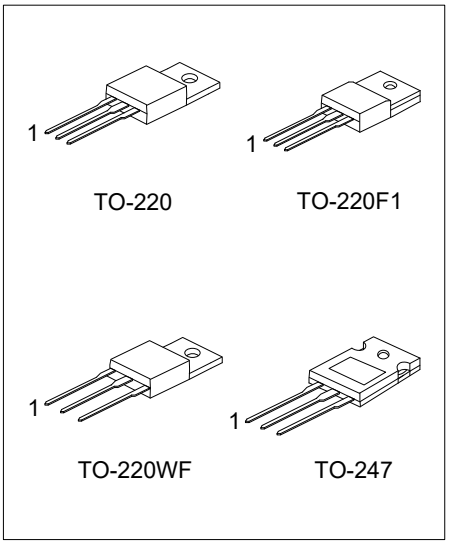
33NM60Z

Power MOSFET

33A, 600V N-CHANNEL SUPER-JUNCTION MOSFET



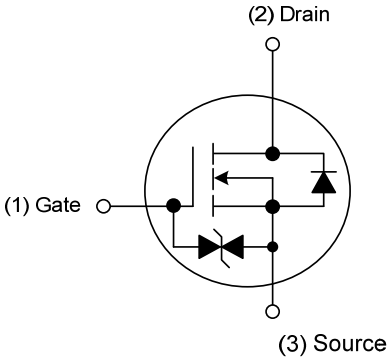
■ DESCRIPTION

The **UTC 33NM60Z** 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

* $R_{DS(ON)} \leq 150\ m\Omega$ @ V_{GS}=10V, I_D=16.5A
* Fast switching capability
* Avalanche energy tested
* Improved dv/dt capability, high ruggedness
* With ESD Protected

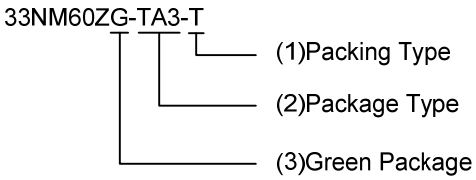
■ SYMBOL



■ ORDERING INFORMATION

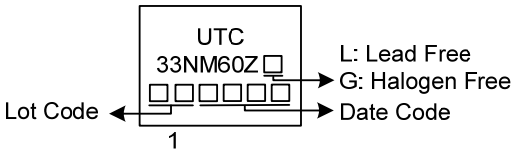
Ordering Number		Package	Pin Assignment									Packing
Lead Free	Halogen Free		1	2	3	4	5	6	7	8	9	
33NM60ZL-TA3-T	33NM60ZG-TA3-T	TO-220	G	D	S	-	-	-	-	-	-	Tube
33NM60ZL-TF1-T	33NM60ZG-TF1-T	TO-220F1	G	D	S	-	-	-	-	-	-	Tube
33NM60ZL-TW1-T	33NM60ZG-TW1-T	TO-220WF	G	D	S	-	-	-	-	-	-	Tube
33NM60ZL-T47-T	33NM60ZG-T47-T	TO-247	G	D	S	-	-	-	-	-	-	Tube

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



(1) T: Tube, R: Tape Reel
(2) TA3: TO-220, TF1: TO-220F1, TW1: TO-220WF
T47: TO-247
(3) G: Halogen Free and Lead Free, L: Lead Free

■ MARKING



■ 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}	±20	V
Drain Current	Continuous (T_C=25°C)	I_D	33	A
	Pulsed (Note 2)	I_{DM}	99	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	435	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	1.2	V/ns
Power Dissipation	TO-220	P_D	118	W
	TO-220F1/TO-220WF		41	W
	TO-247		142	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} = 2.95A, V_{DD} = 50V, R_G = 25Ω Starting T_J = 25°C.
4. I_{SD} ≤ 33A, 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-220F1 TO-220WF	θ_{JA}	62.5	°C/W
	TO-247		40	°C/W
Junction to Case	TO-220	θ_{JC}	1.05	°C/W
	TO-220F1/TO-220WF		3.05	°C/W
	TO-247		0.88	°C/W

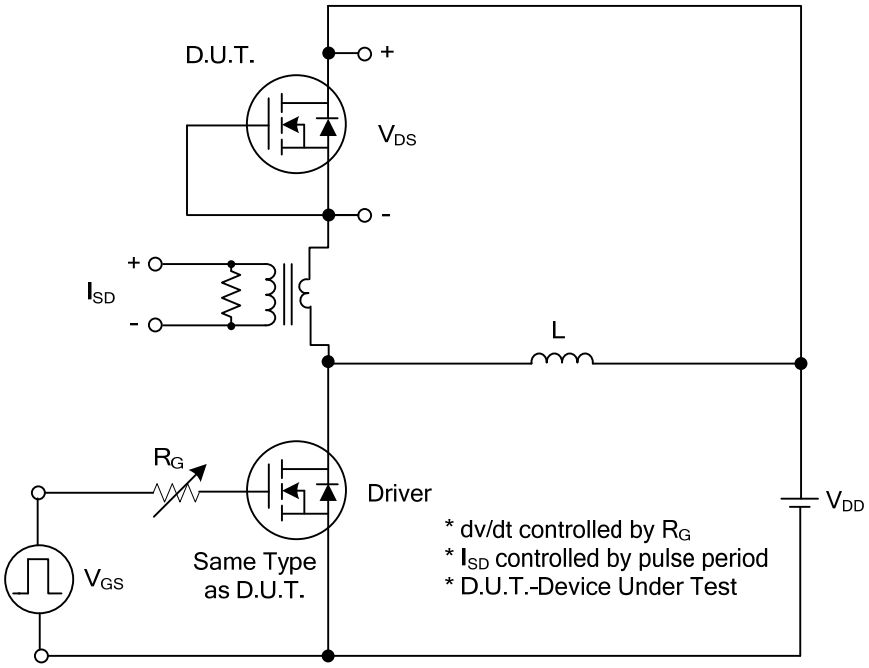
Note: Device mounted on FR-4 substrate P_C board, 2oz copper, with 1inch square copper plate.

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

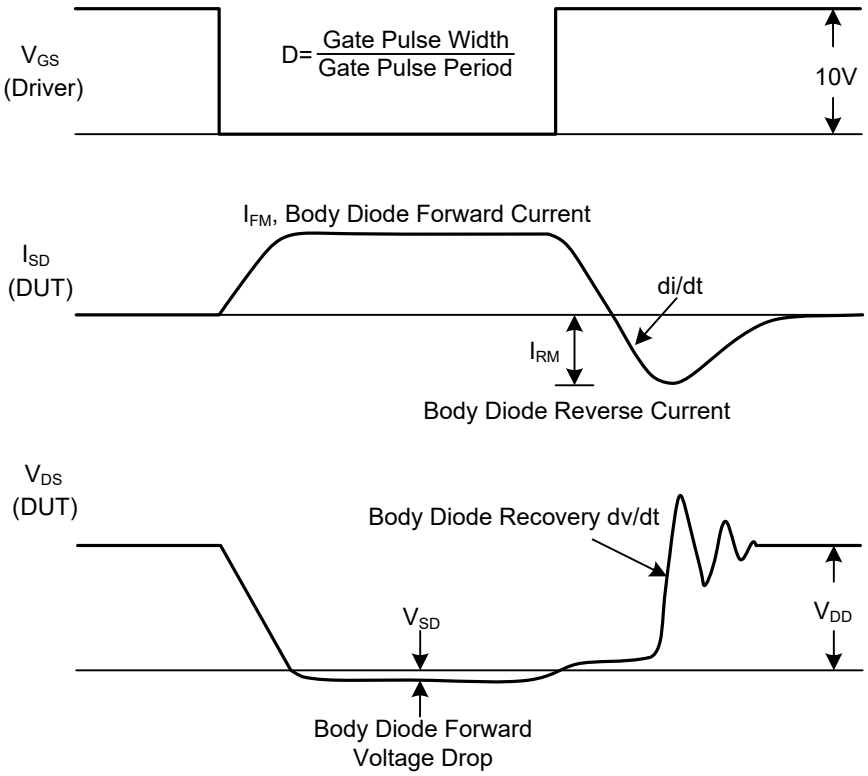
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	BV_{DSS}	V_{GS}=0V, I_D=250μA	600			V
Drain-Source Leakage Current	I_{DSS}	V_{DS}=600V, V_{GS}=0V			10	μA
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20V, V_{DS}=0V			±10	μA
ON CHARACTERISTICS						
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=16.5A			150	mΩ
DYNAMIC CHARACTERISTICS						
Input Capacitance	C_{ISS}	V_{GS}=0V, V_{DS}=50V, f=1MHz		1819		pF
Output Capacitance	C_{OSS}			494		pF
Reverse Transfer Capacitance	C_{RSS}			11		pF
SWITCHING CHARACTERISTICS						
Total Gate Charge (Note 1)	Q_G	V_{DS}=480V, V_{GS}=10V, I_D=33A (Note 1, 2)		77		nC
Gate-Source Charge	Q_{GS}			20		nC
Gate-Drain Charge	Q_{DD}			30		nC
Turn-On Delay Time (Note 1)	$t_{D(ON)}$	V_{DD}=100V, V_{GS}=10V, I_D=33A, R_G =25Ω (Note 1, 2)		30		ns
Turn-On Rise Time	t_R			34		ns
Turn-Off Delay Time	$t_{D(OFF)}$			187		ns
Turn-Off Fall Time	t_F			116		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS						
Maximum Continuous Drain-Source Diode Forward Current	I_S				33	A
Drain-Source Diode Forward Voltage (Note 1)	V_{SD}	I_S=33A, V_{GS}=0V			1.4	V
Body Diode Reverse Recovery Time (Note 1)	t_{rr}	I_S=30A, V_{GS}=0V, dI_F/dt=100A/μs		460		nS
Body Diode Reverse Recovery Charge	Q_{rr}			8140		nC

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

■ TEST CIRCUITS AND WAVEFORMS

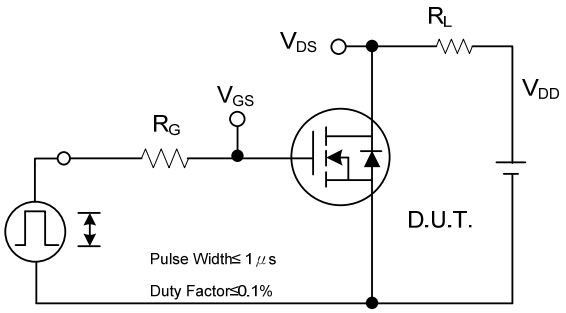


Peak Diode Recovery dv/dt Test Circuit

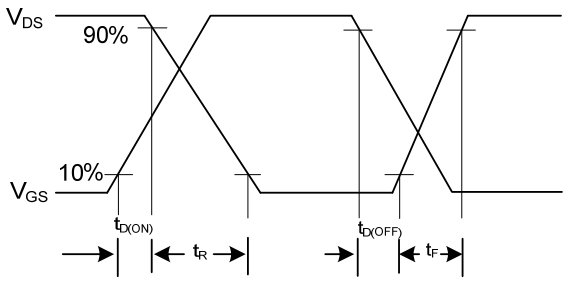


Peak Diode Recovery dv/dt Waveforms

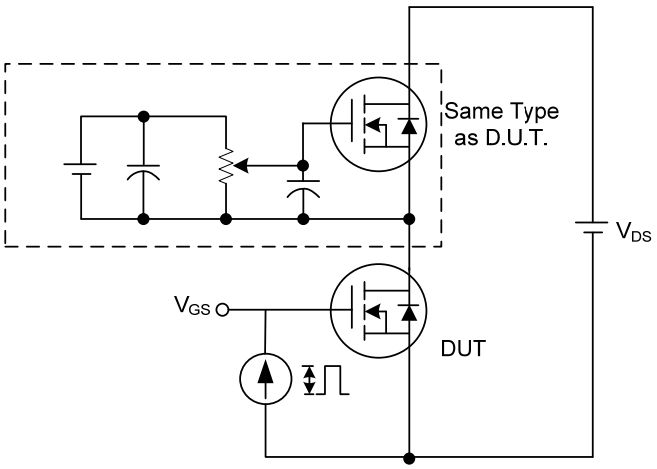
■ TEST CIRCUITS AND WAVEFORMS



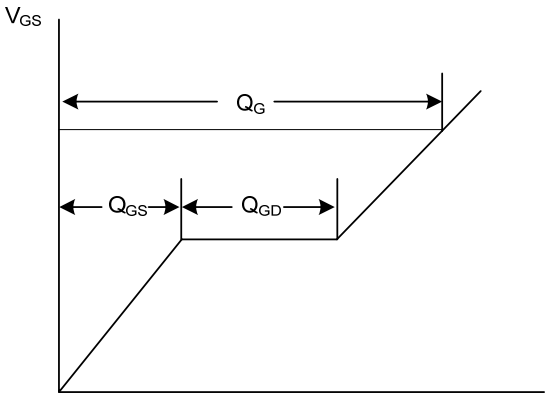
Switching Test Circuit



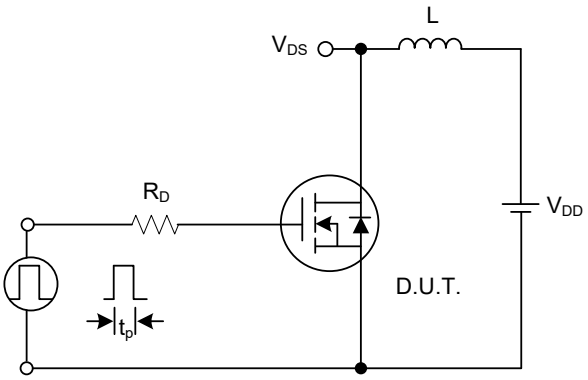
Switching Waveforms



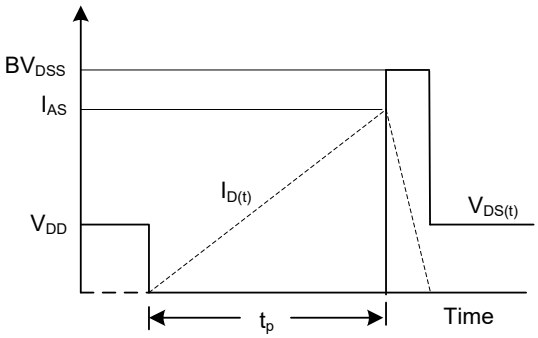
Gate Charge Test Circuit



Gate Charge Waveform



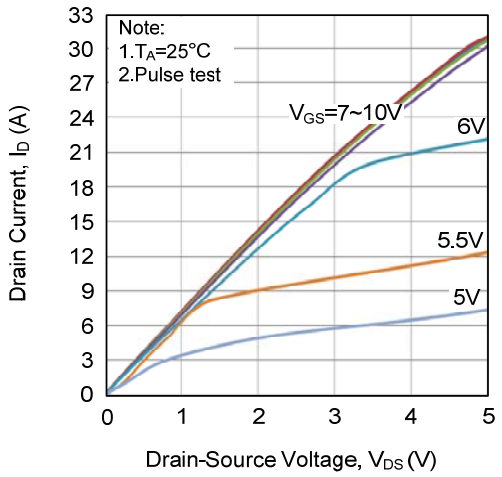
Unclamped Inductive Switching Test Circuit



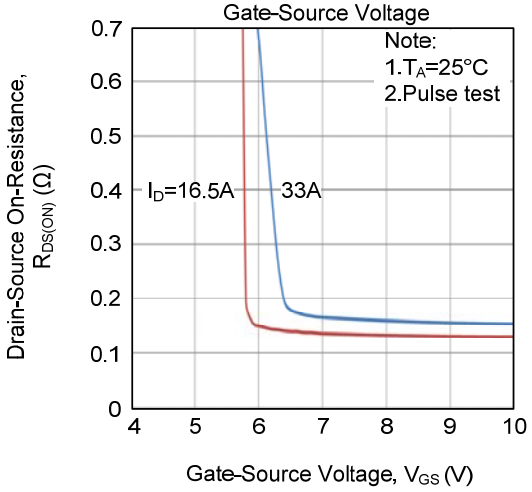
Unclamped Inductive Switching Waveforms

■ TYPICAL CHARACTERISTICS

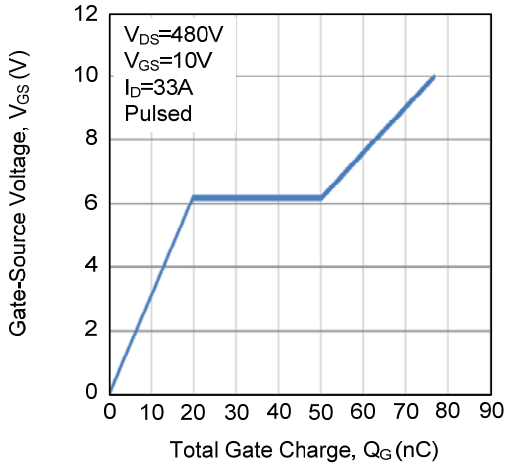
Drain Current vs. Drain-Source Voltage



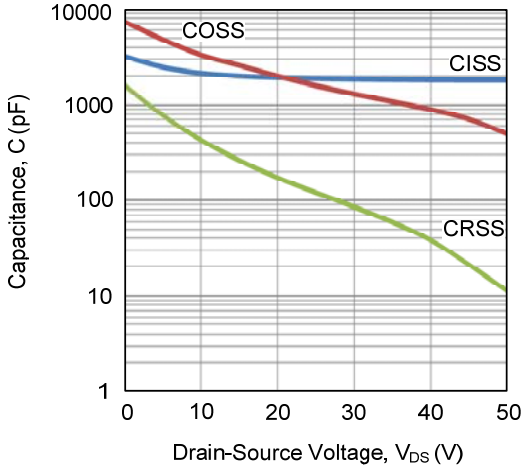
Drain-Source On-Resistance vs. Gate-Source Voltage



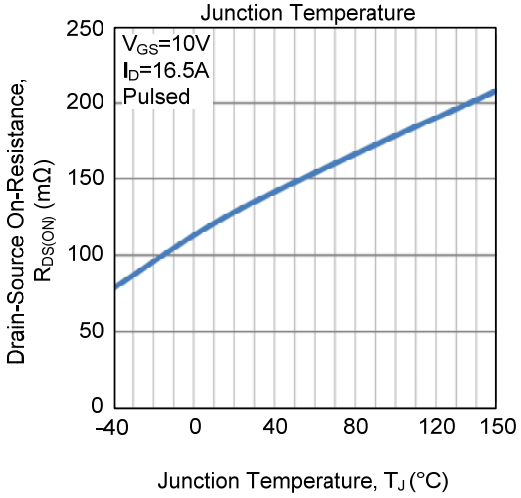
Gate Charge Characteristics



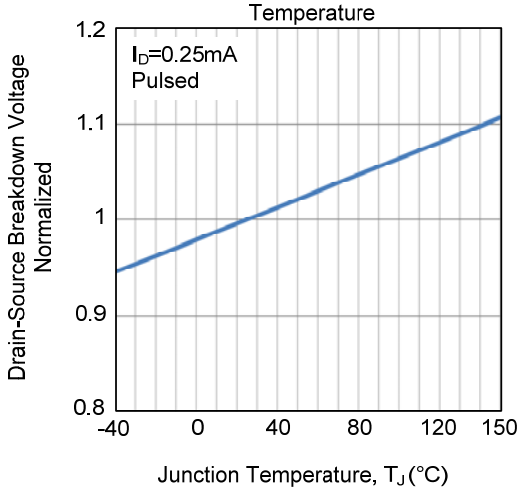
Capacitance Characteristics



Drain-Source On-Resistance vs. Junction Temperature

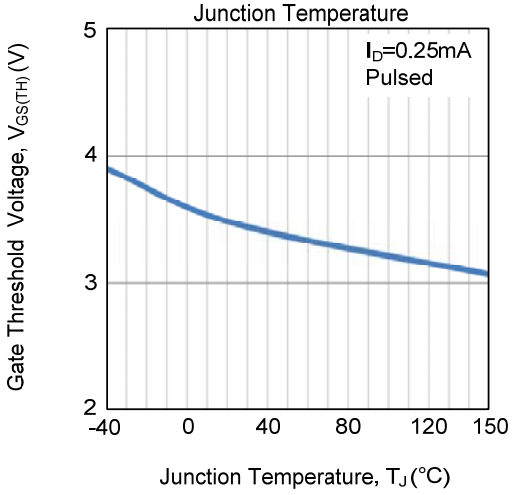


Breakdown Voltage vs. Junction Temperature

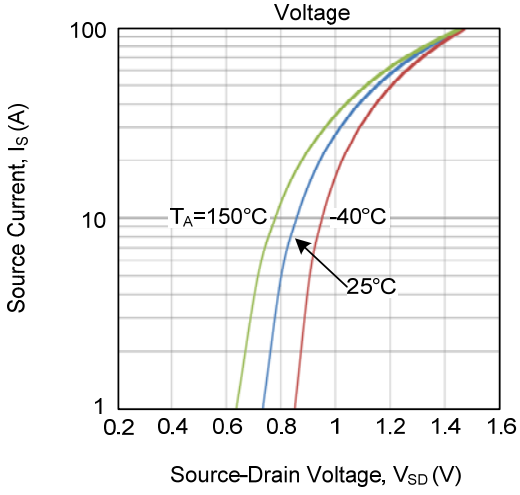


■ TYPICAL CHARACTERISTICS (Cont.)

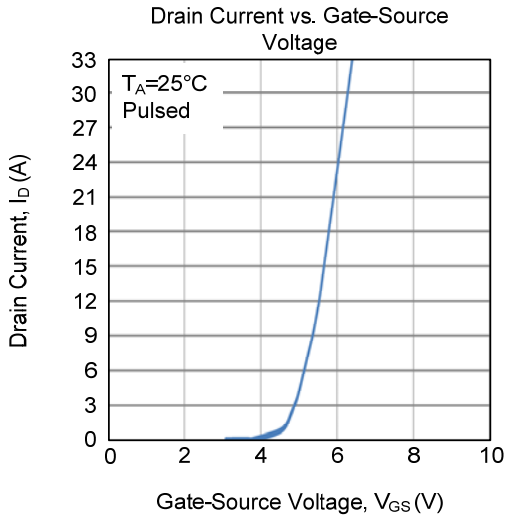
Gate Threshold Voltage vs. Junction Temperature



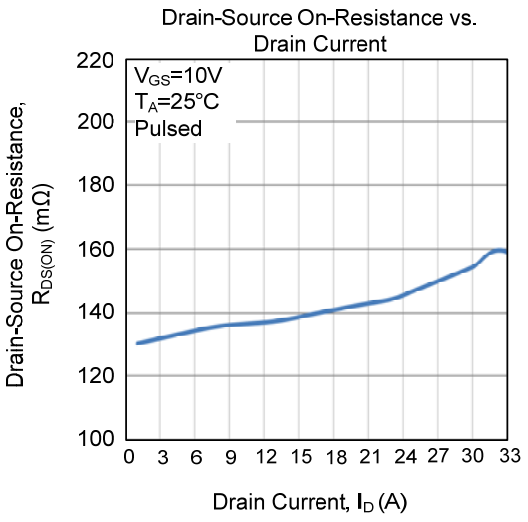
Source Current vs. Source-Drain Voltage



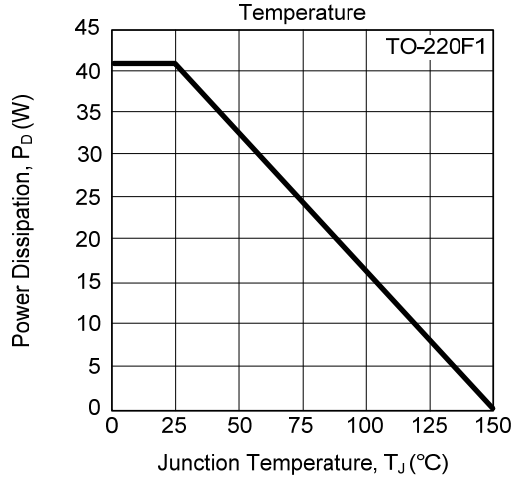
Drain Current vs. Gate-Source Voltage



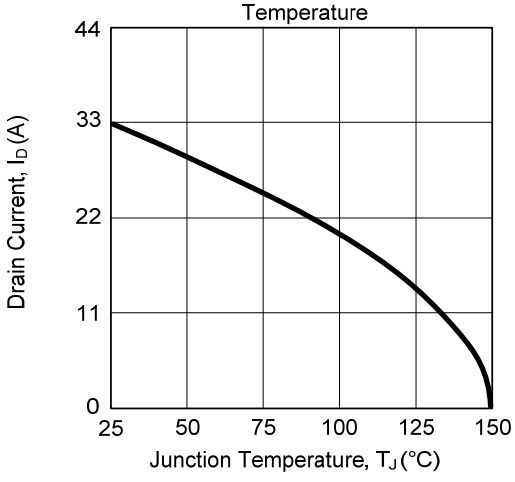
Drain-Source On-Resistance vs. Drain Current



Power Dissipation vs. Junction Temperature



Drain Current vs. Junction Temperature



■ TYPICAL CHARACTERISTICS (Cont.)