

## Wide bandwidth dual JFET operational amplifiers

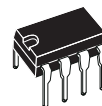
### Features

- Low power consumption
- Wide common-mode (up to  $V_{CC}^+$ ) and differential voltage range
- Low input bias and offset current
- Output short-circuit protection
- High input impedance JFET input stage
- Internal frequency compensation
- Latch up free operation
- High slew rate 16 V/ $\mu$ s (typical)

### Description

These circuits are high speed JFET input dual operational amplifiers incorporating well matched, high voltage JFET and bipolar transistors in a monolithic integrated circuit.

The devices feature high slew rates, low input bias and offset currents, and low offset voltage temperature coefficient.

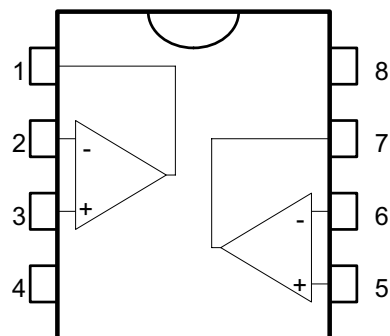


**N**  
**DIP8**  
(Plastic package)



**D**  
**SO-8**  
(Plastic micro package)

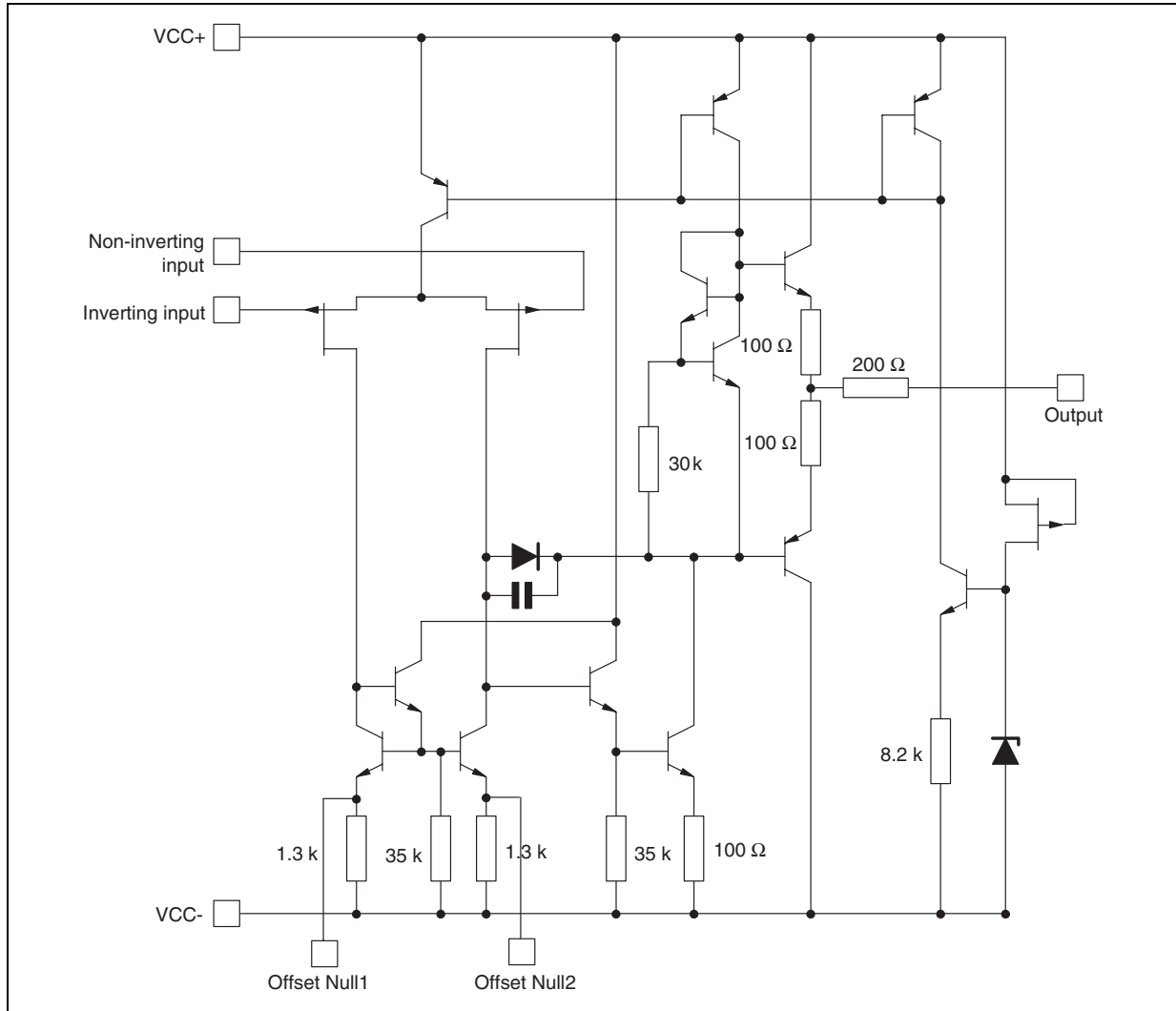
**Pin connections**  
(top view)



- 1 - Output1
- 2 - Inverting input 1
- 3 - Non-inverting input 1
- 4 -  $V_{CC}^-$
- 5 - Non-inverting input 2
- 6 - Inverting input 2
- 7 - Output 2
- 8 -  $V_{CC}^+$

# 1 Schematics

Figure 1. Schematic diagram (each amplifier)



## 2 Absolute maximum ratings and operating conditions

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply voltage <sup>(1)</sup>	±18	V
$V_i$	Input voltage <sup>(2)</sup>	±15	V
$V_{id}$	Differential input voltage <sup>(3)</sup>	±30	V
$R_{thja}$	Thermal resistance junction to ambient <sup>(4)</sup>		
	SO-8 DIP8	125 85	°C/W
$R_{thjc}$	Thermal resistance junction to case <sup>(4)</sup>		
	SO-8 DIP8	40 41	°C/W
	Output short-circuit duration <sup>(5)</sup>	Infinite	
$T_{stg}$	Storage temperature range	-65 to +150	°C
ESD	HBM: human body model <sup>(6)</sup>	1	kV
	MM: machine model <sup>(7)</sup>	200	V
	CDM: charged device model <sup>(8)</sup>	1.5	kV

1. All voltage values, except differential voltage, are with respect to the zero reference level (ground) of the supply voltages where the zero reference level is the midpoint between  $V_{CC}^+$  and  $V_{CC}^-$ .
2. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 volts, whichever is less.
3. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
4. Short-circuits can cause excessive heating and destructive dissipation. Values are typical.
5. The output may be shorted to ground or to either supply. Temperature and/or supply voltages must be limited to ensure that the dissipation rating is not exceeded.
6. Human body model: a 100 pF capacitor is charged to the specified voltage, then discharged through a 1.5 kΩ resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins are floating.
7. Machine model: a 200 pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω). This is done for all couples of connected pin combinations while the other pins are floating.
8. Charged device model: all pins and the package are charged together to the specified voltage and then discharged directly to the ground through only one pin. This is done for all pins.

**Table 2. Operating conditions**

Symbol	Parameter	LF253	LF353	Unit
$V_{CC}$	Supply voltage	6 to 36		V
$T_{oper}$	Operating free-air temperature range	-40 to +105	0 to +70	°C

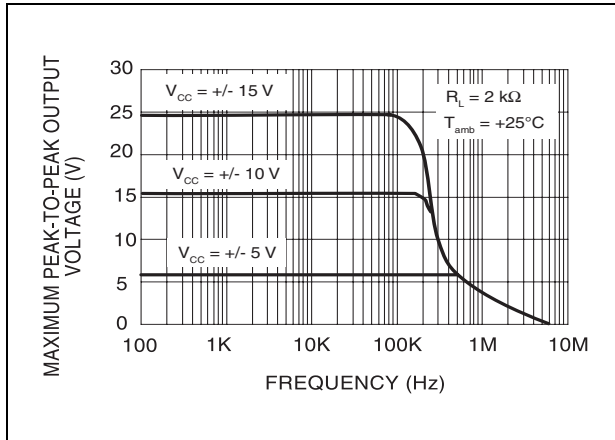
### 3 Electrical characteristics

**Table 3. Electrical characteristics at  $V_{CC} = \pm 15\text{ V}$ ,  $T_{amb} = +25^\circ\text{C}$  (unless otherwise specified)**

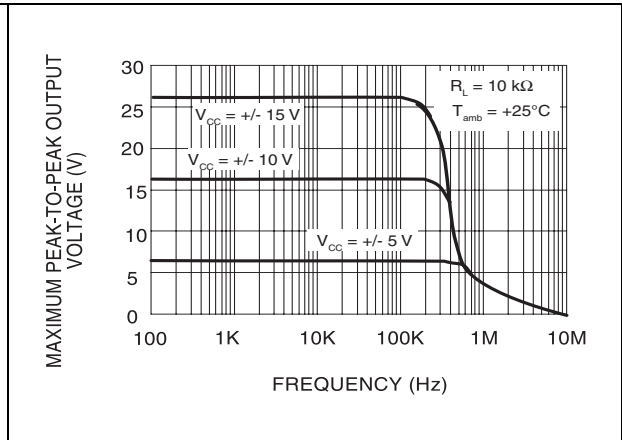
Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{io}$	Input offset voltage ( $R_S = 10\text{k}\Omega$ ) $T_{min} \leq T_{amb} \leq T_{max}$		3	10 13	mV
$DV_{io}$	Input offset voltage drift		10		$\mu\text{V}/^\circ\text{C}$
$I_{io}$	Input offset current <sup>(1)</sup> $T_{min} \leq T_{amb} \leq T_{max}$		5	100 4	pA nA
$I_{ib}$	Input bias current <sup>(1)</sup> $T_{min} \leq T_{amb} \leq T_{max}$		20	200 20	pA nA
$A_{vd}$	Large signal voltage gain ( $R_L = 2\text{k}\Omega$ , $V_o = \pm 10\text{V}$ ) $T_{min} \leq T_{amb} \leq T_{max}$	50 25	200		V/mV
SVR	Supply voltage rejection ratio ( $R_S = 10\text{k}\Omega$ ) $T_{min} \leq T_{amb} \leq T_{max}$	80 80	86		dB
$I_{CC}$	Supply current, no load $T_{min} \leq T_{amb} \leq T_{max}$		1.4	3.2 3.2	mA
$V_{icm}$	Input common mode voltage range	$\pm 11$	+15 -12		V
CMR	Common mode rejection ratio ( $R_S = 10\text{k}\Omega$ ) $T_{min} \leq T_{amb} \leq T_{max}$	70 70	86		dB
$I_{OS}$	Output short-circuit current $T_{min} \leq T_{amb} \leq T_{max}$	10 10	40	60 60	mA
$\pm V_{opp}$	Output voltage swing $R_L = 2\text{k}\Omega$ $R_L = 10\text{k}\Omega$ $T_{min} \leq T_{amb} \leq T_{max}$ $R_L = 2\text{k}\Omega$ $R_L = 10\text{k}\Omega$	10 12 10 12	12 13.5		V
SR	Slew rate, $V_i = 10\text{V}$ , $R_L = 2\text{k}\Omega$ , $C_L = 100\text{pF}$ , unity gain	12	16		V/ $\mu\text{s}$
$t_r$	Rise time, $V_i = 20\text{mV}$ , $R_L = 2\text{k}\Omega$ , $C_L = 100\text{pF}$ , unity gain		0.1		$\mu\text{s}$
$K_{ov}$	Overshoot, $V_i = 20\text{mV}$ , $R_L = 2\text{k}\Omega$ , $C_L = 100\text{pF}$ , unity gain		10		%
GBP	Gain bandwidth product, $f = 100\text{kHz}$ , $V_{in} = 10\text{mV}$ , $R_L = 2\text{k}\Omega$ , $C_L = 100\text{pF}$	2.5	4		MHz
$R_i$	Input resistance		$10^{12}$		$\Omega$
THD	Total harmonic distortion, $f = 1\text{kHz}$ , $A_v = 20\text{dB}$ , $R_L = 2\text{k}\Omega$ , $C_L = 100\text{pF}$ , $V_o = 2V_{pp}$		0.01		%
$e_n$	Equivalent input noise voltage $R_S = 100\Omega$ , $f = 1\text{kHz}$		15		$\frac{\text{nV}}{\sqrt{\text{Hz}}}$
$\phi_m$	Phase margin		45		Degrees
$V_{o1}/V_{o2}$	Channel separation ( $A_v = 100$ )		120		dB

1. The input bias currents are junction leakage currents which approximately double for every  $10^\circ\text{C}$  increase in the junction temperature.

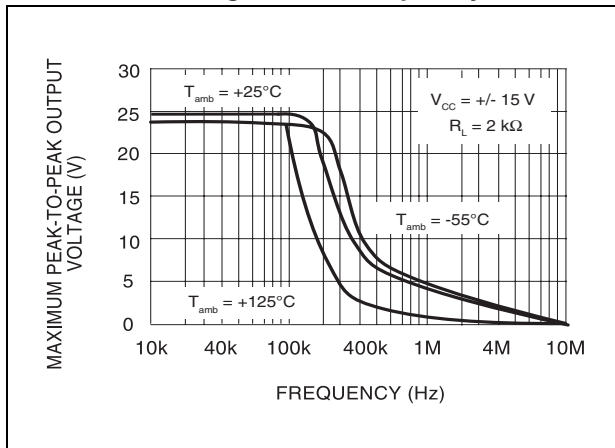
**Figure 2. Maximum peak-to-peak output voltage vs. frequency,  $R_L = 2\text{ k}\Omega$**



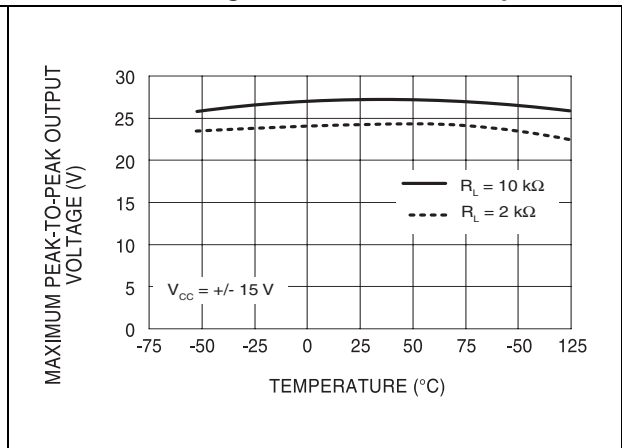
**Figure 3. Maximum peak-to-peak output voltage vs. frequency,  $R_L = 10\text{ k}\Omega$**



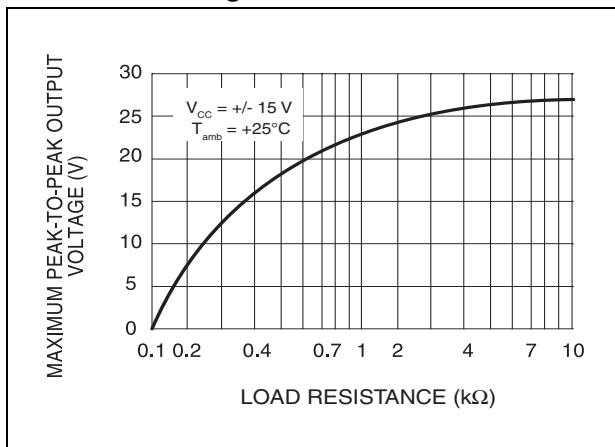
**Figure 4. Maximum peak-to-peak output voltage versus frequency**



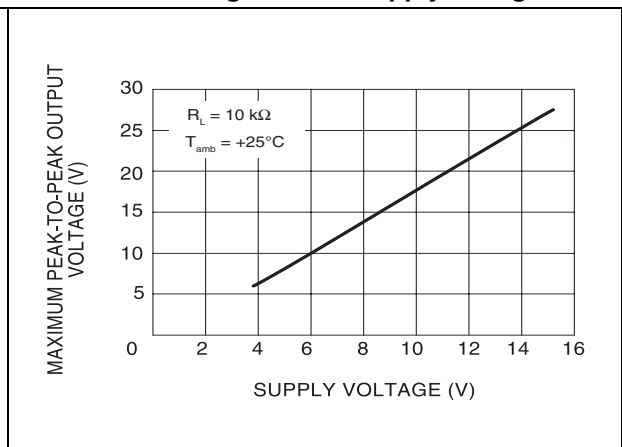
**Figure 5. Maximum peak-to-peak output voltage versus free air temperature**



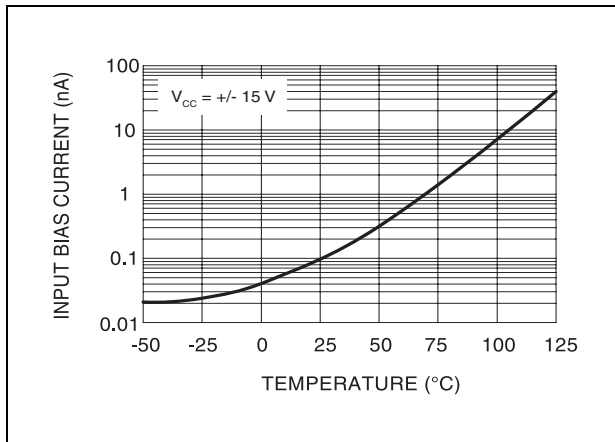
**Figure 6. Maximum peak-to-peak output voltage versus load resistance**



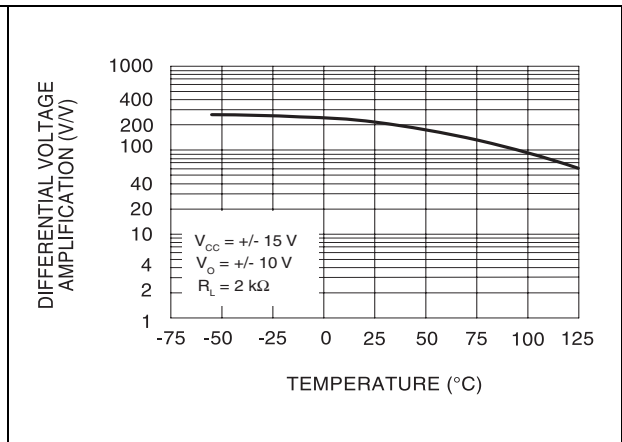
**Figure 7. Maximum peak-to-peak output voltage versus supply voltage**



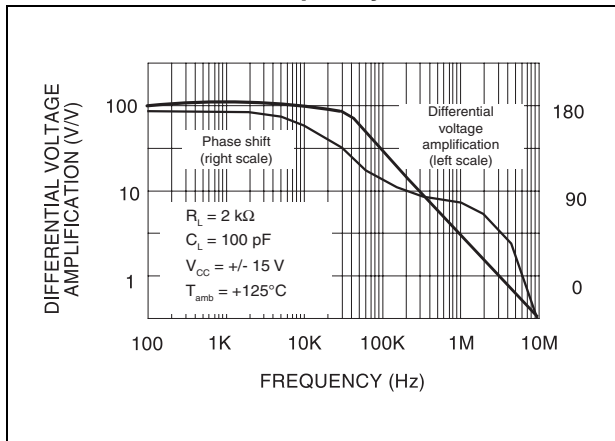
**Figure 8. Input bias current versus free air temperature**



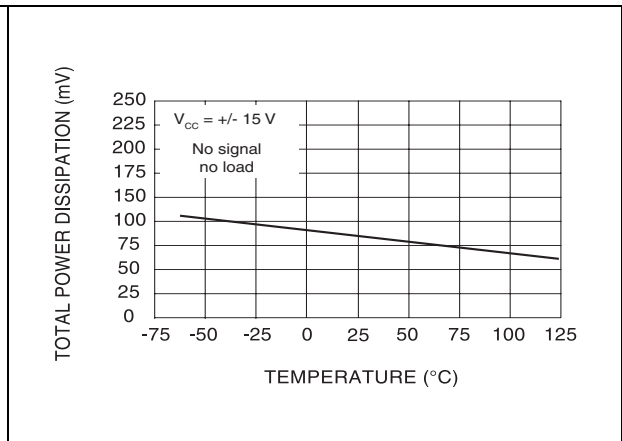
**Figure 9. Large signal differential voltage amplification versus free air temp.**



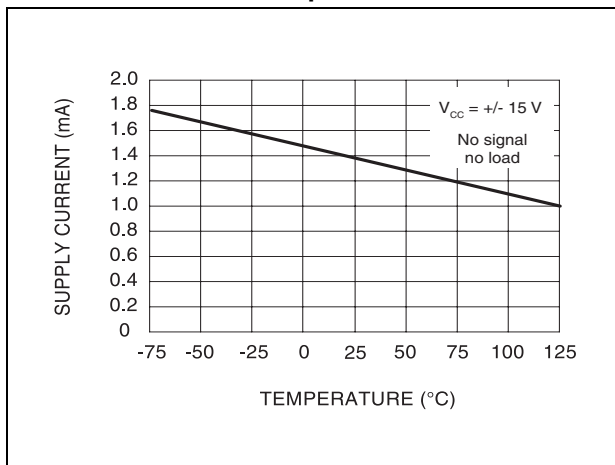
**Figure 10. Large signal differential voltage amplification and phase shift versus frequency**



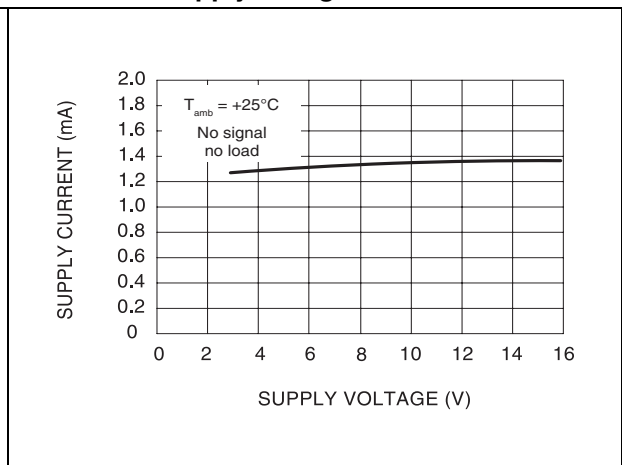
**Figure 11. Total power dissipation versus free air temperature**



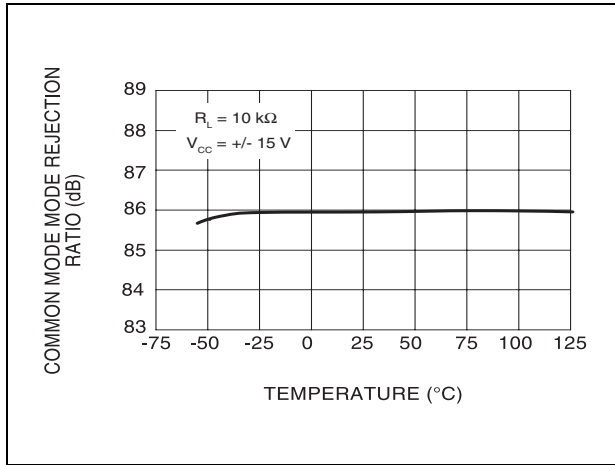
**Figure 12. Supply current per amplifier versus free air temperature**



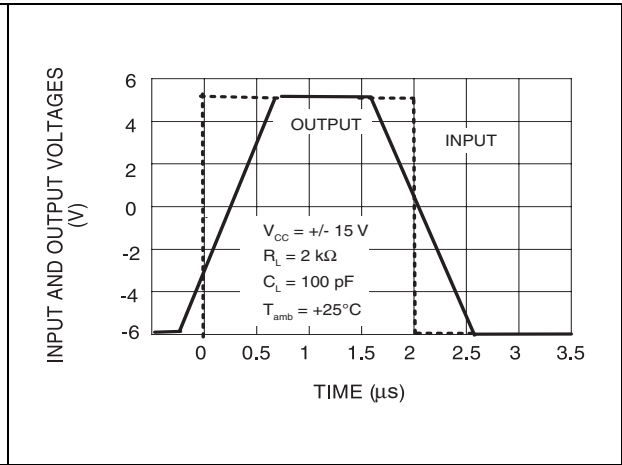
**Figure 13. Supply current per amplifier versus supply voltage**



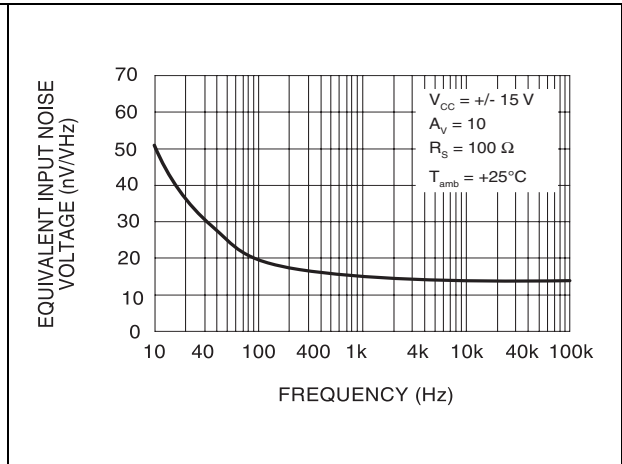
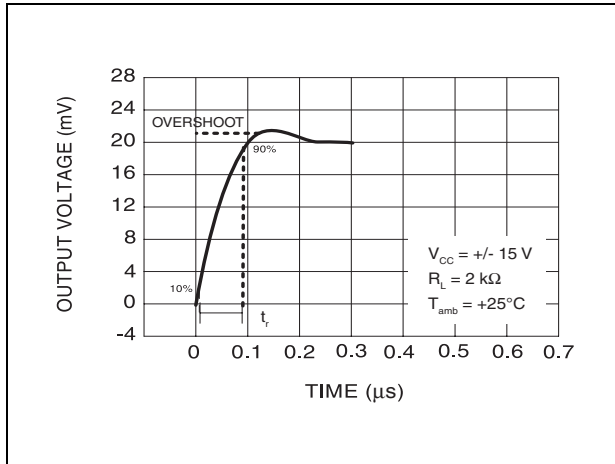
**Figure 14. Common mode rejection ratio versus free air temperature**



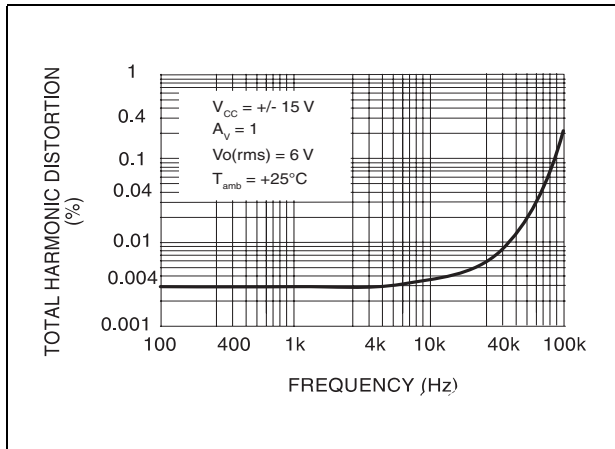
**Figure 15. Voltage follower large signal pulse response**



**Figure 16. Output voltage versus elapsed time** **Figure 17. Equivalent input noise voltage versus frequency**



**Figure 18. Total harmonic distortion versus frequency**



## 4 Parameter measurement information

Figure 19. Voltage follower

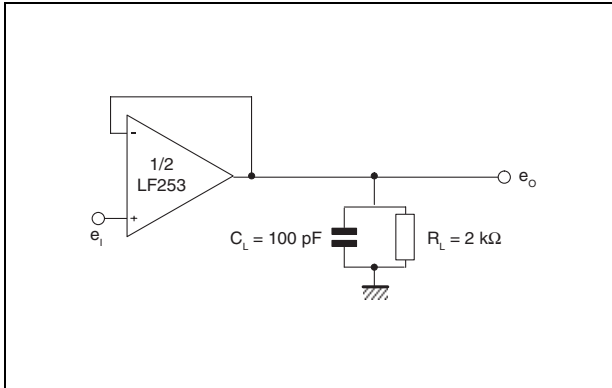
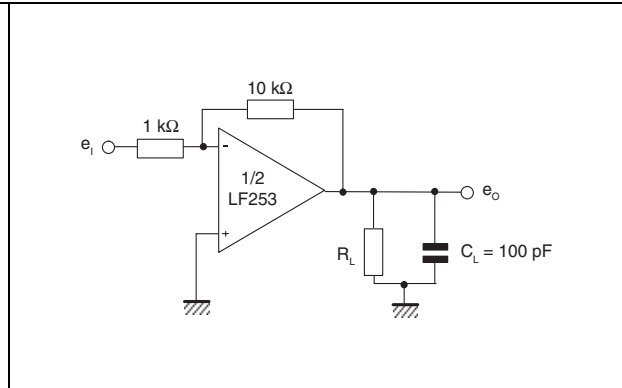


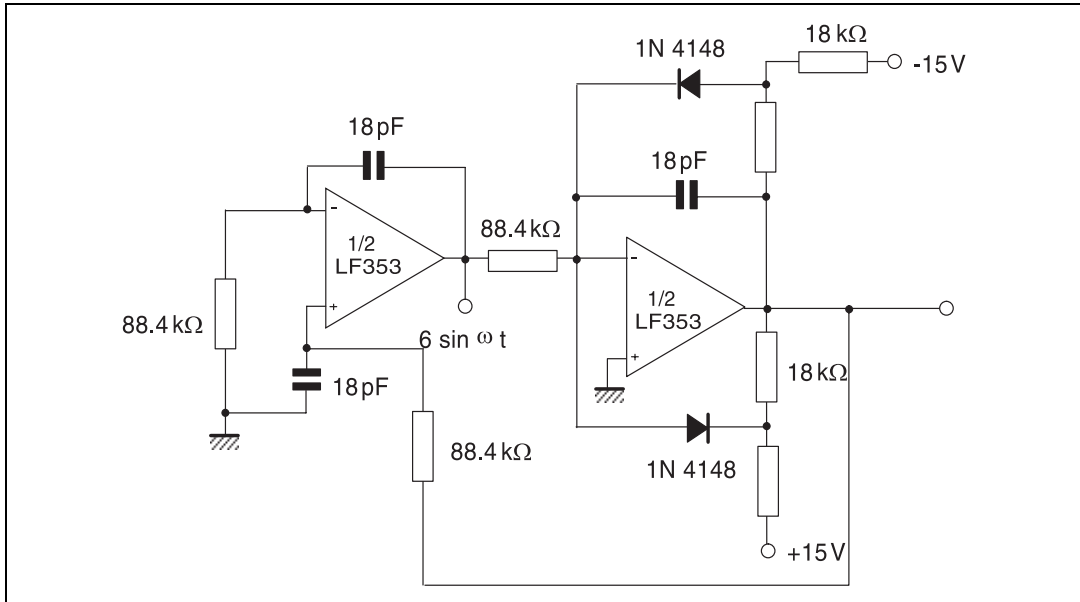
Figure 20. Gain of 10 inverting amplifier





## 5 Typical application

Figure 21. Quadruple oscillator



## 6 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

## 6.1 DIP8 package information

Figure 22. DIP8 package mechanical drawing

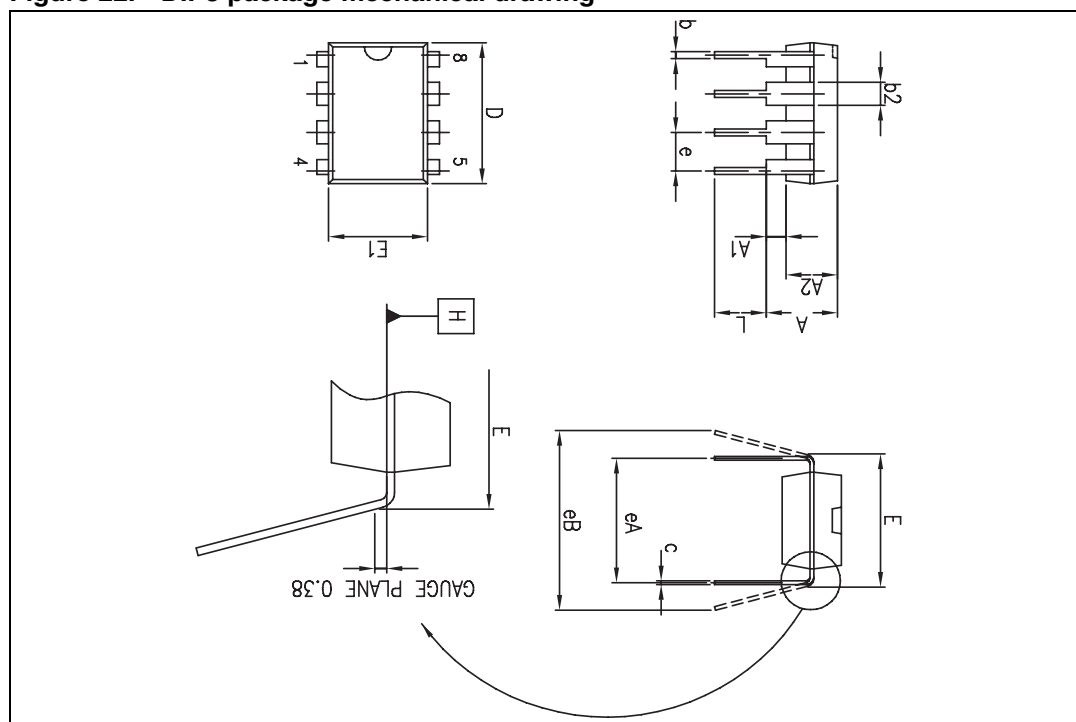


Table 4. DIP8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			5.33			0.210
A1	0.38			0.015		
A2	2.92	3.30	4.95	0.115	0.130	0.195
b	0.36	0.46	0.56	0.014	0.018	0.022
b2	1.14	1.52	1.78	0.045	0.060	0.070
c	0.20	0.25	0.36	0.008	0.010	0.014
D	9.02	9.27	10.16	0.355	0.365	0.400
E	7.62	7.87	8.26	0.300	0.310	0.325
E1	6.10	6.35	7.11	0.240	0.250	0.280
e		2.54			0.100	
eA		7.62			0.300	
eB			10.92			0.430
L	2.92	3.30	3.81	0.115	0.130	0.150

## 6.2 SO-8 package information

Figure 23. SO-8 package mechanical drawing

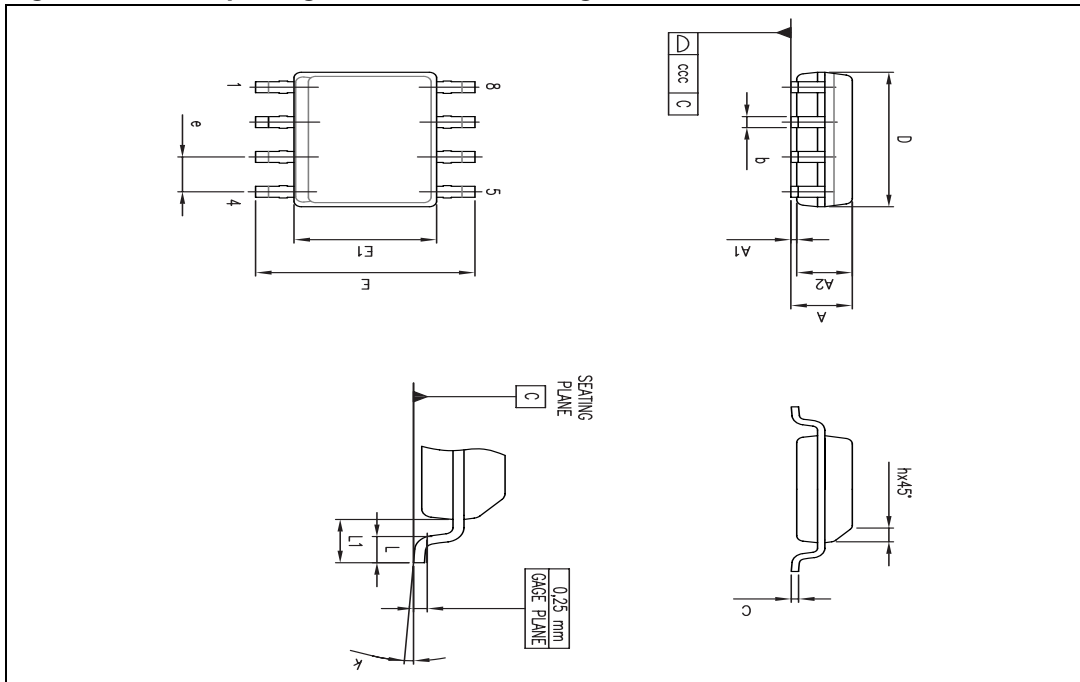


Table 5. SO-8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
A1	0.10		0.25	0.004		0.010
A2	1.25			0.049		
b	0.28		0.48	0.011		0.019
c	0.17		0.23	0.007		0.010
D	4.80	4.90	5.00	0.189	0.193	0.197
E	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.154	0.157
e		1.27			0.050	
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
L1		1.04			0.040	
k	1°		8°	1°		8°
ccc			0.10			0.004

## 7 Ordering information

**Table 6. Order codes**

Order code	Temperature range	Package	Packing	Marking
LF253N	-40°C, +105°C	DIP8	Tube	LF253N
LF253D LF253DT		SO-8	Tube or Tape & reel	253
LF353N	0°C, +70°C	DIP8	Tube	LF353N
LF353D LF353DT		SO-8	Tube or Tape & reel	353

## 8 Revision history

**Table 7. Document revision history**

Date	Revision	Changes
01-Mar-2001	1	Initial release.
08-Sep-2008	2	Updated document format. Removed information concerning military temperature range (LF153). Added L1 parameter dimensions in <a href="#">Table 5: SO-8 package mechanical data</a> .
25-Mar-2010	3	Corrected error in <a href="#">Table 6: Order codes</a> : LF253N, LF253D, LF353N and LF353D proposed in tube packing.