

BIPOLAR ANALOG INTEGRATED CIRCUIT  
 $\mu$ PC1470

MOTOR SPEED REGULATORS

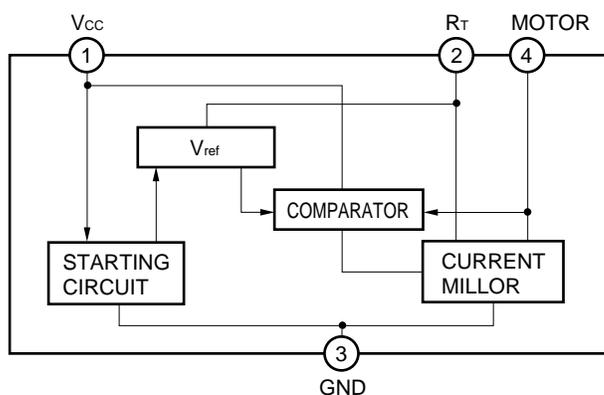
DESCRIPTION

The  $\mu$ PC1470 is a monolithic integrated circuit intended as speed regulators for DC motors of record players, tape and cassette recorders etc. The devices is packaged in a new developed 4-lead quase-TO-126 plastic case.

FEATURES

- Excellent versatility in use.
- High Output current.
- Low Quiescent current.
- Low Reference voltage.
- Excellent parameters stability versus temperature.
- Excellent characteristic at low supply voltage.

BLOCK DIAGRAM

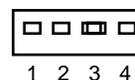
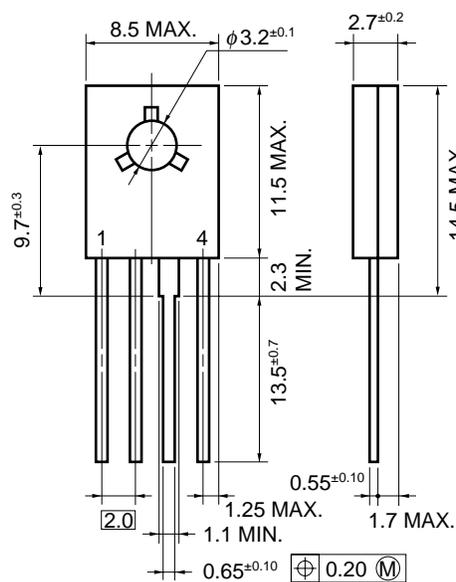


ORDERING INFORMATION

PART NUMBER  
 $\mu$ PC1470H-X

PACKAGE DIMENSIONS

in millimeters



Connection Diagram  
 1. Vcc  
 2. R<sub>T</sub>  
 3. GND  
 4. MOTOR

**ABSOLUTE MAXIMUM RATINGS (TA = 25 °C)**

Supply Voltage	V <sub>CC</sub>	18	V
Circuit Current	I <sub>4</sub>	2*	A
Package Dissipation	P <sub>D</sub>	1.2	W
Operating Temperature	T <sub>A</sub>	-20 to +75	°C
Storage Temperature	T <sub>stg</sub>	-40 to +150	°C

**RECOMMENDED OPERATING CONDITION**

Supply Voltage Range	V <sub>CC</sub>	3.5 to 16	V
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**ELECTRICAL CHARACTERISTICS (TA = 25 °C, V<sub>CC</sub> = 12 V)**

Characteristic	Symbol	MIN.	TYP.	MAX.	UNIT	Test Conditions*
Reference Voltage	V <sub>ref</sub>	1.10	1.27	1.40	V	I <sub>4</sub> = 10 mA Fig. 1
Quiescent Current	I <sub>Q</sub>	0.5	0.8	1.2	mA	R <sub>M</sub> = 180 Ω Fig. 4
Reflection Coefficient	k	18	20	22		R <sub>M1</sub> = 44 Ω, R <sub>M2</sub> = 33 Ω Fig. 2
Saturation Voltage	V <sub>4 (sat)</sub>		1.5	2.0	V	V <sub>CC</sub> = 4.2 V, R <sub>M</sub> = 4.4 Ω Fig. 3
Line Regulation	$\frac{\Delta V_{ref}}{V_{ref}} / \Delta V_{CC}$		0.06		%/V	I <sub>4</sub> = 100 mA, V <sub>CC</sub> = 6.3 to 16 V Fig. 1
	$\frac{\Delta k}{k} / \Delta V_{CC}$		0.4		%/V	I <sub>4</sub> = 100 mA, V <sub>CC</sub> = 6.3 to 16 V Fig. 2
Load Regulation	$\frac{\Delta V_{ref}}{V_{ref}} / \Delta I_4$		-0.02		%/mA	I <sub>4</sub> = 30 to 200 mA Fig. 1
	$\frac{\Delta k}{k} / \Delta I_4$		-0.02		%/mA	I <sub>4</sub> = 30 to 200 mA Fig. 2
Temperature Coefficient	$\frac{\Delta V_{ref}}{V_{ref}} / \Delta T_A$		0.01		%/°C	I <sub>4</sub> = 100 mA, T <sub>A</sub> = -20 to +75 °C Fig. 1
	$\frac{\Delta k}{k} / \Delta T_A$		0.01		%/°C	I <sub>4</sub> = 100 mA, T <sub>A</sub> = -20 to +75 °C Fig. 2

\* Pulse Test: PW ≤ 10 ms, Duty Cycle ≤ 2 %

**TEST CIRCUIT**

Fig. 1

$$\left( V_{ref}, \frac{\Delta V_{ref}}{V_{ref}} / \Delta V_{CC}, \frac{\Delta V_{ref}}{V_{ref}} / \Delta I_4, \frac{\Delta V_{ref}}{V_{ref}} / \Delta T_A \right)$$

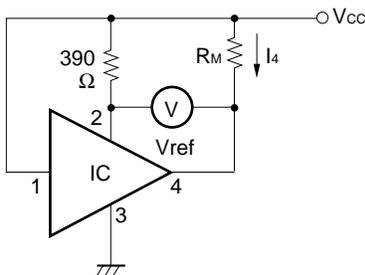
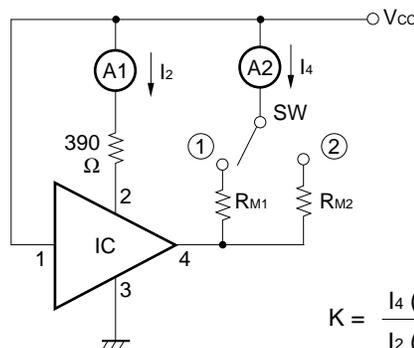


Fig. 2

$$\left( k, \frac{\Delta k}{k} / \Delta V_{CC}, \frac{\Delta k}{k} / \Delta I_4, \frac{\Delta k}{k} / \Delta T_A \right)$$



$$K = \frac{I_4 (SW \text{ ②}) - I_4 (SW \text{ ①})}{I_2 (SW \text{ ②}) - I_2 (SW \text{ ①})}$$

Fig. 3

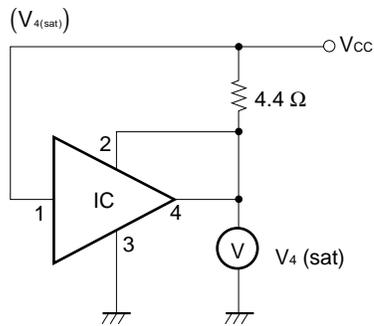
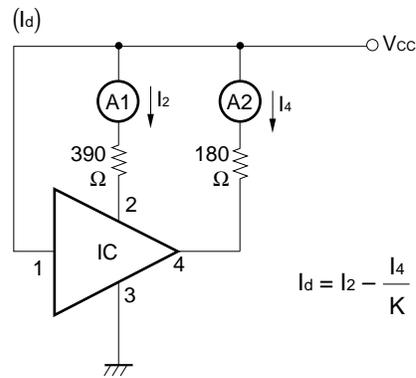
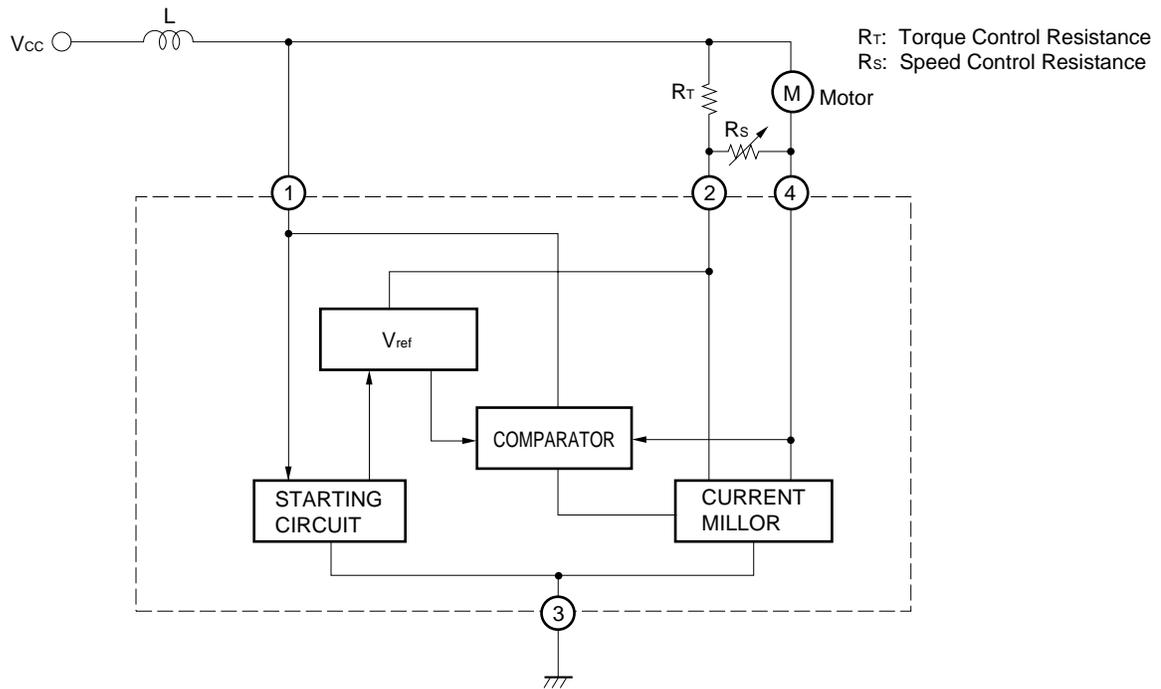


Fig. 4



APPLICATION INFORMATION



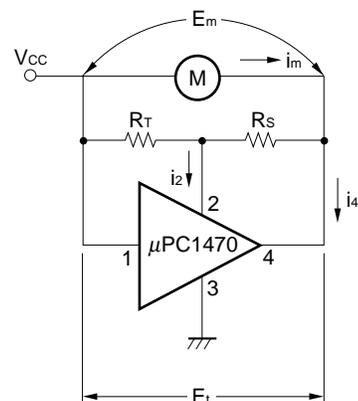
[BASIC EQUATION FOR THE MOTOR]

$$\begin{cases} E_t = V_{ref} + R_T \left( i_2 + \frac{V_{ref}}{R_S} \right) \\ i_2 = \frac{1}{K} i_4 + i_q \\ i_4 = i_m + \frac{V_{ref}}{R_S} \end{cases}$$

$$\begin{aligned} E_t &= V_{ref} + R_T \left( \frac{1}{K} i_4 + i_q + \frac{V_{ref}}{R_S} \right) \\ E_t &= V_{ref} + R_T \left\{ \frac{1}{K} \left( i_m + \frac{V_{ref}}{R_S} \right) + i_q + \frac{V_{ref}}{R_S} \right\} \\ E_t &= V_{ref} \left\{ 1 + \frac{R_T}{R_S} \left( 1 + \frac{1}{K} \right) \right\} + R_T i_q + \frac{R_T}{K} i_m \end{aligned}$$

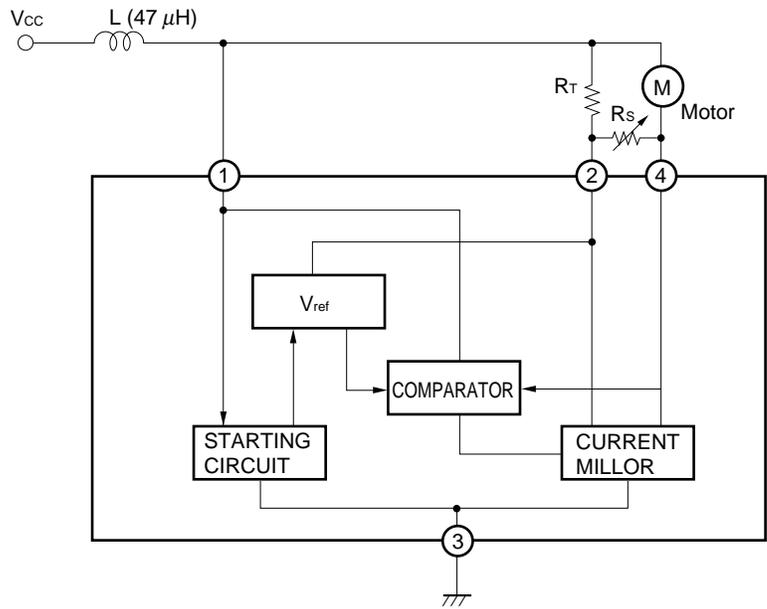
They also give:  $E_m = E_o + R_{mim}$

$$\begin{cases} E_o = V_{ref} \left\{ 1 + \frac{R_T}{R_S} \left( 1 + \frac{1}{K} \right) \right\} + R_T i_q \\ R_m = \frac{R_T}{K} \end{cases}$$



( $E_o$ : Back Electromotive Force  
 $R_m$ : Internal Resistance (of the Motor)  
 $K$ : Reflection Coefficient (=  $i_4/i_2$ )

APPLICATION CIRCUIT



- V<sub>CC</sub> = 12 V
- R<sub>m</sub> = 19.5 Ω
- R<sub>T</sub> = 330 Ω
- R<sub>S</sub> = 1 kΩ
- E<sub>o</sub> = 2.3 V
- K = 20

Notes 1. The motor speed can be adjusted by the variable resistor R<sub>S</sub>.

$$R_{S \min.} = \frac{V_{ref} \cdot R_T}{E_o - V_{ref} - I_q \cdot R_T}$$

2. If R<sub>T max.</sub> > K • R<sub>m min.</sub>, instability of the motor may occur.

## REFERENCE

Document Name	Document No.
Quality grade on NEC semiconductor devices.	IEI-1209
Semiconductor device mounting technology manual.	IEI-1207
Semiconductor device package manual.	IEI-1213
Guide to quality assurance for semiconductor devices.	MEI-1202
Semiconductor selection guide.	MF-1134
NEC semiconductor device reliability/quality control system (Standard linear IC).	IEI-1212

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Anti-radioactive design is not implemented in this product.