

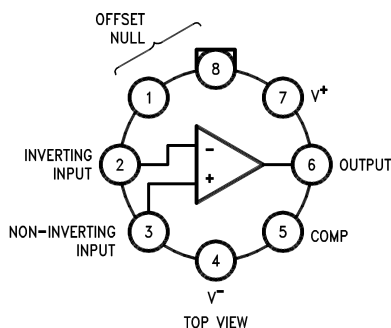
LM725 Operational Amplifier

Check for Samples: [LM725](#)

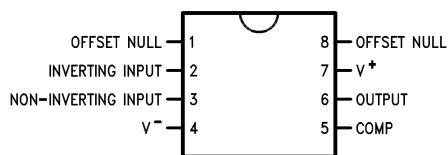
FEATURES

- High Open Loop Gain: 3,000,000
- Low Input Voltage Drift 0.6 $\mu\text{V}/^\circ\text{C}$
- High Common Mode Rejection 120 dB
- Low Input Noise Current 0.15 $\text{pA}/\sqrt{\text{Hz}}$
- Low Input Offset Current 2 nA
- High Input Voltage Range $\pm 14\text{V}$
- Wide Power Supply Range $\pm 3\text{V}$ to $\pm 22\text{V}$
- Offset Null Capability
- Output Short Circuit Protection

CONNECTION DIAGRAM



Metal Can Package



Dual-In-Line Package

DESCRIPTION

The LM725/LM725A/LM725C are operational amplifiers featuring superior performance in applications where low noise, low drift, and accurate closed-loop gain are required. With high common mode rejection and offset null capability, it is especially suited for low level instrumentation applications over a wide supply voltage range.

The LM725A has tightened electrical performance with higher input accuracy and like the LM725, is guaranteed over a -55°C to $+125^\circ\text{C}$ temperature range. The LM725C has slightly relaxed specifications and has its performance guaranteed over a 0°C to 70°C temperature range.

TYPICAL APPLICATIONS

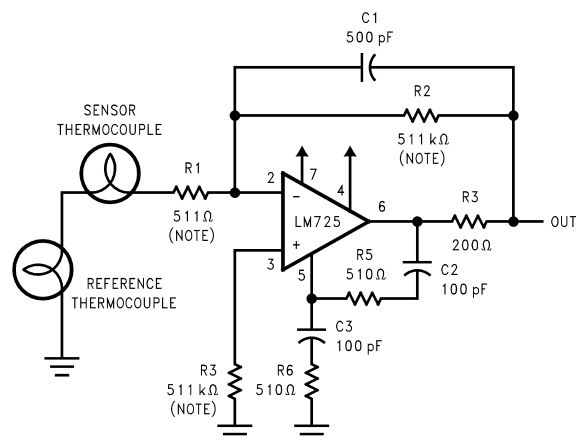


Figure 1. Thermocouple Amplifier



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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

ABSOLUTE MAXIMUM RATINGS ⁽¹⁾

If Military/Aerospace specified devices are required, contact the Texas Instruments Semiconductor Sales Office/ Distributors for availability and specifications. ⁽²⁾

Supply Voltage	±22V
Internal Power Dissipation ⁽³⁾	500 mW
Differential Input Voltage	±5V
Input Voltage ⁽⁴⁾	±22V
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 Sec.)	260°C
Maximum Junction Temperature	150°C
Operating Temperature Range (T _{A(MIN)} to T _{A(MAX)})	
LM725	-55°C to +125°C
LM725A	-55°C to +125°C
LM725C	0°C to +70°C

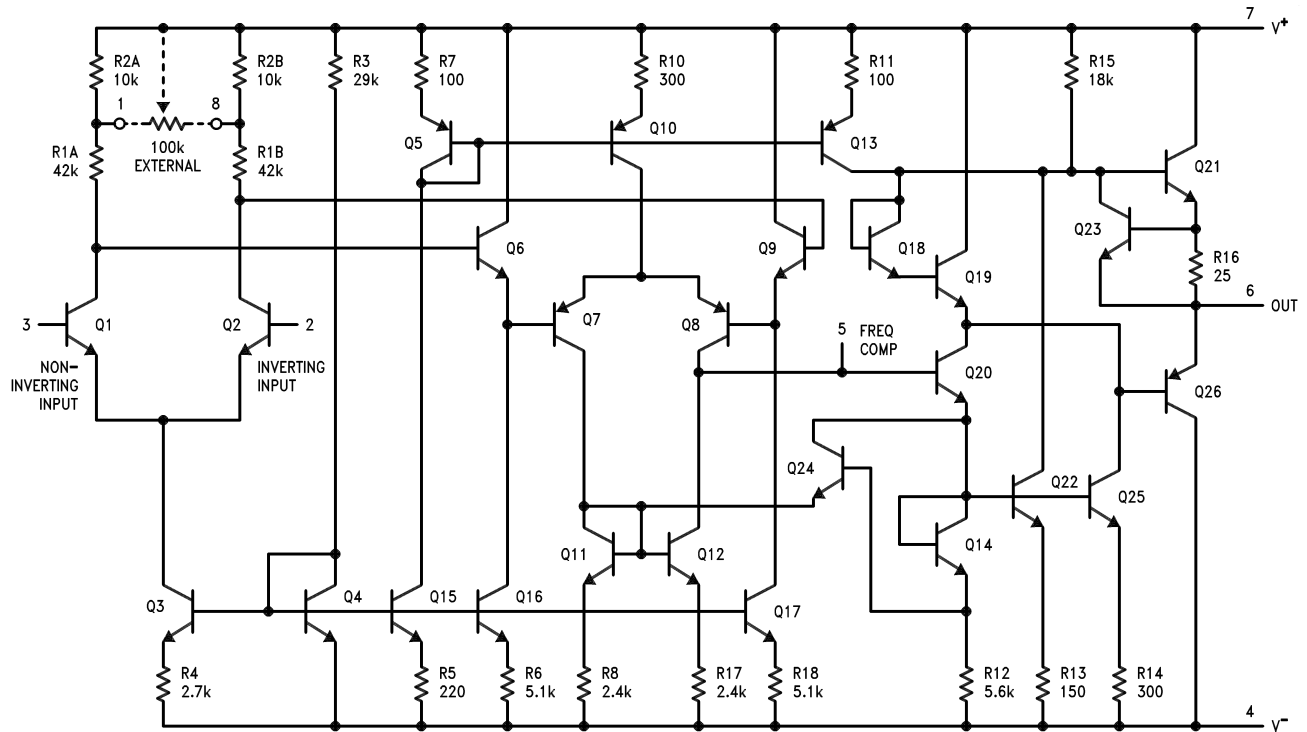
- (1) "Absolute Maximum Ratings" indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but **do not** guarantee specific performance limits.
- (2) For Military electrical specifications RETS725AX are available for LM725AH and RETS725X are available for LM725H.
- (3) Derate at 150°C/W for operation at ambient temperatures above 75°C.
- (4) For supply voltages less than ±22V, the absolute maximum input voltage is equal to the supply voltage.

ELECTRICAL CHARACTERISTICS (1)

Parameter	Conditions	LM725A			LM725			LM725C			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage (Without External Trim)	$T_A = 25^\circ\text{C}$, $R_S \leq 10\text{ k}\Omega$			0.5		0.5	1.0		0.5	2.5	mV
Input Offset Current	$T_A = 25^\circ\text{C}$		2.0	5.0		2.0	20		2.0	35	nA
Input Bias Current	$T_A = 25^\circ\text{C}$		42	80		42	100		42	125	nA
Input Noise Voltage	$T_A = 25^\circ\text{C}$										
	$f_o = 10\text{ Hz}$		15			15			15		$\text{nV}/\sqrt{\text{Hz}}$
	$f_o = 100\text{ Hz}$		9.0			9.0			9.0		$\text{nV}/\sqrt{\text{Hz}}$
	$f_o = 1\text{ kHz}$		8.0			8.0			8.0		$\text{nV}/\sqrt{\text{Hz}}$
Input Noise Current	$T_A = 25^\circ\text{C}$										
	$f_o = 10\text{ Hz}$		1.0			1.0			1.0		$\text{pA}/\sqrt{\text{Hz}}$
	$f_o = 100\text{ Hz}$		0.3			0.3			0.3		$\text{pA}/\sqrt{\text{Hz}}$
	$f_o = 1\text{ kHz}$		0.15			0.15			0.15		$\text{pA}/\sqrt{\text{Hz}}$
Input Resistance	$T_A = 25^\circ\text{C}$		1.5			1.5			1.5		M Ω
Input Voltage Range	$T_A = 25^\circ\text{C}$	± 13.5	± 14		± 13.5	± 14		± 13.5	± 14		V
Large Signal Voltage Gain	$T_A = 25^\circ\text{C}$, $R_L \geq 2\text{ k}\Omega$, $V_{\text{OUT}} = \pm 10\text{V}$	1000	3000		1000	3000		250	3000		V/mV
Common-Mode Rejection Ratio	$T_A = 25^\circ\text{C}$, $R_S \leq 10\text{ k}\Omega$	120			110	120		94	120		dB
Power Supply Rejection Ratio	$T_A = 25^\circ\text{C}$, $R_S \leq 10\text{ k}\Omega$		2.0	5.0		2.0	10		2.0	35	$\mu\text{V}/\text{V}$
Output Voltage Swing	$T_A = 25^\circ\text{C}$, $R_L \geq 10\text{ k}\Omega$	± 12.5	± 13.5		± 12	± 13.5		± 12	± 13.5		V
	$R_L \geq 2\text{ k}\Omega$	± 12.0	± 13.5		± 10	± 13.5		± 10	± 13.5		V
Power Consumption	$T_A = 25^\circ\text{C}$		80	105		80	105		80	150	mW
Input Offset Voltage (Without External Trim)	$R_S \leq 10\text{ k}\Omega$			0.7			1.5			3.5	mV
Average Input Offset Voltage Drift (Without External Trim)	$R_S = 50\Omega$			2.0		2.0	5.0		2.0		$\mu\text{V}/^\circ\text{C}$
Average Input Offset Voltage Drift (With External Trim)	$R_S = 50\Omega$		0.6	1.0		0.6			0.6		$\mu\text{V}/^\circ\text{C}$
Input Offset Current	$T_A = T_{\text{MAX}}$		1.2	4.0		1.2	20		1.2	35	nA
	$T_A = T_{\text{MIN}}$		7.5	18.0		7.5	40		4.0	50	nA
Average Input Offset Current Drift			35	90		35	150		10		$\text{pA}/^\circ\text{C}$
Input Bias Current	$T_A = T_{\text{MAX}}$		20	70		20	100			125	nA
	$T_A = T_{\text{MIN}}$		80	180		80	200			250	nA
Large Signal Voltage Gain	$R_L \geq 2\text{ k}\Omega$										
	$T_A = T_{\text{MAX}}$, $R_L \geq 2\text{ k}\Omega$	1,000,000			1,000,000			125,000			V/V
	$T_A = T_{\text{MIN}}$	500,000			250,000			125,000			V/V
Common-Mode Rejection Ratio	$R_S \leq 10\text{ k}\Omega$	110			100				115		dB
Power Supply Rejection Ratio	$R_S \leq 10\text{ k}\Omega$			8.0			20		20		$\mu\text{V}/\text{V}$
Output Voltage Swing	$R_L \geq 2\text{ k}\Omega$	± 12			± 10			± 10			V

 (1) These specifications apply for $V_S = \pm 15\text{V}$ unless otherwise specified.

SCHEMATIC DIAGRAM



TYPICAL PERFORMANCE CHARACTERISTICS

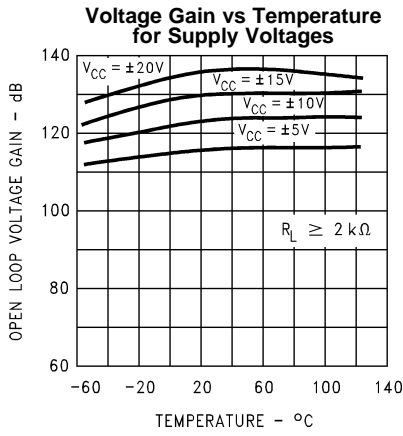


Figure 2.

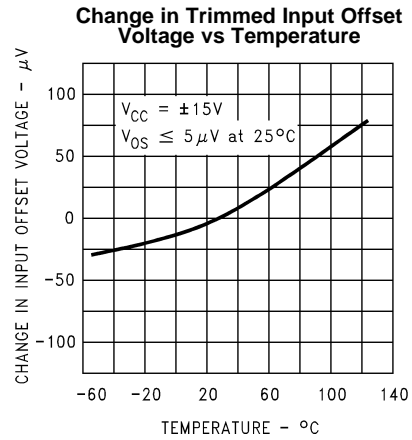


Figure 3.

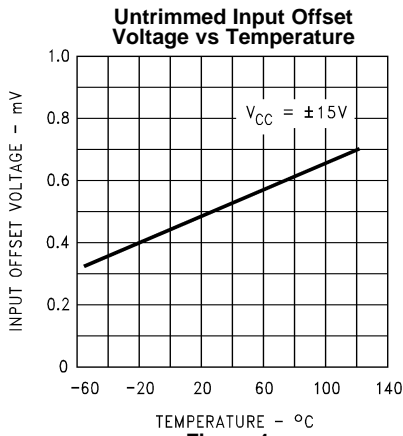


Figure 4.

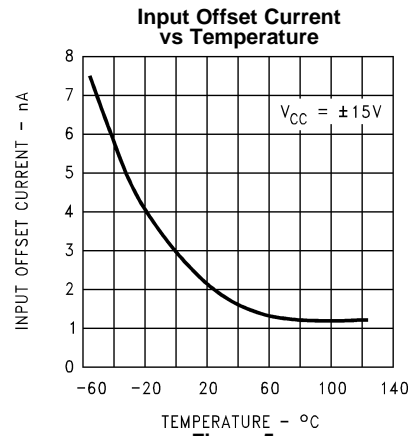


Figure 5.

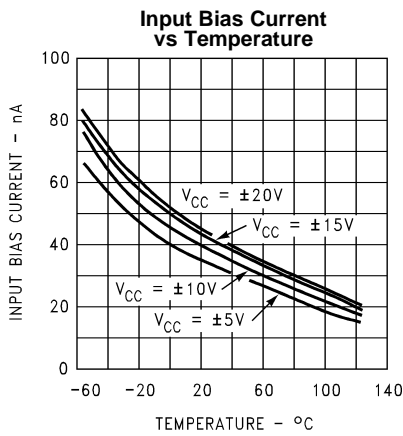


Figure 6.

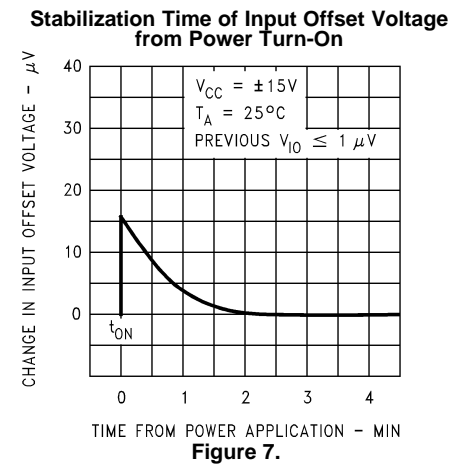


Figure 7.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

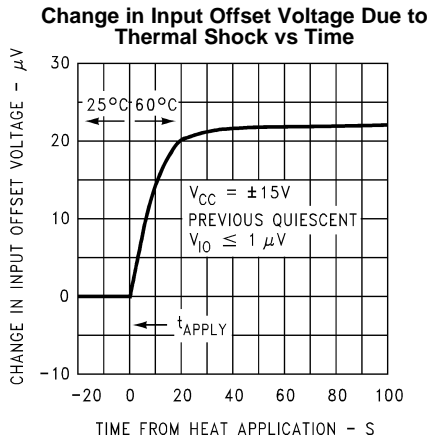


Figure 8.

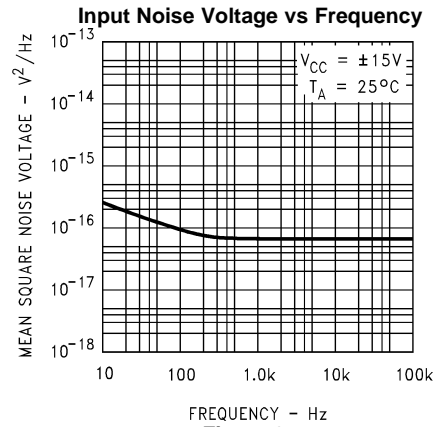


Figure 9.

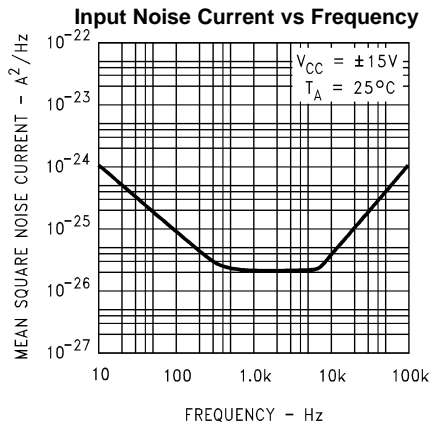


Figure 10.

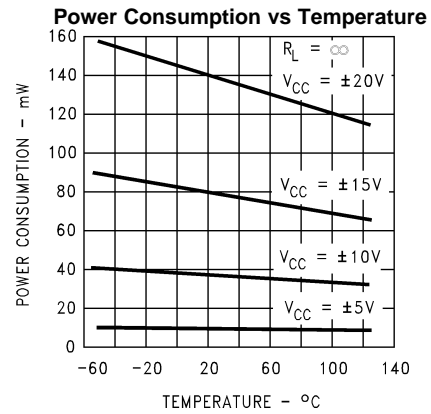


Figure 11.

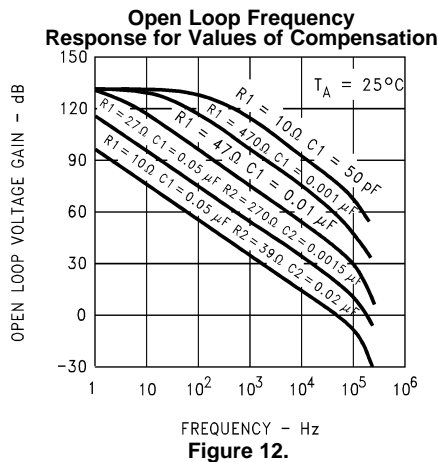


Figure 12.

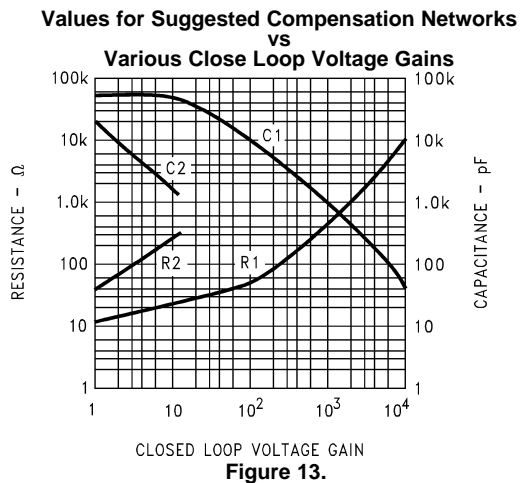
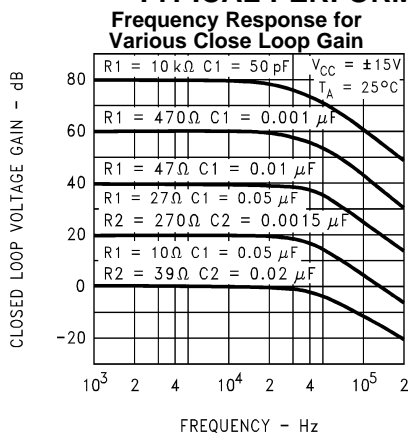


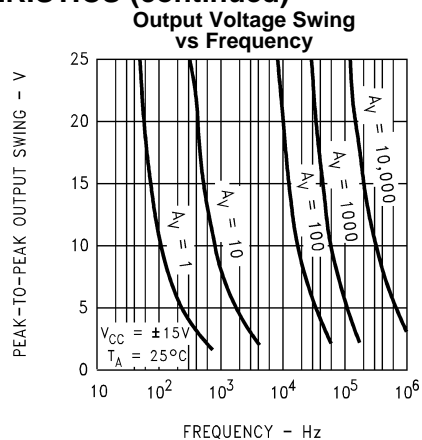
Figure 13.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)



(1) Performance is shown using recommended compensation networks.

Figure 14.



(1) Performance is shown using recommended compensation networks.

Figure 15.

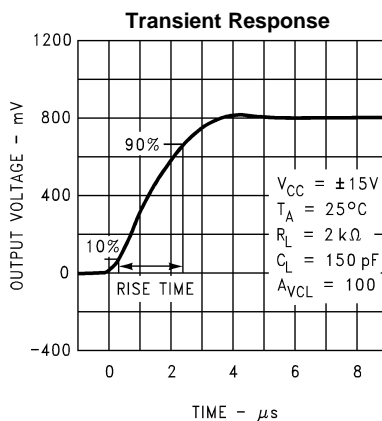


Figure 16.

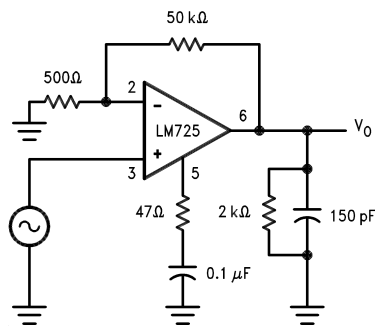


Figure 17. Transient Response Test Circuit

AUXILIARY CIRCUITS

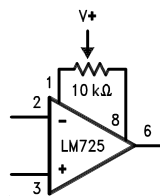


Figure 18. Voltage Offset Null Circuit

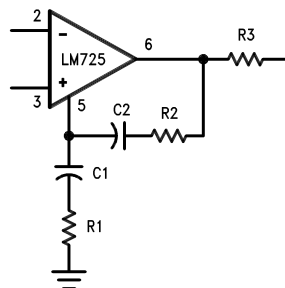
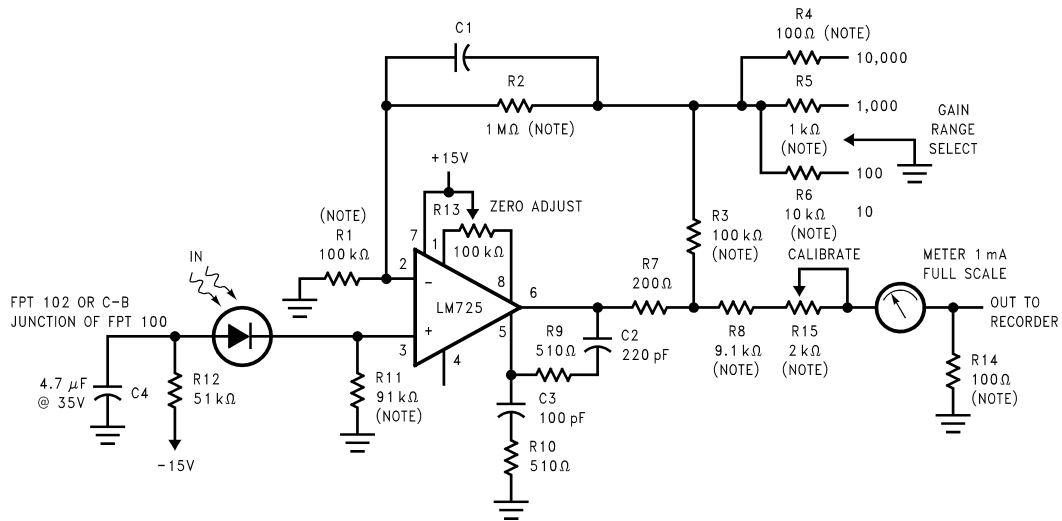


Figure 19. Frequency Compensation Circuit

Table 1. Compensation Component Values

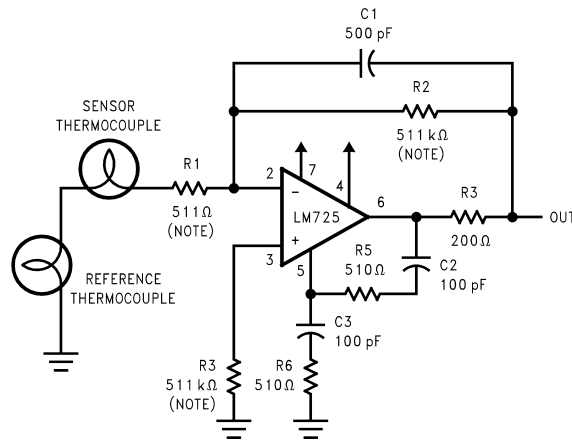
A_v	R_1 (Ω)	C_1 (μF)	R_2 (Ω)	C_2 (μF)
10,000	10k	50 pF		
1,000	470	0.001		
100	47	0.01		
10	27	0.05	270	0.0015
1	10	0.05	39	0.02

TYPICAL APPLICATIONS



DC Gains = 10,000; 1,000; 100; and 10
 Bandwidth = Determined by value of C1

Figure 20. Photodiode Amplifier



$$\frac{R2}{R5} = \frac{R6}{R7} \text{ for best CMR}$$

$$R1 = R4$$

$$R2 = R5$$

$$\text{Gain} = \frac{R6}{R2} + \left(\frac{2R1}{R3} \right)$$

DC Gain = 1000

Bandwidth = DC to 540 Hz

Equivalent Input Noise = 0.24 μV_{rms}

Indicates $\pm 1\%$ metal film resistors recommended for temperature stability.

Figure 21. Thermocouple Amplifier

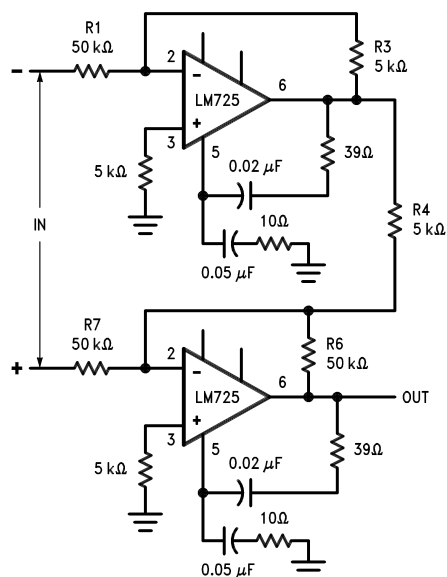
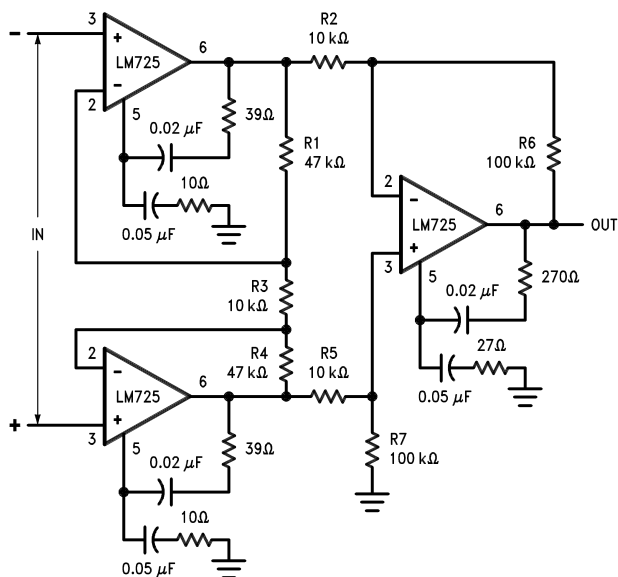


Figure 22. ±100V Common Mode Range Differential Amplifier



$$\frac{R1}{R6} = \frac{R3}{R4} \text{ for best CMRR}$$

$$R3 = R4$$

$$R1 = R6 = 10 R3$$

$$\text{Gain} = \frac{R6}{R7}$$

Figure 23. Instrumentation Amplifier with High Common Mode Rejection

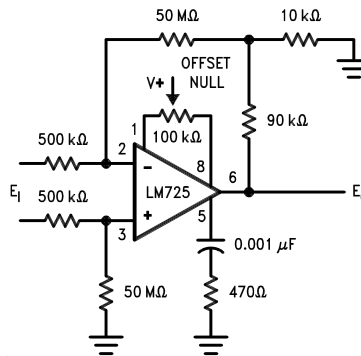


Figure 24. Precision Amplifier $A_{VCL} = 1000$

REVISION HISTORY

Changes from Revision C (April 2013) to Revision D	Page
• Changed layout of National Data Sheet to TI format	11

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