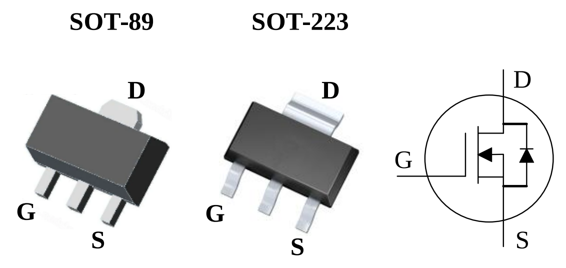
100V N-Channel Depletion-Mode Power MOSFET

General Features

- Depletion Mode (Normally On)
- Proprietary Advanced Planar Technology
- Rugged Polysilicon Gate Cell Structure
- Excellent Temperature Characteristics
- Fast Switching Speed
- With Higher Reliability
- RoHS Compliant
- Halogen-free Available

BV_{DSX}	$R_{DS(ON)}$ (Max.)	I_D
100V	3.0 Ω	0.4A



Applications

- Suppression of Surge Current
- Automotive Electronic Applications
- Normally-on Switches
- Linear Amplifier
- Constant Current Source
- Telecom

Ordering Information

Part Number	Package	Marking	Remark
DMX42C10A	SOT-89	42C10A	Halogen Free
DMS42C10A	SOT-223	42C10A	Halogen Free

Absolute Maximum Ratings

T_A=25°C unless otherwise specified

Symbol	Parameter	DMX42C10A	DMS42C10A	Unit
V_{DSX}	Drain-to-Source Voltage [1]	100		V
V_{DGX}	Drain-to-Gate Voltage [1]	100		V
I_D	Continuous Drain Current	0.4		A
I_{DM}	Pulsed Drain Current [2]	1.6		
P_D	Power Dissipation	1.0	1.5	W
	Derating Factor above 25°C	0.008	0.012	W/°C
V_{GS}	Gate-to-Source Voltage	±20		V
T_L	Soldering Temperature Distance of 1.6mm from case for 10 seconds	300		°C
T_J & T_{STG}	Operating and Storage Temperature Range	-55 to 150		°C

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

Thermal Characteristics

Symbol	Parameter	DMX42C10A	DMS42C10A	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	125	83	°C/W

Electrical Characteristics

OFF Characteristics

T_A =25℃ unless otherwise specified

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
BV_{DSX}	Drain-to-Source Breakdown Voltage	100	--	--	V	V_{GS}=-5V, I_D=250μA
$I_{D(OFF)}$	Drain-to-Source Leakage Current	--	--	1	μA	V_{DS}=100V, V_{GS}=-5V
		--	--	100	μA	V_{DS}=100V, V_{GS}= -5V T_J=125℃
I_{GSS}	Gate-to-Source Leakage Current	--	--	1	μA	V_{GS}=20V, V_{DS}=0V
		--	--	-1		V_{GS}=-20V, V_{DS}=0V

ON Characteristics

T_A =25℃ unless otherwise specified

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
I_{DSS}	Saturated Drain-to-Source Current	400	--	--	mA	V_{GS}=0V, V_{DS}=25V
$R_{DS(ON)}$	Static Drain-to-Source On-Resistance	--	--	3.0	Ω	V_{GS}=0V, I_D=150mA [3]
		--	--	2.8	Ω	V_{GS}=5V, I_D=150mA [3]
$V_{GS(OFF)}$	Gate-to-Source Cut-off Voltage	-3.5	--	-1.5	V	V_{DS}=3V, I_D=8μA
gfs	Forward Transconductance	--	0.46	--	S	V_{DS}=20V, I_D=150mA

Dynamic Characteristics

Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
C_{iss}	Input Capacitance	--	91.4	--	pF	V_{GS}=-5V V_{DS}=25V f=1.0MHz
C_{oss}	Output Capacitance	--	29.4	--		
C_{rss}	Reverse Transfer Capacitance	--	5.7	--		
Q_g	Total Gate Charge	--	2.0	--	nC	V_{GS}=-5V~5V V_{DS}=45V I_D=150mA
Q_{gs}	Gate-to-Source Charge	--	0.52	--		
Q_{gd}	Gate-to-Drain (Miller) Charge	--	0.48	--		

Resistive Switching Characteristics

Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
$t_{d(on)}$	Turn-on Delay Time	--	4.7	--	ns	V_{GS}=-5V~5V V_{DD}=45V I_D=150mA R_G=10 Ω
t_{rise}	Rise Time	--	2.4	--		
$t_{d(off)}$	Turn-off Delay Time	--	12.8	--		
t_{fall}	Fall Time	--	88	--		

Source-Drain Diode Characteristics

T_A=25℃ unless otherwise specified

Symbol	Parameter	Min	Typ.	Max.	Unit	Test Conditions
V_{SD}	Diode Forward Voltage	--	--	1.5	V	I_{SD}=150mA, V_{GS}=-10V

NOTE：

[1] T_J=+25℃ to +150℃.
[2] Repetitive rating, pulse width limited by maximum junction temperature.
[3] Pulse width≤380μs, duty cycle≤2%.

Typical Characteristics

Figure 1. Maximum Power Dissipation vs. Case Temperature

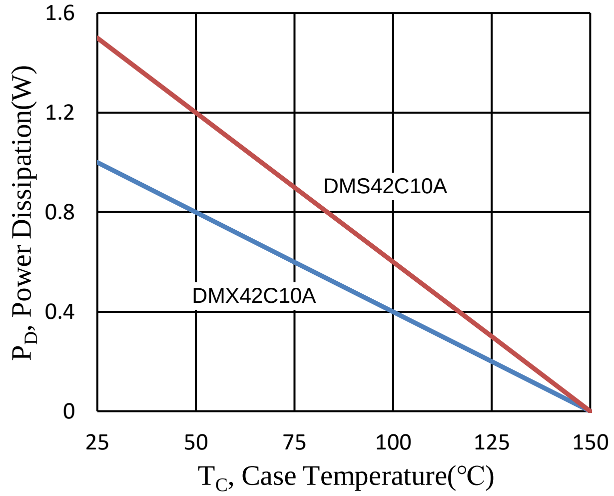


Figure 2. Maximum Continuous Drain Current vs. Case Temperature

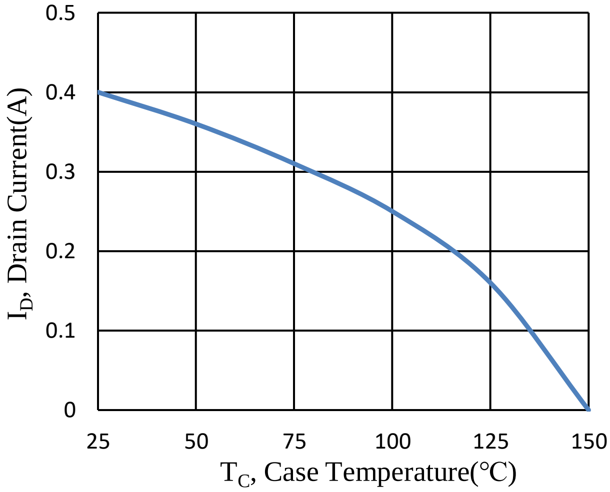


Figure 3. Typical Output Characteristics

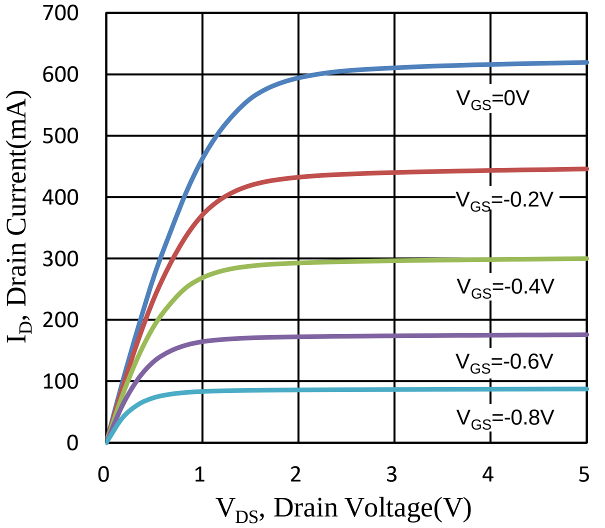


Figure 4. Typical Transfer Characteristics

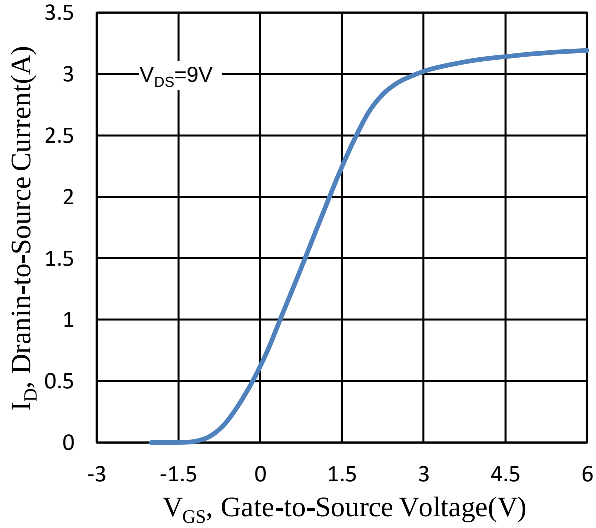


Figure 5. Typical Capacitance vs. Drain-to-Source Voltage

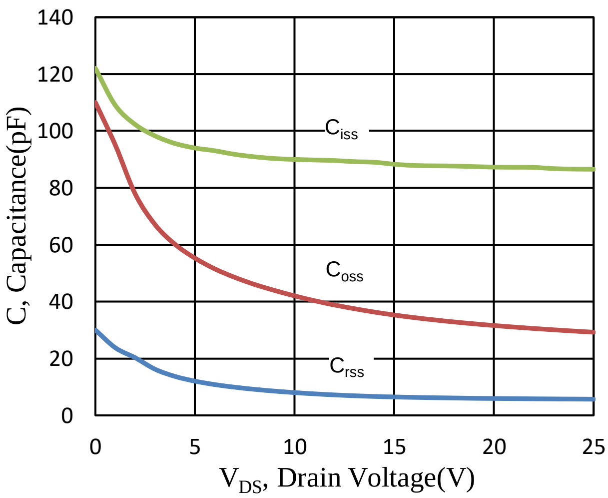


Figure 6. Typical Gate Charge vs. Gate-to-Source Voltage

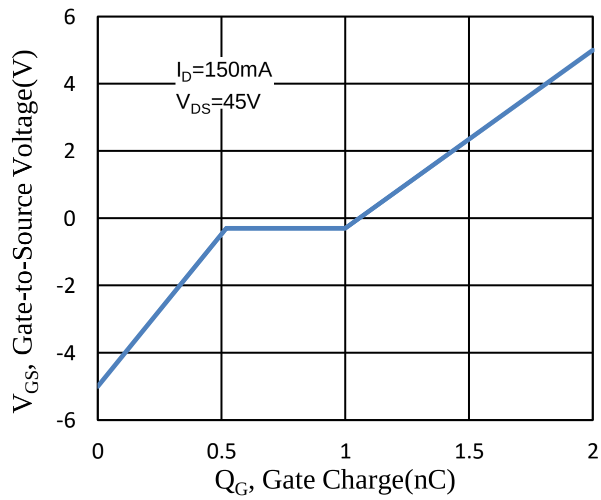


Figure 7. Normalized On-Resistance vs. Ambient Temperature

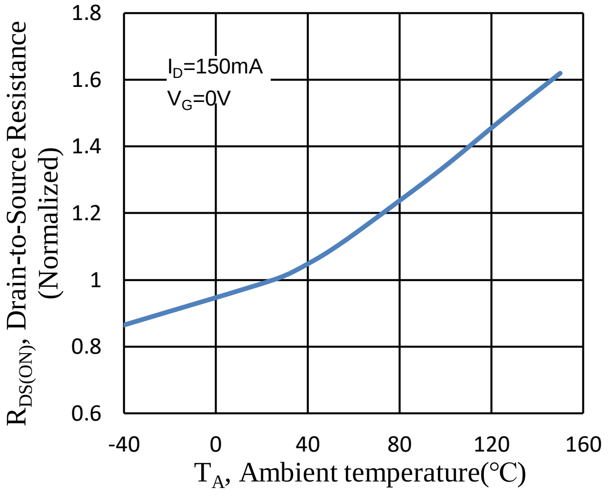


Figure 8. Gate-to-Source Cut-off Voltage vs. Ambient Temperature

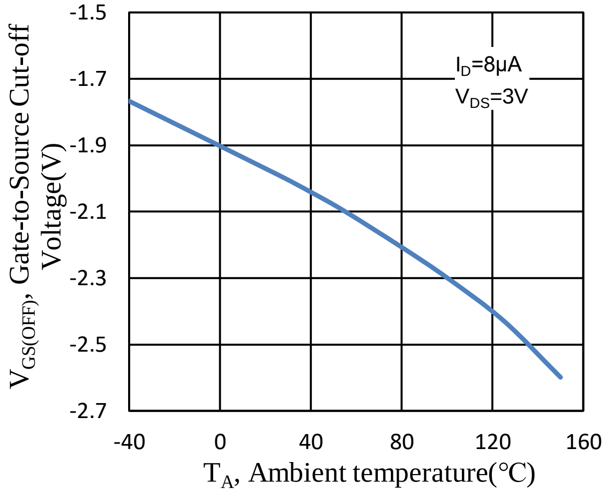


Figure 9. Drain-to-Source Breakdown Voltage vs. Ambient Temperature

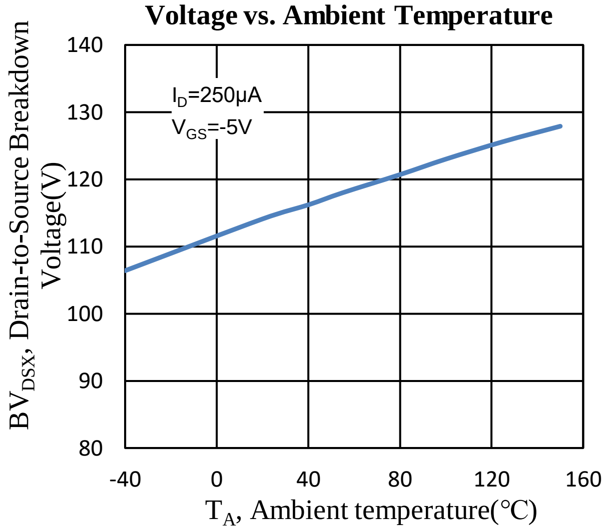
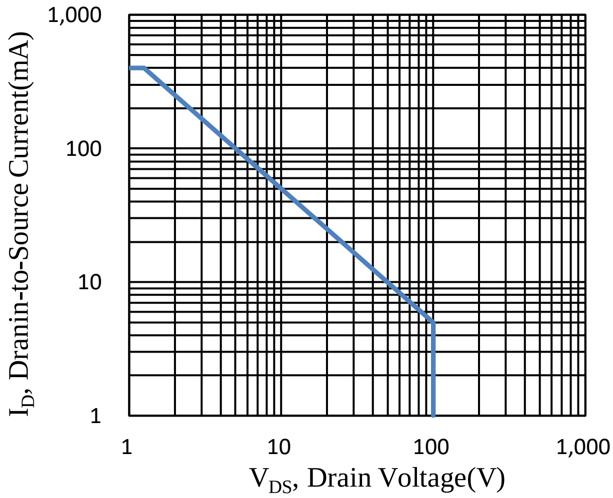


Figure 10. Maximum Forward Safe Operating Area



Typical Application Circuits

The DMX42C10A/DMS42C10A have low leakage current and excellent high-temperature stability, It is very suitable for use in applications such as overcurrent protection, overvoltage protection, and in conjunction with operational amplifiers.

As shown in Figure 11a, the circuit uses the sub-threshold characteristics of the DMS42C10A/DMX42C10A to achieve overcurrent protection or constant current output. The maximum allowable input voltage of the circuit is approximately $V_{IN(MAX)} \approx 100V + V_{OUT} + V_z$.

In the circuit, the maximum voltage across the resistor R_1 is: $V_{R1(MAX)} = V_{R2(MAX)} + V_Z = |V_{GS(OFF)}| + V_Z$, the maximum current through R_1 is: $I_{R1(MAX)} = (V_{GS(OFF)(MAX)} + V_Z)/R_1$, which means the current flowing through the circuit will be limited within a certain range, thus achieving overcurrent protection.

This circuit can also be used as a constant current source to power a load in applications with a wide voltage range input. The constant current is: $I = (V_{GS(OFF)} + V_Z)/R_1$. The threshold voltage $V_{GS(OFF)}$ parameter of the DMS42C10A/DMX42C10A and the zener voltage V_Z have opposite temperature characteristics, allowing for automatic temperature compensation. Therefore, this circuit has good temperature characteristics.

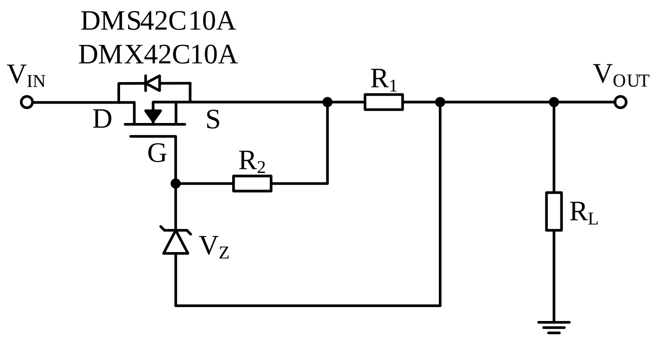


Figure 11a. Constant current source/ Overcurrent protection

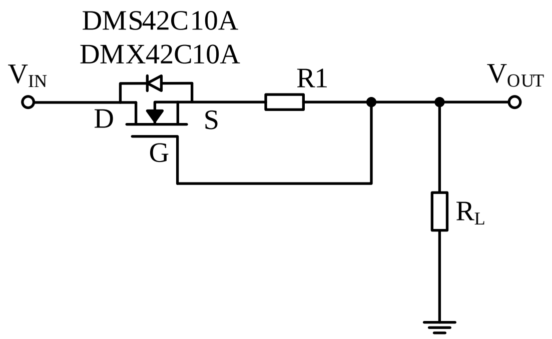


Figure 11b. Overcurrent protection

As shown in Figure 12, the circuit can be used as a voltage regulation circuit to supply power to the load, and as an overvoltage protection circuit to provide overvoltage protection for the load.

When the input voltage is lower than the circuit regulation value, the output voltage V_{OUT} is approximately equal to V_{IN}. When the circuit is regulated and outputting, the output voltage $V_{OUT} = |V_{GS(OFF)}| + V_Z$. Combining the $V_{GS(OFF)}$ parameters of the DMS42C10A / DMX42C10A, users can match the zener diode themselves to achieve different levels of regulated output or overvoltage protection. The larger the resistance of resistor R_2, the smaller the current flowing through the zener diode. It is recommended that $R_2 > 500K\Omega$, which is beneficial for reducing the power consumption of the zener diode.)

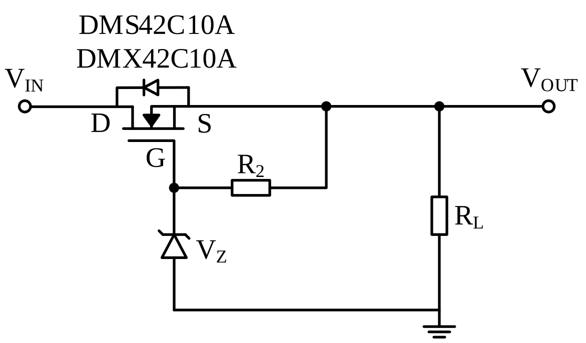


Figure 12: Voltage regulator/Overvoltage protection

The DMS42C10A/DMX42C10A used in combination with an LDO can directly increase the allowable input voltage of the LDO circuit and provide transient surge protection for the LDO.

As shown in the circuit in Figure 13, connecting DMS42C10A/DMX42C10A to the input of the LDO allows the LDO to operate in a circuit environment with a maximum input voltage of 100V and effectively suppresses circuit surges. The input-output voltage difference of the LDO is related to the $V_{GS(OFF)}$ parameter of the depletion MOSFET, and the relationship between the input voltage V_{IN} and the output voltage V_{OUT} of the LDO is:
$V_{IN} = V_{OUT} + |V_{GS(OFF)}|$.

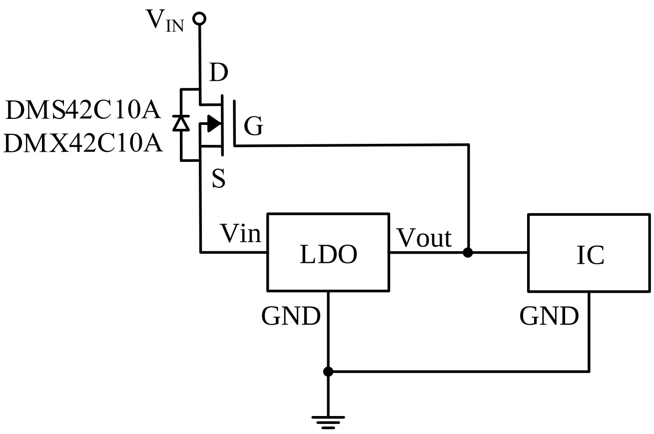


Figure 13. Collocation with LDO

The DMS42C10A/DMX42C10A has extremely low leakage current and high temperature stability, making it ideal for use with operational amplifiers or voltage reference sources to provide a constant voltage to the load.

As shown in Figure 14, the relationship between the input voltage Vi of the operational amplifier and the output voltage V_O of the operational amplifier is $V_O = V_i \times (1 + R_2/R_1)$. When the load is determined, the operating voltage across the load is also determined: $V_S = V_O + |V_{GS}|$, where V_{GS} is numerically equal to the threshold voltage $V_{GS(OFF)}$ of the depletion MOSFET at the corresponding current, that is, $V_S = V_O + |V_{GS(OFF)}|$.

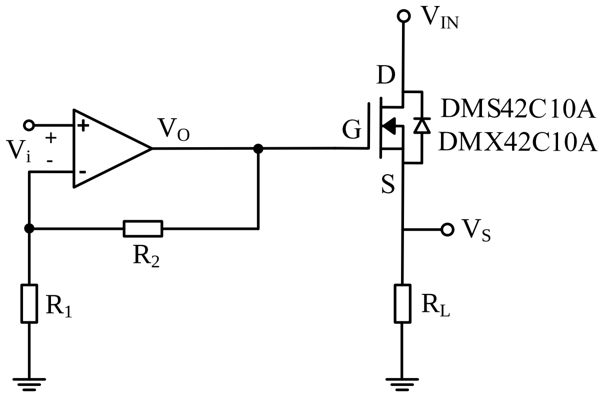
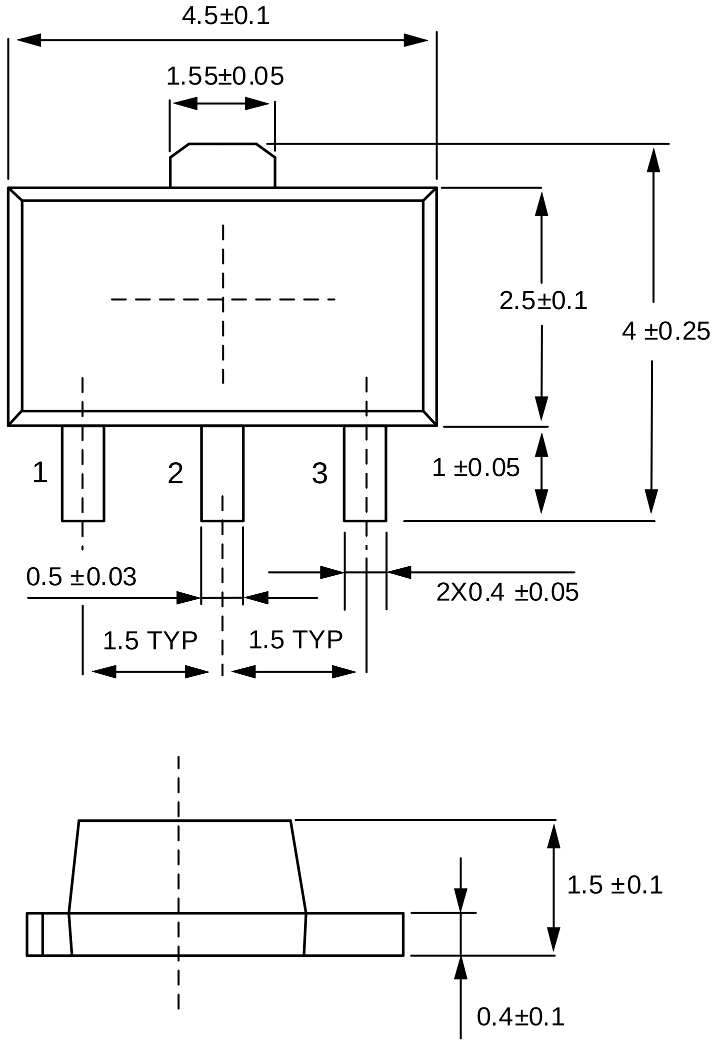


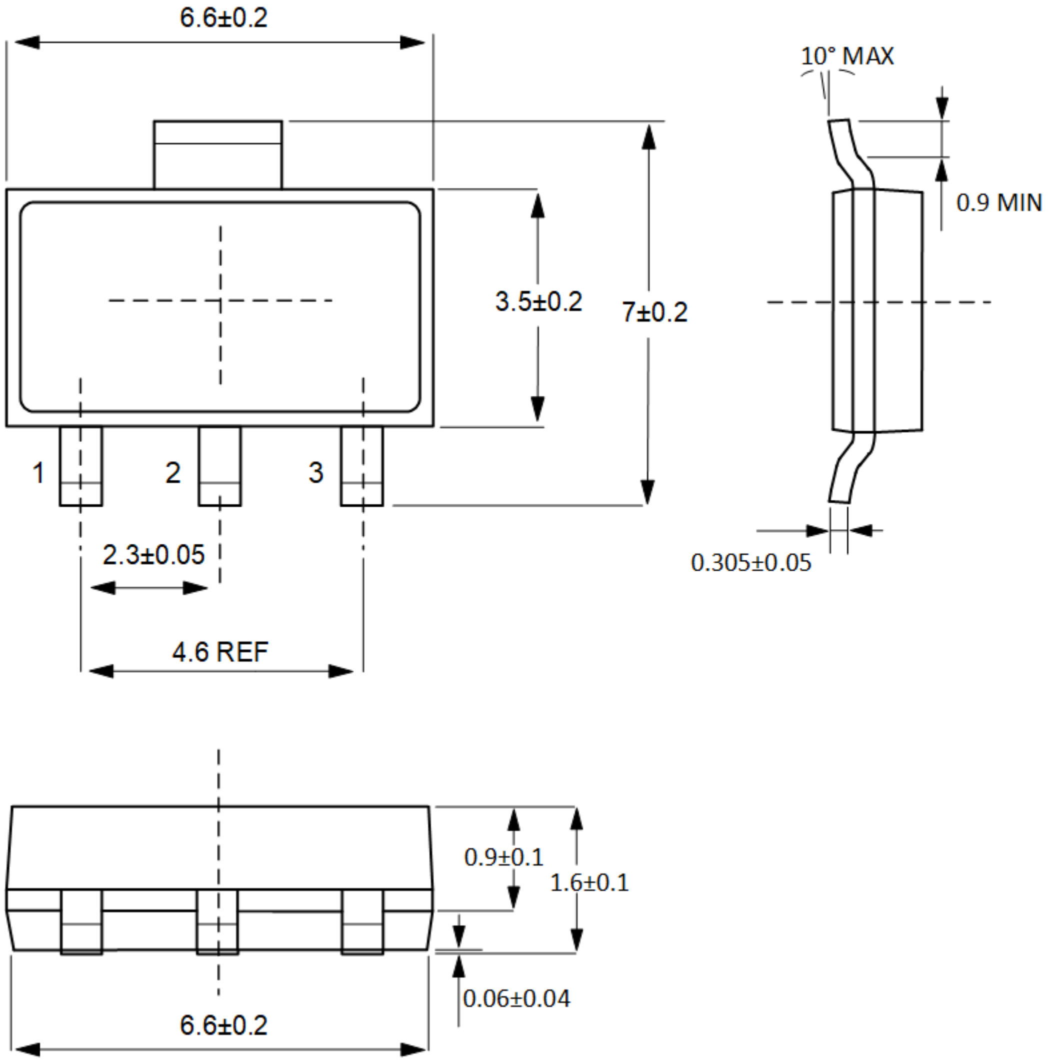
Figure 14. Collocation with operational amplifier

Package Dimensions

SOT-89



SOT-223


6.6±0.2
10° MAX
0.9 MIN
3.5±0.2
7±0.2
1
2
3
2.3±0.05
0.305±0.05
4.6 REF
0.9±0.1
1.6±0.1
0.06±0.04
6.6±0.2

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