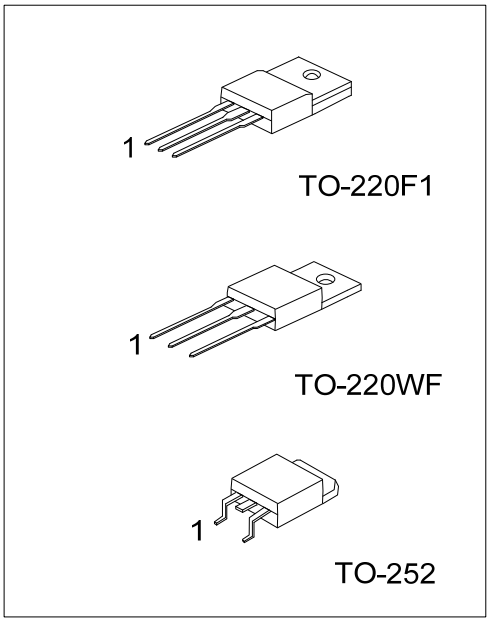
9.0A, 600V N-CHANNEL SUPER-JUNCTION MOSFET



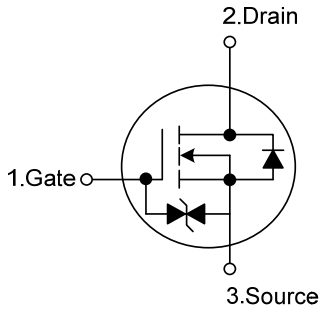
■ DESCRIPTION

The UTC **9NM60Z** 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

* $R_{DS(ON)} \leq 0.6\ \Omega$ @ V_{GS}=10V, I_D=2.5A
* Fast switching capability
* Avalanche energy tested
* Improved dv/dt capability, high ruggedness
* With ESD protection

■ SYMBOL



■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
9NM60ZL-TF1-T	9NM60ZG-TF1-T	TO-220F1	G	D	S	Tube
9NM60ZL-TW1-T	9NM60ZG-TW1-T	TO-220WF	G	D	S	Tube
9NM60ZL-TN3-R	9NM60ZG-TN3-R	TO-252	G	D	S	Tape Reel

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

9NM60ZG-TF1-T

(1)Packing Type — (1) T: Tube, R: Tape Reel

(2)Package Type — (2) TF1: TO-220F1, TW1: TO-220WF, TN3: TO-252

(3)Green Package — (3) G: Halogen Free and Lead Free, L: Lead Free

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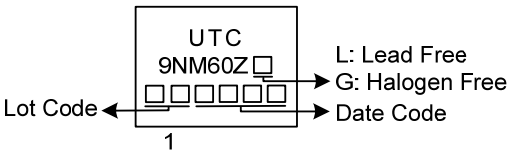
■ MARKING



■ 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	I_D	9	A
	Pulsed (Note 2)	I_{DM}	27	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	42	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	1.2	V/ns
Power Dissipation	TO-220F1/TO-220WF	P_D	23	W
	TO-252		47	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} = 0.9A, V_{DD} = 50V, R_G = 25Ω Starting T_J = 25°C.
4. I_{SD} ≤ 9A, di/dt ≤ 200A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C.

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220F1/TO-220WF	θ_{JA}	62.5	°C/W
	TO-252		110	°C/W
Junction to Case	TO-220F1/TO-220WF	θ_{JC}	5.43	°C/W
	TO-252		2.66 (Note)	°C/W

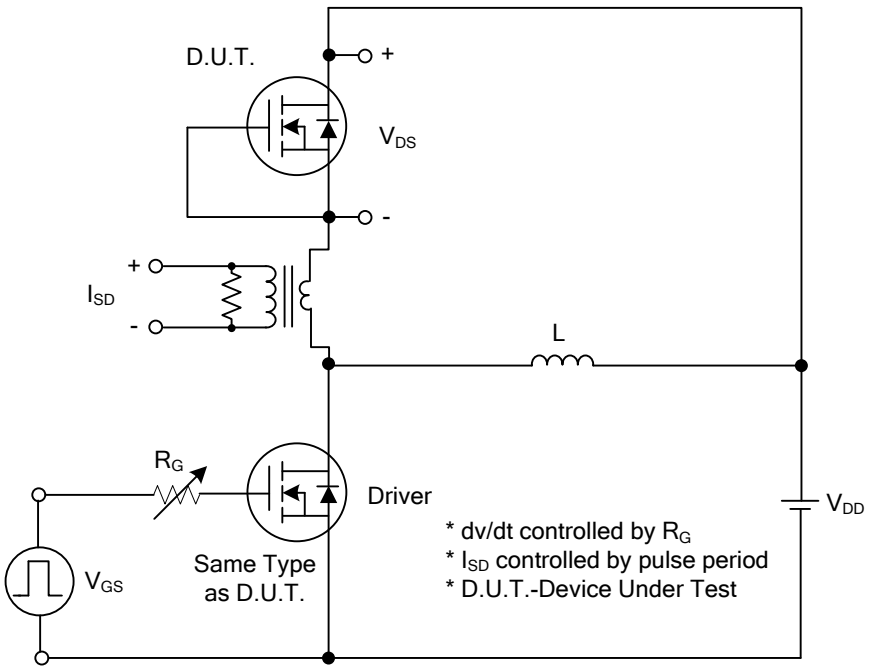
Note: Device mounted on FR-4 substrate P_C board, 2oz copper, with 1inch square copper plate.

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

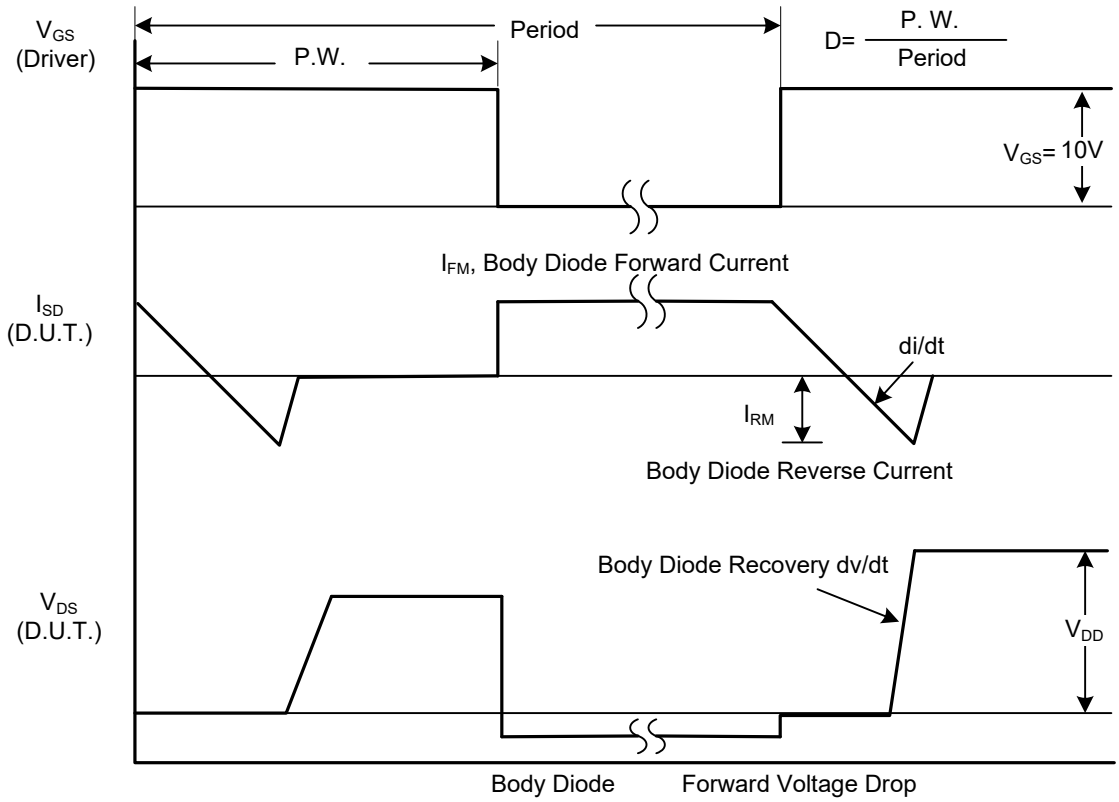
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV_{DSS}	V_{GS}=0V, I_D= 250μA	600			V
Drain-Source Leakage Current		I_{DSS}	V_{DS}=600V, V_{GS}=0V			10	μA
Gate-Source Leakage Current	Forward	I_{GSS}	V_{GS}=20V, V_{DS}=0V			10	μA
	Reverse		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=2.5A			0.6	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C_{ISS}	V_{GS}=0V, V_{DS}=50V, f=1.0 MHz		426		pF
Output Capacitance		C_{OSS}			108		pF
Reverse Transfer Capacitance		C_{RSS}			6		pF
SWITCHING CHARACTERISTICS							
Total Gate Charge (Note 1)		Q_G	V_{DS}=480V, V_{GS}=10V, I_D=1.0A (Note 1, 2)		21		nC
Gate-Source Charge		Q_{GS}			4		nC
Gate-Drain Charge		Q_{GD}			8		nC
Turn-on Delay Time (Note 1)		$t_{D(ON)}$	V_{DS}=100V, V_{GS}=10V, I_D=4.5A, R_G=25Ω (Note 1, 2)		7		ns
Rise Time		t_R			22		ns
Turn-off Delay Time		$t_{D(OFF)}$			50		ns
Fall-Time		t_F			40		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		260		ns
Reverse Recovery Charge		Q_{rr}	dI_F/dt=100A/μs (Note1)		2588		nC

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

■ TEST CIRCUITS AND WAVEFORMS

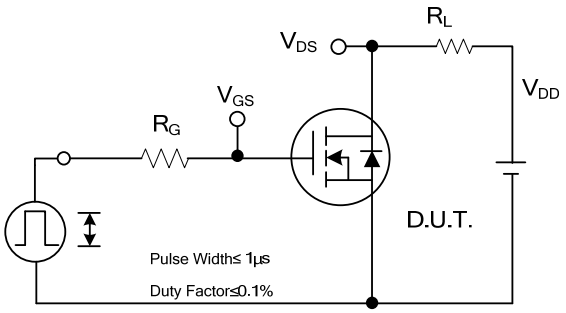


Peak Diode Recovery dv/dt Test Circuit

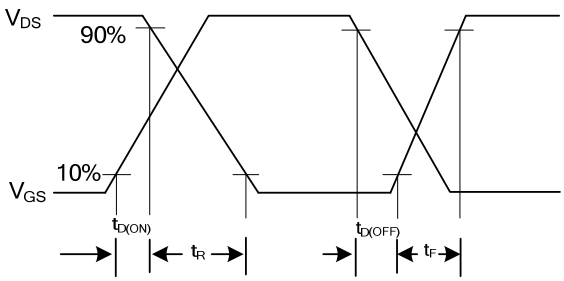


Peak Diode Recovery dv/dt Waveforms

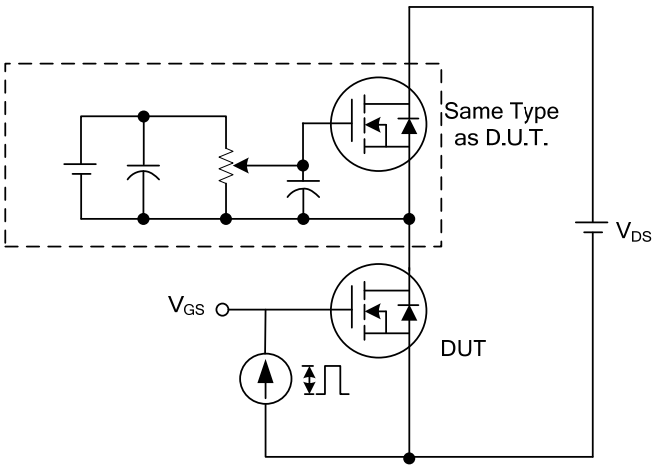
■ TEST CIRCUITS AND WAVEFORMS



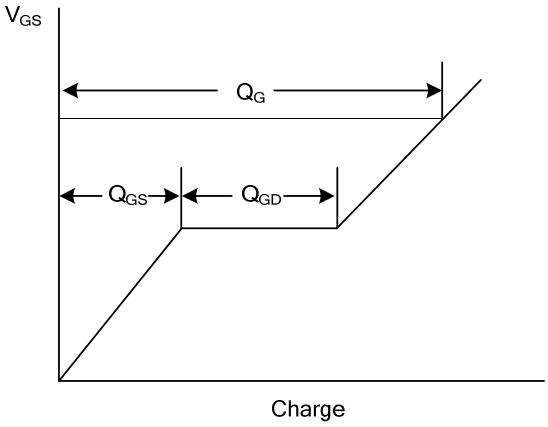
Switching Test Circuit



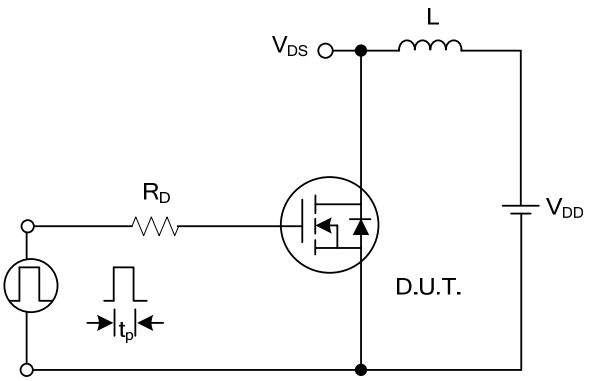
Switching Waveforms



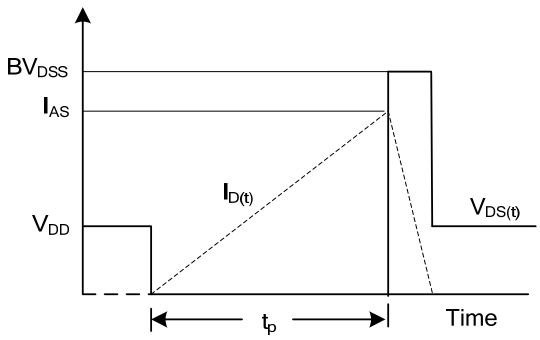
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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