

KUHC - Control Room
Manual



MOSELEY ASSOCIATES, INC.

Warranty

All equipment designed and manufactured by Moseley Associates, Inc. is warranted against defects in workmanship and material that develop under normal use within a period of one (1) year, or (2) years for all MRC series equipment, from the date of original shipment, and is also warranted to meet any specifications represented in writing by Moseley Associates, Inc., so long as the purchaser is not in default under his contract of purchase and subject to the following additional conditions and limitations:

1. The sole responsibility of Moseley Associates, Inc. for any equipment not conforming to this Warranty shall be, at its option:

A. To repair or replace such equipment or otherwise cause it to meet the represented specifications either at the purchaser's installation or upon the return thereof f.o.b. Goleta, California, as directed by Moseley Associates, Inc.; or

B. To accept the return thereof f.o.b. Goleta, California, credit the purchaser's account for the unpaid portion, if any, of the purchase price, and refund to the purchaser, without interest, any portion of the purchase price theretofore paid; or

C. To demonstrate that the equipment has no defect in workmanship or material and that it meets the represented specifications, in which event all expenses reasonably incurred by Moseley Associates, Inc., in so demonstrating, including but not limited to costs of travel to and from the purchaser's installation, and subsistence, shall be paid by purchaser to Moseley Associates, Inc.

2. In case of any equipment thought to be defective, the purchaser shall promptly notify Moseley Associates, Inc., in writing, giving full particulars as to the defects. Upon receipt of such notice, Moseley Associates, Inc. will give instructions respecting the shipment of the equipment, or such other manner as it elects to service this Warranty as above provided.

3. This Warranty extends only to the original purchaser and is not assignable or transferable, does not extend to any shipment which has been subjected to abuse, misuse, physical damage, alteration, operation under improper conditions or improper installation, use or maintenance, and does not extend to equipment or parts not manufactured by Moseley Associates, Inc. and such equipment and parts are subject to only adjustments as are available from the manufacturer thereof.

4. No other warranties, express or implied, shall be applicable to any equipment sold by Moseley Associates, Inc. and no representative or other person is authorized by Moseley Associates, Inc. to assume for it any liability or obligation with respect to the condition or performance of any equipment sold by it, except as provided in this Warranty. This Warranty provides for the sole right and remedy of the purchaser and Moseley Associates, Inc. shall in no event have any liability for consequential damages or for loss, damage or expense directly or indirectly arising from the use of equipment purchased from Moseley Associates, Inc.



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CUSTOMER SERVICE
INFORMATION

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

PRODUCTS COVERED BY WARRANTY/SERVICE AGREEMENT

Telephone Consultation

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

- A. Model Number and Serial Number of unit,
- B. Shipment date or date of purchase of Extended Service Agreement,
- C. Module identification markings,
- D. Be prepared to accurately describe the problems with your unit:
Constant or intermittent? Precise symptoms? Meter readings?
Operational frequency of unit?

Once you are prepared with this information, 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 to Friday). Please do not get upset 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 understand that telephone calls should be kept as short as possible - ultimately our costs in tying up a Technical Service Representative for unnecessary periods of time must result in higher charges on our Service Agreements. It is better to listen to explanations/suggestions/procedures and to call back if you are continuing to experience problems.

If telephone assistance is required, our telephone number is:

(805)968-9621

Emergency (Only) Telephone Consultation

The above number applies to both normal working hours and to emergency out-of-hours 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.

This service is for emergencies only. Please do not expect our Representative to know the status of your order, to take spare parts orders and the like.

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.

PRODUCTS OUT OF WARRANTY/NOT COVERED BY A SERVICE AGREEMENT

Telephone Consultation

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

- A. Model Number and Serial Number of unit,
- B. Module identification markings,
- C. Be prepared to accurately describe the problems with your unit: Constant or intermittent? Precise symptoms? Meter readings? Operational frequency of unit?
- D. The number of your account and name that account is under (parent organization or whatever) OR major credit card details.

The latter is, unfortunately, necessary because the costs of consultation on an older unit - for which a customer has not purchased an Extended Service Agreement - are enormous; we are happy to provide about fifteen minutes of totally free telephone consultation - and the majority of problems can be solved in that time. Beyond that, we are forced to charge - and we do that at our current hourly rate - in quarter-hour units of time.

Once you are prepared with this information, 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 to Friday). Please do not get upset if the particular Representative you should talk to is busy. Leave your name, call letters, equipment type and telephone number(s)

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GENERAL

Replacement Modules

Moseley Associates encourages the purchase of recommended spare parts kits to allow the customer to be totally self-sufficient with regard to parts. We recognize that there are extenuating circumstances when troubleshooting to the component level is neither practical nor possible. If this is the case, replacement module exchange may be the most expedient way of correcting the problem. Each product manual lists recommended spares.

Non-frequency sensitive 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, please 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 the 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 plug in the new one in the same direction. These devices are installed

one way only. Plugging in a new device backward may damage the newly-installed component or the surrounding circuitry. ICs occasionally exhibit temperature-sensitive characteristics. If a suspicious device operates intermittently or appears to drift, Freeze Mist may aid in diagnosing the problem.

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

Use a 40 W 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 the solder, solder-sipping braid, such as solder wick, is very useful. Once the solder has been removed, remove 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 40 W 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. Then remove all residual flux with either flux cleaner or a cotton swab moistened with flux cleaner.

Factory Service

When returning your equipment to Moseley Associates, Inc., the following suggestions are offered to assist you. If you are returning a module, ensure that the module is packed sufficiently 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 should also 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 Authorization Number that you had 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 the survival of the equipment in 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 to the following:

MOSELEY ASSOCIATES, INC.
Attn: Technical Services Dept.
111 Castilian Drive
Goleta, California 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.

WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. This equipment complies with the requirements in Part 15 of FCC Rules for a Class A computing device. Operation of this equipment in a residential area may cause unacceptable interference to radio and TV reception requiring the operator to take whatever steps are necessary to correct the interference.

INSTRUCTION MANUAL

MODEL MRC-1 MICROPROCESSOR
REMOTE CONTROL SYSTEM

REMOTE TERMINAL



MOSELEY ASSOCIATES, INC.
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ii.	Subcarrier Interface	
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1.0 SYSTEM INTRODUCTION

1.1 INTRODUCTION

The MRC-1 Microprocessor Remote Control System is a modular solid-state microprocessor-based system designed to meet the needs of the broadcaster to obtain remote indications of analog and status information, and to provide remote control of his equipment.

The MRC-1 consolidates, into one convenient package, all the features of existing moderately-priced remote control systems that require numerous auxiliary devices to function as a system in addition to many features normally found in large-scale remote control systems. The many features incorporated into the MRC-1 are made possible through the use of a microprocessor as the main control and logic element of each Remote and Control Terminal.

The flexibility of the microprocessor has also led to some changes in the terminology that is used to describe the functions performed by the MRC-1 and the way it is connected as a system. It is highly recommended that personnel installing an MRC-1 for the first time completely read and understand the manual before attempting to connect the MRC-1 to the user's equipment. There are two separate manuals for a complete MRC-1 system. One manual is for the Control Terminal; the second manual for the Remote Terminal.

1.1.1 Manual Organization

This manual has been designed to guide the user through the many features of the MRC-1 in a logical manner. Following the system specifications and unpacking instructions, Section 4 defines the operation of the Remote and Control Terminals. Once the operation of the system is mastered, Section 5 describes how to connect the MRC-1 to equipment being monitored and controlled. Section 6 defines the adjustment and calibration of the unit. Section 7 is a guide to maintenance of equipment should any difficulties be encountered. Section 8 contains circuit card descriptions, schematics and illustrations organized by type of circuit card. The last section will contain data for any options that were ordered as a part of the system. Should options be ordered at some future time, the option data may be appended to this manual by the user.

1.1.2 Technician Safety

The compact and modular design of the MRC-1, with convenient access to all modules and wiring, dictates that, from a safety standpoint, no lethal voltages be accidentally accessible to the technician. With the exception of the AC mains, which are made difficult to access, all internal voltages are less than 15 volts in magnitude. The user-applied voltages are limited to a maximum of 48 volts at any terminal (generally less) so that, when performing normal maintenance on the equipment, no lethal voltages are present inside the chassis. All high-voltage power switching and control must be performed indirectly by equipment external to the MRC-1.

1.2 SYSTEM OVERVIEW

An MRC-1 system consists of a Control Terminal and from one to nine Remote Terminals. Each Remote Terminal may access up to

32 status inputs (ON/OFF), 32 telemetry inputs (analog), and up to 64 command outputs (ON/OFF).

The Control Terminal communicates with each of the Remote Terminals over a single communications circuit that connects all locations. The communication circuit may be either 2-wire or 4-wire (or equivalent) telephone lines, STL subcarrier, aural SCA or private radio/ microwave links. Figure 1-1 is a typical illustration of the Control Terminal connected to several Remote Terminals.

In operation, one of the remote sites is selected for display at the Control Terminal. The value of each of the 32 status inputs is displayed on a set of 32 LED's. Calibrated analog values are digitally displayed one at a time. A CHANNEL SELECT key is used to display the desired channel.

The Remote Terminals perform seven (7) basic functions:

1. The remote keyboards are used to set up the system. When the system is installed, calibration data, alarm criteria, and so forth, are entered at each Remote Terminal keyboard. These may be changed from the remote keyboards during operation.
2. Once the system has been set up, the Remote Terminals process the incoming data according to the details of how the system was set up. The necessary computations for calibration, alarm checking, etc., are performed at the Remote Terminals.
3. The Remote Terminals process and transmit data, and turn ON and OFF the command output lines as instructed by the operator activating the Control Terminal.

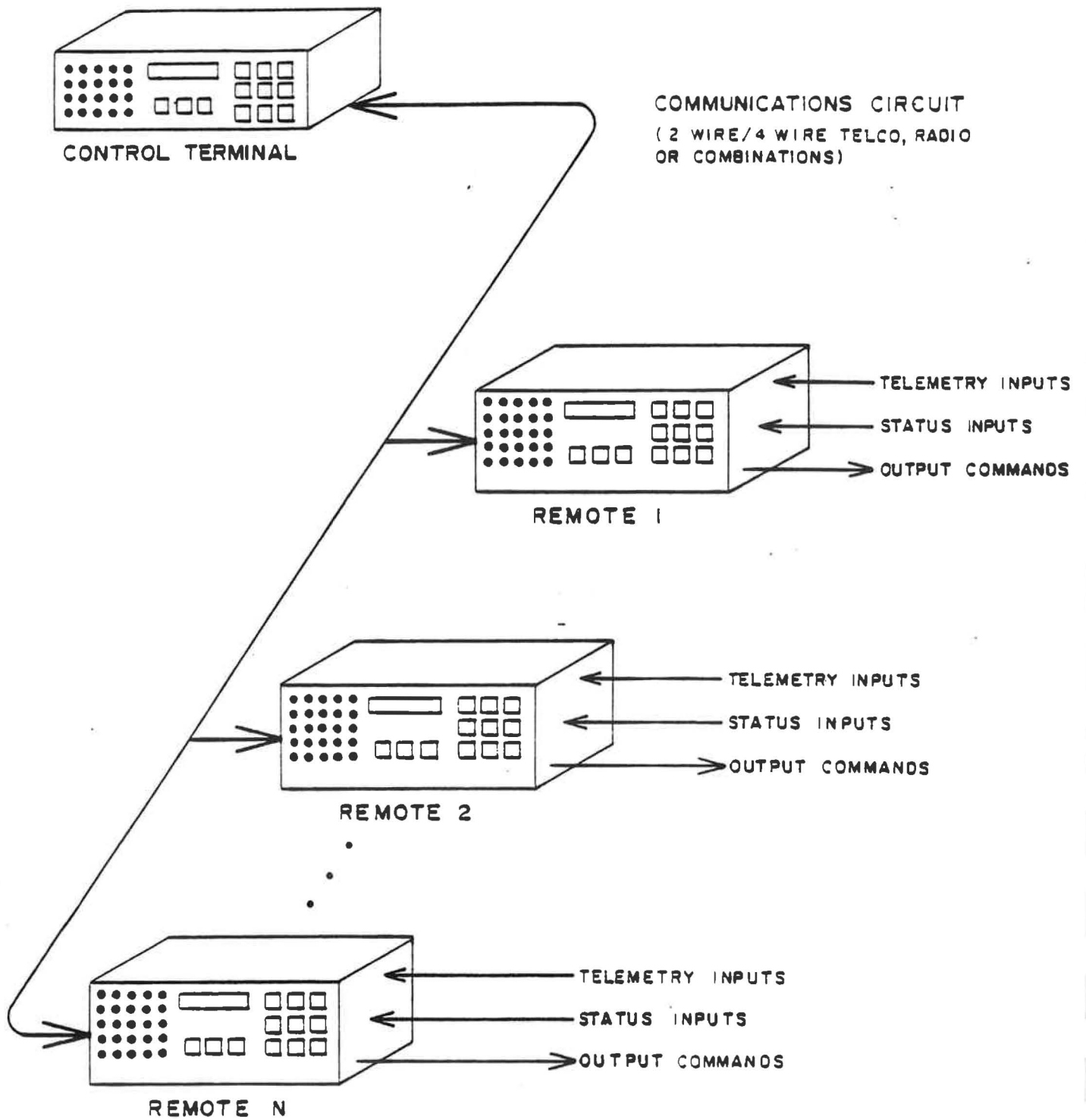


FIGURE I-1
 TYPICAL MRC-1 SYSTEM INTERCONNECT

4. The Remote Terminals check for alarms and notify the Control Terminal should an alarm condition be found.
5. If desired, a remote site may be operated directly from its own front panel, if it is placed in MAINTENANCE OVERRIDE mode.
6. The Remote Terminals provide a fail-safe output as required in broadcast applications.
7. The Remote Terminals continually monitor changes in their individual conditions (e.g., with temperature) and make slight adjustments in calibration calculations as required.

The Control Terminal is specialized to communicate with the various Remote Terminals, requesting display information and processing alarm reports as required. The Control Terminal prepares messages to the various Remote Terminals according to the actions of the user.

Much of the power of the MRC-1 is due to the flexibility available to the user in setting up the system. Specifically:

1. Telemetry (analog) channels may be calibrated in three ways:
 - a. Directly proportional to input level (linear calibration)
 - b. Proportional to the square of the input level (power calibration)
 - c. Proportional to the product of two telemetry (analog) inputs (indirect calibration)
2. Each of these calibrated telemetry (analog) channels may have an upper and lower limit. If these limits have been established, the input is sampled, adjusted

according to calibration, and compared against the limits. Any violation causes an alarm.

3. Each of the individual status inputs may be given attributes causing them to "latch" or be inverted before display. Each status input may be set up to trigger an alarm, either on rising edge or falling edge (or both).
4. Any command output may be assigned to either the RAISE or LOWER key for any specified channel. "Latching" command lines also may be specified, in which case, pushing RAISE turns the command output ON, and pushing LOWER turns it OFF.
5. Telemetry inputs may be assigned "Mute" status inputs. If the "Mute" status input is ON, the telemetry data is displayed and limit-checked normally. If the "Mute" status input is OFF, limit checking is suppressed.

2.0 SYSTEM SPECIFICATIONS

2.1 INTRODUCTION

The MRC-1, as a system, can accommodate a wide variety of options with regard to interfacing the system to the user's equipment. The specifications for each interface, in addition to system specifications, are detailed in this section.

2.2 SYSTEM SPECIFICATIONS

The following are general system specifications for the MRC-1:

Type of System	Microprocessor-based Control and Remote Terminals.
Number of Control Terminals Per System	One (1) Control Terminal active in a system at a time
Number of Remote Terminals	One (1) to nine (9) Remote Terminals in a system
Failsafe:	
Control	Complies with current FCC requirements for AM, FM and TV service. Responds 45 seconds after failure of interconnecting circuit.
Telemetry	Internal timers and monitors for FCC TV compliance
Output	N.C. transistor closure at 48V, 100 mA
Alarm Indications	Visual and aural. Aural alarm defeatable and remoteable.
Maintenance Override	Remote Terminal front-panel control provides Remote Terminal "GO HOME" transistor closure and Control Terminal indication. N.O. transistor at 48V, 100mA, isolated.

Interconnect

Interconnect Classes

2-wire, 4-wire, FM subcarrier, or combinations

2-Wire/4-Wire

Nominal 600 Ω balanced line. Series 3002 (unconditioned) data channel per Bell System Technical Reference PUB-41004. Two-way non-simultaneous. Nominal send level 0 dBm; receive level -30 dBm minimum

FM Subcarrier (Optimal)

Nominal levels 1.5V p-p at 2k Ω . Frequency range 26 kHz to 185 kHz

Modulation

Two-tone FSK; 1200 Hz idle, 2200 Hz mark frequencies

Data Rate

1200 bits per second

Data Format

10 bits, 7-bit ASCII plus parity, start, stop bits

Data Checking

Parity by character, longitudinal redundancy check and fixed formats

Command Functions

Number of Command Lines

16, 32, 48 or 64 lines per Remote Terminal

Command Line Modes

Each line programmable by user for momentary or latching operation

Command Line Association

Each momentary programmed line is user-assignable to one or more telemetry channels. Each latching line is assignable to one telemetry channel.

Tally-Back

Front-panel LED indicators at Remote and Control Terminals

Response Time

250 ms, nominal

Status Functions

Number of Channels

16 or 32 channels per Remote Terminal

States	User-programmable for N.O./N.C. activating front-panel LED's
Attributes	Latching or Following Alarm on rising, falling, or both conditions (or no alarm)
Response Time	250 ms, nominal, per site, from status change at Remote Terminal to Control Terminal indication.
<u>Telemetry Functions</u>	
Number of Channels	16 or 32 channels per Remote Terminal
Calibration	Via keyboard at Remote Terminal in user-selected units of measure
Calibration Modes	Linear, power-to-linear, and indirect power calculation
Display	4 digits with decimal point and polarity sign for value and limits display
Alarms	Fully tolerance-alarmed for high and/or low limits
Muting	User-assignable status channel to cause alarm muting
Input Filtering	Digital two-pole filter
Display Response Time	500 ms, nominal, from request at Control Terminal
Self Check	A self-calibration cycle performed at approximately 4-second intervals
<u>Physical Specifications</u>	
Power:	
Standard Control	120/240 VAC 50/60 Hz, 50 watts, nominal
Remote & Expanded Control	120/240 VAC 50/60 Hz, 100 watts, nominal

Size:

Standard Control 13.3 cm H x 48.3 cm W x 38.1 cm D
(5.25" H x 19" W x 15" D)
Depth less connectors

Remote & Expanded Control 17.8 cm H x 48.3 cm W x 39.4 cm D
(7" H x 19" W x 15.5" D)
Depth less battery or connectors

Operating Temperature 0° - 50°C

2.3 ANALOG-TO-DIGITAL CONVERTER MODULE

The following specifications apply to the analog-to-digital (A/D) converter assembly supplied as a part of the system:

Channels 16 channels per module, 2 modules
(maximum) per Remote Terminal

Resolution One part in 1024

Inputs Double-ended ±3.5 volts nominal,
100k DC bridging

Maximum Input ±5.0 volts. Application of volt-
age above this level causes erratic
operation of one or more channels.
Damage level is ±40 volts.

Sample Interval A channel is sampled more than
twice a second, regardless of the
number of channels in the Remote
Terminal.

Overall Measurement Accuracy Better than 0.5%

2.4 TTL STATUS INPUT MODULE

The following specifications apply to the TTL Status Input Module supplied in the MRC-1 system:

Number of Channels 16 per module, 2 modules (maximum)
per Remote Terminal

Input Configuration	Low-power TTL with 10k pull-up to +5 volts DC
Voltage Reference	Chassis signal ground
Maximum Input Voltage	+5.5 volts DC
Minimum Input Voltage	0.0 volts
Logic High Level Input Voltage	Greater than 2.0 volts
Logic Low Level Input Voltage	Less than 0.8 volts
Short Circuit Output Current	Less than 1.0 ma

2.5 OPTICALLY-ISOLATED STATUS INPUT MODULE

The following specifications apply to the Optically-Isolated Status Input Module that can be interchanged with the TTL Status Module. Both module types may be mixed within a single Remote Terminal:

Number of Channels	16 per module, 2 modules (maximum) per Remote Terminal
Input Configuration	LED optical isolator
Voltage Reference	Two-terminal isolated from reference
Maximum Input Current	30 ma maximum through optical isolator, user-supplied current. User-changeable current limiting resistors
Maximum Voltage	±50 volts above chassis ground

2.6 OPEN COLLECTOR COMMAND OUTPUT MODULE

The Open Collector Command Output Module is supplied in an MRC-1 system for activating external devices:

Number of Outputs	16 command outputs per module, 4 modules (maximum) per Remote Terminal
Output Configuration	High current peripheral driver integrated circuit
Voltage Reference	Chassis signal ground
Maximum Voltage	48 volts DC, user-supplied
Maximum Current	250 ma, user-supplied
Voltage Drop (250 ma)	1.5 volts

2.7 OPTICALLY-ISOLATED COMMAND OUTPUT MODULE

The Optically-Isolated Command Output Module can be interchanged with the Open Collector Output Module for activating external devices:

Number of Outputs	16 command output per module; 4 modules (maximum) per Remote Terminal
Output Configuration	Optical isolator driving high- current Darlington
Voltage Reference	Two-terminal
Maximum Voltage	48 volts DC between terminals, user-supplied
Maximum Current	250 ma, user-supplied
Voltage Drop (250 ma)	1.5 volts

3.0 UNPACKING AND PRE-INSTALLATION CHECKOUT

3.1 UNPACKING

Upon removing the units from the shipping cartons, please inspect them carefully for internal and external damage that may have occurred during transit. Verify that all printed circuit cards are seated firmly in the mother boards. All cards are the same length and all should appear to be seated in the card cage to the same depth.

An instruction manual - Control Terminal or Remote Terminal - is shipped with each unit. There is some terminology that is used to describe the location of components on the PC boards within the card cages. The cards in a Standard Control Terminal are mounted horizontally (component side up) while those in a Remote Terminal or expanded Control Terminal are mounted vertically (component side to the right). The location of the components, i.e., LED's, test points, and switches are always given as if the cards were mounted vertically. The top edge of a card in a Standard Control Terminal is the left-hand edge; the bottom the right side.

Initial checkout of certain options, such as the LOGGER and POWER FAIL/MEMORY are covered in the documentation supplied with the option and presumes that the basic unit pre-installation checks have been performed. All units are checked out as a total system, as ordered.

The main purpose of pre-installation checkout is for the user to gain familiarity with the system while both the Control and

Remote Terminals are easily accessible and together on a bench at the same location. It is recommended that the user read the entire manual to understand the MRC-1 prior to attempting a hookup to his equipment. While the installation is relatively simple and straightforward, certain details of installation and operation, if overlooked, may cause what appear to be equipment failures.

3.2 POWER SUPPLY SHIPPING HOLDDOWN

A shipping screw is provided to hold down the power supply during transit. The screw is located on the left-hand side of the bottom chassis plate near the rear. Removal of the shipping screw prior to installation of the equipment into the rack will allow removal of the power supply assembly for servicing without removing the entire chassis from the rack.

CAUTION

WHENEVER THE UNIT IS SHIPPED, THE SHIPPING SCREW MUST BE INSTALLED AND SECURELY FASTENED. FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN PHYSICAL DAMAGE TO THE UNIT AND VOIDS ALL WARRANTIES IF SHIPPED WITHOUT THE SCREW.

The shipping screw should be saved and taping the screw to the chassis for any possible shipment is encouraged.

3.3 PRE-INSTALLATION CHECKOUT

The following procedures apply to checking the Control and Remote Terminals on a stand-alone basis upon receipt of the units.

1. Verify that the power line voltage selector and fuse are set for the line voltage to be applied to the unit. The voltage selector is located

at the left rear of the chassis. The units are shipped for 120 VAC operation, unless otherwise specified. The voltage selected can be observed on the PC card through the window in the AC power connector. To change the voltage, remove the power cord, slide the access window to the left, and with small needle-nose pliers, grasp and remove the PC card. Orient the card for proper operation - either 120 VAC or 220 VAC only - and firmly replace the PC card. Install the proper fuse for the applied voltage as indicated by the placard on the AC mains connector. Slide the window to the right and install the AC mains connector.

2. Install the backup battery, provided only with the Remote Terminal. Connect the plus terminal of the battery to the red terminal of the CPU I/O connector and the negative to the black terminal of the CPU I/O connector. Batteries are shipped disconnected to prevent complete discharging.
3. Open the front panel by turning the knurled screw on the right side of the panel counterclockwise until the fastener disconnects and the panel can be swung open.
4. Connect the AC power connector to the AC mains. Depress the "ACK" key on the Remote Terminal front panel in order to clear the "cold start" condition which occurs whenever the Remote Terminal is powered up after the contents of memory have been lost.
5. Observe that the three upper LEDs on the CPU board - the bottom slot of the card cage - are ON.

These three LED's monitor the +15, +5 and -15 volt power supplies and are illuminated when there is voltage present.

6. Depress the "Reset" switch on the CPU board. Observe that the single LED near the switch illuminates while the switch is depressed and, for a short period, after the switch is released.
7. Observe the top LED on the modem PC board. It should turn ON and OFF at a periodic rate indicating that the Control Terminal is attempting to communicate with Remote Terminals.
8. Depress the LAMP TEST key. All LED's and displays on the Terminal should illuminate. A second depression of the LAMP TEST key will restore all LED's and displays.
9. This concludes initial checkout. Note that after six seconds an alarm condition will be indicated at the Control Terminal by a flashing "DATA ERROR" LED because of the failure to communicate with a Remote Terminal."

3.4 PRE-INSTALLATION SYSTEM CHECKOUT

Follow the individual checkout procedures for the Control Terminal and each Remote Terminal supplied as part of a system.

The Remote and Control Terminals should be connected back-to-back to verify communications according to the type of communications board supplied.

A. Modem Telco Interface

When telephone lines are used for communication in both directions, this board will be supplied for the Remote and Control Terminals. Two modes of operation are possible; two-wire or four-wire. In the two-wire mode, one telephone pair carries both Remote and Control message transmissions. In the four-wire mode, the Remote and Control Terminal messages are transmitted on separate telephone pairs, giving slightly better noise immunity. Figure 3-1A shows two-wire interconnection techniques. Figure 3-1B shows four-wire interconnection.

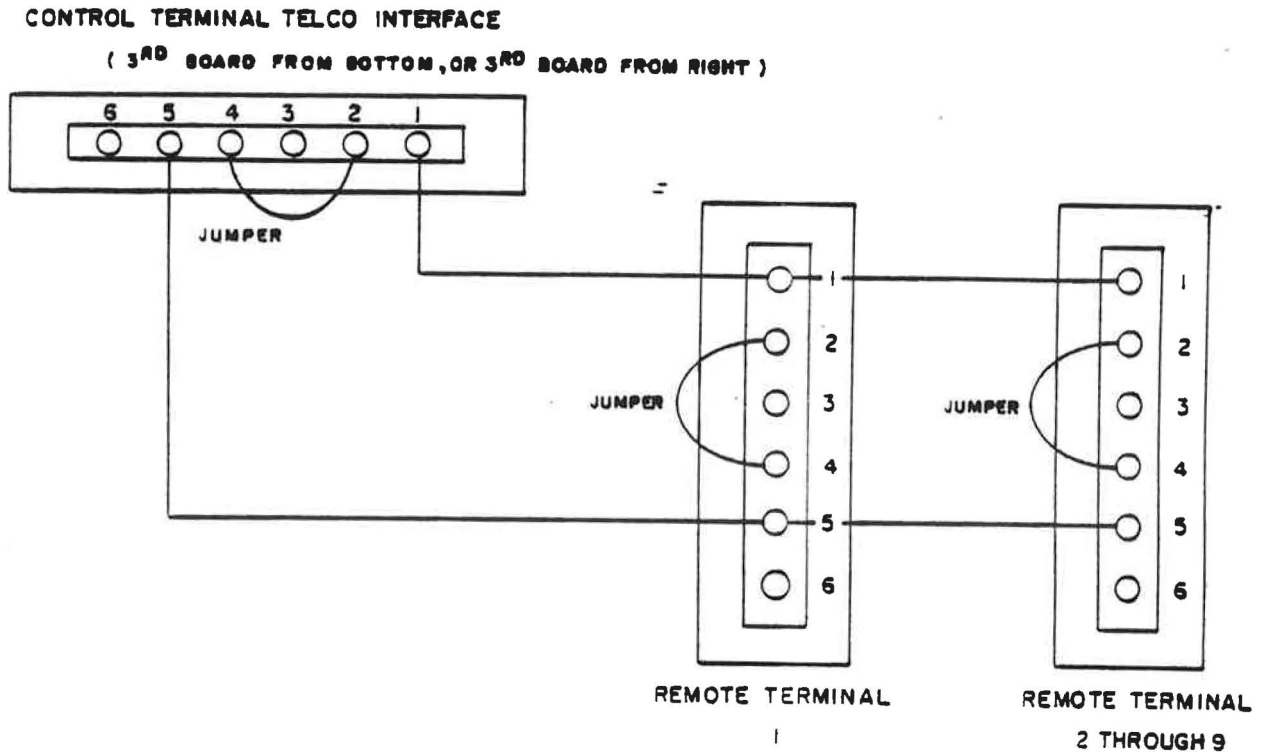


FIG. 3-1A
 TWO-WIRE TELEPHONE LINE INTERCONNECTIONS

CONTROL TERMINAL TELCO INTERFACE

(3RD BOARD FROM BOTTOM, OR 3RD BOARD FROM RIGHT)

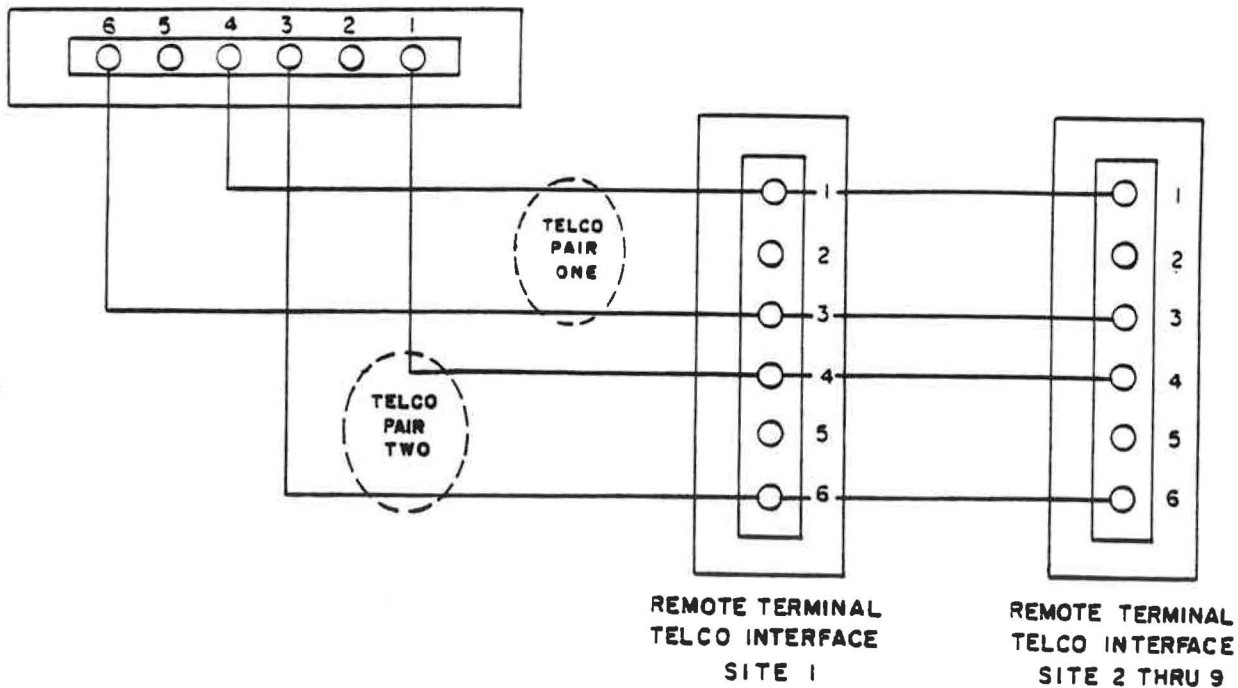


FIG 3-1B

FOUR-WIRE TELCO INTERFACE

After the units are interconnected, measure the output levels and modem input level and adjust, if necessary, as described in Section 6 of this manual. These levels should be checked again when the unit is installed at the final location. Adjusting these controls, taking into consideration actual telco line loss, will greatly improve communications reliability.

B. Subcarrier Interface

When FM subcarriers are used for data in both directions, this board will be supplied. Interconnection is quite simple. Using two BNC-to-BNC connector cables, interconnect units as shown in Fig. 3-2.

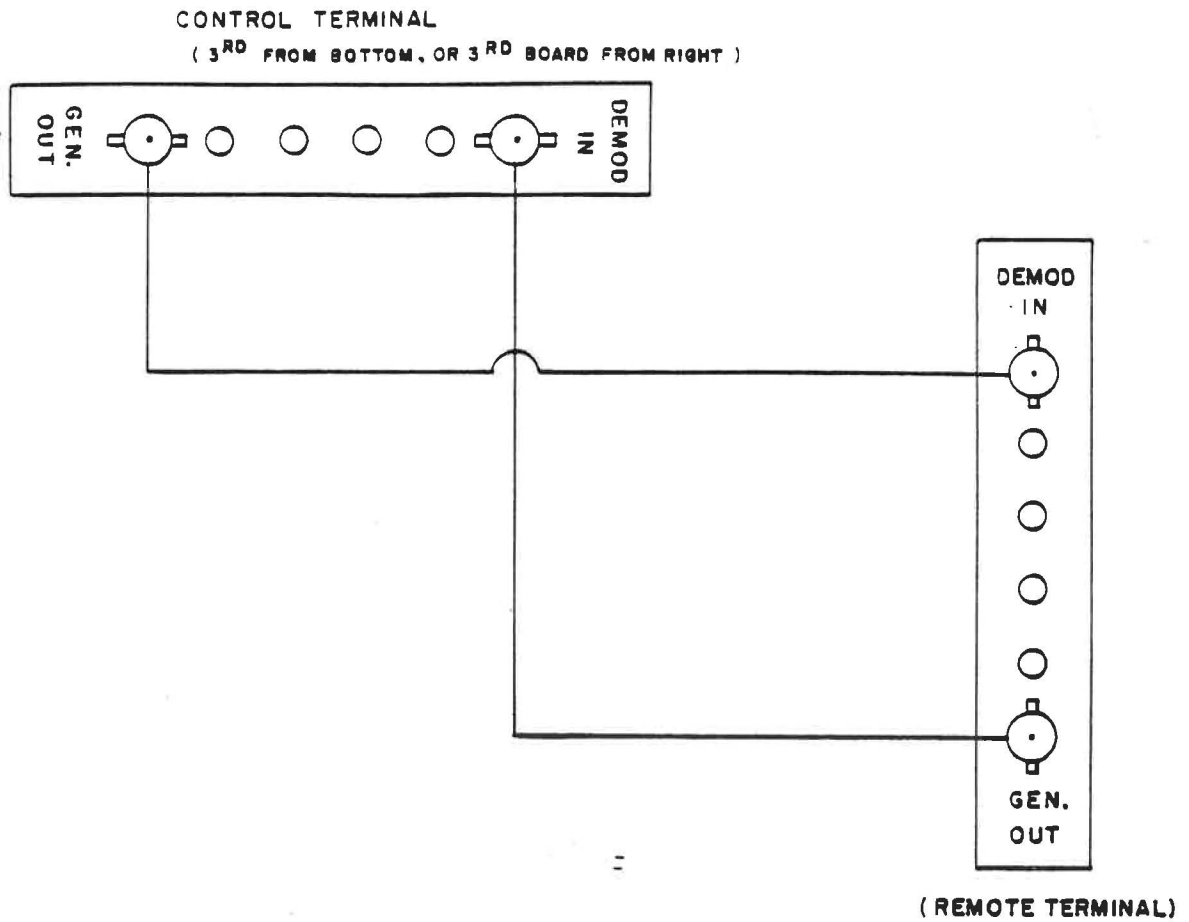


FIG. 3-2
DUAL SUBCARRIER COMMUNICATIONS

C. Subcarrier/Telco Interfaces

When one communication direction is on telephone lines and the other direction is on an FM subcarrier, a combination telephone/subcarrier board is used at each end. Interconnection is shown in Fig. 3-3.

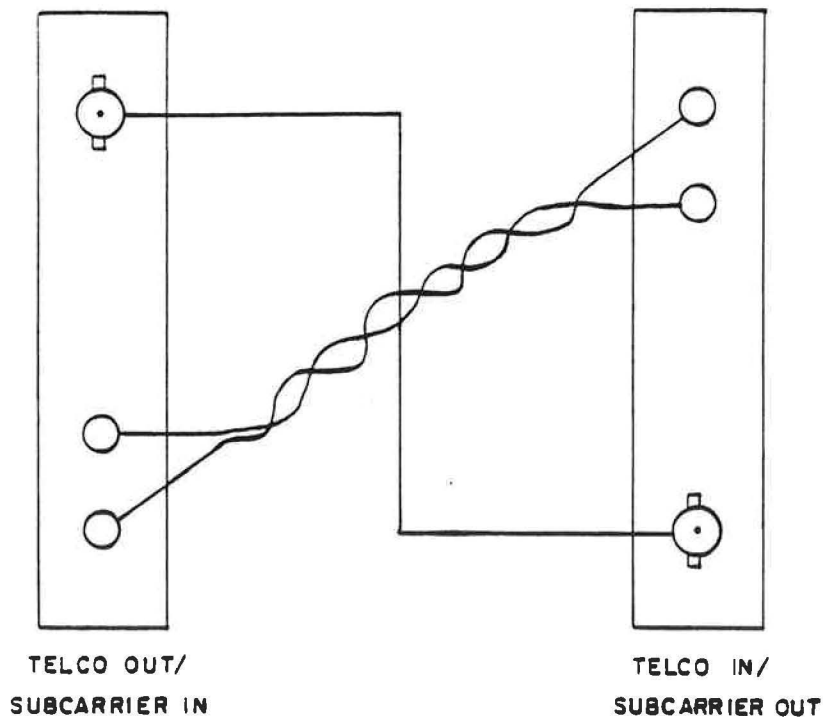


FIG. 3-3
TELCO / SUBCARRIER COMMUNICATIONS

The user may now connect test inputs to status and telemetry I/O interface and loads to control outputs as desired.

Referring to Section 4 of the Remote Terminal manual, telemetry channels that have inputs may be calibrated. Status channels (with or without input connections) may be programmed. Exercising the MAP function, the effect of commands to RAISE and LOWER may be observed.

In the event that any difficulty is encountered, review thoroughly Sections 4 through 7 to determine the cause of the difficulty. Refer especially to Section 8 for wireline modem or subcarrier modem adjustments.

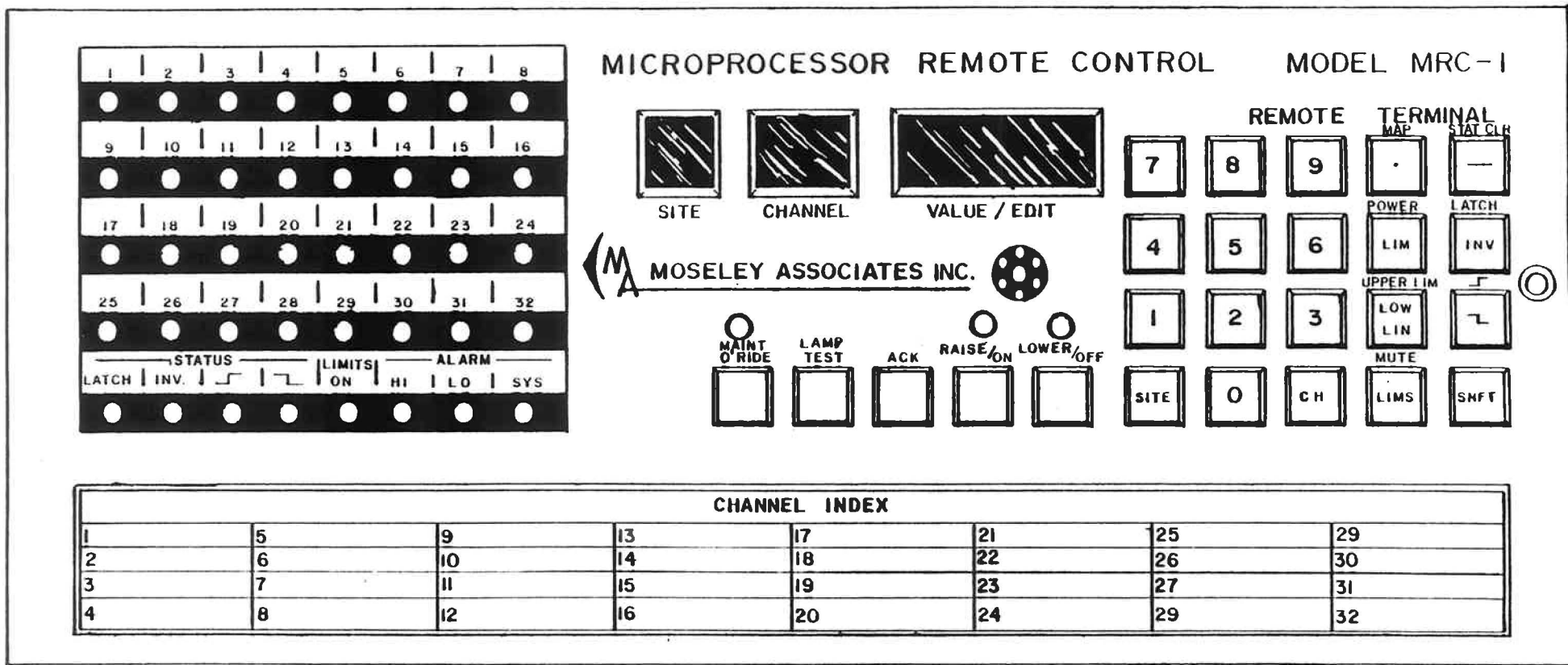


FIGURE 4-1

4.0 REMOTE TERMINAL OPERATION

4.1 INTRODUCTION

This section defines the operation of the Remote Terminal from the operator's view point. A detailed description of each key and its effect on the operation of the MRC-1 Remote Terminal is presented. Once familiarity is gained with the system, reference can be made to the last part of this section where a brief summary of the key operation is given.

4.1.1 Front-Panel Controls and Indications

Referring to an actual Remote Terminal or Figure 4.1, the front panel of the Remote Terminal contains the following.

A. Numeric Displays

1. Site (1 digit)
2. Channel (2 digits)
3. Value/Edit (4 digits + sign)


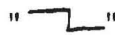
B. LED Displays

1. Status Indicators (32 LED's)
2. Status Attribute Indicators (4 LED's)
3. Alarm Indicators (3 LED's)
4. System Indicators (4 LED's)

C. Audible Alarm

D. Keyboard

1. Value Entry Keys
2. Shift Key
3. Function Keys
 - A. "CH"
 - B. "SITE"

- C. "LATCH", "INVERT", "", "", and "STAT CLR"
- D. "LIN" and "POWER"
- E. "HI LIM" and "LO LIM"
- F. "LIMS"
- G. "MAP", "RAISE", and "LOWER"
- H. "MUTE"
- I. "ACK" (ACKNOWLEDGE)
- J. "LAMP TEST"
- K. "MAINT O'RIDE"
- L. FAILSAFE FUNCTIONS

Each of these will be described in turn.

4.1.2 Numeric Displays

The numeric (7-segment) displays at the Remote Terminal provide the following indications under the condition described:

- A. SITE: The SITE display is a single-digit display indicating which site number has been assigned to a Remote Terminal. In an MRC-1 System which consists of a Control Terminal and one to nine Remote Terminals, each remote must be given a unique site number. If two remote terminals have the same site number, both will respond at once when the Control Terminal attempts to communicate with the duplicated site number, and neither will be able to send back data successfully. The site number is automatically assigned according to strapping on the front-panel printed circuit board, and may be changed by using the site key (described in Section 4.5.2).
- B. CHANNEL: The CHANNEL display is a two-digit display indicating which channel is selected. For example, if "01" appears in the channel display, Telemetry Channel 1 may be calibrated, assigned limits, assigned command outputs, raised, lowered, etc. If

Telemetry Channel 1 has already been calibrated, its current value will appear in the value-edit display.

- C. VALUE-EDIT: The VALUE-EDIT display consists of four digits plus sign. It serves two functions: To display values currently being entered in command key sequences, or if no command sequence is being entered the current value of the selected telemetry channel.

While a key sequence is being entered the numeric keys activated are displayed, with each new digit entered pushing previously entered digits to the left. If more than four digits are entered only the last four digits entered are significant, the remaining being lost. A decimal point in the left-most digit indicates that the shift key was activated. Entering a "-" sign as a part of the key sequence affects the sign portion of the display. At the end of a properly executed key sequence the user will see the results as described later in this section for each key sequence. Any error in the key sequence results in an "E" appearing in the display for two seconds whereupon the display returns to whatever was being displayed just prior to the key sequence.

When not displaying key sequences the value appearing in the display for the channel selected can have the following meanings:

1. If the channel is uncalibrated, the VALUE-EDIT display remains blank.
2. If the channel is in an overflow condition, a flashing "EEEE" will appear in the display. An overflow condition occurs when the telemetry (analog) value for the selected channel is too large to display as calibrated.

For example, if Telemetry Channel 1 is calibrated to display a value of "9000" for 2.0 volts applied, and 5.0 volts is then applied, the resulting value ("22500") will overflow

- the four digits available, and "EEEE" will be displayed.
3. If more than about 6 volts is applied, the selected telemetry channel may be in a saturated condition, i.e., the analog-to-digital converter is operating beyond the range where it is accurate. In this case, a flashing "----" will appear in the display.
 4. Otherwise, the current value of the telemetry channel as calibrated will be displayed.

4.1.3 LED Indications

There are four major groups of LED indications on the front panel to:



- A. Indicate the user's status conditions;
- B. Indicate how a selected status bit has been programmed;
- C. Indicate system details, and;
- D. To indicate system and tolerance alarms.

The functions of each group of LED indicators is as follows:

A. Status Indications

There are 32 red LED's displaying the current value of status channels 1-32. LED's are assigned to channels starting from upper left and proceeding across from left to right. Thus, the first row displays status channels 1-8; the second row displays 9-16; the third row 17-24; and the fourth row 25-32. An "ON" condition is displayed by a steadily lit LED, and an "OFF" condition by an unilluminated LED. If an alarm condition has occurred on a status channel and has not yet been acknowledged, the appropriate LED will flash at a 2 Hz rate. (Alarm conditions may be defined by the user; this and the procedure for acknowledgement will be described later.)

B. Status Programming

There are four green LED's indicating which attributes, if any, have been assigned to the selected status channel. The LED's are labeled "LATCH", "INVERT", " " (Rising edge alarm), and " " (Falling edge alarm). These attributes are selected and removed via key commands described in later paragraphs of this manual. The specific status bit selected and programming displayed in these LED's is indicated by the channel display.

C. System Details

There are four yellow LED's which indicates various details of the status of the system:

- A. The "RAISE/ON" and "LOWER/OFF" LED's show the status of the user-assigned command outputs. If the command channels have been established as momentary in operation, each LED is lit if the assigned command output is "ON" and not lit if the command output is "OFF". For example, suppose channel 12 has been selected for display, with command output 3 established as the raise output, and command output 8 established as the lower output. Then the "RAISE/ON" LED will reflect the status of command output 3 and the "LOWER/OFF" LED that of command output 8. If a command output of latching type has been established instead, then the "RAISE/ON" light indicates that the command output is "ON" and the "LOWER/OFF" LED indicates that the channel is "OFF".
- B. The LED labeled "LIMITS ON/OFF" is lit if limit checking is enabled.
- C. The yellow LED positioned over the key labeled "MAINT O'RIDE" indicates whether the terminal is in maintenance

override status; the LED is illuminated if so. If the system is in Maintenance Override status, RAISE or LOWER commands issued from the Control Terminal will be ignored, and any failsafe condition will be terminated. If the system is not in Maintenance Override status, RAISE or LOWER command issued from the Remote Terminal keyboard will be ignored.

D. Tolerance Alarms

There are three red LED's which are used to indicate alarm conditions. Two of these, labeled "HI" and "LOW", are used to describe the current condition of the selected telemetry channel with respect to its limits. For example, if Channel 7 is being displayed and the current value of that channel, as calibrated, exceeds its upper limit, the "HI" LED will be lit (and flashing at 2 Hz if the alarm has not been acknowledged by pushing the "ACK" key). This, of course, is only if limit checking has been enabled.

Additionally, the LED labeled "SYS" describes the condition of the analog-to-digital conversion hardware. Each Remote Terminal, at approximately 4-second intervals, makes internal tests of various conditions, including the gain-reference and offset voltages. If any of these violate factory-set tolerances, the "SYS" LED is illuminated until the violation of tolerance ends.

4.1.4 Audible Alarm

Each front panel in an MRC-1 system is equipped with an audible alarm. The alarm will sound only if it is enabled via the rear-panel socket. At Remote Terminals, the alarm is used for two functions:

1. In case of a power failure where memory has not been preserved (or when starting the system for the first time), the alarm sounds to indicate the necessity to recalibrate



telemetry channels, re-assign attributes, re-enter limits, etc. (I.E., the user must reinitialize the terminal.) Pushing the Acknowledge key turns off the alarm and begins normal operation. Note that, even if the alarm is not enabled via the rear-panel socket, "ACK" must be pushed to begin normal operation.

2. If an unacknowledged alarm condition is found, the audible alarm indicates the presence of the alarm.

4.2 KEYBOARD INTRODUCTION

The MRC-1 Remote Terminal front panel has 20 keys, each with a function. A shift key is used to enable 11 additional functions. Operations on the front panel keyboard are quite similar to operations on a calculator.

The following abbreviations appear on the Remote Terminal keyboard:

<u>Abbreviation</u>	<u>Meaning</u>
STAT CLR	Status Clear
LIN	Calibrate - Linear
INV	Invert
HI LIM	Upper Limit
LO LIM	Lower Limit
	Rising Edge Alarm
	Falling Edge Alarm
LIMS	Limits On/Off
SHFT	Shift
ACK	Acknowledge
MAINT O'RIDE	Maintenance Override

The MRC-1 is controlled by means of key sequences. If an erroneous or meaningless key sequence is entered, an "E" appears in the value/edit display for 2 seconds.

Examples of this:

1. "SHFT 9"

Undefined - Causes "E"

2. "LIN"

Attempt to calibrate telemetry channel without entering a value.

3. "1 Ø Ø Ø LIN"

This is normally valid, but results in an "E" if an insufficient level is applied to the telemetry input at calibration time.

4.3 VALUE ENTRY KEYS

The value entry keys are the numeric keys 0-9, the decimal point key ("."), and the minus sign key ("-"). Some MRC-1 functions, for example, calibrating telemetry channels, demand a value. Entry of values is made possible by the numeric, sign, and point keys. If a function requires a value, the value is entered before the function key is pushed. For example, to calibrate a telemetry channel at 1000 in linear mode, push:

1 Ø Ø Ø LIN"

As the value is entered, it appears in the value/edit display. If a mistake is made, the value entered may be cleared by pushing the acknowledge ("ACK") Key. When "ACK" is pushed, or the sequence is

complete, the value/edit display returns to indicating the value or status of the selected telemetry channel as calibrated.

The sign key may be pushed at any time up to the final function key; for instance:

"- 1 0 0 0 LIN" and "1 0 0 0 - LIN"

have the same effect, both calibrating the selected telemetry channel in linear mode at -1000.

Decimal points are entered by pushing "." at the proper point in the key sequence, for instance:

"1 0 . 0 0 - LIN"

calibrates the selected telemetry channel in linear mode at -10.00.

If more than four number keys are pushed, only the last four will be used. The excess number keys are shifted off the left end of the value/edit display and are lost as new keys are pushed.

For example:

"- 1 2 3 . 4 1 0 . 0 0 LIN"

has the same effect as the example immediately preceding. Note that the sign is preserved during the entry.

4.4 SHIFT KEY

The shift key (at the lower right of the keypad) chooses the set of functions engraved on the metal part of the front panel rather than those inscribed on the keytops. The shift action is "Push-On/Push-Off" in nature, each push of the shift key reversing the set of functions selected.

The value/edit display visually indicates the presence or absence of a shift in a command line by a dot (similar in appearance to a

decimal point) at the far left end, to the left of the sign position.

Example to illustrate use of shift key:

"1 0 0 0 SHFT LIN"

calibrates the selected telemetry channel at 1000 in power mode, since "POWER" is engraved on the front panel above the "LIN" key. (This will henceforth be shown in the manual as:

"1 0 0 0 SHFT POWER"

using the name of the actual function selected to avoid confusion.)

As further example:

"1 0 0 0 SHFT SHFT LIN"

calibrates in linear mode since the first push of the shift key selects the "UPPER CASE" power function and the second push reselects the "LOWER CASE" linear calibrate function.

4.5 FUNCTION KEYS

Function keys are always the last keystroke in a key sequence - the effect of the key sequence takes place immediately when a function key is pushed. The various remote terminal functions that are performed by each function key is defined below.

4.5.1 "CH" Channel Key

The "CH" (Channel) key is used to change the selected channel. For example, entering:

"1 7 CH"

Makes 17 the selected channel. "17" will appear in the channel display, and if analog input 17 has been calibrated its current value

will appear in the value/edit window. Status Channel 17 may have its latch, invert, or alarm attributes changed. Where applicable, all key sequences will apply to Channel 17.

Pushing the "CH" key with no preceding value will advance the channel by one. Continuing the above example, if we then enter:

"CH"

we will advance to Channel 18. If the selected channel is 32 entering:

"CH"

will make 1 the selected channel.

4.5.2 SITE Key



The "SITE" key is used to assign a different site number to the remote terminal than the one set at the factory or programmed at the rear of the front panel. For example, entering:

"8 SITE"

will make the remote terminal respond as Site 8 rather than its factory-assigned site number. The control terminal will then select this terminal when Site 8 is selected for display. It should be stressed that each remote terminal should have a different site number. If there are two terminals set to the same site number, the system cannot operate.


In the event of a power failure where memory has not been preserved, the remote terminal will, of course, be re-initialized to its factory-assigned site number, regardless of previous use of the site key.




4.5.3 Latch, Invert, , Keys

The "LATCH", "INVERT", "" (Falling Edge Alarm), and "" (Rising Edge Alarm) functions are used to assign and remove attributes for selected status channels. Each of these functions is Push-On/Push-Off in nature. The first time the function is invoked the attribute is added, the second time it is removed, etc. The current status of each of these attributes for the selected channel is displayed on the corresponding green status LED's. For each of these functions, the status channel affected is the channel selected for display (as shown in the channel window).

The invert attribute reverses the external value applied to a status channel before it is displayed. If the external state of status Channel 1 is "OFF" and Channel 1 is assigned an invert attribute, the LED corresponding to status Channel 1 will be lit.

The latch attribute causes a status channel to remain in the "ON" condition after a rising edge (after inversion if applicable) is detected. Subsequent edges are disregarded. The status-clear function returns all latched channels to the "OFF" state until the next rising edge. Alarms and muting are invoked on the basis of status value as modified by latch and inversion.

The "" (Falling Edge Alarm) attribute causes an alarm to occur if a falling edge is detected. Alarms are more fully described in the section describing the "ACKNOWLEDGE" function.

The "" (Rising Edge Alarm) attribute causes an alarm to occur if a rising edge is detected. Note that if a channel has both "" and "" attributes, any edge at all will trigger an alarm.

Examples:

"INV"

reverses the current status of the invert attribute for the selected channel.

"SHFT LATCH"

reverses the latch attribute.

"

reverses the "" attribute.

"SHFT 

reverses the "" attribute.

"SHFT STAT CLR"

releases all latched status channel to the "OFF" state.

Numerical values preceding the function keys in these cases are meaningless, and such key sequences are rejected with an "E". For example:

"1 INV"

does not invert status Channel 1, but rather results in "E" being displayed for two seconds. If Channel 1 is to be inverted, Channel 1 should first be selected using the "CH"key.

4.5.4 "LIN", "POWER" Keys

The "LIN" (linear-calibration) and "POWER" functions are used to calibrate the selected telemetry channel. Linear calibration implies that a change in the external value results in a directly proportional change in the display. For example, if 3 volts are applied to telemetry input 1, and 1 is the selected channel, and

"1 0 0 LIN"

is entered, whenever 3 volts is again applied, "100" will be displayed. If 1.5 volt is applied, "50" will be displayed, etc.

Power calibration is similar to linear calibration, but the change in displayed value changes as the square of the change in applied value. If 3 volts are applied as before, and

"1 0 0 SHFT POWER"

is entered, whenever 3 volts are applied, "100" will be displayed, just as above. But if 1.5 volt is applied, since the applied value has been halved (multiplied X .5), "25" is displayed (since the square of .5 is .25). Similarly, if 6 volts are applied, "400" is displayed.

"INDIRECT METHOD" calibration is also possible, by the convention of entering a negative initial value and choosing power calibration. (A negative number cannot be displayed in a power calibrated channel since no real number may be squared with the result a negative number.) "INDIRECT METHOD" calibration displays a result proportional to the values of the two preceding telemetry channels. For example, if we apply 3 volts to telemetry input 1 and 2 volts to telemetry input 2 and then select Channel 3 for display, and then enter:

"- 1 0 0 . 0 SHFT POWER"

Channel 3 will then be calibrated in "INDIRECT METHOD" mode. Whenever the product of levels applied to Channels 1 and 2 equals 6, "100.0" will be displayed. If we then apply 1 volt to each channel, the product is one sixth of what it was at calibration time, and so one sixth of 100.0, or 16.7 is displayed.

It is good practice to calibrate telemetry inputs with as large as possible a value applied to the input. It is better to apply 5 volts and calibrate than to apply 1 volt and calibrate. This is because analog-to-digital converters return an integer number, proportional to the level applied. So lower levels cause numbers with fewer significant digits to be returned. The calculations for calibration of necessity have a larger percentage error at low values.

For this reason, the MRC-1 will not permit calibration to be made with less than about 256 millivolts applied to the telemetry input. This insures an acceptable level of accuracy. (Better, normally much better, than 0.5%.) An attempt to calibrate with an insufficiently large level results in "E" being displayed for 2 seconds.

4.5.5 LOW LIM, HI LIM Keys

Each telemetry channel may be assigned an upper limit and a lower limit. If limit checking has been enabled and the telemetry channel as calibrated is found to violate one of the limits, an alarm is initiated.

Examples:

"1 0 0 0 LOW LIM"

establishes 1000 as the lower limit for the selected channel.

"1 0 5 0 HI LIM"

establishes 1050 as the upper limit for the selected channel. The limits may be displayed by omitting to enter the value. Continuing the preceding example, pushing:

"LOW LIM"

will display "1000 for two seconds, and pushing

"SHFT HI LIM"

will display "1050 for two seconds.

Once established, limits may be removed by entering 0 as the limit.
Entering:

"0 LOW LIM"

will remove any lower limit established for the selected channel.
Similarly,

"0 SHFT HI LIM"

will remove any upper limit.

If no limit has been established, "0" will be displayed as the limit when a display is requested.

This means, of course, that it is impossible to enter a limit of exactly zero, because the system interprets a limit of zero as no limit at all. This can be circumvented by entering a limit very close to zero. For example, entering:

". 0 0 0 1 SHFT HI LIM"

makes a number very close to zero the upper limit, whereas entering:

"0 SHFT HI LIM"

will make a "HIGH LIMIT ALARM" on the selected channel impossible, and is equivalent to no limit at all.

4.5.6 LIMS Key

Limit checking is enabled and disabled via the "LIMS" key. This key operates in a push-on/push-off manner, the first push enabling

limit checking, and the next push disabling limit checking. The current status is indicated by the "LIMITS ON" LED.

4.5.7 MAP Key

The MRC-1 Remote Terminal may administer up to 64 command outputs. To use these, each command output must first be associated with a channel. This process is called "MAPPING", and is normally done when the system is set up. Once "MAPPED", command outputs are activated by pushing the "RAISE" or "LOWER" keys while the appropriate channel is selected.

For example, suppose we select Channel 10 and enter:

```
"1 SHFT MAP RAISE"
```

("MAP" is the upper case of the "." key.) Then henceforth, whenever we select Channel 10 and push "RAISE", command output line "1" will be activated for as long as the key is pushed.

Now suppose we enter:

```
"2 SHFT MAP LOWER"
```

Similarly, whenever we select Channel 10 and push lower, command output "2" will be activated. Each channel may have two command outputs "MAPPED" to it in this manner. The mapping is removed by entering "0" as the command output number. Entering:

```
"0 SHFT MAP RAISE"
```

will cause the "RAISE" key to have no effect. Likewise:

```
"0 SHFT MAP LOWER"
```

will cause the "LOWER" key to become undefined.

Mapping may be displayed as follows: Entering:

"SHFT MAP RAISE"

will display the number of the command output that is assigned to the raise key, and:

"SHFT MAP LOWER"

will display the number of the command output that is assigned to the lower key. In cases where no mapping has been established, "Ø" will be displayed.

Above, we described momentary operation where pushing the "RAISE" or "LOWER" key causes a command output to be activated but only for as long as the key is pushed. Another mode is possible: "LATCHING" operation. In latching operation, one command output is assigned to a channel; pushing the "RAISE" key activates the command output to the on condition, and pushing the "LOWER" key turns the command output off.

Latching channels are established by specifying the same command output as both "RAISE" and "LOWER" outputs. For example, if we select Channel 11 and enter:

"3 SHFT MAP RAISE"

followed immediately by

"3 SHFT MAP LOWER"

then the command output 3 will be established as a latching command output for Channel 11.

As the final keystroke ("LOWER") is entered, the LED over the lower key is lit to indicating the latching channel is off. Pushing "RAISE" will turn the channel on and light the LED over the "RAISE" key.

Latching command channels are removed by entering Ø, exactly as is done for momentary channels. So:

"Ø SHFT MAP RAISE"

followed immediately by:

"Ø SHFT MAP LOWER"

will turn off the latching command output and will cause the "RAISE" and "LOWER" keys for the selected channel to again be undefined.

The above text has described the procedure to assign a command output channel. Command outputs that are used in the momentary mode may be assigned to more than one channel. This is particularly advantageous when a single control function - say a final amplifier controller - affects several measured parameters - plate voltage, plate current, and measured power output. If these parameters were assigned to Channels 6, 7, and 8 respectively, and command output 4 connected to cause the power controller to increase, with command output 5 causing a decrease, then you can assign the command output 4 and 5 to each of the Channels 6, 7, and 8. To complete key sequence to accomplish this assignment is:

```
6   CH
4   SHIFT MAP RAISE
5   SHIFT MAP LOWER
CH
4   SHIFT MAP RAISE
5   SHIFT MAP LOWER
CH
4   SHIFT MAP RAISE
5   SHIFT MAP LOWER
```

Then, regardless of which of the three channels is selected for display of the telemetry value, activating the RAISE or LOWER keys will cause the power controller to function appropriately.

4.5.8 MUTE Key

The "MUTE" function is used to enable and disable limit checking on the individual telemetry channels, under the control of a status input. Suppose we select Channel 9 and enter:

```
"3  Ø  SHFT  MUTE"
```

then, Status Channel 3Ø will control limit checking on telemetry Channel 9. Whenever Status Channel 3Ø (after latching and inversion, if specified) is OFF, limit checking on telemetry Channel 9 will cease.

When Status Channel 3Ø LED goes ON again (after latching and inversion, if specified), limit checking resumes after a four-second delay.

In this manner, any telemetry channel may have any status input assigned to it as a mute channel.

A mute channel may be removed by entering Ø instead of a valid status channel number; i.e., entering:

```
"Ø  SHFT  MUTE"
```

will cause the selected channel to have its mute assignment removed.

Mute assignments may be displayed by entering:

```
"SHFT  MUTE"
```

If no mute assignment has been made for the selected channel, "Ø" will be displayed.

Note that it is possible to assign more than one telemetry channel to a single status input for muting purposes. All of the telemetry

channels for the main transmitter can be assigned to one status input that indicates the main transmitter is operational, and all telemetry channels for a backup transmitter assigned to a second status channel that indicates the backup transmitter is operational. Telemetry channel alarms will then only occur when the corresponding transmitter is operational. Depending upon how the status inputs are derived from the transmitter, you may want to have an alarm indicated by the change of state of the status channels themselves. I.E., it is possible through the use of the mute function and the manner in which the status used to operate the mute function to have a transmitter fail and no alarm indication. Because of the wide variety of transmitters in use, it is not possible to give specific details. The user must select his best method of incorporating this function.

4.5.9 ACK Key

The "ACK" (acknowledge) key is used to clear alarms. At the remote terminal, the following conditions cause alarms:

- o A status channel with "falling edge" attribute experiences a falling edge.
- o A status channel with "rising edge" attribute experiences a rising edge.
- o An analog channel violates its lower limit.
- o An analog channel violates its upper limit.
- o The fail-safe time-out period has been initiated.
- o The fail-safe time-out period has expired.

When an alarm occurs, the audible alarm sounds (if it has been enabled via the rear-panel socket) and the channel display flashes to indicate

the alarm. This will continue until "ACK" (acknowledge) is pushed.

Once "ACK" has been pushed, the system automatically selects the channel where the alarm condition was detected. (If several alarms have occurred, the channel where the first alarm occurred is selected.) The alarm-causing condition may now be observed on the indicator LED's as follows"

- o If a status alarm has occurred, the appropriate status LED will be flashing at 2 Hz.
- o If a telemetry input has gone below its upper limit, the "LOW" LED will be flashing at 2 Hz.
- o If a telemetry input has risen above its upper limit, the "HI" LED will be flashing at 2 Hz.

The second push of the "ACK" key clears the alarm, causing the flashing to end.

For example, suppose Channel 1Ø is selected when telemetry Channel 3 falls below its lower limit. First the audible alarm sounds if it has been enabled, and the channel display starts flashing to indicate the presence of the alarm. To examine the alarm, push "ACK". Then the sonalert is switched off and the system selects Channel 3. We see the "LOW ALARM" LED flashing at 2 Hz, indicating that the alarm arose because Channel 3 fell below its lower limit. Pushing "ACK" again causes "LOW ALARM" to cease flashing. If the low limit is still being violated, the LED will remain steadily on; if it has risen back within limits, the LED will go off.

Suppose a little later, status Channel 6, which has been given a falling edge alarm attribute, changes from "ON" to "OFF". Then the sonalert will again come on, and the channel display will again flash. After pushing "ACK", the audible alarm is switched off, the

system selects Channel 6, and the LED displaying Status Channel 6 may be observed flashing at 2 Hz. When "ACK" is pushed the second time, the flashing ceases.

To summarize, each alarm is cleared by pushing "ACK" twice. The first push turns off the audible alarm, changes channels, and displays the alarm condition via flashing lights. Acknowledged limit violations continue to be displayed via steadily-ON (not flashing) LED's, until the telemetry value has returned within limits (or limit checking is disabled, or mute status begins).

4.5.10 Lamp Test

The Lamp Test function tests the LED's and the seven-segment displays on the front panel. "LAMP TEST" is a push-on/push-off function - the first push begins the test; the second push ends it.

4.5.11 Maintenance Override

The Maintenance Override function is used to establish local control of the Remote Terminal. If the system is not in Maintenance Override mode, raise and lower commands from the Remote Terminal are disabled.

Conversely, if the system is in Maintenance Override mode, raise and lower commands from the Control Terminal are inhibited and any failsafe condition is discontinued.

Maintenance Override status is invoked and ended by the "MAINT O'RIDE" key. Current Maintenance Override status is indicated by the LED over the function key. If the system is in a Maintenance Override status, the LED will be lit.

4.6 FAILSAFE FUNCTIONS

MRC-1 Remote Terminals provide a "FAILSAFE" output as required in broadcast applications. The failsafe output is activated 45 seconds after signals from the Control Terminal cease ("CONTROL FAILSAFE"). The failsafe output is ended immediately on receipt of a valid message from the Control Terminal, or when maintenance override mode is entered.

In FCC television broadcasting applications, a second type of "FAILSAFE" output is required: If aural plate voltage, aural plate current, aural power output, or visual power output metering vanish for an one hour period, a failsafe output is required ("TELEMETRY FAILSAFE").

A telemetry failsafe is also required if the Remote Terminal is unable to communicate with the Control Terminal for an one hour period.

At the MRC-1 Remote Terminal, there is a single failsafe output which is activated for either or both types of failsafe.

"TELEMETRY" failsafe will occur only if certain key sequences activating it have been entered. These will be demonstrated by example:

Suppose Telemetry Input 13 is aural plate voltage, input 15 is aural plate current; input 17 is aural power output, and input 25 is visual power output. We may initiate failsafe monitoring of these four channels by the following four key sequences:

"1 3 SHFT 1"

This specifies that Telemetry Channel 13 shall be monitored as the first telemetry failsafe channel.

"1 5 SHFT 2"

This specifies that Telemetry Channel 15 shall be monitored as the second telemetry failsafe channel.

"1 7 SHFT 3"

This specifies that Telemetry Channel 17 shall be monitored as the third telemetry failsafe channel.

"2 5 SHFT 4"

This specifies that Telemetry Channel 25 shall be monitored as the fourth telemetry failsafe channel.

All four telemetry failsafe channels having been established, monitoring commences, and should less than about 256 mV be observed at any of the four specified telemetry inputs, the one-hour countdown will begin.

Telemetry failsafe channels may be removed and displayed in a manner exactly analogous to muting, limits or mapped command channels; therefore:

"Ø SHFT 1"

removes the first telemetry failsafe channel and ends failsafe monitoring. Similarly:

"Ø SHFT 2"

"Ø SHFT 3"

"Ø SHFT 4"

remove the other channels.

Entering "SHFT 1", "SHFT 2", "SHFT 3", "SHFT 4" will display those telemetry failsafe channels which have been established previously, or "Ø" if none has been established. If any or all of

the four telemetry failsafe channels have not been established, then telemetry failsafe is inhibited, and only control failsafe is possible.

Selecting "CHANNEL ZERO" will result in a display of the remaining time until failsafe in the VALUE-EDIT window, i.e., entering

"Ø CH"

will cause the remaining time to be displayed. This will, of course, normally be "6Ø", indicating that all is well. Should telemetry failsafe be inhibited, "CHANNEL ZERO" may not be selected; "E" will be displayed if this is attempted.



In the event of any kind of failsafe, all command outputs are inhibited. As described above, putting the terminal into Maintenance Override status ends all failsafe conditions and re-enables command outputs.

When Maintenance Override mode is ended, all timers are reset, so there is once again a 45-second wait until control failsafe and an one-hour wait until telemetry failsafe, regardless of past conditions at the Remote Terminal. In addition, should all four telemetry failsafe channels vanish, then telemetry failsafe is ended.

4.7 MRC-1 REMOTE REFERENCE DATA

The following is a condensed description of MRC-1 Remote Terminal key sequences and functions for quick reference purposes.

SELECT NEW CHANNEL:	X X CH
ADVANCE ONE CHANNEL:	CH
SELECT NEW SITE:	X SITE
INVERT/DEINVERT STATUS CHANNEL:	INV

LATCH/UNLATCH STATUS CHANNEL	SHFT LATCH
ADD/REMOVE FALLING EDGE ALARM	
ADD/REMOVE RISING EDGE ALARM	SHFT 
RELEASE ALL LATCHED CHANNELS	SHFT STAT CLR
CALIBRATE, LINEAR MODE	X X X X LIN
CALIBRATE, POWER MODE (Sign of X X X X must be positive)	X X X X SHFT POWER
CALIBRATE, INDIRECT MODE: (Sign of X X X X must be negative) Display will be proportional to product of two preceding channels. Channels 1 and 2 may not be calibrated in this mode.	- X X X X SHFT POWER
ESTABLISH LOWER LIMIT: (Point position of limit need not match point position of calibration)	X X X X LOW LIM
DISPLAY LOWER LIMIT	LOW LIM
REMOVE LOWER LIMIT	Ø LOW LIM
ESTABLISH UPPER LIMIT: (Point position of limit need not match point position of calibration)	X X X X SHFT UPPER LIM
DISPLAY UPPER LIMIT:	SHFT UPPER LIM
REMOVE UPPER LIMIT:	Ø SHFT UPPER LIM
ENABLE/DISABLE LIMIT CHECKING:	LIMS
ESTABLISH RAISE CHANNEL:	X X SHFT MAP RAISE
DISPLAY RAISE CHANNEL:	SHFT MAP RAISE
REMOVE RAISE CHANNEL:	Ø SHFT MAP RAISE
ESTABLISH LOWER CHANNEL:	X X SHFT MAP LOWER
DISPLAY LOWER CHANNEL:	SHFT MAP LOWER
REMOVE LOWER CHANNEL:	Ø SHFT MAP LOWER

ESTABLISH LATCHING COMMAND CHANNEL: (Where X X in both lines is the channel to be made latching)	X X SHFT MAP RAISE X X SHFT MAP LOWER
RAISE:	RAISE
LOWER:	LOWER
TURN ON LATCHING COMMAND CHANNEL:	RAISE
TURN OFF LATCHING COMMAND CHANNEL:	LOWER
ESTABLISH MUTE CHANNEL:	X X SHFT MUTE
<ul style="list-style-type: none"> A. Mute condition occurs when mute channel is "OFF" (after latch and invert, if applicable.) B. No limit checking during mute condition or for 4 seconds thereafter. 	
DISPLAY MUTE CHANNEL	SHFT MUTE
REMOVE MUTE CHANNEL:	Ø SHFT MUTE
ACKNOWLEDGE ALARM:	ACK ACK
<ul style="list-style-type: none"> A. First push displays channel number and condition, silences audible alarm. B. Second push ends flashing alarm indication. C. In the case of limit violations, steadily-on alarm indication will persist until: analog value is back in bounds; or, mute status begins; or, limit checking is disabled. 	
BEGIN LAMP TEST:	LAMP TEST
END LAMP TEST:	LAMP TEST
BEGIN MAINTENANCE OVERRIDE:	MAINT O'RIDE
<ul style="list-style-type: none"> A. Ends any failsafe condition. B. Inhibits any RAISE/LOWER commands from control end. 	
END MAINTENANCE OVERRIDE	MAINT O'RIDE
<ul style="list-style-type: none"> A. Resets failsafe timers. B. Inhibits commands from remote end. 	
ESTABLISH TM FAILSAFE CHANNEL N: (N=1 to 4)	X X SHFT N

Telemetry failsafe takes place if the analog value on any established telemetry failsafe channel remains below about 0.3 volts for 1 hour, or the Control Terminal fails to receive transmissions from the Remote Terminal for 1 hour. Telemetry failsafe ends if all four telemetry failsafe channels fall to zero.

DISPLAY TM FAILSAFE CHANNEL N: SHFT N

REMOVE TM FAILSAFE CHANNEL N: Ø SHFT N

MISCELLANEOUS:

Control failsafe takes place if a Remote Terminal receives no successful communications directed to it for 45 seconds.

Alarms are disabled for 1Ø seconds after reset.

CALIBRATION OVERFLOW DISPLAY: EEEE

A/D SATURATION DISPLAY (6144 COUNTS) ----

5.0 INSTALLATION

5.1 INTRODUCTION

The purpose of this section is to provide installation details for the MRC-1 Remote Terminal. It also provides other data should the user expand or otherwise modify the system in the future.

CAUTION

ALWAYS REMOVE POWER FROM THE TERMINAL AND DISCONNECT THE BATTERY WHENEVER PRINTED CIRCUIT MODULES ARE REMOVED OR REPLACED IN THE UNIT. FAILURE TO OBSERVE THIS CAUTION MAY CAUSE DAMAGE TO ONE OR MORE MODULES.

5.2 PHYSICAL INSTALLATION

The MRC-1 is designed for industry standard RTMA rack mounting. It is suggested that the Remote Terminal be mounted in the rack at approximately 65 inches height for best operation accessibility. With the power supply shipping screw removed, insert the terminal in the rack or cabinet and install 10/32 x 1" screws with fiber washers through the oval holes in the chassis flanges. Torque screws firmly to provide a secure mounting. Once installed in the rack, all assemblies that normally require service can be removed without removing the chassis from the rack. The extender board is stowed to the left of the power supply. The flat ribbon cable between the front panel and CPU card may have to be disconnected to remove the extender board. At this time, remove the extender board and store in another location at the Remote Terminal site in order to provide maximum ventilation to the Terminal.

5.3 PHONE LINE CONNECTION - 4-WIRE

If you are using a 4-wire interconnect service, the pair of wires

to the Control Terminal is connected to terminals 4 and 6 of the Modem Telco Interface card (third from right assembly at rear of unit). The pair from the Control Terminal is connected to terminals 1 and 3. Note that the Modem Telco Interface contains fuses mounted internal to the card. Should you suspect that, as a result of lightning strike, the phone lines have been hit, remove the two screws securing the Modem Telco Interface card and check and/or replace fuses, as required.

5.4 PHONE LINE CONNECTION - 2-WIRE

If you are using a two-wire interconnect arrangement, place a short jumper between terminals 2 and 4. Then, connect the telephone line to terminals 1 and 5 of the Modem Telco Interface card. See the preceding paragraph for lightning protection fuses.

5.5 FM SUBCARRIER INTERCONNECT

BNC connector J3 is the output of the Remote Terminal and is connected to the equipment over which the subcarrier signal will be transmitted. A BNC connector J2 is used for the subcarrier data being received from the Control Terminal. Note that the components of the subcarrier interface module are frequency dependent. Should your requirements for subcarrier frequencies change in the future, some changes in component values may be required. The component values for various bands of subcarrier frequencies are detailed in Section 8 for the subcarrier interface card, if ordered as part of the system.

5.6 MIXED COMMUNICATIONS

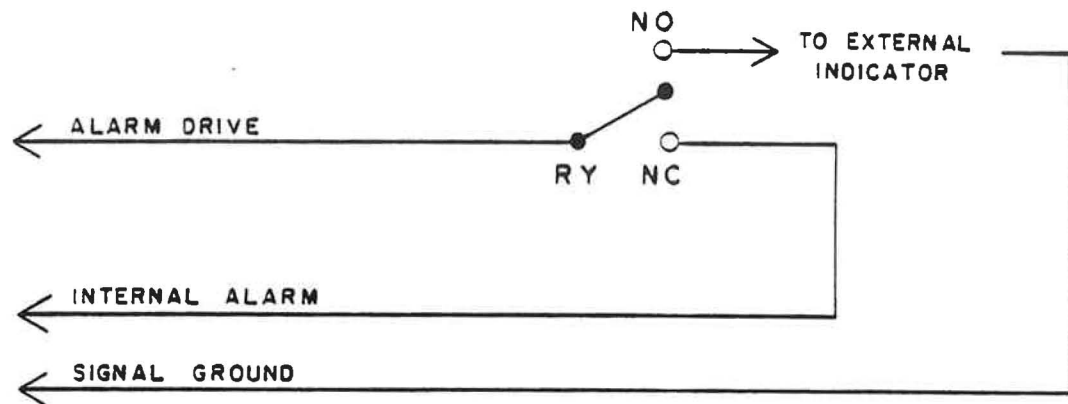
If the system is ordered with mixed communications functions; i.e., telco in/subcarrier out, or telco out/subcarrier in, the connection procedure is similar to that outlined for the previous methods

of communications link interconnection. The subcarrier function (either in or out, as appropriate) is a BNC connector while the telephone circuit is a terminal block connection.

5.7 AUDIBLE ALARM

The control of the audible alarm of the Remote Terminal is accessed through pins 5 and 6 of J1 on the CPU interface card (right module viewed from rear of chassis).

Several alternatives are available to the user. The simplest is to jumper pins 5 and 6 on the connector. In this case, the audible alarm will always be activated when an alarm condition is detected. In the event that the Remote Terminal is located in a studio booth, it is possible to have external control of the audible alarm so that it will be muted when a mike is active if those facilities are available in the studio. Figure 5.1 indicates a typical arrangement of muting the alarm when mikes are active.



RY IS NO WHEN MIKE IS ACTIVE.

RY IS NC WHEN NO MIKES ARE ACTIVE.

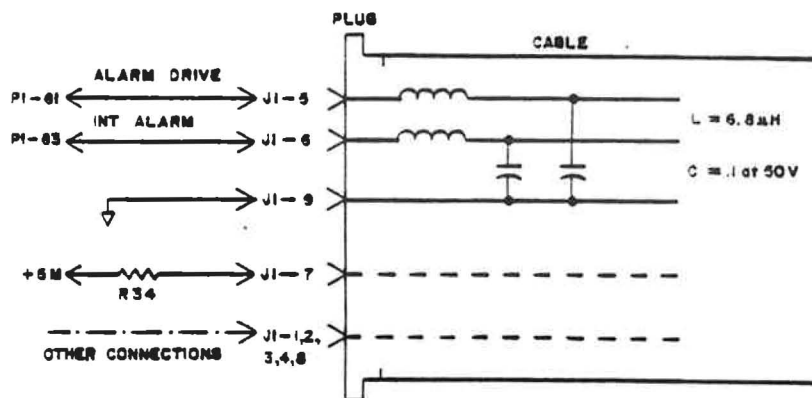
FIGURE 5-1 AUDIBLE ALARM CONNECTIONS

The relay contact (supplied by user) is assumed to be N.O. when any mike is active and N.C. when no mikes are active. The signal labeled to EXTERNAL INDICATOR may be used to operate a user-supplied indicator for an alarm indication.

NOTE: The "ALARM DRIVE" and "INT ALARM" connections are each associated with a trace which runs across the C.P.U. Interface Board, through the Mother Board, across the C.P.U. Board and eventually terminates at the Alarm Driver on the front panel.

Because these connections are generally used at a studio location, and seldom in an R.F. environment, no filtering was included for them.

Considering the susceptibility of any digital logic system to R.F. spikes, it is our suggestion that all MRC-1 customers who use these connections for remote alarms or remote alarm enable switches in an R.F. environment should incorporate a small LC filter in order to isolate the MRC-1 from R.F. interference. It will be easiest to do this by locating the inductors and capacitors near the female plug on the cable when the cable for this jack is made up. Below is a diagram of the procedure to follow.

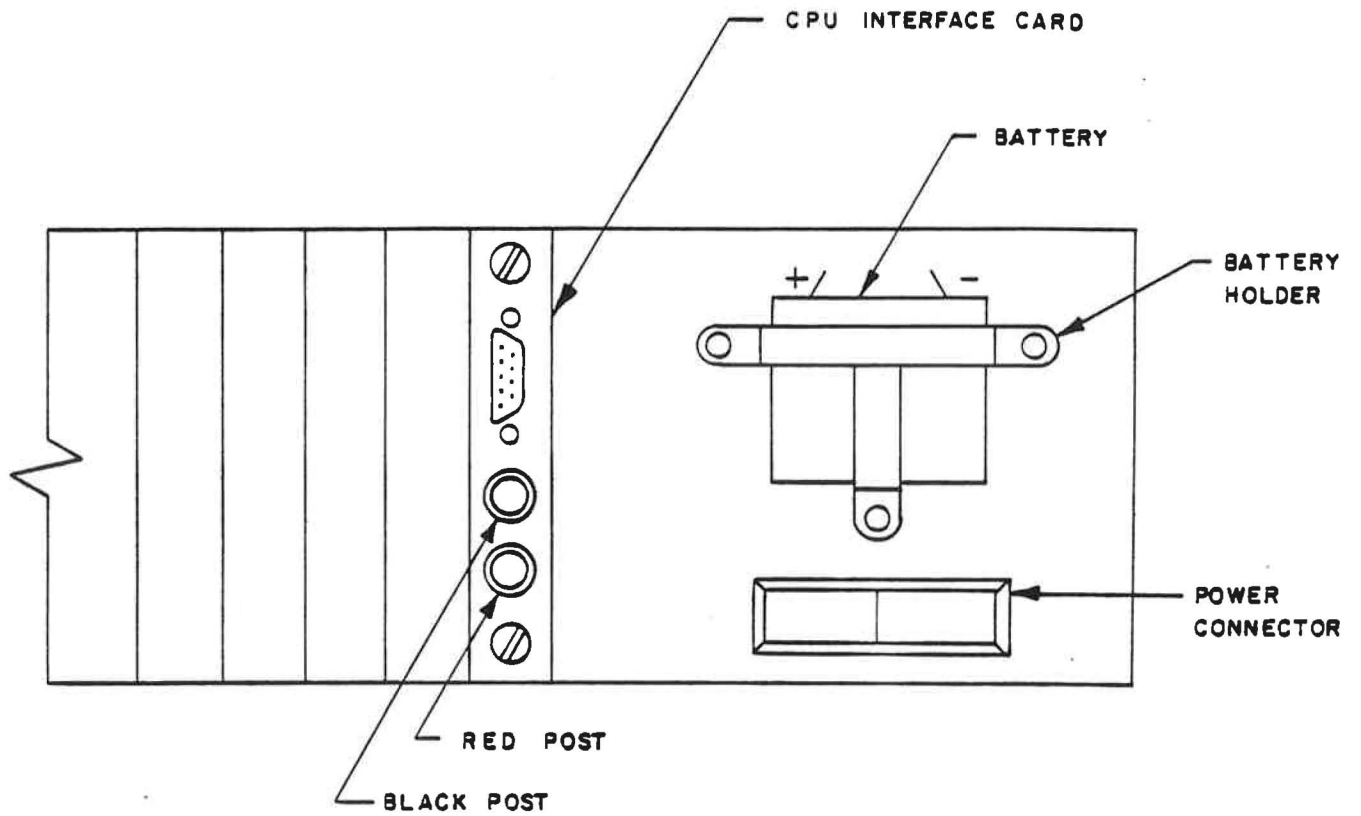


MAI Part Numbers: 14-287.25, 4020343, Inductor
R.F. 6.80 μ H
05-397.25, 4310207, Capacitor
.1 μ F/50 V 20%

5.8 EXTERNAL BATTERY

The Remote Terminal normally requires the use of an external battery to maintain the contents of memory in the event of a power failure. The battery is supplied to maintain memory contents for a period of time during a power failure (not complete terminal operation, however). To connect the battery, first attach the battery holder to the chassis, insert battery and connect the terminals in accordance with Figure 5.2. Batteries are always shipped disconnected to prevent discharge during transit. The positive (+) battery terminal is connected to the red binding post terminal and the negative (-) is connected to the black binding post.

The user may use other batteries in place of the one supplied. In this case, the maximum voltage that may be applied to the terminal posts is 7.0 volts. The nominal design voltage is 6.0 volts, with a float charge of 6.7 volts and a maximum float charge current of 75 ma. If you use an external battery and charger, the charger voltage must never exceed 7.0 volts and must be filtered with no more than 10 mV ripple.



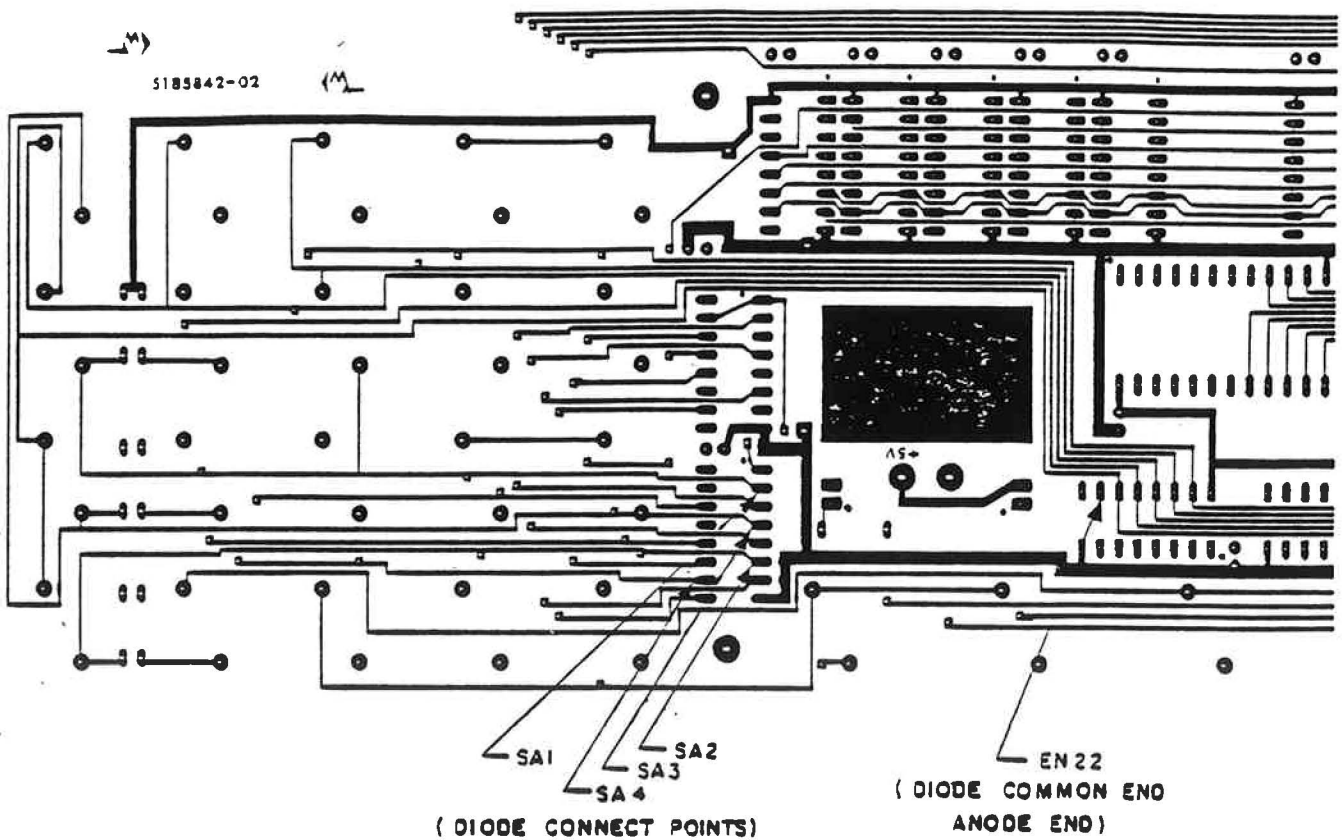
**FIGURE 5-2 BATTERY INSTALLATION
REMOTE TERMINAL**

5.9 SITE SELECTION

It is necessary to program the Remote Terminal with the number of the site for the terminal. It is assumed that sites are numbered sequentially from 1 to N where N is the last site number with no numbers skipped. Note that early production units use a soldered diode matrix instead of the switches. Refer to Figure 5.3 for location and connection chart.

The switches are set as shown in the table below for the number of sites in the system:

SITE	SWITCH POSITIONS			
	1	2	3	4
1	OFF	OFF	OFF	OFF
2	ON	OFF	OFF	OFF
3	OFF	ON	OFF	OFF
4	ON	ON	OFF	OFF
5	OFF	OFF	ON	OFF
6	ON	OFF	ON	OFF
7	OFF	ON	ON	OFF
8	ON	ON	ON	OFF
9	OFF	OFF	OFF	ON



Foil Side of Front Panel PCB Shown

DIODES INSTALLED
 (Diodes are 1N270 or equivalent)

<u>SITE</u>	<u>SA1</u>	<u>SA2</u>	<u>SA3</u>	<u>SA4</u>
1	None	None	None	None
2	Diode	None	None	None
3	None	Diode	None	None
4	Diode	Diode	None	None
5	None	None	Diode	None
6	Diode	None	Diode	None
7	None	Diode	Diode	None
8	Diode	Diode	Diode	None
9	None	None	None	Diode

FIGURE 5.3

SITE IDENTIFICATION DIODES
 (Early Production Units Only)

5.10 FAIL SAFE

The fail-safe output is controlled by a relay capable of switching a load of up to 24 VDC at currents of up to 1 ampere. During normal operation the relay will close a connection between pins 3 and 4 of the rear connector on the CPU Interface Board. When MRC-1 power is removed or a fail-safe condition occurs, the relay will open. Figure 5-4 illustrates a typical application of the fail-safe output.

Inductive loads (relay coils, etc.) should have a "clamping" diode wired across them to inhibit negative voltage spikes. External relays should be used when it is desired to switch to greater loads (or AC loads which must have a Series R (100 Ω)/C (1 μ f) network across them).

These relays may also be interfaced with transistor-transistor logic (TTL) digital circuits. The relay contacts should be wired so that one side is referenced to the digital common (ground), and the other relay contact to the digital input. A pull-up resistor may be necessary, and it is advisable to wire a 1 μ f capacitor and 100 ohm resistor (in series) across the relay output to suppress contact bounce. For further details, refer to Section 8, CPU Interface.

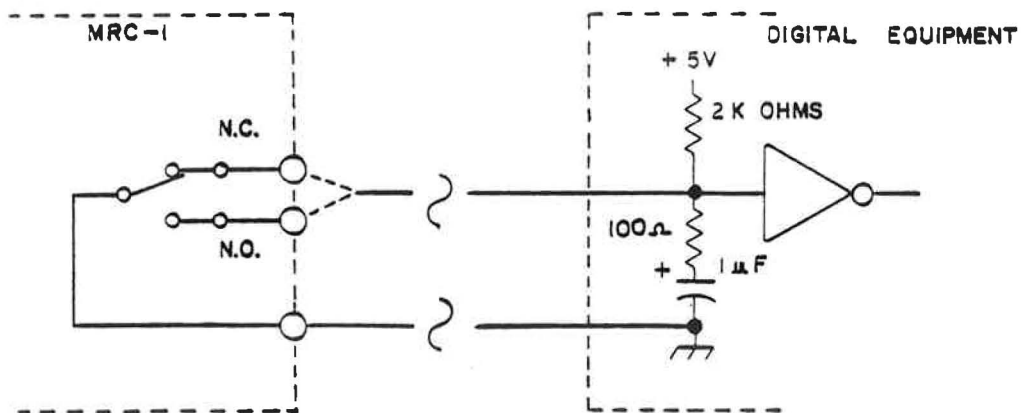


FIGURE 5-4 TYPICAL FAIL SAFE OUTPUT

5.11 MAINTENANCE OVERRIDE

An external indicator is provided in the form of a relay to provide remote indication that the Remote Terminal has been placed in the Maintenance Override mode of operation. This indication is normally used to illuminate a light near the exit of the transmitter room to warn the operator the Remote Terminal has been left in the Maintenance Override Mode. When in the Maintenance Override mode, no commands are accepted by the Remote Terminal from the Control Terminal; hence, you may save yourself a trip to the transmitter site by getting into the habit of removing the Remote Terminal from the Maintenance Override mode before you leave. There is no way to exercise this function from the Control Terminal. You may use a relay or TTL logic for indirect control of the lamp, in which case the wiring illustrated for the failsafe output can be followed (Figure 5-4), except terminals 1 and 2 of J1 are used. A small lamp may be driven directly, as illustrated in Figure 5-5.

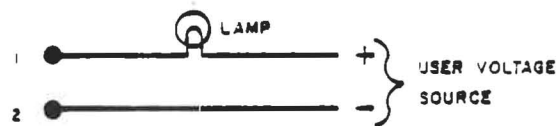


FIGURE 5-5 TYPICAL MAINTENANCE OVERRIDE CONDITION

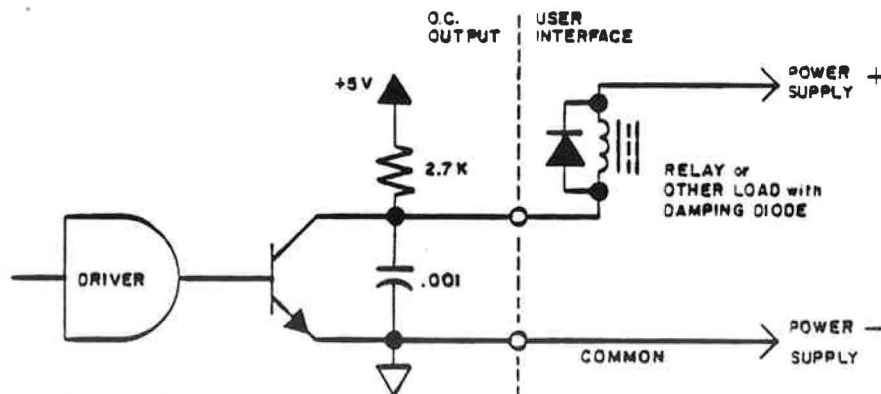


FIGURE 5-6 O.C. OUTPUT INTERFACE

5.12 INPUT/OUTPUT CONNECTORS

The connectors for telemetry (analog), status and commands may now be wired up. A definite wiring pattern has been established for the telemetry (analog) input, TTL status input, optically isolated status input, open collector command output, and the optically isolated command output printed circuit modules through both the filtered and unfiltered interface cards. The most positive voltages of the 16 inputs or outputs are wired consecutively from pins 1 through 16. The negative (or ground return) input or output is wired consecutively from pins 20 through 35. This allows twisted pairs to be used as connections to the modules to reduce external field noise pickup and, at the same time, allows a simple pattern to the connection with the two leads at a slight diagonal on the connector. Proper grounding and shielding techniques should be followed throughout.

For those applications requiring control of high voltage or AC power, a relay isolated command output option is available. The connection from the relay panel to a command output module through an interface card has been pre-wired and only requires it be plugged in.

5.3 INSTALLATION COMPLETION

This completes installation of a Remote Terminal. Power may now be applied to the terminal. Depress the "ACK" key on the Remote Terminal front panel in order to clear the "cold start" condition which occurs whenever power is applied to the Remote Terminal after the contents of memory have been lost. You will observe the three power indicator LEDs on the internally-mounted CPU board illuminate. After a short period, the Reset LED on the CPU board will go out. After a short delay (less than 1 second), the Output and Input LEDs on the modem board should begin to flicker indicating that data is being sent and received. The modems are factory

adjusted for +0.0 dBm output level and a -16.0 dBm receive level. Should the actual levels of your system be radically different, some adjustment of the send and receive levels may be required. Refer to Section 8 for wireline modem and/or subcarrier modem adjustments. External loads if run from DC must have a damping diode across them (e.g. DC relay coil). Connect the diode so that it will normally not conduct. External loads, if AC, must have a series R.C. network across them. (Values of 1 μ f and 100 Ω are suggested.)

At this point, you may enter command sequences at the keyboard to calibrate telemetry (analog) channels, observe and set up status channels, and to set up command outputs.

For the user's convenience, a set of tables (Tables 5-1, 5-2, and 5-3) are provided that allow the user to record the manner in which he has set up the Remote Terminal. You may reproduce these forms as required for your purposes.

Each of the 32 telemetry channels is indicated on the left side of each table and, when completed, they will provide the user a guide for future reference as to how the Remote Terminal was set up. Most column headings are directly related to the set up functions outlined in Section 4 of this manual. The columns labeled "+ Input" and "- Input" are filled in to indicate the connector pins at the interface card. For the command outputs, since the output is mapped to the telemetry channel, the terminals actually connected must be inserted by the user. In Table 5-1, the column labeled "TYPE" is for the type of calibration; i.e., linear (L), power (P), or indirect (I).

TELEMETRY (ANALOG) DATA

TELE- METRY CHANNEL	DESCRIPTION OF VALUE MEASURED	TYPE L, P, I	NOMINAL CALIBRATION	HIGH LIMITS	LOW LIMITS	MUTED BY STATUS	+	-
							INPUT	INPUT
1							1	20
2							2	21
3							3	22
4							4	23
5							5	24
6							6	25
7							7	26
8							8	27
9							9	28
10							10	29
11							11	30
12							12	31
13							13	32
14							14	33
15							15	34
16							16	35
17							1	20
18							2	21
19							3	22
20							4	23
21							5	24
22							6	25
23							7	26
24							8	27
25							9	28
26							10	29
27							11	30
28							12	31
29							13	32
30							14	33
31							15	34
32							16	35

TABLE 5-1

TELEMETRY (ANALOG) DATA TABLE

STATUS DATA

TELE- METRY CHANNELS	DESCRIPTION OF SOURCE OF STATUS	INVERT	LATCH	ALARM I	ALARM I	+ INPUT	- INPUT	
1						1	20	CARD #1
2						2	21	
3						3	22	
4						4	23	
5						5	24	
6						6	25	
7						7	26	
8						8	27	
9						9	28	
10						10	29	
11						11	30	
12						12	31	
13						13	32	
14						14	33	
15						15	34	
16						16	35	
17						1	20	CARD #2
18						2	21	
19						3	22	
20						4	23	
21						5	24	
22						6	25	
23						7	26	
24						8	27	
25						9	28	
26						10	29	
27						11	30	
28						12	31	
29						13	32	
30						14	33	
31						15	34	
32						16	35	

TABLE 5-2

STATUS DATA TABLE

TELE- METRY CHANNEL	RAISE COMMAND				LOWER COMMAND			
	OUTPUT NUMBER	FUNCTION PERFORMED	+ OUT	- OUT	OUTPUT NUMBER	FUNCTION PERFORMED	+ OUT	- OUT
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								

TABLE 5-3

COMMAND OUTPUT TABLE

6.0 HARDWARE/SOFTWARE OVERVIEW

6.1 INTRODUCTION

The purpose of this section is to provide the user with a general overview of the hardware and software of the MRC-1 Remote Terminal. It is not a detailed explanation of microprocessors, but rather, the basic design concepts incorporated into the MRC-1. The user is referred to many excellent texts on microprocessors including M6800 Microcomputer System Design Data, published by Motorola, Inc.

Figure 6-1 is a block representation of the major components of an MRC-1 Remote Terminal. The chassis houses the assemblies. A mother board is located approximately three quarters of the way back from the front of the terminal. The functional cards (i.e., CPU, memory, modem, options, etc.) plug into the mother board from the front.

The user's connection to a functional card occurs through an interface card that plugs into the rear of the mother board. The interface card provides the physical connectors, terminals or barrier strips to which the user makes his connection. In some cases, there can be several interface cards that can be associated with a given functional card. For example, a modem card can have one of four interface cards depending upon the type of communications circuit. In other cases, the same interface card can serve several functional cards. As an example, the Filtered Interface card is normally used with the Telemetry (Analog), Status and Command cards.

The mother board provides;

- o power distribution to all cards,
- o interconnection between functional and interface cards,

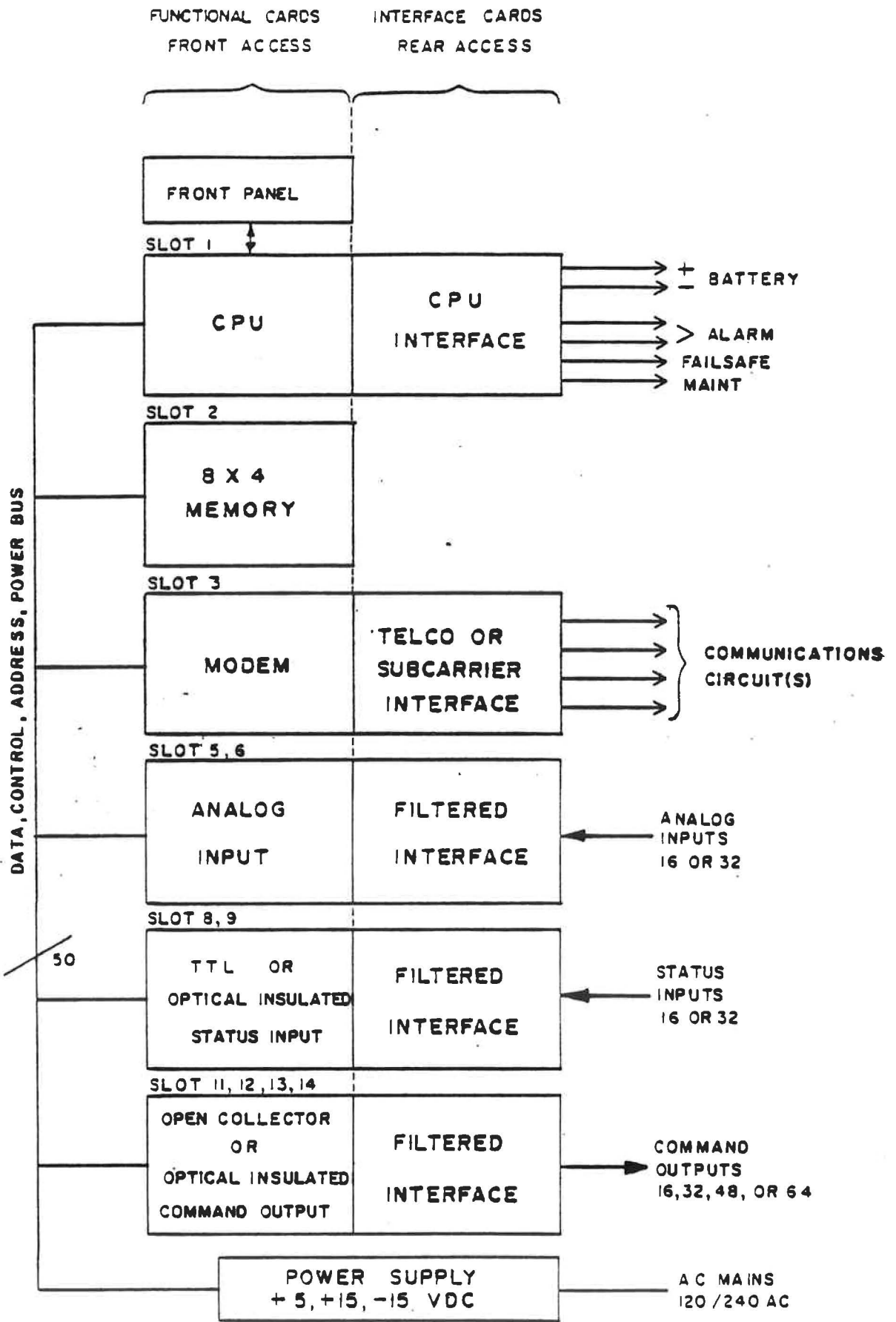


FIGURE 6-1 REMOTE TERMINAL BLOCK DIAGRAM

- o and distribution of control, data, and address busses to the functional cards.

All modules and subassemblies, except for the mother board, are removable without disassembling the chassis.

6.2 BUS ARCHITECTURE

The MRC-1 is designed using a bus structure which allows flexible configuration changes. Fifty control signals and power lines are bussed to each card slot. Cards are accessed by digital words on the address bus and do not require an absolute physical slot to be assigned for each card. An exception to this rule is the CPU card, which must always be plugged into the first slot to obtain an AC power sample for the real-time clock and power fail circuits.

Each printed circuit card edge connector has 100 pins. The even pins contain the common bus signals. The odd pins are used to communicate via interface cards to the external world through the rear panel. To prevent confusion, the even wire-wrap pins are sheared off during manufacturing, leaving only the odd pins for card input/output connections. Signal assignments for the connector pins are shown in Table 6-1.

Note that signal ground, +5, +15, and -15 voltages are available to both functional and interface cards.

TABLE 6-1
MRC-1 BUS ARCHITECTURE

<u>PIN</u>	<u>NAME</u>	<u>DESCRIPTION</u>
1,2,3,4	GROUND	System common signal ground
5,6	PLUS 15V	Positive 15V supply Remote 1.5 amps capacity Control .8 amps capacity
7,8	NEGATIVE 15V	Negative 15V supply Remote 1.5 amps capacity Control .8 amps capacity
9,10	STANDBY 5V	5-volt supply back up by an external battery
12	D0	Bidirectional 3-state data bus is used to transfer data between the microprocessor, its peripherals and memory
14	D1	
16	D2	
18	D3	
20	D4	
22	D5	
24	D6	
26	D7	
28	A0	16-pin address bus Both memory and input/output devices are addressed using these lines.
30	A1	
32	A2	
34	A3	
36	A4	
38	A5	
40	A6	
42	A7	
44	A8	
46	A9	
48	A10	
50	A11	
52	A12	
54	A13	
56	A14	
58	A15	
60	*RESET	This active low input is used to reset and start the microprocessor

TABLE 6-1 (continued)

<u>PIN</u>	<u>NAME</u>	<u>DESCRIPTION</u>
		from a power down condition, resulting from a power failure or an initial start-up of the processor. The signal is generated by the CPU interface card and is used to reset functions in the CPU and various cards that have reset capability.
62	E	1 MHz clock signal used to synchronize all system functions
64	R/*W	This output signals the peripherals and memory devices whether the CPU is in the READ (High) or WRITE (Low) state. The normal standby state of this signal is READ.
66	VMA	Valid Memory Address. This output from the CPU card indicates to peripheral devices that there is a valid address on the bus.
68	PRE	Input/Output Preselect. This line is high when the input/output device address space is accessed.
70	RTC	Real Time Clock. A 50 or 60 Hz signal derived from the AC power line and used as a timing signal.
72	*DMA	Direct Memory Access. When this signal goes low, the CPU card releases control over the address bus.
74	BA	Bus Available. This signal will normally be in the low state; it will go to a high state to indicate that the microprocessor has stopped and the address bus is available. This will occur if the processor is in a HALT state, or if a WAIT instruction is encountered by the microprocessor.

TABLE 6-1 (continued)

<u>PIN</u>	<u>NAME</u>	<u>DESCRIPTION</u>
76	*HALT	When this signal is in the low state, all microprocessor activity will be halted. In the HALT mode, the microprocessor will stop at the end of an instruction, Bus Available will be at a high state, Valid Memory Address will be at a low state.
78	BAUD	19230 Hz square wave used to set the baud rate of ACIA's (Asynchronous Communications Interface Adapters). Data rates of 1200 or 300 baud are possible using this clock.
80	*INT0	Lowest Priority
82	*INT1	Active low prioritized interrupts.
84	*INT2	When one of these lines goes to a low state, the microprocessor suspends its normal operation and begins servicing an interrupt routine. A higher priority routine takes precedence over a lower priority.
86	*INT3	
88	*INT4	
90	*INT5	
92	*INT6	
94	*INT7	Highest Priority
96	*NMI	Non-Maskable Interrupt When this line is pulled to a low state, the processor completes its current instruction and then branches to an interrupt routine. Interrupt cannot be disabled by setting a mask bit.
97 thru 100	PLUS 5V	Positive 5V power supply Remote: 6 amps Control: 3 amps

6.3 SOFTWARE OVERVIEW

When power is restored to a Remote Terminal, there are two things that could have occurred. First, memory could have been lost because of an extended power interruption. If this condition is detected by the software, it is assumed that the Remote Terminal must be recalibrated prior to any use. This requires manual intervention. An alarm condition exists and must be acknowledged by an operator at the Remote Terminal before recalibration can proceed. During this period, the software determines the identification number of the Remote Terminal by reading the switches on the rear of the front panel. Note that each Remote Terminal must have a unique address.

If the Remote Terminal did not lose its memory data as the result of a power failure, a brief internal re-initialization cycle occurs where the software determines the number and type of modules that are in the Remote Terminal. This allows the user to add additional modules within the design capabilities at any time. Power must be turned off and the battery disconnected before removing or inserting printed circuit cards. When power is restored, the software takes inventory of what is currently available and adjusts its internal record keeping accordingly.

As the user performs setup key sequence functions, the data from the key sequence, i.e., telemetry (analog) calibration factors, limits, etc., are retained in the Remote Terminal memory. This data may be recalled by other key sequences either from the Remote or Control Terminals. The point to note is that all factors that affect a Remote Terminal are retained at that Remote Terminal.

Once the Remote Terminal is active, it is always listening to the communications circuit for a message addressed to itself from the Control Terminal. This is called a polling message. In response

to the poll, the Remote Terminal sends a brief answer indicating whether or not an alarm condition exists at the Remote Terminal. For convenience of operation, the software in the Remote Terminal allows the Control Terminal user and the operator of the front panel independent display of all data concerning the Remote Terminal. The Control Terminal operator may view any telemetry channel at the same time the Remote Terminal user is displaying any other or the same telemetry channel. There is one function - the Maintenance Override - which can be activated at the Remote Terminal to disable command activation from the Control Terminal. However, all other display functions at the Control Terminal are enabled.

Telemetry (analog) data is acquired in a cyclic sequence from the analog-to-digital (A/D) converters. When an A/D completes one conversion, the input number is incremented and the next conversion started while the previous conversion is applied through a digital filter and then limit checked. Note that limit checks occur on each conversion as each new sample is acquired. If there are two analog cards in the Remote Terminal, the process is being applied to both simultaneously.

Approximately every four seconds, the software causes each A/D converter to be switched to a set of four reference voltages. At this time, the A/D gain and offset values are determined and all subsequent input samples are corrected.

Status input data is sampled approximately 60 times per second. The attributes that have been assigned to each status input are checked and the results displayed on the front panel.

As a result of a RAISE or LOWER key being depressed, the software determines the output line that has been mapped to the telemetry channel, activates the specified output, and then, checks the output register for operation. If operational, it activates the RAISE or LOWER LED.

During communications with the Control Terminal, extensive error checking is performed to ensure receipt of valid data. The Remote Terminal must receive one valid message within 45 seconds of the previous valid message in order to maintain the fail-safe output active. If the time period is exceeded, the fail-safe output is de-activated.

7.0 MAINTENANCE

7.1 PURPOSE

The purpose of this section is to provide a guide to the maintenance of the MRC-1 at the module level. Section 8 of this manual provides the schematics, card layouts, troubleshooting and adjustment information for the individual card or assembly.

CAUTION

ALWAYS REMOVE POWER FROM THE TERMINAL AND DISCONNECT THE BATTERY WHENEVER PRINTED CIRCUIT MODULES ARE REMOVED OR REPLACED IN THE UNIT. FAILURE TO OBSERVE THIS CAUTION MAY CAUSE DAMAGE TO ONE OR MODULES.

7.2 HANDLING CMOS DEVICES

The MRC-1 contains several CMOS devices, such as 6802 MPU, 6821 PIA, 6850 ACIA, and 2716 EPROMS, which, unfortunately, can be damaged by severe electrical transient voltages. A person walking over a waxed floor, depending upon floor conditions and humidity, can generate voltage potential in excess of 15kV. The following is recommended to reduce damage to the CMOS devices:

1. All CMOS devices should be stored in materials that are anti-static. CMOS devices must not be inserted into Styrofoam.
2. All CMOS devices should be placed on a grounded bench surface and the user should be grounded before touching the device.

3. Nylon, or other static generating materials, should not come into contact with the device.
4. Do not remove boards or CMOS devices with power applied or with battery connected.
5. Treat boards that contain CMOS devices just like the device itself.
6. When wrapping a module for shipment, never use any plastic material that is not marked as being anti-static. Most anti-static plastic material is a pale pink color and identified as such.
7. Always use grounded test equipment to diagnose problems and ground the test equipment to the unit before placing probes on the circuits.

7.3 CARD ADDRESS AND OPTION SWITCHES -

Most card assemblies contain small switches referred to as DIP switches that select the address of the card and, in some cases, provide various common options on the card. Each switch is explained in Section 8 of this manual for the specific module.

Since each card (except the CPU card) can be placed in any card slot, 2 through 15 on the mother board, there needs to be some way of identifying the card when it is inserted. This identification is called the board address and is composed of two parts:

1. A fixed hardwired address that identifies the card type
2. A variable part of the address that identifies the particular card of a given type

For example, if the system contains two Status Input cards, they are identical in all respects except for the DIP switch positions. This allows the software to distinguish between the card that is assigned to Channels 1-16 and the card that is assigned to Channels 17-32.

A uniform convention has been established for setting the switch positions within a given type of board. This is diagrammed below. The UP arrow represents the switch in the ON position; the DOWN arrow, the OFF position. (Note: On most cards, ON is UP, OFF is DOWN, but it can be the other way. Refer to the switch itself.)

DEVICE NUMBER	CHANNEL ASSOCIATION	BCD SWITCH POSITION	DIP SWITCH POSITIONS			
			1	2	3	4
1	1 - 16	0	↓	↓	↓	↓
2	17 - 32	1	↑	↓	↓	↓
3	33 - 48	2	↓	↑	↓	↓
4	49 - 64	3	↑	↑	↓	↓

For troubleshooting purposes, you may interchange cards of the same type - BUT - be sure to set the switches to the proper setting before inserting the card.

7.4 FAULT ISOLATION - LEVEL 1

The MRC-1 contains several indications to aid in fault isolation down to the card level. Always go through these steps before attempting to service the equipment.

1. The three power LED indicators on the CPU card indicate the presence of voltages. The LED's should all glow with approximately the same brightness. If in doubt, check the voltages with a voltmeter.

2. Depress the RESET switch on the CPU board. This forces the CPU to begin the program from the beginning. When reset, all LED's on the front panel will illuminate briefly. Should the LED's remain ON, the fault could be either in the CPU or memory cards.

3. If simple command functions like site, lamp test or channel keys function properly, the most likely candidate is the modem. In most likelihoods, the levels need adjustment (refer to the card description in Section 8). If the top LED of the modem is flashing, it indicates that the modem is being keyed. An AC voltmeter across the output circuit should indicate a voltage that varies in step with the LED. If there is no voltage, check the fuses in the interface card.

If data is getting out onto the communications circuit from the Control Terminal, determine if the Remote Terminal is receiving data. The bottom LED on the Remote modem should flash in step with the transmit LED of the Control Terminal. When the Remote Terminal transmits, its transmit LED will illuminate which, in turn, should cause the receive LED at the Control Terminal to be illuminated. Note that you can force the modem to transmit by activating the TEST switch on the front of the modem card.

When using a 2-wire line, the modem hears itself transmit. You will see the transmit LED flash and the receive LED ON most of the time with a periodic short duration OFF period.

7.5 FAULT ISOLATION - LEVEL 2

The following is a guide to the isolation of problems that are associated with the various sensor inputs to the MRC-1. Each input or output, if subjected to an overvoltage or overcurrent condition, will, in general, affect only a single sensor. If any single telemetry (analog), status or command function fails to function properly, first check the external wiring carefully. With the suspect module placed on the extender card, determine if the signal is present at the input (or output) of the final transistor or gate on the card to your system. If optically-isolated inputs or outputs are involved, be sure that a source is provided and measure the voltages differentially with respect to the chassis. Also, with the analog signals, a minimum voltage of 0.256V must be present across the two inputs in order to calibrate a telemetry channel.

Because of the very heavy filtering that is done on all the lines that pass through the interface cards, do not expect the system to respond to very short-duration pulses. The problem of keeping stray RF energy out of the Remote Terminal places a number of constraints on the response time of all inputs and outputs of the MRC-1.

Along the same line, it is possible that opening up and/or operating a Remote Terminal with cards on an extender board may run into problems due to the RF field present. MRC-1's have been subjected to operation in AM, FM, TV and combination transmitter environments with confirmed success. However, since we have no control over your particular environment, no guarantee is made that the unit will function open in all circumstances.

8.0 CIRCUIT DESCRIPTIONS

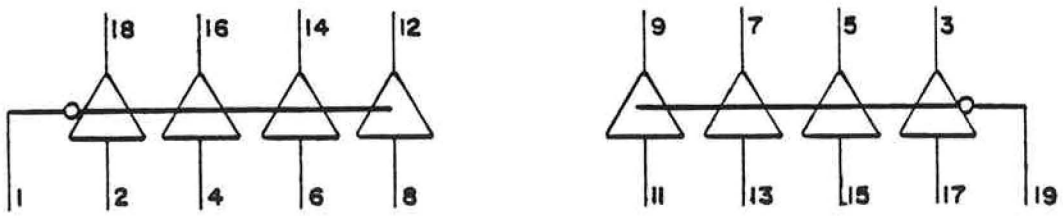
8.1 INTRODUCTION

The circuit description for the various printed circuit modules and assemblies in a standard MRC-1 are contained in this section in the form of a documentation package for each assembly.

Note: On some boards, early production units may contain DM81LS97 integrated circuits in place of the SN74LS244 I.C.'s shown in the prints and mentioned in the descriptions. Similarly, early production units may contain DM81LS98 circuits in place of SN74LS240. (These changes were made due to considerations of parts availability, not due to problems with the older parts.)

Figure 8.1 shows pin-outs for the older and newer parts.

SN74LS244 (on newer production units)



DM81LS97 (on some older production units)

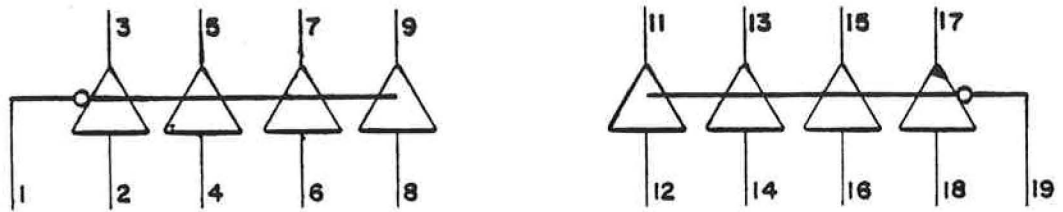


Figure 8.1

SN74LS240 is the same as SN74LS244 except for inversion of the outputs. Similarly, DM81LS98 is an inverting version of DM81LS97.

REMOTE TERMINAL FRONT PANEL

Assembly 20C2703
Schematic 91C7127
PC Board 51B5842

I. PURPOSE

This module has five functions:

1. Display site number, channel number, and value on seven-segment displays
2. Display thirty-two user status inputs (if installed) on discrete LED's
3. Display system status on discrete LED's
4. Provide an audible alarm
5. Encode keyboard entries for use by the CPU board

II. THEORY OF OPERATION

A. Overall: The front panel can be looked upon as a X-Y matrix, the X direction being data, and the Y direction being a location. The X path consists of six bits, while the Y path is five bits describing 32 (2^5) locations, 21 of which are used.

Location bits B0-B4 are decoded using a 4 to 16-bit decoder (U22) to provide locations 1 through 16, and a 3 to 8-bit decoder (U23) to provide locations 17 through 21. When accessing locations 1 through 16, all inputs of U20 are high, forcing the output low. This enables tri-state

buffer U17, allowing data to be sent to U1-U16. When accessing locations 17 through 21, one of the inputs of U20 will be low, forcing the output high, causing pin 12 of U19 to go low. This enables tri-state buffer U21, allowing data from the keyboard matrix to be sent to the CPU board. No locations are accessed unless CB2 (J2-11) is low. This signal is normally high, and pulses low for 7 microseconds when writing new data into locations 1 through 16. It is held low while reading the keyboard.

B. Seven-Segment Displays: Y locations 1 through 8 are used to select the eight seven-segment displays. Data is applied at J2-1 through J2-6 (A0-A5) to the inputs of U17. U17 is used to buffer the relatively low drive capabilities of the signals from the CPU board. Bits A0 through A3 are applied to the A, B, C, and D inputs of the TIL-308 displays. The resultant displays are shown in Fig. 1. Bit A4 is used to control the left-hand decimal point.

C. User Status: Data for the user status appears on A0-A5 and is clocked into hex D latches U1 through U6. This data is active low; the LED is ON if the corresponding bit is low. Resistors R1-R32 are used to limit the current through the LED's.

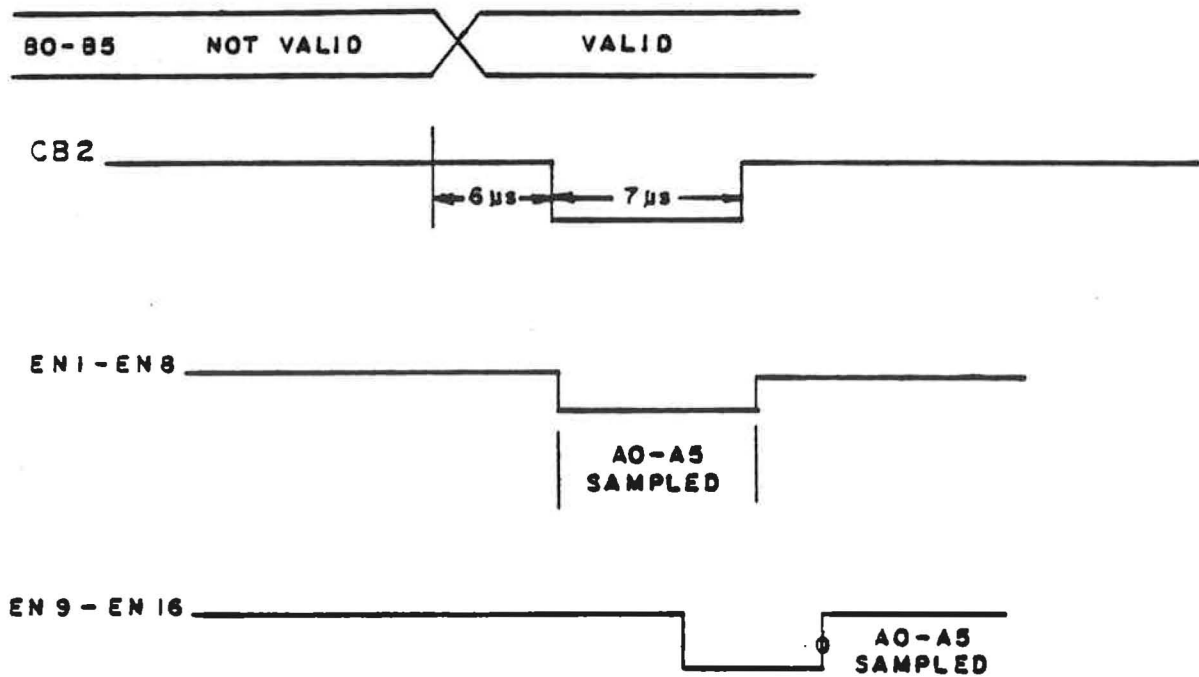
D. System Status: Data for system status is supplied in the same manner as the user status. U7 and U8 are used to store the status and drive the LED's.

E. Audible Alarm: Data bit A4 at location 16 (U8) is latched in at U8 and fed to audible alarm driver Q1. This

bit is active high and drives the Sonalert if J2-15 (alarm drive) and J2-16 (internal alarm) are connected together by the user.

F. Keyboard: During accessing of locations 17 through 21, data lines A0-A5 will normally be low, indicating that no push buttons are activated. A push-button activation will cause the appropriate location line to be connected to a data line, causing the data bit to go high.

III. TIMING DIAGRAMS



IV. TROUBLESHOOTING

1. Verify that the site, channel, and value displays blank out, and all of the discrete LED's are lit during reset (depressing the RESET switch on the CPU board).
If this does not occur, check pins 14 and 13 of U18; both should go low during reset. If this does not occur, refer to the section on the CPU interface board.

2. If certain numbers will not appear on a display, suspect the display IC. If certain numbers will not appear on all the displays, there may be a stuck bit on A0-A5. A stuck bit should also show up on the status lights; this will show up on LAMP TEST, where the LED will not change its state. Stuck bits may be caused by a defective U1-U17 or U21, or a failure on the CPU board. Remove U17 from its socket. All LED's should be OFF and the BCD displays should read "F". If they do not, this indicates either a short to ground or a defective input on U1-U16. Remove U1-U16, one at a time, (leaving only one out at a time) until the displays read correctly. If doing this for all of U1-U16 does not solve the problem, check with an ohmmeter (with the power OFF) from A0-A5 to ground to check for shorts.

3. Most failures in the keyboard will be caused by a malfunctioning key-switch. If a key-switch will not function, try shorting across its two contacts on the rear of the PC board with a jumper wire. If this performs the appropriate function, replace the switch. Another possible problem is if the key-switch is shorted, this

will result in an apparently dead keyboard. The easiest way to check for this is to remove power from the unit and check across each key-switch with an ohmmeter, looking for a shorted switch.

REMOTE TERMINAL FRONT PANEL (20C2703)
24 Aug 1979

56 SOLDER SPADE TERMINALS (2 PLCS)

26 9

DETAIL A

51

26 REF.

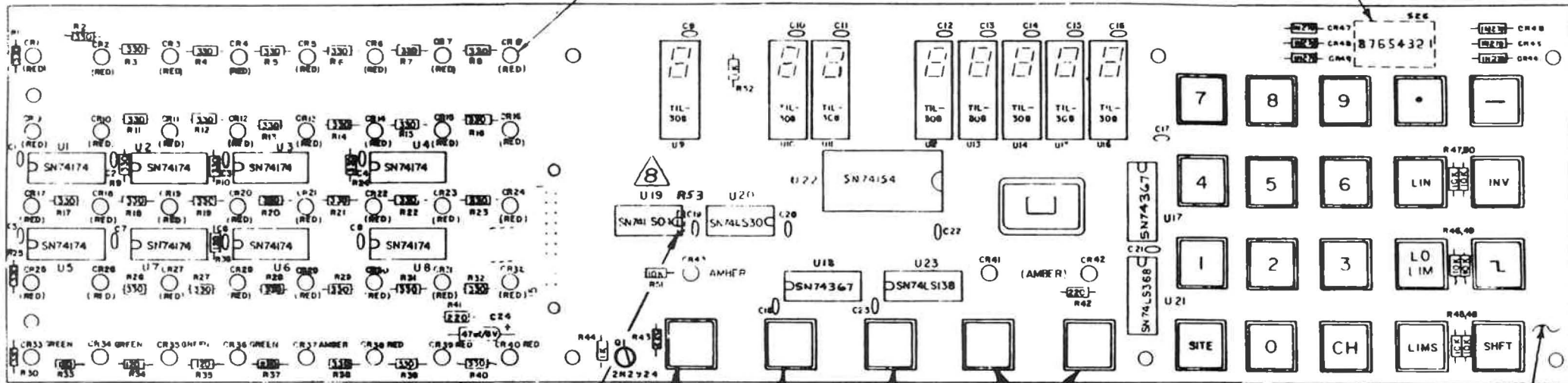
55

50

49

11

10



NOTES

- 1 UNLESS OTHERWISE SPECIFIED
RESISTOR VALUES ARE IN OHMS, 1/4, 10%
CAPACITORS ARE .1μF, 50V
- 2 I.C. BOARD 5185042
- 3 SCHEMATIC 91C7127
- 4 ALL TIL 308 7 SEGMENT DISPLAYS ARE TO BE SELECTED WITHIN
A GRADE RANGE OF 2. EXAMPLE: 2 THRU3; 3 THRU4; 4 THRU5; ETC.
5 BEND RESISTORS AS INDICATED BELOW.

VALUE	TYPE	BEND	QTY	LOCATION
120Ω	CLOSE		1	VERTICALLY MOUNTED (PLANE) R36
120Ω	# 1		3	HORIZONTALLY MOUNTED (PLANE) ALL
220Ω	CLOSE		3	HORIZONTALLY MOUNTED (PLANE) R41,42, VERTICALLY MOUNTED R43
220Ω	# 1		1	HORIZONTALLY MOUNTED (PLANE) R37
330Ω	CLOSE		6	VERTICALLY MOUNTED (PLANE) ALL
330Ω	# 1		29	HORIZONTALLY MOUNTED (PLANE) ALL
1KΩ	CLOSE		2	ALL
10KΩ	CLOSE		7	ALL

- 6 CLOSE BEND IS TO BEND RESISTOR LEADS AS CLOSE TO THE RESISTOR BODY AS POSSIBLE (OUR NORMAL ASSY METHOD)
- # 1 BEND IS TO BE BENT USING A MK-1 BENDING FIXTURE WITH THE RESISTOR INSTALLED IN THE # 1 SLOT AND THE LEAD FORMED AS CLOSE TO BENDING FIXTURE AS POSSIBLE
- 6 SOLDER 10KΩ/W RESISTOR BETWEEN PINS 1 AND 14 OF U19, ON CIRCUIT SIDE
- 7 PLACE LEADS SO THAT FLAT SIDE IS TOWARD DOT ON PC BOARD.
- 8 TRIM LEADS OF U19 AS SHORT AS POSSIBLE AFTER SOLDERING.
- 9 BEFORE SOLDERING, INSTALL CONNECTOR ITEM 26 ON CIRCUIT SIDE OF PC BOARD. USE TWO #2 3/16" X 1/2" B.H. SCREWS AND TWO #2 3/16" RING LOCK WASHERS ON COMPONENT SIDE. TWO #2 FLAT WASHERS ARE TO BE INSTALLED BETWEEN PC BOARD AND CONNECTOR (ON CIRCUIT SIDE). INSTALL TWO #2 3/16" HEX NUTS ON 1 1/2" DIA CONNECTOR. SEE DETAIL "A".
- 10 INSTALL FLAT SIDE OF NOTCH SIDE OF LED TOWARDS FOIL DOT ON PC BOARD ON MOUNTING. ATTACH PC ASSEMBLY TO FRONT PANEL (OR FIXTURE), SERT LED'S AND SOLDER.
- 11 1/2 8 CT'S DIP SWITCH MOUNTED ON THE OPPOSITE SIDE AND ORIENTED AS SHOWN.

ITEM NO: 9201716

UPDATE TO 9201716 REWORKED 8/21/83 ECO 4562 7-16-83 REDRAWN FROM 2002703 ECO 4603 8-28-83 IF		DATE	MOSSLEY ASSOCIATES, INC. SANTA BARBARA RESEARCH PARK BOLETA, CALIFORNIA 93111	
		REVISIONS	COMPONENT LAYOUT MRC-I REMOTE FRONT PANEL	
TOL: FRST. ± 1/16" .015 ± .001 .001 ± .001 < ± 1/8"	DATE	SCALE: FULL		
DRW: JAE	DATE: 8-8-83			
CHK: JAE	DATE: 8-8-83			
EDG: J	DATE: 8-8-83	2002703	L	

PRINT PHANTOM ITEMS
 PRINT COMPONENTS
 PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 92J1716 CROSS REF ITEM DESCRIPTION REM TERM FRT PANEL MRC-1 ENGR DRAW 2002703 L BATCH QTY 1 ITEM TYPE 0 UNIT MEAS EA LDM LEVEL 04 PLANNER 514

QTY	ITEM	OPT	FIRST	LT	EFFECTIVE	DATES
PER	UM	NBR	UP SEQ	ADJ	FRJM	TO
1.000	EA	9				
1.000	EA	4				
1.000	EA	4				
1.000	EA	4				
2.000	EA	4				
1.000	EA	4				
1.000	EA	4				
8.000	EA	4				
8.000	EA	4				
1.000	EA	4				
35.000	EA	4				
4.000	EA	4				
4.000	EA	4				
2.000	EA	4				
20.000	EA	4				
1.000	EA	4				
23.000	EA	4				
1.000	EA	4				
4.000	EA	4				
4.000	EA	4				

PRINT PHANTOM ITEMS
 PRINT COMPONENTS
 PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM	CROSS REF ITEM	DESCRIPTION	REM TERM	FRT PANEL	MRC-1	BATCH	QTY	1	ITEM TYPE	0	LDW LEVEL	04
4201716		ENGR DRAW 20D2703		L					UNIT MEAS	EA	PLANNER	514
COM ITEM	LL CU	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	OPT TYP	NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE FROM	DATES TO
22	00	4410109	RES 350 OHM 1/4W 10% R1,R2,R3,R4,R5,R6,R7,R8,R9,R10,R11,R12,R13,R14, R15,R16,R17,R18,R19,R20,R21,R22,R23,R24,R25, R27,R28,R29,R30,R31,R32,R33,R34	RC075F331K	35.000	EA	4					
23	00	4410247	RES 1K OHM 1/4W 10% R44,R45	RC075F102K	2.000	EA	4					
24	05	4410319	RES 10K OHM 1/4W 10% R46,R47,R48,R49,R50,R51,R53	RC075F103K	8.000	EA	4					
26	05	3110350	CONN SCOTCH FLEX RT ANGLE W/D	3424-1002	1.000	EA	4					
27	05	3170104	SW PB SPST	TFD	25.000	EA	4					
28	05	3170303	BTN NO LEGEND BLU MRC1	05A2619-1 B1	3.000	EA	4					
29	05	3170311	BTN 0 LT GRY MRC1	05A2619-2 B1	1.000	EA	4					
30	05	3170329	BTN 1 LT GRY MRC1	05A2619-3 B1	1.000	EA	4					
31	05	3170337	BTN 2 LT GRY MRC1	05A2619-4 B1	1.000	EA	4					
32	05	3170345	BTN 3 LT GRY MRC1	05A2619-5 B1	1.000	EA	4					
33	05	3170352	BTN 4 LT GRY MRC1	05A2619-6 B1	1.000	EA	4					
34	05	3170360	BTN 5 LT GRY MRC1	05A2619-7 B1	1.000	EA	4					
35	05	3170378	BTN 6 LT GRY MRC1	05A2619-8 B1	1.000	EA	4					
36	05	3170386	BTN 7 LT GRY MRC1	05A2619-9 B1	1.000	EA	4					
37	05	3170394	BTN 8 LT GRY MRC1	05A2619-10 B1	1.000	EA	4					
38	05	3170402	BTN 9 LT GRY MRC1	05A2619-11 B1	1.000	EA	4					
39	05	3170410	BTN 0 BLU MRC1	05A2619-12 B1	1.000	EA	4					
40	05	3170428	BTN - BLU MRC1	05A2619-13 B1	1.000	EA	4					
41	05	3170436	BTN SITE LT GRY MRC1	05A2619-14 B1	1.000	EA	4					
42	05	3170444	BTN CH LT GRY MRC1	05A2619-15 B1	1.000	EA	4					
43	05	3170451	BTN LIN BLU MRC1	05A2619-16 B1	1.000	EA	4					

PRINT PHANTOM ITEMS
 PRINT COMPONENTS
 PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM	CROSS REF ITEM	DESCRIPTION REM TERM FRT PANFL MRC-1	BATCH QTY	1	ITEM TYPE J	LDA LEVEL 04				
7201715		ENGR DRAW 20D2703 L			UNIT MEAS EA	PLANNER 514				
ITEM	CU	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM TO
44	05	3190469	BIN INV BLU MRC1	05A2619-17 B1	1.000	EA 4				
45	05	3190477	BIN Z BLU MRC1	05A2619-18 B1	1.000	EA 4				
46	05	3190485	BIN LIMS BLU MRC1	05A2619-19 B1	1.000	EA 4				
47	05	3190493	BIN SHFT BLU MRC1	05A2619-20 B1	1.000	EA 4				
48	05	3190519	BIN LU LIM BLU MRC1	05A2619-22 B1	1.000	EA 4				
49	05	1010024	SCF PHRD PHPS 2/56 X 1/2 SST	SCREWER HEAD	2.000	EA 4				
50	05	1010131	WSHR LK #2 SR SST	LOCKWASHER #2	2.000	EA 4				
51	06	1010107	NUT HEX 2/56 SST	F-554	2.000	EA 4				
52	05	3190568	BIN NO LEGEND LT GRN MRC1	05A2619-27 B1	2.000	EA 4				
53	05	3190089	SW DIP 3 320	205 d	1.000	EA 4				
54	05	3600012	DIO 1N270 100V 30MM Gc 007 C147,CR45,CR46,CR47,CR48,CR49	1N270	6.000	EA 4				
55	05	1010149	WSHR FL #2 ST	MW-400	2.000	EA 4				
56	05	3270350	LUG GND	336	2.000	EA 4				

CPU BOARD

Schematic 91D7132
Assembly 20B2710
PC Board 51B5849

I. PURPOSE

This module has six (6) functions:

1. CPU and Buffers
2. 2K EPROM and Priority Interrupts
3. I/O Preselect
4. Bit Rate Generator
5. Front-Panel Drive
6. Indicators and Controls for CPU Interface Board

II. ELECTRICAL ADJUSTMENTS

When power is applied to the unit for the first time, R30 should be adjusted. Turn R30 counterclockwise until CR4 (reset) illuminates. Then, turn clockwise until the LED goes off. Continue turning R30 for one more full turn. S1 is used to generate a *PF and *RESET signal, and is used mainly for troubleshooting. A jumper from U9 pin 1 to ground is used to disable the internal RAM on the CPU and is normally installed. A jumper between P1-10 and U1 pin 35 is used to supply power to the internal RAM on the CPU and is not normally installed.

III. THEORY OF OPERATION

Overall: The CPU generates the addresses from which data will be stored or retrieved. The address bus

consists of 16 bits, allowing 65536 (2^{16}) addresses. These lines are used on the CPU to select the PIA (Peripheral Interface Adapter), the EPROM (Erasable Programmable Read Only Memory), and the PIC (Priority Interrupt Controller).

The data bus (D0-D7) is used to carry the data between the CPU and other parts in the system. This bus is bi-directional. When the CPU writes data, the CPU outputs and the peripherals input. Conversely, when the CPU reads data, the CPU inputs and the peripherals output. The direction of data flow is controlled by the R/W (Read or Write) line. Data is read into the CPU when this line is high. The VMA (Valid Memory Address) output of the CPU signals to the address decoding logic that the address line has a valid address on it. No data transfers occur unless this line is high. Output line E (Enable) is a 1 MHz square used for bus timing. Data transfers occur when this line is high. BA (Bus Available) signals that the CPU has gone inactive as a result of a request generated by an external device, such as DMA (Direct Memory Access).

The PIC is used to sequence interrupts to the CPU by allowing higher priority devices to go first. The EPROM is used to store the program (or part of it). The PIA is used to drive the front panel along with six (6) miscellaneous functions. The bit rate generator is used to divide the 1 MHz E signal to approximately 19200 Hz, suitable to run 1200 or 300 baud.

A. CPU and Buffers

Y1 and U1 form a 4.00 MHz crystal oscillator, operating in the parallel resonant mode. C21 and C22 are incorporated to ensure that Y1 does not start oscillating in the third-overtone mode.

U9A disables the internal RAM of the CPU during power up and power down. If the jumper is inserted from pin 1 to ground, the internal RAM will always be disabled. This is the case when a RAM/ROM memory board is used in the system. The NMI input is used for a device requiring very fast service from the CPU. The jumper from P1-10 to U1 pin 35 is used to power the ON CPU RAM; it is not used if a RAM/ROM memory board is used in the system. The HALT input stops the CPU after it is finished executing the present instruction. The CPU then releases itself from the bus and sets the BA (U1, pin 7) output high. This action signifies to the device that pulled HALT low to commence transfer of data on the bus. Address lines A0 through A7 are buffered by tri-state octal buffer U5; likewise, lines A8 through A15 are buffered by U6. The enables for U5 and U6 are controlled by VMA from the CPU. In this way, the address lines to the rest of the system are only active when valid addresses are available. VMA is also gated with the *DMA input by U10A. This allows a DMA controller to simulate VMA to the rest of the system by pulling *DMA low. Data lines D0-D3 are buffered by U7; likewise, D4-D7 are buffered by U8. U10B and U10C are used to enable U7 and U8. One input of U10B and U10C is fed out of phase from the R/W line so only one can be enabled at a time. The other input of U10B and U10C is driven by U17B, which only allows the buffers to be activated if BA is low and if none of the I/O or memory is activated on the CPU board. This is required to prevent both the bus buffers and the PIA or EPROM from trying to feed data to the CPU simultaneously.

B. 2K EPROM and Priority Interrupts

U4 is addressed at locations F800-FFFF which are decoded by U19. Address lines A11-A15 are applied to the inputs of U19 along with VMA and R/W. The R/W is including so that a write operation to

F8000-FFFF will not cause a buss conflict between U4 and the CPU.

The PIC (U3) is addressed at locations FFEO-FFFF which are decoded by U18, U15B and U17A. Address lines A5-A15 are applied to the inputs U18 and U15B along with VMA. During normal operation, address lines A1 through A4 are passed from the A1-A4 inputs of U3 to outputs Z1-Z4 which allows normal addressing of the EPROM. If an interrupt input of U3 is pulled low, it will pull its IRQ output low, generating an interrupt of the CPU. In case of an interrupt, the CPU will fetch the address of the service routine at locations FFF8 and FFF9. These two addresses are decoded by U3, and used to modify its Z1-Z4 outputs in accordance with which interrupt is active, allowing a modified address to reach U4. In this manner, there are eight (8) interrupt service addresses instead of one (1).

C. I/O Preselect

I/O is assigned addresses 8000 through 81FF in this system. Rather than decode all 16 address lines on each I/O board, an I/O preselect system is used. Address lines A9-A15 and VMA are gated together in U16A, U16B and U15A to form *PRE.

This signal goes low when a valid address from 8000 to 81FF is on the address bus. This signal is inverted by U12C to form an active high signal and put on the bus. Most I/O boards conform to the following addressing convention:

A15/A14/A13/A12/A11/A10/A9/A8/A7/A6/A5/A4/A3/A2/A1/A0
1 0 0 0 0 0 0 T T T B B B B R R

Where: 1 = High
 2 = Low
 T = Board Type
 B = Board Number
 R = Register Select

D. Bit Rate Generator

IC's U13 and U14 along with U10D form a synchronous divide by 52 circuit. U14 counts from 3 to 15 providing a division of 13 while U13 divides the output of U14 by 4. In this manner, a 19230 Hz square wave is generated at the baud output. This clock is used by ACIAs (Asynchronous Communications Interface Adapters) to provide data at either 1202 baud or 300.5 baud, which is within 0.2 percent of the standard 1200 and 300 baud.

E. Front-Panel Drive

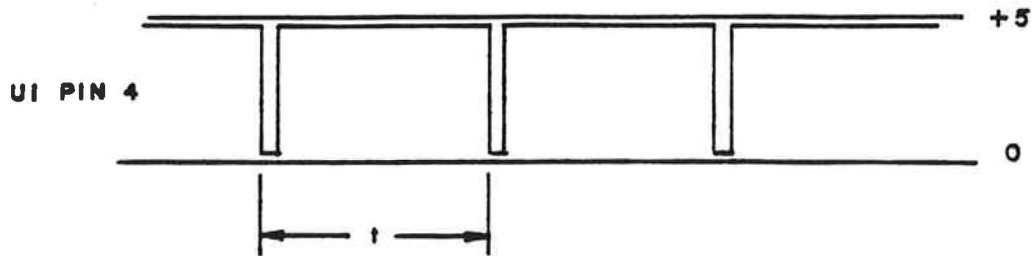
U2 is used to drive the front panel and is located at addresses 8004 through 8007. There are three chip select inputs on the MC6821; 2 active high and 1 active low. The active low input is connected to *PRE which will go active with addresses 8000-81FF. Address lines A6, A7 and A8 are NOR'ed together at U16C and fed to the first active high input. Address line A2 is applied to the second active high input to U2 providing the "04" offset to the base address of 8000. Lines CA1 and CA2 are used as interrupt inputs and allow interrupts every 16.7 ms for 60 Hz or 20 ms for 50 Hz, and also for loss of main power. The interrupt output of U2 is connected on the board to interrupt input 7 of U3. This is the highest priority interrupt. Output lines PA6 and PA7 are applied to the CPU interface card and used for an external maintenance override and failsafe outputs. Output line PB6 and input line PB7 are used for control of the low-battery detector on the CPU interface card. Lines PA0-PA5 are bi-directional and carry data to and from the front panel. Output lines PB0-PB4 are used

to access various elements on the front panel.

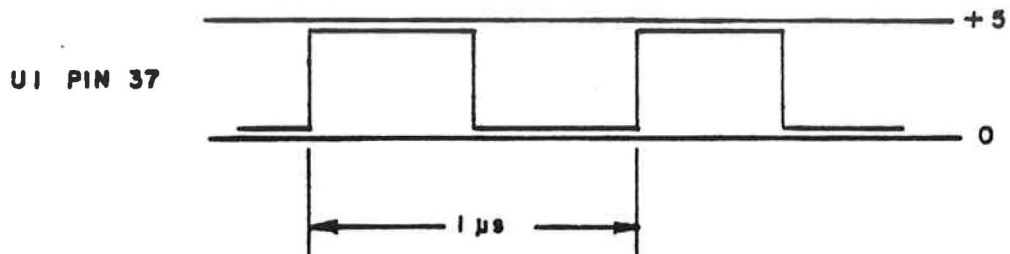
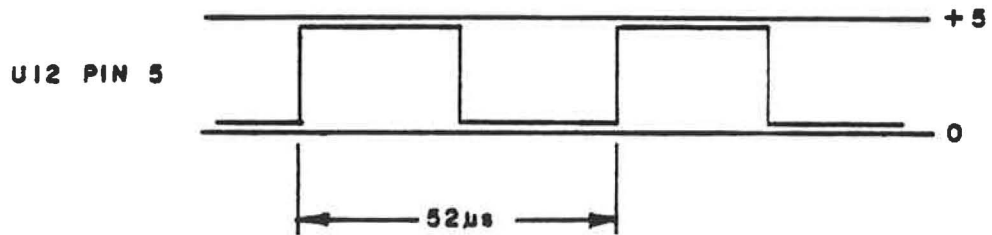
F. Indicators and Controls for CPU Interface Board

Switch S1 is connected from *PF to ground and is used to simulate a power down/power up sequence. This switch is mainly used for troubleshooting. CR4 indicates activity of the reset line and is used to adjust the power fail threshold potentiometer R30. CR1-CR3 are provided to give a visual indication of operation of the +15, -15 and +5V power sources.

IV. TIMING DIAGRAMS



FOR 50 Hz $t = 20$ ms
FOR 60 Hz $t = 16.7$ ms



V. TROUBLESHOOTING

1. CPU and Buffers

- A. Verify +5, +12 and -12 volts are present on board.
- B. The RESET LED (CR4) should be OFF except when switch S1 is depressed or during initial power up.
- C. Verify the ENABLE signal by checking IC U1 pin 37. A 1 MHz square wave should be observed. If this signal is not present, verify proper +5 volt supply voltage is present at pin 8. Pins 1 and 21 should be grounded. If proper IC voltages are present, suspect the crystal or MC6802 IC.
- D. If RAM enable jumper is present, IC U1 pin 36 should be low. If no jumper is present, verify pin 36 of IC U1 is high.
- E. Verify the following levels on IC U1 (MC6802):

*HALT	Pin 2	=	+5 volts (±.25V)
*NMI	Pin 6	=	+5 volts (±.25V)
BA	Pin 7	=	0 volts (±.25V)
*RESET	Pin 40	=	+5 volts (±.25V)
- F. Check IC U1 pin 4 for real time clock interrupt signal (60 Hz pulse). If this signal is absent, check IC U2 pin 40 for the real time clock signal from the CPU interface card.
- G. Check for activity on the Read/Write line, pin 34, and valid memory address, pin 5. Both lines should toggle in a non-periodic manner. If this is not observed, the problem may be in the microprocessor IC or another IC connected to these lines.
- H. Using an oscilloscope, observe the address and data lines,

pins 9 through 33. These lines are three-state and often appear to float in between HI and LOW. The inputs and outputs of the SN74LS244 should appear similar. The data and address lines may be observed using an extender card and checking the even numbered pins between 12 and 58.

2. 2K EPROM and Priority Interrupt

A. Check IC U4 (TMS2716) for proper supply voltages.

+5V Pin 24

-5V Pin 21

GND Pin 12

+12V Pin 19

B. Attach an oscilloscope to chip select (pin 18) of IC U4. After pushing the reset push button, two low-going pulses should be seen. If pulses are not present, check IC U19.

C. Check data and address lines for activity.

D. Observe pin 23 of IC U3. It should be normally high with low-going pulses approximately every 20 ms. If these pulses are not present, check IC U3 pin 11 for these pulses.

3. I/O Preselect

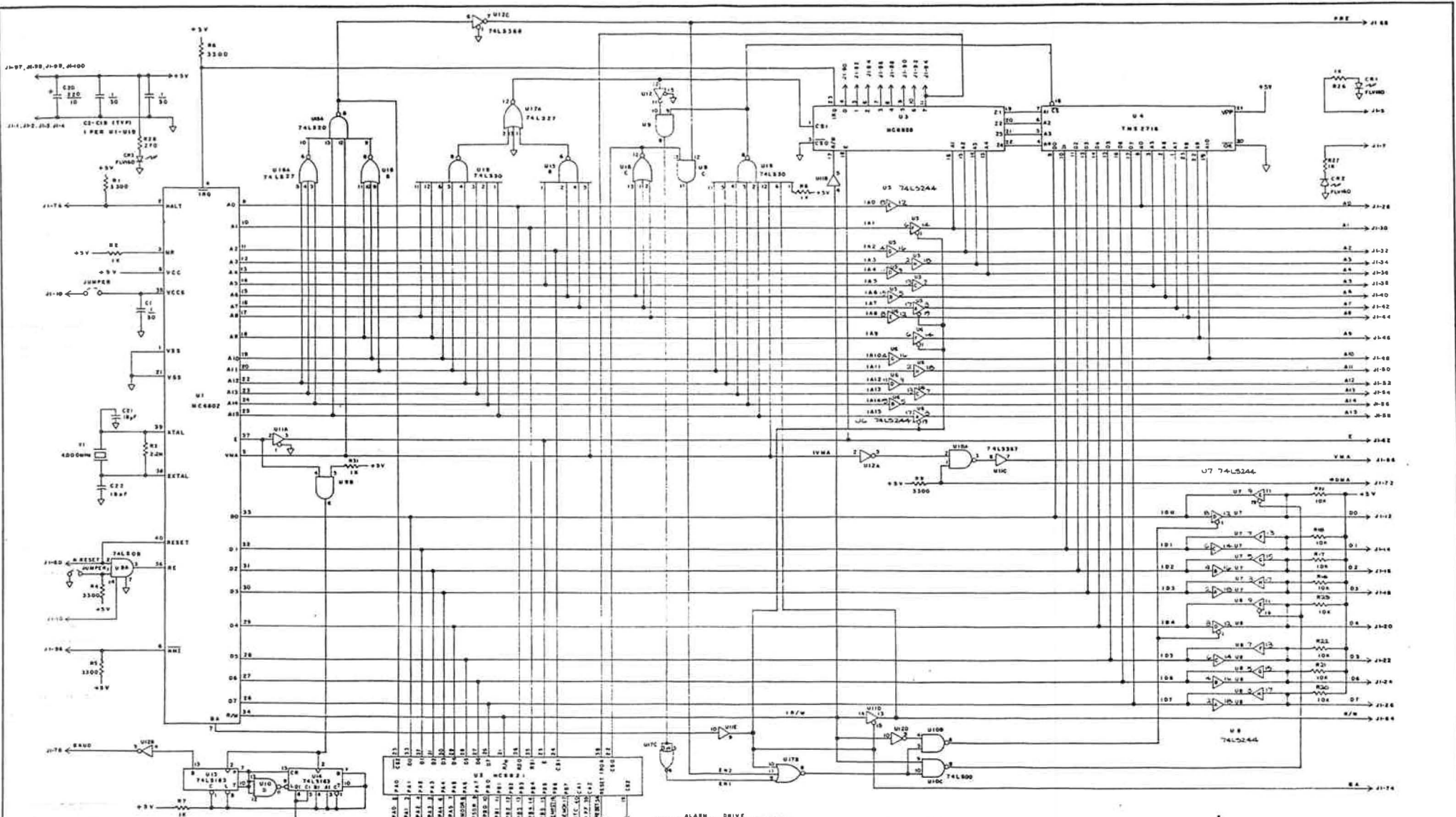
A. Check the inputs of IC U16A and IC U16B for activity coincidental with activity on addresses A9 through A14.

B. Check pin 8 of IC U15A for low-going pulses. If no pulses are observed, check input signals on pins 9, 10, 12 and 13.

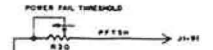
C. Output from the Inverter Buffer (IC U12C) should look similar to IC U15A pin 8, only inverted.

4. Bit Rate Generator

- A. Check for the 1 MHz ENABLE signal on pin 2 of IC U13 and IC U14. If signal is not present, trace back to the origin, IC U1 pin 37.
- B. Check each pin of IC U13 and IC U14, which is pulled high by R7 to verify a "HIGH" very near +5 volts.
- C. Pin 15 of IC U14 should have a 1 μ s pulse every 13 μ sec. IC U13 pin 13 should have a 52 μ sec square wave.

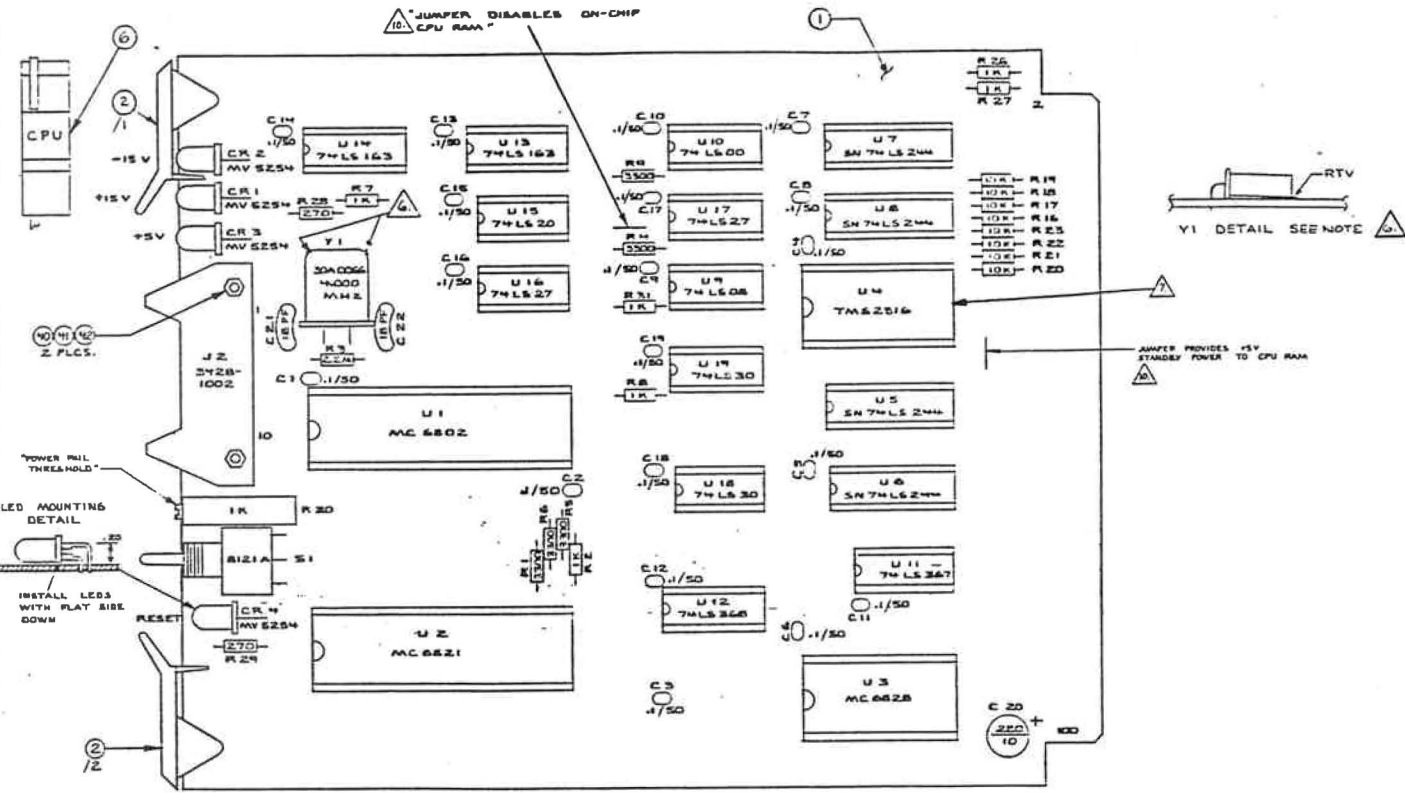


- NOTES
1. UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS 1/4 W 10% CAPACITOR VALUES ARE IN MICROFARADS.
 2. P. C. BOARD SIC3909
 3. COMPONENT LAYOUT 1007710



MOORE ASSOCIATES, INC. 10000 WILSON BLVD. SUITE 200 WASHINGTON, D.C. 20037 (202) 776-1000 FAX (202) 776-1001 TELEX 154200 CABLE MOORE	MOORE ASSOCIATES, INC. SCHEMATIC MRC-1 CPU DATE: 11/11/80 DRAWN BY: J. J. [unreadable] CHECKED BY: J. J. [unreadable] APPROVED BY: J. J. [unreadable]	MOORE ASSOCIATES, INC. 10000 WILSON BLVD. SUITE 200 WASHINGTON, D.C. 20037 (202) 776-1000 FAX (202) 776-1001 TELEX 154200 CABLE MOORE
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9107132 E



NOTES:

1. UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/4W, 10%. CAPACITOR VALUES ARE IN MICROFARADS.

10. ALL JUMPERS ARE #30 AWG, SINGLE STRAND INSULATED WIRE-WRAP WIRE, ADD JUMPERS AS SHOWN.

- 2. P.C. BOARD S1C2849
- 3. SCHEMATIC 910713E
- 4. ALL TRANSISTORS SOLDERED WITHOUT SOCKETS
- 5. ALL I.C.'S ARE MOUNTED IN SOCKETS
- 6. SECURE CRYSTAL TO P.C. BOARD WITH RTV. (DO NOT CORRUPT RTV) SEE Y1 DETAIL (184954)
- 7. U4 TO BE INSTALLED IN TEST.

ITEM NO: 9200288

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MOORE ASSOCIATES, INC.
 1000 W. 10TH AVENUE
 DENVER, CO 80202
 (303) 733-1111
 FAX (303) 733-1112

COMPONENT LAYOUT
 P.C. ASSEMBLY CPU

200 2710

PRINT PHANTOM ITEMS
 PRINT COMPONENTS
 PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 9200288 CROSS REF ITEM DESCRIPTION ASSY,6802 CPU MRC-1/1A ENGR DRAW 2002710 R BATCH QTY 1 ITEM TYPE 1 UNIT MEAS EA LOW LEVEL 02 PLANNER 514

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	OPT TYP	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM TO
1	03	3471927	PCB CENTRAL PROCESSING UNIT	51C5849 G	1.000	EA	9			
2	04	1250075	EJCTR CD (LEFT,RIGHT & 2 PINS)	41-1274L,C12409	1.000	PR	4			
3	03	3170065	SW RT ANG SPOT	8121SD9AGE	1.000	EA	4			
4	05	1110350	S1 CONN SCOTCH FLEX RT ANGLE W/D	3428-1002	1.000	EA	4			
5	05	3340163	J2 XTAL 4.00 MHZ MRC/TCS	30A0066 C	1.000	EA	4			
6	03	3430287	Y1 LBL LOGIC CD CPU	10B1068-01 E	1.000	EA	4			
7	06	4280186	CAP EPOX-DIP 220/10V	K220E10	1.000	EA	4			
8	05	4210064	C20 CAP MICA DIP 18PF 5x	04-15-180J	2.000	EA	4			
9	05	4310207	C21,C22 CAP .1UF/50V 20%	CY20C104M	19.000	EA	4			
10	05	4410171	C1,C2,C3,C4,C5,C6,C7,C8,C9,C10,C11,C12,C13,C14, C15,C16,C17,C18,C19 RES 270 OHM 1/4W 10%	RC07GF271K	2.000	EA	4			
13	06	4410247	R28,R29 RES 1K OHM 1/4W 10%	RC07GF102K	6.000	EA	4			
14	06	4410304	R2,R7,R8,R26,R27,R31 RES 3.3K OHM 1/4W 10%	RC07GF332K	5.000	EA	4			
15	06	4410379	R1,R4,R5,R6,R9 RES 10K OHM 1/4W 10%	RC07GF103K	8.000	EA	4			
16	05	4410619	R16,R17,R18,R19,R20,R21,R22,R23 RES 2.2MEG OHM 1/4W 10%	RC07GF225K	1.000	EA	4			
17	05	4630075	R3 POT CER PC PIN 1K OHM .75W 15T	3006P-1-102	1.000	EA	4			
18	06	3390614	R30 LED GRN 7-12220 DIFFUSED 75DEG	HLMP-3507	4.000	EA	4			
19	05	3660669	CR1,CR2,CR3,CR4 IC SN74LS00N QU 2IN NAND	SN74LS00N	1.000	EA	4			
20	05	3660693	U10 IC SN74LS08N QU 2IN AND	SN74LS08N	1.000	EA	4			
21	03	3660719	U9 IC SN74LS20N DU 4IN NAND	SN74LS20N	1.000	EA	4			
22	03	3660727	U15 IC SN74LS27N TR 3IN NOR	SN74LS27N	2.000	EA	4			
23	05	3660735	U16,U17 IC SN74LS30N SI 8IN NAND	SN74LS30N	2.000	EA	4			
24	05	3660826	U18,U19 IC SN74LS163AN BINCOUNT PRESET	SN74LS163AN	2.000	EA	4			
			U13,U14							

PRINT PHANTOM ITEMS
 PRINT COMPONENTS
 PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 9200288 CROSS REF ITEM DESCRIPTION ASSY,6802 CPU MRC-1/1A ENGR DRAW 2002710 R BATCH QTY 1 ITEM TYPE 1 UNIT MEAS EA LOW LEVEL 02 PLANNER 514

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	OPT TYP	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
25	05	3660867	IC SN74LS367 HEX BUF 3/ST U11	SN74LS367AN	1.000	EA	4				
26	05	3660875	IC SN74LS368 HEX INV 3/ST U12	SN74LS368AN	1.000	EA	4				
27	05	3660859	IC SN74LS244N OCT BUS/DRIV ST U5,U6,U7,U8	SN74LS244N	4.000	EA	4				
29	05	3710027	IC MC6821P PIA INTERFACE U2	MC6821P	1.000	EA	4				
30	04	3710019	IC MC6802P MICROPROCESSOR U1	MC6802P	1.000	EA	4				
31	03	3710035	IC MC6828P PRIOR INTERRUPT U3	MC6828P	1.000	EA	4				
34	06	3250024	SKT DUAL IN LINE 14 PIN U9,U10,U15,U16,U17,U18,U19	640357-1	7.000	EA	4				
35	06	3250032	SKT DUAL IN LINE 16 PIN U11,U12,U13,U14	640358-1	4.000	EA	4				
36	05	3250057	SKT DUAL IN LINE 20 PIN U5,U6,U7,U8	640464-1	4.000	EA	4				
37	05	3250073	SKT DUAL IN LINE 24 PIN U3,U4	640361-1	2.000	EA	4				
38	05	3250099	SKT DUAL IN LINE 40 PIN U1,U2	640379-1	2.000	EA	4				
40	05	1030030	SCR PMHD PHPS 3/48 X 3/8 SST	BINDER HEAD	2.000	EA	4				
41	04	1030089	WSHR LK #3 SR SST	LOCKWASHER #3	2.000	EA	4				
42	05	1030055	NUT HEX 3/48 SM PATT SST	NUT 3/48 SM	2.000	EA	4				

CPU INTERFACE

Schematic 91C7215
Component Layout 20C2781
PC Board 51C5907

I. PURPOSE

The CPU Interface module has eight functions:

1. Power failure sensing.
2. Power-on reset.
3. 50-Hz or 60-Hz real time clock.
4. Battery backup switching and charging.
5. Low battery voltage sensing.
6. Output relays for failsafe and maintenance override indication.
7. Connection for audible alarm muting.
8. Auto-restart in the event of malfunction.

II. SPECIFICATIONS

1. The maximum battery charging current is 75 mA. This is suitable for up to 7.5 Ah Gel-Cell batteries. For a larger battery, use an external charger.
2. For a battery voltage of 6 V, it is float-charged at 6.95 V. The battery is considered discharged when the battery voltage under load drops below 5.0 V. The maximum voltage applied to the battery terminals should not exceed 7.05 V.
3. The voltage and current ratings of the maintenance override and failsafe relays are 24 Vdc and 1 A. Relay contacts are brought on to the rear panel connector.
4. Aural external drive output:
 - maximum voltage = 12 V
 - maximum current = 25 mA
 - maximum current from +5 V output = 25 mA
(internal defeat)

Power user supplied; output is open collector switched to chassis ground.

III. ELECTRICAL ADJUSTMENTS

1. Battery Charge Voltage (R28): This control is set at the factory for 6.95 V \pm 1 V into a 270 ohm load. This is the correct float-charge voltage for the supplied batteries and should not need adjustment.

IV. THEORY OF OPERATION

1. Power Failure Sensing

AC voltage from the secondary of the power supply transformer is supplied at pins P1-11 and P1-13. The ac is full-wave rectified by CR1 and CR2, and then filtered using C1. A potentiometer is connected to P1-91 and ground on the CPU board. R1, R2 and the potentiometer form an adjustable attenuator that is used to compensate for variances in local line voltage and frequency. U1A and R4 form a comparator with hysteresis. The threshold is maintained constant with CR3, a 3.1 V Zener diode. When normal line voltage is applied, the positive input of U1A is above 3.1 V, causing the output to be high. If the ac supply should fail for a period of time (nominally 10 ms), the positive input to the comparator will fall below 3.1 V and cause the output *PF to go low.

2. Power-On Reset

When power is applied to the unit, *PF will go high, allowing C4 to charge through R8. This voltage is applied to the negative input of a comparator consisting of U1B and the 3.1 V reference. After approximately 400 ms, the negative input will reach the reference level causing the output of U1B to go low, which removes the base drive to Q1 allowing the collector to be pulled high by R14. When power is removed from the unit, *PF will go low, discharging C4 through R7 and CR4. Operation is much quicker in this direction and reactivates *RESET approximately 3 ms after *PF goes low.

3. Real Time Clock

AC voltage from the power supply transformer secondary is supplied at P1-13 and rectified by CR5. This is applied through voltage divider R15 and R16 to the positive input of a voltage comparator (U1C). On the output of the comparator is a rectangular wave having a duty cycle of about 55%.

4. Battery Backup Switching and Charging

Fifteen volts from the power supply is regulated down to 7.45 volts by U2. This is passed through CR10 to the battery terminal. R28 is adjusted so that 6.75 V is applied at the battery terminals with no load. R29 is used to

protect U2 in case of a short across the battery terminals. During normal operation, Q3 is biased on through R26 by the +15 V supply; this allows the main 5 V supply to be applied to the 5 V standby bus. When either the +15 V or main 5 V supply fails, the base of Q5 is pulled toward ground by either CR7 or CR8. This forward biases Q4, allowing the battery voltage to be passed to the 5 V standby bus. The 6 V at the battery terminals is reduced to an acceptable voltage by the voltage drops of CR9, Q4 and Q5.

5. Low Battery Voltage Sensing

A comparator (ULD) is used as a bistable multivibrator. When main power is not applied, the voltage at the output of ULD will reflect the voltage of the 5 V standby bus. This voltage is dropped 0.6 V by CR6 and fed back to the positive input of ULD to keep the output high. If the voltage at the positive input falls below the reference voltage, the output of ULD will be forced low. This occurs when the 5 V standby bus falls to 3.1 V. This removes the voltage at the positive input, which effectively latches the output low. Upon reapplication of main power, C6 filters out any glitches that might alter the state of ULD. If the output of ULD did go low, this will tell the computer that the battery failed during the power outage. To reset the latch, a pulse of at least 10 ms is applied by the CPU to P1-71. This causes Q2 to conduct, removing the reference voltage to the comparator. The voltage divider of R22 and R25 is used to provide at least 0.4 V at the positive input to cause the output to go high when the reference voltage is removed.

6. Maintenance Override and Failsafe Relays

To activate the Failsafe output, P1-79 is set high from the CPU module. U5 ensures that the relay will not close when the *RESET line is in its low state, thus preventing a "glitch" when the unit is plugged in or the reset button is pushed. Each gate of U5 has an open-collector output which can sink the current required to activate the relay when both inputs to the gate are in their "high" state. Voltage regulator U4 provides +12 V to the other side of the coil. When the Failsafe relay is activated, closure occurs between pins 3 and 4 of the rear connector.

The Maintenance Override output is almost identical. P1-77 is set high from the CPU module to activate the relay. A closure will then be observed between pins 1 and 2 of the rear connector.

Closure between the Failsafe terminals will be observed when the unit is not in a failsafe condition. Closure across the Maintenance Override terminals will be observed when the unit is in a Maintenance Override condition.

In modules installed in a Control Terminal, these relays are never activated and serve no function. The relays are installed, however, to preserve interchangeability with modules installed in Remote Terminals.

The Maintenance Override and Failsafe relays are capable of switching a load of up to 24 Vdc at currents of up to 1 ampere. Inductive loads (relay coils, etc) should have a "clamping" diode wired across them to inhibit negative voltage spikes. External relays should be used when it is desired to switch greater loads (or ac loads).

These relays may also be interfaced with transistor-transistor logic (TTL) digital circuits. The relay contacts should be wired so that one side is referenced to the digital input. A pull-up resistor may be necessary, and it is advisable to wire a 1 μ F capacitor and a 100-ohm resistor (in series) across the relay output to suppress contact bounce. See Figure 1.1.

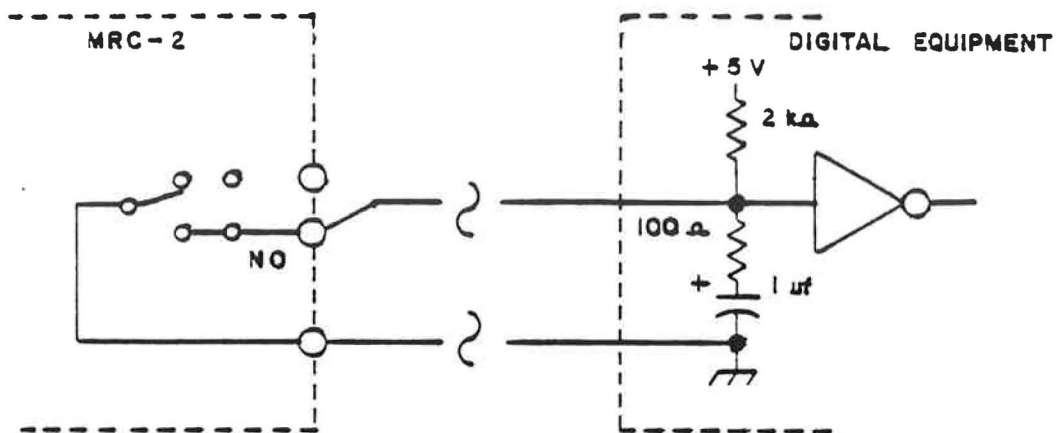


Figure 1.1 Digital circuit interface.

7. Auto-Restart in the Event of Program Malfunction

Integrated circuit U3 is a dual retriggerable monostable multivibrator ("one-shot"). During normal program operation, line P1-71 is continually strobed from the CPU module. Each pulse reaching pin 1 of U3 "retriggers" the first stage of U3 for another 500 ms. The output at pin 13 will remain high as long as pulses at pin 1 arrive at least every 500 ms. Should these pulses cease (because the program has ceased running properly), the output at pin 13 falls to ground. The falling edge at pin 9 causes a 1 ms pulse at pin 5. If the jumper marked "Auto-Restart" has been installed, transistor Q6 is switched on, causing the *RESET line to fall to ground and re-initiating operation of the program.

The jumper marked "Continuous Restart" enables continuous retries, should the first attempt to restart be unsuccessful. This feature does not appear on some early production units.

8. Alarm Drive

An alarm drive output is available to the user at pin 5 of connector J1 at the rear of the chassis. When the system is in a condition where an audible alarm is appropriate (see the Operation section of the manual), a transistor on the front panel assembly is switched on, enabling current to sink to ground. The collector of this transistor is brought out to pin 5 via a trace extending across the CPU module and onto the CPU Interface module. No more than +12 V should be placed on this pin, and a current-limiting resistor should be used so that no more than 25 mA may flow through the transistor. This input is not RF-filtered (since a studio environment is assumed). Figure 1.2 shows a suggested circuit to use if filtering is necessary. We suggest that the components be mounted in the cable near the connector.

9. Internal Alarm

The Sonalert on the front panel is enabled when pin 6 of J1 is connected by a simple jumper to pin 5. Current limiting is provided internally. Unless the jumper is installed, the audible alarm is disabled. Pins 5 and 6 may also be used for remotely disabling the Sonalert (for instance, when a microphone in the studio is active) if a switch is placed between the pins.

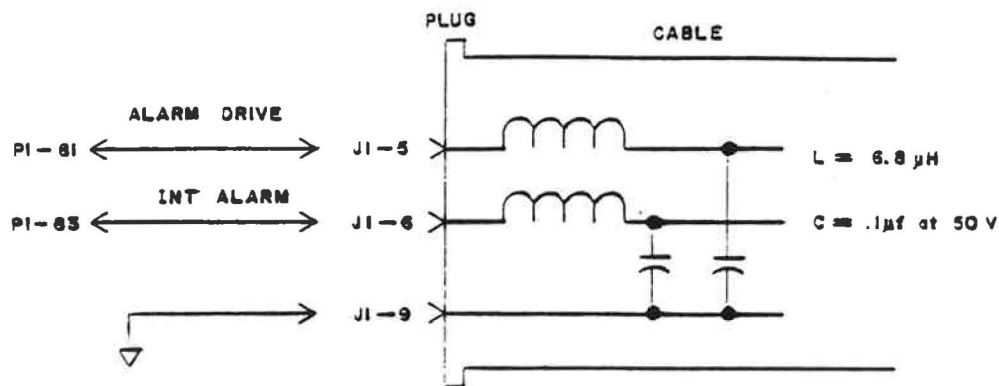
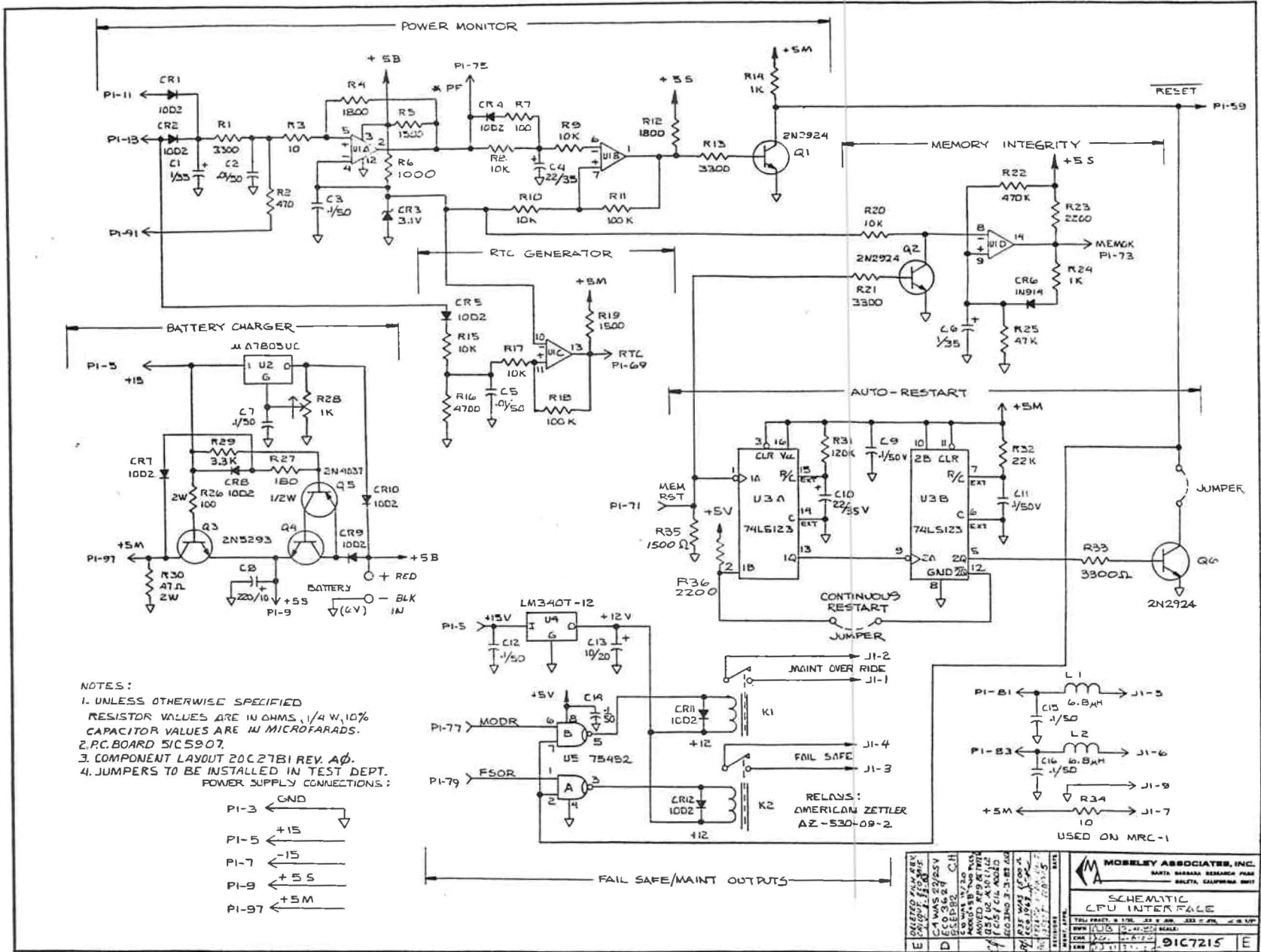


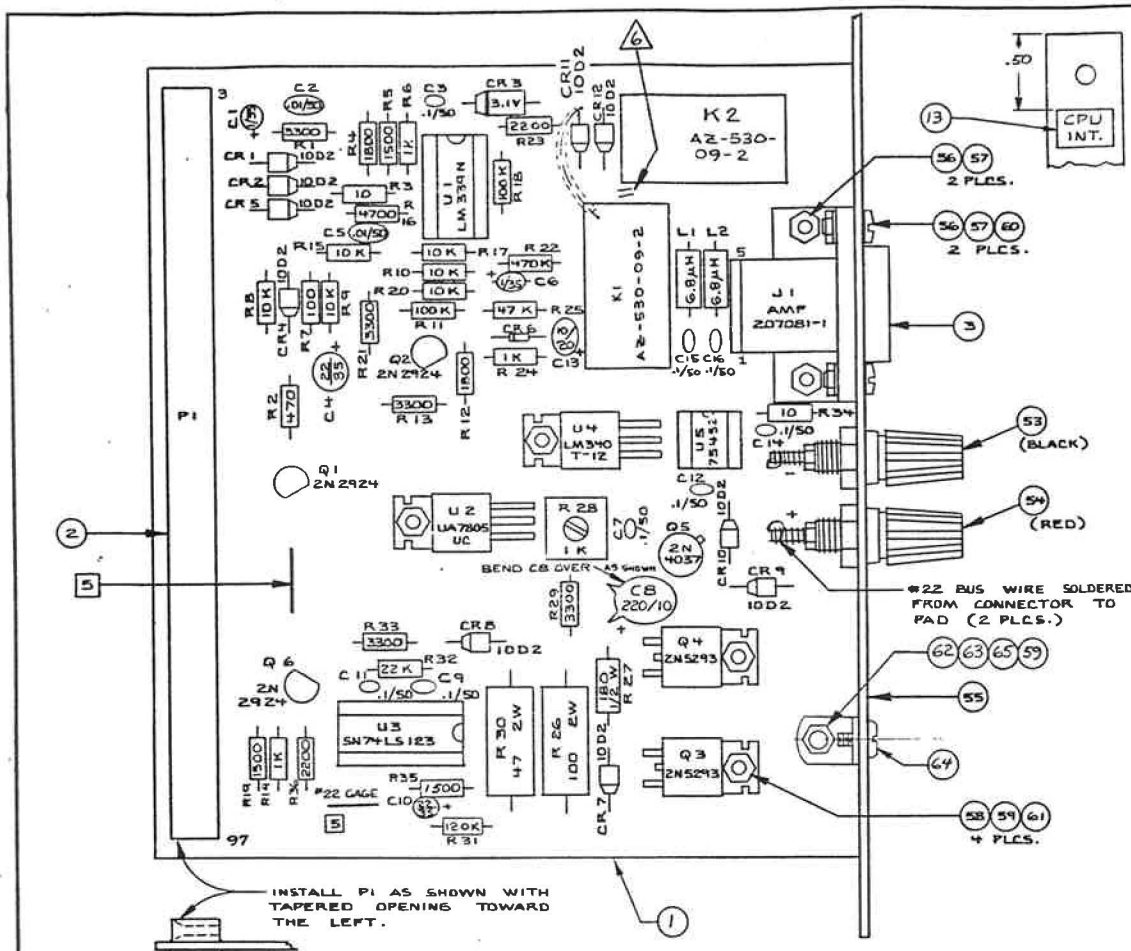
Figure 1.2 RF filter circuit.

V. TROUBLESHOOTING

1. Read the section on troubleshooting presented in Section 10.4 (Fault Isolation).
2. Specific areas on this module that must be functional for operation of the CPU are as follows:
 - a. Verify presence of +5 V on the 5 V standby bus (emitter of Q4). If it is not there, check for short to ground or Q3 open.
 - b. Check for waveform at P1-11 and P1-13 (ac power in). If not there, check CR1, CR2, C1, and the two 100-ohm resistors mounted on the dc power supply (R113 and R114).
 - c. Check voltage at pin 4 of U1. It should be between 3.0 and 3.2 volts. If not, check U1 and CR3.
 - d. Check voltage at U1 pin 2 (*PF). If it is low, try readjusting the trim potentiometer on the CPU module (R30). If this does not correct it, check for shorts or replace U1.
 - e. If *PF is normal but *RESET is still low, check for at least 4.5 V at pin 6 of U1 and 2.5 to 3.5 V at pin 7. If these are normal, pin 1 of U1 should be less than 0.5 V. If not, suspect U1. The collector of Q1 (P1-59) should be near +5 V. If not, check U3 pin 5, which should be near ground. If not, suspect U3. If U3 pin 5 is indeed near ground, suspect Q1, Q6, or a short to ground at P1-59.

- f. Check waveform at U1 pin 13. If a 60-Hz square wave is not present, suspect CR5 or U1.
3. Circuits that will not stop operation of the CPU are:
- a. Maintenance override and failsafe drivers can be checked with a VOM; most probable cause of failure is U4 or U5.
 - b. When main power is applied to the unit, U1 pin 14 should be near +5 V. If it is not, try momentarily grounding pin 8. If pin 14 is still low, suspect CR6, C6 or U1.
 - c. If the voltage at the red (+) battery terminal is not around 7.3 V, suspect U2 or R28 if the voltage is too high. If too low, suspect Q4 or Q5.





65	WASHER #6 SPLIT RING		1090604	1	
64	SCREW #6-32 X 3/16 BN		1090174	1	
63	SCREW #6-32 X 1/4 BN		1090190	1	
62	ANGLE BRACKET W/500 W/15C		2040051	1	
61	SPLIT RING LOCKWASHER #6		1010596	4	
60	SPLIT RING LOCKWASHER #4		1050632	2	
59	NUT 6-32 SMALL PATT		1010554	5	
58	SCREW B.H. 6-32 X 1/4		1090182	4	
57	NUT 4-40 THIN SERIES		1050590	4	
56	SCREW B.H. 4-40 X 5/16		1050145	4	
55	PANEL	5A2B40	2060374	1	
54	BINDING POST EFJ III-2D2	RED	3290004	1	
53	BINDING POST EFJ III-2D3	BLACK	3290012	1	
52	BUS WIRE #22 GA		1621927	1	
51	RELAY AZ-530-09-2	K1,2	3270113	2	
50					
49	DIODE 1N914	CR 6	3600853	1	
48	"	SZ 3.1 1%	CR 3	3610184	1
47	DIODE 10D2	CR12,5,7-12		3610003	10
46	CAPACITOR 22/35	C4, C10	4280095	2	
45	"	10/20	C 13	4280079	1
44	"	220/10	C 8	4280186	1
43					
42		1/50	C12,13,24,35,6	4310207	8
41		.01/50	C2,5	4310132	2
40	CAPACITOR 1/35	C1,6	4280038	2	
39	INDUCTOR 6.8 MH	L1, L2	4020343	2	
38	POT 1K 0.5 W	R 28	4630267	1	
37					
36	RESISTOR 470	R 2	4410205	1	
35	"	10	R3,34	4410023	2
34	"	100	R 7	4710122	1
33	"	47K	R 25	4410452	1
32	"	1K	R6,14,24	4410247	3
31	"	1500	R5,19,35	4410262	3
30	"	1800	R12,4	4410270	2
29	"	2200	R23,3	4410288	2
28	"	3300	R13,21,29,33	4410304	4
27	"	4700	R 16	4410338	1
26	"	10K	R8,10,15,17,20	4410379	6
25	"	22K	R 32	4410411	1
24	"	100K	R11,18	4410444	2
23	"	120K	R 31	4410502	1
22	"	470K	R 22	4410577	1
21	"	3.3K	R29	4410304	1
20	"	180 1/2W	R 27	4420170	1
19					
18	"	47 2W	R 30	4440053	1
17	RESISTOR 100 2W	R 26	4440079	1	
16	TRANSISTOR 2N4037	Q 5	3630191	1	
15	"	2N2924	Q1,2,6	3630027	3
14	TRANSISTOR 2N5293	Q 3,4	3630316	2	
13	LABEL, LOGIC CARD	10A1064-1	3430485	1	
12	I.C. SN 74LS123	U 3	3660768	1	
11	"	SN 74542	U 5	3660925	1
10	"	LM 340T-12	U 4	3650074	1
9	"	UA 7805 UC	U 2	3650173	1
8	I.C. LM 339N	U 1	3730207	1	
7					
6	I.C. SOCKET AMP 640358-1	U 5	3250016	1	
5	"	640357-1	U 1	3250024	1
4	I.C. SOCKET AMP 640358-1	U 3	3250032	1	
3	CONN. AMP 207081-1	J 1	3050234	1	
2	CONN. BERGE 65001-UB1	P 1	3110442	1	
1	P.C. BOARD 51C107	REV-12-22	3472271	1	

NOTES:

- UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/4 W, 10%. CAPACITORS ARE IN MICROFARADS.
- P.C. BOARD 51C5907 REV.-12,-22
- SCHEMATIC 91C7215
- TRIM ALL COMPONENT LEADS NOT TO EXCEED 2/32" IN LENGTH.
- JUMPERS TO BE INSTALLED IN TEST DEPT.
- MAKE ETCHCUT ON COMPONENT SIDE WHERE SHOWN. ADD JUMPER ON CIRCUIT SIDE BETWEEN CR11 AND K1 WHERE SHOWN, USING #30 WIRE-WRAP WIRE.

ITEM NO: 9203076
FIRST USED ON:
MRC-1

ITEM NO.	DESCRIPTION	REF. DESIG.	STOCK NO.	QTY.	
1	P.C. BOARD 51C107	REV-12-22	3472271	1	
2	CONN. BERGE 65001-UB1	P 1	3110442	1	
3	CONN. AMP 207081-1	J 1	3050234	1	
4	I.C. SOCKET AMP 640358-1	U 3	3250032	1	
5	"	640357-1	U 1	3250024	1
6	I.C. SOCKET AMP 640358-1	U 5	3250016	1	

MOSELEY ASSOCIATES, INC.
SANTA BARBARA, CALIFORNIA 93101

COMPONENT LAYOUT
CPU INTERFACE ASSY.

REV. 12-22

20C2781 F

MEMORY BOARD 8 X 4

Schematic 91D7135
Component Layout 20B2712
PC Board 51B5850

I. PURPOSE

This memory board contains additional memory for program and data storage. Up to 8 kilobytes of erasable programmable read only memory (EPROM) may be installed for program storage. Data is both written and read into random access memory (RAM). This board has provisions for four kilobytes of RAM.

II. TECHNICAL DESCRIPTION

Address ranges for both PROM and EPROM are selected independently using slide switches of DIP switch S1, allowing multiple memory boards to be used in special applications. Slide switches 1 and 2 are used to assign EPROM addresses, which occur in 8kbyte blocks from 8000 to FFFF hex. The output of IC U12, Pin 6 is used as an enable strobe for the EPROM chip select decoder (IC U13), allowing the proper memory IC to be selected. Slide switches 3 and 4 are used in assigning RAM addresses which are in 4kbyte blocks ranging from 0000 to 3FFF hex. Pin 8 of IC U12 is used as a RAM access enable strobe for the half of IC U13 used to select the proper RAM IC.

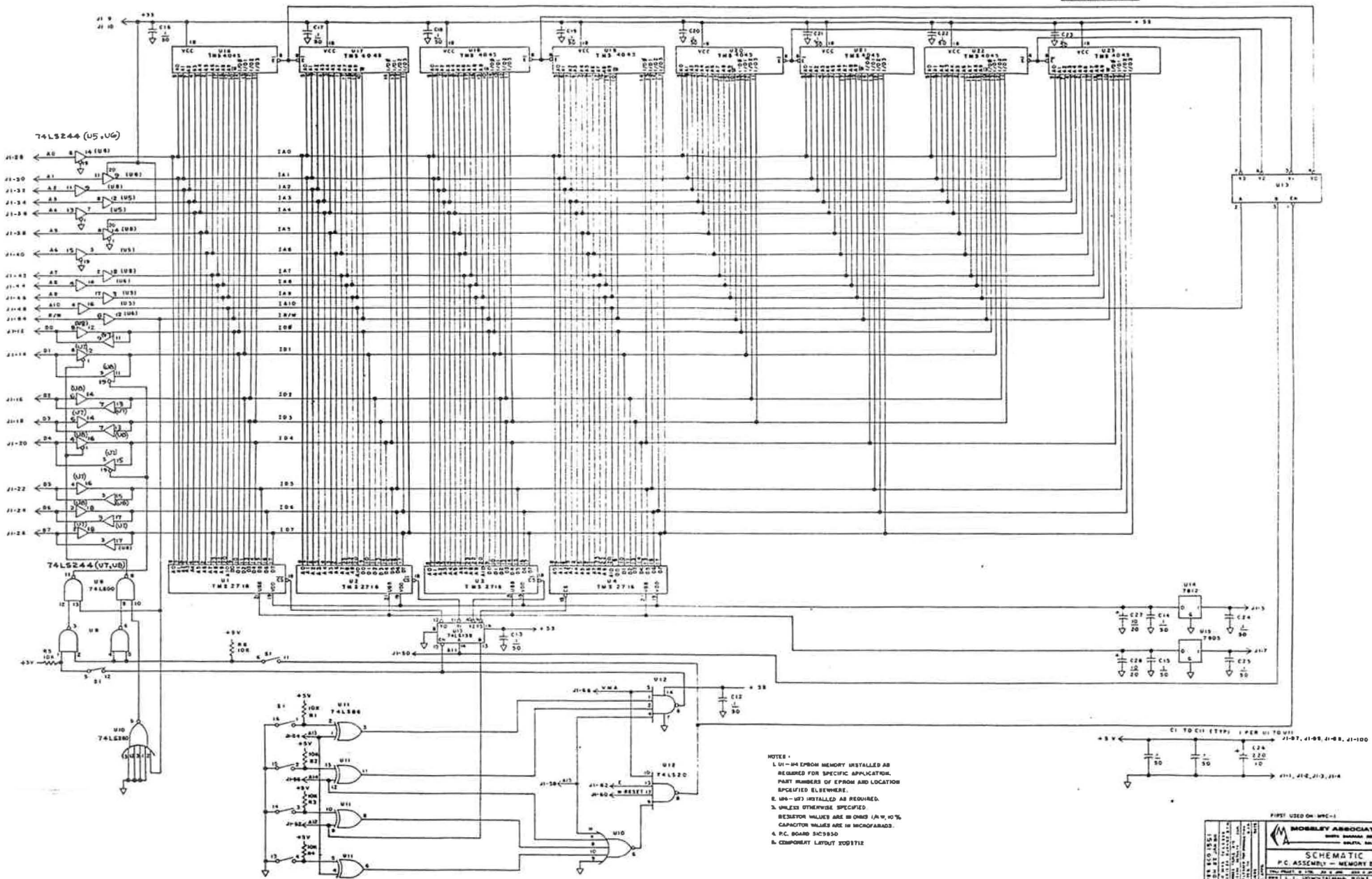
Each TMS2716 EPROM is 8 bits by 2048 words; however, the

TMS4045 RAM is only 4 bits wide by 1024 words. Two RAM IC's are enabled at the same time to allow storage and retrieval of 8-bit data words.

Slide switch 5 disables the address buffers when EPROM is selected. Normally, this switch is closed so EPROM can be read. In applications which require additional memory cards with RAM only, this switch would be opened on the cards without EPROM. Slide switch 6 disables EPROM when RAM is accessed. Its operation is similar to the operation of slide switch 5.

III. TROUBLESHOOTING

- A. Make sure the slide switches are in proper position. In a standard Remote or Control Terminal, all memory board slide switches should be in the ON position.
- B. Verify proper +12, -5, +5 volt supply voltages are present. It is best to measure these voltages at the actual memory IC pins.
- C. Check EPROM ENABLE signal (IC U12, Pin 6) by observing waveform. EPROM should be enabled frequently when the system is operating properly. If no toggling is observed, check the address select circuitry (IC U11 and U12).
- D. Check the RAM ENABLE signal (IC U12, Pin 8) by observing waveform. It should frequently toggle if address selection circuitry is operating properly.
- E. Verify that the SN74LS244 bus drivers are enabled, allowing data to be read and written from the data bus.



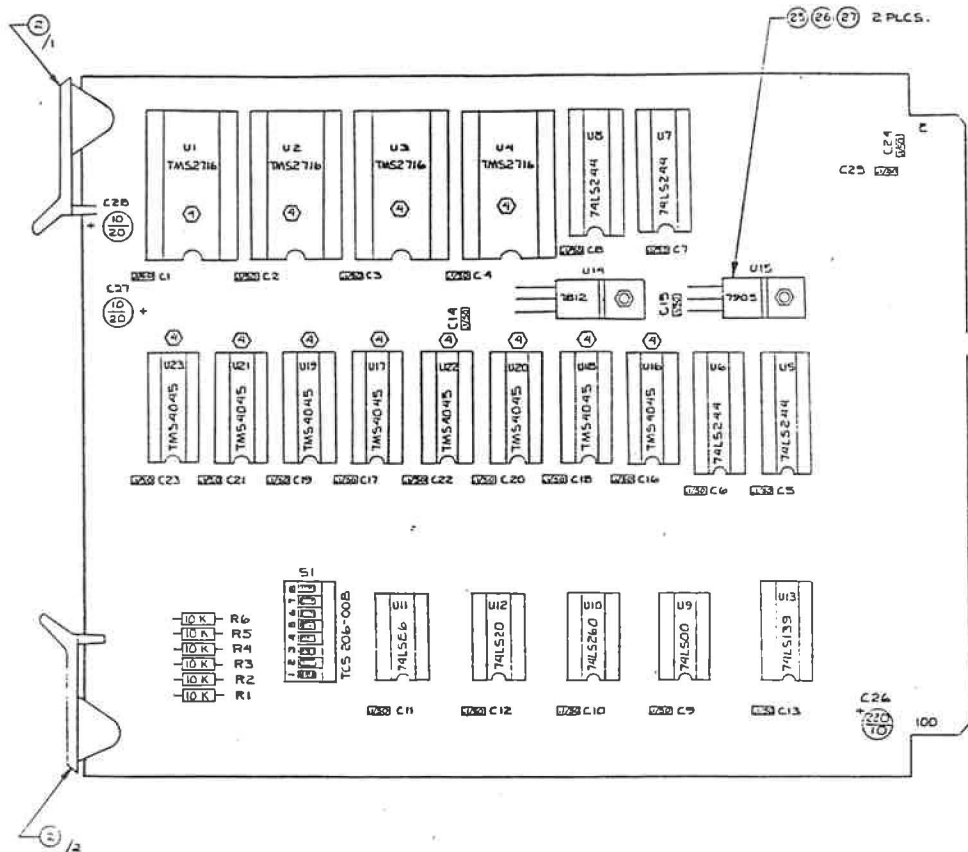
- NOTES:
1. U1-U4 EPROM MEMORY INSTALLED AS REQUIRED FOR SPECIFIC APPLICATION. PART NUMBERS OF EPROM AND LOCATION SPECIFIED ELSEWHERE.
 2. U9-U10 INSTALLED AS REQUIRED.
 3. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS (1/4 W, 10%), CAPACITOR VALUES ARE IN MICROFARADS.
 4. P.C. BOARD SIC850
 5. COMPONENT LAYOUT Z001112

FIRST USED ON: 9107135-1

MOBLEY ASSOCIATES, INC.
 10000 W. 10th Ave. Suite 100
 Denver, Colorado 80202

SCHEMATIC
 P.C. ASSEMBLY - MEMORY BOARD 814

DATE: 11/11/88
 DRAWN BY: J. J. MOBLEY
 CHECKED BY: J. J. MOBLEY
 9107135



NOTES:

1. UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/4 W, 10% CAPACITOR VALUES ARE IN MICROFARDS
2. P.C. BOARD SIC5050-50
3. SCHEMATIC 9107135
4. CMOS I.C. COMPONENTS IDENTIFIED FOR REFERENCE ONLY.
5. CMOS I.C.'S TO BE INSTALLED ON A HIGHER ASSEMBLY LEVEL.
6. I.C. SOCKETS TO BE INSTALLED IN EACH I.C. POSITION.
7. DIPSWITCH (S1) INSTALLED WITHOUT SOCKET. INSTALL WITH SWITCH NO. 1 ON BOTTOM WHEN VIEWING BOARD AS SHOWN.

ITEM	DESCRIPTION	REF DES	STOCK NO	QTY
29				
28				
27				
26				
25				
24				
23				
22				
21				
20				
19				
18				
17				
16				
15				
14				
13				
12				
11				
10				
9				
8				
7				
6				
5				
4				
3				
2				
1				
ITEM DESCRIPTION	REF DES	STOCK NO	QTY	
26	I.C. SOCKET	U15	3250040	1
27	NUT	HW 1/4 X 1/4	1050582	2
28	LOCK WASHER	HW 1/4 X 1/4	1050624	2
29	SCREW	HW 1/4 X 1/4	1050103	2
24	I.C. SOCKET	U14	3250024	1
23	I.C. SOCKET	U13	3250032	1
22	I.C. SOCKET	U12	3250057	1
21	I.C. SOCKET	U11	3250073	1
20	CAPACITOR	C24	4128018	1
19	CAPACITOR	C23	4280074	2
18	CAPACITOR	C22	4310207	25
17				
16	RESISTOR	R1-R6	4410374	6
15				
14	SWITCH, DIP	S1	3190084	1
13	I.C.	U14	3630074	1
12	I.C.	U13	3660800	1
11	I.C.	U12	3660664	1
10	I.C.	U11	3660966	1
9	I.C.	U10	3660719	1
8	I.C.	U9	3660743	1
7	I.C.	U8	3660854	1
6				
5				
4	LABEL		3430241	1
3	I.C.	U15	3450465	1
2	EJECTOR KIT		1250075	1
1	P.C. BOARD		3472412	1

MOORE ASSOCIATES, INC.	MOORE ASSOCIATES, INC.
COMPLETE LAYOUT	COMPLETE LAYOUT
P.C. ASSEMBLY MEMORY 844	P.C. ASSEMBLY MEMORY 844
20D2712 D3	20D2712 D3

MODEM II BOARD

Schematic 91D7233
PC Board 51C5909
Component Layout 20D2787

I. PURPOSE

The modem (MOdulator/DEMOdulator) is used to communicate digital information between Remote and Control Terminals via the telephone lines.

II. SPECIFICATIONS

Transmission Format	7-bit ASCII plus even parity in a 10-bit frame. Transmissions are bi-directional and non-simultaneous.
Transmission Speed	1200 baud/300 band switchable
Error Detection	Character parity and longitudinal check-sum on messages
Modulation	Two-frequency continuous phase FSK MARK = 2200 Hz SPACE = 1200 Hz
Interface	600 Ω telephone lines, strappable two or four-wire configuration.

III. TECHNICAL DESCRIPTION

The MC6850 Asynchronous Communications Interface Adapter (IC U8) provides the data formatting and control to interface serial asynchronous communications information to the 8-bit data bus. The functional configuration of the ACIA

is programmed automatically during system initialization. A programmable control register provides variable word lengths, clock division ratios, transmit control, receiver control and interrupts. The baud-rate generator (IC U16) provides the clock frequency for the ACIA.

The modem has switch-programmable address specification, allowing multiple modem boards to be used in special applications. BCD switch S3, IC U10 and IC U12 provide address decoding for the board. In normal system operation, with only one modem per unit, switch S3 is left in the "0" position. Two SN74LS244 bus drivers (IC U3 and IC U4) are used to write and read data onto the bus. Parts of IC U6 and IC U7 are used to enable reading and writing according to the status of the read/write line and the board address.

Outgoing serial data is modulated into dual tone frequency shift keying by the XR2206 function generator (IC U15). Serial data input is applied to pin 9. A high input causes a low frequency (Mark) of 1200 Hz to be generated. A low input causes a high frequency (Space) of 2200 Hz to be generated. Resistor R38 is used to reduce harmonic distortion.

Transistor Q3 serves as a switch to turn on the modulator according to the request to send (\overline{RTS}) from the ACIA. Switch S2 and parts of IC U11 and IC U13 will turn on the modem continuously for test purposes. The output of the oscillator is AC coupled and fed into a 741 op amp before being transmitted via the telco interface board.

The Deadman Circuit (IC U9) turns off the modulator if communications are disrupted for more than 2.5 seconds.

The incoming FSK signal is fed through a bandpass filter consisting of half of IC U14. The filtered signal is amplified via part of IC U14 and clamped by CR1 and CR2. The clamped signal is then demodulated by the XR2211 (IC U1). The output of the demodulator is buffered by part of U13.

The amplified signal from the third part of IC U13 is peak-detected by CR8, CR7, CR6, and the fourth part of IC U14. This signal is buffered by parts of IC U5 and inverted by transistor Q1 to provide data carrier detect (*DCD).

IV. BASIC MODEM ADJUSTMENT

Normally no adjustment needs be made to the high frequency, low frequency, and VCO controls (R36, R35, and R11). These are painted at the factory with red lacquer to discourage casual adjustment. The procedure for making these adjustments is described in Section V, but it should be stressed that such adjustments under normal circumstances are unnecessary.

Each of the procedures outlined below assumes a one-site system. For multi-site systems, each Remote Terminal must be connected in turn and adjusted.

It is suggested that initial adjustment be made with the units back-to-back on the bench to gain familiarity with the controls prior to installation.

It should be noted that in Section 2, a "Series 3002 (unconditioned) Data Channel per Bell System Technical Reference PUB-41004" is specified. Therefore, this type of line should be specifically requested from the phone company. (It is guaranteed to have certain characteristics when FSK data signals

are transmitted across it.)

In the following adjustment procedure refer to drawing 15B1117 which is bound in with the next group of blueprints for the location of controls and test points on the modem board.

Step 1: Connect the Control and Remote back-to-back on the bench. For a two-wire system, see Figure 1.1. For a four-wire system, see Figure 1.2. For a mixed telco and subcarrier system, see Figure 1.3. For systems using a subcarrier interconnect in both directions, see Figure 1.4.

NOTE: A simulated telephone line with 30 dB loss may be constructed using a T pad with 560 ohms in each arm and 37 ohms to common.

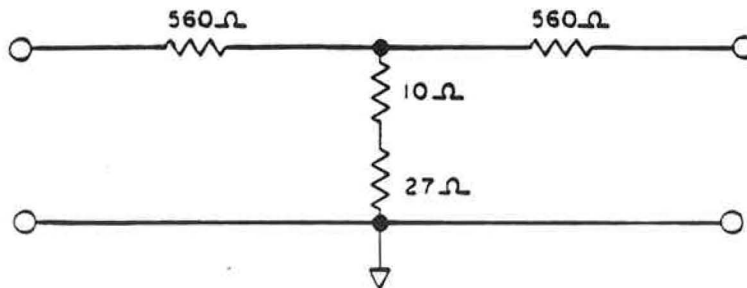


Figure 1.0 - SIMULATED 30 dB PHONE LINE

A Simpson 260 VOM or similar equipment may be used in this adjustment procedure.

Step 2: Apply power to both terminals. Push "ACK" ("acknowledge") at the Remote Terminal keyboard. Disable all active sites at the Control Terminal as follows (see Control Terminal manual Section 4.6.3 for a full explanation of this):

- a. Push "SET-UP". The SET-UP LED should come on.
- b. Press "SITE ENAB" ("site enable").. The SITE window will

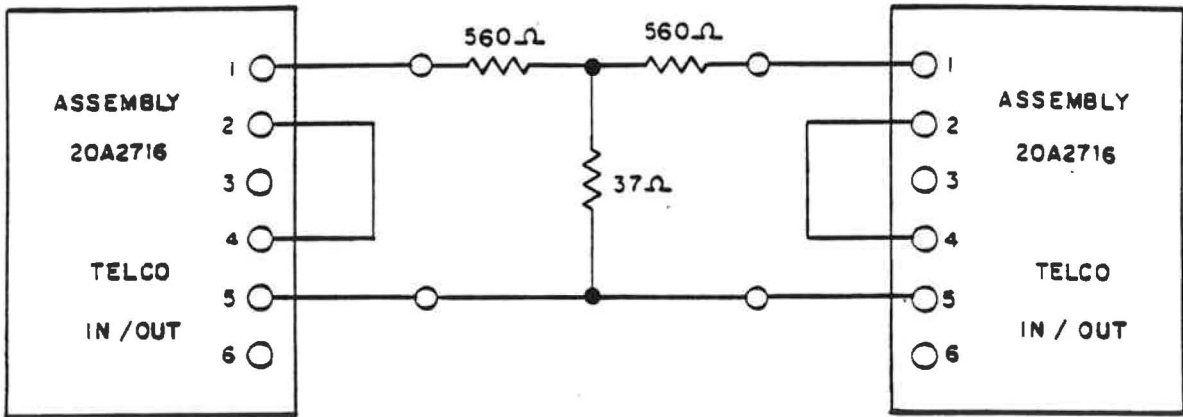


Figure 1.1 - Two-Wire Interconnect

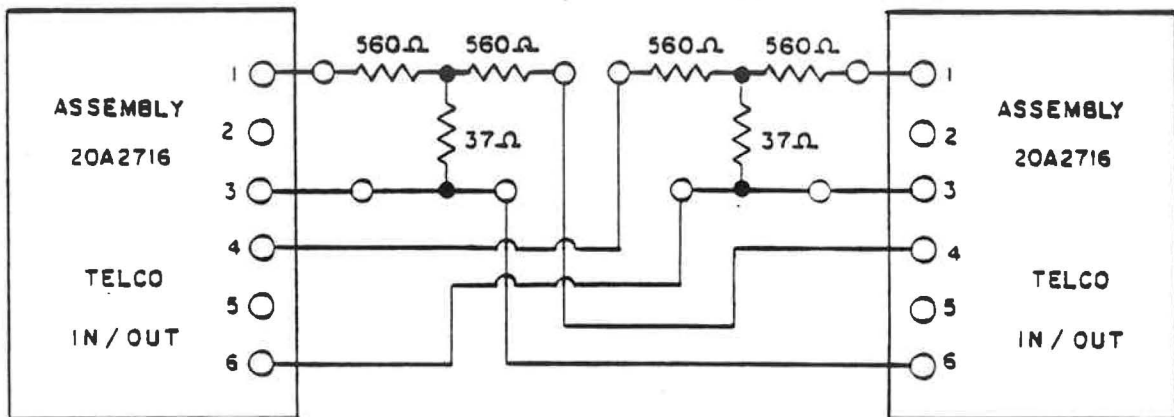


Figure 1.2 - Four-Wire Interconnect

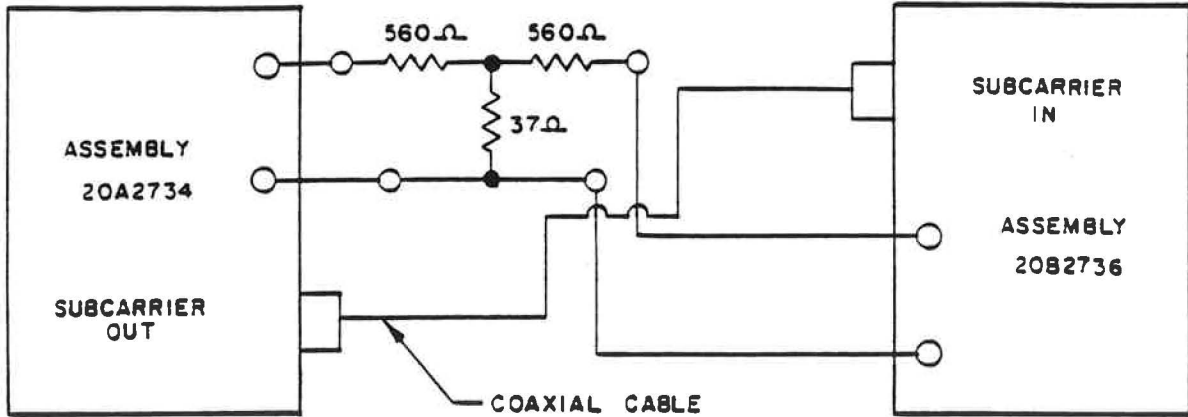


Figure 1.3 - Mixed Subcarrier and Telco

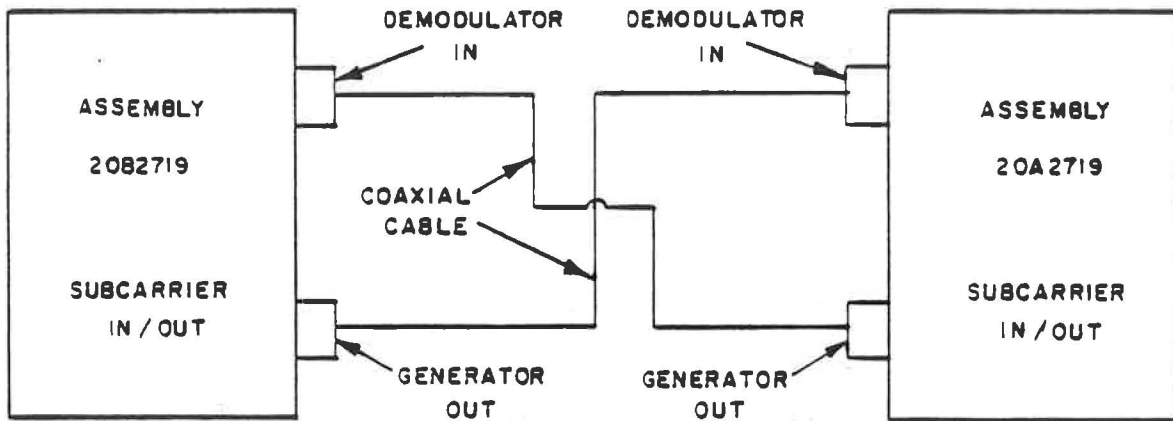


Figure 1.4 - Subcarrier Interconnect

display ".1".

- c. If you have a multi-site system, repeat step (b) for each additional site (select site 2, press site enable, etc.).
- d. The TRANSMIT LED on the front of the modem card should be off, indicating no sites are enabled.

Step 3: Place the toggle switch on the front of the modem cards (S2) in either TEST position at both terminals. This causes both modulators to generate a continuous tone.

Step 4: Adjust the output levels. Use R10 ("send level adjust") on the front of the modem boards.

Two-wire systems: Measure the output level across terminals 1 and 5. Zero dBm should be observed at both the Control and Remote Terminals.

Four-wire system: Measure the output level across terminals 4 and 6. Zero dBm should be observed at both the Control and Remote Terminals.

Mixed systems: Measure the output level at the Telco Output terminals at the appropriate terminal. Zero dBm should be observed. Using a calibrated oscilloscope, measure the voltage at the Subcarrier Output BNC connector at the other terminal. 1.5 volts peak-to-peak should be observed. The OUTPUT potentiometer above the BNC connector should be adjusted if necessary to meet this requirement. The waveform observed should conform to drawing 15A1114. Adjust R10 ("send level adjust") on the front of the modem board if necessary to meet this requirement. (Note: The COARSE and FINE adjustments above the BNC connector have been set at the factory and should not require further adjustment.)

Subcarrier-In/Subcarrier-Out systems: Measure the output at both terminals at the subcarrier output BNC connector and adjust as described immediately above (under "mixed systems").

Step 5: Put the Control Terminal in OPERATE mode (using S2) and the Remote terminal in the right (TEST) position. Adjust the Control Terminal input level using R12 ("receive level adjust") on the front edge of the Control Terminal's modem board. Measure the input levels across test points 6 and 3. Turn R12 clockwise to increase voltage level.

Two-wire system: Between .5 and .6 volts AC should be observed across the test points. (-30 dBm input)

All other systems: Between .5 and .6 volts AC should be observed across the test points. (-30 dBm input)

Step 6: Put the Remote Terminal in OPERATE mode and the Control terminal in the down (TEST) position (using S2). Adjust the Remote Terminal input level (exactly as was done in step 5 at the Control Terminal).

Step 7: Place both terminals in OPERATE mode. Push the RESET button on the front of the CPU boards at both terminals. Re-enable the Remote Terminal by using the "SITE ENAB" key at the Control Terminal keyboard (Refer to Section 4.6.3 of the Control Terminal manual for a full explanation.) This step is essentially the reverse operation to step 2, above.

Step 8: The Control Terminal and Remote Terminal should now be "talking" successfully. A channel number should appear in the CHANNEL display at the Control Terminal. Pushing the CH ("channel") key at the Control Terminal should cause the channel display at the Control Terminal to advance by one channel.

NOTE: The channel numbers at the Control and Remote Terminals are independent of each other. One channel may be observed at the Control Terminal and a different channel at the Remote Terminal. However, both channel numbers are stored at the

Remote Terminal and for a channel number to appear at the Control Terminal, the number must be fetched from the Remote Terminal - thus indicating a successful communication.

The Control Terminal initiates each communication by sending an interrogation to the Remote Terminal. The Remote Terminal replies with its response. As a result, a regular "heartbeat" can be observed on the Transmit LED at the Control Terminal. If the Remote Terminal does not properly receive a message it does not respond and the unit appears to "skip a beat." In a properly adjusted system, a regular pattern of long and short pulses can be observed on the Transmit LED's.

Two Wire Systems: In a two-wire system, each unit can "hear itself speak" so the Receive LED remains on most of the time. Sometimes a pulsation or flicker can be observed.

Other Systems: The Transmit and Receive LED's will flash alternately at both terminals. If a Receive LED remains steadily the input level on the board is probably too high.

Step 9:

Systems Involving Subcarrier: Upon completion of the back-to-back tests and after connection to the actual interconnecting radio link it may be necessary to adjust the OUTPUT pot on the appropriate interface cards at the rear of the terminals, in order to assure proper modulation of the interconnecting radio circuits.

V. FREQUENCY AND VOC ADJUSTMENTS

High frequency, low frequency, and VCO should not nor-

mally need adjustment. To emphasize this fact, R36, R35, and R11 are painted with red lacquer at the factory after their initial alignment. This section is included in case a need arises to re-align the board, perhaps following a repair accomplished by the user. Refer to drawing 15B1117 which is bound in with the next group of blueprints for the location of controls and test points on the Modem Board.

NOTE: If the frequency counter does not give stable readings the following steps are suggested:

A. Place a 10 K Ω resistor between the frequency counter input and TP1 (white) to increase frequency counter input impedance.

B. Reduce false triggering by placing a capacitor between TP1 (white) and ground.

It is suggested that the terminals be connected back-to-back at the same location (see preceding section) so that both ends are easily accessible.

Step 1: With the terminals not connected to each other, prepare to set the frequencies as follows: Connect frequency counter between TP1 (white) and ground (TP3, black).

Step 2: Set the high frequency. Place S2 in HI position and adjust R56 to obtain a frequency of 2200 Hz.

Step 3: Set the low frequency. Place S2 in LOW position and adjust R53 to obtain a frequency of 1200 Hz.

Step 4: Set S1 to CAL position. Connect frequency counter to TP4 (yellow). Adjust R11 (VCO fine tune) to obtain a

frequency of 1700 Hz at TP4.

Step 5: Return S1 & S2 to OPER position and adjust the input and output levels as described in Section IV above, with the terminals connected.

VI. INSTALLATION AND TROUBLESHOOTING

A. Refer to Section IV for instructions for adjustment of the input and output levels.

If trouble is encountered:

B. Check DIP Switch positions. Normally slide switch 1 is ON and other switches are in the OFF position. Make sure S1 is in the OPERATE position at all terminals.

C. Verify that proper power supply voltages are present.

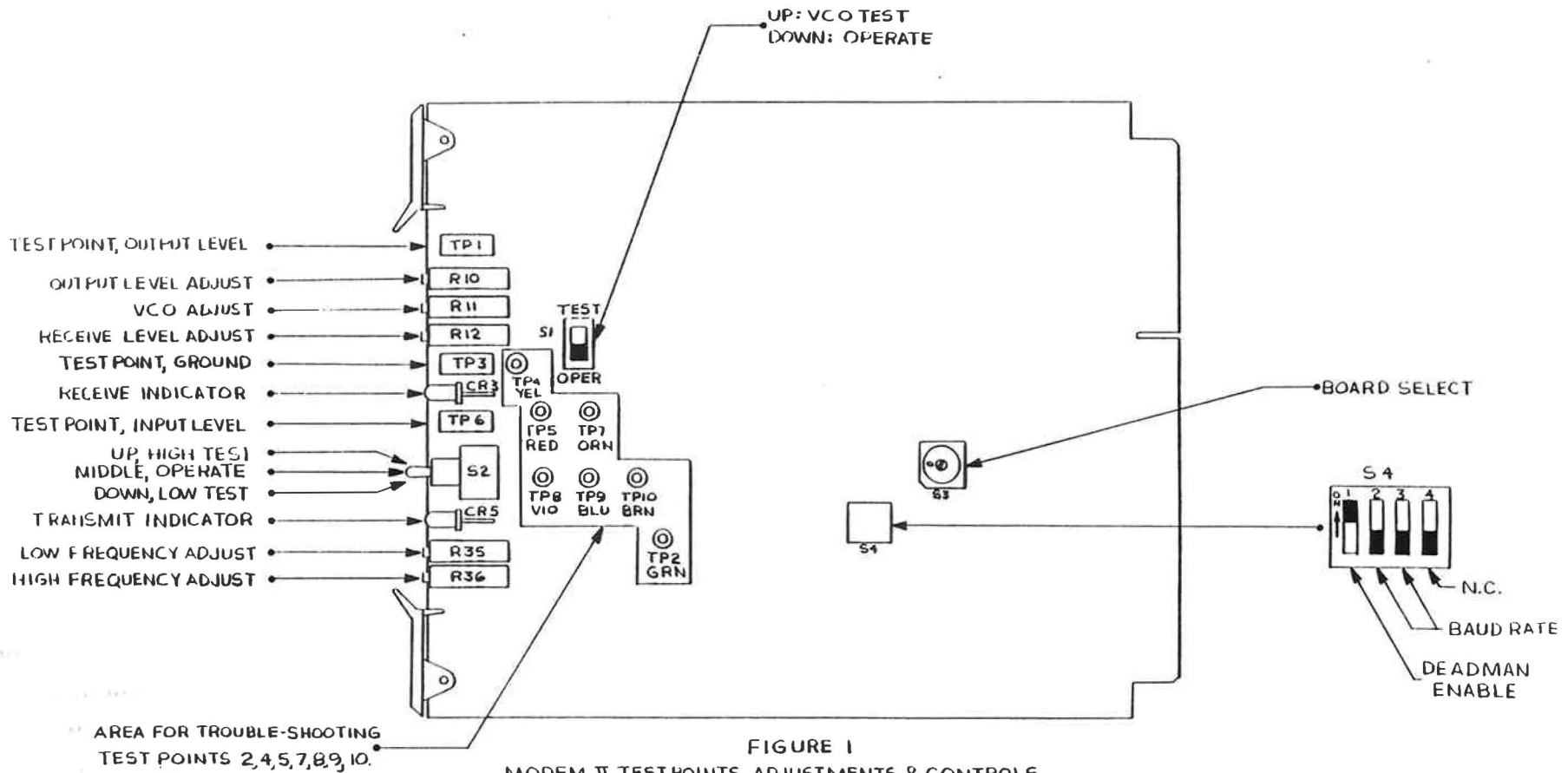
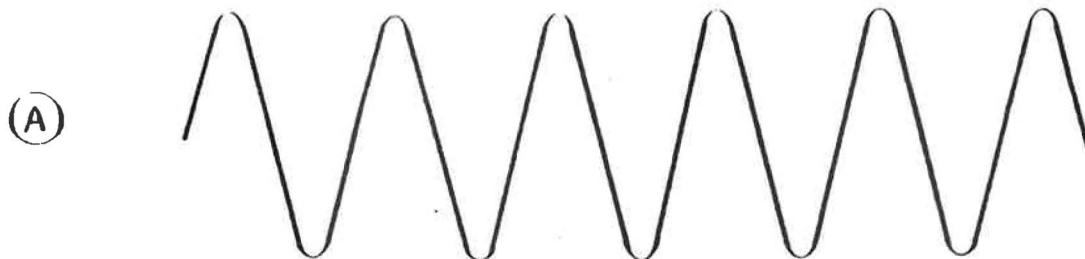


FIGURE 1
MODEM II TEST POINTS, ADJUSTMENTS, & CONTROLS

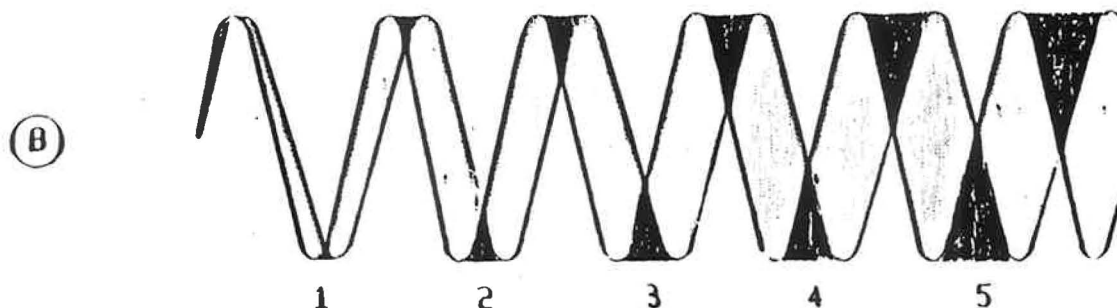
USED ON: MRC FAMILY

REVISIONS DATE DRAWN CHK ENG	DATE		MOBELEY ASSOCIATES, INC. SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 93017	
	MODEM II ADJUSTMENTS, ETC.			
	TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, .XX ± 1/32"		SCALE: 110:1E	
	CAH	9 MAR 81	3-12-81	15B1117

UNMODULATED SUBCARRIER



SUBCARRIER DEVIATED $\pm 5\%$ OF CENTER FREQUENCY

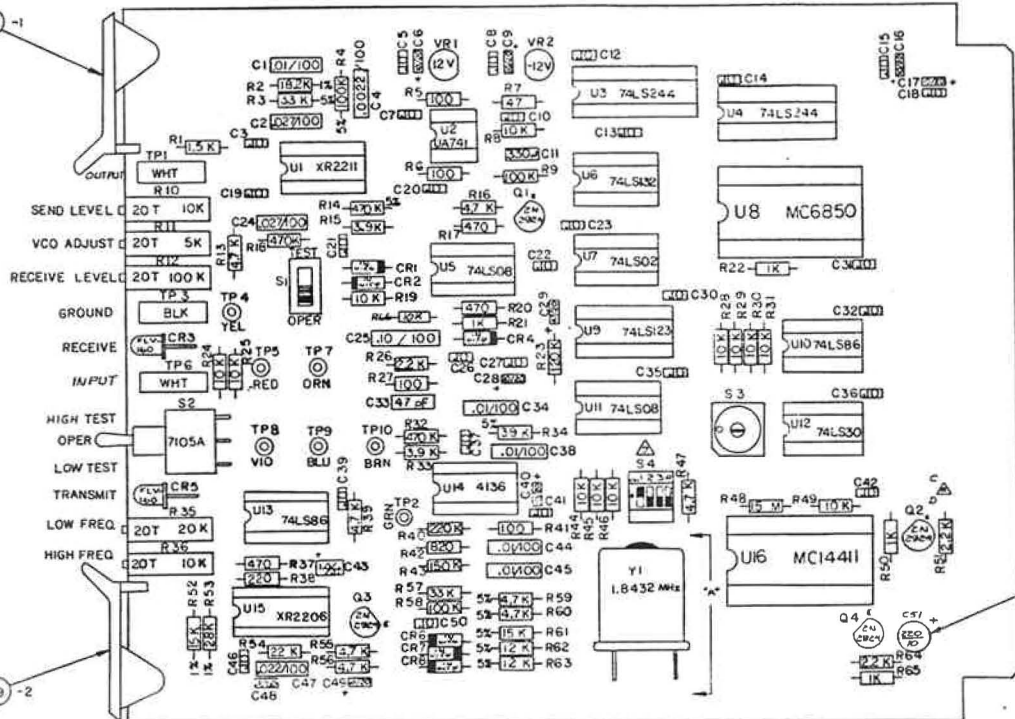
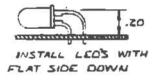
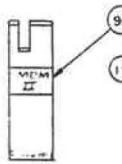


NOTES:

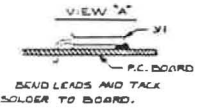
1. USE INTERNALLY - DERIVED POSITIVE - SLOPE TRIGGERED SWEEP.
2. SET SWEEP TIME TO ACHIEVE TRACE "A".
3. SET GENERATOR DEVIATION TO ACHIEVE TRACE "B".

FIRST USED ON: MRC-1

AD RELEASED 9-7-79 REVISIONS DATE	MOSELEY ASSOCIATES, INC. SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 93017	
	STANDARD SUBCARRIER PATTERN	
TOL: FRACT. $\pm 1/32$, .XX $\pm .030$, .XXX $\pm .010$, $< \pm 1/2$ "	DT.W. (SEPT 79)	SCALE:
OWN:	9-7-79	15A1114
CHK:	75	AJ
ENG:	75	AJ



- NOTES:
1. UNLESS OTHERWISE SPECIFIED: ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, 10%; ALL CAPACITOR VALUES ARE IN MICROFARADS, 50V
 2. P.C. BOARD 51C5909, REV.-II, -21.
 3. SCHEMATIC 3107233, REV. A1.
 - 4.
 5. I.C. SOCKETS INSTALLED IN EACH I.C. POSITION
 6. TRANSISTORS INSTALLED WITHOUT SOCKETS.
 7. SWITCHES INSTALLED WITHOUT SOCKETS.
 8. JUMPER TO BE ADDED BETWEEN C & D IN TEST IF NEEDED.
 9. S4 SHOWN FOR 1200 BAUD (19.2 KHZ). FOR 300 BAUD (4.8 KHZ), S4 SHOULD BE



100	2	U3, U4	AMP 640358-1	24 PIN	3250057	75
99	2	U9, U10	AMP 640358-1	14 PIN	3250032	74
98	9	U15, U16, U17, U18	AMP 640357-1	14 PIN	3250024	73
97	11	U2	AMP 640483-1	14 PIN	3250016	72
96		LABEL . MODEM	MMH-4	24 PIN	310436	71
95	11	R48	A.B. 15K 10%		4410450	70
94	2	R18, R32	A.B. 470K 10%		4410435	69
93	7	R40	A.B. 220K 10%		4410426	68
92	11	R43	A.B. 150K 10%		4410410	67
91	11	R23	A.B. 100K 10%		4410392	66
90	2	R6, R55	A.B. 100K 10%		4410494	65
89	11	R37	A.B. 33K 10%		4410431	64
88	11	R24	A.B. 22K 10%		4410411	63
87	13	R21, R22, R23, R24	A.B. 10K 10%		4410379	62
86	14	R25, R26	A.B. 4.7K 10%		4410358	61
85	2	R7, R33	A.B. 3.9K 10%		4410320	60
84	1	R2, R3, R4, R5, R6	A.B. 22K 10%		4410298	59
83	1	R1	A.B. 15K 10%		4410262	58
82	1	R22, R23, R24, R25	A.B. 1K 10%		4410243	57
81	1	R42	A.B. 820 10%		4410219	56
80	1	R41, R20, R21	A.D. 470 10%		4410205	55
79	1	R38	A.B. 220 10%		4410165	54
78	1	R35, R27, R41	A.D. 100 10%		4410122	53
77	1	R7	A.D. 87 10%		4410080	52
76	1	R14	A.B. 470K 5%		4402599	51
	1	R4	A.B. 100K 5%		440491	50
	1	R34	A.B. 33K 5%		440476	49
	1	R3	A.B. 33K 5%		440380	48
	1	R61	A.B. 15K 5%		440341	47
	2	R62, R63	A.B. 12K 5%		440325	46
	2	R59, R60	A.B. 4.7K 5%		440242	45
	1	R53	WCP. ELEC. 1N55C 2B02F		451094	44
	1	R2	WCP. ELEC. 1N55C 1B02F		451078	43
	1	R52	WCP. ELEC. 1N55C 1D02F		451052	42
					41	
	1	R12	BOURNS 3006P-1-104		463059	40
	1	R35	BOURNS 3006P-1-203		463020	39
	2	R10, R30	BOURNS 3006P-1-103		463027	38
	1	R11	BOURNS 3006P-1-502		463043	37
					36	
	1	VR 2	MOTOROLA MC74L12 27V		3650140	35
	1	VR 1	MOTOROLA MC74L12 27V		3650124	34
	1	U2	T.I. 741C1P OR AMP		3660068	33
	1	U15	LYAR. VR2202C		3730089	32
	1	U9	T.I. SN74LS123N		3660769	31
	1	U10	MOTOROLA MC14411P		3660712	30
	1	U12	T.I. SN74LS08N		3660355	29
	2	U10, U13	T.I. SN74LS08N		3660743	28
	2	U5, U11	T.I. SN74LS08N		3660693	27
	1	U7	T.I. SN74LS08N		3660371	26
	1	U16	T.I. SN74LS123N		3660776	25
	1	U1	CMX VR2202C		3730089	24
	1	U14	T.I. MC14411P		3730482	23
	1	U14	MOTA. MC6850P		3730482	22
	2	U3, U4	T.I. SN74LS244N		3660889	21
	1	DIECTOR KIT	VERO. C12409-1/2		250075	19
					18	
	2	CR3, CR5	FAIRCHILD FLV160		3390127	17
	1	MC128 CR6-B	GE INHIB4 SMALL SIGNAL		3600145	16
					15	
	1	Y1	CRYSTAL 1.8432 MHZ 3040073		3340726	14
	1	C51	K220E10		4280186	13
	1	C6, C7, C8, C9, C10	IPPM PHONO 4000SAL 10/20		5230079	12
	1	C43	SPRAGUE 440500000354H		4230038	11
	1	C23, C24	SEI. 22UB273H 0.027/100		4250127	10
	1	C25	SEI. 22UB103M 0.01/100		4250486	9
	1	C2, C24	SEI. 22UB273H 0.027/100		4250312	8
	1	C47	SEI. 22UB223H 0.022/100		4250288	7
	1	C48, C49, C50, C51	SEI. 22UB103M 0.01/100		4250171	6
	1	C11	GED IND. DM-15-33J 330U		4210415	5
	1	C4	SEI. 22UB223H 0.022/100		4250049	4
	1	C33	GED IND. DM-15-470U 47UF		4210415	3
	1	C29	SPRAGUE 440500000354H		4280187	2
	1	P.C. BOARD	MAI 51C5909 REV.-II, -21		3472420	1
	1	REF DES.	DESCRIPTION		STOCK VAL ITEM	

FILM CONFIGURATION		
REFERENCE NAME	CURRENT FILM REV	
CIRCUIT SIDE	51C5909- 11	
COMPONENT SIDE	- 21	
PAD MASTER		
SOLDER MASK	- 31	
SILKSCREEN	- 41	

USEDOM: MRC FAMILY
ITEM NO: 9202899

MOORE ASSOCIATES, INC.
COURTESY ELECTRONIC SUPPLY
COMPONENT LAYOUT
MDCM II
100 BAY STREET
ROSELAND, N.J. 07068
TEL: 201-261-2787

MODEM-TELCO INTERFACE

Schematic 91A7147
Component Layout 20B2716
PC Board 51B5856

I. PURPOSE

The Modem-Telco Interface module interconnects the Modem with either a 2-wire or 4-wire dedicated-circuitry telephone line. Telephone line interconnections are balanced, isolated, fused and filtered.

II. SPECIFICATIONS

Output Distortion	1.5% or less
Input/Output Impedance	300 ohms or 600 ohms strappable by user

III. THEORY OF OPERATION

Telephone line inputs are filtered to reduce RF interference. Each input line is individually fused, using an AGC 1/4-amp fuse. Transformers T1 and T2 are 600-ohm to 600-ohm matching transformers. Resistors R1, R2, R4 and R5 are used to convert 600 ohms to 300 ohms for use in the 2-wire mode. Resistors R3 and R6 are used in the 4-wire mode to make the impedance of the phone line connections approximately 600 ohms. Diodes D1 through D4 are used to protect the transformers and Modem module from large transients on the telephone line.

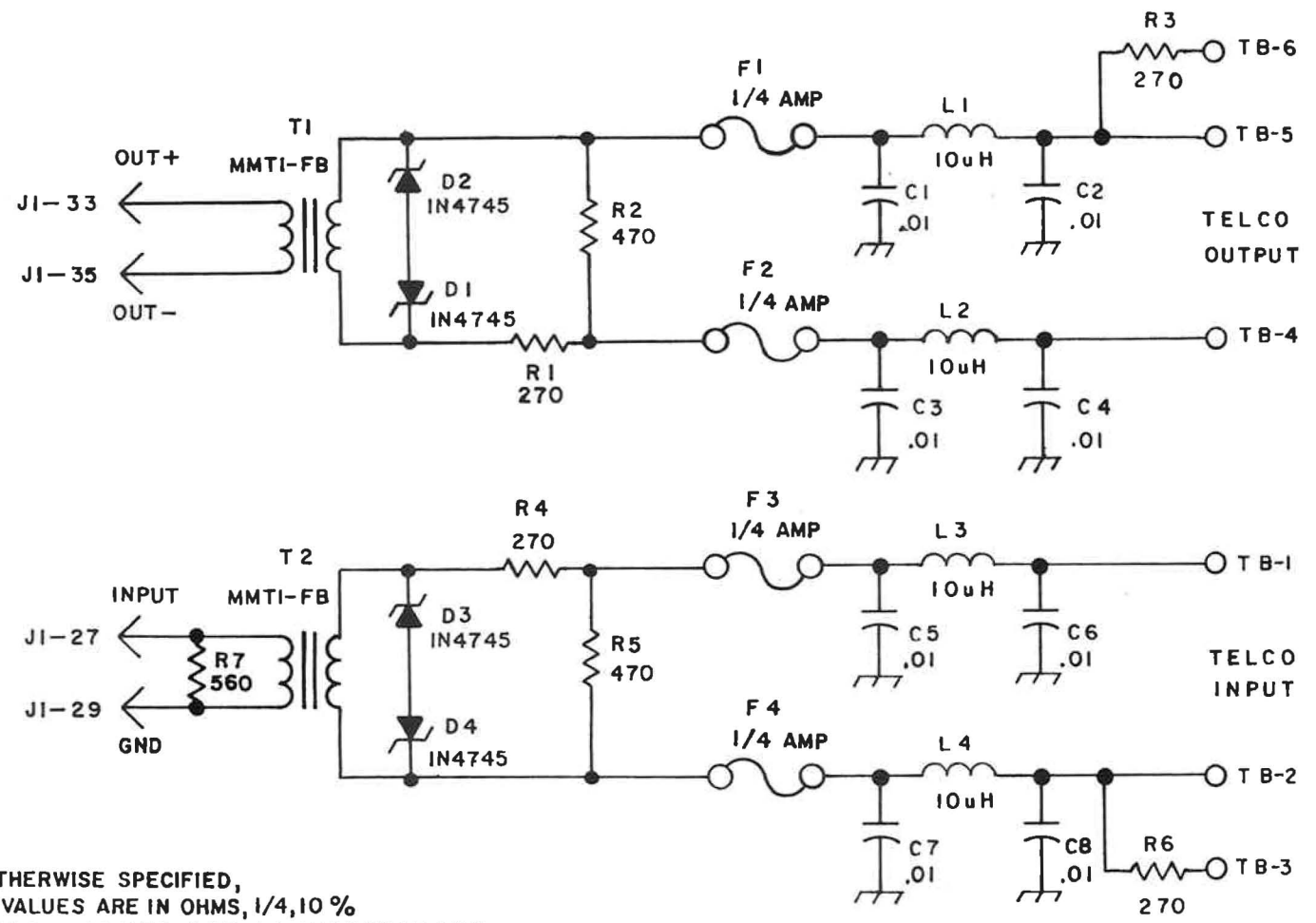
Two interconnection schemes are possible using this module. The 2-wire scheme uses a single pair of wires for communicating in both directions. The 4-wire system uses two pairs of wires separating both telemetry and control signals. The connections necessary for 2-wire interconnections are shown in Figure 1. Figure 2 illustrates 4-wire connections. When interconnecting a Control Terminal with Remote Terminals, no special line polarity must be observed as each input has a balanced 300-ohm or 600-ohm impedance.

A Bell 3002, unconditioned data circuit is specified. The use of long (over 1000 ft) dc continuous circuits is not recommended as their ac frequency response is not guaranteed, and induced currents may prove troublesome.

IV. TROUBLESHOOTING

1. Check fuses and fuse clips for continuity.
2. After lightning damage:
 - a. Check inductors for open circuits.
 - b. Diodes D1 through D4 may be shorted.
 - c. Capacitors C1 through C8 may be shorted.
 - d. Check transformer continuity.

91A7147 A



- NOTES:
1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS, 1/4, 10% CAPACITOR VALUES ARE IN MICROFARADS.
 2. FOR 2 WIRE MODE INSTALL PHONE LINE ACROSS TERMINALS TB-1 AND TB-4 INSTALL JUMPER BETWEEN TB-2 AND TB-5.
 3. FOR 4 WIRE MODE USE TERMINALS TB-4 AND TB-6 FOR OUTPUT. USE TERMINALS TB-1 AND TB-3 FOR INPUT.
 4. ⏏ IS DIRECT CHASSIS GROUND.
 5. P.C. BOARD 51B5856
 6. COMPONENT LAYOUT 20B2716.

FIRST USED ON MRC-1

RELEASED FOR PRODUCTION. 25 APR 79 F.X.Y.	DATE	MOSELEY ASSOCIATES, INC. SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 93017			
	MGMT. APPR.				
	REVISIONS	SCHEMATIC MRC-1 MODEM TELCO INTERFACE			
	A	TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, < ± 1/2°	DWN	A.J.B. 9 JAN 79	SCALE:
		CHK	FXY 24 JAN 79		
		ENG	WLL 25 APR 79	91A7147	A

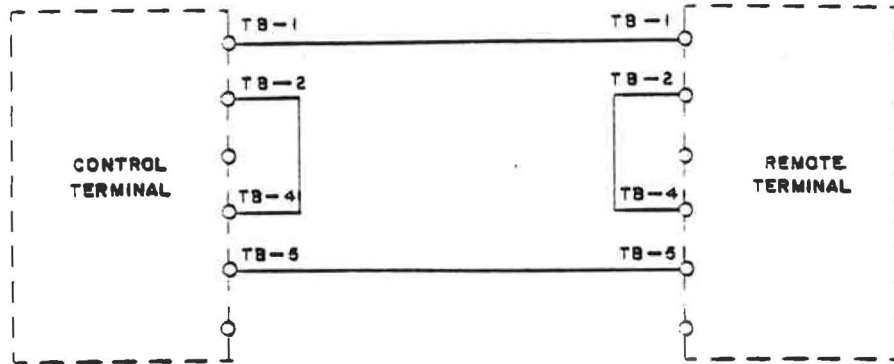


Figure 1. Two-wire interconnections for Modem-Telco Interface modules.

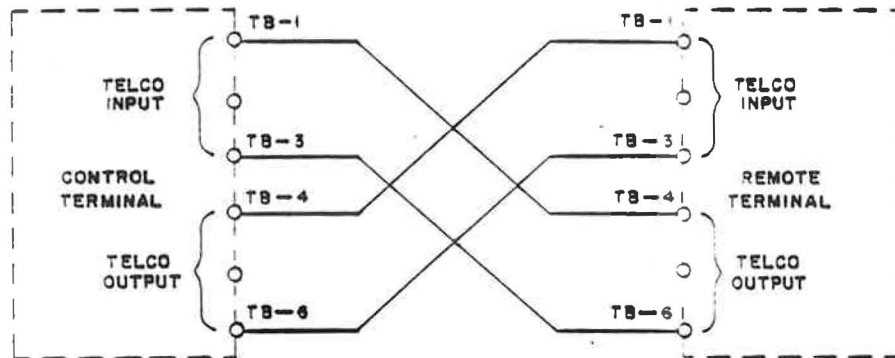
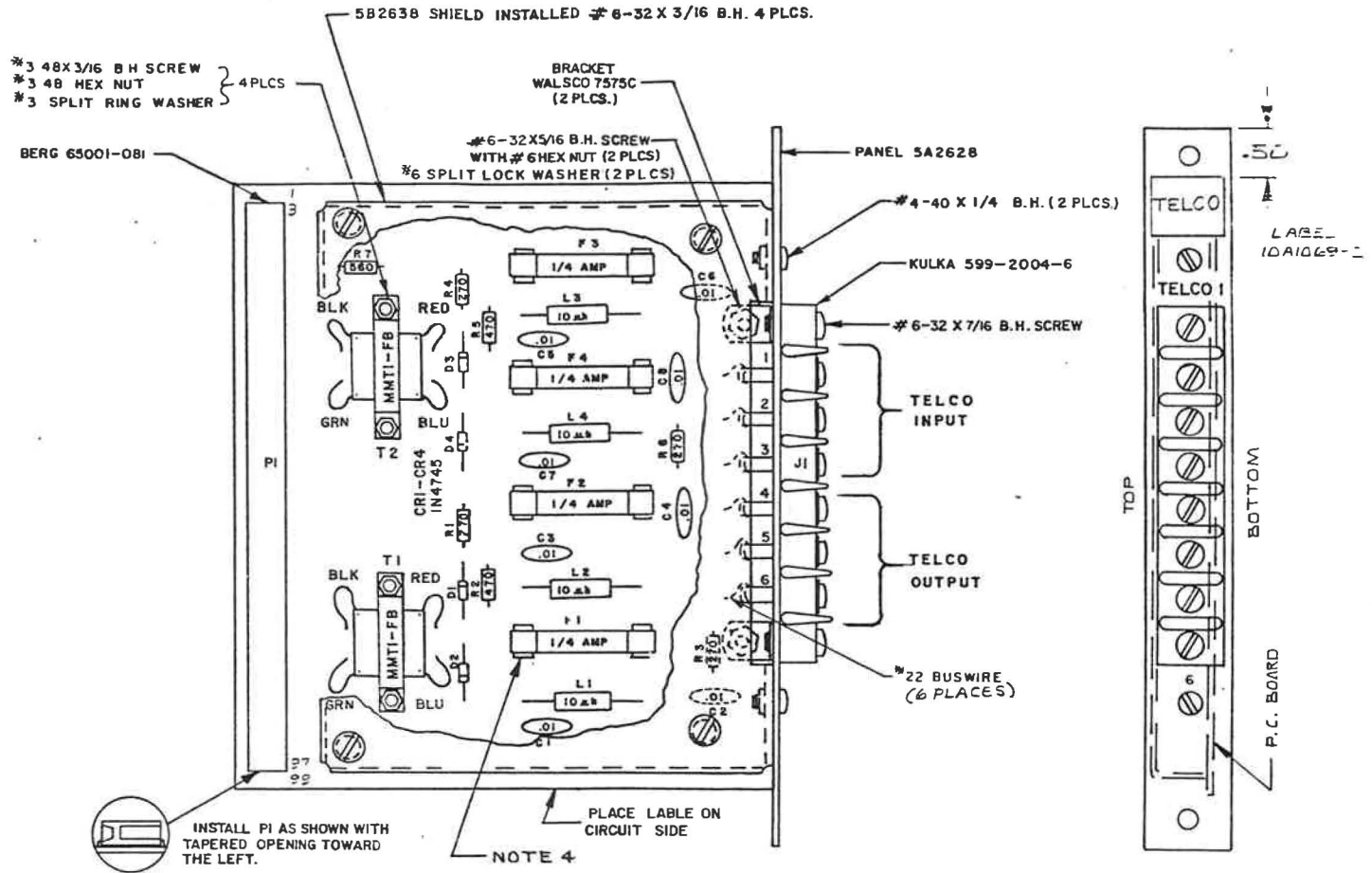


Figure 2. Four-wire interconnections for Modem-Telco Interface modules.



- NOTES:
1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS, 1/4, 10%
 2. P.C. BOARD 5185856
 3. SCHEMATIC 91A7147
 4. SOLDER FUSE CLIP EYELETS TO BOTH SIDES OF BOARD.

REVISONS	DATE	REASON
D1	21 DEC. 83	CHANGE NOTE 4
D		NOTE 2 WAS -02
C3		ECO 3642, 9-1-82
C2		ADD LABEL DIM.
C1		ADD LABEL 10A1069-1
B1		BERG 65001-081 WAS 65001-085
A1		CHANGES AS PER P.C.O. 1521 10AUG79 D.T.W.
A		RELEASED FOR PRODUCTION. REAPPTS. K.V.V.

MOSELEY ASSOCIATES, INC.		SANTA BARBARA RESEARCH PARK		GOLETA, CALIFORNIA 93017	
COMPONENT LAYOUT					
MRC-1 MODEM TELCO INTERFACE					
TOL: FRACT. = 1/32, .XX = .830, .XXX = .818, < = 1/2"					
DWN	A.J.B.	2 JAN 79	SCALE: 1:1		
CHK	F.X.Y.	24 APR 79			
ENG	W.L.L.	25 APR 79		20B2716	D1

TELCO IN/SUBCARRIER OUT

Schematic 91B7144
Component Layout 20A2737
PC Board 51B5865

I. PURPOSE

The Telco In/Subcarrier Out module transmits data via an FM subcarrier and interfaces the modem demodulator with the telephone line for received data. This module is the companion module for Moseley Telco Out/Subcarrier In (20B2736). Operation in several standard subcarrier bands is possible by specifying different frequency-selective components.

II. THEORY OF OPERATION

Incoming data on the telephone line is filtered by L1 and L2 to reduce radio frequency interference. Fuses F1 and F2 are used for protection from large surges on the phone line. Resistors R13, R14, and R15 form a 600-ohm impedance matching network between the phone line and the transformer. T1 is a 600-ohm to 600-ohm impedance matching transformer.

Integrated circuit U1 is a function generator, which is used to generate an FM signal from the frequency shift keyed output of the Modem module. The frequency of oscillation is controlled by applying a control voltage to the activated timing pin (pin 7). Resistors R8, R9, R10, and R11 form a voltage divider network used to adjust the frequency control voltage. Timing capacitor C4 is also used for frequency control. Its value is dependent on which subcarrier band is used. Capacitor C5 is a bypass capacitor required by U1. Resistors R6 and R7 are used to reduce the total harmonic distortion (THD). This can be reduced to 0.5% by trimming, or in the worst case, approximately 2.5%. The dc output level is adjusted by applying a voltage bias to U1 pin 3, using OUTPUT Adjust R4.

III. ADJUSTMENTS

Subcarrier Generator (U1)

1. Remove modulation applied to the subcarrier generator using Send Level Adjust R10 on the modem.

2. Connect a frequency counter to the SUBCARR OUT connector (J3). Adjust subcarrier frequency using pots R9 and R10. R9 is a course frequency adjustment, and R10 is a fine frequency adjustment. Both pots are accessible from the rear panel and are labelled "COARSE" and "FINE".
3. Disconnect the frequency counter and connect a distortion analyzer to the SUBCARR OUT connector (J3). Adjust Distortion pot R6 for minimum distortion. Using this control approximately 0.5% distortion is obtainable. If no distortion analyzer is available, no adjustment on this pot is required. The worst case distortion is approximately 2.5%, which is quite acceptable in most applications.
4. Disconnect the analyzer and attach an oscilloscope to SUBCARR OUT J3. To understand this adjustment, refer to Figure 1.7 in the modem section for representative waveforms. Adjust the oscilloscope to display about six periods of the unmodulated subcarrier as shown in (A). Using the modem Send Level Adjust (R10), increase subcarrier modulation until the fifth crossover occurs midway as shown in (B).
5. Adjust the output level to 2.5 volts peak-to-peak using OUTPUT Adjust R4. This pot is accessible through the rear panel.

IV. TROUBLESHOOTING

- A. Verify that +12 Vdc is present on pin 4 of U1.
- B. Modulator
 1. Verify that the modem is generating an FSK signal, which may be observed at pin 7 of the function generator U1.
 2. If no output is observed, check chip voltages and grounds. If U1 is replaced, verify proper adjustment by performing the subcarrier generator adjustment procedure described in Subsection III.
 3. Note the Modem module must be properly adjusted and working correctly for the Telco In/Subcarrier Out module to function. Refer to the Modem subsection of this manual for troubleshooting details.

G AC EM JTE
ECO 3951
2 AUG 83 CH

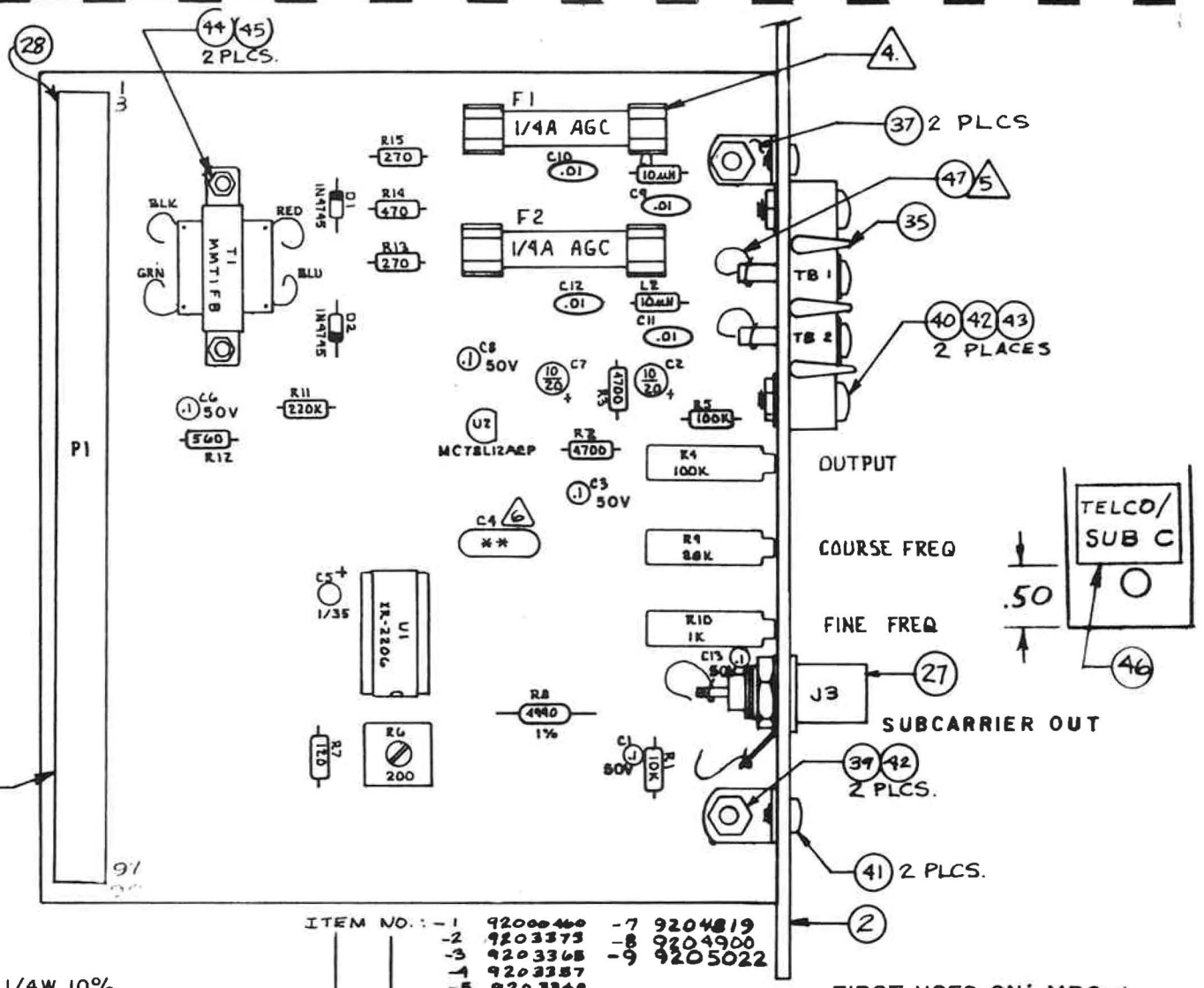
GI CHANGE NOTE
ECO
21 DEC 83 CH

H ADD ITEM 9 ON CHART
-9: 9205022. ECO 4880
8 MAY 84 CH

**

ITEM	FREQ	C4
ITEM 1	20KHz	2530pF
ITEM 2	26KHz	1930pF
ITEM 3	39KHz	1300pF
ITEM 4	67KHz	750pF
ITEM 5	110KHz	560pF
ITEM 6	185 KHz	470pF
ITEM 7	NEUTER	NONE
ITEM 8	92 KHz	560pF
ITEM 9	152 KHz	510 pF

INSTALL PI AS SHOWN WITH TAPERED OPENING TOWARD THE EDGE.



NOTES:

- UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/4W, 10%. CAPACITOR VALUES ARE IN MICROFARADS.
- P.C. BOARD 5185865
- SCHEMATIC 9187144.
- SOLDER FUSE CLIP EYELETS TO BOTH SIDES OF BOARD.
- USE #22 BUSS WIRE AT J3, TB1, AND TB2 TO CONNECT TO P.C.BD. AS SHOWN.
- 7 (NEUTER) DOES NOT HAVE C4 INSTALLED.

ITEM NO. : -1 92000460 -7 9204819
 -2 9203373 -8 9204900
 -3 9203368 -9 9205022
 -4 9203387
 -5 9203388
 -6 9203332

FIRST USED ON: MRC-1

REV	DATE	DESCRIPTION
F	ADDED -7 ECO 3921 S.V. P/29/83	
E	MOVED LABEL LOCATION ECO 3571, 6-24-82	
D4	ADD NOTE 5 ITEM 6 WAS 800 KHz. ECO 3419 MAR-31-82 CH	
C4	ADD LABEL DIM. PCO 3355 2 14 92 DJB	
C3	PARTS LIST CHANGE PCO1892, 9-23-80 ABT	
C2	ADD NOTE 4 PCO1823 WPG 31 JUL 80	
C1	ADD LABEL 10A1069-4 ECO 1696 WPG 25 APR 80	
B1	ADDED "AGP" TO UZ. PCO 1527	
B0	BERG 65001-081 WAS 65001-085. ECO1362 4 SEPT 79 D.T.W.	
A	RELEASED FOR PRODUCTION. 30 APR 79 P. X.Y.	

MOBELEY ASSOCIATES, INC.
 SANTA BARBARA RESEARCH PARK
 GOLETA, CALIFORNIA 93047

COMPONENT LAYOUT
TELCO IN-SUBCARRIER OUT INTERFACE

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, < ± 1/2"

DWN	JAM	9 APR 79	SCALE: FULL
CHK	FXV	26 APR 79	
ENG	WLL	30 APR 79	20A2737

H

FILE = ECO 4258

TELCO OUT/SUBCARRIER IN

Schematic 91C7160
Component Layout 20B2736
PC Board 51A5870

I. PURPOSE

The Telco Out/Subcarrier In module interconnects transmitted signals from the modem with a dedicated telephone line, and demodulates FM subcarrier data transmissions to provide received data to the modem. This module is the companion module to the Telco In/Subcarrier Out assembly (20A2737). Operation in several different standard subcarrier bands is possible by selection of component values.

II. THEORY OF OPERATION

Integrated circuit U1 is a phase-locked loop used to demodulate the incoming FM subcarrier. The input filter connected to pin 2 is a telemetry extraction bandpass filter and is used to reject frequencies other than the telemetry subcarrier. The components used in the input filter are frequency dependent and are specified according to the subcarrier band being used. Recommended signal input at pin 2 is from 10 mV rms to 3 mV rms. The operating frequency is determined by C5, R5 and FREQ Adjust R6. Resistor R3 and capacitor C8 form a lock detect filter to eliminate chatter at the lock detect output (pin 6). Capacitor C9 is used as a bypass capacitor for an internal voltage reference.

The demodulated output is taken from the loop phase detector (pin 11), through a post detection filter made up of R7, C12, and buffer amplifier U2. This buffer amplifier is necessary because of the high impedance output at pin 11. U2 is a non-inverting unity gain operational amplifier.

III. ADJUSTMENTS

1. Telemetry Extraction Filter Adjustment

Apply a modulated subcarrier signal from a subcarrier generator to the input (J1). Adjust inductors L1 and L2 for maximum amplitude and minimum AM. The filter output should be similar in appearance to the subcarrier generator output.

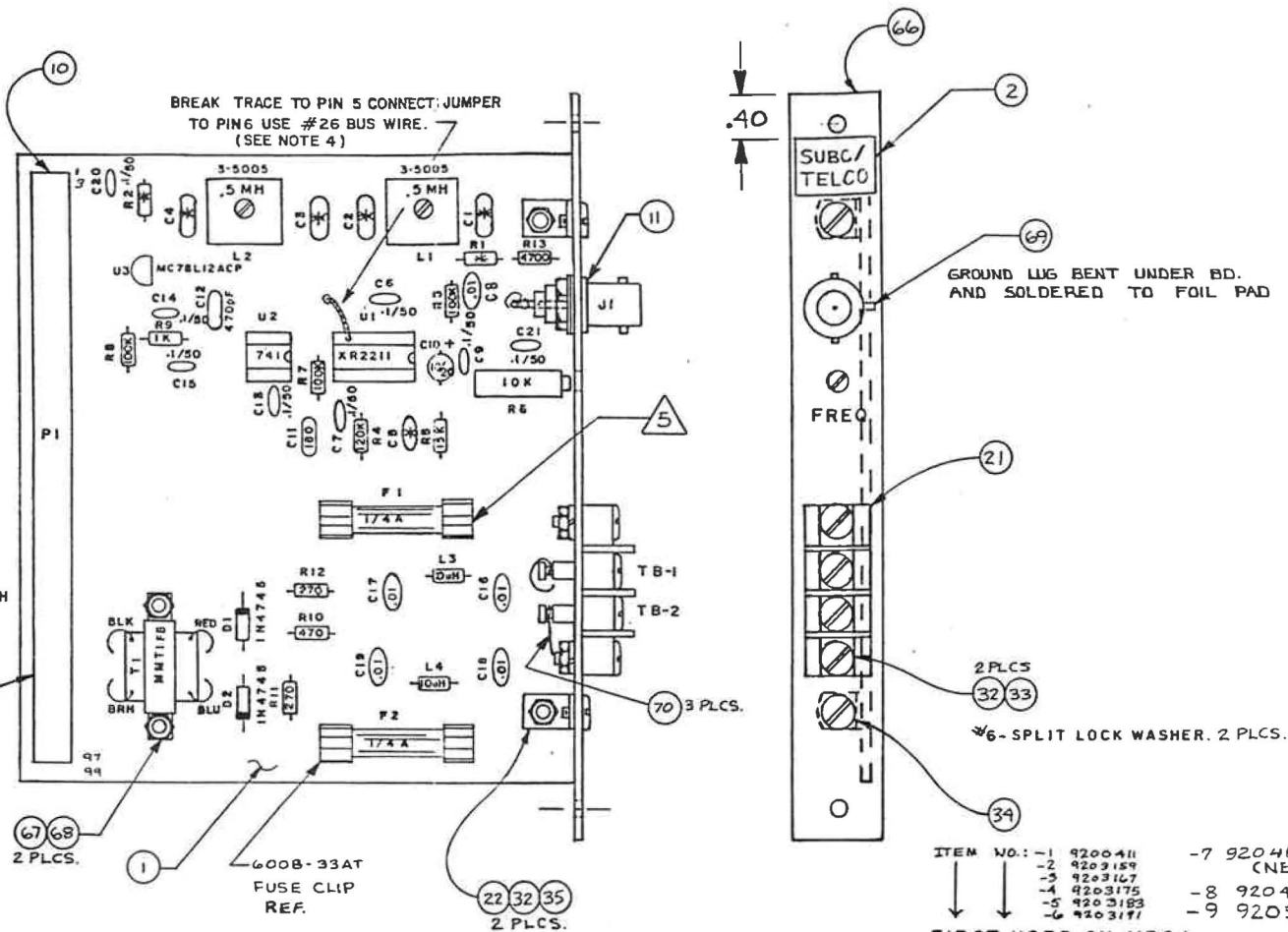
2. FM Demodulator Frequency Adjustment

Apply a modulated subcarrier signal to the input (J1). Adjust R6 (FREQ) for the cleanest FSK output. Note that some residual high-frequency subcarrier may be superimposed on the FSK signal; this is quite normal.

IV. TROUBLESHOOTING

- A. Verify that correct power supply voltages are present on the module (+15, +12, and -15 volts).
- B. Using an oscilloscope, observe the extraction filter output at U1, pin 2. This signal should appear much like the subcarrier generator output. If it is distorted, check the input filter for proper tuning or defective components.
- C. Check demodulator frequency as described in the adjustment subsection above.
- D. Check operation of Buffer Amplifier U2.
- E. Check operation of the Modem module. Refer to the Modem subsection of this manual.

* FREQ DEPENDENT PARTS								
ITEM	FREQ	R1	R2	C1	C2	C3	C4	C5
ITEM 1	20KHZ	470	1500	.0131	.111	.0175	.111	2530pF
ITEM 2	26KHZ	470	1800	.008	.068	.01	.068	1930pF
ITEM 3	39KHZ	820	2700	3600pF	.031	4700pF	.031	1300pF
ITEM 4	67KHZ	1500	4700	1200pF	.01	.0016	.01	750pF
ITEM 5	110KHZ	2200	6800	470pF	3600pF	620pF	3600pF	470pF
ITEM 6	185KHZ	3600	15K	180pF	1500pF	250pF	1500pF	300pF
ITEM 7	NEUTER	Ø	Ø	Ø	Ø	Ø	Ø	Ø
ITEM 8	92KHZ	1800	6200	680pF	.0068	1000pF	.0048	560pF
ITEM 9	152KHZ	3000	10K	270pF	2400pF	430pF	2400pF	510pF



INSTALL (PI) AS SHOWN WITH TAPERED OPENING TOWARD THE EDGE.

- NOTES:
- UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS 1/4 W 10 % CAPACITOR VALUES ARE IN MICROFARADS
 - P.C. BOARD 51A5870
 - SCHEMATIC 9IC7160
 - BREAK TRACE AND CONNECT JUMPER AS SHOWN.
 - SOLDER FUSE CLIP EYELETS TO CIRCUIT SIDE OF BD. AND TO FUSE CLIP ON COMPONENT SIDE OF BD.
 - USE #22 BUS WIRE AT J1, TB1, AND TB2 TO CONNECT TO P.C. BD. AS SHOWN.
 - 7 (NEUTER) DOES NOT HAVE R1, R2, C1 THRU C5 INSTALLED.

ITEM NO.:	-1	9200411	-7	9204801
	-2	9203154		(NEUTER)
	-3	9203167		
	-4	9203175		
	-5	9203183		
	-6	9203191		
	-8	9204884		
	-9	9205014		

FIRST USED ON MRC-1

REV	DATE	DESCRIPTION
J		ADD ITEM 9 TO CHART
H		ADD ITEM 7, 8 ON ECO1694
G		ADD ITEM 7 ON P/L
F		REVISE NOTE 5.
E4		DELETE 20 KHZ. PARTS. FROM CHART.
D4		ADD LABEL 17100.
D3		ADD NOTE 5.
D2		ADD LABEL 10A1069-5.
C2		ARTWORK CHANGE 04.
C1		ADD US INFORMATIONS.
C0		ADD AND USE CHANGE VALUES IN C1 & T1.
B0		REVISE 600B-33AT FUSE CLIP REF.
A		RELEASED FOR PRODUCTION

MOBELEY ASSOCIATES, INC.
 SANTA BARBARA RESEARCH PARK
 GOLETA, CALIFORNIA 93017

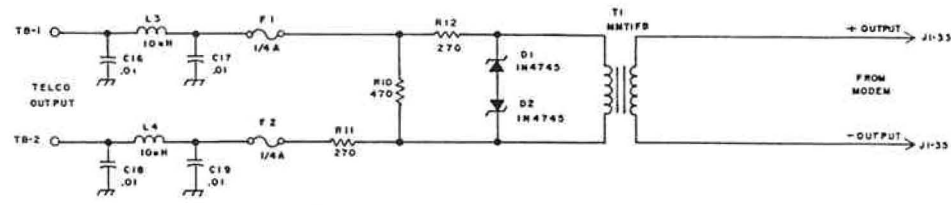
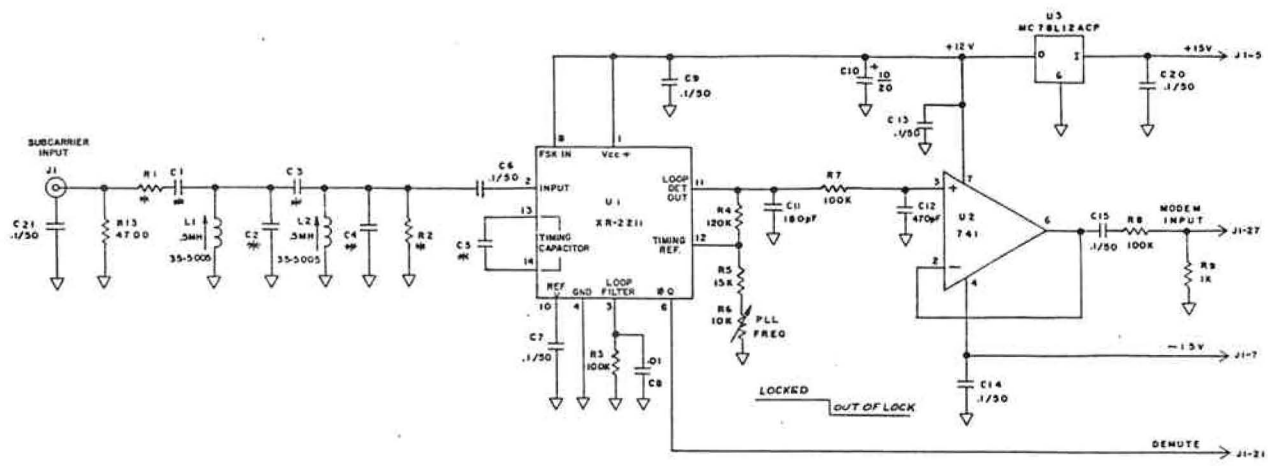
COMPONENT LAYOUT
 TELCO OUT SUBCARRIER IN

TOL: FRACT. = 1/32, .XX = .00, .XXX = .01, < = 1/2"

DWN L.I. 12 APRIL 79 SCALE: FULL

CHK 842

ENG 1011 4/11/79 20B2736 J



* FREQ DEPENDENT PARTS							
	R1	R2	C1	C2	C3	C4	C5
20KHZ	470	1500	.0151	.111	.0175	.111	2550pF
26KHZ	470	1800	.008	.088	.01	.068	1950pF
38KHZ	820	2700	3600pF	.031	4700pF	.031	1300pF
47KHZ	1500	4700	.0012	.01	.0018	.01	750pF
108KHZ	2200	8800	470pF	3600pF	820pF	3600pF	470pF
186KHZ	3500	15K	850pF	1600pF	250pF	1500pF	500pF
NEUTER	Ø	Ø	Ø	Ø	Ø	Ø	Ø
92KHZ	1800	6200	680pF	.0068	1000pF	.0068	560pF
152KHZ	3000	10K	270pF	2400pF	420pF	2400pF	360pF

- NOTES:
- UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS 1/4W 10% CAPACITOR VALUES ARE IN MICROFARADS
 - P. C. BOARD 51AD870
 - COMPONENT LAYOUT 20B2736

FIRST USED ON MRC-1

 MOBLEY ASSOCIATES, INC. SANTA BARBARA BEACH/CA 93101 OXLEY, CALIFORNIA 93101	
SCHEMATIC TELCO OUT/SUBCARRIER IN	
TITLE: TELCO OUT/SUBCARRIER IN DATE: 11-79 DRAWN: J. L. SMITH CHECKED: J. L. SMITH APPROVED: J. L. SMITH	PART NO: 91C7160 REV: F

SUBCARRIER INTERFACE

Schematic 91C7156
Component Layout 20B2719
PC Board 51B5858

I. PURPOSE

The Subcarrier Interface module when used with the Modem II module generates and demodulates FM subcarrier data transmissions.

II. THEORY OF OPERATION

Subcarrier generator U3 is used to generate an FM signal from the frequency shift keyed output of the Modem module. The frequency of oscillation is controlled by applying a control voltage to the activated timing pin (pin 7). Resistors R17, R18, R19 and R20 form a voltage divider network used to adjust the frequency control voltage. Timing capacitor C6 is also used for frequency control. Its value is dependent on which subcarrier band is used. Capacitor C20 is a bypass capacitor required by the IC. Resistors R15 and R16 are used to reduce the total harmonic distortion. This can be reduced to 0.5% by trimming, or in the worst case, approximately 2.5%. The dc output level is adjusted by applying a voltage bias to pin 3, using R14.

U1 is a phase-locked loop used to demodulate the incoming FM subcarrier. The input filter connected to pin 2 is a telemetry extraction bandpass filter and is used to reject frequencies other than the telemetry subcarrier. The components used in the input filter are frequency dependent and are specified according to the subcarrier band being used. Recommended signal input at pin 2 is from 10 mV rms to 3 mV rms. The operating frequency is determined by C5, R5 and R6. Resistor R3 and capacitor C9 form a lock detect filter to eliminate chatter at the lock detect output (pin 6). Capacitor C8 is used as a bypass capacitor for an internal voltage reference. The demodulated output is taken from the loop phase detector (pin 11), through a post detection filter made up of R7 and C12, to buffer amplifier U2. This buffer amplifier is necessary because of the high impedance output at pin 11. U2 is a non-inverting unity gain operational amplifier.

U4 provides +12 V for use on the module.

III. ADJUSTMENTS

A. Subcarrier Generator (U3)

1. Remove modulation applied to the subcarrier generator using Send Level Adjust R10 on the Modem II module.
2. Connect a frequency counter to the GEN OUT connector (J3). Adjust the subcarrier frequency adjustments, COARSE Adjust R19 and FINE Adjust R20. Both pots are accessible from the rear panel.
3. Disconnect the frequency counter and connect a distortion analyzer to the GEN OUT connector (J3). Adjust Distortion pot R15 for minimum distortion. Using this control approximately 0.5% distortion is obtainable. If no distortion analyzer is available, no adjustment on this pot is required. The worst-case distortion is approximately 2.5%, which is quite acceptable in most applications.
4. Disconnect the analyzer and attach an oscilloscope to GEN OUT (J3). To understand this adjustment, see Figure 1.7 in the Modem II subsection for representative waveforms. Adjust the oscilloscope to display about six periods of the unmodulated subcarrier as shown in (A). Using the modem Send Level Adjust R10, increase subcarrier modulation until the fifth crossover occurs midway as shown in (B).
5. Adjust the output level to 2.5 volts peak-to-peak using OUT Adjust R14. This pot is accessible through the rear panel.

B. Subcarrier Demodulator (U1)

1. Telemetry Extraction Filter Adjustment

Apply a modulated subcarrier signal to the DEMOD IN connector (J2). Adjust inductors L1 and L2 for maximum amplitude and minimum AM. The filter output should be similar in appearance to the subcarrier generator output.

2. FM Demodulator Frequency Adjustment

Apply a modulated subcarrier signal to the DEMOD IN connector (J2). Adjust FREQ Adjust R5 for the cleanest FSK output. Note that some residual high-frequency subcarrier may be superimposed on the FSK signal; this is quite normal.

IV. TROUBLESHOOTING

- #### A. Verify that correct power supply voltages are present on the module (+5, +12, and -15 volts).
- #### B. Modulator
1. Verify that the modem is generating an FSK signal, which may be observed at U3, pin 7.

2. If no output is observed, check chip voltages and grounds. If U3 is replaced, verify proper adjustment by performing the subcarrier adjustment procedure described previously.
3. Note the Modem module must be properly adjusted and working correctly for the Subcarrier Interface module to function. Refer to the Modem II subsection of this manual for troubleshooting details.

C. Subcarrier Demodulator

1. Using an oscilloscope, observe the extraction filter output at U1, pin 2. This signal should appear much like the subcarrier generator output. If it is distorted, check the input filter for proper tuning or defective components.
2. Check demodulator frequency as described in the adjustment subsection.
3. Check operation of Buffer Amplifier U2.
4. Check operation of the Modem module. Refer to the Modem II subsection of this manual.

PRINT PHANTOM ITEMS
 PRINT COMPONENTS
 PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 920C353 CROSS REF ITEM DESCRIPTION MRC-1 SUBCARRIER INTFC 20KHZ ENGR DRAW 2002719-1 K BATCH QTY 1 ITEM TYPE 1 LOW LEVEL 01 EFFEC 5/30/84 UNIT MEAS EA PLANNER 511

BCM ITEM	LL CU	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	OPT TYP	FIRST NBR	LT OP SEQ	ADJ	EFFECTIVE DATES FROM	TO
27	05	4410205	RES 470 OHM 1/4W 10% R1	RC07GF471K	1.000	EA	4					
25	06	4410262	RES 1.5K OHM 1/4W 10% R2	RC07GF152K	1.000	EA	4					
46	02	4250205	CAP POLYCARB .0131/100V 3% C1	220P1312H	1.000	EA	4					
47	04	4250502	CAP POLYCARB .111/100V 3% C2,C4	220R1113H	2.000	EA	4					
48	04	4250247	CAP POLYCARB .0175/100V 3% C3	220R1752H	1.000	EA	4					
49	04	4220166	CAP MICA DIP 2530PF 2% C5,C6	DM-19-F2531G	2.000	EA	4					
99	02	9204777	MRC-1 SUBCARRIER INTFC NEUTR	2002719-7 K	1.000	EA	2					

North Branch Form, Inc.

PRINT PHANTOM ITEMS
 PRINT COMPONENTS
 PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 9203290 CROSS REF ITEM DESCRIPTION MRC-1 SUBCARRIER INTFC 26RHZ ENGR DRAW 2002719-2 K BATCH QTY 1 EFFEC 5/30/84 ITEM TYPE I UNIT MEAS EA LOW LEVEL 01 PLANNER 511

BCM ITEM	LL CO	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
28	06	4410205	RES 470 OHM 1/4W 10% R1	RC07GF471K	1.000	EA	4				
30	06	4410270	RES 1.5K OHM 1/4W 10% R2	RC07GF152K	1.000	EA	4				
50	05	4250163	CAP POLYCARB .008/100V 3% C1	2205802H	1.000	EA	4				
51	04	4250445	CAP POLYCARB .068/100V 3% C2,C4	2208683H	2.000	EA	4				
52	04	4220117	CAP MICA DIP 1030PF 2% C5,C6	DM-19-1931G	2.000	EA	4				
65	06	4250171	CAP POLYCARB .01/100V 3% C3	2208103H	1.000	EA	4				
95	02	9204777	MRC-1 SUBCARRIER INTFC NEUTER	2002719-7 K	1.000	EA	2				

PRINT PHANTOM ITEMS
 PRINT COMMENTS
 PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 92032R2 CROSS REF ITEM - DESCRIPTION RRC-1 SUBCARRIER INFC 39KHZ BATCH QTY 1 ITEM TYPE 1 LOW LEVEL 01
 92032R2 CASE DRAW 2002719-3 K DRAWING NUMBER QUANTITY PER UM TYP NBR OPT UP FIRST LT EFFECTIVE DATES TO

FCM ITEM	LL CU	COMPONENT & REF.	DESCRIPTION & COMMENT	INSTRUMENT DRAWING NUMBER	QUANTITY PER	ITEM TYP	OPT NBR	FIRST UP	LT ADJ	EFFECTIVE DATES FROM	EFFECTIVE DATES TO
31	06	4410239	RES R20 0HM 1/4W 10% R1	RC073F21K	1.000	EA	4				
34	05	4410298	RES 7.07K 0HW 1/4W 10% P2	RC07GF272K	1.000	EA	4				
52	05	427019C	CAP MICA DIP 3600PF C1	04-19-352J	1.000	EA	4				
54	04	4270216	CAP MICA DIP 4700PF 5% C3	04-19-472J	1.000	EA	4				
55	04	4220059	CAP PTCR DTP 1300PF C5 & C5	04-19-132J	2.000	EA	4				
53	05	427032G	CAP PCLYCAP 0.11/100V 35 C2 & C4	2204113H	2.000	EA	4				
95	02	4204777	MNC-1 SUBCARRIER INFC NEUTRAL	2002719-7	1.000	EA	2				

PRINT PHANTOM ITEMS
 PRINT COMPONENTS
 PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 9203274 CROSS REF ITEM DESCRIPTION MRC-1 SUBCARRIER INTFC 57KHZ ENGR DRAW 2002719-4 K BATCH QTY 1 EFFEC 5/30/84 ITEM TYPE 1 UNIT MEAS EA LOW LEVEL 01 PLANNER 511

BCM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM TYP	OPT NBR	FIRST GP SEQ	LT ADJ	EFFECTIVE DATES FROM TO
26	06	4410338	RES 4.7K OHM 1/4W 10%	RC07GF472K	1.000	EA	4			
			R2							
29	06	4410262	RES 1.5K OHM 1/4W 10%	RC07GF152K	1.000	EA	4			
			R1							
56	05	4220042	CAP MICA DIP 1200PF	UM-19-122J	1.000	EA	4			
			C1							
57	03	4250023	CAP POLYCARB .0016/100V 3%	2204162H	1.000	EA	4			
			C3							
58	04	4210514	CAP MICA DIP 750PF	UM-15-751J	2.000	EA	4			
			C5-C6							
65	06	4250171	CAP POLYCARB .01/100V 3%	2204103H	2.000	EA	4			
			C2-C4							
99	02	9204777	MRC-1 SUBCARRIER INTFC NEUTER	2002719-7 K	1.000	EA	2			

PRINT PHANTOM ITEMS
 PRINT COMPONENTS
 PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 9203200 CROSS REF ITEM ENGR DRAW 2002719-5 K DESCRIPTION WRC-1 SUBCARRIER INFC 110KHZ BATCH QTY 1 ITEM TYPE 1 LOW LEVEL 01
 EFFEC 5/30/84 UNIT MEAS EA PLANNER 511

ACM ITEM	LC CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM TYP	CPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES
32	05	4410234	RES 2.0PK CWM 1/4W 10K R1	RC07GF222K	1.000	EA	4			
36	05	4410353	RES 5.0PK DWF 174W 10K 3/2	RC07GF6R2K	1.000	EA	4			
42	05	4210406	CAP MICA DIP 470PF	DM-15-471J	2.000	EA	4			
53	05	4220190	CAP MICA DIP 3600PF	DM-19-362J	2.000	EA	4			
59	04	4210499	CAP MICA DIP 370PF C2, C4	DM-15-621J	1.000	EA	4			
60	05	4210490	CAP MICA DIP 560PF C3	DM-15-561J	1.000	EA	4			
95	02	9204777	WRC-1 SUBCARRIER INFC	WRCUTER 2002719-7	1.000	EA	2			

PRINT PHANTOM ITEMS
 PRINT COMPONENTS
 PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 9203253 CROSS REF ITEM DESCRIPTION MRC-1 SUBCARRIER INTEFC 18SKHZ ENGR DRAW 20D2719-6 K BATCH QTY 1 EFFEC 5/30/84 ITEM TYPE 1 UNIT MEAS EA LOW LEVEL 01 PLANNER 511

BCM ITEM	LL CC	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM TYP	OPT NBR	FIRST CP SEQ	LT ADJ	EFFECTIVE DATES FROM TO
27	06	4410395	RES 15K OHM 1/4W 10% R2	RC070F15JK	1.000	EA 4				
33	02	4410312	RES 3.5K OHM 1/4W 10% R1	RC070F35JK	1.000	EA 4				
42	04	4210424	CAP MICA DIP 140PF C1	DM-15-181J	1.000	EA 4				
43	05	4210456	CAP MICA DIP 470PF C6	DM-15-471J	1.000	EA 4				
61	04	4210331	CAP MICA DIP 250PF C3	DM-15-251J	1.000	EA 4				
62	05	4220067	CAP MICA DIP 1500PF C2 & C4	DM-19-152J	2.000	EA 4				
64	04	4210407	CAP MICA DIP 300PF C5	DM-15-301J	1.000	EA 4				
95	02	9204777	MRC-1 SUBCARRIER INTEFC NEUTLR	20D2719-7 K	1.000	EA 2				

PRINT PHANTOM ITEMS
 PRINT COMPONENTS
 PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 9204777 CROSS REF ITEM DESCRIPTION MRC-1 SUBCARRIER INTFC NEUTER ENGR DRAW 2002719-7 K BATCH QTY 1 ITEM TYPE 2 LOW LEVEL 02 EFFEC 5/30/84 UNIT MEAS EA PLANNER 511

SOM ITEM	LL CC	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	OPT NBR	FIRST CP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
1	03	3471976	PCB SUBCARRIER INTRF	5165858 01	1.000	EA	9				
2	03	2050408	PANEL SUBC INTF MRC1	0547635 3	1.000	EA	2				
3	04	3730827	IC XR-2211CP FSK MODEM	XR-2211CP	1.000	EA	4				
4	04	3730819	IC XR-2206CP VCO WAVE GEN	XR-2206CP	1.000	EA	4				
5	04	3650124	IC U4741P OPAMP GEN COMP	U4741CP	1.000	EA	4				
6	06	3250008	SKT DUAL IN LINE 8 PIN	640463-1	1.000	EA	4				
7	06	3250016	SKT DUAL IN LINE 14 PIN	640357-1	1.000	EA	4				
8	06	3250024	SKT DUAL IN LINE 16 PIN	640358-1	1.000	EA	4				
9	06	3250032	CONN 43 PIN	65001-041	1.000	EA	4				
11	04	3110442	CONN HNC BULK	UG-1094/U	2.000	EA	4				
12	03	4630323	POT WW PC PIN 20K OHM .5W	ET34X203	1.000	EA	4				
14	03	4630059	POT WW PC PIN 1K OHM .5W	ET34Y102	1.000	EA	4				
15	03	4630559	POT WW PC PIN 100K OHM .5W	ET34Y104	1.000	EA	4				
16	03	4630315	POT WW PC PIN 10K OHM .5W	ET34Y103	1.000	EA	4				
17	04	4630016	POT CE2 PC PIN 200 OHM .5W	3386R-1-201	1.000	EA	4				
18	06	4410213	RES 500 OHM 1/4W 10%	RC070F500K	1.000	EA	4				
19	06	4410247	RES 1K OHM 1/4W 10%	RC070F100K	1.000	EA	4				
20	06	4410494	RES 100K OHM 1/4W 10%	RC070F100K	4.000	EA	4				
21	06	4410052	RES 470K OHM 1/4W 10%	RN6004901F	1.000	EA	4				
22	06	4410163	RES 220 OHM 1/4W 10%	RC070F220K	1.000	EA	4				
23	06	4410110	RES 120 OHM 1/4W 10%	RC070F120K	1.000	EA	4				
24	06	4410389	RES 10K OHM 1/4W 10%	RC070F100K	1.000	EA	4				

PRINT PHANTOM ITEMS
 PRINT COMPONENTS
 PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM 9204777 CROSS REF ITEM DESCRIPTION MRC-1 SUBCARRIER INTERC NEUTER BATCH QTY 1 ITEM TYPE 2 LOW LEVEL 02
 EFFEC 5/30/84 UNIT MEAS EA PLANNER 511

BLM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	OPT TYP	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM	TO
26	00	4410338	RES 4.7K OHM 1/4W 10% R12, R13, R27	RC07GF472K	3.000	EA	4				
35	05	4410502	RES 120K OHM 1/4W 10% R4	RC07GF124K	1.000	EA	4				
39	05	4310207	CAP .10UF/50V 20% C7, C8, C10, C13, C14, C15, C16, C17, C18, C21, C23, C24	CV27C104M	12.000	EA	4				
40	06	4280038	CAP EPOX-DIP 1/35V C20	1960105X0035HA1	1.000	EA	4				
41	06	4210079	CAP EPOX-DIP 10/25V C19, C22	1960106X0025KA1	2.000	EA	4				
42	04	4210324	CAP MICA DIP 180PF C11	DM-15-181J	1.000	EA	4				
43	05	4210456	CAP MICA DIP 470PF C12	DM-15-471J	1.000	EA	4				
45	05	4310132	CAP DISC .01/50V C9	UK-50-103	1.000	EA	4				
66	04	4041703	COIL ASSEMBLY L1, L2	03-5005 C	2.000	EA	1				
67	04	2060051	BRKT ANGLE	7575-C	2.000	EA	4				
68	05	1090132	SCR BURN SLTD 5/32 X 1/4 SST	BINDER HEAD	4.000	EA	4				
69	05	1090554	NUT HEX 5/32 SM PATT	NUT 5/32 SM	4.000	EA	4				
70	04	1090538	WSHR LK #6 S2 SST	LOCKWASHER #6	4.000	EA	4				
71	05	1190073	LUG	334 w/.375	2.000	EA	4				
72	06	4410395	RES 15K OHM 1/4W 10% R6	RC07GF153K	1.000	EA	4				

PRINT PHANTOM ITEMS
 PRINT COMPONENTS
 PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM CROSS REF ITEM DESCRIPTION MRC-1 SUBCARRIER INTFC 92 KHZ BATCH QTY I ITEM TYPE I LOW LEVEL 01
 9204892 ENGR DRAW 20D2719-8 K EFFEC 5/30/84 UNIT MEAS EA PLANNER 511

BCM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM	OPT TYP	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM TO
30	06	4410270	RES 1.9K OHM 1/4W 10% R1	RC07GF192K	1.000	EA	4			
60	05	4210480	CAP MICA DIP 560PF C5-C6	DM-15-561J	2.000	EA	4			
73	05	4210506	CAP MICA DIP 680PF C1	DM-15-681J	1.000	EA	4			
74	05	4220018	CAP MICA DIP 1000PF C3	DM-19-102J	1.000	EA	4			
75	05	4250130	CAP POLYCARB .0068/100V 3% C2-C4	22U3642H	2.000	EA	4			
76	03	4460267	RES 6.2K OHM 1/4W 5% R2	RC07GF622J	1.000	EA	4			
99	02	9204777	MRC-1 SUBCARRIER INTFC NEUTER	20D2719-7 K	1.000	EA	2			

ANALOG INPUT III

Schematic 91D7343
Component Layout 20D2897
PC Board 51C6013

I. PURPOSE

The Analog Input III board is used to measure 16 differential analog inputs and convert these input voltages to digital signals suitable for use by the microprocessor.

II. SPECIFICATIONS

DC input resistance is 500 k Ω . However, it is recommended that the output impedance of the circuit driving the board not exceed 10 k Ω at .25 Hz, increasing to 25 k Ω at 4 Hz. Normal mode rejection at 60 Hz is 35 dB with a common mode rejection (within input voltage range) of at least 60 dB. For best overall accuracy, the normal mode input should be close to ± 4 V, with maximum inputs not exceeding ± 5 V.

Measurement accuracy is 0.4% ± 1 bit. The maximum input voltage from either input to ground is ± 5 V. Exceeding this voltage will cause improper operation of the board for the duration of the over-voltage condition. If either input voltage exceeds ± 40 V, permanent damage to U11-U15, or U7 may result.

III. ELECTRICAL ADJUSTMENTS

Board addressing is accomplished using HEX switch S1. Up to 16 different A/D channels per board can be accessed, with the lowest 16 data channels on board 0, the next 16

data channels on board 1, and so on. Switch programming positions are shown in Section 7.3. S1 is programmed at the factory and normally will not require changing. If a defective board is replaced, be sure that the address switch is set to the proper position.

IV. THEORY OF OPERATION

The address of the Analog Input is selected by switch S1, and is decoded by the 74LS86 (U9) and the 74LS30 (U5). The board occupies four adjacent address locations in the range from 8140 ± 817F (Hex), with the exact starting address programmed by S1.

When the microprocessor outputs the address of the analog input board, *BOARD SELECT is pulled low, enabling the MC6821 (U1) PIA and the 74LS245 (U8) octal transceiver. The enabled direction of the transceiver is determined by the R/*W line from the microprocessor.

PIA lines PA0-PA7 are used to read the eight least-significant bits of the MN574A (U2) output. The four most-significant bits are read with PB0-PB3. The channel to be converted is output on lines PB4-PB7 and CB2. Line CA2 is used to put the A/D either in read or convert mode, and line CA1 is used to monitor when the A/D conversion is complete.

The three most-significant bits of the channel select lines (CHSEL2-CHSEL4) are used on the inputs of the 74LS138 (U3) 3-to-8 decoder, which selects one of five MC14052 (U11-U15) differential analog multiplexers. Four of the MUXs are used for the sixteen user inputs.

The remaining MUX is used for the four self-check channels (OFFSET/GND, +Vref, -Vref, and +5 V).

The selected differential input signal is buffered by the TL072 (U7) op amps. The buffered differential signal is then converted to a single-ended signal by op amp LM308A (U6) which is configured as a unity-gain differential amplifier. This single-ended signal is then fed directly into the MN574A (U2) A/D converter.

The A/D converter is the heart of the Analog Input board. This hybrid IC contains a successive-approximation register, a 12-bit D/A converter, control logic, a clock, switches, buffers, a comparator, and a precision reference. Since the A/D uses successive-approximation techniques, a conversion is completed in about 25 μ s.

The sequence of commands issued by the software is as follows:

- A. Wait for conversion to be completed.
- B. Set R/*C high (read mode).
- C. Read previously-converted data.
- D. Output channel to MUXs.
- E. Set R/*C low (convert mode).

V. TROUBLESHOOTING

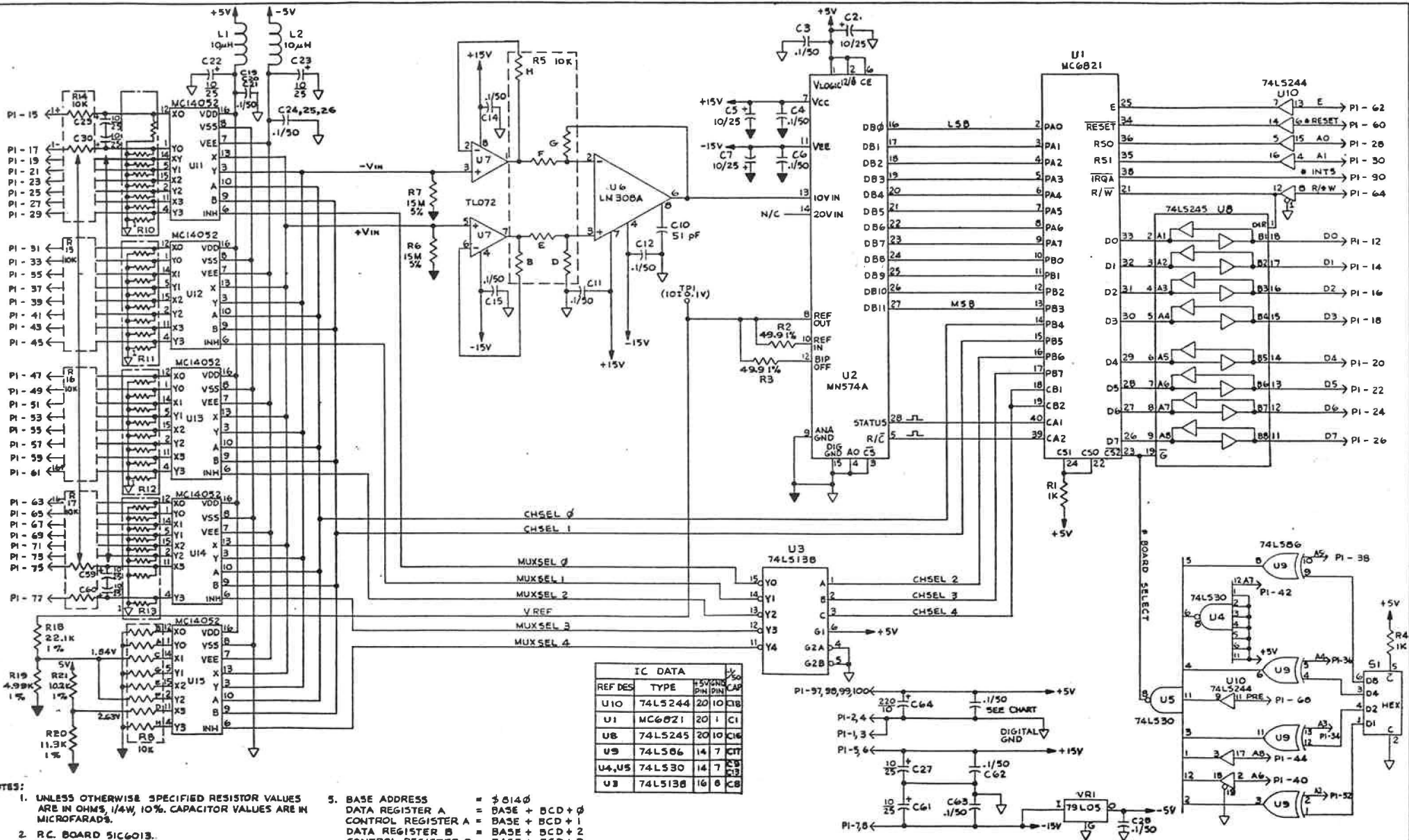
Verify that the Analog Input board and the Filtered Interface board are firmly seated in the corresponding slots.

Check for power supply voltages on the board (see schematic).

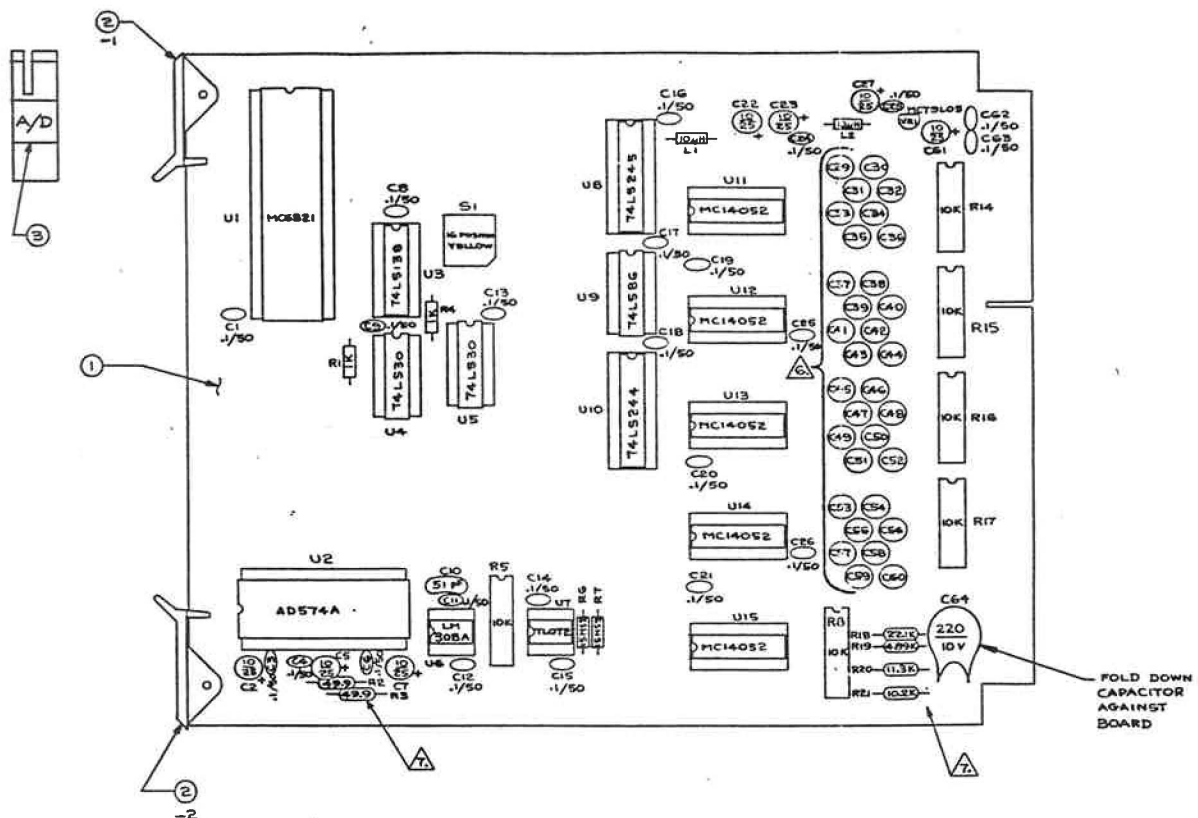
Verify proper switch position by checking for activity on *BOARD SELECT.

Check the R/*C and status lines of the A/D converter (U2-5 and 28) for activity.

Check analog switch addressing. Under normal operations, the system will be scanning all 20 channels.



- NOTES:
- UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/4W, 10%. CAPACITOR VALUES ARE IN MICROFARADS.
 - R.C. BOARD SIC6013.
 - COMPONENT LAYOUT ZOD2897.
 - ALL DIP RESISTORS 10K, 1/8W, 2%.
 - ALL SIP RESISTORS NOT INSTALLED. (MAY BE USED IF INPUTS > 5V ARE DESIRED)
 - BASE ADDRESS = $\$0140$
 DATA REGISTER A = BASE + BCD + 0
 CONTROL REGISTER A = BASE + BCD + 1
 DATA REGISTER B = BASE + BCD + 2
 CONTROL REGISTER B = BASE + BCD + 3



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
 ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, ±10%
 ALL CAPACITOR VALUES ARE IN MICROFARADS
2. P.C. BD 51C6013
3. SCHEMATIC 91D7343
4. IC SOCKETS INSTALLED AT EACH IC POSITION
5. S1, VR1, R5, RD, RM-IT INSTALLED WITHOUT SOCKETS
- △ CAPACITORS C23-C60 ARE 10/85, ALL "+" SIDES ARE INSTALLED TOWARDS THE COMB (RIGHT SIDE OF BOARD).
- △ R2, R3, R18-R21 ARE 1%

USED ON: MRC FAMILY
 ITEM NO 9204827

BOARD MADE IN U.S.A. BY MRC ELECTRONIC CORP. 1000 SOUTH ST. BOSTON, MA 02111-1000 TEL: 617/552-4000 FAX: 617/552-4001	 MRC ASSOCIATES, INC. <small>MEMBER COMPANY</small> 2002897B	
		COMPONENT LAYOUT ANALOG INPUT III
		10/85 CAPS 10/50 CAPS 10K RES 1K RES 220 RES
		10/85 CAPS 10/50 CAPS 10K RES 1K RES 220 RES
		10/85 CAPS 10/50 CAPS 10K RES 1K RES 220 RES

PRINT PHANTOM ITEMS
 PRINT COMPONENTS
 PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM CROSS REF ITEM DESCRIPTION ASSY,ANALOG INPUT III MRC-1/2 BATCH QTY 1 ITEM TYPE 1 LOW LEVEL 03
 9204827 ENGR DRAW 20D2897 B EFFEC 8/17/84 UNIT MEAS EA PLANNER 511

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM TO
1	04	3473600	PCB ANALOG INPUT III	51C6013 A	1.000	EA 4				
2	04	1250075	EJCTR CD (LEFT,RIGHT & 2 PINS)	41-1274L,C12409	1.000	PR 4				
3	04	3430378	LBL LOGIC CD A/D	10A1068-10 CO	1.000	EA 4				
4	06	3250016	SKT DUAL IN LINE 8 PIN U6,U7	640463-1	2.000	EA 4				
5	06	3250024	SKT DUAL IN LINE 14 PIN U4,U5,U9	640357-1	3.000	EA 4				
6	06	3250032	SKT DUAL IN LINE 16 PIN U3,U11,U12,U13,U14,U15	640358-1	6.000	EA 4				
7	05	3250057	SKT DUAL IN LINE 20 PIN U8,U10	640464-1	2.000	EA 4				
8	04	3250081	SKT DUAL IN LINE 28 PIN U2	640362-1	1.000	EA 4				
9	05	3250099	SKT DUAL IN LINE 40 PIN U1	640379-1	1.000	EA 4				
11	04	3150117	SW 16P BCD ROT OUTPUT YELLOW S1	230057G	1.000	EA 4				
12	04	4540233	RES DIP 10K OHM 1/8W 2% (8X) R5,R8,R14,R15,R16,R17	316B103	6.000	EA 4				
13	06	4410247	RES 1K OHM 1/4W 10% R1,R4	RC076F102K	2.000	EA 4				
14	05	4460952	RES 15MEG OHM 1/4W 5% R6,R7	RC076F156J	2.000	EA 4				
15	04	4510863	RES 49.9 OHM 1/8W 1% R2,R3	RN55E49R9F	2.000	EA 4				
16	05	4510103	RES 4.99K OHM 1/8W 1% R19	RN55E4991F	1.000	EA 4				
17	04	4510699	RES 10.2K OHM 1/8W 1% R21	RN55E1022F	1.000	EA 4				
18	04	4510715	RES 11.3K OHM 1/8W 1% R20	RN55E1132F	1.000	EA 4				
19	06	3650132	RGLTR MC79L05 05V 0.1A TU92 VR1	MC79L05 ACP	1.000	EA 4				
20	04	4510657	RES 22.1K OHM 1/8W 1% R18	RN55E2212F	1.000	EA 4				
21	04	4210191	CAP MICA DIP 51PF C10	DM-15-510J	1.000	EA 4				
22	06	4280079	CAP EPOX-DIP 10/25V C2,C5,C7,C22,C23,C27,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	196D106X0025KAI	39.000	EA 4				

PRINT PHANTOM ITEMS
 PRINT COMPONENTS
 PRINT PHANTOM/COMPONENT COMMENTS

PARENT ITEM CROSS REF ITEM DESCRIPTION ASSY, ANALOG INPUT III MRC-1/2 BATCH QTY 1 ITEM TYPE 1 LOW LEVEL 03
 9204827 ENGR DRAW 20B2897 B EFFEC 8/17/84 UNIT MEAS EA PLANNER 511

BOM ITEM	LL CD	COMPONENT & CROSS REF.	DESCRIPTION & COMMENT	ENGINEERING DRAWING NUMBER	QUANTITY PER	ITEM UM TYP	OPT NBR	FIRST OP SEQ	LT ADJ	EFFECTIVE DATES FROM TO
23	06	4280186	CAP EPOX-DIP 220/10V C64	K220E10	1.000	EA 4				
24	05	4310207	CAP .1UF/50V 20% C1,C3,C4,C6,C8,C9,C11,C12,C13,C14,C15,C16,C17,C18,C19,C20,C21,C24,C25,C26,C28,C62,C63	CY20C104M	23.000	EA 4				
26	04	4020244	IDCTR RF 10 UH L1,L2	9230-44	2.000	EA 4				
28	05	3660735	IC SN74LS30N SI 81N NAND U4,U5	SN74LS30N	2.000	EA 4				
29	04	3660743	IC SN74LS86N QU 21N EXCL OR U9	SN74LS86N	1.000	EA 4				
30	05	3660792	IC SN74LS138N 3-BLINEDECIDEMUX U3	SN74LS138N	1.000	EA 4				
31	05	3660859	IC SN74LS244N OCT BUS/DRIV ST U10	SN74LS244N	1.000	EA 4				
32	05	3661162	IC SN74LS245N OCT BUS TRNCVR U8	SN74LS245N	1.000	EA 4				
33	04	3680220	IC DIFFERENTIAL AMUX 4CH U11,U12,U13,U14,U15	MC14052BCP	5.000	EA 4				
34	04	3680279	IC A/D CONVERTER 12 BITS U2	AD574AKD	1.000	EA 4				
35	05	3710027	IC MC6821P PIA INTERFACE U1	MC6821P	1.000	EA 4				
36	04	3730157	IC LM308AN OPAMP PRECISION U6	LM-308AN	1.000	EA 4				
37	04	3730876	IC DUAL OP-AMP U7	TL072A	1.000	EA 4				

STATUS INPUT, TTL II

Schematic 91C7237
Assembly 20D2798
PC Board 51C5912

I. PURPOSE

The Status Input, TTL II module is used to interface the MRC system with 16 TTL inputs. The inputs can be used separately as status or as a single 16-bit word.

II. SPECIFICATIONS

Inputs are TTL active low. Input voltage should be restricted from 0 to +5 volts or module damage may result. A switch closure across the input pins is all that is required to operate a status channel.

III. MODULE ADDRESS SPECIFICATION

Switch S1 is used to assign a module address from 0 to 15. Module 0 will output channels 1 through 16; module 1 will output channels 16 through 32, etc. Programming of S1 is shown in Figure 1. If replacement modules are installed for any reason, verify that S1 is set correctly.

IV. THEORY OF OPERATION

U6, in conjunction with switch S1, is a programmable inverter for address selection. U5 ANDS the outputs of U6 with PRE (I/O Select), A6, A7 and *A8 to form the module address. When switch S1 is set to "0", the module is addressed in its lowest address range, 80C0 to 80C3. When switch S1 is set to "F", the module is addressed from 80FC to 80FF.

When the correct address is decoded, pin 8 of U5 goes to a low state, enabling decoder U4. U1 and U2 are tristate buffers used to gate 8 bits of status information onto the data bus. U3 provides a unique module ID pattern on the data bus when selected.

When address lines A0 and A1 are both low and U4 is enabled, status bits 1 through 8 are gated onto the data bus. When A0 is high and A1 is low, status bits 9 through 16 are gated onto the bus. When A0 is low and A1 is high, the unique module ID is gated onto the bus.

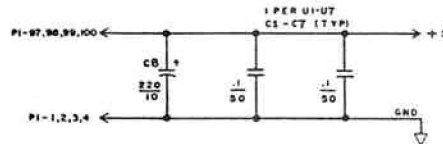
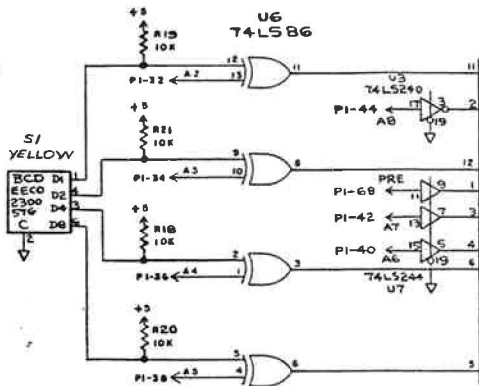
V. TROUBLESHOOTING

Check for periodic low pulses on U5 pin 8, indicating the CPU is attempting to read data from this module. Low-going pulses should also be observed on pins 1 and 19 of U1 and U2.

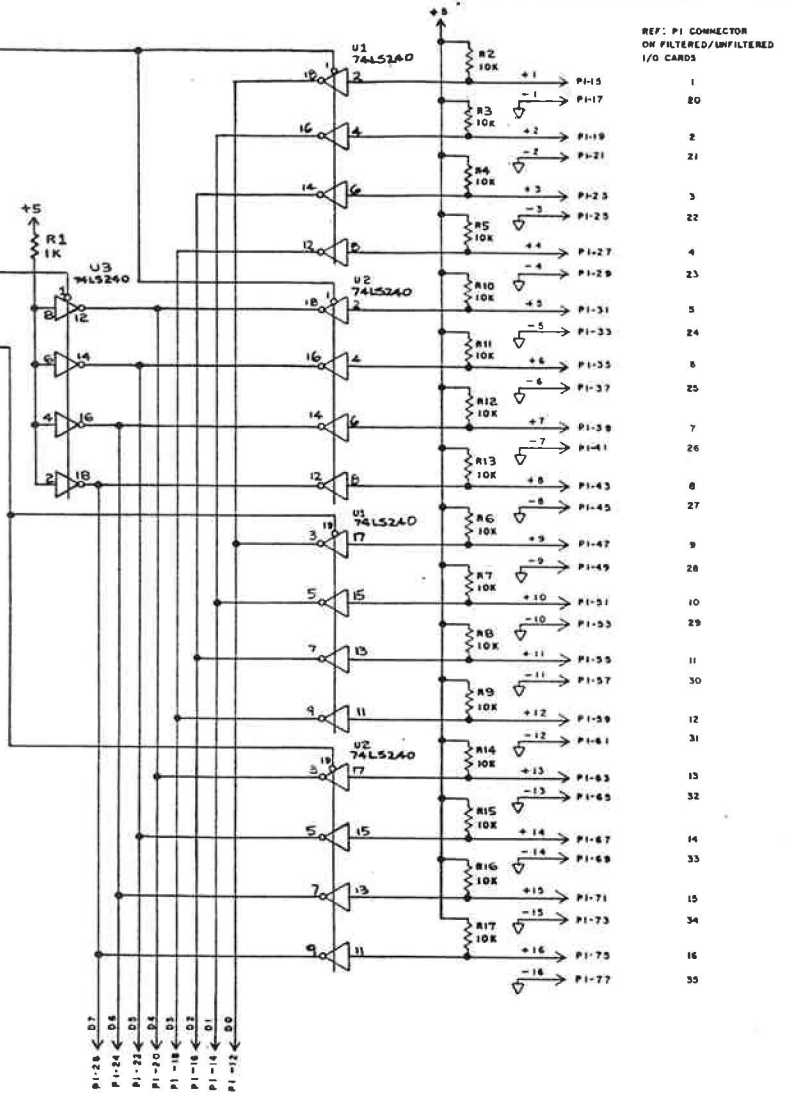
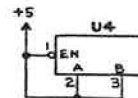
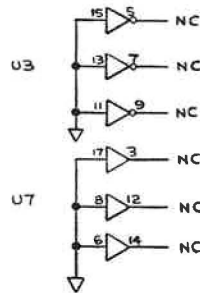
<u>Address</u>	<u>Channels</u>
0	1-16
1	17-32
2	33-48
3	49-64
4	65-80
5	81-96
6	97-112
7	113-128
8	129-144
9	145-160
A	161-176
B	177-192
C	193-208
D	209-224
E	225-240
F	241-256

Figure 1. S1 programming.

TYPE NO.	REF DESIG	PS GND PIN NO.	+5V PIN NO.
74LS86	U6	7	14
74LS30	U5	7	14
74LS139	U4	8	16
74LS240	U1, U2, U3	10	20
74LS244	U7	10	20



- NOTES:
- UNLESS OTHERWISE SPECIFIED
RESISTOR VALUES ARE IN OHMS 1/4W10%
CAPACITOR VALUES ARE IN MICROFARDS.
 - P. C. BOARD 91C8912.
 - COMPONENT LAYOUT 20D2798 REV. Aφ.

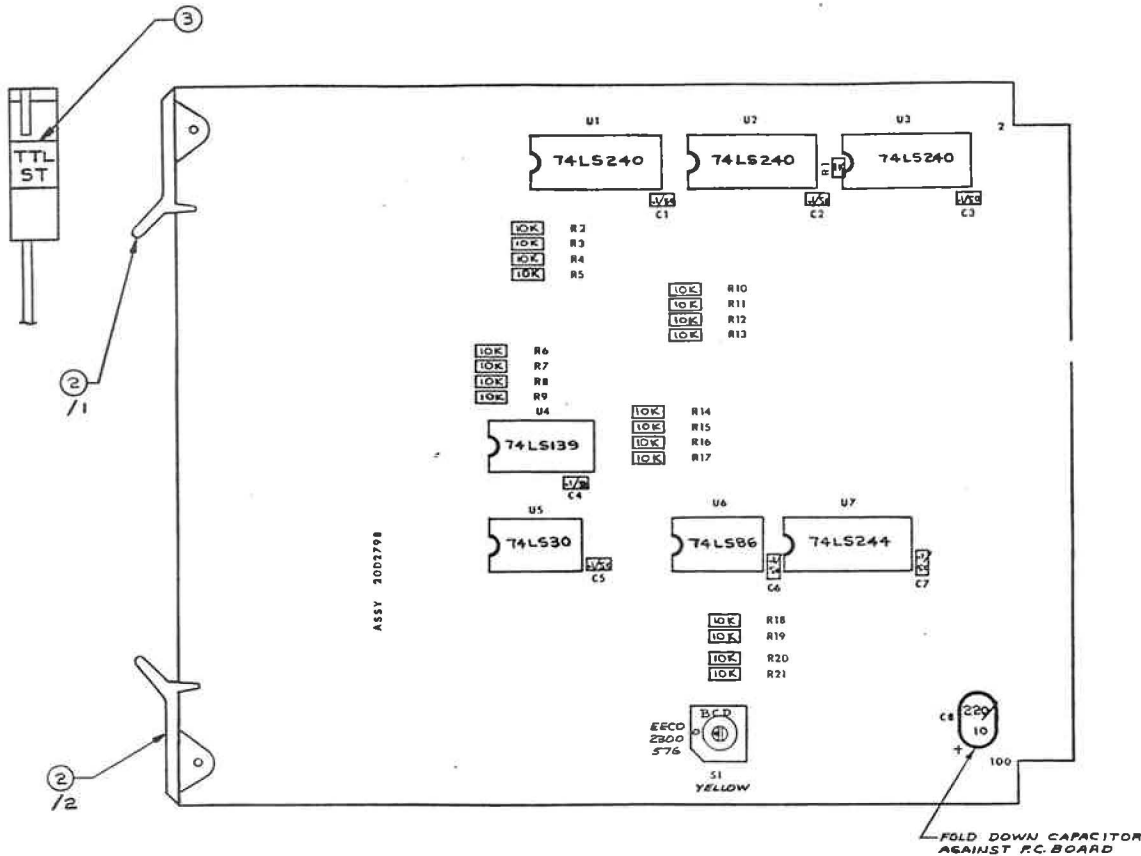


REF: PI CONNECTOR
OR FILTERED/UNFILTERED
I/O CARDS

- 1
- 20
- 2
- 21
- 3
- 22
- 4
- 23
- 5
- 24
- 5
- 25
- 7
- 26
- 8
- 27
- 9
- 28
- 10
- 29
- 11
- 30
- 12
- 31
- 13
- 32
- 14
- 33
- 15
- 34
- 16
- 35

USED ON: MRC FAMILY

DESIGNED BY	DATE	MOSELEY ASSOCIATES, INC.
CHECKED BY		STATUS: INPUT, TTL II
APPROVED BY		91C7237 B



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
RESISTOR VALUES ARE IN OHMS 1/4W 10%
CAPACITOR VALUES ARE IN MICROFARADS
2. I C SOCKETS TO BE INSTALLED AT EACH I C LOCATION
3. SWITCH S1 TO BE INSTALLED WITHOUT A SOCKET
4. P C BOARD 51C5912 REV. -10,-21
5. SCHEMATIC 91C7237 REV.

USED ON MRC FAMILY
ITEM NO: 9203415

ITEM NO.	DESCRIPTION	REF DESIG	STOCK NO.	QTY
16	CAPACITOR, 220µF 10V	C8	4280186	1
15	" .1µF 50V	C1-C7	4310207	7
14	RESISTOR, 10K 1/4W 10%	R2-R21	4410379	20
13	" .1K 1/4W 10%	R1	4410247	1
12	SWITCH, BCD, 1P20 576	S1 YELLOW	3150117	1
11	SOCKET, I.C., 14 PIN	U5, U6	3250024	2
10	" " 16 PIN	U4	3250032	1
9	" " 20 PIN	U1, U2, U3, U7	3250057	4
8	I.C. SN74LS244	U7	3660859	1
7	" SN74LS240	U1, U2, U3	3660974	3
6	" SN74LS139	U4	3660800	1
5	" SN74LS86	U6	3660743	1
4	" SN74LS30	U5	3660735	1
3	LABEL, 10A106T-7		3490345	1
2	EJECTOR PAIR, C12409A/2		1250075	1
1	P C BOARD 51C5912-10,-21		3472446	1

MOORELEY ASSOCIATES, INC.
3015 BROADWAY, SUITE 200
MOUNTAIN VIEW, CALIFORNIA 92654

COMPONENT LAYOUT -
STATUS INPUT, TTL II

DATE: 10/10/81 BY: J. J. J. / J. J. J.

20D2798/AM

STATUS INPUT, OPTO II

Schematic 91C7236
Component Layout 20D2795
PC Board 51C5911

I. PURPOSE

The Status Input, Opto II module is used to bring 16 on/off inputs into the CPU. It can be used for individual bits (status) or as a 16-bit word. Optical isolators are used for maximum noise rejection.

II. SPECIFICATIONS

Each input requires between 5 mA and 30 mA of current (user supplied) to drive the optical isolator for that input. The unit is shipped with 1800 ohm current-limiting resistors. These are suitable for input voltages from 20 V to 48 V. For lower voltages, the resistors will have to be changed to 560 ohms. This will allow operation with input voltages from 6 V to 15 V. The maximum voltage from any input to ground should not exceed ± 50 Vdc. Exceeding this voltage may cause damage to the module.

III. ELECTRICAL ADJUSTMENTS

Switch S1 is used to assign a module address from 0 to 15. Module 0 will output channels 1 through 16; module 1 will output channels 17 through 32, etc. Programming of S1 is given in Figure 1. S1 is programmed at the factory and will normally only be reset if a defective module is replaced. In this case, the switch on the new module should be set to the same position as the module it is replacing.

IV. THEORY OF OPERATION

U1, in conjunction with S1, is used as a programmable inverter for address selection. U2 ANDS the output of U1 along with PRE (I/O Select), A6, A7, and *A8 to form the address at which the module will operate.

With switch S1 set to "0", the address for the module will begin at 80C0 and end at 80C3 as each module uses four addresses. If switch S1 is set to "F", the address for the module will begin at 80FC and end at 80FF.

The output of U2 is used to enable 1-of-4 decoder U3, with only the first three outputs being used. The outputs of U3 are active low enables for tristate buffers U4, U5 and U22.

U4A-D and U5A-D are used to bring the first eight channels onto the data bus, while U4E-H and U5E-H are used to bring the second eight channels onto the data bus. U22 provides a unique module ID pattern on the data bus when selected.

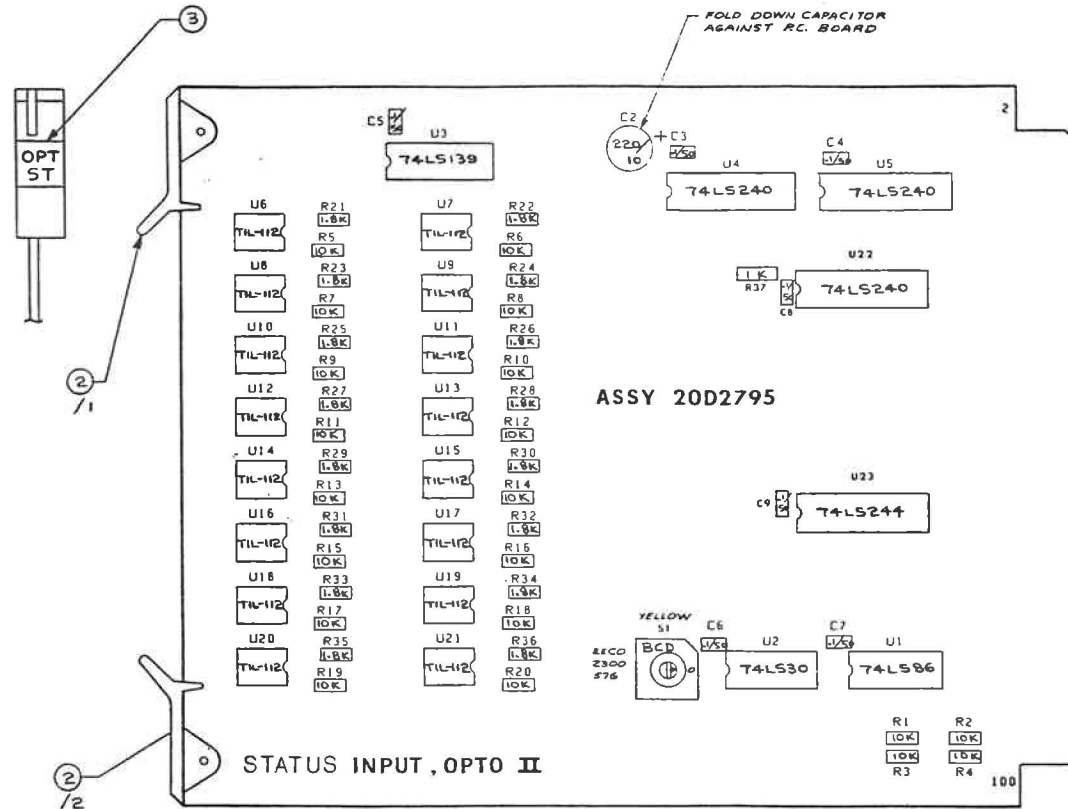
V. TROUBLESHOOTING

As a general guideline, if only certain bits on a module fail to function properly, the cause is usually associated with the input optical isolators. Complete module failure is associated with U1 through U3. If there are multiple modules in the user system, the modules may be interchanged (after setting switch S1) to pinpoint the cause. Before swapping modules, check all inputs to ensure that excessive currents are not being applied.

Verify that pin 5 of the optical isolator drops below 0.8 volts when current is passed through the appropriate input. If not, suspect the optical isolator or a defective input on U4 or U5. Check for a periodic low pulse on U2 pin 8. This indicates that the CPU is trying to read data from this module. Low-going pulses should also appear on pins 1 and 19 of U4 and U5. If not, suspect U1 through U3 or S1.

<u>Address</u>	<u>Channels</u>
0	1-16
1	17-32
2	33-48
3	49-64
4	65-80
5	81-96
6	97-112
7	113-128
8	129-144
9	145-160
A	161-176
B	177-192
C	193-208
D	209-224
E	225-240
F	241-256

Figure 1. S1 programming.



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
RESISTOR VALUES ARE IN OHMS 1/4W 10%
CAPACITOR VALUES ARE IN MICROFARADS
2. I.C. SOCKETS TO BE INSTALLED AT EACH I.C. LOCATION
3. SWITCH S1 TO BE INSTALLED WITHOUT A SOCKET
4. P.C BOARD 51C5911 REV. -10, -20
5. SCHEMATIC 91CT236 REV. Aφ

USED ON MRC FAMILY
ITEM NO: 9203423

19	CAPACITOR 220µf 10V	C2	4280186	1
18	" .1µf 50V	C3-C9	4310207	7
17	RESISTOR 10K, 1/4 W, 10%	R1-R20	4410379	20
16	" 1.8K, 1/4 W, 10%	R21-R36	4410270	16
15	" 1K, 1/4 W, 10%	R37	4410247	1
14	SWITCH BCD, 51C5911-20	S1 YELLOW	3150117	1
13	SOCKET, I.C., 6 PIN	U6-U21	3250008	16
12	" " 14 PIN	U1, U2	3250024	2
11	" " 16 PIN	U3	3250032	1
10	" " 20 PIN	U4, U5, U22, U23	3250057	4
9	I.C. TIL-112	U6-U21	3730777	16
8	" SN74LS244	U23	3660859	1
7	" SN74LS240	U4, U5, U22	3660974	3
6	" SN74LS139	U3	3660800	1
5	" SN74LS86	U1	3660743	1
4	" SN74LS30	U2	3660735	1
3	LABEL MA110A1068-G		3430337	1
2	EJECTOR PAIR, 1/2" DIA		1250075	1
1	P.C BOARD, 51C5911-10, -20		3472453	1
ITEM NO	DESCRIPTION	REF DESIG	STOCK	QTY

MOSELEY ASSOCIATES, INC.
4001 WILSON BLVD
MARIETTA, GA 30067

COMPONENT LAYOUT
STATUS INPUT, OPTO II

REV. 10/80
20D2795

OPEN COLLECTOR COMMAND OUTPUT

Schematic 91C7171
Component Layout 20C2755

I. PURPOSE

The Open Collector Command Output module provides 16 open-collector outputs for driving control relays.

II. SPECIFICATIONS

Maximum voltage that can be applied to outputs without causing output latch-up is 55 V. Up to 300 mA may be sunk by drivers U7 to U14.

III. ELECTRICAL ADJUSTMENTS

Switch S1 is used to assign a module address from 0 to 15. Module 0 will output channels 1 through 16; module 1 will output channels 16 through 32, etc. Programming of S1 is shown in Figure 1. S1 is programmed at the factory and will not normally require changing. Any replacement module should be switched to the same configuration as the original module.

IV. THEORY OF OPERATION

U1, in conjunction with switch S1, is used as a programmable inverter for address selection. U2 ANDS the outputs of U1 along with VMA (Valid Memory Address), PRE (I/O Select), A7 and A8 to form the module address location.

With all four switches in the OFF position, the address for the module will begin at 8180 and end at 8183 as each module requires four addresses. If all four switches are ON, the address will begin at 81BC and end at 81BF.

The output of U2 is inverted by U6 to form an active-high board select, which is fed to the chip select on U3 (pin 24) and to bus buffer selector U6. If the CPU requests data from PIA (Peripheral Interface Adapter) U3, the R/*W (Read/Write) line (J1-64) will be high, enabling pin 19 of U4 and U5 and allowing data to pass onto the data bus. This read function is used to check operation of the PIA. If R/*W is low, pin 19 of U4 and U5 will be low, enabling a command to be written into the PIA.

Output CB2 on U3 is used to disable all outputs simultaneously upon Reset. Transistors Q1 and Q2 are current sources to interface the PIA with drivers U7 to U14.

V. TROUBLESHOOTING

1. Partial Failure (Some Channels Work)

This indicates that at least some PIA channels are functioning. Trace back from the output driver to the output of the PIA. Example: Assume channel 1 does not function. If tally-back does not function, suspect U4, U5 or U3. If the tally-back functions, the failure is in the output driver.

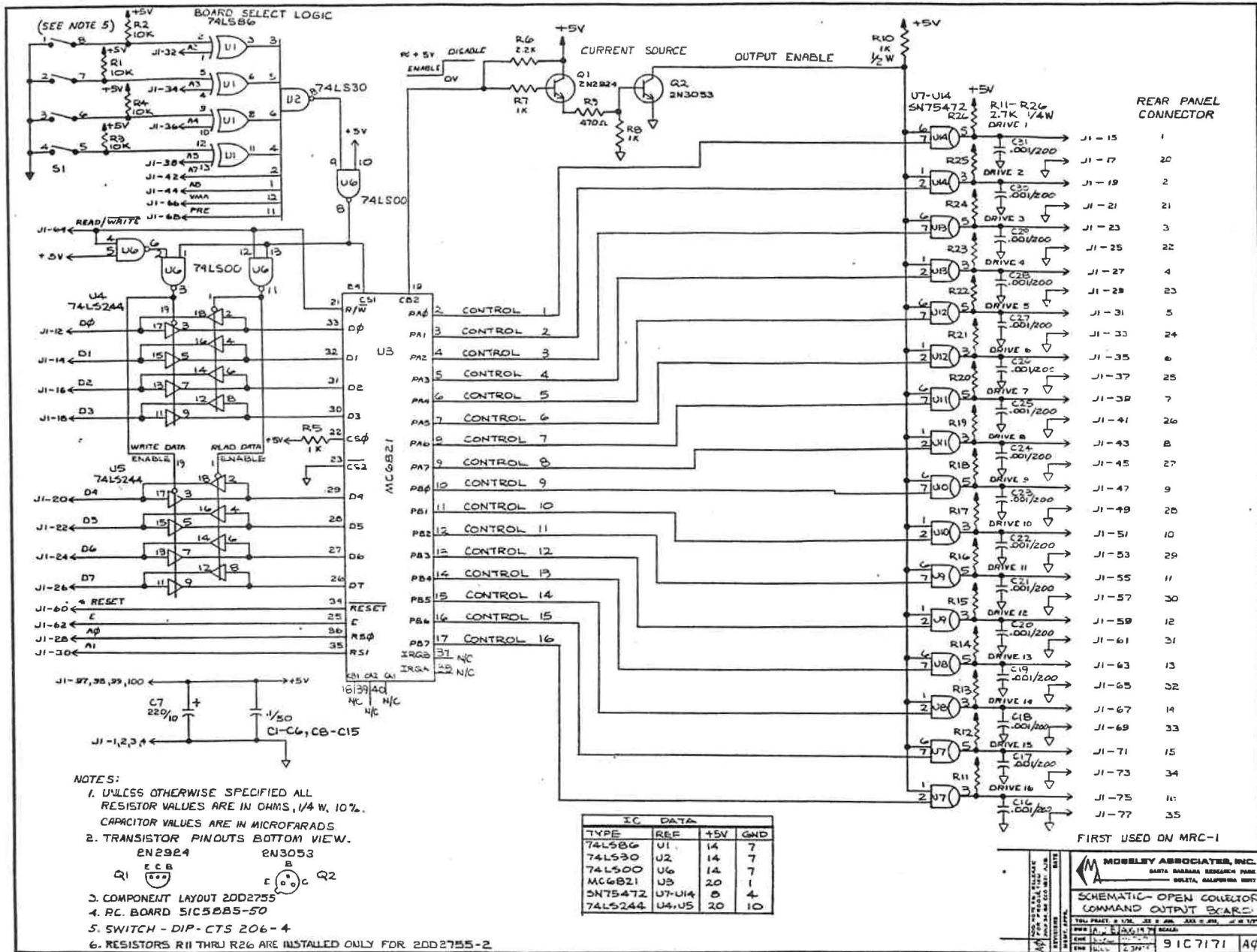
2. Complete Failure (All Channels)

Check U3 pin 19 for a low level. If the ENABLE signal is low, check operation of Q1 and Q2. If pin 19 is high, check U3 pin 24 for an active high pulse when a raise on this module is attempted. If no pulse is seen, verify operation of S1, U1, U2 and U6.

If a pulse is seen at U3 pin 19, verify that the pulses are repeated at Pin 1 of U4 and U5. If these pulses are present, suspect U4, U5 or U3.

<u>Pos 4</u>	<u>Pos 3</u>	<u>Pos 2</u>	<u>Pos 1</u>	<u>Address</u>	<u>Channels</u>
Off	Off	Off	Off	0	1-16
Off	Off	Off	On	1	17-32
Off	Off	On	Off	2	33-48
Off	Off	On	On	3	49-64
Off	On	Off	Off	4	65-80
Off	On	Off	On	5	81-96
Off	On	On	Off	6	97-112
Off	On	On	On	7	113-128
On	Off	Off	Off	8	129-144
On	Off	Off	On	9	145-160
On	Off	On	Off	10	161-176
On	Off	On	On	11	177-192
On	On	Off	Off	12	193-208
On	On	Off	On	13	209-224
On	On	On	Off	14	225-240
On	On	On	On	15	241-256

Figure 1. S1 programming.

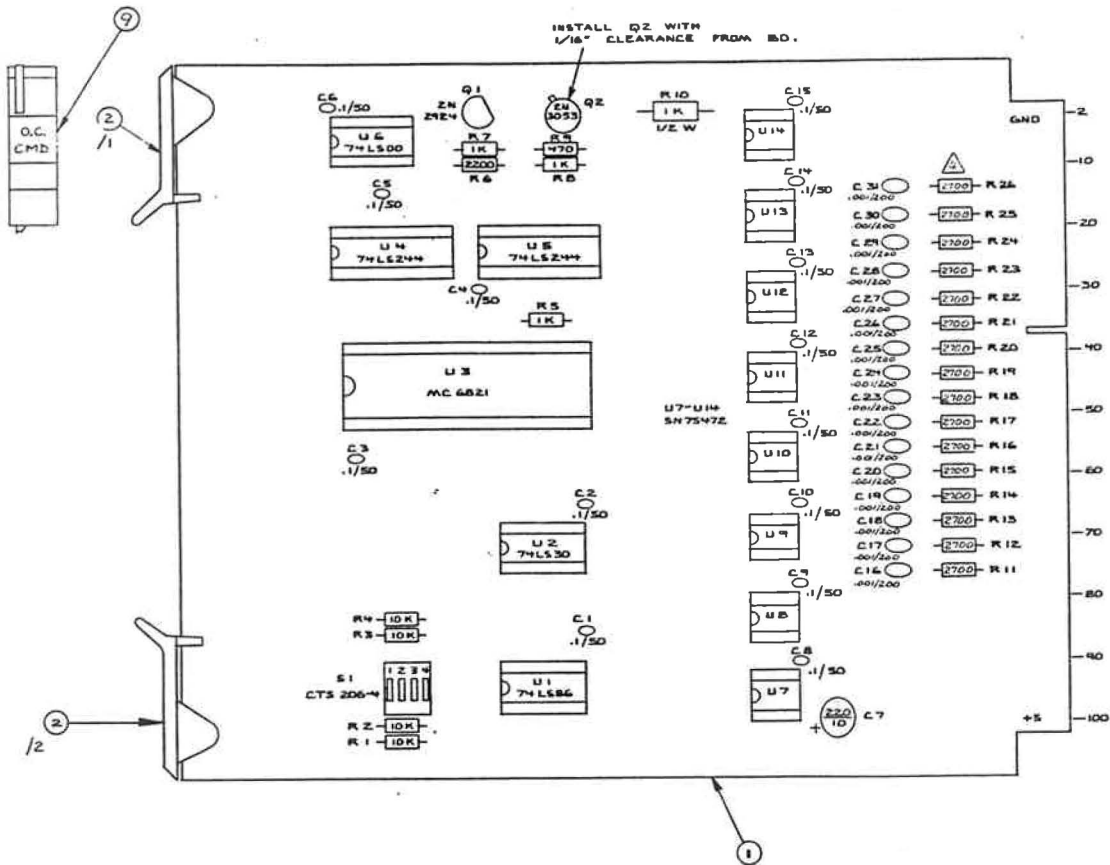


MOBBLEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
SANTA BARBARA, CALIFORNIA 93101

**SCHEMATIC - OPEN COLLECTOR
COMMAND OUTPUT BOARD**

THIS PROJECT # 176, 23 & 24, 25 & 26, 27 & 28, 29 & 30, 31 & 32, 33 & 34, 35 & 36, 37 & 38, 39 & 40, 41 & 42, 43 & 44, 45 & 46, 47 & 48, 49 & 50, 51 & 52, 53 & 54, 55 & 56, 57 & 58, 59 & 60, 61 & 62, 63 & 64, 65 & 66, 67 & 68, 69 & 70, 71 & 72, 73 & 74, 75 & 76, 77 & 78, 79 & 80, 81 & 82, 83 & 84, 85 & 86, 87 & 88, 89 & 90, 91 & 92, 93 & 94, 95 & 96, 97 & 98, 99 & 100

DATE: 10/14/77
DRAWN BY: J. J. MOBBLEY
CHECKED BY: J. J. MOBBLEY
SCALE: 1:1
SHEET NO.: 91C7171
TOTAL SHEETS: 49



NOTES

1. UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/4 W, 10%. CAPACITOR VALUES ARE IN MICROFARADS.
 2. P.C. BOARD SICES85-11-21
 3. SCHEMATIC 91C 7171.
- △ RESISTORS R11 THRU R26 ARE INSTALLED ONLY FOR 20D2755-2

USED ON:
MRC FAMILY

#	Q.C. COMM. OUTPUT ASSY	9204421	-
*	Q.C. COMM. OUTPUT ASSY	7202613	*
			33
			31
			30
			29
16	0 RESISTOR 2700	R11-26	44 0286 28
1	1 " 1K 1/2W	R10	44 0286 27
4	4 " 10K	R1-4	44 0286 26
1	1 " 2200	R6	44 0286 25
3	3 " 1K	R7-9	44 0286 24
1	1 RESISTOR 470	R8	44 0286 23
16	16 CAPACITOR .001	C16-31	43 0286 22
14	14 " .1/50	C1-6,8-9	43 0286 21
1	1 CAPACITOR .22/10	C7	42 0286 20
			19
1	1 SWITCH CTS 206-4	S1	31 0011 18
			17
1	1 IC SOCKET AMP #MS74-1	U3	325 0051 16
2	2 " " " #MS74-1	U4,5	325 0051 15
3	3 " " " #MS74-1	U1,2,6	325 0051 14
5	5 IC SOCKET AMP #MS74-1	U7-14	325 0051 13
			12
1	1 TRANSISTOR 2N 3053	Q1	36 0023 11
1	1 TRANSISTOR 2N 2724	Q2	36 0023 10
1	1 LABEL	10A10MS-1	36 0023 9
2	2 " " " SN75472	U7-14	36 0023 8
1	1 " " " MC 6821	U3	371 0027 7
2	2 " " " 74LS244	U4,5	36 0059 6
1	1 " " " 74LS66	U1	36 0143 5
1	1 " " " 74LS30	U2	36 0125 4
1	1 IC 74LS00	U6	36 0449 3
1	1 EJECTOR PAIR	20D2755-2	125 0075 2
1	1 P.C. BOARD	SICES85-11-21	347244 1
			1
REV	DESCRIPTION	REV	STOCK NO.

MOBBLEY ASSOCIATES, INC.
347244 1
COMPONENT LAYOUT
D.C. COMMAND OUTPUT ASSY
20D2755 B1

OPTICALLY ISOLATED COMMAND OUTPUT

Schematic 91C7129
Component Layout 20D2705
PC Board 51B5846

I. PURPOSE

The Optically Isolated Command Output module provides 16 optically isolated outputs for control of external equipment.

II. SPECIFICATIONS

The maximum voltage that should be applied to the outputs is 48 Vdc. The maximum voltage drop on an ON channel is 1.4 V, with a maximum 240 mA load. When a channel is OFF, the leakage current will not exceed 50 μ A. The outputs incorporate built-in reverse polarity and inductive load protection. The maximum voltage from an output line to ground is \pm 50 Vdc. Exceeding that voltage may cause damage to the module. The output is floating with respect to the chassis.

III. ELECTRICAL ADJUSTMENTS

Switch S1 is used to assign a module address from 0 to 15. Module 0 will output channels 1 through 16; module 1 will output channels 17 through 32, etc. Programming of S1 is given in Figure 1. S1 is programmed at the factory and will normally only be reset if a defective module is replaced. In this case, the switch on the new module should be set to the same position as the module it is replacing.

IV. THEORY OF OPERATION

U1, in conjunction with S1, is used as a programmable inverter for address selection. U2 ANDS the outputs of U1 along with VMA (Valid Memory Address), PRE (I/O Select), A7 (Address Line 7), and A8 (Address Line 8) to form the address at which the module will operate. With all four switches on S1 OFF, the address for the module will begin at 8180 and end at 8183 as each module requires four addresses. If all four switches on S1 are ON, the address for the module will begin at 81BC and end at 81BF.

The output of U2 is inverted by U3B to form an active-high board select, which is fed to the chip select on U6 (pin 24) and the bus buffer selectors U3C and U3D. If the CPU desires to read data from the PIA (Peripheral Interface Adapter) U6, the R/W (Read/Write) line (J1-64) will be high. This causes the output of U3D to go low, which enables U4A-D and U5A-D to activate. This allows data from U6 to pass through U4 and U5 to the data bus. If the CPU desires to write data to U6, the R/W line will be low. This causes the output of U3C to go low, which enables U4E-H and U5E-H to activate. This allows data from the data bus to pass through U4 and U5 to U6.

Output CB2 on U6 (pin 19) is used to disable all outputs simultaneously. This occurs during failsafe. To enable outputs, CB2 is brought low, forward biasing Q33 and Q34 which supply +5 V to the optical isolators. Drivers Q1 through Q16 are used to boost the output current of U6 to a sufficient value in order to drive optical isolators U7 through U22. The outputs of U7 through U22 are used to forward bias the Darlington output transistors Q17 through Q32 (floating from chassis).

V. TROUBLESHOOTING

1. Partial Failure (Some Channels Work)

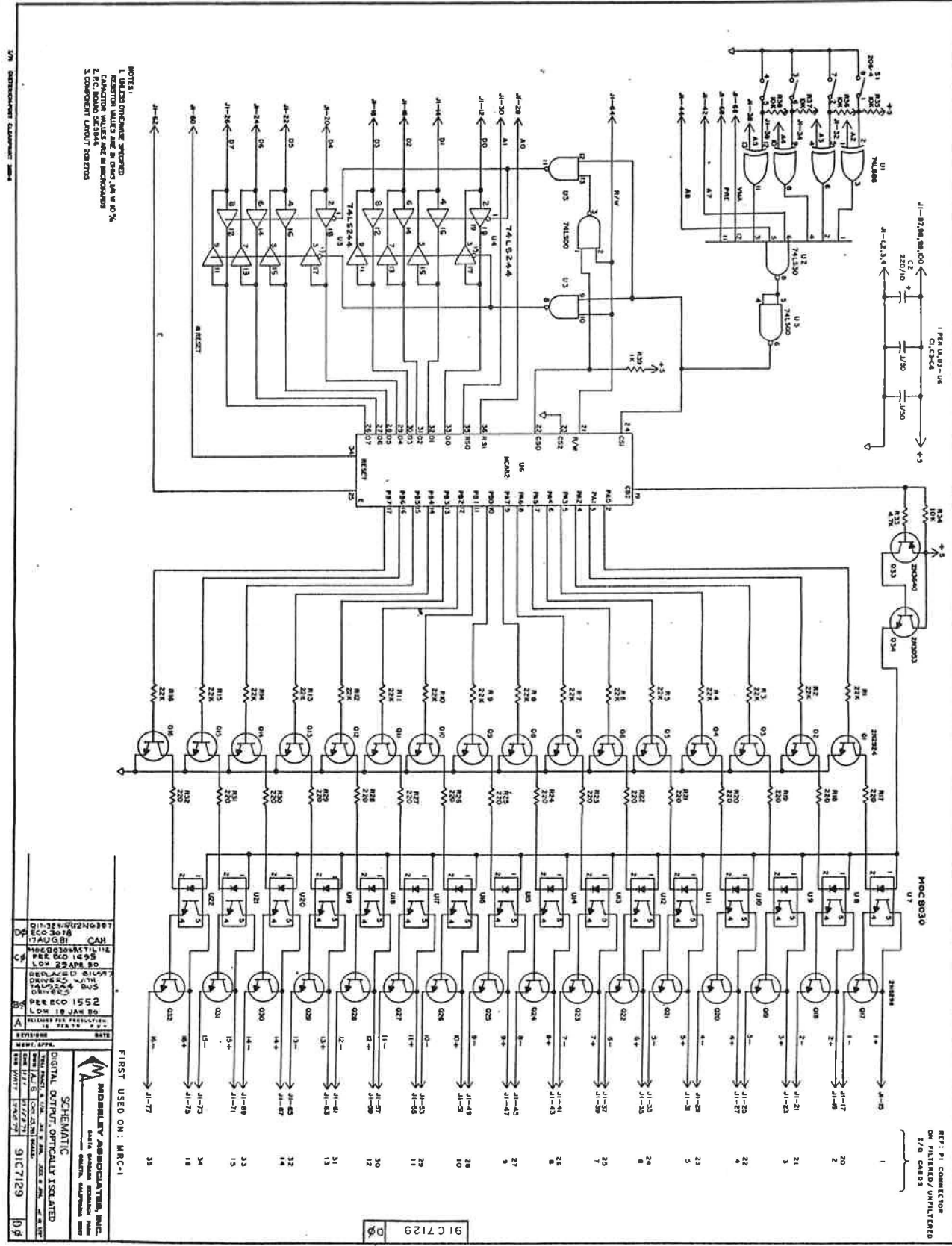
This indicates that PIA U6 is at least partially functioning. Trace back from the output stage to the output of the PIA. Example: Assume output 1 does not function. If the tally-back does not function, suspect U4, U5 or U6. If the tally-back functions, the failure is in the output driver of U6 or the transistor buffers (Q17-Q32).

2. Complete Failure (All Channels)

Check U6 pin 19 for a low level. If it is low, verify that the emitter of Q32 is near 5 V. If it is not, suspect Q33 or Q34. Check U6 pin 24 for an active high pulse when a raise is attempted for a channel on the module. If no pulse is seen, check S1, U1, U2 and U3 pins for correct operation. If a pulse is seen, verify that pulses appear at U4 and U5 pins 1 and 19; if not, suspect U3. If these pulses are present, suspect U4, U5 or U6.

<u>Pos 4</u>	<u>Pos 3</u>	<u>Pos 2</u>	<u>Pos 1</u>	<u>Address</u>	<u>Channels</u>
Off	Off	Off	Off	0	1-16
Off	Off	Off	On	1	17-32
Off	Off	On	Off	2	33-48
Off	Off	On	On	3	49-64
Off	On	Off	Off	4	65-80
Off	On	Off	On	5	81-96
Off	On	On	Off	6	97-112
Off	On	On	On	7	113-128
On	Off	Off	Off	8	129-144
On	Off	Off	On	9	145-160
On	Off	On	Off	10	161-176
On	Off	On	On	11	177-192
On	On	Off	Off	12	193-208
On	On	Off	On	13	209-224
On	On	On	Off	14	225-240
On	On	On	On	15	241-256

Figure 1. S1 programming.



NOTES:
 1. UNLESS OTHERWISE SPECIFIED
 RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE
 SPECIFIED.
 2. CAPACITOR VALUES ARE IN MICROFARADS
 UNLESS OTHERWISE SPECIFIED.
 3. COMPONENT LAYOUT 202703

578 ENCLOSURE/CLAMPING AREA

REV	DATE	DESCRIPTION
A	11/15/77	REVISION FOR PRODUCTION
B	02/01/80	REVISION FOR PRODUCTION
C	03/01/80	REVISION FOR PRODUCTION
D	03/01/80	REVISION FOR PRODUCTION
E	03/01/80	REVISION FOR PRODUCTION
F	03/01/80	REVISION FOR PRODUCTION
G	03/01/80	REVISION FOR PRODUCTION
H	03/01/80	REVISION FOR PRODUCTION
I	03/01/80	REVISION FOR PRODUCTION
J	03/01/80	REVISION FOR PRODUCTION
K	03/01/80	REVISION FOR PRODUCTION
L	03/01/80	REVISION FOR PRODUCTION
M	03/01/80	REVISION FOR PRODUCTION
N	03/01/80	REVISION FOR PRODUCTION
O	03/01/80	REVISION FOR PRODUCTION
P	03/01/80	REVISION FOR PRODUCTION
Q	03/01/80	REVISION FOR PRODUCTION
R	03/01/80	REVISION FOR PRODUCTION
S	03/01/80	REVISION FOR PRODUCTION
T	03/01/80	REVISION FOR PRODUCTION
U	03/01/80	REVISION FOR PRODUCTION
V	03/01/80	REVISION FOR PRODUCTION
W	03/01/80	REVISION FOR PRODUCTION
X	03/01/80	REVISION FOR PRODUCTION
Y	03/01/80	REVISION FOR PRODUCTION
Z	03/01/80	REVISION FOR PRODUCTION

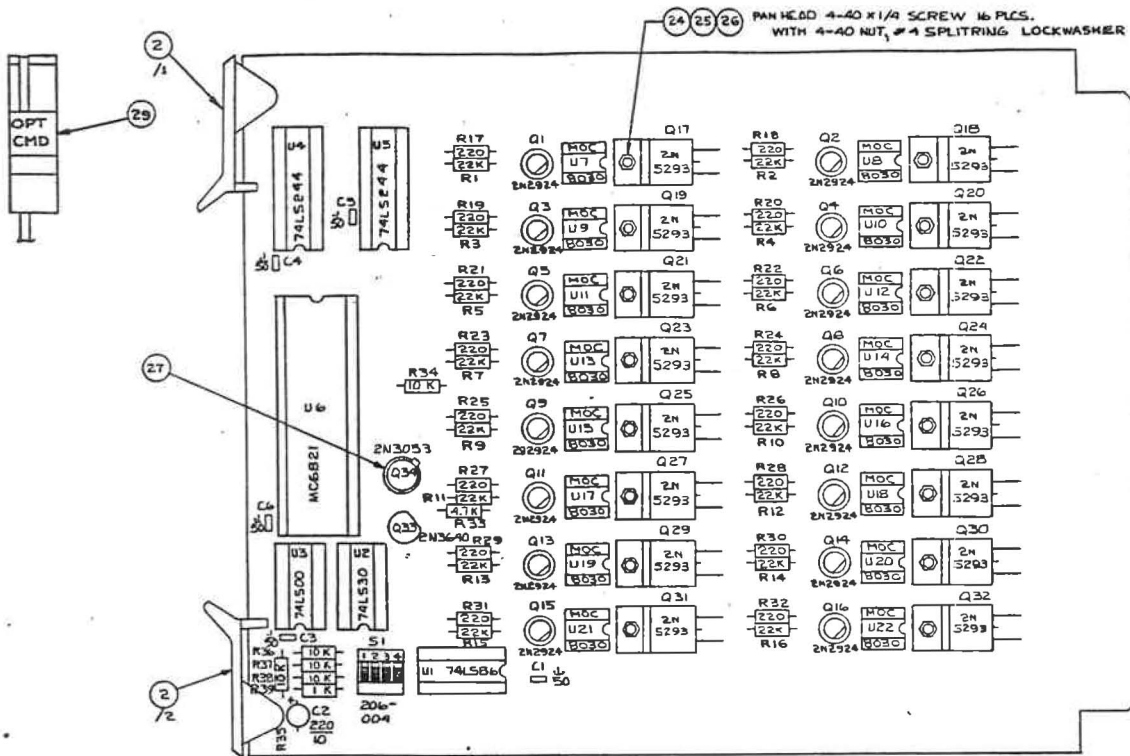
FIRST USED ON: NRC-1

MOORE ASSOCIATES, INC.
 1000 WEST 10TH AVENUE
 DENVER, COLORADO 80202
 (303) 733-1111

SCHEMATIC
 DIGITAL OUTPUT OPTICALLY ISOLATED
 91C7129 10

REF. P1 CONNECTOR
 170 CHANNELS/AMPLIFIED
 1/10 CHAN.

91C7129 08



NOTES:

1. UNLESS OTHERWISE SPECIFIED
RESISTOR VALUES ARE IN OHMS, 1/4 W, 10%.
CAPACITOR VALUES ARE IN MICROFARDS
2. P.C. BOARD SIC584G REV. 12-21
3. SCHEMATIC 91C7129 REV. CØ
4. ALL TRANSISTORS TO BE SOLDERED (WITHOUT SOCKETS)
5. INSTALL DIPSWITCH, S1, WITHOUT SOCKET AND WITH SWITCH NO.1
ON LEFT SIDE WHEN VIEWING BOARD AS SHOWN

ITEM	DESCRIPTION	REF. DES.	STOCK NO.	QTY
29	LABEL	10A1068-B	2430352	1
28	SOCKET 8 PIN, ICC-063-53-C	U7-U22	3250001	16
27	INDUCTOR, INDUCTOR 50T5-A	Q34	3250347	1
26	NUT #4-40		1050632	16
25	LOCKWASHER SPLIT END #4		1050632	16
24	SCREW PAN HD #4-40 X 1/4		1050129	16
23	SOCKET 14 PIN G40357-1	U1, U2, U3	3250001	3
22	" 20 = 640464-1	U4, U5	3250001	2
21	" 40 = 640379-1	U6	3250001	1
20	CAPACITOR K220810 220/10	C2	428010	1
19	" CY200104N .1/50	C1, C3-C6	4310271	5
18	IC MOC8030	U7-U22	3732528	16
17	RESISTOR 220Ω	R17-R32	441010	16
16	" 22K	R1-R16	441041	16
15	" 10K	R34-R38	4410279	5
14	" 4.7K	R33	4410302	1
13	" 1K	R39	4410247	1
12	TRANSISTOR 2N3640	Q33	3430000	1
11	TRANSISTOR 2N3053	Q34	3430035	1
10	SWITCH CTS 206-004	S1	3190071	1
9	IC MC6821P	U6	371022	1
8	" SN74LS244	U4, U5	3460259	2
7	" SN74LS86	U1	3460251	1
6	" SN74LS30	U2	3460235	1
5	" SN74LS00	U3	3460449	1
4	TRANSISTOR 2N2924	Q1 THROUGH Q32	3430016	16
3	TRANSISTOR 2N2924	Q1 THROUGH Q16	3430027	16
2	EJECTOR SET C12409/1, /2		1250075	1
1	P.C. BOARD	SIC584G-R, 21	3471001	1

ROSELEY ASSOCIATES, INC.
DIGITAL OUTPUT OPTICALLY SOL.
20D2705 F1

FILTERED INTERFACE

Schematic 91A7119
Component Layout 20B2718
PC Board 51A5851

I. PURPOSE

The Filtered Interface module provides a means of connecting to an I/O module where RF filtering is required. Each line is passed through an LC lowpass filter to inhibit RF. A metal shield is used to prevent RF field leakage.

II. SPECIFICATIONS

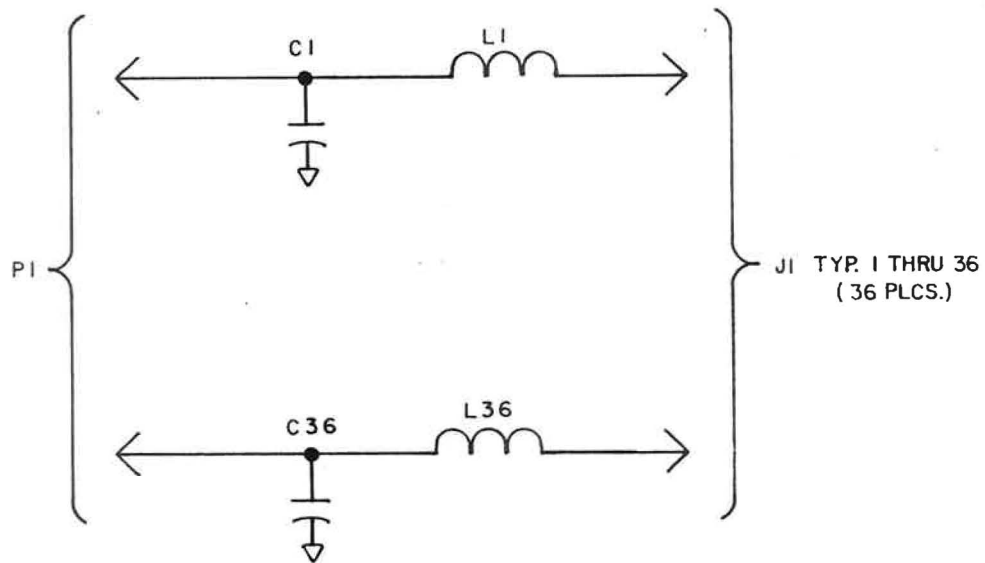
Attenuation:

-10 dB	200 kHz
-20 dB	700 kHz
-40 dB	2 MHz

III. TROUBLESHOOTING

Check for foreign particles across the connector pads, broken traces, and improper solder joints. Check the inductors for continuity and the capacitors for leakage.

Proper shielding and grounding techniques should be observed for all input/output lines.



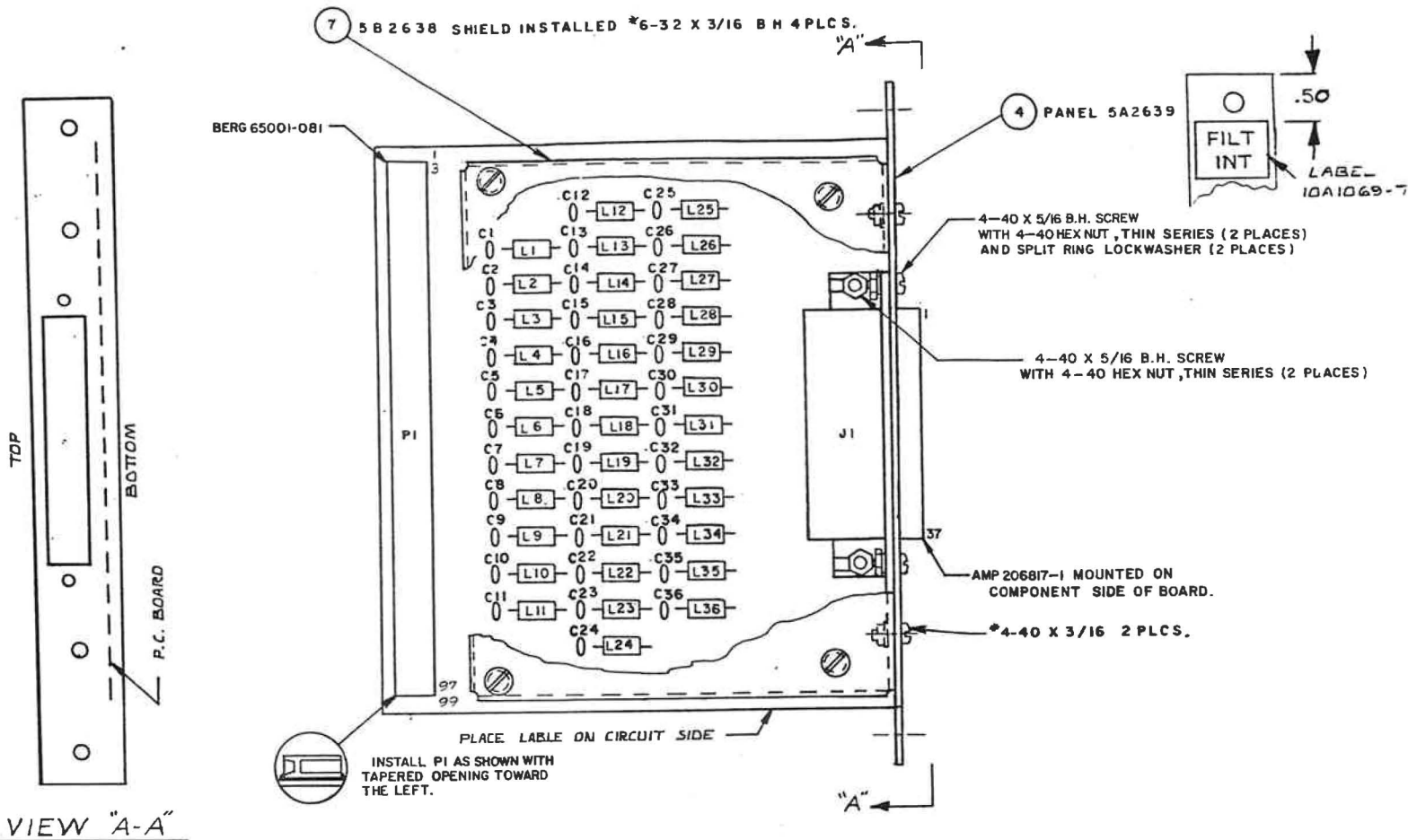
- NOTES:
1. UNLESS OTHERWISE SPECIFIED
CAPACITOR VALUES ARE IN MICROFARADS
 2. C1 THRU C36 ARE .1 at 50V
L1 THRU L36 ARE 6.8 uH
 3. P.C. BOARD 51A5851
 4. COMPONENT LAYOUT 20B2718

P 1	J 1
15	1
17	20
19	2
21	21
23	3
25	22
27	4
29	23
31	5
33	24
35	6
37	25
39	7
41	26
43	8
45	27
47	9
49	28
	19 NOT USED
51	10
53	29
55	11
57	30
59	12
61	31
63	13
65	32
67	14
69	33
71	15
73	34
75	16
77	35
79	17
81	36
83	18
85	37

PIN CONNECTIONS.

RELEASED FOR PRODUCTION F.X.Y. 27 FEB 79	REVISIONS DATE	MGMT. APPR.	MOSELEY ASSOCIATES, INC. SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 93017	
			SCHEMATIC MRC-I FILTERED INTERFACE	
			TOL: FRACT. $\pm 1/32$, .XX $\pm .030$, .XXX $\pm .010$, $\angle \pm 1/2^\circ$	
			DWN A. J. B. 9 NOV. 78	SCALE:
A	CHK FXY 27 FEB 79	ENG HAT7 27 FEB 79	91A7119	A

20B2718 D2



NOTES :

1. UNLESS OTHERWISE SPECIFIED CAPACITOR VALUES ARE IN MICROFARADS.
2. C1 THRU C36 ARE .1 at 50V
L1 THRU L36 ARE 6.8uH
3. P.C. BOARD 51A5851
4. SCHEMATIC 91A7119

VIEW "A-A"

ADD LABEL DIM. D2 P.C. 3355 2/17/78 AJB		MOSLEY ASSOCIATES, INC. SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 93017	
ADD LABEL 10A1069-7 ECO 1696MPG 25APR78		COMPONENT LAYOUT MRC-1 FILTERED INTERFACE	
REVISE WORKING WAS 02 3 DEC 74 ECO 1463 G.J.B.		TOL: FRACT. = 1/32 .XX = .50 .XXX = .010 .< = 1/2"	
CHANGES TO HELP PRODUCTION BERG GEORGE (ENGR) 11/15/78		DWN A.J.B. 7 NOV 78 SCALE: 1:1	
5 SEPT 78 ECO 1362 5 SEPT 78 D.T.W.		CHK FXY 21 FEB 79	
A RELEASED FOR PRODUCTION 27 FEB 78 F.X.Y.		ENG HATT 22 FEB 79	
REVISIONS DATE		20B2718 D2	
MOUNT APPR.			

DIODE-FILTERED INTERFACE II

Schematic 91A7273
Component Layout 20C2823
PC Board 51C5941

I. PURPOSE

The Diode-Filtered Interface module provides filtering and damping for the Status Input, TTL II module. Each input is passed through an LC low-pass filter to inhibit RF. Diodes CR1-CR32 prevent voltages from rising above about 5.8 V or below -0.8 V when the input signal changes suddenly.

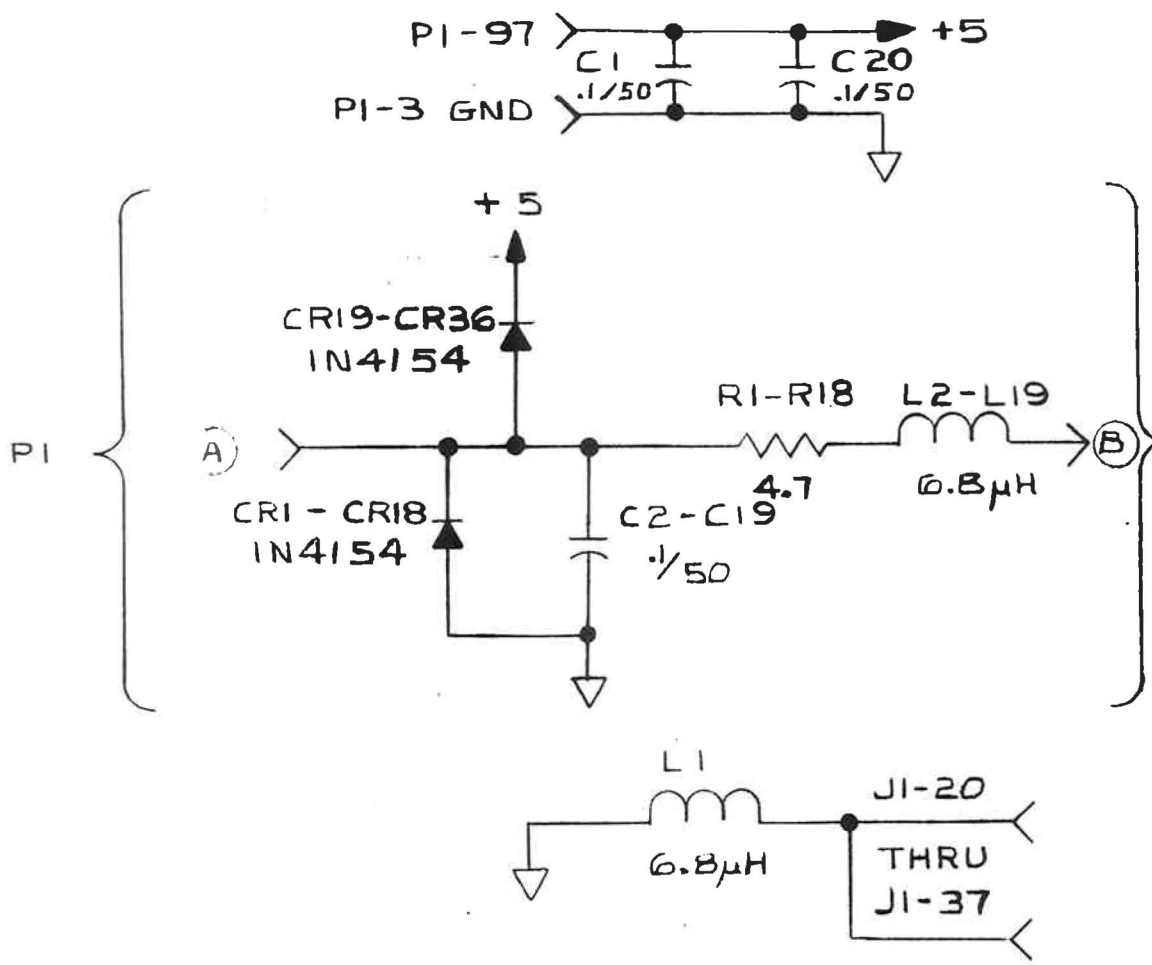
II. SPECIFICATIONS

The attenuation at various frequencies is essentially the same as that of the Filtered Interface module.

III. TROUBLESHOOTING

Check for foreign particles across the connector pads, broken traces, and improper solder joints. Check the inductors for continuity and the capacitors for leakage.

Proper shielding and grounding techniques should be observed for all input/output lines.



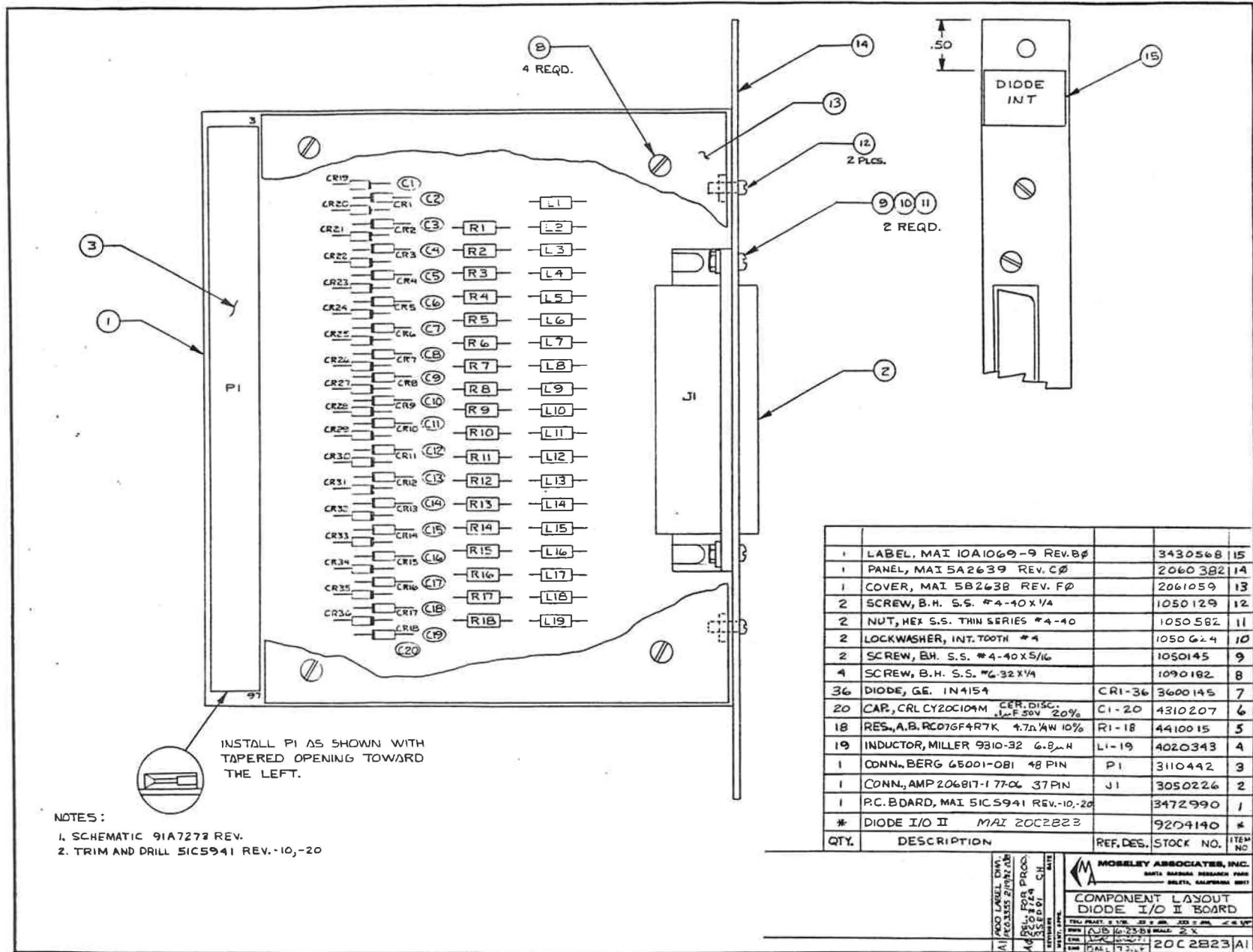
(A)	(B)
PI	J1
15	1
19	2
23	3
27	4
31	5
35	6
39	7
43	8
47	9
51	10
55	11
59	12
63	13
67	14
71	15
75	16
79	17
81	18

TYP.
JI-1 THRU 18
(18 PLCS.)

PIN CONNECTIONS

- UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/4W 10%. CAPACITOR VALUES ARE IN MICROFARADS.
- C1 THRU C20 ARE .1 @ 50V
L1 THRU L19 ARE 6.8μH.
- P.C. BOARD 51C5941.
- COMPONENT LAYOUT 20C2823 REV.

DELETED FILM REV. CALLOUT: ECO 38/5 S.V. 3-23-83	REL. FOR PROD. ECO 3124 ASER81 CH	DATE	MOSELEY ASSOCIATES, INC. SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 93017
		REVISIONS	
B	A	MGMT. APPR.	SCHEMATIC DIODE I/O II TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, < ± 1/2° DWN A.J.B. 26 NOV 79 SCALE: NONE CHK JCR 6-11-81 ENG DARL 11 JUN 81
			91A7273 B



INSTALL PI AS SHOWN WITH TAPERED OPENING TOWARD THE LEFT.

- NOTES:
1. SCHEMATIC 91A7273 REV.
 2. TRIM AND DRILL 51C5941 REV.-10,-20

QTY.	DESCRIPTION	REF. DES.	STOCK NO.	ITEM NO.
1	LABEL, MAI 10A1069-9 REV. B#		3430568	15
1	PANEL, MAI 5A2639 REV. C#		2060382	14
1	COVER, MAI 5B2638 REV. F#		2061059	13
2	SCREW, B.H. S.S. #4-40 X 1/4		1050129	12
2	NUT, HEX S.S. THIN SERIES #4-40		1050582	11
2	LOCKWASHER, INT. TOOTH #4		1050624	10
2	SCREW, B.H. S.S. #4-40 X 5/16		1050145	9
4	SCREW, B.H. S.S. #6-32 X 1/4		1090162	8
36	DIODE, GE. 1N4154		3660145	7
20	CAP., CRL CY20C109M CER. DISC. 100V 20%	C1-20	4310207	6
18	RES., A.B. RC07GF4R7K 4.7% 1/4W 10%	R1-18	4410015	5
19	INDUCTOR, MILLER 9310-32 6.8uH	L1-19	4020343	4
1	CONN., BERG 65001-081 48 PIN	J1	3110442	3
1	CONN., AMP 206817-1 77-06 37 PIN		3050226	2
1	P.C. BOARD, MAI 51C5941 REV.-10,-20		3472990	1
#	DIODE I/O II MAI 20C2823		9204140	#

ADD LABEL CHG.	DATE	MOSELEY ASSOCIATES, INC. SANTA BARBARA, CALIFORNIA 93101
APPROVED FOR PRODUCTION	DATE	
COMPONENT LAYOUT DIODE I/O II BOARD		TEL: (805) 965-2300 FAX: (805) 965-2301 4800 AVENUE 235-B BLDG 211 SANTA BARBARA, CALIF. 93101 20C2823A1
DATE	DATE	

DC POWER SUPPLY
(4 RU Chassis)

Schematic 91C7179
Assembly 21C2655

I. DESCRIPTION

The power supply provides +5 V, +15 V, and -15 V. The module is easily removed for adjustment, service, or replacement. No adjustments are required under normal conditions.

Attached to the rear of the power supply is a Corcom filter, which includes a fuse, an RF filter, and the voltage selection card. A nine-pin Molex connector interfaces the power supply with the chassis wiring harness.

The ac input voltage may be either 120 V or 240 V. The voltage selection card has positions for four input voltages; however, the 100 V and 220 V positions are not connected.

To service the power supply, remove two screws at the front of the power supply and one screw at the rear of the terminal. Slide the module forward.

II. ADJUSTMENT

Three voltage adjustment potentiometers are present for +5 V, +15 V, and -15 V. These adjustments are:

+5 V	V.ADJ.	R108
+15 V	+V.ADJ.	R11
-15 V	-V.ADJ.	R16

A sealed potentiometer is included for current limiting for +5 V (R104).

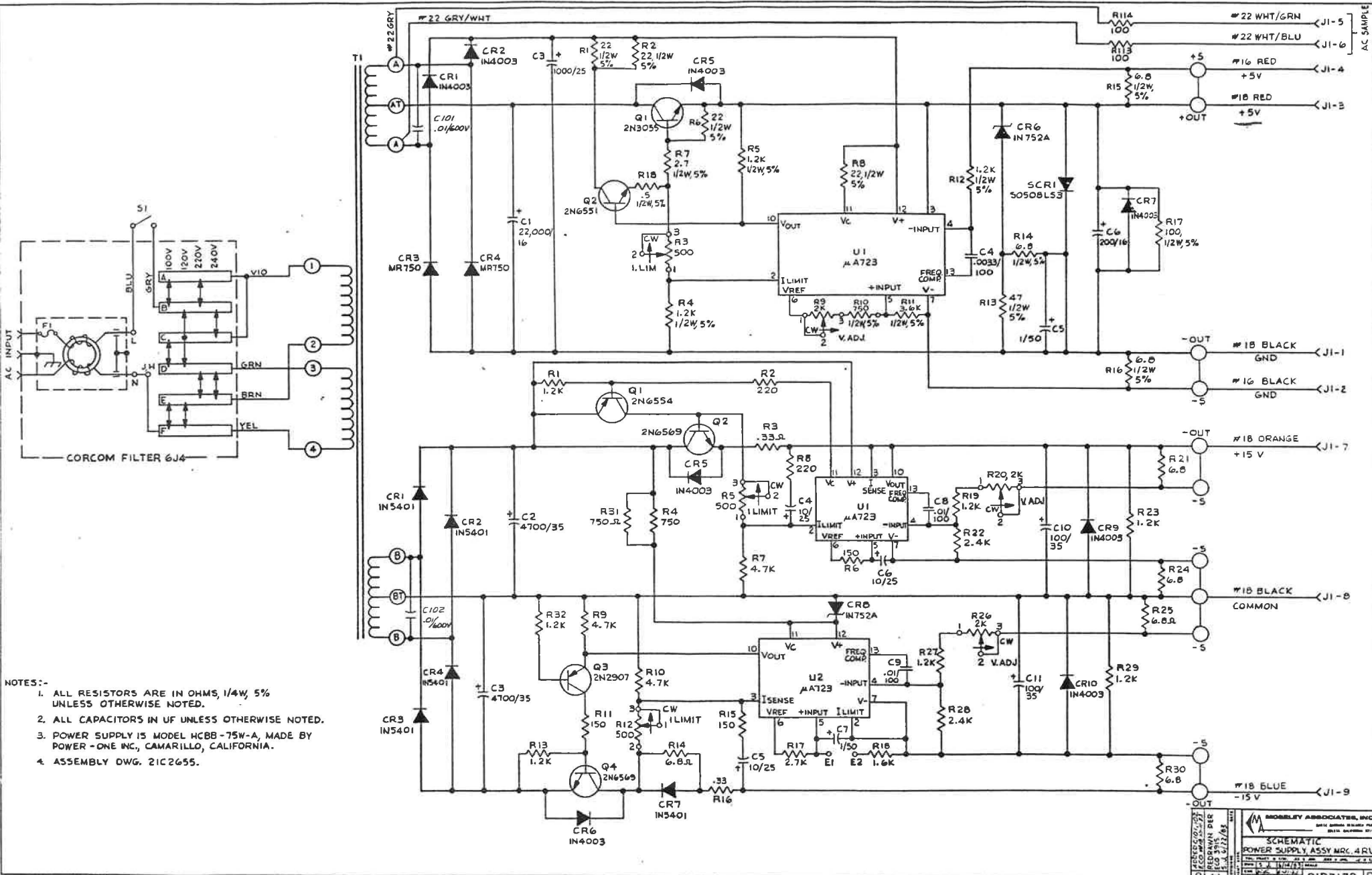
III. 120 VOLT OPERATION

Unless otherwise tagged, the power supply is set for 120 V operation when it is shipped from the factory. Normally no changes are required.

The 120 V label should be visible on the voltage selection card. If a different voltage is visible, remove the card and reinsert so the 120 V label is on the top. The card may be removed by using needle-nose pliers. An MDL 2 A fuse is used for 120 V.

IV. 240 VOLT OPERATION

Change the voltage selection card so the 240 V label is visible when the card is installed. Use an MDL 1 A fuse.



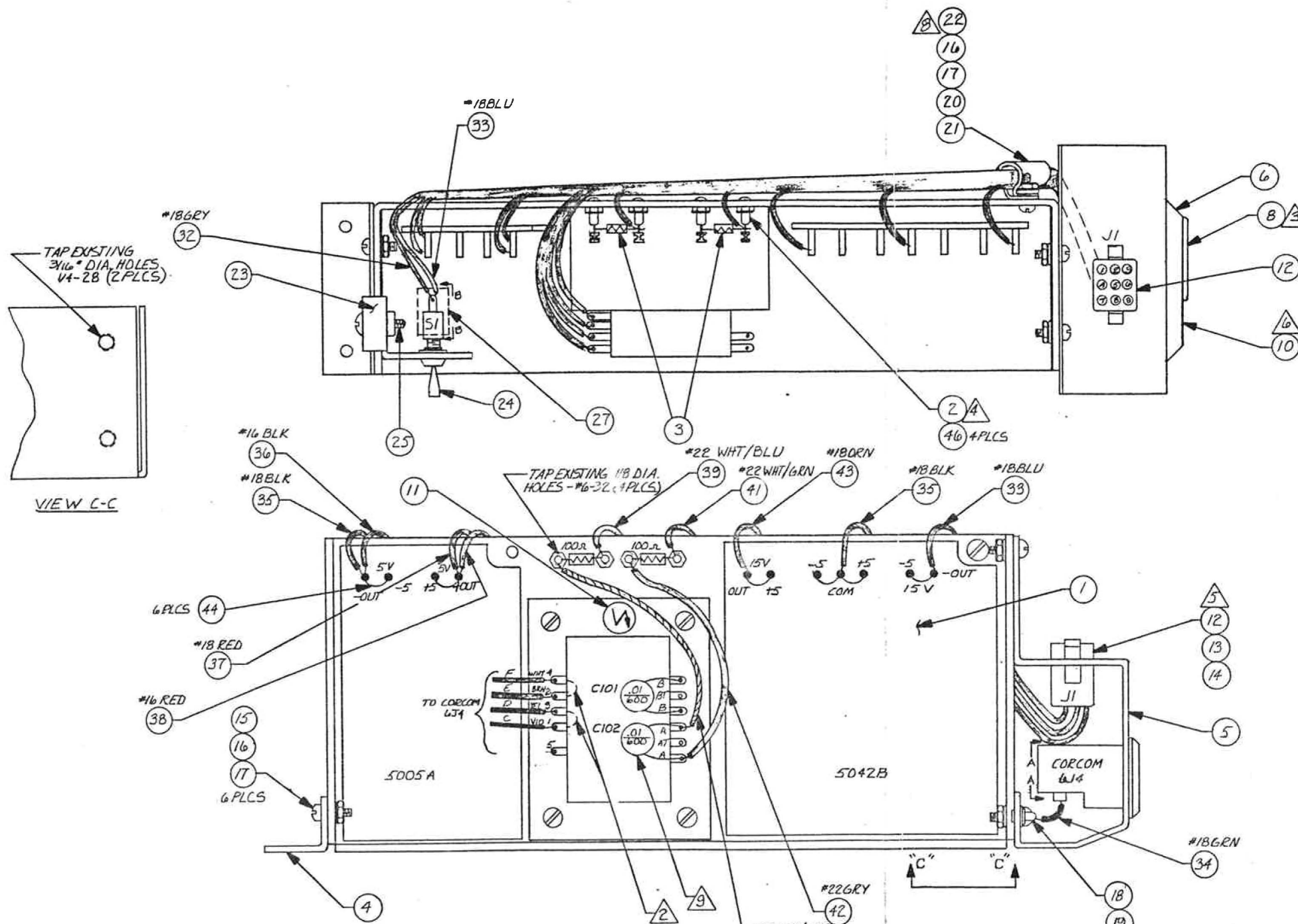
- NOTES:-
1. ALL RESISTORS ARE IN OHMS, 1/4W, 5% UNLESS OTHERWISE NOTED.
 2. ALL CAPACITORS IN UF UNLESS OTHERWISE NOTED.
 3. POWER SUPPLY IS MODEL HCBB-75W-A, MADE BY POWER-ONE INC., CAMARILLO, CALIFORNIA.
 4. ASSEMBLY DWG. 21C2655.

MOBLEY ASSOCIATES, INC.
 1000 W. 10th St. Santa Ana, CA 92701
 (714) 241-1111

SCHEMATIC
 POWER SUPPLY ASSY MRC 4RU

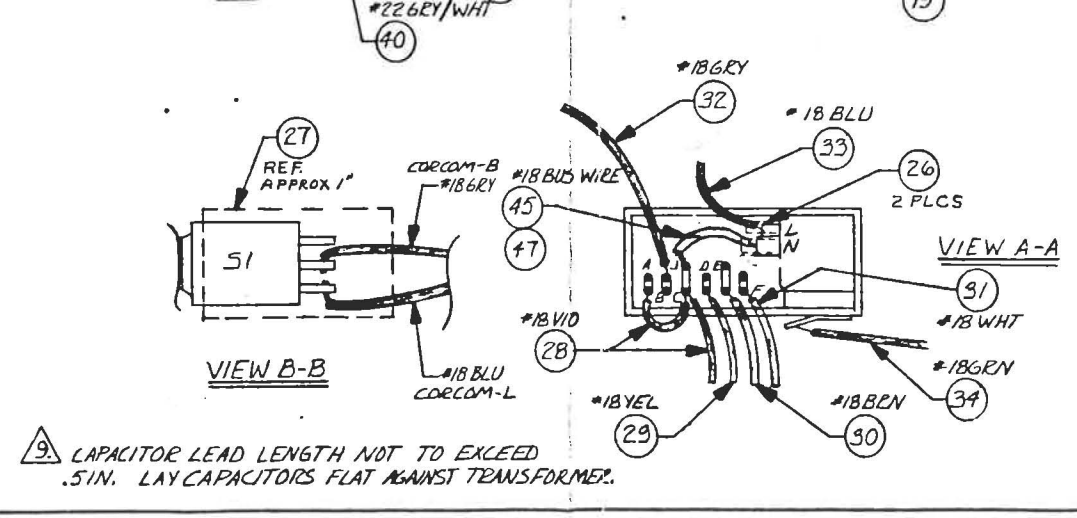
REVISED: 02/78
 C. MOBLEY PER
 10/12/78

91D7179 D



108	TBG	TEFLON	18GA	TFT200-18	ALPHA	1560218	47	
4	WASHER	LCLK	1/16" SR	SST	RELIAB	10900588	96	
0.1"	WIRE BUS		18GA	296	ALPHA	1641301	45	
0.5"	WIRE BUS		20GA	297	ALPHA	1641319	44	
1.2"	WIRE STRD		18GA	ORN	1555	ALPHA	1641588	43
2"	WIRE STRD		22GA	GRAY	BU-730-2208	MILSPEC	1640457	42
1.2"	WIRE STRD		22GA	WHT/GRN	BU-730-22095	MILSPEC	1640689	41
1.0"	WIRE STRD		22GA	6RY/WHT	BU-730-22089	MILSPEC	1640622	40
1.4"	WIRE STRD		22GA	WHT/BLU	BU-730-22096	MILSPEC	1640697	39
1.5"	WIRE STRD		16GA	RED	1557	ALPHA	1641471	38
1.5"	WIRE STRD		18GA	RED	1555	ALPHA	1641570	37
1.6"	WIRE STRD		16GA	BLACK	1557	ALPHA	1641455	36
1.6"	WIRE STRD		18GA	BLACK	1555	ALPHA	1641554	35
0.1"	WIRE STRD		18GA	GREEN	1555	ALPHA	1641703	34
1.9"	WIRE STRD		18GA	BLUE	1555	ALPHA	1641672	33
1.9"	WIRE STRD		18GA	GRAY	1555	ALPHA	1641638	32
2.1"	WIRE STRD		18GA	WHITE	1555	ALPHA	1641547	31
2"	WIRE STRD		18GA	BROWN	1555	ALPHA	1641562	30
2.1"	WIRE STRD		18GA	YELLOW	1555	ALPHA	1641596	29
2.2"	WIRE STRD		18GA	VIOLET	1555	ALPHA	1641620	28
1"	SHRINK TUBING			FIT E21 1/2"	ALPHA	1560069	27	
28	SHRINK TUBING			FIT E21 3/16"	ALPHA	1560036	26	
1	SCREW			BIND. HD. 6-32 X 3/8	RELIAB	1090208	25	
1	SWITCH			TOGGLE FH 123	JBT	3160108	24	
1	SWITCH			BRACKET 5B3013	MAI	2063305	23	
1	CLAMP			CABLE B34	SMITH	1270057	22	
1	WASHER			#8 FLAT SST	RELIAB	1130335	21	
1	SCREW			BIND. HD. 8-32 X 1/2	RELIAB	1130103	20	
1	RIVET			AN470 AD43	RELIAB	1210160	19	
1	GROUND LUG			T 197	WALDOM	1090695	18	
7	LOCK WASHER			INTL #8	RELIAB	1130293	17	
7	NUT			HEX 8-32	RELIAB	1130277	16	
6	SCREW			STL. CAD. PLATE 8-32 X 3/8	RELIAB	1130095	15	
7	CONTACT			SOCKET 60619-1	AMP	3250701	14	
2	CONTACT			SOCKET 61173-1	AMP	3250735	13	
1	SOCKET			HOUSING 1-480274-0	AMP	3250628	12	
1	HV. WARNING LABEL			10-A-1058-2	MAI	3430071	11	
1	FUSE RATING LABEL			85-1503	CORCOM	3430055	10	
0	FUSE MDL			1 AMP	BUSS	3370251	9	
1	FUSE MDL			2 AMP	BUSS	3370277	8	
2	CAP, DISC, CERAMIC			0.1/600V C101, C102	ERIE	4310173	7	
1	POWER INPUT FILTERED			634	CORCOM	3370046	6	
1	BRACKET			MOUNTING 5B-2616	MAI	2061018	5	
1	BRACKET			HOLD DOWN 5A-2615	MAI	2060440	4	
2	RESISTOR, RCOTG F10K			100R 1/4W 10% A/B		4410122	3	
4	TERMINAL			MO2A	USECO	3290629	2	
1	POWER SUPPLY			MCBB-T5W-A	POWER-ONE	5700243	1	
*	POWER SUPPLY ASSY			*21C 2655	MAI	3100611	*	
QTY	DESCRIPTION						STOCK NO.	ITEM NO

- NOTES:**
- USE HARNESS DWG # 29C101B (SCHEMATIC 91D7179).
 - REMOVE EXISTING JUMPERS ON POWER SUPPLY TERMINALS 1-3 AND 2-4 BEFORE ASSEMBLY.
 - INSTALL ITEM 8 (BUSS MDL 2A FUSE) IN ITEM 6.
 - INSTALL USECO 1409A WITH #6 SPLIT RING LOCK WASHER
 - USE TOOL # 90066-5 TO INSTALL ITEM 13 IN TWO SOCKETS AND TOOL # 30124-2 TO INSTALL ITEM 14 IN REMAINING SOCKETS.
 - INSTALL FUSE LABEL BELOW INPUT PLUS ON CORCOM ASSEMBLY TO BE ORIENTED AND READABLE WITH "FUSE PULL".
 - FOR 220-240V OPERATION USE 1 AMP FUSE.
 - INSTALL CABLE CLAMP (ITEM 22) TO HOLD HARNESS BELOW AND BEHIND POWER SUPPLY.



9 CAPACITOR LEAD LENGTH NOT TO EXCEED .5 IN. LAY CAPACITORS FLAT AGAINST TRANSFORMER.

MOSELEY ASSOCIATES, INC.

POWER SUPPLY ASSEMBLY MOD MRL1 ACU TERMINAL

DATE: 12/26/78

SCALE: 1" = 1"

2102655 M

EXTENDER BOARD

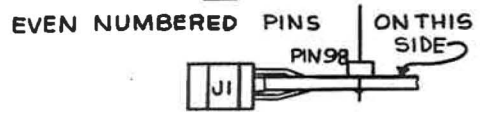
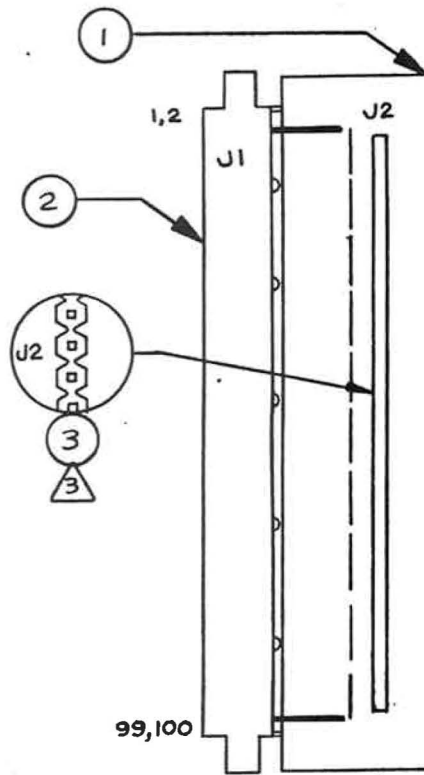
Assembly 20B2724

PC Board 51B5854

I. PURPOSE

The Extender board allows active modules to be mounted outside the Terminal for troubleshooting. Test leads can be attached to the connector leads for ease in examining bus signals and input/output signals. This board contains no active components.

Exposure of MRC modules outside the protected RF chassis environment via the Extender board may cause the unit to be susceptible to RF effects.



- NOTES:
- 1. P.C. BOARD 51B5B54 REV.-11,-21.
 - 2. MOUNT CONNECTOR J1 ON PC. BOARD AS SHOWN AND SOLDER.
 - 3. INSTALL ITEM 3, TRIM TO FIT AS REQD.

USED ON: MRC FAMILY

3	WAFER ASSY, MLD -MOLEX 22-03-2201	TRIM TO FIT AS REQD	3250545	3
1	CONNECTOR MAI 2A1413-3	J1	3090180	2
1	P.C. BOARD MAI 51B5B54	REV.-11,-21	3471968	1
*	EXTENDER BOARD MAI 20B2724		9204348	*
QTY.	DESCRIPTION	REF. DES.	STOCK NO.	ITEM NO.

DELETE EXTRAT
ITEM NO 9203847
E.O. 3657 JAN 81-65 CH

STOCK NO. WAS 1
E9 9200388 E.O. 3474
30 APR 82 C.H.

ADDED NOTE 3
ITEMS WAS ORG.
DIP CHANGES BY ORG.
ECO HELEN COX
13 APR 81 CAH

REDRAWN E202012
13 APR 81 CAH

DATE
MATE
REVISE
MONT. APPL.

MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93040

**COMPONENT LAYOUT
EXTENDER BOARD**

TOL. FRACT. 2 1/32, XX ± .01, XXX ± .005, << 1/2"

DWN CAH 13 APR 81 SCALE: 1:1

CHK [Signature] 4-11-81

ENG HHTX 4-11-81

20B2724 F1

ITEM NUMBER: 9051434 **** S/P MRC-1
 MUSELEY ASSOCIATES, INC.
 111 CASTILIAN DRIVE
 GULETA, CA. 93117
 (805) 968-9021

KIT NUMBER: ST-50A

PAGE 1
 DATE 8/27/85

COMPONENT ITEM NO.	MANUFACTURER PART NUMBER	QTY PER
3390127	FLV160 LED RED 2.0020 WIDE DIFFUSED	10
3390143	MV-5354 LED YEL 10.020 NARROW DIFFUSED	2
3390614	HLMP-3507 LED GRN 7-12020 DIFFUSED 75DEG	2
3000053	1N914 DIO 1N914 75V 75MA SI A398	1
3000145	1N4154 DIO 1N4154 25V 4NS SI D035	1
3000202	1N4740A Z10.0A DIO Z1N4740A 10V 1W 5% AIAY	1
3000230	1N4745A DIO Z1N4745A 16V 1W 5% AIAY	1
3010003	10D2 DIO 10D2 200V 1A SI D039	2
3610169	SZ3.1 DIO 2SZ3.1 3.1V	1
3630027	2N2924-LF5 XT NS2N2924LFS.2w160M025V.1A7P	3
3630035	2N3053 XT NP2N3053 05w100M060V.7A	1
3630191	2N4037 XT PP2N4037 01w060M060V01A	1
3630316	2N5293 XT NP2N5293 36w800K080V04A	3
3650066	LM-329BZ RGLTR LM329BZ 6.9V 30MA T092	1
3650074	LM340T-12 /7812 RGLTR LM340T12/7812 VARV1.5A	1
3650124	MC78L12ACP RGLTR MC78L12 12V 0.1A T092	1
3650132	MC79L05 ACP RGLTR MC79L05 05V 0.1A T092	1
3650140	MC79L12ACLP RGLTR MC79L12 12V/0.1A T092	1
3650157	MC79L15ACP RGLTR MC79L15 15V 0.1A T092	1
3650165	MC7905CT RGLTR MC7905T 05V 1.5A T0220	1
3650173	UA7805UC RGLTR UA7805UC 05V 1.0A T0220	1
3660008	UA741CP IC UA741P OPAMP GEN COMP	1
3660487	SN74154N IC SN74154N 4-16LINE DEMUX	1
3660537	SN74174N IC SN74174N HX D EDGE/TR	2

ITEM NUMBER: 9051434 *** S/P MRC-1
 MUSELEY ASSOCIATES, INC.
 111 CASTILIAN DRIVE
 GOLETA, CA. 93117
 (805) 968-9621

PAGE 2
 DATE 8/27/85

KIT NUMBER: ST-50A

COMPONENT ITEM NO.	MANUFACTURER PART NUMBER	QTY PER
3660509	SN74LS00N IC SN74LS00N QU 2IN NAND	2
3660677	SN74LS02N IC SN74LS02N QU 2IN NOR	1
3660685	SN74LS04N IC SN74LS04N HX INV	1
3660693	SN74LS08N IC SN74LS08N QU 2IN AND	1
3660719	SN74LS20N IC SN74LS20N DU 4IN NAND	1
3660727	SN74LS27N IC SN74LS27N TR 3IN NOR	1
3660735	SN74LS30N IC SN74LS30N SI 6IN NAND	2
3660743	SN74LS86N IC SN74LS86N QU 2IN EXCL OR	2
3660750	SN74LS107AN IC SN74LS107AN DU JK MAS/SL	1
3660768	SN74LS123N IC SN74LS123N DURETRMONOMULTI	1
3660776	SN74LS132N IC SN74LS132N QU 2IN NAND ST	1
3660792	SN74LS136N IC SN74LS136N 3-8LINEDECEMUX	1
3660800	SN74LS139N IC SN74LS139N DU2-4LNDECEMUX	1
3660826	SN74LS163AN IC SN74LS163AN BINCOUNT PRESET	1
3660859	SN74LS244N IC SN74LS244N OCT BUS/DRIV ST	4
3660867	SN74LS367AN IC SN74LS367 HEX BUF 3/ST	1
3660875	SN74LS368AN IC SN74LS368 HEX INV 3/ST	1
3660917	SN75451BP IC SN75451P DU AND HIGHV OC	1
3660925	SN75452BP IC SN75452P DU NAND HIGHV OC	1
3660941	SN75472P IC SN75472N DU NAND HIGHV OC	2
3660958	SN74LS32N IC SN74LS32 QUAD 2-INPUT NOR	1
3660966	SN74LS260N IC SN74LS260N DU 5IN NOR	1
3660974	SN74LS240N IC SN74LS240 OCT BUS/DRIV ST	2
3680063	CD4040BE IC CD4040BE 12 STAGE BIN CT	1

ITEM NUMBER: 9051434 **** S/P MRC-1
MUSELEY ASSOCIATES, INC.
111 CASTILIAN DRIVE
GULETA, CA. 93117
(805) 968-9621

KIT NUMBER: ST-50A

PAGE 3
DATE 8/27/85

COMPONENT ITEM NO.	MANUFACTURER PART NUMBER	QTY PER
3680162	SCL4011AE IC SCL4011AE QU 2IN NAND	1
3680212	MC14411P IC BIT RATE GENERATOR	1
3680220	MC14052BCP IC DIFFERENTIAL AMUX 4CH	2
3690021	TIL-308 IC TIL-308 DISP 7 SEG LDP	2
3710019	MC6802P IC MC6802P MICROPROCESSOR	1
3710027	MC6821P IC MC6821P PIA INTERFACE	2
3710035	MC6828P IC MC6828P PRIOR INTERRUPT	1
3710043	MC6850P IC MC6850P ACIA INTERFACE	1
3710076	MM53107N IC MM53107 OSC ZEXP17 DIV	1
3710225	M5L2114LP-3 IC M5L2114LP RAM STAT 1Kx4 MRC	1
3730132	LF13300D IC LF13300D A-D CONV 4.5DIG	1
3730157	LM-308AN IC LM308AN OPAMP PRECISION	1
3730207	LM-339N IC LM339N COMPARATOR QUAD	1
3730355	MC1488P IC MC1488P QU LINE DRIVER PLST	1
3730363	MC1489P IC MC1489 QU LINE RECEIVER	1
3730462	RC4136N IC RC4136N OPAMP QUAD 741	1
3730595	ADB1200PCN IC ADB1200PCN A-D CONV 12+SGN	1
3730694	NE-531N IC NE-531 OPAMP HI SLEW	1
3730777	TIL-112 IC TIL-112 OPTOCOUPLER	1
3730819	XR-2206CP IC XR-2206CP VCO WAVE GEN	1
3730827	XR-2211CP IC XR-2211CP FSK MODEM	1
3730868	MOC-8030 IC MOC-8030 OPTICAL ISOLATOR	4
3730876	TLO72A IC DUAL OP-AMP	1