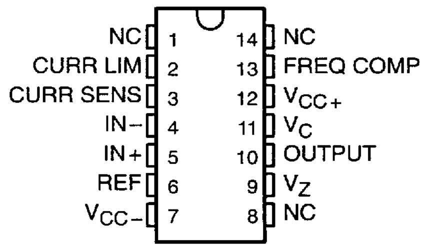
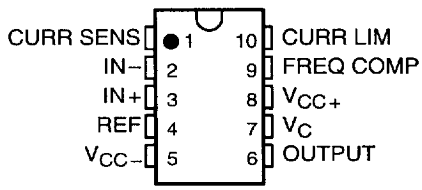
- **150-mA Load Current Without External Power Transistor**
- **Typically 0.02% Input Regulation and 0.03% Load Regulation (µA723M)**
- **Adjustable Current-Limiting Capability**
- **Input Voltages to 40 V**
- **Output Adjustable From 2 V to 37 V**
- **Direct Replacement for Fairchild µA723C and µA723M**

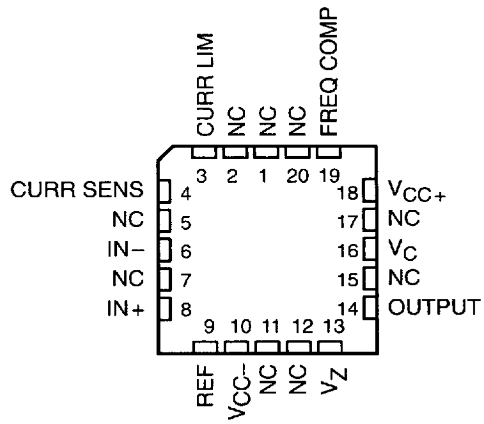
µA723C . . . D OR N PACKAGE
µA723M . . . J PACKAGE
(TOP VIEW)



µA723M . . . U PACKAGE
(TOP VIEW)



µA723M . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

description

The µA723C and µA723M are precision monolithic integrated circuit voltage regulators featuring high ripple rejection, excellent input and load regulation, excellent temperature stability, and low standby current. The circuit consists of a temperature-compensated reference-voltage amplifier, an error amplifier, a 150-mA output transistor, and an adjustable output current limiter.

The µA723C and µA723M are designed for use in positive or negative power supplies as a series, shunt, switching, or floating regulator. For output currents exceeding 150 mA, additional pass elements may be connected as shown in Figures 4 and 5.

The µA723C is characterized for operation from 0°C to 70°C. The µA723M is characterized for operation over the full military temperature range of −55°C to 125°C.

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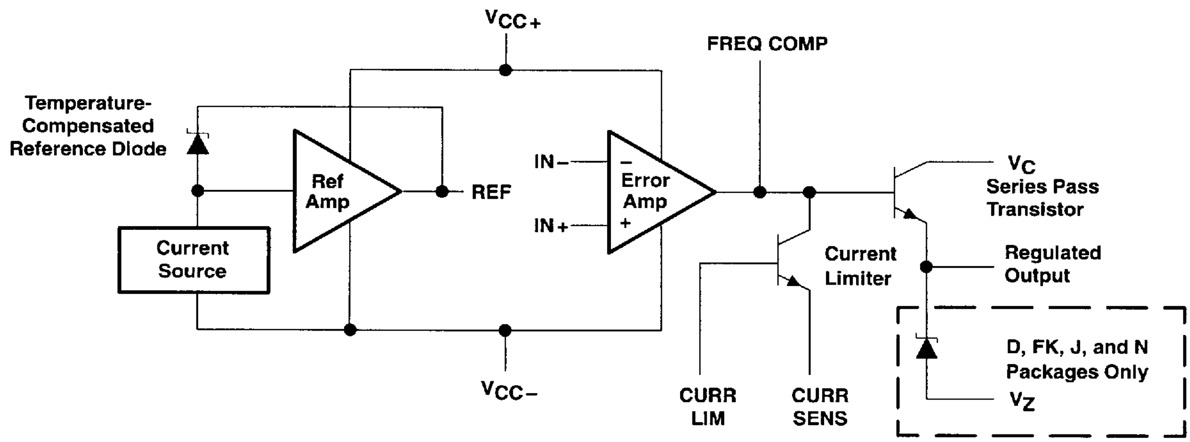
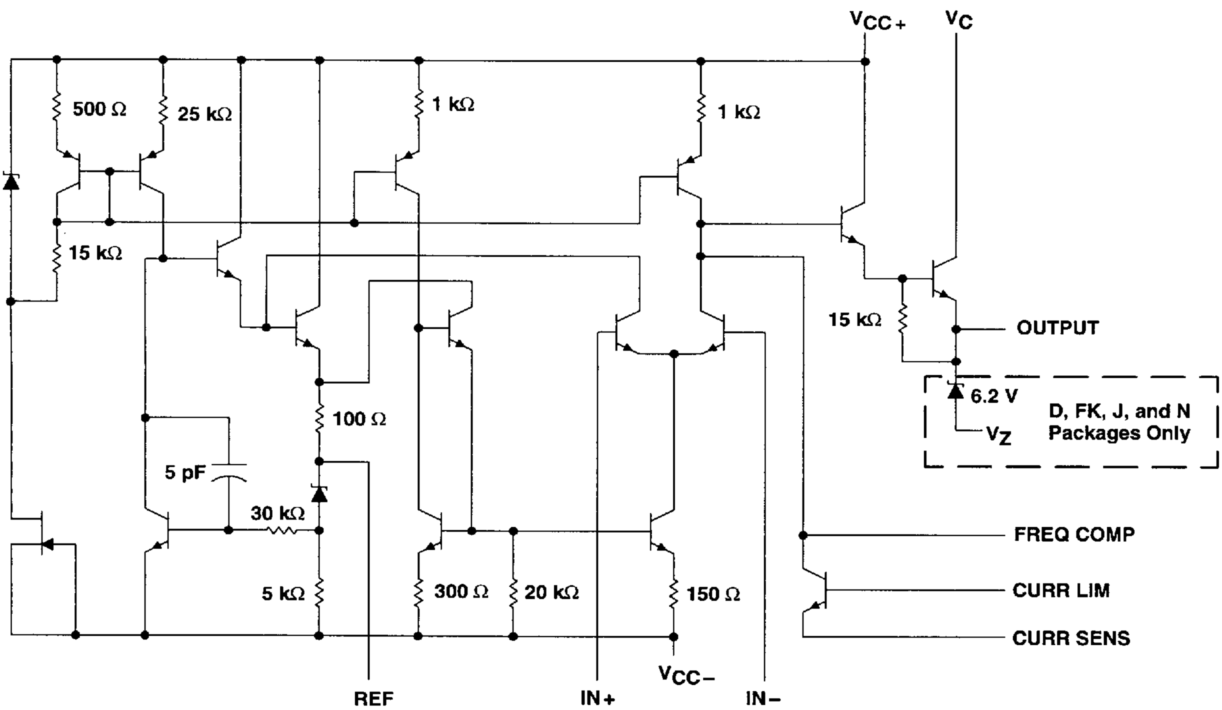
functional block diagram



schematic

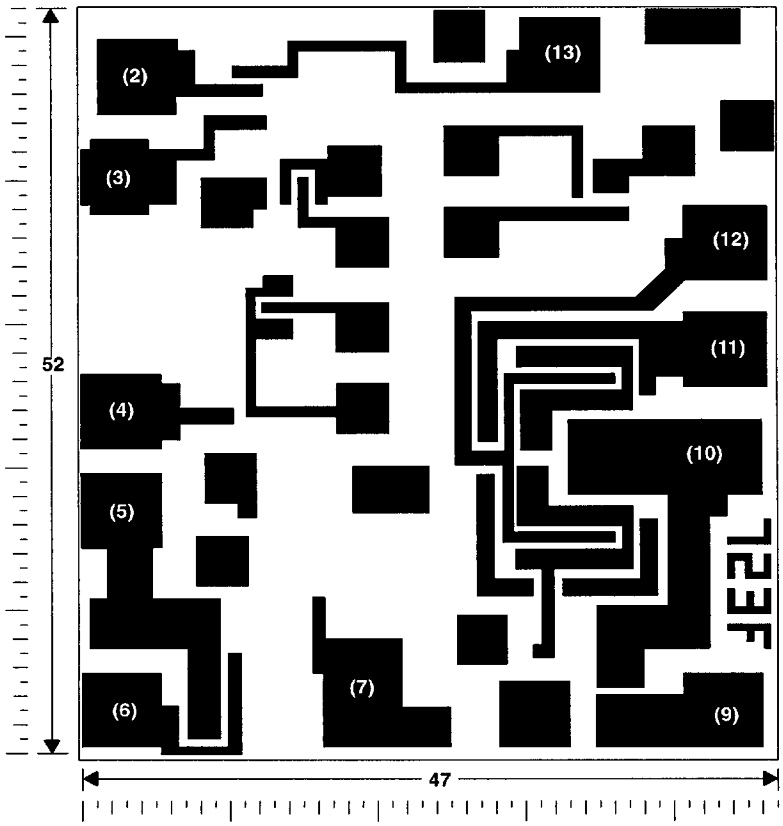


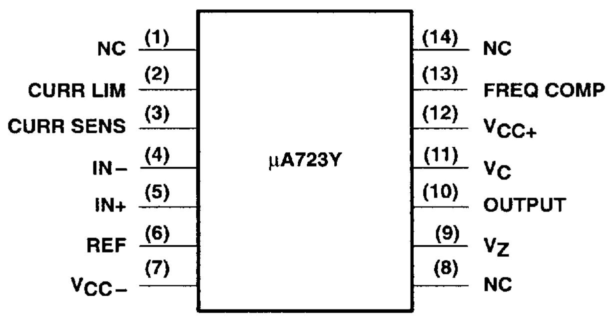
Resistor and capacitor values shown are nominal.

μA723Y chip information

This chip, when properly assembled, displays characteristics similar to the μA723C. Thermal compression or ultrasonic bonding can be used on the doped aluminum bonding pads. The chips can be mounted with conductive epoxy or a gold-silicon preform.

BONDING PAD ASSIGNMENTS





CHIP THICKNESS: 15 MILS TYPICAL

BONDING PADS: 4 × 4 MILS MINIMUM

$T_J$max = 150°C

TOLERANCES ARE ±10%.

ALL DIMENSIONS ARE IN MILS.

TERMINALS 1, 8, AND 14 ARE NOT CONNECTED

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Peak voltage from V_{CC+} to V_{CC-} ($t_w \leq 50$ ms) . . . . . 50 V
Continuous voltage from V_{CC+} to V_{CC-} . . . . .
Input-to-output voltage differential . . . . . 40 V
Differential input voltage to error amplifier . . . . . ±5 V
Voltage between noninverting input and V_{CC-} . . . . .
Current from V_Z . . . . . 25 mA
Current from REF . . . . . 15 mA
Continuous total dissipation (see Note 1) . . . . . See Dissipation Rating Table
Operating free-air temperature range, T_A: μA723C . . . . . 0°C to 7 °C
μA723M . . . . . −55°C to 125°C
Storage temperature range, T_{stg} . . . . . −65 C to 150°C
Case temperature for 60 seconds, T_C: FK package . . . . . 260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: J or U package . . . . . 300 °C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D or N package . . . . . 260 °C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: Power dissipation = $[I_{(standby)} + I_{(ref)}] V_{CC} + [V_C - V_O] I_O$.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25°C$ POWER RATING	DERATING FACTOR	DERATE ABOVE T_A	$T_A = 70°C$ POWER RATING	$T_A = 125°C$ POWER RATING
D	950 mW	7.6 mW/°C	25°C	608 mW	—
FK and J	1000 mW	11.0 mW/°C	59°C	879 mW	274 mW
N	1000 mW	9.2 mW/°C	41°C	733 mW	—
U	675 mW	5.4 mW/°C	25°C	432 mW	135 mW

recommended operating conditions

	MIN	MAX	UNIT
Input voltage, V_I	9.5	40	V
Output voltage, V_O	2	37	V
Input-to-output voltage differential, $V_C - V_O$	3	38	V
Output current, I_O		150	mA

electrical characteristics at specified free-air temperature (see Notes 2 and 3)

PARAMETER	TEST CONDITIONS		T_A†	μA723C			μA723M			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
Input regulation	V_I = 12 V to V_I = 15 V		25°C		0.1	1		0.1	1	mV/V
	V_I = 12 V to V_I = 40 V		25°C		1	5		0.2	2	
	V_I = 12 V to V_I = 15 V		Full range			3			3	
Ripple rejection	f = 50 Hz to 10 kHz,	C_{ref} = 0	25°C		74			74		dB
	f = 50 Hz to 10 kHz,	C_{ref} = 5 μF	25°C		86			86		
Output regulation			25°C		−0.3	−2		−0.3	−1.5	mV/V
			Full range			−6			−6	
Reference voltage, V_{ref}			25°C	6.8	7.15	7.5	6.95	7.15	7.35	V
Standby current	V_I = 30 V,	I_O = 0	25°C		2.3	4		2.3	3.5	mA
Temperature coefficient of output voltage			Full range		0.003	0.015		0.002	0.015*	%/°C
Short-circuit output current	R_{SC} = 10 Ω,	V_O = 0	25°C		65			65		mA
Output noise voltage	BW = 100 Hz to 10 kHz,	C_{ref} = 0	25°C		20			20		μV
	BW = 100 Hz to 10 kHz,	C_{ref} = 5 μF	25°C		2.5			2.5		

*On products compliant to MIL-STD-883, Class B, this parameter is not production tested.
† Full range for μA723C is 0°C to 70°C and for μA723M is −55°C to 125°C.

NOTES: 2. For all values in this table, the device is connected as shown in Figure 1 with the divider resistance as seen by the error amplifier ≤ 10 kΩ. Unless otherwise specified, $V_I = V_{CC+} = V_C$ = 12 V, V_{CC-} = 0, V_O = 5 V, I_O = 1 mA, R_{SC} = 0, and C_{ref} = 0.
3. Pulse-testing techniques must be used that will maintain the junction temperature as close to the ambient temperature as possible.

electrical characteristics, T_A = 25°C (see Notes 2 and 3)

PARAMETER	TEST CONDITIONS		μA723Y			UNIT
			MIN	TYP	MAX	
Input regulation	V_I = 12 V to V_I = 15 V			0.1		mV/V
	V_I = 12 V to V_I = 40 V			1		
Ripple rejection	f = 50 Hz to 10 kHz,	C_{ref} = 0		74		dB
	f = 50 Hz to 10 kHz,	C_{ref} = 5 μF		86		
Output regulation				−0.3		mV/V
Reference voltage, V_{ref}				7.15		V
Standby current	V_I = 30 V,	I_O = 0		2.3		mA
Short-circuit output current	R_{SC} = 10 Ω,	V_O = 0		65		mA
Output noise voltage	BW = 100 Hz to 10 kHz,	C_{ref} = 0		20		μV
	BW = 100 Hz to 10 kHz,	C_{ref} = 5 μF		2.5		

NOTES: 2. For all values in this table, the device is connected as shown in Figure 1 with the divider resistance as seen by the error amplifier ≤ 10 kΩ. Unless otherwise specified, $V_I = V_{CC+} = V_C$ = 12 V, V_{CC-} = 0, V_O = 5 V, I_O = 1 mA, R_{SC} = 0, and C_{ref} = 0.
3. Pulse-testing techniques must be used that will maintain the junction temperature as close to the ambient temperature as possible.

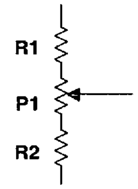
APPLICATION INFORMATION

Table 1. Resistor Values (kΩ) for Standard Output Voltages

OUTPUT VOLTAGE (V)	APPLICABLE FIGURES (see NOTE 4)	FIXED OUTPUT ±5%		OUTPUT ADJUSTABLE ±10% (see NOTE 5)		
		R1 (kΩ)	R2 (kΩ)	R1 (kΩ)	P1 (kΩ)	P2 (kΩ)
3.0	1, 5, 6, 9, 11, 12 (4)	4.12	3.01	1.8	0.5	1.2
3.6	1, 5, 6, 9, 11, 12 (4)	3.57	3.65	1.5	0.5	1.5
5.0	1, 5, 6, 9, 11, 12 (4)	2.15	4.99	0.75	0.5	2.2
6.0	1, 5, 6, 9, 11, 12 (4)	1.15	6.04	0.5	0.5	2.7
9.0	2, 4, (5, 6, 9, 12)	1.87	7.15	0.75	1.0	2.7
12	2, 4, (5, 6, 9, 12)	4.87	7.15	2.0	1.0	3.0
15	2, 4, (5, 6, 9, 12)	7.87	7.15	3.3	1.0	3.0
28	2, 4, (5, 6, 9, 12)	21.0	7.15	5.6	1.0	2.0
45	7	3.57	48.7	2.2	10	39
75	7	3.57	78.7	2.2	10	68
100	7	3.57	105	2.2	10	91
250	7	3.57	255	2.2	10	240
–6 (see Note 6)	3, 10	3.57	2.43	1.2	0.5	0.75
–9	3, 10	3.48	5.36	1.2	0.5	2.0
–12	3, 10	3.57	8.45	1.2	0.5	3.3
–15	3, 10	3.57	11.5	1.2	0.5	4.3
–28	3, 10	3.57	24.3	1.2	0.5	10
–45	8	3.57	41.2	2.2	10	33
–100	8	3.57	95.3	2.2	10	91
–250	8	3.57	249	2.2	10	240

NOTES: 4. The R1/R2 divider may be across either V_O or $V_{(ref)}$. If the divider is across $V_{(ref)}$, use the figure numbers without parentheses. If the divider is across V_O, use the figure numbers in parentheses.

5. To make the voltage adjustable, the R1/R2 divider shown in the figures must be replaced by the divider shown below.



Adjustable Output Circuit

6. For Figures 3, 8, and 10, the device requires a minimum of 9 V between V_{CC+} and V_{CC-} when V_O is equal to or more positive than –9 V.

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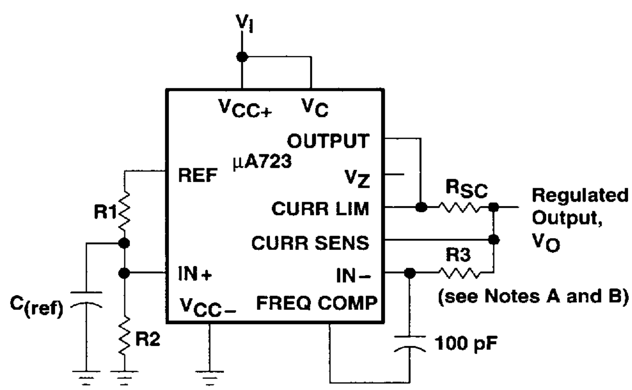
APPLICATION INFORMATION

Table 2. Formulas for Intermediate Output Voltages

Outputs from 2 V to 7 V See Figures 1, 5, 6, 9, 11, 12 (4) and Note 4 $V_O = V_{(ref)} \times \frac{R2}{R1 + R2}$	Outputs from 4 V to 250 V See Figure 7 and Note 4 $V_O = \frac{V_{(ref)}}{2} \times \frac{R2-R1}{R1}$ $R3 = R4$	Current Limiting $I_{(limit)} \approx \frac{0.65\ V}{R_{SC}}$
Outputs from 7 V to 37 V See Figures 2, 4, (5, 6, 9, 11, 12) and Note 4 $V_O = V_{(ref)} \times \frac{R1 + R2}{R2}$	Outputs from −6 V to −250 V See Figures 3, 8, 10 and Notes 4 and 6 $V_O = -\frac{V_{(ref)}}{2} \times \frac{R1 + R2}{R1}$ $R3 = R4$	Foldback Current Limiting See Figure 6 $I_{(knee)} \approx \frac{V_O R3 + (R3 + R4)\ 0.65\ V}{R_{SC} R4}$ $I_{OS} \approx \frac{0.65\ V}{R_{SC}} \times \frac{R3 + R4}{R4}$

NOTES: 4. The R1/R2 divider can be across either V_O or $V_{(ref)}$. If the divider is across $V_{(ref)}$, use figure numbers without parentheses. If the divider is across V_O, use the figure numbers in parentheses.

6. For Figures 3, 8, and 10, the device requires a minimum of 9 V between V_{CC+} and V_{CC-} when V_O is equal to or more positive than −9 V.

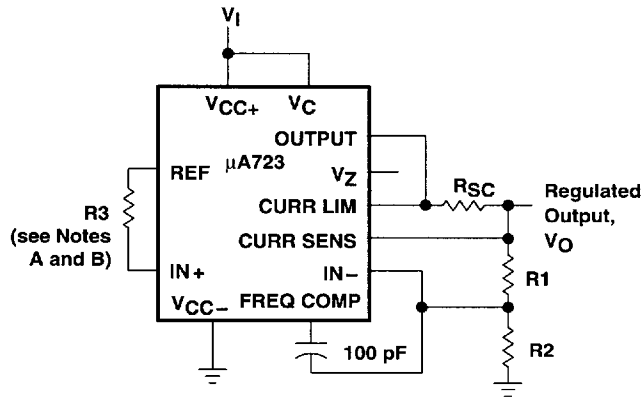


NOTES: A. $R3 = \frac{R1 \times R2}{R1 + R2}$ for minimum α_{VO}

B. R3 may be eliminated for minimum component count. Use direct connection (i.e., $R_3 = 0$).

Figure 1. Basic Low-Voltage Regulator (V_O = 2 V to 7 V)

APPLICATION INFORMATION



NOTES: A. $R3 = \frac{R1 \times R2}{R1 + R2}$ for minimum α_{VO}

B. R3 may be eliminated for minimum component count. Use direct connection (i.e., $R_3 = 0$).

Figure 2. Basic High-Voltage Regulator (V_O = 7 V to 37 V)

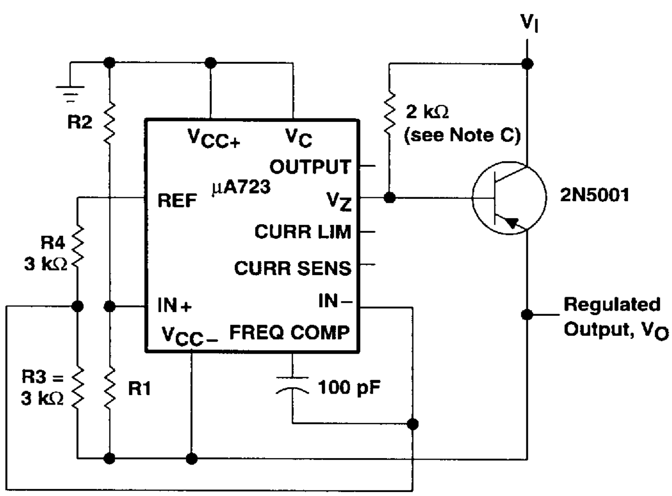


Figure 3. Negative-Voltage Regulator

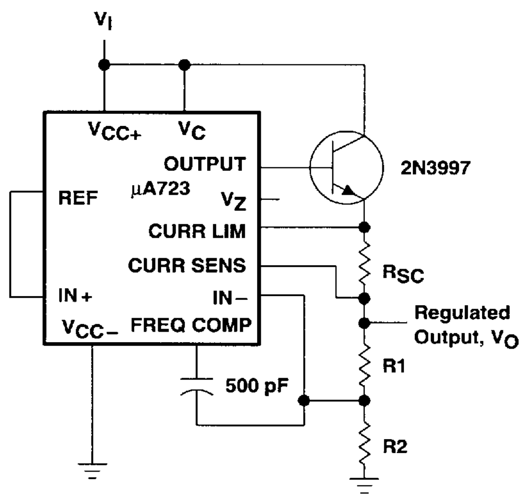


Figure 4. Positive-Voltage Regulator (External N-P-N Pass Terminator)

NOTE A: When 10-lead µA723U devices are used in applications requiring V_Z, an external 6.2-V regulator diode must be connected in series with OUTPUT.

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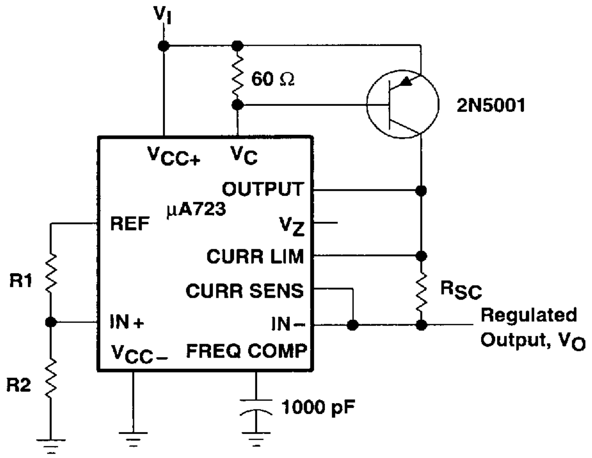


Figure 5. Positive-Voltage Regulator (External P-N-P Pass Transistor)

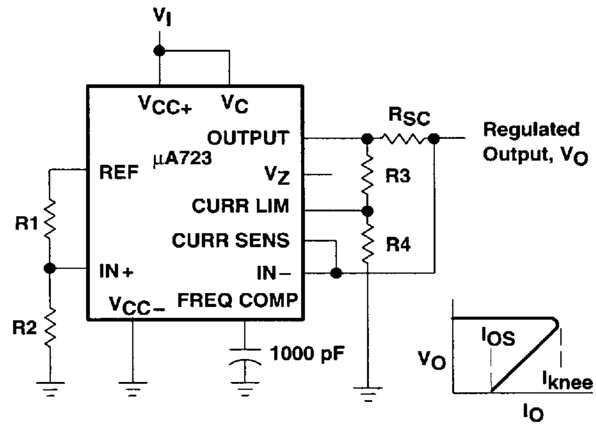
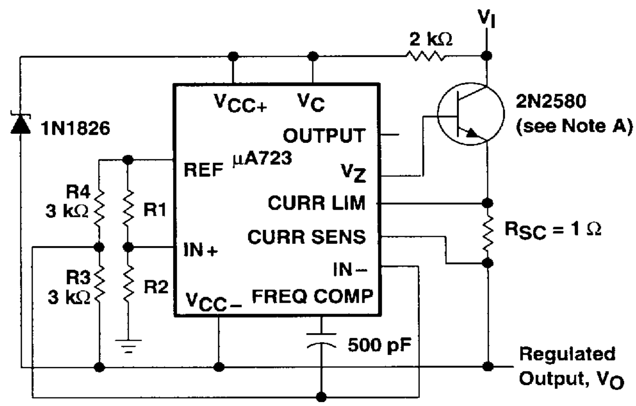


Figure 6. Foldback Current Limiting



NOTE A: When 10-lead µA723U devices are used in applications requiring V_Z, an external 6.2-V regulator diode must be connected in series with OUTPUT.

Figure 7. Positive Floating Regulator

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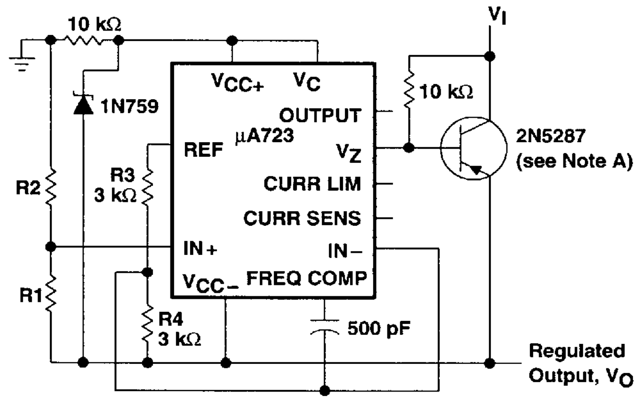
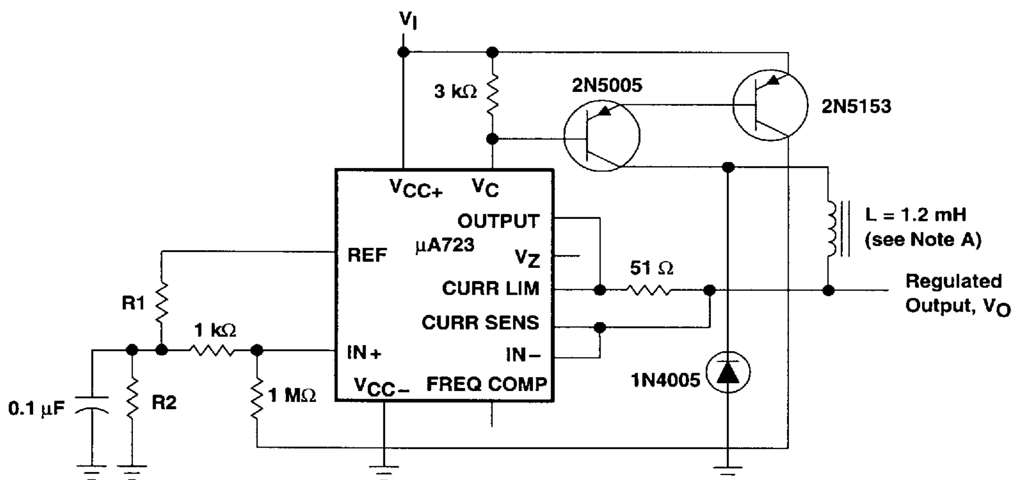


NOTE A: When 10-lead μA723U devices are used in applications requiring V_Z, an external 6.2-V regulator diode must be connected in series with OUTPUT.

Figure 8. Negative Floating Regulator



NOTE A: L is 40 turns of No. 20 enameled copper wire wound on Ferroxcube P36/22-3B7 potted core or equivalent, with a 0.009-inch air gap.

Figure 9. Positive Switching Regulator

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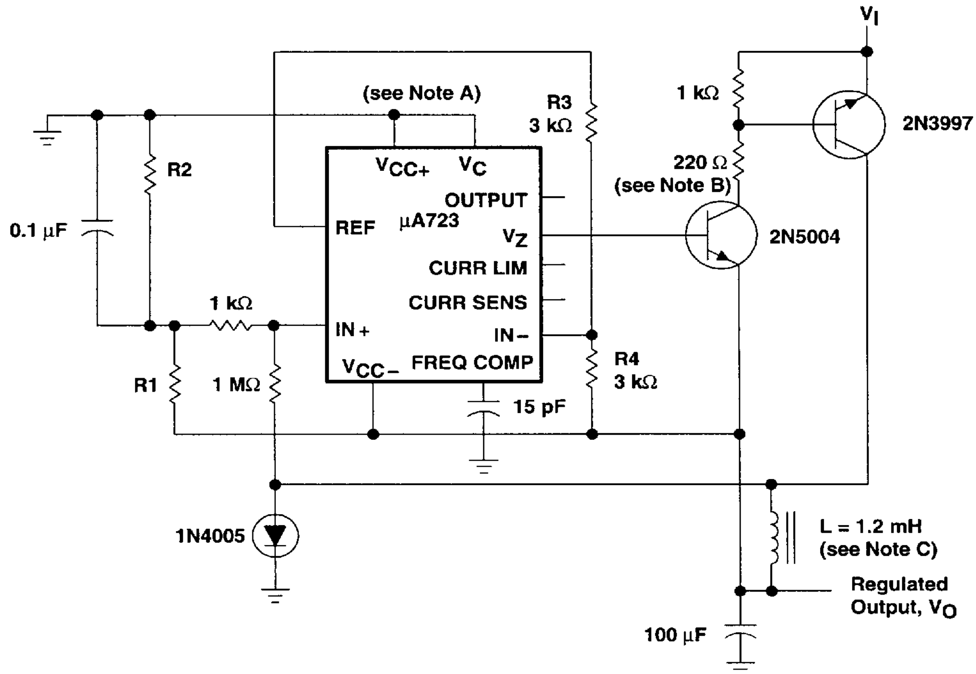
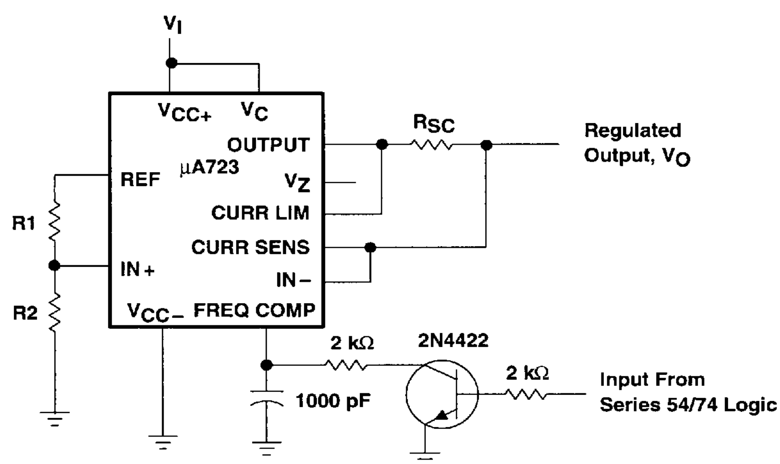


NOTES: A. The device requires a minimum of 9 V between V_{CC+} and V_{CC-} when V_O is equal to or more positive than –9 V.
B. When 10-lead µA723U devices are used in applications requiring V_Z, an external 6.2-V regulator diode must be connected in series with OUTPUT.
C. L is 40 turns of No. 20 enameled copper wire wound on Ferroxcube P36/22-3B7 potted core or equivalent, with a 0.009-inch air gap.

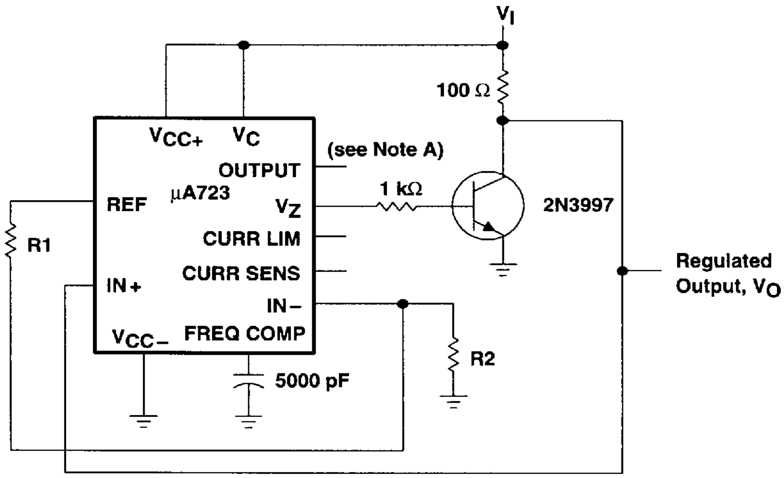
Figure 10. Negative Switching Regulator



NOTE A: A current-limiting transistor can be used for shutdown if current limiting is not required.

Figure 11. Remote Shutdown Regulator With Current Limiting

APPLICATION INFORMATION



NOTE A: When 10-lead µA723U devices are used in applications requiring V_Z, an external 6.2-V regulator diode must be connected in series with OUTPUT.

Figure 12. Shunt Regulator

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