TS1871
TS1872
TS1874

1.8V INPUT/OUTPUT RAIL TO RAIL LOW POWER OPERATIONAL AMPLIFIERS

- OPERATING AT V_{CC} = 1.8V to 6V
- RAIL TO RAIL **INPUT & OUTPUT**
- EXTENDED Vicm (V_{ee} - 0.2V to V_{CC} + 0.2V)
- LOW SUPPLY CURRENT (400µA)
- GAIN BANDWIDTH PRODUCT (1.6MHz)
- HIGH STABILITY
- ESD TOLERANCE (2kV)
- LATCH-UP IMMUNITY
- AVAILABLE IN **SOT23-5 MICROPACKAGE**

DESCRIPTION

The TS187x (Single, Dual & Quad) is operational amplifier able to operate with voltages as low as 1.8V and features both I/O Rail to Rail.

The common mode input voltage extends 200mV @ 25°C beyond the supply voltages while the output voltage swing is within 100mV of each Rail for a 600W load resistor. This I/O Rail to Rail configuration gives the chance to the user to have the entire supply voltage range available. Offering 20mA min., 65mA typ. value and exhibiting an excellent speed-power ratio, 1.6MHz GBP & 400µA supply current, this Op-Amp is very well-suited for battery-supplied and portable applications.

Stability and minimum overshoot with capacitive loads is maintained by 53° typ. of phase margin with 100pF load capacitor @ 1.8V.

APPLICATION

- Battery-powered applications
- Portable communication devices (cell phone)
- Active filters
- Audio driver

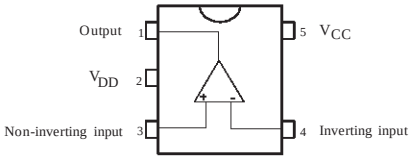
ORDER CODE

Part Number	Temperature Range	Package				SOT23 Marking
		N	D	P	L	
TS1871I/AI	-40, +125°C		•		•	K161/K162
TS1872I/AI		•	•	•		
TS1874I/AI		•	•	•		

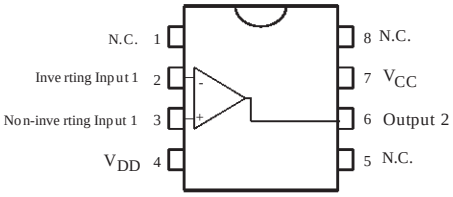
N = Dual in Line Package (DIP)
D = Small Outline Package (SO) - also available in Tape & Reel (DT)
P = Thin Shrink Small Outline Package (TSSOP) - only available in Tape & Reel (PT)
L = Tiny Package (SOT23-5) - only available in Tape & Reel (LT)

PIN CONNECTIONS (top view)

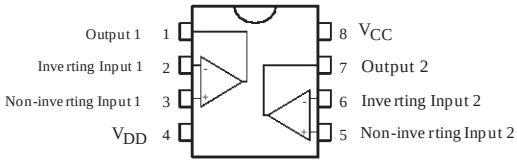
TS1871ILT



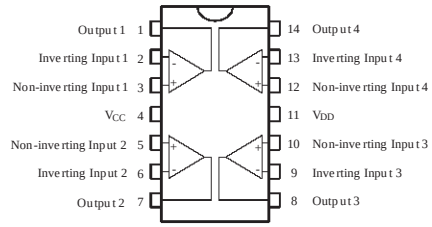
TS1871ID-TS1871IDT



TS1872IN-TS1872ID-TS1872IDT-TS1872IPT



TS1874IN-TS1874ID-TS1874IDT-TS1874IPT



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage [1]	7	V
V_{id}	Differential Input Voltage [2]	±1	V
V_i	Input Voltage [3]	-0.3 to V_{CC} +0.3	V
T_{oper}	Operating Free Air Temperature Range	-40 to + 125	°C
T_{stg}	Storage Temperature	-65 to +150	°C
T_j	Maximum Junction Temperature	150	°C
R_{thjc}	Thermal Resistance Junction to Case [4] SOT23-5 DIP8 DIP14 SO8 SO14 TSSOP8 TSSOP14	 81 42 32 28 22 26 21	°C/W
R_{thja}	Thermal Resistance Junction to Ambient - SOT23-5	256	°C/W
ESD	Human Body Model	2	kV
	Latch-up Immunity	Class A	
	Lead Temperature (soldering, 10sec)	260	°C

1. All voltages values, except differential voltage are with respect to network terminal.
2. Differential voltages are non-inverting input terminal with respect to the inverting input terminal.
3. The magnitude of input and output voltages must never exceed V_{CC} +0.3V.
4. Short-circuits can cause excessive heating. Destructive dissipation can result from simultaneous short-circuit on all amplifiers

OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	1.8 to 6	V
V_{icm}	Common Mode Input Voltage Range [1]	V_{ee} -0.2 to V_{CC} + 0.2	V
V_{icm}	Common Mode Input Voltage Range [2]	V_{ee} to V_{CC}	V

1. At 25°C, for $1.8 \le V_{CC} \le 6V$, V_{icm} is extended to V_{ee} - 0.2V, V_{CC} + 0.2V.
2. In full temperature range, both Rails can be reached when V_{CC} does not exceed 5.5V.

ELECTRICAL CHARACTERISTICS

V_{CC} = **+1.8V**, V_{ee} = **0V**, R_L, C_L connected to $V_{CC}/2$, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage $V_{icm} = V_{out} = V_{CC}/2$ TS1871/2/4 TS1871A/2A/4A		 0.1	 3 1	mV
ΔV_{io}	Input Offset Voltage Drift		2		µV/°C
I_{io}	Input Offset Current [1] $V_{icm} = V_{out} = V_{CC}/2$		3	28	nA
I_{ib}	Input Bias Current [1] $V_{icm} = V_{out} = V_{CC}/2$		40	125	nA
CMR	Common Mode Rejection Ratio $0 \le V_{icm} \le V_{CC}$, $V_{out} = V_{CC}/2$	55	77		dB
SVR	Supply Voltage Rejection Ratio	70	80		dB
A_{vd}	Large Signal Voltage Gain V_{out} = 0.5V to 1.3V R_L = 2kΩ R_L = 600Ω	 77 70	 92 85		dB
V_{OH}	High Level Output Voltage V_{id} = 100mV R_L = 2kΩ R_L = 600Ω	 1.65 1.62	 1.77 1.74		V
V_{OL}	Low Level Output Voltage V_{id} = -100mV R_L = 2kΩ R_L = 600Ω	 	 88 115	 100 150	mV
I_o	Output Source Current V_{ID} = 100mV, $V_O = V_{DD}$ Output Sink Current V_{ID} = -100mV, $V_O = V_{CC}$	 20 20	 65 65		mA
I_{CC}	Supply Current (per amplifier) A_{VCL} = 1, no load		400	560	µA
GBP	Gain Bandwith Product R_L = 10kΩ, C_L = 100pF, f = 100kHz	0.9	1.6		MHz
SR	Slew Rate R_L = 10kΩ, C_L = 100pF, AV = 1	0.68	0.54		V/µs
ϕm	Phase Margin C_L = 100pF		53		Degrees
en	Input Voltage Noise		40		nV/√Hz
THD	Total Harmonic Distortion		0.01		%

1. Maximum values including unavoidable inaccuracies of the industrial test.

ELECTRICAL CHARACTERISTICS

V_{CC} = **+3V**, V_{ee} = **0V**, R_L, C_L connected to $V_{CC}/2$, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage $V_{icm} = V_{out} = V_{CC}/2$ TS1871/2/4 TS1871A/2A/4A		 0.1	 3 1	mV
ΔV_{io}	Input Offset Voltage Drift		2		µV/°C
I_{io}	Input Offset Current [1] $V_{icm} = V_{out} = V_{CC}/2$		3	28	nA
I_{ib}	Input Bias Current [1] $V_{icm} = V_{out} = V_{CC}/2$		4	125	nA
CMR	Common Mode Rejection Ratio $0 \le V_{icm} \le V_{CC}$, $V_{out} = V_{CC}/2$	60	80		dB
SVR	Supply Voltage Rejection Ratio	70	85		dB
A_{vd}	Large Signal Voltage Gain V_{out} = 0.5V to 2.5V R_L = 2kΩ R_L = 600Ω	 80 74	 92 95		dB
V_{OH}	High Level Output Voltage V_{id} = 100mV R_L = 2kΩ R_L = 600Ω	 2.82 2.80	 2.95 2.95		V
V_{OL}	Low Level Output Voltage V_{id} = -100mV R_L = 2kΩ R_L = 600Ω		 88 115	 120 160	mV
I_o	Output Source Current V_{ID} = 100mV, $V_O = V_{DD}$ Output Sink Current V_{ID} = -100mV, $V_O = V_{CC}$	 20 20	 80 80		mA
I_{CC}	Supply Current (per amplifier) A_{VCL} = 1, no load		450	650	µA
GBP	Gain Bandwith Product R_L = 10kΩ, C_L = 100pF, f = 100kHz	1	1.7		kHz
SR	Slew Rate R_L = 10kΩ, C_L = 100pF, AV = 1	0.42	0.6		V/µs
ϕm	Phase Margin C_L = 100pF		53		Degrees
en	Input Voltage Noise		40		nV/√Hz
THD	Total Harmonic Distortion		0.01		%

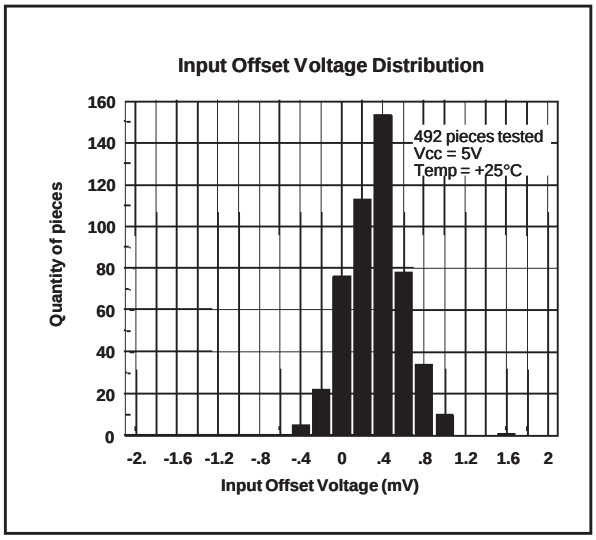
1. Maximum values including unavoidable inaccuracies of the industrial test.

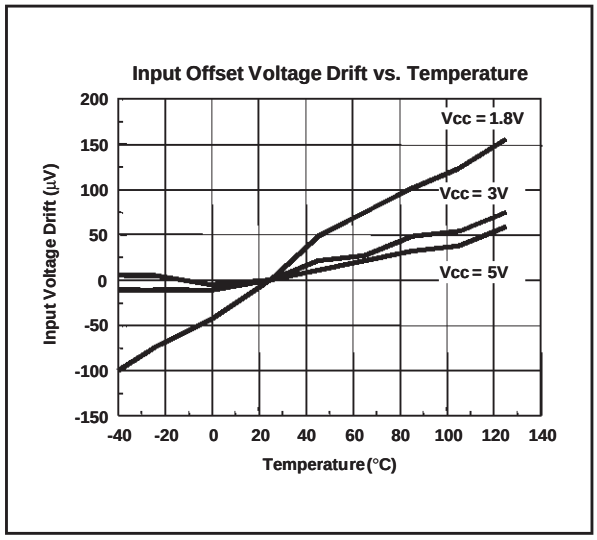
ELECTRICAL CHARACTERISTICS

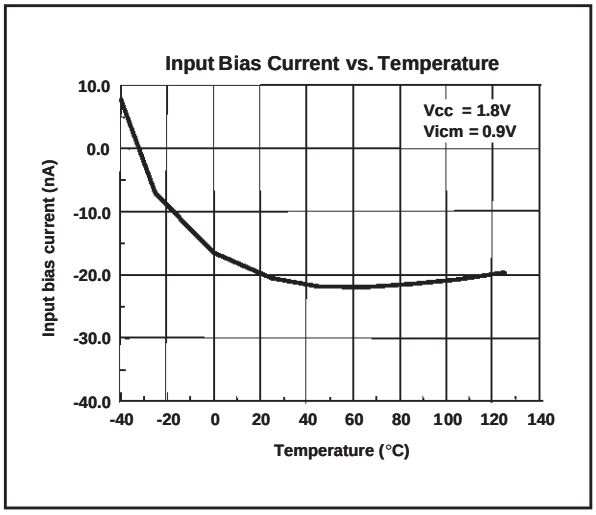
V_{CC} = **+5V**, V_{ee} = **0V**, R_L, C_L connected to $V_{CC}/2$,
T_{amb} = 25°C (unless otherwise specified)

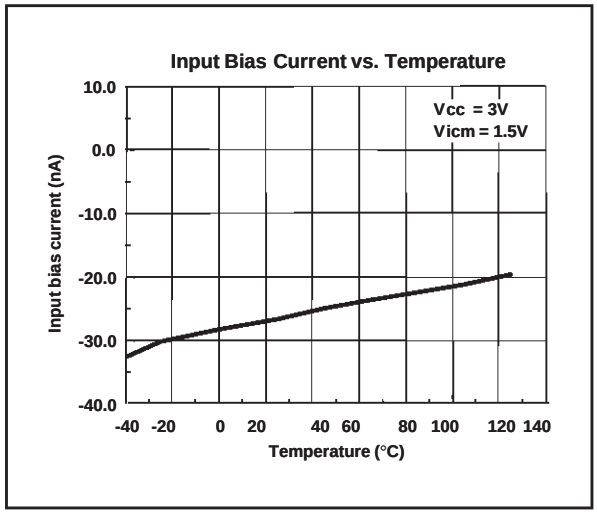
Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage $V_{icm} = V_{out} = V_{CC}/2$ TS1871/2/4 TS1871A/2A/4A		0.1	3 1	mV
ΔV_{io}	Input Offset Voltage Drift		2		µV/°C
I_{io}	Input Offset Current [1] $V_{icm} = V_{out} = V_{CC}/2$		3	30	nA
I_{ib}	Input Bias Current [1] $V_{icm} = V_{out} = V_{CC}/2$		68	130	nA
CMR	Common Mode Rejection Ratio $0 \le V_{icm} \le V_{CC}$, V_{out} different of $V_{CC}/2$	65	85		dB
SVR	Supply Voltage Rejection Ratio	70	90		dB
A_{vd}	Large Signal Voltage Gain V_{out} = 1V to 4V R_L = 2kΩ R_L = 600Ω	 83 77	 92 85		dB
V_{OH}	High Level Output Voltage V_{id} = 100mV R_L = 2kΩ R_L = 600Ω	 4.80 4.75	 4.95 4.90		V
V_{OL}	Low Level Output Voltage V_{id} = -100mV R_L = 2kΩ R_L = 600Ω		 88 115	 130 188	mV
I_o	Output Source Current V_{ID} = 100mV, $V_O = V_{DD}$ Output Sink Current V_{ID} = -100mV, $V_O = V_{CC}$	20 20	80 80		mA
I_{CC}	Supply Current (per amplifier) A_{VCL} = 1, no load		513	835	µA
GBP	Gain Bandwith Product R_L = 10kΩ, C_L = 100pF, f = 100kHz	1	1.8		kHz
SR	Slew Rate R_L = 10kΩ, C_L = 100pF, AV = 1	0.42	0.6		V/µs
ϕm	Phase Margin C_L = 100pF		55		Degrees
en	Input Voltage Noise		40		nV/√Hz
THD	Total Harmonic Distortion		0.01		%

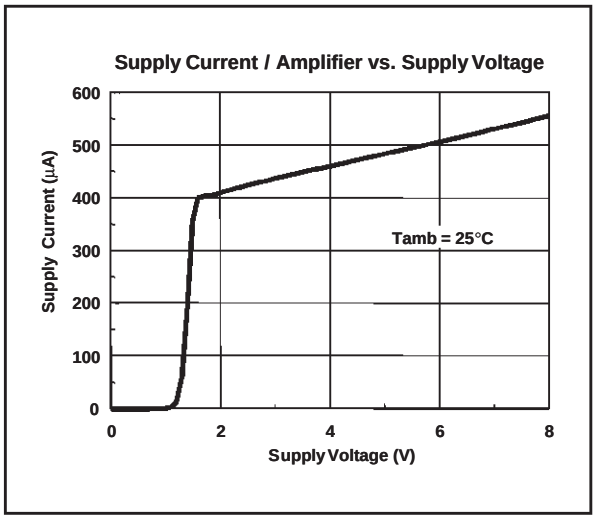
1. Maximum values including unavoidable inaccuracies of the industrial test.

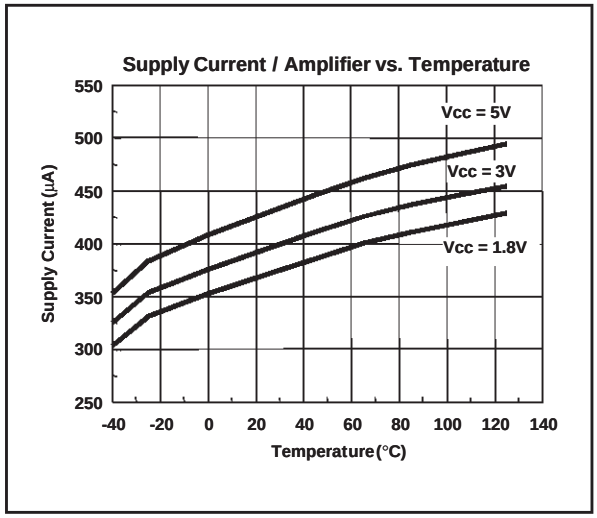

Input Offset Voltage Distribution
Quantity of pieces
160
140
120
100
80
60
40
20
0
492 pieces tested
Vcc = 5V
Temp = +25°C
-2. -1.6 -1.2 -.8 -.4 0 .4 .8 1.2 1.6 2
Input Offset Voltage (mV)

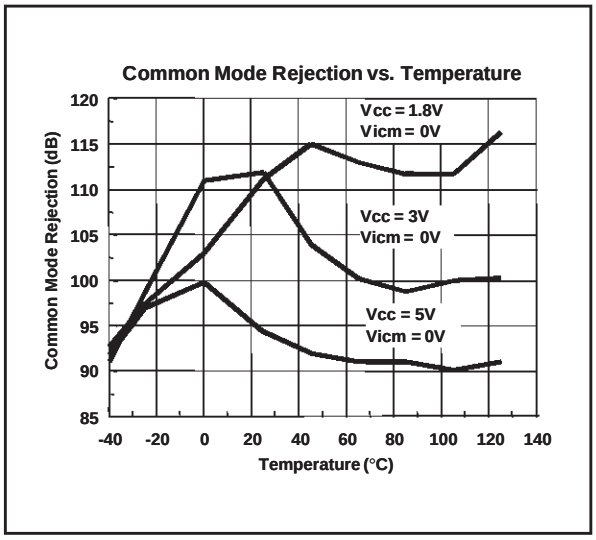

Input Offset Voltage Drift vs. Temperature
Input Voltage Drift (µV)
200
150
100
50
0
-50
-100
-150
Vcc = 1.8V
Vcc = 3V
Vcc = 5V
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)

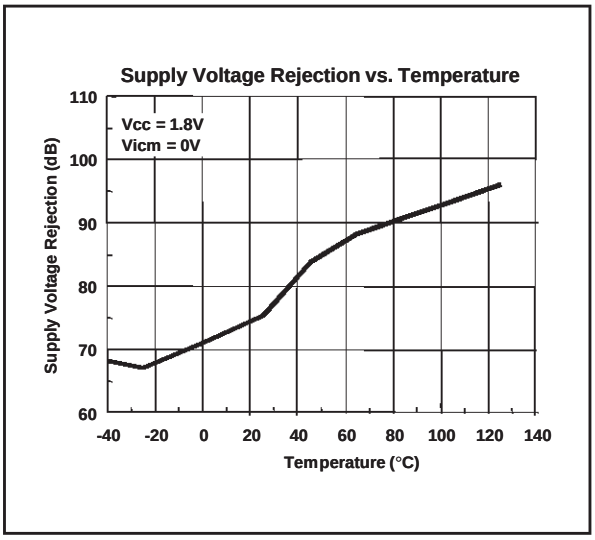

Input Bias Current vs. Temperature
Input bias current (nA)
10.0
0.0
-10.0
-20.0
-30.0
-40.0
Vcc = 1.8V
Vicm = 0.9V
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)

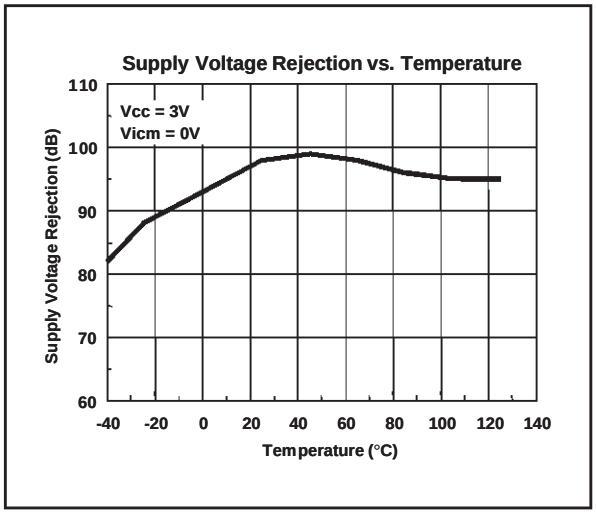

Input Bias Current vs. Temperature
Input bias current (nA)
10.0
0.0
-10.0
-20.0
-30.0
-40.0
Vcc = 3V
Vicm = 1.5V
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)

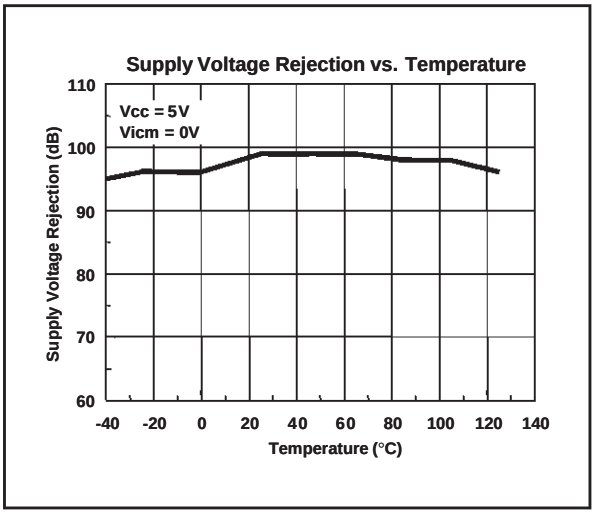

Supply Current / Amplifier vs. Supply Voltage
Supply Current (µA)
600
500
400
300
200
100
0
Tamb = 25°C
0 2 4 6 8
Supply Voltage (V)

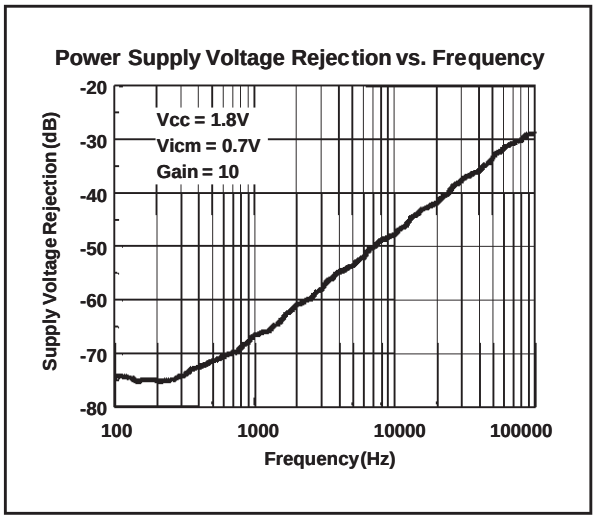

Supply Current / Amplifier vs. Temperature
Supply Current (µA)
550
500
450
400
350
300
250
Vcc = 5V
Vcc = 3V
Vcc = 1.8V
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)

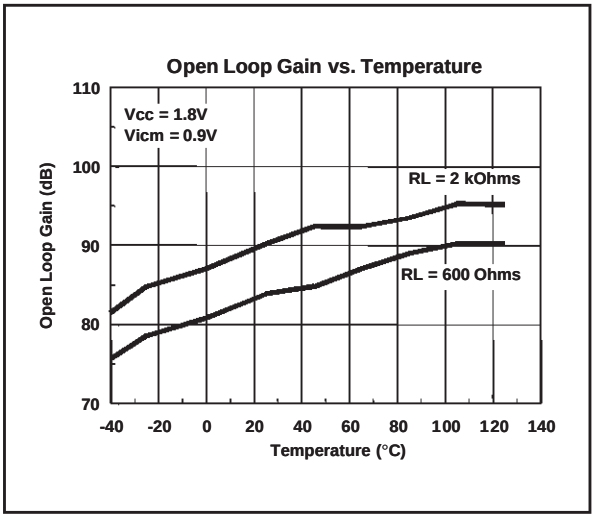

Common Mode Rejection vs. Temperature
Common Mode Rejection (dB)
120
115
110
105
100
95
90
85
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)
Vcc = 1.8V
Vicm = 0V
Vcc = 3V
Vicm = 0V
Vcc = 5V
Vicm = 0V

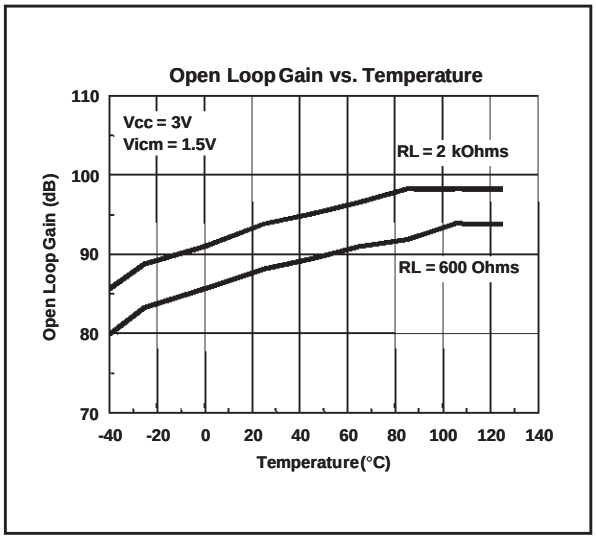

Supply Voltage Rejection vs. Temperature
Supply Voltage Rejection (dB)
110
100
90
80
70
60
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)
Vcc = 1.8V
Vicm = 0V

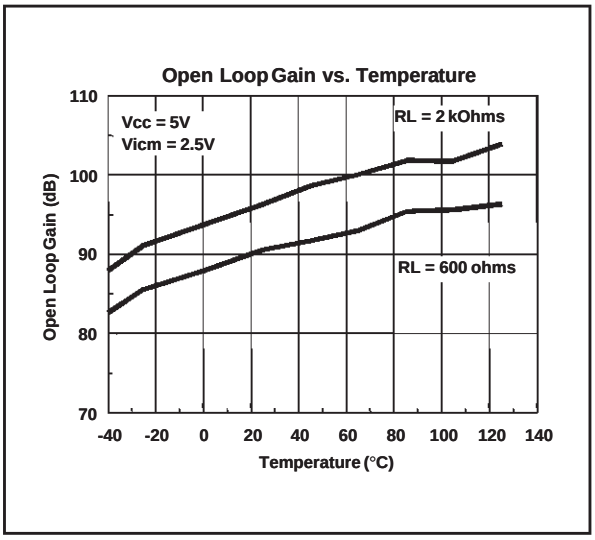

Supply Voltage Rejection vs. Temperature
Supply Voltage Rejection (dB)
110
100
90
80
70
60
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)
Vcc = 3V
Vicm = 0V

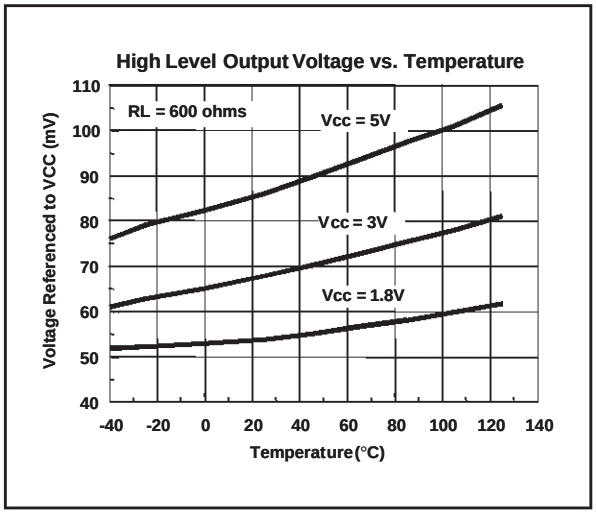

Supply Voltage Rejection vs. Temperature
Supply Voltage Rejection (dB)
110
100
90
80
70
60
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)
Vcc = 5V
Vicm = 0V

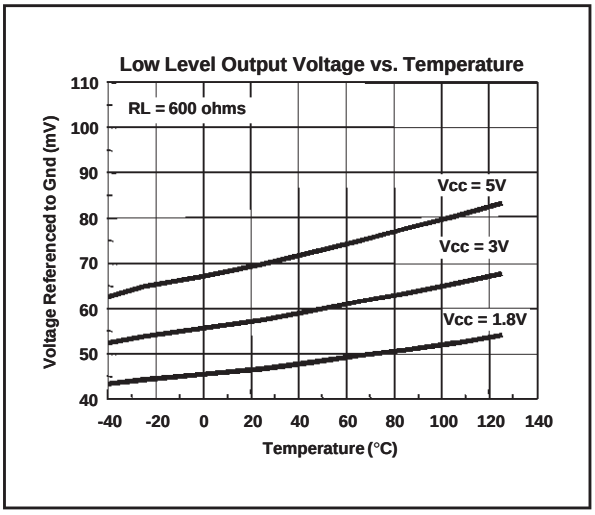

Power Supply Voltage Rejection vs. Frequency
Supply Voltage Rejection (dB)
-20
-30
-40
-50
-60
-70
-80
100 1000 10000 100000
Frequency (Hz)
Vcc = 1.8V
Vicm = 0.7V
Gain = 10

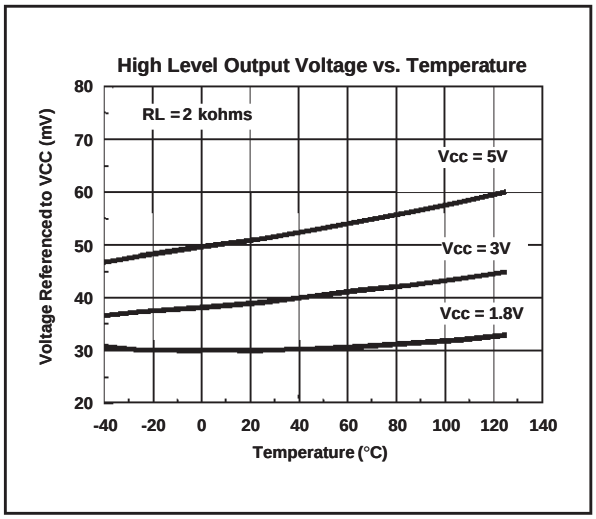

Open Loop Gain vs. Temperature
Open Loop Gain (dB)
110
100
90
80
70
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)
Vcc = 1.8V
Vicm = 0.9V
RL = 2 kOhms
RL = 600 Ohms

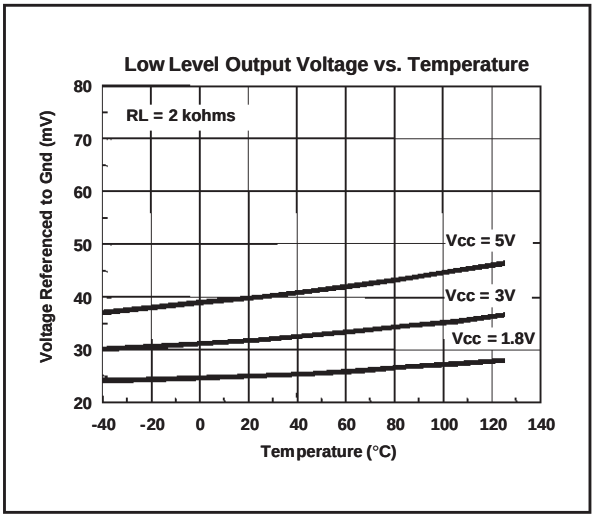

Open Loop Gain vs. Temperature
Vcc = 3V
Vicm = 1.5V
RL = 2 kOhms
RL = 600 Ohms
Open Loop Gain (dB)
Temperature (°C)

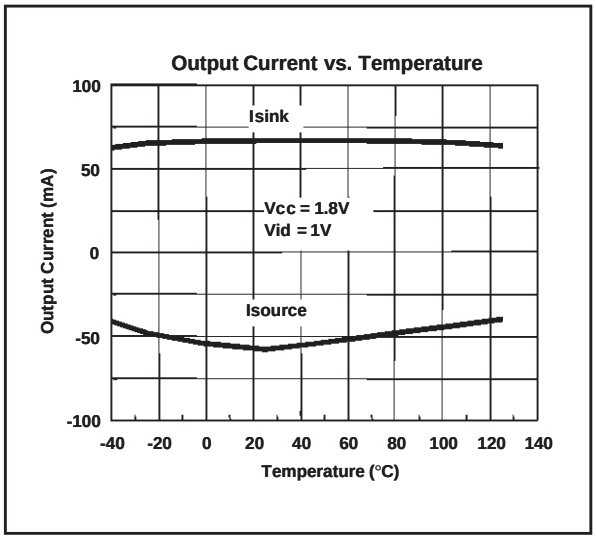

Open Loop Gain vs. Temperature
Vcc = 5V
Vicm = 2.5V
RL = 2 kOhms
RL = 600 ohms
Open Loop Gain (dB)
Temperature (°C)

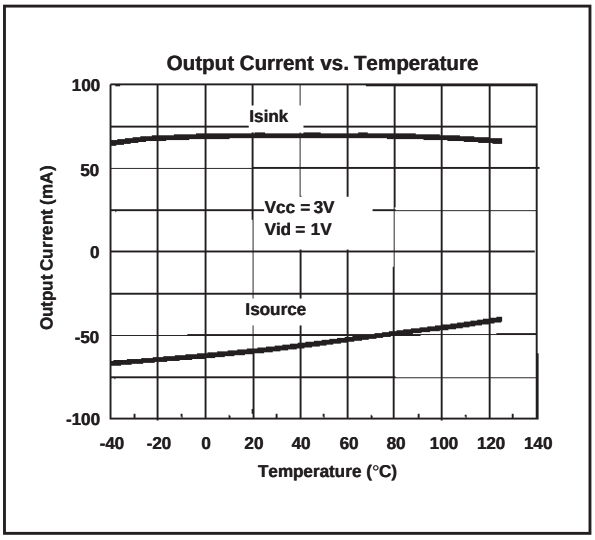

High Level Output Voltage vs. Temperature
RL = 600 ohms
Vcc = 5V
Vcc = 3V
Vcc = 1.8V
Voltage Referenced to VCC (mV)
Temperature (°C)

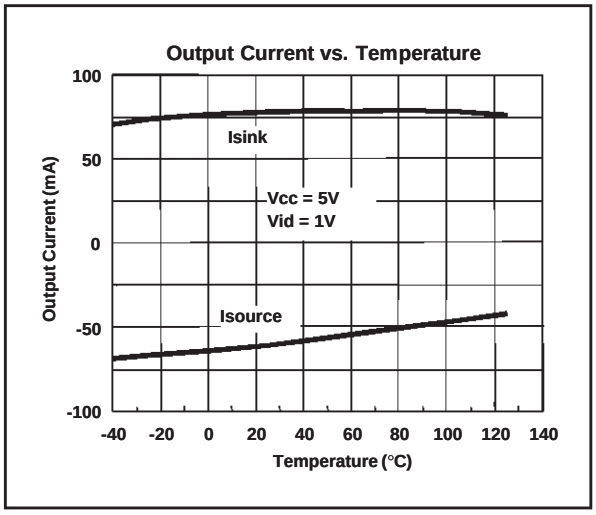

Low Level Output Voltage vs. Temperature
RL = 600 ohms
Vcc = 5V
Vcc = 3V
Vcc = 1.8V
Voltage Referenced to Gnd (mV)
Temperature (°C)

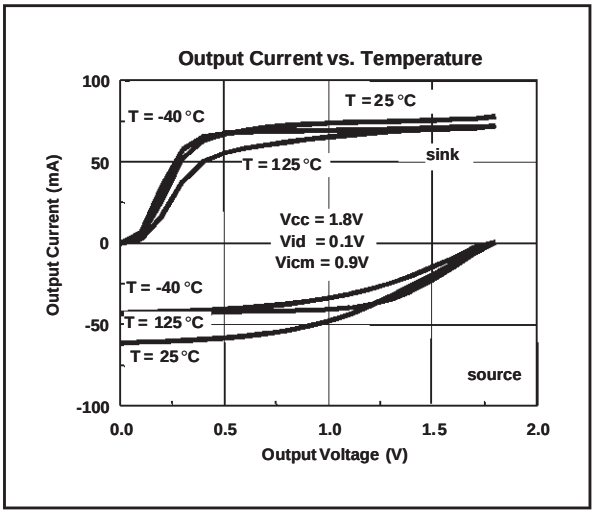

High Level Output Voltage vs. Temperature
RL = 2 kohms
Vcc = 5V
Vcc = 3V
Vcc = 1.8V
Voltage Referenced to VCC (mV)
Temperature (°C)

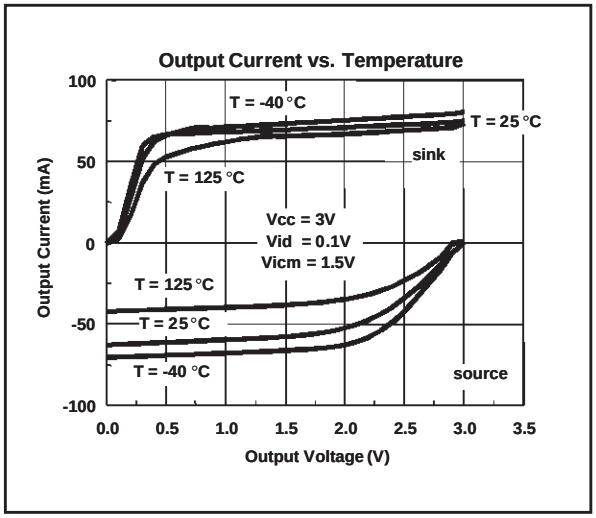

Low Level Output Voltage vs. Temperature
RL = 2 kohms
Vcc = 5V
Vcc = 3V
Vcc = 1.8V
Voltage Referenced to Gnd (mV)
Temperature (°C)

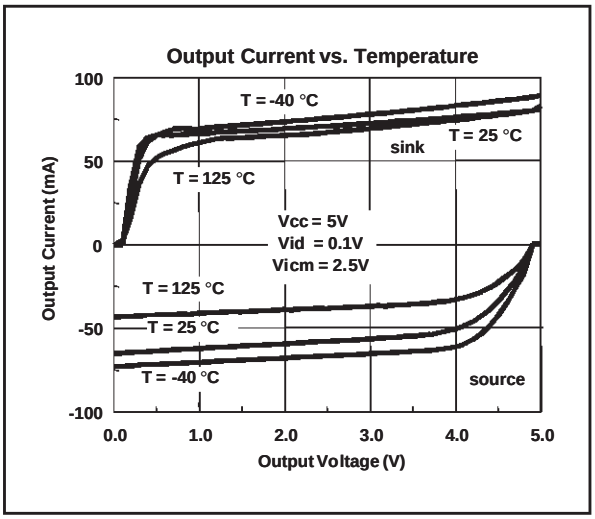

Output Current vs. Temperature
Isink
Vcc = 1.8V
Vid = 1V
Isource
Output Current (mA)
Temperature (°C)

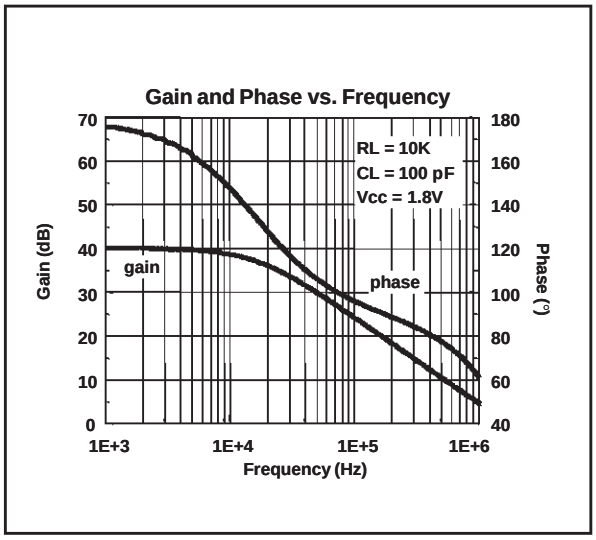

Output Current vs. Temperature
Isink
Vcc = 3V
Vid = 1V
Isource
Output Current (mA)
Temperature (°C)

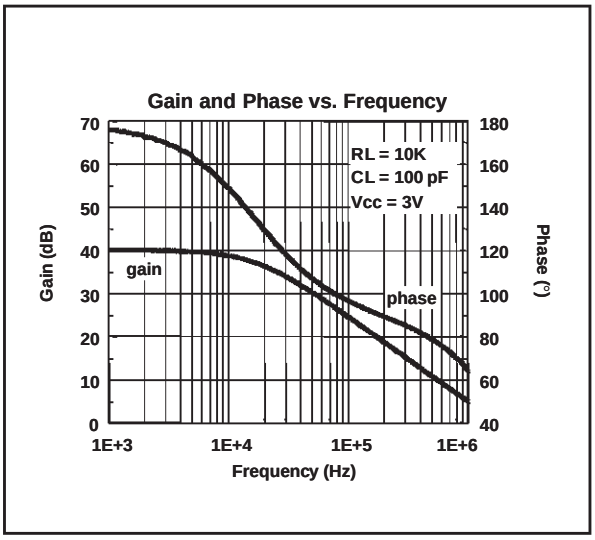

Output Current vs. Temperature
Isink
Vcc = 5V
Vid = 1V
Isource
Output Current (mA)
Temperature (°C)

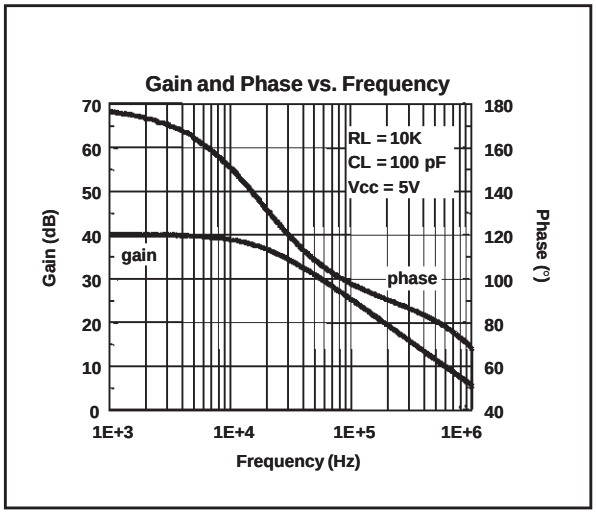

Output Current vs. Temperature
T = -40 °C
T = 25 °C
T = 125 °C
sink
Vcc = 1.8V
Vid = 0.1V
Vicm = 0.9V
T = -40 °C
T = 125 °C
T = 25 °C
source
Output Current (mA)
Output Voltage (V)

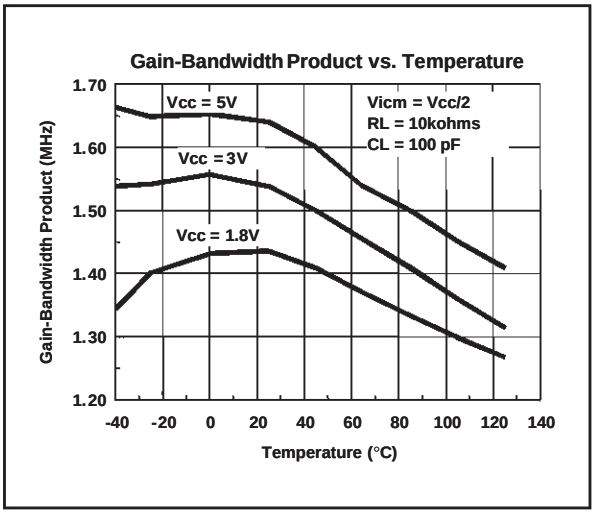

Output Current vs. Temperature
T = -40 °C
T = 25 °C
sink
T = 125 °C
Vcc = 3V
Vid = 0.1V
Vicm = 1.5V
T = 125 °C
T = 25 °C
T = -40 °C
source
Output Current (mA)
Output Voltage (V)

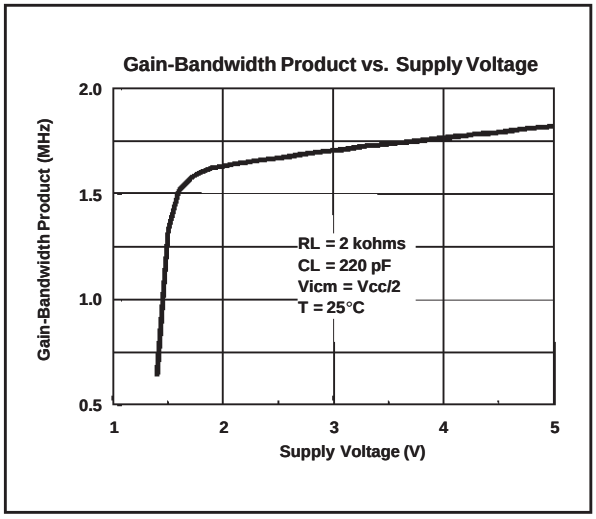

Output Current vs. Temperature
T = -40 °C
T = 25 °C
sink
T = 125 °C
Vcc = 5V
Vid = 0.1V
Vicm = 2.5V
T = 125 °C
T = 25 °C
T = -40 °C
source
Output Current (mA)
Output Voltage (V)

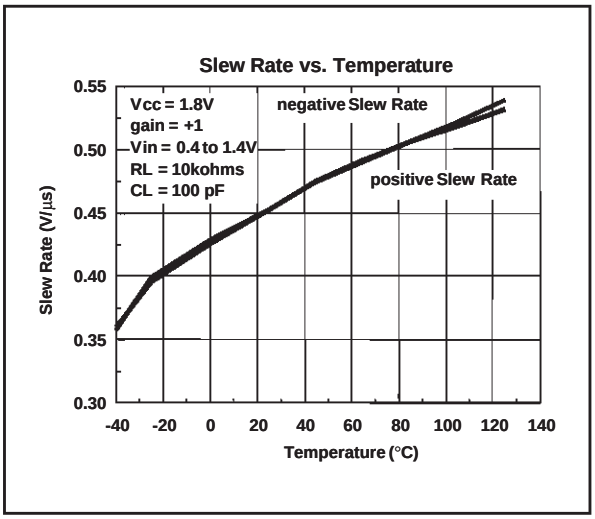

Gain and Phase vs. Frequency
RL = 10K
CL = 100 pF
Vcc = 1.8V
gain
phase
Gain (dB)
Phase (°)
Frequency (Hz)
70
60
50
40
30
20
10
0
180
160
140
120
100
80
60
40
1E+3
1E+4
1E+5
1E+6

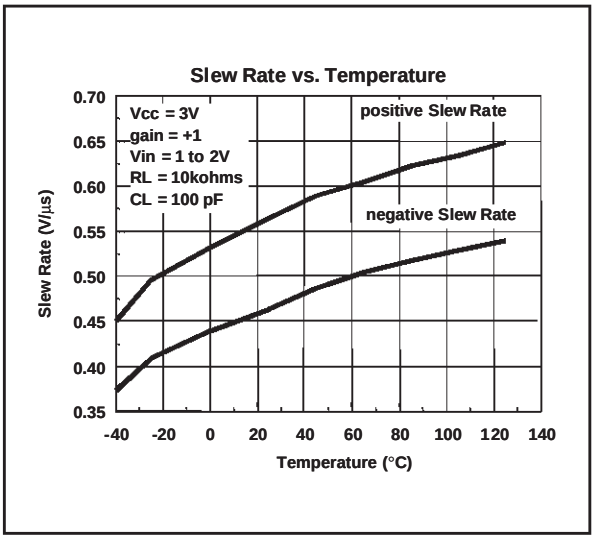

Gain and Phase vs. Frequency
RL = 10K
CL = 100 pF
Vcc = 3V
gain
phase
Gain (dB)
Phase (°)
Frequency (Hz)
70
60
50
40
30
20
10
0
180
160
140
120
100
80
60
40
1E+3
1E+4
1E+5
1E+6

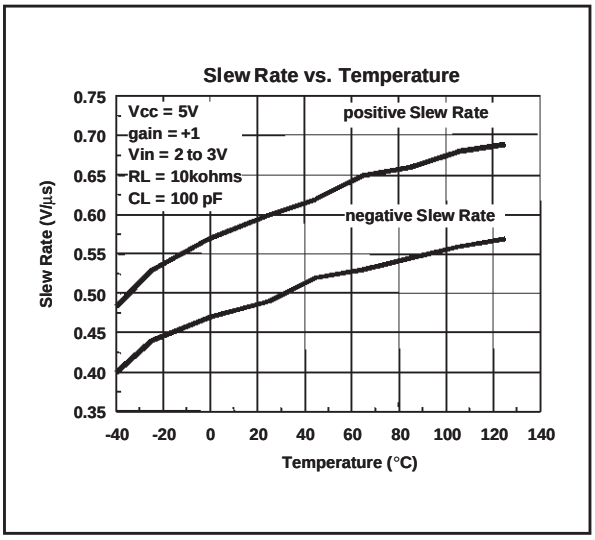

Gain and Phase vs. Frequency
RL = 10K
CL = 100 pF
Vcc = 5V
gain
phase
Gain (dB)
Phase (°)
Frequency (Hz)
70
60
50
40
30
20
10
0
180
160
140
120
100
80
60
40
1E+3
1E+4
1E+5
1E+6

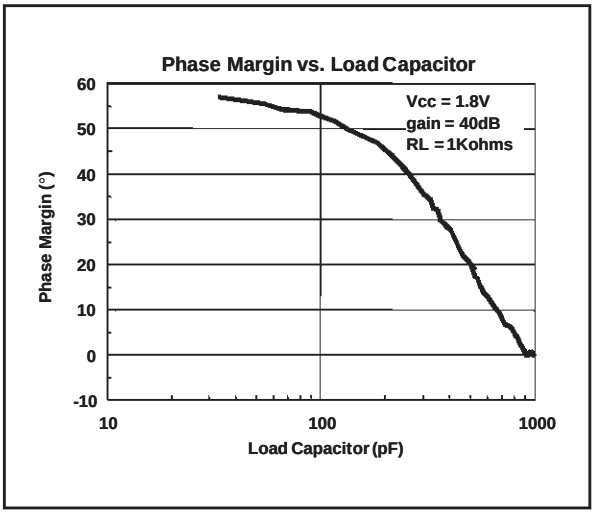

Gain-Bandwidth Product vs. Temperature
Vcc = 5V
Vcc = 3V
Vcc = 1.8V
Vicm = Vcc/2
RL = 10kohms
CL = 100 pF
Gain-Bandwidth Product (MHz)
Temperature (°C)
1.70
1.60
1.50
1.40
1.30
1.20
-40
-20
0
20
40
60
80
100
120
140

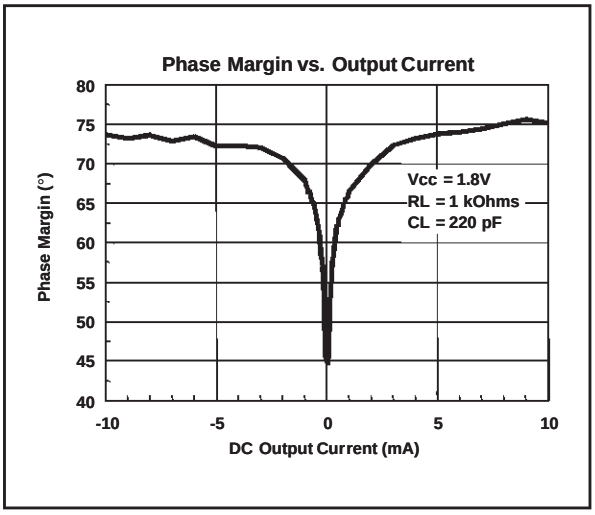

Gain-Bandwidth Product vs. Supply Voltage
RL = 2 kohms
CL = 220 pF
Vicm = Vcc/2
T = 25°C
Gain-Bandwidth Product (MHz)
Supply Voltage (V)
2.0
1.5
1.0
0.5
1
2
3
4
5

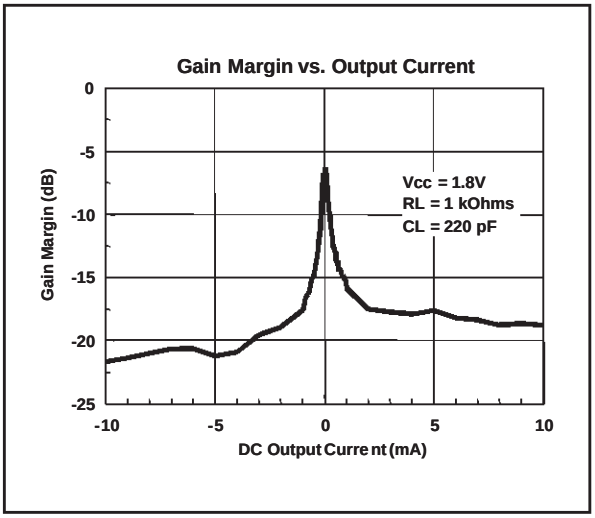

Slew Rate vs. Temperature
Vcc = 1.8V
gain = +1
Vin = 0.4 to 1.4V
RL = 10kohms
CL = 100 pF
negative Slew Rate
positive Slew Rate
Slew Rate (V/µs)
Temperature (°C)
0.55
0.50
0.45
0.40
0.35
0.30
-40
-20
0
20
40
60
80
100
120
140

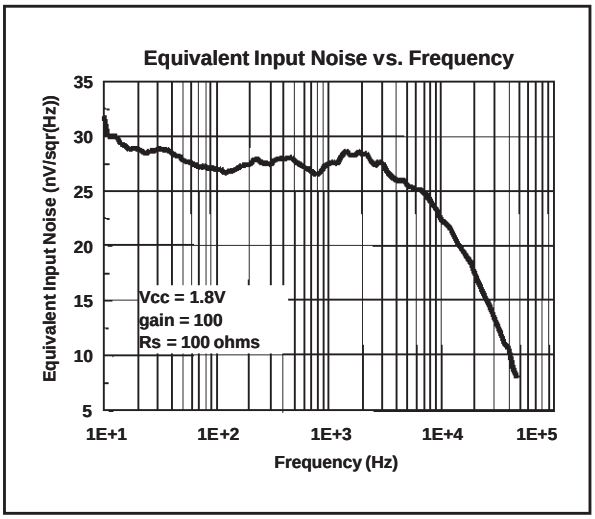

Slew Rate vs. Temperature
Vcc = 3V
gain = +1
Vin = 1 to 2V
RL = 10kohms
CL = 100 pF
positive Slew Rate
negative Slew Rate
Slew Rate (V/µs)
Temperature (°C)

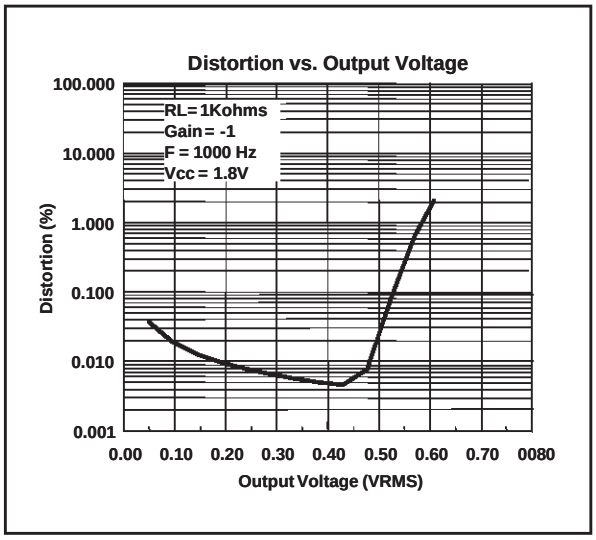

Slew Rate vs. Temperature
Vcc = 5V
gain = +1
Vin = 2 to 3V
RL = 10kohms
CL = 100 pF
positive Slew Rate
negative Slew Rate
Slew Rate (V/µs)
Temperature (°C)

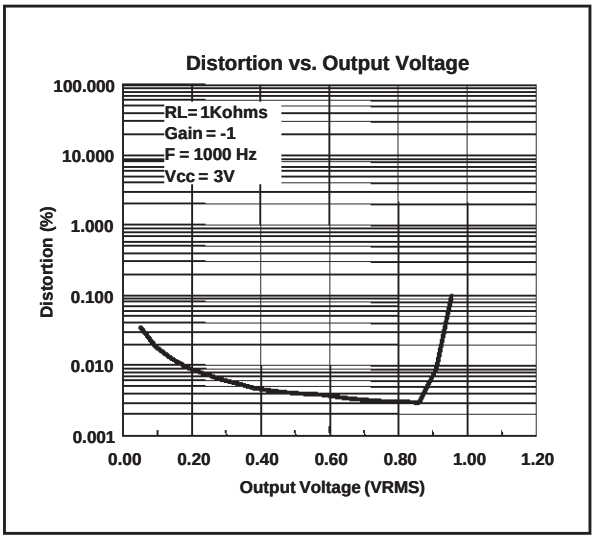

Phase Margin vs. Load Capacitor
Vcc = 1.8V
gain = 40dB
RL = 1Kohms
Phase Margin (°)
Load Capacitor (pF)

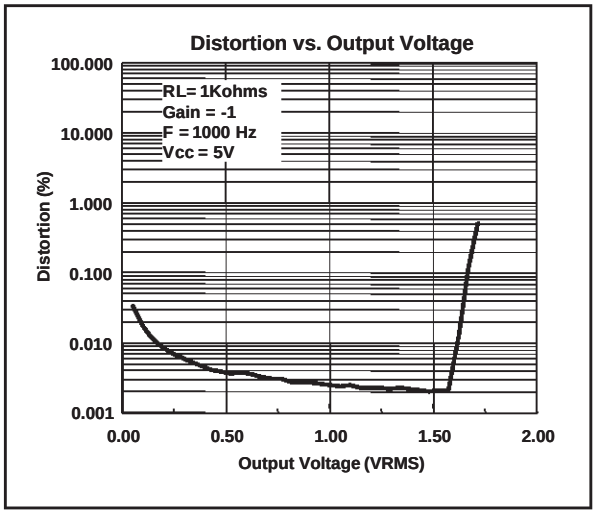

Phase Margin vs. Output Current
Vcc = 1.8V
RL = 1 kOhms
CL = 220 pF
Phase Margin (°)
DC Output Current (mA)

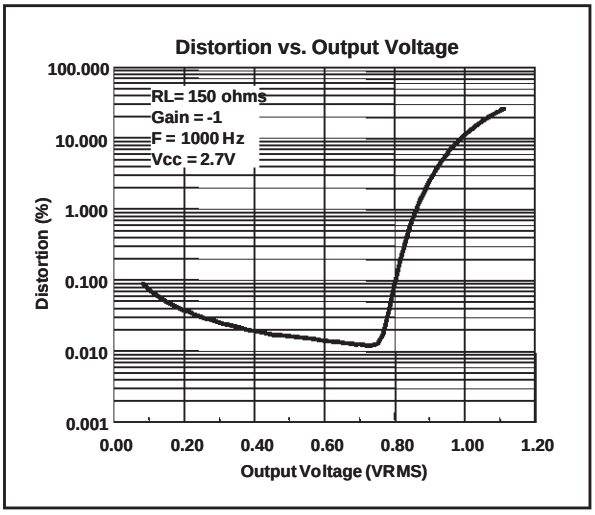

Gain Margin vs. Output Current
Vcc = 1.8V
RL = 1 kOhms
CL = 220 pF
Gain Margin (dB)
DC Output Current (mA)

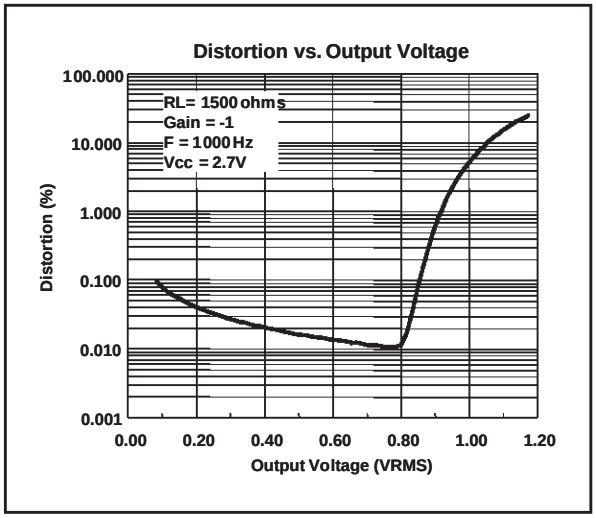

Equivalent Input Noise vs. Frequency
Vcc = 1.8V
gain = 100
Rs = 100 ohms
Equivalent Input Noise (nV/sqr(Hz))
Frequency (Hz)

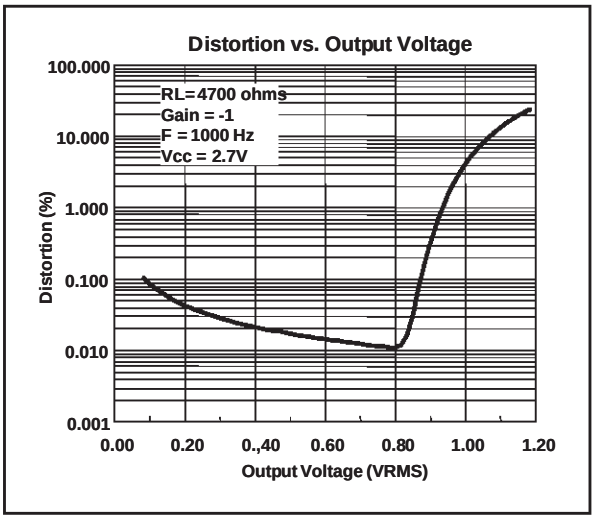

Distortion vs. Output Voltage
RL= 1Kohms
Gain = -1
F = 1000 Hz
Vcc = 1.8V
Distortion (%)
100.000
10.000
1.000
0.100
0.010
0.001
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0080
Output Voltage (VRMS)

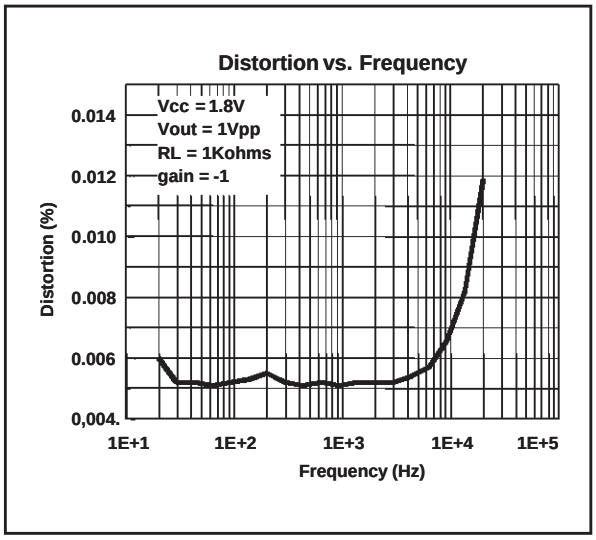

Distortion vs. Output Voltage
RL= 1Kohms
Gain = -1
F = 1000 Hz
Vcc = 3V
Distortion (%)
100.000
10.000
1.000
0.100
0.010
0.001
0.00 0.20 0.40 0.60 0.80 1.00 1.20
Output Voltage (VRMS)

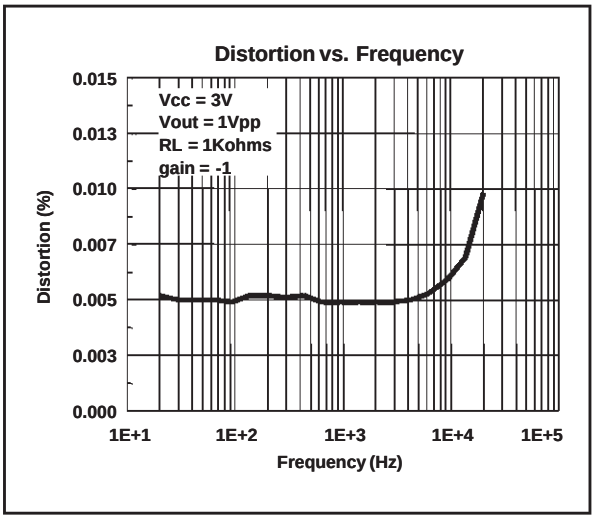

Distortion vs. Output Voltage
RL= 1Kohms
Gain = -1
F = 1000 Hz
Vcc = 5V
Distortion (%)
100.000
10.000
1.000
0.100
0.010
0.001
0.00 0.50 1.00 1.50 2.00
Output Voltage (VRMS)

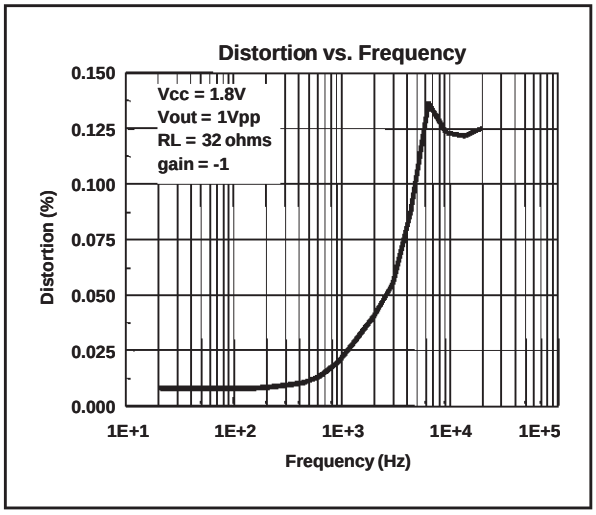

Distortion vs. Output Voltage
RL= 150 ohms
Gain = -1
F = 1000 Hz
Vcc = 2.7V
Distortion (%)
100.000
10.000
1.000
0.100
0.010
0.001
0.00 0.20 0.40 0.60 0.80 1.00 1.20
Output Voltage (VRMS)

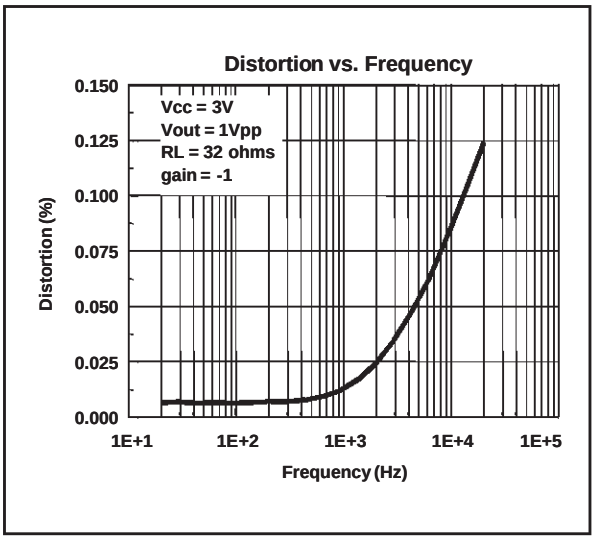

Distortion vs. Output Voltage
RL= 1500 ohms
Gain = -1
F = 1000 Hz
Vcc = 2.7V
Distortion (%)
100.000
10.000
1.000
0.100
0.010
0.001
0.00 0.20 0.40 0.60 0.80 1.00 1.20
Output Voltage (VRMS)

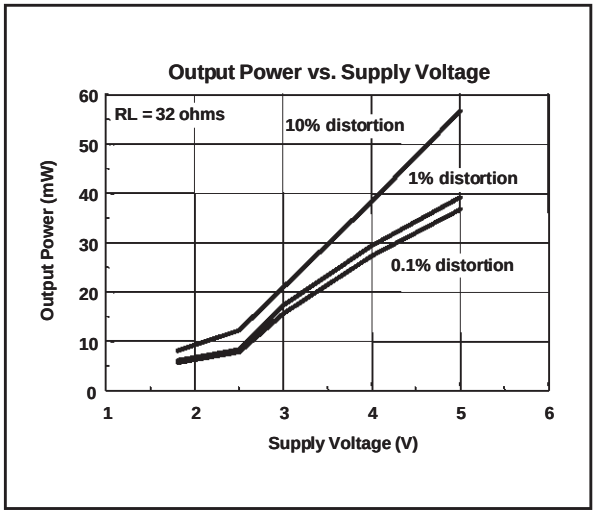

Distortion vs. Output Voltage
RL= 4700 ohms
Gain = -1
F = 1000 Hz
Vcc = 2.7V
Distortion (%)
100.000
10.000
1.000
0.100
0.010
0.001
0.00 0.20 0.,40 0.60 0.80 1.00 1.20
Output Voltage (VRMS)


Distortion vs. Frequency
Vcc = 1.8V
Vout = 1Vpp
RL = 1Kohms
gain = -1
Distortion (%)
0.014
0.012
0.010
0.008
0.006
0,004.
1E+1
1E+2
1E+3
1E+4
1E+5
Frequency (Hz)

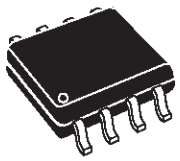

Distortion vs. Frequency
Vcc = 3V
Vout = 1Vpp
RL = 1Kohms
gain = -1
Distortion (%)
0.015
0.013
0.010
0.007
0.005
0.003
0.000
1E+1
1E+2
1E+3
1E+4
1E+5
Frequency (Hz)


Distortion vs. Frequency
Vcc = 1.8V
Vout = 1Vpp
RL = 32 ohms
gain = -1
Distortion (%)
0.150
0.125
0.100
0.075
0.050
0.025
0.000
1E+1
1E+2
1E+3
1E+4
1E+5
Frequency (Hz)


Distortion vs. Frequency
Vcc = 3V
Vout = 1Vpp
RL = 32 ohms
gain = -1
Distortion (%)
0.150
0.125
0.100
0.075
0.050
0.025
0.000
1E+1
1E+2
1E+3
1E+4
1E+5
Frequency (Hz)

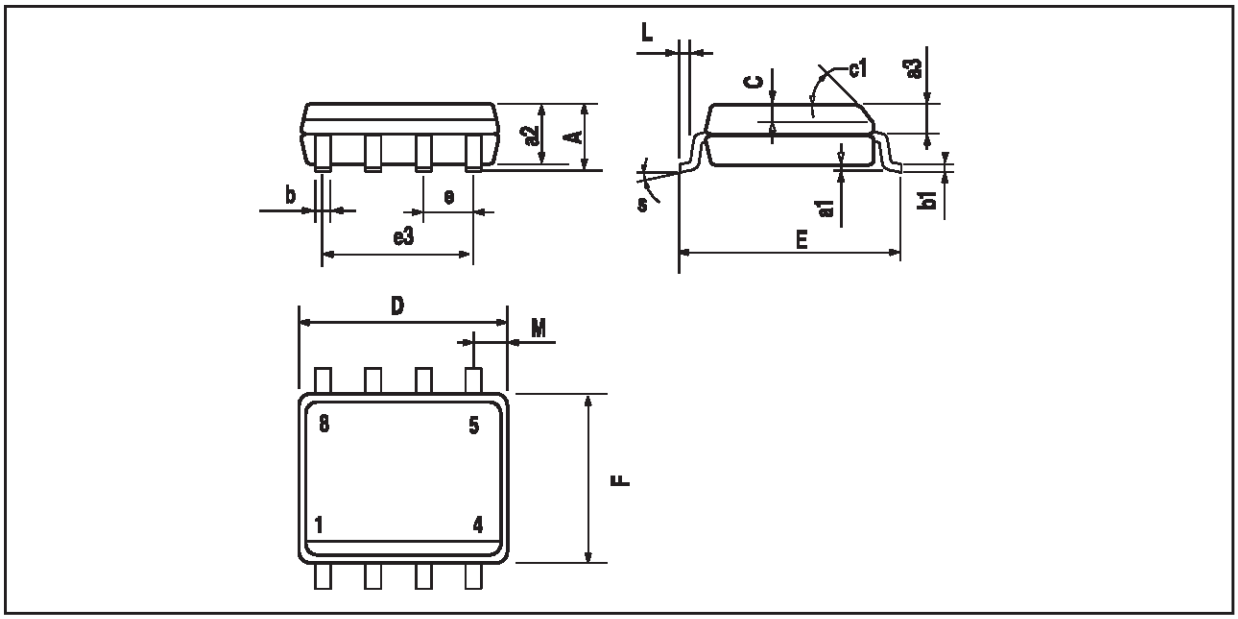

Output Power vs. Supply Voltage
RL = 32 ohms
10% distortion
1% distortion
0.1% distortion
Output Power (mW)
60
50
40
30
20
10
0
1
2
3
4
5
6
Supply Voltage (V)

TS1871ID - TS1872ID



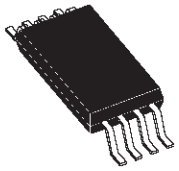
PACKAGE MECHANICAL DATA

8 PINS - PLASTIC MICROPACKAGE (SO)



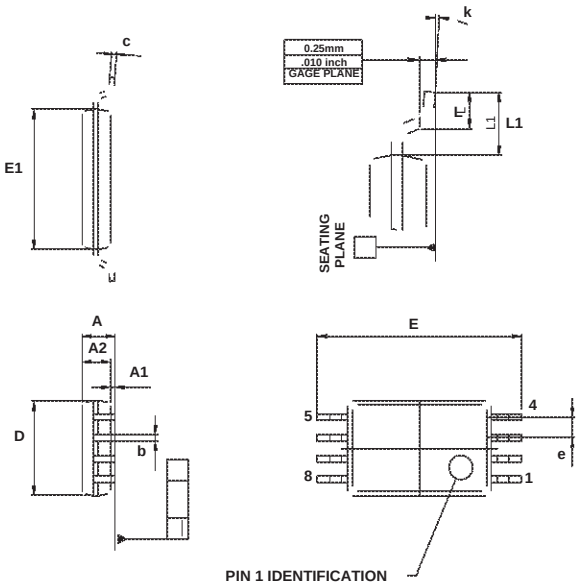
Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.25	0.004		0.010
a2			1.65			0.065
a3	0.65		0.85	0.026		0.033
b	0.35		0.48	0.014		0.019
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.020
c1	45° (typ.)					
D	4.8		5.0	0.189		0.197
E	5.8		6.2	0.228		0.244
e		1.27			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.)					

TS1872IPT



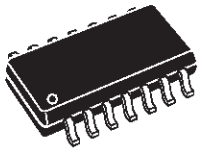
PACKAGE MECHANICAL DATA

8 PINS - THIN SHRINK SMALL OUTLINE PACKAGE



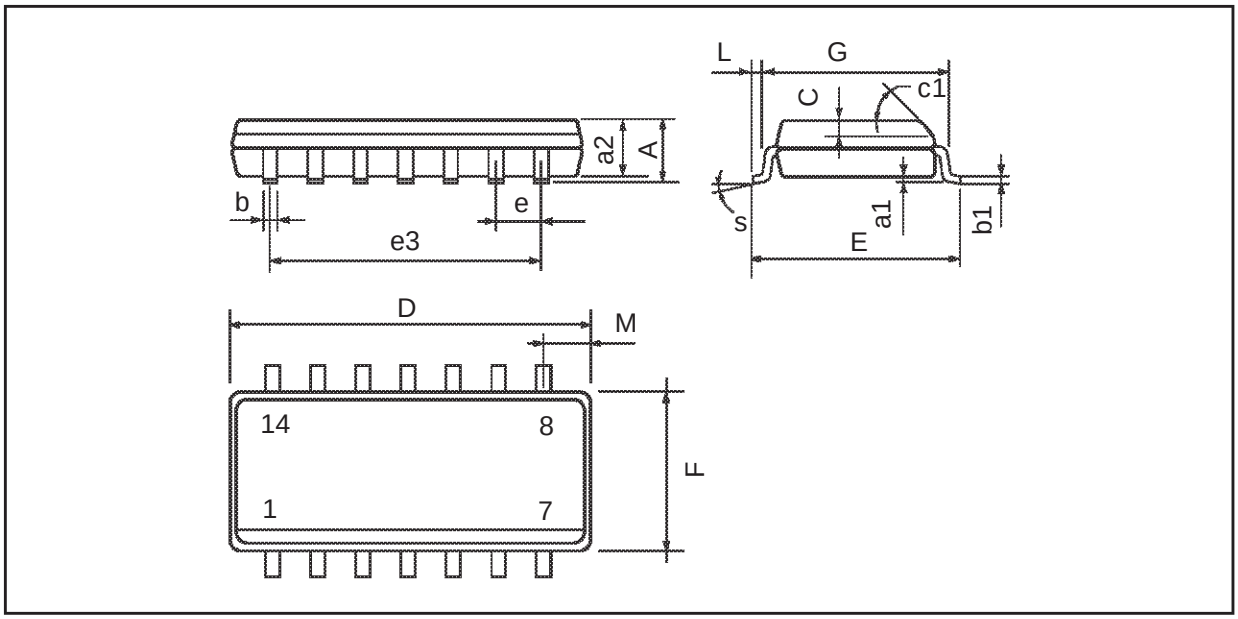
Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
c	0.09		0.20	0.003		0.012
D	2.90	3.00	3.10	0.114	0.118	0.122
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.025	
k	0°		8°	0°		8°
l	0.50	0.60	0.75	0.09	0.0236	0.030

TS1874ID



PACKAGE MECHANICAL DATA

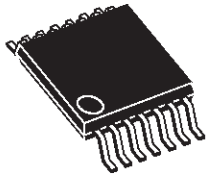
14 PINS - PLASTIC MICROPACKAGE (SO)



Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.2	0.004		0.008
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1	45° (typ.)					
D (1)	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F (1)	3.8		4.0	0.150		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.020		0.050
M			0.68			0.027
S	8° (max.)					

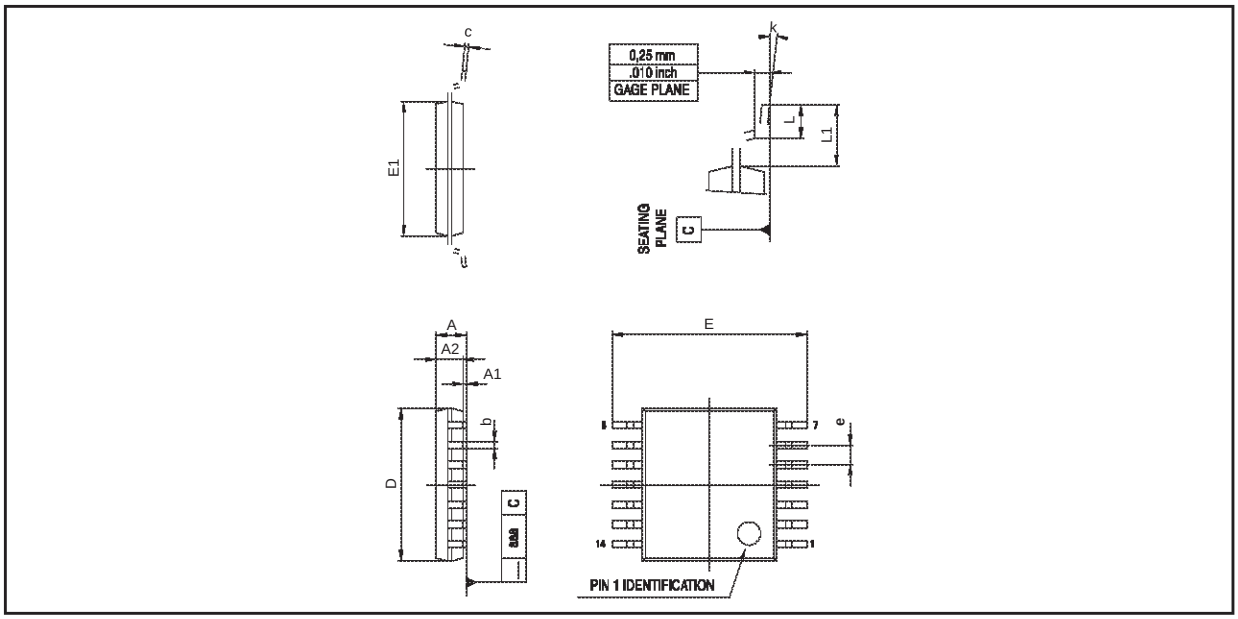
Note : (1) D and F do not include mold flash or protrusions - Mold flash or protrusions shall not exceed 0.15mm (.066 inc) ONLY FOR DATA BOOK.

TS1874IPT



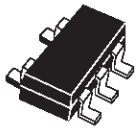
PACKAGE MECHANICAL DATA

14 PINS - THIN SHRINK SMALL OUTLINE PACKAGE



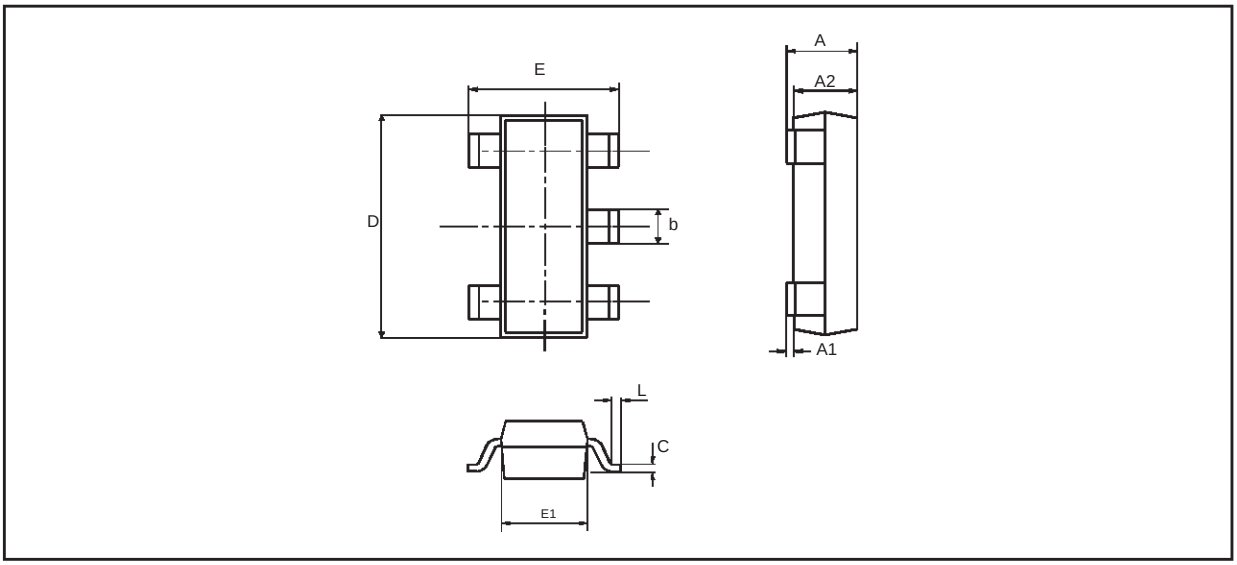
Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
c	0.09		0.20	0.003		0.012
D	4.90	5.00	5.10	0.192	0.196	0.20
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.025	
k	0°		8°	0°		8°
l	0.50	0.60	0.75	0.09	0.0236	0.030

TS1871ILT



PACKAGE MECHANICAL DATA

5 PINS - TINY PACKAGE (SOT23)



Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.90	1.20	1.45	0.035	0.047	0.057
A1	0		0.15			0.006
A2	0.90	1.05	1.30	0.035	0.041	0.051
B	0.35	0.40	0.50	0.014	0.016	0.020
C	0.09	0.15	0.20	0.004	0.006	0.008
D	2.80	2.90	3.00	0.110	0.114	0.118
D1		1.90			0.075	
e		0.95			0.037	
E	2.60	2.80	3.00	0.102	0.110	0.0118
F	1.50	1.60	1.75	0.059	0.063	0.069
L	0.10	0.5	0.60	0.004	0.014	0.024
K	0d		10d	0d		10d