



**TS1851
TS1852
TS1854**

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} ($V_{ee} - 0.2V$ to $V_{CC} + 0.2V$)
- LOW SUPPLY CURRENT ($120\mu A$)
- GAIN BANDWIDTH PRODUCT ($480kHz$)
- HIGH STABILITY (able to drive $500pF$)
- ESD TOLERANCE ($2kV$)
- LATCH-UP IMMUNITY
- AVAILABLE IN **SOT23-5 MICROPACKAGE**

DESCRIPTION

The TS185x (Single, Dual & Quad) is operational amplifier able to operate with voltages as low as 1.8V and features both Input and Output Rail to Rail ($1.71 @ V_{CC} = 1.8V, R_L = 2k\Omega$), $120\mu A$ consumption current and $480kHz$ Gain Bandwidth Product.

With a such low consumption and a sufficient GBP for many applications, this Op-Amp is very well-suited for any kind of battery-supplied and portable equipment applications.

The TS1851 is housed in the space-saving 5 pin SOT23-5 package which simplifies the board design (outside dimensions are $2.8mm \times 2.9mm$).

APPLICATION

- Two-cell battery-powered systems
- Portable/Battery-powered electronic equipment
- Cordless phones
- Cellular phones
- Laptops
- PDAs

ORDER CODE

Part Number	Temperature Range	Package					SOT23 Marking
		N	D	P	L	S	
TS1851/AI	-40, +125°C		•		•		K161/K162
TS1852/AI		•	•	•		•	
TS1854/AI		•	•	•			

S = Small Outline Package (miniSO) - only available in Tape & Reel (ST)

N = Dual in Line Package (DIP)

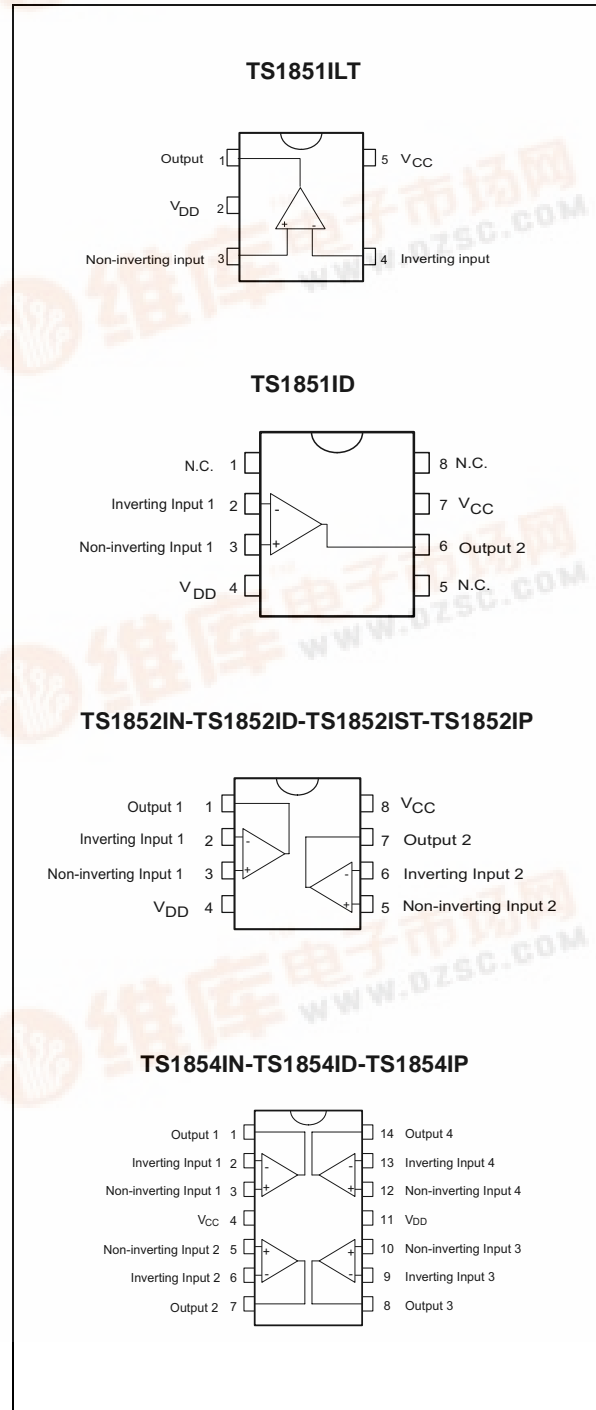
D = Small Outline Package (SO) - also available in Tape & Reel (DT)

P = Thin Shrink Small Outline Package (TSSOP) - only available

L = Tape & Reel (PT)

L = Tiny Package (SOT23-5) - only available in Tape & Reel (LT)

PIN CONNECTIONS (top view)



TS1851-TS1852-TS1854

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 miniSO8 SO8 SO14 TSSOP8 TSSOP14	81 41 33 39 40 31 37 32	°C/W
R_{thja}	Thermal Resistance Junction to Ambient - SOT23-5	256	°C/W
ESD	Human Body Model	2	kV
	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⁾	$V_{ee} - 0.2$ 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 $1.8 \leq V_{CC} \leq 6V$, 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

$V_{CC} = +1.8V$, $V_{EE} = 0V$, $T_{amb} = 25^{\circ}C$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage TS1851/2/4 TS1851A/2A/4A		0.1	3 1	mV
ΔV_{io}	Input Offset Voltage Drift		2		$\mu V/^{\circ}C$
I_{io}	Input Offset Current ¹⁾		1	9	nA
I_{ib}	Input Bias Current ¹⁾		10	50	nA
CMR	Common Mode Rejection Ratio $0 \leq V_{icm} \leq V_{CC}$	55	85		dB
SVR	Supply Voltage Rejection Ratio $V_{icm} = 0.5V$	70	80		dB
A_{vd}	Large Signal Voltage Gain $R_L = 10k\Omega$ $R_L = 2k\Omega$	80 70	100 88		dB
V_{OH}	High Level Output Voltage $R_L = 10k\Omega$ $R_L = 2k\Omega$	1.7 1.65	1.77 1.7		V
V_{OL}	Low Level Output Voltage $R_L = 10k\Omega$ $R_L = 2k\Omega$		40 62	70 90	mV
I_o	Output Source Current $V_{ID} = 100mV$, $V_O = V_{DD}$ Output Sink Current $V_{ID} = -100mV$, $V_O = V_{CC}$	2 2	29 46		mA
I_{CC}	Supply Current (per amplifier) $A_{VCL} = 1$, no load		120	170	μA
GBP	Gain Bandwidth Product $R_L = 10k\Omega$, $C_L = 100pF$, $f = 100kHz$	300	480		kHz
SR	Slew Rate $R_L = 10k\Omega$, $C_L = 100pF$, $AV = 1$	0.1	0.18		$V/\mu s$
ϕ_m	Phase Margin $C_L = 100pF$		60		Degrees
en	Input Voltage Noise		40		nV/\sqrt{Hz}
THD	Total Harmonic Distortion		0.01		%

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

TS1851-TS1852-TS1854

ELECTRICAL CHARACTERISTICS

$V_{CC} = +3V$, $V_{EE} = 0V$, $T_{amb} = 25^{\circ}C$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage TS1851/2/4 TS1851A/2A/4A		0.1	3 1	mV
ΔV_{io}	Input Offset Voltage Drift		2		$\mu V/^{\circ}C$
I_{io}	Input Offset Current ¹⁾		1	9	nA
I_{ib}	Input Bias Current ¹⁾		10	55	nA
CMR	Common Mode Rejection Ratio $0 \leq V_{icm} \leq V_{CC}$	60	90		dB
SVR	Supply Voltage Rejection Ratio $V_{icm} = V_{CC}/2$	70	85		dB
A_{vd}	Large Signal Voltage Gain $R_L = 10k\Omega$ $R_L = 2k\Omega$	83 74	99 90		dB
V_{OH}	High Level Output Voltage $R_L = 10k\Omega$ $R_L = 2k\Omega$	2.9 2.85	2.96 2.94		V
V_{OL}	Low Level Output Voltage $R_L = 10k\Omega$ $R_L = 2k\Omega$		10 46	90 100	mV
I_o	Output Source Current $V_{ID} = 100mV$, $V_O = V_{DD}$ Output Sink Current $V_{ID} = -100mV$, $V_O = V_{CC}$	2 2	47 47		mA
I_{CC}	Supply Current (per amplifier) $A_{VCL} = 1$, no load		150	200	μA
GBP	Gain Bandwidth Product $R_L = 10k\Omega$, $C_L = 100pF$, $f = 100kHz$	370	600		kHz
SR	Slew Rate $R_L = 10k\Omega$, $C_L = 100pF$, $AV = 1$	0.12	0.2		$V/\mu s$
ϕ_m	Phase Margin $C_L = 100pF$		60		Degrees
en	Input Voltage Noise		40		nV/\sqrt{Hz}
THD	Total Harmonic Distortion		0.01		%

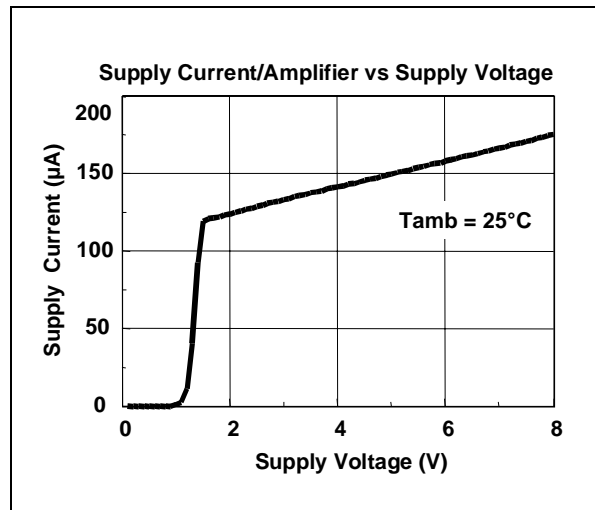
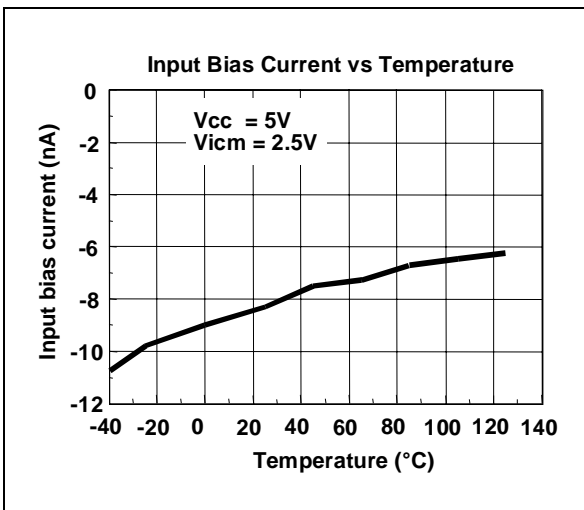
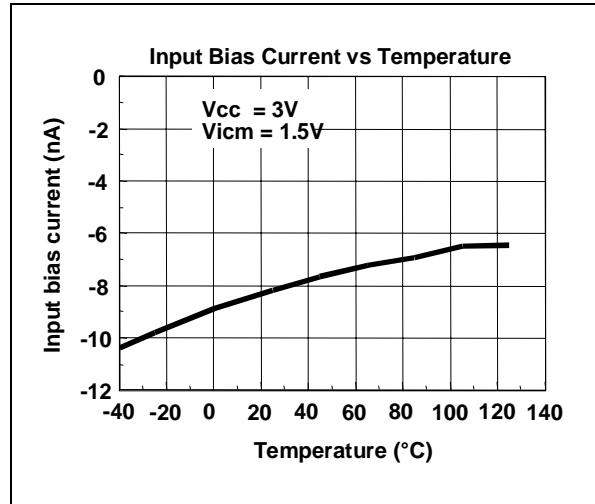
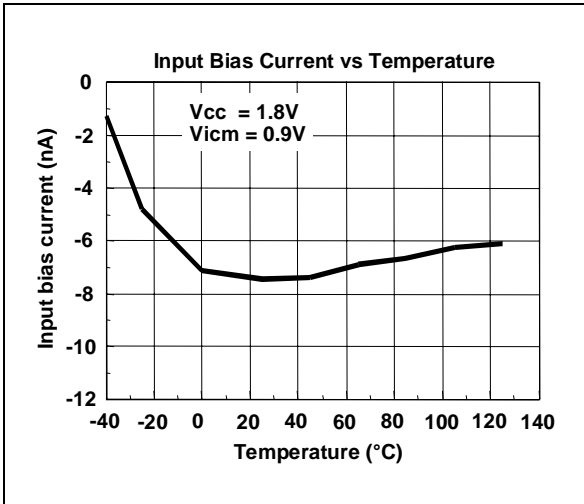
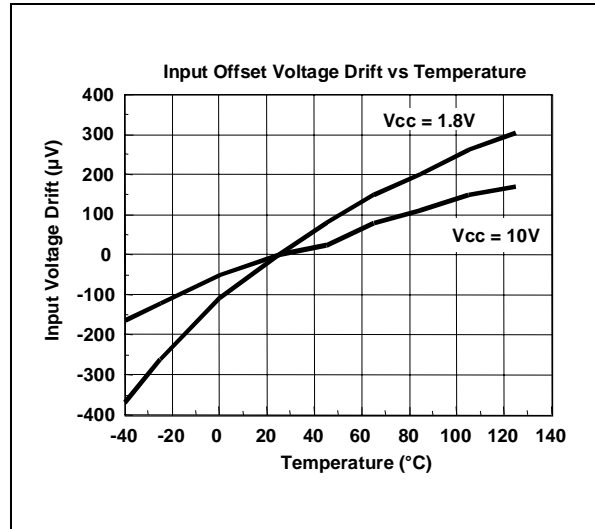
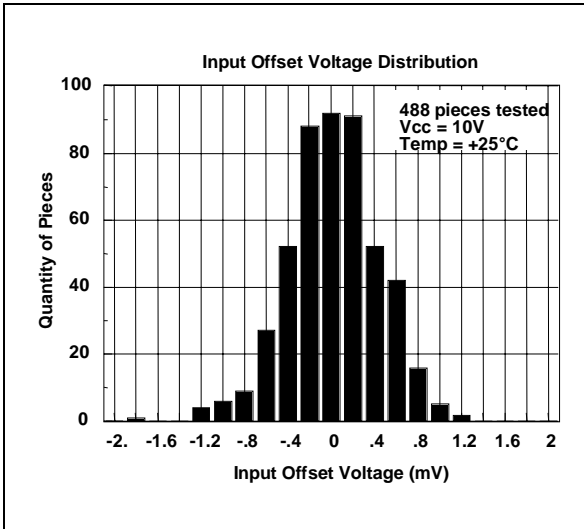
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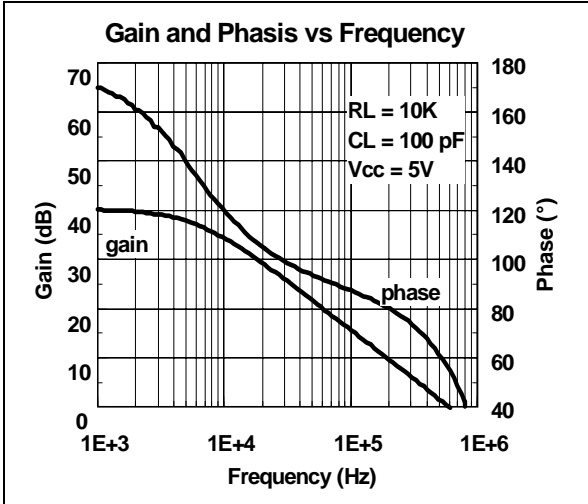
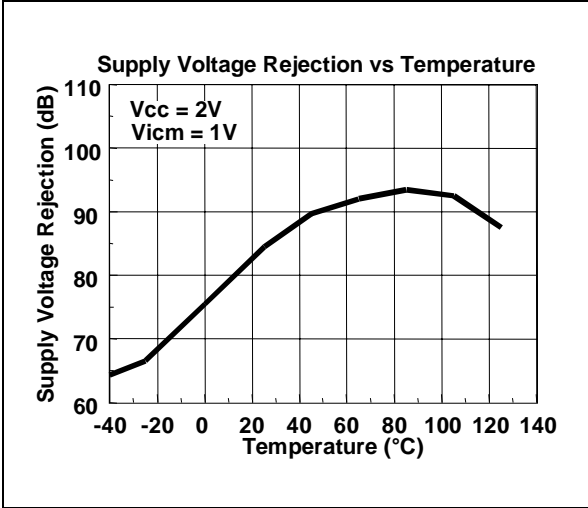
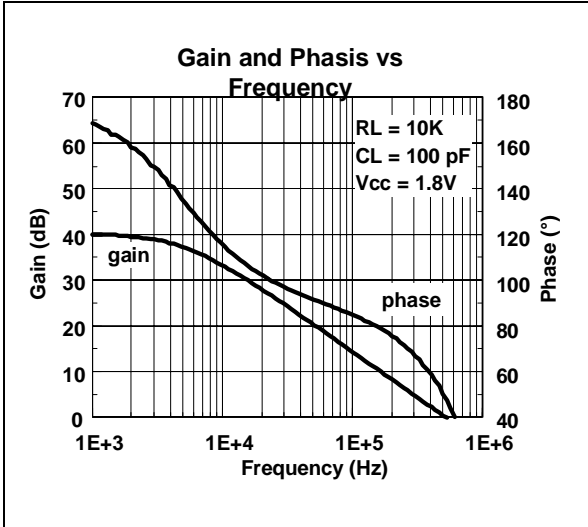
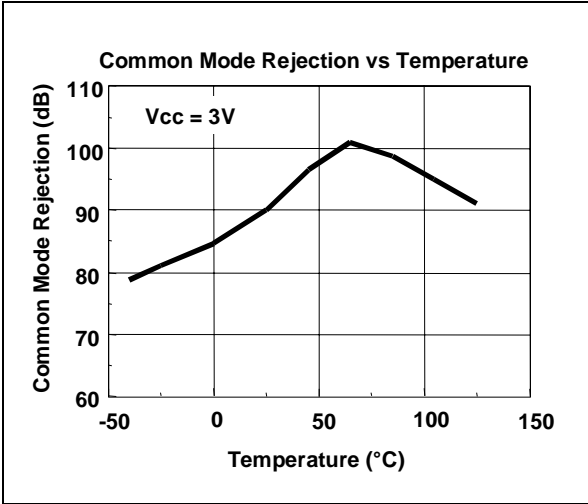
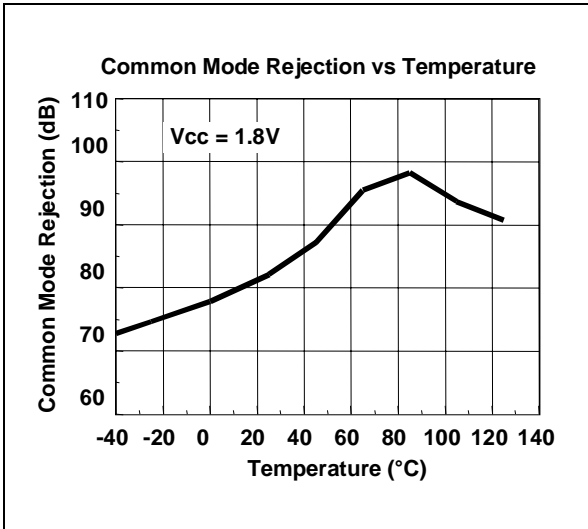
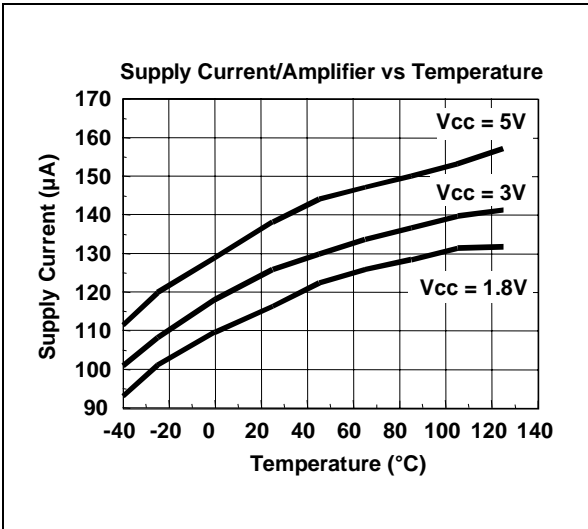
ELECTRICAL CHARACTERISTICS

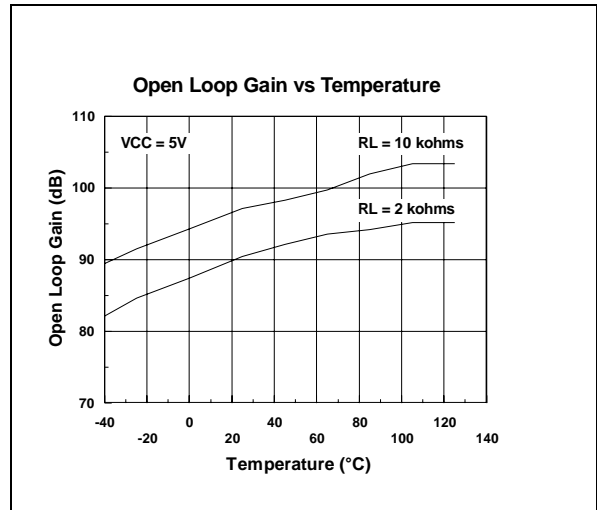
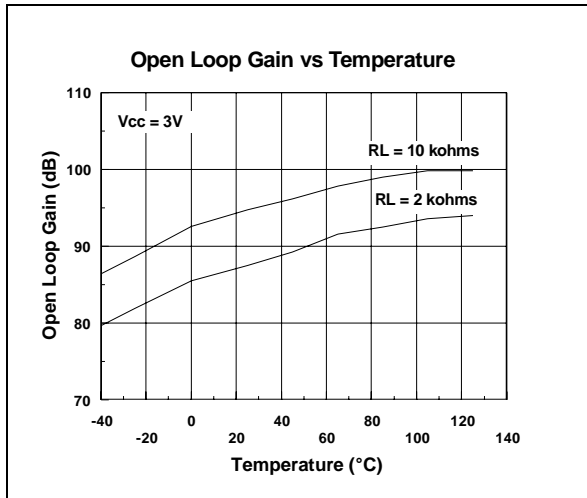
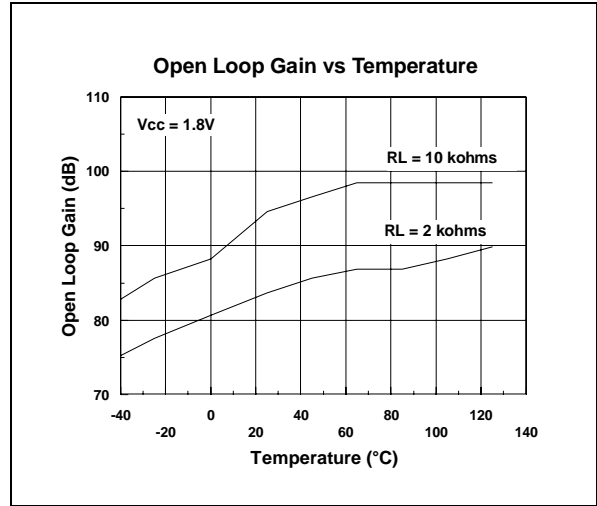
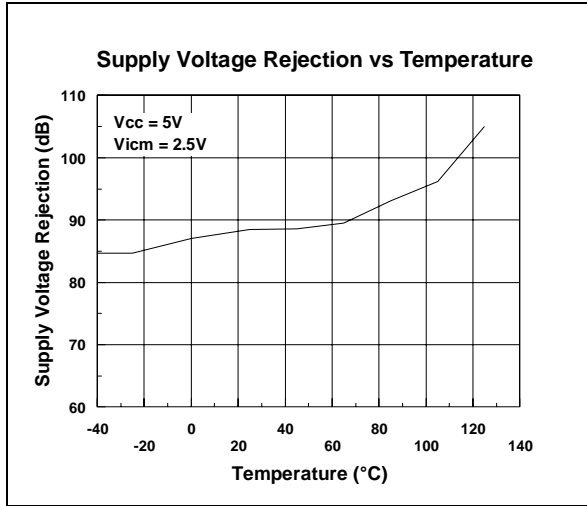
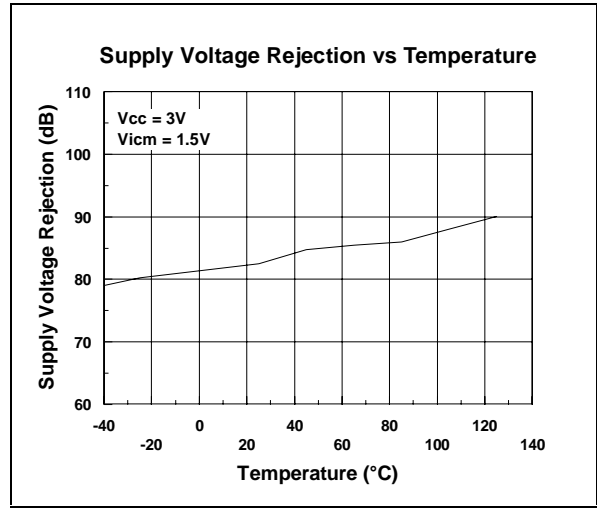
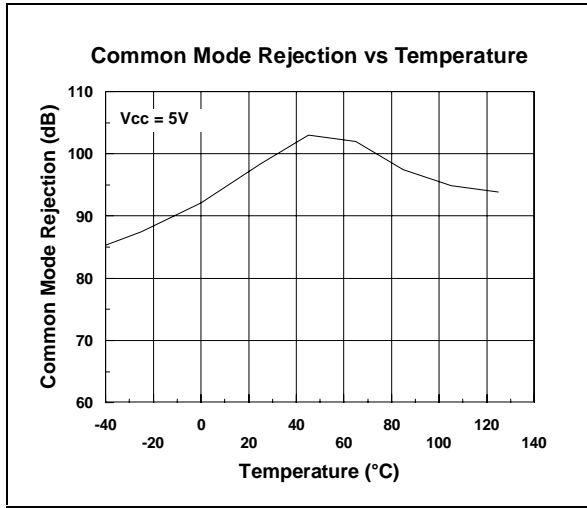
$V_{CC} = +5V$, $V_{ee} = 0V$, $T_{amb} = 25^{\circ}C$ (unless otherwise specified)

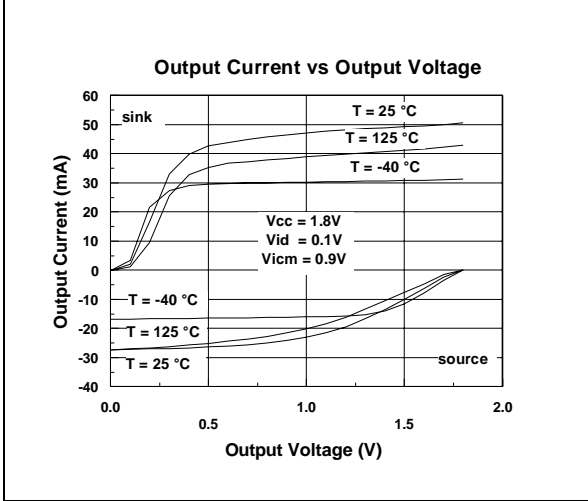
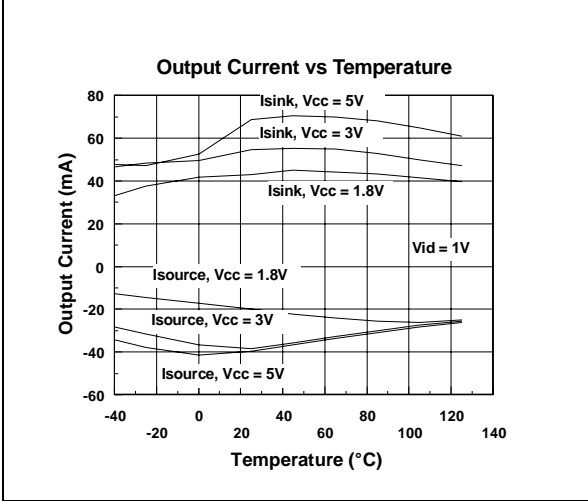
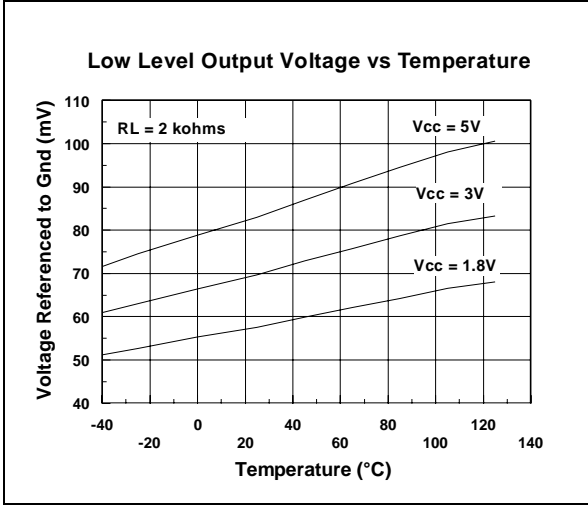
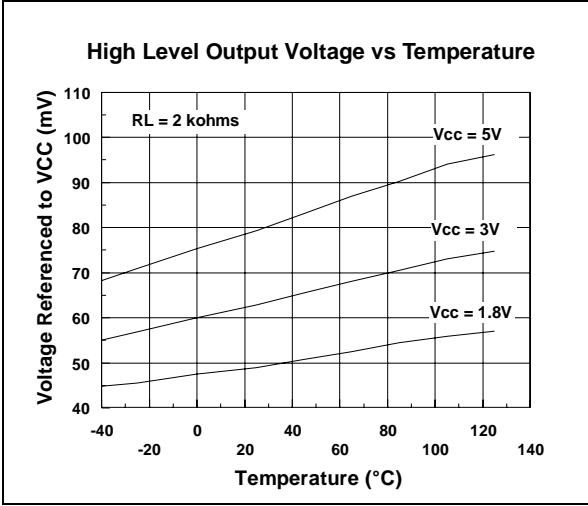
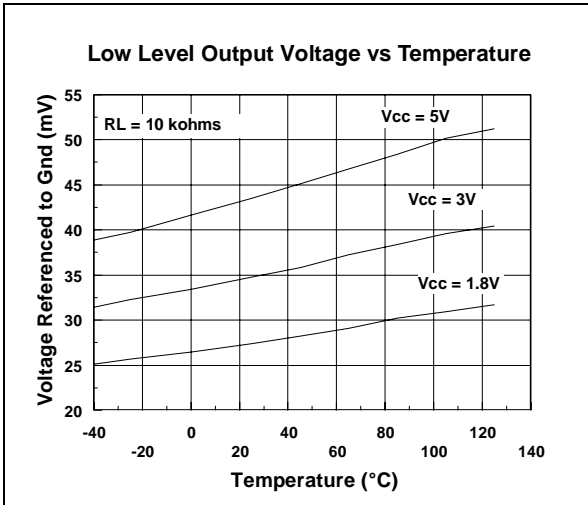
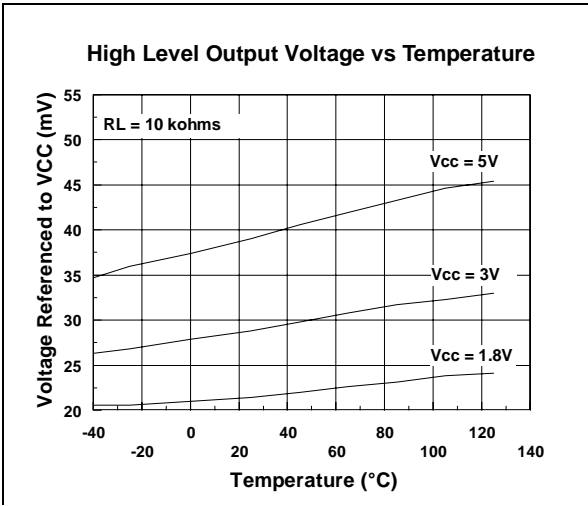
Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage TS1851/2/4 TS1851A/2A/4A		0.1	3 1	mV
ΔV_{io}	Input Offset Voltage Drift		2		$\mu V/^{\circ}C$
I_{io}	Input Offset Current ¹⁾		1	9	nA
I_{ib}	Input Bias Current ¹⁾		16	63	nA
CMR	Common Mode Rejection Ratio $0 \leq V_{icm} \leq V_{CC}$	65	95		dB
SVR	Supply Voltage Rejection Ratio $V_{icm} = V_{CC}/2$	70	90		dB
A_{vd}	Large Signal Voltage Gain $R_L = 10k\Omega$ $R_L = 2k\Omega$	85 77	97 93		dB
V_{OH}	High Level Output Voltage $R_L = 10k\Omega$ $R_L = 2k\Omega$	4.85 4.8	4.95 4.91		V
V_{OL}	Low Level Output Voltage $R_L = 10k\Omega$ $R_L = 2k\Omega$		40 80	180 200	mV
I_o	Output Source Current $V_{ID} = 100mV$, $V_O = V_{DD}$	2	48		mA
	Output Sink Current $V_{ID} = -100mV$, $V_O = V_{CC}$	2	48		
I_{CC}	Supply Current (per amplifier) $A_{VCL} = 1$, no load		162	220	μA
GBP	Gain Bandwidth Product $R_L = 10k\Omega$, $C_L = 100pF$, $f = 100kHz$	380	630		kHz
SR	Slew Rate $R_L = 10k\Omega$, $C_L = 100pF$, $AV = 1$	0.13	0.25		$V/\mu s$
ϕ_m	Phase Margin $C_L = 100pF$		60		Degrees
en	Input Voltage Noise		40		nV/\sqrt{Hz}
THD	Total Harmonic Distortion		0.01		%

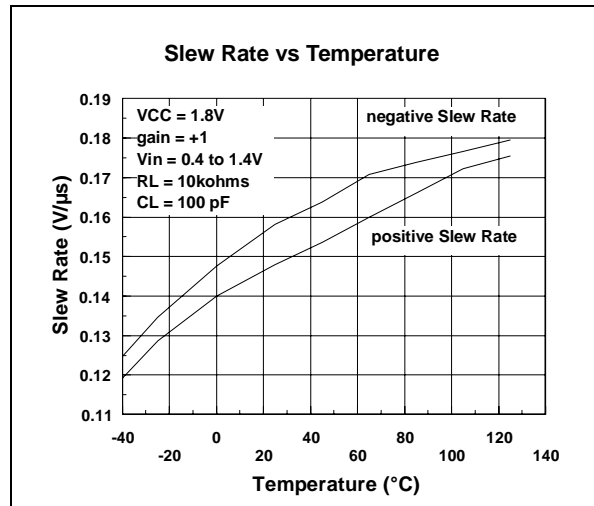
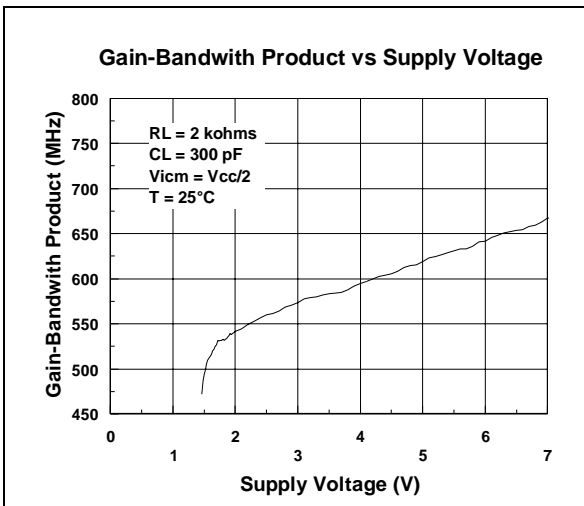
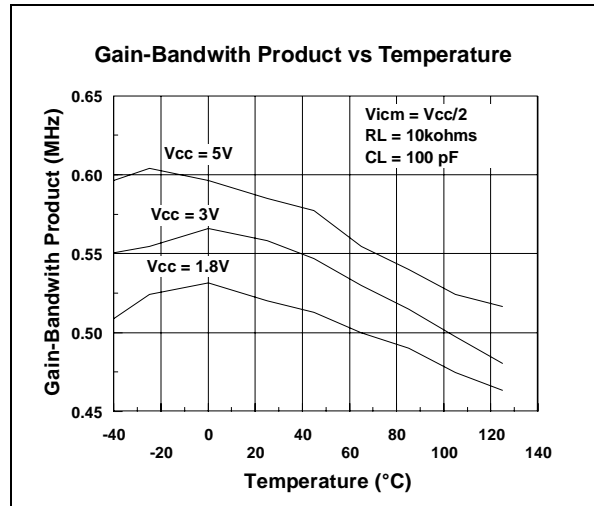
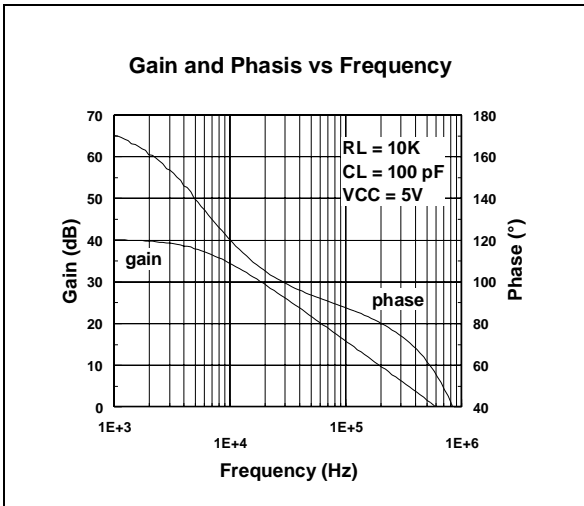
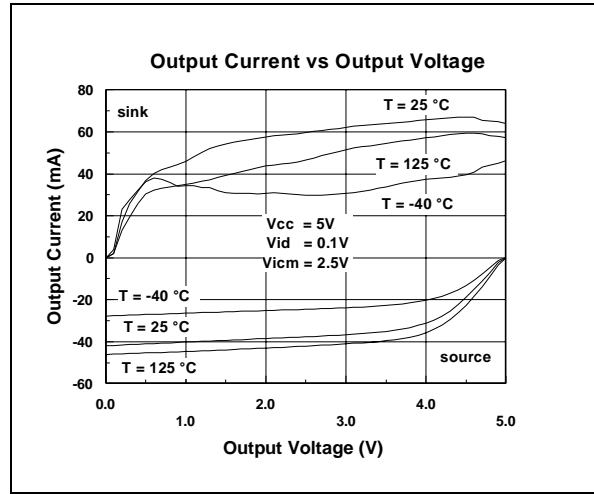
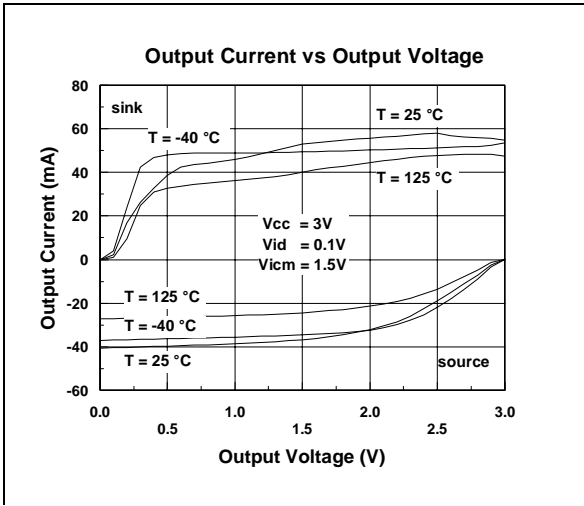
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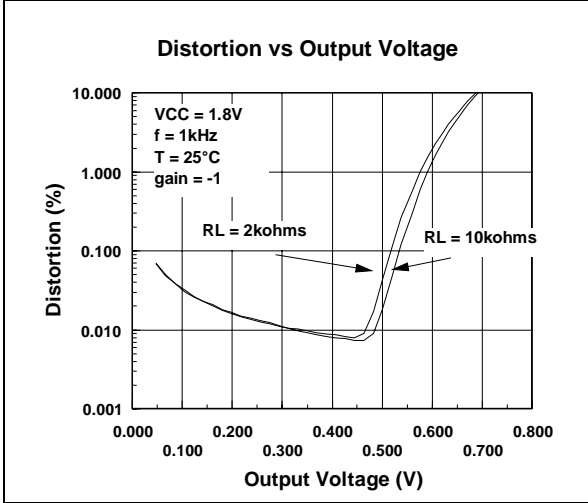
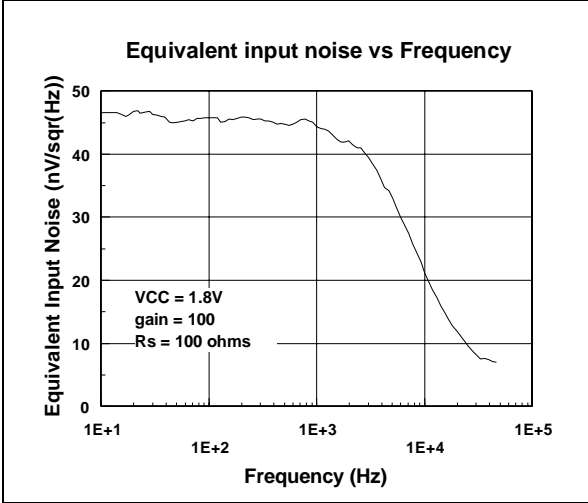
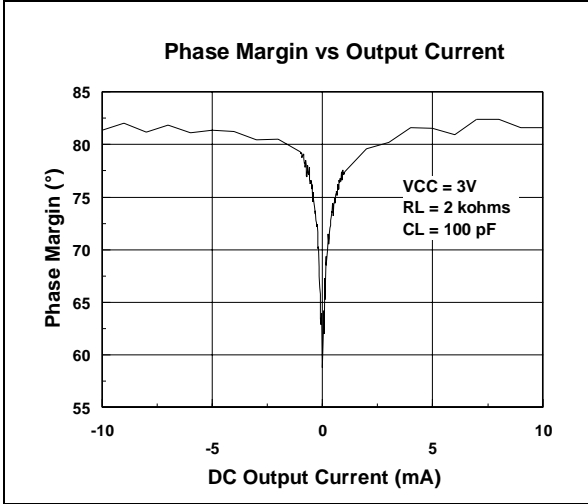
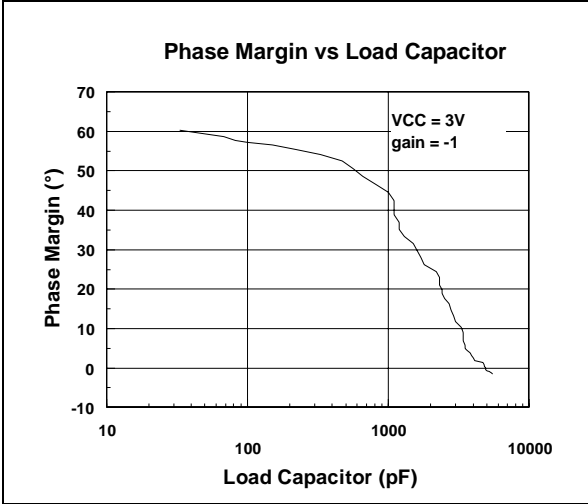
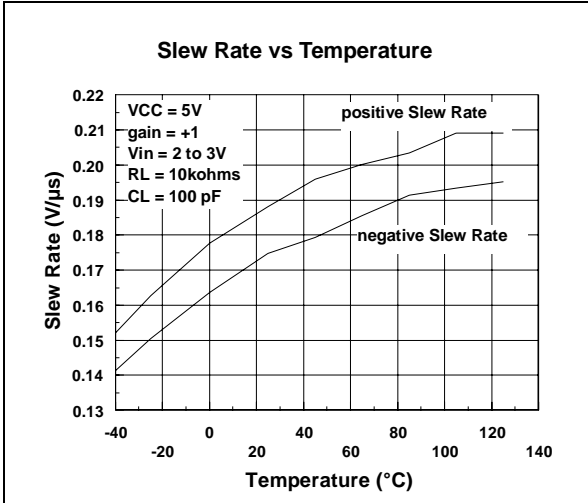
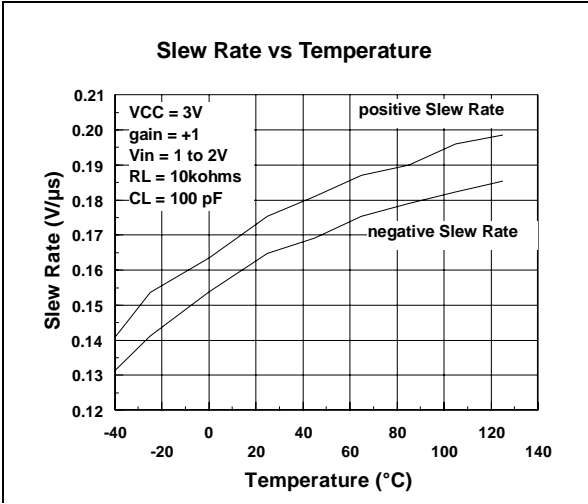


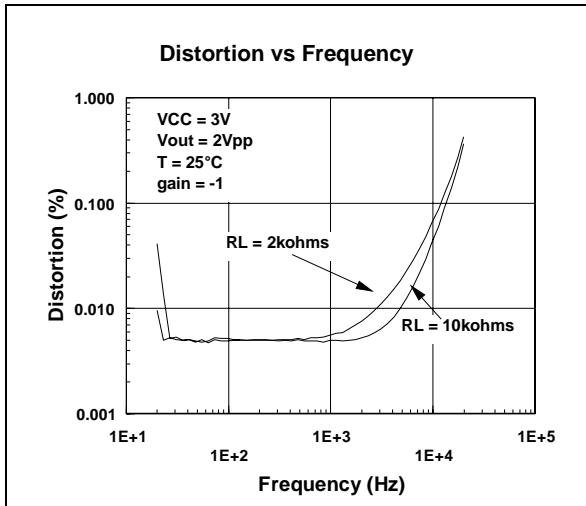
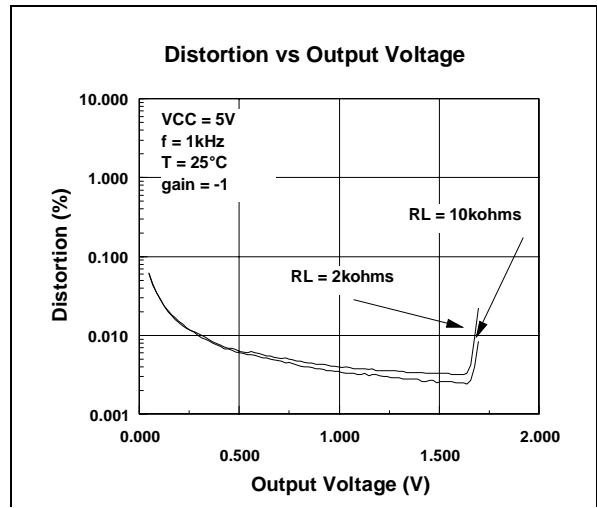
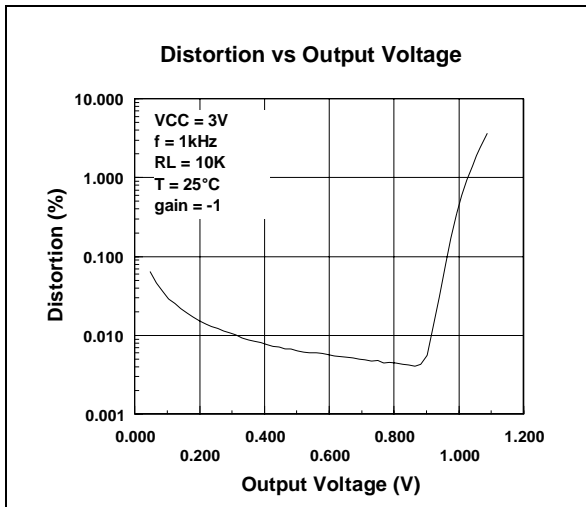




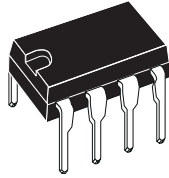




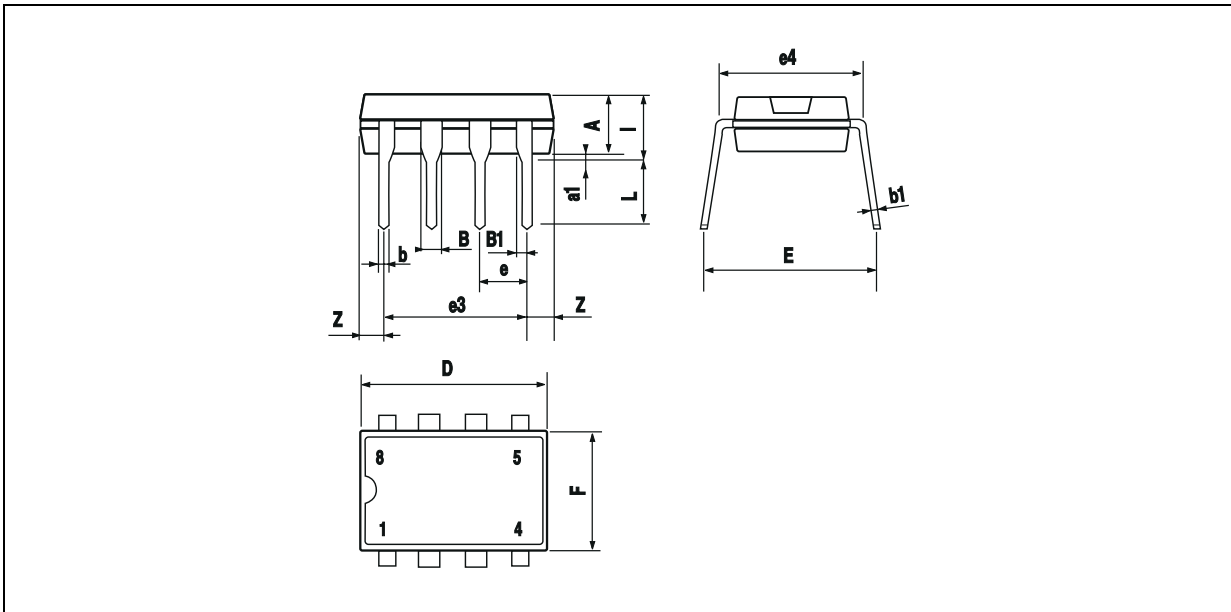




TS1852IN



PACKAGE MECHANICAL DATA
8 PINS - PLASTIC DIP



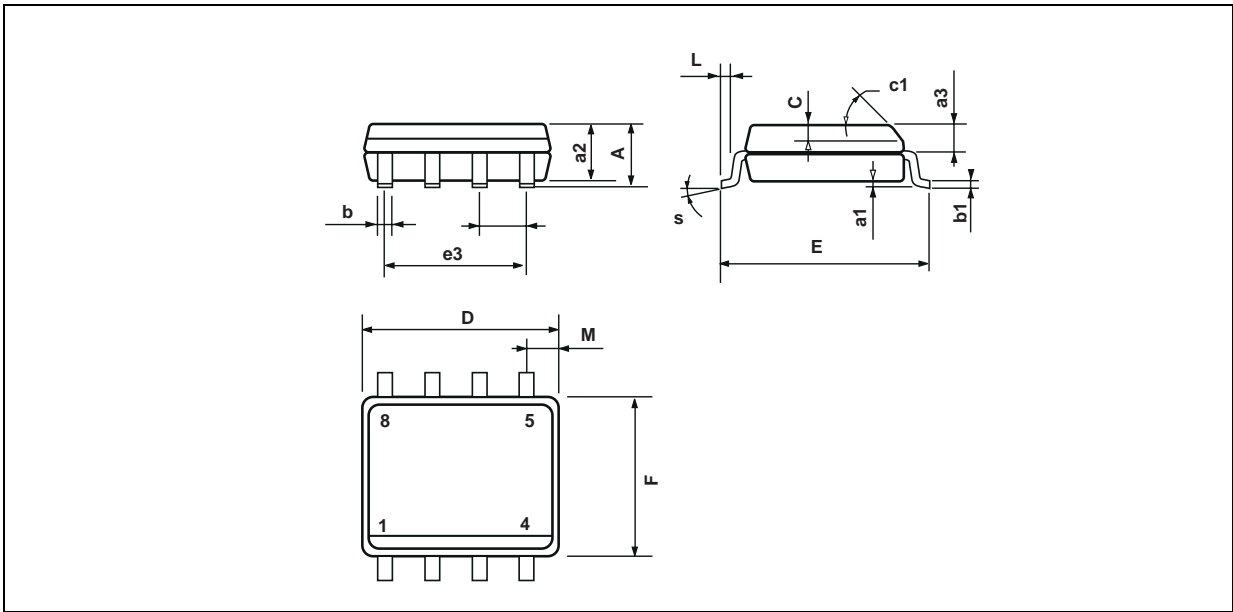
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0.260
i			5.08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

TS1851-TS1852-TS1854

**TS1851ID - TS1851AID - TS1852ID - TS1852AID
 TS1851IDT - TS1851AIDT - TS1852IDT TS1852AIDT**



PACKAGE MECHANICAL DATA
 8 PINS - PLASTIC MICROPACKAGE (SO)

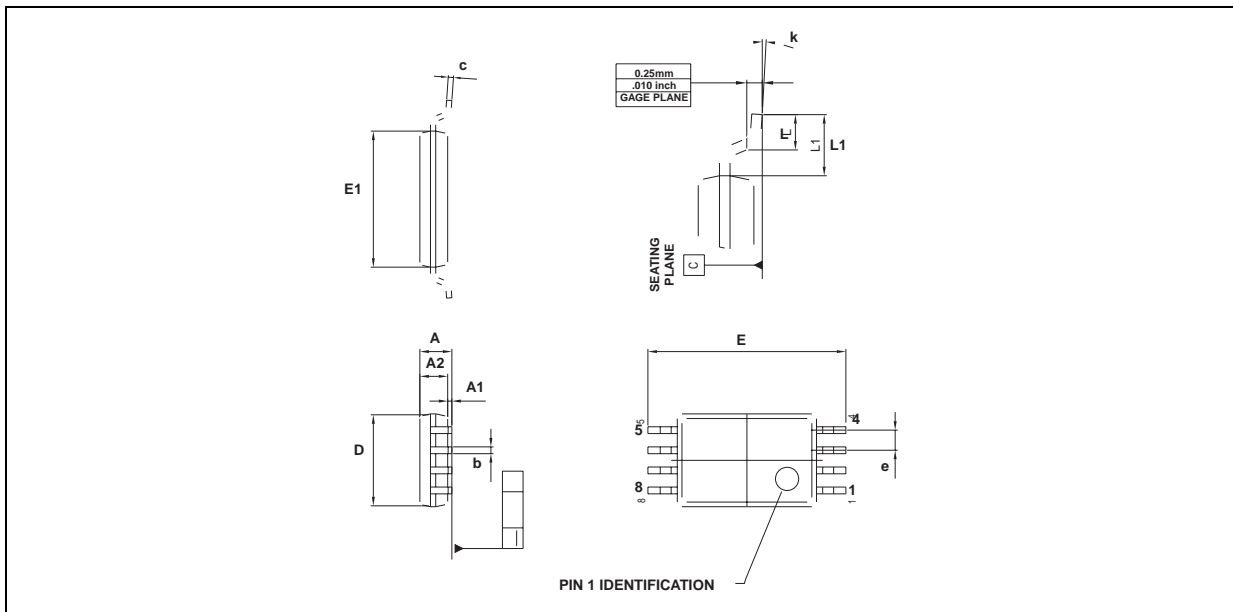


Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0.260
i			5.08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

TS1851IP-TS1851AIP-TS1852IP-TS1852AIP -
 TS1851IPT - TS1851AIPT - TS1852IPT - TS1852AIPT



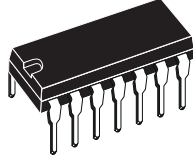
PACKAGE MECHANICAL DATA
 8 PINS - THIN SHRINK SMALL OUTLINE PACKAGE



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	

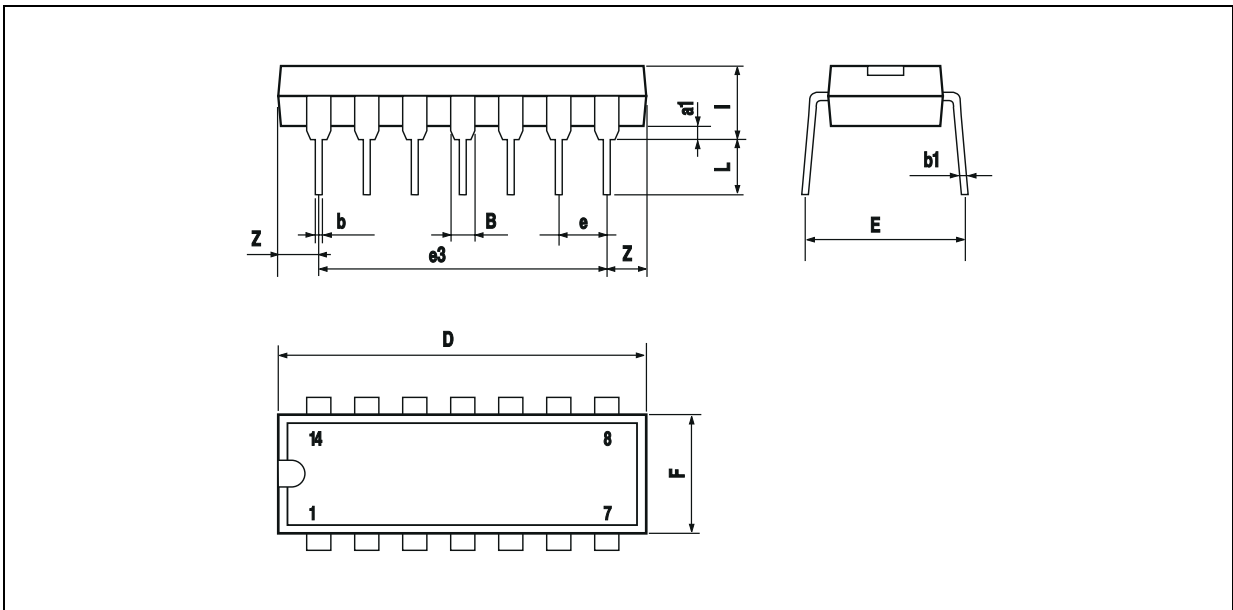
TS1851-TS1852-TS1854

TS1854IN



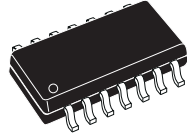
PACKAGE MECHANICAL DATA

14 PINS - PLASTIC DIP

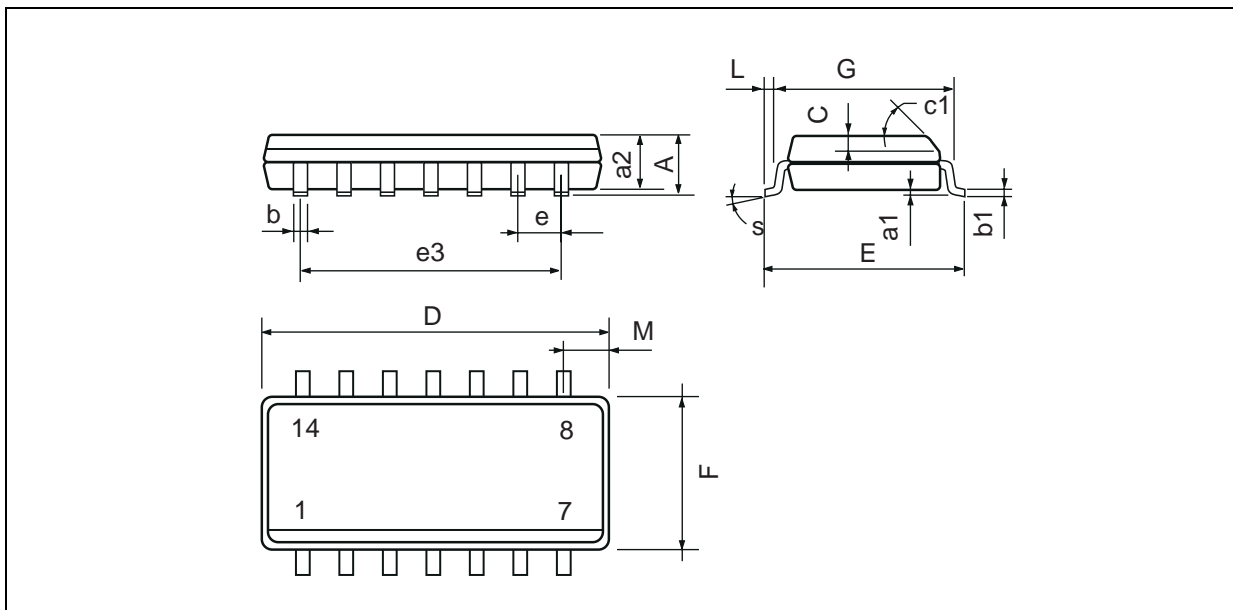


Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
i			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100

TS1854ID-TS1854AID-TS1854IDT-TS1854AIDT



PACKAGE MECHANICAL DATA
14 PINS - PLASTIC MICROPACKAGE (SO)

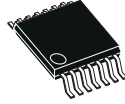


Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.2	0.004		0.008
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1	45° (typ.)					
D (1)	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
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.

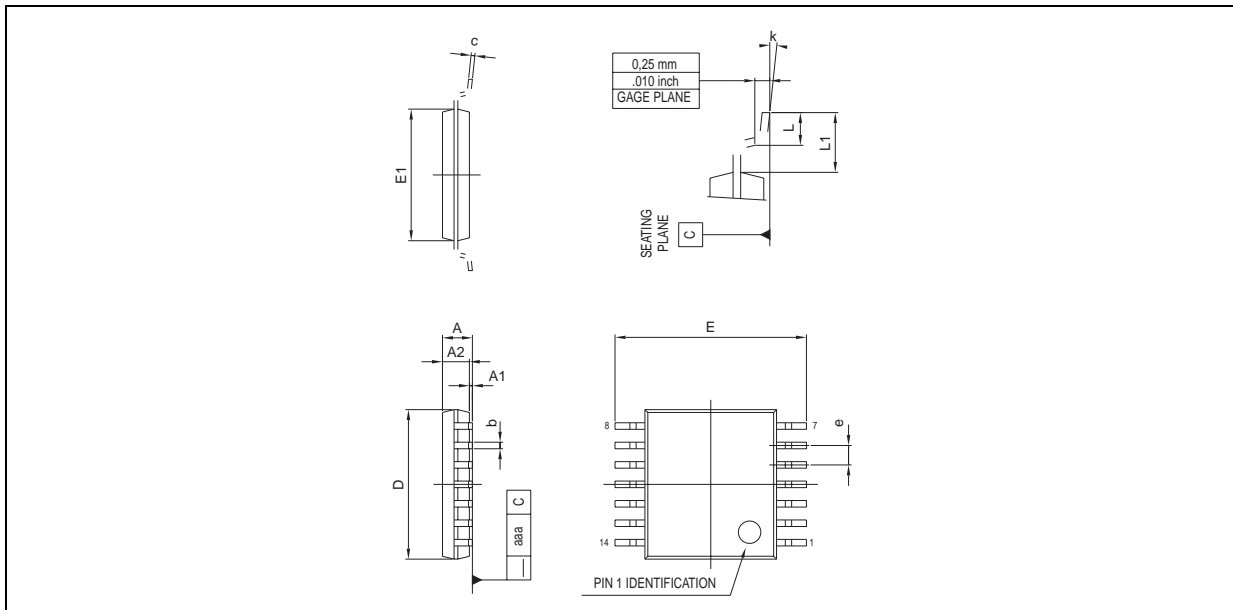
TS1851-TS1852-TS1854

TS1854IP- TS1854AIP- TS185AIP- TS1854IPT



PACKAGE MECHANICAL DATA

14 PINS - THIN SHRINK SMALL OUTLINE PACKAGE

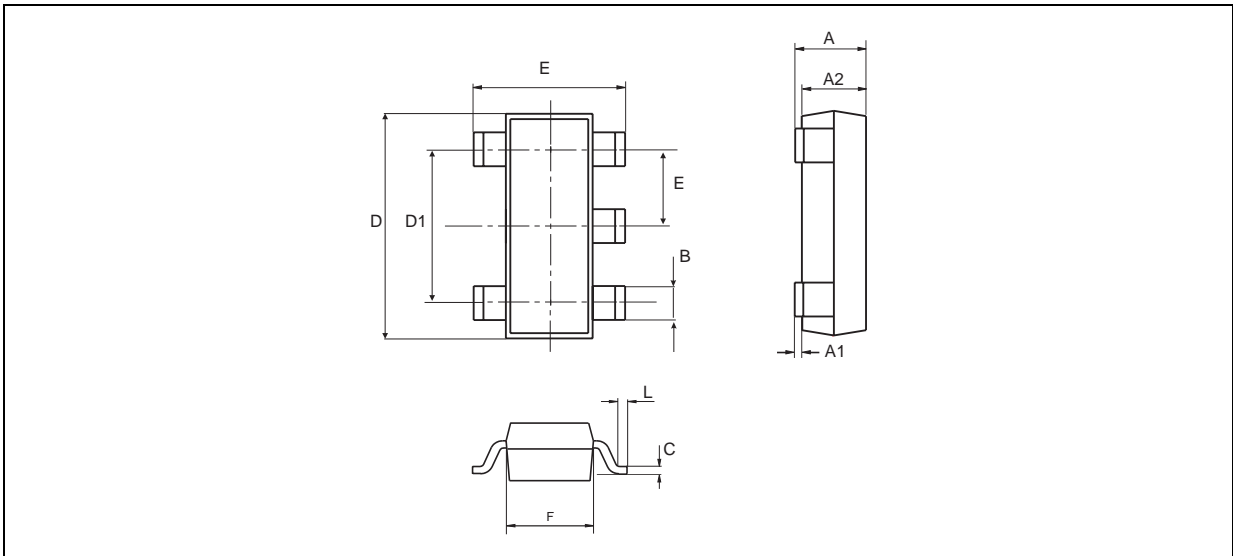


Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
c	0.09		0.20	0.003		0.012
D	4.90	5.00	5.10	0.192	0.196	0.20
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.025	
k	0°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

TS1851ILT - TS1851AILT



PACKAGE MECHANICAL DATA
5 PINS - TINY PACKAGE (SOT23)



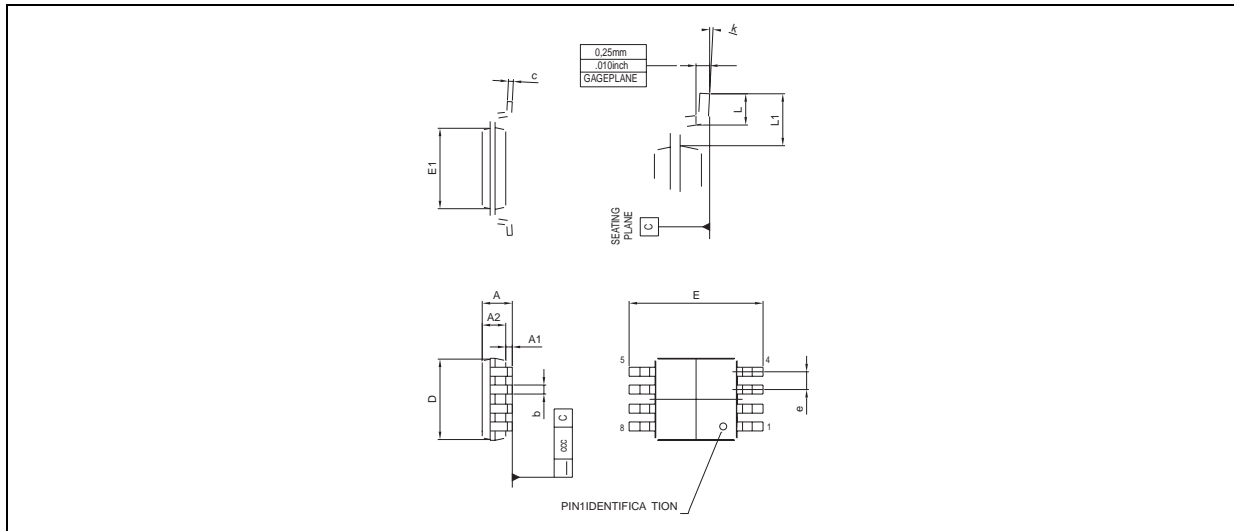
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.90	1.20	1.45	0.035	0.047	0.057
A1	0		0.15			0.006
A2	0.90	1.05	1.30	0.035	0.041	0.051
B	0.35	0.40	0.50	0.014	0.016	0.020
C	0.09	0.15	0.20	0.004	0.006	0.008
D	2.80	2.90	3.00	0.110	0.114	0.118
D1		1.90			0.075	
e		0.95			0.037	
E	2.60	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

TS1851-TS1852-TS1854

TS1852IST



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

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