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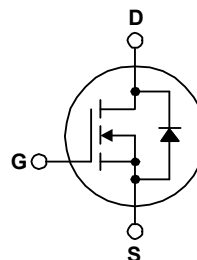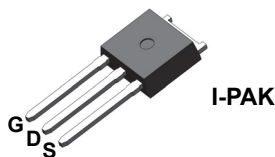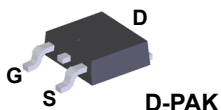
FQD2N60C / FQU2N60C

N-Channel QFET® MOSFET
600 V, 1.9 A, 4.7 Ω

Features

- 1.9 A, 600 V, $R_{DS(on)}$ = 4.7 Ω (Max.) @ V_{GS} = 10 V, I_D = 0.95 A
- Low Gate Charge (Typ. 8.5 nC)
- Low Crss (Typ. 4.3 pF)
- 100% Avalanche Tested
- RoHS Compliant

Description

This N-Channel enhancement mode power MOSFET is produced using ON Semiconductor's proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on-state resistance, and to provide superior switching performance and high avalanche energy strength. These devices are suitable for switched mode power supplies, active power factor correction (PFC), and electronic lamp ballasts.

D-PAK

I-PAK

Absolute Maximum Ratings T_C = 25°C unless otherwise noted.

Symbol	Parameter		FQD2N60CTM / FQU2N60CTU	Unit
V_{DSS}	Drain-Source Voltage		600	V
I_D	Drain Current - Continuous (T_C = 25°C)		1.9	A
	- Continuous (T_C = 100°C)		1.14	A
I_{DM}	Drain Current - Pulsed	(Note 1)	7.6	A
V_{GSS}	Gate-Source Voltage		± 30	V
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)	120	mJ
I_{AR}	Avalanche Current	(Note 1)	1.9	A
E_{AR}	Repetitive Avalanche Energy	(Note 1)	4.4	mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	4.5	V/ns
P_D	Power Dissipation (T_A = 25°C)*		2.5	W
	Power Dissipation (T_C = 25°C)		44	W
	- Derate above 25°C		0.35	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to +150	°C
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds		300	°C

Thermal Characteristics

Symbol	Parameter	FQD2N60CTM / FQU2N60CTU	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	2.87	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (minimum pad of 2 oz copper), Max.	110	
	Thermal Resistance, Junction-to-Ambient (* 1 in² pad of 2 oz copper), Max.	50	

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FQD2N60C	FQD2N60CTM	D-PAK	330 mm	16 mm	2500 units
FQU2N60C	FQU2N60CTU	I-PAK	Tube	N/A	70 units

Electrical Characteristics T_C = 25°C unless otherwise noted.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 µA	600	--	--	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250 µA, Referenced to 25°C	--	0.6	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 600 V, V_{GS} = 0 V	--	--	1	µA
		V_{DS} = 480 V, T_C = 125°C	--	--	10	µA
I_{GSSF}	Gate-Body Leakage Current, Forward	V_{GS} = 30 V, V_{DS} = 0 V	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	V_{GS} = -30 V, V_{DS} = 0 V	--	--	-100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 µA	2.0	--	4.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = 10 V, I_D = 0.95 A	--	3.6	4.7	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40 V, I_D = 0.95 A	--	5.0	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz	--	180	235	pF
C_{oss}	Output Capacitance		--	20	25	pF
C_{rss}	Reverse Transfer Capacitance		--	4.3	5.6	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 300 V, I_D = 2 A, R_G = 25 Ω	--	9	28	ns
t_r	Turn-On Rise Time		--	25	60	ns
$t_{d(off)}$	Turn-Off Delay Time		--	24	58	ns
t_f	Turn-Off Fall Time	(Note 4)	--	28	66	ns
Q_g	Total Gate Charge	V_{DS} = 480 V, I_D = 2 A, V_{GS} = 10 V	--	8.5	12	nC
Q_{gs}	Gate-Source Charge		--	1.3	--	nC
Q_{gd}	Gate-Drain Charge	(Note 4)	--	4.1	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	1.9	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	7.6	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 1.9 A	--	--	1.4	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = 2 A, dI_F / dt = 100 A/µs	--	230	--	ns
Q_{rr}	Reverse Recovery Charge		--	1.0	--	µC

NOTES:

1. Repetitive Rating : Pulse width limited by maximum junction temperature.

2. L = 56 mH, I_{AS} = 2 A, V_{DD} = 50 V, R_G = 25 Ω, starting T_J = 25°C.

3. $I_{SD} \leq$ 2 A, di/dt $\leq$ 200 A/µs, $V_{DD} \leq BV_{DSS}$, starting T_J = 25°C.

4. Essentially independent of operating temperature.

Typical Performance Characteristics
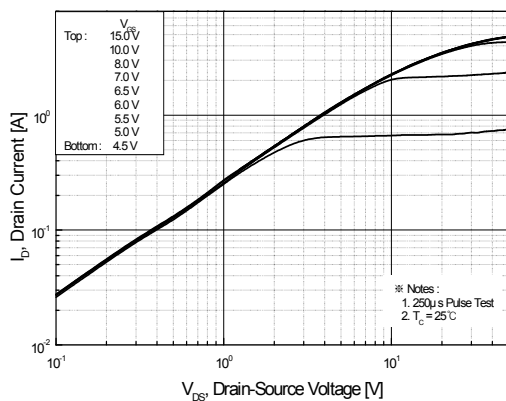
Figure 1. On-Region Characteristics

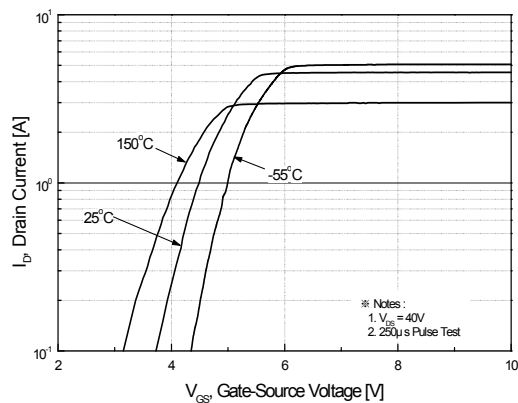**Figure 2. Transfer Characteristics**

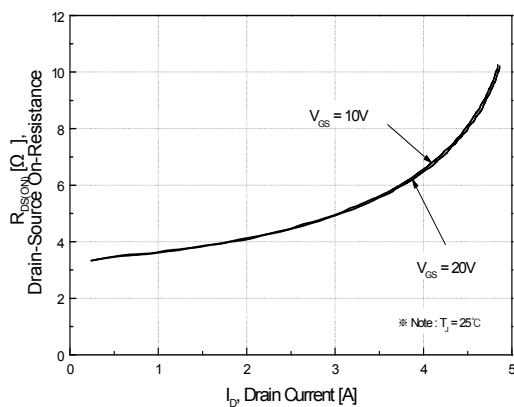**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**

Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperatue
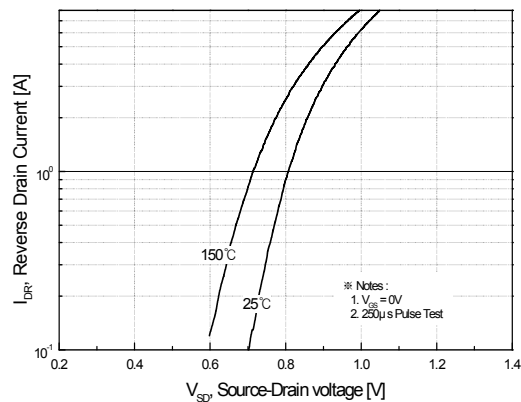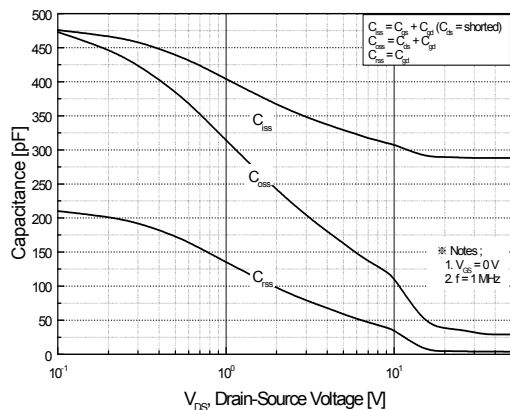

Figure 5. Capacitance Characteristics

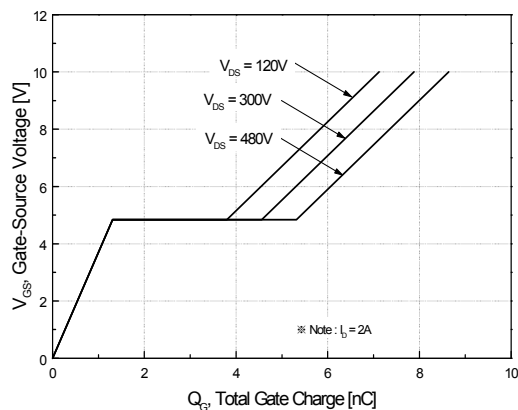**Figure 6. Gate Charge Characteristics**

FQD2N60C / FQU2N60C — N-Channel QFET® MOSFET

Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

BV$_{DSS}$, (Normalized) Drain-Source Breakdown Voltage vs. T$_J$, Junction Temperature [°C]

※ Notes :
1. V$_{GS}$ = 0 V
2. I$_D$ = 250 μA
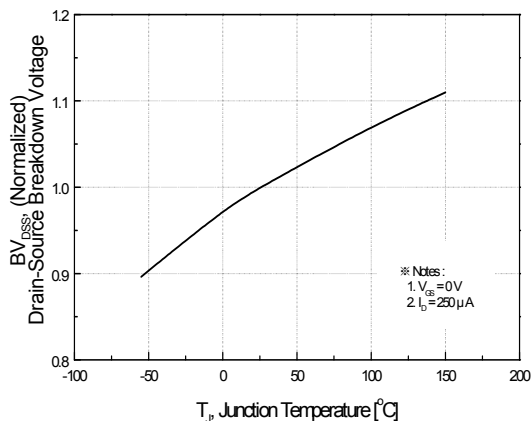
Figure 8. On-Resistance Variation vs. Temperature

R$_{DS(ON)}$, (Normalized) Drain-Source On-Resistance vs. T$_J$, Junction Temperature [°C]

※ Notes :
1. V$_{GS}$ = 10 V
2. I$_D$ = 0.95 A
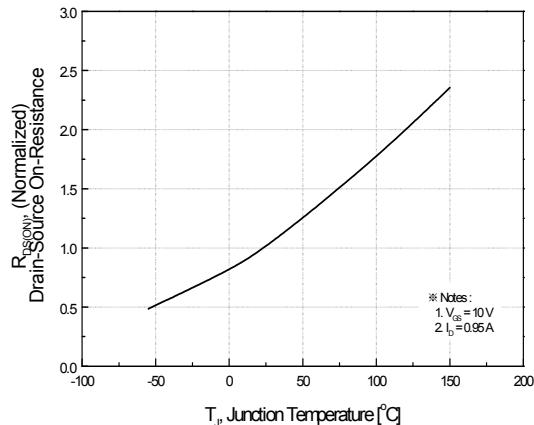
Figure 9. Maximum Safe Operating Area

I$_D$, Drain Current [A] vs. V$_{DS}$, Drain-Source Voltage [V]

Operation in This Area is Limited by R$_{DS(on)}$

100 μs
1 ms
10 ms
100 ms
DC

※ Notes :
1. T$_C$ = 25 °C
2. T$_J$ = 150 °C
3. Single Pulse
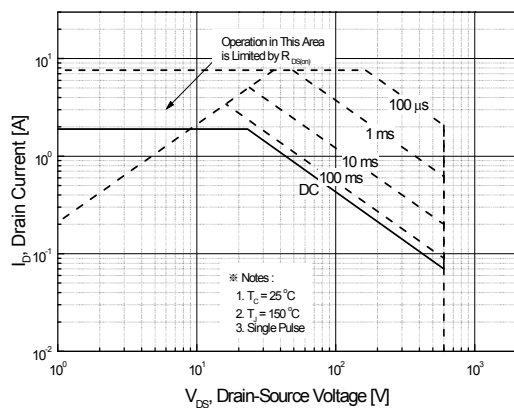
Figure 10. Maximum Drain Current vs. Case Temperature

I$_D$, Drain Current [A] vs. T$_C$, Case Temperature [°C]
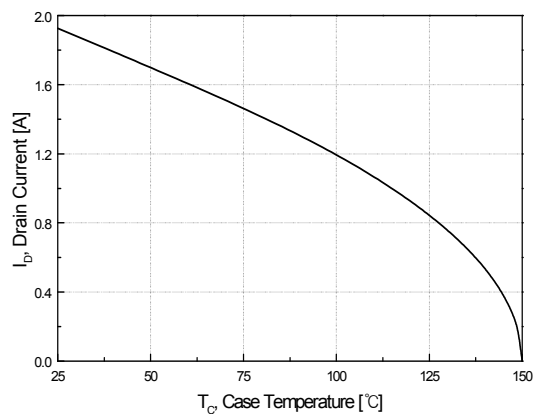
Figure 11. Transient Thermal Response Curve

Z$_{θJC}$(t), Thermal Response [°C/W] vs. t$_1$, Square Wave Pulse Duration [sec]

D = 0.5
0.2
0.1
0.05
0.02
0.01
single pulse

※ Notes :
1. Z$_{θJC}$(t) = 2.87 °C/W Max.
2. Duty Factor, D = t$_1$/t$_2$
3. T$_{JM}$ - T$_C$ = P$_{DM}$ * Z$_{θJC}$(t)

P$_{DM}$
t$_1$
t$_2$

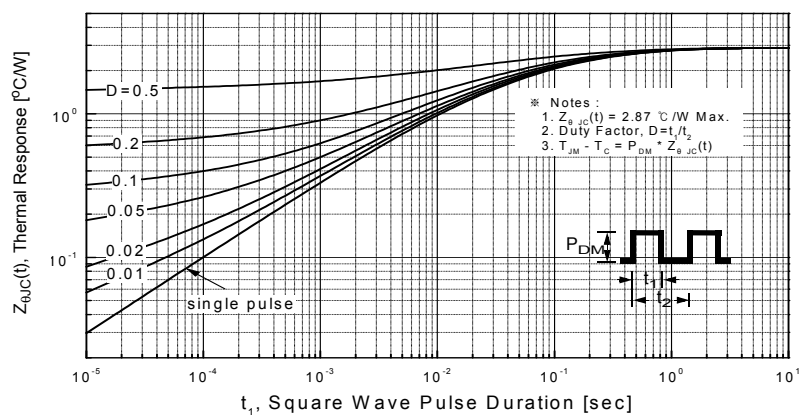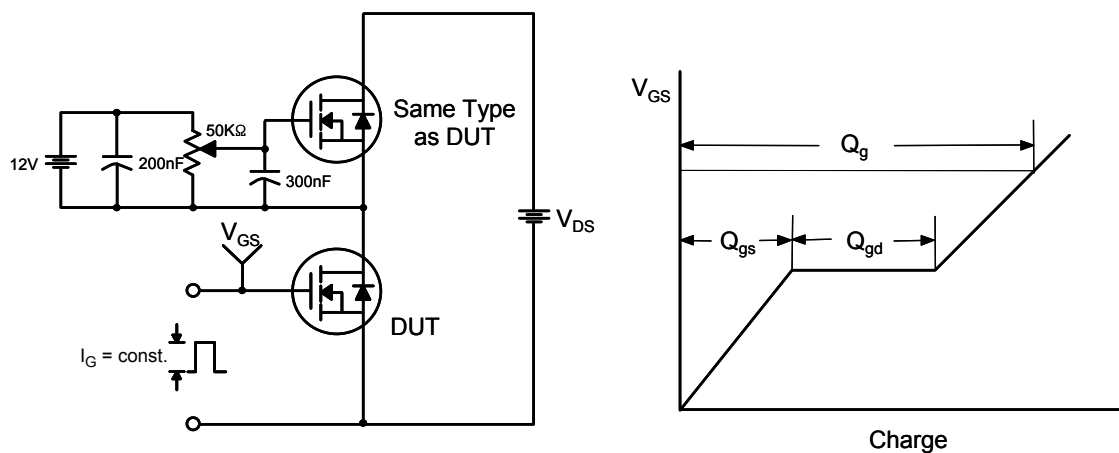## Figure 12. Gate Charge Test Circuit & Waveform

Figure 13. Resistive Switching Test Circuit & Waveforms
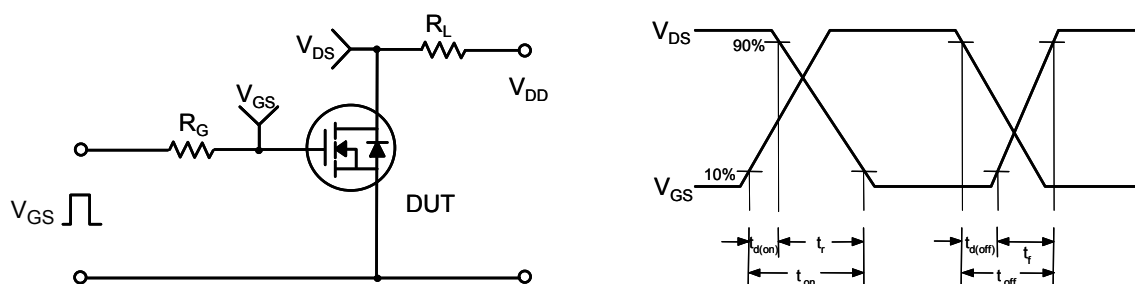
Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms
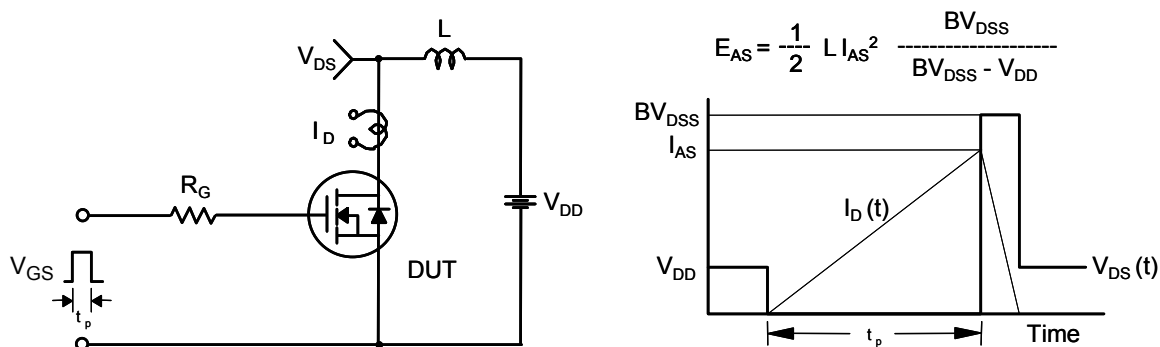

$$E_{AS} = \frac{1}{2} L I_{AS}^2 \; \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$

Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

DUT

V_{DS}

I_{SD}

L

Driver

R_G

Same Type
as DUT

V_{DD}

V_{GS}

• dv/dt controlled by R_G
• I_{SD} controlled by pulse period

V_{GS}
(Driver)

$$D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$$

10V

I_{SD}
(DUT)

I_{FM} , Body Diode Forward Current

di/dt

I_{RM}

Body Diode Reverse Current

V_{DS}
(DUT)

Body Diode Recovery dv/dt

V_{SD}

V_{DD}

Body Diode
Forward Voltage Drop

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