UMW®

FQD13N06L
60V N -Channel MOSFET

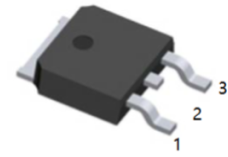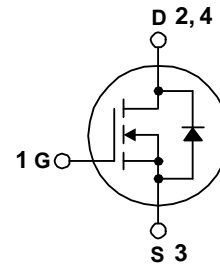## Features

- V_{DS} =60V

- I_D = 5.5 A

- $R_{DS(ON)}$ (at V_{GS} =10V) < 115mΩ

- $R_{DS(ON)}$ (at V_{GS} =5V) < 145mΩ

- Low Gate Charge (Typ. 4.8 nC)

- Low Crss (Typ. 17 pF)

- Low Level Gate Drive Requirements Allowing

- Direct Operation form Logic Drivers

1.G   2.D   3.S
TO-252(DPAK) top view

D 2, 4

1 G

S 3

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

Symbol	Parameter		FQD13N06LTM	Unit
V_{DSS}	Drain-Source Voltage		60	V
I_D	Drain Current - Continuous (T_C = 25°C)		11	A
	- Continuous (T_C = 100°C)		7	A
I_{DM}	Drain Current - Pulsed	(Note 1)	44	A
V_{GSS}	Gate-Source Voltage		± 20	V
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)	90	mJ
I_{AR}	Avalanche Current	(Note 1)	11	A
E_{AR}	Repetitive Avalanche Energy	(Note 1)	2.8	mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	7.0	V/ns
P_D	Power Dissipation (T_A = 25°C) *		2.5	W
	Power Dissipation (T_C = 25°C)		28	W
	- Derate above 25°C		0.22	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to +150	°C
T_L	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds		300	°C

Thermal Characteristics

Symbol	Parameter	FQD13N06LTM	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	2.5	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Minimum Pad of 2-oz Copper), Max.	110	
	Thermal Resistance, Junction to Ambient (*1 in^2 Pad of 2-oz Copper), Max.	50	

Electrical Characteristics $T_C = 25^{\circ}C$ unless otherwise noted.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 µA	60			V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250 µA, Referenced to 25°C		0.05		V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 60 V, V_{GS} = 0 V			1	µA
		V_{DS} = 48 V, T_C = 150°C			10	µA
I_{GSSF}	Gate-Body Leakage Current, Forward	V_{GS} = 20 V, V_{DS} = 0 V			100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	V_{GS} = -20 V, V_{DS} = 0 V			-100	nA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 µA	1.0		2.5	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = 10 V, I_D = 5.5 A V_{GS} = 5 V, I_D = 5.5 A		92 115	115 145	mΩ
g_{FS}	Forward Transconductance	V_{DS} = 25 V, I_D = 5.5 A		6		S
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz		270	350	pF
C_{oss}	Output Capacitance			95	125	pF
C_{rss}	Reverse Transfer Capacitance			17	23	pF
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 30 V, I_D = 6.8 A, R_G = 25 Ω		8	25	ns
t_r	Turn-On Rise Time			90	190	ns
$t_{d(off)}$	Turn-Off Delay Time			20	50	ns
t_f	Turn-Off Fall Time	(Note 4)		40	90	ns
Q_g	Total Gate Charge	V_{DS} = 48 V, I_D = 13.6 A, V_{GS} = 5 V		4.8	6.4	nC
Q_{gs}	Gate-Source Charge			1.6		nC
Q_{gd}	Gate-Drain Charge	(Note 4)		2.7		nC
I_S	Maximum Continuous Drain-Source Diode Forward Current				11	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current					44
A V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 11 A			1.5	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = 13.6 A, dI_F / dt = 100 A/µs		45		ns
Q_{rr}	Reverse Recovery Charge			45		nC

Notes:
1. Repetitive rating : pulse-width limited by maximum junction temperature.
2. L = 870 µH, I_{AS} = 11 A, V_{DD} = 25 V, R_G = 25 Ω, starting T_J = 25ºC.
3. I_{SD} ≤ 13.6 A, di/dt ≤ 300 A/µs, V_{DD} ≤ BV_{DSS}, starting T_J = 25ºC.
4. Essentially independent of operating temperature.
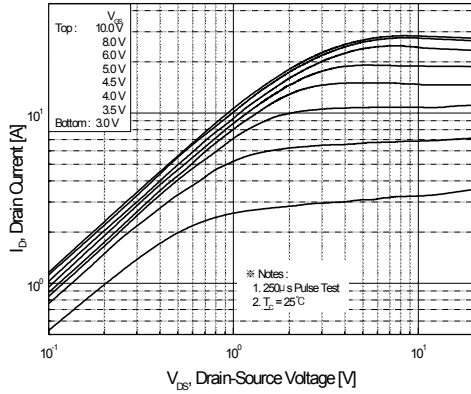
Typical Characteristics
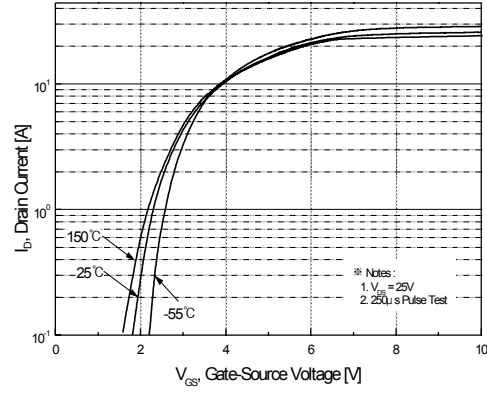
Figure 1. On-Region Characteristics

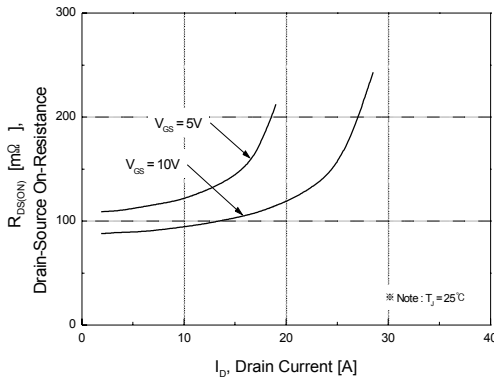**Figure 2. Transfer Characteristics**

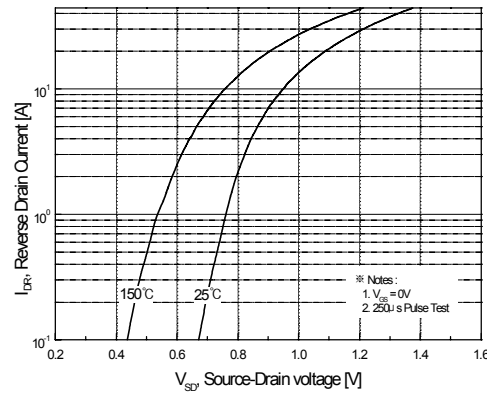**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**

Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature
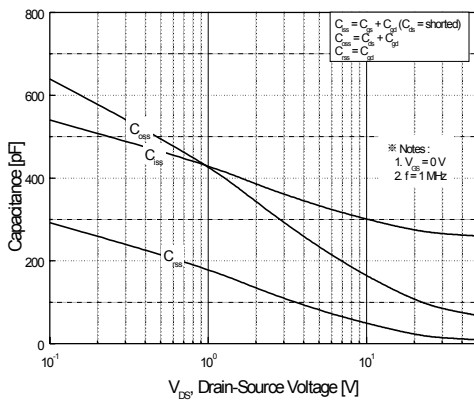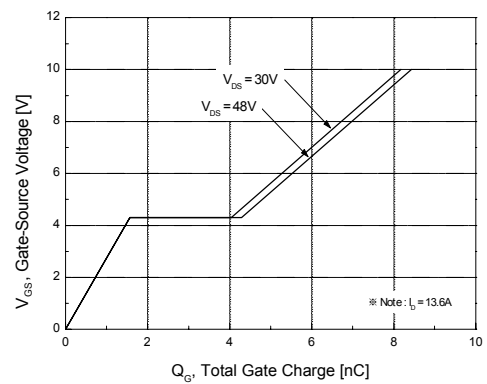
Figure 5. Capacitance Characteristics

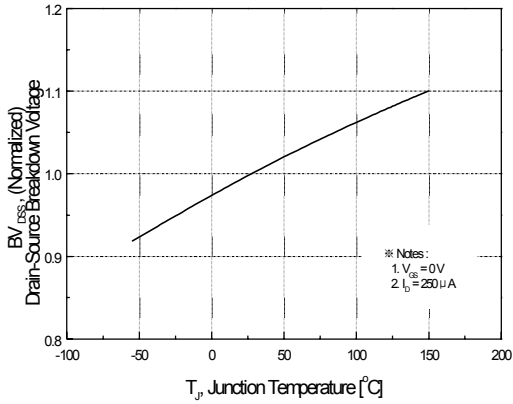**Figure 6. Gate Charge Characteristics**

Typical Characteristics
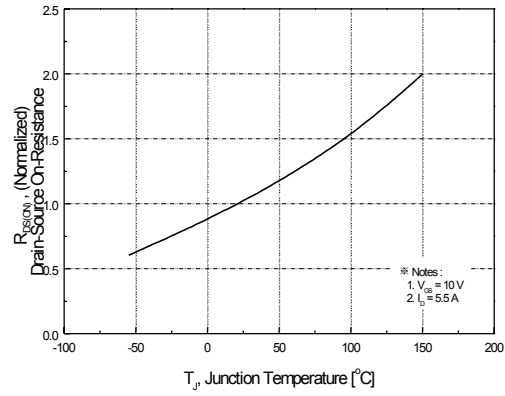

Figure 7. Breakdown Voltage Variation
vs. Temperature

Figure 8. On-Resistance Variation
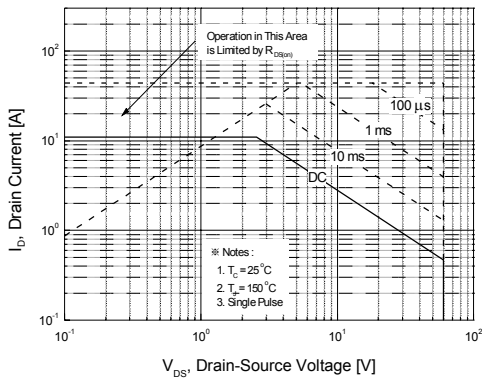vs. Temperature

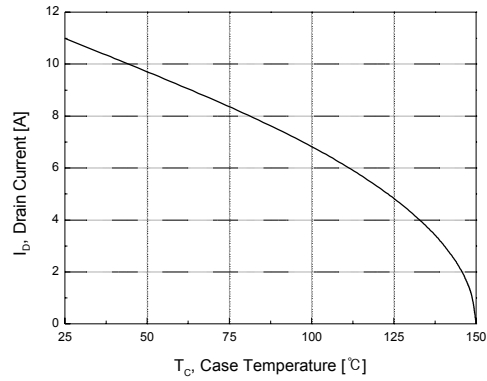Figure 9. Maximum Safe Operating Area

Figure 10. Maximum Drain Current
vs. Case Temperature
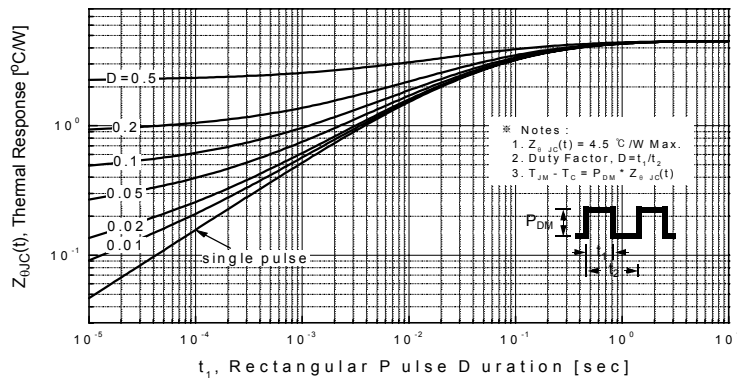

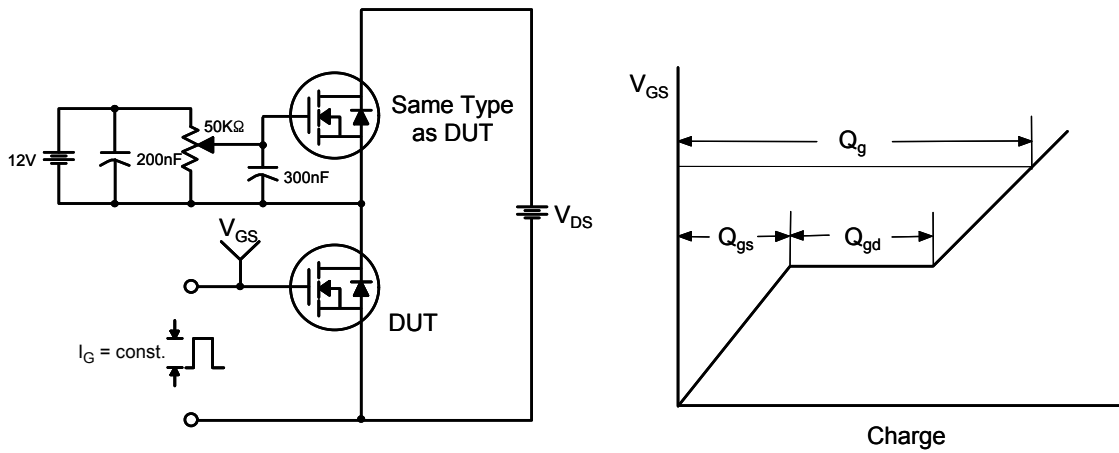Figure 11. Transient Thermal Response Curve
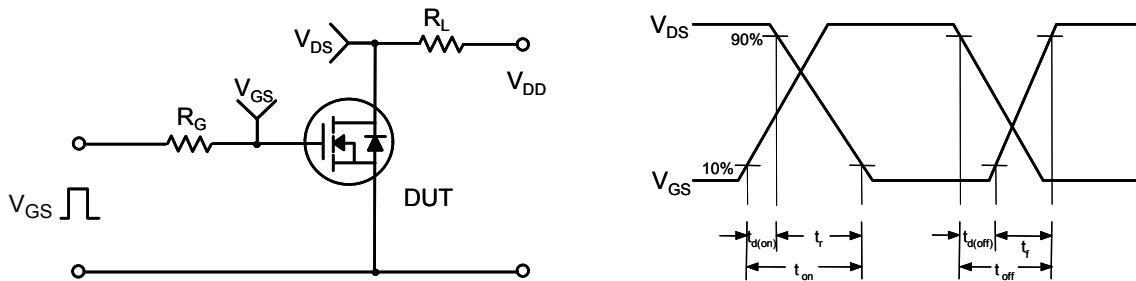
Figure 12. Gate Charge Test Circuit & Waveform

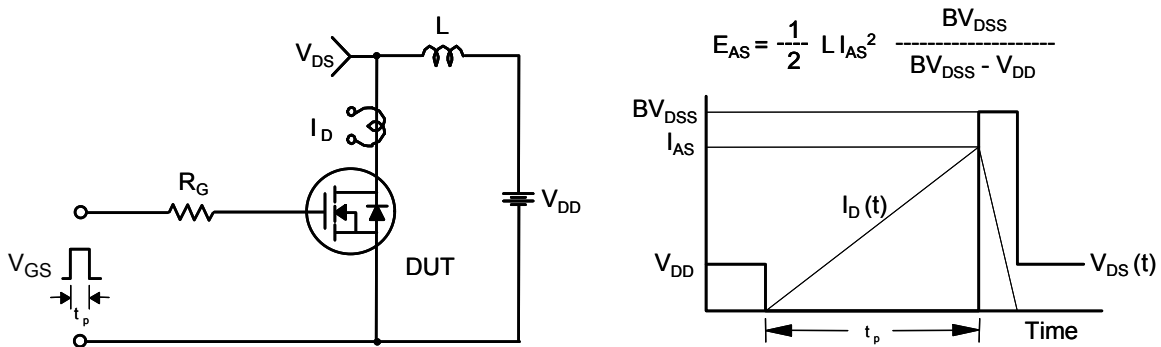**Figure 13. Resistive Switching Test Circuit & Waveforms**

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

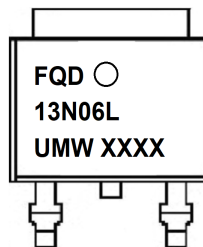**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**

Package Mechanical Data TO-252

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.10		2.50	0.083		0.098
A2	0		0.10	0		0.004
B	0.66		0.86	0.026		0.034
B2	5.18		5.48	0.202		0.216
C	0.40		0.60	0.016		0.024
C2	0.44		0.58	0.017		0.023
D	5.90		6.30	0.232		0.248
D1		5.30REF			0.209REF	
E	6.40		6.80	0.252		0.268
E1	4.63			0.182		
G	4.47		4.67	0.176		0.184
H	9.50		10.70	0.374		0.421
L	1.09		1.21	0.043		0.048
L2	1.35		1.65	0.053		0.065
V1		7°			7°	
V2	0°		6°	0°		6°

Marking

FQD ○
13N06L
UMW XXXX

Ordering information

Order code	Package	Baseqty	Deliverymode
UMW FQD13N06LTM	TO-252	2500	Tape and reel

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IRS2092STRPBF-EL IPS70R2K0CEAKMA1 TK31J60W5,S1VQ(O TK31J60W,S1VQ(O TK16J60W,S1VQ(O 2SK2614(TE16L1,Q)

DMN1017UCP3-7 EFC2J004NUZTDG P85W28HP2F-7071 DMN1053UCP4-7 NTE2384 DMC2700UDMQ-7 DMN2080UCB4-7

DMN61D9UWQ-13 US6M2GTR DMN31D5UDJ-7 DMP22D4UFO-7B IPS60R3K4CEAKMA1 DMN1006UCA6-7 DMN16M9UCA6-7

STF5N65M6 IRF40H233XTMA1 STU5N65M6 DMN6022SSD-13 DMN13M9UCA6-7 DMTH10H4M6SPS-13 IPS60R360PFD7SAKMA1

DMN2990UFB-7B SSM3K35CT,L3F IPLK60R1K0PFD7ATMA1 2N7002W-G MCAC30N06Y-TP IPWS65R035CFD7AXKSA1

MCQ7328-TP SSM3J143TU,LXHF DMN12M3UCA6-7 PJMF280N65E1_T0_00201 PJMF380N65E1_T0_00201

PJMF280N60E1_T0_00201 PJMF600N65E1_T0_00201 PJMF900N65E1_T0_00201