# INSTRUCTION MANUAL
for
# MODEL PBR-21
# SOLID-STATE
# REMOTE CONTROL SYSTEM



MOSELEY ASSOCIATES, INC.
SANTA BARBARA CALIFORNIA

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P. O. Box 3192

SANTA BARBARA, CALIFORNIA

JUNE 1965

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## Introduction and General Description

The Model PBR-21 Solid-State Remote Control System is designed to control AM, FM, and TV broadcast transmitters. 21 metering and 42 control functions are provided by this system which requires only a single, two-way signal circuit for operation. This may be a wire line, with or without amplification, carrier telephone aparatus, VHF radio links, or aural and TV STL multiplex subcarrier circuits. Because of this design, there is no necessity for a DC path between the transmitter and the remote control point.

All of the transistors and diodes employed in the Model PBR-21 System are silicon devices. The transistors are all of one type and are mounted in sockets. Two spare transistors are provided in both the Studio and Transmitter Control units. A panel containing three illuminated 4" rectangular meters is provided as a standard item with each system. Each of the 21 metering positions can be made to appear on any given meter by changing the jumper wires for the meter lamps and metering signal in the Studio Control Unit. It would be possible, also, to employ 21 separate meters, each one displaying the information corresponding to the selected push-button.

The principles of operation employed in the PBR-21 Remote Control System are straightforward. Three oscillators employing stabilized torodial inductors and silver mica capacitors generate the LOWER, RAISE, and FAIL-SAFE control frequencies. The frequencies are respectively, 2000 cps, 2450 cps, and 3000 cps. The FAIL-SAFE tone is interrupted by a transistor gate to cause the stepper switch in the Transmitter Control Unit to advance and/or to seek its home or calibrate position. A binary counter chain controlled by push-button logic determines the proper sequency of interruption to the FAIL-SAFE tone.

Telemetry is performed by converting DC sampling voltages from the transmitter, tower lights, etc. to a frequency operating in the 400 to 750 cps spectrum. NOTE: For certain applications when the PBR-21 System is used in a radio remote control system, the range of telemetering frequencies is changed to a 22 - 36 cps instead of 400 - 750 cps. Operation and functions remain the same. A simple Schmitt trigger circuit and a diode pulse counter converts this frequency back to DC for meter readout at the remote control point.

The Model PBR-21 Remote Control System consists of three separate units. The Studio Control Unit and the three-meter panel are located at the remote control point. The Transmitter Control Unit is placed adjacent to the transmitter or transmitters being controlled. 22 push-buttons are located on the Studio Control Unit. The first push-button is reserved for calibrating the metering system; the remaining twenty-one are for control and metering. The calibration button is red and is located at the upper left-hand side of the push-button bank. A rocking arm switch, with a center off position, is used to transmit LOWER, RAISE (ON or OFF) commands. SLOPE and CALIB. SET controls on the Studio Control Unit permit the calibration of the metering information. A power switch and power line fuse post are also located on the front panel of the Studio Control Unit. Two indicator lamps show the status of the control system. A small push-button enables the operator to quickly confirm the information being received on any push-button selection.

The Transmitter Control Unit contains 21 multiturn calibration controls, one for each of the metering channels. In addition to the power switch, pilot lamp, and fuse holder, three buttons enable an operator at the transmitter site to operate the control system. Fail-safe circuitry is included in this unit and will operate if the control circuit is open for any period exceeding approximately 25 seconds. The output control circuitry of the Model PBR-21 can be likened to one row of 21 SPDT center off switches, with all poles tied together. The selection of these switches is controlled by the push-buttons on the Studio Control Unit, and the position of the selected switch is determined by the operation of the LOWER-RAISE switch, also on the Studio Control Unit. All control, metering, and line connections are made on a barrier strip located on the rear of the chassis.

There are a total of 6 plug-in printed circuit boards containing all of the essential electronic circuitry. Four of these boards, Boards A, B, C, and D, are located in the two card cages mounted on each side of the Studio Control Unit chassis. Boards E and F are mounted in a single cage on the Transmitter Control Unit. The boards are designed so they cannot be inserted into the socket unless properly oriented. CAUTION: It is possible, however, to interchange boards so always be sure that the proper circuit board is plugged into the proper socket. The copper circuitry on each printed board has been electroplated with a thin film of gold to prevent oxidation.

The power supplies, electric-wave filter, stepper switch, and relays are mounted on the chassis of the Model PBR-21 Control System. The relays are of the plug-in type and are held in position with a retaining clamp.

When operating the Model PBR-21 Control System over a radio or STL circuit, the control and metering tone signals are brought out separately

on the Studio and Transmitter Control Units.

Specifications

| | |
|---|---|
| Control Functions | 21 RAISE, 21 LOWER Commands |
| Metering | 21 telemetering channels<br>0 - 4 volts DC (approx.) for full scale deflection |
| Metering Input Impedence | 10,000 ohms. |
| Control Relay Rating | 2A/30VDC, 120VAC, non-inductive load |
| Fail-Safe | Activated when control line interruption exceeds 25 seconds |
| Line Requirements | 20 db allowable loss from 400 - 3000 cps |
| Calibration Reference | Zener Diode |
| Mechanical | Studio Control Unit 7" X 19"<br>Meter Panel 5 1/4" X 19"<br>Transmitter Control Unit 5 1/4" X 19" |
| Power Requirements | 120/240 VAC, 50 - 60 cps |
| Finish | Anodized and etched aluminum panels |

Installation

Prior to bench-testing the equipment or proceeding with the installation, it is recommended that the entire Model PBR-21 be examined for any damage or loose components due to shipping vibrations. In particular, the inside of each printed circuit card cage should be carefully examined. While the transistor sockets used will firmly hold the transistors in place, a visual inspection is suggested and any loose transistor should be well-seated in the socket. NOTE: The transistor sockets are all oriented the same way, and each transistor mounts in the socket in the same relative position.

Before installing the Model PBR-21 Remote Control System, the equipment should be operated on a back-to-back basis so that personnel can familiarize themselves with the operation of the unit. The cable from the meter panel should be connected in the corresponding socket on the rear of the Studio Control Unit. The power cables from the Studio and Transmitter Control Units should be connected to a source of 120VAC, 50-60 cps.

CAUTION: If the available power is 240 V, 50 - 60 cps, change power transformer primary wiring as shown on schematic diagrams for the Studio and Transmitter Control Units. A pair of wires, or shielded cable, is then used to connect the LINE input terminals of the Studio Control Unit to the LINE input terminals on the Transmitter Control Unit. The power switches on both units should then be turned on. Occasionally the stepper switch may be actuated when the power switch is initially turned on. This is a normal condition and does not indicate any malfunction of the system. Next, depress the red calibration button. This will cause the stepper switch to advance to the CALIBRATE or home position. The lamps in the left-hand meter will turn on after the stepper has stopped and the meter should have an indication near mid-scale. When the LOWER control is actuated, the meter will fall to zero. Also, the lower relay, K804, in the Transmitter Control Unit can be checked for operation. If the meter does not read zero, adjust the CALIB. SET control for zero with the LOWER control command on. Next, release the control button, and adjust the SLOPE control until the pointer falls between the two arrows mid-range on the meter scale. The system is now calibrated. When depressing any other push-button, the stepper switch will automatically advance to that position. As this is done, the red CYCLE lamp turns on and remains on until the stepper switch has reached its proper position. At this time, the red CYCLE lamp turns off and the green READ lamp turns on. If the RECYCLE button is pressed, the circuitry will automatically place the stepper switch in the home or calibrate position, and then advance it until it comes to rest on the position corresponding to the depressed push-button.

If the RAISE or LOWER buttons on the Transmitter Control Unit are pressed, the appropriate relays will function. The position of the stepper switch in the Transmitter Control Unit can be changed by pressing the STEPPER button. When this button is pushed for approximately 1 second, the stepper switch will move to the home position. Incremental steps can be made by pressing the STEPPER button for a brief moment. To advance the stepper switch to the 5th position, for example, the operator would press the STEPPER button five times, each time being rather brief. No tally indication is given the operator at the Transmitter Control Unit. A plastic card is mounted on the panel, however, to easily identify each meter position with the parameter it controls or telemeters.

A voltage source, such as available from a volt-ohm meter, can be placed between any given telemetering input and ground barrier point. Next, push the button corresponding to this number on the Studio Control Unit. By adjusting the calibration potentiometer associated with this channel, the deflection of the selected meter on the meter panel can be made to vary. Such back-to-back testing will enable the operator to familarize himself with the operation of the Model PBR-21 Remote Control System

and to understand how the system works before it has been put into service.

The meter panel and Studio Control Unit should be installed in a standard 19" rack at the desired remote control point. The signal control pair should be connected to the appropriate barrier terminals on the rear of the chassis. If the unit is to be used over a radio link, such as the Moseley Model PCL-2B aural STL, then the metering input and control output connectors will be separated. These should be connected to the channels assigned to convey the respective information. The meter panel is designed to be mounted directly above the Studio Control Unit. Panel notchings will match standard 19" equipment racks used in broadcast service. A total of 12 1/4" of panel space is required for the studio control equipment.

The 5 1/4" Transmitter Control Unit should be mounted near the transmitter(s) it is to control so metering and control leads can be neatly installed. Power for the LOWER and RAISE output circuitry of the Model PBR-21 is connected to the barrier terminals marked COMMON and 117VAC. Note that this circuit has a separate fuse on the rear panel and that this circuit is not connected in any way to the 117VAC obtained through the power cable. The contacts of the control relays are rated at 60 watts into a resistive load. While two sets of contacts are paralleled, care should be taken not to attempt switching loads exceeding 60 watts. When heavy loads are to be controlled, it is suggested that an appropriate 117VAC power relay be used with properly-rated contacts.

Line Requirements

The Model PBR-21 is normally manufactured for operation over a single wire or telephone carrier circuit. The equipment is designed to operate with input levels ranging from - 20 dbm to +10 dbm. Should amplifiers be used in the circuit, care should be taken to limit the received signal on both the Transmitter and Studio Control Units to this range. If the line noise level or cross-talk is unusually high, the LOWER-RAISE control relays may be actuated. This false relay operation will render the control system unreliable.

The output voltage from the telemetering oscillation in the Transmitter Control Unit is normally wired to develop approximately 0 dbm across a 600 ohm line. If it is desirable to increase or decrease this level by 5 db, the output connections on printed circuit Board F should be changed. (Refer to schematic Drawing 91B-6127)

Operation

Once, installed, it is recommended that the equipment be left on continuously. If the back-to-back bench-test procedure outlined in the previous

section was done, operation of the equipment will be quite straightforward. It will be briefly reviewed again. At the remote control point, press the CALIB. push-button on the Studio Control Unit. Next, actuate the LOWER control switch and adjust the CALIB. SET control until the left-hand meter reads zero. Then release the LOWER control switch and adjust the SLOPE control until the pointer falls between the two arrows. The system is now calibrated. Next, push Button 1. This will cause the stepper at the transmitter site to advance to the first position. (When making a change of only one position, the red lamp may not always operate.) This position is quite often chosen as the PA voltage position. When making the initial installation, the operator at the transmitter should note the value of this parameter for the transmitter and advise the operator at the remote control point. He should then adjust the #1CALIBRATE control until the studio operator advises him that the left-hand meter reading corresponds to the actual transmitter PA voltage value. The other channels can be similarly calibrated.

The broadcast transmitter can be placed in a radiate position, for example, by pushing the #1 button and actuating the RAISE command. Likewise, the carrier can be removed by operating the LOWER command when in the #1 position.

Theory of Operation

The control and metering functions of the Model PBR-21 Remote Control System are accomplished using frequencies in the 400 to 3000 cps spectrum. Three stable oscillators operating at 2000, 2450, and 3000 cps operate LOWER, RAISE, and CONTROL circuits. As a 3000 cps control tone is present at all times except when the operator wishes to select another control channel, the control tone also acts as a fail-safe tone. Thus, the 3000 cps tone may be referred to as either the control or fail-safe signal. The LOWER or RAISE tones are applied to the system only when the operator desires to control any given parameter at the transmitter site.

In addition to the fail-safe or control tone, a metering tone is also present in the system. When wire lines are used, the metering tone varies between 400 and 750 cps. As indicated earlier, this frequency may be in the 22 to 36 cps band in the event a radio link is being used to relay control and metering signals associated with standard or FM broadcast transmitters. In operation, DC sampling voltages from the transmitter are converted to tones by a linear voltage-controlled oscillator in the Transmitter Control Unit. These tones are converted back into analog information by a pulse counter in the Studio Control Unit for presentation on the appropriate meter.

The circuits used in the Model PBR-21 when taken individually are basic and simple to understand. However, the combined operation may seem complex unless the operation is thoroughly understood. The circuitry associated with the selection of an individual control channel might, for example, seem rather complex. Before explaining the detailed operation of the circuit, it would be well to briefly describe "AND" and "OR" gate circuits that are used in the Model PBR-21 Control System.

Figure #1 shows a typical "AND" gate with five inputs. In order for there to be any output signal, all five inputs must be present. The waveforms drawn to the left of the five input terminals represent the signals being applied to the "AND" gate. The output waveform shown below the input signals is present only when Inputs #1 and #2 and #3 and #4 and #5 are all on. Hence the name "AND".

Figure #2 shows another common circuit, the "OR" gate. This is a three-input "OR" gate and the output pulse is present when Input #1 or #2 or #3 is present. The name for this circuit is also obvious.

The Studio and Transmitter Control Units of the Model PBR-21 Remote Control System are shown in block diagrams on Drawings SKA-6082 and SKA-6083, respectively. Let us first consider the operation of the Studio Control Unit. Drawing SKA-6082 is divided into two sections: the bottom part, called the Control Section, contains the 2000, 2450 and 3000 cps oscillators, control tone gate, and summing amplifier. This section also contains the telemetering detector circuitry for converting the metering tones into a DC voltage for meter readout. The 800 cps low-pass filter prevents the control tones from saturating the input telemetering amplifier. A Schmitt trigger follows the telemetering amplifier and isolates the output DC signal from changes in level of the input metering tone.

The blocks above the dotted line are all part of the logic circuitry which controls the control tone gate. That is, the output of this section turns off (gates) the 3000 cps oscillator at definite intervals each time the push-button selection bank is operated. It should be repeated that short interruptions of the 3000 cps control tone will cause the stepper to advance one position. A slightly longer interruption will move the stepper switch to the home or CALIB. position. Thus, the control gate receives two different pulse widths to turn off the 3000cps tone, and these, in turn, are used to either advance the stepper switch incrementally or to rapidly advance it to the home position.

The timing information for the binary logic system is derived from a continuously-running 9 cps clock-oscillator. There are two outputs from the clock. One of these outputs is applied to a trigger switch.

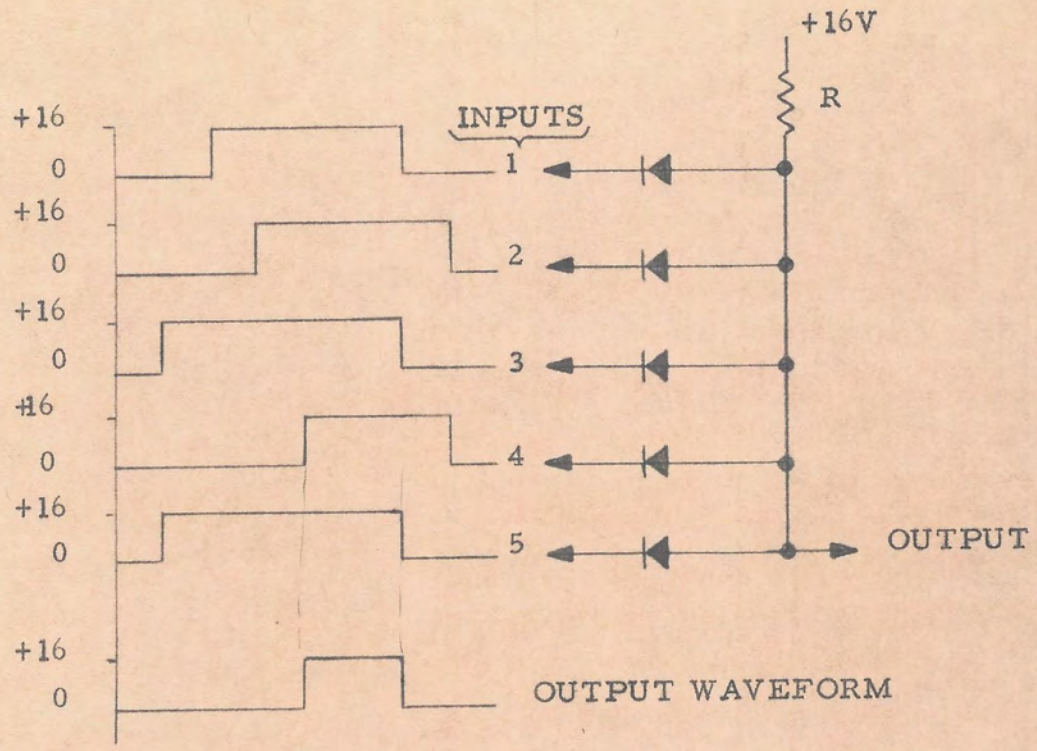



FIGURE 1.

FIVE INPUT "AND" GATE

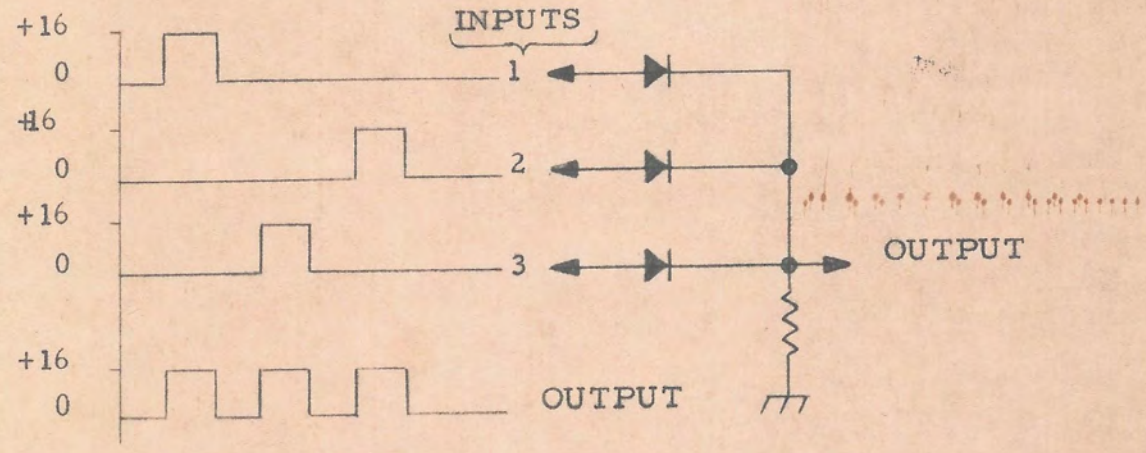



FIGURE 2.

THREE INPUT "OR" GATE

If this switch is open, negative-going pulses from the clock are applied to the input of a five-stage binary divider. A circuit of this type has $2^5$ or 32 different states of condition. That is, each flip-flop will either be in the flip or flop state. For example, the 11th position would occur when the first, second, and fourth stages are conducting in the same transistor while the third and the fifth binary stages are conducting in the opposite transistor. Thus, it is possible to derive a voltage from each collector in all the binary flip-flops, and when properly selected and applied to an "AND" gate, this voltage will produce an output signal which will turn off the trigger switch and prevent additional pulses from advancing the binary divider. As soon as a different push-button is selected, the trigger switch allows clock pulses to advance the binary chain. It will only stop when all five inputs to the "AND" gate, as selected by the push-button assembly, again turn off the trigger switch to stop the clock pulses.

The five binary stages have a capacity to assume 32 different states. However, the stepper switch in the Transmitter Control Unit has only 22 positions, 21 of them for control and metering and the 22nd for the calibration function. Thus, when the binary divider reaches the state corresponding to #23, it must be reset to zero to begin counting again so as to maintain synchronism with the stepper switch. This is accomplished with another five-input "AND" gate. This is essentially the same as having a permanent 23rd push-button which, when activated, applies a pulse to the two-shot reset generator. This generator has two outputs, one slightly longer in duration than the other. The longer of the two outputs is applied to the binary divider to return each stage to the zero position. This means that the binary chain is reset. This same pulse is also applied to the trigger switch to prevent clock pulses from entering the binary divider chain.

A two-input "OR" gate is connected to the collectors of the first binary stage so that an output pulse is obtained each time a clock pulse enters the binary system.

The output from this "OR" gate is applied to a bi-stable gate control flip-flop. A pulse from the "OR" gate will shift the bi-stable flip-flop to the other state, which, in turn, controls the control tone gate, causing the 3000 cps control tone to be turned off. However, a pulse derived from the second output of the 9 cps clock restores the bi-stable gate to its previous position, 1/2 clock cycle later, thus restoring the output of the 3000 cps tone to the line. It will be remembered that the two-shot reset generator has two outputs. The long time-duration pulse resets the binary divider chain to zero. The shorter output pulse is applied to the bi-stable gate control flip-flop, which causes the control tone gate to remain closed long enough for the stepper switch in the

Transmitter Control Unit to move to the home position. The longer pulse from the two-shot reset generator assures that the binary divider will not start functioning until all the relays and the stepper in the Transmitter Control Unit have operated.

When the RECYCLE button is pushed, the two-shot reset generator is pulsed just as if the binary chain had advanced to the 23rd position. When this is done, the binary chain is promptly reset, the control gate, which advances the stepper in the Transmitter Control Unit to the home position, is closed, and if the push-button selector is in, for example, the 11th position, the trigger switch will allow clock pulses to enter and advance the binary countdown chain until the 11th state is reached. At this point, the five-input "AND" gate selected by the 11th push-button will produce an output pulse to turn off this trigger switch. Thus, the RECYCLE button which is mounted on the front panel of the Studio Control Unit is a convenient way to quickly reconfirm the position of any depressed button in the Model PBR-21 Control System.

The operation of the Transmitter Control Unit as shown in block diagram SKA-6083 is quite straightforward and needs little explanation. The input signals from the line are passed through a 2000 cps high-pass filter, limited and amplified, and applied to the LOWER, RAISE, and CONTROL detectors. When a tone of the proper frequency is present, a voltage is obtained to operate a relay-driver amplifier. In the case of the 3000 cps CONTROL tone, a pulsing and reset relay are employed such that short interruptions of the 3000 cps signal causes only the pulsing relay to operate. This causes the stepper switch to advance one position. When a longer pulse interruption occurs, such as generated by the two-shot reset generator in the Studio Control Unit, the reset relay also operates. This causes the stepper switch to immediately advance to the home position. If the 3000 cps signal is not restored within approximately 25 seconds, a time-delay circuit causes the fail-safe relay driver to actuate the FAIL-SAFE relay.

When the 2000 and 2450 cps tones are applied to the system, the appropriate control relay operates and applies the control voltage through the stepper switch to the barrier strip corresponding to the number of the push-button selected by the operator at the remote control point. Because of the switch employed on the Studio Control Unit, LOWER and RAISE commands may not be given simultaneously.

The DC sampling voltages to be telemetered are applied to the calibration controls mounted on the front panel of the Transmitter Control Unit. A gold-plated switch deck on the stepper selects the output of the desired channel and applies the sampling voltage to a telemeter DC amplifier. The output of this amplifier is used to control the frequency

of a voltage-controlled oscillator. When normal signal circuits are employed, the frequency of the oscillator varies between approximately 400 and 750 cps. The lower frequency corresponds to ground potential, while the high frequency is produced when a signal of approximately +4 volts DC is applied at the metering input. A low-pass filter with a cut-off frequency near 800 cps removes the harmonic content from the oscillator waveform. This filter prevents the metering signal from actuating the control tone relays.

In the home or CALIB. position of the stepper switch, a voltage derived from a Zener reference diode is applied to the input of the telemeter DC amplifier. This will cause the oscillator to assume a frequency of approximately 575 cps. When the LOWER relay is actuated, this voltage is removed and the voltage-controlled oscillator shifts to the frequency corresponding to a zero potential input.

Schematic Drawings 91B-6122, 91B-6123, 91B-6124, and 91B-6125 show the actual circuits contained on printed Boards A through D respectively. Drawing 91B-6129 shows the power supply, read and recycle relays, filters, and interconnections between the individual plug-in cards. Drawing SKA-6086 shows the manner in which the push-button selector switch is wired. Circuit Board A contains the 9 cps clock oscillator, bi-stable gate control flip-flop, a time-sharing gate circuit to control the 3000 cps output, the two-shot reset generator, cycling-read relay control, and summing amplifier. The cycling-read circuit operates a relay which shows the operator when the binary divider chain is being pulsed by turning on the red lamp on the front panel of the Studio Control Unit. This relay is also connected with the telemetering indication relay so that a green panel lamp will turn on after the binary logic is solved and telemetering signal is present. The telemetering detector and relay driver stage are located on Board D. Should the telemetering tone stop, the green lamp will extinguish. This condition also causes the meter to be shorted. Potentiometer R421 is in series with the SLOPE control on the front panel and is used as a coarse metering gain set.

The trigger amplifier, Q201, and the five flip-flops associated with the binary divider chain are located on printed circuit Board B. Diodes CR203 and CR204 are the "OR" gate which pulses the bi-stable gate control flip-flop on Board A. Diodes CR202, CR205, CR206, CR207, and CR208 comprise the five-input "AND" gate to reset the binary divider when it reaches the 23rd state.

Printed circuit Board C contains the three oscillators. The frequency of oscillation is determined by tuning capacitors C305, C313, and C321. Proper feedback voltage for the oscillators is determined by

the transfer characteristics of the bridged-T network between the bases and collectors of transistors Q301, Q303, and Q305. Resistors R307, R319, and R331 determine the Q of the feedback network and hence the stability of the oscillator. Proper setting of this control can be made by finding that point where the circuit just begins to oscillate. Then advance the multiturn potentiometer three turns in the direction that sustains oscillation. A secondary winding on the inductor is used to couple-out energy from the oscillator.

Schematics 91B-6126 and 91B-6127 show the circuits mounted on printed Boards E. and F. Board E contains three detector circuits and relay drivers for the control tones. Note that the detector circuitry is quite similar to the oscillators except that an output winding is not employed. Tuning of the detector is accomplished by the capacitor shunted across the inductor. The sensitivity of the detector is determined by the Q of the bridged- T circuit, which is again controlled by the shunt-resistive element (R503, R517, and R530). The proper setting for these controls is approximately three turns away from the point at which the detectors will oscillate. Emitter-followers are connected to the output of each detector and drive a voltage-doubler rectifier circuit which controls the relay-driver transistor. Circuit Board F contains telemeter DC amplifier, voltage-controlled oscillator, Zener calibration diode, Fail-Safe relay driver, and input amplifier to drive the control tone detectors on Board E. The telemeter DC amplifier, Q601, employs two diodes in the base circuit to obtain a double-junction voltage drop to bias the transistor just into the linear conduction region. R601 provides current feedback for stability.

Schematic Drawing 91B-6130 shows the power supply, relays, filters, and interconnection between the two printed circuit sockets located on the Transmitter Control Unit. It should be noted that transistors operating as amplifiers, oscillators, or detectors employ a small capacitor between the base and emitter to eliminate their susceptibility to transient or stray RF fields.

Maintenance

Being of solid-state design, the Model PBR-21 Remote Control System should require little maintenance. The stepper switch on the Transmitter Control Unit is lubricated at the time of final checkout and should not require additional oiling for 50,000 operations. If it does become exposed to dust and grime to the point where operation is erratic, the stepper switch should be oiled in accordance with the instructions given in an oiling kit, Type PD-9100-1, available from the Automatic Electric Company, Northlake, Illinois. The push-button selector switches are self-wiping and should not require attention. In the event, however, that one set of contacts should become unusable, a spare contact set is provided

on each of the 22 push-button positions.

Two spare transistors are mounted on the D and F printed circuit boards. Note that the transistors all plug in the socket in the same relative position and that the socket is wired for the standard transistor base configuration.

A printed circuit extension board is provided with each Model PBR-21 Remote Control System and will allow any given board to be operated out of the cage. It can then be easily checked with appropriate test instruments.

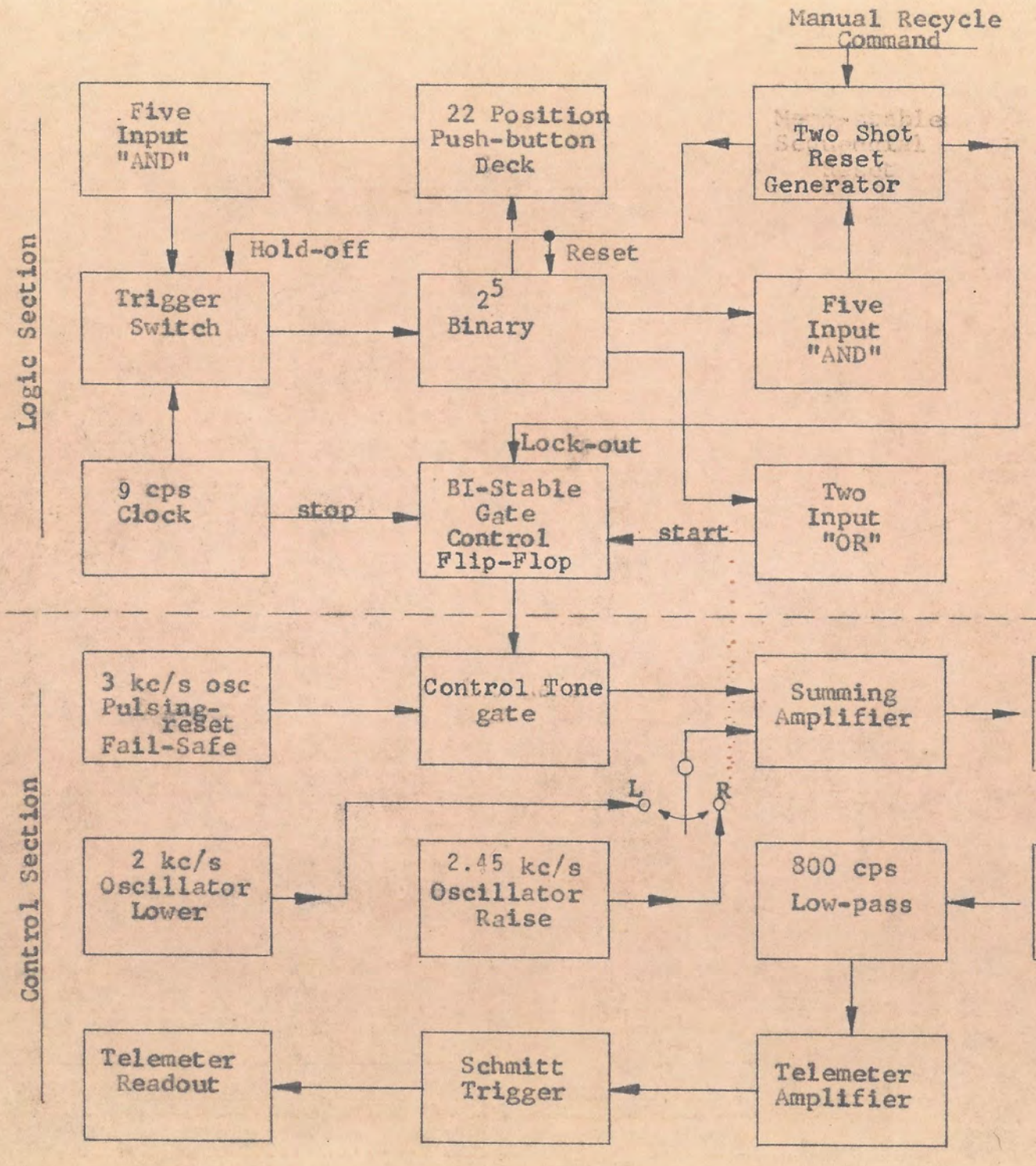
Should it become necessary to let the binary divider on Board B run continuously, removal of Q201 will prevent the trigger switch from being closed by the reset pulse or the logic derived from the push-button selector bank.

Meter Sequence Modification

Unless otherwise specified, the metering signals and supply voltage for the illuminated meters are wired to the push-button selector switch in the following manner. The CALIB. and control channel #1 information appears on the left-hand meter of the three meter panel. Channel #2 signal and lamp voltages are routed to the middle meter, while all other positions are routed to the right-hand meter. This meter contains a 0 - 100 logging scale as well as a percent output or antenna current scale for FM and AM transmitters, respectively.

If it desirable to change this sequence, it will be necessary to modify the jumper wiring on the two terminal strips mounted on the rear of the stepper switch assembly. There are 21 individual terminals on each strip. Access to these terminals can be obtained by removing the dust cover over the push-button assembly. When viewing the Studio Control Unit from the rear, the top row of terminals carries the telemetering signals and the lower row carries the 28 volts AC for the meter illumination lamps. The terminals at the right-hand side of the strips are associated with #1 control channel. The next set of terminals to the left are associated with the second channel. This sequence continues so that the 21st meter and light terminals are on the extreme left-hand side. If control position #11, for example, is to meter and control the plate voltage of an auxiliary transmitter, then the buss wires connected to the 11th metering and light terminals should be removed. These terminals should then be bussed to #1 terminal at the right-hand side. Care should be taken to prevent accidental shorts between terminals when making this modification. It should be noted that the jumper sequence on the upper and lower terminals should be the same; otherwise, the lamp voltage and metering information will not appear on the same meter.

REVISIONS




A. To line Transformer when control and metering is by metallic line
B. To subcarrier genarator when control and metering is by Radio Link

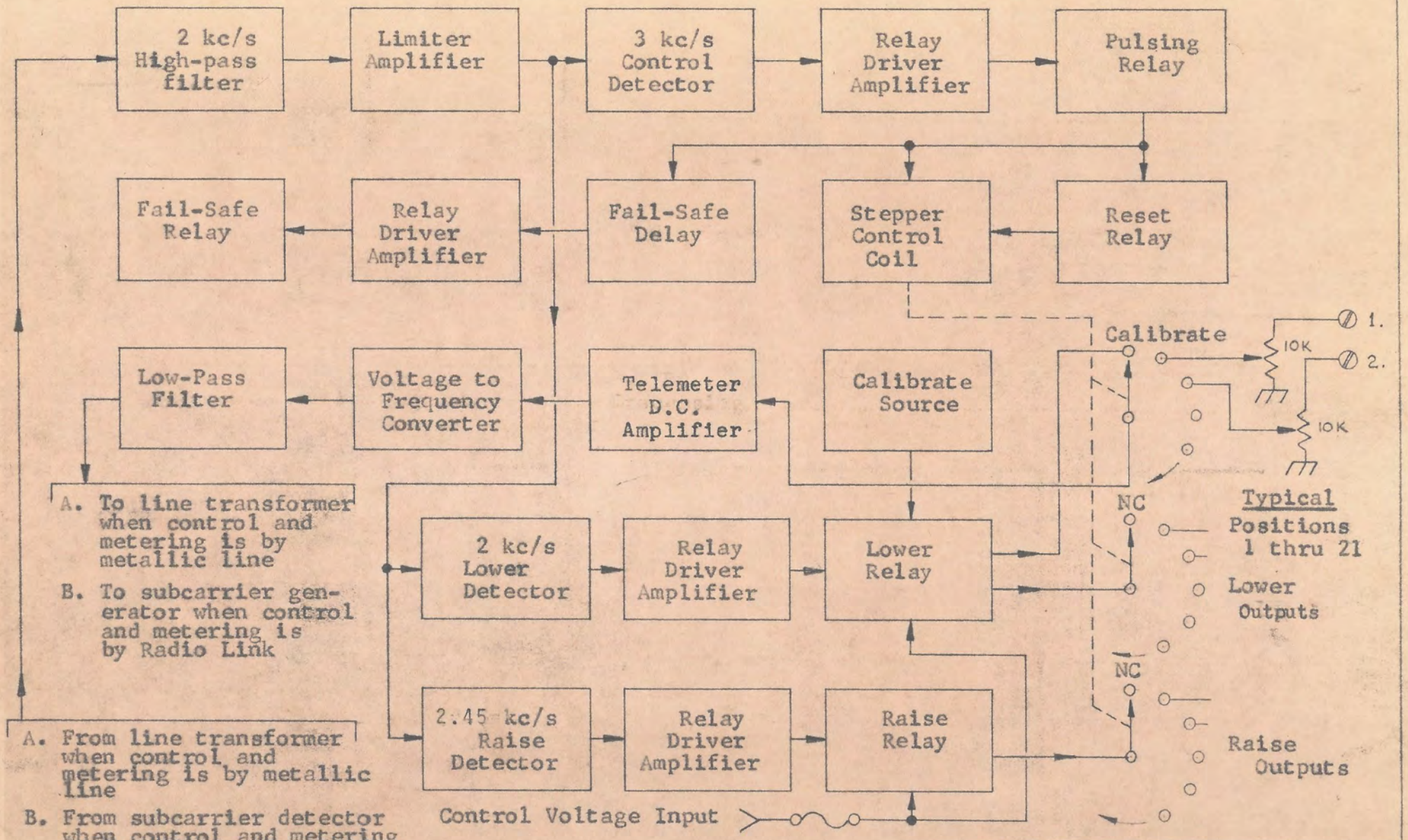
A. From line transformer when control and metering is by metallic line
B. From subcarrier detector when control & metering is by Radio Link

MOSELEY ASSOCIATES INC.
Santa Barbara, California

BLOCK DIAGRAM
PBR-21 STUDIO UNIT

DRN: GWD 2-65
CHK: H. Ham 2-65

SKA-6082



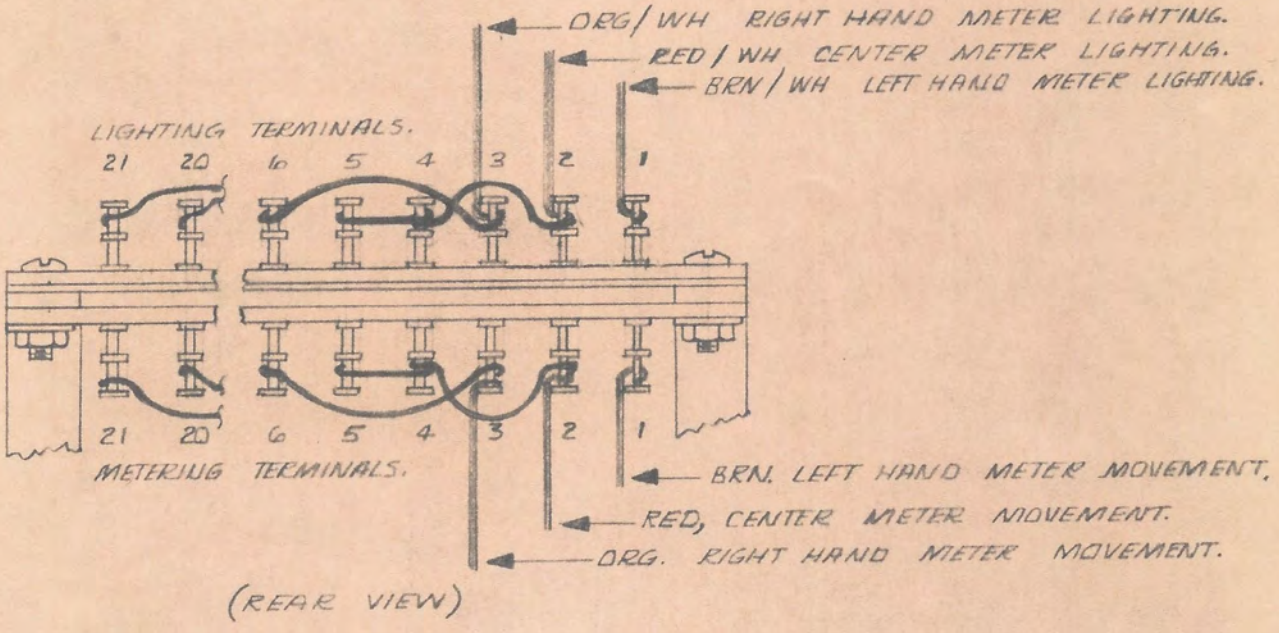

MOSELEY ASSOCIATES INC.
Santa Barbara, California

BLOCK DIAGRAM
PBR-21 XMTR. UNIT

DRN: GWD 2-65
CHK: H. Thom 2-65

SKA-6083

REVISIONS




IN THIS EXAMPLE OF METER AND PUSHBUTTON ASSEMBLY WIRING, THE LEFT HAND METER (AS VIEWED FROM THE FRONT) DISPLAYS ONLY READINGS TAKEN ON PUSHBUTTON NUMBER 1. THE CENTER METER DISPLAYS NUMBERS 2, 4, AND 5. THE RIGHT HAND METER DISPLAYS PUSH BUTTONS 3 AND 6.

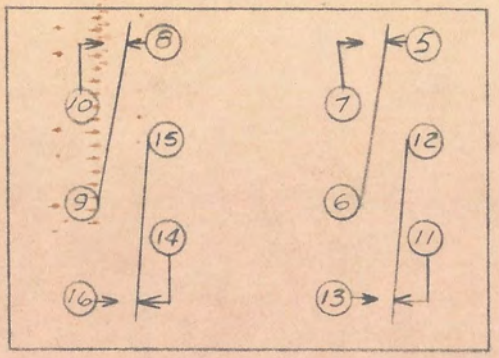
THE ABOVE DRAWING IS AN EXAMPLE AND DOES NOT NECESSARLY INDICATE THE EXACT WIRING OF YOUR PBR-21 PUSH BUTTON ASSEMBLY.

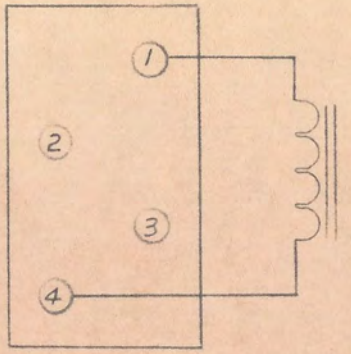
MOSELEY ASSOCIATES, INC.
SANTA BARBARA, CALIFORNIA

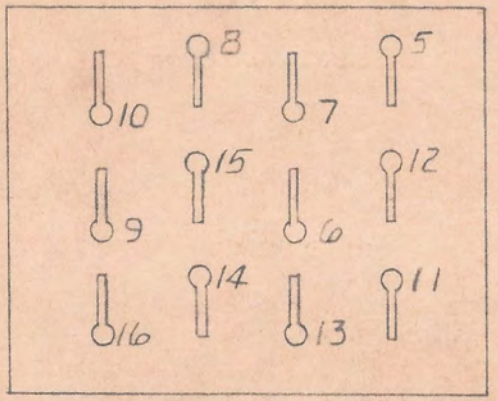
METER WIRING
MODEL PBR-21

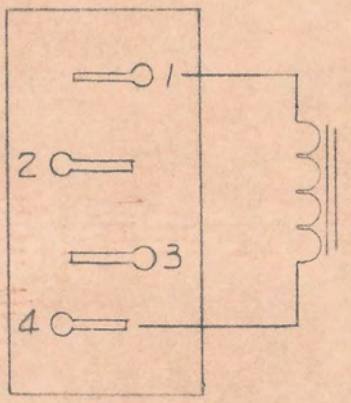
| | | |
|---|---|---|
| DWN RM 9/66 | 2A1110 | |
| APPR. JLP 9/65 | | |

CONTACTS SHOWN
WITH RELAY
DE-ENERGIZED.




COIL RESISTANCE
600 Ω DC

PULL IN 12 ma dc
DROP OUT 3 ma dc

BOTTOM VIEW
(NO SCALE)



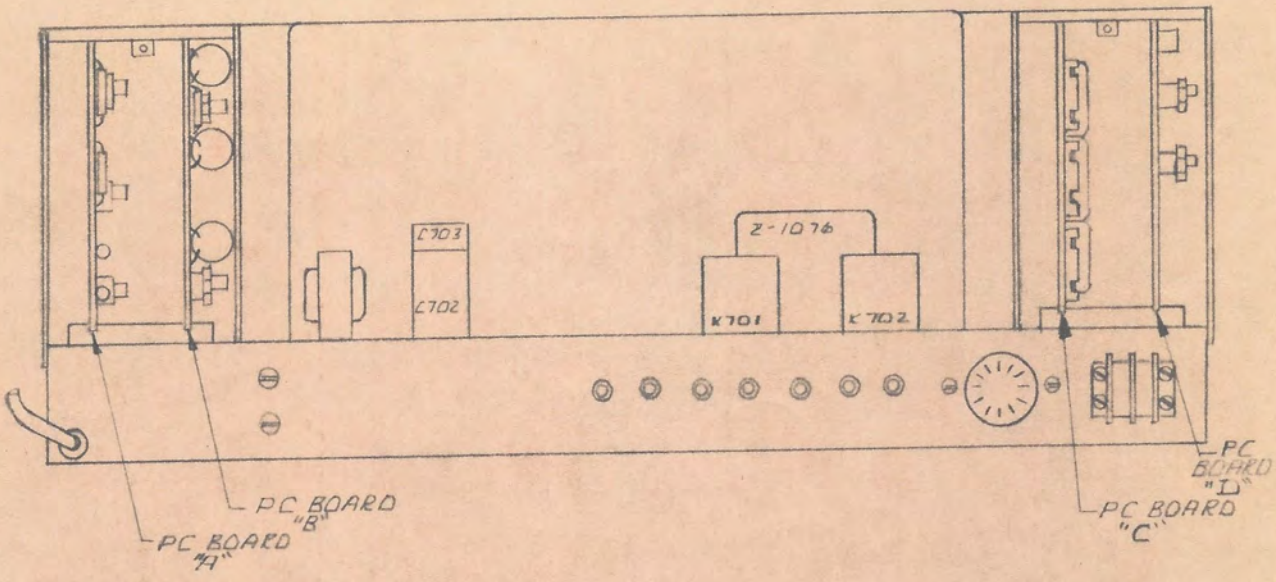
MOSELEY ASSOCIATES, INC.
SANTA BARBARA, CALIFORNIA

RELAY SOCKET DIAGRAM

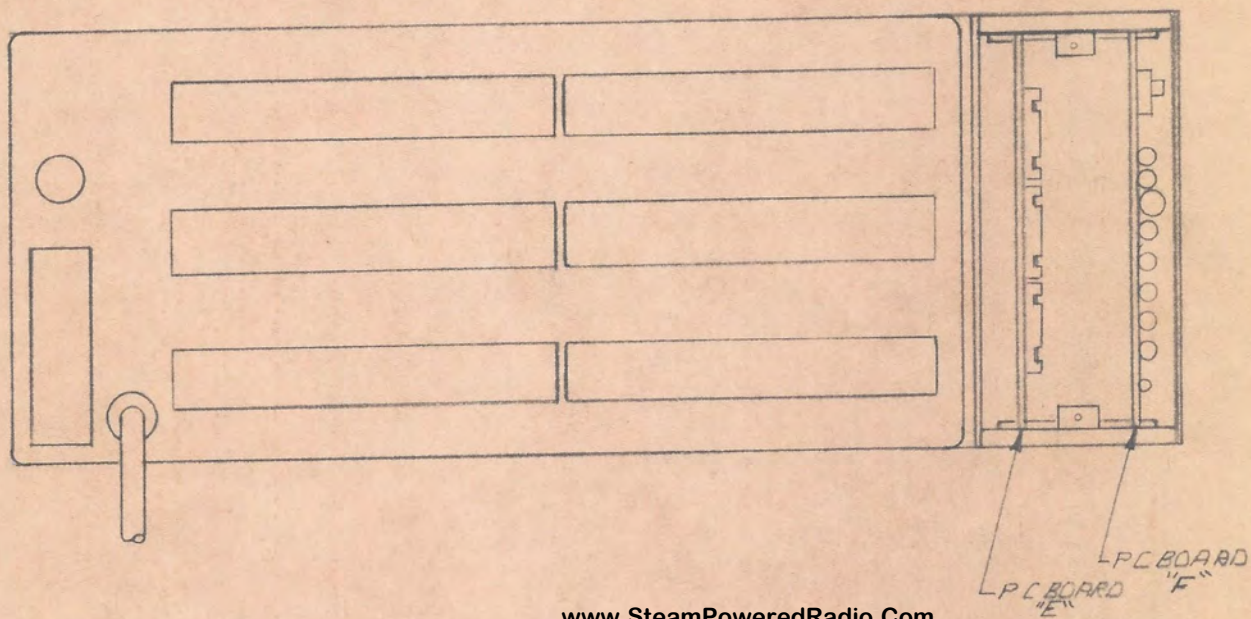
DWN RM 8/65
APP. H. Hann 8/65

5A 1113

# STUDIO CONTROL UNIT
REAR VIEW




# TRANSMITTER CONTROL UNIT
REAR VIEW






NOTE:
PRINTED CIRCUIT BOARDS ARE INSERTED SO THAT COMPONENTS ARE ON RIGHT HAND SIDE OF PC BOARD WHEN VIEWED FROM REAR.

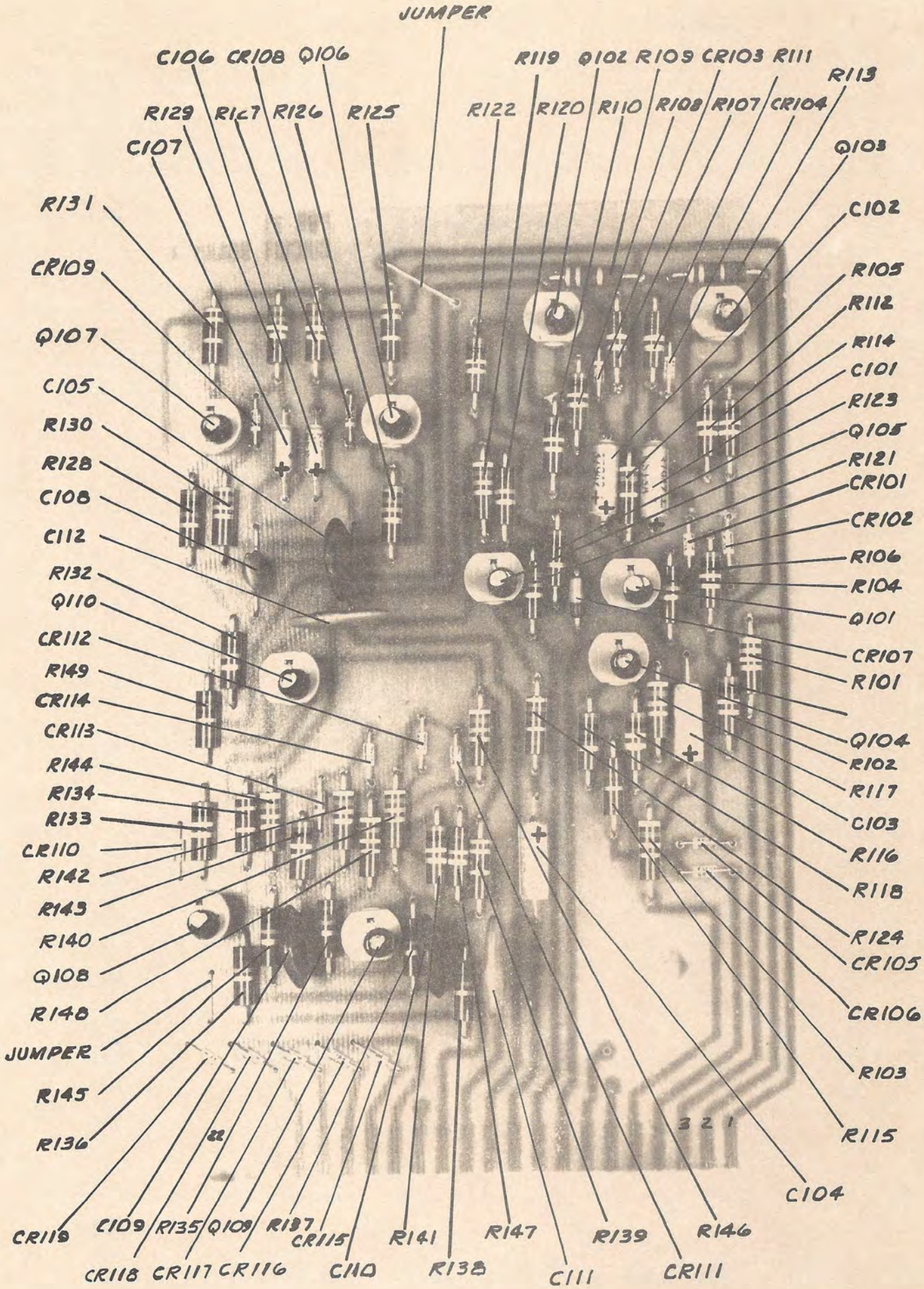
MOSELEY ASSOCIATES INC.
SANTA BARBARA, CALIFORNIA

PC BOARD PLACEMENT
MODEL PBR-21

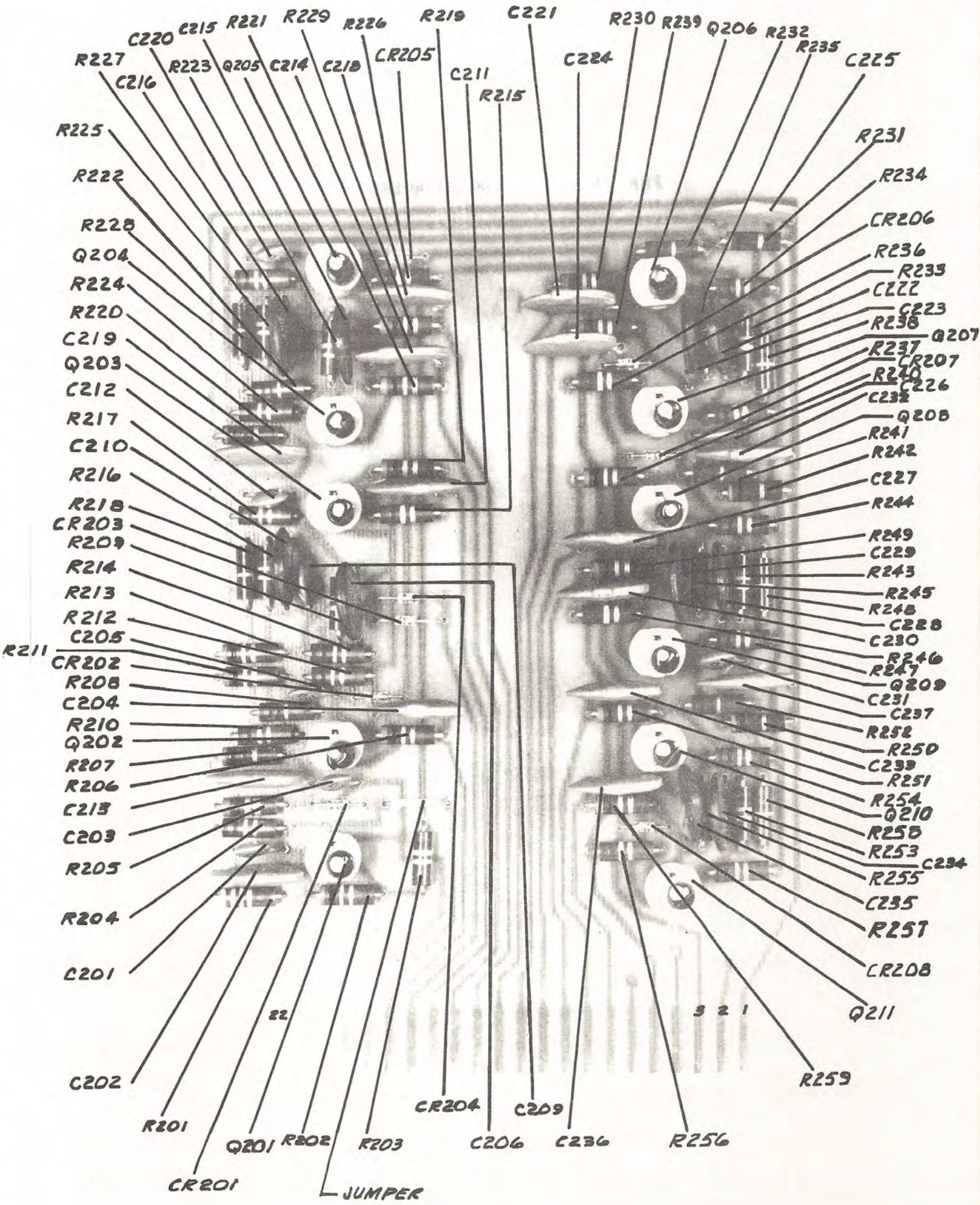
DWN REM 8/65
APP H. Hamm 9/65

SA 1114

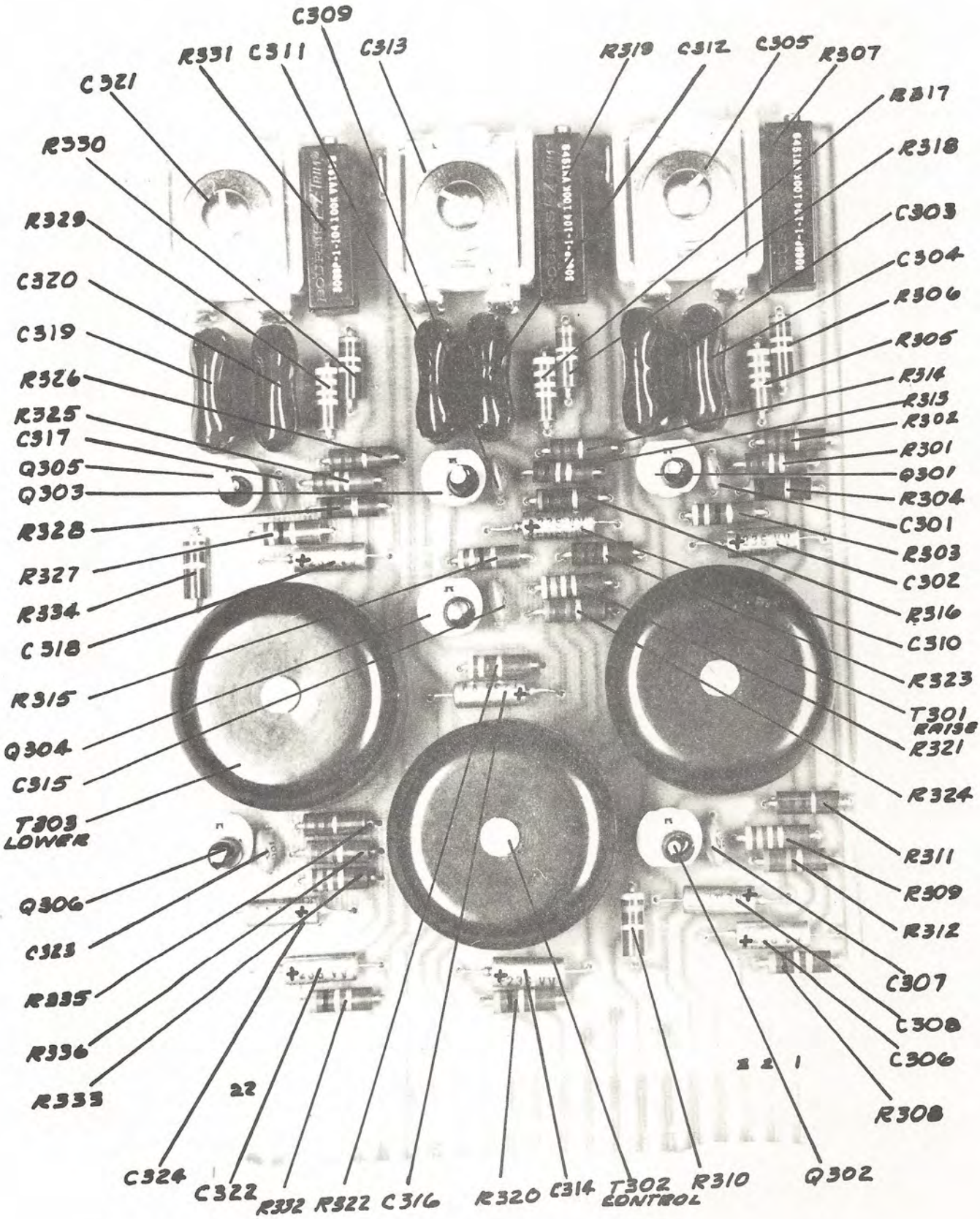
SA 1114



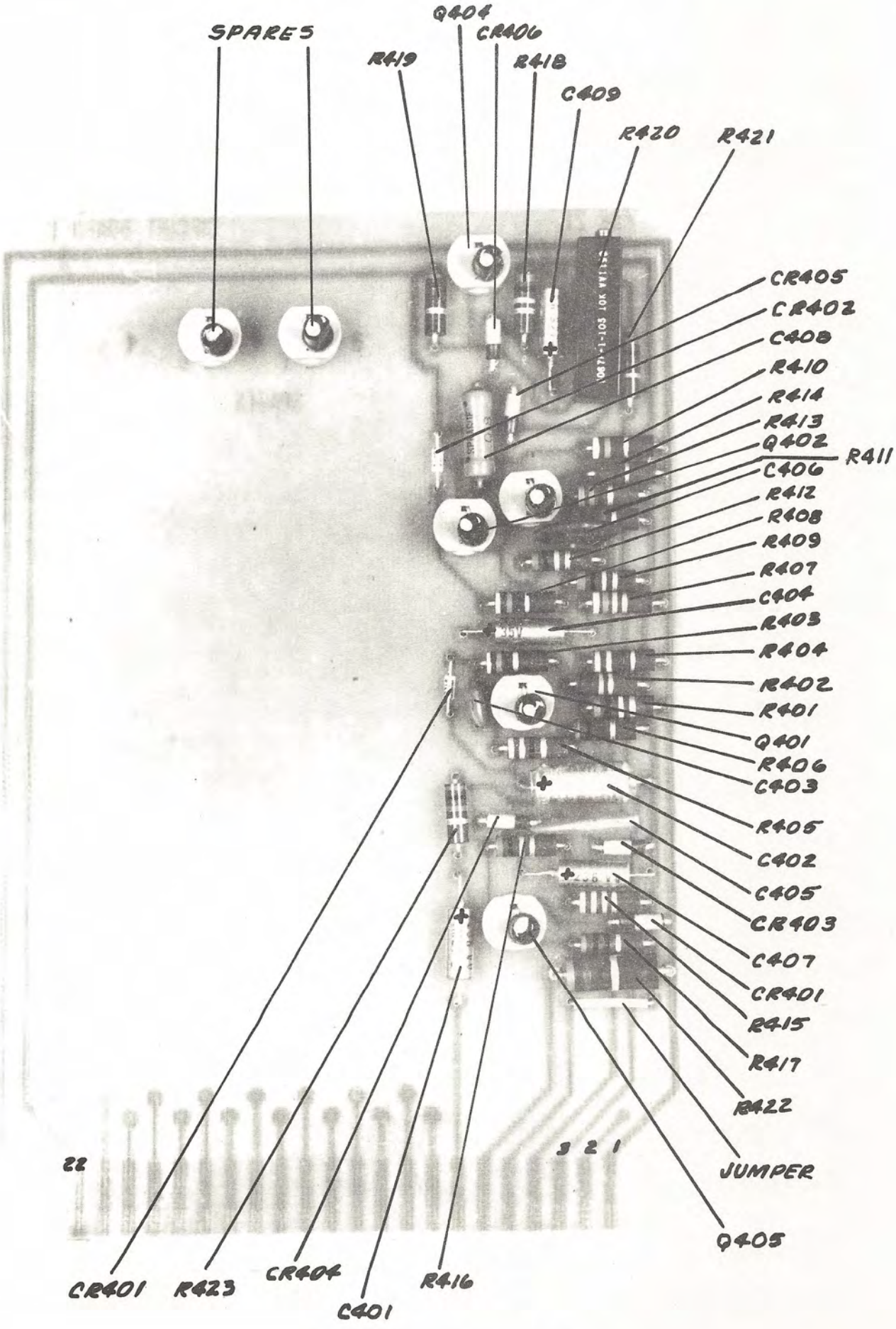

CIRCUIT BOARD "A"



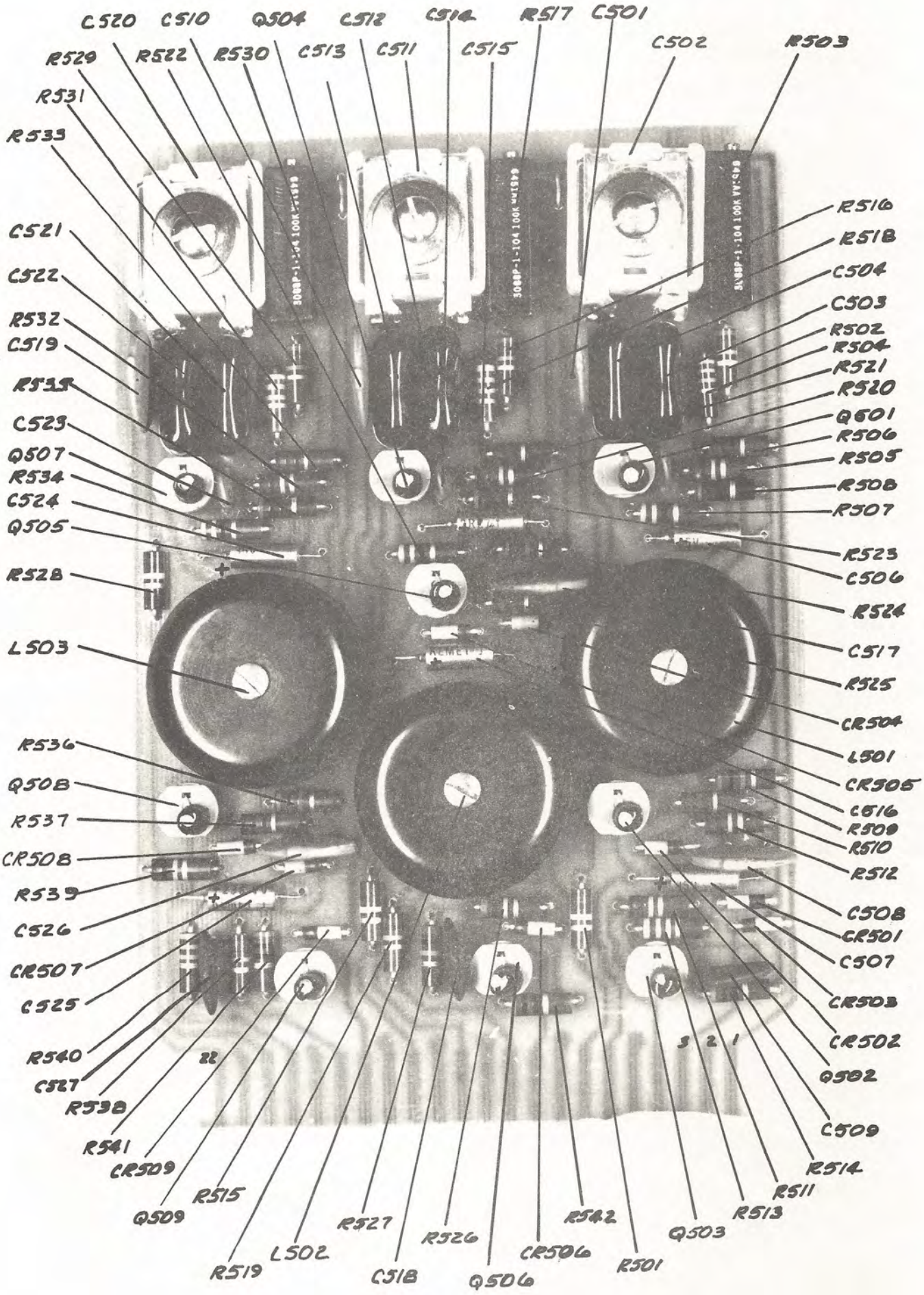

CIRCUIT BOARD "B"



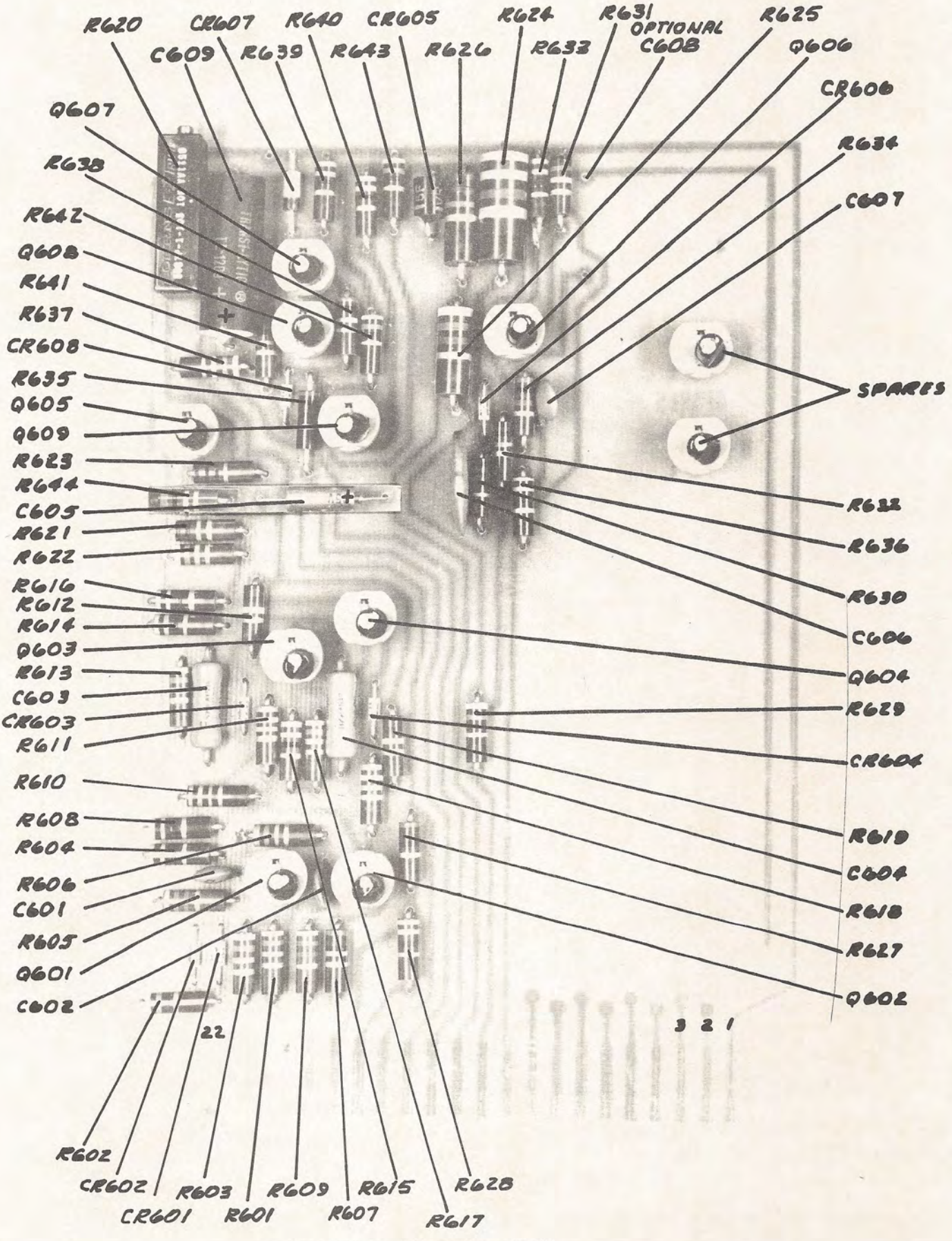

CIRCUIT BOARD "C"



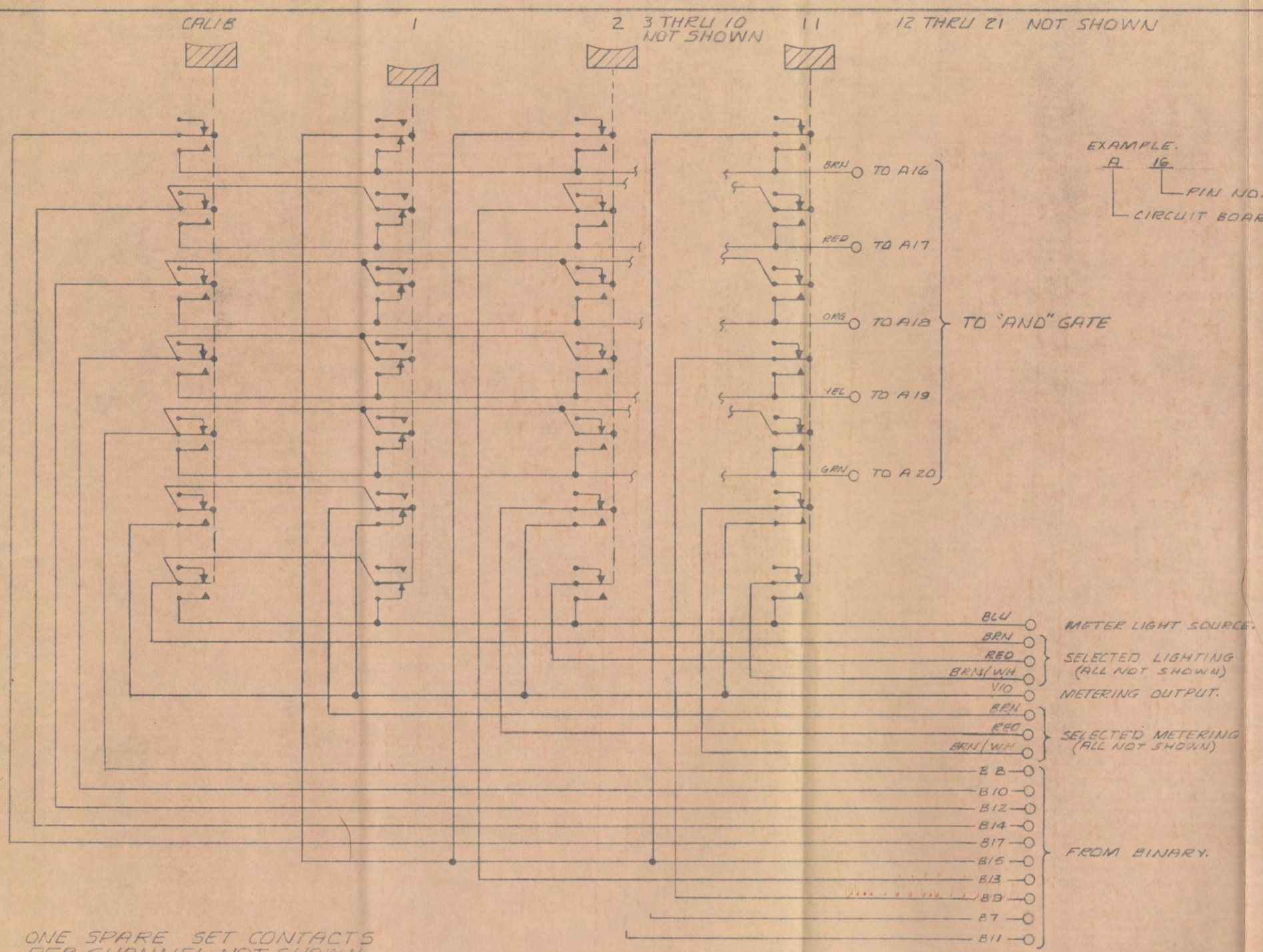

CIRCUIT BOARD "D"




CIRCUIT BOARD "E"




CIRCUIT BOARD "F"




ONE SPARE SET CONTACTS PER CHANNEL NOT SHOWN.



MOSELEY ASSOCIATES, INC.
SANTA BARBARA, CALIFORNIA

PUSH BUTTON CONFIGURATION
MODEL PBR-21

| | | |
|---|---|---|
| DWN RM 3/69 | SKB 6087 | |
| CHK'D GWD 3/69 | | |

TWO-SHOT RESET GENERATOR

CYCLING-READ RELAY CONTROL

CONTROL SUMMING AMPLIFIER

(1) +15±1V

R101 330K

R105 4.7K

C101 6.8

R107 220K

R109 3.3K

R111 220K

R113 3.3K

(3) IN FROM B-3 'AND' GATE

R102 100K

15V 0.1V DURING RESET

C102 4.7

0.2V 15V DURING RESET

0.2V 13V DURING RESET

CR105

CR107 SD-6 1 AMP 600 PIV AVALANCHE

5V CYCLING 15V NOT CYCLING

R119 4.7K

TRIGGER HOLD-OFF (2) TO B-5

LONG PULSE RESET

(8) TO CYCLING READ RELAY

R103 470K

(5) IN FROM RECYCLE PUSHBUTTON

Q 101

CR103

Q 102

CR104

Q 103

CR106

R120 22K

Q 105

R104 22K

R106 100K

CR101

CR102

R108 100K

R110 100K

R112 100K

R114 100K

R115 2.2K

Q 104

R116 100K

C103 .2

R117 47K

R118 10Ω

R121 27K

R122 100K

R123 1K

9V

R124 470Ω

C104 .2

(10) TO YEL LEAD LINE TRANS.

9V P-P

SUMMED 2 KC LOWER AND 3KC CONTROL (NOT CYCLING) SHOWN AS EXAMPLE

TRANSISTOR SOCKET (TOP)

ZN2924 (BOTTOM)

(22) GND

(4) IN FROM B-19 COLLECTOR TRIG SW

(9) IN FROM RAISE-LOWER SW

10V P-P

2KC WHEN LOWER SWITCH IS PUSHED 2.5KC WHEN RAISE SWITCH IS PUSHED.

9 C.P.S. CLOCK

BI-STATE GATE CONTROL

3 KC CONTROL GATE

APPROX 9 CPS

15V P-P

R125 3.3K

R127 180K

R129 180K

R131 3.3K

C108 .001

C106 .47

C107 .47

Q 106

CR108

CR109

Q 107

C105 .005

R126 68K

R130 68K

ON PULSE FROM B-16 'OR' GATE

(13)

R128 100Ω

3KC IN

(12)

R134 3.3K

C109 .005

3KC ON 12V

3KC OFF 0.1V

R135 22K

R133 100K

Q 108

CR110

R132 22K

R136 22K

R139 3.3K

C110 .005

0.1 12V

3KC ON

3KC OFF

R137 22K

Q 109

R140 47K

R144 47K

R146 47K

R141 100K

R142 47K

R143 100K

CR111

CR112

CR113

CR114

Q 110

5V

C111 .1

C112 .1

R145 22K

R147 22K

R138 22K

R148 470K

R149 2.2K

8V P-P

3KC IS CONTINUOUS WHEN SYSTEM IS NOT CYCLING.

8V P-P

(16) FROM P.B. LOGIC SW. CR115

(17) FROM P.B. LOGIC SW. CR116

(18) FROM P.B. LOGIC SW. CR117

(19) FROM P.B. LOGIC SW. CR118

(20) FROM P.B. LOGIC SW. CR119

CLOCK FULL CYCLE (11) TO B-18

P.B. LOGIC GATE (15) TO B-20

PINS 6, 7, 14, 21 NOT USED.

NOTES: UNLESS OTHERWISE NOTED.

1. ALL RESISTORS, 1/2W, 10%.
2. ALL CAPACITORS, MICROFARAD.
3. ALL DIODES, 1N4154.
4. ALL TRANSISTORS, 2N2924.

3KC INTERRUPTED AT CLOCK RATE WHILE SYSTEM IS CYCLING.

MOSELEY ASSOCIATES INC.
SANTA BARBARA, CALIFORNIA

P.C. BOARD A
MODEL PBR-21

DWN [illegible] 6/65
CHKD H. Horn 6/65

91B 6122

+15±V

TRIGGER SWITCH

BINARY FLIP-FLOP #1

BINARY FLIP-FLOP #2

(1)

(18) N FROM A-11 — FULL CYCLE CLOCK

(20) IN FROM A-15 — PB LOGIC GATE

(5) FROM A-2 RESET

(22) GND

R204 22K, R205 10K, CR201, R201 330K, R202 100K, R203 220K, C201 .001, C202 .1, Q201

C203 .005, C213 .1, C204 .1, R207 1K, R208 2.2K, CR202, C205 .001, R206 10K, C206 .005, R209 22K, Q202, R210 22K, R211 100K, CR203, CR204, R212 22K, R213 100K, C209 .001, C210 .005, R214 22K, R215 150K, R216 22K, Q203, R217 22K, C211 .1, R218 2.2K, R219 10K, C212 .005, C219 .1, R220 1K, C214 .1, R221 10K, Q204, R222 2.2K, C215 .005, R223 22K, R224 22K, C216 .005, R225 22K, R226 50K, R227 22K, Q205, R228 2.2K, CR205, R229 10K, C218 .1, Q225 .1, X

(19) TO CYLIND. INDICATOR DR GATE A-4

(16) TO STEPPING GATE A-13

(3) TO A-3 NAND GATE

(17) TO P.B. LOGIC SW

(15) TO P.B. LOGIC SW

(14) TO P.B. LOGIC SW

(13) TO P.B. LOGIC SW

BINARY FLIP-FLOP #3

BINARY FLIP-FLOP #4

BINARY FLIP-FLOP #5

X

R231 1K, C220 .005, R230 10K, R232 2.2K, C222 .005, R233 22K, C223 .005, R235 22K, CR206, R238 2.2K, R239 10K, Q206, Q207, C221 .1, R234 22K, R236 150K, R237 22K, C224 .1, C232 .1, C226 .005, C227 .1, R242 1K, CR207, R240 10K, R241 2.2K, C228 .005, R243 22K, C229 .005, R245 22K, R248 2.2K, R249 10K, Q208, Q209, R244 22K, R246 150K, R247 22K, C230 .1, C232 .1, C231 .005, R250 1K, C233 .1, R251 10K, R252 2.2K, C234 .005, R253 22K, C235 .005, R255 22K, R258 2.2K, CR 208, R259 10K, Q210, Q211, R254 22K, R256 150K, R257 22K, C236 .1

(12) TO P.B LOGIC SW.

(11) TO P.B LOGIC SW.

(10) TO P.B LOGIC SW.

(9) TO P.B LOGIC SW

(8) TO P.B LOGIC SW.

(7) TO P.B LOGIC SW

TRANSISTOR SOCKET (TOP)

2N2924 (BOTTOM) — B, C, E

+9VDC / 0VDC

TYPICAL BINARY COLLECTOR WAVEFORM - RATE AND DUTY CYCLE WILL VARY DEPENDING ON BINARY STAGE VIEWED. CONTINUOUS CYCLING POSSIBLE BY REMOVING Q 201 EACH BINARY FLIP FLOP SHOULD RUN AT 1/2 ITS OWN INPUT RATE.

A. ALL TRANSISTORS 2N2924.
3. ALL DIODES IN4154.
2. ALL CAPACITORS MICROFARAD.
1. ALL RESISTORS 1/2W, 10%.

NOTES: UNLESS OTHERWISE NOTED.

REVISIONS

R215 R226 R234 R246 R256 WAS 220K

A

MOSELEY ASSOCIATES INC.
SANTA BARBARA, CALIFORNIA

P.C BOARD B
MODEL PBR21

DWN RM 6/65
CHKD H. Horn 6/65

91B6123 A

## 2.45 KC OSC. (RAISE)

## 2.5 KC AMP.

## 3 KC OSC (CONTROL)

## 3 KC AMP

## 2 KC OSC (LOWER)

## 2 KC AMP

(1) +15 ±1V

(22) GND

10V P-P

R302 2.2K

9V

R305 33K

C303 .01 DM5%

C304 .01 DM5%

T301 710 MHy

R309 47K

R311 2.2K

8V

+ C308 2

(4) TEST POINT 2.5KC TONE.

(7) 2.5KC RAISE TONE OUT TO RAISE/LOWER SW.

10V P-P

R306 15K

C305 350MMf TO 1180 MMf

R810 4.7K

1V

Q 302

C307 .001

(5) CONNECT 5 TO 3 TO STOP OUTPUT OF 2.5 KC TONE.

3V

Q 301

C301 .001

R303 33Ω

R307 100K

CW

R308 10K

+ C306 2

R312 150Ω

(3)

R301 22K

R304 1K

+ C302 2

TRANSISTOR SOCKET (TOP)

2N2924 (BOTTOM)

R314 2.2K

R317 33K

C311 .01 DM5%

C312 .01 DM5%

T302 480 MHy

R321 47K

R323 2.2K

+ C316 2

(11) TEST POINT 3 KC CONTROL TONE

(13) 3 KC CONTROL TONE OUT TO A12.

R318 15K

C313 350MMf TO 1180 MMf

R322 4.7K

Q 304

C315 .001

(12) CONNECT 12 TO 10 TO STOP OUTPUT OF 3 KC CONTROL TONE.

Q 303

C309 .001

R315 33Ω

R319 100K

CW

R320 10K

+ C314 2

R324 150Ω

(10)

R313 22K

R316 1K

+ C310 2

VOLTAGE AND WAVEFORMS SHOWN FOR THE 2.5KC RAISE OSCILLATOR AND AMPLIFIER ARE TYPICAL OF 2KC AND 3KC CIRCUITS ALSO.

R326 2.2K

R329 33K

C319 .01 DM5%

C320 .01 DM5%

T303 1.1 Hy

R333 47K

R335 2.2K

+ C324 2

(17) TEST POINT 2KC TONE.

(20) 2KC LOWER TONE OUT TO RAISE/LOWER SW.

R330 100K

C321 350MMf TO 1180 MMf

R334 4.7K

Q 306

C323 .001

(18) CONNECT 18 TO 16 TO STOP OUTPUT OF 2KC TONE.

Q 305

C317 .001

R327 33Ω

(16)

R331 100K

CW

R332 10K

+ C322 2

R336 150Ω

R325 2.2K

R328 1K

+ C318 2

3. ALL TRANSISTORS 2N2924.
2. ALL CAPACITORS MICRO FARAD. C305, C313, C321 ARCO #307.
1. ALL RESISTORS 1/2W, 10%.

NOTES: UNLESS OTHERWISE NOTED.

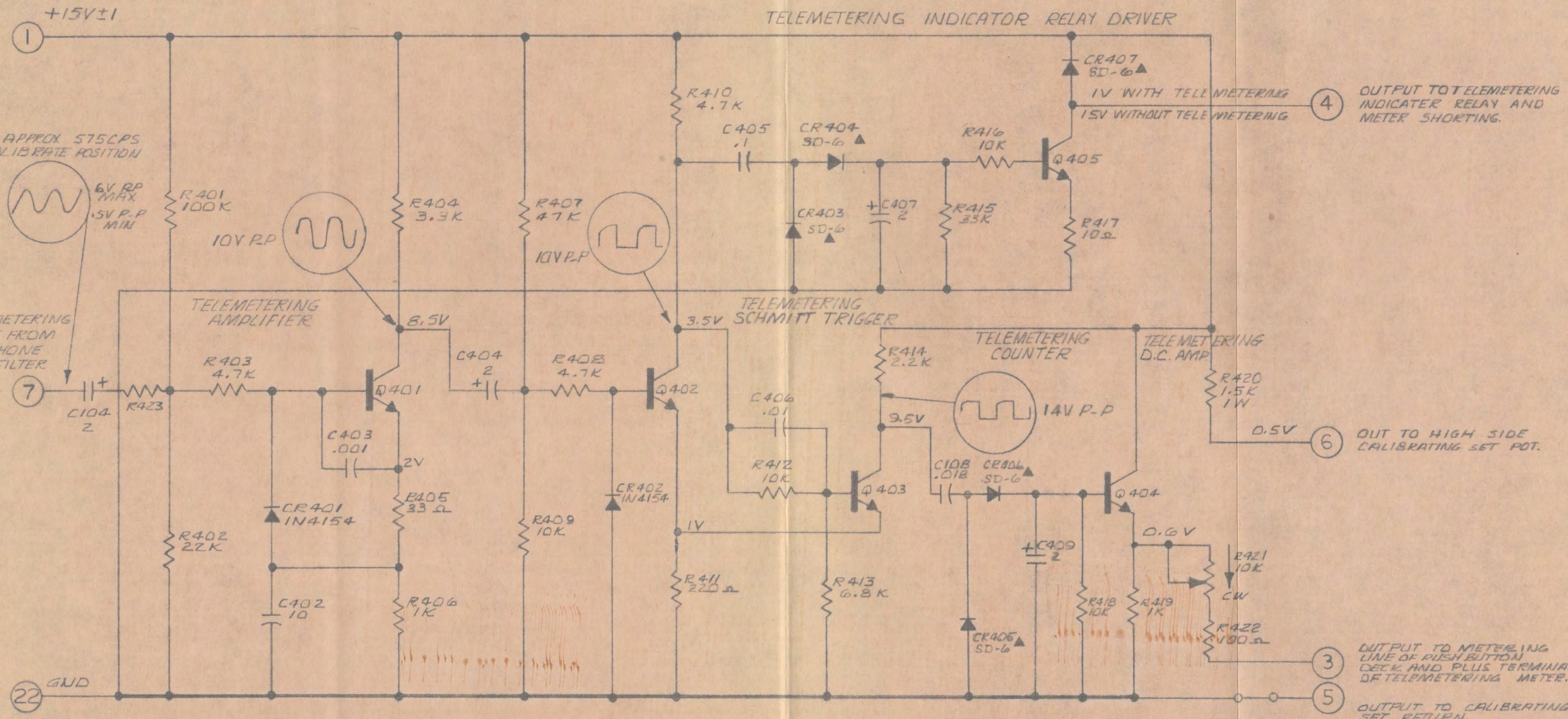


MOSELEY ASSOCIATES INC.
SANTA BARBARA, CALIFORNIA

PC BOARD C
MODEL PBR 21

DWN. RM 6/65
CHKD. H. Ham 7-65

918-6124




4. ▲ SD-6 DIODES ARE 1 AMP 600 PIV AVALANCHE.
3. ALL TRANSISTORS 2N2924.
2. ALL CAPACITORS MICROFARAD.
1. ALL RESISTORS 1/2W 10%.

NOTES: UNLESS OTHERWISE NOTED.



MOSELEY ASSOCIATES INC.
SANTA BARBARA, CALIFORNIA.

PC BOARD D
MODEL PBR-21

DWN BM 6/65
CHKD H. Hamm 7-65

91B6125

## 2.45 KC TUNED AMPLIFIER ('RAISE' CIRCUIT)

## 'RAISE' RELAY DRIVER

(1) +15V±1V

(22) GND

IN FROM LIMITING LINE AMP F-10 (7)

R501 220K

C501 .1

L501 710 MHy

C502 350 TO 1180 MMF

C503 .01

C504 .01

R502 15K

R503 100K CW

R504 33K

R505 22K

Q501

C505 .001

R506 2.2K

R507 33Ω

R508 1K

C506 2

Q502

R509 100Ω

R510 2.2K

C507 2

CR502

CR501

C508 .1

R511 22K

R512 22K

R513 33K

Q503

C509 .01

CR503

R514 10Ω

(6) 2.5 KC TUNED AMPLIFIER TEST POINT.

(4) TO LOCAL CONTROL 'RAISE' PUSHBUTTON.

(3) TO 'RAISE' RELAY.

TRANSISTOR SOCKET (TOP)

2N2924 B C (BOTTOM) E

## 3 KC TUNED AMPLIFIER ('CONTROL' CIRCUIT)

## 'CONTROL' RELAY DRIVER

IV P-P MIN

7V P-P MAX

IN FROM LIMITING LINE AMP F-10 (14)

R515 220K

C510 .1

L502 480 MHy

C511 350 TO 1180 MMF

C512 .01

C513 .01

R516 15K

R517 100K CW

R518 33K

R519 22K

Q504

C514 .001

2.5V

R520 22K

R522 33Ω

R523 1K

C515 2

9V

R521 2.2K

11V P-P

R524 100Ω

Q505

R525 2.2K

C516 2

CR505

CR504

C517 .1

R526 10K

R527 10K

Q506

C518 .01

CR506

R542 10Ω

0.8V ENERGIZED 15V DE-ENERGIZED

(12) 3 KC TUNED AMPLIFIER TEST POINT.

(10) TO LOCAL CONTROL STEPPER PUSHBUTTON.

(9) TO STEPPER RELAY.

8V P-P

NOTES: UNLESS OTHERWISE NOTED.
1. ALL RESISTORS 1/2 W, 10%.
2. ALL CAPACITORS MICROFARAD.
3. ALL DIODES SD-6 1 AMP 600 PIV AVALANCHE.
4. ALL TRANSISTORS 2N2924

WAVE FORMS AND D.C. VOLTAGES SHOWN FOR 3 KC CIRCUIT ARE TYPICAL FOR RAISE (2.5KC) AND LOWER (2.0KC) WHEN RAISE OR LOWER TONE IS APPLIED.

## 2 KC TUNED AMPLIFIER ('LOWER' CIRCUIT)

## 'LOWER' RELAY DRIVER

IN FROM LIMITING LINE AMP F-10 (20)

R528 220K

C519 .1

L503 1.1 Hy

C520 350 TO 1180 MMF

C521 .01

C522 .01

R529 15K

R530 100K CW

R531 33K

R532 22K

Q507

CR523 .001

R533 2.2K

R534 33Ω

R535 1K

C526 .1

Q508

R536 100Ω

R537 2.2K

C524 2

CR508

CR507

C526 .1

R538 22K

R539 22K

R540 33K

Q509

CR527 .01

CR509

R541 10Ω

(19) 2 KC TUNED AMPLIFIER TESTPOINT.

(17) TO LOCAL CONTROL 'LOWER' PUSHBUTTON.

(16) TO 'LOWER' RELAY.

MOSELEY ASSOCIATES INC.
SANTA BARBARA, CALIFORNIA

P.C. BOARD E
MODEL PER-21

DWN RM 6/65
CHKD H. Horn 7-65

91B6126

REVISIONS

B705
2 LIGHTS
3
4
5 LIGHTS COMM
7 METER RETURN
8 METERING
9
10
METERING SOCKET
+13V
RECYCLE
PB701
S701
S702
A
B
RED
GRY
BLK/WH
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
BRN
RED
ORN
YEL
GRN
ORN/WH
RED/WH
BRN/WH
BLK/WH
VIO/WH
GRY/WH
VIO/WH
BLU/WH
GRN/WH
YEL WH
PUSH BUTTON DECK
BLU (LIGHTS)
VIO (METER)
LOWER
RAISE
S703
C
+15V RED
TP4 YEL
TP7 VIO
TP5 GRN
TP8 GRY
RED/WH
TP6 BLU
BLU/WH
GRN/WH
R703
SLOPE
5K
CW
S704
D
ORN/WH
ORN
BLK
VIO
ORN WH
15
14
16
X
9
8
10
CALIB
50Ω
CW
R705
K702
1
4
+16V
TP3
TP2
LO-PASS
Ω-1076
YEL
RED
BLK
BNC TELEMETERING IN.
T702
GRN
BRN
BLK
YEL
BLU
1/4 AMP
600-Ω LINE
1/4 AMP
Z=5K
BNC CONTOL OUT
BNC FOR RADIO LINK ONLY.
COLOR CODE

| | |
|---|---|
| 1 | BRN |
| 2 | RED |
| 3 | ORN |
| 4 | YEL |
| 5 | GRN |
| 6 | BLU |
| 7 | VIO |
| 8 | GRY |
| 9 | WH |
| 10 | BLK |
| 11 | BRN/WH |
| 12 | RED/WH |
| 13 | ORN/WH |
| 14 | YEL/WH |
| 15 | GRN/WH |
| 16 | BLU/WH |
| 17 | VIO/WH |
| 18 | GRY/WH |
| 19 | BRN/BLK WH |
| 20 | BLK/WH |
| 21 | — |
| 22 | BLK |

240V 50/60~
BLK
RED/BLK
WH
BLK/WH
SW701
BLK
117 VAC
RED
BLK
1AMP SB
WH
BLK/WH
T701
GRN
GRN
C701 .01
X
Y
CR701
CR702
CR703
CR704
.5D-1 14.8 100 PIV
R701 20Ω 10W
R702 20Ω 10W
TP1
+15V±1V
25VAC X
GND
500/50 C702
1000/50 C703
.47/100 C704
CR704 1N1606
K701
1
4
15
16
14
10
9
8
+15V
CYCLE
#1819 BULB
READ
CYCLING READ.



MOSELEY ASSOCIATES INC.
SANTA BARBARA, CALIFORNIA.
STUDIO CONTROL UNIT
WIRING DIAGRAM - PBR-21
DWN RM 6/65
CHKD
9186130

BNC CONTROL IN
TP12
HI-PASS 2-1077
BLU
T5801
1/4 A.
GRN
GRY
LINE 600Ω
T802
Z = 5K
BRN
1/4 A
BLU
YEL
RED
LO-PASS 2-1076
YEL
BNC METERING OUT
TP13
R804 2.2K
BNC FOR RADIO LINK ONLY
S801
S802
RED
RED
WH
RAISE
PB1
GRN
YEL/WH
TP14
STEPPER
PB2
BRN
GRN/WH
TP15
ORN.
LOWER
PB3
VIO
BLU/WH
TP16
+15V
GRY
BLK
+5DBM
GRN
-5DBM
VIO
YEL
0DBM
BLU
BLU
GRY/WH
AUX/WH
OR W/WW
BRN/WH
+15V
K801 FAIL SAFE
YEL/WH
VIO
YEL
GRY
T5801
1
2
3
FAIL SAFE
GRN/WH
PULSING
HOMING
STEPPER
24 V.DC
R804 R456
K806
C808 .01
C807 .01
CALIB RESET POSITION
BRN
BRN/WH
C810
C809 .01
.01
K802 CALIB
K806 3000 MFD
T5802
TELEMETERING
GOLD PLATED DECK
R807 THRU R828 10K
BRN
RED
ORN
K806A
21
T5803
LOWER
COMM.
K806B
YEL
COMM
117VAC
K804 LOWER
K806C
K805 RAISE
RAISE
T5804
117 VAC CONTROL 1 AMP
C811 .01
R806 68Ω
R805 10Ω
K803 PULSING
SW801
BLK T-801
#1819 BULB
GRN
RED/BLK
WH
BLK/WH
117 VAC
C801 .01
1A SB
R801 10Ω 10W
R802 20Ω 10W
R803 20Ω 10W
C802 500
C803 1000
C804 1000
C805 .47
CR806 IN1606
TP11 29VDC
+15V±1V
TP10
* CR801 CR802 CR803 CR804 SD-1 - 1A @ 100 PIV
NOTE: FOR 240 V OPERATION CONNECT RED/BLK & WHITE.

A C806 WAS 1500 MFD

MOSELEY ASSOCIATES INC.
SANTA BARBARA, CALIFORNIA.

TRANSMITTER CONTROL UNIT
WIRING DIAGRAM PBR-21

DWN RM 6/65
CHKD
91B-6129
A