Cuestiones

1. Causas de las perturbaciones electromagnéticas. ¿ Qué es EMC ?. Recomendaciones para el montaje de instalaciones industriales de sistemas electrónicos.
2. Obtener la secuencia de ponderación, g_n, de un filtro paso bajo FIR de orden 4, m=2N=4, con ventana rectangular, tal que la frecuencia de corte sea de 100Hz y la frecuencia de muestreo 800Hz.

(4 puntos, 45 min)

Problema

Cada vez más son utilizadas las células Peltier para la refrigeración de sistemas. El efecto Peltier se basa en la conversión de energía eléctrica en calorífica, haciendo un gradiente de temperatura entre la cara fría y la cara caliente (ver figura 1).

Se desea montar un sistema de absorción del calor mediante el efecto Peltier, de manera que en la cara fría de la célula va desde la temperatura ambiente hasta los -2.5ºC. Se pide:

1. Haciendo uso del sensor de temperatura LM35, determinar el circuito del transductor para medir el rango de temperatura de la cara fría (de 20ºC a -2.5ºC). Definir la curva característica y el rango dinámico de la señal de salida.
2. Utilizando el INA114 y el transductor del punto anterior, diseñar el circuito de instrumentación capaz de satisfacer la curva de transferencia de la figura 2.
3. La señal de salida procedente del amplificador de instrumentación se va a muestrear mediante un CAD. Sabiendo que la frecuencia de muestreo es de 100Hz y el rango dinámico del convertidor es de 0-10V, diseñar el filtro *antialiasing* tal que el ancho de banda sea de 10 Hz y a la frecuencia de Nyquist se desea al menos una atenuación de 20 dB.
4. Realizar la descripción textual del filtro, para simular en el PSPICE, su respuesta en frecuencia.

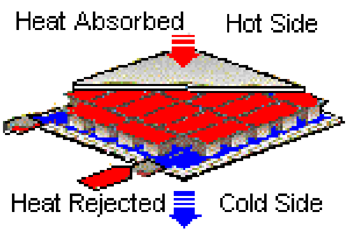


Figura 1 Célula Peltier

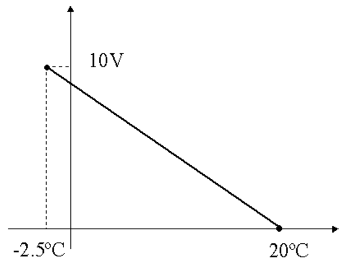


Figura 2 Curva cararterística

Datos

$$D = \frac{10^{0.1A_{min}} - 1}{10^{0.1A_{max}} - 1}$$

Butterworth

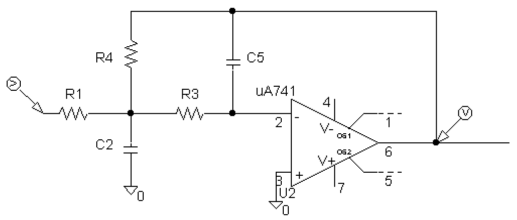
$$n \geq \frac{\log D}{2\log(\frac{1}{k})}$$

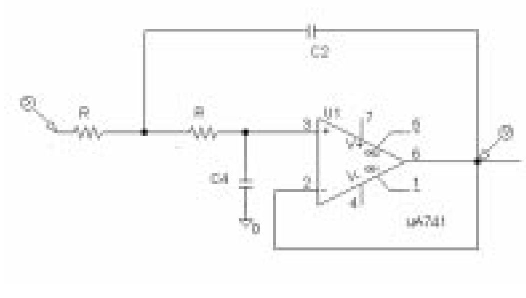
Tchebychev

$$n \geq \frac{\cosh^{-1}\sqrt{D}}{\cosh^{-1}(\frac{1}{k})}$$

$U_c = \pm 12V$

*Células de Rausch y Sallen-Key





$$A_0 = -\frac{R_4}{R_1}; \omega_0 = \frac{1}{\sqrt{R_3 R_4 C_2 C_5}}; Q = \frac{\sqrt{R_3 R_4 C_2 C_5}}{R_3 R_4 C_5\left(\frac{1}{R_1} + \frac{1}{R_3} + \frac{1}{R_4}\right)}$$

$$A_0 = 1; \omega_0 = \frac{1}{R\sqrt{C_2 C_4}}; Q = \frac{1}{2\sqrt{\frac{C_4}{C_2}}}$$

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*tabla de polinomios de Butterworth y Tchebychev

n	D(s)
1	s+1
2	s^2+1.41s+1
3	(s+1)(s^2+s+1)
4	(s^2+0.76s+1)(s^2+1.85s+1)
5	(s+1)(s^2+0.62s+1)(s^2+1.62s+1)
6	(s^2+0.52s+1)(s^2+1.42s+1)(s^2+1.93s+1)
7	(s+1)(s^2+0.44s+1)(s^2+1.25s+1)(s^2+1.8+1)
8	(s^2+0.39s+1)(s^2+1.11s+1)(s^2+1.66s+1)(s^2+1.99s+1)
9	(s+1)(s^2+0.35s+1)(s^2+s+1)(s^2+1.53s+1)(s^2+1.88s+1)
10	(s^2+0.32s+1)(s^2+0.9s+1)(s^2+1.41s+1)(s^2+1.78s+1) (s^2+1.98s+1)

n	N(s)	D(S)	ω_c
1	1.96	(s+1.96)	1
2	0.98	(s^2+1.09s+1.10)	1.12
3	0.49	(s+0.49)(s^2+0.49s+0.99)	1.09
4	0.25	(s^2+0.67s+0.28)(s^2+0.27s+0.99)	1.05
5	0.12	(s+0.28)(s^2+0-46s+0.42)(s^2+0.18s+0-98)	1.02
6	0.061	(s^2+0.12s+0.99)(s^2+0.34s+0.55)(s^2+0.46s+0.13)	1.023
7	0.03	(s+0.2)(s^2+0.09s+0.99)(s^2+0.25s+0.65)(s^2+0.37s+0.23)	1.013
8	0.015	(s^2+0.07s+0.99)(s^2+0.19+0.72)(s^2+0.29s+0.24) (s^2+0.35s+0.007)	1.013
9	0.0076	(s+0.16)(s^2+0.05s+0.99)(s^2+0.16+0.78)(s^2+0.25S+0.44) (s^2+0.3S+0.14)	1.01
10	0.0038	(s^2+0.04S+0.99)(s^2+0.13S+0.81)(s^2+0.2S+0.52) (s^2+0.25S+0.22)(s^2+0.28+0.04)	1.008

(6 puntos, 1H15min)

LM35/LM35A/LM35C/LM35CA/LM35D
Precision Centigrade Temperature Sensors

General Description

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ˚ Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼˚C at room temperature and ±¾˚C over a full −55 to +150˚C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1˚C in still air. The LM35 is rated to operate over a −55˚ to +150˚C temperature range, while the LM35C is rated for a −40˚ to +110˚C range (−10˚ with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

Features

- Calibrated directly in ˚ Celsius (Centigrade)
- Linear + 10.0 mV/˚C scale factor
- 0.5˚C accuracy guaranteeable (at +25˚C)
- Rated for full −55˚ to +150˚C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 µA current drain
- Low self-heating, 0.08˚C in still air
- Nonlinearity only ±¼˚C typical
- Low impedance output, 0.1 Ω for 1 mA load

Typical Applications

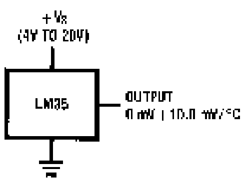
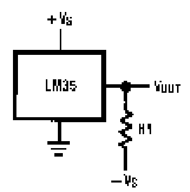


FIGURE 1. Basic Centirade Temperature Sensor (+2˚C to +150˚C)



Choose R_1 = $-V_S$/50 µA
V_{OUT}=+1,500 mV at +150˚C
= +250 mV at +25˚C
= −550 mV at −55˚C

FIGURE 2. Full-Range Centigrade Temperature Sensor

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

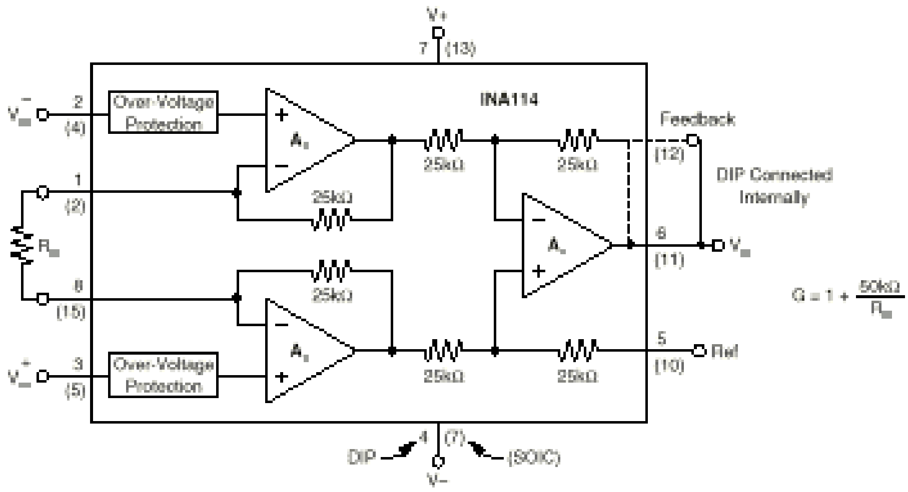
DESCRIPTION

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.



Resolución

Cuestión 2

$$g_n = \{0.16 \quad 0.225 \quad 0.25 \quad 0.225 \quad 0.16\}$$

Problema