

FAN4041

Precision Micropower Shunt Voltage Reference

Features

- Adjustable shunt reference
- Tolerances to $\pm 0.5\%$ (25°C)
- Low output noise
- Low temperature coefficient to 100 ppm/°C max
- · Small packages
- · Extended operating current range

Applications

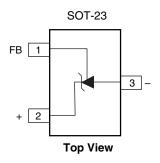
- · Portable equipment
- · Disk drives
- Instrumentation
- · Audio equipment
- · Data acquisition systems

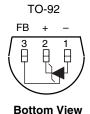
Description

The FAN4041 adjustable precision shunt references are ideal for space- and cost-sensitive applications. They are available with output voltage tolerances of 0.5% and 1%. They also have excellent temperature coefficients, to 100ppm/°C for the tighter tolerance grades. The FAN4041 series has an extended operating current range, sinking as much as 25mA.

The FAN4041 series is available in SOT-23 and TO-92 packages.

Connection Diagrams





Absolute Maximum Ratings¹

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		
Maximum Output Voltage	12 V		
Storage Temperature Range	-65 150 °C		°C
Lead Temperature (Soldering, 10 sec.)		300	°C

Notes:

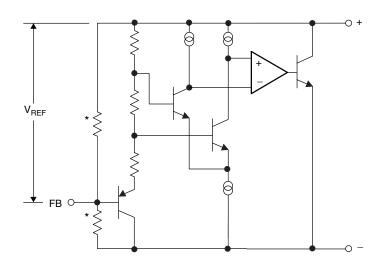
Recommended Operating Conditions

Parameter	Min.	Max.	Unit
Continuous cathode current, I _K	0.07	25	mA
Operating temperature range in free air, TA	-40	85	°C
Output Voltage Range	1.24	10	V

Dissipation Rating Table

Package	Power Rating T _A ≤ 25°C	Derating Factor T _A ≥ 25°C	Power Rating T _A = 70°C
TO-92	550mW	5.5mW/°C	302mW
SOT23	306mW	3.0mW/°C	168mW

Equivalent Schematic



^{*}External adjust components.

^{1.} Functional operation under these conditions is not implied. Permanent damage may occur if the device is subjected to conditions outside these ratings.

PRODUCT SPECIFICATION FAN4041

Guaranteed Electrical Characteristics, FAN4041

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

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

				Limits		Units
Symbol	Parameter	Conditions		С	D	
V _{REF}	Reference Voltage	$I_{K} = 100 \mu A, V_{OUT} = 5V$		1.220	1.220	V*
TCV _{Ref}	Reference Voltage Tolerance	$I_{K} = 100 \mu A, V_{OUT} = 5V$		±6.2	±12	mV
			•	±14	±24	mV
I _{RMIN}	Mimimum Operating Current		•	65	70	μA
ΔV _{REF} /ΔT	Reference Voltage Temperature Coefficient	I _K = 1mA	•	±100	±150	ppm/°C
$\Delta V_{RFF}/\Delta I_{K}$	Reference Voltage Change with	$I_{RMIN} \le I_{K} \le 1mA$ $1mA \le I_{K} \le 12mA$ $1mA \le I_{K} \le 25mA$	•	2.0	2.5	mV
11121	Operating Current	$1 \text{mA} \le I_{K}^{N} \le 12 \text{mA}$	•	8	10	mV
		$1mA \le I_K \le 25mA$		12	15	mV*
$\Delta V_{REF} / \Delta V_{O}$	Reference Voltage Change with Output Voltage	I _K =1mA	•	-2.5	-3.0	mV/V
I _{FB}	Feedback Current		•	120	200	nA
Z _{KA}	Reverse Dynamic Impedance	I _K =1mA, f=120Hz, I _{AC} =0.1I _K				
		V _{OUT} = V _{REF}		0.3	0.3	Ω^{\star}
		V _{OUT} = 10V		2	2	Ω*
e _N	Wideband Noise	I_{K} =100 μ A, $V_{OUT} = V_{REF}$ 10Hz \leq f \leq 10kHz		20	20	μV _{RMS} *
ΔV_{REF}	Reference Voltage Long-term Stability	t=1000hrs, T=25°C, I _K =100μA		120	120	ppm*

^{*}Typical.

Applications Information

The FAN4041 is a precision micro-power curvature-corrected bandgap shunt voltage reference. For space critical applications, the FAN4041 is available in the sub-miniature SOT-23 package. The FAN4041 has been designed for stable operation without the need of an external capacitor connected between the "+" pin and the "-" pin. If, however, a bypass capacitor is used, the FAN4041 remains stable. The minimum operating current is 65µA for the FAN4041.

In a conventional shunt regulator application (Figure 1), an external series resistor (R_S) is connected between the supply voltage and the FAN4041. R_S determines the current that flows through the load (I_L) and the FAN4041 (I_Q). Since load current and supply voltage may vary, R_S should be small enough to supply at least the minimum acceptable I_Q to the FAN4041 even when the supply voltage is at its minimum and the load current is at its maximum value. When the supply voltage is at its minimum, R_S should be large enough so that the current flowing through the FAN4041 is less than 25 mA.

 R_S should be selected based on the supply voltage, (V_S) , the desired load and operating current, $(I_L \text{ and } I_Q)$, and the FAN4041's reverse breakdown voltage, V_R .

$$R_S = \frac{V_S - V_R}{I_L - I_O}$$

The FAN4041 output voltage can be adjusted to any value in the range of 1.220V through 10V. It is a function of the internal reference voltage (V_{REF}) and the ratio of the external feedback resistors as shown in Figure 2. The output voltage is found using the equation

$$V_{O} = V_{REF} \left[\left(\frac{R2}{R1} \right) + 1 \right] \tag{1}$$

where V_O is the output voltage. The actual value of the internal V_{REF} is a function of V_O . The "corrected" V_{REF} is determined by

$$V_{REF} = \Delta V_{O} \left(\frac{\Delta V_{REF}}{\Delta V_{O}} \right) + V_{Y}$$
 (2)

where

$$V_Y = 1.220V$$
 and $\Delta V_O = V_O - V_Y$

 $\Delta V_{REF}/\Delta V_O$ is found in the Electrical Characteristics and is -2.5mV/V for the C-grade. You can get a more accurate indication of the output voltage by replacing the value of V_{REF} in equation (1) with the value found using equation (2). Note that the actual output voltage can deviate from that predicted using the typical value of $\Delta V_{REF}/\Delta V_O$ in equation (2): for C-grade parts, the worst-case $\Delta V_{REF}/\Delta V_O$ is -2.5mV/V. For D-grade parts, the worst-case $\Delta V_{REF}/\Delta V_O$ is -3.0mV/V.

Typical Applications

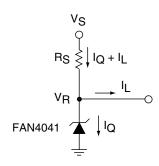


Figure 1. Shunt Regulator

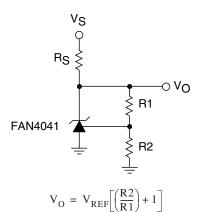


Figure 2. Adjustable Shunt Regulator

Mechanical Dimensions

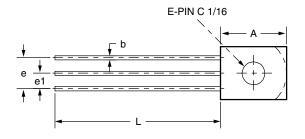
TO-92 Package

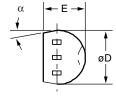
Cymbol	Inches		Millin	Notes	
Symbol	Min.	Max.	Min.	Max.	Notes
Α	.170	.210	4.32	5.33	
b	.015	.021	.38	.53	
С	.014	.020	.36	.51	
øD	.175	.205	4.45	5.21	
Е	.125	.165	3.18	4.19	
e	.095	.105	2.41	2.67	
e1	.045	.055	1.14	1.40	
L	.500	_	12.70	_	
S	.080	.115	2.03	2.92	
α	4°	6°	4°	6°	

Notes:

- 1. Package outline exclusive of any mold flashes dimension.
- 2. Package outline exclusive of burr dimension.







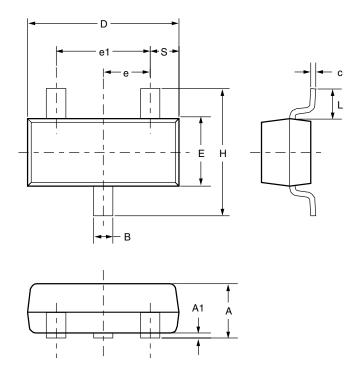
Mechanical Dimensions (continued)

SOT-23 Package

Symbol	Inches		Millin	Notes	
Syllibol	Min.	Max.	Min.	Max.	Notes
Α	.035	.044	.89	1.12	
A1	.0004	.004	.01	.10	
В	.012	.020	.30	.50	
С	.003	.008	.08	.20	
D	.110	.120	2.80	3.04	
E	.047	.055	1.20	1.40	
е	.037 BSC .95 BS		BSC		
e1	.075 BSC		1.90 BSC		
Н	.083	.104	2.10	2.64	
L	.021	.021 REF		REF	
S	.016	Nom	.395 Nom		

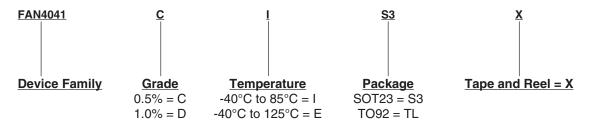
Notes:

- 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

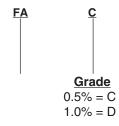
Example: FAN4041CIS3



SOT-23 Package Marking Information

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





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