



## 1NM70-S

Preliminary

Power MOSFET

### 1.0A, 700V N-CHANNEL SUPER-JUNCTION MOSFET

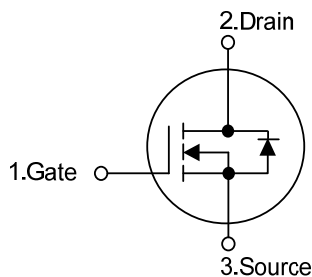
#### DESCRIPTION

The **UTC 1NM70-S** 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

- \*  $R_{DS(ON)} < 4.3\Omega$  @  $V_{GS} = 10V$ ,  $I_D = 0.5A$
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved dv/dt capability, high ruggedness

#### SYMBOL

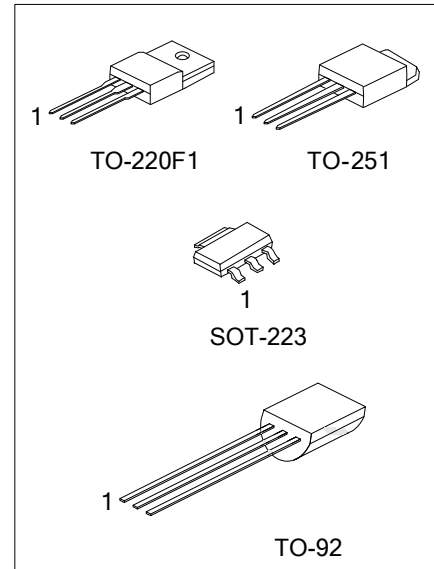


#### ORDERING INFORMATION

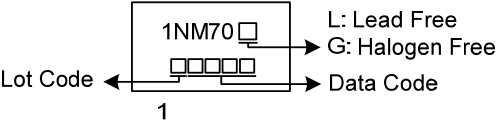
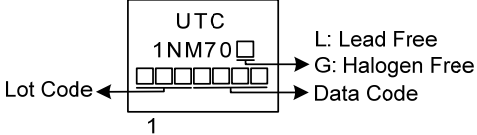
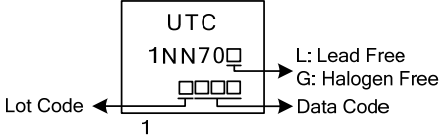
Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
1NM70L-AA3-R	1NM70G-AA3-R	SOT-223	G	D	S	Tape Reel
1NM70L-TF1-R	1NM70G-TF1-R	TO-220F1	G	D	S	Tape Reel
1NM70L-TM3-R	1NM70G-TM3-R	TO-251	G	D	S	Tape Reel
1NM70L-T92-B	1NM70G-T92-B	TO-92	G	D	S	Tape Box
1NM70L-T92-K	1NM70G-T92-K	TO-92	G	D	S	Bulk

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

<p>1NM70G-AA3-R</p> <p>(1) Packing Type (2) Package Type (3) Green Package</p>	<p>(1) B: Tape Box, K: Bulk, R: Tape Reel (2) AA3: SOT-223, TF1: TO-220F1, TM3: TO-251, T92: TO-92 (3) G: Halogen Free and Lead Free, L: Lead Free</p>
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## ■ MARKING

Package	Marking
SOT-223	 <p>Diagram showing the marking on a SOT-223 package. The marking consists of the part number '1NM70' followed by a small square symbol. Below this, there are four small squares representing the Lot Code and four small squares representing the Data Code. Arrows point from the Lot Code and Data Code to their respective labels. The number '1' is shown below the Data Code. To the right of the diagram, the text 'L: Lead Free' and 'G: Halogen Free' is displayed.</p>
TO-220F1 / TO-251	 <p>Diagram showing the marking on a TO-220F1 / TO-251 package. The marking consists of the text 'UTC' above the part number '1NM70', followed by a small square symbol. Below this, there are four small squares representing the Lot Code and four small squares representing the Data Code. Arrows point from the Lot Code and Data Code to their respective labels. The number '1' is shown below the Data Code. To the right of the diagram, the text 'L: Lead Free' and 'G: Halogen Free' is displayed.</p>
TO-92	 <p>Diagram showing the marking on a TO-92 package. The marking consists of the text 'UTC' above the part number '1NN70', followed by a small square symbol. Below this, there are four small squares representing the Lot Code and four small squares representing the Data Code. Arrows point from the Lot Code and Data Code to their respective labels. The number '1' is shown below the Data Code. To the right of the diagram, the text 'L: Lead Free' and 'G: Halogen Free' is displayed.</p>

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

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage		$V_{DS}$	700	V
Gate-Source Voltage		$V_{GS}$	$\pm 30$	V
Drain Current	Continuous	$I_D$	1.0	A
	Pulsed (Note 2)	$I_{DM}$	4	A
Avalanche Current (Note 2)		$I_{AR}$	0.77	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	41	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns
Power Dissipation	SOT-223	$P_D$	8	W
	TO-220F1		21	W
	TO-251		28	W
	TO-92		1.6	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.  $L=138\text{mH}$ ,  $I_{AS}=0.77\text{A}$ ,  $V_{DD}=50\text{V}$ ,  $R_G=25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$

4.  $I_{SD}\leq 1.0\text{A}$ ,  $di/dt\leq 200\text{A}/\mu\text{s}$ ,  $V_{DD}\leq BV_{DS}$ , Starting  $T_J = 25^\circ\text{C}$

■ THERMAL CHARACTERISTICS

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	SOT-223	$\theta_{JA}$	150	$^\circ\text{C}/\text{W}$
	TO-220F1		62.5	$^\circ\text{C}/\text{W}$
	TO-251		110	$^\circ\text{C}/\text{W}$
	TO-92		180	$^\circ\text{C}/\text{W}$
Junction to Case	SOT-223	$\theta_{JC}$	15.6	$^\circ\text{C}/\text{W}$
	TO-220F1		5.95	$^\circ\text{C}/\text{W}$
	TO-251		4.46	$^\circ\text{C}/\text{W}$
	TO-92		78	$^\circ\text{C}/\text{W}$

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

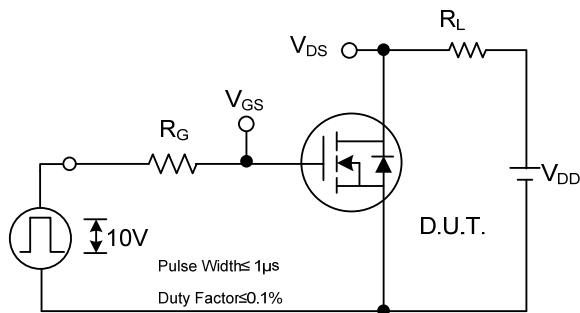
PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS							
Drain-Source Breakdown Voltage		$BV_{DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	700			V
Drain-Source Leakage Current		$I_{DSS}$	$V_{DS} = 700V, V_{GS} = 0V$			10	$\mu A$
Gate-Source Leakage Current	Forward	$I_{GSS}$	$V_{GS} = 30V, V_{DS} = 0V$			100	nA
	Reverse		$V_{GS} = -30V, V_{DS} = 0V$			-100	nA
ON CHARACTERISTICS							
Gate Threshold Voltage		$V_{GS(TH)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	2.5		4.5	V
Static Drain-Source On-State Resistance		$R_{DS(ON)}$	$V_{GS} = 10V, I_D = 0.5A$			4.3	$\Omega$
DYNAMIC CHARACTERISTICS							
Input Capacitance		$C_{ISS}$	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$		116		pF
Output Capacitance		$C_{OSS}$			62		pF
Reverse Transfer Capacitance		$C_{RSS}$			8		pF
SWITCHING CHARACTERISTICS							
Total Gate Charge (Note 1)		$Q_G$	$V_{DS} = 50V, V_{GS} = 10V, I_D = 0.5A$ $I_G = 100\mu A$ (Note 1, 2)		14.6		nC
Gate-Source Charge		$Q_{GS}$			1.5		nC
Gate-Drain Charge		$Q_{GD}$			4.5		nC
Turn-On Delay Time (Note 1)		$t_{D(ON)}$	$V_{DD} = 30V, V_{GS} = 10V, I_D = 0.5A,$ $R_G = 25\Omega$ (Note 1, 2)		37		ns
Turn-On Rise Time		$t_R$			38		ns
Turn-Off Delay Time		$t_{D(OFF)}$			63		ns
Turn-Off Fall Time		$t_F$			19		ns
DRAIN-SOURCE DIODE CHARACTERISTICS							
Continuous Drain-Source Current		$I_S$				1.0	A
Maximum Body-Diode Pulsed Current		$I_{SM}$				4.0	A
Drain-Source Diode Forward Voltage (Note 1)		$V_{SD}$	$I_S = 1.0A, V_{GS} = 0V$			1.4	V
Body Diode Reverse Recovery Time (Note 1)		$t_{rr}$	$I_S = 1.0A, V_{GS} = 0V,$		162		nS
Body Diode Reverse Recovery Charge		$Q_{rr}$	$dI_F/dt = 100A/\mu s$		0.7		$\mu C$

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

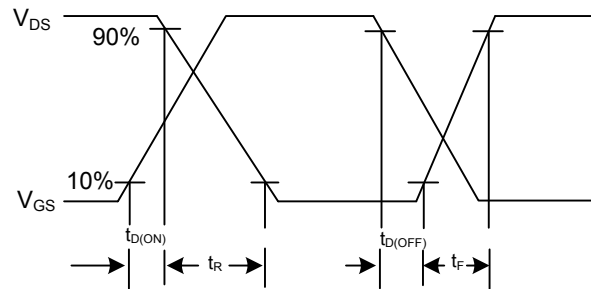
2. Essentially independent of operating temperature.



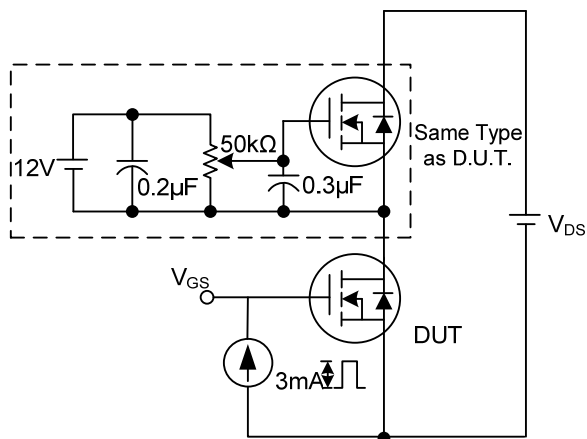
# ■ TEST CIRCUITS AND WAVEFORMS (Cont.)



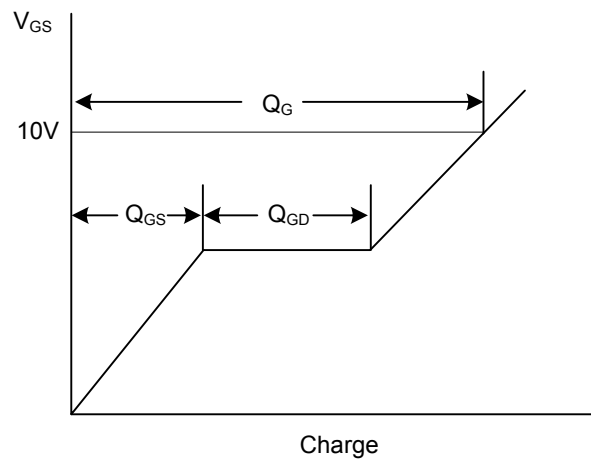
Switching Test Circuit



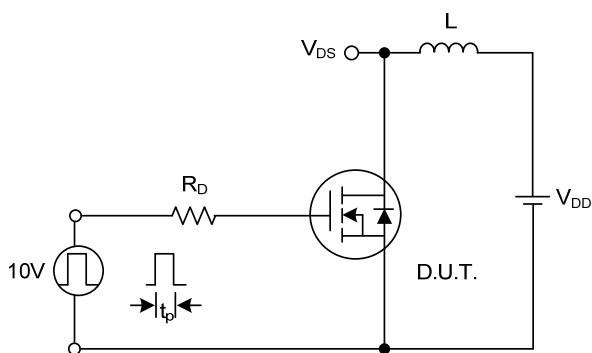
Switching Waveforms



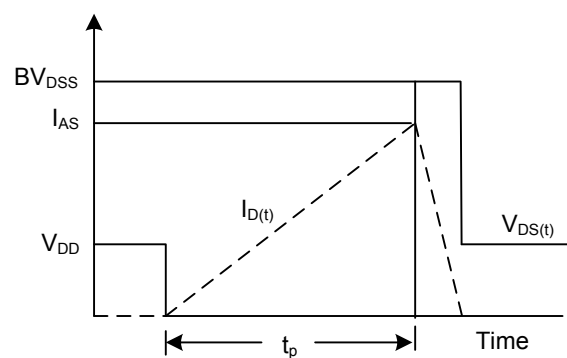
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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