FUJITSU

VOLTAGE REGULATOR

MB3752

February 1988
Edition 1.0

VOLTAGE REGULATOR

The Fujitsu MB3752 is a monolithic voltage regulator IC. It contains a temperature compensated reference voltage circuit, a surge protected error amplifier and high current protected circuit.

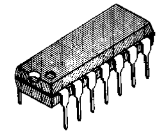
High current regulator, negative power supply regulator, floating regulator and switching regulator are made up by selection of external components.

Constant current limiting or foldback current limiting is selected by selection of external components.

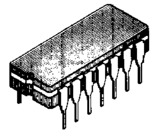
It is suitable both industrial and consumer voltage regulator system.

The high performance makes a lot of application and enables operation with various functions.

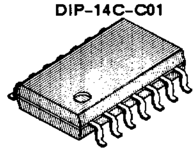
- High Load Regulation: 0.03 % (1 mA ≤ I_L ≤ 50 mA)
- Wide Input Voltage Range: 40 V max.
- Wide Output Voltage Range: 2 V to 37 V
- Compatible with Fairchild μA723
- Packages
  - — 14-pin plastic DIP package (Suffix: -P)
  - — 14-pin ceramic DIP package (Suffix: -Z)
  - — 14-pin plastic Flat package (Suffix: -PF)



PLASTIC PACKAGE
DIP-14P-M02

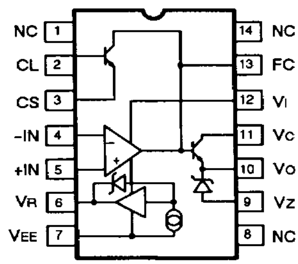


CERAMIC PACKAGE
DIP-14C-C01



PLASTIC PACKAGE
FPT-14P-M01

PIN ASSIGNMENT



ABSOLUTE MAXIMUM RATINGS (see NOTE) (T_A = 25°C)

Rating	Symbol	Value			Unit
		Ceramic	Plastic	Flat	
Storage Temperature	T_{STG}	-65 ~ +150	-55 ~ +125	-55 ~ +125	°C
Operating Temperature	T_A	-55 ~ +125	-20 ~ +75	-20 ~ +75	°C
Power Dissipation	P_D	1000	800	620 *	mW
Output Current	I_L	150	150	150	mA
Zener Current	I_Z	25	25	25	mA
Current from V_{REF}	I_R	15	15	15	mA
Input Voltage	V_{IN}	40	40	40	V

NOTE: * FLAT package is mounted on the epoxy board. (4cm x 4cm x 1.5mm)

Permanent device damage may occur if the above **Absolute Maximum Ratings** are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields. However, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit.

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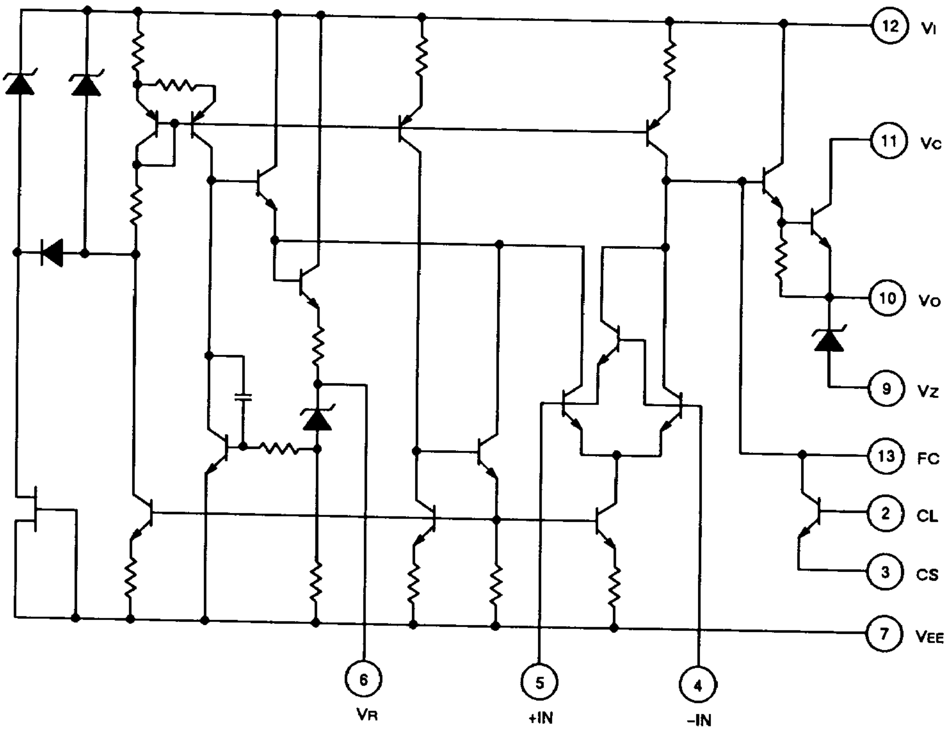
Fig. 1 — MB3752 EQUIVALENT CIRCUIT



RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Value	Unit
Input Voltage	V_{IN}	9.5 to 40	V
Load Current	I_L	1 to 50	mA
Operating Temperature	T_A	-20 to 75	°C

ELECTRICAL CHARACTERISTICS

(V_{IN} = 12 V, I_L = 1 mA, R_{SC} = 0, V_O = 5 V, T_A = 25°C)

Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
Input Voltage	V_{IN}		9.5		40	V
Output Voltage	V_O		2.0		37	V
Input-to-output Voltage Differential	$V_{IN}-V_O$		3.0		38	V
Bias Current	I_I	I_L = 0, V_{IN} = 30 V			4.0	mA
Reference Voltage	V_R		6.80	7.15	7.50	V
Input Regulation 1	R_{IN1}	12 V ≤ V_{IN} ≤ 15 V		0.01	0.1	%
Input Regulation 2	R_{IN2}	12 V ≤ V_{IN} ≤ 40 V		0.1	0.5	%
Input Regulation 3	R_{IN3}	12 V ≤ V_{IN} ≤ 15 V, 0°C ≤ T_A ≤ 70°C			0.3	%
Load Regulation 1	R_{LD1}	1 mA ≤ I_L ≤ 50 mA		0.03	0.2	%
Load Regulation 2	R_{LD2}	1 mA ≤ I_L ≤ 50 mA, 0°C ≤ T_A ≤ 70°C			0.6	%
Temperature Regulation	R_T	0°C ≤ T_A ≤ 70°C		0.2	1.0	%
Ripple Rejection Ratio	R.R.	f = 50 Hz to 10 kHz, C_R = 0		74		dB
		f = 50 Hz to 10 kHz, C_R = 5 µF		86		dB
Short Circuit Output Current	I_{SC}	V_O = 0, R_{SC} = 10 Ω	60	70	80	mA

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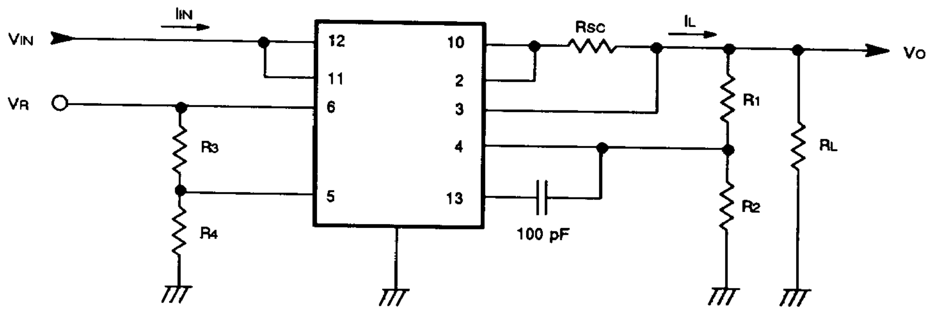
Fig. 2 — MEASUREMENT CIRCUIT



i) $2\text{ V} \leq V_O \leq V_R$ $\quad V_O = V_R \dfrac{R_4}{R_3 + R_4}$, $\quad R1 = \dfrac{R_3 \cdot R_4}{R_3 + R_4}$, $\quad R_2 = \infty$, $R_3 + R_4 \fallingdotseq 7\text{ k}\Omega$

ii) $V_R \leq V_O \leq 37\text{ V}$ $\quad V_O = V_R \left(1 + \dfrac{R_1}{R_2}\right)$, $\quad R_3 = \dfrac{R_1 \cdot R_2}{R_1 + R_2}$, $\quad R_4 = \infty$, $R_2 \fallingdotseq 7\text{ k}\Omega$

iii) Equations for measurement items

a) $I_B = I_{IN} \left(\begin{array}{l} R_1 = 1.5\text{ k},\ R_3 = 0,\ I_L = 0, \\ R_2 = \infty,\ R_4 = \infty,\ R_L = \infty \end{array} \right)$

b) $R_{IN1} = \dfrac{V_O\ (15\text{ V}) - V_O\ (12\text{ V})}{V_O\ (12\text{ V})} \times 100$

c) $R_{IN2} = \dfrac{V_O\ (40\text{ V}) - V_O\ (12\text{ V})}{V_O\ (12\text{ V})} \times 100$

d) $R_{LD} = \dfrac{V_O\ (1\text{ mA}) - V_O\ (50\text{ mA})}{V_O\ (1\text{ mA})} \times 100$

e) $I_{SC} = I_L$ $\quad (R_L = 0)$

f) $R_T = \dfrac{V_O\ (\text{MAX}) - V_O\ (\text{MIN})}{V_O\ (25\ °\text{C})} \times 100$

Note: (b) to (f)
($V_O = 5$ V setting, $R_1 = 1.5\text{ k}\Omega$, $R_2 = \infty$, $R_3 = 2.15\text{ k}\Omega$, $R_4 = 5\text{ k}\Omega$, $R_L = 5\text{ k}\Omega$)

TYPICAL CHARACTERISTICS CURVES

Fig. 3 - INPUT-TO-OUTPUT VOLTAGE DIFFERENTIAL vs. MAXIMUM LOAD CURRENT

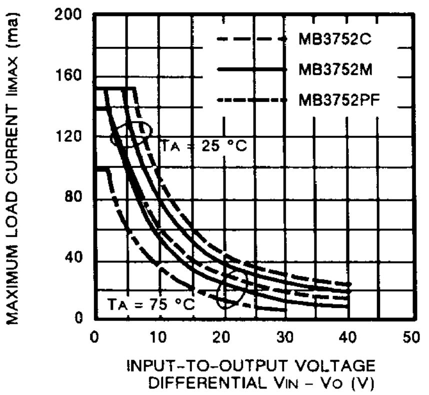


Fig. 4 - INPUT VOLTAGE vs. BIAS CURRENT

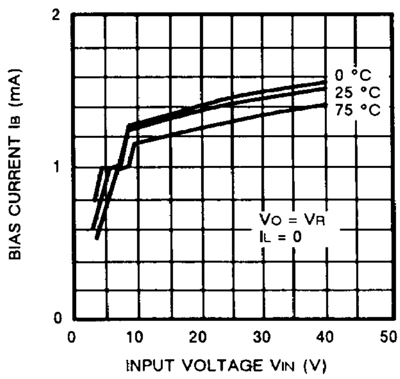


Fig. 5 - LOAD CURRENT vs. LOAD REGULATION

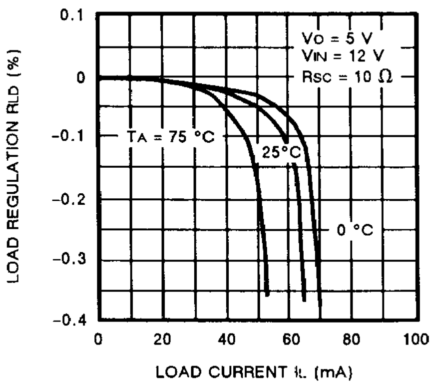
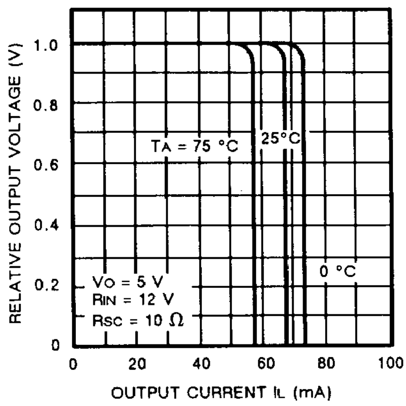


Fig. 6 - CURRENT LIMIT



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TYPICAL CHARACTERISTICS CURVES (Continued)

Fig. 7 – LOAD CURRENT vs. LOAD REGULATION

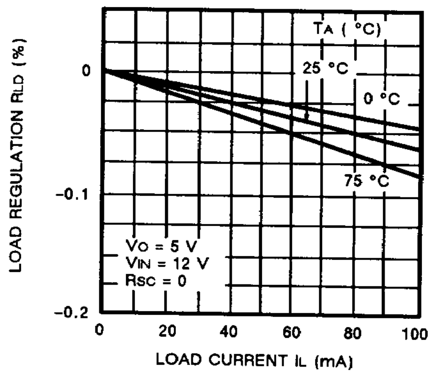


Fig. 8 – JUNCTION TEMPERATURE vs. CURRENT LIMIT SENSE VOLTAGE

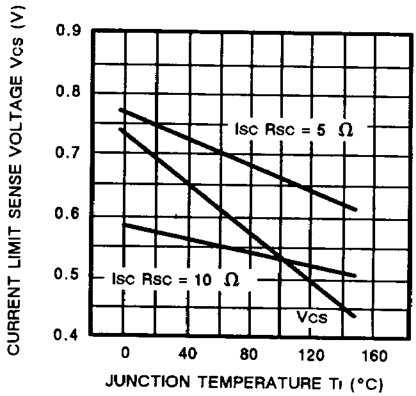


Fig. 9 – INPUT-TO-OUTPUT VOLTAGE DIFFERENTIAL vs. LINE REGULATION

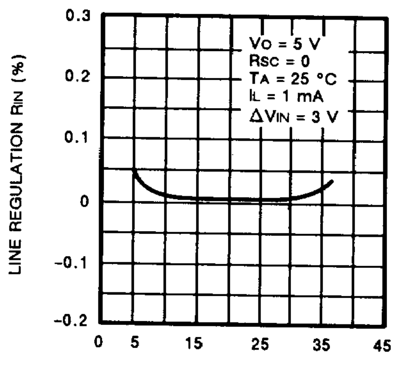
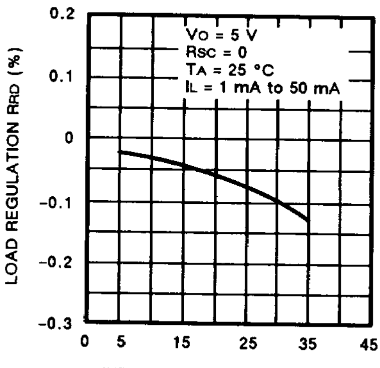


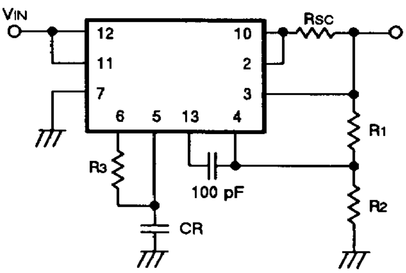
Fig. 10 – INPUT-TO-OUTPUT VOLTAGE DIFFERENTIALvs. LOAD REGULATION



APPLICATION EXAMPLES

Fig. 11 – BASIC HIGH VOLTAGE REGULATOR

$V_R \leq V_O \leq 37$ V

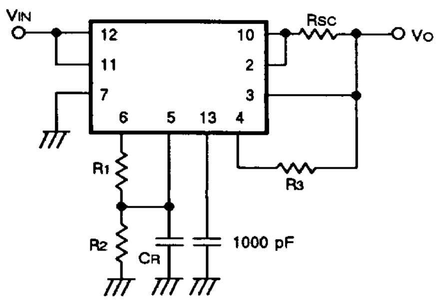


$$V_O = V_R \cdot \frac{R_1 + R_2}{R_2}$$

$$R_3 = \frac{R_1 \cdot R_2}{R_1 + R_2}$$ for minimum temperature drift

Fig. 12 – BASIC LOW VOLTAGE REGULATOR

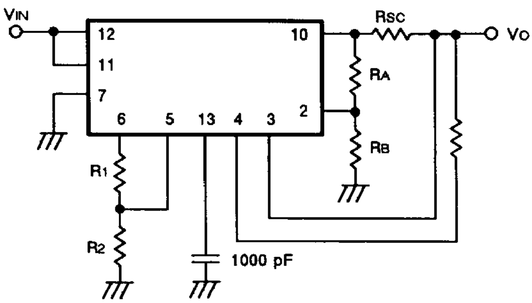
$2\ V \leq V_O \leq V_R$

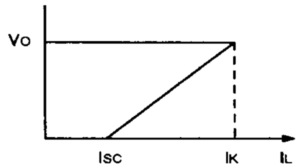


$$V_O = V_R \cdot \frac{R_2}{R_1 + R_2}$$

$$R_3 = \frac{R_1 \cdot R_2}{R_1 + R_2}$$ for minimum temperature drift

Fig. 13 – FOLDBACK CURRENT LIMITING REGULATOR





$I_L \leq I_K \quad V_O = V_R \cdot \frac{R_2}{R_1 + R_2}$

$$R_3 = \frac{R_1 \cdot R_2}{R_1 + R_2}$$ for minimum temperature drift

$$V_O = \frac{R_B \cdot R_{SC}}{R_A} \cdot I_L - V_{SC}\left(1 + \frac{R_B}{R_A}\right)$$

$$I_{SC} = \frac{V_{SC}}{R_{SC}} \cdot \left(1 + \frac{R_A}{R_B}\right), \quad V_{SC} \fallingdotseq 0.7\ V$$

$$I_K = I_{SC} + \frac{V_O}{R_{SC}} \cdot \frac{R_A}{R_B}$$

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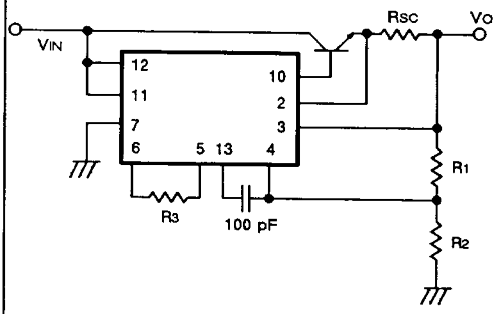
APPLICATION EXAMPLES (Continued)

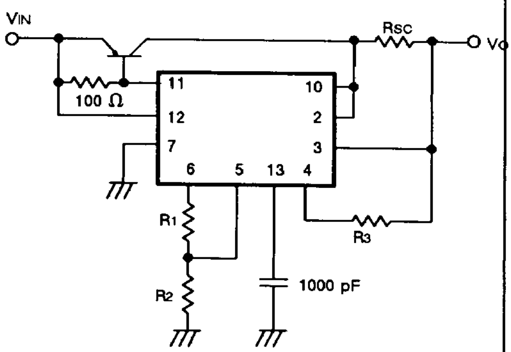
Fig. 14 – POSITIVE VOLTAGE REGULATOR NPN TRANSISTOR



$$V_O = V_R \cdot \frac{R_1 + R_2}{R_2}$$

$$R_3 = \frac{R_1 \cdot R_2}{R_1 + R_2}$$ for minimum temperature drift

Fig. 15 – POSITIVE VOLTAGE REGULATOR PNP TRANSISTOR

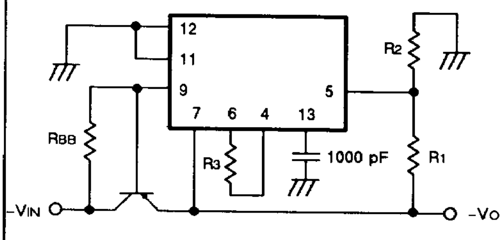


$$V_O = V_R \cdot \frac{R_2}{R_1 + R_2}$$

$$R_3 = \frac{R_1 \cdot R_2}{R_1 + R_2}$$ for minimum temperature drift

Fig. 16 – NEGATIVE VOLTAGE REGULATOR

$|V_O| \geq 9.5$ V

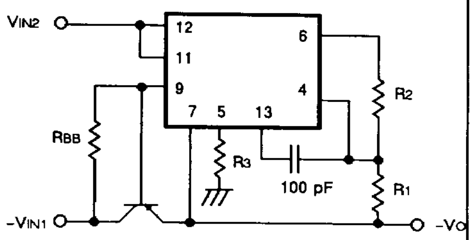


$$V_O = V_R \cdot \left(1 + \frac{R_2}{R_1}\right)$$

$$R_3 = \frac{R_1 \cdot R_2}{R_1 + R_2}$$ for minimum temperature drift

Fig. 17 – NEGATIVE VOLTAGE REGULATOR

$0 \leq |V_O| \leq V_R$



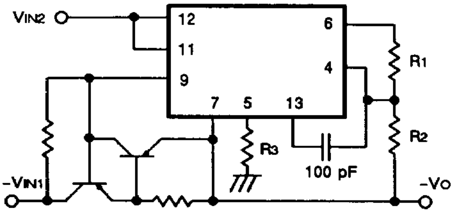
$$V_O = \frac{V_R}{(1 + R_2/R_1)}, \quad V_{IN2} + V_O \geq 9.5 \text{ V}$$

$$R_3 = \frac{R_1 \cdot R_2}{R_1 + R_2}$$ for minimum temperature drift

APPLICATION EXAMPLES (Continued)

Fig. 18 - NEGATIVE VOLTAGE REGULATOR (CURRENT LIMITING)

$0 \leq |V_O| \leq V_R$



$I_L = \frac{V_{CS}}{R_{SC}}$ $(V_{CS} \doteqdot 0.7\ V,\ V_O = 0)$

$I_L = \frac{V_R}{(1 + R_2/R_1)}$, $V_{IN2} + V_O \geq 9.5V$

$R_3 = \frac{R_1 \cdot R_2}{R_1 + R_2}$ for minimum temperature drift

Fig. 19 - SWITCHING REGULATOR

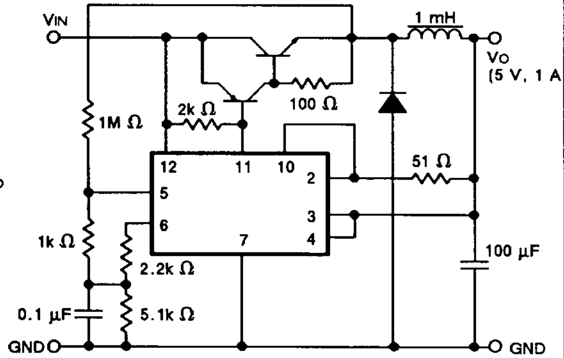


Fig. 20 DUAL TRACKING REGULATOR (CURRENT LIMITING)

$V_{O1} = V_R \left(1 + \frac{R_1}{R_2}\right)$ $V_{O1} \geq V_R$

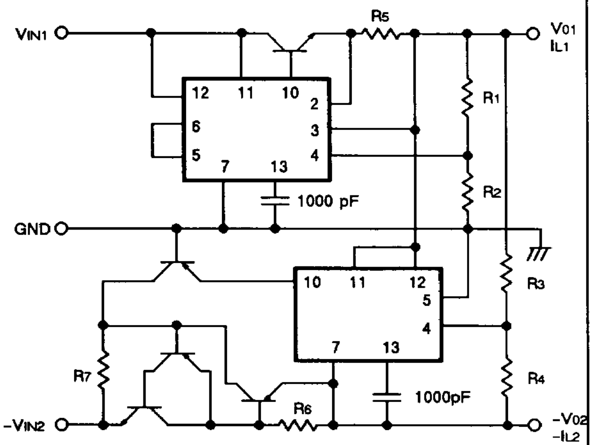
$V_{O1} + V_{O2} \geq 40\ V$

$V_{O2} = \frac{R_4}{R_3} V_{O1}$

$I_{L1MAX} \doteqdot \frac{0.7}{R_5}$

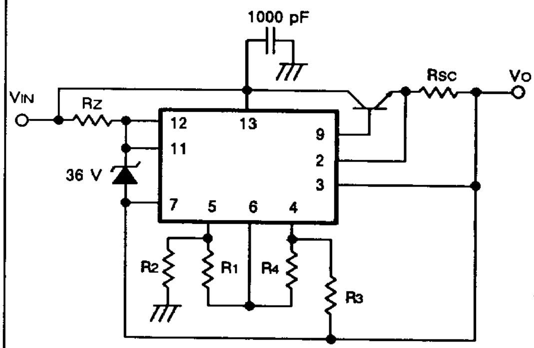
$I_{L2MAX} \doteqdot \frac{0.6}{R_5}$

Example for ±15V, ±1A
R1 = 8.2k Ω
R2 = 7.5k Ω
R3 = 15k Ω
R4 = 15k Ω
R5 = R6 = 0.39 Ω
R7 = 2k Ω



APPLICATION EXAMPLES (Continued)

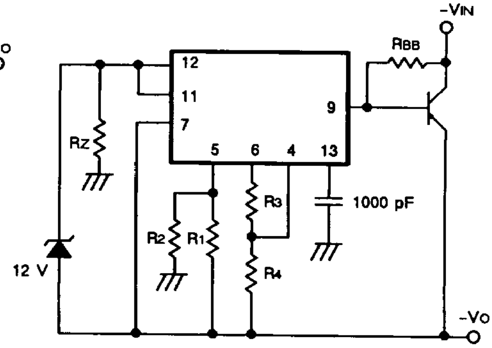
Fig. 21 – POSITIVE FLOATING VOLTAGE REGULATOR



$R_3 = R_4 = 3.3k\ \Omega$

$$V_O = V_R \cdot \frac{R_2 - R_1}{2R_1}$$

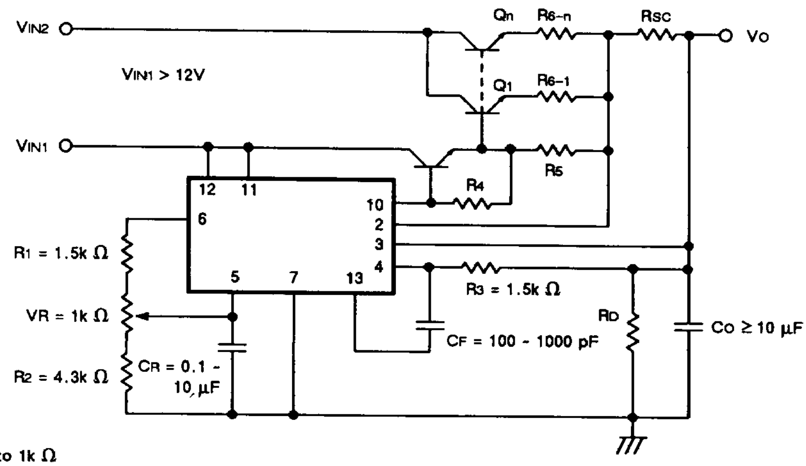
Fig. 22 – NEGATIVE FLOATING VOLTAGE REGULATOR



$R_3 = R_4 = 3.3k\ \Omega$

$$V_O = V_R \cdot \frac{R_1 + R_2}{2R_1}$$

Fig. 23 – 5 V HIGH CURRENT VOLTAGE REGULATOR



$R_4 = 100\ \Omega$ to $1k\ \Omega$
$R_5 = 10\ \Omega$ to $100\ \Omega$

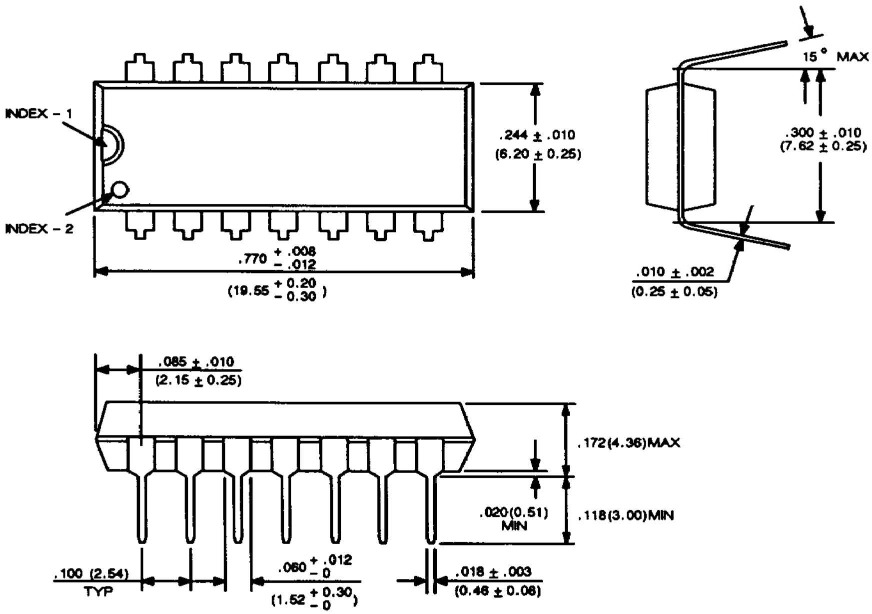
$$I_{LMAX} = \frac{V_{CS}}{R_{SC}} \left(\begin{array}{l} V_{CS} \fallingdotseq 0.7\ V \text{ at } 25\ °C \\ \Delta V_{CS}/\Delta T_j = -2\ mV/°C \end{array} \right)$$

$$V_{IN2} > V_{OMAX} + V_{CESATOUT} + R_{SC} \cdot I_{LMAX} + \frac{1}{n} - R_6 \cdot I_{LMAX} + \frac{V_{IN2P}}{2}$$

$V_{CESATOUT}$: Maximum value between Q_1 to Q_n
R_6 : $R_{6-1} = R_{6-2}$ ...... $= R_{6-n} = R_6$
V_{IN2P} : Maximum ripple amplitude of V_{IN2}

PACKAGE DIMENSIONS

14-LEAD PLASTIC DUAL-IN-LINE PACKAGE
(CASE No.: DIP-14P-M02)

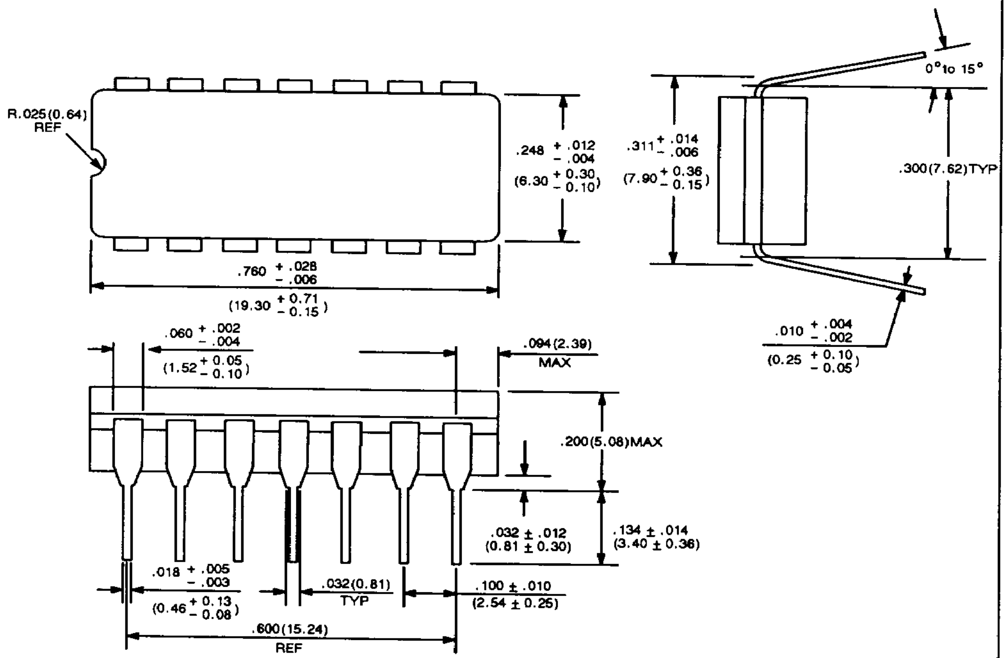


Dimensions in
inches (millimeters)

D14010S-3C

PACKAGE DIMENSIONS (Continued)

14-LEAD CERAMIC (CERDIP) DUAL-IN-LINE PACKAGE
(CASE NO.: DIP-14C-C01)



Dimensions in inches (millimeters)

D14005S-2C

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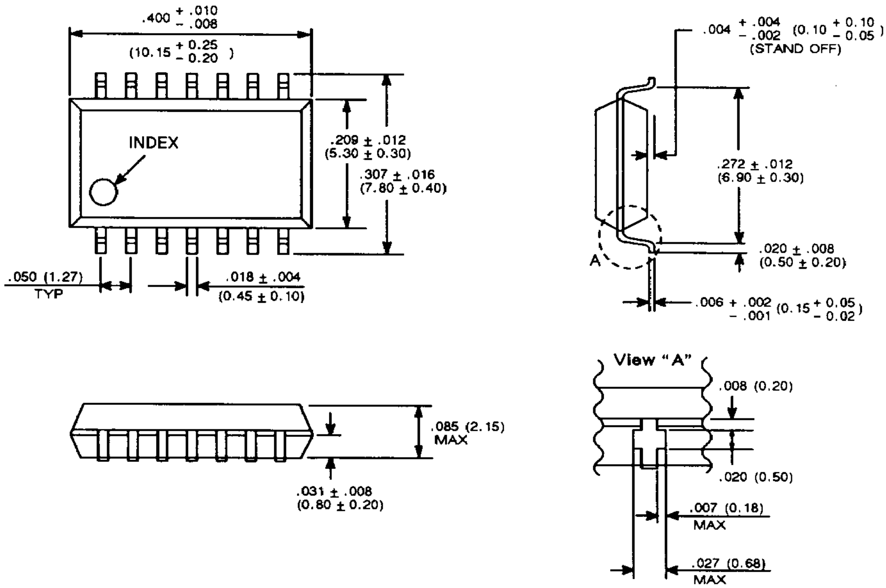
PACKAGE DIMENSIONS (Continued)

14-LEAD PLASTIC FLAT PACKAGE
(CASE No.: FPT-14P-M01)



Dimensions in
inches (millimeters)

F14003S-2C

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