



## F21NM50

Preliminary

Power MOSFET

## 21A, 500V N-CHANNEL SUPER-JUNCTION MOSFET

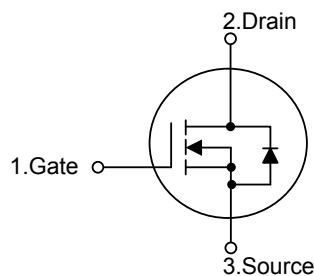
### DESCRIPTION

The **UTC F21NM50** is a N-Channel enhancement mode silicon gate super junction power MOSFET with fast body diode 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

- \*  $R_{DS(ON)} \leq 0.23 \Omega$  @  $V_{GS}=10V$ ,  $I_D=10.5A$
- \* Fast body diode MOSFET technology
- \* High Switching Speed

### SYMBOL



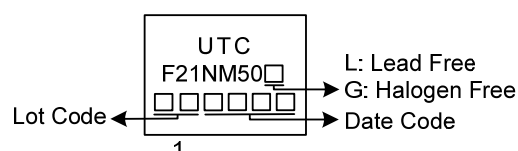
### ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
F21NM50L-TF1-T	F21NM50G-TF1-T	TO-220F1	G	D	S	Tube
F21NM50L-TF2-T	F21NM50G-TF2-T	TO-220F2	G	D	S	Tube
F21NM50L-T47-T	F21NM50G-T47-T	TO-247	G	D	S	Tube

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

<p>F21NM50G-TF1-T</p> <p>(1) Packing Type</p> <p>(2) Package Type</p> <p>(3) Green Package</p>	<p>(1) T: Tube</p> <p>(2) TF1: TO-220F1, TF2: TO-220F2, T47: TO-247</p> <p>(3) G: Halogen Free and Lead Free, L: Lead Free</p>
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### MARKING



■ ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$ , unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage		$V_{DSS}$	500	V
Gate-Source Voltage		$V_{GSS}$	$\pm 30$	V
Drain Current	Continuous	$I_D$	21	A
	Pulsed (Note 2)	$I_{DM}$	42	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	614	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	12.1	V/ns
Power Dissipation	TO-220F1/TO-220F2	$P_D$	30	W
	TO-247		186	W
Junction Temperature		$T_J$	+150	$^\circ\text{C}$
Storage Temperature		$T_{STG}$	-55 ~ +150	$^\circ\text{C}$

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.  $L = 66\text{mH}$ ,  $I_{AS} = 4.3\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 21\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220F1/TO-220F2	$\theta_{JA}$	62.5	$^\circ\text{C}/\text{W}$
	TO-247		50	$^\circ\text{C}/\text{W}$
Junction to Case	TO-220F1/TO-220F2	$\theta_{JC}$	4.16	$^\circ\text{C}/\text{W}$
	TO-247		0.67	$^\circ\text{C}/\text{W}$

■ ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		BV <sub>DSS</sub>	V <sub>GS</sub> =0V, I <sub>D</sub> = 250μA	500			V
Drain-Source Leakage Current		I <sub>DSS</sub>	V <sub>DS</sub> =500V, V <sub>GS</sub> =0V			10	μA
Gate-Source Leakage Current	Forward	I <sub>GSS</sub>	V <sub>GS</sub> =30V, V <sub>DS</sub> =0V			100	nA
	Reverse		V <sub>GS</sub> =-30V, V <sub>DS</sub> =0V			-100	nA
ON CHARACTERISTICS							
Gate Threshold Voltage		V <sub>GS(TH)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	2.5		4.5	V
Static Drain-Source On-State Resistance		R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =10.5A			0.23	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C <sub>ISS</sub>	V <sub>GS</sub> =0V, V <sub>DS</sub> =25V, f=1.0 MHz		1146		pF
Output Capacitance		C <sub>OSS</sub>			916.3		pF
Reverse Transfer Capacitance		C <sub>RSS</sub>			98.1		pF
SWITCHING CHARACTERISTICS							
Total Gate Charge (Note 1)		Q <sub>G</sub>	V <sub>DS</sub> =400V, V <sub>GS</sub> =10V, I <sub>D</sub> =21A I <sub>G</sub> =1mA (Note 1, 2)		47.5		nC
Gate-Source Charge		Q <sub>GS</sub>			14		nC
Gate-Drain Charge		Q <sub>GD</sub>			17.1		nC
Turn-on Delay Time (Note 1)		t <sub>D(ON)</sub>	V <sub>DS</sub> =100V, V <sub>GS</sub> =10V, I <sub>D</sub> =21A, R <sub>G</sub> =6Ω (Note 1, 2)		10.5		ns
Rise Time		t <sub>R</sub>			18.7		ns
Turn-off Delay Time		t <sub>D(OFF)</sub>			45.2		ns
Fall-Time		t <sub>F</sub>			22.1		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Maximum Body-Diode Continuous Current		I <sub>S</sub>				21	A
Maximum Body-Diode Pulsed Current		I <sub>SM</sub>				42	A
Drain-Source Diode Forward Voltage (Note 1)		V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =21A			1.4	V
Reverse Recovery Time (Note 1)		t <sub>rr</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =21A,		204.5		ns
Reverse Recovery Charge		Q <sub>rr</sub>	dl <sub>r</sub> /dt=100A/μs (Note1)		3.2		μC

Notes: 1. Pulse Test : Pulse width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$ .

2. Essentially independent of operating temperature.

[illegible]

The diagram illustrates the timing relationships for a MOSFET switching event, showing the relationship between the gate-source voltage ( $V_{GS}$ ), the drain-source current ( $I_{SD}$ ), and the drain-source voltage ( $V_{DS}$ ).

**Gate-Source Voltage ( $V_{GS}$  (Driver)):** This signal is a square wave. The pulse width is labeled **P.W.**, and the total duration of one cycle is labeled **Period**. The duty cycle is defined as  $D = \frac{P.W.}{Period}$ . The peak voltage is indicated as  $V_{GS} = 10V$ .

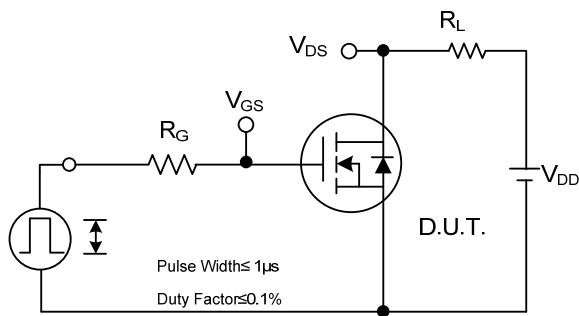
**Drain-Source Current ( $I_{SD}$  (D.U.T.)):** This signal shows the current flowing through the device. During the **Body Diode Forward Current** phase, the current is  $I_{FM}$ . During the **Body Diode Reverse Current** phase, the current is  $I_{RM}$ . The rate of change of current during the reverse phase is labeled  $di/dt$ .

**Drain-Source Voltage ( $V_{DS}$  (D.U.T.)):** This signal shows the voltage across the device. It includes the **Body Diode Recovery  $dv/dt$**  phase, where the voltage rises from zero to the full  $V_{DD}$  level.

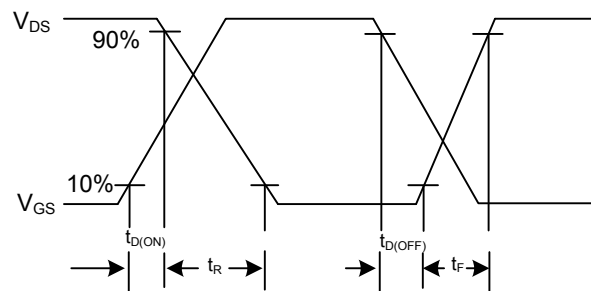
**Body Diode Forward Voltage Drop:** This is the voltage drop across the body diode during forward conduction.

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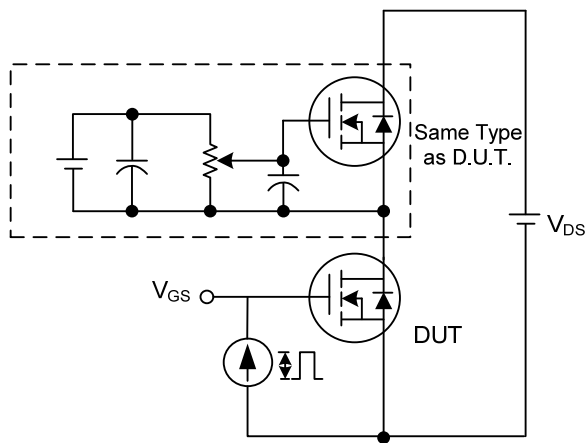
## ■ TEST CIRCUITS AND WAVEFORMS



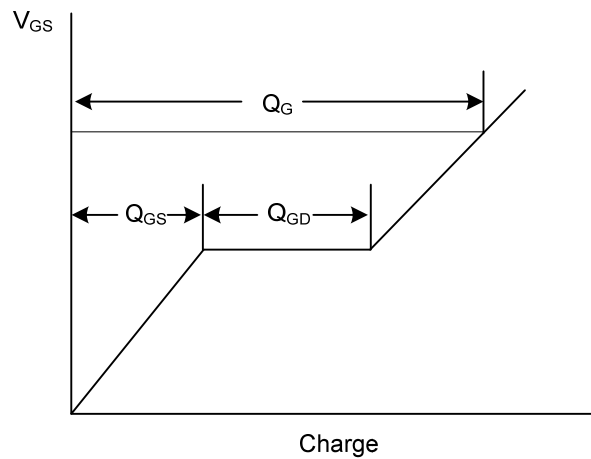
Switching Test Circuit



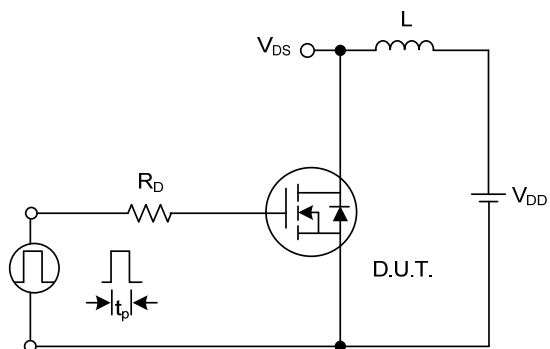
Switching Waveforms



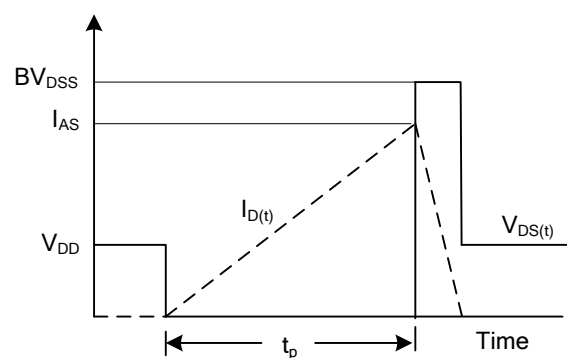
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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