



1N60Q-TA

Preliminary

Power MOSFET

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

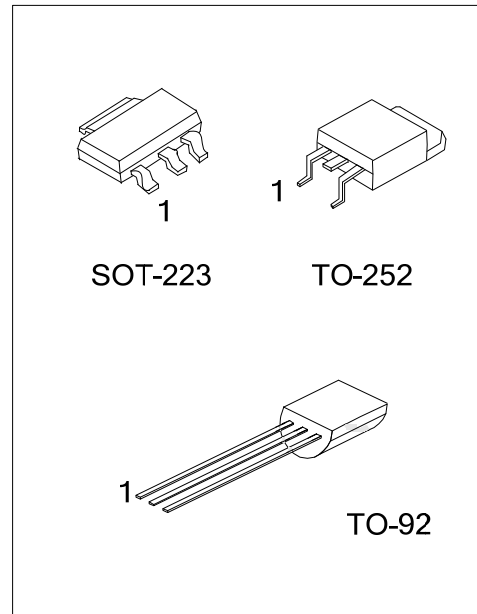
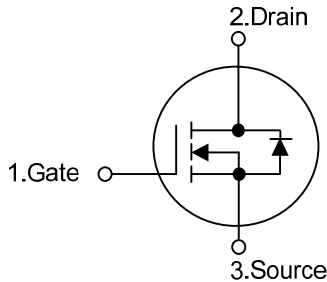
■ DESCRIPTION

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

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

■ SYMBOL



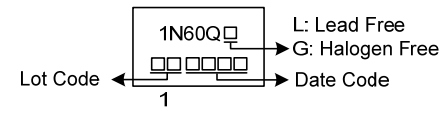
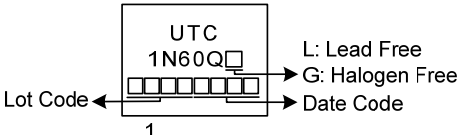
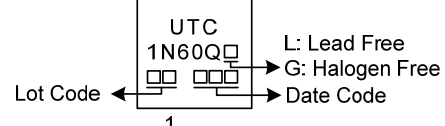
■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
1N60QL-AA3-R	1N60QG-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

<p>1N60QG-AA3-R</p>	<p>(1) R: Tape Reel, B: Tape Box, K: Bulk (2) AA3: SOT-223, TN3: TO-252, T92: TO-92 (3) G: Halogen Free and Lead Free, L: Lead Free</p>
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■ MARKING

PACKAGE	MARKING
SOT-223	 <p>Diagram showing marking on a SOT-223 package. The marking includes '1N60Q' followed by a small square, a lot code (four digits), and a date code (four digits). A '1' is printed below the lot code. To the right, 'L: Lead Free' and 'G: Halogen Free' are indicated with arrows pointing to the right.</p>
TO-252	 <p>Diagram showing marking on a TO-252 package. The marking includes 'UTC' above '1N60Q' followed by a small square, a lot code (seven digits), and a date code (four digits). A '1' is printed below the lot code. To the right, 'L: Lead Free' and 'G: Halogen Free' are indicated with arrows pointing to the right.</p>
TO-92	 <p>Diagram showing marking on a TO-92 package. The marking includes 'UTC' above '1N60Q' followed by a small square, a lot code (four digits), and a date code (four digits). A '1' is printed below the lot code. To the right, 'L: Lead Free' and 'G: Halogen Free' are indicated with arrows pointing to the right.</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}	± 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	Single Pulsed (Note 2)	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	θ_{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	θ_{JC}	16	$^\circ\text{C}/\text{W}$
	TO-252		4.46	$^\circ\text{C}/\text{W}$
	TO-92		80	$^\circ\text{C}/\text{W}$

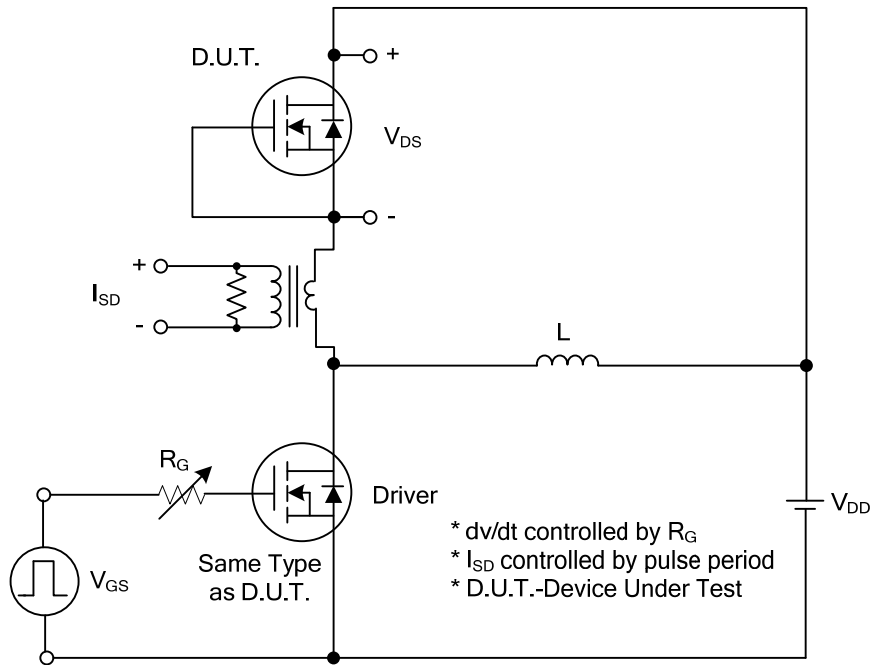
■ ELECTRICAL CHARACTERISTICS ($T_C=25^\circ\text{C}$, unless otherwise specified.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=250\mu A$	600			V
Drain-Source Leakage Current	I_{DSS}	$V_{DS}=600V, V_{GS}=0V$			10	μA
Gate-Source Leakage Current	Forward	I_{GSS}			100	nA
	Reverse				-100	nA
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2.0		4.0	V
Static Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=0.5A$			9.0	Ω
DYNAMIC CHARACTERISTICS						
Input Capacitance	C_{ISS}	$V_{DS}=25V, V_{GS}=0V, f=1\text{MHz}$		195		pF
Output Capacitance	C_{OSS}			20		pF
Reverse Transfer Capacitance	C_{RSS}			3		pF
SWITCHING CHARACTERISTICS						
Total Gate Charge (Note 1)	Q_G	$V_{DS}=50V, V_{GS}=10V, I_D=1.3A, I_G=100\mu A$ (Note 1, 2)		13		nC
Gate-Source Charge	Q_{GS}			1.3		nC
Gate-Drain Charge	Q_{GD}			1		nC
Turn-On Delay Time (Note 1)	$t_{D(ON)}$	$V_{DD}=30V, V_{GS}=10V, I_D=0.5A, R_G=25\Omega$ (Note 1, 2)		28		ns
Turn-On Rise Time	t_R			19		ns
Turn-Off Delay Time	$t_{D(OFF)}$			53		ns
Turn-Off Fall Time	t_F			25		ns
SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS						
Maximum Continuous Drain-Source Diode Forward Current	I_S				1	A
Maximum Pulsed Drain-Source Diode Forward Current	I_{SM}				4	A
Drain-Source Diode Forward Voltage (Note 1)	V_{SD}	$V_{GS}=0V, I_S=1.0A$			1.4	V
Reverse Recovery Time (Note 1)	t_{rr}	$V_{GS}=0V, I_S=1.0A,$		200		ns
Reverse Recovery Charge	Q_{rr}	$di_F/dt=100A/\mu s$ (Note 1)		0.44		μC

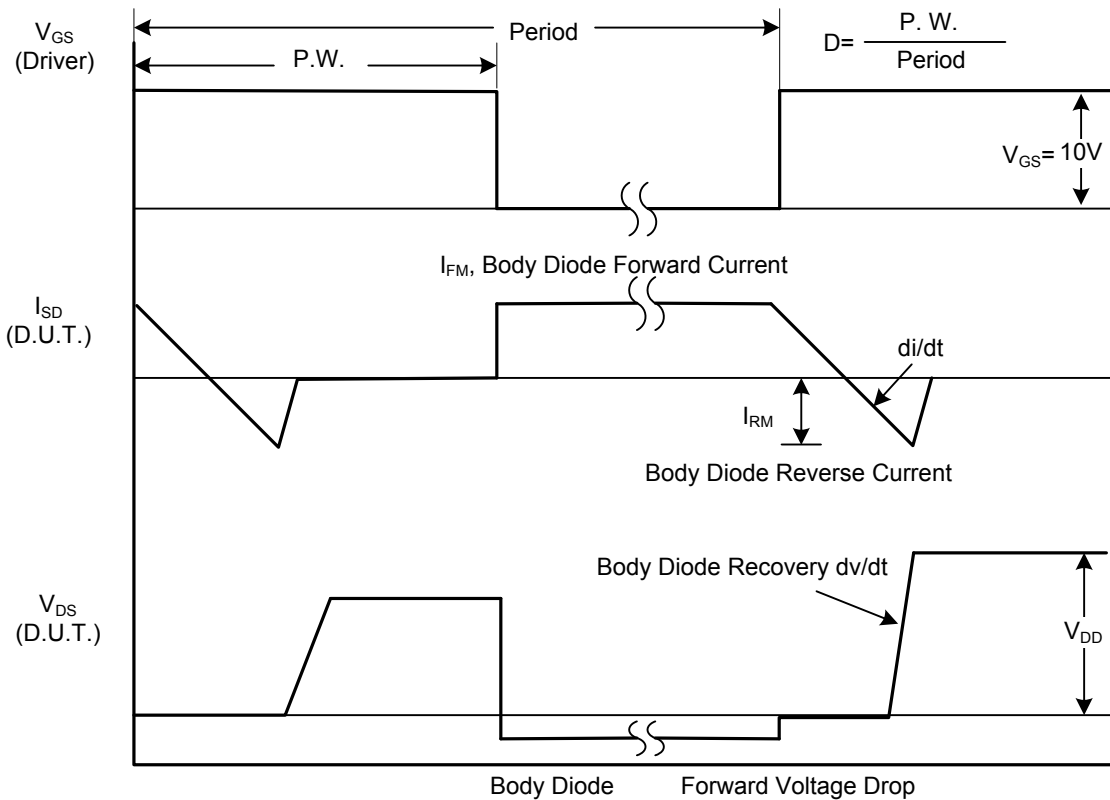
Notes: 1. Pulse Test: Pulse width $\leq 300\mu s$, Duty cycle $\leq 2\%$.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

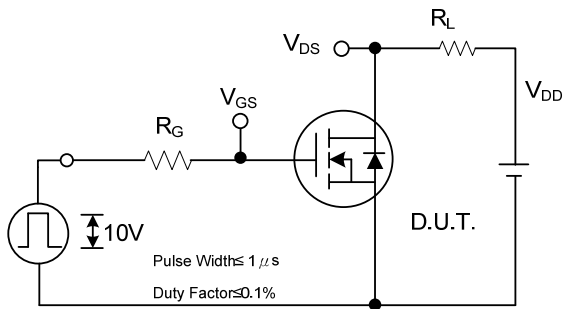


Peak Diode Recovery dv/dt Test Circuit

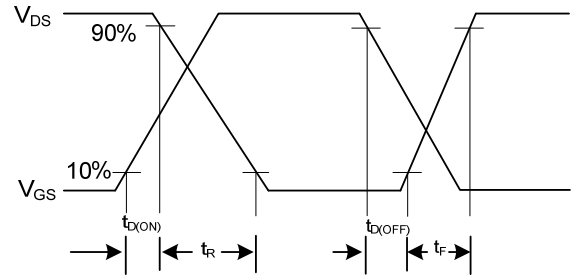


Peak Diode Recovery dv/dt Waveforms

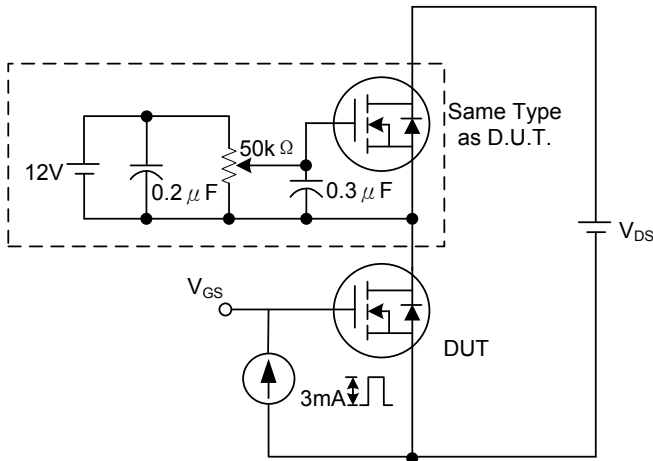
■ TEST CIRCUITS AND WAVEFORMS (Cont.)



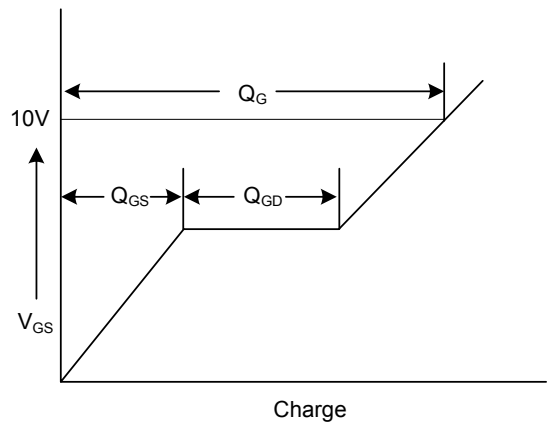
Switching Test Circuit



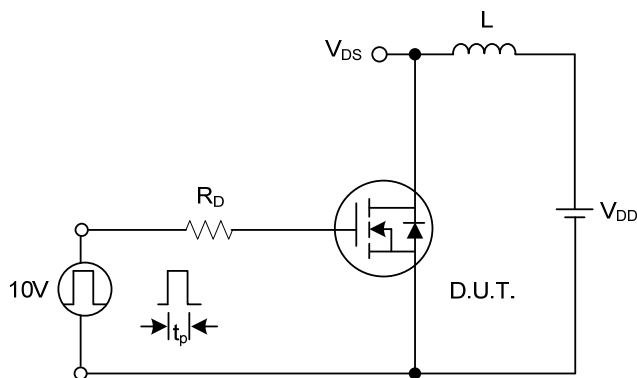
Switching Waveforms



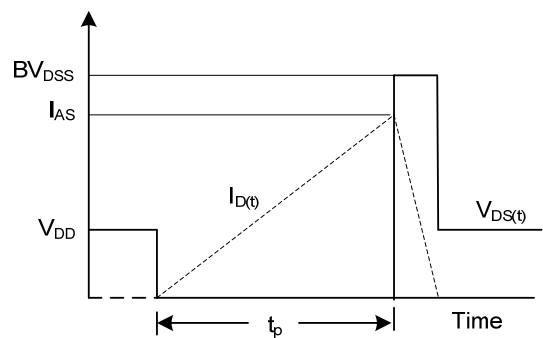
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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