



ON Semiconductor®

# FQT1N60C

## N-Channel QFET® MOSFET

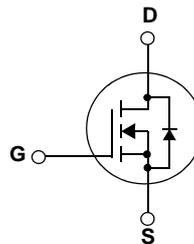
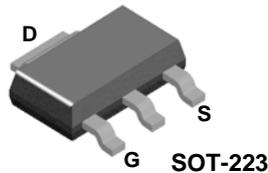
600V, 0.2 A, 11.5 Ω

### Description

This N-Channel enhancement mode power MOSFET is produced using ON Semiconductor's proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on-state resistance, and to provide superior switching performance and high avalanche energy strength. These devices are suitable for switched mode power supplies, active power factor correction (PFC), and electronic lamp ballasts.

### Features

- 0.2 A, 600 V,  $R_{DS(on)}=9.3 \Omega(V^{-1})@V_{GS}=10 V, I_D=0.1 A$
- Low Gate Charge (Typ.  $t_{r1} = 15 \text{ nC}$ )
- Low  $C_{rss}$  (Typ.  $t_{r2} = 10 \text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant



### MOSFET Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted\*

Symbol	Parameter	FQT1N60C	Unit
$V_{DSS}$	Drain to Source Voltage	600	V
$V_{GSS}$	Gate to Source Voltage	$\pm 30$	V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	0.2
		- Continuous ( $T_C = 100^\circ\text{C}$ )	0.12
$I_{DM}$	Drain Current	- Pulsed (Note 1)	0.8
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	33
$I_{AR}$	Avalanche Current	(Note 1)	0.2
$E_{AR}$	Repetitive Avalanche Energy	(Note 1)	0.2
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	4.5
$P_D$	Power Dissipation	( $T_A = 25^\circ\text{C}$ )	2.1
		- Derate above $25^\circ\text{C}$	0.02
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	Min.	Max.	Unit
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient*	-	60	$^\circ\text{C}/\text{W}$

\* When mounted on the minimum pad size recommended (PCB Mount)

**Package Marking and Ordering Information**  $T_C = 25^\circ\text{C}$  unless otherwise noted

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FQT1N60C	FQT1N60C	SOT-223	330mm	12mm	4000

**Electrical Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
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**Off Characteristics**

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}, T_J = 25^\circ\text{C}$	600	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$ , Referenced to $25^\circ\text{C}$	-	0.6	-	$\text{V}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 600\text{V}, V_{GS} = 0\text{V}$ $V_{DS} = 480\text{V}, T_C = 125^\circ\text{C}$	-	-	25 250	$\mu\text{A}$
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 30\text{V}, V_{DS} = 0\text{V}$	-	-	$\pm 100$	nA

**On Characteristics**

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$	2.0	-	4.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{V}, I_D = 0.1\text{A}$	-	9.3	11.5	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 40\text{V}, I_D = 0.1\text{A}$ (Note 4)	-	0.75	-	S

**Dynamic Characteristics**

$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{V}, V_{GS} = 0\text{V}$ $f = 1\text{MHz}$	-	130	170	pF
$C_{oss}$	Output Capacitance		-	19	25	pF
$C_{rss}$	Reverse Transfer Capacitance		-	3.5	6	pF
$Q_g$	Total Gate Charge at 10V	$V_{DS} = 480\text{V}, I_D = 1\text{A}$ $V_{GS} = 10\text{V}$ (Note 4, 5)	-	4.8	6.2	nC
$Q_{gs}$	Gate to Source Gate Charge		-	0.7	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		-	2.7	-	nC

**Switching Characteristics**

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 300\text{V}, I_D = 1\text{A}$ $R_G = 25\Omega$ (Note 4, 5)	-	7	24	ns
$t_r$	Turn-On Rise Time		-	21	52	ns
$t_{d(off)}$	Turn-Off Delay Time		-	13	36	ns
$t_f$	Turn-Off Fall Time		-	27	64	ns

**Drain-Source Diode Characteristics**

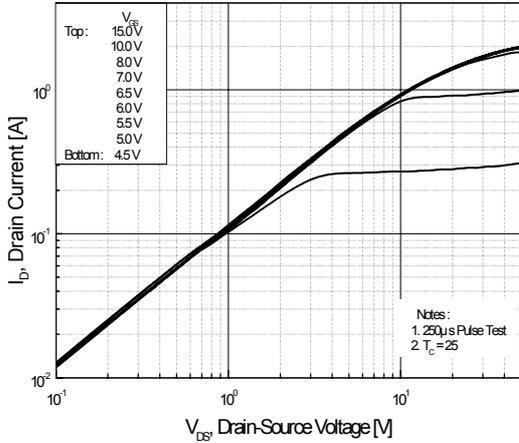
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	0.2	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	0.8	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{V}, I_{SD} = 0.2\text{A}$	-	-	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{V}, I_{SD} = 1\text{A}$	-	190	-	ns
$Q_{rr}$	Reverse Recovery Charge	$di_F/dt = 100\text{A}/\mu\text{s}$ (Note 4)	-	0.53	-	$\mu\text{C}$

**Notes:**

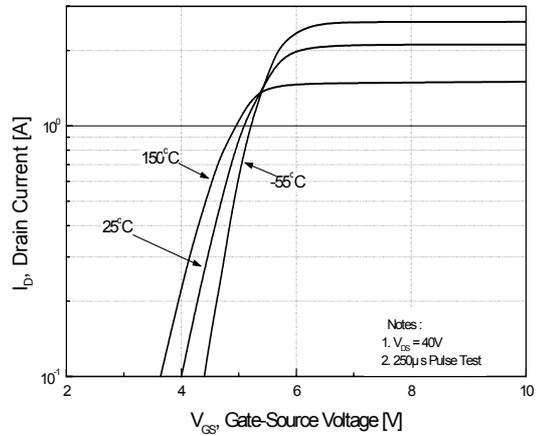
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L = 59\text{mH}, I_{AS} = 1.1\text{A}, V_{DD} = 50\text{V}, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 0.2\text{A}, di/dt \leq 200\text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Pulse Test: Pulse width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$
5. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

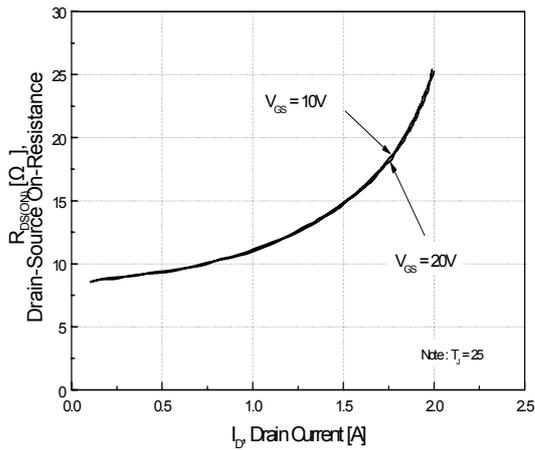
**Figure 1. On-Region Characteristics**



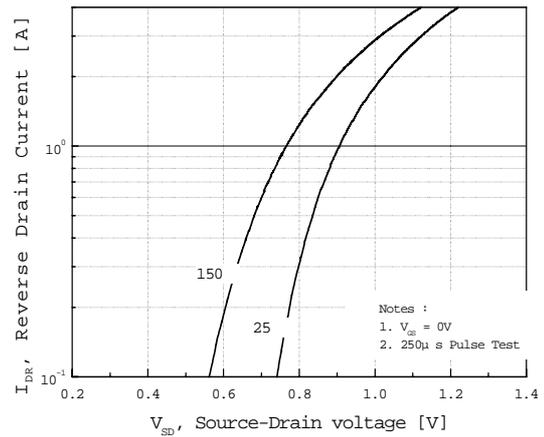
**Figure 2. Transfer Characteristics**



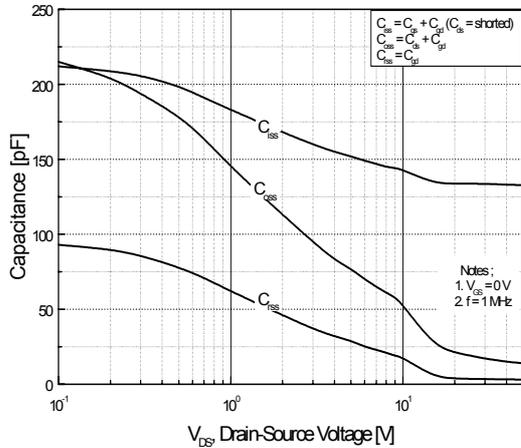
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



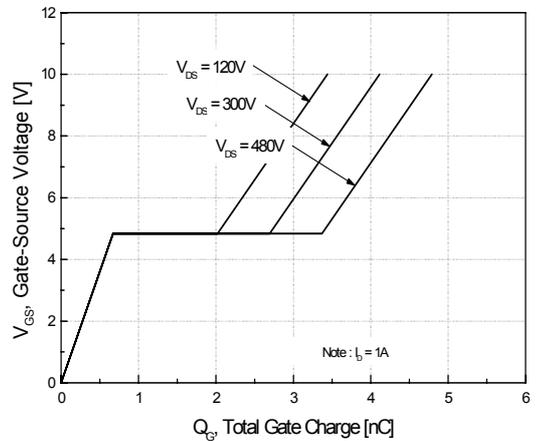
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

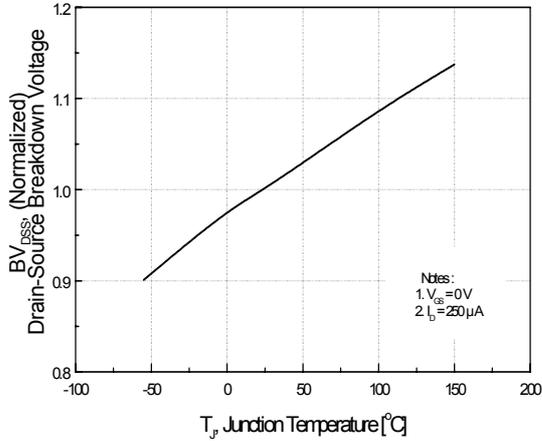


**Figure 6. Gate Charge Characteristics**

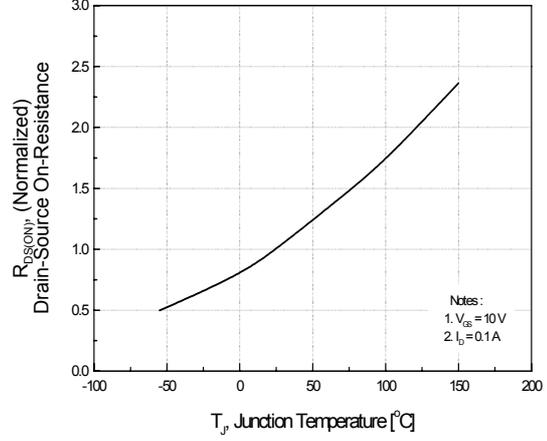


Typical Performance Characteristics (Continued)

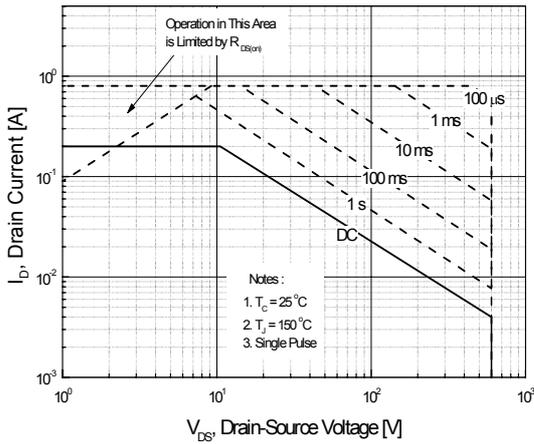
**Figure 7. Breakdown Voltage Variation vs. Temperature**



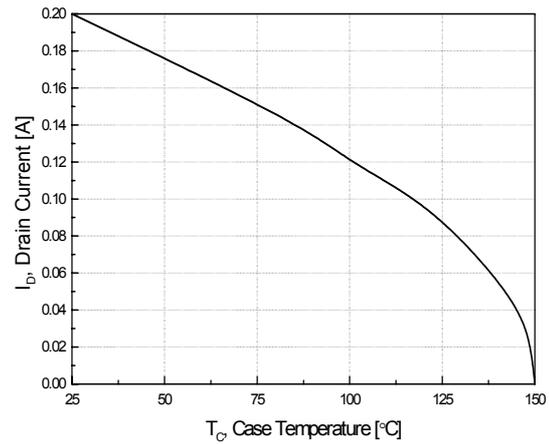
**Figure 8. On-Resistance Variation vs. Temperature**



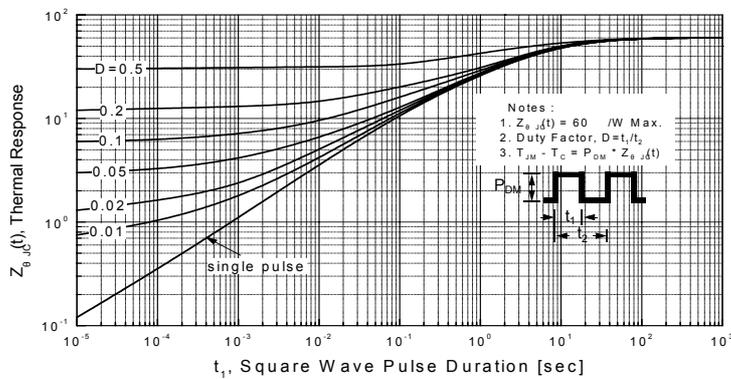
**Figure 9. Maximum Safe Operating Area**



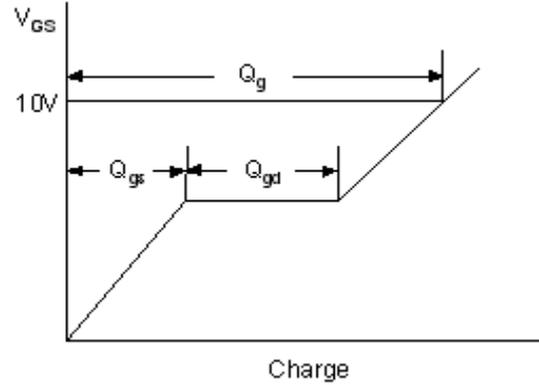
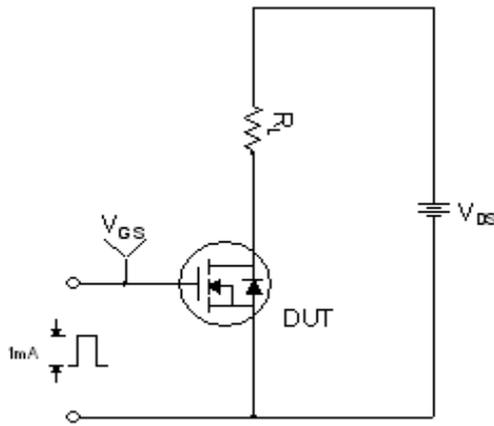
**Figure 10. Maximum Drain Current vs. Case Temperature**



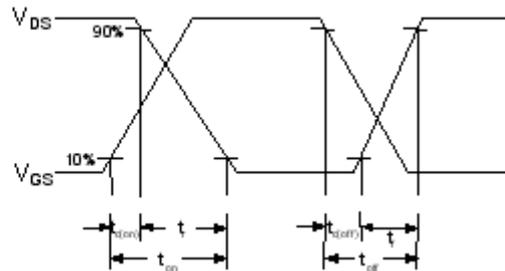
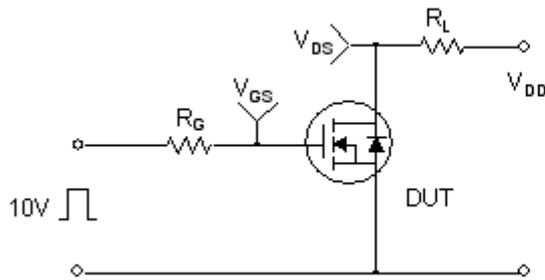
**Figure 11. Transient Thermal Response Curve**



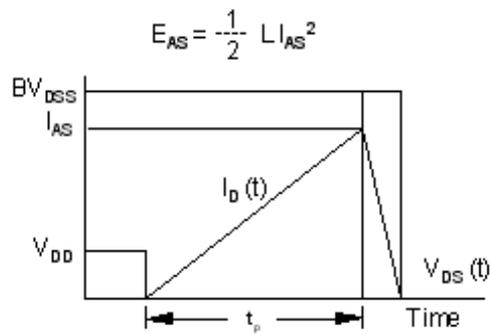
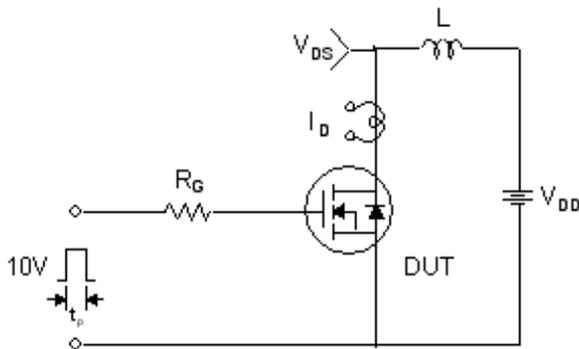
**Gate Charge Test Circuit & Waveform**



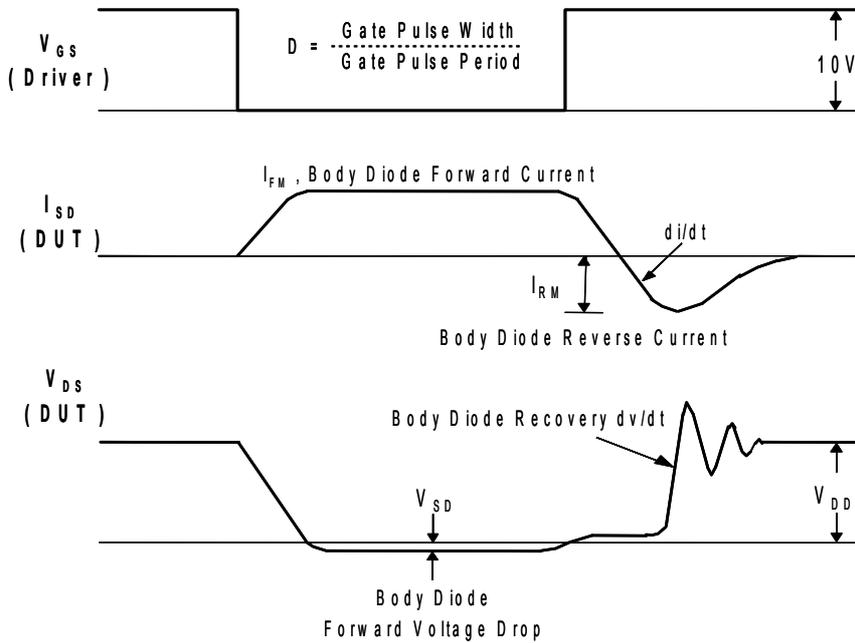
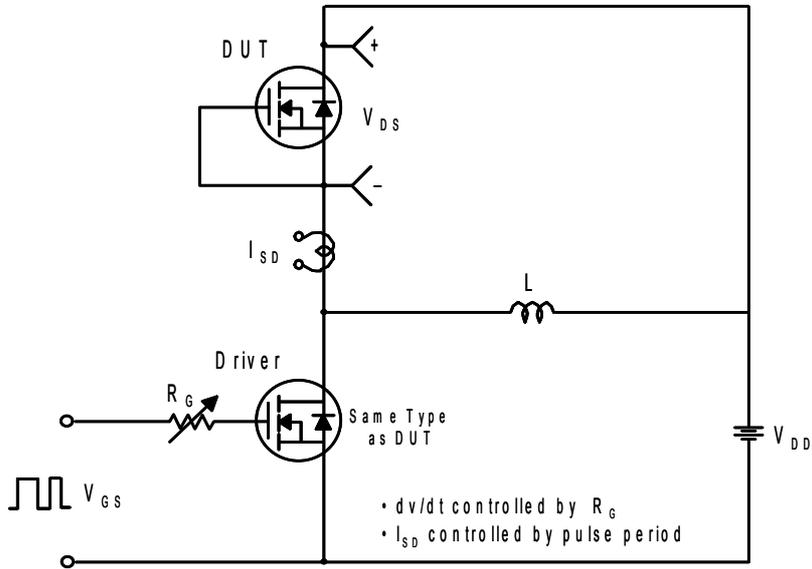
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

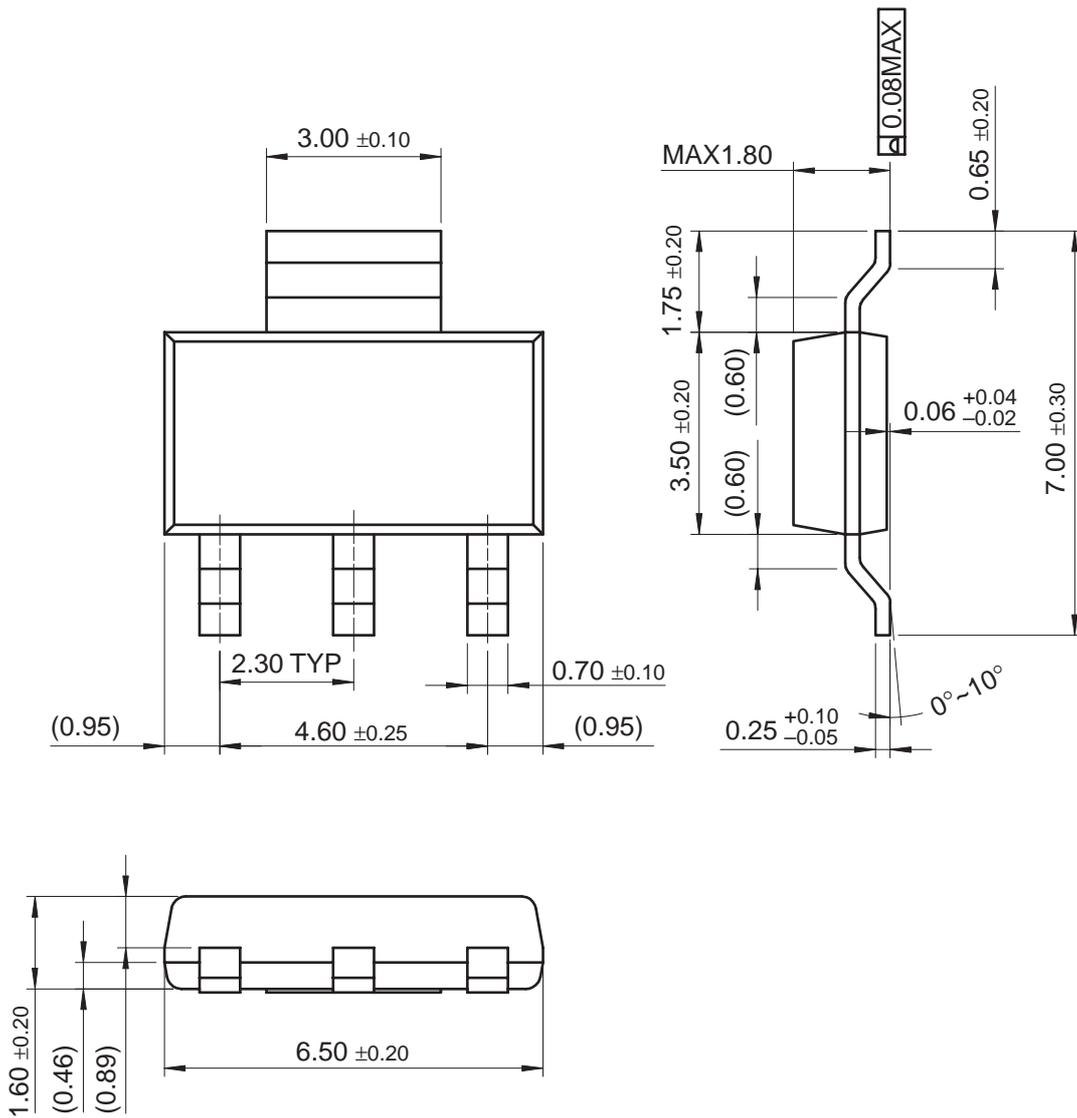


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

SOT-223



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