

### General Description

The QM04N60F is the highest performance N-ch MOSFETs with extreme high cell density, which provide excellent R<sub>DS(on)</sub> and gate charge for most of the synchronous buck converter applications.

The QM04N60F meet the RoHS and Green Product requirement, 100% EAS guaranteed with full function reliability approved.

### Features

- Super Low Gate Charge
- Excellent CdV/dt effect decline
- 100% EAS Guaranteed
- Green Device Available

### Absolute Maximum Ratings

Symbol	Parameter	Rating	Units
V <sub>DS</sub>	Drain-Source Voltage	600	V
V <sub>GS</sub>	Gate-Source Voltage	±30	V
I <sub>D</sub> @T <sub>C</sub> =25°C	Continuous Drain Current, V <sub>GS</sub> @ 10V <sup>1</sup>	4	A
I <sub>D</sub> @T <sub>C</sub> =100°C	Continuous Drain Current, V <sub>GS</sub> @ 10V <sup>1</sup>	2.6	A
I <sub>DM</sub>	Pulsed Drain Current <sup>2</sup>	8	A
EAS	Single Pulse Avalanche Energy <sup>3</sup>	19.3	mJ
I <sub>AS</sub>	Avalanche Current	6	A
P <sub>D</sub> @T <sub>C</sub> =25°C	Total Power Dissipation <sup>4</sup>	41.6	W
T <sub>STG</sub>	Storage Temperature Range	-55 to 150	°C
T <sub>J</sub>	Operating Junction Temperature Range	-55 to 150	°C

### Thermal Data

Symbol	Parameter	Typ.	Max.	Unit
R <sub>θJA</sub>	Thermal Resistance Junction-ambient (Steady State) <sup>1</sup>	---	62	°C/W
R <sub>θJC</sub>	Thermal Resistance Junction-Case <sup>1</sup>	---	3	°C/W

### Product Summary

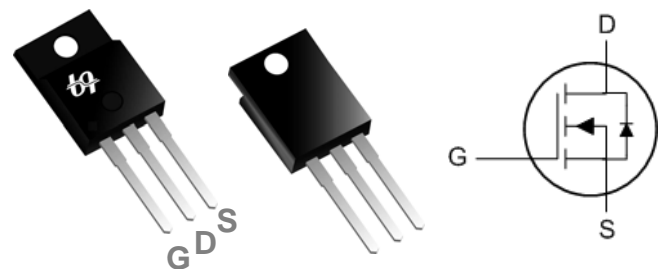


BVDSS	R <sub>DS(on)</sub>	I <sub>D</sub>
600V	2.0 Ω	4A

### Applications

- High efficient switched mode power supplies
- Electronic lamp ballast
- LCD TV/ Monitor
- Adapter

### TO220F Pin Configuration



### Electrical Characteristics ( $T_J=25^\circ\text{C}$ , unless otherwise noted)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=250\mu A$	600	---	---	V
$\Delta BV_{DSS}/\Delta T_J$	$BV_{DSS}$ Temperature Coefficient	Reference to $25^\circ\text{C}$ , $I_D=1\text{mA}$	---	0.56	---	V/ $^\circ\text{C}$
$R_{DS(ON)}$	Static Drain-Source On-Resistance <sup>2</sup>	$V_{GS}=10V, I_D=2A$	---	1.6	2.0	$\Omega$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS}=V_{DS}, I_D=250\mu A$	2	---	5	V
$\Delta V_{GS(th)}$	$V_{GS(th)}$ Temperature Coefficient		---	-8	---	mV/ $^\circ\text{C}$
$I_{DSS}$	Drain-Source Leakage Current	$V_{DS}=480V, V_{GS}=0V, T_J=25^\circ\text{C}$	---	---	2	$\mu A$
$I_{GSS}$	Gate-Source Leakage Current	$V_{GS}=\pm 30V, V_{DS}=0V$	---	---	$\pm 100$	nA
gfs	Forward Transconductance	$V_{DS}=15V, I_D=2A$	---	4.1	---	S
$R_g$	Gate Resistance	$V_{DS}=0V, V_{GS}=0V, f=1\text{MHz}$	---	3.3	6.6	$\Omega$
$Q_g$	Total Gate Charge (10V)	$V_{DS}=480V, V_{GS}=10V, I_D=1A$	---	18.7	26.2	nC
$Q_{gs}$	Gate-Source Charge		---	5.9	8.3	
$Q_{gd}$	Gate-Drain Charge		---	5.8	8.1	
$T_{d(on)}$	Turn-On Delay Time	$V_{DD}=300V, V_{GS}=10V, R_G=10\Omega, I_D=1A$	---	11.6	23	ns
$T_r$	Rise Time		---	20.4	36.7	
$T_{d(off)}$	Turn-Off Delay Time		---	32	64	
$T_f$	Fall Time		---	30	60	
$C_{iss}$	Input Capacitance	$V_{DS}=25V, V_{GS}=0V, F=1\text{MHz}$	---	874	1224	pF
$C_{oss}$	Output Capacitance		---	53	74	
$C_{rss}$	Reverse Transfer Capacitance		---	3.8	5.3	

### Guaranteed Avalanche Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
EAS	Single Pulse Avalanche Energy <sup>5</sup>	$V_{DD}=50V, L=1\text{mH}, I_{AS}=4A$	8.6	---	---	mJ

### Diode Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$I_S$	Continuous Source Current <sup>1,6</sup>	$V_G=V_D=0V$ , Force Current	---	---	4	A
$I_{SM}$	Pulsed Source Current <sup>2,6</sup>		---	---	8	A
$V_{SD}$	Diode Forward Voltage <sup>2</sup>	$V_{GS}=0V, I_S=1A, T_J=25^\circ\text{C}$	---	---	1	V
$t_{rr}$	Reverse Recovery Time	$I_F=1A, di/dt=100A/\mu s, T_J=25^\circ\text{C}$	---	174	---	nS
$Q_{rr}$	Reverse Recovery Charge		---	495	---	nC

Note :

- 1.The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ copper.
- 2.The data tested by pulsed , pulse width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$
- 3.The EAS data shows Max. rating . The test condition is  $V_{DD}=50V, V_{GS}=10V, L=1\text{mH}, I_{AS}=5.2A$
- 4.The power dissipation is limited by  $150^\circ\text{C}$  junction temperature
- 5.The Min. value is 100% EAS tested guarantee.
- 6.The data is theoretically the same as  $I_D$  and  $I_{DM}$ , in real applications , should be limited by total power dissipation.

### Typical Characteristics

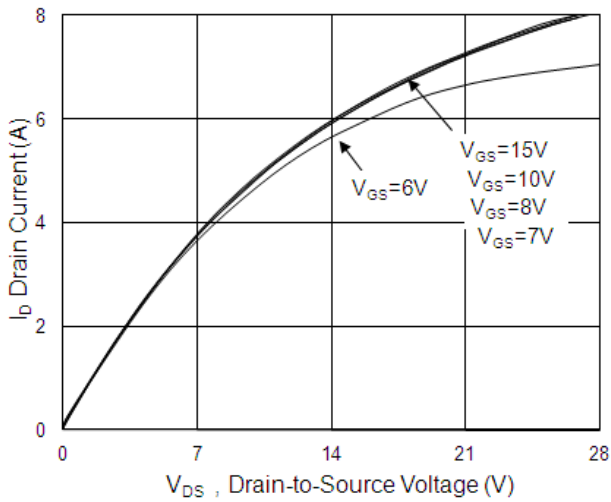


Fig.1 Typical Output Characteristics

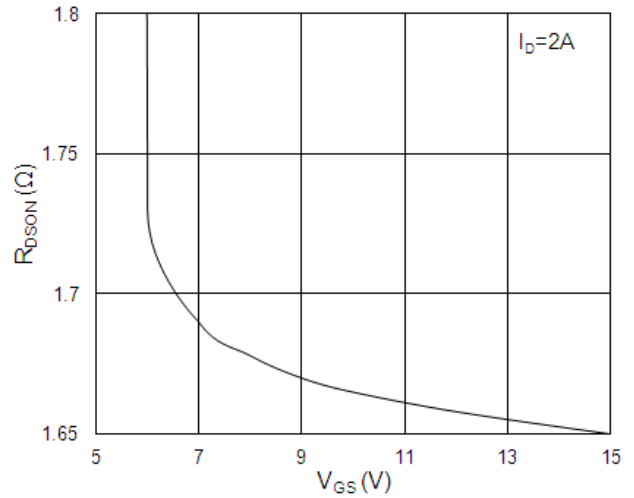


Fig.2 On-Resistance vs. G-S Voltage

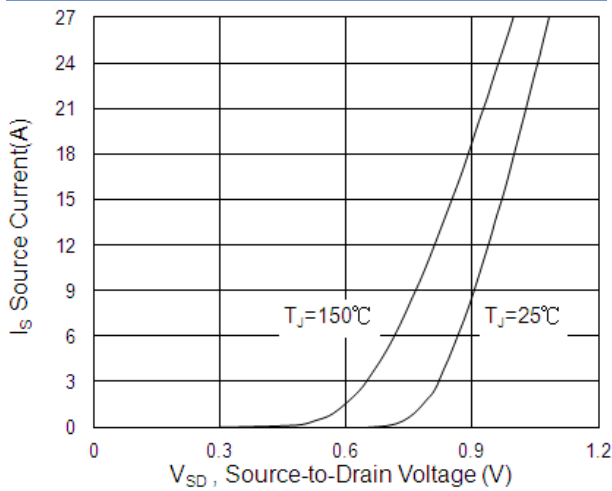


Fig.3 Forward Characteristics of Reverse

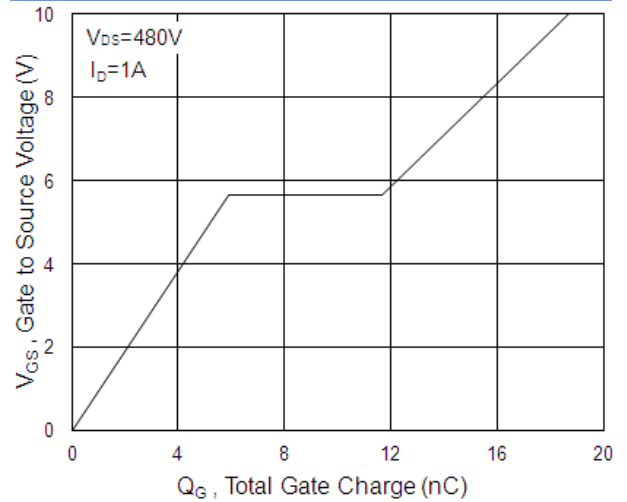


Fig.4 Gate-Charge Characteristics

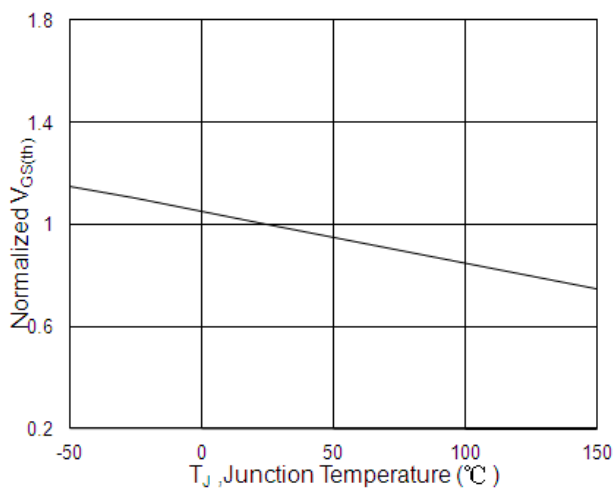


Fig.5 Normalized  $V_{GS(th)}$  vs.  $T_J$

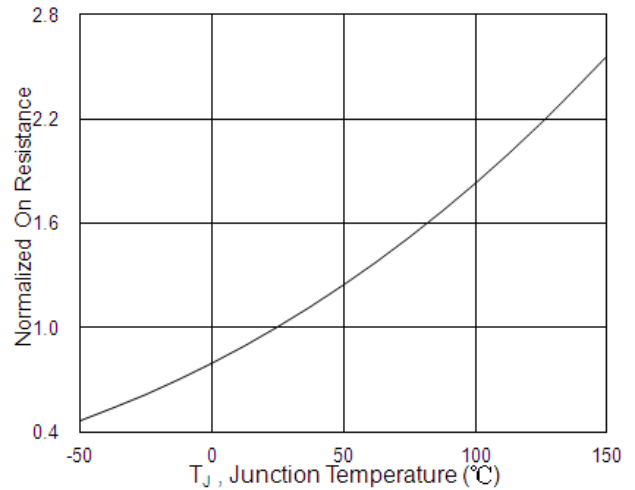


Fig.6 Normalized  $R_{DS(on)}$  vs.  $T_J$

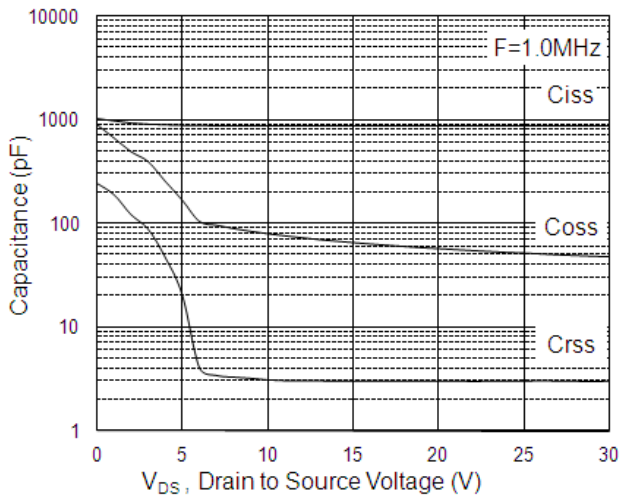


Fig.7 Capacitance

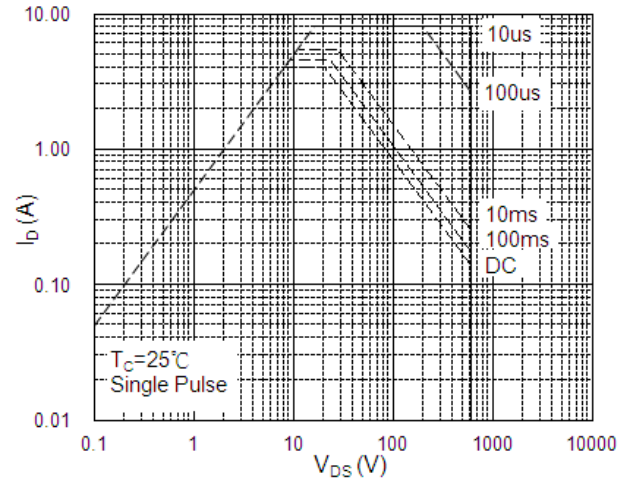


Fig.8 Safe Operating Area

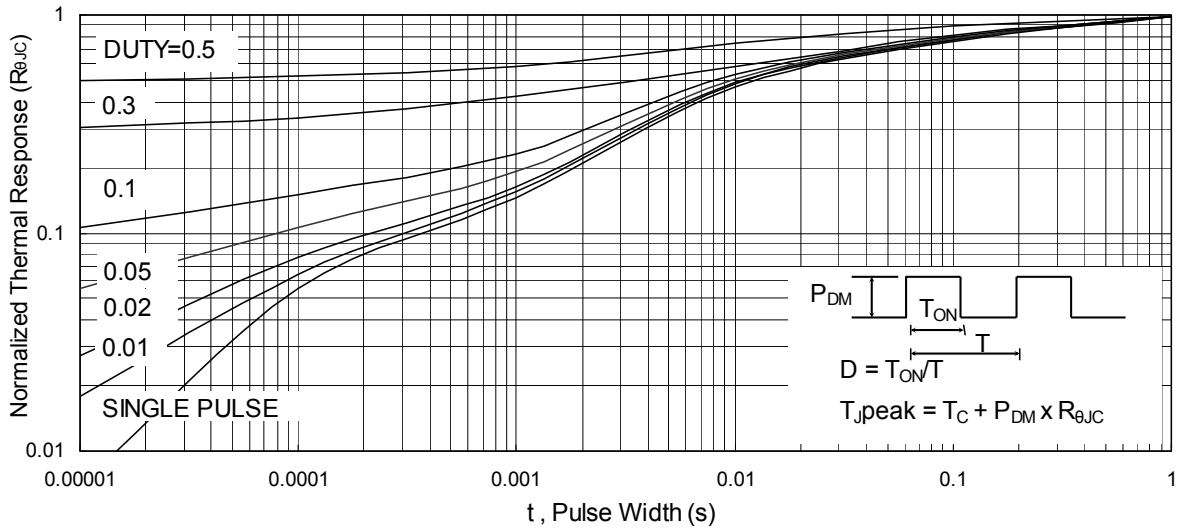


Fig.9 Normalized Maximum Transient Thermal Impedance



Fig.10 Switching Time Waveform

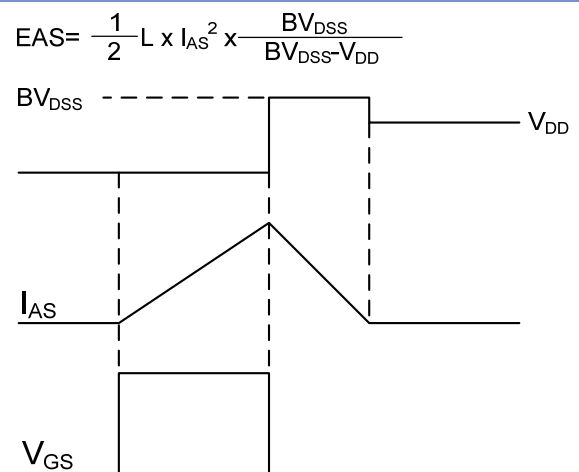


Fig.11 Unclamped Inductive Switching Waveform