

Precision Adjustable Shunt Regulator

MM1431 Series

Overview

This IC is adjustable shunt regulator, which provides a highly accurate 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

- High accuracy reference voltage
- Programmable output voltage

Main specifications

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

- Cathode to Anode voltage : V_{REF} to 35V
- Cathode current : 0.6mA to 50mA
- Operating ambient temperature : -30°C to 105°C
- Reference voltage : Typ. 2.495V
- Reference voltage accuracy : $\pm 0.8\%$ (MM1431CURE, MM1431CNRE, MM1431ENRE, MM1431GNRE)
 $\pm 0.5\%$ (MM1431FNRE)
 $\pm 0.4\%$ (MM1431DURE, MM1431DNRE)
- Reference input current : Max. 4 μA
- Minimum operating current : Max. 0.6mA
- Off-state cathode current : Max. 1.0 μA
- Dynamic impedance : Max. 0.8 Ω

Packages

- SC-82ABB
- SOT-23A
- SOT-25A

Application

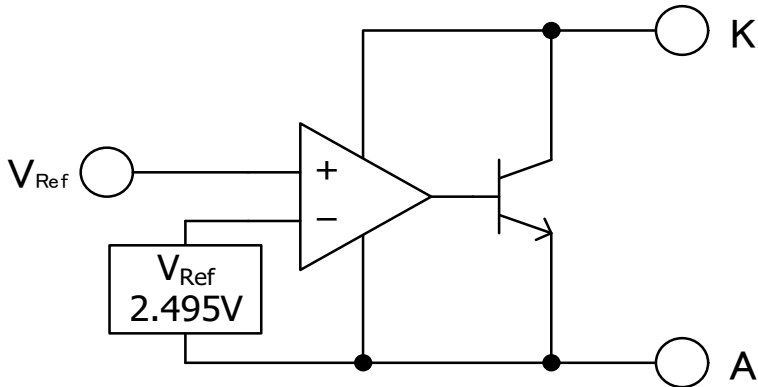
- Reference voltage circuit

Line-up

Parts name	Reference voltage	Packages	Pin configuration				
			1 pin	2 pin	3 pin	4 pin	5 pin
MM1431CURE	2.495V $\pm 0.8\%$	SC-82ABB	N.C.	A	K	V_{REF}	-
MM1431CNRE	2.495V $\pm 0.8\%$	SOT-25A	N.C.	SUB	K	V_{REF}	A
MM1431DURE	2.495V $\pm 0.4\%$	SC-82ABB	N.C.	A	K	V_{REF}	-
MM1431DNRE	2.495V $\pm 0.4\%$	SOT-23A	V_{REF}	K	A	-	-
MM1431ENRE	2.495V $\pm 0.8\%$	SOT-23A	K	V_{REF}	A	-	-
MM1431FNRE	2.495V $\pm 0.5\%$	SOT-23A	K	V_{REF}	A	-	-
MM1431GNRE	2.495V $\pm 0.8\%$	SOT-23A	V_{REF}	K	A	-	-

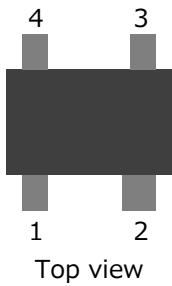


Block Diagram



Pin Configuration

- SC-82ABB



<MM1431CURE, MM1431DURE>

Pin No.	Symbol	Function
1	N.C.	N.C. terminal
2	A	Anode terminal
3	K	Cathode terminal
4	V _{Ref}	Reference terminal

- SOT-23A



<MM1431DNRE, MM1431GNRE>

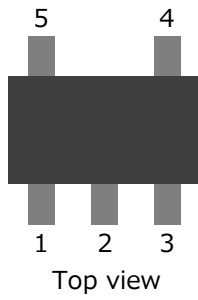
Pin No.	Symbol	Function
1	V _{Ref}	Reference terminal
2	K	Cathode terminal
3	A	Anode terminal

<MM1431ENRE, MM1431FNRE>

Pin No.	Symbol	Function
1	K	Cathode terminal
2	V _{Ref}	Reference terminal
3	A	Anode terminal

Pin Configuration

- SOT-25A



<MM1431CNRE>

Pin No.	Symbol	Function
1	N.C.	N.C. terminal
2	SUB	SUB terminal *Connect to GND.
3	K	Cathode terminal
4	V _{Ref}	Reference terminal
5	A	Anode terminal

Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit
Operating temperature	T_{opr}	-30	105	°C
Storage temperature	T_{stg}	-40	125	°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
Power Dissipation	P_d	-	150 (ALONE)	mW

Recommended Operating Conditions

Item	Symbol	Min.	Max.	Unit
Cathode to Anode voltage	V_K	V_{ref}	35	V
Cathode current	I_K	0.6	50	mA

Electrical characteristics

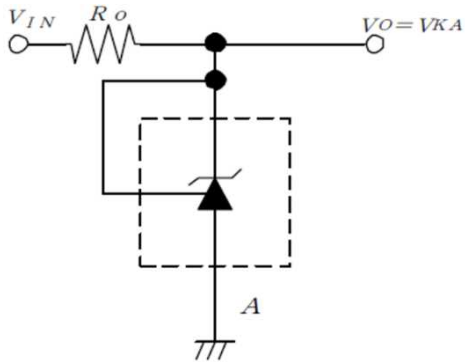
(Unless otherwise specified, $T_a=25^\circ\text{C}$)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Reference voltage	V_{Ref}	$V_{KA}=V_{Ref}$ MM1431C, MM1431E, MM1431G	2.475	2.495	2.515	V
		MM1431F	2.483	2.495	2.507	
		MM1431D	2.485	2.495	2.505	
Reference voltage deviation over temperature range	$\frac{\Delta V_{Ref}}{\Delta T_a}$	$V_{KA}=V_{Ref}$, $I_K=10\text{mA}$ $T_a=-30^\circ\text{C}$ to 85°C	-	± 10	-	mV
Line regulation	$\frac{\Delta V_{Ref}}{\Delta V_{KA}}$	$\Delta V_{KA}=V_{Ref}$ to 10V $I_K=10\text{mA}$	-	-1.4	-2.7	mV/V
		$\Delta V_{KA}=10\text{V}$ to 35V $I_K=10\text{mA}$	-	-1	-2	
Reference input current	I_{Ref}	$V_{KA}=V_{Ref}$, $R_1=10\text{K}\Omega$, $R_2=\infty$	-	1	4	μA
Reference input current deviation over temperature range	$\frac{\Delta I_{Ref}}{\Delta T_a}$	$V_{KA}=V_{Ref}$, $R_1=10\text{K}\Omega$, $R_2=\infty$, $T_a=-30^\circ\text{C}$ to 85°C	-	± 0.5	-	μA
Minimum Cathode current for reguration	I_{Kmin}	$V_{KA}=V_{ref}$	-	0.3	0.6	mA
Off-state Cathode current	I_{Koff}	$V_{KA}=35\text{V}$, $V_{Ref}=0\text{V}$	-	0.1	1.0	μA
Dynamic impedance	$ Z_{KA} $	$V_{KA}=V_{Ref}$, $f \leq 1\text{kHz}$ $I_K=1\text{mA}$ to 50mA	-	0.4	0.8	Ω

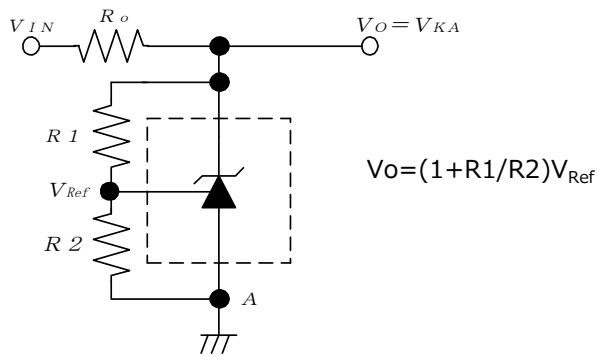


Test circuit

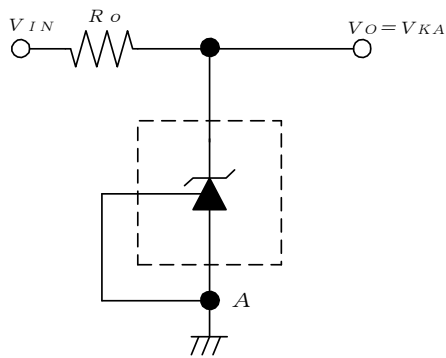
1) Cathode to Anode voltage $V_{KA}=V_{Ref}$



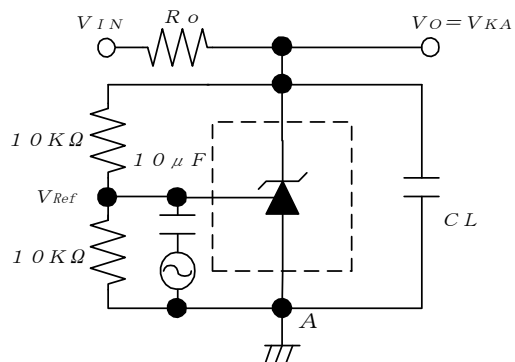
2) Cathode to Anode voltage $V_{KA} \geq V_{Ref}$



7) Off-state Cathode current

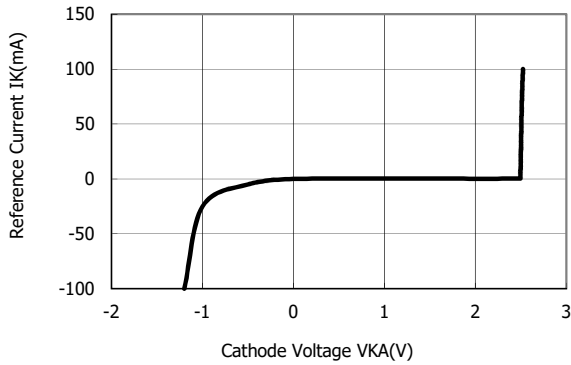


10) Open loop voltage gain

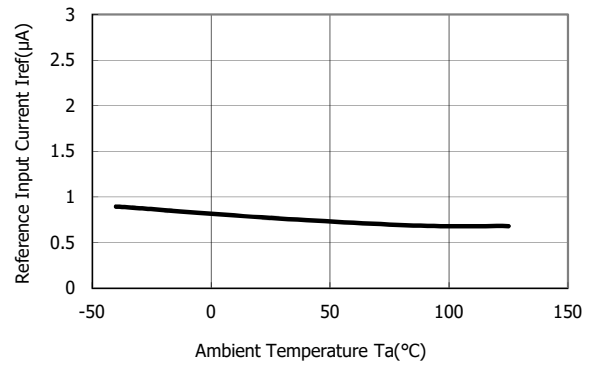


Typical performance characteristics

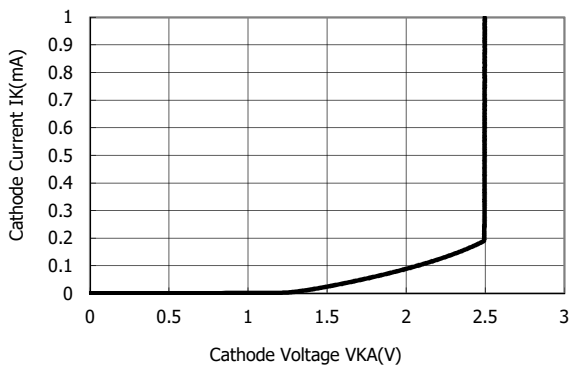
High Current Characteristics



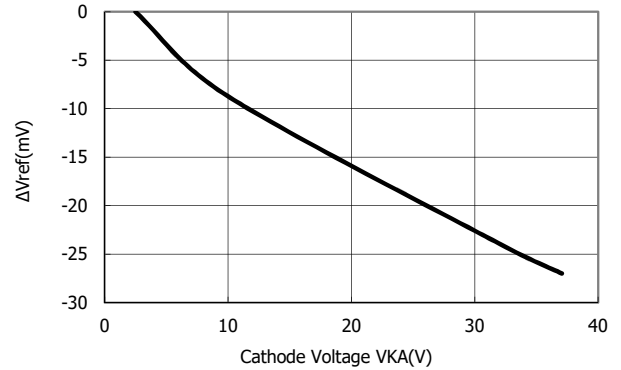
Reference Input Current



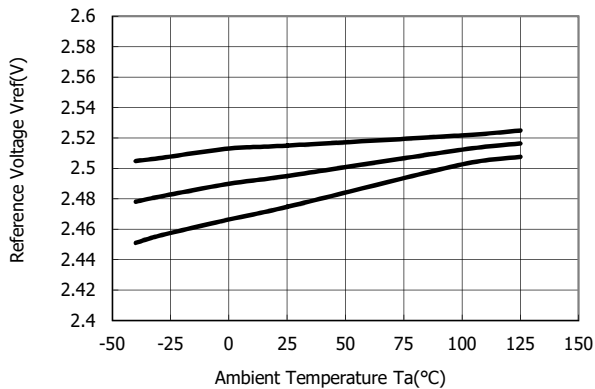
Low Current Operating Characteristics



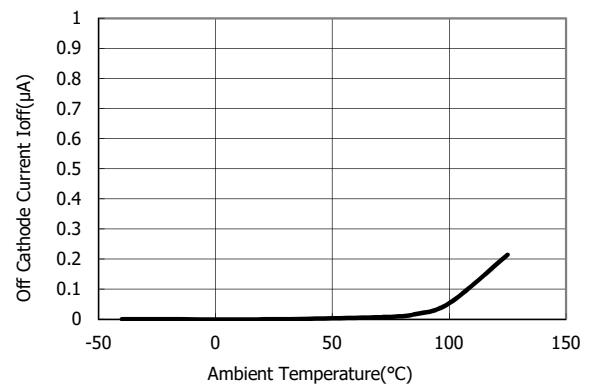
Reference Voltage Line Regulation



Reference Voltage $I_K=10mA$

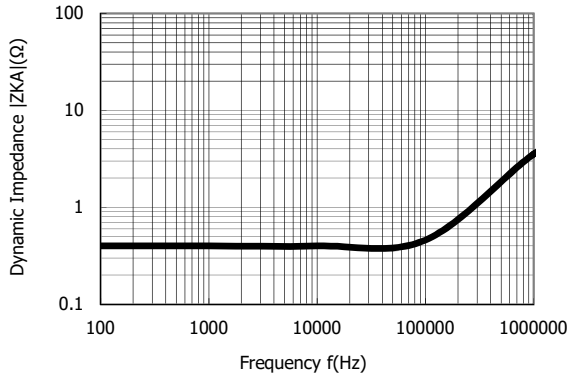


Off State Leakage $V_{KA}=35V$

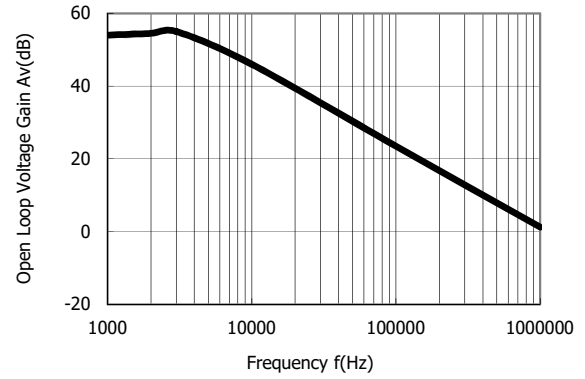


Typical performance characteristics

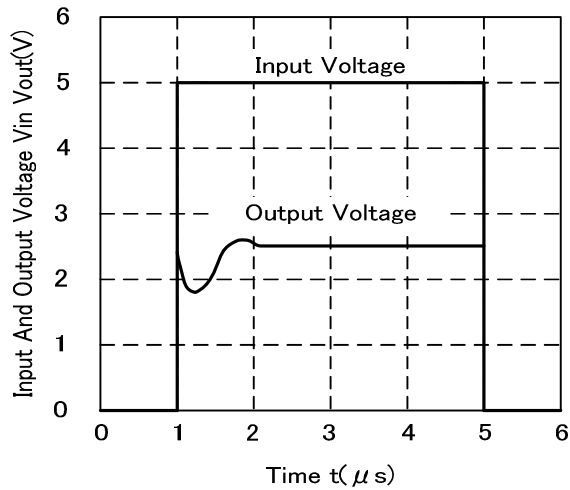
Dynamic Output Impedance



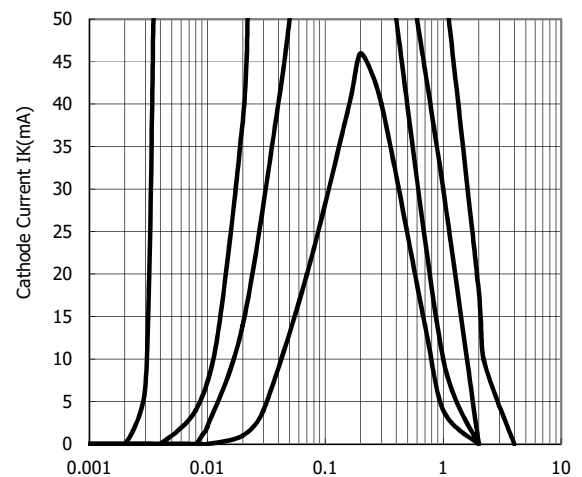
Open Loop Voltage Gain $V_{KA}=5V$



Pulse Response



Stability Boundary Conditions



Load Capacitance C_L (μF)
 a: $V_{KA}=V_{ref}$, b: $V_{KA}=5V$, c: $V_{KA}=10V$, d: $V_{KA}=15V$
 Cathode Voltage AT the temp. of $T_a=25^\circ C$ and $I_{KA}=10mA$
 C_L : Accumulating ceramic capacitor

Notes concerning stability operation region

- The MM1431EN requires external capacitors for regulator stability. These capacitors must be correctly selected for good performance
- It isn't necessary to be able to thrust at the capacity with the switching power supply use between VKA.