INSTRUCTION
MANUAL

MODEL DRS-1A DIGITAL REMOTE CONTROL SYSTEM

with

ADDENDUM A STATUS SUBSYSTEM

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

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Santa Barbara Research Park
111 Castilian Drive
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TABLE OF CONTENTS

TABLE OF CONTENTS

Page

APPENDIX A - DIGITAL LOGIC FUNDAMENTALS

INSTRUCTION MANUAL

MODEL DRS-1A

DIGITAL REMOTE CONTROL SYSTEM

I. INTRODUCTION

The Model DRS-1A Digital Remote Control System was designed to remotely control TV, FM, and AM transmitters. In addition, the system is ideally suited for use in industrial or other applications wherever a need exists for remote data telemetry sampling and control. A total of 30 metering channels and 30 bidirectional (on/off, raise/lower, etc.) control functions are provided by the system in increments of ten channels. A 24-channel status/alarm subsystem is included as an option. Full FCC-required metering and control fail-safe functions are provided for controlling TV transmitters. For automatic recording of telemetry, the companion Model DLS-1 Digital Logging System provides the capability of printing up to 20 parameters.

Interconnection between the studio or control point (Control Terminal) and transmitter site (Remote Terminal) requires only a single full-time, two-way, voice-grade wire line or radio link. The standard DRS-1A employing a telephone line interconnection is referred to as the Model DRS-1AW. When options are installed to enable subcarrier techniques to be used, it is referred to as the Model DRS-1AR.

Digital techniques are used in the design of the DRS-1A. This ensures accurate transmitter-to-studio telemetry tracking and allows one-man calibration from the transmitter or remote location. Error checking is included in the data receivers to prevent erroneous telemetry readings and control functions. Control feedback indications are given to ensure the operator that the system is functioning properly.

Ease of operation has been a prime consideration in the design of the DRS-1A. Figures 1, 2, and 3 illustrate and explain the front-panel controls and displays. Note the similarity between the Control Terminal and Remote Terminal and the functional grouping of the controls.

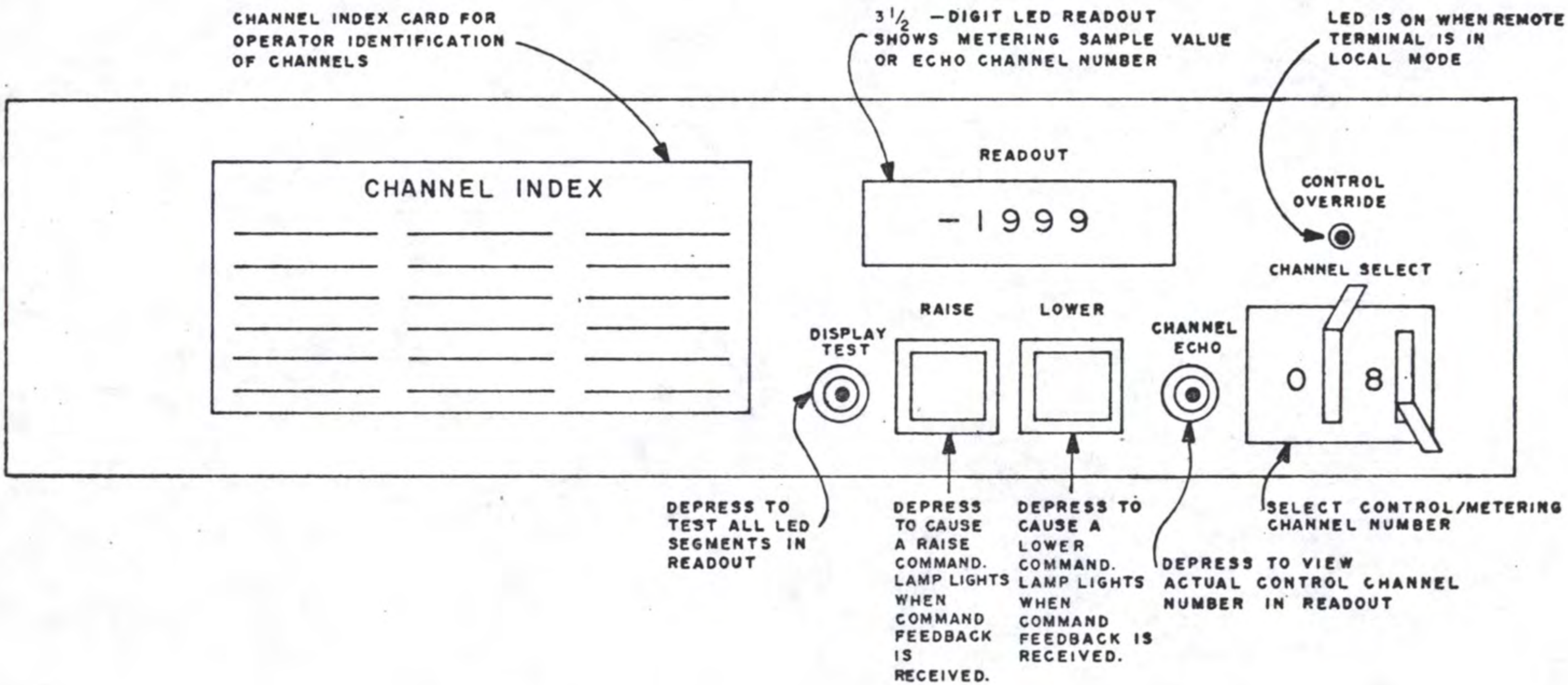


FIGURE I— CONTROL TERMINAL FRONT PANEL

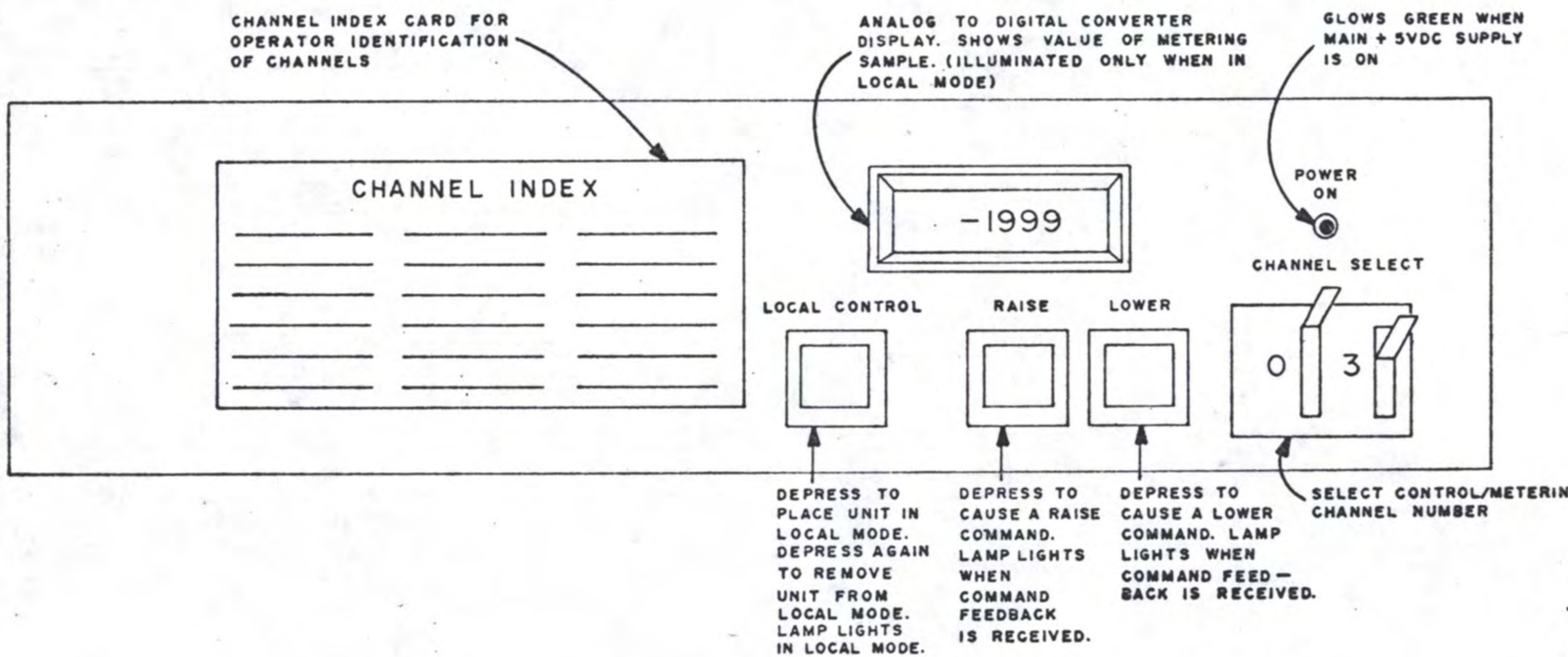


FIGURE 2 — REMOTE TERMINAL FRONT PANEL

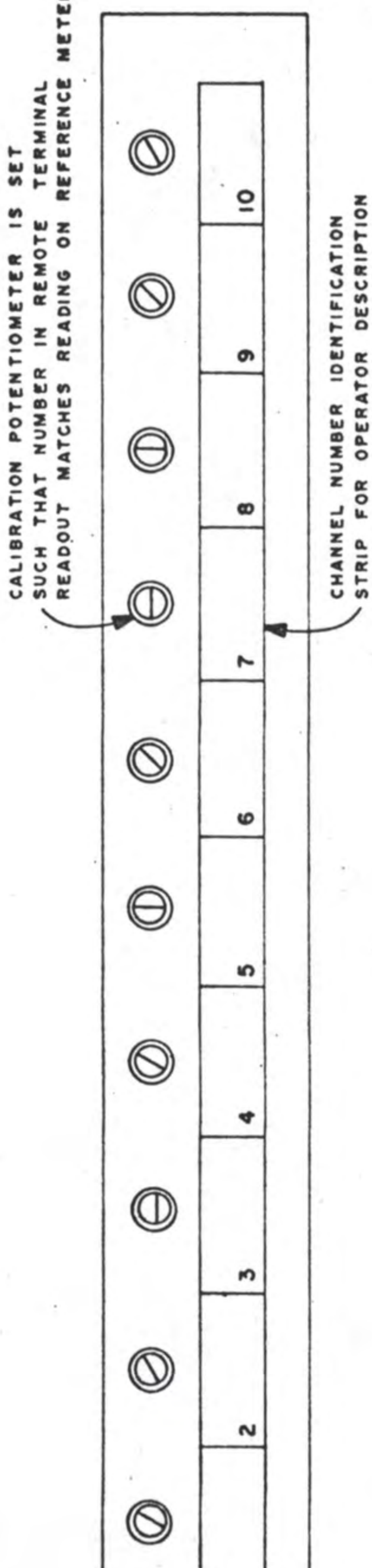


FIGURE 3 — SELECTOR UNIT FRONT PANEL

II. SPECIFICATIONS

Type	Fully digital command and telemetry.
Number of Telemetry Channels	Ten minimum, expandable to 20 or 30, selected one at a time.
Telemetry Input	±1 VDC for ±1000 reading on display. Full 100% overrange capability (±1.999 VDC for reading of ±1999). Each input isolated and floating (up to 350 VDC); 100KΩ input impedance.
Telemetry Accuracy	0.1% of full scale
Telemetry Update	270 milliseconds with audible telemetry; 1.3 seconds with subaudible telemetry.
Calibration Controls	Multiturn potentiometers
Control System	
Number of Channels	Ten On/Raise and ten Off/Lower minimum, expandable to 20 or 30, isolated.
Control Output Ratings	120 VAC or VDC, 50 watts non-inductive maximum, fused at one ampere.
Telephone Line Studio-Transmitter Interconnection (DRS-1AW)	
Telephone Line Impedance	600Ω
Telephone Line Levels	0 dBm, adjustable
Control FSK Frequencies	2300 Hz to 2500 Hz
Telemetry FSK Frequencies	1300 Hz to 1500 Hz
Allowable Line Loss	30 dB (with 0 dBm send level)

Radio Link Studio-Transmitter Interconnection (DRS-1AR)	
Radio Link Impedances	2000Ω nominal
Radio Link Levels	1.5 volts peak-to-peak, adjustable
Control Subcarrier Frequencies	26 kHz typical for monaural STL. 110 kHz typical for composite stereo STL.
Subaudible Telemetry Frequencies (Option)	Occupies region to 45 Hz.
Telemetry Subcarrier Frequencies (Option)	67 kHz typical, 41 kHz alternate for FM, 39 kHz for TV.
Operating Temperature Range	0°C to 70°C
Power Requirements, 30-Channel configuration with all status channels activated.	
Control Terminal	120/140 VAC, 50-60 Hz, 30 watts
Remote Terminal	120/140 VAC, 50-60 Hz, 35 watts
19-inch Vertical Rack Space	
Control Terminal	8.89 cm (3-1/2 inches)
Status Panel-Control Terminal	4.45 cm (1-3/4 inches)
Remote Terminal	8.89 cm (3-1/2 inches)
Status Panel-Remote Terminal	4.45 cm (1-3/4 inches)
10-channel Selector Unit	4.45 cm (1-3/4 inches)
Domestic Shipping Weight, Basic 10-channel system	23.1 kg (51 pounds)

III. UNPACKING

The DRS-1A units should be carefully unpacked and inspected for any shipping damage. Keep all packing material in case a claim is to be made against the carrier for damages. Any damages should be reported immediately to the delivery carrier.

Remove the top covers from all units. Due to normal shipping vibration, some plug-in components may not be fully seated. Verify that all integrated circuits, relays, and other plug-in components are properly seated in their respective sockets or connectors.

IV. INSTALLATION

A. General Information

IT IS HIGHLY RECOMMENDED THAT NO CONNECTIONS BE MADE TO THE DRS-1A UNTIL THE BASIC CONCEPTS OF HOW THE SYSTEM OPERATES ARE UNDERSTOOD BY THE INSTALLING PERSONNEL. These concepts, as well as installation suggestions and comments, are explained in the next few pages of this manual. Bear in mind that if the units are interconnected with a telephone line, the system is a DRS-1AW; if wireless (subcarrier) interconnections are used, the system is a DRS-1AR. The subaudible telemetry option is typically available only for the DRS-1AR system.

Connections which will be required at the Control Terminal are to the power source and either the telephone line (for the DRS-1AW) or the STL/radio equipment (for the DRS-1AR). If a Status Subsystem is included, the user may wish to make connections to the external drivers for additional visual or aural indications. The metering fail-safe output may also be connected to an external warning device.

At the Remote Terminal, required connections are to the power source and either the telephone line or radio equipment. If required by the licensing agency, the fail-safe outputs must also be connected to the transmitter. In addition, the Selector Units must be connected to the Remote Terminal with the cable provided. Optionally, the Status Panel-Remote Terminal must be similarly connected. The control and metering connections should <u>not</u> be made until the studio and transmitter units of the DRS-1A have been interconnected and confirmed as operational.

The Control Terminal sends frequency-shift-keyed (FSK) control signals in the region of 2300 Hz to 2500 Hz to the Remote Terminal. In the wire-line DRS-1AW system, these signals are sent to the transmitter via a telephone line. In the radio DRS-1AR system, the signals are sent via a subcarrier on a radio link. The Remote Terminal returns FSK telemetry signals in the region of 1300 Hz to 1500 Hz to the Control Terminal via telephone line or subcarrier. As an option, subaudible signals up to 45 Hz may be sent via a subcarrier (SCA) on an FM broadcast transmitter.

The DLS-1 Logger may share the DRS-1A telemetry data link. The DLS-1 FSK frequencies are 750 Hz to 900 Hz. In addition, modulation information derived from a monitor may share the data link in the region of 300 Hz to 500 Hz.

The wire-line system is illustrated in block diagram form in Figure 4, and the radio system is illustrated in Figure 5.

B. Wireless Operation for FM Broadcast Transmitters

If the telephone line interconnection is not used, the control signals are sent to the transmitter site by using subcarrier techniques. As shown in Figure 5, the control FSK modulator at the studio frequency-modulates a subcarrier generator. The output of this subcarrier generator is then applied to the multiplex or subcarrier input of an aural STL (microwave) transmitter. In this manner, the control signals "ride piggyback" on the STL going to the transmitter site. This subcarrier generator is a standard addition to the Control Terminal of the DRS-1AR for wireless operation.

At the transmitter site the subcarrier output from the aural STL receiver is applied to a subcarrier demodulator located in the DRS-1A Remote Terminal. The output from this demodulator is a replica of the control signal which originated at the studio. This

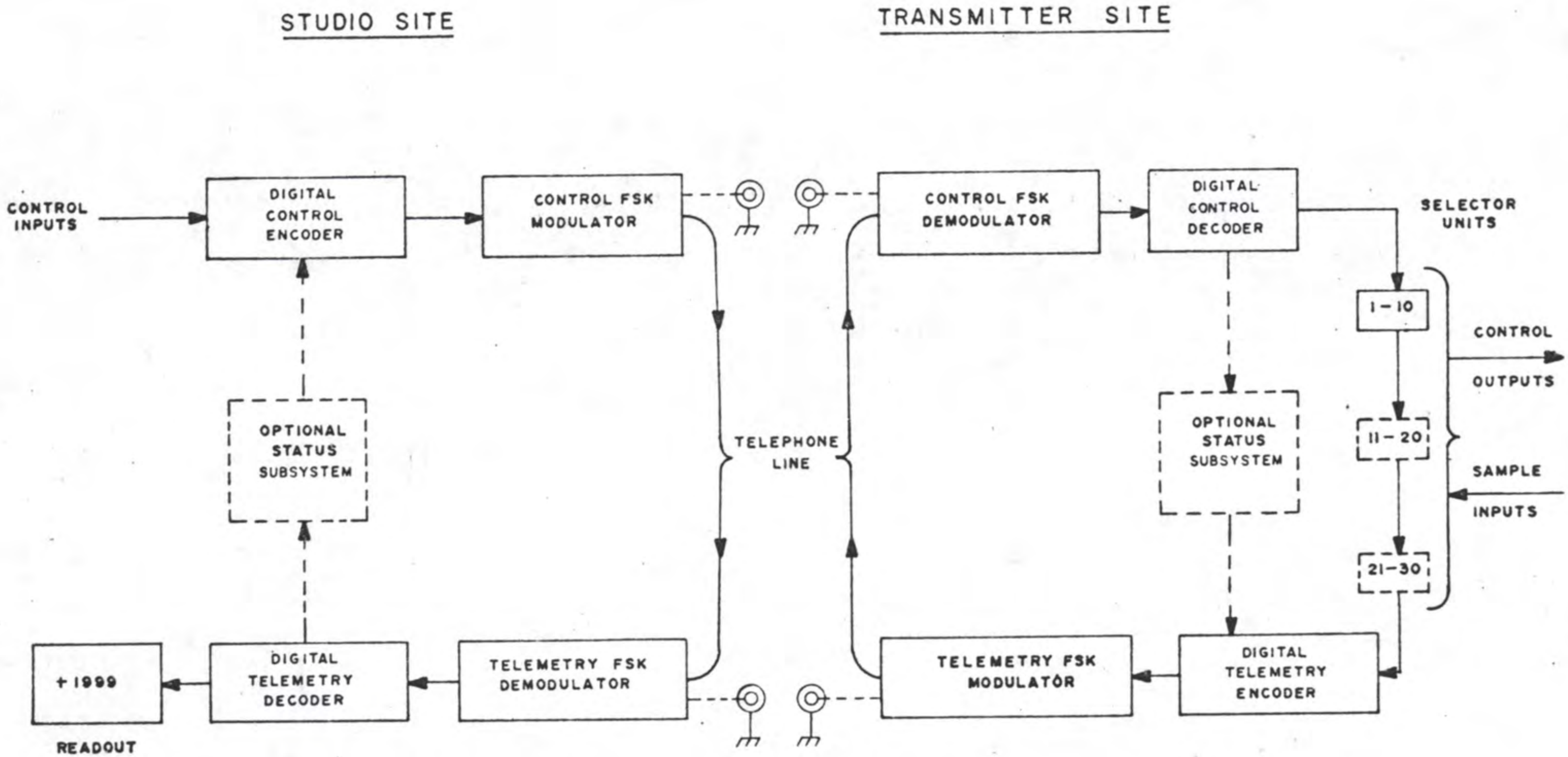


FIGURE 4. DRS-1AW REMOTE CONTROL SYSTEM
WITH TELEPHONE LINE INTERCONNECTION

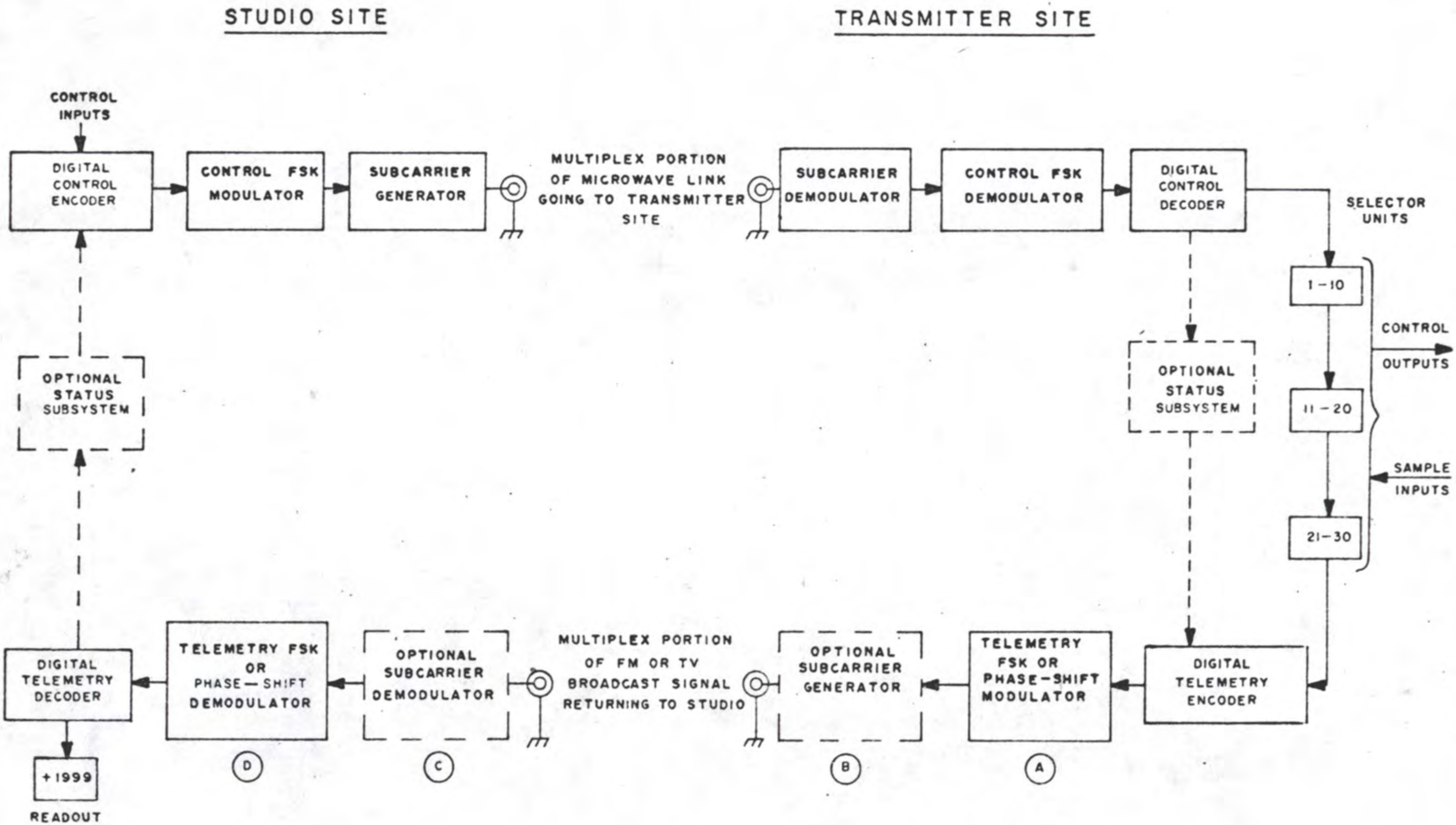


FIGURE 5. DRS-1AR REMOTE CONTROL SYSTEM WITH RADIO-LINK INTERCONNECTION

signal is then internally applied to the control FSK demodulator in the DRS-1AR as in the basic system. The subcarrier demodulator at the transmitter site is a standard addition to the remote terminal of the DRS-1AR for wireless operation.

In this same manner, the telemetry signals may be returned from the transmitter to the studio by using a subcarrier. As shown in Figure 5, the telemetry FSK modulator frequency-modulates a subcarrier generator at the transmitter site. This subcarrier generator is usually a part of the main FM transmitter. As with the control signals, the telemetry signal now rides piggyback on the broadcast carrier in the form of an SCA signal which is then received at the studio. Here the subcarrier is extracted and demodulated by an SCA receiver or SCA modulation monitor. The output of this receiver or SCA demodulator is a replica of the telemetry signal generated at the Remote Terminal.

When the telemetry signal is returned to the studio in this manner, it is customary to use the optional subaudible frequency range for the telemetry signal. In this case, the telemetry phase-shift modulator and demodulator are factory-installed as shown at "A" and "D" in Figure 5 instead of the FSK modems. In this way, program material such as background music may also be broadcast on the SCA subcarrier. This low-frequency telemetry signal is usually adjusted to modulate the SCA subcarrier about 14 dB below program. Because it is in the low audio spectrum and because it modulates the subcarrier at a low level, it causes little degradation of the music service.

Before the program signal is mixed with the subaudible telemetry signal at the transmitter site, the program signal MUST be fed through a high-pass filter to prevent the low-frequency program material from interfering with the telemetry signal. This filter should be down 10 dB at 80 Hz, and 20 dB at 70 Hz, and 35 dB or more at 50 Hz and below. A suitable high-pass filter, with 600Ω input and output impedances and a nominal insertion loss of 6 dB, is the Moseley Associates Type 2-1388.

If the FM transmitter does not contain an SCA generator, then a subcarrier generator is installed at the transmitter site as shown at "B" in Figure 5. If program service is to be accommodated, the Moseley Associates Model SCG-8 SCA Generator is recommended. No modifications are necessary to it or to the DRS-1AR for such operation. If program service is not a requirement, then an internal subcarrier generator can be added to the DRS-1A Remote Terminal. This telemetry-only SCA generator is installed in place of the subcarrier generator jumper/terminating board in the DRS-1A Remote Terminal. Such a subcarrier generator is an optional item which may be easily added to the standard DRS-1AR Remote Terminal.

If the receiver or monitor at the studio does not have an internal SCA demodulator but a sample of the broadcast subcarrier is available, then a subcarrier demodulator can be added to the Control Terminal of the DRS-1A as shown at "C" in Figure 5. This subcarrier demodulator will accept the subcarrier and demodulate it to recover the metering signal. This signal is a replica of the original telemetry signal generated at the transmitter site. It is internally routed to the telemetry demodulator in the DRS-1A Control Terminal. This added subcarrier demodulator at the studio site is an available option which may be added to the standard wireless DRS-1AR. When the internal subcarrier units are employed, the standard high-speed (1300 Hz to 1500 Hz) telemetry system is usually preferred since no program provisions are provided. The FSK modems are factory-installed as shown at "A" and "D" in Figure 5.

C. Wireless Operation for TV Transmitters

Figure 5 also illustrates a typical TV installation. The telemetry signal usually returns as a subcarrier of the TV aural signal at 39 kHz. The high-speed (FSK) telemetry modems are recommended for this purpose.

Control signals may be relayed to the transmitter site in a number of different ways. An FM subcarrier as shown in Figure 5 may be multiplexed on an aural STL. Alternately, a spare sound channel of a video STL may provide the interconnection path. In these instances, a DRS-1AW configuration will be supplied. Figure 4 depicts the use of the BNC connectors for this type of application.

D. Equipment Location

Providing that installation personnel understand the principles involved for the particular version of the DRS-1A being used, installation of the Control and Remote Terminals may proceed. The first stage of the installation will involve the remote control units only; no connections will be made to the transmitting equipment. After the remote control units are installed and their operation is confirmed, the remainder of the installation will be accomplished.

Since the Control Terminal will receive frequent operator attention during the routine controlling and logging operation, its location at the studio should receive careful attention. Since occasional readjustment of the front-panel controls at the transmitter site may be required, this unit, too, should be mounted at an appropriate height. In each case it is recommended that the racks should be well-bonded to a good system ground.

E. Studio-Transmitter Interconnections

The various interconnections should now be made. The control path to the transmitter site and the telemetry path returning to the studio should be completed. This may be nothing more than just connecting the telephone line, or it may involve the full complement of subcarrier equipment. Figure 6 illustrates the telephone line connections, and no comment is needed.

Figure 7 illustrates subcarrier and radio equipment connections and should be understood to avoid error. Occasional reference to Figure 5 may be helpful. At the studio the control output connection will normally deliver a subcarrier frequency-modulated by the control tone. This subcarrier will be routed to the STL transmitter multiplex or subcarrier input. If the DRS-1AR internal subcarrier generator is not used, it is replaced by a jumper/terminating board, and the control output connector will deliver the control FSK tones.

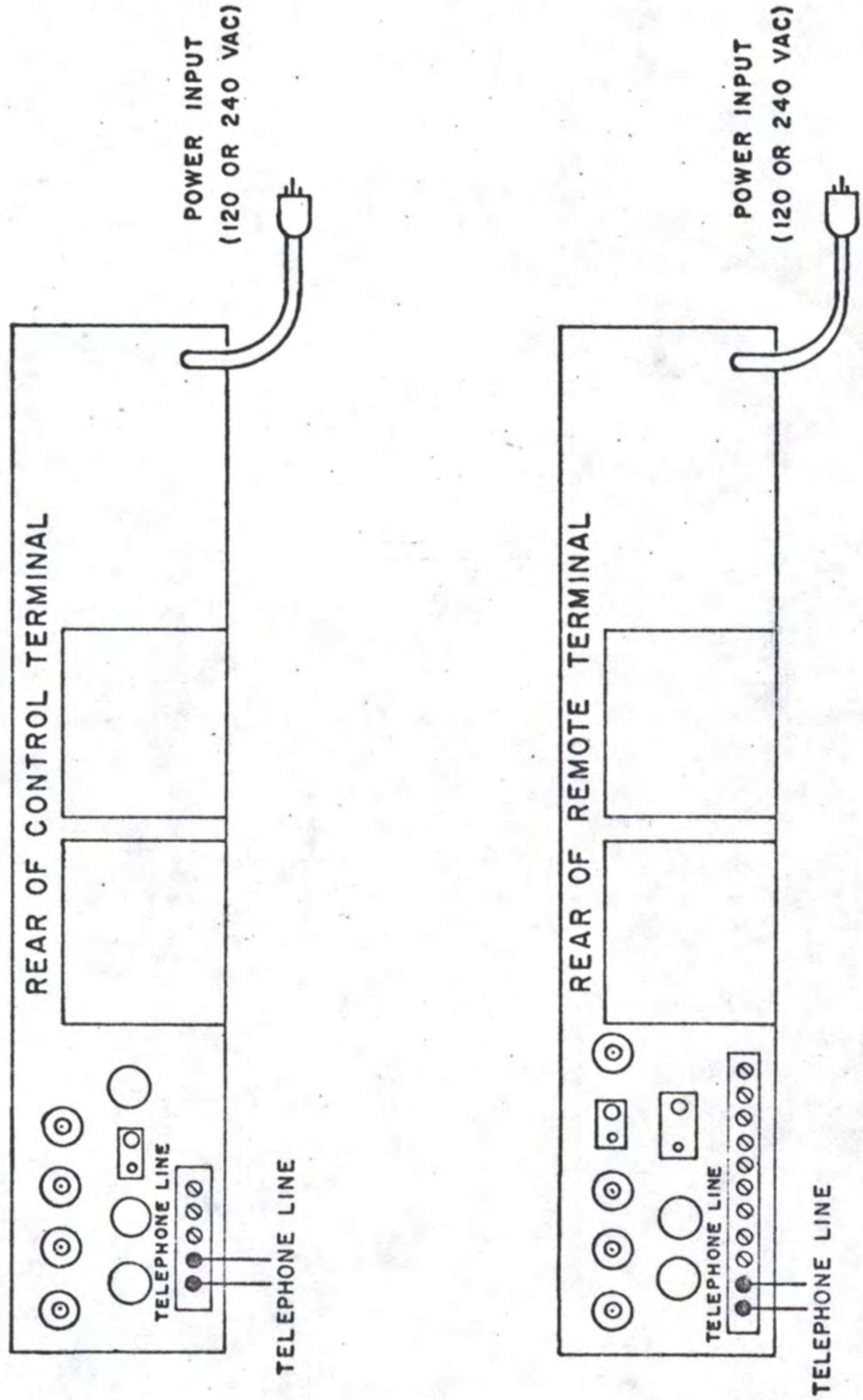


FIGURE 6 — TELEPHONE LINE INTERCONNECTIONS

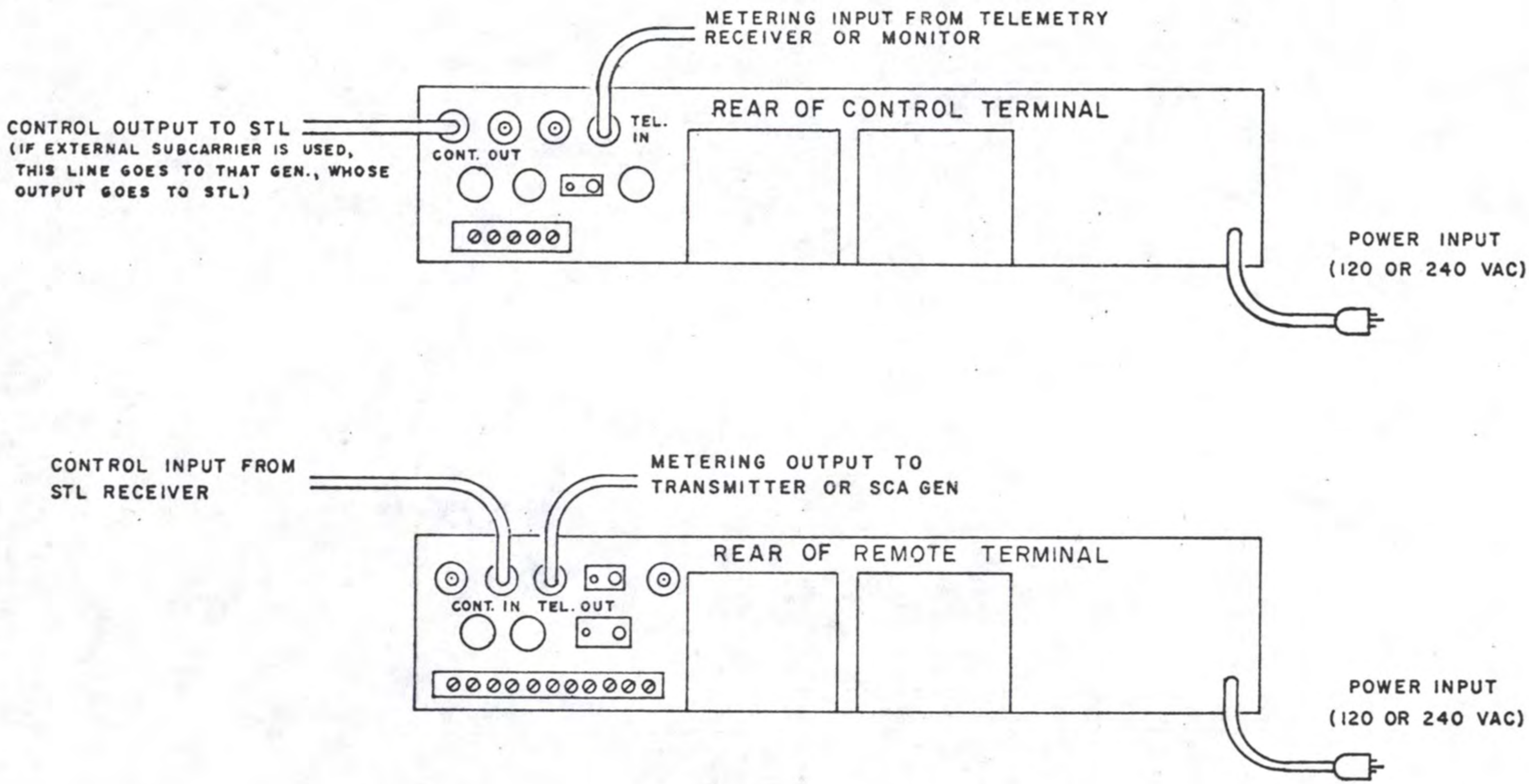


FIGURE 7 — WIRELESS INTERCONNECTIONS

This signal may be routed either to an external subcarrier generator at the studio, or it may be applied directly to the modulator of some other system whose output is ultimately at the transmitter site.

Telemetry input to the Control Terminal will normally be applied from the output of a telemetry receiver. The output of this receiver may be any receiver capable of extracting the telemetry signal from the broadcast transmission. For FM, an SCA receiver modified for telemetry purposes is customarily used. For TV, telemetry input to the Control Terminal will be applied from the output of an aural monitor.

If this telemetry input is a sample of the undemodulated subcarrier as radiated by the FM or TV transmitter, then an optional internal subcarrier demodulator substitutes for the jumper/terminating board in the Control Terminal. The telemetry input connector should then have applied to it the subcarrier sample which is then internally demodulated in the DRS-1AR Control Terminal.

The Remote Terminal telemetry output connector will normally deliver the telemetry signal. The output from this connector will be applied either to an external subcarrier generator (commonly done in SCA applications) or to another return link to the studio. When the DRS-1AR Remote Terminal contains the subcarrier generator, the output from the telemetry connector will be a subcarrier which is applied to the FM or TV transmitter multiplex or subcarrier input connector.

The Remote Terminal control input connector will generally be connected to the multiplex or subcarrier output from the aural STL receiver. Under these conditions, the internal subcarrier demodulator in the DRS-1AR Remote Terminal will demodulate and extract from the subcarrier a replica of the control signal originating at the studio. If the control signal is already in the form of the audible control tones generated at the studio, then the internal subcarrier demodulator is replaced by a jumper/terminating board. The control tone, which is routed internally to the control FSK demodulator, is applied to the control input connector.

When both the Control Terminal and Remote Terminal have been mounted in their respective racks or cabinets and the electrical interconnections have been made, the next step is to install the optional Status Subsystem. Refer to Figures 8 and 9 and Addendum A for this installation.

The Selector Unit(s) will be installed now. Referring to Figure 9, note that only one Selector Unit is connected to the Remote Terminal. The other unit or units are connected in a "daisy chain" manner from one unit to the next. It does not matter which Selector Unit is connected to the Remote Terminal. Do not make any other connections to the units at this time.

F. Functional Test Procedure

After the DRS-1A has been installed, verify that all connections are correct. Power may then be applied to both units. Use the following procedure to verify that the system is functioning properly:

PROCEDURE	OBSERVATION
1) Place Remote Terminal in LOCAL	Remote Terminal digital readout and LOCAL light are on. Control Terminal CONTROL OVERRIDE LED is on.
2) At Remote Terminal, select several numbers on the CHANNEL SELECT switches.	Listen for relays activating in the Selector Unit(s).
3) Select Channel 01 at Remote Terminal. Depress CHANNEL ECHO at Control Terminal.	"001" appears in the Control Terminal readout.
4) Apply a 1.5 VDC battery to the 1M terminals on the rear of Selector Unit 1-10. Adjust Channel 1 calibration pot fully in both directions. Reverse battery polarity and repeat.	Both Control Terminal and Remote Terminal readouts display properly from 000 to approximately ±1500.

PROCEDURE	OBSERVATION
5) Connect an ohmmeter to the 1R terminals on the rear of Selector Unit 1-10.	Ohmmeter reads infinity.
6) Depress RAISE button on Remote Terminal.	Ohmmeter shows continuity. RAISE feedback lamps light on front panels of both Control Terminal and Remote Terminal.
7) Connect ohmmeter to the 1L terminals of the Selector Unit.	Ohmmeter reads infinity.
8) Depress LOWER button on Remote Terminal.	Ohmmeter shows continuity. LOWER feedback lamps light.
9) Return Remote Terminal to non-local mode (LOCAL switch off).	Remote Terminal readout is blank except for polarity display. LOCAL light is off. CONTROL OVERRIDE LED is off.
10) Select several channels at Control Terminal. Depress CHANNEL ECHO button for each selected channel.	Value in readout matches selected channel.
11) Depress RAISE button.	RAISE feedback lamp lights.
12) Depress LOWER button.	LOWER feedback lamp lights.
13) If Status Subsystem is included, depress CLEAR button on Status Panel-Remote Terminal.	All LED's at studio and transmitter go out.
14) Depress TEST button on Status Panel-Remote Terminal.	All LED's illuminate.
15) Depress TEST button on Status Panel-Control Terminal.	All LED's illuminate, then clear in groups of six.

PROCEDURE	OBSERVATION
16) At rear of Status Panel-Remote Terminal, apply contact closure to several terminals.	Corresponding LED's illuminate at both studio and transmitter.
17) Depress CLEAR button on Status Panel-Control Terminal.	All LED's go out.
18) Remove power from Remote Terminal to test telemetry fail-safe.	After 20 seconds, readout on Control Terminal flashes at about 1 Hz rate.
19) Restore power to Remote Terminal. Connect ohmmeter from control fail-safe "NO" contact to "ARM" contact on rear of Remote Terminal.	Ohmmeter shows continuity.
20) Remove power from Control Terminal to test control fail-safe.	Ohmmeter reads infinity after 20 seconds.
21) Place Remote Terminal in LOCAL.	Ohmmeter shows continuity.
22) Remove power from Remote Terminal.	Ohmmeter reads infinity within one second.

Should there be a problem at this point, check the interconnections between studio and transmitter and be sure that each line is carrying the correct signal. To assist in the initial setup, recommended standards are shown in Table 1. The first three measurements involving the telephone line are made at the telephone line terminals. The remaining measurements are applicable to wireless systems and are made at the BNC connectors. Refrain from making internal adjustments unless a reading is definitely unsatisfactory in a manner that is correctable by adjustment.

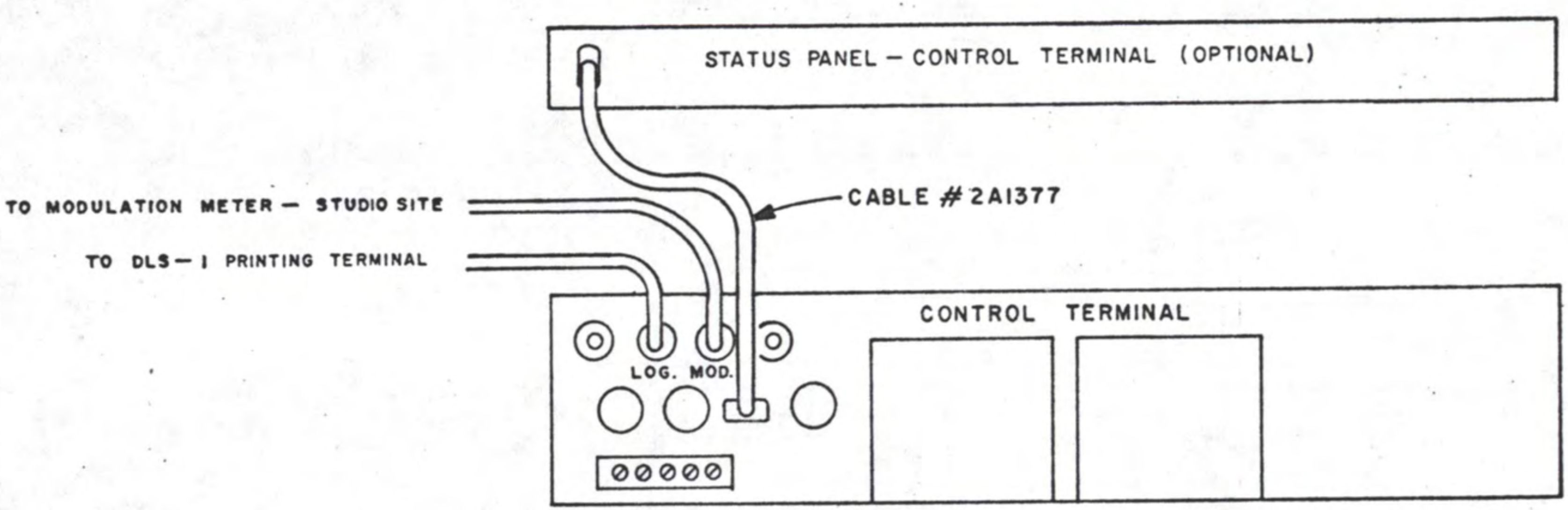


FIGURE 8 — STUDIO SITE CONNECTIONS

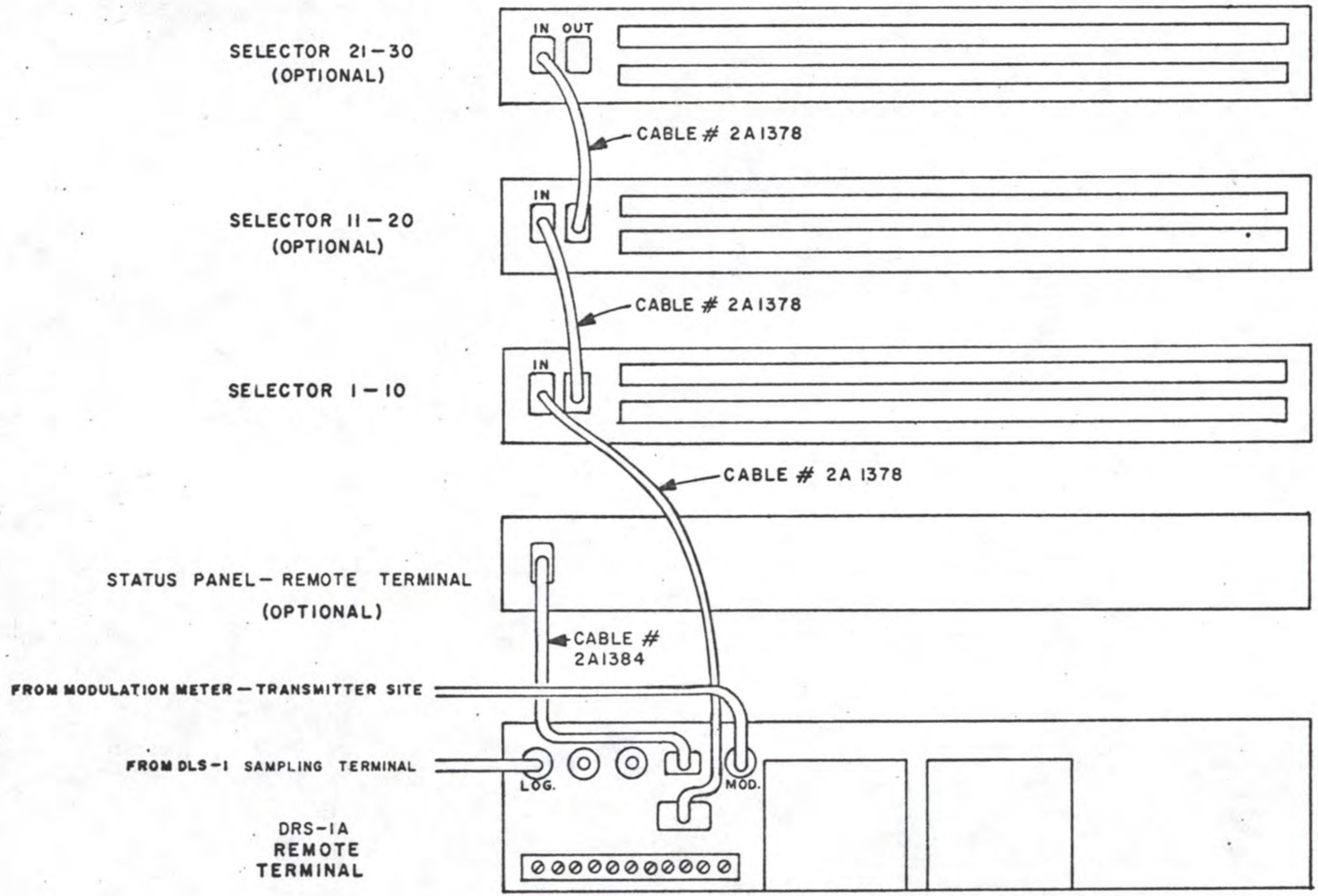


FIGURE 9 — TRANSMITTER SITE CONNECTIONS

TABLE 1

Recommended Control and Telemetry Standards

Signal	Level
Control signal leaving studio	0 dBm
Telemetry signal leaving transmitter	0 dBm
Maximum telephone line loss, 300 Hz to 2500 Hz (with 0 dBm send level at each end of line)	30 dB
Subcarrier generator output at studio site (used for control; connects to STL transmitter)	1.5 volts peak-to-peak
Subcarrier demodulator input at transmitter site (used for control; driven by STL receiver)	1.5 volts peak-to-peak of subcarrier
Subcarrier generator output at transmitter site (used for metering return to studio; connects to FM or TV transmitter)	Adjustable up to 6 volts peak-to-peak
Subcarrier demodulator input at studio site (used for metering; driven by FM or TV receiver)	1.5 volts peak-to-peak of subcarrier
Control signal direct output at studio (connects to external subcarrier generator)	1.5 volts peak-to-peak, adjustable
Control signal direct input at transmitter site (driven from STL via external subcarrier demodulator)	1.5 volts peak-to-peak
Telemetry signal direct output at transmitter site (connects to external subcarrier generator)	Subaudible: 6 volts peak-to-peak. Audible: approximately 1.5 volts peak-to-peak, adjustable.

Signal	Level
Metering signal direct input at studio site (driven from SCA receiver)	1.5 volts peak-to-peak of metering signal
Deviation of SCA subcarrier at FM transmitter site by telemetry signal	800 Hz

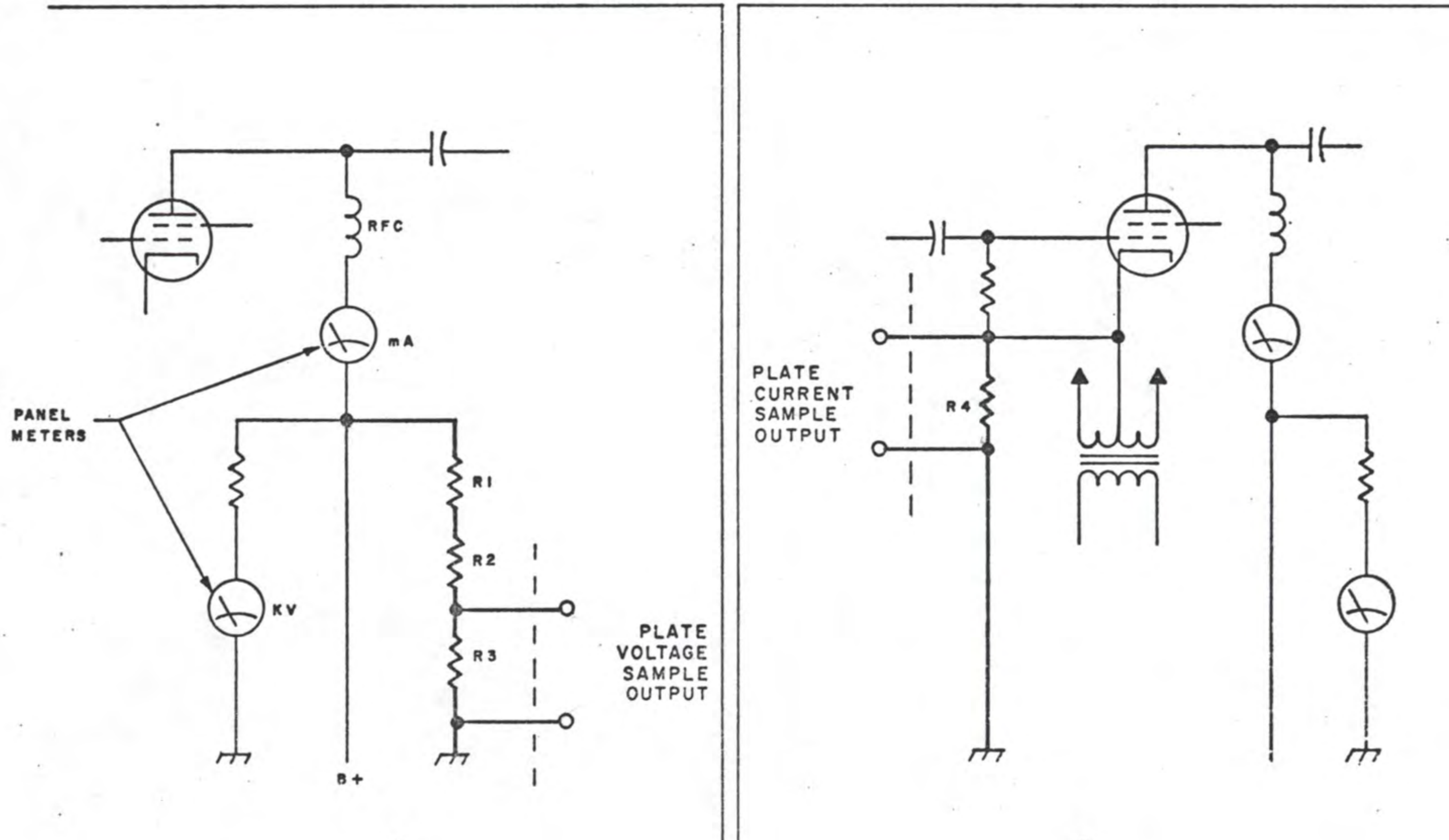
G. Metering

> MAKE NO CONNECTIONS TO THE METERING INPUTS ON THE DRS-1A UNTIL THE REQUIREMENTS OUTLINED IN THE FOLLOWING PARAGRAPHS ARE UNDERSTOOD.

The metering signals applied to the DRS-1A Selector Unit metering inputs are not the same voltages or currents that are indicated on the broadcast transmitter panel meters. Instead, they are derived independently in a manner such that they do not interfere with the regular meters but are representative of the readings of those meters. Because the actual voltage or current to be measured is not brought out from the broadcast transmitter, but rather only a sample of it is, this voltage is also known as the metering sample. Figure 10 will help to illustrate this point.

In "A" of Figure 10, resistors R1, R2, and R3 have been added to develop an output voltage representative of plate voltage. Resistors R1 and R2 are typically in the several megohm range, with wattage ratings in the vicinity of 10 watts to 20 watts. Stable metal-oxide resistors are preferred. Resistor R3 is in the vicinity of 10KΩ to 100KΩ and serves to keep the output sample terminals at a reasonable voltage should the external load (the remote control metering input) be removed. The target output voltage is 2 volts DC, with a 1-volt minimum and a 10-volt maximum. Less than 2 volts may not allow a full-scale reading. More than 4 volts may make it difficult for the setting of calibration controls to obtain a specific reading. This assembly is available from Moseley Associates as Type PVK-1 or PVK-2 Plate Voltage Sampling Kits.

In Figure 10 "B", a shunt resistor in the vicinity of 1Ω is shown added as R4. This resistor develops a sample of plate current but



A

DERIVING PLATE VOLTAGE SAMPLE

B

DERIVING PLATE CURRENT SAMPLE

FIG. 10

at a safe location. The value of this resistor should be calculated to develop 2 volts target with normal plate current flowing.

> MAKE CONNECTIONS TO THIS RESISTOR SECURELY: IF IT OPENS OR IF ITS CONNECTIONS BECOME CORRODED, THE OUTPUT SAMPLE TERMINALS WILL HAVE EXCESSIVE VOLTAGE ON THEM. PARALLELED RESISTORS ARE PREFERRED FOR THIS REASON.

Bear in mind that the DRS-1A metering inputs must be in the form of DC. Hence, if it is desired to include a sample of filament voltage in the metering line-up, the AC voltage must be rectified. A simple method of accomplishing this is shown in Figure 11 at "A". This same technique may be used for monitoring line voltage. The filament voltage may be rectified directly if it has a center tap or one side is at ground potential. This device is available as an accessory from Moseley Associates, Type LVK-2 Line Voltage Sampling Kit.

AM antenna base current may be measured by noting that the tower is a linear device, and then measuring <u>voltage</u> instead. The two are directly related. The circuitry in Figure 11 "B" has been proven to be satisfactory. The 10 pf capacitor may be a short piece of coaxial cable or a small-value, transmitting-type mica capacitor. The two capacitors in series form an RF voltage divider, down to approximately 20 volts to 50 volts peak. This RF is rectified by the diode (preferably germanium, but use a 150 volt or 200 volt high-speed device in any event) and smoothed by the 0.01µf capacitor. For high base-voltage installations, reduce the value of the 10 pf capacitor so that the RF voltage at the junction of the two capacitors is of the order of 30 volts peak. This same system may be used to measure transmission-line or common-point current. This unit is available from Moseley Associates as Type RFK-1 AM-RF Transmission Line Voltage Sampling Kit. Alternatively, the analog (DC) output of a type-approved antenna monitor may be used to measure the base current.

In FM installations, RF voltage is also typically sampled to represent forward power. A diode assembly used for this application is depicted in Figure 11 "C". This device is available from Moseley Associates as Type RFK-2 or RFK-3 FM-RF Transmission Line Voltage Sampling Kits.

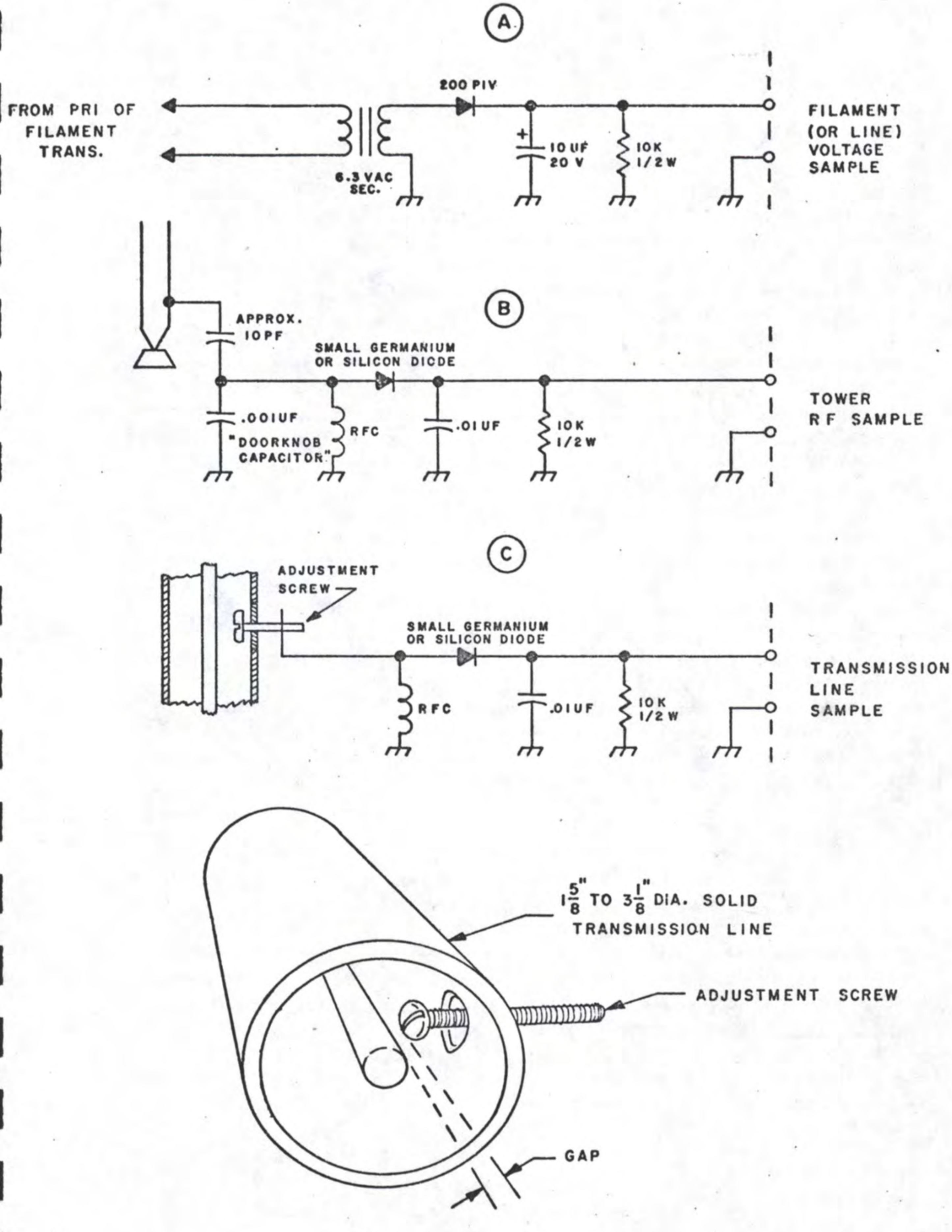

A
FROM PRI OF FILAMENT TRANS.
200 PIV
6.3 VAC SEC.
10 UF 20 V
10K 1/2 W
FILAMENT (OR LINE) VOLTAGE SAMPLE
B
APPROX. 10PF
SMALL GERMANIUM OR SILICON DIODE
.001UF
"DOORKNOB CAPACITOR"
RFC
.01UF
10K 1/2W
TOWER RF SAMPLE
C
ADJUSTMENT SCREW
SMALL GERMANIUM OR SILICON DIODE
RFC
.01UF
10K 1/2 W
TRANSMISSION LINE SAMPLE
1 5/8" TO 3 1/8" DIA. SOLID TRANSMISSION LINE
ADJUSTMENT SCREW
GAP

FIG. 11

The outputs from reflectometers and frequency monitors are generally at a low level requiring special interfacing. Both of these are solved through the use of a DC amplifier. For nonlinear applications, such as reflectometers, the Moseley Associates Type PLC-1 Power-to-Linear Converter is recommended. For linear applications, such as frequency monitors, the Moseley Associates Type CSA-3 DC Amplifier is recommended.

Bear in mind that whatever the source of the metering voltage sample, it should measure in the vicinity of ±2 volts DC when a 100K resistor is connected across it, and it should measure not more than 10 volts when this resistor is disconnected. If the sample is above or below ground, all terminals and points where it is exposed should be covered. It must not be more than 350 volts peak or DC referenced to ground, or damage may result to the DRS-1A. It should not be more than 50 volts above or below ground unless wiring is protected. The use of shielded wire, conduit, and other techniques to keep RF out of the metering samples should be encouraged.

If the installing personnel understand the metering sample requirements, they may proceed with installing the metering circuitry. As an alternative, the metering circuitry installation may be delayed and accomplished along with the control circuitry installation. In either case, note that the metering samples are applied to the "M" terminals on the rear of the Selector Unit(s).

H. Control

MAKE NO CONNECTIONS TO THE CONTROL TERMINALS ON THE DRS-1A UNTIL THE COMMENTS IN THE FOLLOWING PARAGRAPHS ARE UNDERSTOOD.

Refer to Figure 12 for a simplified schematic of the control portion of the DRS-1A. A series of relays allows a pair of terminals to be selected, one at a time. After a pair has been selected, circuit continuity may be completed by energizing the Raise relay. When the Raise relay is de-energized, the terminal-pair circuit continuity is removed. When a terminal pair is not selected, no connection is made to it.

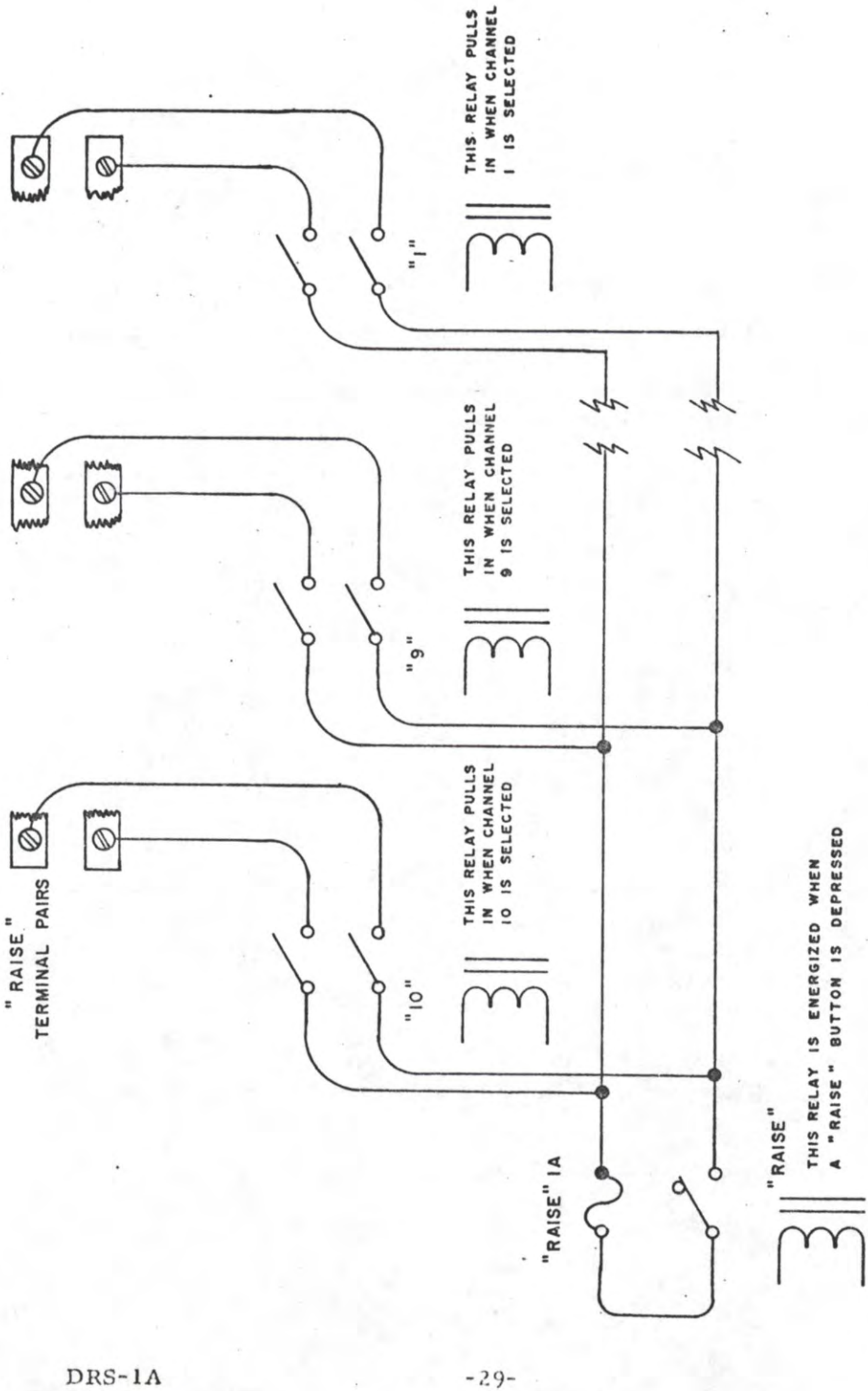


FIGURE 12 - SIMPLIFIED CONTROL CONNECTIONS IN THE DRS-1A

This entire system is duplicated for the Lower terminal pairs. There is no connection between the Raise and Lower wiring.

Not shown is a third set of contacts on each channel relay which selects the metering sample for that channel.

Figure 13 shows some very simple examples of control circuitry and how such circuitry is connected to the DRS-1A Selector Unit. When Channel 1 is selected, the 24 VDC relay coil will be energized by pressing the RAISE button. Going to Channel 4 and pressing the LOWER button will cause the same effect as pressing the push button shown on the drawing.

There are no conditions inside the DRS-1A which would connect any of these channels to one another. This gives great flexibility in the control system since various voltages, AC and DC, etc., may be mixed. Nevertheless, it is considered a wise move to use a repeating or "interface" relay between the DRS-1A and the outside loads. In this manner serious control transients are kept out of the DRS-1A circuitry. It is suggested that these relays be operated from a simple DC power supply and that a diode be connected across each relay coil. Connect the diode in a manner such that it would not normally conduct. This diode forms an effective transient suppressor. The use of an interface relay also allows a form of power gain; loads up to several amperes may now be switched without ill effect to the DRS-1A.

There are situations where a connection must be <u>opened</u> upon application of a control impulse. Turning off the filaments of a transmitter is an example of such a situation. The only way this can be accomplished is to use the "back" (normally closed) contacts on an interface relay. Energizing the relay will then open the external circuit.

This is further illustrated in Figure 13. Going to Channel 10 and pressing the RAISE button will energize the relay and open the external circuit.

The current through the control contacts in the DRS-1A should never

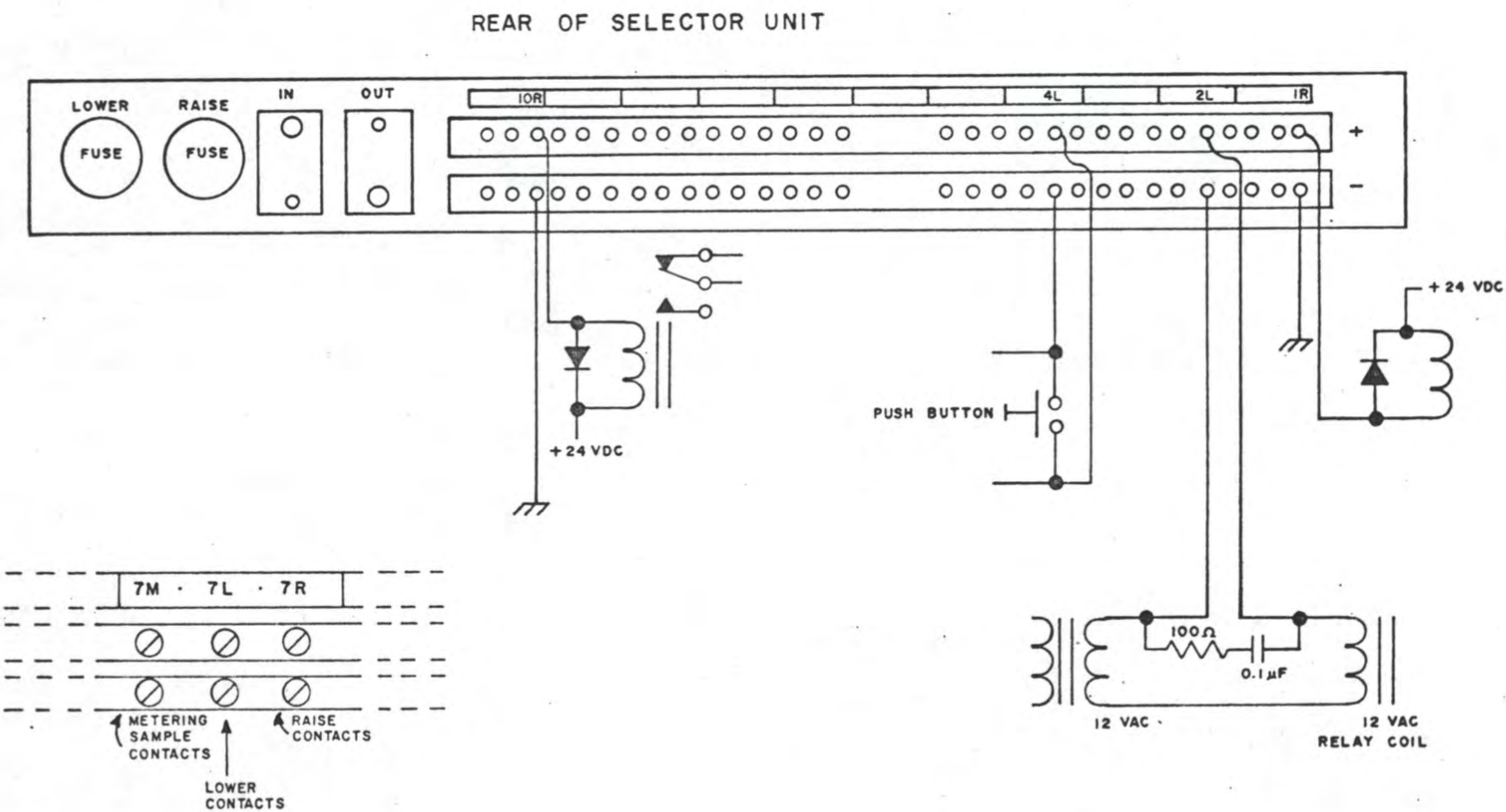


FIGURE 13 – SIMPLE EXAMPLES OF CONTROL CIRCUITRY EXTERNAL TO THE DRS-1A

exceed 1 ampere even on a transient basis; a lesser value is to be preferred. External loads if run from DC must have a damping diode as previously mentioned. If external loads are AC, they must have a series RC network across them. (Values of 0.1μf and 100Ω are suggested for the small loads permitted by the DRS-1A). The control system voltages should preferably not exceed 250 volts DC or peak AC. The use of interface relays is to be encouraged.

After the control system has been planned and found to comply with the requirements outlined above, it may be installed. If the metering connections have not been made, they, too, may be installed.

I. Fail-Safe Connections

Current Federal Communications Commission regulations require that the remote control system be fail-safe, meaning that a control system or link failure will automatically take the transmitter off the air. There are two independent fail-safe subsystems in the DRS-1A. The control fail-safe logic removes the transmitter from the air if the control section of the DRS-1A should fail. For TV, telemetry fail-safe logic starts an external one-hour timer should the telemetry section of the DRS-1A fail. The Moseley Associates Model FSU-1 Metering Fail-Safe Unit is recommended for television applications.

Referring to Figure 14, the control fail-safe outputs are in the form of single-pole, double-throw relay contacts labeled NO, ARM, and NC. When the control system is operational, the internal fail-safe relay is energized, and the normally open contact (NO) is closed to the ARM terminal. When a failure occurs, the NO contact opens and the NC contact closes. The same result occurs if power fails within the DRS-1A Remote Terminal. Note that the terms "normally open" and "normally closed" refer to the contact when the relay is de-energized (when there is a control failure).

The metering fail-safe outputs on the Remote Terminal are labeled METERING "+" and "-". The "+" terminal is connected internally through a 1-ampere fuse to the +24 VDC supply of the Remote

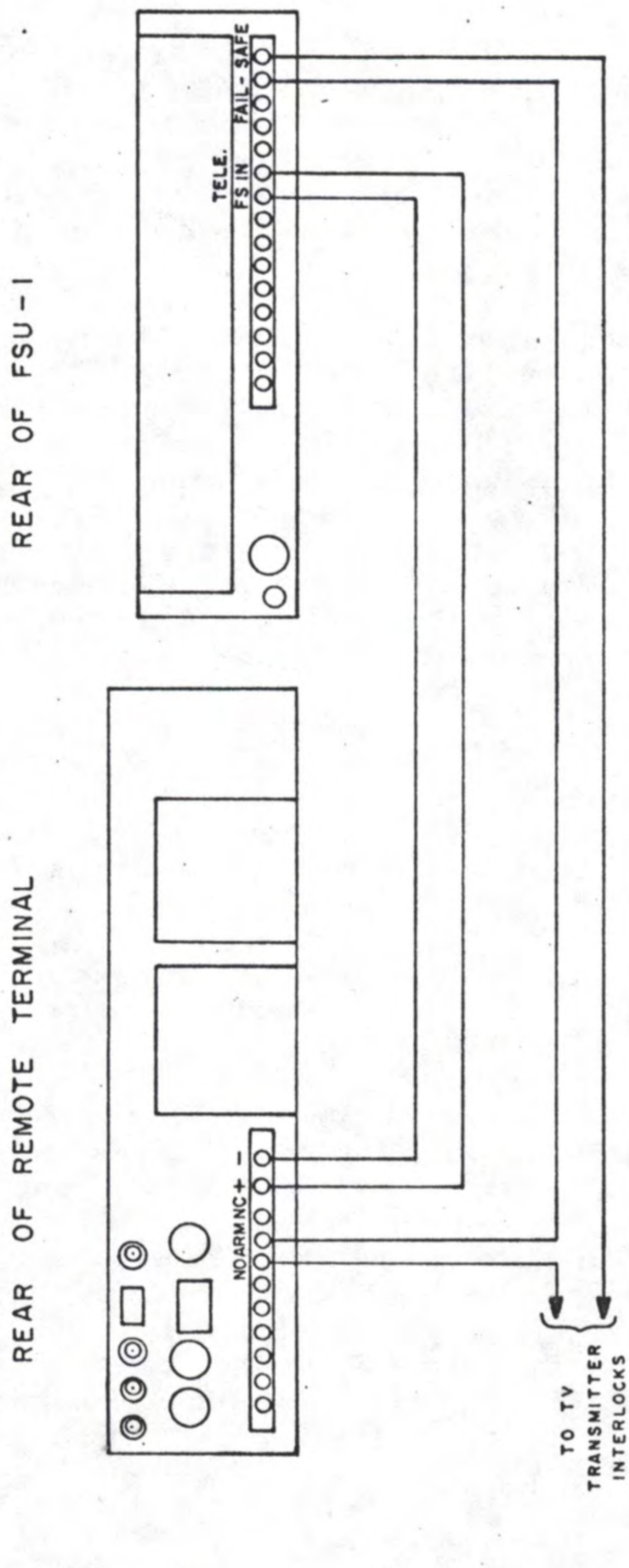


FIGURE 14 - REMOTE TERMINAL FAIL-SAFE CONNECTION

Terminal. The "-" terminal is connected to the collector of a 30V, 300 ma transistor which is driven by the metering fail-safe logic. When the system is functional, the "-" terminal is pulled to ground (the transistor is on). When a failure occurs, the transistor is turned off causing the "-" terminal to float. An external relay or an FSU-1 Metering Fail-Safe Unit may be connected to these terminals as shown in Figure 14.

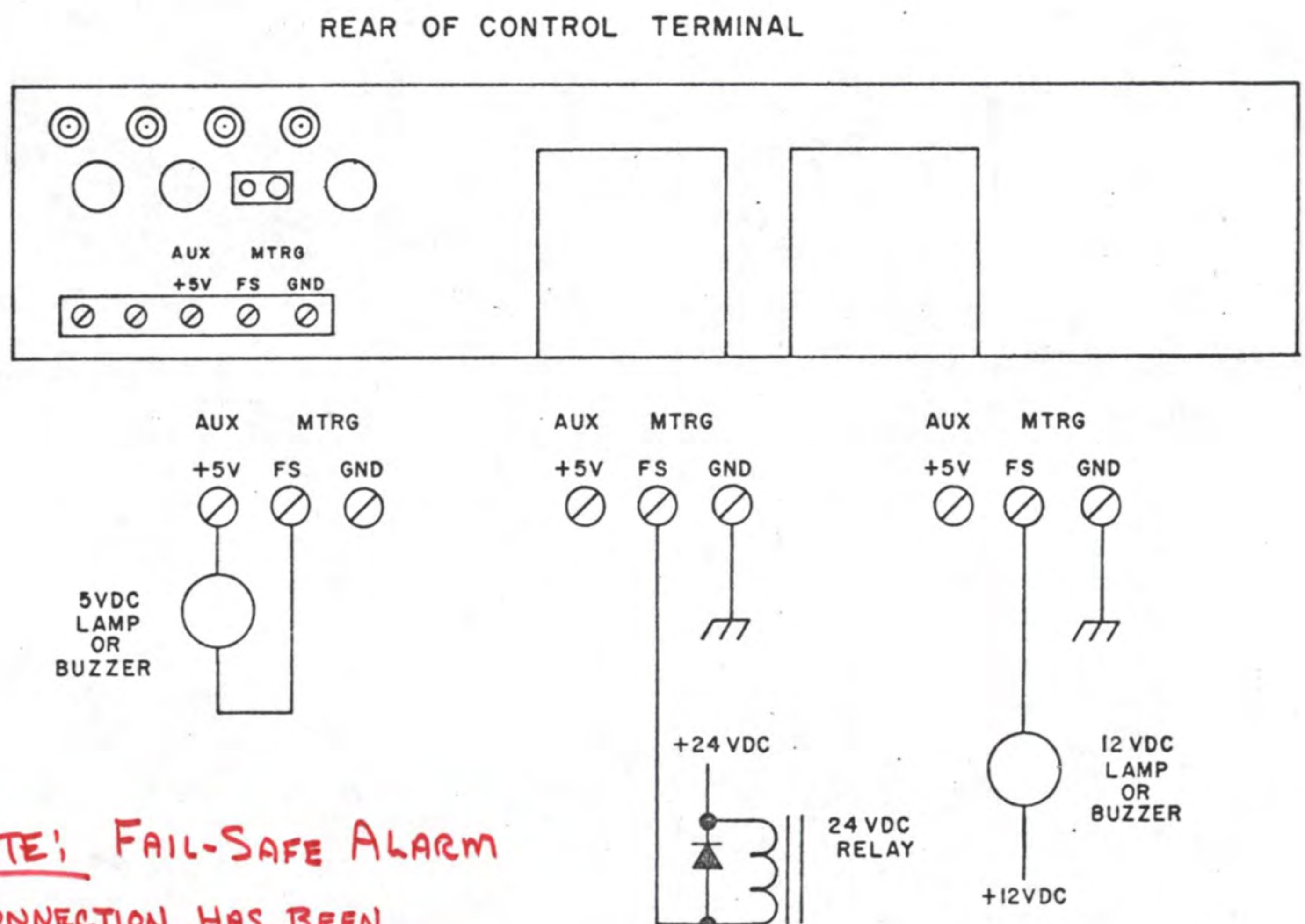
Metering fail-safe outputs are also provided on the rear of the Control Terminal labeled +5, FS, and GND. The +5 terminal supplies +5 VDC through the AUX 5V fuse for powering an external relay, lamp, buzzer, etc. The FS terminal is connected to a transistor driven by the metering fail-safe logic. GND is chassis-ground. When a failure system is functional, the FS terminal is floating. When a failure occurs, the FS terminal is pulled to ground. Note that this is the reverse of the "-" terminal on the Remote Terminal explained above. Refer to Figure 15 for typical uses of the metering fail-safe terminals.

J. Miscellaneous Connections

On the rear of the Remote Terminal, a set of contacts labeled LOCAL CONTROL is provided. These contacts originate from the LOCAL switch on the front panel. When the switch is on, these contacts are closed. A 120 VAC or 120 VDC, 50-watt maximum load may be connected in series with these contacts. A typical application of this feature would be a lamp positioned somewhere near the transmitter building door to remind the operator that the Remote Terminal is in the LOCAL mode.

Also on the rear of the Remote Terminal are BNC connectors labeled LOGGER and MOD. IN. If a Moseley Associates Model DLS-1 Digital Logging System is to share the DRS-1A data link, connect the DLS-1 to the LOGGER BNC connector. If a Moseley Associates Model MMP-1 Modulation Meter Panel is to share the data link, connect it to the MOD IN. BNC connector.

On the rear of the Control Terminal are BNC connectors labeled LOGGER and MODULATION. Connect the DLS-1 Printing Terminal



NOTE: FAIL-SAFE ALARM CONNECTION HAS BEEN RE-WIRED INTERNALLY TO MAINTENANCE OVERRIDE INDICATOR.

FIGURE 15 — TYPICAL CONTROL TERMINAL FAIL-SAFE CONNECTIONS

to the LOGGER connection. Connect the MMP-1 Modulation Meter Panel, to the MODULATION connector.

K. Calibration

Calibration of the DRS-1A is quite simple. Since the readings at the Control Terminal exactly track those at the Remote Terminal, only one man at the transmitter site is required for calibration.

Place the Remote Terminal in the LOCAL mode. Set all of the calibration potentiometers on the Selector Unit(s) to minimum (full counterclockwise). Select the first channel to be calibrated. Adjust the corresponding potentiometer clockwise until the reading on the Remote Terminal matches the reading on the reference meter. Note that if the control is advanced too far, the readout will begin to blink when the reading goes higher than 1999. Do not attempt to calibrate the display to read greater than 1900 unless absolutely necessary. It would be better to change the reading from 1934 to 0193, for example, by turning the potentiometer counterclockwise.

CAUTION: DO NOT CALIBRATE CLOSE TO THE READOUT MAXIMUM OF 1999. NUMBERS GREATER THAN THIS CAUSE AN OVERRANGE CONDITION WHICH, ALTHOUGH NOT HARMFUL TO THE DRS-1A, GIVES ERRONEOUS READINGS ON BOTH THE REMOTE TERMINAL AND CONTROL TERMINAL DISPLAYS.

Continue to calibrate all of the channels. If a potentiometer seems too sensitive, causing a problem in calibration, the metering sample voltage is too high and must be reduced. Never exceed a sampling voltage of 10 VDC.

To ensure compliance with current Federal Communications Commission requirements, the readings at both studio and transmitter locations should be verified.

V. OPERATION

A. Telemetry and Control System

Operation of the DRS-1A is straightforward. It is suggested that power and other connections be applied to the units continuously. Under normal operating conditions, be sure that the LOCAL CONTROL switch on the Remote Terminal is in the OFF (out) position to allow control from the Control Terminal. Note that the readout display on the Remote Terminal is blanked (except for polarity) and that the LOCAL light is off when the Control Terminal has control. The CONTROL OVERRIDE LED is also off on the Control Terminal.

Set the CHANNEL SELECT switches on the Control Terminal to the desired channel number. To verify that this number has been received and decoded at the Remote Terminal, depress CHANNEL ECHO. The actual channel number will appear in the readout. Verify that the selected and echoed channel numbers match.

> CAUTION: DO NOT SELECT A CHANNEL NUMBER GREATER THAN 30. THE ACTUAL CHANNEL NUMBER WILL DIFFER FROM THE SELECTED NUMBER IN THIS CASE. FOR EXAMPLE, SELECTING CHANNEL 50 ACTUALLY CAUSES CHANNEL 10 TO BE ACTIVATED.

Release the CHANNEL ECHO switch. The selected telemetry value will appear in the readout. A "jitter" in the right-most digit of several counts is normal. An excessive amount of jitter is caused by one of the following:

1) A rapidly changing telemetry sample such as base current or modulator current.

2) Poor lead-dress and shielding of the telemetry sample from the transmitter to the Selector Unit.

3) A noisy calibration potentiometer.

4) A dirty comb connector on the rear of the A-D converter. Clean it with a pencil eraser.

5) Dirty relay contacts in the Selector Unit.

6) A defective A-D converter.

To initiate a Raise control function, depress the RAISE switch. The Raise feedback light in the switch will go on to indicate that the Raise relay in the Remote Terminal did actually close. The LOWER switch and feedback light operate in a similar manner. If both switches are accidentally pushed, neither control function will occur. Also, control functions are disabled while the CHANNEL ECHO switch is depressed.

Operation from the Remote Terminal is similar to operation from the Control Terminal. When the LOCAL CONTROL switch is activated (in), the Remote Terminal readout and the lamp in the switch are illuminated. In this condition, the RAISE, LOWER, and CHANNEL SELECT switches on the Control Terminal are disabled, while those on the Remote Terminal are enabled. If CHANNEL ECHO is depressed, the channel selected at the Remote Terminal will be displayed on the Control Terminal readout. Any command functions will be indicated by the appropriate light on both the Remote and Control Terminals.

It is recommended that the CHANNEL SELECT switches be returned to channel 00 when the system is not being used for telemetry readings or for control functions. Selecting this channel causes all metering and control relays to open, thus preventing an accidental closure of a Raise or Lower relay (due, for example, to an equipment or component failure). It is also recommended that the DISPLAY TEST switch be checked daily to ensure that the displayed data is correct. The test causes all of the LED segments to be displayed as "-1.8.8.8".

B. Fail-Safe Indications

The control and telemetry functions of the DRS-1A are independent subsystems. A failure in one does not necessarily imply a failure in the other. Thus, separate control and telemetry (metering) fail-safe outputs and indications are provided. The absence of valid telemetry for 20 seconds causes the Control Terminal readout to blink at about 1 Hz. Also, the metering fail-safe outputs on both the Control Terminal and Remote Terminal will actuate and start the one-hour timer in the FSU-1 Metering Fail-Safe Unit if installed. The absence of valid control information for 20 seconds causes the control fail-safe relay to open. No other indication is given except that the transmitter will be removed from the air.

Both telemetry and control fail-safe outputs on the rear of the Remote Terminal may be overridden by going to the LOCAL mode on the Remote Terminal.

VI. CIRCUIT DESCRIPTION

A. General Description

> NOTE: THE DRS-1A USES DIGITAL LOGIC TECHNIQUES TO ORGANIZE THE FLOW OF DATA BETWEEN STUDIO AND TRANSMITTER. THOSE UNFAMILIAR WITH DIGITAL CIRCUITRY SHOULD AT THIS TIME READ APPENDIX A.

The Remote Terminal logic organizes the A-D data and status/alarm data into four 8-bit "words". These words are sent serially to the Control Terminal. As each word arrives, it is temporarily latched until all words have arrived. Then the front-panel readout is updated.

The Control Terminal logic organizes channel number and control information into two 8-bit words. These words are sent serially to the Remote Terminal which decodes the information into command functions.

Table 2 shows how the control and telemetry words are organized bit by bit. The names are descriptive only and do not necessarily correspond to actual names on the schematics. A bar over a name or an * before a name indicates negative logic, meaning that the bit is considered true when it is low.

Definition of Terms:

$\overline{\text{CHAN 11}}$ to $\overline{\text{CHAN 22}}$: Control channel number originating from the CHANNEL SELECT switches. The format is $\overline{\text{CHANij}}$ where "i" is the digit number and "j" is the binary weight of that bit. For example, $\overline{\text{CHAN 21}}$ refers to the tens digit and has a weight of 1. $\overline{\text{CHAN 14}}$ refers to the units digit and has a binary weight of 4.

$\overline{\text{RAISE}}$: The raise control bit. It goes low when the RAISE switch is pushed.

$\overline{\text{LOWER}}$: The lower control bit. It goes low when the LOWER switch is pushed.

CONTROL: The control enable bit. It goes high when RAISE or LOWER switches are pushed.

$\overline{\text{CHAN ECHO}}$: This bit goes low when the CHANNEL ECHO switch is pushed.

$\overline{\text{STATUS CLEAR}}$: This bit goes low when the CLEAR switch is pushed on the Status Panel-Control Terminal.

MFE: This bit goes high when a metering fail-safe condition occurs.

CFG: This bit is the control fail-safe generator. It is low for WORD 1 and high for WORD 2. It is also used by the Remote Terminal as a word synchronization bit.

D11 - D41: These 13 bits are the output of the A-D converter. The numbering is similar to $\overline{\text{CHANij}}$ discussed earlier. D11 is the least significant bit. D41 is the most significant.

DPOL: This is the polarity bit. It is high when the telemetry reading is negative.

TABLE 2

BIT STRUCTURE

	CONTROL TRANSMISSION		TELEMETRY TRANSMISSION			
BIT	WORD 1	WORD 2	WORD 1	WORD 2	WORD 3	WORD 4
1	$\overline{\text{CHAN 11}}$	$\overline{\text{RAISE}}$	D11	D21	D31	$\overline{\text{STATUS 1}}$
2	$\overline{\text{CHAN 12}}$	$\overline{\text{LOWER}}$	D12	D22	D32	$\overline{\text{STATUS 2}}$
3	$\overline{\text{CHAN 14}}$	$\overline{\text{CHAN ECHO}}$	D14	D24	D34	$\overline{\text{STATUS 3}}$
4	$\overline{\text{CHAN 18}}$	$\overline{\text{STATUS CLEAR}}$	D18	D28	D38	$\overline{\text{STATUS 4}}$
5	$\overline{\text{CHAN 21}}$		$\overline{\text{RAISE TALLY}}$		D41	$\overline{\text{STATUS 5}}$
6	$\overline{\text{CHAN 22}}$		$\overline{\text{LOWER TALLY}}$	$\overline{\text{OVERRIDE}}$	DPOL	$\overline{\text{STATUS 6}}$
7	CONTROL	MFE	D WORD 1=0	D WORD 1=1	D WORD 1=0	WS1
8	CFG=0	CFG=1	D WORD 2=0	D WORD 2=0	D WORD 2=1	WS2

RAISE TALLY: This bit goes low when the Raise relay closes.

LOWER TALLY: This bit goes low when the Lower relay closes.

OVERRIDE: This bit goes low when the Remote Terminal is in the LOCAL mode.

D WORD 1, D WORD 2: These two bits are the "address" of the current word being transmitted. D WORD 1 is also used as a metering fail-safe generator.

STATUS 1 - STATUS 6: These six bits represent a group of 6 status channels originating in the Status Panel-Remote Terminal. When low, that status channel is on.

WS1, WS2: These two bits indicate which one of four groups of status bits is being transmitted.

B. Control Terminal

1. Timing

Referring to Schematic 91C6760, IC3F forms an oscillator tuned to 1.2288 MHz. Assume X1 is low. Then, since each section of 3F acts as an inverter, X2 goes high which causes X3 to go low which causes X4 to go high. X1, which was originally low, will then go high. Thus, the circuit oscillates as it tries to catch up with itself. The 100KΩ resistor assures that the oscillations will start, and the crystal stabilizes the oscillations.

X4 is buffered by a NAND gate before being coupled to dividers 4F and 4E. The 1.2 MHz signal is divided into several frequencies for use in timing of the data flow. CLK1 is a 4800 Hz square wave applied to Pin 40 of IC1A which sets the transmitter baud rate to 300 bits per second. The clock RRC applied to Pin 17 is jumpered to either 600 Hz for subaudible applications or to CLK1 (4800 Hz) for audible telemetry. Buffers 5A connected to 4E and 4F are CMOS-to-TTL converters.

2. Control Encoder Logic

The output TR8 of 5A Pin 10 is a 4.6875 Hz clock which is used as a control fail-safe generator and word number bit. It is fed to word selector 4A Pin 1, transmitter 1A Pin 33, and word selector 5C Pin 1. As shown in Table 2, this bit is low for the first word and high for the second word. Bits 1-4 of the control transmission contain channel number information in WORD 1 and command information in WORD 2. IC4A senses TR8 at Pin 1 and selects channel information at inputs 1A-4A when TR8 is low. When TR8 is high, the 1B-4B inputs to 4A are presented to transmitter 1A.

Bit 7 of the control transmission is also word selectable; IC5C senses TR8 at Pin 1 and selects the control enable input 1A (CONTROL) when TR8 is low. When TR8 is high, input 1B (MFE) is presented to transmitter 1A. $\overline{\text{CHAN 21}}$ and $\overline{\text{CHAN 22}}$ go directly to 1A since bits 5 and 6 do not change from WORD 1 to WORD 2.

THRL originates from 4E Pin 12. It is a 9.375 Hz clock which strobes transmitter 1A on its rising edge. Since it is at twice the frequency of TR8, a word is transmitted each time TR8 changes.

The serial output from 1A Pin 25 is wired to header 1C Pin 29 from where it is wired to the control FSK modulator.

3. Telemetry Decoder Logic

Serial data from the telemetry FSK or phase-shift demodulator is coupled through header 1C Pin 31 to 1A Pin 20. DR at 1A Pin 19 goes high after 8 data bits have been received. The next high CLK15 causes $\overline{\text{DRR}}$ to go low through NAND gate 3G which resets the receiver logic in 1A. If no error occurs, FE and PE will be low causing $\overline{\text{ERROR}}$ to be high. DR NANDED with $\overline{\text{ERROR}}$ causes $\overline{\text{DLATCH}}$ to go low. $\overline{\text{DLATCH}}$ is used to strobe storage latches. If an error occurs, $\overline{\text{DLATCH}}$ does not go low and the erroneous data is not latched or presented to the operator.

Bits 7 and 8 of the telemetry transmission contain word number information. When WS1 and WS2 are low, WORD 1 has been received. Word decoder 4C gives a low-going pulse at Pin 1

(CLK13) which latches word bits 1-6 into IC5B. When WS1 is high and WS2 is low, CLK12 goes low when DLATCH goes low to latch the second group of six data bits in IC4B. When WS1 is low and WS2 is high, LATCH goes low to update the front-panel display.

Status synchronizer 3B detects when WS2 goes high indicating that WORD 3 has arrived. After the readout has been updated, one-shot 4D gives a pulse DR1 when DR falls from high to low. When DR1 falls, 3B is clocked which causes X9 to go high when WS2 is high. X9 disables word decoder 4C, preventing status information in WORD 4 from interfering with telemetry data. At the same time, STATRDY goes low. This signal, fed to the Status Panel-Control Terminal, enables bits 1-6 from WORD 4 to be latched. IC3A buffers the data before it is cabled to the Status Panel-Control Terminal. SLATCH, a buffered version of DLATCH, causes status data to be stored.

X9 is also fed back to the K input of 3B. When DR1 falls after status information has been latched, 3B clocks causing X9 to go low and STATRDY to go high. This enables 4C to decode the first three words and disables the Status Panel.

If a framing error occurs, FRAMING occurs at 3D Pin 11. This signal is fed to the telemetry phase-shift demodulator and causes the serial data to reverse its phase.

Raise and Lower feedback information is latched in 5B. The drivers at 4G turn the lamps on when feedback bits are received. Similarly, the CONTROL OVERRIDE LED is turned on when OVERRIDE goes low.

4. Metering Fail-Safe

Received bit WS1 toggles up and down when the telemetry link and logic functions are normal. When WS1 falls, 4D is strobed which causes STROBE to occur. This pulse resets counter 3E. MFE thus remains low. If WS1 should stop toggling, STROBE fails to occur, allowing 3E to count when CLK11 falls. About 20 seconds later, 3E reaches a count of 8 which causes MFE to go high. MFE goes low which freezes the clock input to 3E. When this condition occurs, MFE is sent to the Remote Terminal and driver 4H turns on. $\overline{\text{MFS}}$ is fed to the back panel of the Control Terminal and may be used to drive on external alarm. In addition, CLK10 in conjunction with MFE causes $\overline{\text{BLANK}}$ to pulse at about 1 Hz. This signal fed to the front-panel display causes the display to blink to alert the operator of a telemetry fail-safe condition.

When valid telemetry is restored, WS1 causes STROBE to clear 3E and MFE goes low. The front-panel display then stops blinking.

5. Front-Panel Readout

The 14 bits of telemetry are brought to the front-panel display board. When the third telemetry word has been received, LATCH goes low which latches the telemetry bits in the display. The three TIL308 IC's (IC401-IC403) contain built-in latches. The TIL304 IC (IC404) is a display only. IC405 is used as a latch, and IC406 is a driver. The front-panel TEST switch when closed causes all segments of the display to turn on. When a telemetry fail-safe occurs, the signal BLANK causes all segments to turn off.

6. Power Supply

The AC power source is fused, RF filtered, and fed to T1. Device 2001 is a lightning spark gap. It protects against overvoltages caused by switching surges, contact with foreign circuits, and lightning discharges either induced or conducted.

CR1, C1, and C4 form a +9 VDC unregulated supply fed to the Status Panel-Control Terminal. IC1 and C5 form a regulated +5 VDC supply. CR2, C2, C6, IC2, and C7 form a +12 VDC supply. C3, C8, IC3, and C9 form a -12 VDC supply.

7. Control FSK Modulator (Schematic 91B6761)

IC501 generates a sine wave at Pin 2 whose frequency is determined by capacitor C501 and resistors R505, R506, and R507. The greater the total resistance, the lower the frequency. When the serial control data at terminal 4 is high, Q501 and Q502 are turned on. R505 is effectively shorted by Q502 which results in a lowered resistance path to IC501. The upper FSK frequency is thus adjusted by R507 to 2500 Hz. When the serial data is low, Q501 and Q502 are turned off. R505 is restored in the resistance path and is adjusted to produce a lower FSK frequency of 2300 Hz.

The high-impedance output of IC501 is level-shifted by C502 and buffered to low impedance by IC502. The other section of IC502 and IC503 form a bandpass filter. Section 1 of IC504 amplifies the FSK signal before being placed on the phone line through R517 and R518. CR501 and CR502 clamp voltage spikes on the phone line. The FSK signal is also coupled through C509 to the telemetry FSK demodulator. Section 2 of IC504 amplifies the signal which is then coupled to the internal subcarrier generator board or to the rear-panel CONTROL OUT BNC connector.

8. Telemetry FSK Demodulator (Schematic 91B6758)

The telemetry FSK signal from either the phone line or subcarrier equipment is jumpered through C201 to notch amplifier IC201. For a phone line system, the control FSK signal at the notch input is subtracted from the combined telemetry and control signals on the phone line by IC201. R201 adjusts how much subtraction is obtained.

The next six amplifier sections form an active bandpass filter to pass the 1300 Hz - 1500 Hz telemetry signal. The signal is then boosted by amplifier IC204 and is cleaned up by Schmitt-trigger IC205. CR201, CR202, and R222 limit the signal to ±0.7V before it is applied to demodulator IC206.

Squelch comparator IC205 turns off Q201 when the signal at TP203 is greater than about 6.5V peak-to-peak. When the signal drops below this level, the output of IC205 switches to about +11 VDC which turns on Q201. The collector of Q201 clamps the telemetry data at terminal 8 to ground. R226 adds Schmitt-trigger action to IC205.

The FSK demodulator IC206 is a phase-locked loop. The signal at Pin 4 is phase-compared with an internal VCO (voltage-controlled oscillator) at Pin 6. The output of the phase detector at Pin 2 is filtered and fed to Pin 1 where an internal comparator slices it. The comparator output feeds a transistor whose collector is connected to Pin 8. R238 pulls the output to +5V when the FSK frequency is 1500 Hz. When the frequency is 1300 Hz, the internal transistor pulls the output low.

The VCO output is at TP206. The VCO free-running frequency is determined by C217, R239, and R240. R240 is adjusted for a free-running VCO frequency of 1400 Hz. Under normal conditions, the VCO is phase-locked to the signal at Pin 4.

9. Telemetry Phase-Shift Demodulator (Schematic 91B6759)

When subaudible telemetry is used, the telemetry phase-shift demodulator is used instead of the telemetry FSK demodulator. The received subaudible signal is filtered and amplified by IC301 and IC302. It is fed through a Schmitt trigger and buffered to 5-volt logic by Q302. IC304 doubles the frequency and applies a pulse to IC305 each time the input waveform rises or falls. Counter IC305 is reset when the input changes state. When a phase inversion occurs in the input signal, the counter clocks to the 12 state, and a pulse occurs at the output of IC306. This changes the state of flip-flop IC307. Thus, the telemetry data to the receiver changes state each time the input data changes phase.

Phase inverter IC304 changes the phase of the telemetry data if a framing error occurs. IC307 changes state when FRAMING goes high, causing the EXCLUSIVE-OR gate to invert the telemetry signal.

C. Remote Terminal

1. Timing

Referrring to Schematic 91C6748, IC2F forms a crystal oscillator identical to that in the Control Terminal. The output is divided by 3E and 3F into several timing signals. The receiver portion of IC1A is synchronized to either 300 baud or 37.5 baud through jumper header 3D to signal 600 Hz or CLK2. Clock 9.375 Hz controls the channel-change sequencer as described later. CLK1 is fed to the control fail-safe counter logic. Divider 2D generates CLK4 at 18.75 Hz for audible telemetry or at 3.125 Hz for sub-audible telemetry. CLK4 advances word-select counter 2G and causes XMIT to strobe transmitter 1A.

2. Telemetry Encoder Logic

Data from the digital panel meter (T11-T41 & TPOL) is fed to data selectors 4E, 4F, 2H and 2J. Signals TALLY and *Tally determine whether the A-D reading or the control-channel number is to be sent to the Control Terminal. When TALLY is low, 4E and 4F select the A-D reading. *TALLY is high when TALLY is low, and it causes the outputs of gates 2J and 2H to pass A-D data. When the CHANNEL ECHO switch on the Control Terminal is pushed, TALLY goes high which causes 4E and 4F to select the channel number MET11-MET22. Also, *TALLY is low which causes the outputs of gates 2H and 2J to go low.

The telemetry data thus selected appears as D11-D41 and DPOL. It is fed to word selectors 3G, 3H, 3J and 3K. Status data appears as S1-S6. *RTALLY goes low when the master raise relay closes. LTALLY goes low when the master lower relay closes. SW1 and SW2 address which group of six status bits is being transmitted.

Recall that four eight-bit telemetry words are sent to the Control Terminal. The word selectors choose eight bits at a time and present them to transmitter 1A as TR1-TR8. Word-select counter 2G determines which word is to be transmitted. Timing signal CLK4 advances 2G after each word has been transmitted. CLK4 also causes XMIT to start the transmission. When 2G is advanced, the word-address bits WS1 and WS2 change and cause word selectors 3G-3K to present a new eight-bit word to 1A.

Word-select counter 2G, in conjunction with cycle-length-select jumper header 3D and gates 5D, cause a "dead" transmission to occur after a complete transmission cycle has been completed. Normally, header 3D is set up to send four eight-bit words to the Control Terminal. After these words have been sent, CL1 and CL2 go high causing STROBE 1 to go low. STROBE 1 turns off dead transmission gate 5D, preventing CLK4 from causing XMIT to occur. Thus, transmitter 1A is not strobed for one cycle. R1 and WS4 then reset word-select counter 2G to start the cycle over. Optionally, header 3D may be jumpered to allow only three eight-bit words to be transmitted. Status information is thus removed from the transmission cycle. The result is a 20% increase in telemetry update time to the Control Terminal.

The purpose of the dead transmission is to allow the receiver in the Control Terminal to synchronize with the incoming data stream by preventing any negative-going (high to low) transitions from occurring during one word time. The receiver thus will detect the first start bit of the first word correctly. If no dead transmission occurred periodically, the receiver could possibly falsely synchronize to any negative-going transistion in the data stream.

STROBE 1 causes one-shot 3C to give a pulse ADVANCE at the end of each transmission cycle. ADVANCE is fed to the Status Panel-Remote Terminal to cause the next six bits of status information to be presented to the word selectors. ADVANCE also causes CONVERT to occur. This signal causes latches internal to the A-D converter to be updated. The A-D is free-running with respect to the DRS-1A transmission timing. CONVERT thus updates the A-D data only when the transmitter is ready for it.

3. Control Decoder Logic

Control data from the control FSK demodulator is fed to receiver

1A Pin 20. DR goes high when a new eight-bit word has arrived. The next high CLK8 causes DRR to go low which resets the receiver portion of 1A.

Recall that two words are sent to the Remote Terminal. When RR8 is low, the first word has arrived. High-going STROBE 2 then latches RR1-RR6 in receiver latch 3A. When the second word arrives, RR8 is high and bits RR1-RR6 are latched into 3B by STROBE 3. The output of 3A thus contains channel number information, and that of 3B contains control information (Raise, Lower, etc.).

Received bit RR7 is latched into 5C Pin 8 when STROBE 2 goes high (i.e. RR8 is low and the first word has arrived). The latched bit *CONTROL goes high when either Raise or Lower is depressed at the studio. Thus, the *CONTROL bit enables the RAISE or LOWER functions to be gated through 5B after they arrive in the second word. This arrangement requires two complete words to be received before a RAISE or LOWER function is initiated; therefore, it decreases the likelihood of ever initiating a random RAISE or LOWER command.

PE goes high if a parity error occurs, and FE goes high if a framing error occurs. *ERRSET goes low clearing error flip-flop 2A. *ERROR then goes low clearing the receiver latches. In this case, all control relays are opened, and Raise and Lower functions are locked out. When a transmission arrives without error, *ERRSET goes high which allows DR to set the error flip-flop. *ERROR then goes high allowing receiver latches 3A and 3B to be updated.

Received bit *STATCLR from 3B Pin 10 is fed to the Status Panel-Remote Terminal. When low, it causes the status latches to be cleared.

Received bit *CHTALLY from 3B Pin 7 is fed to latch 2A. Recall that ADVANCE occurs at the end of each transmission cycle. Thus, *CHTALLY is stored in 2A after a transmission cycle has occurred. This prevents A-D information from being confused with channel-number echo information during the middle of a transmission cycle. TALLY goes high when the CHANNEL ECHO switch at the Control Terminal is closed. *TALLY goes low. TALLY causes data selectors 4E and 4F to present the channel number to the word selectors. *TALLY clears D24-D41 and DPOL.

4. Local/Remote Selectors

The front-panel CHANNEL SELECT switch information appears as *L11-*L22. *OVERRIDE goes low when the LOCAL CONTROL switch is closed. *LWR4 and *RAIS4 go low when the corresponding LOWER and RAISE switches are closed. *OVERRIDE causes lamp driver 6E to turn on the LOCAL lamp in the switch.

The local-control information bits are fed to local/remote selectors 4J and 4K. Received control information from receiver latches 3A and 3B is also fed to 4J and 4K. When the Control Terminal has control, *OVERRIDE is high which causes 4J and 4K to select *C11-*C22 as the channel number and *RAIS5 and *LWR5 as the Raise/Lower information. When the Remote Terminal has control, local-control information is selected by the local/remote selectors.

*RAIS2 goes low when a Raise command is given. *LWR2 goes low when a Lower command is given. Gates 5F lock out both Raise and Lower functions should both commands be given simultaneously. Gates 6F lock out Raise and Lower functions if *LOCK goes low. *LOCK goes low when the CHANNEL ECHO switch is closed on the Control Terminal provided that the Remote Terminal is not in LOCAL (*OVERRIDE is high). MRAISE and MLOWER from 6F are Raise and Lower command bits fed to the Selector Unit(s).

5. Channel-Change Logic

The selected channel number appears in inverted form as *MET11-*MET22. Inverters 5J change the number to positive logic (MET11-MET22). BCD-to-binary converter 4H then changes the binary-coded decimal number into a binary number. The five bits are fed to channel latch 6G and channel-change comparators 6H and 6J.

Assume that channel 7 has been selected for awhile. The binary channel number (00111) is present at both the inputs and outputs of channel latch 6G. Both sets of inputs to the channel-change comparators are equal, and output *INHIBIT of 6J is high. DISABLE is low, enabling channel decoder 6K.

Now assume that the channel number is changed to 6 (00110). The output of 6G remains at 7, but the input has changed. The B inputs to 6H and 6J differ from the A inputs. *INHIBIT goes low, and DISABLE goes high. The channel decoder is disabled causing all control relays to open. Also, CONVERT is disabled, preventing the A-D from updating.

The channel-change comparators continue to detect a channel number difference until channel latch 6G is updated by CHLATCH. This signal originates from channel-change sequencer 5H. When DISABLE goes high, X2 goes high on the first falling edge of 9.375 Hz. CHLATCH will then go low on the second falling edge of 9.375 Hz. On the third edge, CHLATCH goes high which updates channel latch 6G. The channel-change comparators then detect no difference, allowing DISABLE to fall which enables the channel decoder.

Thus, when a new channel is detected, all relays immediately open. The new number is updated in 6G after three cycles of 9.375 Hz. Then the new relay is energized. This procedure ensures that no two relays will be closed simultaneously during a channel-number change.

The channel number is fed in coded form to the Selector Unit(s). SELØ1-SELØ4 address a particular channel in a group of eight channels. SELØ8-SEL32 address one of the four groups.

6. Fail-Safe Logic

Received bit RR8 normally toggles when the control data link is valid. It is fed to one-shot 3C which resets control fail-safe counter 5E. This circuit is identical to that described in the Control Terminal circuit description.

CFAIL goes high during a control fail-safe condition. Driver 6F opens provided that the Remote Terminal is not in LOCAL (*OVERRIDE is high). When the Remote Terminal is in LOCAL, CFAIL is overridden. FS1 is fed to the control fail-safe relay.

Received bit MFE is high during a metering fail-safe condition. Driver 6F opens when not in LOCAL. Again, placing the Remote Terminal in LOCAL overrides the fail-safe circuitry. FS2 is fed to the power supply board and rear panel.

7. Miscellaneous Logic

*RTALLY goes low when a raise relay closes. The RAISE lamp is then turned on. Similarly, the LOWER lamp goes on when *LTALLY goes low.

Signal *BLANK goes low when the Remote Terminal is not in LOCAL. It causes the A-D display to turn off.

8. Power Supply

AC line power is fused by F1 and RF-filtered by board 51A5514 before being applied to power transformer T1 and regulator SQ2.12.30. Device 2001 is a lightning spark gap. It protects against overvoltages as described previously in the Control Terminal Power Supply.

Bridge CR5, C2, and C9 form a +9 VDC unregulated supply which is fed to the Status Panel-Remote Terminal. IC1 and C10 form a +5 VDC regulated supply to power the main electronics. CR1, CR2, and C1 form a +24 VDC supply to power the control fail-safe and Selector Unit relays. CR6, C3, IC2, and C6 form a +12 VDC supply that is fed to the modems. C4, IC3, and C8 form a -12 VDC supply which is fed to the modems, A-D converter, and receiver/transmitter IC1A.

Regulator SQ2.12.30 forms a floating +12 VDC and -12 VDC supply to power the analog section of the A-D converter. Optical isolators internal to the A-D provide 350 VDC isolation between the metering sample and main electronics.

Mounted on the same board with regulator SQ2.12.30 are the control fail-safe relay and metering fail-safe supply. The anode of CR3 is connected to the control fail-safe driver on the wire-wrap board. The anode of CR4 is connected to the metering fail-safe driver. F2 protects the relay power supply should an inadvertent short occur at the metering fail-safe terminals. CR3 and CR4 protect the fail-safe drivers from inductive voltage surges caused by relay coils.

9. Telemetry FSK Modulator (Schematic 91B6753)

The telemetry FSK modulator is similar to the control FSK modulator discussed earlier. However, the FSK frequencies are 1300 Hz and 1500 Hz as adjusted by R505 and R507. In addition, logger and modulation tones are added to the telemetry signal by IC504. The resultant tone is placed on the phone line and is fed to either the internal subcarrier generator board or to the rear-panel TELEMETRY OUT BNC connector.

10. Control FSK Demodulator (Schematic 91B6750)

The control FSK demodulator is similar to the telemetry FSK demodulator discussed earlier. IC206 is tuned to 2400 Hz by R235. When the input at Pin 4 is 2500 Hz, the output at Pin 8 is +5 V. When the input is 2300 Hz, the output is low.

11. Telemetry Phase-Shift Modulator (Schematic 91B6754)

For subaudible applications, the telemetry phase-shift modulator is used instead of the telemetry FSK modulator. Telemetry data at 37.5 baud is modulated by a 37.5 Hz clock by latch IC501 and EXCLUSIVE-OR gate IC502. When the data does not change, the signal at IC501 Pin 5 is stationary and the signal at TP501 is a 37.5 Hz square wave. When the data constantly changes at an 18.75 Hz rate, the signal at TP501 is an 18.75 Hz square wave. Normally, the data is not a constant square wave or level, but rather is a changing pattern depending upon the telemetry reading, status bits, etc. The signal at TP501 will be a waveform which varies between 18.75 Hz and 37.5 Hz. A data-bit change causes the signal to reverse its phase, resulting in the lower-frequency waveform.

The 50 Hz low-pass filter removes sidebands above subaudible frequencies. The signal is then amplified before being fed to the TELEMETRY OUT BNC connector.

D. Selector Unit

1. Channel Decoder/Drivers (Schematic 91C6737)

Channel-number information from the Remote Terminal is fed to decoder/drivers IC2, IC3, IC4 and IC5. SELØ1-SELØ4 are applied to all four decoders. SELØ8-SEL32 are each applied to one decoder and are used as enable lines. Only one of the enable signals is low at a given time. Channels 1-7 are enabled when SELØ8 is low. Channels 8-15 are enabled when SEL16 is low. Similarly, channels 16-23 are enabled when SEL24 goes low, and channels 24-30 are enabled when SEL32 goes low.

Assume channel 19 is selected. SEL24 will be low. SELØ1-SELØ4 will be Ø11. IC4 decodes this information and pulls the open-collector driver at Pin 4 to ground. A relay connected to this pin will thus be energized.

For a 1-10 Selector Unit, relays K1-K10 are wired to IC2 and IC3; for an 11-20 unit, the relays are wired to IC3 and IC4; for a 21-30 unit, the relays are wired to IC4 and IC5. Thus, each Selector Unit is identical except for the wiring of the relays. This enables each Selector Unit to be daisy-chained to the others as each unit shares the "data bus."

2. Metering

Analog (metering) signals A+ and A- are connected to all ten relays K1-K10. The analog sample for the selected channel is placed on the A+ and A- bus. The analog voltage is floating with respect to chassis ground.

3. Control

IC1 contains the Raise and Lower relay drivers. The Raise control bus is connected via the back contacts of Lower relay K12 to the channel relays. A Raise command closes the Raise relay which closes the Raise contacts on the selected channel. The Lower bus works in the same manner. F1 and F2 fuse the busses to protect the relays.

E. Subcarrier Generator (Schematic 91C6755)

The block diagram of the subcarrier generator is shown in Figure 16. This module is used when a signal, either control or telemetry, is to be conveyed from one site to another in piggyback fashion on a radio link.

The modulation, either control signals in the 2300 Hz to 2500 Hz region or telemetry signals in the subaudible or 1300 Hz to 1500 Hz region, is applied via a deviation adjustment to the modulated oscillator. This is a free-running multivibrator with temperature compensation and voltage regulation. The typical amount of frequency deviation is about 5% to 6% of the subcarrier frequency. The output of the modulated oscillator is applied to a buffer amplifier. The output of the buffer is applied to a low-pass filter for removal of unwanted harmonics of the subcarrier. The filter output is amplified and applied to the output level control. The output of the module may be applied to an STL for conveying control signals to the transmitter site in wireless control applications, or it may be applied to an FM or TV exciter for wireless return of telemetry to the studio in wireless telemetry applications.

The three controls on this module allow adjustment of the modulation (deviation) of the modulated oscillator itself, adjustment of the oscillator's center frequency, and adjustment of the subcarrier output level.

F. Subcarrier Demodulator (Schematic 91C6749)

The block diagram of the subcarrier demodulator is shown in Figure 17. This module is used to extract and demodulate a subcarrier which is carrying either control or telemetry information.

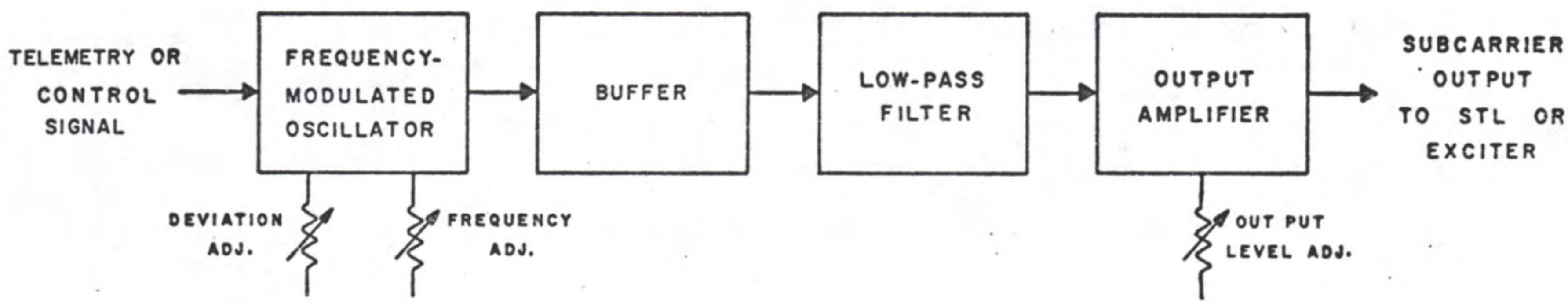


FIG.16 - SUBCARRIER GENERATOR

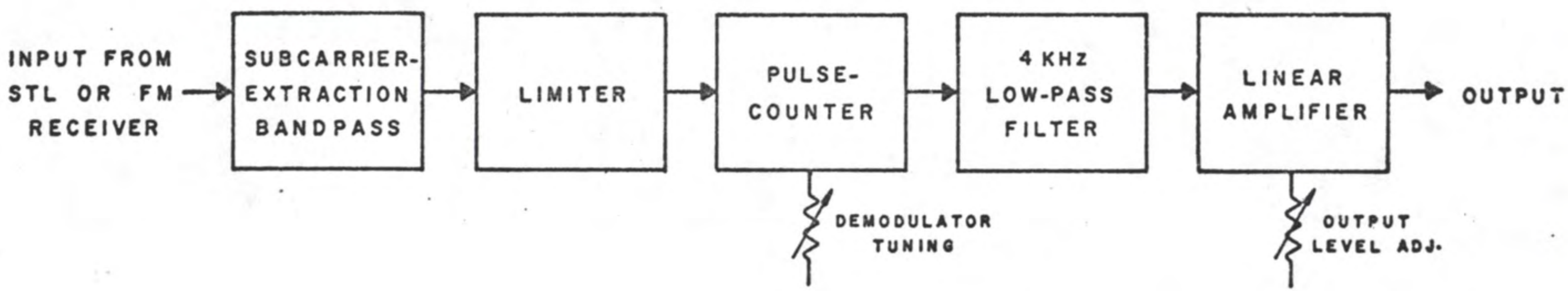


FIG. 17 - SUBCARRIER DEMODULATOR

The input to this module is derived from either the multiplex output of an STL or the composite output of an FM monitor or receiver. The subcarrier signal and its important sidebands are passed by the input bandpass filter, while program material and other unwanted components are rejected. The output of the bandpass filter is applied to a limiter where amplitude variations are removed and the subcarrier signal is turned into a square wave. This signal is then applied to a pulse-counting demodulator circuit. The output of the demodulator is applied to a 4000 Hz low-pass filter where the subcarrier and possible high-frequency beat notes are rejected. Telemetry signals and control signals are passed by this filter. The output of the filter is built up in amplitude by the output amplifier. The adjustments on this module are for demodulator tuning and output level adjustment. The subcarrier bandpass filter is also tuneable.

VII. ADJUSTMENTS

All modem frequency adjustments have been preset at the factory. The modems should only be aligned if a frequency-sensitive component has been changed or if data transmission problems occur after it has been determined that the transmission links between studio and transmitter are of good quality. Do not attempt adjustment unless an oscilloscope and frequency counter are available.

STUDIO A. Control FSK Modulator (Schematic 91B6761)

1. Short the junction of R503 and R504 to ground. Connect the frequency counter to TP501 (orange). Adjust R507 until the counter reads 2500 Hz.

2. Remove the short from R503 and R504. Remove Q501 from its socket. Adjust R505 until the counter reads 2300 Hz.

3. Repeat Steps 1 and 2 until no further improvement is obtained. Then replace Q501 in its socket.

4. With the telephone line connected, measure the phone line terminals with an AC voltmeter. Adjust R516 for a 0 dBm

(2.19 V peak-to-peak) reading on the voltmeter.

5. Observe TP503 (green) with an oscilloscope. Adjust R520 for a reading of 1.5 V peak-to-peak.

STUDIO

B. Telemetry FSK Demodulator (Schematic 91B6758)

1. Observe TP201 (orange) with an oscilloscope. Remove the telephone line from the Control Terminal. Note the signal amplitude at TP201. Then short the phone line terminals together. Again observe the signal amplitude at TP201. Now adjust R201 until the signal amplitude at TP201 with the phone terminals open is the same amplitude as with the terminals shorted. This amplitude should be about 3 V peak-to-peak. Then reconnect the telephone line.

2. Short TP204 (blue) to ground. Observe TP206 (brown) with a frequency counter. Adjust R240 until the counter reads 1400 Hz. Then remove the short at TP204.

XMTR

C. Telemetry FSK Modulator (Schematic 91C6748)

1. Short the junction of R502 and R503 to ground. Connect the frequency counter to TP501 (orange). Adjust R507 until the counter reads 1500 Hz.

2. Remove the short from R502 and R503. Remove Q501 from its socket. Adjust R505 until the counter reads 1300 Hz.

3. Repeat Steps 1 and 2 until no further improvement is obtained. Then replace Q501 in its socket.

4. With the telephone line connected, measure the phone line terminals with an AC voltmeter. Adjust R518 for a 0 dBm (2.19 V peak-to-peak) reading on the voltmeter.

5. Observe TP506 (brown) with an oscilloscope. Adjust R527 for a reading of 1.5 V peak-to-peak.

XmTR,

D. Control FSK Demodulator (Schematic 91C6748)

1. Observe TP201 (orange) with an oscilloscope. Remove the telephone line from the Remote Terminal. Note the signal amplitude at TP201. Then short the phone line terminals together. Again, observe the signal amplitude at TP201. Now adjust R201 until the signal amplitude at TP201 with the phone terminals open is the same amplitude as with the terminals shorted. This amplitude should be about 3 V peak-to-peak. Then reconnect the telephone line.

2. Short TP204 (blue) to ground. Observe TP206 (brown) with a frequency counter. Adjust R235 until the counter reads 2400 Hz. Then remove the short at TP204.

E. Telemetry Phase-Shift Demodulator (Schematic 91B6759)

Adjust R320 for a 20 V peak-to-peak signal at TP302 (yellow).

F. Subcarrier Generator (Schematic 91C6755)

1. Frequency adjust (R604): This control adjusts the center frequency of the subcarrier generator. Observe the yellow test point with a counter or oscilloscope, and adjust the frequency control for the correct frequency. It may be advisable if a counter is used, and will be necessary if an oscilloscope is used, to first remove any modulation on the subcarrier prior to setting the frequency. This can be accomplished by turning down the modulation using the deviation control.

2. Deviation adjust (R601): This control is set by using an SCA modulation monitor, an oscilloscope, or by observing the subcarrier demodulator. Adjust the deviation control for a subcarrier deviation of about 5% of its center frequency.

If the subcarrier demodulator is used to measure the subcarrier deviation, refer to the section on that module for instructions.

3. Output level adjust (R631): This control is set for about 20% injection of subcarrier into an aural STL, or 1.5 V peak-to-peak at the output of the subcarrier generator. If the subcarrier generator is used to modulate an FM exciter, then this control is adjusted for 9% modulation of the FM carrier. Notice that the word "deviation" as used in this section means modulation of the subcarrier by the control or telemetry signal, and the word "injection" means modulation of the main carrier by the subcarrier.

G. Subcarrier Demodulator (Schematic 91C6749)

1. With 1.5 V peak-to-peak of subcarrier applied to the subcarrier demodulator, adjust the four inductors (LA, LB, LC, LD) for maximum subcarrier amplitude coincident with minimum ripple or modulation as observed with an oscilloscope connected to the orange test point. This filter realignment should not be necessary unless a component has been replaced.

2. Demodulator tuning (R118): This control is used to set the operating point of the pulse-counting discriminator. Connect an ordinary voltmeter to the green test point, and adjust the demodulator tuning control for a reading of 4 VDC. This reading should be within the range of 3 V to 5 VDC. Be sure the subcarrier is on frequency and of the correct amplitude before this adjustment is made.

3. Output level adjust (R126): This control is used to set the output level from the subcarrier demodulator. This control is set for 1.5 V peak-to-peak output from the demodulator as observed at the blue test point. Should a particular unit yield higher than this figure, the demodulator tuning control may be adjusted counterclockwise for a vernier adjustment. The subcarrier is being deviated correctly for control purposes (studio-to-transmitter link) when 0.2 V rms is measured at the yellow test point of the

subcarrier demodulator when the demodulator tuning control is set for 4 VDC at that test point.

VIII. TROUBLESHOOTING

Digital techniques are used almost exclusively in the DRS-1A. Before attempting to troubleshoot the DRS-1A, be sure to read the circuit description section to become familiar with digital logic circuitry and its implementation in this system. Refer to the description, schematics, and timing diagrams while working on the units.

> NOTE: ASIDE FROM THE AC LINE POWER ON THE PRIMARY SIDE OF T1 AND REGULATOR SQ2.12.30, NO DANGEROUS VOLTAGES ARE INHERENT TO THE DRS-1A ITSELF. HOWEVER, DANGEROUS VOLTAGES MAY BE PRESENT WHEN IT IS CONNECTED TO A LIVE TRANSMITTER. REMOVE ANY SUCH VOLTAGES BEFORE TROUBLESHOOTING THE DRS-1A.

The following hints may prove quite helpful while troubleshooting:

1. If possible, remove sources of RF when the circuitry is exposed. RF tends to make operation unpredictable.

2. Determine which features are functional and which are not. Know what is wrong, then attempt to repair it systematically.

3. If nothing seems to work, first check the power supplies and fuses. If normal, check the crystal-oscillator and clock-divider outputs.

4. Check for serial data coming from Pin 25 of IC1A on the wire-wrap boards. Also check for serial data arriving at Pin 20 and positive-going pulses at Pin 19.

5. Observe the other points on the wire-wrap boards where pulses should occur. Refer to the schematics and circuit descriptions for the locations of such pulses.

6. If a pulse seems to be missing or does not have a correct TTL amplitude, suspect gates and IC's connected to the pulse as well as the IC that generates it. A bad input to a 7404, for example, can load down a clock signal line.

7. If an IC is suspect, check for proper power (+5 VDC, ground, -12 VDC) on the appropriate pins. Refer to drawings 21B2477, 21B2469, and 21B2470 for the location of the power pins and IC's.

8. When installing or removing an IC, be sure power is OFF.

9. Remove IC's very carefully. A long slender screwdriver blade is recommended to assist in prying an IC from its socket. Remove headers in the same manner. Be especially careful when removing a 40-pin IC.

10. When installing an IC, note how Pin 1 is positioned in relation to the socket. Referring to Figure 18, this pin is usually identified by an indentation on the IC or by a dot or other mark. Pin 1 is usually marked on a socket by a small diagonal cut and/or a notch. Never force an IC into its socket. If difficulty is

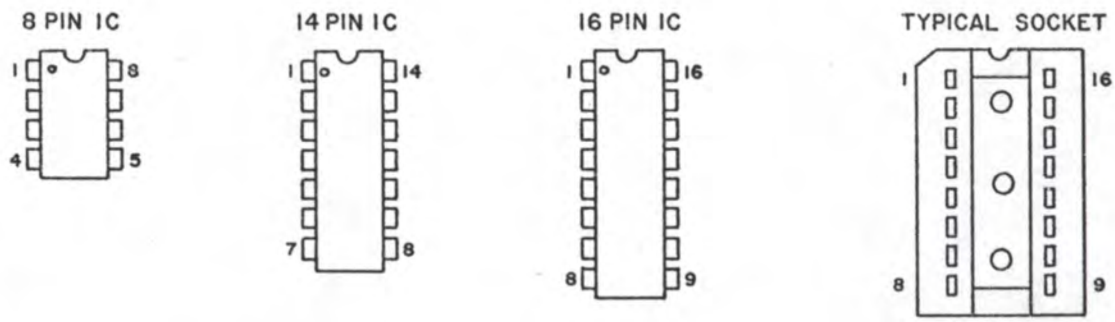


FIGURE 18

encountered, straighten and align all pins. Then place them in the socket and gently push the IC in place. Again, be especially careful when installing a 40-pin IC. Visually inspect for bent pins after insertion of any IC or header into its socket.

10. Check modem test points for proper signal levels and shapes. Verify correct DC voltage levels.

11. Verify that the telephone line is of good quality. Check the phone line fuses.

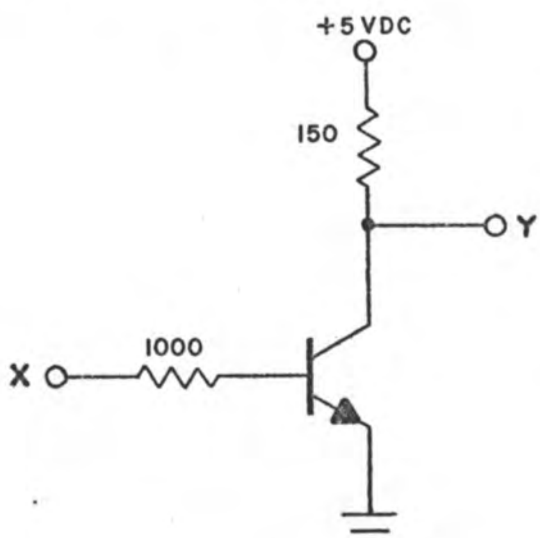
APPENDIX A

DIGITAL LOGIC FUNDAMENTALS

For those unfamiliar with digital circuitry, this section will provide a short introduction to digital logic and its application in the DRS-1A. Digital techniques may seem strange and difficult to master to those previously unexposed to the world of "zeros" and "ones." However, the nature of the digital world lends itself to rapid understanding after a few basic concepts have been understood.

In the analog world, circuits deal mostly with voltages and currents in signal processing applications. These voltages and currents may assume an infinite number of values. In the digital world, however, we usually speak of only two signal levels, "zero" and "one." A zero is also called a "low", and a one is also called a "high." In 5-volt TTL (transistor-transistor-logic) digital circuits, of which the DRS-1A is mostly comprised, a high is represented by a voltage between 2.5 VDC and 5.0 VDC. A low is represented by a voltage between 0.0 VDC and 0.4 VDC. Note, however, that we are not concerned here with exact voltage levels, but rather with the ones and zeros they represent.

How are the logic states zero and one implemented? Figure 19 below shows a highly simplified logic element called an inverter.



TRUTH TABLE

X (INPUT)	Y (OUTPUT)
0 (LOW)	1 (HIGH)
1 (HIGH)	0 (LOW)

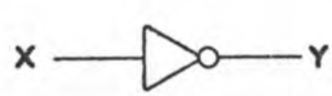
SYMBOL 

FIGURE 19

Note that the transistor is operated in either its cutoff region (off) or its saturated region (on). It acts like a simple switch depending upon the state of the input X. When X is high, the output Y is pulled low because the transistor is saturated. When X is low, Y is high because the transistor is cut off. In digital logic, such transistors are never operated in the linear or amplifying mode. Y is either low or high with no in-between states. The "truth table" shows the logical behavior of the inverter. Note the symbol for an inverter.

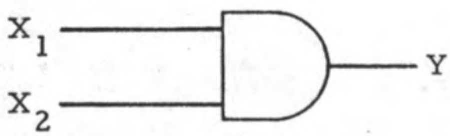
The IC's used in the DRS-1A can be considered as "black boxes" with one or more inputs and one or more outputs. Do not be concerned with how an IC works internally. The only matter of importance is how the input(s) affect the output(s). We have already seen how an inverter behaves. An IC called a 7404 is nothing more than six separate inverters. With six inputs and six outputs plus 5 VDC and ground connections, the 7404 hex inverter can physically be packaged in a 14-pin DIP (dual inline package) IC. The majority of logic IC's is contained in 14-pin and 16-pin packages.

The terms "gate," "latch," "flip-flop," "counter," and others describe the general classes of logic functions currently available as standard IC's. The DRS-1A consists of a carefully planned logic structure built from these basic logic building blocks. The "glue" that holds these blocks together is the clock and timing logic which makes the DRS-1A function in an orderly and precise manner. The clue to understanding the DRS-1A is to first learn what each IC does and then to understand how the elements tie together in terms of time.

This manual does not attempt to explain how all IC's used in the DRS-1A function. Many data books are available which describe currently available logic IC's. An excellent one is entitled The TTL Data Book by Texas Instruments. This is the prime reference book used by the designers of the DRS-1A.

The following examples of logic elements used in the DRS-1A illustrate typical logic functions:

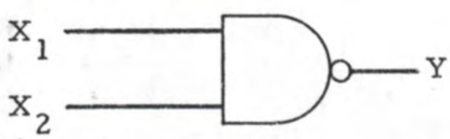
1. "AND" gate



$\frac{1}{4}$ 7408

INPUTS X_1	INPUTS X_2	OUTPUT Y
0	0	0
0	1	0
1	0	0
1	1	1

2. "NAND" gate

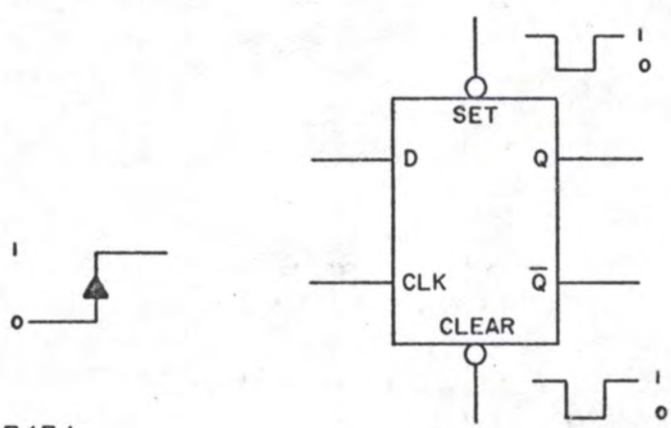


$\frac{1}{4}$ 7400

INPUTS X_1	INPUTS X_2	OUTPUT Y
0	0	1
0	1	1
1	0	1
1	1	0

Note that the NAND gate output is opposite from the AND gate. The circle on the NAND symbol indicates inversion. (The term "NAND" comes from "Not AND").

3. Latches



$\frac{1}{2}$ 7474

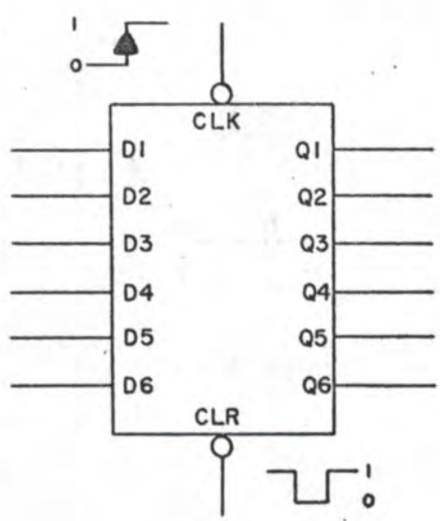
The "latch" or "flip-flop" is an elementary memory or storage unit. One "bit" of information can be stored in a latch. A bit refers to the smallest unit of binary or logic information. The 7474 type latch is known as "D" or data flip-flop.

It has four inputs (D, CLK, SET, and CLEAR) and two outputs (Q and $\overline{Q}$). A bar over a symbol refers to an inverted logic level. When output Q is a zero, output $\overline{Q}$ is a one. The logic level at input D is stored in the latch and presented at the outputs on the rising edge of the CLK or clock input. At any other time the input D may change states without affecting the outputs. Thus, the latch output Q remembers what the input D was when the CLK input last went from zero to one.

Two inputs are provided which override the CLK input. When SET is low, the output Q is forced or set to 1 ($\overline{Q}$ goes to 0). When CLEAR is low, Q is cleared to 0 ($\overline{Q}$ goes to 1).

Note that the 7474 differs from a gate like the AND or NAND gate. A gate has no memory. The output always reflects the current state of the inputs. The output of a 7474, however, depends upon <u>when</u> the D input occurred with respect to the CLK input.

The 74174 hex D latch combines six D-type latches in a 16-pin IC as shown below. It is similar in function to the 7474. However, the $\overline{Q}$ outputs are not available on the 74174. Also, all six of the CLK inputs are tied together to a common CLK line. The SET

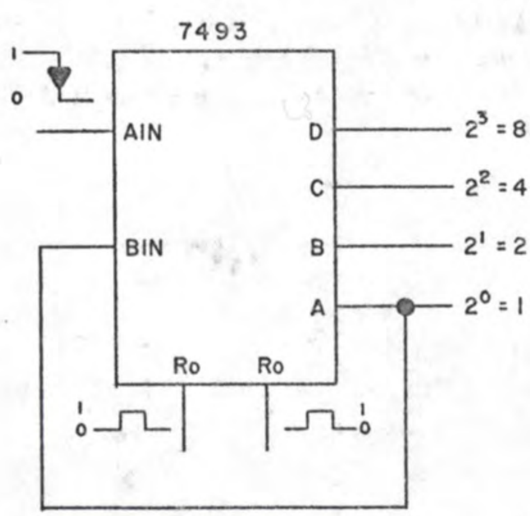


line is not available in the 74174. Like the 7474, the outputs Q1 through Q6 remember what the inputs D1 through D6 were at the last positive (zero to one) transition of the CLK input. Thus, the 74174 can be used as a six-bit memory in the DRS-1A.

4. Counters

One digital logic signal can assume either of two states, zero or one. A one-bit latch such as a 7474 can be made to alternate from one state to the next each time the clock input goes through one cycle. This forms a one-bit counter. By adding more flip-flops, more bits are added and the maximum count is increased.

The 7493 shown below is a four-bit counter. Output A changes state each time the clock at AIN falls from one to zero. Output B changes state every second time the clock falls. Output C changes every fourth time, and output D every eighth time. All four outputs return to the same state after 16 clock cycles. Thus the 7493 is known as a divide-by-16 binary counter.



OUTPUT STATES				DECIMAL EQUIVALENT
D	C	B	A	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13
1	1	1	0	14
1	1	1	1	15

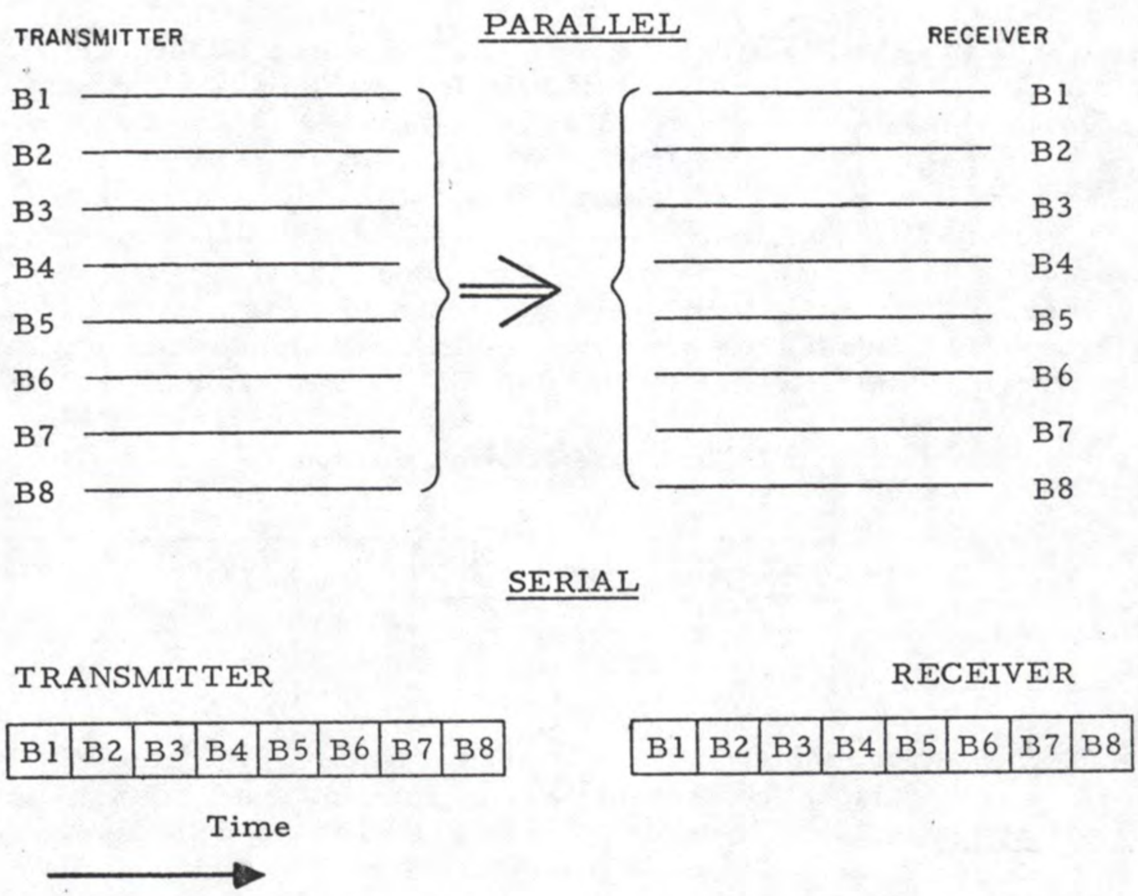
There are 16 unique output states for a four-bit counter as shown above. Each state represents a binary number. Each binary digit has a "weight" depending upon its position in the number. The least significant bit has a weight of $2^0=1$. Each bit has a weight two times greater than the bit to its right. For example, the 6-bit number 101101 is equal to $1x2^5 + 0x2^4 + 1x2^3 + 1x2^2 + 0x2^1 + 1x2^0 = 32 + 0 + 8 + 4 + 0 + 1 = 45$.

An analog-to-digital converter (A-D), such as that used in the DRS-1A, uses counters to count the number of clock pulses enabled by the level of the DC input voltage. Assuming a perfect analog section, the A-D reading becomes more accurate when the number of counter bits is increased. The DRS-1A converter uses 14 bits to "describe" analog voltages between -2 VDC and +2 VDC for an accuracy of 0.1% of full scale.

5. Parallel and Serial Data Representations

Logic information in the DRS-1A is transmitted from the Remote Terminal to the Control Terminal over only one data link. However, the A-D converter presents information 14 bits at a time in "parallel". The logic in the Remote Terminal thus formats parallel data into "serial" data for transmission to the Control Terminal. If this were not done, 14 telephone lines would be required!

The figure below illustrates the difference between the parallel and serial representation of eight data bits.



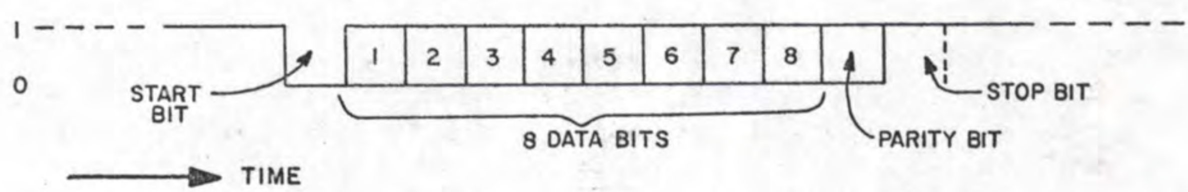
Note that all eight bits are available at any given time when in parallel. There is no delay when transmitting parallel bits. However, eight data lines are required. In contrast, only one bit is available at a time when in serial. It takes a finite time to transmit the bits. But the advantage is that only one data line is required. Thus, serial transmission is used in the DRS-1A at 300 baud. The term "baud" refers to bits per second. Three hundred data bits are sent per second over the high-speed DRS-1A data link.

6. Universal Asynchronous Receiver/Transmitter

The TR1602 40-pin IC used in the DRS-1A should be no cause for alarm if parallel and serial data representations are understood. It is basically a parallel-to-serial transmitter and a serial-to-parallel receiver that do all the work. How it works inside is irrelevant. All that matters is that it is fed parallel data and that it generates the same parallel data at the other end of the data link.

There is a total of 32 bits of parallel information to send from the Remote Terminal to the Control Terminal. The TR1602 can only transmit 8 bits at a time, however. Multiplexer IC's are used to select a group of 8 bits which are then presented to the TR1602 TR1 through TR8 inputs. A strobe pulse is then applied to Pin 23 to start the parallel-to-serial conversion and transmission.

The serial output at Pin 25 has the following format:



Note that the output is high between transmissions. The first bit is always low and is called the start bit. This bit synchronizes the receiver portion of the TR1602 at the other end of the data link to the transmitted signal. The next 8 bits are the 8 data bits which were presented in parallel to the transmitter portion of the TR1602. An even parity bit follows next. This bit is forced to a value automatically such that the number of ones in the transmission is an even number. For example, if the eight data bits are 10110110, the parity bit would be a 1 to make the total number of ones equal to six (an even number). Finally, a high stop bit occurs to signal the end of the transmission.

The receiver portion of the TR1602 automatically synchronizes to the incoming serial data stream at Pin 20. It presents the eight data bits in parallel at outputs RR1 through RR8. In addition, two error outputs are used in the DRS-1A. PE at Pin 13 goes high if a parity error occurs. The receiver checks to see that the total number of received ones is an even number. If not, PE will go high, indicating a transmission error. Similarly, FE at Pin 14 will go high if a framing error occurs. This happens if an invalid stop bit is detected (if the stop bit is low instead of high). The outputs PE and FE are used in the DRS-1A to prevent erroneous telemetry readings and control commands in instances when the data link between studio and transmitter is garbled.

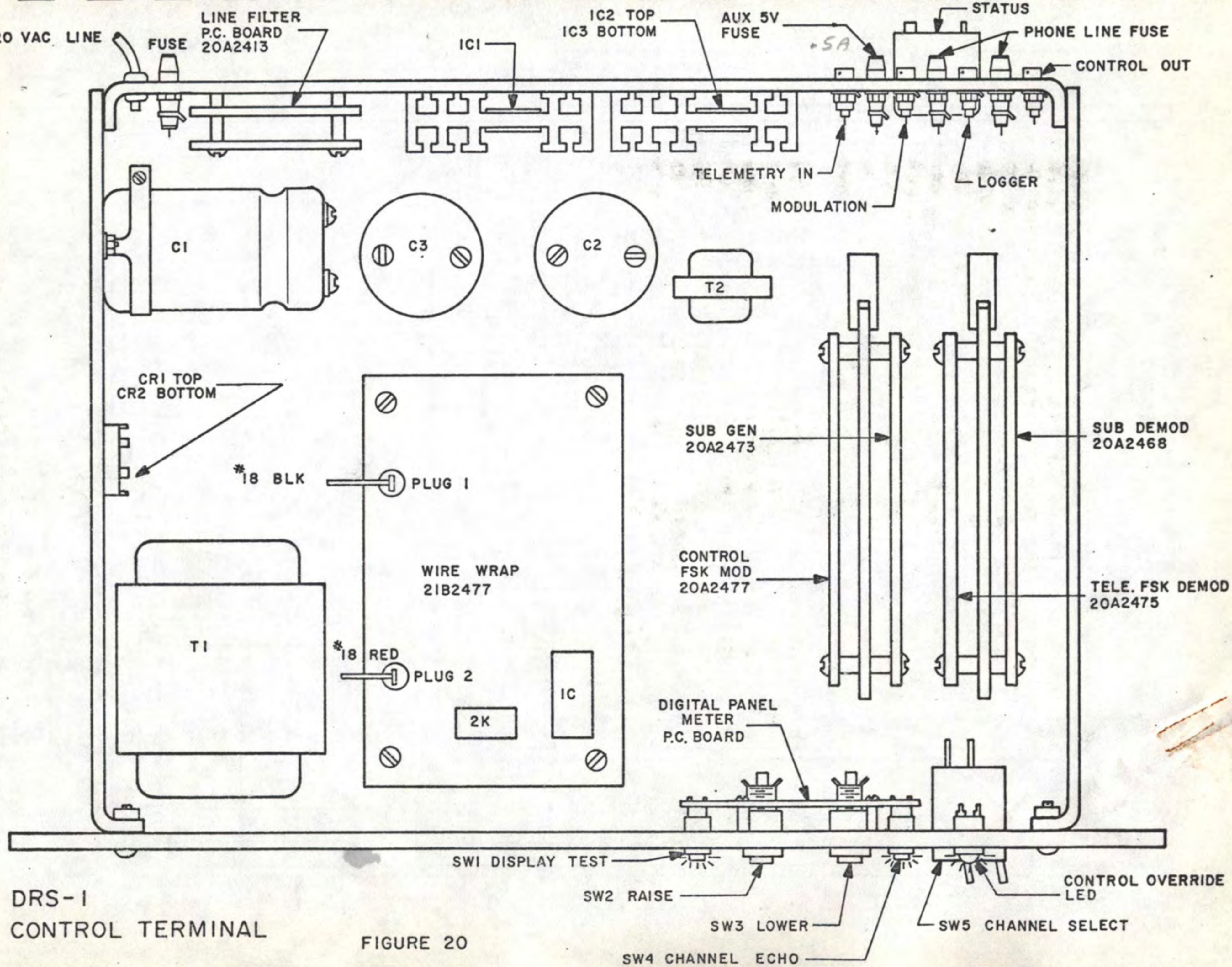
Output DR at Pin 19 goes high when a new transmission has arrived. Thus, the TR1602 is quite simple to apply. Give it eight bits of data, and strobe Pin 23 at one end of the data link. At the other end just wait for Pin 19 to go high, and then latch the eight received bits. Suddenly the awesome 40-pin IC becomes quite a powerful tool for getting data from one place to the other!

7. Timing and Clock Logic

Timing is critical to any digital system. Without it, logical data would flow through the system randomly causing unknown results. In the case of the DRS-1A, status/alarm information might appear as a garbled telemetry reading on the Control Terminal if no timing circuitry were included to coordinate the flow of data.

The term "clock" refers to any periodic logic signal, such as a square wave or pulse train, which is used to synchronize the operation of a digital logic system. The DRS-1A clocks are all precisely crystal-controlled and generated by a master oscillator at both studio and transmitter. The master clock is divided down by two 4020 IC's into several frequencies which are used to clock latches and counters, to strobe the TR1602 transmitter at Pin 23, and to set the serial baud rate of the TR1602. Everything happens according to a fixed schedule or "timing diagram." (Refer to the Circuit Description section for a more detailed analysis of the DRS-1A timing.) Thus, data from the A-D converter and the Status Panel-Remote Terminal is routed according to a fixed schedule to the TR1602 for transmission to the Control Terminal. Similarly, command information is routed to the Remote Terminal. The logic of the DRS-1A is thus divided into two main elements; the logic that moves data, and the timing logic that controls the movement.

In summary, remember that all logic signals are either zero or one. All IC's have very specialized functions and are easy to apply once the input-output truth table or description is understood. Treat them as black boxes. The DRS-1A logic is mostly concerned only with data flow from one point to the next with timing logic to control the movement. Armed with this knowledge, now read the Circuit Description, Section VI of this manual, and become familiar with the actual DRS-1A circuitry.



DRS-1
CONTROL TERMINAL

FIGURE 20

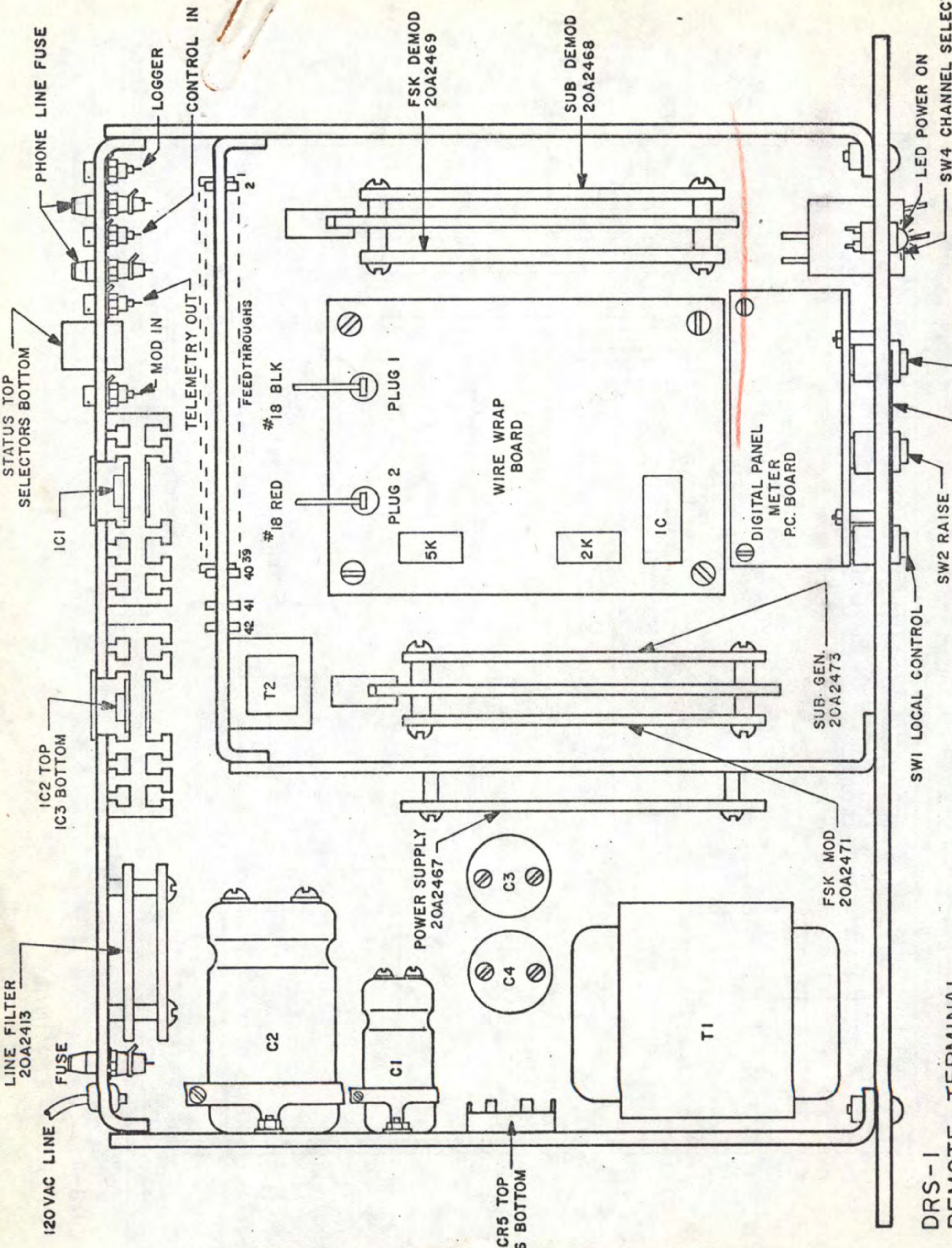
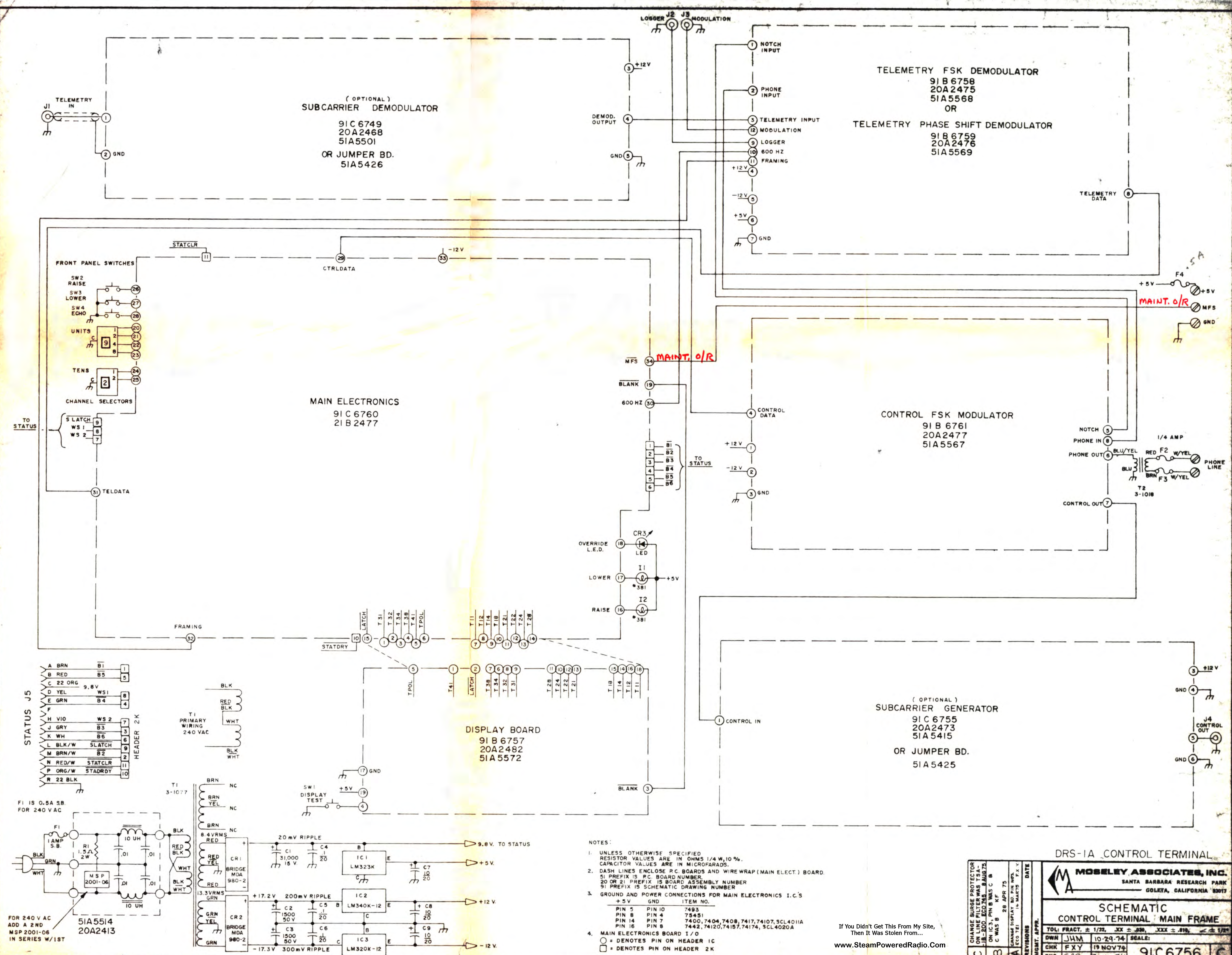


FIGURE 21

DRS-1
REMOTE TERMINAL



NOTES:

1. UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES ARE IN OHMS 1/4 W, 10 %.
   CAPACITOR VALUES ARE IN MICROFARADS.
2. DASH LINES ENCLOSE P.C. BOARDS AND WIRE WRAP (MAIN ELECT.) BOARD.
   51 PREFIX IS P.C. BOARD NUMBER.
   20 OR 21 PREFIX IS BOARD ASSEMBLY NUMBER
   91 PREFIX IS SCHEMATIC DRAWING NUMBER
3. GROUND AND POWER CONNECTIONS FOR MAIN ELECTRONICS I.C.'S

+5V	GND	ITEM NO.
PIN 5	PIN 10	7493
PIN 8	PIN 4	75451
PIN 14	PIN 7	7400, 7404, 7408, 7417, 74107, SCL4011A
PIN 16	PIN 8	7442, 74120, 74157, 74174, SCL4020A

4. MAIN ELECTRONICS BOARD I/O
   ○ = DENOTES PIN ON HEADER 1C
   □ = DENOTES PIN ON HEADER 2K

DRS-1A CONTROL TERMINAL

REVISIONS		DATE
C	CHANGE SURGE PROTECTOR ON LINE FILTER WAS TSA-1B-200 ECO 745	8 AUG 75
B	ON IC3, PIN B WAS C & C WAS B KF	28 APR 75
A	CHANGE DISPLAY BD. PIN NO'S. ECO 721	14 MAR 75 F.X.Y.

MGMT. APPR.

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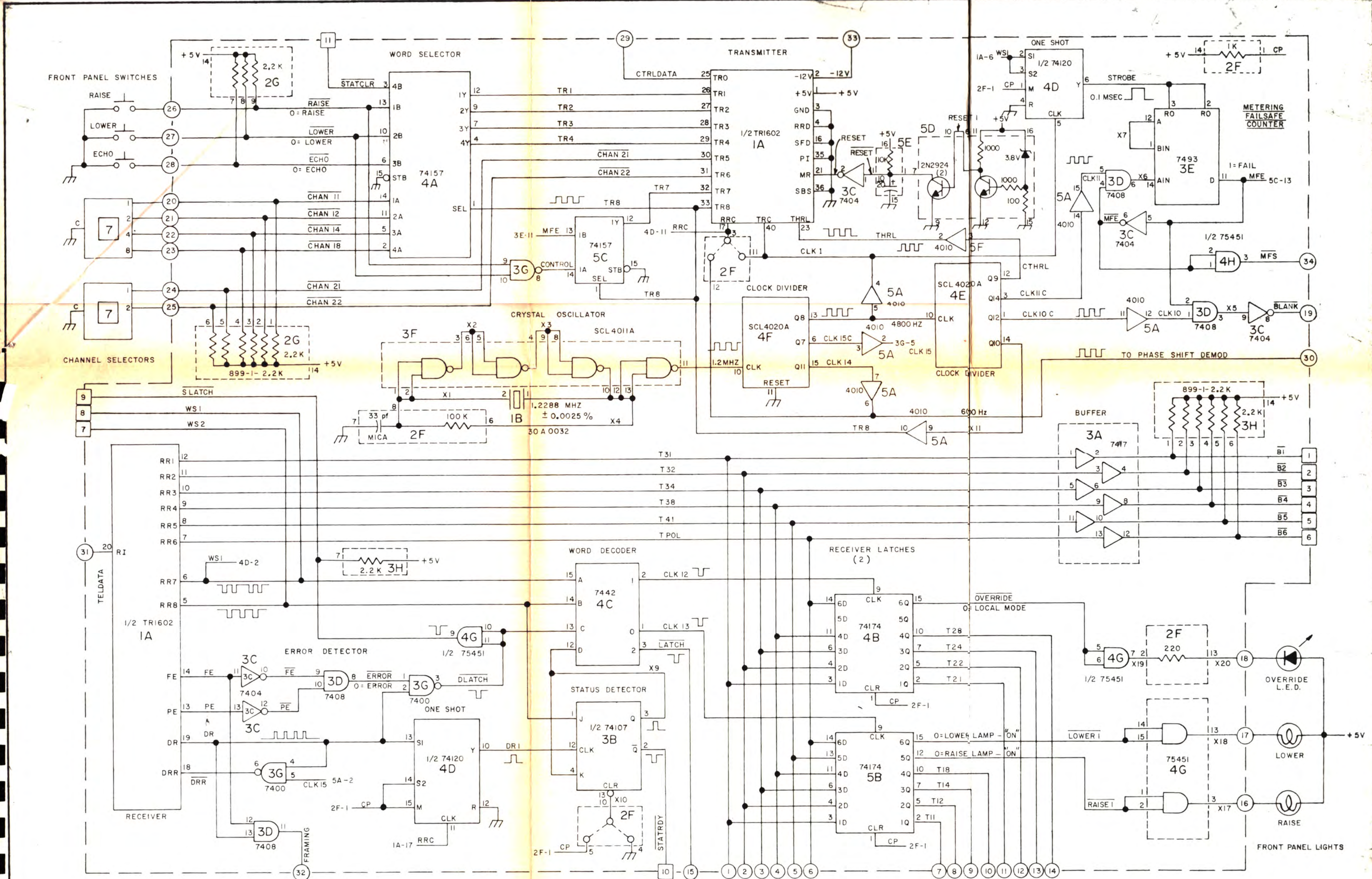
GOLETA, CALIFORNIA 93017

SCHEMATIC
CONTROL TERMINAL MAIN FRAME

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	JHM	10-29-74	SCALE:
CHK	FXY	19 NOV 74	91C6756 C
ENG	SRB	20 NOV 74	

7/73 DIETERICH-POST CLEARPRINT 1020-6



POWER CONNECTIONS

+5 V	GND	ITEM
PIN 5	PIN 10	7493
PIN 8	PIN 4	75451
PIN 14	PIN 7	7400, 7404, 7408, 7417, 74107, SCL4011A
PIN 16	PIN 8	7442, 74120, 74157, 74174, SCL4020A
PIN 1,16	PIN 8	4010

NOTES:

1. UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/4 W, 10%. CAPACITOR VALUES ARE IN MICROFARADS.
2. ▢ DENOTES STATUS I/O (2K)
3. ◯ DENOTES MISC. I/O (IC)
4. ASSOCIATED DRAWINGS, WIRE WRAP PANEL 5B2203 COMPONENT LAYOUT AND POWER DISTRIBUTION 21B2477

REV	REVISIONS	DATE
D	ADDED 5F PER E.C.O. 769 11-11-75 G.W.	
C	ADD 3E & 5D PER ECO 727 17 APR 75 KF	
B	REVISED PER ECO 712 JHW 2-13-75	
A	REVISED - ADDED IC 5A 21/NOV/74 KF ECO694	

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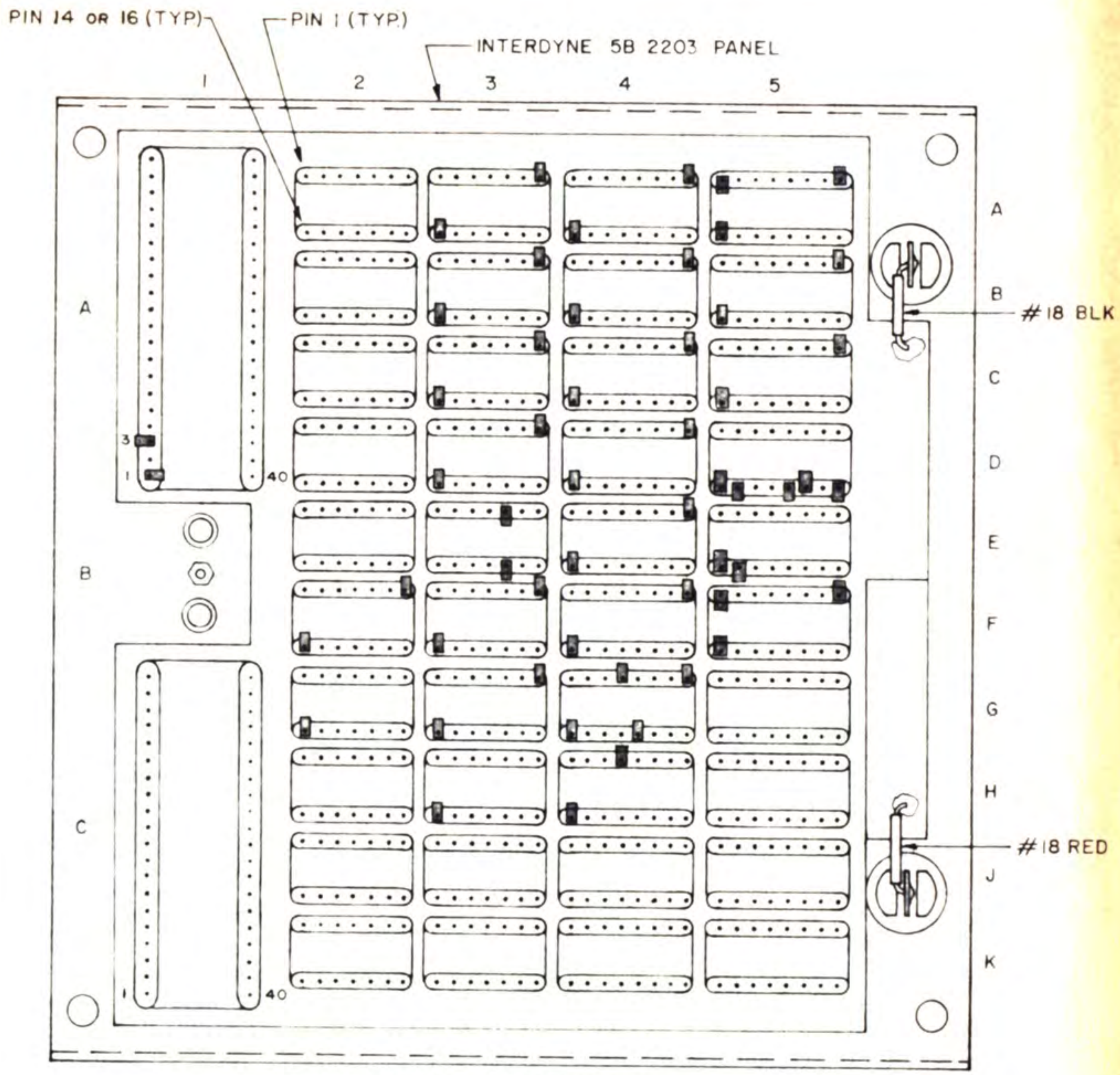
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93017

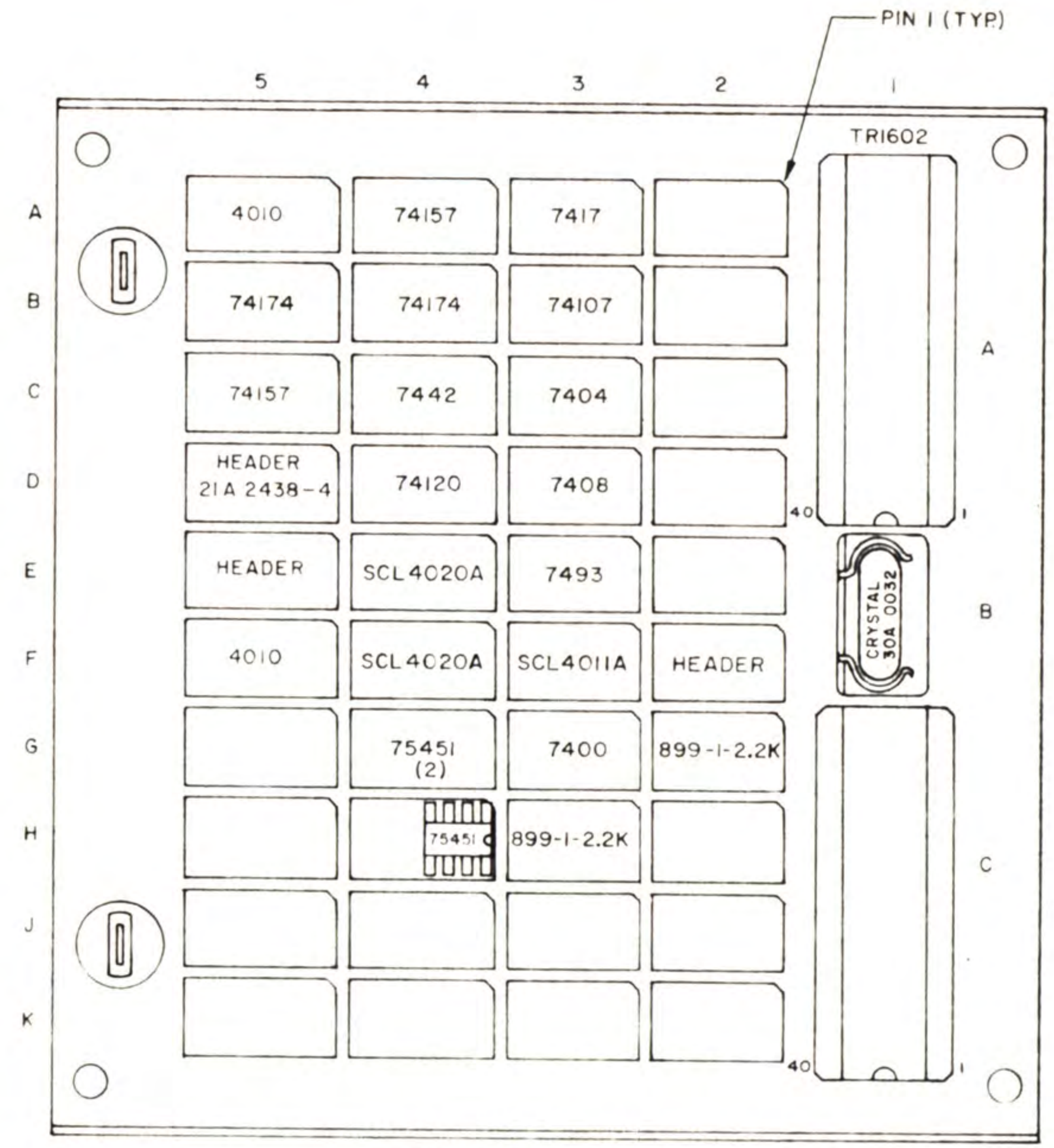
SCHEMATIC
MAIN ELECTRONICS DRS-1 CONTROL TERM.

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	JHW	10-7-74	SCALE:
CHK	FXY	21OCT74	
ENG	SRB	24OCT74	91C6760 D



POWER DISTRIBUTION

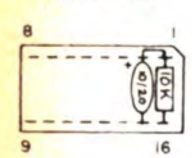


COMPONENT LAYOUT

NOTES

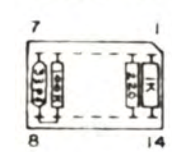
1. UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES ARE IN OHMS, 1/4W, 10%
   CAPACITOR VALUES ARE IN MICROFARADS.
2. INSTALL SOLDER TABS TO POWER AND GROUND PLANES WHERE INDICATED.
3. 14 PIN HEADER IS CAMBION # 702-3725-01-03-00
   16 " " " " # 702-3728-01-03-00
4. JUMPER WIRE IS # 26, SLEEVE AS REQUIRED.
5. SCHEMATIC 91C 6760

HEADER 5E



SOLDER PIN 1 & 2

HEADER 2F



SOLDER PIN 8 & 9

HEADER JUMPER OPTIONS

1) AUDIBLE – JUMPER PINS 3 & 11
2) SUBAUDIBLE – JUMPER PINS 3 & 12
3) 4 WORDS (WITH STATUS) – JUMPER PINS 5 & 10
4) 3 WORDS (NO STATUS) – JUMPER PINS 4 & 10

REVISIONS		DATE
E	ADDED 5F PER E.C.O. 769 11-11-75 GV	
D	ADD HEADERS 5E & 5D KF ECO 727 16APR 75	
C	REVISED: ADDED IC 5C 13 FEB 75 JHM ECO 712	
B	REVISED – ADDED IC 5A 21 NOV 74 KF ECO 694	
A	ATTACHED PIN 8 & 9 (2F) KF 5/NOV/74	

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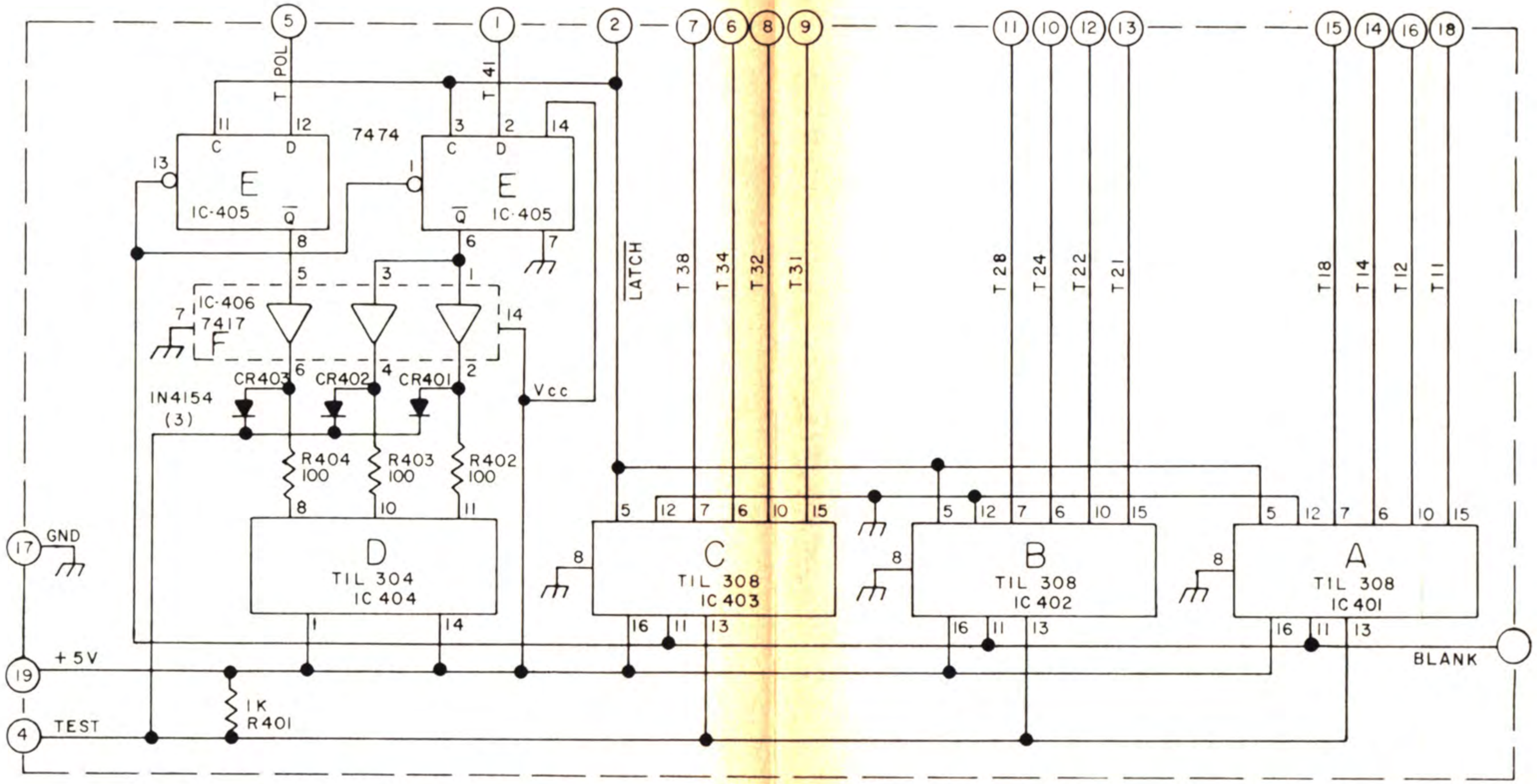
COMP LAYOUT & PWR DIST.
DRS-1 C.T. MAIN ELECTRONICS

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	REB	26JULY74	SCALE: FULL
CHK	FXY	28 A	
ENG			21B 2477 E

5/71 DIETERICH-POST CLEARPRINT 1020 8



NOTES:

1. UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS 1/4 W, 10 %. CAPACITOR VALUES ARE IN MICROFARADS.
2. P.C. BOARD 51A5572
3. COMPONENT LAYOUT 20 A 2482

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REVISIONS	DATE
A REVISE PIN NOS FOR 2 SIDED P.C. BD. ECO 721 14MAR75 F X Y	

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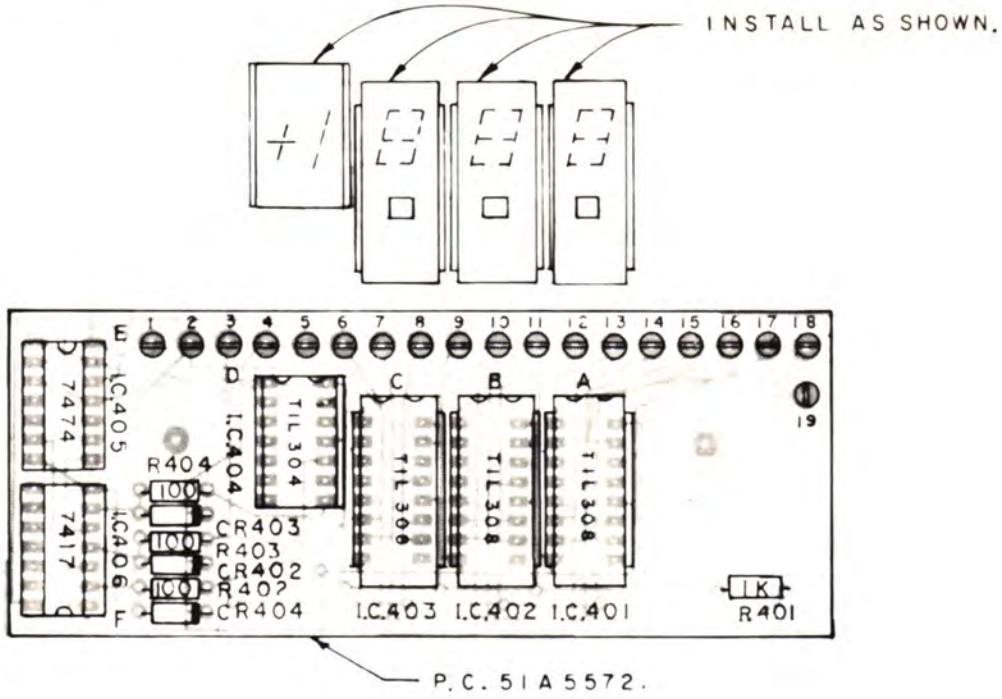
GOLETA, CALIFORNIA 93017

SCHEMATIC
DISPLAY BOARD DRS-1 C.T.

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	JHM	10-21-74	SCALE:
CHK	F X Y	4 NOV 74	91 B 6757 A
ENG	SFB	11-4-74	

MGMT. APPR.



NOTES

1. UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES ARE IN OHMS, 1/4W, 10 %
   CAPACITOR VALUES ARE IN MICROFARADS.
2. P.C. BOARD 51A5572
3. SCHEMATIC 91B6757.
4. —[▭]— DENOTES DIODE (IN4154)

REV	DESCRIPTION	DATE
B	REDESIGN. BOARD REV A. 20 JAN 75 L.I.	
A	ADDED READOUT VIEW. 15 JAN 75 L.I.	
REVISIONS		DATE
MGMT. APPR.		

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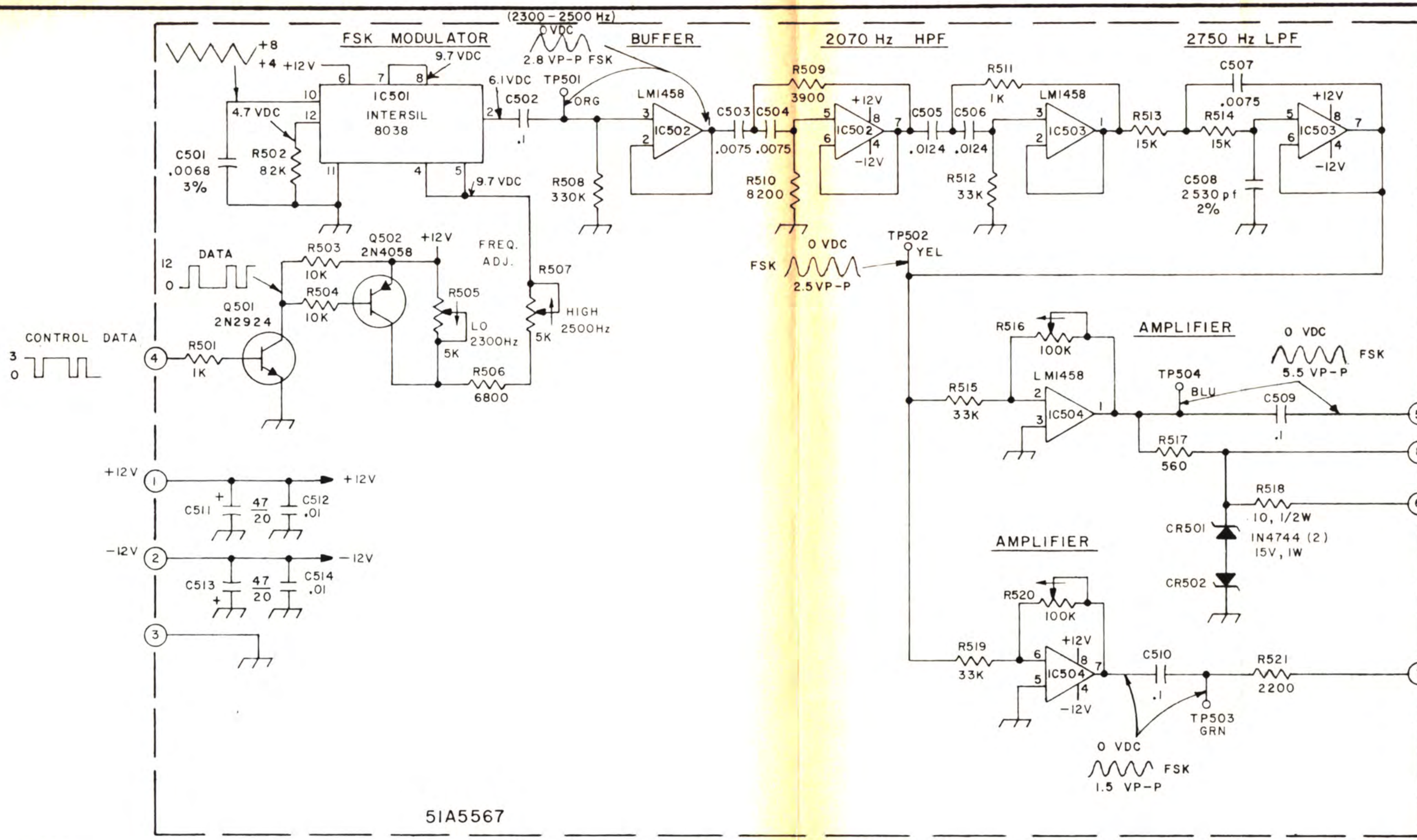
GOLETA, CALIFORNIA 93017

COMPONENT LAYOUT
DRS-I C.T. DISPLAY BOARD.

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°			
DWN	L.I.	29 AUG 74	SCALE: FULL
CHK	FXY	16 SEP 74	20A2482 B
ENG	SRB	9 OCT 74	



NOTES

1. UNLESS OTHERWISE NOTED ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 10% AND CAPACITOR VALUES ARE IN MICROFARADS
2. P.C. BOARD 51A5567
3. COMPONENT LAYOUT 20A 2477

DRS-1 (C.T.)

A	CHGD R506, R507, R516 E R520 C.W. ARROW REVERSED 11-12-75 GM

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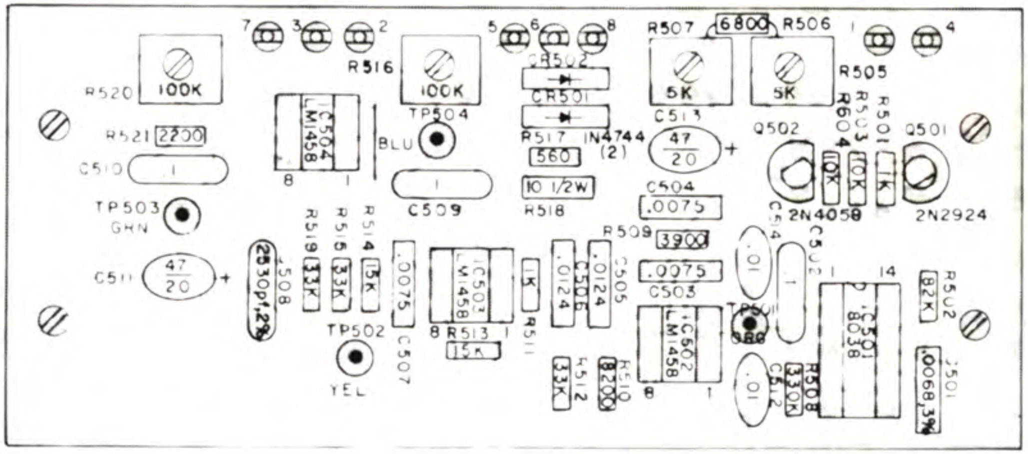
SCHEMATIC
CONTROL FSK MODULATOR

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	FET	JUL 74	SCALE:
CHK	FXY	26AUG74	
ENG	SRB	27AUG74	91B 6761 A



NOTES

1. UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 10% AND CAPACITOR VALUES ARE IN MICROFARADS
2. P C BOARD 51A 5567
3. SCHEMATIC 9 B6761

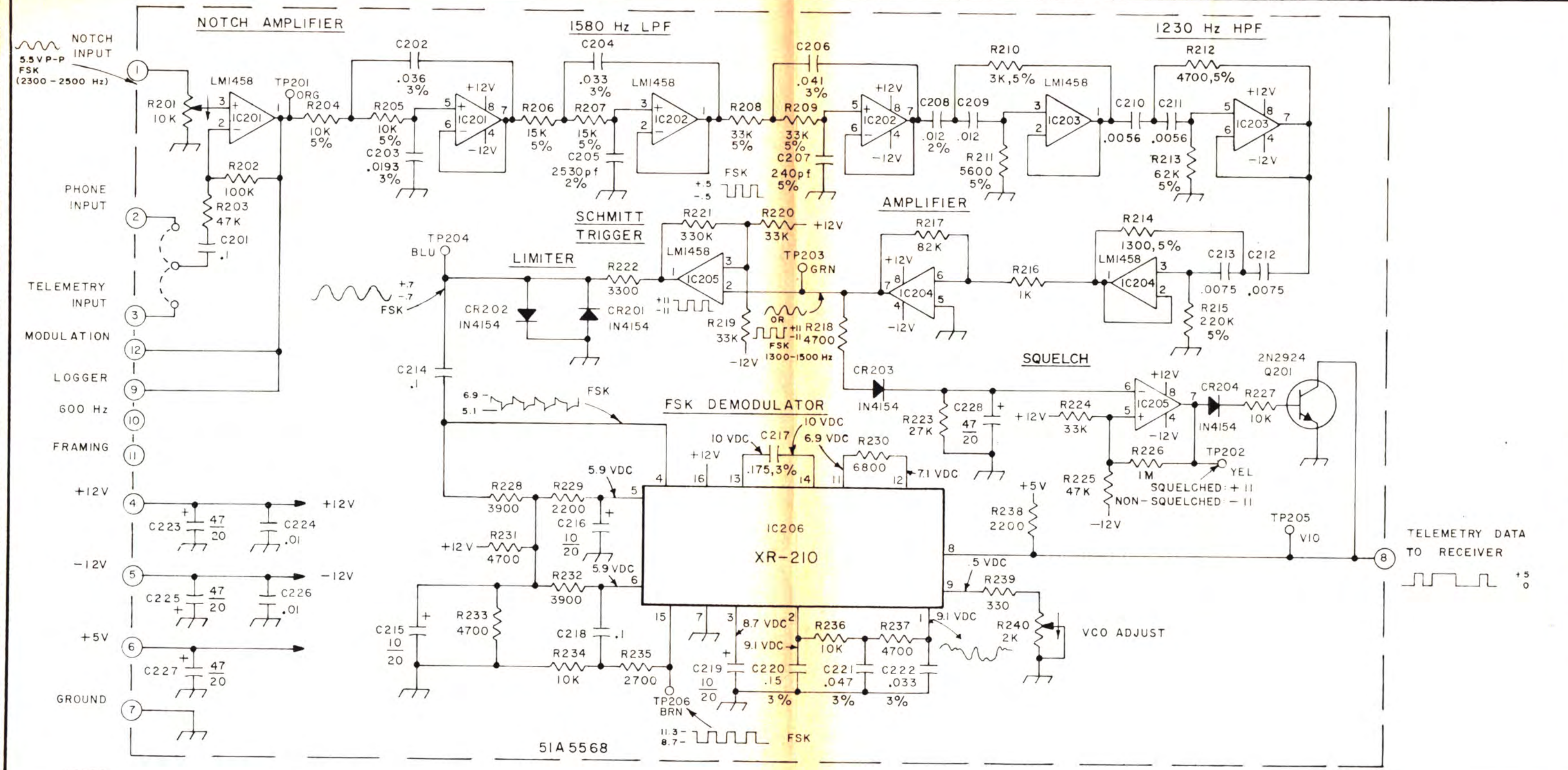
DRS-1 (C.T.)

REVISIONS	DATE
A — CHG POTS TO ADJUSTOR SCREWS ARE UP & BEND R506 TO ACCOMODATE POTS	11-11-75
MGMT. APPR.	

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

COMPONENT LAYOUT
CONTROL FSK MODULATOR

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°			
DWN	FET	JUL 1974	SCALE: FULL
CHK		26 AUG 74	20A2477
ENG	SRB	27 AUG 74	A



NOTES

1. UNLESS OTHERWISE NOTED ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 10% AND CAPACITOR VALUES ARE IN MICROFARADS.
2. P.C. BOARD 51A 5568
3. COMPONENT LAYOUT 20A 2475.

DRS-1 (C.T.)

REVISIONS	
C	CHGD R201 & R240 CW ARROW REVERSED 11-12-75 GM
B	C226 WAS .47 MF R230 WAS 5600 ECO 719 6MAR75 FXY
A	VALUE CHANGES MADE 21 OCT 74 KF ECO 686

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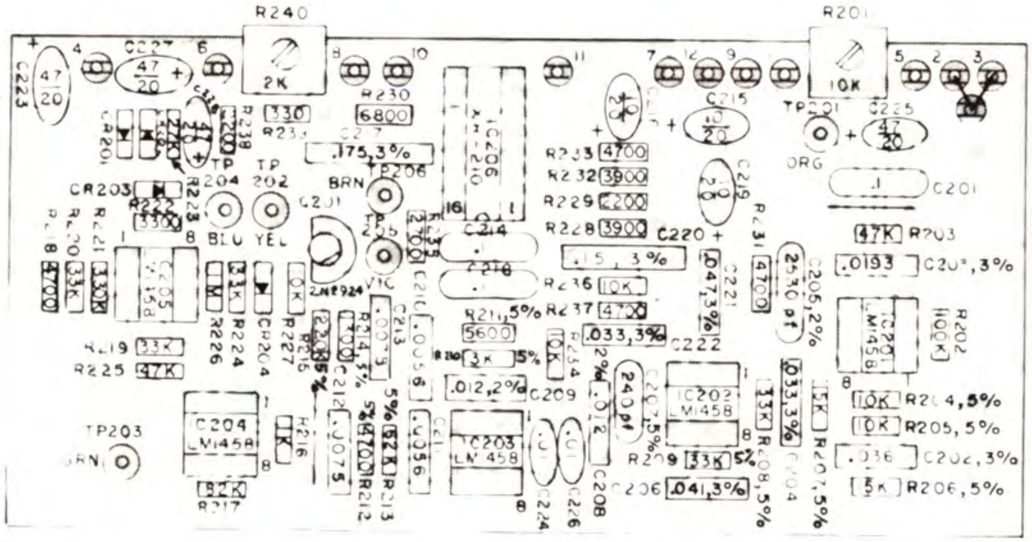
SCHEMATIC
TELEMETRY FSK DEMODULATOR

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	FET	JUL 74	SCALE:
CHK	FXY	23 AUG 74	91B 6758 C
ENG			



NOTES

1. UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUE ARE IN OHMS, 1/4W, 10% AND CAPACITOR VALUES ARE IN MICROFARADS DIODES ARE IN4154
2. P.C. BOARD 51A5568
3. SCHEMATIC 91B6758

DRS-1 (C.T)

REVISIONS	DATE
E	CHGD POTS 50 ADJUSTOR SCREWS ARE UP ...
D	CHANGED JUMPER OPTION 4SEPT75
C	R231(4700Ω) WAS LABELED R230 R230 WAS 5600Ω MAR 75
B	C220 WAS 47MF R230 WAS 5600 ECO 719 MAR 75
A	VALUE CHANGES MADE 21 OCT 74 KF ECO 680

MGMT. APPR.

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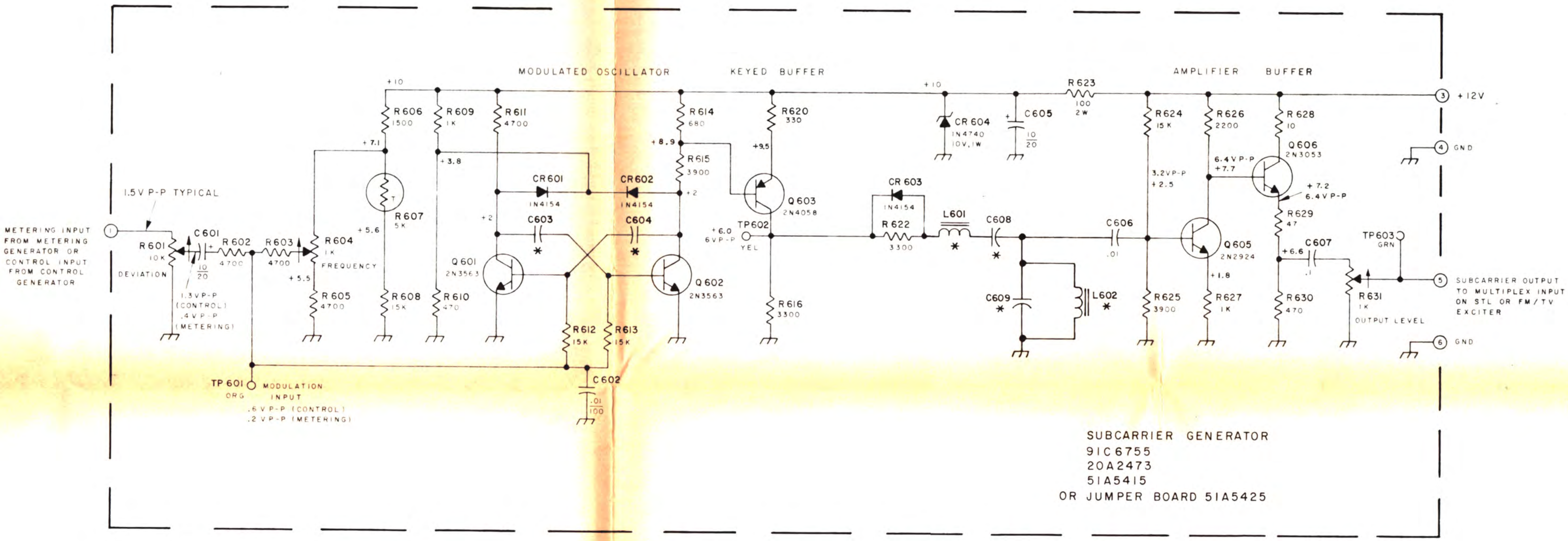
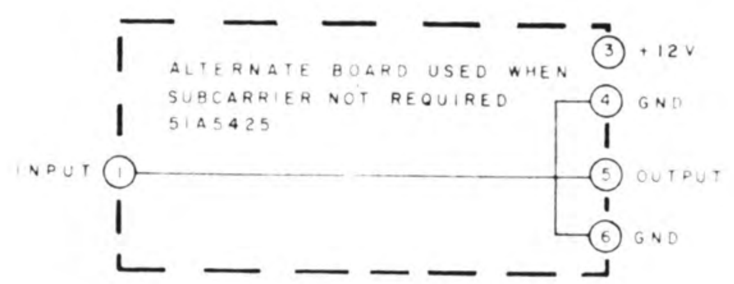
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93017

COMPONENT LAYOUT
TELEMETRY FSK DEMODULATOR

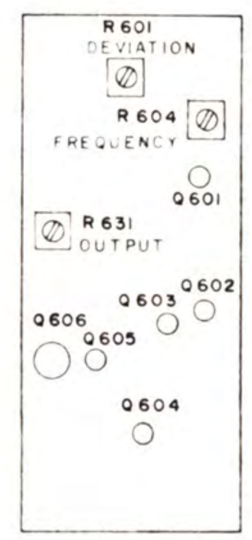
TOL: FRACT. ± 1/32, .XX ± .030, .XXX .010, ∠ ± 1/2°			
DWN	FET	JUL 974	SCALE: FULL
CHK		26 AUG 74	20A 2475 E
ENG		27 AUG 74	





* FREQUENCY DETERMINED PARTS

	C603,604	C607	C608	L601	L602
ITEM 1 (26 KHz)	1500 pf	910 pf	7500 pf	47 mH	4.7 mH
ITEM 2 (39 KHz)	1000 pf	560 pf	4700 pf	33 mH	4.7 mH
ITEM 3 (41 KHz)	1000 pf	750 pf	4700 pf	22 mH	3.3 mH
ITEM 4 (67 KHz)	560 pf	330 pf	2700 pf	22 mH	2.2 mH
ITEM 5 (95 KHz)	360 pf	330 pf	2200 pf	10 mH	1.5 mH
ITEM 6 (110 KHz)	330 pf	390 pf	1500 pf	4.7 mH	1.5 mH
ITEM 7 (135 KHz)	270 pf	300 pf	1300 pf	4.7 mH	1.0 mH
ITEM 8 (185 KHz)	220 pf	160 pf	1200 pf	4.7 mH	680 uH



P.C. BOARD TOP VIEW

NOTES

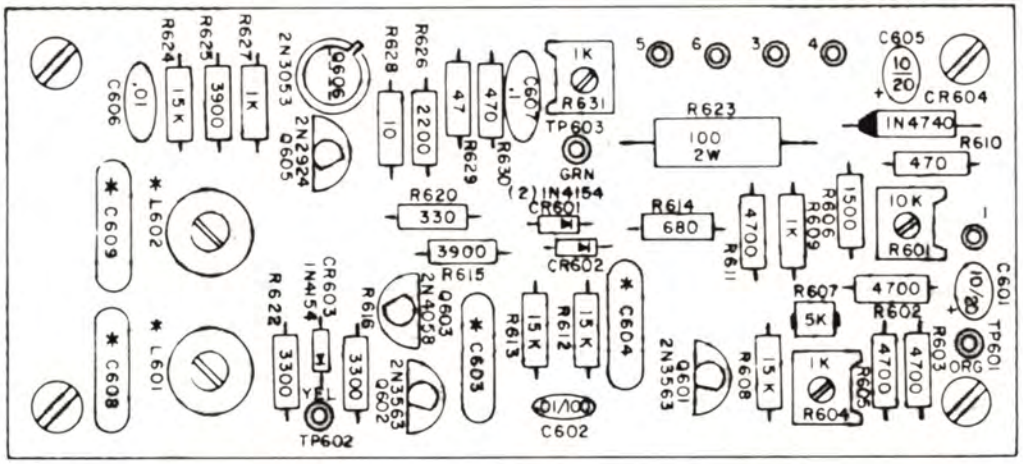
1. UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/2 W, 10%. CAPACITOR VALUES ARE IN MICROFARADS.
2. P.C. BOARD 51A5415-A
3. COMPONENT LAYOUT 20A2473.

REVISIONS		
A	CHANGE CIRCUITRY ADD CHART ECO 778	11 DEC '75

MOSELEY ASSOCIATES, INC.
SANTA BARBARA, CALIFORNIA

SCHEMATIC DRS-1
SUBCARRIER GENERATOR

TOL	FRACT ± 1/32	XX ± .030	XXX ± .010
DWN	FXY	22OCT74	SCALE:
CHK			
ENG	SRB	4Nov74	91C6755 A



	C603,04	C608	C609	L601	L602
ITEM 1 (26 KHz)	1500 pf	910 pf	7500 pf	47 mH	4.7 mH
ITEM 2 (39 KHz)	1000 pf	560 pf	4700 pf	33 mH	4.7 mH
ITEM 3 (41 KHz)	1000 pf	750 pf	4700 pf	22 mH	3.3 mH
ITEM 4 (67 KHz)	560 pf	330 pf	2700 pf	22 mH	2.2 mH
ITEM 5 (95 KHz)	360 pf	330 pf	2200 pf	10 mH	1.5 mH
ITEM 6 (110 KHz)	330 pf	390 pf	1500 pf	4.7 mH	1.5 mH
ITEM 7 (135 KHz)	270 pf	300 pf	1300 pf	4.7 mH	1.0 mH
ITEM 8 (185 KHz)	220 pf	160 pf	1200 pf	4.7 mH	680 uH

NOTES:

1. UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES ARE IN OHMS 1/2W, 10%
   CAPACITOR VALUES ARE IN MICROFARADS
2. SCHEMATIC 91 C 6755
3. P.C BOARD 51 A 5415 - A

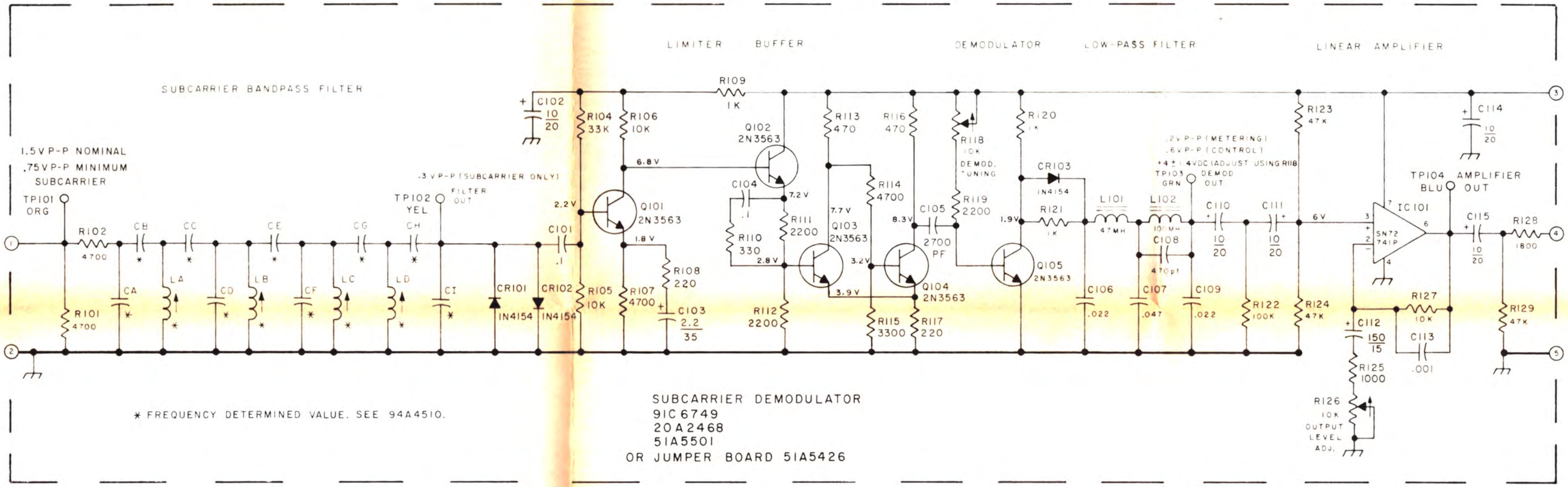
REV	REVISIONS	DATE	MGMT. APPR.
A	ARTWORK REV A ECO 778 REDRAWN 25 NOV 75 JHM		

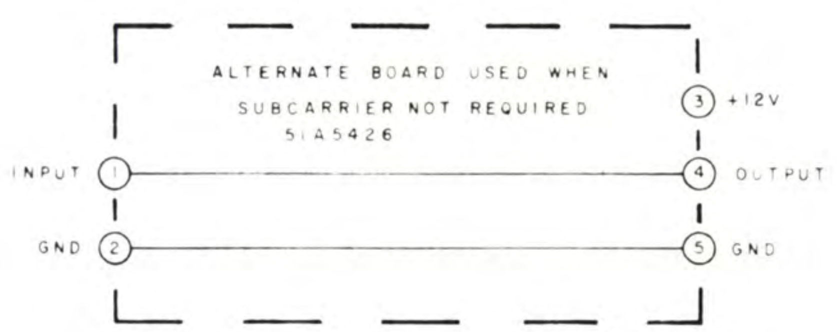
MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93017

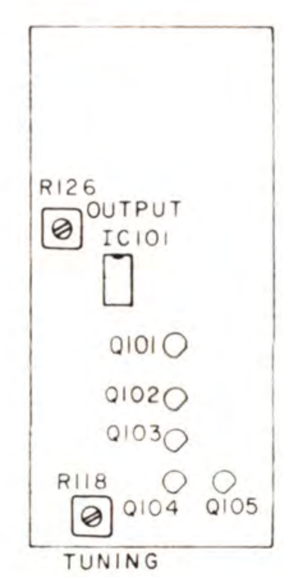
COMPONENT LAYOUT
SUBCARRIER GENERATOR DRS-1

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	JHM	25 Nov 75	SCALE:
CHK	FXY	19 DEC 75	20 A 2473 — A
ENG	JLT	22 DEC 75	







P.C. BOARD
TOP VIEW

NOTES:

1. UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES ARE IN OHMS, 1/2 W, 10%.
   CAPACITOR VALUES ARE IN MICROFARADS.
   DIODES ARE IN4154, TRANSISTORS ARE 2N3563
2. P.C. BOARD 51A5501.
3. COMPONENT LAYOUT 20A2468.
4. *. FREQUENCY DETERMINED COMPONENT
   SEE 94A4510.

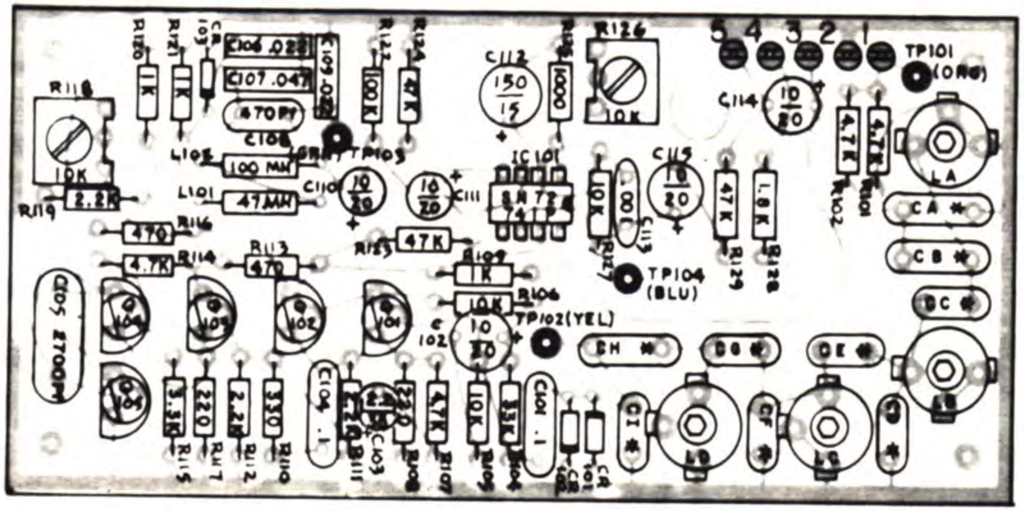
MOSELEY ASSOCIATES, INC.
SANTA BARBARA, CALIFORNIA

SCHEMATIC DRS-1
SUBCARRIER DEMODULATOR

TOL FRACT ± 1/32, .XX ± .030, .XXX ± .010

DWN	F X Y	22OCT74	SCALE:
CHK			91C6749
ENG	SRB	1NOV74	

REVISIONS
DATE



NOTES:

1 UNLESS OTHERWISE SPECIFIED

RESISTOR VALUES ARE IN OHMS, 1/2 W, 10%

CAPACITOR VALUES ARE IN MICROFARADS.
TRANSISTORS ARE 2N3563, DIODES ARE IN4154

2 P. C. BOARD 51A5501

3 SCHEMATIC 91C6749

4 * FREQUENCY DETERMINED COMPONENT
SEE 94A4510

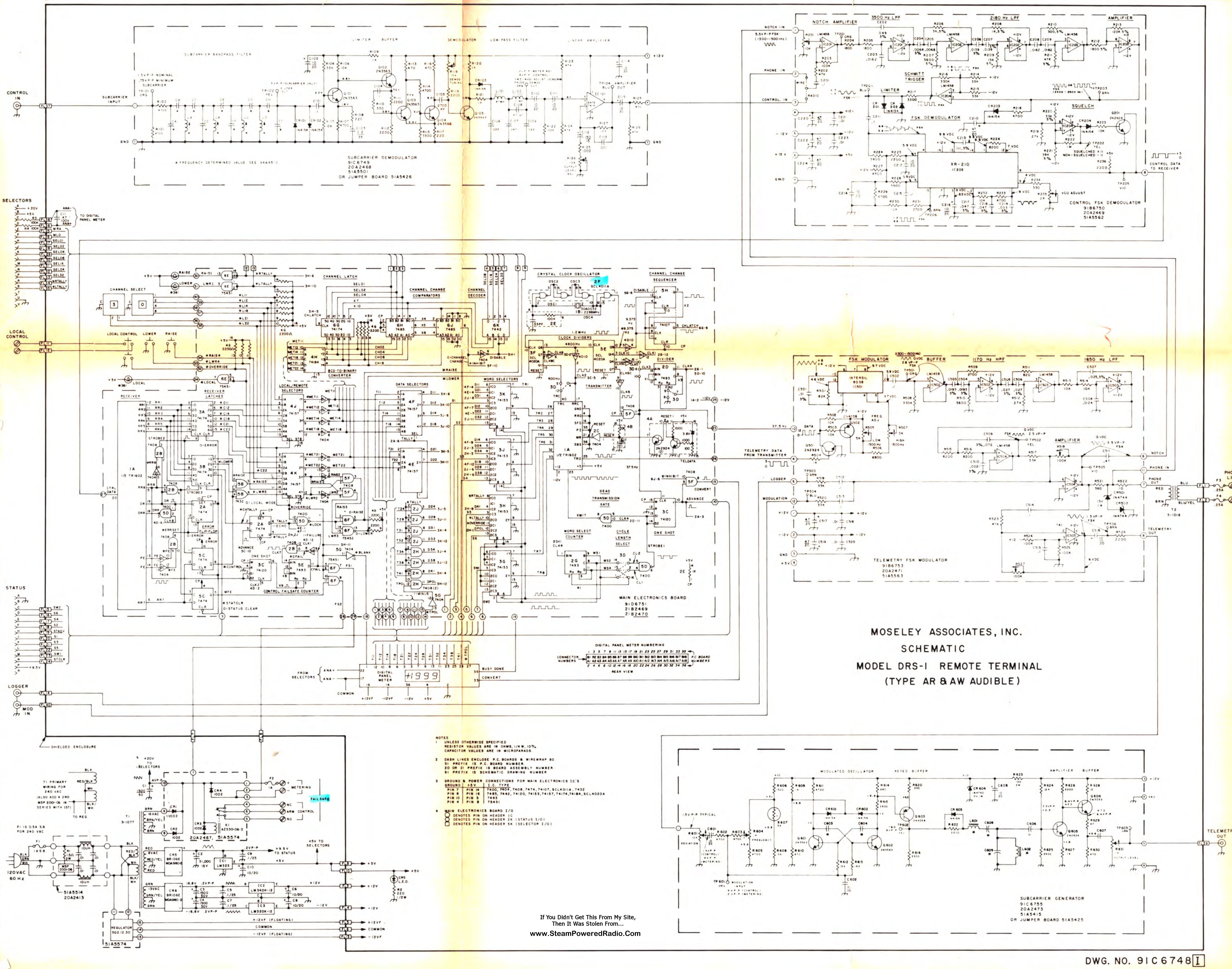
USED ON DRS-1

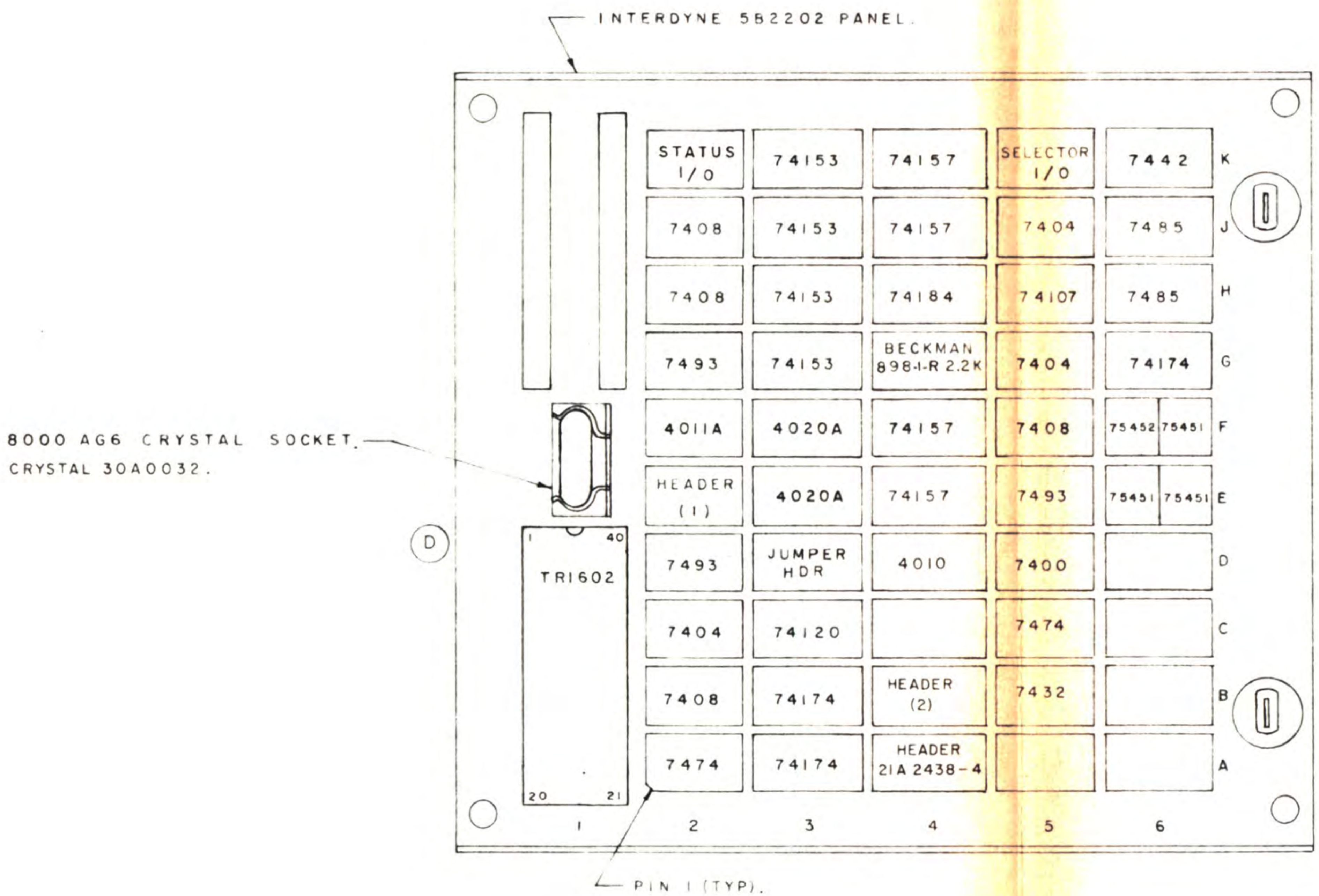
A	ADD POLARITY @ C103	JHM 18 NOV 74
REVISIONS		DATE
MGMT. APPR.		

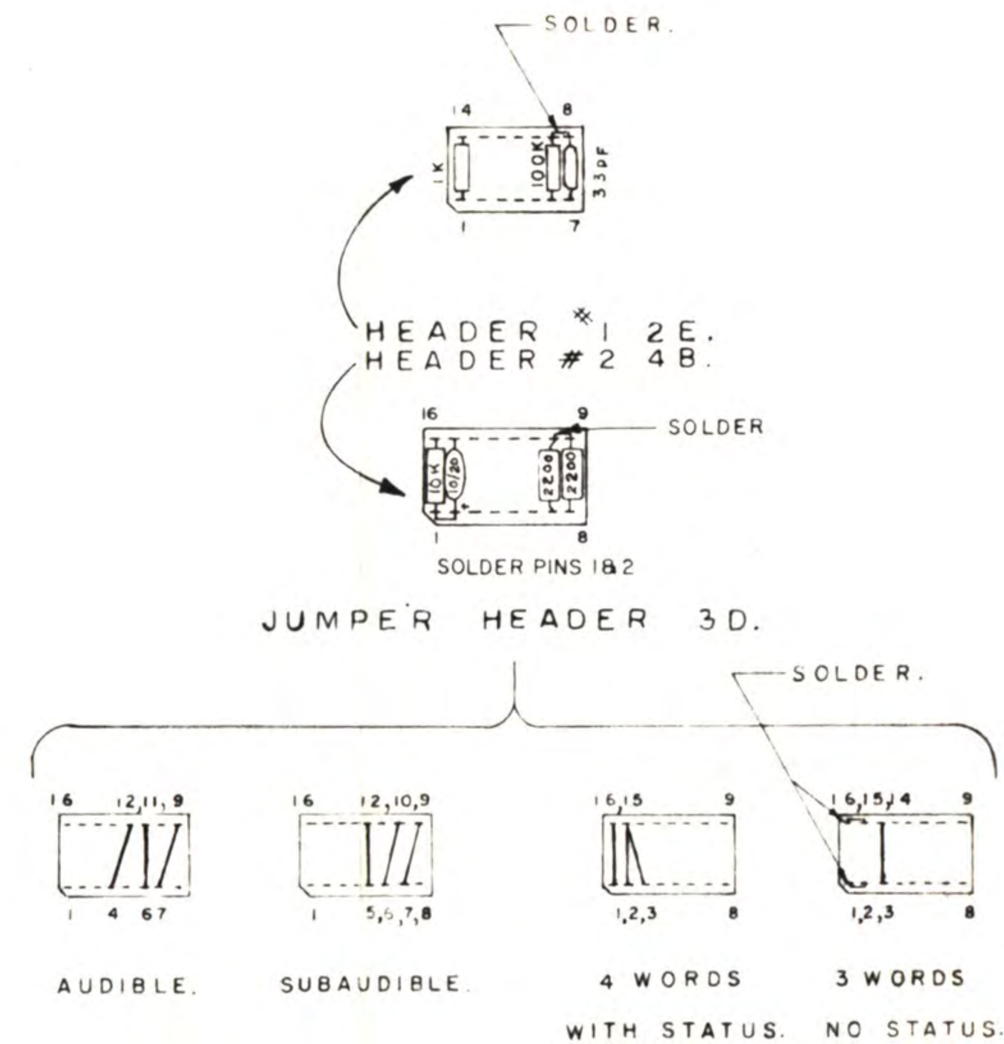
MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93017

COMPONENT LAYOUT
SUBCARRIER DEMODULATOR

TOL: FRACT. ± 1/32, .XX ± .010, .XXX ± .010, ∠ ± 1/2°			
DWN	JHM	11-1-74	SCALE: FULL
CHK	FXY	4 NOV 74	20A2468 A
ENG	SRB	4 NOV 74	


MOSELEY ASSOCIATES, INC.
SCHEMATIC
MODEL DRS-1 REMOTE TERMINAL
(TYPE AR & AW AUDIBLE)
DWG. NO. 91C6748 I
SUBCARRIER DEMODULATOR
91C6749
20A2468
51A5501
OR JUMPER BOARD 51A5426
CONTROL FSK DEMODULATOR
91B6750
20A2469
51A5562
MAIN ELECTRONICS BOARD
91D6751
21B2469
21B2470
TELEMETRY FSK MODULATOR
91B6753
20A2471
51A5563
SUBCARRIER GENERATOR
91C6755
20A2473
51A5415
OR JUMPER BOARD 51A5425
NOTES
1 UNLESS OTHERWISE SPECIFIED
RESISTOR VALUES ARE IN OHMS, 1/4 W, 10%.
CAPACITOR VALUES ARE IN MICROFARADS.
2 DASH LINES ENCLOSE P.C. BOARDS & WIREWRAP BD.
51 PREFIX IS P.C. BOARD NUMBER.
20 OR 21 PREFIX IS BOARD ASSEMBLY NUMBER.
91 PREFIX IS SCHEMATIC DRAWING NUMBER
3 GROUND & POWER CONNECTIONS FOR MAIN ELECTRONICS I.C.'S
GROUND | +5V | I.C. TYPE
PIN 7 | PIN 14 | 7400, 7404, 7408, 7474, 74107, SCL4011A, 7432
PIN 8 | PIN 16 | 7485, 7442, 74120, 74153, 74157, 74174, 74184, SCL4020A
PIN 10 | PIN 5 | 7493
PIN 4 | PIN 8 | 75451
4 MAIN ELECTRONICS BOARD I/O
DENOTES PIN ON HEADER 1C
DENOTES PIN ON HEADER 2K (STATUS I/O)
DENOTES PIN ON HEADER 5K (SELECTOR I/O)





COMPONENT SIDE.

NOTES:

1. 14 PIN HEADER IS CAMBION # 702-3725-01-03-00.
   16 PIN HEADER IS CAMBION # 702-3728-01-03-00.
2. JUMPER WIRE IS #26 GA SLEEVE AS REQUIRED.
3. UNLESS OTHERWISE SPECIFIED.
   RESISTOR VALUES ARE IN OHMS 1/4 W 10%.
   CAPACITOR VALUES ARE IN MICROFARADS.
4. SCHEMATIC 91C 6748 (AUDIBLE) 91C 6762 (SUBAUDIBLE)
   POWER DISTRIBUTION 21B2469

REVISIONS	DATE
F	ADDED 2 RESISTOR TO HEADER 4B PER ECO 806 4-5-76 GM
E	CHGD JUMPER ON HEADER 3D AUDIBLE FROM PINS 8&9 TO PINS 7&8 7/3/75 GM
D	ADDED LOCATION MARK TO TRI 1602 4 JUNE 75 L.I.
C	ADD HEADERS 4A & B ECO 728 KF 16 APR 75
B	ADD 7474 AT 5C. ADD 7432 AT 5B ECO 712 19FEB75 FXY
A	ADD 4010 AT 4D. ECO 694 22NOV74 F.X.Y.

MGMT. APPR.

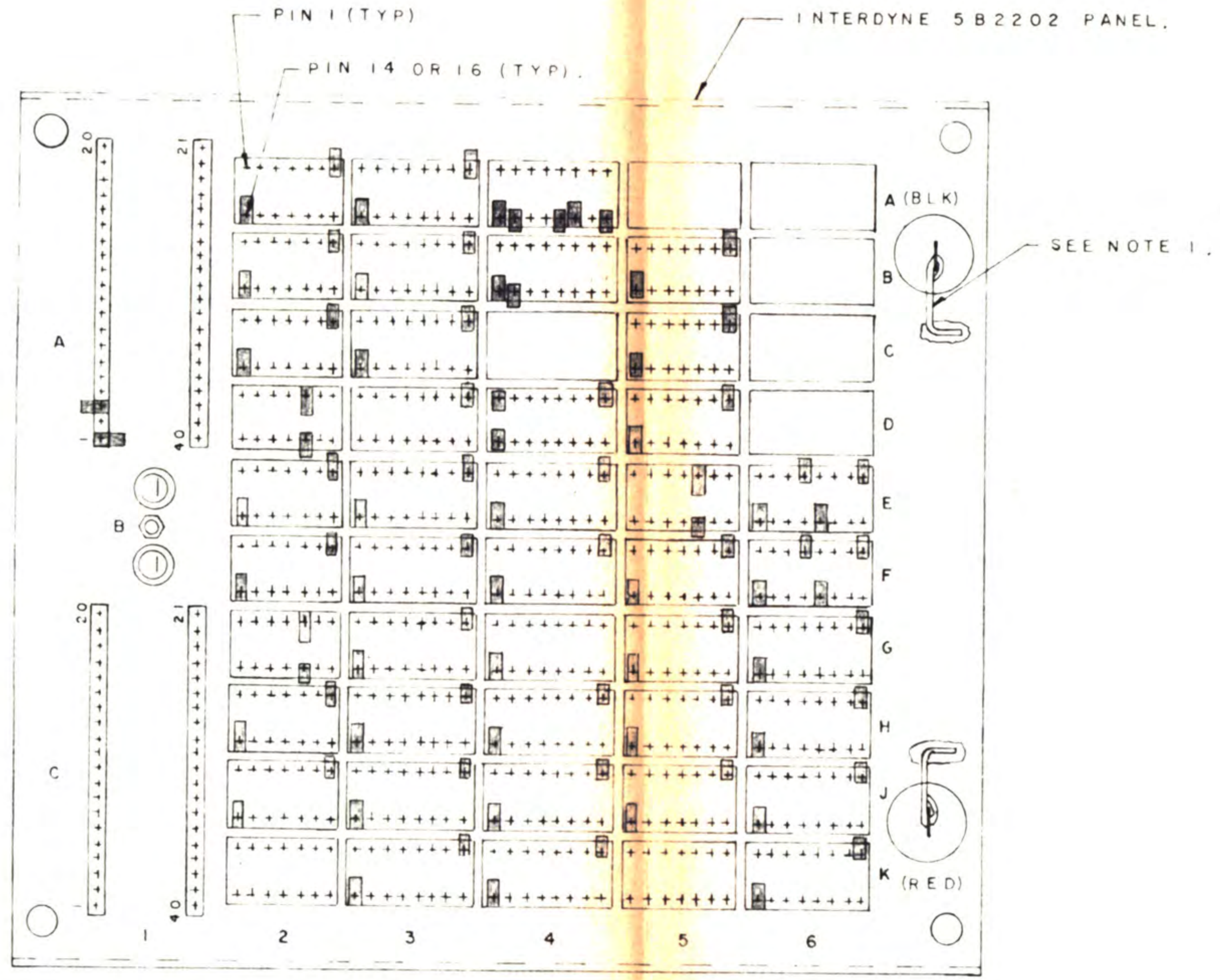
MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93017

COMPONENT PLACEMENT
DRS-1 R.T. MAIN ELECTRONICS.

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	L. I.	14MAY74	SCALE: FULL	
CHK	F X Y	29AUG74	21B2470	F
ENG	[illegible]	29AUG74		

5/71 DIETERICH-POST CLEARPRINT 1020-8



WIRING SIDE.

NOTES:

1. UNLESS INSTALLED BY VENDOR, SOLDER #18 BUS WIRE TO POWER PLANES 2 PLACES.
2. COMPONENT LAYOUT 21B2470
   SCHEMATIC 91C6748 (AUDIBLE) 91C6762 (SUBAUDIBLE)
3. INSTALL SOLDER TABS TO POWER AND GROUND PLANES WHERE INDICATED.

REVISIONS		
C	ADD PWR & GND CONNECTIONS TO 4A & B ECO 728 KF 16 APR 75	
B	ADD TABS AT 5B & 5C ECO 712	19 FEB 75 FXY
A	ADD TABS AT LOCATION 4D ECO 694	22 NOV 74 FXY

DATE

MGMT. APPR.

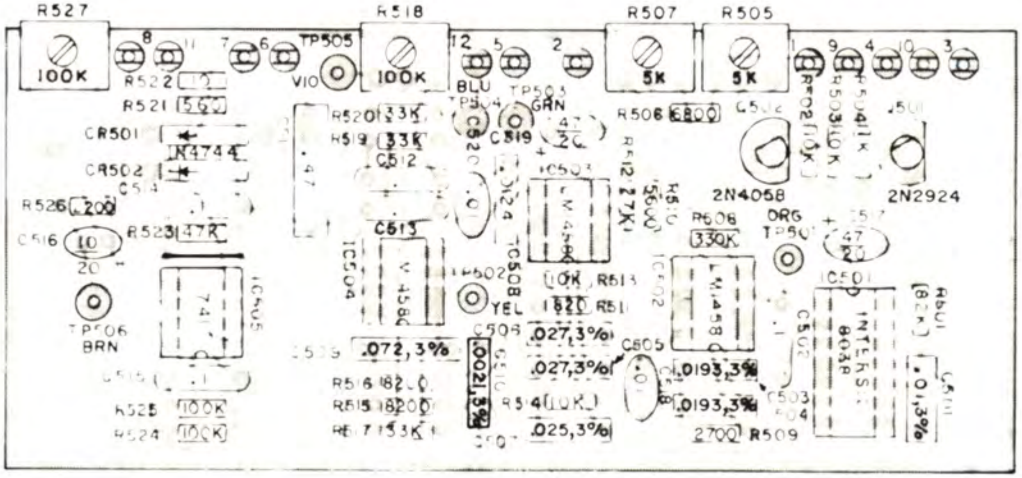
MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93017

POWER DISTRIBUTION
DRS-1 R.T MAIN ELECTRONICS.

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	L. I.	16 MAY 74	SCALE: FULL
CHK	FXY	28 AUG 74	21B2469 C
ENG	FAB	29 AUG 74	

5/71 DIETERICH-POST CLEARPRINT 1020-8



NOTES

1. UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, 10 %
   CAPACITOR VALUES ARE IN MICROFARADS
2. P.C. BOARD 51A5563
3. SCHEMATIC 9.B6753.

DRS-1 (R.T.)

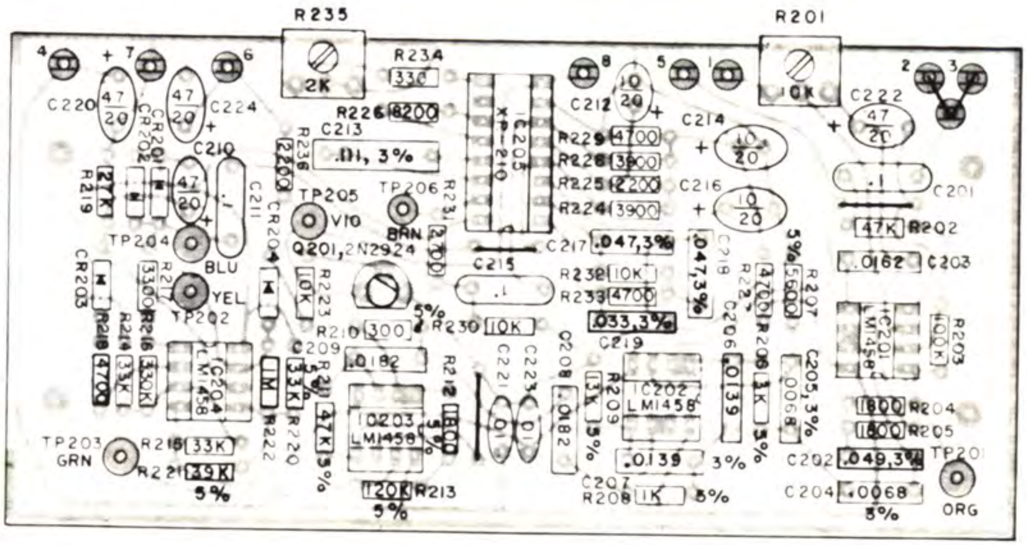
REVISIONS	DATE	MGMT. APPR.
A CHGD POTS SO ADJUSTING SCREWS ARE UP. GM	11-11-75	

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

COMPONENT LAYOUT
TELEMETRY FSK MODULATOR

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	FET	9 JUL 74	SCALE: FULL	
CHK		26 AUG 74	20A 2471	A
ENG		27 AUG 74		



NOTES

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

   DIODES ARE IN4154
2. P.C. BOARD 51A5562.
3. SCHEMATIC 9186750.

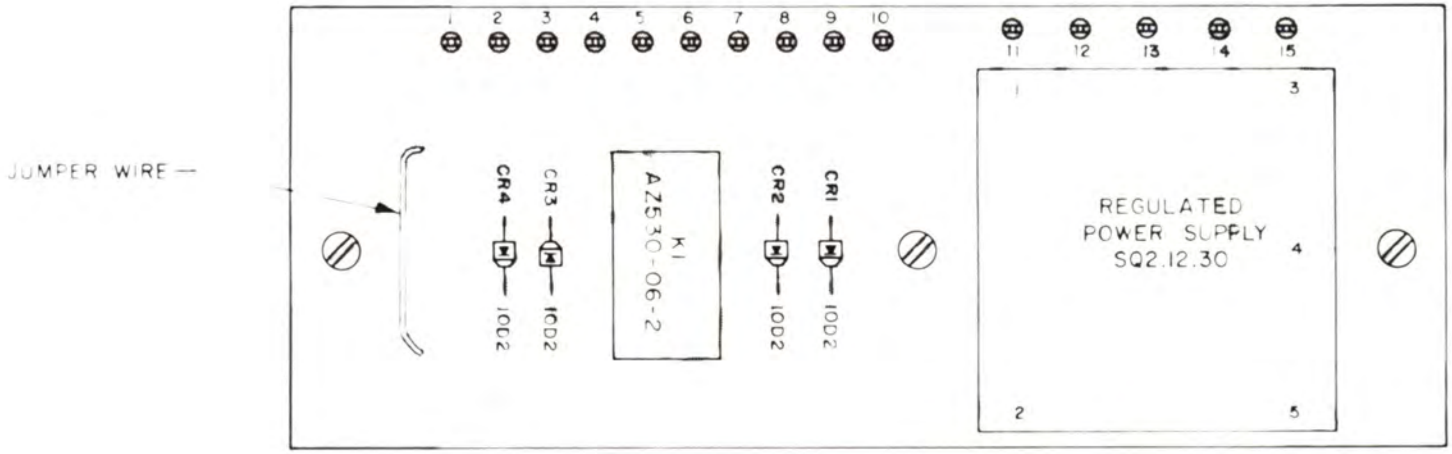
DRS-1 (R.T.)

REVISIONS		DATE	MGMT. APPR.
D	CHGD POTS 50 ADJUSTOR SCREWS ARE UP & C206. C207, R211, R221, R212, R213, R220 VALUE CHG. PER E.C.O. T&B 11-11-75 GM		
C	CHANGED JUMPER OPTION. 3 SEPT 75 L.I.		
B	ADD ADJUSTOR NOTE KF 26 MAR 75		
A	VALUE CHANGES MADE 21 OCT 74 KF ECO 686		

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

COMPONENT LAYOUT
CONTROL FSK DEMODULATOR

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°			
DWN	FET	9 JUL 74	SCALE: FULL
CHK	FXY	26 AUG 74	20A 2469 — D
ENG	JRB	27 AUG 74	



NOTES
1 P.C. BOARD 51A 5574
2 SCHEMATIC 91 C 6762

REVISIONS	DATE
A REMOVE FUSE & HOLDER ECO 735 JHM	22 MAY 75

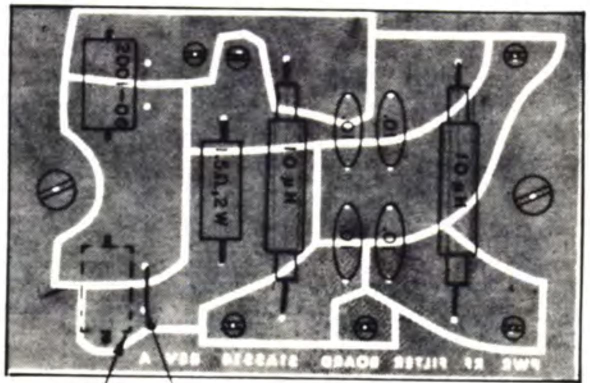
MGMT. APPR.

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

COMPONENT LAYOUT
DRS-1 R.T. PWR SUPPLY

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	REB	31 JULY 74	SCALE:
CHK	F X r	27 AUG 74	20A 2467 A
ENG	SRB	27 AUG 74	



USED ON:
PLU-1
DRS-1 C.T. & R.T.

NOTES

1 UNLESS OTHERWISE SPECIFIED
RESISTOR VALUES ARE IN OHMS
CAPACITOR VALUES ARE IN MICROFARADS

2 P C BOARD 51A5514

3 SCHEMATIC 91C 6665. (PLU-1)

5. FOR 240VAC, REMOVE JUMPER AND INSTALL AN ADDITIONAL JOSLYN MSP 2001-06

REV	REVISIONS	DATE
C	CHANGE SURGE PROTECTOR AND NOTE 5 PER ECO 745 JHM 8 AUG 75	
B	RESISTOR WAS 1.5Ω, 1W, ADD DRS-1 27 AU ,74 FXY	
A	ARTWORK REV A 4/MAR./74 REB	
	MGMT. APPR.	

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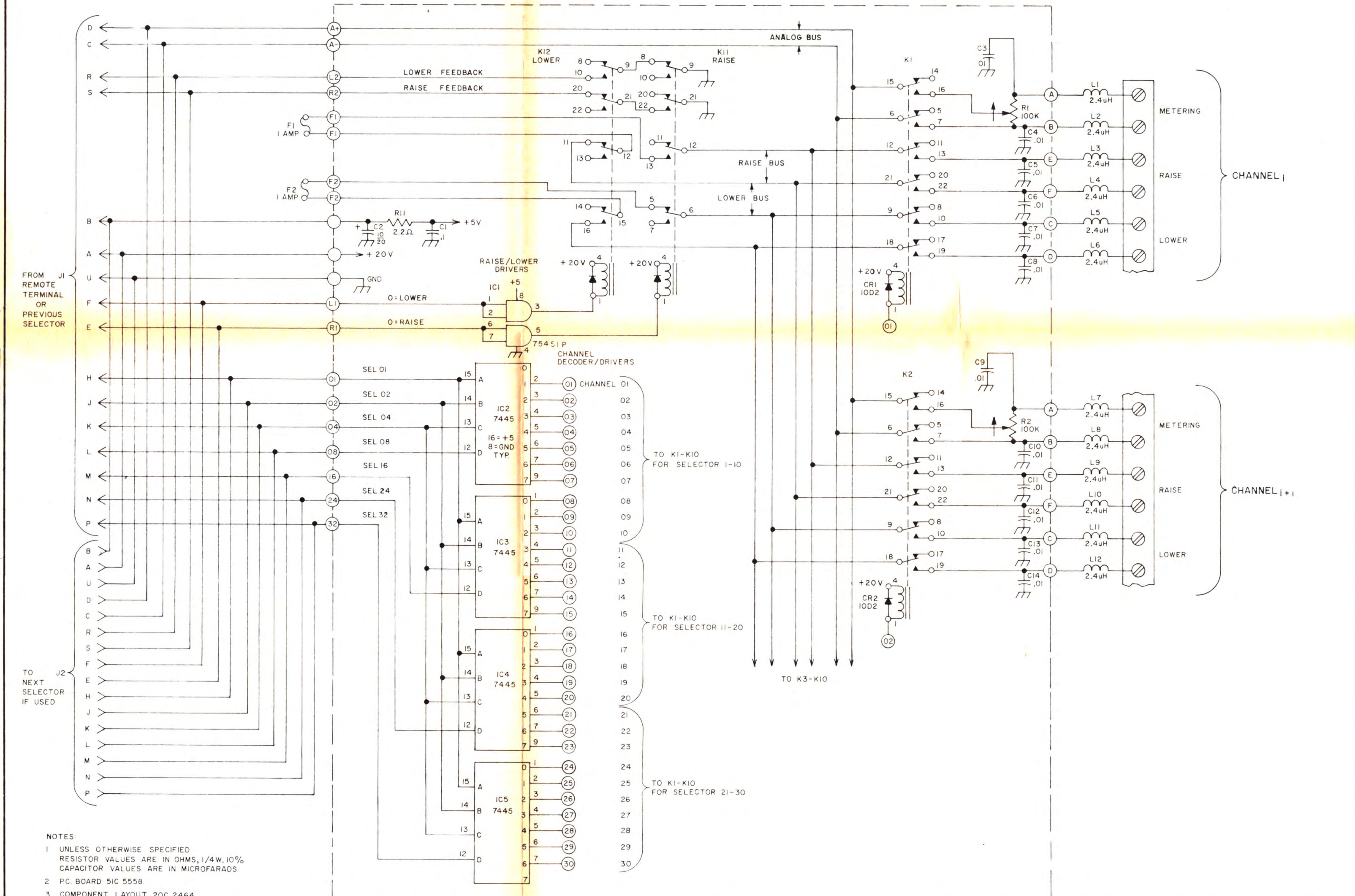
GOLETA, CALIFORNIA 93017

COMPONENT LAYOUT
PWR RF FILTER BOARD

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°		
DWN	P.M	10-15-73
CHK	FXY	[illegible]
ENG	PRB	[illegible] 17,73

SCALE: FULL

20A2413 C



NOTES:

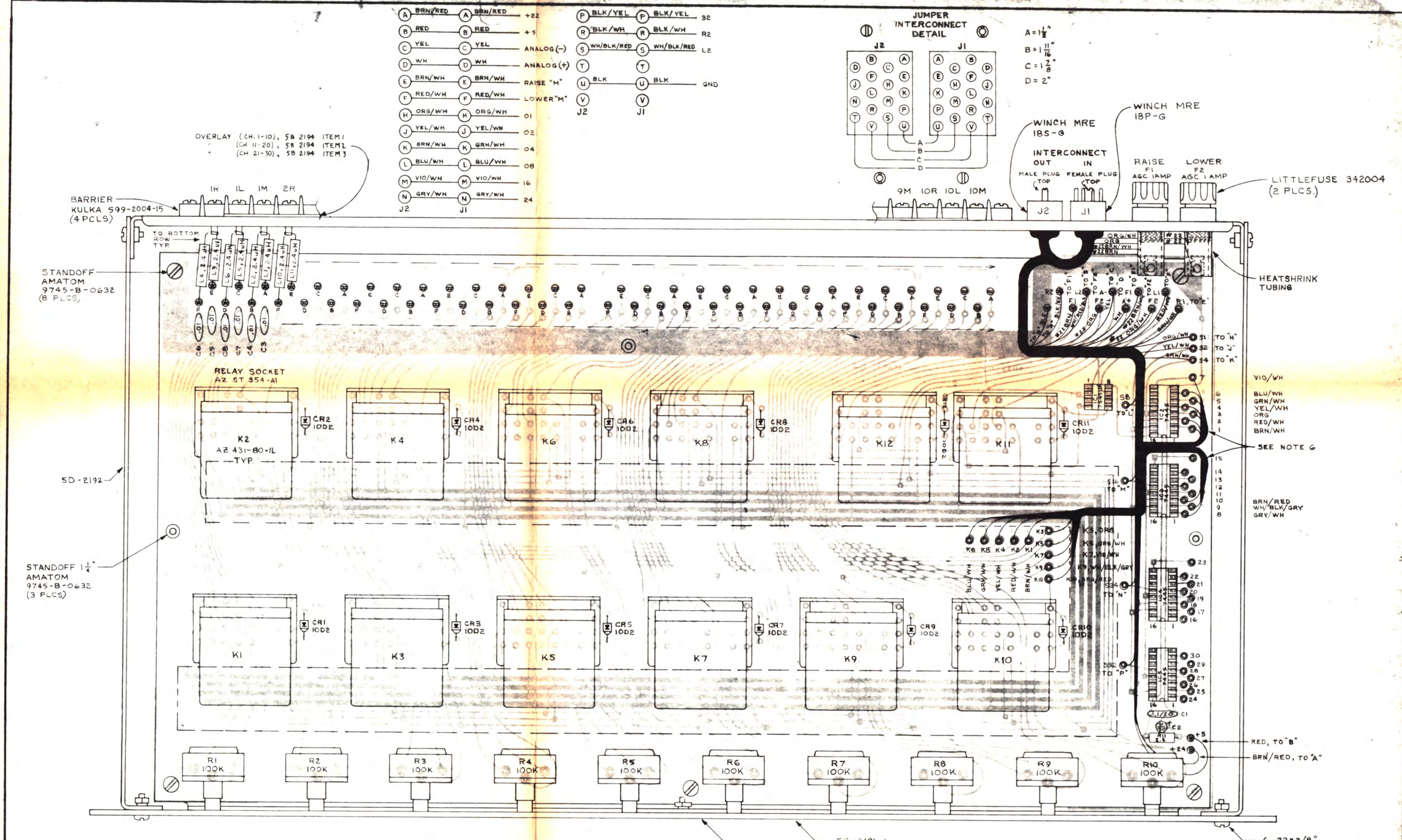
1. UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/4W, 10%. CAPACITOR VALUES ARE IN MICROFARADS.
2. P.C. BOARD 51C 5558
3. COMPONENT LAYOUT 20C 2464

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

SCHEMATIC
SELECTOR UNIT DRS-1

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°			
DWN	REB	19 JUNE 74	SCALE:
CHK	FXY	27 AUG 74	
ENG	SRB	27AUG74	91C 6737

REVISIONS | MGMT. APPR. | DATE



NOTES:

1. UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/2W, 10% CAPACITOR VALUES ARE MICROFARADS
2. COMPONENT SIDE OF BOARD, SHOWN IN DASH LINES, MUST BE COATED WITH INSULATING TAPE (BRADY CO *WS8V 10RDR)
3. P.C. BOARD 5IC 5558.
4. SCHEMATIC 9IC 6737.
5. CHASSIS COVER 5C 2193.
6. CONNECT TERMINALS K1-K10 TO TERMINALS 1-10 FOR SELECTOR CHANNELS 1-10. (INSTALL IC2 & IC3 ONLY)
   " " " " " 11-20 " " " 11-20. (" IC3 & IC4 ")
   " " " " " 21-30 " " " 21-30. (" IC4 & IC5 ")
7. ALL WIRING #26 UNLESS OTHERWISE SPECIFIED.

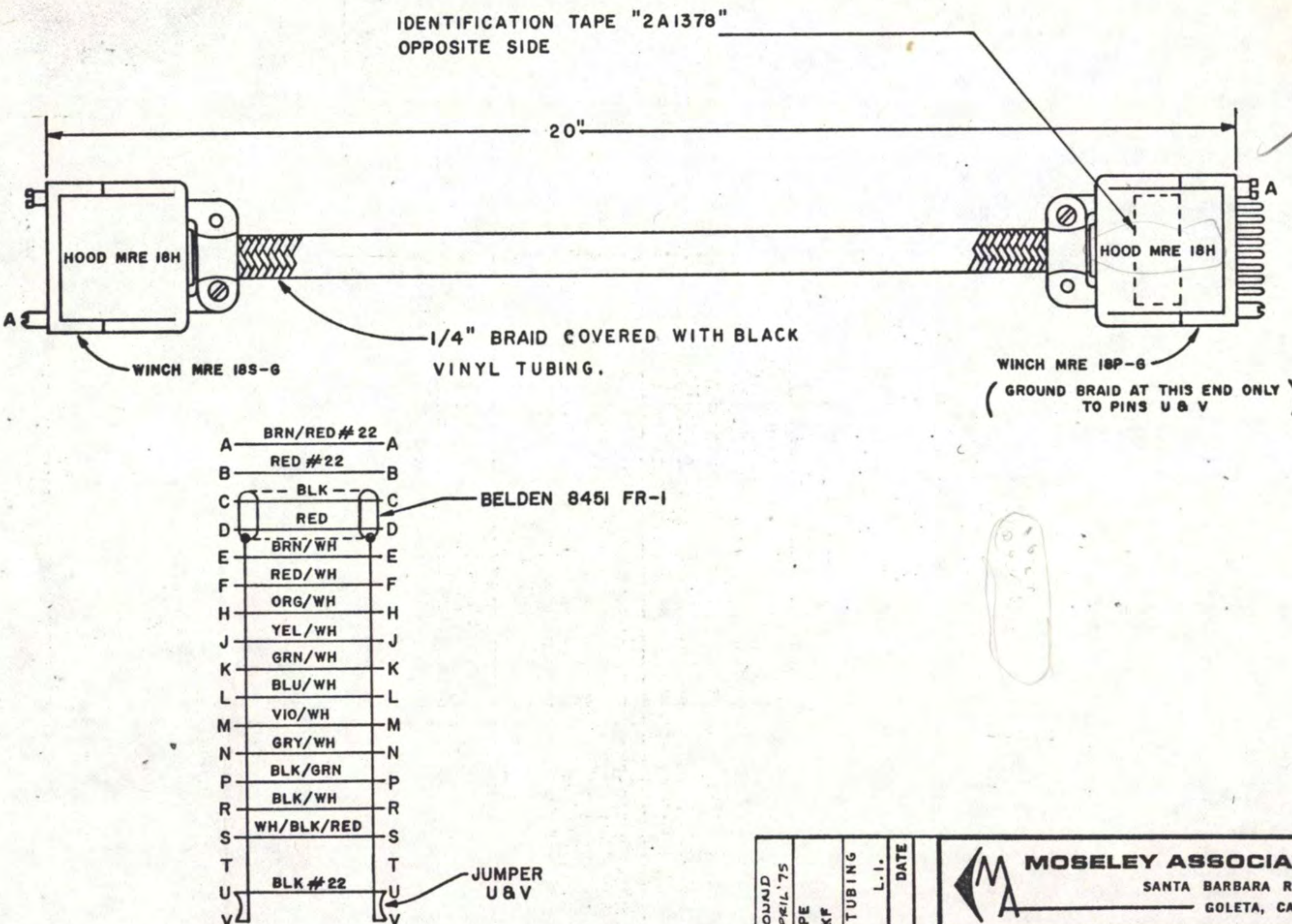
REVISIONS			
C	INSULATING TAPE WAS SPRAY, 10/OCT 75	L.I.	
B	ADD #22 TO ESSE WIRES, 7 FEB 75	FXY	
A	OVERLAY 5B 2194 ADDED	10/OCT/74	KF

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

COMPONENT LAYOUT
SELECTOR UNIT DRS-1

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	REB	3 JULY 74	SCALE:
CHK	FXY	27 AUG 74	
ENG	SRB	27 AUG 74	20C 2464 C



NOTES:

1 UNLESS OTHERWISE SPECIFIED WIRES ARE #26.

REV	REVISIONS	DATE
C	ADD NOTE GROUND BRAID --- 7 APRIL '75	
B	ADDED I.D. TAPE	18 OCT 74 KF
A	ADDED VINYL TUBING	3 OCT 74 L.I.

MGMT. APPR.

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

CABLE ASSEMBLY
DRS-1 SELECTOR UNIT

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°			
DWN	REB	29 JULY 74	SCALE:
CHK	FXY	23 AUG 74	2A 1378 — C
ENG	SRB	26 AUG 74	

Status Subsystem

INSTRUCTION MANUAL

ADDENDUM A
STATUS SUBSYSTEM
for
MODEL DRS-1A

MOSELEY ASSOCIATES, INC.
Santa Barbara Research Park
111 Castilian Drive
Goleta, California 93017

Revised
December, 1974

TABLE OF CONTENTS

ADDENDUM A

STATUS SUBSYSTEM

for

MODEL DRS-1A

I. INTRODUCTION

The Status Subsystem is an optional addition to the Model DRS-1A Digital Remote Control System. The Status Subsystem provides 24 on/off or go/no-go channels which may be used to monitor the status of broadcast transmitters and industrial controls, as well as applications where on/off conditions need to be monitored. Each status channel is activated by a momentary or continuous dry contact or transistor closure, and remains latched until manually cleared by the operator. LED's at both the remote site and control site indicate which channels are activated. In addition, external alarm devices may be added to the control terminal to alert the operator of alarm conditions.

The front panel of each status terminal is identical as shown in Figure 1.

II. INSTALLATION

The Status Subsystem for the DRS-1A consists of two status panels and two interconnecting cables. Referring to Figure 8 in the DRS-1A Instruction Manual, the Status Panel-Control Terminal is mounted next to the Control Terminal. Cable No. 2A1377 is installed between the two units. The Status Panel-Remote Terminal is mounted next to the Remote Terminal and is connected with Cable No. 2A1378. Be sure not to confuse the two cables as they have identical connectors. Also, note that the Status Panel-Remote Terminal is the larger of the two status units.

After the equipment has been installed and connected to the main DRS-1A system, the status portion of the Functional Test Procedure as given in steps 13-17 of Section IV.F. of the DRS-1A Instruction Manual should be followed.

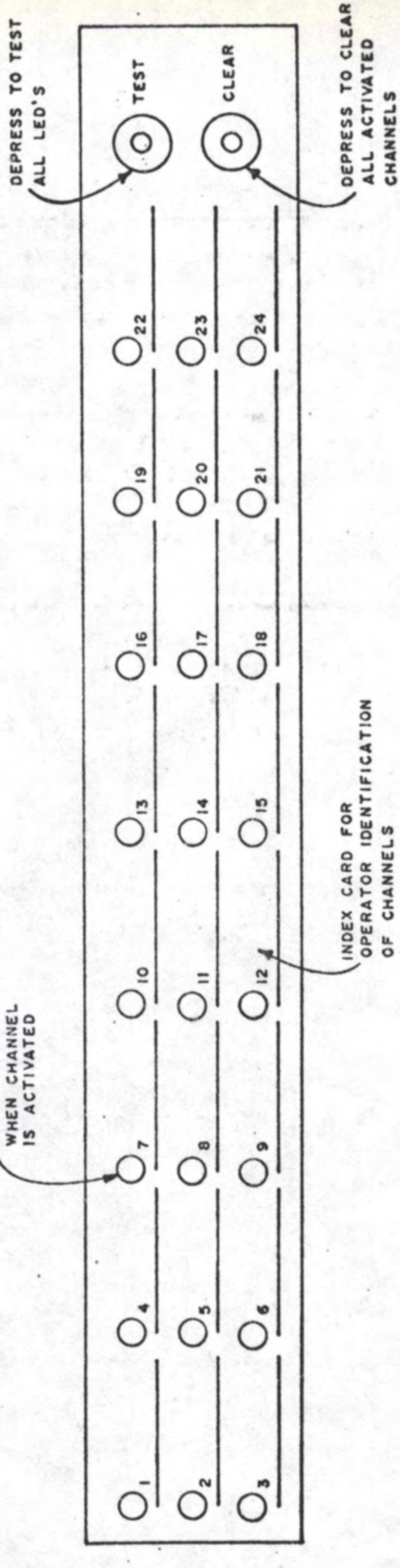


FIGURE 1 – STATUS PANEL

The inputs to the Status Subsystem are made to the rear of the Status Panel-Remote Terminal as shown in Figure 2. A momentary contact closure or transistor sink to ground is required to latch (activate) a status channel. RF filtering of each input is accomplished internally to the status chassis. However, it is strongly recommended that long leads to the unit be shielded to prevent RF interference.

> CAUTION: EACH INPUT IS CONNECTED INTERNALLY TO A TTL DIGITAL LOGIC GATE. DO NOT APPLY ANY NEGATIVE VOLTAGE OR A VOLTAGE GREATER THAN 5 VDC TO ANY STATUS INPUT OR DAMAGE MAY RESULT.

The bottom row of terminals is connected to chassis ground. The top row is connected to each channel individually. Channels may be paralleled together in cases where a back-up status channel is desired. For instance, one switch may be connected to both channels 12 and 20 simply by jumpering inputs 12 and 20 together and applying the switch to either input.

In addition to the LED indications on the front of each Status Panel, rear-panel outputs are provided on the Status Panel-Control Terminal to which external devices may be connected as shown in Figure 2. When a channel is activated, the corresponding transistor is turned on and then may be used to drive a DC relay coil, lamp, buzzer, or similar device. The bottom row of terminals is connected to chassis ground. Each top terminal is connected to the collector of a driver transistor.

> CAUTION: ONLY POSITIVE DC LOADS MAY BE CONNECTED. DO NOT APPLY MORE THAN 24 VDC TO ANY EXTERNAL OUTPUT. LOAD CURRENTS MUST NOT EXCEED 200 MILLIAMPS. ALL INDUCTIVE LOADS MUST HAVE A DIODE CONNECTED ACROSS THEM SUCH THAT THE DIODE DOES NOT NORMALLY CONDUCT. (See Figure 2)

The external outputs may be paralleled together to drive a common device. For example, output 2 could be jumpered to output 1 such that an alarm on either channel 1 or 2 will close the relay.

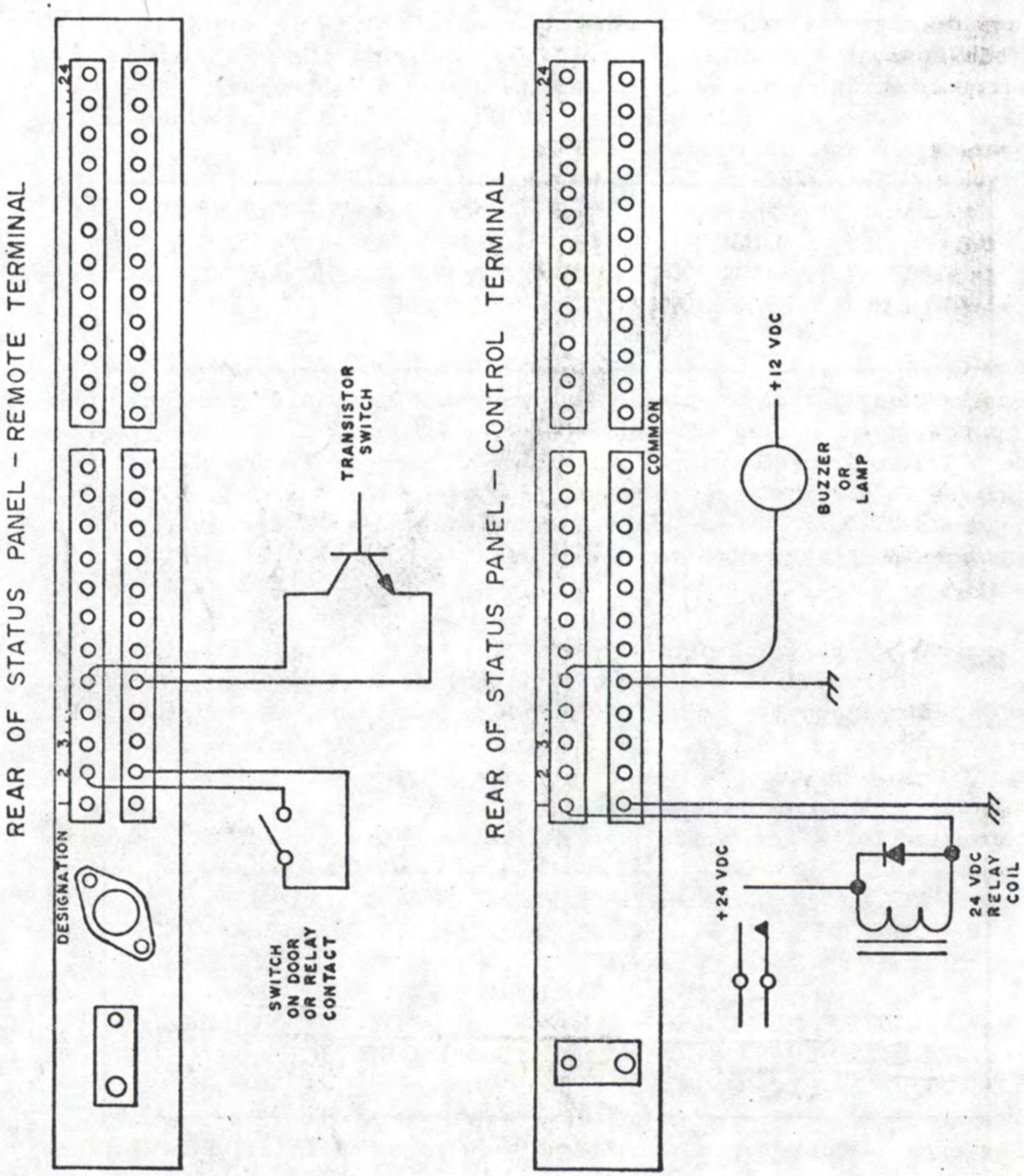


FIGURE 2 - TYPICAL STATUS CONNECTIONS

III. OPERATION

Operation of the Status Subsystem is independent of the main DRS-1A Digital Remote Control System. There is no correspondence between control system channels and status system channels.

When activated, status channels are displayed on both status panels. The CLEAR switch on either unit causes all channels to be unlatched. When CLEAR is released, channels which have contact closures applied will again be activated. Note that when a closure is removed, that channel remains latched until the CLEAR switch is depressed.

The TEST switch on the Status Panel-Remote Terminal causes a local test of the LED displays. It does not cause the Status Panel-Control Terminal displays to light up.

The TEST switch on the Status Panel-Control Terminal activates all of the LED's and external drivers. When TEST is released, the unlatched channels will clear in groups of six as updated information is received from the Status Panel-Remote Terminal.

IV. CIRCUIT DESCRIPTION

A. Status Panel-Control Terminal

1. Power Supply

Unregulated voltage from the Control Terminal is filtered by C1 and regulated to +5 VDC by IC1. The output of IC1 is filtered by C2 through C8 and powers the rest of the unit.

2. Receiver Latches

The six data bits $\overline{B1}$ - $\overline{B6}$ are brought to latches D, E, G, and H in parallel. The CLK inputs to the latches originate from decoder B. Signal STATUS READY goes low after the third word has arrived at the Control Terminal. DRR goes low as each word arrives. WS1 and WS2 contain word number and status group information. After $\overline{\text{STATUS READY}}$ goes low, and when $\overline{\text{DRR}}$ goes low when the fourth word arrives, decoder B sends a low-going pulse at only one of its outputs depending upon the state of WS1 and WS2. Thus, only one of the latches is clocked at a given time. It takes four complete transmission cycles of four words each to update all 24 status channels.

3. Drivers

IC's A, C, F, and J are non-inverting drivers for the front-panel LED's. A low input to a driver turns on the corresponding LED. The 75451 external drivers also turn on when a low logic level is applied. These drivers can handle 24 VDC, 200 mA loads, and may be paralleled to the same load.

4. Front-Panel Controls

The signal $\overline{\text{CLEAR}}$ at connector Pin N is normally pulled up to +5V by R1. Switch SW1 when pushed causes CLEAR to go low. This bit is sent to the Status Panel-Remote Terminal to clear the latches.

R2 normally pulls up the CLR inputs to latches D, E, G, and H. When SW2 is pushed, the CLR inputs go low which clears the latches. This turns on the 24 LED's and external drivers. (Recall that a status channel is on when the corresponding status bit is low.) When SW2 is released, the status LED's will turn off in groups of six as each latch is updated.

B. Status Panel-Remote Terminal

1. Power Supply

Unregulated voltage from the Remote Terminal is filtered by C27 and regulated to +5 VDC by IC7. The output of IC7 is filtered by C28 and powers the rest of the unit.

2. Input Latches

Each input is filtered and pulled up to +5 VDC as illustrated by R1, R2, and C1. A contact closure pulls an input low which resets the corresponding latch in IC1-IC6. The latch output goes low when the channel is activated.

The set inputs to IC1-IC6 are all connected together to the CLEAR line. When CLEAR goes low, all of the latches are set causing all status channels to be de-activated.

3. Word Counter

Signal ADVANCE from the Remote Terminal occurs after a transmission cycle has been completed. One-shot IC8 buffers ADVANCE and applies a low-going pulse to word counter IC9. The counter advances on the falling edge of this pulse. The two-bit counter state is fed to the Remote Terminal via IC10 and to 4-to-1 multiplexers IC11-IC13.

4. Multiplexers

Only one group of six status bits is sent to the Remote Terminal at any time. The 24 status channels are multiplexed into six bits by IC11-IC13. Word counter IC9 addresses which one of the four six-bit groups is presented as $\overline{B1}$-$\overline{B6}$. When the count is 00, channels 1-6 are chosen. When the count is 01, channels 7-12 are chosen. Similarly, count 10 chooses channels 13-18 and count 11 chooses channels 19-24.

5. Displays

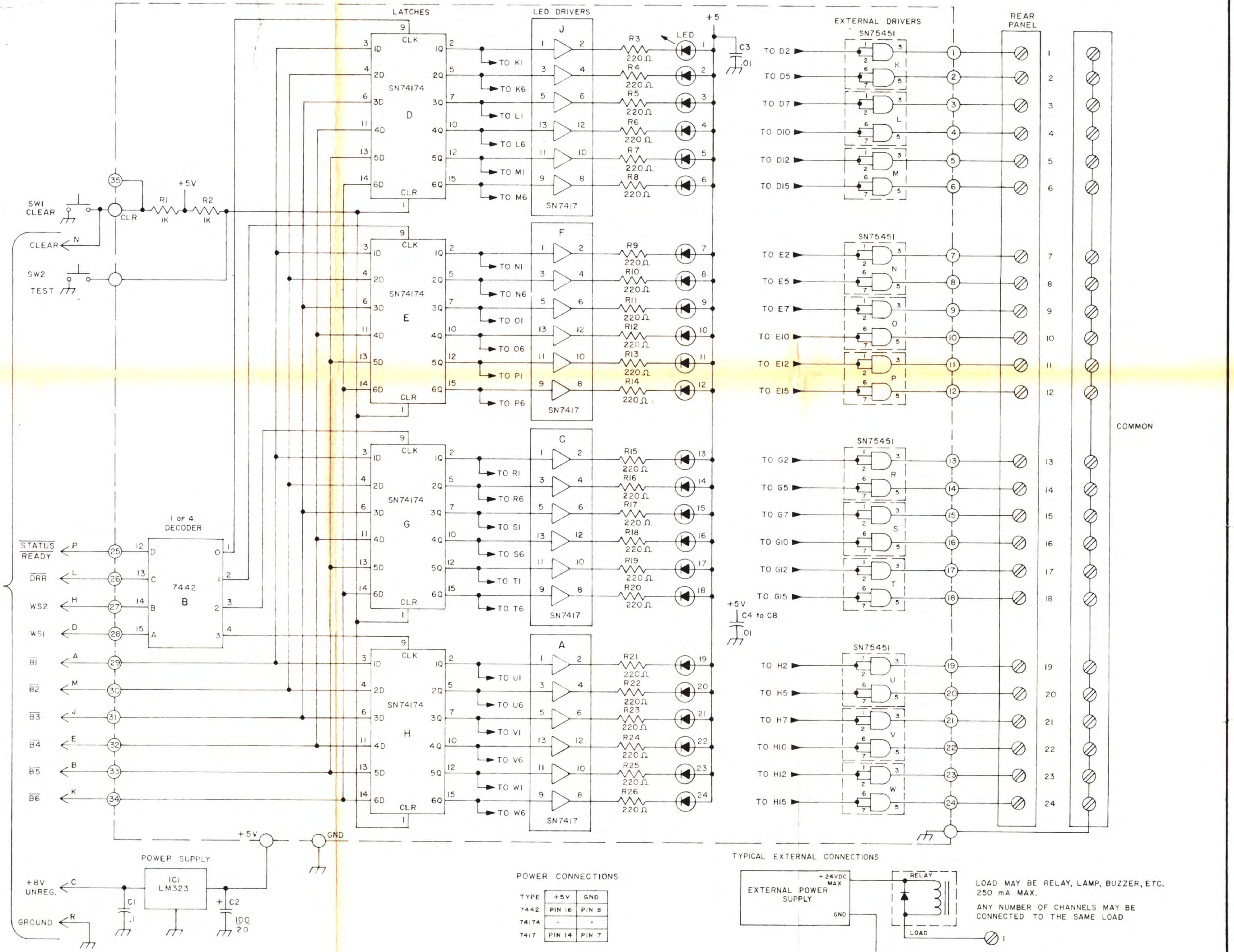
The outputs of latches IC1-IC6 are also fed to drivers IC14-IC17. A low input to a driver causes the corresponding LED to turn on. All of the LED's turn on when the TEST switch is closed.

V. LATCHING TO NON-LATCHING MODIFICATION INSTRUCTIONS

To convert the DRS-1 status subsystem from a latching to a nonlatching mode of indication requires a decision to be made concerning the sequence or order of the nonlatching status channels.

Implementation Scheme #1 consists of removing one or more of the 74279's (IC1 through IC6 schematic 91C6764, Remote Terminal Status) and installing 16 pin headers with jumpers between pins 1 and 4, 5 and 7, 10 and 9, and 14 and 13. The problem with this scheme is nonlatching channels are separated by six channels. For example, converting IC1 would yield nonlatching status indications for channels 1, 7, 13, and 19. However, this scheme is very easily implemented. Therefore, it would be simple to convert all status channels to the nonlatching mode.

Implementation Scheme #2 consists of removing the wirewrap wires from the outputs of the 74279's (Pins 4, 7, 9, and 13 of IC1 through IC6) to the inputs of the 74153's (Pins 3, 4, 5, 6, 10, 11, 12, and 13 of IC11 through IC13) on a channel per channel basis. Then, adding a wirewrap wire from the inputs of the 74279's (Pins 1, 5, 10, and 14) to the appropriate inputs of the 74153's. Obviously, the advantage this scheme presents is that nonlatching status indications can now be consecutive. For example, to change channels 1 and 2 to a nonlatching mode would require the removal of wires from IC1 pin 4 to IC11 pin 6 and IC2 pin 4 to IC11 pin 10. Then, add wires from IC1 pin 1 to IC11 pin 6 and IC2 pin 1 to IC11 pin 10.



POWER CONNECTIONS

TYPE	+5V	GND
7442	PIN 16	PIN 8
74174	"	"
7417	PIN 14	PIN 7

NOTES:

1. UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/4 W, 10%. CAPACITOR VALUES ARE IN MICROFARADS.
2. P.C. BOARD 51B 5559A
3. COMPONENT LAYOUT 20B 2466.

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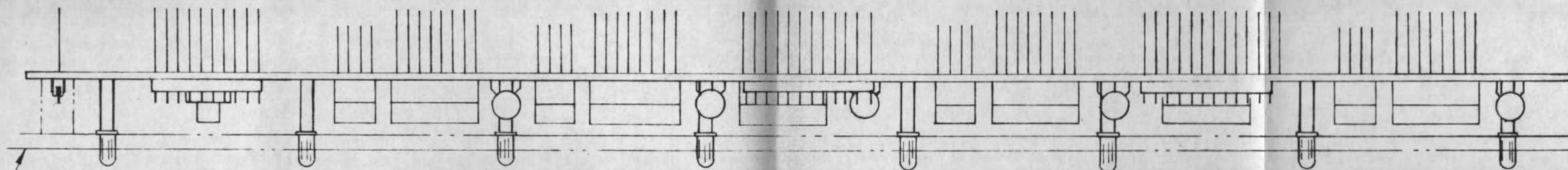
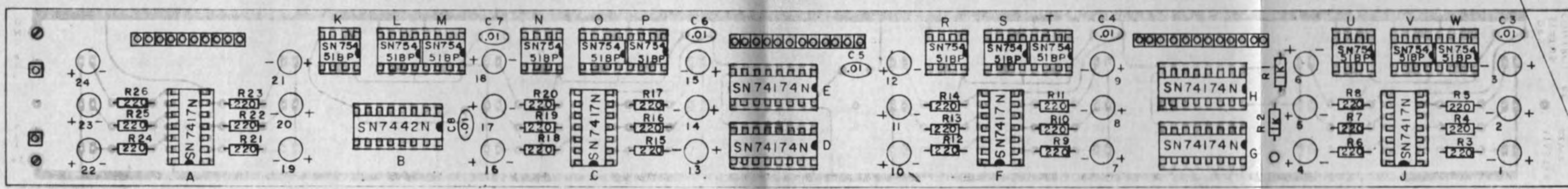
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93017

SCHEMATIC
DRS-1 CONTROL TERMINAL STATUS

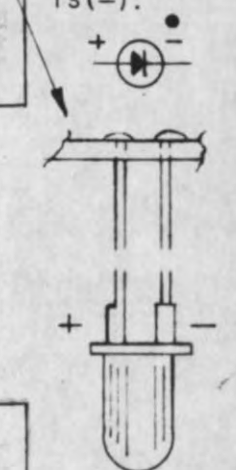
TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°
DWN REB 6 AUG 74 SCALE:
CHK FXY 22 AUG 74
ENG SRB 26 AUG 74
9IC 6747



USE FRONT PANEL 5C2185-3 & 1/2" SPACERS
AS FIXTURE TO POSITION & SOLDER L.E.D.S.

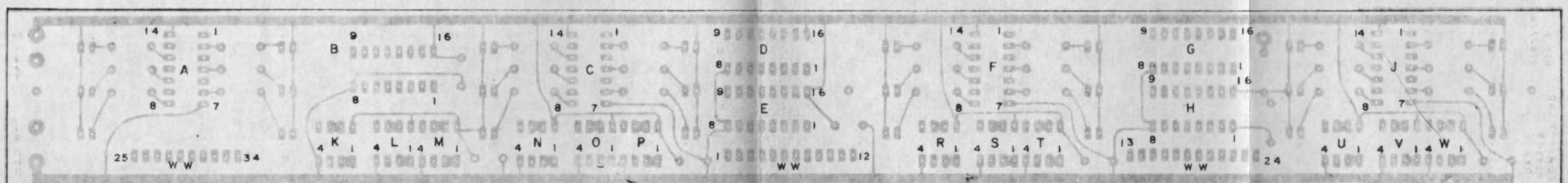


COMPONENT SIDE



NOTE: DOT(●) ON P.C.BOARD IS(−).

TYP-LAMP
2X SIZE.



WIREWRAP SIDE

NOTES

1. UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES ARE IN OHMS, 1/4 W, 10%
   CAPACITOR VALUES ARE IN MICROFARADS.
2. P.C. BOARD 51B5559.
3. SCHEMATIC 91C6747.
4. FOR WIRE HOOK UP SEE LIST. (51B5559)
5. NEXT ASSEMBLY 21C2482.
6. ⊡○○○○○○○○○ DENOTES MOLEX WAFER ASS'Y 22-03-2201 CUT AS REQUIRED.

REVISIONS		DATE	MGMT. APPR.
C	INSTALL MOLEX 2 PLCS	13 MARCH 75 L.I.	
B	MOLEX PINS WERE ROBINSON/NUGENT. ADDED NOTE 6	KF 20 DEC 74	
A	ADDED NOTE, DOT (●) ON P.C. BOARD IS (−).	3 SEPT 74 L.I.	

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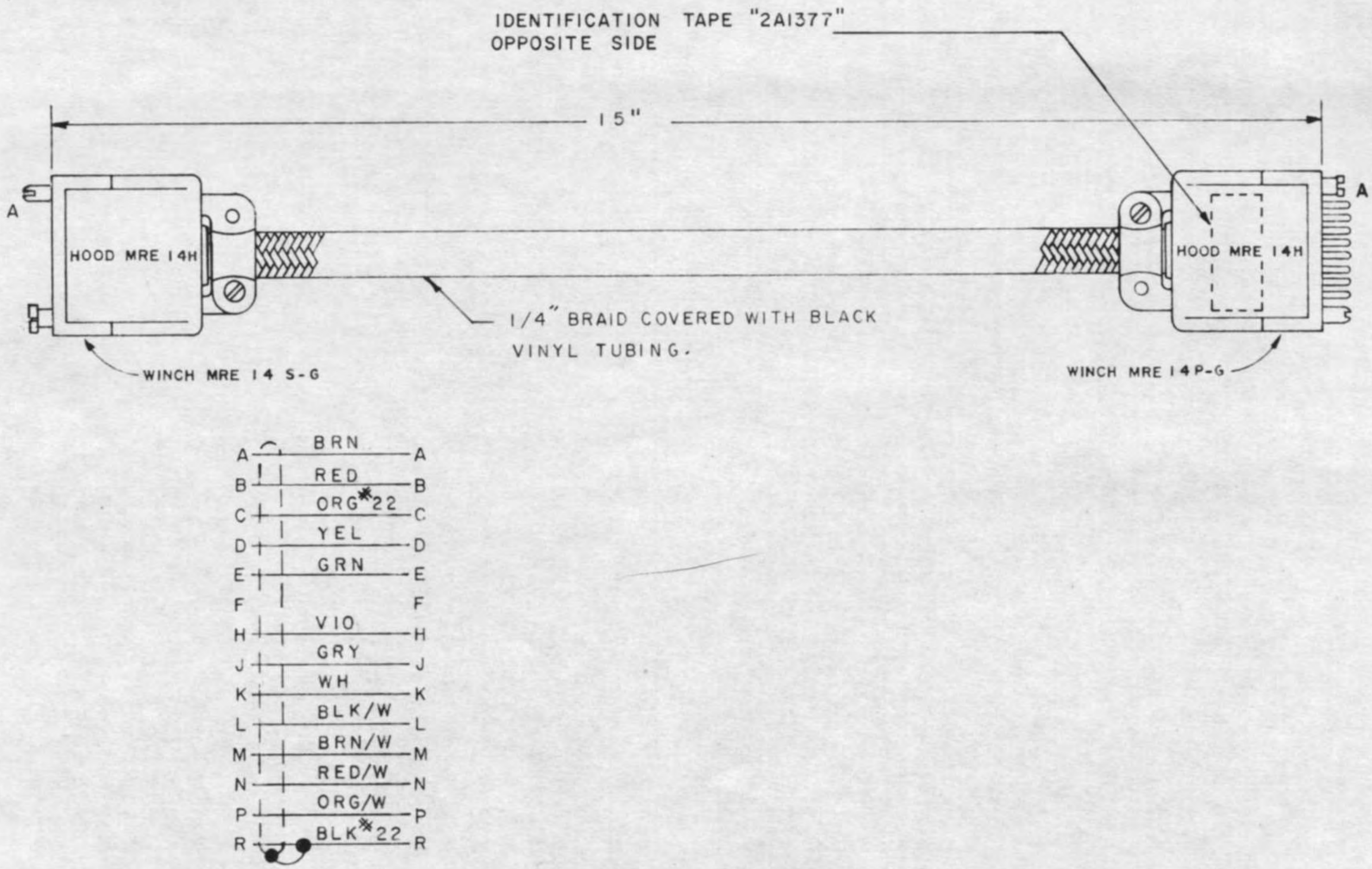
COMPONENT LAYOUT
DRS-1 STATUS CONTROL BOARD

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	L.I.	29JULY74	SCALE: FULL	
CHK	FXY	22 AUG74	20B2466	C
ENG	SRB	22 AUG74		

5/71 DIETERICH-POST CLEARPRINT 1020-8



NOTES:

1 UNLESS OTHERWISE SPECIFIED WIRES ARE #26.

REV	REVISIONS	DATE	MGMT. APPR.
B	ADDED I.D. TAPE	18OCT74 KF	
A	ADDED VINYL TUBING	3OCT74 L.I.	

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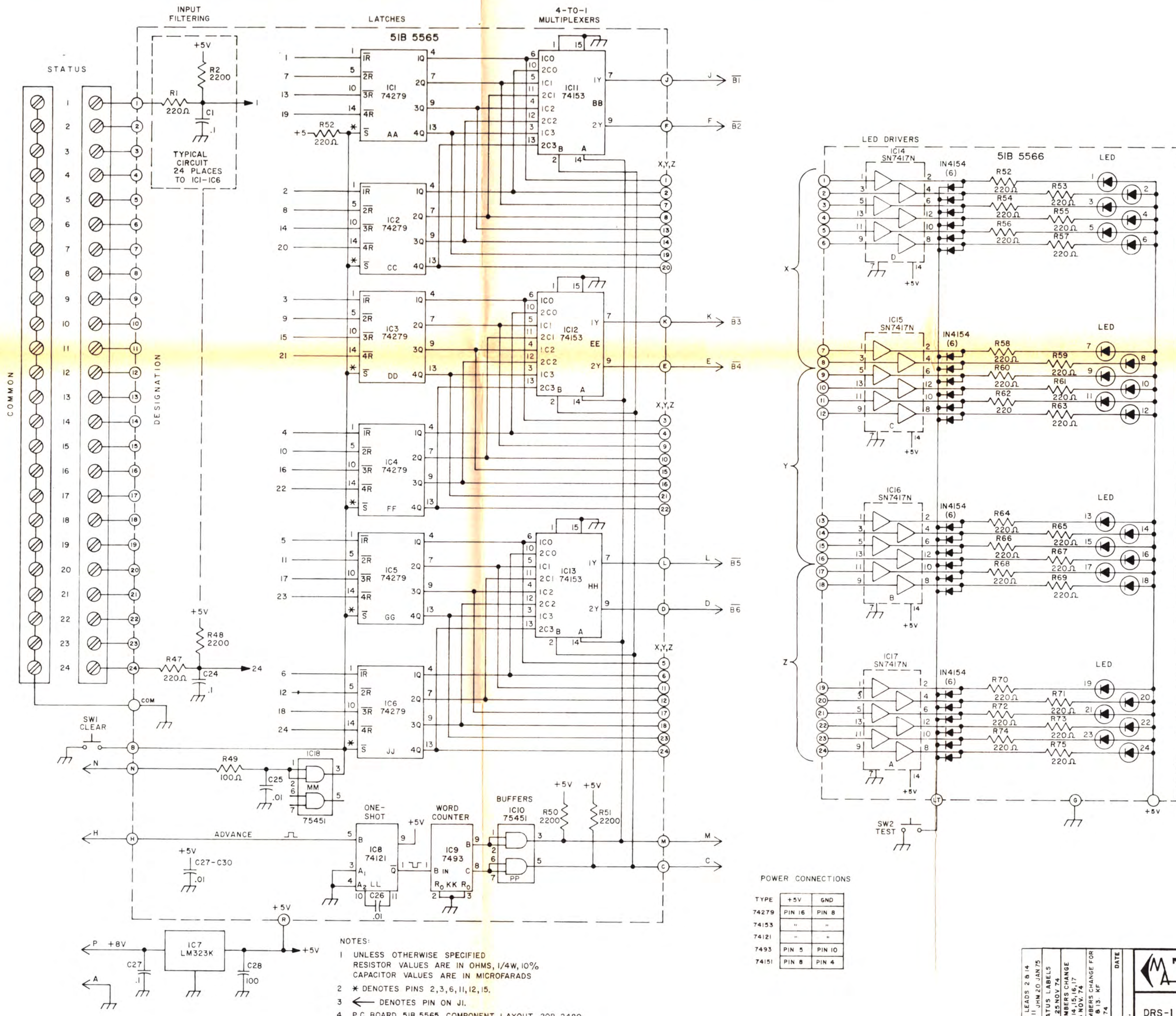
CABLE ASSEMBLY
DRS-1 C.T. STATUS.

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°			
DWN	L.I.	6AUG74	SCALE: NONE
CHK	FXY	15AUG74	2A1377 B
ENG	SRB	22AUG74	



NOTES:

1. UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/4W, 10% CAPACITOR VALUES ARE IN MICROFARADS
2. ✱ DENOTES PINS 2, 3, 6, 11, 12, 15.
3. ← DENOTES PIN ON J1.
4. P.C. BOARD 5IB 5565, COMPONENT LAYOUT 20B 2480.
   " 5IB 5566, " " 20B 2481.

POWER CONNECTIONS

TYPE	+5V	GND
74279	PIN 16	PIN 8
74153	"	"
74121	"	"
7493	PIN 5	PIN 10
74151	PIN 8	PIN 4

REVISIONS

		DATE	MGMT. APPR.
D	SWITCH LEADS 2 & 14 ON IC-11	JHM 20 JAN 75	
C	ADD STATUS LABELS	JHM 25 NOV 74	
B	PIN NUMBERS CHANGE FOR IC14, 15, 16, 17	JHM 14 NOV. 74	
A	PIN NUMBERS CHANGE FOR IC 11, 12 & 13.	KF 7/NOV/74	

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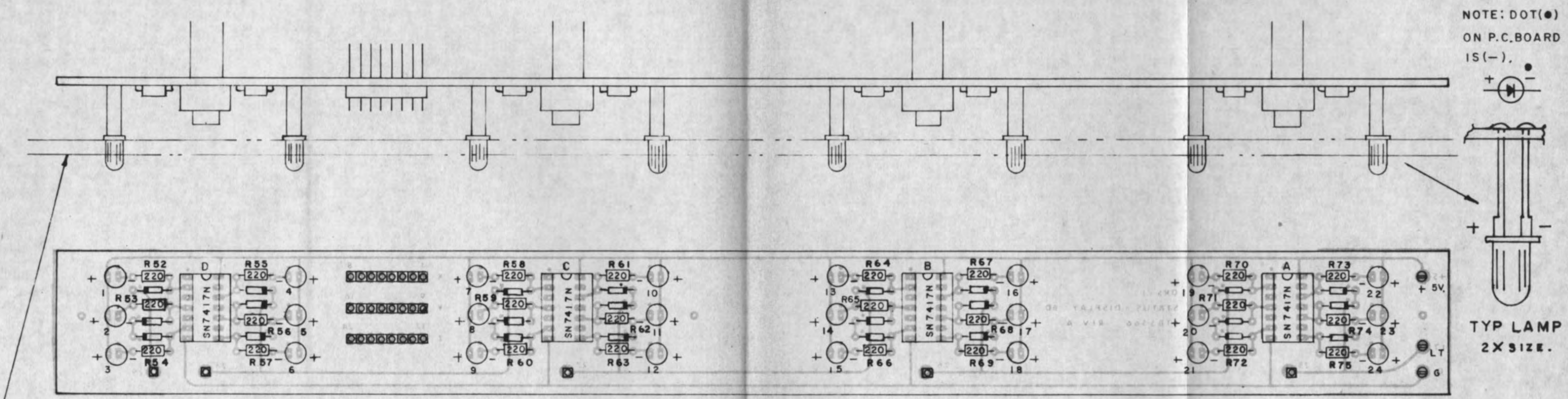
SCHEMATIC
DRS-1 REMOTE TERMINAL STATUS

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	REB	22 AUG 74	SCALE:
CHK	FXY	26 AUG 74	
ENG	SRB	29 AUG 74	

91C 6764 D



USE FRONT PANEL 5C2197 & 1/2" SPACERS
AS FIXTURE TO POSITION & SOLDER L.E.D.'S

NOTES

1. UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES ARE IN OHMS 1/4 W, 10%
   CAPACITOR VALUES ARE IN MICROFARADS.
2. P C BOARD 51B5566
3. SCHEMATIC 91C6764
4. FOR WIRE HOOK UP SEE LIST (51B5565B)
5. —▭— DENOTES DIODES. (1N4154).
6. ▭▭▭▭▭▭▭▭ DENOTES MOLEX WAFER ASS'Y 22-03-2201 CUT AS REQUIRED

REVISIONS		
D	ARTWORK REV. A, MOVE R65 AND DIODE.	15 MAY 75 F.X.Y.
C	ADDED 220 Ω TO R60 & R63	27 FEB 75 L.I.
B	MOLEX PINS WERE ROBINSON/NUGENT PINS. ADDED NOTE 6	KF 20 DEC 74
A	ADDED NOTE, DOT(●) ON P.C.BOARD IS(−)	3 SEPT. 74 L.I.

MGMT. APPR.

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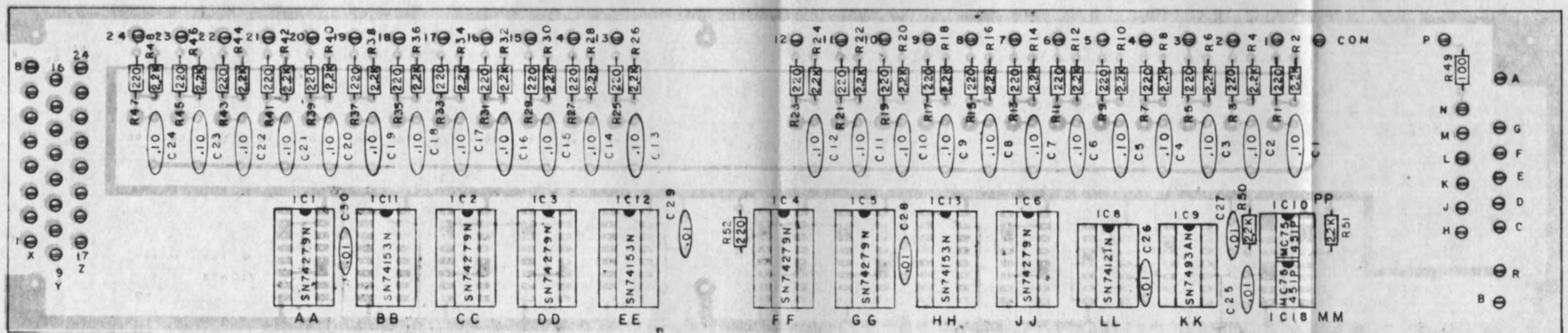
COMPONENT LAYOUT
DRS-I R.T. STATUS DISPLAY BD.

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	L.I.	8AUG74	SCALE: FULL
CHK	FXY	28AUG74	20B2481 D
ENG	SRB	29AUG74	



NOTES:

1. UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES ARE IN OHMS, 1/4 W, 10%
   CAPACITOR VALUES ARE IN MICROFARADS.
2. P.C. BOARD 51B5565
3. SECHEMATIC 91C6764
4. FOR WIRE HOOK UP SEE LIST (51B5565B)

A	IC12 WAS IC4, IC4 WAS IC12	7 NOV74 L.I.
REVISIONS		DATE
MGMT. APPR.		

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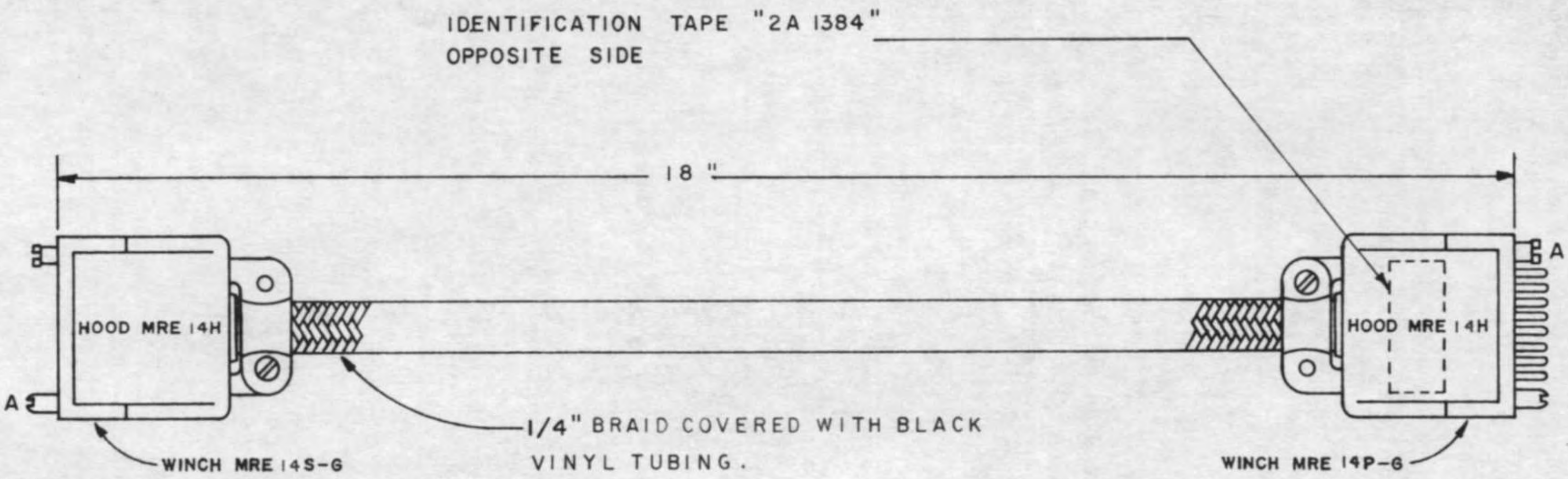
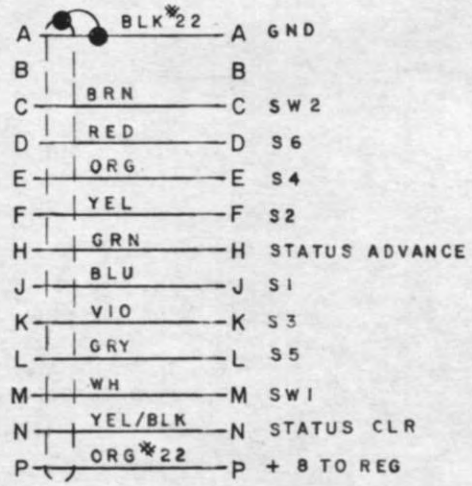
COMPONENT LAYOUT
DRS-1 STATUS REMOTE.

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	L.I.	13AUG74	SCALE: FULL
CHK	FXY	28AUG74	20B2480 A
ENG	SRB	29AUG74	





NOTES:

1 UNLESS OTHERWISE SPECIFIED WIRES ARE #26.

REVISIONS		DATE
B	ADDED I.D. TAPE KF	18 OCT 74
A	ADDED VINYL TUBING L.I.	3 OCT 74

MGMT. APPR.

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

CABLE ASSEMBLY
DRS-1 REMOTE TERMINAL STATUS

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	L.I.	27 AUG 74	SCALE: NONE
CHK	FXY	27 AUG 74	2A1384 B
ENG	SRB	28 AUG 74	