

510
SINGLE CHANNEL
PROFESSIONAL
POWER AMPLIFIER

USER MANUAL

Q U A D

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1.0 DESCRIPTION

Introduction

The Quad 510 is a single channel power amplifier designed for professional users including broadcast, power signal distribution and public address. The main feature of the Quad 510 power amplifier is the fitting of a heavy duty output transformer. The power output is best described as a minimum of 150VA into a range of loads to which the Quad 510 can be matched by correct selection of the appropriate taps on its output transformer.

Applications include working 100v line systems but, as the Quad 510 is able to provide a match to loads between 2Ω and 80Ω , the uses of the amplifier are also suited to driving particularly non-standard loads. The Quad 510 amplifier will also provide a very high quality amplification for the discerning music listener whose requirements to drive particular loudspeakers can be best met by this unique amplifier.

Input and output 'signal present' indicators are provided and these can provide a useful diagnostic aid particularly when a number of amplifiers are mounted in the same rack. The intensity of the indicators is dependent on the level of the programme.

The Quad 510 amplifier uses an implementation of the current dumping technique. This circuit topology was first used on the renowned Quad 405 amplifier and resulted in the award of a Queen's Award for Technological Innovation.

The Quad 510 is constructed in a rugged case which is designed to withstand reasonable treatment by professional users.

Current Dumping

Current dumping involves a feed forward error correction technique and it eliminates many of the problems associated with transistor amplifiers. It is covered by patents in several countries. In a current dumping amplifier there is in effect both a low power very high quality amplifier and a high power heavy duty amplifier.

The low power amplifier controls the loudspeakers at all times and it calls upon the high power amplifier to provide most of the muscle. The small amplifier is arranged so that provided that the large power transistors can deliver almost the full amount of required output current the small low power amplifier will provide the remainder accurately and completely. Therefore the output signal quality is solely dependent on the performance of the small signal amplifier and since this amplifier is only required to deliver low powers it can be made very accurate indeed.

The problems of crossover distortion, quiescent current adjustment, thermal tracking and transistor matching disappear. Current dumping amplifiers require no internal adjustments or alignment and the choice of output power transistor types is less restrictive.

Options

The Quad 510 power amplifier is fitted with balanced signal inputs using a valve based type transformer assembly. Further, as a consequence of using a special non-toroidal transformer there is no need for a mains inrush current limiter to be fitted.

The balanced transformer input on the Quad 510 is ideally suited in systems which are driven from balanced lines or where isolation is required. This arrangement also ensures trouble free use within unbalanced systems provided sensible grounding policies are adhered to.

Variants

There are no major variants of the Quad 510. The standard version of the Quad 510 uses a XLR, 3 pole chassis mounted socket for the input and a Neutrik NL4FC output connector. The amplifier has a balanced level control and the sensitivity is -4dBu for full output into a matched load.

2.0 INSTALLATION

The Quad 510 amplifier is shipped in a protective polystyrene shell and packed in a heavy duty cardboard carton. The packing materials should be retained for use in the unlikely event of a return for servicing being necessary.

Contents

The packing contains the following:

Main Unit:	One Quad 510 version amplifier.
Accessories:	One 2m length of IEC socket terminated mains lead. Part No. QESOE2A. One manual. Part No. OI518EC. One NL4FC cable mounting connector to match that mounted on the chassis. Part No. PPNL4FC. (An adhesive label which indicates the wiring convention is also supplied). One GRP board comprising 6 edge connector cards with gold plated connections. Part No. I12825A (to be used in setting the output to the required load impedance, each card is marked for a different output voltage range).

Shortages should be notified to the Distributor or the Factory as appropriate. Further supplies of accessories can be purchased as required.

Mains voltage Selection

The Quad 510 can be set internally for either 240/220V or 120/110V ac working. Note that the voltage of the unit as shipped from the factory is clearly marked on the rear panel and a similar clear marking should be made if the setting is changed. Note also that the fuse rating must also be altered to suit, (2.5 AT for 240V and 5 AT for 120V). The setting of the mains voltage involves changing links on the primary of the transformer. The setting of these links is shown in the circuit diagram. The Quad 510 will function safely from mains voltages up to 6% of the nominal 240V ac. Mains voltages lower than the nominal values will reduce the output power available.

Mains Input Connection

The mains input connector is via a standard CEE22 plug and socket. The amplifier chassis must be connected to ground via the mains supply lead. A simple retaining clip ensures that the mains connector cannot be removed accidentally. The mains lead supplied should be wired to the mains supply plug with due regard to following colour conventions:

Brown wire	Live connection
Blue wire	Neutral connection
Green/yellow wire	Safety earth

The Brown wire must be connected to the terminal marked L or coloured Red. The Blue wire must be connected to the terminal marked N or coloured Black. The Green/Yellow wire must be connected to the terminal marked E or coloured Green or Green/Yellow.

Note: The amplifier must be protected by a 10A fuse when a 13A plug is used, or if another type of plug is used, by a 10A fuse either in the plug or adapter, or at the distribution board. If in doubt consult a qualified electrician.

Earthing Requirements

It is usually a safety requirement that the mains lead earth connection is properly connected to the amplifier chassis.

Connectors

There exists a variety of input and output connector conventions. The Quad 510 is supplied with the wiring convention for the input XLR style connector marked on the rear panel. Certain markets have standardised on the so called NAB convention. It should be noted that some manufacturers have used the alternative gender of chassis connector.

IEC Input Convention

As supplied for UK models.

Chassis Mounted Socket

Pin 1: Chassis
Pin 2: Hot or phase
Pin 3: Cold or signal return

Note: On XLR connectors pin 1 mates before the other two pins and thus makes the safety earth first.

NAB Input Convention

To special order.

Chassis Mounted Socket

Pin 1: Cold or signal return
Pin 2: Connected to pin 1
Pin 3: Hot or phase

Neutrik Speakon Connector

Neutrik Speakon output convention for single output 100V line systems (supplied as standard on most models).

Chassis Mounted Socket

Pin 1+: Not used
Pin 1-: Amplifier safety earth
Pin 2+: Amplifier 'low' or 'cold' connection
Pin 2-: Amplifier 'hot' output

Note: If there is any distinction between the so called hot and cold outputs of a transformer within the installation then it is recommended that the connection which is closer to 0V or ground should be treated as the low or cold terminal.

IEC Output Convention

To special order.

Chassis Mounted plug

Pin 1: Not used
Pin 2: Amplifier output
Pin 3: Amplifier return or 0V

NAB Output Convention

To special order.

Chassis Mounted Plug

Pin 1: Amplifier return or 0V

Pin 2: Connected to pin 1

Pin 3: Amplifier output

Output Connection Requirements

The NAB convention does not have the advantage of a safety earth connection to the input socket. Also the sense of the output connections are reversed which could cause an amplifier output to be shorted in some systems.

The use of the Neutrik Speakon connector provides power amplifiers with a dedicated output connector which has been designed for high current loads. It obviates the problems often associated with binding posts and provides a sensible way out of the quandary of XLR genders and wiring conventions. It additionally provides a higher current rating than the XLR styles, a better cable grip, the option of solderless installation and the forthcoming acceptance as a standard throughout the IEC.

Optimum performance will only be achieved if the amplifier is correctly grounded. The amplifier should be treated as a four terminal device and care must be taken to ensure that there is no connection between the cold sides of an input and related output.

The following points must be observed:

- 1 Output cables which have the cold pin connected to the chassis should not be used.
- 2 The cold side of the input should not be connected to the cold side of the output.
- 3 A chassis connection for the screen, if required, can be obtained on pin 1 of the XLR input connector on the IEC wiring convention only.

3.0 OPERATION

The amplifier is switched on by the power switch on the front panel. The green front panel mounted LED should light. The gain can be adjusted by the gain control which is fitted with a simple tamper resistant device. Gain is at maximum when the control is rotated fully clockwise. The 0 dBu marking represents the point where maximum output can be obtained for a 0 dBu (0.775V rms) input level. This may be used as a convenient reference point.

Output Load Matching

The Quad 510 amplifier is supplied with a strip of gold plated pcb edge connector cards which should be used to set the amplifier output transformer to match the intended load.

Reference to the circuit diagram will show that the printed track on the small pcb cards allow the 6 major useful matching points to be achieved simply by breaking off the correct one and plugging it in.

The six available taps and their matched loads with the nominal maximum output voltage at full power are:

2Ω=17V rms 4.5Ω=25V rms 8Ω= 33V rms

18Ω=50V rms 32Ω =67V rms 80Ω=100V rms

The 6 pcb.cards are labelled and it is a simple matter to break off the required one and insert it, the correct way up, into the socket through the slot in the rear panel of the amplifier. The remaining cards should be retained for future use.

Output Configurations

A useful property of a transformer coupled amplifier is the ability to connect it in series or parallel. This is a direct consequence of the provision of a transformer coupled input and output. It is necessary, of course, to maintain the isolation between input and output signal paths in order to capitalise on this attribute. Connection in series will provide greater output voltage swings whilst connection in parallel will allow the delivery of greater current into a low impedance. Note that in this regard the input and the output of the Quad 510 amplifier are in the same phase.

Signal Indicators

The Quad 510 amplifier is fitted with visual input and output 'signal present' indicators. These will light when signals are present and they can provide a useful diagnostic aid particularly if a number of amplifiers are mounted in the same rack. The indicator intensity is dependent on the level of the programme signal.

Protection

The Quad 510 amplifier includes full protection against short circuits, input overload and inadequate ventilation. It is fitted with a thermal sensor which, when an excessive temperature is detected for any reason, switches off the amplifier until it has cooled sufficiently. When the thermal trip point has been reached the front panel power LED will go out. The amplifier channel will cycle through this process until the cause of overheating is corrected or the input signal is reduced.

Fuse

The replacement fuse value is:

FS2: Mains fuse 240V ac supply 20x5 mm T2.5A

FS2: Mains fuse 120V ac supply 20x5 mm T5A

The replacement of FS2 requires removal of the IEC mains plug.

Thermal Considerations

The Quad 510 amplifier is designed for mounting in a nominal 483 mm (19inch) wide rack in which it occupies a 2U (89 mm) space. It can, of course, be used free standing. In either situation adequate free flowing ventilation should be provided. In enclosed spaces, for example when placed in a rack with other equipment which dissipates significant heat, then consideration should be given to the provision of forced ventilation.

4.0 SERVICE AND MAINTENANCE

The Quad 510 amplifier is carefully tested and inspected in all of the stages during the manufacturing process and before packing and delivery to ensure that it will provide many years of reliable service. All amplifiers are soak tested for at least 24 hours before being subjected to a second visit to the final electronics test area.

In the rare circumstance of failure the Quad 510 amplifier can usually be serviced in the field by replacing a complete amplifier board and associated heatsinks assembly. The replacement procedure requires a Pozidrive screwdriver only. No setting up or electronic alignment is required. Replacement modules and individual components (which can be identified by way of the related parts list and circuit diagram) should be obtained through the vendor from whom the amplifier was purchased. It will be necessary to quote the amplifier serial number.

If the amplifier has to be returned to the vendor or directly to Quad then it should be sent in its original packing.

Warranty

The Quad 510 amplifier is guaranteed against any defect in material or workmanship for a period of twelve months from the date of purchase. Within this period the supply of replacement parts will be free of charge provided that the failure was not due to misuse, accident or negligence. Freight costs are not covered unless this has been locally agreed. Within the UK the guarantee offered with this equipment does not limit the customer's statutory rights. A guarantee card is not supplied with this unit and the guarantee period commences on the day on which the unit is delivered.

Preventative Maintenance

There are no user adjustable controls within the Quad 510 amplifier. Like any equipment of its class it will not benefit from immersion in liquids nor if it is resident in a damp environment for any appreciable time. Both operating and storage temperatures should be maintained within the range of -5°C to $+45^{\circ}\text{C}$. The panel work may be cleaned using a moist cloth. Strong organic solvents should be avoided as they are likely to have a deleterious effect on the paint finish.

Repair

Where repair is not, for a variety of reasons, a matter of simply replacing a module reference should be made to the circuit diagram and the related parts list in order to ascertain the appropriate replacement part number. These parts will be held by and are available from Quad and its Distributors.

Packing

If the amplifier is returned to Quad it is desirable that the original packing is used. The equipment will be returned in this packing where possible. Quad will charge for the use of fresh packing materials where used.

Spares

Spare parts are not normally supplied as part of each amplifier. However in any particular application Quad will be pleased to consider any request to provide, for a given shipment or installation, a spares provision. The contents of this would be negotiated as required. A spares parts list is available for isolated spares requirements and parts can be requested through Quad's distributors or through Quad directly.

5.0 TECHNICAL

The technical details of the 510 amplifier is given in this section.

Circuit Description

The circuit diagram should be referred to. The detailed function of the parts of the circuit should be apparent to those aware of discrete analog design techniques. A few guiding notes may help.

T2 is the amplifier input transistor and also the input to the high quality low power class A amplifier which fills in where the current dumpers leave off. T12, 13, 14, 15 are the output devices and protection is provided by T6 and T9 and their associated circuitry. DC control is provided by IC1 and its associated feedback path. The current dumping bridge is formed by C8, R31A+B, R30 and L3. R33 and C9 form a classic Zobel network. The output transformer, L6, is connected directly to the amplifier output. L6 is a specially designed and manufactured transformer and L5 is the valve based screened input transformer.

The signal detecting circuitry is formed around IC100. Similar circuitry is fed with a buffered version of the input signal and by an attenuated version of the output signal.

The power supply comprises a simple diode bridge and capacitor system.

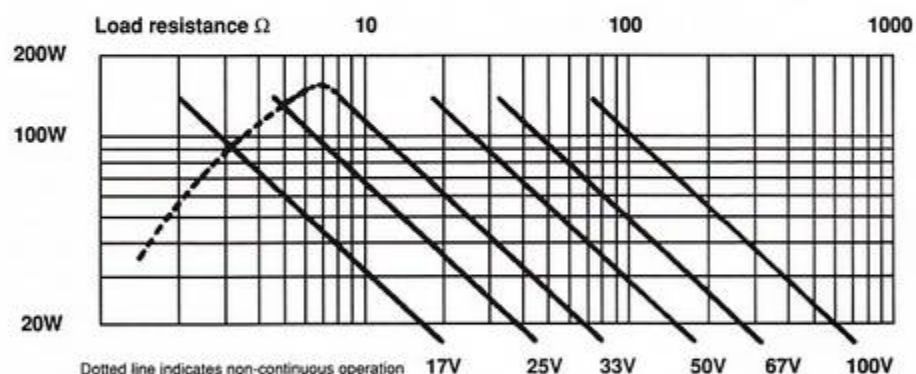
Parts List

For the most part the amplifier employs readily available components whose provenance will not normally be the cause of any great difficulty. Some parts are clearly specialised and these should be obtained from Quad or its authorised professional distributors.

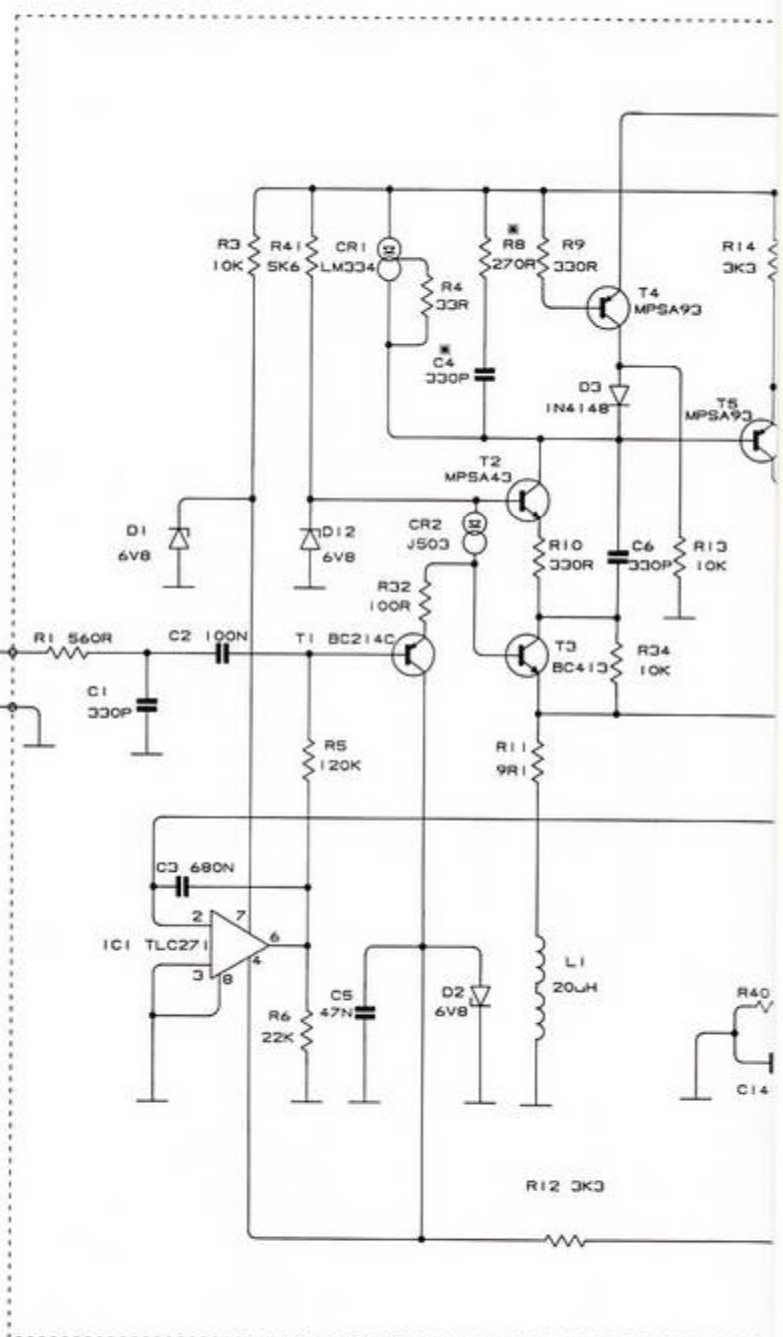
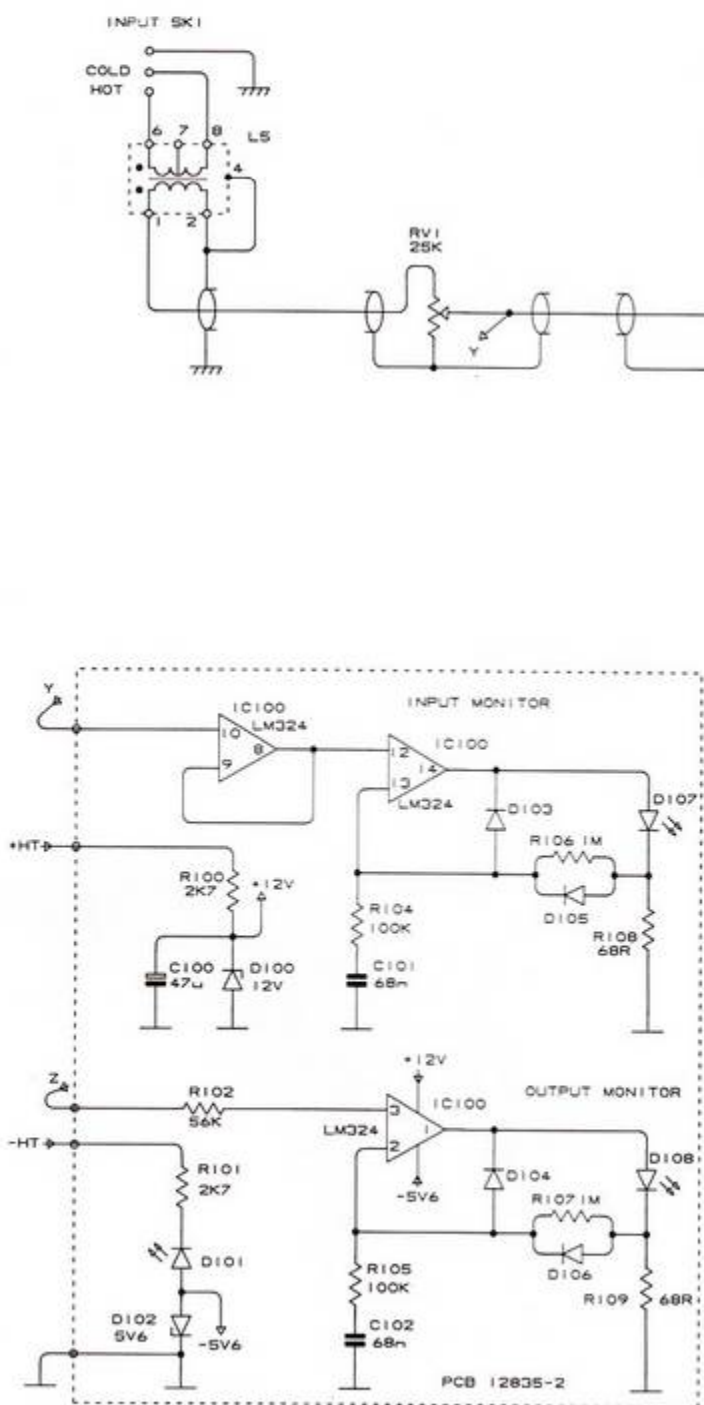
Performance Specification

Power Output (typ):	150W into any matched load at 1 kHz <0.1% THD+N, 240V supply
Frequency Response:	40 Hz-20 kHz -0.5 dB ref 1 kHz
Power Response:	25 Hz-30 kHz -3 dB ref 1 kHz
Distortion:	<0.03% THD+N, 40 Hz any level up to 135W <0.01% THD+N, 1 kHz any level up to 135W <0.1% THD+N, 20 kHz any level up to 135W
Input Sensitivity:	500 mV (-2 dBu) for 135W output
Hum And Noise:	-115 dB 'A' wtd ref full power 15.7 kHz bandwidth
Input Impedance:	20 k Ω in parallel with 50H
Output Regulation:	<10%
Load Impedance Matching:	2 Ω (17V rms) to 72 Ω (100V rms)
Phase:	Input and output are in phase
Load Stability:	Unconditional, any load
Power Requirements:	350 VA
Thermal Protection:	85°C, internal heatsink temperature
Weight:	13 kg, less packing
Dimensions:	W483 (19W" rack) x H89 (2U) x D320 mm

Graph of Max. Power Output Versus Load Impedance

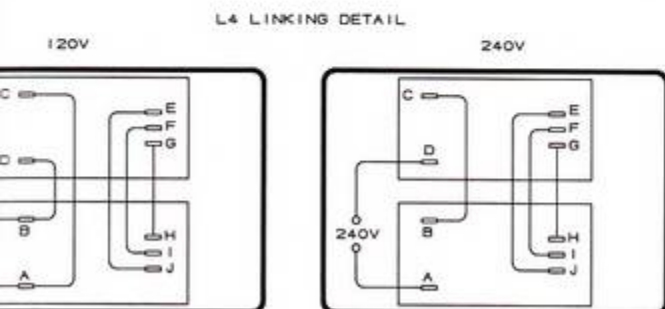
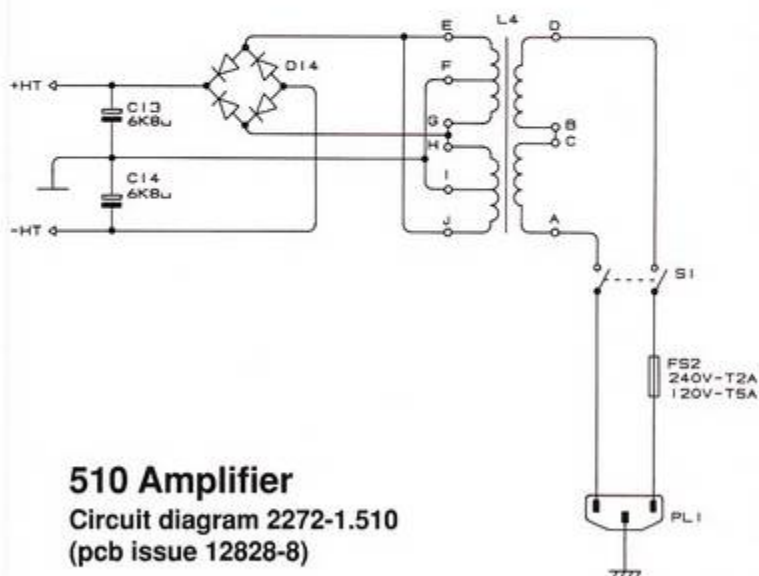
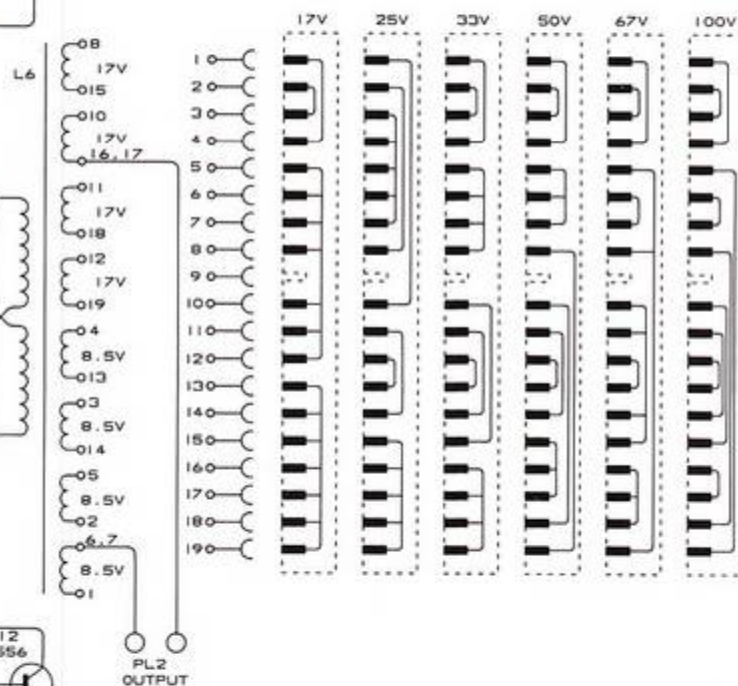
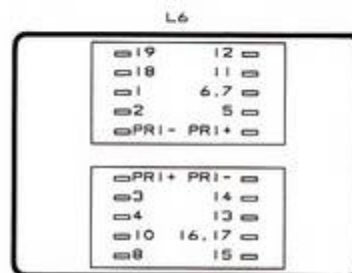
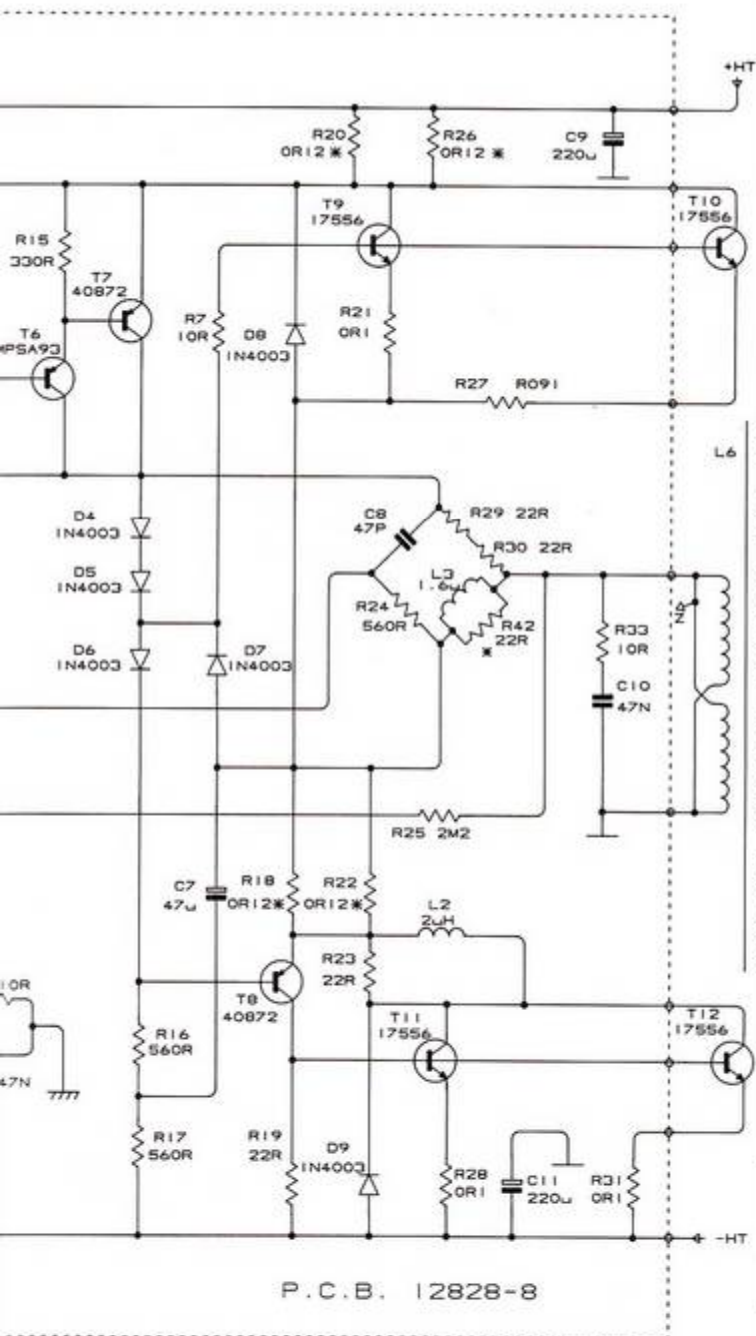


The right is reserved to alter performance and specifications as required.



* VALUE SUBJECT TO CHANGE
 17556 ALTERNATIVE - MJ15003
 MPSA93 ALTERNATIVE - ZTX 542





510 Amplifier
Circuit diagram 2272-1.510
(pcb issue 12828-8)