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_{DD} - 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 an operational amplifier family able to operate with voltage as low as 1.8V and features both I/O Rail to Rail.

The common mode input voltage extends 200mV at 25°C beyond the supply voltages while the output voltage swing is within 100mV of each Rail with 600 Ohm load resistor. This device consumes typically 400µA per channel while offering 1.6Mhz of gain-bandwidth product. The amplifier provides high output drive capability typically at 65mA-load.

These performances make the TS187X family ideal for sensor interface, battery-supplied and portable applications.

APPLICATION

- Battery-powered applications (Toys)
- Portable communication devices (cell phone)
- Audio driver (Headphone Driver)
- Laptop/Notebook computers

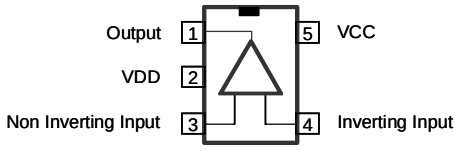
ORDER CODE

Part Number	Temperature Range	Package					SOT23 Marking
		N	D	P	L	S	
TS1871I/AI	-40, +125°C		•		•		K171/172
TS1872I/AI		•	•	•		•	K171/172
TS1874I/AI		•	•	•			

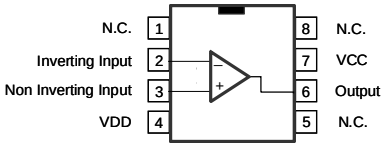
N = Dual in Line Package (DIP)
S = MiniSO Package (miniSO) - also available in Tape & Reel (ST)
D = Small Outline Package (SO) - also available in Tape & Reel (DT)
P = Thin Shrink Small Outline Package (TSSOP) - only available in Tape & Reel (PT)
L = Tiny Package (SOT23-5) - only available in Tape &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

PIN CONNECTIONS (top view)

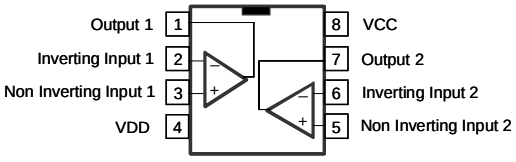
TS1871ILT



TS1871ID-TS1871IDT



TS1872IST-TS1872IN-TS1872ID-TS1872IPT



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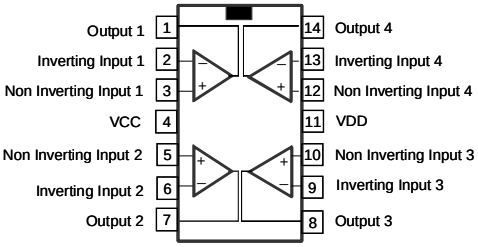


ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage [1]	7	V
V_{id}	Differential Input Voltage [2]	±1	V
V_i	Input Voltage [3]	V_{DD}-0.3 to V_{CC} +0.3	V
T_{stg}	Storage Temperature	-65 to +150	°C
T_j	Maximum Junction Temperature	150	°C
R_{thja}	Thermal Resistance Junction to Ambient[4] SOT23-5 SO8 SO14 TSSOP8 TSSOP14 miniSO8	 250 175 150 200 175 180	°C/W
ESD	Human Body Model	2	kV
	Latch-up Immunity	Class A	
	Lead Temperature (soldering, 10sec)	250	°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_{DD} - 0.2 to V_{CC} + 0.2	V
V_{icm}	Common Mode Input Voltage Range [2]	V_{DD} to V_{CC}	V
T_{oper}	Operating Free Air Temperature Range	-40 to + 125	°C

1. At 25°C, for $1.8 \le V_{CC} \le 6V$, V_{icm} is extended to V_{DD} - 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_{DD} = **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] $V_{icm} = V_{out} = V_{CC}/2$		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	0.38	0.54		V/µs
ϕm	Phase Margin C_L = 100pF		53		Degrees
en	Input Voltage Noise		27		nV/√Hz
THD	Total Harmonic Distortion		0.01		%

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

ELECTRICAL CHARACTERISTICS

V_{CC} = **+3V**, V_{DD} = **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] $V_{icm} = V_{out} = V_{CC}/2$		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		MHz
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		27		nV/√Hz
THD	Total Harmonic Distortion		0.01		%

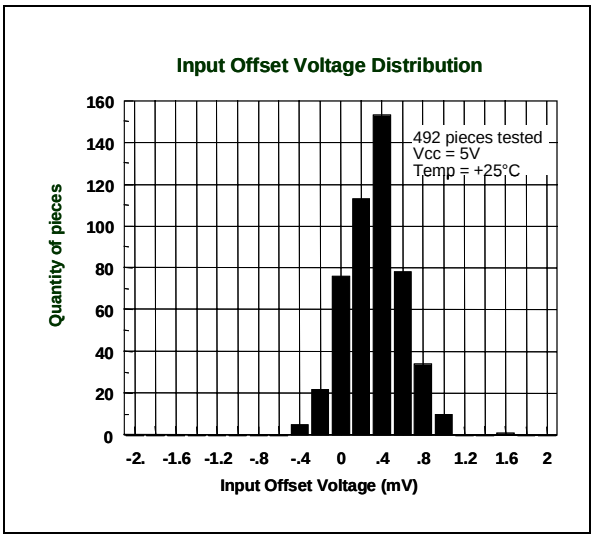
1. Maximum values including unavoidable inaccuracies of the industrial test.

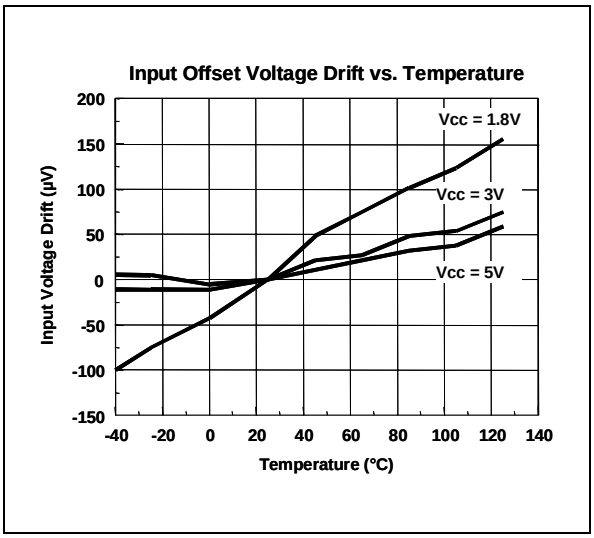
ELECTRICAL CHARACTERISTICS

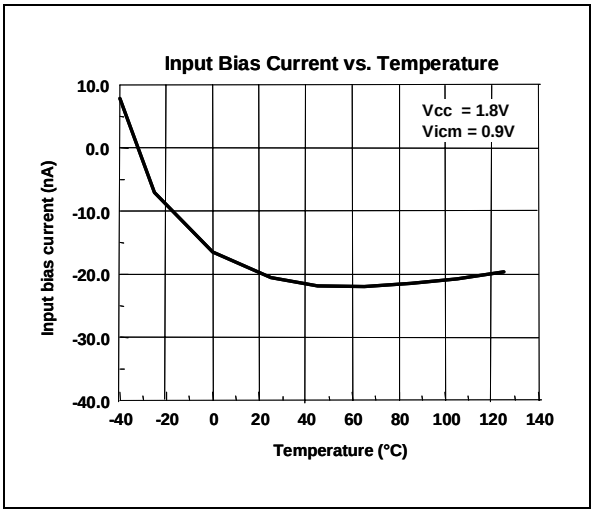
V_{CC} = **+5V**, V_{DD} = **0V**, R_L, C_L connected to $V_{CC}/2$,
T_{amb} = 25°C (unless otherwise specified)

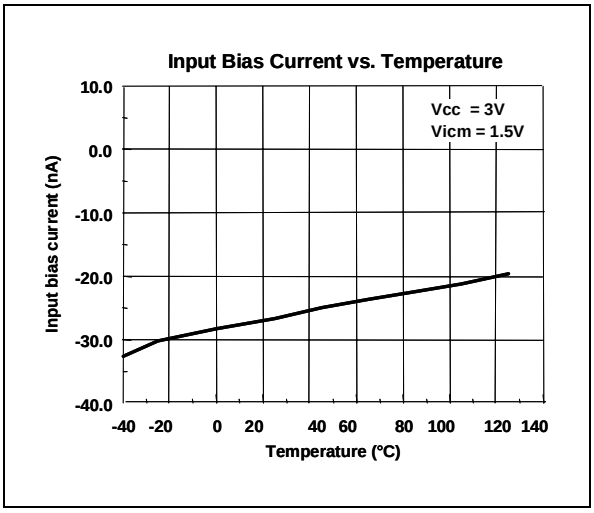
Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage $V_{icm} = V_{out} = V_{CC}/2$ TS1871/2/4 TS1871A/2A/4A		 0.1	 3 1	mV
ΔV_{io}	Input Offset Voltage Drift		2		µV/°C
I_{io}	Input Offset Current [1] $V_{icm} = V_{out} = V_{CC}/2$		3	30	nA
I_{ib}	Input Bias Current [1] $V_{icm} = V_{out} = V_{CC}/2$		70	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		500	835	µA
GBP	Gain Bandwith Product R_L = 10kΩ, C_L = 100pF, f = 100kHz	1	1.8		MHz
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		27		nV/√Hz
THD	Total Harmonic Distortion		0.01		%

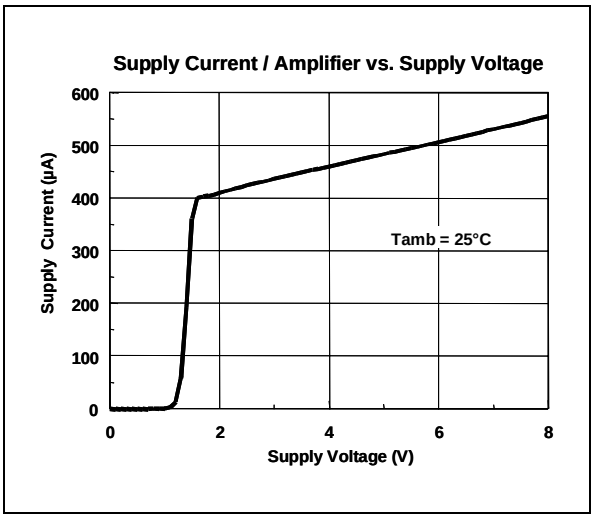
1. Maximum values including unavoidable inaccuracies of the industrial test.

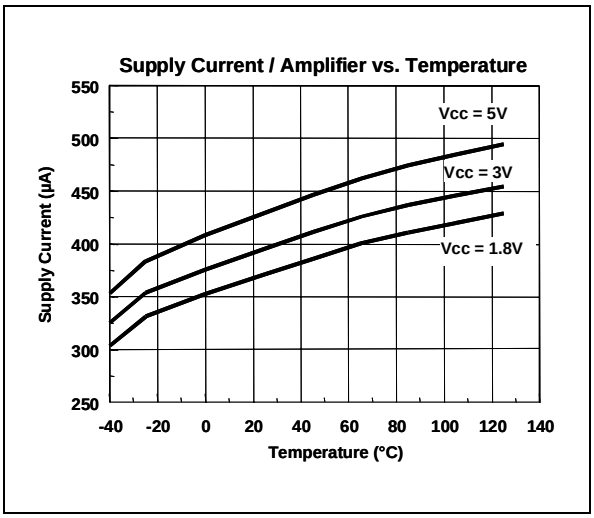

Input Offset Voltage Distribution
492 pieces tested
Vcc = 5V
Temp = +25°C
Quantity of pieces
160
140
120
100
80
60
40
20
0
-2.
-1.6
-1.2
-.8
-.4
0
.4
.8
1.2
1.6
2
Input Offset Voltage (mV)

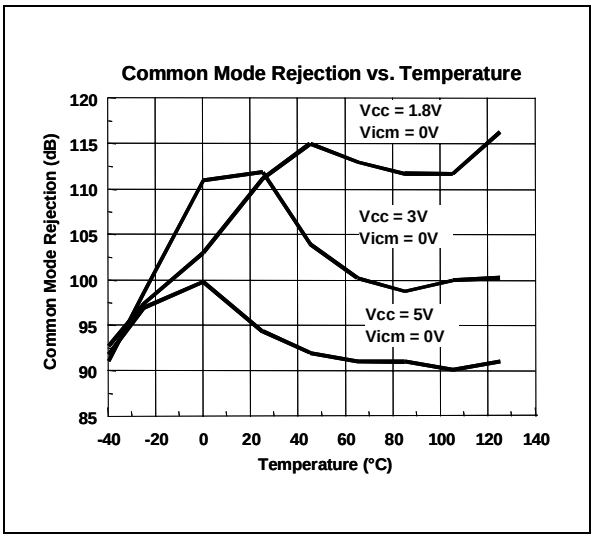

Input Offset Voltage Drift vs. Temperature
Vcc = 1.8V
Vcc = 3V
Vcc = 5V
Input Voltage Drift (µV)
200
150
100
50
0
-50
-100
-150
-40
-20
0
20
40
60
80
100
120
140
Temperature (°C)

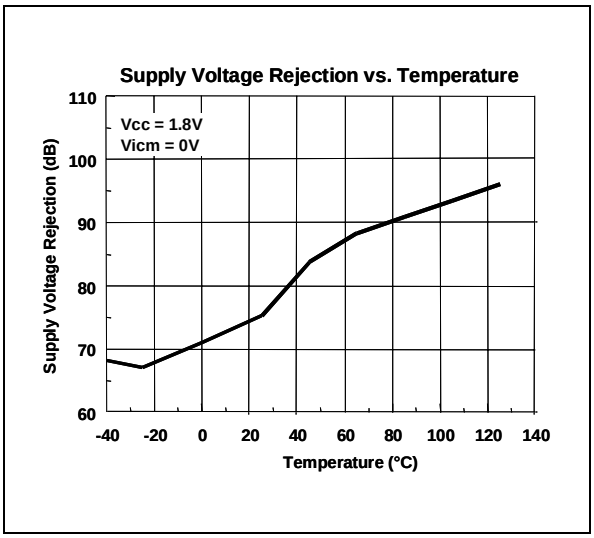

Input Bias Current vs. Temperature
Vcc = 1.8V
Vicm = 0.9V
Input bias current (nA)
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-40
-20
0
20
40
60
80
100
120
140
Temperature (°C)

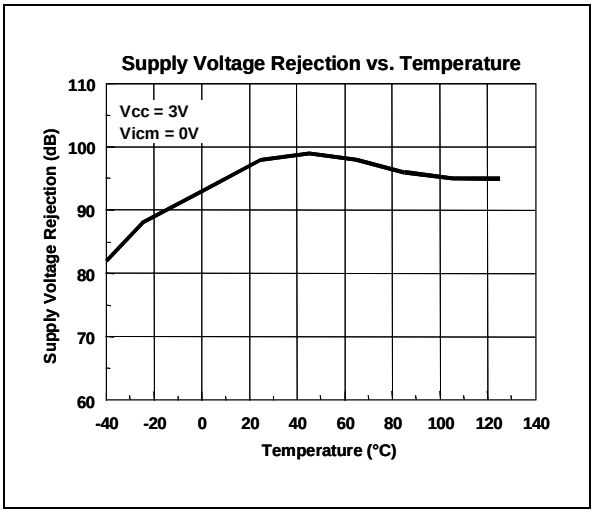

Input Bias Current vs. Temperature
Vcc = 3V
Vicm = 1.5V
Input bias current (nA)
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-40
-20
0
20
40
60
80
100
120
140
Temperature (°C)

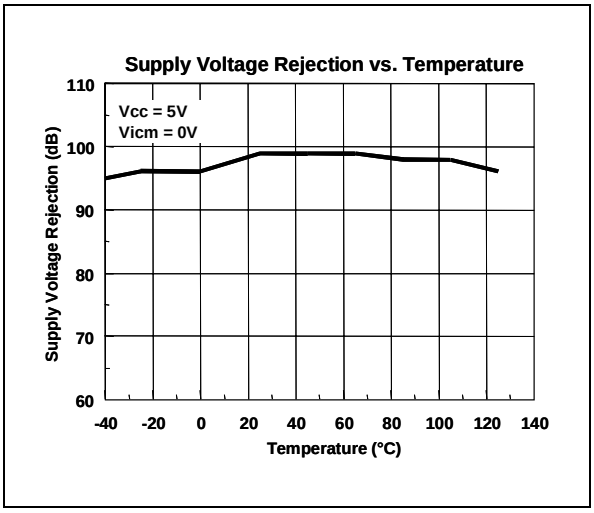

Supply Current / Amplifier vs. Supply Voltage
Tamb = 25°C
Supply Current (µA)
600
500
400
300
200
100
0
0
2
4
6
8
Supply Voltage (V)

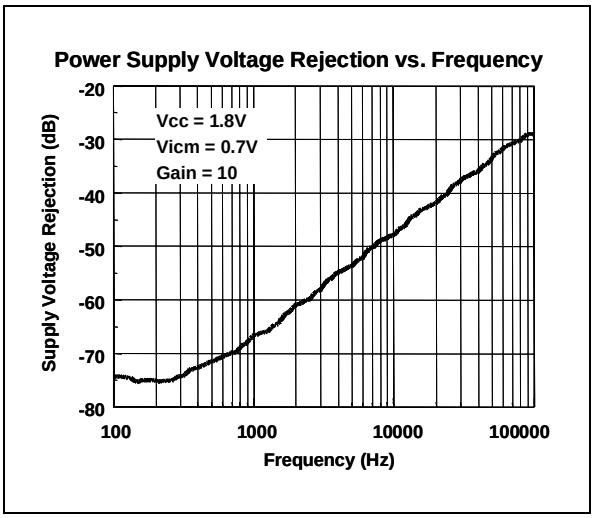

Supply Current / Amplifier vs. Temperature
Vcc = 5V
Vcc = 3V
Vcc = 1.8V
Supply Current (µA)
550
500
450
400
350
300
250
-40
-20
0
20
40
60
80
100
120
140
Temperature (°C)

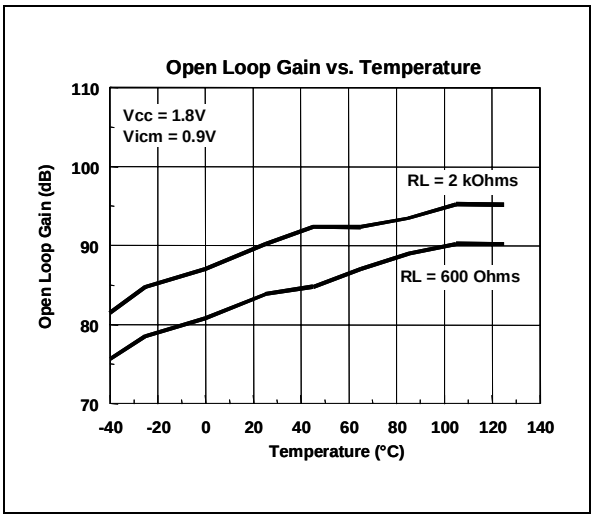

Common Mode Rejection vs. Temperature
Common Mode Rejection (dB)
120
115
110
105
100
95
90
85
Vcc = 1.8V
Vicm = 0V
Vcc = 3V
Vicm = 0V
Vcc = 5V
Vicm = 0V
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)

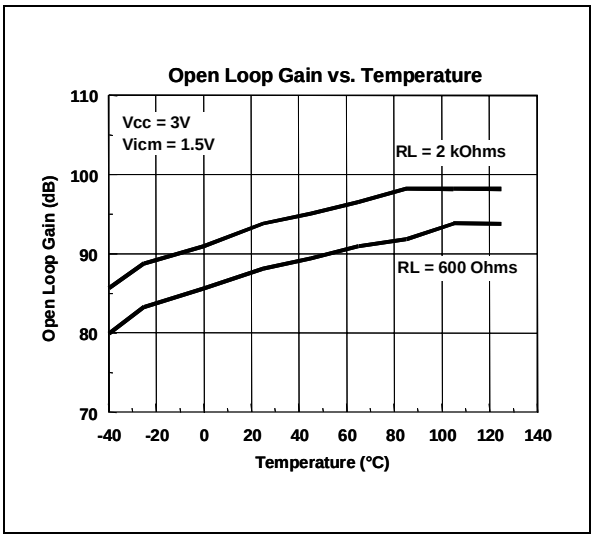

Supply Voltage Rejection vs. Temperature
Supply Voltage Rejection (dB)
110
100
90
80
70
60
Vcc = 1.8V
Vicm = 0V
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)

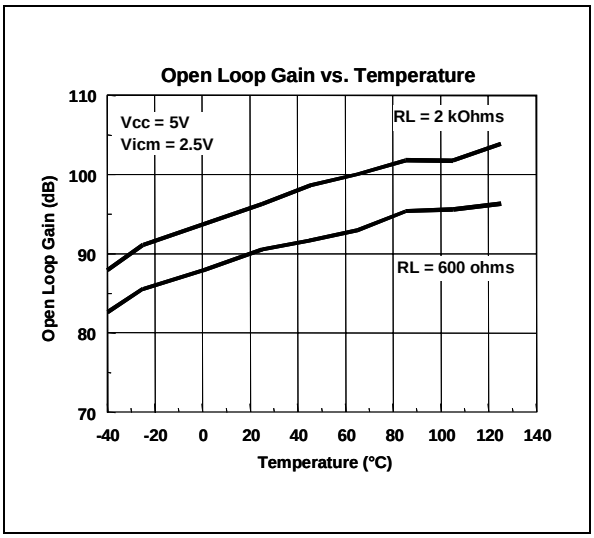

Supply Voltage Rejection vs. Temperature
Supply Voltage Rejection (dB)
110
100
90
80
70
60
Vcc = 3V
Vicm = 0V
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)

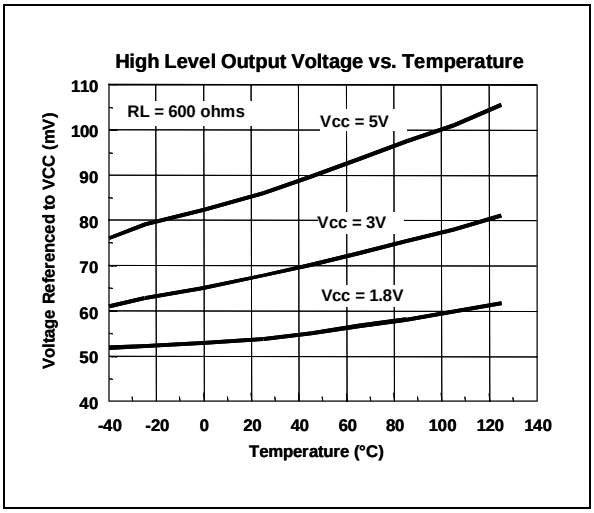

Supply Voltage Rejection vs. Temperature
Supply Voltage Rejection (dB)
110
100
90
80
70
60
Vcc = 5V
Vicm = 0V
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)

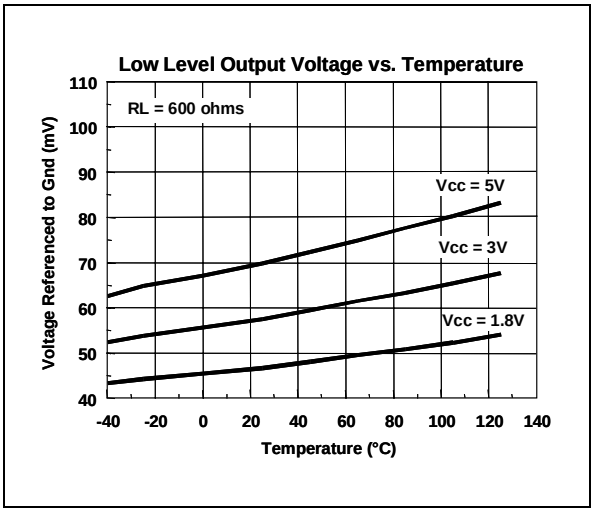

Power Supply Voltage Rejection vs. Frequency
Supply Voltage Rejection (dB)
-20
-30
-40
-50
-60
-70
-80
Vcc = 1.8V
Vicm = 0.7V
Gain = 10
100 1000 10000 100000
Frequency (Hz)

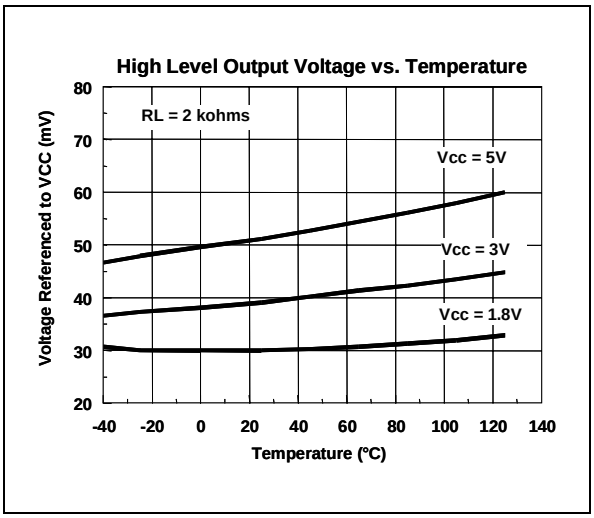

Open Loop Gain vs. Temperature
Open Loop Gain (dB)
110
100
90
80
70
Vcc = 1.8V
Vicm = 0.9V
RL = 2 kOhms
RL = 600 Ohms
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)

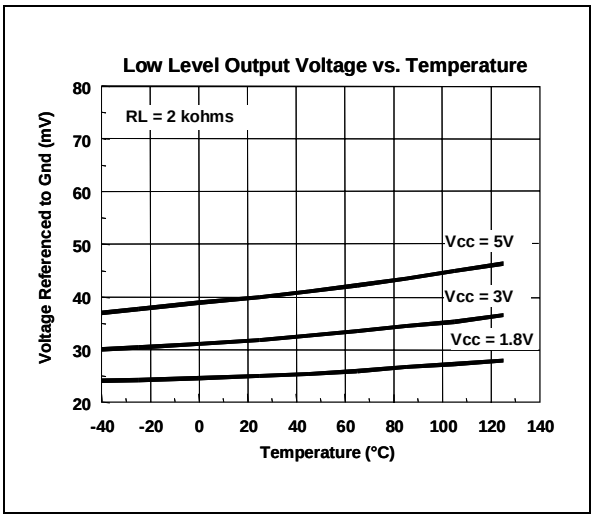

Open Loop Gain vs. Temperature
Vcc = 3V
Vicm = 1.5V
RL = 2 kOhms
RL = 600 Ohms
Open Loop Gain (dB)
110
100
90
80
70
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)

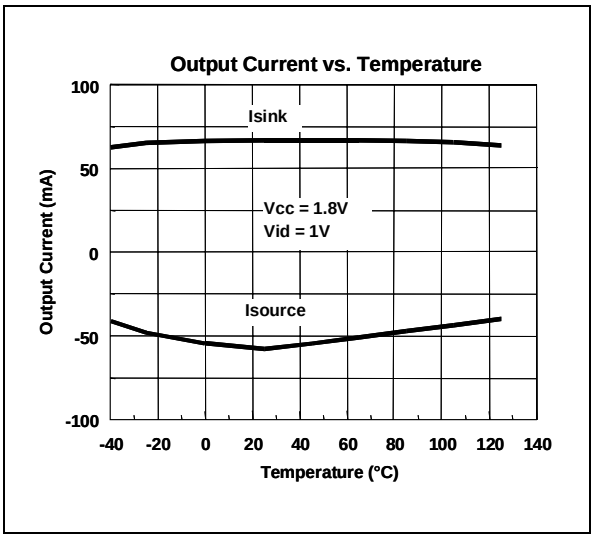

Open Loop Gain vs. Temperature
Vcc = 5V
Vicm = 2.5V
RL = 2 kOhms
RL = 600 ohms
Open Loop Gain (dB)
110
100
90
80
70
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)

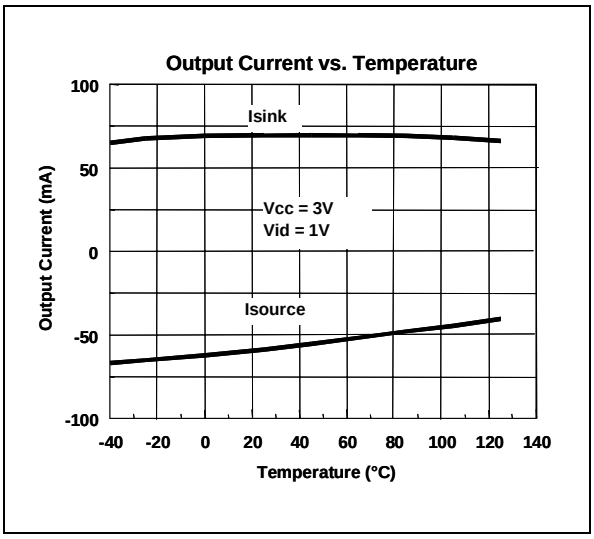

High Level Output Voltage vs. Temperature
RL = 600 ohms
Vcc = 5V
Vcc = 3V
Vcc = 1.8V
Voltage Referenced to VCC (mV)
110
100
90
80
70
60
50
40
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)

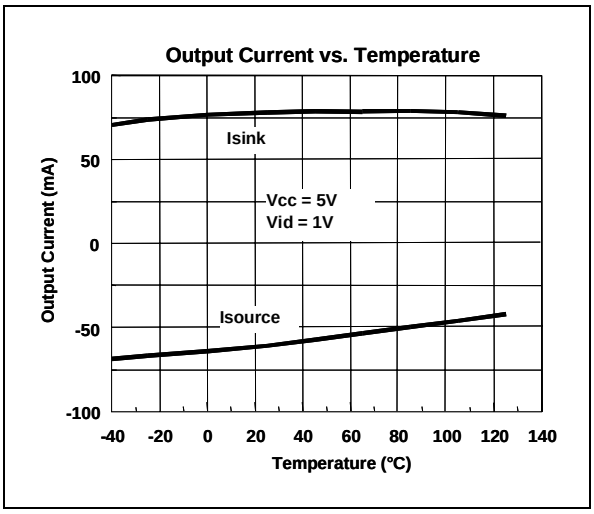

Low Level Output Voltage vs. Temperature
RL = 600 ohms
Vcc = 5V
Vcc = 3V
Vcc = 1.8V
Voltage Referenced to Gnd (mV)
110
100
90
80
70
60
50
40
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)

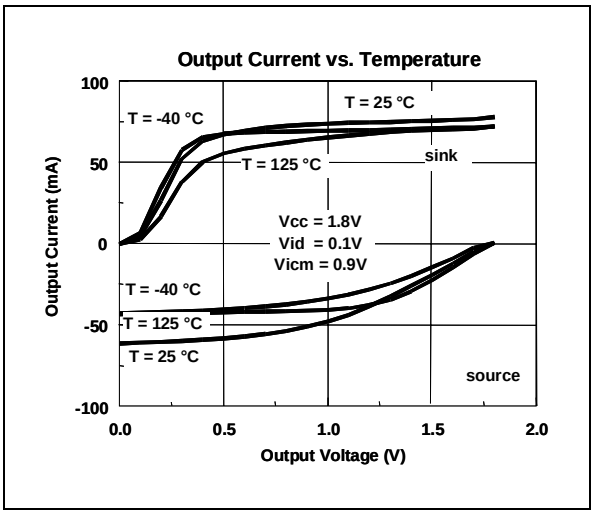

High Level Output Voltage vs. Temperature
RL = 2 kohms
Vcc = 5V
Vcc = 3V
Vcc = 1.8V
Voltage Referenced to VCC (mV)
80
70
60
50
40
30
20
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)

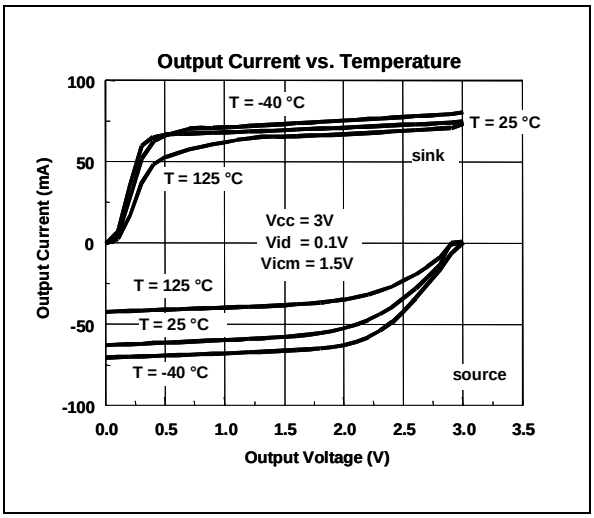

Low Level Output Voltage vs. Temperature
RL = 2 kohms
Vcc = 5V
Vcc = 3V
Vcc = 1.8V
Voltage Referenced to Gnd (mV)
80
70
60
50
40
30
20
-40 -20 0 20 40 60 80 100 120 140
Temperature (°C)

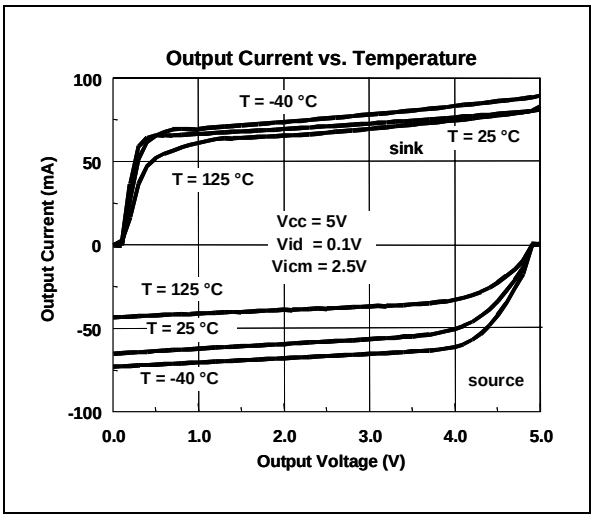

Output Current vs. Temperature
Isink
Vcc = 1.8V
Vid = 1V
Isource
Output Current (mA)
Temperature (°C)

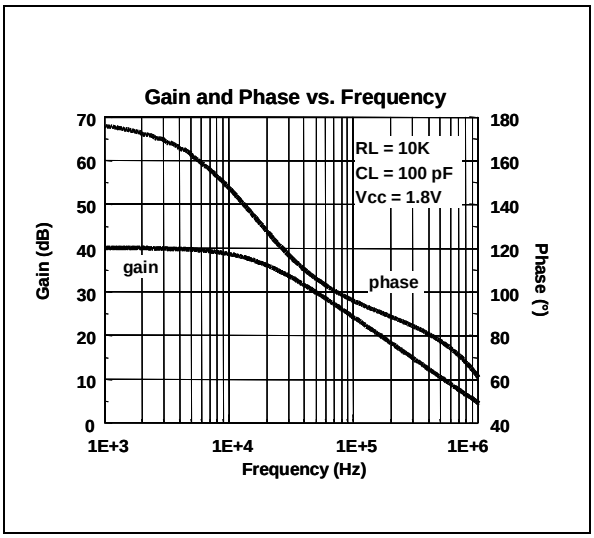

Output Current vs. Temperature
Isink
Vcc = 3V
Vid = 1V
Isource
Output Current (mA)
Temperature (°C)

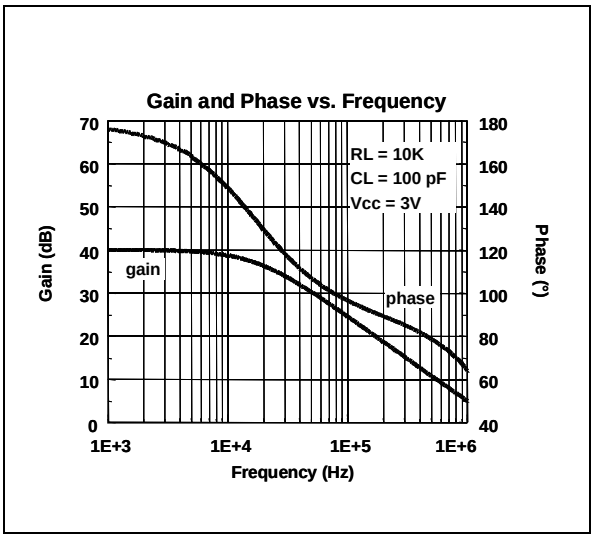

Output Current vs. Temperature
Isink
Vcc = 5V
Vid = 1V
Isource
Output Current (mA)
Temperature (°C)

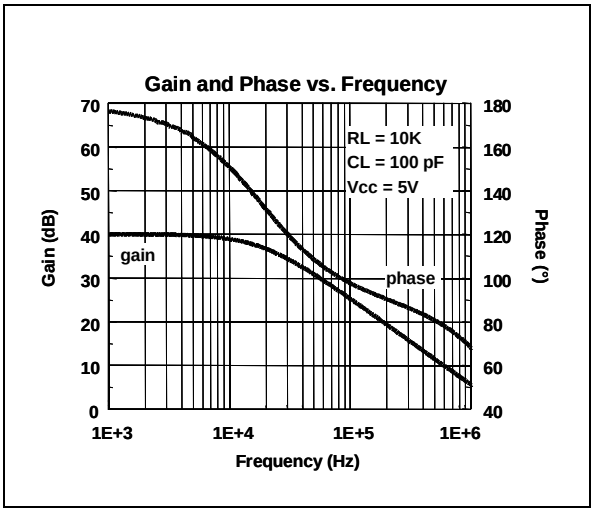

Output Current vs. Temperature
T = -40 °C
T = 25 °C
T = 125 °C
sink
Vcc = 1.8V
Vid = 0.1V
Vicm = 0.9V
T = -40 °C
T = 125 °C
T = 25 °C
source
Output Current (mA)
Output Voltage (V)

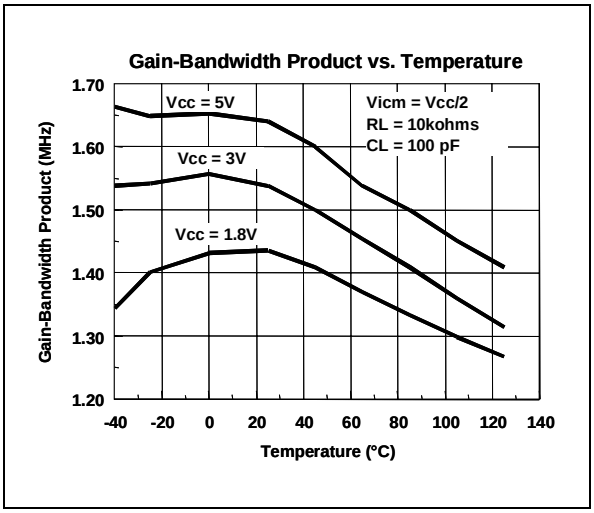

Output Current vs. Temperature
T = -40 °C
T = 25 °C
sink
T = 125 °C
Vcc = 3V
Vid = 0.1V
Vicm = 1.5V
T = 125 °C
T = 25 °C
T = -40 °C
source
Output Current (mA)
Output Voltage (V)

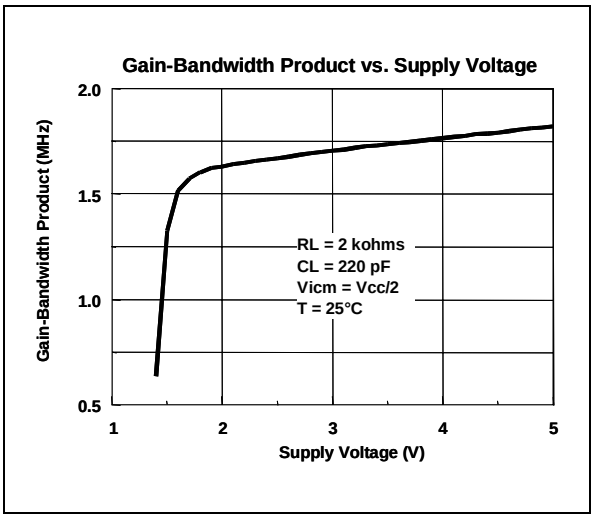

Output Current vs. Temperature
T = -40 °C
T = 25 °C
sink
T = 125 °C
Vcc = 5V
Vid = 0.1V
Vicm = 2.5V
T = 125 °C
T = 25 °C
T = -40 °C
source
Output Current (mA)
Output Voltage (V)

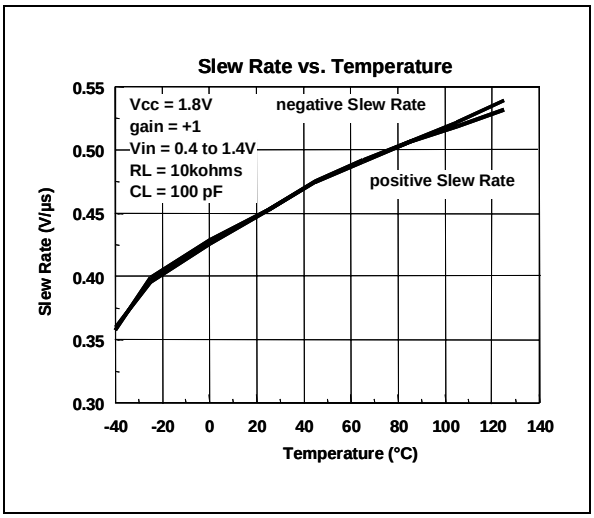

Gain and Phase vs. Frequency
RL = 10K
CL = 100 pF
Vcc = 1.8V
gain
phase
Gain (dB)
Phase (°)
Frequency (Hz)
70
60
50
40
30
20
10
0
180
160
140
120
100
80
60
40
1E+3
1E+4
1E+5
1E+6

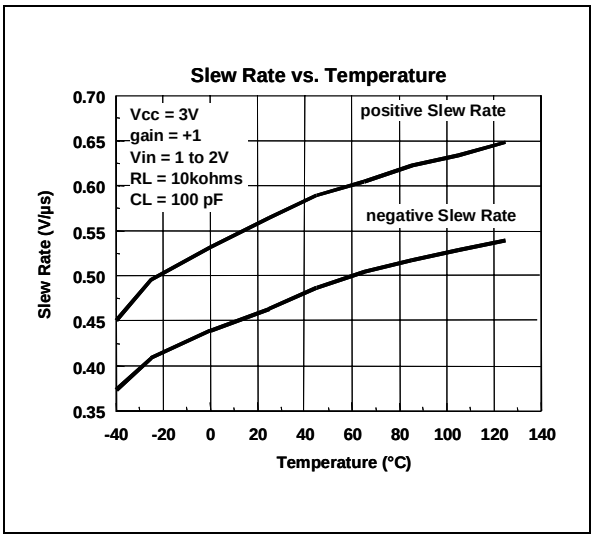

Gain and Phase vs. Frequency
RL = 10K
CL = 100 pF
Vcc = 3V
gain
phase
Gain (dB)
Phase (°)
Frequency (Hz)
70
60
50
40
30
20
10
0
180
160
140
120
100
80
60
40
1E+3
1E+4
1E+5
1E+6

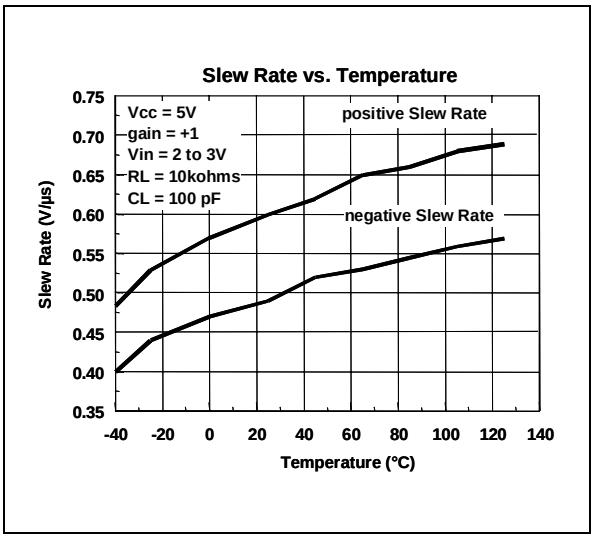

Gain and Phase vs. Frequency
RL = 10K
CL = 100 pF
Vcc = 5V
gain
phase
Gain (dB)
Phase (°)
Frequency (Hz)
70
60
50
40
30
20
10
0
180
160
140
120
100
80
60
40
1E+3
1E+4
1E+5
1E+6

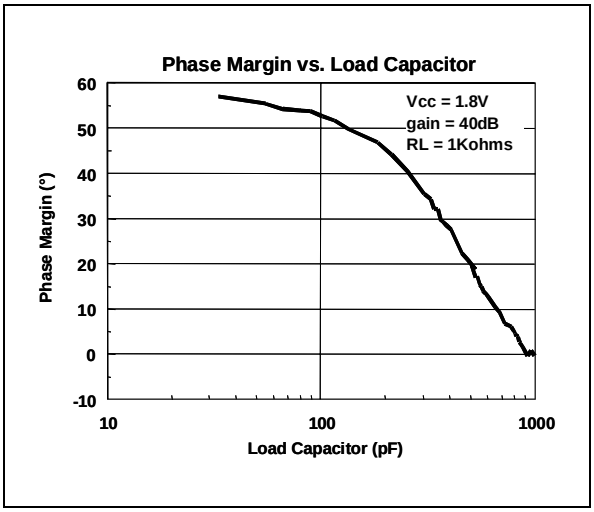

Gain-Bandwidth Product vs. Temperature
Vcc = 5V
Vcc = 3V
Vcc = 1.8V
Vicm = Vcc/2
RL = 10kohms
CL = 100 pF
Gain-Bandwidth Product (MHz)
Temperature (°C)
1.70
1.60
1.50
1.40
1.30
1.20
-40
-20
0
20
40
60
80
100
120
140

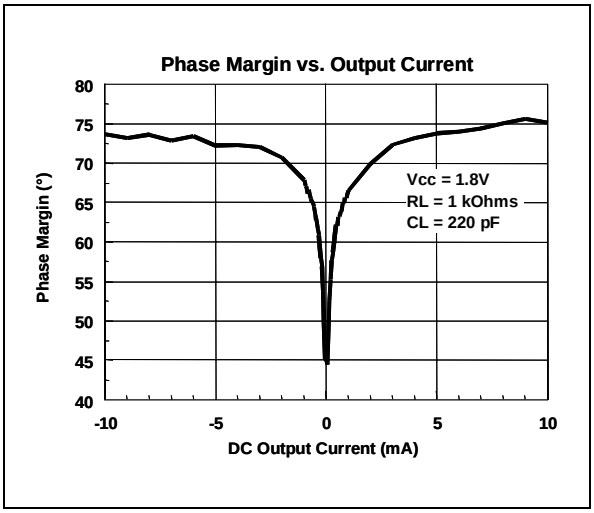

Gain-Bandwidth Product vs. Supply Voltage
RL = 2 kohms
CL = 220 pF
Vicm = Vcc/2
T = 25°C
Gain-Bandwidth Product (MHz)
Supply Voltage (V)
2.0
1.5
1.0
0.5
1
2
3
4
5

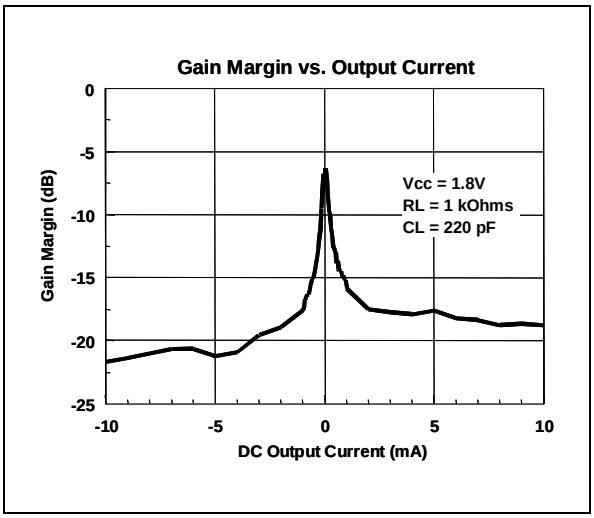

Slew Rate vs. Temperature
Vcc = 1.8V
gain = +1
Vin = 0.4 to 1.4V
RL = 10kohms
CL = 100 pF
negative Slew Rate
positive Slew Rate
Slew Rate (V/µs)
Temperature (°C)
0.55
0.50
0.45
0.40
0.35
0.30
-40
-20
0
20
40
60
80
100
120
140

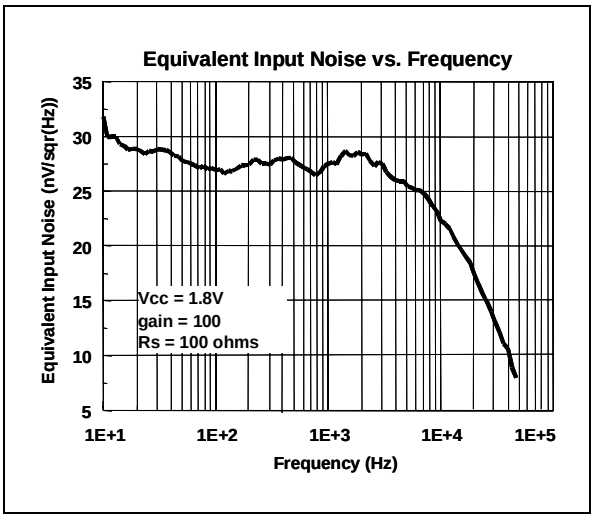

Slew Rate vs. Temperature
Vcc = 3V
gain = +1
Vin = 1 to 2V
RL = 10kohms
CL = 100 pF
positive Slew Rate
negative Slew Rate
Slew Rate (V/µs)
Temperature (°C)

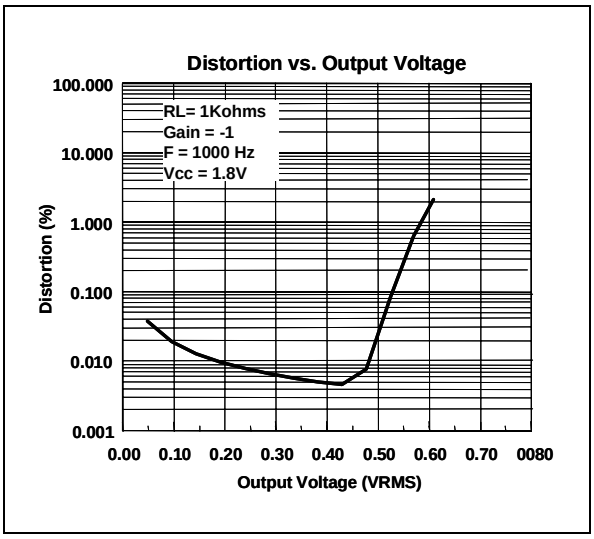

Slew Rate vs. Temperature
Vcc = 5V
gain = +1
Vin = 2 to 3V
RL = 10kohms
CL = 100 pF
positive Slew Rate
negative Slew Rate
Slew Rate (V/µs)
Temperature (°C)

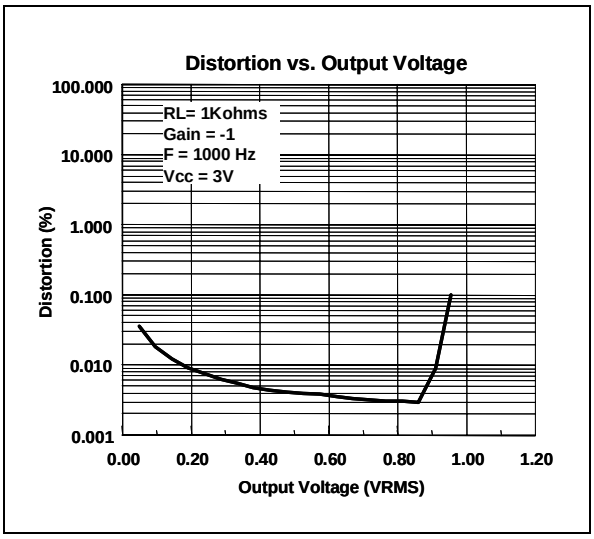

Phase Margin vs. Load Capacitor
Vcc = 1.8V
gain = 40dB
RL = 1Kohms
Phase Margin (°)
Load Capacitor (pF)

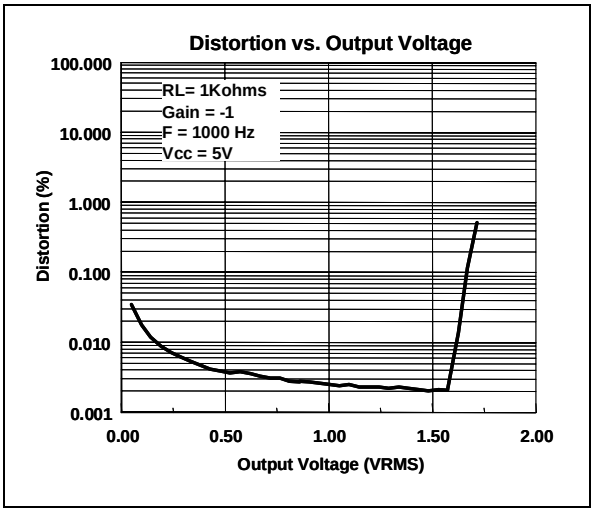

Phase Margin vs. Output Current
Vcc = 1.8V
RL = 1 kOhms
CL = 220 pF
Phase Margin (°)
DC Output Current (mA)

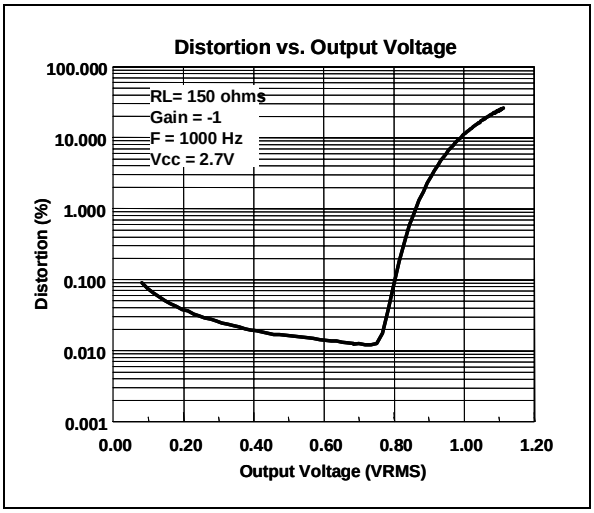

Gain Margin vs. Output Current
Vcc = 1.8V
RL = 1 kOhms
CL = 220 pF
Gain Margin (dB)
DC Output Current (mA)

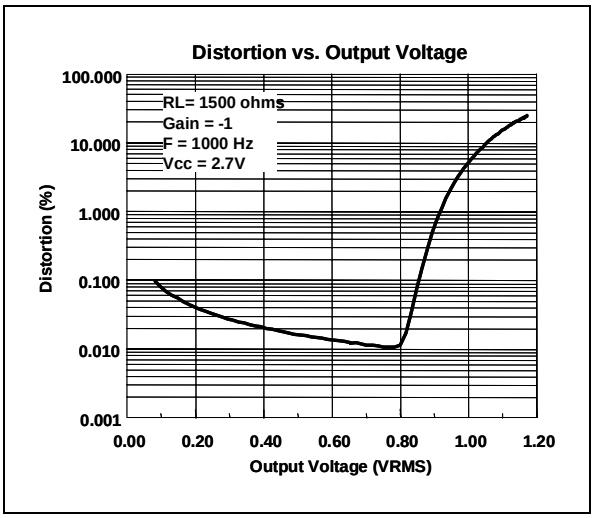

Equivalent Input Noise vs. Frequency
Vcc = 1.8V
gain = 100
Rs = 100 ohms
Equivalent Input Noise (nV/sqr(Hz))
Frequency (Hz)

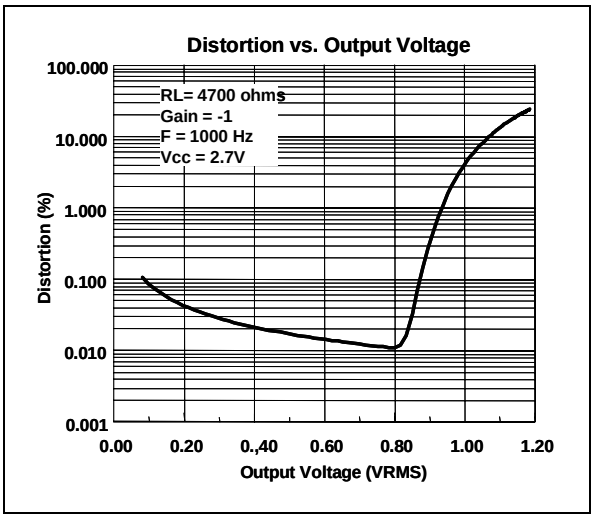

Distortion vs. Output Voltage
RL= 1Kohms
Gain = -1
F = 1000 Hz
Vcc = 1.8V
Distortion (%)
100.000
10.000
1.000
0.100
0.010
0.001
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0080
Output Voltage (VRMS)

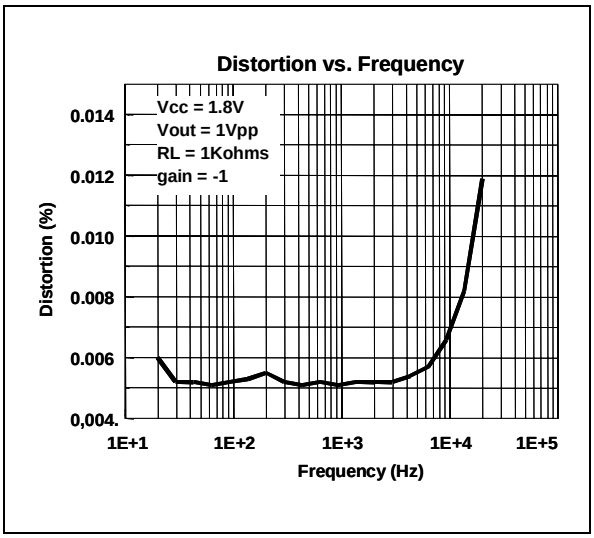

Distortion vs. Output Voltage
RL= 1Kohms
Gain = -1
F = 1000 Hz
Vcc = 3V
Distortion (%)
100.000
10.000
1.000
0.100
0.010
0.001
0.00 0.20 0.40 0.60 0.80 1.00 1.20
Output Voltage (VRMS)

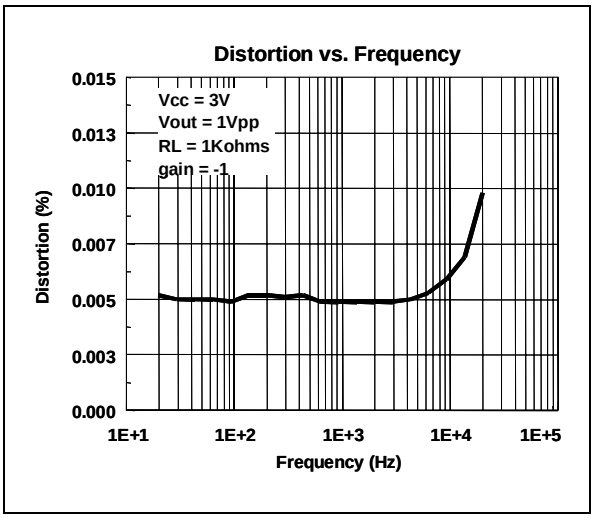

Distortion vs. Output Voltage
RL= 1Kohms
Gain = -1
F = 1000 Hz
Vcc = 5V
Distortion (%)
100.000
10.000
1.000
0.100
0.010
0.001
0.00 0.50 1.00 1.50 2.00
Output Voltage (VRMS)

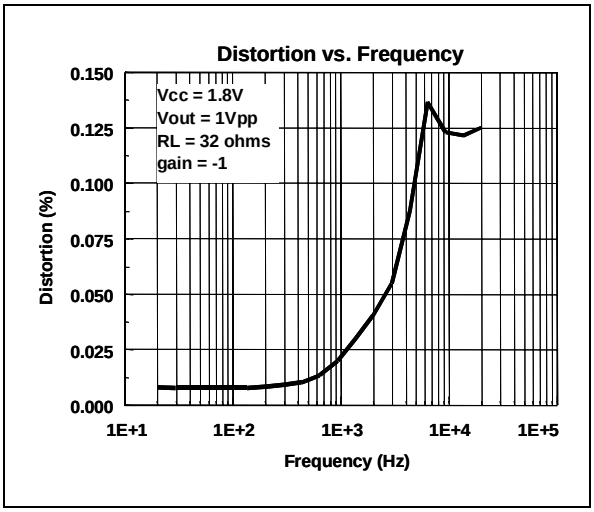

Distortion vs. Output Voltage
RL= 150 ohms
Gain = -1
F = 1000 Hz
Vcc = 2.7V
Distortion (%)
100.000
10.000
1.000
0.100
0.010
0.001
0.00 0.20 0.40 0.60 0.80 1.00 1.20
Output Voltage (VRMS)

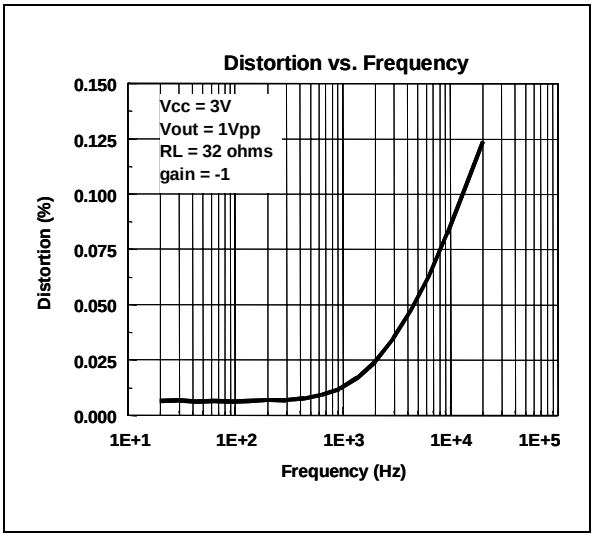

Distortion vs. Output Voltage
RL= 1500 ohms
Gain = -1
F = 1000 Hz
Vcc = 2.7V
Distortion (%)
100.000
10.000
1.000
0.100
0.010
0.001
0.00 0.20 0.40 0.60 0.80 1.00 1.20
Output Voltage (VRMS)

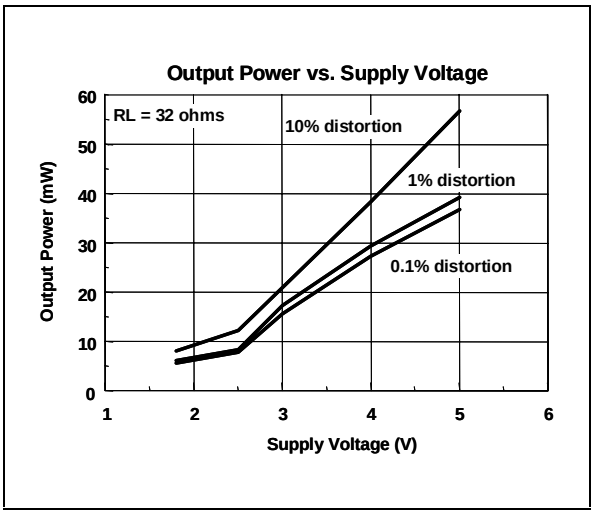

Distortion vs. Output Voltage
RL= 4700 ohms
Gain = -1
F = 1000 Hz
Vcc = 2.7V
Distortion (%)
100.000
10.000
1.000
0.100
0.010
0.001
0.00 0.20 0.40 0.60 0.80 1.00 1.20
Output Voltage (VRMS)


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)

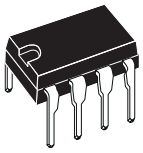

Distortion vs. Frequency
Vcc = 3V
Vout = 1Vpp
RL = 1Kohms
gain = -1
Distortion (%)
0.015
0.013
0.010
0.007
0.005
0.003
0.000
1E+1
1E+2
1E+3
1E+4
1E+5
Frequency (Hz)


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)

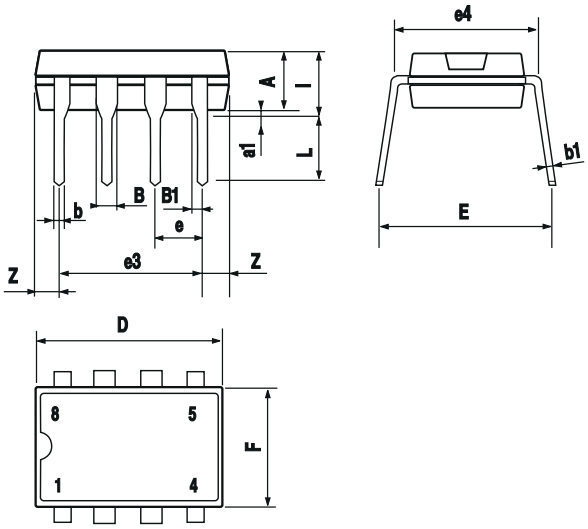

Output Power vs. Supply Voltage
RL = 32 ohms
10% distortion
1% distortion
0.1% distortion
Output Power (mW)
60
50
40
30
20
10
0
1
2
3
4
5
6
Supply Voltage (V)

TS1872IN



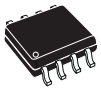
PACKAGE MECHANICAL DATA

8 PINS - PLASTIC DIP



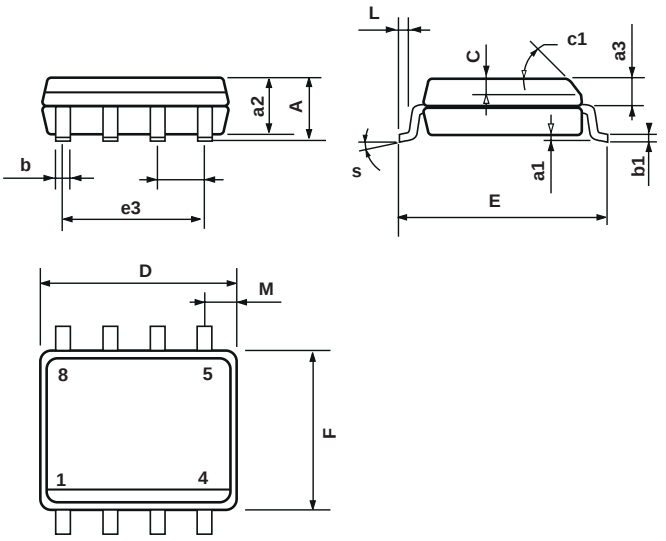
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0260
i			5.08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

TS1871ID - TS1872ID



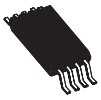
PACKAGE MECHANICAL DATA

8 PINS - PLASTIC MICROPACKAGE (SO)



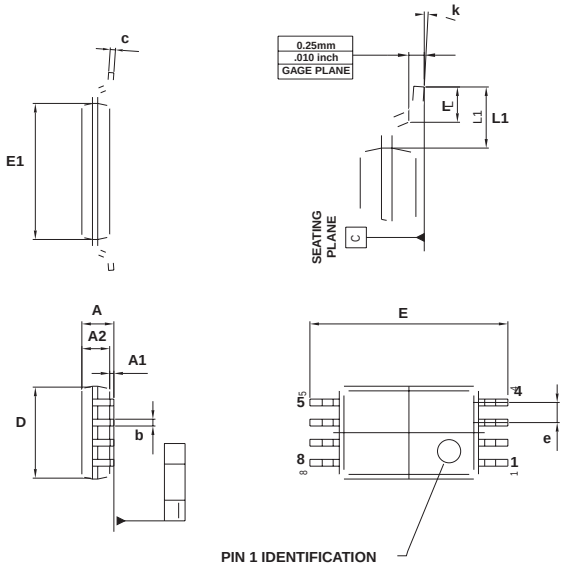
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0260
i			5.08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

TS1872IPT



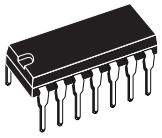
PACKAGE MECHANICAL DATA

8 PINS - THIN SHRINK SMALL OUTLINE PACKAGE



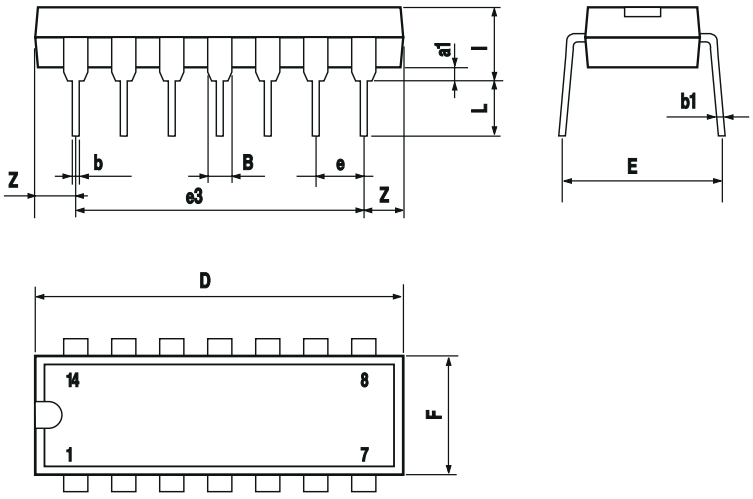
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
c	0.09		0.20	0.003		0.012
D	2.90	3.00	3.10	0.114	0.118	0.122
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.025	
k	0°		8°	0°		8°
l	0.50	0.60	0.75	0.09	0.0236	0.030
L	0.45	0.600	0.75	0.018	0.024	0.030
L1		1.000			0.039	

TS1874IN



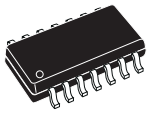
PACKAGE MECHANICAL DATA

14 PINS - PLASTIC DIP



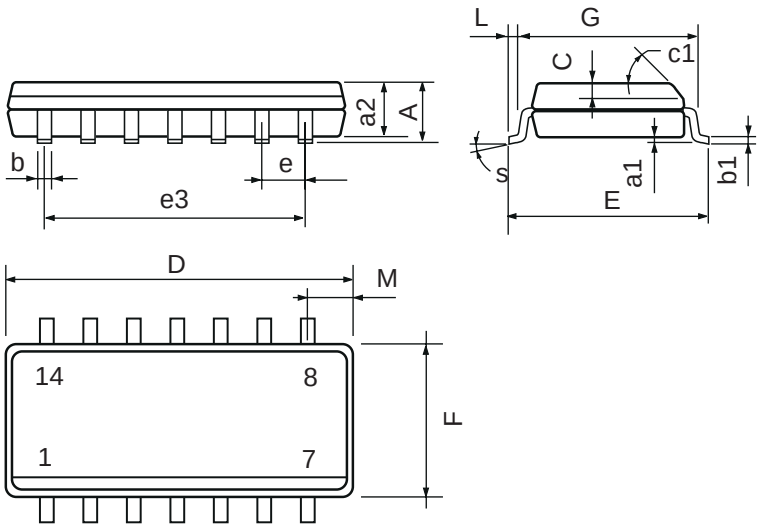
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
i			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100

TS1874ID



PACKAGE MECHANICAL DATA

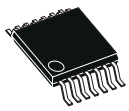
14 PINS - PLASTIC MICROPACKAGE (SO)



Dimensions	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.)					

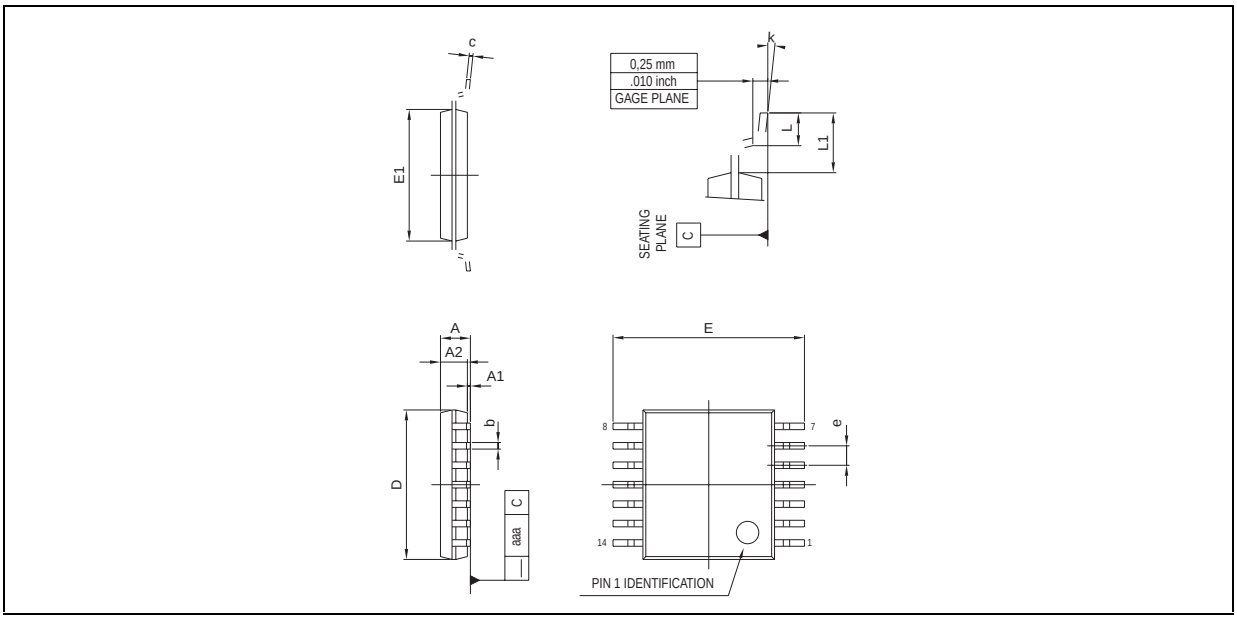
Note : (1) D and F do not include mold flash or protrusions - Mold flash or protrusions shall not exceed 0.15mm (.066 inc) ONLY FOR DATA BOOK.

TS1874IPT



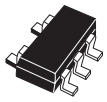
PACKAGE MECHANICAL DATA

14 PINS - THIN SHRINK SMALL OUTLINE PACKAGE



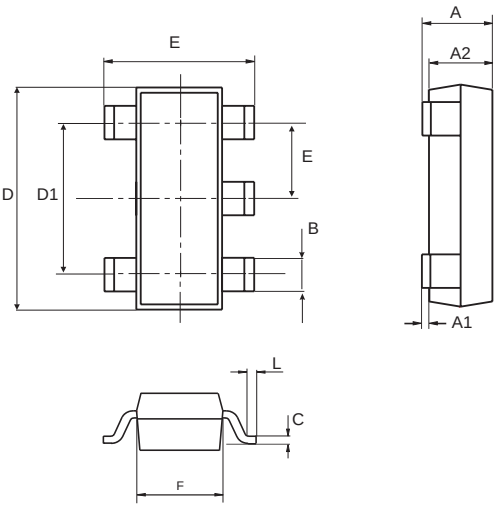
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
c	0.09		0.20	0.003		0.012
D	4.90	5.00	5.10	0.192	0.196	0.20
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.025	
k	0°		8°	0°		8°
L	0.450	0.600	0.750	0.018	0.024	0.030
L1		1.00			0.039	
aaa			0.100			0.004

TS1871ILT



PACKAGE MECHANICAL DATA

5 PINS - TINY PACKAGE (SOT23)

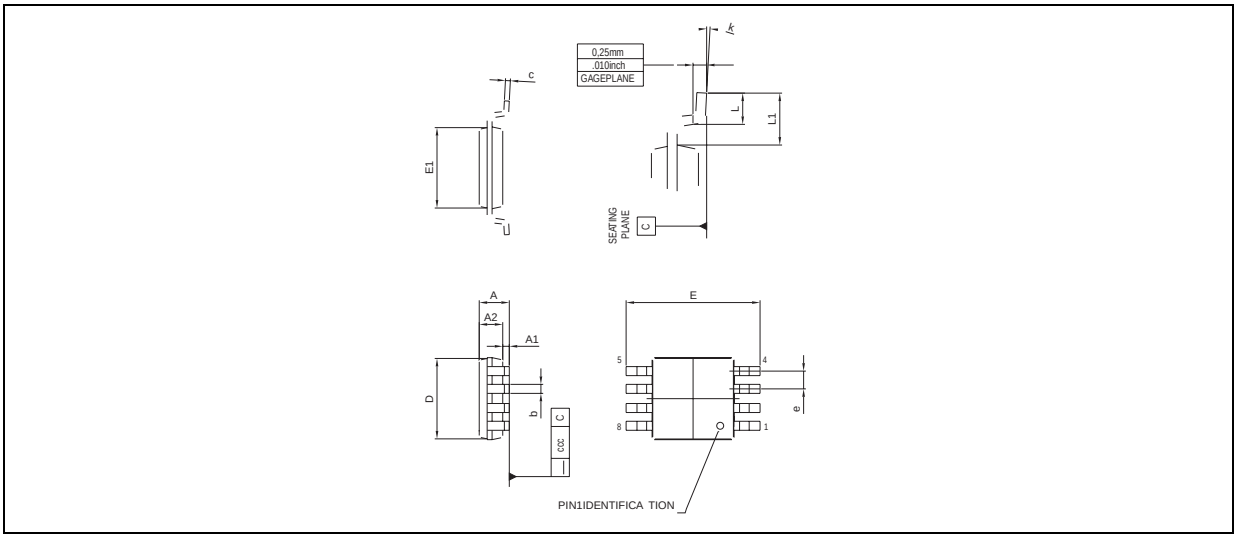


Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.90	1.20	1.45	0.035	0.047	0.057
A1	0		0.15			0.006
A2	0.90	1.05	1.30	0.035	0.041	0.051
B	0.35	0.40	0.50	0.014	0.016	0.020
C	0.09	0.15	0.20	0.004	0.006	0.008
D	2.80	2.90	3.00	0.110	0.114	0.118
D1		1.90			0.075	
e		0.95			0.037	
E	2.60	2.80	3.00	0.102	0.110	0.118
F	1.50	1.60	1.75	0.059	0.063	0.069
L	0.3	0.5	0.60	0.012	0.014	0.024
K	0d		10d	0d		10d

TS1872IST

PACKAGE MECHANICAL DATA

8 PINS - PLASTIC MICROPACKAGE (miniSO)



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.100			0.043
A1	0.050	0.100	0.150	0.002	0.004	0.006
A2	0.780	0.860	0.940	0.031	0.034	0.037
b	0.250	0.330	0.400	0.010	0.013	0.016
c	0.130	0.180	0.230	0.005	0.007	0.009
D	2.900	3.000	3.100	0.114	0.118	0.122
E	4.750	4.900	5.050	0.187	0.193	0.199
E1	2.900	3.000	3.100	0.114	0.118	0.122
e		0.650			0.026	
L	0.400	0.550	0.700	0.016	0.022	0.028
L1		0.950			0.037	
k	0d	3d	6d	0d	3d	6d
aaa			0.100			0.004