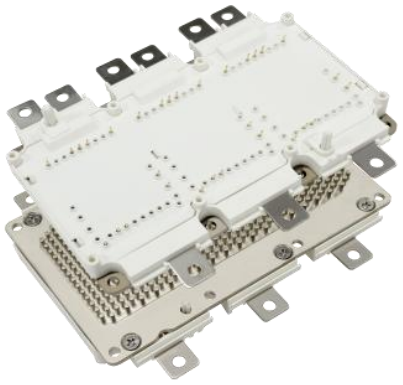
Silicon Carbide (SiC) Module - Taichipillars™ SiC Power Module for Traction Inverter,Single-Side Direct Cooling,2.5mohm, 1200V,6-Pack

HPSC800FS12B



KXHPD 154.40×92.0(SPB)
CASE 183AM

MARKING DIAGRAM

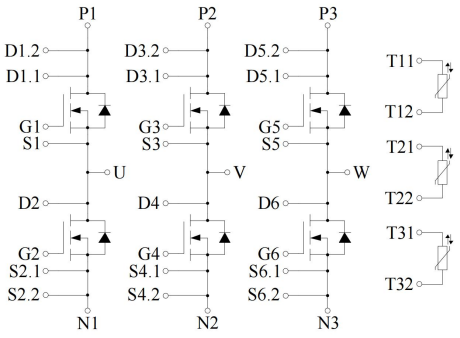
Product Description

The HPSC800FS12B is part of the Taichipillars™ SiC power module for traction inverter, a revolutionary high mobility compound semiconductor product family that offers increased performance,better efficiency, and higher power density in similar and highly compatible packaging solutions.

The module integrates 1200V SiC MOSFET in a 6−pack configuration. For assembly ease and reliability, a new generation of press−fit pins are integrated into the power module for signal terminals. In addition, it also integrates an optimized pin−fin heatsink in the baseplate.

To enhance reliability and thermal performance, sintering technology is applied for die attach. The module is designed to meet AQG324 automotive standard.

PIN ASSIGNMENTS



ORDERING INFORMATION

Device	Package
HPSC800FS12B	KXHPD (Pb-Free)

Features

- Taichipillars™ cooling w/ integrated Pin−fin Heatsink
- Thermal Conductivity Increase of over 5%
- $T_{vj.Max}$ = 175℃ for Continuous Operation
- Low $R_{ds(on)}$ at High Temperatures,Suitable for High-temperature Operation
- Sintered Die Technology for High Reliability Performance
- Fine Cell Planar Gate Technology for Chips
- Low Switching Losses,Low Inductive Design≤15nH
- These Devices are Pb−Free and are RoHS Compliant
- $V_{gs(th)}$ and $V_{(BR)DSS}$ have good consistency

Typical Applications

- Hybrid and Electric Vehicle Traction Inverter
- Automotive application
- Inverter for motor drive

Pin Description

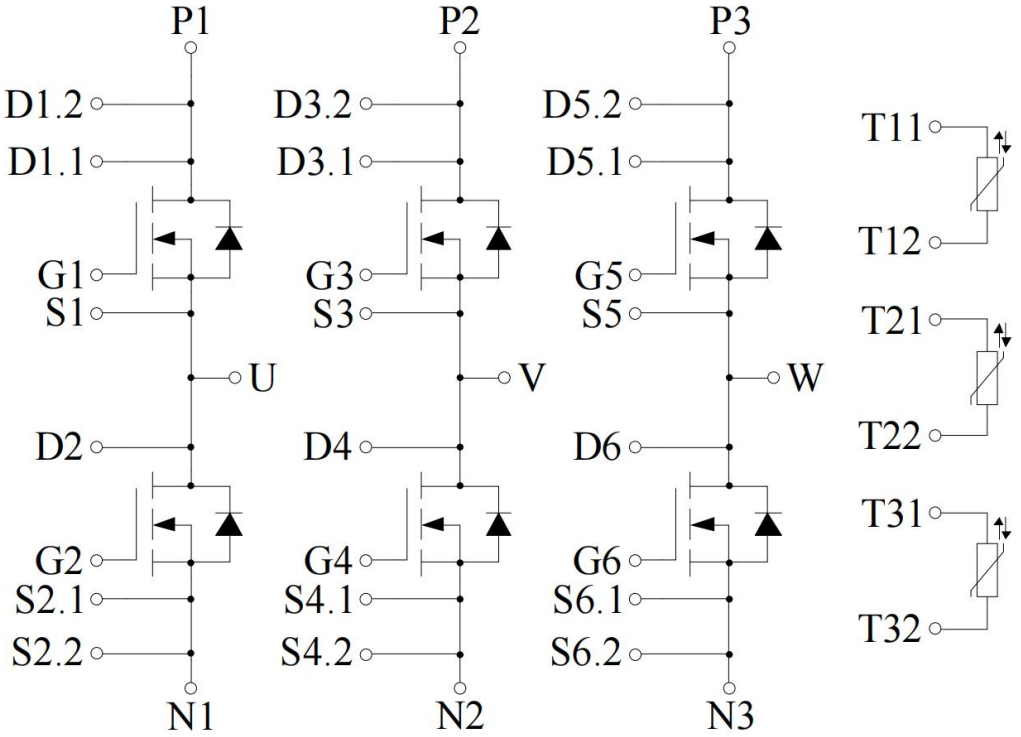


Fig 1. Pin Description

PIN FUNCTION DESCRIPTION

Pin #	Pin Function Description
P1, P2, P3	Positive Power Terminals
N1, N2, N3	Negative Power Terminals
U	Phase U Output
V	Phase V Output
W	Phase W Output
G1−G6	SiC MOSFET Gate
S1,S2.1,S2.2,S3,S4.1,S4.2,S5,S6.1,S6.2	SiC MOSFET Source / Gate Return
D1.1,D1.2,D2,D3.1,D3.2,D4,D5.1,D5.2,D6	SiC MOSFET Drain Sense
T11, T12	Phase U Temperature Sensor Output
T21, T22	Phase V Temperature Sensor Output
T31, T32	Phase W Temperature Sensor Output

Materials

DBC Substrate: Si_3N_4 isolated substrate, basic isolation

Terminals: Copper + Tin electro−plating

Signal Leads: Copper + Tin plating

Pin−fin Base plate: Taichipillars TM+ Copper + Ni plating

Flammability Information

The module frame meets UL94V-0 flammability rating

MODULE CHARACTERISTICS (T_{vj} = 25°C, Unless Otherwise Specified)

Symbol	Parameter	Rating	Unit
T_{vj}	Operating Junction Temperature	−40 to 175	°C
T_{STG}	Storage Temperature Range	−40 to 125	°C
V_{ISO}	Isolation Voltage (AC, 50Hz, 5s)	2500	V
$R_{DD'+SS'}$	Module Lead Resistance, Terminals−Chip	0.6	mΩ
G	Module Weight	720	g
CTI	Comparative Tracking Index	>200	-
d_{creep}	Creepage: Terminal to Heatsink Terminal to Terminal	9.0 9.0	mm
d_{clear}	Clearance: Terminal to Heatsink Terminal to Terminal	4.5 4.5	mm

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Δp	Pressure Drop in Cooling Circuit	10 L/min, 65°C, 50/50 EGW	-	95	-	mbar
P(Note 1)	Maximum Pressure in Cooling Loop (relative)	$T_{Baseplate}$ < 40°C $T_{Baseplate}$ > 40°C	- -	- -	2.5 2.0	bar

1. EPDM rubber 50 durometer 'O' ring used.

ABSOLUTE MAXIMUM RATINGS (T_{vj} = 25℃, Unless Otherwise Specified)

Symbol	Parameter	Rating	Unit
V_{DS}	Drain−to−Source Voltage	1200	V
V_{GS}	Gate−to−Source Voltage	+20/-5	V
I_{DS}	Continuous DC Drain Current, V_{GS} = 18V, T_{vj} = 175℃, T_F = 65℃ @ 10LPM, $R_{thj_F.max}$ (Note 2)	800	A
$I_{DS.pulsed}$	Pulsed Drain Current @ V_{GS} = 18V, limited by $T_{vj.Max}$	1600	A
$I_{SD.BD}$	Continuous DC Body Diode Current, V_{GS} = −5V, T_{vj} = 175℃, T_F = 65℃ @10LPM, using Ref. Heatsink (Note 2)	800	A
$I_{SD.pulsed}$	Pulsed Body Diode Current, V_{GS} = −5 V, limited by $T_{vj.Max}$	1600	A
P_{tot}	Total Power Dissipation $T_{vj.Max}$ = 175℃, T_F = 65℃, Ref. Heatsink (typ)	2050	W

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

2. Verified by characterization/design, not by test.

MOSFET CHARACTERISTICS (T_{vj} = 25℃, Unless Otherwise Specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$T_{vj\ op}$	Temperature under switching conditions		-40	-	175	°C
$R_{DS(on)}$	Drain-source On Resistance	V_{GS} = 18V,I_{DS} = 480A,T_{vj} = 25°C	-	2.52	3.55	mΩ
		V_{GS} = 18V,I_{DS} = 480A,T_{vj} = 175°C	-	4.16	-	mΩ
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	V_{GS} = 0V,I_{DS} = 1mA	1200	-	-	V
$V_{GS(th)}$	Gate Threshold Voltage	I_{DS} = 296mA,V_{DS} = V_{GS},T_{vj} = 25°C	1.52	2.13	3.21	V
		I_{DS} = 296mA,V_{DS} = V_{GS},T_{vj} = 175°C	0.95	1.39	2.28	V
Q_{gs}	Gate to Source Charge	V_{DS} = 850V,V_{GS} = -5V to 18V,I_{DS} = 780A	-	581	-	nC
Q_{gd}	Gate to Drain Charge		-	958	-	nC
Q_g	Total Gate Charge		-	1.65	-	uC
R_{Gint}	Internal gate resistor	f = 1MHz,T_j = 25°C	-	266	-	mΩ
C_{iss}	Input Capacitance	V_{DS} = 850V,V_{GS} = 0V, f = 1MHz	-	65.6	-	nF
C_{oss}	Output Capacitance		-	2.31	-	nF
C_{rss}	Reverse Transfer Capacitance		-	1.83	-	nF
I_{GSS}	Gate-source Leakage Current	V_{GS} = 20V,T_{vj} = 25°C	-	-	100	nA
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 1200V,T_{vj} = 25°C	-	-	150	uA

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Delay Time, Inductive Load	V_{DS} = 650V,I_{DS} = 600A,R_{Gon} = 12Ω, R_{Goff} = 8.2Ω,V_{GS} = -5V/+18V,L_S = 7uH, T_{vj} = 25℃	-	262.7	-	ns
t_r	Rise Time, inductive load		-	254.4	-	ns
$t_{d(off)}$	Turn-Off Delay Time, Inductive Load		-	367.7	-	ns
t_f	Fall Time, Inductive Load		-	97.6	-	ns
E_{on}	Energy Dissipation During Turn-on Time		-	55.9	-	mJ
E_{off}	Energy Dissipation During Turn-off Time		-	41.9	-	mJ
$t_{d(on)}$	Turn-on Delay Time, Inductive Load	V_{DS} = 650V,I_{DS} = 600A,R_{Gon} = 12Ω, R_{Goff} = 8.2Ω,V_{GS} = -5V/+18V,L_S = 7uH, T_{vj} = 125℃	-	182.1	-	ns
t_r	Rise Time, inductive load		-	229.4	-	ns
$t_{d(off)}$	Turn-Off Delay Time, Inductive Load		-	443.8	-	ns
t_f	Fall Time, Inductive Load		-	96.6	-	ns
E_{on}	Energy Dissipation During Turn-on Time		-	50.4	-	mJ
E_{off}	Energy Dissipation During Turn-off Time		-	46.1	-	mJ
$t_{d(on)}$	Turn-on Delay Time, Inductive Load	V_{DS} = 650V,I_{DS} = 600A,R_{Gon} = 12Ω, R_{Goff} = 8.2Ω,V_{GS} = -5V/+18V,L_S = 7uH, T_{vj} = 175℃	-	150.4	-	ns
t_r	Rise Time, inductive load		-	215.1	-	ns
$t_{d(off)}$	Turn-Off Delay Time, Inductive Load		-	479.7	-	ns
t_f	Fall Time, Inductive Load		-	96.3	-	ns
E_{on}	Energy Dissipation During Turn-on Time		-	48.6	-	mJ
E_{off}	Energy Dissipation During Turn-off Time		-	46.8	-	mJ
$t_{d(on)}$	Turn-on Delay Time, Inductive Load	V_{DS} = 650V,I_{DS} = 1040A,R_{Gon} = 12Ω, R_{Goff} = 8.2Ω,V_{GS} = -5V/+18V,L_S = 7uH, T_{vj} = 25℃	-	256.6	-	ns
t_r	Rise Time, inductive load		-	363.5	-	ns
$t_{d(off)}$	Turn-Off Delay Time, Inductive Load		-	288.6	-	ns
t_f	Fall Time, Inductive Load		-	101.4	-	ns
E_{on}	Energy Dissipation During Turn-on Time		-	107.7	-	mJ
E_{off}	Energy Dissipation During Turn-off Time		-	85.3	-	mJ
$t_{d(on)}$	Turn-on Delay Time, Inductive Load	V_{DS} = 650V,I_{DS} = 1040A,R_{Gon} = 12Ω, R_{Goff} = 8.2Ω,V_{GS} = -5V/+18V,L_S = 7uH, T_{vj} = 125℃	-	175.4	-	ns
t_r	Rise Time, inductive load		-	325.8	-	ns
$t_{d(off)}$	Turn-Off Delay Time, Inductive Load		-	370.9	-	ns
t_f	Fall Time, Inductive Load		-	99.2	-	ns
E_{on}	Energy Dissipation During Turn-on Time		-	94.5	-	mJ
E_{off}	Energy Dissipation During Turn-off Time		-	90.5	-	mJ
$t_{d(on)}$	Turn-on Delay Time, Inductive Load	V_{DS} = 650V,I_{DS} = 1040A,R_{Gon} = 12Ω, R_{Goff} = 8.2Ω,V_{GS} = -5V/+18V,L_S = 7uH, T_{vj} = 175℃	-	149.8	-	ns
t_r	Rise Time, inductive load		-	296.1	-	ns
$t_{d(off)}$	Turn-Off Delay Time, Inductive Load		-	401.6	-	ns
t_f	Fall Time, Inductive Load		-	98.6	-	ns
E_{on}	Energy Dissipation During Turn-on Time		-	91.3	-	mJ
E_{off}	Energy Dissipation During Turn-off Time		-	92.9	-	mJ

BODY DIODE CHARACTERISTICS (T_{vj} = 25℃, Unless Otherwise Specified)

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
V_{SD}	Forward Voltage	I_{SD} = 1040A,T_{vj} = 25℃		-	4.99	5.87	V
		I_{SD} = 480A,T_{vj} = 25℃		1.81	3.81	5.81	V
I_{rrm}	Peak Reverse Recovery Current	V_{SD} = 650V,I_{SD} = 600A,R_{Gon} = 12Ω, R_{Goff} = 8.2Ω,V_{GS} = -5V/+18V, di/dt = 2610A/us	T_{vj} = 25℃	-	170.7	-	A
Q_{rr}	Recovered Charge		T_{vj} = 25℃	-	7.83	-	uC
t_{rr}	Reverse Recover Time		T_{vj} = 25℃	-	78.7	-	ns
E_{rr}	Reverse Recovery Energy		T_{vj} = 25℃	-	0.34	-	mJ
			T_{vj} = 125℃	-	0.93	-	mJ
			T_{vj} = 175℃	-	1.56	-	mJ
I_{rrm}	Peak Reverse Recovery Current	V_{SD} = 650V,I_{SD} = 1040A,R_{Gon} = 12Ω, R_{Goff} = 8.2Ω,V_{GS} = -5V/+18V, di/dt = 3520A/us	T_{vj} = 25℃	-	224.1	-	A
Q_{rr}	Recovered Charge		T_{vj} = 25℃	-	10.62	-	uC
t_{rr}	Reverse Recover Time		T_{vj} = 25℃		80.3		ns
E_{rr}	Reverse Recovery Energy		T_{vj} = 25℃		0.48		mJ
			T_{vj} = 125℃		1.36		mJ
			T_{vj} = 175℃		2.25		mJ

NTC SENSOR CHARACTERISTICS (T_{vj} = 25℃, Unless Otherwise Specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
R_{25}	Rated Resistance	Tc = 25℃	-	5	-	k Ω
Δ R/R	Deviation of R25	Tc = 25℃, R25 = 5 k Ω	-5	-	5	%
P_{25}	Power Dissipation	Tc = 25℃	-	-	20	mW
$B_{25/50}$	B−Value	R = R_{25} exp [$B_{25/50}$ (1/T−1/298)]	-	3375	-	K
$B_{25/80}$	B−Value	R = R_{25} exp [$B_{25/80}$ (1/T−1/298)]	-	3411	-	K
$B_{25/120}$	B−Value	R = R_{25} exp [$B_{25/120}$ (1/T−1/298)]	-	3433	-	K

THERMAL CHARACTERISTICS

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$R_{th(j-f)}$	Thermal Resistance Junction To Coolant	8L/min;50%乙二醇，50%水	-	0.073	-	K/W

TYPICAL CHARACTERISTIC

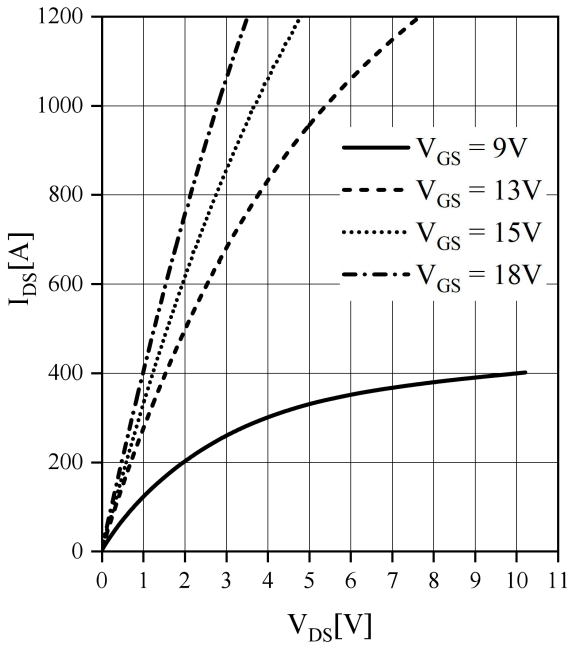


Fig.2 Output Characteristic MOSFET (typical)(T_{vj}=25℃)

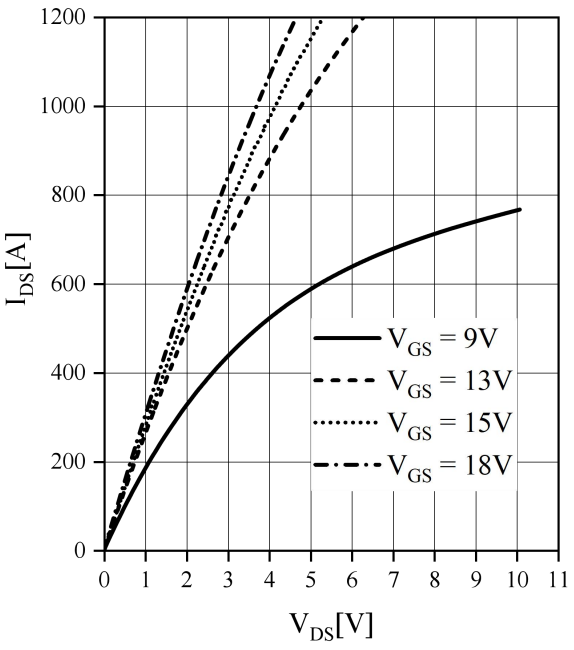


Fig.3 Output Characteristic MOSFET (typical)(T_{vj}=125℃)

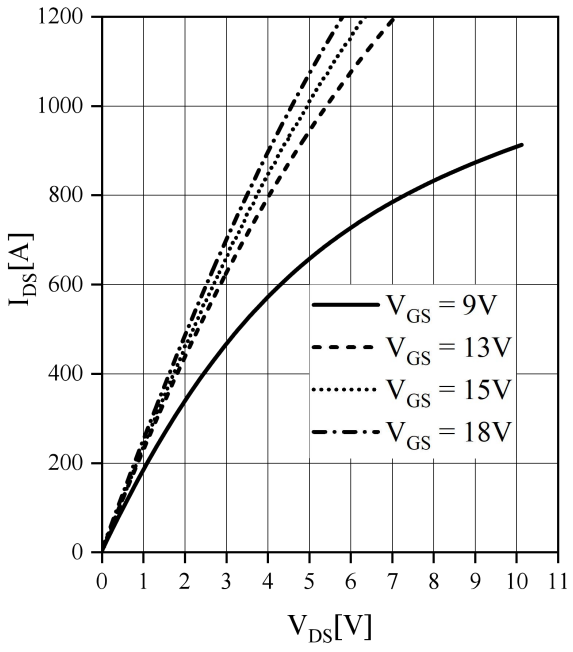


Fig.4 Output Characteristic MOSFET (typical)(T_{vj}=175℃)

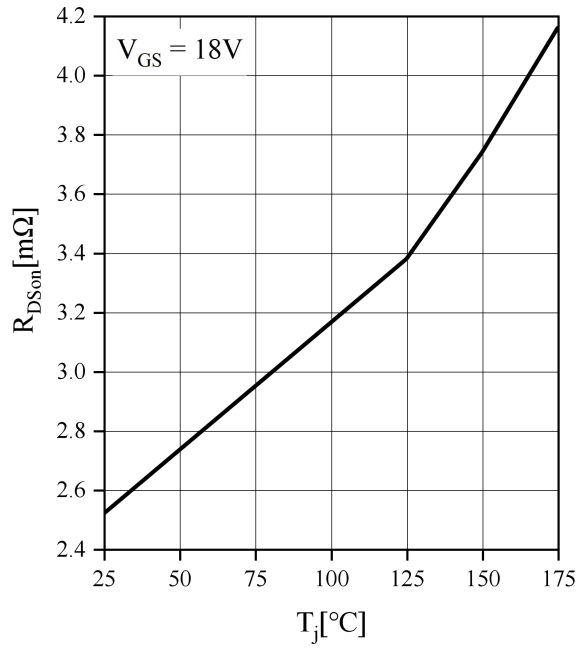


Fig.5 Drain-source On Resistance vs. Junction Temperature

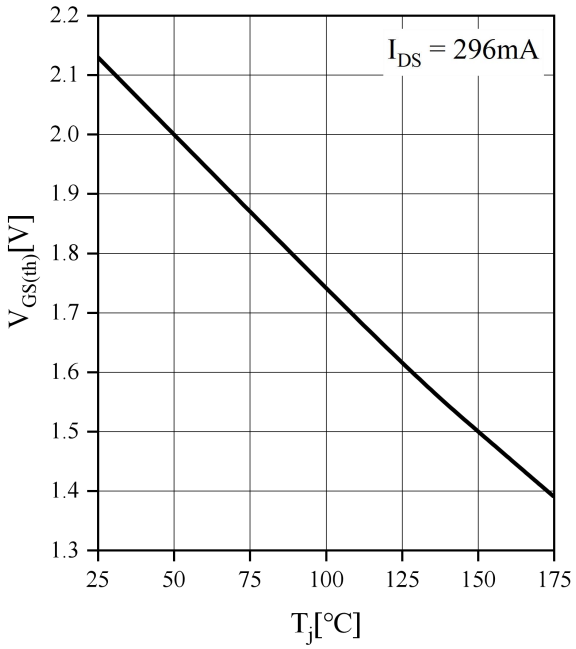


Fig.6 Gate Threshold Voltage vs. Junction Temperature

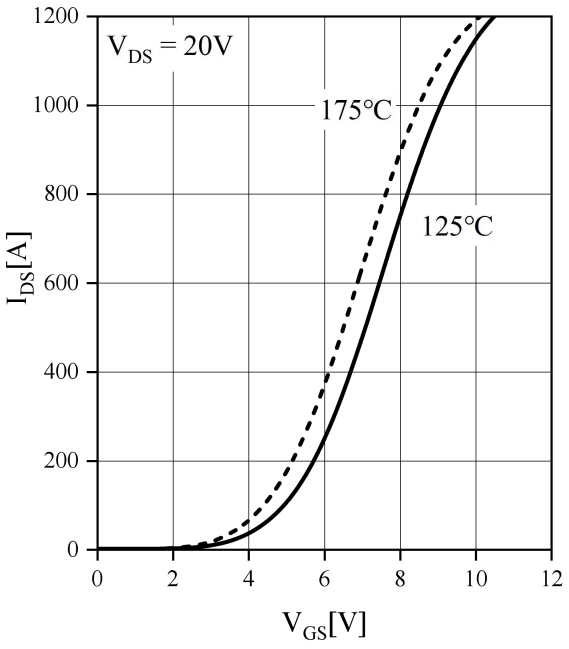


Fig.7 Typ. Transfer Characteristics

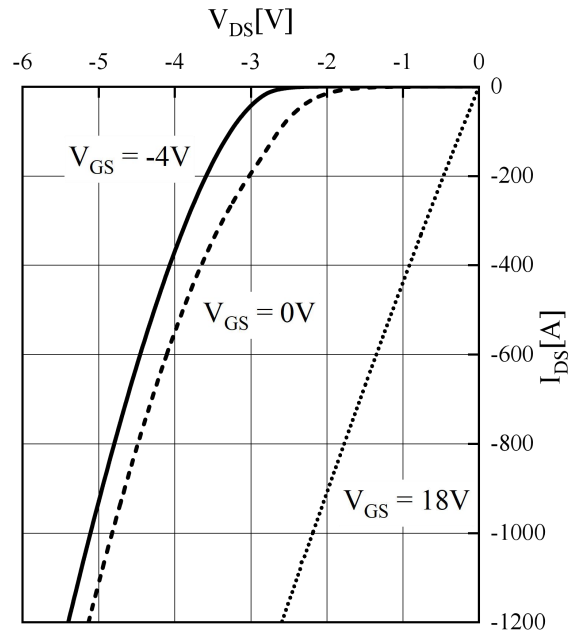


Fig.8 3rd Quadrant Characteristics(T_{vj}=25℃)

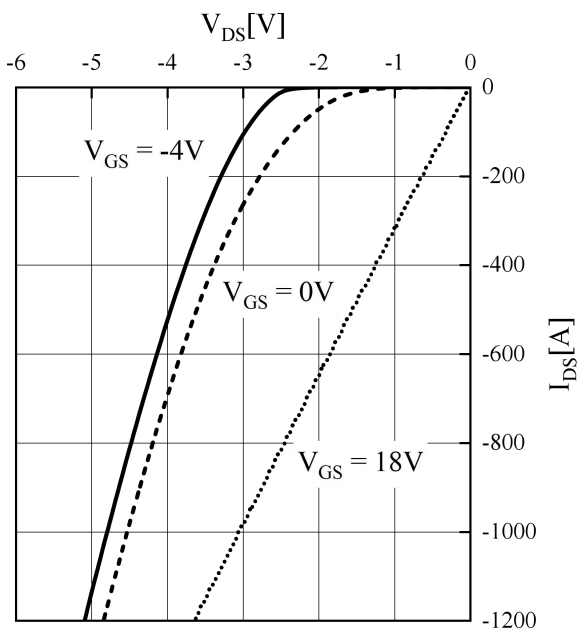


Fig.9 3rd Quadrant Characteristics(T_{vj}=125℃)

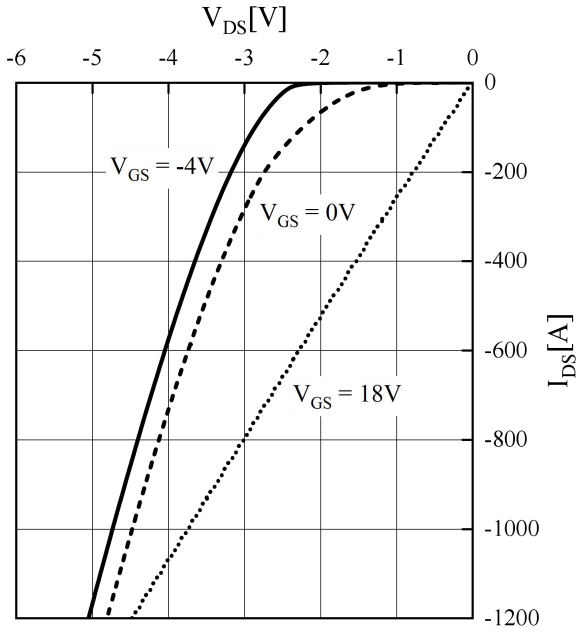


Fig.10 3rd Quadrant Characteristics(T_{vj}=175℃)

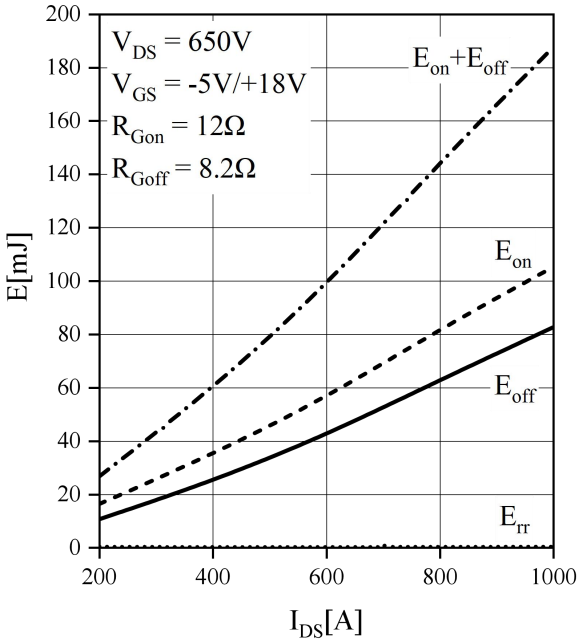


Fig.11: Switching Loss vs. Drain Current(T_{vj}=25℃)

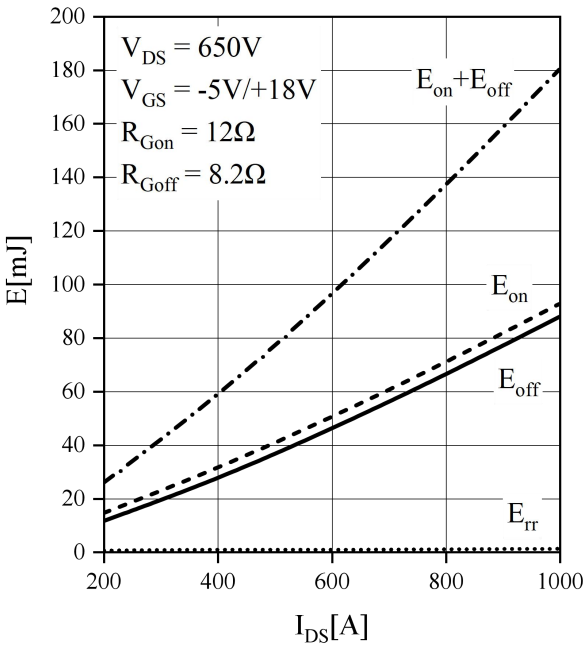


Fig.12 Switching Loss vs. Drain Current(T_{vj}=125℃)

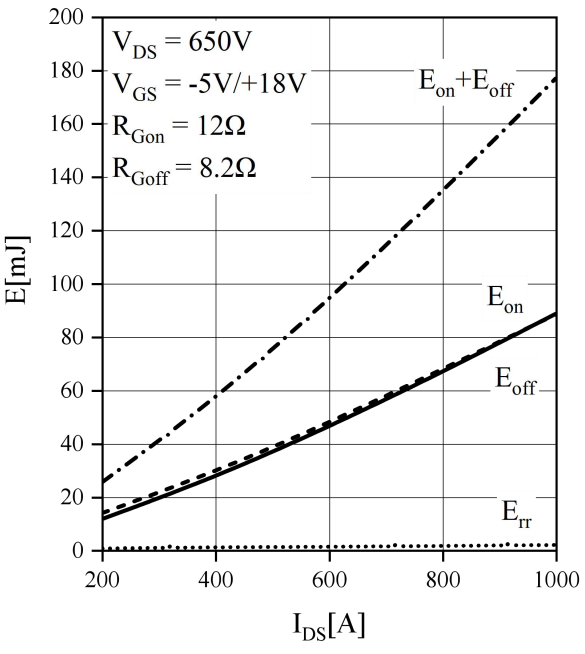


Fig.13 Switching Loss vs. Drain Current (T_{vj}=175℃)

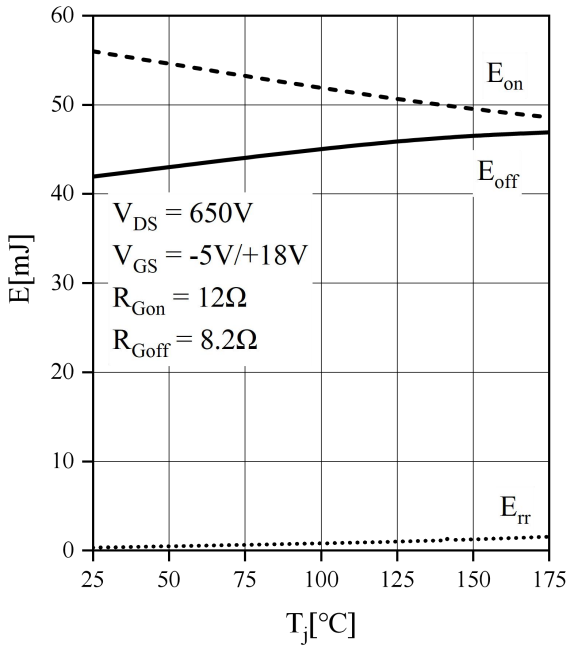


Fig.14 Switching Loss vs. Junction Temperature

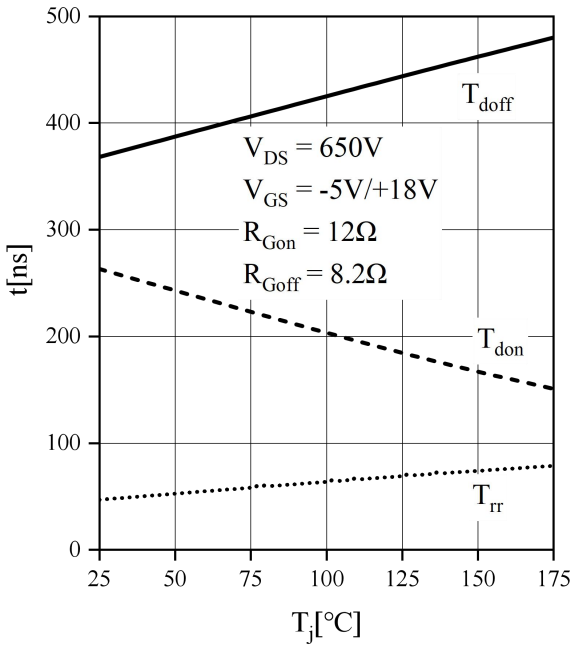


Fig.15 Switching Times vs. Junction Temperature

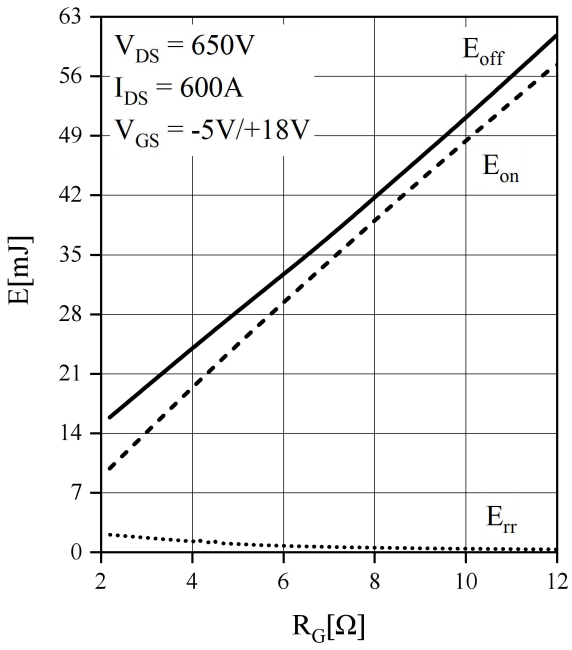


Fig.16 Switching Loss vs. Gate Resistor(T_{vj}=25℃)

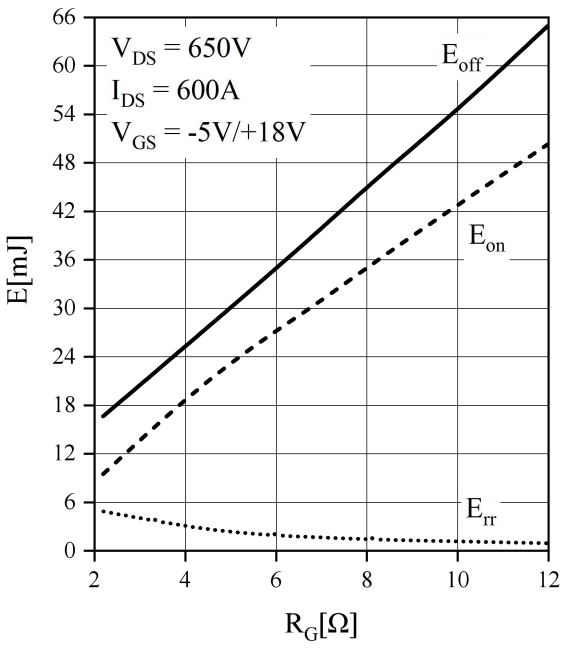


Fig.17 Switching Loss vs. Gate Resistor(T_{vj}=125℃)

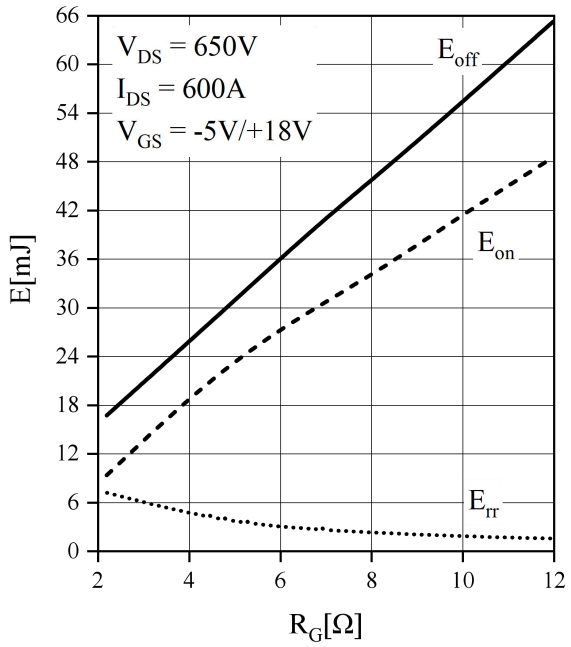


Fig.18 Switching Loss vs. Gate Resistor(T_{vj}=175℃)

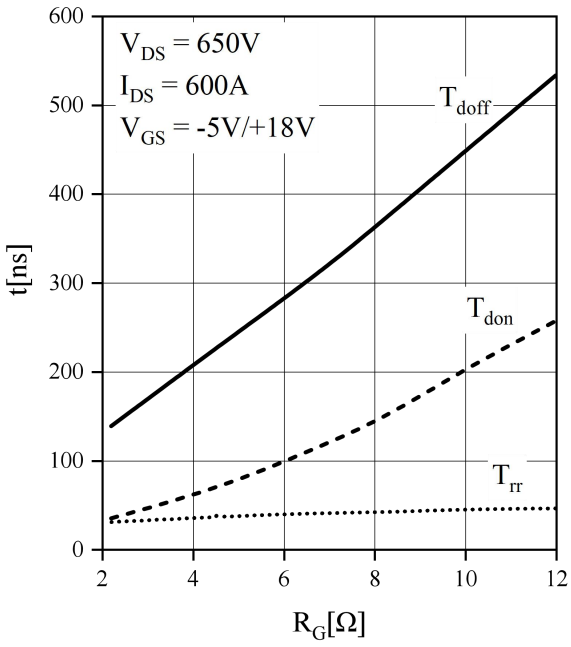


Fig.19 Switching Times vs. Gate Resistor (T_{vj}=25℃)

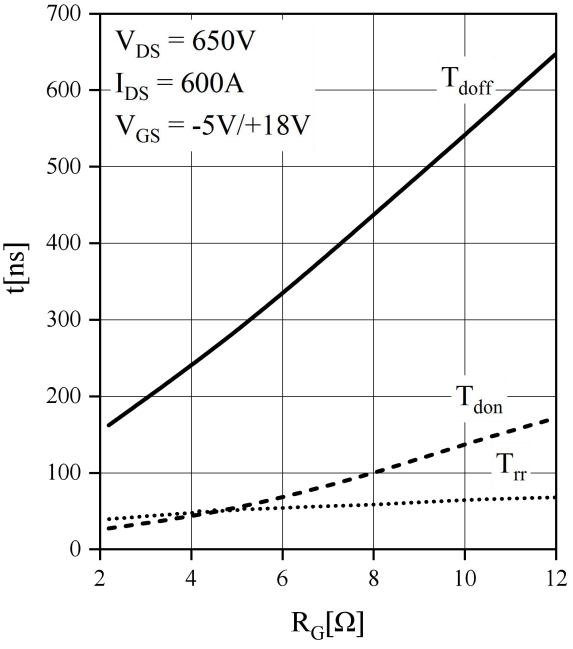


Fig.20 Switching Times vs. Gate Resistor(T_{vj}=125℃)

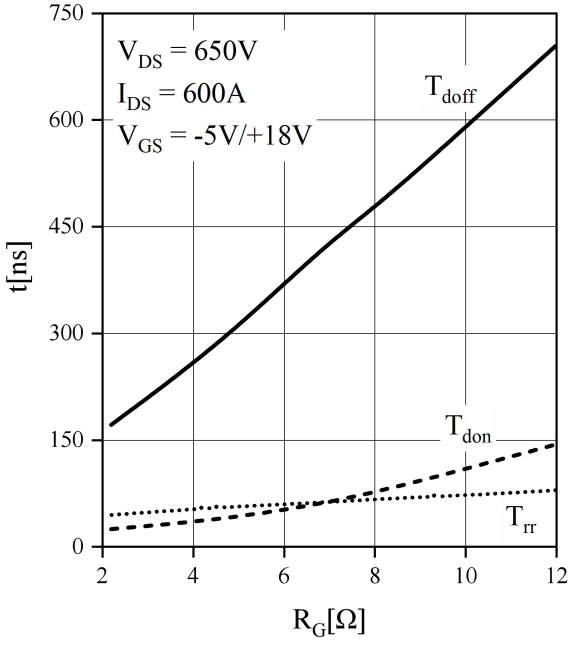


Fig.21 Switching Times vs. Gate Resistor(T_{vj}=175℃)

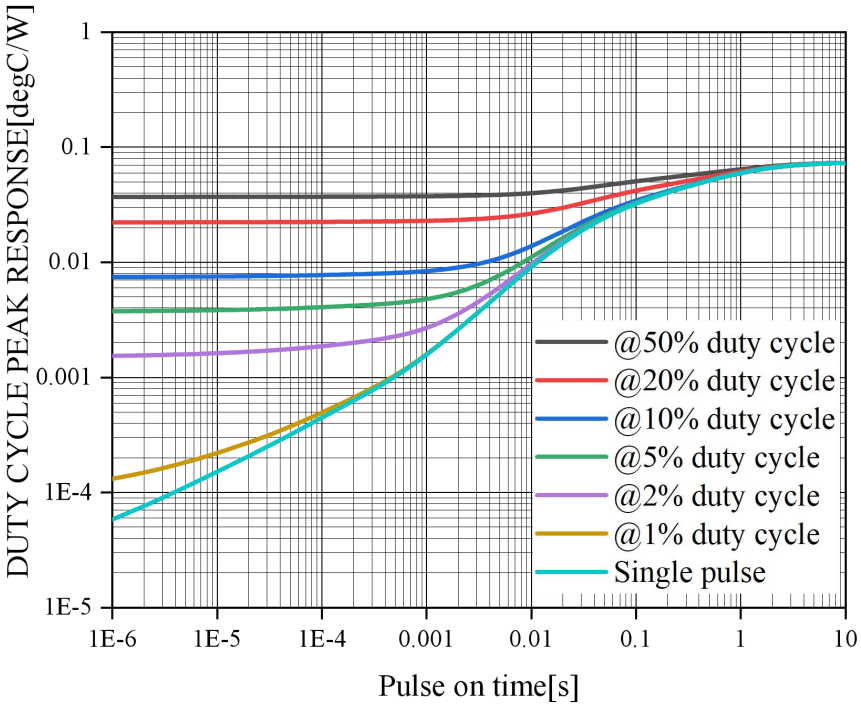


Fig.22 Typ.transient thermal impedance (MOSFET)

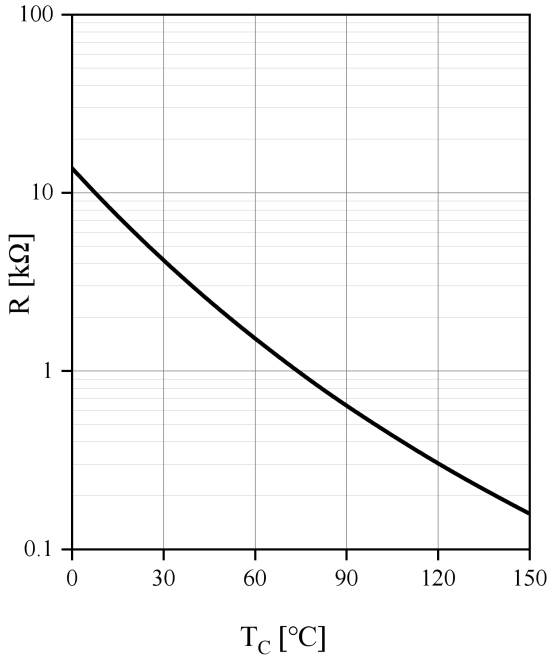


Figure 23. NTC Temperature Characteristic

Package Drawing

