このxlsプログラムは、種々の伝達関数から予測される周波数応答を図示します。

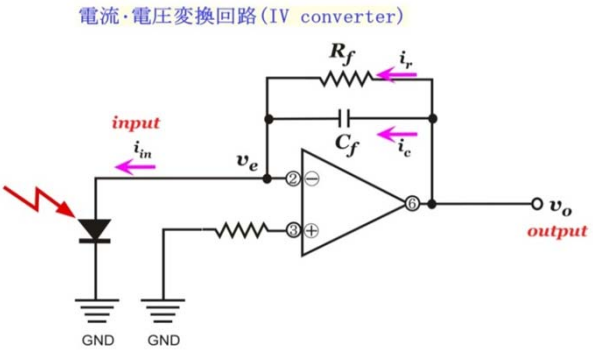
G(s) = 1/(As^2+Bs+C) 型の伝達関数の場合
⇒ ワークシート「Bode02」のA, B, C列4行目に、A, B, Cのデータを代入します。

G(s) = (s+A)/(s+B) 型の伝達関数の場合
⇒ ワークシート「Bode03」のA, B列4行目に、A, Bのデータを代入します。

G(s) = (Ds^2+Es+F)/(As^2+Bs+C) 型の伝達関数の場合
⇒ ワークシート「Bode04」のA～F列4行目に、A～Fのデータを代入します。

例として、Bode02には、IVコンバーター、Bode03には、微分型IVコンバ
の例を入れてあります。

Example Bode01



$$i_{in} = i_r + i_c$$
$$v_o - v_e = R_f \cdot i_r$$
$$C_f \frac{d}{dt}(v_o - v_e) = i_c$$

↓ ラプラス変換後

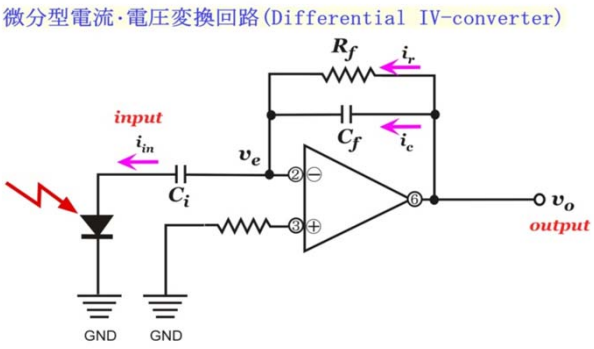
$$I_{in} = I_r + I_c$$
$$V_o - V_e = R_f \cdot I_r$$
$$sC_f(V_o - V_e) = I_c$$

$$\therefore \mathrm{G(s)} = \frac{V_o - V_e}{I_c} = \frac{R_f}{sR_fC_f + 1}$$

Transfer function: $\mathrm{G}(j\omega) = \frac{V_o - V_e}{I_c} = \frac{R_f}{j\omega R_f C_f + 1}$

Gain: $|\mathrm{G}(j\omega)| = \frac{R_f}{\sqrt{(\omega R_f C_f)^2 + 1}}$

Example Bode03



$$i_{in} = i_r + i_c$$
$$v_o - v_e = R_f \cdot i_r$$
$$C_f \frac{d}{dt}(v_o - v_e) = i_c$$
$$C_i \frac{d}{dt} v_e = i_{in}$$

↓ ラプラス変換後

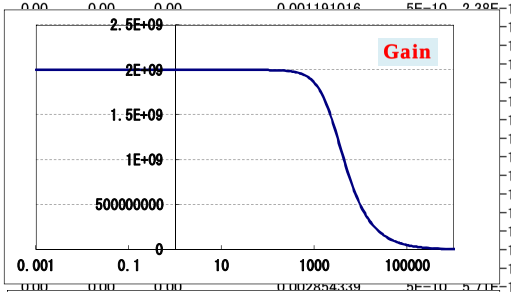
$$I_{in} = I_r + I_c$$
$$V_o - V_e = R_f \cdot I_r$$
$$sC_f(V_o - V_e) = I_c$$
$$sC_i V_e = I_{in}$$

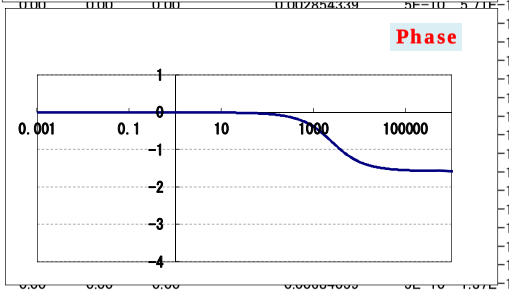
$$\therefore \mathrm{G(s)} = \frac{V_o}{I_c} = \frac{sR_f(C_f + C_i) + 1}{s^2 R_f C_f C_i + sC_f C_i}$$

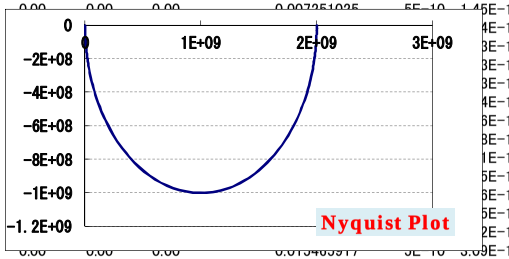
G(s) = 1/(As^2+Bs+C) 型伝達関数の場合

A	B	C
0.00E+00	2.00E-13	5.00E-10

w	−Aw^2+C	Bjw	Real	Image	Amp	δ	mδ
0	5E-10	0	2E+09	0	2E+09	0	0
0.001	5E-10	2E-16	2E+09	−800	2E+09	−4E-07	−1
0.00106	5E-10	2.12E-16	2E+09	−848	2E+09	−4.2E-07	−1
0.0011236	5E-10	2.25E-16	2E+09	−898.88	2E+09	−4.5E-07	−1
0.001191016	5E-10	2.38E-16	2E+09	−952.813	2E+09	−4.8E-07	−1
0.001262177	5E-10	2.52E-16	2E+09	−1009.98	2E+09	−5E-07	−1
0.001337348	5E-10	2.67E-16	2E+09	−1070.58	2E+09	−5.4E-07	−1
0.001417247	5E-10	2.83E-16	2E+09	−1134.82	2E+09	−5.7E-07	−1
0.001501187	5E-10	3E-16	2E+09	−1202.9	2E+09	−6E-07	−1
0.001590438	5E-10	3.18E-16	2E+09	−1275.08	2E+09	−6.4E-07	−1
0.001684259	5E-10	3.37E-16	2E+09	−1351.58	2E+09	−6.8E-07	−1
0.001783914	5E-10	3.57E-16	2E+09	−1432.68	2E+09	−7.2E-07	−1
0.001889568	5E-10	3.78E-16	2E+09	−1518.64	2E+09	−7.6E-07	−1
0.002001188	5E-10	4E-16	2E+09	−1609.76	2E+09	−8E-07	−1
0.002119033	5E-10	4.24E-16	2E+09	−1706.34	2E+09	−8.5E-07	−1
0.002243772	5E-10	4.49E-16	2E+09	−1808.72	2E+09	−9E-07	−1
0.002375348	5E-10	4.75E-16	2E+09	−1917.25	2E+09	−9.6E-07	−1
0.002514274	5E-10	5.03E-16	2E+09	−2032.28	2E+09	−1E-06	−1
0.002660725	5E-10	5.32E-16	2E+09	−2154.22	2E+09	−1.1E-06	−1
0.002815322	5E-10	5.63E-16	2E+09	−2283.47	2E+09	−1.1E-06	−1
0.002978238	5E-10	5.96E-16	2E+09	−2420.48	2E+09	−1.2E-06	−1
0.003150061	5E-10	6.3E-16	2E+09	−2565.71	2E+09	−1.3E-06	−1
0.003331222	5E-10	6.66E-16	2E+09	−2719.65	2E+09	−1.4E-06	−1
0.003522497	5E-10	7.04E-16	2E+09	−2882.83	2E+09	−1.4E-06	−1
0.003724172	5E-10	7.45E-16	2E+09	−3055.8	2E+09	−1.5E-06	−1
0.003936498	5E-10	7.87E-16	2E+09	−3239.15	2E+09	−1.6E-06	−1
0.004159732	5E-10	8.32E-16	2E+09	−3433.5	2E+09	−1.7E-06	−1
0.004394133	5E-10	8.79E-16	2E+09	−3639.51	2E+09	−1.8E-06	−1
0.004639988	5E-10	9.28E-16	2E+09	−3857.88	2E+09	−1.9E-06	−1
0.004897788	5E-10	9.8E-16	2E+09	−4089.35	2E+09	−2E-06	−1
0.005167496	5E-10	1.03E-15	2E+09	−4334.71	2E+09	−2.2E-06	−1
0.005449154	5E-10	1.09E-15	2E+09	−4594.79	2E+09	−2.3E-06	−1
0.005743492	5E-10	1.15E-15	2E+09	−4870.48	2E+09	−2.4E-06	−1
0.006050963	5E-10	1.21E-15	2E+09	−5162.71	2E+09	−2.6E-06	−1
0.006372353	5E-10	1.27E-15	2E+09	−5472.47	2E+09	−2.7E-06	−1
0.006708287	5E-10	1.34E-15	2E+09	−5800.82	2E+09	−2.9E-06	−1
0.007059438	5E-10	1.41E-15	2E+09	−6148.87	2E+09	−3.1E-06	−1
0.007426549	5E-10	1.49E-15	2E+09	−6517.8	2E+09	−3.3E-06	−1
0.007810359	5E-10	1.56E-15	2E+09	−6908.87	2E+09	−3.5E-06	−1
0.008211708	5E-10	1.64E-15	2E+09	−7323.4	2E+09	−3.7E-06	−1
0.008631538	5E-10	1.73E-15	2E+09	−7762.81	2E+09	−3.9E-06	−1
0.009070904	5E-10	1.81E-15	2E+09	−8228.57	2E+09	−4.1E-06	−1
0.009530986	5E-10	1.91E-15	2E+09	−8722.29	2E+09	−4.4E-06	−1
0.010013095	5E-10	2E-15	2E+09	−9245.63	2E+09	−4.6E-06	−1
0.010518684	5E-10	2.1E-15	2E+09	−9800.36	2E+09	−4.9E-06	−1
0.011049354	5E-10	2.21E-15	2E+09	−10388.4	2E+09	−5.2E-06	−1
0.011606868	5E-10	2.32E-15	2E+09	−11011.7	2E+09	−5.5E-06	−1
0.012193154	5E-10	2.44E-15	2E+09	−11672.4	2E+09	−5.8E-06	−1
0.012810317	5E-10	2.56E-15	2E+09	−12372.7	2E+09	−6.2E-06	−1
0.013460644	5E-10	2.69E-15	2E+09	−13115.1	2E+09	−6.6E-06	−1
0.014146619	5E-10	2.83E-15	2E+09	−13902	2E+09	−7E-06	−1
0.014871024	5E-10	2.97E-15	2E+09	−14736.1	2E+09	−7.4E-06	−1
0.015636872	5E-10	3.13E-15	2E+09	−15620.3	2E+09	−7.8E-06	−1
0.016393872	5E-10	3.28E-15	2E+09	−13115.1	2E+09	−6.6E-06	−1
0.017377504	5E-10	3.48E-15	2E+09	−13902	2E+09	−7E-06	−1
0.018420154	5E-10	3.68E-15	2E+09	−14736.1	2E+09	−7.4E-06	−1
0.019525364	5E-10	3.91E-15	2E+09	−15620.3	2E+09	−7.8E-06	−1
0.020696885	5E-10	4.14E-15	2E+09	−16557.5	2E+09	−8.3E-06	−1
0.021938698	5E-10	4.39E-15	2E+09	−17551	2E+09	−8.8E-06	−1
0.02325502	5E-10	4.65E-15	2E+09	−18604	2E+09	−9.3E-06	−1
0.024650322	5E-10	4.93E-15	2E+09	−19720.3	2E+09	−9.9E-06	−1
0.026129341	5E-10	5.23E-15	2E+09	−20903.5	2E+09	−1E-05	−1
0.027697101	5E-10	5.54E-15	2E+09	−22157.7	2E+09	−1.1E-05	−1
0.029358927	5E-10	5.87E-15	2E+09	−23487.1	2E+09	−1.2E-05	−1
0.031120463	5E-10	6.22E-15	2E+09	−24896.4	2E+09	−1.2E-05	−1
0.032987691	5E-10	6.6E-15	2E+09	−26390.2	2E+09	−1.3E-05	−1
0.034966952	5E-10	6.99E-15	2E+09	−27973.6	2E+09	−1.4E-05	−1
0.037064969	5E-10	7.41E-15	2E+09	−29652	2E+09	−1.5E-05	−1

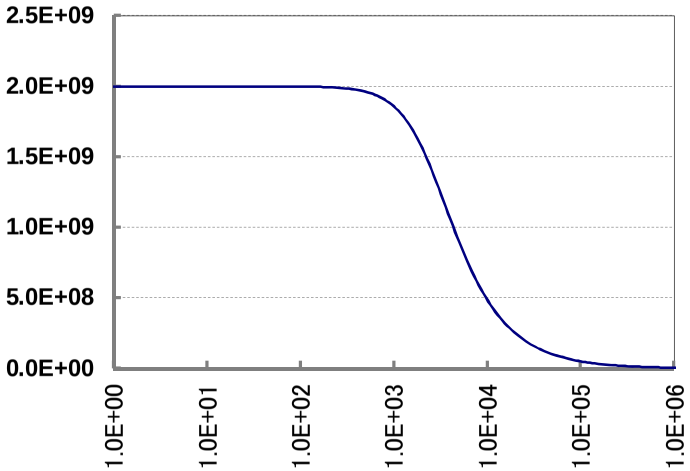






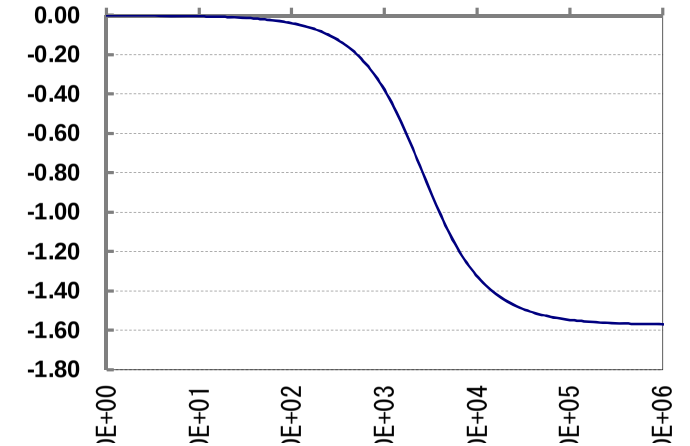
C_f 2.00E-13 R_f 2.00E+09

Gain



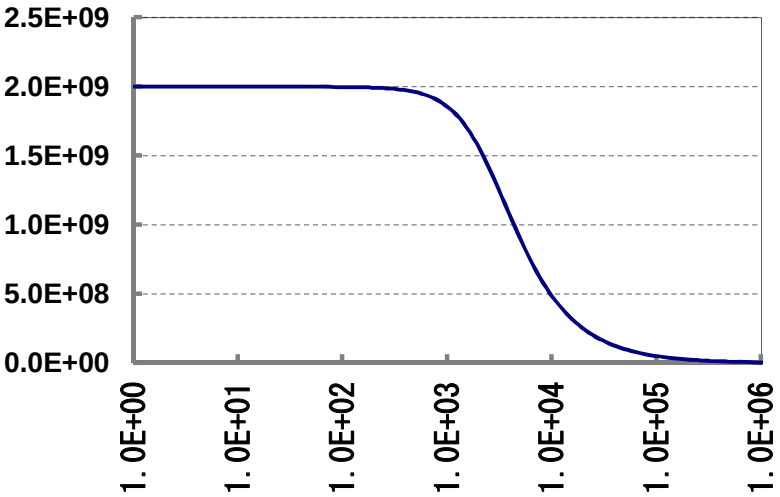
IV conterter
See
Note 140827

Phase



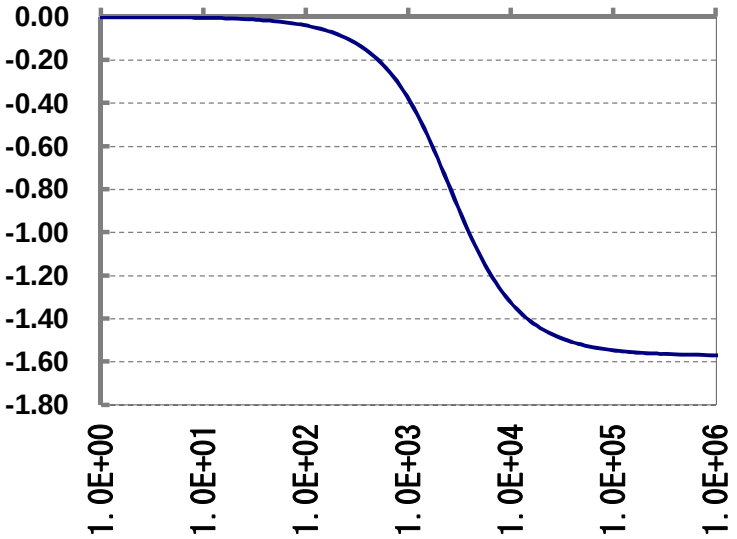
C_f 2.0E-13 R_f 2.0E+09 C_i 1.0E-05

Gain



See
Note 140827
IV diff converter

Phase



UA741

GENERAL PURPOSE SINGLE OPERATIONAL AMPLIFIER

- LARGE INPUT VOLTAGE RANGE
- NO LATCH-UP
- HIGH GAIN
- SHORT-CIRCUIT PROTECTION
- NO FREQUENCY COMPENSATION
- REQUIRED
- SAME PIN CONFIGURATION AS THE UA709

N
DIP8
(Plastic Package)

D
SO8
(Plastic Micropackage)

DESCRIPTION

The UA741 is a high performance monolithic operational amplifier constructed on a single silicon chip. It is intented for a wide range of analog applications.

- Summing amplifier
- Voltage follower
- Integrator
- Active filter
- Function generator

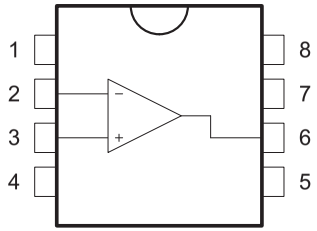
The high gain and wide range of operating voltages provide superior performances in integrator, summing amplifier and general feedback applications. The internal compensation network (6dB/octave) insures stability in closed loop circuits.

ORDER CODE

Part Number	Temperature Range	Package	
		N	D
UA741C	0°C, +70°C	•	•
UA741I	-40°C, +105°C	•	•
UA741M	-55°C, +125°C	•	•
Example : UA741CN			

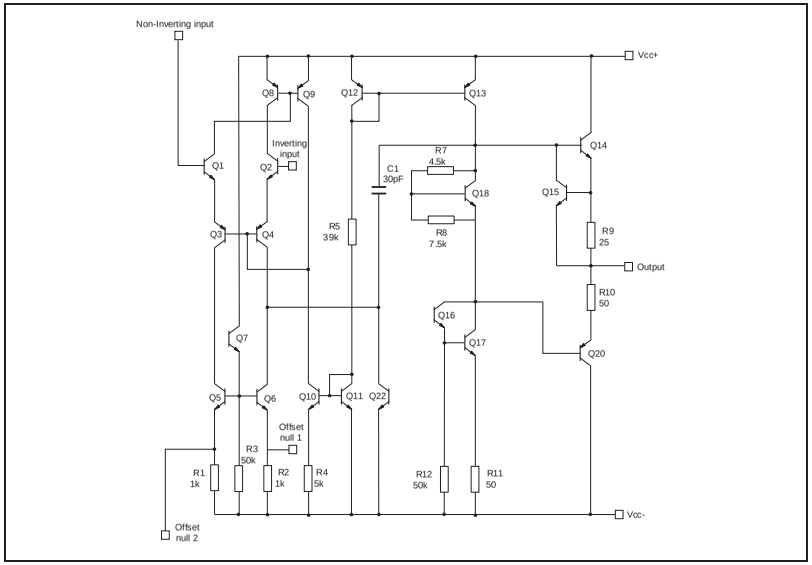
N = Dual in Line Package (DIP)
D = Small Outline Package (SO) - also available in Tape & Reel (DT)

PIN CONNECTIONS (top view)



1 - Offset null 1
2 - Inverting input
3 - Non-inverting input
4 - V_{CC}^-
5 - Offset null 2
6 - Output
7 - V_{CC}^+
8 - N.C.

SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	UA741M	UA741I	UA741C	Unit
V_{CC}	Supply voltage	±22			V
V_{id}	Differential Input Voltage	±30			V
V_i	Input Voltage	±15			V
P_{tot}	Power Dissipation [1]	500			mW
	Output Short-circuit Duration	Infinite			
T_{oper}	Operating Free-air Temperature Range	-55 to +125	-40 to +105	0 to +70	°C
T_{stg}	Storage Temperature Range	-65 to +150			°C

1. Power dissipation must be considered to ensure maximum junction temperature (Tj) is not exceeded.

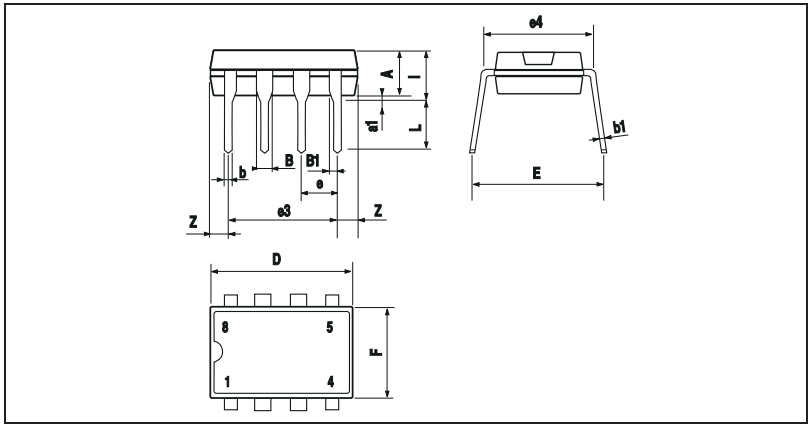
ELECTRICAL CHARACTERISTICS

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		$\frac{nV}{\sqrt{Hz}}$
∅m	Phase Margin		50		Degrees

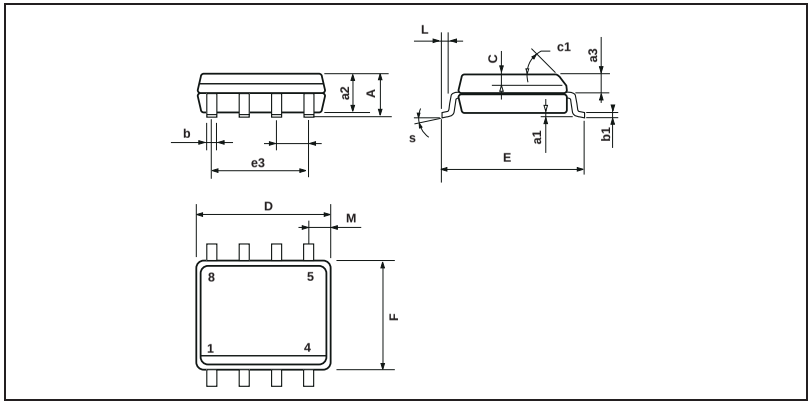
PACKAGE MECHANICAL DATA

8 PINS - PLASTIC DIP



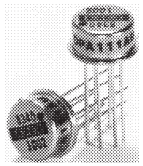
Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0260
i			5.08			0.200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

PACKAGE MECHANICAL DATA
8 PINS - PLASTIC MICROPACKAGE (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.)					

BURR-BROWN®



OPA111

Low Noise Precision *Difet*® OPERATIONAL AMPLIFIER

FEATURES

- LOW NOISE: 100% Tested, 8nV√Hz max (10kHz)
- LOW BIAS CURRENT: 1pA max
- LOW OFFSET: 250µV max
- LOW DRIFT: 1µV/°C max
- HIGH OPEN-LOOP GAIN: 120dB min
- HIGH COMMON-MODE REJECTION: 100dB min

APPLICATIONS

- PRECISION INSTRUMENTATION
- DATA ACQUISITION
- TEST EQUIPMENT
- OPTOELECTRONICS
- MEDICAL EQUIPMENT—CAT SCANNER
- RADIATION HARD EQUIPMENT

DESCRIPTION

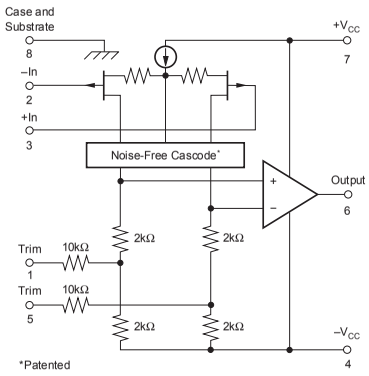
The OPA111 is a precision monolithic dielectrically isolated FET (***Difet***®) operational amplifier. Outstanding performance characteristics allow its use in the most critical instrumentation applications.

Noise, bias current, voltage offset, drift, open-loop gain, common-mode rejection, and power supply rejection are superior to BIFET® amplifiers.

Very low bias current is obtained by dielectric isolation with on-chip guarding.

Laser trimming of thin-film resistors gives very low offset and drift. Extremely low noise is achieved with patented circuit design techniques. A new cascode design allows high precision input specifications and reduced susceptibility to flicker noise.

Standard 741 pin configuration allows upgrading of existing designs to higher performance levels.



*Patented

BIFET® National Semiconductor Corp., ***Difet***® Burr-Brown Corp.

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PDS-526K Printed in U.S.A. August, 1995

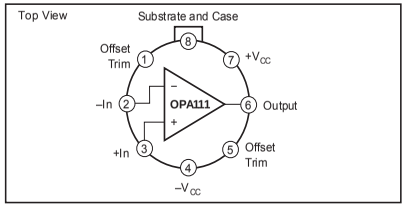
ELECTRICAL (FULL TEMPERATURE RANGE SPECIFICATIONS)

At V_{CC} = ±15VDC and T_A = T_{MIN} to T_{MAX} unless otherwise noted.

PARAMETER	CONDITION	OPA111AM MIN	OPA111AM TYP	OPA111AM MAX	OPA111BM MIN	OPA111BM TYP	OPA111BM MAX	OPA111SM MIN	OPA111SM TYP	OPA111SM MAX	UNITS
TEMPERATURE RANGE											
Specification Range	Ambient Temp.	–25		+85	–25		+85	–55		+125	°C
INPUT											
OFFSET VOLTAGE(1)											
Input Offset Voltage	V_{CM} = 0VDC		±220	±1000		±110	±500		±300	±1500	µV
Average Drift			±2	±5		±0.5	±1		±2	±5	µV/°C
Supply Rejection	V_{CC} = ±10V to ±18V	86	100		90	100		86	100		dB
			±10	±50		±10	±32		±10	±50	µV/V
BIAS CURRENT(1)											
Input Bias Current	V_{CM} = 0VDC		±50	±250		±30	±130		±820	±4100	pA
OFFSET CURRENT(1)											
Input Offset Current	V_{CM} = 0VDC		±30	±200		±15	±100		±510	±3100	pA
VOLTAGE RANGE											
Common-Mode Input Range		±10	±11		±10	±11		±10	±11		V
Common-Mode Rejection	V_{IN} = ±10VDC	86	100		90	100		86	100		dB
OPEN-LOOP GAIN, DC											
Open-Loop Voltage Gain	R_L ≥ 2kΩ	110	120		114	120		110	120		dB
RATED OUTPUT											
Voltage Output	R_L = 2kΩ	±10.5	±11		±11	±11.5		±11	±11.5		V
Current Output	V_O = ±10VDC	±5.25	±10		±5.25	±10		±5.25	±10		mA
Short Circuit Current	V_O = 0VDC	10	40		10	40		10	40		mA
POWER SUPPLY											
Current, Quiescent	I_O = 0mADC		2.5	3.5		2.5	3.5		2.5	3.5	mA

NOTES: (1) Offset voltage, offset current, and bias current are measured with the units fully warmed up.

CONNECTION DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Supply	±18VDC
Internal Power Dissipation(1)	750mW
Differential Input Voltage(2)	±36VDC
Input Voltage Range(2)	±18VDC
Storage Temperature Range	–65°C to +150°C
Operating Temperature Range	–55°C to +125°C
Lead Temperature (soldering, 10s)	+300°C
Output Short Circuit Duration(3)	Continuous
Junction Temperature	+175°C

NOTES: (1) Packages must be derated based on θ_{JC} = 150°C/W or θ_{JA} = 300°C/W. (2) For supply voltages less than ±18VDC, the absolute maximum input voltage is equal to +18V > V_{IN} > $–V_{CC}$ – 6V. See Figure 2. (3) Short circuit may be to power supply common only. Rating applies to +25°C ambient. Observe dissipation limit and T_J.

PACKAGE INFORMATION

MODEL	PACKAGE	PACKAGE DRAWING NUMBER(1)
OPA111AM	TO-99	001
OPA111BM	TO-99	001
OPA111SM	TO-99	001

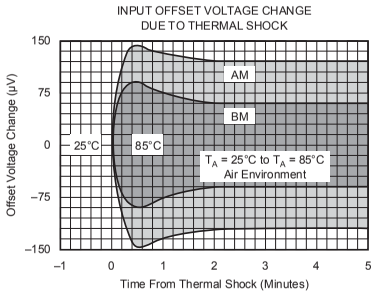
NOTE: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix D of Burr-Brown IC Data Book.

ORDERING INFORMATION

MODEL	PACKAGE	TEMPERATURE RANGE	OFFSET VOLTAGE, MAX (µV)
OPA111AM	TO-99	–25°C to +85°C	±500
OPA111BM	TO-99	–25°C to +85°C	±250
OPA111SM	TO-99	–55°C to +125°C	±500

TYPICAL PERFORMANCE CURVES (CONT)

T_A = +25°C, V_{CC} = ±15VDC unless otherwise noted.



APPLICATIONS INFORMATION

OFFSET VOLTAGE ADJUSTMENT

The OPA111 offset voltage is laser-trimmed and will require no further trim for most applications. As with most amplifiers, externally trimming the remaining offset can change drift performance by about 0.3µV/°C for each 100µV of adjusted offset. Note that the trim (Figure 1) is similar to operational amplifiers such as 741 and AD547. The OPA111 can replace most other amplifiers by leaving the external null circuit unconnected.

INPUT PROTECTION

Conventional monolithic FET operational amplifiers require external current-limiting resistors to protect their inputs against destructive currents that can flow when input FET gate-to-substrate isolation diodes are forward-biased. Most BIFET amplifiers can be destroyed by the loss of $-V_{CC}$.

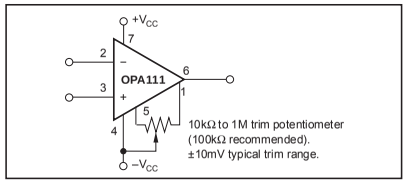


FIGURE 1. Offset Voltage Trim.

Unlike BIFET amplifiers, The ***Difet*** OPA111 requires input current limiting resistors only if its input voltage is greater than 6V more negative than $-V_{CC}$. A 10kΩ series resistor will limit input current to a safe level with up to ±15V input levels, even if both supply voltages are lost.

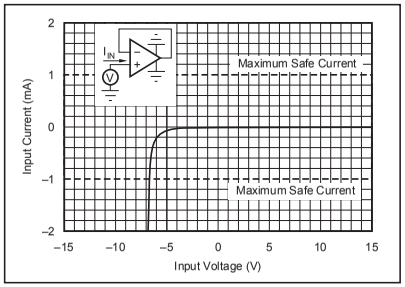


FIGURE 2. Input Current vs Input Voltage with ±V_{CC} Pins Grounded.

Static damage can cause subtle changes in amplifier input characteristics without necessarily destroying the device. In precision operational amplifiers (both bipolar and FET types), this may cause a noticeable degradation of offset voltage and drift. Static protection is recommended when handling any precision IC operational amplifier.

GUARDING AND SHIELDING

As in any situation where high impedances are involved, careful shielding is required to reduce "hum" pickup in input leads. If large feedback resistors are used, they should also be shielded along with the external input circuitry.

Leakage currents across printed circuit boards can easily exceed the bias current of the OPA111. To avoid leakage problems, it is recommended that the signal input lead of the OPA111 be wired to a Teflon standoff. If the OPA111 is to be soldered directly into a printed circuit board, utmost care must be used in planning the board layout. A "guard" pattern should completely surround the high impedance input leads and should be connected to a low impedance point which is at the signal input potential.

The amplifier case should be connected to any input shield or guard via pin 8. This insures that the amplifier itself is fully surrounded by guard potential, minimizing both leakage and noise pickup (see Figure 3).

If guarding is not required, pin 8 (case) should be connected to ground.

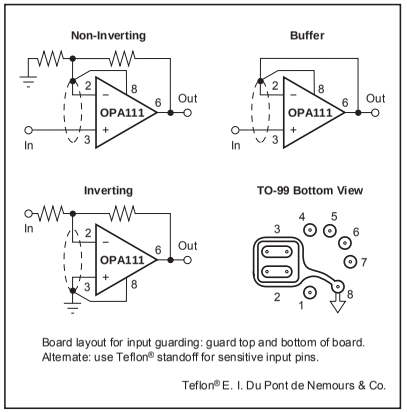


FIGURE 3. Connection of Input Guard.

NOISE: FET VERSUS BIPOLAR

Low noise circuit design requires careful analysis of all noise sources. External noise sources can dominate in many cases, so consider the effect of source resistance on overall operational amplifier noise performance. At low source impedances, the lower voltage noise of a bipolar operational amplifier is superior, but at higher impedances the high current noise of a bipolar amplifier becomes a serious liability. Above about 15kΩ, the OPA111 will have a lower total noise than an OP-27 (see Figure 4).

BIAS CURRENT CHANGE VERSUS COMMON-MODE VOLTAGE

The input bias current of most popular BIFET operational amplifiers are affected by common-mode voltage (Figure 5). Higher input FET gate-to-drain voltage causes leakage and ionization (bias) currents to increase. Due to its cascode input stage, the extremely low bias current of the OPA111 is not compromised by common-mode voltage.

APPLICATIONS CIRCUITS

Figures 6 through 18 are circuit diagrams of various applications for the OPA111.

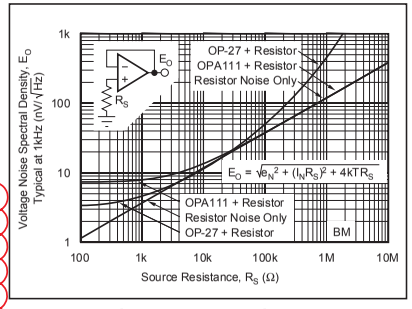


FIGURE 4. Voltage Noise Spectral Density vs Source Resistance.

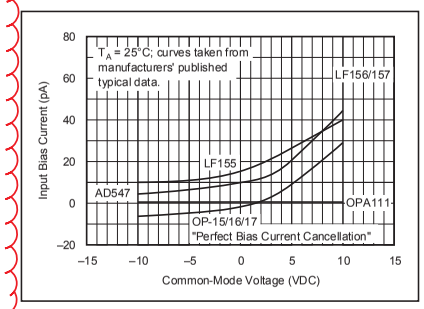


FIGURE 5. Input Bias Currrent vs Common-Mode Voltage.

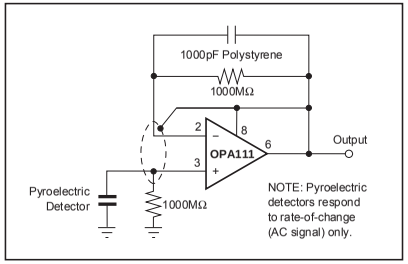


FIGURE 6. Pyroelectric Infrared Detector.

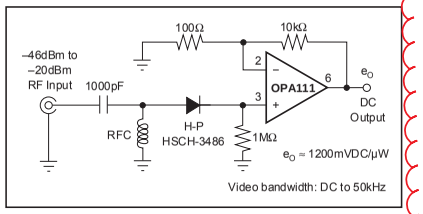


FIGURE 7. Zero-Bias Schottky Diode Square-Law RF Detector.

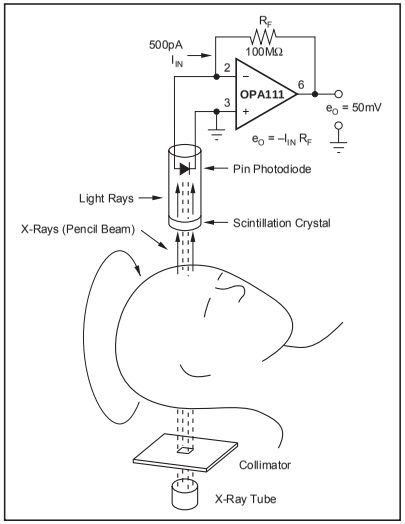


FIGURE 8. Computerized Axial Tomography (CAT) Scanner Channel Amplifier.

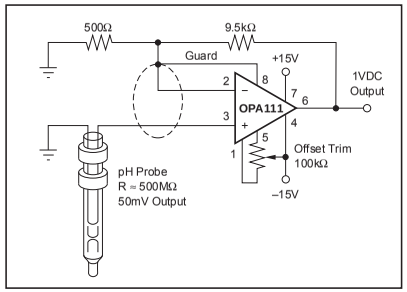


FIGURE 9. High Impedance ($10^{14}\Omega$) Amplifier.

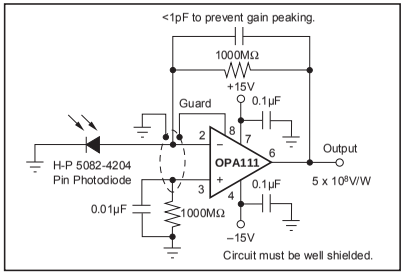


FIGURE 10. Sensitive Photodiode Amplifier.

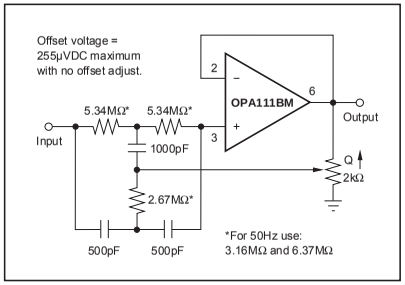


FIGURE 11. 60Hz Reject Filter.

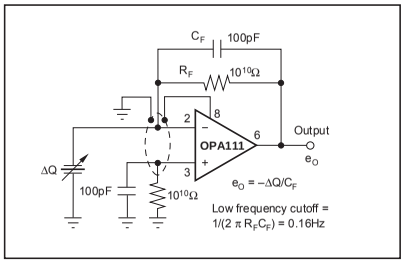


FIGURE 12. Piezoelectric Transducer Charge Amplifier.

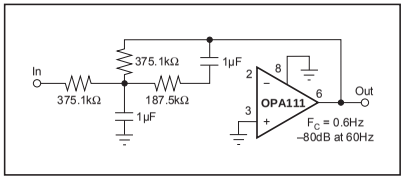


FIGURE 13. 0.6Hz Second-Order Low-Pass Filter.

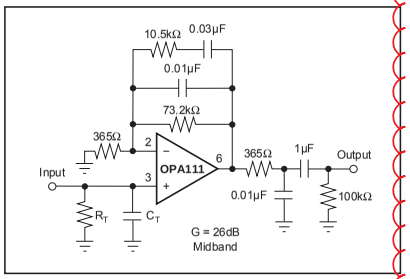


FIGURE 14. RIAA Equalized Phono Preamplifier.

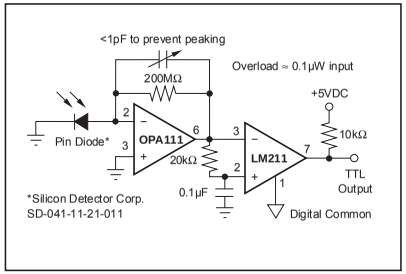


FIGURE 15. High Sensitivity (under 1nW) Fiber Optic Receiver for 9600 Baud Manchester Data.

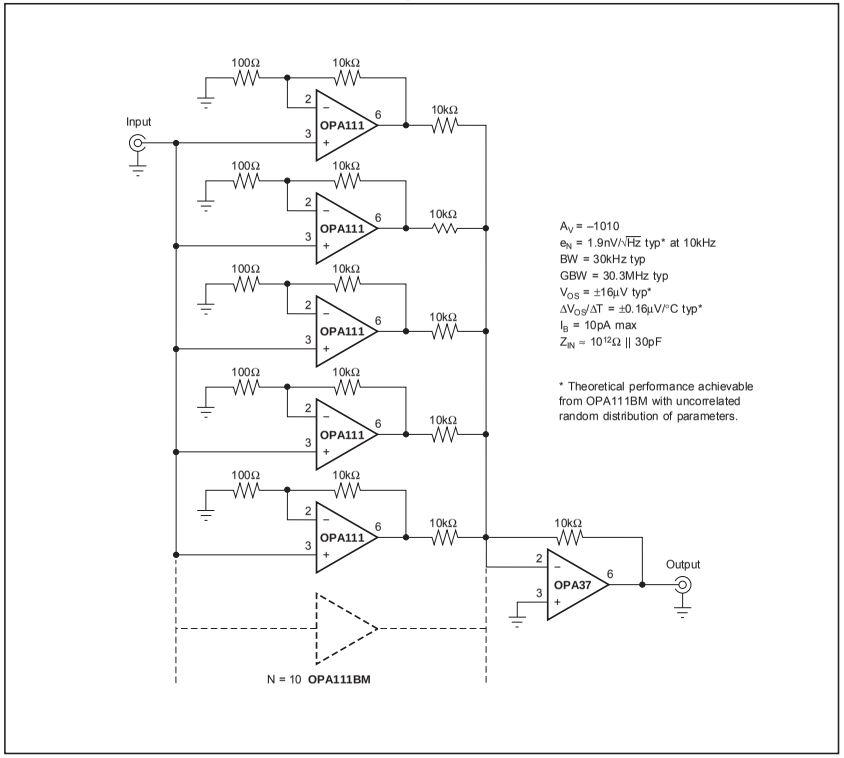


FIGURE 16. 'N' Stage Parallel-Input Amplifier for Reduced Relative Amplifier Noise at the Output.

PACKAGE OPTION ADDENDUM

9-Oct-2007

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
OPA111AM	NRND	TO-99	LMC	8	20	Green (RoHS & no Sb/Br)	AU	N / A for Pkg Type
OPA111BM	NRND	TO-99	LMC	8	20	Green (RoHS & no Sb/Br)	AU	N / A for Pkg Type
OPA111SM	OBSOLETE	TO-99	LMC	8		TBD	Call TI	Call TI
OPA111SMQ	OBSOLETE	TO-99	LMC	8		TBD	Call TI	Call TI

[1] The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

[2] Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

[3] MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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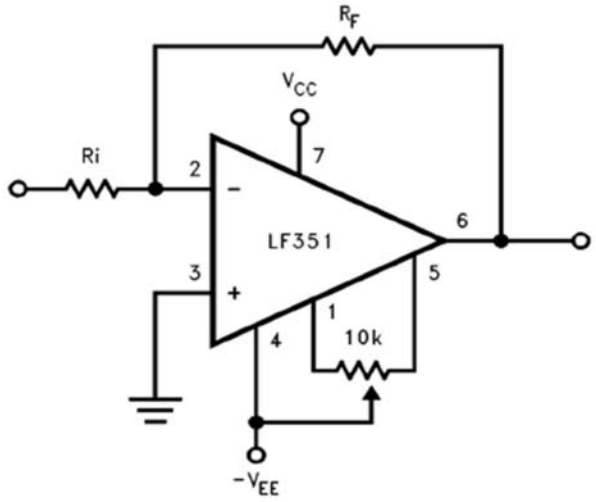
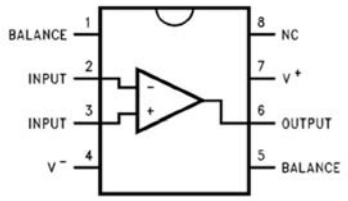
IMPORTANT NOTICE

Typical Connection

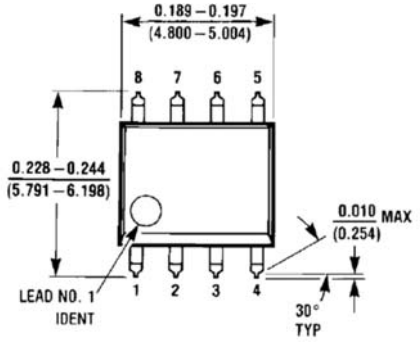


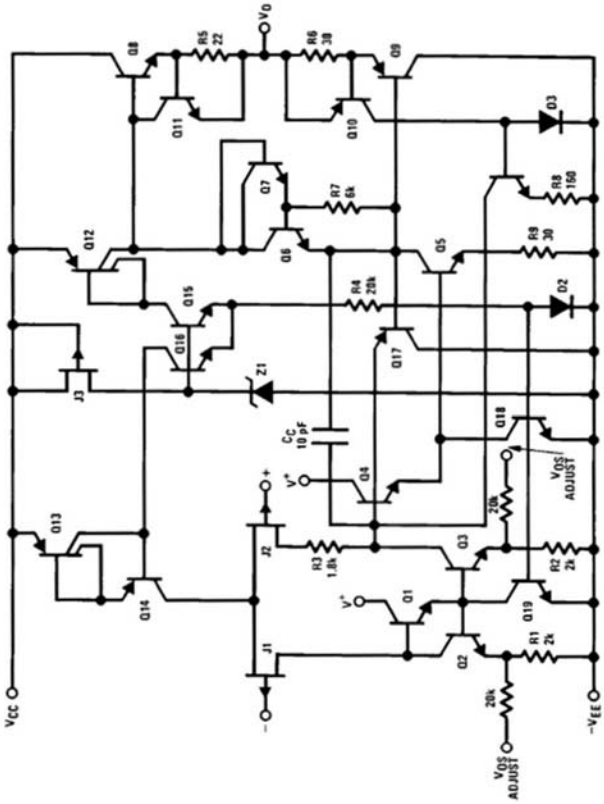
TL/H/5648–11

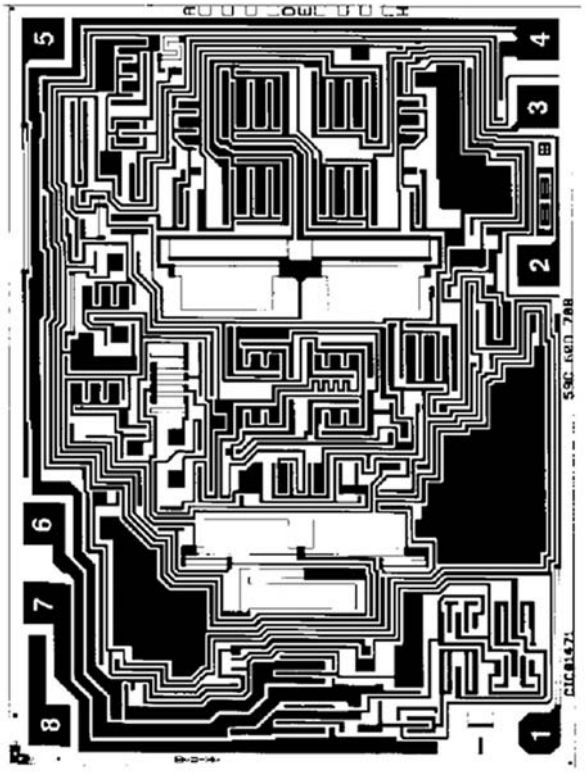
Dual-In-Line Package



Order Number LF351M or LF351N
See NS Package Number M08A or N08E







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