



CM431

LOW VOLTAGE ADJUSTABLE SHUNT REGULATOR

GENERAL DESCRIPTION

The CM431 is a three-terminal adjustable shunt voltage regulator with specified thermal stability and pin-to-pin compatible with the earlier 431 series. The output voltage can be adjusted to any value between V_{REF} and 36V by using two external resistors. The CM431 offers low output impedance for improved load regulation with a typical output impedance of 200m Ω . Because of the active output circuitry, the CM431 can replace the zener diodes in applications such as switching power supplies, OVP crowbar circuits, references for A/D, D/A converters with improved turn-on characteristics.

FEATURES

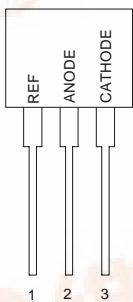
- ◆ Initial voltage reference accuracy of 1.0%.
- ◆ Sink current capability from 1mA to 100mA
- ◆ Typical output dynamic impedance less than 200m Ω ;
- ◆ Adjustable output voltage from V_{REF} to 36V
- ◆ Available in SOT-23, SOT-89, TO-92, & SOP-8
- ◆ Low output noise
- ◆ Typical equivalent full range temperature coefficient of 30ppm/ $^{\circ}C$

APPLICATIONS

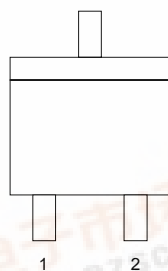
- ◆ Voltage Reference
- ◆ Precision shunt regulator
- ◆ High current shunt regulator
- ◆ PWM down converter with reference
- ◆ Voltage monitor

PIN CONFIGURATION

TO-92
Front View



SOT-23-3
Top View

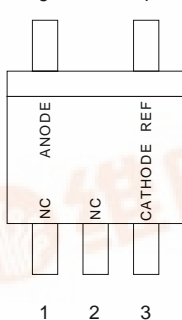


	CM431XCM233	CM431XCM2R3
Pin 1	REF	CATHODE
Pin 2	CATHODE	REF
Pin 3	ANODE	ANODE

Suffix "X": Grade "A", "B", "C", or "D"

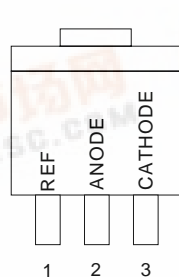
SOT-23-5

Top View



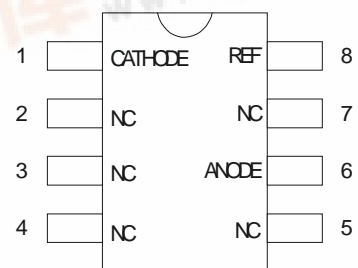
SOT-89

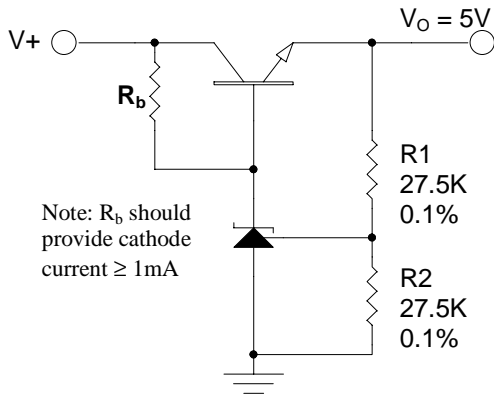
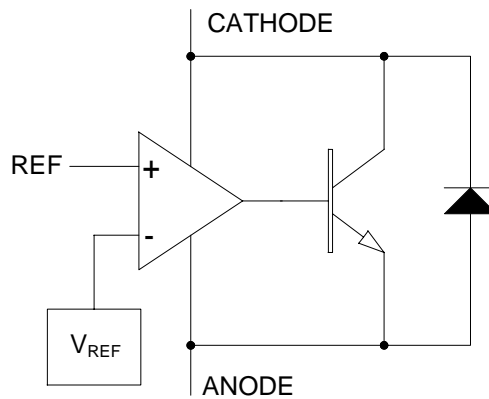
Top View



SOP-8

Top View



TYPICAL APPLICATION

5V Precision Regulator
BLOCK DIAGRAM

ORDERING INFORMATION

PACKAGE	TOLERANCE			T/R Quantity
	0.5%	0.7%	1.0%	
SOT-23 ⁽¹⁾	CM431ACM233	CM431DCM233	CM431BCM233	TR=3K
SOT-23 ⁽¹⁾	CM431ACM2R3	CM431DCM2R3	CM431BCM2R3	TR=3K
SOT-89 ⁽¹⁾	CM431ACM89	CM431DCM89	CM431BCM89	TR=1K
TO-92 ⁽²⁾	CM431ACN	CM431DCN	CM431BCN	TA=2K
SOP-8	CM431ACS	CM431DCS	CM431BCS	

Notes :

- (1) Add suffix "TR" for Tape & Reel.
- (2) Add suffix "TA" for Tape Ammo.

**ABSOLUTE MAXIMUM RATINGS**

Cathode to Anode Voltage (V_{KA}) (Note 2)	-0.3V to 37V
Continuous Cathode Current (I_K)	-100mA to 150mA
Reference Input Current (I_{REF})	-50uA to 10mA
Maximum junction temperature range, T_J	150 °C
Storage temperature range	-65°C to 150°C
Lead temperature (soldering, 10 seconds)	260 °C
Note 1: Exceeding these ratings could cause damage to the device. All voltages are with respect to Ground. Currents are positive into, negative out of the specified terminal.	
Note 2: Voltage values are with respect to the anode terminal unless otherwise noted.	

POWER DISSIPATION TABLE

Package	θ_{JA} (°C/W)	Derating factor (mW/°C) $T_A \geq 25^\circ\text{C}$	$T_A \leq 25^\circ\text{C}$ Power rating(mW)	$T_A = 70^\circ\text{C}$ Power rating(mW)	$T_A = 85^\circ\text{C}$ Power rating (mW)
SOP-8	165	6.06	757	485	394
TO-92	156	6.41	801	513	417
SOT-89	71(note)	14.1	1763	1128	916
SOT-23	285	3.5	438	280	228

Note :

- For SOT-89 package, Thermal Resistance-Junction to Tab (θ_{JT}) = 35 °C/W. $T_J = T_{TAB} + (P_D \times \theta_{JT})$
- θ_{JA} : Thermal Resistance-Junction to Ambient
Junction Temperature Calculation: $T_J = T_A + (P_D \times \theta_{JA})$.
The θ_{JA} numbers are guidelines for the thermal performance of the device/PC-board system.
All of the above assume no ambient airflow.

RECOMMENDED OPERATING CONDITIONS

	Min	Max	Units
Operating free air temperature range, T_A	0	105	°C
Cathode current, I_K	1	100	mA
Cathode voltage, V_{KA}	0	36	V



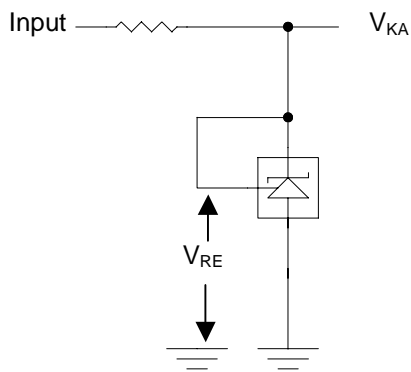
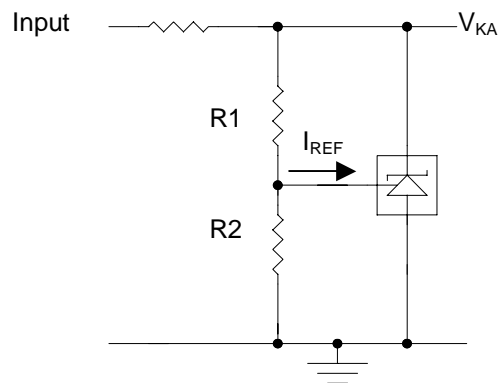
ELECTRICAL CHARACTERISTICS

Unless otherwise specified, these specifications apply over the operating ambient temperatures with $T_A = 25^\circ\text{C}$.

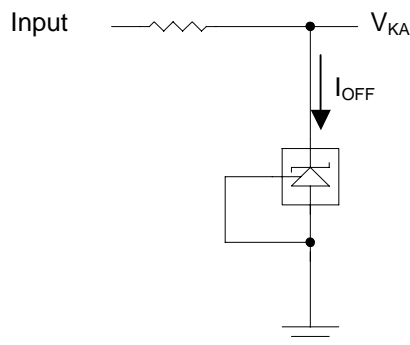
Parameter	Symbol	Test Conditions	CM431			Units
			Min	Typ	Max	
Reference Input Voltage	V_{REF}	$I_K = 10\text{mA}, V_{KA} = V_{REF}, 0.5\%$	2.482	2.495	2.507	V
		$I_K = 10\text{mA}, V_{KA} = V_{REF}, 0.7\%$	2.478	2.495	2.512	V
		$I_K = 10\text{mA}, V_{KA} = V_{REF}, 1.0\%$	2.470	2.495	2.520	V
Reference Drift		$I_K = 10\text{mA}, V_{KA} = V_{REF}, 0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$		4	17	mV
Voltage Ratio, Ref to Cathode (note 4)		$I_K = 10\text{mA}, V_{KA} = 2.5\text{V to } 36\text{V}$		-1.4	-2.7	mV/V
Reference Input Current	I_{REF}	$I_K = 10\text{mA}, V_{KA} = V_{REF}$		2	4	μA
		$I_K = 10\text{mA}, V_{KA} = V_{REF}, 0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$			2.3	
Minimum Operating Current	I_{MIN}	$V_{KA} = V_{REF}$		0.4	1	mA
Off-State Cathode Current	I_{OFF}	$V_{KA} = 36\text{V}, V_{REF} = 0\text{V}$		0.1	1	μA
Dynamic Impedance	$ Z_{KA} $	$V_{KA} = V_{REF}, I_K = 1\text{mA to } 100\text{mA}, f \leq 1\text{kHz}$		0.2	0.5	Ω

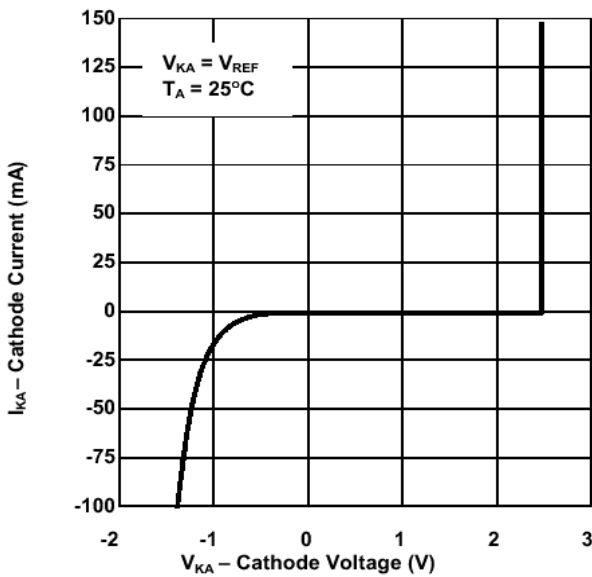
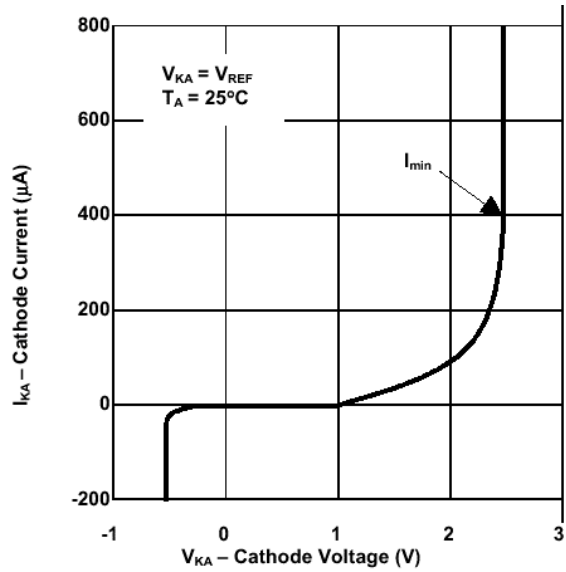
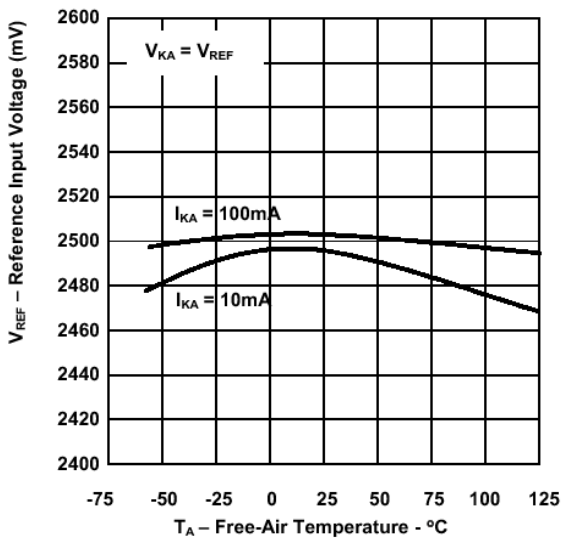
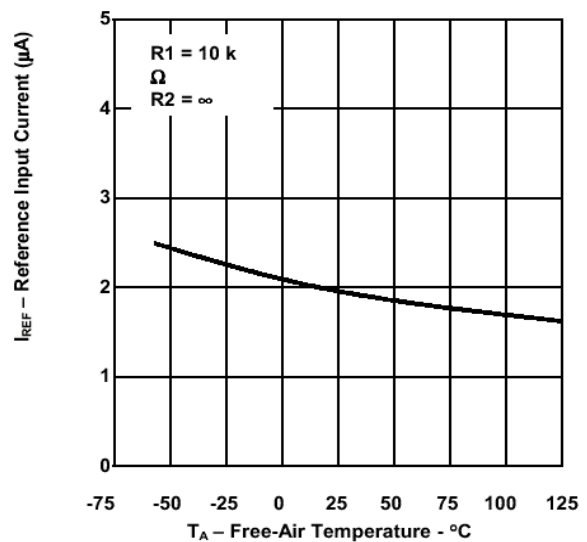
Note 3: These parameters are guaranteed by design

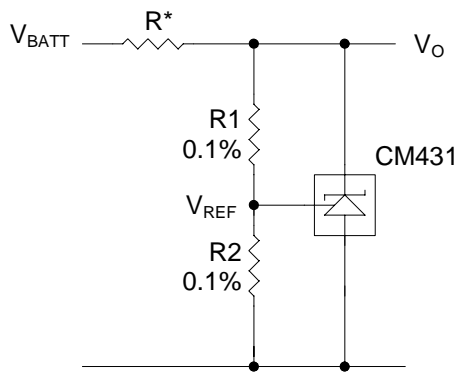
Note 4: $\frac{\Delta V_{REF}}{\Delta V_{KA}}$ Ratio of change in reference input voltage to the change in cathode voltage

PARAMETER MEASUREMENT INFORMATION

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


$$(1 + R1/R2) + I_{REF} \times R1$$

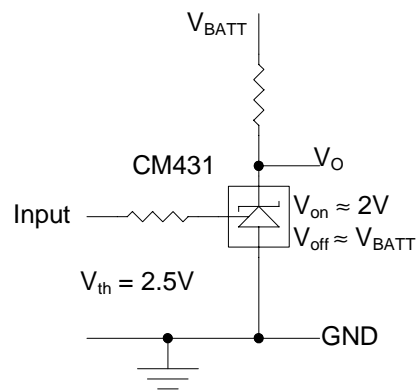
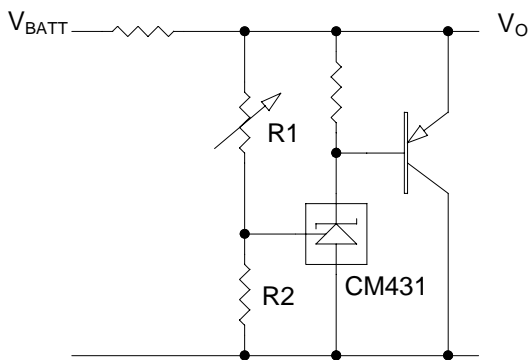
Figure 2. Test Circuit for $V_{KA} > V_{REF}$

Figure 3. Test Circuit for I_{OFF}

TYPICAL CHARACTERISTICS
Cathode Current vs. Cathode Voltage

Cathode Current vs. Cathode Voltage

Ref. Input Voltage vs. Free-Air Temperature

Ref. Input Current vs. Free-Air Temperature


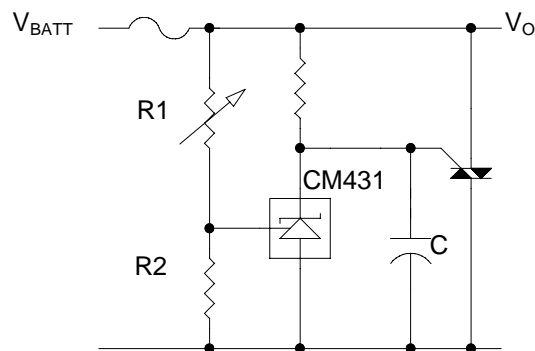
APPLICATION INFORMATION


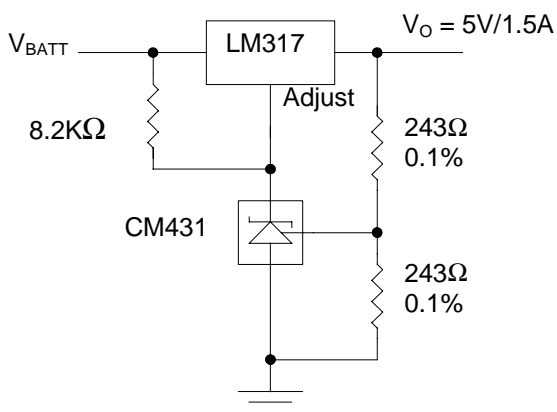
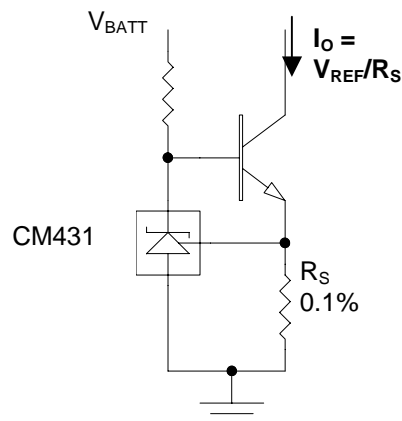
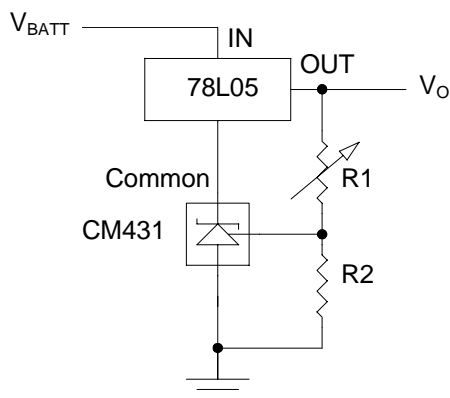
$$V_O = (1 + R1/R2) \times V_{REF}$$

Note: R should provide 1mA cathode current to the CM431 of minimum V_{BATT}

Figure 4. Shunt Regulator

Figure 5. Single-Supply Comparator With Temperature compensated threshold.


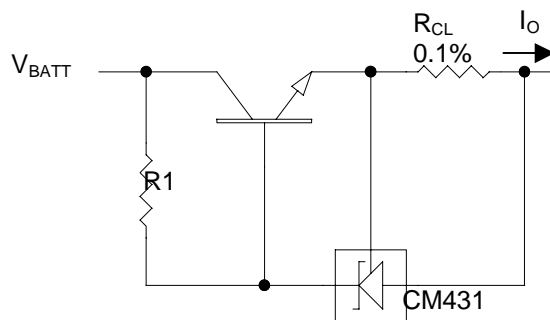
$$V_O = (1 + R1/R2) \times V_{REF}$$

Figure 6. High-Current Shunt Regulator

Figure 7. Crowbar Circuit

APPLICATION INFORMATION (continued)

Figure 8. Precision 5V, 1.5A Regulator

Figure 9. Precision Constant Current Sink


$$V_O = (1 + R_1/R_2) \times V_{REF}$$

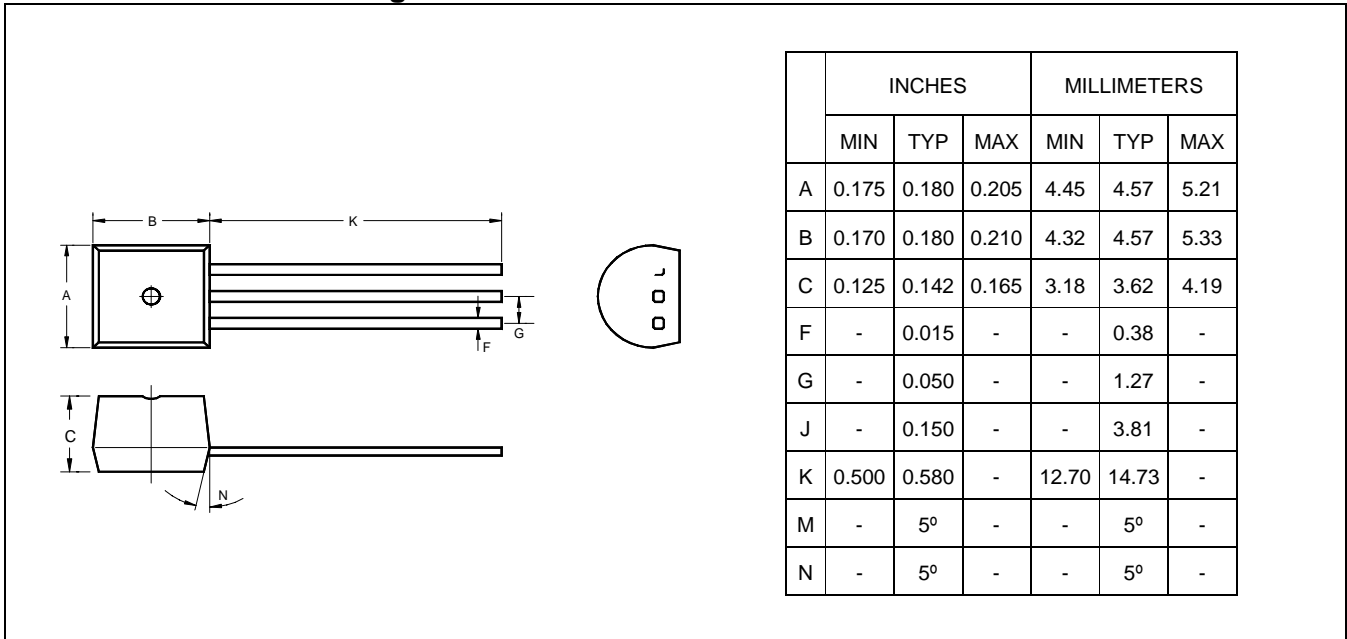
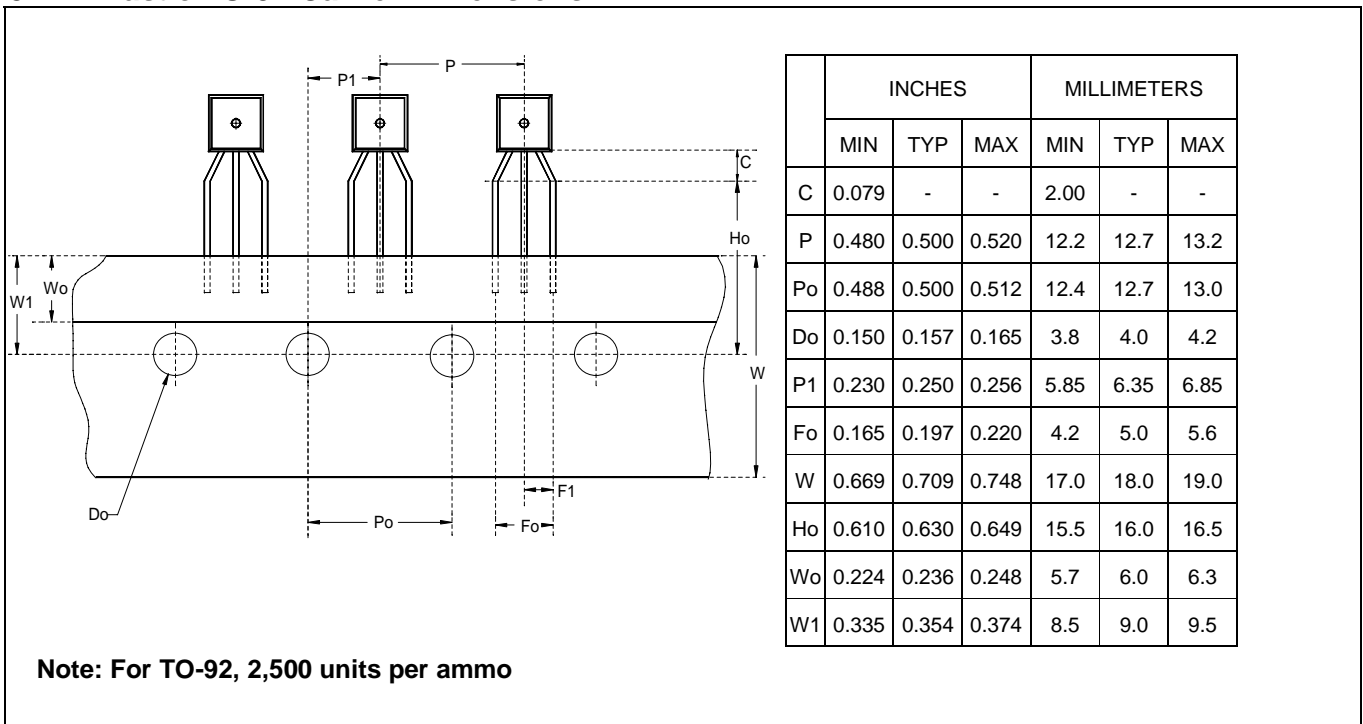
$$\text{Min } V_O = V_{REF} + 5V$$

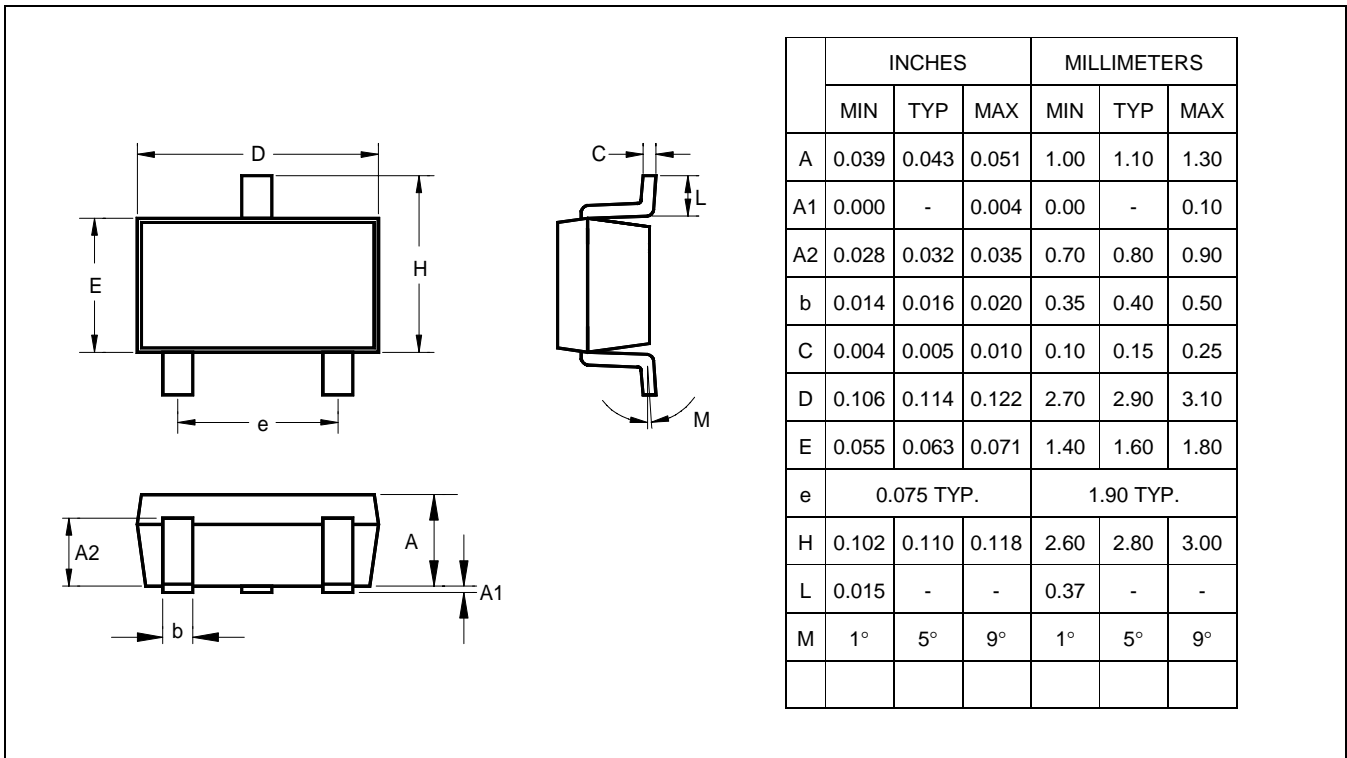
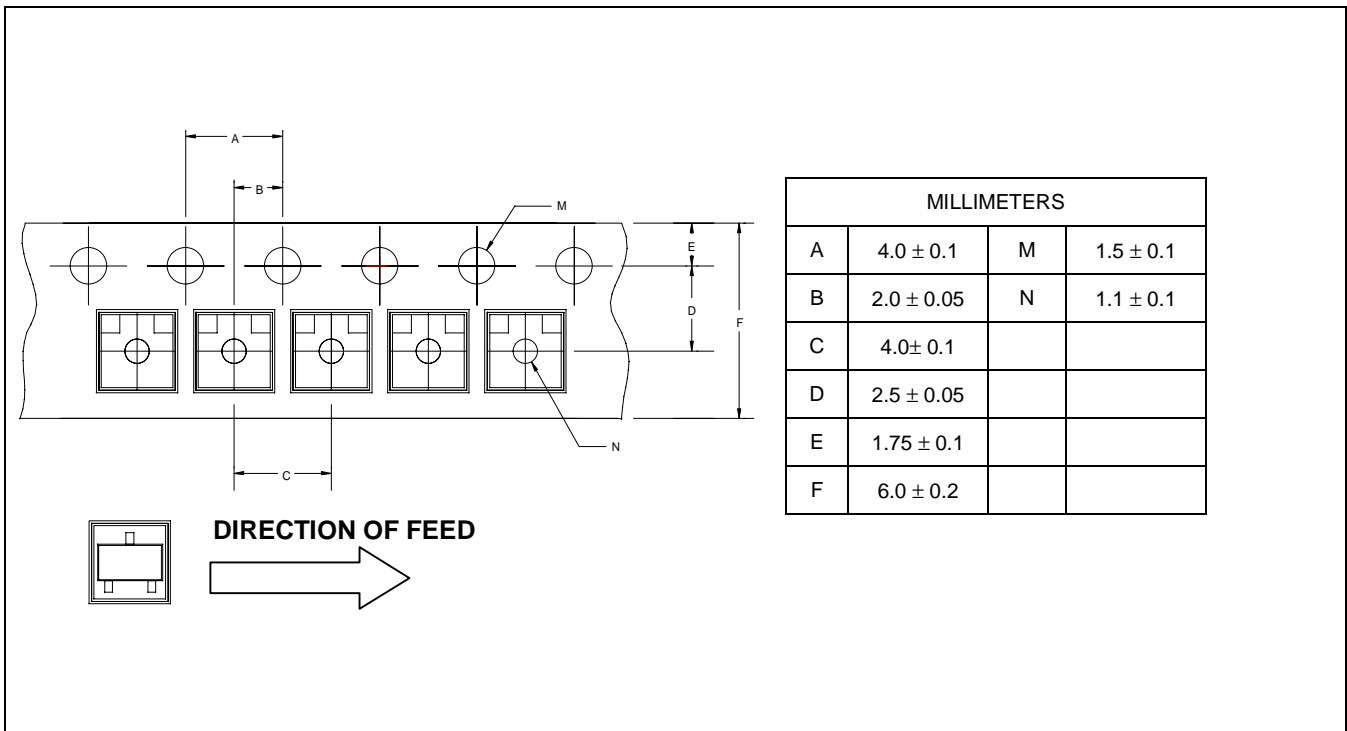
Figure 10. Output Control of a Three-Terminal Fixed Regulator


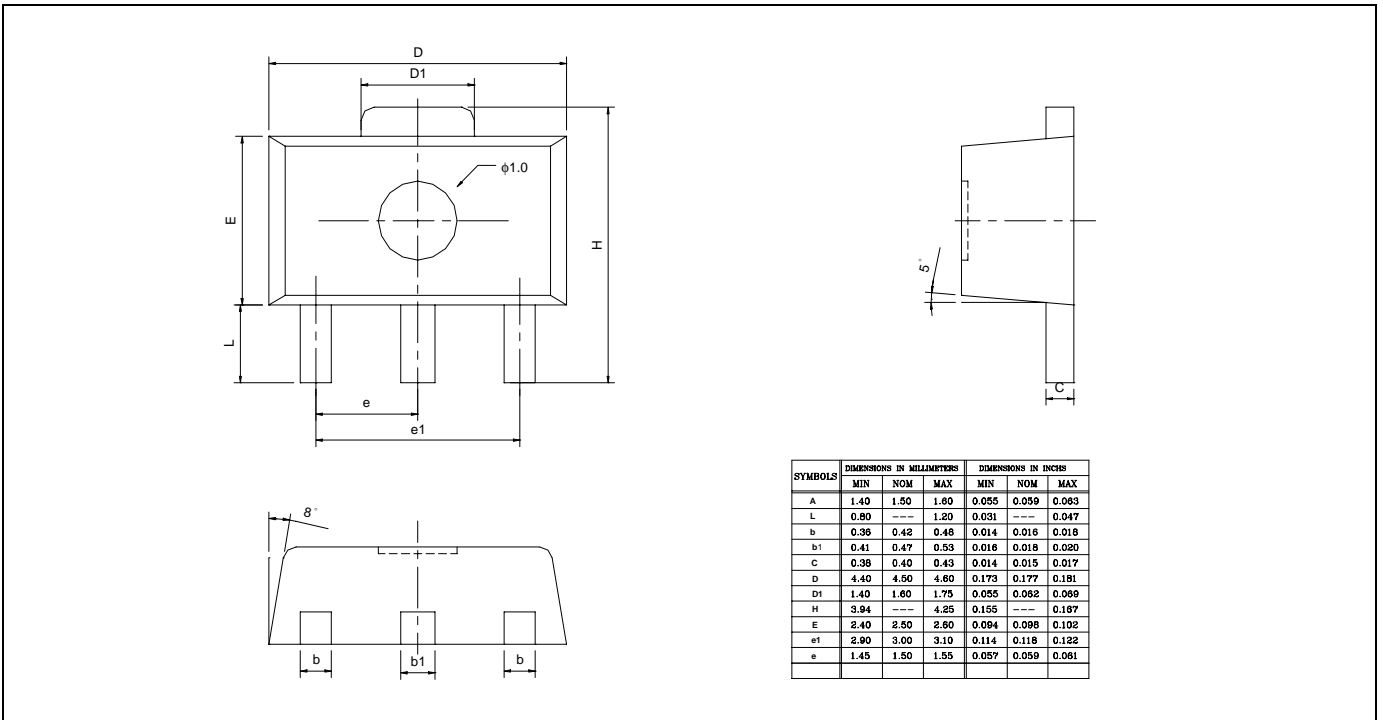
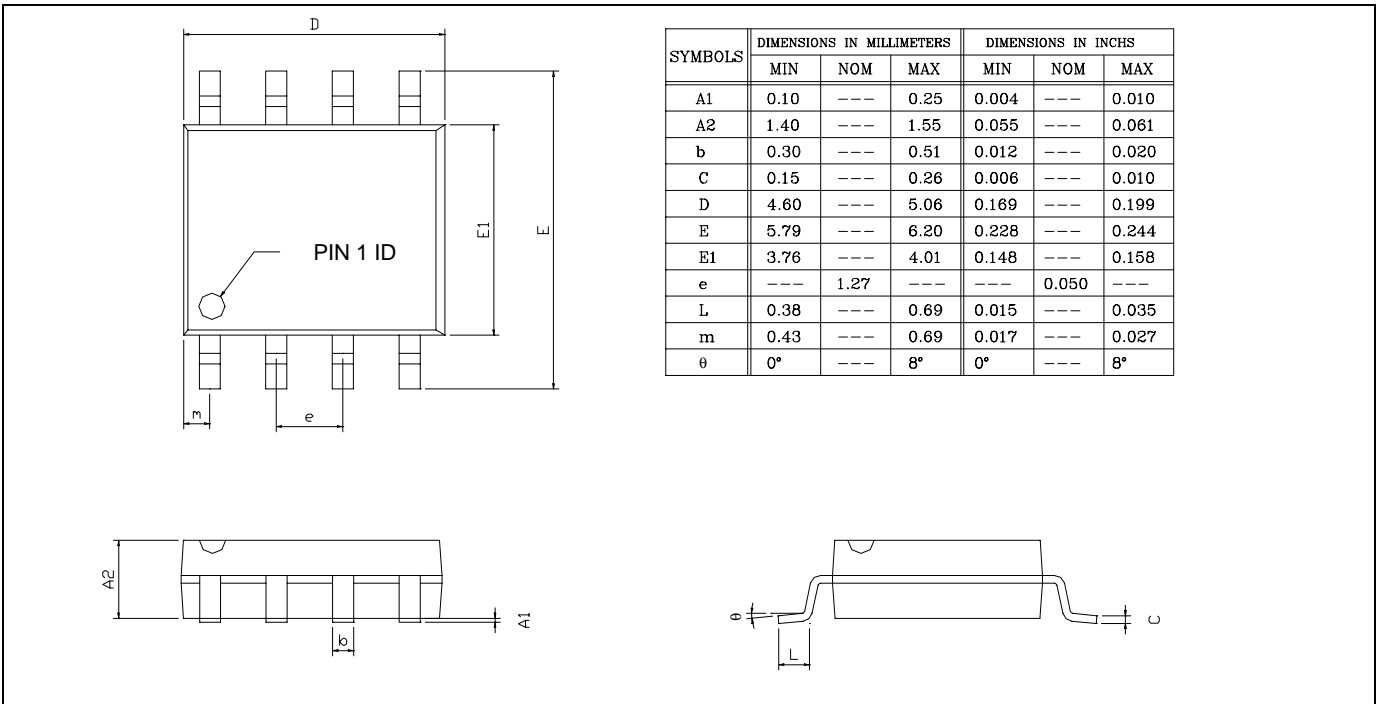
$$I_{OUT} = (V_{REF}/R_{CL}) + I_{KA}$$

$$R_1 = V_{BATT}/((I_O/h_{FE}) + I_{KA})$$

Figure 11. Precision Current Limiter

3-Pin Plastic TO-92 Package Dimension

3-Pin Plastic TO-92 Carrier Dimensions


Surface Mount SOT-23

Surface Mount SOT-23 Carrier Dimensions


SOT-89 Package Dimension

8-Pin Plastic S.O.I.C.


**IMPORTANT NOTICE**

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HsinChu Headquarter

5F, No. 11, Park Avenue II,
Science-Based Industrial Park,
HsinChu City, Taiwan
TEL: +886-3-5679979
FAX: +886-3-5679909

Sales & Marketing

11F, No. 306-3, Sec. 1, Ta Tung Rd.,
Hsichih, Taipei Hsien 221
Taiwan, R.O.C.
TEL: +886-2-86921591
FAX: +886-2-86921596
