TDA1154

SPEED REGULATOR FOR DC MOTORS

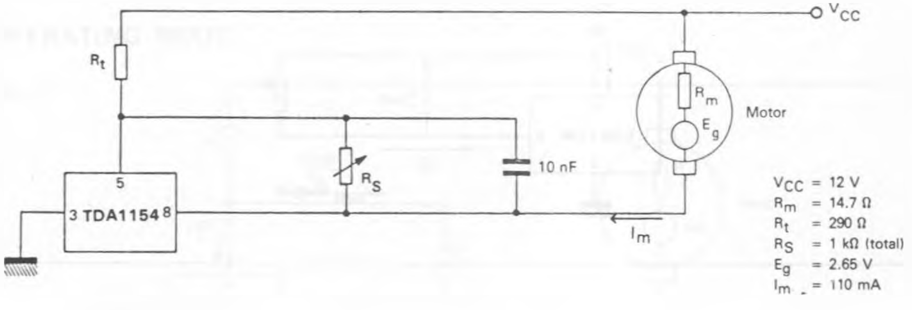
- MATCHING FLEXIBILITY TO MOTORS WITH VARIOUS CHARACTERISTICS
- BUILT-IN CURRENT LIMIT
- ON-CHIP 1.2V REFERENCE VOLTAGE
- STARTING CURRENT: 0.5A @2.5V
- REFLECTION COEFFICIENT K = 20

The TDA1154 is a monolithic integrated circuit intended for speed regulation of permanent magnet dc motors used in record players, tape recorders, cassette recorders and toys.

The circuit offers an excellent speed regulation with much higher power supply, temperature and load variations than conventional circuits built around discrete components.

ORDER CODE: TDA1154

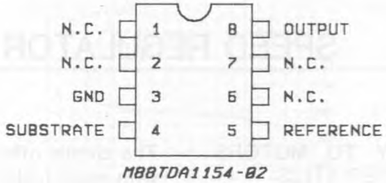
Fig. 1 - Application circuit



V_{CC} = 12 V
R_m = 14.7 Ω
R_t = 290 Ω
R_S = 1 kΩ (total)
E_g = 2.65 V
I_m = 110 mA

3 : Ground
5 : Reference
8 : Output
Other pins are not connected

PIN CONNECTION



ABSOLUTE MAXIMUM RATINGS

V_{CC}	Supply voltage	20	V
I_O	Output current	1.2	A
P_{tot}	Power dissipation	(see curve)	W
T_j	Junction temperature	+150	°C
T_{stg}	Storage temperature range	-55 to +150	°C

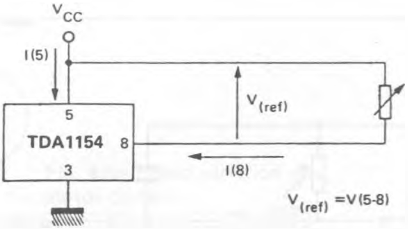


Fig. 2 - Test circuit

THERMAL DATA

$R_{th\ j-amb}$	Thermal resistance junction-ambient	max	100	°C/W
$R_{th\ j-amb}$	Thermal resistance junction-pin 4	max	70	°C/W

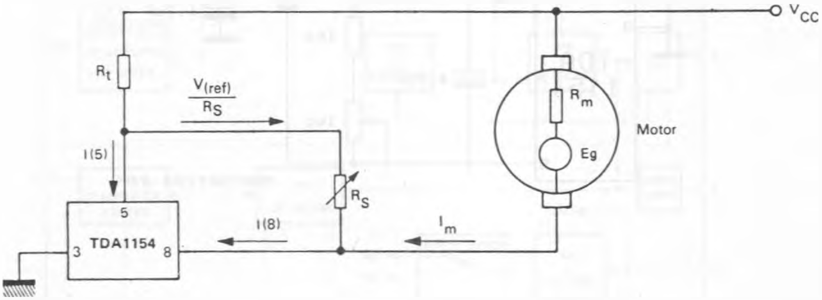
ELECTRICAL CHARACTERISTICS $T_{amb} = +25°C$ (Unless otherwise specified)

Parameter		Test Conditions	Min.	Typ.	Max.	Unit
$V_{(ref)}$	Reference voltage	$V_{CC} = +6V \quad I(8) = 0.1A$	1.15	1.25	1.35	V
$\frac{\Delta V_{(ref)}}{V_{(ref)}} / \Delta T$	Reference voltage temperature coefficient	$V_{CC} = +6V \quad I(8) = 0.1A$ $T_{amb} = -20°C$ to $+70°C$	–	0.02	–	%/°C
$\frac{\Delta V_{(ref)}}{V_{(ref)}} / \Delta V_{CC}$	Line regulator	$V_{CC} = +4V$ to $+18V$ $I(8) = 0.1A$	–	0.02	–	% /V
$\frac{\Delta V_{(ref)}}{V_{(ref)}} / \Delta I(8)$	Load regulator	$V_{CC} = +6V$ $I(8) = 25$ to 400 mA	–	0.009	–	% /mA
$V(5-3)$	Minimum supply voltage	$I(8) = 0.1A \quad \frac{\Delta V_{(ref)}}{V_{(ref)}} = -5\%$	2.5	–	–	V
$I(8)$	Starting current(*)	$\frac{\Delta V_{(ref)}}{V_{(ref)}} = -50\%$				A
		$V_{CC} = +5V$	1.2	–	–	
		$V_{CC} = +2.5V$	0.5	0.8	–	
$I_O(5)$	Quiescent current on pin 5	$V_{CC} = +6V \quad I(8) = 100\,\mu A$	–	1.7	–	mA
K	$K = \frac{\Delta I(8)}{\Delta I(5)}$ reflection coefficient	$V_{CC} = +6V \quad I(8) = 0.1A$	18	20	22	
$\frac{\Delta K}{K} / \Delta V_{CC}$	K spread versus V_{CC}	$V_{CC} = +6V$ to $+18V$ $I(8) = 0.1A$	–	0.45	–	%/V
$\frac{\Delta K}{K} / \Delta I(8)$	K spread versus I(8)	$V_{CC} = +6V$ $I(8) = 25$ to 400 mA	–	0.005	–	%/mA
$\frac{\Delta K}{K} / \Delta T$	K spread versus temperature	$V_{CC} = +6V \quad I(8) = 0.1A$ $T_{amb} = +20°C$ to $+70°C$	–	0.02	–	%/°C

(*) An internal protection circuit reduces the current if the temperature of the junction increase: $I(8) = 0.75A$ at $T_j = +140°C$.

OPERATING MODE

Fig. 3



The circuit maintains a 1.2V constant reference voltage between pins 5 and 8:

$$V(5-8) = V_{(ref)} = 1.2V$$

The current (I(5)) drawn by the circuit at pin 5 is sum of two currents.

One is constant: $I_O(5) = 1.7$ mA and the other is proportional to pin 8 current (I(8)):

$$I(5) = I_O(5) + I(8)\,K \,(a) \qquad (I_O(5) = 1.7\,mA,\ K = 20)$$

If E_g and R_m are motor back electromotive force and motor internal resistance respectively, then:

$$E_g + R_m I_m = R_t \left[I(5) + \frac{V_{(ref)}}{R_S} \right] + V_{(ref)} \quad \text{(b)}$$

From figure 2 it is seen that:

$$I(8) = I_m + \frac{V_{(ref)}}{R_S} \quad \text{(c)}$$

Substituting equations (a) and (c) into (b) yields:

$$\underbrace{E_g = I_m \left[\frac{R_t}{K} - R_m \right] +}_{(1)}$$

$$\underbrace{+ V_{(ref)} \left[\frac{R_t}{R_s} \left(1 + \frac{1}{K}\right) + 1 \right] + R_t I_O(5) \quad \text{(d)}}_{(2)}$$

The motor speed will be independent of the resisting torque if E_g is also independent of I_m. Therefore, in order to determine the value of R_t term(1) in (d) must be zero:

$$R_t = K \ R_m \ (K = 20)$$

If $R_t > KR_m$, an instability may occur as a result of overcompensation.
The value of R_S is determined by term (2) in (d) so as to obtain the back electromotive force (E_g) corresponding to required motor speed:

$$R_S = R_t \frac{V_{(ref)} (1 + 1/K)}{E_g - V_{(ref)} - R_t I_O(5)} \cong$$

$$\cong R_t \frac{V_{(ref)}}{E_g - V_{(ref)} - R_t I_O(5)}$$

Where $V_{(ref)} = 1.2V$ and $I_O(5) = 1.7$ mA

Fig. 4 - Application circuit