

LM723

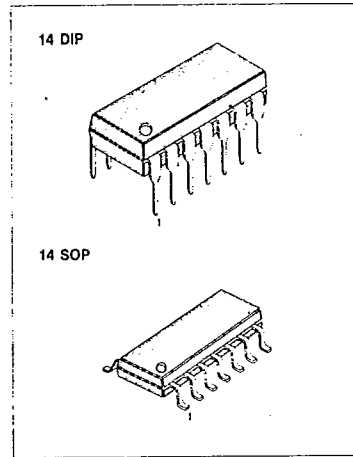
LINEAR INTEGRATED CIRCUIT

PRECISION VOLTAGE REGULATOR

The LM723 is a monolithic integrated circuit voltage regulator featuring high ripple rejection, excellent output and load regulation, excellent temperature stability, and low standby current.

FEATURES

- Positive or Negative Supply Operation.
- 0.01% line and load regulation
- Output voltage adjustable from 2 to 37 volts.
- Output current to 150mA without external pass transistor



BLOCK DIAGRAM

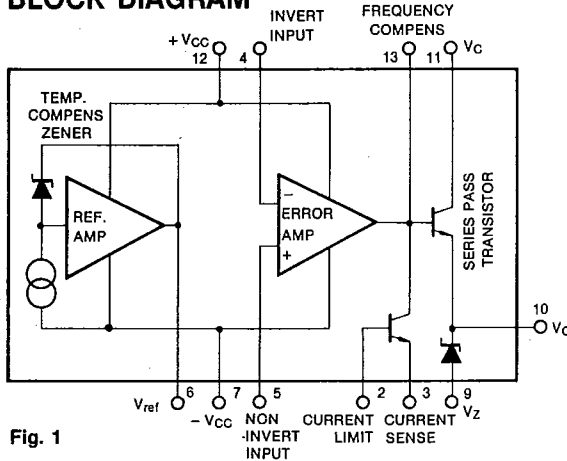


Fig. 1

ORDERING INFORMATION

Device	Package	Operating Temperature
LM723CN	14 DIP	0 ~ +70°C
LM723CD	14 SOP	
LM723IN	14 DIP	-25 ~ +85°C
LM723ID	14 SOP	

SCHEMATIC DIAGRAM

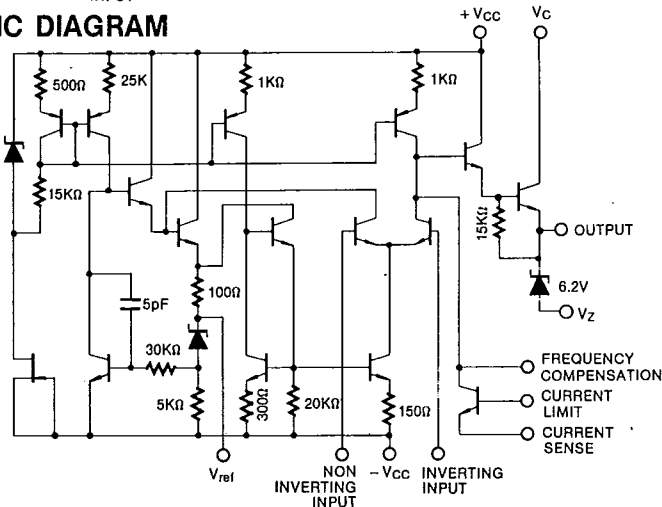


Fig. 2

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ABSOLUTE MAXIMUM RATINGS

Characteristic	Symbol	Value	Unit
Pulse Voltage from V+ to V- (50ms)	V _{IN(P)}	50	V _{peak}
Continous Voltage from V+ to V-	V _{IN}	40	V
Input-Output Voltage Differential	V _{IN-V_O}	40	V
Maximum Output Current	I _o	150	mA
Differential Input Voltage	V _{ID}	±5	V
Voltage Between Non-Inverting Input and V-	V _{IE}	8	V
Current from V _Z	I _Z	25	mA
Current from V _{REF}	I _{REF}	15	mA
Power Dissipation	P _D	1000	mW
Operating Temperature	T _{opr}	-25 ~ +85	°C
Storage Temperature	T _{stg}	0 ~ +70	°C
		-65 ~ +150	°C

ELECTRICAL CHARACTERISTICS

(unless otherwise specified, T_a = 25°C, V_I = V_{CC} = V_C = 12V, V_O = +5V, I_L = 1.0mA, R_{SC} = 0, C_I = 100pF, C_{ref} = 0 and divider impedance as seen by error Amplifier ≤ 10KΩ connected as shown in figure 3)

Characteristic	Symbol	Test Conditions	LM7231/LM723C			Unit
			Min	Typ	Max	
Line Regulation	ΔV _O	V _I = 12V to 15V		0.01	0.1	%
		V _I = 12V to 40V		0.1	0.5	
Load Regulation	ΔV _O	T _{MIN} ≤ T _A ≤ T _{MAX} V _I = 12V to 15V			0.3	%
		I _o = 1mA to 50mA		0.03	0.2	
Ripple Rejection	RR	f = 100Hz to 10KHz, C _{REF} = 0		74		dB
		f = 100Hz to 10KHz, C _{REF} = 5μF		86		
Average Temperature Coefficient of Output Voltage	ΔV _O /ΔT	T _{MIN} ≤ T _A ≤ T _{MAX}		0.003	0.015	%/°C
Short Circuit Current Limit	I _{SC}	R _{SC} = 10Ω, V _O = 0		65		mA
Reference Voltage	V _{REF}		6.80	7.15	7.50	V
Output Noise Voltage	V _N	f = 100Hz to 10KHz, C _{REF} = 0		20		μV _{rms}
		f = 100Hz to 10KHz, C _{REF} = 5μF		2.5		
Long-term Stability	V _O /T			0.1		%/1000HR
Standby Current Drain	I _o	I _L = 0, V _{IN} = 30V		2.3	4.0	mA
Input Voltage Range	V _I		9.5		40	V
Output Voltage Range	V _O		2.0		37	V
Input-Output Voltage Differential	V _D		3.0		38	V

* Note: T_{MIN} = 0°C for LM723C
= -25°C for LM7231

T_{MAX} = 70°C for LM723C
= 85°C for LM7231

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Table 1 — Resistor values (K Ω) for standard output voltage

Output Voltage	Applicable Figures	Fixed Output $\pm 5\%$		Output Adjustable $\pm 10\%$			Output Voltage	Applicable Figures	Fixed Output $\pm 5\%$		Output Adjustable $\pm 10\%$		
		R ₁	R ₂	R ₁	P ₁	R ₂			R ₁	R ₂	R ₁	P ₁	R ₂
+3	3, 6	4.12	3.01	1.8	0.5	1.2	-6*	5	3.57	2.43	1.2	0.5	0.75
+5	3, 6	2.15	4.99	0.75	0.5	2.2	-9	5	3.48	5.36	1.2	0.5	2
+6	3, 6	1.15	6.04	0.5	0.5	2.7	-12	5	3.57	8.45	1.2	0.5	3.3
+9	4, 6	1.87	7.15	0.75	1	2.7	-15	5	3.65	11.5	1.2	0.5	4.3
+12	4, 6	4.87	7.15	2	2	3	-28	5	3.57	24.3	1.2	0.5	10
+15	4, 6	7.87	7.15	3.3	1	3							
+28	4, 6	21	7.15	5.6	1	2							

Note: *V_{CC} must be connected to a +3V or greater supply.

Table II — Formulae for intermediate output voltages

Outputs from +2 to +7 volts Fig. 3 $V_o = [V_{ref} \times \frac{R_2}{R_1 + R_2}]$	Foldback Current Limiting $I_{KNEE} = [\frac{V_o R_3}{R_{sc} R_4} + \frac{V_{SENSE} (R_3 + R_4)}{R_{sc} R_4}]$ $I_{SHORT\ CKT} = [\frac{V_{SENSE}}{R_{sc}} \times \frac{R_3 + R_4}{R_4}]$	Current Limiting $I_{LIMIT} = \frac{V_{SENSE}}{R_{sc}}$
Outputs from +7 to +37 volts Fig. 4, 6 $V_o = [V_{ref} \times \frac{R_1 + R_2}{R_2}]$	Output from -6 to -250 volts Fig. 5 $V_o = [\frac{V_{ref}}{2} \times \frac{R_1 + R_2}{R_1}]; R_3 = R_4$	

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APPLICATION INFORMATION

Basic low voltage regulator ($V_o = 2$ to $7V$)

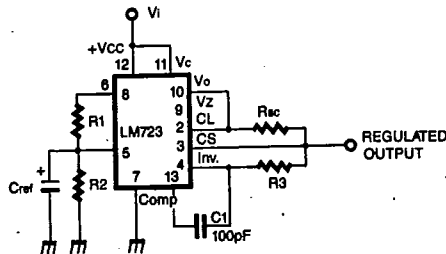


Fig. 3

Note: $R_3 = R_1 \cdot R_2 / (R_1 + R_2)$ for minimum temperature drift.
 R_3 may be eliminated for minimum component count.

Basic high voltage regulator ($V_o = 7$ to $37V$)

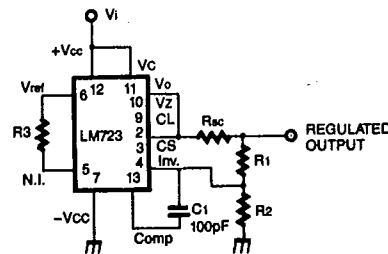


Fig. 4

Note: $R_1 \cdot R_2 / (R_1 + R_2)$ for minimum temperature drift.
 R_3 may be eliminated for minimum component count.

Typical performance

Regulated Output Voltage.....	5V
Line Regulation ($\Delta V_i = 3V$).....	0.5mV
Load Regulation ($\Delta I_o = 50mA$).....	1.5mV

Typical performance

Regulated Output Voltage.....	15V
Line Regulation ($\Delta V_i = 3V$).....	1.5mV
Load Regulation ($\Delta I_o = 50mA$).....	4.5mV

Negative voltage regulator

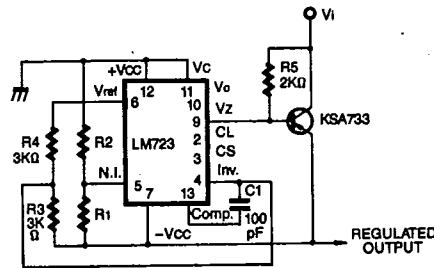


Fig. 5

Typical performance

Regulated output Voltage.....	-15V
Line Regulation ($\Delta V_i = 3V$).....	1mV
Load Regulation ($\Delta I_o = 100mA$).....	2mV

Positive voltage regulator
 (External NPN Pass Transistor)

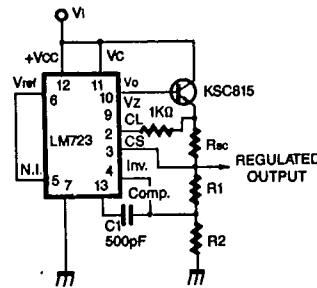


Fig. 6

Typical performance

Regulated Output Voltage.....	+15V
Line Regulation ($\Delta V_i = 3V$).....	1.5mV
Load Regulation ($\Delta I_o = 1A$).....	15mV

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Maximum output current vs. voltage drop

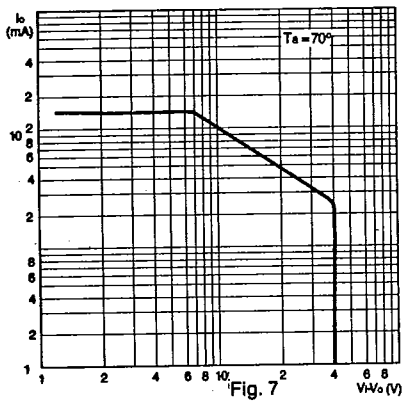


Fig. 7

Current limiting characteristics

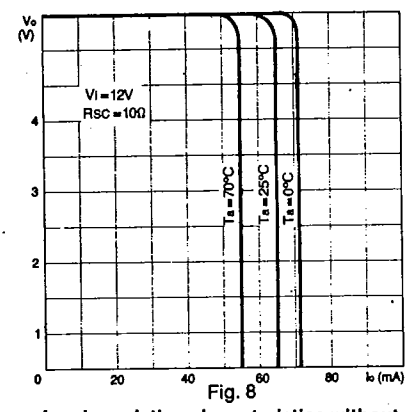


Fig. 8

Current limiting characteristics vs. junction temperature

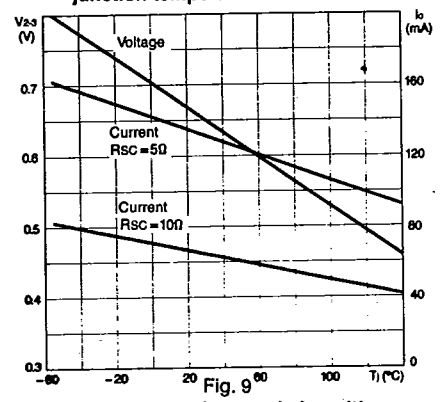


Fig. 9

Load regulation characteristics without current limiting

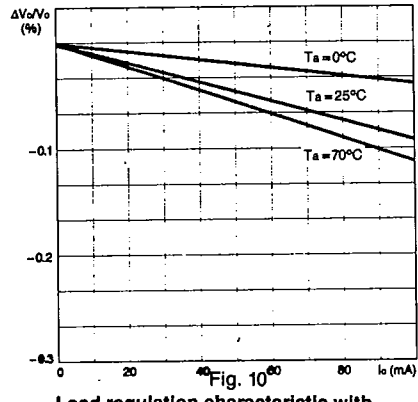


Fig. 10

Load regulation characteristics with current limiting

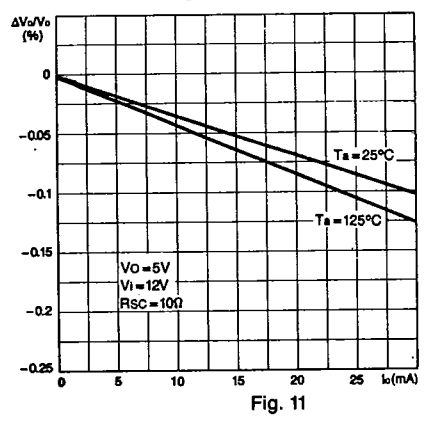


Fig. 11

Load regulation characteristic with current limiting

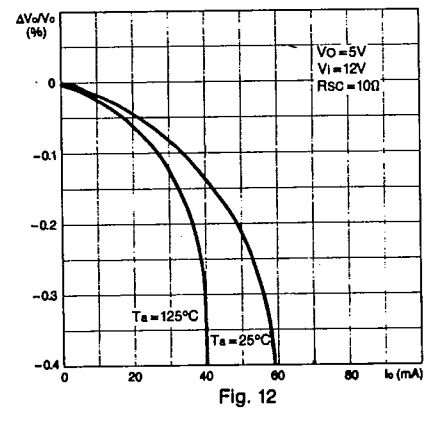


Fig. 12

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Line regulation — voltage drop

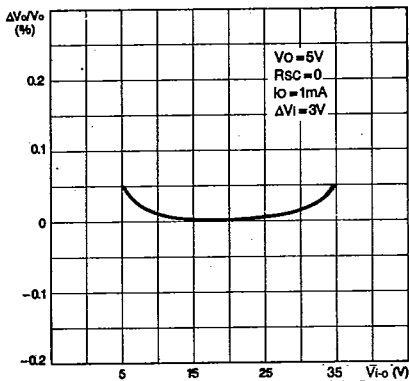


Fig. 13

Load regulation — voltage drop

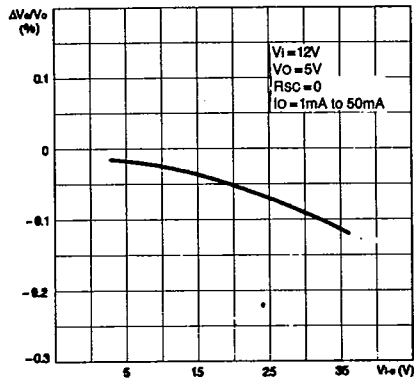


Fig. 14

Quiescent drain current vs. input voltage

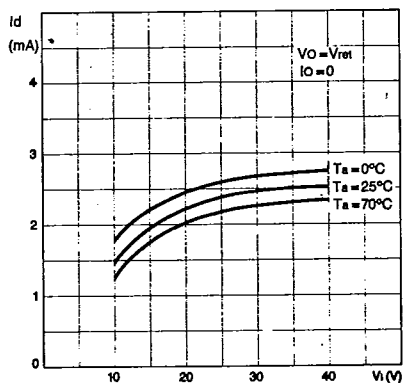


Fig. 15

Line transient response

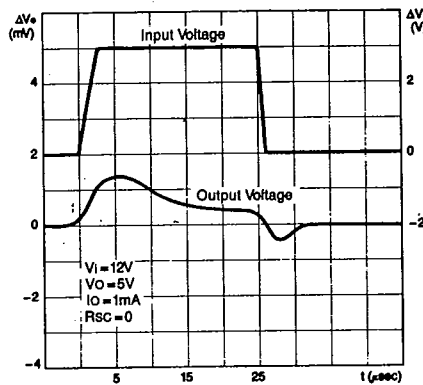


Fig. 16

Load transient response

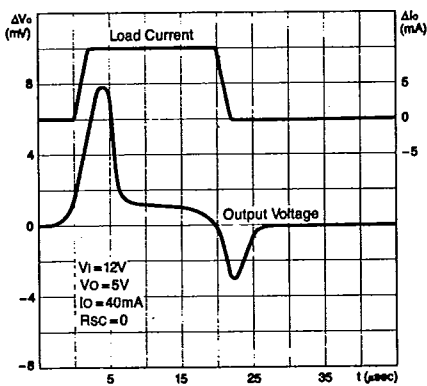


Fig. 17

Output impedance vs. frequency

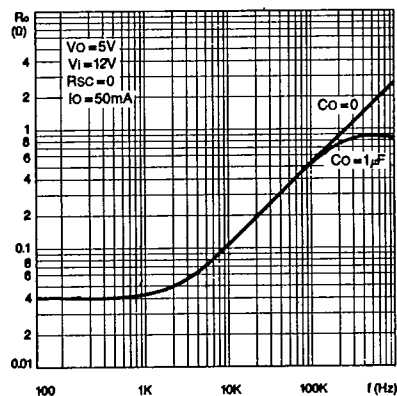


Fig. 18