Silicore
芯谷科技

D8634

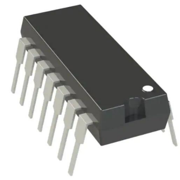
470μA,6MHz, Rail-to-Rail I/O COMS Operational Amplifier

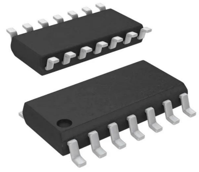
General Description

The D8634(quad) is low noise, low voltage, and low power operational amplifier, that can be designed into a wide range of applications. The D8634 have a high gain-bandwidth product of 6MHz, a slew rate of 3.7V/μs, and a quiescent current of 470μA/ amplifier at 5V.

The D8634 is designed to provide optimal performance in low voltage and low noise systems. It provides rail-to-rail output swing into heavy loads. The input common-mode voltage range includes ground, and the maximum input offset voltage are 3.5m V for D8634.

It is specified over the extended industrial temperature range (-40˚C to + 125 ˚C). The operating range is from 2.5V to 5.5V.


DIP14


SOP14


TSSOP14

Features

- Low Cost
- Rail-to-Rail Input and Output: 0. 8m V Typical VOS
- High Gain- Bandwidth Product: 6 MHz
- High Slew Rate: 3.7V/μ s
- Settling Time to 0.1% with 2V Step: 2.1μs
- Overload Recovery Time: 0.9μs
- Low Noise : 12nV/ Hz
- Operates on 2. 5V to 5 . 5V Supplies
- Input Voltage Range = -0.1V to + 5 .6V with VS = 5.5V
- Low Power: 470μA/Amplifier Typical Supply Current

Package Information

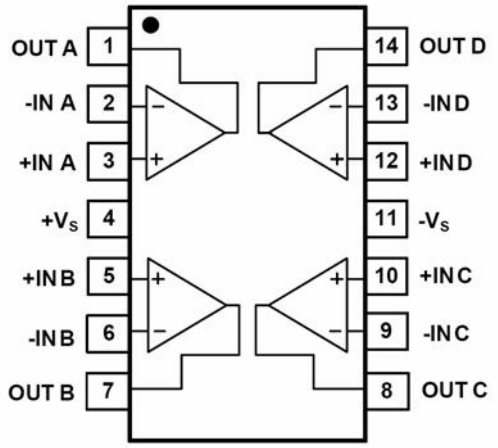
Part NO.	Package Description	Package Marking	Package Option
D8634	DIP14	CHMC SXXXX D8634	25/Tube
D8634F	SOP14	CHMC SXXXX D8634F	50/Tube 4000/Reel
D8634T	TSSOP14	CHMC D8634T SXXXX	60/Tube 3000/Reel

CHMC:Trademark D8634/D8634F/D8634T:Part NO. SXXXX:Lot NO.

Applications

- Sensors
- Audio
- Active Filters
- A/D Converters
- Communications
- Test Equipment
- Cellular and Cordless Phones
- Laptops and PDAs
- Photodiode Amplification
- Battery-Powered Instrumentation

Pin Connection



D8634(DIP14)/D8634F(SOP14)/D8634T(TSSOP14)

Absolute Maximum Ratings *1

Characteristic		Value	Unit
Supply Voltage		7.5	V
Common- mode input voltage		(-Vs)-0.5V～ (+Vs)+0.5V	V
Operating Temperature		-55 ～+150	°C
Storage Temperature		-65 ～+150	°C
Junction temperature		160	°C
Lead temperature range (soldering 10sec)		260	°C
ESD susceptibility	HBM	1500	V
	MM	400	V

* Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

CAUTION

This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection.
SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

Electrical Characteristics (unless otherwise specified: V_S=+ 5 V, V_{CM} = V_S /2,R_L =600 Ω,T_A =25 °C)

Characteristics	Symbol	Test conditions	Min	Typ	Max	Unit
Input Characteristics						
Input offset voltage	V_{OS}			0.8	3.5	mV
Input bias current	I_B			1		pA
Input offset current	I_{OS}			1		pA
Common- mode voltage	V_{CM}	Vs=5.5V	-0.1 to +5.6(typ.)			V
Common- mode rejection ratio	CMRR	Vs=5.5V,V_{CM} =-0.1V to 4V	75	90		dB
		Vs=5.5V,V_{CM} =-0.1V to 5.6V		83		dB
Open-loop voltage gain	A_{OL}	R_L=600Ω,V_O=0.15V to 4.85V	90	97		dB
		R_L=10kΩ,V_O=0.05V to 4.95V		108		dB
Input offset voltage drift	$\Delta V_{OS}/\Delta T$			2.4		µV/℃
Output Characteristics						
Output voltage swing from rail		R_L=600Ω		0.1		V
		R_L=10kΩ,		0.015		V
Output current	I_{OUT}		49	53		mA
Closed-loop output impedance		f= 200 kHz, G= 1		3		Ω
Power- down disable						
Turn-on time				4		µs
Turn-off time				1.2		µs
DISABLE voltage-off					0.8	V
DISABLE voltage-on			2			V
Power supply						
Operating voltage range			2.5		5.5	V
Power supply rejection ratio	PSRR	Vs=+2.5V to +5. 5 V V_{CM} =(-Vs)+0.5V	74	91		dB
Quiescent current/amplifier	I_Q	I_{OUT} =0		470	590	µA
Dynamic Performance						
Gain-bandwidth product	GBP	R_L=10kΩ		6		MHz
Phase margin	φ_O			60		degress
Full power bandwidth	BWp	<1% distortion, R_L=600Ω		250		kHz
Slew rate	SR	G=+1.2V Step, R_L=10kΩ		3.7		V/µs
Setting time to 0.1%	ts	G=+1.2V Step, R_L=600Ω		2.1		µs
Overload recovery time		V_{IN} ·Gain= Vs, R_L=600Ω		0.9		µs
Noise Performance						
Voltage noise density	e_n	f=1kHz		12		nV/√Hz
Current noise density	i_n	f=1kHz		3		fA/√Hz

Application Summary

Driving Capacitive Loads

The D8634 can directly drive 1000pF in unity- gain without oscillation. The unity-gain follower (buffer) is the most sensitive configuration to capacitive loading. Direct capacitive loading reduces the phase margin of amplifiers and this results in ringing or even oscillation.

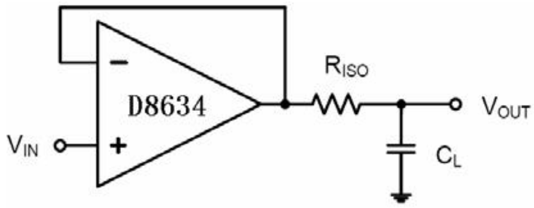


Figure 1. Indirectly Driving Heavy Capacitive Load

Applications that require greater capacitive drive capability should use an isolation resistor between the output and the capacitive load like the circuit in Figure 1.

The isolation resistor R_{ISO} and the load capacitor C_L form a zero to increase stability. The bigger the R_{ISO} resistor value, the more stable V_{OUT} will be. Note that this method results in a loss of gain accuracy because R_{ISO} forms a voltage divider with the R_{LOAD} .

An improvement circuit is shown in Figure 2. It provides DC accuracy as well as AC stability. RF provides the DC accuracy by connecting the inverting signal with the output. C_F and R_{ISO} serve to counteract the loss of phase margin by feeding the high frequency component of the output signal back to the amplifier's inverting input, thereby preserving phase margin in the overall feedback loop.

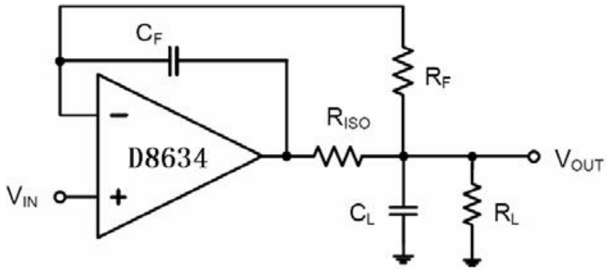


Figure 2. Indirectly Driving Heavy Capacitive Load with DC Accuracy

For no-buffer configuration, there are two others ways to increase the phase margin: (a) by increasing the amplifier's gain or (b) by placing a capacitor in parallel with the feedback resistor to counteract the parasitic capacitance associated with inverting node.

Power-Supply Bypassing and Layout

The D8634 family operates from either a single +2. 5 V to +5.5V supply or dual ±1.25V to ±2.75V supplies. For single-supply operation, bypass the power supply V_{DD} with a 0.1μ F ceramic capacitor which should be placed close to the V_{DD} pin. For dual-supply operation, both the V_{DD} and the V_{SS} supplies should be bypassed to ground with separate 0. 1μF ceramic capacitors. 2. 2μF tantalum capacitor can be added for better performance.

Good PC board layout techniques optimize performance by decreasing the amount of stray capacitance at the op amp's inputs and output. To decrease stray capacitance, minimize trace lengths and widths by placing external components as close to the device as possible. Use surface-mount components whenever possible.

For the operational amplifier, soldering the part to the board directly is strongly recommended. Try to keep the high frequency big current loop area small to minimize the EMI (electromagnetic interfacing).

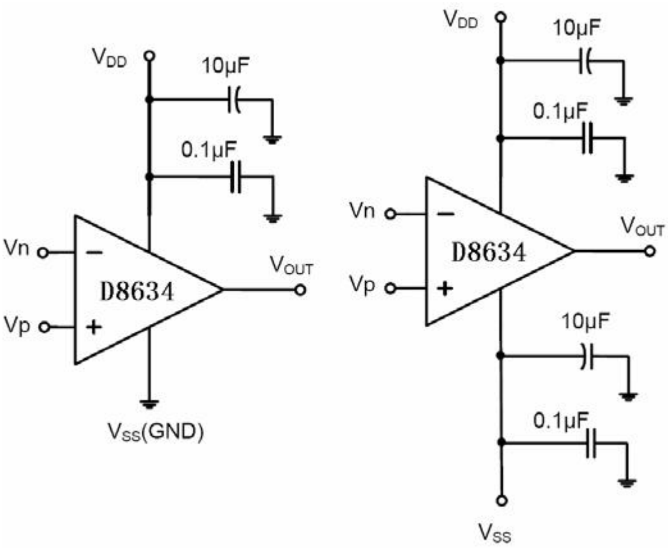


Figure 3. Amplifier with Bypass Capacitors Grounding

Grounding

A ground plane layer is important for D8634 circuit design. The length of the current path speed currents in an inductive ground return will create an unwanted voltage noise. Broad ground plane areas will reduce the parasitic inductance.

Input-to-Output Coupling

To minimize capacitive coupling, the input and output signal traces should not be parallel. This helps reduce unwanted positive feedback.

Differential Amplifier

The circuit shown in Figure 4 performs the difference function. If the resistors ratios are equal ($R_4/R_3 = R_2/R_1$), then $V_{OUT} = (Vp - Vn) \times R_2 / R_1 + V_{REF}$.

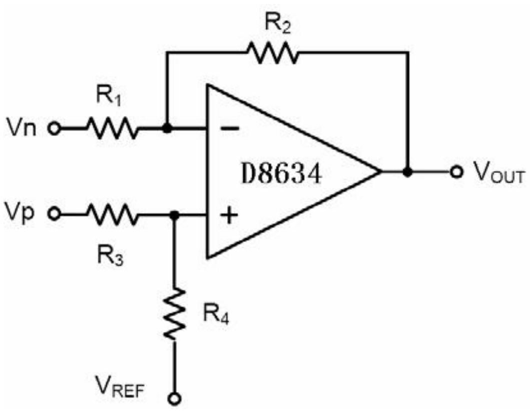


Figure 4. Differential Amplifier

Instrumentation Amplifier

The circuit in Figure 5 performs the same function as that in Figure 4 but with the high input impedance.

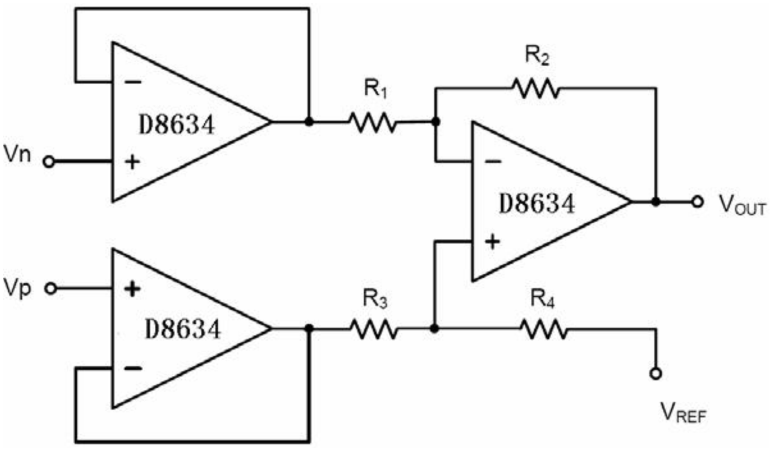


Figure 5. Instrumentation Amplifier Low Pass Active Filter

Low Pass Active Filter

The low pass filter shown in Figure 6 has a DC gain of($-R_2/R_1$) and the –3dB corner frequency is $1/2\pi R_2C$. Make sure the filter is within the bandwidth of the amplifier. The Large values of feedback resistors can couple with parasitic capacitance and cause
undesired effects such as ringing or oscillation in high- speed amplifiers. Keep resistors value as low as possible and consistent with output loading consideration.

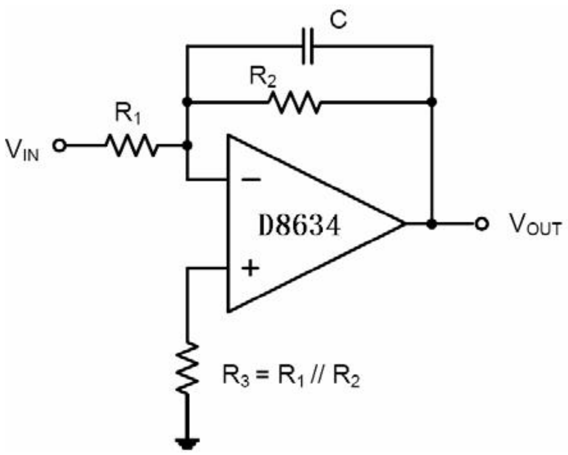
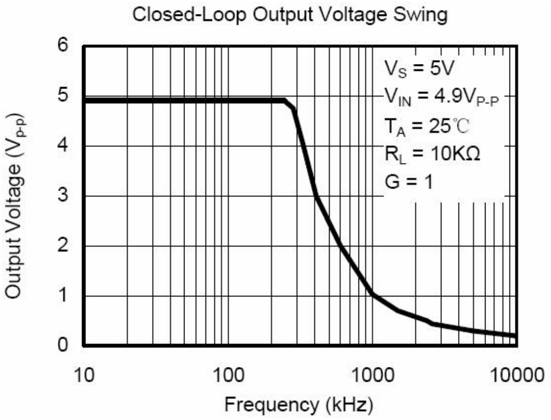
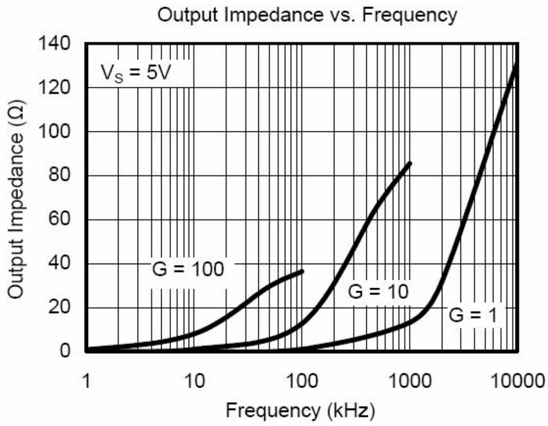


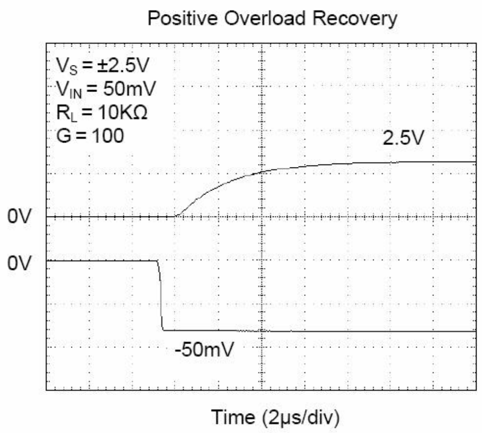
Figure 6. Low Pass Active Filter

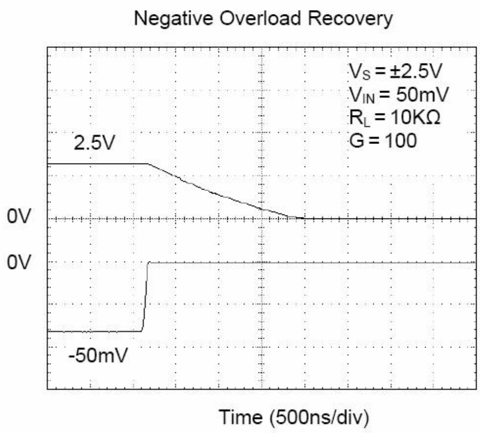
Typical Curve

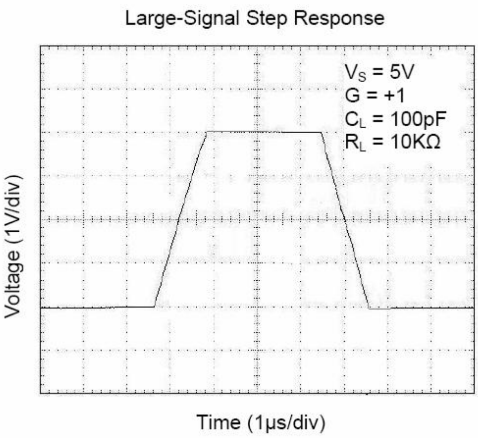
(At T_A =25 °C, V_{CM} = V_S /2,R_L =600 Ω,unless otherwise noted)

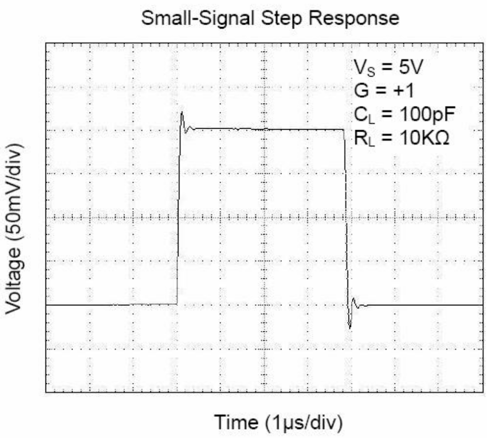


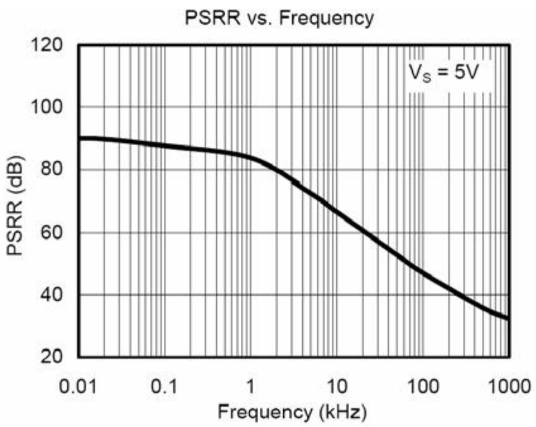


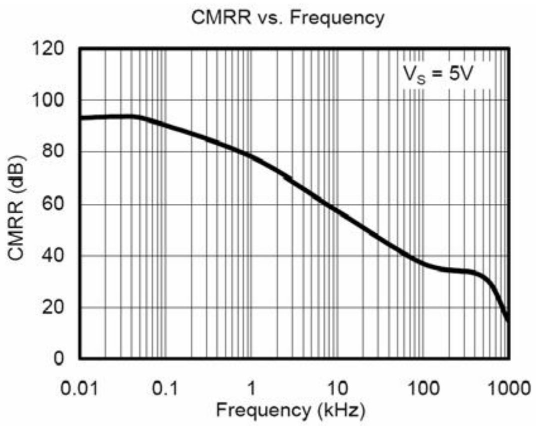


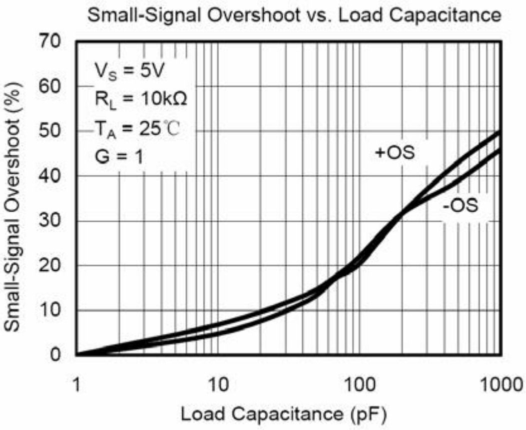


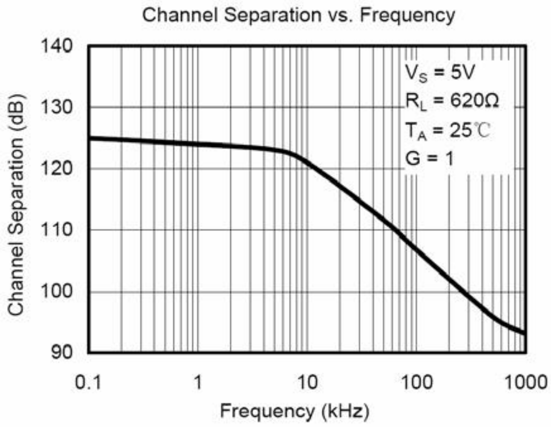


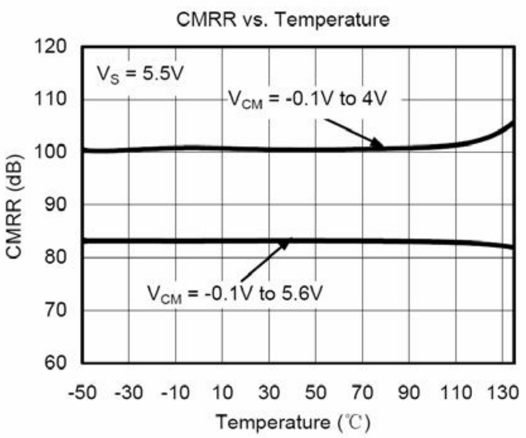


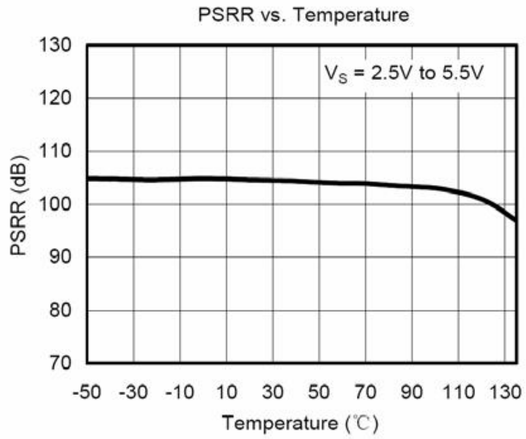

PSRR vs. Frequency
PSRR (dB)
Frequency (kHz)
V_S = 5V
120
100
80
60
40
20
0.01
0.1
1
10
100
1000

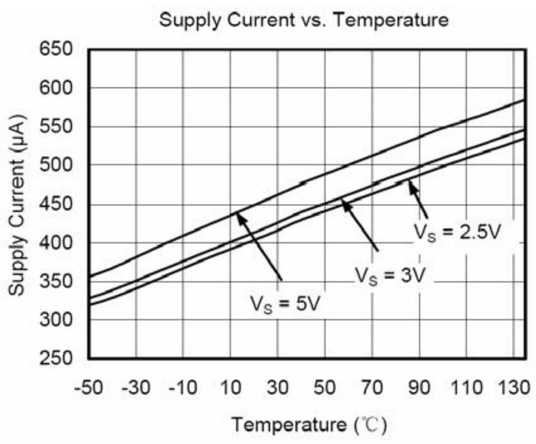

CMRR vs. Frequency
CMRR (dB)
Frequency (kHz)
V_S = 5V
120
100
80
60
40
20
0
0.01
0.1
1
10
100
1000

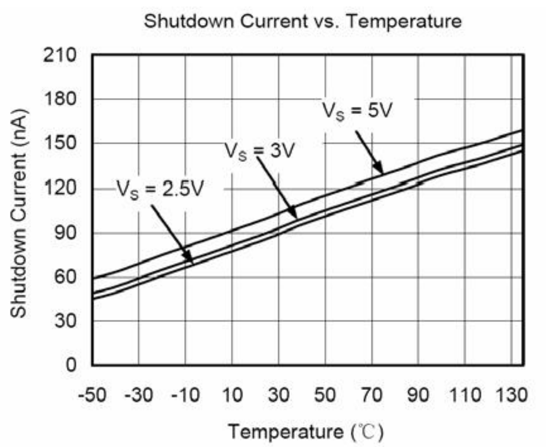

Small-Signal Overshoot vs. Load Capacitance
Small-Signal Overshoot (%)
Load Capacitance (pF)
V_S = 5V
R_L = 10kΩ
T_A = 25℃
G = 1
+OS
-OS
70
60
50
40
30
20
10
0
1
10
100
1000

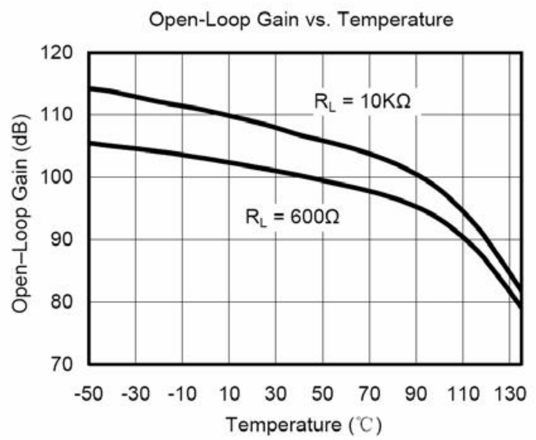

Channel Separation vs. Frequency
Channel Separation (dB)
Frequency (kHz)
V_S = 5V
R_L = 620Ω
T_A = 25℃
G = 1
140
130
120
110
100
90
0.1
1
10
100
1000

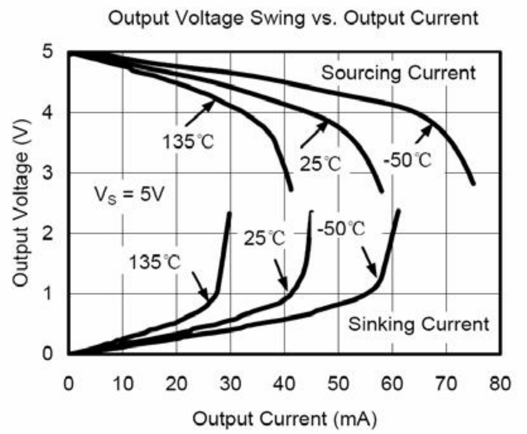

CMRR vs. Temperature
CMRR (dB)
Temperature (℃)
V_S = 5.5V
V_{CM} = -0.1V to 4V
V_{CM} = -0.1V to 5.6V
120
110
100
90
80
70
60
-50
-30
-10
10
30
50
70
90
110
130

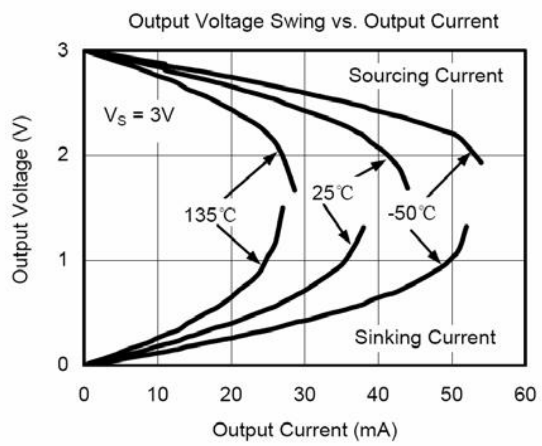

PSRR vs. Temperature
PSRR (dB)
Temperature (℃)
V_S = 2.5V to 5.5V
130
120
110
100
90
80
70
-50
-30
-10
10
30
50
70
90
110
130

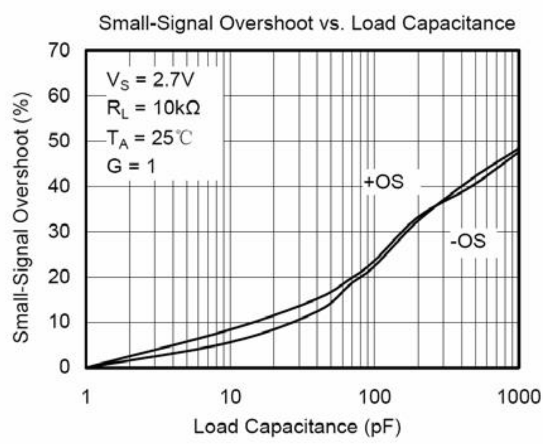

Supply Current vs. Temperature
Supply Current (μA)
Temperature (℃)
V_S = 2.5V
V_S = 3V
V_S = 5V
650
600
550
500
450
400
350
300
250
-50 -30 -10 10 30 50 70 90 110 130


Shutdown Current vs. Temperature
Shutdown Current (nA)
Temperature (℃)
V_S = 5V
V_S = 3V
V_S = 2.5V
210
180
150
120
90
60
30
0
-50 -30 -10 10 30 50 70 90 110 130

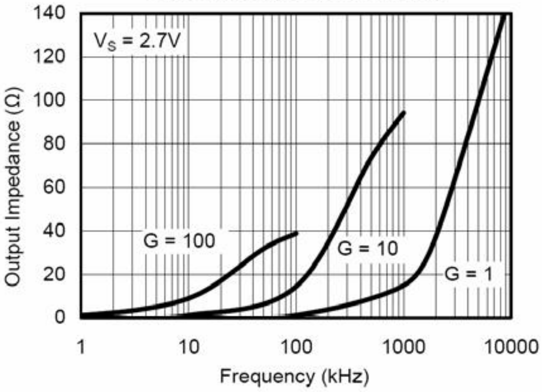

Open-Loop Gain vs. Temperature
Open–Loop Gain (dB)
Temperature (℃)
R_L = 10KΩ
R_L = 600Ω
120
110
100
90
80
70
-50 -30 -10 10 30 50 70 90 110 130


Output Voltage Swing vs. Output Current
Output Voltage (V)
Output Current (mA)
Sourcing Current
Sinking Current
V_S = 5V
135℃
25℃
-50℃
135℃
25℃
-50℃
5
4
3
2
1
0
0 10 20 30 40 50 60 70 80

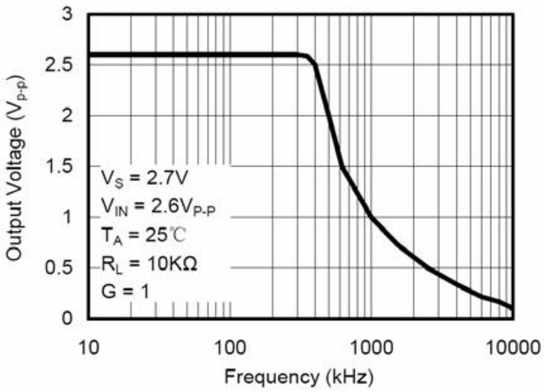

Output Voltage Swing vs. Output Current
Output Voltage (V)
Output Current (mA)
Sourcing Current
Sinking Current
V_S = 3V
135℃
25℃
-50℃
3
2
1
0
0 10 20 30 40 50 60


Small-Signal Overshoot vs. Load Capacitance
Small-Signal Overshoot (%)
Load Capacitance (pF)
V_S = 2.7V
R_L = 10kΩ
T_A = 25℃
G = 1
+OS
-OS
70
60
50
40
30
20
10
0
1 10 100 1000

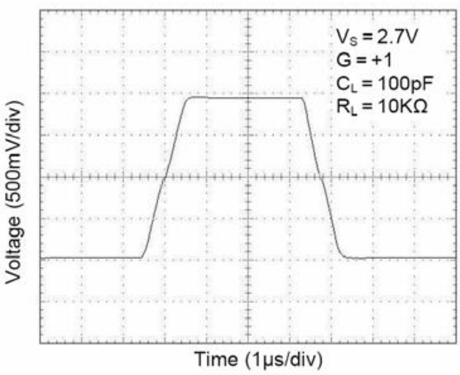
Output Impedance vs. Frequency



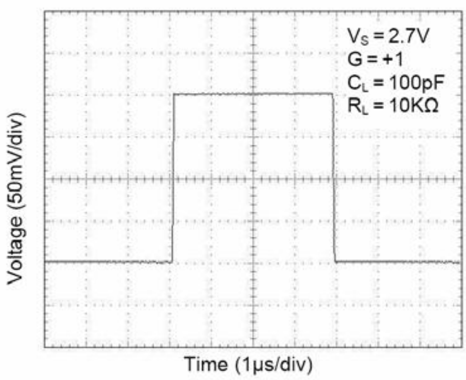
Closed-Loop Output Voltage Swing



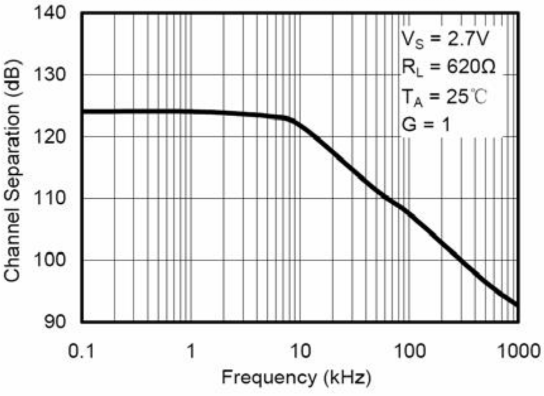
Large-Signal Step Response



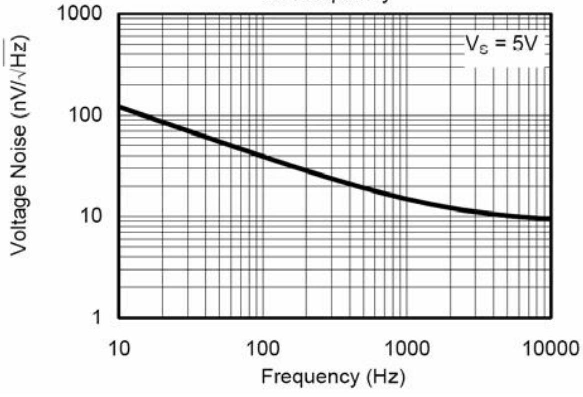
Small-Signal Step Response



Channel Separation vs. Frequency

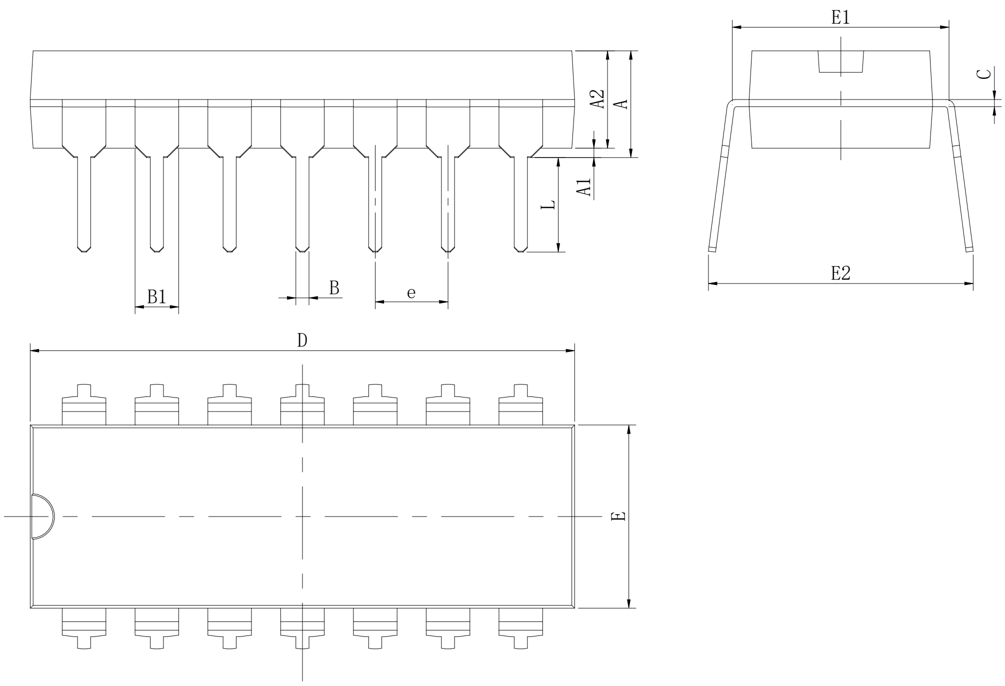


Input Voltage Noise Spectral Density vs. Frequency



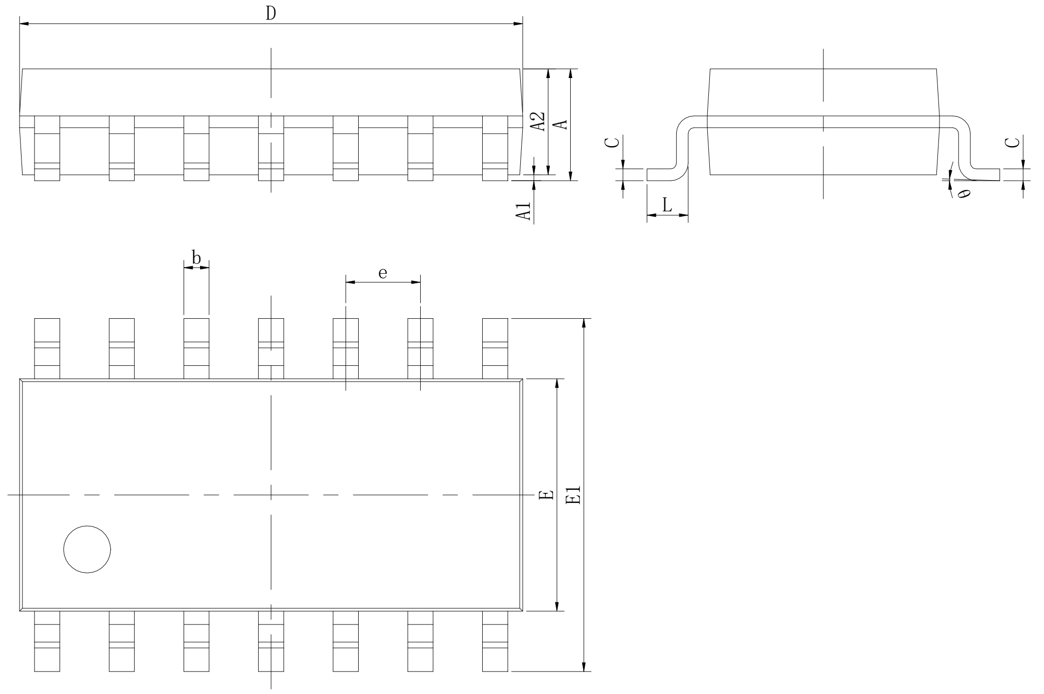
Outline Dimensions

DIP14 Unit: mm



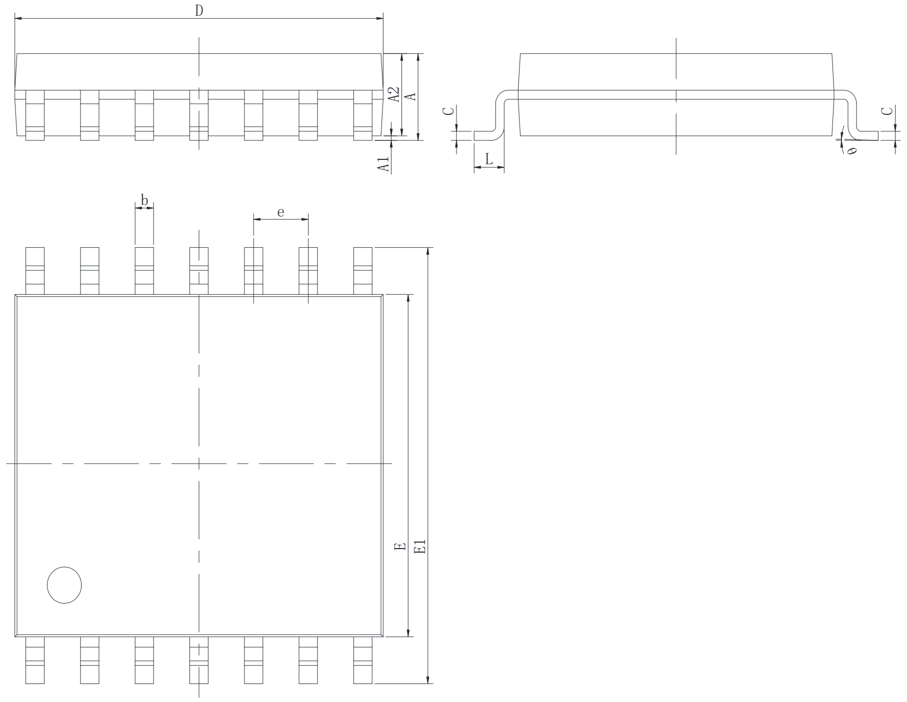
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.710	4.310	0.146	0.170
A1	0.510		0.020	
A2	3.200	3.600	0.126	0.142
B	0.380	0.570	0.015	0.022
B1	1.524(BSC)		0.060(BSC)	
C	0.204	0.360	0.008	0.014
D	18.800	19.200	0.740	0.756
E	6.200	6.600	0.244	0.260
E1	7.320	7.920	0.288	0.312
e	2.540(BSC)		0.100(BSC)	
L	3.000	3.600	0.118	0.142
E2	7.800	9.000	0.307	0.354

SOP14 Unit: mm



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	8.360	8.760	0.329	0.345
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

TSSOP14 Unit: mm



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.900	1.050	0.035	0.041
b	0.200	0.280	0.007	0.011
c	0.130	0.170	0.005	0.006
D	4.900	5.100	0.192	0.200
E	4.300	4.500	0.169	0.177
E1	6.200	6.600	0.244	0.259
e	0.650(BSC)		0.025(BSC)	
L	0.450	0.750	0.017	0.029
θ	0°	8°	0°	8°

Statements

- Silicore Technology reserves the right to make changes without further notice to any products or specifications herein. Before customers place an order, customers need to confirm whether datasheet obtained is the latest version, and to verify the integrity of the relevant information.

- Failure or malfunction of any semiconductor products may occur under particular conditions, customers shall have obligation to comply with safety standards when customers use Silicore Technology products to do their system design and machine manufacturing, and take corresponding safety measures in order to avoid potential risk of failure that may cause personal injury or property damage.

- The product upgrades without end, Silicore Technology will wholeheartedly provide customers integrated circuits that have better performance and better quality.