LEM
PROFESSIONAL SOUND

SERVICE MANUAL

hercules

Active loudspeaker system

GENERALMUSIC®

code 270287

Index

Notice

Service must be carried out by qualified personnel only. Any tampering carried out by unqualified personnel during the guarantee period will forfeit the right to guarantee.

For a correct operation of the instrument, after having switched off, be careful to wait at least 3 seconds before switching on again.

To improve the device's specifications, the schematic diagrams may be subject to change without prior notice.

All components marked by this symbol have special safety characteristics, when replacing any of these components use only manufacturer's specified parts.

The (μ) micro symbol of capacitance value is substituted by U.

The (Ω) omega symbol of resistance value is substituted by E.

The electrolytic capacitors are 25Vdc rated voltage unless otherwise specified.

All resistors are 1/8W unless otherwise specified.

All switches shown in the "OFF" position. All DC voltages measured to ground with a voltmeter 20KOhm/V.

- Soldering point.
- Male connector.
- Female connector.
- M/F faston connector.
- Supply voltage.
- Test point.
- Flag joined with one or more flags with the same signal name inscribed.
- Logic supply ground.
- Analog supply ground.
- Chassis ground.
- Earth ground.

ATTENTION Observe precautions when handling electrostatic sensitive devices.

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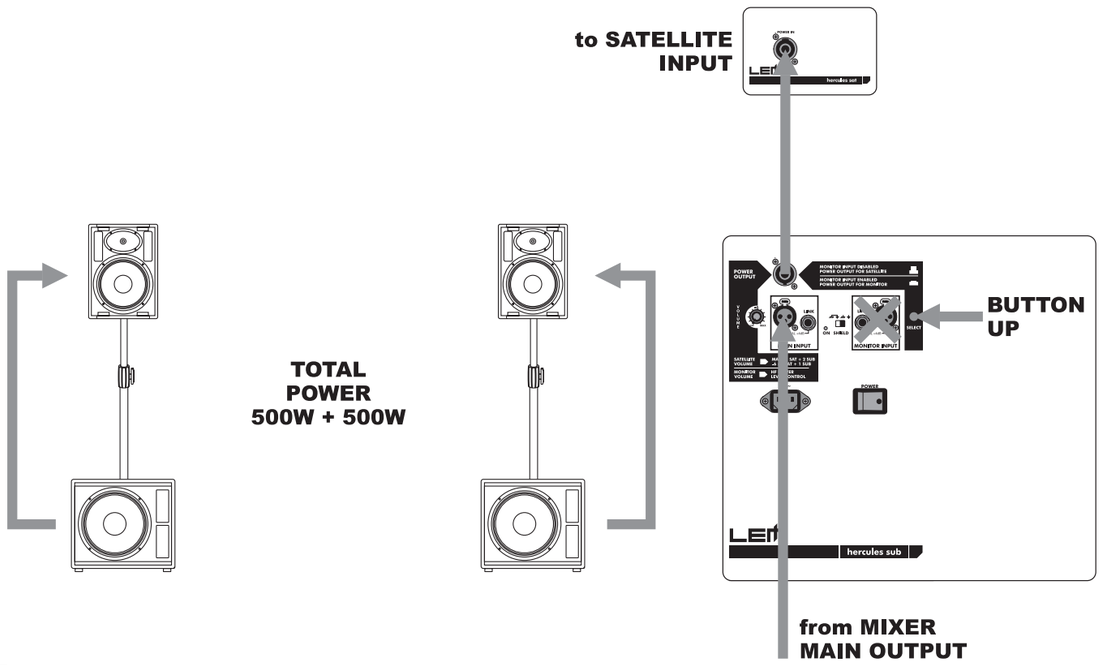
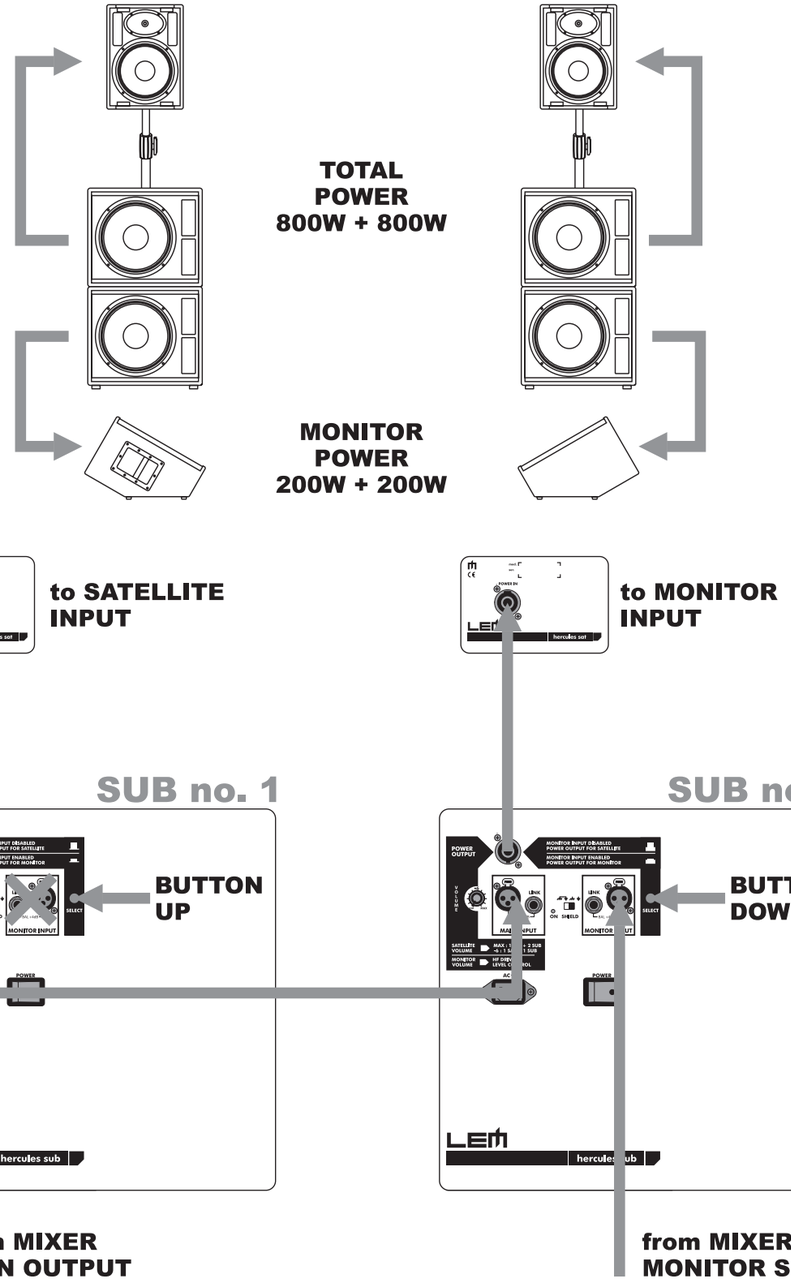
		HERCULES SAT	HERCULES SUB
LOUDSPEAKER SPECIFICATIONS			
COMPONENTS	*High*	1" driver with EWT horn	
	Low	12" woofer	15" woofer
POWER HANDLING (EIA RS-426A)	*W continuous* *W peak*	50 (high) + 150 (mid) 100 (high) + 300 (mid)	300 600
IMPEDANCE	*Ohms*	8 + 8	8
CONNECTIONS		1 x SPEAKON	
CONSTRUCTION		Chipboard with black scratch-resistant paint - Protection metal grid	
DIMENSIONS	*mm (WxHxD)*	370x506x325	546x476x630
WEIGHT	*kg*	16.4	39
AMPLIFIER SPECIFICATIONS			
EIA OUTPUT POWER (1kHz, max THD 1%)	*W*	150 + 150	300
INPUT SENSITIVITY	*dBu*	+4	
INPUT IMPEDANCE	*kohms*	30 (balanced) - 15 (unbalanced)	
ACTIVE CROSSOVER	*High* *Mid* *Low*	LP: - /HP:24dB/oct.@3kHz LP:18dB/oct.@2kHz/HP:24dB/oct.@105Hz	 LP:18dB/oct.@85Hz/HP:24dB/oct.@35Hz
DISTORSION	*%*	<0.02 (THD+Noise)	
CONTROLS		Power output volume - MONITOR selector - Shield ON/OFF	
CONNECTIONS		2 x JACK + XLR-F (MAIN + MONITOR input) - SPEAKON (power output)	
POWER SUPPLY		See label on the unit	
SYSTEM SPECIFICATIONS			
SENSITIVITY (SPL 1W/1m)	*dBspl*	99	
MAX SPL continuous	*dBspl*	122	
MAX SPL peak	*dBspl*	125	
FREQUENCY RESPONSE	*Hz (-10dB)*	38 - 22k	
DISPERSION (OxV)	°	60 x 40	

STANDARD SETUP



DOUBLE SETUP



TEST PROCEDURES & ADJUSTMENTS

These procedure are relative to all system amplifiers inside the Sub woofer cabinet.

PRECAUTION

• To prevent short circuit during any test, **the oscilloscope must be EARTH insulated**, this occurs because some test require to connect its probe to the amplifier output, non-compliance may cause damages to oscilloscope inputs circuitry.
• Before removing or installing any modules and connectors, **disconnect the amplifier from AC MAINS** and measure the DC supply voltages across each of the power supply capacitors. If your measurement on any of the caps is greater than 10Vdc, connect a 100ohm 30W resistor across the applicable caps to discharge them for your safety. Remember to remove the discharge resistor immediately after discharging caps. **Do not power up the amplifier with the discharge resistor connected**.
• Read these notes entirely before proceeding to any operation. These notes are not comprehensive of all damages that possibly occur, but includes some specifically advices, checks and adjustments relative to this amplified speaker.
• Do not check the amplifier with the speakers connected use the appropriate load resistors only.
• BE CAREFUL increasing the Variac you must not exceed the nominal mains voltage plus its tolerance (see specifications) any upper voltage can be cause of damage.

REMARKS

• The internal LOW speaker is connected to two amplifiers working in bridge configuration.
• The SAT speaker is connected to POWER OUTPUT socket with two internal separate amplifiers for MID and HIGH range speakers.

VISUAL CHECK

• Check the speakers for any damaging (cone-breaking, interruption or further).
• Before proceed to supply the amplifier check visually the internal assembly, if appears an evident damage find the most possible reasons that cause it.
• Check the wiring cables for possible interruptions or shorts.
• If the damage has burnt a printed circuit board don't try to repair it, replace with a new one.

TEST INSTRUMENTS

• Audio Generator
• Oscilloscope
• Digital Multimeter
• Temperature Meter
• 4ohm 200W, 8ohm 400W, 100ohm 30W resistors
• Variac (0÷250Vac)

TECHNICAL SPECIFICATIONS

Power Requirements:	(230Vac±10% 50Hz)	690VA
or	(115Vac±10% 50/60Hz)	690VA
Max Low Out Power*:	(8ohm)	308W
Max Mid Out Power*:	(8ohm)	145W
Max High Out Power*:	(8ohm)	33W
Low Limited Out*:	(8ohm)	140Vpp
Mid Limited Out*:	(4ohm)	80Vpp
High Limited Out*:	(4ohm)	46Vpp
Frequency Response:	(Sub+Sat / LOW)	25Hz ÷ 105Hz
(amplifier+speaker)	(Sub+Sat / MID)	105Hz ÷ 2.6KHz
	(Sub+Sat / HIGH)	2.6KHz ÷ 20KHz
Frequency X-Over	(Low/High)	105Hz / 2.6KHz
Frequency Response:	(Monitor / LowMID)	69Hz ÷ 2.6KHz
(amplifier+speaker)	(Monitor / HIGH)	2.6KHz ÷ 20KHz
Frequency X-Over	(Low)	2.6KHz
Main Input Sensitivity:	(+4dBu)	1.229V_{RMS}
Monitor Input Sensitivity:	(+4dBu)	1.229V_{RMS}
Input Impedance:	(balanced)	30Kohm
	(unbalanced)	15Kohm
Voltage Gain:	(average)	30±1dB
IMD:	(SMPTE 60Hz/7KHz 4:1)	<0.1%
THD:	(THD+N)	<0.1%
S/N Ratio:	(unweighted)	>100dB

* Note: measured with the IHF standard method and just before the limiters became operative.

SETUP

• Connect the Variac between the mains and the amplifier and set it at zero voltage.
• Disconnect all the Speakers.
• Turn full clockwise all the VOLUME potentiometers.
• Connect the audio generator to each channel input and set it to 100Hz -10dBu (245mV_{RMS}) sinusoidal signal.
• Connect the oscilloscope probe to the LOW OUT, clip to - and tip to + before RL2, set it to 10V/div. 2mS/div.
• The load resistor is disconnected.
• The procedures that follow must be executed subsequently in the order specified.

SUPPLY CHECK

• Verify with the Multimeter the insulation between the heatsink and all transistor collectors (TR58,57,56,55,54,53,52,51,50,49,48,47,46,32,29,28,17,13,12,5).
• Verify with the Multimeter the PTC resistor value, it must be between 50 and 200ohm.
• Remove the transformer secondary fuses, set the Variac to the nominal mains voltage, check with the Multimeter the AC supply voltages:
F1-F2=70±2Vac.
• Re-set the Variac at zero voltage, turn off the amplifier and put the fuses back on its holders.
• Set up the Variac slowly monitoring the oscilloscope screen, it should display the input signal amplified with distortion but without any DC voltage; starts from half of nominal mains voltage it should display the sinusoidal signal amplified without distortions, if a distortion occur or the protection trips check the amplifier as suggested in the ADVICES section; if a protection trips without any reason, also check the other MID and HIGH amplifiers connecting the two oscilloscope probes to the respective outputs before the relay (tip at + clip at -), note that to make a valid measurement for these amplifiers you have to set the oscillator test frequency properly (1000Hz for MID, 10KHz for HIGH).
• During any test the fan runs at the slower speed (15Vdc) till the output signal reaches and exceeds 15Vp, then the fan turns at the faster speed (24Vdc).
• When the Variac ac voltage reaches the nominal voltage verify the DC supplies as follow:

TR49 collector pin 2 (+Vcc)	=+49±2Vdc
TR51 collector pin 2 (-Vcc)	=-49±2Vdc
IC2 pin 2	=+17±1Vdc
IC1 pin 3	=-17±1Vdc

• If one or more voltages don't correspond, check the rectifiers, capacitors and transformers disconnecting them from circuitry, refer to schematics.

LOW AMPLIFIER CHECK

• The channel output signal must be symmetrical without visible distortion with an amplitude of about 25Vp and oscillation as shown in *Fig.1* (note: the figure is representative don't refer to its level). If there is a distortion read the section ADVICES.
• Set up the oscilloscope to 20V/div. and increase the input signal, when the input signal reaches about +5dBu (1.38V_{RMS}) the amplifier output reaches its maximum output at about 70Vp (70Vp with load attached), increasing the input at +10dBu (2.45V_{RMS}) the output signal must remain at the same level.
• Connect the 8ohm 400W load on the output and repeat the check.

BIAS ADJUSTMENT (LOW):

• Set the generator level at zero, connect the Multimeter across the R5 resistor, then adjust VR2 trimmer to read 6±0.5mVdc.
• Verify the same voltage across R52.
• Connect the Multimeter across the R141 resistor, then adjust VR4 trimmer to read 6±0.5mVdc.
• Verify the same voltage across R142.

MID AMPLIFIER CHECK and Level Adjustment

• Set up the generator to 1KHz -10dBu (245mV_{RMS}) sinusoidal signal.
Move the oscilloscope probe tip on MID OUTPUT, clip to - and tip to + before RL1, set it to 5V/div. 200µS/div.
• The channel output signal must be symmetrical without visible distortion and oscillation as shown in *fig.1* (note: the figure is representative don't refer to its level). If there is a distortion read the section ADVICES.
• Adjust VR1 on INPUT BOARD to obtain an output level of 15.5Vp.
• Set up the oscilloscope to 20V/div. and increase the input signal, when the input signal reaches about +5dBu (1.38V_{RMS}) the amplifier output reaches its maximum at about 48Vp (40Vp with load attached), increasing the input at +10dBu the output signal must remain at the same level.
• Connect the 4ohm 200W load on output and repeat the check without re-adjust VR1.

BIAS ADJUSTMENT (MID):

• Set the generator level at zero, connect the Multimeter across the R4 resistor, then adjust VR1 trimmer to read 10±0.5mVdc.
• Verify the same voltage across R22.

HIGH AMPLIFIER CHECK

• Set the generator to 10KHz 245mV_{RMS} (-10dBu) sinusoidal signal.
Move the oscilloscope probe tip on HIGH OUTPUT, clip to - and tip to + before RL1, set it to 5V/div. 20µS/div.
• The channel output signal must be symmetrical without visible distortion and oscillation as shown in *fig.1* (note: the figure is representative don't refer to its level). If there is a distortion read the section ADVICES.
• Set up the oscilloscope to 10V/div. and increase the input signal, when the input signal reaches about +5dBu (1.38V_{RMS}) the amplifier output reaches its maximum at about 23Vp (23Vp with load attached), increasing the input at +10dBu the output signal must remain at the same level.
• Connect the 4ohm 200W load on output and repeat the check.

BIAS ADJUSTMENT (HIGH):

• Set the generator level at zero, connect the Multimeter across the R113 resistor, then adjust VR3 trimmer to read 10±0.5mVdc.
• Verify the same voltage across R94.

BANDWIDTH CHECK:

• As a reference we report in *fig.2* the x-over curves (*1a*=LOW *2a*=MID *3a*=HIGH) with the SELECT switch on MAIN SYSTEM and we report in *fig.3* the x-over curves (*2a*=MID *2b*=HIGH) with the SELECT switch on MONITOR, all these curves are obtained with the generator level at -10dBu (0.245V_{RMS}), check them if necessary.

TEMPERATURE PROTECTION CHECK:

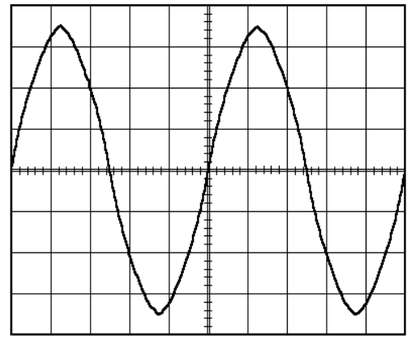
• Placing a welder tip close to a PTC (R13 and R14) the fan must turn to the maximum speed and the relais disconnect the loads.

ADVICES

• If the input sinewave appears to be distorted during the negative cycle, you can assume that the problem is located somewhere in the circuitry of the positive rail.
• If the positive cycle appears distorted, you can assume that the problem is in the circuitry of the negative low rail. Refer to the schematics.
• If you have determinate that the problem is a short on a supply rail, you must check the output transistors to determine which transistor devices are bad.
• Use a soldering iron to lift one leg of each emitter pin and measure the emitter-collector resistance on each device.
• Unsolder and lift one leg of each base pin and check the base-collector resistance of each transistor and replace any that measure as a short.
• If all the transistors are OK, unsolder and lift one leg of each diode and check them.
• Check the circuit board for open foil traces.
• Use the Multimeter as Ohm-meter to check the resistors, particularly the base and emitter resistors of damaged transistor.

FIGURES

FIG 1



TRACE setting.
TIMEBASE.
AMPLITUDE:

Fig.2

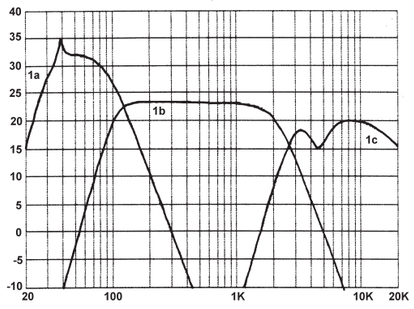
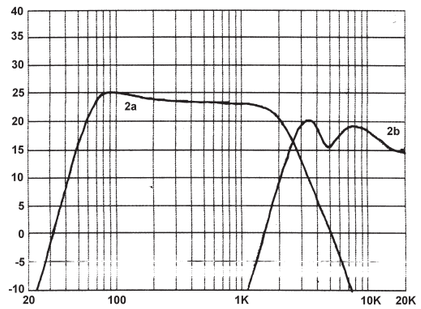


Fig.3



768271 - INPUT BOARD

MAIN INPUT

SUB EQ & SUBSONIC FILTER

105Hz/18dB

VOLUME

SAT SELECT MONITOR

SYSTEM EQUALIZER

2.6KHz/24dB

MONITOR EQUALIZER

MONITOR INPUT

105Hz/24dB

2.6KHz/18dB

69Hz/24dB

CN1

CN2

727645 - AMPLIFIER BOARD

150W AMPLIFIER

300W BRIDGE AMPLIFIER

150W AMPLIFIER

SPEAKON OUTPUT

DC-VOLTAGE & CURRENT SENSORS

TEMPERATURE SENSORS

+VCC +17V GND -17V -VCC

RECTIFIERS & REGULATORS

MUTING

PROTECTIONS

CN1

FAN

886220 SAT/MONITOR SPEAKER

SPEAKON INPUT

886221 - HERCULES SUB 230V (EU)
886222 - HERCULES SUB 115V (US)

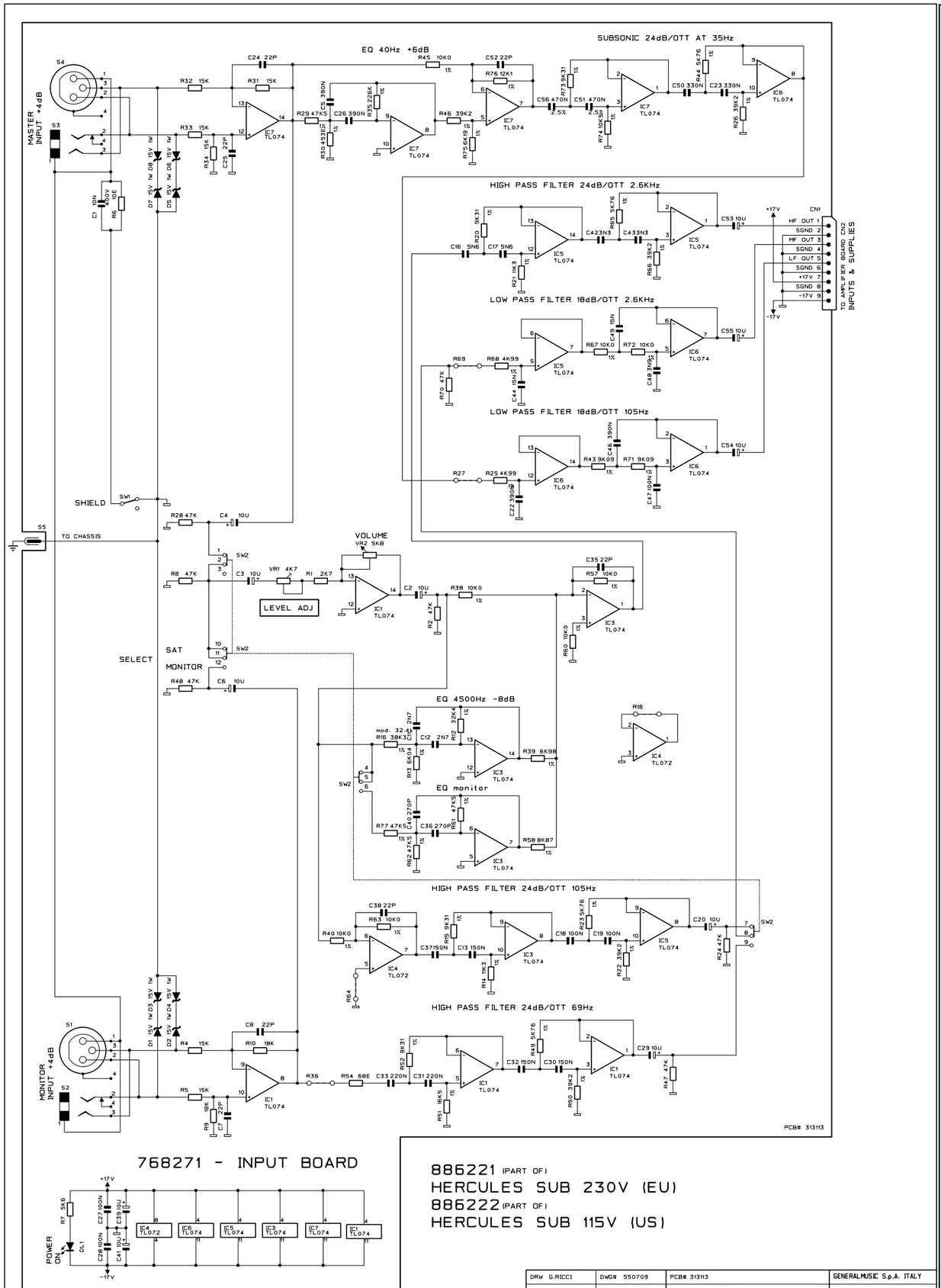
737143 - AMPLIFIER ASSEMBLY (EU)
737144 - AMPLIFIER ASSEMBLY (US)

238090
690W 230VAC
TRANSFORMER (EU)

238091
690W 115VAC
TRANSFORMER (US)

MAINS

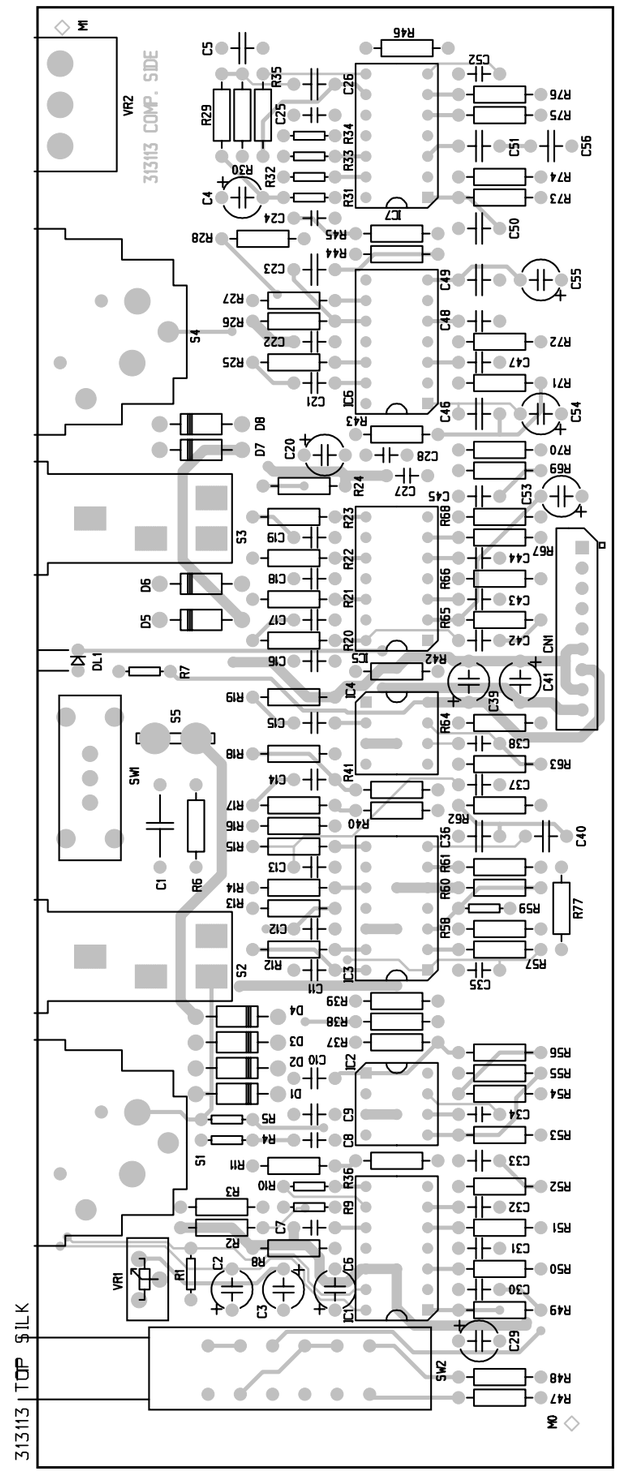
DRW G.BOCCATO	DWG# 550714	PCB#	GENERALMUSIC S.p.A. ITALY
CKD G.RICCI	DATE 15-02-2003	SCHEMATIC DIAGRAM BLOCK DIAGRAM	
APP. R.FALCONI	REV: A		



768271 - INPUT BOARD

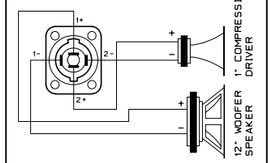
886221 (PART OF)
HERCULES SUB 230V (EU)
886222 (PART OF)
HERCULES SUB 115V (US)

DRW G.RICCI	DWG# 550709	PCB# 313113	GENERALMUSIC S.p.A. ITALY
CKD F.GATTO	DATE 10/06/02	SCHEMATIC DIAGRAM INPUT BOARD	ALL RIGHTS ARE RESERVED. NO COPIES OR REPRODUCE THIS DOCUMENT WITHOUT WRITTEN CONSENT BY GENERALMUSIC.
APP. N.ZAVATTA	REV: D		



DRW: G.RICCI	DWG: 315113	SCHEMATIC DIAGRAM Hercules	GENERALMUSIC S.p.A. Italy
CKD: F.GATTO	DATE: 25-03-03	Input Board Pcb Layout	ALL RIGHTS ARE RESERVED, NO COPIES OR REPRODUCE THIS DOCUMENT WITHOUT WRITTEN CONSENT BY GENERALMUSIC.
APP: N.ZAVATTA	REV: A		

886220
HERCULES SAT
8 Ohm



LF AMPLIFIER

LIMITER

LF BIAS ADJ

15" WOOFER SPEAKER

MF AMPLIFIER

MF BIAS ADJ

HF AMPLIFIER

HF BIAS ADJ

MUTING

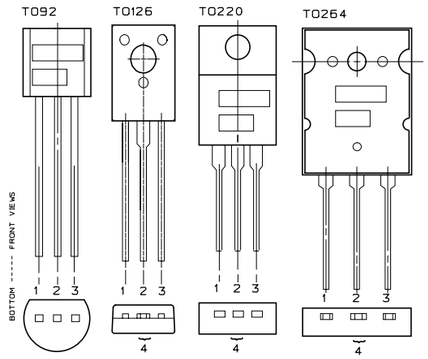
DC PROTECTION

TEMPERATURE SENSORS

FAN DRIVER

FAN

TRANSISTOR PACKAGES



NOTE: ALL DC VOLTAGES ENCLOSED INTO SQUARES ARE MEASURED IN STEADY STATE WITHOUT INPUT SIGNAL AT 25°C AND NOMINAL MAINS VOLTAGE SUPPLY.

727645 - AMPLIFIER BOARD

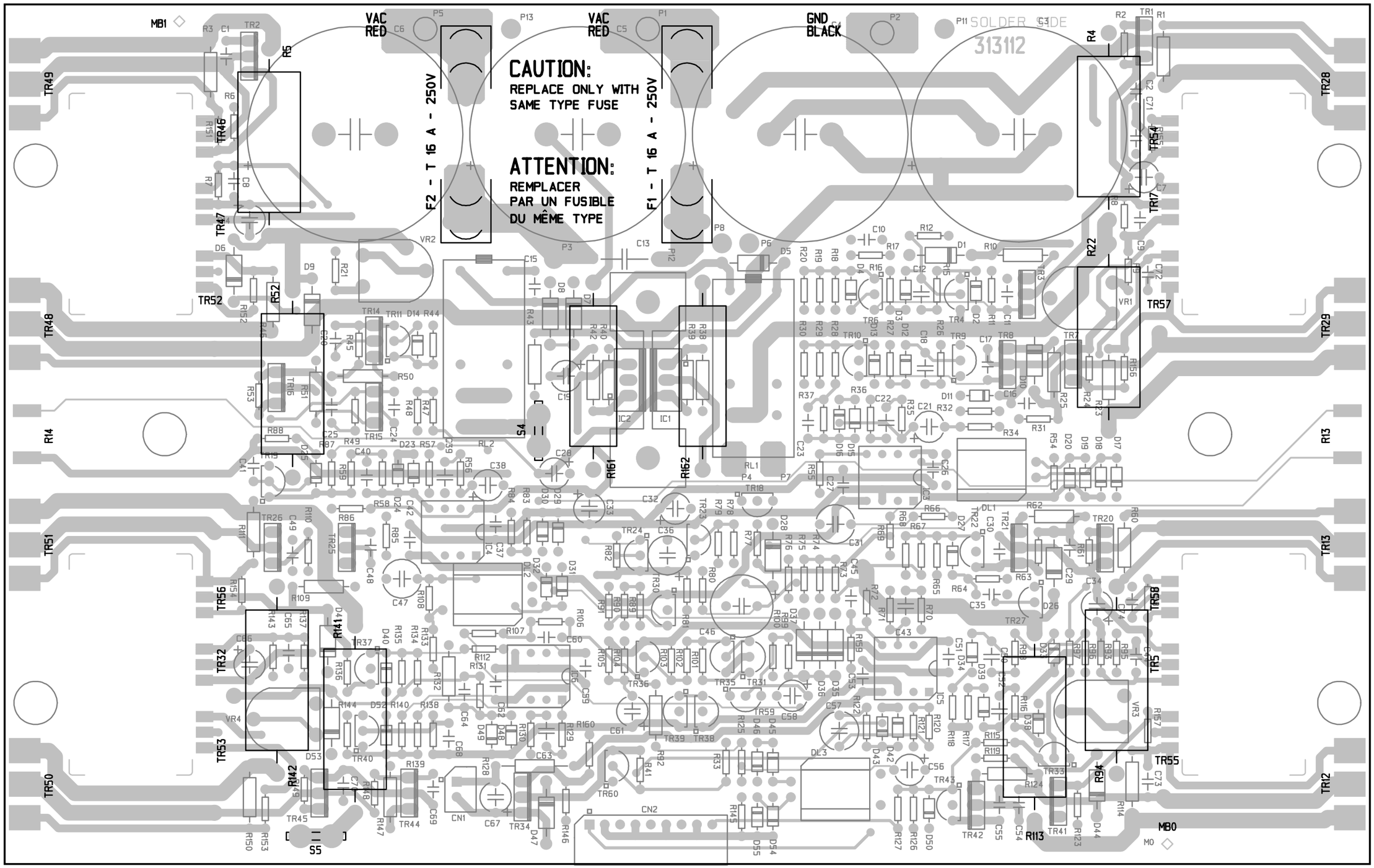
POWER SUPPLIES

886221 (PART OF)
HERCULES SUB 230V (EU)
886222 (PART OF)
HERCULES SUB 115V (US)

DRW G.RICCI	DWG# 550710	PCB# 313112	GENERALMUSIC S.p.A. ITALY
CKD G.BOCCATO	DATE 11/04/2002	SCHEMATIC DIAGRAM	ALL RIGHTS ARE RESERVED. NO COPIES OR REPRODUCE THIS DOCUMENT WITHOUT WRITTEN CONSENT BY GENERALMUSIC.
APP. N.ZAVATTA	REV: A	AMPLIFIER BOARD	

DRW: G.DINI	DWG: 313112	SCHEMATIC DIAGRAM Hercules	GENERALMUSIC S.p.A. Italy
CKD: G.RICCI	DATE: 25-03-03	Amplifier Board Pcb Layout	
APP.: D.ROSSETTI	REV.: A	(SOLDER SIDE)	

313112 BOT SILK



Spare Part List

Legend

EU = 230Vac Europe version

US = 115Vac United States version

Code		Description
		Optional Accessories
950978		SC31 Aluminium Telescopic Stand (SUB-SAT)
950860		SC20 Metallic Telescopic Stand (standalone SAT)
950860		SC30 Aluminium Telescopic Stand (standalone SAT)
		Accessories
887101		10mt Speakon-Speakon 4 Conductors Cable
277388		SAT Owner's Manual (English/Italian)
277389		SUB Owner's Manual (English/Italian)
130297		Mains Cable (EU)
130283		Mains Cable (US)
		SAT
727647		Horn Assembly
347407	*	EWT Gray Elliptical Horn
229048	*	1" 8ohm Compression Driver
229051	**	**1" 8ohm Diaphgram for 229048 Driver**
210267	*	Gasket between Horn and Box
210211	*	Gasket between Driver and Horn
177789	*	Driver Support
120346	*	WL4x20tc Black Screw
120152	*	M6x8tsp Black Screw
727646		Input Panel Assembly
778173	*	Speakon Cables Assembly
141200	**	Speakon Socket (NL4MP Neutrik)
667762	*	Input Panel
120581	*	M3 Black Self-Locking Nut
120451	*	3.2x7x0.5 Black Washer
120030	*	M3x12tsp Black Screw
717091		Cabinet Assembly
430097	*	Wooden Cabinet
340270	*	25x12mm Rubber Foot
323005	*	8x2.5mm Bumpon Rubber (Insertion hole=3.5x6.5)
177328	*	220x160mm Metal Handle
177325	*	Suspension Flange
120664	*	M6 4-tips Lock Nut
120662	*	M5 4-tips Lock Nut
120661	*	M4 4-tips Lock Nut
120341	*	WL4x20tt Black Screw
120111	*	M6x25tsp Black Screw
667759		Speaker Net
227082		**12" 8ohm Woofer Speaker**
210272		Speaker Filler (400gr/m² 30x50x4cm)
210217		Black Sealer (specify mt)
210215		Adhesive Rubber Foam 10x1.9mm (Specify mt)
180822		LEM Logo Adhesive Plate
180821		"Hercules Sat" Adhesive Label
180587		Model Data & Code Adhesive Label
150298		100x2.5mm Nylon Cable Tie
120483		5mm Black Shakeproof Washer
120461		5.3x10x1 Black Washer
120411		WL3.5x20tt Black Screw
120281		WL3x15tt Black Screw
120123		M5x25tc Black Screw
120059		M4x25tc Black Screw
		SUB
841231		100Cm 2 Wires Black/Brown Faston/Faston
737143		**Amplifier Assembly (EU)**
737144		**Amplifier Assembly (US)**
SKK347002	*	ø 15x17mm Black Knob with Red Needle
SKK347001	*	ø 8x9mm Black Button Cap
841280	*	Single 15cm AWG18 White Faston/Faston Wire
841272	*	12.5cm Yel/Grn Faston/Faston Wire
841182	*	9 Wires 25cm Crimp Terminal Cable
841006	*	10cm Yel/Grn Faston/Faston AWG18 Wire
768271	*	**Input Board (Pcb#313113)**
141187	**	Hor Female XLR Socket (NC3FAH Neutrik)
140930	**	9 Contacts Hor Male Connector
140394	**	4sw 2pos H Slider Switch
140220	**	Jack Slim Horizontal S-F Socket APJ678 Adimpex
120857	**	6.3mm Vertical Male Faston for Pcb
110267	**	1sw 2pos Horizontal Slider Switch
100084	**	TL074 Quad J-Fet Operational Amplifier
100061	**	TL072 Dual J-Fet Operational Amplifier
080743	**	3mm Wide Diffused Green Led
080293	**	15V 1W 5% Zener Diode
074570	**	5KB RK16 Hor Rotary Potentiometer K15C31
070163	**	4K7 20% Vertical Linear Trimmer
052051	**	18K 1/8w 5% Resistor
052050	**	15K 1/8w 5% Resistor
052048	**	10K 1/8w 5% Resistor
052041	**	2K7 1/8w 5% Resistor
050571	**	47K 1/4W 5% Resistor
050231	**	68E 1/4W 5% Resistor
050131	**	10E 1/4W 5% Resistor
042761	**	226K 1/4W 1% Metalized Film Resistor
042685	**	47K5 1/4W 1% Metalized Film Resistor
042672	**	39K2 1/4W 1% Metalized Film Resistor
042671	**	38K3 1/4W 1% Metalized Film Resistor
042664	**	32K4 1/4W 1% Metalized Film Resistor
042628	**	16K5 1/4W 1% Metalized Film Resistor
042615	**	12K1 1/4W 1% Metalized Film Resistor
042610	**	11K3 1/4W 1% Metalized Film Resistor
042606	**	10K5 1/4W 1% Metalized Film Resistor
042605	**	10K0 1/4W 1% Metalized Film Resistor
042601	**	9K31 1/4W 1% Metalized Film Resistor
042600	**	9K09 1/4W 1% Metalized Film Resistor
042599	**	8K87 1/4W 1% Metalized Film Resistor
042584	**	6K98 1/4W 1% Metalized Film Resistor
042574	**	6K19 1/4W 1% Metalized Film Resistor
042573	**	6K04 1/4W 1% Metalized Film Resistor
042571	**	5K76 1/4W 1% Metalized Film Resistor
042565	**	4K99 1/4W 1% Metalized Film Resistor
042437	**	453E 1/4W 1% Metalized Film Resistor
030245	**	10u 50V 20% Vert Electrolytic Capacitor
021032	**	470n 63V 10% MKT Polyester Capacitor
021031	**	390n 63V 10% MKT Polyester Capacitor
021030	**	330n 63V 10% MKT Polyester Capacitor
021028	**	220n 63V 10% MKT Polyester Capacitor
021026	**	150n 63V 10% MKT Polyester Capacitor
021024	**	100n 63V 10% MKT Polyester Capacitor
021014	**	15n 63V 10% MKT Polyester Capacitor
021009	**	5n6 63V 10% MKT Polyester Capacitor
021007	**	3n9 63V 10% MKT Polyester Capacitor
021006	**	3n3 63V 10% MKT Polyester Capacitor
021005	**	2n7 63V 10% MKT Polyester Capacitor
020250	**	10n 400V 10% MKT Polyester Capacitor
010595	**	100n 50V -20+80% Ceramic Cap. Multilayer
010394	**	270p 50V 10% CL2 Ceramic Capacitor
010271	**	22p 50V 10% CL2 Ceramic Capacitor
727645	*	**Amplifier Board (Pcb#313112)**
778172	**	Cables Assembly
340079	**	TO220 Mica Washer
340078	**	TO220 Insulated Bush
170960	**	TO220 h=25mm Heatsink
160178	**	Copper Jumper
140930	**	9 Contacts Hor Male Connector
140917	**	2 Contacts Vert Male Connector
120582	**	M3 Black Nut
120521	**	3mm Black Spring Washer
120451	**	3.2x7x0.5 Black Washer
120005	**	M3x10tc Screw
110307	**	**Relay 24V / 2 Switch 5A 250Vac**
100067	**	LM337T TO220 1.2-37V 1.5A Adjustable Regulator
100066	**	LM317T TO220 1.2-37V 1.5A Adjustable Regulator
100061	**	TL072 Dual J-Fet Operational Amplifier
090920	**	MJE802 TO126 Npn Darl Transistor
090917	**	MJE350 TO126 Pnp Transistor
090916	**	MJE340 TO126 Npn Transistor
090201	**	2N5401 TO92 Pnp Transistor
090200	**	2N5550 TO92 Npn Transistor
090194	**	BC560C TO92 LN Pnp Transistor
090183	**	BC550C TO92 LN Npn Transistor
090153	**	BC327 TO92 Pnp Transistor
080901	**	VTL5C4 Analog Optoisolator
080282	**	13V 1W 5% Zener Diode
080245	**	7V5 1W 5% Zener Diode
080156	**	1N4002 1A 100V Rectifier Diode
080103	**	1N4148 100mA 75V Signal Diode
070106	**	470E 20% Horizontal Linear Trimmer
052062	**	150K 1/8w 5% Resistor
052060	**	100K 1/8w 5% Resistor
052058	**	68K 1/8w 5% Resistor
052057	**	56K 1/8w 5% Resistor
052056	**	47K 1/8w 5% Resistor
052054	**	33K 1/8w 5% Resistor
052052	**	22K 1/8w 5% Resistor
052051	**	18K 1/8w 5% Resistor
052049	**	12K 1/8w 5% Resistor
052048	**	10K 1/8w 5% Resistor
052044	**	4K7 1/8w 5% Resistor
052043	**	3K9 1/8w 5% Resistor
052040	**	2K2 1/8w 5% Resistor
052039	**	1K8 1/8w 5% Resistor
052038	**	1K5 1/8w 5% Resistor
052036	**	1K 1/8w 5% Resistor
052035	**	820E 1/8w 5% Resistor
052033	**	560E 1/8w 5% Resistor
052032	**	470E 1/8w 5% Resistor
052030	**	330E 1/8w 5% Resistor
052024	**	100E 1/8w 5% Resistor
050291	**	220E 1/4W 5% Resistor
050231	**	68E 1/4W 5% Resistor
050131	**	10E 1/4W 5% Resistor
042725	**	100K 1/4W 1% Metalized Film Resistor
042534	**	2K80 1/4W 1% Metalized Film Resistor
042405	**	221E 1/4W 1% Metalized Film Resistor
040221	**	56E 1/2W 5% Resistor
030884	**	10000U 80V 20% Snap-In Electrolytic Capacitor
030715	**	1000u 6v3 20% Vert Electrolytic Capacitor
030560	**	4700u 80v 20% Snap-In Electrolytic Capacitor
030485	**	100u 25V 20% Vert Electrolytic Capacitor
030324	**	22u 50V 20% Vert Electrolytic Capacitor
030005	**	1u 50V 20% Vert Electrolytic Capacitor
021012	**	10n 63V 10% MKT Polyester Capacitor
020250	**	10n 400V 10% MKT Polyester Capacitor
010595	**	100n 50V -20+80% Ceramic Cap. Multilayer
010462	**	1n 50V 10% CL2 Ceramic Capacitor
010402	**	330p 50V 10% CL2 Ceramic Capacitor
010387	**	220p 50V 10% CL2 Ceramic Capacitor
010345	**	100p 50V 10% CL2 Ceramic Capacitor
010333	**	82p 50V 10% CL2 Ceramic Capacitor
010293	**	33p 50V 10% CL2 Ceramic Capacitor
010271	**	22p 50V 10% CL2 Ceramic Capacitor
347060	**	Nylon Cable Tie with 3mm Eye
340751	**	TO126 Mica Washer
340186	**	Adhesive Cable Fixing
340154	**	TO3P/TO218 Mica Washer
340079	**	TO220 Mica Washer
340078	**	TO220 Insulated Bush
210216	**	Adhesive Rubber Foam 20x5mm (Specify mt)
210215	**	Adhesive Rubber Foam 10x1.9mm (Specify mt)
177790	**	Heatsink
177773	**	Cyclop Amp Right Support
177768	**	Cyclop Amp Left Support
150298	**	100x2.5mm Nylon Cable Tie
120849	**	Hor Pc Male Faston 2.8
120584	**	M4 Black Nut
120522	**	4mm Black Spring Washer
120521	**	3mm Black Spring Washer
120453	**	4.2x9x0.8 Black Washer
120451	**	3.2x7x0.5 Black Washer
120257	**	B2.9x9.5tc Black Screw
120063	**	M4x20tc Black Screw
120005	**	M3x10tc Screw
110119	**	Fuse Clip 10A max (EU) (US)
090920	**	MJE802 TO126 Npn Darl Transistor
090919	**	MJE15031 TO220 Pnp Transistor
090918	**	MJE15030 TO220 Npn Transistor
SKK090013	**	**2SC5200 TO264 Npn Transistor**
SKK090014	**	**2SA1943 TO264 Pnp Transistor**
080821	**	Ptc 100° PTH9L04BD222TS2F330 Murata
080607	**	KBPC2502 25A 200V Rectifier Diode Bridge
060351	**	82E 5W 10% Wire Resistor
060051	**	0E22 5W 5% Wire Resistor
727632	*	Fan Assembly
140919	**	Molex 5264 2 Contacts Housing
140870	**	Molex 5263 Female Crimping Contact
110359	**	**24Vdc 80x25mm Fan**
667758	*	Panel
238091	*	**Transformer 115Vac (US)**
238090	*	**Transformer 230Vac (EU)**
180707	*	GND Symbol Adhesive Label
150314	*	6.3mm Faston Insulator
150298	*	100x2.5mm Nylon Cable Tie
120841	*	6.3mm Female Brassed Faston
120587	*	M6 Black Nut
120584	*	M4 Black Nut
120582	*	M3 Black Nut
120523	*	6mm Black Spring Washer
120522	*	4mm Black Spring Washer
120521	*	3mm Black Spring Washer
120472	*	6.4x24x2 Black Washer
120453	*	4.2x9x0.8 Black Washer
120451	*	3.2x7x0.5 Black Washer
120256	*	B2.9x9.5tsp Black Screw
120131	*	M6x80te Black Screw
120063	*	M4x20tc Black Screw
120025	*	M3x10tsp Black Screw
110614	*	Mains Socket
110291	*	16A 250Vac Bipolar Power Switch
110038	*	T16A Fuse 6.3x32mm (US)
020491	*	100nF 10% 250Vac Polyester Capacitor
717083		Speaker Box Assembly
430089	*	Wooden Speaker Box
340969	*	37x15mm Rubber Foot
323070	*	9.5x3.8mm Bumpon Rubber
190236	*	d=50/60 w=24mm Caster
177783	*	Black Metallic Flange
177328	*	220x160mm Metal Handle
177325	*	Suspension Flange
120664	*	M6 4-tips Lock Nut
120662	*	M5 4-tips Lock Nut
120483	*	5mm Black Shakeproof Washer
120461	*	5.3x10x1 Black Washer
120417	*	WL4X35tt Black Screw
120411	*	WL3.5x20tt Black Screw
120124	*	M5x30tc Black Screw
120111	*	M6x25tsp Black Screw
667744		Speaker Net
227083		**15" 8ohm Woofer Speaker**
210274		Speaker Filler (400gr/m² 100x50x4cm)
210272		Speaker Filler (400gr/m² 30x50x4cm)
210217		Black Sealer (specify mt)
180822		LEM Logo Adhesive Plate
180587		Model Data & Code Adhesive Label
150314		6.3mm Faston Insulator
120483		5mm Black Shakeproof Washer
120461		5.3x10x1 Black Washer
120414		WL3.5x35tt Black Screw
120341		WL4x20tt Black Screw
120124		M5x30tc Black Screw

Note:

- All dimensions are in mm unless otherwise specified.
- The screw description is defined as follows:
  type of screw + diameter + X + length + type of head
  where type of screw is one of these:
  M = Metric thread
  B = Self-tapping screw for metal
  WL = Self-tapping screw for wood
  and type of head is one of these:
  tc = cylinder Phillips head
  ts = flared Phillips head
  tt = rounded Phillips head
  te = hexagonal nut head
  tsp = flat flared Phillips head
  tce = cylinder Allen hexagonal head
  tspe = flat flared Allen hexagonal head
- The washer description is defined as follow:
  hole diameter + X + external diameter + X + thick
- Each spare part is single quantity unless otherwise specified.
- Asterisk prefix explanation:
  Omitted = First level spare part.
  One asterisk = Second level, part of previous listed first level part.
  Two asterisk = Third level, part of previous listed second level part.
  Three asterisk = ...
- Any request for not above mentioned part must encompass specific description including:
  1) Model name,
  2) Section name,
  3) Module code,
  4) Reference name,
  5) Quantity number.