



5NM70A-U2

Preliminary

Power MOSFET

5.0A, 700V N-CHANNEL SUPER-JUNCTION MOSFET

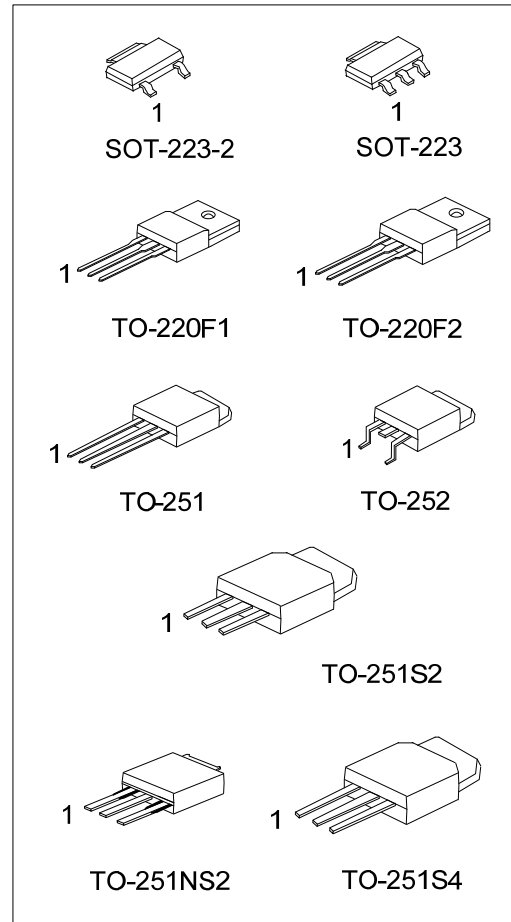
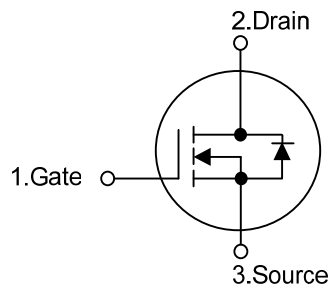
■ DESCRIPTION

The UTC **5NM70A-U2** 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 high rugged avalanche characteristics. This power MOSFET is usually used in high speed switching applications at power supplies, PWM motor controls, high efficient AC to DC converters and bridge circuits.

■ FEATURES

- * $R_{DS(ON)} \leq 1.8 \Omega$ @ $V_{GS} = 10V$, $I_D = 1.25A$
- * Fast Switching Capability
- * Improved dv/dt Capability, High Ruggedness

■ SYMBOL



■ ORDERING INFORMATION

Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
5NM70AL-U2-AA2-R	5NM70AG-U2-AA2-R	SOT-223-2	G	D	S	Tape Reel
5NM70AL-U2-AA3-R	5NM70AG-U2-AA3-R	SOT-223	G	D	S	Tape Reel
5NM70AL-U2-TF1-T	5NM70AG-U2-TF1-T	TO-220F1	G	D	S	Tube
5NM70AL-U2-TF2-T	5NM70AG-U2-TF2-T	TO-220F2	G	D	S	Tube
5NM70AL-U2-TM3-T	5NM70AG-U2-TM3-T	TO-251	G	D	S	Tube
5NM70AL-U2-TMS2-T	5NM70AG-U2-TMS2-T	TO-251S2	G	D	S	Tube
5NM70AL-U2-TMS4-T	5NM70AG-U2-TMS4-T	TO-251S4	G	D	S	Tube
5NM70AL-U2-TMN2-T	5NM70AG-U2-TMN2-T	TO-251NS2	G	D	S	Tube
5NM70AL-U2-TN3-R	5NM70AG-U2-TN3-R	TO-252	G	D	S	Tape Reel

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

5NM70AG-U2-AA2-R (1) Packing Type (2) Package Type (3) Version Code (4) Green Package	(1) T: Tube, R: Tape Reel (2) AA2: SOT-223-2, AA3: SOT-223, TF1: TO-220F1, TF2: TO-220F2, TM3: TO-251, TMS2: TO-251S2, TMS4: TO-251S4, TN3: TO-252, TMN2: TO-251NS2 (3) Version U2 (4) G: Halogen Free and Lead Free, L: Lead Free
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■ MARKING

SOT-223-2 / SOT-223	TO-220F1 / TO-220F2 / TO-251 TO-251S2 / TO-251S4 / TO-251NS2 / TO-252
Version Code ← 1 5NM70A □ U2 □ □ □ → L: Lead Free → G: Halogen Free → Date Code	Version Code ← 1 UTC 5NM70A □ U2 □ □ □ □ → L: Lead Free → G: Halogen Free → Date Code

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

PARAMETER			SYMBOL	RATINGS	UNIT
Drain-Source Voltage			V _{DSS}	700	V
Gate-Source Voltage			V _{GSS}	±30	V
Drain Current	Continuous	T _C =25°C	I _D	5	A
		T _C =100°C		3.4	A
	Pulsed (Note 2)		I _{DM}	20	A
Avalanche Energy	Single Pulsed (Note 3)		E _{AS}	116	mJ
Peak Diode Recovery dv/dt (Note 4)			dv/dt	3	V/ns
Power Dissipation	SOT-223-2/SOT-223		P _D	8	W
	TO-220F1/TO-220F2			30	W
	TO-251/TO-251S2			48	W
	TO-251S4/TO-251NS2				
	TO-252				
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. $L = 144\text{mH}$, $I_{AS} = 1.27\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\Omega$, Starting $T_J = 25^\circ\text{C}$

4. $I_{SD} \leq 5.0\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_J = 25^\circ\text{C}$

■ **THERMAL DATA**

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	SOT-223-2/SOT-223	θ_{JA}	150	$^\circ\text{C}/\text{W}$
	TO-220F1/TO-220F2		62.5	$^\circ\text{C}/\text{W}$
	TO-251/TO-251S2		110	$^\circ\text{C}/\text{W}$
	TO-251S4/TO-251NS2			
	TO-252			
Junction to Case	SOT-223-2/SOT-223	θ_{JC}	15.6	$^\circ\text{C}/\text{W}$
	TO-220F1/TO-220F2		4.17	$^\circ\text{C}/\text{W}$
	TO-251/TO-251S2		2.6	$^\circ\text{C}/\text{W}$
	TO-251S4/TO-251NS2			
	TO-252			

Note: Device mounted on FR-4 substrate P_c board, 2oz copper, with 1inch square copper plate.

■ **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 =250μA	700			V
Drain-Source Leakage Current		I _{DSS}	V _{DS} =700V, V _{GS} =0V			1	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	2.5		4.5	V
Static Drain-Source On-State Resistance		R _{DS(ON)}	V _{GS} =10V, I _D =1.25A			1.8	Ω
DYNAMIC CHARACTERISTICS							
Input Capacitance		C _{ISS}	V _{GS} =0V, V _{DS} =25V, f=1.0MHz		250		pF
Output Capacitance		C _{OSS}			150		pF
Reverse Transfer Capacitance		C _{RSS}			14		pF
SWITCHING CHARACTERISTICS							
Total Gate Charge (Note 1)		Q _G	V _{DS} =50V, V _{GS} =10V, I _D =1.3A , I _G =100μA (Note 1, 2)		24		nC
Gate to Source Charge		Q _{GS}			3		nC
Gate to Drain Charge		Q _{GD}			7		nC
Turn-ON Delay Time (Note 1)		t _{D(ON)}	V _{DD} =30V, V _{GS} =10V, I _D =0.5A, R _G =25Ω (Note 1, 2)		40		ns
Rise Time		t _R			55		ns
Turn-OFF Delay Time		t _{D(OFF)}			120		ns
Fall-Time		t _F			30		ns
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS							
Maximum Body-Diode Continuous Current		I _S				5	A
Maximum Body-Diode Pulsed Current		I _{SM}				20	A
Drain-Source Diode Forward Voltage (Note 1)		V _{SD}	I _S =5.0A, V _{GS} =0V			1.4	V
Body Diode Reverse Recovery Time (Note 1)		t _{rr}	I _S =5.0A, V _{GS} =0V,		310		ns
Body Diode Reverse Recovery Charge		Q _{rr}	dlf/dt=100A/μs		3		μC

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

2. Essentially independent of operating temperature.

D.U.T.

V_{DS}

I_{SD}

L

V_{DD}

Driver

R_G

V_{GS}

Same Type as D.U.T.

- * dv/dt controlled by R_G
- * I_{SD} controlled by pulse period
- * D.U.T.-Device Under Test

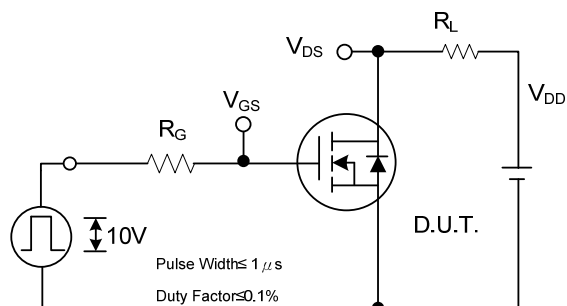
Timing diagram for a MOSFET switching a load inductor. The diagram shows three waveforms: V_{GS} (Driver), I_{SD} (D.U.T.), and V_{DS} (D.U.T.).

- V_{GS} (Driver): A square wave with pulse width (P.W.) and period (Period). The duty cycle is defined as $D = \frac{P.W.}{Period}$. The peak gate voltage is $V_{GS} = 10V$.
- I_{SD} (D.U.T.): The source-drain current. It shows forward current I_{FM} (Body Diode Forward Current) during the pulse and reverse current I_{RM} (Body Diode Reverse Current) during the recovery phase. The slope of the reverse current is labeled di/dt .
- V_{DS} (D.U.T.): The drain-source voltage. It shows the body diode forward voltage drop and the recovery dv/dt during the reverse current phase. The peak drain voltage is V_{DD} .

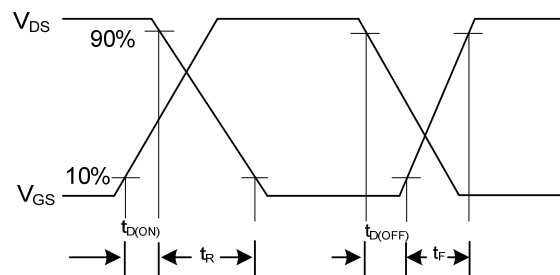
Labels at the bottom indicate the regions: Body Diode Forward Voltage Drop and Body Diode Recovery dv/dt .

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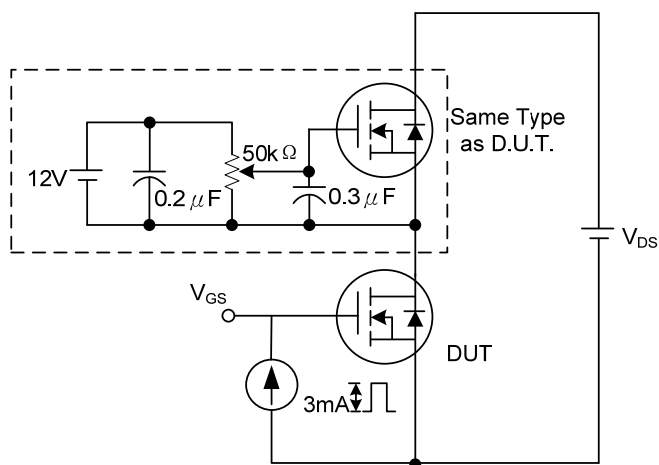
■ TEST CIRCUITS AND WAVEFORMS



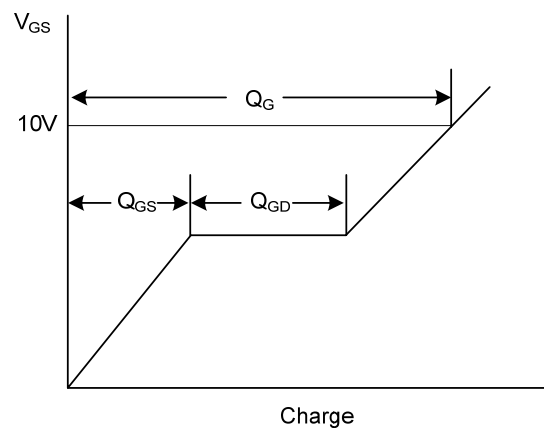
Switching Test Circuit



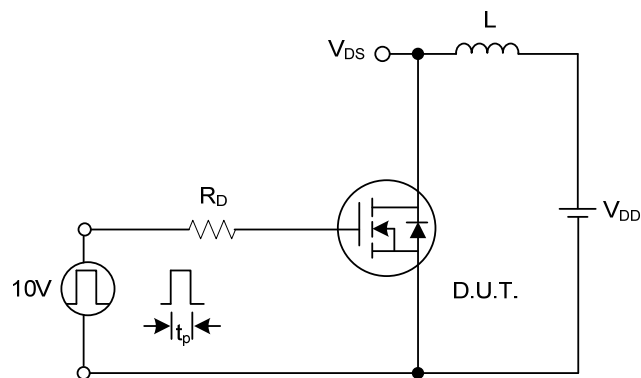
Switching Waveforms



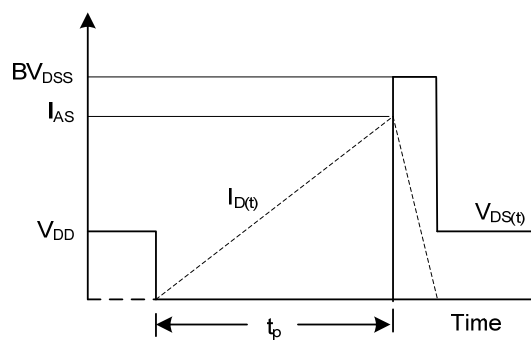
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

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