

PROJECT

Regulator KITS

Design by Alan Williamson

Text by Alan Williamson and Maurice Hunt

This article describes a versatile range of compact, easy to build and use fixed voltage, positive- and negative-rail regulator kits. They are available in three current-supplying capacities, of 100mA, 500mA and 1A, and of various voltage ratings.

The regulators can be used in any applications requiring a DC power supply stage capable of supplying a smooth and steady voltage level, and the positive- and negative-rail regulators may be combined as necessary, to create a dual-rail supply – details provided.

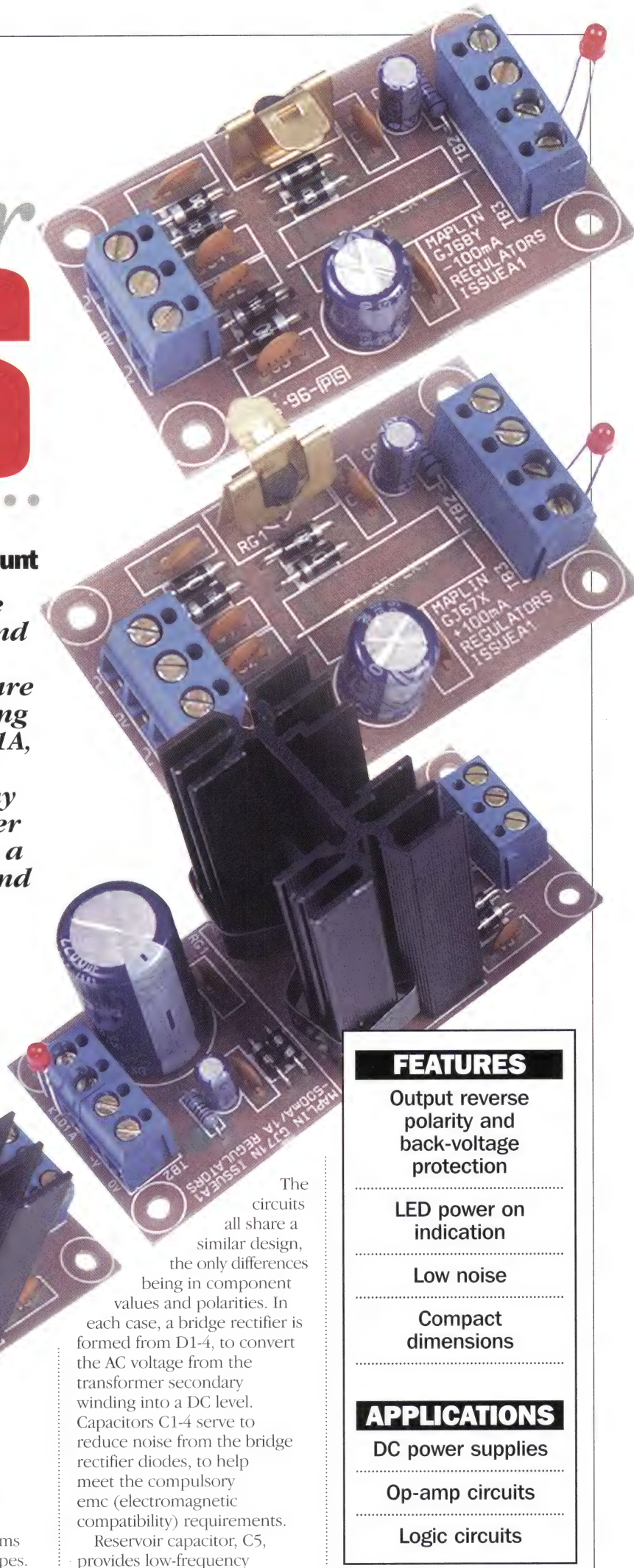
PROJECT RATING

3

Kits Available
See Table 3

Circuit Description

Refer to Figures 1 to 4, showing the circuit diagrams of the various regulator types.



FEATURES

Output reverse polarity and back-voltage protection

LED power on indication

Low noise

Compact dimensions

APPLICATIONS

DC power supplies

Op-amp circuits

Logic circuits

The circuits all share a similar design, the only differences

being in component values and polarities. In

each case, a bridge rectifier is formed from D1-4, to convert the AC voltage from the transformer secondary winding into a DC level. Capacitors C1-4 serve to reduce noise from the bridge rectifier diodes, to help meet the compulsory emc (electromagnetic compatibility) requirements.

Reservoir capacitor, C5, provides low-frequency

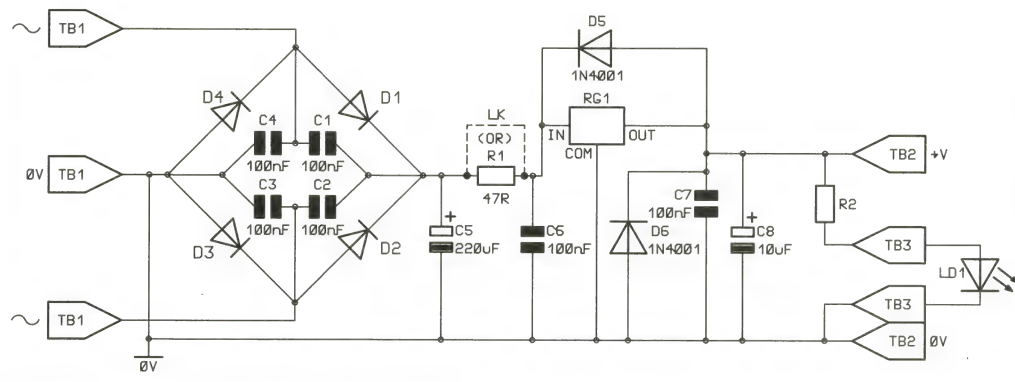


Figure 1. +100mA Regulator circuit diagram.

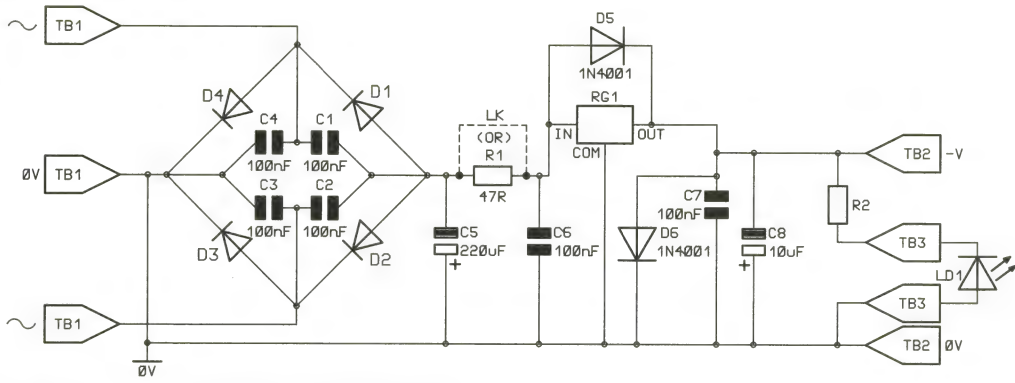


Figure 2. -100mA Regulator circuit diagram.

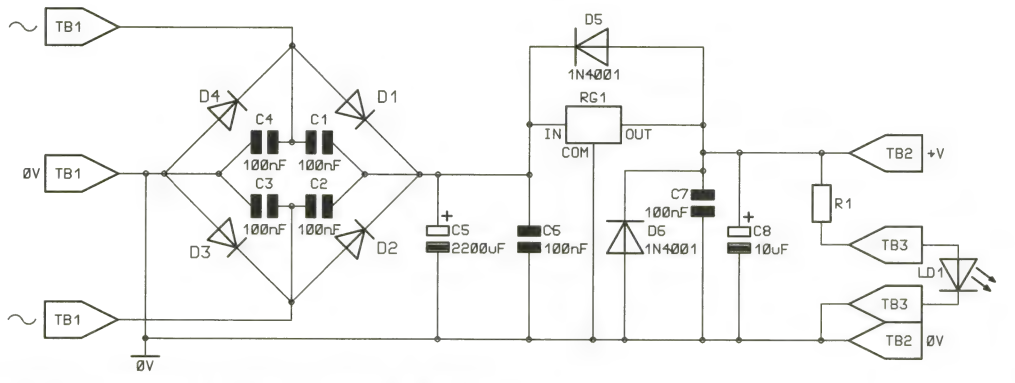


Figure 3. +500mA/1A Regulator circuit diagram.

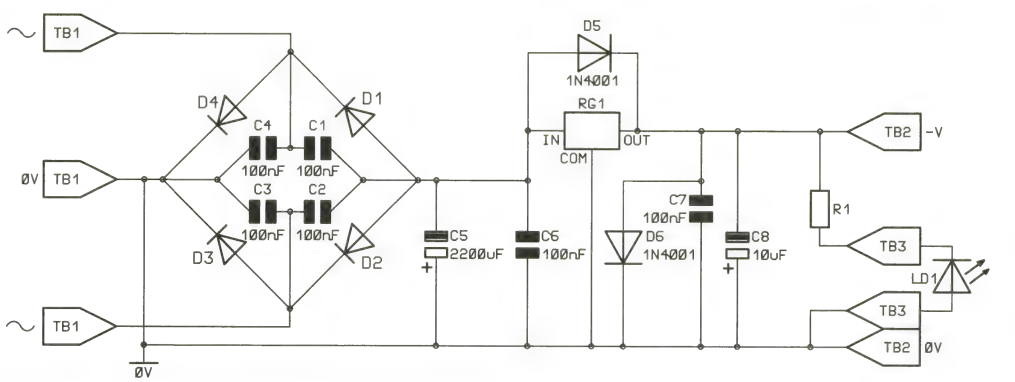


Figure 4. -500mA/1A Regulator circuit diagram.

decoupling of the DC supply, and C6, high-frequency decoupling. Resistor R1 is only fitted on the $\pm 15V$ 100mA regulators, to reduce excess power dissipation of the regulator. RG1 is the voltage regulator employed to govern the output voltage at the required current. Diode D5 is connected in reverse-bias between the RG1's input and output terminals, and protects the regulator if a voltage (of the same polarity) is applied to the output terminals (i.e. from a circuit with a large supply capacitance, for example). D6, conversely, protects the regulator if a voltage of reverse polarity is fed into the output terminals.

C8 provides low-frequency decoupling of the output, while C7 is used for high-frequency decoupling of same. LED LD1 is used to indicate that power is present at the output terminals, and also to provide the required minimum load; if an LED is not required, an equivalent resistive load (minimum 5mA) MUST be fitted in its place. This is particularly important on the negative-rail regulators, to prevent floating of the output voltage. Do NOT alter the resistor value to allow the use of a low-current LED for LD1, since it will not sufficiently load the output.

PCB Construction

Refer to Table 1 if building the 100mA regulators, and Table 2 for the 500mA/1A versions, for details on the components used for a particular regulator – beware of subtle differences! Note that the 500mA/1A regulators share identical PCBs, although in all cases, there are different PCBs for the positive and negative regulators; there are four types of PCB in all. The main visible difference between the various completed boards is in the size of the heatsinks – obviously, the higher the current rating, the larger the heatsink required to dissipate the higher temperature generated. The 100mA regulators have a small clip-on brass heatsink (Type 92F – $36^{\circ}C/W^*$), while the 500mA and 1A regulators have a far more substantial aluminium vaned heatsink, that for the 1A regulators (Type BW50-2 – $5.8^{\circ}C/W$) being around 10mm higher than the Type BW38-2 ($7.2^{\circ}C/W$) heatsink used on the 500mA regulators.

* This value of thermal resistance applies only if the heatsink is fitted to the PCB by means of both its solder lugs.

In all cases, assemble the boards in order of ascending component size, commencing with the wire links (if applicable), but do not fit C5 or the voltage regulator RG1 yet.

Ensure that polarised components (i.e., diodes, electrolytic capacitors and LED) are fitted the correct way round, in accordance with the PCB legend/wiring diagram.

Heatsink Fitting

For the 100mA Regulators, a small brass clip-on heatsink is clipped onto voltage regulator RG1, and soldered to the PCB by means of its two solder tags.

It is important to solder it to the board, to provide adequate heat dissipation.

For the 500mA/1A Regulators, a large vaned aluminium heatsink is used. This should be soldered to the PCB by means of its two posts, BEFORE fitting the regulator. The procedure then is to ensure that the surfaces are clean prior to placing the semiconductor insulator pad between the regulator's metal back and the heatsink. Next, with the regulator in place with its leads in the appropriate PCB holes, affix the clip, by pushing it on at the front, having placed it at the correct height (to match that of the regulator body – NOT the metal tab). Do NOT attempt to slide the clip on along the length of the heatsink. If, for any reason, the clip needs to be removed, use thin-nose pliers to gently release its ends from the heatsink, and lift it away.

Having fitted the heatsink, proceed to fit reservoir capacitor, C5, ensuring correct polarity.

With the board fully assembled, check your work carefully for misplaced components, solder whiskers, bridges or dry joints, then clean excess flux off the board using a suitable solvent.

Kit Order Code	Voltage	Regulator	Transformer (250mA)	PCB	R1	R2
95155	-15V	79L15 (WQ87U)	12-0-12V (YN16S)	95181	47Ω 3W (W47R)	1k3 (M1K3)
95156	-12V	79L12 (WQ86T)	9-0-9V (YN15R)	95181	LINK	1k (M1K)
95157	-5V	79L05 (WQ85G)	6-0-6V (YN14Q)	95181	LINK	270Ω (M270R)
95158	+5V	78L05 (QL26D)	6-0-6V (YN14Q)	95180	LINK	270Ω (M270R)
95160	+12V	78L12 (WQ77J)	9-0-9V (YN15R)	95180	LINK	1k (M1K)
95161	+15V	78L15 (QL27E)	12-0-12V (YN16S)	95180	47Ω 3W (W47R)	1k3 (M1K3)

DO NOT connect transformer centre tap. Inclusion of an LED is necessary for minimum load. Resistors are 0-6W 1% Metal Film (unless stated).

Table 1. Fixed voltage regulators, ±5V to ±15V, 100mA.

COMMON PARTS LIST FOR 100mA REGULATORS

CAPACITORS

C1-4,6,7	100nF 50V Ceramic Disc	6	(BX03D)
C5	220μF 35V Radial Electrolytic	1	(AT60Q)
C8	10μF 63V Radial Electrolytic	1	(AT77J)

SEMICONDUCTORS

D1-6	1N4001	6	(QL73Q)
LD1	3mm Red LED	1	(CZ22Y)

MISCELLANEOUS

FS1	50mA Time Delay Glass Fuse	1	(CZ85G)
TB1	3-way 5mm PCB-mounting Terminal Block	1	(JY94C)
TB2,3	2-way 5mm PCB-mounting Terminal Block	2	(JY92A)
	Heatsink Type 92F	1	(HQ79L)
	Instruction Leaflet	1	(XZ31J)
	Constructors' Guide	1	(XH79L)

Assembled board dimensions (WDH): 60 × 36 × 17mm

Kit	Voltage	Current	Regulator	Transformer	PCB	R1	C5	FS1	Heatsink
95163	-15V	500mA	79M15 (WQ90X)	9-0/9-0V 12VA (series) (WB11M)	95184	(M1K3)	1,000μF 35V (AT63T)	50mA (CZ85G)	(AX84F)
95164	-12V	500mA	79M12 (WQ89W)	9-0/9-0V 12VA (series) (WB11M)	95184	(M1K)	1,000μF 35V (AT63T)	50mA (CZ85G)	(AX84F)
95165	-5V	500mA	79M05 (WQ88V)	6-0/6-0V 12VA (series) (WB06G)	95184	(M270R)	1,000μF 35V (AT63T)	50mA (CZ85G)	(AX84F)
95166	+5V	500mA	78M05 (QL28F)	6-0/6-0V 12VA (series) (WB06G)	95183	(M270R)	1,000μF 35V (AT63T)	50mA (CZ85G)	(AX84F)
95167	+12V	500mA	78M12 (QL29G)	9-0/9-0V 12VA (series) (WB11M)	95183	(M1K)	1,000μF 35V (AT63T)	50mA (CZ85G)	(AX84F)
95168	+15V	500mA	78M15 (QL30H)	9-0/9-0V 12VA (series) (WB11M)	95183	(M1K3)	1,000μF 35V (AT63T)	50mA (CZ85G)	(AX84F)
95169	-24V	1A	7924 (AV15R)	12-0/12-0V 25VA (series) (WB25C)	95184	(M2K2)	2,200μF 50V (AT72P)	125mA (CZ88V)	(AX85G)
95170	-15V	1A	7915 (QL36P)	9-0/9-0V 25VA (series) (QL36P)	95184	(M1K3)	2,200μF 35V (AT64U)	125mA (CZ88V)	(AX85G)
95171	-12V	1A	7912 (WQ93B)	15-0/15-0V 25VA (parallel) (DH27E)	95184	(M1K)	2,200μF 35V (AT64U)	125mA (CZ88V)	(AX85G)
95172	-8V	1A	7908 (AW76H)	6-0/6-0V 12VA (series) (DH27E)	95184	(M560R)	2,200μF 35V (AT64U)	100mA (CZ86T)	(AX85G)
95173	-5V	1A	7905 (WQ92A)	9-0/9-0V 12VA (parallel) (WB11M)	95184	(M270R)	2,200μF 35V (AT64U)	100mA (CZ86T)	(AX85G)
95174	+5V	1A	7805 (QL28F)	9-0/9-0V 12VA (parallel) (WB11M)	95183	(M270R)	2,200μF 35V (AT64U)	100mA (CZ86T)	(AX85G)
95175	+6V	1A	7806 (AW69A)	9-0/9-0V 12VA (parallel) (WB11M)	95183	(M390R)	2,200μF 35V (AT64U)	100mA (CZ86T)	(AX85G)
95176	+8V	1A	7808 (AW70M)	6-0/6-0V 12VA (series) (YJ50E)	95183	(M560R)	2,200μF 35V (AT64U)	100mA (CZ86T)	(AX85G)
95177	+12V	1A	7812 (QL32K)	15-0/15-0V 25VA (parallel) (DH27E)	95183	(M1K)	2,200μF 35V (AT64U)	125mA (CZ88V)	(AX85G)
95178	+15V	1A	7815 (QL33L)	9-0/9-0V 25VA (series) (DH26D)	95183	(M1K3)	2,200μF 35V (AT64U)	125mA (CZ88V)	(AX85G)
95179	+24V	1A	7824 (AV11M)	12-0/12-0V 25VA (series) (WB25C)	95183	(M2K2)	2,200μF 50V (AT72P)	125mA (CZ88V)	(AX85G)

Fuse FS1 is a Time Delay glass type. Inclusion of an LED is necessary for minimum load. Resistors are 0-6W 1% Metal Film (Unless Stated).

Table 2. Fixed voltage regulators, ±5V to ±24V, 500mA/1A.

COMMON PARTS LIST FOR 500mA/1A REGULATORS

CAPACITORS

C1-4,6,7	100nF 50V Ceramic Disc	6	(BX03D)
C8	10μF 63V Radial Electrolytic	1	(AT77J)

SEMICONDUCTORS

D1-6	1N4001	6	(QL73Q)
LD1	3mm Red LED	1	(CZ22Y)

MISCELLANEOUS

TB1	3-way 5mm PCB-mounting Terminal Block	1	(JY94C)
TB2,3	2-way 5mm PCB-mounting Terminal Block	2	(JY92A)
	Heatsink Clip	1	(AX86T)
	TO218 Semiconductor Insulator Pad	1	(UL74R)
	Instruction Leaflet	1	(XZ32K)
	Constructors' Guide	1	(XH79L)

Assembled board dimensions (WDH): 84 × 36 × 42mm (500mA Regulator)
84 × 36 × 54mm (1A Regulator)



Important Safety Note

It is important to note that mains voltage is potentially lethal. Full details of mains wiring connections are shown in this article, and every possible precaution must be taken to avoid the risk of electric shock during maintenance and use of the final unit, which should never be operated with the box lid removed. Safe construction of the unit is entirely dependent on the skill of the constructor, and adherence to the instructions given in this article. If you are in any doubt as to the correct way to proceed, consult a suitably qualified electrician or engineer.

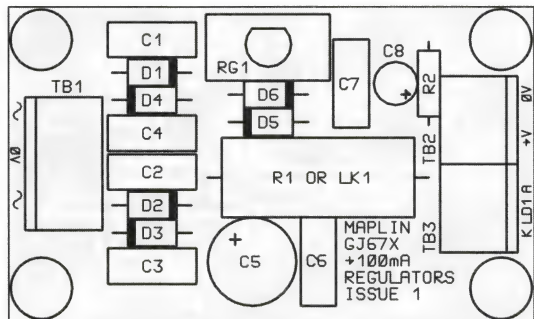


Figure 5. +100mA Regulator PCB legend and track.

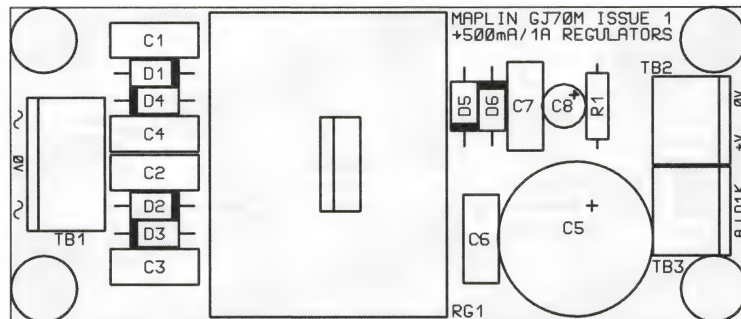


Figure 7. +500mA/1A Regulator PCB legend and track.

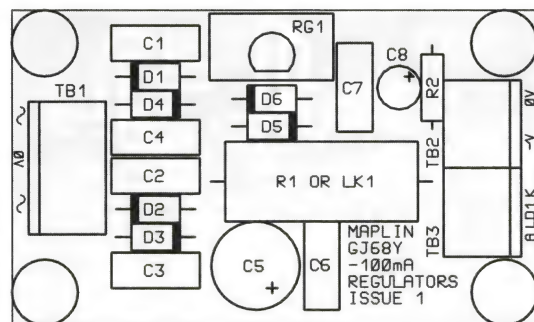


Figure 6. -100mA Regulator PCB legend and track.

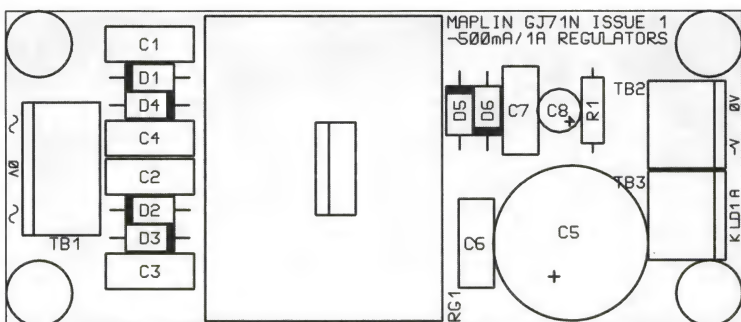


Figure 8. -500mA/1A Regulator PCB legend and track.

Testing and Use

Refer to Figures 9 to 15, showing the various wiring configurations possible with these Regulator Kits. Take care to select the correct type of transformer for the particular regulator(s) being used, and to ensure that they are correctly wired as per the relevant diagrams. Using the specified transformer and heatsink enables the regulators to provide the full stated output current up to a temperature of 70°C, i.e. 45°C above an ambient temperature of 25°C.

If boxing the regulators, ensure that sufficient ventilation is provided for the heatsink(s). It is **ESSENTIAL** that the transformer is properly housed, and that the mains wiring connections are adequately insulated. Remember to carry out any mains wiring in accordance with the safety warning printed in this article.

ELECTRONICS

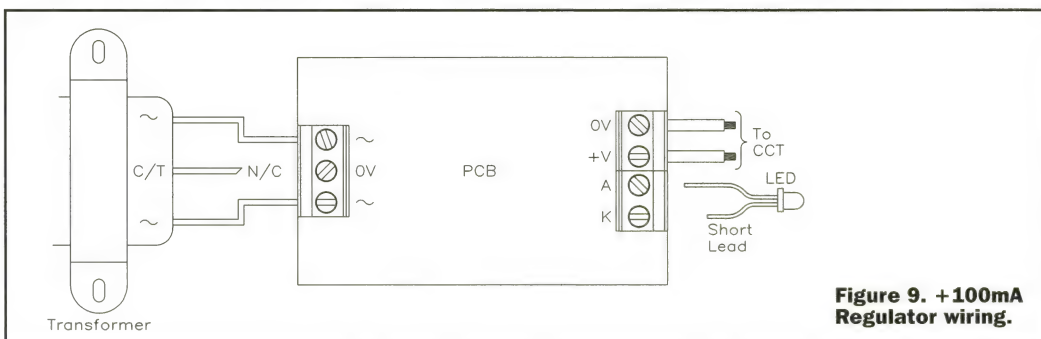


Figure 9. +100mA Regulator wiring.

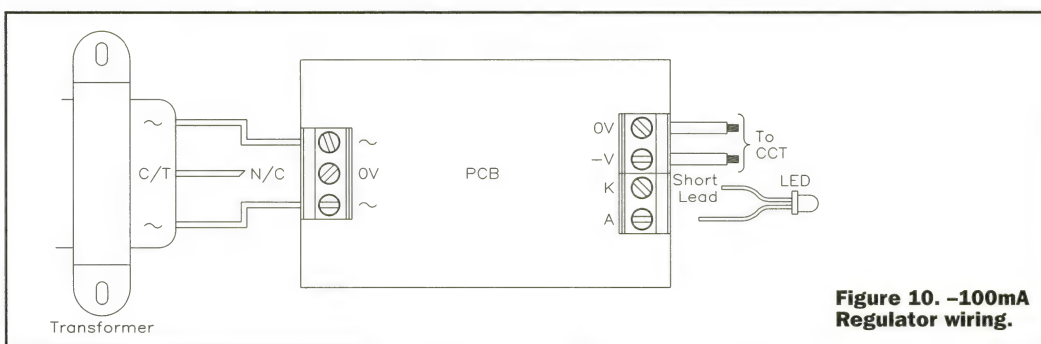


Figure 10. -100mA Regulator wiring.

Order Code	Description	Price	Order Code	Description	Price
95155	-15V 100mA Regulator	£5.99	95169	-24V 1A Regulator	£8.99
95156	-12V 100mA Regulator	£5.99	95170	-15V 1A Regulator	£8.99
95157	-5V 100mA Regulator	£5.99	95171	-12V 1A Regulator	£8.99
95158	+5V 100mA Regulator	£5.99	95172	-8V 1A Regulator	£8.99
95160	+12V 100mA Regulator	£5.99	95173	-5V 1A Regulator	£8.99
95161	+15V 100mA Regulator	£5.99	95174	+5V 1A Regulator	£8.99
95163	-15V 500mA Regulator	£7.99	95175	+6V 1A Regulator	£8.99
95164	-12V 500mA Regulator	£7.99	95176	+8V 1A Regulator	£8.99
95165	-5V 500mA Regulator	£7.99	95177	+12V 1A Regulator	£8.99
95166	+5V 500mA Regulator	£7.99	95178	+15V 1A Regulator	£8.99
95167	+12V 500mA Regulator	£7.99	95179	+24V 1A Regulator	£8.99
95168	+15V 500mA Regulator	£7.99			

Table 3. Kits available from Maplin.

The above items (Tables 1 and 2) are available as kits, which offers a saving over buying the parts separately. Regulator Kits 95155, 95161 Price £5.99 Regulator Kits 95163, 95168 Price £7.99 Regulator Kits 95169, 95179 Price £8.99

The following new items (which are included in the kit) are also available separately, but are not shown in the 1996/97 Maplin Catalogue. Regulator PCBs* 95180, 95181 Price £2.29 Regulator PCBs* 95183, 95184 Price £2.49 * See Tables 1 and 2

Figure 11. Linking + and - regulators using dual secondary windings transformer.

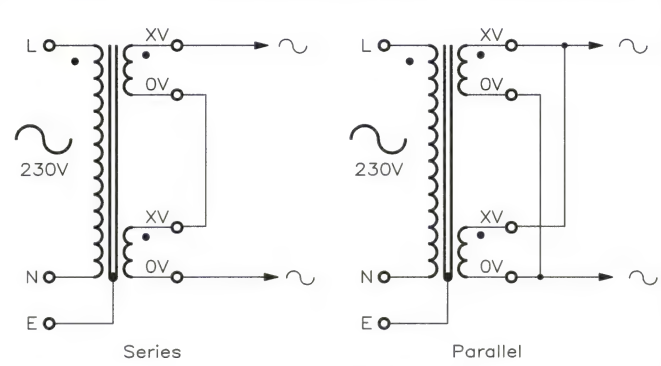
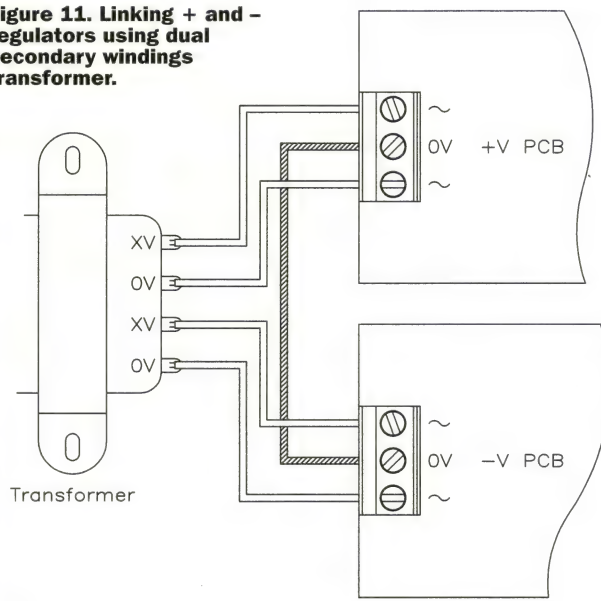


Figure 14. Transformer serial/parallel wiring (500mA/1A Regulators).

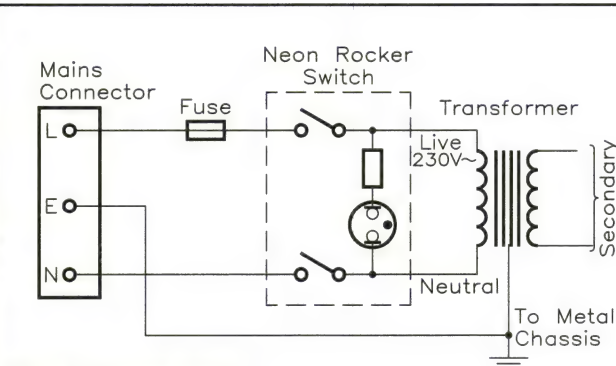


Figure 12. Mains wiring.

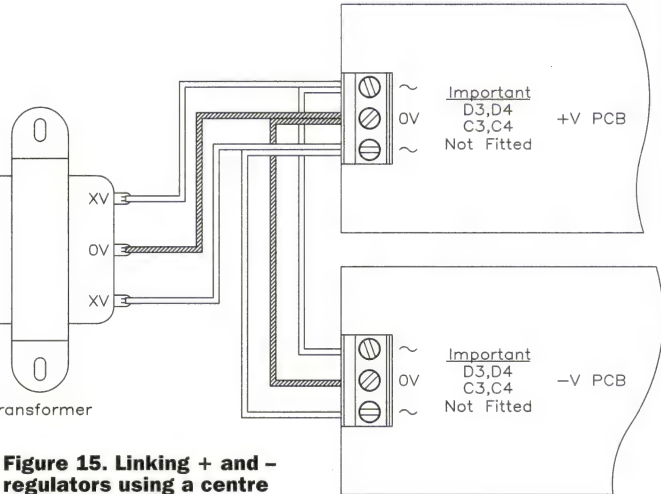


Figure 15. Linking + and - regulators using a centre tap transformer.

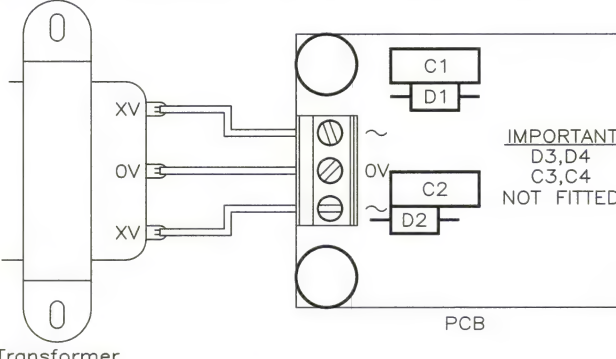
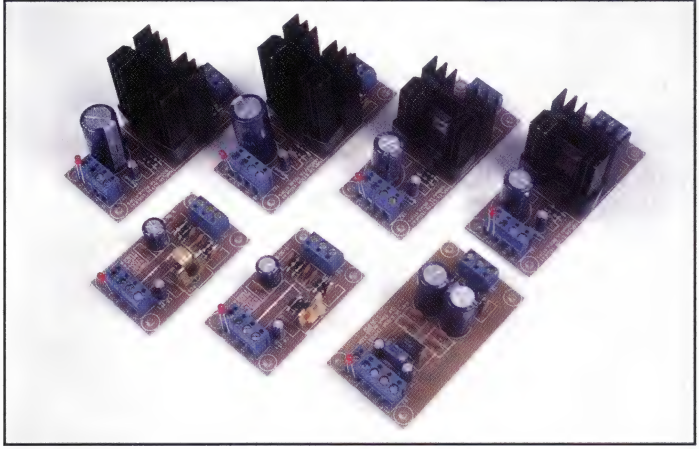


Figure 13. Regulator centre tap wiring.



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