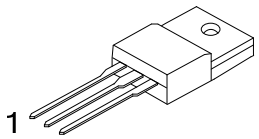
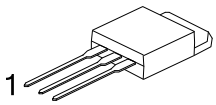
9NM65-V

Power MOSFET

9A, 650V N-CHANNEL SUPER-JUNCTION MOSFET



TO-220F1



TO-262

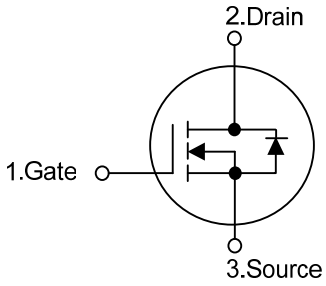
■ DESCRIPTION

The **UTC 9NM65-V** 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 DC-DC, AC-DC converters for power applications.

■ FEATURES

* $R_{DS(ON)}$ < 0.62 Ω @ V_{GS} = 10V, I_D = 4.5A
* Fast Switching Capability
* Avalanche Energy Tested
* Improved dv/dt Capability, High Ruggedness

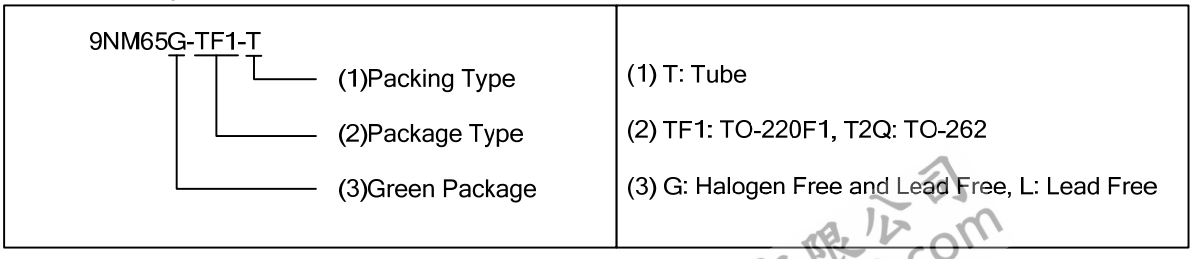
■ SYMBOL



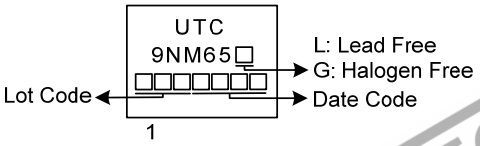
■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen-Free		1	2	3	
9NM65L-TF1-T	9NM65G-TF1-T	TO-220F1	G	D	S	Tube
9NM65L-T2Q-T	9NM65G-T2Q-T	TO-262	G	D	S	Tube

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



■ MARKING



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

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage		V_{DSS}	650	V
Gate-Source Voltage		V_{GSS}	±30	V
Drain Current	Continuous	I_D	9	A
	Pulsed (Note 2)	I_{DM}	18	A
Avalanche Energy	Single Pulsed (Note 3)	E_{AS}	346	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	6	V/ns
Power Dissipation	TO-220F1	P_D	46	W
	TO-262		154	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=60mH, I_{AS}=3.4A, V_{DD}=50V, R_G=25 Ω, 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		$θ_{JA}$	62.5	°C/W
Junction to Case	TO-220F1	$θ_{JC}$	2.72	°C/W
	TO-262		0.81	°C/W

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■ 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	650			V
Drain-Source Leakage Current		I_{DSS}	V_{DS} = 650V, V_{GS} = 0V			10	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
ON CHARACTERISTICS							
Gate Threshold Voltage		$V_{GS(TH)}$	V_{DS} = V_{GS}, I_D = 250μA	1.0		3.0	V
Static Drain-Source On-State Resistance		$R_{DS(ON)}$	V_{GS} = 10V, I_D = 4.5A			0.62	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C_{ISS}	V_{GS}=0V, V_{DS}=25V, f=1MHz		810		pF
Output Capacitance		C_{OSS}			365		pF
Reverse Transfer Capacitance		C_{RSS}			25		pF
SWITCHING CHARACTERISTICS							
Total Gate Charge (Note 1)		Q_G	V_{DS}=150V, V_{GS}=10V, I_D=5A I_G=3mA (Note 1, 2)		24		nC
Gateource Charge		Q_{GS}			4.8		nC
Gate-Drain Charge		Q_{GD}			6.6		nC
Turn-ON Delay Time (Note 1)		$t_{D(ON)}$	V_{DD}=80V, V_{GS}=10V, I_D=8A, R_G =25Ω (Note 1, 2)		6		ns
Rise Time		t_R			22		ns
Turn-OFF Delay Time		$t_{D(OFF)}$			110		ns
Fall-Time		t_F			50		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Maximum Body-Diode Continuous Current		I_S				9	A
Maximum Body-Diode Pulsed Current		I_{SM}				18	A
Drain-Source Diode Forward Voltage (Note 1)		V_{SD}	I_S=9A, V_{GS}=0V			1.4	V
Body Diode Reverse Recovery Time (Note 1)		t_{rr}	I_S=9A, V_{GS}=0V, dI_F/dt=100A/μs		250		ns
Body Diode Reverse Recovery Charge		Q_{rr}			2.2		μC

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

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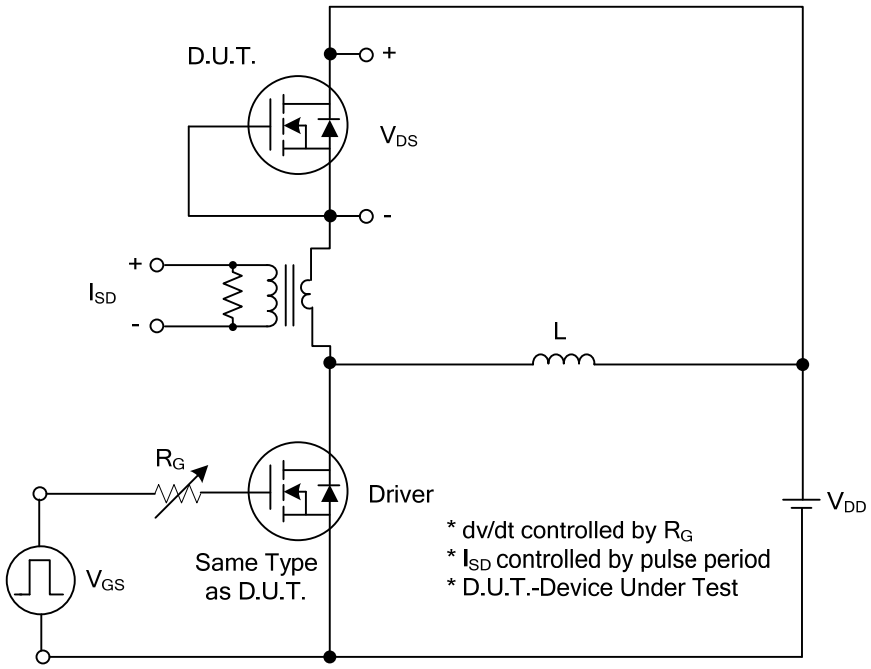
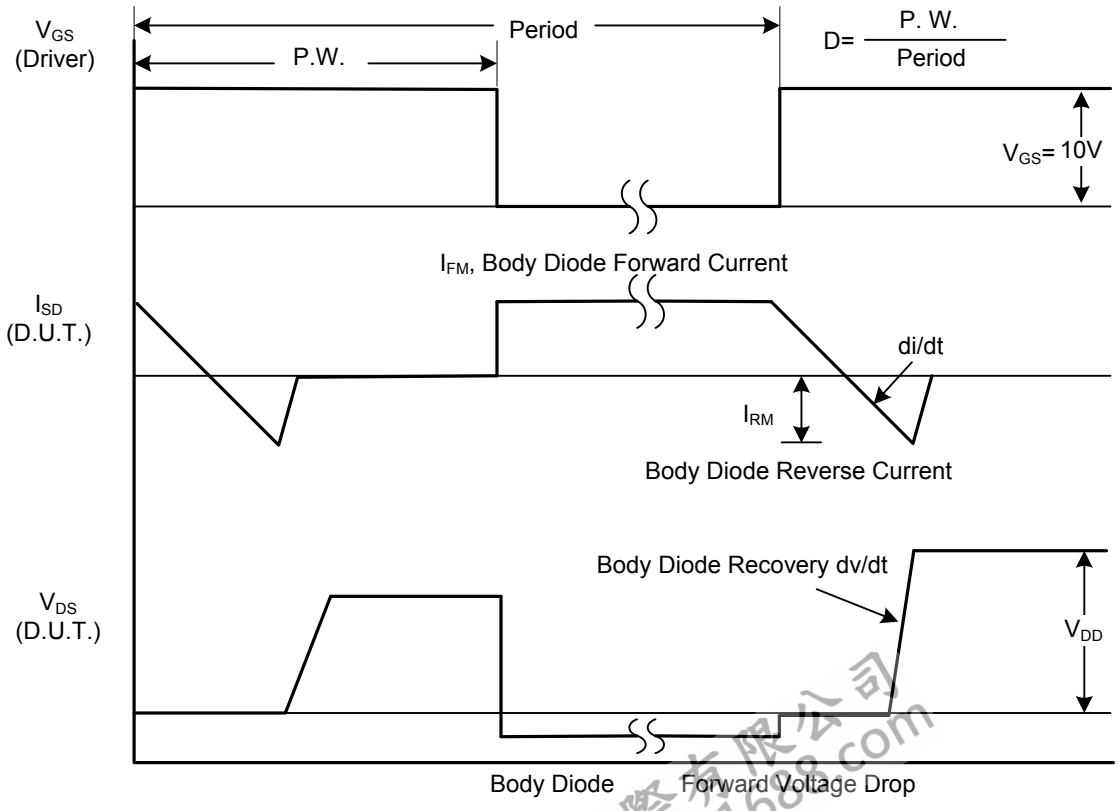
■ TEST CIRCUITS AND WAVEFORMS



Peak Diode Recovery dv/dt Test Circuit



Peak Diode Recovery dv/dt Waveforms

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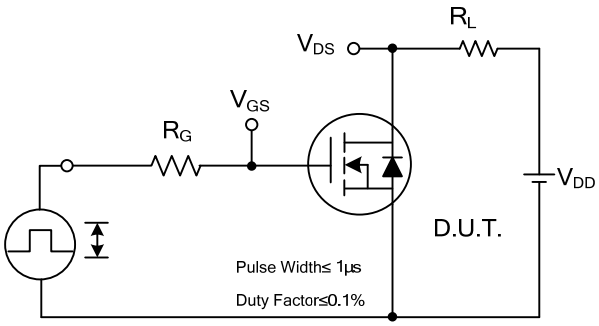
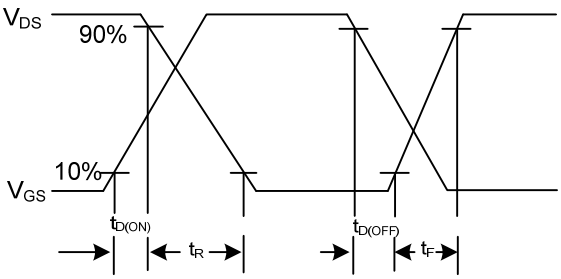
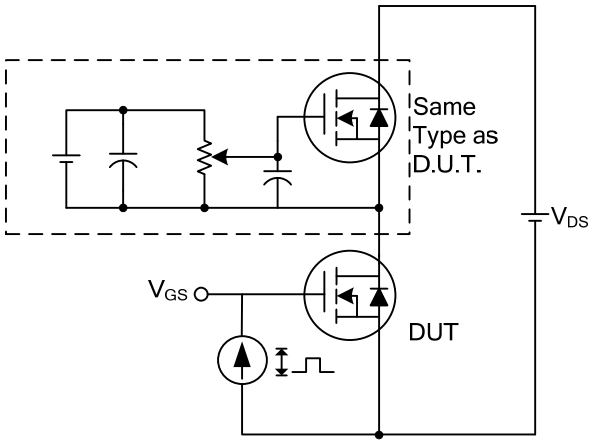


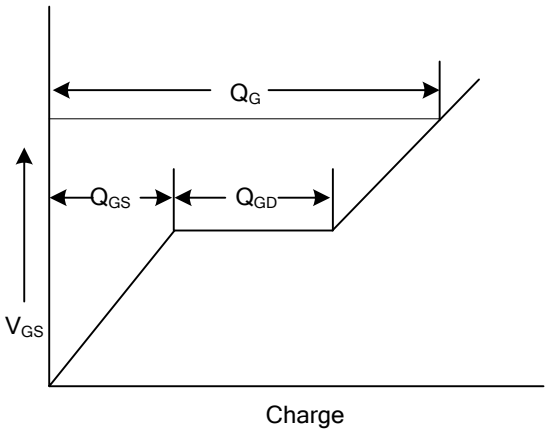
Switching Test Circuit



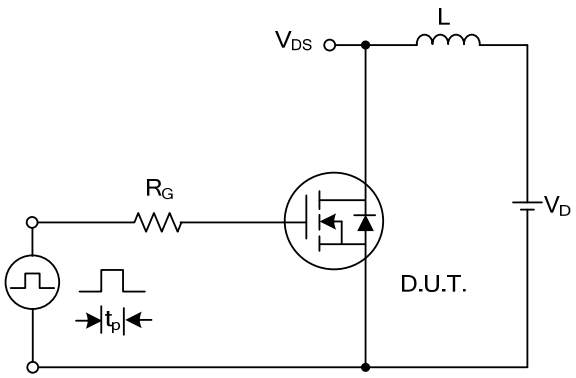
Switching Waveforms



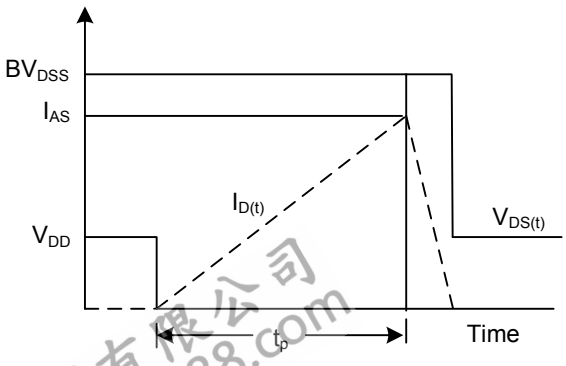
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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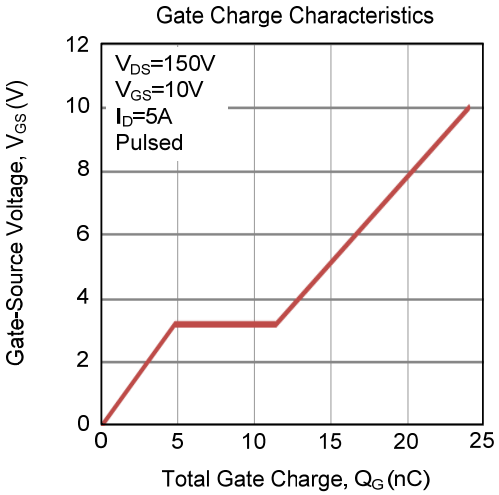
■ TYPICAL CHARACTERISTICS



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