



## 1N60Q-TA

Preliminary

Power MOSFET

### 1.0A, 600V N-CHANNEL POWER MOSFET

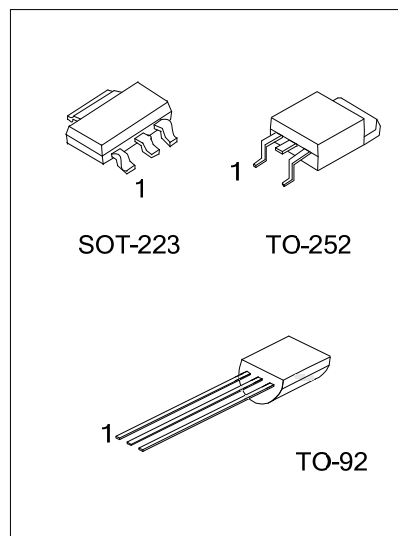
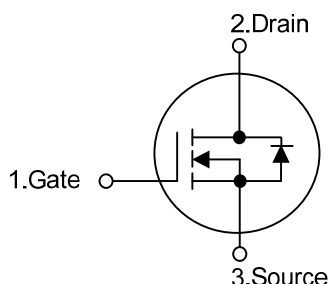
#### DESCRIPTION

The UTC **1N60Q-TA** is a high voltage MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

#### FEATURES

- \*  $R_{DS(ON)} < 9.0\Omega$  @  $V_{GS}=10V$ ,  $I_D=0.5A$
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved dv/dt capability, high ruggedness

#### SYMBOL



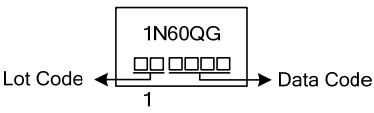
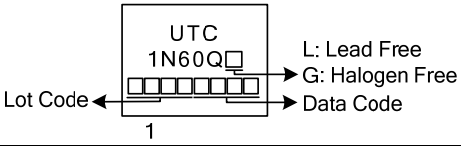
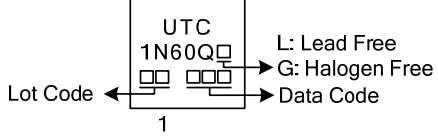
#### ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
-	1N60Q G-AA3-R	SOT-223	G	D	S	Tape Reel
1N60QL-TN3-R	1N60QG-TN3-R	TO-252	G	D	S	Tape Reel
1N60QL-T92-B	1N60QG-T92-B	TO-92	G	D	S	Tape Box
1N60QL-T92-K	1N60QG-T92-K	TO-92	G	D	S	Bulk

Note: Pin Assignment: G: Gate D: Drain S: Source

1N60QG-AA3-R	(1)Packing Type (2)Package Type (3)Green Package	(1) R: Tape Reel, B: Tape Box, K: Bulk (2) AA3: SOT-223, TN3: TO-252, T92: TO-92 (3) L: Lead Free, G: Halogen Free and Lead Free
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## ■ MARKING

PACKAGE	MARKING
SOT-223	 <p>Diagram showing the marking on a SOT-223 package. The package is labeled "1N60QG". Below the label, there are four small squares representing the Lot Code and four small squares representing the Data Code. Arrows point from the Lot Code and Data Code labels to their respective squares. A "1" is printed below the squares.</p>
TO-252	 <p>Diagram showing the marking on a TO-252 package. The package is labeled "UTC" and "1N60Q". Below the label, there are four small squares representing the Lot Code and four small squares representing the Data Code. Arrows point from the Lot Code and Data Code labels to their respective squares. A "1" is printed below the squares. To the right of the package, the text "L: Lead Free" and "G: Halogen Free" is shown, with arrows pointing to the "L" and "G" characters respectively.</p>
TO-92	 <p>Diagram showing the marking on a TO-92 package. The package is labeled "UTC" and "1N60Q". Below the label, there are four small squares representing the Lot Code and four small squares representing the Data Code. Arrows point from the Lot Code and Data Code labels to their respective squares. A "1" is printed below the squares. To the right of the package, the text "L: Lead Free" and "G: Halogen Free" is shown, with arrows pointing to the "L" and "G" characters respectively.</p>

■ ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$ , unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage		$V_{DSS}$	600	V
Gate-Source Voltage		$V_{GSS}$	$\pm 30$	V
Continuous Drain Current	Continuous ( $T_C=25^\circ\text{C}$ )	$I_D$	1.0	A
	Pulsed (Note 2)	$I_{DM}$	4.0	A
Avalanche Current (Note 2)		$I_{AR}$	1	A
Avalanche Energy		$E_{AS}$	60	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	3.5	V/ns
Power Dissipation	SOT-223	$P_D$	7.8	W
	TO-252		28	W
	TO-92		1.56	W
Junction Temperature		$T_J$	+150	$^\circ\text{C}$
Storage Temperature		$T_{STG}$	-55 ~ +150	$^\circ\text{C}$

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. Repetitive Rating: Pulse width limited by maximum junction temperature.

3.  $L = 120\text{mH}$ ,  $I_{AS} = 1\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 1\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL RESISTANCES CHARACTERISTICS

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	SOT-223	$\theta_{JA}$	150	$^\circ\text{C}/\text{W}$
	TO-252		140	$^\circ\text{C}/\text{W}$
	TO-92		110	$^\circ\text{C}/\text{W}$
Junction to Case	SOT-223	$\theta_{JC}$	16	$^\circ\text{C}/\text{W}$
	TO-252		4.46	$^\circ\text{C}/\text{W}$
	TO-92		80	$^\circ\text{C}/\text{W}$

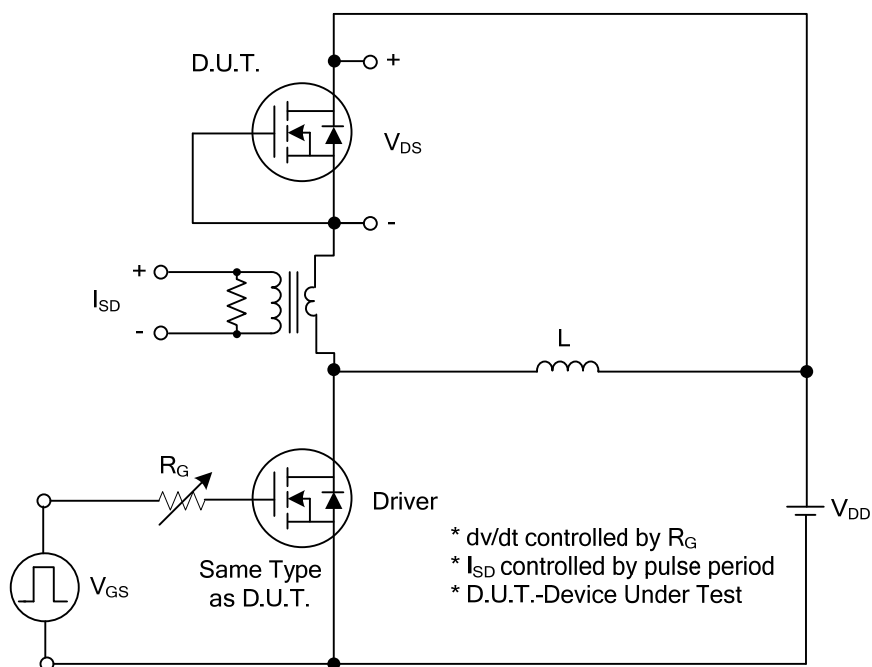
■ ELECTRICAL CHARACTERISTICS (T<sub>C</sub>=25°C, unless otherwise specified.)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV <sub>DSS</sub>	V <sub>GS</sub> =0V, I <sub>D</sub> =250μA	600			V
Drain-Source Leakage Current		I <sub>DSS</sub>	V <sub>DS</sub> =600V, V <sub>GS</sub> =0V			10	μA
Gate-Source Leakage Current	Forward	I <sub>GSS</sub>	V <sub>GS</sub> =30V, V <sub>DS</sub> =0V			100	nA
	Reverse		V <sub>GS</sub> =-30V, V <sub>DS</sub> =0V			-100	nA
ON CHARACTERISTICS							
Gate Threshold Voltage		V <sub>GS(TH)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	2.0		4.0	V
Static Drain-Source On-State Resistance		R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =0.5A			9.0	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C <sub>ISS</sub>	V <sub>DS</sub> =25V, V <sub>GS</sub> =0V, f=1MHz		195		pF
Output Capacitance		C <sub>OSS</sub>			20		pF
Reverse Transfer Capacitance		C <sub>RSS</sub>			3		pF
SWITCHING CHARACTERISTICS							
Total Gate Charge (Note 1)		Q <sub>G</sub>	V <sub>DS</sub> =50V, V <sub>GS</sub> =10V, I <sub>D</sub> =1.3A, I <sub>G</sub> =100μA (Note 1, 2)		13		nC
Gate-Source Charge		Q <sub>GS</sub>			1.3		nC
Gate-Drain Charge		Q <sub>GD</sub>			1		nC
Turn-On Delay Time (Note 1)		t <sub>D(ON)</sub>	V <sub>DD</sub> =30V, V <sub>GS</sub> =10V, I <sub>D</sub> =0.5A, R <sub>G</sub> =25Ω(Note 1, 2)		28		ns
Turn-On Rise Time		t <sub>R</sub>			19		ns
Turn-Off Delay Time		t <sub>D(OFF)</sub>			53		ns
Turn-Off Fall Time		t <sub>F</sub>			25		ns
SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS							
Maximum Continuous Drain-Source Diode Forward Current		I <sub>S</sub>				1	A
Maximum Pulsed Drain-Source Diode Forward Current		I <sub>SM</sub>				4	A
Drain-Source Diode Forward Voltage (Note 1)		V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =1.0A			1.4	V
Reverse Recovery Time (Note 1)		t <sub>rr</sub>	V <sub>GS</sub> = 0V, I <sub>S</sub> = 1.0A,		200		nS
Reverse Recovery Charge		Q <sub>rr</sub>	dl <sub>F</sub> / dt =100A/μs (Note 1)		0.44		μC

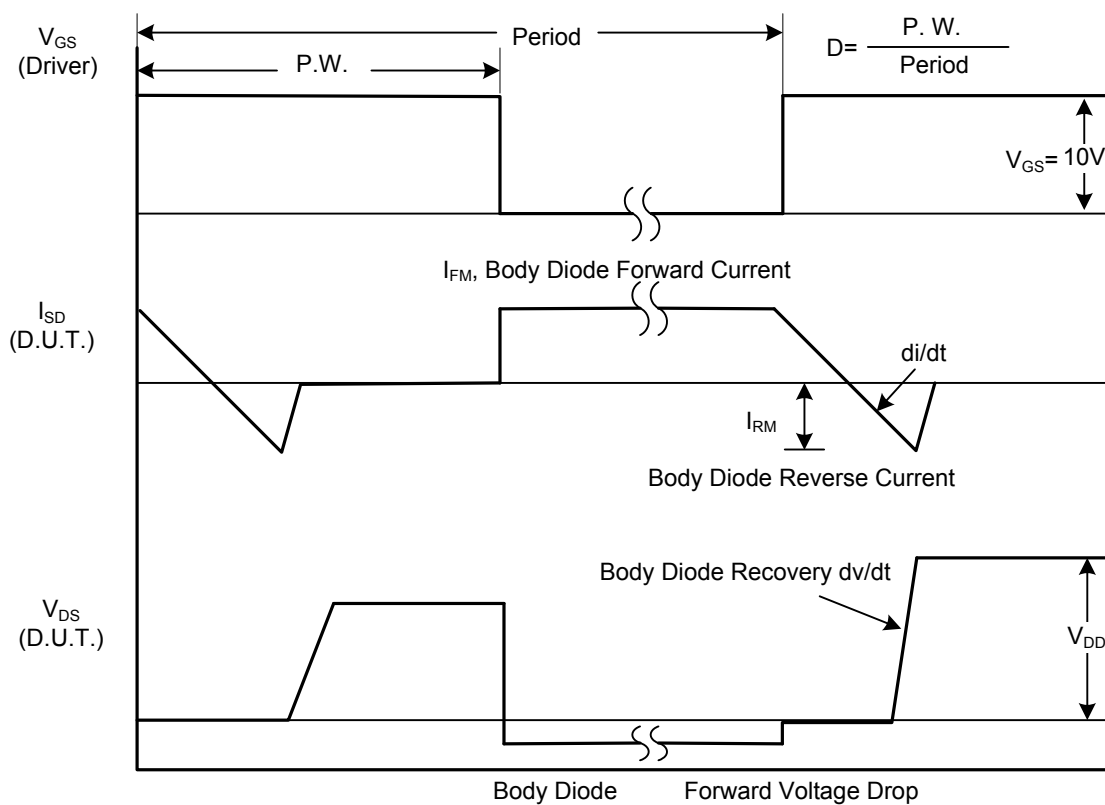
Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

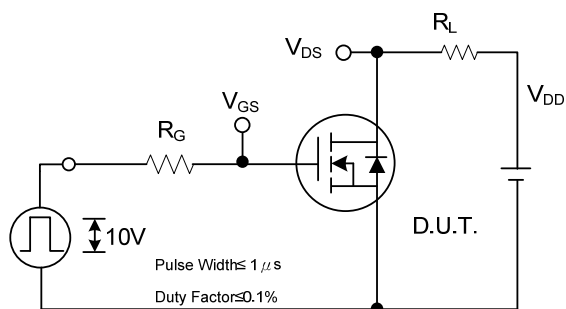


Peak Diode Recovery dv/dt Test Circuit

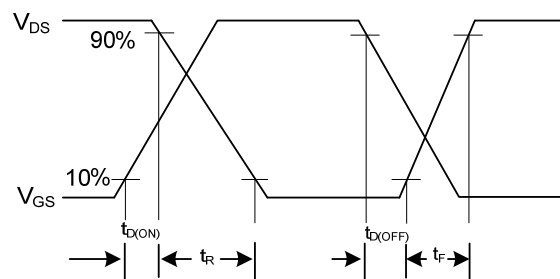


Peak Diode Recovery dv/dt Waveforms

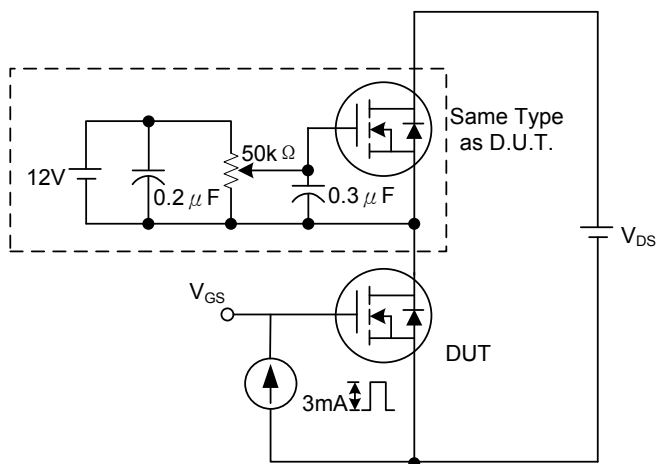
# ■ TEST CIRCUITS AND WAVEFORMS (Cont.)



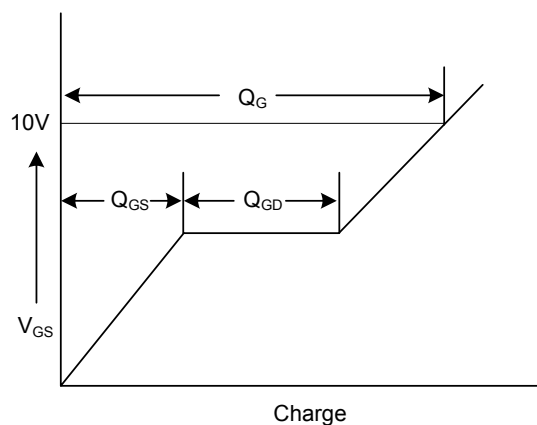
Switching Test Circuit



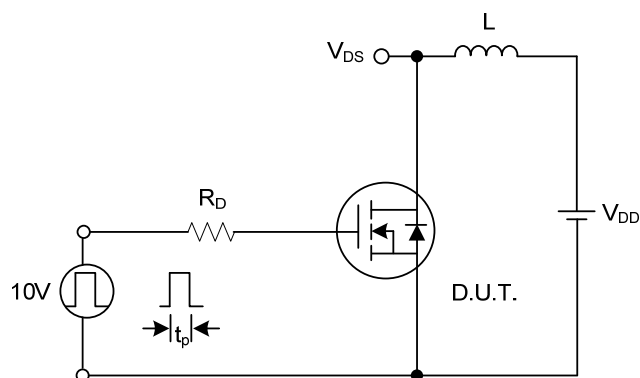
Switching Waveforms



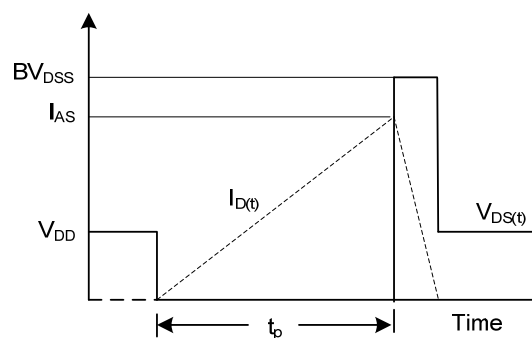
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms



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