



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 V_{icm} ($V_{DD} - 0.2V$ to $V_{CC} + 0.2V$)
- LOW SUPPLY CURRENT ($400\mu A$)
- 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 600 Ohm 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

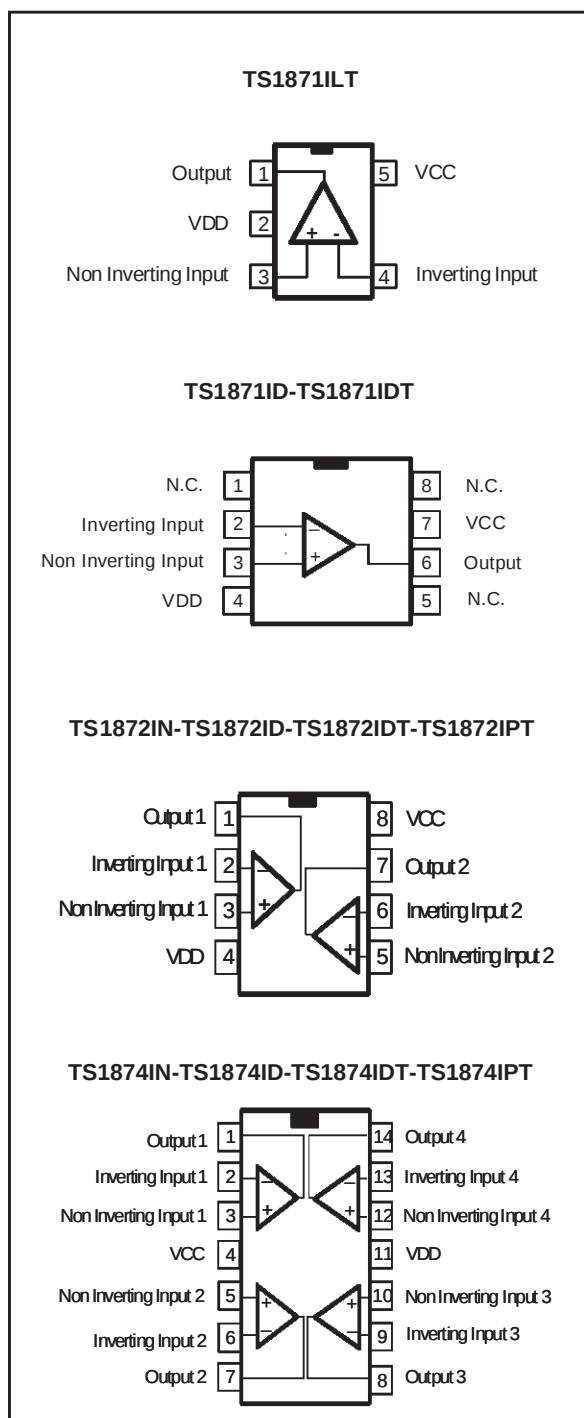
- Battery-powered applications (Toys)
- Portable communication devices (cell phone)
- Audio driver (Headphone Driver)
- Laptop/Notebook computers

ORDER CODE

Part Number	Temperature Range	Package				SOT23 Marking
		N	D	P	L	
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)



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_{thja}	Thermal Resistance Junction to Ambient ⁴⁾ SOT23-5 SO8 SO14 TSSOP8 TSSOP14	250 175 150 200 175	°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⁾	$V_{DD} - 0.2$ to $V_{CC} + 0.2$	V
V_{icm}	Common Mode Input Voltage Range ²⁾	V_{DD} to V_{CC}	V

1. At 25°C, for $1.8 \leq V_{CC} \leq 6V$, 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 $V_{CC}/2$, $T_{amb} = 25^\circ C$ (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		$\mu V/^\circ C$
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 $0 \leq V_{icm} \leq V_{CC}$, $V_{out} = V_{CC}/2$	55	77		dB
SVR	Supply Voltage Rejection Ratio	70	80		dB
A_{vd}	Large Signal Voltage Gain $V_{out} = 0.5V$ to $1.3V$ $R_L = 2k\Omega$ $R_L = 600\Omega$	77 70	92 85		dB
V_{OH}	High Level Output Voltage $V_{id} = 100mV$ $R_L = 2k\Omega$ $R_L = 600\Omega$	1.65 1.62	1.77 1.74		V
V_{OL}	Low Level Output Voltage $V_{id} = -100mV$ $R_L = 2k\Omega$ $R_L = 600\Omega$		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 Bandwidth Product $R_L = 10k\Omega$, $C_L = 100pF$, $f = 100kHz$	0.9	1.6		MHz
SR	Slew Rate $R_L = 10k\Omega$, $C_L = 100pF$, $AV = 1$	0.38	0.54		$V/\mu s$
ϕ_m	Phase Margin $C_L = 100pF$		53		Degrees
en	Input Voltage Noise		27		$nV/\sqrt{Hz}$
THD	Total Harmonic Distortion		0.01		%

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

TS1871-TS1872-TS1874

ELECTRICAL CHARACTERISTICS

$V_{CC} = +3V$, $V_{DD} = 0V$, R_L , C_L connected to $V_{CC}/2$, $T_{amb} = 25^\circ C$ (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		$\mu V/^\circ C$
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 $0 \leq V_{icm} \leq V_{CC}$, $V_{out} = V_{CC}/2$	60	80		dB
SVR	Supply Voltage Rejection Ratio	70	85		dB
A_{vd}	Large Signal Voltage Gain $V_{out} = 0.5V$ to $2.5V$ $R_L = 2k\Omega$ $R_L = 600\Omega$	80 74	92 95		dB
V_{OH}	High Level Output Voltage $V_{id} = 100mV$ $R_L = 2k\Omega$ $R_L = 600\Omega$	2.82 2.80	2.95 2.95		V
V_{OL}	Low Level Output Voltage $V_{id} = -100mV$ $R_L = 2k\Omega$ $R_L = 600\Omega$		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 Bandwidth Product $R_L = 10k\Omega$, $C_L = 100pF$, $f = 100kHz$	1	1.7		MHz
SR	Slew Rate $R_L = 10k\Omega$, $C_L = 100pF$, $AV = 1$	0.42	0.6		V/ μs
ϕ_m	Phase Margin $C_L = 100pF$		53		Degrees
en	Input Voltage Noise		40		nV/ $\sqrt{Hz}$
THD	Total Harmonic Distortion		0.01		%

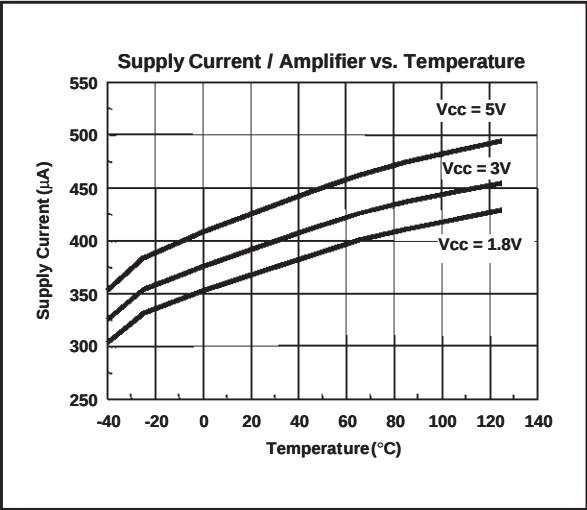
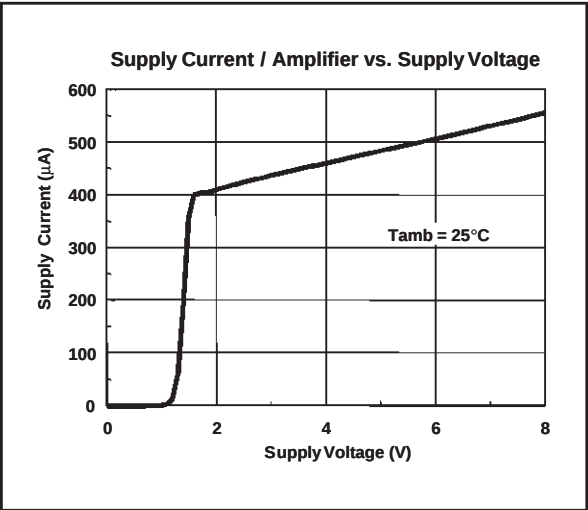
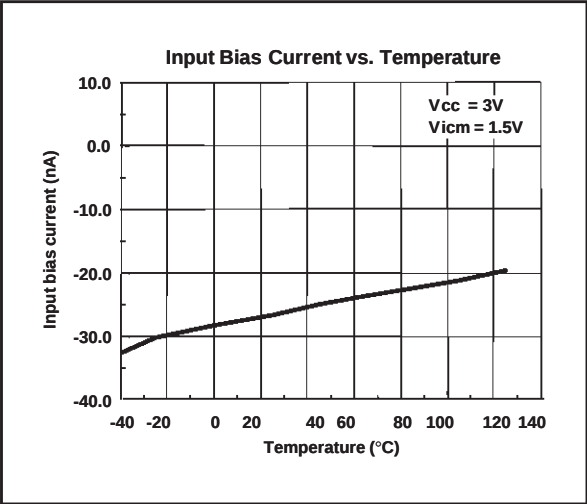
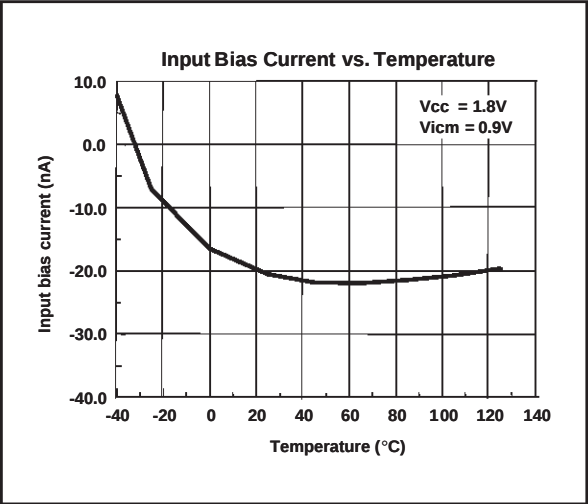
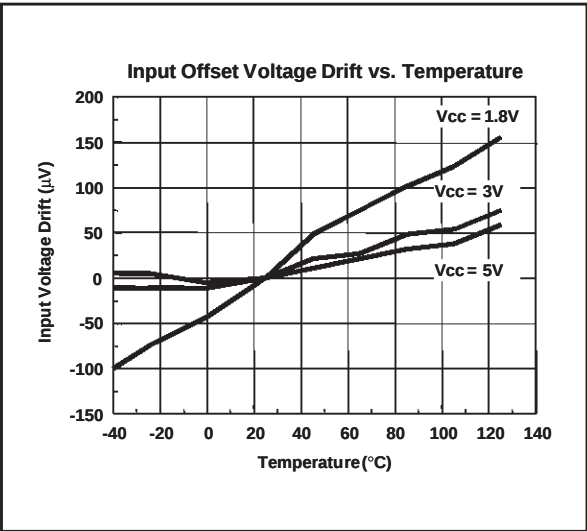
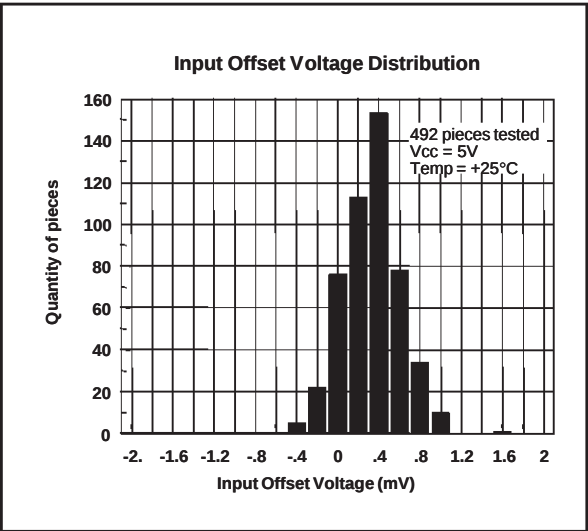
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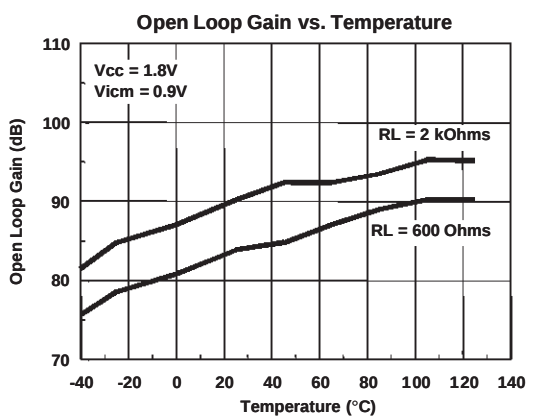
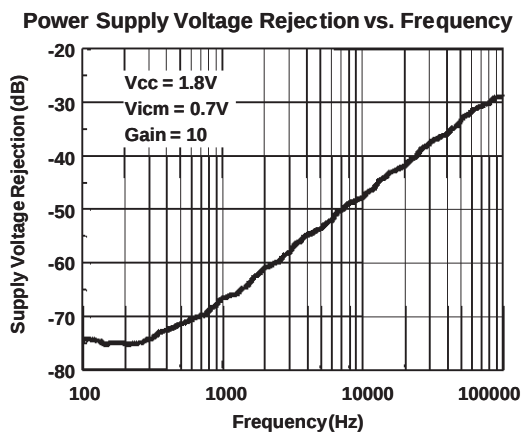
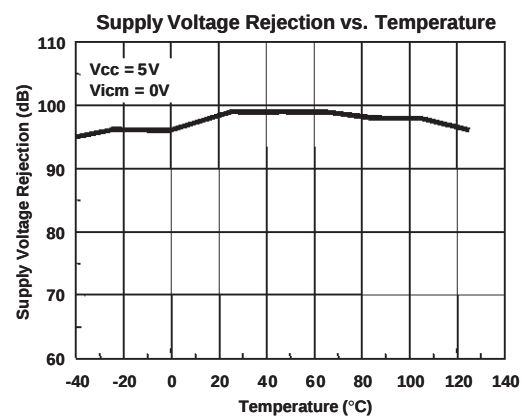
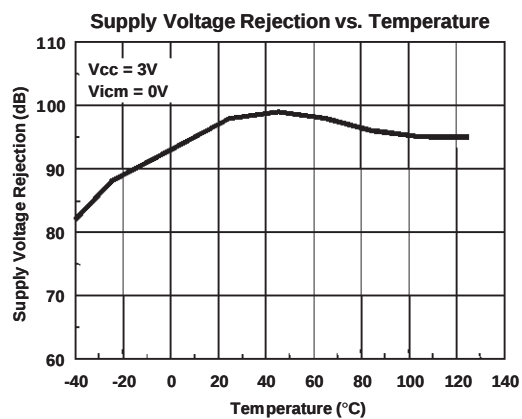
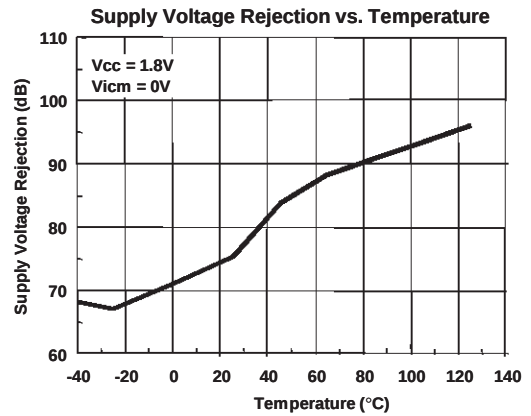
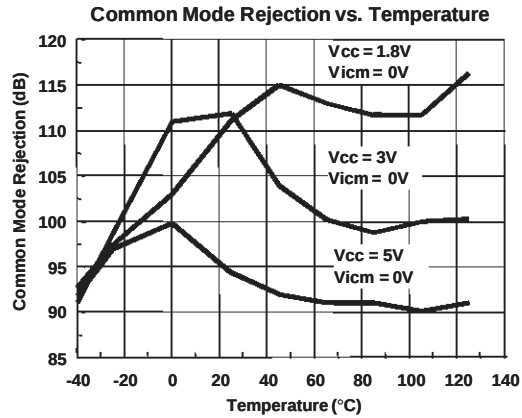
ELECTRICAL CHARACTERISTICS

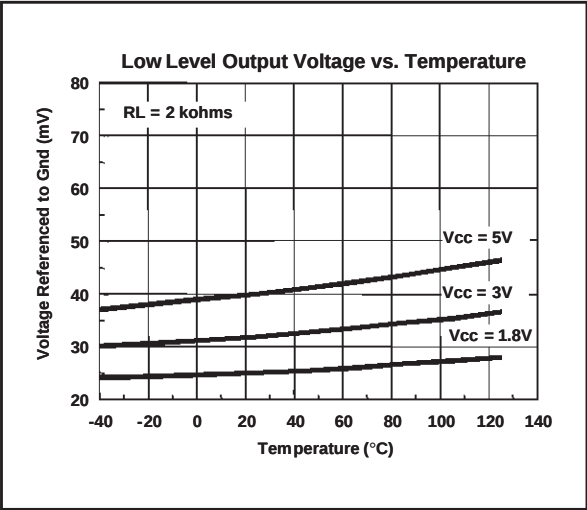
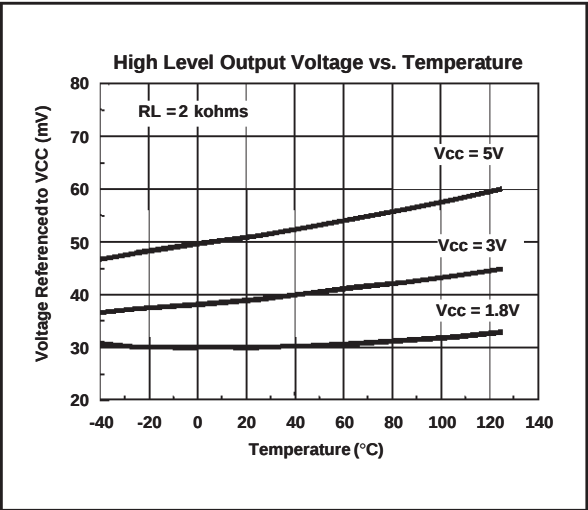
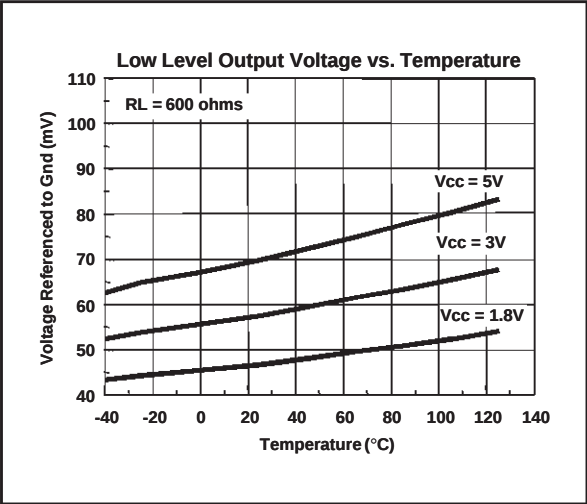
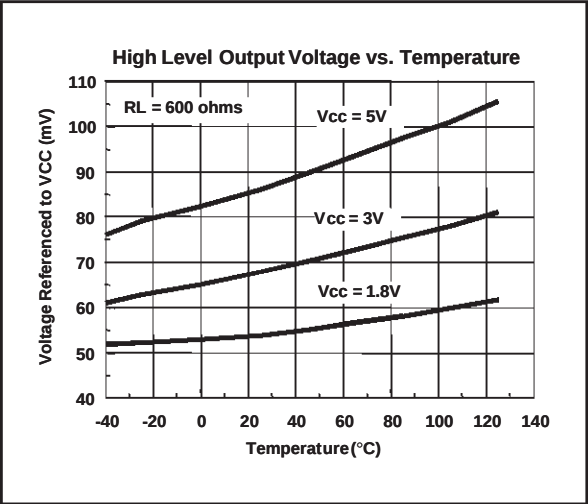
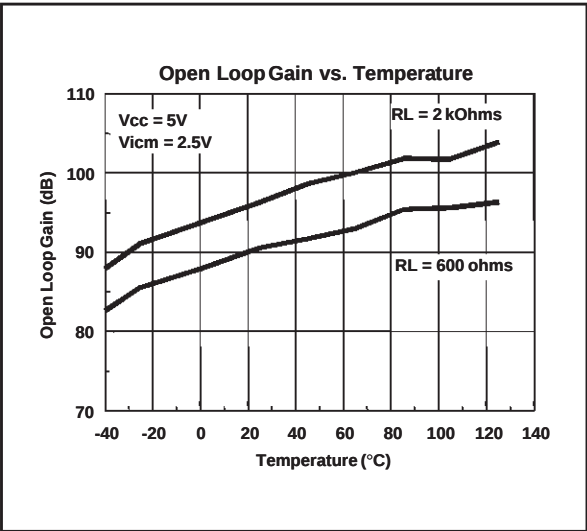
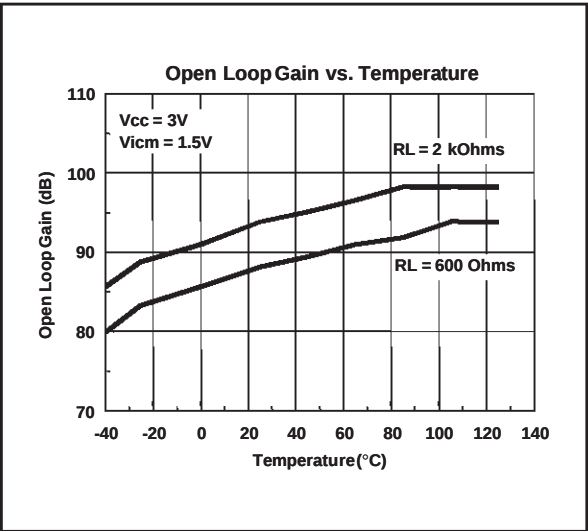
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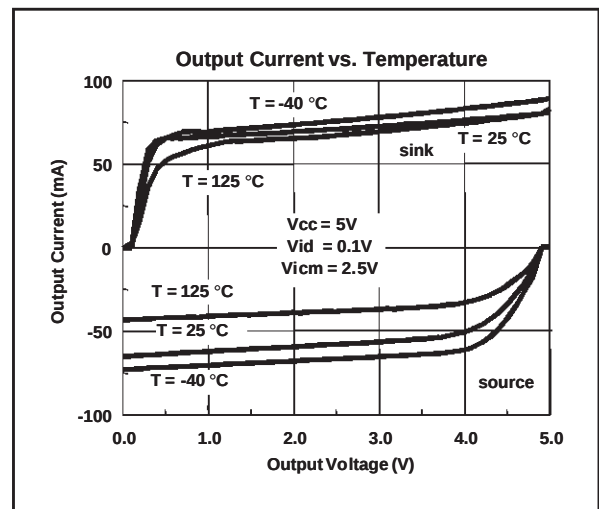
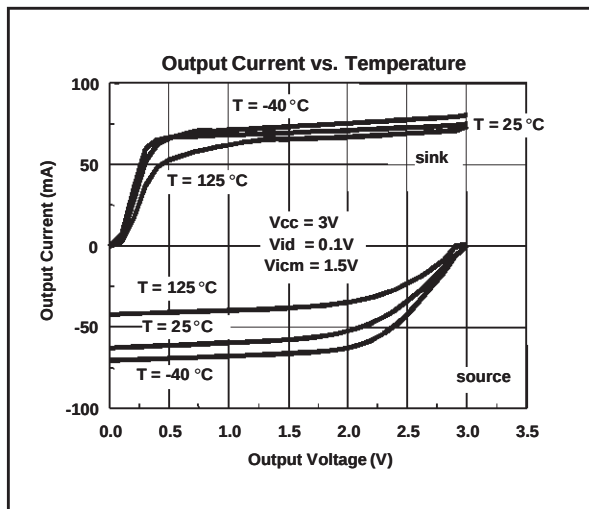
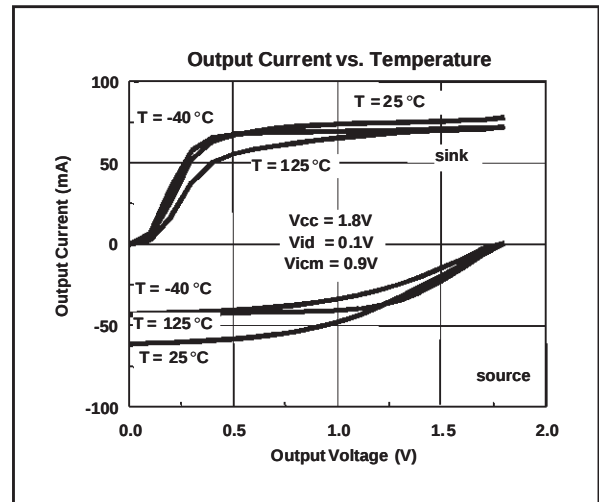
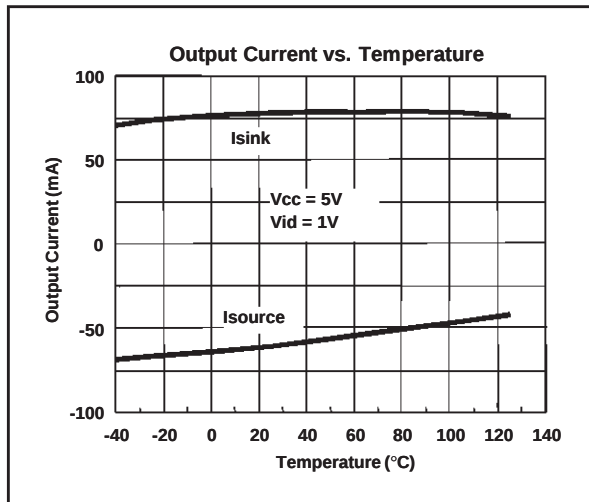
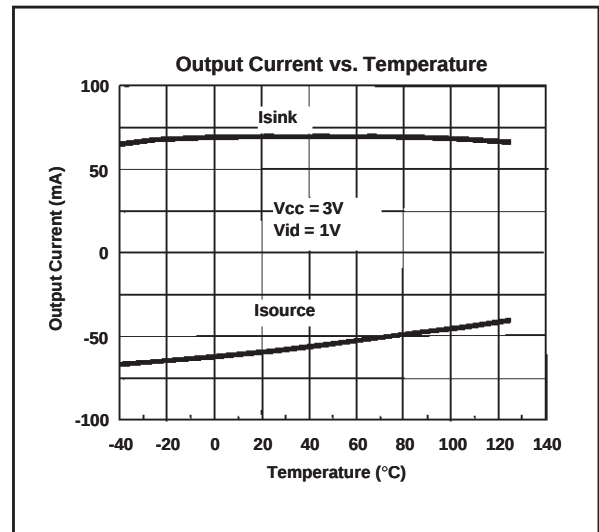
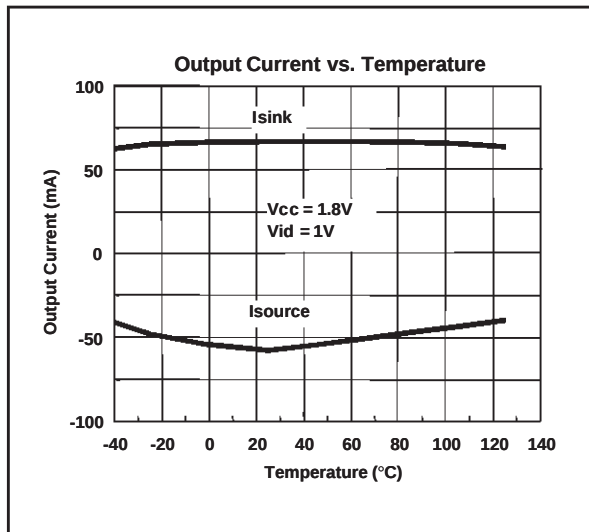
Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage $V_{icm} = V_{out} = V_{CC}/2$ TS1871/2/4 TS1871A/2A/4A		0.1	3 1	mV
ΔV_{io}	Input Offset Voltage Drift		2		$\mu V/^{\circ}C$
I_{io}	Input Offset Current ¹⁾ $V_{icm} = V_{out} = V_{CC}/2$		3	30	nA
I_{ib}	Input Bias Current ¹⁾ $V_{icm} = V_{out} = V_{CC}/2$		68	130	nA
CMR	Common Mode Rejection Ratio $0 \leq V_{icm} \leq V_{CC}$, 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 $4V$ $R_L = 2k\Omega$ $R_L = 600\Omega$	83 77	92 85		dB
V_{OH}	High Level Output Voltage $V_{id} = 100mV$ $R_L = 2k\Omega$ $R_L = 600\Omega$	4.80 4.75	4.95 4.90		V
V_{OL}	Low Level Output Voltage $V_{id} = -100mV$ $R_L = 2k\Omega$ $R_L = 600\Omega$		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 $R_L = 10k\Omega$, $C_L = 100pF$, $f = 100kHz$	1	1.8		MHz
SR	Slew Rate $R_L = 10k\Omega$, $C_L = 100pF$, $AV = 1$	0.42	0.6		V/ μs
ϕ_m	Phase Margin $C_L = 100pF$		55		Degrees
en	Input Voltage Noise		40		nV/ $\sqrt{Hz}$
THD	Total Harmonic Distortion		0.01		%

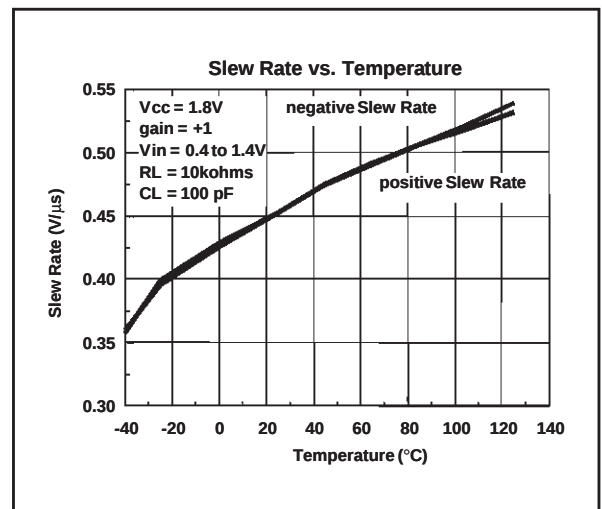
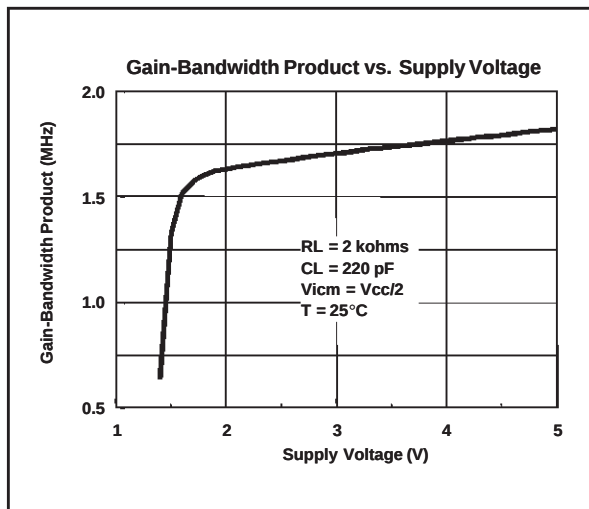
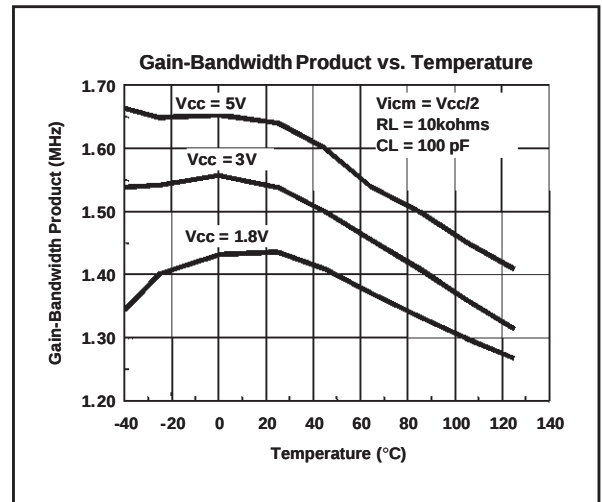
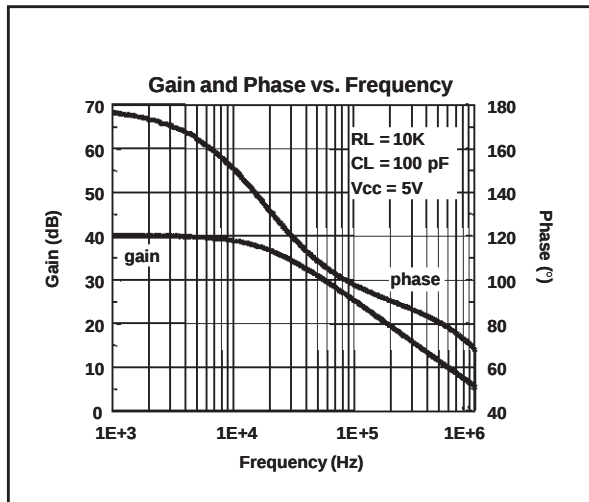
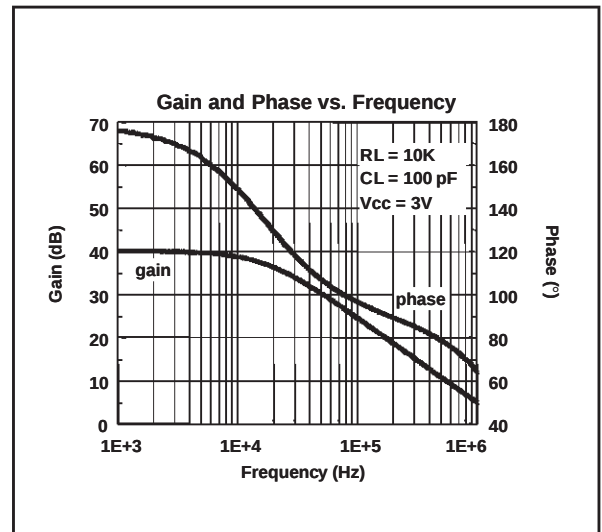
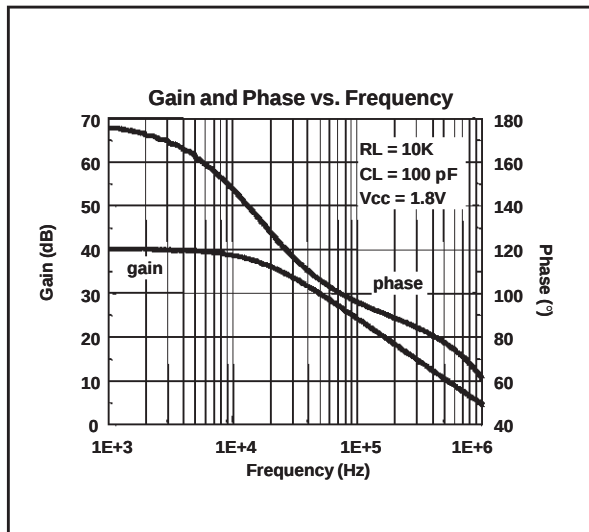
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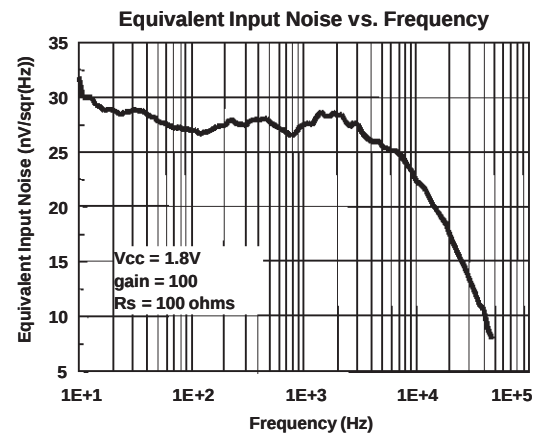
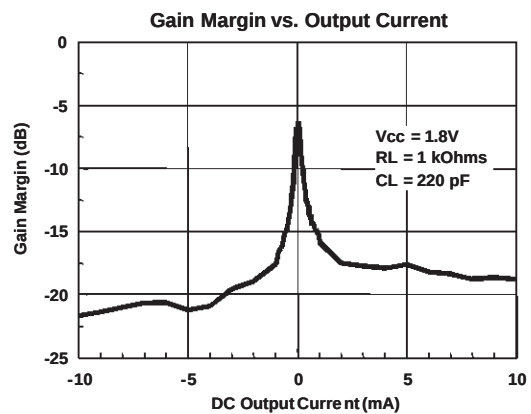
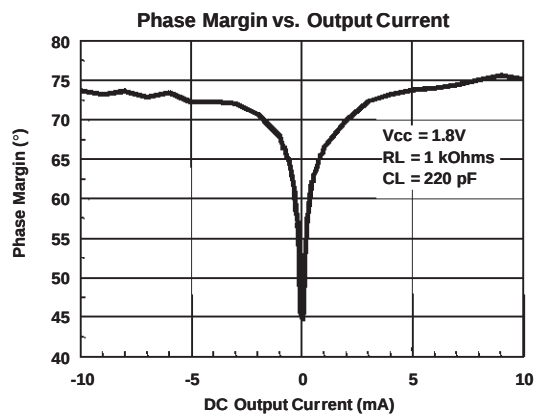
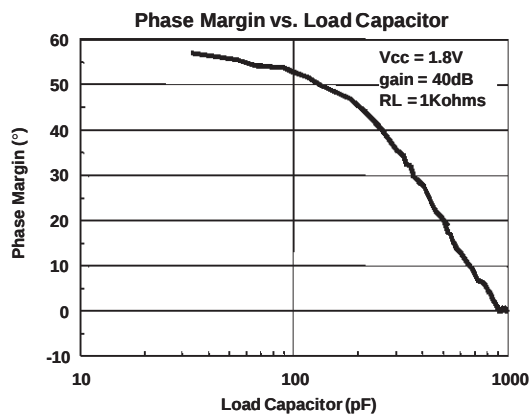
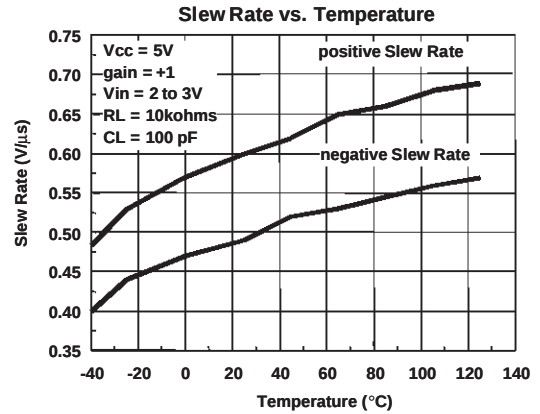
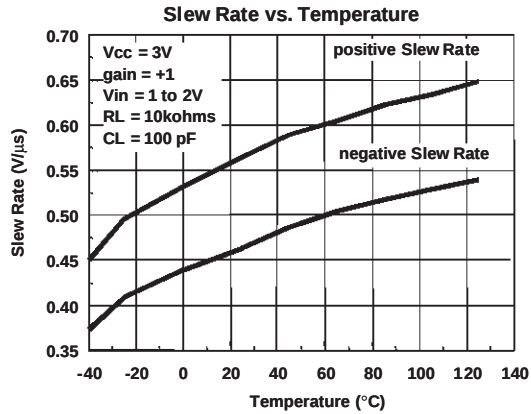


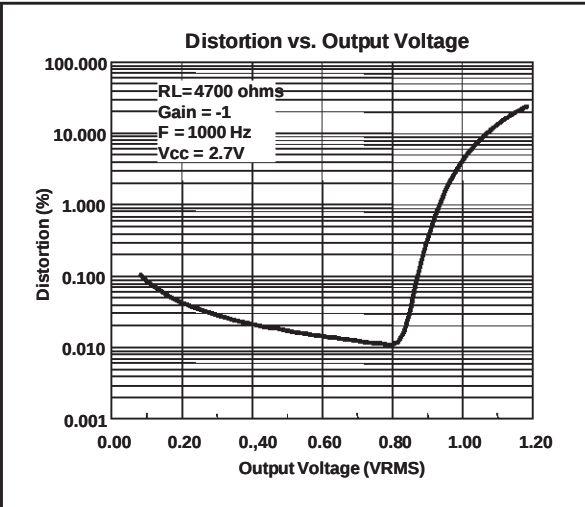
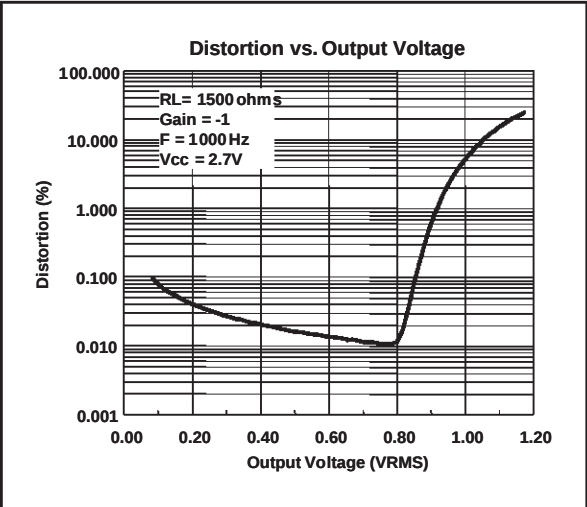
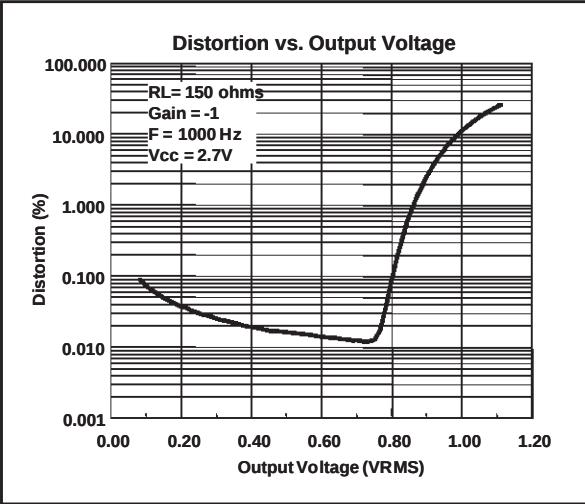
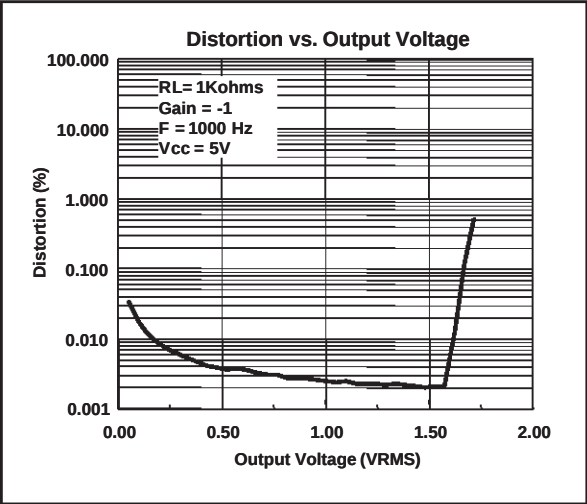
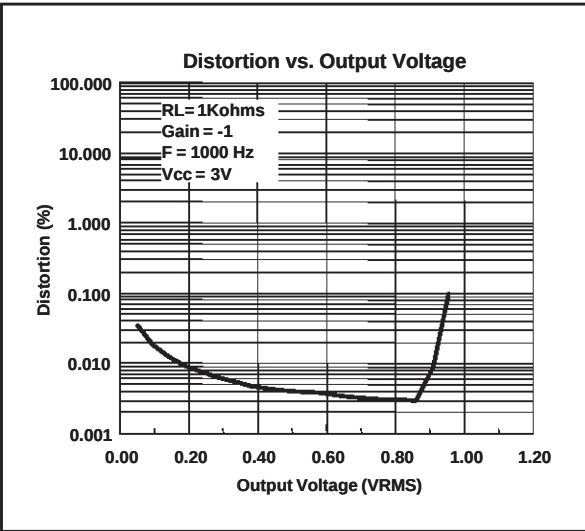
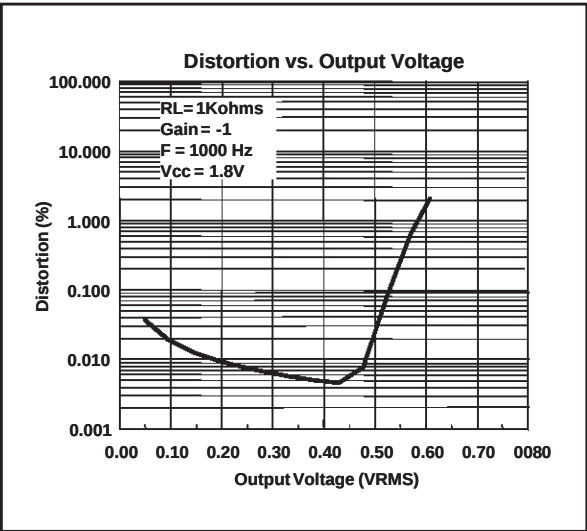


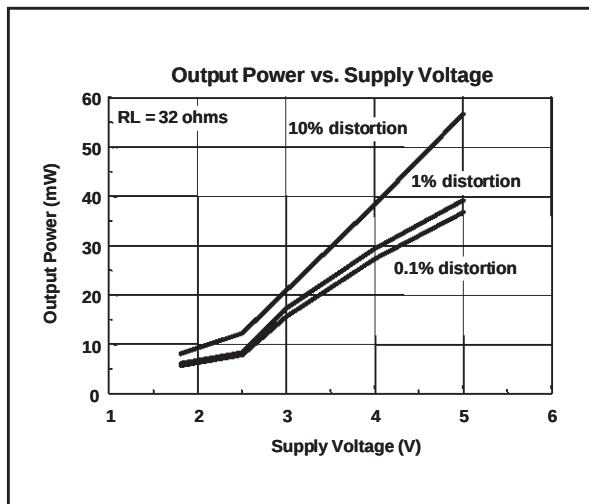
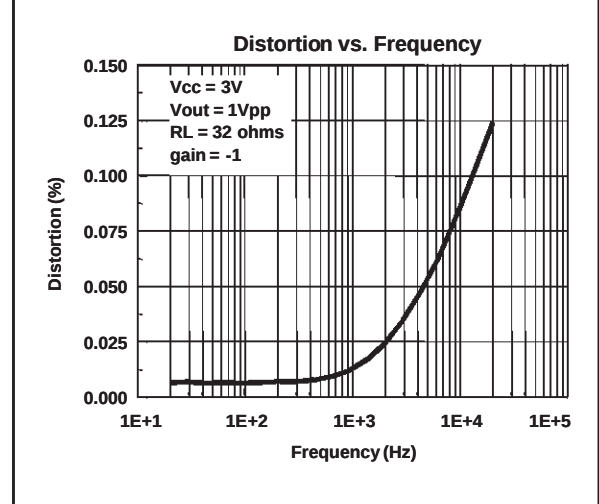
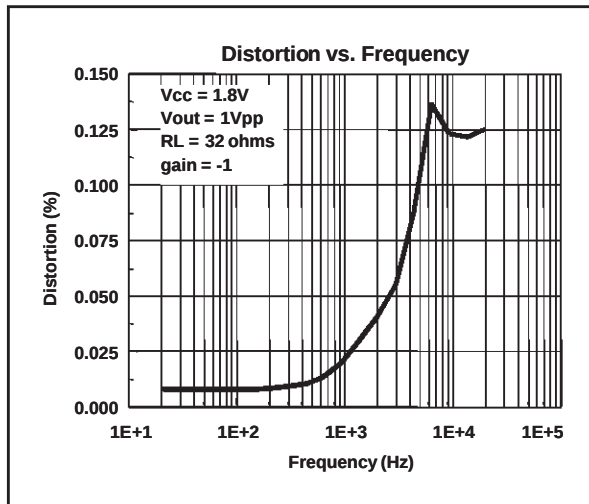
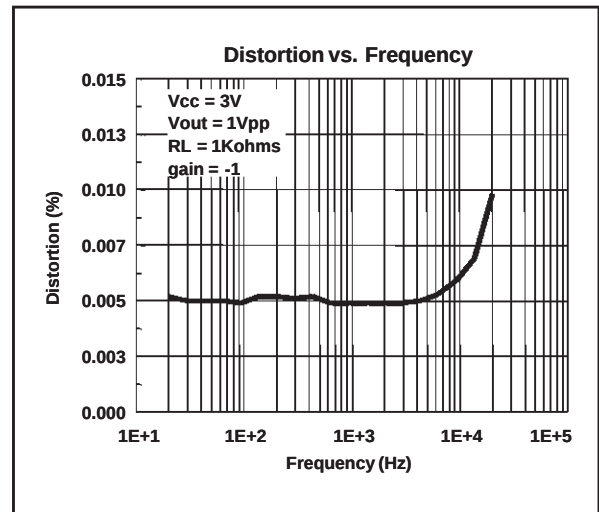
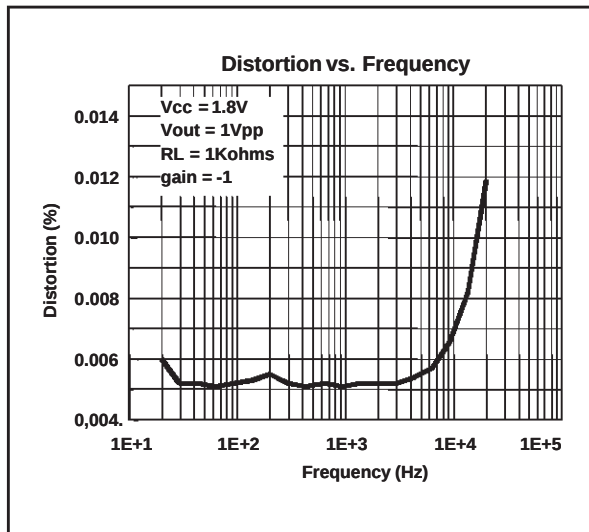






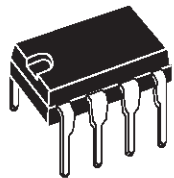




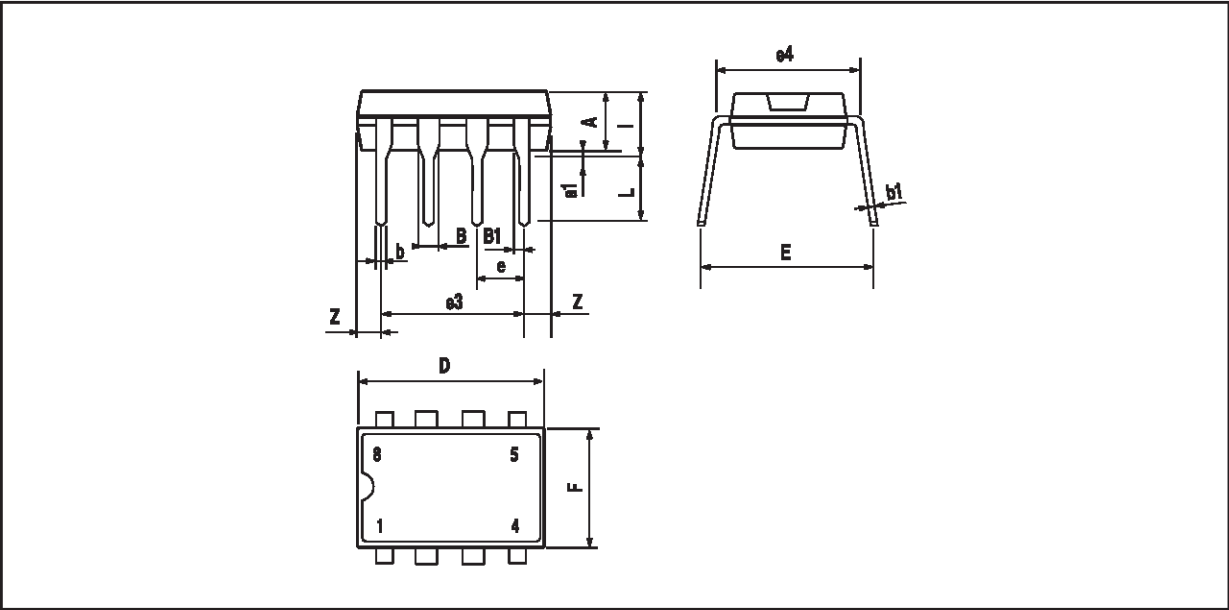


TS1871-TS1872-TS1874

TS1872IN

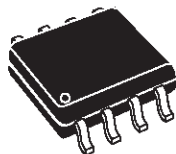


PACKAGE MECHANICAL DATA
8 PINS - PLASTIC DIP



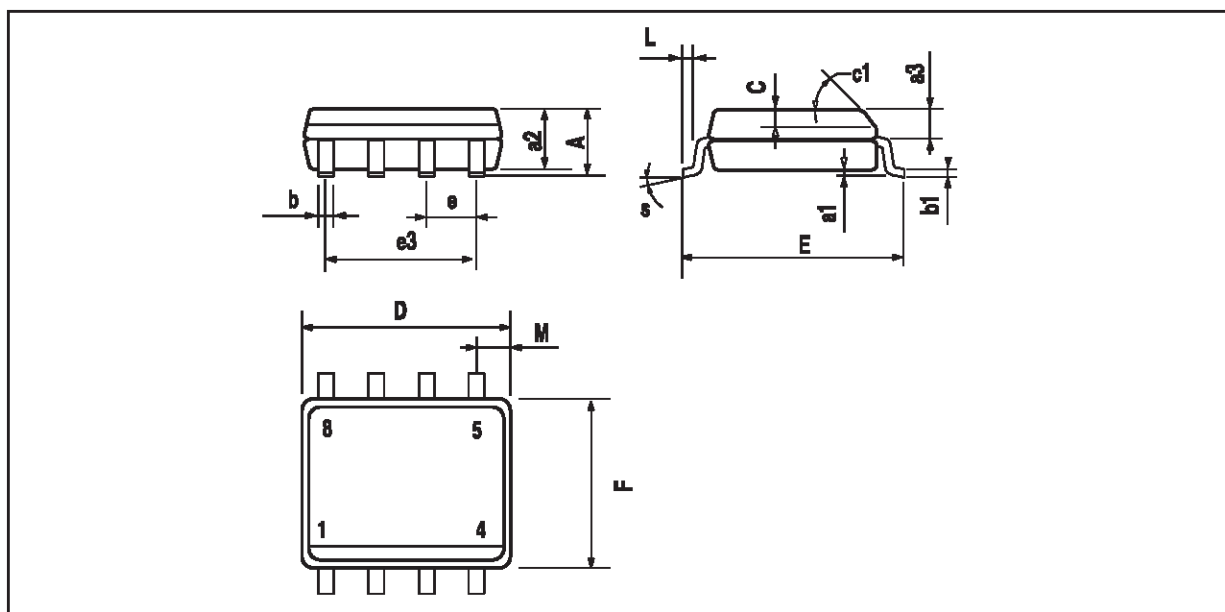
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0.260
i			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

TS1871ID - TS1872ID



PACKAGE MECHANICAL DATA

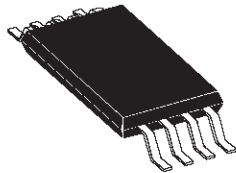
8 PINS - PLASTIC MICROPACKAGE (SO)



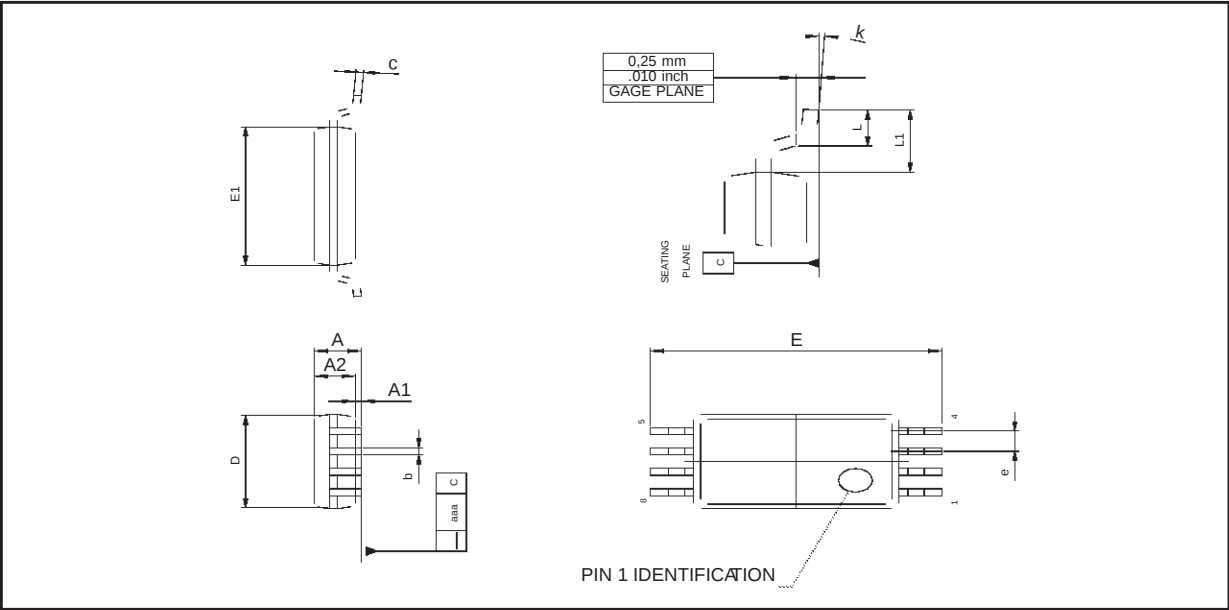
Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.25	0.004		0.010
a2			1.65			0.065
a3	0.65		0.85	0.026		0.033
b	0.35		0.48	0.014		0.019
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.020
c1	45° (typ.)					
D	4.8		5.0	0.189		0.197
E	5.8		6.2	0.228		0.244
e		1.27	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

TS1871-TS1872-TS1874

TS1872IPT

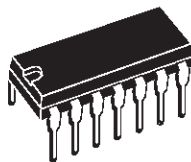


PACKAGE MECHANICAL DATA
8 PINS - THIN SHRINK SMALL OUTLINE PACKAGE



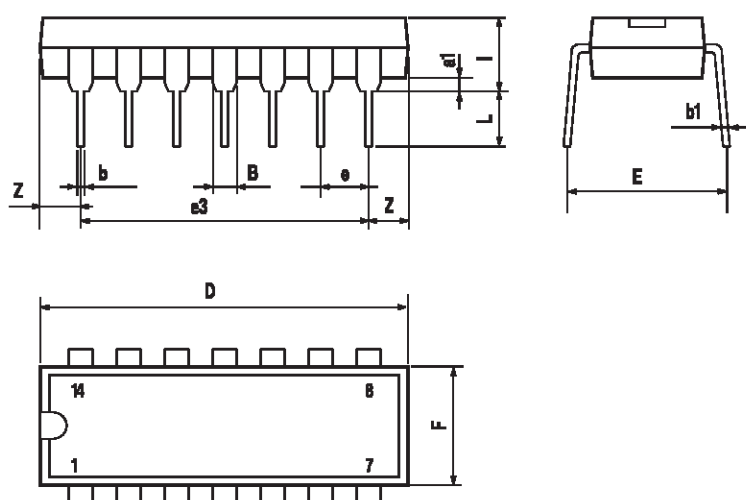
Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
c	0.09		0.20	0.003		0.012
D	2.90	3.00	3.10	0.114	0.118	0.122
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.025	
k	0°		8°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

TS1874IN



PACKAGE MECHANICAL DATA

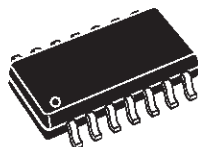
14 PINS - PLASTIC DIP



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

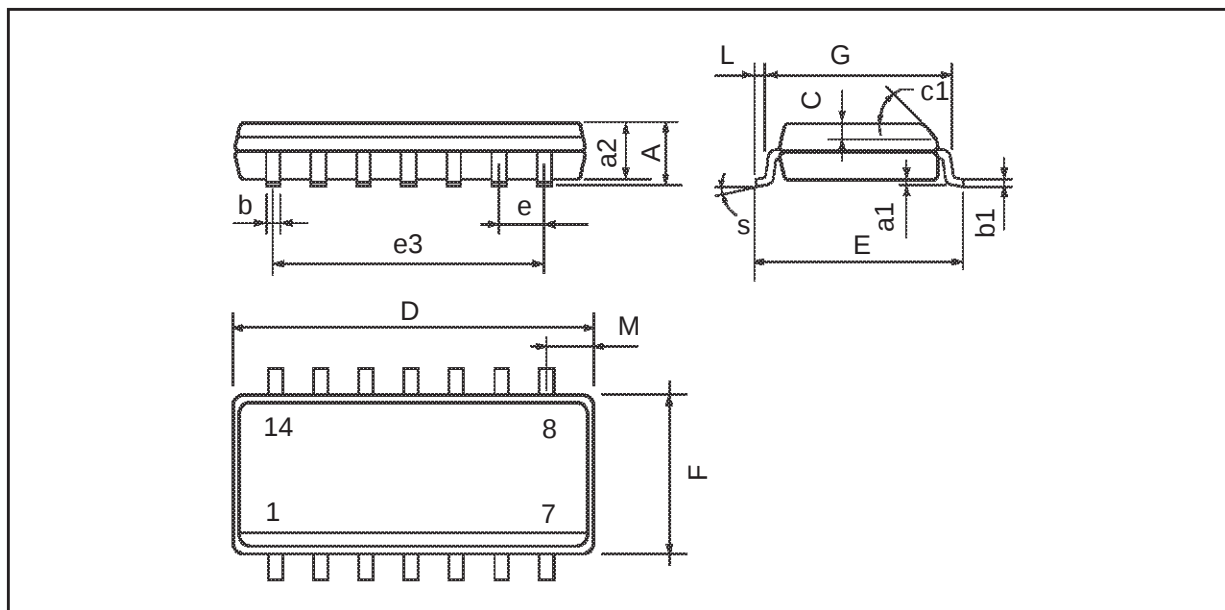
TS1871-TS1872-TS1874

TS1874ID



PACKAGE MECHANICAL DATA

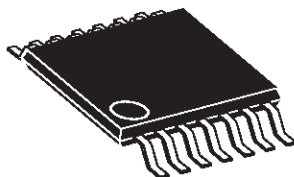
14 PINS - PLASTIC MICROPACKAGE (SO)



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.)					

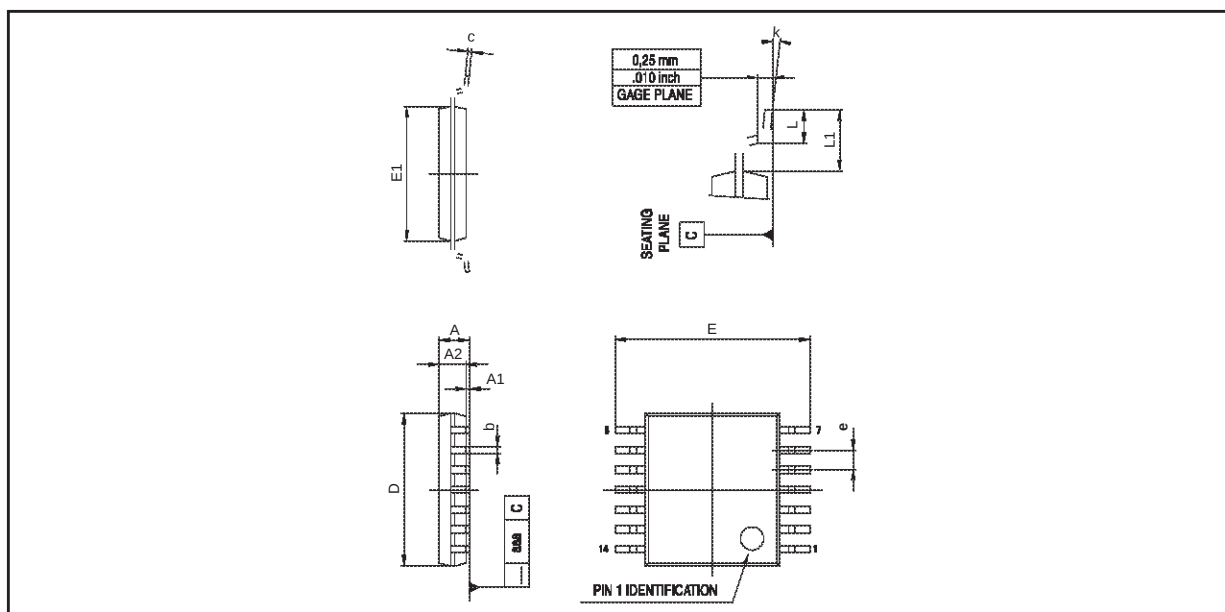
Note : (1) D and F do not include mold flash or protrusions - Mold flash or protrusions shall not exceed 0.15mm (.066 inc) ONLY FOR DATA BOOK.

TS1874IPT



PACKAGE MECHANICAL DATA

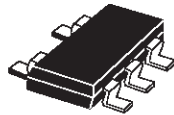
14 PINS - THIN SHRINK SMALL OUTLINE PACKAGE



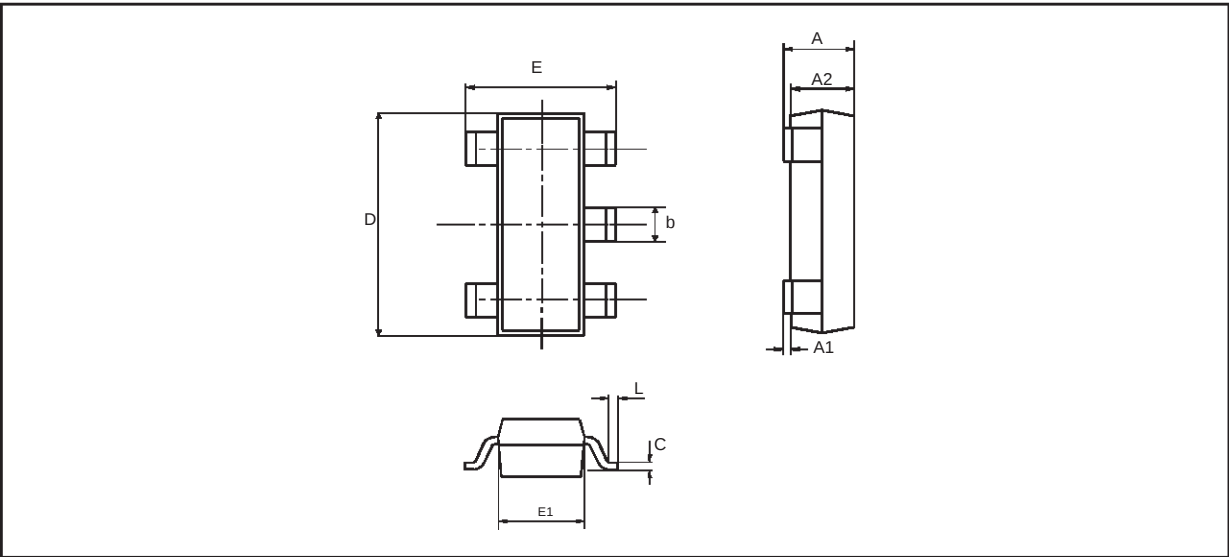
Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
c	0.09		0.20	0.003		0.012
D	4.90	5.00	5.10	0.192	0.196	0.20
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.025	
k	0°		8°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

TS1871-TS1872-TS1874

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

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