



**TS861
TS862
TS864**

RAIL TO RAIL MICROPOWER BICMOS COMPARATORS

- ULTRA LOW CURRENT CONSUMPTION ($6\mu\text{A}/\text{comp}$ at $V_{CC}=2.7\text{V}$)
- RAIL TO RAIL CMOS INPUTS
- PUSH PULL OUTPUTS
- SUPPLY OPERATION FROM 2.7V TO 10V
- LOW PROPAGATION DELAY
- LOW FALL AND RISE TIME: 20ns
- ESD PROTECTION (2kV)
- LATCH-UP IMMUNITY (Class A)
- AVAILABLE IN SOT23-5 MICROPACKAGE

DESCRIPTION

The TS86x (Single, Dual & Quad) is a Rail to Rail comparator characterized for 2.7V to 10V operation over -40°C to $+85^{\circ}\text{C}$ temperature range. It exhibits an excellent speed to power ratio, featuring a current consumption of $6\mu\text{A}$ per comparator and a response time of 500ns at 2.7V for 100mV over-drive.

Due to its ultra low power consumption and its availability in tiny package, the TS86x comparator family is perfectly suited to battery powered systems. The output stage is designed with a push pull structure allowing a direct connection to microcontroller without additional pull-up resistor.

APPLICATION

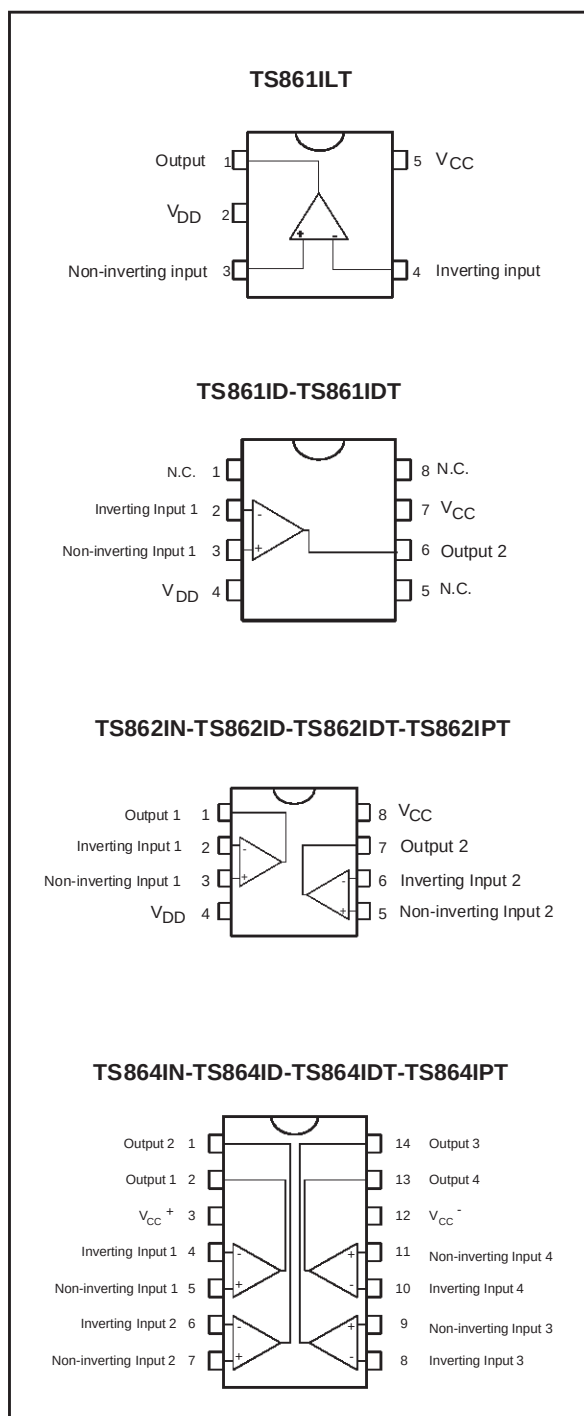
- Battery-powered systems (eg: Alarm)
- Portable communication systems
- Smoke/gas/fire detectors
- Portable computers

ORDER CODE

Part Number	Temperature Range	Package				SOT23 Marking
		N	D	P	L	
TS861I TS861AI	$-40, +85^{\circ}\text{C}$	•	•		•	K501 K502
TS862I TS862AI	$-40, +85^{\circ}\text{C}$	•	•	•		
TS864I TS864AI	$-40, +85^{\circ}\text{C}$	•	•	•		

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⁾	12	V
V_{id}	Differential Input Voltage ²⁾	± 12	V
V_{in}	Input Voltage Range ³⁾	-0.3 to 12.3	V
T_{std}	Storage Temperature Range	-65 to +150	°C
T_j	Maximum Junction Temperature	150	°C
P_D	Power dissipation ⁴⁾ SOT23-5 DIP8 DIP14 SO8 SO14 TSSOP8 TSSOP14	500 1250 1560 710 830 625 710	mW
ESD	Human Body Model	2	kV
	Machine Model	200	V
	Latch-up Immunity	Class A	
	Lead Temperature (soldering, 10 sec)	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 and destructive dissipation. P_D is calculated with $T_{amb} = +25^\circ C$, $T_j = +150^\circ C$ and

$R_{thja} = 250^\circ C/W$ for SOT23-5 package
 $= 100^\circ C/W$ for DIP8 package
 $= 80^\circ C/W$ for DIP14 package
 $= 175^\circ C/W$ for SO8 package
 $= 150^\circ C/W$ for SO14 package
 $= 200^\circ C/W$ for TSSOP8 package
 $= 175^\circ C/W$ for TSSOP14 package

OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	2.7 to 10	V
V_{icm}	Common Mode Input Voltage Range	$V_{CC}^- - 0.3$ to $V_{CC}^+ + 0.3$	V
T_{oper}	Operating Free Air Temperature Range	-40 to + 85	°C

ELECTRICAL CHARACTERISTICS**V_{CC} = +2.7V****T_{amb} = 25°C (unless otherwise specified)**

Symbol	Parameter	Min.	Typ.	Max.	Unit
V _{io}	Input Offset Voltage TS861/2/4 Tmin<T<Tmax		3	15 18	mV
	TS861/2/4A Tmin<T<Tmax		3	7 10	
ΔV _{io}	Input Offset Voltage Drift		6		μV/°C
I _{io}	Input Offset Current ¹⁾ Tmin<T<Tmax		1	150 300	pA
I _{ib}	Input Bias Current ¹⁾ Tmin<T<Tmax		1	300 600	pA
V _{OH}	High Level Output Voltage I _{source} =2.5mA Tmin<T<Tmax	2.35 2.15	2.45		V
V _{OL}	Low Level Output Voltage I _{sink} =2.5mA Tmin<T<Tmax		0.2	0.35 0.45	V
A _{vd}	Large Signal Voltage Gain ²⁾		240		dB
CMR	Common Mode Rejection Ratio 0 < V _{ICM} < 2.7V		65		dB
SVR	Supply Voltage Rejection Ratio 0 < V _{CC} < 10V		80		dB
I _{CC}	Supply current per comparator no load, output low no load, output high		6 8	12 14	μA
T _{plh}	Propagation delay from output low to output high V _{ICM} =1.35V, f=10kHz, C _L =50pF overdrive = 10mV overdrive = 100mV		1.5 0.6		μs
T _{phl}	Propagation delay from output high to output low V _{ICM} =1.35V, f=10kHz, C _L =50pF overdrive = 10mV overdrive = 100mV		1.5 0.5		μs
T _f	Fall time f=10kHz, C _L =50pF, overdrive=100mV		20		ns
T _r	Rise time f=10kHz, C _L =50pF, overdrive=100mV		20		ns

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

2. Design evaluation

3. Limits are 100% production tested at 25°C. Limits over temperature are guaranteed through correlation and by design.

TS861-TS862-TS864

ELECTRICAL CHARACTERISTICS

$V_{CC} = +5V$

$T_{amb} = 25^{\circ}C$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage TS861/2/4 $T_{min} < T < T_{max}$		3	15 18	mV
	TS861/2/4A $T_{min} < T < T_{max}$		3	7 10	
ΔV_{io}	Input Offset Voltage Drift		6		$\mu V/^{\circ}C$
I_{io}	Input Offset Current ¹⁾ $T_{min} < T < T_{max}$		1	150 300	pA
I_{ib}	Input Bias Current ¹⁾ $T_{min} < T < T_{max}$		1	300 600	pA
V_{OH}	High Level Output Voltage $I_{source}=5mA$ $T_{min} < T < T_{max}$	4.6 4.45	4.8		V
V_{OL}	Low Level Output Voltage $I_{sink}=5mA$ $T_{min} < T < T_{max}$		0.2	0.4 0.55	V
A_{vd}	Large Signal Voltage Gain ²⁾		240		dB
CMR	Common Mode Rejection Ratio $0 < V_{ICM} < 5V$		70		dB
SVR	Supply Voltage Rejection Ratio $2.7 < V_{CC} < 10V$		80		dB
I_{CC}	Supply current per comparator no load, output low no load, output high		6 8	12 14	μA
T_{plh}	Propagation delay from output low to output high $V_{ICM}=2.5V$, $f=10kHz$, $C_L=50pF$ overdrive = 10mV overdrive = 100mV		2 0.5		μs
T_{phl}	Propagation delay from output high to output low $V_{ICM}=2.5V$, $f=10kHz$, $C_L=50pF$ overdrive = 10mV overdrive = 100mV		2 0.4		μs
T_f	Fall time $f=10kHz$, $C_L=50pF$, overdrive=100mV		20		ns
T_r	Rise time $f=10kHz$, $C_L=50pF$, overdrive=100mV		20		ns

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

2. Design evaluation

3. Limits are 100% production tested at 25°C. Limits over temperature are guaranteed through correlation and by design

ELECTRICAL CHARACTERISTICS**V_{CC} = +10V****T_{amb} = 25°C (unless otherwise specified)**

Symbol	Parameter	Min.	Typ.	Max.	Unit
V _{io}	Input Offset Voltage (V _{ICM} = V _{CC} / 2) TS861/2/4 Tmin<T<Tmax		3	15 18	mV
ΔV _{io}	Input Offset Voltage Drift		6		μV/°C
I _{io}	Input Offset Current ¹⁾ Tmin<T<Tmax		1	150 300	pA
I _{ib}	Input Bias Current ¹⁾ Tmin<T<Tmax		1	300 600	pA
V _{OH}	High Level Output Voltage I _{source} =5mA Tmin<T<Tmax	9.6 9.45	9.8		V
V _{OL}	Low Level Output Voltage I _{sink} =5mA Tmin<T<Tmax		0.2	0.4 0.55	V
A _{vd}	Large Signal Voltage Gain ²⁾		240		dB
CMR	Common Mode Rejection Ratio 0 < V _{ICM} < 10V		75		dB
SVR	Supply Voltage Rejection Ratio 2.7 < V _{CC} < 10V		80		dB
I _{CC}	Supply current per comparator no load, output low no load, output high		7 10	14 16	μA
T _{plh}	Propagation delay from output low to output high V _{ICM} =5V, f=10kHz, C _L =50pF overdrive = 10mV overdrive = 100mV		3 0.5		μs
T _{phl}	Propagation delay from output high to output low V _{ICM} =5V, f=10kHz, C _L =50pF overdrive = 10mV overdrive = 100mV		2.6 0.4		μs
T _f	Fall time f=10kHz, C _L =50pF, overdrive=100mV		20		ns
T _r	Rise time f=10kHz, C _L =50pF, overdrive=100mV		20		ns

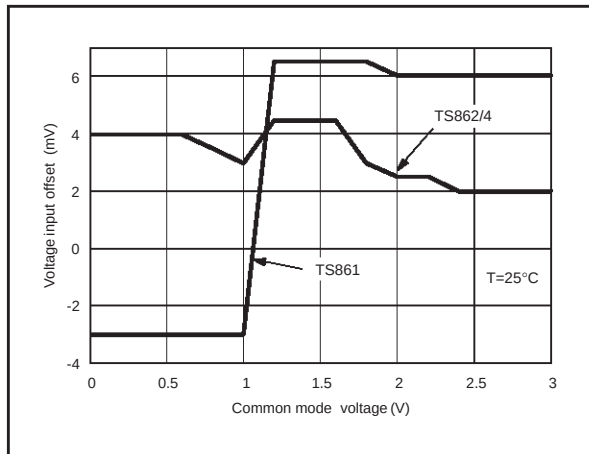
1. Maximum values including unavoidable inaccuracies of the industrial test.

2. Design evaluation

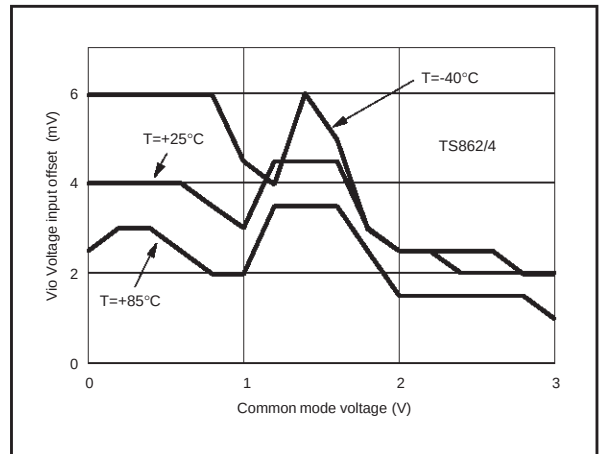
3. Limits are 100% production tested at 25°C. Limits over temperature are guaranteed through correlation and by design.

TS861-TS862-TS864

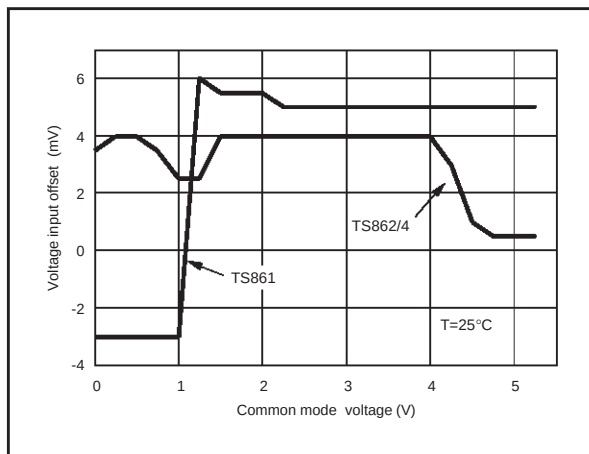
V_{IO} versus V_{ICM} at $V_{CC} = 2.7V$



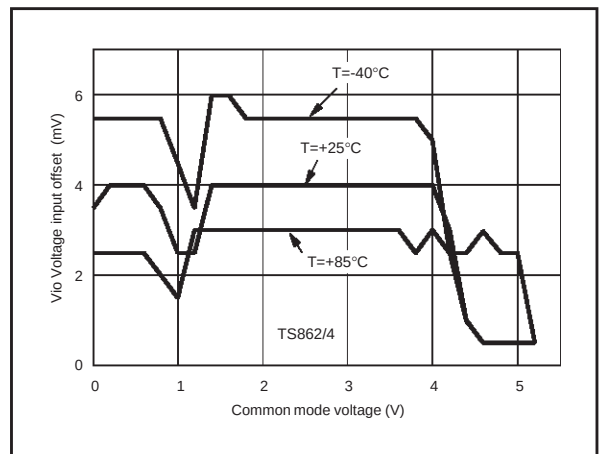
V_{IO} versus V_{ICM} and temperature at $V_{CC} = 2.7V$



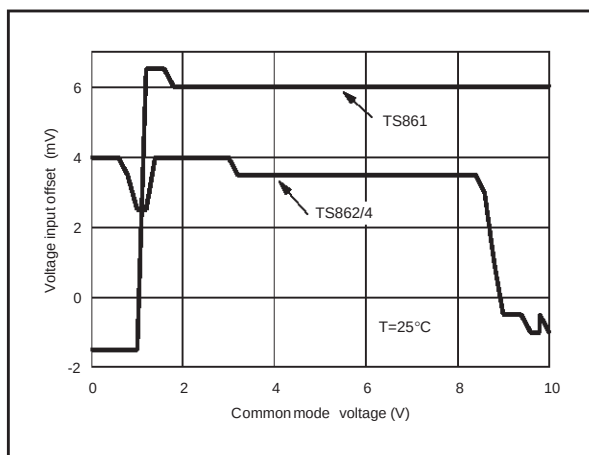
V_{IO} versus V_{ICM} at $V_{CC} = 5V$



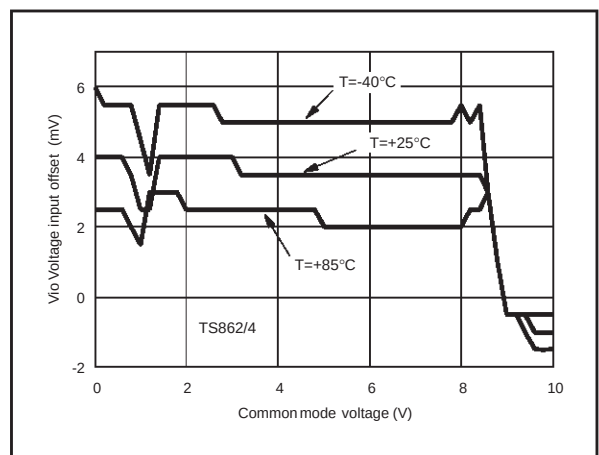
V_{IO} versus V_{ICM} and temperature at $V_{CC} = 5V$



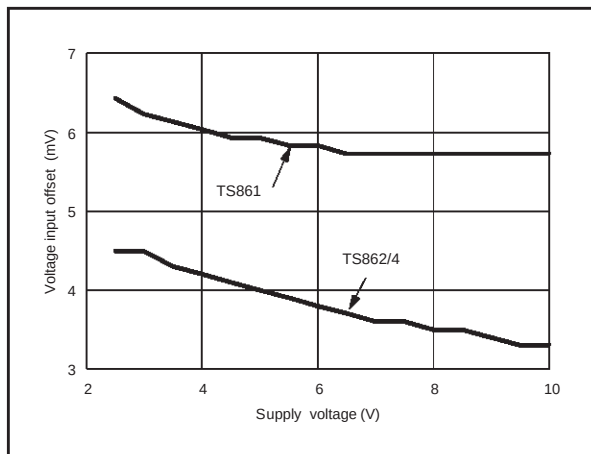
V_{IO} versus V_{ICM} at $V_{CC} = 10V$



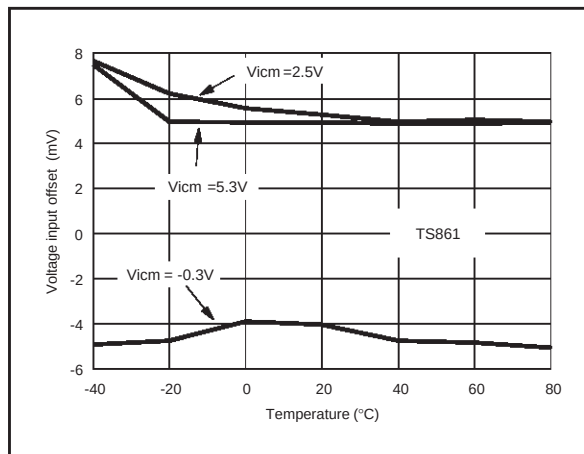
V_{IO} versus V_{ICM} and temperature at $V_{CC} = 10V$



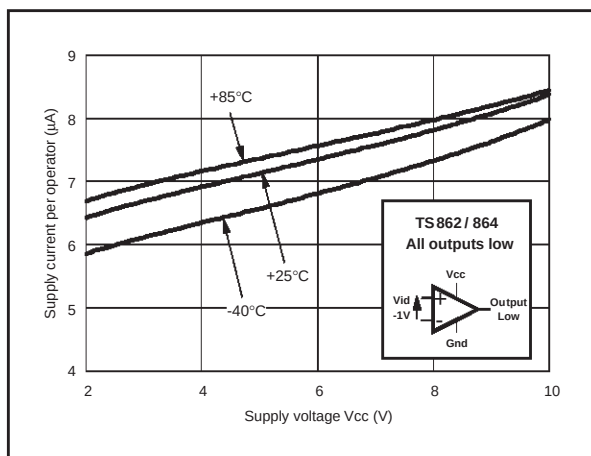
V_{IO} versus V_{CC} at $V_{ICM} = V_{CC} / 2$



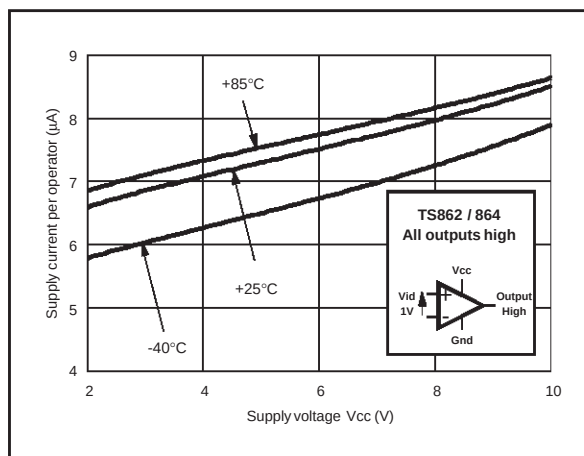
V_{IO} versus temperature at $V_{CC} = 5V$



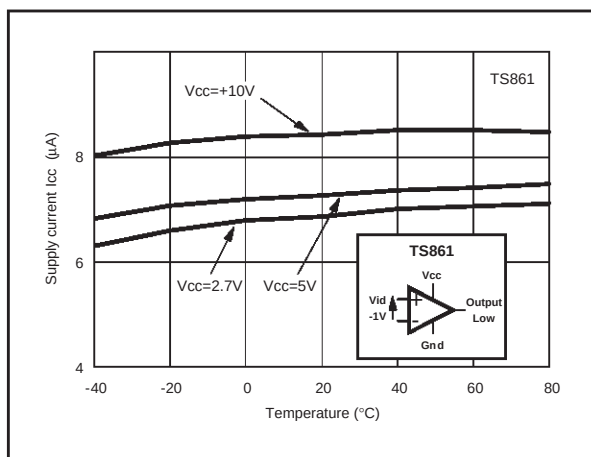
Supply Current (I_{CC}) vs Supply Voltage (V_{CC})



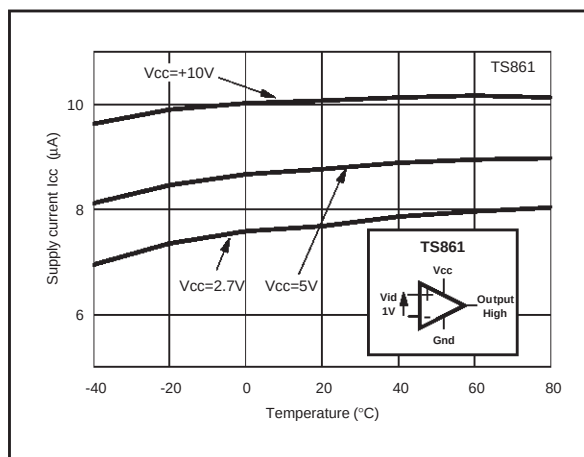
Supply Current (I_{CC}) vs Supply Voltage (V_{CC})



Supply Current (I_{CC}) vs Temperature

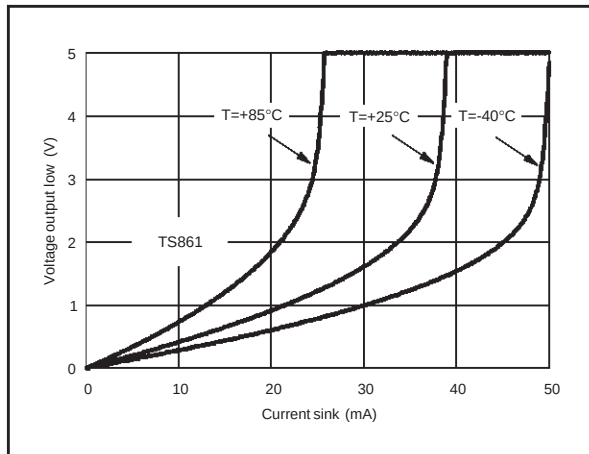


Supply Current (I_{CC}) vs Temperature

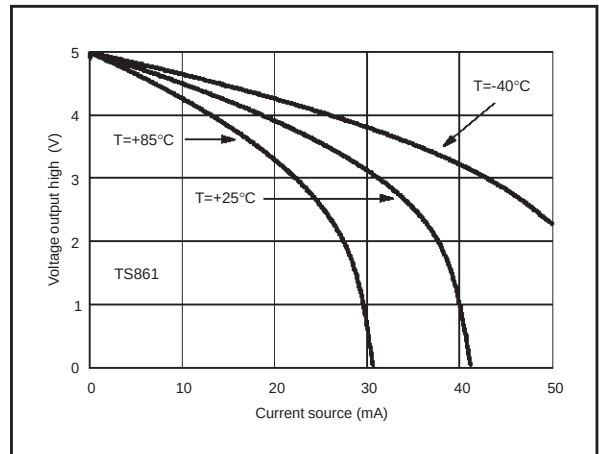


TS861-TS862-TS864

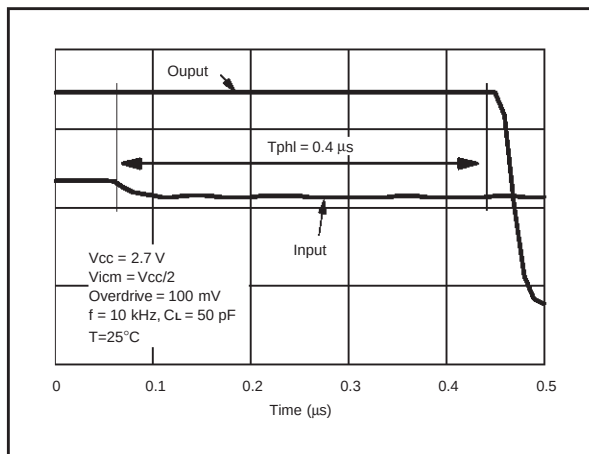
V_{OL} versus I_{SINK} and temperature at $V_{CC}=5V$



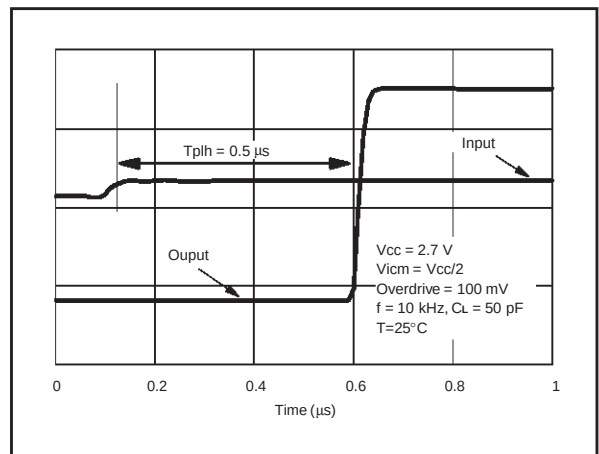
V_{OH} vs I_{SOURCE} and temperature at $V_{CC}=5V$



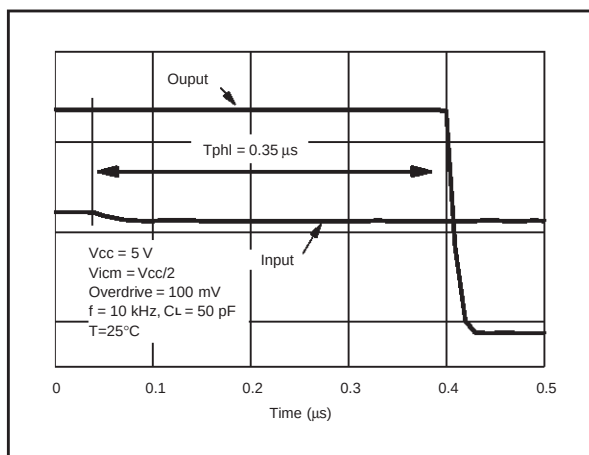
Response time T_{PHL} at $V_{CC}= 2.7V$



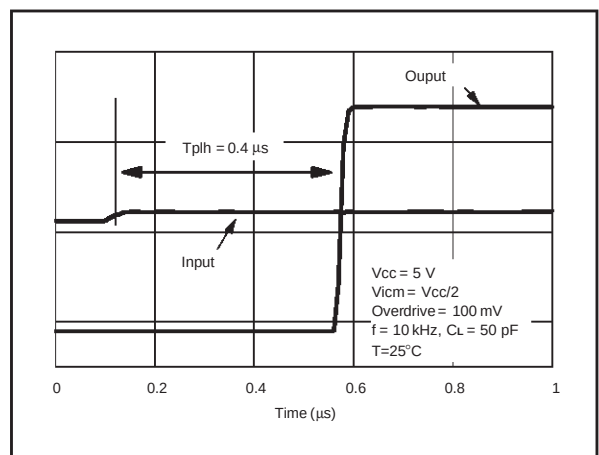
Response time T_{PLH} at $V_{CC}= 2.7V$



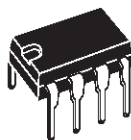
Response time T_{PHL} at $V_{CC}= 5V$



Response time T_{PLH} at $V_{CC}= 5V$

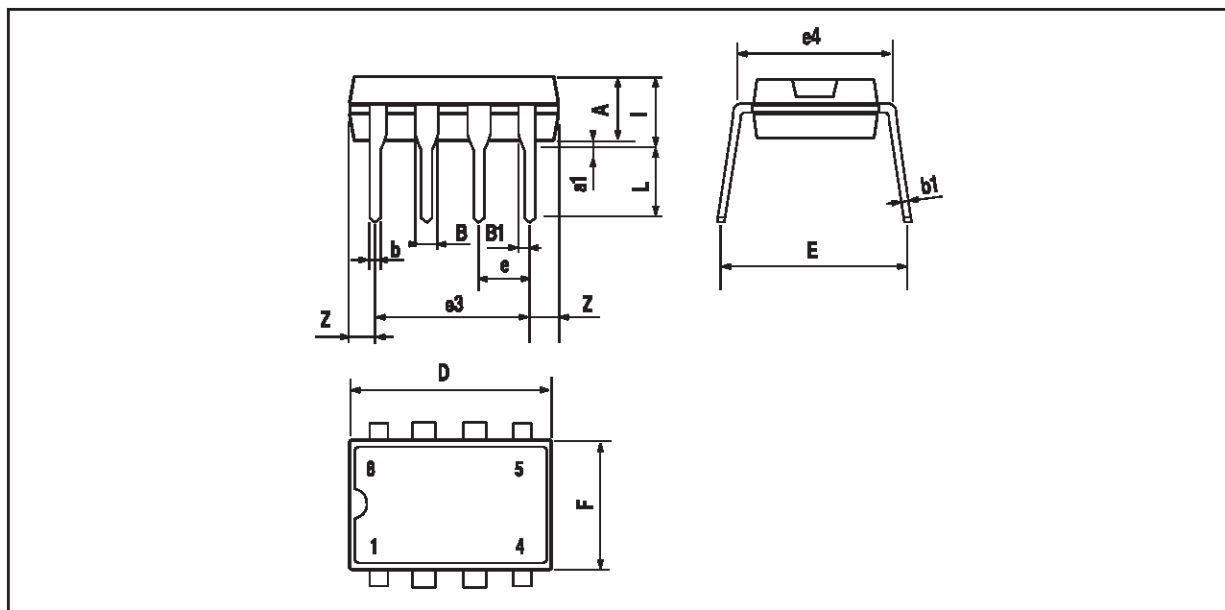


TS861IN - TS862IN



PACKAGE MECHANICAL DATA

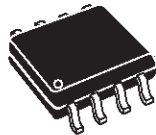
8 PINS - PLASTIC PACKAGE



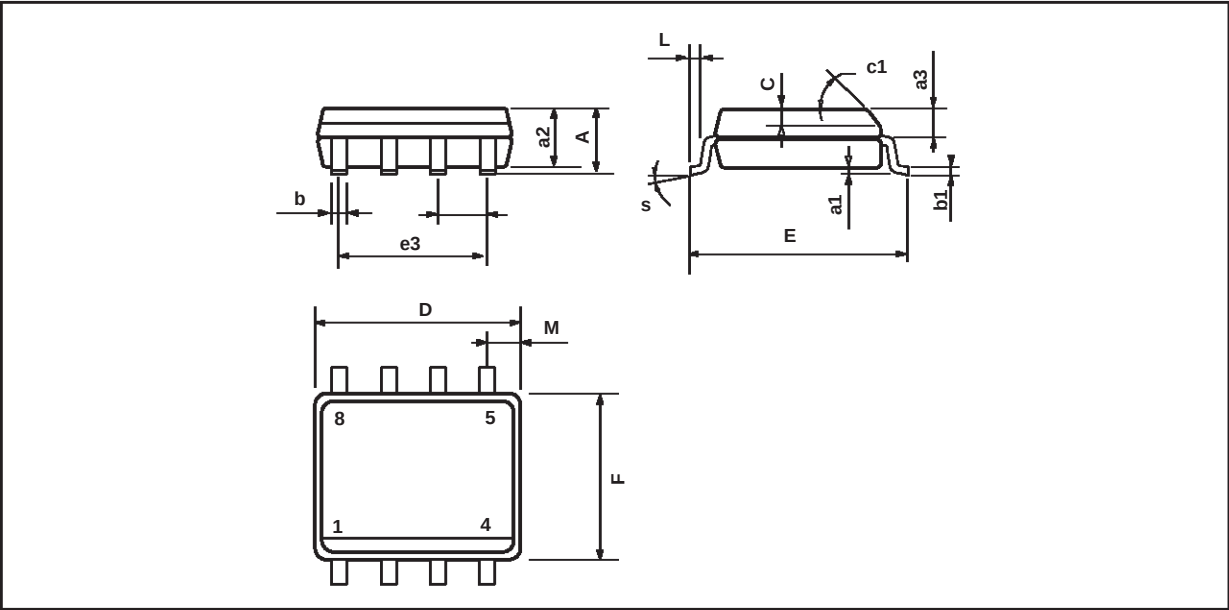
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0.260
i			5.08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

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TS861ID - TS862ID

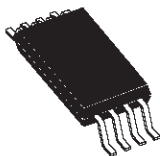


PACKAGE MECHANICAL DATA
8 PINS - PLASTIC MICROPACKAGE (SO)



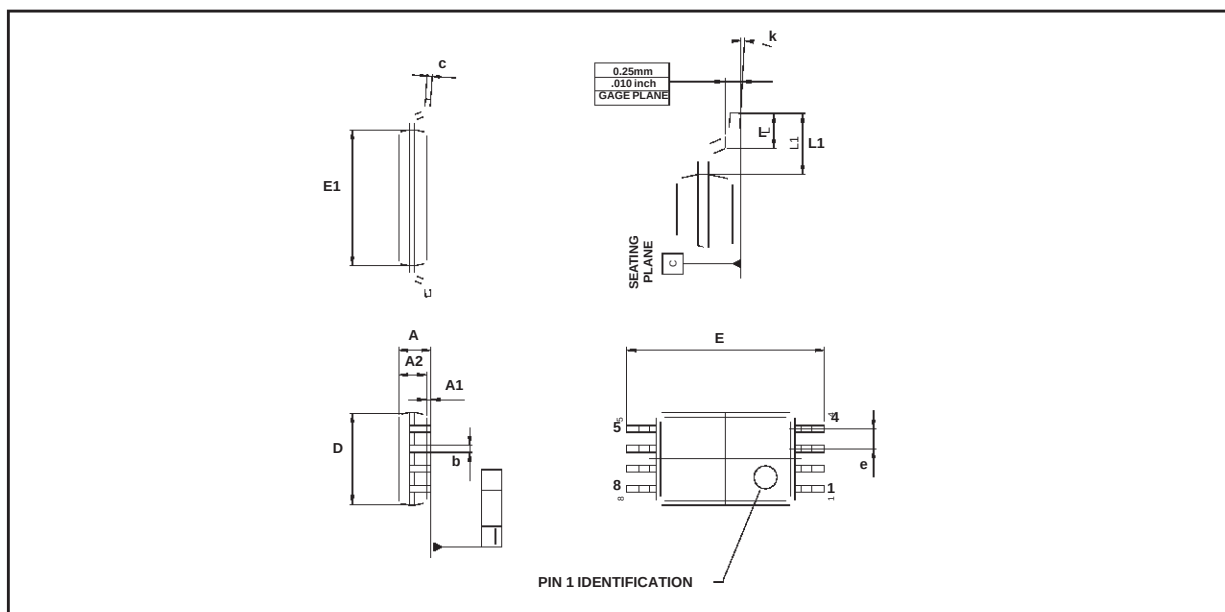
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.25	0.004		0.010
a2			1.65			0.065
a3	0.65		0.85	0.026		0.033
b	0.35		0.48	0.014		0.019
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.020
c1	45° (typ.)					
D	4.8		5.0	0.189		0.197
E	5.8		6.2	0.228		0.244
e	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

TS862IPT



PACKAGE MECHANICAL DATA

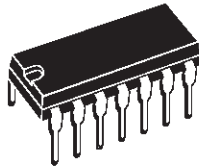
8 PINS - THIN SHRINK SMALL OUTLINE PACKAGE



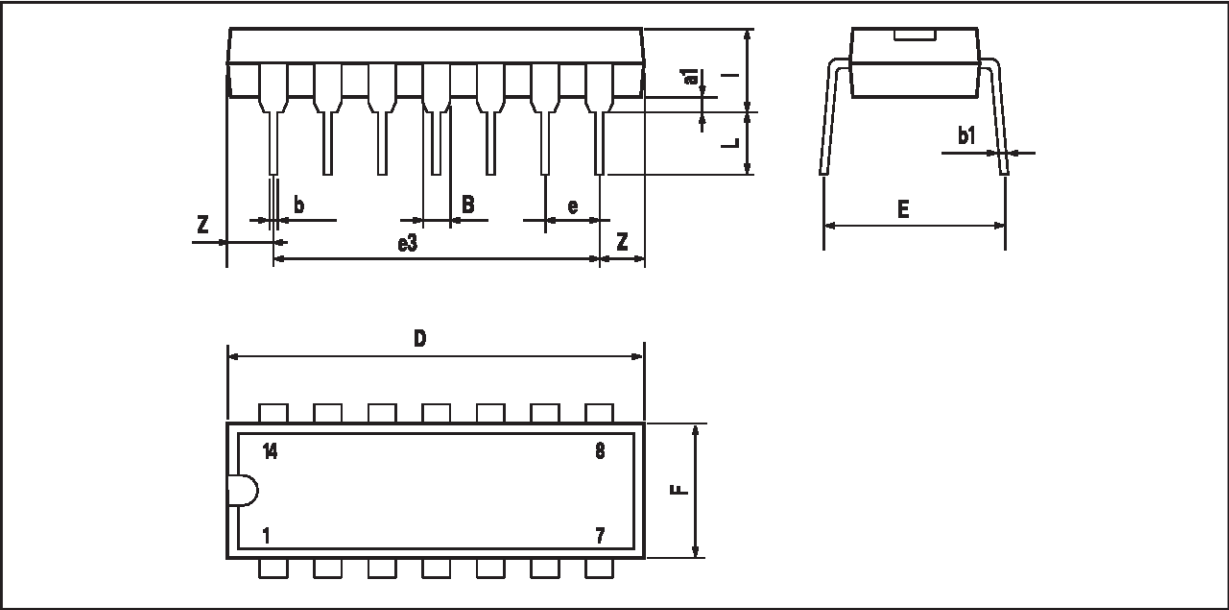
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
c	0.09		0.20	0.003		0.012
D	2.90	3.00	3.10	0.114	0.118	0.122
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.025	
k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

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TS864IN

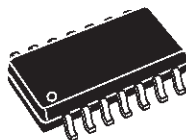


PACKAGE MECHANICAL DATA
14 PINS - PLASTIC PACKAGE



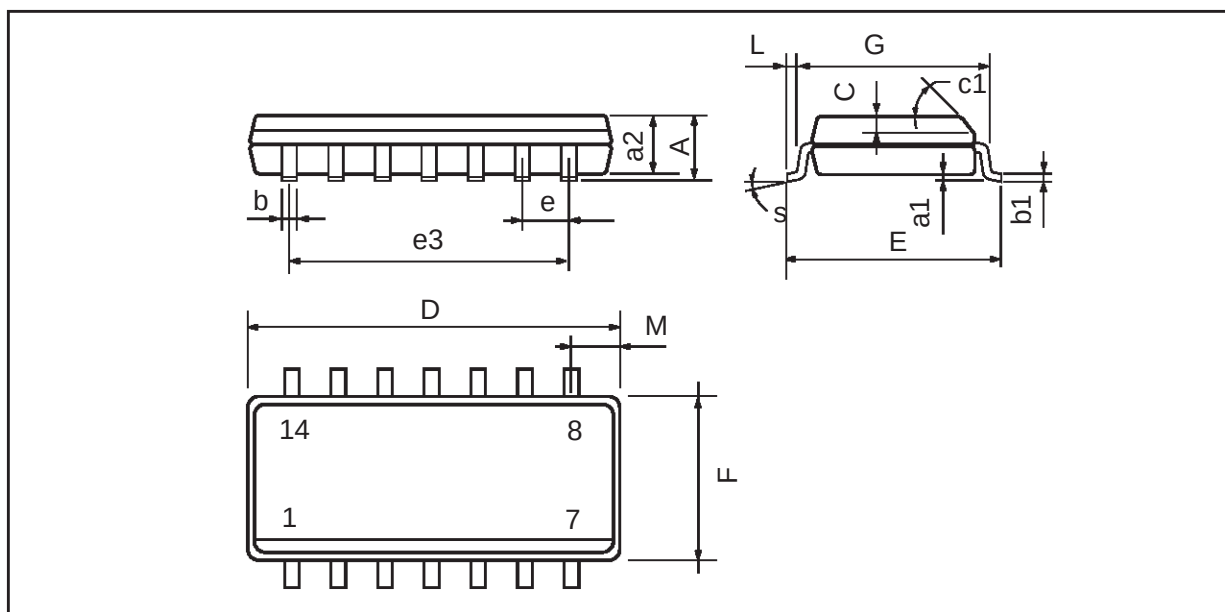
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
i			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100

TS864ID



PACKAGE MECHANICAL DATA

14 PINS - PLASTIC MICROPACKAGE (SO)

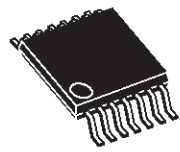


Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.2	0.004		0.008
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1	45° (typ.)					
D (1)	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	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

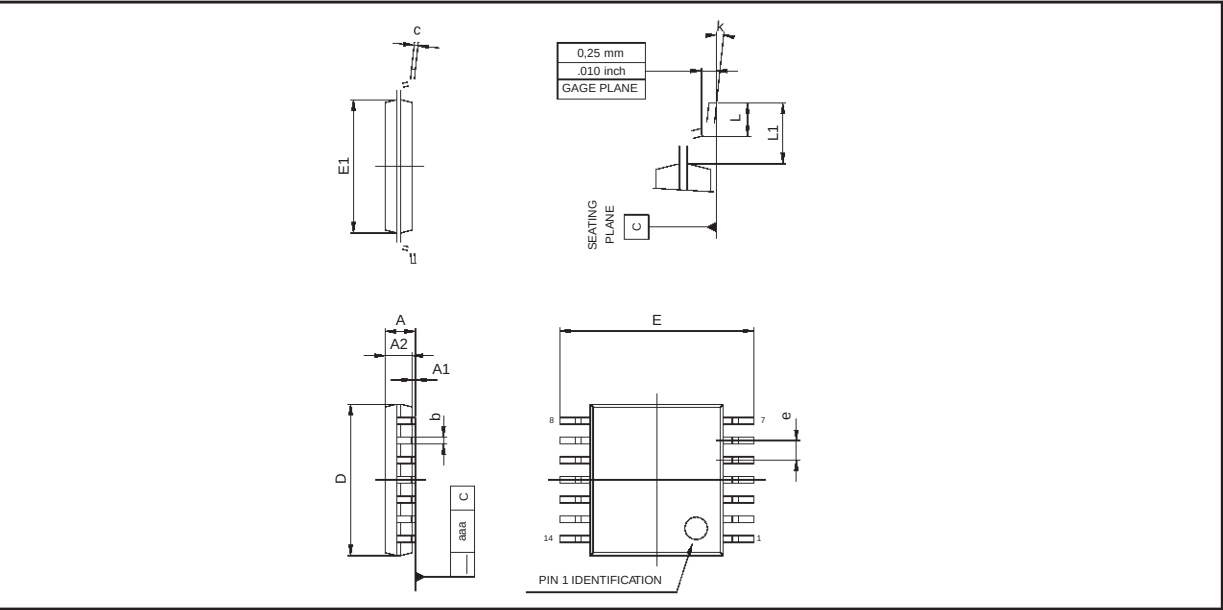
Note : (1) D and F do not include mold flash or protrusions - Mold flash or protrusions shall not exceed 0.15mm (.066 inc) ONLY FOR DATA BOOK.

TS861-TS862-TS864

TS864IPT



PACKAGE MECHANICAL DATA
14 PINS - THIN SHRINK SMALL OUTLINE PACKAGE

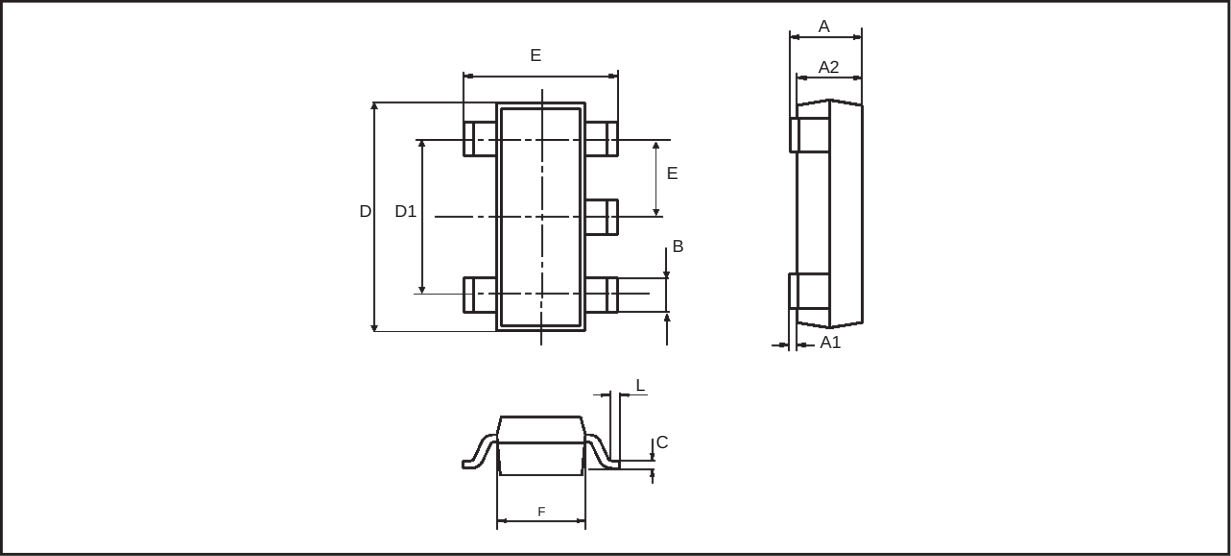


Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
c	0.09		0.20	0.003		0.012
D	4.90	5.00	5.10	0.192	0.196	0.20
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.025	
k	0°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

TS861ILT



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

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