

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.

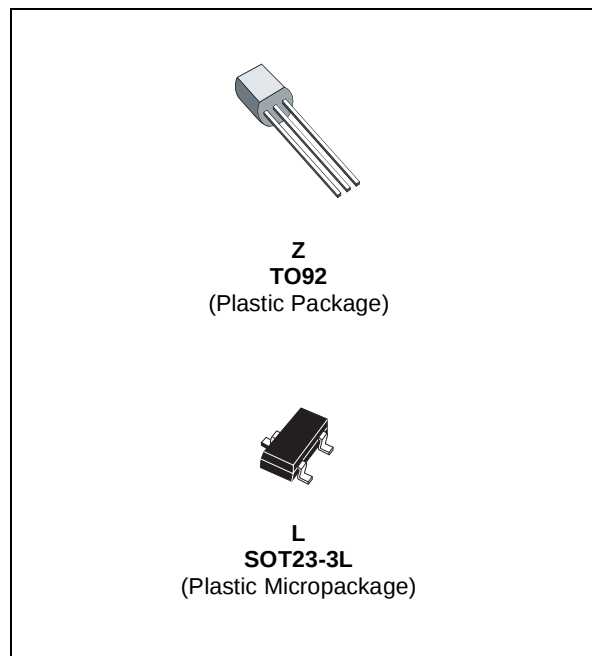
APPLICATION

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

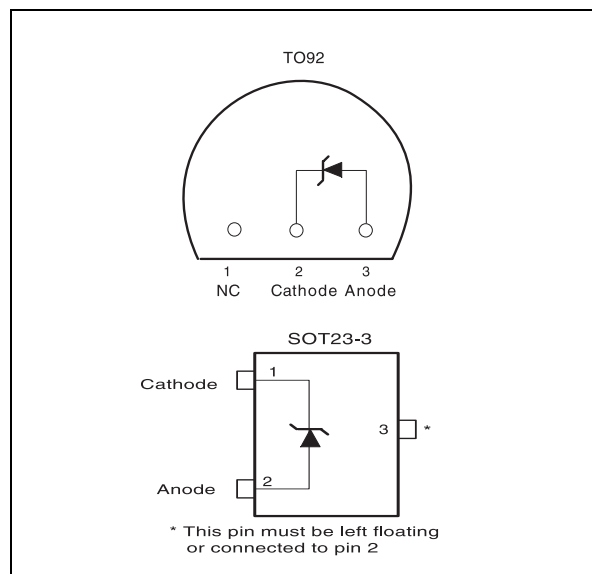
ORDER CODE

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

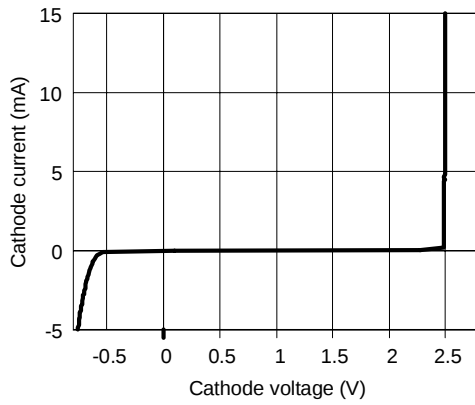
Note: Limits are 100% production tested at 25°C. Limits over temperature are guaranteed through correlation and by design.**ELECTRICAL CHARACTERISTICS****TS4040D (1% Precision)**

Tamb = 25°C (unless otherwise specified)

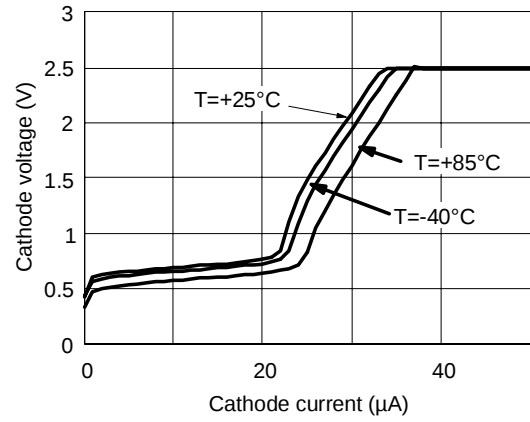
Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
Vk	Reverse Breakdown Voltage	$I_k = 100\mu A$	2.475	2.5	2.525	V
	Reverse Breakdown Voltage Tolerance	$I_k = 100\mu A$ $-40^\circ C < T < +85^\circ C$	-25 -49		25 49	mV
Ikmin	Minimum Operating Current	$T = 25^\circ C$		40	65	μA
		$-40^\circ C < T < +85^\circ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

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

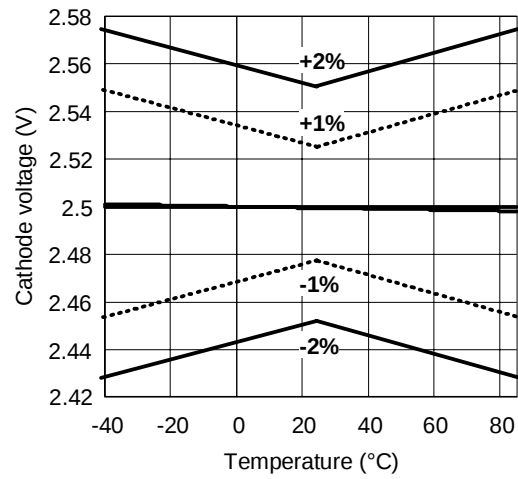
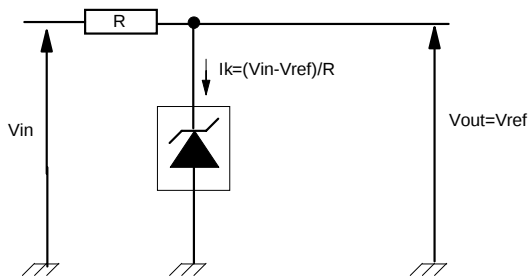
Reference voltage versus cathode current



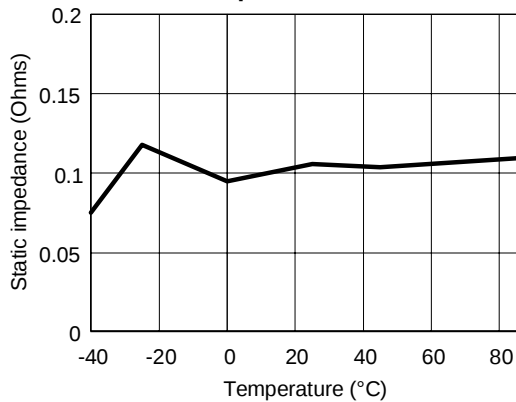
Minimum operating current



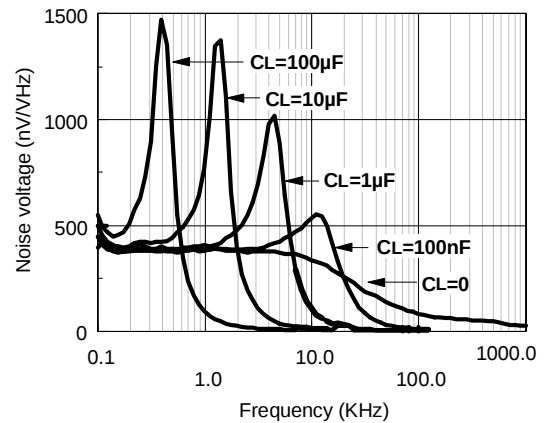
Test circuit

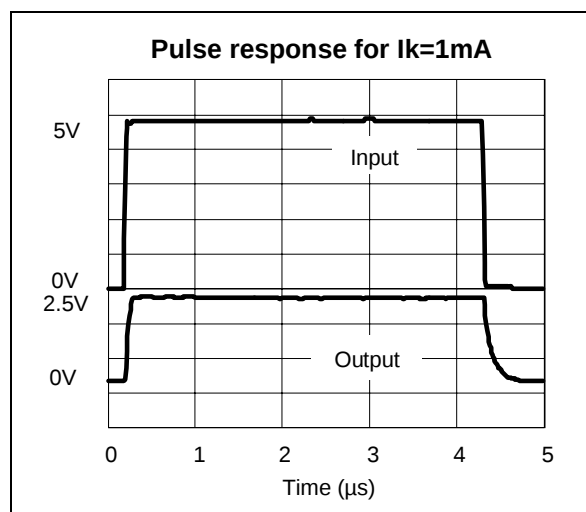
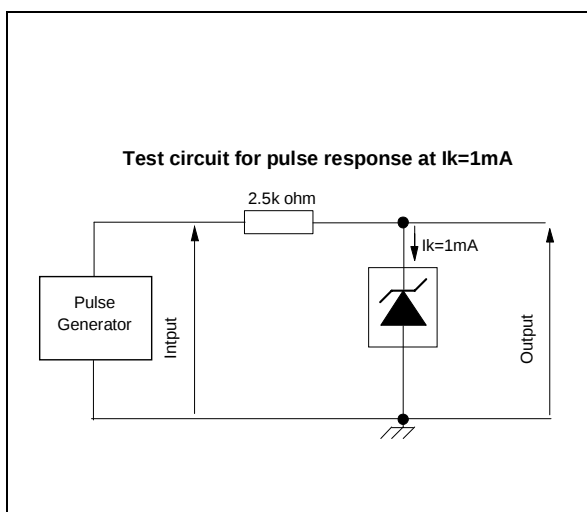
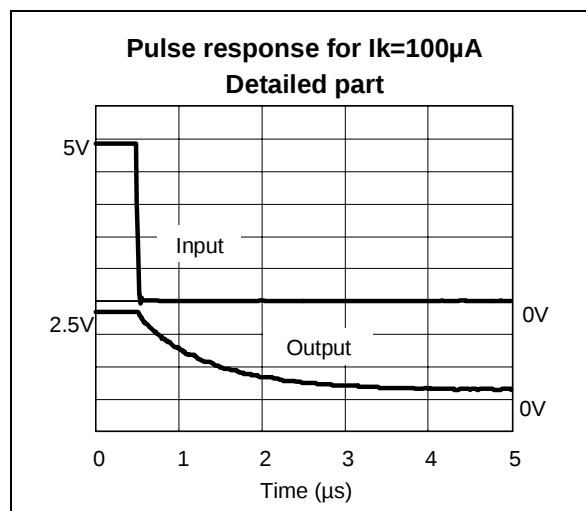
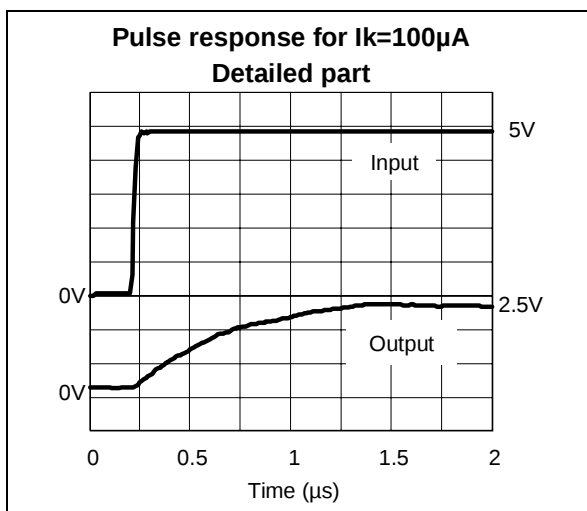
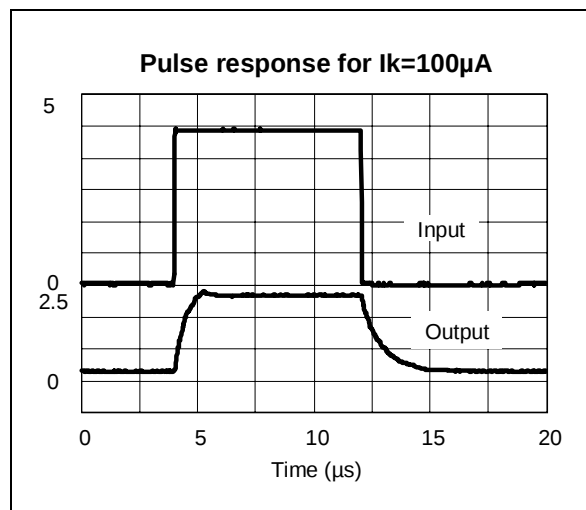
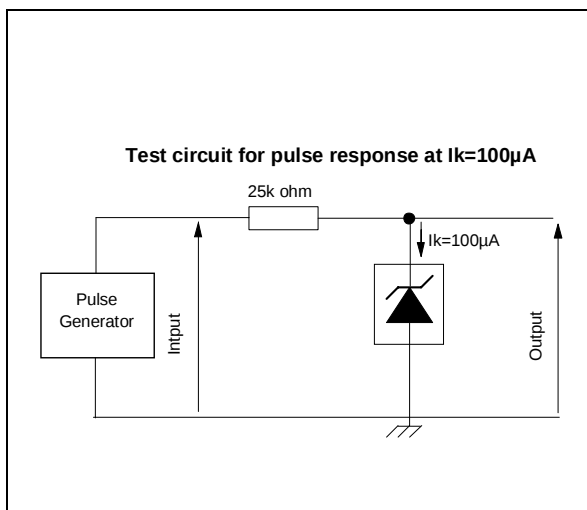


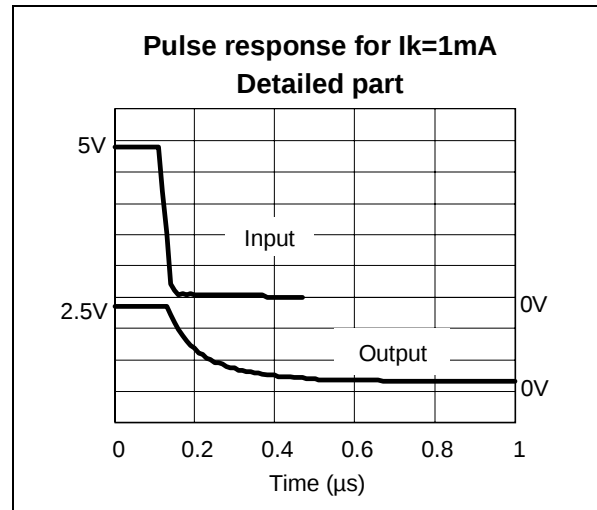
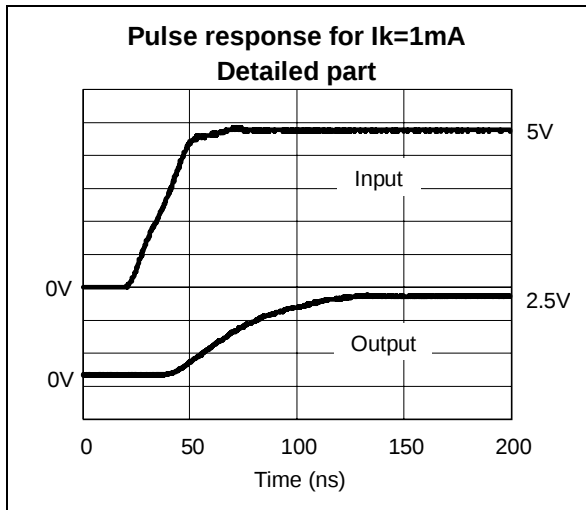
Static impedance (Rka) versus temperature



Noise voltage versus Frequency

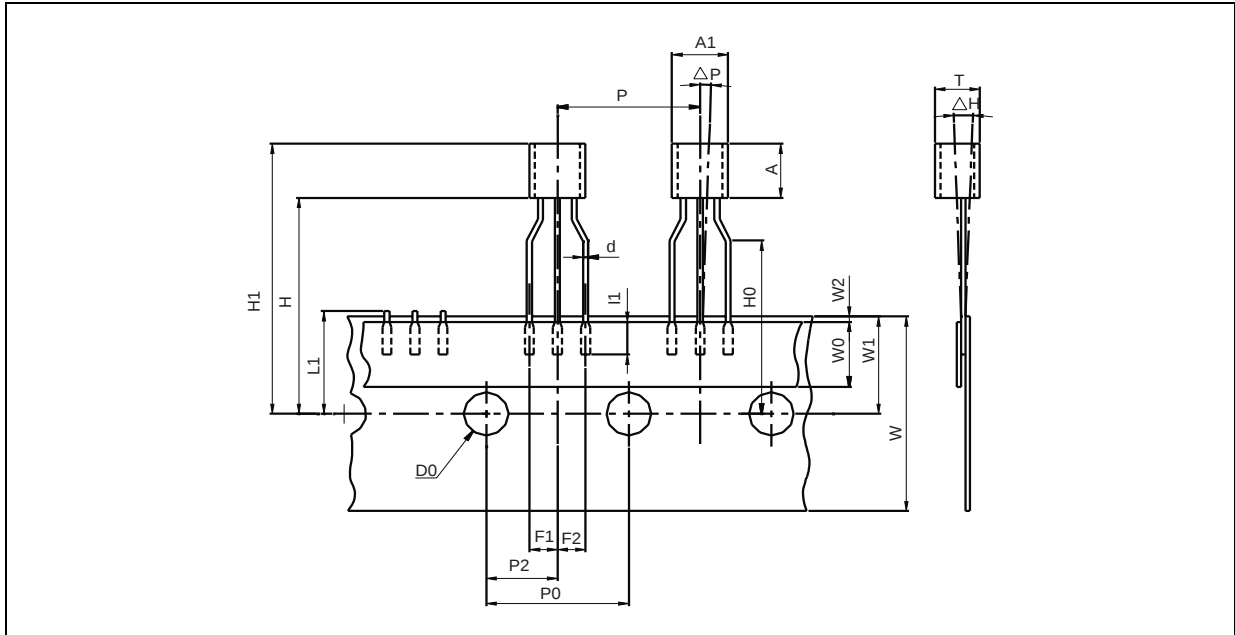






PACKAGE MECHANICAL DATA

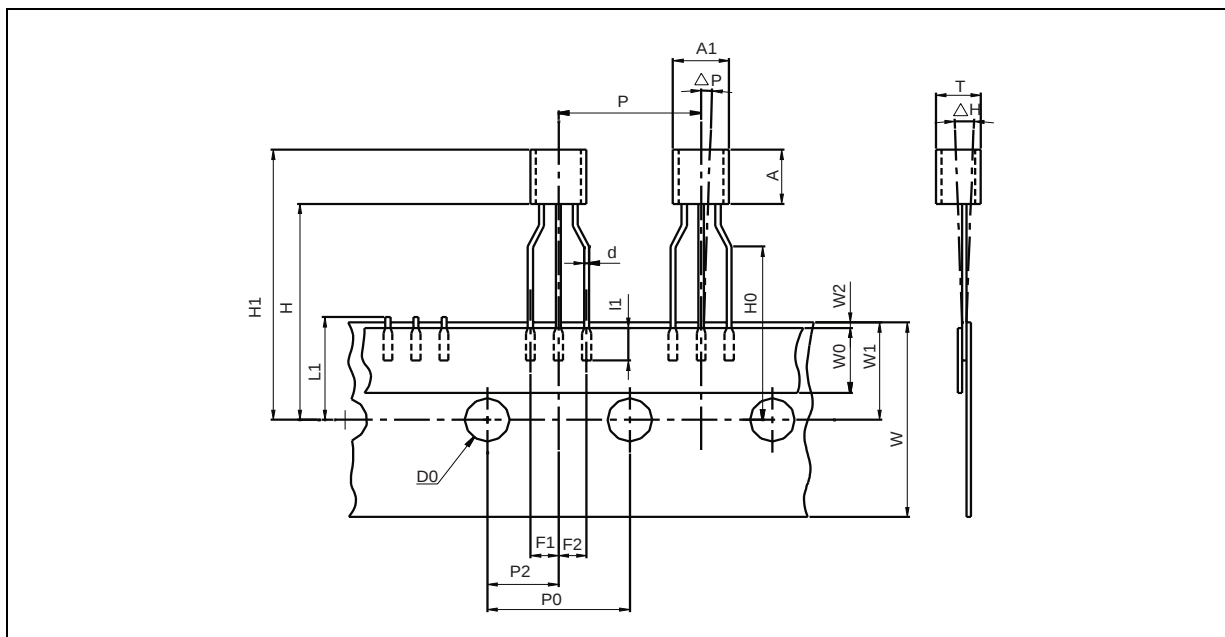
3 PINS - PLASTIC PACKAGE TO92 (TAPE & REEL)



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

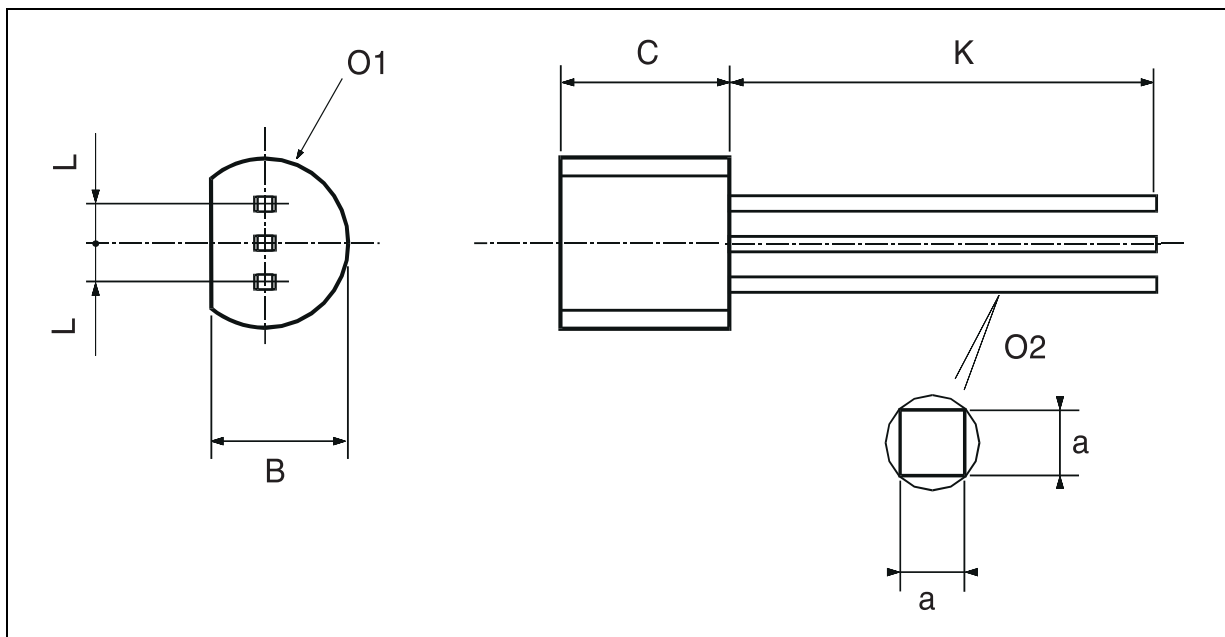
PACKAGE MECHANICAL DATA

3 PINS - PLASTIC PACKAGE TO92 (TAPE AMMO PACK)



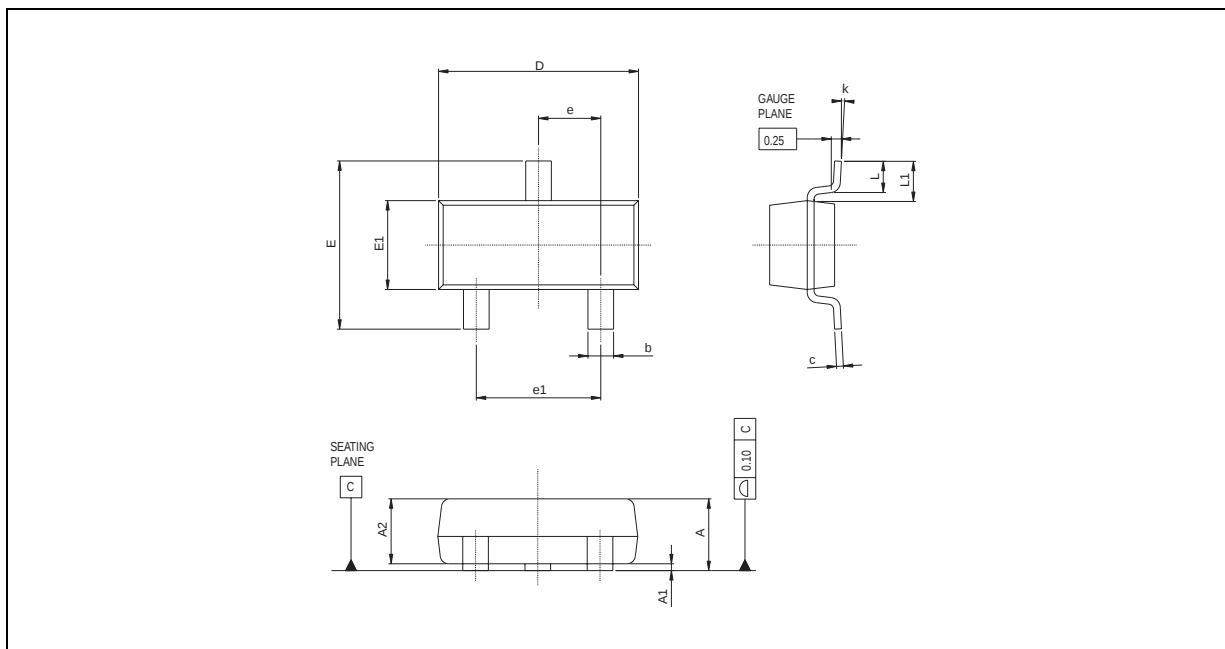
Dim.	Millimeters			Inches		
	Min	Typ.	Max.	Min.	Typ.	Max.
AL			5.0			0.197
A			5.0			0.197
T			4.0			0.157
d		0.45			0.018	
l1	2.5			0.098		
P	11.7	12.7	13.7	0.461	0.500	0.539
PO	12.4	12.7	13	0.488	0.500	0.512
P2	5.95	6.35	6.75	0.234	0.250	0.266
F1/F2	2.4	2.5	2.8	0.094	0.098	0.110
Δh	-1	0	1	-0.039	0	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 (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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