

UTC UNISONIC TECHNOLOGIES CO., LTD

7N50

Preliminary

7A, 500V N-CHANNEL **POWER MOSFET**

DESCRIPTION

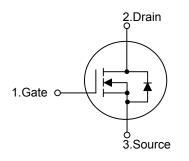
The UTC 7N50 is an N-channel mode power MOSFET using UTC's advanced technology to provide customers with planar stripe and DMOS technology. This technology allows a minimum on-state resistance and superior switching performance. It also can withstand high energy pulse in the avalanche and commutation mode.

The UTC 7N50 is generally applied in high efficiency switch mode power supplies, active power factor correction and electronic lamp ballasts based on half bridge topology.

FEATURES

- * $R_{DS(ON)}$ =1.0 Ω @ V_{GS} =10V
- * High Switching Speed
- * 100% Avalanche Tested

SYMBOL

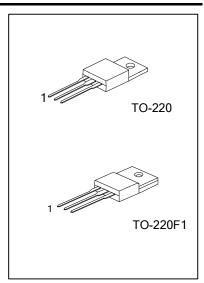


ORDERING INFORMATION

Ordering Number		Deekage	Pin Assignment			Decking	
Lead Free	Halogen Free	Package	1	2	3	Packing	
7N50L-TA3-T	7N50G-TA3-T	TO-220	G	D	S	Tube	
7N50L-TF1-T	7N50G-TF1-T	TO-220F1	G	D	S	Tube	

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

7N50L-TA3-T (1)Packing Type (2)Package Type	(1) T: Tube (2) TA3: TO-220 ,TF1: TO-220F1
(3)Lead Free	(3) G: Halogen Free, L: Lead Free



■ ABSOLUTE MAXIMUM RATINGS (T_c=25°C, unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT		
Drain-Source Voltage		V _{DSS}	500	V		
Gate-Source Voltage			V _{GSS}	±30	V	
Desire Oursent	Continu	ous (T _C =25°C)	ID	7 (Note 5)	А	
Drain Current	Pulsed	(Note 2)	I _{DM}	28 (Note 5)	А	
Avalanche Current (Note 2)		I _{AR}	7	А		
Avalanche Energy	Single F	Pulsed (Note 3)	E _{AS}	270	mJ	
	Repetiti	ve (Note 4)	E _{AR}	8.9	mJ	
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns		
Power Dissipation (T _c =25°C) TO-220 TO-220		TO-220		89	w	
		TO-220F1	D	39	vv	
Derate above 25°C		TO-220	PD	0.71	W/°C	
		TO-220F1		0.31	W/ C	
Junction Temperature			TJ	+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 = 10mH, I_{AS} = 7A, V_{DD} = 50V, R_G = 25 Ω , Starting T_J = 25°C

- 4. $I_{SD} \le 7A$, di/dt $\le 200A/\mu s$, $V_{DD} \le BV_{DSS}$, Starting $T_J = 25^{\circ}C$
- 5. Drain current limited by maximum junction temperature

THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient		θ _{JA}	62.5	°C/W
Junction to Case	TO-220	0	1.4	°0141
	TO-220F1	θ _{JC}	3.2	°C/W



■ ELECTRICAL CHARACTERISTICS (T_c=25°C, unless otherwise noted)

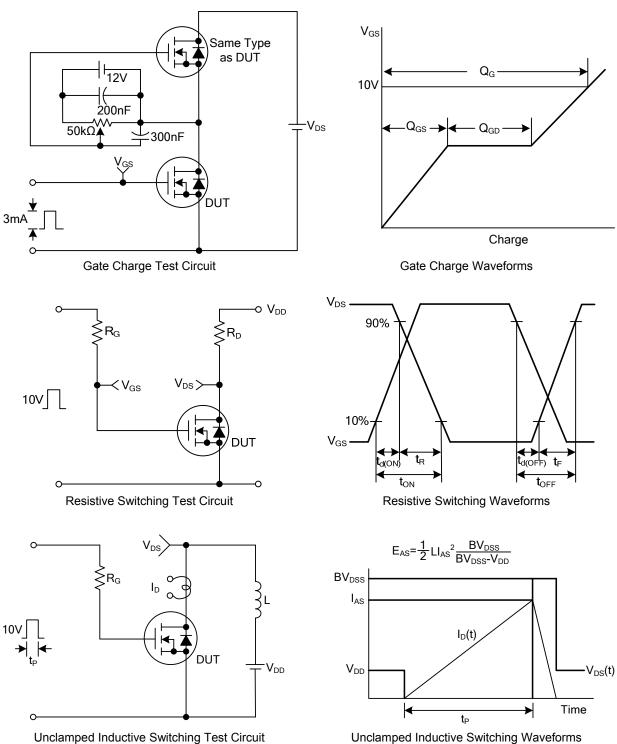
$\begin{array}{ c c c c c c } \hline Drain-Source Breakdown Voltage & BV_{DSS} & I_p=250\mu A, V_{GS}=0V & 500 & V \\ \hline Drain-Source Leakage Current & I_{DSS} & V_{DS}=500V, V_{GS}=0V & 1 \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline ON CHARACTERISTICS & & & & \\ \hline Cate Threshold Voltage & V_{GS}(TH) & V_{DS}=V_{GS}, I_p=250\mu A & 2.0 & 4.0 & V \\ \hline Static Drain-Source On-State Resistance & R_{DS}(ON) & V_{GS}=10V, I_p=3.5A & 0.8 & 1.0 & \Omega \\ \hline DYNAMIC PARAMETERS & & & & & \\ \hline Total Gate Charge & C_{GS} & V_{GS}=0V, V_{DS}=25V, f=1.0MHz & 95 & 190 & pF \\ \hline Reverse Transfer Capacitance & C_{RSS} & & & & \\ \hline Total Gate Charge & Q_{G} & & & \\ \hline Cate to Drain Charge & Q_{GD} & & & & \\ \hline Turn-ON Delay Time & t_{D(ON)} & & & & \\ \hline Turn-OFF Delay Time & t_{D(OFF)} & & & & \\ \hline Turn-OFF Delay Time & t_{C} & & & & \\ \hline Turn-OFF Delay Time & t_{C} & & & & \\ \hline Source - DRAIN DIODE RATINGS AND CHARACTERISTICS & & & \\ \hline Source - Drain Diode Continuous Current & I_{S} & & & & \\ \hline Maximum Body-Diode Continuous Current & I_{S} & & & & & \\ \hline Maximum Body-Diode Pulsed Current & I_{SM} & & & & & & & & \\ \hline Maximum Body-Diode Porward Voltage & V_{SD} & I_s=7A, V_{GS}=0V, & & & & & & & & & & & & & & \\ \hline Drain-Source Diode Forward Voltage & V_{SD} & & & & & & & & & & & & & & & & & & &$						-			
$\begin{array}{ c c c c c c } \hline Drain-Source Breakdown Voltage & BV_{DSS} & I_p=250\mu A, V_{GS}=0V & 500 & V \\ \hline Drain-Source Leakage Current & I_{DSS} & V_{DS}=500V, V_{GS}=0V & 1 \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline V_{DS}=400V, T_c=125^\circ C & 10 & \mu \\ \hline ON CHARACTERISTICS & & & & \\ \hline Cate Threshold Voltage & V_{GS}(TH) & V_{DS}=30V, V_{DS}=0V & 100 & nA \\ \hline ON CHARACTERISTICS & & & & & \\ \hline Cate Threshold Voltage & V_{GS}(TH) & V_{DS}=V_{GS}, I_p=250\mu A & 2.0 & 4.0 & V \\ \hline Static Drain-Source On-State Resistance & R_{DS}(ON) & V_{GS}=10V, I_p=3.5A & 0.8 & 1.0 & \Omega \\ \hline DYNAMIC PARAMETERS & & & & & \\ \hline Total Capacitance & C_{GSS} & V_{GS}=0V, V_{DS}=25V, f=1.0MHz & 95 & 190 & pF \\ \hline Reverse Transfer Capacitance & C_{RSS} & & & & & \\ \hline Total Gate Charge & Q_{G} & V_{GS}=10V, V_{DS}=400V, I_p=7A & 12.8 & 16.6 & nC \\ \hline Gate to Drain Charge & Q_{GD} & & & & & \\ \hline Turn-ON Delay Time & t_{D(OFF)} & & & & & & \\ \hline Turn-OFF Delay Time & t_{D(OFF)} & & & & & & & \\ \hline Turn-OFF Delay Time & t_{D(OFF)} & & & & & & & & & & \\ \hline Turn-OFF Delay Time & t_{C} & & & & & & & & & & & \\ \hline SoURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS & & & & & & & & & & & & \\ \hline Maximum Body-Diode Continuous Current & I_S & & & & & & & & & & & & & & & & & & &$	PARAMETER		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
$\begin{array}{ c c c c c } \hline Drain-Source Leakage Current & I_{DSS} & V_{DS}=500V, V_{GS}=0V & 1 & 1 \\ V_{DS}=400V, T_{C}=125^{\circ}C & 10 & 10 \\ V_{DS}=400V, T_{C}=125^{\circ}C & 10 & A \\ \hline V_{DS}=400V, V_{DS}=0V & 100 & A \\ \hline V_{GS}=-30V, V_{DS}=0V & 100 & A \\ \hline ON CHARACTERISTICS & V_{GS(TH)} & V_{DS}=V_{GS, I_D}=250\muA & 2.0 & 4.0 & V \\ \hline Static Drain-Source On-State Resistance & R_{DS(ON)} & V_{GS}=10V, I_{D}=35A & 0.8 & 1.0 & \Omega \\ \hline DYNAMIC PARAMETERS & V_{GS(TH)} & V_{GS}=0V, V_{DS}=25V, f=1.0MHz & 95 & 190 & pF \\ \hline Output Capacitance & C_{ISS} & V_{GS}=0V, V_{DS}=25V, f=1.0MHz & 95 & 190 & pF \\ \hline Dutput Capacitance & C_{RSS} & V_{GS}=0V, V_{DS}=25V, f=1.0MHz & 95 & 190 & pF \\ \hline SWITCHING PARAMETERS & V_{GS}=10V, V_{DS}=25V, f=1.0MHz & 95 & 190 & pF \\ \hline SWITCHING PARAMETERS & V_{GS}=10V, V_{DS}=400V, I_{D}=7A & 12.8 & 16.6 & nC \\ \hline Gate to Drain Charge & Q_{G} & V_{GS}=10V, V_{DS}=400V, I_{D}=7A & 12.8 & 16.6 & nC \\ \hline Gate to Drain Charge & Q_{GS} & V_{DS}=25V, I_{D}=7A, R_{G}=25\Omega & 55 & 120 & ns \\ \hline Turn-ON Delay Time & t_{D(ON)} & V_{D}=250V, I_{D}=7A, R_{G}=25\Omega & 55 & 120 & ns \\ \hline SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS & V_{DS}=25V, I_{D}=7A, R_{G}=25\Omega & 0.55 & 120 & ns \\ \hline SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS & Maximum Body-Diode Continuous Current & I_{S} & 0.55 & 0.7 & A \\ \hline Maximum Body-Diode Continuous Current & I_{S} & I_{S}=7A, V_{GS}=0V, V_{S}=20V, V_{S}=275 & ns \\ \hline Drain-Source Diode Forward Voltage & V_{SD} & I_{S}=7A, V_{GS}=0V, V_{SD} & 275 & ns \\ \hline \end{array}$	OFF CHARACTERISTICS								
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	Drain-Source Breakdown Voltage		BV _{DSS}	I _D =250μA, V _{GS} =0V	500			V	
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	Drain-Source Leakage Current		I _{DSS}	V _{DS} =500V, V _{GS} =0V			1		
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$				V _{DS} =400V, T _C =125°C			10	μA	
IREVERSE $V_{GS}=-30V, V_{DS}=0V$ -100 nA ON CHARACTERISTICS Gate Threshold Voltage $V_{GS}(TH)$ $V_{DS}=V_{GS}, I_D=250\muA$ 2.0 4.0 V Static Drain-Source On-State Resistance $R_{DS(ON)}$ $V_{GS}=10V, I_D=3.5A$ 0.8 1.0 Ω DYNAMIC PARAMETERS Input Capacitance C_{ISS} $V_{GS}=0V, V_{DS}=25V, f=1.0MHz$ 95 190 pF Reverse Transfer Capacitance C_{RSS} $V_{GS}=10V, V_{DS}=25V, f=1.0MHz$ 95 190 pF SWITCHING PARAMETERS C_{RSS} $V_{GS}=10V, V_{DS}=25V, f=1.0MHz$ 95 190 pF SWITCHING PARAMETERS C_{RSS} $V_{GS}=10V, V_{DS}=400V, I_D=7A$ 12.8 16.6 nC Gate to Source Charge Q_{GD} $V_{GS}=10V, V_{DS}=400V, I_D=7A$ 3.7 nC Gate to Drain Charge Q_{GD} $V_{DD}=250V, I_D=7A, R_G=25\Omega$ 5.8 nC Turn-OF Delay Time $t_{D}(OFF)$ $V_{DD}=250V, I_D=7A, R_G=25\Omega$ 55 120 ns SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS 35 <	Gate- Source Leakage Current	Forward	- I _{GSS}	V _{GS} =+30V, V _{DS} =0V			+100	nA	
Gate Threshold Voltage $V_{GS(TH)}$ $V_{DS}=V_{GS}, I_D=250\muA$ 2.04.0VStatic Drain-Source On-State Resistance $R_{DS(ON)}$ $V_{GS}=10V, I_D=3.5A$ 0.81.0 Ω DYNAMIC PARAMETERSInput Capacitance C_{ISS} $V_{GS}=0V, V_{DS}=25V, f=1.0MHz$ 95190pFOutput Capacitance C_{RSS} $V_{GS}=0V, V_{DS}=25V, f=1.0MHz$ 913.5pFSWITCHING PARAMETERSTotal Gate Charge Q_G $V_{GS}=10V, V_{DS}=400V, I_D=7A$ 12.816.6nCGate to Source Charge Q_{GS} $V_{GS}=10V, V_{DS}=400V, I_D=7A$ 3.7nCGate to Drain Charge Q_{GD} $V_{DD}=250V, I_D=7A, R_G=25\Omega$ 55120nsTurn-ON Delay Time $t_D(OFF)$ $(Note 1, 2)$ 2560nsFall-Time t_F 3580nssososoSOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICSMaximum Body-Diode Continuous Current I_S 7AMaximum Body-Diode Forward Voltage V_{SD} $I_S=7A, V_{GS}=0V, I_D=7V, V_{DS}=0V, I_A V_{DS}=0V$		Reverse		V_{GS} =-30V, V_{DS} =0V			-100	nA	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	ON CHARACTERISTICS								
DYNAMIC PARAMETERSInput Capacitance C_{ISS} C_{OSS} $V_{GS}=0V, V_{DS}=25V, f=1.0MHz$ 720 940 pF Output Capacitance C_{OSS} $Reverse Transfer CapacitanceC_{RSS}V_{GS}=0V, V_{DS}=25V, f=1.0MHz95190pFSWITCHING PARAMETERS913.5pFSWITCHING PARAMETERSQ_GCate to Source ChargeQ_GQ_{GD}V_{GS}=10V, V_{DS}=400V, I_D=7A(Note 1, 2)12.816.6nCGate to Drain ChargeQ_{GS}Q_{GD}V_{GS}=10V, V_{DS}=400V, I_D=7A(Note 1, 2)3.7nCGate to Drain ChargeQ_{GD}U_{DOP}5.8nC3.7nCGate to Drain ChargeQ_{GD}U_{DOP}V_{DD}=250V, I_D=7A, R_G=25\Omega55120nsTurn-ON Delay Timet_RV_{DOP}=FV_{DD}=250V, I_D=7A, R_G=25\Omega55120nsTurn-OFF Delay Timet_FV_{DD}=250V, I_D=7A, R_G=25\Omega55120nsSOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS7AMaximum Body-Diode Continuous CurrentI_S7AMaximum Body-Diode Pulsed CurrentI_{SM}28ADrain-Source Diode Forward VoltageV_{SD}I_S=7A, V_{GS}=0V1.4VBody Diode Reverse Recovery Timet_{rr}I_S=7A, V_{GS}=0V275ns$	Gate Threshold Voltage		V _{GS(TH)}	V _{DS} =V _{GS} , I _D =250µA 2.0			4.0	V	
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	Static Drain-Source On-State Re	esistance	R _{DS(ON)}	V _{GS} =10V, I _D =3.5A		0.8	1.0	Ω	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	DYNAMIC PARAMETERS					-			
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Input Capacitance		C _{ISS}			720	940	рF	
SWITCHING PARAMETERSTotal Gate Charge Q_G $V_{GS}=10V, V_{DS}=400V, I_D=7A$ 12.816.6nCGate to Source Charge Q_{GS} $(Note 1, 2)$ 5.8nCGate to Drain Charge Q_{GD} $(Note 1, 2)$ 5.8nCTurn-ON Delay Time $t_{D(ON)}$ k_R $V_{DD}=250V, I_D=7A, R_G=25\Omega$ 6620nsTurn-OFF Delay Time t_R $V_{DD}=250V, I_D=7A, R_G=25\Omega$ 55120nsFall-Time t_F 3580nsSOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICSMaximum Body-Diode Continuous Current I_S 7AMaximum Body-Diode Pulsed Current I_{SM} 28ADrain-Source Diode Forward Voltage V_{SD} $I_S=7A, V_{GS}=0V,$ 1.4VBody Diode Reverse Recovery Time t_{rr} $I_S=7A, V_{GS}=0V,$ 275ns	Output Capacitance		C _{OSS}	V _{GS} =0V, V _{DS} =25V, f=1.0MHz		95	190	рF	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Reverse Transfer Capacitance		C _{RSS}	1		9	13.5	рF	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	SWITCHING PARAMETERS		_	_					
$\begin{array}{c c c c c c c c } \hline Gate to Source Charge & Q_{GS} & (Note 1, 2) & 3.7 & 10C \\ \hline Gate to Drain Charge & Q_{GD} & 5.8 & nC \\ \hline Turn-ON Delay Time & t_{D(ON)} & 6 & 20 & ns \\ \hline Rise Time & t_R & V_{DD}=250V, I_D=7A, R_G=25\Omega & 55 & 120 & ns \\ \hline Turn-OFF Delay Time & t_F & 355 & 80 & ns \\ \hline SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS & $$SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS \\ \hline Maximum Body-Diode Continuous Current & I_S & 7 & A \\ \hline Maximum Body-Diode Pulsed Current & I_{SM} & 28 & A \\ \hline Drain-Source Diode Forward Voltage & V_{SD} & I_S=7A, V_{GS}=0V & 1.4 & V \\ \hline Body Diode Reverse Recovery Time & t_{fr} & I_S=7A, V_{GS}=0V, & 275 & ns \\ \hline \end{array}$	Total Gate Charge		Q_{G}			12.8	16.6	nC	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Gate to Source Charge		Q_{GS}			3.7		nC	
Rise Time t_R V_{DD} =250V, I_D =7A, R_G =25 Ω 55120nsTurn-OFF Delay Time $t_{D(OFF)}$ (Note 1, 2)2560nsFall-Time t_F 3580nsSOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICSMaximum Body-Diode Continuous Current I_S 7AMaximum Body-Diode Pulsed Current I_{SM} 28ADrain-Source Diode Forward Voltage V_{SD} I_S =7A, V_{GS} =0V1.4VBody Diode Reverse Recovery Time t_{rr} I_S =7A, V_{GS} =0V,275ns	Gate to Drain Charge		Q_{GD}			5.8		nC	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Turn-ON Delay Time		t _{D(ON)}			6	20	ns	
Fall-Time t_F 3580nsSOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICSMaximum Body-Diode Continuous Current I_S 7AMaximum Body-Diode Pulsed Current I_{SM} 28ADrain-Source Diode Forward Voltage V_{SD} $I_S=7A, V_{GS}=0V$ 1.4VBody Diode Reverse Recovery Time t_{rr} $I_S=7A, V_{GS}=0V$,275ns	Rise Time			V_{DD} =250V, I_{D} =7A, R_{G} =25 Ω		55	120	ns	
SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS Maximum Body-Diode Continuous Current Is 7 A Maximum Body-Diode Pulsed Current Ism 28 A Drain-Source Diode Forward Voltage V _{SD} Is=7A, V _{GS} =0V 1.4 V Body Diode Reverse Recovery Time trr Is=7A, V _{GS} =0V, 275 ns	Turn-OFF Delay Time		t _{D(OFF)}	(Note 1, 2)		25	60	ns	
Maximum Body-Diode Continuous Current I_S 7AMaximum Body-Diode Pulsed Current I_{SM} 28ADrain-Source Diode Forward Voltage V_{SD} $I_S=7A, V_{GS}=0V$ 1.4VBody Diode Reverse Recovery Time t_{rr} $I_S=7A, V_{GS}=0V,$ 275ns	Fall-Time		t _F			35	80	ns	
Maximum Body-Diode Pulsed Current I_{SM} 28ADrain-Source Diode Forward Voltage V_{SD} $I_S=7A, V_{GS}=0V$ 1.4VBody Diode Reverse Recovery Time t_{rr} $I_S=7A, V_{GS}=0V,$ 275ns	SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS								
Drain-Source Diode Forward VoltageV_SDI_S=7A, V_GS=0V1.4VBody Diode Reverse Recovery TimetrrI_S=7A, V_GS=0V,275ns	Maximum Body-Diode Continuous Current		I _S				7	А	
Body Diode Reverse Recovery Time t_{rr} Is=7A, V _{GS} =0V,275ns	Maximum Body-Diode Pulsed Current		I _{SM}				28	Α	
	Drain-Source Diode Forward Voltage		V _{SD}	I _S =7A, V _{GS} =0V			1.4	V	
Body Diode Reverse Recovery Charge Q_{RR} $dI_F/dt=100A/\mu s$ (Note 1)0.04 μC	Body Diode Reverse Recovery Time		t _{rr}	I _S =7A, V _{GS} =0V,		275		ns	
	Body Diode Reverse Recovery Charge		Q_RR	dI _F /dt=100A/µs (Note 1)		0.04		μC	

Notes: 1. Pulse Test: Pulse width \leq 300µs, Duty cycle \leq 2%

2. Essentially independent of operating temperature



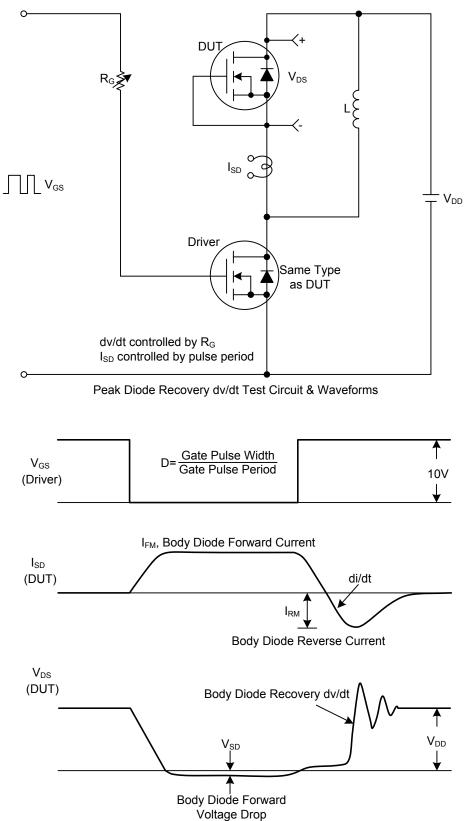
TEST CIRCUITS AND WAVEFORMS



Unclamped Inductive Switching Waveforms



■ TEST CIRCUITS AND WAVEFORMS(Cont.)





UTC assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all UTC products described or contained herein. UTC products are not designed for use in life support appliances, devices or systems where malfunction of these products can be reasonably expected to result in personal injury. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner. The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice.

