

INSTRUCTION MANUAL

MODEL TRC-15A

REMOTE CONTROL SYSTEM

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# TRC-15A INSTRUCTION MANUAL

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MODEL TRC-15A  
REMOTE CONTROL SYSTEM

I. INTRODUCTION

The Model TRC-15A Remote Control System was designed specifically to remotely control FM and standard broadcast transmitters. A total of 15 metering channels and 15 bi-directional (on/off, raise/lower, etc.) control functions are provided by the system. Interconnection between studio and transmitter requires only a single full-time, two-way, voice-grade wire line or radio link. The environment in which the equipment normally functions and the operator using it have both been carefully considered. Excellent performance has been achieved by careful design, and available options make the TRC-15A a versatile remote control system.

The standard TRC-15A uses a telephone line interconnection between the studio and transmitter sites. This system is defined by referring to it as the TRC-15AW. When options are installed to enable sub-carrier or other wireless techniques to be used, it is referred to as the TRC-15AR.

II. SPECIFICATIONS

Number of metering channels	15 (selected one at a time)
Metering system input	Approximately 1 VDC for full-scale studio-meter deflection; nominal 20K resistive floating input, insulated for 350 VDC
Calibration controls	Multiturn potentiometers
Calibration voltage source	Internal Zener diode
Metering system stability	With weekly transmitter-unit checks and daily studio-unit checks, better than 1% exclusive of operator setting or reading error
Control System	
Number of channels	15 On/Raise and 15 Off/Lower, isolated
Control output ratings	1 ampere maximum, 120 VAC maximum

Telephone line studio-transmitter interconnection (TRC-15AW)	
Telephone line impedance	600 $\Omega$
Telephone line levels	0 dBm, adjustable
Control tone frequency	300 Hz to 375 Hz
Metering tone frequency	800 Hz to 1200 Hz
Allowable line loss	30 dB (with 0 dBm send levels)
Radio link studio-transmitter interconnection (TRC-15AR)	
Radio link impedances	2000 $\Omega$ nominal
Radio link levels	1.5 volts peak-to-peak
Control subcarrier frequencies	26 kHz typical for monaural STL. 110 kHz typical for composite stereo STL.
Metering tone frequency	20 Hz to 30 Hz
Metering tone level	Adjustable up to 6 volts peak-to-peak behind 600 $\Omega$
Metering subcarrier (option)	67 kHz typical, 41 kHz alternate
Semiconductor devices	All silicon diodes, integrated circuits, and JEDEC-registered transistors
Operating temperature range	-30°C to +60°C
Power requirements (each end)	120/240 VAC, 50-60 Hz, 20 watts
19 inch vertical rack space	5 $\frac{1}{4}$ inches, each end
Domestic shipping weight	60 pounds

### III. UNPACKING

The TRC-15A 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. Should this inspection reveal any damage, immediately file a claim with the carrier.

It is recommended that the front panels be pulled forward for a brief superficial inspection. Be sure the various printed circuit boards are secure, the integrated circuits and transistors are seated in their sockets, and that the fuse-holders are installed. The rear door of the transmitter unit should be swung down and the relays and fuses confirmed as being in place.

### IV. INSTALLATION

#### A. General Information

IT IS HIGHLY RECOMMENDED THAT NO CONNECTIONS BE MADE TO THE TRC-15A 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 two units are interconnected with a telephone line, the system is a TRC-15AW, or if wireless (subcarrier) interconnections are used, the system is a TRC-15AR.

Connections which will be required at the studio unit are to the power source and either the telephone line (for the TRC-15AW) or the STL/radio equipment (for the TRC-15AR). At the transmitter site these same connections will be required in addition to connections to the control and metering circuits. The control and metering connections should not be made until the studio and transmitter units of the TRC-15A have been interconnected and confirmed as working alone.

The studio unit of the TRC-15A sends control signals in the region of 300 Hz to the transmitter site. In the wire-line TRC-15AW system these signals are sent to the transmitter via a telephone line. In the radio TRC-15AR system the signals are sent via a subcarrier on a radio link. The transmitter unit returns metering signals to the studio unit. These signals are in the region of 800 Hz to 1200 Hz in the case of the wire-line TRC-15AW, or they are in the region of 20 Hz to 30 Hz in the case of the radio TRC-15AR system.

The wire-line system is illustrated in block diagram form in Figure 1, and the elementary radio system is illustrated in Figure 2.

## B. Wireless FM

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 2, the control generator 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 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 studio unit of the TRC-15AR for wireless operation.

At the transmitter site the subcarrier output from the STL receiver is applied to a subcarrier demodulator located in the TRC-15AR transmitter unit. The output from this demodulator is a replica of the control signal which originated at the studio. This signal is then internally applied to the control demodulator in the TRC-15AR as in the basic system. The subcarrier demodulator at the transmitter site is a standard addition to the transmitter unit of the TRC-15AR for wireless operation.

In a similar manner, the metering signals may be returned from the transmitter to the studio by using a subcarrier. As shown in Figure 3, the metering generator 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 metering 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. The output of this receiver or SCA demodulator is a replica of the metering signal generated at the transmitter site.

When the metering signal is returned to the studio in this manner, it is customary to use the frequency range of 20 Hz to 30 Hz for the metering signal. In this way, program material such as background music may also be broadcast on the SCA subcarrier. It has been found in practice that there is little interaction between the two. This low-frequency metering signal, which is referred to as the subaudible metering 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. By the same token, low-pass

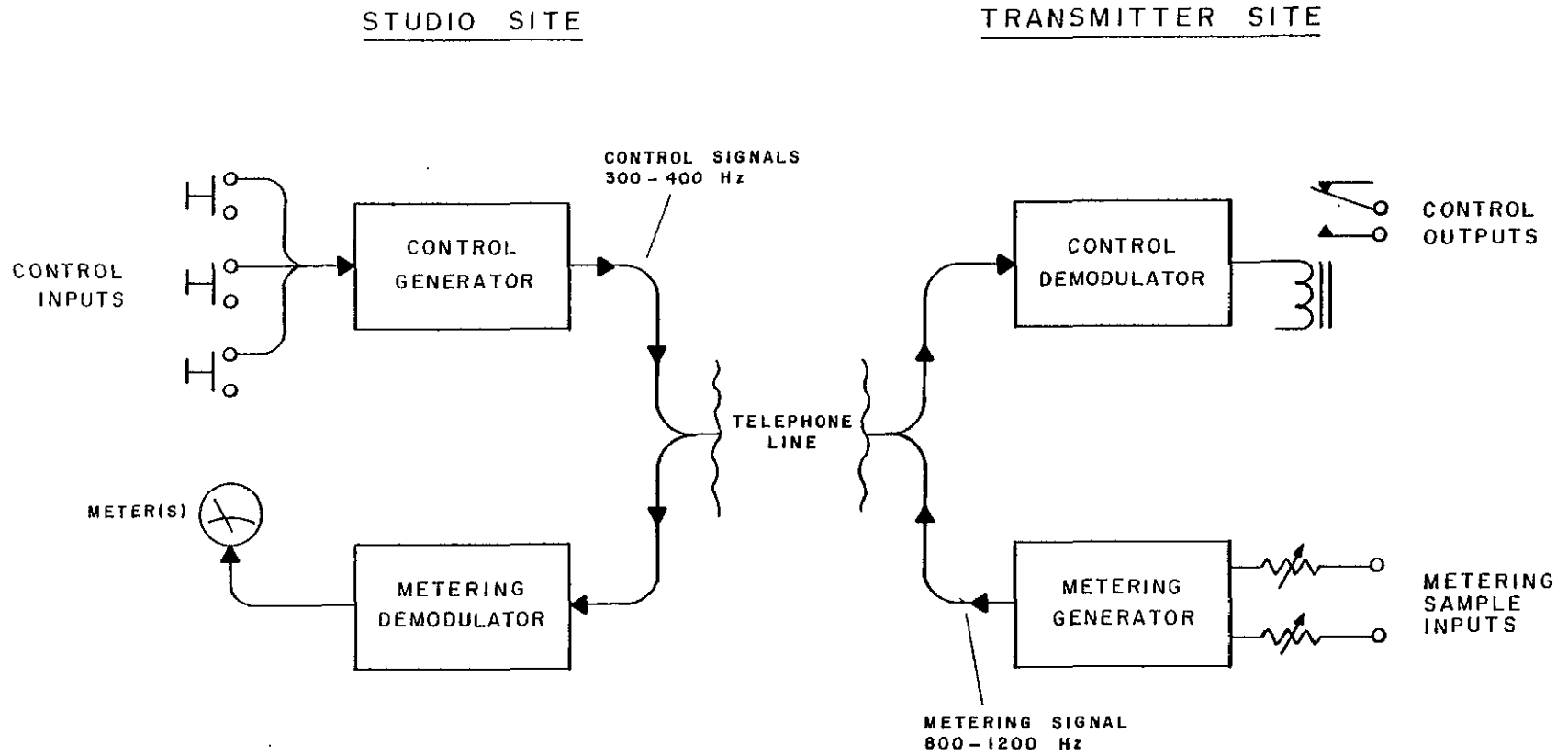


FIG. 1-BASIC TRC-15A REMOTE CONTROL SYSTEM EQUIPMENT ILLUSTRATED COMPRISES THE STANDARD WIRELINE SYSTEM (TRC-15AW)

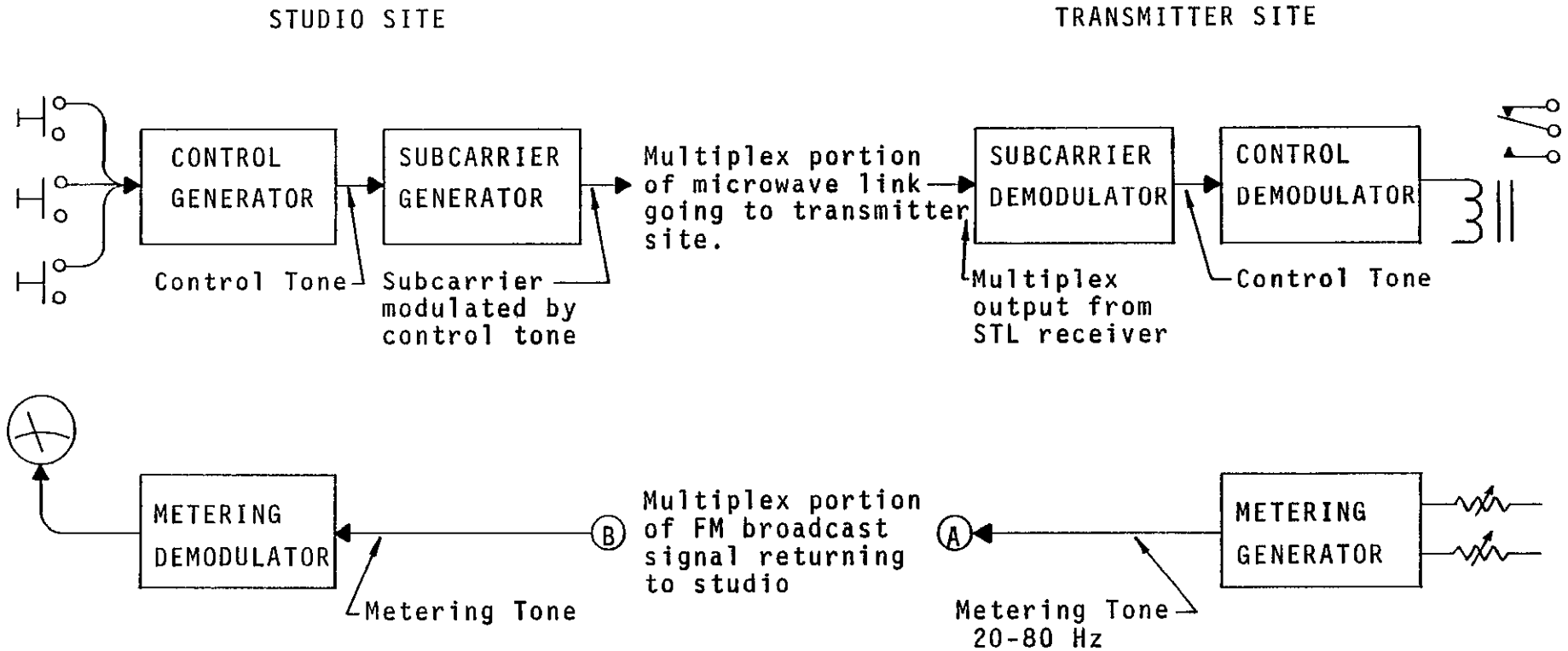


Fig. 2 - Basic Wireless FM version of the TRC-15A.

Equipment illustrated comprises the standard wireless system (TRC-15AR). At "A" is an SCA subcarrier generator, usually a part of the FM transmitter. At "B" is an FM/SCA receiver external to the TRC-15AR.



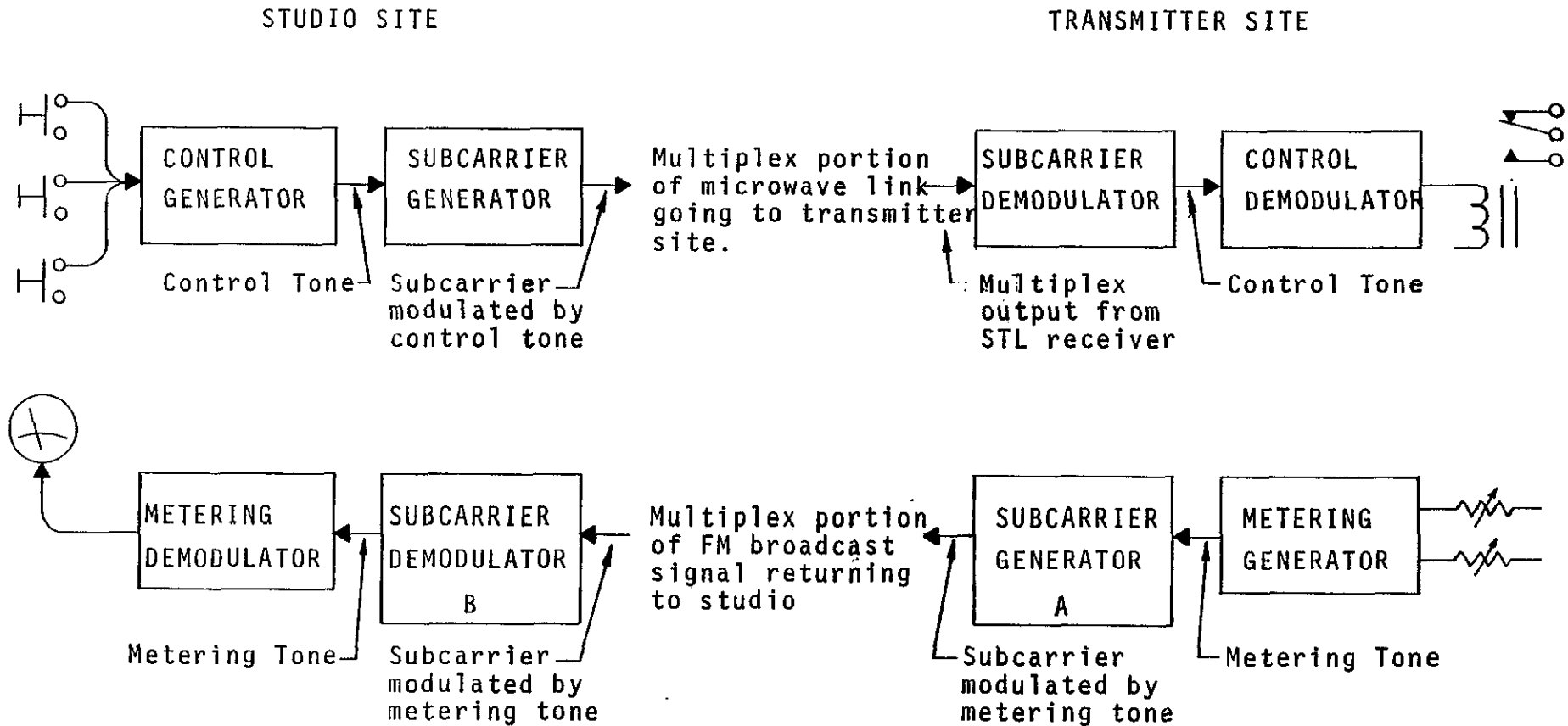


Fig. 3 - Wireless FM version of the TRC-15AR

Equipment shown is the same as in Fig. 2 with added optional subcarrier equipment for metering return. A subcarrier generator has been added for telemetry-only service at "A", and an internal subcarrier has been added for demodulation of this subcarrier at "B".

filtering in the TRC-15AR keeps the normal program material above 40 Hz out of the metering circuitry.

If the FM transmitter does not contain an SCA generator, then a subcarrier generator is installed at the transmitter site as shown at "A" in Figure 2. 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 TRC-15AR for such operation. If program service is not a requirement, then an internal subcarrier generator can be added to the TRC-15A transmitter unit as shown in Figure 3. This telemetry-only SCA generator is installed in place of the subcarrier generator jumper/terminating board in the TRC-15AR transmitter unit. Such an added subcarrier generator at the transmitter site is an available option which may be added to the standard wireless TRC-15AR.

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 studio unit of the TRC-15A as shown at "B" in Figure 3. This subcarrier demodulator will accept the subcarrier and demodulate it to recover the metering signal. This signal is a replica of the original metering signal generated at the transmitter site. It is internally routed to the metering demodulator in the TRC-15AR studio unit. This added subcarrier demodulator at the studio site is an available option which may be added to the standard wireless TRC-15AR.

#### C. Wireless AM

Figure 4 illustrates a modification of the wireless FM installation applicable for wireless AM broadcast transmitters. Here the control tones are conveyed to the transmitter site as in Figure 2, but the metering tone is returned to the studio directly on the main AM broadcast signal. As in the case of FM with its SCA subcarrier, the metering signal is in the 20 Hz to 30 Hz range. The modulation of the AM carrier by the subaudible metering signal is set to about 5%. (6% is the maximum allowed by the FCC Rules.)

#### D. Equipment Location

Providing that installation personnel understand the principles involved for the particular version of the TRC-15A being used, installation of the studio and transmitter units may proceed. The first stage of 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.

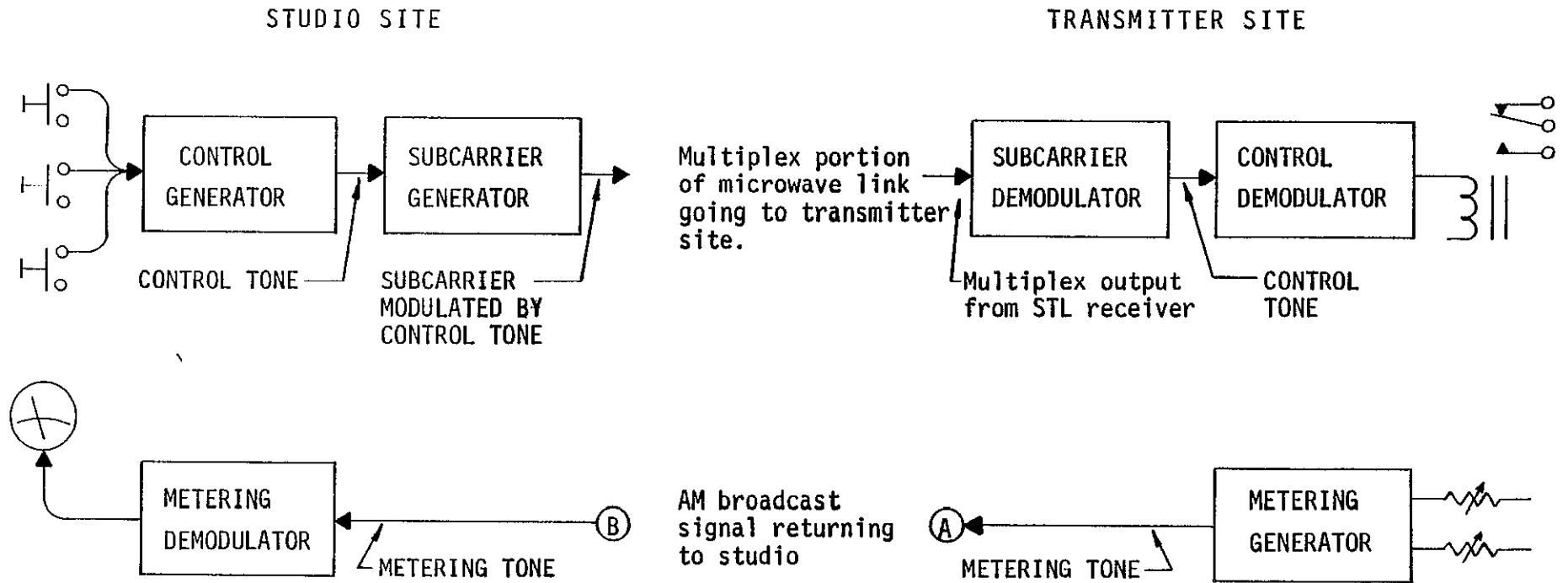


Fig. 4 - Wireless AM version of the TRC-15AR  
 Note the similarity to the Fig. 22. At "A" is a standard broadcast (AM) transmitter, and at "B" is an AM receiver tuned to that frequency. TRC-15AR equipment involved is the standard wireless system (TRC-15AR).

Since the studio unit 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 metering 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 5 illustrates the telephone line connections, and no comment is needed.

Figure 6 illustrates subcarrier and radio equipment connections and should be understood to avoid error. Occasional reference to Figures 2 and 3 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 TRC-15AR internal subcarrier generator is not used, it is replaced by a jumper/terminating board, and the control output connector will deliver the control tone itself. This tone 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.

Metering input to the studio unit will normally be applied from the output of a telemetry receiver. The output of this receiver will normally be the metering tone itself. The metering receiver may be any receiver capable of extracting the metering tone from the broadcast transmission. For FM an SCA receiver modified for telemetry purposes is customarily used. For AM any receiver with a 1.5 volt peak-to-peak subaudible output may be used. (The studio unit of the TRC-15A can be easily modified to increase its sensitivity by as much as 20 dB above this figure.)

If this metering input is a sample of the undemodulated subcarrier as radiated by the FM transmitter, then an internal subcarrier demodulator substitutes for the jumper/terminating board in the studio. The metering input connector should then have applied to it the SCA subcarrier sample which is then internally demodulated in the TRC-15AR studio unit.

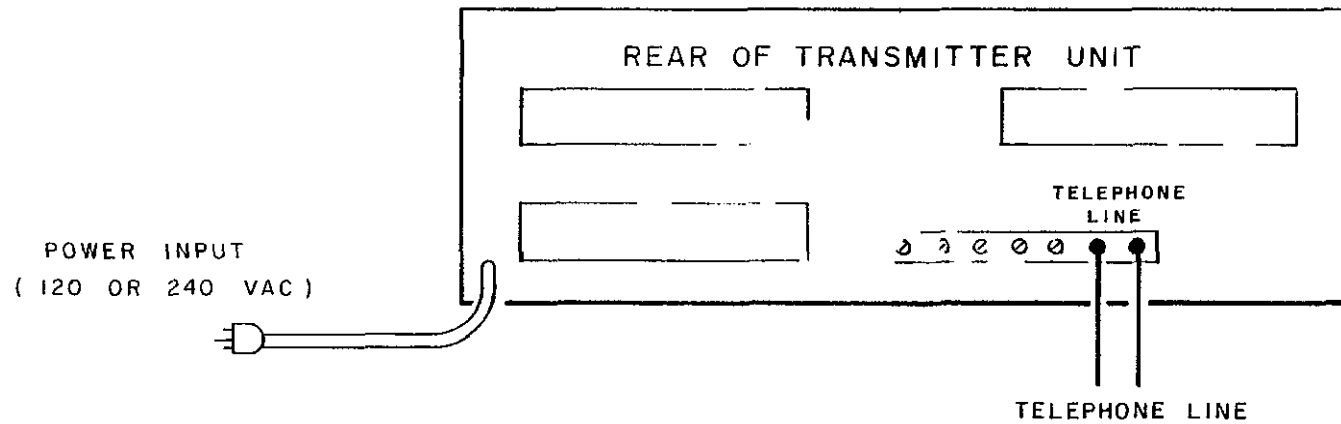
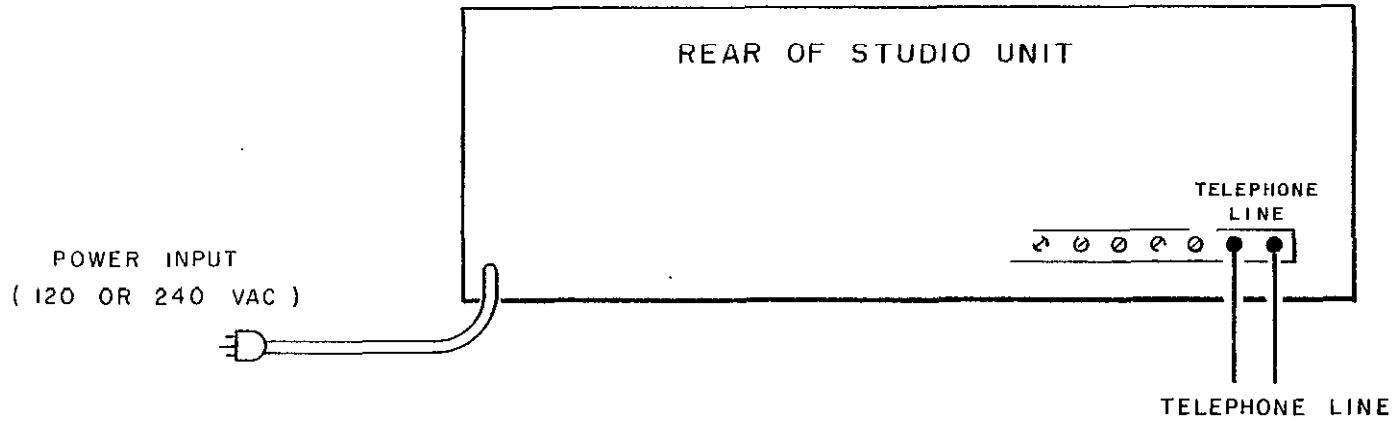


FIG. 5 - TELEPHONE LINE INTERCONNECTIONS

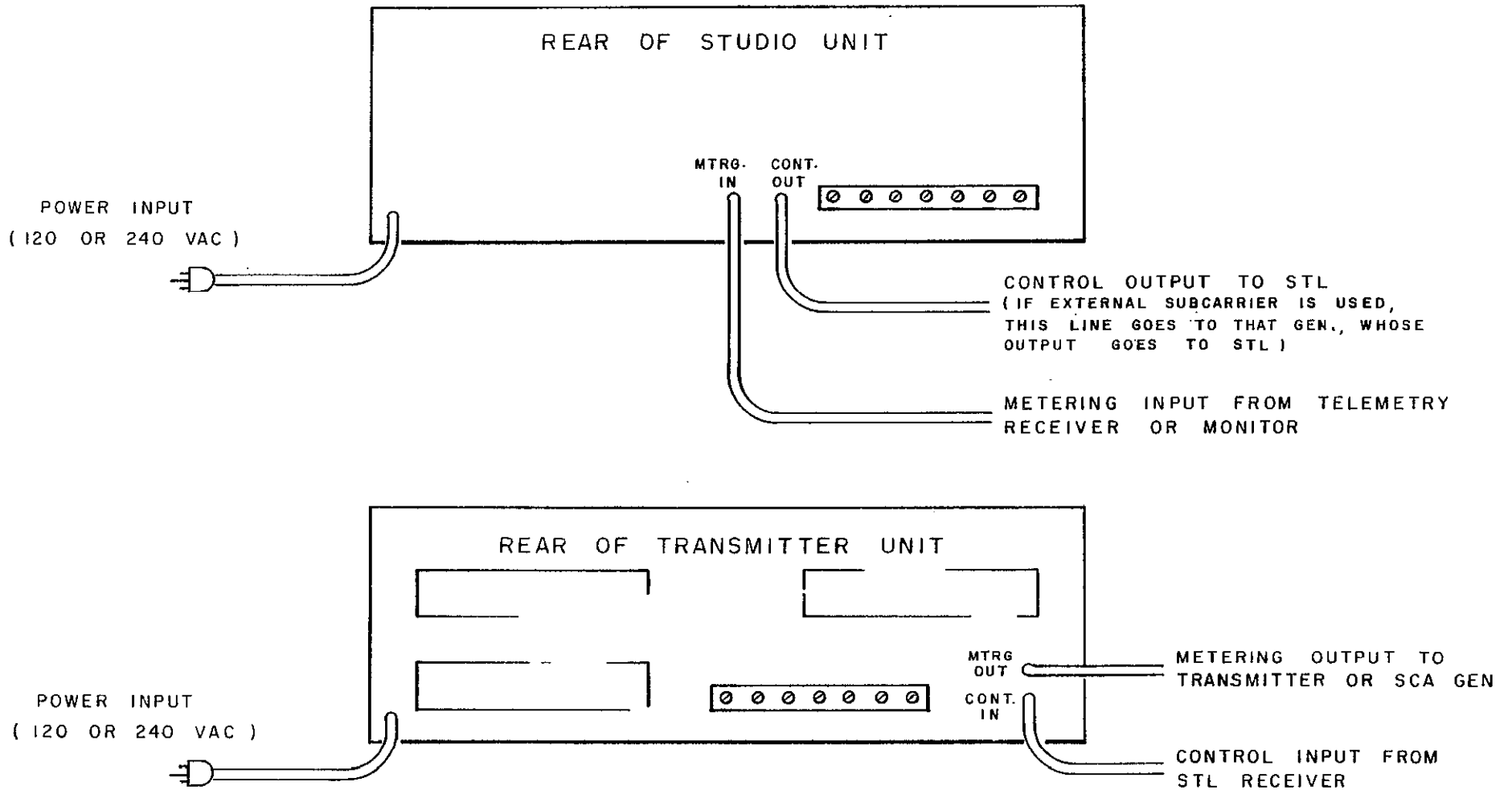


FIG. 6 - WIRELESS INTERCONNECTIONS

The transmitter unit metering output connector will normally deliver the metering tone. The output from this connector will be applied via a mixing network, such as a Moseley Associates MIU-2 Metering Insertion Unit, either to an external subcarrier generator (commonly done in SCA applications) or to another return link to the studio, such as an AM transmitter. When the TRC-15AR transmitter unit contains the subcarrier generator, the output from the metering connector will be a subcarrier which is applied to the FM transmitter multiplex or subcarrier input connector.

The transmitter unit control input connector will generally be connected to the multiplex or subcarrier output from the STL receiver. Under these conditions, the internal subcarrier demodulator in the TRC-15AR transmitter unit will demodulate and extract from the subcarrier a replica of the control tone originating at the studio. If the control signal is already in the form of the audible control tone generated at the studio, then the internal subcarrier demodulator is replaced by a jumper/terminating board. The control input connector then has applied to it the control tone which is routed internally to the control demodulator.

When both studio and transmitter units have been mounted in their respective racks or cabinets and the electrical interconnections have been made, the next step is to check that control signals originating at the studio are received correctly at the transmitter. Likewise, the metering signals must be satisfactorily returned from the transmitter to the studio site. It is advisable at this point to have made no connections to the transmitter control output terminals or to the metering input terminals.

Power may now be applied to both units. If the telephone line is of a satisfactory quality (in the case of the TRC-15AW) or the radio equipment is properly connected (for the TRC-15AR), then pressing the RAISE button at the studio should make the Raise relay at the transmitter site pull in. Pressing the LOWER button should make the Lower relay pull in. Pressing a numbered button at the studio should cause the corresponding numbered relay at the transmitter to become energized.

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 remainder are applicable to wireless systems and are made at the Type BNC (coax) connectors. Refrain from making internal

adjustments unless a reading is definitely unsatisfactory in a manner that is correctable by adjustment.

TABLE I

Recommended Control and Metering Signal Standards - TRC-15A

Control tone leaving studio	0 dBm
Metering tone leaving transmitter	0 dBm
Maximum telephone line loss, 300 Hz to 1200 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 transmitter)	Adjustable up to 6 volts peak-to-peak
Subcarrier demodulator input at studio site (used for metering; driven by FM 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
Control signal direct input at transmitter site (driven from STL via external subcarrier demodulator)	1.5 volts peak-to-peak
Metering signal direct output at transmitter site (connects to AM transmitter or to external subcarrier generator)	Subaudible: up to 6 volts peak-to-peak, adjustable. Audible: approximately 1.5 volts peak-to-peak, fixed
Metering signal direct input at studio site (driven from AM or SCA receiver)	1.5 volts peak-to-peak of metering signal
Modulation of AM transmitter by metering signal	5% (6% maximum)
Deviation of SCA subcarrier at FM transmitter site by metering signal	800 Hz



## F. Metering

MAKE NO CONNECTIONS TO THE METERING INPUTS ON THE TRC-15A UNTIL THE REQUIREMENTS OUTLINED IN THE FOLLOWING PARAGRAPHS ARE UNDERSTOOD.

The metering signals applied to the TRC-15A metering inputs are not the same voltages or currents that are indicated on the 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 transmitter, but rather only a sample of it is, this voltage is also known as the metering sample. Figure 7 will help to illustrate this point.

In "A" of this drawing, 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 10K $\Omega$  to 100K $\Omega$  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 1 volt may not allow full-scale deflection of the studio meter, and more than 4 volts may result in difficult setting of the calibration controls. This assembly is available from Moseley Associates as Type PVK-1 or PVK-2.

In Figure 7 "B," a shunt resistor in the vicinity of 1 $\Omega$  is shown added as R4. This resistor develops a sample of plate current but 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 PRE-  
FERRED FOR THIS REASON.

Bear in mind that the TRC-15A 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 8 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-1.

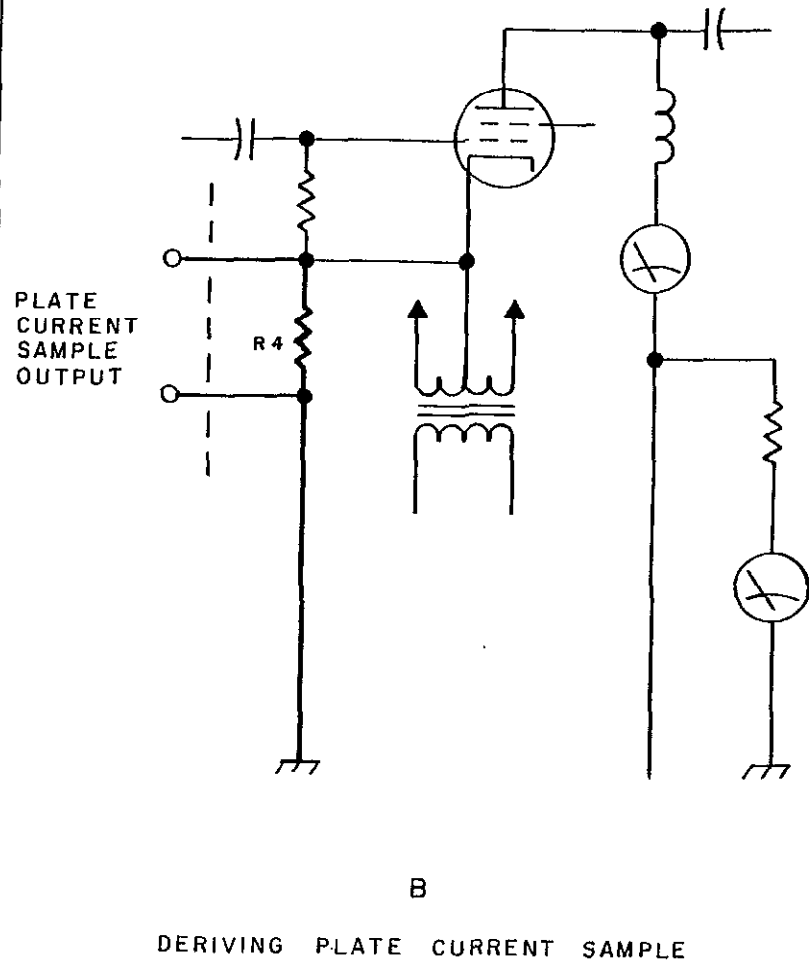
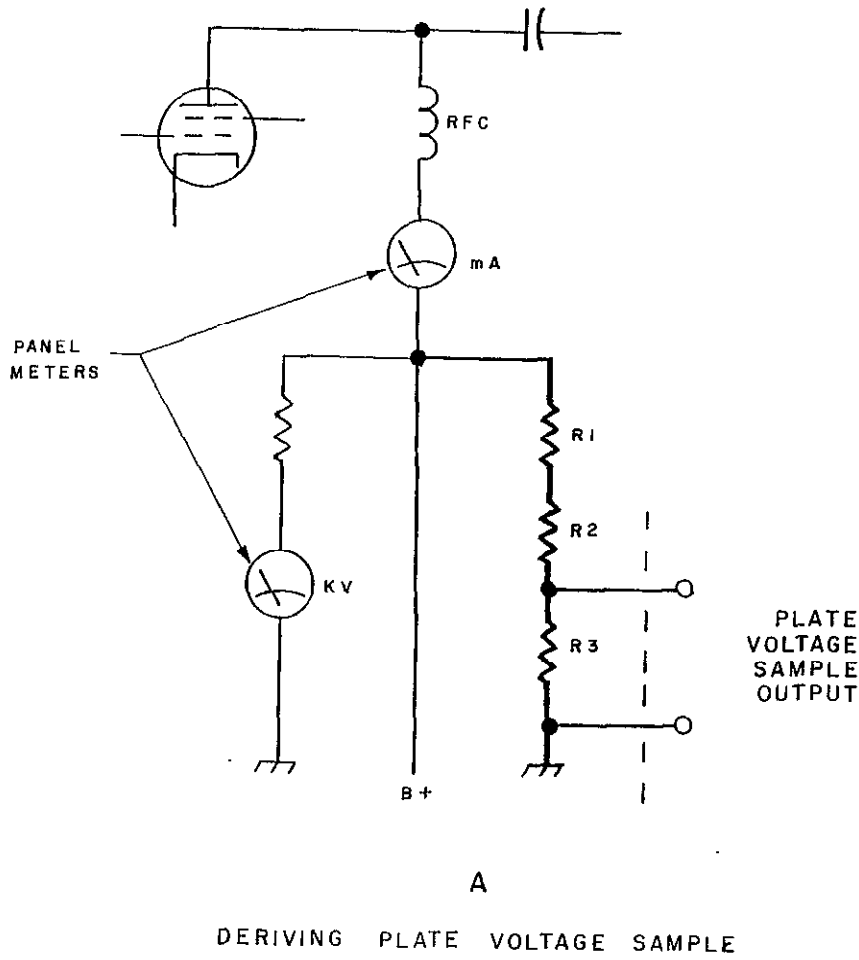
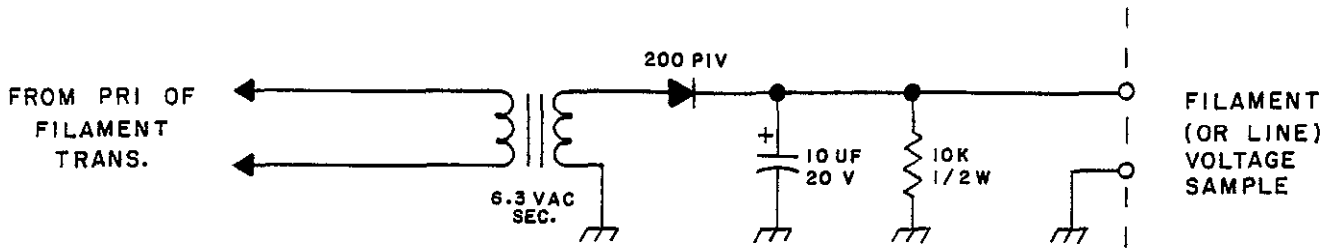
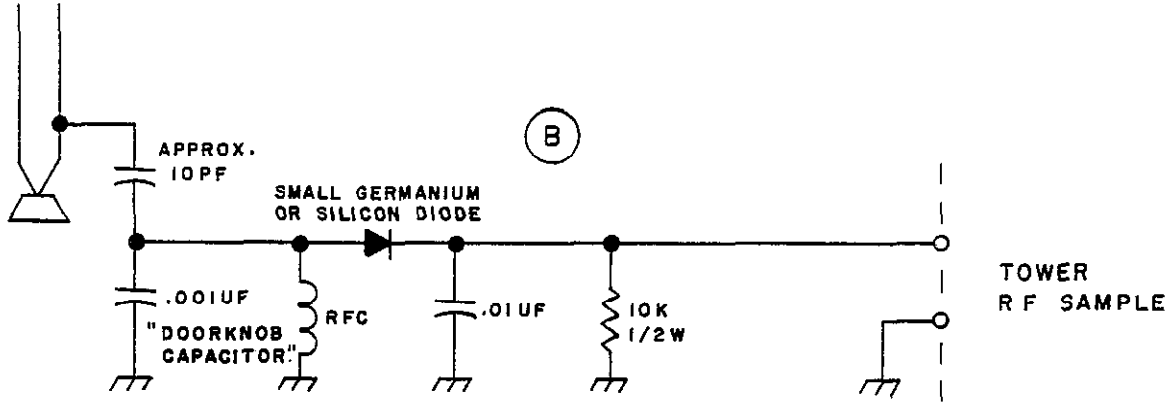


FIG. 7

(A)



(B)



(C)

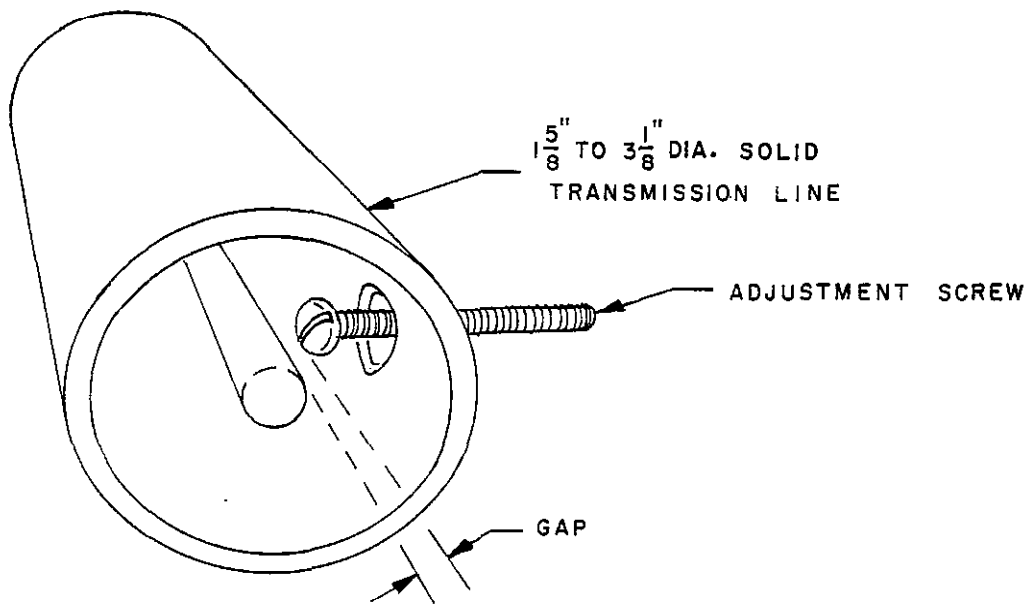
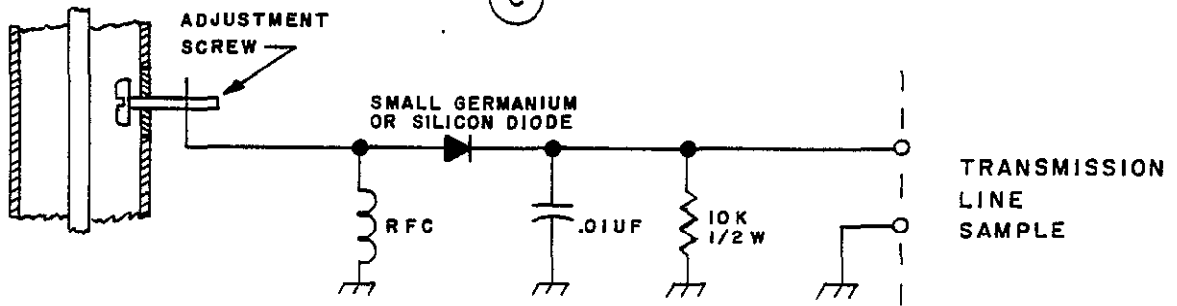


FIG. 8

Antenna base current may be measured by noting that the tower is a linear device, and then measuring voltage instead. The two are directly related. Figure 8 "B" has been proven to be satisfactory. The 10 pf capacitor may be a short piece of coaxial cable or a small-value transmitting-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 0.01  $\mu$ f 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.

In FM installations a scaled-down version of the system shown on "B" may be used. Shown in "C," this system must be carefully constructed. In this case, purchase from a manufacturer is recommended. This device is available from Moseley Associates as Type RFK-2 or RFK-3.

The outputs from reflectometers and frequency monitors are generally low (of the order of 25 microamperes at low voltage in the case of a typical reflectometer), and in the case of frequency monitors an offset adjustment may be required (no input results in half-scale deflection). Both of these complications are solved by using a DC amplifier, such as the Moseley Associates Type DCA-1. The DC amplifier is connected between the reflectometer or monitor and the input to the TRC-15A.

Bear in mind that whatever the source of the metering voltage sample, it should measure in the vicinity of 2 volts DC when a 22K 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 TRC-15A. 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.

## G. Control

MAKE NO CONNECTIONS TO THE CONTROL TERMINALS ON THE TRC-15A UNTIL THE COMMENTS IN THE FOLLOWING PARAGRAPHS ARE UNDERSTOOD.

Refer to Figure 9 for a simplified schematic of the control portion of the TRC-15A. A series of relays, identified as "1" through "15," 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 at all. When a channel is selected, all other channels are disconnected (locked out).

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 10 shows some very simple examples of control circuitry and how they are connected to the TRC-15A transmitter unit. When Channel 1 is selected, the 24 VDC relay coil will be energized by pressing the RAISE button. Going to Channel 2 and pressing the LOWER button will energize the 12 VAC relay coil. Proceeding 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 connections inside the TRC-15 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 TRC-15A and the outside loads. In this manner serious control transients are kept out of the TRC-15A 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 TRC-15A.

There are situations where a connection must be opened upon application of a control impulse. Turning off the filaments on 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.

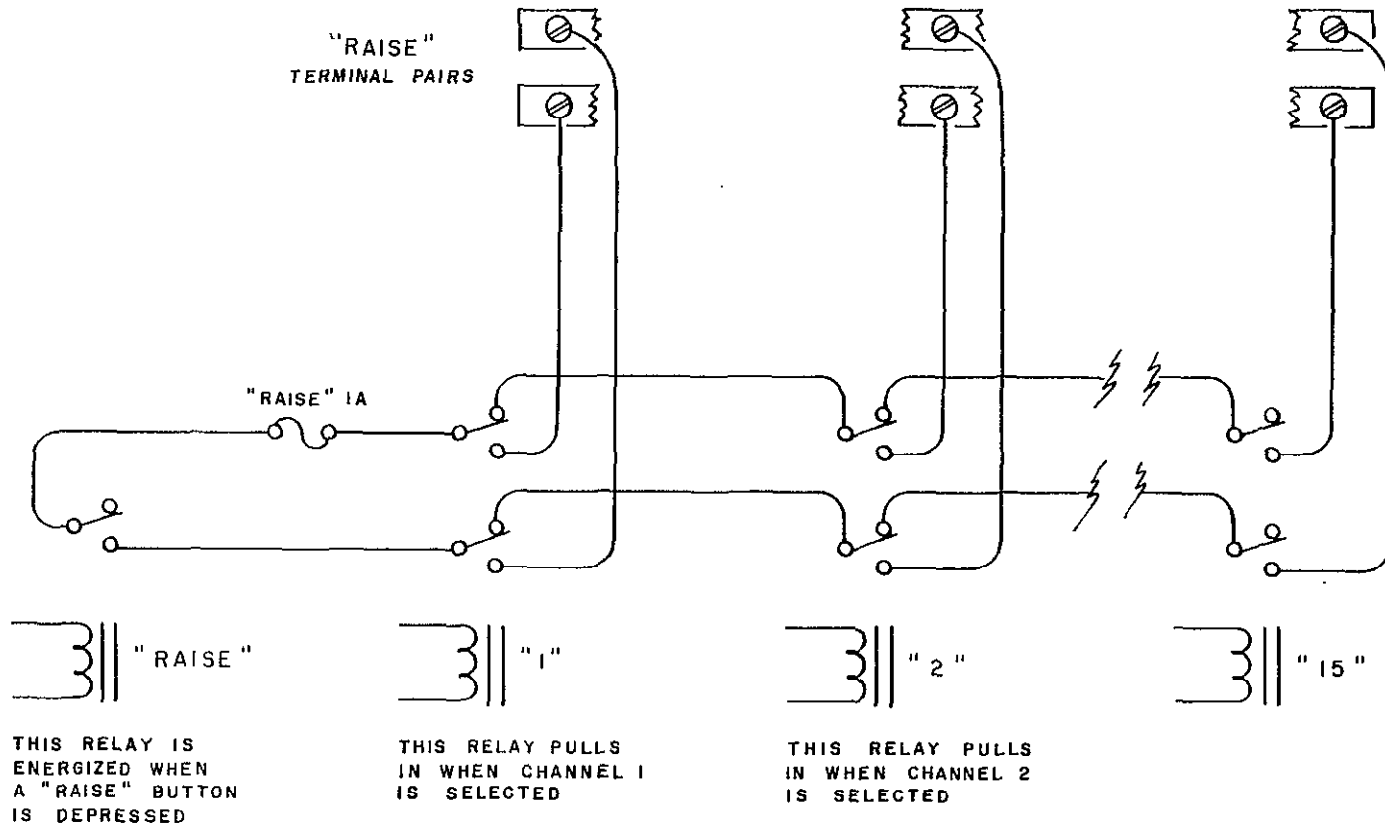


FIG. 9 - SIMPLIFIED CONTROL CONNECTIONS IN THE TRC-15

REAR OF TRANSMITTER UNIT

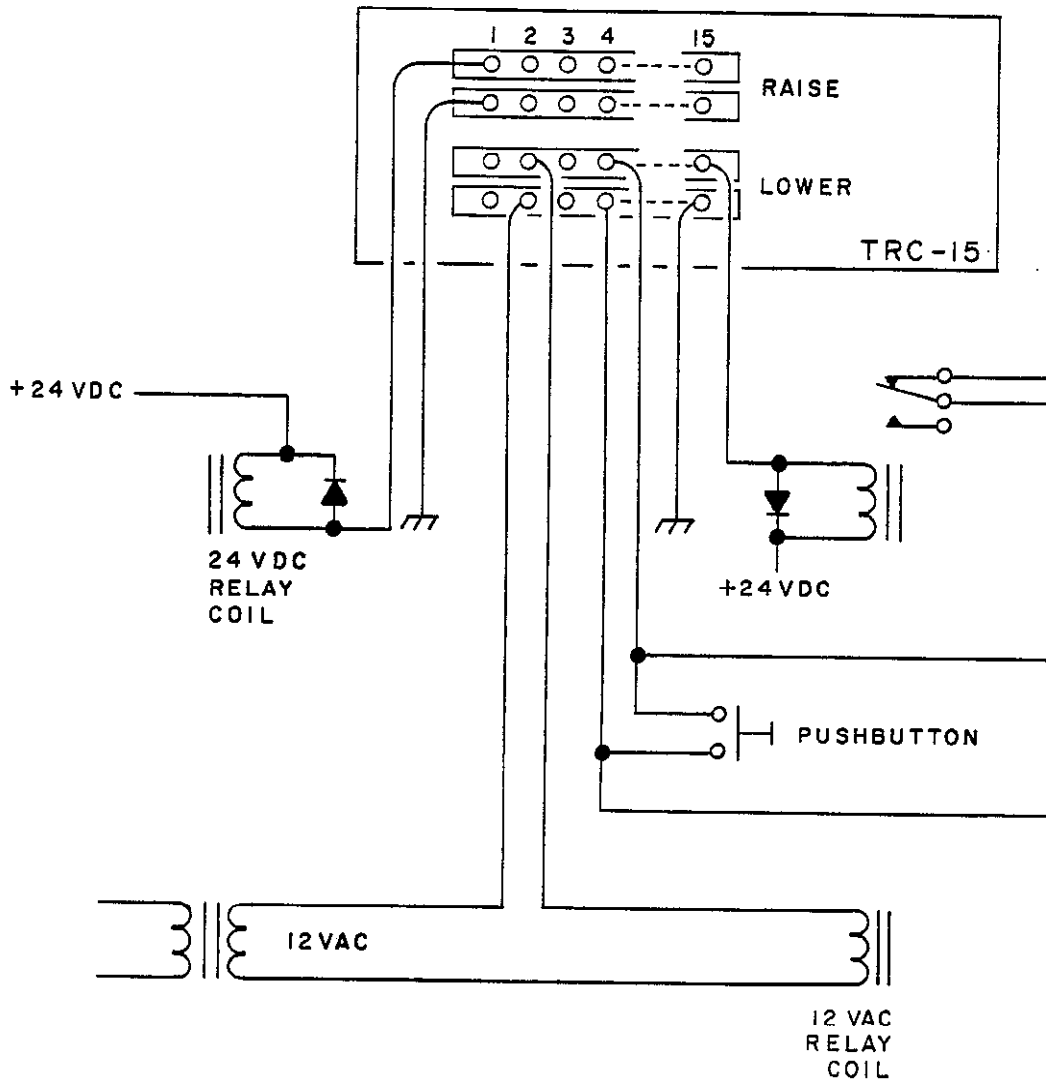


FIG. 10 - SIMPLE EXAMPLES OF CONTROL CIRCUITRY EXTERNAL TO THE TRC-15

This is further illustrated in the right-hand portion of Figure 10. Going to Channel 15 and pressing the LOWER button will energize the relay and open the external circuit.

The current through the control contacts in the TRC-15A should never 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. External loads if AC must have a series RC network across them. (Values of 0.1  $\mu$ f and 100 $\Omega$  are suggested for the small loads permitted by the TRC-15A.) 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.

FCC regulations require that the remote control system be fail-safe, meaning that a control system or link failure will take the transmitter off the air. This is accomplished in the TRC-15A by means of the fail-safe circuitry in the transmitter unit. The fail-safe output is in the form of a single-pole, double-throw relay contact. When the control system is operational, the fail-safe relay internal to the TRC-15A transmitter unit is energized and a pair of terminals on the rear of the transmitter unit is closed. When a failure in the control system occurs, the normally-closed fail-safe terminals are opened. These terminals should be connected in the transmitter control system in a manner that will take the transmitter off the air should they be opened. A simple and commonly used method is to insert these contacts in series with the transmitter-door interlock system. Use appropriate insulation should these wires be exposed at any point in the installation.

The terminals labelled Aux. Power on the rear of the transmitter unit of the TRC-15A are intended to supply power to accessory kits supplied by Moseley Associates, Inc. Up to 100 milliamps are available from these terminals, which deliver plus and minus 15 volts. Indiscriminate usage of this power for miscellaneous nonremote control purposes is not advised. These terminals are NOT for battery operation of the equipment.

## V. OPERATION

If the installation has been accomplished with the help of the preceding instructions, operation of the TRC-15A is quite simple. It is suggested that power and other connections be applied to the units continuously. The front-panel controls are then operational at all times. Be sure



that the LOCAL/REMOTE switch at the transmitter site is in the REMOTE position when the studio is to assume control. At that time the Calibrate channel may be selected. Merely press the CAL button. Now press the RAISE button. The meter at the studio should show a deflection to midscale. If it does not, adjust the CALIBRATE control until it does. Now release the RAISE button. The meter should drop to zero deflection. If it does not, adjust the ZERO SET control. Recheck the midscale deflection by pressing the RAISE button. At this point the metering system is operating correctly, and a control function may be selected. Going, for example to Channel 1, pressing the RAISE button will cause the circuit at the transmitter connected to the Raise/1 output to be operative. This might very well operate a latching relay to turn on the transmitter filaments. Other channels may be selected and operated as well as monitored.

Note that in the case of wireless systems, it is important that the radio subcarrier links be operating correctly before control or metering can be accomplished.

Operation of the system can be accomplished from the transmitter site by pressing the LOCAL button. This disconnects the studio from the system. To go to a new channel, press the ADVANCE button. RAISE and LOWER buttons control their respective relays just as if they were being controlled from the studio. The selected channel can be determined by observing the front-panel readout lamps. After finishing calibration or other checks at the transmitter site, be sure to press the REMOTE button to allow studio control of the system.

## VI. CIRCUIT DESCRIPTION

Each of the subassemblies or modules in the TRC-15A will be described with the help of individual block diagrams. Detailed information will be found on the schematic itself. Remember the two basic signal flow paths in the TRC-15A. One, the control signal, is from the studio or control point to the transmitter or remote unit. The other, the metering signal, is from the transmitter or remote unit back to the studio or control point. Overall views of the system can be obtained by referring to the main schematics of the studio and transmitter unit. The individual modules are discussed in the following paragraphs.

### A. Control Generator

The block diagram of the control generator is shown in Figure 11. This module develops a control tone which is frequency-shift-keyed in accordance with various control commands. The tone idles at 300 Hz and is keyed upwards to approximately 375 Hz. Any of four different commands

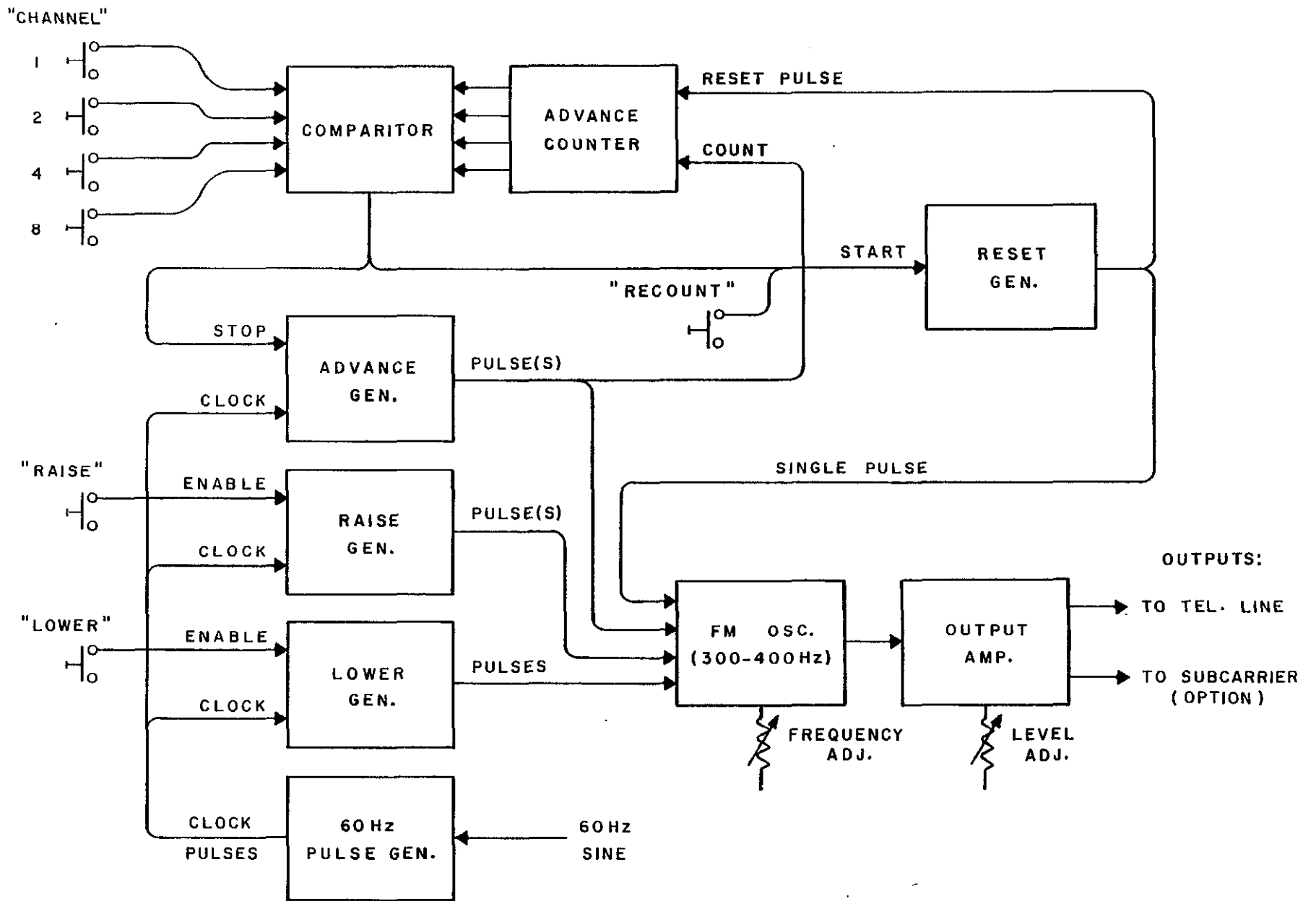


FIG.II - BLOCK DIAGRAM, CONTROL GENERATOR

can cause this shift to be applied to the oscillator. These various commands are in the form of pulses of different widths. One is the reset signal which causes the electronics portion of the transmitter unit to return to a reset or calibrate position. This signal is about 0.3 second long. A second command is a channel counting pulse, used to determine which channel's metering is selected and at the same time enabling a specific Raise/Lower output terminal pair to be actuated. These Count pulses are about 0.033 second long. Finally either a Raise or Lower command may be sent to the transmitter to actually allow such a Raise or Lower output to be used. The Lower signal is a train or series of pulses about 0.066 second long. All of these signals are derived from a pulse generator locked to the power line except the Reset Pulse. This is a single pulse triggered by pushing the front-panel RECYCLE button or any front-panel channel button. Whenever any channel button is depressed, a single Reset Pulse is immediately generated. This pulse resets the channel-counter at the studio and is also sent to the transmitter site. At both locations the channel-selecting electronics returns to the start or calibrate position.

Immediately after this occurs, the advance generator generates a series of pulses which drive the advance counter. This continues until the advance counter develops a binary number which agrees with the number selected by the front-panel push-button deck. When this occurs, the advance generator is stopped. The advance generator is stopped. The advance generator output is also applied to the frequency-shift-keyed oscillator for transmission to the transmitter site.

When the system is not advancing to a new channel and is not resetting, then Raise or Lower commands may be applied.

The remainder of the digital circuitry on the control generator board is devoted to electronically interlocking the system against simultaneous transmission of more than one command at a time. The various commands are also separated by appropriate time delays.

Two adjustments are located on this module. One is used to set the idling frequency of the control oscillator, and the other is used to adjust the amplitude of the control tone at the telephone line output terminals.

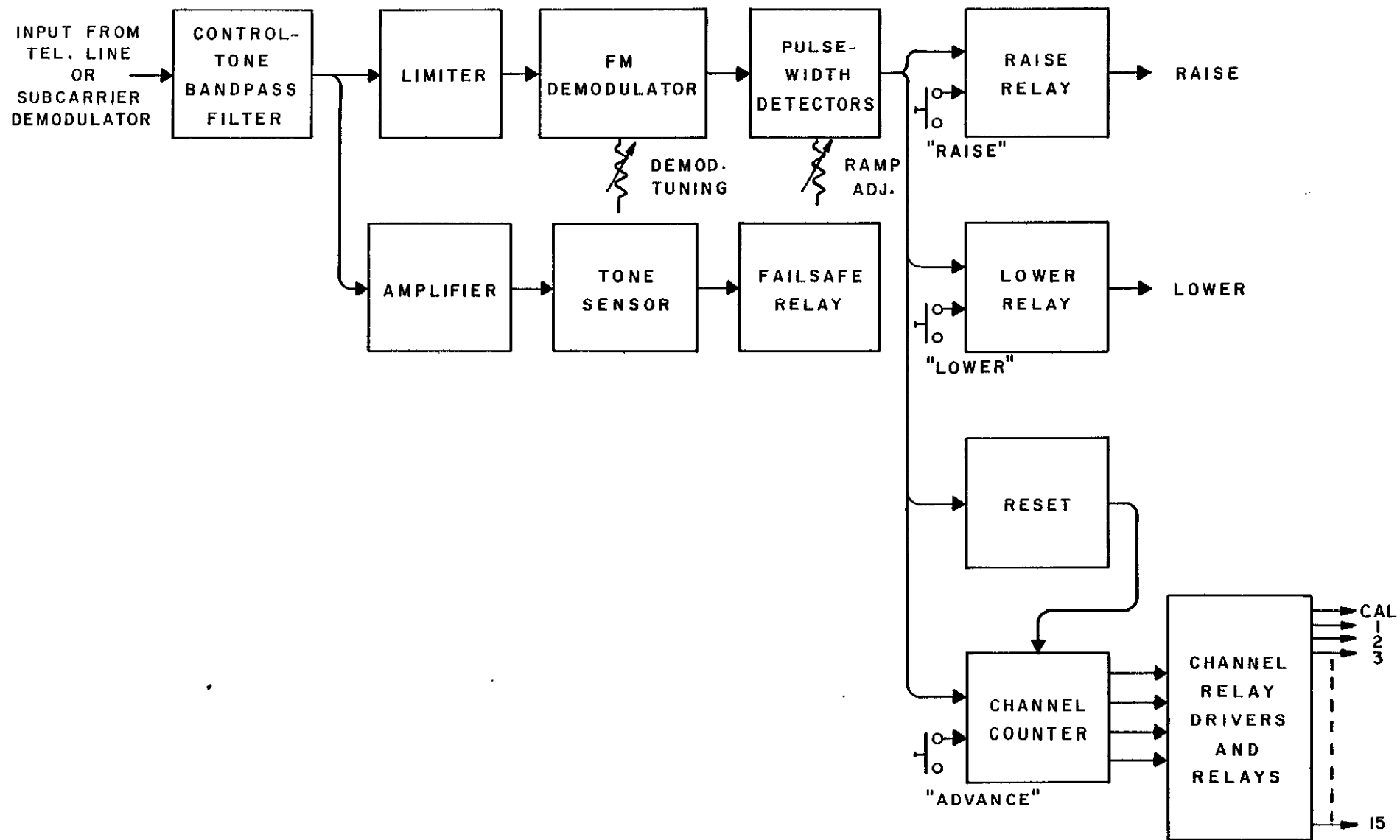


FIG. 12- BLOCK DIAGRAM, CONTROL DEMODULATOR

## B. Control Demodulator

The block diagram of the control demodulator is shown in Figure 12. This module receives and processes the control tone which originated at the studio. The various commands impressed upon the control tone by frequency-modulating it are separated and routed to their correct locations.

The control tone is extracted from other tones which may be present on the telephone line or subcarrier by means of a bandpass filter. Following this filter are an amplifier and limiter which provide a constant-amplitude signal for the FM demodulator. The control tone is frequency-shift-keyed and normally resides at a frequency of approximately 300 Hz. The various commands are sent as pulses of modulation using different pulse widths or durations. They are separated by using pulse-width detectors. A series of four such separators determines whether the pulses are for resetting, for advancing to a new channel, or for operating the Raise or Lower relays.

An input control-tone level-sensor is used to operate the fail-safe system. Failure of the control tone will cause deactivation of the fail-safe relay.

Other circuitry is used to allow local control of the unit by means of the front-panel buttons. Finally, circuitry is included to interlock various circuits so that they operate only in the correct sequence.

The two adjustments on this board enable correct operation of the frequency demodulator and of the pulse separator.

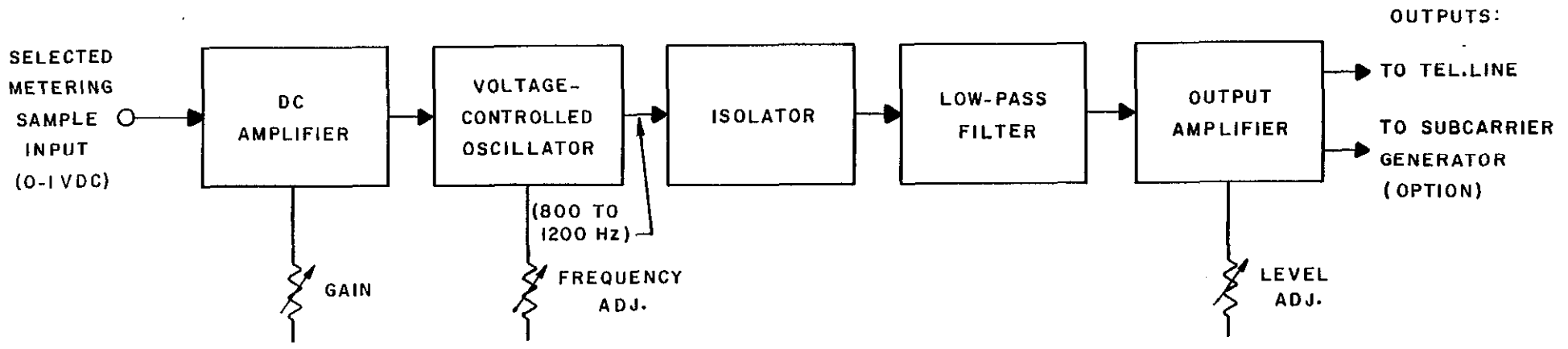


FIG. 13 - AUDIBLE METERING GENERATOR

### C. Audible Metering Generator

The block diagram of the audible metering generator is shown in Figure 13. This module converts the DC metering sample into an audible tone which may be conveyed back to the studio on a telephone line or other voice-grade link.

The selected metering sample is applied to a DC amplifier. This amplifier has a shaped frequency response to reduce its response to audible frequencies. It also has adjustable gain for system calibration. The output is applied to a voltage-controlled oscillator. This oscillator idles, with no metering input, at a frequency of 800 Hz. This frequency will shift upward in direct proportion to the applied metering sample amplitude. It will reach its upper limit of 1200 Hz, representing full-scale deflection of the studio meter, upon application of a 1 volt DC sample.

This entire portion of the module, including its power supply and regulators, is floating with no connection to ground. To translate the output of the voltage-controlled oscillator down to ground, an optical isolator is used. The output of this device is a square wave which is applied to a low-pass filter for conversion to a sine wave. This is applied to an output amplifier to drive the telephone line. An output is also available for application to a subcarrier generator should a radio return link to the studio be used.

Adjustments on this board include an idling-frequency adjustment for the voltage-controlled oscillator, a gain control for the DC amplifier allowing full-scale sensitivity adjustment, and an output level control to adjust the level of the metering tone as applied to the telephone line.

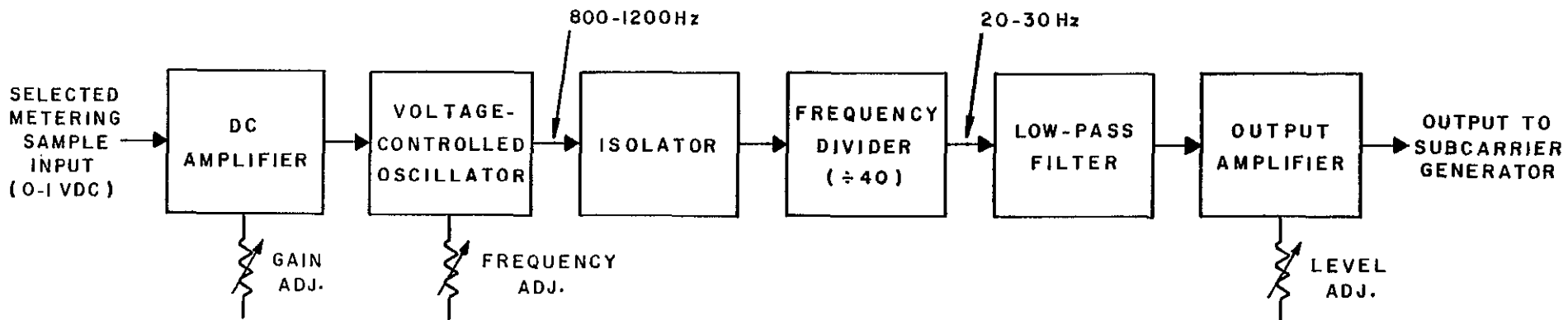


FIG. 14 - SUBAUDIBLE METERING GENERATOR



#### D. Subaudible Metering Generator

The block diagram of the subaudible metering generator is shown in Figure 14. This module converts the DC metering sample into a tone in the 20 Hz to 30 Hz region which may be conveyed back to the studio on a subcarrier or other return link capable of passing 20 Hz.

The selected metering sample is applied to the input DC amplifier. This amplifier has a roll-off to reduce its response to audio frequencies above about 30 Hz. The gain of the amplifier is adjustable for system calibration. Its output is applied to a voltage-controlled oscillator. This oscillator idles, with no metering input, at a frequency of 800 Hz. The frequency will shift upward in direct proportion to the applied metering sample amplitude. It will reach its upper limit of 1200 Hz, representing full-scale deflection of the studio meter, upon application of a 1 volt DC sample.

This entire portion of the module, including the power supply and regulators, is floating with no connection to ground. To translate the output of the voltage-controlled oscillator down to ground, an optical isolator is used. The output of this device is applied to an integrated circuit divider chain for frequency scaling down to the 20 Hz to 30 Hz region. The output of this divider chain is a square wave which is applied to a low-pass filter for conversion to a sine wave. This sine wave is applied to an adjustable-gain amplifier which drives either the internal metering-return SCA subcarrier generator or an external subcarrier system.

Adjustments on this module include an idling-frequency adjustment for the voltage-controlled oscillator, a gain control for the DC amplifier, and an output level control to adjust the level of the metering tone applied to the subcarrier generator.

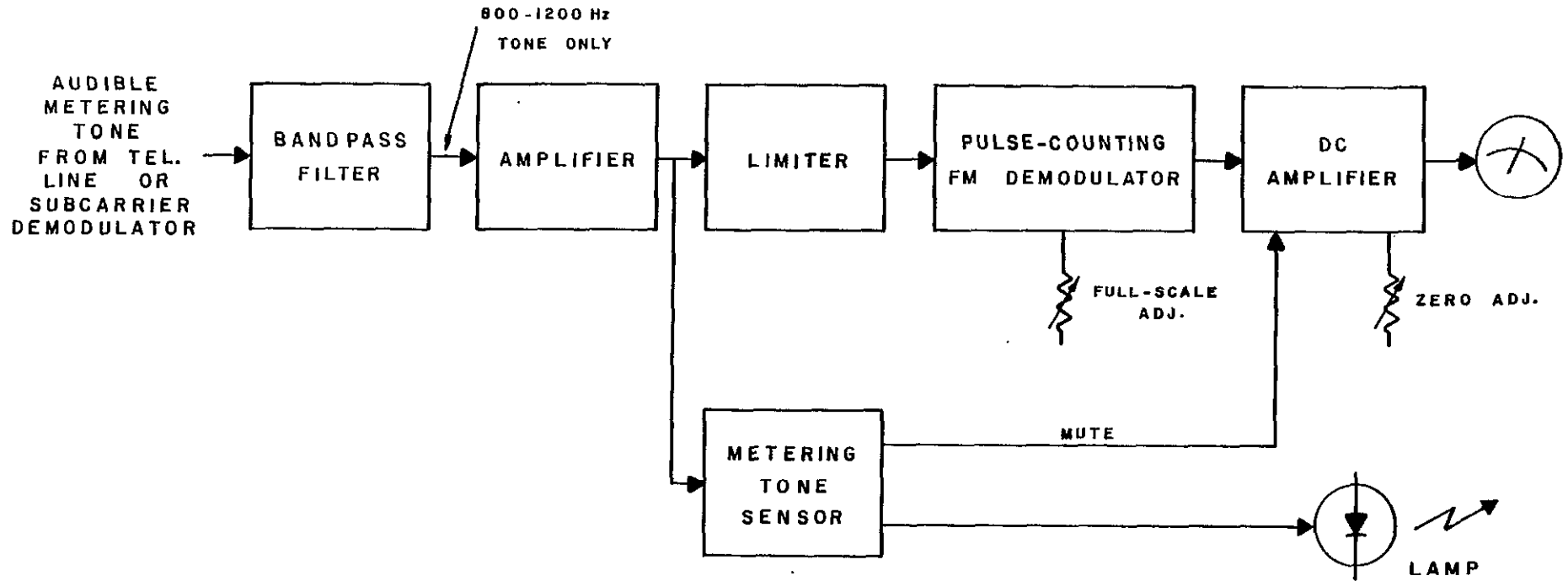


FIG. 15 - AUDIBLE METERING DEMODULATOR

### E. Audible Metering Demodulator

The block diagram of the audible metering demodulator is shown in Figure 15. This module processes the metering tone into a direct current suitable for application to the meter movement in the studio unit.

An on-board strapping option allows selection of metering recovery from either the telephone line or a subcarrier demodulator. The selected signal is then applied to the metering-extraction bandpass filter. This filter passes the metering tone, in the 800 Hz to 1200 Hz region, and rejects other signals which may be present at the input. The output of this bandpass filter is then amplified and applied to both a limiter and a level-sensing circuit. This latter circuit allows the front-panel metering-read lamp to be energized. The limiter drives a pulse-counting demodulator employing a Schmitt trigger and monostable multivibrator. The output of this demodulator is applied to a DC amplifier which is arranged so as to provide considerable control over the meter ballistics. In addition, the input level-sensor is connected to a muting system in order that the meter comes to rest near zero when the metering tone is of insufficient amplitude.

The only two adjustments on this board are both involved with meter ballistics. Electrically connected but physically removed from the board are two more controls for adjusting the meter zero position (when the tone is at 800 Hz) and for adjusting the meter deflection in the calibrate mode (when the tone is at 1000 Hz).

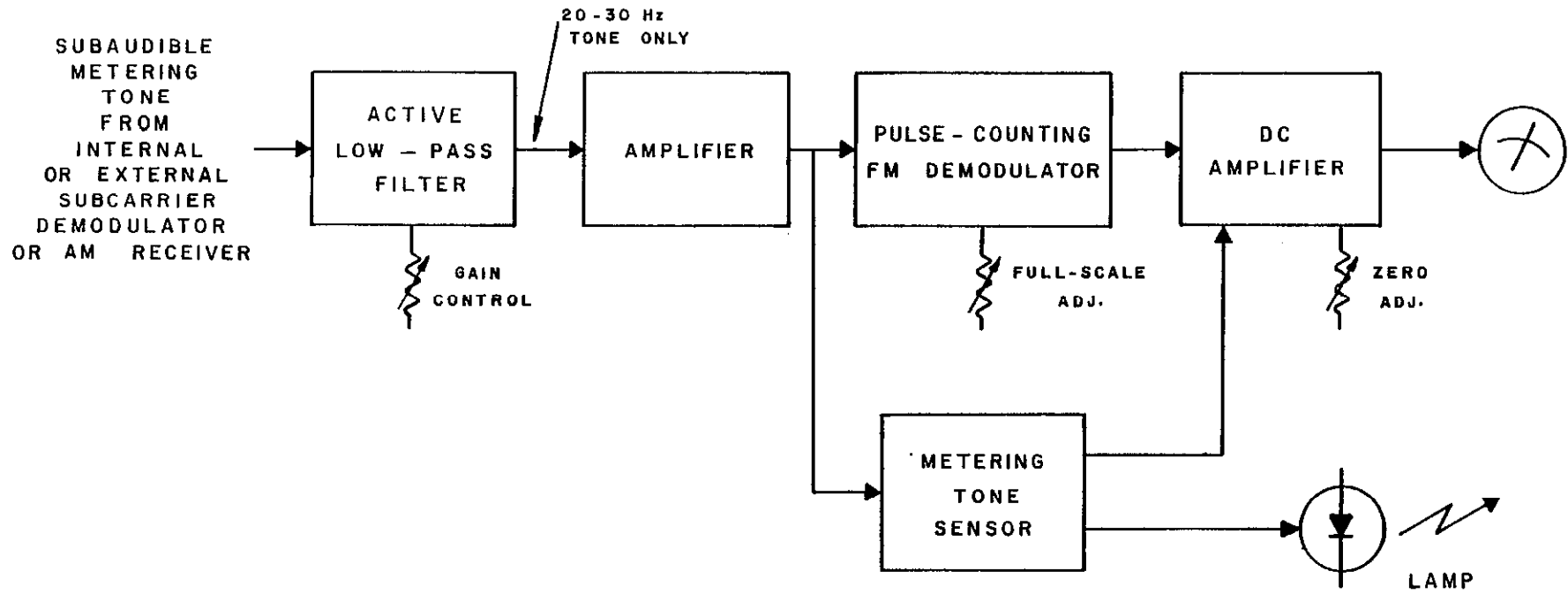


FIG.16 - SUBAUDIBLE METERING DEMODULATOR

## F. Subaudible Metering Demodulator

The block diagram of the subaudible metering demodulator is shown in Figure 16. This module processes the subaudible metering tone into a direct current suitable for application to the meter movement in the studio unit.

The signal as applied to this board will generally have program material on it as well as the subaudible metering signal. This program material is rejected, and only the subaudible tone is passed by the active low-pass filter. This filter significantly outperforms a conventional L-C filter at the frequencies involved (20 Hz to 30 Hz). Following the filter is an amplifier to increase the amplitude to a value suitable for application to the following stages. This stage is a Schmitt-trigger circuit which shapes the sinusoidal tone to a square wave, required to trigger the following monostable multivibrator. The monostable and associated circuitry form the last stage of a pulse-counting demodulator. The output of this demodulator is applied to a DC amplifier which has a cutoff frequency of about 5 Hz. In this way the 20 Hz to 30 Hz metering signal is kept from causing "dither" or quivering of the meter pointer, while still maintaining a reasonable rate of response for the meter movement. The output of the Schmitt trigger is connected to a muting system to cause the meter to come to rest near zero when the metering tone is of insufficient amplitude.

The only adjustment on this board is an input sensitivity control. Physically removed from the board are the Meter Zero adjust and Sensitivity adjust controls.

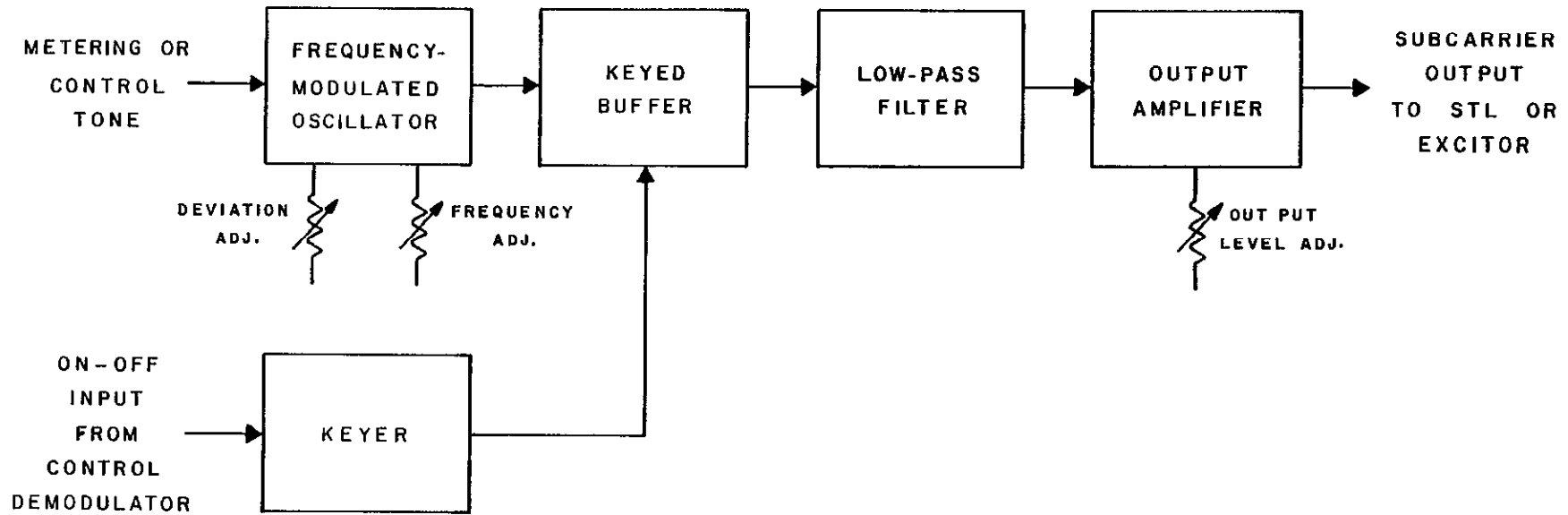


FIG.17 - SUBCARRIER GENERATOR

## G. Subcarrier Generator

The block diagram of the subcarrier generator is shown in Figure 17. This module is used when a signal, either control or metering, is to be conveyed from one site to another in piggyback fashion on a radio link.

The modulation, either control tones in the 300 Hz to 400 Hz region or metering tones in the 20 Hz to 30 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 peak frequency deviation of this oscillator by the control or metering tone is about 5% of the subcarrier frequency for control purposes and about 1% (or more) for metering purposes. The output of the modulated oscillator is applied to a buffer amplifier. This buffer can be keyed on or off by means of a 5 volt signal applied to a muting-input terminal. This signal, if used, is normally supplied by the control demodulator module. By removing the keyer transistor, the subcarrier will always remain on. 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 exciter for wireless return of metering to the studio in wireless metering 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.

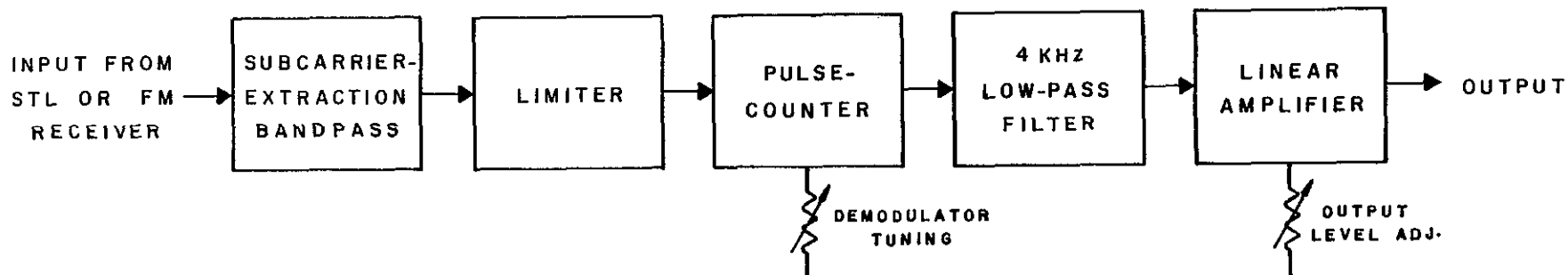


FIG. 18 - SUBCARRIER DEMODULATOR



## H. Subcarrier Demodulator

The block diagram of the subcarrier demodulator is shown in Figure 18. This module is used to extract and demodulate a subcarrier which is carrying either control or metering information.

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. Metering signals in the 20 Hz to 30 Hz range and control signals in the 300 Hz to 400 Hz range 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. ADJUSTMENT

### A. Routine

The only controls on the TRC-15A which are intended to be routinely checked or reset are those on the front panel. At the studio the controls involved are the Zero and Calibrate controls. (See section V. OPERATION.)

Located at the transmitter site are the channel Calibration controls. These are used to make the studio meter readings coincide with those on the transmitter. With the help of a communications link to the studio, one channel at a time is selected and the studio meter readout is compared with the appropriate transmitter meter. If errors exist, readjust the correct channel Calibration control. The settings of these controls should be checked as often as required or deemed necessary, probably weekly.

## B. Internal

The various modules in the TRC-15A have adjustable controls provided to allow for realistic manufacturing tolerances and operational flexibility. The settings of these adjustments should not be altered unless it has been determined that a problem exists which will be cured by a specific readjustment. For the location of these adjustments, refer to the schematic for that particular module. When making measurements involving a test point, the common side of the test equipment is connected to the chassis with the exception of IC's 2, 3, 4, Q1 and the input to IC5 on the metering generator board. Measurements in this area should be referenced to the floating common which is available at pin 5 of this board.

## C. Control Generator

1. Control-tone frequency: The control tone idles at a frequency of 300 Hz and is frequency-shift-keyed upward to about 375 Hz. The idling frequency should be within the limits of 280 Hz and 320 Hz. Observe the violet test point on the control generator board, and adjust the control-tone frequency to an indicated 300 Hz. Use a frequency counter, or compare the tone with an audio oscillator of good reputation, or use an oscilloscope to set the tone to the fifth harmonic of the power line.

2. Control-tone amplitude: The amplitude of the control tone may be adjusted, normally to a level of 0 dBm into the telephone line. Use a VTVM calibrated directly in dBm for this adjustment, or an AC VOM as an alternate. Should excessive RF or noise appear on the line, use the grey test point on the control generator board. If this is done, set for an indication of +6 dBm. The drop in an internal resistor will reduce this to 0 dBm on the telephone line. There is no adjustment provided for the control-tone output level as applied to the subcarrier generator; this is fixed by internal resistor values to a suitable value.

## D. Control Demodulator

1. Demodulator tuning: This control sets the operating point of the pulse counter. It may be set by observing the green test point on the control demodulator board. While observing this test point, press the Raise button on the studio unit to send a continuous pulse train. Then set the demodulator tuning control for zero volts DC as read on an ordinary DC voltmeter connected between ground and the green test point on the control demodulator. When the button at the studio is released, the green test point will show a negative voltage reading. When the Raise, Lower, or Recycle buttons are held down, the reading will go to zero and will show "dither" or low-frequency variation due to the presence of the low-frequency train.

2. Ramp adjustment: This control allows the various pulses to be correctly separated according to their width. If misadjusted, one control command could be misinterpreted by the electronics as being another. For example, pressing the studio RAISE button might result in the Lower relay being energized, or perhaps the other way around. Prior to resetting the ramp adjustment, be sure that the control generator and the demodulator tuning controls are both correctly set. To adjust the ramp control, press the studio RAISE button. When the Ramp adjustment control is turned, a point will be reached where the Lower relay will be energized instead of the Raise relay. Turning the control the other way, the Raise relay will become de-energized. The correct setting for this control is midway between these two settings. After resetting this control, confirm that all other functions are satisfactory. Minor readjustment may be necessary.

#### E. Audible Metering Generator

1. 800 Hz adjust: This control sets the "no input" frequency of the metering oscillator. To set this control, go to an unused telemetry input or the CAL position. Connect a frequency counter or other measurement device (see the suggestions listed under "Control Generator") to the grey test point on the audible metering generator board. Set the 800 Hz adjustment for an indication of 800 Hz. The acceptable limits are 780 Hz to 830 Hz.

2. 1000 Hz adjust: This control sets the sensitivity of the voltage-controlled metering oscillator. When the calibration voltage is applied to the unit, this control is adjusted for a metering oscillator frequency of 1000 Hz. To set this control, go to the CAL position and press the RAISE button. This applies the calibration voltage to the system. Set the 1000 Hz adjustment for an indication of 1000 Hz using the same procedure as mentioned in the previous paragraph. Acceptable limits would be 980 Hz to 1020 Hz.

3. Telephone line metering level adjust: This control sets the amplitude of the metering tone applied to the telephone line. This will normally be set to a level of 0 dBm into the line. Use a VTVM calibrated in dBm for this adjustment, or an AC VOM as an alternate. Should the line have RF or noise on it, use the white test point on the audible metering generator board. If this is done, set for an indication of +6 dBm. The drop in an internal resistor will reduce this to 0 dBm on the telephone line. There is no adjustment provided for the metering tone level applied to the subcarrier generator; this is fixed by internal resistor values to a suitable value.

## F. Subaudible Metering Generator

For adjustment of this module, refer to the procedures outlined for the audible metering generator. The only change is that the figure 800 should be changed to read 20, and the figure 1000 will become 25. This is due to the divide-by-forty circuit in the subaudible metering generator. In addition, the output is to the subcarrier generator only, and it is adjustable. Set this control for a deviation of the subcarrier of about 800 Hz peak deviation.

## G. Audible Metering Demodulator

1. Overshoot adjustment: This control sets the effective damping of the meter movement. First, set both controls on this board fully counterclockwise. Then adjust the overshoot adjustment so that the meter nearly overshoots when a step voltage is applied to the metering system. A convenient step for adjustment is the calibrate signal. Merely select the calibrate channel, and alternately press and release the RAISE button for a step input to the metering system from the internal calibration voltage at the transmitter site.

2. Acceleration adjust: This control sets the amplitude of the "speed-up" signal applied to the meter movement. After the overshoot adjustment is made, the acceleration is adjusted. As it is advanced from the starting counterclockwise extreme, it will be noticed that the meter movement is more and more responsive. Finally, the meter overshoots, and the control may be backed off somewhat. The meter-movement rise time is quickened if a small overshoot is allowable.

## H. Subaudible Metering Demodulator

1. Input level adjust: The only control on this board is an input level adjustment. With a signal containing subaudible metering information applied to the module, adjust the input level control for a reading of -6 VDC as measured at the violet test point using an ordinary voltmeter. Should the input signal be of very low amplitude, the sensitivity can be increased by installing a resistor in parallel with R15. A value of 2200  $\Omega$  installed in the holes provided will give an increase in sensitivity of about five times (14 dB). A 470  $\Omega$  resistor will yield a gain increase of about 20 times (26 dB).

## I. Subcarrier Generator

1. Frequency adjust: 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 done by turning down the modulation using the deviation control.

2. Deviation adjust: 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 for control purposes or 800 Hz for metering service. If the subcarrier demodulator is used to measure the subcarrier deviation, refer to the section on that module for instruction.

3. Output level adjust: This control is set for about 20% injection of subcarrier into an aural STL, or 1.5 volts 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 metering signal, and the word injection means modulation of the main carrier by the subcarrier.

#### J. Subcarrier Demodulator

With 1.5 volts peak-to-peak subcarrier applied to the subcarrier demodulator, adjust the four inductors for maximum subcarrier amplitude coincident with minimum ripple or modulation as observed with an oscilloscope connected to the yellow test point. This filter realignment should not be necessary unless a component has been replaced.

1. Demodulator tuning: 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 5 volts DC. This reading should be within the range of 4 volts to 6 volts DC and must not exceed 7 volts DC. Be sure the subcarrier is on frequency and of the correct amplitude before this adjustment is made.

2. Output level adjust: This control is used to set the output level from the subcarrier demodulator. This control is set for 1.5 volts 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 volt rms is measured at the green test point of the subcarrier demodulator when the demodulator tuning control is set for 5 volts DC at that test point.

## VIII. MAINTENANCE AND REPAIR

After installation, it is considered good practice to observe the various points of the system with available test equipment. If an oscilloscope is available at that time, especially interesting to view is the series of waveforms shown on the various schematics. These observations will enable maintenance personnel to become familiar with the electronics in a painless manner.

The TRC-15A has been built by craftsmen using the highest quality of components. Only the latest of appropriate and proven designs have been employed. In spite of these manufacturing efforts, and in spite of careful treatment during installation and operation, a component may eventually fail and cause a problem. An understanding of how the system works will help in diagnosing the failure.

The following comments may prove of help during such a time of stress.

1. If possible, remove nearby sources of RF when the electronic circuitry is exposed. RF tends to re-bias amplifiers and saturate IC's, making operation unpredictable.
2. Try to isolate the problem to a specific area. To assist in this, voltages and waveforms are shown on the schematics at key points. By comparing the suspect unit with the measurements given on the schematics, the problem can usually be localized quickly.
3. If an integrated circuit is suspect, carefully remove the original and plug in the new one in the same direction. These devices are installed one way only, and plugging in the new one backwards may damage it. The "key" on these IC's is a small dot at pin 1, or an indentation at one end, or (for round IC's only) a tab extending out from the highest numbered pin. The correct manner of insertion is also shown on the component layout drawings.
4. If removal of a component from a printed-circuit board is required, use a 40 watt soldering iron with a 1/8 inch tip. Do NOT use a soldering gun. Remove all of the solder from the component and from the associated board pads. Then lift out the component. Its lead may have to be cut. As an assist in de-soldering, solder-sipping braid such as Solderwick may be used.
5. Make an effort to solve any problem on your own. Should you repair the ailing unit, a tremendous increase in self-confidence results. This comment is included because IC's are still new to many in the broadcast industry. Even if you do not succeed in obtaining a satisfactory repair, you will have gained familiarity with an otherwise

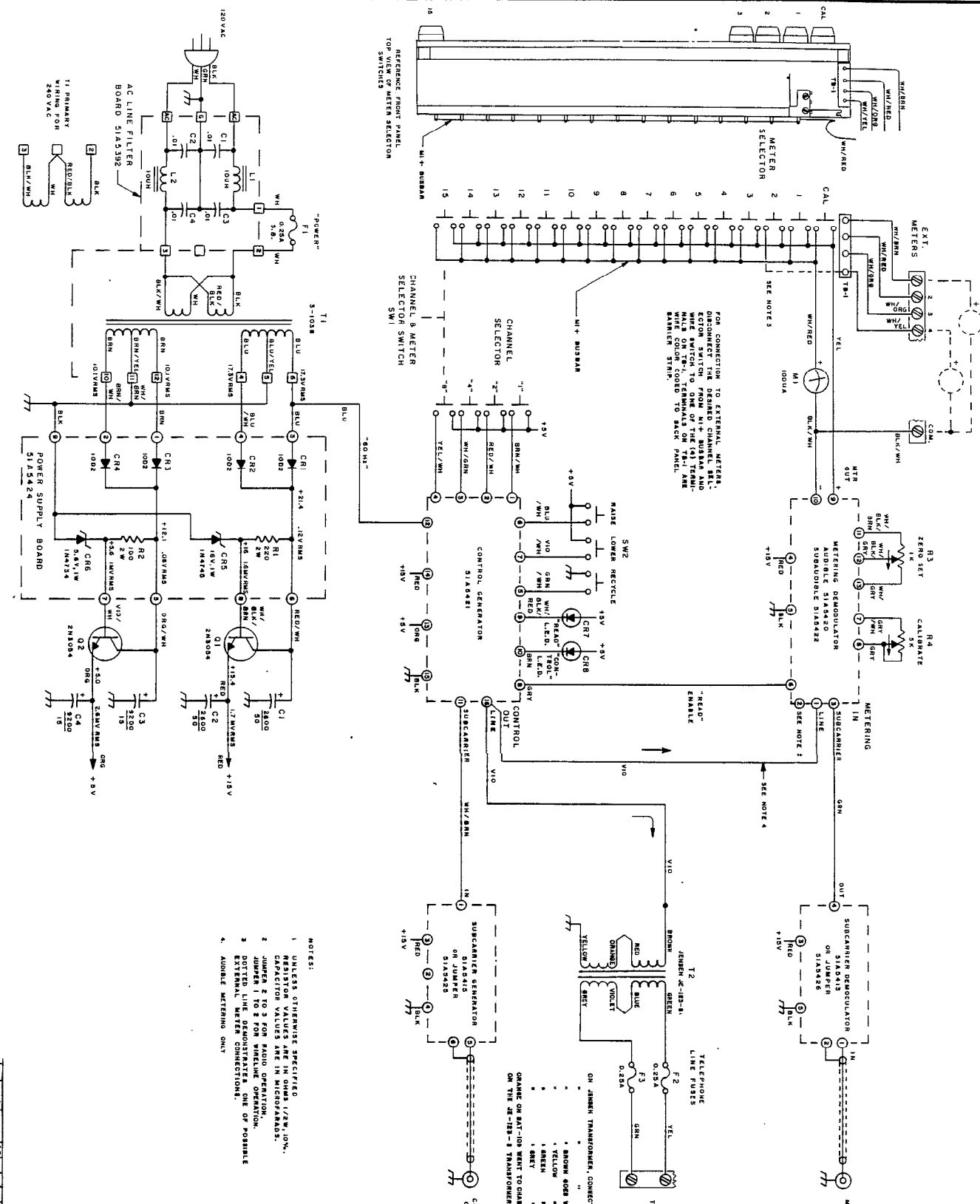
seldom-encountered piece of equipment.

6. Be sure it is still wired and connected. Check the fuses. Make as many measurements as you can.

7. There are two general routes which may be taken regarding factory servicing of the equipment. One is to diagnose the problem to a module level. Then a replacement module is mailed out. The second route is a return of the complete (both units) system to the factory. Obviously this method is more time consuming.

8. Do not return equipment without having first contacted the factory. Should communications be necessary regarding the TRC-15A, address your correspondence to:

Customer Service Department  
MOSELEY ASSOCIATES, INC.  
111 Castilian Drive  
Goleta, California 93017  
Telephone: (805) 968-9621



- NOTES:
- UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS (1/2W, 1/4W). CAPACITOR VALUES ARE IN MICROFARADS.
  - JUMPER 2 TO 3 FOR RADIO OPERATION.
  - JUMPER 1 TO 2 FOR WHEELS OPERATION.
  - SYSTEM, LINE AND WIRE CONNECTIONS.
  - ADAPTABLE METERS ONLY

OR JUMPER TRANSFORMER, CONNECT RED TO GRANGE AND BLEEDING BLUE TO GROUND. \* YELLOW GORN WHEN BLK-WHITE WENT ON 841-109 \* YELLOW \* RED-WHITE \* GREY \* RED \* GRANGE ON 841-109 WENT TO GRANGE; THERE IS NO SUCH CONNECTION ON THE 48-128-3 TRANSFORMER

REVISIONS	DATE
A	12/11/72
B	11/11/72
C	11/11/72
D	11/11/72
E	11/11/72
F	11/11/72
G	11/11/72
H	11/11/72
I	11/11/72
J	11/11/72
K	11/11/72
L	11/11/72
M	11/11/72
N	11/11/72
O	11/11/72
P	11/11/72
Q	11/11/72
R	11/11/72
S	11/11/72
T	11/11/72
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V	11/11/72
W	11/11/72
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Y	11/11/72
Z	11/11/72

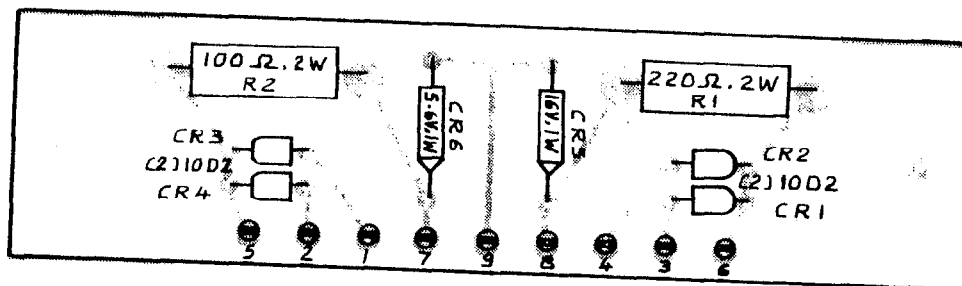
**(CONTROL TERMINAL)**

**MOSELEY ASSOCIATES, INC.**  
SANTA BARBARA, CALIFORNIA

**TRC-15 STUDIO UNIT**  
SCHEMATIC UNIT

DRAWN BY: J. L. MOSELEY  
CHECKED BY: J. L. MOSELEY  
DATE: 11/11/72  
SCALE: 1:1  
JOB NO: 91 C 6560  
PAGE: 54





NOTES:

- 1 P.C. BOARD 51A 5424
- 2 SCHEMATIC 91C 6560

STUDIO UNIT (CONTROL TERM.)

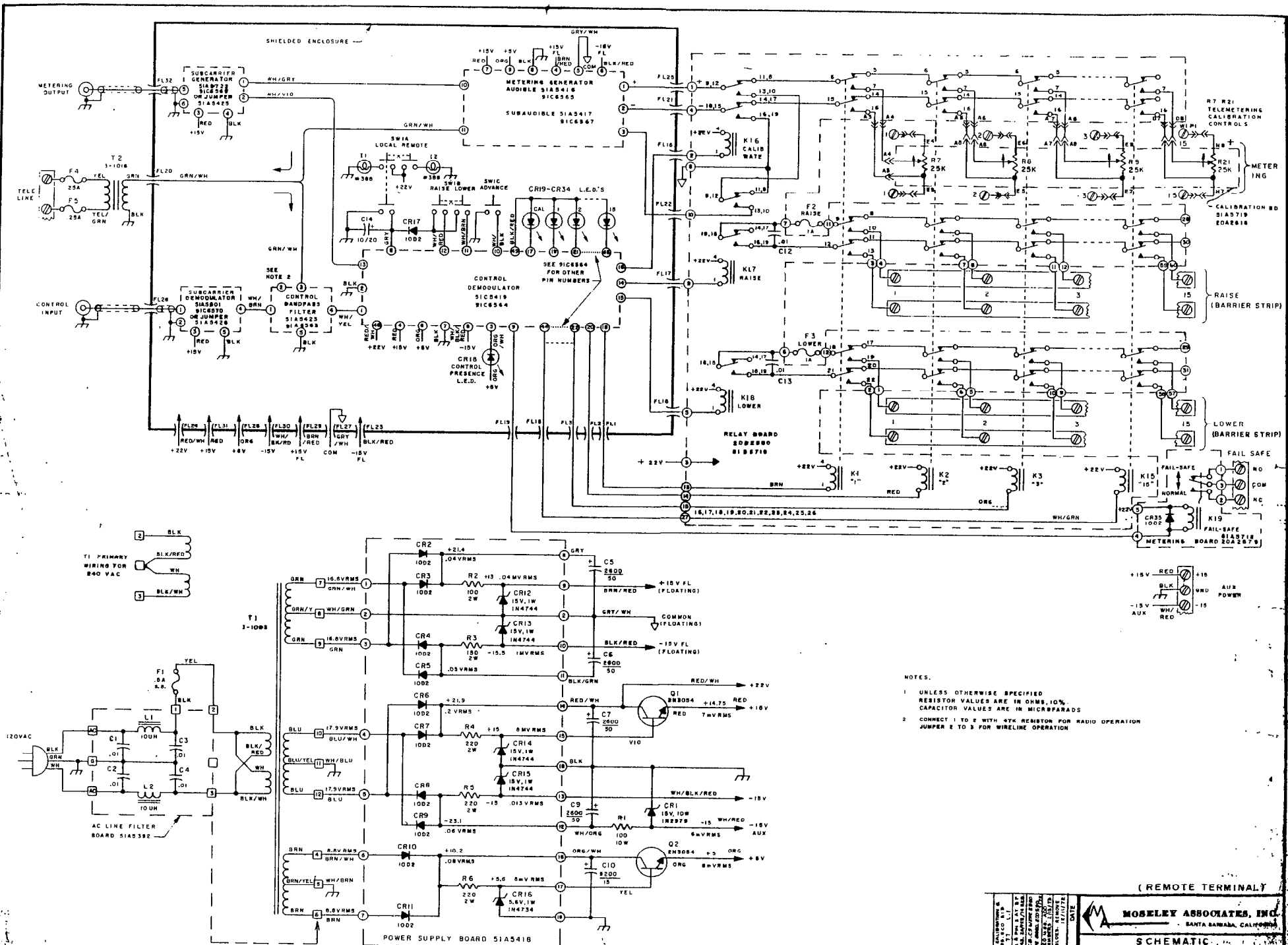
**MOSELEY ASSOCIATES, INC.**  
 SANTA BARBARA RESEARCH PARK  
 GOLETA, CALIFORNIA 93017

COMPONENT LAYOUT  
 POWER SUPPLY TRC-15

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

DWN	<i>[Signature]</i>	8-4-72	SCALE: FULL
CHK	FXY	9/29/72	
ENG	JLP	29 SEP 72	20A2335

REVISIONS DATE MGMT. APPR.



NOTES.

- UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 10% CAPACITOR VALUES ARE IN MICROFARADS
- CONNECT 1 TO 2 WITH 47K RESISTOR FOR RADIO OPERATION JUMPER 2 TO 3 FOR WIRELINE OPERATION

(REMOTE TERMINAL)

**MOSELEY ASSOCIATES, INC.**  
SANTA BARBARA, CALIFORNIA

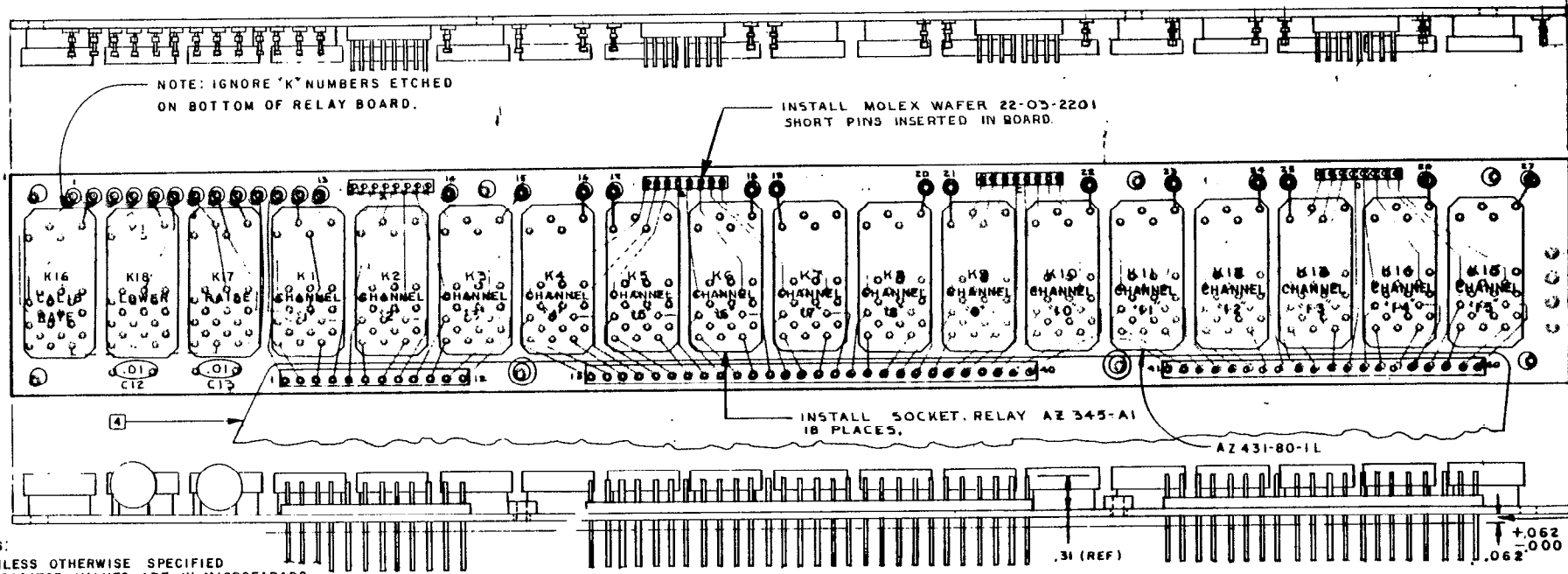
**SCHEMATIC**  
TRC-15 TRANSMITTER UNIT

TOL. FRAC. ± 0.5% 1/2 ± 0.1% 1/4 ± 0.1% 1/8 ± 0.1% 1/16 ± 0.1%

OWN. / E.Y. / R.92/70 SCALE: 1" = 1"

CHK. / S.W. / 1/7/70 91C608

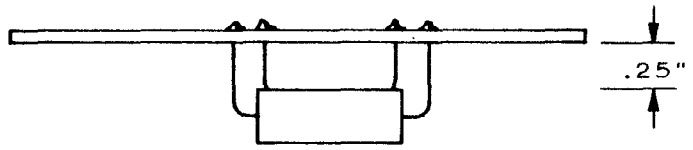
REVISIONS: 1. REV. 1.0 1/7/70



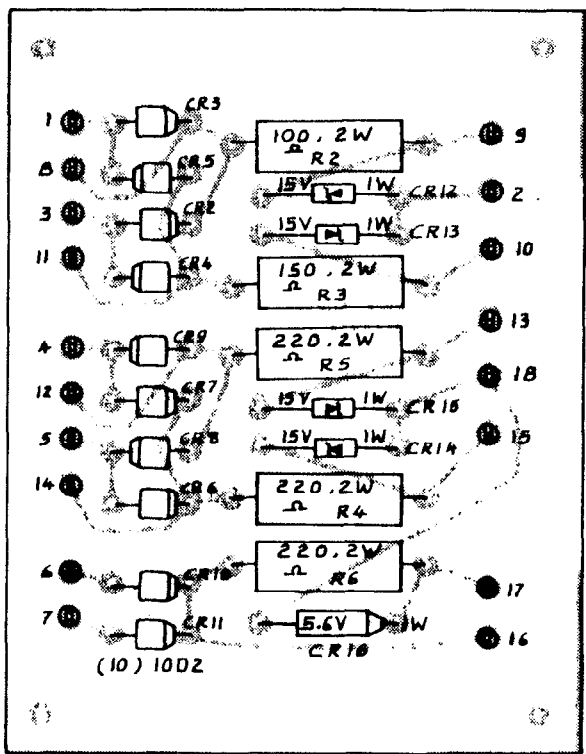
- NOTES:
- UNLESS OTHERWISE SPECIFIED CAPACITOR VALUES ARE IN MICROFARADS.
  - P.C. BOARD 51B5716.
  - SCHEMATIC 91C6561.
  - FLEX CIRCUIT NO. 51B5723 ENGAGED OVER PINS PUSH CIRCUIT DOWN TO REST ON THE PLASTIC PIN STRIPS SOLDER SECURELY IN PLACE.

BERG 65560-431 STRIP 3 PLC  
LONG PINS INSERTED IN BOARD  
CUT OFF PINS BELOW BOARD  
AFTER SOLDERING IN PLACE.

REMOVE TERMINALS 2-26-80 EPO BOARD 51B5723 ADDED. ECO 131 9 AUG 74 DTW SOME NEW STRIP LOCATION 17 OCT 78 ECO 879 L.L. CORRECTION KIT L K18 WASHERS WERE REVERSED ADDED AZ 431-80-1L & IGNORE "K" NOTE 28 MARCH 77 L.L. NATURE REVC. ADD KIT KITZ. NO. 11 MAR 77. BAW REVISIONS MKT. APPR. DATE	<p><b>MOBELEY ASSOCIATES, INC.</b> SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 90471</p>	<b>COMPONENT LAYOUT</b>		SCALE: FULL	
TOL: FRACT. ± 1/32, .3K ± .02, .XXK ± .015, < .25K		OWN GM	5-27-76	SCALE: FULL	
ENR JCT	FXV	18 MAR 77	20B2580		
	JCT	16 MAR 77	FO		



ELEVATE R2-R6  
AND CR12-CR16



NOTES:

- 1 P. C. BOARD 51A 5418
- 2 SCHEMATIC SIC 6961

TRC-15 REMOTE / XMTR

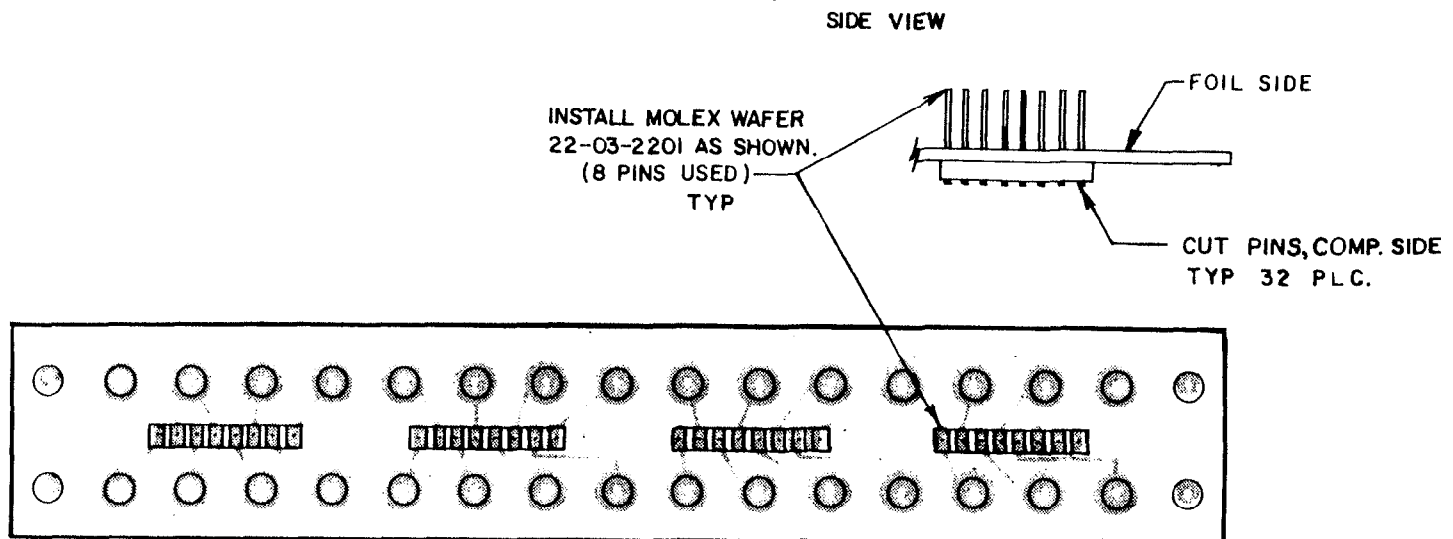
**MOSELEY ASSOCIATES, INC.**  
SANTA BARBARA RESEARCH PARK  
GOLETA, CALIFORNIA 93017

COMPONENT LAYOUT  
PWR. SUPPLY BD.

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

DWN	<i>K.P.</i>	8-2-72	SCALE: FULL
CHK	FXV	9/29/72	20A 2336 AI
ENG	JCP	2/3/72	

A	PARTS LIST UPDATED. PCB LAYOUT FEBRUARY D.T.W.	REVISIONS	DATE
		MGMT. APPR.	

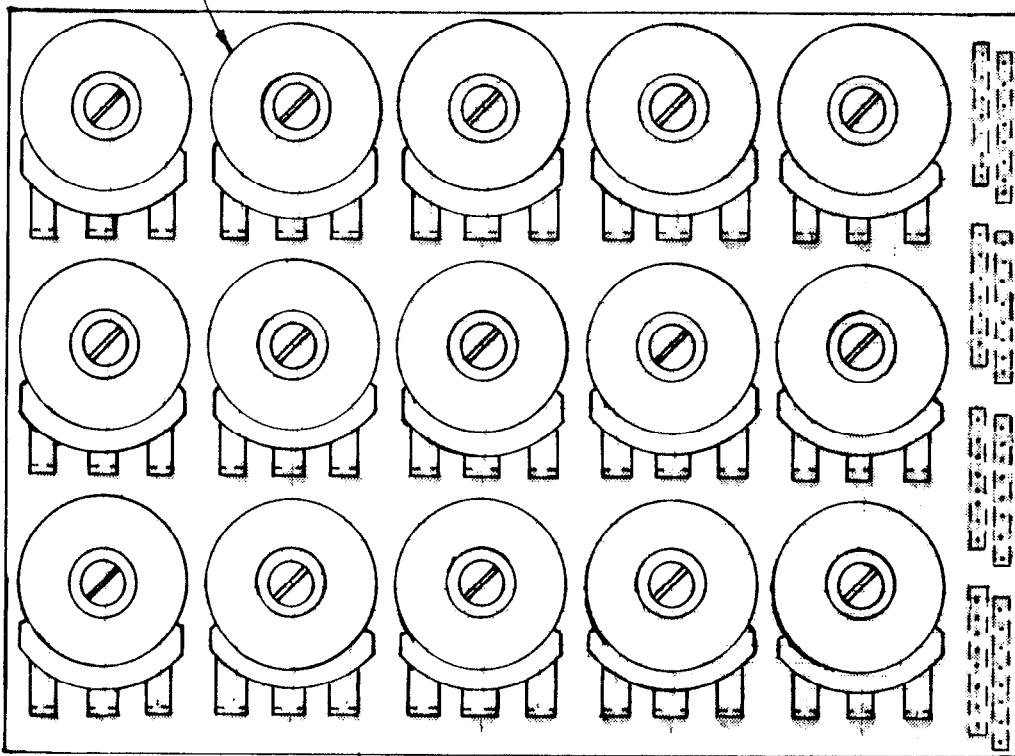


NOTES:

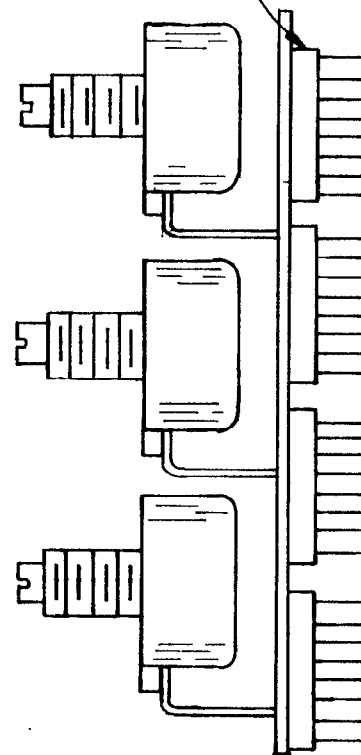
1. P.C. BOARD 51A5718.
2. SCHEMATIC 91C6561.

PAR'S LIST UPDATED. PCD 1568 1FEB80 D.T.W. CHANGE VIEW OF BOARD A.J.G. ARTWORK REV 02 REMOVE CR15 & K19 ECD 093 10 JUL 77 MF		REVISIONS DATE MGMT. APPR.		<b>MOBELEY ASSOCIATES, INC.</b> SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 93017	
<b>COMPONENT LAYOUT</b> METERING INPUT BRD. TRC-15 RT.				TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, < ± 1/2"	
DWN	GM	5-26-76	SCALE:		
CHK	FXV	31 MAR 77	20A2579		
ENG	JCT	31 MAR 77			
BI	B	A	BI		

CTS LM 4022 10 TURN  
25K POT 15 REQ.




MOLEX 22-03-2201  
WAFER 8 REQ.



NOTES

1. SCHEMATIC 91C6561
2. P.C. BOARD 51A5719


REVISIONS MGMT. APPR.	DATE			 <b>MOSELEY ASSOCIATES, INC.</b> SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 93017
	<b>COMPONENT LAYOUT</b> <b>TRC-15 TRANS CALIBRATION BD.</b>			
	TOL: FRACT. $\pm 1/32$ , .XX $\pm .030$ , .XXX $\pm .010$ , $\angle \pm 1/2^\circ$			
	DWN	L.I.	25MAR77	
CHK	FXV	31 MAR 77	20A2616	
ENG	JCP	31 MAR 77		

BRN  1  
 RED  2  
 ORG  3  
 YEL  4  
 GRN  5  
 BLU  6  
 VIO  7  
 GRY  8  
 WH  9  
 WH/BLK  10  
 WH/BRN  11  
 WH/RED  12  
 WH/ORG  13  
 WH/BRN  14  
 WH/GRN  15  
 BLK/YEL  CAL.  
 WH/BK/GRY  METERING NEGATIVE  
 #22 BLK/WH  RAISE  
 #22 YEL/BLK  LOWER  
 #22 BLK/WH  -15 FLOATING  
 #22 WH/BLK  +22  
 #22 BLK/WH  FAILSAFE  
 #22 GRN  TEL. LINE COAX  
 #22 VIO/WH  CAL. VOLTAGE  
 #22 WH/BK/GRY  METERING NEGATIVE  
 #22 WH/BLK  +22  
 #22 WH/BRN  +15 FLOATING  
 #22 WH/GRN  +15 FLOATING  
 #22 WH/BK/RED  -15  
 #22 WH/BLK  +22  
 #22 WH/BRN  +15 FLOATING  
 #22 WH/WH  METERING POSITIVE  
 #22 WH/BLK  -15  
 #22 WH/GRN  METERING POSITIVE  
 #22 WH/BLK  +15  
 #22 WH/GRN  CONTROL COAX  
 #22 WH/BLK  METERING OUTPUT  
 #22 WH/GRN  FLOATING COMMON

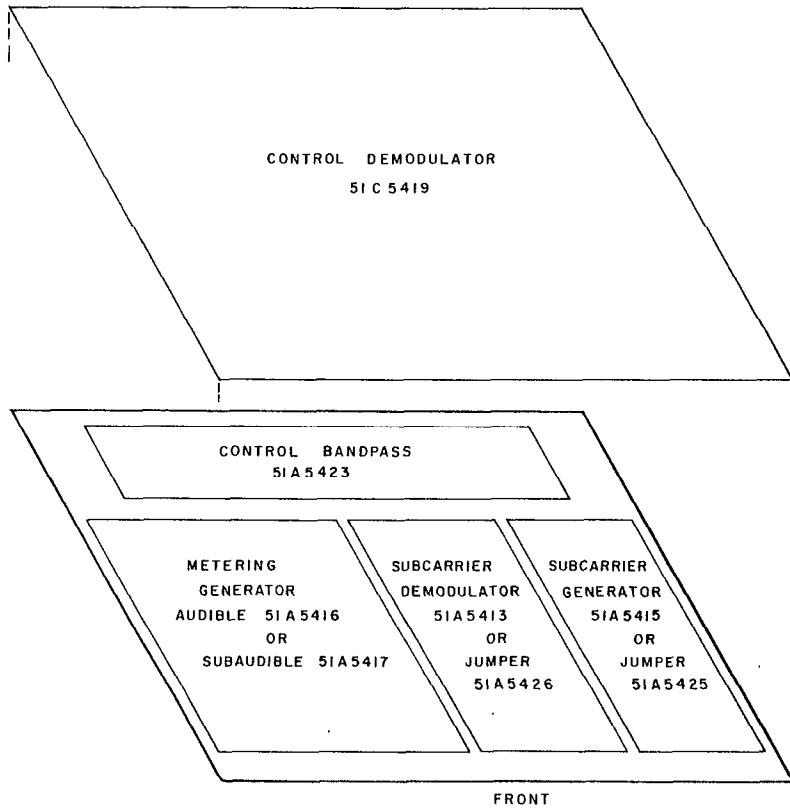
REAR VIEW

NOTES

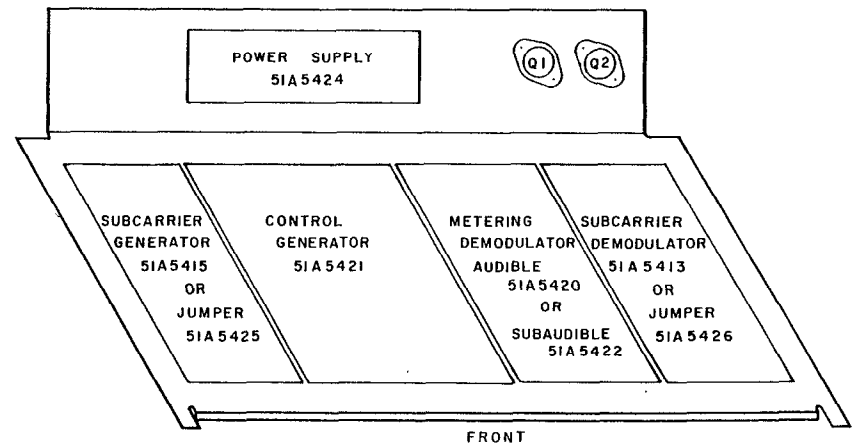
1 UNLESS SPECIFIED WIRE IS #26

REVISIONS DESIGNED BY DATE	 <b>MOSELEY ASSOCIATES, INC.</b> SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 93017	
	<b>WIRE IDENTIFICATION</b> <b>TRC-15 XMTR UNIT PARTITION</b>	
	TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, <math>\angle \pm 1/2^\circ</math>	
DWN <input checked="" type="checkbox"/>	CHK <input checked="" type="checkbox"/>	ENG <input checked="" type="checkbox"/>
DATE 12/11/72	SCALE:	21A 2362

TRANSMITTER  
UNIT

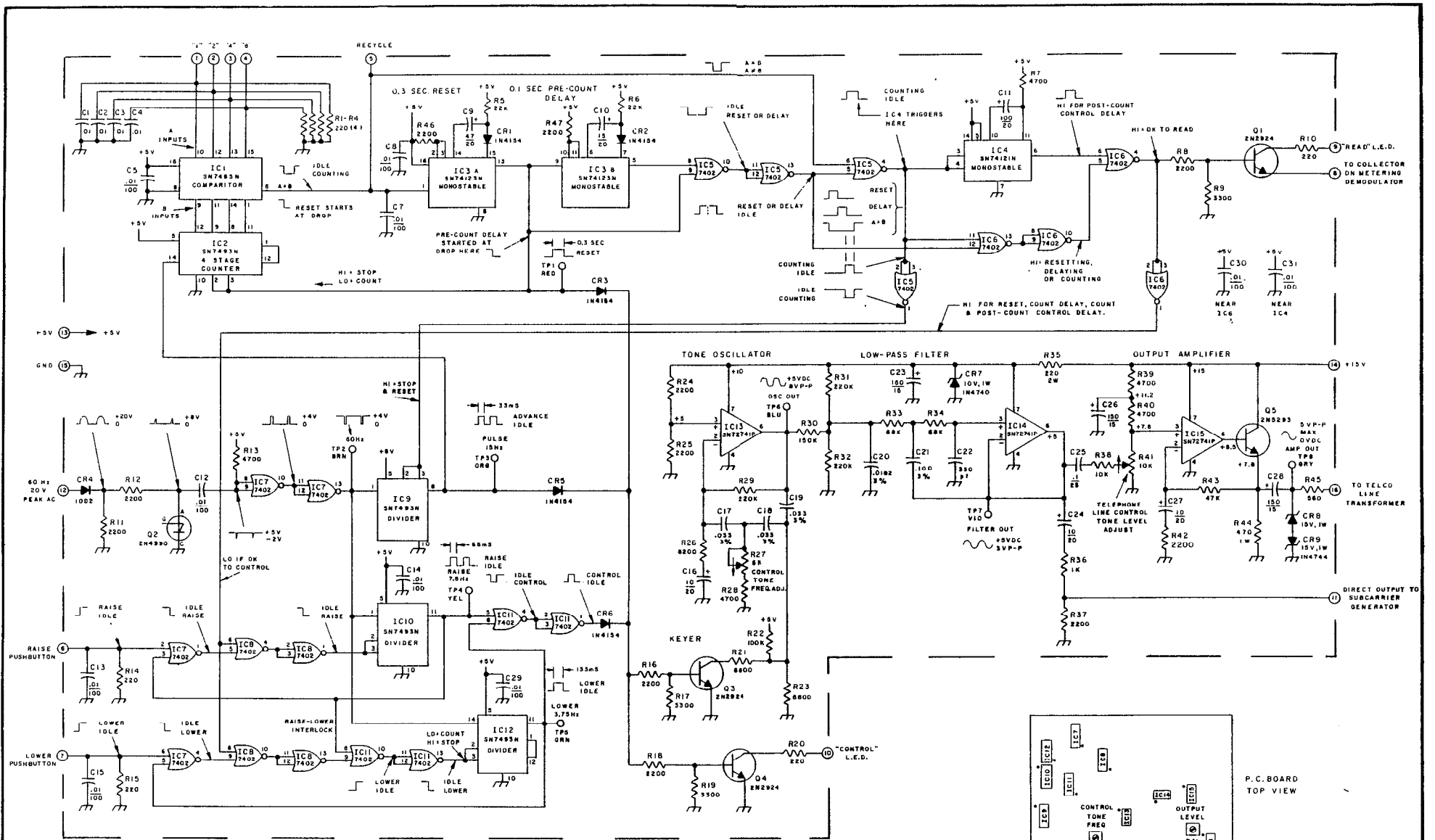


STUDIO  
UNIT

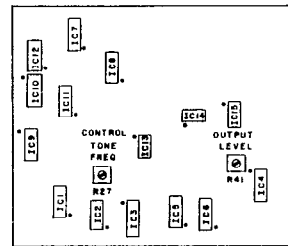


REVISIONS MENT. APPR.	DATE	MOSELEY ASSOCIATES, INC.	
		SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 93017	
		P. C. BOARD LOCATIONS	
		TRC-15 TRANSMITTER & STUDIO	
	TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, < ± 1/2"		
	OWN	P-A	12/11/72
	CHK	F-XV	12/11/72
	ENG	JCT	11/26/72
		SCALE:	21B 2363



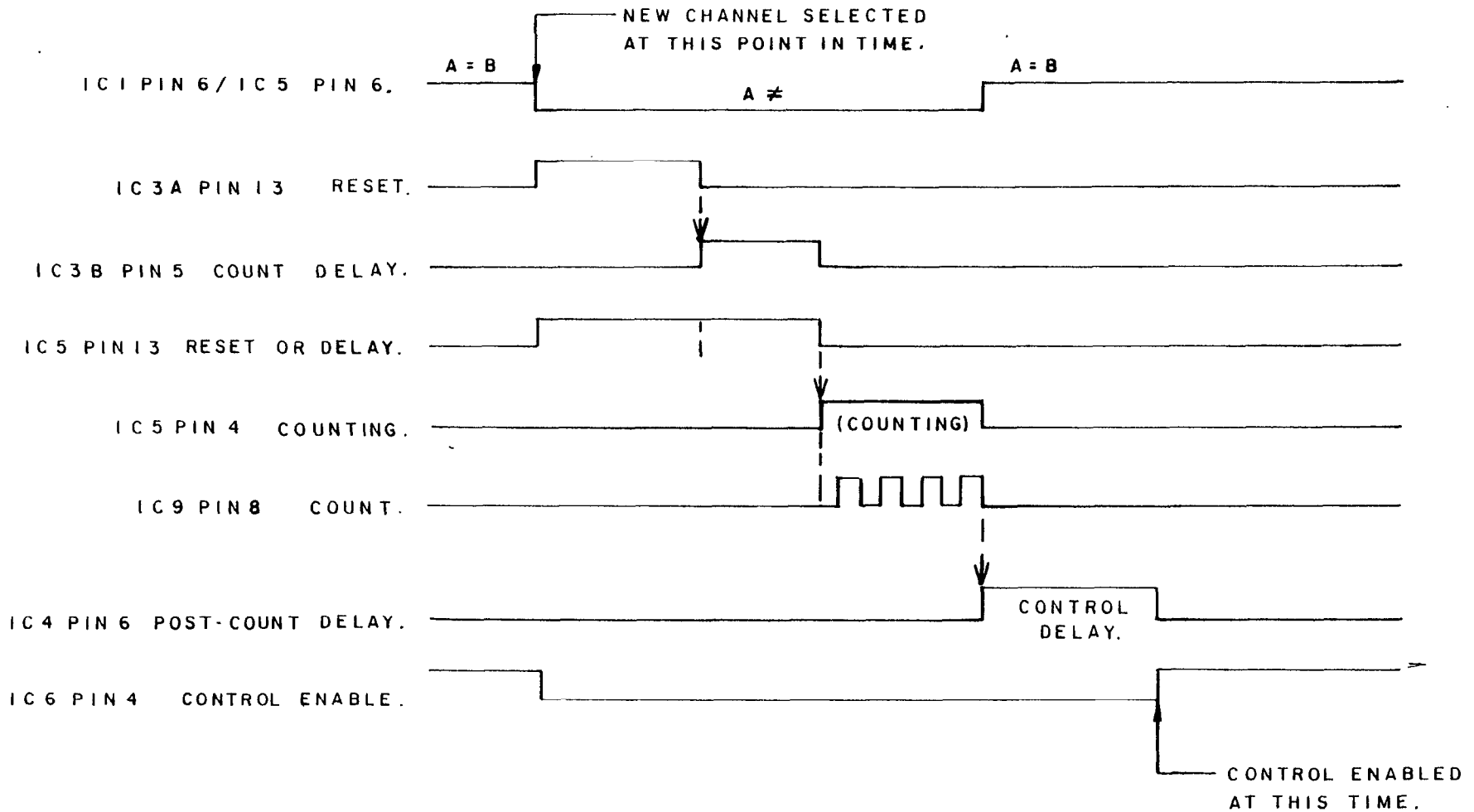



- NOTES
- UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/2W, 10%. CAPACITOR VALUES ARE IN MICROFARADS.
  - I.C.'S LISTED AS 7402 ARE SN7402N PIN 14 IS +5V, PIN 7 IS GND
  - P.C. BOARD S1A5421
  - COMPONENT LAYOUT 20A2337
  - TYPICAL DIGITAL IC OUTPUT WAVEFORM  
HI +2.4V OR HIGHER  
LO +0.4V OR LOWER

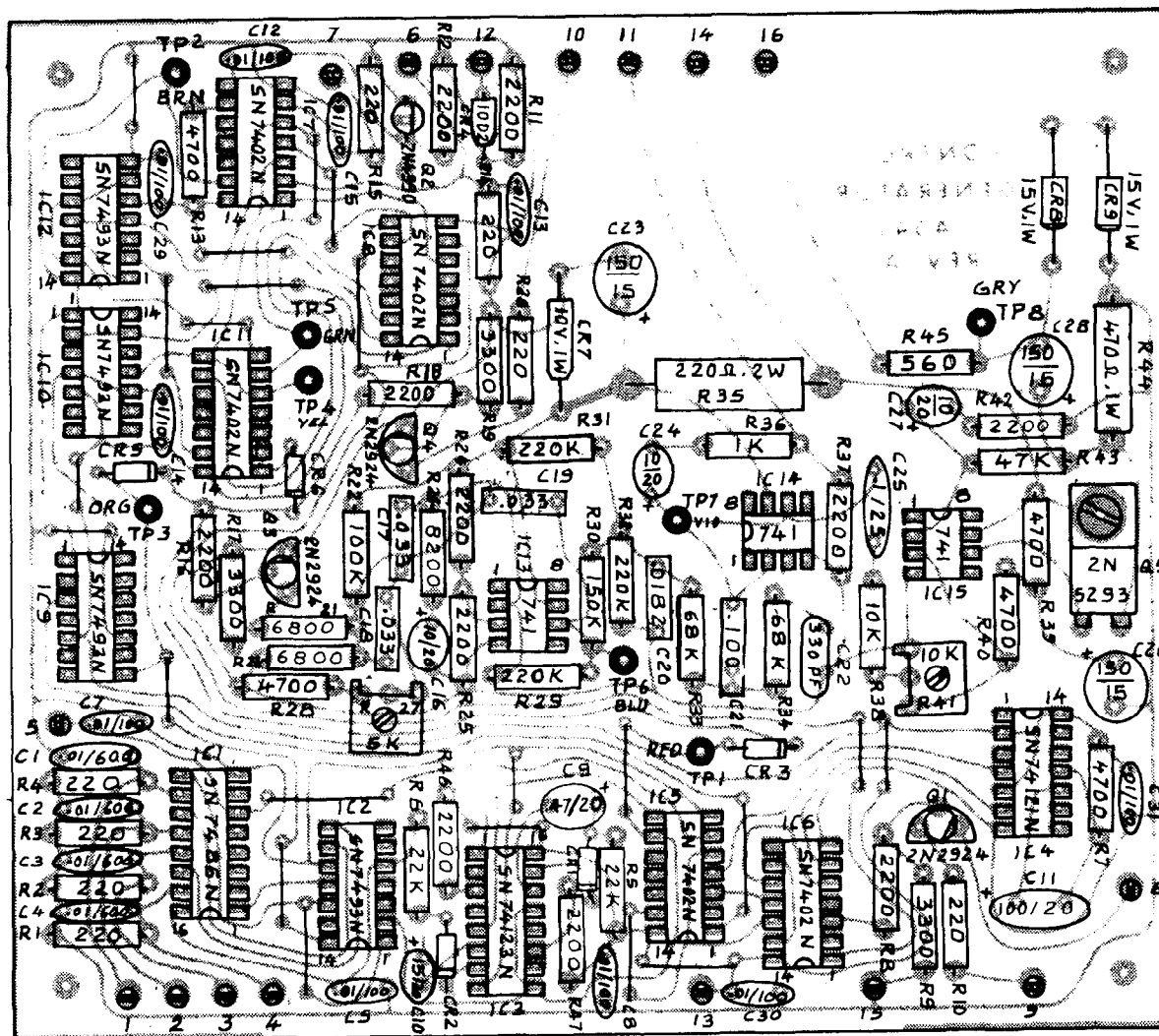


(CONTROL TERMINAL) STUDIO

REV	DATE	BY	CHK	APP	SCALE
1	4/17/72	...	...	...	...
<b>MOSELEY ASSOCIATES, INC.</b> SANTA BARBARA, CALIFORNIA <b>SCHEMATIC TRC-15 CONTROL GENERATOR</b>					
<b>91 C 6562</b>					




REVISIONS MGMT. APPR.	DATE		
	 <b>MOSELEY ASSOCIATES, INC.</b> SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 93017		
	<b>TRC 15A CONTROL GENERATION TIMING DIAGRAM</b>		
	TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, < ± 1/2"		
DWN	L. I.	15 JULY 76	SCALE: NONE.
CHK			
ENG	JLT	15 JUL 76	92A1188

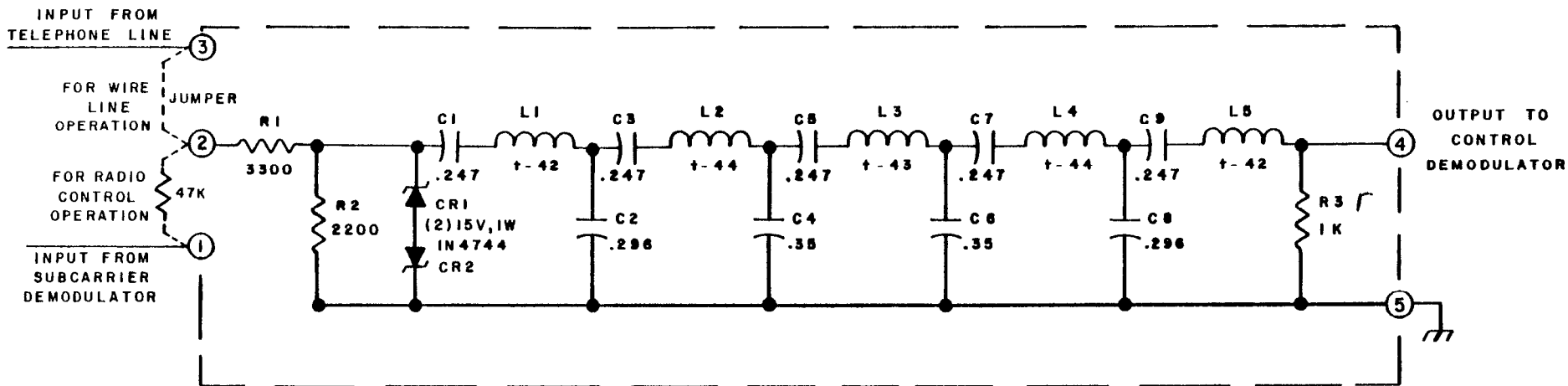


NOTES:

- 1 UNLESS OTHERWISE SPECIFIED  
RESISTOR VALUES ARE IN OHMS, 1/2W, 10%.  
CAPACITOR VALUES ARE IN MICROFARADS.  
DIODES ARE IN 4154.
- 2 I.C.'S LISTED AS 741 ARE 5N72741P
- 3 \* DENOTES SELECTED VALUES
- 4 P.C. BOARD 51A 5421
- 5 SCHEMATIC 91C 6562

STUDIO (CONTROL TERM.)


PARTS LIST UPDATED. 1-EM 58 40DED. PCO 1568 2FEB 80 D.T.W.		DATE	
R42 WAS 10K	5/15/73		
ECO 596			
ADD R46 & R47 ART WK			
REV. A. ECO 581	12/72		
REVISIONS		DATE	
MGMT. APPR.			
 <b>MOSELEY ASSOCIATES, INC.</b> SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 93017			
<b>COMPONENT LAYOUT</b> <b>CONTROL GENERATOR TRC-15</b>			
TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, < ± 1/2"			
DWN	<i>RJA</i>	B-3-72	SCALE: FULL
CHK	FXY	9/26/72	
ENG	JCT	2/30/72	
20 A 2337			B1

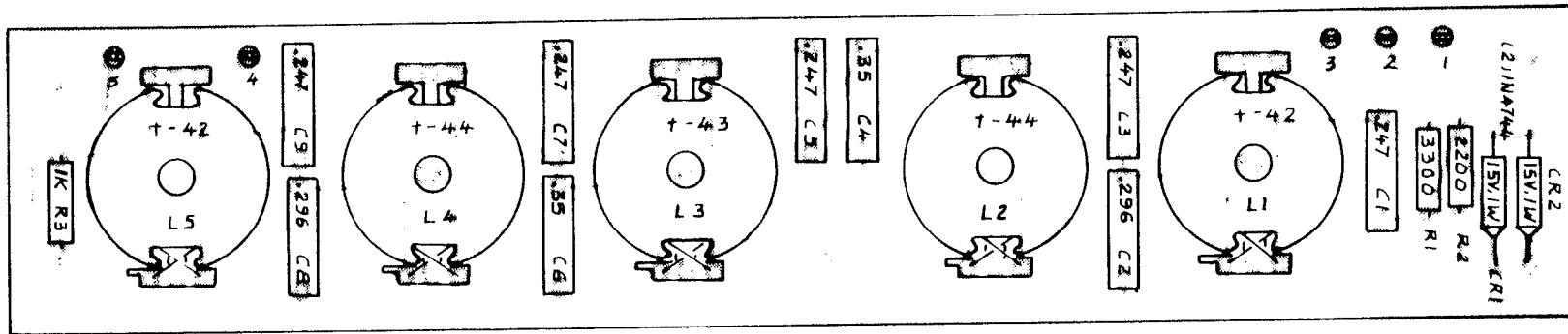


NOTES:

- 1 UNLESS OTHERWISE SPECIFIED  
RESISTOR VALUES ARE IN OHMS, 1/2W, 10%.  
CAPACITOR VALUES ARE IN MICROFARADS.
- 2 † - DENOTES DWG 2C-1400
- 3 P.C. BOARD 51A5423
- 4 COMPONENT LAYOUT 20A2338

REMOTE TERM. (XMTR)


REVISIONS MGMT. APPR.	 <b>MOSELEY ASSOCIATES, INC.</b> SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 93017		
	<b>SCHEMATIC TRC-15          CONTROL BANDPASS FILTER</b>		
	TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, < ± 1/2°		
	DWN CHK ENG	R.P.  JCT	9/19/72  27SEP72
	SCALE: NONE		91A 6563

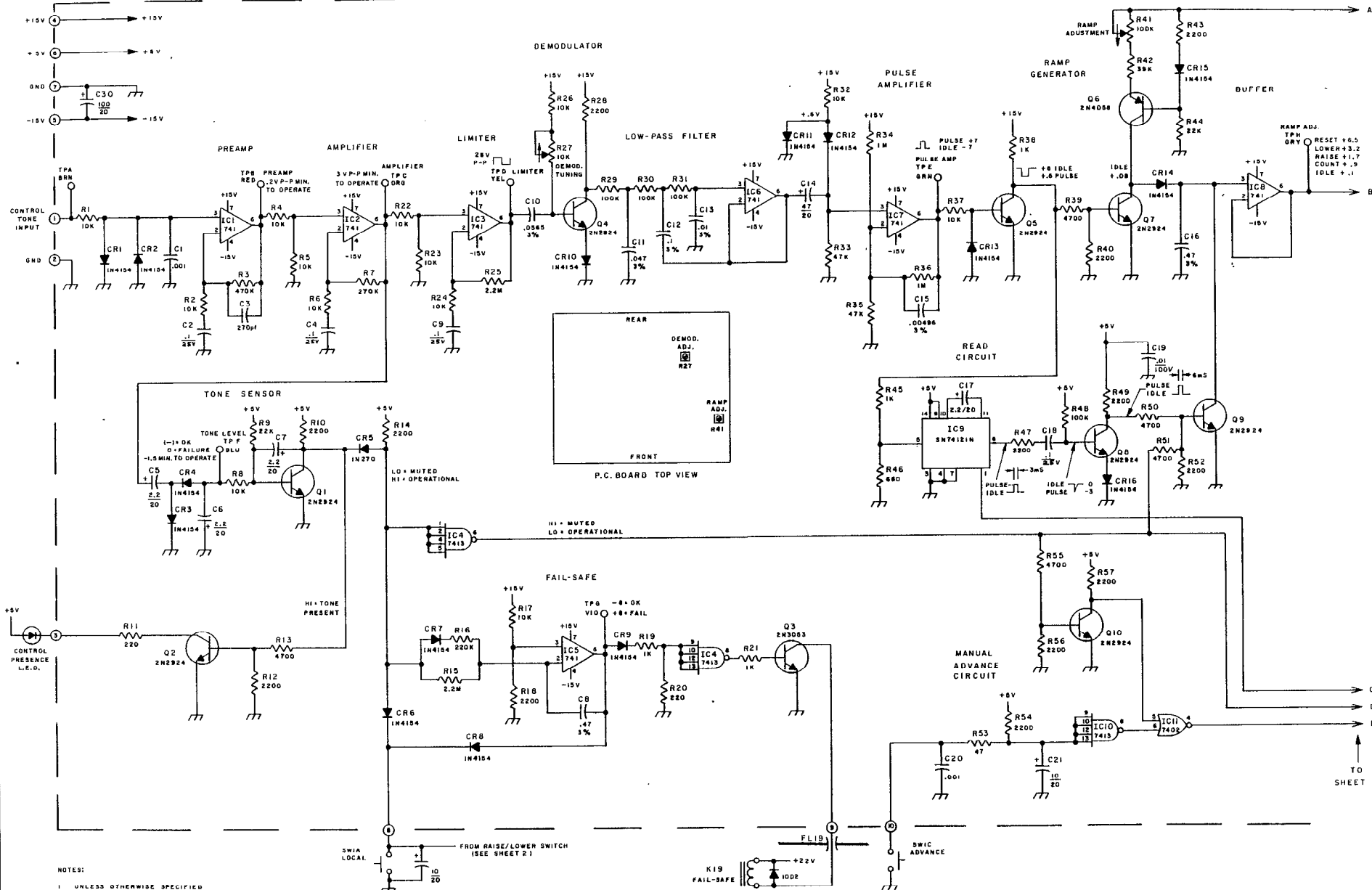


NOTES:

- 1 UNLESS OTHERWISE SPECIFIED  
RESISTOR VALUES ARE IN OHMS, 1/2W, 10%  
CAPACITOR VALUES ARE IN MICROFARADS
- 2 P.C. BOARD SI A 5423
- 3 SCHEMATIC 91A 6563
- 4 † - DENOTES DWG 2C-1400

REMOTE TERM. (XMTR)

AI PARTS LIST UPDATED. PCD1566 FEB80 D.T.W.	DATE	 <b>MOSELEY ASSOCIATES, INC.</b> SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 93017	
	REVISIONS		
	MGMT. APPR.	TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, < ± 1/2"	
	AI	DWN <i>PJ</i> 9/19/72 CHK FXY 9/26/72 ENG JLT 27SEP72	SCALE: FULL 20A2338



- NOTES:
- UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/2 W, 10%. CAPACITOR VALUES ARE IN MICROFARADS.
  - I.C.'S LISTED AS 741 ARE SN72741P
  - I.C.'S LISTED AS 7402 (E.G.) ARE SN7402N. (TYP.) PIN 14 IS +5V, PIN 7 IS GND
  - P.C. BOARD D1C0419.
  - COMPONENT LAYOUT 20C2339.
  - ALL DI CAPS ARE 100V ALL -I CAPS ARE 35V

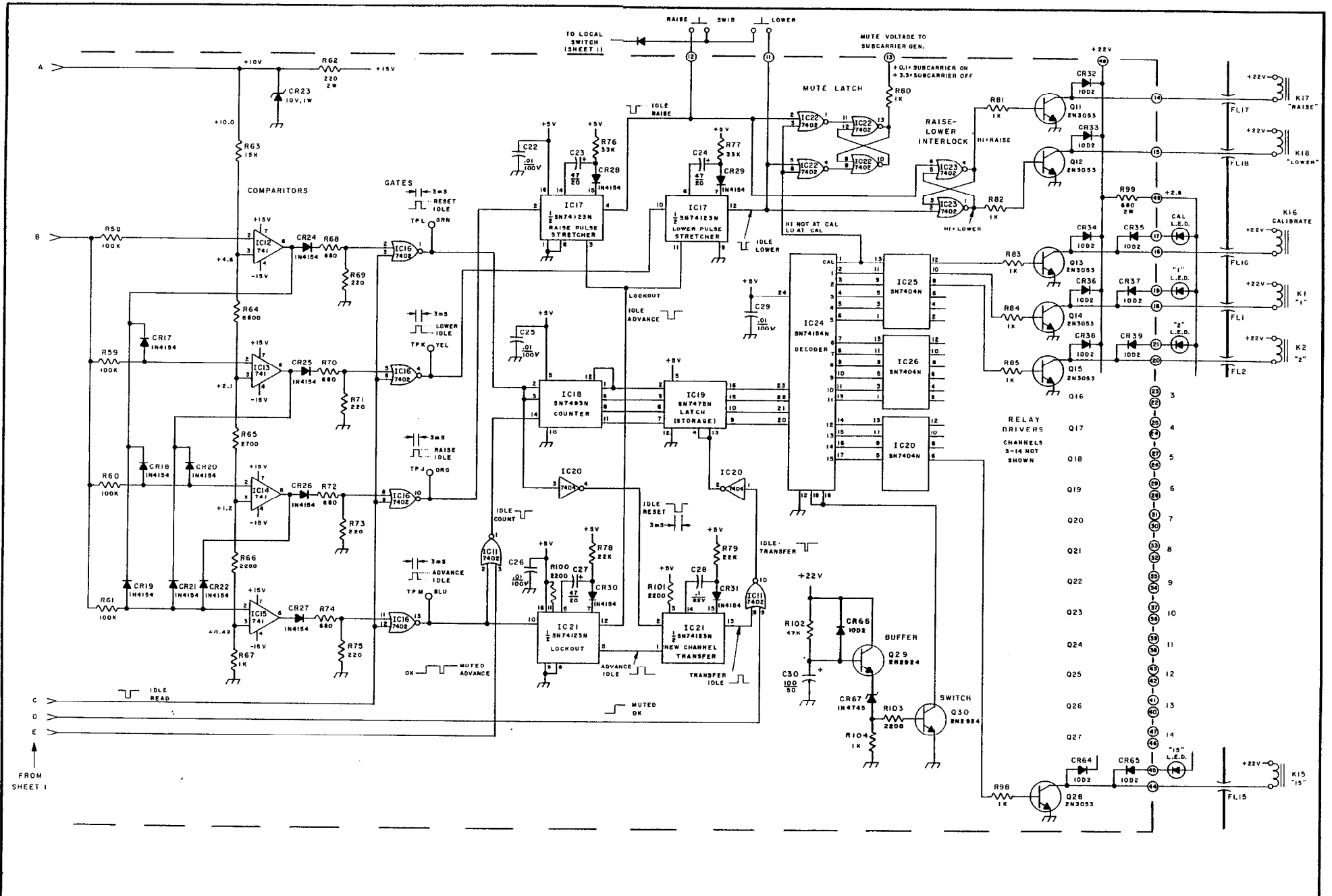
(REMOTE TERMINAL) XMTR

**MOSELEY ASSOCIATES, INC.**  
SANTA BARBARA, CALIFORNIA

**SCHEMATIC TRC-15 CONTROL DEMODULATOR**

REV	DATE	BY	CHK	ENG
1	12/77	JL	JL	JL

101: FRAC1 = 0.02 1K 5 00 10K 2 010  
 00001 P 2 V R/12/772 SCALE  
 91C6564 EI



(REMOTE TERMINAL) XMTR

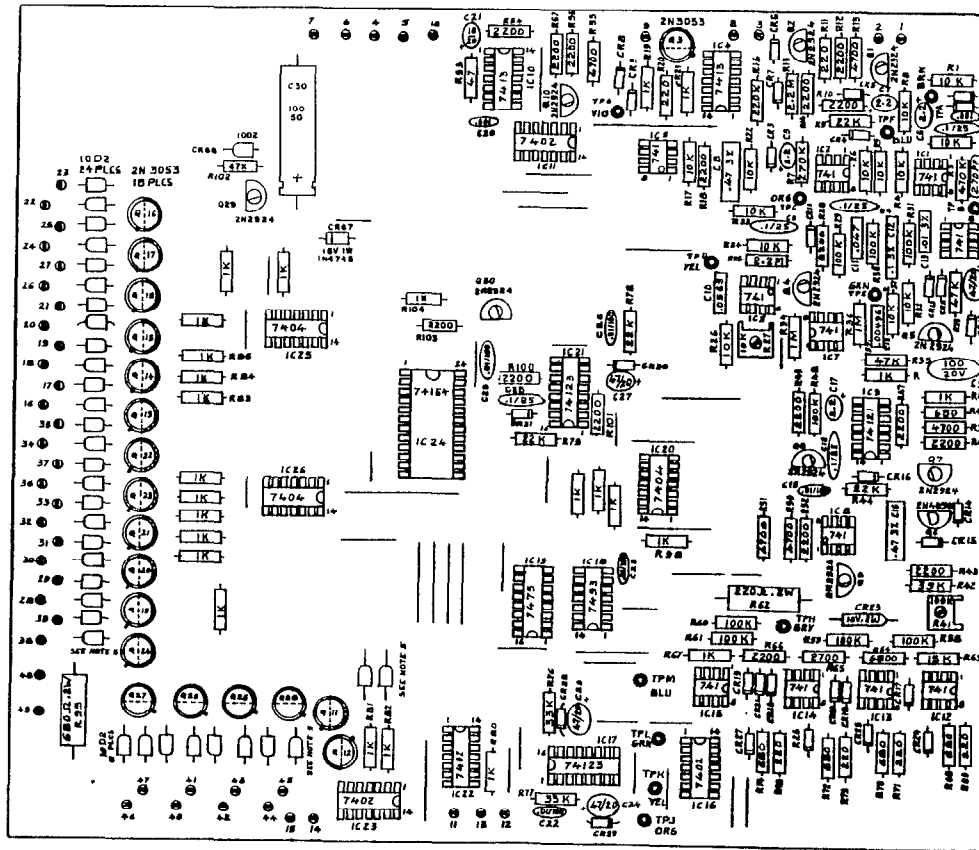
E1	SEE SHEET 1	DATE	12/72
E2	DESIGN: J. H. W. B. W.	DATE	
E3	DESIGN: J. H. W. B. W.	DATE	
E4	DESIGN: J. H. W. B. W.	DATE	
E5	DESIGN: J. H. W. B. W.	DATE	
E6	DESIGN: J. H. W. B. W.	DATE	
E7	DESIGN: J. H. W. B. W.	DATE	
E8	DESIGN: J. H. W. B. W.	DATE	
E9	DESIGN: J. H. W. B. W.	DATE	
E10	DESIGN: J. H. W. B. W.	DATE	
E11	DESIGN: J. H. W. B. W.	DATE	
E12	DESIGN: J. H. W. B. W.	DATE	
E13	DESIGN: J. H. W. B. W.	DATE	
E14	DESIGN: J. H. W. B. W.	DATE	
E15	DESIGN: J. H. W. B. W.	DATE	
E16	DESIGN: J. H. W. B. W.	DATE	
E17	DESIGN: J. H. W. B. W.	DATE	
E18	DESIGN: J. H. W. B. W.	DATE	
E19	DESIGN: J. H. W. B. W.	DATE	
E20	DESIGN: J. H. W. B. W.	DATE	
E21	DESIGN: J. H. W. B. W.	DATE	
E22	DESIGN: J. H. W. B. W.	DATE	
E23	DESIGN: J. H. W. B. W.	DATE	
E24	DESIGN: J. H. W. B. W.	DATE	
E25	DESIGN: J. H. W. B. W.	DATE	
E26	DESIGN: J. H. W. B. W.	DATE	
E27	DESIGN: J. H. W. B. W.	DATE	
E28	DESIGN: J. H. W. B. W.	DATE	
E29	DESIGN: J. H. W. B. W.	DATE	
E30	DESIGN: J. H. W. B. W.	DATE	
E31	DESIGN: J. H. W. B. W.	DATE	
E32	DESIGN: J. H. W. B. W.	DATE	
E33	DESIGN: J. H. W. B. W.	DATE	
E34	DESIGN: J. H. W. B. W.	DATE	
E35	DESIGN: J. H. W. B. W.	DATE	
E36	DESIGN: J. H. W. B. W.	DATE	
E37	DESIGN: J. H. W. B. W.	DATE	
E38	DESIGN: J. H. W. B. W.	DATE	
E39	DESIGN: J. H. W. B. W.	DATE	
E40	DESIGN: J. H. W. B. W.	DATE	
E41	DESIGN: J. H. W. B. W.	DATE	
E42	DESIGN: J. H. W. B. W.	DATE	
E43	DESIGN: J. H. W. B. W.	DATE	
E44	DESIGN: J. H. W. B. W.	DATE	
E45	DESIGN: J. H. W. B. W.	DATE	
E46	DESIGN: J. H. W. B. W.	DATE	
E47	DESIGN: J. H. W. B. W.	DATE	
E48	DESIGN: J. H. W. B. W.	DATE	
E49	DESIGN: J. H. W. B. W.	DATE	
E50	DESIGN: J. H. W. B. W.	DATE	
E51	DESIGN: J. H. W. B. W.	DATE	
E52	DESIGN: J. H. W. B. W.	DATE	
E53	DESIGN: J. H. W. B. W.	DATE	
E54	DESIGN: J. H. W. B. W.	DATE	
E55	DESIGN: J. H. W. B. W.	DATE	
E56	DESIGN: J. H. W. B. W.	DATE	
E57	DESIGN: J. H. W. B. W.	DATE	
E58	DESIGN: J. H. W. B. W.	DATE	
E59	DESIGN: J. H. W. B. W.	DATE	
E60	DESIGN: J. H. W. B. W.	DATE	
E61	DESIGN: J. H. W. B. W.	DATE	
E62	DESIGN: J. H. W. B. W.	DATE	
E63	DESIGN: J. H. W. B. W.	DATE	
E64	DESIGN: J. H. W. B. W.	DATE	
E65	DESIGN: J. H. W. B. W.	DATE	
E66	DESIGN: J. H. W. B. W.	DATE	
E67	DESIGN: J. H. W. B. W.	DATE	
E68	DESIGN: J. H. W. B. W.	DATE	
E69	DESIGN: J. H. W. B. W.	DATE	
E70	DESIGN: J. H. W. B. W.	DATE	
E71	DESIGN: J. H. W. B. W.	DATE	
E72	DESIGN: J. H. W. B. W.	DATE	
E73	DESIGN: J. H. W. B. W.	DATE	
E74	DESIGN: J. H. W. B. W.	DATE	
E75	DESIGN: J. H. W. B. W.	DATE	
E76	DESIGN: J. H. W. B. W.	DATE	
E77	DESIGN: J. H. W. B. W.	DATE	
E78	DESIGN: J. H. W. B. W.	DATE	
E79	DESIGN: J. H. W. B. W.	DATE	
E80	DESIGN: J. H. W. B. W.	DATE	
E81	DESIGN: J. H. W. B. W.	DATE	
E82	DESIGN: J. H. W. B. W.	DATE	
E83	DESIGN: J. H. W. B. W.	DATE	
E84	DESIGN: J. H. W. B. W.	DATE	
E85	DESIGN: J. H. W. B. W.	DATE	
E86	DESIGN: J. H. W. B. W.	DATE	
E87	DESIGN: J. H. W. B. W.	DATE	
E88	DESIGN: J. H. W. B. W.	DATE	
E89	DESIGN: J. H. W. B. W.	DATE	
E90	DESIGN: J. H. W. B. W.	DATE	
E91	DESIGN: J. H. W. B. W.	DATE	
E92	DESIGN: J. H. W. B. W.	DATE	
E93	DESIGN: J. H. W. B. W.	DATE	
E94	DESIGN: J. H. W. B. W.	DATE	
E95	DESIGN: J. H. W. B. W.	DATE	
E96	DESIGN: J. H. W. B. W.	DATE	
E97	DESIGN: J. H. W. B. W.	DATE	
E98	DESIGN: J. H. W. B. W.	DATE	
E99	DESIGN: J. H. W. B. W.	DATE	
E100	DESIGN: J. H. W. B. W.	DATE	

MOSELEY ASSOCIATES, INC.  
 SANTA BARBARA, CALIFORNIA

SCHEMATIC TRC-15  
 CONTROL DEMODULATOR

TOL. FRACT. = 1/32 XX = 0.00 XXX = 0.10  
 DWN F X Y 9/12/72 SCALE  
 CHK  
 ENG

91C 6564 EI



NOTES:

- 1 UNLESS OTHERWISE SPECIFIED  
RESISTOR VALUES ARE IN OHMS, 1/2W, 10%  
CAPACITOR VALUES ARE IN MICROFARADS  
DIODES ARE IN-4124 EXCEPT CR5 IS IN-270.
- 2 I.C.'S LISTED AS 741 ARE SN72741P
- 3 P. C. BOARD SIC5413
- 4 SCHEMATIC SIC65B4
- 5 BOARD.
- 6 ALL 01 CAPS ARE 100V  
ALL 1 CAPS ARE 25V

TRC-15 REMOTE UNIT

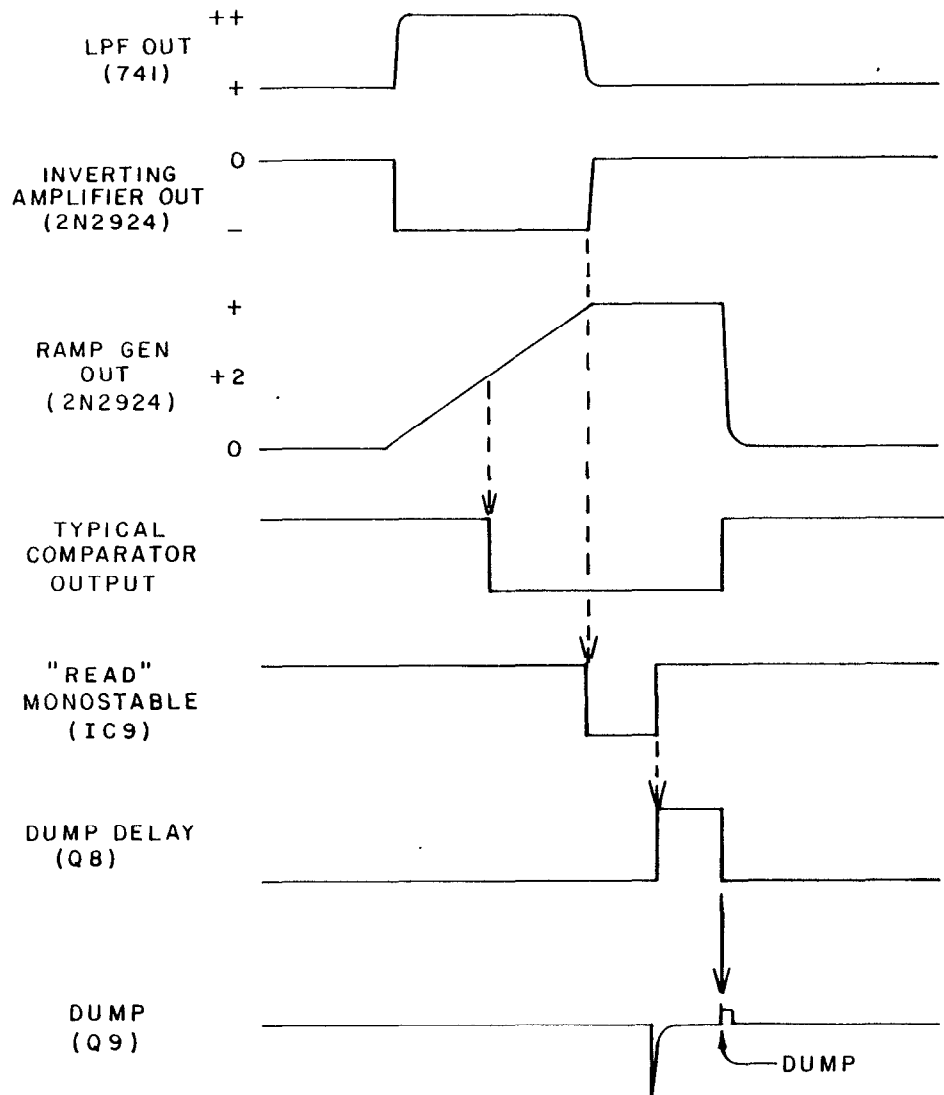
MOSELEY ASSOCIATES, INC.  
SANTA BARBARA, CALIFORNIA

COMPONENT LAYOUT  
TRANSMITTER CONTROL DEMOD.

SCALE FULL  
20C 2339 E3

REVISIONS	DATE
E2	11/11/72
E1	11/11/72
D	11/11/72
C	11/11/72
B	11/11/72
A	11/11/72





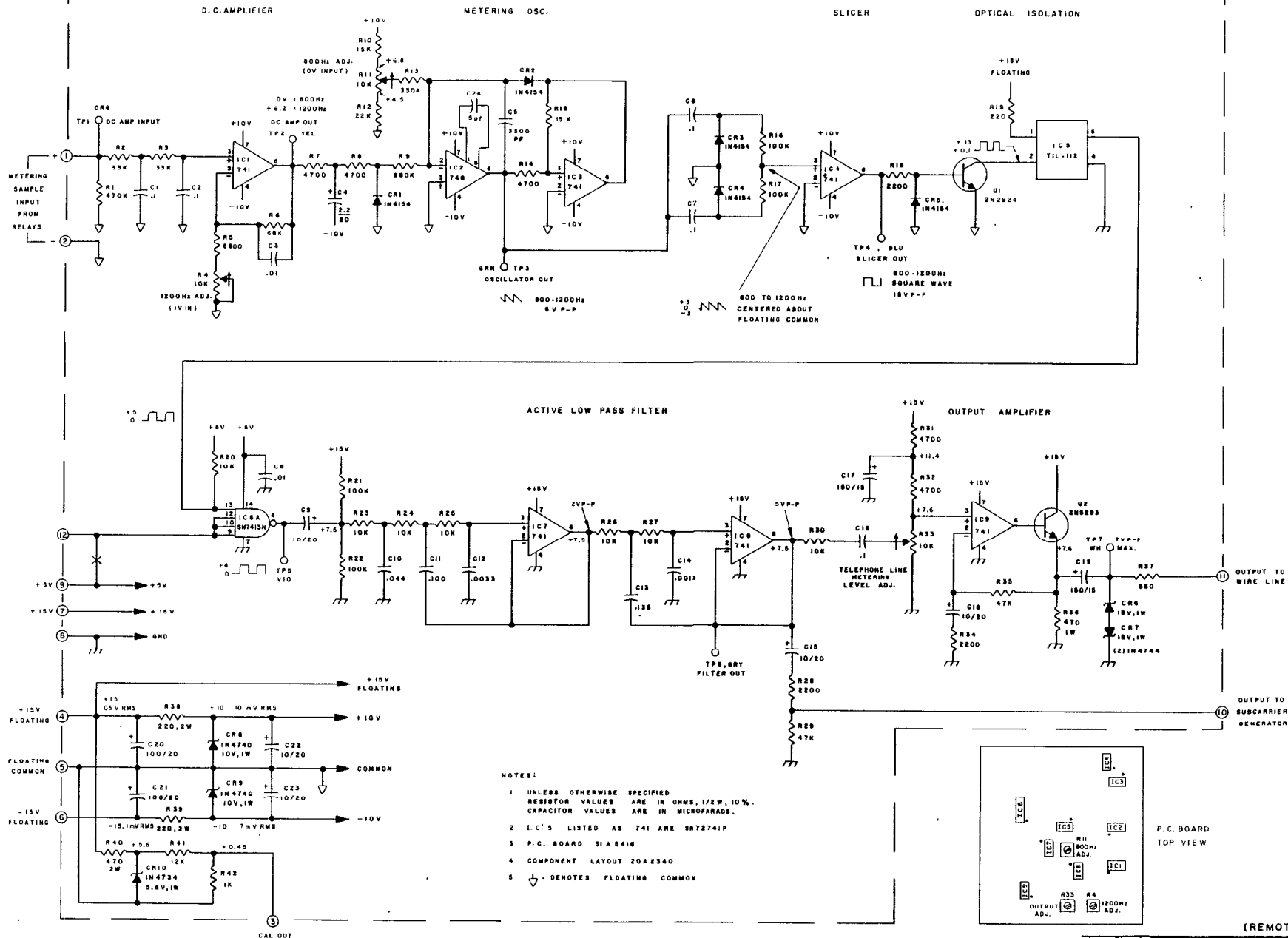
REVISIONS  
MGMT. APPR.  
DATE

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

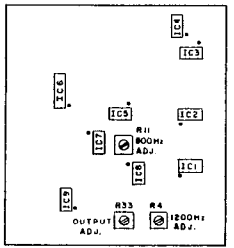
**TRC-15 CONTROL DEMODULATION  
 TIMING DIAGRAM**

TOL: FRACT.  $\pm 1/32$ , .XX  $\pm .030$ , .XXX  $\pm .010$ ,  $< \pm 1/2^\circ$

DWN	FX'Y	13 JUL 76	SCALE:
CHK			
ENG	JCT	15 Jul 76	92A 1189



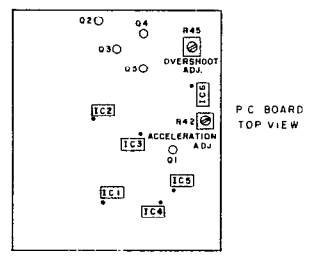
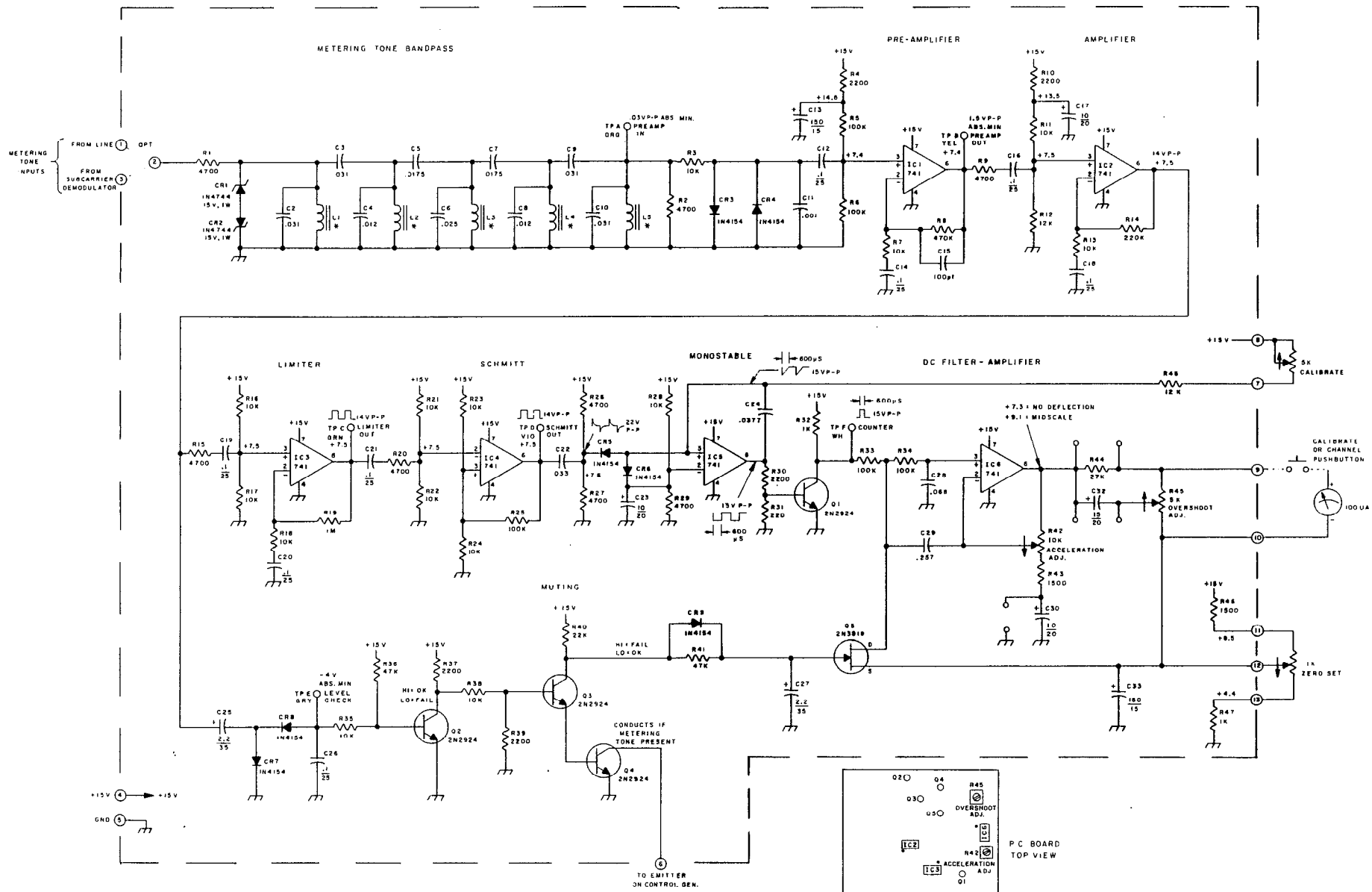
- NOTES:
- UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/2W, 10%. CAPACITOR VALUES ARE IN MICROFARADS.
  - I.C.'S LISTED AS 741 ARE SN72741P
  - P.C. BOARD SIA 8418
  - COMPONENT LAYOUT Z0A2340
  - ▽ - DENOTES FLOATING COMMON



(REMOTE TERM) XMTR

MOSELEY ASSOCIATES, INC. SANTA BARBARA, CALIFORNIA	
SCHEMATIC TRC-15	
AUDIBLE METERING GENERATOR	
TOL. FRAC. = 1/2 KK = 000 XXX = 010	
DWN: 1/2	8/18/73
CHK: C	9/27/73
ENG: JLT	8/27/73
REV. NO. 1	91C 6565

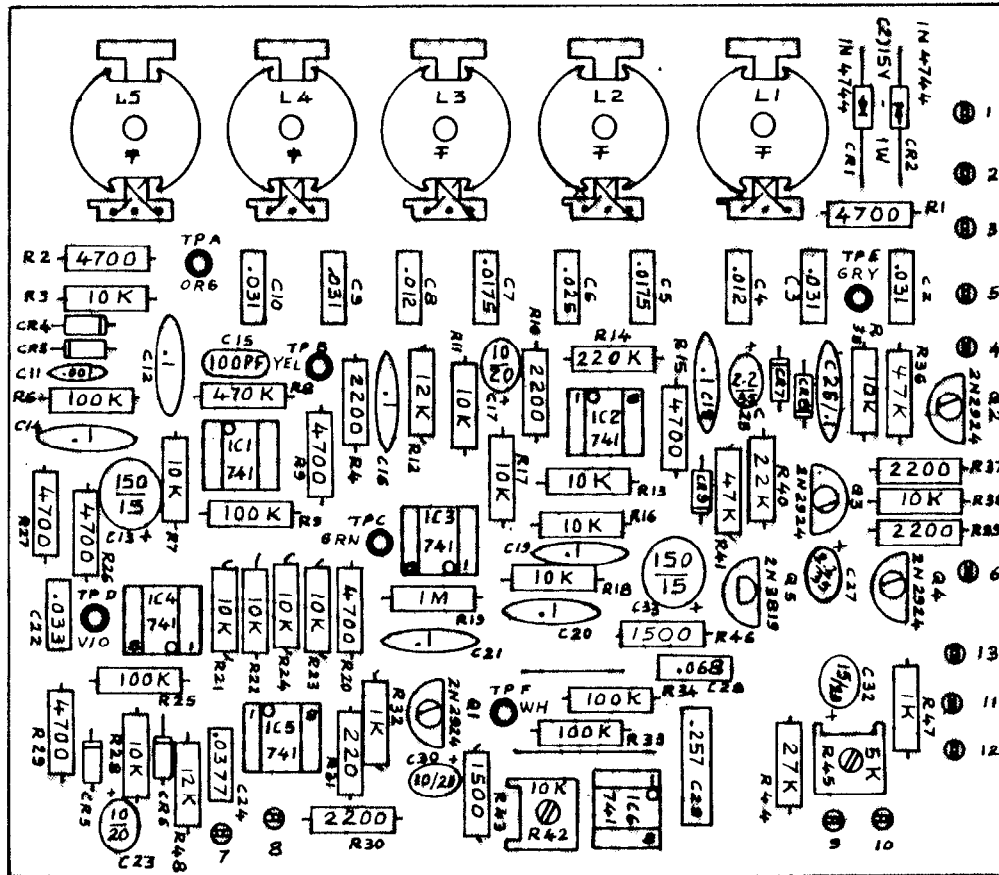




- NOTES
- 1 UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/2W, 10% CAPACITOR VALUES ARE IN MICROFARADS
  - 2 I.C.'S LISTED AS 741 ARE SN72741P
  - 3 P.C BOARD S1A542D
  - 4 COMPONENT LAYOUT 20A2341
  - 5 \* CO11 2C1400-045

STUDIO (CONTROL TERMINAL)

P.C. BOARD ECOBORN 10/20/72	REVISIONS	DATE	MOSELEY ASSOCIATES, INC.				
			SANTA BARBARA, CALIFORNIA				
	<b>SCHEMATIC TRC-15</b> <b>AUDIBLE METERING DEMODULATOR</b>						
	TO:	FRAC:	132	XX	030	XX	010
	DWN:	FXY	7/14/72	SCALE			
CHK:							
ENG:	LC7	2/24/72	91C 6566			A	

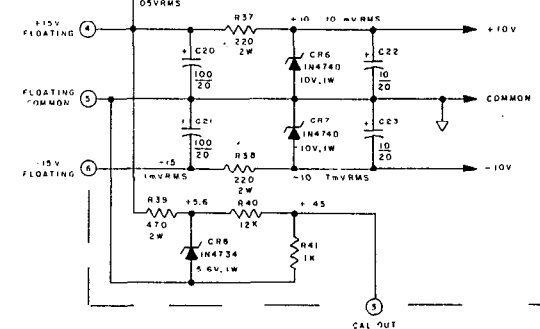
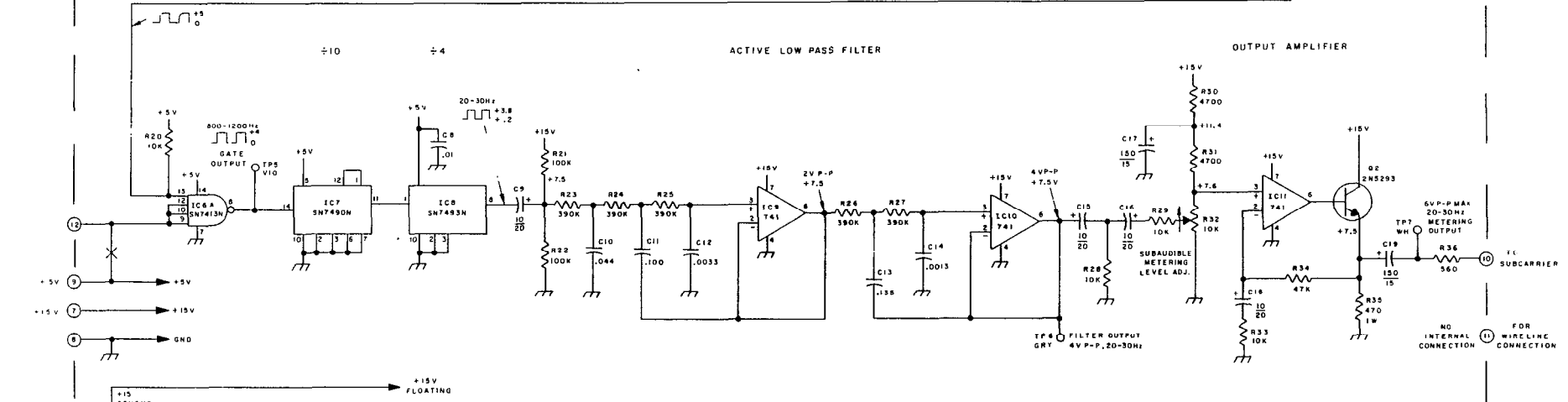
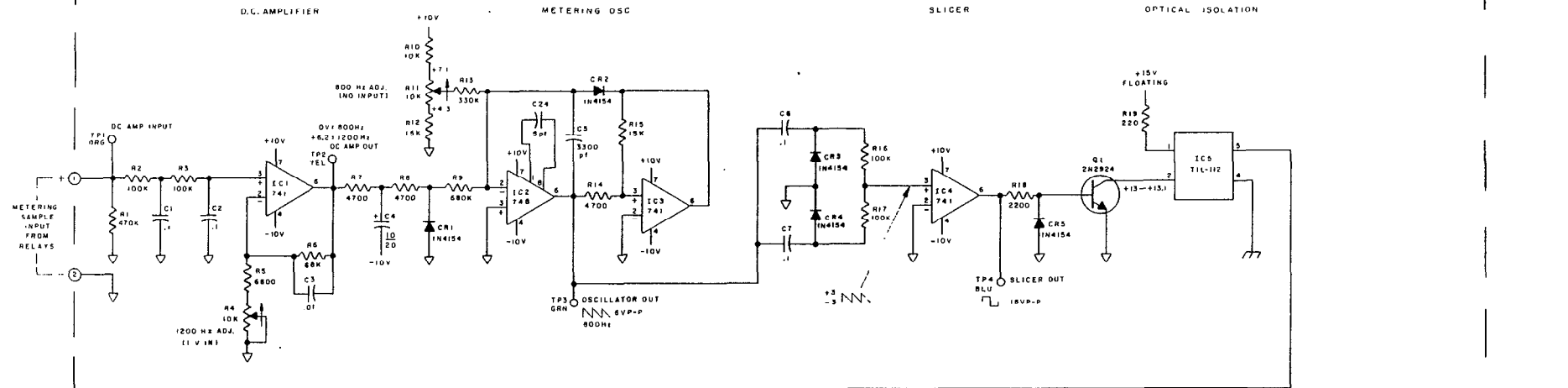


NOTES:

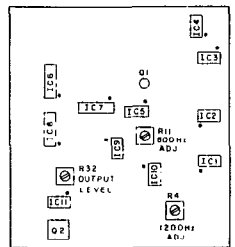
- 1 UNLESS OTHERWISE SPECIFIED  
RESISTOR VALUES ARE IN OHMS, 1/2W.10%  
CAPACITOR VALUES ARE IN MICROFARADS  
DIODES ARE IN 4154
- 2 I.C.'S LISTED AS 741 ARE SN 72741P
- 3 F DENOTES DRG. 2C-1400-045
- 4 P.C. BOARD 51A 5420
- 5 SCHEMATIC 91L 6566

TRC-15 CONTROL/STUDIO

PARTS LIST UPDATED. PCD 156B 1 FEB 69 D.T.W.		DATE	MOSELEY ASSOCIATES, INC.	
REVISIONS		MGMT. APPR.	SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 93017	
A			COMPOONENT LAYOUT	
A			SCU AUD. MTRG DEMOD.	
11			TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, < ± 1/2°	
A			DWN	7-28-72
A			CHK	FX Y 9/26/72
A			ENG	JLP 27SEP72
A			20 A 2341	
A			AI	

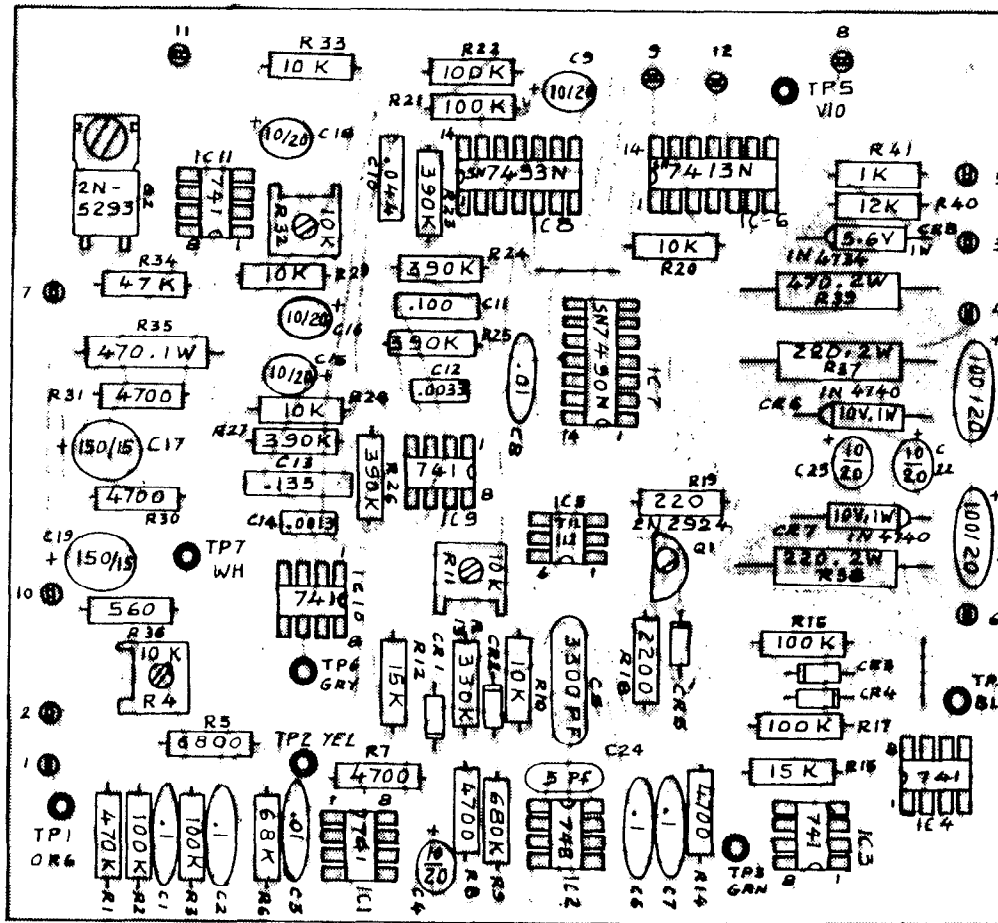


- NOTES:
- 1 UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/2W, 10%. CAPACITOR VALUES ARE IN MICROFARADS
  - 2 I.C.'S LISTED AS 741 ARE SN72741P
  - 3 P.C. BOARD 51A5417.
  - 4 COMPONENT LAYOUT 20A2342
  - 5 ▽ DENOTES FLOATING COMMON



(REMOTE TERMINAL) XMTR

MOSELEY ASSOCIATES, INC.	
SCHAUMBURG, ILLINOIS	
SCHEMATIC TRC-15	
SUBAUDIBLE METERING GENERATOR	
REV. 1	DATE
DESIGNED BY	SCALE
CHECKED BY	SCALE
ENG. NO.	91C6567



NOTES:

- 1 UNLESS OTHERWISE SPECIFIED  
RESISTOR VALUES ARE IN OHMS, 1/2W, 10%.  
CAPACITOR VALUES ARE IN MICROFARADS.  
DIODES ARE IN 4154.
- 2 I.C.'S LISTED AS 741 ARE SN72741P
- 3 P.C. BOARD 51A 5417
- 4 SCHEMATIC 91C 6567

TRC-15 REMOTE/XMTR



**MOSELEY ASSOCIATES, INC.**

SANTA BARBARA RESEARCH PARK  
GOLETA, CALIFORNIA 93017

**COMPONENT LAYOUT  
SUBAUD. MTRG. GEN.**

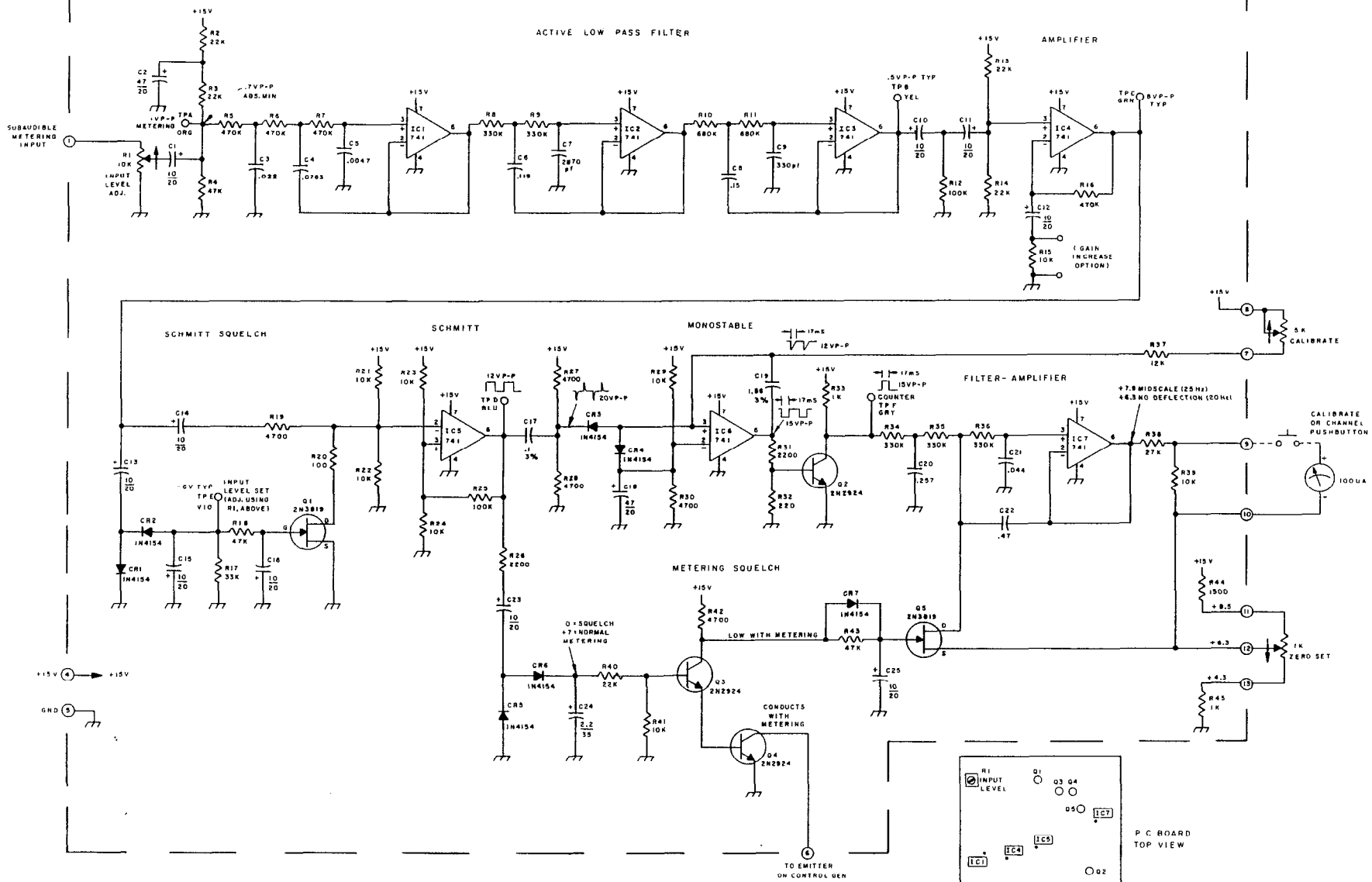
TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, < 1/2"

REV	DATE	MGMT APPR.	REVISIONS
B			PARTS LIST UPDATED. PCO 1568 1FEB69 D.T.W.
D			REMOVE NOTE #5 ADD C-24 ON COMPONENT SIDE PER ARTWORK REV. B JHM 20 MAR 75
A			ADD C-24 BY ECO 627 R-15 WAS 22K JHM IC-2 WAS 741 1-3-74

REV	DATE	MGMT APPR.	REVISIONS
DWN			
CHK			
ENG			

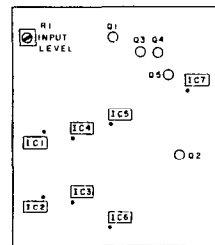
7-31-72  
9/26/72  
27SEP72

SCALE: FULL  
20A2342 B1



NOTES:

- 1 UNLESS OTHERWISE SPECIFIED  
RESISTOR VALUES ARE IN OHMS, 1/2 W, 10%  
CAPACITOR VALUES ARE IN MICROFARADS
- 2 I.C.'S LISTED AS 741 ARE SN72741P
- 3 P.C. BOARD 51A5422
- 4 COMPONENT LAYOUT 20A2345.

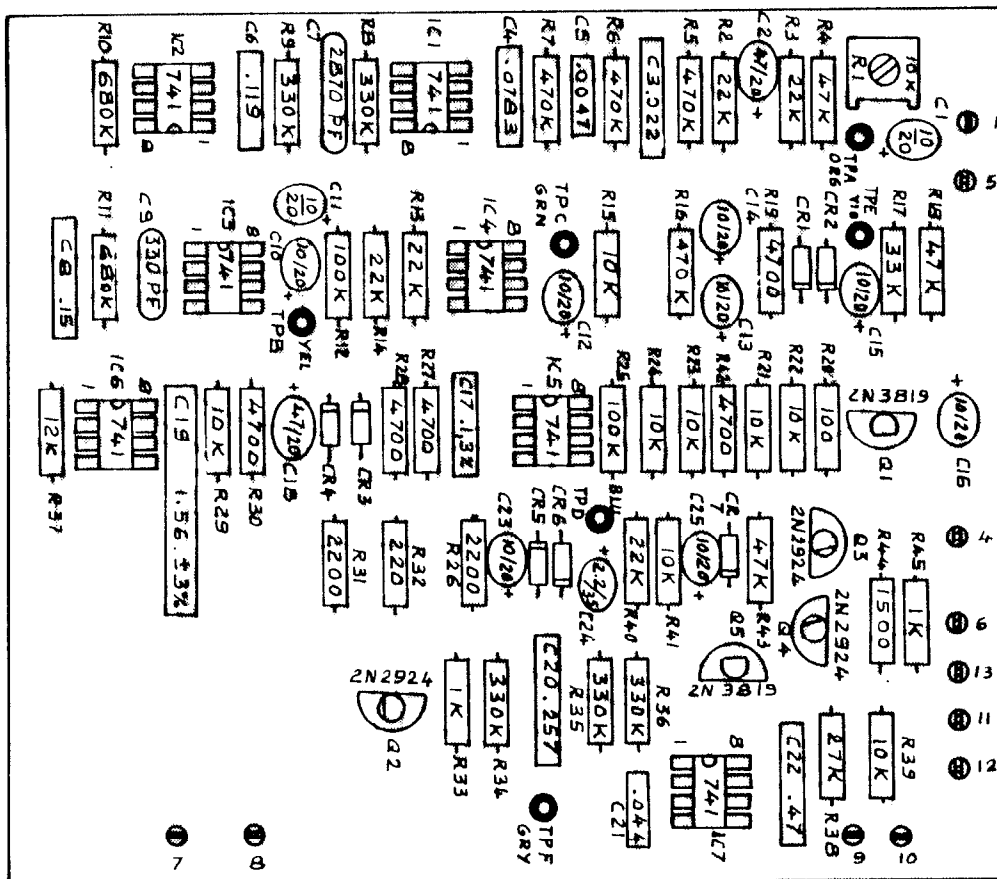


P.C. BOARD  
TOP VIEW

(CONTROL TERMINAL) STUDIO

MOBELEY ASSOCIATES, INC. SANTA BARBARA, CALIFORNIA	
<b>SCHEMATIC TRC-15 SUBAUDIBLE METERING DEMOD.</b>	
TO: FRACT - 132 Xx - 000 3xx - 010	SCALE
DWN F x Y 7/18/72	91C 6568 B
CHK	ENG JCT
REVISIONS DATE	DATE





NOTES:

- 1 UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/2W, 10%. CAPACITOR VALUES ARE IN MICROFARADS. DIODES ARE IN 4154
- 2 I.C.'S LISTED AS 741 ARE SN72741P
- 3 P.C BOARD 51A 5422
- 4 SCHEMATIC 91C 656B

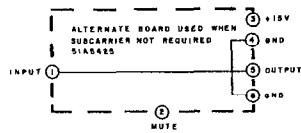
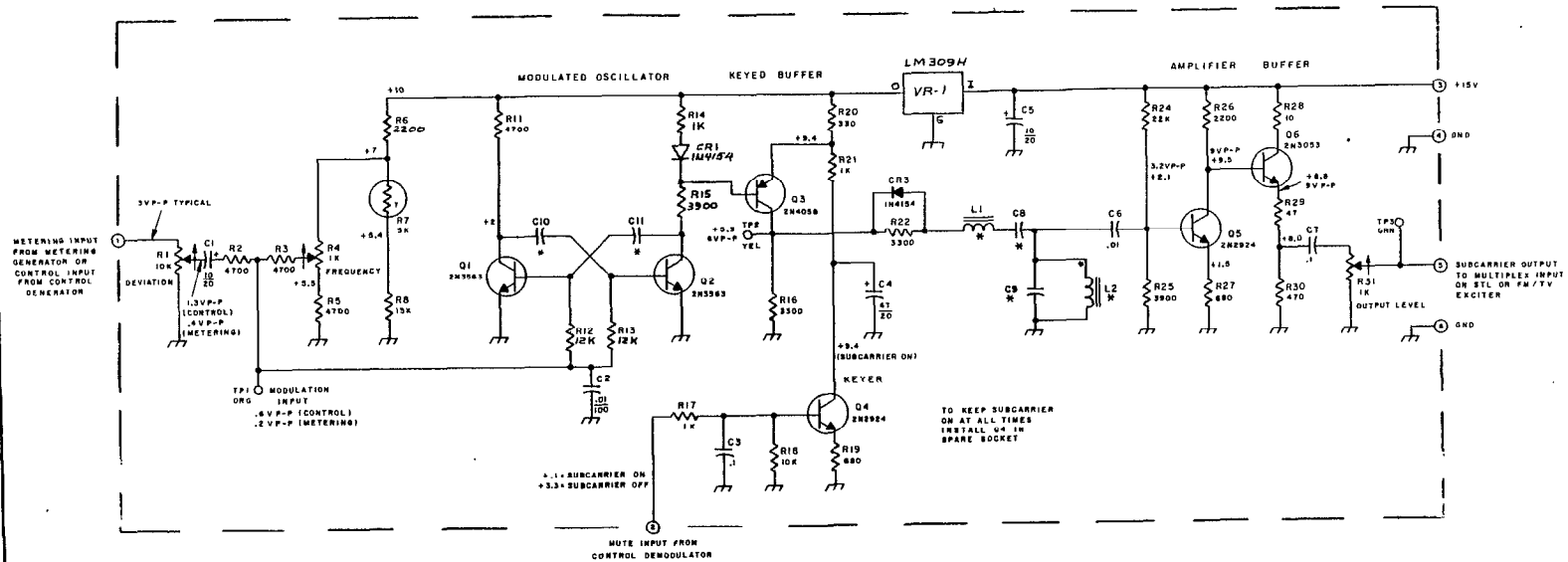
TRC-15 CONTROL TERM.

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

**COMPONENT LAYOUT**  
**SUBAUDIBLE METERING DEMOD.**

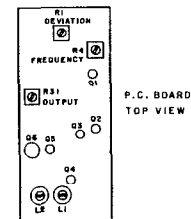
TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, < ± 1/2"			
DWN	RJF	8-2-72	SCALE: FULL
CHK	FXY	9/26/72	
ENG	JLP	27SEP72	20A2343 BI

REVISIONS	DATE	MGMT. APPR.
A	2/14/72	
B	10/03/72	
B	10/05/72	
B	10/05/72	
B	10/05/72	



\* FREQUENCY DETERMINED PARTS

ITEM	C10, C11	C9	C8	L1	L2
1 (28 KHz)	910 pf	7500 pf	910 pf	47 mh	4.7 mh
2 (39 KHz)	560 pf	4700 pf	560 pf	33 mh	4.7 mh
3 (41 KHz)	560 pf	4700 pf	750 pf	22 mh	3.3 mh
4 (67 KHz)	330 pf	2700 pf	330 pf	22 mh	2.3 mh
5 (95 KHz)	240 pf	2200 pf	330 pf	10 mh	1.5 mh
6 (110 KHz)	200 pf	1500 pf	390 pf	4.7 mh	1.5 mh
7 (135 KHz)	160 pf	1300 pf	300 pf	4.7 mh	1.0 mh
8 (185 KHz)	120 pf	1200 pf	180 pf	4.7 mh	680 ah
9 (152 KHz)	240 pf	820 pf	51 pf	22 mh	1.0 mh



- NOTES
- UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/2 W, 10% CAPACITOR VALUES ARE IN MICROFARADS.
  - P. C. BOARD STARTS
  - COMPONENT LAYOUT 20A8844.

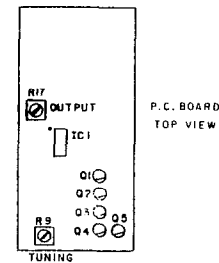
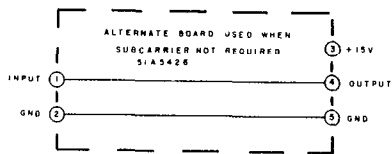
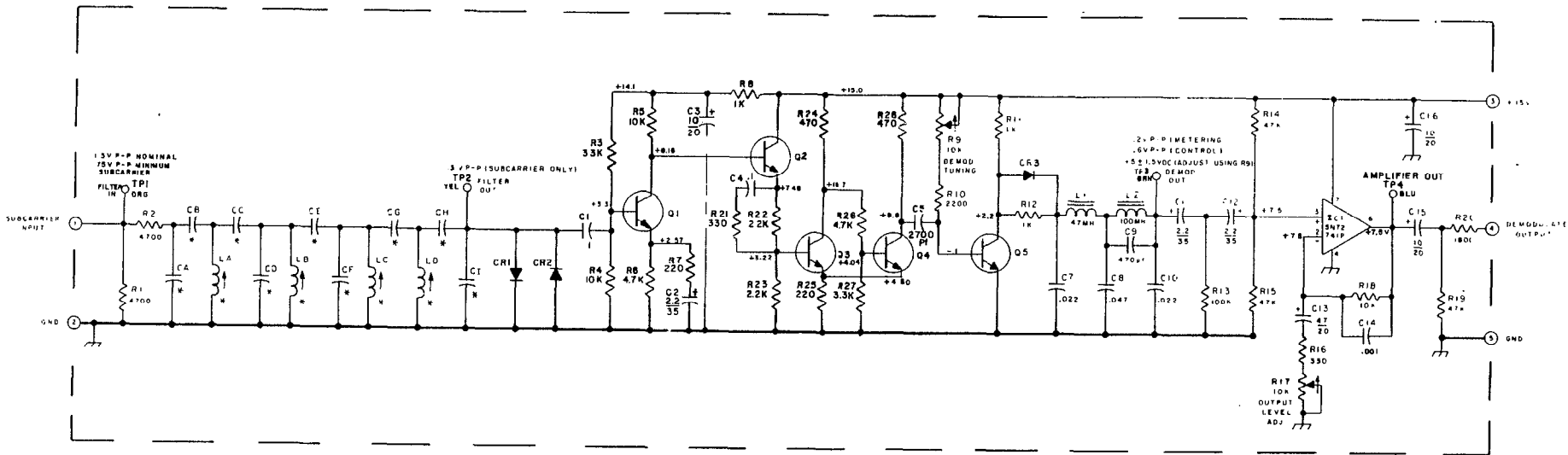
CHANGES PER REVISIONS		DATE	
1	DATE	1/24/72	SCALE
2	CHK	JCY	91 C 65 69
3	ENG	JCY	91 C 65 69

MOSELEY ASSOCIATES, INC.  
SANTA BARBARA, CALIFORNIA

SCHEMATIC TRC-15  
SUBCARRIER GENERATOR

100 WORKING TO : 000 1 210





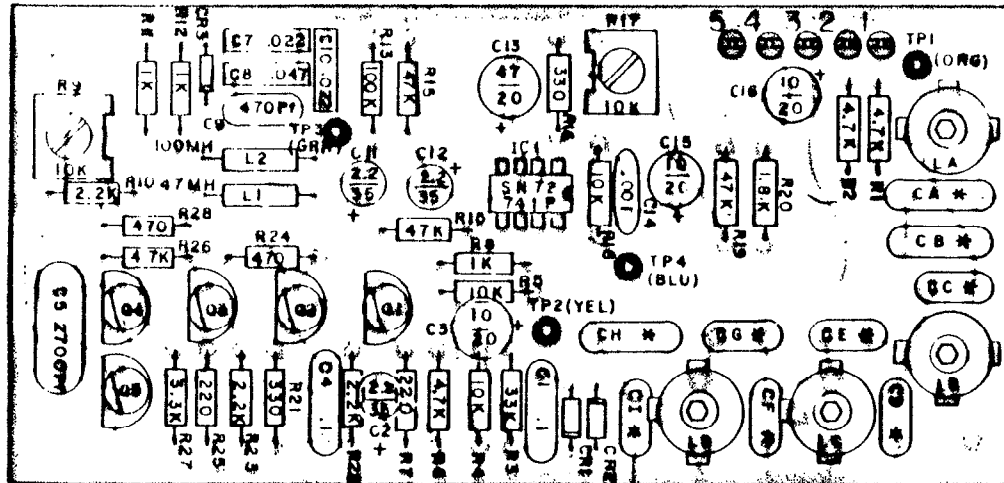
NOTES

- 1 UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/2 W, 10% CAPACITOR VALUES ARE IN MICROFARADS. DIODES ARE 1N4154, TRANSISTORS ARE 2N5563.
- 2 P.C. BOARD 51A8801
- 3 COMPONENT LAYOUT 20A2345
- 4 W FREQUENCY DETERMINED COMPONENT SEE 9444510

REPLACED IC		DATE	
C CIRCUIT WITH DISCRETE COMPONENTS		1/24/72	
DESIGNED BY: J. J. W. 11-73		SCALE	
CHECKED BY: J. J. W. 11-73		100 XX 2 D10	
APPROVED BY: J. J. W. 11-73		91C 6570	
REVISIONS		SCALE	
DWN	J. J. W.	1/24/72	100 XX 2 D10
CHK	J. J. W.	1/24/72	91C 6570
ENG	J. J. W.	1/24/72	91C 6570

**MOSELEY ASSOCIATES, INC.**  
SANTA BARBARA, CALIFORNIA


**SCHEMATIC TRC-15  
SUBCARRIER DEMODULATOR**



NOTES:

- 1 UNLESS OTHERWISE SPECIFIED  
RESISTOR VALUES ARE IN OHMS, 1/2 W, 10%  
CAPACITOR VALUES ARE IN MICROFARADS.  
TRANSISTORS ARE 2N3063, DIODES ARE IN4154
- 2 P. C BOARD 61A6501
- 3 SCHEMATIC 91C6870
- 4 \* FREQUENCY DETERMINED COMPONENT  
SEE 94A4510

TRC-15AR

D1 ADDED 152 KHZ TO P/L ECO 1969 JCE		DATE	
C1 PARTS LIST UPDATED. P001558 1 FEB 80 DTW.		REVISIONS	
C1 NEW CIRCUITRY		INGMT. APPL.	
C1 ECO 500 7-1-73		DATE	
 <b>MOSELEY ASSOCIATES, INC.</b> SANTA BARBARA RESEARCH PARK GOLETA, CALIFORNIA 93017			
<b>COMPONENT LAYOUT</b> <b>SUBCARRIER DEMODULATOR</b>			
TOL: FRACT. ± 1/32, XX ± .030, XXX ± .010, < ± 1/2"			
DWN	P.M.	7-11-73	SCALE: FULL
CHK	FXY	7/19/73	
ENG	-CT	18/2/73	
20A2345			D1