



# L165

## 3A POWER OPERATIONAL AMPLIFIER

- OUTPUT CURRENT UP TO 3A
- LARGE COMMON-MODE AND DIFFERENTIAL MODE RANGES
- SOA PROTECTION
- THERMAL PROTECTION
- $\pm 18V$  SUPPLY

### DESCRIPTION

The L165 is a monolithic integrated circuit in Pentawatt® package, intended for use as power operational amplifier in a wide range of applications, including servo amplifiers and power supplies. The high gain and high output power capability provide superior performance wherever an operational amplifier/power booster combination is required.

### APPLICATION CIRCUITS

Figure 1. Gain > 10.

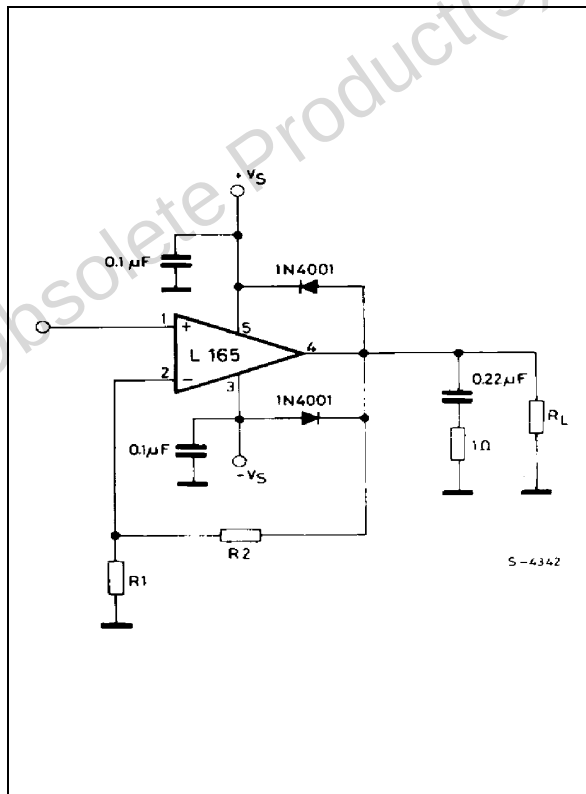
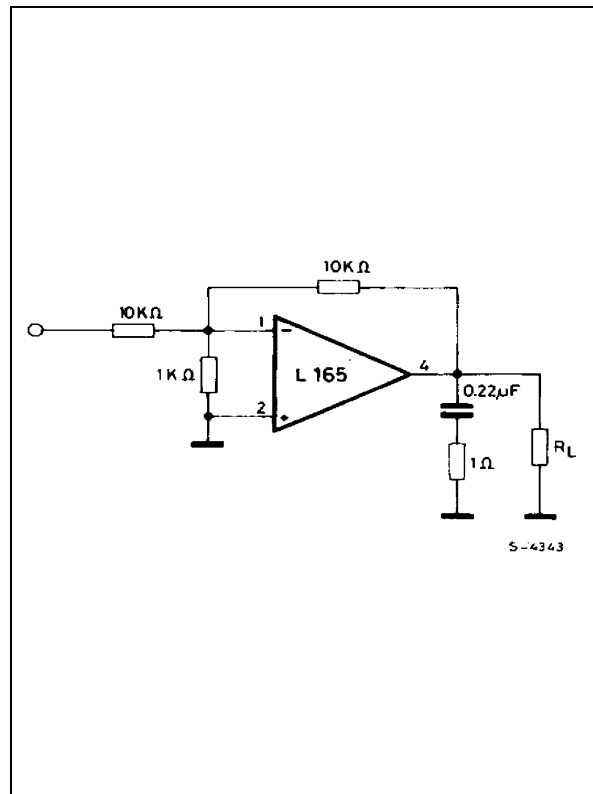


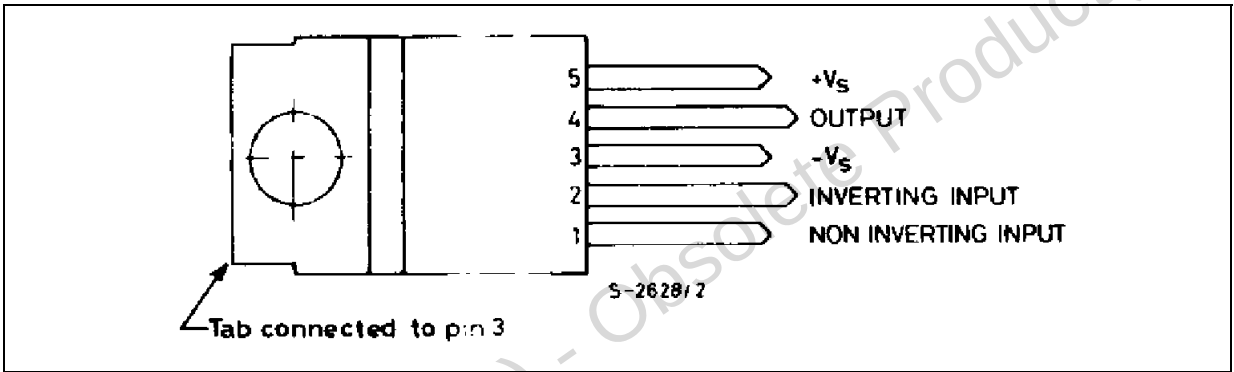
Figure 2. Unity gain configuration.



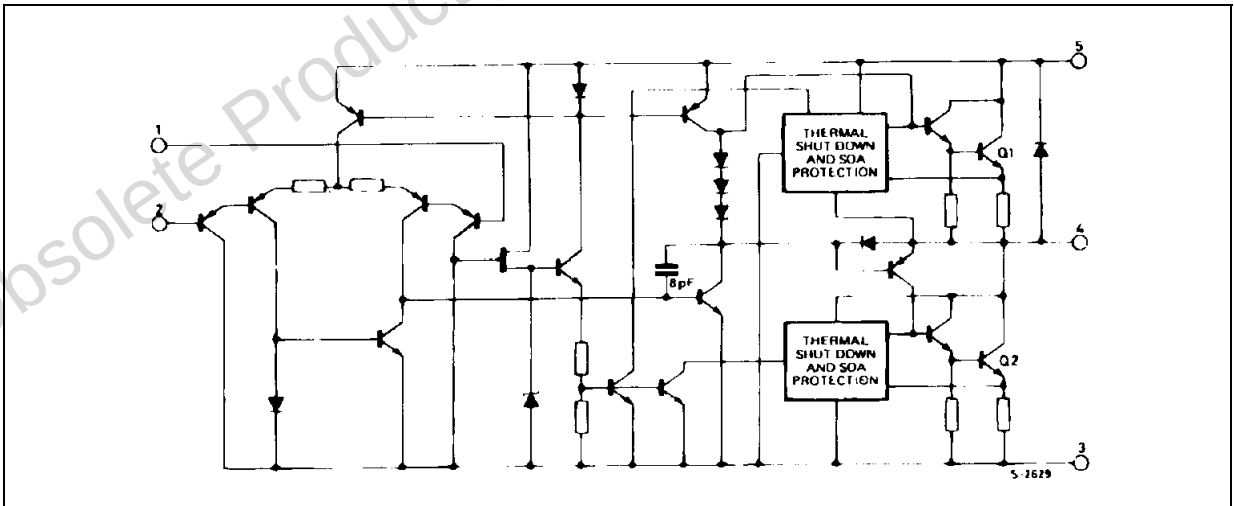
ABSOLUTE MAXIMUM RATINGS

| Symbol         | Parameter                                          | Value      | Unit             |
|----------------|----------------------------------------------------|------------|------------------|
| $V_S$          | Supply voltage                                     | $\pm 18$   | V                |
| $V_5 V_4$      | Upper power transistor $V_{CE}$                    | 36         | V                |
| $V_4 V_3$      | Lower power transistor $V_{CE}$                    | 36         | V                |
| $V_i$          | Input voltage                                      | $V_S$      |                  |
| $V_j$          | Differential input voltage                         | $\pm 15$   | V                |
| $I_o$          | Peak output current (internally limited)           | 3.5        | A                |
| $P_{tot}$      | Power dissipation at $T_{case} = 90^\circ\text{C}$ | 20         | W                |
| $T_{stg}, T_j$ | Storage and junction temperature                   | -40 to 150 | $^\circ\text{C}$ |

PIN CONNECTION (Top view)



SCHEMATIC DIAGRAM



THERMAL DATA

| Symbol          | Parameter                            | Value | Unit               |
|-----------------|--------------------------------------|-------|--------------------|
| $R_{th-j-case}$ | Thermal resistance junction-case max | 3     | $^\circ\text{C/W}$ |

**ELECTRICAL CHARACTERISTICS** ( $V_S = \pm 15\text{ V}$ ,  $T_J = 25\text{ }^{\circ}\text{C}$  unless otherwise specified)

| Symbol   | Parameter                          | Test Condition                                                                                                                                      | Min.    | Typ.     | Max.      | Unit               |
|----------|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------|----------|-----------|--------------------|
| $V_S$    | Supply Voltage                     |                                                                                                                                                     | $\pm 6$ |          | $\pm 18$  | V                  |
| $I_d$    | Quiescent Drain Current            | $V_S = \pm 18\text{ V}$                                                                                                                             |         | 40       | 60        | mA                 |
| $I_b$    | Input Bias Current                 |                                                                                                                                                     |         | 0.2      | 1         | $\mu\text{A}$      |
| $V_{OS}$ | Input Offset Voltage               |                                                                                                                                                     |         | $\pm 2$  | $\pm 10$  | mV                 |
| $I_{OS}$ | Input Offset Current               |                                                                                                                                                     |         | $\pm 20$ | $\pm 200$ | nA                 |
| SR       | Slew-rate                          | $G_V = 10$                                                                                                                                          | 8       |          |           | V/ $\mu\text{s}$   |
|          |                                    | $G_V = 1\text{ }(^{\circ})$                                                                                                                         | 6       |          |           |                    |
| $V_O$    | Output Voltage Swing               | $f = 1\text{ kHz}$<br>$I_P = 0.3\text{ A}$<br>$I_P = 3\text{ A}$                                                                                    |         | 27<br>24 |           | $V_{pp}$           |
|          |                                    | $f = 10\text{ kHz}$<br>$I_P = 0.3\text{ A}$<br>$I_P = 3\text{ A}$                                                                                   |         | 27<br>24 |           | $V_{pp}$           |
| R        | Input Resistance (pin 1)           | $f = 1\text{ KHz}$                                                                                                                                  | 100     | 500      |           | K $\Omega$         |
| $G_V$    | Voltage Gain (open loop)           |                                                                                                                                                     |         | 80       |           | dB                 |
| $e_N$    | Input Noise Voltage                | $B = 10\text{ to }10\,000\text{ Hz}$                                                                                                                |         | 2        |           | $\mu\text{V}$      |
| $i_N$    | Input Noise Current                | $f = 1\text{ KHz}$                                                                                                                                  |         | 100      |           | pA                 |
| CMR      | Common-mode Rejection              | $R_g \leq 10\text{ K}\Omega$ ; $G_V = 30\text{ dB}$                                                                                                 |         | 70       |           | dB                 |
| SVR      | Supply Voltage Rejection           | $R_g = 22\text{ K}\Omega$ ; $V_{\text{ripple}} = 0.5\text{ V}_{\text{rms}}$<br>$f_{\text{ripple}} = 100\text{ Hz}$<br><br>$G_V = 10$<br>$G_V = 100$ |         | 60<br>40 |           | dB<br>dB           |
|          |                                    |                                                                                                                                                     |         |          |           |                    |
|          | Efficiency                         | $f = 1\text{ kHz}$ ; $R_L = 4\Omega$<br>$I_P = 1.6\text{ A}$ ; $P_O = 5\text{ W}$                                                                   |         | 70       |           | %                  |
|          |                                    | $I_P = 1.6\text{ A}$ ; $P_O = 18\text{ W}$                                                                                                          |         | 60       |           | %                  |
| $T_{SD}$ | Thermal Shut-down Case Temperature | $P_{\text{tot}} = 12\text{ W}$                                                                                                                      |         | 110      |           | $^{\circ}\text{C}$ |
|          |                                    | $P_{\text{tot}} = 6\text{ W}$                                                                                                                       |         | 130      |           | $^{\circ}\text{C}$ |

Figure 3. Open loop frequency response.

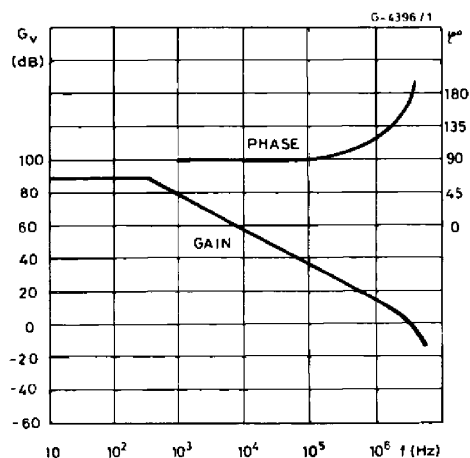


Figure 4. Closed loop frequency response (circuit of figure 2).

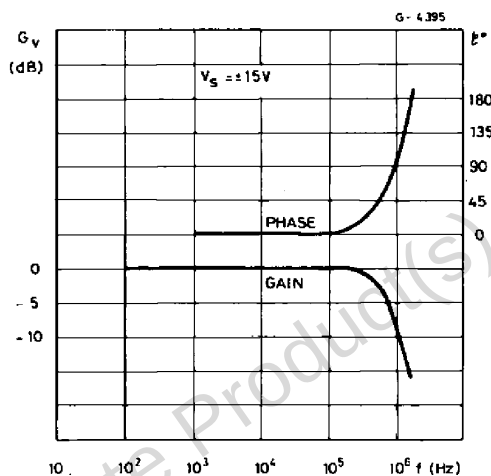


Figure 5. Large signal frequency response.

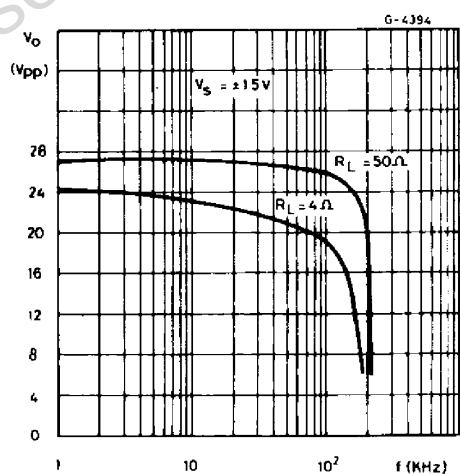


Figure 6. Maximum output current vs. voltage [VCE] across each output transistor.

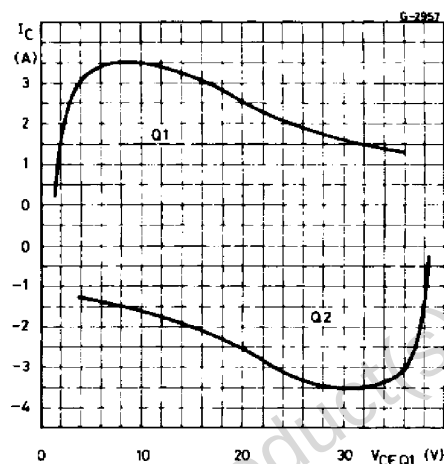


Figure 7. Safe operating area and collector characteristics of the protected power transistor.

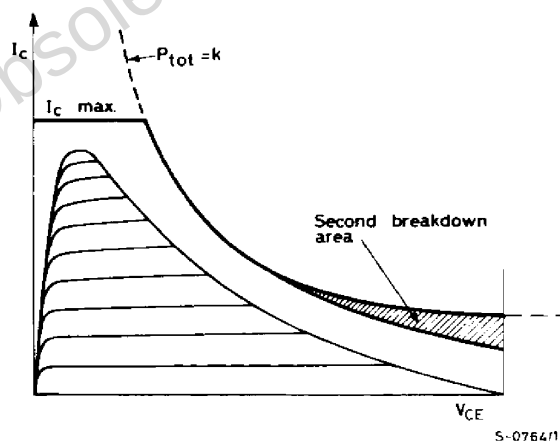


Figure 8. Maximum allowable power dissipation vs. ambient temperature.

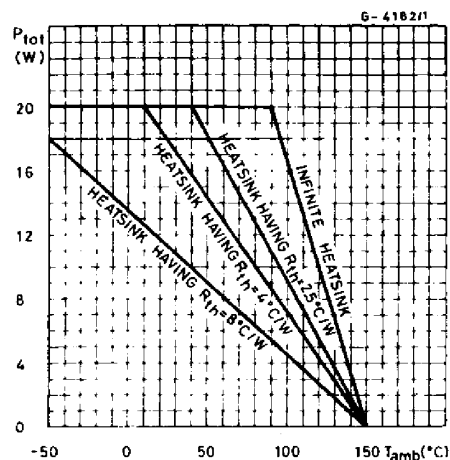


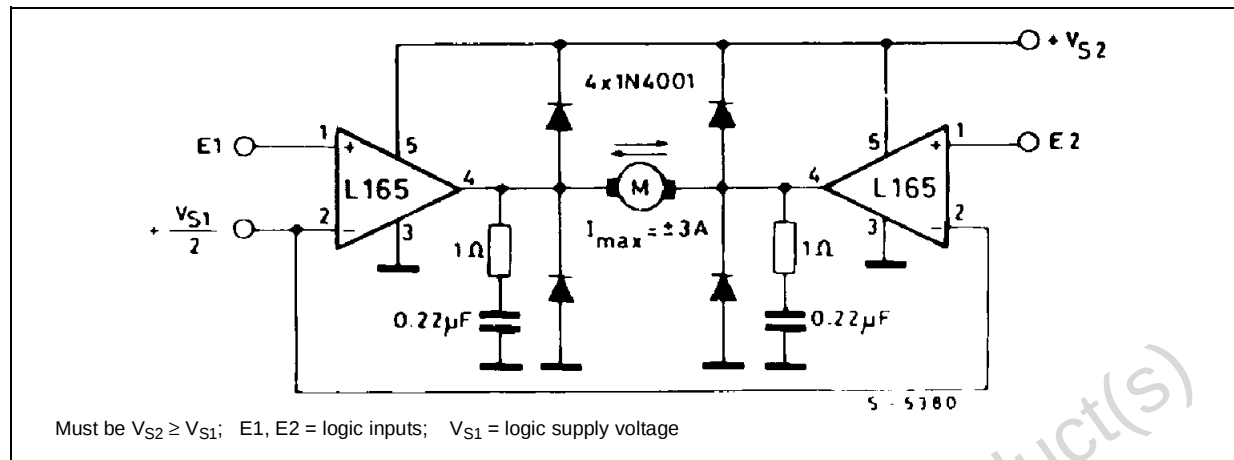
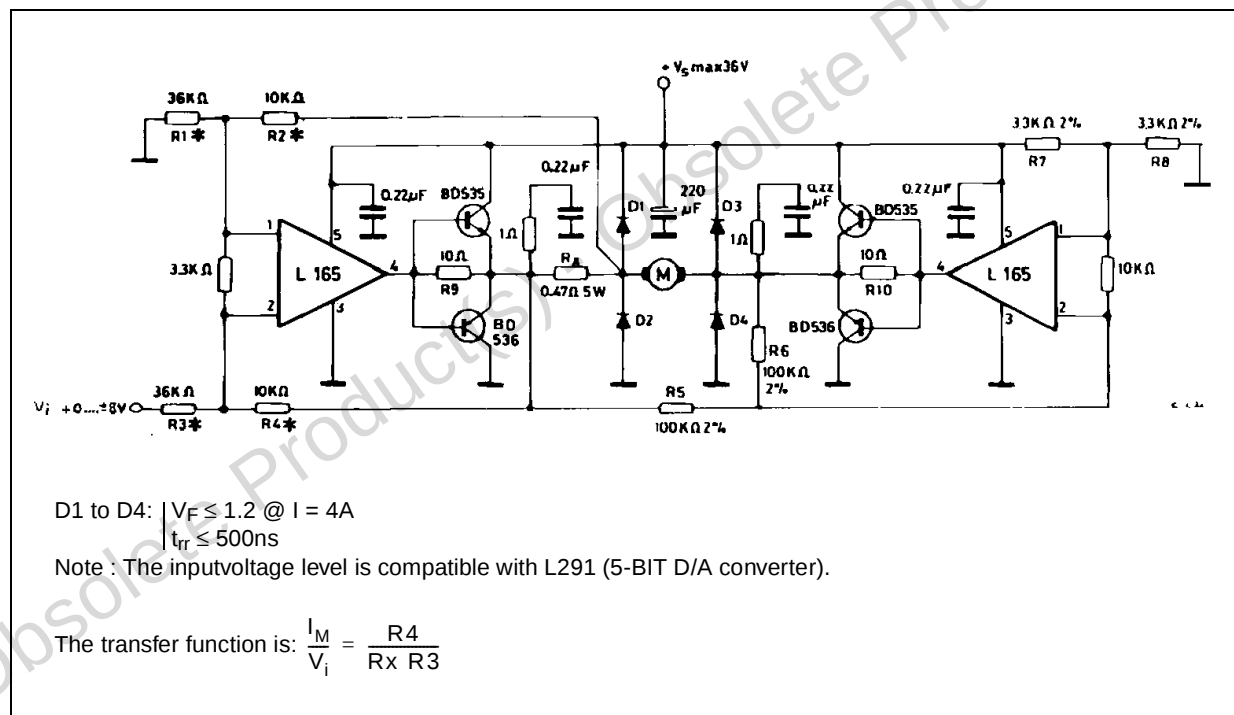
Figure 9. Bidirectional DC motor control with TTL/CMOS/ $\mu$ P compatible inputs.Figure 10. Motor current control circuit with external power transistors ( $I_{\text{motor}} > 3.5\text{A}$ ).

Figure 11. High current tracking regulator.

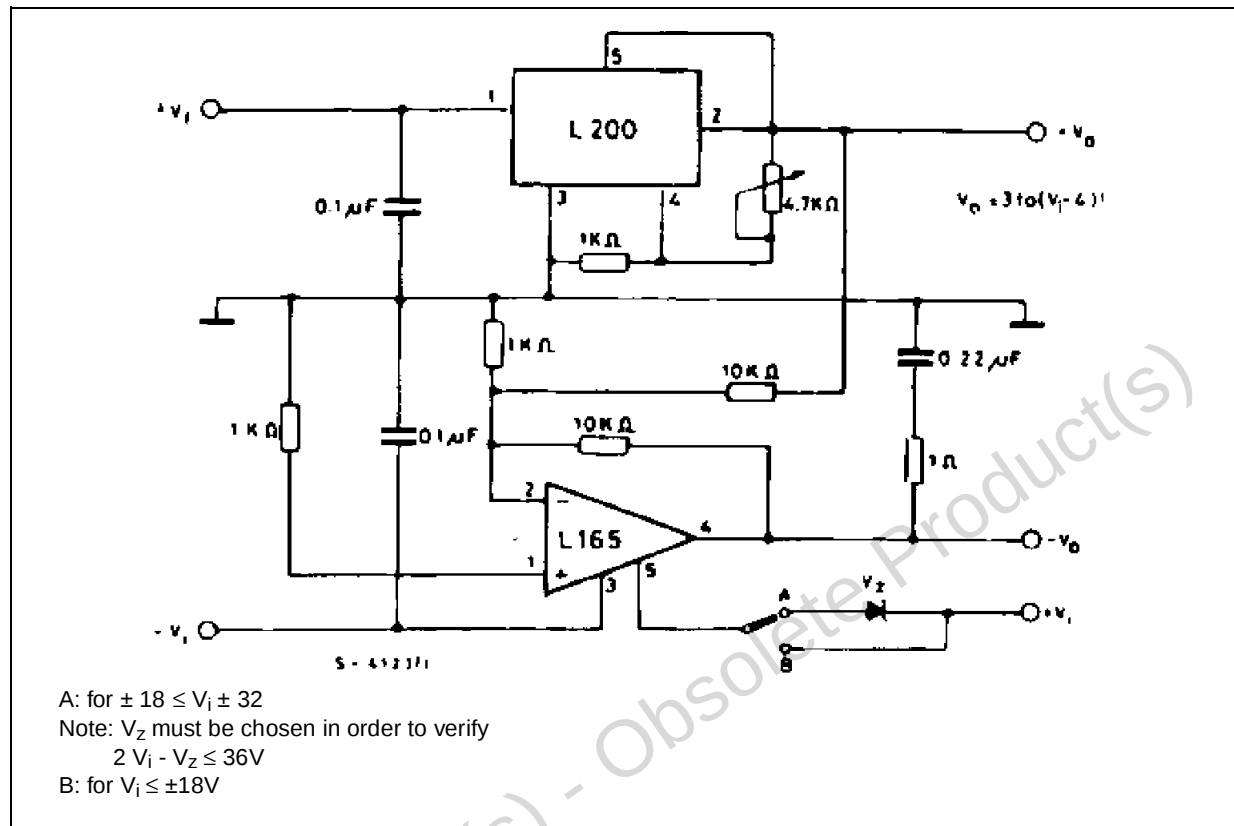


Figure 12. Bidirectional speed control of DC motor (Compensation networks not shown).

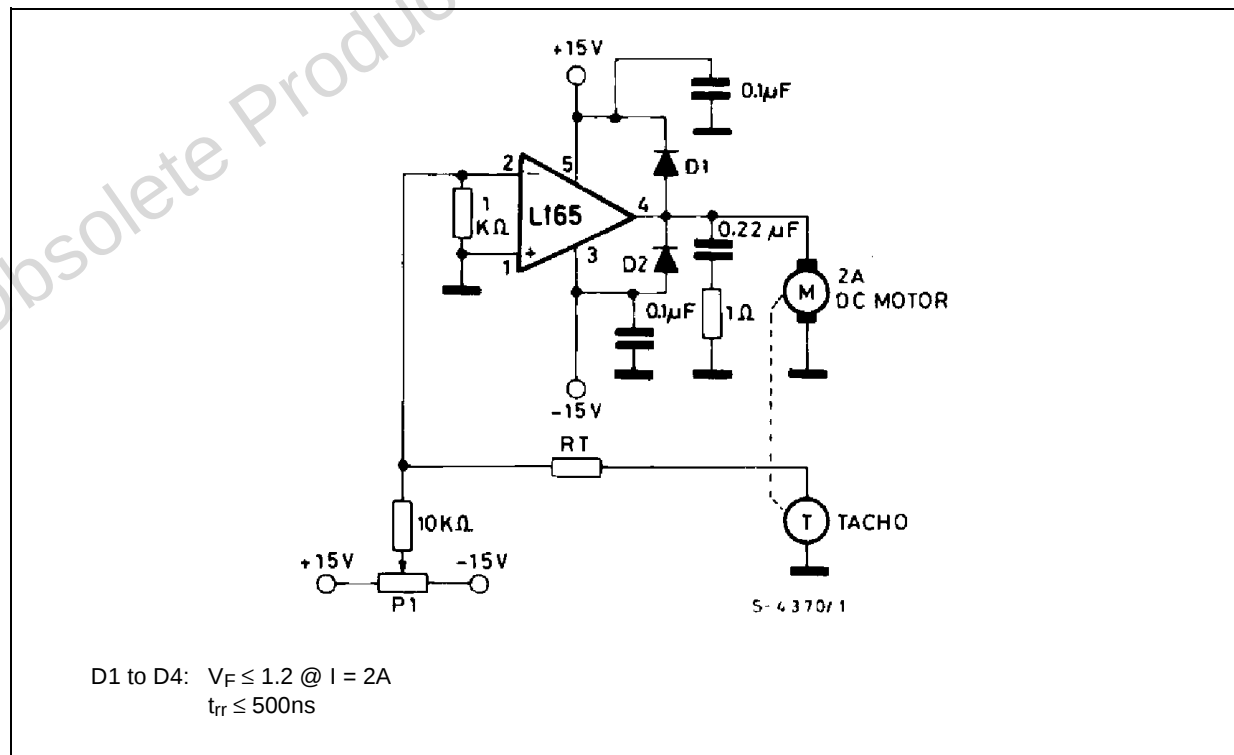


Figure 13. Split power supply.

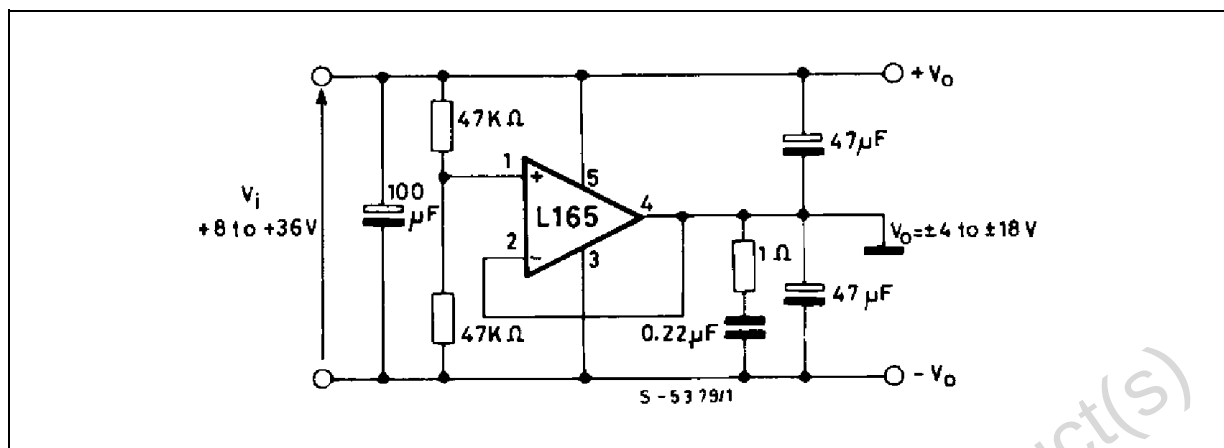
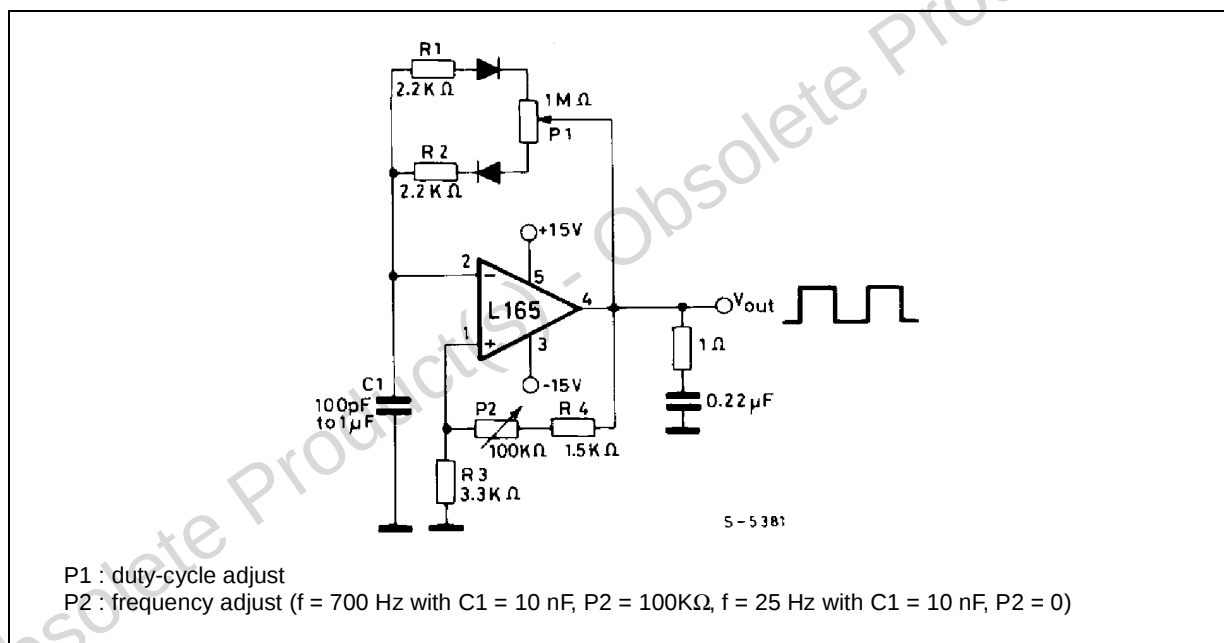


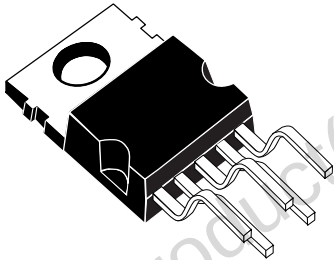
Figure 14. Power squarewave oscillator with independent adjustments for frequency and duty-cycle.



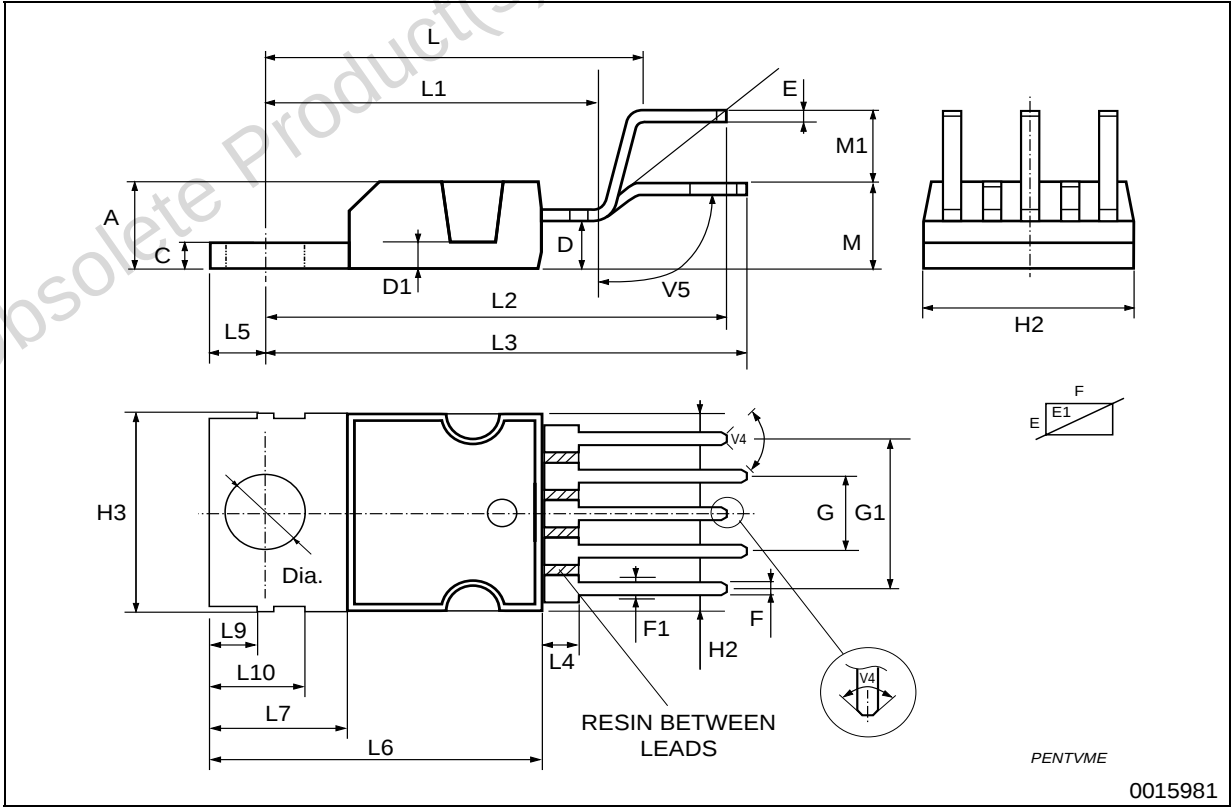
| DIM. | mm         |       |       | inch  |       |       |
|------|------------|-------|-------|-------|-------|-------|
|      | MIN.       | TYP.  | MAX.  | MIN.  | TYP.  | MAX.  |
| A    |            |       | 4.8   |       |       | 0.189 |
| C    |            |       | 1.37  |       |       | 0.054 |
| D    | 2.4        |       | 2.8   | 0.094 |       | 0.110 |
| D1   | 1.2        |       | 1.35  | 0.047 |       | 0.053 |
| E    | 0.35       |       | 0.55  | 0.014 |       | 0.022 |
| E1   | 0.76       |       | 1.19  | 0.030 |       | 0.047 |
| F    | 0.8        |       | 1.05  | 0.031 |       | 0.041 |
| F1   | 1.0        |       | 1.4   | 0.039 |       | 0.055 |
| G    | 3.2        | 3.4   | 3.6   | 0.126 | 0.134 | 0.142 |
| G1   | 6.6        | 6.8   | 7.0   | 0.260 | 0.268 | 0.276 |
| H2   |            |       | 10.4  |       |       | 0.409 |
| H3   | 10.05      |       | 10.4  | 0.396 |       | 0.409 |
| L    | 17.55      | 17.85 | 18.15 | 0.691 | 0.703 | 0.715 |
| L1   | 15.55      | 15.75 | 15.95 | 0.612 | 0.620 | 0.628 |
| L2   | 21.2       | 21.4  | 21.6  | 0.831 | 0.843 | 0.850 |
| L3   | 22.3       | 22.5  | 22.7  | 0.878 | 0.886 | 0.894 |
| L4   |            |       | 1.29  |       |       | 0.051 |
| L5   | 2.6        |       | 3.0   | 0.102 |       | 0.118 |
| L6   | 15.1       |       | 15.8  | 0.594 |       | 0.622 |
| L7   | 6.0        |       | 6.6   | 0.236 |       | 0.260 |
| L9   | 2.1        |       | 2.7   | 0.008 |       | 0.106 |
| L10  | 4.3        |       | 4.8   | 0.17  |       | 0.189 |
| M    | 4.23       | 4.5   | 4.75  | 0.167 | 0.178 | 0.187 |
| M1   | 3.75       | 4.0   | 4.25  | 0.148 | 0.157 | 0.167 |
| V4   | 40° (typ.) |       |       |       |       |       |
| V5   | 90° (typ.) |       |       |       |       |       |
| Dia  | 3.65       |       | 3.85  | 0.144 |       | 0.152 |

**OUTLINE AND  
MECHANICAL DATA**

Weight: 2.00gr



**Pentawatt V**



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