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TONEOHM 850A SERVICE MANUAL

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TONEOHM 850A SERVICE MANUAL

POLAR INSTRUMENTS LTD. HARDWARE WARRANTY

1. Product Warranty. Product hardware is warranted to be free from defects in material and workmanship during the Warranty Period (as defined below). Product hardware is warranted to conform substantially to Polar's then current (as of the date of Polar's product shipment) published user documentation during the Warranty Period. The Warranty Period is twelve (12) months. Product support beyond these periods may be available at additional cost – consult Polar for details.

2. Warranty Claims. Polar shall incur no liability under this warranty if the end user fails to provide Polar with notice of the alleged defect during the applicable Warranty Period and within seven (7) days of delivery to end user or, if the defect would not have been reasonably apparent on inspection, within seven (7) days of its discovery by end user. After receiving such notice, Polar will notify the purchaser of its designation of one of the following problem resolution methods:

   Return to Factory: The allegedly defective goods must be returned to Polar within seven days of Polar's notice and in accordance with Polar's instructions advised at the time.

   Other: Polar will use commercially reasonable efforts to repair, correct or work around the problem by means of telephone support or other means reasonably determined by Polar.

   Polar shall incur no liability under this warranty if Polar's tests disclose that the alleged defect is due to causes not within Polar's reasonable control, including alteration or abuse of the goods. Under the *Return to Factory* alternative, if a Product is determined not to be defective or to have a defect due to causes not within Polar's reasonable control, Polar reserves the right to apply a processing charge.

3. Damage in Transit. End user must notify Polar and the carrier of any claim for damage in transit within two (2) days of receipt of the damaged merchandise. Failure to do so may result in the carrier and/or Polar refusing to accept liability in which case end user must pay the purchase price as if the hardware had been delivered without damage.

4. Polar's Liability Polar's liability, and end user's sole and exclusive remedy, shall be limited to the express remedies set forth in this Polar Hardware Warranty.

5. Disclaimer of Warranties. **POLAR MAKES NO OTHER WARRANTIES, EXPRESS, IMPLIED OR STATUTORY, REGARDING PRODUCTS. ALL OTHER WARRANTIES AS TO THE QUALITY, CONDITION, MERCHANTABILLITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT ARE EXPRESSLY DISCLAIMED.**

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LIMITATIONS SHALL APPLY, NOTWITHSTANDING THE FAILURE OF ANY EXCLUSIVE REMEDIES.

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DECLARATIONS

European Community Directive Conformance Statement

Refer to the Operator Manual to determine conformance with European Community Directives.

SAFETY

WARNING The service instructions contained in this manual are for use by qualified electronic service personnel only.

WARNING

The LIVE and NEUTRAL lines on this unit are BOTH fused.

When the unit is connected to its supply, the opening of covers or removal of panels is likely to expose dangerous voltages.

GROUNDING

This unit must be earthed (grounded); do not operate the instrument with the safety earth disconnected. Ensure the instrument is connected to an outlet with an effective protective conductor terminal (earth). Do not negate this protective action by using an extension cord without a protective conductor.

Note: This instrument is fitted with 3-wire grounding type plug designed to fit only into a grounding type power outlet. If a special local plug must be fitted to the power cord ensure this operation is performed by a skilled electronics technician and that the protective ground connection is maintained. The plug that is cut off from the power cord must be safely disposed of.

Power cord color codes are as follows:

Europe

brown	live
blue	neutral
green/yellow	earth (ground)

United States

black	live
white	neutral
green	ground

POWER SUPPLY

Check that the indicated line voltage setting corresponds with the local mains power supply. See the rear panel for line voltage settings.

Changing the line voltage settings on this instrument must only be performed by a skilled electronics technician. Instructions for changing the line voltage settings are contained in Section 5.

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OPERATION

This manual contains instructions and warnings which must be observed by the user to ensure safe operation. Operating this instrument in ways other than detailed in this manual may impair the protection provided by the instrument and may result in the instrument becoming unsafe. Retain these instructions for later use.

The unit is designed to be used and serviced indoors in an electrical workshop environment at a stable work station comprising a bench or similar work surface.

Use only the accessories (e.g. test probes and clips) provided by Polar Instruments.

The instrument must be maintained and repaired by a skilled electronics technician in accordance with the manufacturer's instructions.

If it is likely that the protection has been impaired the instrument must be made inoperative, secured against unintended operation and referred to qualified service personnel.

Protection may be impaired if, for example, the instrument:

- Shows signs of physical damage
- Fails to operate normally when the operating instructions are followed
- Has been stored for prolonged periods under unfavourable conditions
- Has been subjected to excessive transport stresses
- Has been exposed to rain or water or been subject to liquid spills

CAUTION

Electrical Isolation

Always disconnect the board under test from the local mains supply (including ground) before using this instrument unless the test method specifically calls for the board to be powered.

Static Sensitive Devices

This unit contains Static Sensitive Devices. Static discharge can damage some electronic components. Care must be taken when handling these components. Observe appropriate precautions to avoid damage.

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SPECIFICATIONS

Resistance Ranges	
Number of Ranges	5
Hi sensitivity Ω	Approx. 40mΩ, uncalibrated
200mΩ	200mΩ, 4%
2Ω	2Ω, 4%
200Ω	200Ω, 4%
20kΩ	20kΩ, 4%
Probe tip voltage	60mV max.
Probe Protection	Momentary contact to 100V
Voltage Ranges	
2mV	2mV, 4%, ±15µV (Rin=120Ω)
20mV	20mV, 4%, ±15µV (Rin=120Ω)
2V	2V, 4%, ±15µV (Rin=1MΩ)
20V	20V, 4%, ±15µV (Rin=1MΩ)
Current Trace	
Sensitivity	Detects current flow with 200Ω connected to Drive Source
Drive Source	0-550mV, adjustable
Display	0.7", 3½ digit LCD
Tone	Internal speaker, headphone socket, adjustable volume
Power Cord	Detachable

SYMBOLS

⚠ REFER TO MANUAL

Front panel: These sockets are for connecting only Polar Instruments probes and connectors for use as described in the Operator Manual. To prevent damage to this product and to ensure its safe use observe the specifications given in this manual when connecting to terminals marked with this symbol.

Internal PCB: Refer to the Service Manual for information on changing line voltage settings and the fuse values required. Both Line and Neutral are fused.

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ENVIRONMENTAL OPERATING CONDITIONS

The instrument is designed to be used and repaired indoors only, under the following environmental conditions:

Altitude	Up to 2000m
Temperature	+5°C to +40°C ambient
Relative humidity	RH 80% maximum at 31°C — derate linearly to 50% at 40°C
Mains borne transients	As defined by Installation Category II (Overvoltage Category II) in IEC664
Pollution Degree	2 (IEC664)

Power Requirements

230V ± 10%, 115V ± 10% or 100V ± 10% at 50/60Hz, 15VA.

Fuses

230V 50mAT
115V 100mAT

Physical characteristics (excluding accessories)

Dimensions 300 mm (11.8 in.) wide
110 mm (4.4 in.) high
260 mm (10.3 in.) deep

Weight 1.5 kg (3.3 lb.)

ACCESSORIES

Standard Accessories

Needle Probe set	ACC152
Current Trace Probe	ACC34
Drive Source Clips	ACC33
Operator manual	MAN150

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SECTION 1 – PERFORMANCE CHECK

MAINTENANCE AND CALIBRATION OF INSTRUMENTS

For most of Polar Instruments' products there are two maintenance procedures — the **Performance Check** and the **Adjustment Procedure.** Some instruments may have a single (combined) procedure.

Performance Check

The Performance Check (or Checkout Procedure) is used to verify the basic functions of the instrument. This does not usually require the removal of instrument covers, but may require the use of external test equipment. This procedure is not intended to verify the calibration of the instrument.

Adjustment Procedure

The Adjustment Procedure (or Calibration Procedure) is used to check and, if necessary, adjust the instrument's calibration settings. Before carrying out the Adjustment Procedure the instrument's Performance Check (if applicable) should be carried out, and any detected defects should be rectified. *The Adjustment Procedure and rectification of defects should only be carried out by qualified technician.*

Recommendations for Routine Maintenance

Where a Performance Check is available for an instrument this may be used as required to confirm the basic operation of the product.

To maintain the calibration of an instrument it is recommended that its Calibration/Adjustment Procedure is carried out at intervals not exceeding 12 months.

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TONEOHM 850A PERFORMANCE CHECK

> *NOTE: If no probes are connected the performance of the instrument is not defined and any sounds or readings should be ignored.*

Equipment required

1. DC voltage source which can be set to an accuracy of 0.1% in the range 1 to 10V
2. High tolerance resistors of the following values:

10KΩ 1KΩ 100Ω 1Ω and 0.1Ω

It will be easier to measure the test resistors if they are soldered to a piece of prototyping circuit board. Note that the 1KΩ and 1Ω resistors need to be connected in series

3. 200Ω 5% resistor

Procedure

1. Connect the Needle Probes, turn on the TONEOHM 850A and allow 20 minutes for the instrument to warm up.
2. Select the 20V range and apply the probes to a source of 10V DC.
3. Check the reading is 10V ± 4%.
4. Select the 2V range and change the voltage source to 1V.
5. Check for a reading of 1V ± 4%.
6. Apply 10V to a 1KΩ and 1Ω Resistor in series.
7. Connect the probes across the 1Ω resistor (red probe to +ve end) and check for a reading of 10mV ± 4%.
8. Vary the voltage and check the tone changes.
9. Set the voltage to 1V and select 2mV. Check for a reading of 1mV ± 4%.
10. Reverse the probes and check for a warbling tone.
11. Select the 20KΩ range and connect the probes to the 10KΩ resistor. Check for a reading of 10KΩ ± 4%. A warble *may* be generated in this range.
12. Select the 200Ω range and measure the 100Ω resistor. Check for a reading of 100Ω ± 4%.
13. Select the 2Ω range and measure the 1Ω resistor. Check for a reading of 1Ω ± 4%.
14. Measure the 100mΩ resistor using the 200mΩ range and check for a reading within 4%. *Note that contact pressure can affect the readings*.
15. Select TRACE, fit the Drive Source leads and Trace Probe and connect a 200Ω resistor between the drive source clips.
16. Turn the Drive Source control fully clockwise and check for a reading of at least 20 counts when the probe is brought close to a Drive Source lead. A tone should also be heard.

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SECTION 2 – CALIBRATION

CALIBRATION PROCEDURE

> *WARNING: Hazardous voltages are exposed on the PCB when the cover is removed. This procedure should only be performed by a technically qualified person aware of the hazards and taking all reasonable care.*

Equipment required

A high tolerance (0.1%) voltage source of 10V.
A high tolerance (0.1%) 100Ω resistor.

1. Remove the two screws at the rear that retain the cover. Lift the rear of the cover and remove.
2. Turn on the instrument and allow 20 minutes to warm up.
3. Select the 20V range and connect the Needle Probes to the 10V source
4. Adjust R301 for a reading of 10.0
5. R301 is accessed through the hole in the front panel PCB beneath the Drive Source control R200.
6. Select the 200Ω range and connect the probes to a high tolerance 100Ω resistor.
7. Adjust R64 for a reading of 100.0
8. Select TRACE and plug in the Trace Probe and Drive Source leads. Connect the Drive Source leads to the 100Ω resistor. Turn the Drive Source control fully clockwise.
9. Place the Trace Probe tip against one of the Drive Source leads and rotate the tip for maximum reading. Now adjust the frequency control R78 for maximum display reading while maintaining the probe tip position against the source lead.
10. Remove the power cable and reassemble the instrument.

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SECTION 3 – CIRCUIT DESCRIPTION

TONEOHM 850A CIRCUIT DESCRIPTION

Note: versions below serial number 10609 (850A) may not have some of the EMC control components fitted.

Input and Switching

Refer to the 850A Input and Switching schematic

U6 is a chopper stabilised op-amp whose overall gain is set by R_i R47 and R_f R40 or R52 depending on gain selected. This is the x 10 or x 100 gain to the display DVM chip. Incorporated into the feedback path of the amp is an additional non-linear network which modifies the drive to the sound generator. All signal connections to the DIN sockets J1 and J2 are decoupled to ground to divert RF picked up on cables.

R38, R39, and R41 form a potential divider to reduce the input voltage to U6 in 2V and 20V ranges while also setting the input impedance to 1M. R55 sets the input impedance in 2mV and 20mV ranges.

Sound Generator

Refer to the 850A Sound Generator schematic

U3D and Q1 form a voltage controlled oscillator whose output frequency is determined by the collector current of Q1.

U4A divides the output of U3D by 2 to provide a symmetrical square wave which is amplified by U5 to drive the loudspeaker.

The voltages applied to the VCO are controlled by U2, U9B, U3A, U3B, U3C and the output voltage of U6 as follows:

a) 2Vand 20V ranges
   U4A pin 6 is held at +5V by S3 and S4. This sets U4A output, blocking the square wave feed to U5.

b) 2mV and 20mV ranges
   +5V on U2 pin 6 switches U2D transmission gate on and U2B off. U6 output is inverted by U9B and connected to R117 thus driving the VCO.

   If the probes are measuring a negative voltage greater than 20 μV (approximately) then U3B output is high, turning gate U2A on. The DC levels prevent U9B from driving R117 and in this way the VCO does not run and no sound is produced.

   When the probes are measuring a voltage lower than –20 μV then U3A takes R11B low and U3B via D80 allows oscillator U3C to run. This pulses U4A causing a unique pulsing tone for negative voltages.

c) All resistance ranges

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U2D is held off and U2B is on coupling U6 output to R117. For very low readings U3B output goes high allowing U3C oscillator to run. This pulses U4A to cause a pulsing tone for low resistance readings.

d) TRACE
The conditions are as for 2mV and 20mV.

Drive Source

Refer to 850A Drive Source schematic

U7, U8, Q5 and Q6 form the drive source circuit. When TRACE is selected oscillator U7A is allowed to free run at a frequency of approximately 80kHz, adjusted by R78. U8 and Q6 provide a low impedance output to drive the circuit under test.

U7C monitors the voltage across R90 caused by Drive Source current. When this voltage exceeds approximately 5mA then U7C output goes low, turning on the Drive Source LED.

U7D and Q5 form a protection circuit that turns off the supply of current to Q6 if the Drive Source leads are connected to a negative voltage.

U1C and U1D form an amplifier for the signal detected by the current trace probe. U1A is a precision rectifier producing a DC output across C3 proportional to the detected signal. This is buffered by U1B and divided by R14 and R15. This output is then applied to U6 which drives the display and tone generator.

DVM

Refer to the 850A DVM schematic

U300 is a dual slope DVM chip which drives the LCD. U301 is used to convert the DC decimal point levels from the range switch to the square waves necessary for the LCD.

Power Supply

Refer to 850A Power Supply schematic

Note that Line and Neutral are both fused.

The Drive Source has its own floating winding rectified and smoothed. From this a regulated 5V is obtained using U13.

The other transformer secondary is rectified and smoothed to supply 5V regulator U11. C400 pumps charge into C401 to supply the –ve regulator U400.

U9A and transistors Q2 and Q3 form a voltage follower capable of driving a load to ground. The voltage set on R64 (approximately 55mV) is used to drive the current limiting resistor selected by the range switch. D27 protects for +ve transients and D82 shuts off the current if a –ve overload is applied.

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SECTION 4 – DISMANTLING INSTRUCTIONS

DISMANTLING THE TONEOHM 850A

Disconnect the power cord from the rear of the instrument before commencing.

Remove the two screws from the rear of the instrument and lift the cover at the rear first and remove.

Removing the PCBs

To remove the PCBs:

- Remove the two screws retaining the power inlet connector and lift this off the lugs.
- Remove the power switch button (pull off).
- Remove the two screws from the DIN socket board and remove from its mounting lugs.
- Remove the 8 screws retaining the main board and then those holding the front panel board.
- Remove the Volume and Drive Source knob (pull off) and then withdraw the boards from the enclosure by lifting the rear of the main board first (hold the switch hard in) and move backwards a few centimetres.
- Remove the front panel board then lift the assembly out.

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SECTION 5 – LINE VOLTAGE AND FUSE CHANGING

WARNING: There are hazardous voltages inside the instrument when connected to its power supply. REMOVE THE POWER CORD before touching any part of the line input circuit. Note that high voltages may continue to be present for 2 minutes after power is removed until internal capacitors discharge.

LINE VOLTAGE SELECTION AND FUSE CHANGING

Note: *When replacing fuses always use the type and rating stated in SPECIFICATIONS.*

- Remove the two screws holding the cover on and lift it off.
- Locate the line selector links adjacent to the power transformer and remove using suitable pliers.
- For 230V operation fit the links in the location(s) marked 230V (240V). (Note that early instruments have only one link used for 230V and that the PCB may be marked 240V).
- For 115V operation fit two links at the locations marked 115V (or 110V).
- Remove the supply fuses (early instruments only have one fuse) and replace with the values listed in SPECIFICATIONS.
- Replace the instrument cover and replace the screws.
- Obscure the original setting on the rear panel label and mark the new setting clearly.
- Connect to a supply at the new voltage and confirm operation.

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SECTION 6 – FAULT DIAGNOSIS

WARNING: Hazardous voltages are exposed on the PCB when the cover is removed. These procedures should only be performed by a technically qualified person aware of the hazards and taking all reasonable care.

TROUBLESHOOTING HINTS

1 Using a DVM, check the power supplies at the marked test pads. Note that the drive source supplies are floating and the DVM –ve lead should be connected to the 0VDS test point when testing +5VDS and +12VDS.

2 If the Ohms ranges are not working correctly first check the operation in Volts then check the open circuit voltage at the probe tips in ohms ranges. This should be approximately 55mV.

3 Locate the circuit block in which the fault exists and troubleshoot from the circuit diagrams.

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SECTION 7 – MAINTENANCE AND CLEANING

Cleaning

Clean the TONEOHM 850A with a cloth lightly moistened with water with a small amount of mild detergent.

Alternatively, a cloth lightly moistened with alcohol (ethanol or methylated spirit) or isopropyl alcohol (IPA) may be used.

Do not spray cleaners directly onto the instrument.

Technical Support

For technical support contact your local Polar Instruments distributor or Polar Instruments Ltd. at the address at the front of this manual.

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SECTION 8 – REPLACEMENT PARTS

To ensure correct parts are supplied, orders for replacements should include the following details:

Instrument type
Instrument serial number
Firmware version (if applicable)
Circuit reference (if applicable) and description

Note: Parts marked with an asterisk (*) have been subject to modification in later instruments.

> *Safety critical parts (listed in bold type) must be replaced with parts obtained from Polar Instruments Ltd or your Polar Instruments distributor to ensure continued safe operation.*

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ELECTRICAL PARTS

PART Nº	Qty	Description	Circuit Reference
CEA103	3	10µF 16v Radial	C6, C8, C9
CEA105	3	220µF 35v Radial	C18, *C19, C40, C52
CEA111	1	1000µF 16v Radial	C20
CEA129	2	470µF 35v Radial	C400, C401
CVD101	8	0.1µF 100v Radial Polyester	C3, C4, C5, C31, C32, C33, C34, C35
CVD102	4	0.01µF 400v Radial Polyester	C2, C7, C16, C41
CVD106	1	82pF 63v	C13
CVD115	1	33pF 63v Ceramic	C15
CVD116	1	100pF 63v Ceramic	C301
CVD119	1	270pF 100v Ceramic	C30
CVD130	1	0.022µF 400v Polyester	C1
CVD140	19	0.1µF Axial Ceramic	C17, C23, C24, C25
CVD143	1	0.1µF Poly Box	C36
CVD146	1	1nF Polyester	C42
CVD147	1	4n7 Polyester	C408
CVD149	1	0.01µF 250v Skeleton Poly	C302
CVD150	1	0.1µF 100v Skeleton Poly	C300
CVD151	2	0.22µF 100v Skeleton Poly	C303, C304
CVD154	2	2n2 Polyester	C409, C410
CVD155	5	470pF Polypropylene	C402, C403, C404, C405, C406
CVD157	1	.047µF Radial Polyester	C407
DSP101	33	1N4148 150ma 75v	D1, D2, D3, D4, D5, D18, D25, D26 D28, D29, D30, D31, D32, D33, D34, D35, D36, D41, D43, D44, D63, D64, D65, D66, D67, D68, D69, D80, D81, D82, D402, D700, D701
DSP102	12	1N4007	*D17, D27, D42, D101 – D108, D400, D401
DZA312	1	ZENER DIODE 3.3V	D70
FCA103	**(2)**	**100mA T Fuse**	**F1, F2 (110V)**
FCA125	**2**	**50mA T Fuse**	**F1, F2**
ICA106	2	LM339N	U3, U7
ICA116	1	4016B	U2
ICA122	1	4013B	U4
ICA123	1	78L05	*U12, U13
ICA125	1	ICL7650	U6
ICA126	1	CA3140E	U8
ICA128	1	7805	U11
ICA129	1	ICL7106CPL	U300
ICA130	1	MC14070BCP	U301
ICA162	1	LF353N	U9
ICA186	1	TL084CN (Alternative: LF347N)	U1
ICA187	1	LM386N-1	U5
ICA280	1	79L05	U400
LDD125	1	3.5 DIGIT LCD	
LED115	11	LED Red	D300, D50–D59
MAA123	2	FUSEHOLDER PCB	F1, F2
MPCD1016	1	Main PCB	
MPCD1017	1	Panel PCB	

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MPCD1020	1	DIN PCB			
MPP122	1	CABLE TIE			
MPP200	11	LED Spacer			
MQX154	2	DIN SOCKET 5 x 45`			
MQX155	1	DI SOCKET 5 x 60N`			
MQX222	1	3.5MM STEREO JACK SKT			
MQX238	2	LCD Connector			
MQX259p2	1	2 Pin Header			
MQX299	2	Link			
MQX300	5	Link Socket			
QNN304	2	2N3904			Q2, Q6
QPP102	2	2N3906			Q1, Q5
QPP103	1	MJE350			Q3
RCC103	1	120R		5%	R55
RCC108	1	68R	2w	5%	R88
RCF000	1	Link			LK4
RCF100K	9	100K	1/4W	5%	R3, R54, R68, R77, R109, R111, R114, R115, R303
RCF100R	1	100R	1/4W	5%	R42
RCF10K	12	10K	1/4W	5%	R6, R51, R71, R72, R73, R92, R101, R105, R116, R125, R135, R161
RCF10R	3	10R	1/4W	5%	R15, R151, R152
RCF12K	1	12K	1/4W	5%	R130
RCF150K	2	150K	1/4W	5%	R53, R49
RCF1K0	7	1K0	1/4W	5%	R1, R2, R4, R12, R67, R79, R86
RCF1K2	2	1K2	1/4W	5%	R110, R112
RCF1K8	1	1K8	1/4W	5%	R121
RCF1M0	6	1M0	1/4W	5%	R302, R305, R306, R307, R63, R120
RCF1R0	1	1R0	1/4W	5%	R57
RCF20K	1	20K	1/4W	5%	R14
RCF22K	8	22K	1/4W	5%	R46, R102, R107, R117, R118, R106, R133, R300
RCF270R	2	270R	1/4W	5%	R94, R122
RCF2K2	1	2K2	1/4W	5%	*R154
RCF2M2	1	2M2	1/4W	5%	R127
RCF2R2	3	2R2	1/4W	5%	R43, R90, R160
RCF330R	1	330R	1/4W	5%	R150
RCF3K3	1	3K3	1/4W	5%	R66
RCF3K9	2	3K9	1/4W	5%	R89, R91
RCF470K	2	470K	1/4W	5%	R104, R113
RCF47K	7	47K	1/4W	5%	R48, R70, R74, R75, R123, R124, R304
RCF4M7	1	4M7	1/4W	5%	R93
RCF560K	1	560K	1/4W	5%	R56
RCF56R	2	56R	1/4W	5%	R8, R9
RCF5K6	3	5K6	1/4W	5%	R87, R103, R119
RCF6K8	1	6K8	1/4W	5%	R65
RCF680R	1	680R	1/4W	5%	R309
RCF82K	1	82K	1/4W	5%	R76
RCF910K	1	910K	1/4W	5%	R50
RCT100K	2	100K	1/4W	1%	R81, R85
RCT10R	1	10R	1/4W	1%	R59

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RCT11R0	1	11R0	1/4W	1%	R58
RCT180K	1	180K	1/4W	1%	R84
RCT18K	1	18K	1/4W	1%	R82
RCT1K	1	1K	1/4W	1%	R41
RCT1M0	2	1M0	1/4W	1%	R38, R153
RCT200R	1	200R	1/4W	1%	R47
RCT20K	1	20K	1/4W	1%	R52
RCT220K	1	220K	1/4W	1%	R83
RCT2K0	1	2K0	1/4W	1%	R40
RCT560K	1	560K	1/4W	1%	R62
RCT56R	1	56R	1/4W	1%	R60
RCT5K6	1	5K6	1/4W	1%	R61
RCT9K1	1	9K1	1/4W	1%	R39
RVB315	1	PRESET	100K		R78
RVB319	1	PRESET	10K		R64
RVB311	1	PRESET	470R		R301
RVP114	2	PANEL POT	100K		R200, R128
SWB133	**1**	**POWER SWITCH**			**S11**
SWB156	1	RANGE SWITCH			S1–10
TXM114	**1**	**TRANSFORMER**			**T1** (below serial 10609)
TXM136	**1**	**TRANSFORMER**			**T1** (serial 10609 to 11912)
TXM141	**1**	**TRANSFORMER**			**T1** (serial 12000 up)

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MECHANICAL PARTS

PART Nº	Qty	Description
EPM117	1	LOUDSPEAKER (0.5W)
MCA138	1	ENCLOSURE TOP
MCA139	1	ENCLOSURE BOTTOM
MCA162	1	FRONT MOULDING
MKB128	2	KNOB – Grey push on
MKB129	10	KNOB – Grey button
MKB127	2	KNOB – Cap grey
MKB153	1	Button Black
MMP152	0.01	CLOTH (SPEAKER)
MMP187	2	LOUDSPEAKER BRACKET
MNS107	12	K30 X 6 Self Tap
MNS117	4	M3x10mm
MNS163	4	M3 X 12 CSK
MNS166	4	STARLOCK
MNS175	4	M3 Flange nut
MNS176	6	K30 X 8 Self Tap
MPA164	.045m	2.4mm Heatshrink
MPP191	2	TILT LEG
MPP193	4	STICK-ON FEET
MPP198	2	TILT BASE
MPP230	1	Tie Wrap
MPP231	2	Inset Covers
MQX254	**1**	**POWER INLET**
MWP156	1	SERIAL Nº LABEL
MWPD1036	1	LABEL – 850A
MWP1056	1	REAR LABEL
WMA101	0.14m	Ribbon Cable (2 way)
WMA102	**0.075**	**Blue Wire**
WMA103	**0.075**	**Brown Wire**
WMA104	0.075	GREEN/YELLOW WIRE
WMA197	1	Speaker Lead
WMA293	3	10 Way Jumper Cables
WMA302	1	6 Way Link

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SECTION 9 – SCHEMATIC DIAGRAMS

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