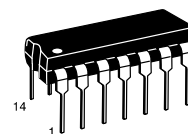


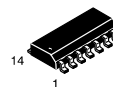
Voltage Regulator

- Output Voltage Adjustable from 2.0 Vdc to 37 Vdc
- Output Current to 150 mAdc Without External Pass Transistors
- 0.01% Line and 0.03% Load Regulation
- Adjustable Short Circuit Protection

VOLTAGE REGULATOR

SEMICONDUCTOR
TECHNICAL DATA

P SUFFIX
PLASTIC PACKAGE
CASE 646



D SUFFIX
PLASTIC PACKAGE
CASE 751A
(SO-14)

ORDERING INFORMATION

Device	Alternate	Operating Temperature Range	Package
MC1723CD	—	$T_A = 0^\circ \text{ to } +70^\circ \text{C}$	SO-14
MC1723CP	LM723CN $\mu\text{A}723\text{PC}$		Plastic DIP

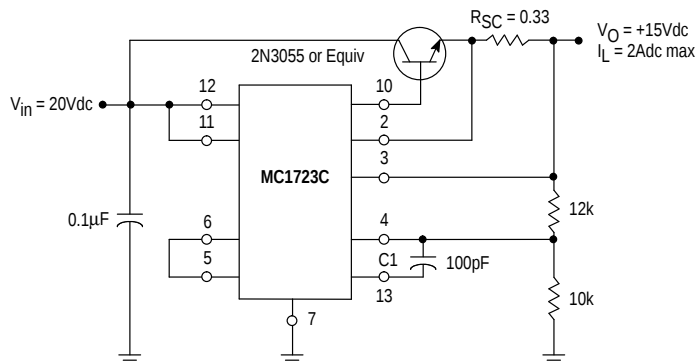
(7 < V₀ < 37)

V_{in} is connected to pin 12. Pin 11 is connected to pin 6. Pin 6 is connected to resistor R3, which is connected to pin 5. Pin 5 is connected to capacitor C_{ref} to ground. Pin 7 is connected to ground. Pin 10 is connected to the output V₀ through resistor R_{SC}. Pin 2 is connected to pin 3. Pin 3 is connected to the output V₀. Pin 4 is connected to capacitor C1 (100pF) to ground. Pin 13 is connected to ground. The output V₀ is also connected to resistor R1, which is connected to resistor R2 to ground.

$$V_0 \approx 7 \left(\frac{R_1 + R_2}{R_2} \right) \quad I_{SC} = \frac{V_{sense}}{R_{SC}} = \frac{0.66}{R_{SC}} \quad \text{at } T_J = +25^\circ\text{C}$$

For best results 10 k < R₂ < 100 k
 For minimum drift R₃ = R₁ || R₂

Figure 3. Typical NPN Current Boost Connection



MC1723C

MAXIMUM RATINGS (T_A = +25°C, unless otherwise noted.)

Rating	Symbol	Value	Unit
Pulse Voltage from V _{CC} to V _{EE} (50 ms)	V _{I(p)}	50	V _{pk}
Continuous Voltage from V _{CC} to V _{EE}	V _I	40	V _{dc}
Input–Output Voltage Differential	V _I –V _O	40	V _{dc}
Maximum Output Current	I _L	150	mAdc
Current from V _{ref}	I _{ref}	15	mAdc
Current from V _Z	I _Z	25	mA
Voltage Between Noninverting Input and V _{EE}	V _{ie}	8.0	V _{dc}
Differential Input Voltage	V _{id}	±5.0	V _{dc}
Power Dissipation and Thermal Characteristics T _A = +25°C Derate above T _A = +25°C Thermal Resistance, Junction–to–Air	P _D 1/θ _{JA} θ _{JA}	1.25 10 100	W mW/°C °C/W
Operating and Storage Junction Temperature Range	T _J , T _{stg}	–65 to +175	°C
Operating Ambient Temperature Range	T _A	0 to +70	°C

ELECTRICAL CHARACTERISTICS (T_A = +25°C, V_{in} 12 V_{dc}, V_O = 5.0 V_{dc}, I_L = 1.0 mAdc, R_{SC} = 0, C₁ = 100 pF, C_{ref} = 0 and divider impedance as seen by the error amplifier ≤ 10 kΩ connected as shown in Figure 2, unless otherwise noted.)

Characteristics	Symbol	Min	Typ	Max	Unit
Input Voltage Range	V _I	9.5	–	40	V _{dc}
Output Voltage Range	V _O	2.0	–	37	V _{dc}
Input–Output Voltage Differential	V _I –V _O	3.0	–	38	V _{dc}
Reference Voltage	V _{ref}	6.80	7.15	7.50	V _{dc}
Standby Current Drain (I _L = 0, V _{in} = 30 V)	I _{IB}	–	2.3	4.0	mAdc
Output Noise Voltage (f = 100 Hz to 10 kHz) C _{ref} = 0 C _{ref} = 5.0 μF	V _n	– –	20 2.5	– –	μV(RMS)
Average Temperature Coefficient of Output Voltage (T _{low} < T _A < T _{high})	TCV _O	–	0.003	0.015	%/°C
Line Regulation (T _A = 25°C) { 12 V < V _{in} < 15 V 12 V < V _{in} < 40 V (T _{low} < T _A < T _{high}) 12 V < V _{in} < 15 V	Reg _{line}	– – –	0.01 0.1 –	0.1 0.5 0.3	% V _O
Load Regulation (1.0 mA < I _L < 50 mA) T _A = 25°C T _{low} < T _A < T _{high}	Reg _{load}	– –	0.03 –	0.2 0.6	% V _O
Ripple Rejection (f = 50 Hz to 10 kHz) C _{ref} = 0 C _{ref} = 5.0 μF	RR	– –	74 86	– –	dB
Short Circuit Current Limit (R _{SC} = 10 Ω, V _O = 0)	I _{SC}	–	65	–	mAdc
Long Term Stability	ΔV _O /Δt	–	0.1	–	%/1000 Hr.

NOTE: T_{low} to T_{high} = 0° to +70°C

Figure 4. Maximum Load Current as a Function of Input-Output Voltage Differential

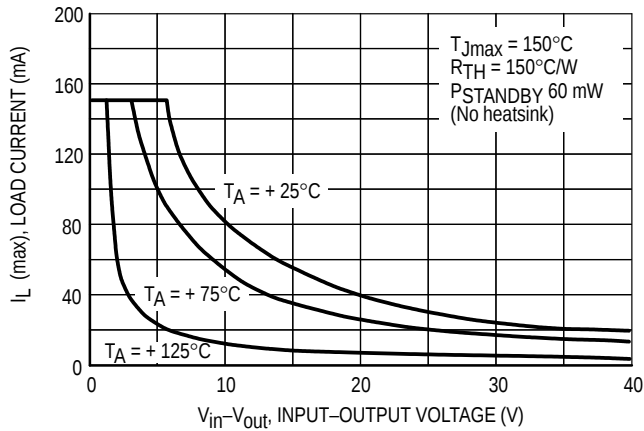


Figure 5. Load Regulation Characteristics Without Current Limiting

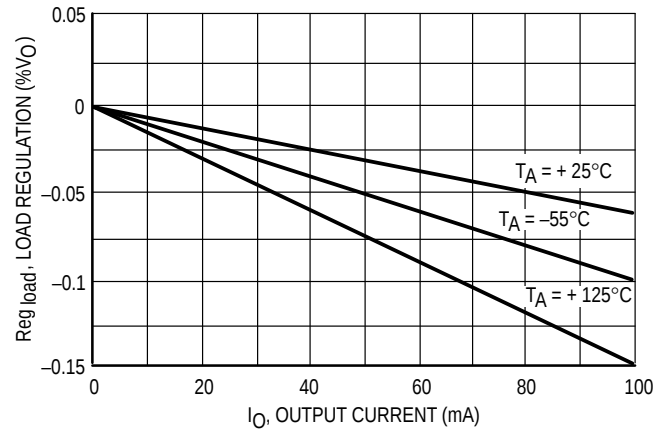


Figure 6. Load Regulation Characteristics With Current Limiting

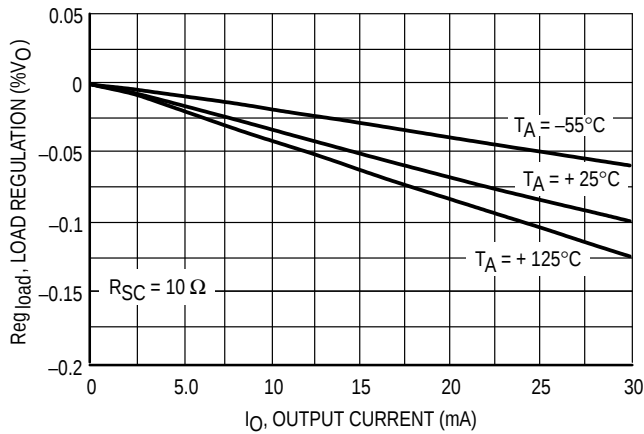


Figure 7. Load Regulation Characteristics With Current Limiting

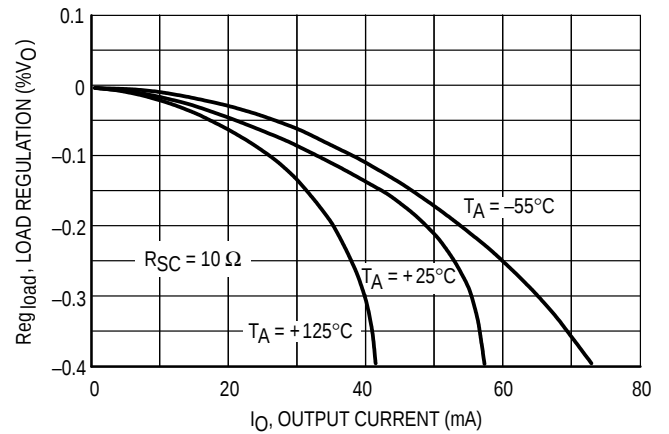


Figure 8. Current Limiting Characteristics

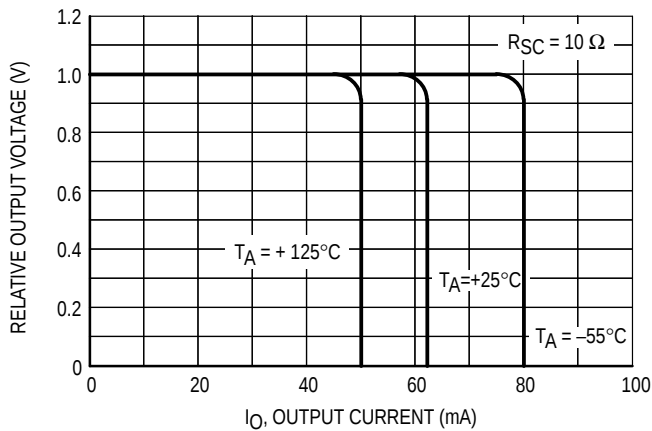


Figure 9. Current Limiting Characteristics as a Function of Junction Temperature

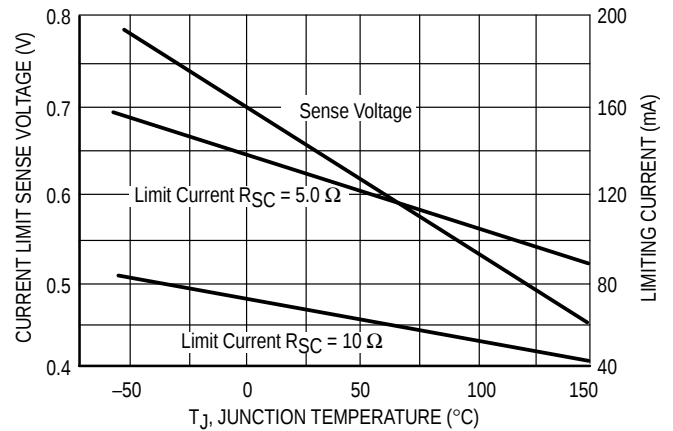


Figure 10. Line Regulation as a Function of Input-Output Voltage Differential

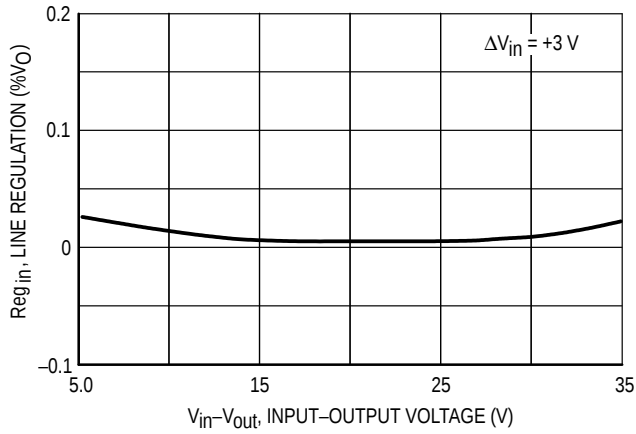


Figure 11. Load Regulation as a Function of Input-Output Voltage Differential

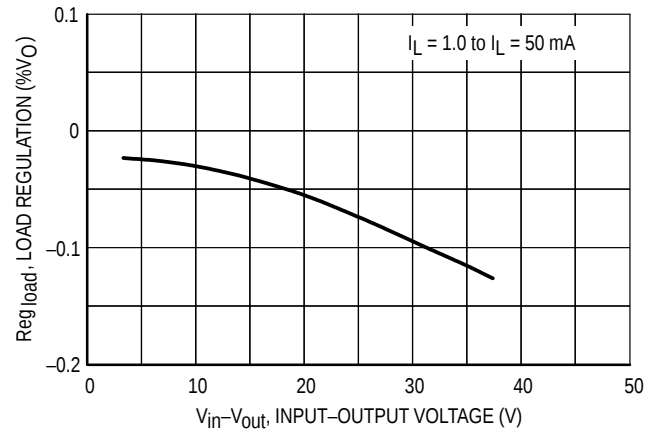


Figure 12. Standby Current Drain as a Function of Input Voltage

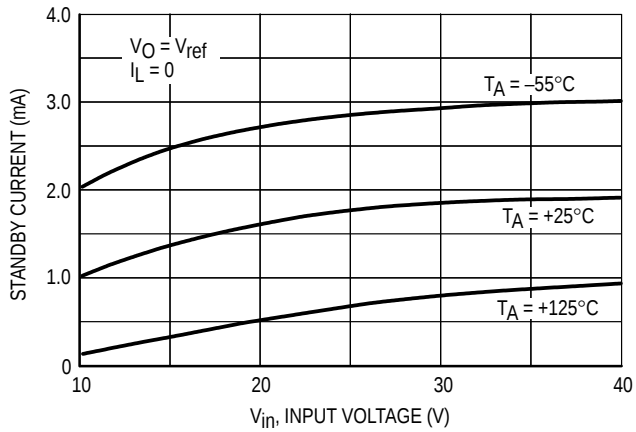


Figure 13. Line Transient Response

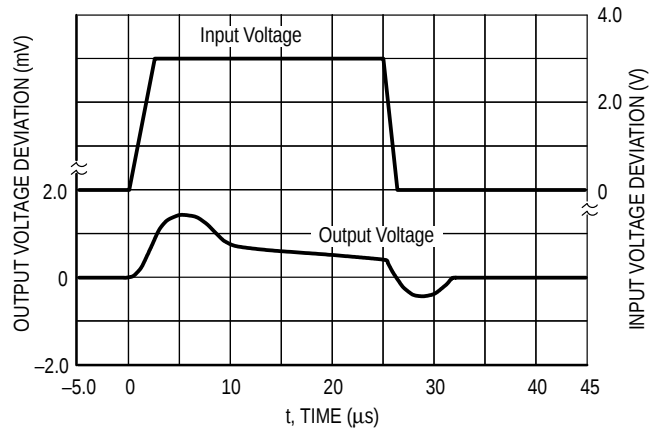


Figure 14. Load Transient Response

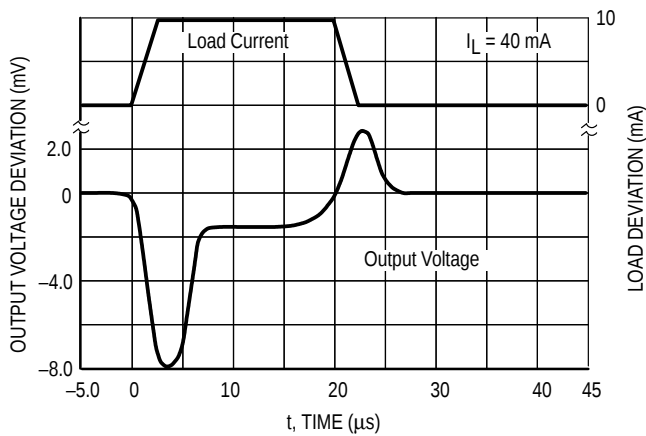
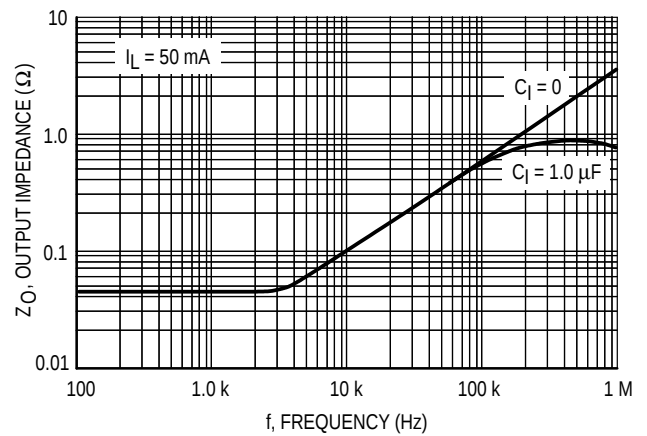
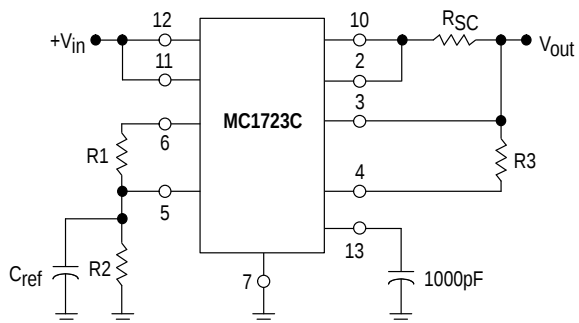


Figure 15. Output Impedance as Function of Frequency



MC1723C

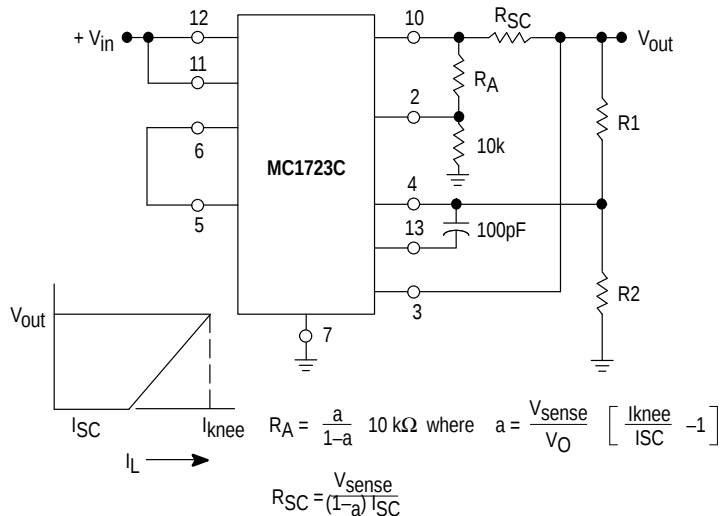
Figure 16. Typical Connection for $2 < V_O < 7$



$$V_O \approx 7 \left[\frac{R_2}{R_1 + R_2} \right] \quad I_{SC} = \frac{V_{sense}}{R_{SC}} \approx \frac{0.66}{R_{SC}} \text{ at } T_J = +25^\circ\text{C}$$

For best results $10 \text{ k} < R_1 + R_2 < 100 \text{ k}$
For minimum drift $R_3 = R_1 R_2$

Figure 17. Foldback Connection



$$R_A = \frac{a}{1-a} 10 \text{ k}\Omega \text{ where } a = \frac{V_{sense}}{V_O} \left[\frac{I_{knee}}{I_{SC}} - 1 \right]$$

$$R_{SC} = \frac{V_{sense}}{(1-a) I_{SC}}$$

Figure 18. +5.0 V, 1.0 A Switching Regulator

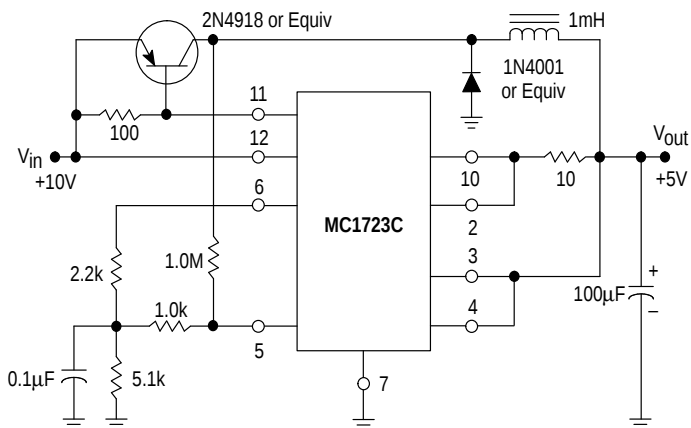


Figure 19. +5.0 V, 1.0 A High Efficiency Regulator

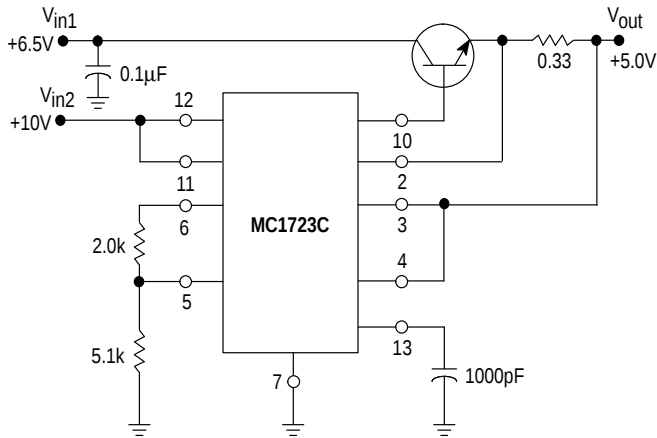


Figure 20. +15 V, 1.0 A Regulator with Remote Sense

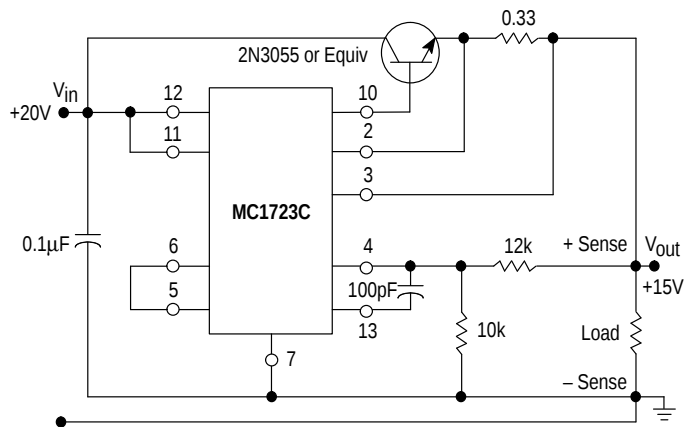
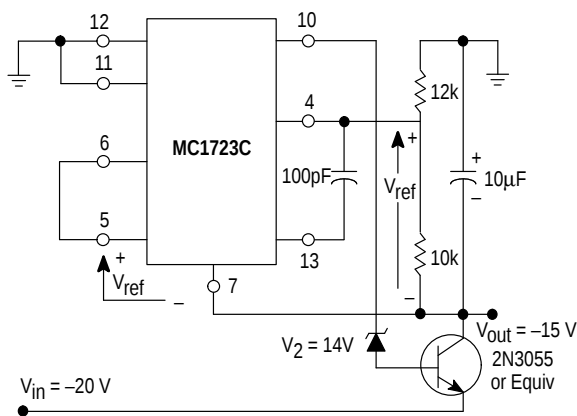
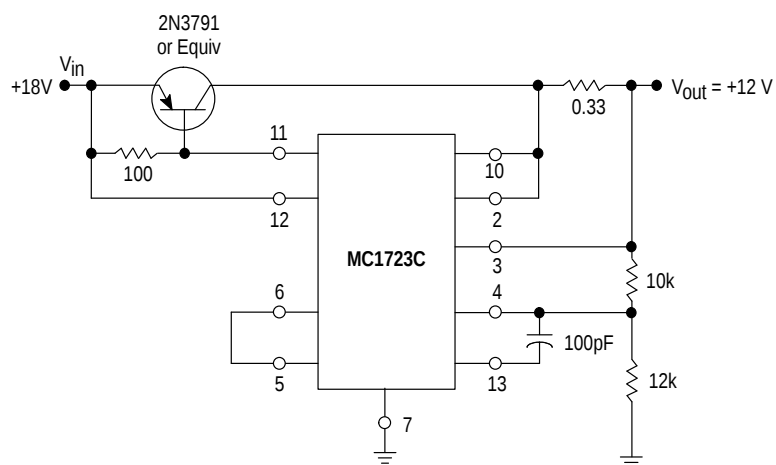


Figure 21. -15 V Negative Regulator



MC1723C

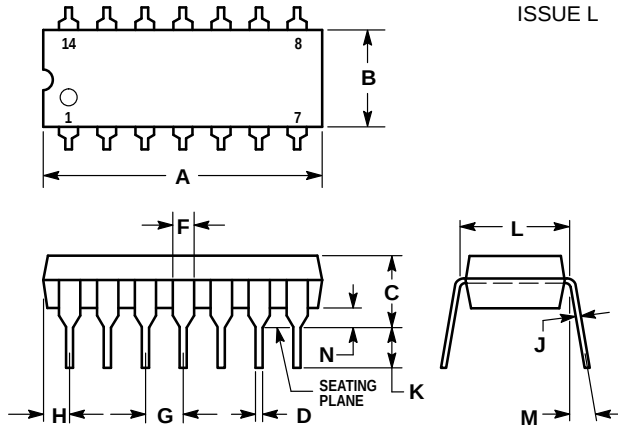
Figure 22. +12V, 1.0 A Regulator
(Using PNP Current Boost)



MC1723C

OUTLINE DIMENSIONS

P SUFFIX PLASTIC PACKAGE CASE 646-06 ISSUE L

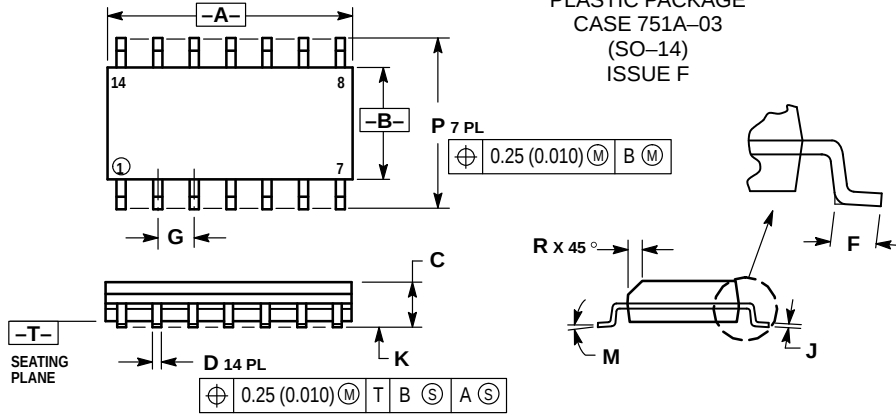


NOTES:

- LEADS WITHIN 0.13 (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
- DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
- DIMENSION B DOES NOT INCLUDE MOLD FLASH.
- ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.715	0.770	18.16	19.56
B	0.240	0.260	6.10	6.60
C	0.145	0.185	3.69	4.69
D	0.015	0.021	0.38	0.53
F	0.040	0.070	1.02	1.78
G	0.100 BSC		2.54 BSC	
H	0.052	0.095	1.32	2.41
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.300 BSC		7.62 BSC	
M	0°	10°	0°	10°
N	0.015	0.039	0.39	1.01

D SUFFIX PLASTIC PACKAGE CASE 751A-03 (SO-14) ISSUE F



NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
- MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
- DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.344
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.228	0.244
R	0.25	0.50	0.010	0.019

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