UFMG

Universidade Federal de Minas Gerais
Departamento de Engenharia Eletrônica

Laboratório de Controle e Automação I

Instrumentação
Strain Gages
Balança de Precisão

Prof. Anísio R. Braga, CEFET/MG
Prof. José Carlos R. de Oliveira, DELT/UFMG

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STRAIN GAGES

Sensor de Deformação

Deformações e fadiga são geradas em componentes, subsistemas e sistemas, devido a peso, temperatura, pressão, vibração ou forças de deslocamento. Um dos métodos mais usuais para realizar estas medições é através do uso de extensômetros metálicos, ou strain gauges ("gages"), conectados em ponte de Wheatstone.

O **Extensômetro** baseia-se no princípio de que, quando um condutor está sujeito a um esforço de tensão ou compressão, ocorre uma variação de sua resistência. A amplitude da variação, relacionada com a resistência original, é proporcional à intensidade do esforço aplicado, ou ainda:

$$E = Esforço\ (máxima\ microdeformação) = \frac{\text{var}iação\ do\ comprimento}{comprimento\ \text{original}} = \frac{\Delta L}{L}$$

Em aplicações de extensômetros utiliza-se uma constante de proporcionalidade conhecida como **Fator de Calibração** (Gage Factor), que varia de 2 a 4 para as ligas mais usuais na fabricação de extensômetros,. Este parâmetro é baseado na variação da resistência ocorrida no extensômetro para sua resistência total, relacionada com a variação no comprimento do condutor para seu comprimento unitário, ou ainda:

$$GF = \frac{\Delta R / R}{\Delta L / L}$$

A tensão de saída do amplificador de um medidor de deformação, com extensômetros em ponte de Wheatstone é dada por:

$$e_o = \Delta R / R * V_{ex} * G$$

onde Vex é a tensão de alimentação da ponte e G é o ganho do amplificador de instrumentação.

Exemplo: Uma ponte de extensômetros com G=2 e $\Delta L / L$ =1500μ_E (dados provenientes de catálogo do fabricante), possui $\Delta R / R = 2 * 1500 = 3000\mu_E$.

Desta maneira, pode-se calcular a tensão de saida do medidor como sendo:

$$e_o = 3000 * V_{ex} * G.$$

BALANÇA DE PRECISÃO

PREPARAÇÃO

1) Ler o Tutorial " Strain Gage Technical Data" da OMEGA Engineering.

2) Descrever as funções e as principais características dos circuitos integrados LM723 e INA114, com o auxílio dos datasheets da National Semicondutor e da Burr – Brown.

3) Descrever o funcionamento do Módulo Condicionador para Células de Carga (Prof. Anísio R. Braga, 2002). A ponte de Wheatstone com strain gages e a fonte de alimentação são externos ao Módulo. Este, por sua vez, é constituído por quatro elementos:

- Regulador de Tensão, para excitação da ponte de Wheatstone (tensão V_{ex});
- Circuito de Balanceamento da ponte;
- Amplificador de Instrumentação, para aumentar o nível da tensão de desequilíbrio da ponte;
- Filtro RC passa - baixa, para atenuar ruídos de 60 Hz existentes no sinal de saída.

PARTE EXPERIMENTAL

1) Verificar a construção física da balança e a fixação dos strain gages na sua haste metálica. Analisar os esforços possíveis sobre os mesmos. Quais dos strain gages sofrerão tração e quais sofrerão compressão?

2) Fazer o ajuste de "zero" com o prato vazio.

3) Fazer o ajuste de "fundo de escala", de modo que a massa M = 300g de um corpo padrão corresponda à tensão de saída Vo = +3,0 Volts.

   ATENÇÃO: não utilizar pesos muito elevados, para não deformar a balança. Limitar a escolha ao peso de 300g, e tomar cuidado ao manusear os padrões secundários de peso, a serem utilizados na calibração, pois eles não devem ser tocados com as mãos.

4) Levantar pontos (Vo x M) da Característica Estática da Balança, utilizando os diversos corpos padrão. Trabalhar com variações (intervalos) de 20 gramas, sendo 16 pontos com variações crescentes e 16 com variações decrescentes. Observar que, dos 16 pontos, um se refere à balança sem carga.

5) Com o auxilio de um Software (p. ex., Planilha Excel ou MATLAB) obter o gráfico V_O [Volts] x M [gramas].

- Fazer uma regressão linear nessa curva experimental.

- Obter a função analítica $V'_O = f(M)$, isto é, a equação de calibração do transdutor. Qual é o ganho do transdutor?
- Calcular e plotar o erro de linearidade do transdutor, em função da massa M:

$$E_L(M) = V_O(M) - V'_O(M)$$

Para qual faixa de massa M o erro é maior? Por quê?

- ~~Determinar as características do desempenho estático possíveis~~.
- Verificar, com um osciloscópio, o ruído presente na medição e o efeito da filtragem realizada.

6) Estudar, agora, o Comportamento Dinâmico da Balança, identificando uma função de transferência:

$$G(s) = Vo / M$$

Para isso, com o auxílio de um osciloscópio digital, fazer a aquisição do sinal Vo com o tempo, tanto para um degrau de massa igual a 200 gramas (aplicado no prato da balança), quanto para um impulso (aplicado com um "peteleco" na barrinha). Em cada caso, exportar o sinal do osciloscópio para um microcomputador, através de comunicação serial. Se necessário, repetir os testes, para obter uma massa de dados para validação.
Medir o período das oscilações (intervalo de tempo entre picos), assim como plotar a envoltória em um gráfico semi-logarítmico e fazer sua regressão linear. O ganho estático de G(s) é a inclinação da característica estática já obtida, ou seja, o ganho do transdutor.

7) Encontrado um modelo dinâmico para este sistema, validá-lo.

8) Analisar o comportamento dinâmico da Balança. Ele é adequado? Por quê? Qual(ais) alteração(ões) mecânica(s) e /ou elétrica(s) poderiam ser feitas, de forma a alterar esse comportamento?

9) Tirar conclusões. Comentar as características estáticas e dinâmicas da balança.

Referências Bibliográficas

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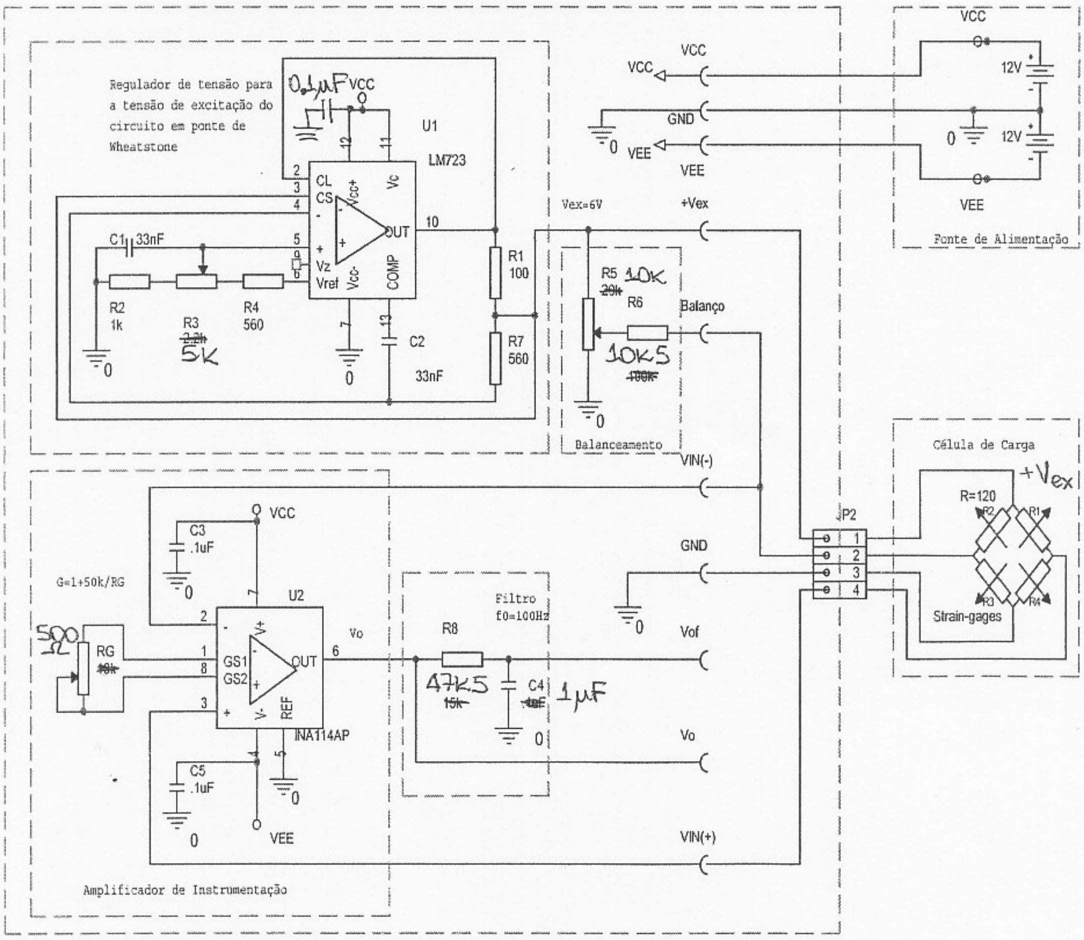
Módulo Condicionador para Células de Carga



Strain Gage Technical Data

Fonte: www.omega.com/techref/strain-gage.html
Data: 05/07/2002.

THE STRAIN GAGE IS ONE OF THE MOST IMPORTANT TOOLS of the electrical measurement technique applied to the measurement of mechanical quantities. As their name indicates, they are used for the measurement of strain. As a technical term "strain" consists of tensile and compressive strain, distinguished by a positive or negative sign. Thus, strain gages can be used to pick up expansion as well as contraction. The strain of a body is always caused by an external influence or an internal effect. Strain might be caused by forces, pressures, moments, heat, structural changes of the material and the like. If certain conditions are fulfilled, the amount or the value of the influencing quantity can be derived from the measured strain value. In experimental stress analysis this feature is widely used. Experimental stress analysis uses the strain values measured on the surface of a specimen or structural part to state the stress in the material and also to predict its safety and endurance. Special transducers can be designed for the measurement of forces or other derived quantities, e.g., moments, pressures, accelerations, and displacements, vibrations and others. The transducer generally contains a pressure sensitive diaphragm with strain gages bonded to it.

Strain Gage Measurement

The most universal measuring device for the electrical measurement of mechanical quantities is the strain gage. Several types of strain gages depend on the proportional variance of electrical resistance to strain: the piezoresistive or semi-conductor gage, the carbon-resistive gage, the bonded metallic wire, and foil resistance gages.

The bonded resistance strain gage is by far the most widely used in experimental stress analysis. These gages consist of a grid of very fine wire or foil bonded to the backing or carrier matrix. The electrical resistance of the grid varies linearly with strain. In use, the carrier matrix is bonded to the surface, force is applied, and the strain is found by measuring the change in resistance. The bonded resistance strain gage is low in cost, can be made with a short gage length, is only moderately affected by temperature changes, has small physical size and low mass, and has fairly high sensitivity to strain.

In a strain gage application, the carrier matrix and the adhesive must work together to transmit the strains from the specimen to the grid. In addition, they serve as an electrical insulator and heat dissipator.

The three primary factors influencing gage selection are operating temperature, state of strain (gradient, magnitude, and time dependence) and stability required.

Because of its outstanding sensitivity, the Wheatstone bridge circuit is the most frequently used circuit for static strain measurements. Ideally, the strain gage is the only resistor in the circuit that varies and then only due to a change in strain on the surface.

There are two main methods used to indicate the change in resistance caused by strain on a gage in a Wheatstone bridge. Often, an indicator will rebalance the bridge, displaying the change in resistance required in micro-strain. the second method installs an indicator, calibrated in micro-strain, that responds to the voltage output of the bridge. This method assumes a linear relationship between voltage out and strain, an initially balanced bridge, and known V in. In reality, the V out-strain relationship is nonlinear, but for strains up to a few thousand micro-strain, the error is not significant.

Potential Error Sources

In a stress analysis application, the entire gage installation cannot be calibrated as can some pressure transducers. Therefore, it is important to examine potential error sources prior to taking data.

Some gages may be damaged during installation. It is important therefore to check the resistance of the strain gage prior to stress.

Electrical noise and interference may alter your readings. Shielded leads and adequately insulating coatings may prevent these problems. A value of less than 500 M ohms (using an ohmmeter) usually indicates surface contamination.

Thermally induced voltages are caused by thermocouple effects at the junction of dissimilar metals within the measurement circuit. Magnetically induced voltages may occur when the wiring is located in a time varying magnetic field. Magnetic induction can be controlled by using twisted lead wires and forming minimum but equal loop areas in each side of the bridge.

Temperature effects on gage resistance and gage factor should be compensated for as well. This may require measurement of temperature at the gage itself, using thermocouples, thermistors, or RTDs. Most metallic gage alloys, however, exhibit a nearly linear gage factor variation with temperature over a broad range which is less than ±1% within ±100°C.

Prime Strain Gage Selection Considerations

- Gage Length
- Number of Gages in Gage Pattern
- Arrangement of Gages in Gage Pattern
- Grid Resistance
- Strain Sensitive Alloy
- Carrier Material
- Gage Width
- Solder Tab Type
- Configuration of Solder Tab
- Availability

Strain gage dimensions

The active grid length, in the case of foil gages, is the net grid length without the tabs and comprises the return loops of the wire gages. The carrier, dimensions are designed by OMEGA for the optimum function of the strain gage.

Strain gage resistance

The resistance of a strain gage is defined as the electrical resistance measured between the two metal ribbons or contact areas intended for the connection of measurement cables. The range comprises strain gages with a nominal resistance of 120, 350, 600, and 700 Ohms.

Gage Factor (Strain Sensitivity)

The strain sensitivity k of a strain gage is the proportionality factor between the relative change of the resistance.

The strain sensitivity is a figure without dimension and is generally called gage factor.

The gage factor of each production lot is determined by sample measurements and is given on each package as the nominal value with its tolerance.

Reference Temperature.

The reference temperature is the ambient temperature for which the technical data of the strain gages are valid, unless temperature ranges are given. The technical data quoted for strain gages are based on a reference temperature of 23°C.

Temperature Characteristic

Temperature dependent changes of the specific strain gage grid resistance occur in the applied gage owing to the linear thermal expansion coefficients of the grid and specimen materials. These resistance changes appear to be mechanical strain in the specimen. The representation of the apparent strain as a function of temperature is called the temperature characteristic of the strain gage application. In order to keep apparent strain through temperature changes as small as possible, each strain gage is matched during the production to a certain linear thermal expansion coefficient. OMEGA offers strain gages with temperature characteristics matched to ferritic steel and aluminum.

Service Temperature Range

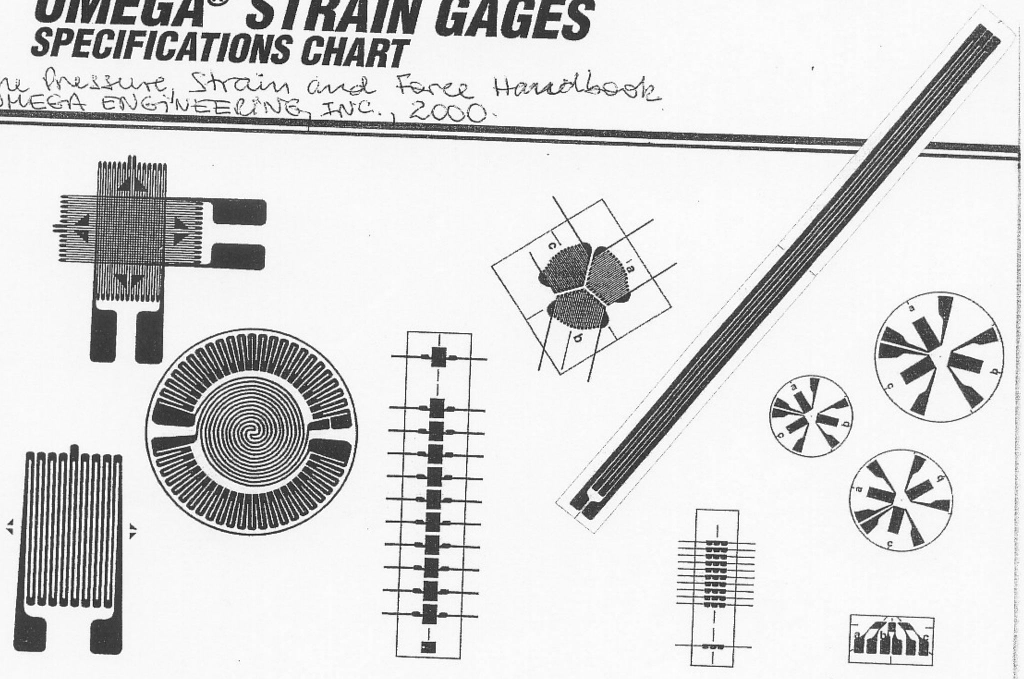
The service temperature range is the range of ambient temperature where the use of the strain gages is permitted without permanent changes of the measurement properties. Service temperature ranges are different whether static or dynamic values are to be sensed.

Maximum Permitted RMS Bridge Energizing Voltage

The maximum values quoted are only permitted for appropriate application on materials with good heat conduction (e.g., steel of sufficient thickness) if room temperature is not exceeded. In other cases temperature rise in the measuring grid area may lead to measurement errors. Measurements plastics and other materials with bad heat conduction require the reduction of the energizing voltage or the duty cycle (pulsed operation).

OMEGA® STRAIN GAGES
SPECIFICATIONS CHART

The Pressure, Strain and Force Handbook
OMEGA ENGINEERING, INC., 2000.



	SG SERIES	KFG SERIES
Foil strain gages are constructed by embedding a foil measuring element into a carrier.		
Foil measuring grid	Constantan foil 5 µm thick	Constantan foil 6 µm thick
Carrier	Polyimide	Kapton
Substrate thickness	50 µm	15 µm
Cover thickness	25 µm	9 µm
Connection dimensions in (mm) [in]	Solder pads or ribbon leads (30 long x.05 thick x 3 wide) [1.2 long x .002 thick x .012 wide]	27 AWG strand polyvinyl insulation (1 x 2) [.04 x .08]
Nominal resistance	Stated in “to order” box	120 ±0.4 ohms
Resistance tolerance per package	0.5%	03%
Gage factor (µΩ/µ/µϵ) (actual value printed on each package)	Approximately 2.0	2.10 ±10%
Gage factor tolerance per package	1.0%	1.0%
Thermal Properties		
Reference temperature	23°C/73°F	23°C/73°F
Service temperature:		
Static measurements	-30 to 250°C (-22 to 482°F)	-20 to 100°C (-4 to 212°F)
Dynamic measurements	-30 to 300°C (-22 to 572°F)	-20 to 100°C (-4 to 212°F)
Temperature characteristics:		
Steel	11 ppm°C (6.1 ppm°F)	10.8 ppm°C (6 ppm°F)
Aluminum	23 ppm°C (12.8 ppm°F)	—
Uncompensated	±20 ppm°C (±11.1 ppm°F)	—
Temperature compensated range	-5 to 120°C (5 to 248°F)	10 to 80°C (50 to 176°F)
Tolerance of temp. compensation	1 ppm°C (0.5 ppm°F)	1 ppm°C (0.5 ppm°F)
Mechanical Properties		
Maximum strain	3% or 30,000 µϵ	5% or 50,000 µϵ
Hysteresis	Negligible	Negligible
Fatigue (at ±1500 µϵ)	> 10,000,000 cycles	> 10,000,000 cycles
Smallest bending radius	3 mm (⅛ inch)	3 mm (⅛ inch)
Transverse sensitivity	—	Stated on each package

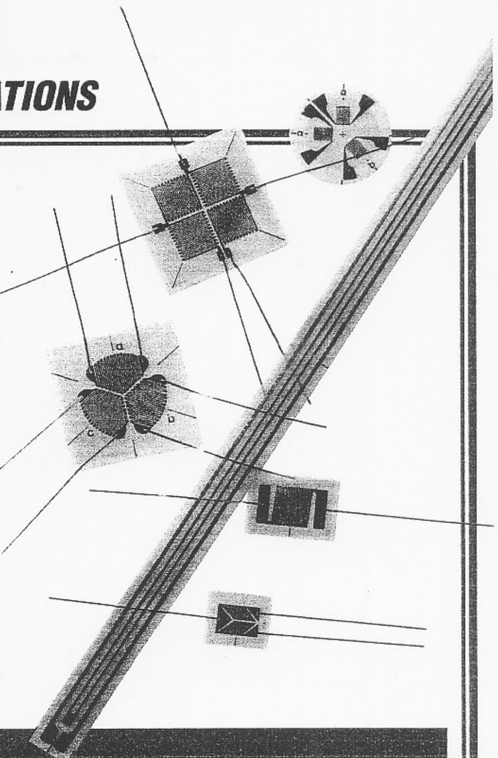
OMEGA® STRAIN GAGES
GENERAL PURPOSE STRAIN GAGES FOR STATIC AND DYNAMIC APPLICATIONS

- ✓ Very Flexible, Mechanically Strong
- ✓ Small Bending Radius
- ✓ Broad Temperature Range
- ✓ Ribbon Leads, Solder Pads, or Wire Lead Connections
- ✓ Clear Alignment Marks
- ✓ Affix with Cold or Hot Curing Adhesives

OMEGA® strain gages are available in a variety of different models to cover most strain measurement applications. Their rugged construction and flexibility make them suitable for static and dynamic measurement with a high degree of accuracy. The measuring grid is formed by etching Constantan foil, which is then completely sealed in a carrier medium composed of polyimide film.

Basic Unit

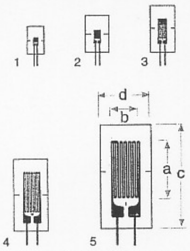
$49



MOST POPULAR MODELS

The most popular strain gage models are highlighted. Delivery of these models is normally off-the-shelf.

To Order *(Specify Model Number)*

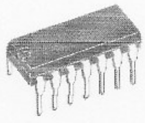
TYPE SERIES	MODEL NO.	PRICE PER PKG OF 10	NOMINAL RESISTANCE (Ω)	DIMENSIONS [MM] GRID A	B	CARRIER C	D	MAX PERMITTED BRIDGE ENERGIZING VOLTAGE (V RMS)	ACCESSORY TERMINAL PADS PART NO.	FIG.
✓ **Encapsulated with Ribbon Leads (Accessory Terminal Pads Are Used to Attach Heavier Gage Wire to Ribbon Leads)**	**SG-1.5/120-LY11**	**$49**	120	1.5	1.1	4.8	3.5	2.5	TP-1	1
	SG-2/350-LY11	**55**	350	2.0	1.8	7.5	4.5	4	TP-1	2
	SG-3/120-LY11	**55**	120	3.0	1.5	8.0	4.0	4	TP-2	3
	SG-3/350-LY11	**55**	350	3.0	2.5	8.0	6.0	8	TP-2	3
	SG-6/120-LY11	**70**	120	6.0	3.0	12.5	6.0	9	TP-3	4
LY11 Temperature characteristics matched to steel	**SG-7/350-LY11**	**79**	350	7.0	3.5	14.0	8.0	15	TP-3	4
	SG-7/1000-LY11	**145**	1000	7.0	3.8	12.0	6.0	20	TP-3	4
LY13 Temperature characteristics matched to aluminum	**SG-13/1000-LY11**	**125**	1000	13.5	5.5	24.0	12.0	30	TP-3	5
	SG-1.5/120-LY13	**49**	120	1.5	1.1	4.8	3.5	3	TP-1	1
	SG-2/350-LY13	**55**	350	2.0	1.8	7.5	4.5	5	TP-1	2
	**SG-3/120-LY13**	**55**	120	3.0	1.5	8.0	4.0	6	TP-2	3
	SG-3/350-LY13	**55**	350	3.0	2.5	8.0	6.0	8	TP-2	3
	SG-6/120-LY13	**70**	120	6.0	3.0	12.5	6.0	10	TP-3	4
	SG-7/350-LY13	**79**	350	7.0	3.5	14.0	8.0	15	TP-3	4
	SG-7/1000-LY13	**145**	1000	7.0	3.8	12.0	6.0	20	TP-3	4
	SG-13/1000-LY13	**125**	1000	13.5	5.5	24.0	12.0	30	TP-3	5

For Accessory Terminal Pads, see page E-25.

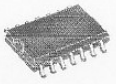
LM723

HIGH PRECISION VOLTAGE REGULATOR

- INPUT VOLTAGE UP TO 40V
- OUTPUT VOLTAGE ADJUSTABLE FROM 2 TO 37V
- POSITIVE OR NEGATIVE SUPPLY OPERATION
- SERIES, SHUNT, SWITCHING OR FLOATING OPERATION
- OUTPUT CURRENT TO 150mA WITHOUT EXTERNAL PASS TRANSISTOR
- ADJUSTABLE CURRENT LIMITING



DIP-14

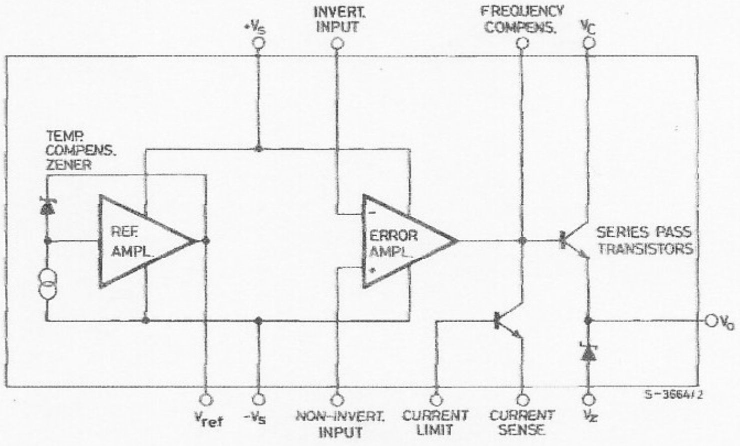


SO-14

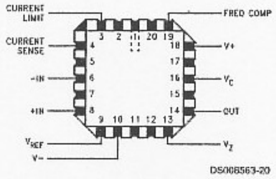
DESCRIPTION

The LM723 is a monolithic integrated programmable voltage regulator, assembled in 14-lead dual in-line plastic and SO-14 micro package. The circuit provides internal current limiting. When the output current exceeds 150mA an external NPN or PNP pass element may be used. Provisions are made for adjustable current limiting and remote shut-down.

SCHEMATIC DIAGRAM

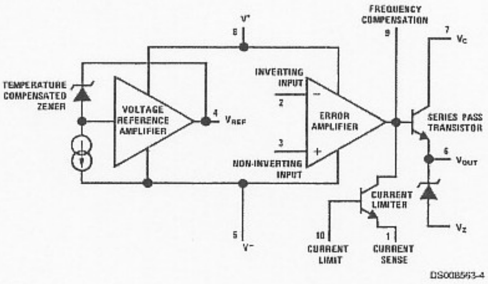


Connection Diagrams (Continued)



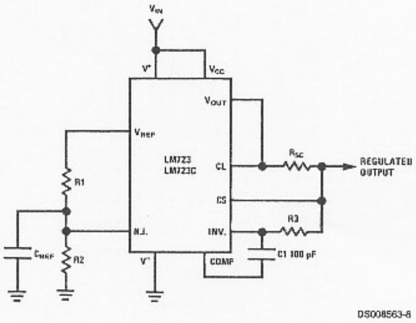
Top View
Order Number LM723E/883
See NS Package E20A

Equivalent Circuit*



*Pin numbers refer to metal can package.

Typical Application



Note: $R3 = \frac{R1\,R2}{R1 + R2}$

for minimum temperature drift.

Typical Performance

Regulated Output Voltage	5V
Line Regulation (ΔV_{IN} = 3V)	0.5mV
Load Regulation (ΔI_L = 50 mA)	1.5mV

FIGURE 1. Basic Low Voltage Regulator (V_{OUT} = 2 to 7 Volts)

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

(Note 10)

Pulse Voltage from V^+ to V^- (50 ms)	50V
Continuous Voltage from V^+ to V^-	40V
Input-Output Voltage Differential	40V
Maximum Amplifier Input Voltage (Either Input)	8.5V
Maximum Amplifier Input Voltage (Differential)	5V
Current from V_Z	25 mA
Current from V_{REF}	15 mA
Internal Power Dissipation	
Metal Can (Note 2)	800 mW
Cavity DIP (Note 2)	900 mW
Molded DIP (Note 2)	660 mW
Operating Temperature Range	
LM723	−55°C to +150°C
LM723C	0°C to +70°C
Storage Temperature Range	
Metal Can	−65°C to +150°C
Molded DIP	−55°C to +150°C
Lead Temperature (Soldering, 4 sec. max.)	
Hermetic Package	300°C
Plastic Package	260°C
ESD Tolerance	1200V
(Human body model, 1.5 kΩ in series with 100 pF)	

Electrical Characteristics (Note 3) (Note 10)

Parameter	Conditions	LM723			LM723C			Units
		Min	Typ	Max	Min	Typ	Max	
Line Regulation	V_{IN} = 12V to V_{IN} = 15V		0.01	0.1		0.01	0.1	% V_{OUT}
	−55°C ≤ T_A ≤ +125°C			0.3				% V_{OUT}
	0°C ≤ T_A ≤ +70°C						0.3	% V_{OUT}
	V_{IN} = 12V to V_{IN} = 40V		0.02	0.2		0.1	0.5	% V_{OUT}
Load Regulation	I_L = 1 mA to I_L = 50 mA		0.03	0.15		0.03	0.2	% V_{OUT}
	−55°C ≤ T_A ≤ +125°C			0.6				% V_{OUT}
	0°C ≤ T_A ≤ +70°C						0.6	% V_{OUT}
Ripple Rejection	f = 50 Hz to 10 kHz, C_{REF} = 0		74			74		dB
	f = 50 Hz to 10 kHz, C_{REF} = 5 μF		86			86		dB
Average Temperature Coefficient of Output Voltage (Note 8)	−55°C ≤ T_A ≤ +125°C		0.002	0.015				%/°C
	0°C ≤ T_A ≤ +70°C					0.003	0.015	%/°C
Short Circuit Current Limit	R_{SC} = 10Ω, V_{OUT} = 0		65			65		mA
Reference Voltage		6.95	7.15	7.35	6.80	7.15	7.50	V
Output Noise Voltage	BW = 100 Hz to 10 kHz, C_{REF} = 0		86			86		μVrms
	BW = 100 Hz to 10 kHz, C_{REF} = 5 μF		2.5			2.5		μVrms
Long Term Stability			0.05			0.05		%/1000 hrs
Standby Current Drain	I_L = 0, V_{IN} = 30V		1.7	3.5		1.7	4.0	mA
Input Voltage Range		9.5		40	9.5		40	V
Output Voltage Range		2.0		37	2.0		37	V
Input-Output Voltage Differential		3.0		38	3.0		38	V
θ_{JA}	Molded DIP					105		°C/W
θ_{JA}	Cavity DIP		150					°C/W
θ_{JA}	H10C Board Mount in Still Air		165			165		°C/W
θ_{JA}	H10C Board Mount in 400 LF/Min Air Flow		66			66		°C/W
θ_{JC}			22			22		°C/W

Note 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.

Note 2: See derating curves for maximum power rating above 25°C.

Note 3: Unless otherwise specified, T_A = 25°C, $V_{IN} = V^+ = V_C$ = 12V, V^- = 0, V_{OUT} = 5V, I_L = 1 mA, R_{SC} = 0, C_1 = 100 pF, C_{REF} = 0 and 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.

Note 4: L_1 is 40 turns of No. 20 enameled copper wire wound on Ferroxcube P36/22-3B7 pot core or equivalent with 0.009 in. air gap.

Note 5: Figures in parentheses may be used if R1/R2 divider is placed on opposite input of error amp.

Note 6: Replace R1/R2 in figures with divider shown in *Figure 13.*

Note 7: V^+ and V_{CC} must be connected to a +3V or greater supply.

Note 8: For metal can applications where V_Z is required, an external 6.2V zener diode should be connected in series with V_{OUT}.

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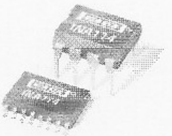


INA114

Precision INSTRUMENTATION AMPLIFIER

FEATURES

- LOW OFFSET VOLTAGE: 50μV max
- LOW DRIFT: 0.25μV/°C max
- LOW INPUT BIAS CURRENT: 2nA max
- HIGH COMMON-MODE REJECTION: 115dB min
- INPUT OVER-VOLTAGE PROTECTION: ±40V
- WIDE SUPPLY RANGE: ±2.25 to ±18V
- LOW QUIESCENT CURRENT: 3mA max
- 8-PIN PLASTIC AND SOL-16

APPLICATIONS

- BRIDGE AMPLIFIER
- THERMOCOUPLE AMPLIFIER
- RTD SENSOR AMPLIFIER
- MEDICAL INSTRUMENTATION
- DATA ACQUISITION

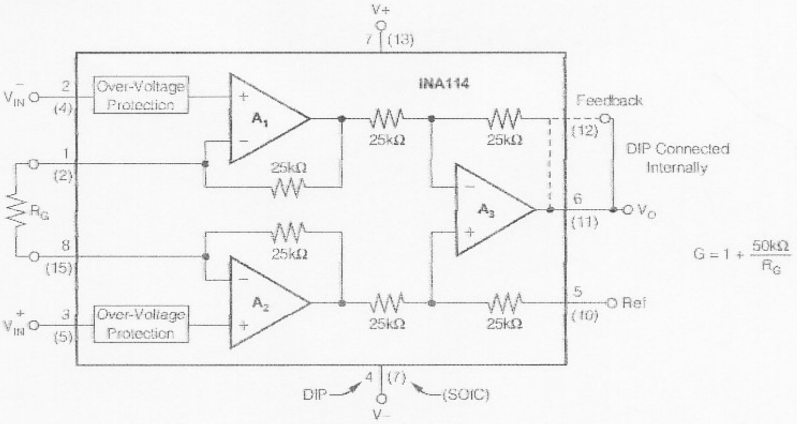
DESCRIPTION

The INA114 is a low cost, general purpose instrumentation amplifier offering excellent accuracy. Its versatile 3-op amp design and small size make it ideal for a wide range of applications.

A single external resistor sets any gain from 1 to 10,000. *Internal input protection can withstand up to ±40V without damage.*

The INA114 is laser trimmed for very low offset voltage (50μV), drift (0.25μV/°C) and high common-mode rejection (115dB at G = 1000). It operates with power supplies as low as ±2.25V, allowing use in battery operated and single 5V supply systems. Quiescent current is 3mA maximum.

The INA114 is available in 8-pin plastic and SOL-16 surface-mount packages. Both are specified for the –40°C to +85°C temperature range.



$$G = 1 + \frac{50k\Omega}{R_G}$$

International Airport Industrial Park • Mailing Address: PO Box 11400, Tucson, AZ 85734 • Street Address: 6730 S. Tucson Blvd., Tucson, AZ 85706 • Tel: (520) 746-1111 • Twx: 910-952-1111
Internet: http://www.burr-brown.com/ • FAXLine: (800) 548-6133 (US/Canada Only) • Cable: BBRCORP • Telex: 066-6491 • FAX: (520) 889-1510 • Immediate Product Info: (800) 548-6132