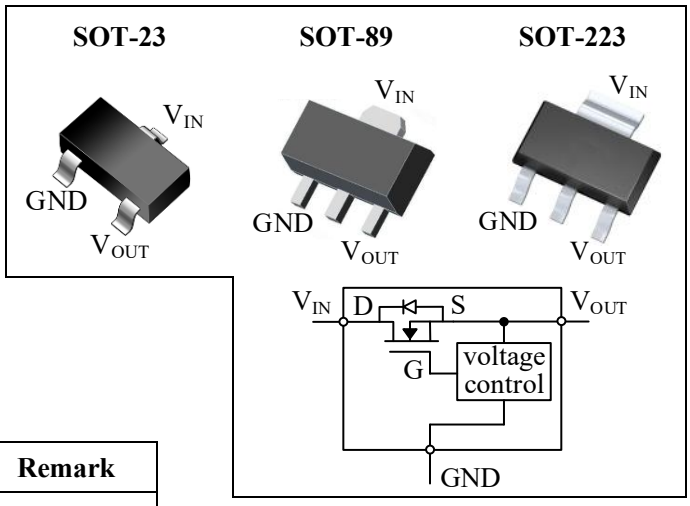
600V MOSovp™ Voltage Regulator / Current Regulator

General Features

- Typical Output Voltage: 3.2V @ I_{OUT}=1mA
- Maximum Input Voltage: 600V
- High-speed Transient Response
- Excellent Temperature Characteristics
- Overvoltage Protection
- High Reliability
- RoHS Compliant
- Halogen-free Available

V_{IN}	$R_{DS(on)(Typ.)}$	I_{OUT}
600V	65Ω	0.03A



Applications

- Overvoltage Protection
- Voltage Regulator
- Current Source
- Industrial Automation
- Automotive
- Sensor Applications

Ordering Information

Part Number	Package	Marking	Remark
AKZ03V60R	SOT-23	03V60	Halogen Free
AKX03V60R	SOT-89	03V60	Halogen Free
AKS03V60R	SOT-223	03V60	Halogen Free

Typical Applications

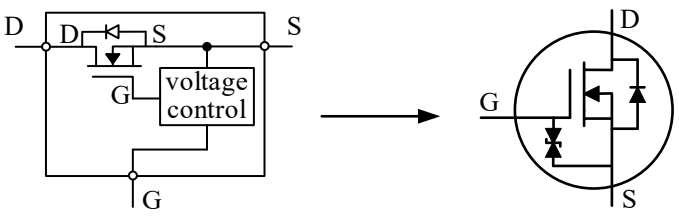
The AKZ03V60R Series is an integrated off-line voltage regulator developed by ARK, based on MOSovp™ technology. It can be used not only as a standard depletion-mode MOSFET, but also as a high-voltage transient suppressor or a simple voltage regulator and current source.

This series of high-voltage integrated regulators retains the linear conduction characteristics of N-channel depletion-mode MOSFETs. Featuring a temperature-compensated design, it offers a higher stable output voltage and current than traditional counterparts compared with conventional depletion-mode MOSFETs because of its superior $V_{GS(off)}$ temperature coefficient.

The AKZ03V60R Series can be easily configured with a current-limiting resistor to form a constant current source, functioning as a current regulator. Moreover, it offers improved thermal stability due to its integrated temperature compensation mechanism.

The AKZ03V60R Series retains most of the characteristics of a depletion-mode MOSFET and can be used directly as an N-channel depletion-mode MOSFET, as shown below:

- V_{IN} is equivalent to the Drain (D)
- V_{OUT} is equivalent to the Source (S)
- GND is equivalent to the Gate (G)



The AKZ03V60R series can replace conventional depletion-mode MOSFETs and perform multiple functions.

1. Voltage Regulator

The typical regulated-power-supply circuit for the AKZ03V60R series is shown below:

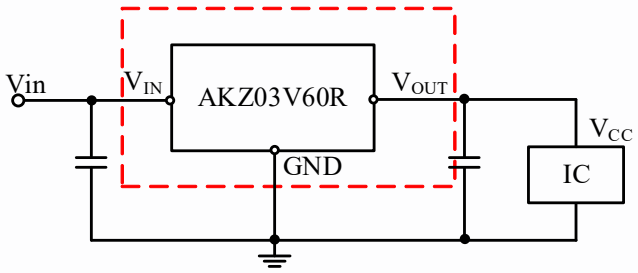


Figure 1. Used as a Voltage regulator

As shown in Figure 1, AKZ03V60R can be used as a voltage regulator to provide a stable voltage to the load or IC, allowing input voltage up to 600V with low output ripple, with extremely high stability and reliability.

The AKZ03V60R series also features automatic temperature compensation, and its output voltage better temperature stability. It also features fast response, effectively suppressing circuit surges.

2. Surge Protection

The typical over-voltage protection circuit for the AKZ03V60R series is shown below:

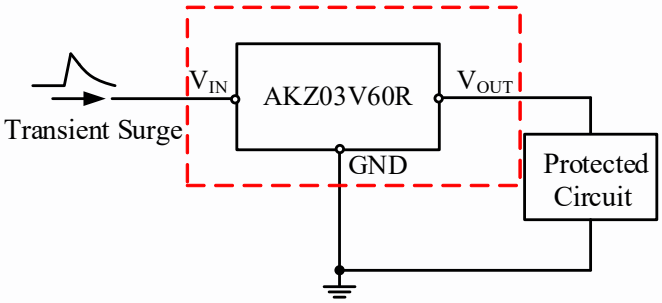


Figure 2. Over voltage protection

As shown in Figure 2, the AKZ03V60R acts as an overvoltage protector, offering fast transient response and effective surge suppression. When a transient event occurs, it switches almost instantaneously to a high-resistance state, clamping the output voltage and protecting the load.

3. Constant Current Source & Over Current Protection

The AKZ03V60R series retains the fundamental characteristics of N-channel depletion-mode MOSFETs. Thus, when combined with a current-limiting resistor, it forms a simple constant-current source and can therefore be regarded as a current limiter. Thanks to its on-chip, state-of-the-art temperature compensation, it is ideal for use as a simple and stable current source. It is shown below:

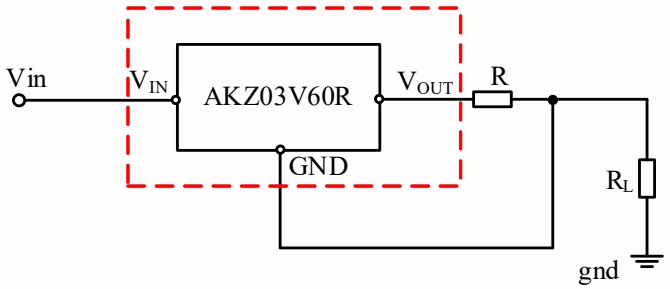


Figure 3. Current source/Current limiter

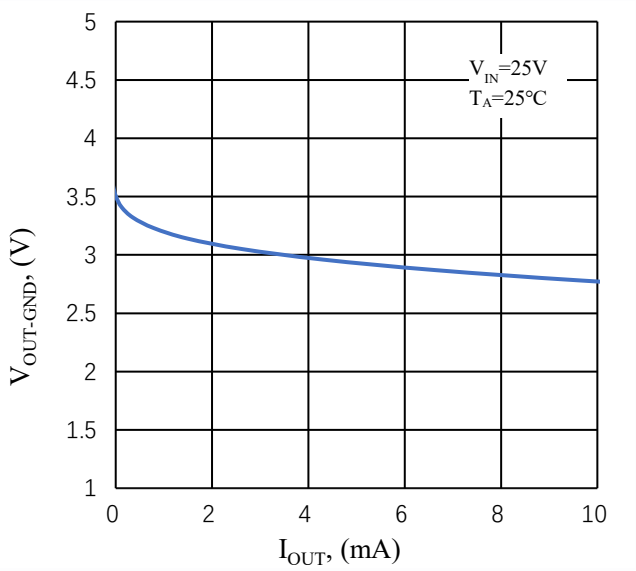


Figure 4. V_{OUT} vs I_{OUT}

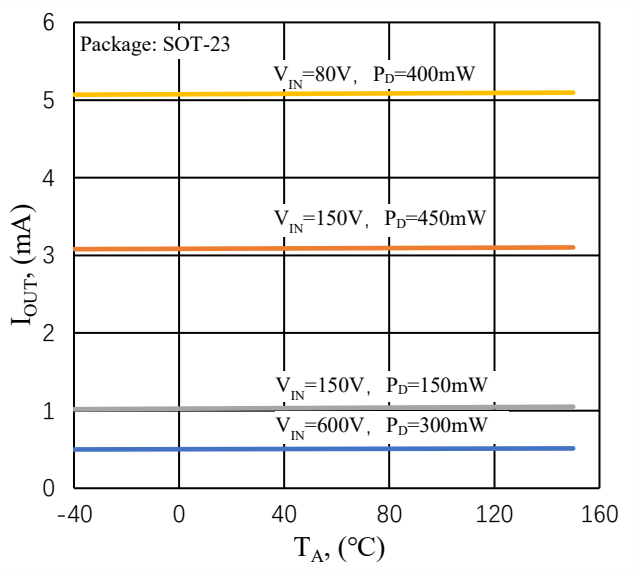


Figure 5. I_{OUT} vs. T_A

Figure 4 presents the typical relationship between output voltage (V_{OUT}) and load current (I_{OUT}) for the AKZ03V60R. This data enables engineers to conveniently determine the relationship between preset constant/current-limiting values and the required current-limiting resistance value: $R = V_{OUT\text{-}GND} / I_{OUT}$. The table below directly lists corresponding typical values for selected current-limiting resistance (R) and preset I_{OUT} values, with additional data derivable from Figure 4.

$V_{OUT\text{-}GND}$ (V)	3.5	3.2	3.1	3.0	2.98	2.93	2.77
I_{OUT} (mA)	0.1	1	2	3	4	5	10
R (Ω)	35000	3200	1550	1000	746	586	277

Note: Parameters may vary by lot; resistances in this table are for reference only.

4. Switching Power Supply Start-Up

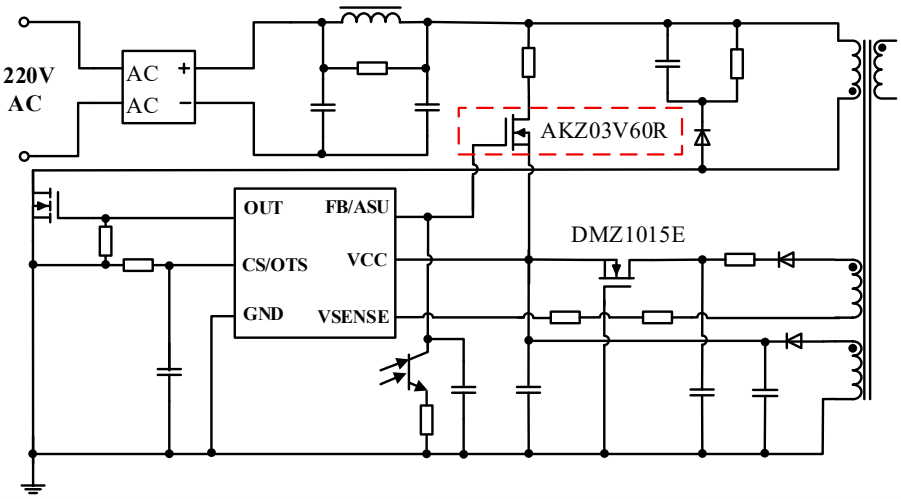


Figure 6. Type-C PD Charger Start-Up

5. Wide Input Voltage Range LDO Solution

The AKZ03V60R series retains the basic characteristics of N-channel depletion-mode MOSFETs and can directly work with LDOs. As illustrated in Figure 7, the AKZ03V60R directly converts high input voltages to stabilized low-level outputs for the LDO's input stage. Consequently, the input voltage range of LDO is extend up to the AKZ03V60R rating voltage indirectly. Additionally, it quickly and effectively suppresses surges to protect the LDO. In this configuration, the maximum input voltage for the LDO is: $V_{in\_LDO} = V_{out\_LDO} + V_{OUT\_GND(MAX)}$.
($V_{OUT\_GND(MAX)}$: denotes the voltage from V_{OUT} to GND at I_{OUT} = 8μA.)

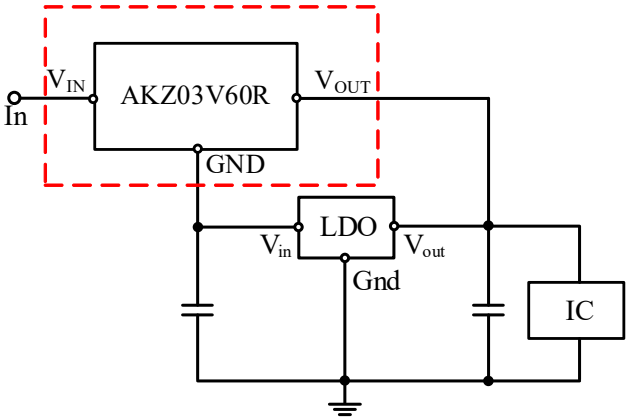


Figure 7. Wide-Input-Voltage LDO Solution

Absolute Maximum Ratings

T_A = 25°C unless otherwise specified

Symbol	Parameter	AKZ03V60R	AKX03V60R	AKS03V60R	Unit
V_{IN}	Input Voltage to GND [1]	600			V
V_{SGND}	Source to GND Voltage	±8			V
I_{OUT}	Continuous V_{OUT} Current [1]	30	50	70	mA
P_D	Power Dissipation [2]	0.5	1.0	1.5	W
T_L	Soldering Temperature Distance of 1.6mm from case for 10s	300			°C
T_J & T_{STG}	Operating and Storage Temperature Range	-55 to 150			°C

Caution: Stresses beyond those listed in the "Absolute Maximum Ratings" may cause permanent damage to the device.

Thermal Characteristics

Symbol	Parameter	AKZ03V60R	AKX03V60R	AKS03V60R	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	250	125	83	°C/W

Electrical Characteristics

T_A = 25°C unless otherwise specified

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
V_{IN}	Input Voltage to GND	--	--	600	V	T_J = −40°C to +125°C
V_{OUT}	Output Voltage	--	3.7	--	V	V_{IN} = 10 to 150V, I_{OUT} = 8μA
		--	3.3	--	V	V_{IN} = 10 to 150V, I_{OUT} = 500μA
		--	3.2	--	V	V_{IN} = 10 to 150V, I_{OUT} = 1 mA
		--	2.9	--	V	V_{IN} = 10 to 150V, I_{OUT} = 5 mA
		--	2.8	--	V	V_{IN} = 10 to 50V, I_{OUT} = 10mA
BV_{DSX}	Drain-to-Source Breakdown Voltage	600	--	--	V	V_{GNDS} = -8V I_{OUT} = 250μA
$R_{DS(on)}$	Static On-state Resistance [2]		65	100	Ω	V_{SGND} = 0V I_{OUT} = 50mA

NOTE:

[1] Cannot exceed the Power Dissipation of the device.
[2] Pulse width ≤ 380μs, duty cycle ≤ 2%.

Typical Characteristics

Figure 8a. V_{OUT} vs. V_{IN}

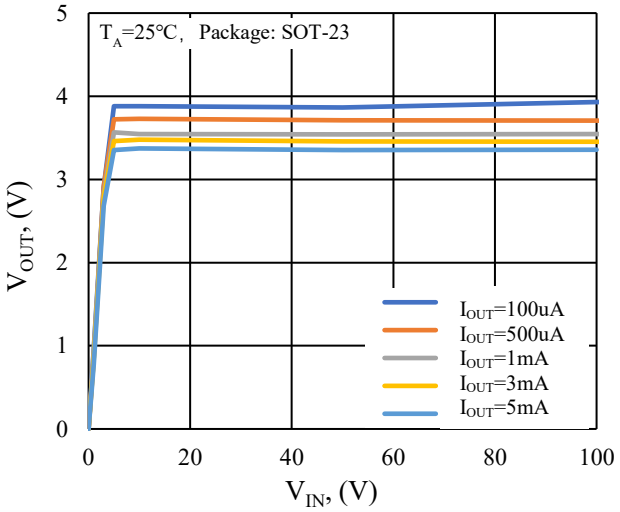


Figure 8b. V_{OUT} vs. V_{IN}

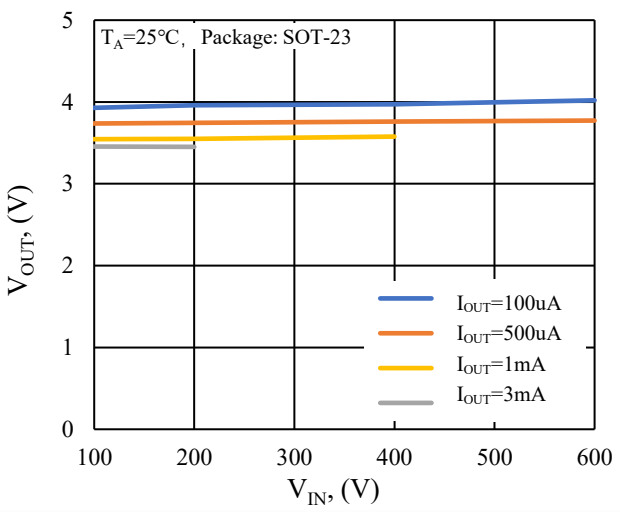


Figure9. V_{OUT} vs. T_A

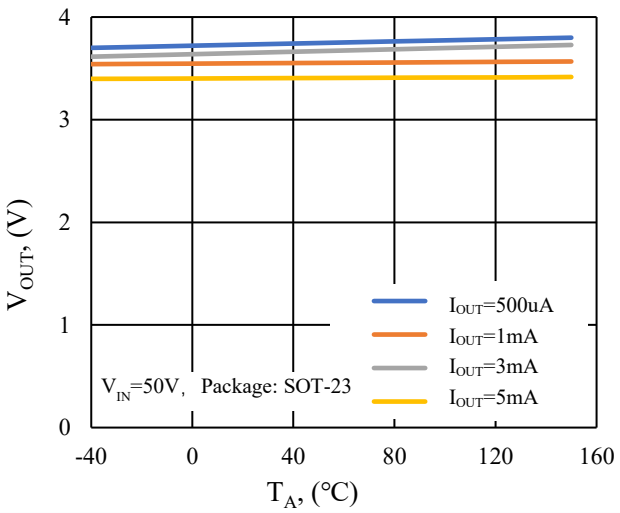
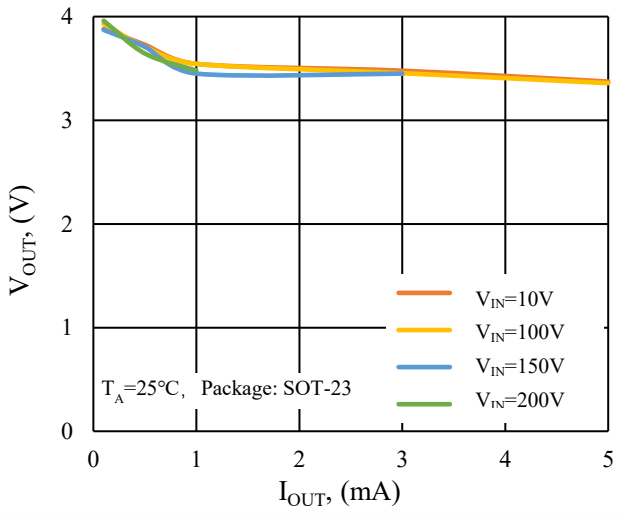
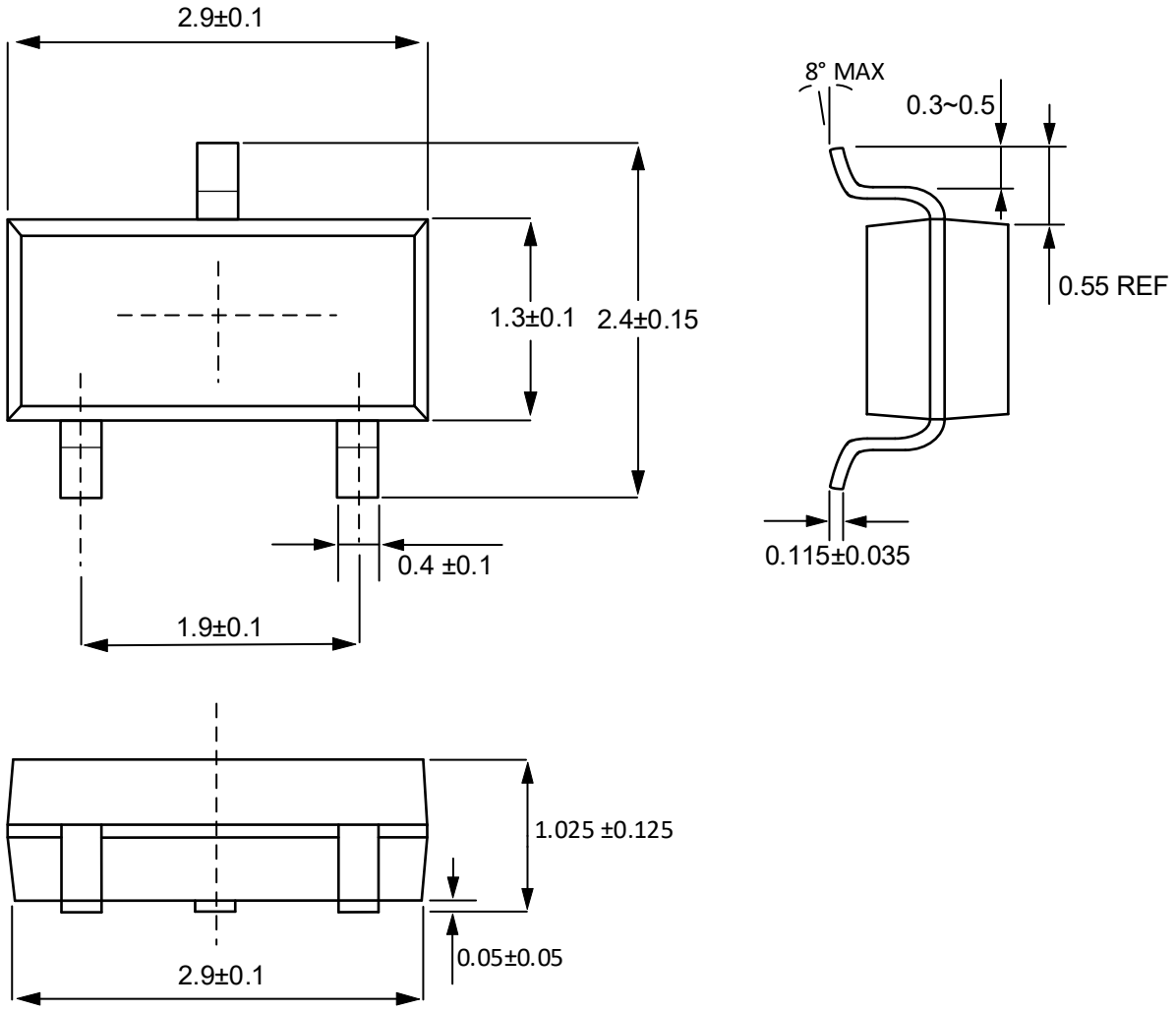


Figure 10. Typical V_{OUT} vs. I_{OUT}



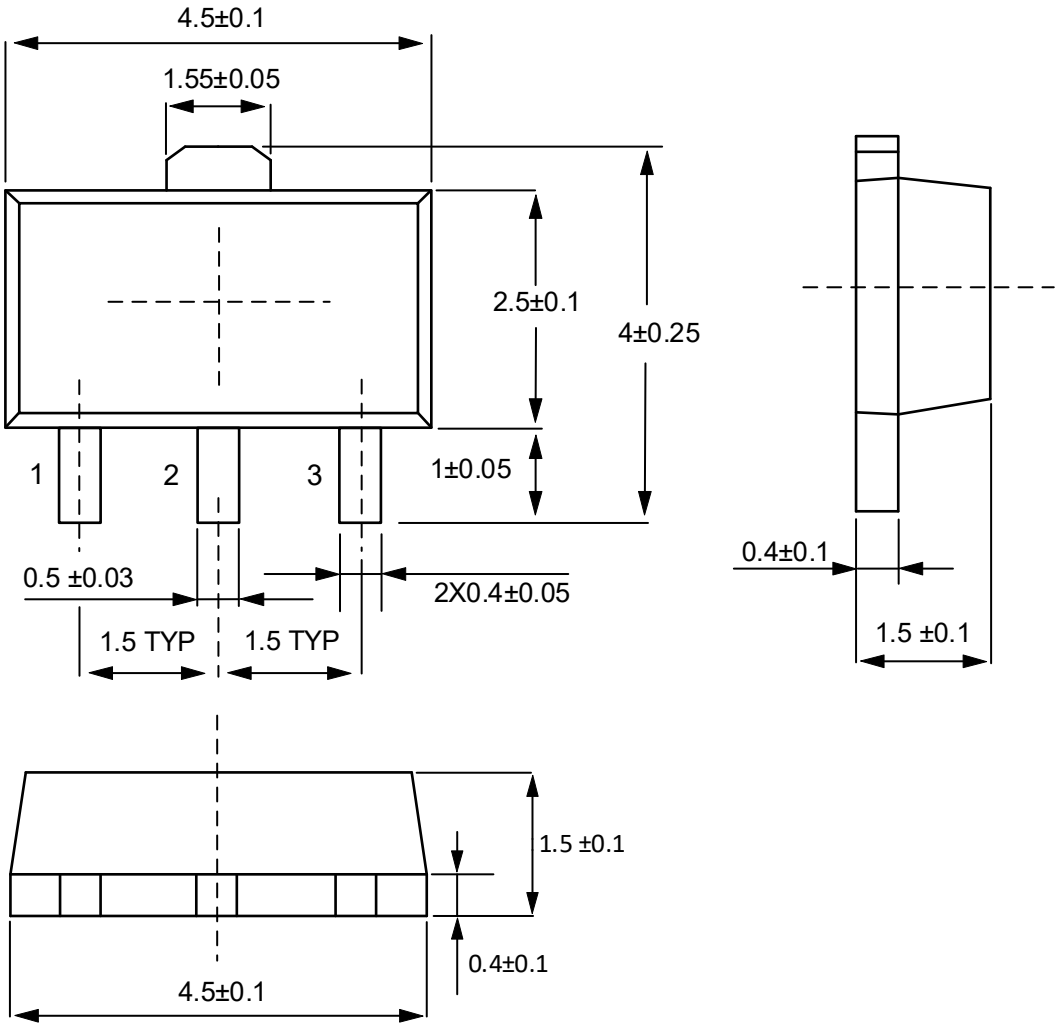
Package Dimensions

SOT-23



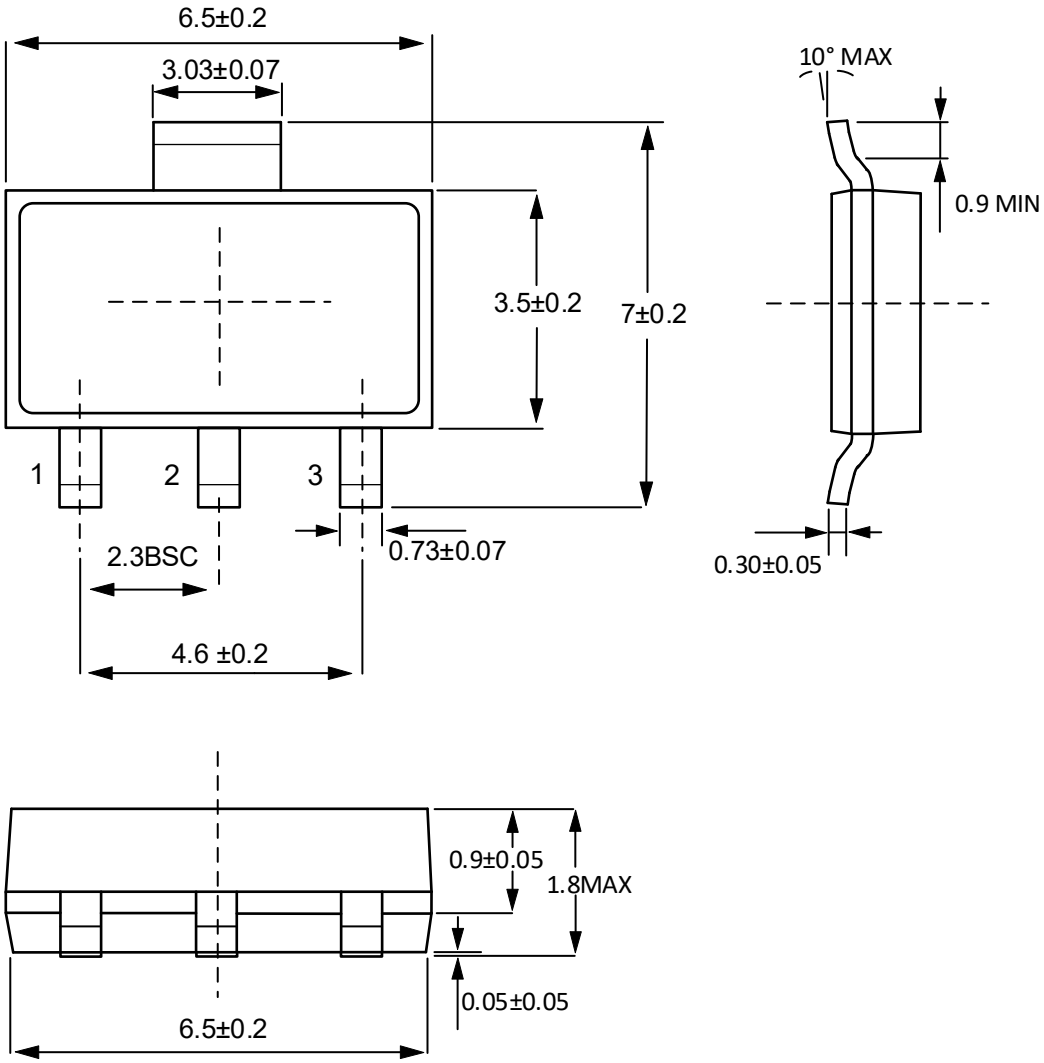
Unit：mm

SOT-89



Unit：mm

SOT-223



Unit：mm

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