Part D T889 Power Amplifier

Caution: **There are no user serviceable components in these power amplifiers. Refer all servicing to your nearest Tait Dealer or Customer Service Organisation.**

This part of the manual is divided into five sections, as listed below. There is a detailed table of contents at the start of each section.

Section	Title
1	General Information
2	Circuit Operation
3	Initial Adjustment
4	Fault Finding
5	PCB Information

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1 T889 General Information

This section provides a brief description of the T889 power amplifier, along with detailed specifications and a list of types available.

The following topics are covered in this section.

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1.1 Introduction

The T889 is an FM base station power amplifier designed for single or multichannel operation within the 850 to 870MHz frequency range. The rated output power capability is 20 to 70W.

The PA comprises a broad band, two stage drive amplifier whose output is split to drive four separate output stages. The outputs from these final stages are then recombined and filtered before being fed to the output socket. This type of balanced output stage offers two advantages over single ended types:

- improved intermodulation performance in the presence of high signal levels from adjacent transmitters;
- enhanced reliability: if one of the four output stages fails, the transmitter can still produce half its rated power.

VSWR and thermal protection are incorporated into the basic design, while monitoring and alarm signals are available for both forward and reverse power. The output power is adjustable from the front panel.

The main PCB is mounted directly on a die-cast chassis/heatsink. For long-term reliability, five high quality, low loss Teflon PCBs are sweated to the main PCB in areas of high RF current. Extensive use is also made of the latest surface mount technology.

Forced air cooling for the heatsink is provided on the T889 by a fan, which is activated whenever the transmitter is keyed. Thermal sensors will also activate the fan automatically if the internal temperature reaches an unacceptable level.

The T889 has a width of 120mm and occupies a double space in a Tait rack frame, which has the ability to accommodate up to seven standard modules.

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1.2 Specifications

1.2.1 Introduction

The performance figures given are minimum figures, unless otherwise indicated, for equipment operating at standard room temperature (+22°C to +28°C) and standard test voltage (13.8V DC).

Ambient temperature is defined as the temperature of the air at the input to the cooling fan mounted on the heatsink.

Where applicable, the test methods used to obtain the following performance figures are those described in the EIA specification. Refer to Section 1.2.3 for details of test standards.

Details of test methods and the conditions which apply for Type Approval testing in all countries can be obtained from Tait Electronics Ltd.

1.2.2 General

Frequency Range	.. 850-870MHz
Power Output:	
Rated Power	.. 70W
Range Of Adjustment	.. 20 to 100W (typical)
Input Power	.. 4-5W
Duty Cycle Rating	.. 70W continuous to +60°C ambient temperature .. 100W continuous to +25°C ambient temperature .. 100W @ 55% duty cycle to +60°C ambient temperature
Intermodulation (PA with output isolator)	.. -70dBc or -40dBi[1] with 25dB isolation & interfering signal of -30dBc (ETS 300 086)
Mismatch Capability:	
Ruggedness	.. refer to your nearest Tait Dealer or Customer Service Organisation
Stability	.. 5:1 VSWR (all phase angles)

1. dBi denotes the level of intermodulation product relative to the interfering signal.

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Supply Voltage:

Operating Voltage	.. 10.8 to 16V DC
Standard Test Voltage	.. 13.8V DC
Polarity	.. negative earth only
Polarity Protection	.. crowbar diode

Maximum Supply Current (@ 100W):

Standby	.. 50mA
Transmit	.. 27A (22A typical @ 850MHz)

Operating Temperature Range .. -30°C to +60°C ambient temperature

Dimensions:

Height	.. 183mm
Width	.. 120mm
Length	.. 340mm

Weight .. 3.5kg

1.2.3 Test Standards

Where applicable, this equipment is tested in accordance with the following standards.

1.2.3.1 European Telecommunication Standard

ETS 300 086 January 1991

Radio equipment and systems; land mobile service; technical characteristics and test conditions for radio equipment with an internal or external RF connector intended primarily for analogue speech.

1.2.3.2 Telecommunications Industry Association

ANSI/TIA/EIA-603-1992

Land mobile FM or PM communications equipment measurement and performance standards.

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1.3 Product Codes

The three groups of digits in the T880 Series II product code provide information about the model, type and options fitted, according to the conventions described below.

The following explanation of T880 Series II product codes is not intended to suggest that any combination of features is necessarily available in any one product. Consult your nearest Tait Dealer or Customer Service Organisation for more information regarding the availability of specific models, types and options.

Model

The Model group indicates the basic function of the product, as follows:

T88X-XX-XXXX
T885 receiver
T881 5W transmitter
T889 70W power amplifier

Type

The Type group uses two digits to indicate the basic RF configuration of the product.

The first digit in the Type group designates the frequency range:

T88X-**X**X-XXXX
'1' for 800-870MHz
'2' for 860-910MHz
'3' for 890-960MHz

The second digit in the Type group indicates the channel spacing and is not applicable to power amplifiers:

T88X-X**X**-XXXX '0' for all power amplifiers

Options

T88X-XX-**XXXX** The Options group uses four digits and/or letters to indicate any options that may be fitted to the product. This group is currently not used for the T889 power amplifier.

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1.4 Standard Product Range

The following table lists the range of standard T889 types (i.e. no options fitted) available at the time this manual was published. Consult your nearest Tait Dealer or Customer Service Organisation for more information.

Frequency Range (MHz)	850-870
PA Type: T889-	10

You can identify the PA type by checking the product code printed on a label on the rear of the heatsink (Figure 1.1 in Part A shows typical labels).

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2 T889 Circuit Operation

This section provides a basic description of the circuit operation of the T889 PA.

Refer to Section 5 where the parts lists, grid reference index and diagrams will provide detailed information on identifying and locating components.

The following topics are covered in this section.

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2.1 Introduction

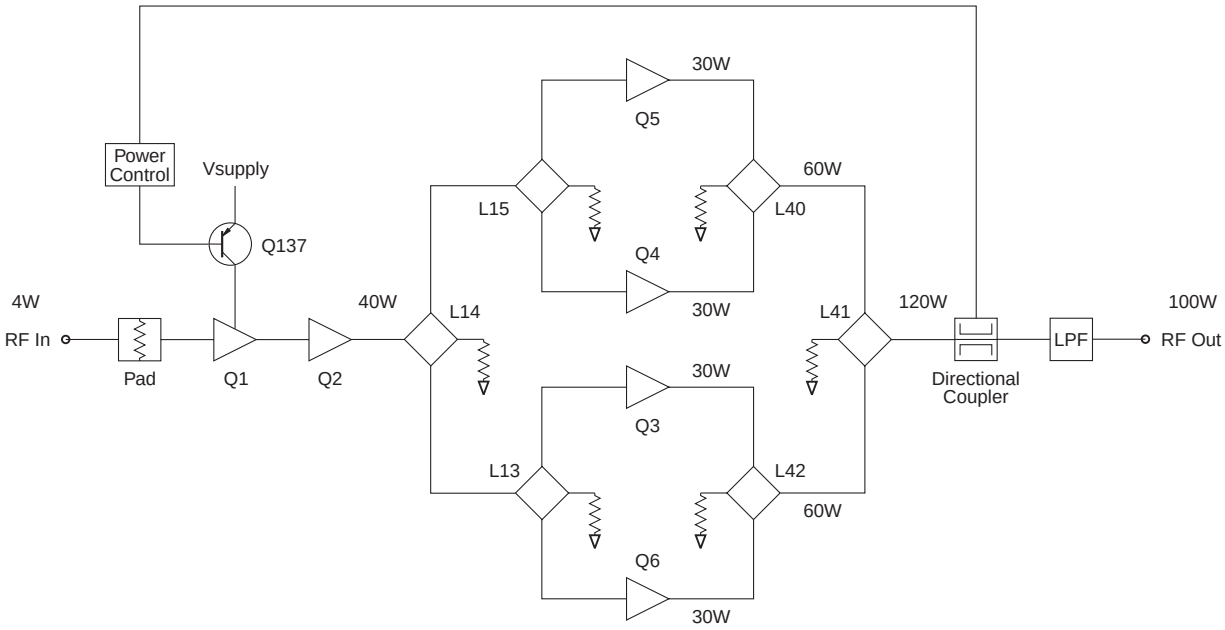

Figure 2.1 T889 High Level Block Diagram

The T889 comprises a three stage RF power amplifier with extensive control circuitry. The final stage is composed of four transistors (Q3, Q4, Q5 & Q6) whose outputs are combined to provide the rated output power.

The configuration of each of the main circuit blocks may be seen on a functional level in Figure 2.1.

2.2 RF Circuitry

(Refer to the RF section circuit diagram in Section 5.)

The driver stage of the T889 consists of a two stage transistor amplifier (Q1, Q2) which delivers a minimum of 40W. This signal is split via three 3dB couplers (L13, L14 & L15) and used to drive the four final amplifiers (Q3, Q4, Q5 & Q6). These outputs are recombined by L40, L41 & L42 and passed to the antenna socket via the directional coupler and low pass filter.

The directional coupler senses forward and reflected power, which is rectified (DCIC1, DCIC2) and passed to the control circuitry for metering, alarm and power control purposes.

Power control is via a series pass transistor (Q137), which controls the supply voltage on the collector of the driver transistor (Q1).

2.3 Control Circuitry

(Refer to the control section circuit diagram in Section 5.)

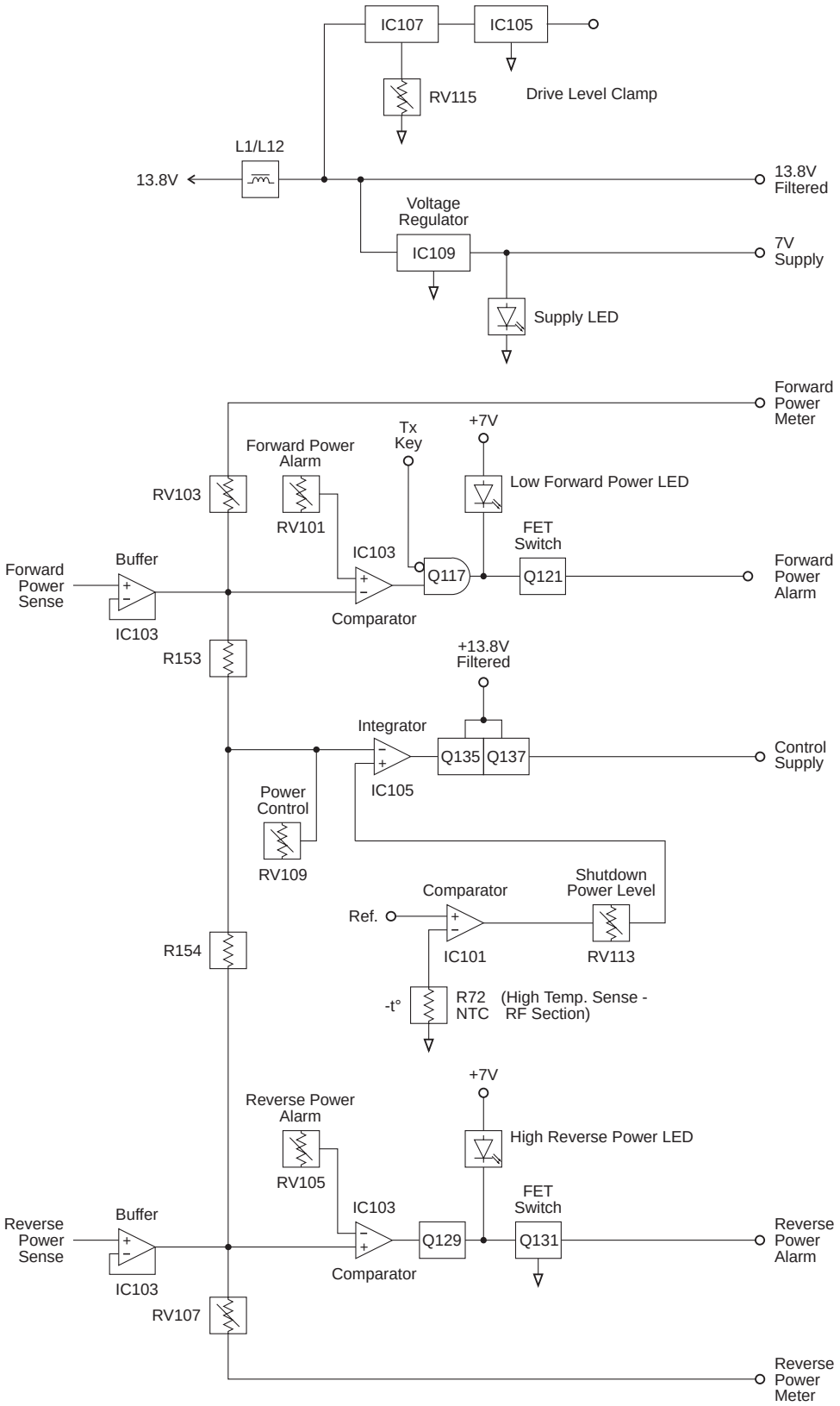

Figure 2.2 T889 Control Circuitry Block Diagram

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2.3.1 Power Control

The DC voltages from the directional coupler representing forward and reflected power are buffered by the two voltage followers, IC103 pins 1, 2 & 3 and pins 8, 9 & 10. Their outputs are summed at an integrator (IC105 pins 1, 2 & 3), which drives the series pass control element (Q137).

Forward and reflected power are summed so that, under high output VSWR, the power control turns the PA down. This is because the control loop adjusts for the same DC voltage from the directional coupler that would have been present if there were no reflected power.

2.3.2 Driver Power Level

The maximum output power of the T889 can be limited by placing a ceiling on the driver output power level using RV115 (accessible through the side cover). For example, if RV115 is set for a maximum output power of 50W, the range of adjustment using RV109 (front panel power adjust) will be 20 to 50W.

Note: You must make this adjustment at the operating frequency of the PA. If you change the operating frequency, you must readjust RV115 to clamp the power at the new frequency.

Caution: **You must set the driver power level clamp (RV115) according to the operational output power and ambient temperature, as described in Section 3.3. The unit may be damaged if RV115 is not set correctly.**

2.3.3 Thermal Protection

At excessively high temperatures, the output power will automatically reduce to a preset level (set by RV113), thus preventing the PA from overheating.

A thermistor controlled voltage divider (R168, R72) applies a voltage to a comparator with hysteresis (IC101 pins 8, 9 & 10).

The output current from the comparator is summed into the power control network via RV113 so that the power level to which the PA must turn down may be set.

2.3.4 Forward And Reverse Power Alarms

If forward power drops below, or reverse power rises above, presettable limits, alarms may be triggered.

The alarm outputs are open drain configuration and are low under normal conditions (i.e. forward and reverse power levels are normal).

IC103 pins 12, 13 & 14 and pins 5, 6 & 7 form comparators with thresholds adjusted via RV101 and RV105 respectively. The inputs are from the forward and reverse power signals from the directional coupler, buffered by IC103 pins 1, 2 & 3 and pins 8, 9 & 10. Thus, the power levels at which the forward and reverse power alarms are triggered are defined by RV101 and RV105 respectively.

2.3.5 Forward And Reverse Power Metering

Forward and reverse power signals from the two IC103 buffers are available for metering purposes. The output currents are adjustable via RV103 (forward power) and RV107 (reverse power).

2.3.6 Fan Control Circuitry

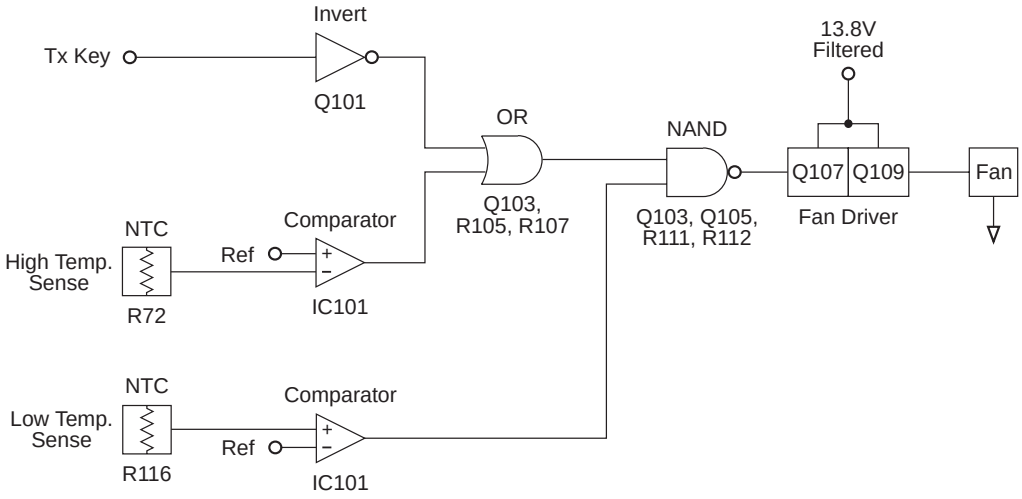

Figure 2.3 T889 Fan Control Logic Diagram

Comparator IC101 pins 8, 9 & 10 are set to trigger at heatsink temperatures greater than +70°C, and pins 1, 2 & 3 at temperatures greater than -10°C.

A logic AND function is applied to the comparator outputs by Q103 and Q105, thereby turning on the fan unconditionally (via Q107 and Q109) if the heatsink temperature exceeds +70°C.

A logic OR function is applied to comparator IC101 pins 8, 9 & 10 and Tx-Key signals, thereby turning on the fan when the transmitter is keyed and the temperature is between -10°C and +70°C.

If the temperature drops below -10°C, Q105 is turned off, preventing either Q101 or Q103 from activating the fan.

Fan operation may be summarised as follows:

T < -10°C	- fan unconditionally turned off
-10°C < T < +70°C	- fan turned on only when transmitter keyed
T > +70°C	- fan unconditionally turned on.

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2.4 Power Supply & Regulator Circuits

(Refer to the control section circuit diagram in Section 5.)

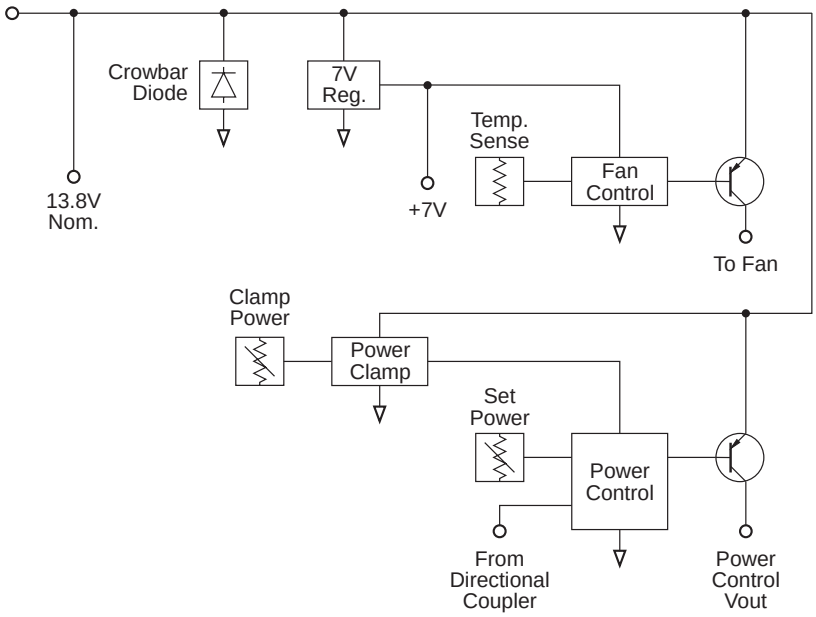

Figure 2.4 T889 Power Supply & Regulator Circuitry Block Diagram

The T889 is designed to operate off a 10.8-16V DC supply (13.8V nominal). A 7V supply runs directly off the 13.8V rail, driving the fan control, power control and alarm circuitry.

A crowbar diode is fitted for protection against connection to a power supply of incorrect polarity. It also provides transient overvoltage protection.

Note: A fuse must be fitted in the power supply line for the diode to provide effective protection.

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3 T889 Initial Adjustment

Caution: **This equipment contains CMOS devices which are susceptible to damage from static charges. Refer to Section 1.2 in Part A for more information on anti-static procedures when handling these devices.**

The following section describes the full adjustment procedure to be carried out before operating the T889.

Note: The T889 requires no RF tuning or alignment.

Refer to Section 5 where the parts lists, grid reference index and diagrams will provide detailed information on identifying and locating components.

The following topics are covered in this section.

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3.1 Test Equipment Required

- DC power supply capable of delivering 30A at 13.8V.
- Multimeter or DMM (e.g. Fluke 77).
- RF power meter (e.g. HP 435 series or Bird Wattmeter).
- 250W 40dB attenuator.
- 150W 3dB 50 ohm pad.
- 'BNC' to 'N' type adaptors (e.g. Amphenol, Greenpar).
- Appropriate trimming tools.

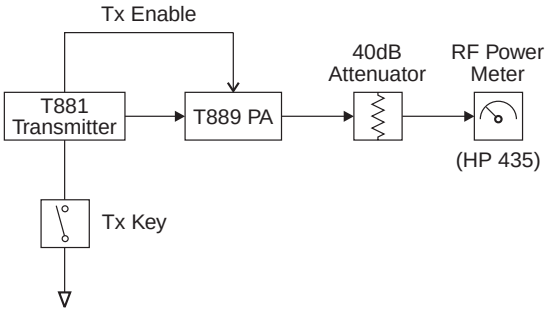

Figure 3.1 T889 Test Equipment Set-up

Caution: **Do not connect attenuators or DC blocks between the T881 and T889 or the cyclic keying circuitry will not function correctly.**

3.2 Preliminary Checks

Check for short circuits between the positive rail and earth.

Set up the test equipment as in Figure 3.1.

Connect the T889 to a 13.8V DC supply.

Check that the quiescent current is <50mA.

Key the transmitter by earthing the key line (D-range 1 [PL100] pin 13).

Check that the power supply is still at 13.8V under load.

Check that the regulated power control supply is approximately 7V.

Note: The output power and alarm levels should be set with the side cover on. If the cover is removed for other adjustment procedures, make a final check of the output power and alarm levels with the side cover on.

3.3 Setting The Output Power

Caution: **If the high temperature shutdown power level has not yet been set or is unknown, check that the unit does not overheat while setting the output power.**

Note 1: You must set up the T889 according to the following instructions ***before*** operation in a radio system. ***Do not*** use the factory default settings as they may not suit your operating frequency.

To obtain optimum performance from the T889, ensure that the T881 transmitter used in this set-up procedure is the one that will be used with the PA in the radio system.

Note 2: Cables and connectors can easily cause a power loss of several watts if either too long or poorly terminated. Always use the shortest possible leads (or connectors instead of leads) between the T889 and power meter set-up.

You will need appropriate extension leads if you wish to carry out the adjustment procedures with the T889 withdrawn from the rack in the latched position. Alternatively, disconnect and withdraw the T889 and reconnect it behind the rack.

Note 3: The actual power used may be limited by regulatory requirements.

Set the transmitter to the required operating frequency.

Connect the transmitter output to the PA input via a thru-line wattmeter with a 10W full scale reading. Special BNC/N leads will be required.

Connect an RF power meter to the PA output connector via a 40dB attenuator.

With the transmitter ***not*** keyed, set RV115 (driver power clamp) to maximum (fully clockwise).

Set RV109 (front panel power control) to maximum (fully clockwise).

Key on the transmitter.

Quickly (within 30 seconds) adjust RV115 to the required power setting, according to the values given in Table 3.1.

Adjust RV109 to set the power output to the required level, according to Table 3.1.

Caution: ***Do not*** **allow the output power to exceed these levels as this will seriously reduce the reliability of the PA.**

Do not **use RV115 to set the output power as this will disable the thermal protection circuitry. The power clamp must always be 20W above the set output power.**

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Ambient Temperature (°C)[a]	Maximum Continuous Output Power (W)	Power Setting For RV115 (W)
≤+25	100	120
+30	96	116
+35	91	111
+40	87	107
+45	83	103
+50	78	98
+55	74	94
+60[b]	70	90

a. Ambient temperature is defined as the temperature of the air at the input to the cooling fan mounted on the heatsink.

b. The T889 is also rated at 100W @ 55% duty cycle to +60°C.

Table 3.1 T889 Rated Output Power vs Ambient Temperature

3.4 High Temperature Shutdown Power Level

Set RV109 (front panel power control) to the required output power.

Earth pin 9 of IC101 (the pad at NTC R72 is convenient).

Adjust RV113 (shutdown power level) for an output power of 20W.

Remove the earth from pin 9 of IC101 (or the pad of R72).

3.5 Remote Forward Power Meter Calibration

If a remote meter is connected, adjust RV103 (forward power meter calibration) for the remote reading to agree with the RF power meter reading.

3.6 Remote Reverse Power Meter Calibration

If a remote meter is connected, connect a 50 ohm 3dB pad (with the output open circuit) to the PA output.

Apply RF drive and Tx-Key.

Adjust RV107 (reverse power meter calibration) for a quarter of the forward power reading.

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3.7 Setting Alarm Levels

Note: If forward and reverse power metering is being used, set up their calibration (Section 3.5 and Section 3.6) before setting the alarm levels.

3.7.1 Forward Power

Power up the T889 and adjust RV109 (front panel power control) so that the output power is at the alarm level required (e.g. 80W if the T889 normally operates at 100W).

Adjust RV101 (forward power alarm set) so that the forward power alarm LED lights.

Check the alarm level setting by adjusting the power up and down and observing the alarm LED. A few watts hysteresis can be expected.

Readjust RV109 for the normal operating level.

Note: Remote indication is available at pin 3 of the D-range connector.

3.7.2 Reverse Power

Power up the T889 and adjust RV109 (front panel power control) for the normal operating power level.

Place a known mismatch of the required value (e.g. 3:1 VSWR) and adjust RV105 (reverse power alarm set) so that the reverse power alarm LED lights.

Example: A VSWR of 3:1 can be simulated by connecting an unterminated 150W 3dB pad to the PA output. This will result in a return loss of 6dB.

Note: Remote indication is available at pin 4 of the D-range connector.

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4 T889 Fault Finding

Caution: **This equipment contains CMOS devices which are susceptible to damage from static charges. Refer to Section 1.2 in Part A for more information on anti-static procedures when handling these devices.**

The following test procedures and fault finding flow charts may be used to help locate a hardware problem, however they are by no means a complete fault finding procedure. If you still cannot trace the fault after progressing through them in a logical manner, contact your nearest Tait Dealer or Customer Service Organisation. If necessary, you can get additional technical help from Customer Support, Radio Systems Division, Tait Electronics Ltd, Christchurch, New Zealand (full contact details are on page 2).

Refer to Section 5 where the parts lists, grid reference index and diagrams will provide detailed information on identifying and locating components.

The following topics are covered in this section.

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4.1 Visual Checks

Remove the side cover from the T889 and inspect the PCB for damaged or broken components, paying particular attention to the surface mounted devices (SMDs). Also check for defective solder joints.

Refer to Section 4.7, Section 4.8 and Section 3 of Part A for more details on repair and replacement of components.

4.2 UNC Thread Screws

All black finish Pozidriv screws used in the T889 are 4-40 UNC thread and cannot be interchanged with M3 screws. Note that different lengths are used in different applications.

4.3 Component Checks

If you suspect a transistor is faulty, you can assess its performance by measuring the forward and reverse resistance of the junctions. Unless the device is completely desoldered, first make sure that the transistor is not shunted by some circuit resistance. Use a good quality EVM (e.g. Fluke 75) for taking the measurements (or a 20k ohm/V or better multimeter, using only the medium or low resistance ranges). The collector current drawn by multi-junction transistors is a further guide to their performance.

Note: Q1 (2SC2933) and Q2-Q6 (SD1414) are common base transistors.

If an IC is suspect, the most reliable check is to measure the DC operating voltages. Due to the catastrophic nature of most IC failures, the pin voltages will usually be markedly different from the recommended values in the presence of a fault. The recommended values can be obtained from either the circuit diagram or the component data catalogue.

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4.4 DC Checks

Note: No RF power is to be applied during these checks.

Check that +13.8V is present on the collectors of Q2, Q3, Q4, Q5 and Q6. Make this measurement when the transmitter is not keyed.

Check that approximately 8-13.8V is present on the collector of Q1 (the level is dependent on RV115 being set to maximum).

Check that +13.8V is present at pin 4 of IC103 and pin 4 of IC101.

Check that approximately 8-13.8V is present at pin 8 of IC105 (the level is dependent on RV115 being set to maximum).

Check that +7.0V is present at the output of regulator IC109 (pin 7).

4.5 RF Checks

The PA Fault Finding Chart (Section 4.6.1) provides a systematic approach for locating a fault in the RF circuitry. Use this chart in conjunction with Figure 4.1, which shows the locations of the 50Ω input and output test points for RF transistors Q1-Q6.

Transistor	Input Transmission Line	Output Transmission Line
Q1-Q2	L16 (Q1)	L21 (Q2)
Q3	L24	L23
Q4	L26	L32
Q5	L33	L39
Q6	L43	L49

Note 1: ***Always*** test individual PA stages at the 50Ω test points, located at the ends of the semi-rigid transmission lines furthest away from the RF transistors.

Note 2: ***Always*** test Q1 and Q2 as a pair.

Note 3: Use 50Ω semi-rigid coax for the flying test leads. Ensure each output is terminated in a 50Ω load of the correct power rating.

For problems with the power control circuitry, refer to the Power Control Fault Finding Chart (Section 4.6.2).

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replace A4 pages D4.5/D4.6 with A3 pages D4.5/D4.6

Figure 4.1 T889 Test Break Point Location

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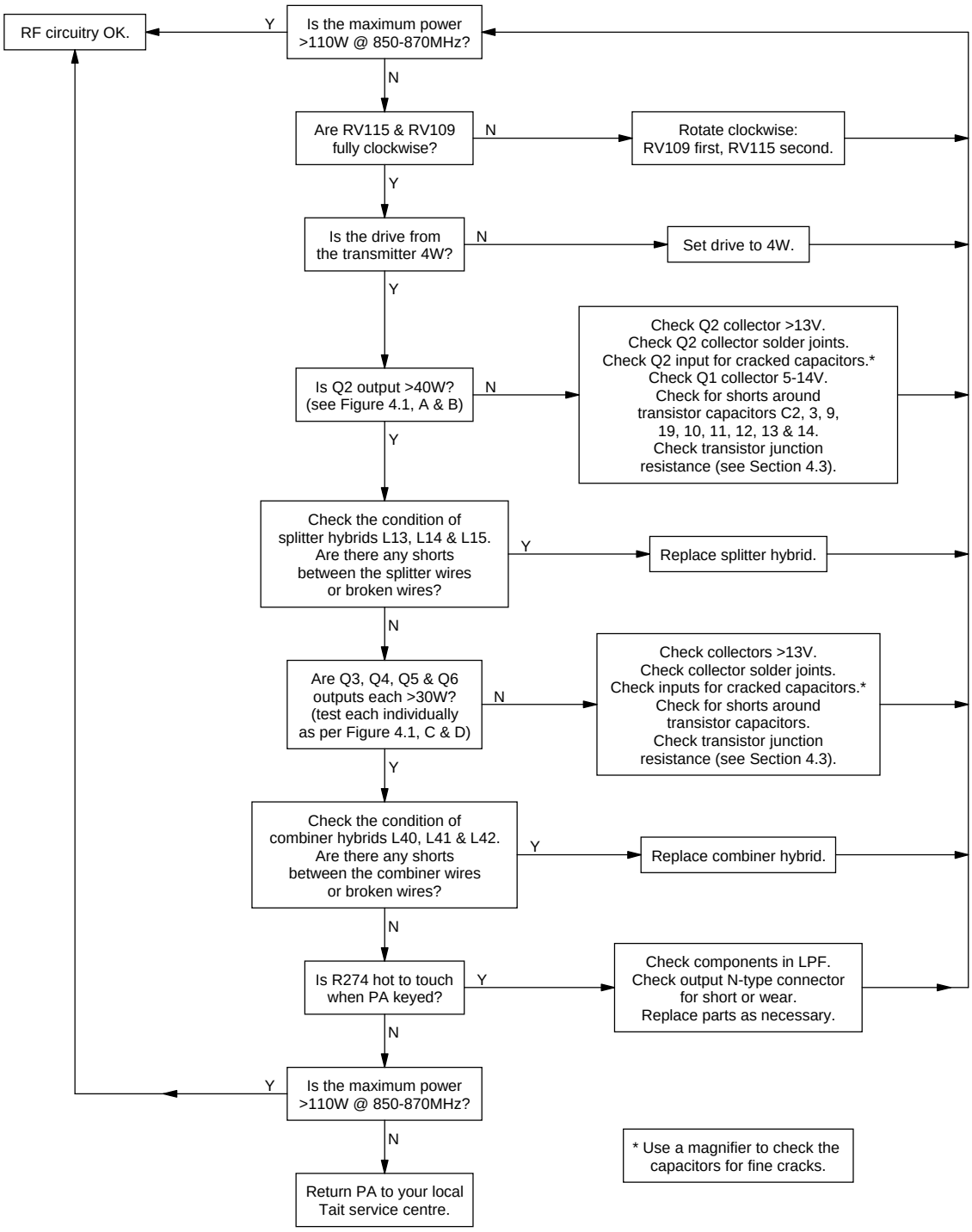
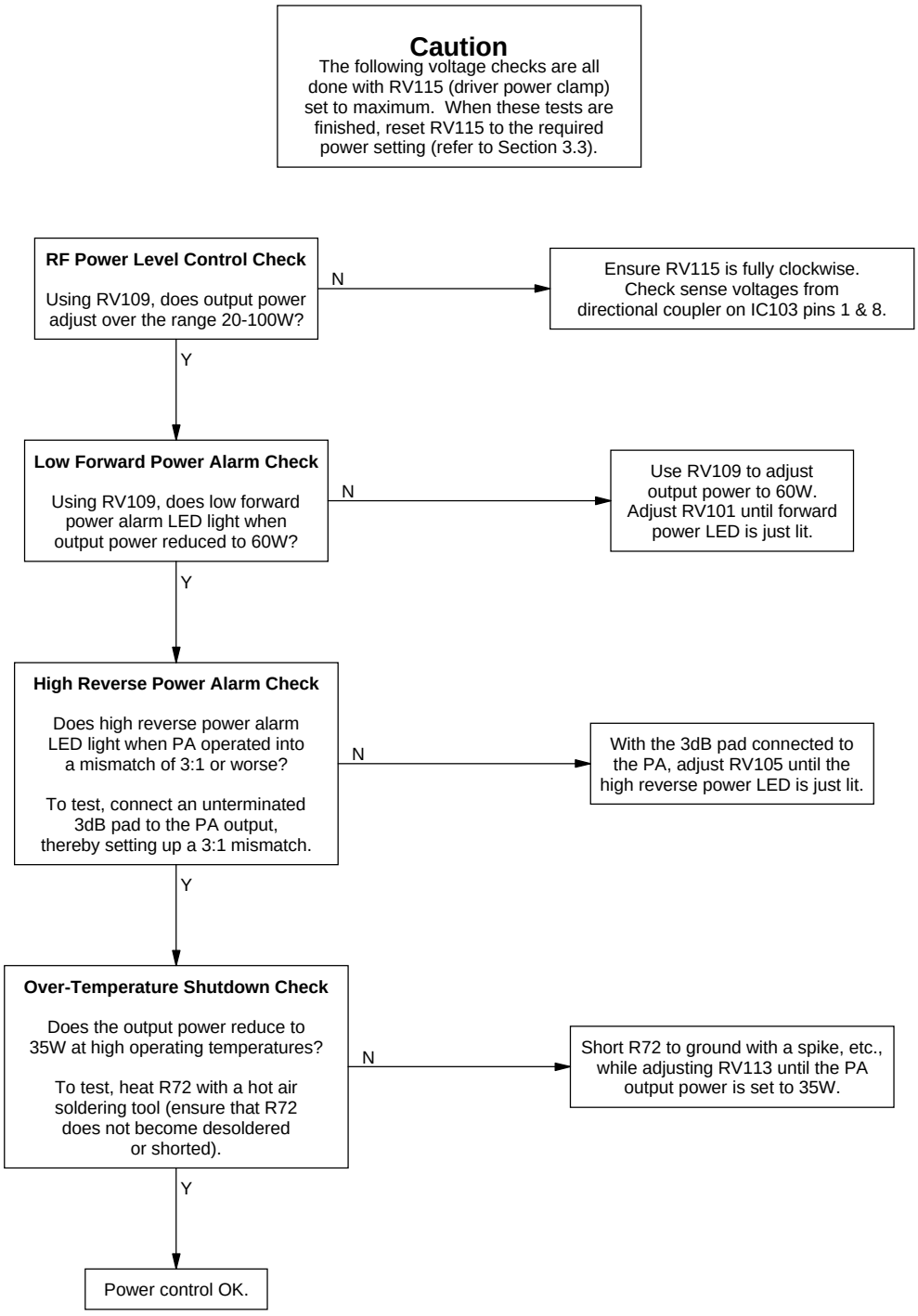
4.6 Fault Finding Charts

4.6.1 PA



4.6.2 Power Control



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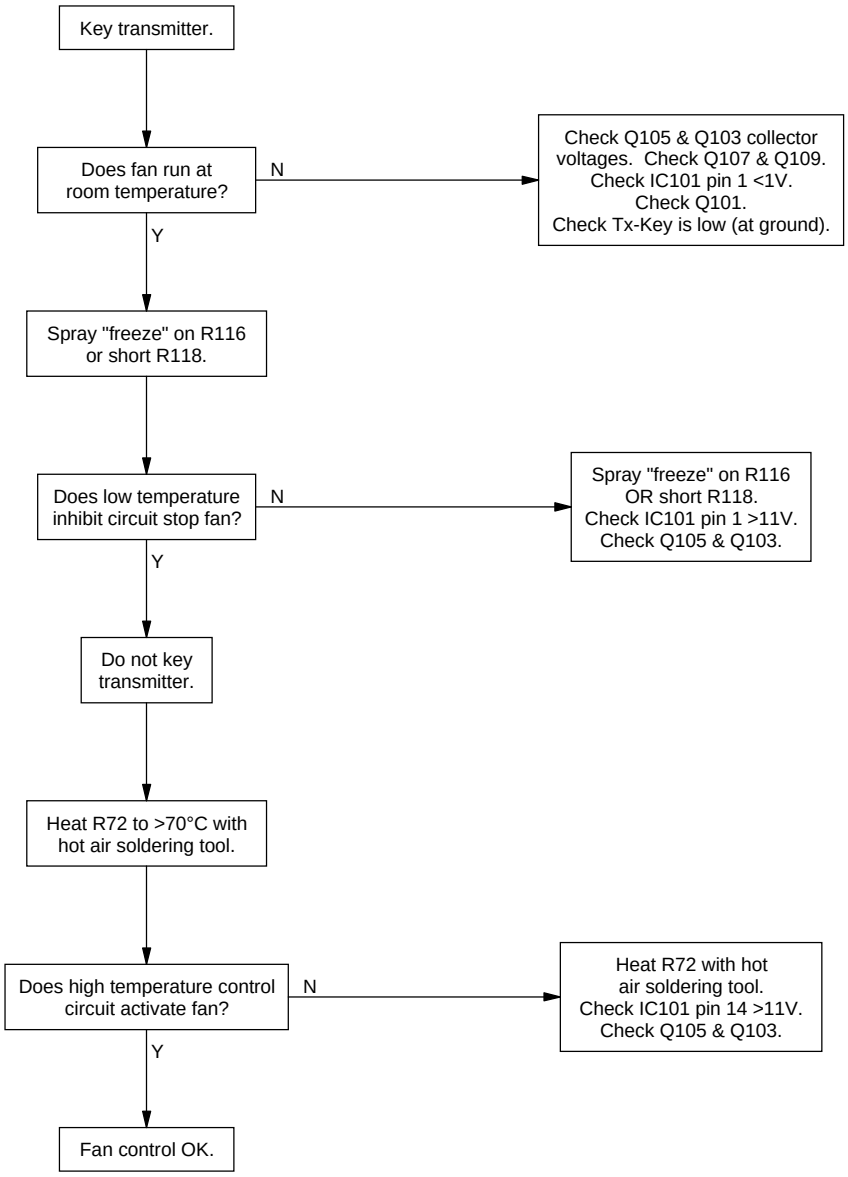
4.6.3 Fan Control Circuitry



4.7 Replacing RF Power Transistors

Caution: **Failure to comply with the following procedure can result in failure of the device due to poor heatsinking, or worse, can endanger the health of the assembler if the beryllium oxide die carrier is smashed during assembly.**

Caution: **As the location of certain components in the PA is critical to performance, it is important that any components removed or disturbed are refitted in *exactly* the same position.**

Caution: **Do not apply too much heat or pressure to the PCB pads and tracks as you may damage them or lift them from the PCB, causing permanent damage to the PA.**

4.7.1 Transistor/Capacitor Spacing

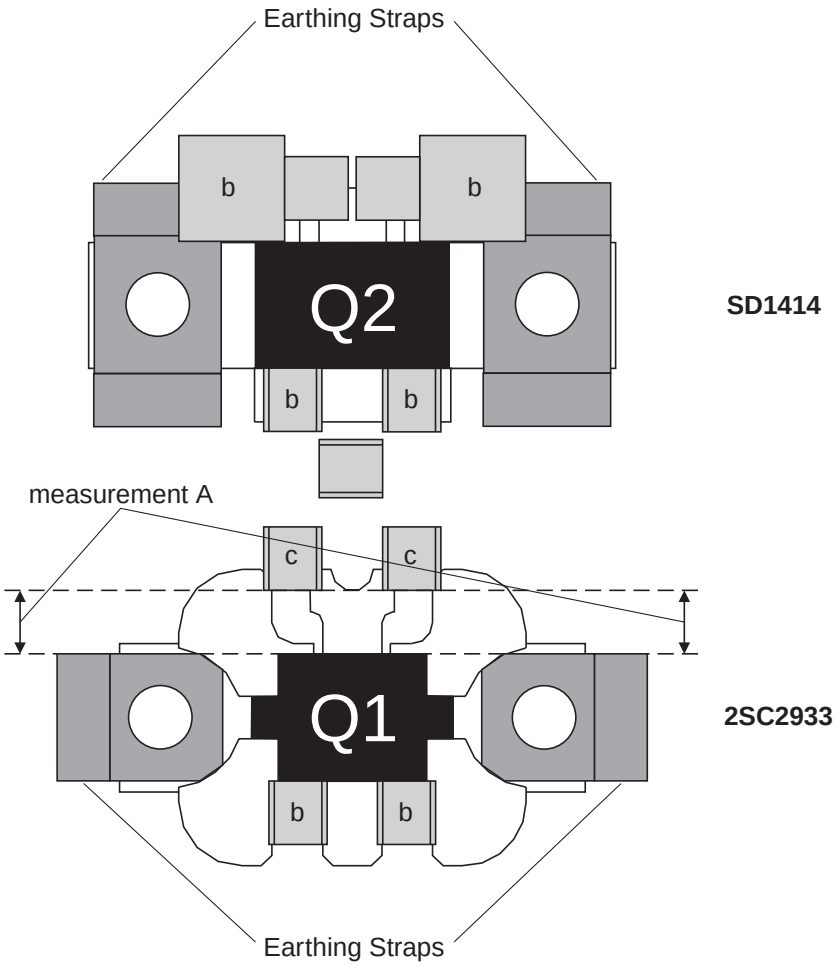


Figure 4.2 T889 Typical Transistor/Capacitor Spacing (Q1 & Q2 Shown)

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4.7.1.1 Q1 (2SC2933 Pre-Driver)

Refer to Figure 4.2.

Position the capacitors labelled “b” hard up against the transistor body.

The exact positioning of the capacitors labelled "c" is important in order to achieve at least 40W output power from Q2. You may need to readjust their positioning after replacing Q1 to achieve the required output power level. We therefore suggest the following procedure:

- before removing Q1, measure the distance between the capacitors labelled “c” and the transistor body (measurement “A”);
- after you have replaced Q1, replace these capacitors in the same position, using measurement "A" as a reference;
- measure the output power from Q2 and adjust the exact positioning of these capacitors to achieve at least 40W.

4.7.1.2 Q2, Q3, Q4, Q5 & Q6 (SD1414)

Refer to Figure 4.2.

Position all capacitors labelled “b” hard up against the transistor body.

4.7.2 Replacement Procedure

Note: This procedure requires high quality solder joints. We strongly recommend that you use a 100W soldering iron and low melting point solder (62% tin, 36% lead, 2% silver).

Desolder and remove the components from around the transistor.

Desolder the transistor tabs and earthing straps by heating with a soldering iron and lifting away from the PCB with a screwdriver or thin stainless steel spike.

Remove the transistor retaining screws and remove the transistor.

Remove any excess solder from the PCB pads with solder wick.

Lightly tin the underside of the tabs on the replacement transistor and earthing straps. Remove any excess solder to leave a thin, even layer on the tabs.

Apply a small amount of heatsink compound (Dow-Corning 340 or equivalent) to the transistor mounting surface. Sufficient compound should be used to ensure an even film over the entire mounting surface.

Place the transistor on the PCB in the correct orientation (ensuring the tabs are flush to the surface), fit the new earthing straps and torque down the retaining screws to the correct torque (0.7Nm/6in.lbf.).

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Solder all transistor tabs and earthing straps to the PCB.

Caution: **Do not solder the transistor tabs before torquing down otherwise the device may be broken.**

Replace all other components in exactly the same positions as noted previously.

4.8 Removing The PCB From The Heatsink

Note 1: This is a lengthy procedure and should be considered only after all other checks have been carried out. There are no components on the bottom of the PCB.

Note 2: T889 PAs manufactured after August 25th 2000 will have a heatspreader fitted between the main PCB and the heatsink to help dissipate the heat generated by transistors Q2-Q6. Refer to TN-632 for more details.

Remove the harmonic filter shield lid.

Desolder the power feed to the fan from the PCB.

Remove the 50 ohm output N-type connector by unscrewing it from the heatsink casting and desoldering it from the PCB.

Unplug the 50 ohm input coaxial cable from the PCB, unscrew the BNC connector from the heatsink, and remove the connector and cable (cutting cable ties as required).

Desolder the positive and negative power feed wires from the PCB.

Disconnect the ribbon cable from the D-range PCB.

Remove the 2 screws securing the D-range connector and PCB to the heatsink and withdraw the assembly and wires from the heatsink.

Remove the mounting screws for the following transistors:

Q1, Q2, Q3, Q4, Q5, Q6 and Q137.

Remove the mounting screws for the termination resistors:

R276, R277, R278, R272, R274 and R275.

Remove the retaining screws for the wireline couplers:

L13, L14, L15, L40, L41 and L42.

Remove the 13 PCB retaining screws.

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Push the three LEDs out of their front panel grommets.

Lift the PCB gently from the heatsink to gain access to the underside of the board.

Note: R272-278 and Q1-Q6 may be stuck down with heatsink compound. You may need to carefully prise them away from the heatsink with a small screwdriver.

Caution: **Keep the heatsink compound clean while the PCB is detached. Any objects caught in the heatsink compound underneath the device which prevent effective earthing and/or heatsinking may cause the device to fail.**

Caution: **Do not operate the PA with the PCB detached as the heatsink is used for earthing and heat dissipation.**

To replace the PCB, reverse the order of removal, taking care that the wiring is correctly positioned and not 'pinched'.

Note: Torque down the transistor and termination resistor mounting screws to the correct torque (90N.cm/8in.lbf.).

Make sure that the heatsink compound has stayed clean, and that the insulating pad for Q137 is not damaged.

If you have difficulty refitting the LEDs, try pushing the body of the LED back into the grommet with a thin screwdriver or spike.

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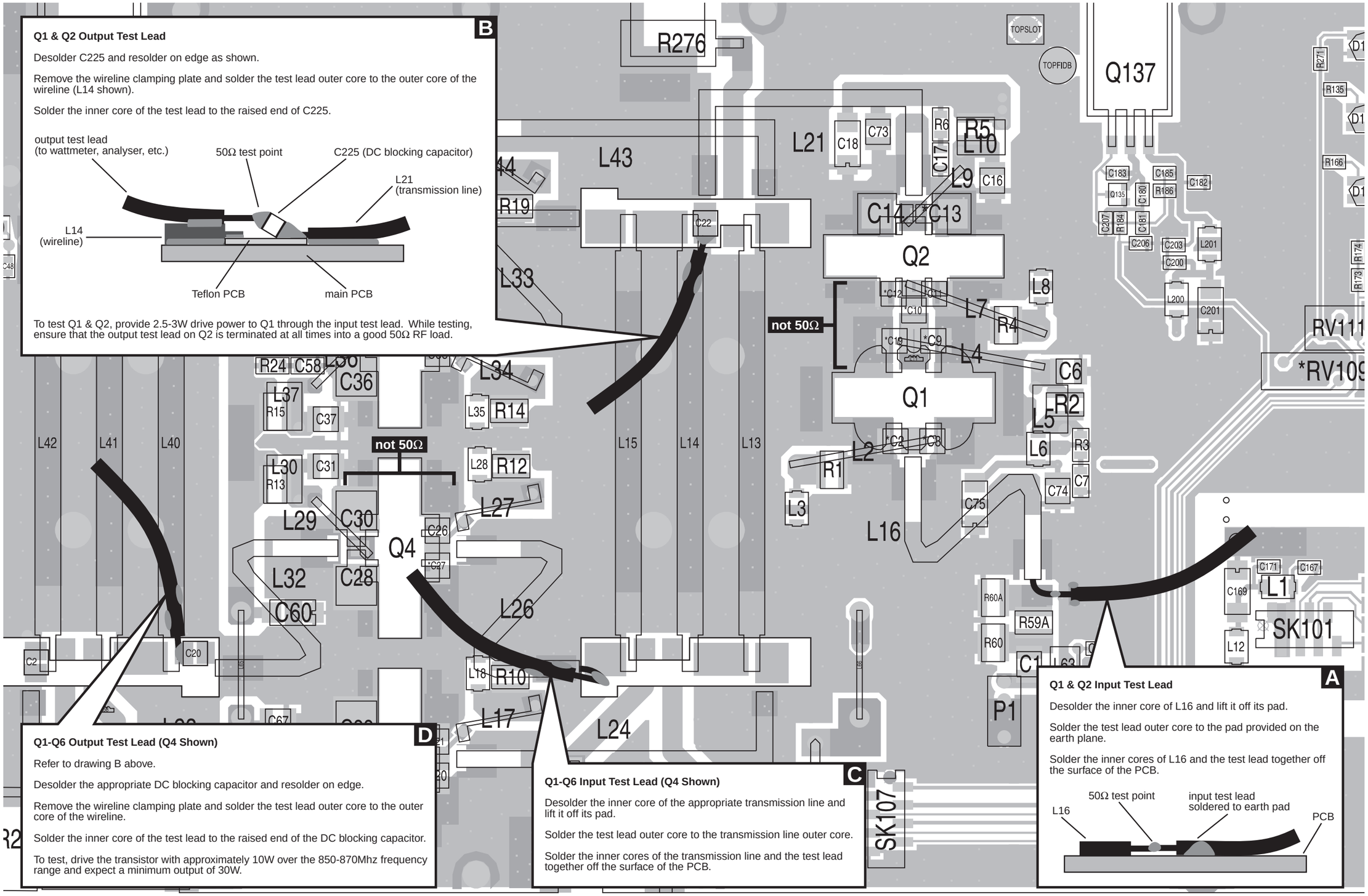

Figure 4.1 T889 Test Break Point Location

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5 T889 PCB Information

Caution: **This equipment contains CMOS devices which are susceptible to damage from static charges. Refer to Section 1.2 in Part A for more information on anti-static procedures when handling these devices.**

This section provides the following information:

- parts lists
- grid reference index
- mechanical assembly drawing
- PCB layouts
- circuit diagrams.

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5.1 Introduction

Product Type Identification

You can identify the PA type by checking the product code printed on a label on the rear of the chassis/heatsink (product codes are explained in Section 1.3 in this Part of the manual, and Figure 1.1 in Part A shows typical labels).

PCB Identification

All PCBs are identified by a unique 10 digit "internal part number" (IPN), e.g. 220-01390-02, which is screen printed onto the PCB (usually on the top side), as shown in the example below:

The last 2 digits of this number define the issue status, which starts at 00 and increments through 01, 02, 03, etc. as the PCB is updated. Some issue PCBs never reach full production status and are therefore not included in this manual. A letter following the 10 digit IPN has no relevance in identifying the PCB for service purposes.

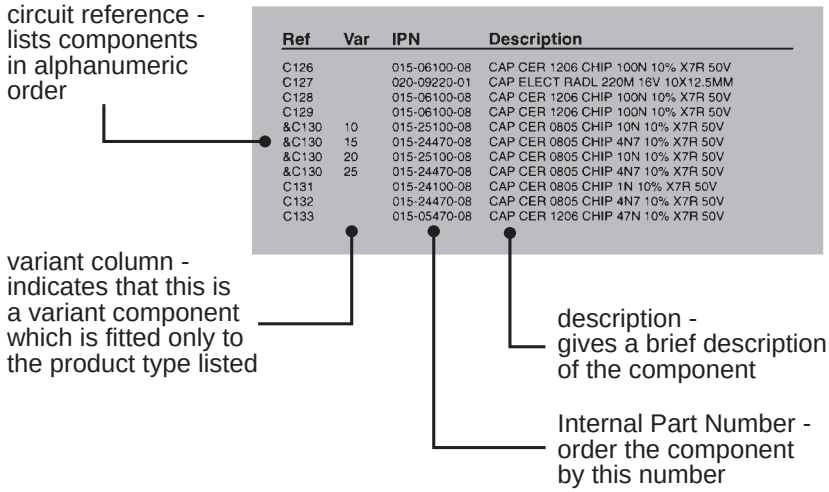
Note: It is important that you identify which issue PCB you are working on so that you can refer to the appropriate set of PCB information.

Parts Lists

The 10 digit numbers (000-00000-00) in this Parts List are "internal part numbers" (IPNs). We can process your spare parts orders more efficiently and accurately if you quote the IPN and provide a brief description of the part.

The components listed in this parts list are divided into two main types: those with a circuit reference (e.g. C2, D1, R121, etc.) and those without (miscellaneous and mechanical).

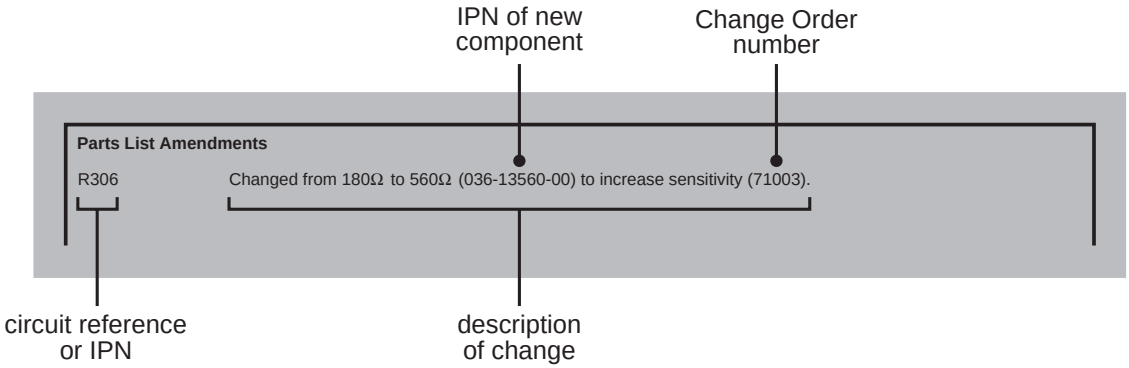
Those with a circuit reference are grouped in alphabetical order and then in numerical order within each group. Each component entry comprises three or four columns, as shown below:



The miscellaneous and mechanical section lists the variant and common parts in IPN order.

Parts List Amendments

At the front of the parts list is the Parts List Amendments box (an example of which is shown below). This box contains a list of component changes which took place after the parts list and diagrams in this section were compiled. These changes (e.g. value changes, added/deleted components, etc.) are listed by circuit reference in alphanumeric order and supersede the information given in the parts list or diagrams. Components without circuit references are listed in IPN order. The number in brackets at the end of each entry refers to the Tait internal Change Order document.



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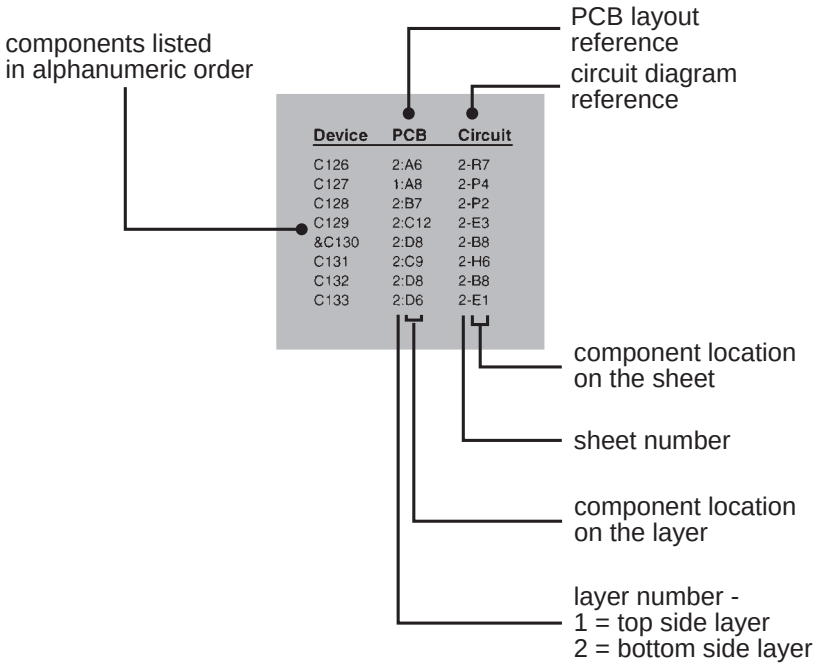
Variant Components

A variant component is one that has the same circuit reference but different value or specification in different product types. Where two products share the same PCB, the term “variant” is also used to describe components unplaced in one product. Variant components have a character prefix, such as “&”, “=” or “#”, before the circuit reference (e.g. &R100).

Grid Reference Index

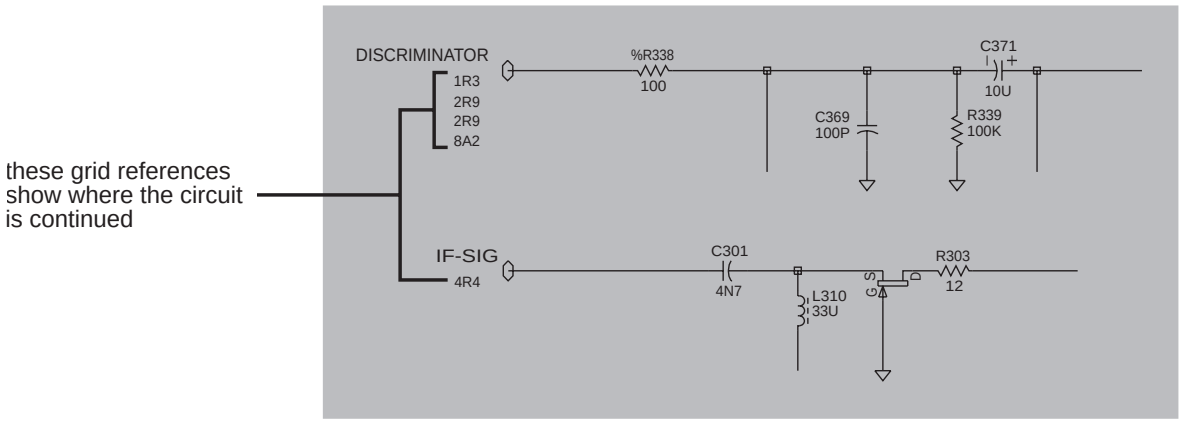
This section contains a component grid reference index to help you find components and labelled pads on the PCB layouts and circuit diagrams. This index lists the components and pads in alphanumeric order, along with the appropriate alphanumeric grid references, as shown below:



Using CAD Circuit Diagrams

Reading a CAD circuit diagram is similar to reading a road map, in that both have an alphanumeric border. The circuit diagrams in this manual use letters to represent the horizontal axis, and numbers for the vertical axis. These circuit diagram "grid references" are useful in following a circuit that is spread over two or more sheets.

When a line representing part of the circuitry is discontinued, a reference will be given at the end of the line to indicate where the rest of the circuitry is located, as shown below. The first digit refers to the sheet number and the last two characters refer to the location on that sheet of the continuation of the circuit (e.g. 1R3).



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5.2 T889 Power Amplifier PCB

This section contains the following information.

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T889 Parts List (IPN 220-01326-04)

How To Use This Parts List

The components listed in this parts list are divided into two main types: those with a circuit reference (e.g. C2, D1, R121, etc.) and those without (miscellaneous and mechanical).

Those with a circuit reference are grouped in alphabetical order and then in numerical order within each group. Each component entry comprises three or four columns: the circuit reference, variant (if applicable), IPN and description. A number in the variant column indicates that this is a variant component which is fitted only to the product type listed. Static sensitive devices are indicated by an (S) at the start of the description column.

The miscellaneous and mechanical section lists the variant and common parts in IPN order. Where possible, a number in the legend column indicates their position in the mechanical assembly drawing.

The Parts List Amendments box below lists component changes that took place after the parts list and diagrams in this section were compiled. These changes (e.g. value changes, added/deleted components, etc.) are listed by circuit reference in alphanumeric order and supersede the information given in the parts list or diagrams. Components without circuit references are listed in IPN order.

Parts List Amendments

C130, C159	Deleted to reduce the effects of internal RF circulation on forward and reverse power meter calibration (711128).
D101, D105	Removed from the main PCB and replaced by two 1N4148 diodes (IPN 001-50012-00) placed on the D-range PCB: one soldered between PL101 pins 5 and 7 (cathode), the other between PL101 pins 6 and 8 (cathode). To allow external power meters to read zero and still provide meter overvoltage protection (710978).
DCR1, DCR2	Changed from 100Ω (IPN 036-13100-00) to 270Ω (IPN 036-13270-00) to improve the directivity of the directional coupler (710959).
Q135	SMD transistor (IPN 000-10008-17) replaced with a leaded BD139 (IPN 000-00011-91) as the SMD part is underrated and prone to failure - refer to TN-604 for the replacement procedure (711147).
R123, R158	Changed from 1k resistors (IPN 036-14100-00) to BA592 diodes (IPN 001-10059-20) to allow external power meters to read zero (710978).
R149	Changed from 12k (IPN 036-15120-00) to 6k8 (IPN 036-14680-00) to increase the reverse power sense gain to improve alarm operation (710958).
258-00010-03	Cooling fan: some T889 PAs may be fitted with a different fan (IPN 258-00010-06). If so, a 100µH inductor (IPN 056-00021-02) may be fitted in series in the fan power feed wire with a 10µF capacitor (IPN 025-08100-03) fitted in parallel with this inductor (710921).

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Parts List Amendments - Continued

This page is provided for entering future amendments to the Parts List.

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Ref	Var	IPN	Description
C1		015-02470-03	CAP CER 47P 5% 500V GRH111
*C2		015-02120-07	CAP CER CHIP 12P 5% 500V MULTI
*C3		015-02120-07	CAP CER CHIP 12P 5% 500V MULTI
C4		015-24470-08	CAP CER 0805 4N7 10% X7R 50V
C6		015-02470-03	CAP CER 47P 5% 500V GRH111
C7		015-06100-08	CAP CER 1206 100N 10% X7R 50V
*C9		015-02100-07	CAP CER CHIP 10P 5% 500V MULTI
*C10		015-02100-07	CAP CER CHIP 10P 5% 500V MULTI
*C11		015-02120-07	CAP CER CHIP 12P 5% 500V MULTI
*C12		015-02120-07	CAP CER CHIP 12P 5% 500V MULTI
*C13		029-02200-02	CAP MICA 5 CASE 20P 5%
C14		029-02220-02	CAP MICA 5 CASE 22P 5%
C16		015-02470-03	CAP CER 47P 5% 500V GRH111
C17		015-06100-08	CAP CER 1206 100N 10% X7R 50V
C18		014-07470-03	L) CAP TANT SMD 4U7 35V 20%
*C19		015-02120-07	CAP CER CHIP 12P 5% 500V MULTI
C20		015-02150-07	CAP CER CHIP 15P 5% 500V MULTI
*C21		015-02120-07	CAP CER CHIP 12P 5% 500V MULTI
C22		029-02180-02	CAP MICA 5 CASE 18P 5%
C23		029-02220-02	CAP MICA 5 CASE 22P 5%
C24		015-02470-03	CAP CER 47P 5% 500V GRH111
C26		015-02150-07	CAP CER CHIP 15P 5% 500V MULTI
*C27		015-02120-07	CAP CER CHIP 12P 5% 500V MULTI
C28		029-02180-02	CAP MICA 5 CASE 18P 5%
C29		015-06100-08	CAP CER 1206 100N 10% X7R 50V
C30		029-02220-02	CAP MICA 5 CASE 22P 5%
C31		015-02470-03	CAP CER 47P 5% 500V GRH111
C33		015-02150-07	CAP CER CHIP 15P 5% 500V MULTI
*C34		015-02120-07	CAP CER CHIP 12P 5% 500V MULTI
C35		029-02180-02	CAP MICA 5 CASE 18P 5%
C36		029-02220-02	CAP MICA 5 CASE 22P 5%
C37		015-02470-03	CAP CER 47P 5% 500V GRH111
C39		014-07470-03	L) CAP TANT SMD 4U7 35V 20%
C40		015-02150-07	CAP CER CHIP 15P 5% 500V MULTI
*C41		015-02120-07	CAP CER CHIP 12P 5% 500V MULTI
C42		029-02180-02	CAP MICA 5 CASE 18P 5%
C43		029-02220-02	CAP MICA 5 CASE 22P 5%
C44		015-02470-03	CAP CER 47P 5% 500V GRH111
C46		015-06100-08	CAP CER 1206 100N 10% X7R 50V
C47		014-07470-03	L) CAP TANT SMD 4U7 35V 20%
C48		015-24470-08	CAP CER 0805 4N7 10% X7R 50V
C52		015-24470-08	CAP CER 0805 4N7 10% X7R 50V
C58		015-06100-08	CAP CER 1206 100N 10% X7R 50V
C59		014-07470-03	L) CAP TANT SMD 4U7 35V 20%
C60		014-07470-03	L) CAP TANT SMD 4U7 35V 20%
C66		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C67		015-02470-03	CAP CER 47P 5% 500V GRH111
C68		015-02470-03	CAP CER 47P 5% 500V GRH111
C72		015-02470-03	CAP CER 47P 5% 500V GRH111
C73		015-02470-03	CAP CER 47P 5% 500V GRH111
C74		015-02470-03	CAP CER 47P 5% 500V GRH111
C75		014-07470-03	L) CAP TANT SMD 4U7 35V 20%
C97		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C98		015-24470-08	CAP CER 0805 4N7 10% X7R 50V
C101		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C103		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C105		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C107		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C109		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C111		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C113		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C115		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C117		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C119		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C121		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C123		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C125		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C127		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C129		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C130		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C131		014-07100-02	CAP TANT CHIP 1U0 3.2 X 1.6MM
C132		015-24100-08	CAP CER 0805 1N 10% X7R 50V
C133		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C139		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C143		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C145		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C147		015-25100-08	CAP CER 0805 10N 10% X7R 50V
C149		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C151		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C153		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C155		015-25100-08	CAP CER 0805 10N 10% X7R 50V
C159		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C161		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C162		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C164		015-24470-08	CAP CER 0805 4N7 10% X7R 50V
C167		015-24100-08	CAP CER 0805 1N 10% X7R 50V
C169		014-07470-03	L) CAP TANT SMD 4U7 35V 20%
C171		015-24470-08	CAP CER 0805 4N7 10% X7R 50V
C173		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C174		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C176		015-06100-08	CAP CER 1206 100N 10% X7R 50V
C177		015-25100-08	CAP CER 0805 10N 10% X7R 50V
C178		015-25100-08	CAP CER 0805 10N 10% X7R 50V
C179		015-06100-08	CAP CER 1206 100N 10% X7R 50V
C180		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C181		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C182		015-24470-08	CAP CER 0805 4N7 10% X7R 50V
C183		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C185		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C187		015-06100-08	CAP CER 1206 100N 10% X7R 50V
C189		015-25100-08	CAP CER 0805 10N 10% X7R 50V
C190		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C192		015-06100-08	CAP CER 1206 100N 10% X7R 50V
C193		015-06100-08	CAP CER 1206 100N 10% X7R 50V
C195		014-08100-00	CAP TANT CHIP 10M 16VW +-20%
C196		014-07100-02	CAP TANT CHIP 1U0 3.2 X 1.6MM
C197		015-25100-08	CAP CER 0805 10N 10% X7R 50V
C198		015-06100-08	CAP CER 1206 100N 10% X7R 50V
C199		014-07470-00	CAP TANT CHIP 4U7 3.5 X 2.8MM
C200		015-24470-08	CAP CER 0805 4N7 10% X7R 50V
C201		014-07470-03	L) CAP TANT SMD 4U7 35V 20%
C203		015-24100-08	CAP CER 0805 1N 10% X7R 50V
C204		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C205		015-22470-01	CAP CER 0805 47P 5% NPO 50V
C206		015-23100-01	CAP CER 0805 100P 5% NPO 50V
C207		015-23100-01	CAP CER 0805 100P 5% NPO 50V
C210		015-23100-01	CAP CER 0805 100P 5% NPO 50V
C211		015-23100-01	CAP CER 0805 100P 5% NPO 50V
C225		015-02470-03	CAP CER 47P 5% 500V GRH111
C245		015-02470-03	CAP CER 47P 5% 500V GRH111
C250		015-02470-03	CAP CER 47P 5% 500V GRH111
C252		015-02470-03	CAP CER 47P 5% 500V GRH111
C258		015-02470-03	CAP CER 47P 5% 500V GRH111
D101		001-50012-00	S) DIODE AI 1N4148 SI
D103		008-00014-79	S)LED 3MM RED WITH WIRE
D105		001-50012-00	S) DIODE AI 1N4148 SI
D107		008-00014-80	S)LED 3MM GREEN WITH WIRE
D109		008-00014-79	S)LED 3MM RED WITH WIRE
D113		001-00012-90	S) DIODE MR2520L O-VOLT SUPP
DCC1		015-22470-01	CAP CER 0805 47P 5% NPO 50V
DCC4		015-22470-01	CAP CER 0805 47P 5% NPO 50V
DCIC1		001-10066-00	DIODE SCHOTTKY HSMS2815
DCIC2		001-10066-00	DIODE SCHOTTKY HSMS2815
DCR1		036-13270-00	RES M/F 0805 270E 5%
DCR2		036-13270-00	RES M/F 0805 270E 5%
FTC		012-04100-05	CAP F/THRU 1N SUPPR FLTR S-MTG
IC101		002-10003-24	S) IC SMD 324 4X O-AMP SO14
IC103		002-10003-24	S) IC SMD 324 4X O-AMP SO14
IC105		002-10003-58	S) IC SMD LM358 DUAL O-AMP
IC107		002-12951-00	IC SMD LP2951CM ADJ VLTGE REG
IC109		002-10003-17	(S) IC LM317L REG S0-8 100MA
L1		065-10004-20	BEAD FE SMD CBD 4.6/3/3-4S2
L2		051-00644-00	IND HAIRPIN 17MM TALL T889
L3		065-10004-20	BEAD FE SMD CBD 4.6/3/3-4S2
L4		051-00644-00	IND HAIRPIN 17MM TALL T889
L5		052-08160-55	COIL A/W 5.5T/6.0MM HOR 0.8MM
L6		065-10004-20	BEAD FE SMD CBD 4.6/3/3-4S2
L7		051-00644-00	IND HAIRPIN 17MM TALL T889
L8		065-10004-20	BEAD FE SMD CBD 4.6/3/3-4S2
L9		051-00643-00	IND HAIRPIN 10MM TALL T889
L10		052-08160-55	COIL A/W 5.5T/6.0MM HOR 0.8MM
L12		065-10004-20	BEAD FE SMD CBD 4.6/3/3-4S2
L13		051-00619-00	COUPLR WRELNE 53MM JCKT STRGT
L14		051-00619-00	COUPLR WRELNE 53MM JCKT STRGT
L15		051-00619-00	COUPLR WRELNE 53MM JCKT STRGT
L16		051-00626-00	COAX 1/4 WAVE XFMR 35E HELI LH
L17		051-00648-00	IND ETCH HAIRPIN 14.3NH POWF
L18		065-10004-20	BEAD FE SMD CBD 4.6/3/3-4S2
L19		051-00643-00	IND HAIRPIN 10MM TALL T889
L20		052-08160-55	COIL A/W 5.5T/6.0MM HOR 0.8MM
L21		051-00623-00	COAX 1/4 WAVE XFMR 25E HAIRPIN
L23		051-00624-00	COAX 1/4 WAVE XFMR 25E HCKY LH
L24		051-00629-00	COAX 1/4 WAVE XFMR 35E HCKY RH
L26		051-00627-00	COAX 1/4 WAVE XFMR 35E HELI RH
L27		051-00648-00	IND ETCH HAIRPIN 14.3NH POWF
L28		065-10004-20	BEAD FE SMD CBD 4.6/3/3-4S2
L29		051-00643-00	IND HAIRPIN 10MM TALL T889
L30		052-08160-55	COIL A/W 5.5T/6.0MM HOR 0.8MM
L32		051-00621-00	COAX 1/4 WAVE XFMR 25E HELI LH
L33		051-00626-00	COAX 1/4 WAVE XFMR 35E HELI LH
L34		051-00648-00	IND ETCH HAIRPIN 14.3NH POWF
L35		065-10004-20	BEAD FE SMD CBD 4.6/3/3-4S2
L36		051-00643-00	IND HAIRPIN 10MM TALL T889
L37		052-08160-55	COIL A/W 5.5T/6.0MM HOR 0.8MM
L39		051-00622-00	COAX 1/4 WAVE XFMR 25E HELI RH
L40		051-00619-00	COUPLR WRELNE 53MM JCKT STRGT
L41		051-00619-00	COUPLR WRELNE 53MM JCKT STRGT
L42		051-00619-00	COUPLR WRELNE 53MM JCKT STRGT
L43		051-00628-00	COAX 1/4 WAVE XFMR 35E HCKY LH
L44		051-00648-00	IND ETCH HAIRPIN 14.3NH POWF
L45		065-10004-20	BEAD FE SMD CBD 4.6/3/3-4S2
L46		051-00643-00	IND HAIRPIN 10MM TALL T889
L47		052-08160-55	COIL A/W 5.5T/6.0MM HOR 0.8MM
L49		051-00645-00	COAX 1/4 WAVE XFMR 25E HCKY RH
L50		056-10330-02	(L) IND SMD 330NH
L51		056-10330-02	(L) IND SMD 330NH
L52		056-10330-02	(L) IND SMD 330NH
L55		051-00646-00	IND ETCHED HAIRPIN 13NH LPF
L57		051-00647-00	IND ETCHED HAIRPIN 14.6NH LPF
L59		051-00647-00	IND ETCHED HAIRPIN 14.6NH LPF
L61		051-00646-00	IND ETCHED HAIRPIN 13NH LPF

Ref	Var	IPN	Description
L63		052-56130-85	COIL A/W 8.5T/3.0MM HOR 0.56MM
L64		051-00632-00	LNK 15MM 1.4MM2 COP STP 1.5SLV
L65		051-00632-00	LNK 15MM 1.4MM2 COP STP 1.5SLV
L66		051-00632-00	LNK 15MM 1.4MM2 COP STP 1.5SLV
L175		051-00638-01	COAX T889 SEMI-RIG N-TYPE EXTN
L200		065-10004-20	BEAD FE SMD CBD 4.6/3/3-4S2
L201		065-10004-20	BEAD FE SMD CBD 4.6/3/3-4S2
LINK2		036-10000-00	RES M/F 0805 ZERO OHM
P1		240-02100-44	SKT COAX MINI JACK PCB MT ANG.
Q1		000-00293-30	S) XSTR 2SC2933 NPN 900MHZ 14W
Q2		000-00141-40	LS) XSTR SD1414 6LFL UHF 45W
Q3		000-00141-40	LS) XSTR SD1414 6LFL UHF 45W
Q4		000-00141-40	LS) XSTR SD1414 6LFL UHF 45W
Q5		000-00141-40	LS) XSTR SD1414 6LFL UHF 45W
Q6		000-00141-40	LS) XSTR SD1414 6LFL UHF 45W
Q101		000-10008-57	S) XSTR SMD BCW70 PNP SOT23 SS
Q103		000-10008-17	S) XSTR SMD BC817-25 NPN SOT23
Q105		000-10008-17	S) XSTR SMD BC817-25 NPN SOT23
Q107		000-10008-57	S) XSTR SMD BCW70 PNP SOT23 SS
Q109		000-10008-69	S) XSTR SMD BC869 PNP 1W SOT89
Q111		000-10008-57	S) XSTR SMD BCW70 PNP SOT23 SS
Q115		000-10008-57	S) XSTR SMD BCW70 PNP SOT23 SS
Q117		000-10008-17	S) XSTR SMD BC817-25 NPN SOT23
Q119		000-10008-48	S) XSTR SMD BCW60 NPN SOT23 SS
Q121		000-10017-00	LS) XSTR SMD BF170LT1 SOT23
Q123		000-10008-57	S) XSTR SMD BCW70 PNP SOT23 SS
Q125		000-10008-57	S) XSTR SMD BCW70 PNP SOT23 SS
Q127		000-10008-57	S) XSTR SMD BCW70 PNP SOT23 SS
Q129		000-10008-17	S) XSTR SMD BC817-25 NPN SOT23
Q131		000-10017-00	LS) XSTR SMD BF170LT1 SOT23
Q133		000-10008-48	S) XSTR SMD BCW60 NPN SOT23 SS
Q135		000-10008-17	S) XSTR SMD BC817-25 NPN SOT23
Q137		000-00030-95	S) XSTR 2N6107 PNP TO220 AF
Q138		000-10008-48	S) XSTR SMD BCW60 NPN SOT23 SS
R1		036-02100-03	L) RES 1218 PWR 10E 20% 1W
R2		036-02100-03	L) RES 1218 PWR 10E 20% 1W
R3		036-02100-02	RES 10E 1206 200V 250MW RC01
R4		036-02100-03	L) RES 1218 PWR 10E 20% 1W
R5		036-02100-03	L) RES 1218 PWR 10E 20% 1W
R6		036-02100-02	RES 10E 1206 200V 250MW RC01
R10		036-02100-03	L) RES 1218 PWR 10E 20% 1W
R11		036-02100-03	L) RES 1218 PWR 10E 20% 1W
R12		036-02100-03	L) RES 1218 PWR 10E 20% 1W
R13		036-02100-03	L) RES 1218 PWR 10E 20% 1W
R14		036-02100-03	L) RES 1218 PWR 10E 20% 1W
R15		036-02100-03	L) RES 1218 PWR 10E 20% 1W
R19		036-02100-03	L) RES 1218 PWR 10E 20% 1W
R20		036-02100-03	L) RES 1218 PWR 10E 20% 1W
R21		036-02100-02	RES 10E 1206 200V 250MW RC01
R24		036-02100-02	RES 10E 1206 200V 250MW RC01
R29		036-02100-02	RES 10E 1206 200V 250MW RC01
R59A		036-01560-03	L) RES 1218 PWR 5E6 20% 1W
R60		036-03820-03	L) RES 1218 PWR 820E 20% 1W
R60A		036-03820-03	L) RES 1218 PWR 820E 20% 1W
R72		045-04470-00	RES NTC SMD 4K7 5% 20MW
R101		036-14100-10	RES M/F 0805 1K 1%
R102		036-16220-00	RES M/F 0805 220K 5%
R103		036-15330-00	RES M/F 0805 33K 5%
R104		036-16470-00	RES M/F 0805 470K 5%
R105		036-15150-00	RES M/F 0805 15K 5%
R106		036-15150-00	RES M/F 0805 15K 5%
R107		036-14390-10	RES M/F 0805 3K9 1%
R108		036-14330-10	RES M/F 0805 3K3 1%
R109		036-15100-10	RES M/F 0805 10K 1%
R111		036-14820-10	RES M/F 0805 8K2 1%
R112		036-14680-10	RES M/F 0805 6K8 1%
R113		036-14100-10	RES M/F 0805 1K 1%
R114		036-16100-00	RES M/F 0805 100K 5%
R115		036-16220-00	RES M/F 0805 220K 5%
R116		045-04470-00	RES NTC SMD 4K7 5% 20MW
R117		036-16220-00	RES M/F 0805 220K 5%
R118		036-15270-00	RES M/F 0805 27K 5%
R119		036-16470-00	RES M/F 0805 470K 5%
R120		036-15220-00	RES M/F 0805 22K 5%
R121		036-15150-00	RES M/F 0805 15K 5%
R122		036-14390-10	RES M/F 0805 3K9 1%
R123		001-10059-20	LS) DIODE SMD BA592 SW SOD323
R124		036-16100-00	RES M/F 0805 100K 5%
R125		036-15100-10	RES M/F 0805 10K 1%
R126		036-14100-10	RES M/F 0805 1K 1%
R127		036-15100-10	RES M/F 0805 10K 1%
R129		036-17100-10	RES M/F 0805 1M 1%
R130		036-14220-00	RES M/F 0805 2K2 5%
R131		036-16180-00	RES M/F 0805 180K 5%
R132		036-14100-10	RES M/F 0805 1K 1%
R133		036-15100-10	RES M/F 0805 10K 1%
R134		036-13470-00	RES M/F 0805 470E 5%
R135		036-13680-00	RES M/F 0805 680E 5%
R136		036-15100-10	RES M/F 0805 10K 1%
R137		036-14220-00	RES M/F 0805 2K2 5%
R138		036-15100-10	RES M/F 0805 10K 1%
R141		036-15100-10	RES M/F 0805 10K 1%
R142		036-15100-10	RES M/F 0805 10K 1%
R143		036-15100-10	RES M/F 0805 10K 1%

Ref	Var	IPN	Description
R144		036-15820-00	RES M/F 0805 82K 5%
R145		036-15470-10	RES M/F 0805 47K 1%
R146		036-14180-00	RES M/F 0805 1K8 5%
R148		036-15120-00	RES M/F 0805 12K 5%
R149		036-14680-10	RES M/F 0805 6K8 1%
R151		036-15100-10	RES M/F 0805 10K 1%
R152		036-15100-10	RES M/F 0805 10K 1%
R153		036-14470-10	RES M/F 0805 4K7 1%
R154		036-14470-10	RES M/F 0805 4K7 1%
R155		036-13220-00	RES M/F 0805 220E 5%
R156		036-13100-10	RES M/F 0805 100E 1%
R158		001-10059-20	LS) DIODE SMD BA592 SW SOD323
R159		036-15100-10	RES M/F 0805 10K 1%
R160		036-14470-10	RES M/F 0805 4K7 1%
R162		036-17100-10	RES M/F 0805 1M 1%
R164		036-14220-00	RES M/F 0805 2K2 5%
R165		036-14100-10	RES M/F 0805 1K 1%
R166		036-13680-00	RES M/F 0805 680E 5%
R168		036-15100-10	RES M/F 0805 10K 1%
R169		036-14100-10	RES M/F 0805 1K 1%
R170		036-14100-10	RES M/F 0805 1K 1%
R171		036-14100-10	RES M/F 0805 1K 1%
R172		036-15100-10	RES M/F 0805 10K 1%
R173		036-13470-00	RES M/F 0805 470E 5%
R174		036-13220-00	RES M/F 0805 220E 5%
R175		036-16220-00	RES M/F 0805 220K 5%
R176		036-15100-10	RES M/F 0805 10K 1%
R177		036-14470-10	RES M/F 0805 4K7 1%
R178		036-16100-00	RES M/F 0805 100K 5%
R179		036-15100-10	RES M/F 0805 10K 1%
R180		036-16150-00	RES M/F 0805 150K 5%
R181		036-14390-10	RES M/F 0805 3K9 1%
R182		036-16100-00	RES M/F 0805 100K 5%
R183		036-14470-10	RES M/F 0805 4K7 1%
R184		036-14100-10	RES M/F 0805 1K 1%
R185		036-14220-00	RES M/F 0805 2K2 5%
R186		036-13100-10	RES M/F 0805 100E 1%
R187		036-12220-00	RES M/F 0805 22E 5%
R188		036-16100-00	RES M/F 0805 100K 5%
R189		036-14150-00	RES M/F 0805 1K5 5%
R190		036-12220-00	RES M/F 0805 22E 5%
R191		036-14100-10	RES M/F 0805 1K 1%
R192		036-13220-00	RES M/F 0805 220E 5%
R193		036-12100-00	RES M/F 0805 10E 5%
R194		036-12220-00	RES M/F 0805 22E 5%
R271		036-13680-00	RES M/F 0805 680E 5%
R272		039-50500-00	RES TERM 50E 50W RFP50-50TCG
R274		039-00100-50	RES TERM 50E 100W RFP-100-50TW
R275		039-50500-00	RES TERM 50E 50W RFP50-50TCG
R276		039-02050-00	RES TERM 50E 20W RFP20-50TPC
R277		039-50500-00	RES TERM 50E 50W RFP50-50TCG
R278		039-02050-00	RES TERM 50E 20W RFP20-50TPC
R280		036-14100-10	RES M/F 0805 1K 1%
R285		036-13560-00	RES M/F 0805 560E 5%
RV101		042-04500-05	RES PRESET SMD 5K CER 4MM SQ
RV103		042-05500-05	RES PRESET SMD 50K CER 4MM SQ
RV105		042-04500-05	RES PRESET SMD 5K CER 4MM SQ
RV107		042-05500-05	RES PRESET SMD 50K CER 4MM SQ
*RV109		044-04200-06	RES PRE MULT 2K 15T PNL MTG
RV113		042-06500-05	RES PRESET SMD 500K CER 4MM SQ
RV115		042-05200-05	RES PRESET SMD 20K CER 4MM SQ
SHIELD1		319-01219-00	SHIELD WALL T889 LOW PASS FILT
SK101		240-10000-05	CONN SMD SKT 8W 2R M-MATCH
SK103		240-10000-05	CONN SMD SKT 8W 2R M-MATCH
SK105		240-10000-05	CONN SMD SKT 8W 2R M-MATCH
SK107		240-10000-05	CONN SMD SKT 8W 2R M-MATCH

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T889 Mechanical & Miscellaneous Parts (220-01326-04)

IPN	Legend	Description
025-08100-03		CAP 10M 35V 20% TANT 5MM L/S
044-04200-07		RES POT COVER H-83P
056-00021-02		IND FXD 100UH AX
070-01001-00		D-RANGE 15 WAY COMPL T800
201-00030-02		WIRE T/C WIRE 7/0.2 PVC RED
201-00050-25		AUTO 154 RED 41/0.3 PVC
201-00050-26		AUTO 154 BLACK 41/0.3 PVC
219-02591-01		LOOM RIBBON 8 WAY FOR T839PA
219-02593-01		LOOM RIBBON ASSY FOR T889PA
219-02600-00		RG316 CABLE ASSEMBLY T889 PA
219-02639-00		CABLE ASSEMBLY RG223/UN TO BNC
220-01326-04		PCB T889 90W PA SERIES II
240-02010-54		SKT 15W DRANGE PNL MTG 125 C
240-02100-51		SKT N-TYPE FLANGE FEM SEMI-RIG
240-06010-14		CLAMP LATCHING 15 W D RANGE
240-06010-15		BLOCK LATCHING 15W D RANGE
258-00010-06		FAN 12V 119x119x25 (CHAMPION)
302-05204-00		BRKT A3M2314 F/THRU MTG T859
303-11182-02		HEATSINK T889 MECH, DRILLED
303-23117-00		COVER SIDE COMPL A2M2223
306-01010-00		FERRULE A4M948 HANDLE
308-01007-00		HANDLE A4M949 FXD EQUIP
316-06515-00		PNL FRT T889 SCRND COMPLETE
318-01011-00		RAIL A2M1872 BOTTOM T377 PA
318-01012-00		RAIL A3M1873 TOP T377 PA
319-01187-00		SHIELD LID T889 HARMONIC FLTR
319-01202-00		SHIELD T869PA CONTROL CIRCUIT
319-01220-00		SHIELD LID T889 LOW PASS FILTE
319-30061-00		SPACER PLATE T889 WIRELINE
319-30062-00		SPACER T889 PRE DRIVER XSTR
319-40009-00		STRAP RF PWR XSTR EARTHING 889
345-00040-09		SCRW M3*6MM CSK POZI TRUNC
345-00040-16		SCRW M3X20MM P/POZ ST BZ
349-00020-07		SCRW 4-40 X 5/16 P/POZ T/T BLK
349-00020-09		SCRW T/T 4-40X3/8 IN P/POZ BLK
349-00020-36		SCREW TT M3X8m PANTORX BLK
349-00020-43		SCRW T/T M4X12MM P/POZ BZ
349-00020-49		SCRW T/T M4X35MM P/POZ BZ
349-00020-50		SCRW T/T 4-40 * 5/8 P/POZ BLK
352-00010-29		NUT M4 NYLOC HEX
353-00010-10		WSHR M3 FLAT 7MM*0.6MM ST BZ
356-00010-01		TAG SOLDER 3MM SHORT M6132/3.2
356-00010-03		TAG SOLDER 3MM LONG M614/3.2
356-00010-26		PIN TRACK HARWIN FOR 1.6MM PCB
356-00010-26		PIN TRACK HARWIN FOR 1.6MM PCB
357-00010-45		CLAMP CABLE 4.8MM P CLIP
360-00010-41		BUSH SHORTY BLK
362-00010-07		GASKET SIL INSULATING TO-220
362-00010-13		BUSH INSULATING 1.1MM TOP HAT
362-00010-33		GROMMET LED MTG 3MM
365-00100-20		LABEL WHITE S/A 28X11MM
369-00010-14		TIE CABLE NYLON 100*2.6MM
399-00010-56		BAG PLASTIC 200*250MM
400-00020-07		SLEEVING 2MM SIL RUBBER
400-00020-30		HEATSHRINK 3MM

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T889 Grid Reference Index (IPN 220-01326-04)

How To Use This Grid Reference Index

The first digit in the PCB layout reference is a "1" or "2", indicating the top or bottom side layout respectively, and the last two characters give the location of the component on that diagram.

The first digit in the circuit diagram reference is the sheet number, and the last two characters give the location of the component on that sheet.

Device	PCB	Circuit	Device	PCB	Circuit	Device	PCB	Circuit	Device	PCB	Circuit
C1	1:R2	2-B4	C111	1:A3	1-D7	C225	1:N7	2-I4	L17	1:L2	2-K7
*C2	1:Q5	2-D3	C113	1:A2	1-F8	C245	1:F2	2-P7	L18	1:K2	2-K7
*C3	1:Q5	2-D3	C115	1:A2	1-F8	C250	1:G2	2-P5	L19	1:J1	2-N7
C4	1:A1	1-N7	C117	1:A2	1-F9	C252	1:G7	2-P3	L20	1:H1	2-N7
C6	1:S6	2-D4	C119	1:A2	1-G8	C258	1:F7	2-P1	L21	1:P8	2-I4
C7	1:S4	2-C4	C121	1:B5	1-B6				L23	1:G2	2-O7
*C9	1:Q6	2-E3	C123	1:B5	1-B6	D101	1:B4	1-H5	L24	1:M2	2-J7
*C10	1:Q6	2-F4	C125	1:A3	1-D6	D101	1:B4	1-H5	L26	1:L3	2-J5
*C11	1:Q6	2-F3	C127	1:B3	1-D6	D103	1:V8	1-M8	L27	1:L4	2-K5
*C12	1:Q6	2-G3	C129	1:A3	1-Q4	D105	1:A5	1-K2	L28	1:K5	2-K5
*C13	1:Q7	2-H3	C130	1:B3	1-J5	D105	1:A5	1-L2	L29	1:J4	2-N5
C14	1:Q7	2-H3	C131	1:A1	1-K6	D107	1:V9	1-L4	L30	1:H4	2-N5
C16	1:R8	2-G4	C132	1:A2	1-L7	D109	1:V8	1-N5	L32	1:H3	2-O5
C17	1:Q8	2-G4	C133	1:B1	1-M7	D113	1:P1	1-Q1	L33	1:L7	2-J3
C18	1:P8	2-F4	C139	1:A1	1-N6				L34	1:L6	2-K3
*C19	1:Q6	2-E3	C143	1:B3	1-D5	DCC1	1:E7	2-S4	L35	1:K5	2-K3
C20	1:K1	2-K7	C145	1:B3	1-E5	DCC4	1:D7	2-S3	L36	1:J6	2-N4
*C21	1:K2	2-L7	C147	1:E5	1-F4	DCC100	1:D6	2-T4	L37	1:H5	2-N4
C22	1:J2	2-M7	C149	1:E4	1-F5	DCC101	1:C6	2-U4	L39	1:H7	2-O3
C23	1:J1	2-M7	C151	1:B2	1-B4	DCC102	1:C8	2-U4	L40	1:G5	2-Q4
C24	1:J1	2-O7	C153	1:A1	1-B3	DCC103	1:B8	2-V4	L41	1:F5	2-Q5
C26	1:K4	2-K5	C155	1:D4	1-G3	DCC104	1:B6	2-V4	L42	1:F5	2-R5
*C27	1:K4	2-L5	C159	1:A5	1-K2	DCIC1	1:D7	2-S4	L43	1:M8	2-J1
C28	1:J4	2-M5	C161	1:A2	1-M4	DCIC2	1:E8	2-S4	L44	1:L8	2-K1
C29	1:J1	2-N6	C162	1:B3	1-N4	DCR1	1:D8	2-S4	L45	1:L7	2-K1
C30	1:J4	2-M5	C164	1:B2	1-P4	DCR2	1:E7	2-S4	L46	1:J9	2-N2
C31	1:J5	2-O5	C167	1:U4	1-P2				L47	1:H9	2-N2
C33	1:K6	2-K3	C169	1:U3	1-P2	IC101	1:D5	1-G0	L49	1:G8	2-O1
*C34	1:K6	2-L3	C171	1:U4	1-Q2	IC101	1:D5	1-B6	L50	1:E7	2-T5
C35	1:J6	2-M3	C173	1:D4	1-B0	IC101	1:D5	1-M0	L51	1:N1	2-U9
C36	1:J6	2-M3	C174	1:C5	1-C0	IC101	1:D5	1-B7	L52	1:D9	2-T3
C37	1:J5	2-N4	C176	1:E3	1-E0	IC101	1:D5	1-C1	L55	1:D6	2-T4
C39	1:H1	2-O6	C177	1:C1	1-F0	IC103	1:B1	1-C3	L57	1:C7	2-U4
C40	1:K8	2-K1	C178	1:E5	1-G0	IC103	1:B1	1-K8	L58	1:F2	2-R5
*C41	1:K8	2-L1	C179	1:C3	1-G2	IC103	1:B1	1-F0	L59	1:B8	2-U4
C42	1:J8	2-M1	C180	1:T8	2-D5	IC103	1:B1	1-L4	L61	1:B7	2-V4
C43	1:J9	2-M1	C181	1:T7	2-D5	IC103	1:B1	1-C2	L63	1:S2	2-A4
C44	1:J9	2-N2	C182	1:T8	2-C6	IC105	1:D3	1-G2	L64	1:H7	2-P3
C46	1:J9	2-O2	C183	1:S8	2-C5	IC105	1:D3	1-N0	L65	1:H2	2-O7
C47	1:H9	2-O2	C185	1:T8	2-C6	IC105	1:D3	1-M0	L66	1:Q2	2-F5
C48	1:E7	2-U5	C187	1:D2	1-J1	IC107	1:D2	1-K1	L175		2-W4
C52	1:C9	2-T3	C189	1:D3	1-N1	IC109	1:C2	1-N1	L200	1:T6	2-D7
C58	1:J6	2-O4	C190	1:D3	1-N1				L201	1:T7	2-D7
C59	1:H7	2-O4	C192	1:C2	1-N0	L1	1:U3	1-P2			
C60	1:H3	2-O4	C193	1:C4	1-P0	L2	1:Q5	2-C3	LINK2	1:V7	1-D1
C66	1:S3	2-B4	C195	1:C3	1-Q0	L3	1:P4	2-C3			
C67	1:H2	2-O6	C196	1:C2	1-J1	L4	1:R6	2-D4	P1	1:R2	2-A4
C68	1:H6	2-P4	C197	1:C2	1-L1	L5	1:S5	2-D4	P4	1:A7	2-W4
C72	1:H8	2-P2	C198	1:D2	1-L1	L6	1:S5	2-C5			
C73	1:Q8	2-F4	C199	1:D3	1-M1	L7	1:R6	2-F3	P101	1:A5	1-R9
C74	1:S4	2-B4	C200	1:T7	2-D6	L8	1:S7	2-F3	P112	1:U4	1-R0
C75	1:R4	2-C4	C201	1:T6	2-D6	L9	1:Q8	2-H4	P113	1:U2	1-R1
C97	1:P1	2-U9	C203	1:T7	2-C6	L10	1:R8	2-H4			
C98	1:P1	2-V9	C204	1:A1	1-N7	L11	1:Q6	2-E4	PL101	2:V3	2-D0
C101	1:D4	1-B7	C205	1:A1	1-P7	L12	1:U3	1-Q2			
C103	1:D5	1-B8	C206	1:T7	2-E5	L13	1:N5	2-I4	Q1	1:Q5	2-D4
C105	1:A3	1-D8	C207	1:S7	2-D5	L14	1:N5	2-I5	Q2	1:Q7	2-G4
C107	1:A3	1-D9	C210	1:D1	1-G1	L15	1:M5	2-J5	Q3	1:K1	2-M7
C109	1:A3	1-D8	C211	1:C1	1-H1	L16	1:R4	2-C4	Q4	1:K4	2-M5

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Device	PCB	Circuit
Q5	1:K6	2-M3
Q6	1:K8	2-M1
Q101	1:A3	1-C8
Q103	1:A3	1-D8
Q105	1:B2	1-D6
Q107	1:A2	1-F8
Q109	1:A2	1-G8
Q111	1:A5	1-K7
Q115	1:A2	1-M7
Q117	1:B1	1-M7
Q119	1:A3	1-M6
Q121	1:A1	1-P8
Q123	1:B3	1-E5
Q125	1:B3	1-E5
Q127	1:E4	1-F4
Q129	1:B2	1-N4
Q131	1:B3	1-P4
Q133	1:C5	1-E0
Q135	1:S8	2-C5
Q137	1:T8	2-B5
Q138	1:A1	1-K6
R1	1:P5	2-C3
R2	1:S5	2-D4
R3	1:S5	2-C4
R4	1:R6	2-F3
R5	1:R8	2-G4
R6	1:Q8	2-G4
R10	1:L2	2-J7
R11	1:H1	2-N7
R12	1:L5	2-J5
R13	1:H4	2-N5
R14	1:L5	2-J3
R15	1:H5	2-N4
R19	1:L7	2-J1
R20	1:H9	2-N2
R21	1:H9	2-O2
R24	1:H6	2-O4
R29	1:H1	2-N6
R59A	1:R3	2-B4
R60	1:R3	2-B3
R60A	1:R3	2-B3
R72	1:P1	2-T9
R101	1:C4	1-A7
R102	1:E4	1-A9
R103	1:E5	1-A7
R104	1:D4	1-B9
R105	1:A5	1-C8
R106	1:A3	1-C8
R107	1:A5	1-D7
R108	1:A3	1-D9
R109	1:A3	1-D8
R111	1:A3	1-E8
R112	1:A2	1-E8
R113	1:A2	1-F9
R114	1:B4	1-A6
R115	1:B5	1-A6
R116	1:B4	1-A6
R117	1:B5	1-A6
R118	1:B5	1-B6
R119	1:B4	1-C6
R120	1:A5	1-K7
R121	1:B4	1-C6
R122	1:B5	1-D6
R123	1:B2	1-H7
R124	1:B1	1-K8
R125	1:B2	1-K8
R126	1:B4	1-J5
R127	1:A4	1-J7
R129	1:B1	1-L8
R130	1:B1	1-L8
R131	1:A2	1-K7
R132	1:B1	1-L8
R133	1:A2	1-K7
R134	1:A1	1-K6
R135	1:V9	1-M9

Device	PCB	Circuit
R136	1:A2	1-L7
R137	1:A2	1-L6
R138	1:A3	1-M6
R141	1:B3	1-D5
R142	1:B3	1-E5
R143	1:A3	1-E4
R144	1:B4	1-F4
R145	1:E4	1-F5
R146	1:E4	1-F5
R148	1:B2	1-A4
R149	1:B4	1-A3
R151	1:B2	1-B4
R152	1:A1	1-B3
R153	1:B2	1-E4
R154	1:A2	1-E3
R155	1:D4	1-G2
R156	1:D4	1-F3
R158	1:A1	1-K3
R159	1:A1	1-L4
R160	1:C3	1-K4
R162	1:A1	1-L3
R164	1:B2	1-M4
R165	1:B2	1-M3
R166	1:V8	1-N5
R168	1:C4	1-A1
R169	1:C5	1-A0
R170	1:C4	1-B1
R171	1:C5	1-B0
R172	1:B4	1-B1
R173	1:V7	1-C1
R174	1:V7	1-C1
R175	1:C4	1-C0
R176	1:D4	1-D0
R177	1:D5	1-D0
R178	1:D3	1-E1
R179	1:D3	1-E0
R180	1:E3	1-E0
R181	1:D4	1-E2
R182	1:E3	1-E0
R183	1:E3	1-F1
R184	1:S7	2-D5
R185	1:D4	1-H2
R186	1:T8	2-C6
R187	1:C1	1-F0
R188	1:D2	1-L1
R189	1:C3	1-L0
R190	1:E4	1-G0
R191	1:C2	1-P0
R192	1:B2	1-P0
R193	1:B3	1-Q1
R194	1:D3	1-M1
R271	1:V9	1-L5
R272	1:F9	2-Q4
R274	1:G1	2-Q5
R275	1:F1	2-R5
R276	1:N9	2-I4
R277	1:N1	2-I5
R278	1:L1	2-J5
R280	1:A4	1-L3
R285	1:D1	1-H1
RV101	1:C4	1-J8
RV103	1:C4	1-H5
RV105	1:C3	1-K4
RV107	1:C2	1-K3
*RV109	1:V6	1-C2
RV111	1:V6	1-D2
RV113	1:C3	1-E1
RV115	1:C2	1-L1
S3	1:E8	2-T4
S4	1:D9	2-T3
SHIELD1	1:C7	2-C0
SK101	1:U3	2-K0

Device	PCB	Circuit
SK103	1:A4	2-F0
SK105	1:C1	2-I0
SK107	1:Q1	2-G0
TB1		2-I4
TB2		2-I4
TB3		2-P7
TB4		2-Q7
TB5		2-P5
TB6		2-P5
TB7		2-P3
TB8		2-P3
TB9		2-P1
TB10		2-Q1

Device	PCB	Circuit

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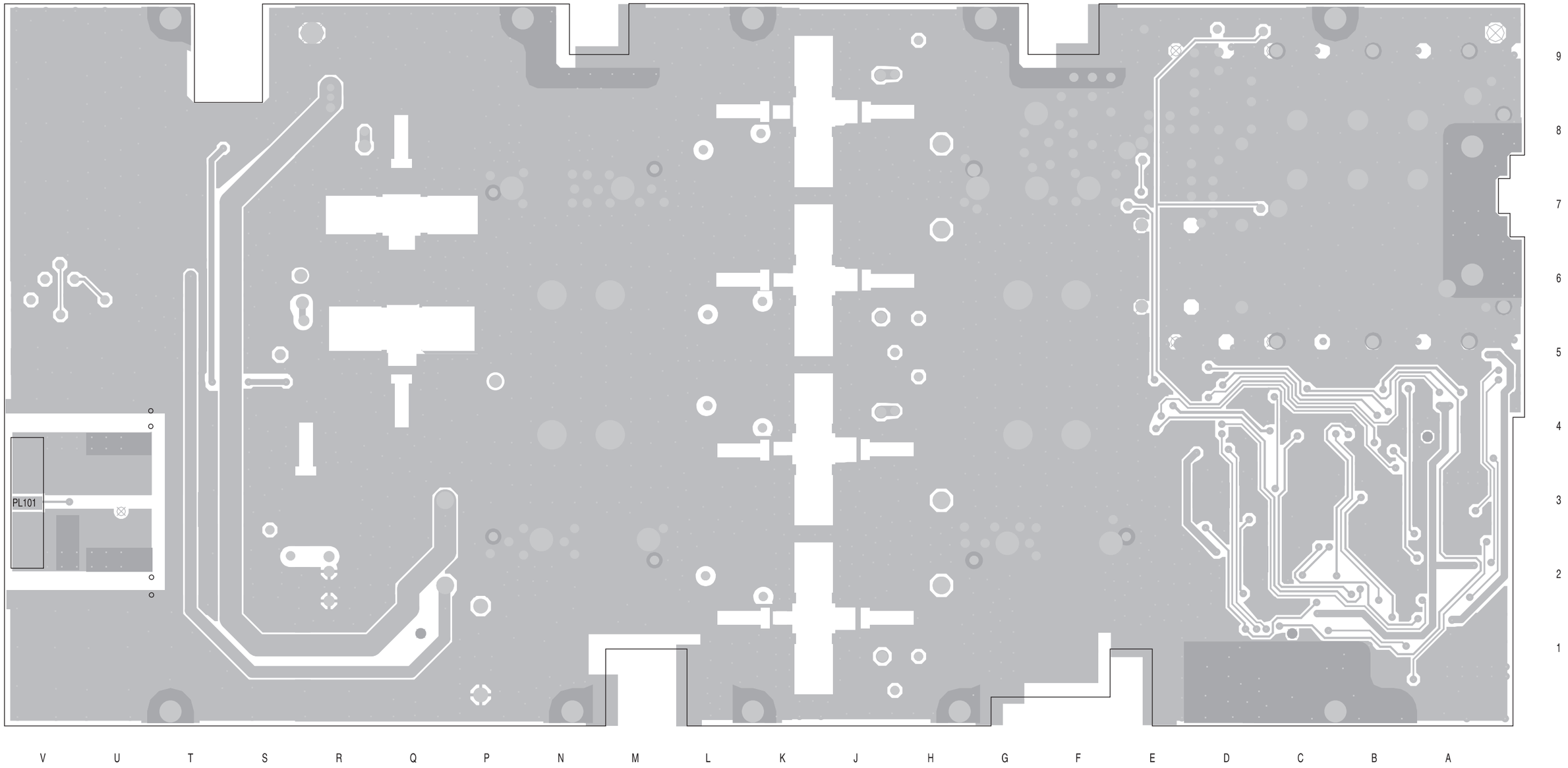

T889 PCB Layout - Bottom Side
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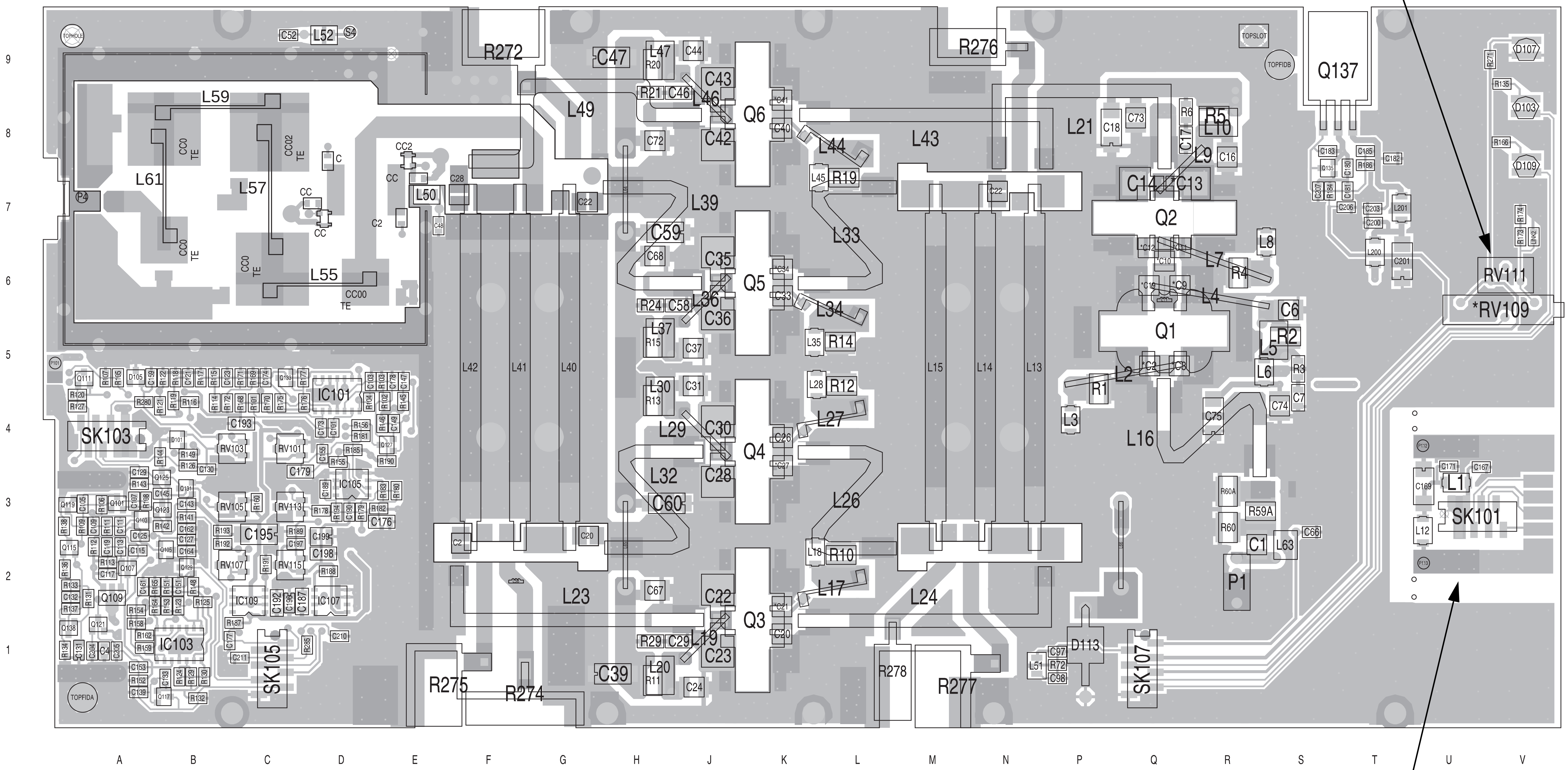
RV111 may be fitted instead of *RV109 to convert the output power adjustment to internal access only.



The circuitry for the break-off D-range PCB is shown on the control section circuit diagram.

T889 PCB Layout - Top Side
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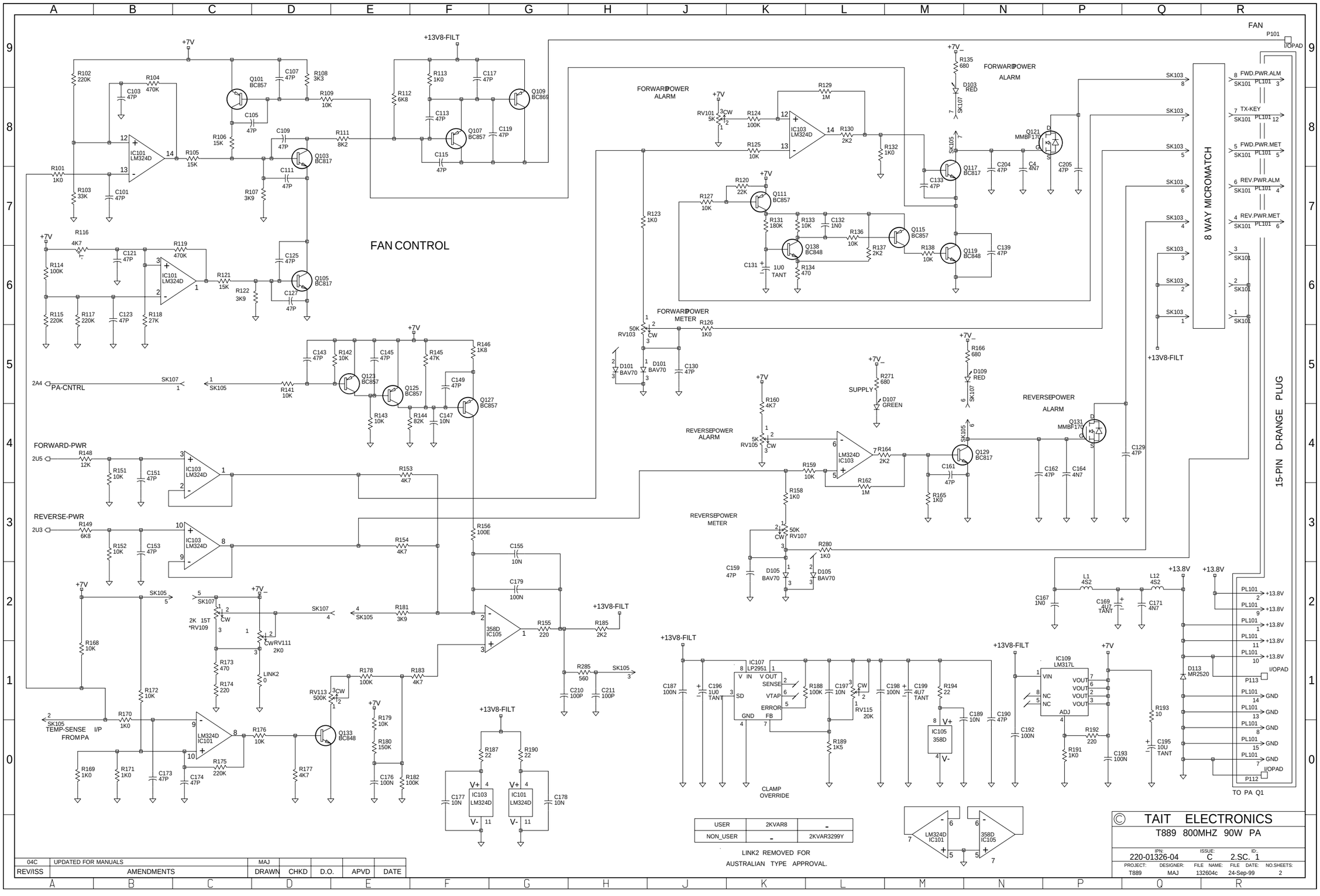

USER	2KVAR8	-
NON_USER	-	2KVAR3299Y

Sheet 1 - T889 Control Section
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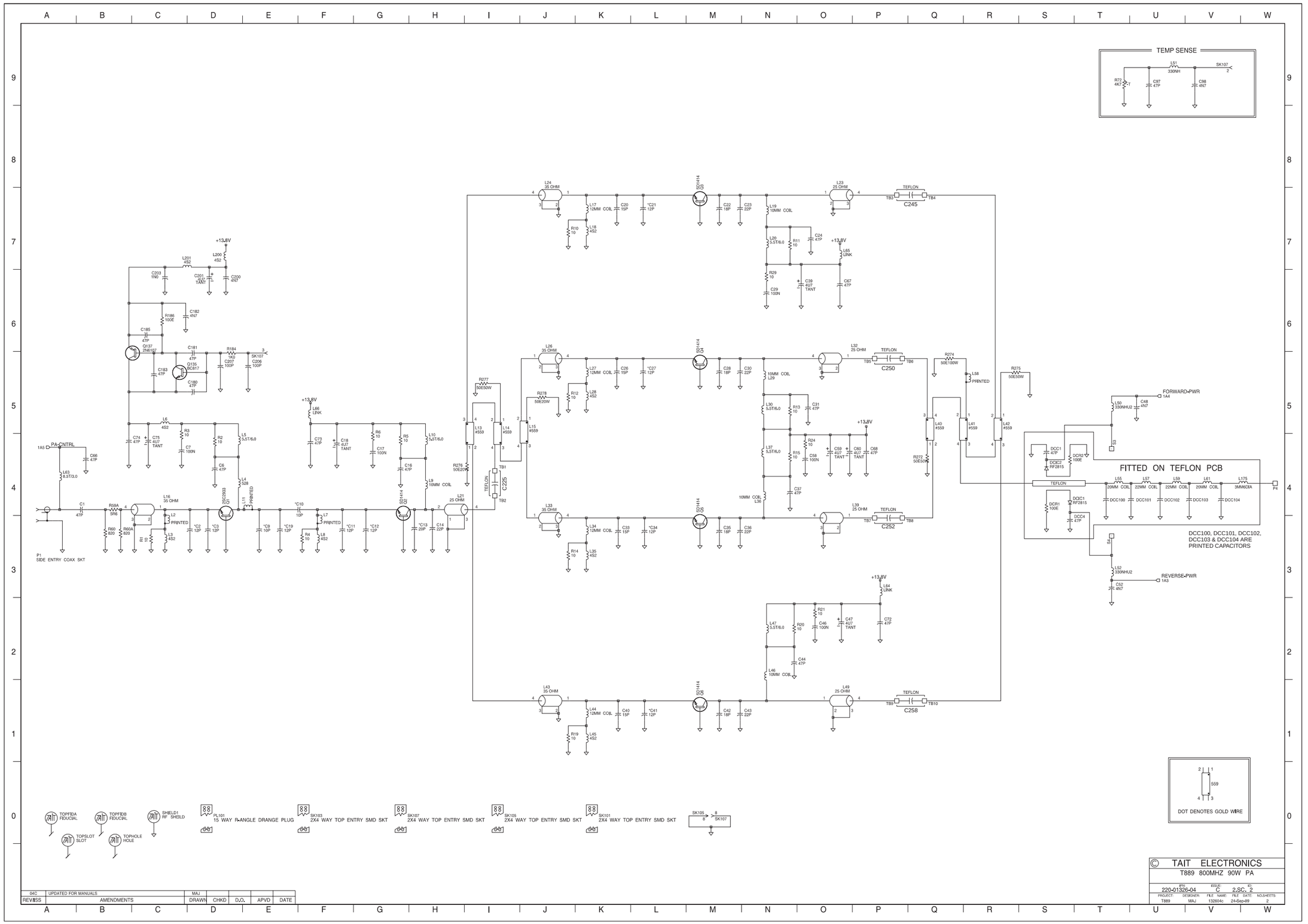

Sheet 2 - T889 RF Section
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