



FQD4N60/FQI4N60/FQU4N60

600V,4A N-Channel MOSFET

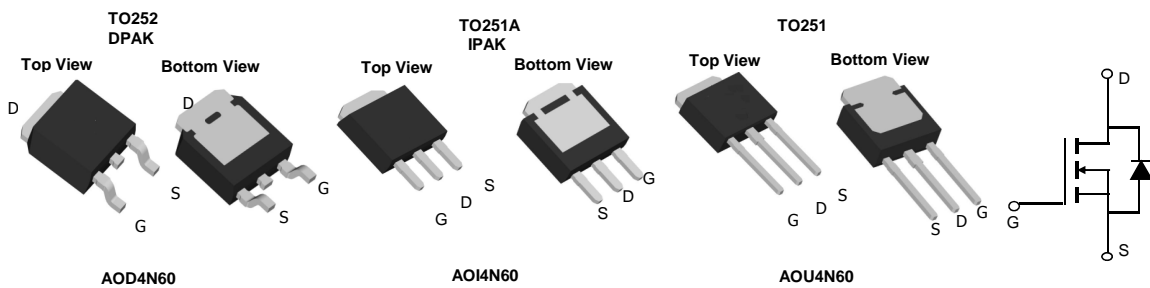
General Description

The FQD4N60 & FQI4N60 & FQU4N60 have been fabricated using an advanced high voltage MOSFET process that is designed to deliver high levels of performance and robustness in popular AC-DC applications. By providing low $R_{DS(on)}$, C_{iss} and C_{rss} along with guaranteed avalanche capability these parts can be adopted quickly into new and existing offline power supply designs.

Product Summary

V_{DS}	700V@150°C
I_D (at $V_{GS}=10V$)	4A
$R_{DS(on)}$ (at $V_{GS}=10V$)	< 2.3Ω

100% UIS Tested!
100% R_g Tested!



Absolute Maximum Ratings $T_A=25^\circ C$ unless otherwise noted

Parameter	Symbol	Maximum	Units
Drain-Source Voltage	V_{DS}	600	V
Gate-Source Voltage	V_{GS}	±30	V
Continuous Drain Current ^B	I_D	$T_C=25^\circ C$	4
		$T_C=100^\circ C$	2.6
Pulsed Drain Current ^C	I_{DM}	14	A
Avalanche Current ^C	I_{AR}	2.8	A
Repetitive avalanche energy ^C	E_{AR}	118	mJ
Single pulsed avalanche energy ^H	E_{AS}	235	mJ
MOSFET dv/dt ruggedness	dv/dt	50	V/ns
Peak diode recovery dv/dt		5	
Power Dissipation ^B	P_D	$T_C=25^\circ C$	104
		Derate above 25°C	0.83
Junction and Storage Temperature Range	T_J, T_{STG}	-50 to 150	°C
Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds	T_L	300	°C

Thermal Characteristics

Parameter	Symbol	Typical	Maximum	Units
Maximum Junction-to-Ambient ^{A,G}	$R_{\theta JA}$	43	55	°C/W
Maximum Case-to-sink ^A	$R_{\theta CS}$	-	0.5	°C/W
Maximum Junction-to-Case ^{D,F}	$R_{\theta JC}$	1	1.2	°C/W

Electrical Characteristics (T_J=25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
STATIC PARAMETERS						
BV _{DSS}	Drain-Source Breakdown Voltage	I _D =250μA, V _{GS} =0V, T _J =25°C	600			V
		I _D =250μA, V _{GS} =0V, T _J =150°C		700		
BV _{DSS} /ΔT _J	Zero Gate Voltage Drain Current	I _D =250μA, V _{GS} =0V		0.67		V/°C
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} =600V, V _{GS} =0V			1	μA
		V _{DS} =480V, T _J =125°C			10	
I _{GSS}	Gate-Body leakage current	V _{DS} =0V, V _{GS} =±30V			±100	nA
V _{GS(th)}	Gate Threshold Voltage	V _{DS} =5V, I _D =250μA	3.4	4.1	4.5	V
R _{DS(ON)}	Static Drain-Source On-Resistance	V _{GS} =10V, I _D =2A		1.8	2.3	Ω
g _{FS}	Forward Transconductance	V _{DS} =40V, I _D =2A		6		S
V _{SD}	Diode Forward Voltage	I _S =1A, V _{GS} =0V		0.76	1	V
I _S	Maximum Body-Diode Continuous Current			4		A
I _{SM}	Maximum Body-Diode Pulsed Current			14		A
DYNAMIC PARAMETERS						
C _{iss}	Input Capacitance	V _{GS} =0V, V _{DS} =25V, f=1MHz	420	528	640	pF
C _{oss}	Output Capacitance		35	53	70	pF
C _{rss}	Reverse Transfer Capacitance		2.5	4.8	7	pF
R _g	Gate resistance	V _{GS} =0V, V _{DS} =0V, f=1MHz	1.2	2.5	3.8	Ω
SWITCHING PARAMETERS						
Q _g	Total Gate Charge	V _{GS} =10V, V _{DS} =480V, I _D =4A	9.5	12	14.5	nC
Q _{gs}	Gate Source Charge		2.8	3.6	4.5	nC
Q _{gd}	Gate Drain Charge		2.2	4.4	6.6	nC
t _{D(on)}	Turn-On DelayTime	V _{GS} =10V, V _{DS} =300V, I _D =4A, R _G =25Ω		17		ns
t _r	Turn-On Rise Time			26		ns
t _{D(off)}	Turn-Off DelayTime			34		ns
t _f	Turn-Off Fall Time			21		ns
t _{rr}	Body Diode Reverse Recovery Time	I _F =4A, di/dt=100A/μs, V _{DS} =100V	150	190	230	ns
Q _{rr}	Body Diode Reverse Recovery Charge	I _F =4A, di/dt=100A/μs, V _{DS} =100V	1.9	2.4	3	μC

- A. The value of R_{θJA} is measured with the device in a still air environment with T_A=25° C.
- B. The power dissipation P_D is based on T_{J(MAX)}=150° C in a TO252 package, using junction-to-case thermal resistance, and is more useful in setting the upper dissipation limit for cases where additional heatsinking is used.
- C. Repetitive rating, pulse width limited by junction temperature T_{J(MAX)}=150° C.
- D. The R_{θJA} is the sum of the thermal impedance from junction to case R_{θJC} and case to ambient.
- E. The static characteristics in Figures 1 to 6 are obtained using <300 μs pulses, duty cycle 0.5% max.
- F. These curves are based on the junction-to-case thermal impedance which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of T_{J(MAX)}=150° C.
- G. These tests are performed with the device mounted on 1 in² FR-4 board with 2oz. Copper, in a still air environment with T_A=25° C.
- H. L=60mH, I_{AS}=2.8A, V_{DD}=150V, R_G=10Ω, Starting T_J=25° C

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

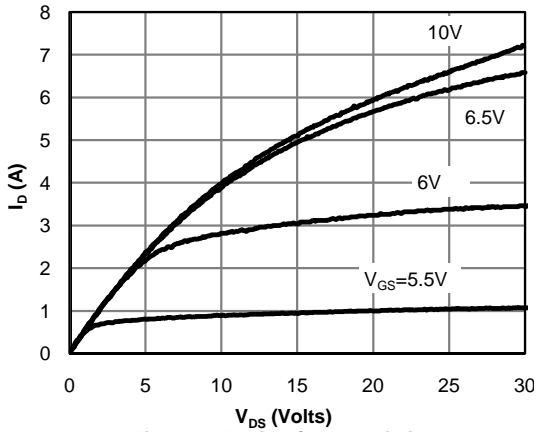


Fig 1: On-Region Characteristics

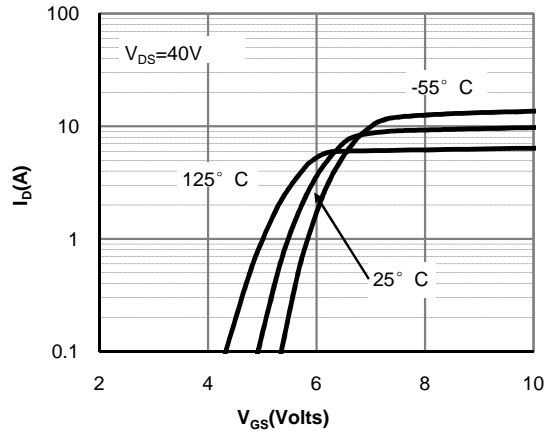


Figure 2: Transfer Characteristics

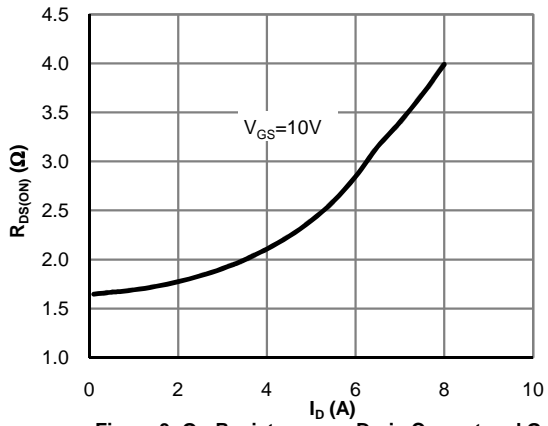


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

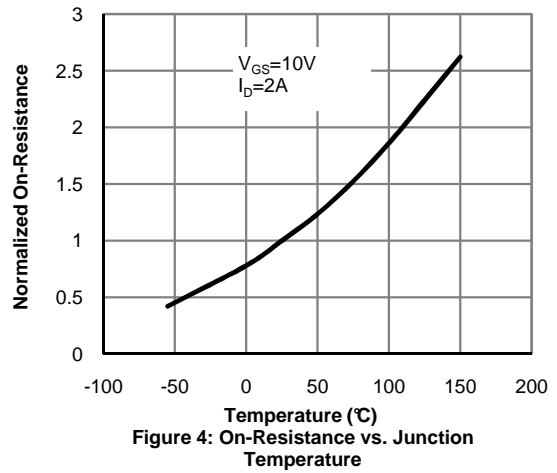


Figure 4: On-Resistance vs. Junction Temperature

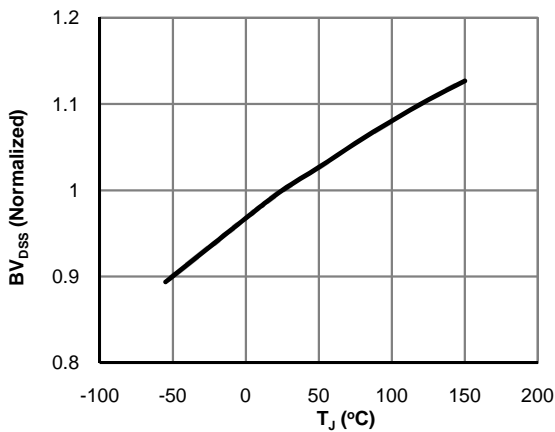


Figure 5: Break Down vs. Junction Temperature

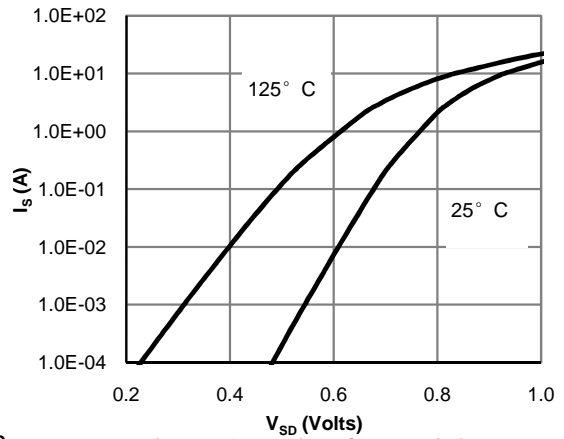


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

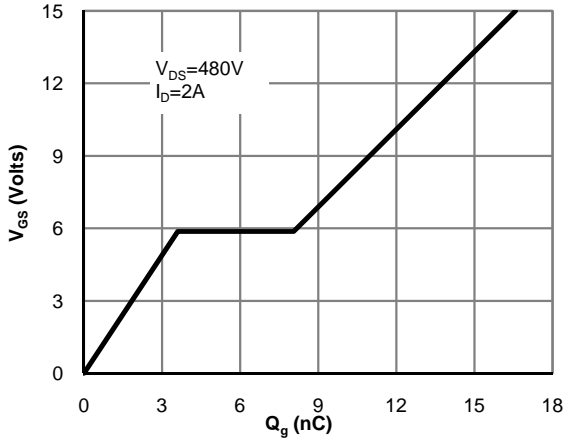


Figure 7: Gate-Charge Characteristics

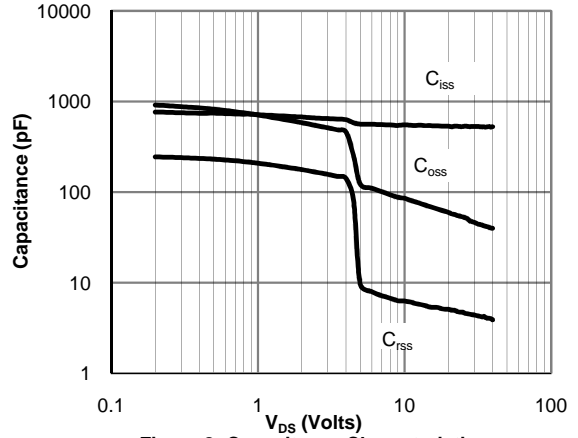


Figure 8: Capacitance Characteristics

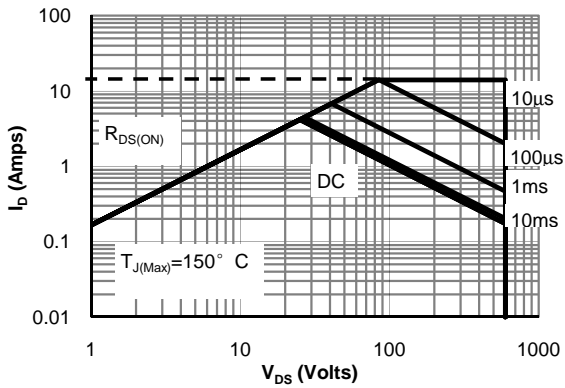


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

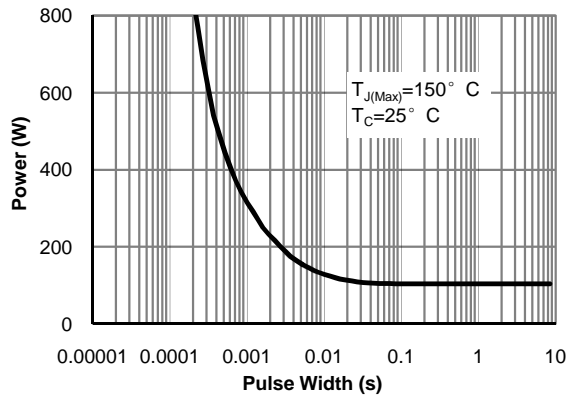


Figure 10: Single Pulse Power Rating Junction-to-Case (Note F)

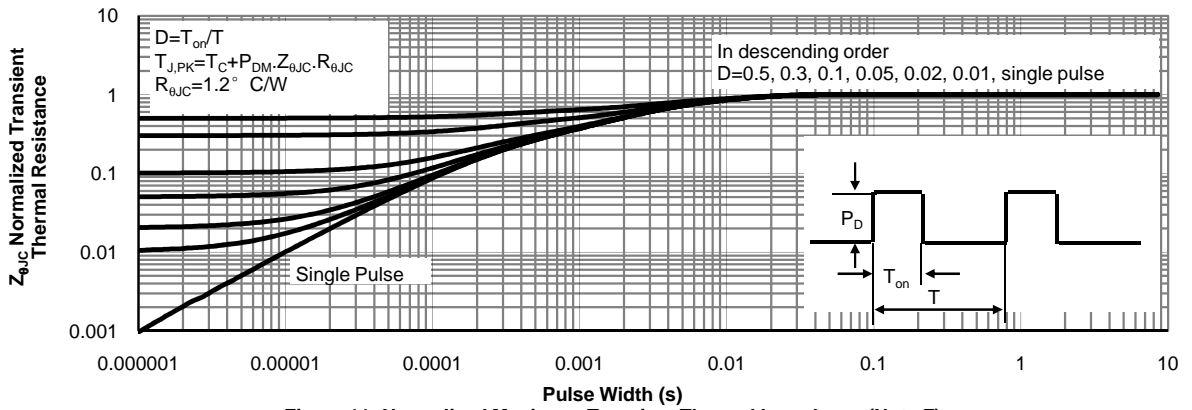


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

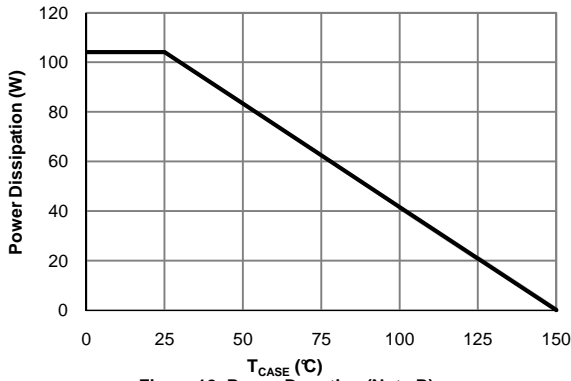


Figure 12: Power De-rating (Note B)

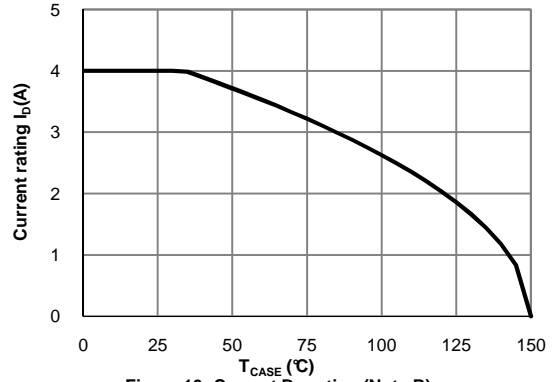


Figure 13: Current De-rating (Note B)

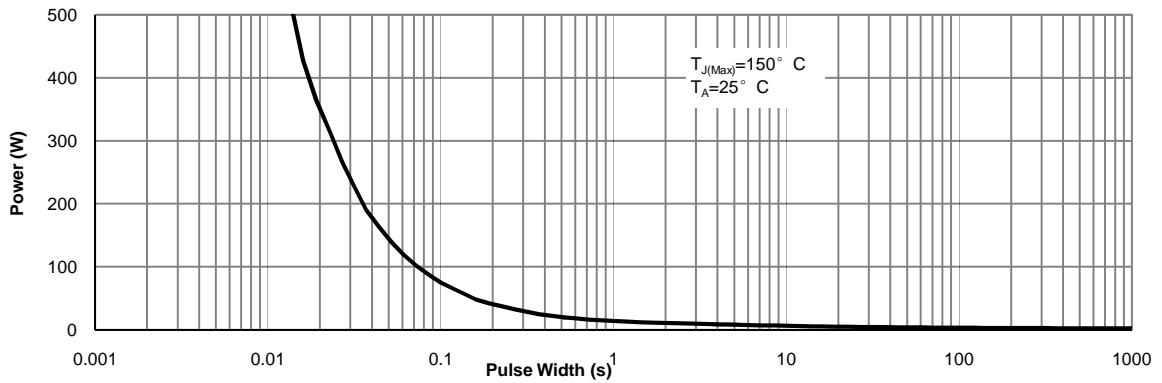


Figure 14: Single Pulse Power Rating Junction-to-Ambient (Note G)

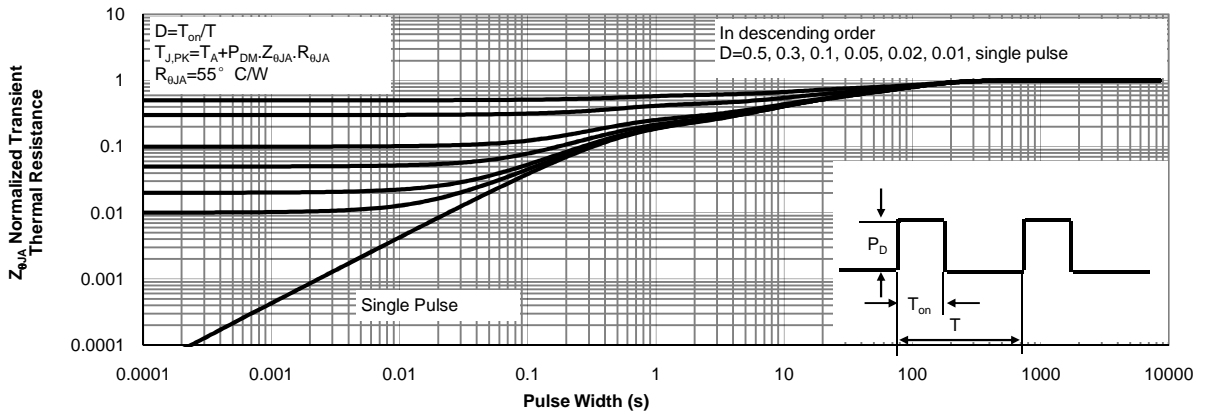
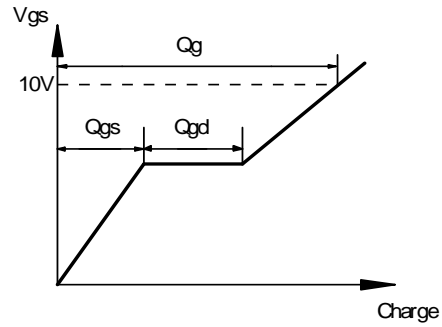
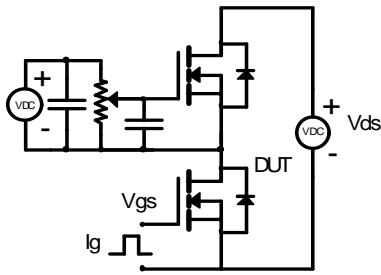
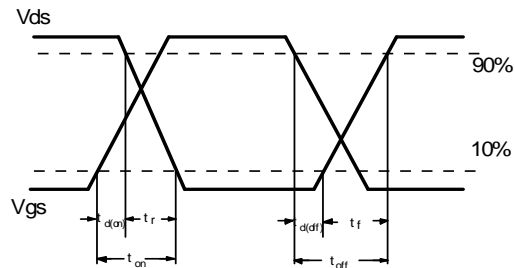
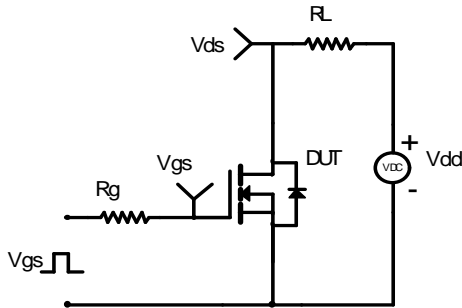


Figure 15: Normalized Maximum Transient Thermal Impedance (Note G)

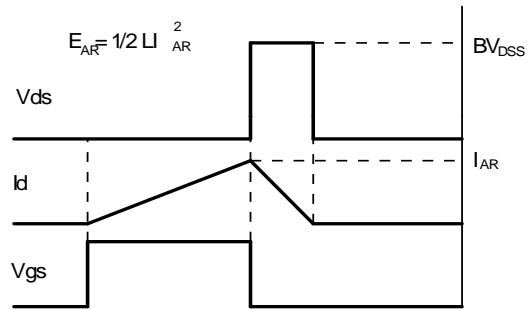
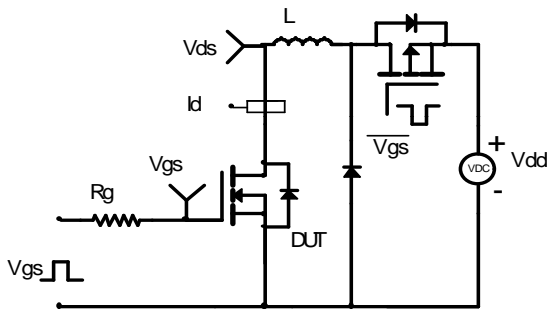
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

