μA723
Precision Voltage Regulator

Description

The μA723 is a monolithic voltage regulator constructed using the Fairchild Planar Epitaxial process. The device consists of a temperature compensated reference amplifier, error amplifier, power series pass transistor and current-limit circuitry. Additional NPN or PNP pass elements may be used when output currents exceeding 150 mA are required. Provisions are made for adjustable current-limiting and remote shutdown. In addition to the above, the device features low standby current drain, low temperature drift and high ripple rejection. The μA723 is intended for use with positive or negative supplies as a series, shunt, switching or floating regulator. Applications include laboratory power supplies, isolation regulators for low level data amplifiers, logic card regulators, small instrument power supplies, airborne systems and other power supplies for digital and linear circuits.

- **Positive Or Negative Supply Operation**
- **Series, Shunt, Switching Or Floating Operation**
- **0.01% Line And Load Regulation**
- **Output Voltage Adjustable From 2 V To 37 V**
- **Output Current To 150 mA Without External Pass Transistor**

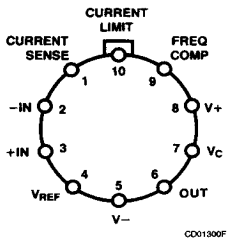
Absolute Maximum Ratings

Storage Temperature Range	
Ceramic DIP/Metal Can	−65°C to +175°C
Molded DIP/SO Package	−55°C to +150°C
Operating Temperature Range	
Extended (μA723M)	−55°C to +125°C
Commercial (μA723C)	0°C to +70°C
Lead Temperature	
Ceramic DIP/Metal Can (soldering, 60 s)	300°C
Molded DIP/SO-14 (soldering, 10 s)	265°C
Internal Power Dissipation[1,2]	
10L-Metal Can	1.07 W
14L-Ceramic DIP	1.36 W
14L-Molded DIP	1.04 W
SO-14	0.93 W
Pulse Voltage from V+ to V−, (50 ms) (μA723M)	50 V
Continuous Voltage from V+ to V−	40 V
Input/Output Voltage Differential	40 V
Differential Input Voltage	±5.0 V
Voltage Between Non-Inverting Input and V−	8.0 V
Current from V_Z	25 mA
Current from V_{REF}	15 mA

Notes

1. $T_{J\ Max}$ = 150°C for the Molded DIP, and 175°C for the Metal Can and Ceramic DIP.
2. Ratings supply to ambient temperature at 25°C. Above this temperature, derate the 10L-Metal Can at 7.1 mW/°C, the 14L-Ceramic DIP at 9.1 mW/°C, the 14L-Molded DIP at 8.3 mW/°C, and the SO-14 at 7.5 mW/°C.

Connection Diagram
10-Lead Metal Package
(Top View)

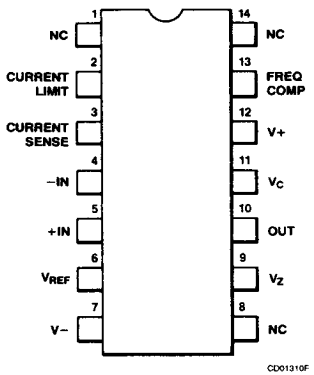


Lead 5 connected to case.

Order Information

Device Code	Package Code	Package Description
μA723HM	5X	Metal
μA723HC	5X	Metal

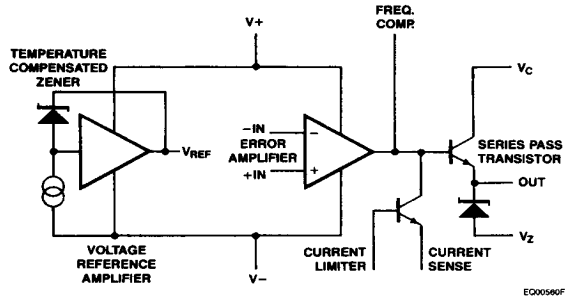
Connection Diagram
14-Lead DIP and SO-14 Package
(Top View)



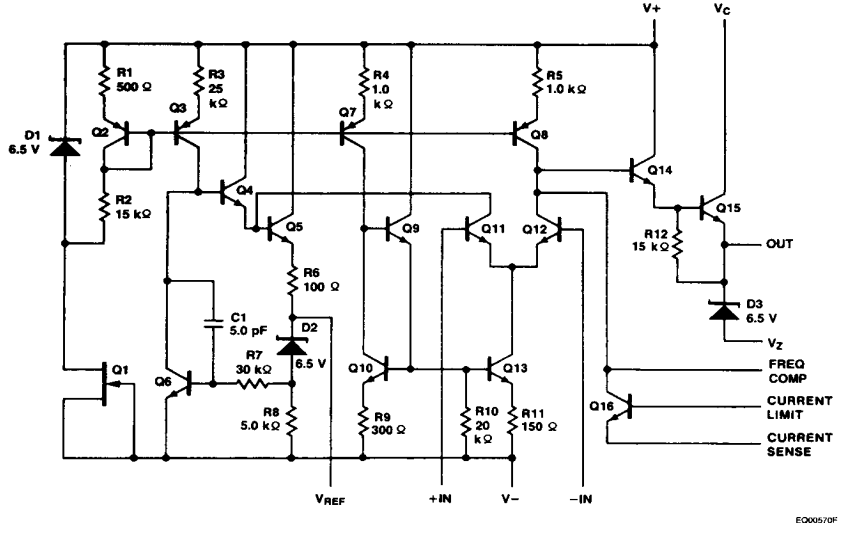
Order Information

Device Code	Package Code	Package Description
μA723DM	6A	Ceramic DIP
μA723DC	6A	Ceramic DIP
μA723PC	9A	Molded DIP
μA723SC	KD	Molded Surface Mount

Block Diagram



Equivalent Circuit



μA723M
Electrical Characteristics $T_A = 25°C$, $V_I = V+ = V_C = 12$ V, $V- = 0$, $V_O = 5$ V, $I_L = 1$ mA, $R_{SC} = 0$, C1 = 100 pF, $C_{REF} = 0$, unless otherwise specified.

Symbol	Characteristic[1]	Condition	Min	Typ	Max	Unit
$V_{R\ LINE}$	Line Regulation	$V_I = 12$ V to $V_I = 15$ V		0.01	0.1	$\%V_O$
		$V_I = 12$ V to $V_I = 40$ V		0.02	0.2	
		$-55°C \leqslant T_A \leqslant +125°C$, $V_I = 12$ V to $V_I = 15$ V			0.3	
$V_{R\ LOAD}$	Load Regulation	$I_L = 1$ mA to $I_L = 50$ mA		0.03	0.15	$\%V_O$
		$-55°C \leqslant T_A \leqslant +125°C$, $I_L = 1$ mA to $I_L = 50$ mA			0.6	
$\Delta V_I/\Delta V_O$	Ripple Rejection	f = 50 Hz to 10 kHz		74		dB
		f = 50 Hz to 10 kHz, $C_{REF} = 0.5$ μF		86		
$\Delta V_O/\Delta T$	Average Temperature Coefficient of Output Voltage	$-55°C \leqslant T_A \leqslant +125°C$		0.002	0.015	%/°C
I_{OS}	Output Short Circuit Current	$R_{SC} = 10\ \Omega$, $V_O = 0$		65		mA
V_{REF}	Reference Voltage	$I_{REF} = 0.1$ mA	6.95	7.15	7.35	V
V_{REF}(Load)	Reference Voltage Change With Load	$I_{REF} = 0.1$ mA to 5 mA			20	mV
N_O	Noise	BW = 100 Hz to 10 kHz, $C_{REF} = 0$		20		μV_{rms}
		BW = 100 Hz to 10 kHz, $C_{REF} = 5.0\mu F$		2.0		
S	Long Term Stability	$T_J = T_{J\ Max}$ | $T_A = 25°C$ For End Point Measurement		0.1		%/1000 hrs
I_{SCD}	Standby Current Drain	$I_L = 0$, $V_I = 30$ V		2.3	3.5	mA
V_{IR}	Input Voltage Range		9.5		40	V
V_{OR}	Output Voltage Range		2.0		37	V
$V_I - V_O$	Input/Output Voltage Differential		3.0		38	V

μA723C

Electrical Characteristics $T_A = 25°C$, $V_I = V+ = V_C = 12$ V, $V- = 0$, $V_O = 5$ V, $I_L = 1$ mA, $R_{SC} = 0$, $C1 = 100$ pF, $C_{REF} = 0$, unless otherwise specified.

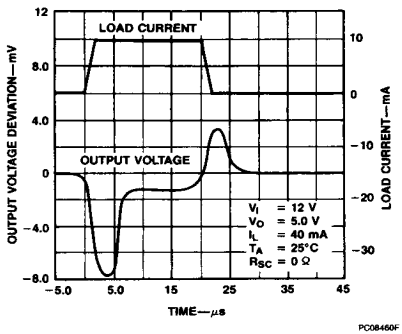
Symbol	Characteristic[1]	Condition	Min	Typ	Max	Unit
$V_{R\ LINE}$	Line Regulation	$V_I = 12$ V to $V_I = 15$ V		0.01	0.1	$\%V_O$
		$V_I = 12$ V to $V_I = 40$ V		0.1	0.5	
		$0°C \leq T_A \leq 70°C$, $V_I = 12$ V to $V_I = 15$ V			0.3	
$V_{R\ LOAD}$	Load Regulation	$I_L = 1.0$ mA to $I_L = 50$ mA		0.03	0.2	$\%V_O$
		$0°C \leq T_A \leq 70°C$, $I_L = 1.0$ mA to $I_L = 50$ mA			0.6	
$\Delta V_I/\Delta V_O$	Ripple Rejection	f = 50 Hz to 10 kHz		74		dB
		f = 50 Hz to 10 kHz, $C_{REF} = 5$ μF		86		
$\Delta V_O/\Delta T$	Average Temperature Coefficient of Output Voltage	$0°C \leq T_A \leq 70°C$		0.003	0.015	%/°C
I_{OS}	Output Short Circuit Current	$R_{SC} = 10\ \Omega$, $V_O = 0$		65		mA
V_{REF}	Reference Voltage	$I_{REF} = 0.1$ mA	6.80	7.15	7.50	V
V_{REF}(Load)	Reference Voltage Change With Load	$I_{REF} = 0.1$ mA to 5 mA			20	mV
N_O	Noise	BW = 100 Hz to 10 kHz, $C_{REF} = 0$		20		μV_{rms}
		BW = 100 Hz to 10 kHz, $C_{REF} = 5$ μF		2.0		
S	Long Term Stability	$T_J = T_{J\ Max}$ | $T_A = 25°C$ For End Point Measurement		0.1		%/1000 hrs
I_{SCD}	Standby Current Drain	$I_L = 0$, $V_I = 30$ V		2.3	4.0	mA
V_{IR}	Input Voltage Range		9.5		40	V
V_{OR}	Output Voltage Range		2.0		37	V
$V_I - V_O$	Input/Output Voltage Differential		3.0		38	V

Note

1. Divider impedance as seen by error amplifier ≤ 10 kΩ connected as shown in *Figure 1*. Line and load regulation specifications are given for the condition of constant chip temperature. Temperature drifts must be taken into account separately for high dissipation conditions.

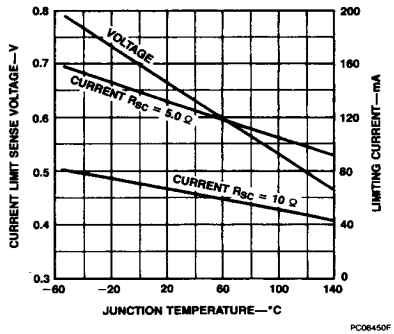
Typical Performance Curves for μA723 and μA723C

Load Transient Response



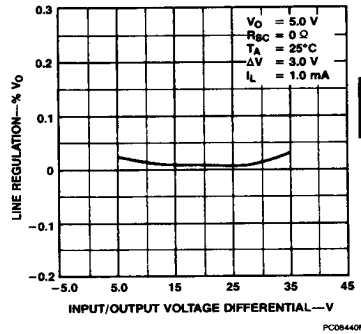
PC08460F

Current-Limiting Characteristics vs Junction Temperature



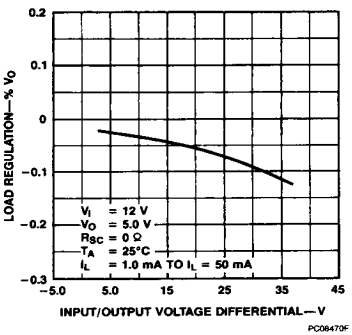
PC08450F

Line Regulation vs Input/Output Voltage Differential



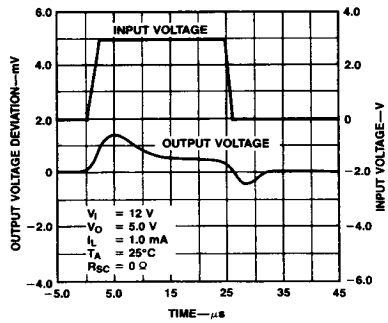
PC08440F

Load Regulation vs Input/Output Voltage Differential



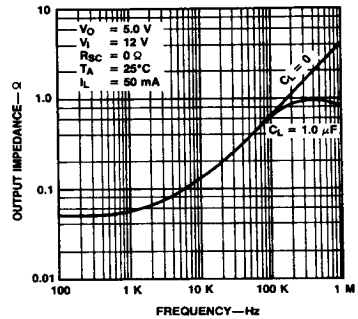
PC08470F

Line Transient Response



PC08480F

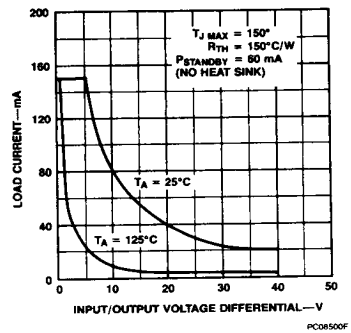
Output Impedance vs Frequency



PC08490F

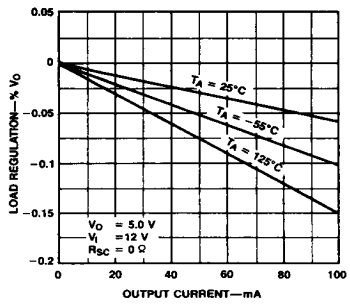
Typical Performance Curves for μA723

Maximum Load Current vs Input/Output Voltage Differential



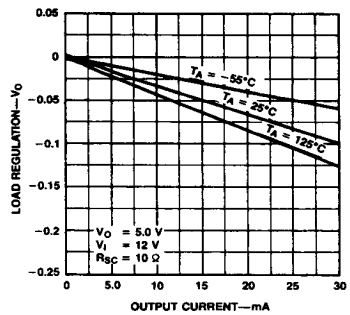
PC08500F

Load Regulation Characteristics Without Current-Limiting



PC08510F

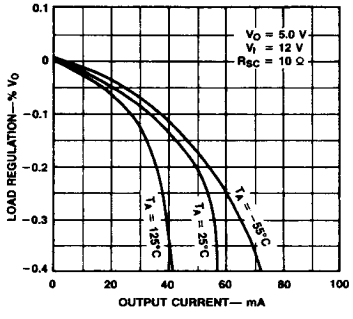
Load Regulation Characteristics With Current-Limiting



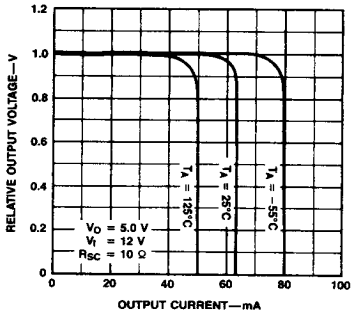
PC08520F

Typical Performance Curves for μA723

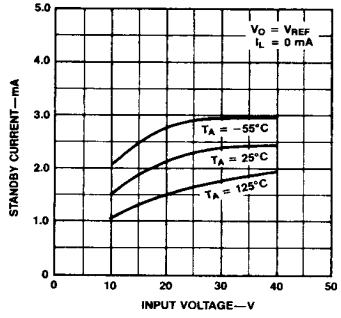
Load Regulation Characteristics With Current-Limiting



Current-Limiting Characteristics

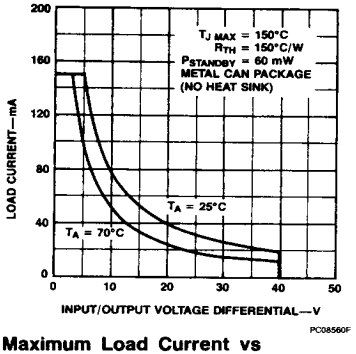


Standby Current Drain vs Input Voltage

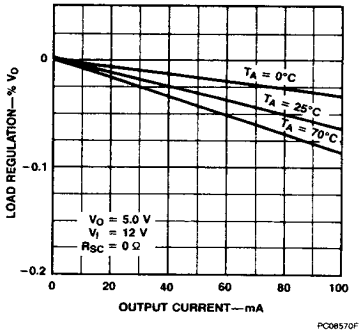


Typical Performance Curves for μA723C

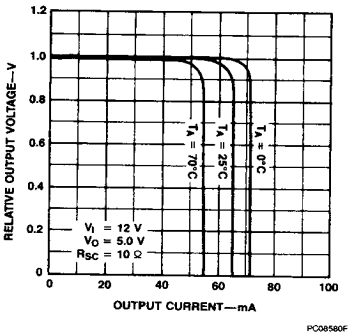
Maximum Load Current vs Input/Output Voltage Differential



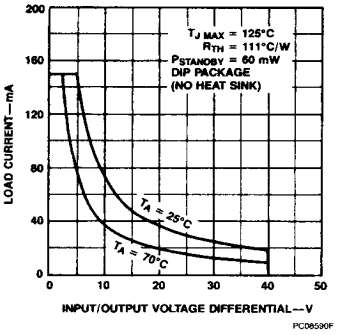
Load Regulation Characteristics Without Current-Limiting



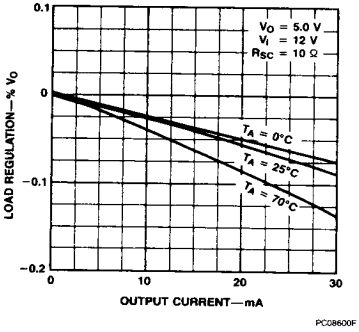
Current-Limiting Characteristics



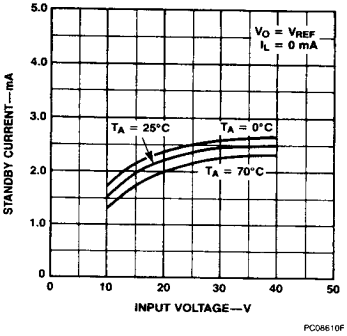
Maximum Load Current vs Input/Output Voltage Differential



Load Regulation Characteristics With Current-Limiting

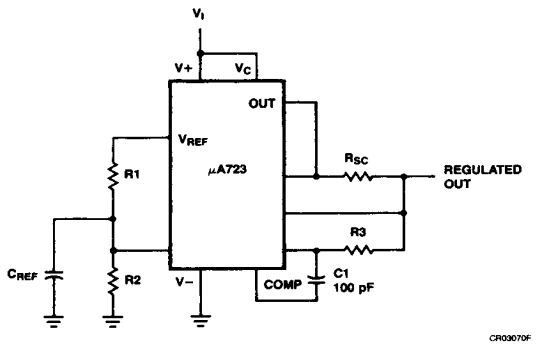


Standby Current Drain vs Input Voltage



Typical Applications

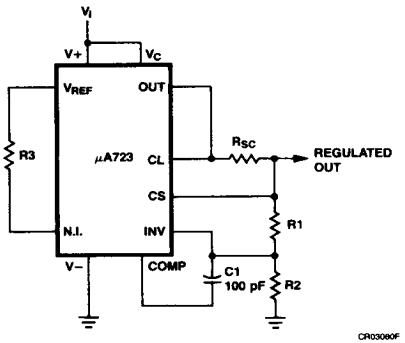
Figure 1 Basic Low Voltage Regulator
(V_O = 2.0 V to 7.0 V)



Typical Performance	
Regulated Output Voltage	+5.0 V
Line Regulation (ΔV_I = 3.0 V)	0.5 mV
Load Regulation (ΔI_L = 50 mA)	1.5 mV

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

Figure 2 Basic High Voltage Regulator
(V_O = 7.0 V to 37 V)

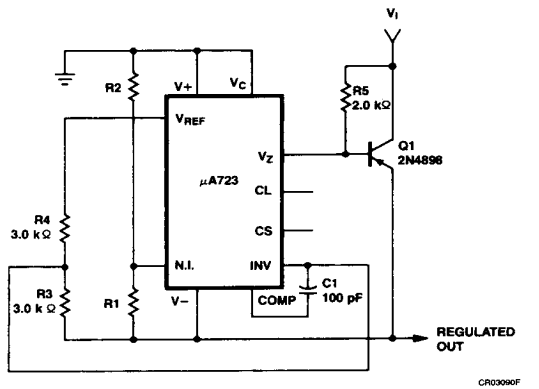


Typical Performance	
Regulated Output Voltage	+15 V
Line Regulation (ΔV_I = 3.0 V)	1.5 mV
Load Regulation (ΔI_L = 50 mA)	4.5 mV

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

R_3 may be eliminated for minimum component count.

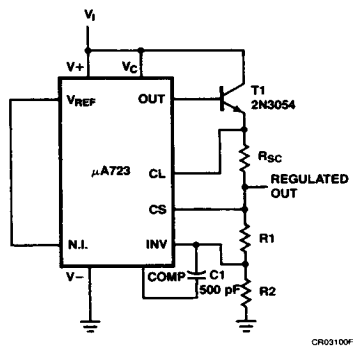
Figure 3 Negative Voltage Regulator (Note 1)



Typical Performance	
Regulated Output Voltage	−15 V
Line Regulation (ΔV_I = 3.0 V)	1 mV
Load Regulation (ΔI_L = 100 mA)	2 mV

Note
1. For metal can applications where V_Z is required, an external 6.2 V Zener diode should be connected in series with V_O.

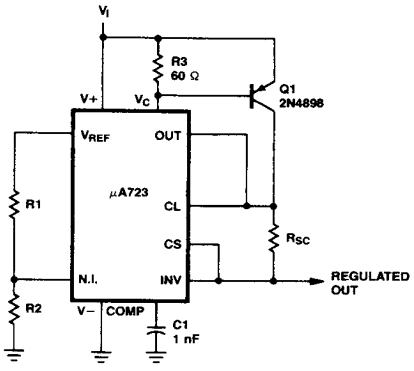
Figure 4 Positive Voltage Regulator (External NPN Pass Transistor)



Typical Performance	
Regulated Output voltage	+15 V
Line Regulation (ΔV_I = 3.0 V)	1.5 mV
Load Regulation (ΔI_L = 1.0 A)	15 mV

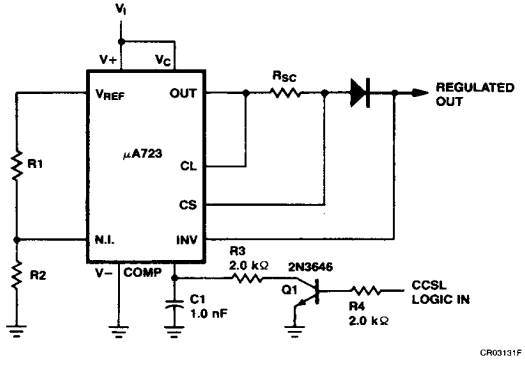
Typical Applications (Cont.)

Figure 5 Positive Voltage Regulator (External PNP Pass Transistor)



Typical Performance	
Regulated Output Voltage	+5.0 V
Line Regulation (ΔV_I = 3.0 V)	0.5 mV
Load Regulation (ΔI_L = 1.0 A)	5.0 mV

Figure 7 Remote Shutdown Regulator with Current-Limiting (Note 1)

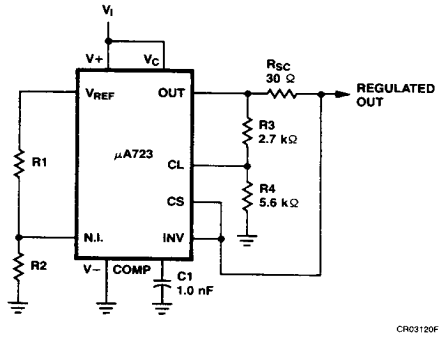


Typical Performance	
Regulated Output Voltage	+5.0 V
Line Regulation (ΔV_I = 3.0 V)	0.5 mV
Load Regulation (ΔI_L = 50 mA)	1.5 mV

Note

1. Current limit transistor may be used for shutdown if current limiting is not required. Add diode if $V_O > 10$ V.

Figure 6 Foldback Current-Limiting



Typical Performance	
Regulated Output Voltage	+5.0 V
Line Regulation (ΔV_I = 3.0 V)	0.5 mV
Load Regulation (ΔI_L = 10 mA)	1.0 mV
Short Circuit Current	20 mA

Figure 8 Output Voltage Adjust