

ADVANCE INFORMATION

SPEED REGULATOR FOR DC MOTORS

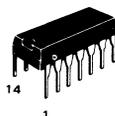
The TDA1041 monolithic integrated circuit is a speed regulator for permanent magnet DC motors for use in record players, tape recorders and in-car cassette players.

The motor speed is regulated to compensate for variations in battery voltage, temperature and load. The part's performance is significantly higher than that of conventional circuits using discrete components.

- The flexibility to adapt to motors with widely varying characteristics.
- Electronic speed change.
- High-stability internal reference voltage.
- Low saturation voltage.
- High starting current.

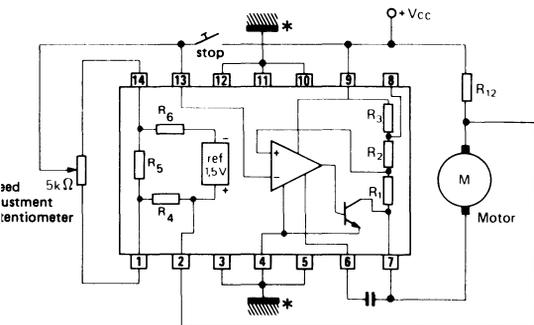
SPEED REGULATOR FOR DC MOTORS

CASE CB-504



DP14 SUFFIX
PLASTIC PACKAGE

APPLICATION CIRCUIT



- $R_1 = 6,8 \text{ k}\Omega$
- $R_2 = 1,2 \text{ k}\Omega$
- $R_3 = 1,4 \text{ k}\Omega$
- $R_4 = 1 \text{ k}\Omega$
- $R_5 = 2,7 \text{ k}\Omega$
- $R_6 = 2,3 \text{ k}\Omega$

*Pins 3-4-5-10-11-12 have to be connected to wide copper area on printed board for good dissipation.

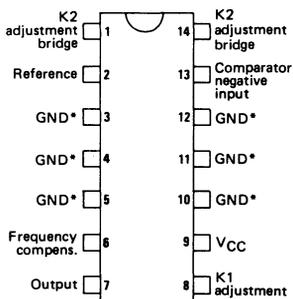
$$1 \text{ V} < \text{c.e.m.f.} < 3 \text{ V}$$

$$R_{12} = \frac{R_{\text{MOT}}}{2,7}$$

$$1,8 \text{ V} < \text{c.e.m.f.} < 6 \text{ V}$$

$$R_{12} = \frac{R_{\text{MOT}}}{6}, R_3 \text{ short-circuited}$$

PIN ASSIGNMENT



*Grounds have to be connected together to wide copper area on printed board for good dissipation.

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MAXIMUM RATINGS $T_{amb} = 25^{\circ}\text{C}$

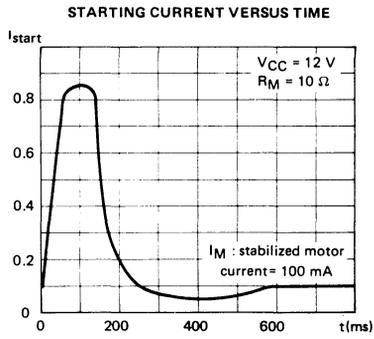
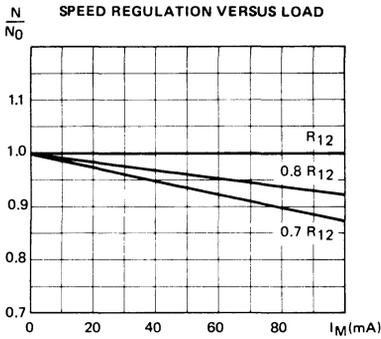
| Rating | Symbol | Value | Unit |
|------------------------|-----------|---------------------------|--------------------|
| Supply voltage | V_{CC} | $3.8 \leq V_{CC} \leq 18$ | V |
| Maximum output current | I_O | 1 | A |
| Junction temperature | T_J | 150 | $^{\circ}\text{C}$ |
| Storage temperature | T_{stg} | -40, +150 | $^{\circ}\text{C}$ |

THERMAL CHARACTERISTICS

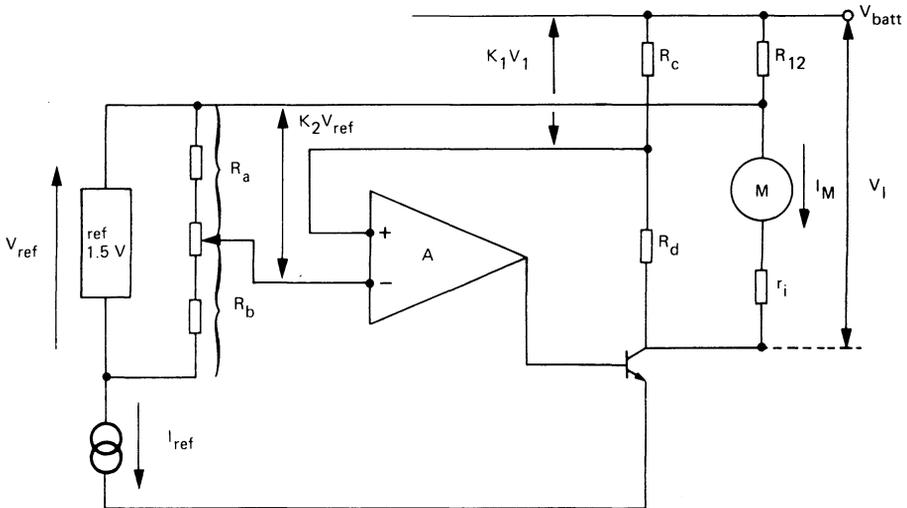
| Characteristic | Symbol | Value | Unit |
|-------------------------------------|---------------|-------|-----------------------------|
| Junction-ambient thermal resistance | $R_{th(j-a)}$ | 60 | $^{\circ}\text{C}/\text{W}$ |
| Junction-case thermal resistance | $R_{th(j-c)}$ | 15 | $^{\circ}\text{C}/\text{W}$ |

ELECTRICAL CHARACTERISTICS $T_{amb} = 25^{\circ}\text{C}$; $V_{CC} = 9\text{ V}$ (unless otherwise specified)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|--|--|------------|----------------------|-----------|------------------------------|
| Reference voltage between pin 2 and 14 | $V_{(ref)}$ | 0.7 | 0.95 | 1.15 | V |
| Regulator supply current | I_{CC} | - | $6 + \frac{I_O}{80}$ | - | mA |
| Reference voltage temperature coefficient (without load) $T_{amb} = 0 \text{ to } 70^{\circ}\text{C}$ | $\frac{\Delta V_{(ref)}}{\Delta t(v_j)}$ | - | -0.1 | - | $\text{mV}/^{\circ}\text{C}$ |
| Reference voltage versus supply voltage (without load) $V_{CC} = 6 \text{ to } 15\text{ V}$ $V_{CC} = 4 \text{ to } 18\text{ V}$ | ΔV_{ref} | -3 -15 | 0 0 | +3 +15 | mV |
| Amplifier input current | I_{IB} | - | 4 | 15 | μA |
| Output transistor saturation voltage $I_O = 0.2\text{ A}$ $I_O = 0.8\text{ A}$ | V_{CEsat} | - - | 0.15 1 | - 1.8 | V |
| Starting current $V_{CC} = 3.8\text{ V}$; $R_{MOT} = 10\ \Omega$ $V_{CC} = 12\text{ V}$; $R_{MOT} = 10\ \Omega$ | I_O | 0.3 0.7 | - 0.85 | - - | A |
| Speed regulation versus load ($I_O = 50 \text{ to } 100\text{ mA}$) | $\frac{\Delta \omega}{\omega}$ | - | 0.6 | - | % |
| Speed regulation coefficient versus supply voltage $\frac{\Delta V_{CC}}{V_{CC}} = \pm 33\%$; $I_O = 70\text{ mA}$ | $\frac{\Delta \omega}{\omega}$ | - | ± 0.3 | - | % |



OPERATING PRINCIPLE



Amplifier gain $A = \infty$
 $K_1 = \frac{R_c}{R_c + R_d}$ $K_2 = \frac{R_a}{R_a + R_b}$

The motor back e.m.f. (E) is proportional to the speed (N in rpm).

- (1)
 $E = K\phi N$
 $\phi = \text{flux}$
 $K = \text{motor constant}$
 $N = \text{number of revolutions}$

The motor current (I_M) is proportional to the torque (C_M)

(2)
 $I_M = \frac{C_M}{K\phi}$

The motor voltage is :

- (3)
 $V_M = E + r_i \cdot I_M$
 where
 $r_i = \text{motor internal resistance}$

The circuit operates by compensating for any variation in r_i in order to maintain E constant as follows :

The motor current I_M causes a voltage drop in r_i . If the torque varies with a constant motor voltage, the back e.m.f. E varies, as does the speed N.

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Assuming that the amplifier gain A is very high :

$$(4) \quad V_1 = V_M + R_{12} I_M + R_{12} I_{ref}$$

$$(5) \quad K_1 V_1 = K_2 V_{ref} + R_{12} (I_M + I_{ref})$$

Combining equations (4) and (5) :

$$(6) \quad K_1 E + K_1 I_M (r_i + R_{12}) + K_1 R_{12} I_{ref} = K_2 V_{ref} + R_{12} (I_M + I_{ref})$$

$$(7) \quad E = \frac{K_2}{K_1} V_{ref} + I_{ref} R_{12} \left(\frac{1}{K_1} - 1 \right) + I_M \left[R_{12} \left(\frac{1}{K_1} - 1 \right) - r_i \right] = K \phi N$$

The term $\left[R_{12} \left(\frac{1}{K_1} - 1 \right) - r_i \right]$ may be eliminated by selecting an appropriate value for R_{12} .

Equation (7) is then written :

$$(8) \quad E = \frac{K_2}{K_1} V_{ref} + R_{12} \left(\frac{1}{K_1} - 1 \right) I_{ref} = K \phi N$$

As the terms of equation (8) are constant, neither E nor N varies. V_{ref} is the reference voltage stabilized against variations in supply voltage and temperature. The required value for R_{12} is :

$$(9) \quad R_{12} = \frac{r_i}{\frac{1}{K_1} - 1}$$

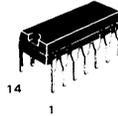
The closed loop system formed by the integrated circuit, the motor and R_{12} features both voltage and current feedback.

The system is conditionally stable if :

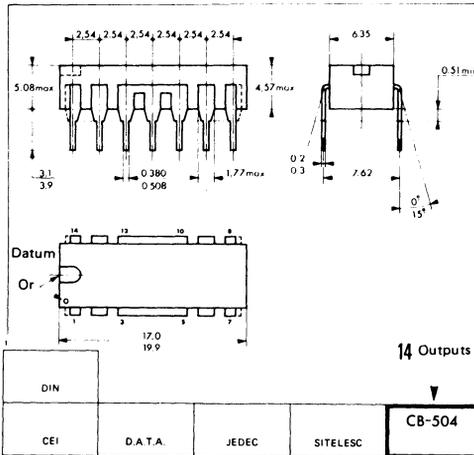
$$R_{12} \leq \frac{r_i}{\frac{1}{K_1} - 1}$$

In practice, the value of R_{12} is calculated to compensate for spread in terms of the value of R_{12} and the motor parameters.

CASE CB-504



DP14 SUFFIX
PLASTIC PACKAGE



This is advance information and specifications are subject to change without notice. Please inquire with our sales offices about the availability of the different packages.