Pye Telecommunications Limited Cambridge England.
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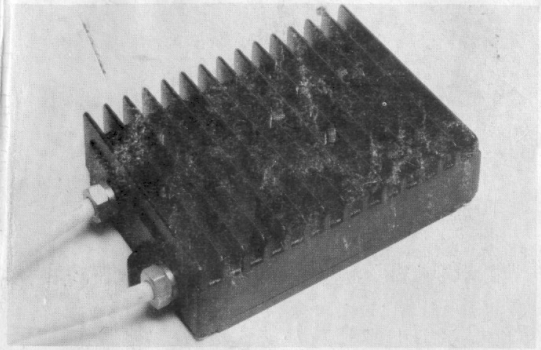
50P

VOLTAGE REGULATOR (24–12V)
TYPE VR200
SERVICE MANUAL

Issue 2 Sept '76



SECTION 1
GENERAL INFORMATION

SUMMARY OF DATA

Input Supply	24V DC nominal at 5A Working range 22–32V
Output	12V DC nominal at 5A Adjustable between 12,5V and 14,5V
Fusing	5A (input and output)
Switching	In negative line, linked to associated radiotelephone OFF/ON switch
Dimensions (over major projections)	207mm wide x 52mm high x 133mm deep (8,15 in. x 2,05 in. x 5,25 in.)
Weight	1,60 kg (3lb 9oz)
Casing	Die-cast, finned, weatherproof.

Typical figures based on normal operating conditions

INTRODUCTION

The Voltage Regulator (24–12V) Type VR200 is a self contained add-on unit, designed to permit operation from a 24V DC supply of 12V AM or FM radiotelephones having a current consumption of up to 5A. Negative line switching is controlled by the OFF/ON switch of the radiotelephone.

A protection circuit against reverse polarity and short circuits is incorporated.

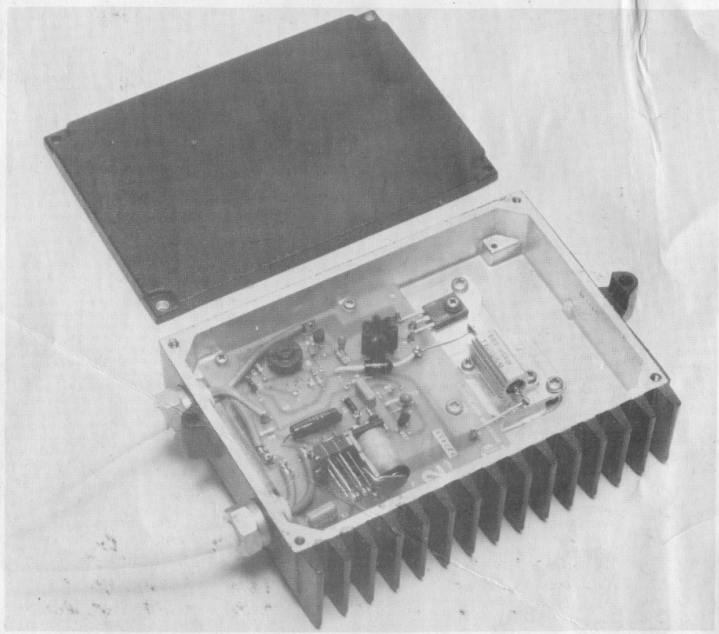
External connections are made by two flying cables.

CONSTRUCTION

The unit consists of a motherboard mounted in a heavy duty, die-cast weatherproof case.

With the exception of TR3 and R9 all the circuitry is accommodated on the motherboard. TR3 and R9 are secured by one and two M3 x 8 mm screws respectively to a heatsink which, in turn, is secured to the case by three M4 x 16 mm screws.

An input cable and an output cable are provided, both of which enter the case via weatherproof glands. The case is sealed by the cover, fitted with an insert gasket and secured by four M4 x 20 mm screws.



SECTION 2
INSTALLATION

PRE-INSTALLATION CHECKS

CAUTION

'Pozidriv' screws are used throughout this equipment. Use only the appropriate size of 'Pozidriv' screwdrivers.

1. Unpack container and check Installation Items against parts list. (See Section 5). Check that no obvious damage has occured during transit.

   NOTE: Pye Telecommunications Ltd. must be advised by letter of any shortage or damage within 10 days of receipt.

2. Observing polarity, connect Test Load (i.e. radiotelephone), set to 'off', to the brown and blue leads of the 12V cable.

3. Fit 5A fuses into fuseholder and connect power supply to 24V input, ensuring that the polarity of the supply is correct. Adjust the power supply for 32V output.

4. Connect switched negative line (yellow/green lead of the 12V cable) to power supply negative terminal and use meter to check the 'off load' supply current consumption is between 90 and 130 mA. Switch off supply.

5. Connect meter (set to 25V) across the Test Load. Switch on Test Load and check that the output voltage is not less than 13,5V for a maximum load current of 5A.

INSTALLATION PROCEDURE

Equipment Required

Installation Items (See under headed title in Section 5 – Parts List)

'Pozidriv' and flat-blade screwdrivers for mounting screws

Soldering Iron

Power drill for drilling mounting holes

Drill for No. 6 Self-tapping screws: 2,80mm (or No. 35)

Drill for No. 10 self-tapping screws: 3,40mm (or No. 29)

NOTES: 1. *Instructions for installing the radiotelephone are shown in the appropriate Installation Instruction and/or Service Manual. The equipment should be installed in line with the code of practice for installation of mobile radio (available from the Service Department).*

Notes Contd

2. *Power leads are colour coded: Brown = positive, Blue = Negative. The negative switching lead (in the 12V cable) is coded yellow/green.*
3. *Cables (not supplied) used between; battery and Fuseholder (8), radiotelephone connector block and Terminal Block (9), switching lead connections of Terminal Blocks (9) and (10), should be 2,5 mm (70/0070).*
4. *The item to be fitted can be used as a drilling template.*
5. *If possible, the cables should be routed away from the areas of extreme heat and possible battery acid leakage; to minimize noise pick-up, they should be kept clear of ignition circuits.*
6. *Wherever possible, existing holes in the bulkhead should be used. If metalwork has to be drilled, ensure that the new holes are fitted with grommets.*
7. *Before finalising the sites of the items to be fitted, check their feasibility by running the cables.*
8. *Refer to the Typical Installation Diagram, Figure 2.1, throughout this procedure.*

Procedure

NOTE *In this procedure the operations marked with an asterisk are necessary only when the radiotelephone is not fitted with an ancillary switching lead as standard.*

*1. Remove radiotelephone from the cradle and take off cover. Fit 500mm length of 3-lead 2,5mm cable as instructed in the appropriate Installation Instruction or Service Manual for the radiotelephone equipment. Replace cover and refit radiotelephone to cradle.

*2. Locate 3-way Terminal Block (10) within 500mm run of 3-lead cable entry. Drill out and secure (10) with two No. 6 slot pan head self-tapping screws.

3. Locate Fuseholder (5) (part of radiotelephone installation items) within 500mm run of radiotelephone power lead. Drill out and secure Fuseholder (5) with two No. 6 slot pan head self-tapping screws. Do not fit fuses at this stage.

4. Select and mark a clean (preferably) dry site for the Regulator (7), ensuring that adequate ventilation is provided. From this position, determine the site of 3-way Terminal Block (9) within 1 metre run of the VR200 (7).

5. Locate Fuseholder (8) as close as possible to the vehicle battery and preferably within 1 metre run of the VR200 (7).

6. Place the VR200 mounting plate on the site selected and using it as a template drill out and secure using four No. 10 slot pan head self-tapping screws. Secure the VR200 to the mounting plate with the two M5 screws.

7. Terminal Block (9) and Fuseholder (8) – using each item in turn as a template, drill out and secure using two No. 6 slot pan head self-tapping screws per item. Do not fit fuses at this stage.

8. Connect the VR200 12V power and switching cable to Terminal Block (9).

9. Observing polarity, link the brown and blue leads of Terminal Block (9) to the radiotelephone Connector Block (4) via fuseholder (5) so that both leads are fused.

*10. Link the yellow/green leads of Terminal Blocks (9) and (10) to complete the switching circuit.

11. For radiotelephones fitted with ancillary switching lead as standard; connect switching lead to the yellow/green lead of Terminal Block (9) to complete the switching circuit.

12. Connect VR200 24V power cable to Fuseholder (8) to fuse both leads.

NOTE: 3-lead cable is provided for both the 12V and 24V cables of the VR200. As only two leads (brown and blue) are used to connect the 24V supply, the yellow/green lead should be trimmed back to the outer insulation of the 24V cable.

13. Observing polarity, connect Fuseholder (8) to the 24V battery (6) using leads which are not common to any other circuit.

14. Check that the installation is correct.

15. Insert 5A fuses in Fuseholders (5) and (8).

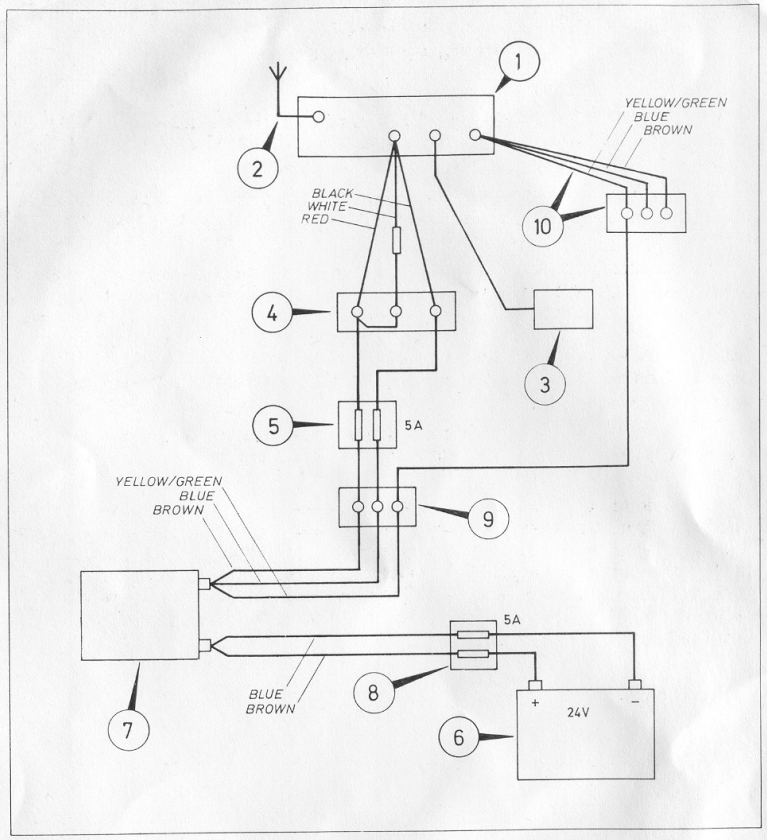


Fig. 2.1 Typical Installation

LEGEND

1. Radiotelephone
2. Antenna
3. Loudspeaker
4. Connector Block
5. Fuseholder
6. Battery
7. VR200
8. Fuseholder
9. Connector Block
10. Lead Assembly (Including Connector Block)

SECTION 3
TECHNICAL DESCRIPTION

Essentially, the VR200 Regulator circuit consists of a series limiter (TR3) controlled by TR1 and TR2. Polarity protection is provided by D1. Protection against excessive voltage output from the VR200 is provided by CSR1.

Completing a switched negative supply causes relay RLA/2 to energise; contacts A1 and A2 close to connect the 24V DC input supply to activate the regulator.

Transistor TR2 samples the regulated output voltage and compares it with the reference voltage, determined by zener diode D4. Any change in the output voltage develops an error signal between TR2 base and emitter which is applied to the base of TR1 causing the volt-drop to vary in such a manner as to restore the output voltage at the emitter of the power transistor (TR3) to normal (12,5V–14,5V depending on the setting of potentiometer RV1). The output is thus stabilised against changes whether produced by variations of input voltage or load current.

Polarity protection is provided by D1 which, in the event of the input connections being reversed, prevents RLA from energising thus preventing the reversed input supply being applied to the regulator circuit.

Certain fault conditions may cause excessive voltage output from the regulator. Protection against excessive output voltages, and therefore protection of the radiotelephone, is provided by thyristor CSR1. This fault condition causes CSR1 to conduct, resulting in RLA being de-energised and the load current to fall to zero. The protection circuit is automatically reset when the equipment is switched off. The main protection against transient pulse voltages in the supply line is provided by diode D5.

SECTION 4
SERVICING

PRECAUTIONS AND GENERAL INFORMATION

'Pozidriv' Screws

'Pozidriv' screws are used throughout this equipment. Only the correct size of 'Pozidriv' screwdriver should be used to release or tighten these screws. The use of any other screwdriver type can result in severe damage to the screw-head.

Replacement of Wire-Ended Components

When replacing wire-end components, ensure that the wires do not protrude more than 1mm beyond the printed wiring surface. Failure to do this may result in short circuiting the component to the casing.

Soldering

Soldering operations should be kept to a minimum. Ensure that the equipment is switched off before soldering. Printed conductor should be clean before applying solder or soldering iron. The amount of solder applied and the dwell time of the soldering iron should be kept to the minimum required for practical purposes. Avoid excessive heat by using heat shunts. Always check that the hole in the printed conductor is clear of solder before fitting a component. Wherever possible a low voltage DC soldering iron, with an earthed bit, should be used.

When soldering wire ends into plated-through holes fitted on the printed wire board, ensure that the solder flows through the hole to emerge on the other side of the board.

Printed Circuits

Take particular care not to bend the printed wiring board when removing and replacing it, or when working on it. Bending can cause hairline breaks in the printed conductors and such breaks are very difficult to locate. Do not connect test leads to a printed conductor.

EQUIPMENT ACCESS

Tools Required

'Pozidriv' screwdrivers No. 1 and 2.

Soldering iron

Procedure

Release the 4 x M4 screws which secure the cover to the case; lift the cover and carefully remove the insert gasket.

To remove the exposed printed wiring board and chassis mounted components, unsolder the input and output leads and release; the M3 screw securing the power transistor (TR3), the 2 x M3 screws securing the resistor (R9) and the 4 x M3 screws securing the printed wiring board. Carefully withdraw the board with the attached components from the equipment case.

Component Replacement

When replacing components which are screwed to the equipment case, ensure that the mating surfaces of the case and the components are thoroughly clean and are lightly coated with thermal grease (i.e. Dow Corning Type 340 heat sink compound).

TEST EQUIPMENT

Unless otherwise suitably equipped with test equipment of the calibre required for fault location and repair of the VR200, the following list of test equipment is suitable.

Power Supply	Adjustable 0–32V DC 6A minimum	
Multimeter	20,000Ω/volt	Pye TM1A or Avometer Model 8
10kΩ Resistor	±5% 0,25W	Pye Part No. PM01448
Test Load		Radiotelephone
AC Millivoltmeter		

CHECKS AND ADJUSTMENTS

(a) Check that the resistance between:—
  (i) positive input lead and case
  (ii) negative input lead and case
  is infinity in each instance.

(b) Check that the resistance between the positive and negative leads of the 24V input cable is greater than 10k ohms.

(c) Connect the Test Load (set to 'off') to the brown and blue leads (observing polarity) of the 12V output cable.

(d) Connect the Power Supply Unit to the 24V input cable (observing polarity) and adjust it for 32V output.

(e) Connect switched negative line (yellow/green lead of the 12V output cable) to Power Supply Unit negative and check that relay RLA operates.

(f) Connect meter (set to 25V) across Test Load and adjust RV1 for reading of 14,5V; check that the supply current consumption is between 90 and 130mA.

(g) Switch on the Test Load and check that the output voltage is not less than 13,5V when drawing maximum current. Check that any high frequency ripple on the output line is less than 2mV.

(h) Switch off and disconnect test equipment.

Over Voltage Protection Circuit Check

NOTE: The following check should be undertaken only if any of the following components are changed:— D3, D6, R3, R4, R5, C3 and CSR1.

(i) Switch off power supply unit.

(ii) Disconnect Test Load and connect a 10kΩ resistor to the brown and blue leads of the 12V output cable.

(iii) Reduce the input voltage to less than 15V and short circuit the collector and emitter of TR3.

(iv) Switch on power supply unit and slowly increase input voltage until thyristor CSR1 conducts, thus causing RLA to be de-energised and the load current to fall to zero. Check that this input voltage is between 17,5V and 21V.

(v) Switch off power supply unit, remove short circuit and carry out checks (a) to (h).

SECTION 5
PARTS LISTS

NOTATION

In the following Parts Lists component values are designated as follows:—

Capacitors Values given in micro Farads unless otherwise stated

22	= 22 microFarad	(F x 10^{-6})
22n	= 22 nanoFarad	(F x 10^{-9})
22p	= 22 picoFarad	(F x 10^{-12})

Fractional values shown thus:

2u2	= 2,2 microFarad	(22 x 10^{-7})F
2n2	= 2,2 nanoFarad	(22 x 10^{-10})F
2p2	= 2,2 picoFarad	(22 x 10^{-13})F

Resistors Values given in Ohms unless otherwise stated

22	= 22 ohms	
22k	= 22 kilohms	(Ohms x 10^{3})
22M	= 22 Megohms	(Ohms x 10^{6})

Fractional values are shown thus:

2Ω2	= 2,2 ohms	
2k2	= 2,2 kilohms	= (22 x 10^{2})
2M2	= 2,2 Megohms	= (22 x 10^{5})

ORDERING OF SPARE PARTS

When ordering spares, please quote the description and Part No. of the item and the part number of the sub-assembly on which it is used together with the equipment code number given on the identity plate fixed to the side of the equipment.

The right is reserved to fit alternative types of semiconductors with equal or improved performance to those quoted in the Parts List.

ABBREVIATIONS

carbon film	c. flim	printed wiring board	PWB
electrolytic	elect.	steel	st.
polyester	poly	wire wound	w.w

VOLTAGE REGULATOR (24V–12V) TYPE VR200
AT04703

MISCELLANEOUS ITEMS

Description	Part No.	Remarks/Code
PWB Regulator Assembly	AT27678	see headed list
Cover	BT15621	
Gland, 2 off	BT17678	
Gland Nut, 2 off	BT19206	
Gland Washer, 4 off	BT29217	
Washer Gasket, 2 off	BT29218	
Sealing Washer, 2 off	BT29219	
Unit Label	BT18466	
Instruction Label	BT18936	
Heatsink	BT36649/01	For TR3 and R9
Regulator Case	BT39002/01	
'O' Ring	FS15107	
Cable, 3 Core, 2m	FC07326	Input and Output Leads
Identity Sleeve	FS20131/01	12V
Identity Sleeve	FS20131/02	24V
Washer, steel, M3, 4 off	QA15005/A	For PWB to case
Washer, steel, M4 Large, 4 off	QA15007/A	For cover to case
Screws:–		
'Pozidriv', Pan, st, Taptite, M3 x 10,4 off	QJ11552/X1	For PWB to case
'Pozidriv', Pan, st, M3 x 8mm, 3 off	QJ11902/A	For TR3 and R9 to heatsink
'Pozidriv, Pan, st, M4 x 16mm, 3 off	QJ11920/A	For heatsink to case
'Pozidriv', Pan, st, M4 x 20mm, 4 off	QJ11921/A	For cover to case

INSTALLATION ITEMS — AT85737/01

consisting of:–

Mounting Plate Assembly	AT12641	
Fuseholder	FH02837	
Terminal Block, 3-way	FT16450	
Fuses, 5A, 2 off	FF99006	
Washer, st, M5 Large, 2 off	QA15009/A	For mounting plate to case
Screws, 'Pozidriv', Pan, st, M5 x 30mm, 2 off	QJ11937/A	For mounting plate to case
Screws, Slot, Pan, Self Tap, st, No.6 x ¾, 6 off	QW41212/A	2/Fuseholder, 4 Terminal Blocks
Screws, Slot, Pan, Self Tap, st, No.10 x ½,4 off	QQ41208/A	For mounting plate

Switching Lead Assembly — AT12739

Description	Part No.	Remarks/Code
consisting of:–		
Grommet	FG02548	
Terminal Block, 3-Way	FT16450	
Receptacle, Mini, PV strip, 3 off	FC00787	
Black Cable, 500mm	FC07321	

REGULATOR PWB ASSEMBLY
AT27678

CAPACITORS

100n	±10%	100V		Poly.	PQ99501	C1,2
1u	±20%	35V		Elect.	PS99502	C6
100u	±20%	3V		Elect.	PS99510	C3
Not used						C4,C5

RESISTORS

1Ω5	±5%				PL40120	*R9
10	±5%	0,25W	250V	c. film	PM01412	R2
100	±5%	0,25W	250V	c. film	PM01424	R3
220	±5%	6W		w.w	PM01228	R1
470	Linear Potentiometer				PL09603/00	RV1
820	±5%	0,25W	250V	c. film	PM01435	R6
1k	±5%	0,25W	250V	c. film	PM01436	R7,8
1k8	±5%	0,25W	250V	c. film	PM01439	R4
4k7	±5%	0,25W	250V	c. film	PM01444	R5

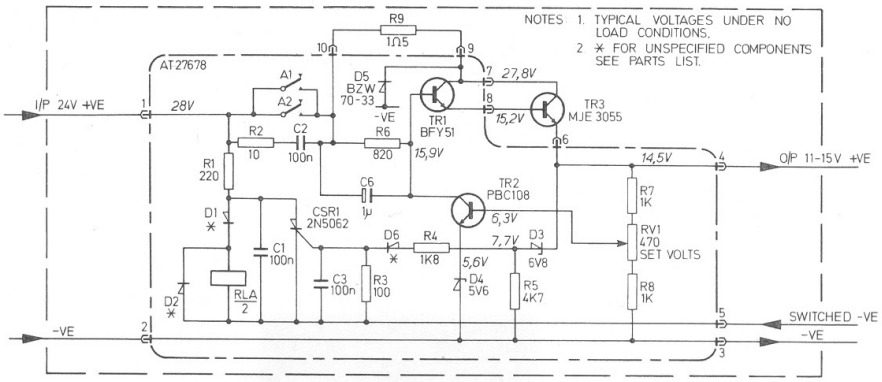
SEMICONDUCTORS

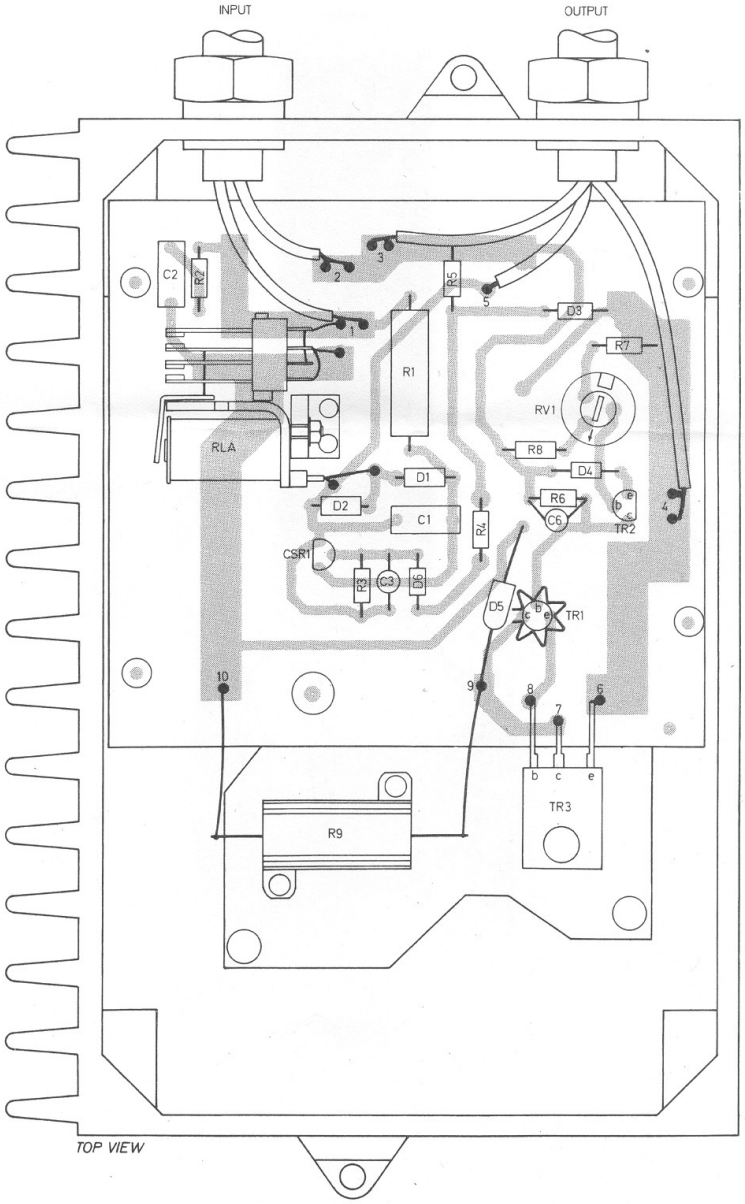
Transistor MJE3055	FV05838	*TR3
Transistor PBC108	FV05800	TR2
Transistor BFY51	FV05803	TR1
Thyristor 2N5062	FV08976	CSR1
Diode 1N4148	FV05808	D6
Diode 5,6V	FV05812	D4
Diode 6,8V	FV05813	D3
Diode BZW 70–33	FV05527	D5
Diode 1N4001	FV05840	D1,2

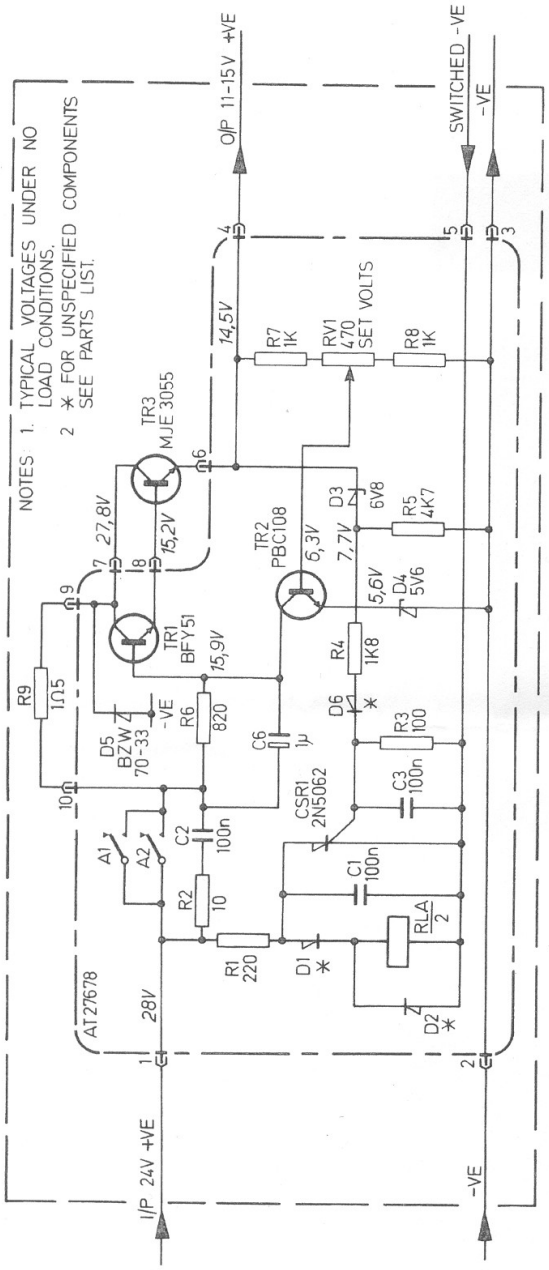
MISCELLANEOUS

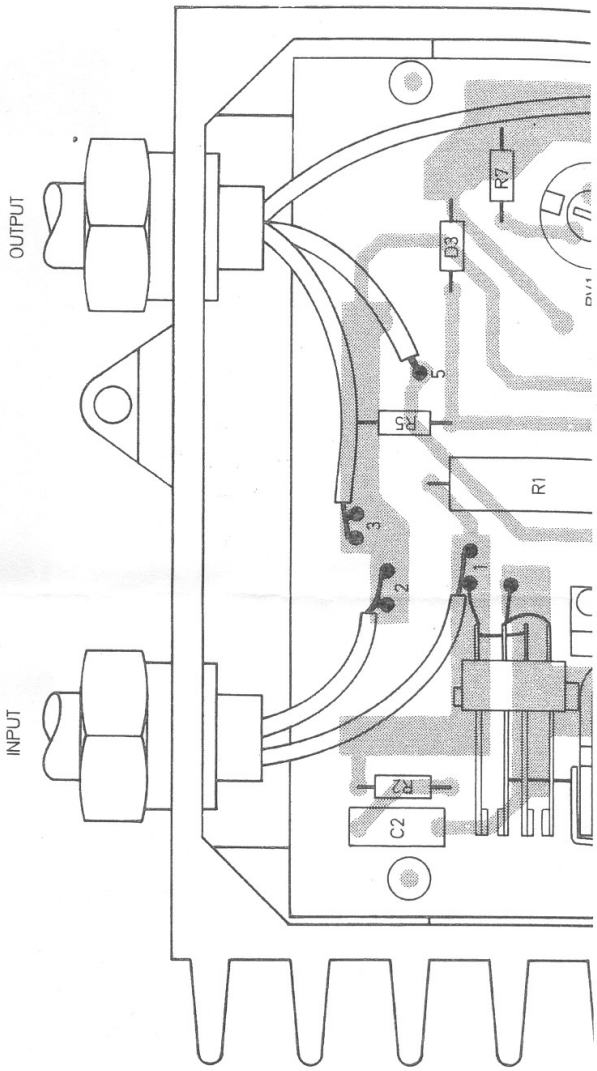
PWB Mechanical Assembly	AT12565	
Bracket	BT11137	For RLA
Relay	FR02718	RLA
Heatsink	EA15164	For TR1
Screws, 'Pozidriv', Pan, st, M2,5 x 6mm, 2 off	QJ11945/A	For relay bracket
Hexagonal Full Nut, st, M2,5 , 2 off	QA11604/A	For relay bracket
Insulating Bead, 2 off	FJ00007	For R1

*Denotes components mounted on heatsink secure to Regulator case


NOTES 1. TYPICAL VOLTAGES UNDER NO LOAD CONDITIONS.
2 * FOR UNSPECIFIED COMPONENTS SEE PARTS LIST.
AT27678
I/P 24V +VE
-VE
O/P 11-15V +VE
SWITCHED -VE
-VE
R9 1Ω15
R1 220
R2 10
C2 100n
R6 820
C6 1μ
D1 *
D2 *
C1 100n
C3 100n
R3 100
RLA
CSR1 2N5062
D6 *
R4 1K8
D4 5V6
R5 4K7
D3 5V8
TR1 BFY51
TR2 PBC108
TR3 MJE 3055
R7 1K
RV1 470 SET VOLTS
R8 1K
28V
27,8V
15,2V
15,9V
14,5V
5,3V
7,7V
5,6V


INPUT
OUTPUT
C2
R2
R5
D3
R7
R1
RV1
RLA
R8
D1
D4
D2
C1
R6
C6
TR2
R4
CSR1
R3
C3
D6
D5
TR1
R9
TR3
b c e
TOP VIEW





G3ZON
1st September 2009