



Power MOSFETS

DATASHEET

LM60400CAQ8A

N-Channel AND P-Channel
Enhancement Mode MOSFET

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Quality Management Systems

ISO 9001:2015 Certificate

LM60400CAQ8A



N-Channel AND P-Channel Enhancement Mode MOSFET

Pin Description

Ordering Information

SOP-8L (TOP view)	Symbol	Symbol	N-Channel	P-Channel	Unit
		V_{DSS}	60	-60	V
		$R_{DS(ON)-Max}$	40	72	m Ω
		I_D	4.8	-3.6	A

Feature

- Fast switching speed
- Reliable and Rugged
- ROHS Compliant & Halogen-Free

Applications

- Fan Motor Control
- Synchronous Rectification

Ordering Information

Orderable Part Number	Package Type	Form	Shipping	Marking
LM60400CAQ8A	SOP-8L	Tape & Reel	3000 / Tape & Reel	60400 □□□□□□

Note : □□□□□□ = Lot Code

Absolute Maximum Ratings ($T_J=25^\circ\text{C}$ Unless Otherwise Noted)

Symbol	Parameter	N-Channel	P-Channel	Unit
V_{DSS}	Drain-Source Voltage	60	-60	V
V_{GSS}	Gate-Source Voltage	± 20	± 20	V
T_J	Maximum Junction Temperature	150	150	$^\circ\text{C}$
T_{STG}	Storage Temperature Range	-55 to 150	-55 to 150	$^\circ\text{C}$
I_S	Diode Continuous Forward Current	$T_A=25^\circ\text{C}$ 2.2	-2.0	A
$I_{DM}^{①}$	Pulse Drain Current Tested	$T_A=25^\circ\text{C}$ 12	-9	A
I_D	Continuous Drain Current	$T_A=25^\circ\text{C}$ 4.8 $T_A=70^\circ\text{C}$ 3.9	-3.6 -2.9	A
P_D	Maximum Power Dissipation	$T_A=25^\circ\text{C}$ 1.7 $T_A=70^\circ\text{C}$ 1.1		W
$I_{AS}^{②}$	Avalanche Current, Single pulse	L=0.1mH 18 L=0.5mH 9	-20 -11	A
$E_{AS}^{②}$	Avalanche Energy, Single pulse	L=0.1mH 16 L=0.5mH 20	20 30	mJ

Thermal Characteristics

Symbol	Parameter	Rating	Unit
$R_{\theta JA}^{③}$	Thermal Resistance-Junction to Ambient	$t \leq 10s$ 48 Steady State 74	$^\circ\text{C/W}$ $^\circ\text{C/W}$

Note ① : Max. current is limited by junction temperature.

Note ② : UIS tested and pulse width are limited by maximum junction temperature 150°C

Note ③ : Surface Mounted on 1in^2 FR-4 board with 1oz.

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N-Channel Electrical Characteristics (T_J=25°C Unless Otherwise Noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Static Electrical Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V, I _{DS} =250uA	60	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} =48V, V _{GS} =0V	-	-	1	uA
V _{GS(th)}	Gate Threshold Voltage	V _{DS} =V _{GS} , I _{DS} =250uA	1	1.8	3	V
I _{GSS}	Gate Leakage Current	V _{GS} =±20V, V _{DS} =0V	-	-	±100	nA
R _{DS(ON)} ④	Drain-Source On-state Resistance	V _{GS} =10V, I _{DS} =5A	-	33	40	mΩ
		V _{GS} =4.5V, I _{DS} =5A	-	38	50	
gfs	Forward Transconductance	V _{DS} =10V, I _{DS} =1A	-	7.38	-	S
Dynamic Characteristics ⑥						
R _G	Gate Resistance	V _{GS} =0V, V _{DS} =0V, Freq.=1MHz	-	6.5	-	Ω
C _{iss}	Input Capacitance	V _{GS} =0V, V _{DS} =30V, Freq.=1MHz	-	649	-	pF
C _{oss}	Output Capacitance		-	65	-	
C _{rss}	Reverse Transfer Capacitance		-	27	-	
td(ON)	Turn-on Delay Time	V _{GS} =10V, V _{DS} =30V, Id=1A, RGEN=6Ω	-	27.6	-	nS
tr	Turn-on Rise Time		-	67.8	-	
td(OFF)	Turn-off Delay Time		-	86.8	-	
tf	Turn-off Fall Time		-	67.2	-	
Qg	Total Gate Charge	V _{GS} =4.5V, V _{DS} =30V Id=5A	-	6.6	-	nC
Qg	Total Gate Charge	V _{GS} =10V, V _{DS} =30V, Id=5A	-	13.9	-	
Qgs	Gate-Source Charge		-	2.4	-	
Qgd	Gate-Drain Charge		-	2.5	-	
Source-Drain Characteristics						
VSD④	Diode Forward Voltage	ISD=2A, VGS=0V	0.4	-	1.1	V
trr	Reverse Recovery Time	IF=2A, VR=0V	-	15.2	-	nS
Qrr	Reverse Recovery Charge	dIF/dt=100A/μs	-	10	-	nC

Note ④ : Pulse test (pulse width≤300us, duty cycle≤2%).

Note ⑤ : Guaranteed by design, not subject to production testing.

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N-Channel Typical Characteristics

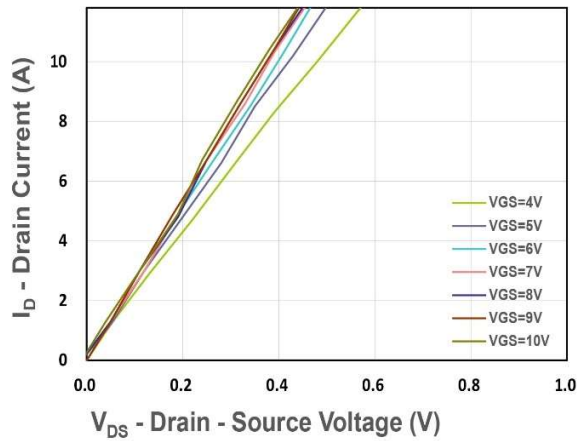


Figure 1. Output Characteristics

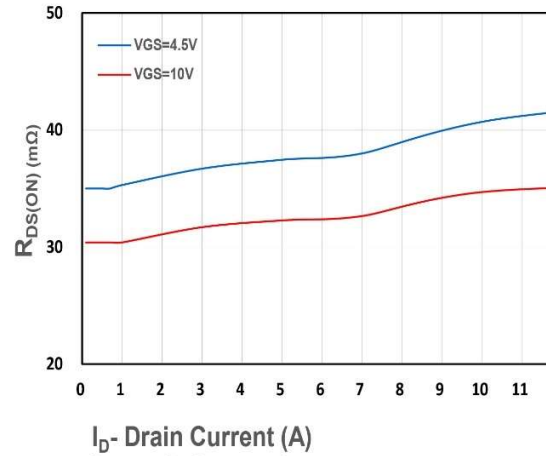


Figure 2. On-Resistance vs. I_D

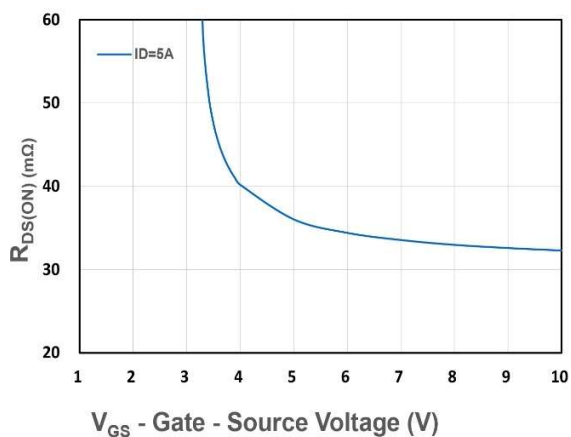


Figure 3. On-Resistance vs. V_{GS}

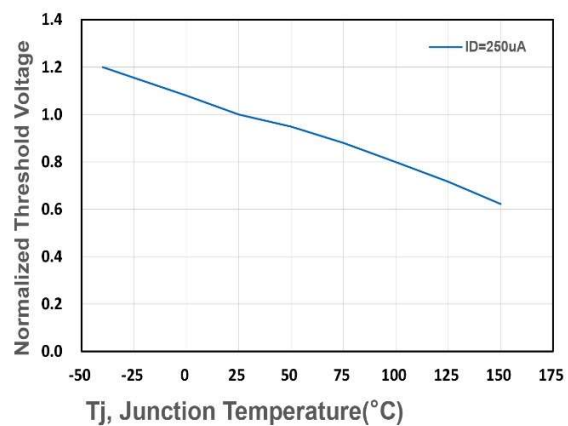


Figure 4. Gate Threshold Voltage

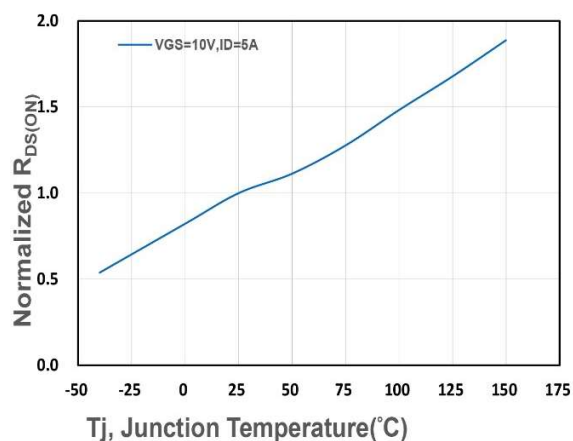


Figure 5. Drain-Source On Resistance

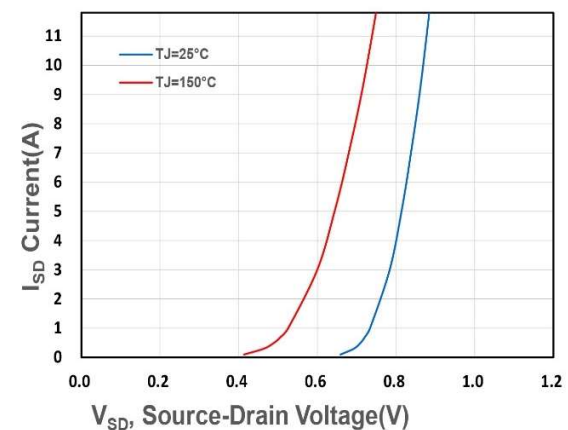
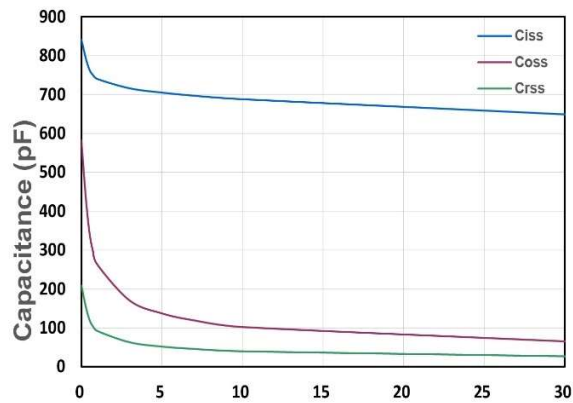
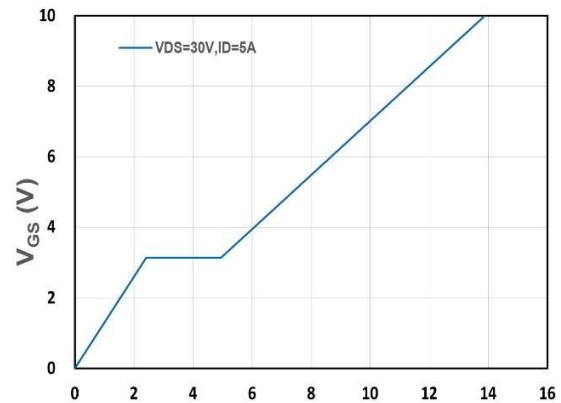


Figure 6. Source-Drain Diode Forward

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V_{DS} - Drain - Source Voltage (V)
Figure 7. Capacitance



Q_g , Total Gate Charge (nC)
Figure 8. Gate Charge Characteristics

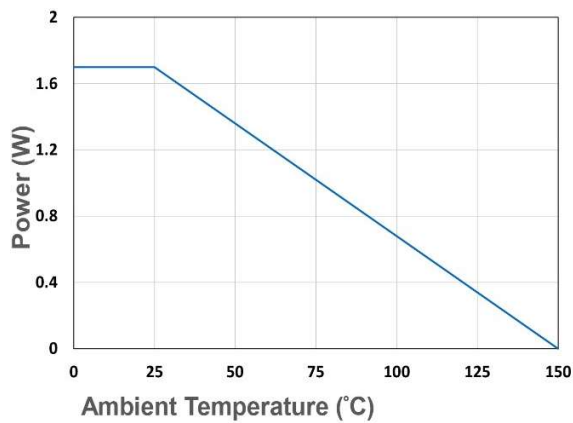


Figure 9. Power Dissipation

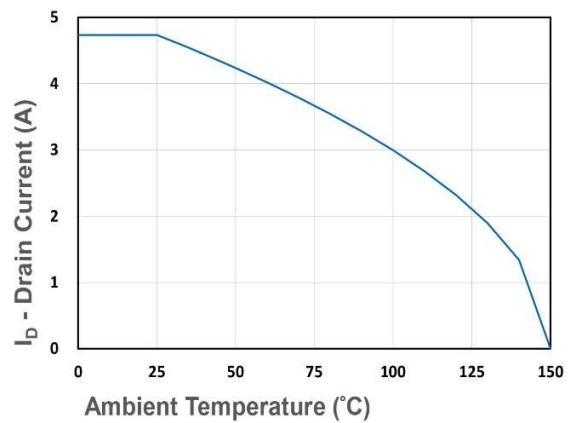


Figure 10. Drain Current

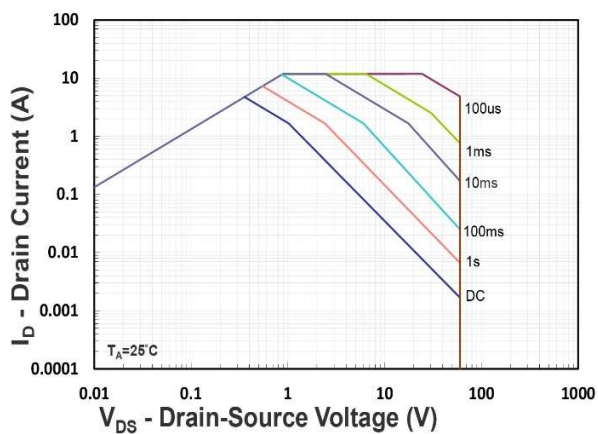
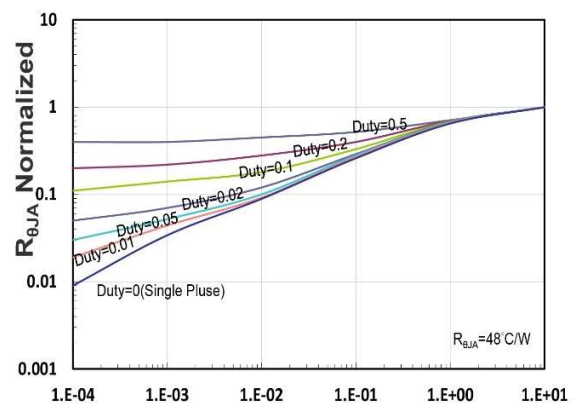


Figure 11. Safe Operating Area



t_1 , Square Wave Pulse Duration (s)
Figure 12. $R_{\theta JA}$ Transient Thermal Impedance

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P-Channel Electrical Characteristics (T_J=25°C Unless Otherwise Noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Static Electrical Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V, I _{DS} =-250uA	-60	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} =-48V, V _{GS} =0V	-	-	-1	uA
V _{GS(th)}	Gate Threshold Voltage	V _{DS} =V _{GS} , I _{DS} =-250uA	-1	-1.8	-3	V
I _{GSS}	Gate Leakage Current	V _{GS} =±20V, V _{DS} =0V	-	-	±100	nA
R _{DS(ON)} ^④	Drain-Source On-state Resistance	V _{GS} =-10V, I _{DS} =-5A	-	60	72	mΩ
		V _{GS} =-4.5V, I _{DS} =-4A	-	72	93	
gfs	Forward Transconductance	V _{DS} =-10V, I _{DS} =-1A	-	10	-	S
Dynamic Characteristics ^⑥						
R _G	Gate Resistance	V _{GS} =0V, V _{DS} =0V, Freq.=1MHz	-	24	-	Ω
C _{iss}	Input Capacitance	V _{GS} =0V, V _{DS} =-30V, Freq.=1MHz	-	1220	-	pF
C _{oss}	Output Capacitance		-	70	-	
C _{rss}	Reverse Transfer Capacitance		-	54	-	
td(ON)	Turn-on Delay Time	V _{GS} =-30V, V _{DS} =-30V, Id=-1A, RGEN=6Ω	-	1.9	-	nS
tr	Turn-on Rise Time		-	21.2	-	
td(OFF)	Turn-off Delay Time		-	153	-	
tf	Turn-off Fall Time		-	58.4	-	
Qg	Total Gate Charge	V _{GS} =-4.5V, V _{DS} =-30V Id=-5A	-	13.5	-	nC
Qg	Total Gate Charge	V _{GS} =-10V, V _{DS} =-30V, Id=-5A	-	28	-	
Qgs	Gate-Source Charge		-	3.5	-	
Qgd	Gate-Drain Charge		-	4.3	-	
Source-Drain Characteristics						
VSD ^④	Diode Forward Voltage	ISD=-1.7A, VGS=0V	-0.4	-	-1.1	V
trr	Reverse Recovery Time	IF=-1.7A, VR=0V	-	11.2	-	nS
Qrr	Reverse Recovery Charge	dIF/dt=100A/μs	-	5.5	-	nC

P-Channel Typical Characteristics

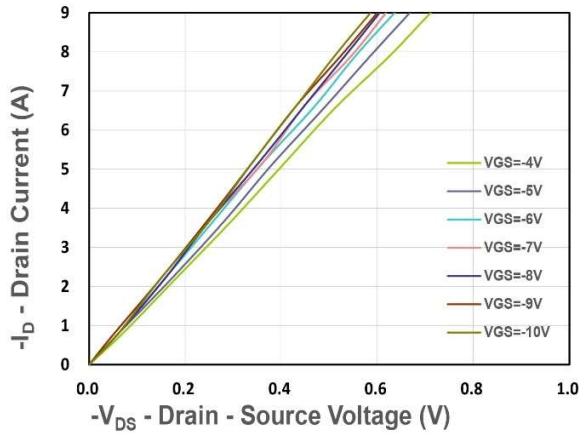


Figure 1. Output Characteristics

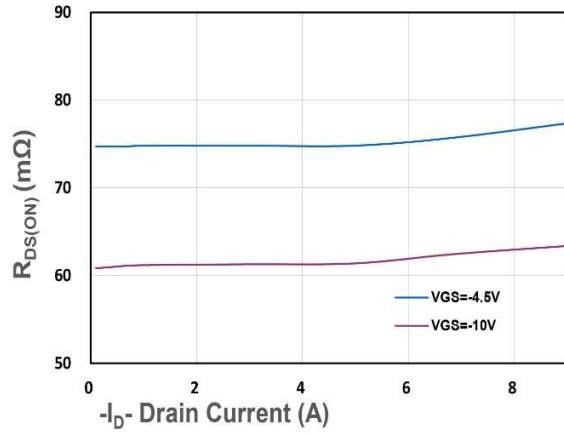


Figure 2. On-Resistance vs. I_D

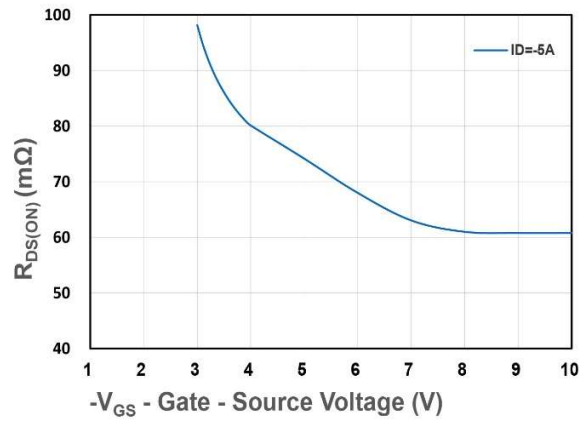


Figure 3. On-Resistance vs. V_{GS}

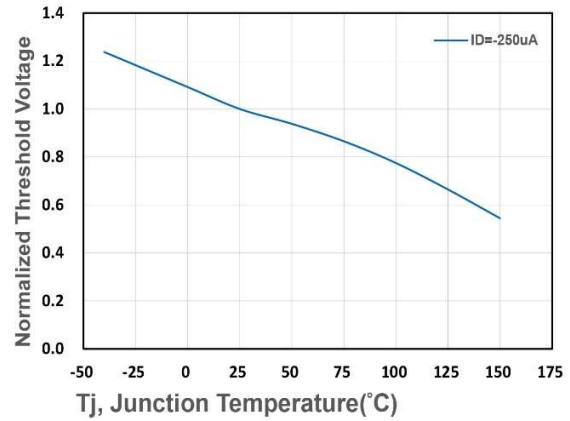


Figure 4. Gate Threshold Voltage

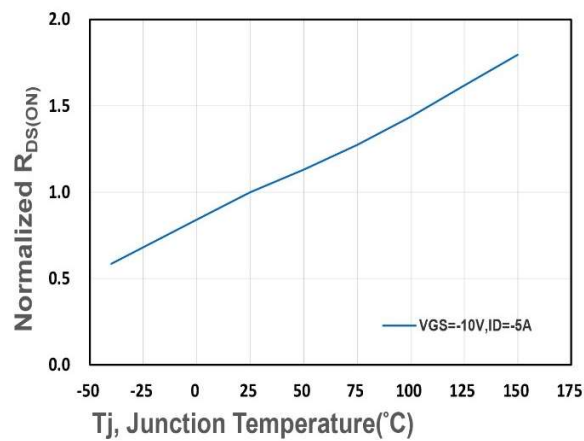


Figure 5. Drain-Source On Resistance

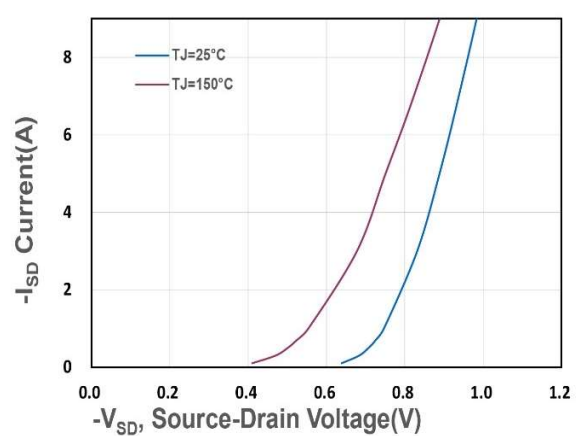


Figure 6. Source-Drain Diode Forward

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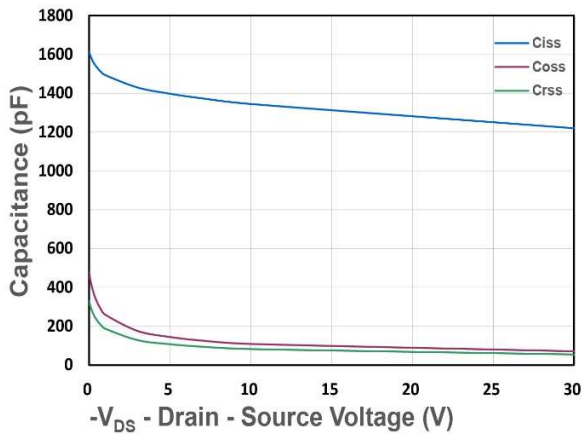


Figure 7. Capacitance

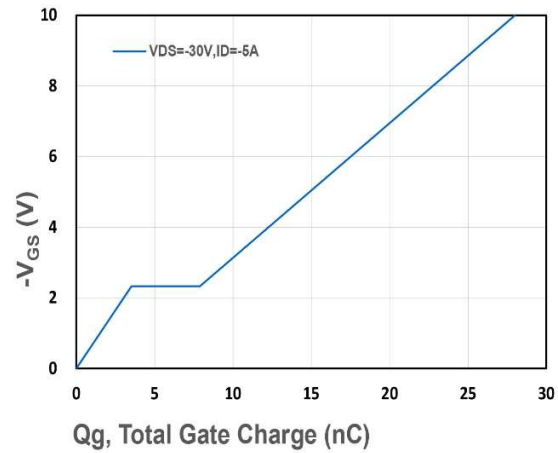


Figure 8. Gate Charge Characteristics

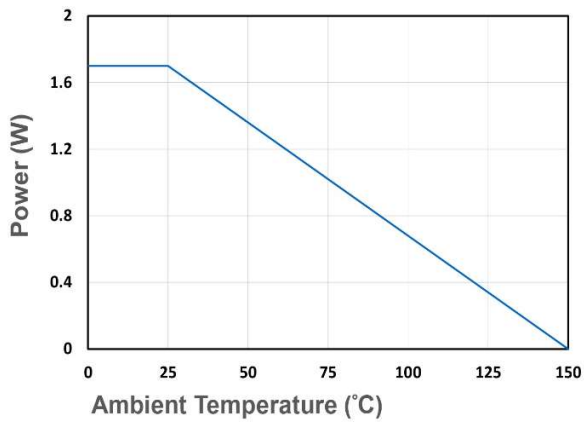


Figure 9. Power Dissipation

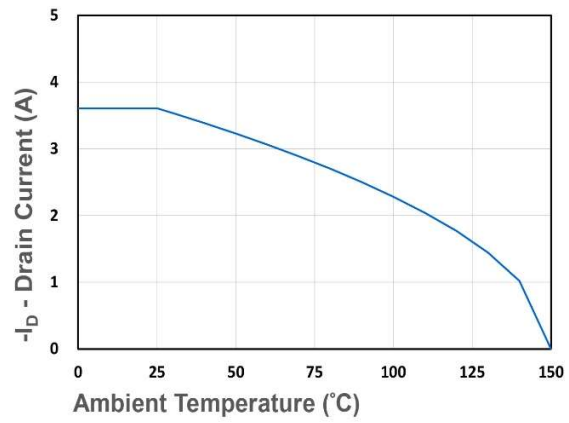


Figure 10. Drain Current

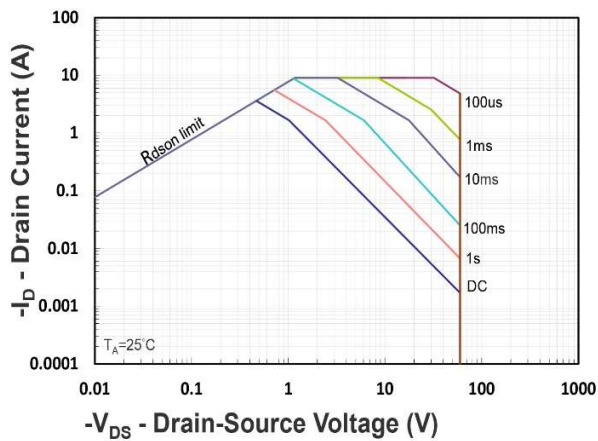


Figure 11. Safe Operating Area

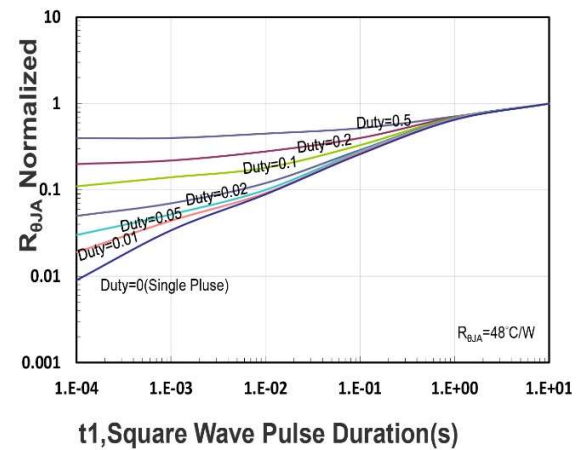


Figure 12. $R_{\theta JA}$ Transient Thermal Impedance