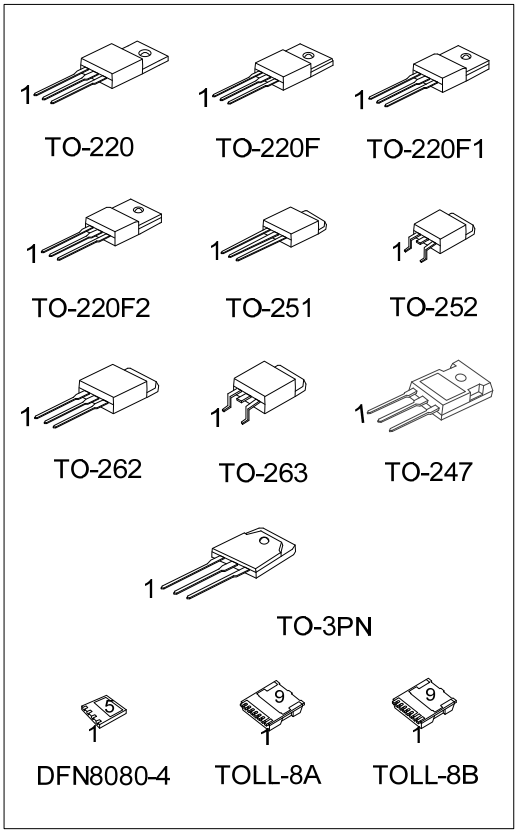
9NM95Z

Power MOSFET

9.0A, 950V N-CHANNEL SUPER-JUNCTION MOSFET



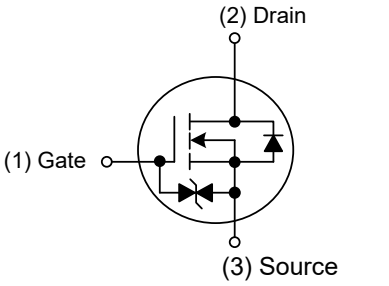
■ DESCRIPTION

The UTC **9NM95Z** is a Super Junction MOSFET Structure and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and a high rugged avalanche characteristics. This power MOSFET is usually used at AC-DC converters for power applications.

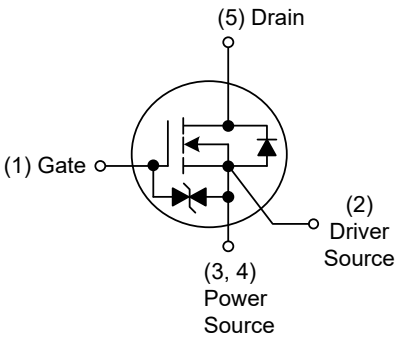
■ FEATURES

* $R_{DS(ON)} \leq 1.4\ \Omega$ @ V_{GS}=10V, I_D=4.5A
* High Switching Speed

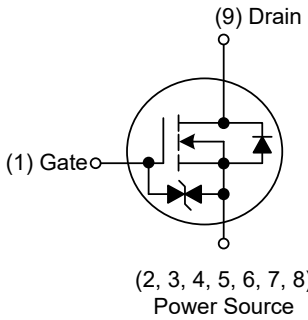
■ SYMBOL



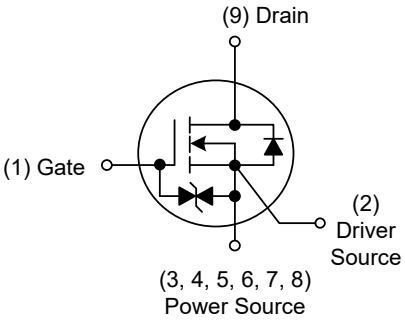
TO-220 / TO-220F / TO-220F1
TO-220F2 / TO-251 / TO-252
TO-247 / TO-262 / TO-263 / TO-3PN



DFN8080-4



TOLL-8A

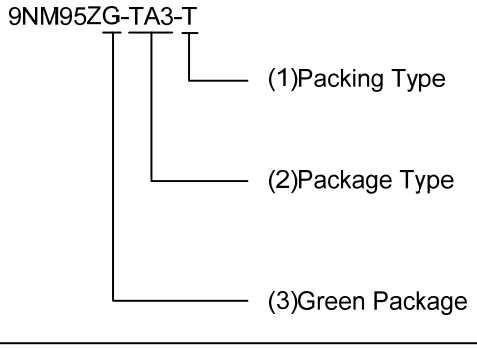


TOLL-8B

■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment									Packing
Lead Free	Halogen Free		1	2	3	4	5	6	7	8	9	
9NM95ZL-TA3-T	9NM95ZG-TA3-T	TO-220	G	D	S	-	-	-	-	-	-	Tube
9NM95ZL-TF1-T	9NM95ZG-TF1-T	TO-220F1	G	D	S	-	-	-	-	-	-	Tube
9NM95ZL-TF2-T	9NM95ZG-TF2-T	TO-220F2	G	D	S	-	-	-	-	-	-	Tube
9NM95ZL-TF3-T	9NM95ZG-TF3-T	TO-220F	G	D	S	-	-	-	-	-	-	Tube
9NM95ZL-TM3-T	9NM95ZG-TM3-T	TO-251	G	D	S	-	-	-	-	-	-	Tube
9NM95ZL-TN3-R	9NM95ZG-TN3-R	TO-252	G	D	S	-	-	-	-	-	-	Tape Reel
9NM95ZL-T2Q-T	9NM95ZG-T2Q-T	TO-262	G	D	S	-	-	-	-	-	-	Tube
9NM95ZL-TQ2-T	9NM95ZG-TQ2-T	TO-263	G	D	S	-	-	-	-	-	-	Tube
9NM95ZL-TQ2-R	9NM95ZG-TQ2-R	TO-263	G	D	S	-	-	-	-	-	-	Tape Reel
9NM95ZL-T47-T	9NM95ZG-T47-T	TO-247	G	D	S	-	-	-	-	-	-	Tube
9NM95Z L-T3N-T	9NM95Z G-T3N-T	TO-3PN	G	D	S	-	-	-	-	-	-	Tube
9NM95ZL-K04-8080-R	9NM95ZG-K04-8080-R	DFN8080-4	G	S	S	S	D	-	-	-	-	Tape Reel
9NM95ZL-T8A-R	9NM95ZG-T8A-R	TOLL-8A	G	S	S	S	S	S	S	S	D	Tape Reel
9NM95ZL-T8B-R	9NM95ZG-T8B-R	TOLL-8B	G	S	S	S	S	S	S	S	D	Tape Reel

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

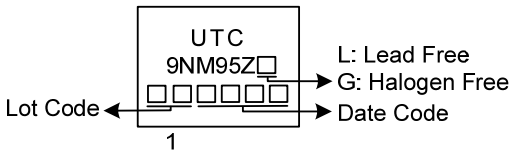
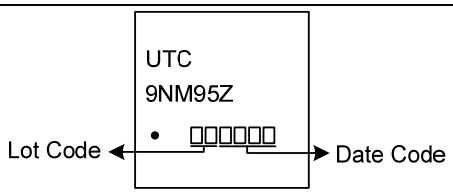
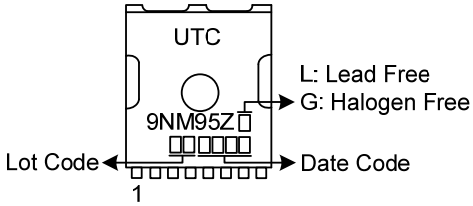


(1) T: Tube, R: Tape Reel

(2) TA3: TO-220, TF1: TO-220F1, TF2: TO-220F2, TF3: TO-220F, TM3: TO-251, TN3: TO-252, T2Q: TO-262, TQ2: TO-263, T3N: TO-3PN, T47: TO-247, T8A: TOLL-8A, T8B: TOLL-8B, K04-8080: DFN8080-4

(3) G: Halogen Free and Lead Free L: Lead Free

■ MARKING

TO-220 / TO-220F / TO-220F1 TO-220F2 / TO-251 / TO-252 TO-247 / TO-262 / TO-263 / TO-3PN	DFN8080-4
	
TOLL-8A / TOLL-8B	-
	-

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

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage		V_{DSS}	950	V
Gate-Source Voltage		V_{GSS}	±20	V
Drain Current	Continuous	I_D	9	A
	Pulsed (Note 2)	I_{DM}	27	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	225	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	1	V/ns
Power Dissipation	TO-220/TO-262 TO-263	P_D	70	W
	TO-220F/TO-220F1 TO-220F2		27	W
	TO-3PN		130	W
	TO-247		120	W
	TO-251/TO-252		36	W
	DFN8080-4		50	W
	TOLL-8A/TOLL-8A		150	W
Junction Temperature		T_J	+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 maximum junction temperature.
3. L = 100mH, I_{AS} = 2.1A, V_{DD} = 50V, R_G = 25Ω Starting T_J = 25°C
4. I_{SD} ≤ 9.0A, di/dt ≤ 200A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/TO-220F TO-220F1/TO-220F2 TO-262/TO-263	θ_{JA}	62.5	°C/W
	TO-3PN		30	°C/W
	TO-247		40	°C/W
	TO-251/TO-252		110	°C/W
	DFN8080-4/TOLL-8A/TOLL-8A		35	°C/W
Junction to Case	TO-220/TO-262/TO-263	θ_{JC}	1.78	°C/W
	TO-220F/TO-220F1 TO-220F2		4.62	°C/W
	TO-3PN		0.96	°C/W
	TO-247		1.04	°C/W
	TO-251/TO-252		3.47 (Note)	°C/W
	DFN8080-4		2.5 (Note)	°C/W
	TOLL-8A/TOLL-8A		0.83 (Note)	°C/W

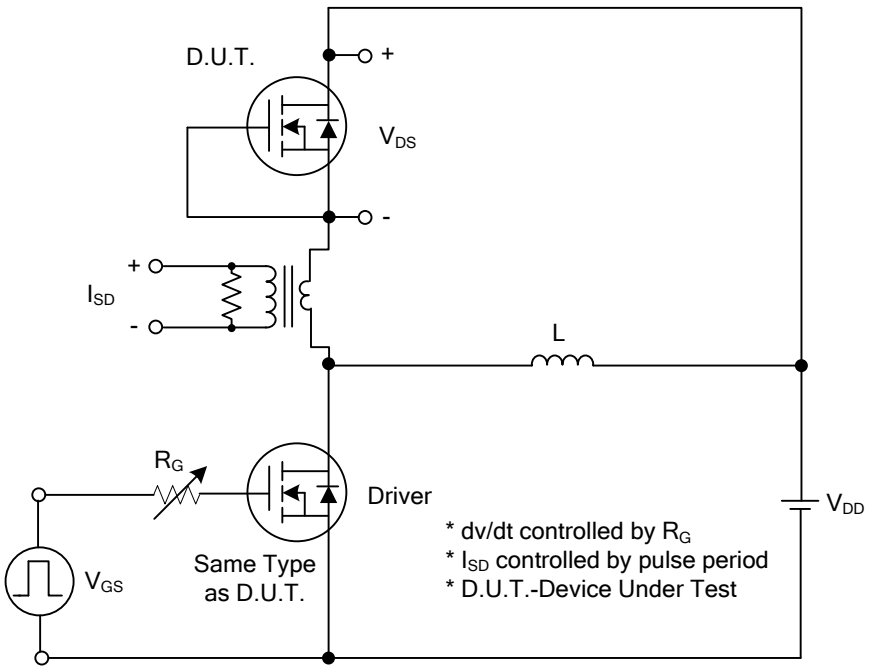
Note: Device mounted on FR-4 substrate P_C board, 2oz copper, with 1inch square copper plate.

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

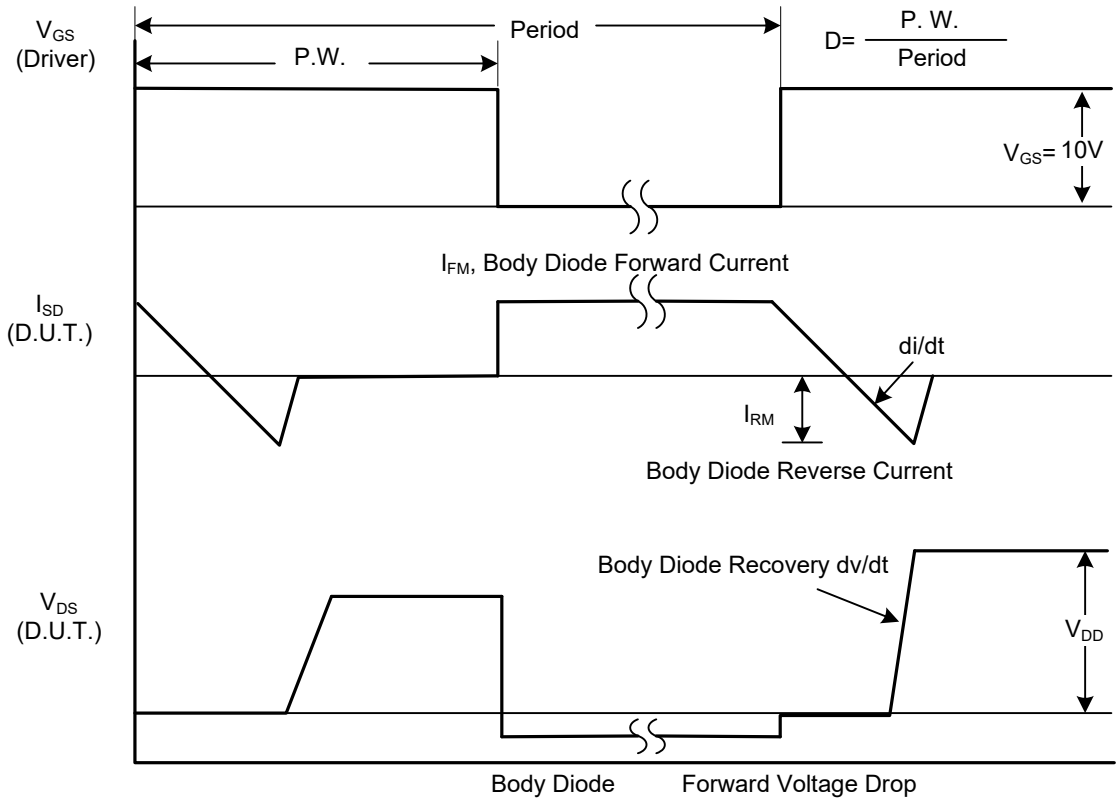
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV_{DSS}	V_{GS}=0V, I_D= 250μA	950			V
Drain-Source Leakage Current		I_{DSS}	V_{DS}=950V, V_{GS}=0V			10	μA
Gate-Source Leakage Current	Forward	I_{GSS}	V_{GS}=20V, V_{DS}=0V			10	μA
	Reverse		V_{GS}=-20V, V_{DS}=0V			-10	μA
ON CHARACTERISTICS							
Gate Threshold Voltage		$V_{GS(TH)}$	V_{DS}=V_{GS}, I_D=250μA	2.5		4.5	V
Static Drain-Source On-State Resistance		$R_{DS(ON)}$	V_{GS}=10V, I_D=4.5A			1.4	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C_{ISS}	V_{GS}=0V, V_{DS}=50V, f=1.0 MHz		676		pF
Output Capacitance		C_{OSS}			54		pF
Reverse Transfer Capacitance		C_{RSS}			2		pF
SWITCHING CHARACTERISTICS							
Total Gate Charge (Note 1)		Q_G	V_{DS}=760V, V_{GS}=10V, I_D=9.0A (Note 1, 2)		33		nC
Gateource Charge		Q_{GS}			8		nC
Gate-Drain Charge		Q_{GD}			13		nC
Turn-on Delay Time (Note 1)		$t_{D(ON)}$	V_{DS}=100V, V_{GS}=10V, I_D=9.0A, R_G=25Ω (Note 1, 2)		11		ns
Rise Time		t_R			22		ns
Turn-off Delay Time		$t_{D(OFF)}$			79		ns
Fall-Time		t_F			30		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Maximum Body-Diode Continuous Current		I_S				9	A
Drain-Source Diode Forward Voltage (Note 1)		V_{SD}	I_S=9.0A, V_{GS}=0V			1.4	V
Reverse Recovery Time (Note 1)		t_{rr}	I_S=9.0A, V_{GS}=0V		544		ns
Reverse Recovery Charge		Q_{rr}	dI_F/dt=100A/μs (Note1)		8.7		μC

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

■ TEST CIRCUITS AND WAVEFORMS

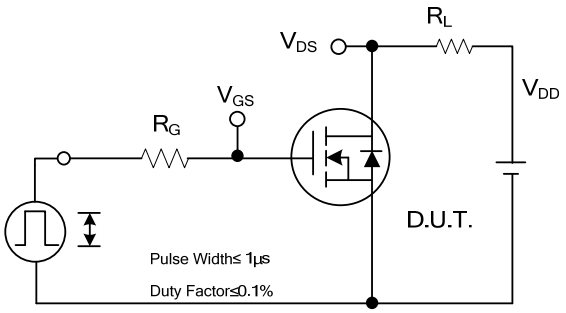


Peak Diode Recovery dv/dt Test Circuit

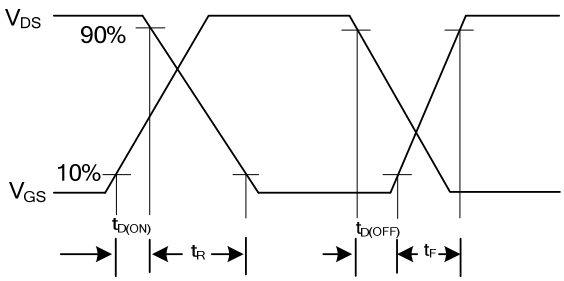


Peak Diode Recovery dv/dt Waveforms

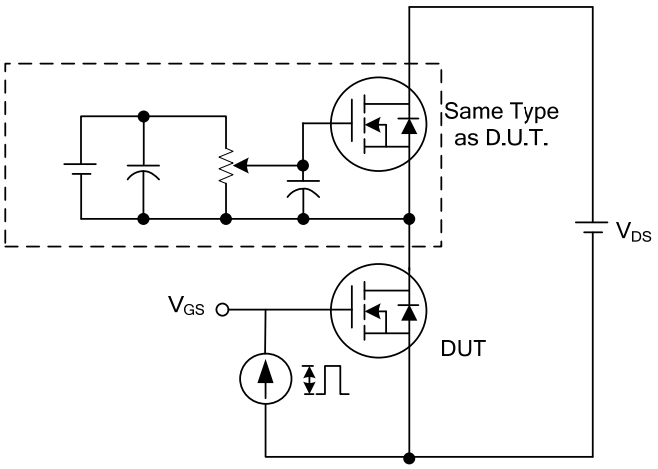
■ TEST CIRCUITS AND WAVEFORMS



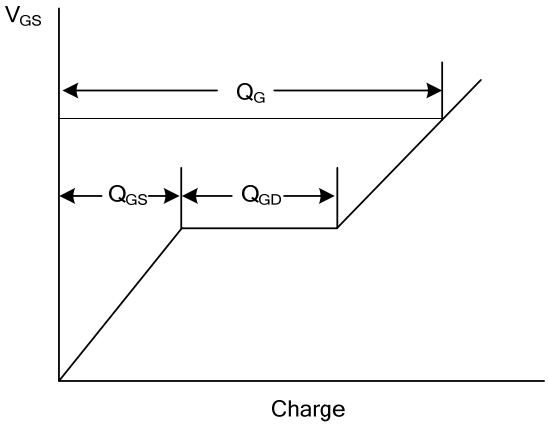
Switching Test Circuit



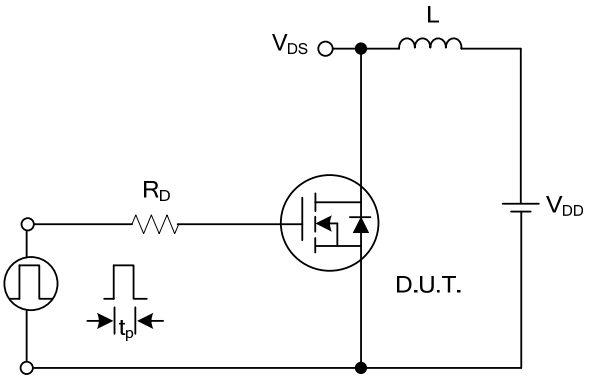
Switching Waveforms



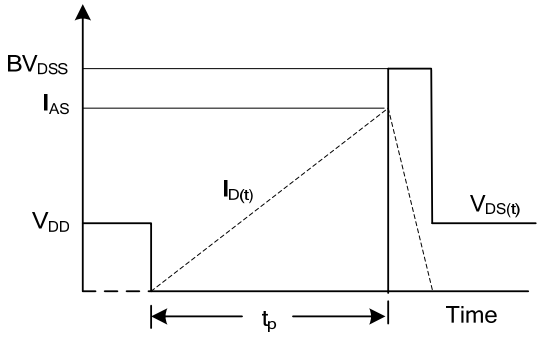
Gate Charge Test Circuit



Gate Charge Waveform



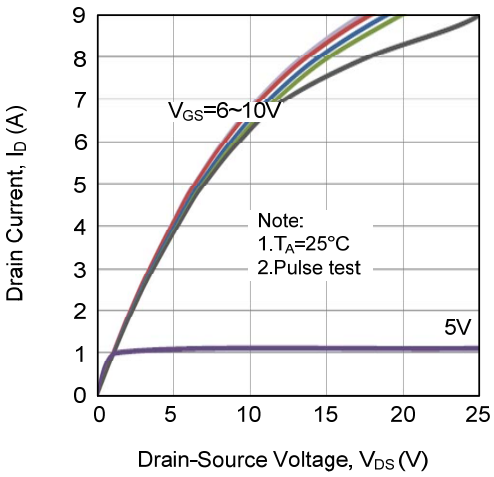
Unclamped Inductive Switching Test Circuit



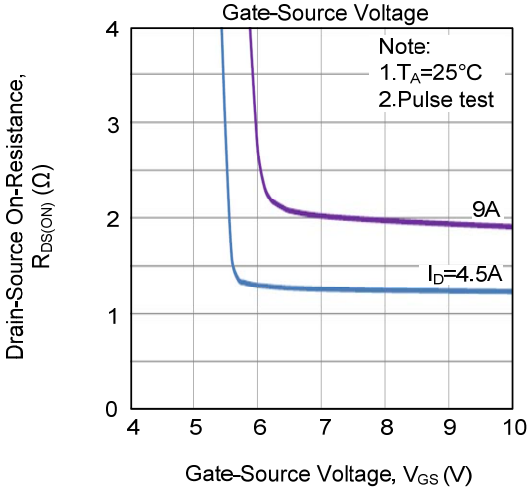
Unclamped Inductive Switching Waveforms

■ TYPICAL CHARACTERISTICS

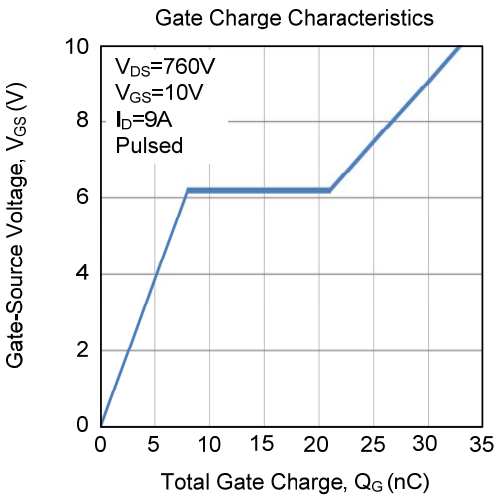
Drain Current vs. Drain-Source Voltage



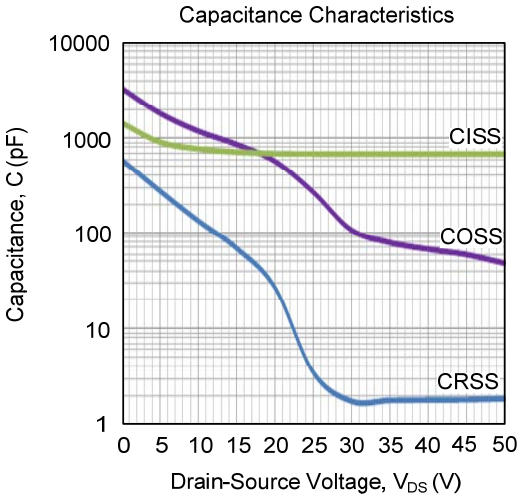
Drain-Source On-Resistance vs. Gate-Source Voltage



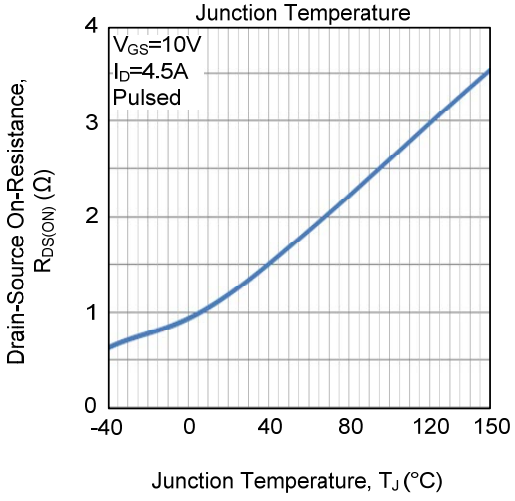
Gate Charge Characteristics



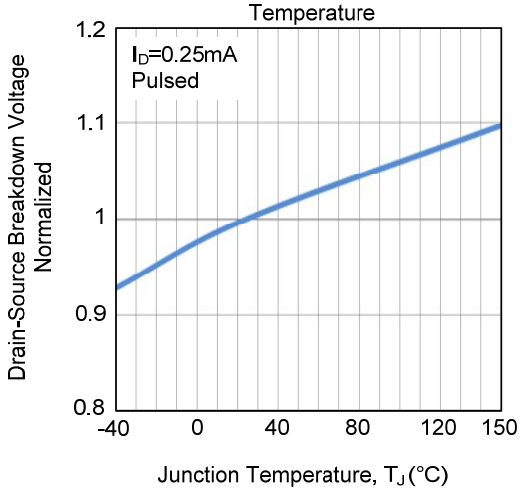
Capacitance Characteristics



Drain-Source On-Resistance vs. Junction Temperature

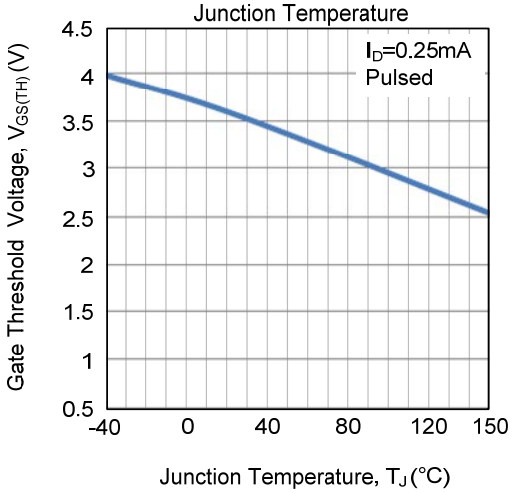


Breakdown Voltage vs. Junction Temperature

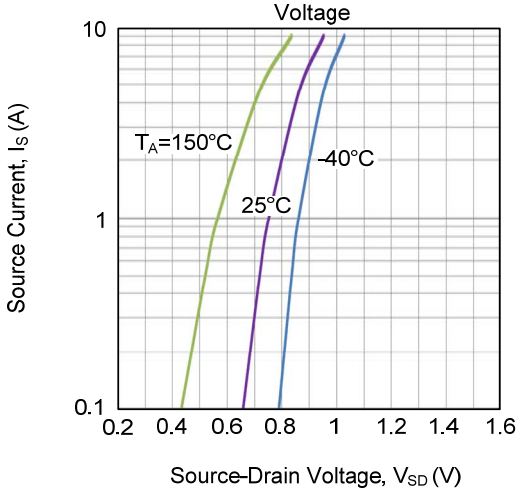


■ TYPICAL CHARACTERISTICS (Cont.)

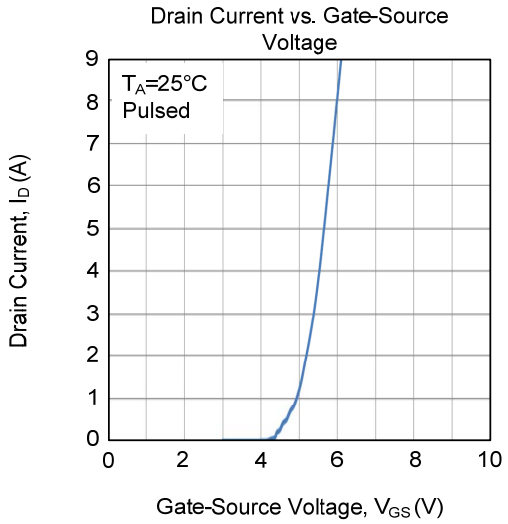
Gate Threshold Voltage vs. Junction Temperature



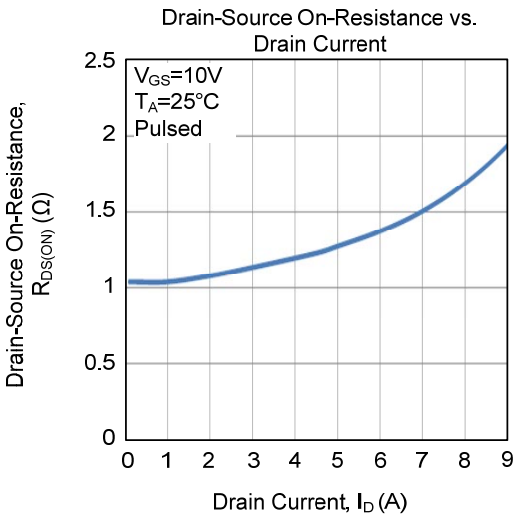
Source Current vs. Source-Drain Voltage



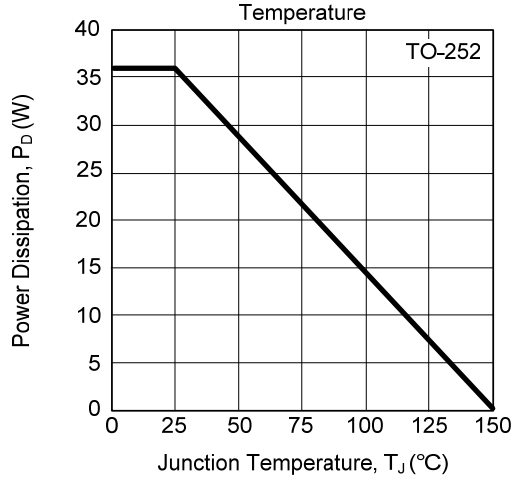
Drain Current vs. Gate-Source Voltage



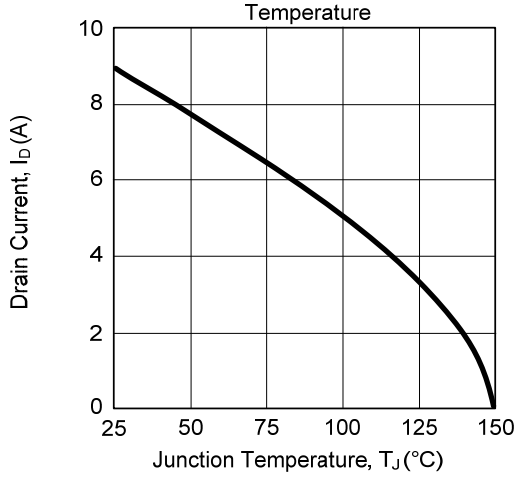
Drain-Source On-Resistance vs. Drain Current



Power Dissipation vs. Junction Temperature



Drain Current vs. Junction Temperature



■ TYPICAL CHARACTERISTICS (Cont.)