

## 2.5V MICROPOWER SHUNT VOLTAGE REFERENCE

- 2.5V OUTPUT VOLTAGE
- ULTRA LOW CURRENT CONSUMPTION:  
40µA TYP.
- HIGH PRECISION @ 25°C  
±2% and ±1%
- HIGH STABILITY WHEN USED WITH  
CAPACITIVE LOAD
- INDUSTRIAL TEMPERATURE RANGE:  
-40 to +85°C
- 150ppm/°C MAXIMUM TEMPERATURE  
COEFFICIENT

### DESCRIPTION

The TS4040 is a low power shunt voltage reference providing a stable 2.5V output voltage over the industrial temperature range (-40 to +85°C). Available in SOT23-3 surface mount package, it can be designed in applications where space saving is a critical issue.

The low operating current is a key advantage for power restricted designs. In addition, the TS4040 is very stable and can be used in a broad range of application conditions.

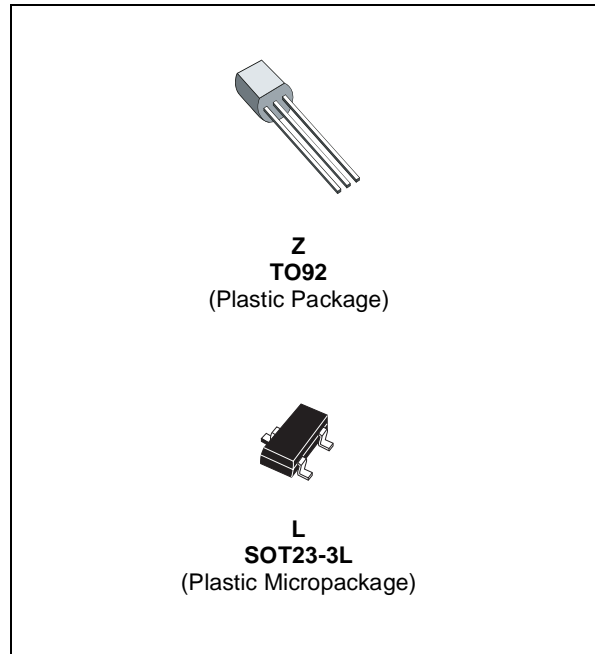
### APPLICATION

- Computers
- Instrumentation
- Battery chargers
- Switch Mode Power Supply
- Battery operated equipments

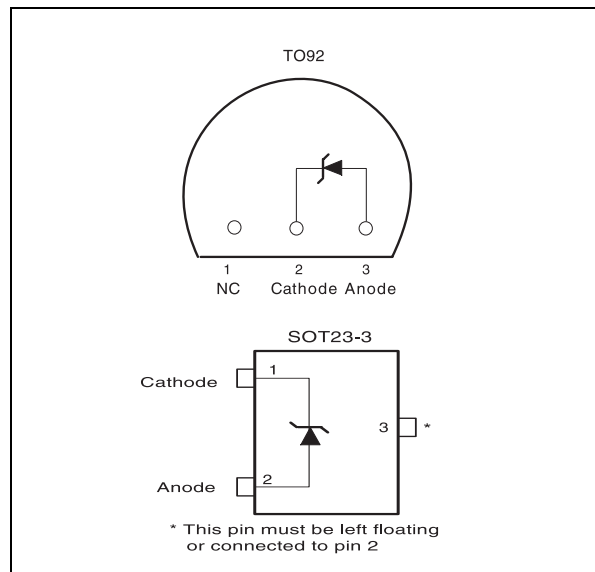
### ORDER CODE

Precision	TO92	SOT23-3	SOT23 Marking
2%	TS4040EIZ-2.5	TS4040EILT-2.5	L243
1%	TS4040DIZ-2.5	TS4040DILT-2.5	L242
Single temperature range: -40 to +85°C			

Z = TO92 Plastic package - also available in Bulk (Z), Tape & Reel (ZT) and Ammo Pack (AP)  
 LT = Tiny Package (SOT23-3) - only available in Tape & Reel (LT)



### PIN CONNECTIONS (top view)



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
$I_k$	Reverse Breakdown Current	20	mA
$I_f$	Forward Current	10	mA
$P_d$	Power Dissipation <sup>1)</sup> SOT23-3 TO92	360 625	mW
$T_{std}$	Storage Temperature	-65 to +150	°C
ESD	Human Body Model (HBM)	2	kV
	Machine Model (MM)	200	V
Tlead	Lead Temperature (soldering, 10 seconds)	260	°C

1.  $P_d$  has been calculated with  $T_{amb} = 25^\circ\text{C}$ ,  $T_{junction} = 150^\circ\text{C}$  and  $R_{thja} = 200^\circ\text{C/W}$  for the TO92 package  
 $R_{thja} = 340^\circ\text{C/W}$  for the SOT23-3 package

**OPERATING CONDITIONS**

Symbol	Parameter	Value	Unit
$I_{kmin}$	Minimum Operating Current	60	$\mu\text{A}$
$I_{kmax}$	Maximum Operating Current	15	mA
$T_{oper}$	Operating Free Air Temperature Range	-40 to +85	°C

**ELECTRICAL CHARACTERISTICS****TS4040E (2% Precision)**

Tamb = 25°C (unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
Vk	Reverse Breakdown Voltage	$I_k = 100\mu\text{A}$	2.45	2.5	2.55	V
	Reverse Breakdown Voltage Tolerance	$I_k = 100\mu\text{A}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$	-50 -74		50 74	mV
Ikmin	Minimum Operating Current	$T = 25^\circ\text{C}$		40	65	$\mu\text{A}$
		$-40^\circ\text{C} < T < +85^\circ\text{C}$			70	
$\Delta V_{\text{ref}}/\Delta T$	Average Temperature Coefficient	$I_k = 100\mu\text{A}$		30	150	ppm/°C
$\Delta V_k/\Delta I_k$	Reverse Breakdown Voltage Change with Operating Current Range	$I_{k\text{min}} < I_k < 1\text{mA}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$		0.4	1 1.2	mV
		$1\text{mA} < I_k < 15\text{mA}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$		2.5	8 10	
Rka	Reverse Static Impedance	$I_k = I_{k\text{min}} \text{ to } 1\text{mA}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$		0.4	1 1.2	$\Omega$
		$I_k = 1 \text{ to } 15\text{mA}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$		0.2	0.6 0.7	
Kvh	Long Term Stability	$I_k = 100\mu\text{A}$ , $t = 1000\text{hrs}$		120		ppm
En	Wide Band Noise	$I_k = 100\mu\text{A}$ $10\text{Hz} < f < 10\text{kHz}$		35		$\mu\text{V}_{\text{rms}}$

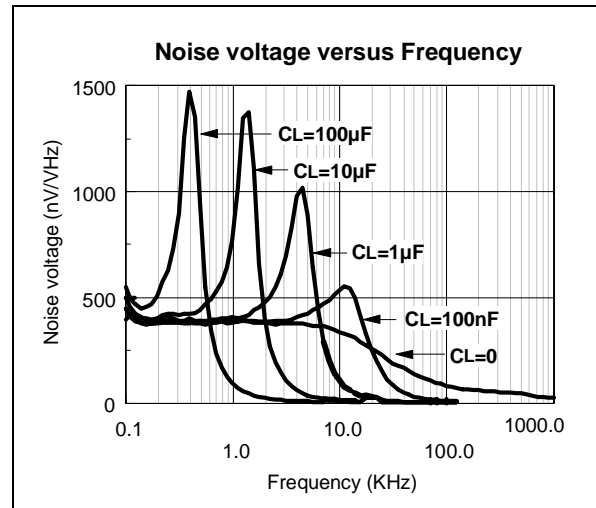
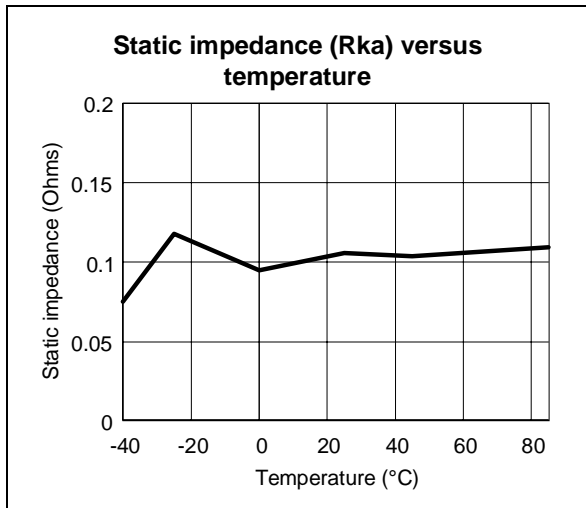
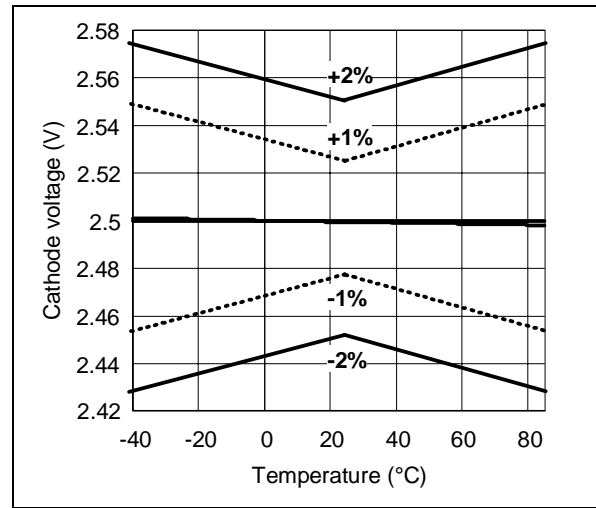
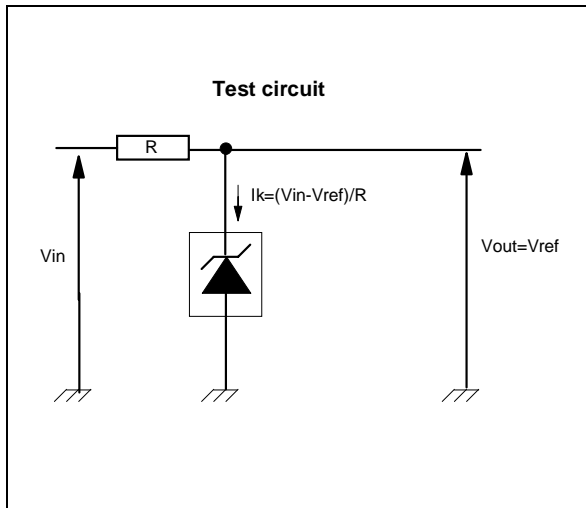
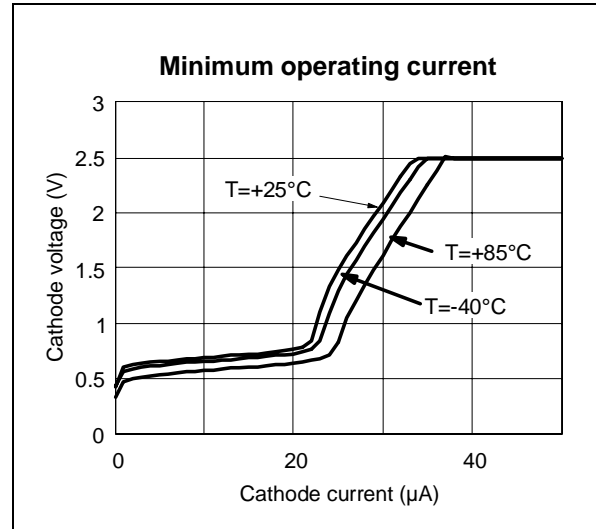
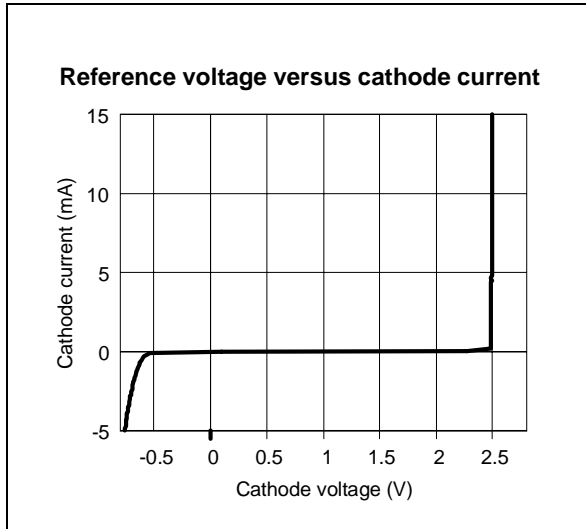
Note: Limits are 100% production tested at 25°C. Limits over temperature are guaranteed through correlation and by design.

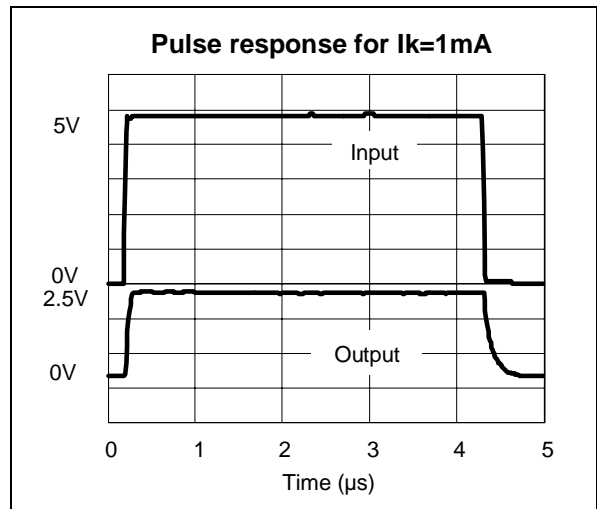
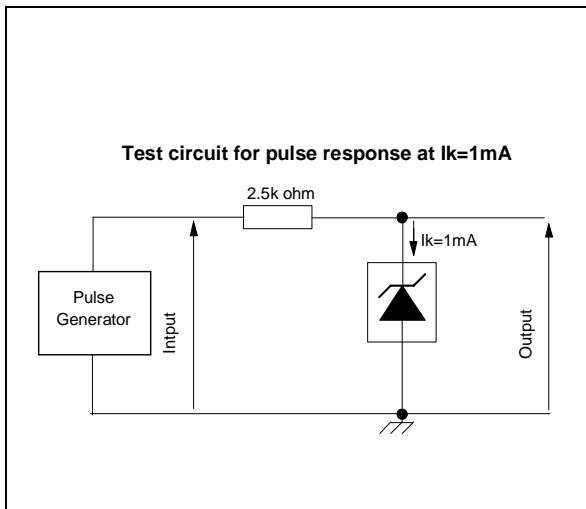
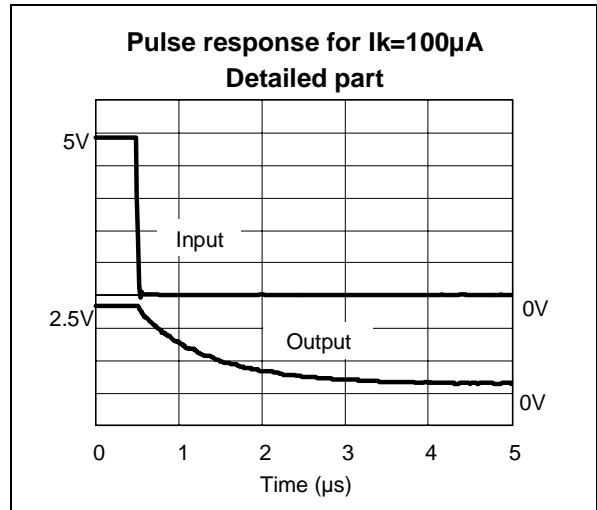
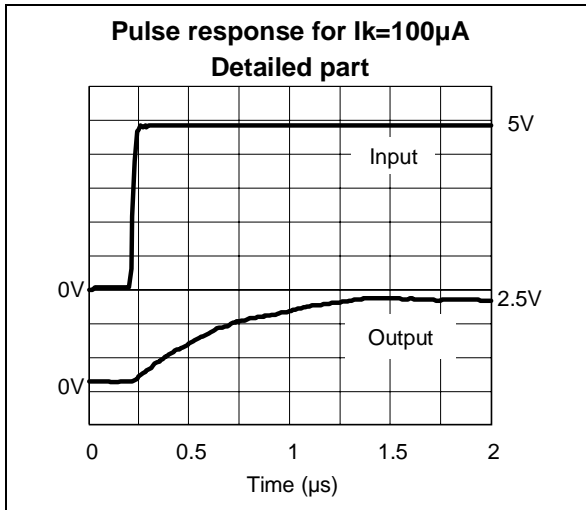
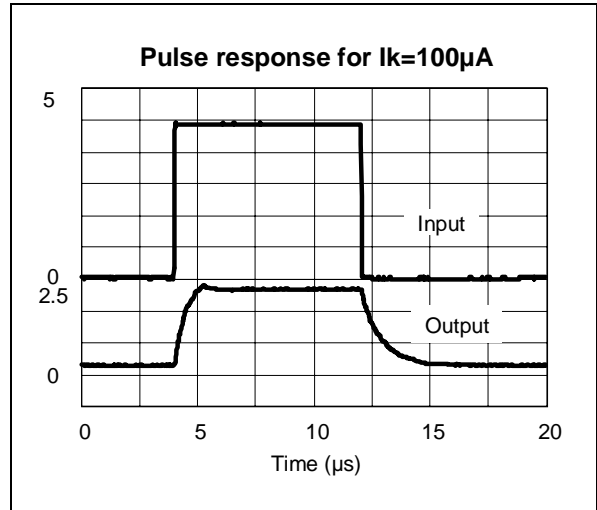
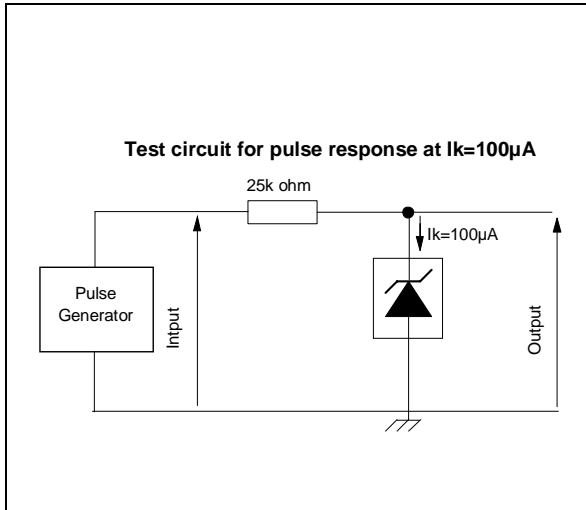
**ELECTRICAL CHARACTERISTICS****TS4040D (1% Precision)**

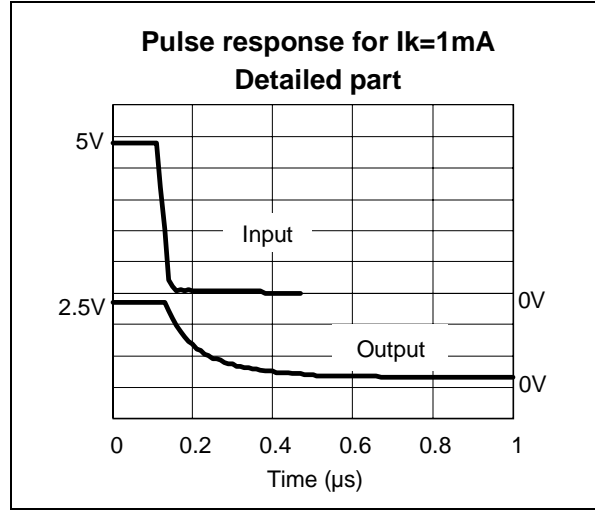
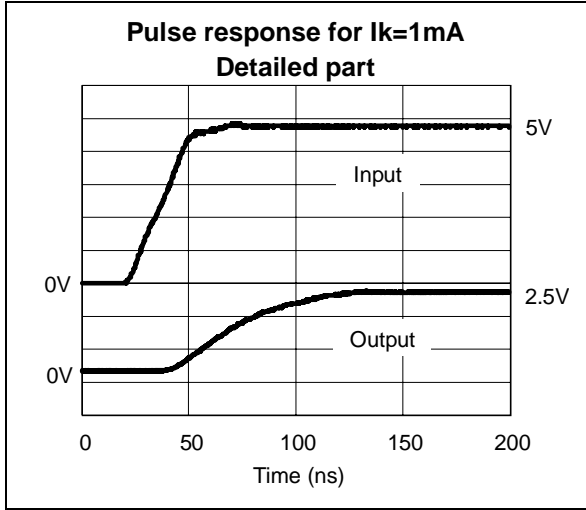
Tamb = 25°C (unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
Vk	Reverse Breakdown Voltage	$I_k = 100\mu\text{A}$	2.475	2.5	2.525	V
	Reverse Breakdown Voltage Tolerance	$I_k = 100\mu\text{A}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$	-25 -49		25 49	mV
Ikmin	Minimum Operating Current	$T = 25^\circ\text{C}$		40	65	$\mu\text{A}$
		$-40^\circ\text{C} < T < +85^\circ\text{C}$			70	
$\Delta V_{\text{ref}}/\Delta T$	Average Temperature Coefficient	$I_k = 100\mu\text{A}$		30	150	ppm/°C
$\Delta V_k/\Delta I_k$	Reverse Breakdown Voltage Change with Operating Current Range	$I_{k\text{min}} < I_k < 1\text{mA}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$		0.4	1 1.2	mV
		$1\text{mA} < I_k < 15\text{mA}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$		2.5	8 10	
Rka	Reverse Static Impedance	$I_k = I_{k\text{min}} \text{ to } 1\text{mA}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$		0.4	1 1.2	$\Omega$
		$I_k = 1\text{mA} \text{ to } 15\text{mA}$ $-40^\circ\text{C} < T < +85^\circ\text{C}$		0.2	0.6 0.7	
Kvh	Long Term Stability	$I_k = 100\mu\text{A}$ , $t = 1000\text{hrs}$		120		ppm
En	Wide Band Noise	$I_k = 100\mu\text{A}$ $10\text{Hz} < f < 10\text{kHz}$		35		$\mu\text{V}_{\text{rms}}$

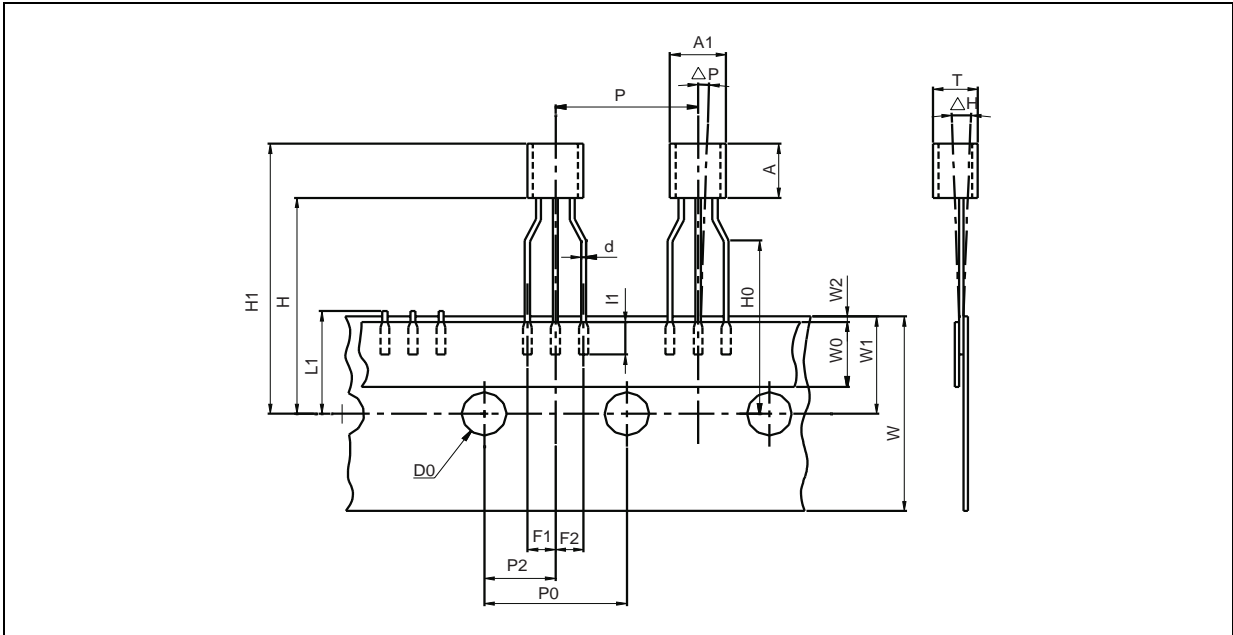
Note: Limits are 100% production tested at 25°C. Limits over temperature are guaranteed through correlation and by design.





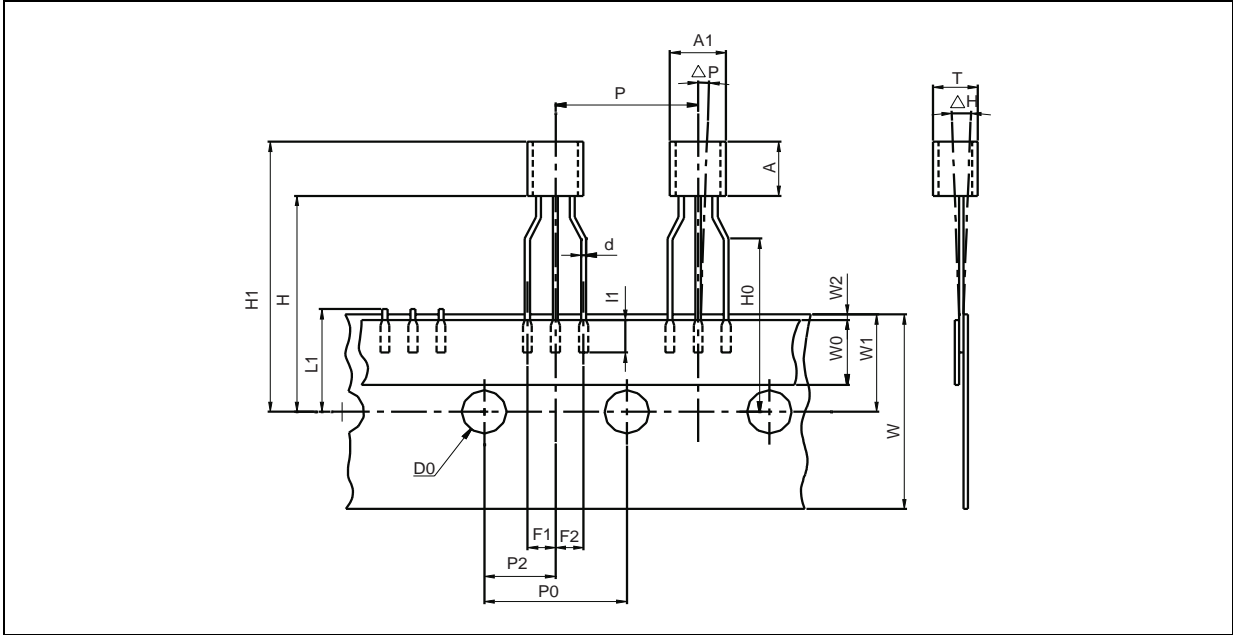


**PACKAGE MECHANICAL DATA**  
**3 PINS - PLASTIC PACKAGE TO92 (TAPE & REEL)**



Dim.	Millimeters			Inches		
	Min	Typ.	Max.	Min.	Typ.	Max.
AL			5.0			0.197
A			5.0			0.197
T			4.0			0.157
d		0.45			0.018	
l1	2.5			0.098		
P	11.7	12.7	13.7	0.461	0.500	0.539
PO	12.4	12.7	13	0.488	0.500	0.512
P2	5.95	6.35	6.75	0.234	0.250	0.266
F1/F2	2.4	2.5	2.8	0.094	0.098	0.110
Δh	-1	0	1	-0.039	0	0.039
ΔP	-1	0	1	-0.039	0	0.039
W	17.5	18.0	19.0	0.689	0.709	0.748
W0	5.7	6	6.3	0.224	0.236	0.248
W1	8.5	9	9.75	0.335	0.354	0.384
W2			0.5			0.020
H			20			0.787
H0	15.5	16	16.5	0.610	0.630	0.650
H1			25			0.984
DO	3.8	4.0	4.2	0.150	0.157	0.165
L1			11			0.433

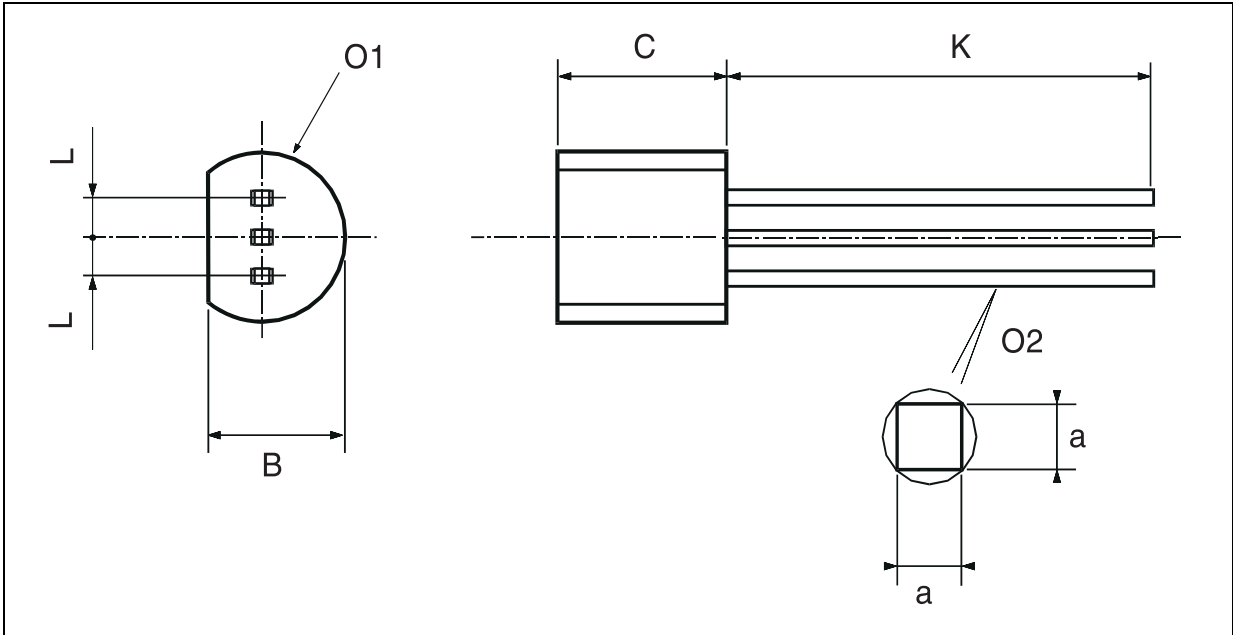
**PACKAGE MECHANICAL DATA**  
**3 PINS - PLASTIC PACKAGE TO92 (TAPE AMMO PACK)**



Dim.	Millimeters			Inches		
	Min	Typ.	Max.	Min.	Typ.	Max.
AL			5.0			0.197
A			5.0			0.197
T			4.0			0.157
d		0.45			0.018	
I1	2.5			0.098		
P	11.7	12.7	13.7	0.461	0.500	0.539
PO	12.4	12.7	13	0.488	0.500	0.512
P2	5.95	6.35	6.75	0.234	0.250	0.266
F1/F2	2.4	2.5	2.8	0.094	0.098	0.110
Δh	-1	0	1	-0.039	0	0.039
ΔP	-1	0	1	-0.039	0	0.039
W	17.5	18.0	19.0	0.689	0.709	0.748
W0	5.7	6	6.3	0.224	0.236	0.248
W1	8.5	9	9.75	0.335	0.354	0.384
W2			0.5			0.020
H			20			0.787
H0	15.5	16	16.5	0.610	0.630	0.650
H1			25			0.984
DO	3.8	4.0	4.2	0.150	0.157	0.165
L1			11			0.433

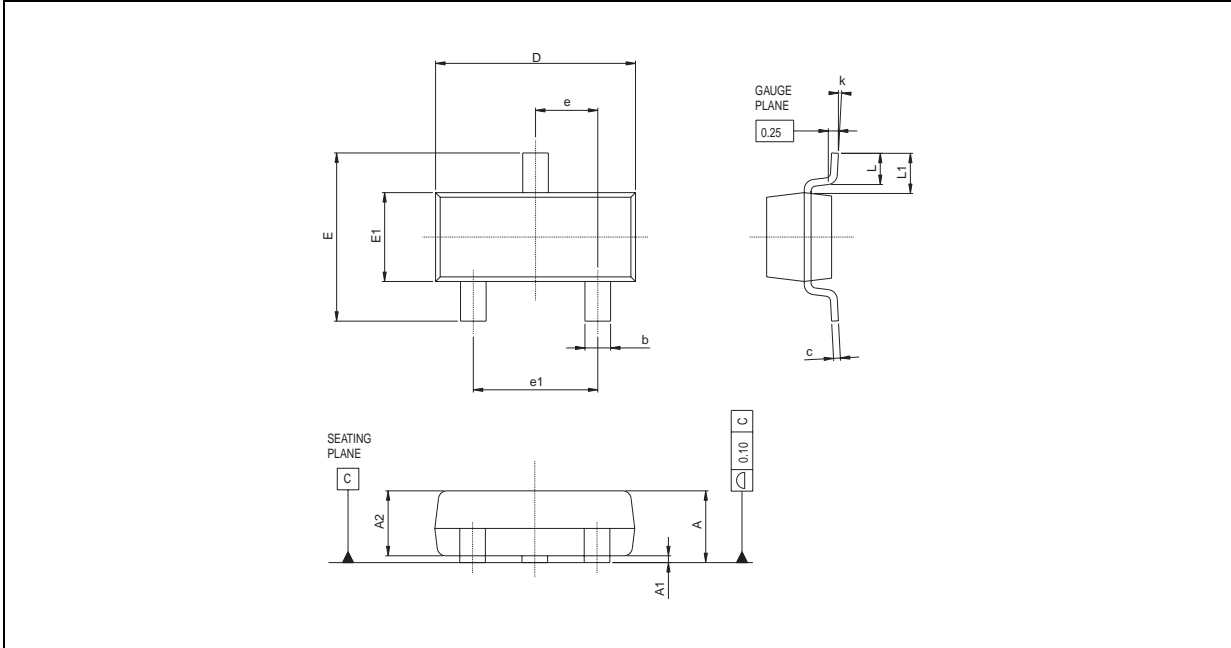


**PACKAGE MECHANICAL DATA**  
**3 PINS - PLASTIC PACKAGE TO92 (BULK)**



Dim.	Millimeters			Inches		
	Min	Typ.	Max.	Min.	Typ.	Max.
L		1.27			0.05	
B	3.2	3.7	4.2	0.126	0.1457	0.1654
O1	4.45	5.00	5.2	0.1752	0.1969	0.2047
C	4.58	5.03	5.33	0.1803	0.198	0.2098
K	12.7			0.5		
O2	0.407	0.5	0.508	0.016	0.0197	0.02
a	0.35			0.0138		

**PACKAGE MECHANICAL DATA**  
**3 PINS - TINY PACKAGE (SOT23)**



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.890		1.120	0.035		0.044
A1	0.010		0.100	0.0004		0.004
A2	0.880	0.950	1.020		0.037	0.040
b	0.300		0.500	0.012		0.020
c	0.080		0.200	0.003		0.008
D	2.800	2.900	3.040	0.110	0.114	0.120
E	2.100		2.640	0.083		0.104
E1	1.200	1.300	1.400	0.047	0.051	0.055
e		0.950			0.037	
e1		1.900			0.075	
L	0.400	0.500	0.600	0.016	0.020	0.024
L1		0.540			0.021	
k	0°		8°			

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