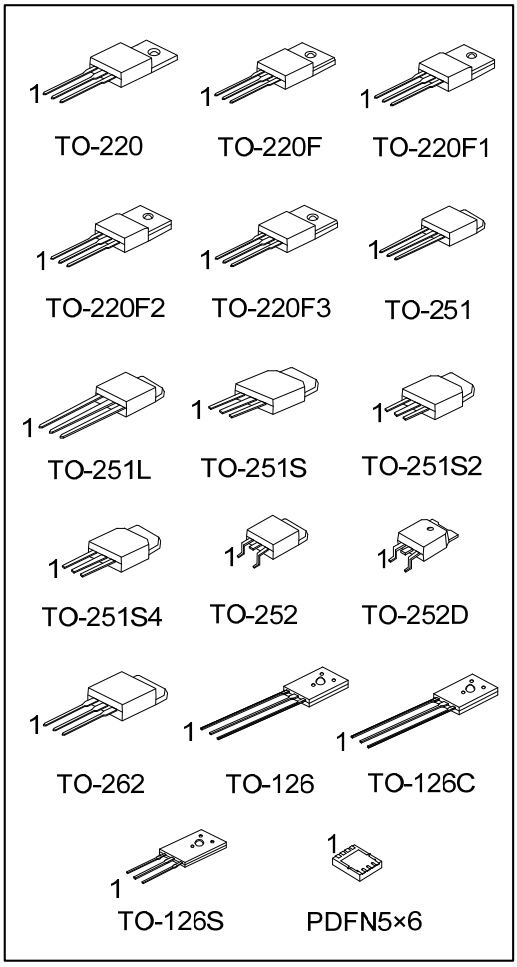
2N60

Power MOSFET

2.0A, 600V N-CHANNEL POWER MOSFET



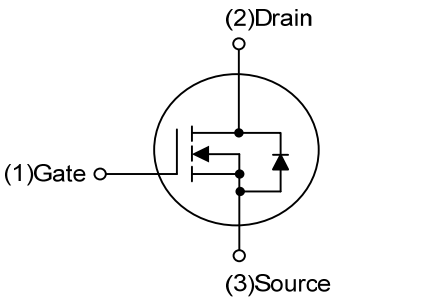
■ DESCRIPTION

The UTC **2N60** is a high voltage power 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 AC to DC converters and bridge circuits.

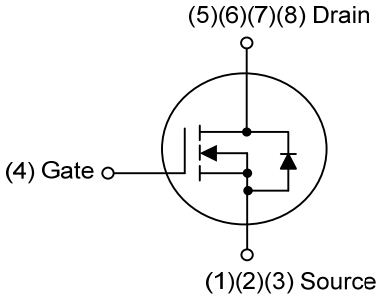
■ FEATURES

* $R_{DS(ON)} \leq 5.0\ \Omega$ @ V_{GS} = 10V, I_D =1.0A
* Fast switching capability
* Avalanche energy specified
* Improved dv/dt capability, high ruggedness

■ SYMBOL



TO-220/TO-220F/TO-220F1/TO-220F2
TO-220F3/TO-251/TO-251LTO-251S
TO-251S2/TO-251S4/TO-252/TO-252D
TO-262/TO-126/TO-126C/TO-126S

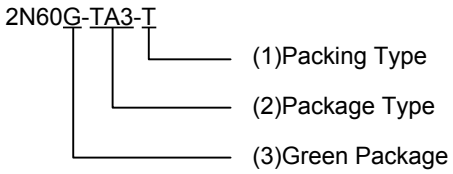


PDFN5×6

■ ORDERING INFORMATION

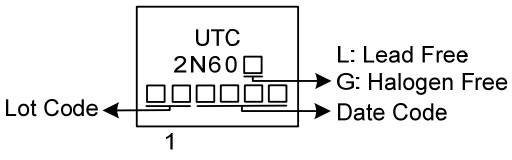
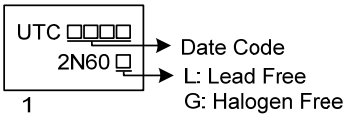
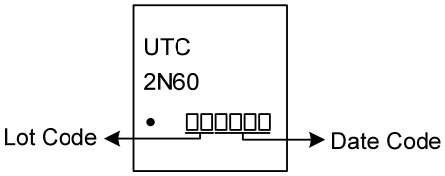
Ordering Number		Package	Pin Assignment								Packing
Lead Free	Halogen Free		1	2	3	4	5	6	7	8	
2N60L-TA3-T	2N60G-TA3-T	TO-220	G	D	S	-	-	-	-	-	Tube
2N60L-TF1-T	2N60G-TF1-T	TO-220F1	G	D	S	-	-	-	-	-	Tube
2N60L-TF2-T	2N60G-TF2-T	TO-220F2	G	D	S	-	-	-	-	-	Tube
2N60L-TF3-T	2N60G-TF3-T	TO-220F	G	D	S	-	-	-	-	-	Tube
2N60L-TF3T-T	2N60G-TF3T-T	TO-220F3	G	D	S	-	-	-	-	-	Tube
2N60L-TM3-T	2N60G-TM3-T	TO-251	G	D	S	-	-	-	-	-	Tube
2N60L-TMA-T	2N60G-TMA-T	TO-251L	G	D	S	-	-	-	-	-	Tube
2N60L-TMS-T	2N60G-TMS-T	TO-251S	G	D	S	-	-	-	-	-	Tube
2N60L-TMS2-T	2N60G-TMS2-T	TO-251S2	G	D	S	-	-	-	-	-	Tube
2N60L-TMS4-T	2N60G-TMS4-T	TO-251S4	G	D	S	-	-	-	-	-	Tube
2N60L-TN3-R	2N60G-TN3-R	TO-252	G	D	S	-	-	-	-	-	Tape Reel
2N60L-TND-R	2N60G-TND-R	TO-252D	G	D	S	-	-	-	-	-	Tape Reel
2N60L-T2Q-T	2N60G-T2Q-T	TO-262	G	D	S	-	-	-	-	-	Tube
2N60L-T60-K	2N60G-T60-K	TO-126	G	D	S	-	-	-	-	-	Bulk
2N60L-T6C-K	2N60G-T6C-K	TO-126C	G	D	S	-	-	-	-	-	Bulk
2N60L-T6S-K	2N60G-T6S-K	TO-126S	G	D	S	-	-	-	-	-	Tube
2N60L-P5060-R	2N60G-P5060-R	PDFN5×6	S	S	S	G	D	D	D	D	Tape Reel

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



(1) T: Tube, R: Tape Reel, K:Bulk
(2) TA3: TO-220, TF1: TO-220F1, TF2: TO-220F2
TF3: TO-220F, TF3T: TO-220F3, TM3: TO-251,
TMA: TO-251L, TMS: TO-251S, TMS2: TO-251S2,
TMS4: TO-251S4, TN3: TO-252, TND: TO-252D,
T2Q: TO-262, T60: TO-126, T6C:TO-126C,
T6S:TO-126S, P5060: PDFN5×6
(3) G: Halogen Free and Lead Free, L: Lead Free

■ MARKING

PACKAGE		MARKING
TO-220 TO-220F TO-220F1 TO-220F2 TO-220F3 TO-251 TO-251L	TO-251S TO-251S2 TO-251S4 TO-252 TO-252D TO-262	
TO-126 TO-126C TO-26S		
PDFN5×6		

■ ABSOLUTE MAXIMUM RATINGS (T_C = 25°C, unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage		V_{DSS}	600	V
Gate-Source Voltage		V_{GSS}	±30	V
Avalanche Current (Note 2)		I_{AR}	2.0	A
Drain Current	Continuous	I_D	2.0	A
	Pulsed (Note 2)	I_{DM}	8.0	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	140	mJ
	Repetitive (Note 2)	E_{AR}	4.5	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Power Dissipation (T_C = 25°C)	TO-220/ TO-262	P_D	54	W
	TO-220F/TO-220F1 TO-220F3		23	W
	TO-220F2		24	W
	TO-251/TO-251L TO-251S/TO-251S2 TO-251S4/TO-252 TO-252D		44	W
	TO-126/TO-126C TO-126S		40	W
	PDFN5×6		22	W
Junction Temperature		T_J	+150	°C
Operating Temperature		T_{OPR}	-55 ~ +150	°C
Storage Temperature		T_{STG}	-55 ~ +150	°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 T_J.
3. L=64mH, I_{AS}=2.0A, V_{DD}=50V, R_G=25 Ω, Starting T_J = 25°C
4. I_{SD}≤2.4A, di/dt≤200A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C

■ THERMAL DATA

PARAMETER	PACKAGE	SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/TO-220F TO-220F1/TO-220F2 TO-220F3/TO-262	$θ_{JA}$	62.5	°C/W
	TO-251/TO-251L TO-251S/TO-251S2 TO-251S4/TO-252 TO-252D		100	°C/W
	TO-126/TO-126C TO-126S		89	°C/W
	PDFN5×6		75 (Note)	°C/W
Junction to Case	TO-220/TO-262	$θ_{JC}$	2.32	°C/W
	TO-220F/TO-220F1 TO-220F3		5.5	°C/W
	TO-220F2		5.43	°C/W
	TO-251/TO-251L TO-251S/TO-251S2 TO-251S4/TO-252 TO-252D		2.87	°C/W
	TO-126/TO-126C TO-126S		3.12	°C/W
	PDFN5×6		5.6 (Note)	°C/W

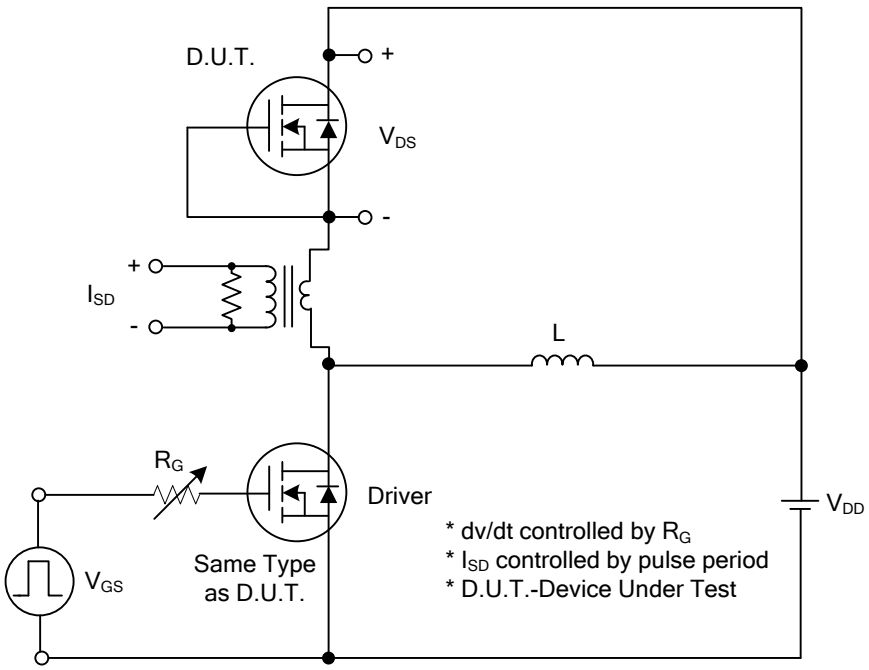
Note: Device mounted on FR-4 substrate PC board, 2oz copper, with 1inch square copper plate.

■ ELECTRICAL CHARACTERISTICS (T_J=25°C, unless otherwise specified)

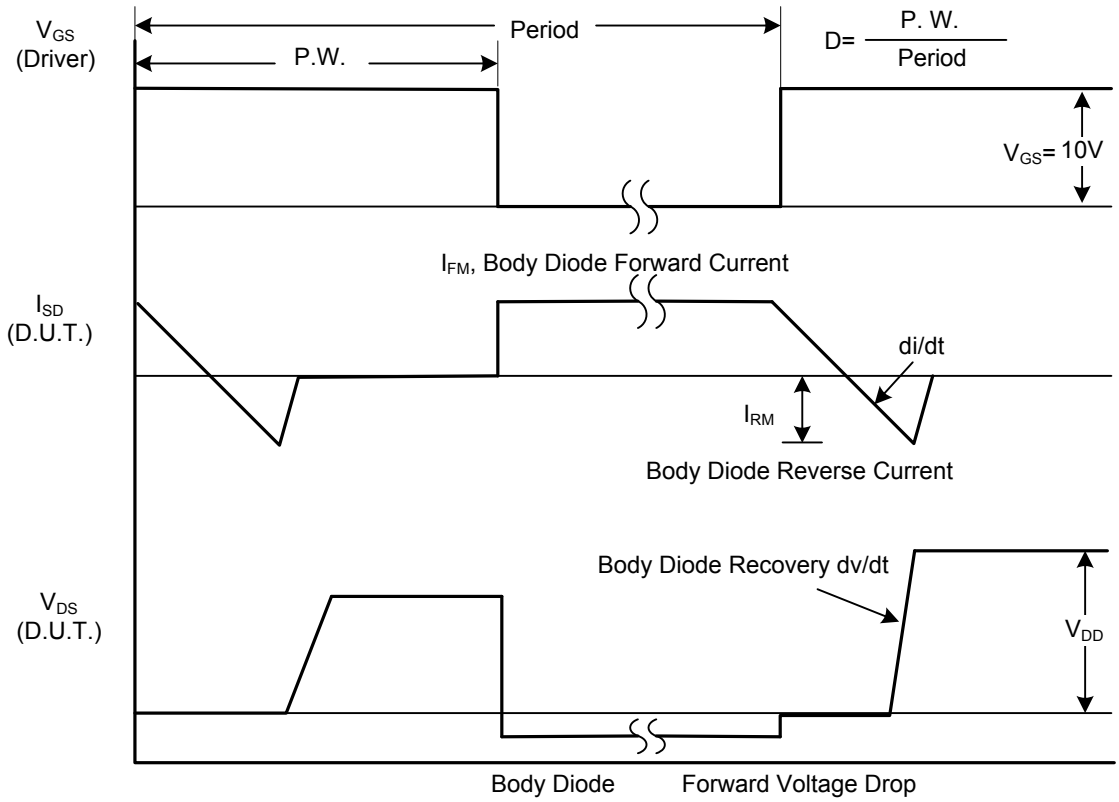
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV_{DSS}	V_{GS} = 0V, I_D = 250μA	600			V
Drain-Source Leakage Current		I_{DSS}	V_{DS} = 600V, V_{GS} = 0V			10	μA
			V_{DS} = 480V, T_C = 125°C			100	μA
Gate-Source Leakage Current	Forward	I_{GSS}	V_{GS} = 30V, V_{DS} = 0V			100	nA
	Reverse		V_{GS} = -30V, V_{DS} = 0V			-100	nA
Breakdown Voltage Temperature Coefficient		$\triangle BV_{DSS}/\triangle T_J$	I_D=250μA, Referenced to 25°C		0.4		V/°C
ON CHARACTERISTICS							
Gate Threshold Voltage		$V_{GS(TH)}$	V_{DS} = V_{GS}, I_D = 250μA	2.0		4.0	V
Static Drain-Source On-State Resistance		$R_{DS(ON)}$	V_{GS} = 10V, I_D =1.0A		3.6	5	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C_{ISS}	V_{DS} =25V, V_{GS} =0V, f =1MHz		300	350	pF
Output Capacitance		C_{OSS}			45	50	pF
Reverse Transfer Capacitance		C_{RSS}			10	13	pF
SWITCHING CHARACTERISTICS							
Total Gate Charge		Q_G	V_{DS}=480V, V_{GS}=10V, I_D=2.4A (Note 1, 2)		40	50	nC
Gate-Source Charge		Q_{GS}			4.2		nC
Gate-Drain Charge		Q_{GD}			8.4		nC
Turn-On Delay Time		$t_{D(ON)}$	V_{DD} =300V, I_D =2.4A, R_G=25Ω (Note 1, 2)		40	60	ns
Turn-On Rise Time		t_R			35	55	ns
Turn-Off Delay Time		$t_{D(OFF)}$			90	120	ns
Turn-Off Fall Time		t_F			50	60	ns
DRAIN-SOURCE DIODE CHARACTERISTICS							
Continuous Drain-Source Current		I_S				2.0	A
Pulsed Drain-Source Current		I_{SM}				8.0	A
Drain-Source Diode Forward Voltage		V_{SD}	V_{GS} = 0 V, I_{SD} = 2.0A			1.4	V
Reverse Recovery Time		t_{rr}	V_{GS} = 0 V, I_{SD} = 2.4A, di/dt = 100 A/μs (Note 1)		180		ns
Reverse Recovery Charge		Q_{rr}			0.72		μC

Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle≤2%.
2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

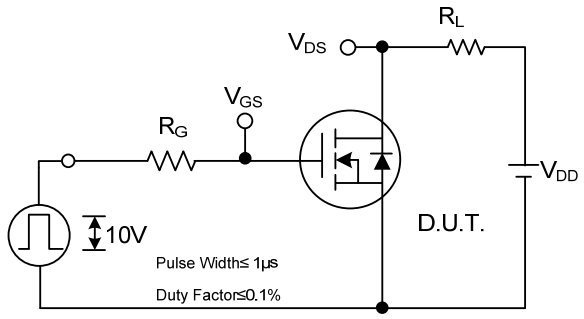


Peak Diode Recovery dv/dt Test Circuit

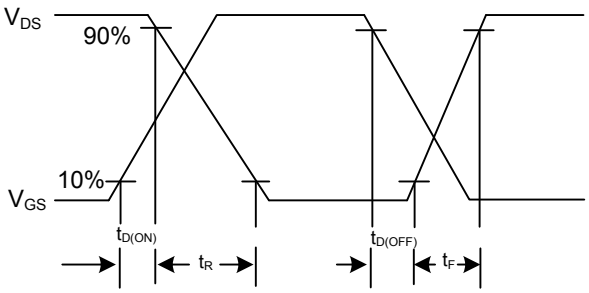


Peak Diode Recovery dv/dt Waveforms

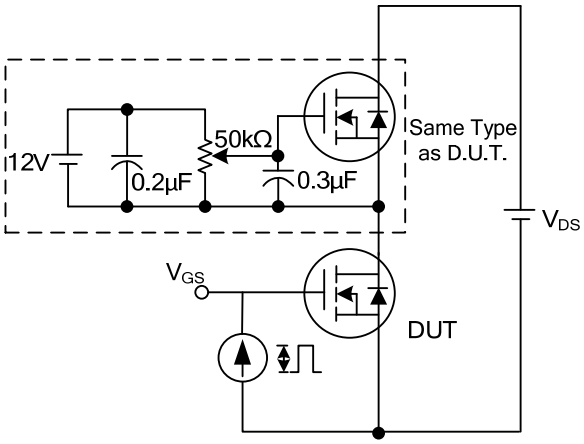
■ TEST CIRCUITS AND WAVEFORMS



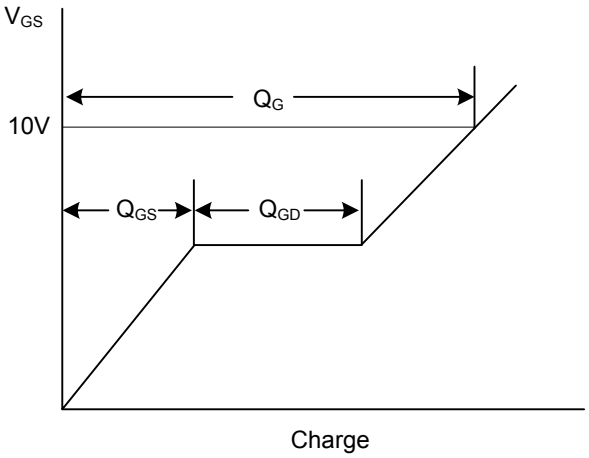
Switching Test Circuit



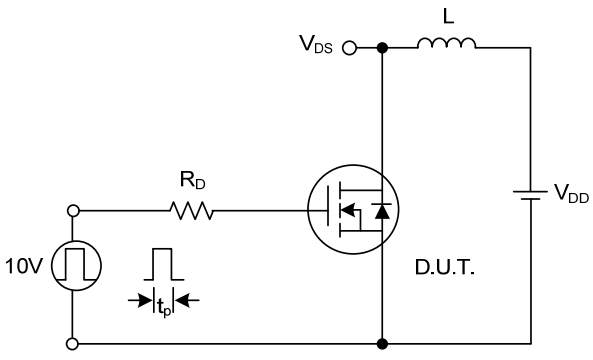
Switching Waveforms



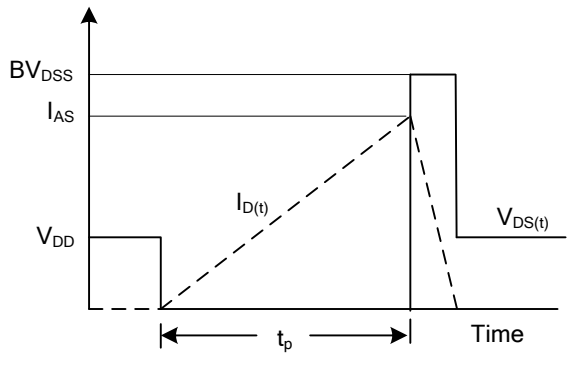
Gate Charge Test Circuit



Gate Charge Waveform



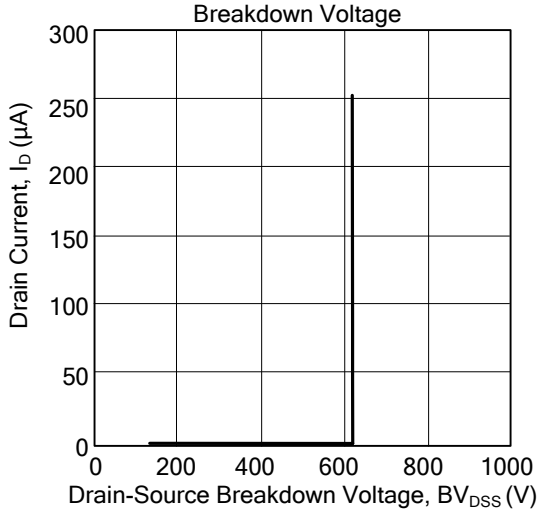
Unclamped Inductive Switching Test Circuit



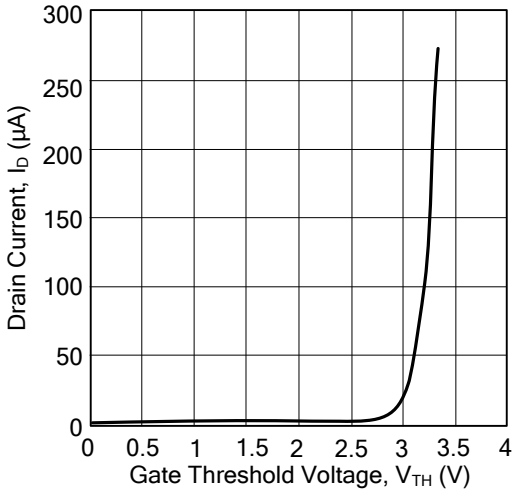
Unclamped Inductive Switching Waveforms

■ TYPICAL CHARACTERISTICS

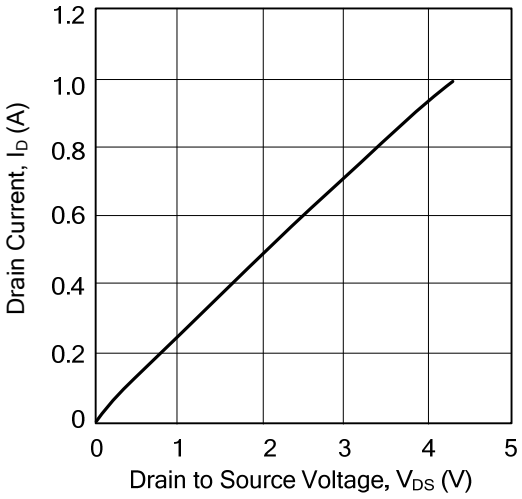
Drain Current vs. Drain-Source Breakdown Voltage



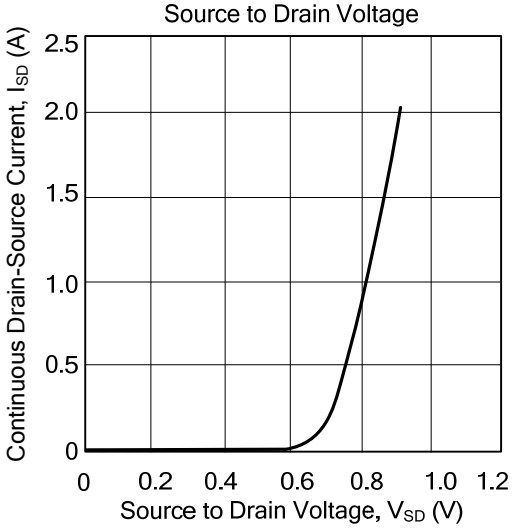
Drain Current vs. Gate Threshold Voltage



Drain-Source On-State Resistance Characteristics



Continuous Drain-Source Current vs. Source to Drain Voltage



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