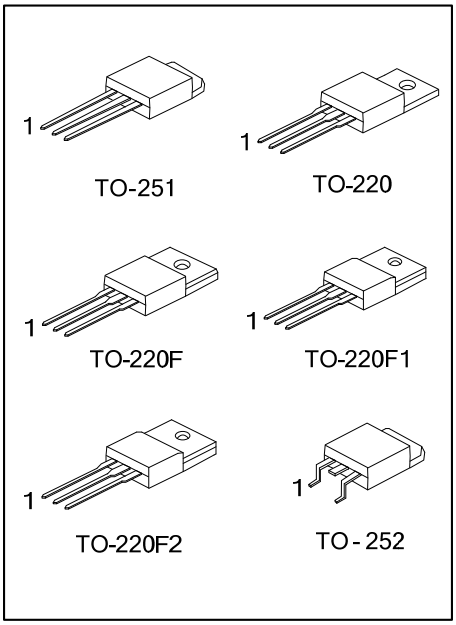
4NM65-SHA

Preliminary ***Power MOSFET***

4.0A, 650V N-CHANNEL SUPER-JUNCTION MOSFET



■ DESCRIPTION

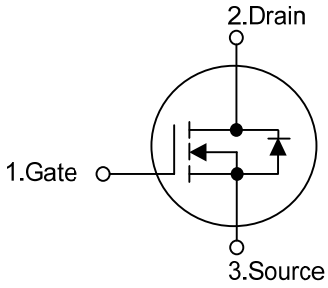
The UTC **4NM65-SHA** is a high voltage super junction MOSFET and is designed to have better characteristics.

The UTC **4NM65-SHA** Utilizing an advanced charge-balance technology, enhance system efficiency, improve EMI and reliability. such as low gate charge, low on-state resistance and have a high power density and high rugged avalanche characteristics. This super junction MOSFET usually used at AC/DC power conversion, and industrial power applications.

■ FEATURES

* $R_{DS(ON)}$ < 1.5Ω @ V_{GS} = 10V, I_D = 2.0A
* Fast Switching Capability
* Avalanche Energy Specified
* Improved dv/dt Capability, High Ruggedness

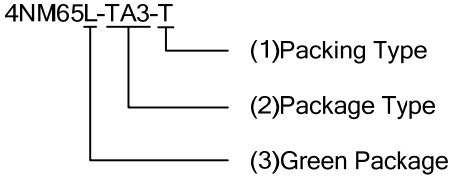
■ SYMBOL



■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
4NM65L-TA3-T	4NM65G-TA3-T	TO-220	G	D	S	Tube
4NM65L-TF3-T	4NM65G-TF3-T	TO-220F	G	D	S	Tube
4NM65L-TF1-T	4NM65G-TF1-T	TO-220F1	G	D	S	Tube
4NM65L-TF2-T	4NM65G-TF2-T	TO-220F2	G	D	S	Tube
4NM65L-TM3-R	4NM65G-TM3-R	TO-251	G	D	S	Tape Reel
4NM65L-TN3-R	4NM65G-TN3-R	TO-252	G	D	S	Tape Reel

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

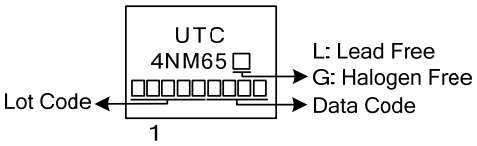


(1) T: Tube, R: Tape Reel

(2) TA3: TO-220, TF3: TO-220F, TF1: TO-220F1, TF2: TO-220F2, TM3: TO-251, TN3: TO-252

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

■ MARKING



■ 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	4.0	A
	Pulsed (Note2)	I_{DM}	16	A
Avalanche Energy	Single Pulsed (Note3)	E_{AS}	155	mJ
Peak Diode Recovery dv/dt (Note4)		dv/dt	4.83	V/ns
Power Dissipation	TO-220	P_D	106	W
	TO-220F		34	W
	TO-220F1/TO-220F2		36	W
	TO-251TO-252		50	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 maximum junction temperature
3. L=159mH, I_{AS}=1.4A, V_{DD}=50V, R_G=25 Ω, Starting T_J = 25°C
4. I_{SD}≤4.0A, di/dt≤200A/μs, V_{DD}≤ BV_{DSS}, Starting T_J = 25°C

■ THERMAL RESISTANCES CHARACTERISTICS

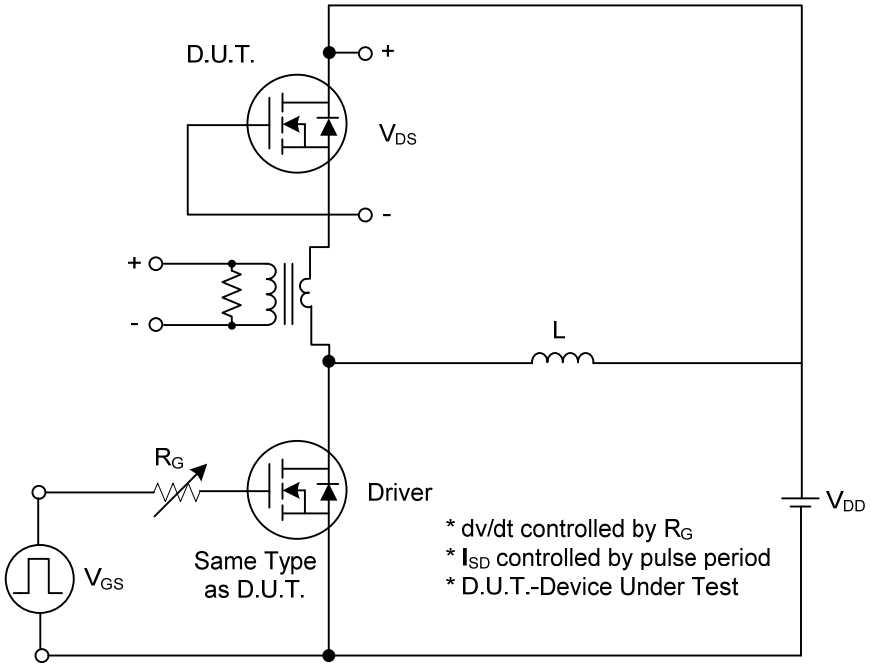
PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220/TO-220F TO-220F1/TO-220F2	$θ_{JA}$	62.5	°C/W
	TO-251TO-252		110	°C/W
Junction to Case	TO-220	$θ_{JC}$	1.18	°C/W
	TO-220F/TO-220F1		3.67	°C/W
	TO-220F2		3.47	°C/W
	TO-251/TO-252		2.5	°C/W

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

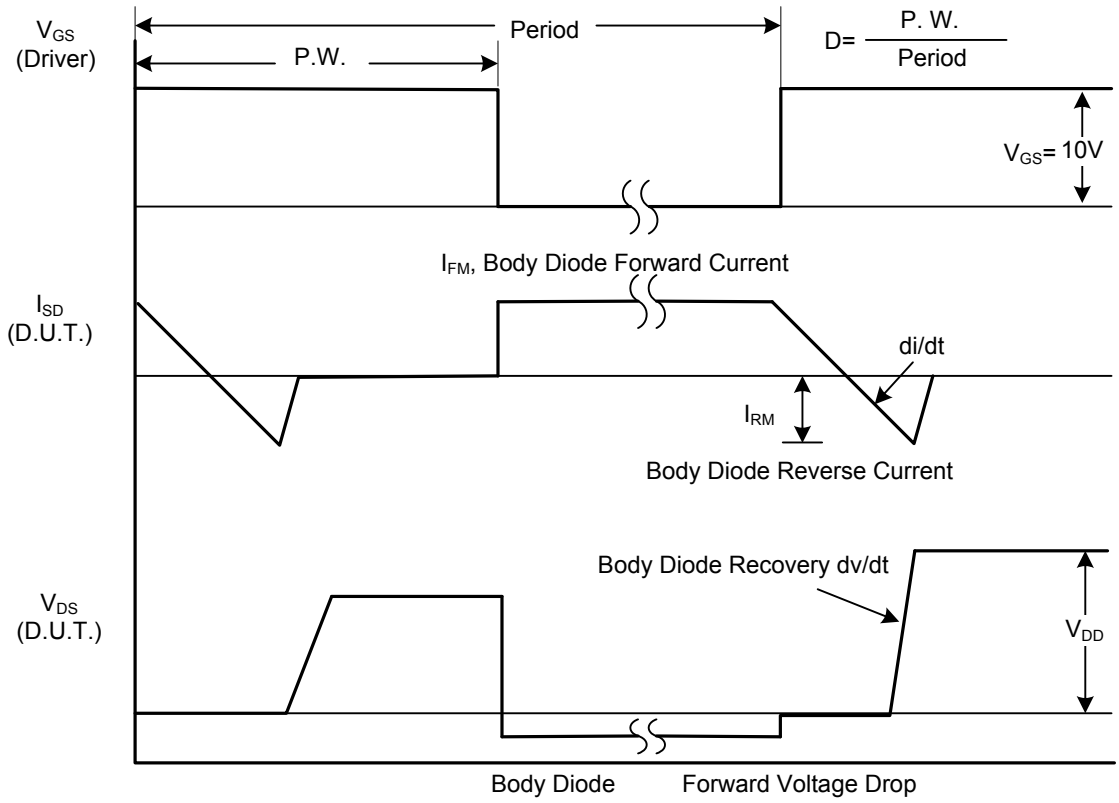
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV_{DSS}	V_{GS} = 0 V, I_D = 250μA	650			V
Drain-Source Leakage Current		I_{DSS}	V_{DS} = 650 V, V_{GS} = 0 V			10	μA
Gate-Source Leakage Current	Forward	I_{GSS}	V_{GS} = 30 V, V_{DS} = 0 V			100	nA
	Reverse		V_{GS} = -30 V, V_{DS} = 0 V			-100	nA
Breakdown Voltage Temperature Coefficient		$\triangle BV_{DSS}/\triangle T_J$	I_D=250μA, Referenced to 25°C		0.6		V/°C
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} = 10 V, I_D = 2.0A			1.5	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C_{ISS}	V_{DS} = 25 V, V_{GS} = 0V, f = 1MHz		250		pF
Output Capacitance		C_{OSS}			177		pF
Reverse Transfer Capacitance		C_{RSS}			19		pF
SWITCHING CHARACTERISTICS							
Turn-On Delay Time		$t_{D(ON)}$	V_{DD} = 30V, I_D = 0.5A, R_G = 25Ω (Note 1, 2)		54		ns
Turn-On Rise Time		t_R			50		ns
Turn-Off Delay Time		$t_{D(OFF)}$			114		ns
Turn-Off Fall Time		t_F			37		ns
Total Gate Charge		Q_G	V_{DS}= 50V,I_D= 1.3A, V_{GS}= 10V (Note 1, 2)		55		nC
Gate-Source Charge		Q_{GS}			3.8		nC
Gate-Drain Charge		Q_{GD}			9.2		nC
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Continuous Drain-Source Diode Forward Current		I_S				4.0	A
Pulsed Drain-Source Diode Forward Current		I_{SM}				16	A
Drain-Source Diode Forward Voltage		V_{SD}	V_{GS} = 0 V, I_S =4.0A			1.4	V
Body Diode Reverse Recovery Time		t_{rr}	V_{GS}=0V, I_S=10A dI$_F$/dt=100A/μs		244		ns
Body Diode Reverse Recovery Charge		Q_{RR}			1915		nC

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

■ TEST CIRCUITS AND WAVEFORMS

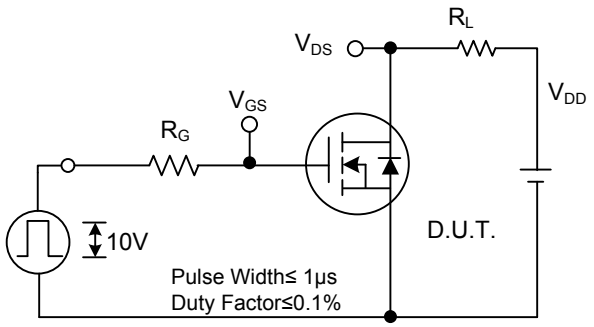


Peak Diode Recovery dv/dt Test Circuit

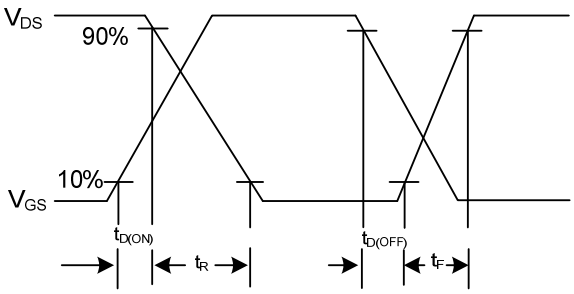


Peak Diode Recovery dv/dt Waveforms

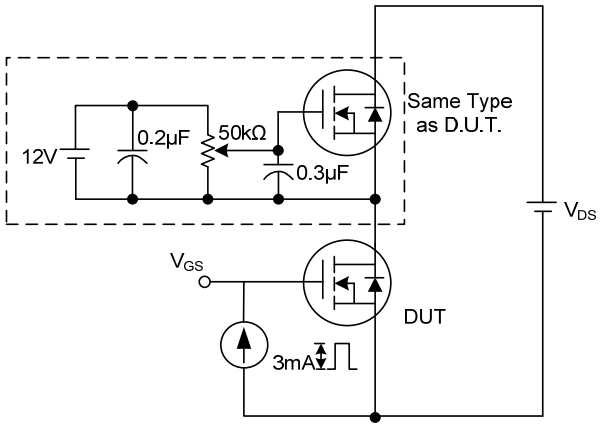
■ TEST CIRCUITS AND WAVEFORMS (Cont.)



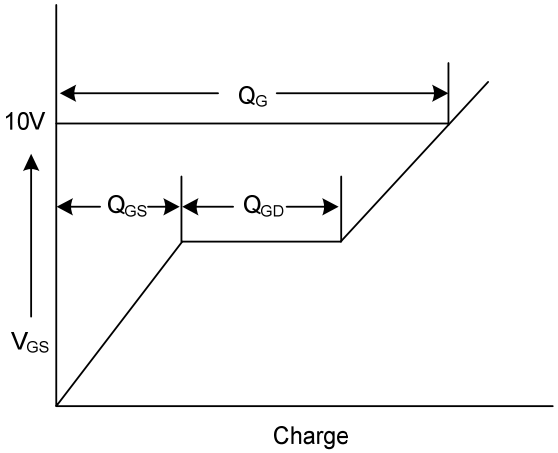
Switching Test Circuit



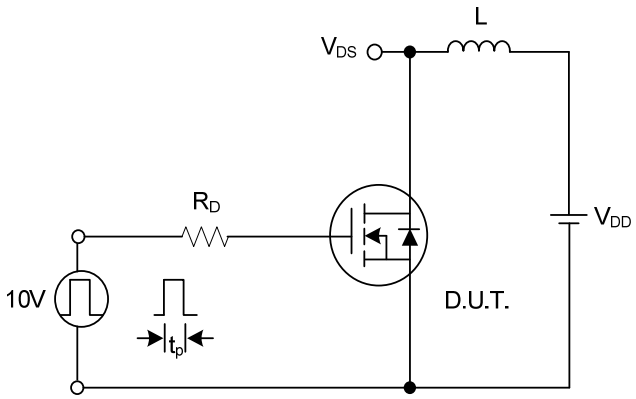
Switching Waveforms



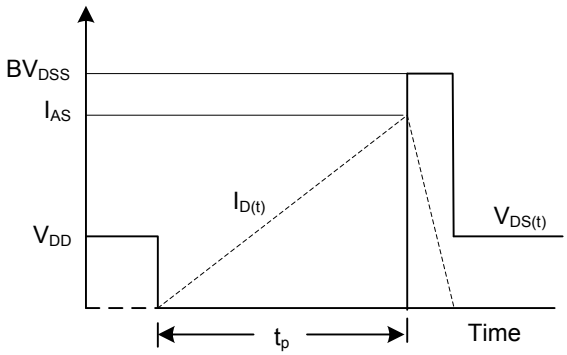
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms