 DISPLAY DRIVERS

The LCD multiplexing drive signals originate in drivers U1 and U2. Four backplane and 32 front plane drive signals are applied to the LCD module. The four different voltage levels required by the LCD are derived from the R1, R2, and R3 voltage divider.

2.3 ONE-OF-TEN DECODER

Front panels LED's are driven by the 1-of-10 decoder from inputs on the MØ-M3 data lines. The decoded signals cause U6 to output a low level on one of the ten output lines to light the appropriate LED.

2.4 SERIAL INTERFACE

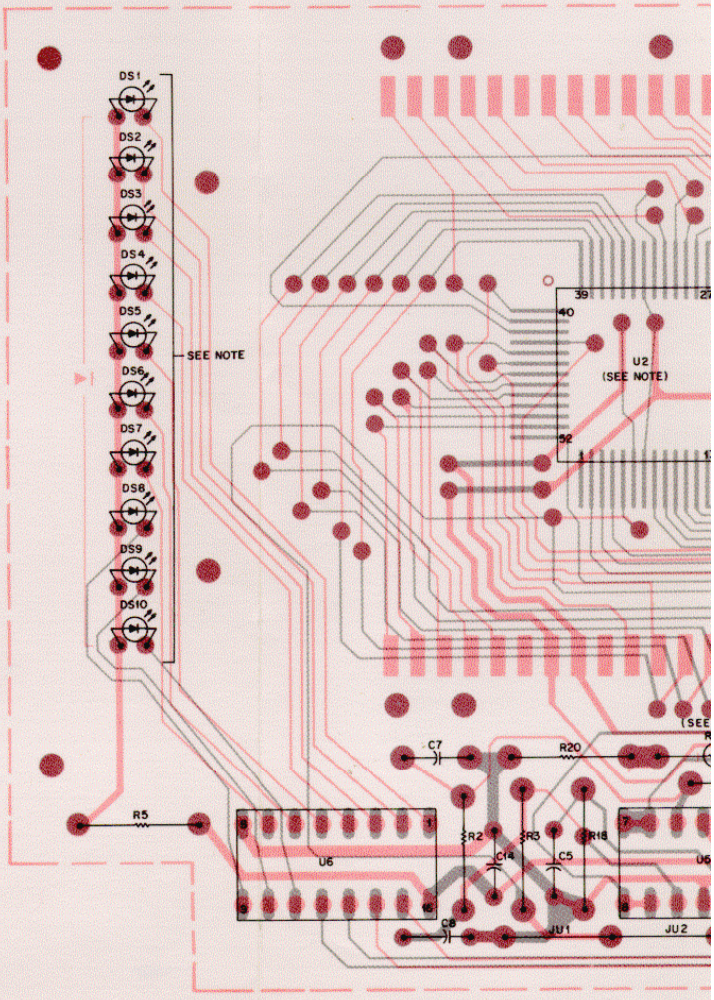
Display drivers U1 and U2 communicate with the front panel interface module via an 8-bit interface. Signals to level shifters U3 and U4 include a free running 170 kHz clock (LCD CK), a serial data stream ($\overline{SI}$), a control or data line ($\overline{C}$/D), a low level reset ($\overline{RESET}$), driver select CSA or CSB, serial data clock (SCK), and an output signal, $\overline{BSY}$.

2.5 TEMPERATURE COMPENSATION

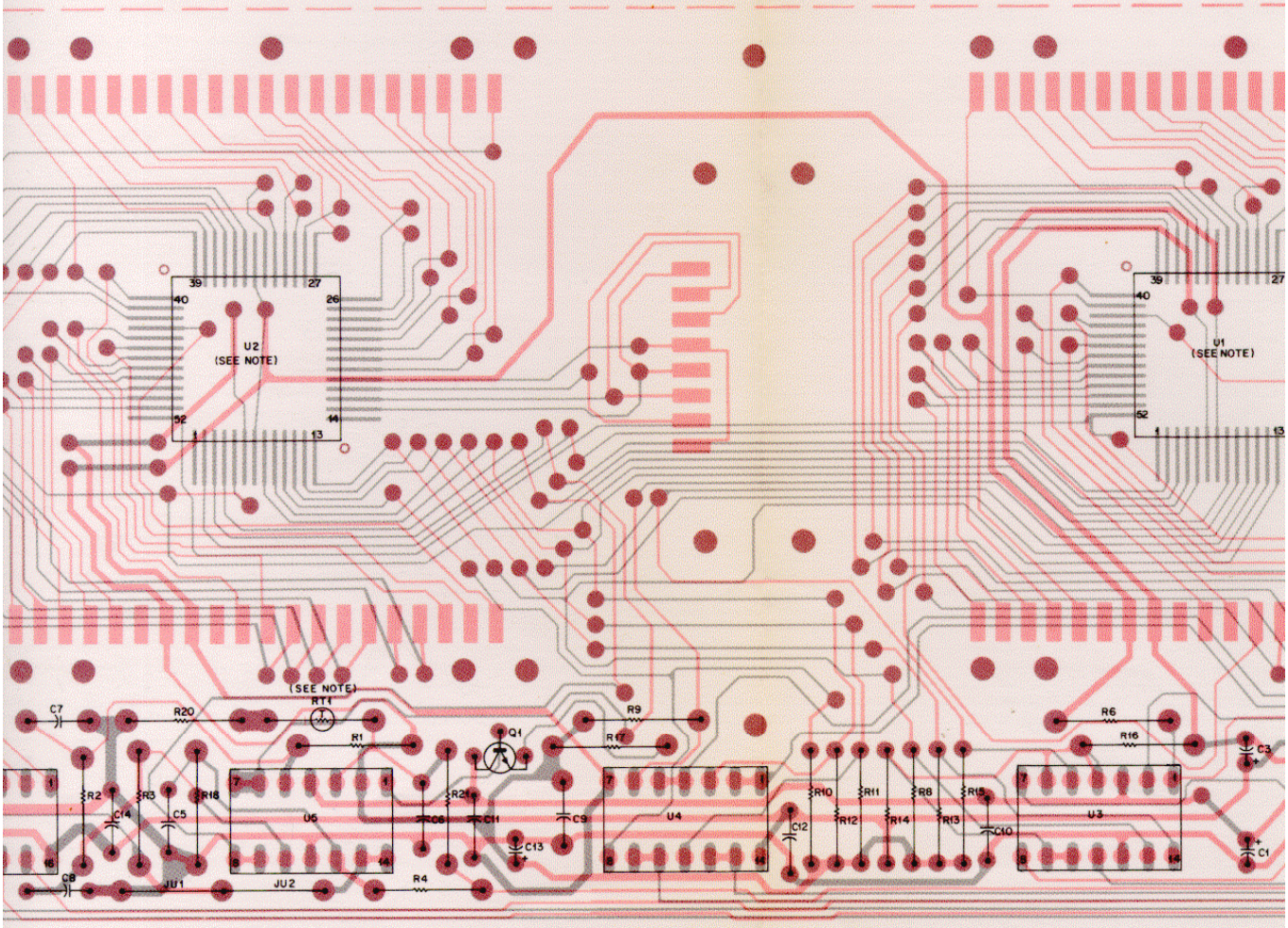
To maintain a stable presentation on the LCD, the reference voltage and U1 and U2 supply voltages are temperature compensated by regulator U5. Transistor Q1 provides current gain.

FRONT PANEL DISPLAY BOARD (A15)

MODEL RTL4101A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST

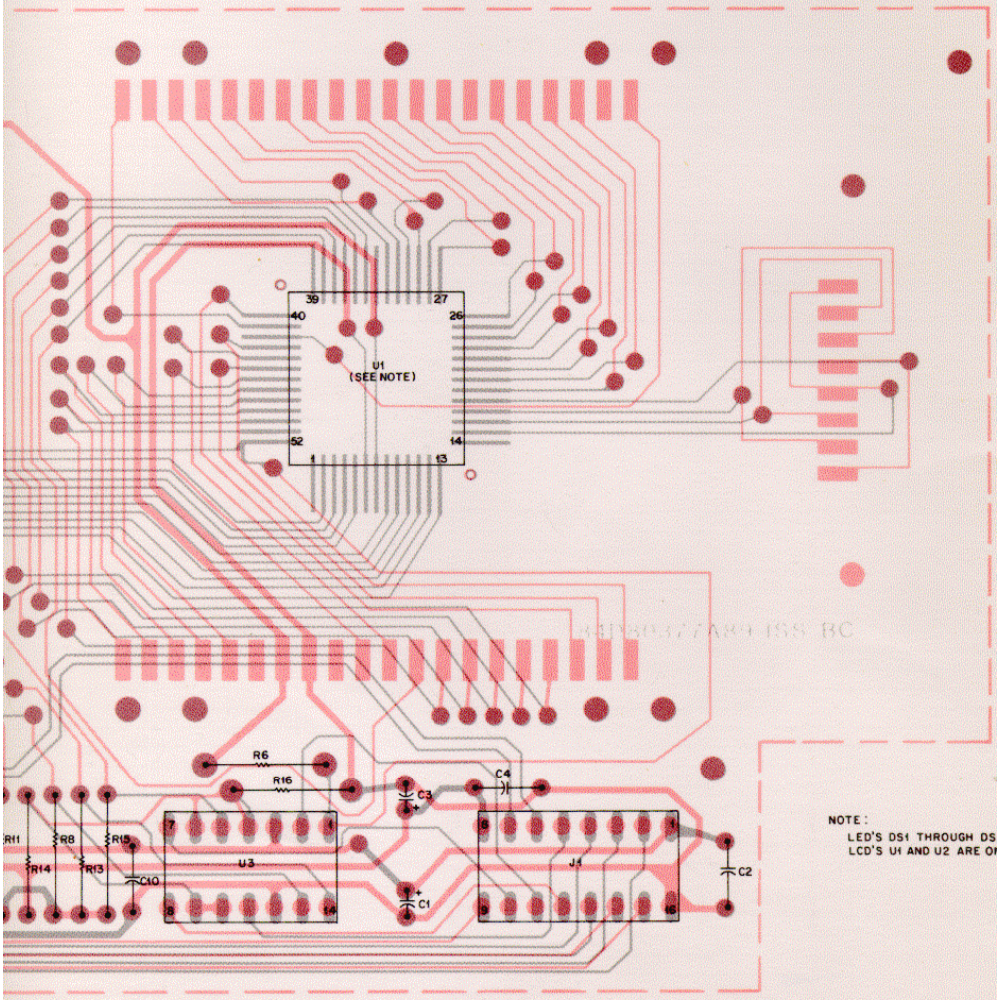


*Motorola No. **PEPS-36858-O***
(Sheet 1 of 2)
8/12/83-PHI



SHOWN FROM COMPONENT SIDE

COMPONENT SIDE ● BD-EE
SOLDER SIDE ● BD-EE
OL-EE

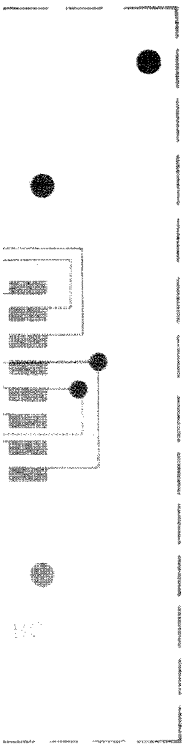


J1
DETAIL

+12V	1	16	GND
M3	2	15	M1
M2	3	14	M0
$\overline{S1}$	4	13	CBS
$\overline{RESET}$	5	12	$\overline{C/D}$
CSA	6	11	$\overline{BSY}$
SCK	7	10	LCD CK
+5V	8	9	VRSF

NOTE:
LED'S DS1 THROUGH DS10, THERMISTOR RT1, AND LCD'S U1 AND U2 ARE ON SOLDER SIDE.

COMPONENT SIDE - BD-EEPS-36394-0
SOLDER SIDE - BD-EEPS-36393-0
OL-EEPS-36392-A



J1
DETAIL

+12 V	1	16	GND
M3	2	15	M1
M2	3	14	MØ
$\overline{S1}$	4	13	CBS
$\overline{RESET}$	5	12	$\overline{C/D}$
CSA	6	11	$\overline{BSY}$
SCK	7	10	LCD CK
+5V	8	9	VRSF

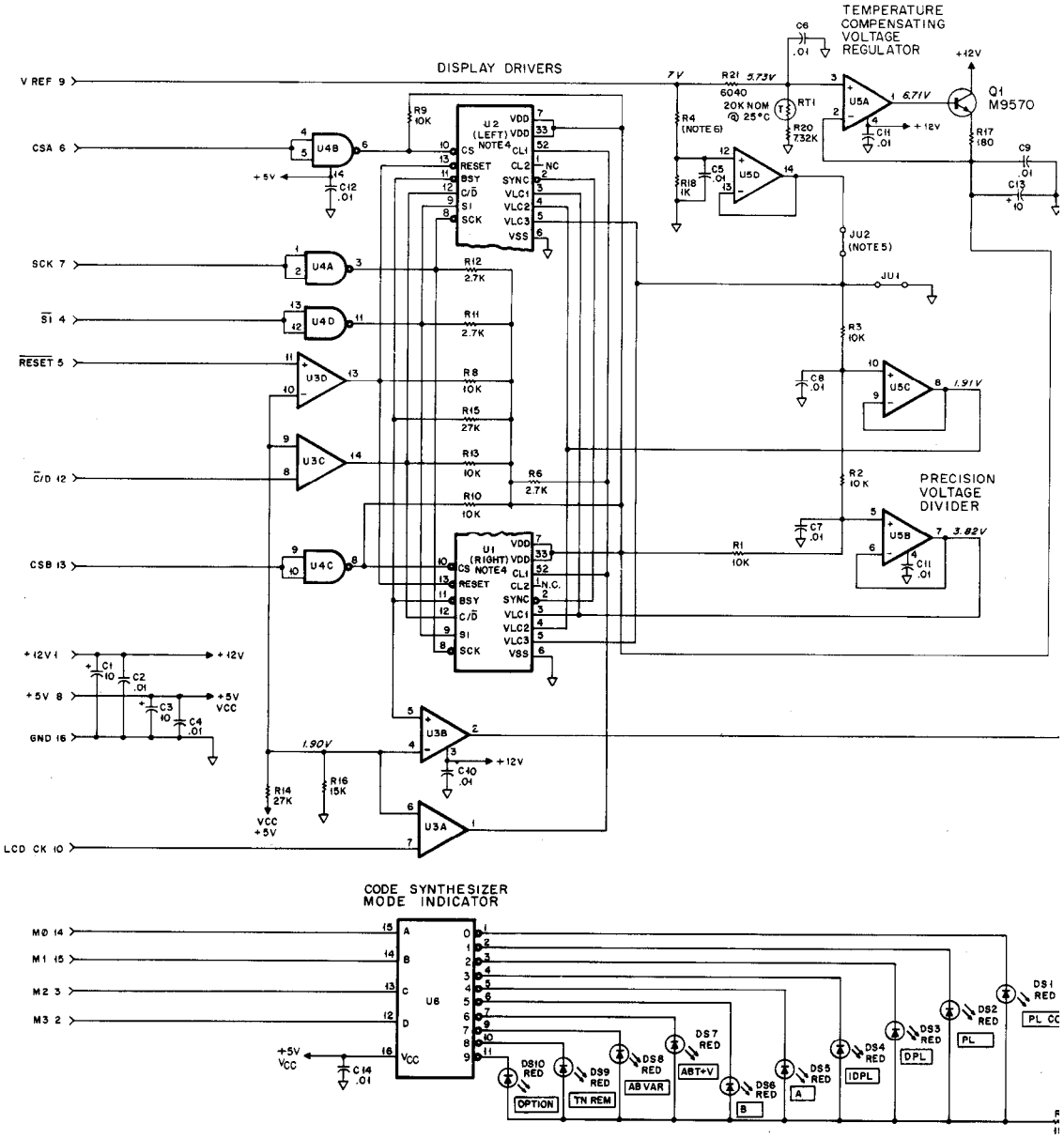
NOTE:
LED'S DS1 THROUGH DS10, THERMISTOR RT1, AND LCD'S, U1 AND U2 ARE ON SOLDER SIDE.

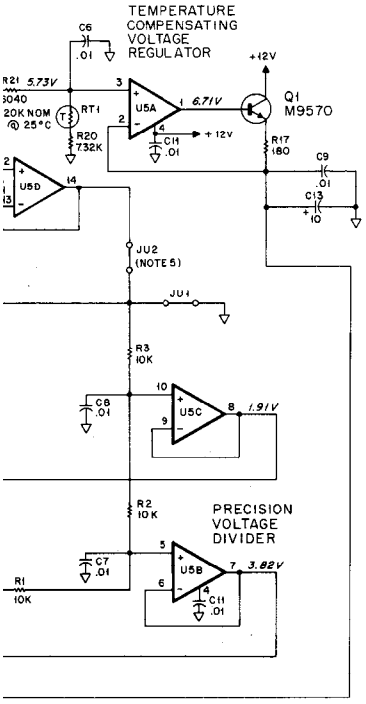
parts list

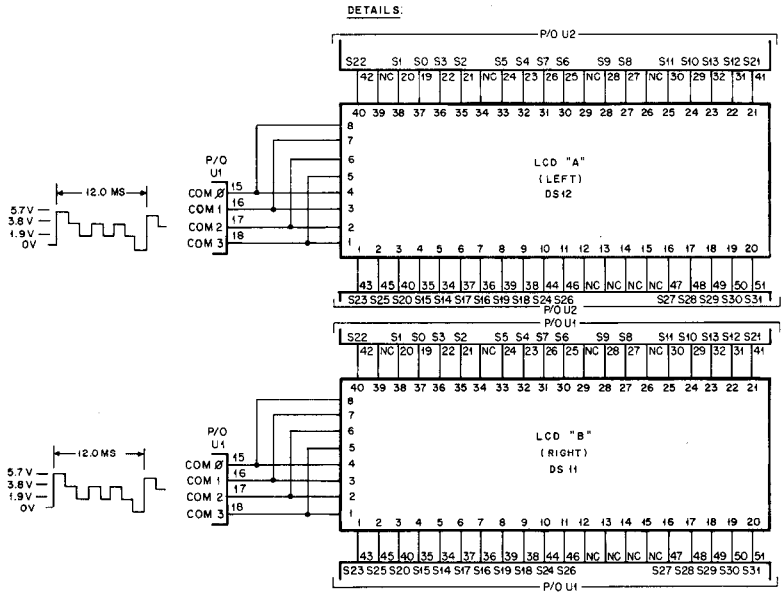
RTL4101A Front Panel Display Board — PL-8456-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF + 10-30%; 100 V: unless otherwise stated
C1	23-84665F01	10 + 100-10%; 25 V
C2	21-82428B21	.01
C3	23-84665F01	10 + 100-10%; 25 V
C4	21-82428B21	.01
C5		NOT USED
C6 thru 12	21-82428B21	.01
C13	23-84665F01	10 + 100-10%; 25 V
C14	21-82428B21	.01
		light emitting diode: (see note)
DS1 thru 10	48-84404E03	red
DS11, 12	72-80377A01	display, custom
		transistor: (see note)
Q1	48-869570	NPN; type M9570
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1, 2, 3	6-83175C03	10k ± 1%; 1/8 W
R4		NOT USED
R5	6-11009C29	150
R6	6-11009C59	2.7k
R7		NOT USED
R8, 9, 10	6-11009C73	10k
R11, 12	6-11009C59	2.7k
R13	6-11009C73	10k
R14, 15	6-11009C83	27k
R16	6-11009C77	15k
R17	6-11009C31	180
R18	6-11009C49	1k
R19		NOT USED
R20	6-10621C78	7.32k ± 1%; 1/8 W
R21	6-10621C70	6.04k ± 1%; 1/8 W
		thermistor:
RT1	6-80378A45	20k @ 25°C
		integrated circuit: (see note)
U1, 2	51-80378A98	display driver
U3	51-84371K74	quad open collector NAND gate
U4	51-83627M04	quad comparator
U5	51-83629M08	quad operational amplifier
U6	51-80365A18	decoder driver
		mechanical parts
	3-124671	SCREW, tapping; 4-24 x 1/4"; 16 used
	13-80377A39	BEZEL, LCD; 2 used
	31-80377A47	STRIP, Zebra; 4 used
	31-80377A48	STRIP, stepped Zebra; 2 used
	32-80390A78	GASKET, bezel; 2 used
	43-80378A93	BLOCK, mounting
	84-80377A89	CIRCUIT BOARD
	9-80330A49	SOCKET, 16-pin

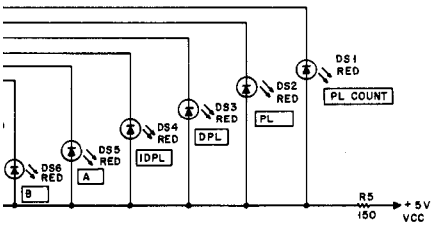
note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.


TEMPERATURE COMPENSATING VOLTAGE REGULATOR
DISPLAY DRIVERS
PRECISION VOLTAGE DIVIDER
CODE SYNTHESIZER MODE INDICATOR
V REF 9
CSA 6
SCK 7
SI 4
RESET 5
C/D 12
CSB 13
LCD CK 10
+12V 1
+5V 8
GND 16
M0 14
M1 15
M2 3
M3 2
U1 (RIGHT) NOTE 4
U2 (LEFT) NOTE 4
U3A
U3B
U3C
U3D
U4A
U4B
U4C
U4D
U5A
U5B
U5C
U5D
U6
Q1 M9570
RT1
JU1
JU2 (NOTE 5)
1.90V
6.71V
3.82V
1.91V
DS1 RED
DS2 RED
DS3 RED
DS4 RED
DS5 RED
DS6 RED
DS7 RED
DS8 RED
DS9 RED
DS10 RED
PL CC
PL
DPL
IDPL
A
B
ABT+V
ABVAR
TN REM
OPTION


TEMPERATURE
COMPENSATING
VOLTAGE
REGULATOR
C6
.01
+12V
R21 5.73V
3040
20K NOM
@ 25°C
RT1
U5A
6.71V
Q1
M9570
R20
732K
+12V
C14
.01
R17
180
C9
.01
C13
10
U5D
J4
JU2
(NOTE 5)
JU1
R3
10K
U5C
1.91V
C8
.01
R2
10K
PRECISION
VOLTAGE
DIVIDER
U5B
3.82V
C7
.01
C11
.01
R1
10K


DETAILS:
P/O U2
P/O U1
LCD "A"
(LEFT)
DS12
LCD "B"
(RIGHT)
DS 11
12.0 MS
5.7V
3.8V
1.9V
0V
COM Ø
COM 1
COM 2
COM 3
S22 S1 S0 S3 S2 S5 S4 S7 S6 S9 S8 S11 S10 S13 S12 S21
S23 S25 S20 S15 S14 S17 S16 S19 S18 S24 S26 S27 S28 S29 S30 S31

11 BSY

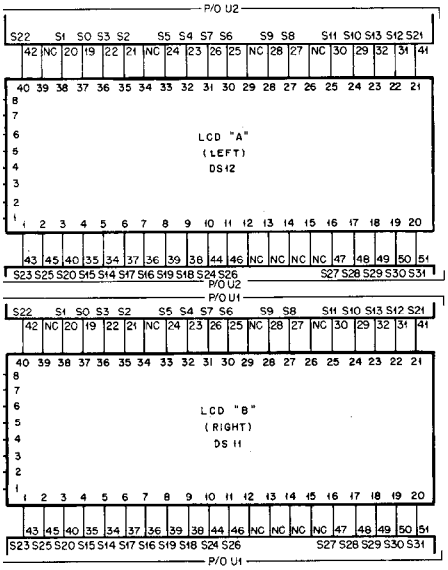

DS1
RED
PL COUNT
DS2
RED
PL
DS3
RED
DPL
DS4
RED
IDPL
DS5
RED
A
DS6
RED
B
R5
150
+5V
VCC

EEPS-36391-A

FRONT PANEL DISPLAY BOARD (A15)

MODEL RTL4101A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST

DETAILS:



NOTES:

1. Unless otherwise indicated, resistor values are in ohms, capacitor values are in microfarads, and inductor values are in millihenries.
2. IC types are TTL and CMOS devices.
3. Connections for integrated circuits on this board are as follows:

Reference Designation	Mfgr's Description	+12 V	VCC	Gnd
U1	Display Driver			6
U2	Display Driver			6
U3	Quad Comparator	3		12
U4	Quad Open Collector NAND		14	7
U5	Quad Op Amp	4		11
U6	1 of 10 Decoder		16	8

4. The LCD display interconnect wiring is shown in the detailed section on this drawing.
5. JU2 is not presently used. It is shown on the drawing for information only.
6. C5 and R4 are shown for information only. They are not used.

FRONT PANEL DISPLAY BOARD

*Motorola No. **PEPS-36858-O***
(Sheet 2 of 2)
8/12/83-PHI

MOTOROLA INC.
Communications
Sector

BATTERY PACK (A16)

MODEL RTP4021A

1. BATTERY PACK INSTALLATION

The following instructions detail the correct procedure for battery pack (RTP4021A) installation. See Figure 1.

Step 1. Remove and discard 4 nuts holding the battery retaining bars to the battery case. Remove the retaining bars and batteries from the case.

Step 2. Extract the Red and Black battery leads from the battery compartment.

Step 3. Place the battery case in the battery compartment. Screw in the center screws and attach the retaining bars with the 4 screws removed in Step 1. The battery case should now be attached with 6 screws.

Step 4. Connect the Red lead to the + terminal, the Black lead to the − terminal on one end and jumper from + to − on the other end of the batteries which places the batteries in series.

NOTE

EXT DC/BATTERY switch must be in the BATTERY position for battery operation.

2. BATTERY CHARGING

The following instructions detail the correct procedure for battery charging.

NOTE

Prolonged discharge of the battery can cause permanent damage to the battery. By law, new batteries must be shipped discharged.

Step 1. Connect the service monitor to an ac power source and select BATTERY on the rear panel. Turn the service monitor to ON. The service monitor charges in either the BATTERY **or** EXT DC positions.

Step 2. Read the battery voltage by selecting BATT on the right LCD. A fully charged battery reads 13.7 volts.

A newly installed battery will charge overnight. Overnight charging of the battery can be accomplished by leaving the service monitor in ON or STANDBY.

NOTE

If ac power is connected to the service monitor, ac power is used automatically rather than dc power.

parts list

RTP4021A Battery Pack — PL-8642-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		mechanical parts
	1-80350A37	CABLE & CONNECTOR
	2-7019	NUT: 4-40 × 4 × 3/32", hex steel; 6 used
	3-138804	SCREW, machine; 4-40 × 5/16" Phillips; hex
	4-80395A88	WASHER, nylon; 4 used
	7-80377A37	BRACKET; mounting
	32-80390A79	GASKET; mounting; 4 used
	42-80377A38	CLAMP; 2 used
	60-80395A50	BATTERY; 6 V, 8 AH; 2 used 6501BB

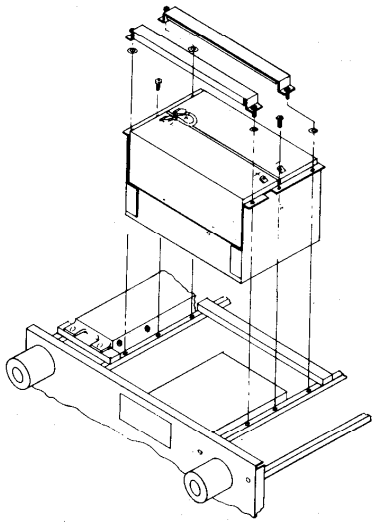


Figure 1. Battery Installation

BATTERY PACK

technical writing services
1301 E. Algonquin Road, Schaumburg, Il. 60196

parts list

RTX1008A Basic Chassis — PL-8500-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		motor:
B1	59-80378A94	fan
		capacitor, fixed:
C1 thru 7	21-83596E13	.001 uF ± 10%; 500 V
		light emitting diode:
DS1	48-05776C01	red
		coil:
E1 thru 7	76-83960B01	ferrite, core
E8, 9	76-80397A74	ferrite bead
		fuse:
F1	65-42092	2 amp; 250 V
F2	65-80397A22	8 amp; 32 V
		filter:
FL1	91-80390A52	line
		connector, receptacle:
J1 thru 5	9-855268	female; single contact (BNC)
J6	9-830418	female; 4-contact
J6	15-10811A07	housing, plug; 4-contact
J7	9-80378A51	female; single contact (BNC)
		coil, rf:
L1 thru 7	24-82549D41	choke; 100 mH
		connector, plug:
P1	15-80378A57	housing, 60-contact
P2	15-80390A10	housing, 9-contact
P3	28-80390A05	male; 3-contact A.C.
		resistor:
R1	18-80378A30	variable: 5k; includes S3
R2	18-80378A29	variable; 5k
R3, 4	18-80378A21	variable; 100k
R5		part of S4
R6, 7	18-80378A22	variable; 2k
R8		part of S5
R9	18-80378A30	variable: 5k; includes S6
R10		part of S9
		varistor:
R11	6-80395A72	1200 amp, 430 V @25°C
		switch:
S1	40-80378A10	spst, toggle
S2	40-80378A27	rotary; 5 position
S3		part of R1
S4	40-80397A32	1 pole; 4 position
S5	40-80378A24	rotary: 1 pole; 4 position
S6		part of R9
S7, 8	40-80378A35	spdt
S9	40-80397A30	1 pole; 3 position
S10	40-80397A33	rotary: 1 pole; 3 position
S11	40-80378A35	single pole triple throw
S12	40-80395A84	dpdt
S13	40-80390A50	rocker

ref. no.		mechanical parts
1	36-80337A83	KNOB; 8 used
2	36-80397A63	KNOB
3	36-80337A86	KNOB; 4 used
4	36-80337A87	KNOB (BLK and BLU)
5	36-80337A85	KNOB (BLK); 2 used
	2-115123	NUT, 10-32 × 3/8 × 1/8"; 2 used
	2-131435	NUT, 4-40 × 1/4 × 3/32"; 3 used
	3-136782	SCREW, machine: 2-56 × 3/16"; 2 used
	3-138804	SCREW, machine: 4-40 × 5/16"; 36 used
	3-138929	SCREW, machine: 4-40 × 5/8"; 14 used
	3-139579	SCREW, machine: 4-40 × 5/16"; 14 used
	3-140207	SCREW, machine: 4-40 × 5/16"; 8 used
	3-80335A97	SCREW, machine: BLK; 6-32 × 0.312"; 7 used
	43-80312B10	SPACER BEAM; 2 used
	43-80397A41	STANDOFF; hex 1/4"; 8 used
	4-8406	LOCKWASHER, #2 internal; 2 used
	4-140208	LOCKWAHER, #4 split; 8 used
	4-140209	LOCKWASHER, #6 split; 7 used
	7-80390A17	BRACKET, card guide; 2 used
	2-84201D82	NUT; 2 used
	3-139013	SCREW, machine; 4-40 × 3/16; Phillips; 8 used
	4-8434	LOCKWASHER; #4 int.; 4 used
	26-80312B13	SHIELD; 4 used
	26-80397A70	SHIELD
	26-80397A78	SHIELD
	26-80397A67	SHIELD
	26-80397A69	SHIELD
	46-80377A49	GUIDE, card; 2 used
	46-80395A24	GUIDE, card (ORG); 2 used
	46-80395A25	GUIDE, card (YEL); 2 used
	46-80395A26	GUIDE, card (BLU); 2 used
	46-80395A27	GUIDE, card (RED); 2 used
	46-80395A28	GUIDE, card (BRN); 2 used
	46-80395A29	GUIDE, card (GRN); 2 used
	46-80395A30	GUIDE, card (VIO); 2 used
	47-80377A11	BEAM, main
	47-80377A12	BEAM, main
	47-80377A13	BEAM, main
	47-80377A14	BEAM, main
	47-80377A15	BEAM, main
	47-80377A16	BEAM, main
	47-80377A17	BEAM, cross
	47-80377A18	BEAM, cross
	47-80377A19	BEAM, cross
	47-80377A20	BEAM, center
	47-80377A21	BEAM, support
	47-80378A63	BEAM, center
	55-80378A53	HANDLE
	55-80390A29	STRIKE; 2 used
	55-80395A05	HINGE; 2 used
	64-80377A28	BEZEL
	26-80397A70	SHIELD
	5-80395A54	GROMMET
	15-80377A34	HOUSING, power supply
	46-80377A40	GUIDE, card; 2 used
	64-80377A23	PLATE, base
	1-80350A06	ASSEMBLY FRONT PANEL includes: refer J1 thru 6, R1, 2, 3, 4, 9, L1, 2, 3, S1, 2, 4, 9, 10, 11, 12, P1
	1-80350A21	ASSEMBLY CABLE w/CONNECTOR includes P1
	30-848407	CABLE, 2 conductor shielded; 9-1/2" used
	30-859004	CABLE, coaxial RG188/U
	39-80378A68	CONTACT, crimp; 54 used
	1-80350A39	ASSEMBLY FILTER BOARD includes: refer C4, 5, 6, 7 and L4, 5, 6, 7, & E4, 5, 6, 7
	4-7699	LOCKWASHER #13/16" internal
	4-115021	LOCKWASHER #1/4" internal; 6 used
	4-125904	LOCKWASHER: 0.375 × 0.625 × .030; 7 used
	4-80395A94	WASHER, dress; 3 used
	4-80397A42	WASHER, retainer
	7-80378A50	BRACKET, LED mounting
	13-80390A41	BEZEL; 2 used
	13-80390A42	BEZEL
	14-80312B01	INSULATOR, shield; 1/2 × 3/4
	26-80397A60	SHIELD, connector
	26-80397A65	SHIELD
	29-10261A05	LUG, soldering; 3 used
	30-83794C01	CABLE, coaxial; 6" used
	35-80390A46	SCREEN, scope w/graticule
	64-80377A50	PANEL, front
	64-80377A51	PANEL, front
	1-80350A12	ASSEMBLY REAR PANEL includes: B1, F1, F2, E8, E9, FL1, P1 and P3
	2-115123	NUT, 10-32 × 3/8 × 1/8"; 4 used
	2-131435	NUT, 4-40 × 1/4 × 3/32"; 3 used
	2-132616	NUT, 6-32 × 1/4 × 3/32 × 1/8"; 4 used
	3-138810	SCREW, machine: 4-40 × 5/8"
	3-490642	SCREW, machine: 10-32 × 1-1/2"; 4 used
	3-80312B02	SCREW, machine: 4-40 × 1-1/8"; 4 used
	3-80335A97	SCREW (BLK): 6-32 × 0.312; 4 used
	3-80395A09	SCREW, Phillips pan: 4-40 × 0.375; 5 used
	4-7607	WASHER, flat: 0.125 × 0.281 × .027
	4-140208	LOCKWASHER, #4 split; 10 used
	4-140209	LOCKWASHER, #6 split; 4 used
	9-82083C02	RECEPTACLE, fuse
	13-80390A35	GRILLE
	14-80395A81	INSULATOR
	14-80397A73	INSULATOR
	26-80397A68	SHIELD
	29-5248	LUG, soldering; 2 used
	29-80395A60	CONTACT, insulator; 2 used
	30-80395A86	CABLE, 9 conductor
	35-80397A71	SCREEN, fan
	38-80395A08	CAP, sealing connector
	39-10184A24	CONTACT, receptacle; 2 used
	39-10184A91	CONTACT, receptacle; 3 used
	39-80395A83	TERMINAL, socket; 6 used
	39-80397A64	CONTACT; 2 used
	42-82143C01	CLAMP, cable
	43-80390A34	SPACER; 4 used
	64-80377A22	PANEL, back
	75-80378A91	FEET, rubber; 4 used

RTL4125A H...

REFERE... SYMB...
BT1

15-80312 B6

R2200A Servi...

REFEREI... SYMBC...
J1

RTL4125A Hardware Kit — PL-8478-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		battery:
BT1	60-83294N03	3 V; lithium
		non-referenced items
	3-138804	SCREW, machine; 4-40 × 5/16"; 21 used
	3-139581	SCREW, machine; 4-40 × 5/16"; 2 used
	3-140207	SCREW, machine; 4-40 × 5/16"; 21 used
	3-80335A97	SCREW, black; 6-32 × 0.312"; 3 used
	4-1714	WASHER, flat; 0.250 × 0.562 × .054
	4-7607	WASHER, flat; 0.125 × 0.281 × .027; 2 used
	4-135739	WASHER, flat: 0.128 × 0.800 × .021
	4-140208	WASHER, lock #4 split; 21 used
	4-140209	WASHER, lock #6 split; 3 used
	4-80395A88	WASHER, nylon; 2 used
	7-80390A16	BRACKET, clip
	15-80377A24	COVER, top
	30-80397A62	CORD, line AC
	32-80390A18	GASKET
	33-80310A66	TAG, serial
	36-80337A83	KNOB; 3 used
	36-80397A63	KNOB
	41-80397A46	SPRING
	41-80397A47	SPRING
	41-80397A48	SPRING
	42-80313A70	TIE WRAP 4"
	54-80338A82	CARD, warranty
	54-80397A77	LABEL
	54-83581L01	LABEL, line cord
	58-84300A98	ADAPTER, male "N"

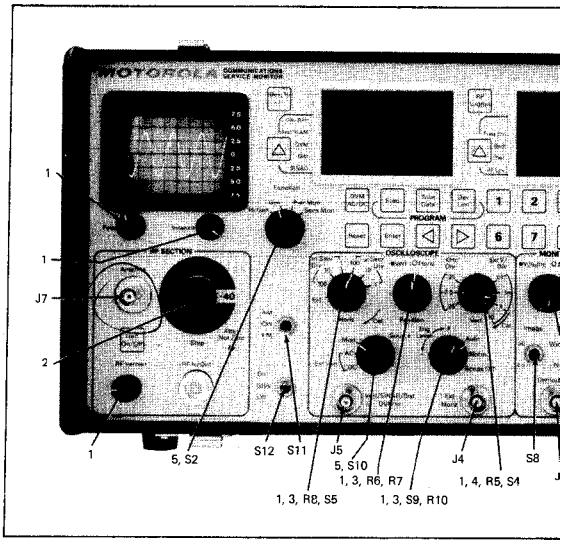
R2200A Service Monitor — PL-8476-O

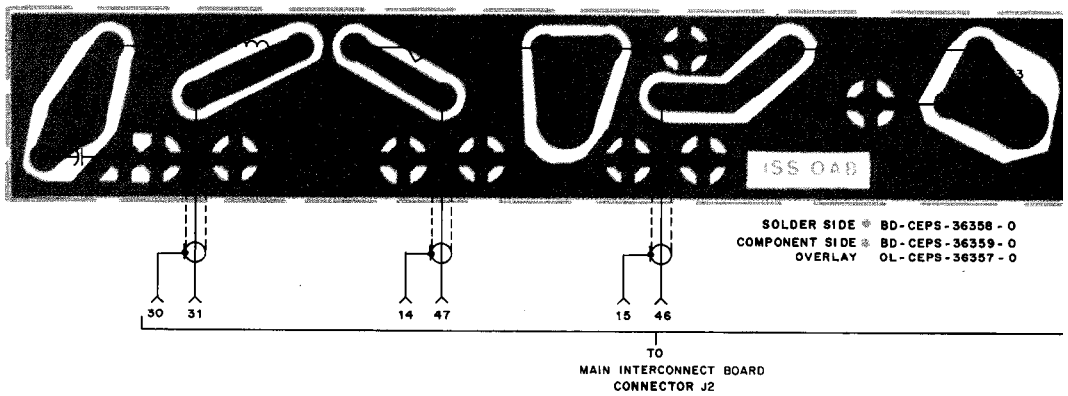
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector:
J1	28-82365D02	male, single contact (phono)
		mechanical parts
	1-80307A71	ASSEMBLY IC, interconnect; 6.0"
	1-80307A73	ASSEMBLY IC, interconnect; 2.5"
	1-80350A26	ASSEMBLY CABLE & CONNECTOR includes: J1
	30-83794C01	CABLE, coaxial; 20"
	1-80350A27	ASSEMBLY BOTTOM COVER includes:
	4-114970	WASHER, flat; 0.125 × 0.250 × .020; 6 used
	15-80377A25	COVER, bottom
	55-80334A52	BAIL, self-lock
	75-82566B01	BUMPER, rubber; 2 used
	1-80350A30	ASSEMBLY CABLE & CONNECTOR, includes: J1
	1-80356A08	ASSEMBLY CABLE, coaxial
	1-80350A31	ASSEMBLY CABLE & CONNECTOR, includes: J1
	30-859004	CABLE, coaxial RG188U; 18" used

RPX4249A Fuse Kit — PL-8481-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F1	65-80377A61	0.1 amp; 125 V
F2	65-80347A22	8 amp; 32 V
F3	65-42092	2 amp; 250 V

Front Cover
15-80312B46





SHOWN FROM COMPONENT SIDE

RTL4125A Hardware Kit — PL-8478-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		battery:
BT1	60-83294N03	3 V; lithium
		non-referenced items
	3-138804	SCREW, machine; 4-40 × 5/16"; 21 used
	3-139581	SCREW, machine; 4-40 × 5/16"; 2 used
	3-140207	SCREW, machine; 4-40 × 5/16"; 21 used
	3-80335A97	SCREW, black; 6-32 × 0.312"; 3 used
	4-1714	WASHER, flat; 0.250 × 0.562 × .054
	4-7607	WASHER, flat; 0.125 × 0.281 × .027; 2 used
	4-135739	WASHER, flat; 0.128 × 0.800 × .021
	4-140208	WASHER, lock #4 split; 21 used
	4-140209	WASHER, lock #6 split; 3 used
	4-80395A88	WASHER, nylon; 2 used
	7-80390A16	BRACKET, clip
	15-80377A24	COVER, top
	30-80397A62	CORD, line AC
	32-80390A18	GASKET
	33-80310A66	TAG, serial
	36-80337A83	KNOB; 3 used
	36-80397A63	KNOB
	41-80397A46	SPRING
	41-80397A47	SPRING
	41-80397A48	SPRING
	42-80313A70	TIE WRAP 4"
	54-80338A82	CARD, warranty
	54-80397A77	LABEL
	54-83581L01	LABEL, line cord
	58-84300A98	ADAPTER, male "N"

15-80312B69

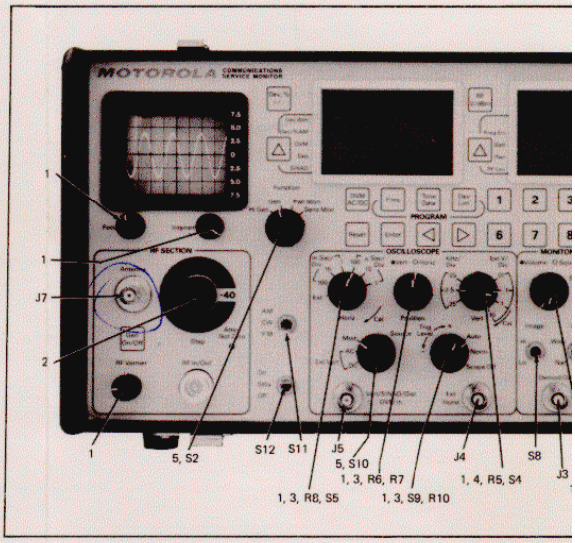
R2200A Service Monitor — PL-8476-O

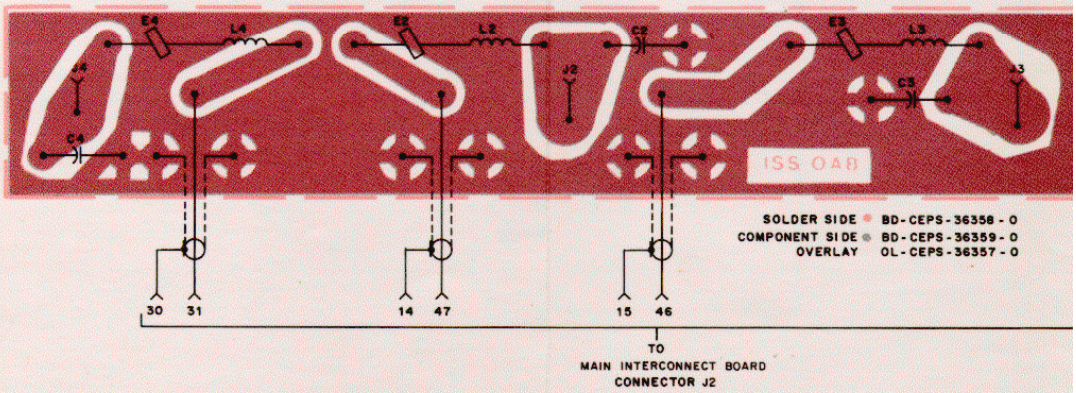
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector:
J1	28-82365D02	male, single contact (phono)
		mechanical parts
	1-80307A71	ASSEMBLY IC, interconnect; 6.0"
	1-80307A73	ASSEMBLY IC, interconnect; 2.5"
	1-80350A26	ASSEMBLY CABLE & CONNECTOR includes: J1
	30-83794C01	CABLE, coaxial; 20"
	1-80350A27	ASSEMBLY BOTTOM COVER includes:
	4-114970	WASHER, flat; 0.125 × 0.250 × .020; 6 used
	15-80377A25	COVER, bottom
	55-80334A52	BAIL, self-lock
	75-82566B01	BUMPER, rubber; 2 used
	1-80350A30	ASSEMBLY CABLE & CONNECTOR, includes: J1
	1-80356A08	ASSEMBLY CABLE, coaxial
	1-80350A31	ASSEMBLY CABLE & CONNECTOR, includes: J1
	30-859004	CABLE, coaxial RG188U; 18" used

RPX4249A Fuse Kit — PL-8481-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F1	65-80377A61	0.1 amp; 125 V
F2	65-80347A22	8 amp; 32 V
F3	65-42092	2 amp; 250 V

Front Cover
15-80312B46



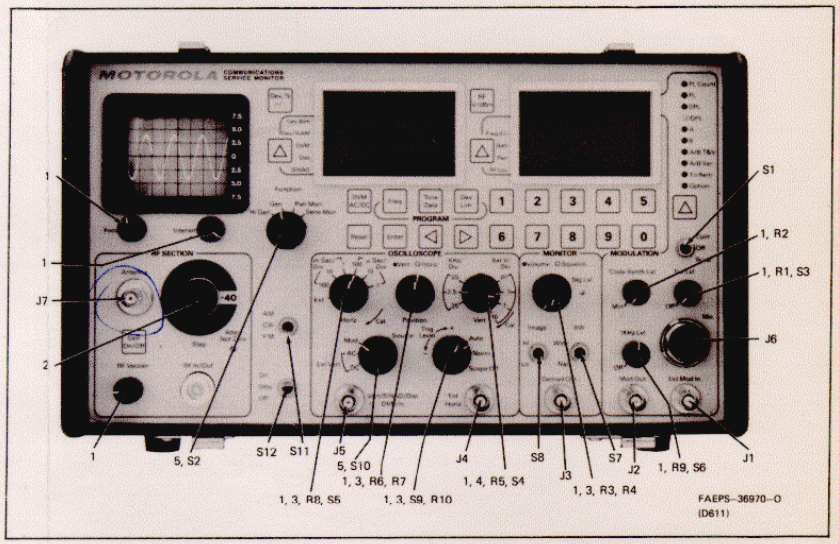


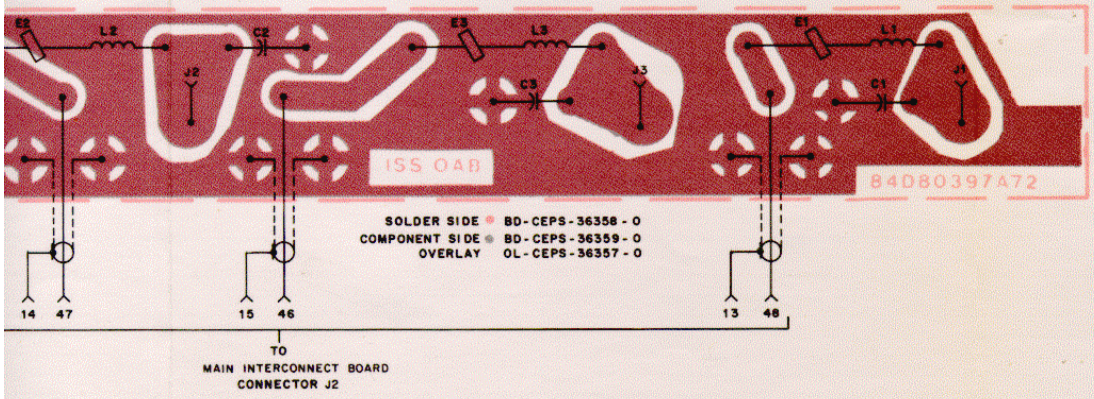
SHOWN FROM COMPONENT SIDE

RPX4249A Fuse Kit PL-8481-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F1	65-80377A61	0.1 amp; 125 V
F2	65-80347A22	8 amp; 32 V
F3	65-42092	2 amp; 250 V

Front Cover
15-80312B46





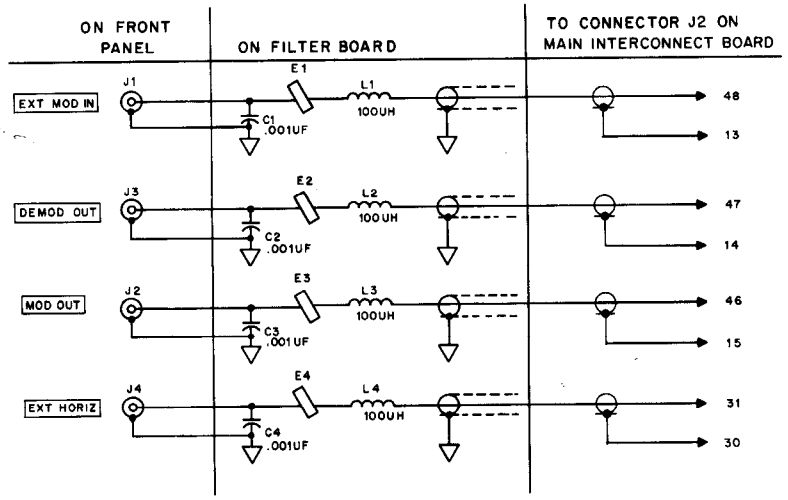
SHOWN FROM COMPONENT SIDE

CHASSIS MECHANICAL LESS REAR PANEL AND MAIN INTERCONNECT BOARD (A17)

MODEL RTX1008A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST

FUNCTION

The Chassis Mechanical section includes parts lists for the mechanical and electrical parts that mount on the chassis. Also included is a filter board that mounts to the chassis. The chassis main interconnect board is covered in a separate instruction section, 68P81064E69, in this manual.

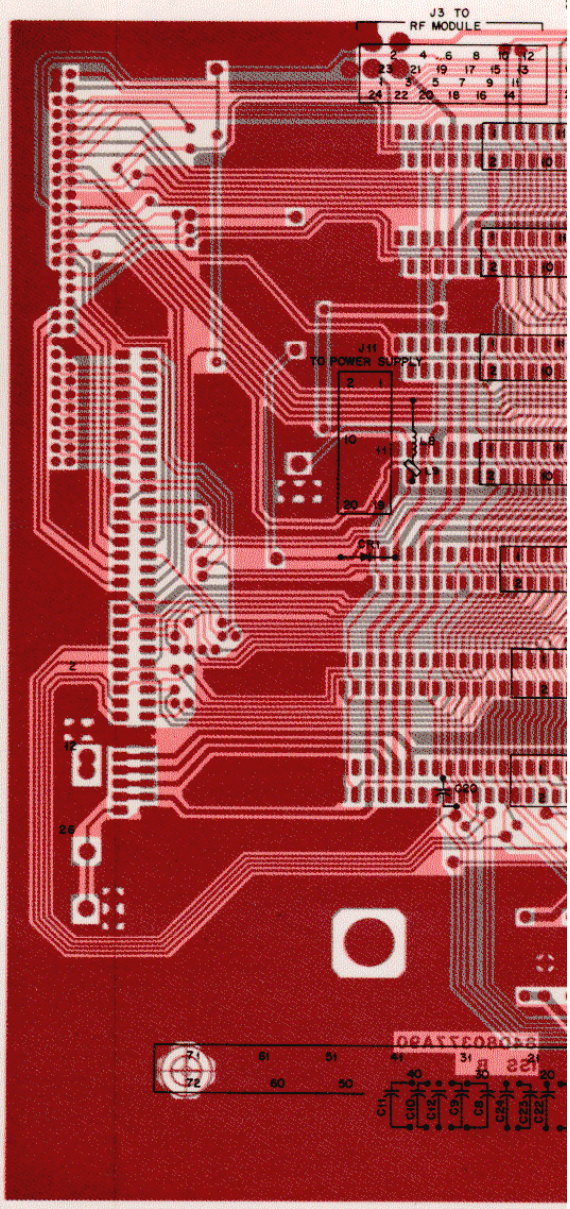


LEGEND:
⏚ = DIGITAL GROUND

CHASSIS MECHANICAL

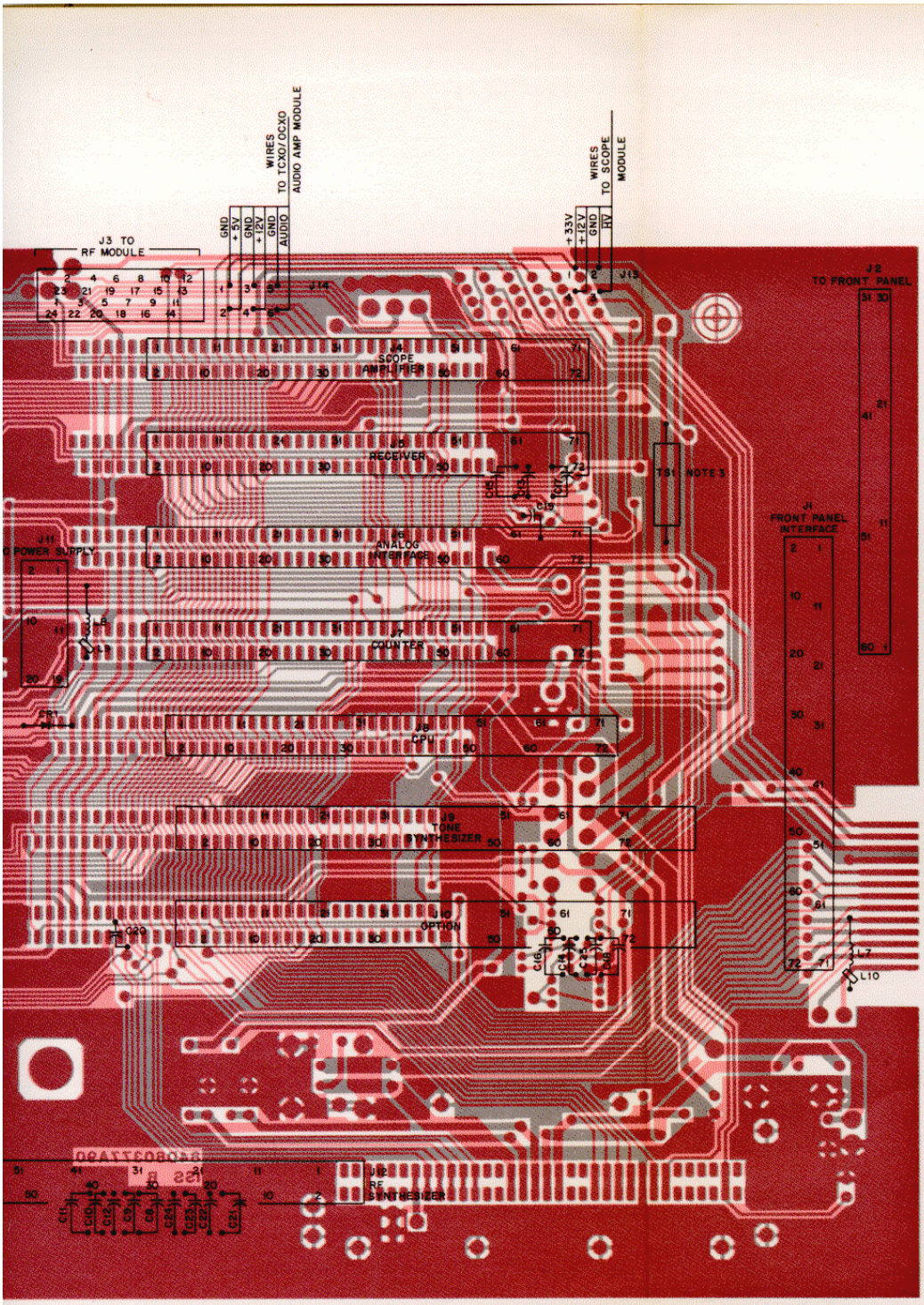
MAIN INTERCONNECT BOARD (A18)

MODEL RTL4099A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



(REVERSED)
(REVERSED) CO

SHOWN
(CAPACIT

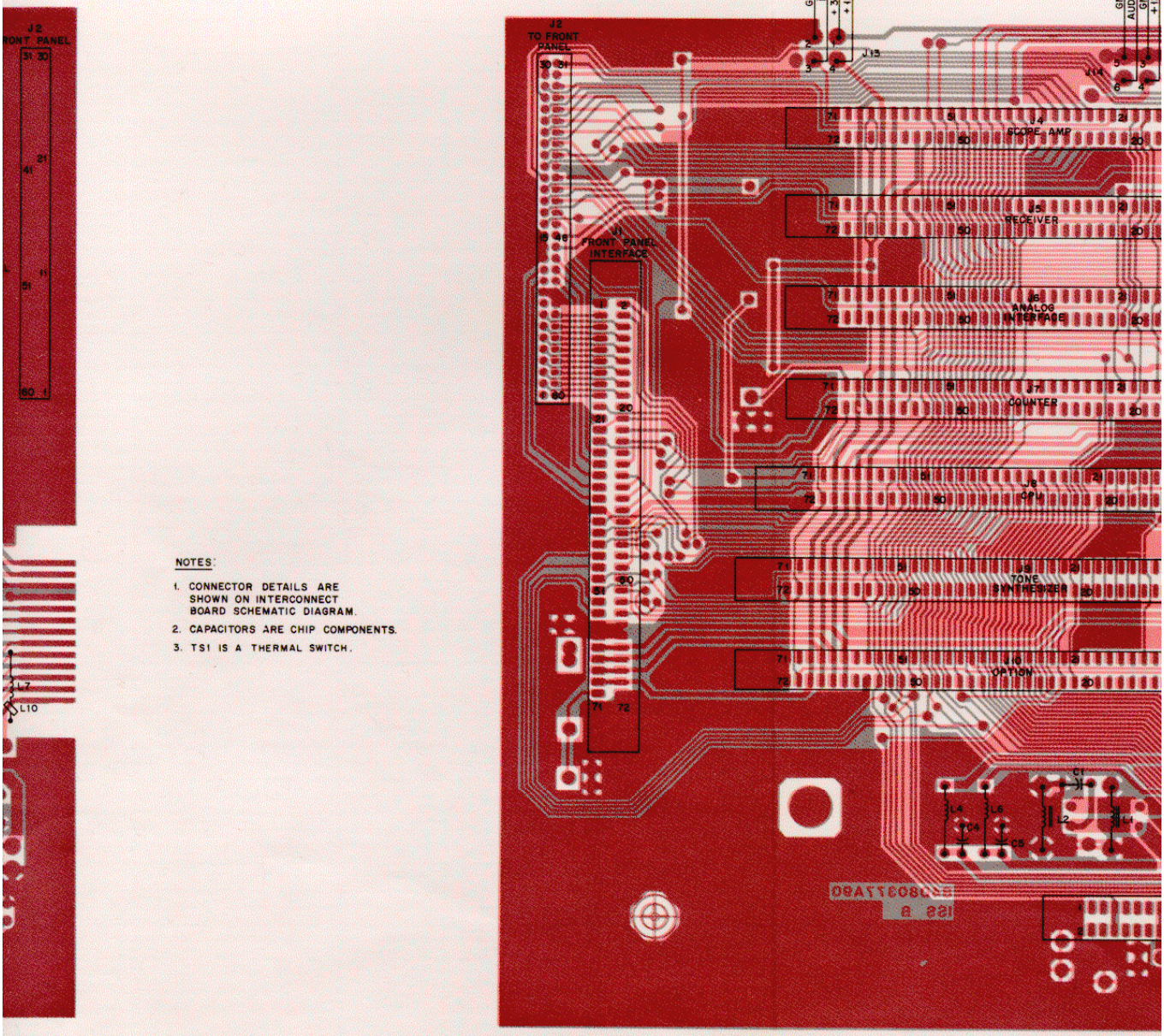


NOTES:

1. CONNECTOR DETAILS ARE SHOWN ON INTERCONNECT BOARD SCHEMATIC DIAGRAM
2. CAPACITORS ARE CHIP COMP
3. TS1 IS A THERMAL SWITCH.

(REVERSED) SOLDER SIDE ● BD-DEPS-36452-O
(REVERSED) COMPONENT SIDE ● BD-DEPS-36453-O
OL-EEPS-36454-O

SHOWN FROM SOLDER SIDE
(CAPACITORS ARE CHIP COMPONENTS)

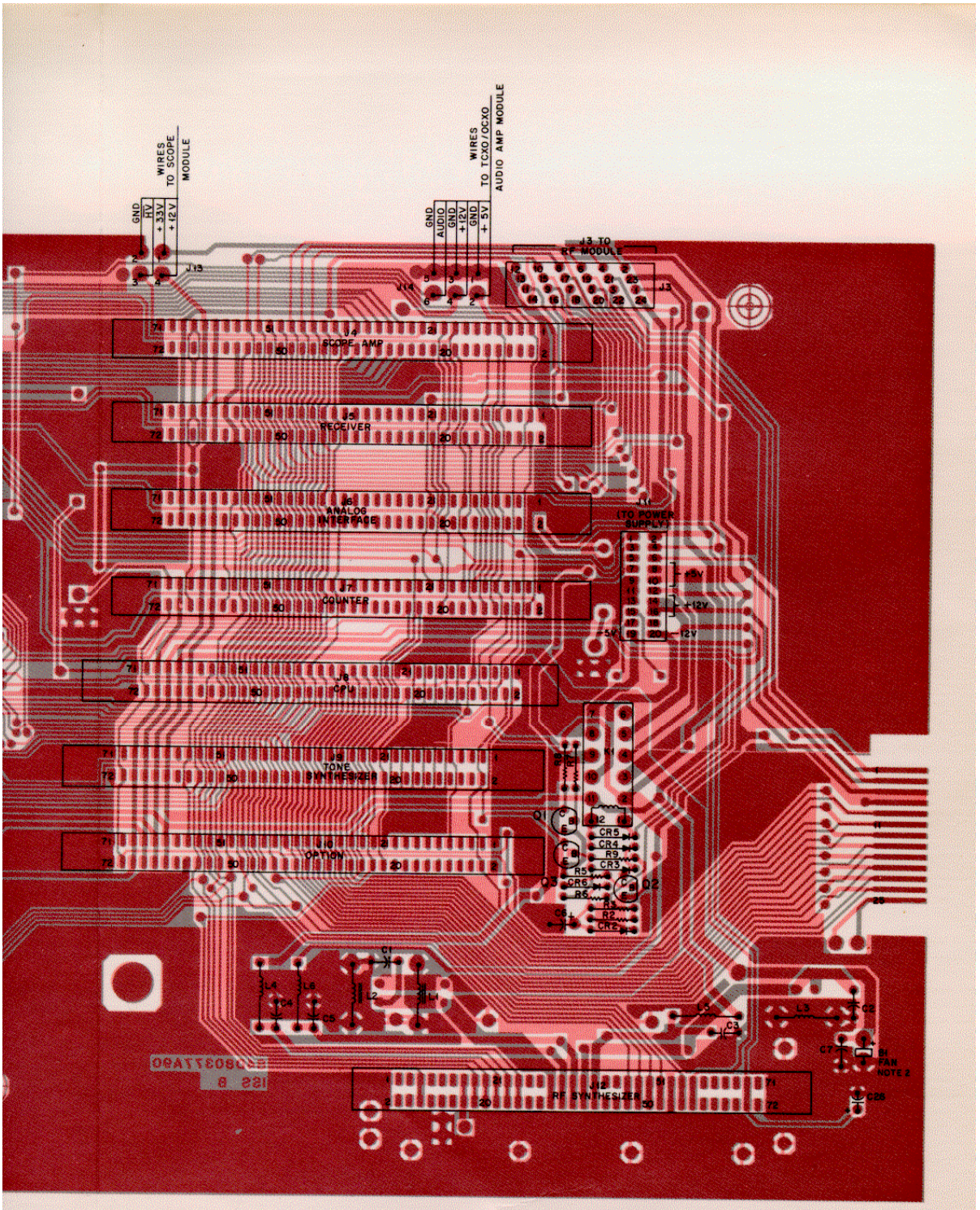


NOTES:

1. CONNECTOR DETAILS ARE SHOWN ON INTERCONNECT BOARD SCHEMATIC DIAGRAM.
2. CAPACITORS ARE CHIP COMPONENTS.
3. TS1 IS A THERMAL SWITCH.

SOLDER SIDE ● BD-DEPS-36
COMPONENT SIDE ● BD-DEPS-36
OL-EEPS-36

SHOWN FROM COMPONE



SOLDER SIDE ● BD-DEPS-36452-0
COMPONENT SIDE ● BD-DEPS-36453-0
OL-EEPS-36451-0

SHOWN FROM COMPONENT SIDE

parts list

RTL4099A Main Interconnect Board — PL-8472-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1 thru 4	21-82372C07	.05 + 80-20%; 25 V
C5	21-82428B21	.01 uF + 10-30%; 100 V
C6	23-84665F14	220 uF + 150-10%; 16 V
C7	21-82428B21	.01 uF + 10-30%; 100 V
C8 thru 20	21-80376A25	.001 uF ± 10%; 50 V (chip)
C21, 22, 23, 24	21-80376A14	220 pF ± 2%; 50 V (chip)
C25	21-80376A25	.001 uF ± 10%; 50 V (chip)
C26	23-84665F02	15 uF + 100-10%; 25 V
		diode: (see note)
CR1	48-83654H02	silicon
CR2	48-83654H01	silicon
CR3	48-83654H02	silicon
CR4, 5	48-82466H01	silicon
		connector, receptacle:
J1	9-80377A45	female; 72-contact (edge connector)
J2	9-80378A59	female; 60-contact
J3	30-80390A13	cable, 24-conductor; includes P302
J4 thru 10	9-80377A45	female; 72-contact (edge connector)
J11	1-80350A24	cable, 20 conductor includes P3
J12	9-80377A45	female; 72-contact (edge connector)
J13	1-80350A22	cable, 4 conductor includes P2
J14	1-80350A23	cable, 6 conductor includes P14
		relay:
K1	80-80378A31	4 pole, single throw; 720 ohms
		coil, rf:
L1, 2, 3	25-83127G01	choke: 1 mH
L4, 5, 6	24-82549D41	choke: 100 uH
L7, 8	24-83451F01	choke: 15 uH
L9, 10	76-83960B01	ferrite bead
		transistor: (see note)
Q1	48-869570	NPN; type M9570
Q2	48-869648	NPN; type M9648
Q3	48-869706	Darlington; M9706
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1		NOT USED
R2	6-124A01	10
R3	6-124A73	10k
R5, 6	6-124A89	47k
R7	6-124A73	10k
R8	6-124A65	4.7k
R9	6-124A89	47k
		switch:
TS1	80-80397A26	spst, temperature dependent
		voltage regulator: (see note)
VR1	48-82256C15	Zener type; 5.1 V
		mechanical parts
	42-80313A70	TIE WRAP: 4"; 5 used
	30-83794C01	CABLE, coaxial; WHT

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

NOTE:

1. CONNECTOR DETAILS ARE SHOWN ON INTERCONNECT BOARD SCHEMATIC DIAGRAM.
2. FAN B1 IS MOUNTED ON REAR PANEL.

TRANSISTOR DETAILS:

Q1, Q2

Q3

CONNECTOR DETAILS

PIN NUMBER	J9 A12 TONE SYNTHESIZER	J10 A09 OPTION	J8 A08 CPU
1	GND	GND	GND
2	GND	GND	LC BUSY
3	—	—	340 kHz
4	OPT PRES	OPT PRES	OPT PRES
5	—	—	—
6	—	—	AD INT
7	—	—	—
8	—	—	COUNT INT
9	REC AUD	REC AUD	REC AUD
10	—	—	—
11	—	—	—
12	—	—	—
13	—		—
14	—		—
15	—	—	—
16	—	—	—
17	—	—	—
18	—	—	—
19	—	—	BAT 1
20	—	—	—
21	GND	GND	GND
22	AF OUT	AF OUT	AF OUT
23	GND	GND	GND
24	1 kHz	1 kHz	1 kHz
25	TN SYNTH OUT	TN SYNTH OUT	TN SYNTH OUT
26	MOD	MOD	MOD
27	SQ OPN	SQ OPN	SQ OPN
28	NOPINT	NOPINT	NOPINT
29	NTSRQ	NTSRQ	NTSRQ
30	PCTL	PCTL	PCTL
31	I/O 7	I/O 7	I/O 7
32	PFLG	PFLG	PFLG
33	I/O 5	I/O 5	I/O 5
34	I/O 6	I/O 6	I/O 6
35	I/O 3	I/O 3	I/O 3
36	I/O 4	I/O 4	I/O 4
37	I/O 1	I/O 1	I/O 1
38	I/O 2	I/O 2	I/O 2
39	P.O.R.	P.O.R.	P.O.R.
40	I/O 0	I/O 0	I/O 0
41	D6	D6	D6
42	D7	D7	D7
43	D4	D4	D4
44	D5	D5	D5
45	D2	D2	D2
46	D3	D3	D3
47	D0	D0	D0
48	D1	D1	D1
49	$\overline{STB2}$	$\overline{STB2}$	$\overline{STB2}$
50	$\overline{STB3}$	$\overline{STB3}$	$\overline{STB3}$
51	$\overline{STB0}$	$\overline{STB0}$	$\overline{STB0}$
52	STB1	STB1	STB1
53	A2	A2	A2
54	A3	A3	A3
55	A0	A0	A0
56	A1	A1	A1
57	DPL	DPL	DPL
58	GND	GND	GND
59	—	—	—
60	—	—	—
61	− 12 V	− 12 V	− 12 V
62	− 12 V	− 12 V	− 12 V
63	+ 12 V	+ 12 V	+ 12 V
64	+ 12 V	+ 12 V	+ 12 V
65	− 5 V	− 5 V	− 5 V
66	− 5 V	− 5 V	− 5 V
67	+ 5 V	+ 5 V	+ 5 V
68	+ 5 V	+ 5 V	+ 5 V
69	—	—	—
70	IRQ	IRQ	IRQ
71	GND	GND	GND
72	GND	GND	GND

PIN NUMBER	J7 A10 COUNTER	J6 A07 ANALOG INTERFACE	J5 A06 RECEIVER	J4 A04 SCOPE AMPLIFIER
1	GND	GND	GND	GND
2	AUDIO	EXT VERT IN	—	GND
3	—	GND	SQ IND	SQ IND
4	10.7 MHz	GND	10.7 MHz	—
5	—	—	—	HOR VERN 2
6	AD INT	—	—	—
7	—	—	—	EXT HOR IN**
8	COUNT INT	—	—	—
9	REC AUD	REC AUD	REC AUD	REC AUD
10	MOD OUT	MOD OUT	MOD OUT	MOD OUT
11	AM MOD AUDIO	AM MOD AUDIO	AM MOD AUDIO	—
12	DEMOD OUT	DEMOD OUT	DEMOD OUT	DEMOD OUT
13	BTRY SENS	BTRY SENS	—	—
14	A/D INPUT	A/D	—	—
15	PCT AM	PCT AM	PCT AM	—
16	—	AGC	AGC	—
17	—	—	SQ POT 1	SQ POT 1
18	—	—	SQ POT 2	SQ POT 2
19	VOL 1	VOL 1	VOL 1	VOL 1
20	VOL 2	VOL 2	VOL 2	VOL 2
21	CAR & MOD LEVEL OUT	CAR & MOD LEVEL OUT	—	—
22	—	POWER METER	POWER METER	—
23	—	—	—	HV
24	1 kHz	—		—
25	—	—	—	—
26	MOD	—	—	—
27	—	—	—	VERT VERN 1
28	—	—	—	VERT VERN 2
29	—	—	—	TRIG LVL 2
30	—	—	—	TRIG LVL 3
31	—	—	—	HOR POS 3
32	—	—	—	TRIG LVL 1
33	—	—	—	HOR POS 1
34	—	—	—	HOR POS 2
35	—	—	—	VERT POS 2
36	—	—	—	VERT POS 3
37	—	—	—	—
38	—	—	—	VERT POS 1
39	P.O.R.	P.O.R.	P.O.R.	P.O.R.
40	—	—	—	—
41	D6	D6	D6	D6
42	D7	D7	D7	D7
43	D4	D4	D4	D4
44	D5	D5	D5	D5
45	D2	D2	D2	D2
46	D3	D3	D3	D3
47	D0	D0	D0	D0
48	D1	D1	D1	D1
49	$\overline{STB2}$	$\overline{STB2}$	$\overline{STB2}$	$\overline{STB2}$
50	$\overline{STB3}$	$\overline{STB3}$	$\overline{STB3}$	$\overline{STB3}$
51	$\overline{STB0}$	$\overline{STB0}$	$\overline{STB0}$	$\overline{STB0}$
52	STB1	STB1	STB1	STB1
53	A2	A2	A2	A2
54	A3	A3	A3	A3
55	A0	A0	A0	A0
56	A1	A1	A1	A1
57	SIGN	SIGN	—	—
58	GND	GND	GND	GND
59	—	—	GND	—
60	PK DET	PK DET	—	—
61	− 12 V	− 12 V	12 V	− 12 V
62	− 12 V	− 12 V	12 V	− 12 V
63	+ 12 V	+ 12 V	+ 12 V	+ 12 V
64	+ 12 V	+ 12 V	+ 12 V	+ 12 V
65	− 5 V	− 5 V	5 V	5 V
66	AC/DC SEL	AC/DC SEL	—	—
67	+ 5 V	+ 5 V	+ 5 V	+ 5 V
68	+ 5 V	+ 5 V	+ 5 V	+ 5 V
69	10 MHz	—	—	—
70	IRQ	—	—	—
71	GND	GND	GND	GND
72	GND	GND	GND	GND

**From Filter Board on Front Panel

PIN NUMBER	J13 A03 SCOPE MODULE
1	+ 33 V
2	GND
3	HV
4	+ 12 V

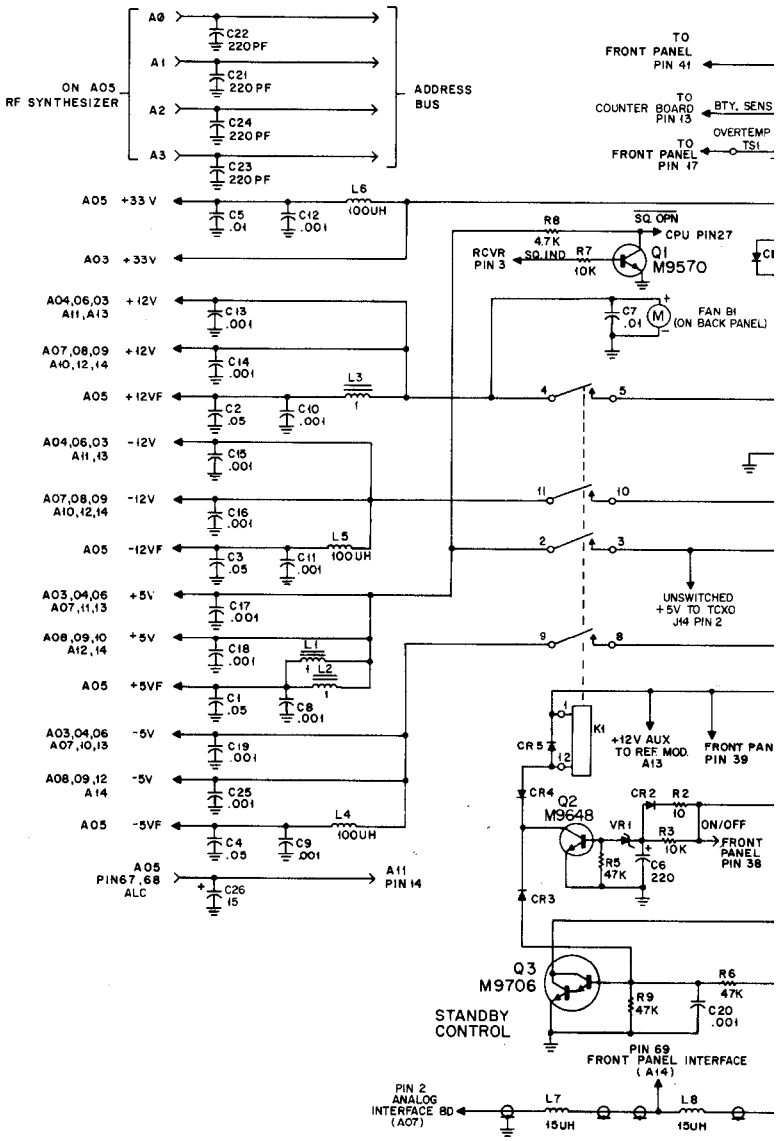
PIN NUMBER	J14 A13 REF/AUDIO MODULE
1	GND
2	+ 5 V
3	GND
4	+ 12 AUX
5	GND
6	AUDIO

PIN NUMBER	J1 A14 FRONT PANEL INTERFACE	J3* A11 RF INTERFACE
1	GND	D7
2	LC BUSY	D0
3	C5	D1
4	340 kHz	D2
5	C3	D3
6	C4	D4
7	C1	A1
8	C2	A0
9	R7	STB1
10	C0	A2
11	R5	A3
12	R6	+ 5 V
13	R3	GND
14	R4	ALC
15	R1	LO/HI SEL
16	R2	CAR & MOD LEVEL OUT
17	BW WIN	POWER METER
18	R0	AM MOD AUDIO
19	BAT 1	$\overline{P.O.R.}$
20	—	D5
21	SIG GND	D6
22	AF OUT	STB3
23	AF OUT	12 V
24	1 kHz	+ 12 V
25	TN SYN OUT	—
26	MOD	—
27	EXT MOD IN	—
28	—	—
29	PTT	—
30	MIC INPUT	—
31	1 kHz LEV 2	—
32	REC AUD	—
33	EXT LEV 2	—
34	1 kHz LEV 1	—
35	CD SYN LEV 2	—
36	EXT LEV 1	—
37	GND	—
38	CD SYN LEV 1	—
39	P.O.R.	—
40	GND	—
41	D6	—
42	D7	—
43	D4	—
44	D5	—
45	D2	—
46	D3	—
47	D0	—
48	D1	—
49	$\overline{STB2}$	—
50	$\overline{STB3}$	—
51	$\overline{STB0}$	—
52	$\overline{STB1}$	—
53	A2	—
54	A3	—
55	A0	—
56	A1	—
57	GND	—
58	GND	—
59	GND	—
60	GND	—
61	− 12 V	—
62	− 12 V	—
63	+ 12 V	—
64	+ 12 V	—
65	− 5 V	—
66	+ 5 V	—
67	+ 5 V	—
68	+ 5 V	—
69	EXT VERT IN	—
70	GND	—
71	GND	—
72	GND	—

*J2 has 60 pins; J3 has 24 pins.

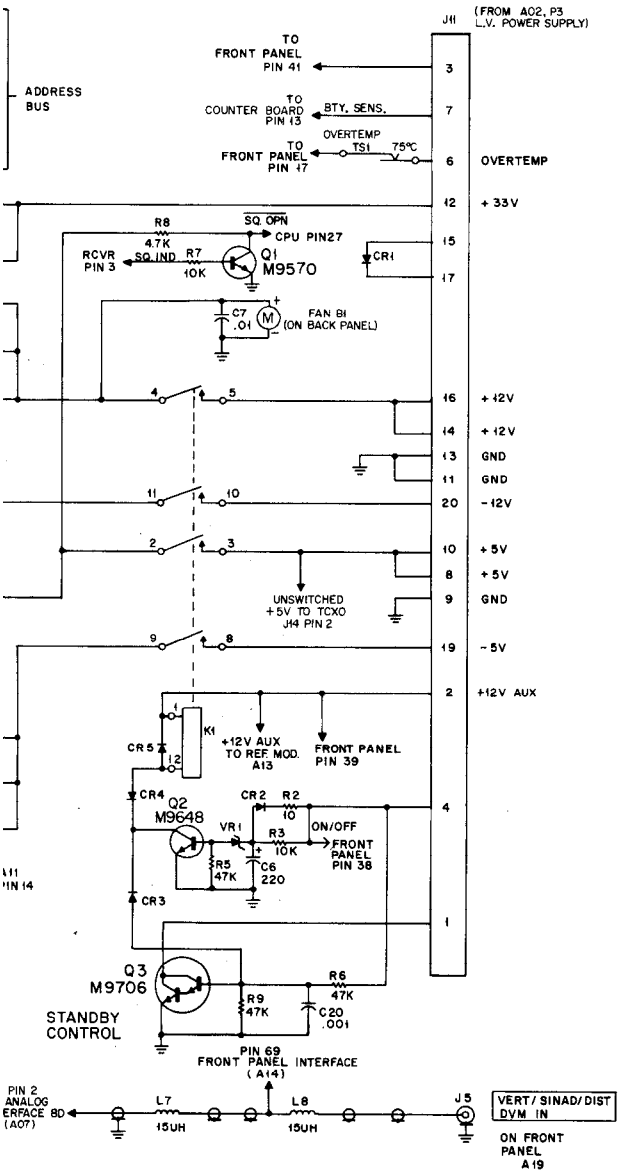
PIN NUMBER	J1 A14 FRONT PANEL INTERFACE	J3* A11 RF INTERFACE	J12 A05 RF SYNTHESIZER	J2* A19 FRONT PANEL
1	GND	D7	GND	—
2	LC BUSY	D6	GND	R0
3	C5	D1	—	R2
4	340 kHz	D2	—	R4
5	C3	D3	—	R6
6	C4	D4	—	C0
7	C1	A1	1 kHz	C2
8	C2	A0	1 kHz	C4
9	R7	STB1	—	—
10	C0	A2	—	GND
11	R5	A3	—	EXT. LEV. 2
12	R6	+ 5 V	—	CD SYN. LEV. 2
13	R3	GND	—	GND
14	R4	ALC	—	GND
15	R1	LO/HI SEL	10 MHz	GND
16	R2	CAR & MOD LEVEL OUT	10 MHz	EXT. LEV. 1
17	BW W/N	POWER METER	A1	ON/OFF PIN 1
18	R0	AM MOD AUDIO	A1	VOL 2
19	BAT 1	P.O.R.	A0	SQ. 2
20	—	D5	A0	SQ. IND
21	SIG. GND	D6	STB1	TRIG. 3
22	AF OUT	STB3	STB1	SQ. 1
23	AF OUT	12 V	A3	VERT. POS. 2
24	1 kHz	+ 12 V	A3	HOR. POS. 1
25	TN. SYN. OUT	—	A2	HOR. POS. 3
26	MOD	—	A2	TRIG. 2
27	EXT. MOD IN	—	—	HOR. VERN. 2
28	—	—	—	VERT. VERN. 1
29	PTT	—	—	GND
30	MIC INPUT	—	—	GND
31	1 kHz LEV. 2	—	+ 5 VF	EXT. HOR. IN**
32	REC. AUD.	—	+ 5 VF	SPKR.
33	EXT. LEV. 2	—	- 5 VF	VERT. VERN. 2
34	1 kHz LEV. 1	—	- 5 VF	VERT. POS. 1
35	CD. SYN. LEV. 2	—	+ 33 VF	VERT. POS. 2
36	EXT. LEV. 1	—	+ 33 VF	HOR. POS. 2
37	GND	—	+ 12 VF	TRIG. 1
38	CO. SYN. LEV. 1	—	+ 12 VF	ON/OFF PIN 5
39	P.O.R.	—	- 12 VF	ON/OFF PIN 4
40	GND	—	- 12 VF	GND
41	D6	—	—	ON/OFF PIN 3
42	D7	—	—	VOL 1
43	D4	—	—	CD. SYN. LEV. 1
44	D5	—	—	1 kHz LEV. 1
45	D2	—	D0	MIC. IN
46	D3	—	D0	MOD OUT**
47	D0	—	D1	DEMOD OUT**
48	D1	—	D1	EXT. MOD IN**
49	STB2	—	D3	PTT
50	STB3	—	D3	1 kHz LEV 2
51	STB0	—	D2	GND
52	STB1	—	D2	GND
53	A2	—	GND	C5
54	A3	—	GND	C3
55	A0	—	MOD	C1
56	A1	—	MOD	R7
57	GND	—	LO/HI BAND	R5
58	GND	—	LO/HI BAND	R3
59	GND	—	—	R1
60	GND	—	—	BW W/N COM.
61	- 12 V	—	—	—
62	- 12 V	—	—	—
63	+ 12 V	—	—	—
64	+ 12 V	—	—	—
65	- 5 V	—	—	—
66	- 5 V	—	—	—
67	+ 5 V	—	ALC	—
68	+ 5 V	—	ALC	—
69	EXT. VERT. IN	—	—	—
70	GND	—	—	—
71	GND	—	GND	—
72	GND	—	GND	—

*J2 has 60 pins; J3 has 24 pins.



MAIN IN

SCHEMA



EEPS-36450-A

NOTE:

1. Unless otherwise specified; all resistors are in ohms; all capacitors are in microfarads; and all inductors are in millihenries.
2. A list of assemblies referenced is shown in Table 1.

Table 1. List of Assemblies

Assembly Number	Assembly/Subassembly Name
A01	Rear Panel
A02	Low Voltage Power Supply
A03	Scope Module
A04	Scope Amplifier Board
A05	RF Synthesizer Module
A06	Receiver Board
A07	Analog Interface Board
A08	CPU Board
A09	Option
A10	Counter Board
A11	RF Module
A12	Tone Synthesizer Board
A13	Reference/Audio Module
A14	Front Panel Interface Board
A15	Front Panel Display Board
A16	Battery Pack
A17	Chassis Mechanical Less Rear Panel and Main Interconnect Board
A18	Main Interconnect Board
A19	Front Panel

MAIN INTERCONNECT BOARD (A18)

MODEL RTL4099A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST

NOTE:

1. Unless otherwise specified; all resistors are in ohms; all capacitors are in microfarads; and all inductors are in millihenries.
2. A list of assemblies referenced is shown in Table 1.

Table 1. List of Assemblies

Assembly Number	Assembly/Subassembly Name
A01	Rear Panel
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A13	Reference/Audio Module
A14	Front Panel Interface Board
A15	Front Panel Display Board
A16	Battery Pack
A17	Chassis Mechanical Less Rear Panel and Main Interconnect Board
A18	Main Interconnect Board
A19	Front Panel

FUNCTION

The main interconnect board provides a common interface for all of the modules and circuit boards. This includes the power supply lines, address and data lines, and any other lines which are needed for the boards to interconnect to one another. These same signals are routed from the board through wires or ribbon cables to other modules (modules that do not plug directly into the main interconnect board). The board also contains circuitry that delays the power supply when switching from the STBY to ON position, and filtering of the supply lines that go into the rf synthesizer. The front panel wiring harness plugs into this board.

FRONT PANEL (A19)

The front panel assembly consists of a front panel display board (A15), a filter board, and the R2200 Service Monitor operating switches and controls. The front panel display board is described in instruction section 68P81064E66 in this manual. The filter board is shown as part of Chassis Mechanical instruction section 68P81064E68 in this manual. The front panel operating switches and controls are shown schematically in the respective instruction sections wherein the switches and controls interact. The front panel parts list is a part of the Basic Chassis Kit Model RTX1008A which appears in Chassis Mechanical instruction section 68P81064E68.

1. ACCESSORY KIT RPX4097A

1.1 Accessory Kit RPX4097A consists of a connector shell, clamp, and four connector pins. These parts can be used to fabricate a mating plug for the male dc power connector at the back of the service monitor. This enables a user to make a dc power cable to interconnect a separate power source to the service monitor.

1.2 Assemble the connector kit as follows:

Step 1. Connect pin 1 to + (11 to 17 V dc); pin 2 to NC; pin 3 to NC; and pin 4 to ground.

NOTE

Use wire large enough to carry 6 amps with no significant loss, i.e,
18 AWG for up to 6 feet;
20 AWG for up to 16 feet.
The terminals supplied are #18-#14 with inside diameter .110"-.150".

Step 2. Select EXT DC on the rear panel.

Step 3. With no ac power applied to the service monitor, turn the service monitor to ON and measure the external dc voltage using the BATT measurement on the right LCD. This voltage must be between 11 and 17 volts dc for proper operation.

NOTE

If ac power is connected to the service monitor, ac power is used automatically rather than dc power.

parts list

RPX4097A Accessory Kit — PL-8479-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, receptable:
P1	15-10811A08	housing, 4-contact
	9-83741F01	female; single-contact; 4 used
		mechanical part
	15-10812A01	SHELL, connector

2. TEST MICROPHONE RTM4000B

The test microphone contains the microphone element and a push-to-talk (PTT) switch. The microphone converts speech to transmit audio signals for the service monitor. The PTT switch turns the microphone on and off.

parts list

RTM4000B Test Microphone — PL-8477-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1	23-82601A34	2 uF + 100-10%; 25 V
C2, 3	21-84547A17	3300 pF ± 20%; 25 V
		cartridge:
DP1	50-83905L01	dynamic, impedance, 400 ohm; ± 20%; @1 kHz
		connector, receptacle:
J1	28-16370	male; 4-contact
		transistor: (see note)
Q1	48-869642	NPN; type M9642
		switch:
S1	40-84241G05	dpdt, slide
		integrated circuit: (see note)
U1	51-84333G79	preamplifier hybrid
		mechanical parts
	1-80796B52	ASSEMBLY, preamplifier; includes: C2, C3, Q1, U1
	3-139797	SCREW, tapping; 5-20 × 5/8"; 3 used
	15-83573L01	HOUSING, microphone front
	33-80348A01	NAMEPLATE
	33-83577L01	NAMEPLATE
	35-83575L01	GRILLECLOTH
	38-83574L01	PUSHBUTTON, microphone
	54-84962K01	TAG, safety
	30-83586L01	CORD, coiled; 3 conductor
	41-83576L01	SPRING, strain relief
	4-1725	WASHER, flat; 0.266 × 0.562 × .040
	4-82707B01	WASHER, flat
	15-83572L01	HOUSING, microphone rear
	29-5247	LUG, soldering

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

INSTRUCTION MANUAL REVISION

68-80312B69 Tol

SMR4944
June 25, 1985

GENERAL

Software enhancements have been made to the R2200 since the printing of this instruction manual. The purpose of this revision is to explain how these changes affect the operation of the service monitor. The following information should be used in place of section 3.4.1 on page 3-3 of the operator's manual.

GENERATOR AND MONITOR FREQUENCY PROGRAMMING

The R2200 service monitor now has the capability of storing a separate RF frequency for monitor and generate. To program the monitor frequency set the function switch to "Pwr Mon" or "Sens Mon". To enter a monitor frequency press the [Freq] program key. Immediately, the first digit on the left LCD will blink indicating the point of entry. Next, enter the desired frequency. Resolution is specified at 100 Hz on frequencies to 999.9999MHz meaning seven decimal digits are valid entries. As the 7 digits are entered using the keys 0 thru 9, the blinking cursor moves to the right automatically but may also be manually moved using [▷] right or [◁] left cursors. To clear the entire entry, press [Reset] . If the [Reset] key is immediately depressed a second time, the original number stored in memory is displayed and the programming sequence is terminated. Pressing [Enter] loads the frequency and also leaves the frequency programming mode.

For example, if a frequency of 190.050 MHz is present in the left LCD display, an RF monitor frequency of 455.321 MHz can be entered into the non-volatile memory as:

PRESS NUMERIC KEY	PRESS PROGRAM KEY	DISPLAY	COMMENT
	Freq	190.050	
4		490.050	
5		450.050	
6		456.050	
	◁	456.050	Manually correct entry
5		455.060	
321		455.321	Complete entry
	Enter	455.321	

Note: Boxed area indicates flashing digit. (point of data entry)

The monitor RF frequency is now stored. The same sequence is used to program the generator RF frequency, except the function switch should be set to the "Gen" or "Hi Gen" position.

FREQUENCY COPYING

If the desired generator frequency is to be the same as the programmed monitor frequency, it is not necessary to enter the frequency twice. The frequency copy mode can be used as follows:

PRESS NUMERIC KEY	PRESS PROGRAM KEY	DISPLAY	COMMENT
	Freq	455.3210	Displays monitor frequency
	(previously stored generator frequency now displayed)		Set function switch to "Gen" or "Hi Gen"
	Freq	455.3210	Displays monitor frequency again
	Enter	455.3210	Generator frequency is now 455.3210

The programmed generator frequency is now the same as the monitor frequency. In a similar manner, the monitor frequency can be copied from the stored generator frequency.

FREQUENCY STEPPING

Frequency stepping can be accomplished by using the [Tone Data] and [Dev Lim] keys. First, enter the frequency programming mode by pressing the [Freq] key. The flashing digit can now be decremented using the [Tone Data] key or incremented using the [Dev Lim] key. Even while the digit is flashing, the frequency indicated on the display is the actual operating frequency. It is not necessary to press [Enter] every time a change is made. Frequencies are stored in non-volatile memory when [Enter] is pressed. The [▷] and [◁] keys are used to position the flashing cursor as desired.

PRESS NUMERIC KEY	PRESS PROGRAM KEY	DISPLAY	COMMENT
	[Freq]	455.3210	enter program mode
	[▷]	455.3210	reposition flashing digit
	[▷]	455.3210	
	[▷]	455.3210	
	[Dev Lim]	455.4210	100 KHz increment
	[Dev Lim]	455.5210	100 KHz increment
	[Tone Data]	455.4210	100 KHZ decrement
	[Enter]	455.4210	flashing ceases exit program mode