Precision Programmable Reference

Features

- Reference Voltage Tolerance at 25°C
  - 0.5% (Grade B)
- Operation Temperature Range: −40°C to 125°C
- 0.2-Ω Typical Output Impedance
- Sink Current Capability: 1 mA to 80 mA
- Adjustable Output Voltage: V_{REF} to 36 V
- Qualified for Automotive Applications with AEC-Q100 Reliability Test
- Package: SOT23G-3
- Recommend TPR433B-S for Open Loop Applications

Applications

- Power
- LED Lighting
- Current Sensing
- Instrumentation
- Industry

Description

The TPR431 is an adjustable shunt voltage reference with guaranteed temperature stability over the operating temperature range. The device temperature range is extended from −40 °C up to +125 °C. The output voltage can be set to any value between 2.5 and 36 V with two external resistors. The TPR431 operates with a wide current range from 1 to 80 mA with a typical dynamic impedance of 0.2 Ω.

Typical Application Circuit

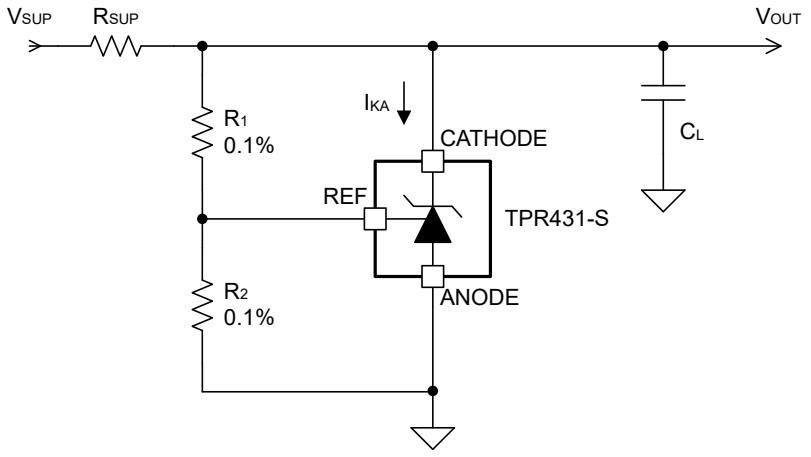


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Product Family Table

Order Number	Grade	Voltage Tolerance	AEC-Q100 Reliability Test	Package
TPR431B-S3TR-S	B	0.5%	Pass	SOT23G-3

Revision History

Revision	Notes
Rev.Pre.0	Pre-released datasheet.
Rev.Pre.1	Updated Spec and Figure.
Rev.A.0	Initial releases.
Rev.A.1	1. Removed Grade A P/N. 2. Updated "Qualified for Automotive Applications with AEC-Q100 Reliability Test".
Rev.A.2	1. Added Alternative Part Number for Open-Loop Application in Features. 2. Added Typical Application Circuit. 3. Added Pin Description. 4. Added Figure 5 and Figure 6 in Typical Performance Characteristics.

Pin Configuration and Functions

TPR431-S
SOT23G-3 Package
Top View

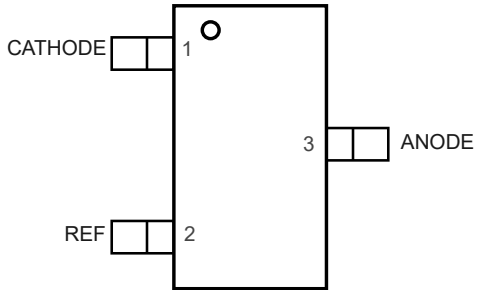


Table 1. Pin Functions: TPR431-S

Pin	Name	I/O	Description
3	ANODE	O	Common ANODE pin. Suggest connect this pin to the ground directly.
1	CATHODE	I/O	CATHODE pin. The input of the shunt current/voltage.
2	REF	I	REF threshold pin.

Specifications

Absolute Maximum Ratings

Parameter		Min	Max	Unit
Cathode Voltage			37	V
Continuous Cathode Current		−100	150	mA
Reference Input Current			10	mA
T_J	Maximum Junction Temperature	−40	150	°C
T_A	Operating Temperature Range	−40	125	°C
T_{STG}	Storage Temperature Range	−65	150	°C
T_L	Lead Temperature (Soldering 10 sec)		260	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime

ESD, Electrostatic Discharge Protection

Parameter		Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001 (1)	±2	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002 (2)	±1	kV

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

Recommended Operating Conditions

Parameter		Min	Max	Unit
V_{KA}	Cathode Voltage	V_{REF}	36	V
I_{KA}	Cathode Current	1	80	mA

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOT23G-3	400	120	°C/W

Electrical Characteristics

All test conditions: T_A = +25°C, unless otherwise noted.

Parameter		Conditions	Min	Typ	Max	Unit
V_{REF}	Reference Voltage	V_{KA} = V_{REF}, I_{KA} = 10 mA, B grade, 0.5% Initial Accuracy	2.483	2.495	2.507	V
V_{DEV}	Reference Input Voltage Deviation over Temperature Range	V_{KA} = V_{REF}, I_{KA} = 10 mA, T_A = −40 to 85°C		5	15	mV
		V_{KA} = V_{REF}, I_{KA} = 10 mA, T_A = −40 to 125°C		11	30	mV
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio of the Change in Reference Voltage to the Change in Cathode Voltage	I_{KA} = 10 mA, V_{KA} = 10 V to V_{REF}	−1.5	0.3	1.5	mV/V
		I_{KA} = 10 mA, V_{KA} = 36 V to 10 V	−1	0.1	1	mV/V
I_{REF}	Reference Input Current	I_{KA} = 10 mA, R1 = 10 K, R2 Open		1	4	μA
ΔI_{REF}	I_{REF} Deviation over Full Temperature Range	I_{KA} = 10 mA, R1 = 10 K, R2 Open, T_A = −40 to 125°C		0.1	1	μA
$I_{KA(MIN)}$	Minimum Cathode Current for Regulation	V_{KA} = V_{REF}		0.4	1	mA
$I_{KA(OFF)}$	Off-state Current	V_{KA} = 36 V, V_{REF} = 0 V		0.2		μA
$\|Z_{KA}\|$	Dynamic Output Impedance	V_{KA} = V_{REF}, f <= 1 kHz, I_{KA} = 1 mA to 80 mA		0.2		Ω

Typical Performance Characteristics

All test conditions: T_A = +25°C, unless otherwise noted.

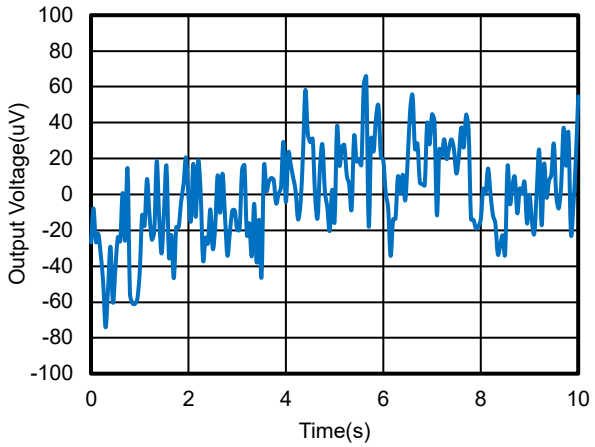


Figure 1. 0.1 to 10-Hz Output Voltage Noise

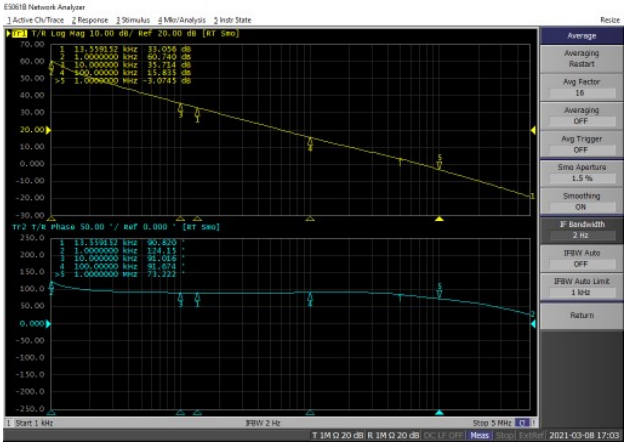


Figure 2. Gain and Phase vs. Frequency

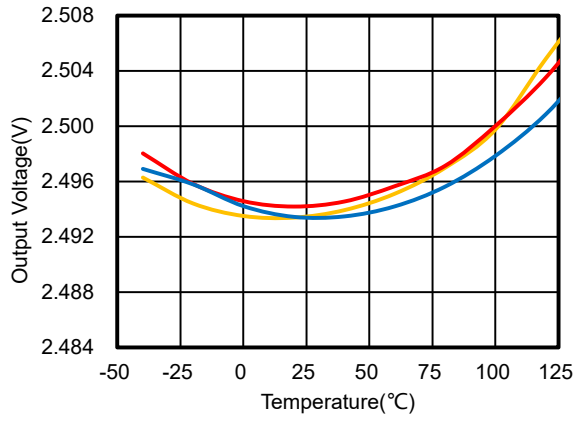
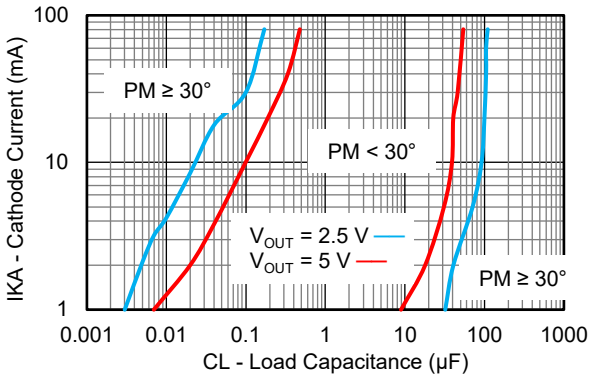


Figure 3. Reference Voltage vs. Temperature

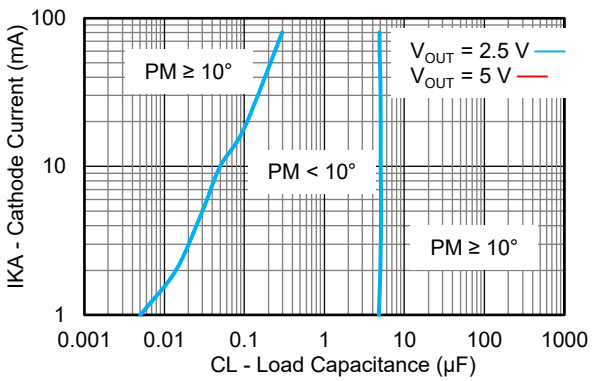


Figure 4. Pulse Response



The areas within the boundary represent application conditions that may cause the phase margin (PM) < 30°. V_{OUT} ≥ 10 V, all current and all capacitance conditions have ≥ 30° phase margin.

Figure 5. Stability Boundary Conditions



The areas within the boundary represent application conditions that may cause the phase margin (PM) < 10°. V_{OUT} ≥ 5 V, all current and all capacitance conditions have ≥ 10° phase margin.

Figure 6. Stability Boundary Conditions

Detailed Description

Overview

The TPR431 is an adjustable shunt voltage reference with guaranteed temperature stability over the operating temperature range. The device temperature range is extended from −40 °C up to +125 °C. The output voltage can be set to any value between 2.5 and 36 V with two external resistors. The TPR431 operates with a wide current range from 1 to 80 mA with a typical dynamic impedance of 0.2 Ω.

Functional Block Diagram

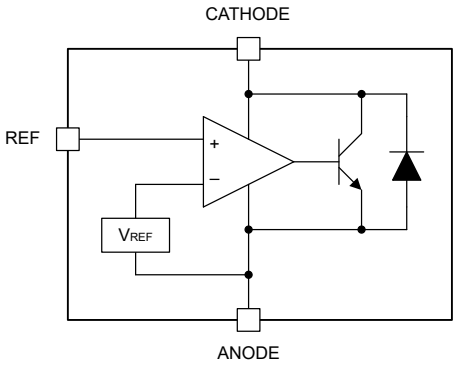
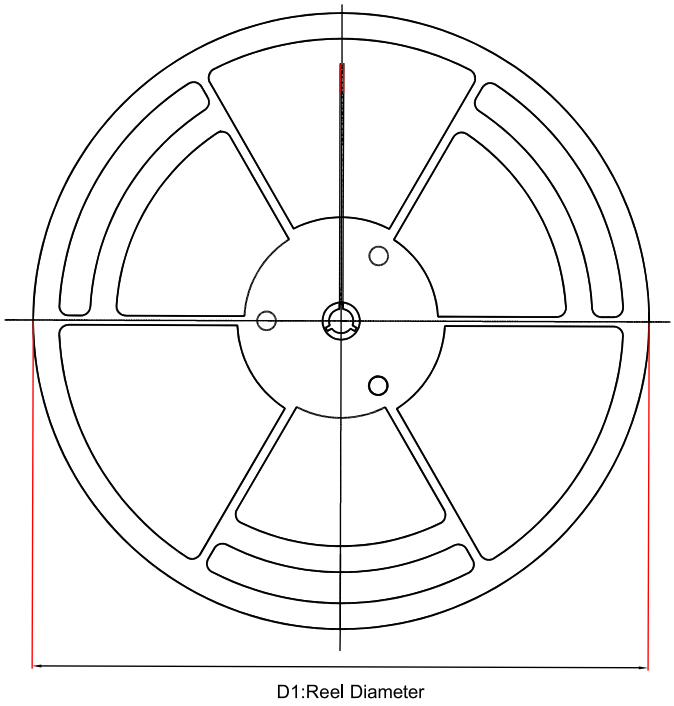
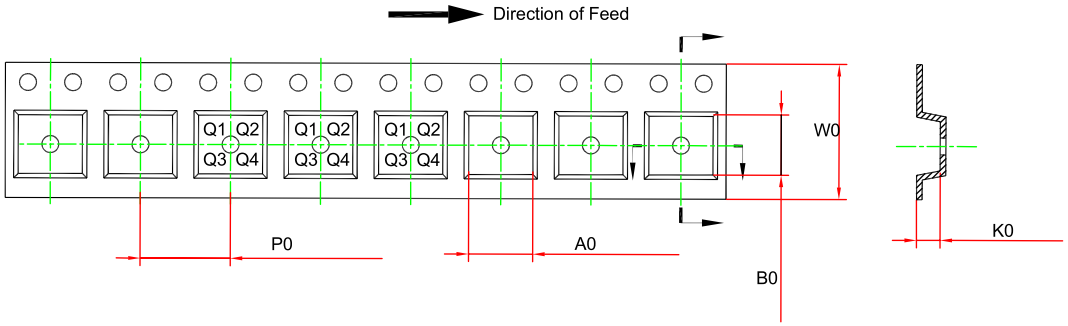


Figure 7. Functional Block Diagram

Tape and Reel Information





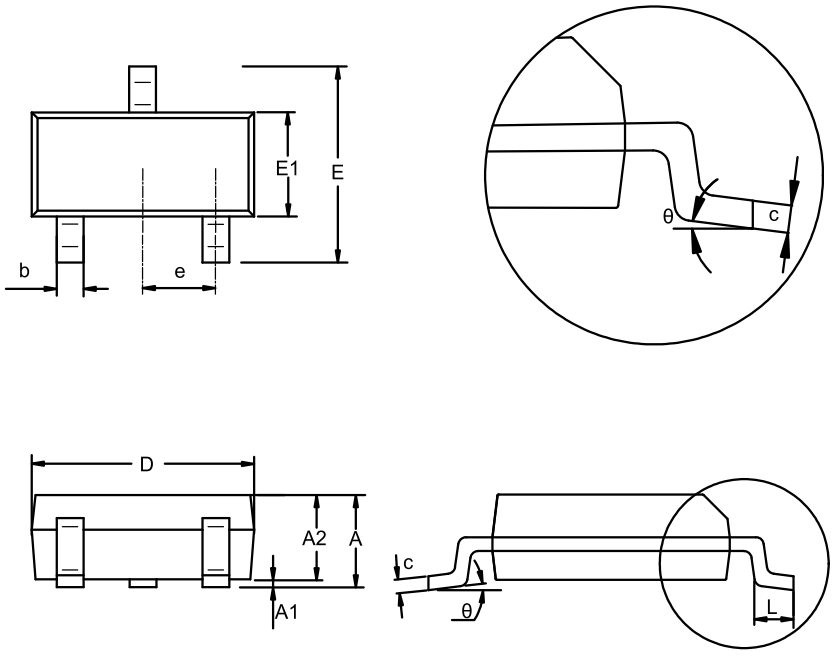


Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPR431B-S3TR-S	SOT23G-3	178	12.1	3.15	2.77	1.22	4.0	8.0	Q3

Package Outline Dimensions

SOT23G-3

Package Outline Dimensions 3ST(SOT23G-3-A)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.890	1.120	0.035	0.044
A1	0.000	0.100	0.000	0.004
A2	0.890	1.100	0.035	0.043
b	0.300	0.500	0.012	0.020
c	0.132	0.230	0.005	0.009
D	2.800	3.000	0.110	0.118
E	2.250	2.640	0.089	0.104
E1	1.200	1.400	0.047	0.055
e	0.950 BSC		0.037 BSC	
L	0.300	0.600	0.012	0.024
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

Order Information

Order Number	Junction Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPR431B-S3TR-S	−40 to 125°C	SOT23G-3	R31	MSL3	Tape and Reel, 3000	Green

Green: 3PEAK defines "Green" to mean RoHS compatible and free of halogen substances.

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