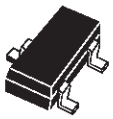
TS4040

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 CAPACITICE LOAD**
- **INDUSTRIAL TEMPERATURE RANGE: -40 to +85°C**
- **150ppm/°C MAXIMUM TEMPERATURE COEFFICIENT**

Z
TO92
(Plastic Package)



L
SOT23-3L
(Plastic Micropackage)

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). Availabe 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

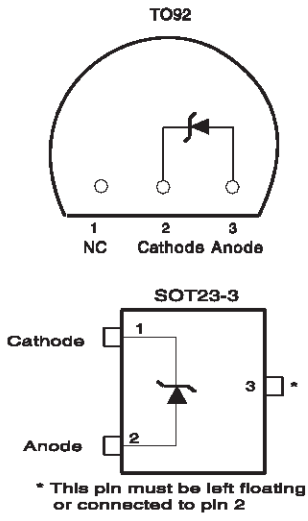
- Computers
- Instrumentation
- Battery chargers
- Switch Mode Power Supply
- Battery operated equipments

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
LT = Tiny Package (SOT23-5) - 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_{oper}	Operating Free Air Temperature Range	-40 to +85	°C
T_{std}	Storage Temperature	-65 to +150	°C
ESD	Human Body Model (HBM)	2	kV
	Machine Model (MM)	200	V
Tlead	Lead Temperatue (soldering, 10 seconds)	260	°C

1. Pd has been calculated with Tamb = 25°C, Tjunction =150°C andRthja = 200°C/W for the TO92 package
Rthja = 340°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

ELECTRICAL CHARACTERISTICS
TS4040E (2% Precision)
Tamb = 25°C (unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
Vk	Reverse Breakdown Voltage	Ik = 100µA	2.45	2.5	2.55	V
	Reverse Breakdown Voltage Tolerance	Ik = 100µA -40°C < T < +85°C	-50 -74		50 74	mV
Ikmin	Minimum Operating Current	T = 25°C		40	65	µA
		-40°C < T < +85°C			70	
ΔVref/ΔT	Average Temperature Coefficient	Ik = 100µA		30	150	ppm/°C
ΔVk/ΔIk	Reverse Breakdown Voltage Change with Operating Current Range	Ikmin < Ik < 1mA -40°C < T < +85°C		0.4	1 1.2	mV
		1mA < Ik < 15mA -40°C < T < +85°C		2.5	8 10	
Rka	Reverse Static Impedance	Ik = Ikmin to 1mA -40°C < T < +85°C		0.4	1 1.2	Ω
		Ik = 1 to 15mA -40°C < T < +85°C		0.2	0.6 0.7	
Kvh	Long Term Stability	Ik = 100µA, t = 1000hrs		120		ppm
En	Wide Band Noise	Ik = 100µA 10Hz < f < 10kHz		35		µVrms

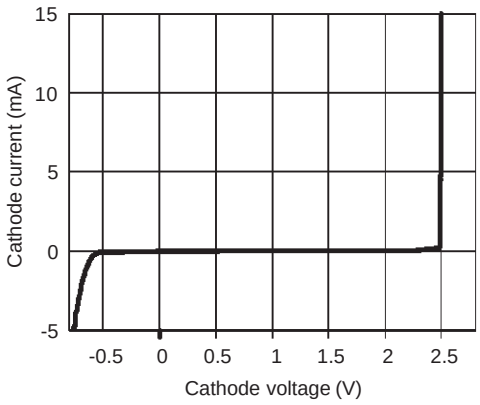
Note: Limits are 100% production tested at 25°C. Limits over temperature are guaranteed through correlation and by design.

ELECTRICAL CHARACTERISTICS
TS4040D (1% Precision)
Tamb = 25°C (unless otherwise specified)

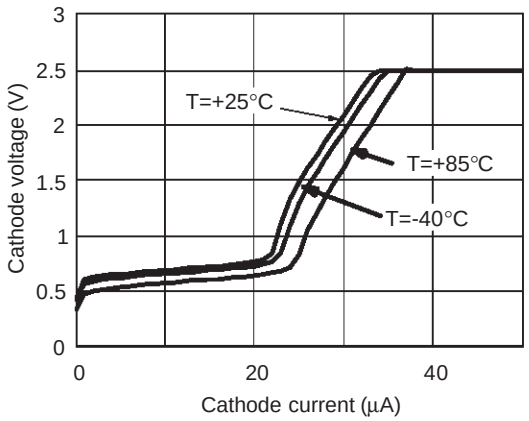
Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
Vk	Reverse Breakdown Voltage	Ik = 100µA	2.475	2.5	2.525	V
	Reverse Breakdown Voltage Tolerance	Ik = 100µA -40°C < T < +85°C	-25 -49		25 49	mV
Ikmin	Minimum Operating Current	T = 25°C		40	65	µA
		-40°C < T < +85°C			70	
ΔVref/ΔT	Average Temperature Coefficient	Ik = 100µA		30	150	ppm/°C
ΔVk/ΔIk	Reverse Breakdown Voltage Change with Operating Current Range	Ikmin < Ik < 1mA -40°C < T < +85°C		0.4	1 1.2	mV
		1mA < Ik < 15mA -40°C < T < +85°C		2.5	8 10	
Rka	Reverse Static Impedance	Ik = Ikmin to 1mA -40°C < T < +85°C		0.4	1 1.2	Ω
		Ik = 1mA to 15mA -40°C < T < +85°C		0.2	0.6 0.7	
Kvh	Long Term Stability	Ik = 100µA, t = 1000hrs		120		ppm
En	Wide Band Noise	Ik = 100µA 10Hz < f < 10kHz		35		µVrms

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

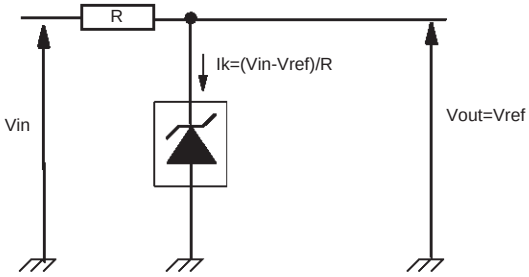
Reference voltage versus cathode current

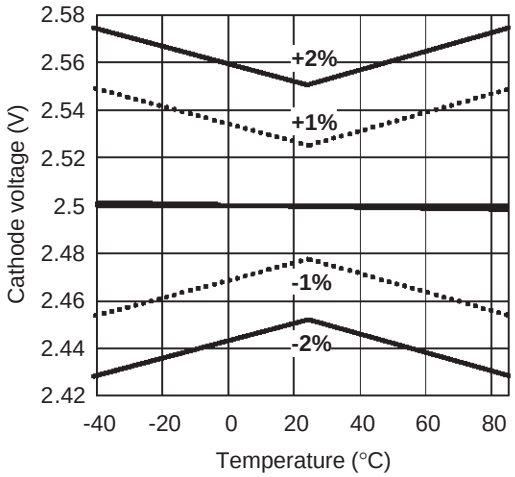


Minimum operating current

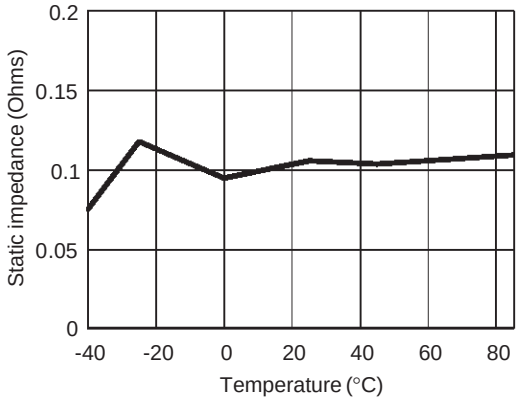


Test circuit

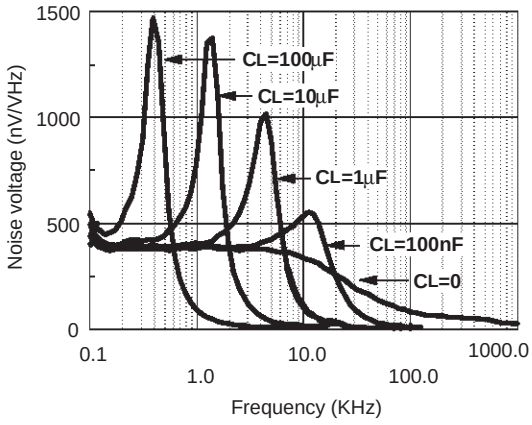




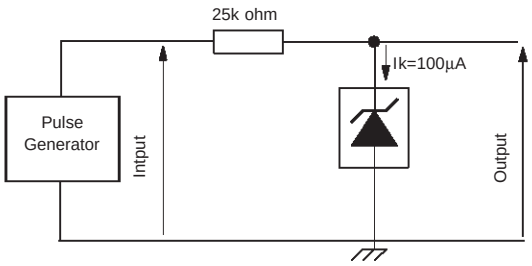
Static impedance (Rka) versus temperature



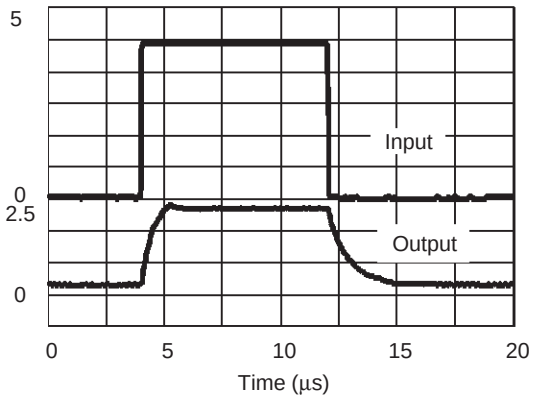
Noise voltage versus Frequency



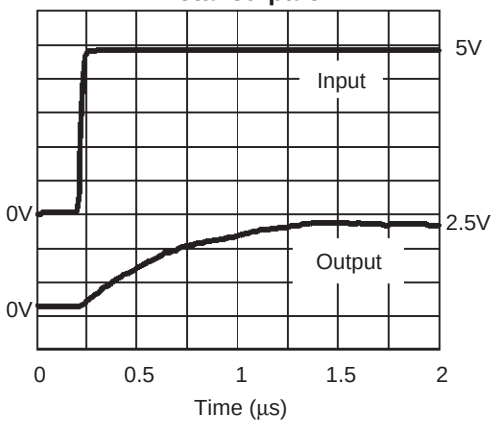
Test circuit for pulse response at Ik=100µA



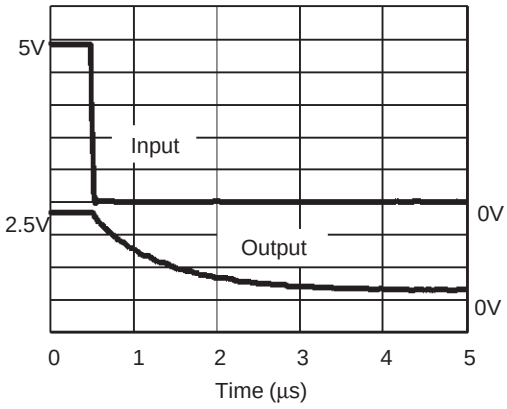
Pulse response for Ik=100µA



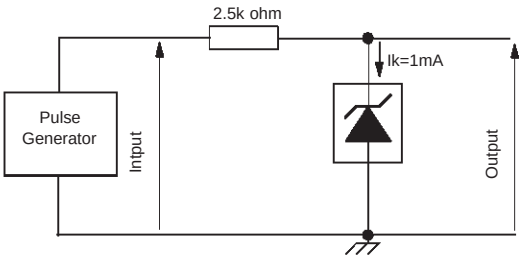
Pulse response for Ik=100µA
Detailed part



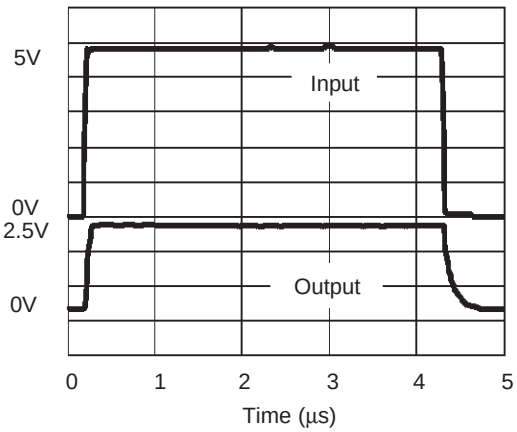
Pulse response for Ik=100µA
Detailed part

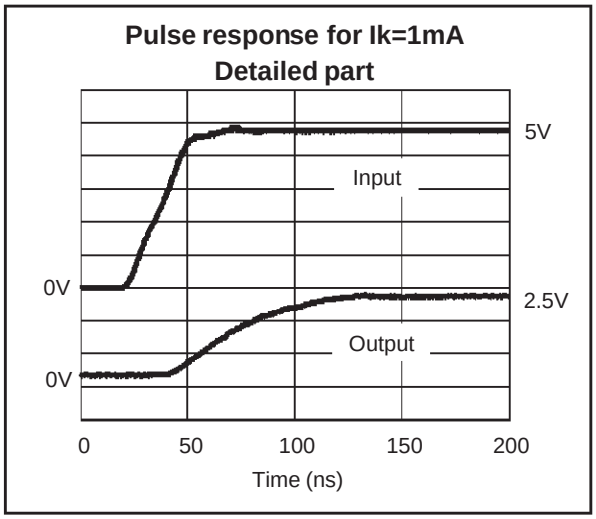


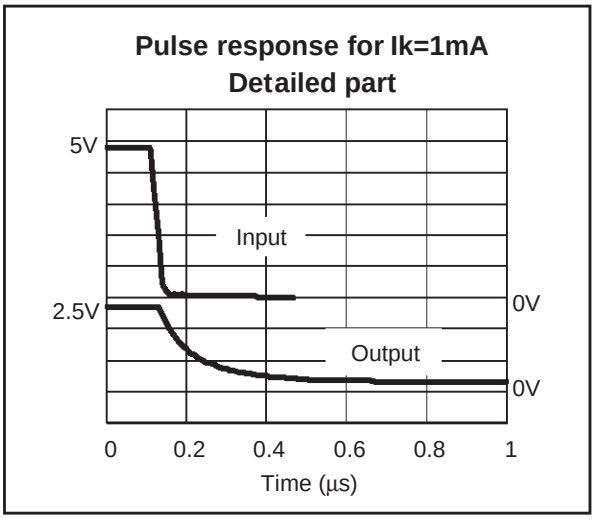
Test circuit for pulse response at Ik=1mA



Pulse response for Ik=1mA

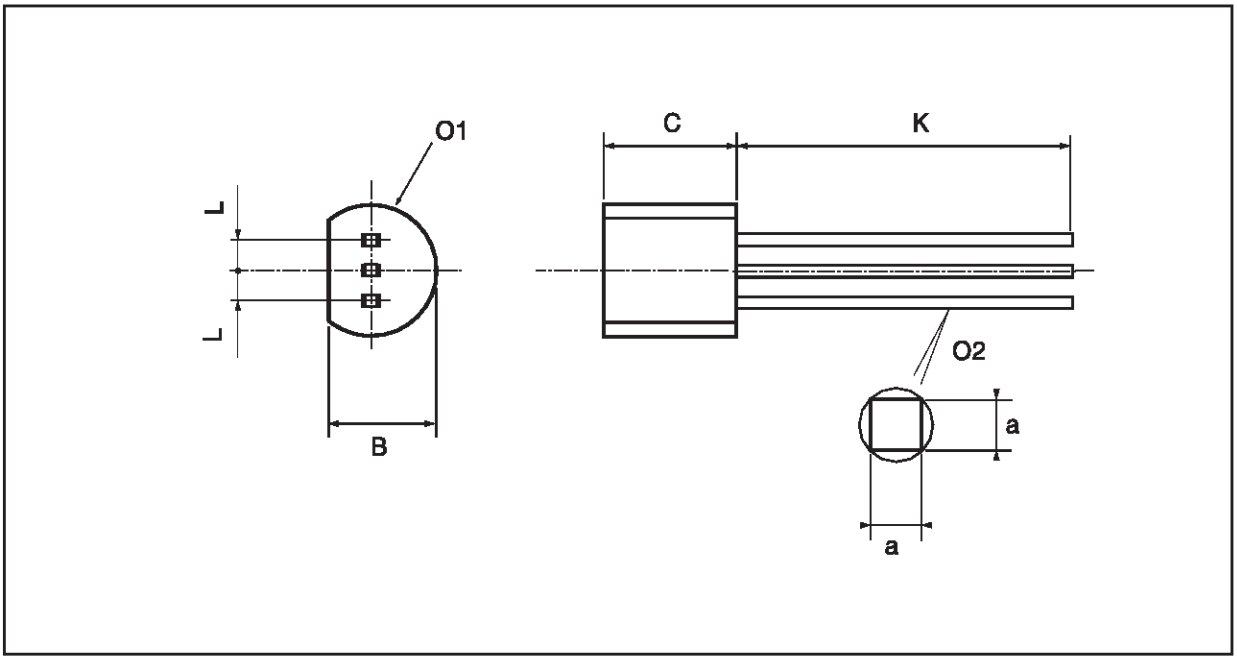



Pulse response for Ik=1mA
Detailed part
5V
Input
0V
2.5V
Output
0V
0
50
100
150
200
Time (ns)


Pulse response for Ik=1mA
Detailed part
5V
Input
2.5V
0V
Output
0V
0
0.2
0.4
0.6
0.8
1
Time (µs)

PACKAGE MECHANICAL DATA

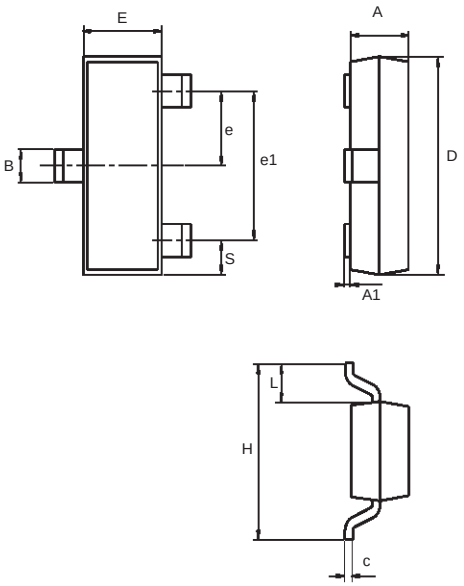
3 PINS - PLASTIC PACKAGE TO92



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)



Dim.	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°			