

# Precision Adjustable Shunt Regulator MM1431 Series

## Outline

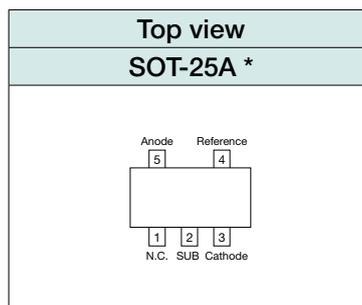
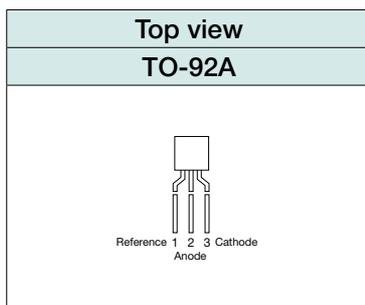
This IC is 3-terminal adjustable shunt regulator, which provides a highly accurate 0.8% bandgap reference voltage. The output voltage can be adjusted to any value between reference voltage  $V_{REF}$  and 35V with two external resistors. Moreover, there are a lot of ranges of the application as a zener diode besides the replacement is possible because it has steep turn-on characteristics.

## Features

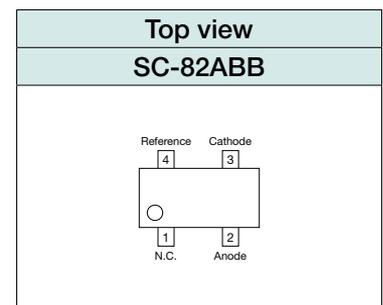
(Unless otherwise specified,  $T_{opr}=+25^{\circ}\text{C}$ )

- |  |  |
|--|--|
| (1) Reference voltage tolerance                      | $V_{REF}=2.495\text{V}\pm 0.8\%$   |
| (2) Output voltage can be adjusted                   | $V_{REF}\leq V_o\leq 35\text{V}$   |
| (3) Low Dynamic Output Impedance                     | $ Z_{KA} \leq 0.2\Omega$ typ.  |
| (4) Specifications                                   |  |
| ● Operating Temperature                              | $-30\sim+85^{\circ}\text{C}$   |
| ● Cathode to Anode voltage                           | $V_{KA}\quad V_{REF}\sim 35\text{V}$   |
| ● Cathode current                                    | $I_K\quad 0.6\sim 50\text{mA}$   |
| ● Reference voltage                                  | $V_{REF}\quad 2.495\text{V}\pm 0.8\%$  |
| ● Reference voltage deviation over temperature range | $\pm 10\text{mV}\quad (V_{KA}=V_{REF}, I_K=10\text{mA}\quad T_a=-30\sim+85^{\circ}\text{C})$ |
| ● Minimum Cathode Current                            | $I_{Kmin.}\quad 0.6\text{mA max.}$   |
| ● Off-state Cathode Current                          | $I_{OFF}\quad 0.1\mu\text{A typ.}$   |

## Pin Assignment



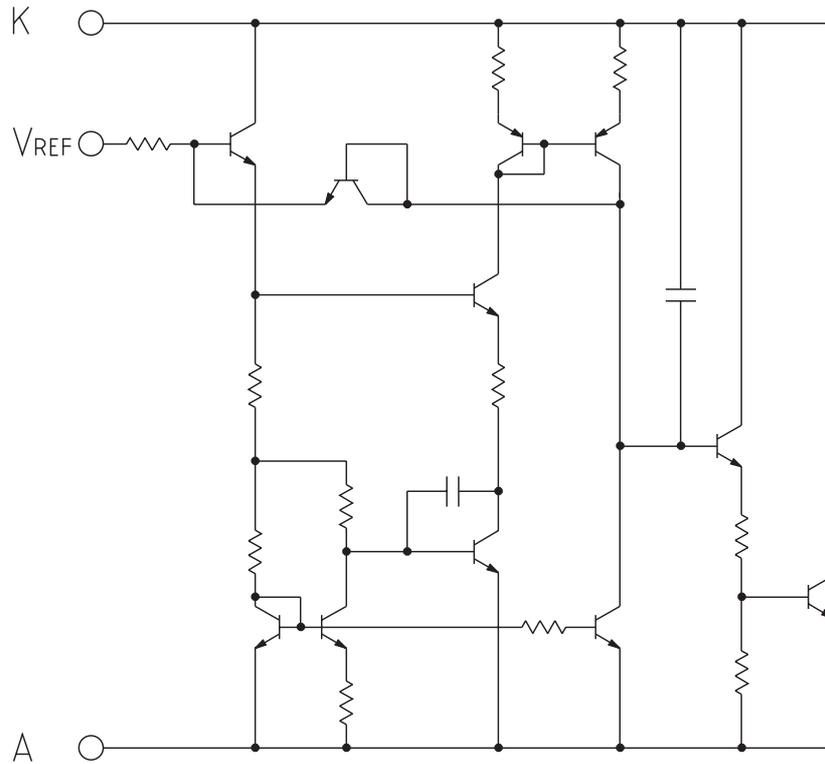
\* note : The second terminal is SUB, so connect the terminal to GND.



## Product list

Packages	Parts no.	Reference voltage	Cathode current	Dynamic impedance
TO-92A (BULK)	MM1431AT	2.495V $\pm$ 0.8%	0.6~50 mA	0.2 $\Omega$ typ. / 0.5 $\Omega$ Max
TO-92A (TAPING)	MM1431ATT	2.495V $\pm$ 0.8%	0.6~50 mA	0.2 $\Omega$ typ. / 0.5 $\Omega$ Max
SOT-25A	MM1431ANRE	2.495V $\pm$ 0.8%	0.6~50 mA	0.2 $\Omega$ typ. / 0.5 $\Omega$ Max
SC-82ABB	MM1431CURE	2.495V $\pm$ 0.8%	0.6~50 mA	0.2 $\Omega$ typ. / 0.8 $\Omega$ Max
SC-82ABB	MM1431DURE	2.495V $\pm$ 0.4%	0.6~50 mA	0.2 $\Omega$ typ. / 0.8 $\Omega$ Max

**Equivalent Circuit Diagram**



**Absolute Maximum Ratings** (Ambient Temperature,  $T_a=25^\circ\text{C}$ )

Item	Symbol	Ratings	Unit
Operating Temperature	$T_{OPR}$	-30~+85	$^\circ\text{C}$
Storage Temperature	$T_{STG}$	-40~+125	$^\circ\text{C}$
Cathode to Anode voltage	$V_{KA}$	35	V
Cathode current	$I_K$	-100~100	mA
Reference input current	$I_{REF}$	-0.05~10	mA
Allowable loss	$P_d$	550 (TO-92) 150 (SOT-25A)	mW

**Recommended Operating Conditions** (Ambient Temperature,  $T_a=25^\circ\text{C}$ )

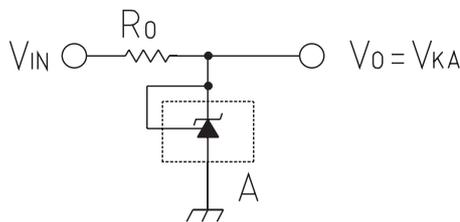
Cathode to Anode voltage	$V_{KA}$	$V_{REF}\sim 35$	V
Cathode current	$I_K$	0.6~50	mA

**Electrical Characteristics** (Ambient Temperature,  $T_a=25^\circ\text{C}$ )

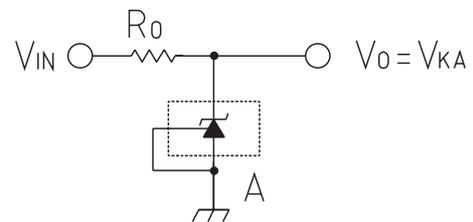
Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Unit
Reference voltage	$V_{REF}$	$V_{KA}=V_{REF}, I_K=10\text{mA}$	2.475	2.495	2.515	V
Reference voltage deviation over temperature range	$\Delta V_{REF}/\Delta T_a$	$V_{KA}=V_{REF}, I_K=10\text{mA}$ $T_a=-30\sim+85^\circ\text{C}$		$\pm 10$		mV
Load regulation	$\Delta V_{REF}$	$\Delta V_{KA}=V_{REF}\sim 10\text{V}$ $I_K=10\text{mA}$		-1.4	-2.7	mV/V
	$\Delta V_{KA}$	$\Delta V_{KA}=10\text{V}\sim 35\text{V}$ $I_K=10\text{mA}$		-1	-2	mV/V
Reference input current	$I_{REF}$	$I_K=10\text{mA}$ $R_1=10\text{K}$ , $R_2=\infty$		1	4	$\mu\text{A}$
Reference input current deviation over temperature range	$\Delta I_{REF}/\Delta T_a$	$I_K=10\text{mA}$ $R_1=10\text{K}$ , $R_2=\infty$ $T_a=-30\sim+85^\circ\text{C}$		$\pm 0.5$		$\mu\text{A}$
Minimum Cathode Current	$I_{Kmin.}$	$V_{KA}=V_{REF}$		0.3	0.6	mA
Off-state Cathode Current	$I_{OFF}$	$V_{KA}=35\text{V}$ , $V_{REF}=0\text{V}$		0.1	1.0	$\mu\text{A}$
Dynamic Impedance	$ Z_{KA} $	$V_{KA}=V_{REF}$ , $f \leq 1\text{kHz}$ $I_K=1\sim 50\text{mA}$		0.2	0.5	$\Omega$

**Measuring Circuit**

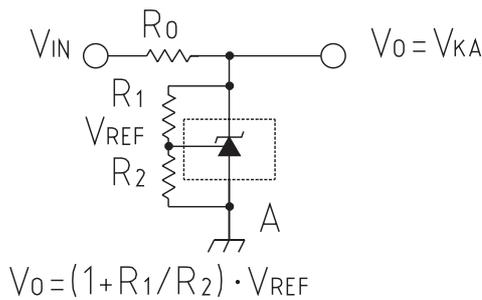
(1)  $V_{KA}=V_{REF}$



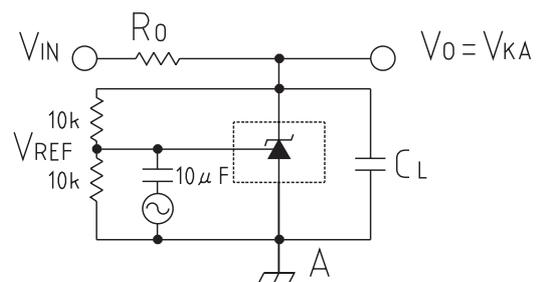
(3)  $I_{OFF}$



(2)  $V_{KA} \geq V_{REF}$   $V_0=V_{KA}=V_{REF}$



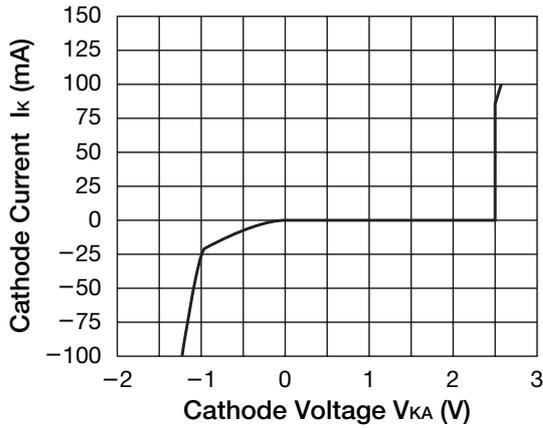
(4) Open Loop Voltage Gain



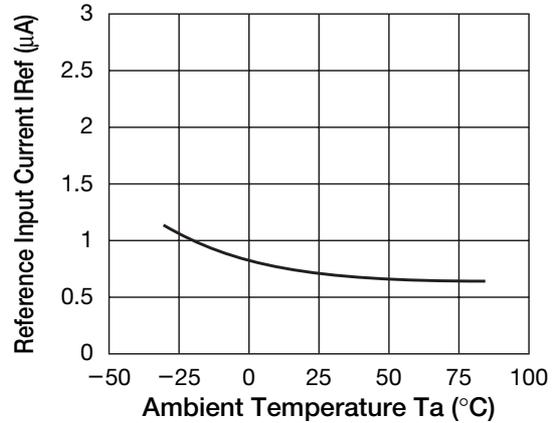
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Characteristics

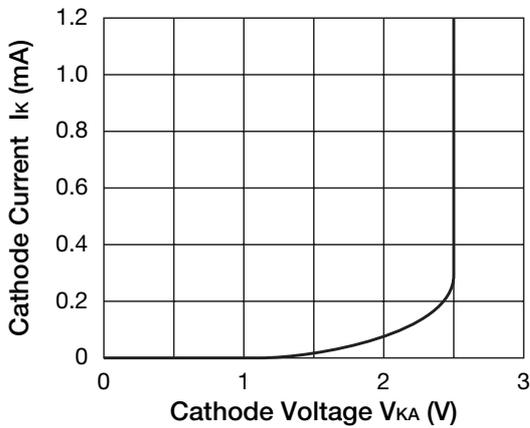
High Voltage Operating Characteristics



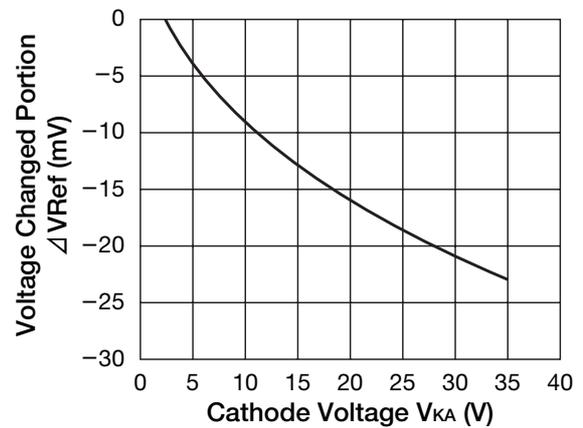
Reference Input Current



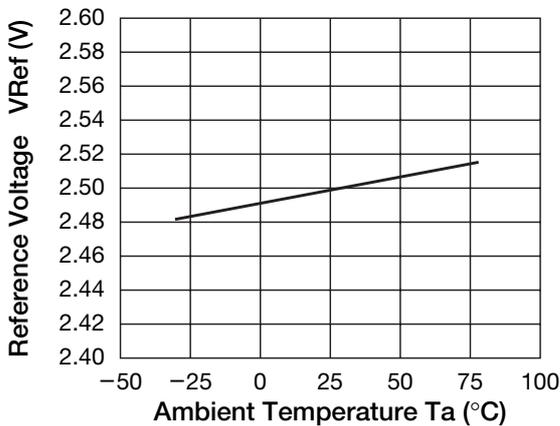
Low Current Operating Characteristics



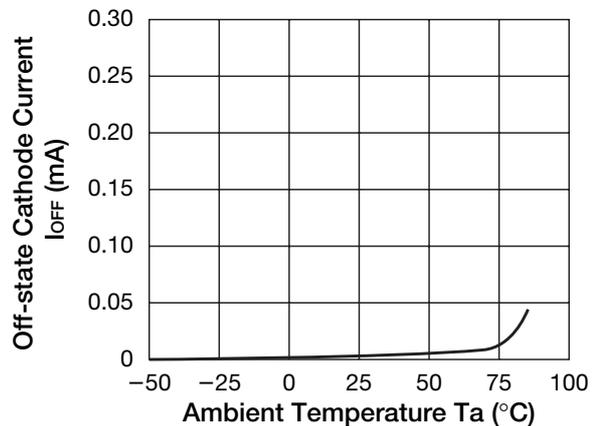
Reference Voltage



Reference Voltage

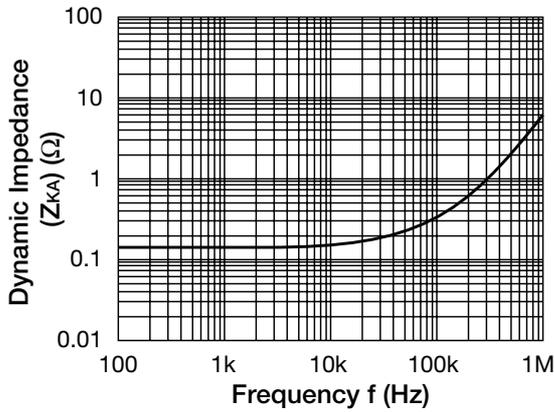


Off State Leakage

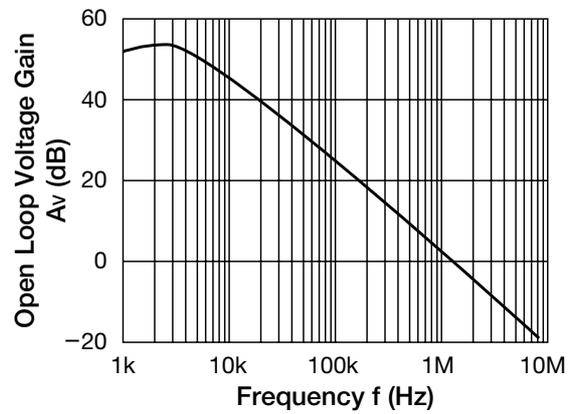


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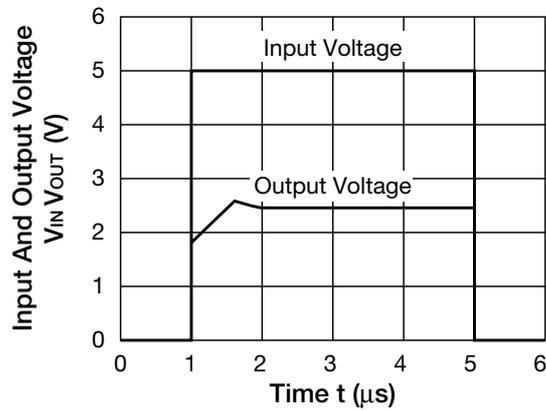
■ Dynamic Output Impedance



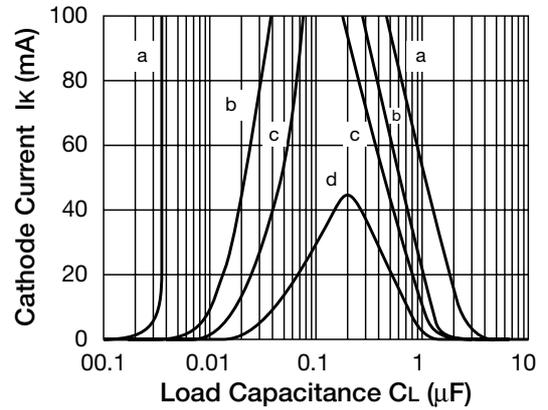
■ Open loop Voltage Gain  $V_{KA}=5V$



■ Pulse Response



■ Stability Boundary Conditions



a:  $V_{KA}=V_{REF}$  b:  $V_{KA}=5V$  c:  $V_{KA}=10V$

d:  $V_{KA}=15V$

Cathode voltage temperature  $T_a=25^{\circ}C$

$I_{KA}=10mA$   $C_L$ : Ceramic capacitor

Notes concerning stability operation region

The MM1431AT/AN requires external capacitors for regulator stability. These capacitors must be correctly selected for good performance.