

# AP6928GMT-HF

**Halogen-Free Product**



**Advanced Power  
Electronics Corp.**

*DUAL N-CHANNEL MOSFET WITH  
SCHOTTKY DIODE*

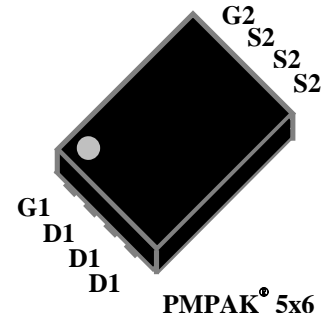
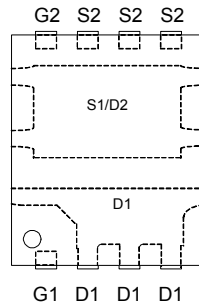
- ▼ Simple Drive Requirement
- ▼ Easy for Synchronous Buck Converter Application
- ▼ RoHS Compliant & Halogen-Free

## Description

Advanced Power MOSFETs from APEC provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The control MOSFET (CH-1) and synchronous MOSFET (CH-2) co-package for synchronous buck converters.

	CH-1	$BV_{DSS}$	30V
		$R_{DS(ON)}$	8.5m $\Omega$
		$I_D$	48A
	CH-2	$BV_{DSS}$	30V
		$R_{DS(ON)}$	2.6m $\Omega$
		$I_D$	105A



## Absolute Maximum Ratings

Symbol	Parameter	Rating		Units
		CH-1	CH-2	
$V_{DS}$	Drain-Source Voltage	30	30	V
$V_{GS}$	Gate-Source Voltage	$\pm 20$	$\pm 12$	V
$I_D @ T_C = 25^\circ C$	Continuous Drain Current (Chip Limited)	48	105	A
$I_D @ T_A = 25^\circ C$	Continuous Drain Current <sup>3</sup> , $V_{GS} @ 10V$	15	31	A
$I_D @ T_A = 70^\circ C$	Continuous Drain Current <sup>3</sup> , $V_{GS} @ 10V$	12	24.8	A
$I_{DM}$	Pulsed Drain Current <sup>1</sup>	40	60	A
$P_D @ T_A = 25^\circ C$	Total Power Dissipation	3.13	3.9	W
$T_{STG}$	Storage Temperature Range	-55 to 150		$^\circ C$
$T_J$	Operating Junction Temperature Range	-55 to 150		$^\circ C$

## Thermal Data

Symbol	Parameter	Rating		Units
		CH-1	CH-2	
Rthj-c	Maximum Thermal Resistance, Junction-case	4	2.8	$^\circ C/W$
Rthj-a	Maximum Thermal Resistance, Junction-ambient <sup>3</sup>	40	32	$^\circ C/W$
Rthj-a	Maximum Thermal Resistance, Junction-ambient <sup>4</sup>	70	60	$^\circ C/W$



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## CH-1 Electrical Characteristics @T<sub>j</sub>=25°C(unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> =0V, I <sub>D</sub> =250uA	30	-	-	V
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance <sup>2</sup>	V <sub>GS</sub> =10V, I <sub>D</sub> =12A	-	7	8.5	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =8A	-	10	12.5	mΩ
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250uA	1.1	1.5	3	V
g <sub>fs</sub>	Forward Transconductance	V <sub>DS</sub> =10V, I <sub>D</sub> =12A	-	36	-	S
I <sub>DSS</sub>	Drain-Source Leakage Current	V <sub>DS</sub> =24V, V <sub>GS</sub> =0V	-	-	10	uA
I <sub>GSS</sub>	Gate-Source Leakage	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V	-	-	±100	nA
Q <sub>g</sub>	Total Gate Charge	I <sub>D</sub> =12A	-	6.5	10.4	nC
Q <sub>gs</sub>	Gate-Source Charge	V <sub>DS</sub> =15V	-	1.5	-	nC
Q <sub>gd</sub>	Gate-Drain ("Miller") Charge	V <sub>GS</sub> =4.5V	-	3	-	nC
t <sub>d(on)</sub>	Turn-on Delay Time	V <sub>DS</sub> =15V	-	7.5	-	ns
t <sub>r</sub>	Rise Time	I <sub>D</sub> =1A	-	5	-	ns
t <sub>d(off)</sub>	Turn-off Delay Time	R <sub>G</sub> =3.3Ω	-	18	-	ns
t <sub>f</sub>	Fall Time	V <sub>GS</sub> =10V	-	7	-	ns
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> =0V	-	600	960	pF
C <sub>oss</sub>		V <sub>DS</sub> =15V	-	220	-	pF
C <sub>rss</sub>	Reverse Transfer Capacitance	f=1.0MHz	-	100	-	pF
R <sub>g</sub>	Gate Resistance	f=1.0MHz	-	2.7	5.4	Ω

## Source-Drain Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V <sub>SD</sub>	Forward On Voltage <sup>2</sup>	I <sub>S</sub> =12A, V <sub>GS</sub> =0V	-	-	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	I <sub>S</sub> =12A, V <sub>GS</sub> =0V,	-	20	-	ns
Q <sub>rr</sub>	Reverse Recovery Charge	dI/dt=100A/μs	-	10	-	nC



**CH-2 Electrical Characteristics @T<sub>j</sub>=25°C(unless otherwise specified)**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=250\mu A$	30	-	-	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance <sup>2</sup>	$V_{GS}=10V, I_D=20A$	-	2.1	2.6	mΩ
		$V_{GS}=4.5V, I_D=12A$	-	2.9	3.5	mΩ
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=250\mu A$	1	1.6	3	V
$g_{fs}$	Forward Transconductance	$V_{DS}=10V, I_D=20A$	-	50	-	S
$I_{DSS}$	Drain-Source Leakage Current	$V_{DS}=24V, V_{GS}=0V$	-	-	500	uA
$I_{GSS}$	Gate-Source Leakage	$V_{GS}=\pm 12V, V_{DS}=0V$	-	-	+100	nA
$Q_g$	Total Gate Charge	$I_D=20A$	-	67	107	nC
$Q_{gs}$	Gate-Source Charge	$V_{DS}=15V$	-	18	-	nC
$Q_{gd}$	Gate-Drain ("Miller") Charge	$V_{GS}=4.5V$	-	31	-	nC
$t_{d(on)}$	Turn-on Delay Time	$V_{DS}=15V$	-	21	-	ns
$t_r$	Rise Time	$I_D=1A$	-	12.5	-	ns
$t_{d(off)}$	Turn-off Delay Time	$R_G=3.3\Omega$	-	100	-	ns
$t_f$	Fall Time	$V_{GS}=10V$	-	42	-	ns
$C_{iss}$	Input Capacitance	$V_{GS}=0V$	-	9300	14880	pF
$C_{oss}$	Output Capacitance	$V_{DS}=15V$	-	1170	-	pF
$C_{riss}$	Reverse Transfer Capacitance	$f=1.0MHz$	-	880	-	pF
$R_g$	Gate Resistance	$f=1.0MHz$	-	1.2	2.4	Ω

**Source-Drain Diode**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{SD}$	Diode+Schottky Forward On Voltage <sup>2</sup>	$I_S=1A, V_{GS}=0V$	-	0.5	0.64	V
$t_{rr}$	Body Diode+Schottky Reverse Recovery Time	$I_S=10A, V_{GS}=0V,$ $di/dt=100A/\mu s$	-	40	-	ns
$Q_{rr}$	Body Diode+Schottky Reverse Recovery Charge		-	40	-	nC

**Notes:**

- 1.Pulse width limited by Max. junction temperature.
- 2.Pulse test
- 3.Surface mounted on 1 in<sup>2</sup> copper pad of FR4 board, t ≤10sec.
- 4.Surface mounted on 1 in<sup>2</sup> copper pad of FR4 board, on steady-state

THIS PRODUCT IS SENSITIVE TO ELECTROSTATIC DISCHARGE, PLEASE HANDLE WITH CAUTION.

USE OF THIS PRODUCT AS A CRITICAL COMPONENT IN LIFE SUPPORT OR OTHER SIMILAR SYSTEMS IS NOT AUTHORIZED.

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Channel-1

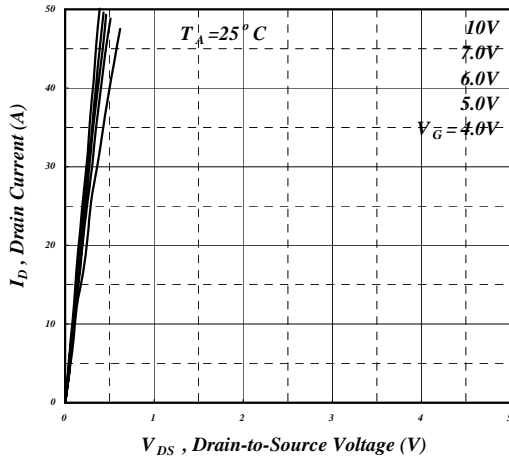


Fig 1. Typical Output Characteristics

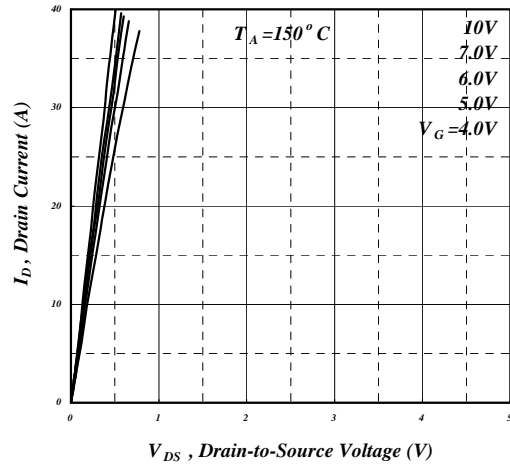


Fig 2. Typical Output Characteristics

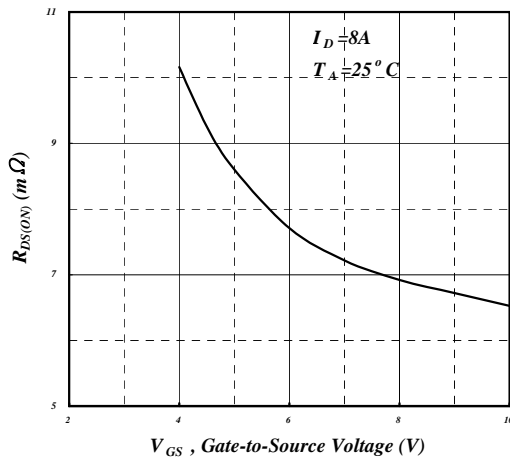


Fig 3. On-Resistance v.s. Gate Voltage

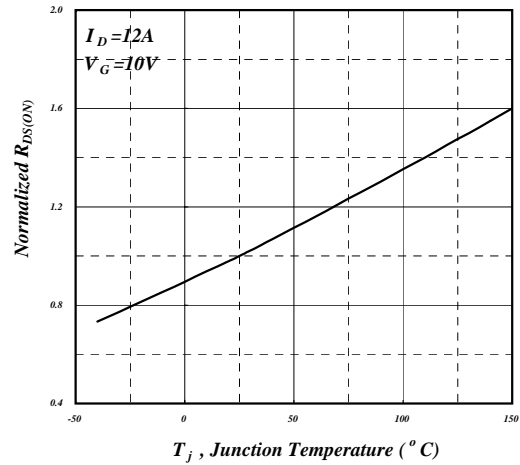


Fig 4. Normalized On-Resistance v.s. Junction Temperature

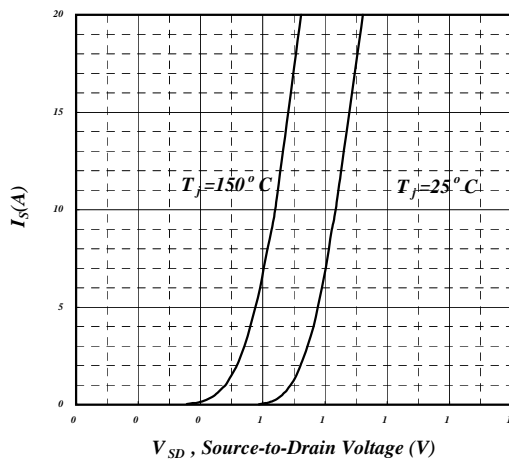


Fig 5. Forward Characteristic of Reverse Diode

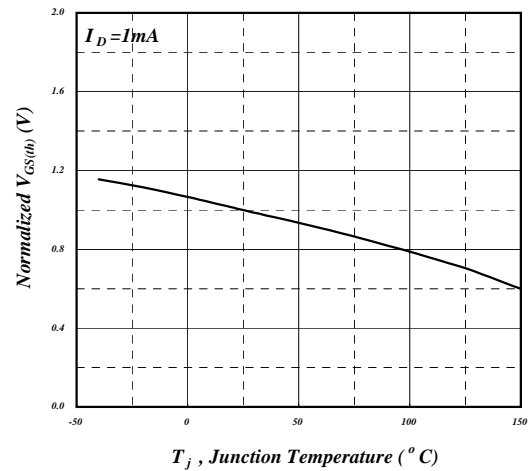


Fig 6. Gate Threshold Voltage v.s. Junction Temperature



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## Channel-1

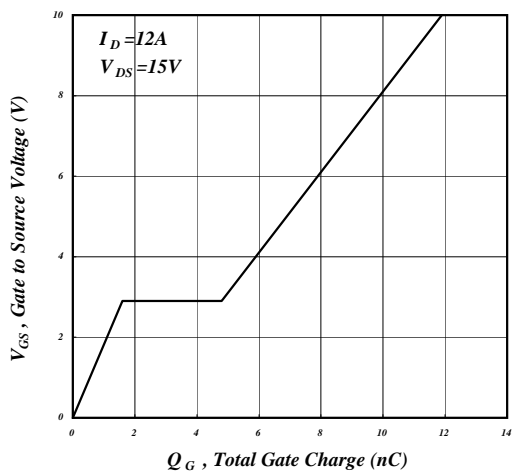


Fig 7. Gate Charge Characteristics

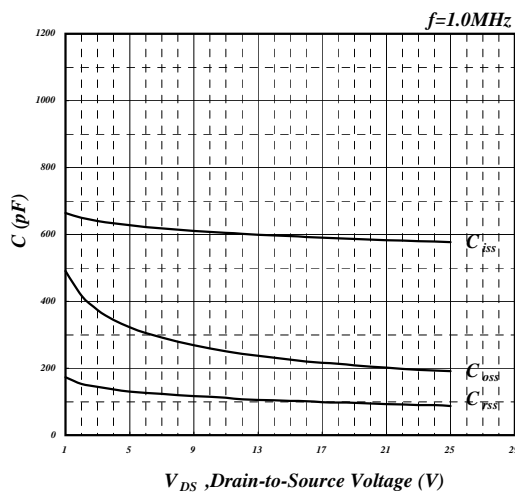


Fig 8. Typical Capacitance Characteristics

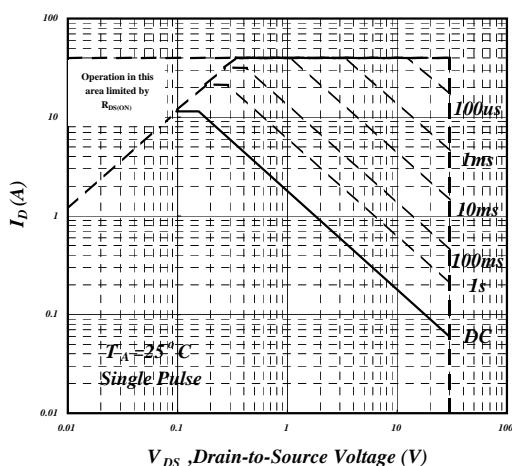


Fig 9. Maximum Safe Operating Area

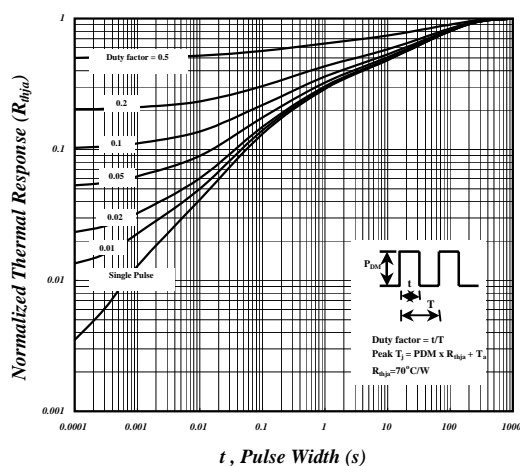


Fig 10. Effective Transient Thermal Impedance

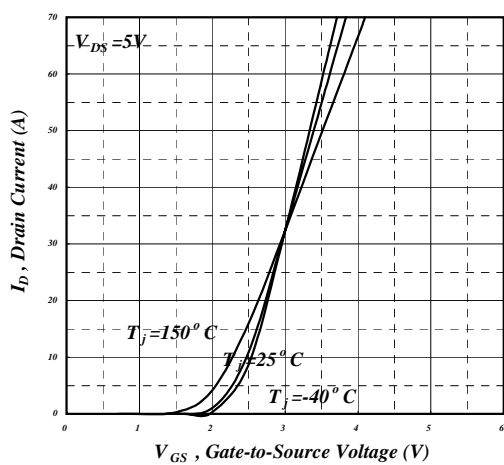


Fig 11. Transfer Characteristics

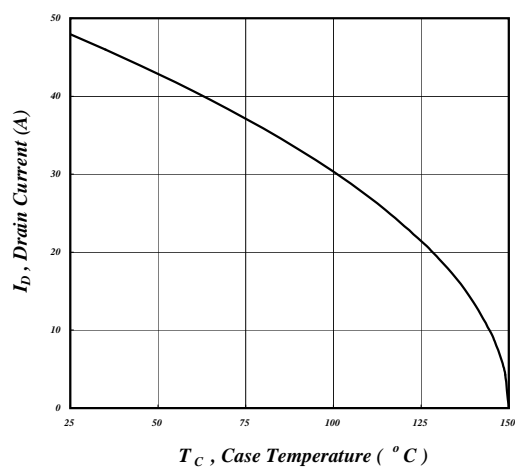


Fig 12. Maximum Continuous Drain Current v.s. Case Temperature



Channel-2

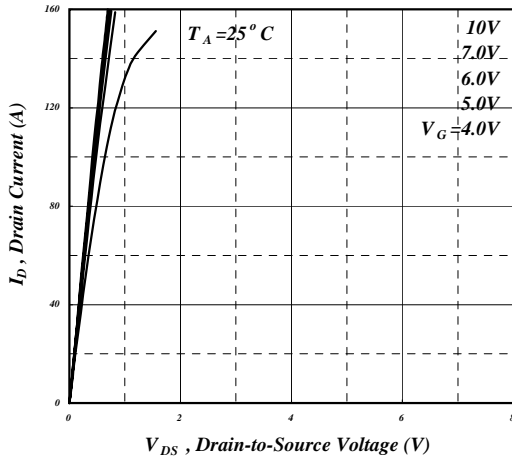


Fig 1. Typical Output Characteristics

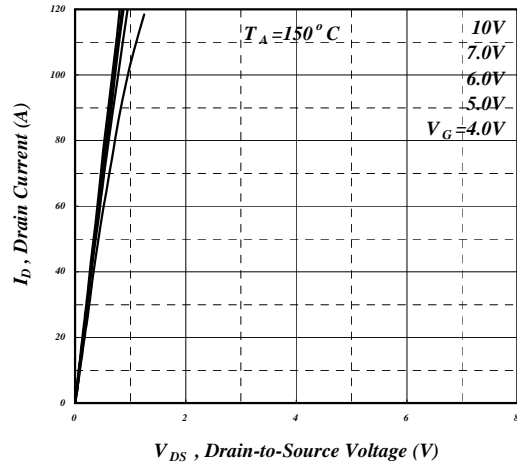


Fig 2. Typical Output Characteristics

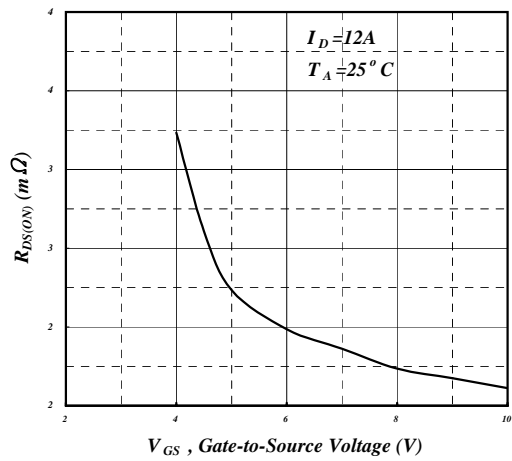


Fig 3. On-Resistance v.s. Gate Voltage

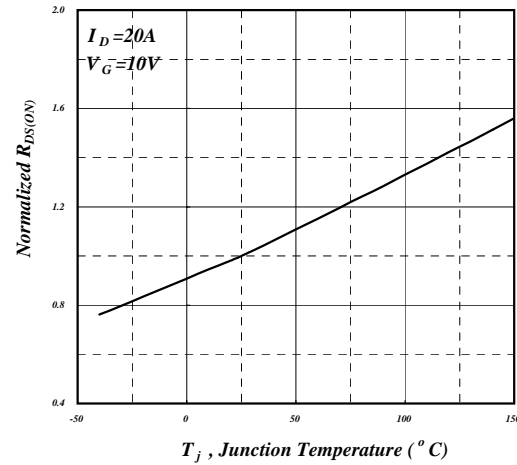


Fig 4. Normalized On-Resistance v.s. Junction Temperature

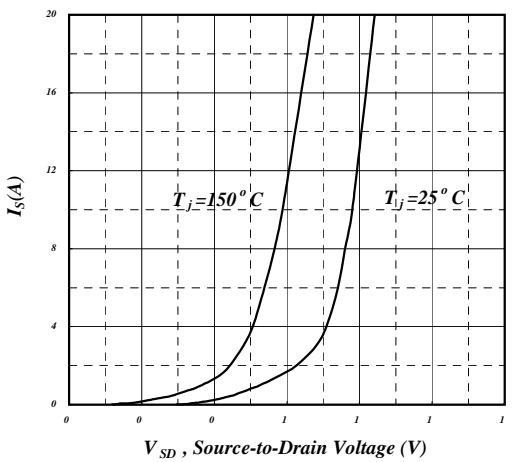


Fig 5. Forward Characteristic of Reverse Diode

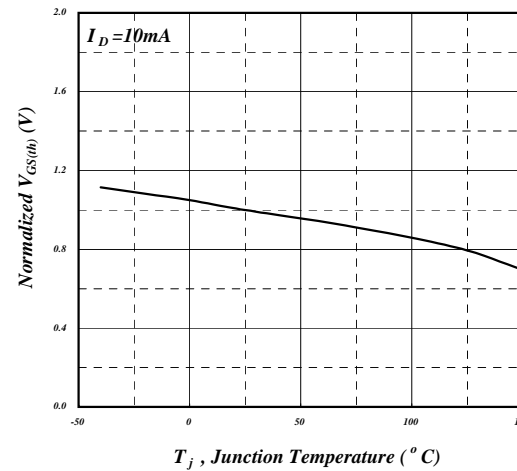


Fig 6. Gate Threshold Voltage v.s. Junction Temperature



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## Channel-2

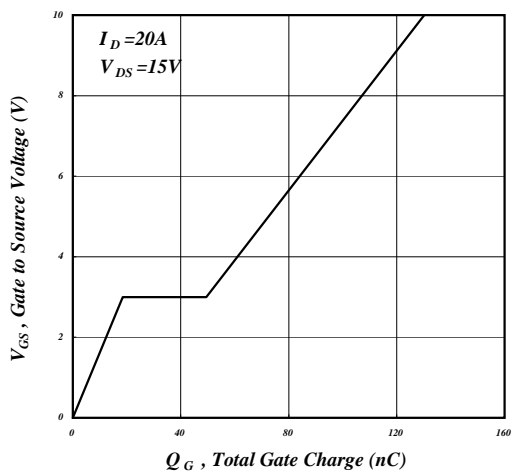


Fig 7. Gate Charge Characteristics

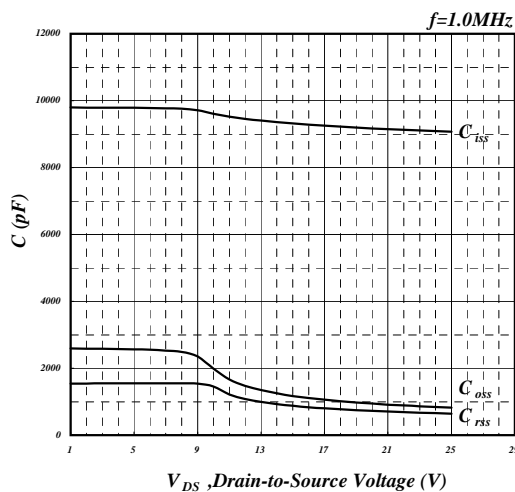


Fig 8. Typical Capacitance Characteristics

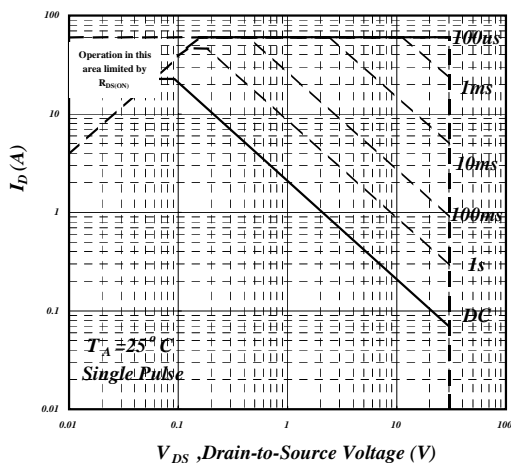


Fig 9. Maximum Safe Operating Area

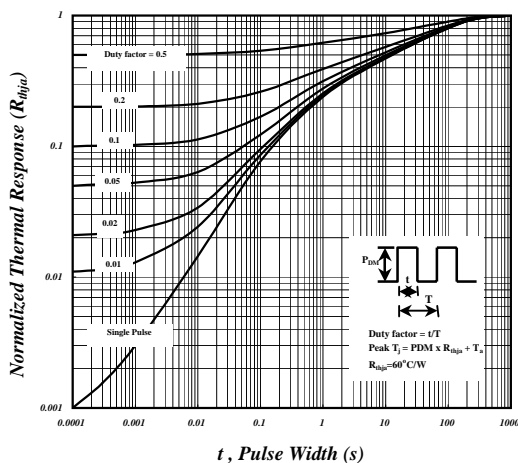


Fig 10. Effective Transient Thermal Impedance

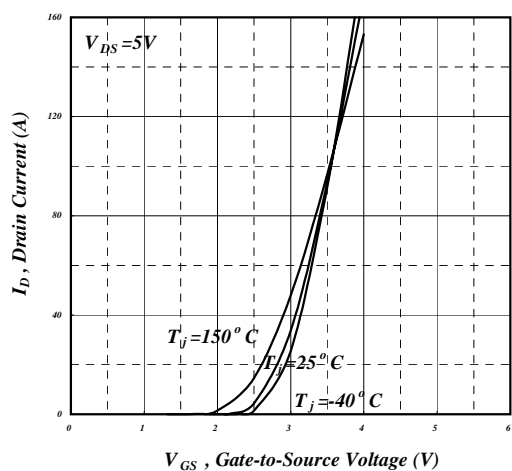


Fig 11. Transfer Characteristics

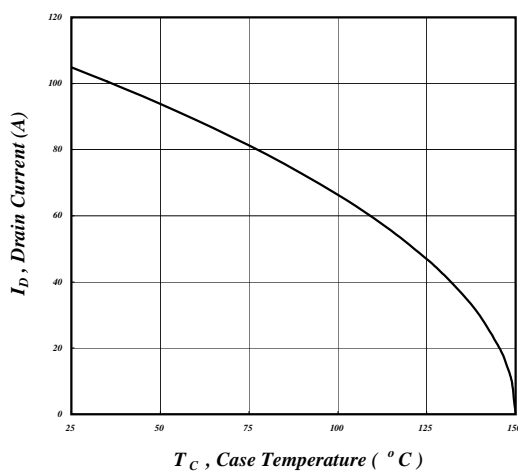


Fig 12. Maximum Continuous Drain Current v.s. Case Temperature