MOTOR SPEED REGULATOR WITH THERMAL SHUT-DOWN

The TDA1059B is a monolithic integrated circuit with a current limiter and with good thermal characteristics in a TO-126 plastic package for easy mounting. It is intended to regulate the speed of d.c. motors in record players, cassette recorders and car cassette recorders.

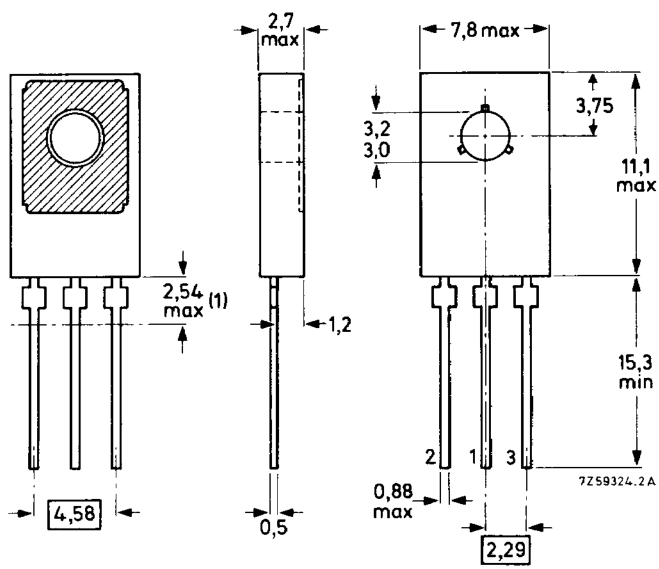
QUICK REFERENCE DATA

Supply voltage	$V_P = V_{2\text{-}1}$	typ.	9	V
			3,3 to 16	V
Internal reference voltage	V_{ref}	typ.	1,3	V
Drop-out voltage	$V_{3\text{-}1}$	typ.	1,8	V
Limited output current	I_{3lim}	typ.	0,6	A
Multiplication coefficient	k	typ.	9	

PACKAGE OUTLINE

Dimensions in mm

Fig. 1 TO-126 (SOT-32).
Pin 1 connected to metal part of mounting surface.



(1) Within this region the cross-section of the leads is uncontrolled.

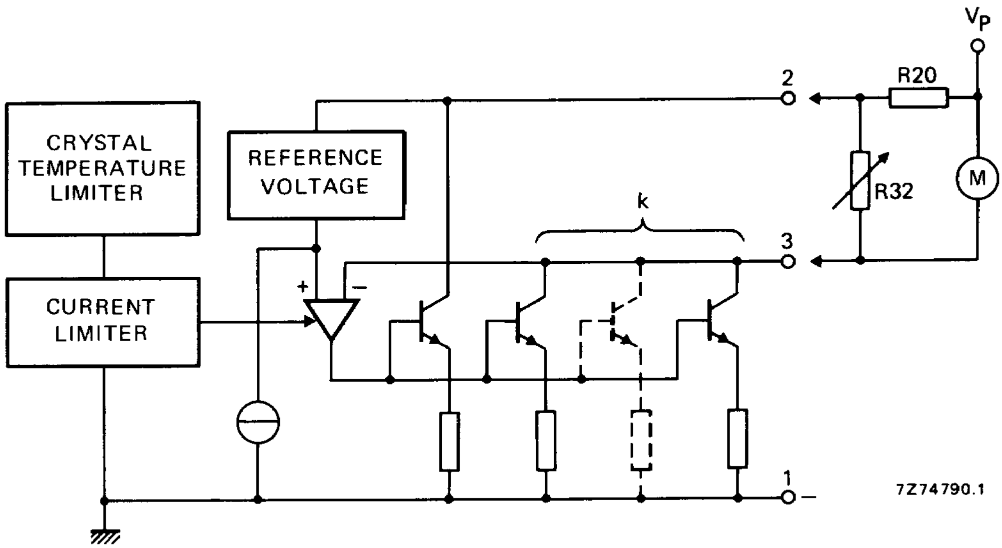


Fig. 2 Functional diagram.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage	$V_P = V_{2\text{-}1}$	max.	16 V
Storage temperature	T_{stg}	−55 to + 150	°C
Operating ambient temperature (see Fig. 3 and note)	T_{amb}	−25 to + 130	°C

THERMAL RESISTANCE

From junction to case	$R_{th\,j\text{-}c}$	=	10 K/W
From junction to ambient	$R_{th\,j\text{-}a}$	=	100 K/W

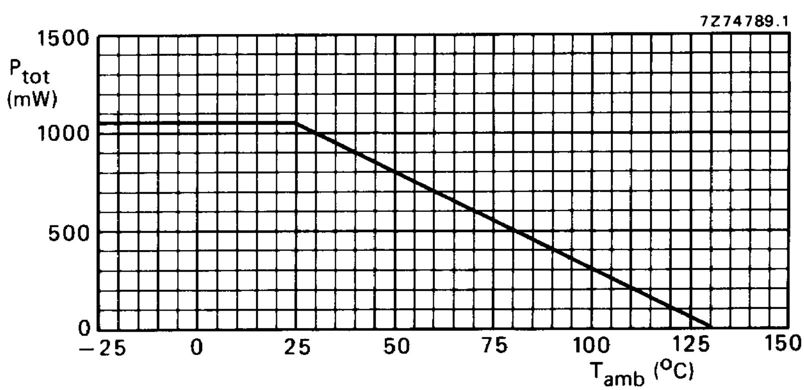


Fig. 3 Power derating curve.

Note

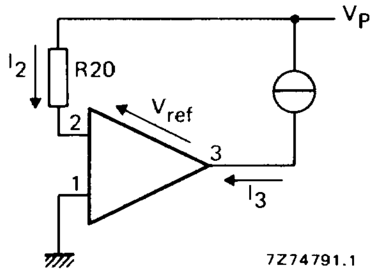
At ambient temperatures above 130 °C, the crystal temperature limiter decreases the internal power consumption.

CHARACTERISTICS

V_P = 9 V; T_{amb} = 25 °C; R20 = 0; heatsink with R_{th} = 100 K/W and after thermal stabilization; unless otherwise specified; see test circuit Fig. 4.

		min.	typ.	max.	
Supply voltage	$V_P = V_{2\text{-}1}$	3,3	9	16	V
Internal reference voltage V_P = 3,3 V; I_3 = 80 mA	V_{ref}	1,24	1,3	1,36	V
Drop-out voltage I_3 = 80 mA; ΔV_{ref} = 5%	$V_{3\text{-}1}$	–	1,8	2,06	V
Quiescent current; I_3 = 0	I_q	1,8	2,3	2,8	mA
Limited output current*	I_{3lim}	0,3	0,6	1	A
Multiplication coefficient I_3 = 50 mA ± 10 mA	$k = \frac{\Delta I_3}{\Delta I_2}$	8,5	9	9,5	
Line regulation V_P = 3,3 to 16 V at I_3 = 50 mA					
reference voltage variation	$\frac{\Delta V_{ref}}{V_{ref}} / \Delta V_P$	−0,115	0	+0,115	%/V
multiplication coefficient variation I_3 = 50 ± 10 mA	$\frac{\Delta k}{k} / \Delta V_P$	–	0,86	–	%/V
input current variation; I_3 = 50 mA	$\frac{\Delta I_2}{\Delta V_P}$	−15	0	+20	µA/V
Load regulation					
reference voltage variation I_3 = 20 to 80 mA	$\frac{\Delta V_{ref}}{V_{ref}} / \Delta I_3$	0	19	38,5	%/A
multiplication coefficient variation I_3 = 30 ± 10 to 70 ± 10 mA	$\frac{\Delta k}{k} / \Delta I_3$	−0,075	0	+0,075	%/mA
Temperature coefficient I_3 = 50 mA; T_{amb} = −15 to +65 °C					
reference voltage variation	$\frac{\Delta V_{ref}}{V_{ref}} / \Delta T_{amb}$	−0,03	0	+0,03	%/K
multiplication coefficient variation ΔI_3 = ± 10 mA	$\frac{\Delta k}{k} / \Delta T_{amb}$	–	0,008	–	%/K
input current variation	$\frac{\Delta I_2}{\Delta T_{amb}}$	−2	0	+2	µA/K

* If the motor is stopped by a mechanical brake, the current limitation is effective in the supply voltage range. If the motor is short-circuited, the TDA1059B will be damaged if the supply voltage is higher than 10 V due to parasitic oscillations.

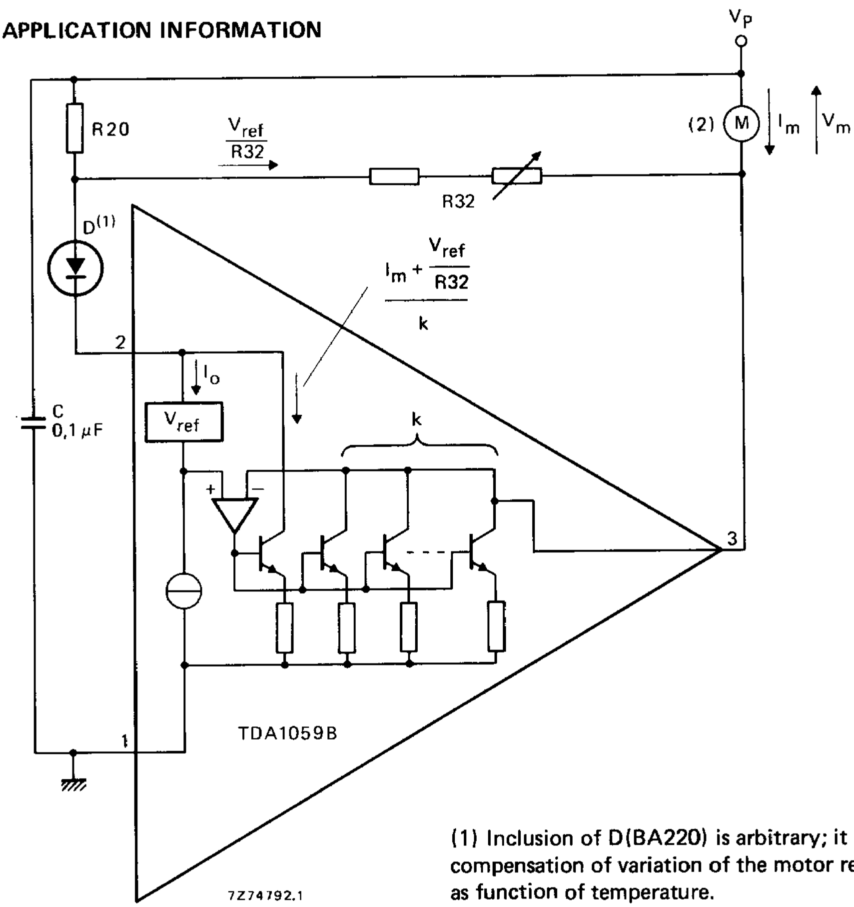


Note

For start operation: V_{ref} must start with final V_P = 6,7 V and a time constant of 3 τ = 100 ms in which τ = R.C; R = source impedance, C = by-pass capacitor.

Fig. 4 Test circuit.

APPLICATION INFORMATION



(1) Inclusion of D(BA220) is arbitrary; it permits compensation of variation of the motor resistance as function of temperature.

(2) Motor example (without diode D):

Catalogue no. 9904 120 01806; n = 2000 rev/min; R20 = 180 Ω (± 2%); R32 = 100 Ω + 100 Ω (variable).

Fig. 5 Example of using the TDA1059B in a d.c. motor speed regulation circuit.

Motor equations

$E_m = \alpha_1 n$ where: α_1, α_2 = motor constant

$I_m = \alpha_2 r$ n = number of revolutions

$V_m = E_m + R_m I_m$ r = motor torque

E_m = back electromotive force

R_m = motor resistance

The back electromotive force (E_m) in Fig. 5 can be expressed (excluding diode D) as:

$$E_m = \left(\frac{R20}{k} - R_m \right) I_m + V_{ref} \left\{ 1 + \frac{R20}{R32} \left(1 + \frac{1}{k} \right) \right\} + R20.I_o$$

and including diode D, as:

$$E_m = \left(\frac{R20}{k} - R_m \right) I_m + \left(V_{ref} + V_D \right) \left\{ 1 + \frac{R20}{R32} \left(1 + \frac{1}{k} \right) \right\} + R20.I_o$$

Speed regulation is constant when E_m is independent of I_m variations; this will be obtained when $R20 = kR_m$.

E_m, and therefore the motor speed, is regulated by R32. A practical condition for stability is $R20 < kR_m$.