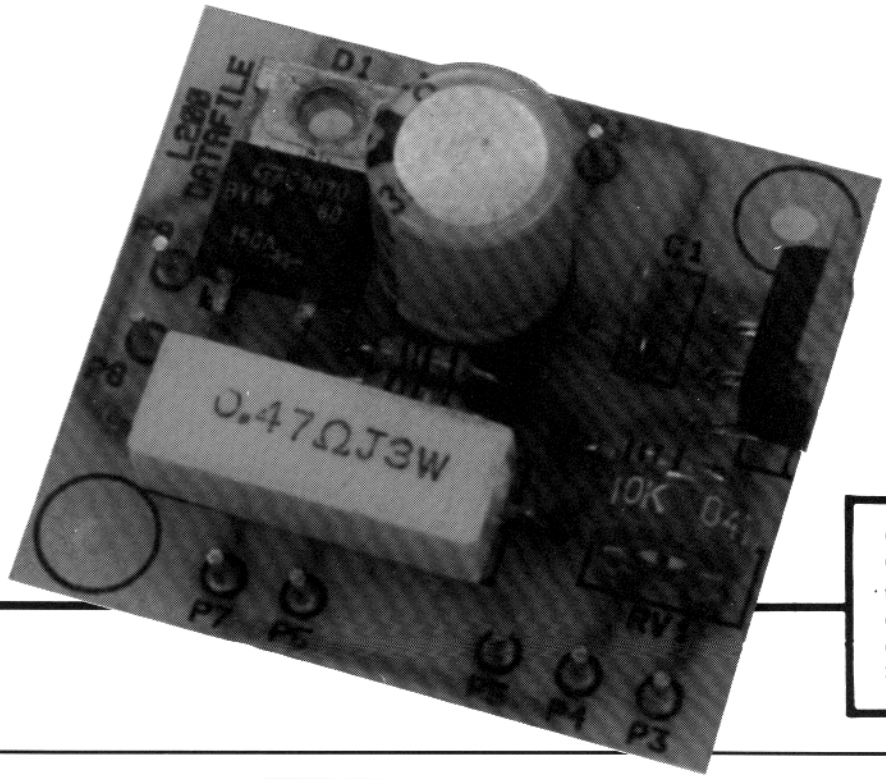
DATA FILE

L200 ADJUSTABLE VOLTAGE/CURRENT REGULATOR



'Data Files' are intended as 'building blocks' for constructors to experiment with and the components supplied provide a good starting point for further development.

FEATURES

★ Adjustable output current ★ Adjustable output voltage ★ Low quiescent current
★ Short circuit protection ★ Thermal overload protection

APPLICATIONS

★ Power supplies ★ Battery chargers ★ DC–DC converter

Parameter	Conditions	Min.	Typ.	Max.
DC input Voltage	Absolute Maximum			40V
Quiescent Current Drain (pin 3)	Input Voltage (V_i) = 20V		4·2mA	9·2mA
Output Voltage Range	Output Current = 10mA	2·85V		36V
Operating Junction Temperature Range (L200C)	Absolute Maximum	−25°C		+150°C
Line Regulation	V_i = 8V to 18V, V_o = 5V	48dB	60dB	
Dropout voltage between pins 1 and 5	Output Current = 1·5A $\Delta V_o \leq 2\%$		2V	2·5V
Reference Voltage (pin 4)	Input Voltage (V_i) = 20V Output Current (I_o) = 10mA	2·64V	2·77V	2·86V

Table 1. L200 typical electrical characteristics.

Introduction

The L200 is a monolithic IC designed for programmable voltage and current regulation. Voltage outputs between 2·85V and 36V may be accommodated, at currents of up to 2A. The device is supplied in a 5-pin package; the IC pin-out is shown in Figure 1. The L200 has internal protection to minimise the possibility of damage to the device; this comprises current limiting, power limiting, thermal shutdown and input over-voltage protection (up to 60V for 10mS). Table 1 shows typical electrical characteristics for the device. In addition some typical performance figures are shown in Figure 2.

General Description

As can be seen from the block diagram shown in Figure 3, the L200 regulator uses a relatively sophisticated design. The device may be used in several different configurations to provide voltage or current regulation.

Current limiting is controlled by connecting a resistor between pin 2 and pin 5 of the L200. The current limit

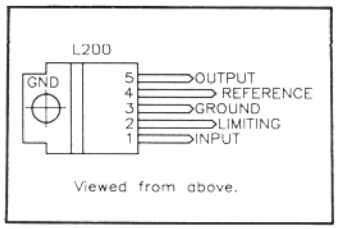


Figure 1. L200 IC pinout.

threshold is approximated by the expression:

$I_o = V_{sc} \div R_{sc}$

where:

I_o = Output Current (A)
V_{sc} = Current Limit Sense Voltage (V)
R_{sc} = Resistance between pin 5 and pin 2 (Ω)

The current limit sense voltage is variable depending on several factors including load and temperature but is typically 0·45V.

Power dissipation is controlled by the internal Safe Operating Area (SOA) protection circuitry of the L200. The device can supply a current of up to 2A as long as the input/output differential voltage is less than 20V. With differential

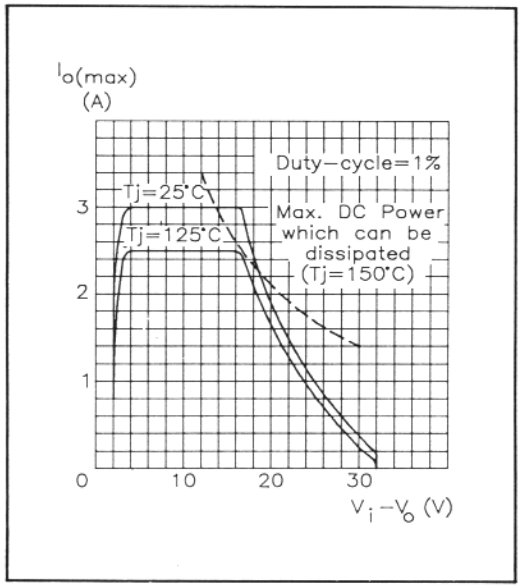


Figure 2a. Typical safe operating area protection.

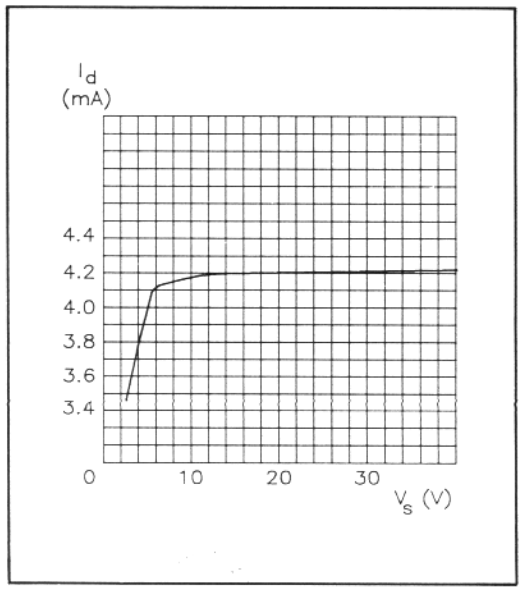


Figure 2b. Quiescent current (I_d) vs. voltage (V_s).

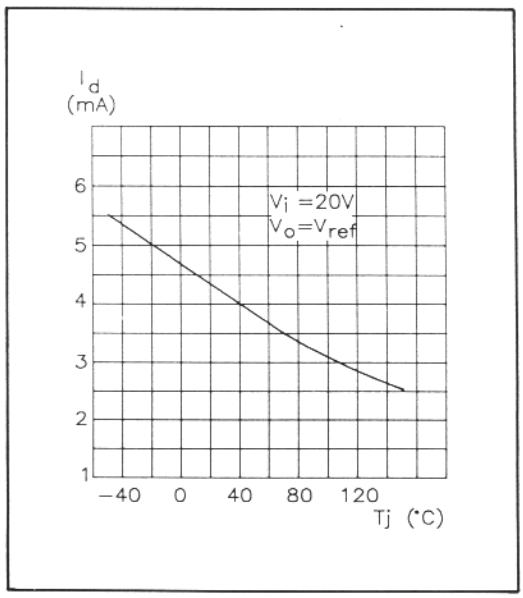


Figure 2c. Quiescent current (I_d) vs. junction temperature (T_j).

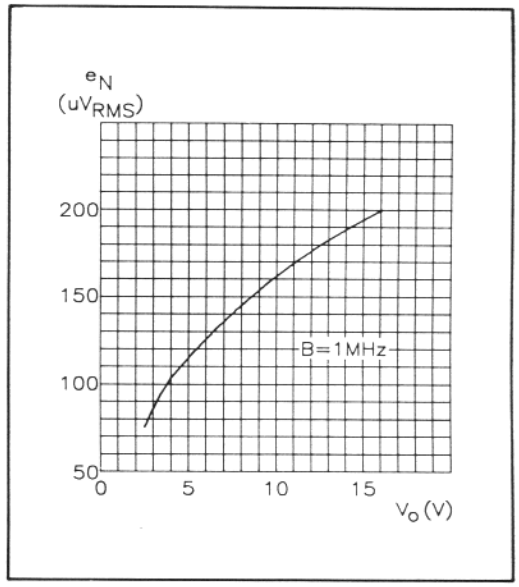


Figure 2d. Output noise voltage (°N) vs. output voltage (V_o) for 1MHz bandwidth.

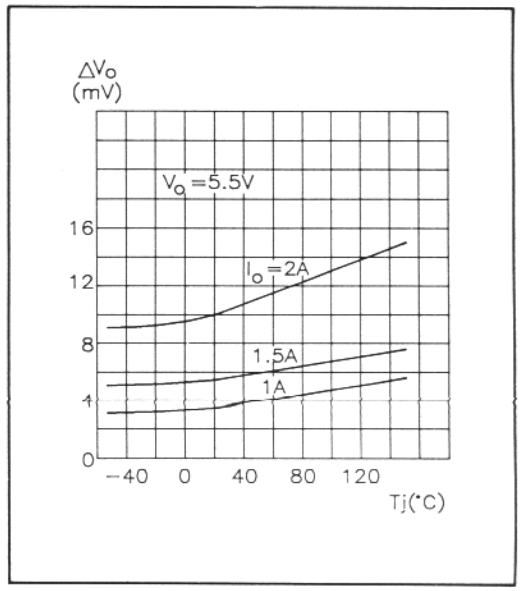


Figure 2e. Voltage load regulation (ΔV_o) vs. junction temperature (T_j).

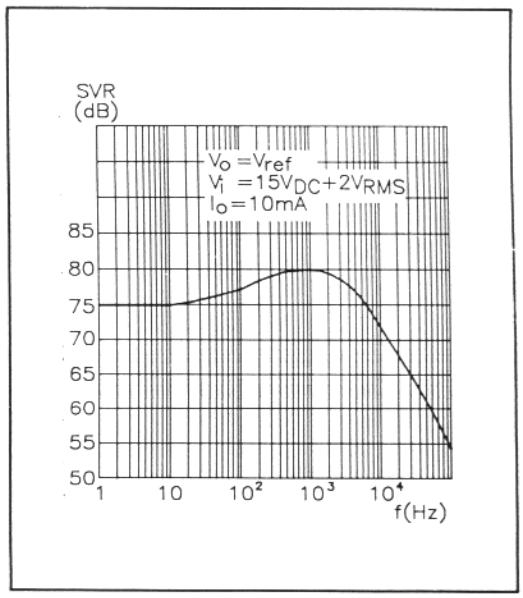


Figure 2f. Supply voltage rejection (SVR) vs. frequency (f).

voltages above 20V the maximum current output drops considerably; if this value is exceeded, then the SOA protection limits the output current so as to reduce power dissipation and prevent damage to the device.

Output voltage is determined by the value of the resistors connected between pin 3 & pin 4 and pin 4 & pin 2 of the device. The final output voltage may be approximated by the expression:

$V_o = V_{ref}(1 + (R2 \div R1))$

where:

V_o = output voltage (V)
V_{ref} = reference voltage on pin 4 (V)
R1 = resistance between pin 4 & pin 3 (Ω)
R2 = resistance between pin 2 & pin 4 (Ω)

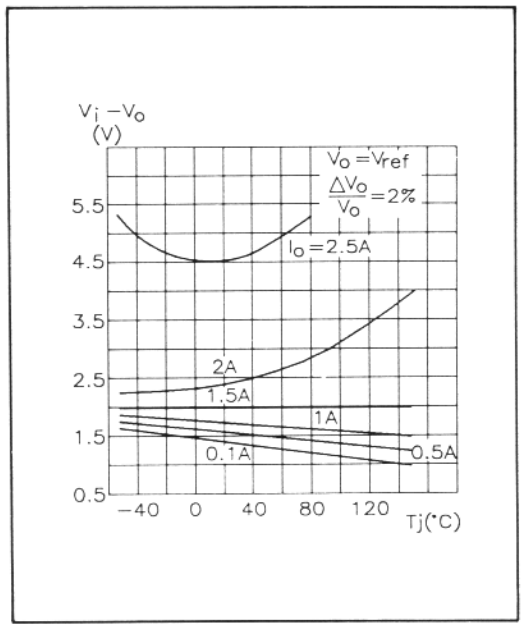


Figure 2g. Dropout voltage ($V_i - V_o$) vs. junction temperature (T_j).

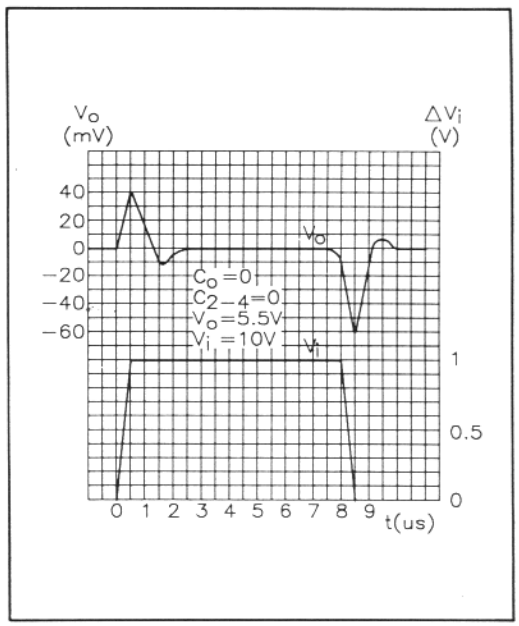


Figure 2h. Voltage transient response.

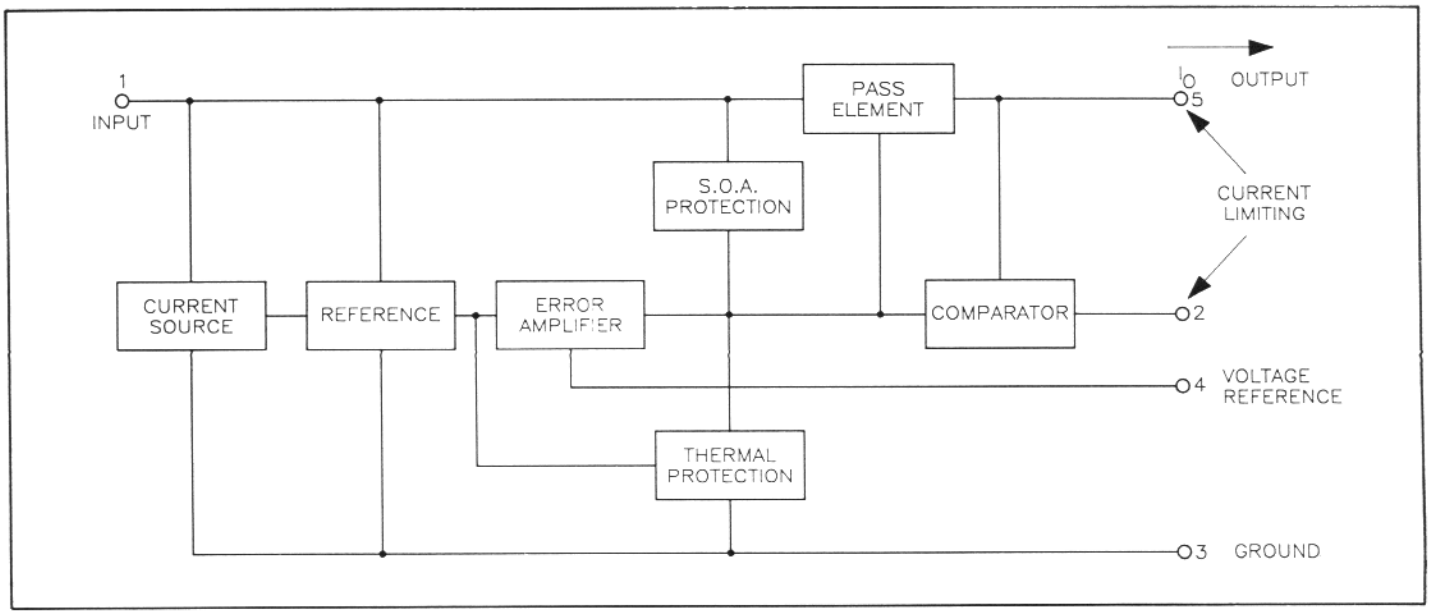


Figure 3. L200 block diagram.

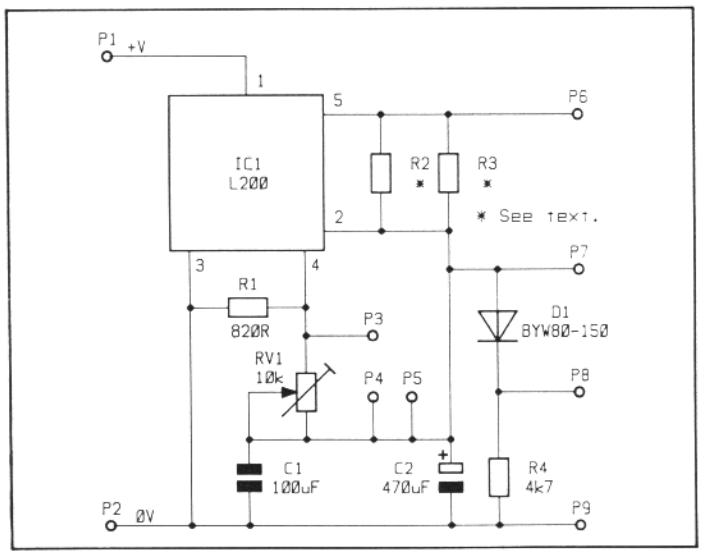


Figure 4. Module circuit diagram.

For the purpose of approximate calculation, V_{ref} may be taken at a typical value of 2·77V although in practice this figure may vary very slightly.

Kit Available

A kit of parts is available for a basic application circuit using the L200 regulator IC. The kit includes a high quality fibreglass PCB with a printed legend to aid component positioning. Figure 4 shows the circuit diagram of the module and Figure 5 shows the legend. To allow the module to be as versatile as possible, some of the component positions on the PCB are left open, so that the parameters of the module may be determined by the user. In particular, the values of resistors R2 and R3 (which determine the current limiting threshold of the regulator) are subject to selection, depending on the individual application.

For connection information reference should be made to the wiring diagram shown in Figure 6. Input connections to the module are made to P1 (Input +V) and P2 (0V). Output connections are made to P8 (Output +V) and P9 (0V).

To maintain correct regulation, it is important that the input/output differential voltage is never allowed to fall below the regulator dropout voltage. The dropout voltage may vary but as a general rule, it is recommended that the input voltage is always at least 4V

above the maximum required output voltage.

Output voltage control is via preset resistor RV1. Provision is also made for an external voltage control potentiometer and this may be connected to P3, P4 and P5. If an external voltage control is used, then RV1 should NOT be fitted. If a fixed output is required, then a fixed resistor may be connected between P3 and P4; once again, RV1 should NOT be fitted as this is effectively in parallel with any external voltage control resistors.

The current limit threshold of the module is set by resistors, R2 and R3. Two Parallel resistors are used to enable the very low values of resistance required for higher current limit thresholds to be achieved. It should be noted that R3 may either be a 0·6W or a 3W type and a separate set of holes is provided for both types. For some applications it may of course be possible to achieve the correct value using one resistor only. Provision is also provided for an external current limiting resistor, which may be connected between P6 and P7. A low value variable resistor may be used for variable current limit control but at higher current levels the resolution will become increasingly poor. The approximate current limit threshold may be calculated using the following method, assuming a typical voltage of 0·45V between P6 and P7 (pin 5 and pin 2 of the IC):

$I_o = 0{\cdot}45 \div Rsc$

where I_o is the output current and Rsc is the total parallel resistance between P6 and P7 (R2, R3 and any external current limit resistor in parallel) in ohms.

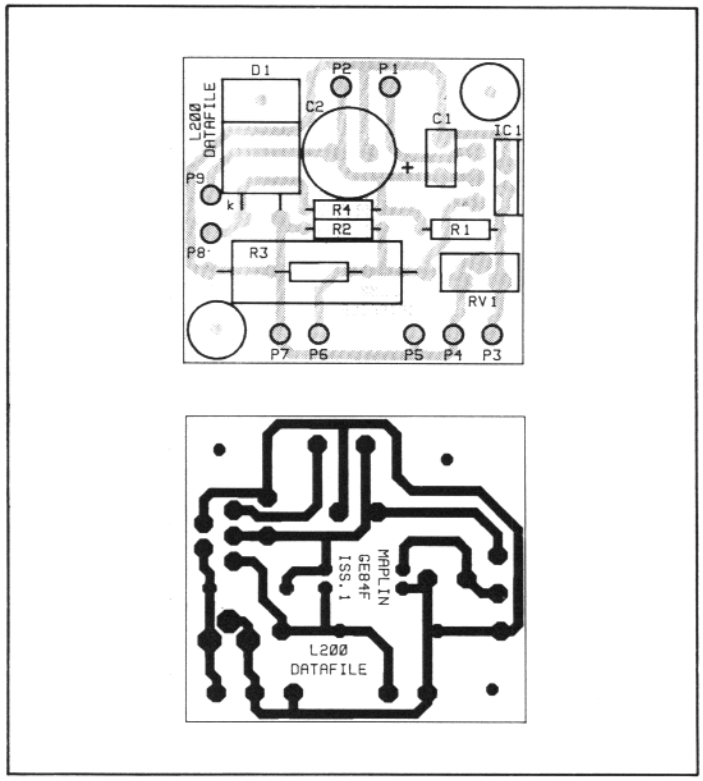


Figure 5. PCB legend and track.

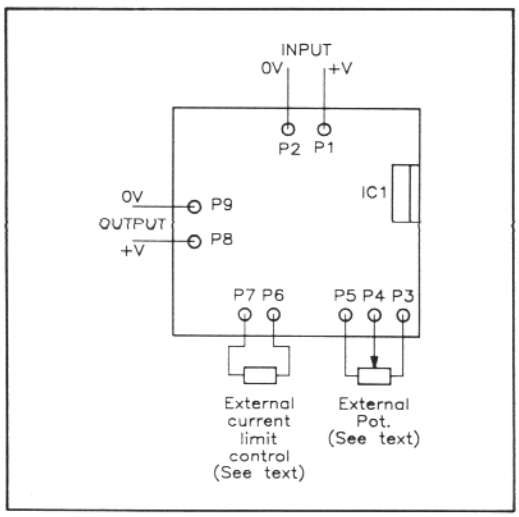


Figure 6. Wiring diagram.

Heatsink

At higher power levels, it is necessary to use a suitable heatsink to prevent IC1 from reaching excessive temperatures. The type of heatsink used is dependant on the individual application. In some cases, a large area of metal such as the side of an enclosure may already be available. The tab of the L200 is at 0V potential and will bolt directly to a heatsink if this is also at 0V potential; however, in some cases it may be necessary to isolate the tab of the L200 (if the heatsink is not at 0V potential). An insulating bush and a greaseless or mica washer should be used for this purpose, as illustrated in Figure 7.

Typical heatsinks for use with the L200 up to 20W are shown in Table 2. The parameters shown are intended to provide general guidelines and the power ratings may be found to vary slightly in different applications.

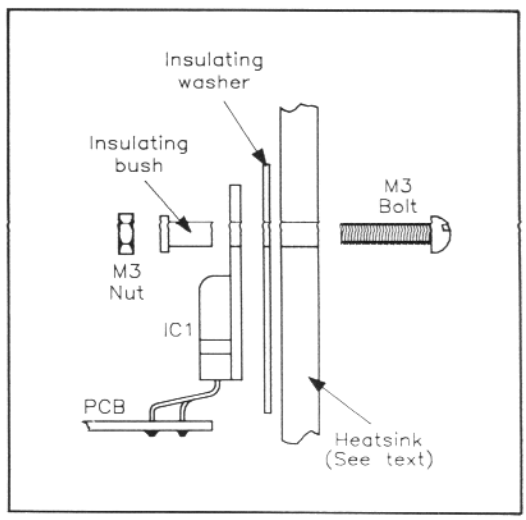


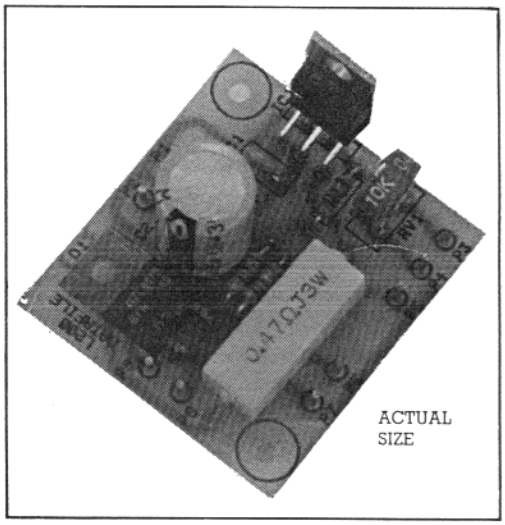
Figure 7. Heatsinking.

Regulator Power Dissipation	Heatsink (Stock Code)
Up to 500mW	No heatsink required
500mW–1·5W	Vaned Heatsink TO126 (JX21X)
1·5W–3·5W	High Power Twisted Vane (FG55K)
3·5W–10W	Heatsink 4Y (FL41U)
10W–20W	Flat Heatsink (FL42V)

Table 2. Typical heatsinks for the L200.

Parameter	Conditions	
Input Voltage		5V–35V
Output Voltage		2·8–32·8V
Output Current (Max)	For Input/Output Differential Voltage Less than 20V	2A
Quiescent Current (Max)		11mA

Table 3. Specification of prototype module.



The assembled L200 module.

Please note: any of the higher power heatsinks are also suitable for lower power applications and where the power dissipation is variable, the maximum power dissipation under worst case conditions should be used for the purposes of selecting a heatsink.

In addition to heatsinking for the L200, it is also recommended that a small heatsink (such as JX21X) is used for D1 when the module is used at current levels in excess of 750mA; in this case D1 should be mounted vertically and the heatsink bolted to the tab. Table 3 shows the specification of the prototype module.

L200 VOLTAGE/CURRENT REGULATOR PARTS LIST

RESISTORS: All 0·6W 1% Metal Film (unless specified)			
R1	820Ω	1	(M820R)
R2	*See Text*	1	
R3	*See Text*	1	
R4	4k7	1	(M4K7)
RV1	Vert Encl Preset 10k	1	(UH16S)
CAPACITORS			
C1	Monores Cap 100nF	1	(RA49D)
C2	PC Elect 470μF 35V	1	(FF16S)
SEMICONDUCTORS			
IC1	L200	1	(YY74R)
D1	BYW80-150	1	(UK63T)
MISCELLANEOUS			
P1-9	Pins 2145	9	(FL24B)★
	L200 PCB	1	(GE84F)
	Instruction Leaflet	1	(XT00A)
	Constructors' Guide	1	(XH79L)

The Maplin 'Get-You-Working' Service is not available for this project.

The above items are available as a kit.

Order As LP69A (L200 Data File)

Please Note: Order Code marked with a ★ is not available singly, see current Maplin Catalogue for full ordering information.

The following new item (which is included in the kit) is also available separately:
L200 PCB **Order As GE84F**

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