RFL Industries, Inc. • A Dowty Group Company

Model 65 PREAMP Preamplifier and Model 65 PWRAMP Amplifier

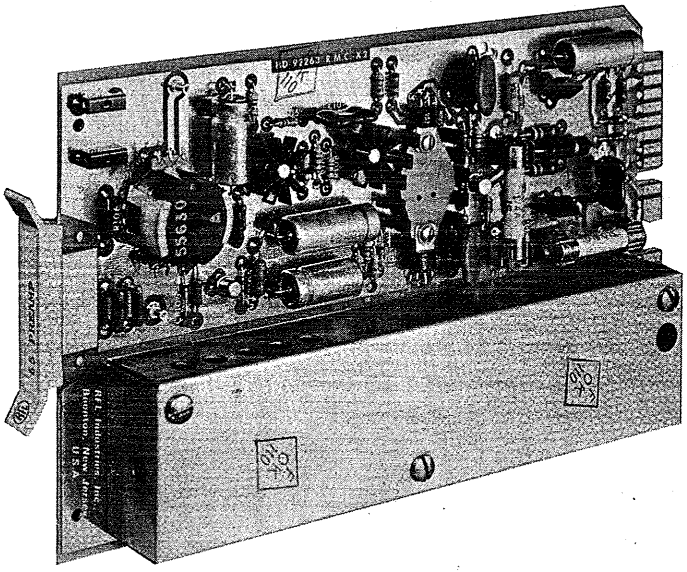

Figure 1. Model 65 PREAMP Preamplifier.

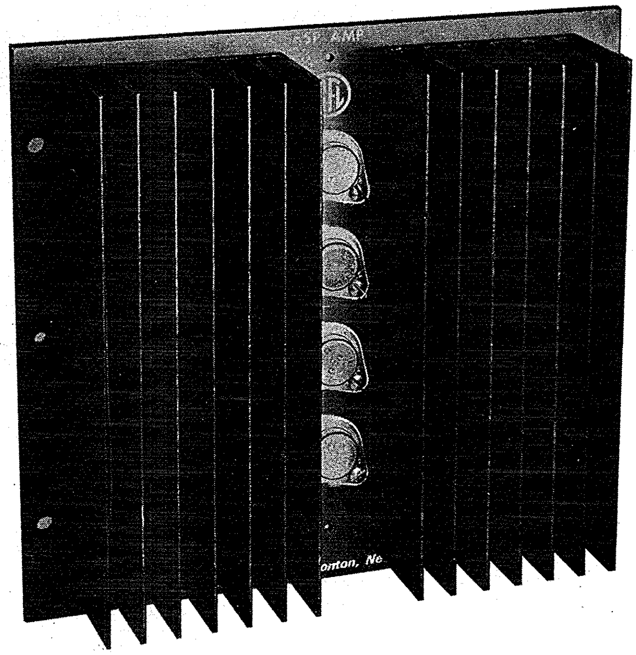

Figure 2. Model 65 PWRAMP 40-Watt Power Amplifier.

DESCRIPTION

GENERAL

The Models 65 PREAMP and 65 PWRAMP are elements of the Series 65 Single-Sideband Carrier System. The Model 65 PREAMP will supply the driving power for up to six units of the Model 65 PWRAMP. These may be paralleled for greater output power, selectable in steps of 40 watts. When paralleled, gains and phases are equalized so that maximum power is delivered to the common, 50-ohm load.

The Model 65 PWRAMP must be driven by the Model 65 PREAMP. It cannot be driven directly from either the Model 65 MOD Modulator or the Model 65 UPCONV Upconverter. The Model 65 PREAMP is not used as an output amplifier. For output power at lower levels, the Model 65 AMP Two-Watt Amplifier is recommended.

The Model 65 PREAMP is constructed on a circuit card which plugs into a Model 68 Chassis, like all other circuit modules of the Series 65 System. Because of its greater size, however, the power amplifier is mounted differently.

The height of the Model 65 PWRAMP is 8-3/4 inches (222 mm). This corresponds to the height of a standard 19-inch (482 mm) relay-rack panel using five standard rack units. The width of the power amplifier is precisely one-half the width of the relay-rack panel. The size of the Model 65 PS-DC power supply required for the power amplifier is identical, so that when the two units are bolted together they form a single unit occupying the space of a standard 8-3/4-inch-high relay-rack panel. A power supply will operate only one amplifier. When more than one is used, amplifiers and their power supplies may be bolted together and positioned on the relay rack in any convenient arrangement.

Figure 1 shows the appearance of the Model 65 PREAMP. The Model 65 PWRAMP is shown as Figure 2.

MODEL 65 PREAMP

As shown on the block diagram of its circuit, Figure 3, the preamplifier has four stages of gain. Gain of the first two stages is adjustable by selection of jumper positions. A potentiometer at Stage three provides for fine adjustment of gain. There is also a 3-dB voltage gain in a transformer between Stages three and four.

The first three stages are constructed on a plug-on board, mounted on the main board and contained in a shielded enclosure visible in the lower part of Figure 1.

The preamplifier operates over a frequency range of 4 to 500 kHz in two ranges, 4-60 kHz and 30-500 kHz. Range is chosen by selecting the appropriate interstage transformer. For its operation, the preamplifier requires both the usual plus and minus 12-volt power, used by other elements of the Series 65 System, and also plus and minus 37-volt power. Both are taken from the power supply used for the Model 65 PWRAMP.

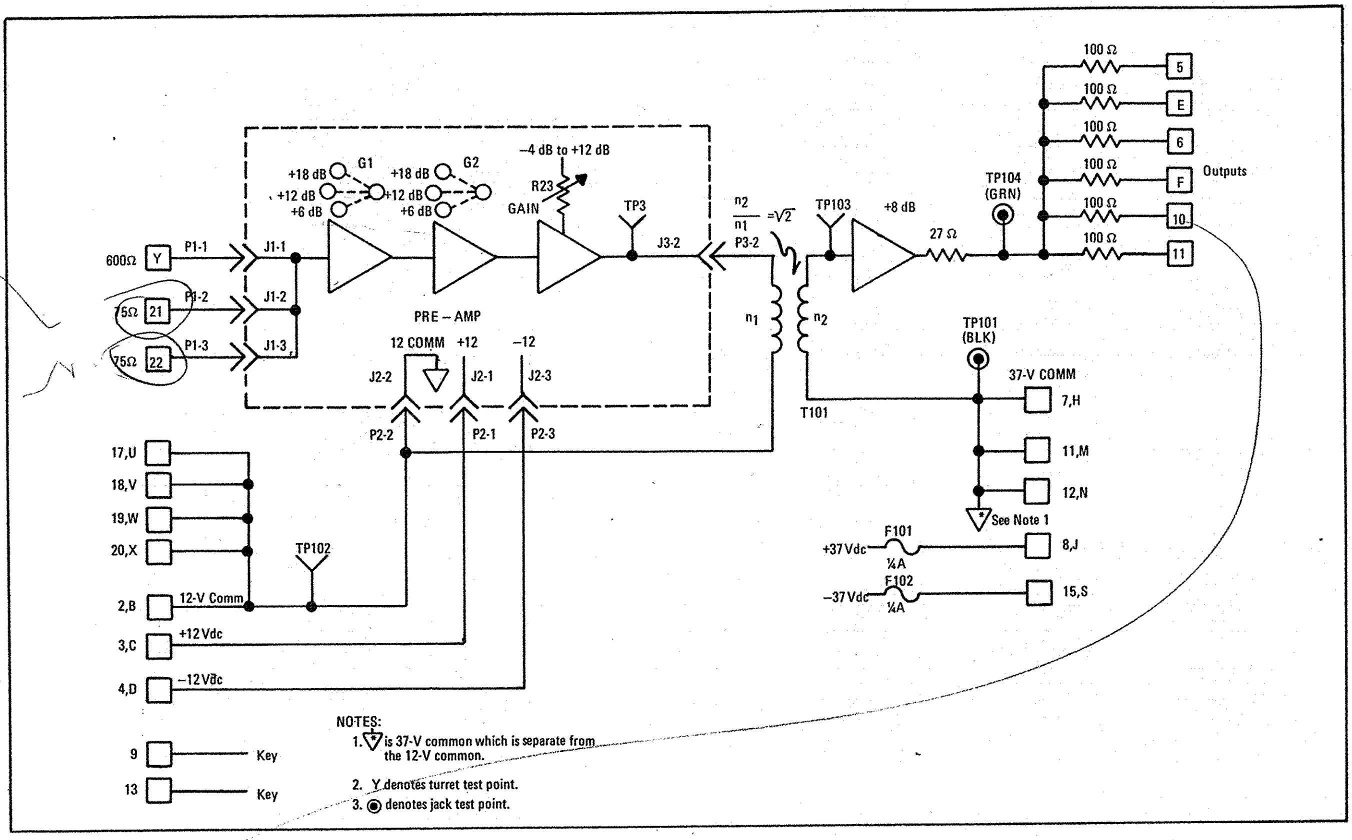

Figure 3. Block diagram of circuits, Model 65 PREAMP.

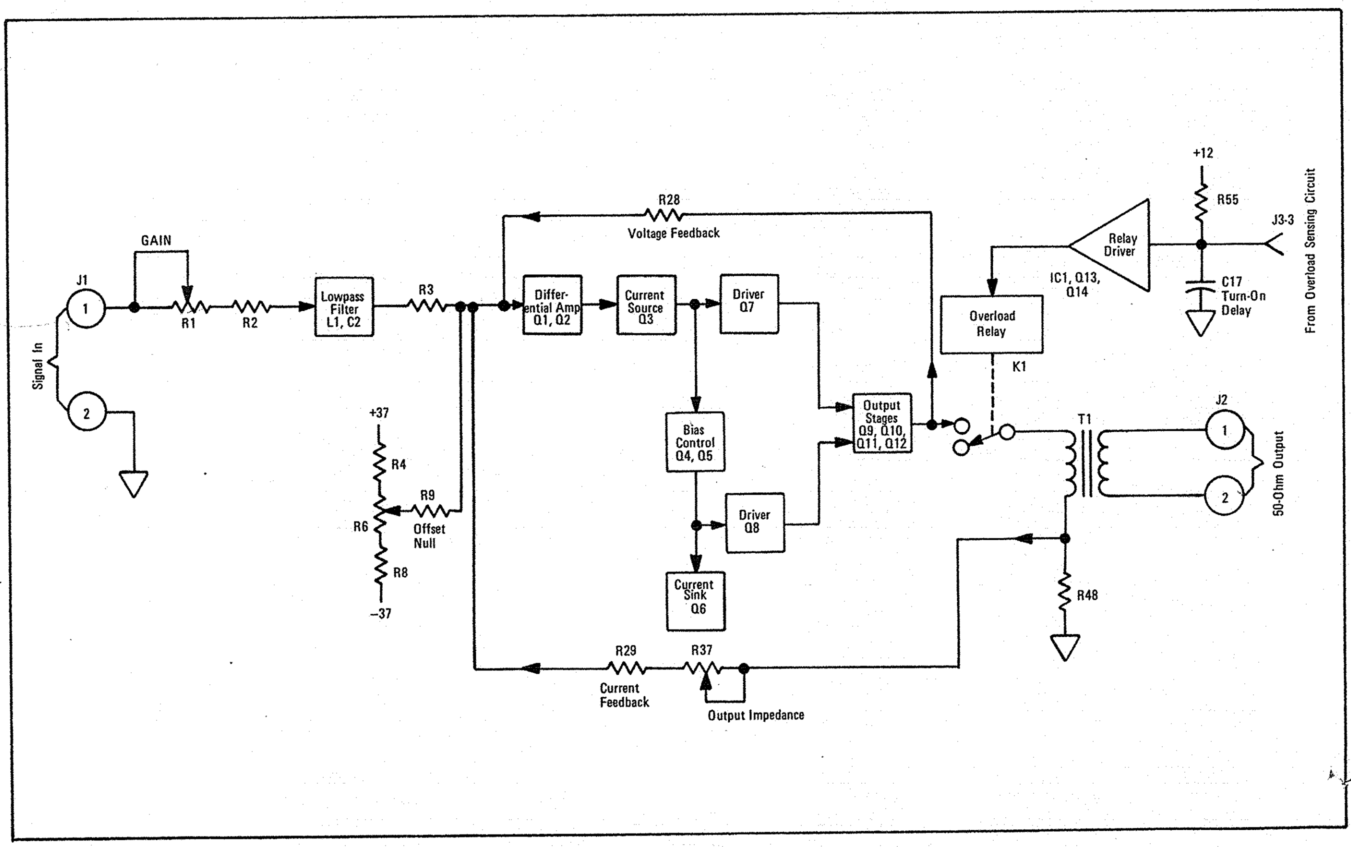

Figure 4. Block diagram of circuits, Model 65 PWRAMP.

MODEL 65 PWRAMP

Like the preamplifier, the power amplifier, with circuits outlined in Figure 4, operates over a frequency range of 4 to 500 kHz in two ranges, 4-60 kHz and 30-500 kHz, by selecting the appropriate output transformer. Voltage feedback is used to minimize distortion and to stabilize gain. Adjustable current feedback matches the amplifier's output impedance to the load with a minimum loss of power and maximum return loss.

Overload protection is afforded by a relay which delays application of the load, when power is applied, until quiescent conditions have stabilized. It also removes the load when the current drain exceeds a preset limit. The amplifier is designed to be powered by the unregulated plus and minus 37-Vdc output of the Model 65 PS-DC Power Supply.

SERIES 65 SSB SYSTEM Model 65 PREAMP and Model 65 PWRAMP	65 PREAMP HB-92260	Transformer HB-55630	Transformer HB-55631	65 PWRAMP HB-92600	Transformer HB-55635	Transformer HB-55634	
65 PREAMP-1 (30-500 kHz)	•	•					
65 PREAMP-2 (4-60 kHz)	•		•				
65 PWRAMP-1 (30-500 kHz)				•	•		
65 PWRAMP-2 (4-60 kHz)				•		•	

SPECIFICATIONS

MODEL 65 PREAMP

Frequency Response: Two ranges, either 4-60 kHz or 30-500 kHz, each ±0.5 dB with respect to midband response.

Harmonic Distortion:

400 kHz or less: −55 dBmo or better.
500 kHz or less: −50 dBmo or better.

Third-Order Intermodulation Distortion: Better than −60 dBmo.

Idle Noise: −65 dBmo for 3 kHz bandwidth.

Power Requirements: Requires plus and minus 12 Vdc, regulated, 50 mA and also plus and minus 37 Vdc, 50 mA, unregulated, both available from the Model 65 PS-DC Power Supply.

Operating-Temperature Range:

Meets all specifications: 0-40°C.
Operable without failure: −20 to 60°C.

Size: Requires three module spaces in an RFL Model 68 Chassis.

MODEL 65 PWRAMP

Power Output: Up to 40 watts to a 50-ohm load. Amplifiers may be paralleled for greater power.

Frequency Response: Two ranges, either 4-60 kHz or 30-500 kHz, each ±1 dB with respect to midband response.

Harmonic Distortion: Second harmonic is 40 dB or better below fundamental.

Intermodulation Distortion:

400 kHz or less: better than −60 dB.
500 kHz or less: better than −56 dB.

Return Loss: Greater than 10 dB.

Power Requirement: Both plus and minus 37 Vdc, unregulated, 1.6 ampere, available from Model 65 PS-DC Power Supply.

Operating Temperature Range:

Meets all specifications: 0-45°C.
Operable without failure: −20 to 60°C.

Size and Weight: The amplifier alone is 8.75 inches high by 9.5 inches wide (222 x 241 mm). The heat sink protrudes 2.25 inches (57 mm) in front of a plane determined by the rails of the relay rack in which it mounts, and it extends 2.25 inches (57 mm) behind that plane. When bolted together with its companion power supply, the width of the assembly is exactly 19 inches (482 mm), the width of a standard relay-rack panel.

Weight of the amplifier alone is 6 lbs., 11 oz., (3 kg).

INSTALLATION

GENERAL

When supplied by RFL as a unit of a complete Series 65 Single-Sideband Carrier System, the amplifiers will be installed and interconnected as part of the system, and no special procedures for installation should be necessary. For other cases, including routine maintenance, the notes following will be helpful.

Figure 5 shows terminal connections to the circuit card of the Model 65 PREAMP. Reference to the schematic will make the meaning of the designations clearer. A suitable mating connector, which will mount in the Model 68 Chassis, is TRW/Cinch Part 251-22-30-261, RFL Part HA-38545.

For access to the sides of the circuit board while plugged into the chassis, the Model 68 EXT Universal Card Extender, Assembly HB-39585 is a necessary accessory.

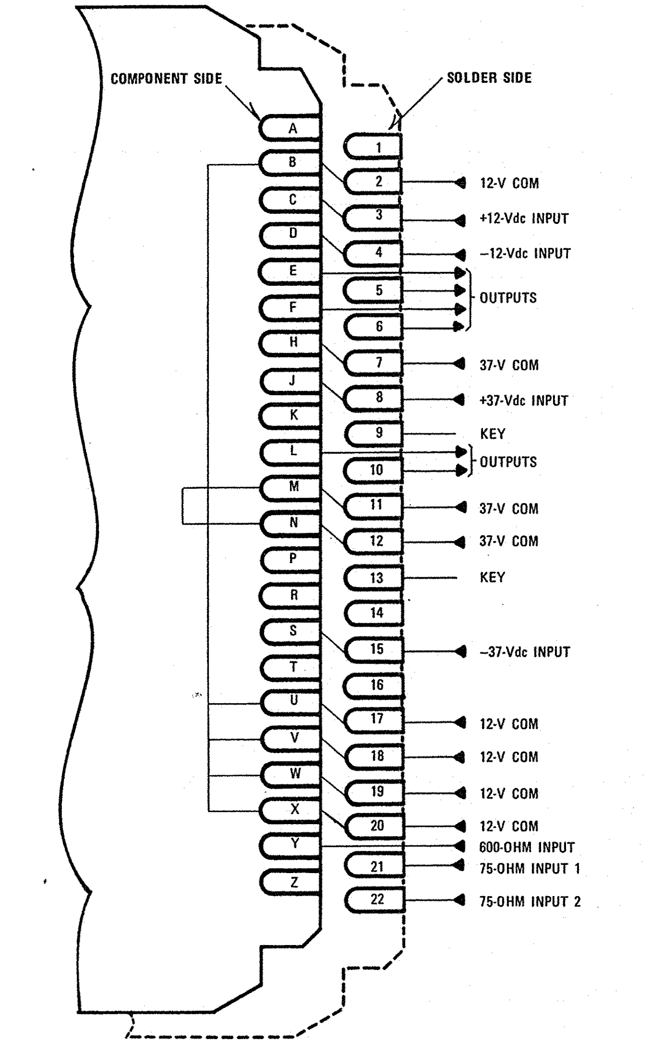

Figure 5. Edge-connector-terminal assignments, Model 65 PREAMP.

MODEL 65 PREAMP

The gain of the preamplifier is set by adjusting R23, GAIN, with a screwdriver while using a bridging type (high–impedance) frequency-selective voltmeter to monitor the output voltage at TP104. The preamplifier should be installed on an extender card. Use one of the following procedures:

Using Single-Tone Input

The input test-tone level should be 27 mV at either Terminal 21 or 22. Alternatively, it may be 436 mV at Terminal Y. For this adjustment, only one input signal should be present.

An access hole for R23, GAIN, will be found at the front of the shield enclosing the low-level stages. It is also identified on Figure 6. Set Jumpers G1 and G2 at maximum gain, 18 dB, and, with the preamplifier loaded with all power amplifiers which it is to drive, adjust GAIN for a level of 12 Vrms at TP104 as indicated on the voltmeter.

TABLE I

Number of Signals at Test-Tone Level	Jumper Settings G1	Jumper Settings G2
1	18 dB	18 dB
2	12	18
3	12	18
4	12	12
5	12	12
6	12	12
7	12	12
8	6	12
9	6	12
10	6	12
11	6	12
12	6	12
13	6	12
14	6	12
15	6	12
16	6	6

Using Multiple-Tone Input

The peak voltage output of the preamplifier may not exceed 12 Vrms. If two signals of test-tone level, therefore, are applied to the input, each one separately may not produce an output level exceeding 6 Vrms at TP104. Similarly, if there are n output signals at that tone level, then each individually may not produce an output voltage exceeding (12/n) Vrms at TP104. To reduce the gain of the preamplifier to the proper level, Jumpers G1 and G2 must be set according to the directions of Table 1.

To change jumper settings the shield over the preamplifier, held with three binder-head screws, must be removed to gain access.

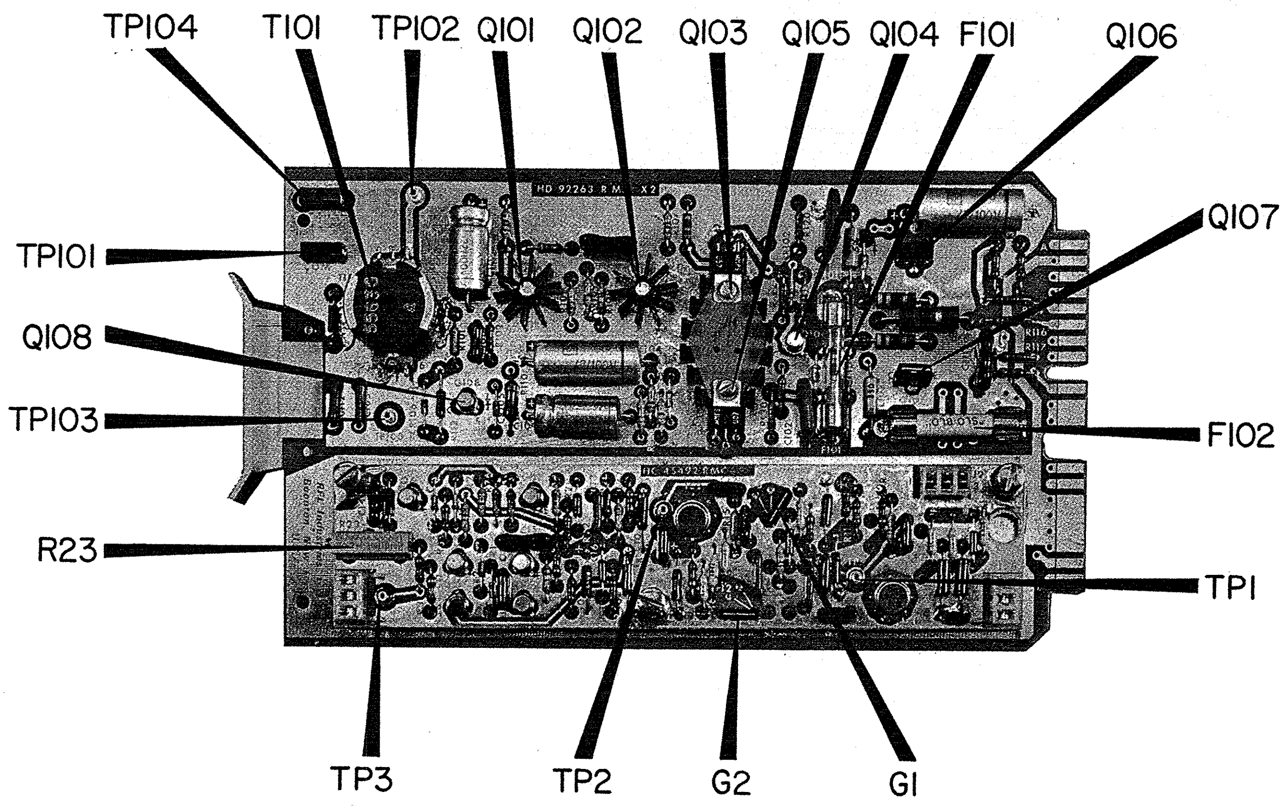

Figure 6. Location of adjustments, Model 65 PREAMP.

MODEL 65 PWRAMP

Voltage Gain

Voltage gain of the Model 65 PWRAMP from input to the primary of the output transformer is 6 dB. When using only one power amplifier, a precise adjustment of gain is not important, although the GAIN control, R1, gives a control range from about 5 to 8 dB. It may be located by reference to Figure 7.

When amplifiers are paralleled for greater power, their gains must be equalized. To effect this adjustment set their inputs (the output of the preamplifier) to 2 Vrms, using 20 kHz for a low-range amplifier, or 100 kHz for a high-range unit. Remove the load from J2, OUTPUT, and connect a high-impedance ac voltmeter between TP1 and common of Amplifier 1. Record the reading.

Move the voltmeter to TP1 of the second amplifier and adjust its GAIN control until the meter reading is the same. Repeat the foregoing for all amplifiers used so that all outputs are equal.

The phase of all amplifier outputs has been set at the factory to be within a few degrees of each other.

Output Impedance

The OUTPUT-IMPEDANCE control, R27, is used to maximize return loss by matching the output impedance of the amplifier to the load. It is a factory adjustment and should not be moved.

Null Adjustment

OFFSET-NULL adjustment, R6, is used to balance out unequal quiescent currents through transistor combinations Q9-Q10 and Q11-Q12 which otherwise would result in a dc offset voltage at the amplifier's output. To adjust, connect a dc voltmeter between TP1 (high) and common at J3, Terminal 2. With no signal applied, adjust R6 for less than 0.01 volts. When amplifiers are paralleled, this should be done separately for each amplifier.

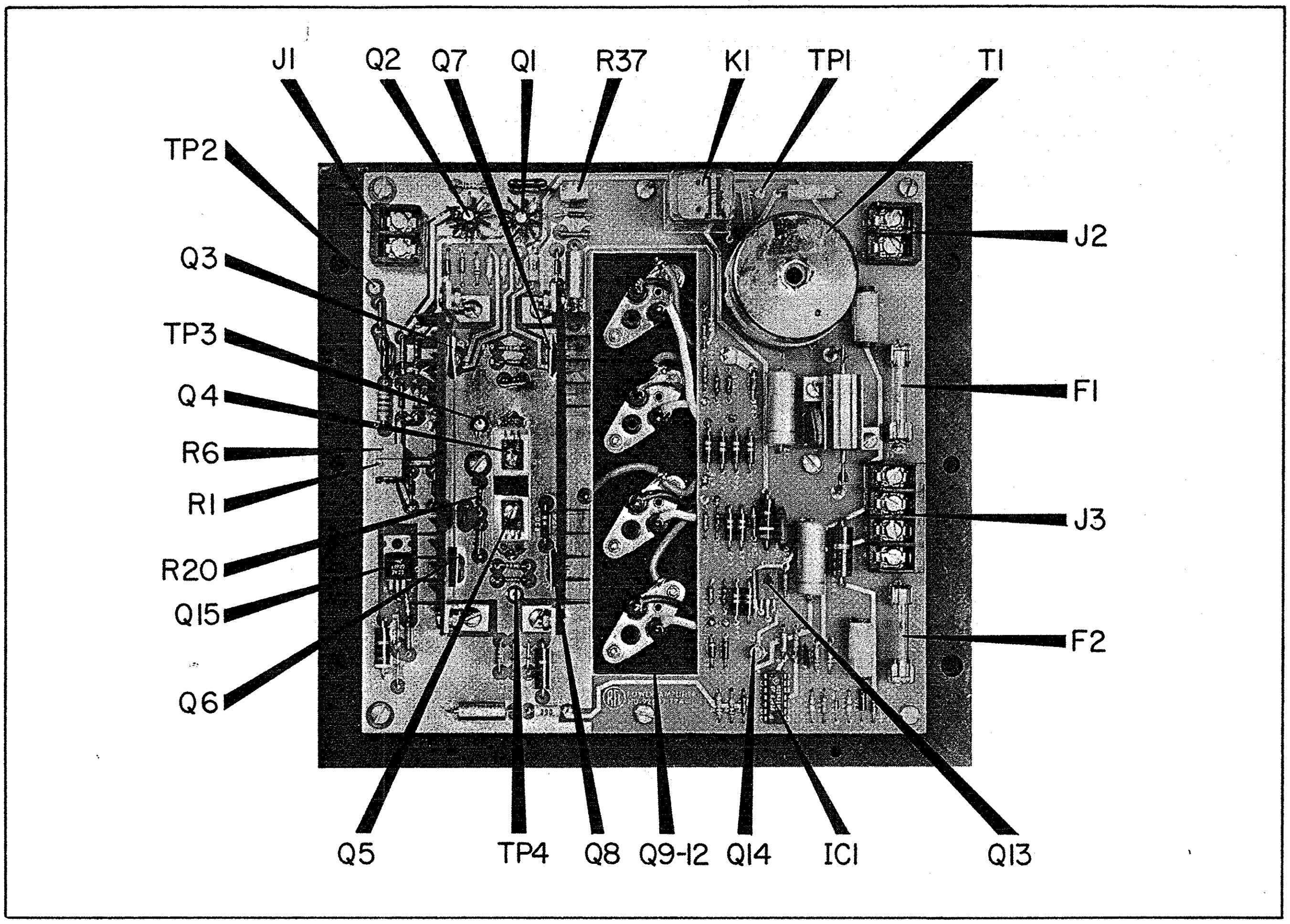

Figure 7. Location of adjustments, Model 65 PWRAMP.

MAINTENANCE

General

Routine maintenance of the system is effected most easily through periodic check of voltage levels at all test points in the chassis. Six-month intervals are suggested. It is recommended that at the time of installation all test-point levels be recorded and the record retained for future reference.

Levels measured at times of periodic maintenance should approximate those first recorded. If it becomes necessary to effect a significant adjustment of the circuit element determining the level at a test point, this should be taken as an indication of incipient failure.

CIRCUIT DETAILS

MODEL 65 PREAMP PREAMPLIFIER

It will be observed, on Figure 8, that two 75-ohm inputs and one 600-ohm input are provided. Input levels for full output are 27 mV at 75 ohms (–20 dBm) and 436 mV at 600 ohms (–5 dBm). These enter the circuit at IC1. Any one of three fixed-gain adjustments for the stage may be selected by positioning Jumper G1. Gain is adjusted by changing the negative-feedback factor. Adjustment of the fixed gain of Stage 2, IC2, is effected similarly by using G2. IC2 feeds Stage 3.

Stage 3 consists of a differential amplifier (Q1 and Q2), a transistor amplifier (Q3), and complementary emitter-follower drivers (Q4 and Q5). Q6 is a current sink. CR1 and CR2 provide the bias voltage needed for the amplifier to operate in Class AB. Stage 3 may be considered as an operational amplifier in which R22 is the input resistor, and in which R23 and R24, in series, act as the feedback element. Gain of Stage 3 is continuously variable, with R23, over the range from –4 to 12 dB.

Stage 4 is similar in operation to Stage 3 except that it operates from an unregulated power supply delivering plus and minus 37 Vdc. R101 is the input resistor; R102 is the feedback resistor. Interstage transformer T101 isolates the 12-volt common from the 37-volt common. There is also a 3-dB voltage gain in T101. Q108, in the emitter return of Q101 and Q102, acts to maintain a constant dc offset at the output, irrespective of variation in the unregulated 37-volt supply.

Stage 4 has a direct output through 27 ohms, R131, and six individual 100-ohm outputs to six connector terminals, through resistors R113 through R118. These are used to drive one or more Model 65 PWRAMP output amplifiers.

The preamplifier has two frequency ranges, 4-60 kHz and 30-500 kHz. The desired range is selected by using the appropriate interstage transformer. These are detailed on the parts list.

The two 37-volt power-supply inputs are fed to the output stage through 0.25-ampere slo-blo fuses. In addition, any high-voltage transients coming from output line are clamped to V+ or V– through diodes CR103 and CR104.

MODEL 65 PWRAMP

The power amplifier, the schematic of which appears as Figure 9, has a nominal no-load voltage gain of 6 dB, set by feedback resistor R28 and input resistors R2, R3 and GAIN potentiometer R1. This closed-loop gain, as with an operational amplifier, is independent of the gain of the individual stages of the amplifier. A variation of no-load voltage gain of about 3 dB is possible with R1.

The input signal from the preamplifier is applied to J1, and the input impedance of the amplifier is approximately 2K ohms. L1 and C2 act as a low-pass filter. Q1 and Q2 form a differential amplifier. R4 through R9 form an offset-nulling network to add a small positive or negative dc voltage to the amplifier's summing junction at the base of Q1. This compensates for any unbalance that may be in the amplifier, so that its quiescent output voltage at TP1 is zero.

Q15, with R15, CR8, and CR9, form a constant-current circuit to the emitters of differential amplifier Q1-Q2 to insure that the dc offset remains within acceptable limits over the full range of supply-voltage variation. Q3 and Q6 are a current source and sink which supply base-drive current to driver transistors Q7 and Q8. The value of R20, usually near 300 ohms, is selected at the factory so that, together with Q4, R21, and diode-connected Q5, a bias current of about 200 mA is provided to the output transistors, Q9 through Q12. This insures Class-AB operation with minimum crossover distortion. If any components are replaced, one should check to see that the total quiescent current taken from the +37-volt supply does not exceed 400 mA.

Q4 and Q5 are mounted on the same heat sink as the output transistors. Hence, the bias current tends to remain constant over a wide thermal range. Q7 drives output stages Q9 and Q10 in parallel, while Q8 drives Q11 and Q12, also in parallel. Q9 through Q12 are power transistors mounted on a thick aluminum plate to which additional heat sinks are attached. R28, located centrally on the schematic, is the feedback resistor which, with R1, R2, and R3, sets the closed-loop gain of the amplifier. R29, R37, and R48 provide current feedback. This adjusts the output impedance of the amplifier so that the impedance looking back into T1 from the line will match the load. CR3 and CR4 provide protection to the output transistors against any reverse-voltage transients which might appear at the amplifier's output.

NOTE: CR10, normally bypassed by J4, is used when two or more amplifiers are paralleled for greater carrier output power. CR10 is employed for this application by removing J4.

CR10 is in the CKT for 11 Amps

Overload Protection

IC1, Q13, Q14, and K1 form an overload-protection circuit. Upon turn on, the output of IC1C will go low after about 1-1/2 second. The period is determined by the charging time constant of R55 and C17. The output of IC1D then goes high and turns on Q14 and Q13 and energizes relay K1. This delay in connecting the load to the amplifier insures that quiescent conditions have been stabilized and that inrush current to the load is not excessive. If the dc current drain of the amplifier exceeds a preset limit, owing to signal overdrive or accidental short circuit, a sensing circuit in the power supply applies a negative going (ground) signal to IC1A through Terminal 3. This turns off Q13 and Q14, and de-energizes K1 which removes the load and protects the transistors against failure.

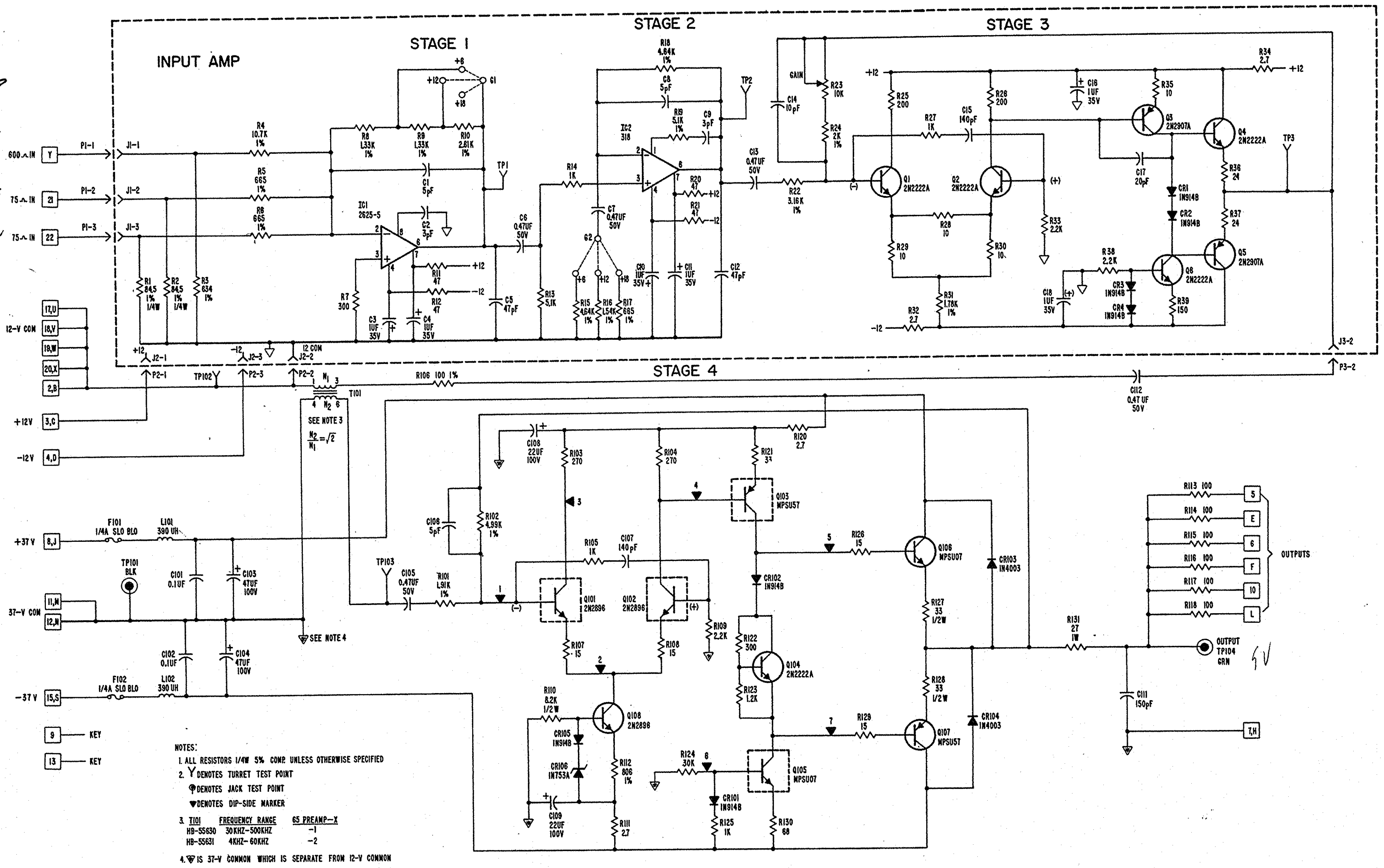

Figure 8. Schematic of circuit, Model 65 PREAMP.

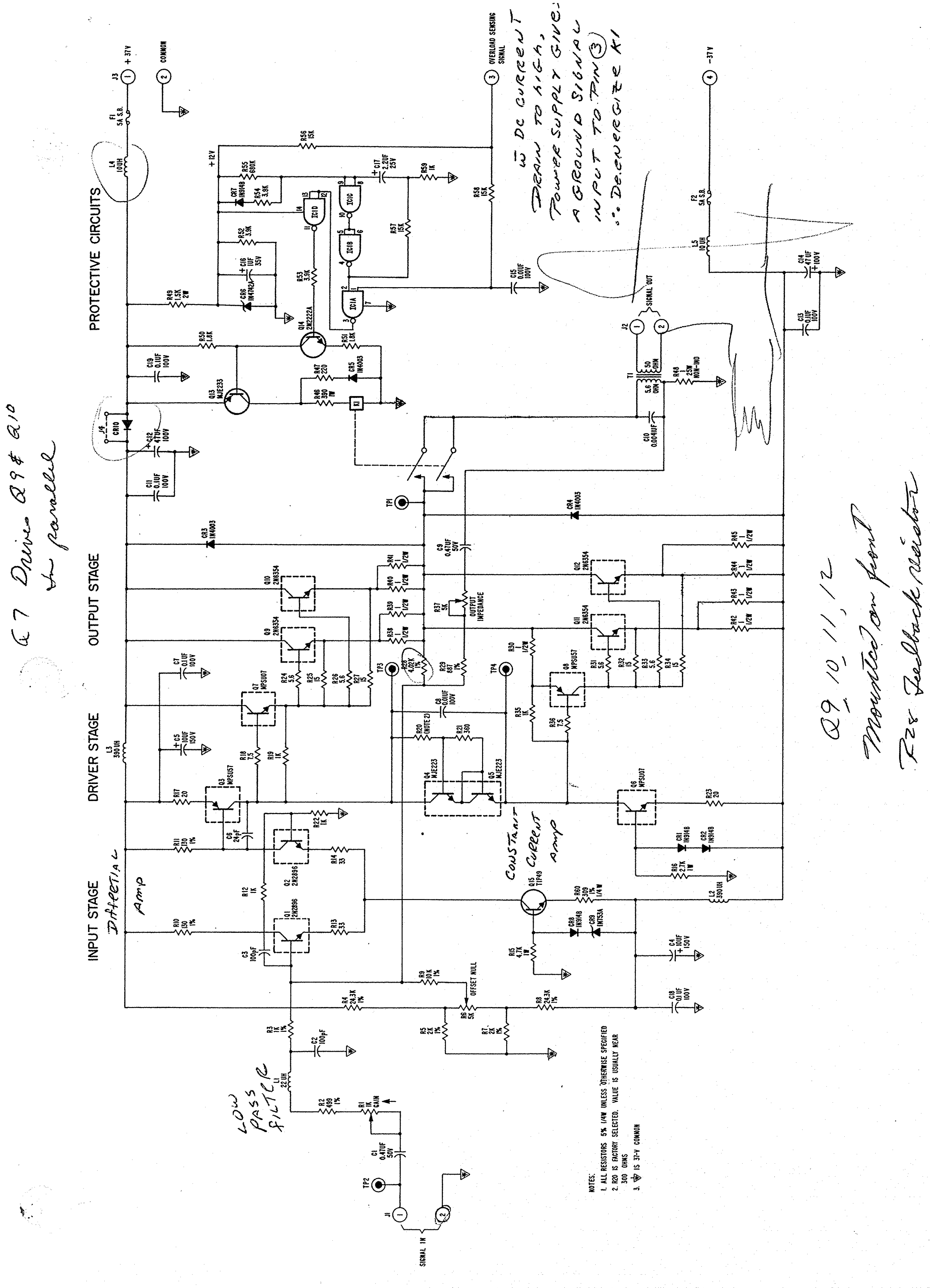

Figure 9. Schematic of circuit, Model 65 PWRAMP.