LINEAR INTEGRATED CIRCUITS

TCA 900
TCA 910

PRELIMINARY DATA

MOTOR SPEED REGULATORS

The TCA 900 and TCA 910 are linear integrated circuits in Jedec TO-126 plastic package. They are designed for use as speed regulators for DC motors of record players, tape recorders and cassettes.

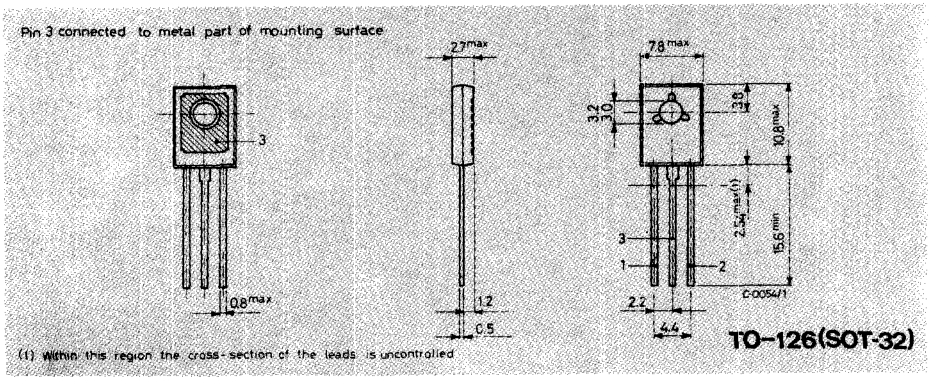
The TCA 900 is particularly suitable for battery operated portable equipments, and the TCA 910 for car-battery and mains operations.

ABSOLUTE MAXIMUM RATINGS

		TCA 900	TCA 910
V_s	Supply voltage	14 V	20 V
P_{tot}	Total power dissipation at T_{amb} = 70 °C	0.8 W	
	at T_{case} = 100 °C	5 W	
→ T_{stg}, T_j	Storage and junction temperature	-40 to 150 °C	

MECHANICAL DATA

Dimensions in mm



TO-126(SOT-32)

TCA 900
TCA 910

THERMAL DATA

→ $R_{th\ j\text{-}case}$	Thermal resistance junction-case	max.	10	°C/W
→ $R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max.	100	°C/W

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C and $R_S = \infty$ unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit	Fig.
V_{ref}	Reference voltage (between pins 2 and 3)	V_s = 5.5 V I_m = 70 mA R_T = 0		2.6		V	1
I_{d3}	Quiescent current (at pin 3)	$V_{1\text{-}3}$ = 5.5 V I_2 = 0 R_T = 0		2.6		mA	—
V_m	*Output voltage* (for **TCA 900** only)	V_s = 5.5 V I_m = 70 mA R_T = 91 Ω		3.6	3.9	V	1
V_m	Output voltage (for **TCA 910** only)	V_s = 9 V I_m = 70 mA R_T = 270 Ω		5.6	6.3	V	1
$V_{1\text{-}2}$	Dropout voltage	$\Delta V_m/V_m$ = -1% I_m = 70 mA R_T = 91 Ω		1.2		V	1
I_2	Limiting output current (at pin 2)	$V_{1\text{-}3}$ = 5.5 V $V_{2\text{-}3}$ = 0		400		mA	—
$K = \Delta I_2/\Delta I_3$		V_s = 5.5 V I_2 = -70 mA ΔI_2 = ±10 mA R_T = 0		8.5		—	1
$\frac{\Delta V_m}{V_m}/\Delta V_s$	Line regulation (for **TCA 900** only)	V_s = 5.5 V to 12 V I_m = 70 mA R_T = 91 Ω		0.1		%/V	1

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit	Fig.
$\frac{\Delta V_m}{V_m} / \Delta V_s$	Line regulation (for **TCA 910** only)	V_s = 10 V to 16 V I_m = 70 mA R_T = 270 Ω		0.1		%/V	1
$\frac{\Delta V_m}{V_m} / \Delta I_m$	Load regulation	V_s = 5.5 V I_m = 40 to 100 mA R_T = 0		0.005		%/mA	1
$\frac{\Delta V_{ref}}{V_{ref}} / \Delta T_{amb}$	Temperature coefficient	V_{1-3} = 5.5 V I_2 = -70 mA T_{amb} = -20 to 70 °C		0.01		%/°C	—

Fig. 1 - Test circuit.

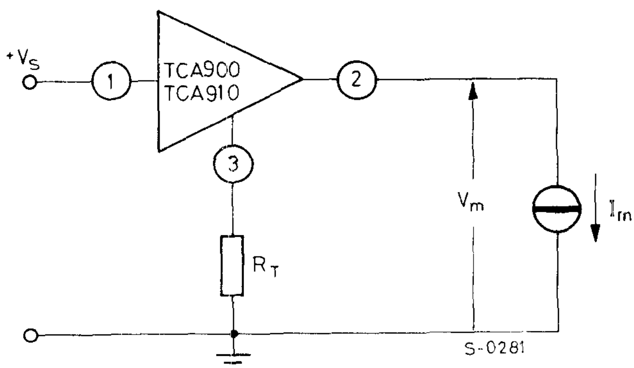


Fig. 2 - Typical application circuit.

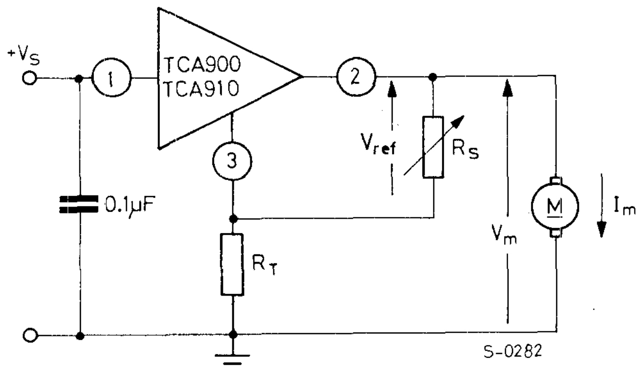


Fig. 3 - Normalized K versus I_2

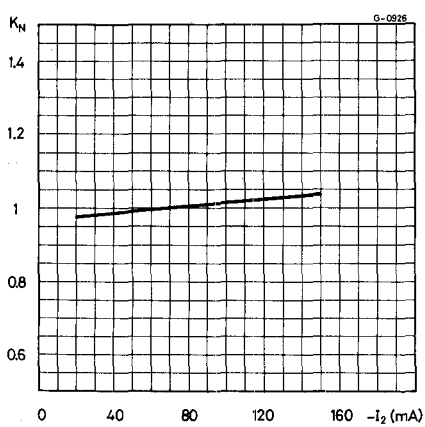
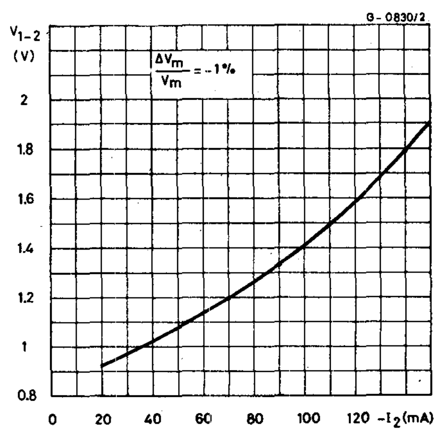


Fig. 4 - Dropout voltage versus output current



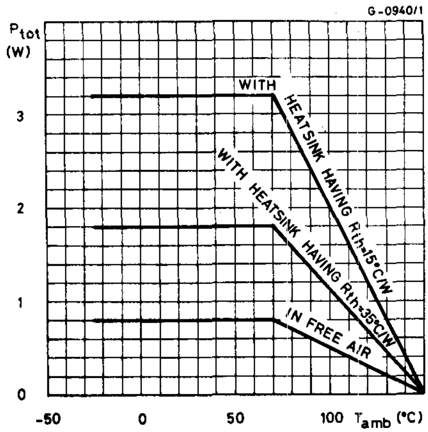


Fig. 5 - Maximum allowable power dissipation versus ambient temperature

APPLICATION INFORMATION

The regulator supplies the motor in such a way as to keep its speed constant, independent of supply voltage, applied torque and ambient temperature variations. The basic equation for the motor is:

$$V_m = E_0 + R_m I_m = a_1 n + a_2 c$$

Where:
- V_m = supply voltage applied to the motor
- E_0 = back electromotive force
- n = motor speed (r.p.m)
- R_m = internal resistance (of the motor)
- I_m = current absorbed (by the motor)
- a_1 and a_2 = constants
- c = drive torque

A voltage supply with the following characteristics

$E = E_0$ E = electromotive force

$R_o = -R_m$ R_o = output resistance

gives performance required.

This means that a variation in current absorbed by the motor, due to a variation in torque applied, causes a proportional variation in regulator output voltage.

In fig. 6 is shown the minimum allowable E_0 versus R_T.

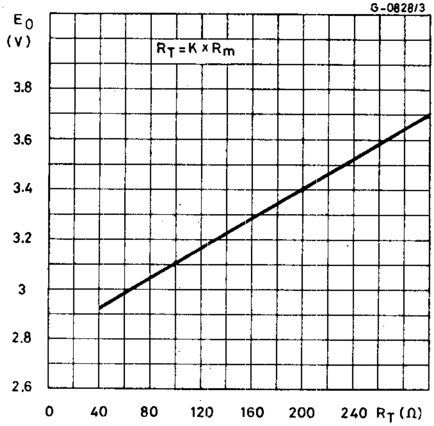


Fig. 6 - Minimum E_0 allowable versus R_T.

The TCA 900 and TCA 910 give a reference constant voltage V_{ref} (between pins 2 and 3) independent of variations of V_s, I_2 and ambient temperature.

They also give:

$$I_3 = I_{d3} + I_2/K$$

Where:
- I_3 = total current at pin 3
- I_{d3} = quiescent current at pin 3 ($I_2 = 0$)
- I_2 = current at pin 2
- K = constant.

The output voltage V_m, applied to the motor has the following value:

$$V_m = \underbrace{V_{ref} + R_T \left[\frac{V_{ref}}{R_s} \left(1 + \frac{1}{K} \right) + I_{d3} \right]}_{\text{Term 1}} + \underbrace{\frac{I_m}{K} R_T}_{\text{Term 2}}$$

Term 1 equals E_0 and fixes the motor speed by means of the variable resistor R_s;

Term 2 $\frac{I_m}{K} \cdot R_T$ equals the term $R_m \cdot I_m$ and, therefore, compensates variations of torque applied.

Complete compensation is achieved when:

$$R_T = K R_m$$

If $R_{T\,max} > K R_{m\,min}$ instability may occur.