

# FAN4040

## Precision Micropower Shunt Voltage Reference

### Features

- Fixed 2.500V, 3.300V and 5.00V
- Tolerances to  $\pm 0.1\%$  (25°C)
- Low output noise
- Low temperature coefficient to 100ppm/°C
- Small package
- Extended operating current range
- Extended temperature range

### Applications

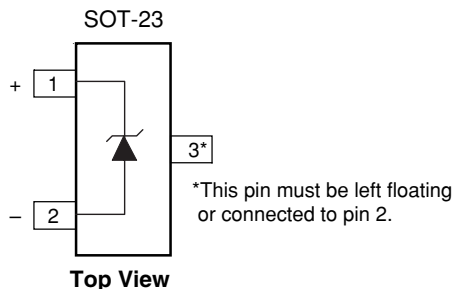
- Portable equipment
- Disk drives
- Instrumentation
- Audio equipment
- Data acquisition systems

### Description

The FAN4040 series of precision shunt references are ideal for space- and cost-sensitive applications. They are available in three output voltages (2.500V, 3.300V and 5.00V) and with four output voltage tolerances (0.1%, 0.2%, 0.5% and 1%). They also have excellent temperature coefficients, to 100ppm/°C for the tighter tolerance grades. The FAN4040 series has an extended operating current range, sinking as much as 25mA.

The FAN4040 series is available in SOT-23 package.

### Connection Diagrams



## Absolute Maximum Ratings<sup>1</sup>

Ratings are over full operating free-air temperature range unless otherwise noted.

Parameter	Min.	Max.	Unit
Continuous cathode current, $I_K$	-30	30	mA
Power dissipation	See Dissipation Rating Table		
Storage Temperature Range	-65	150	°C
Lead Temperature (Soldering, 10 sec.)		300	°C

### Notes:

- Functional operation under these conditions is not implied. Permanent damage may occur if the device is subjected to conditions outside these ratings.

## Recommended Operating Conditions

Parameter	Min.	Max.	Unit
Continuous cathode current, $I_K$	0.025	25	mA
Operating temperature range in free air, $T_A$	I Grade	85	°C
	E Grade	125	°C

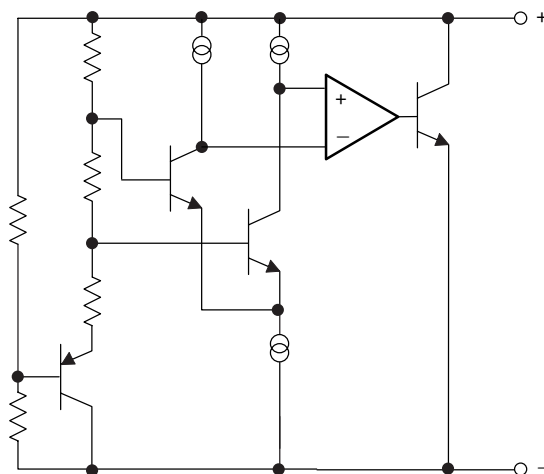
## Dissipation Rating Table

Package	Power Rating $T_A \leq 25^\circ\text{C}$	Derating Factor $T_A \geq 25^\circ\text{C}$	Power Rating $T_A = 70^\circ\text{C}$
SOT23 <sup>1</sup>	306mW	3.0mW/°C	168mW

### Note:

- It is recommended to connect pin 3 to pin 2 to ensure optimal thermal performance.

## Equivalent Schematic



### Guaranteed Electrical Characteristics, FAN4040-2.5, Industrial Temperature Range

(T<sub>A</sub> = 25°C unless otherwise specified, in free air)

The • denotes specifications which apply over the full operating temperature range.

Symbol	Parameter	Conditions	Limits				Units
			A	B	C	D	
V <sub>R</sub>	Reverse Breakdown Voltage	I <sub>K</sub> = 100µA	2.500	2.500	2.500	2.500	V*
TCV <sub>R</sub>	Reverse Breakdown Voltage Tolerance	I <sub>K</sub> = 100µA	±2.5 • ±19	±5.0 ±21	±12 ±29	±25 ±49	mV mV
I <sub>RMIN</sub>	Minimum Operating Current		• 65	65	65	70	µA
ΔV <sub>R</sub> /ΔT	Reverse Breakdown Voltage Temperature Coefficient	I <sub>K</sub> = 1mA	• ±100	±100	±100	±150	ppm/°C
ΔV <sub>R</sub> (ΔI <sub>K</sub> )	Reverse Breakdown Voltage Change with Operating Current	I <sub>RMIN</sub> ≤ I <sub>K</sub> ≤ 1mA	• 1.2	1.2	1.2	1.5	mV
		1mA ≤ I <sub>K</sub> ≤ 15mA	• 8.0	8.0	8.0	10.0	mV
		1mA ≤ I <sub>K</sub> ≤ 25mA	10	10	10	12	mV*
Z <sub>KA</sub>	Reverse Dynamic Impedance	I <sub>K</sub> =1mA, f=120Hz, I <sub>AC</sub> =0.1I <sub>K</sub>	1.0	1.0	1.0	1.3	Ω*
e <sub>N</sub>	Wideband Noise	I <sub>K</sub> =100µA, 10Hz ≤ f ≤ 10kHz	35	35	35	35	µV <sub>RMS</sub> *
ΔV <sub>R</sub>	Reverse Breakdown Voltage Long-term Stability	t=1000hrs, T=25°C, I <sub>K</sub> =100µA	120	120	120	120	ppm*

\*Typical.

### Guaranteed Electrical Characteristics, FAN4040-3.3, Industrial Temperature Range

(T<sub>A</sub> = 25°C unless otherwise specified, in free air)

The • denotes specifications which apply over the full operating temperature range.

Symbol	Parameter	Conditions	Limits				Units
			A	B	C	D	
V <sub>R</sub>	Reverse Breakdown Voltage	I <sub>K</sub> = 100µA	3.300	3.300	3.300	3.300	V*
TCV <sub>R</sub>	Reverse Breakdown Voltage Tolerance	I <sub>K</sub> = 100µA	±3.3 • ±25	±6.6 ±28	±17 ±38	±33 ±65	mV mV
I <sub>RMIN</sub>	Minimum Operating Current		• 70	70	70	75	µA
ΔV <sub>R</sub> /ΔT	Reverse Breakdown Voltage Temperature Coefficient	I <sub>K</sub> = 1mA	• ±100	±100	±100	±150	ppm/°C
ΔV <sub>R</sub> (ΔI <sub>K</sub> )	Reverse Breakdown Voltage Change with Operating Current	I <sub>RMIN</sub> ≤ I <sub>K</sub> ≤ 1mA	• 1.2	1.2	1.2	1.5	mV
		1mA ≤ I <sub>K</sub> ≤ 15mA	• 10	10	10	13	mV
		1mA ≤ I <sub>K</sub> ≤ 25mA	12	12	12	15	mV*
Z <sub>KA</sub>	Reverse Dynamic Impedance	I <sub>K</sub> =1mA, f=120Hz, I <sub>AC</sub> =0.1I <sub>K</sub>	1.0	1.0	1.0	1.3	Ω*
e <sub>N</sub>	Wideband Noise	I <sub>K</sub> =100µA, 10Hz ≤ f ≤ 10kHz	70	70	70	70	µV <sub>RMS</sub> *
ΔV <sub>R</sub>	Reverse Breakdown Voltage Long-term Stability	t=1000hrs, T=25°C, I <sub>K</sub> =100µA	120	120	120	120	ppm*

\*Typical.

## Guaranteed Electrical Characteristics, FAN4040-5.0, Industrial Temperature Range

( $T_A = 25^\circ\text{C}$  unless otherwise specified, in free air)

The • denotes specifications which apply over the full operating temperature range.

Symbol	Parameter	Conditions	Limits				Units
			A	B	C	D	
$V_R$	Reverse Breakdown Voltage	$I_K = 100\mu\text{A}$	5.00	5.00	5.00	5.00	V*
$TCV_R$	Reverse Breakdown Voltage Tolerance	$I_K = 100\mu\text{A}$	$\pm 5$ • $\pm 40$	$\pm 10$ • $\pm 45$	$\pm 24$ • $\pm 60$	$\pm 50$ • $\pm 100$	mV mV
$I_{RMIN}$	Minimum Operating Current		• 65	• 65	• 65	• 70	$\mu\text{A}$
$\Delta V_R/\Delta T$	Reverse Breakdown Voltage Temperature Coefficient	$I_K = 1\text{mA}$	• $\pm 100$	• $\pm 100$	• $\pm 100$	• $\pm 150$	ppm/ $^\circ\text{C}$
$\Delta V_R (\Delta I_K)$	Reverse Breakdown Voltage Change with Operating Current	$I_{RMIN} \leq I_K \leq 1\text{mA}$ $1\text{mA} \leq I_K \leq 15\text{mA}$ $1\text{mA} \leq I_K \leq 25\text{mA}$	• 1.2 • 8.0 10	1.2 8.0 10	1.2 8.0 10	1.5 10.0 12	mV mV mV*
$Z_{KA}$	Reverse Dynamic Impedance	$I_K = 1\text{mA}$ , $f = 120\text{Hz}$ , $I_{AC} = 0.1I_K$	1.0	1.0	1.0	1.3	$\Omega^*$
$e_N$	Wideband Noise	$I_K = 100\mu\text{A}$ , $10\text{Hz} \leq f \leq 10\text{kHz}$	70	70	70	70	$\mu\text{V}_{RMS}^*$
$\Delta V_R$	Reverse Breakdown Voltage Long-term Stability	$t = 1000\text{hrs}$ , $T = 25^\circ\text{C}$ , $I_K = 100\mu\text{A}$	120	120	120	120	ppm*

\*Typical.

## Guaranteed Electrical Characteristics, FAN4040-2.5, Extended Temperature Range

( $T_A = 25^\circ\text{C}$  unless otherwise specified, in free air)

The • denotes specifications which apply over the full operating temperature range.

Symbol	Parameter	Conditions	Limits				Units
			A	B	C	D	
$V_R$	Reverse Breakdown Voltage	$I_K = 100\mu\text{A}$	2.500	2.500	2.500	2.500	V*
$TCV_R$	Reverse Breakdown Voltage Tolerance	$I_K = 100\mu\text{A}$	$\pm 2.5$ • $\pm 25$	$\pm 5.0$ • $\pm 30$	$\pm 12$ • $\pm 35$	$\pm 25$ • $\pm 49$	mV mV
$I_{RMIN}$	Minimum Operating Current		• 65	• 65	• 65	• 70	$\mu\text{A}$
$\Delta V_R/\Delta T$	Reverse Breakdown Voltage Temperature Coefficient	$I_K = 1\text{mA}$	• $\pm 100$	• $\pm 100$	• $\pm 100$	• $\pm 150$	ppm/ $^\circ\text{C}$
$\Delta V_R (\Delta I_K)$	Reverse Breakdown Voltage Change with Operating Current	$I_{RMIN} \leq I_K \leq 1\text{mA}$ $1\text{mA} \leq I_K \leq 15\text{mA}$ $1\text{mA} \leq I_K \leq 25\text{mA}$	• 1.5 • 10.0 10	1.5 10.0 10	1.5 10.0 10	1.5 10.0 12	mV mV mV*
$Z_{KA}$	Reverse Dynamic Impedance	$I_K = 1\text{mA}$ , $f = 120\text{Hz}$ , $I_{AC} = 0.1I_K$	1.0	1.0	1.0	1.3	$\Omega^*$
$e_N$	Wideband Noise	$I_K = 100\mu\text{A}$ , $10\text{Hz} \leq f \leq 10\text{kHz}$	70	70	70	70	$\mu\text{V}_{RMS}^*$
$\Delta V_R$	Reverse Breakdown Voltage Long-term Stability	$t = 1000\text{hrs}$ , $T = 25^\circ\text{C}$ , $I_K = 100\mu\text{A}$	120	120	120	120	ppm*

\*Typical.

### Guaranteed Electrical Characteristics, FAN4040-3.3, Extended Temperature Range

(T<sub>A</sub> = 25°C unless otherwise specified, in free air)

The • denotes specifications which apply over the full operating temperature range.

Symbol	Parameter	Conditions	Limits				Units
			A	B	C	D	
V <sub>R</sub>	Reverse Breakdown Voltage	I <sub>K</sub> = 100µA	3.300	3.300	3.300	3.300	V*
TCV <sub>R</sub>	Reverse Breakdown Voltage Tolerance	I <sub>K</sub> = 100µA	±3.3 • ±30	±6.6 ±35	±17 ±42	±33 ±65	mV mV
I <sub>RMIN</sub>	Minimum Operating Current		• 70	70	70	75	µA
ΔV <sub>R</sub> /ΔT	Reverse Breakdown Voltage Temperature Coefficient	I <sub>K</sub> = 1mA	• ±100	±100	±100	±150	ppm/°C
ΔV <sub>R</sub> (ΔI <sub>K</sub> )	Reverse Breakdown Voltage Change with Operating Current	I <sub>RMIN</sub> ≤ I <sub>K</sub> ≤ 1mA	• 1.5	1.5	1.5	1.5	mV
		1mA ≤ I <sub>K</sub> ≤ 15mA	• 10	10	10	13	mV
		1mA ≤ I <sub>K</sub> ≤ 25mA	12	12	12	15	mV*
Z <sub>KA</sub>	Reverse Dynamic Impedance	I <sub>K</sub> =1mA, f=120Hz, I <sub>AC</sub> =0.1I <sub>K</sub>	1.0	1.0	1.0	1.3	Ω*
e <sub>N</sub>	Wideband Noise	I <sub>K</sub> =100µA, 10Hz ≤ f ≤ 10kHz	70	70	70	70	µV <sub>RMS</sub> *
ΔV <sub>R</sub>	Reverse Breakdown Voltage Long-term Stability	t=1000hrs, T=25°C, I <sub>K</sub> =100µA	120	120	120	120	ppm*

\*Typical.

### Guaranteed Electrical Characteristics, FAN4040-5.0, Extended Temperature Range

(T<sub>A</sub> = 25°C unless otherwise specified, in free air)

The • denotes specifications which apply over the full operating temperature range.

Symbol	Parameter	Conditions	Limits				Units
			A	B	C	D	
V <sub>R</sub>	Reverse Breakdown Voltage	I <sub>K</sub> = 100µA	5.00	5.00	5.00	5.00	V*
TCV <sub>R</sub>	Reverse Breakdown Voltage Tolerance	I <sub>K</sub> = 100µA	±5 • ±50	±10 ±60	±24 ±70	±50 ±100	mV mV
I <sub>RMIN</sub>	Minimum Operating Current		• 100	100	100	100	µA
ΔV <sub>R</sub> /ΔT	Reverse Breakdown Voltage Temperature Coefficient	I <sub>K</sub> = 1mA	• ±100	±100	±100	±150	ppm/°C
ΔV <sub>R</sub> (ΔI <sub>K</sub> )	Reverse Breakdown Voltage Change with Operating Current	I <sub>RMIN</sub> ≤ I <sub>K</sub> ≤ 1mA	• 1.5	1.5	1.5	1.5	mV
		1mA ≤ I <sub>K</sub> ≤ 15mA	• 10	10	10	15	mV
		1mA ≤ I <sub>K</sub> ≤ 25mA	10	10	10	12	mV*
Z <sub>KA</sub>	Reverse Dynamic Impedance	I <sub>K</sub> =1mA, f=120Hz, I <sub>AC</sub> =0.1I <sub>K</sub>	1.0	1.0	1.0	1.3	Ω*
e <sub>N</sub>	Wideband Noise	I <sub>K</sub> =100µA, 10Hz ≤ f ≤ 10kHz	70	70	70	70	µV <sub>RMS</sub> *
ΔV <sub>R</sub>	Reverse Breakdown Voltage Long-term Stability	t=1000hrs, T=25°C, I <sub>K</sub> =100µA	120	120	120	120	ppm*

\*Typical.

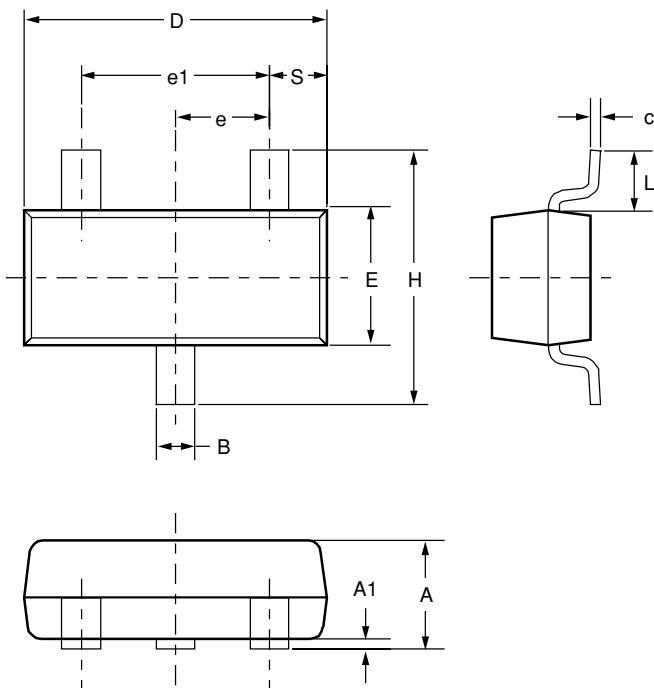
# Mechanical Dimensions

## SOT-23 Package

Symbol	Inches		Millimeters		Notes
	Min.	Max.	Min.	Max.	
A	.035	.044	.89	1.12	
A1	.0004	.004	.01	.10	
B	.012	.020	.30	.50	
c	.003	.008	.08	.20	
D	.110	.120	2.80	3.04	
E	.047	.055	1.20	1.40	
e	.037 BSC		.95 BSC		
e1	.075 BSC		1.90 BSC		
H	.083	.104	2.10	2.64	
L	.021 REF		.54 REF		
S	.016 Nom		.395 Nom		

**Notes:**

1. Dimensions are inclusive of plating.
2. Dimensions are exclusive of mold flash & metal burr.
3. Comply to JEDEC TO-236.
4. This drawing is for matrix leadframe only.



## Ordering Information

Example: FAN4040DIS325X ('X' denotes Tape and Reel)

<u>FAN4040</u>	<u>D</u>	<u>I</u>	<u>S3</u>	<u>25</u>
	<b>Grade</b>	<b>Temperature</b>	<b>Package</b>	<b>Voltage</b>
	0.1% = A*	-40°C to 85°C – I	SOT23 = S3	2.5V = 25
	0.2% = B	-40°C to 125°C – E		3.3V = 33
	0.5% = C			5.0V = 5
	1.0% = D			

\* 'A' grade is a special order. Please contact factory for availability.

## SOT-23 Package Marking Information

Only 3 fields of marking are possible on an SOT-23. This table gives the meaning of these fields.

Example: F2A

<u>F</u>	<u>2</u>	<u>A</u>
	<b>Voltage</b>	<b>Grade</b>
	2.5V = 2	0.1% = A
	3.3V = 3	0.2% = B
	5.0V = 5	0.5% = C
		1.0% = D

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.