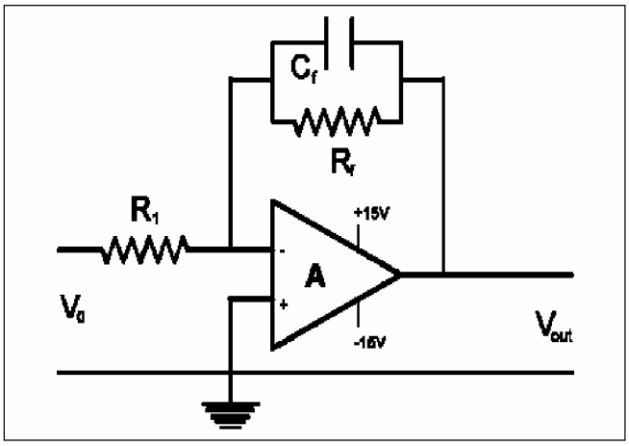
THERMOMECHANICAL MEASUREMENTS FOR ENERGY SYSTEMS

MENR (A.A. 2017-2018)

Laboratory n. 3

A digital acquisition system is made of a PC pentium dual core, with a data acquisition board (NI 6052E) and a terminal unit (NI ELVIS) to generate and acquire analog signals and digital data.

The system is programmed by a dedicated software (LabView 8.2™) to generate an output signal and to acquire input data at the same time. On the breadboard, the prototype board of the terminal unit, an amplified RC filter is assembled, as shown in the figure below.



1. Generate a sine signal to input to the active filter (RC) with whatever frequency. Look at the waveform on the screen, define which output ($f_{D/A}$) and input ($f_{A/D}$) sample frequencies to the system are correct for the selected signal.

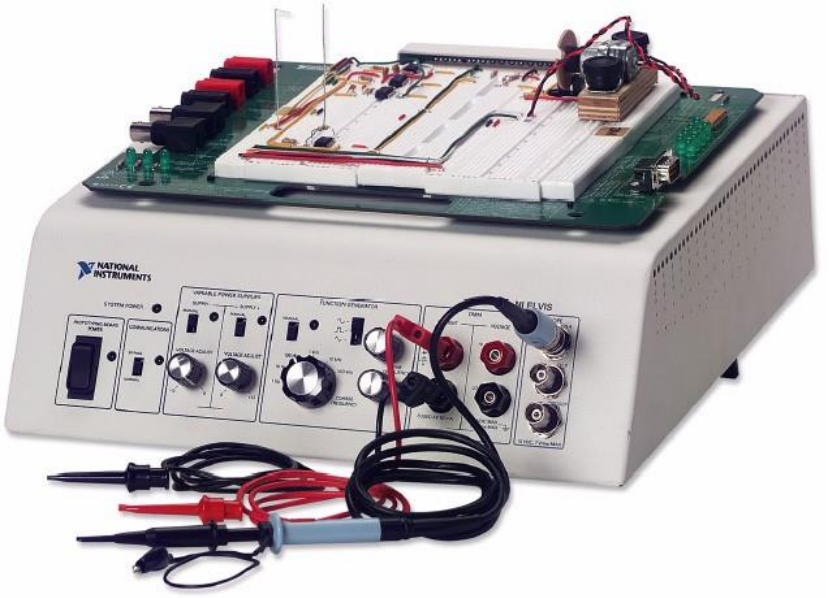
2. Define the gain G and the cut off frequency f_t of the dynamic filter. Change the input signal frequency to the filter, define which sample frequency (minimum) is correct at the filter's cut-off frequency f_t, both for the generated signal ($f_{D/A}$) and for the acquired one ($f_{A/D}$).

3. Verify the % difference between the theoretical f_t and the theoretical gain G of the filter and the values acquired experimentally, bearing in mind the filter's cut-off frequency is equal to $f_t = \frac{1}{2\pi R_f C_f}$ instead the transfer function (gain + frequency response) is $\frac{V_{out}}{V_{in}} = -\frac{R_f}{R_1} \times \frac{1}{1+j\omega R_f C_f}$ with R_1 = 2,2 kΩ; R_f = 10 kΩ; C_f = 0.1 μF (nominal values).

4. Using as input signal a square wave, define the frequency band for which the dynamic RC filter works correctly as "signal integrator" and with which sample frequencies $f_{D/A}$ and $f_{A/D}$ of the Digital/Analog and Analog/Digital converters, respectively.

(Attachments: NI ELVIS introductory flyer; Amp Op UA741CN data sheet)

Lab 1
NI ELVIS
Workspace Environment



The NI ELVIS environment consists of the hardware workspace for building circuits and interfacing experiments, and the NI ELVIS software. The NI ELVIS software, all created in LabVIEW has two main types: the soft front panel (SFP) instruments and LabVIEW APIs, which are just additional LabVIEW VIs for custom control and access to the features of the NI ELVIS benchtop workstation.

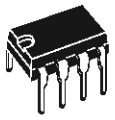
Goal

This lab introduces the NI ELVIS workstation to show how electronic component properties can be measured. Circuits are then built on the protoboard and later analyzed with the NI ELVIS software suite of LabVIEW based soft front panels (SFP) or software instruments. In addition, this experiment demonstrates the use of NI ELVIS within a LabVIEW programming environment.

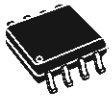
UA741

GENERALPURPOSE SINGLEOPERATIONALAMPLIFIER

- LARGEINPUTVOLTAGERANGE
- NOLATCH-UP
- HIGHGAIN
- SHORT-CIRCUITPROTECTION
- NOFREQUENCYCOMPENSATION
- REQUIRED
- SAMEPINCONFIGURATIONASTHEUA709



N
DIP8
(PlasticPackage)



D
SO8
(PlasticMicropackage)

DESCRIPTION

TheUA741isahighperformancemonolithicoperationalamplifierconstructedonasinglesiliconchip.Itisintentedforawiderangeofanalogapplications.

- Summingamplifier
- Voltagefollower
- Integrator
- Activefilter
- Functiongenerator

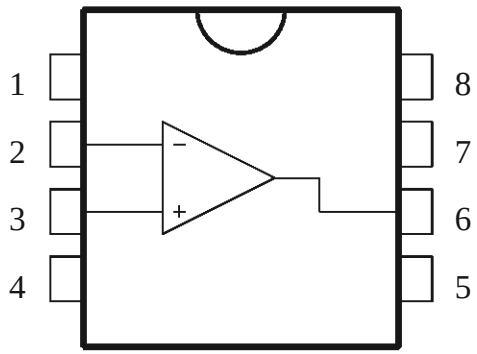
Thehighgainandwiderangeofoperatingvoltagesprovidesuperiorperformancesinintegrator, summingamplifierandgeneralfeedbackapplications.Theinternalcompensationnetwork(6dB/octave)insuresstabilityinclosedloopcircuits.

ORDERCODE

PartNumber	TemperatureRange	Package	
		N	D
UA741C	0°C,+70 °C	•	•
UA741I	-40°C,+105 °C	•	•
UA741M	-55°C,+125 °C	•	•
Example: UA741CN			

N= DualinLinePackage(DIP)
D= SmallOutlinePackage(SO)-alsoavailableinTape&Reel(DT)

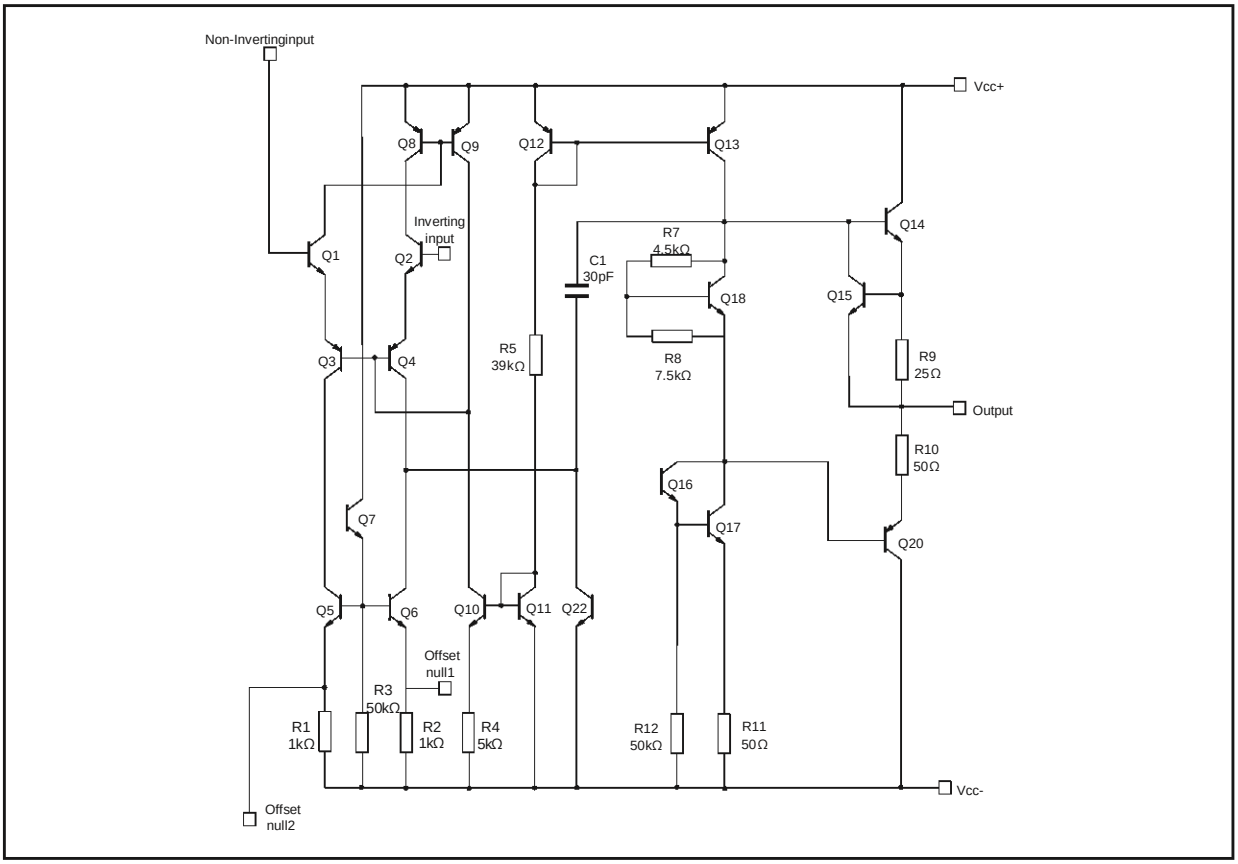
PINCONNECTIONS (topview)



1- Offsetnull 1
2- Invertinginput
3- Non-invertinginput
4- V_{CC}^-
5- Offsetnull 2
6- Output
7- V_{CC}^+
8- N.C.

November2001

SCHEMATICDIAGRAM



ABSOLUTEMAXIMUMRATINGS

Symbol	Parameter	UA741M	UA741I	UA741C	Unit
V_{CC}	Supplyvoltage	±22			V
V_{id}	DifferentialInputVoltage	±30			V
V_i	InputVoltage	±15			V
P_{tot}	PowerDissipation [1]	500			mW
	OutputShort-circuitDuration	Infinite			
T_{oper}	OperatingFree-airTemperatureRange	-55 to +125	-40 to +105	0 to +70	°C
T_{stg}	StorageTemperatureRange	-65 to +150			°C

1. Powerdissipationmustbeconsideredtoensuremaximumjunctiontemperature(Tj)isnotexceeded.

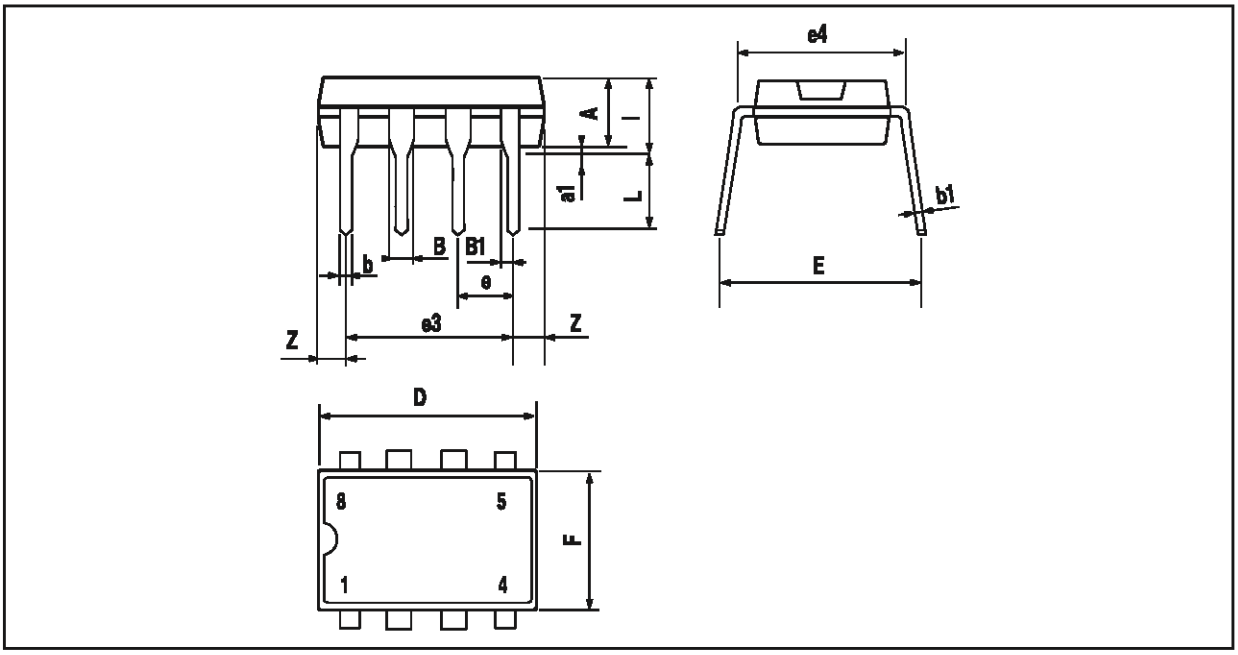
ELECTRICAL CHARACTERISTICS

V_{CC} = ±15V, T_{amb} = +25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage ($R_s \leq 10k\Omega$) T_{amb} = +25°C $T_{min} \leq T_{amb} \leq T_{max}$		1	5 6	mV
I_{io}	Input Offset Current T_{amb} = +25°C $T_{min} \leq T_{amb} \leq T_{max}$		2	30 70	nA
I_{ib}	Input Bias Current T_{amb} = +25°C $T_{min} \leq T_{amb} \leq T_{max}$		10	100 200	nA
A_{vd}	Large Signal Voltage Gain (V_o = ±10V, R_L = 2kΩ) T_{amb} = +25°C $T_{min} \leq T_{amb} \leq T_{max}$	 50 25	 200		V/mV
SVR	Supply Voltage Rejection Ratio ($R_s \leq 10k\Omega$) T_{amb} = +25°C $T_{min} \leq T_{amb} \leq T_{max}$	 77 77	 90		dB
I_{CC}	Supply Current, no load T_{amb} = +25°C $T_{min} \leq T_{amb} \leq T_{max}$		1.7	2.8 3.3	mA
V_{icm}	Input Common Mode Voltage Range T_{amb} = +25°C $T_{min} \leq T_{amb} \leq T_{max}$	 ±12 ±12			V
CMR	Common Mode Rejection Ratio ($R_S \leq 10k\Omega$) T_{amb} = +25°C $T_{min} \leq T_{amb} \leq T_{max}$	 70 70	 90		dB
I_{OS}	Output short Circuit Current	10	25	40	mA
$\pm V_{opp}$	Output Voltage Swing T_{amb} = +25°C R_L = 10kΩ R_L = 2kΩ $T_{min} \leq T_{amb} \leq T_{max}$ R_L = 10kΩ R_L = 2kΩ	 12 10 12 10	 14 13		V
SR	Slew Rate V_i = ±10V, R_L = 2kΩ, C_L = 100pF, unity Gain	0.25	0.5		V/µs
t_r	Rise Time V_i = ±20mV, R_L = 2kΩ, C_L = 100pF, unity Gain		0.3		µs
K_{ov}	Overshoot V_i = 20mV, R_L = 2kΩ, C_L = 100pF, unity Gain		5		%
R_i	Input Resistance	0.3	2		MΩ
GBP	Gain Bandwith Product V_i = 10mV, R_L = 2kΩ, C_L = 100pF, f =100kHz	0.7	1		MHz
THD	Total Harmonic Distortion f = 1kHz, A_v = 20dB, R_L = 2kΩ, V_o = $2V_{pp}$, C_L = 100pF, T_{amb} = +25°C		0.06		%
e_n	Equivalent Input Noise Voltage f = 1kHz, R_s = 100Ω		23		$\frac{nV}{\sqrt{Hz}}$
Øm	Phase Margin		50		Degrees

PACKAGEMECHANICALDATA

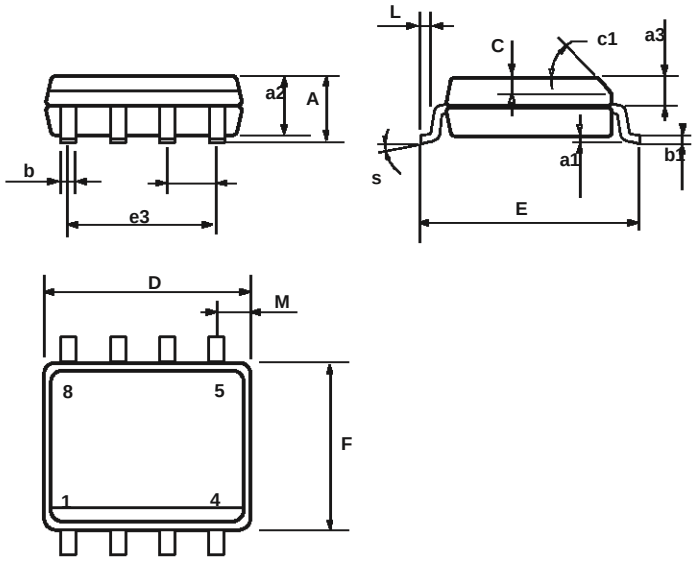
8 PINS-PLASTICDIP



Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0260
i			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

PACKAGEMECHANICALDATA

8 PINS-PLASTICMICROPACKAGE(SO)



Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.25	0.004		0.010
a2			1.65			0.065
a3	0.65		0.85	0.026		0.033
b	0.35		0.48	0.014		0.019
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.020
c1	45° (typ.)					
D	4.8		5.0	0.189		0.197
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		3.81			0.150	
F	3.8		4.0	0.150		0.157
L	0.4		1.27	0.016		0.050
M			0.6			0.024
S	8° (max.)					