



## 4N70

Power MOSFET

### 4.4A, 700V N-CHANNEL POWER MOSFET

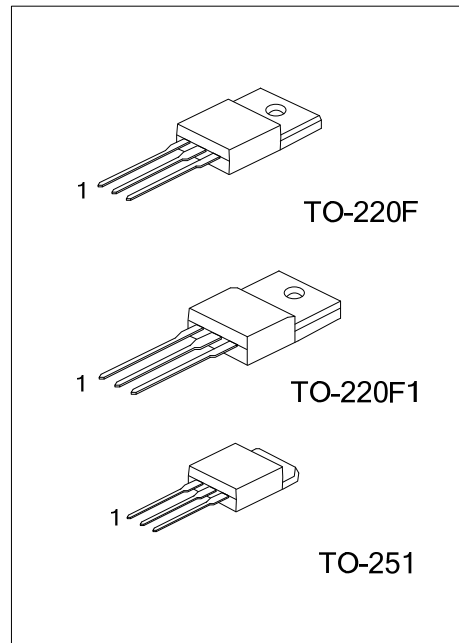
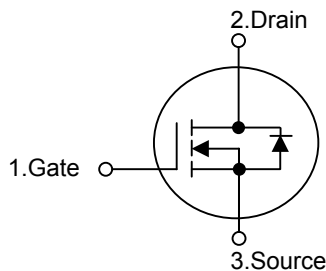
#### DESCRIPTION

The UTC **4N70** is a high voltage power MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and high rugged avalanche. This high speed switching power MOSFET is usually used in power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

#### FEATURES

- \*  $R_{DS(ON)} = 2.8\Omega @ V_{GS} = 10V$
- \* Ultra Low Gate Charge ( Typical 15nC )
- \* Low Reverse Transfer Capacitance (  $C_{RSS} = \text{Typical } 8.0 \text{ pF}$  )
- \* 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	
4N70L-TF1-T	4N70G-TF1-T	TO-220F1	G	D	S	Tube
4N70L-TF3-T	4N70G-TF3-T	TO-220F	G	D	S	Tube
4N70L-TM3-T	4N70G-TM3-T	TO-251	G	D	S	Tube

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

<p>4N70L-TF1-T</p> <p>(1) Packing Type (2) Package Type (3) Lead Free</p>	<p>(1) T: Tube (2) TF1: TO-220F1, TF3: TO-220F, TM3: TO-251 (3) G: Halogen Free, L: Lead Free</p>
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■ ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ , unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage		$V_{DSS}$	700	V
Gate-Source Voltage		$V_{GSS}$	$\pm 30$	V
Avalanche Current (Note 2)		$I_{AR}$	4.4	A
Drain Current	Continuous	$I_D$	4.4	A
	Pulsed (Note 2)	$I_{DM}$	17.6	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	260	mJ
	Repetitive (Note 2)	$E_{AR}$	10.6	mJ
Peak Diode Recovery $dv/dt$ (Note 4)		$dv/dt$	4.5	V/ns
Power Dissipation	TO-220F/TO-220F1	$P_D$	36	W
	TO-251		49	
Junction Temperature		$T_J$	+150	$^\circ\text{C}$
Operating Temperature		$T_{OPR}$	-55 ~ +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.  $L = 26.9\text{mH}$ ,  $I_{AS} = 4.4\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD} \leq 4.4\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220F/TO-220F1	$\theta_{JA}$	62.5	$^\circ\text{C}/\text{W}$
	TO-251		110	
Junction to Case	TO-220F/TO-220F1	$\theta_{Jc}$	3.47	$^\circ\text{C}/\text{W}$
	TO-251		2.55	

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

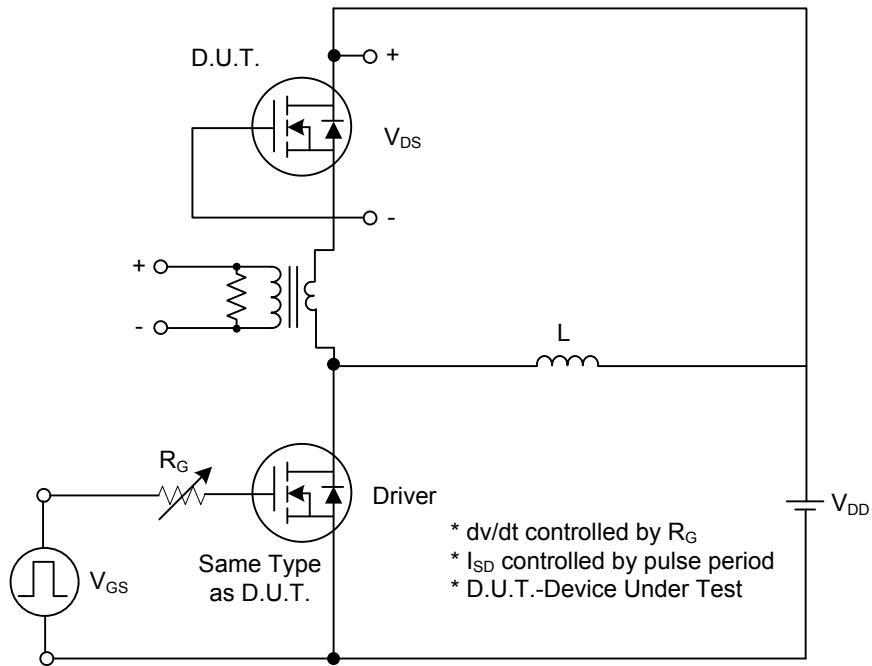
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS} = 0\text{V}$ , $I_D = 250\ \mu\text{A}$	700			V
Drain-Source Leakage Current	$I_{DSS}$	$V_{DS} = 700\text{V}$ , $V_{GS} = 0\text{V}$			10	$\mu\text{A}$
Gate-Source Leakage Current	Forward	$I_{GSS}$	$V_{GS} = 30\text{V}$ , $V_{DS} = 0\text{V}$		100	nA
Breakdown Voltage Temperature Coefficient	$\Delta BV_{DSS}/\Delta T_J$	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		0.6		$\text{V}/^\circ\text{C}$
<b>ON CHARACTERISTICS</b>						
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$	2.0		4.0	V
Static Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS} = 10\text{V}$ , $I_D = 2.2\text{A}$		2.6	2.8	$\Omega$
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	$C_{ISS}$	$V_{DS} = 25\text{V}$ , $V_{GS} = 0\text{V}$ , $f = 1\text{MHz}$		520	670	pF
Output Capacitance	$C_{OSS}$			70	90	pF
Reverse Transfer Capacitance	$C_{RSS}$			8	11	pF
<b>SWITCHING CHARACTERISTICS</b>						
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD} = 350\text{V}$ , $I_D = 4.4\text{A}$ , $R_G = 25\ \Omega$ (Note 1, 2)		13	35	ns
Turn-On Rise Time	$t_R$			45	100	ns
Turn-Off Delay Time	$t_{D(OFF)}$			25	60	ns
Turn-Off Fall Time	$t_F$			35	80	ns
Total Gate Charge	$Q_G$	$V_{DS} = 560\text{V}$ , $I_D = 4.4\text{A}$ , $V_{GS} = 10\text{V}$ (Note 1, 2)		15	20	nC
Gate-Source Charge	$Q_{GS}$			3.4		nC
Gate-Drain Charge	$Q_{GD}$			7.1		nC

■ ELECTRICAL CHARACTERISTICS(Cont.)

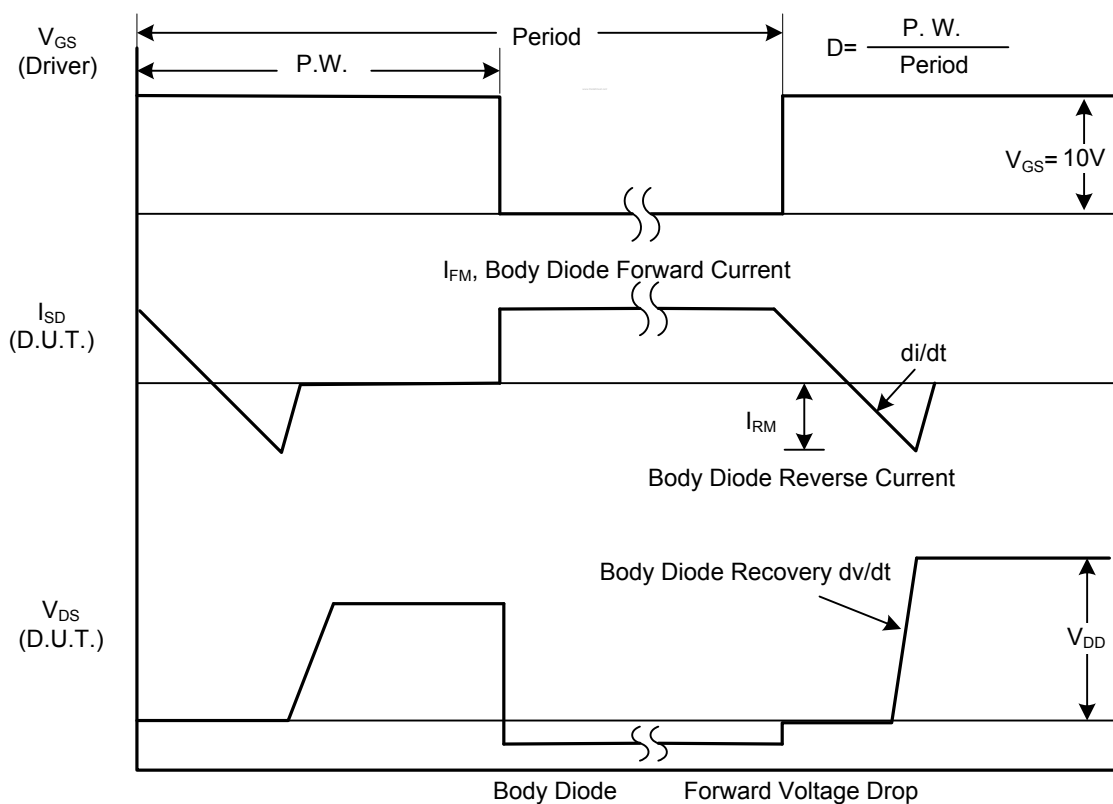
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS</b>						
Drain-Source Diode Forward Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}, I_S = 4.4\text{ A}$			1.4	V
Maximum Continuous Drain-Source Diode Forward Current	$I_S$				4.4	A
Maximum Pulsed Drain-Source Diode Forward Current	$I_{SM}$				17.6	A
Reverse Recovery Time	$t_{rr}$	$V_{GS} = 0\text{ V}, I_S = 4.4\text{ A},$		250		ns
Reverse Recovery Charge	$Q_{RR}$	$di/dt = 100\text{ A}/\mu\text{s}$ (Note 1)		1.5		$\mu\text{C}$

Notes: 1. Pulse Test: Pulse width  $\leq 300\mu\text{s}$ , Duty cycle  $\leq 2\%$   
 2. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

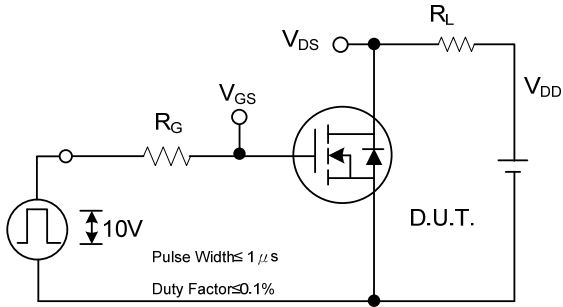


Peak Diode Recovery  $dv/dt$  Test Circuit

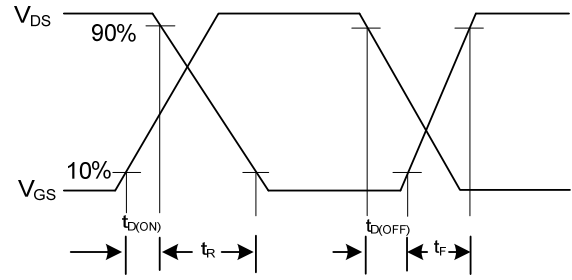


Peak Diode Recovery  $dv/dt$  Waveforms

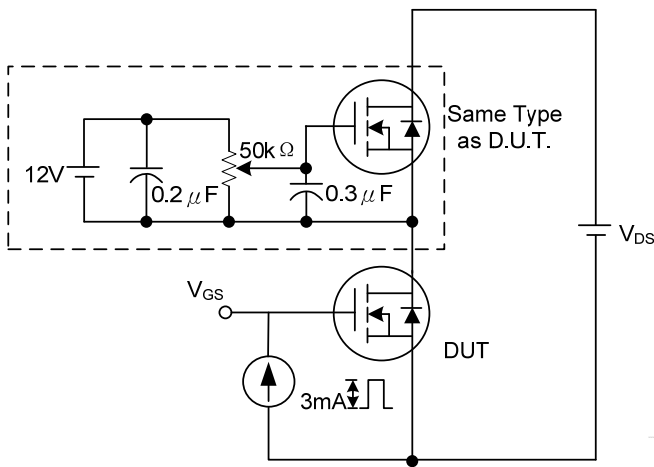
## TEST CIRCUITS AND WAVEFORMS (Cont.)



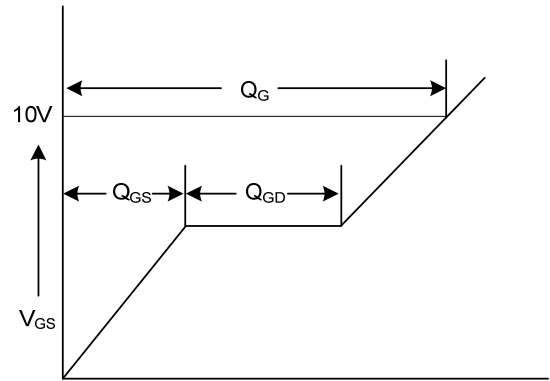
**Switching Test Circuit**



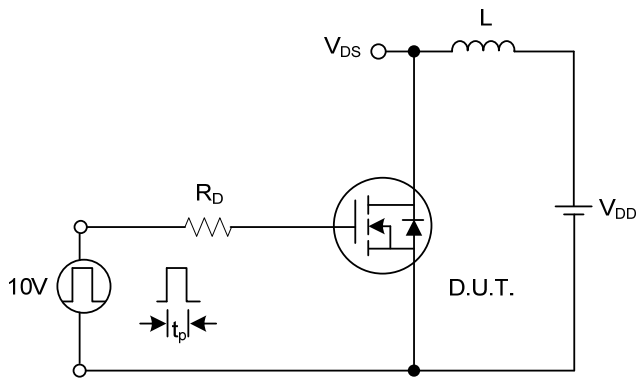
**Switching Waveforms**



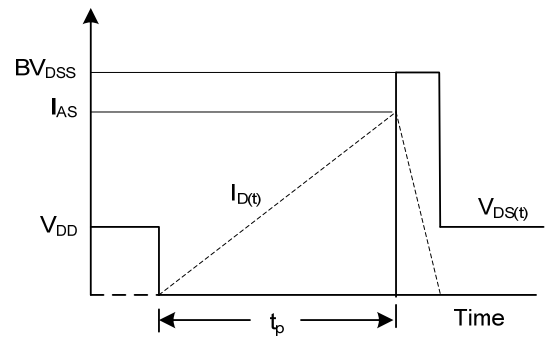
**Gate Charge Test Circuit**



**Gate Charge Waveform**

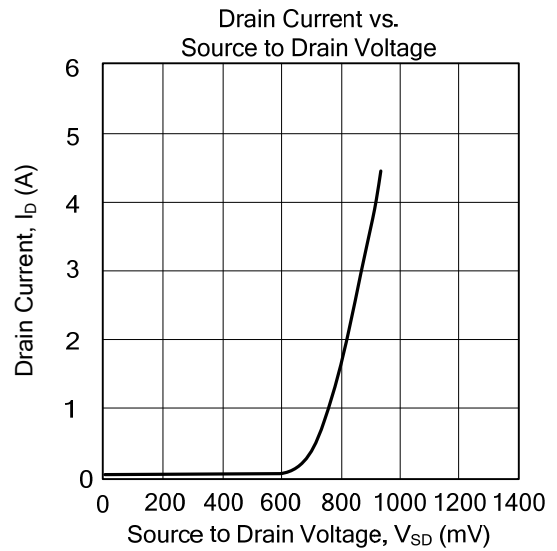
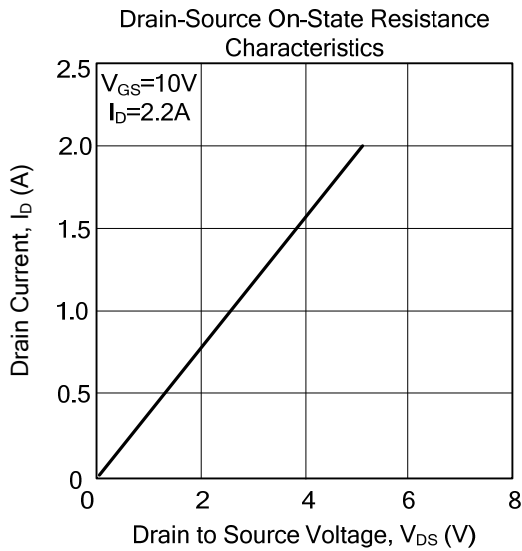
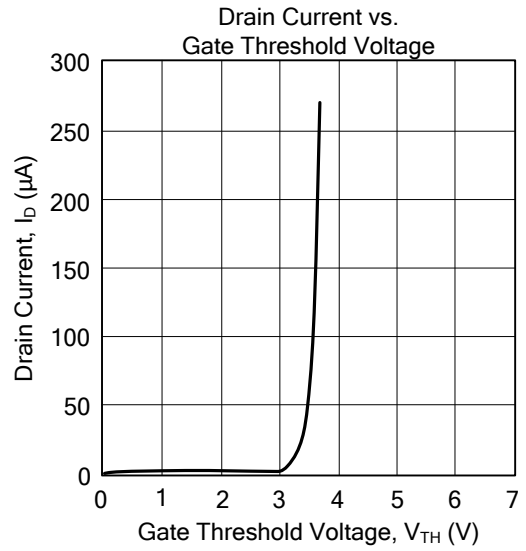
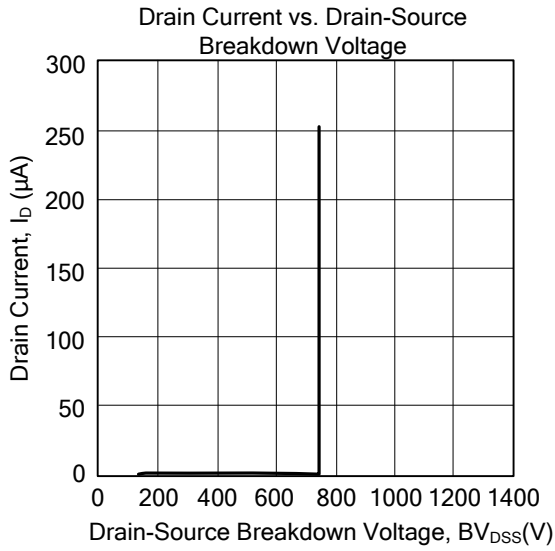


**Unclamped Inductive Switching Test Circuit**



**Unclamped Inductive Switching Waveforms**

■ TYPICAL CHARACTERISTICS



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