User Manual

MRC 1620LP
Remote Control System

Doc. 602-10653-01 Rev C

Released November 1995

Moseley

Moseley
Associates
Incorporated

111 Castilian Drive
Santa Barbara, CA
93117-3093

Phone 805 968 9621
Telex 658448
Fax 805 685 9638

MRC 1620LP Manual Doc #602-10653-01 Rev. C
Revision Configuration:

SECTION	DWG	REV	ECO	REVISED/ RELEASED
Table of Contents	602-10653-TC1	C	DCO1001	November 1995
1	602-10653-11	C	DCO1001	November 1995
2	602-10653-21	C	DCO1001	November 1995
3	602-10653-31	C	DCO1001	November 1995
4	602-10653-41	C	DCO1001	November 1995
5	602-10653-51	C	DCO1001	November 1995
6	602-10653-61	C	DCO1001	November 1995
7	602-10653-71	C	DCO1001	November 1995
8	602-10653-81	A	DCO1001	November 1995

Table of Contents

List of Illustrations

List of Schematics and Assembly Drawings

Glossary

A/C/S	Analog/Command/Status
A/D	Analog to Digital
ACIA	Asynchronous Communications Interface Adapter
BPS	Bits Per Second
CPU	Central Processing Unit
CT	Control Terminal
D/A	Digital to Analog
EEPROM	Electrically-Erasable Programmable Read-Only Memory
FCC	Federal Communications Commission
FET	Field Effect Transistor
FM	Frequency Modulation
FSK	Frequency-Shift Keying
I/O	Input/Output
IC	Integrated Circuit
LED	Light-Emitting Diode
MAI	Moseley Associates, Inc.
MPU	Microprocessing Unit
NC	Normally Closed
NO	Normally Open
PC	Personal Computer
PCB	Printed Circuit Board
PIA	Peripheral Interface Adapter
PSTN	Public Switched Telephone Network
RAM	Random Access Memory
RF	Radio Frequency
RT	Remote Terminal
STL	Studio-to-Transmitter Link
Telco	Telephone Company
THD	Total Harmonic Distortion
TTL	Transistor-Transistor Logic
VCO	Voltage-Controlled Oscillator

Section 1

System Characteristics

1.1 Introduction

The Model MRC 1620LP Remote Control System provides the ability to monitor and control broadcast transmitters and similar installations from remote locations.

It provides sixteen analog "telemetry" channels, which are digital displays of analog input voltages. Four digits plus decimal point and sign are provided. There are sixteen status (on-off) displays; each is an LED which is lit or not according to the presence of an external contact closure. There are thirty-two relay outputs (sixteen raise-lower pairs) which may be activated by the user by selecting a channel and pressing the **RAISE** or **LOWER** button on the front panel.

The MRC 1620LP allows a variety of configurations to be used:

- Remote Terminal (RT) and Control Terminal (CT).
- RT and Personal Computer (PC) as the Control Terminal.
- RT and CT with a PC connected to the RT.
- RT and CT with a PC connected to the CT.
- RT and CT with a PC connected to both the CT and RT.
- RT and PC as the CT with additional PC connected to the RT.

Intercommunication between Control and Remote Terminals may be by leased telephone line (2-wire or 4-wire), or optionally by subcarrier or mixed subcarrier and wire systems. Various subcarrier frequencies are available.

The PC may be connected directly (with leased lines, subcarriers, or RS-232) or via the Public Switched Telephone Network (PSTN/Dialup) at either the Remote or Control Terminal. For use with a PC, it is necessary to use TaskMaster20™ or MasterController™ software available from Moseley. This manual discusses the Remote and Control Terminal configuration and set up. Operation of the TaskMaster20 or MasterController software is described in a separate manual.

Microprocessor technology at both Control and Remote Terminals allows advanced standard features such as single-person keyboard calibration, tolerance alarms, and non-volatile memory.

1.2 System Specifications

Type of System	Microprocessor-based Control and Remote Terminals.
Failsafe	Complies with current FCC requirements. Responds after failure of interconnecting circuit. User-programmable from 1 to 9999 minutes (0 to 166 hours). Can be disabled.
Failsafe Output	RT SPDT relay contacts (Form C) 2A, 30 Vdc, noninductive
Alarm Indications	Visual and aural (both RT and CT). Aural alarm defeatable and remoteable.
Maintenance Override	(RT only) Front-panel control provides RT relay closure. SPDT relay contacts (Form C) 2A, 30 Vdc, noninductive. LED indication at both RT and CT.

Interconnects

Classes	2-wire or 4-wire leased-line, FM subcarrier, or combination.
2-wire and 4-wire	600 ohm balanced line, nominal Send level: 0 dBm, nominal Receive level: -30 dBm minimum Requires Voicegrade Series 422 (2-wire) or Series 420 (4-wire) data channel with basic conditioning. Formerly Series 3002 – Bell System Technical Reference PUB-41004.
Subcarrier (Optional)	2200 ohm nominal unbalanced line, in & out Send level: $1.5V_{P-P}$, nominal Receive level: 0.25 V_{P-P}, minimum Frequency modulation of subcarrier on a specific frequency between 26 kHz and 185 kHz.
Modulation	Two-tone FSK; 1200/2200 Hz
Data Rate	1200 bps; half duplex
Serial Interface	RS-232 serial port for direct or "AT" modem connection to PC 2400 or 1200 or 300 bps.
Serial Interface	RS-232 serial port for interface to user equipment; 2400, 1200, or 300 bps.
RS232 I/O board	Used for conversion of Telco/subcarrier port to RS-232 port; 2400, 1200, or 300 bps.
Data Format (all)	8 data bits, 1 stop bit, no parity

Command Functions

Number of Outputs	16 raise, 16 lower
Inputs	Front-panel raise/lower buttons
Outputs	SPDT (Form C) relay contacts, 2A, 30 Vdc, non-inductive
Response Time	500ms, typical

Status Functions

Number of Inputs	16 inputs (48 optional)
Inputs	TTL-compatible closures at the Remote Terminal. (3300 ohm internal pull-up resistors)
Input Filtering	L-C low-pass filter for each input
Input States	User programmable for N.O. or N.C. contacts
Indication	Front-panel green LEDs at RT and CT (can be changed to red)
Response Time	1 second typical from status change to indication at the CT. 250ms typical when commands are being issued from the CT.

Telemetry (Analog) Functions

Number of Channels	16 inputs
Inputs	Analog ± 4.5 Vdc maximum, single ended referenced to ground.
Input Impedance	500 kOhm, nominal
Input Filtering	L-C low-pass filter for each channel
Calibration	Via front-panel buttons in millivolt, linear, power or indirect power mode. A minimum of 0.25 volts required for full-scale calibration (9999) to maintain stated accuracy.
A/D	One part in 4096 (12 bits + sign)
Measurement Accuracy	Better than 0.5%
Sample Rate	Greater than 9 times/second on displayed channel.
Display	4 digits (9999 maximum), plus sign and decimal point. Alphanumeric set up menu.
Response Time	1 second typical from an input change to display at the CT. 250ms typical when commands are being issued from the CT.

Physical

Power Requirement	9-36 Vdc input, 3 Watts
AC Power Supply Adapter	Wall unit type 12 Vdc regulated output, 500 mA 100-120 Vac input standard, 220-240 Vac with European line connector available
Operating Temperature	0 to 50°C
Size (W x H x D)	49 cm x 18 cm x 23 cm (19" x 7" x 9")

Options

TaskMaster20™	Single-site MRC 1620LP PC Software requires IBM PC/XT or equivalent, or better.
MasterController™	Multi-site MRC 1620LP/MRC 2 PC Software requires IBM PC/AT or equivalent, or better.
Subcarrier Communications	Available on standard frequencies from 26 to 185 kHz.
Extended Status	Adds up to 32 additional Status Inputs, 4 at a time (must give up 1 analog channel per 4 Status Inputs). Provides latching relay capability, below.
Latching Relays	Adds capability to substitute magnetically latching relays for the standard momentary relays. Requires Extended Status option.

Specifications are subject to change without notice.

1.3 System Description

The Control and Remote Terminals consist of several printed circuit modules sharing the processing load. The Remote and Control Terminals perform different functions, but most of their modules are identical. The exceptions are the Analog/Command/Status board and the External Relay board, which are installed only in the Remote Terminal. The following sections describe the general purpose of the individual modules and how they interact with one another. For more detail, see Section 4, Module Descriptions.

1.3.1 CPU

This board, located directly behind the front-panel printed circuit board, is the heart of the MRC 1620LP terminal. It contains the Motorola 6809 Microprocessor, program instructions in FLASH RAM, set up parameters in EEPROM, and the RS-232 port. An address bus and data bus provide communication with other modules. The CPU board distributes power (RELAY +15, ANALOG +15, ANALOG -15, and +5) from the power supply to the other boards.

1.3.2 Front Panel

The Front Panel board, mounted on the chassis access door, provides operator interface via push buttons, an alphanumeric display, and LED indicators. It communicates with the CPU board on the I/O bus.

1.3.3 Power Supply

A wall-mounted power supply/transformer provides regulated 12 Vdc to the internal power supply. The internal power supply board provides +15, -15, and +5 Vdc to the system. The standard wall-mounted power supply accepts 100-120 Vac. Power supplies accepting 220-240 Vac are also available. In either case, protection is provided a 1/2 A slow-blow fuse.

1.3.4 Data Modems

Data modems plug onto the CPU board, interfacing the serial data used by the CPU to and from FSK carrier modulation. Modems are available for Telco or subcarrier communication between the Control and Remote Terminals. These are further divided into transmitters and receivers (input and output). A terminal may be configured with modems of the same type – one input and one output – or it may transmit with one type and receive with another. A system communicating by Telco line exclusively may be configured for 2-wire or 4-wire operation.

Frequency-specific components and jumpers on the modem boards set baud rate, FSK frequency, and – in the subcarrier modems – subcarrier frequency. Subcarrier boards are available in standard frequencies from 26 kHz to 185 kHz. The Telco interface frequencies are within the audio region.

1.3.5 External Relay (Remote Terminal Only)

The External Relay board is mounted on the rear panel of the Remote Terminal, outside the chassis. It provides two relays for each analog (telemetry) channel, a failsafe relay, and a maintenance override relay. (34 relays total). Barrier strip connections for the 16 analog voltage samples and 16 status inputs are also provided on this board.

Each analog channel has one RAISE relay (activated momentarily when the channel receives a RAISE command), and a LOWER relay (activated on LOWER). Both N.O. and N.C. contacts are available to the user. The Failsafe and Maintenance Override relays are activated by conditions described later in this manual.

Telemetry and status data arriving through the barrier strips is sent to the Analog/Command/Status board for processing.

1.3.6 Analog/Command/Status (Remote Terminal Only)

The Analog/Command/Status board is mounted on the rear panel inside the chassis. It communicates with the CPU board and the External Relay board using the I/O bus. An important function of the module is the Analog to Digital conversion of the analog sample channels.

1.3.7 Communications I/O

The Communications I/O board is mounted on the outside of the rear panel of the chassis. Connectors for all communication between Control Terminal, Remote Terminal, and personal computer are on this board, including barrier strip connections for Telco communication, BNC connections for Subcarrier communication, a 9-pin "D" connector for PC communications (COM 1), and a 9-pin "D" connector for special applications (COM 2). Protection against surges over the Telco lines is provided. Communications data is routed to and from the Data Modems via the CPU board. The internal alarm buzzer is enabled by installing a jumper at barrier strip connections on the Communications I/O board.

1.3.8 External I/O (Remote Terminal Only)

The optional External I/O board functions like the External Relay board which it replaces. This board accepts 32 additional Status Inputs and converts them to analog voltages for the Analog/Command/Status board. When using the External I/O board, latching relays may be substituted for the standard momentary relays on the telemetry channels. **One or two** latching relays may be substituted for **each pair** of momentary Raise/Lower relays. A latching relay (or both, if two are installed) is "SET" when the corresponding channel receives a RAISE command and "RESET" by a LOWER command.

Section 2

Installation

2.1 Introduction

We recommend that you read the entire MRC 1620LP manual prior to hookup of the equipment. At the very least, please read this section (Installation), and Section 3 (Operation). The following discussion of system installation assumes the Remote Terminal will be at a transmitter site and the Control Terminal will be at a studio.

2.2 Unpacking

The MRC 1620LP Remote and Control Terminals should be carefully unpacked and inspected for shipping damage. Keep all packing materials until the performance of the system is confirmed. Save the carton and foam inserts in case the equipment must be shipped in the future. Should inspection reveal any shipping damage, visible or hidden, immediately file a claim with the carrier.

We recommend that the front panels to both the Remote and Control Terminals be opened for a brief inspection of the internal components. Ascertain that all boards, assemblies, socketed components, and cables are mechanically secure.

Four screws hold the power supply in place during shipment (located on the underside of the chassis). They should be removed from each terminal before installation. Retain these shipping screws and reinstall them if the terminals are to be moved. This will insure safe transportation.

CAUTION

Do not apply power to either terminal until the procedure in Section 2.3 is completed.

Do not attempt to make adjustments of any kind until the nature of each adjustment is understood.

2.3 Line Voltage

The Remote and Control Terminals each require 3 watts at 9-36 Vdc. A wall-mount power supply converting 100-120 Vac to regulated 12 Vdc at 500 mA is normally supplied. Wall-mount converters for 220-240 Vac are also available. In either case, a 1/2 A slow-blow fuse is used. Verify the supply you have received matches the voltage you will be using. Contact Moseley if you do not have the correct power supply.

2.4 Site Selection

The Remote and Control Terminals must be set to the same site number for proper operation. The site select switch is provided for multi-site operation with PC Software. Set DIP switch S2, located on the CPU assembly, as follows (S2-8 is not used):

SITE	S2-1	S2-2	S2-3	S2-4	S2-5	S2-6	S2-7
0*	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1	ON	OFF	OFF	OFF	OFF	OFF	OFF
2	OFF	ON	OFF	OFF	OFF	OFF	OFF
3	ON	ON	OFF	OFF	OFF	OFF	OFF
4	OFF	OFF	ON	OFF	OFF	OFF	OFF
5	ON	OFF	ON	OFF	OFF	OFF	OFF
6	OFF	ON	ON	OFF	OFF	OFF	OFF
7	ON	ON	ON	OFF	OFF	OFF	OFF
8	OFF	OFF	OFF	ON	OFF	OFF	OFF
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
125	ON	OFF	ON	ON	ON	ON	ON
126	OFF	ON	ON	ON	ON	ON	ON
127	ON	ON	ON	ON	ON	ON	ON

* Factory Default

2.5 Preinstallation Checkout

Becoming familiar with the system before separating the Control and Remote Terminals by many miles may prevent problems during final installation. Following a basic functional check, it is advisable to simulate actual installation by connecting the terminals "back-to-back" on a test bench, as described in the following sections. Read Section 3 (Operation) with the system in front of you.

> ***CAUTION***
>
> *Always disconnect power from the terminal when printed circuit boards are removed or replaced. Failure to do so may cause damage to one or more boards.*

Connect the wall mounted transformers to the two terminals (the Remote Terminal may be recognized by the relays on the rear panel). Plug the transformers into

an ac power source. Open the front panel of each terminal by manually unscrewing the knurled knob and find the power switch, located on the circuit board at the left of the chassis. Turn the power switch to the ON position, or up.

Perform the following steps and observations for both terminals:

- The alphanumeric display should show "RT" or "CT" followed by the site number (typically 0). This display (RT/CT and site number) indicates channel 0.
- After a few seconds the FAILSAFE and ALARM LED's should begin flashing.
- Remote Terminal only: After about 10 seconds the display will go blank and the two LED's will be the only LED's displayed. This is the power saver feature.
- Press **ACK** key to acknowledge the failsafe alarm.
- The display should show **"19 1"**. This indicates the failsafe channel (channel 19) has been selected automatically because of the alarm, and the factory default failsafe time of one minute is shown.
- Press the **CHANNEL UP** arrow key to return to channel 0.
- Test the alphanumeric display and LED's by pressing the **SET UP** and **UPPER LIMIT** keys simultaneously. All LED's and display segments should illuminate.
- Release the keys to restore the LED's and display.

2.6 Communications Interconnections

The following paragraphs tell how to connect the two terminals to form an MRC 1620LP system.

Set the DIP switches on the data modem boards as follows:

Board	SW1-1	SW1-2	SW1-3	SW1-4	SW1-5
Telco Input	ON	ON	OFF	OFF	
Telco Output (2-wire)	ON	ON	OFF	OFF	OFF
Telco Output (4-wire)	ON	OFF	ON	OFF	OFF
Subcarrier Input	ON	ON	OFF	OFF	
Subcarrier Output	ON	OFF	ON	OFF	OFF

2.6.1 Telco Interconnect

When telephone lines are used for communication in both directions between the two terminals, the possible modes of operation are 2-wire or 4-wire. In 2-wire mode, one telephone pair carries both Remote and Control message transmissions. In the 4-wire mode, the Remote and Control Terminal messages are transmitted on separate telephone pairs or their equivalents, giving slightly better noise immunity. In either case, the conditions of a Voicegrade Series 422 (2-wire)/420 (4-wire) data channel with basic conditioning should be maintained.

The Communications I/O board on the rear of each chassis contains varistors that give some protection against lightning strikes. However, we strongly recommend the use of an external lightning arrestor on all phone lines, particularly those at a transmitter site (where the Remote Terminal is located).

If you use a 2-wire Telco circuit, verify that each of the four Telco boards (two at each terminal) is jumpered for 2-wire operation. Connect the TELCO INPUT terminals on the rear of the Remote unit to the TELCO INPUT terminals on the rear of the Control unit as shown in Figure 2-1.

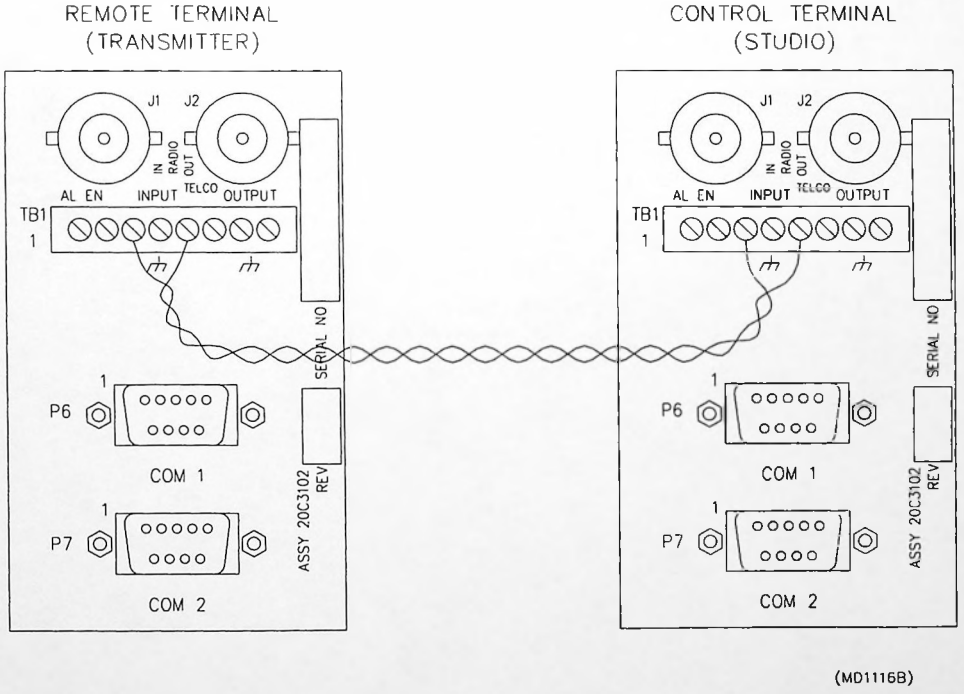


Figure 2-1
2-Wire Telco Communications

If you use a 4-wire Telco circuit, verify that each of the Telco boards (two at each terminal) is jumpered for 4-wire operation. Connect the TELCO INPUT terminals on the rear of the Remote unit to the TELCO OUTPUT terminals on the rear of the Control unit and vice-versa, as shown in Figure 2-2.

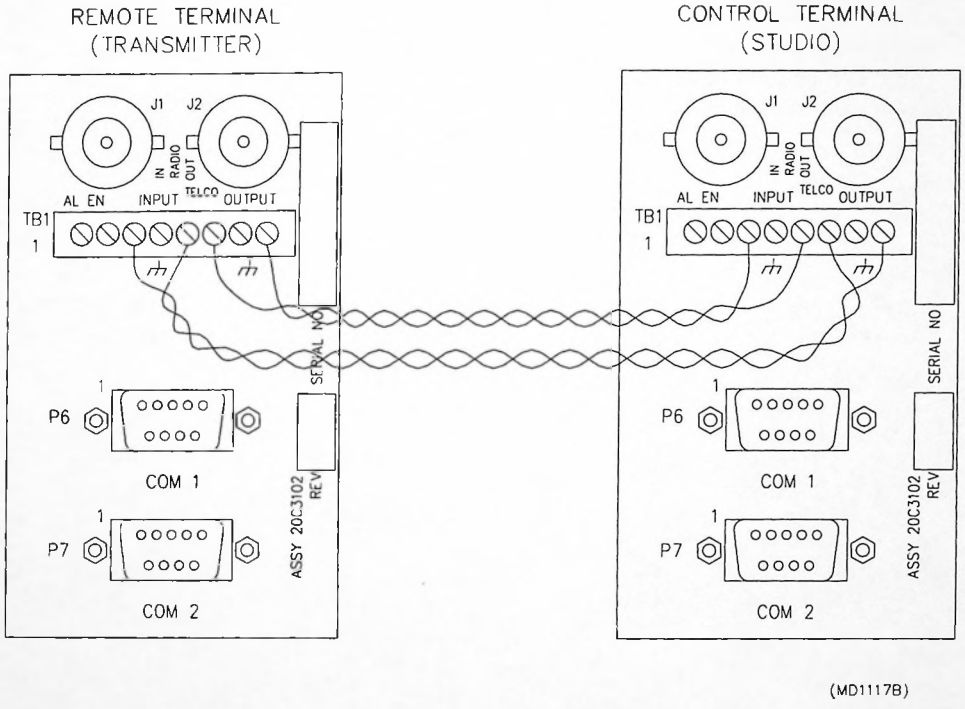


Figure 2-2
4-Wire Telco Communications

2.6.2 Subcarrier Interconnects

When FM subcarriers are to be used for data in both directions, Subcarrier Input and Output boards are normally supplied. Connect the RADIO INPUT of the Remote unit to the RADIO OUTPUT of the Control unit, and vice-versa, as shown in Figure 2-3.

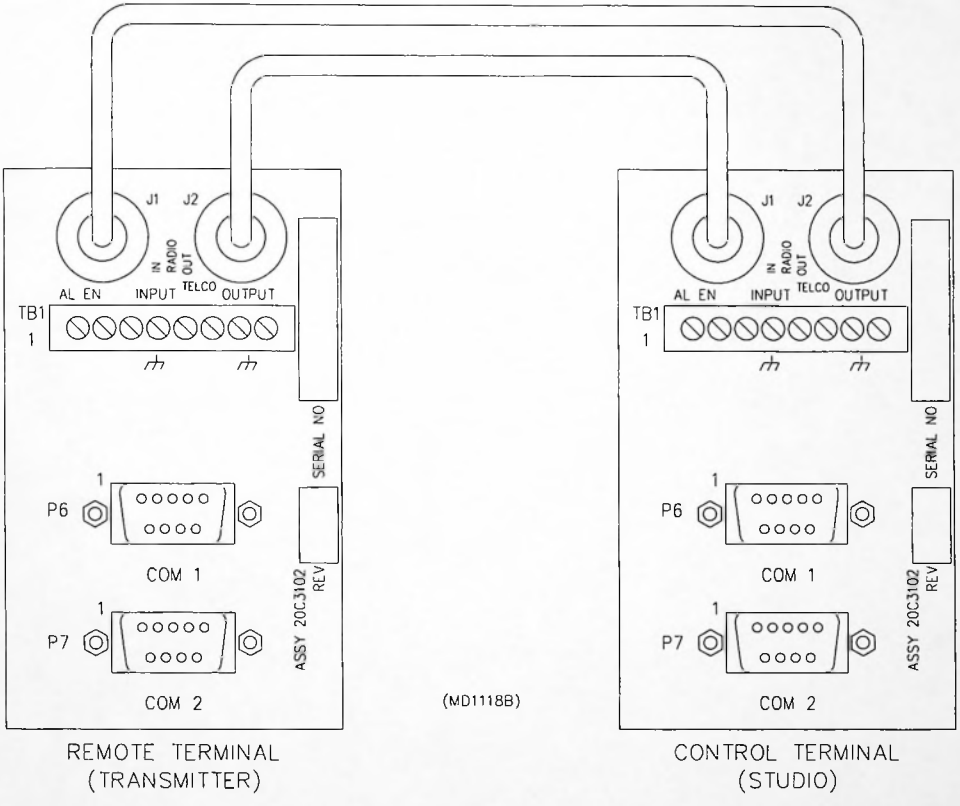


Figure 2-3
Subcarrier Communications

Verify that the correct frequencies for your application are installed. For example, if you want a 110 kHz subcarrier circuit for use over your STL (from Control to Remote) and a 67 kHz subcarrier circuit for use over the air (from Remote to Control), be sure the 110 kHz Subcarrier Input board and the 67 kHz Subcarrier Output board are installed on the Remote Terminal CPU board. The 110 kHz Subcarrier Output board and the 67 kHz Subcarrier Input board should be located at the Control Terminal. Connectors P3 and P4 are interchangeable.

2.6.3 Mixed Interconnects

When one communication direction is by telephone lines (or equivalent) and the other direction is by subcarrier, the appropriate modem boards are supplied. Verify that the Telco boards (one at each terminal) are jumpered for 4-wire operation.

If you use Subcarrier communications from Control to Remote (such as with an STL) and Telco communications from Remote to Control (such as a Telemetry Return Link), verify that the Subcarrier Input board and the Telco Output board are installed on the CPU board of the Remote Terminal. The Subcarrier Output board and the Telco Input board should be installed at the Control Terminal. See Figure 2-4.

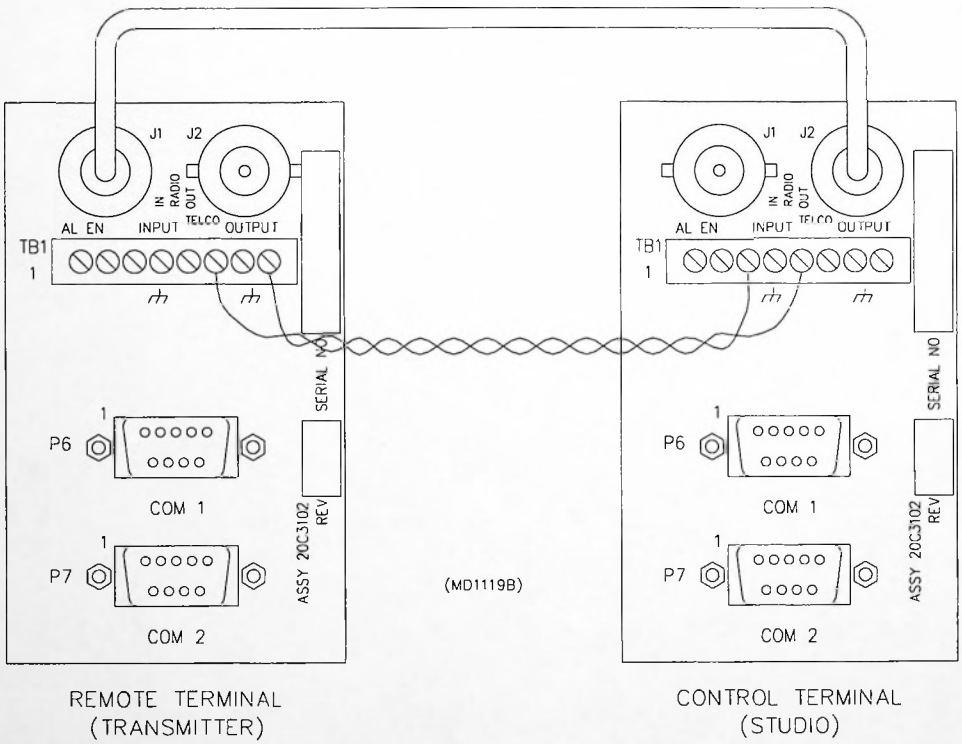


Figure 2-4
Mixed Communications (Case 1)

If you use Telco communications from Control to Remote and Subcarrier communications from Remote to Control, then verify that the Telco Input board and the Subcarrier Output board are installed on the CPU board of the Remote Terminal. The Telco Output board and the Subcarrier Input board should be located at the Control Terminal. See Figure 2-5.

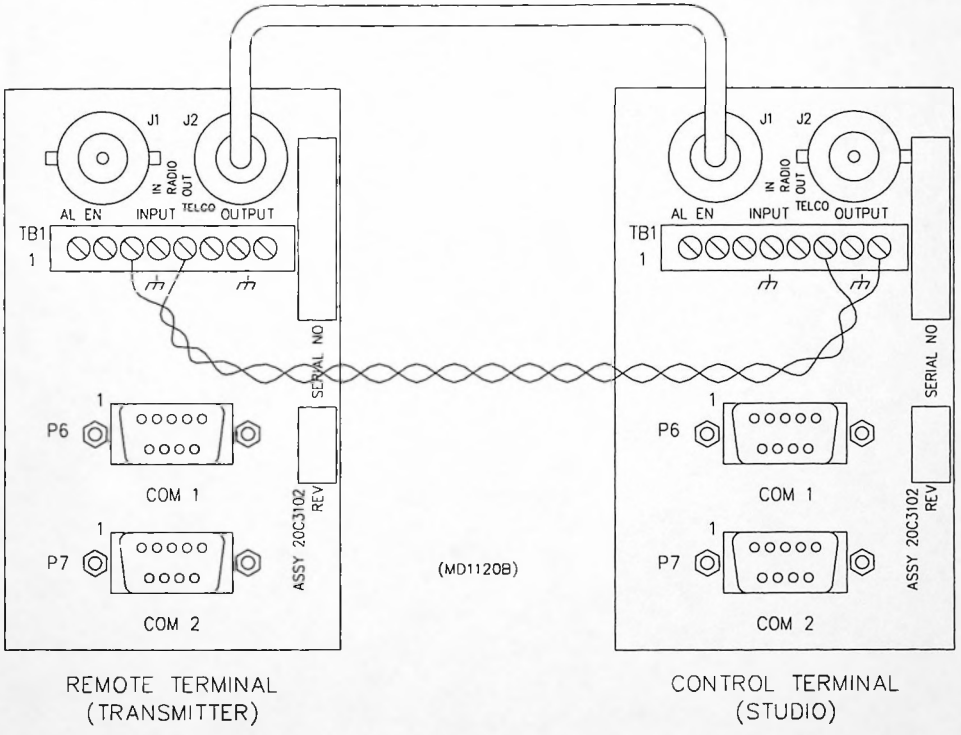


Figure 2-5
Mixed Communications (Case 2)

2.7 System Checkout

Now that both Remote and Control Terminals are connected back-to-back on a bench in front of you, it is a good time to review the SET UP operation of the MRC 1620LP as discussed in Section 3. Figure 2-6 is provided to help you plan your installation.

CHANNEL	TELEMETRY DESCRIPTION	MODE (M,L,P,I)	NORMAL CALIBRATION	UPPER LIMIT	LOWER LIMIT	MUTE CHAN	STATUS DESCRIPTION	INVERT (YES/NO)	ALARM (N,F,R,B)	MUTE CHAN
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										

Figure 2-6
Set Up Worksheet

2.8 Physical Installation

The MRC 1620LP is designed for industry-standard RTMA rack mounting. If the power supply shipping screws are removed prior to installation, all boards that normally require service can be removed without removing the chassis from the rack.

2.9 Audible Alarm

Control of the audible alarm is provided at both Remote and Control Terminals by the ALARM ENABLE connections on the Communications I/O board at the rear of each chassis. *BZDRV is buzzer drive and *INTBZ is internal buzzer.

For the audible alarm to always be activated when an alarm condition is detected, install a jumper between terminals 1 and 2.

If a terminal is located in a studio booth, the buzzer can be muted when a microphone is active, as in Figure 2-7. The relay contact (user-supplied) is assumed to be open when any mike is active and closed when no mikes are active.

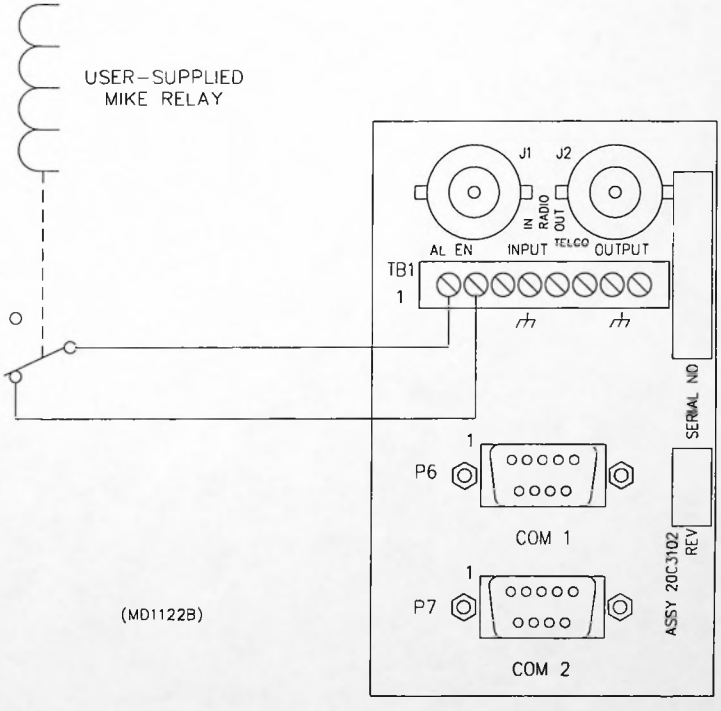


Figure 2-7
Alarm Buzzer Muting

To use an external indicator such as a lamp or buzzer, note that the buzzer driver signal (*BZDRV) at TB1-1 is a transistor closure capable of sinking only 50 mA at 12 V (to signal ground). For larger loads, use an external relay (user-supplied). See Figure 2-8.

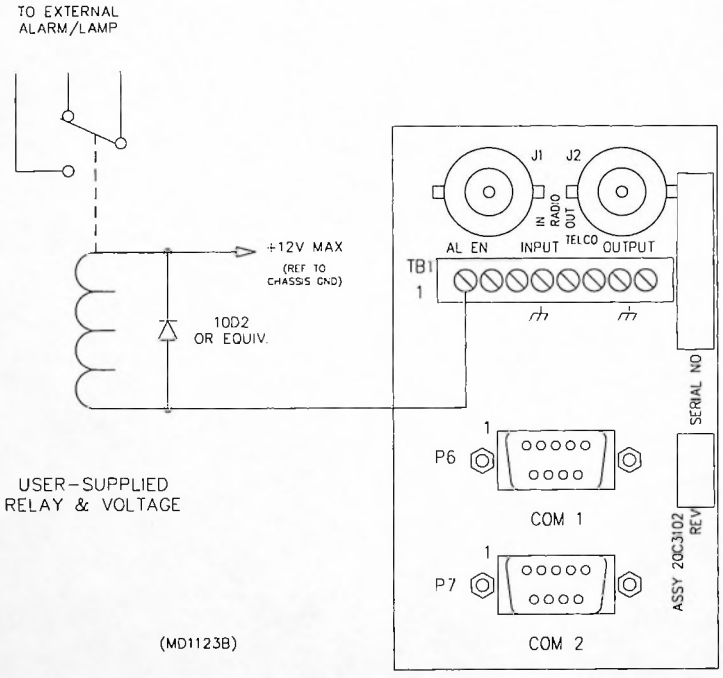


Figure 2-8
External Alarm

2.10 Analog Inputs

The analog input terminals are on the External Relay board, mounted on the rear of the Remote Terminal. Full-scale input is ±4.5 Vdc. If an input exceeds approximately 5 V, "OUCH" will appear in the display and erratic operation may occur on one or more channels. Each input has an integral low-pass filter, so any signal other than dc will be averaged. Inputs are single-ended (that is, one side of the signal is tied to analog ground. To input a signal that is floating above analog ground, an external differential and/or isolation amplifier must be used.

Ground unused analog inputs to prevent erroneous readings.

2.11 Status Inputs

The status input terminals are on the External Relay board, mounted on the rear of the Remote Terminal. Each input is TTL compatible (that is, 0 to 0.8 Vdc is a "low", and 2.4 to 5.0 Vdc is a "high"). Each input has a 3.3K ohm pull-up, so a simple contact closure (such as a relay) can operate a status input. When using a contact closure, install an RC network (100 ohm, 0.1 uF) across the contacts as shown in figure 2-9 to suppress contact bounce.

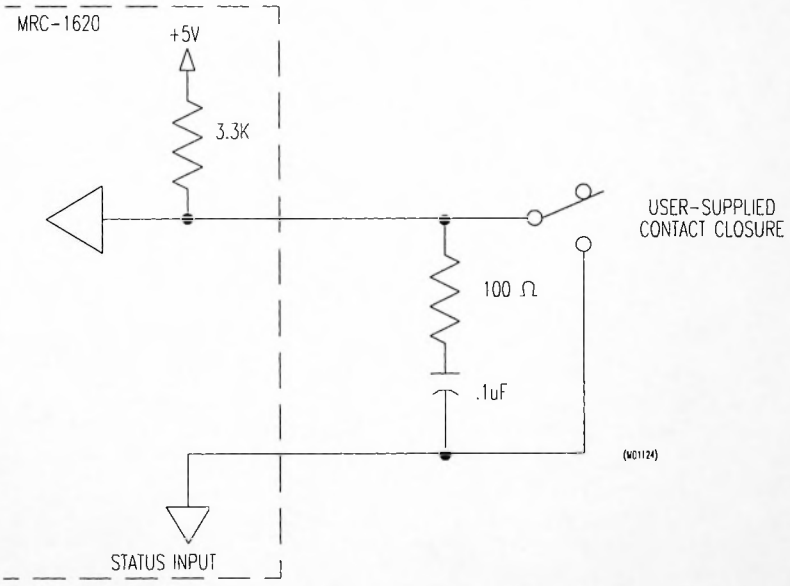


Figure 2-9
Status Input Interfacing

2.12 Relay Outputs

Each of the 34 relays (16 RAISE, 16 LOWER, Maintenance Override, and Failsafe) is rated at 30V and 2A, non-inductive. Larger loads and/or higher voltages require an external relay (user supplied), driven by the MRC 1620LP relay.

When interfacing the relays to TTL equipment, an RC network (100 ohm, 0.1 uF) should be used to suppress contact bounce, and a pull-up resistor may be needed, depending on the particular application. See Figure 2-10.

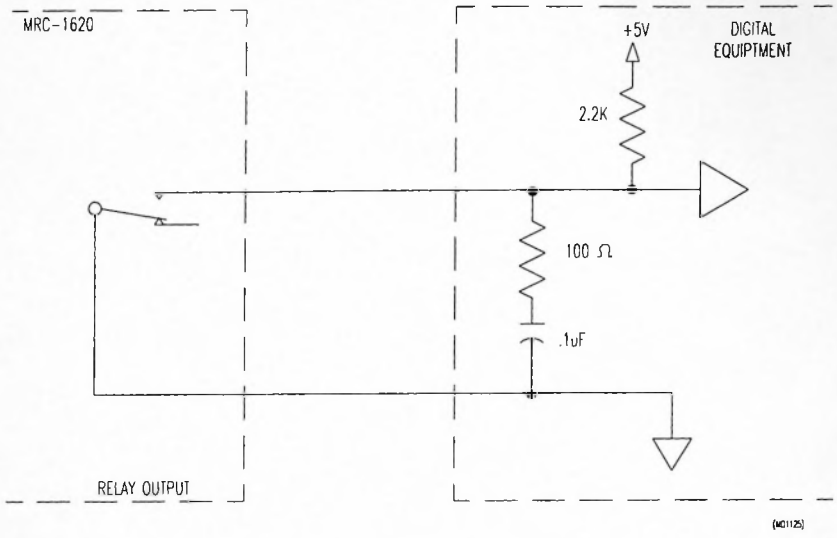


Figure 2-10
Relay Output Interfacing

When interfacing MRC 1620LP relays to external relays, external "snubbing" networks (100 ohm, 0.1 uF) must be installed across external ac relay coils or other ac loads; "clamping" diodes (1N4002 or equivalent) must be installed across external dc relay coils. This is required to avoid erratic operation and possible damage to the MRC 1620LP. See Figure 2-11.

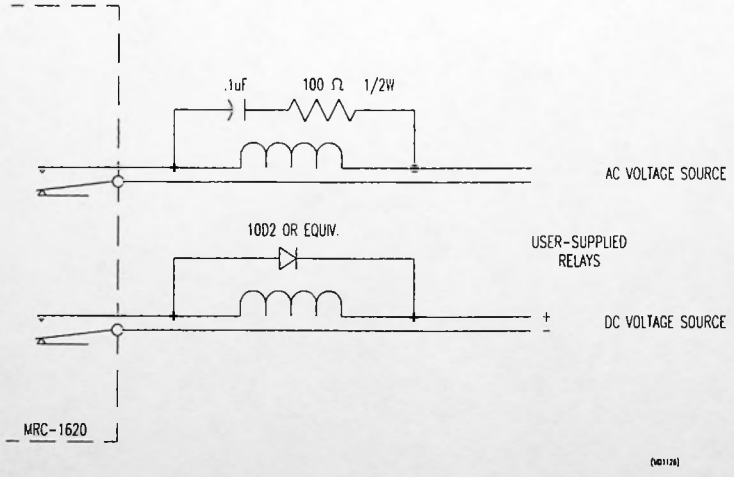


Figure 2-11
Relay-Relay Interfacing

2.12.1 Raise and Lower

Each RAISE and LOWER output has form C contacts. A RAISE relay is energized when the corresponding channel receives a RAISE command, and a LOWER relay is energized by a LOWER command.

If the Extended Status or Latching Relay option is installed, **one or two** latching relays may be substituted for **each pair** of momentary RAISE/LOWER relays. A latching relay will be "SET" by a RAISE command and "RESET" by a LOWER command. If two latching relays are installed for a single channel, both will be SET by a RAISE and both RESET by a LOWER.

2.12.2 Maintenance Override

The Maintenance Override relay has form C contacts. The relay is energized when the Remote Terminal is placed in the Maintenance Override condition.

2.12.3 Failsafe

The failsafe relay has form C contacts. The relay is energized when there **is not** a failsafe condition, and is relaxed when there **is** a failsafe condition at the Remote Terminal.

2.13 Extended Status Inputs

The extended status inputs have the same specifications and requirements as the normal status inputs (see Section 2.11). One analog channel must be given up for each four extended status inputs. Jumpers on the External I/O board convert analog channels into extended status channels as shown in the table below.

Analog Channel	Extended Status Channels	Enabling Jumper
16	17-20	H16
15	21-24	H15
14	28-28	H14
13	29-32	H13
12	33-36	H12
11	37-40	H11
10	41-44	H10
9	45-48	H9

Use the extended status channels in the order indicated. If a particular analog channel is not being used for extended status and is required for analog input, cut the appropriate jumper (H9-H16) on the External I/O board.

Section 3

Operation

3.1 Introduction

If possible, the reader should have the Control and Remote Terminals connected back-to-back for experimentation while reading this section. Pushing the buttons on the front panel cannot damage the units. Place the Control and Remote terminals together on a bench or table top, and connect them using wire or coax cable terminated by BNC connectors, depending on the interconnection options you have ordered. Refer to Section 2.6 for information on interconnection, Section 2.3 for line voltage selection, and Section 2.5 for preinstallation checkout.

After the terminals are connected, apply power to each terminal using the power switch located inside the chassis. Open the front panel using the knurled knob to access the power switch, located toward the left side on the power supply board.

If you do not have the units available while reading this section, Figure 3-1 shows a front panel for reference. The Control and Remote terminals have identical front panels. You can tell them apart by displaying Channel 0 or by looking at the rear of the units; channel 0 shows "RT" or "CT", and the Remote Terminal has an external relay board mounted on the rear.

As might be expected from their physical resemblance, operation of the Control and Remote Terminals is similar. The Remote Terminal (the unit installed at the transmitter) requires additional set up steps. Operation of the Remote Terminal will be described, followed by a description of how the Control Terminal differs.

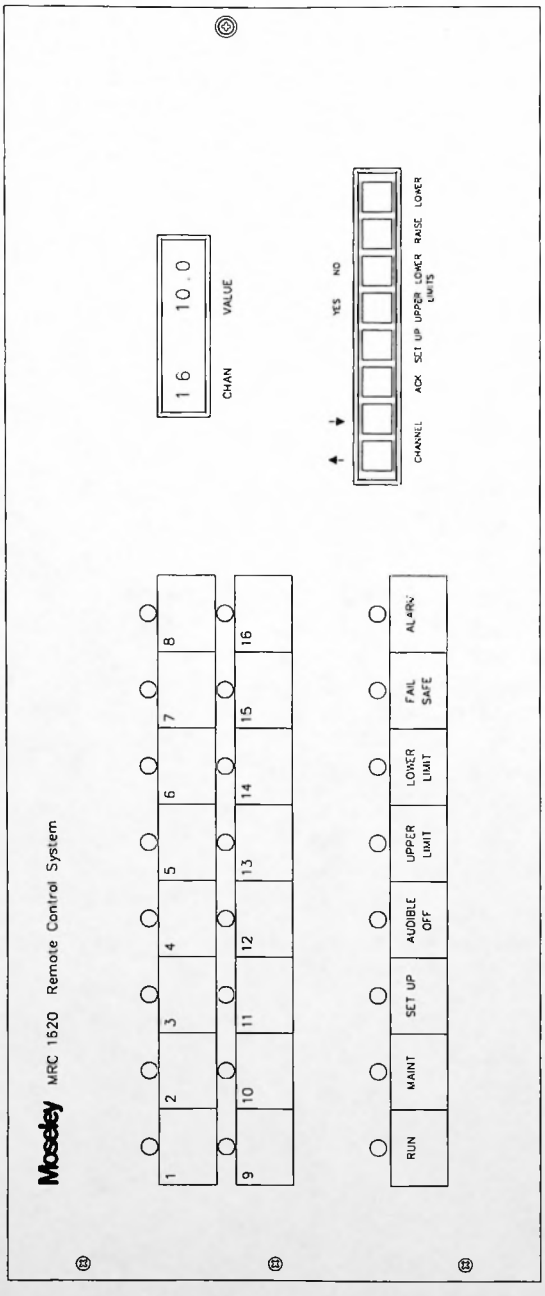


Figure 3-1
MRC 1620LP Front Panel

3.2 Remote Terminal Operation

The front panel alphanumeric display always shows one of the twenty channels (numbered 0 to 19). Channel 0 is displayed automatically on power-up. A power saver feature – on channel 0 only – reduces power usage by deactivating the alphanumeric display and most of the front panel LED's after ten seconds. The RUN, MAINT, FAILSAFE, and ALARM LED's (all explained later), remain active. Pressing any button resets the power saver, returning all front panel displays to normal for ten seconds.

To select a different channel, press the **UP** or **DOWN** arrow keys. To change channels quickly, press and hold the key. After channel 19, channel 0 is selected (and vice-versa).

Channel 0 displays the terminal type ("RT") and the site number.

Channels 1 to 16 display the current value of the sixteen analog (telemetry) inputs.

Channel 17 tests the A/D (analog-to-digital) converter. The A/D reference voltage is fed through the input amplifier and back into the A/D converter. Channel 17 should always read 2048 ± 20.

Channel 18 indicates the performance of the interconnection between terminals. The first two digits represent the quality of communications (proportion of error-free messages) received from the other terminal (hardwire, or HW). The second pair of digits represents the quality of communications being received from the PC port. The third pair of digits represents the quality of communications being received from the alternate port (special port, or SP). Each of these data quality displays is a number from 00 to 99, with 99 being the best indication.

Channel 19 displays the failsafe time as a number of minutes (between 0 and 9999). If the failsafe sequence has been initiated, the time remaining in the failsafe count-down is shown. If the sequence has not been initiated, the user-set failsafe time is shown (factory default is one minute). If failsafe is not enabled, "0" will be displayed.

The RUN LED provides a quick indication of conditions at the terminal. The Remote Terminal RUN LED will be OFF if the terminal is:

- in maintenance override
- in set up mode
- initializing the EEPROM
- in failsafe or impending failsafe

3.2.1 Channel 0

When channel 0 is selected, several testing and control functions may be accessed by pressing **SET UP** simultaneously with other keys, as specified below:

- **Lamp Test**

  Press **SET UP** and **UPPER LIMIT** simultaneously.

All LED's and all segments of the alphanumeric display should illuminate while the keys are held.

- **Audible Alarm Test**

  Press **SET UP** and **LOWER LIMIT** simultaneously.

  The front panel audible alarm will sound while the keys are pressed.

> ***NOTE***
>
> *An enabling jumper must be installed on the rear of the unit to allow the alarm to sound. Refer to Section 2.9 for information.*

- **Audible Alarm Enable/Disable**

  Press **SET UP** and **RAISE** simultaneously.

  Each simultaneous push of these keys reverses the status of audible alarming. The LED labeled AUDIBLE OFF is illuminated when the alarm is disabled. The audible alarm disable function does not disable the audible alarm test.

- **Maintenance Override Enable/Disable**

  Press **SET UP** and **LOWER** simultaneously.

  FCC regulations traditionally have required that only one point at a time in a Remote Control system may be the "control point". The control point has the ability to execute command actions. In the Moseley MRC product line, when the Remote Terminal is the control point, there is said to be a "Maintenance Override" condition. This corresponds to the local/remote function on many older remote controls and is essential for personnel security at the transmitter site.

  When a maintenance override condition exists, the MAINT LED is lit at both Control and Remote Terminals. The **RAISE** and **LOWER** keys at the Control Terminal are disabled and the **RAISE** and **LOWER** keys are enabled at the Remote Terminal. A relay at the Remote Terminal is closed when the system is in a maintenance override condition. This permits the connection of an external light or alarm to warn personnel to remove the system from Maintenance Override Mode before leaving the transmitter site. ***MAINTENANCE OVERRIDE MAY NOT BE ENDED FROM THE CONTROL TERMINAL.*** Each simultaneous push of **SET UP** and **LOWER** at the Remote Terminal while channel 0 is selected reverses the current state of maintenance override.

- **Clear All Alarms**

  Press **SET UP** and **ACK** simultaneously.

  The various conditions that cause alarms in the MRC 1620LP will be described later. If there are several different alarms (for instance, several channels go out of tolerance) the alarms will be "stacked". Normally each alarm will be displayed

in turn (that is, each time **ACK** is pushed, the next alarm is displayed). If you do not want to step through all the alarms, use this function to clear all alarms.

Initial indications on power-up:

Channel 0 may display certain conditions on power-up. These displays are:

- **"RB <site#>"** displayed: Battery RAM (U12) is not installed on the CPU board or the battery is weak (replace U12).
- **"RE <site#>"** displayed: EEPROM (U13) is not installed on the CPU board or is defective (replace U13)
- **AUDIBLE OFF** LED flashing: The MRC 1620LP is initializing the EEPROM for the first time

3.2.2 Channels 1 to 16

For channels 1 through 16, the front panel keys have the following functions:

- **RAISE:**

  Activates the momentary RAISE relay associated with the selected channel.

- **LOWER:**

  Activates the momentary LOWER relay associated with the selected channel.

> ***NOTE***
>
> ***RAISE*** *and* ***LOWER*** *at the Remote Terminal will have no effect unless the unit is in maintenance override mode. Maintenance override defeats RAISE and LOWER at the Control Terminal.*

- **UPPER LIMIT** and **LOWER LIMIT:**

  These keys are used to display tolerance limits for the selected channel. (Limits are established via set up mode, described later.) The limit is displayed as long as the key is held down. "0" indicates that no limit has been set for the selected channel, not that the limit is set to 0 units.

- **ACK** (Acknowledge):

  This key is used to acknowledge alarms, and is discussed in more detail in the following section.

Acknowledging Alarms

The following conditions cause alarms at the Remote Terminal:

- Channels 1 to 16 out of user-established tolerance limits.
- Status alarms. (Alarms may be established on transitions of the 16 status channels. This will be described later.)
- Channel 17: A/D test out of factory-preset tolerances.
- Channel 18: Interruption of data from Control Terminal.
- Channel 19: Failsafe started/activated.

When one or more of these conditions occurs, the alarm LED begins flashing. The appropriate alarming channel is selected automatically. If the audible alarm has not been disabled (via **SET UP** and **RAISE** on channel 0, as described previously) and the enabling jumper has been installed on the rear panel, the audible alarm will sound. Pressing **ACK** acknowledges the alarm and, if the alarm conditions continue, the ALARM LED remains on steadily.

In the case of telemetry tolerance alarms, the red LED's labeled UPPER LIMIT or LOWER LIMIT are illuminated as appropriate, for as long as the out-of-tolerance condition persists. These LED's pertain to the selected channel only. If another channel is selected and that channel is not in an alarm condition, the LED will go out. If alarm conditions end, the alarm must still be acknowledged. The affected channel will be selected automatically, but the tolerance LED's will not be lit.

For status alarms, the appropriate status LED will be flashing when a rising or falling edge has occurred. The LED will be flashing at a 25% duty cycle (that is, mostly off) if the current state of that status channel is OFF. The LED will be flashing at a 75% duty cycle (mostly on) if the current state of the status channel is ON.

> ***NOTE***
>
> *"ON" means there is a closure across the status channel input, unless the status is inverted (see Section 3.3.1, Status Invert), in which case "ON" means the input is open.*
>
> *"OFF" means the input is open, unless the status is inverted, in which case "OFF" means there is a closure across the input.*

The duty cycle does not indicate which type of alarm (rising or falling) occurred. When **ACK** is pushed, the alarm indication goes away until another alarm transition occurs.

If several alarms have occurred (on different channels), the alarms will be "stacked". Pushing **ACK** clears the first alarm, and the next alarmed channel is automatically selected. After a four-second delay the alarm LED flashes again and the audible alarm sounds (if it has been enabled). Once again, when the operator pushes

ACK, the next alarmed channel is selected. This process continues until all of the alarms have been cleared.

When no unacknowledged alarms remain, pushing **ACK** selects channels where the previously acknowledged alarm condition remains in effect. If there is more than one such channel, each channel will be selected in turn as **ACK** is pushed successively. (You must wait four seconds between pushes.)

If an analog channel is muted (see Section 3.3.1 Analog Mute Channel), a square bracket ([ ) will appear in front of the value, and limit checking will be suspended for that analog channel. If a status channel is muted (see Section 3.3.1 Status Mute Channel), alarm checking will be suspended for that status channel.

3.2.3 Failsafe Sequence

If either the Remote or Control Terminal senses that it is no longer receiving data transmissions from the other terminal, the failsafe sequence commences. If the data performance declines to 50 (99 being the best indication), an alarm is sounded for channel 18. If data performance reaches 00, the FAILSAFE LED on the front panel begins to flash and the failsafe countdown begins (initiating at a user-specified nominal time). When three minutes or less remain in the countdown, an alarm is sounded for channel 19. When zero minutes is reached, the FAILSAFE LED remains on steadily, another alarm is sounded on channel 19, and the failsafe relay relaxes at the RT. This relay can be employed to make your transmitter inoperative under failsafe conditions. As soon as communication from Control to Remote is reestablished, the LED goes off and the failsafe relay energizes again.

Entering maintenance override at the Remote Terminal ends failsafe. Failsafe can be disabled (see Section 3.3.3 for failsafe Set up).

3.2.4 Extended Status

If the Extended Status option is installed, the channels will behave differently. The additional status channels, numbered ST17 through ST48, appear between channels 19 and 0.

When one of these channels is displayed, the normal LED status display turns into one of two extended status displays; extended status channels 17 through 32 are displayed on the LED's simultaneously if the selected channel is between ST17 and ST32, and extended status channels 33 through 48 are displayed on the LED's simultaneously if the selected channel is between ST33 and ST48.

An extended status channel in alarm will be indicated with an asterisk (*) next to the displayed valued and the appropriate LED will flash. A muted channel is displayed with a bracket ([) in front of the value.

The RAISE, LOWER, UPPER, and LOWER LIMIT keys have no effect when an extended status channel is displayed. The CHANNEL, ACK, and SETUP keys work as before.

3.3 Remote Terminal Set Up

Channels 1 to 16 can be calibrated, given tolerance alarm limits, and so forth (see Section 3.3.1). Channel 18 is used to set up communications header and trailer bytes (see Section 3.3.2). Duration of the failsafe sequence is set on channel 19 (see Section 3.3.3).

To enter set up mode, select a channel using the **UP** or **DOWN** arrow keys and press **SET UP**.

While in set up mode, the SET UP LED is lit and the RUN LED is off. Set up may be thought of as a sequence of questions. At the end of the sequence the SET UP LED goes off, the RUN LED goes on, and only then do the various parameters you have selected go into effect. To abort the sequence before finishing (thereby losing any parameters you have just entered) simply press **SET UP** again.

> *NOTE*
>
> *You must go through the entire sequence or none of your entries will take effect. Sample telemetry voltages must be present during telemetry set up. Status inputs should be connected for status alarm set up.*

While in set up mode, the keys marked UPPER LIMIT and LOWER LIMIT mean YES and NO ("YES" and "NO" are marked above the keys). In general, press **NO**, **UP**, or **DOWN** as appropriate until the alphanumeric display shows your selection. Then press **YES** to accept the parameter and go to the next question.

The set up parameters may be checked at any time without changing them, by pressing **SET UP** and then **YES** successively. A single parameter may be changed without changing the others, by using **NO**, **UP**, or **DOWN** keys as appropriate and then pressing **YES** until you reach the end of the sequence.

3.3.1 Channels 1 to 16 Set Up

Setting the Telemetry Calibration Mode

To set the calibration mode, select a channel and press the **SET UP** key. You will see MVOLT in the alphanumeric display. This is the first telemetry calibration mode option. The choices are MVOLT (millivolt), LINEAR, POWER, and INDIRECT (INDIRECT is not available for channel 1). The modes are described below. Select the displayed mode by pressing **YES**, or press **NO** to see the next mode.

- **MVOLT** – specifies that the display value for the selected channel will be expressed in millivolts. For example, if channel 1 is calibrated in MVOLT mode and 3.2 volts is applied to the corresponding analog input, "3200*" will be displayed. The "*" indicates that value is in millivolts.

- **LINEAR** – specifies that the display value will be directly proportional to the input sample voltage for the channel being set up. A calibration value will be entered later.
- **POWER** – specifies that the display value will vary as the square of the input sample voltage. This mode can be used to compute power from a telemetry input that varies in proportion to current. This mode also requires a calibration value, which will be entered later.
- **INDIRECT** – specifies that the display value will vary in proportion to the product of the input voltage of the channel being set up and the input voltage of the next lower-numbered channel. For instance, if channel 2 is calibrated in INDIRECT mode, the input voltages on channel 1 and 2 are multiplied, and the value displayed for channel 2 is proportional to this product. (As with LINEAR and POWER modes, you will enter a calibration factor later.) INDIRECT mode is not an option when setting up channel 1 because it has no next lower channel.
- **EXT STAT** – specifies that the selected analog channel will be used for extended status (requires Extended Status option). This mode is only valid for analog channels 9 through 16. Each analog channel calibrated this way is converted to four extended status channels; the analog input function becomes unavailable for the converted channel. A calibration value is required (explained later). The extended status channel attributes are set up using the displayed extended status channels after the corresponding analog channel has been calibrated. The channel correspondence between analog and extended status channels is shown in the following table. Channels should be used in the order indicated. If you are not using a particular analog channel for extended status and you wish to use the channel for analog input, cut the appropriate jumper H9-H16 on the External I/O board.

Analog Channel	Extended Status Channels	Enabling Jumper
16	17-20	H16
15	21-24	H15
14	28-28	H14
13	29-32	H13
12	33-36	H12
11	37-40	H11
10	41-44	H10
9	45-48	H9

Setting the Decimal Point Position

When MVOLT mode has been selected, the next three choices are skipped and the display advances directly to upper limit entry (see below).

In LINEAR, POWER, and INDIRECT modes, the decimal point choices are:

- XXXX.

- XXX.X
- XX.XX
- X.XXX
- .XXXX

The selection specifies the position of the decimal point for the display. Press **NO** until you see the position you want, then press **YES**.

Displayed Sign

This selection, for LINEAR, POWER, and INDIRECT modes, specifies the sign of the calibration value (see below). Select using **NO** and **YES**.

- SIGN +
- SIGN –

Calibration Value

The process of entering a calibration value is analogous to the calibration of an older remote control unit, where a trim-pot was adjusted to obtain a desired reading on a meter. In the case of the MRC 1620LP a sample input voltage is applied, and the display value is adjusted using the **UP** and **DOWN** keys to obtain the desired value.

For example, suppose you apply a 3.0 volt telemetry sample to the input for channel two, select channel 2, press **SET UP**, select Linear mode, select XXX.X, and select sign +. When you get to the calibration value, the display starts at 100.0. This may be adjusted to any value by using **UP** and **DOWN** keys. Let's suppose 100.0 is exactly what you want. Press **YES**. After completing the remaining questions, you leave set up mode. Now, if 3.0 volts is applied to the input for channel 2, 100.0 will be displayed when channel 2 is selected. If 1.5 volts is applied, this is half as much, so 50.0 will be displayed. Suppose you had chosen POWER instead of LINEAR mode (with all the other entries exactly the same). For a 3.0 volt sample applied to the input, the display says 100.0, just as for LINEAR. But when you apply 1.5 volts, the input voltage is half as much, so the display value falls according to the square of one-half (that is, one-fourth) and therefore 25.0 is displayed.

Let us take the same example again, but this time choose INDIRECT mode. Suppose a 1.0 volt sample has been applied to channel 1 and 3.0 volts to channel 2 at calibration time. We once again choose 100.0 as the calibration value. Since the display value is proportional to the product of the two voltages, we can develop the following table:

	Channel 1 Input:	Channel 2 Input:	Channel 2 Display:
Original Conditions:	1.0 V	3.0 V	100.0
Changing Conditions:	0.5 V (× 1/2)	3.0 V (× 1)	50.0
	0.5 V (× 1/2)	1.5 V (× 1/2)	25.0
	3.0 V (× 3)	3.0 V (× 1)	300.0

Due to the characteristics of the A/D converter used in the MRC 1620LP, accuracy is proportional to the input sample voltage at the time of calibration. If less than 0.25 V were to be applied, the accuracy could not meet the specification of 0.5%. Therefore, attempts to calibrate with less than 0.25 V applied to the appropriate input (both inputs in INDIRECT mode) will be ignored. The channel will remain calibrated as it was before you entered set up mode. In general, the input voltage should be near full-scale for calibration. However, the applied voltage should never exceed 4.5 volts.

The calibration value for extended status (EXT STAT) is 3968. The decimal point and the sign are ignored by the firmware. The analog channel must be calibrated with all the associated extended status inputs open (OFF). Press NO until 3968 appears, then press YES. Upper and lower limits and analog mute channel are not used for extended status calibration.

Upper and Lower Limits

After you have entered the calibration factor, you are asked for upper and lower telemetry tolerance limits. If the value as calibrated goes outside the tolerance you have entered, an alarm results. Setting a tolerance of 0 defeats the limit. The system displays an initial value of 5% over or under the display value, as appropriate. For example, if you have calibrated the channel to display 100.0, the initial upper limit will be 104.9, and the initial lower limit will be 95.0. You may use **UP** and **DOWN** keys to change the limit as required. Pressing **NO** will set the display value to 0. Press **YES** when the display shows the correct value and the limit will be established.

Analog Mute Channel

Upper and lower limit checking for an analog channel may be suspended (muted) when a user-specified status channel is "OFF" (see note). After completing limits set up, you are asked to specify which status channel will mute the analog channel being set up. Setting the mute channel to 0 turns off the muting for the analog channel (that is, limits will always be checked). Use the **UP** and **DOWN** keys to change the mute channel.

> ***NOTE***
>
> *Muting is always determined based on* ***displayed status*** *of a status channel (that is, LED off indicates status = "OFF"). The displayed status should be distinguished from the condition of the status input itself – if STAT NORM is applied to a status channel, "OFF" means the status input is open; if STAT INV is applied, "OFF" means there is a closure at the input. See Status Invert below.*

Status Invert

This completes set up of the analog telemetry input for the selected channel. The remainder of the set up sequence is for STATUS indications. The first choices are:

- STAT NORM
- STAT INV

This selection allows you to invert the status applied to the input before it is displayed. When STAT NORM is selected, a closure across the status input terminals for the selected channel causes the LED to be ON. When there is no continuity between the terminals, the LED is OFF. Selecting STAT INV reverses this.

Status Alarms

The next selection sets the conditions for status alarms:

- NONE
- RISING
- FALLING
- BOTH

When RISING is specified, an alarm will be triggered whenever the LED indication for the selected status channel goes from OFF to ON. FALLING causes an alarm on the opposite transition. BOTH specifies an alarm for either transition. Select NONE if you are not using the status inputs, to prevent erroneous alarms upon leaving the set up mode.

Status Mute Channel

Status alarm checking for a status channel may be suspended (muted) when a user-specified status channel is OFF. This is analogous to telemetry limit check muting. You are prompted to specify which status channel will mute the status channel you are setting up. Setting the mute channel to 0 turns off muting (that is, alarms are always checked) for the status channel.

> ***NOTE***
>
> *Muting is always determined based on **displayed status** of a status channel (that is, LED off indicates status = "OFF"). The displayed status should be distinguished from the condition of the status input itself – if STAT NORM is applied to a status channel, "OFF" means the status input is open; if STAT INV is applied, "OFF" means there is a closure at the input. See Status Invert above.*

Selecting the status mute channel completes the set up of this channel. The SET UP LED will go off, and the telemetry value as calibrated will be displayed, assuming the sample is still connected.

3.3.2 Channel 18 – Communications Header and Trailer Bytes

Select Channel 18 and press **SET UP**. "HBYTE=nn" will be displayed, where nn is a value from 0 to 16 indicating the number of header fill bytes preceding normal MRC 1620LP communications messages. These bytes are used to accommodate network delays. Settings for three modems are shown below. Press **YES** to accept the value and continue. "TBYTE=nn" will be displayed, indicating the number of trailer fill bytes appended to normal MRC 1620LP communications messages. Select the desired time and press **YES** to accept the value. The factory default for both values is zero.

Modem Type	HBYTE	TBYTE
Moseley Internal	0	0
"AT" dialup	0	0
Multitech 202T (AT PC)	2	0

3.3.3 Channel 19 – Failsafe Set Up

Select Channel 19 and press **SET UP**. "FS= nnnn." will be displayed, where nnnn is a value from 0 to 9999. 0 disables the failsafe, and values from 1 to 9999 represent duration of the failsafe sequence in minutes – prior to failsafe execution (see section 3.2.3 for more information). Factory default is 1 minute. Select the desired time using the **UP** and **DOWN** keys. Press **YES** to accept the time and exit set up.

> ***NOTE***
>
> *Be sure to consult the current FCC rules and regulations regarding failsafe.*

The failsafe time should be set to a value which is determined by your transmitter installation. If you are using a PC control terminal with dial-up operation only, you might set the failsafe time to just longer than the period that you intend to dial the RT. For example, set the failsafe time to 180 if you intend to dial the RT for 3 hours, or 1440 for 24 hours. The RT will then dial the PC if it has not been queried within the allotted time. 9999 minutes corresponds to about 166 hours, just short of a week.

3.3.4 Channels ST17 to ST48 Extended Status Set Up

The appropriate analog channel must be calibrated first. See Calibration Mode. Select an extended status channel and press SETUP. Follow the procedure for normal status set up as outlined in Section 3.3.1.

> ***NOTE***
>
> *Extended status muting can only be performed by normal status channels (1-16).*

3.4 Control Terminal Operation

Operation of the Control Terminal is similar to that of the Remote. The differences are:

- Channel 0 does not have the "power saver" feature.
- The status of Maintenance Override at the Remote Terminal may not be changed from the Control Terminal. Therefore, pressing **SET UP** and **LOWER** simultaneously on channel 0 will have no effect. There is no maintenance override relay at the Control Terminal.
- There is no failsafe sequence at the Control Terminal. However, alarms will be generated when the Remote Terminal is in failsafe or impending failsafe, as follows:
    - channel 18 alarm if communication with RT degrades to 50
    - RUN LED turns off
    - channel 19 alarm and failsafe LED flashes if communication with RT degrades to 00
- There is no set up at the Control Terminal except Channel 18 (to set communications header and trailer bytes). Pressing **SET UP** has no effect when other channels are selected.
- When there is no return data from the Remote Terminal (that is, the data quality is 00), a RAISE or LOWER from the Control Terminal to the Remote Terminal will take up to four seconds to complete. Therefore, hold down

RAISE or **LOWER** for four seconds to insure the command is received if there is no return data.

- The RUN LED will be OFF when:
  - RT is in maintenance override
  - RT is being set up
  - CT is being set up
  - CT is initializing the EEPROM
  - data quality from the RT is less than 50.

After power is first applied to the Remote Terminal or to the Control Terminal, or after either experiences a reset (via the reset switch or due to a power glitch), the Remote Terminal will transfer its calibration parameters to the Control Terminal. This initial calibration may take about 20 seconds, during which the SET UP LED flashes. Upon completion of the transfer, the LED will stop flashing and control of the Remote Terminal will be possible.

3.5 Quick Reference

This summary of MRC 1620LP operation and set up is provided for quick reference.

3.5.1 Operation

- **UP / DOWN** increments or decrements the selected channel.
- **RAISE** activates RAISE relay for selected channel.
- **LOWER** activates LOWER relay for selected channel.
- **UPPER LIMIT / LOWER LIMIT** display telemetry tolerance limits (a limit of 0 means no limit has been established).
- **ACK** (when ALARM LED is flashing and audible alarm is sounding (if enabled)) acknowledges tolerance alarm or status alarm. The channel in alarm state will be automatically selected. If there is more than one alarm, they will be presented in order of channel number.
- **ACK** (when ALARM LED is on but not flashing) discloses any previously acknowledged alarms where the alarm condition persists. These include:
  - Telemetry channel remaining out tolerance
  - Status channel remaining OFF after falling edge alarm
  - Status channel remaining ON after rising edge alarm
- RUN LED is OFF (at both terminals) if:
  - Remote Terminal is in maintenance override
  - Either terminal is in set up

- Remote Terminal is in failsafe or impending failsafe
- Remote Terminal is not communicating with the Control Terminal

- The channel displays are as follows:
  - Channel 0 – After ten seconds the Remote Terminal goes into "power saver mode", with only the RUN, MAINT, SET UP, and ALARM LEDs enabled.
  - Channels 1 to 16 – Telemetry inputs
  - Channel 17 – A/D gain reference (should be 2048 ±20 counts)
  - Channel 18 – Data link performance figures (for HW/PC/SP). Each performance value is expressed as a number between 00 and 99 (99 being best).
  - Channel 19 – Failsafe duration setting or time until failsafe execution, expressed as minutes from 0 to 9999.
  - Channels ST17 to ST48 – Extended Status inputs

- When channel 0 is selected, the following combinations of keys pressed simultaneously perform the indicated functions:
  - **SET UP** & **UPPER LIMIT**: Lamp Test
  - **SET UP** & **LOWER LIMIT**: Audible Alarm Test
  - **SET UP** & **RAISE**: Toggle Audible Alarm
  - **SET UP** & **LOWER**: Toggle Maintenance Override (RT only)
  - **SET UP** & **ACK**: Clear all unacknowledged alarms

- Failsafe Sequence
  1. Alarm is initiated for channel 18 when Control to Remote Terminal link performance is < 50.
  2. Countdown commences (from time specified on channel 19) and FAILSAFE LED begins flashing when link performance = 00.
  3. Alarm is initiated for channel 19 when countdown < 4.
  4. Alarm is initiated for channel 19, failsafe relay relaxes, and FAILSAFE LED remains on steadily when countdown = 0.

3.5.2 SET UP SEQUENCE

To set up a channel at the Remote Terminal, select the desired channel and press **SET UP**. Telemetry samples must be present. The set up options are shown below in order of appearance. Make selections using **NO**, **UP**, **DOWN**, and **YES** as appropriate.

- **Telemetry Calibration Mode**

  MVOLT (millivolt display)

  LINEAR (proportional to input)

  POWER (proportional to square of input)

  INDIRECT (proportional to product of the selected channel and the next lower channel; not allowed on channel 1)

  EXT STAT (Extended Status only valid for channels 9 to 16)

- **Telemetry Display Decimal Point**

  XXXX.

  XXX.X

  XX.XX

  X.XXX

  .XXXX

- **Sign of Telemetry Calibration Factor**

  SIGN +

  SIGN –

- **Telemetry Calibration Value**

  (specify a value)

- **Telemetry Upper Tolerance Limit**

  (specify a value)

- **Telemetry Lower Tolerance Limit**

  (specify a value)

- **Analog Mute Channel**

  (specify a channel)

- **Status Input Inversion**

  STAT NORM (not inverting)

  STAT INV (inverting)

- **Status Alarm**

  NONE (no alarm)

  FALLING (alarm on LED change to OFF)

  RISING (alarm on LED change to ON)

  BOTH (alarm on any transition)

  Leave all unused status channels set to NONE.

- **Status Mute Channel**

  (specify a channel)

Section 4

Module Characteristics

4.1 Introduction

This section provides theory of operation for the MRC 1620LP. Please see Section 7 for the schematics and assembly drawings referred to for each module.

4.2 Power Supply

Schematic: 91D7508
Assembly: 20B3097-1

The power supply module requires 3 watts at 9 to 36 Vdc. This is converted to +15 Vdc, -15 Vdc, and +5 Vdc. These system voltages are sent via a six conductor cable to the CPU board for distribution to the other assemblies.

Each MRC 1620LP terminal is normally shipped with a wall-mount power supply/transformer for line voltage input. The standard wall-mount supply accepts 100 to 120 Vac. 220 to 240 Vac supplies are also available. Either supply provides 12 Vdc regulated at 500 mA. Protection is provided by a 1/2 A slow-blow fuse.

4.3 CPU

Schematic: 91A7509
Assembly: 20B3098

This section provides a comprehensive technical description of the CPU board. Rather than giving a detailed explanation of microprocessors, it is limited to a discussion of their use in this assembly. Many texts on microprocessors are available for further reference.

The CPU board is composed of six sections, each described in the paragraphs following.

- MPU
- Address Decoding
- System I/O
- Reset Circuitry
- Modem I/O
- RS-232 I/O

MPU

U11 is the MC6809 MPU (Microprocessing Unit) which generates the address from which data will be stored or retrieved. The address bus (A0-A15) consists of 16

bits, allowing 65,536 (2^{16}) addresses. These lines are used on the CPU board to select the PIA (Peripheral Interface Adapter), ACIA's (Asynchronous Communications Interface Adapters), RAM (Random Access Memory), EEPROM (Electrically-Erasable Programmable Read-Only Memory), or the FLASH RAM.

The bidirectional data bus (D0-D7) carries data between the MPU and other parts of the CPU board. To write data to another device on the board, the MPU puts the appropriate address on address lines A0-A15; puts data on data lines D0-D7; and strobes the R/*W (Read/Write) line low to signal a write operation. To read data from another device, the MPU asserts the address, strobes R/*W high, and reads the data on the data lines.

Communication between the MPU and devices external to the CPU assembly is described later (see System I/O).

Other signals associated with the MC6809 are as follows:

- E (Enable) is a 1 MHz square wave used for bus timing – data transfers occur on the falling edge of E.
- Q is a quadrature signal with E (90 degrees out of phase with E).
- BA (indicates bus access) is not used.
- RESET disables operation and resets the MPU to a known state.
- IRQ, *FIRQ, and *NMI are interrupt inputs.
- HALT and *DMA/BREQ are inputs used with direct memory access schemes and are not used in the MRC 1620LP.
- MRDY is a memory ready signal used to interface with slow memories and is also not used in the MRC 1620LP.
- XTAL and EXTAL connect with Y1 to form a 4.0 MHz oscillator.

Address Decoding

Decoding of addresses internal to the CPU board is performed by the 22V10 PAL at U2.

Below is a chart showing the range of addresses for which a specific integrated circuit is selected.

Integrated Circuit	Address(hex)
RAM (U12)	0000-1FFF
EEPROM (U13)	4000-5FFF
PIA (U18)	7B00-7BFF
ACIA 1 (U14)	7C00-7CFF
ACIA 2 (U15)	7D00-7DFF
ACIA 3 (U16)	7E00-7EFF
SITE SWITCH (S2)	7F00-7FFF
FLASH RAM (U10)	8000-FFFF

System I/O

The bulk of the system I/O is done through the PIA installed at U18. PA0-PA7 are bidirectional data lines, buffered by U19. PB0-PB4 (used as outputs only) address external I/O devices after buffering by U20. PB5 selects the data direction (input versus output) of the data bus PA0-PA7; a low on PB5 sets the bidirectional buffer U19 to allow an input operation. At the same time, the PIA (U18) configures itself internally to accept input on PA0-PA7. Output is accomplished in much the same way, except PB5 is driven high to set U19 for output while the PIA prepares to output on PA0-PA7. In addition, the PIA strobes *WRSTR (Write Strobe) to signal the addressed device of the write operation.

Other system I/O handled by this PIA (U18) includes notification via the Analog/-Command/Status signal *ADRDY when the Analog-to-Digital converter (A/D) finishes a conversion. The C75 clock (75 Hz) at the input of CB1 works in conjunction with the PIA to form a real-time clock that interrupts the processor for timing purposes every 13.312 ms.

Reset Circuitry

The microprocessor RESET is controlled by a MAX705 microprocessor supervisory circuit at U1. This device provides an interrupt upon power failure, debounces the RESET button, and conditions the RESET signal.

Modem I/O

The Modem I/O section of the CPU board works in conjunction with the Data Modems installed in the Communications Input and Communications Output plugs P3 and P4 (the plugs are interchangeable). Baud rate selection is accomplished by jumpers within each Data Modem which connect the communications clocks F4 (4800 Hz) or F6 (19200 Hz) to the receiver clock RXCLK or transmitter clock TXCLK, as appropriate. Other clocks (F1 to F3 and F5) are available for special applications (see the schematic for frequencies).

RS-232 I/O

The RS-232 I/O section of the CPU board provides two RS-232 asynchronous ports, P6 (COM 1) and P7 (COM 2). Both ports are accessible on the Communications I/O panel at the rear of the chassis. P6 and the ACIA located at U15 are dedicated for communication between the MRC 1620LP and a PC, either by direct connection with a null modem cable or via external modems. P7 and the ACIA located at U14 are used for special applications that require communication with other equipment (contact Moseley Associates for more information). Baud rate selection is accomplished by jumper selection at E2 and E1 for ACIA's U15 and U14, respectively. Jumper E4 allows the user to assert the RS232 signals DCD, CTS, or DSR for the special communications port P7.

Memory

EEPROM containing user set up parameters is at U13, and can be configured with a 2k or 32k device, jumper selectable at U13 (32k is standard).

8k of RAM with clock/calendar is located at U12

FLASH RAM containing program instructions is located at U10. Program updates or special applications firmware may be uploaded in the field via a PC-based software program supplied by Moseley Associates. The jumper at E3 (next to U17) must be in the PGM position for field programming. E3 directs the programming voltage generated by U17 to the FLASH RAM. Return E3 to the OFF position after programming.

4.4 Front Panel

Schematic: 91D7300
Assembly: 20B2855

The Front Panel board communicates with the CPU over the Address and Data I/O buses, AB0-AB4 and IODB0-IODB7. Incoming data is buffered by U7. Most address decoding is handled by the two 2-to-4 line decoders in U9. The Front Panel has four sections – alphanumeric display output, LED output, buzzer output, and switch input – each described below.

Switch inputs (that is, operator inputs) are buffered through U8 before being output on the data bus. U8 is enabled by the *RDSW signal derived from U10's decoding of AB2-AB4.

LED data is stored in the 8-bit bus latches U4, U5, and U6 (bottom, top, and middle rows, respectively) which are strobed by *LEDB, *LEDM, and *LEDT when U9 detects the proper I/O address, and the write strobe *WRSTR is driven low. The LED's may be changed from green to red by reversing their polarity.

The alphanumeric displays U1 and U2 are set to accept data from the data bus when the *DSL or *DSR (left or right) lines are driven low by U9. Lines AB0 and AB1 address the displays.

The audible buzzer signal is supplied by the D-type flip-flop U3. This is set to latch on the incoming data (on DB0-DB1) whenever the *ALARM line (generated by U9 decoding) is driven low. If the audible alarm jumper is installed on the back of the Communications I/O board, the collector of Q1 driving the buzzer drive signal *BZDRV is looped back to the internal buzzer activate line *INTBZ causing it to drive the audible alarm.

4.5 Analog/Command/Status (A/C/S) Board

Schematic: 91D7302
Assembly: 20C3099

As suggested by its name, the A/C/S board performs three functions for the MRC 1620LP Remote Terminal. All communication between this board and the CPU board is by the I/O address and data buses AB0-AB4 and IODB0-IODB7. The 3-to-8 line decoder U12 serves as the I/O address decoder to enable the various sections of the board.

The status inputs, supplied by the External Relay board, are each filtered by a 6.8 mH inductor and a .1 uF capacitor. When the proper I/O address is asserted by the CPU board, U12 drives either the *STLO (for status inputs ST1-ST8) or *STHI (for status inputs ST9-ST16) low to enable the appropriate bus driver U13 or U14 to put status input data on the I/O data lines.

Command outputs (relay signals) are generated by addressable latches U4, U5, U21, U22, and U23. U12 drives the *RELAY signal low when it detects a latch address. When *RELAY is low and the CPU strobes *WRSTR, U19, another 3-to-8 line decoder, decodes data lines D3-D5 to select the proper addressable latch. Output from the addressable latches, generated from D0-D2 and D7, are fed into U9, U10, U16, U17, and U18 relay drivers, which ultimately activate the proper relay on the External Relay board.

The analog path and its associated Analog-to-Digital converter (A/D) comprise the rest of the A/C/S circuitry. Single-ended analog inputs from the External Relay board are received on lines AD1-AD16, where they are filtered by a 6.8 mH inductor, a .1 uF capacitor, and an RC network consisting of a 33K ohm resistor and a .1 uF capacitor. They are then presented to the inputs of the analog multiplexers U1 and U2. When the A/D address is received from the CPU, U12 drives the *ADSET line low. At the same time, the CPU puts an analog channel number on the data I/O bus, then strobes the *WRSTR line. Through U11, *WRSTR activates the 8-bit latch U6. The output of U6 (that is, the analog channel number) then selects the proper analog input channel via the analog multiplexers U1, U2, and U3. U3 presents the analog voltage to the input of op amp U8. The signal is buffered and fed to the A/D converter.

When the A/D converter finishes conversion, it signals the CPU board via the *ADRDY line. The CPU responds by selecting the I/O addresses which activate in turn, through U12, the *ADLO and *ADHI lines. These signal U7 to place the digital data (in two consecutive bytes) on the data I/O lines.

4.6 External Relay

Schematic: 91D7303
Assembly: 20B2858

The External Relay board in the Remote Terminal is one of the simpler boards in the MRC 1620LP system. Its provides barrier strips for input of analog samples and status inputs and for connection to command outputs (the relay contacts). Connections

for the Maintenance Override and Failsafe relays are also provided. All of the relays are mounted on this board, and are activated by signals from the Analog/Command/-Status board. The analog and status inputs are single sided (that is, one side is ground).

4.7 Communications I/O

Schematic: 91B7511
Assembly: 20C3102

The Communications I/O board provides a communication interface between the CPU board and the outside world. Terminal block connections for Telco input and output, and BNC connectors for radio input and output are on this board. Varistors function as back-to-back zener diodes, providing sensitive high-energy filtering. Connections for internal alarm buzzer enabling are also on the terminal block. The board has two 9-pin "D" connectors for RS-232 interfacing. COM 1 (P6) is for communication between the MRC 1620LP and a PC, either by direct connection with a null modem cable or via external modems. COM 2 (P7) is reserved for special applications that require communication with other equipment (contact Moseley Associates for more information).

4.8 Data Modems

This section describes the data modems available for the MRC 1620LP. Each modem card has different configurations, but operation is independent of configuration. The exception to this is the 2-wire Telco configuration.

Telco Input

Schematic: 91C7304
Assembly: 20B2859

The Telco Input board has four sections: RF filter, active coupler, audio bandpass filter, and FSK demodulator. Modulated data received through the Communications I/O board is passed to J1-23 and J1-24. RF filtering rejects high-frequency energy. Zener diodes CR1 and CR2 prevent voltage from exceeding 17 volts. The signal is coupled through transformer T1 to amplifier U2.

For 2-wire operation, the 2-wire/4-wire jumper is set to the 2-wire position, allowing FSK data generated by the Telco Output board to be injected through R14 to the secondary of T1, and ultimately to be coupled, in the opposite direction from above, to the 2-wire Telco line. In the 4-wire position, the jumper grounds the line to R14. In either case, the input signal is filtered by the 4-pole bandpass filter, then presented to the input of the FSK demodulator. The frequencies used are 1200 Hz and 2200 Hz. Frequency-dependent components and their values are specified on the schematic.

FSK data to digital data demodulation is accomplished by the phase-locked loop based IC U1. The range of the internal voltage-controlled oscillator is set by frequency

dependent components C3, C7 and R7. When the proper carrier frequencies are presented on the input pin, the chip signals the CPU board that the carrier is present by driving the *DATA CARRIER DETECT line low. Demodulated data is sent to the CPU board on the RECEIVE DATA line.

The data transmission rate for Telco communications is 1200 baud. Accordingly, the Telco receiver selects 1200 baud demodulation rate by connecting the C19200 clock (19200 Hz) from the CPU board to the RXCLK receiver clock input.

Telco Output

Schematic: 91C7305
Assembly: 20C2860

The Telco Output board generates FSK data from serial digital output from the CPU board. It consists of four sections: modulator, output amplifier, RF filter, and radio control circuit.

The modulator section is built around U1, a function generator configured to produce frequency-shifted sine waves. The high-frequency carrier is set to 2200 Hz by R5 and HIGH FREQ ADJ potentiometer R7, while R6 and LOW FREQ ADJ R2 set the low-frequency carrier to 1200 Hz. Component values for frequency-determining parts and S1 dip switch positions are specified on the schematic. The function generator is activated when the CPU board drives the request-to-send *RTS line low (for 2-wire operation, S1-2 and S1-3 keep Q1 off, simulating a steady low on *RTS). The carrier frequency is modulated by the serial data from the CPU board on the TRANSMIT DATA line.

FSK data from U1 is then amplified by op amp U2, whose gain is set by OUTPUT LVL potentiometer R12. If the installation is operating over a 2-wire line, the 2-wire jumper is installed, coupling the FSK output to the 2-wire line through the Telco Input board. For 4-wire operation, the 4-wire jumper is installed, coupling the output signal through T1 to the RF filtering circuitry and the Telco Output line.

RF filtering protects the FSK modulation circuitry against high-frequency energy and voltage transients exceeding 17 volts on the Telco lines.

The Telco communications data transmission rate of 1200 baud is set by jumper E1, which connects the transmit clock TXCLK to the C19200 clock (19200 Hz). E2 is special applications.

The radio control circuit allows keying a transmitter on when a radio is used to communicate between the control site and the transmitter site. The Telco output is fed to the audio input of the radio, and the radio circuit acts like the microphone key to cause the transmitter to operate.

Subcarrier Input

Schematic: 91D7306
Assembly: 20B2861

Subcarrier modulation differs from FSK modulation of the audio spectrum in that it is composed of two modulation processes. The first translates serial data into FSK in the audio region. The second takes that audio FSK and frequency-modulates a subcarrier with it.

The Subcarrier Input board accepts modulated data from a companion Subcarrier Output board within the MRC 1620LP system. The board consists of four major sections: input filter, subcarrier demodulator, audio bandpass filter, and data demodulator.

Subcarrier frequency may be 26, 39, 67, 110, 152, or 185 kHz. Frequency-dependent component values and S1 dip switch settings are specified on the schematic. Input filtering forms a bandpass filter centered around the selected subcarrier frequency. The filtered subcarrier is presented to the phase-locked loop based subcarrier demodulator U3, which produces audio FSK data. The internal voltage-controlled oscillator frequency is determined by C27. FSK ADJ potentiometer R27 fine-tunes the VCO. Audio FSK data is then filtered by the 4-pole audio bandpass filter before being presented to the input of the FSK demodulator U1. FSK demodulation is identical to that of the Telco demodulator, described earlier. C7 is the VCO timing capacitor, and VCO ADJUST potentiometer R7 fine-tunes the VCO. U1 drives the RECEIVE DATA line with the demodulated serial data. In addition, when the FSK demodulator receives a valid audio carrier, U1 signals the CPU board by driving the *DATA CARRIER DETECT line low.

Subcarrier Output

Schematic: 91D7307
Assembly: 20D2862

The Subcarrier Output board generates a frequency-modulated subcarrier from digital serial data received from the CPU board. The modulation scheme is a two-step process. Digital data is modulated into audio FSK data, and the audio FSK data then frequency-modulates the subcarrier.

The Subcarrier Output board has three sections: audio FSK modulator, output amplifier, and subcarrier generator. The audio FSK modulator is based around function generator U1. Activation of U1 occurs when the CPU board drives the request-to-send *RTS line low, forcing Q1 into cutoff. Serial data on the TRANSMIT DATA line frequency-modulates the carrier. R9 and HIGH FREQ ADJ potentiometer R9 set the high-frequency carrier to 2200 Hz while R6 and LOW FREQ ADJ potentiometer R2 set the low-frequency carrier to 1200 Hz.

Audio FSK data is coupled through C9 to the output amplifier U3, whose gain is determined by SUBCARRIER MODULATION ADJUST potentiometer R17, then fed into the subcarrier generator U2.

The subcarrier frequencies available include 26, 39, 67, 110, 152, and 185 kHz. Timing capacitor C8 determines the subcarrier frequency – a list of values is provided on the schematic. Potentiometers R8 and R7 are coarse and fine frequency adjustments. OUTPUT LEVEL ADJ potentiometer R21 sets the modulated subcarrier output level. DISTORTION ADJ potentiometer R13 may be adjusted to minimize the Total Harmonic Distortion (THD) of the subcarrier sinusoid.

4.9 Cable Assemblies

The following cable assemblies are used on the MRC 1620LP:

DWG #	Description	Purpose
24C1167	9F-25M Modem Cable Assembly	MRC 1620LP to Modem
24C1170	9F-25F Null Modem Cable Assembly	MRC 1620LP to PC/XT (25-pin)
24C1171	9F-9F Null Modem Cable Assembly	MRC 1620LP to PC/AT (9-pin)

4.10 External I/O

Schematic: 91B7465
Assembly: 20B3051

The optional External I/O board on the Remote Terminal performs the same functions as the standard External Relay board it replaces. In addition, it provides a terminal strip interface for extended status inputs. With this option, up to 48 status inputs are supported. The status inputs are added in sets of four, each set of four costing one analog channel. Also with this option, **one or two** latching relays may be substituted for **each pair** of momentary RAISE/LOWER relays. A latching relay (or both, if two are installed) is SET by a RAISE command and RESET by a LOWER command.

4.11 RS-232 I/O

Schematic: 91C7486
Assembly: 20C3074

The optional RS-232 I/O board plugs into P3 or P4 of the CPU board, converting a Telco/subcarrier port to an RS-232 port. This allows direct connection of the Remote Terminal to Control Terminal or PC at RS-232 signal levels. While using the RS-232 I/O board, the rear panel interconnects that are normally used for Telco and Subcarrier are used for RS-232 signals, precluding Telco or subcarrier communication. Figure 4-1 identifies these signals at the Communications I/O board.

Table 4-1 and 4-2 show the appropriate switch settings on the RS-232 I/O board for the RT and CT.

Table 4-1 Remote Terminal Switch Settings for RS-232 Input

Switch	Position*	Function
S1-1	1	RXD
2	1	Gnd
3	1†	DTR/DCD connect
4	0	DTR
5	0	DCD
6	0	2400 baud
7	1	1200 baud
8	0	300 baud
S2-1	0	TXD
2	0	Gnd
3	0	RTS/CTS connect
4	0	RTS
5	0	CTS
6	0	2400 baud
7	0	1200 baud
8	0	300 baud

Table 4-2 Control Terminal Switch Settings for RS-232 Output

Switch	Position*	Function
S1-1	0	RXD
2	0	Gnd
3	0	DTR/DCD connect
4	0	DTR
5	0	DCD
6	0	2400 baud
7	0	1200 baud
8	0	300 baud
S2-1	1	TXD
2	1	Gnd
3	1	RTS/CTS connect
4	0	RTS
5	0	CTS
6	0	2400 baud
7	1	1200 baud
8	0	300 baud

* *switch setting: 0 = open = off; 1 = closed = on*

† *0 for Revision 1 assemblies*

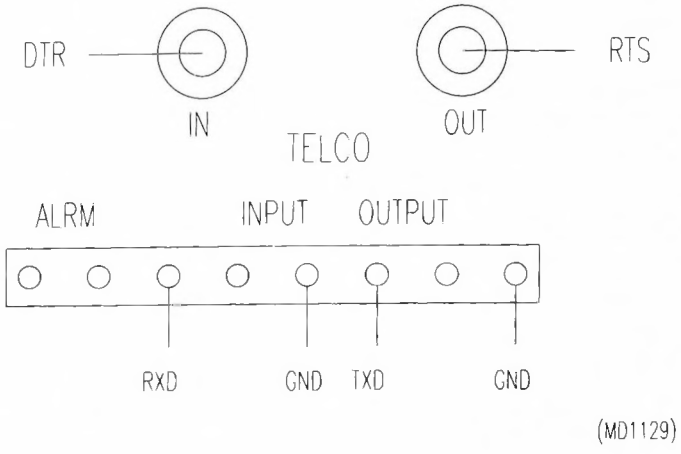


Figure 4-1
RS-232 I/O Signal Descriptions on Communications I/O board

Section 5

Alignment Procedures

5.1 Introduction

This section outlines the alignment of the Telco and Subcarrier Input and Output boards. Included with the alignment instructions for each module are troubleshooting procedures specific to that module. General system troubleshooting follows the alignment procedures. Refer to Section 4 (Module Characteristics) for a detailed description of how each module works.

Many of the smaller integrated circuits are soldered to the printed circuit boards to enhance reliability. For this reason, it is strongly recommended that users stock spare modules and do any necessary repairs by module exchange. Exchanging boards facilitates troubleshooting and can reduce downtime.

5.2 Test Equipment

The following table lists the test equipment recommended for use in the alignment procedures. Equivalent items of test equipment may be substituted.

Instrument Type	Suggested Model
Frequency Counter	Data Precision 7540
Distortion Analyzer	Hewlett Packard 334A
Oscilloscope	30 MHz bandwidth

5.3 Alignment Procedures

5.3.1 Telco Input and Telco Output Alignment

The purpose of this procedure is to align a pair of Telco boards (input and output). The boards to be aligned are normally in different terminals (Remote and Control) with both terminals located at the test bench. Aligning the boards in pairs does not mean the boards are limited to communication with each other; they may be moved to another terminal, kept in reserve as a backup, and so on.

Connect the boards using the rear panel terminal strips. Be sure that the appropriate "TELCO OUTPUT" terminals are connected to the appropriate "TELCO INPUT" terminals.

Telco Output Alignment

1. Connect a frequency counter to TP1. Set S1 to TEST (S1-3 ON, the other positions OFF).

2. With S1-4 OFF, adjust LOW FREQ pot R2 to obtain 1200 ± 5 Hz.

3. Move S1-4 to ON, and adjust HIGH FREQ pot R7 to obtain 2200 ± 5 Hz. Disconnect the frequency counter.

4. Connect an oscilloscope to the TELCO INPUT terminals on the rear of the chassis (if boards are set for 2-wire) or the TELCO OUTPUT terminals (if the boards are set for 4-wire). Adjust OUTPUT LEVEL pot R12 for 0 dBm (2.2 V_{P-P}).

5. Return the Telco Output board to the operate mode (S1-1 and S1-2 ON, the other positions OFF).

Telco Input Alignment

1. Connect a frequency counter to TP1. Set S1 to CALIBRATE (S1-1 and S1-2 OFF, S1-3 ON, S1-4 does not matter). Adjust VCO ADJ pot R5 to obtain approximately 1700 Hz. Disconnect the frequency counter.

2. Connect an oscilloscope to RECEIVE DATA (U1-7).

3. Set S1 to OPERATE (S1-1 and S1-2 ON, S1-3 OFF). On the Telco **Output** board (the Output board that is connected to this Input board), set S1 to TEST (S1-1, S1-2, and S1-4 OFF, S1-3 and S1-5 ON).

4. Carefully adjust VCO ADJ pot R5 on the Telco Input board to obtain a square wave.

5. Return both boards to the OPERATE mode (S1-1 and S1-2 ON, the other positions OFF; if using 4-wire, set S1-2 on Output board to OFF).

Troubleshooting Telco Boards

1. Align the Telco Output board before aligning the Telco Input board.

2. Verify +15 V and -15 V are reaching the appropriate pins on the IC's (see the schematics).

Telco Output Troubleshooting

1. Check the frequency-dependent values for the modulator (see table on the schematic).

2. Check for a signal at the output of the XR2206 modulator (U1-2). If no signal is present, the problem is likely to be in the modulator. Otherwise, the problem is probably the 741 output op amp (U2).

Telco Input Troubleshooting

1. Verify an FSK signal on the output of the filter (U2-10). If not present, check the frequency-dependent values of the filter (see table on the

schematic). If they are correct, then suspect the RC4136 quad op amp (U2).

2. If there is an FSK signal present on the output of the filter, check the switch positions.

3. Check the frequency-dependent values surrounding the FSK demodulator (U1), (see table on the schematic). If these are correct, suspect the demodulator (U1).

5.3.2 Subcarrier Input and Subcarrier Output Alignment

The purpose of this procedure is to align a pair of Subcarrier boards (input and output). The boards to be aligned are normally in different terminals (Remote and Control) with both terminals located at the test bench. Aligning the boards in pairs does not mean the boards are limited to communication with each other; they may be moved to another terminal, kept in reserve as a backup, and so on. Make sure the Subcarrier Output board is configured for the same frequency as the Subcarrier Input board (see the schematics).

Connect the boards using the rear panel BNC connectors. Be sure that the appropriate "RADIO OUT" connector is connected to the appropriate "RADIO IN" connector.

Subcarrier Output Alignment

1. Connect a frequency counter to TP1. Set S1 to TEST (S1-2 ON, the other positions OFF).

2. Adjust LOW FREQ pot R2 to obtain 1200 ± 5 Hz. Move S1-4 to the ON position and adjust HIGH FREQ pot R9 to obtain 2200 ± 5 Hz. Disconnect the frequency counter.

3. Remove modulation applied to the subcarrier generator by turning MODULATION ADJUST pot R17 fully counter clockwise.

4. Remove the cable connecting "RADIO IN" to "RADIO OUT". Connect the frequency counter to the "RADIO OUT" BNC connector on the rear of the chassis.

5. Adjust the subcarrier frequency to the nominal frequency for which the board is configured, using COARSE FREQ pot R8 and FINE FREQ pot R7. Disconnect the frequency counter.

6. Connect a distortion analyzer to the "RADIO OUT" BNC.

7. Adjust DISTORTION pot R13 for minimum distortion. Using this control, approximately 0.5% distortion is obtainable. If no distortion analyzer is available, then no adjustment of this pot is required. The worst-case

distortion is approximately 2.5% which is quite acceptable in most applications. Disconnect the analyzer.

8. Attach an oscilloscope to the "RADIO OUT" BNC.

9. Adjust the oscilloscope to display about six periods of the unmodulated subcarrier as shown at the top of Figure 5-1. Using MODULATION ADJUST pot R17, increase subcarrier modulation until the fifth crossover occurs midway through a wave period as shown at the bottom of the figure.

10. Adjust OUTPUT LEVEL pot R21 to obtain 1.5 V_{P-P}. Remove the oscilloscope.

11. Return the board to OPERATE mode (S1-1 and S1-2 ON, the other positions OFF).

Subcarrier Input Alignment

1. Set the Subcarrier **Output** board to TEST (S1-3 and S1-5 ON, the other positions OFF).

2. Connect the "RADIO OUT" BNC to the "RADIO IN" BNC. This applies a modulated subcarrier to the input of the Subcarrier Input board.

3. Move the oscilloscope probe to TP2. Adjust inductors L1 and L2 to obtain minimum AM and maximum amplitude. The filter output at TP2 should be similar in appearance to the modulated subcarrier input (this was observed in steps 9 and 10 of the Subcarrier Output Alignment procedure).

4. Move the oscilloscope probe to the bottom end of R13 (U2-10). Adjust FSK pot R27 to obtain the cleanest FSK output. Note that it is normal for some residual high-frequency subcarrier to be superimposed on the FSK signal. Remove the oscilloscope.

5. Connect a frequency counter to TP1. Set S1 to CALIBRATE (S1-1 and S1-2 OFF, S1-3 ON). Adjust VCO ADJ pot R7 obtain 1700 ± 10 Hz. Disconnect the frequency counter.

6. Connect the oscilloscope to RECEIVE DATA (U1-7). Set S1 to OPERATE (S1-1 and S1-2 ON, S1-3 OFF). On the Subcarrier **Output** board, set S1 to TEST (S1-1, S1-2, and S1-4 OFF, S1-3 and S1-5 ON). Carefully adjust VCO ADJ pot R7 on the Subcarrier Input board to obtain a square wave.

7. Return both boards to OPERATE (S1-1, S1-2 ON, and the other positions OFF).

Troubleshooting the Subcarrier Boards

1. Align the Subcarrier Output board before aligning the Subcarrier Input board.

2. Verify +15 V and -15 V are reaching the appropriate IC pins (see the tables on the schematics).

Subcarrier Output Troubleshooting

1. Check the frequency-dependent values of the subcarrier generator (see the table on the schematic).

2. Check for an FSK signal on the output of the XR2206 modulator (U1-2). If no signal is present, suspect the switch settings or the modulator itself.

3. Check for a signal at the output of the 741 op amp (U3-6). If the FSK signal is not present, suspect the op amp.

4. Check for a subcarrier signal on the output of the subcarrier generator (U2-2). If the signal is not present, U2 is probably the problem.

Subcarrier Input Troubleshooting

1. Verify the frequency-dependent values for the input filter.

2. If the filter output cannot be obtained, one or more of the filter components is probably at fault.

3. If the FSK signal cannot be obtained properly, then the XR2211 subcarrier demodulator (U3) probably is at fault.

4. If the FSK signal is present at the input of the audio filter and not at the output, check the component values of the filter. If these are correct, the RC4136 quad op amp (U2) is probably bad.

5. If the FSK signal is present at the output of the audio filter and the components surrounding the FSK demodulator are correct, the problem is probably the XR2211 (U1).

5.4 General System Troubleshooting

The following steps may help isolate the cause of system trouble:

1. Verify that all cables are securely attached to the printed circuit boards.

2. Verify that all IC's are either seated firmly in their sockets or properly soldered into the printed circuit boards. Check especially for bent pins.

3. Verify the presence of the three system voltages (+5 Vdc, +15 Vdc, and -15 Vdc).

4. Press the RESET switch (S1) on the Central Processor board. This forces the program to start from the beginning. When reset, all LED's on the front panel will illuminate briefly. If the LED's remain ON, the fault may be either the Front Panel board or the CPU board.

5. If the keys seem to be operating properly (for example, the CHANNEL keys), then the most likely candidates are the modem boards (Telco Input and Output, Subcarrier Input and Output.). Verify that these boards have been aligned properly.

6. If the problem involves only one or two channels, check the Analog/Command/Status board, the External Relay board, and the interface wiring to your equipment.

7. If a board is suspect, try substituting a known working board For example, the CPU or Front Panel boards might be exchanged with the other terminal.

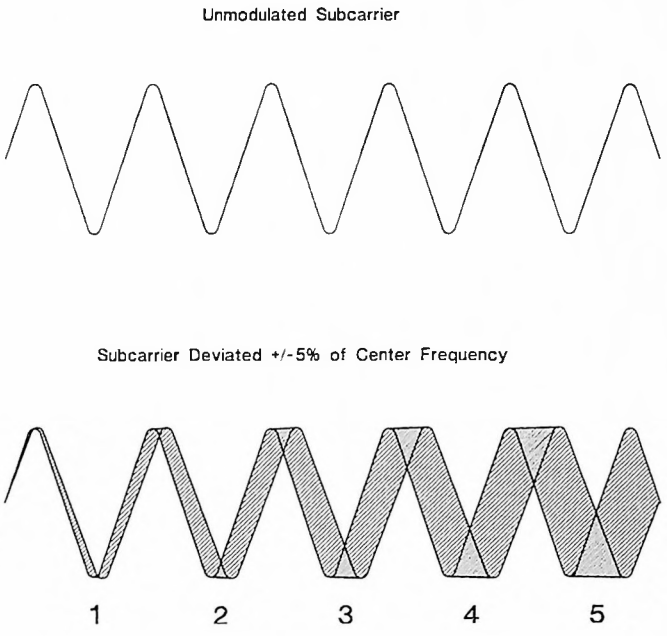


Figure 5-1
FM/FSK Modulation

Section 6

Customer Service Information

6.1 Introduction

Moseley Associates, Inc. has a Technical Services Department to assist Moseley product users who experience difficulties. Our service is available at two levels: telephone consultation, and factory service. Different circumstances apply depending on whether product(s) are under Warranty/Service Agreement or outside Warranty/Service Agreement status.

Please read the manual; a large portion of telephone calls to Moseley request information which is needed due to non-familiarity with the equipment. The majority of those questions are already answered by the Installation/Operation sections of each manual. If these do not help your problem, the first step in any factory service transaction should always be telephone consultation.

6.2 Telephone Consultation

If telephone assistance is necessary, please have the following information available prior to calling the factory:

- Model Number and Serial Number of unit;
- Shipment date or date of purchase of an Extended Service Agreement;
- Suspected module identification markings;
- Be prepared to accurately describe the problems with the unit: Constant or intermittent? Precise symptoms? Meter readings? Operational frequency of unit?
- Factory test data, if applicable.

Once you are prepared with the information above, contact our Technical Services Department for assistance. A Technical Services Representative who knows your product(s) is available during normal work hours (8:00 a.m. to 5:00 p.m., Pacific time, Monday through Friday). Please have patience if the particular representative you should talk to is busy. Leave your name, call letters, equipment type, and telephone number(s) where you can be reached in the next few hours. Someone will get back to you as soon as possible.

Please be prepared to keep telephone consultations as short as possible in order to free up the Technical Service Representative to help someone else in trouble. Usually, the Technical Service Representative will make suggestions and recommendations for your next step. After trying these, you may call back if you continue to experience problems.

For telephone assistance, call **(805) 968-9621**.

After Hours Emergency Only Telephone Consultation

Emergency service is provided from 5:00 p.m. to 10:00 p.m., Pacific time, Monday to Friday, and from 8:00 a.m. to 10:00 p.m., Pacific time, on weekends and holidays. For telephone assistance, call (805) 968-9621.

This after-hours service is for *emergencies only*. Please do not expect our representative to know the status of your order, to take orders for parts, or to be equipped to help with installation problems.

6.3 Factory Service

Arrangements for factory service can be made after consultation with the factory Technical Service Representative and his assignment to you of a Return Authorization (R.A.) number. This number expedites your equipment's routing from the Receiving Department to Technical Services.

The following suggestions are offered to assist you when returning your equipment to Moseley Associates, Inc. If you are returning a module, ensure that the module is carefully packed to withstand the rigors of the journey. Make sure the shipping carton is packed evenly and fully, with packing material filling all voids so that the module cannot shift inside the shipping carton. The package also should be marked in red with the words "Electronic Equipment" or "Fragile". Remember, the condition of the module is totally dependent on the care taken in the packing. Reference the return order number, previously obtained from the factory, on the outside of the carton or on the shipping label. Make sure that the name of your company is listed on the shipping label, and insure your module appropriately.

If you are shipping a complete chassis, all modules should be tied down as they were originally received. On some Moseley Associates equipment, shipping screws are required on the underside or topside of the chassis. In this case, printing on the chassis will indicate where such screws should be installed and secured.

Include any and all descriptions of the difficulties encountered with your equipment in the field. This will greatly assist us in processing your equipment and returning it as expeditiously as possible.

Use the original shipping carton in which your equipment was supplied, if possible. Ensure that the carton is packed evenly and fully, with packing material filling any voids so that the chassis cannot shift inside the carton. Make sure the carton is sealed properly with either nylon-reinforced tape or shipping sealing tape. Mark the outside of the carton "Electronic Equipment - Fragile" in big, red letters. This will assist in the survival of the equipment during the shipping process. Again, bear in mind that the survival of the unit depends almost solely on the preparation taken in shipping it.

When returning your equipment to our factory, please address it as follows:

MOSELEY ASSOCIATES, INC.

Attn: Technical Services Department

111 Castilian Drive

Santa Barbara, CA 93117

Display your return authorization number clearly on the shipping label, and insure the equipment for the appropriate amount.

All equipment must be shipped prepaid; Moseley Associates, Inc. will return the equipment prepaid under Warranty and Service Agreement conditions, and either freight collect or billed for equipment not covered by Warranty or a Service Agreement.

6.4 General

Replacement Modules

Moseley Associates encourages the purchase of spare parts kits to allow the customer to be totally self sufficient with regard to parts. We recognize that there are circumstances when troubleshooting to the component level is either impractical or impossible. If this is the case, replacement module exchange may be the most expedient way of correcting the problem.

Replacement modules are normally available for immediate shipment. If you require a replacement module from Moseley Associates, please give your shipping address to our Technical Services Engineer. If the module or equipment to be supplied to your company is to be held at the airport with a telephone number to call, provide at least two telephone numbers. This will often expedite the delivery or pickup of the replacement module or equipment.

Field Repair

Always try to isolate the problem to a specific area or module, if possible. By comparing actual wave shapes and levels with those referenced on the block and level diagrams or schematics, the problem often can be localized to the component level.

If an integrated circuit is suspect, carefully remove the original and install the new one in the same direction. These devices are installed one way only. Installing a new device backward may damage the newly-installed component or the surrounding circuitry. ICs occasionally exhibit temperature-sensitive characteristics. If a device operates intermittently, or appears to drift, Freeze Mist may aid in diagnosing the problem.

If a soldered component must be removed from a printed circuit board, do the following:

- Use a 40W soldering iron with a 1/8-inch tip. Do not use a soldering gun. Excessive heat may cause damage.

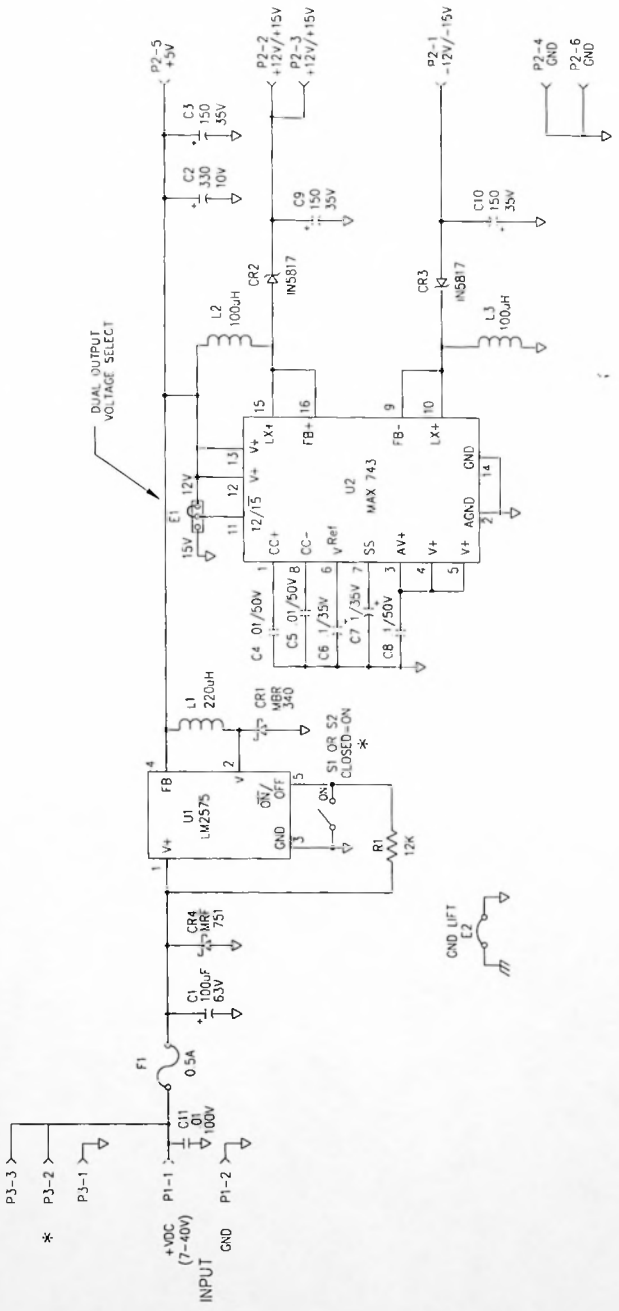
- Remove all solder contacting the lead or leads from the component and from the associated printed circuit pad. To assist in the removal of solder, solder wicking braid is very useful. Once the solder has been removed, gently loosen the component leads and extract the component from the board.

When installing the new component, pre-bend the leads of the replacement component so they will easily fit into the appropriate PC board holes. Solder each lead of the component to the bottom side of the board with a 40W soldering iron with a 1/8-inch tip. Always use a good brand of rosin-core solder. The solder joint should be smooth and shiny. Also, be sure that excessive heat is not used in this soldering operation. Excessive heat will damage the printed circuit pad that comes in contact with the new component. Finally, cut each lead of the replacement component close to the solder on the pad side of the printed circuit board with a pair of diagonal cutters. Completely remove all residual flux with a cotton swab or brush moistened with flux cleaner.

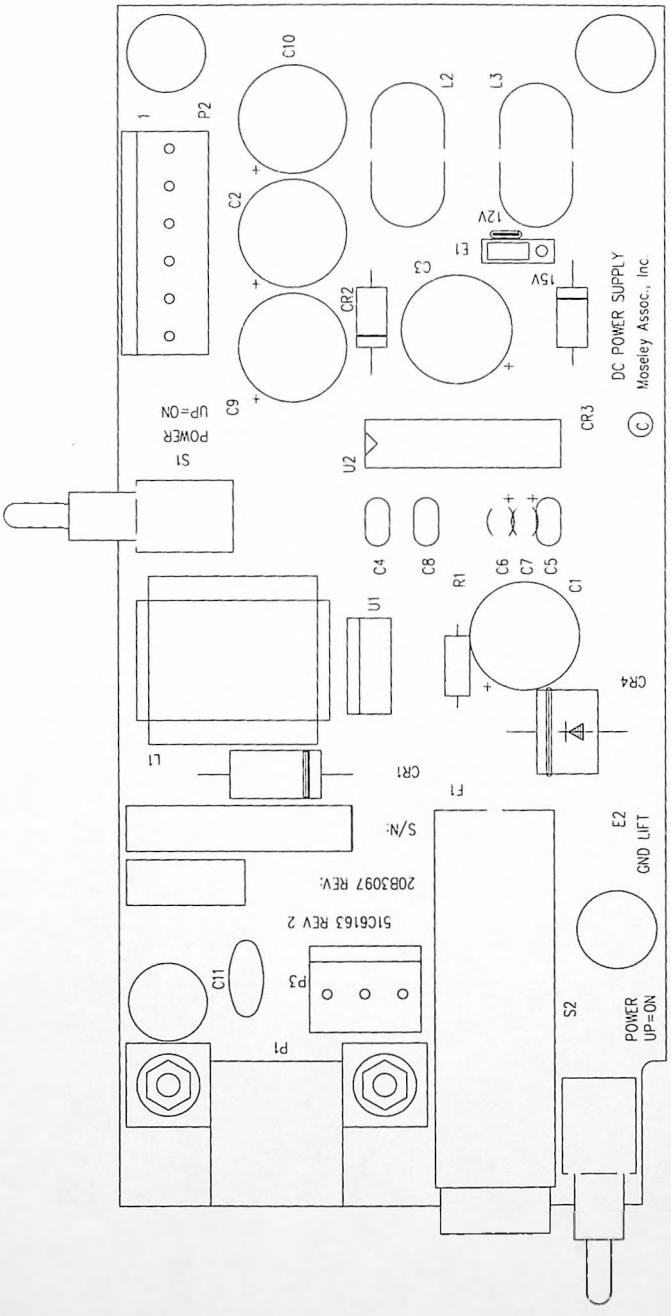
Section 7

Schematics and Assembly Drawings

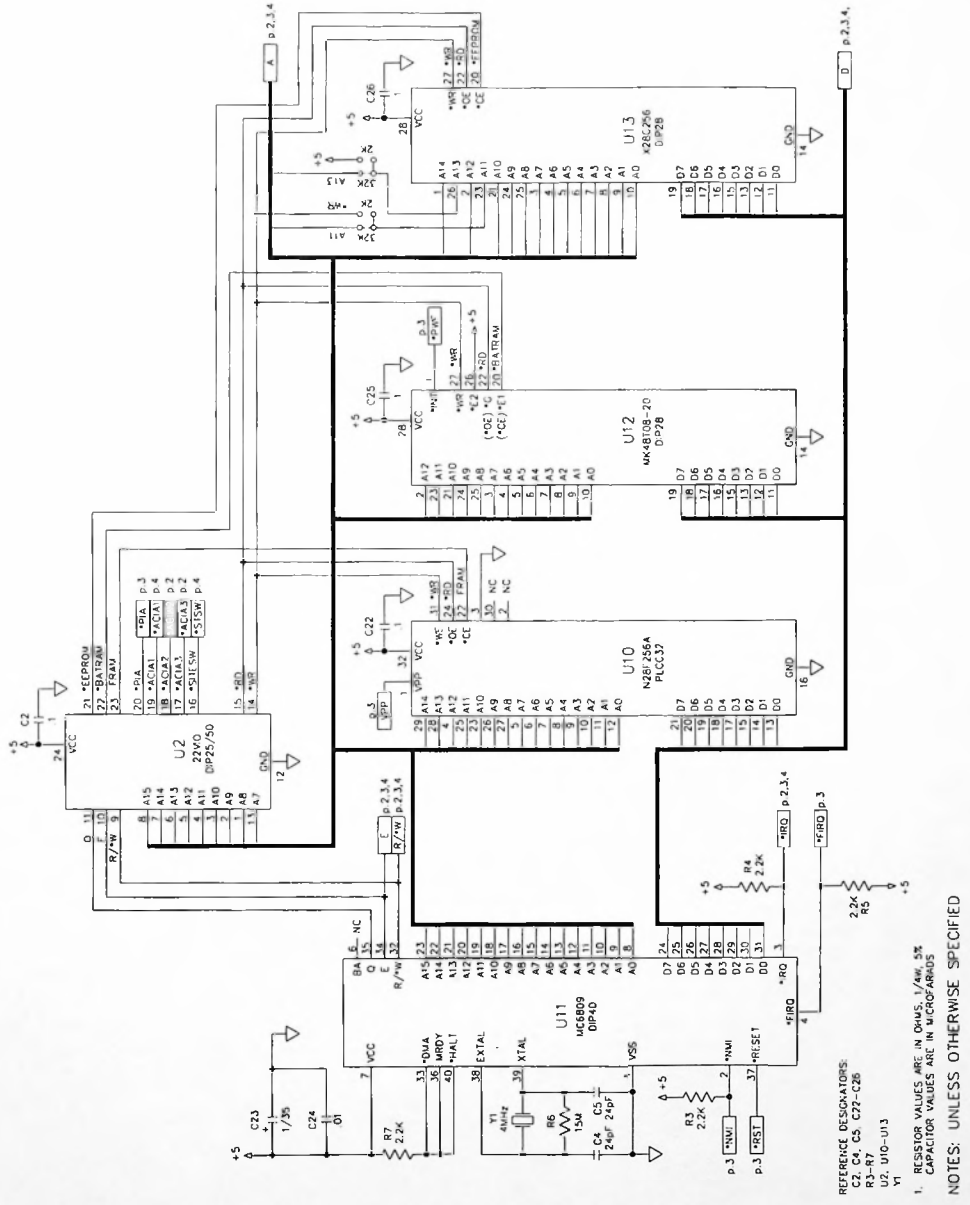
Please see Section 1 (System Characteristics)
and Section 4 (Module Characteristics) for further information.



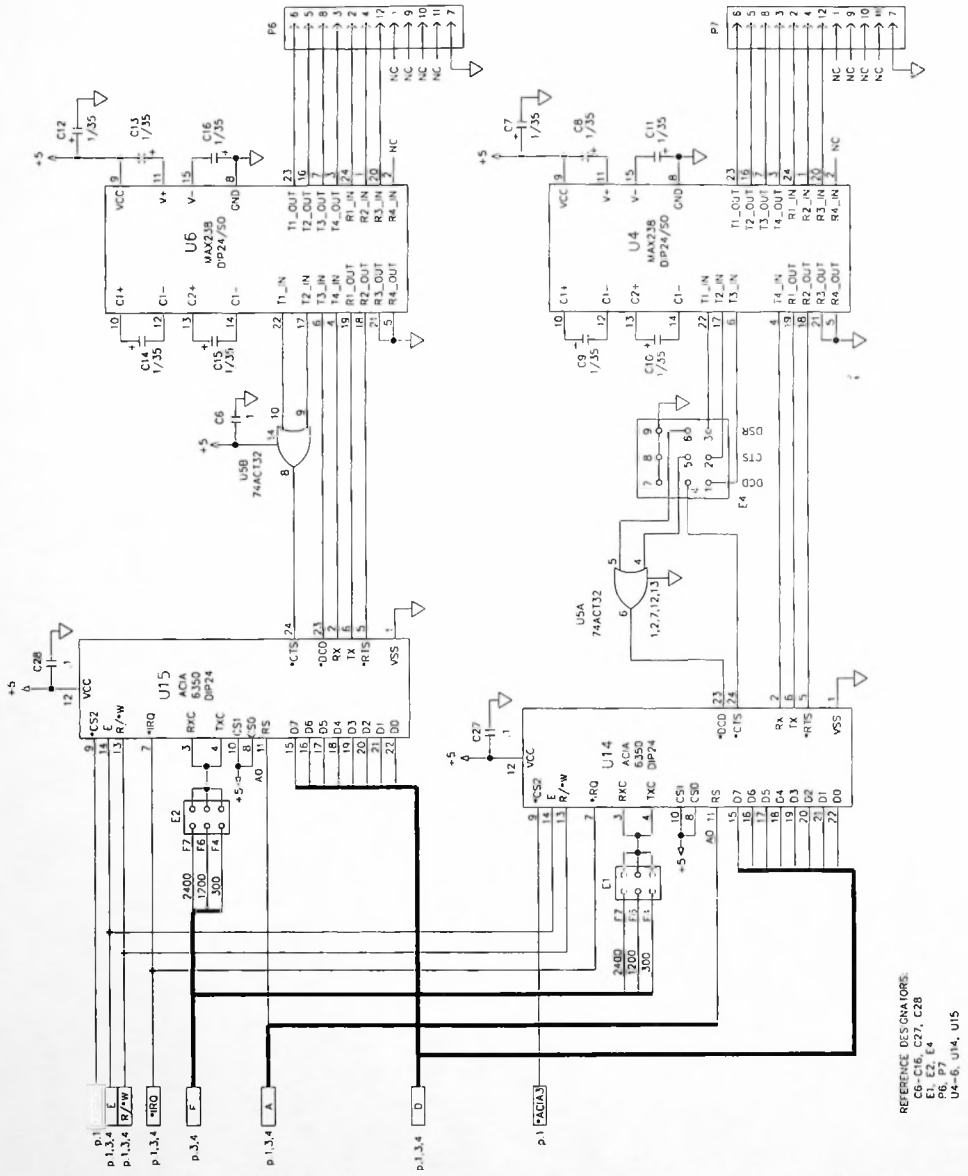
Power Supply Schematic (91D7508 Rev 2)



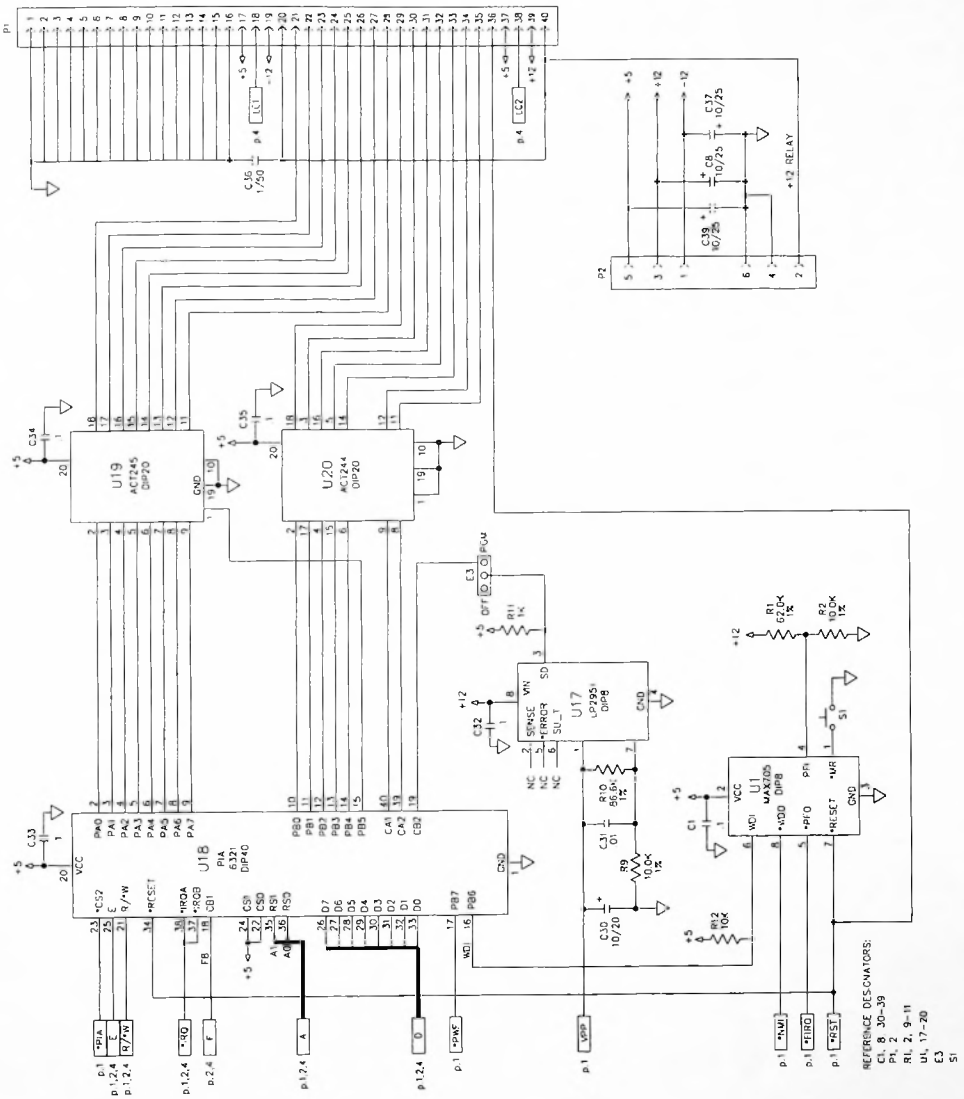
Power Supply Assembly (20B03097-1 Rev 3)



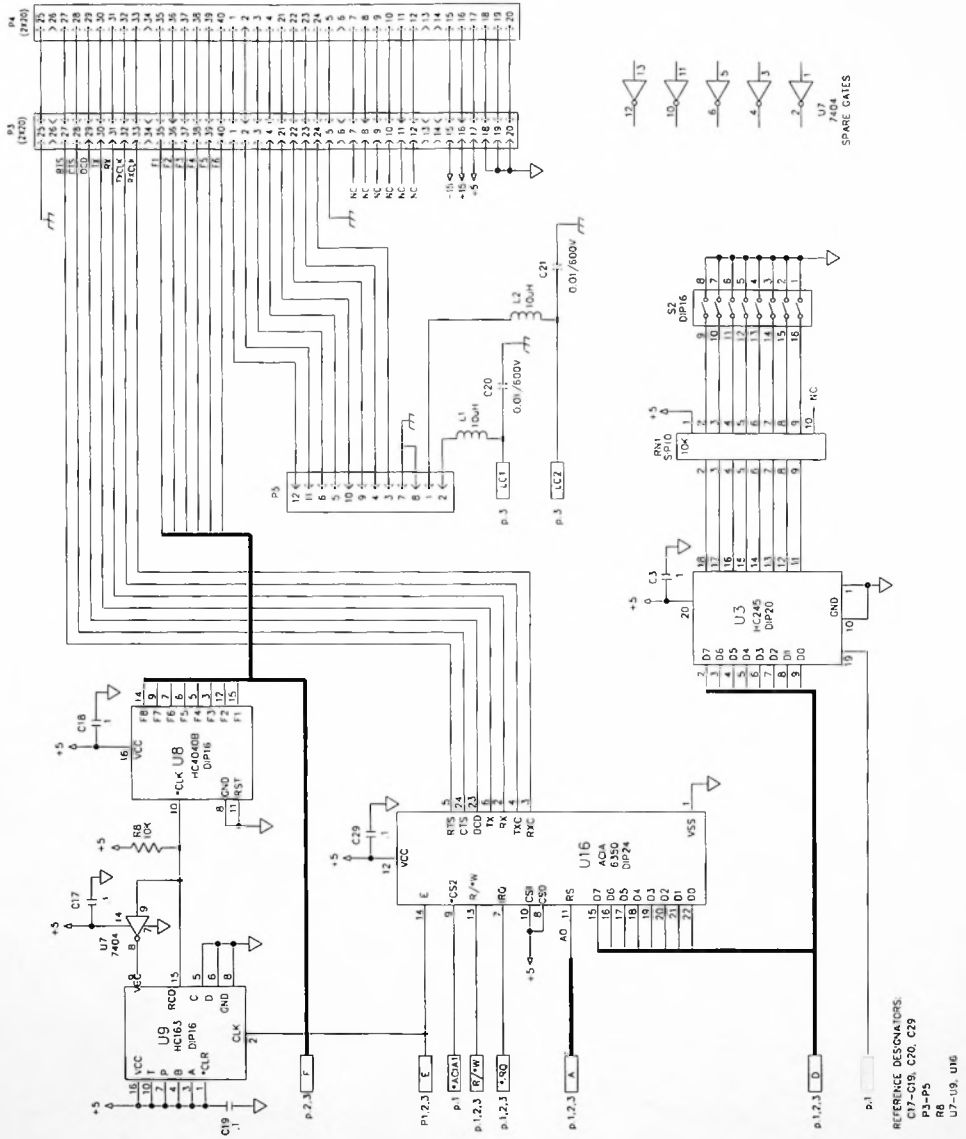
CPU Schematic, p. 1 of 4 (91A7509 Rev 1)

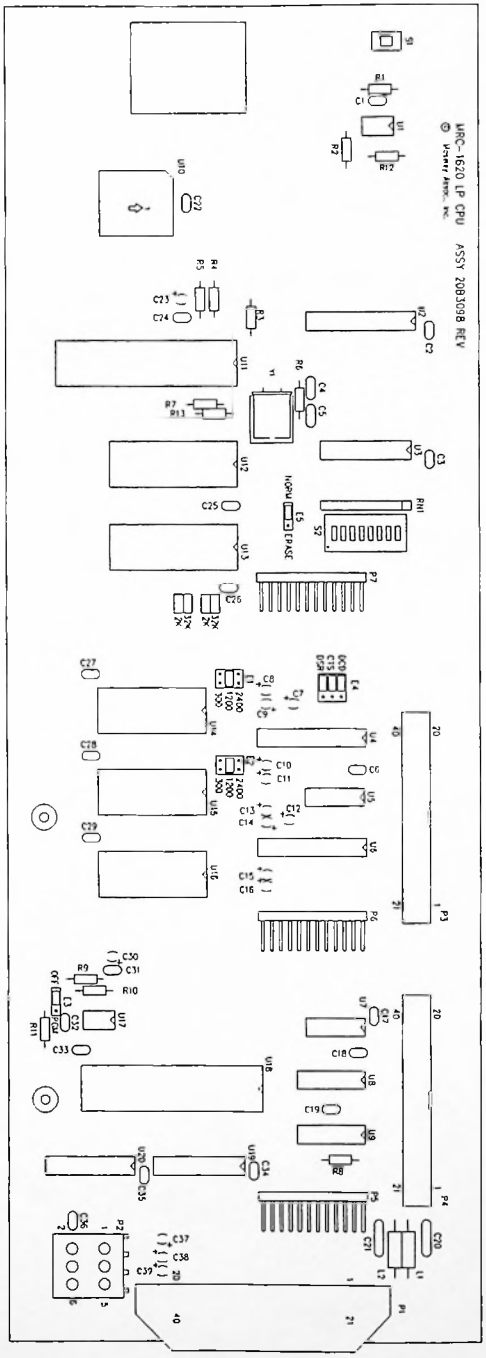


CPU Schematic, p. 2 of 4 (91A7509 Rev 1)

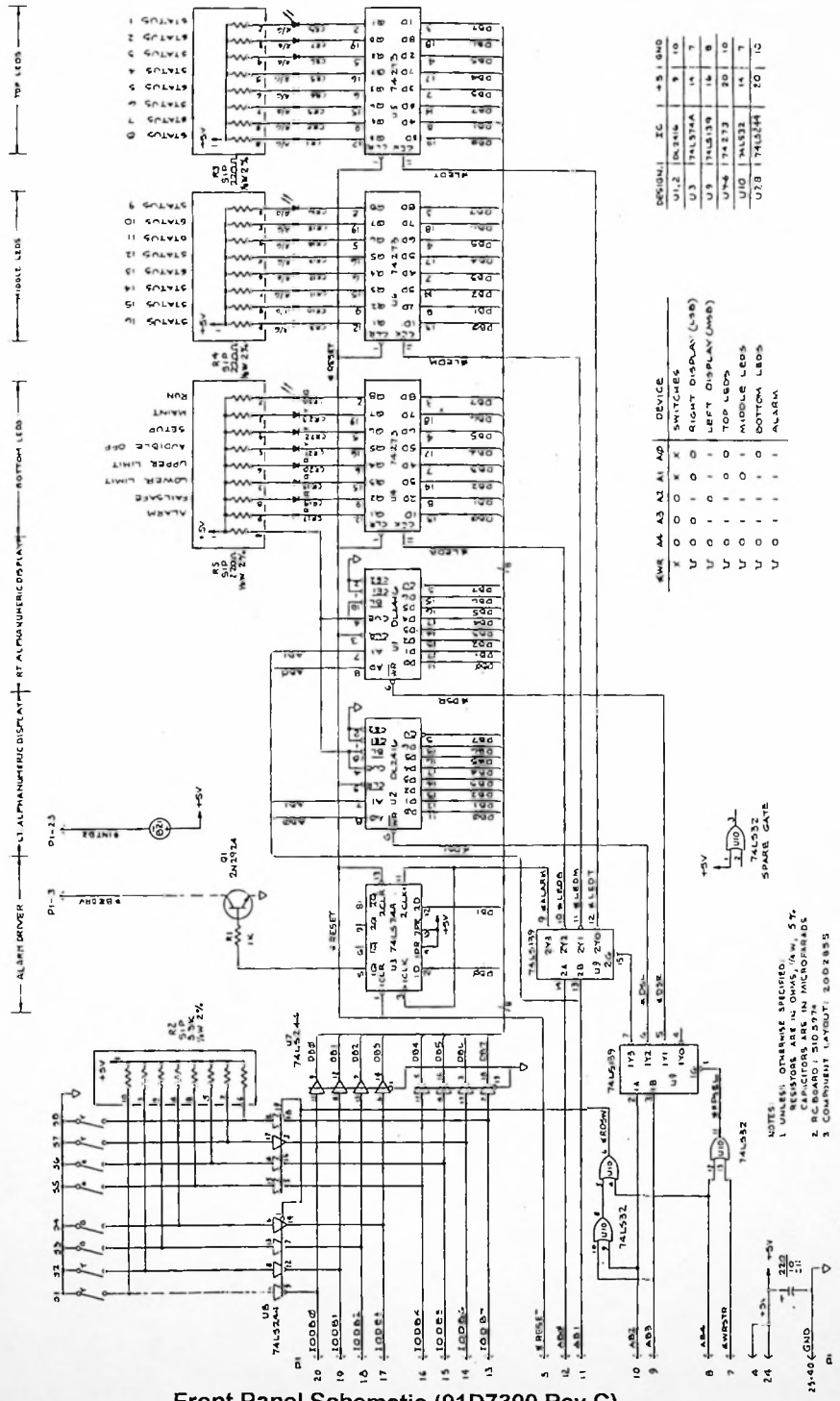


CPU Schematic, p. 3 of 4 (91A7509 Rev 1)

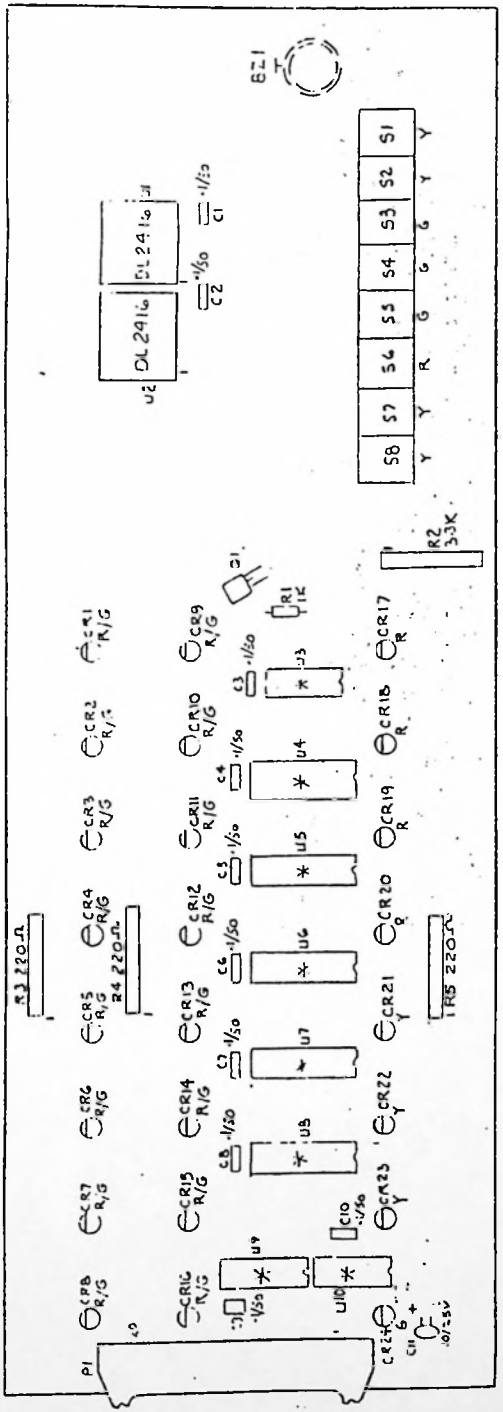

P4 (2X20)
P3 (2X20)
U7 7404 SPARE GATES
S2 DIP16
RN1 SIP10 10K
10 NC
U3 HC245 DIP20
U16 ACIA 6350 DIP24
U8 HC4040B DIP16
U9 HC163 DIP16
U7 7404
L1 10UH
L2 10UH
C20 0.01/600V
C21 0.01/600V
P5
LC1
LC2
C3
C17
C18
C19
C29
R8 10K
REFERENCE DESIGNATORS:
C17-C19, C20, C29
P3-P5
R8
U7-U9, U16



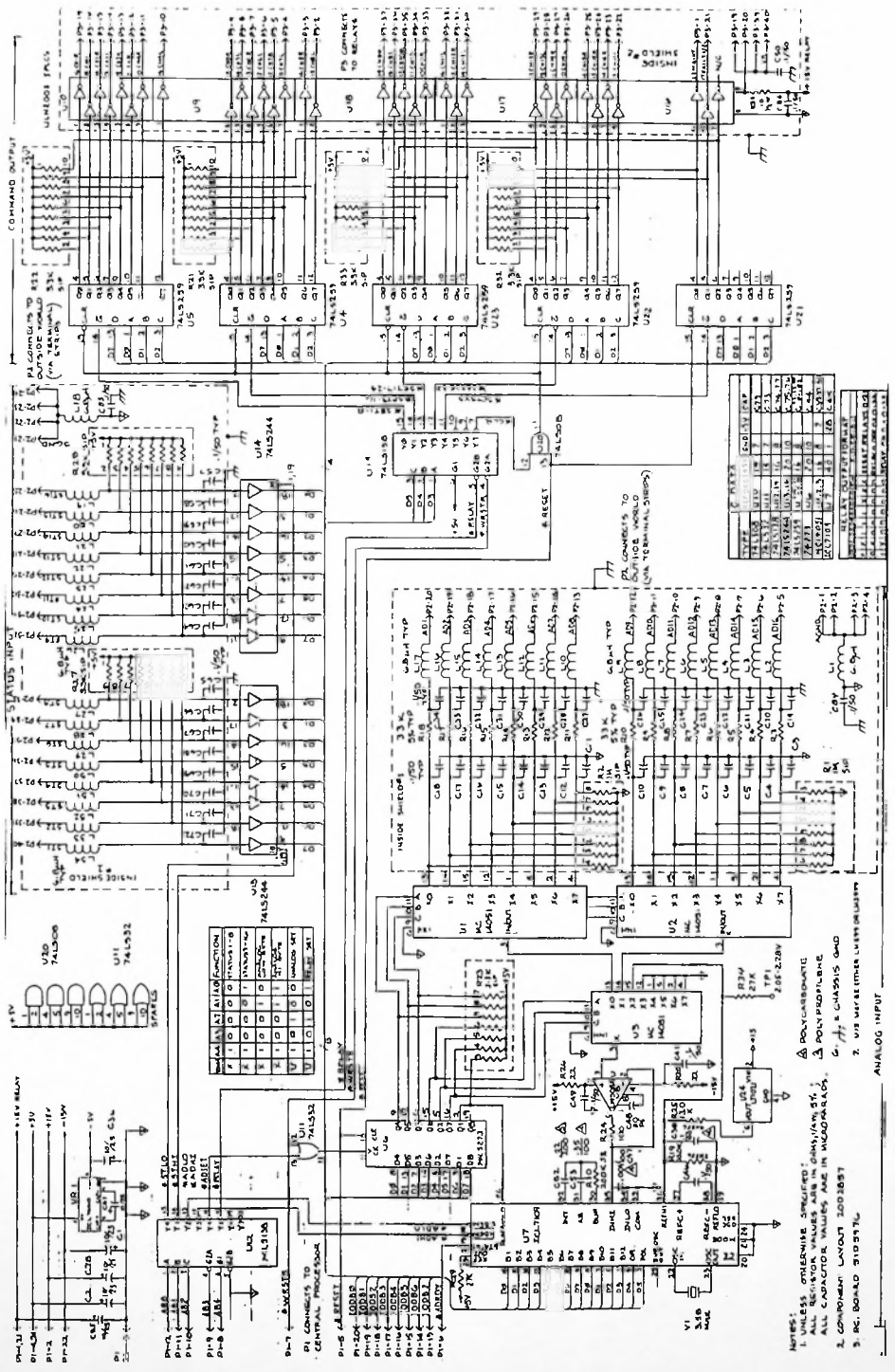
CPU Assembly (20B3098 Rev 4)



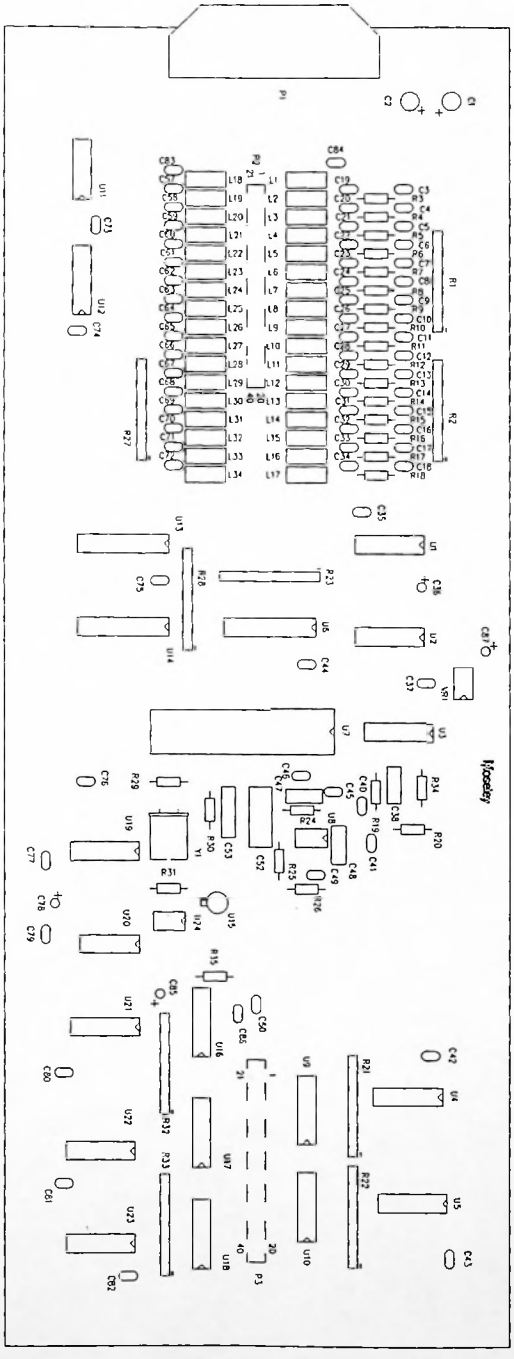
Front Panel Schematic (91D7300 Rev C)



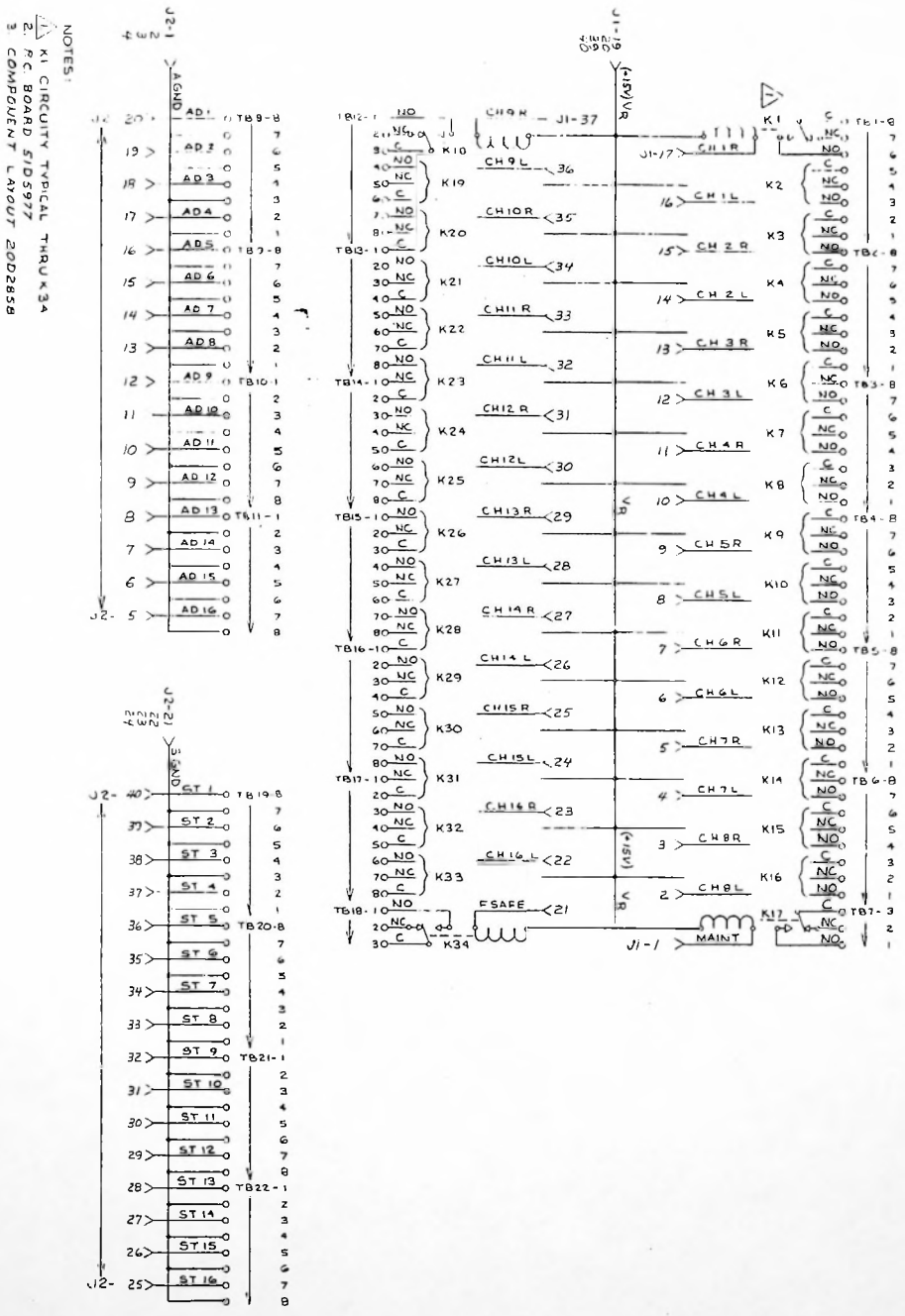
Front Panel Assembly (20B2855 Rev G)



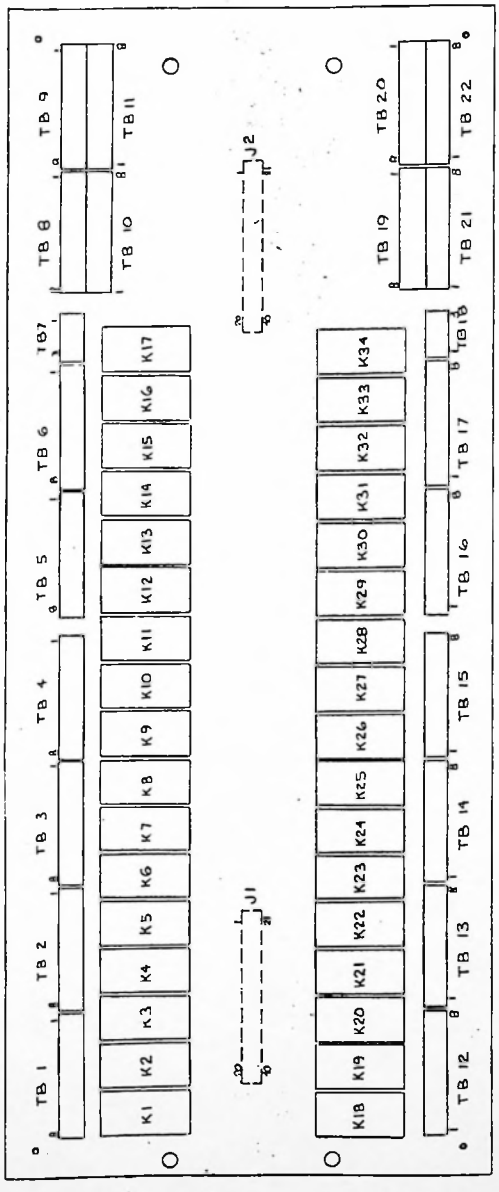
Analog/Command/Status Schematic (91D7302 Rev D)



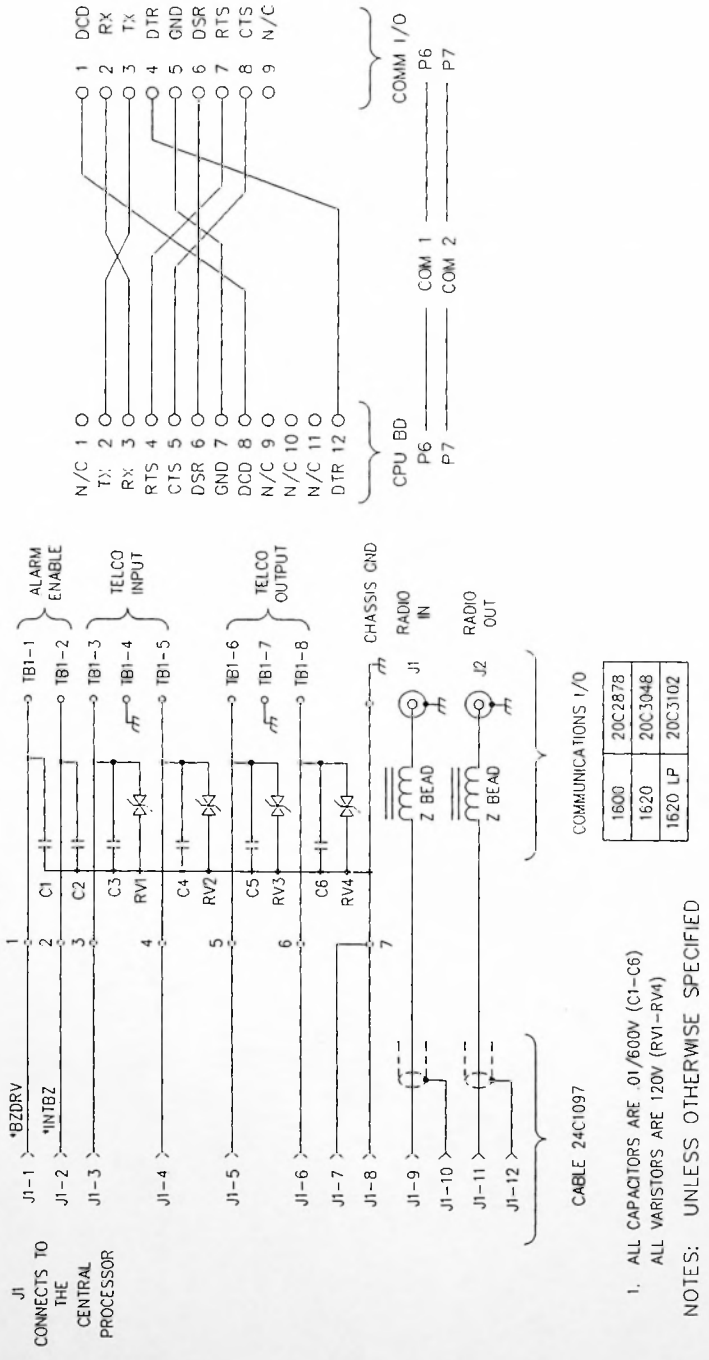
Analog/Command/Status Assembly (20C3099 Rev 1)



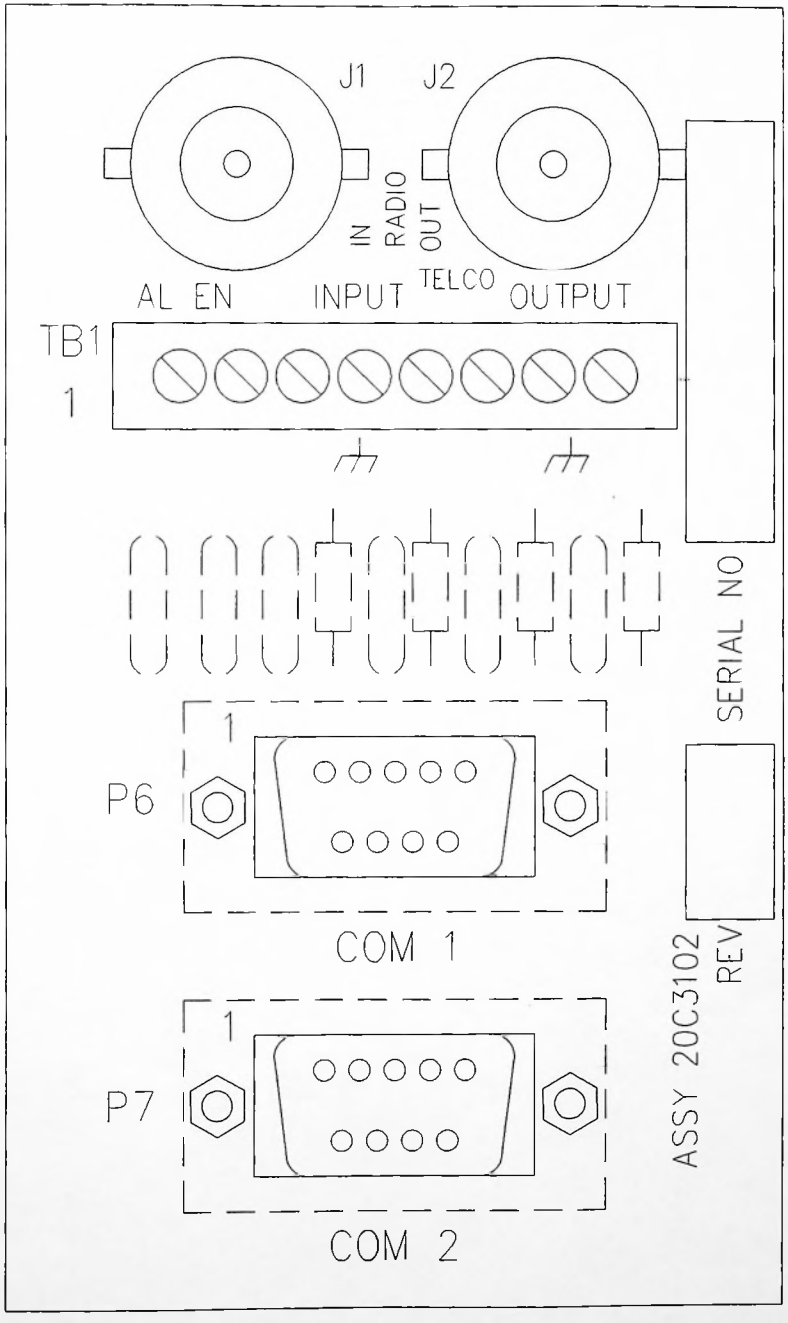
External Relay Schematic (91D7303 Rev A)



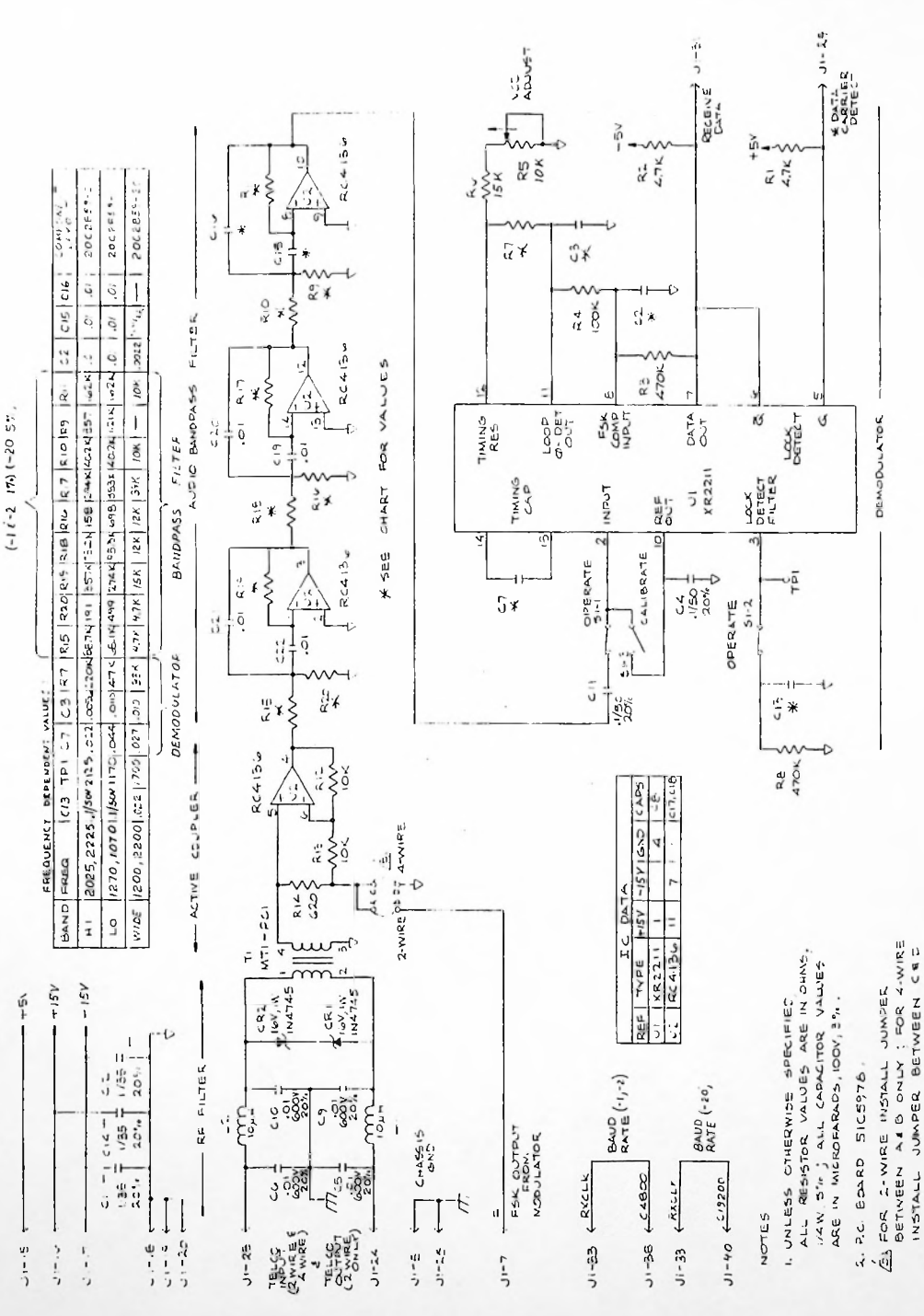
External Relay Assembly (20B2858 Rev A)



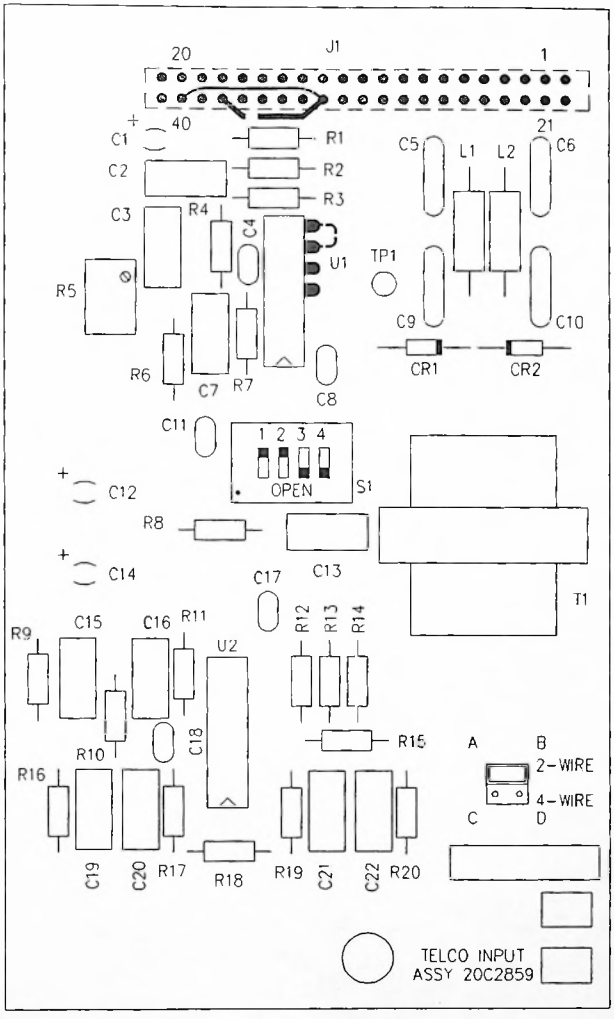
Communications I/O Schematic (91B7511 Rev 1)



Communications I/O Assembly (20C3102 Rev 1)

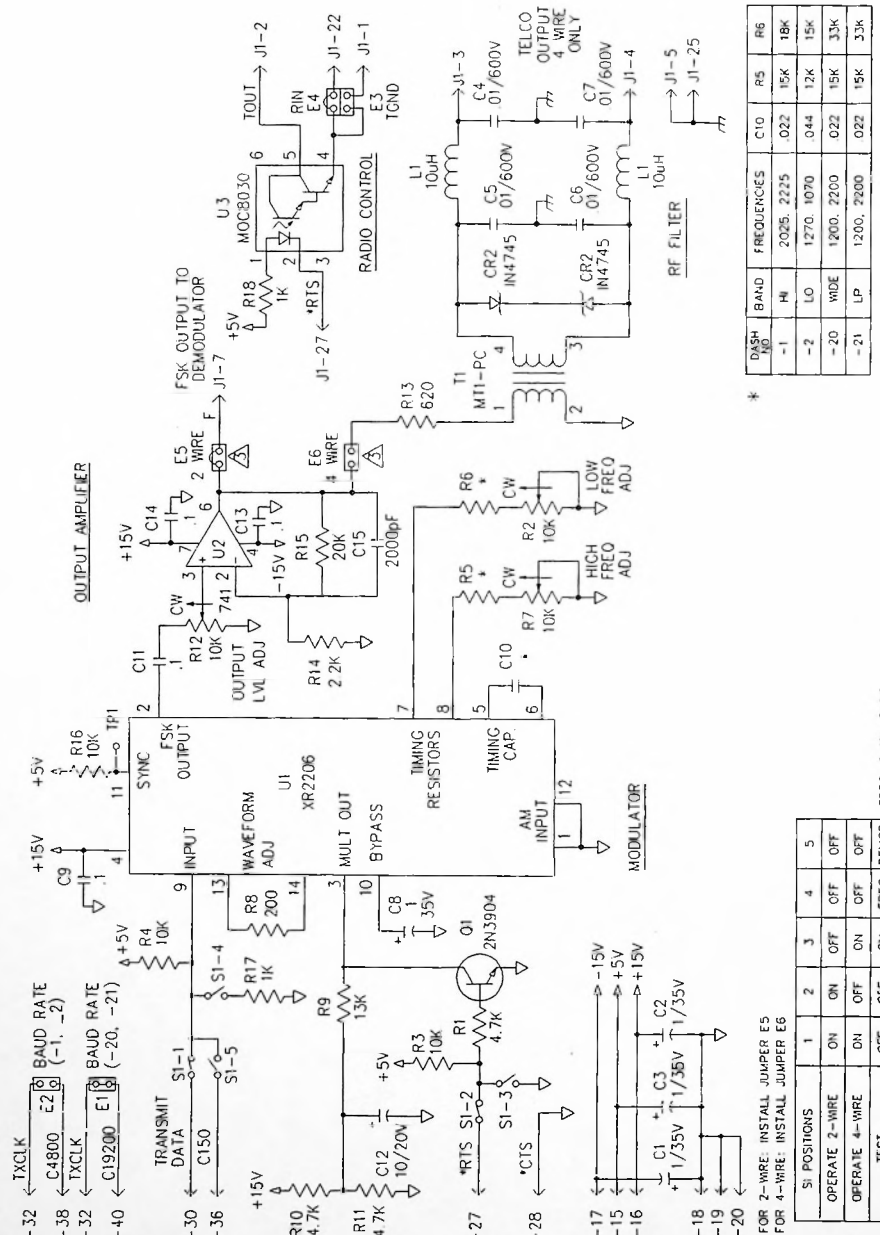


Telco Input Schematic (91C7304 Rev D)



ITEM NO	DASH NO	BAND	FREQUENCIES
9204512	-1	HI	2025, 2225
9204686	-2	LO	1270, 1070
9205931	-20	LP	1200, 2200

Telco Input Assembly (20B2859 Rev G)



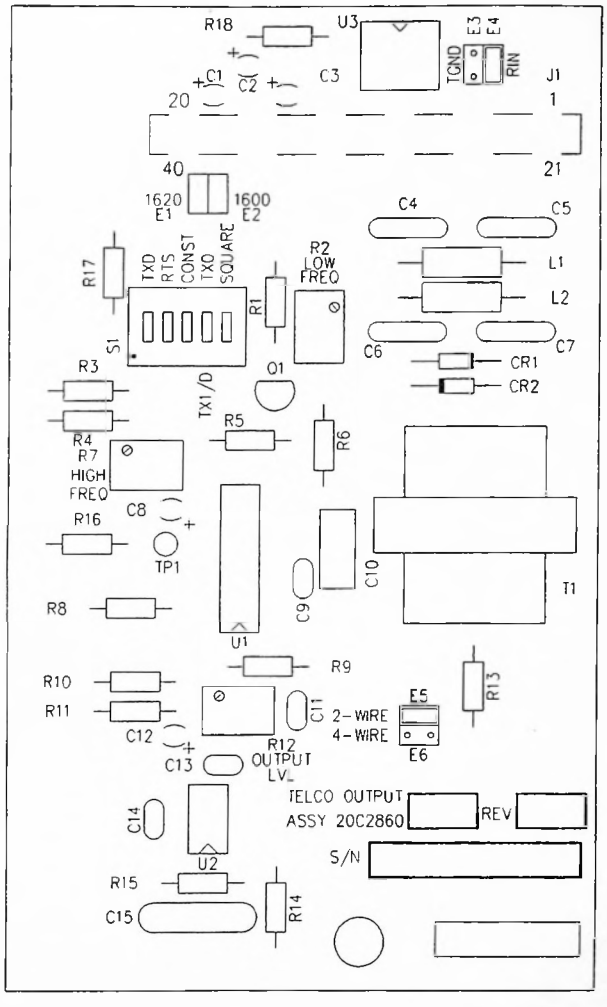
SI POSITIONS	1	2	3	4	5
OPERATE 2-WIRE	ON	ON	OFF	OFF	OFF
OPERATE 4-WIRE	ON	OFF	ON	OFF	OFF
TEST	OFF	OFF	ON	FREQ	DEMOD

FREQ. 1=HI 0=LO

*

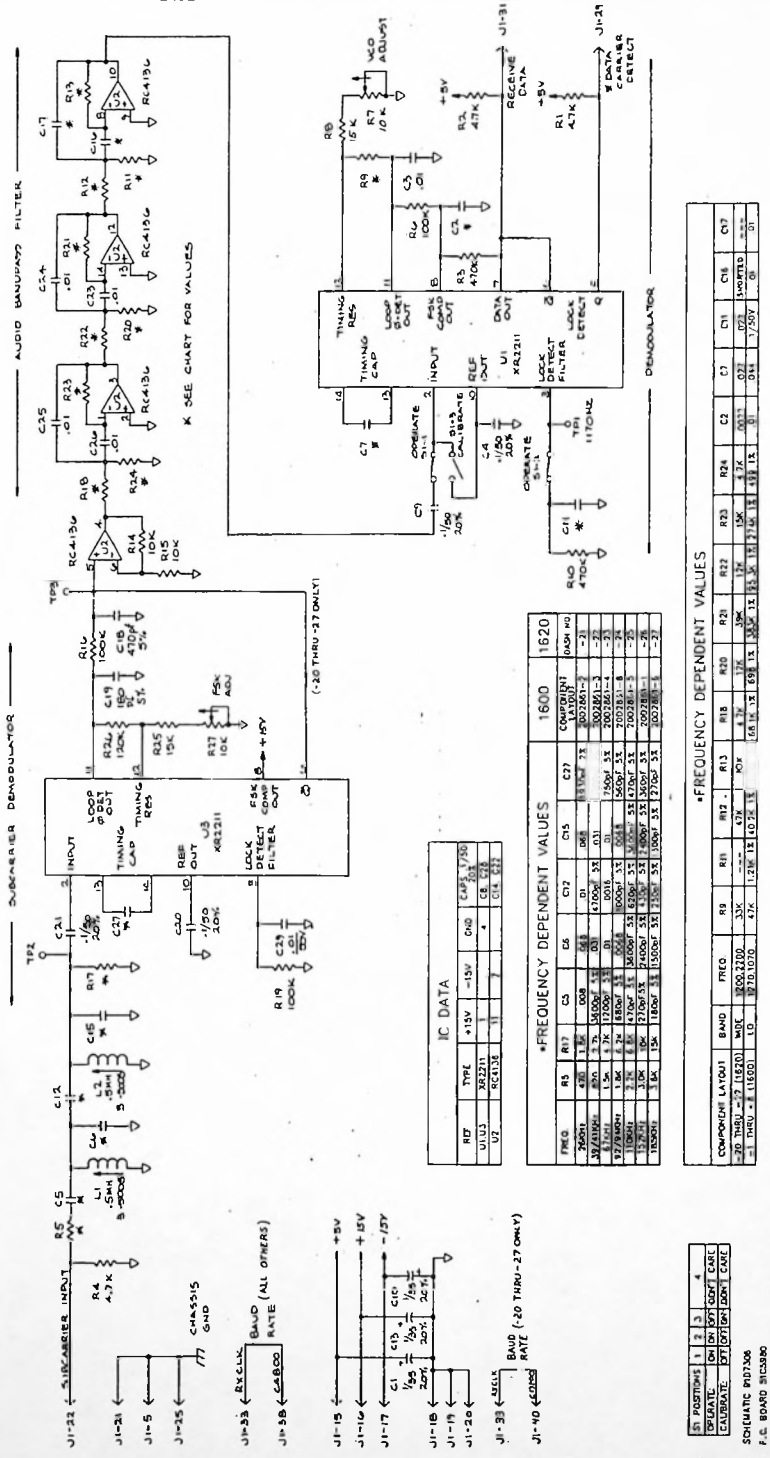
DASH NO	BAND	FREQUENCIES	C10	R5	R6
-1	HI	2025, 2225	.022	15K	18K
-2	LO	1270, 1070	.044	12K	15K
-20	WIDE	1200, 2200	.022	15K	33K
-21	LP	1200, 2200	.022	15K	33K

Telco Output Schematic (91C7305 Rev E)

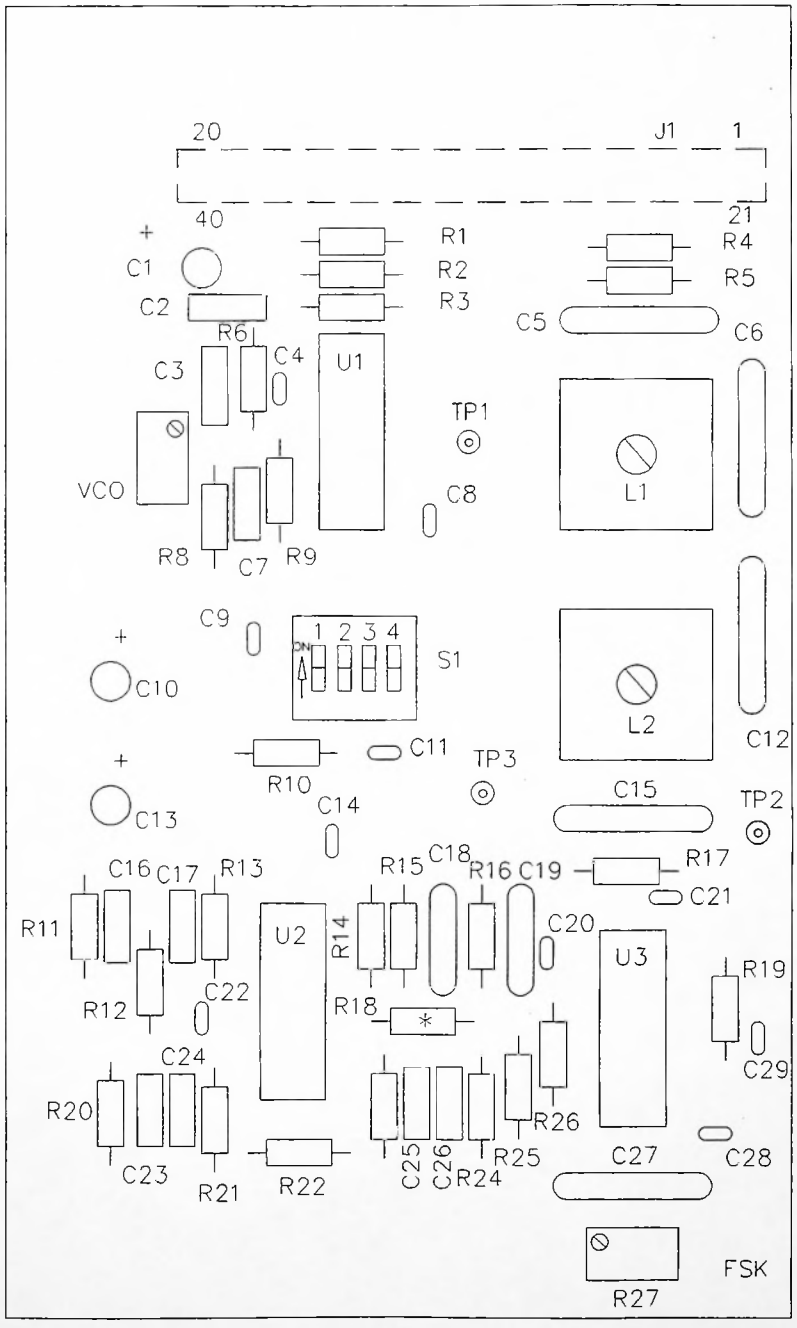


ITEM NO	DASH NO	BAND	FREQUENCIES
9204694	-1	HI	2025, 2225
9204520	-2	LO	1270, 1070
9206905	-21	LP	1200, 2200

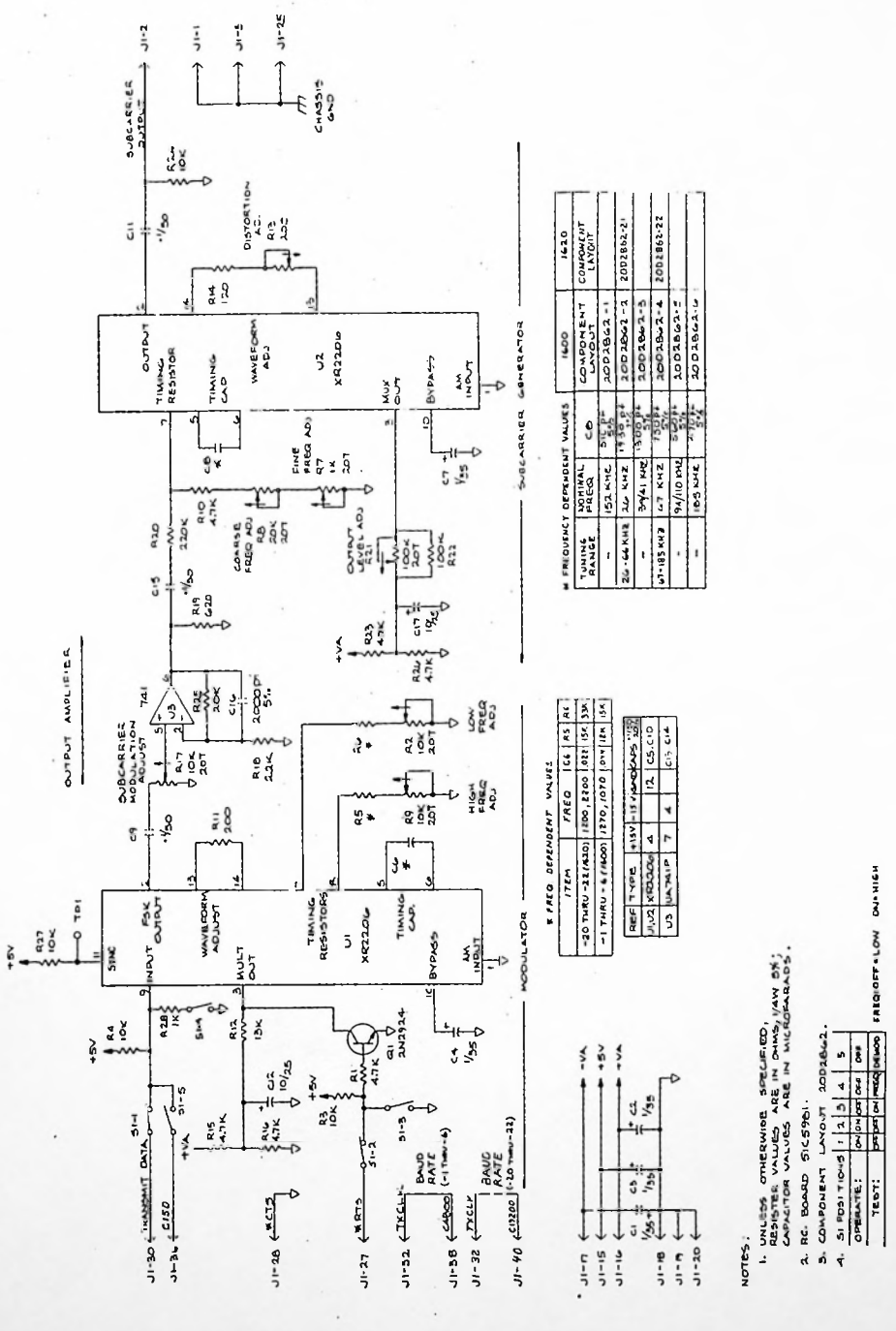
Telco Output Assembly (20C2860 Rev I)



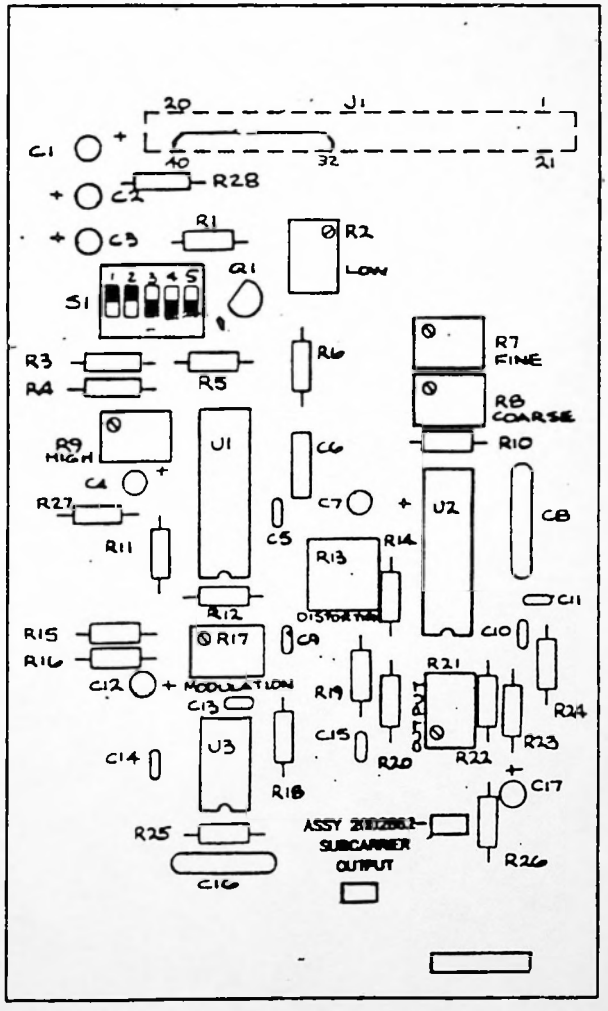
Subcarrier Input Schematic (91D7306 Rev F)



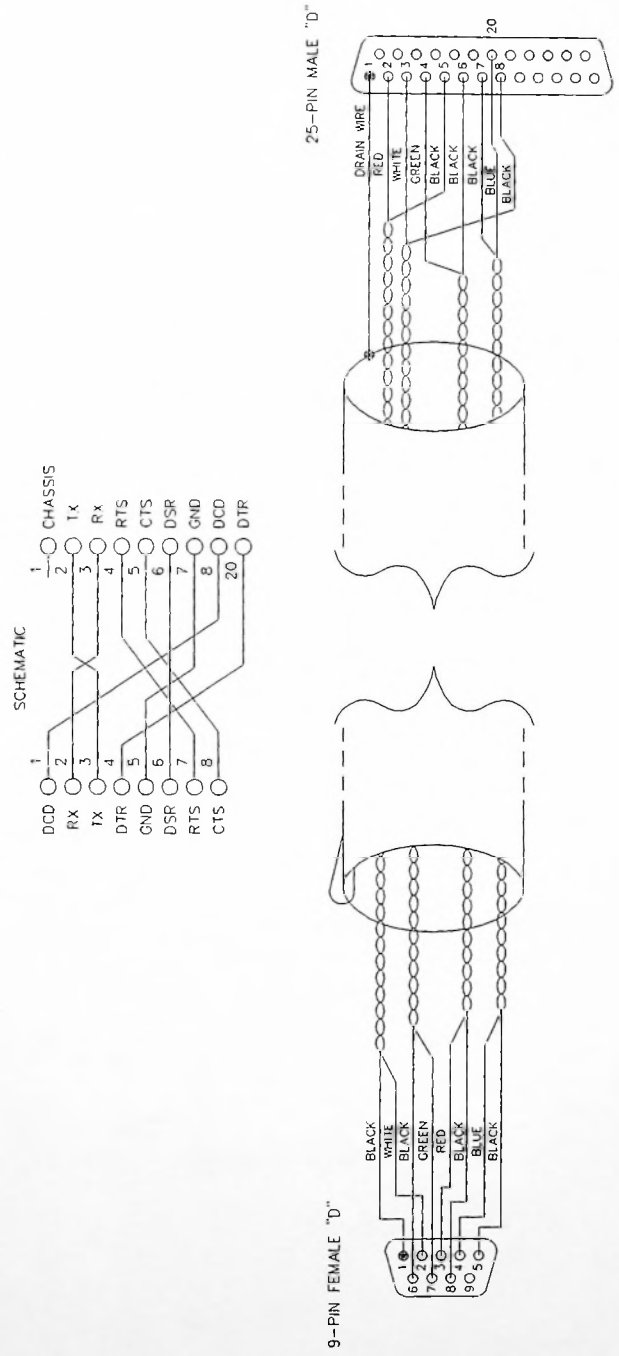
Subcarrier Input Assembly (20B2861 Rev H)



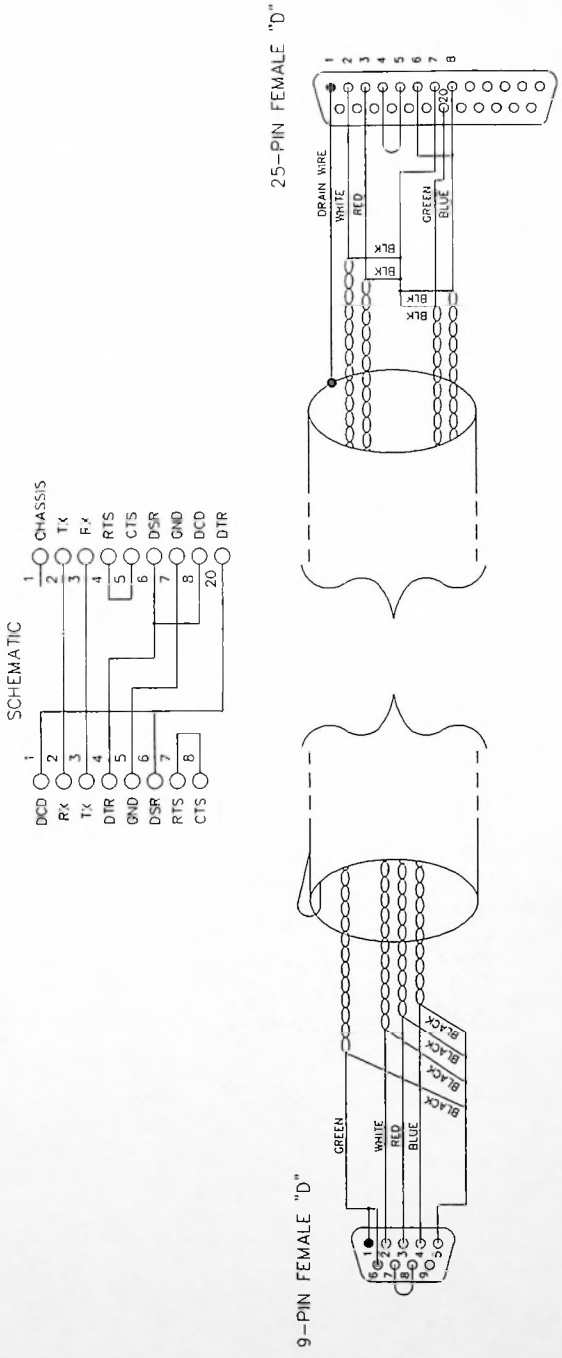
Subcarrier Output Schematic (91D7307 Rev D)



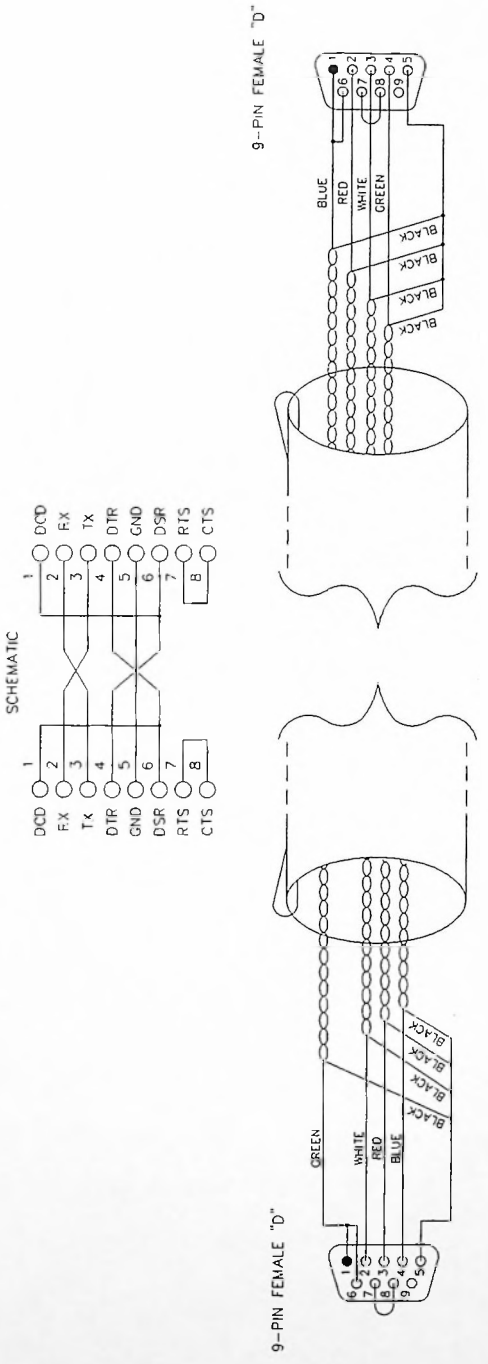
Subcarrier Output Assembly (20D2862 Rev G)



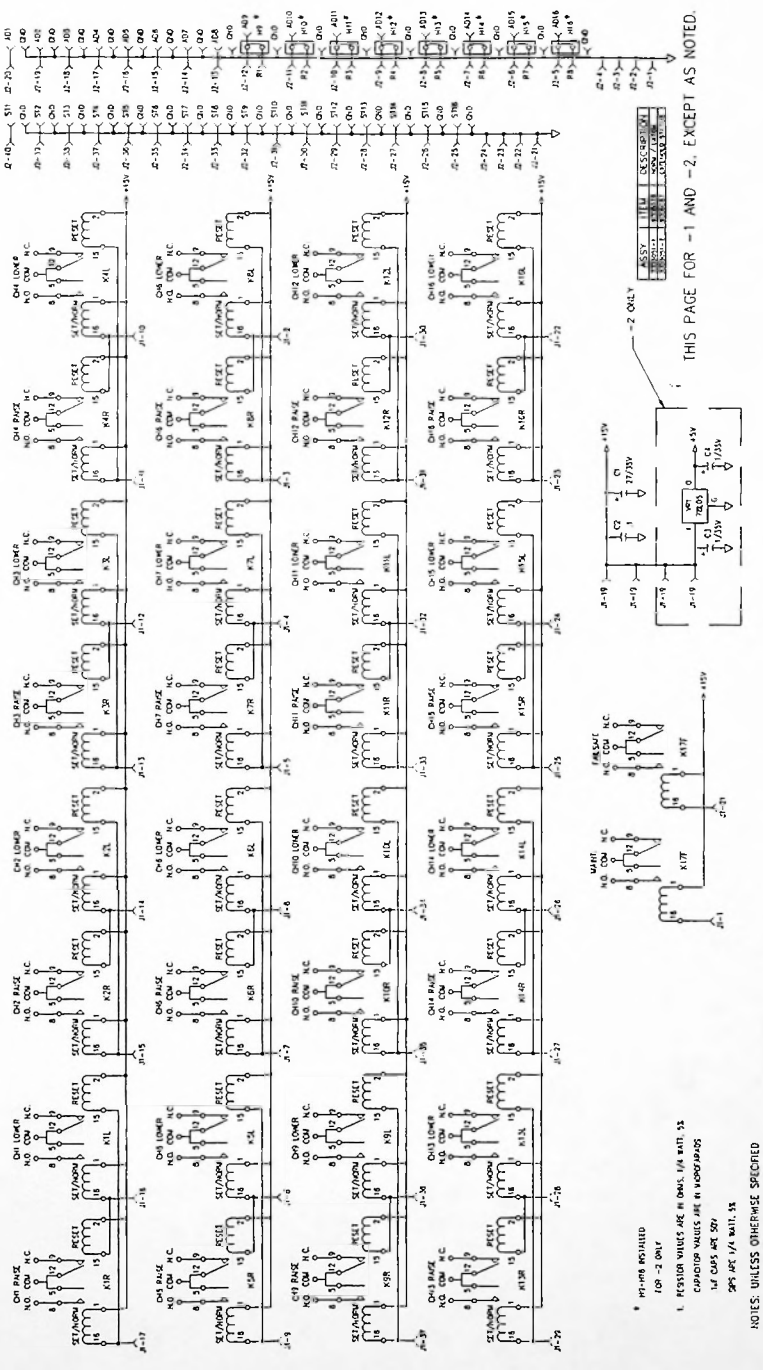
9F-25M Modem Cable Assembly (24C1167 Rev B)



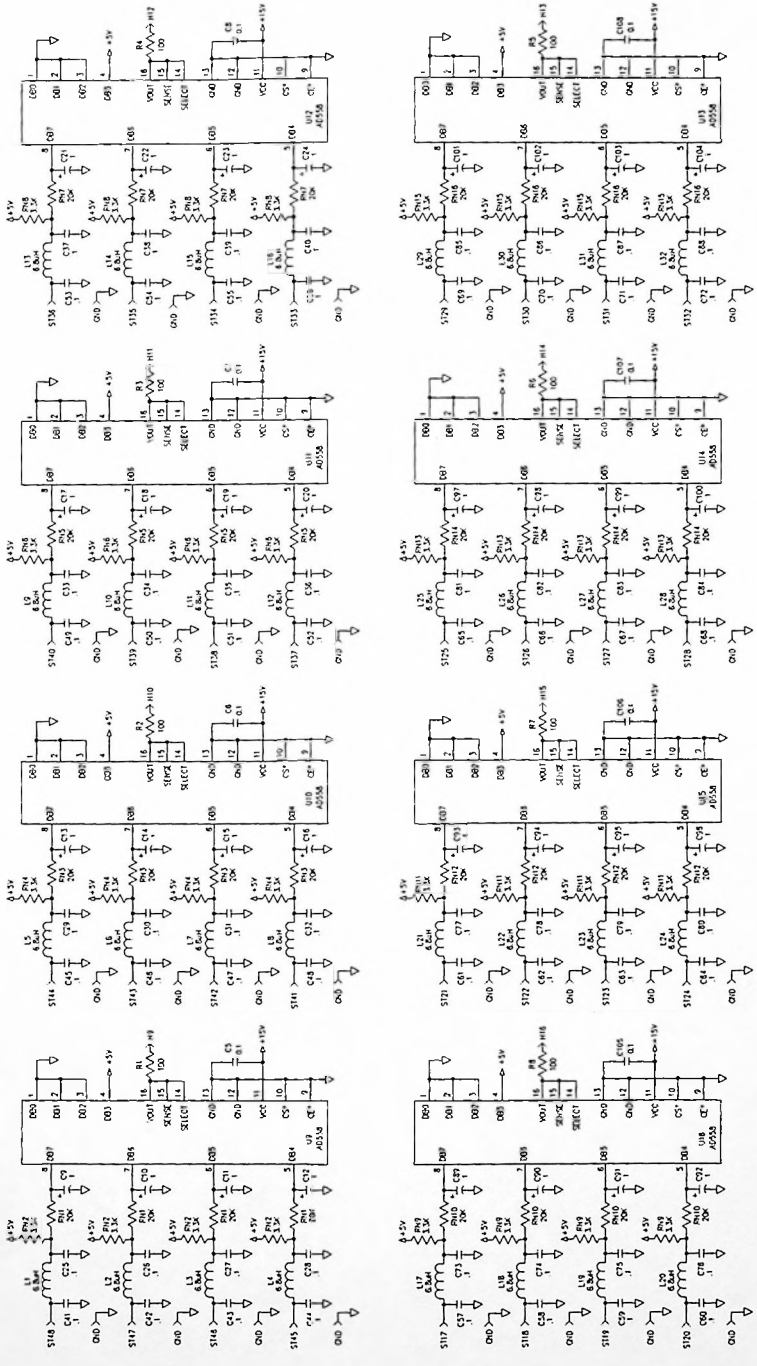
9F-25F Null Modem Cable Assembly (24C1170 Rev B)



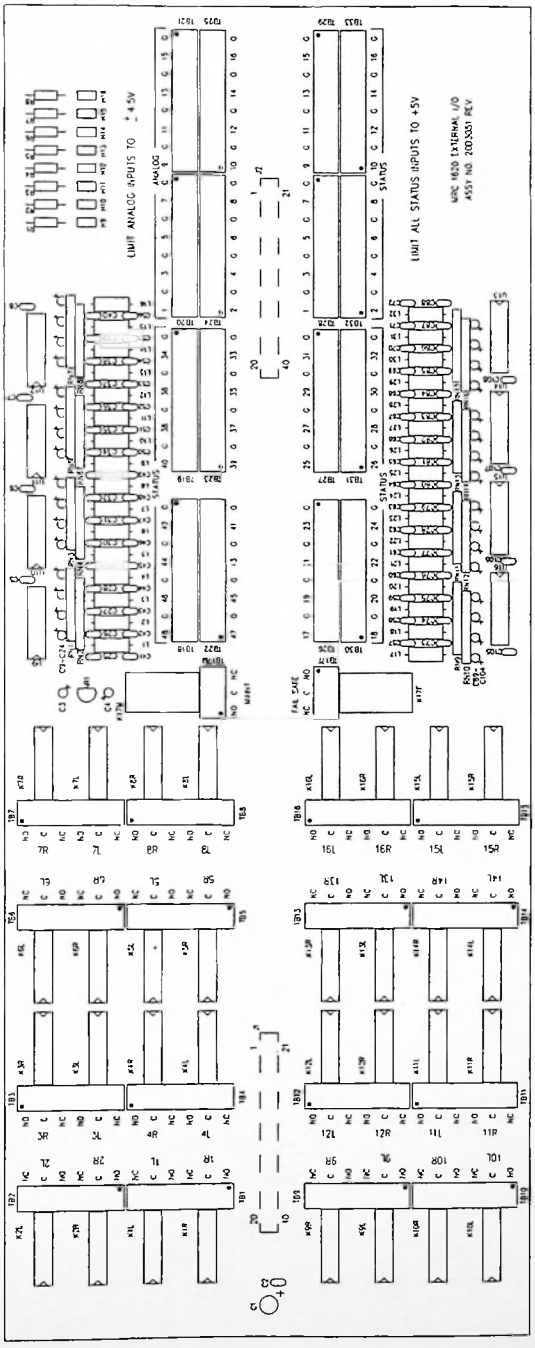
9F-9F Null Modem Cable Assembly (24C1171 Rev B)



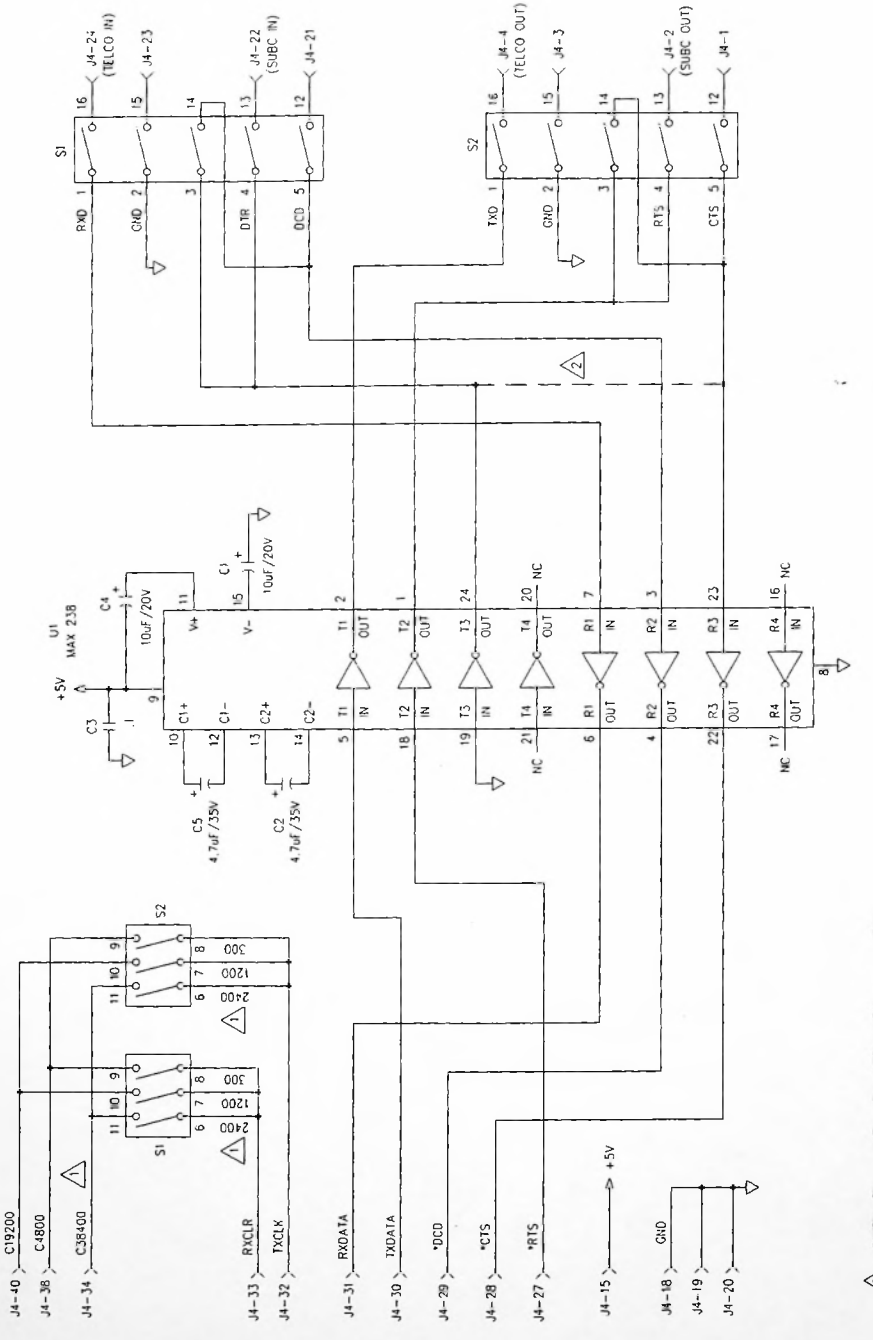
External I/O Schematic, p. 1 of 2 (91B7465 Rev B)



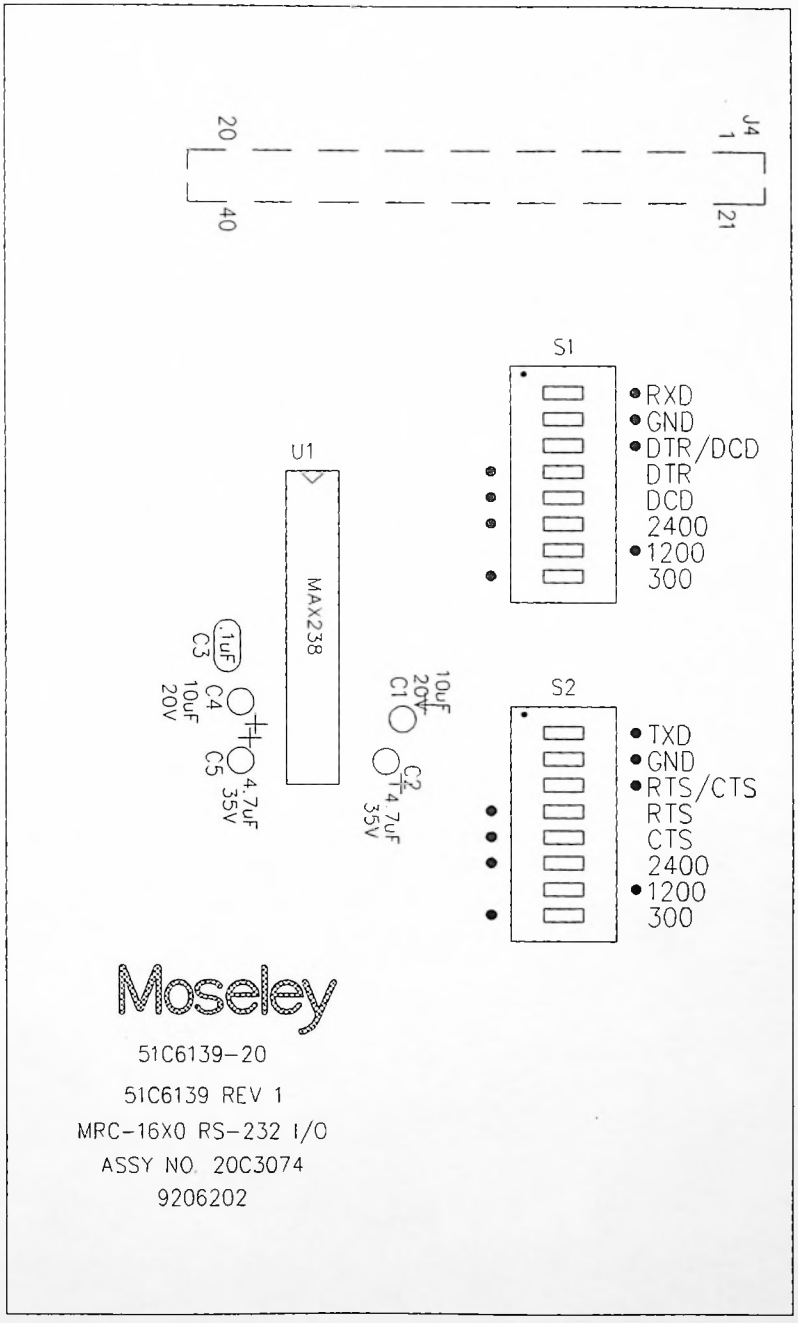
External I/O Schematic, p. 2 of 2 (91B7465 Rev B)



External I/O Assembly (20B3051 Rev B)



RS-232 I/O Schematic (91C7486 Rev 2)



RS-232 I/O Assembly (20C3074 Rev 1)

Notes

Section 8

Parts Lists

This section contains parts referenced by assembly drawings and schematic diagrams in Section 7.

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206464 DESCRIPTION: ASSY PWR SPLY 9-48V MRC1620 LP
ENG. 20B3097-1 R: 3

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
1090208	SCR PNH PHPS 6-32 X 3/8 SST		2.000	EA
1090554	NUT HEX 6-32 SM PATT		2.000	EA
1090562	WSHR LK #6 INTL T CD PL		2.000	EA
3091139	CONN 6PIN HDR BRKAWAY LKG .156 P2	MLSS156-6-X-B	1.000	EA
3091147	HDR .025X.100 STRT 20P 1ROW E1	MFSS100-20-X-B	.150	EA
3111283	CONN PCB HDR 2 POS MALE PINS P1	1-350942-0	1.000	EA
3160256	SW TGL SPDT ON-NONE-ON PC MT S1	7101MDAV2KE22	1.000	EA
3250032	SKT IC DIP 16 PIN .3 U2	ICO-163-S8A-T	1.000	EA
3250917	JUMPER MINI FOR 2 PINS=.025/.1 E1	929952-10	1.000	EA
3370079	FUSE .25X1.25 FAST 0.5 A F1	AGC 1/2	1.000	EA
3370608	FUSE HLDR HOR PCMT .25X1.25CAR F1	HBH-I	1.000	EA
3474913	PCB MRC-1620 LP DC PWR SPLY	51C6163 R: 2	1.000	EA
3610227	DIO MR-751 100V 6A (194-04) CR4	MR-751	1.000	EA
3610342	DIO SCH 40V 3.0A (267) CR1	MBR340P	1.000	EA
3610409	DIO SCH 20V 1.0A DO41 CR2,CR3	1N5817	2.000	EA
3650546	RGLTR SW BUCK 5V 1A T0220-5 U1	LM2575T-5.0LB03	1.000	EA
3650595	RGLTR SWITCHED MODE U2	MAX743CPE	1.000	EA
4050241	IDCTR 220U 1.4A (FOR LM2575) L1	PE-52626	1.000	EA
4050258	IDCTR 100 UH IRON CORE TOROID L2,L3	51-548	2.000	EA
4260345	CAP ALLYTIC 330/10V RAD 105C C2	ECEA1AGE331	1.000	EA
4260352	CAP ALLYTIC 100/63 RAD C1	UVX1J101MPA	1.000	EA
4280038	CAP TANT LS .125 1/35V 20% C7	TAP105M035GSB	1.000	EA
4280509	CAP TANT .1/35V 20% .100 LS C6	TAP104M035SCS	1.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206464 DESCRIPTION: ASSY PWR SPLY 9-48V MRC1620 LP
ENG. 20B3097-1 R: 3

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
4310140	CAP DISC .01/100V C11	TG-S10	1.000	EA
4310264	CAP CER .1/50V Z5U 20% T&R C8	C324C104M5U5CA	1.000	EA
4310272	CAP CER .01/50V X7R 10% T&R C4,C5	C324C103K5R5CA	2.000	EA
4351730	CAP ALLYTIC 150/35 LOW ESR C3,C9,C10	UPL1V151MPH6	3.000	EA
4570512	RES 1/4W 5% CF 12K OHM AXL R1	06A1016	1.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206475 DESCRIPTION: ASSY CPU MRC-1620 LP
ENG. 20B3098 R: 4

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
1090182	SCR PNH PHPS 6-32 X 1/4 SST		2.000	EA
1090562	WSHR LK #6 INTL T CD PL		2.000	EA
1230275	STDF 1/4 HEX 6-32 X 7/16 AL	8214-A-0632	2.000	EA
3090222	HDR .025X.100 RTNG 12P 1ROW P5,P6,P7	1-104430-0	3.000	EA
3250917	JUMPER MINI FOR 2 PINS=.025/.1 E1,E2,E3,E4(3),E5 (ASSY REV 4,	929952-10 PCB REV 5)	7.000	EA
3661048	IC MC6809P MPU U11	EF6809P	1.000	EA
3661907	IC 74ACT244 OCT B/D 3ST 20PDIP U20	CD74ACT244E	1.000	EA
3661956	IC 74ACT245 8BUS TRNCVR 20PDIP U3,U19	CD74ACT245PC	2.000	EA
3680311	IC RS-232 4-DRV 4-RX U4,U6	MAX238CNG	2.000	EA
3710886	IC EEPROM 32K X 8 300NS U13	X28C256P-30	1.000	EA
3711041	IC HD63B21P PIA INTERFACE U18	HD63B21P	1.000	EA
3711058	IC HD6350P ACIA INTERFACE U14,U15,U16	HD63A50P	3.000	EA
3711108	IC RAM STAT/BAT 8K X 8 W/RTC U12	MK48T08B-15	1.000	EA
8000065	ASSY CPU MRC-1620 LP-OUT VNDR	20B3098 R: 4	1.000	EA
9107970	IC PROG 1620LP RT CPU U10 U10	26M1193 R: 1	1.000	EA
9107988	IC PROG 1620LP CPU U2 U2	26M1194 R: 1	1.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 8000065 DESCRIPTION: ASSY CPU MRC-1620 LP-OUT VNDR
ENG. 20B3098 R: 4

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
1560630	TAPE FOAM DBL-SIDE 1/8X1X36YDS	#4016 (A-20)	.062	YD
3091378	CONN 36 PIN BRKAWAY STR HDR E1,E2,E3,E4,E5 (ASSY REV 4, PCB REV 5)	CA-S36-24C-44	.750	EA
3110111	CONN MALE 6 PIN POWER P2	1-380999	1.000	EA
3110509	CONN SCTCHFLX R ANGLE W/0 EJCT P1	3432-1002	1.000	EA
3110574	CONN 2X20 M STR PC SHROUDER P3,P4	CA-40HL-1F	2.000	EA
3170008	SW PB SPST OFF-MOM PCMT SEALED S1	EP11SD1CBE	1.000	EA
3190089	SW DIP 8 POSITION SEALED S2	76SB08S	1.000	EA
3250057	SKT IC DIP 20 PIN .3 U3,U19,U20	ICO-203-S8A-T	3.000	EA
3250073	SKT IC DIP 24 PIN .6 U14,U15,U16	ICO-246-S8A-T	3.000	EA
3250081	SKT IC DIP 28 PIN .6 U12,U13	ICO-286-S8A-T	2.000	EA
3250099	SKT IC DIP 40 PIN .6 U11,U18	ICO-406-S8A-T	2.000	EA
3251071	SKT IC DIP 24 PIN .3 U2,U4,U6	ICO-243-S8A-T	3.000	EA
3251253	SKT IC PLCC 32 PIN U10	PLCCB-032-PS-T	1.000	EA
3340163	XTAL 4.00 MHZ MRC/TCS Y1	30A0066 R: C	1.000	EA
3474905	PCB MRC-1620 LP CPU	51B6162 R: 5	1.000	EA
3650579	RGLTR +ADJ .1A LOWDR SHUT DIP8 U17	LP2951CN	1.000	EA
3661931	IC 74ACT163 SYNCH BI CT 16PDIP U9	CD74ACT163E	1.000	EA
3661964	IC 74ACT04 HEX INV 14PDIP U7	CD74ACT04E	1.000	EA
3661972	IC 74ACT32 QU 2 IN OR 14PDIP U5	CD74ACT32E	1.000	EA
3680063	IC CD4040BE 12 STAGE BIN CT U8	CD4040BE	1.000	EA
3711090	IC SPVSRY PWR RST WD U1	MAX705CPA	1.000	EA
4020376	IDCTR RF 10 UH L1,L2	74F105AP	2.000	EA
4200150	CAP MICA DIP 24PF 5% C4,C5	DM-5-240J	2.000	EA

PARENT ITEM: 8000065 DESCRIPTION: ASSY CPU MRC-1620 LP-OUT VNDR
ENG. 20B3098 R: 4

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
4280038	CAP TANT LS .125 1/35V 20% C7,C8,C9,C10,C11,C12,C13,C14,C15,C16,C23	TAP105M035GSB	11.000	EA
4280079	CAP TANT LS .125 10/20V 20% C30,C37,C38,C39	TAP106M020GSB	4.000	EA
4310173	CAP DISC .01/600V C20,C21	811000Z5U0103M	2.000	EA
4310264	CAP CER .1/50V Z5U 20% T&R C1,C2,C3,C6,C17,C18,C19,C22,C25,C26,C27,C28,C29, C32,C33,C34,C35,C36	C324C104M5U5CA	18.000	EA
4310272	CAP CER .01/50V X7R 10% T&R C24,C31	C324C103K5R5CA	2.000	EA
4510145	RES 1/4W 1% MF 10.0K OHM AXL R1,R9,R13 (ASSY REV 4, PCB REV 5)	5043ED10K00F	3.000	EA
4511069	RES 1/4W 1% MF 86.6K OHM AXL R10	5043ED86K60F	1.000	EA
4512208	RES 1/4W 1% MF 61.9K OHM AXL R2	5043ED61K90F	1.000	EA
4540134	RES SIP 10K OHM 1/8W 2% 10 RN1	4610X-101-103	1.000	EA
4570320	RES 1/4W 5% CF 1.0K OHM AXL R11	06A1016	1.000	EA
4570376	RES 1/4W 5% CF 2.2K OHM AXL R3,R4,R5,R7	06A1016	4.000	EA
4570504	RES 1/4W 5% CF 10K OHM AXL R8,R12	06A1016	2.000	EA
4570820	RES 1/4W 5% CF 15MEG OHM AXL R6	06A1016	1.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206442 DESCRIPTION: ASSY PCB FP MRC-1620 LP
ENG. 20D2855-2 R: G

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
3110509	CONN SCTCHFLX R ANGLE W/O EJCT P1	3432-1002	1.000	EA
3170826	SW PB SPST-RED S6	320.01-E1-1-RED	1.000	EA
3170834	SW PB SPST-YEL S1,S2,S7,S8	320.01-E1-1-YEL	4.000	EA
3170842	SW PB SPST-GRN S3,S4,S5	320.01-E1-1-GRN	3.000	EA
3250057	SKT IC DIP 20 PIN .3 U7,U8	ICO-203-S8A-T	2.000	EA
3390127	LED RED 3.5@10 DIFF65 T1.75 CR17,CR18,CR19,CR20	HLMP-3300	4.000	EA
3390143	LED YEL 8.0@10 DIFF75 T1.75 CR21,CR22,CR23	HLMP-3401	3.000	EA
3390598	LED R/G 2@10 DIFF 2-LEAD CR1,CR2,CR3,CR4,CR5,CR6,CR7, CR8,CR9,CR10,CR11,CR12,CR13, CR14,CR15,CR16	MV5491A	16.000	EA
3390614	LED GRN 5.2@10 DIFF75 T1.75 CR24	HLMP-3507	1.000	EA
3390804	HORN ALARM 4-7VDC 2200HZ 85@10 BZ1	HMB-06	1.000	EA
3473329	PCB FRONT PANL MRC1600/1620/LP	51D5974 R: B	1.000	EA
3630027	XT NS2N2924LFS.2W160M025V.1A7P Q1	2N2924	1.000	EA
3661881	IC 74ACT74 DUAL D FF 14PDIP U3	CD74ACT74E	1.000	EA
3661907	IC 74ACT244 OCT B/D 3ST 20PDIP U7,U8	CD74ACT244E	2.000	EA
3661923	IC 74ACT273 OCTAL FF 20PDIP U4,U5,U6	CD74ACT273E	3.000	EA
3661972	IC 74ACT32 QU 2 IN OR 14PDIP U10	CD74ACT32E	1.000	EA
3661980	IC 74ACT139 DCDR/DEMUX 16PDIP U9	CD74ACT139E	1.000	EA
3690054	DISPLAY 17-SEG 4-DIGIT RED U1,U2	DL-2416T	2.000	EA
4280079	CAP TANT LS .125 10/20V 20% C11	TAP106M020GSB	1.000	EA
4310264	CAP CER .1/50V Z5U 20% T&R C1,C2,C3,C4,C5,C6,C7,C8,C9,C10	C324C104M5U5CA	10.000	EA
4540167	RES SIP 3.3K 1/8W 2% R2	4610X-101-332	1.000	EA
4540217	RES SIP 220 OHM 1/8W 2% R3,R4,R5	4610X-101-221	3.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206442 DESCRIPTION: ASSY PCB FP MRC-1620 LP
ENG. 20D2855-2 R: G

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
4570320	RES 1/4W 5% CF 1.0K OHM AXL R1	06A1016	1.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206459 DESCRIPTION: ASSY ANLG/CMD/STAT MRC-1620 LP
ENG. 20C3099 R: 1

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
2062826	SHIELD MRC1600/1620/LP RF #1	05B2907 R: C	1.000	EA
2062867	SHIELD MRC1600/1620/LP RF #2	05B2917 R: C	1.000	EA
3110574	CONN 2X20 M STR PC SHROUDER	CA-40HL-1F	2.000	EA
3661907	IC 74ACT244 OCT B/D 3ST 20PDIP U13,U14	CD74ACT244E	2.000	EA
3730629	IC ICL7109CPL A-D CONV 12BITS U7	ICL7109CPL	1.000	EA
4250007	CAP POLYCARB .001/100V 3% C47	22NB102H	1.000	EA
4250486	CAP POLYCARB .1/100V 3% C38	22NB104H	1.000	EA
4250619	CAP POLYCARB .35/100V 3% C53	22NB354H	1.000	EA
4250684	CAP .22/200V 10% AXIAL C52	X363/.22/10%	1.000	EA
8000073	ASSY ANALOG/CMD/STAT MRC1620LP	20C3099	1.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 8000073 DESCRIPTION: ASSY ANALOG/CMD/STAT MRC1620LP
ENG. 20C3099

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
3110509	CONN SCTCHFLX R ANGLE W/0 EJCT P1	3432-1002	1.000	EA
3250057	SKT IC DIP 20 PIN .3 U13,U14	ICO-203-S8A-T	2.000	EA
3250099	SKT IC DIP 40 PIN .6 U7	ICO-406-S8A-T	1.000	EA
3340189	XTAL 3.579545 MHZ MRC/TCS Y1	30A0072 R: D	1.000	EA
3474897	PCB ANALOG/CMD/STAT MRC1620 LP	51D5976 R: D	1.000	EA
3650603	RGLTR VREF LT1021 5V1OMA 8PDIP U24	LT1021DCN8-5	1.000	EA
3661873	IC 74ACT08 QU 2IN AND 14PDIP U20	CD74ACT08E	1.000	EA
3661899	IC 74ACT138 3-8 DCD/DMX 16PDIP U12,U19	CD74ACT138E	2.000	EA
3661915	IC 74HCT259 OCT LTCH 16PDIP U4,U5,U21,U22,U23	74HCT259N	5.000	EA
3661923	IC 74ACT273 OCTAL FF 20PDIP U6	CD74ACT273E	1.000	EA
3661972	IC 74ACT32 QU 2 IN OR 14PDIP U11	CD74ACT32E	1.000	EA
3680139	IC MC14051P 8CH MUX R280 7V U1,U2,U3	MC14051P	3.000	EA
3680287	IC VOLTAGE CONVERTER(+5 TO -5) VR1	ICL7660CPA	1.000	EA
3730157	IC LM308AN OPAMP PRECISION U8	LM308AN	1.000	EA
3731007	IC 7-DARLINGTON ARRAY HI-V,A U9,U10,U16,U17,U18	ULN2003AN	5.000	EA
4020343	IDCTR RF 6.80 UH L1,L2,L3,L4,L5,L6,L7,L8,L9,L10,L11,L12,L13,L14, L15,L16,L17,L18,L19,L20,L21,L22,L23,L24,L25,L26, L27,L28,L29,L30,L31,L32,L33,L34	9310-32	34.000	EA
4210134	CAP MICA DIP 30PF 5% C48	DM-15-300J	1.000	EA
4280079	CAP TANT LS .125 10/20V 20% C1,C2,C36,C78,C85,C87	TAP106M020GSB	6.000	EA
4310264	CAP CER .1/50V Z5U 20% T&R C3,C4,C5,C6,C7,C8,C9,C10,C11,C12,C13,C14,C15,C16, C17,C18,C19,C20,C21,C22,C23,C24,C25,C26,C27,C28, C29,C30,C31,C32,C33,C34,C35,C37,C40,C41,C42,C43, C44,C45,C46,C49,C50,C57,C58,C59,C60,C61,C62,C63, C64,C65,C66,C67,C68,C69,C70,C71,C72,C73,C74,C75, C76,C77,C79,C80,C81,C82,C83,C84,C86	C324C104M5U5CA	71.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 8000073 DESCRIPTION: ASSY ANALOG/CMD/STAT MRC1620LP
ENG. 20C3099

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
4470290	RES 1/2W 5% CC 10 OHM AXL R35	RC20GF100K	1.000	EA
4510145	RES 1/4W 1% MF 10.0K OHM AXL R19	5043ED10K00F	1.000	EA
4512190	RES 1/4W 1% MF 13.0K OHM AXL R25	5043ED13K00F	1.000	EA
4540167	RES SIP 3.3K 1/8W 2% R21,R22,R23,R27,R28,R32,R33	4610X-101-332	7.000	EA
4540225	RES SIP 1M 1/8W 2% R1,R2	4610X-101-105	2.000	EA
4570040	RES 1/4W 5% CF 22 OHM AXL R20,R26	06A1016	2.000	EA
4570144	RES 1/4W 5% CF 100 OHM AXL R24	06A1016	1.000	EA
4570564	RES 1/4W 5% CF 27K OHM AXL R29,R34	06A1016	2.000	EA
4570580	RES 1/4W 5% CF 33K OHM AXL R3,R4,R5,R6,R7,R8,R9,R10,R11,R12,R13,R14,R15,R16, R17,R18,	06A1016	16.000	EA
4570700	RES 1/4W 5% CF 200K OHM AXL R30	06A1016	1.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9204504 DESCRIPTION: ASSY EXT. RLY MRC-1600/1620/LP
ENG. 20D2858 R: A

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
1050129	SCR PNH PHPS 4-40 X 1/4 SST		4.000	EA
2062966	SHIELD INSULA. MRC1600/1620/LP	05C2936 R: B	1.000	EA
3110582	CONN F 44 PIN STRAIGHT PC MTG J1,J2	66953-022	2.000	EA
3270162	RELAY SPDT 3A 12VDC PC MT SEAL K1,K2,K3,K4,K5,K6,K7,K8,K9,K10,K11,K12,K13,K14, K15,K16,K17,K18,K19,K20,K21,K22,K23,K24,K25,K26, K27,K28,K29,K30,K31,K32,K33,K34	HA1EDC12V	34.000	EA
3291135	TERM STRIP PC MOUNT 3 POSITION MKDSN 1.5/3 TB7,TB18		2.000	EA
3291143	TERM STRIP PC MOUNT 8 POSITION MKDSN 1.5/8 TB1,TB2,TB3,TB4,TB5,TB6,TB8,TB9,TB10,TB11,TB12, TB13,TB14,TB15,TB16,TB17,TB19,TB20,TB21,TB22		20.000	EA
3473352	PCB EXTERNAL RELAY MRC-1600/LP	51D5977 R: D	1.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206491 DESCRIPTION: ASSY PCB MRC-1620 LP COMM I\O
ENG. 20C3102 R: 1

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
1050939	SCR JACK 3/16HEX4-40 X 5/16L P6,P7	4750-3	4.000	EA
1560036	TUBING SHRINK BLACK 3/16" J1,J2	MIL-I-23053/5	.167	FT
2300879	ASSY CA MRC16001620/LP COM I/O	24B1097-1 E	1.000	EA
2301307	ASSY CA MRC1620LP CPU-I/O 17IN P6	24B1178-1 R: 2	1.000	EA
2301489	ASSY CA MRC1620LP CPU-I/O 19IN P7	24B1178-2 R: 2	1.000	EA
3030244	CONN BNC BULKHD UG-1094/U J1,J2	227754-1	2.000	EA
3291143	TERM STRIP PC MOUNT 8 POSITION TB1	MKDSN 1.5/8	1.000	EA
3474921	PCB MRC-1620 LP COMM I/O	51B6164 R: A	1.000	EA
4130035	FERRITE BEAD J1,J2	K 5 001 00/3B	2.000	EA
4310173	CAP DISC .01/600V C1,C2,C3,C4,C5,C6	811000Z5U0103M	6.000	EA
4590170	VARISTOR RV1,RV2,RV3,RV4	V-120-MA1A	4.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9205931 DESCRIPTION: ASSY COMP MRC1620/LP TELCO IN
ENG. 20C2859-20 R: G

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
1640366	W W/W GREEN	M0015-195A	.100	FT
1641927	W BUSS 22GA C15	298	.050	FT
3091253	HDR .025X.100 STRT 72P 2ROW 2 WIRE/4 WIRE	CA-D72-24C-44	.056	EA
3110582	CONN F 44 PIN STRAIGHT PC MTG J1	66953-022	1.000	EA
3190071	SW DIP 4 POSITION SEALED S1	76SB04S	1.000	EA
3250917	JUMPER MINI FOR 2 PINS=.025/.1 2 WIRE	929952-10	1.000	EA
3473360	PCB TELCO INPUT MRC-1600/LP	51C5978 R: B	1.000	EA
3600236	DIO Z1N4745A 16V 1W 5% AIAY CR1,CR2	1N4745A	2.000	EA
3730462	IC RC4136N OPAMP QUAD 741 U2	RC4136N	1.000	EA
3730827	IC XR2211CP FSK MODEM U1	XR2211CP	1.000	EA
4020376	IDCTR RF 10 UH L1,L2	74F105AP	2.000	EA
4090106	XFMR T1	MT1-PC	1.000	EA
4250049	CAP POLYCARB .0022/100V 3% C2	22NB222H	1.000	EA
4250171	CAP POLYCARB .01/100V 3% C3,C19,C20,C21,C22	22NB103H	5.000	EA
4250288	CAP POLYCARB .022/100V 3% C13	22NB223H	1.000	EA
4250312	CAP POLYCARB .027/100V 3% C7	22NB273H	1.000	EA
4280038	CAP TANT LS .125 1/35V 20% C1,C12,C14	TAP105M035GSB	3.000	EA
4310173	CAP DISC .01/600V C5,C6,C9,C10	811000Z5U0103M	4.000	EA
4310264	CAP CER .1/50V Z5U 20% T&R C4,C8,C11,C17,C18	C324C104M5U5CA	5.000	EA
4570280	RES 1/4W 5% CF 620 OHM AXL R14	06A1016	1.000	EA
4570440	RES 1/4W 5% CF 4.7K OHM AXL R1,R2,R15,R20	06A1016	4.000	EA
4570504	RES 1/4W 5% CF 10K OHM AXL R10,R11,R12,R13	06A1016	4.000	EA
4570512	RES 1/4W 5% CF 12K OHM AXL R16,R18	06A1016	2.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9205931 DESCRIPTION: ASSY COMP MRC1620/LP TELCO IN
ENG. 20C2859-20 R: G

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
4570528	RES 1/4W 5% CF 15K OHM AXL R6,R19	06A1016	2.000	EA
4570580	RES 1/4W 5% CF 33K OHM AXL R7	06A1016	1.000	EA
4570596	RES 1/4W 5% CF 39K OHM AXL R17	06A1016	1.000	EA
4570668	RES 1/4W 5% CF 100K OHM AXL R4	06A1016	1.000	EA
4570756	RES 1/4W 5% CF 470K OHM AXL R3,R8	06A1016	2.000	EA
4630273	POT CER PC PIN 10K OHM .5W 25T R5	3296W-1-103	1.000	EA
600-10366-01	SCHEM TELCO INPUT MRC-1620	91C7304 R: D	.000	EA
603-10146-01	PROCESS SPEC ASSY MARKING/LBL	PS-3002 R: 2	.000	EA
603-10149-01	PROCESS SPEC ASSEMBLY STANDARD	PS-3001 R: 2	.000	EA
9999897	REV ECO# DATE COMMENTS G 5417 10/03/94 ADD HEADER + MINI JUMP FOR 2/4 WIRE SELECT REDRAW CAD		.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206905 DESCRIPTION: ASSY PCB 1620LP TELCO OUT/OPTO
ENG. 20C2860-21 R: I

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
3091253	HDR .025X.100 STRT 72P 2ROW E3/E4,E5/E6	CA-D72-24C-44	.112	EA
3110582	CONN F 44 PIN STRAIGHT PC MTG J1	66953-022	1.000	EA
3190790	SW DIP 5 POSITION SEALED S1	76SB05S	1.000	EA
3250917	JUMPER MINI FOR 2 PINS=.025/.1 E5	929952-10	1.000	EA
3475126	PCB TELCO OUTPUT 1620 W/OPTO	51B5979 R: D	1.000	EA
3600236	DIO Z1N4745A 16V 1W 5% AIAY CR1,CR2	1N4745A	2.000	EA
3630456	XT 2N3904 Q1	2N3904	1.000	EA
3660008	IC UA741P OPAMP GEN COMP U2	UA741CP	1.000	EA
3730819	IC XR2206CP VCO WAVE GEN U1	XR2206CP	1.000	EA
3730868	IC OPTOISO DCIN DLNGTNOUT 30MA U3	MOC-8030	1.000	EA
4020376	IDCTR RF 10 UH L1,L2	74F105AP	2.000	EA
4090106	XFMR T1	MT1-PC	1.000	EA
4220125	CAP MICA DIP 2000PF 5% C15	DM-19-202J	1.000	EA
4250833	CAP POLYPRO .022/63V 2.5% 5MM C10	FKP2 .022/63/2	1.000	EA
4280533	CAP TANT 1/35V 20% .100 LS C1,C2,C3,C8	TAP105M035SRW	4.000	EA
4280541	CAP TANT 10/20V 20% .100 LS C12	T351E106K020AS	1.000	EA
4310173	CAP DISC .01/600V C4,C5,C6,C7	811000Z5U0103M	4.000	EA
4310264	CAP CER .1/50V Z5U 20% T&R C9,C11,C13,C14	C324C104M5U5CA	4.000	EA
4570192	RES 1/4W 5% CF 200 OHM AXL R8	06A1016	1.000	EA
4570280	RES 1/4W 5% CF 620 OHM AXL R13	06A1016	1.000	EA
4570320	RES 1/4W 5% CF 1.0K OHM AXL R17,R18	06A1016	2.000	EA
4570376	RES 1/4W 5% CF 2.2K OHM AXL R14	06A1016	1.000	EA
4570440	RES 1/4W 5% CF 4.7K OHM AXL R1,R10,R11	06A1016	3.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206905 DESCRIPTION: ASSY PCB 1620LP TELCO OUT/OPTO
ENG. 20C2860-21 R: I

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
4570504	RES 1/4W 5% CF 10K OHM AXL R3,R4,R16	06A1016	3.000	EA
4570520	RES 1/4W 5% CF 13K OHM AXL R9	06A1016	1.000	EA
4570528	RES 1/4W 5% CF 15K OHM AXL R5	06A1016	1.000	EA
4570540	RES 1/4W 5% CF 20K OHM AXL R15	06A1016	1.000	EA
4570580	RES 1/4W 5% CF 33K OHM AXL R6	06A1016	1.000	EA
4630273	POT CER PC PIN 10K OHM .5W 25T R2,R7,R12	3296W-1-103	3.000	EA
600-10349-01	SCHEM MRC1600/1620LP TELCO OUT	91C7305 R: E	.000	EA
603-10146-01	PROCESS SPEC ASSY MARKING/LBL	PS-3002 R: 2	.000	EA
603-10149-01	PROCESS SPEC ASSEMBLY STANDARD	PS-3001 R: 2	.000	EA
9999897	REV ECO# DATE COMMENTS I 5343 02/10/94 NEW ITEM#. USES PCB 3475126. INCLUDES OPTOISOLATOR CIRCUIT. 5343A1 09/16/94 ADD 2/4 WIRE JUMPER		.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9205998 DESCRIPTION: ASSY SUBC IN 67KHZ MRC-1620/LP
ENG. 20C2861-23 R: H

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
4210514	CAP MICA DIP 750PF 5% C27	DM-15-751J	1.000	EA
4220042	CAP MICA DIP 1200PF 5% C5	DM-19-122J	1.000	EA
4250023	CAP POLYCARB .0016/100V 3% C12	22UB162H	1.000	EA
4250171	CAP POLYCARB .01/100V 3% C6,C15	22NB103H	2.000	EA
4570344	RES 1/4W 5% CF 1.5K OHM AXL R5	06A1016	1.000	EA
4570440	RES 1/4W 5% CF 4.7K OHM AXL R17	06A1016	1.000	EA
9205956	ASSY SUBC IN NEUTER MRC-1620	20C2861-20 R: H	1.000	EA
9990011	NOTE 1 SEE APPROPRIATE COMPONENT LAYOUT FOR PARTS PLACEMENT: MRC-1/MRC-2 20D2719 MRC-1600/MRC-1620 20D2861		.000	EA
9999897	REV ECO# DATE COMMENTS A 3922 30JUN83 RELEASED FOR PRODUCTION B 3957 29AUG83 ADDED -7 (92 KHZ) C 4080 10MAY84 ADDED -8 (152 KHZ) D 5068 14JUN89 CHANGE DWG NO TO 25M,ADD NOTES		.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9205956 DESCRIPTION: ASSY SUBC IN NEUTER MRC-1620
ENG. 20C2861-20 R: H

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
1640366	W W/W GREEN DO NOT INSTALL -- THIS WIRE TO BE DELETED NEXT REV	M0015-195A	.333	FT
3110582	CONN F 44 PIN STRAIGHT PC MTG J1	66953-022	1.000	EA
3190071	SW DIP 4 POSITION SEALED S1	76SB04S	1.000	EA
3473386	PCB SUBCARRIER INPUT MRC-1600	51C5980 R: C	1.000	EA
3730462	IC RC4136N OPAMP QUAD 741 U2	RC4136N	1.000	EA
3730827	IC XR2211CP FSK MODEM U1,U3	XR2211CP	2.000	EA
4041703	COIL ASSEMBLY L1,L2	03-5005 R: C	2.000	EA
4210324	CAP MICA DIP 180PF 5% C19	DM-15-181J	1.000	EA
4210456	CAP MICA DIP 470PF 5% C18	DM-15-471J	1.000	EA
4250049	CAP POLYCARB .0022/100V 3% C2	22NB222H	1.000	EA
4250171	CAP POLYCARB .01/100V 3% C3,C23,C24,C25,C26	22NB103H	5.000	EA
4250288	CAP POLYCARB .022/100V 3% C11	22NB223H	1.000	EA
4250312	CAP POLYCARB .027/100V 3% C7	22NB273H	1.000	EA
4280038	CAP TANT LS .125 1/35V 20% C1,C10,C13	TAP105M035GSB	3.000	EA
4310264	CAP CER .1/50V Z5U 20% T&R C4,C8,C9,C14,C20,C21,C22,C28	C324C104M5U5CA	8.000	EA
4310272	CAP CER .01/50V X7R 10% T&R C29	C324C103K5R5CA	1.000	EA
4570440	RES 1/4W 5% CF 4.7K OHM AXL R1,R2,R4,R18,R24	06A1016	5.000	EA
4570504	RES 1/4W 5% CF 10K OHM AXL R13,R14,R15	06A1016	3.000	EA
4570512	RES 1/4W 5% CF 12K OHM AXL R20,R22	06A1016	2.000	EA
4570528	RES 1/4W 5% CF 15K OHM AXL R8,R23,R25	06A1016	3.000	EA
4570580	RES 1/4W 5% CF 33K OHM AXL R9	06A1016	1.000	EA
4570596	RES 1/4W 5% CF 39K OHM AXL R21	06A1016	1.000	EA
4570612	RES 1/4W 5% CF 47K OHM AXL R12	06A1016	1.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9205956 DESCRIPTION: ASSY SUBC IN NEUTER MRC-1620
ENG. 20C2861-20 R: H

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
4570668	RES 1/4W 5% CF 100K OHM AXL R6,R16,R19	06A1016	3.000	EA
4570676	RES 1/4W 5% CF 120K OHM AXL R26	06A1016	1.000	EA
4570756	RES 1/4W 5% CF 470K OHM AXL R3,R10	06A1016	2.000	EA
4630273	POT CER PC PIN 10K OHM .5W 25T R7,R27	3296W-1-103	2.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206004 DESCRIPTION: ASSY SUBC IN 92/94KHZ 1620/LP
ENG. 20C2861-24 R: H

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
4210480	CAP MICA DIP 560PF 5% C27	DM-15-561J	1.000	EA
4210506	CAP MICA DIP 680PF 5% C5	DM-15-681J	1.000	EA
4220018	CAP MICA DIP 1000PF 5% C12	DM-19-102J	1.000	EA
4250130	CAP POLYCARB .0068/100V 3% C6,C15	22NB682H	2.000	EA
4570360	RES 1/4W 5% CF 1.8K OHM AXL R5	06A1016	1.000	EA
4570464	RES 1/4W 5% CF 6.2K OHM AXL R17	06A1016	1.000	EA
9205956	ASSY SUBC IN NEUTER MRC-1620	20C2861-20 R: H	1.000	EA
9990011	NOTE 1 SEE APPROPRIATE COMPONENT LAYOUT FOR PARTS PLACEMENT: MRC-1/MRC-2 20D2719 MRC-1600/MRC-1620 20D2861		.000	EA
9999897	REV ECO# DATE COMMENTS A 3922 30JUN83 RELEASED FOR PRODUCTION B 3957 29AUG83 ADDED -7 (92 KHZ) C 4080 10MAY84 ADDED -8 (152 KHZ) D 5068 14JUN89 CHANGE DWG NO TO 25M,ADD NOTES		.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206012 DESCRIPTION: ASSY SUBC IN 110KHZ MRC1620/LP
ENG. 20C2861-25 R: H

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
4210456	CAP MICA DIP 470PF 5% C5,C27	DM-15-471J	2.000	EA
4210498	CAP MICA DIP 620PF 5% C12	DM-15-621J	1.000	EA
4220190	CAP MICA DIP 3600PF 5% C6,C15	DM-19-362J	2.000	EA
4570376	RES 1/4W 5% CF 2.2K OHM AXL R5	06A1016	1.000	EA
4570472	RES 1/4W 5% CF 6.8K OHM AXL R17	06A1016	1.000	EA
9205956	ASSY SUBC IN NEUTER MRC-1620	20C2861-20 R: H	1.000	EA
9990011	NOTE 1 SEE APPROPRIATE COMPONENT LAYOUT FOR PARTS PLACEMENT: MRC-1/MRC-2 20D2719 MRC-1600/MRC-1620 20D2861		.000	EA
9999897	REV ECO# DATE COMMENTS A 3922 30JUN83 RELEASED FOR PRODUCTION B 3957 29AUG83 ADDED -7 (92 KHZ) C 4080 10MAY84 ADDED -8 (152 KHZ) D 5068 14JUN89 CHANGE DWG NO TO 25M,ADD NOTES		.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206020 DESCRIPTION: ASSY SUBC IN 152KHZ MRC1620/LP
ENG. 20C2861-26 R: H

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
4210399	CAP MICA DIP 270PF 5% C5	DM-15-271J	1.000	EA
4210423	CAP MICA DIP 360PF 5% C27	DM-15-361J	1.000	EA
4210449	CAP MICA DIP 430PF 5% C12	DM-15-431J	1.000	EA
4220158	CAP MICA DIP 2400PF 5% C6,C15	DM-19-242J	2.000	EA
4570400	RES 1/4W 5% CF 3.0K OHM AXL R5	06A1016	1.000	EA
4570504	RES 1/4W 5% CF 10K OHM AXL R17	06A1016	1.000	EA
9205956	ASSY SUBC IN NEUTER MRC-1620	20C2861-20 R: H	1.000	EA
9990011	NOTE 1 SEE APPROPRIATE COMPONENT LAYOUT FOR PARTS PLACEMENT: MRC-1/MRC-2 20D2719 MRC-1600/MRC-1620 20D2861		.000	EA
9999897	REV ECO# DATE COMMENTS A 3922 30JUN83 RELEASED FOR PRODUCTION B 3957 29AUG83 ADDED -7 (92 KHZ) C 4080 10MAY84 ADDED -8 (152 KHZ) D 5068 14JUN89 CHANGE DWG NO TO 25M,ADD NOTES		.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206038 DESCRIPTION: ASSY SUBC IN 185KHZ MRC1620/LP
ENG. 20C2861-27 R: H

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
4210324	CAP MICA DIP 180PF 5% C5	DM-15-181J	1.000	EA
4210381	CAP MICA DIP 250PF 5% C12	DM-15-251J	1.000	EA
4210399	CAP MICA DIP 270PF 5% C27	DM-15-271J	1.000	EA
4220067	CAP MICA DIP 1500PF 5% C6,C15	DM-19-152J	2.000	EA
4570416	RES 1/4W 5% CF 3.6K OHM AXL R5	06A1016	1.000	EA
4570528	RES 1/4W 5% CF 15K OHM AXL R17	06A1016	1.000	EA
9205956	ASSY SUBC IN NEUTER MRC-1620	20C2861-20 R: H	1.000	EA
9990011	NOTE 1 SEE APPROPRIATE COMPONENT LAYOUT FOR PARTS PLACEMENT: MRC-1/MRC-2 20D2719 MRC-1600/MRC-1620 20D2861		.000	EA
9999897	REV ECO# DATE COMMENTS A 3922 30JUN83 RELEASED FOR PRODUCTION B 3957 29AUG83 ADDED -7 (92 KHZ) C 4080 10MAY84 ADDED -8 (152 KHZ) D 5068 14JUN89 CHANGE DWG NO TO 25M,ADD NOTES E 5145 24SEP90 CHANGE 300PF MICA TO 270PF MICA		.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9205964 DESCRIPTION: ASSY COMP 1620/LP SUBC OUT NEU
ENG. 20D2862-20 R: G

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
1640366	W W/W GREEN	M0015-195A	.100	FT
3110582	CONN F 44 PIN STRAIGHT PC MTG J1	66953-022	1.000	EA
3190790	SW DIP 5 POSITION SEALED S1	76SB05S	1.000	EA
3473394	PCB SUBCARRIER OUT 16001620/LP	51C5981 R: A	1.000	EA
3630027	XT NS2N2924LFS.2W160M025V.1A7P Q1	2N2924	1.000	EA
3660008	IC UA741P OPAMP GEN COMP U3	UA741CP	1.000	EA
3730819	IC XR2206CP VCO WAVE GEN U1,U2	XR2206CP	2.000	EA
4220125	CAP MICA DIP 2000PF 5% C16	DM-19-202J	1.000	EA
4250288	CAP POLYCARB .022/100V 3% C6	22NB223H	1.000	EA
4280038	CAP TANT LS .125 1/35V 20% C1,C2,C3,C4,C7	TAP105M035GSB	5.000	EA
4280079	CAP TANT LS .125 10/20V 20% C12,C17	TAP106M020GSB	2.000	EA
4310264	CAP CER .1/50V Z5U 20% T&R C5,C9,C10,C11,C13,C14,C15	C324C104M5U5CA	7.000	EA
4570160	RES 1/4W 5% CF 120 OHM AXL R14	06A1016	1.000	EA
4570192	RES 1/4W 5% CF 200 OHM AXL R11	06A1016	1.000	EA
4570280	RES 1/4W 5% CF 620 OHM AXL R19	06A1016	1.000	EA
4570320	RES 1/4W 5% CF 1.0K OHM AXL R28	06A1016	1.000	EA
4570376	RES 1/4W 5% CF 2.2K OHM AXL R18	06A1016	1.000	EA
4570440	RES 1/4W 5% CF 4.7K OHM AXL R1,R10,R15,R16,R23,R26	06A1016	6.000	EA
4570504	RES 1/4W 5% CF 10K OHM AXL R3,R4,R24,R27	06A1016	4.000	EA
4570520	RES 1/4W 5% CF 13K OHM AXL R12	06A1016	1.000	EA
4570528	RES 1/4W 5% CF 15K OHM AXL R5	06A1016	1.000	EA
4570540	RES 1/4W 5% CF 20K OHM AXL R25	06A1016	1.000	EA
4570580	RES 1/4W 5% CF 33K OHM AXL R6	06A1016	1.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9205964 DESCRIPTION: ASSY COMP 1620/LP SUBC OUT NEU
ENG. 20D2862-20 R: G

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
4570668	RES 1/4W 5% CF 100K OHM AXL R22	06A1016	1.000	EA
4570708	RES 1/4W 5% CF 220K OHM AXL R20	06A1016	1.000	EA
4630018	POT CER PC PIN 200 OHM .5W R13	3386R-1-201	1.000	EA
4630273	POT CER PC PIN 10K OHM .5W 25T R2,R9,R17	3296W-1-103	3.000	EA
4630331	POT CER PC PIN 20K OHM .5W 25T R8	3296W-1-203	1.000	EA
4630778	POT CER PC PIN 100KOHM .5W 25T R21	3296W-1-104	1.000	EA
4630786	POT CER PC PIN 1K OHM .5W 25T R7	3296W-1-102	1.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206046 DESCRIPTION: ASSY COMP 1620/LP SUBOUT26-66
ENG. 20D2862-21 R: G

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
4220117	CAP MICA DIP 1930PF 2% C8	DM-19-1931G	1.000	EA
9205964	ASSY COMP 1620/LP SUBC OUT NEU	20D2862-20 R: G	1.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206053 DESCRIPTION: ASSY COMP 1620/LP SUBOUT67-185
ENG. 20D2862-22 R: G

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
4210514	CAP MICA DIP 750PF 5% C8	DM-15-751J	1.000	EA
9205964	ASSY COMP 1620/LP SUBC OUT NEU	20D2862-20 R: G	1.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206079 DESCRIPTION: ASSY COMP MRC1620 I/O NRM/LTCH
ENG. 20D3051-1 R: B

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
3110582	CONN F 44 PIN STRAIGHT PC MTG	66953-022	2.000	EA
3250032	SKT IC DIP 16 PIN .3 K1L,K1R,K2L,K2R,K3L,K3R,K4L,K4R,K5L,K5R,K6L,K6R, K16L,K16R K7L,K7R,K8L,K8R,K9L,K9R,K10L,K10R,K11L,K11R, K12L,K12R,K13L,K13R,K14L,K14R,K15L,K15R,	ICO-163-S8A-T	32.000	EA
3270428	RELAY 1A1B 5A 12VDC PC NORM K1L,K1R,K2L,K2R,K3L,K3R,K4L,K4R,K5L,K5R,K6L,K6R, K16L,K16R,K17M,K17F K7L,K7R,K8L,K8R,K9L,K9R,K10L,K10R,K11L,K11R, K12L,K12R,K13L,K13R,K14L,K14R,K15L,K15R,	DSP1E-DC12V	34.000	EA
3270436	RELAY 1A1B 5A 12VDC PC LTCH K1R,K2R,K3R,K4R,K5R,K6R,K7R,K8R,K9R,K10R,K11R, K12R,K13R,K14R,K15R,K16R	DSP1E-L2-DC12V	.000	EA
3291135	TERM STRIP PC MOUNT 3 POSITION MKDSN 1.5/3 TB17M,TB17F		2.000	EA
3291143	TERM STRIP PC MOUNT 8 POSITION MKDSN 1.5/8 TB20,TB21,TB24,TB25,TB28,TB29,TB32,TB33		8.000	EA
3291200	TERM STRIP PC MOUNT 6 POSITION MKDSN 1.5/6 TB1,TB2,TB3,TB4,TB5,TB6,TB7,TB8,TB9,TB10,TB11, TB12,TB13,TB14,TB15,TB16		16.000	EA
3474624	PCB EXTENDED I/O MRC-1620	51D6124 R: A	1.000	EA
4280103	CAP TANT LS .250 33/35V 20% C1	TAP336M035HSB	1.000	EA
4310264	CAP CER .1/50V Z5U 20% T&R C2	C324C104M5U5CA	1.000	EA
600-10199-01	SCHEM MRC-1620LP EXTERNAL I/O	91D7465 R: B	.000	EA
603-10146-01	PROCESS SPEC ASSY MARKING/LBL	PS-3002 R: 2	.000	EA
603-10149-01	PROCESS SPEC ASSEMBLY STANDARD	PS-3001 R: 2	.000	EA
9999897	REV ECO# DATE COMMENTS B 5307 06/21/94 DRAWING CHANGE ONLY		.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206087 DESCRIPTION: ASSY COMP MRC1620 I/O EXTND ST
ENG. 20D3051-2 R: B

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
3110582	CONN F 44 PIN STRAIGHT PC MTG J1,J2	66953-022	2.000	EA
3110905	JUMPER BUSS WIRE 0.1 IN H9,H10,H11,H12,H13,H14,H15,H16	J0.100X0.125P24	8.000	EA
3250032	SKT IC DIP 16 PIN .3 K1L,K1R,K2L,K2R,K3L,K3R,K4L,K4R,K5L,K5R,K6L,K6R, K7L,K7R,K8L,K8R,K9L,K9R,K10L,K10R,K11L,K11R,K12L, K12R,K13L,K13R,K14L,K14R,K15L,K15R,K16L,K16R	ICO-163-S8A-T	32.000	EA
3270428	RELAY 1A1B 5A 12VDC PC NORM K1L,K1R,K2L,K2R,K3L,K3R,K4L,K4R,K5L,K5R,K6L,K6R, K7L,K7R,K8L,K8R,K9L,K9R,K10L,K10R,K11L,K11R,K12L, K12R,K13L,K13R,K14L,K14R,K15L,K15R,K16L,K16R,K17F, K17M	DSP1E-DC12V	34.000	EA
3270436	RELAY 1A1B 5A 12VDC PC LTCH K1R,K2R,K3R,K4R,K5R,K6R,K7R,K8R,K9R,K10R,K11R, K12R,K13R,K14R,K15R,K16R	DSP1E-L2-DC12V	.000	EA
3291135	TERM STRIP PC MOUNT 3 POSITION TB17M,TB17F	MKDSN 1.5/3	2.000	EA
3291143	TERM STRIP PC MOUNT 8 POSITION TB18,TB19,TB20,TB21,TB22,TB23,TB24,TB25,TB26,TB27, TB28,TB29,TB30,TB31,TB32,TB33	MKDSN 1.5/8	16.000	EA
3291200	TERM STRIP PC MOUNT 6 POSITION TB1,TB2,TB3,TB4,TB5,TB6,TB7,TB8,TB9,TB10,TB11, TB12,TB13,TB14,TB15,TB16	MKDSN 1.5/6	16.000	EA
3474624	PCB EXTENDED I/O MRC-1620	51D6124 R: A	1.000	EA
3650272	RGLTR 78L05C 05V 0.1A TO92 VR1	MC78L05CP	1.000	EA
3680337	IC D/A 8-BIT W/REF U9,U10,U11,U12,U13,U14,U15,U16	AD558JN	8.000	EA
4020343	IDCTR RF 6.80 UH L1,L2,L3,L4,L5,L6,L7,L8,L9,L10,L11,L12,L13,L14, L15,L16,L17,L18,L19,L20,L21,L22,L23,L24,L25,L26, L27,L28,L29,L30,L31,L32	9310-32	32.000	EA
4280038	CAP TANT LS .125 1/35V 20% C3,C4,C9,C10,C11,C12,C13,C14,C15,C16,C17,C18,C19, C20,C21,C22,C23,C24,C89,C90,C91,C92,C93,C94,C95, C96,C97,C98,C99,C100,C101,C102,C103,C104	TAP105M035GSB	34.000	EA
4280103	CAP TANT LS .250 33/35V 20% C1	TAP336M035HSB	1.000	EA
4310264	CAP CER .1/50V Z5U 20% T&R C2,C5,C6,C7,C8,C25,C26,C27,C28,C29,C30,C31,C32, C33,C34,C35,C36,C37,C38,C39,C40,C41,C42,C43,C44, C45,C46,C47,C48,C49,C50,C51,C52,C53,C54,C55,C56, C57,C58,C59,C60,C61,C62,C63,C64,C65,C66,C67,C68, C69,C70,C71,C72,C73,C74,C75,C76,C77,C78,C79,C80, C81,C82,C83,C84,C85,C86,C87,C88,C105,C106,C107, C108	C324C104M5U5CA	73.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206087 DESCRIPTION: ASSY COMP MRC1620 I/O EXTND ST
ENG. 20D3051-2 R: B

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.		QUANTITY PER	UM
4540274	RES SIP 3.3K 1/4W 5% 8P/4R RN2,RN4,RN6,RN8,RN9,RN11,RN13,RN15	4608X-102-332		8.000	EA
4540332	RES SIP 20K 1/4W 5% 8P/4R RN1,RN3,RN5,RN7,RN10,RN12,RN14,RN16	4608X-102-203		8.000	EA
4570144	RES 1/4W 5% CF 100 OHM AXL R1,R2,R3,R4,R5,R6,R7,R8	06A1016		8.000	EA
600-10114-01	SCHEM LOCAL TEST SET MRC-2	91A7534	R: 1	.000	EA
600-10199-01	SCHEM MRC-1620LP EXTERNAL I/O	91D7465	R: B	.000	EA
603-10146-01	PROCESS SPEC ASSY MARKING/LBL	PS-3002	R: 2	.000	EA
603-10149-01	PROCESS SPEC ASSEMBLY STANDARD	PS-3001	R: 2	.000	EA
9999897	REV ECO# DATE COMMENTS B 5307 06/21/94 DRAWING CHANGES ONLY			.000	EA

MOSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
SANTA BARBARA, CA 93117-3093
(805) 968-9621

DATE: 11/15/95

PARENT ITEM: 9206202 DESCRIPTION: ASSY COMP MRC16X0 RS-232 I/O
ENG. 20C3074 R: 1

COMPONENT ITEM NO.	COMPONENT DESCRIPTION AND COMMENTS	ENG. DRAWING NO.	QUANTITY PER	UM
3110582	CONN F 44 PIN STRAIGHT PC MTG J4	66353-022	1.000	EA
3190089	SW DIP 8 POSITION SEALED S1,S2	76SB08S	2.000	EA
3474749	PCB MRC16X0 RS-232 I/O	31C6139 R: 1	1.000	EA
3680311	IC RS-232 4-DRV 4-RX U1	MAX236CNG	1.000	EA
4280053	CAP TANT LS .125 4.7/35V 10% C2,C5	TAP475K035GSB	2.000	EA
4280079	CAP TANT LS .125 10/20V 20% C1,C4	TAP106M020GSB	2.000	EA
4310264	CAP CER .1/50V Z5U 20% T&R C3	C324C104M5U5CA	1.000	EA