ADJUSTABLE PRECISION SHUNT REGULATORS

FEATURES

- **Reference Voltage High Accuracy at 25℃:**
  - **0.4% B Grade**
  - **0.8% A Grade**
- **Programmable Precise Output Voltage:**
  - **TS431H/TS432H 2.5V to 36V**
- **Low Temperature Deviation: 4.5mV (Typ)**
- **Equivalent Full-Range Temperature Coefficient with 20ppm/℃ (Typ)**
- **Low Output Noise**
- **Sink Current Capability: 1mA to 100mA**
- **Typical Output Impedance: 0.2Ω**
- **High Stability under Capacitive Load**
- **Operation Junction Temperature: -40℃ to +125℃**
- **SOT-23-G Package**

APPLICATIONS

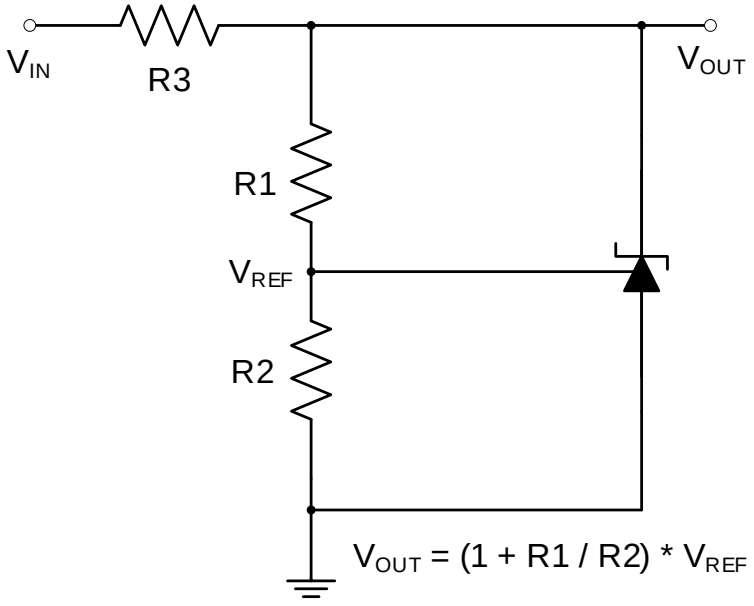
- **Precision Voltage Reference**
- **High Current Shunt Regulator**
- **Power Converter/Inverter**
- **Charger**

PRODUCT DESCRIPTION

The TS431H/TS432H series ICs are three-terminal adjustable shunt regulators offering excellent temperature stability.

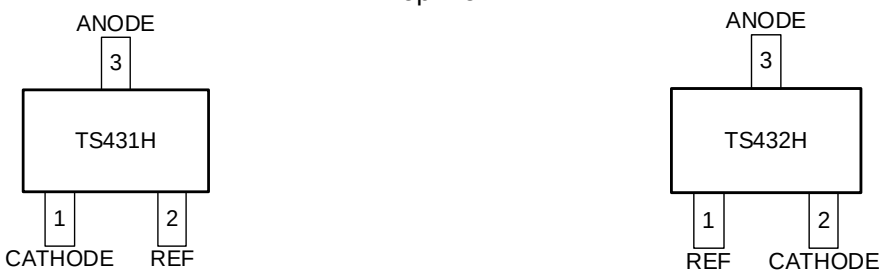
The output voltage can be programmable to any voltage between Vref (2.5V) and the corresponding maximum cathode voltage by two external resistors. The TS431H/TS432H maximum output voltage is 36V.

The TS431H/TS432H precision reference series provide 0.4% and 0.8% initial accuracy grades. These devices have a typical output impedance of 0.2Ohm. Active output circuitry provides a very sharp turn on characteristic, making these devices excellent replacements for zener diodes in many applications, such as onboard regulation, adjustable power supplies, and switching power supplies.



PIN CONFIGURATION AND FUNCTIONS

Top View



FUNCTIONAL BLOCK DIAGRAM AND SYMBOL

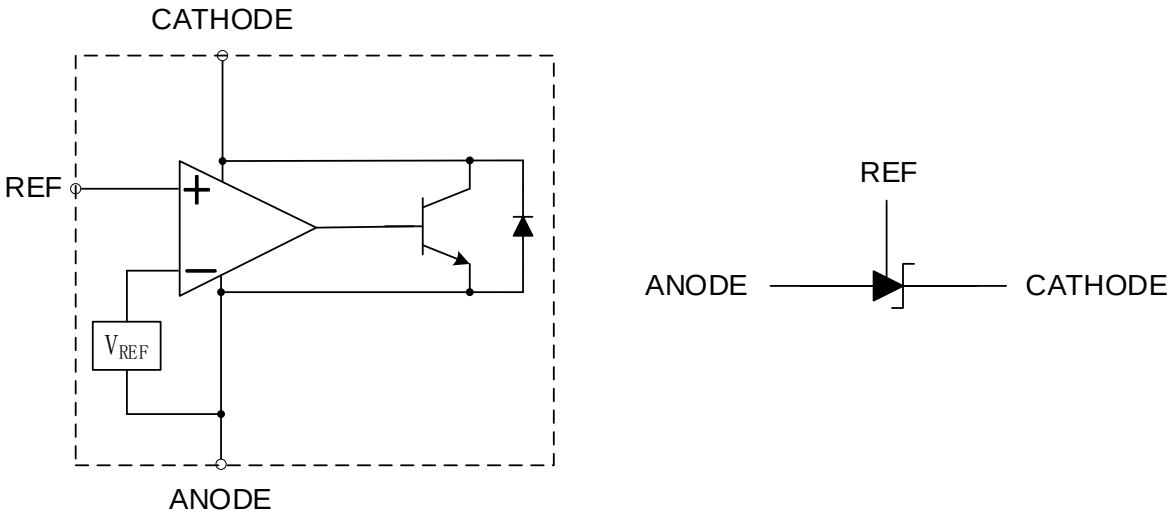


Figure 1 functional block diagram and symbol

RECOMMENDED OPERATING CONDITIONS

Parameter	Min	Max	Unit
Cathode voltage range, V_{kA}	Vref	36	V
Cathode current range, I_{kA}	1	100	mA
Operating virtual junction temperature, T_J	-40	125	˚C

ABSOLUTE MAXIMUM RATINGS

Parameter	Min	Max	Unit
Cathode Voltage Range	-0.3	40	V
Cathode Current Range	-100	150	mA
Reference Input Current Range		10	mA
Junction Temperature		150	˚C
Power Dissipation		370	mW
Storage Temperature Range	-65	150	˚C
Lead Temperature (Soldering, 10s)		260	˚C
ESD HBM		±2000	V

ORDERING INFORMATION

Model	Part Number	Eco Plan	Package	Grade, Accuracy	Container, Pack Qty
TS431H-A	TS431HASOT23GR	RoHS	SOT-23-G	A, 0.8%	Reel, 3000
TS431H-B	TS431HBSOT23GR	RoHS	SOT-23-G	B, 0.4%	Reel, 3000
TS432H-A	TS432HASOT23GR	RoHS	SOT-23-G	A, 0.8%	Reel, 3000
TS432H-B	TS432HBSOT23GR	RoHS	SOT-23-G	B, 0.4%	Reel, 3000

ESD CAUTION

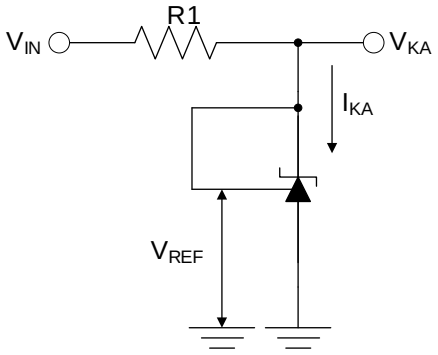
ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjects to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

ELECTRICAL CHARACTERISTICS

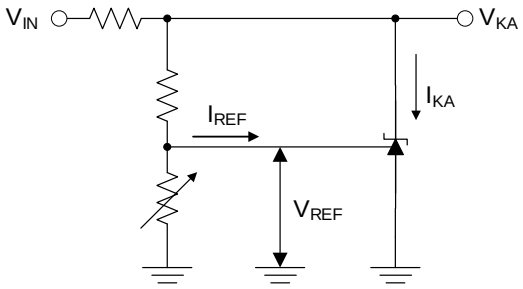
Boldface limits apply over the specified Junction temperature range, **T_J = −40℃ to +125℃.**
At T_A = +25℃ (unless otherwise noted)

Parameter		Test Circuit	Operating Conditions		Min	Typ	Max	Unit
V_{REF}	Reference Voltage	1	V_{KA} = V_{REF}, I_{KA} = 10mA	B Grade A Grade	2.49 2.48	2.50 2.50	2.51 2.52	V
ΔV_{REF}	Deviation of Reference Voltage over Full Temperature Range	1	V_{KA} = V_{REF}, I_{KA} = 10mA	0 to +70℃ -40 to +85℃ **-40 to +125℃**		4.5 4.5 **4.5**	8 10 **16**	mV **mV**
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio of Change in Reference Voltage to The Change in Cathode Voltage	2	I_{KA} = 10mA	ΔV_{KA} = V_{REF} to 10V ΔV_{KA} = 10V to 36V		1.0 0.5	2.7 2.0	mV/V
I_{REF}	Reference Current	2	I_{KA} = 10mA, R1 = 10kΩ, R2 = ∞			0.7	4	μA
ΔI_{REF}	Deviation of Reference Current over Full Temperature Range	2	**I_{KA} = 10mA, R1 = 10kΩ, R2 = ∞, T_A = -40℃ to +125℃**			**0.4**	**1.2**	**uA**
I_{KA_MIN}	Minimum Cathode Current for Regulation	1	V_{KA} = V_{REF}			0.4	1.0	mA
I_{KA_OFF}	Off-State Cathode Current	3	V_{REF} = 0, V_{KA} = 36V			0.05	1.0	μA
Z_{KA}	Dynamic Impedance	4	V_{KA} = V_{REF}, I_{KA} = 1 to 100mA, f ≤ 1.0kHz			0.2	0.5	Ω
θ_{JA}	Thermal Resistance (Junction to Case)		SOT-23-G			135		℃/W

PARAMETER MEASUREMENT INFORMATION

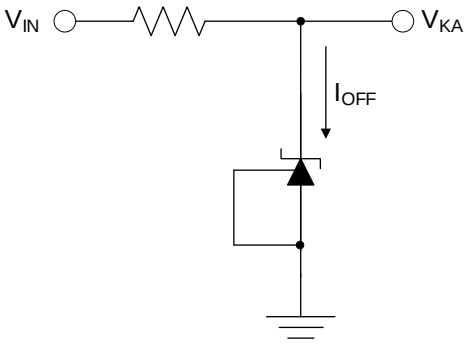


Test Circuit 1 for $V_{KA} = V_{REF}$

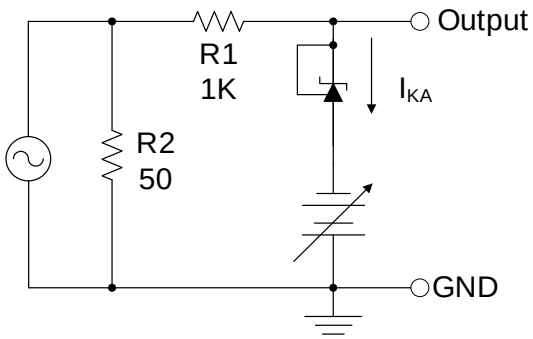


$V_{KA} = V_{REF}(1 + R1/R2) + I_{REF} * R1$

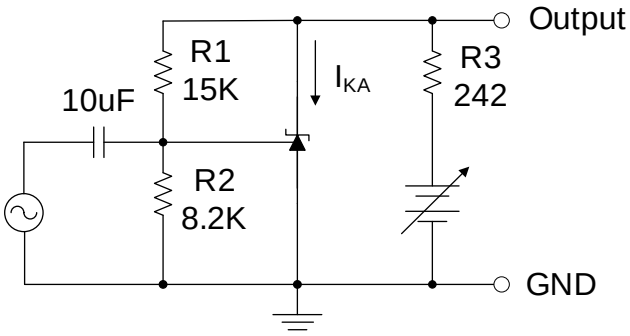
Test Circuit 2 for $V_{KA} > V_{REF}$



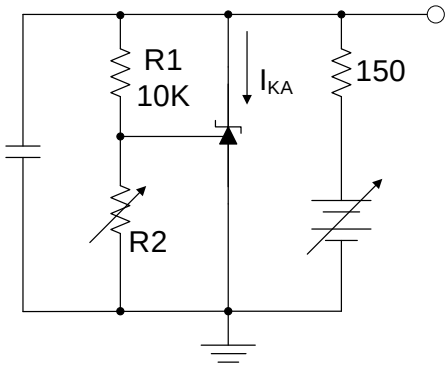
Test Circuit 3 for I_{OFF}



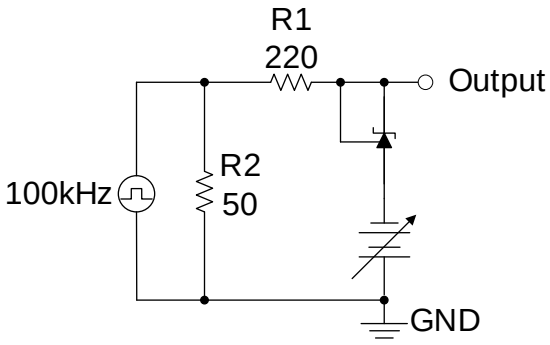
Test Circuit 4 for Z_{KA}



Test Circuit 5 for Gain



Test Circuit 6 for Stability

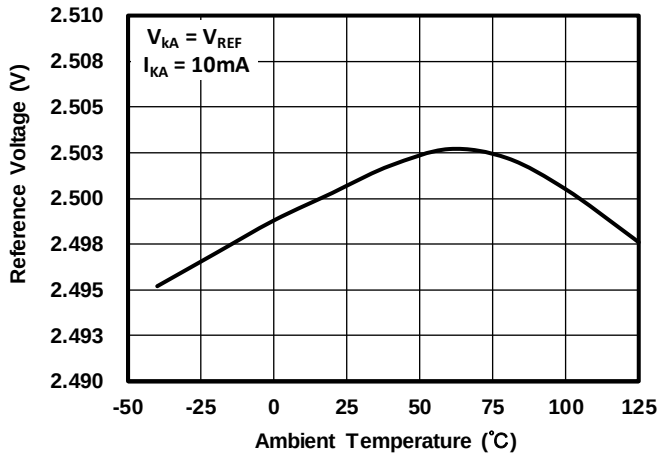


Test Circuit 7 for Input Response

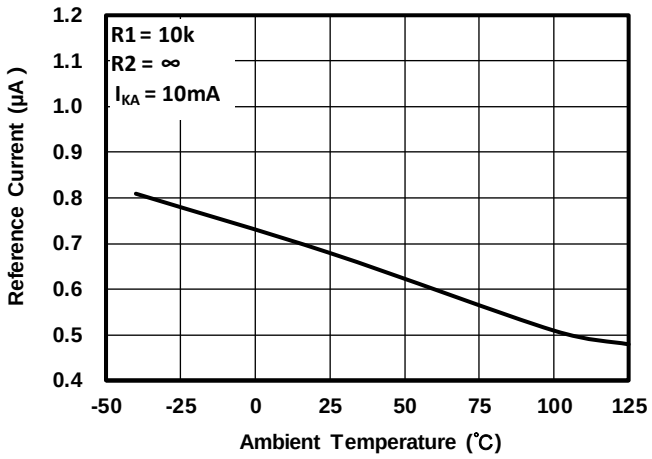
TYPICAL CHARACTERISTICS

At T_A = +25°C (unless otherwise noted)

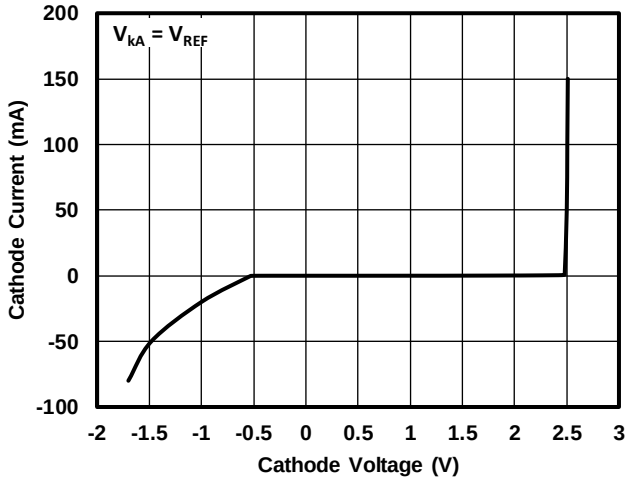
Reference Voltage vs Ambient Temperature



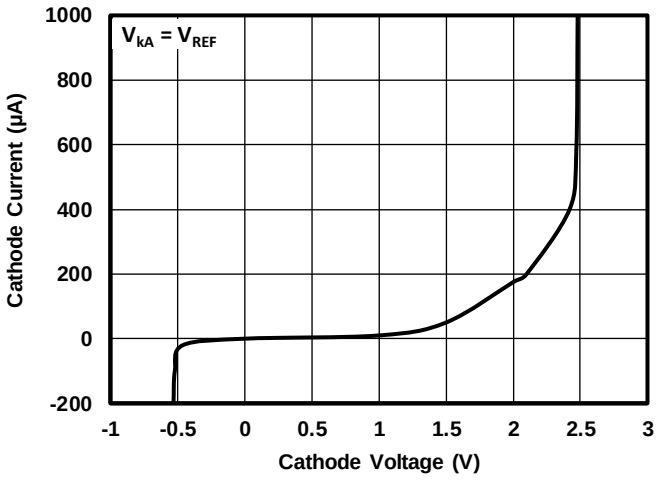
Reference Current vs Ambient Temperature



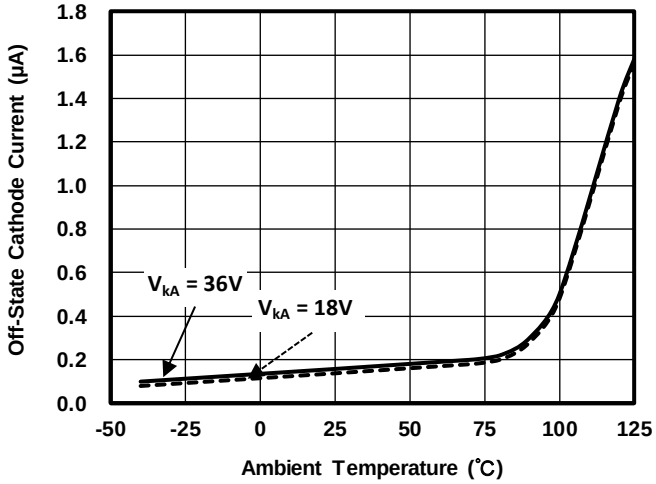
Cathode Current vs Cathode Voltage



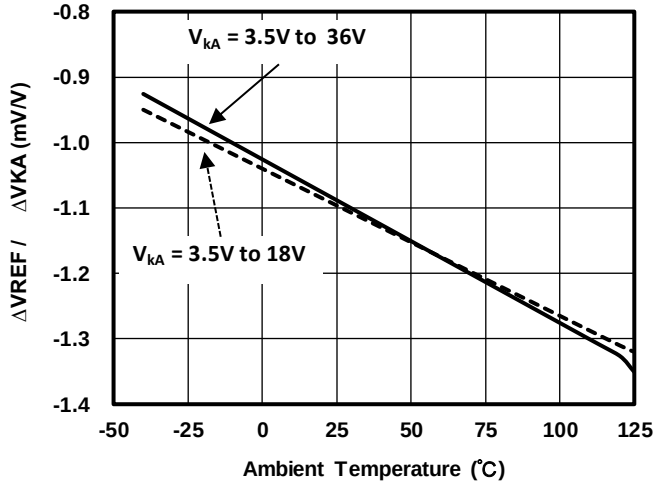
Cathode Current vs Cathode Voltage



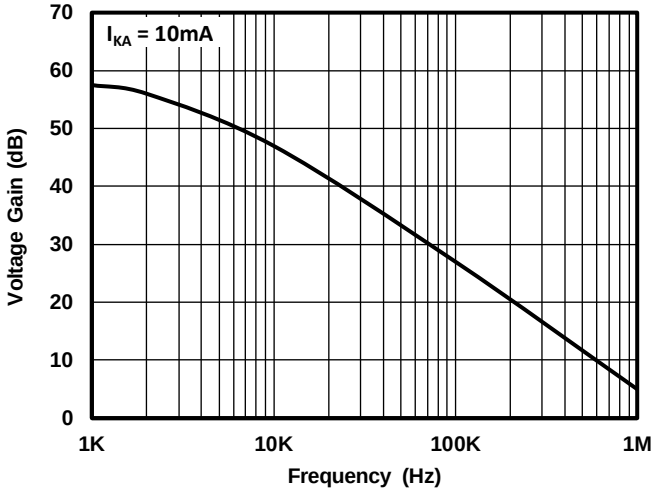
Off-State Cathode Current vs Ambient Temperature



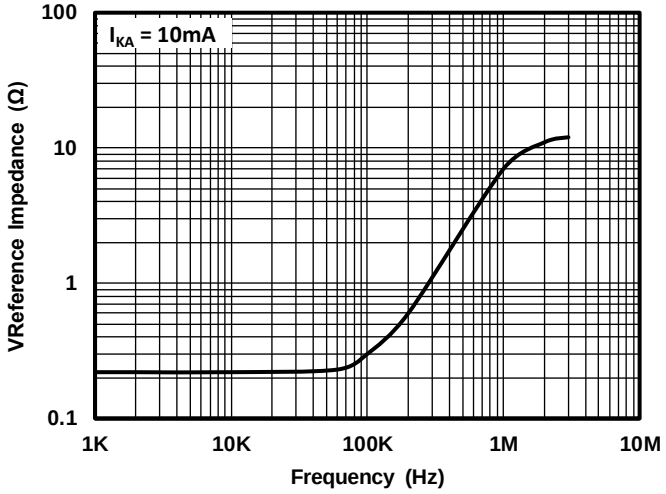
Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage



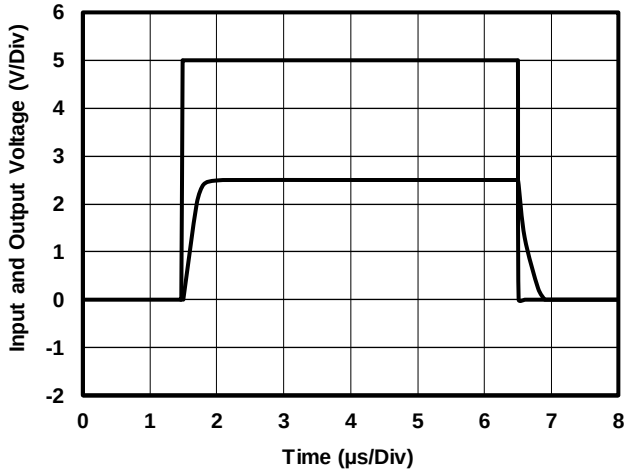
Small Signal Voltage Gain vs Frequency



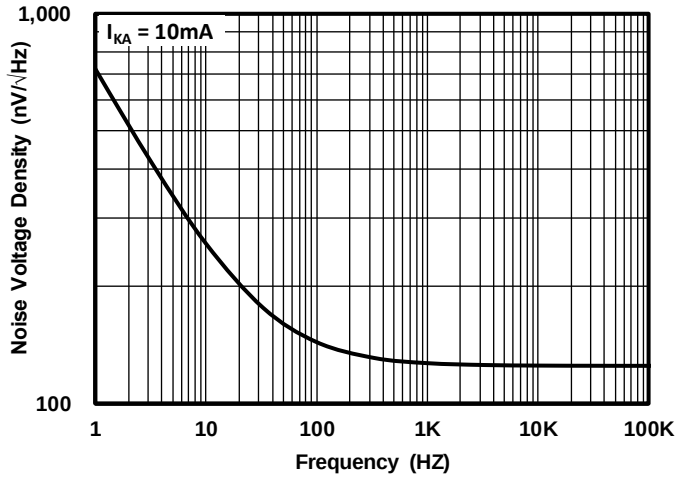
Reference Impedance vs Frequency



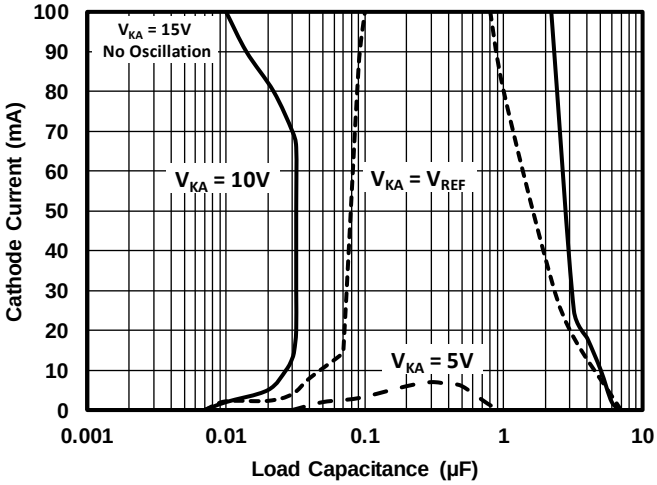
Input Response



Input Noise Voltage Density vs Frequency

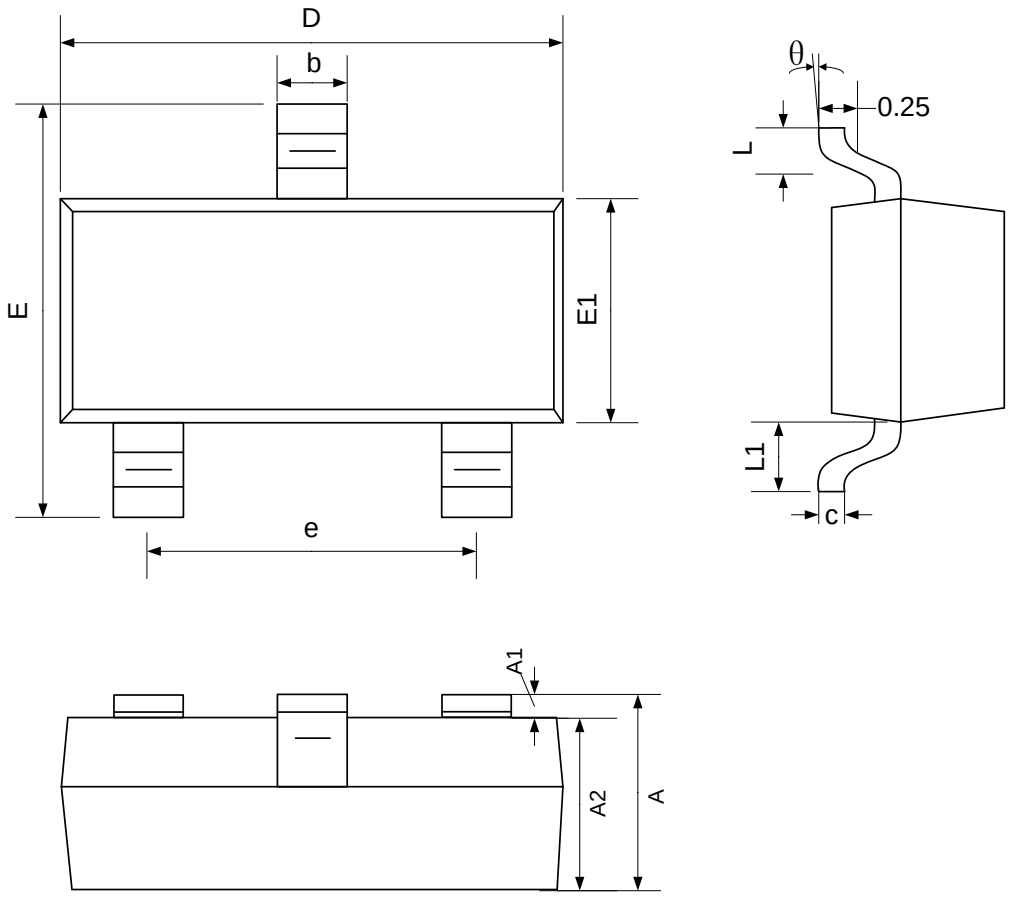


TS431H/TS432H Stability Boundary Conditions vs Load Capacitance



MECHANICAL DIMENSIONS

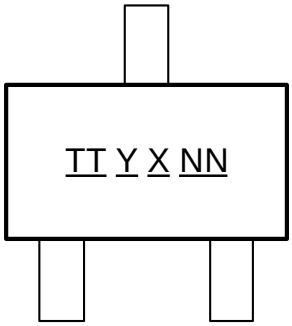
SOT-23-G PACKAGE MECHANICAL DRAWING



SOT-23-G PACKAGE MECHANICAL DATA

symbol	Dimensions in Millimeters		Dimensions in Inches	
	min	max	min	max
A	1.15Max		0.045Max	
A1	0	0.100	0	0.004
A2	0.900	1.100	0.035	0.043
b	0.300	0.500	0.012	0.020
c	0.132	0.202	0.005	0.008
D	2.800	3.000	0.110	0.118
E	2.250	2.550	0.089	0.100
E1	1.200	1.400	0.047	0.055
e	1.800	2.000	0.071	0.079
L	0.300	0.500	0.012	0.020
L1	0.550 REF.		0.022 REF.	
θ	0	8	0	8

PACKAGING MARKING INFORMATION

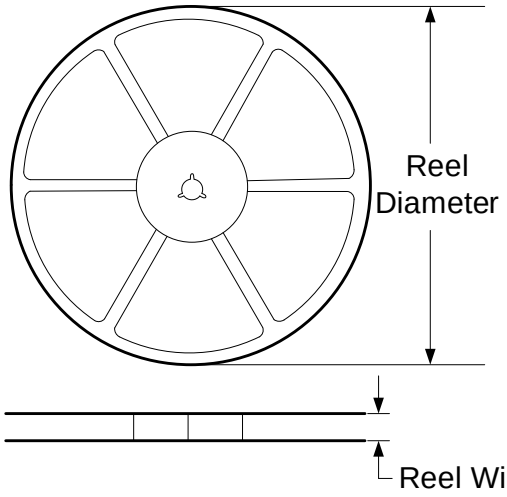


Legend	**TT**	**Product Number** TS431H : 31 TS432H : 32
	Y	**Monthly Code** C : 3 月
	X	**Factory Code**
	NN	**Batch Number**

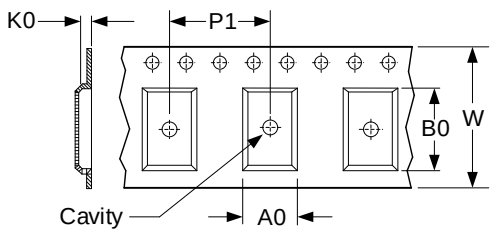
Monthly Code	A	B	C	D	E	F	G	H	I	J	K	L
Y	1 月	2 月	3 月	4 月	5 月	6 月	7 月	8 月	9 月	10 月	11 月	12 月

TAPE AND REEL INFORMATION

REEL DIMENSIONS

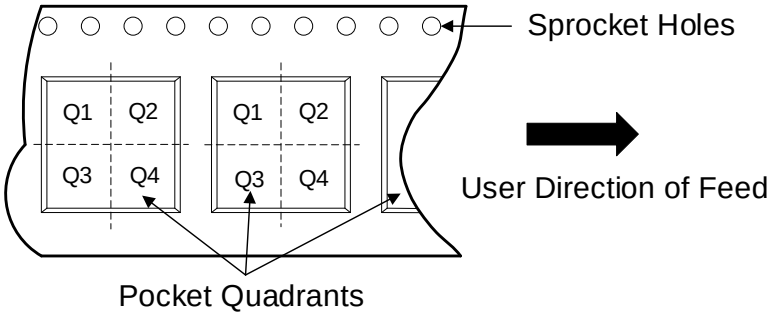


TAPE DIMENSIONS



A0	Dimensioon designed to accommodate the component width
B0	Dimensioon designed to accommodate the component length
K0	Dimensioon designed to accommodate the component width thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadran
TS431HASOT23GR	SOT-23-G	3	3000	178.0	12.3	3.15	2.77	1.22	4.0	8.0	Q3
TS431HBSOT23GR	SOT-23-G	3	3000	178.0	12.3	3.15	2.77	1.22	4.0	8.0	Q3
TS432HASOT23GR	SOT-23-G	3	3000	178.0	12.3	3.15	2.77	1.22	4.0	8.0	Q3
TS432HBSOT23GR	SOT-23-G	3	3000	178.0	12.3	3.15	2.77	1.22	4.0	8.0	Q3

REVISION HISTORY

NOTE: Page numbers for previous revisions may be different from that of the current version.

2021/02/26 – REV KY1.0.2 to REV KY1.0.3
Updated TYPICAL CHARACTERISTICS……7

2021/03/29 – REV KY1.0.3 to REV KY1.0.4
Updated PARAMETER MEASUREMENT INFORMATION……5

2021/04/22 – REV KY1.0.4 to REV KY1.1.4
Added TS432H……5

2021/08/10 – REV KY1.1.4 to REV KY1.1.5
Updated Grade Accuracy……3

2021/11/09 – REV KY1.1.5 to REV KY1.1.6
Added PACKAGING MARKING INFORMATION……9

2022/6/24 – REV KY1.1.6 to REV KY1.1.7
Updated PACKAGING MARKING INFORMATION……9

CONTACT INFORMATION

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