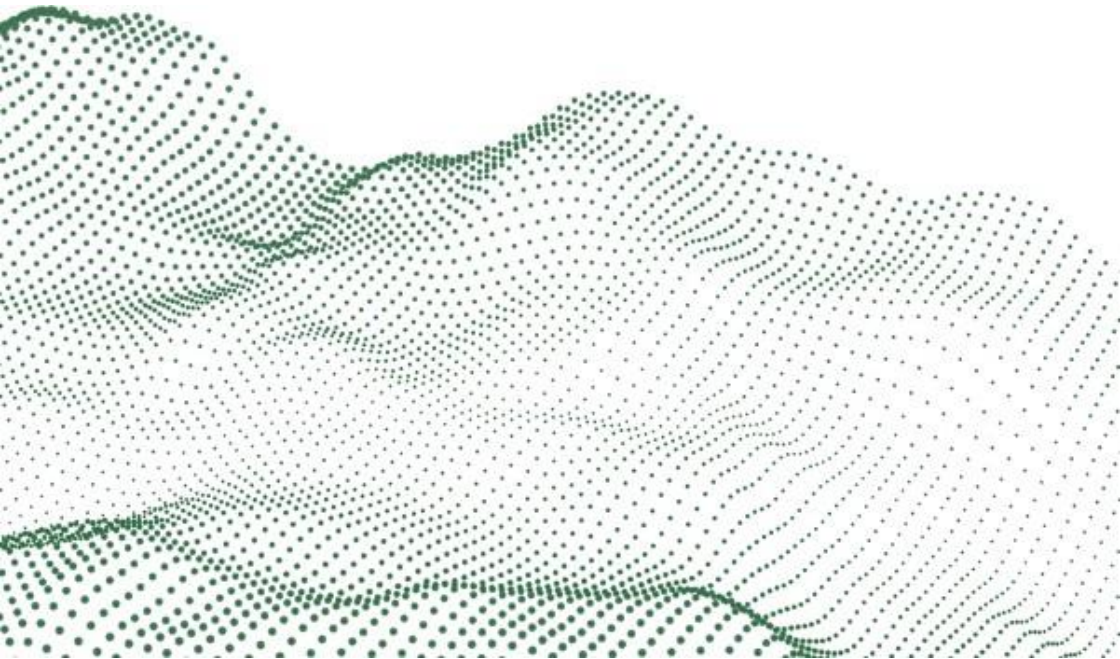
Brückewell

Products Introduction

-Oct 2024-



About us

Bruckewell Technology Co., LTD is a discrete semiconductor design company that have the able to offer KGD wafer-level products to provide silicon and wide bandgap (WBG) power semiconductor devices.

We pride ourselves in our expertise in all areas of power semiconductor technology and business operations, our technical team that from Vishay & Infineon contributes over 25 years expertise in power semiconductor.

Through innovation technical excellence and continuous improvement.

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SiC MOSFET

GaN

MOSFET

High Power Density

Cooling server and Fan application

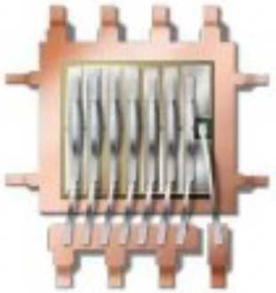
IPM DFN14X12

Isolated Dual-Channel Gate Driver

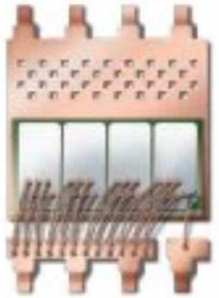
High Power Density MOSFET Sub-Assembly Structure

Brückewell

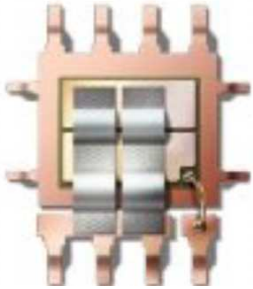
Ai Wire Bonding



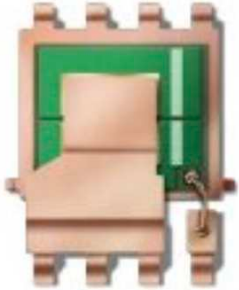
Cu Wire Bonding



Al Ribbon(S), Wire(G)

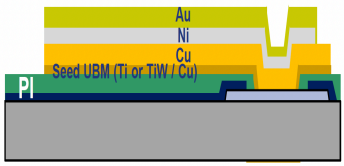


Cu Clip(S), Wire(G)



Cu Clip with Au Bump(S), Wire(G)

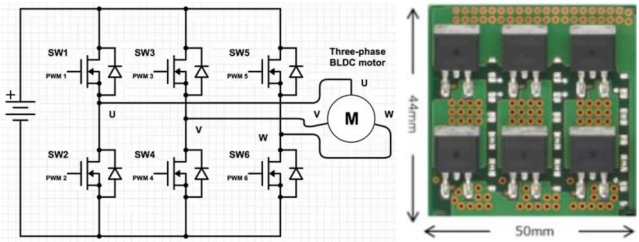
Wafer top metal structure, Au Bump



DFN14X12 for the three-phase BLDC motor application

Three-phase BLDC motor is typically powered by three pairs of MOSFETs arranged in a bridge structure and controlled by PWM. PWM offers precise control over the motor's speed and torque. The 40V MOSFETs inverter power module is available, will extend to 60~100V MOSFETs, and SiC MOS for the high frequency applications.

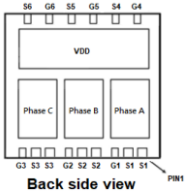
The major space of PCB is from the six MOSFET.



Bruckewell Proposal

The MSIE40N150-6/MSIE40N90-6 used the six MOS in one package to **save 90% area**, improve the EMI and high reliability.

14mmX12mm



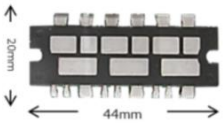
Back side view

This innovative power module is suitable for 12V motor control, electric assisted steering, etc., and can enhance the operation of three-phase BLDC motor.

Competitors

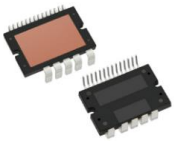
MG031E120004A

save 60% area



NXV04V120DB1

save 40% area



44mmX29mm

Niche low-cost low-voltage MOS solution with 12" wafer:

-30V P-Ch as an example

The semiconductor industry is evolving rapidly to meet the demand for high efficiency and cost-effectiveness. With the shift to twelve-inch wafer technology, manufacturers are finding new ways to offer value to customers. In China, the transition to twelve-inch wafers for discrete semiconductor components, especially MOSFETs, is gaining momentum.

Capitalizing on this trend, our company has developed a 30V P-Channel MOSFET that outperforms competitors in terms of specifications and cost-efficiency. While traditionally the 3407 series MOSFET was priced higher than the 3409 series, advancements in twelve-inch wafer technology have allowed us to offer superior specifications at lower cost.

As can be seen from the below comparison table, our MS34P07 price is **40% lower** than other brands 3407 series, it is also 20-30% lower than the 3409 series.

	Bruckewell	PANJIT	AOSMD	Diodes	PANJIT	AOSMD	Diodes
MFG.	MS34P07	PJA3407E	AO3407	DMG3407SSN	PJA3409E	AO3409	DMP3165L
ID	4.1A	4A	4.1A	4A	3A	2.6A	3.3A
VDS	-30V	-30V	-30V	-30V	-30V	-30V	-30V
RDS(on)	50~75mohm	53~80mohm	52~87mohm	50~72mohm	95~115mohm	110~180mohm	90~134mohm
Price(USD)	0.6X	X	X	X	0.8X	0.7X	0.8X
	Better Performance						
	Best Price						
No matter you need 2A~4A with the standard RDS(on) or ultra low RDS(on), MS34P07 offer the better RDS(on) with best Price							

Remark: X is the example price base.

40V N-Ch, DFN5X6 MOSFET Selection Guide

Due to the increasing demand for small-sized but high-power density products, Bruckewell has developed a series of Silicon high-power density 40V MOSFETs in DFN5x6 packaging. In addition to chip design, specifications are enhanced through different packaging and wire bonding technologies.

Application: electric vehicles, machine tools and brushless motors, etc.

RDS(on)MAX@VGS=4.5V					
RDS(on)/Amp	**21A~30A**	**50A~55A**	**70A~75A**	**90A~160A**	**180A~250A**
15-18mΩ	40N095D				
12-15mΩ		40N085 40N085AU			
9-12mΩ	40N30D 40N30DAU	40N065D 40N065DAU	40N70D 40N70DAU		
7-9mΩ			40N065 40N065AU		
5-7mΩ				40N032 40N032AU	
1-3mΩ				40N020 40N020AU	40N01 40N02
RDS(on)MAX@VGS=10V					
RDS(on)/Amp	**21A~30A**	**50A~55A**	**70A~75A**	**90A~160A**	**180A~250A**
8-10mΩ	40N095D 40N30D 40N30DAU	40N085 40N085AU			
6-8mΩ		40N065D 40N065DAU	40N70D 40N70DAU 40N065 40N065AU		
2-4mΩ				40N032 40N032AU	
1-2mΩ				40N020 40N020AU	40N01 40N02

Isolated Dual-Channel Gate Driver-IGD8233 series

P2P compatibility with Skyworks SI8233 and Novosense NSI6602 makes the IGD8233 Series a top choice for replacing scarce materials, especially amidst the surge of cutting-edge technologies in power supplies, motors, and air conditioning drivers.

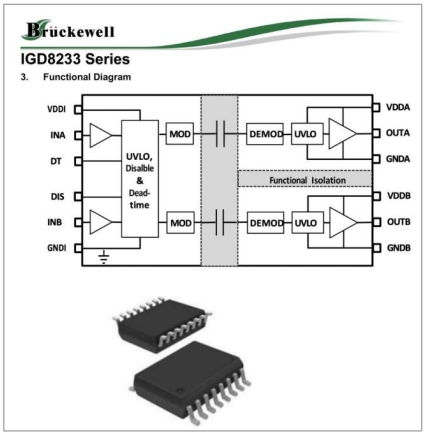
Designed to optimize Bruckewell MOSFETs and IGBTs

Industrial Applications:

- Power Delivery Systems
- Motor Control Systems
- Isolated DC-DC Power Supplies
- Lighting Control Systems
- Plasma Displays
- Solar and Industrial Inverters

Automotive Applications:

- On-board Chargers
- Battery Management Systems
- Charging Stations
- Traction Inverters
- Hybrid Electric Vehicles
- Battery Electric Vehicles



Part Number	Peak Current	UVLO	DT	DIS	Package
IGD8233AW	+4.0A/-6.0A	6.5V/6.85V	Y	Y	SOW16
IGD 8233BW	+4.0A/-6.0A	8.5V/8.0V	Y	Y	SOW16
IGD 8233CW	+4.0A/-6.0A	13.2V/12.2V	Y	Y	SOW16
IGD 8233AS	+4.0A/-6.0A	6.5V/6.85V	Y	Y	SOP16
IGD 8233BS	+4.0A/-6.0A	8.5V/8.0V	Y	Y	SOP16
IGD 8233CS	+4.0A/-6.0A	13.2V/12.2V	Y	Y	SOP16

With me,
Power for you.

1
IGBT

Our IGBT can replace the C6 Cool MOS
Better RDS(on) than the C3~C5
Low Cost than the C6 SJ MOS

All products are available in industrial grade and automotive grade.

GTD05N060

600-V Field Stop IGBT copacked with fast and soft antiparallel diode

Features

- High efficiency in hard switching and resonant topologies
- Easy paralleling capability due to positive temperature coefficient in VCE(on)
- Pb-free lead plating
- RoHS compliant

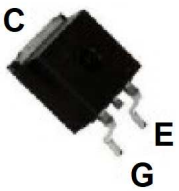
Benefits

- Low EMI
- Low Gate Charge QG
- Very soft, fast recovery full current anti-parallel diode
- Higher Switching Frequency up to 150kHz

Typical Applications

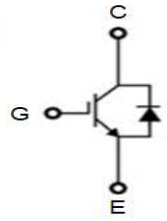
- Industrial UPS
- Charger
- Energy Storage
- Three-level Solar String Inverter
- Welding
- Inductive cooking
- Inverterized microwave ovens
- Resonant converters
- Soft switching applications

Package Type : TO-252



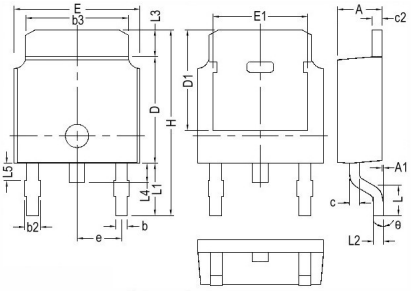
RoHS Compliant

Graphic Symbol



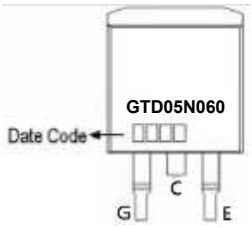
V_{CE}(on) typ. = 1.7V &
R_{CE}(on) typ. = 340mΩ
@ V_{GE} = 15V, Ic = 5A
Equivalent MOSFET Parameters
R_{DS}(on) typ. = 340mΩ
@ V_{GS} = 15V, I_D = 5A

Package Dimension



REF.	Millimeter			REF.	Millimeter		
	Min.	Nom.	Max.		Min.	Nom.	Max.
A	2.20	2.30	2.38	E1	4.40	-	-
A1	0	-	0.127	e	2.286 BSC		
b	0.64	0.76	0.88	H	9.40	10.00	10.40
b2	0.77	0.84	1.14	L	1.40	1.52	1.77
b3	5.21	5.34	5.46	L1	2.743 Ref.		
c	0.45	0.50	0.60	L2	0.508 BSC		
c2	0.45	0.50	0.58	L3	0.89	-	1.27
D	6.00	6.10	6.223	L4	0.64	-	1.01
D1	5.21	-	-	L5	-	-	-
E	6.40	6.60	6.731	θ	0°	-	10°

Marking



GTD05N060

600-V Field Stop IGBT copacked with fast and soft antiparallel diode

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings			
Symbol	**Parameter**	**Value**	**Units**
V_{CE}	Collector-Emitter Voltage, Tvj ≥25°C	600	V
I_C	DC Collector current, Tc = 25°C	10	A
	DC Collector current, Tc = 100°C	5	
$I_{C\ pulse}$	Pulsed collector current, tp ≤ 1ms	20	A
I_F	Diode forward current, Tc = 25°C	10	A
	Diode forward current, Tc = 100°C	5	
$I_{F\ pulse}$	Diode pulsed current, tp ≤ 1ms	20	A
V_{GE}	Gate-Emitter voltage Transient Gate-Emitter voltage (tp ≤10µs, D < 0.010)	±20	V
P_{tot}	Power Dissipation (T_C =25°C)	60	W
T_{VJ}	Operating Junction Temperature	-55…175	°C
T_{STG}	Storage Temperature	-55…175	°C

Thermal Resistance Ratings			
Symbol	**Parameter**	**Maximum**	**Units**
$R_{\theta JA}$	Maximum Junction-to-Ambient	62.5	°C/W
$R_{\theta JC}$	IGBT Maximum Junction-to-Case	2.1	°C/W
$R_{\theta JC}$	Diode Maximum Junction-to-Case	4	°C/W

GTD05N060

600-V Field Stop IGBT copacked with fast and soft antiparallel diode

Static Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GE\ (th)}$	Gate-emitter threshold voltage	V_{CE} =V_{GE}, I_C =250μA	4.5	5.5	6.5	V
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE} =0V, I_C =1mA	600	-	-	V
$V_{CE(on)}$	Collector-Emitter saturation voltage	V_{GE} =15V, I_C =5A Tvj=25°C	1.2	1.7	2.1	V
		V_{GE} =15V, I_C =5A Tvj=150°C	-	1.8	-	
$R_{CE(on)}$	Collector-Emitter saturation resistor	V_{GE} =15V, I_C =5A Tvj=25°C	-	340	-	mΩ
V_F	Diode Forward Voltage	V_{GE} =0V, I_F =5A Tvj=25°C	-	1.7	-	V
		V_{GE} =0V, I_F =5A Tvj= 125°C	-	1.5	-	
I_{GES}	Gate-Emitter leakage current	V_{CE} =0V, V_{GE} =±20V	-	-	±200	nA
I_{CES}	Zero gate voltage collector current	V_{CE} =600V, V_{GE} =0V	-	-	10	uA

IGBT AC Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
C_{IES}	Input Capacitance	V_{CE}=25 V, V_{GE}=0 V, f=1MHz	-	289	-	pF
C_{OES}	Output Capacitance		-	33	-	
C_{RES}	Reverse Transfer Capacitance		-	7.5	-	
Q_g	Total Gate Charge	V_{CC}=400 V_{GE}=15V, I_C =5A	-	12	-	nC
$t_{d(on)}$	Turn-On Delay Time	V_{CE}=400 V, V_{GE}=15V, I_C =5A R_{Gon} = 62Ω	-	22	-	ns
t_r	Rise Time		-	13	-	
$t_{d(off)}$	Turn-Off Delay Time		-	91	-	
t_f	Fall Time		-	25	-	
E_{on}	Turn-On Switching Energy		-	123	-	uJ
E_{off}	Turn-Off Switching Energy		-	53	-	

Diode AC Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
I_{rrm}	Diode peak reverse recovery current	V_{CE}=400 V, V_{GE}=0V, I_F = 5 A, dIEC/dt=200A/μs	-	2.7	-	A
Q_{rr}	Diode reverse recovery Charge		-	145	-	nC
t_{rr}	Diode reverse recovery time		-	35	-	ns

GTD05N060

600-V Field Stop IGBT copacked with fast and soft antiparallel diode

- **Typical Electrical Characteristics**

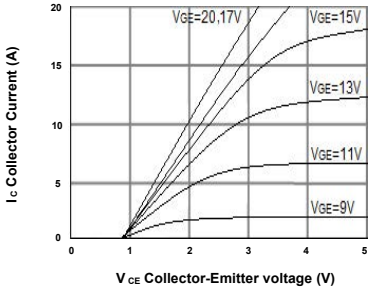


FIG.1-Output Characteristics Tvj = 25°C

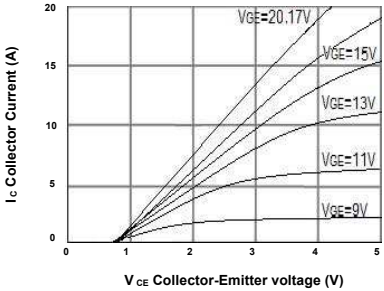


FIG.2- Output Characteristics Tvj = 150°C

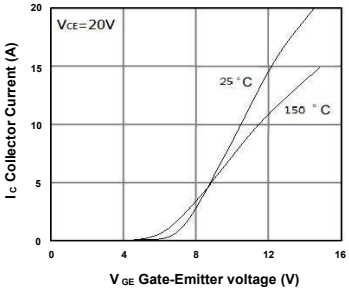


FIG.3- Transfer Characteristics

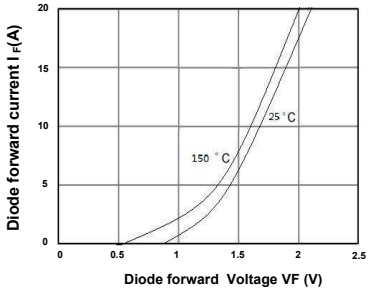


FIG.4- Diode forward Characteristics

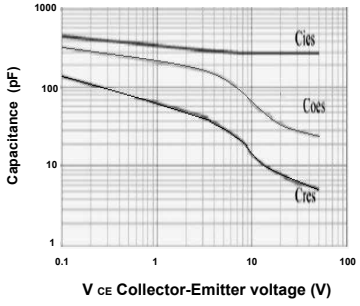


FIG.5- Capacitance

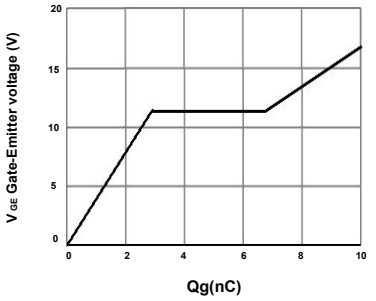


Fig.6- Gate-Charge Characteristics

GTD05N060

650-V Field Stop IGBT copacked with fast and soft antiparallel diode

- **Typical Electrical Characteristics**

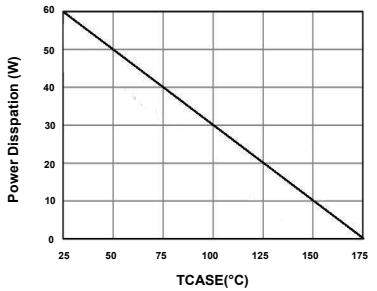


FIG.7- Power Disspation as a Function of Case

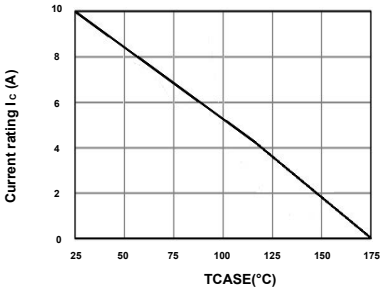


FIG.8- Current De-rating

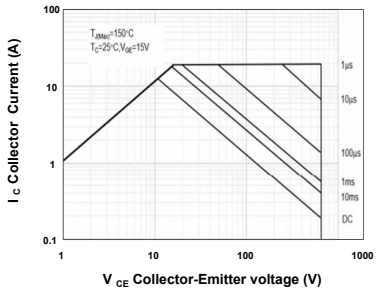


FIG.9- Safe Operation Area

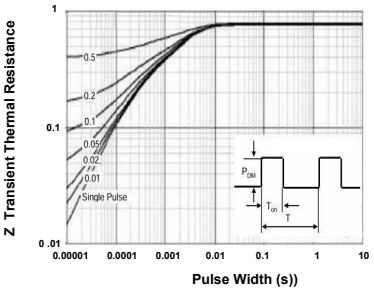


FIG.10- Transient Thermal Impedance for IGBT

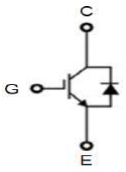
GTF20N065

650-V Field Stop IGBT copacked with fast and soft antiparallel diode

Features

- High efficiency in hard switching and resonant topologies
- Easy paralleling capability due to positive temperature coefficient in VCE(on)
- Pb-free lead plating
- RoHS compliant

Graphic Symbol



V_{CE}(on) typ. = 1.6V &
R_{CE}(on) typ. = 80mΩ
@ V_{GE} = 15V, I_C = 20A
Equivalent MOSFET Parameters
R_{DS}(on) typ. = 80mΩ
@ V_{GS} = 15V, I_D = 20A

Benefits

- Low EMI
- Low Gate Charge QG
- Very soft, fast recovery full current anti-parallel diode
- Higher Switching Frequency up to 150kHz

Typical Applications

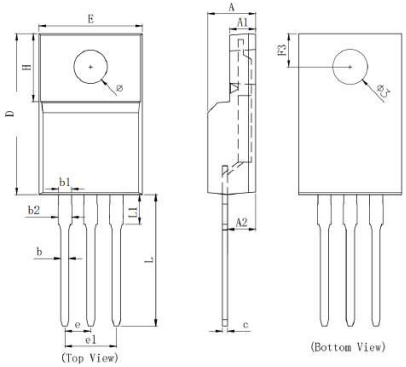
- Industrial UPS
- Charger
- Energy Storage
- Three-level Solar String Inverter
- Welding
- Inductive cooking
- Inverterized microwave ovens
- Resonant converters
- Soft switching applications

Package type : TO-220F

Packing & Order Information

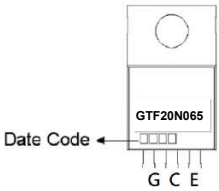
2,000/Box

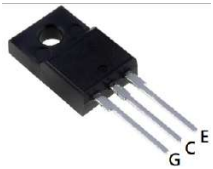
Package Dimension



SYMBOL	MILLIMETER			SYMBOL	MILLIMETER		
	MIN	Typ.	MAX		MIN	Typ.	MAX
A	4.500	4.700	4.900	E	9.960	10.160	10.360
A1	2.340	2.540	2.740	e	2.540 BSC		
A2	2.560	2.760	2.960	e1	5.080 BSC		
b	0.700	0.800	0.950	L	12.680	12.980	13.280
b1	1.180	1.280	1.430	L1	2.780	2.930	3.080
b2	1.250	1.350	1.550	F3	3.150	3.300	3.450
c	0.400	0.500	0.650	Φ	3.030	3.180	3.430
D	15.570	15.870	16.170	Φ3	3.150	3.460	3.650
H	6.700 REF						

Marking





RoHS Compliant

GTF20N065

650-V Field Stop IGBT copacked with fast and soft antiparallel diode

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings			
Symbol	**Parameter**	**Value**	**Units**
V_{CE}	Collector-Emitter Voltage, Tvj ≥25°C	650	V
I_C	DC Collector current, Tc = 25°C	40	A
	DC Collector current, Tc = 100°C	20	
$I_{C\ pulse}$	Pulsed collector current, tp ≤ 1ms	80	A
I_F	Diode forward current, Tc = 25°C	20	A
	Diode forward current, Tc = 100°C	10	
$I_{F\ pulse}$	Diode pulsed current, tp ≤ 1ms	50	A
V_{GE}	Gate-Emitter voltage Transient Gate-Emitter voltage (tp ≤10μs, D < 0.010)	±20	V
P_{tot}	Power Dissipation (T_C =25°C)	40	W
T_{VJ}	Operating Junction Temperature	-55…150	°C
T_{STG}	Storage Temperature	-55…150	°C

Thermal Resistance Ratings			
Symbol	**Parameter**	**Maximum**	**Units**
$R_{\theta JA}$	Maximum Junction-to-Ambient	65	°C/W
$R_{\theta JC}$	IGBT Maximum Junction-to-Case	3.3	°C/W
$R_{\theta JC}$	FRD Maximum Junction-to-Case	6.7	°C/W

GTF20N065

650-V Field Stop IGBT copacked with fast and soft antiparallel diode

Static Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
$V_{GE\ (th)}$	Gate-emitter threshold voltage	V_{CE} =V_{GE}, I_C =1mA	5.0	5.8	6.5	V
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE} =0V, I_C =500uA	650	-	-	V
$V_{CE(on)}$	Collector-Emitter saturation voltage	V_{GE} =15V, I_C =20A Tvj=25°C	-	1.6	2.0	V
		V_{GE} =15V, I_C =20A Tvj=150°C	-	1.75	-	
$R_{CE(on)}$	Collector-Emitter saturation resistor	V_{GE} =15V, I_C =20A Tvj=25°C	-	75	-	mΩ
V_F	Diode Forward Voltage	V_{GE} =0V, I_F =20A Tvj=25°C	-	1.5	1.7	V
		V_{GE} =0V, I_F =20A Tvj= 125°C	-	1.4	-	
I_{GES}	Gate-Emitter leakage current	V_{CE} =0V, V_{GE} =±20V	-	-	±200	nA
I_{CES}	Zero gate voltage collector current	V_{CE} =650V, V_{GE} =0V Tvj=25°C	-	-	10	uA

IGBT AC Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
C_{IES}	Input Capacitance	V_{CE}=25 V, V_{GE}=0 V, f=1MHz	-	1500	-	pF
C_{OES}	Output Capacitance		-	128	-	
C_{RES}	Reverse Transfer Capacitance		-	28.7	-	
Q_g	Total Gate Charge	V_{CC}=400 V_{GE}=15V, I_C =20A	-	43.9	-	nC
$t_{d(on)}$	Turn-On Delay Time	V_{CE}=400 V, V_{GE}=15V, I_C =20A R_{Gon} = 10Ω	-	16	-	ns
t_r	Rise Time		-	56	-	
$t_{d(off)}$	Turn-Off Delay Time		-	52	-	
t_f	Fall Time		-	82	-	
E_{on}	Turn-On Switching Energy		-	0.79	-	mJ
E_{off}	Turn-Off Switching Energy		-	0.3	-	

Diode AC Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
I_{rrm}	Diode peak reverse recovery current	V_{CE}=400 V, V_{GE}=0V, I_F = 20A, dIEC/dt=100A/μs	-	2.7	-	A
Q_{rr}	Diode reverse recovery Charge		-	347	-	nC
t_{rr}	Diode reverse recovery time		-	254	-	ns

GTF20N065

650-V Field Stop IGBT copacked with fast and soft antiparallel diode

- **Typical Electrical Characteristics**

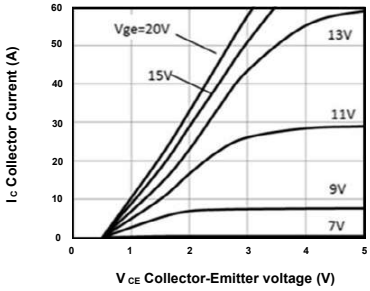


FIG.1-Output Characteristics Tvj = 25°C

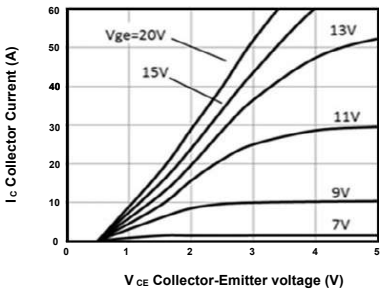


FIG.2- Output Characteristics Tvj = 175°C

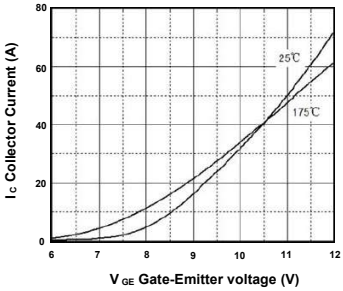


FIG.3- Transfer Characteristics

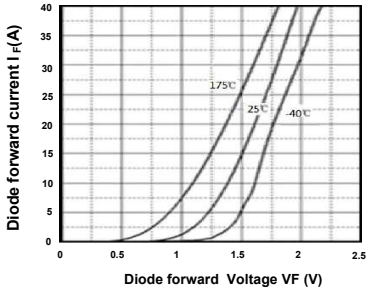


FIG.4- Diode forward Characteristics

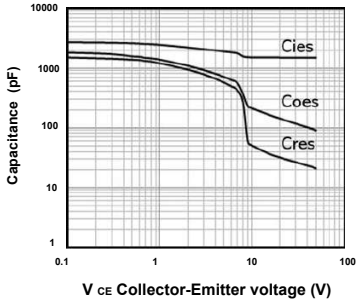


FIG.5- Capacitance

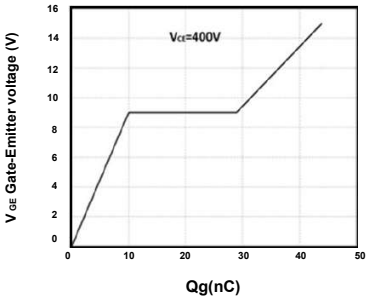


Fig.6- Gate-Charge Characteristics

GTF20N065

650-V Field Stop IGBT copacked with fast and soft antiparallel diode

- **Typical Electrical Characteristics**

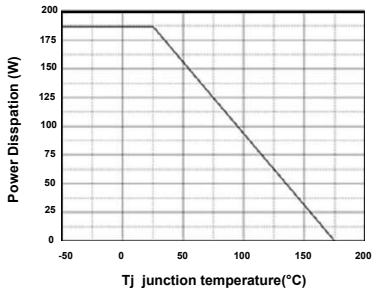


FIG.7- Power Disspation vs Junction Temperature

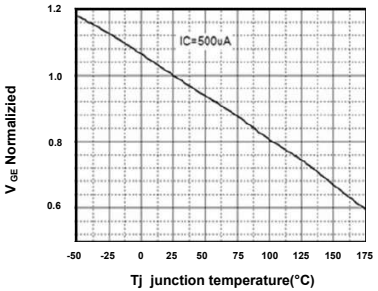


FIG.8- V_{GE} Normalized vs Junction temperature

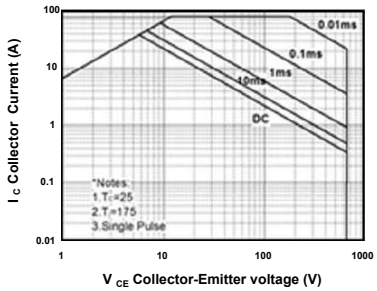


FIG.9- Safe Operation Area

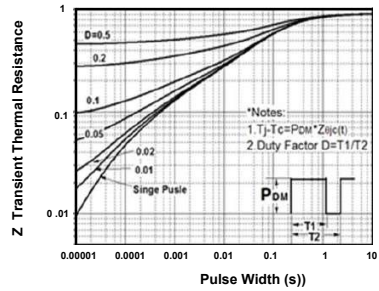


FIG.10- Transient Thermal Impedance for IGBT

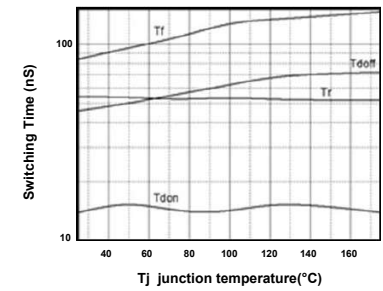


FIG.11- Switching Time vs Junction Temperature

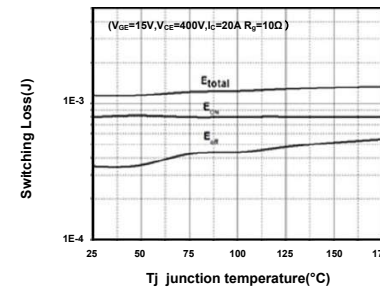


FIG.12- Switching Loss vs Junction Temperature

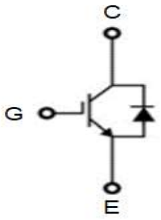
GTP20N065

650-V Field Stop IGBT copacked with fast and soft antiparallel diode

Features

- High efficiency in hard switching and resonant topologies
- Easy paralleling capability due to positive temperature coefficient in VCE(on)
- Pb-free lead plating
- RoHS compliant

Graphic Symbol



V_{CE}(on) typ. = 1.6V &
R_{CE}(on) typ. = 80mΩ
@ V_{GE} = 15V, I_C = 20A
Equivalent MOSFET Parameters
R_{DS}(on) typ. = 80mΩ
@ V_{GS} = 15V, I_D = 20A

Benefits

- Low EMI
- Low Gate Charge QG
- Very soft, fast recovery full current anti-parallel diode
- Higher Switching Frequency up to 150kHz

Typical Applications

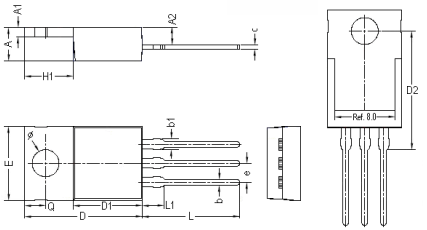
- Industrial UPS
- Charger
- Energy Storage
- Three-level Solar String Inverter
- Welding
- Inductive cooking
- Inverterized microwave ovens
- Resonant converters
- Soft switching applications

Package type：TO-220

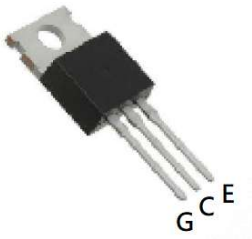
Packing & Order Information

2,000/Box

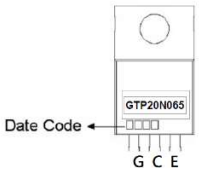
Package Dimension



REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	4.30	4.70	D2	15.70	17.00
A1	1.20	1.40	E	9.70	10.36
A2	2.30	2.79	e	2.54 BSC	
b	0.70	0.90	H1	6.10	6.70
b1	1.20	1.75	L	12.80	13.90
c	0.34	0.60	L1	-	4.00
D	14.70	16.10	Q	2.60	3.00
D1	8.60	9.30	Ø	3.55	3.95



Marking



RoHS Compliant

GTP20N065

650-V Field Stop IGBT copacked with fast and soft antiparallel diode

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings			
Symbol	**Parameter**	**Value**	**Units**
V_{CE}	Collector-Emitter Voltage, Tvj ≥25°C	650	V
I_C	DC Collector current, Tc = 25°C	40	A
	DC Collector current, Tc = 100°C	20	
$I_{C\ pulse}$	Pulsed collector current, tp ≤ 1ms	80	A
I_F	Diode forward current, Tc = 25°C	40	A
	Diode forward current, Tc = 100°C	20	
$I_{F\ pulse}$	Diode pulsed current, tp ≤ 1ms	80	A
V_{GE}	Gate-Emitter voltage Transient Gate-Emitter voltage (tp ≤10μs, D < 0.010)	±20	V
P_{tot}	Power Dissipation (T_C =25°C)	187	W
T_{VJ}	Operating Junction Temperature	-55…175	°C
T_{STG}	Storage Temperature	-55…175	°C

Thermal Resistance Ratings			
Symbol	**Parameter**	**Maximum**	**Units**
$R_{\theta JA}$	Maximum Junction-to-Ambient	62.5	°C/W
$R_{\theta JC}$	IGBT Maximum Junction-to-Case	0.8	°C/W
$R_{\theta JC}$	FRD Maximum Junction-to-Case	2.1	°C/W

GTP20N065

650-V Field Stop IGBT copacked with fast and soft antiparallel diode

Static Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
$V_{GE\ (th)}$	Gate-emitter threshold voltage	V_{CE} =V_{GE}, I_C =250μA	5.5	6.0	6.5	V
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE} =0V, I_C =500uA	650	-	-	V
$V_{CE(on)}$	Collector-Emitter saturation voltage	V_{GE} =15V, I_C =20A, Tvj=25°C	-	1.6	2.0	V
		V_{GE} =15V, I_C =20A, Tvj=150°C	-	1.75	2.2	
$R_{CE(on)}$	Collector-Emitter saturation resistor	V_{GE} =15V, I_C =20A, Tvj=25°C	-	80	-	mΩ
V_F	Diode Forward Voltage	V_{GE} =0V, I_F =20A, Tvj=25°C	-	1.6	2.0	V
		V_{GE} =0V, I_F =20A, Tvj=125°C	-	1.4	-	
I_{GES}	Gate-Emitter leakage current	V_{CE} =0V, V_{GE} =±20V	-	-	±200	nA
I_{CES}	Zero gate voltage collector current	V_{CE} =650V, V_{GE} =0V Tvj=25°C	-	-	10	uA

IGBT AC Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
C_{IES}	Input Capacitance	V_{CE}=25 V, V_{GE}=0 V, f=1MHz	-	1500	-	pF
C_{OES}	Output Capacitance		-	128	-	
C_{RES}	Reverse Transfer Capacitance		-	28.7	-	
Q_g	Total Gate Charge	V_{CC}=400 V_{GE}=15V, I_C =20A	-	43.9	-	nC
$t_{d(on)}$	Turn-On Delay Time	V_{CE}=400 V, V_{GE}=15V, I_C =20A R_{Gon} = 10Ω	-	16	-	ns
t_r	Rise Time		-	56	-	
$t_{d(off)}$	Turn-Off Delay Time		-	52	-	
t_f	Fall Time		-	82	-	
E_{on}	Turn-On Switching Energy		-	0.79	-	mJ
E_{off}	Turn-Off Switching Energy		-	0.3	-	

Diode AC Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
I_{rrm}	Diode peak reverse recovery current	V_{CE}=400 V, V_{GE}=0V, I_F = 20A, dIEC/dt=100A/μs	-	2.7	-	A
Q_{rr}	Diode reverse recovery Charge		-	347	-	nC
t_{rr}	Diode reverse recovery time		-	254	-	ns

GTP20N065

650-V Field Stop IGBT copacked with fast and soft antiparallel diode

- **Typical Electrical Characteristics**

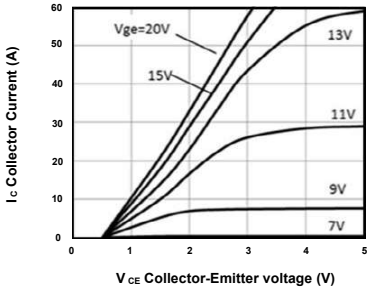


FIG.1-Output Characteristics Tvj = 25°C

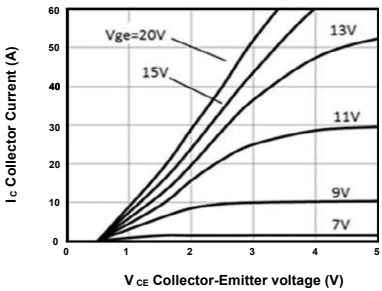


FIG.2- Output Characteristics Tvj = 175°C

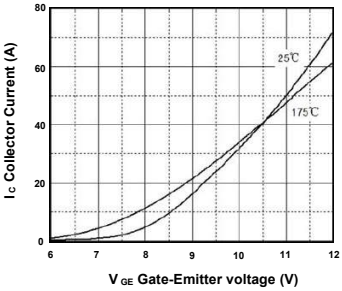


FIG.3- Transfer Characteristics

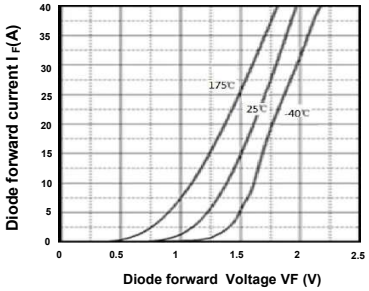


FIG.4- Diode forward Characteristics

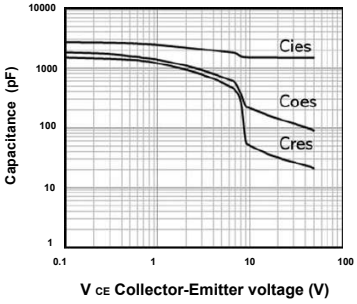


FIG.5- Capacitance

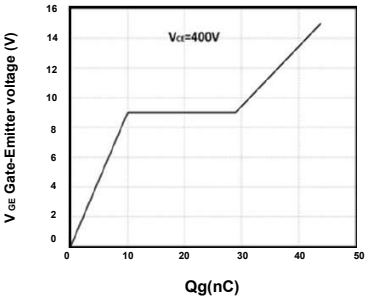


Fig.6- Gate-Charge Characteristics

GTP20N065

650-V Field Stop IGBT copacked with fast and soft antiparallel diode

- **Typical Electrical Characteristics**

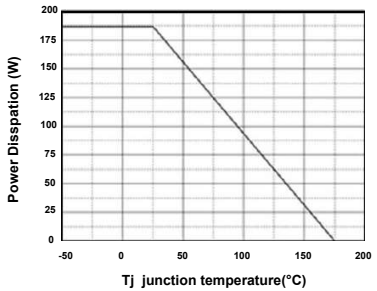


FIG.7- Power Disspation vs Junction Temperature

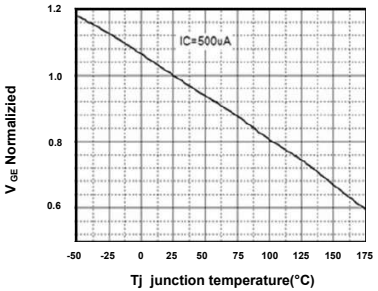


FIG.8- V_{GE} Normalized vs Junction temperature

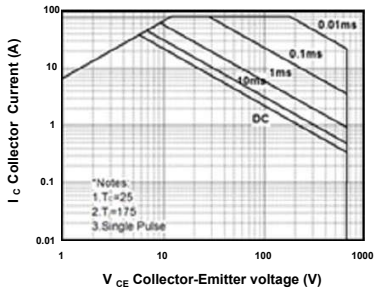


FIG.9- Safe Operation Area

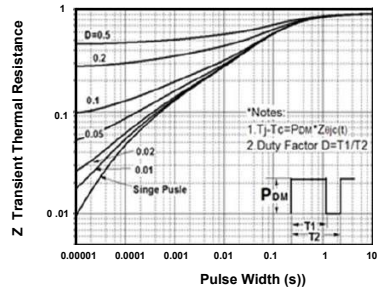


FIG.10- Transient Thermal Impedance for IGBT

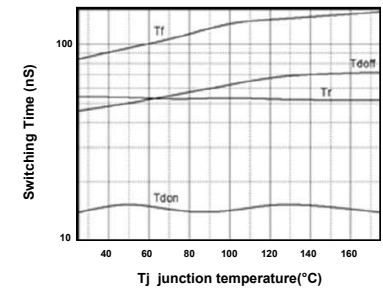


FIG.11- Switching Time vs Junction Temperature

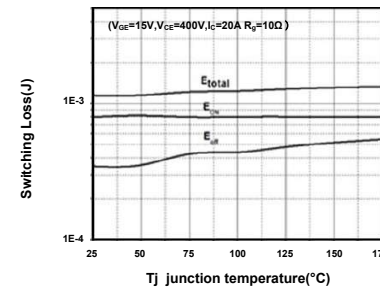


FIG.12- Switching Loss vs Junction Temperature

GTSB20N065

650-V Hybrid IGBT with Built-In SiC-SBD

Features

- High efficiency in hard switching and resonant topologies
- Easy paralleling capability due to positive temperature coefficient in VCE(on)
- Pb-free lead plating
- RoHS compliant

Benefits

- Low EMI
- Low Gate Charge QG
- Low Switching Loss & Soft Switching
- Built in No Recovery Silicon Carbide SBD
- Higher Switching Frequency up to 150kHz

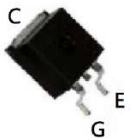
Typical Applications

- Industrial UPS
- Charger
- Energy Storage
- Three-level Solar String Inverter
- Welding
- Inductive cooking
- Inverterized microwave ovens
- Resonant converters
- Soft switching applications

Package type： TO-263

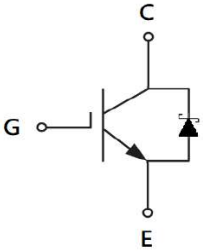
Packing & Order Information

800/Reel



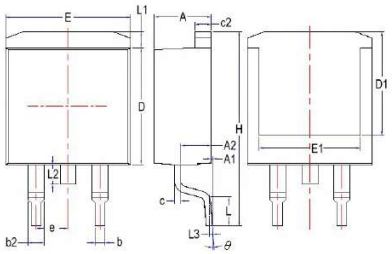
RoHS Compliant

Graphic Symbol



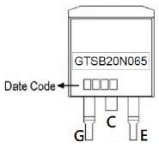
V_{CE}(on) typ. = 1.6V &
R_{CE}(on) typ. = 80mΩ
@ V_{GE} = 15V, I_C = 20A
Equivalent MOSFET Parameters
R_{DS}(on) typ. = 80mΩ
@ V_{GS} = 15V, I_D = 20A

Package Dimension



REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	4.37	4.77	E	9.80	10.36
A1	0.00	0.25	E1	7.06	-
A2	2.20	2.80	e	2.54 BSC	
b	0.70	0.96	H	14.70	15.70
b2	1.17	1.47	L	2.00	2.60
c	0.30	0.60	L1	1.07	1.47
c2	1.22	1.42	L2	1.40	1.75
D	8.50	9.30	L3	0.25 BSC	
D1	6.60	-	θ	0°	9°

Marking



GTSB20N065

650-V Hybrid IGBT with Built-In SiC-SBD

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

Symbol	Parameter	Value	Units
V_{CE}	Collector-Emitter Voltage, Tvj ≥25°C	650	V
I_C	DC Collector current, Tc = 25°C	40	A
	DC Collector current, Tc = 100°C	20	
$I_{C\ pulse}$	Pulsed collector current, tp ≤ 1ms	80	A
I_F	Diode forward current, Tc = 25°C	20	A
	Diode forward current, Tc = 100°C	10	
$I_{F\ pulse}$	Diode pulsed current, tp ≤ 1ms	40	A
V_{GE}	Gate-Emitter voltage Transient Gate-Emitter voltage (tp ≤10μs, D < 0.010)	±20	V
P_{tot}	Power Dissipation (T_C =25°C)	137	W
T_{VJ}	Operating Junction Temperature	-55…175	°C
T_{STG}	Storage Temperature	-55…175	°C

Thermal Resistance Ratings

Symbol	Parameter	Maximum	Units
$R_{\theta JA}$	Maximum Junction-to-Ambient	62.5	°C/W
$R_{\theta JC}$	IGBT Maximum Junction-to-Case	0.8	°C/W
$R_{\theta JC}$	SBD Maximum Junction-to-Case	1.5	°C/W

GTSB20N065

650-V Hybrid IGBT with Built-In SiC-SBD

Static Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GE\ (th)}$	Gate-emitter threshold voltage	V_{CE}=V_{GE}, I_C=250μA	5.0	5.8	6.5	V
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE}=0V, I_C=500uA	650	-	-	V
$V_{CE(on)}$	Collector-Emitter saturation voltage	V_{GE}=15V, I_C=20A Tvj=25°C	-	1.6	2.0	V
		V_{GE}=15V, I_C=20A Tvj=150°C	-	1.75	2.2	
$R_{CE(on)}$	Collector-Emitter saturation resistor	V_{GE}=15V, I_C=20A Tvj=25°C	-	80	-	mΩ
V_F	Diode Forward Voltage	V_{GE}=0V, I_F=10A Tvj=25°C	-	1.6	2.0	V
		V_{GE}=0V, I_F=10A Tvj= 125°C	-	1.4	-	
I_{GES}	Gate-Emitter leakage current	V_{CE}=0V, V_{GE}=±20V	-	-	±200	nA
I_{CES}	Zero gate voltage collector current	V_{CE}=650V, V_{GE}=0V Tvj=25°C	-	-	25	uA
		V_{CE}=650V, V_{GE}=0V Tvj=175°C	-	-	250	

IGBT AC Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
C_{IES}	Input Capacitance	V_{CE}=25 V, V_{GE}=0 V, f=1MHz	-	1500	-	pF
C_{OES}	Output Capacitance		-	128	-	
C_{RES}	Reverse Transfer Capacitance		-	28.7	-	
Q_g	Total Gate Charge	V_{CC}=400 V_{GE}=15V, I_C=20A	-	43.9	-	nC
$t_{d(on)}$	Turn-On Delay Time	V_{CE}=400 V, V_{GE}=15V, I_C=20A R_{Gon} = 10Ω	-	16	-	ns
t_r	Rise Time		-	56	-	
$t_{d(off)}$	Turn-Off Delay Time		-	52	-	
t_f	Fall Time		-	82	-	
E_{on}	Turn-On Switching Energy		-	0.79	-	mJ
E_{off}	Turn-Off Switching Energy		-	0.3	-	

Diode AC Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
I_{rrm}	Diode peak reverse recovery current	V_{CE}=400 V, V_{GE}=0V, I_F = 10A, dIEC/dt=100A/μs	-	2.7	-	A
Q_{rr}	Diode reverse recovery Charge		-	33	-	nC
t_{rr}	Diode reverse recovery time		-	26	-	ns

GTSB20N065

650-V Hybrid IGBT with Built-In SiC-SBD

- **Typical Electrical Characteristics**

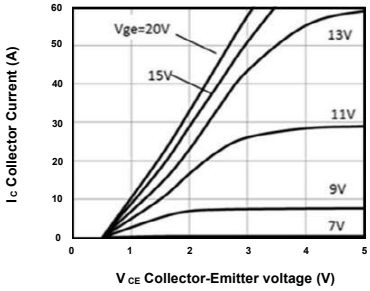


FIG.1-Output Characteristics Tvj = 25°C

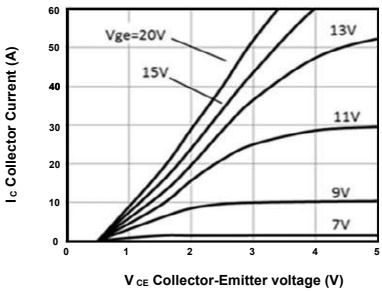


FIG.2- Output Characteristics Tvj = 175°C

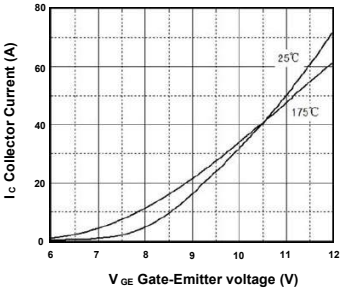


FIG.3- Transfer Characteristics

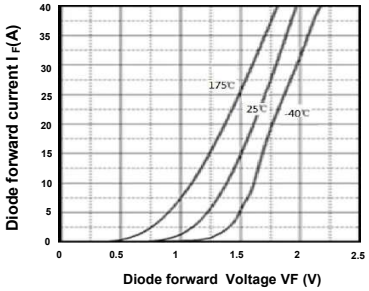


FIG.4- Diode forward Characteristics

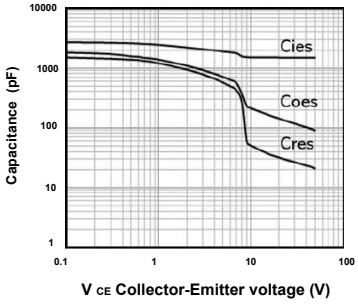


FIG.5- Capacitance

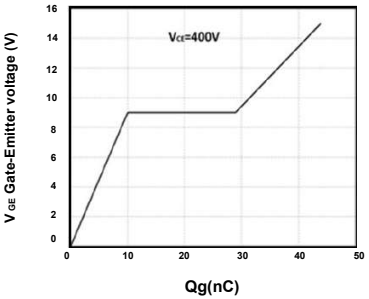


Fig.6- Gate-Charge Characteristics

GTSB20N065

650-V Hybrid IGBT with Built-In SiC-SBD

- **Typical Electrical Characteristics**

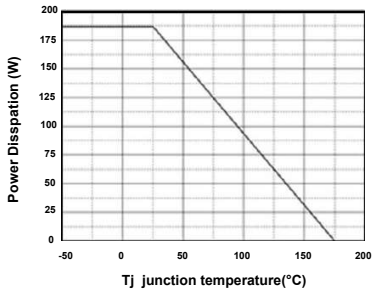


FIG.7- Power Disspation vs Junction Temperature

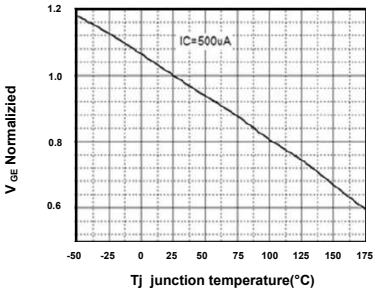


FIG.8- V_{GE} Normalized vs Junction temperature

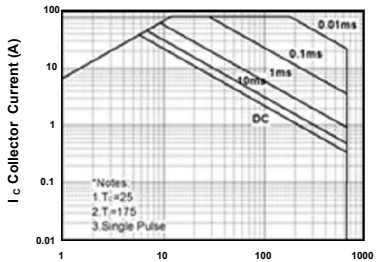


FIG.9- Safe Operation Area

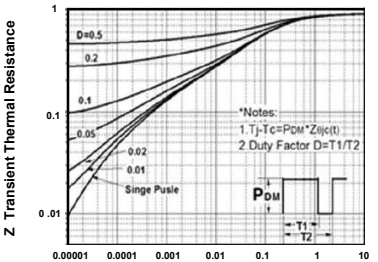


FIG.10- Transient Thermal Impedance for IGBT

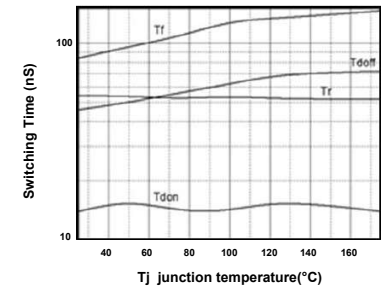


FIG.11- Switching Time vs Junction Temperature

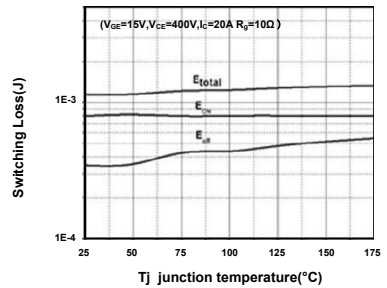


FIG.12- Switching Loss vs Junction Temperature

GTSF20N065

650-V Hybrid IGBT with Built-In SiC-SBD

Features

- High efficiency in hard switching and resonant topologies
- Easy paralleling capability due to positive temperature coefficient in VCE(on)
- Pb-free lead plating
- RoHS compliant

Benefits

- Low EMI
- Low Gate Charge QG
- Low Switching Loss & Soft Switching
- Built in No Recovery Silicon Carbide SBD
- Higher Switching Frequency up to 150kHz

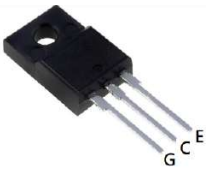
Typical Applications

- Industrial UPS
- Charger
- Energy Storage
- Three-level Solar String Inverter
- Welding
- Inductive cooking
- Inverterized microwave ovens
- Resonant converters
- Soft switching applications

Package type：TO-220F

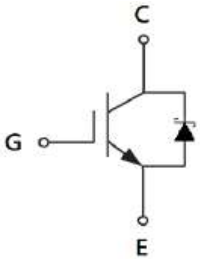
Packing & Order Information

2,000/Box



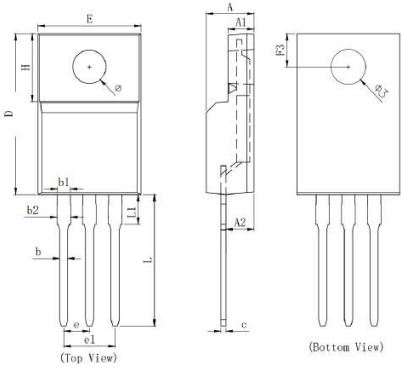
RoHS Compliant

Graphic Symbol



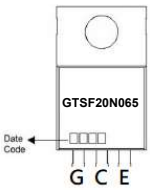
V_{CE}(on) typ. = 1.6V &
R_{CE}(on) typ. = 80mΩ
@ V_{GE} = 15V, I_C = 20A
Equivalent MOSFET Parameters
R_{DS}(on) typ. = 80mΩ
@ V_{GS} = 15V, I_D = 20A

Package Dimension



SYMBOL	MILLIMETER			SYMBOL	MILLIMETER		
	MIN	Typ.	MAX		MIN	Typ.	MAX
A	4.500	4.700	4.900	E	9.960	10.160	10.360
A1	2.340	2.540	2.740	e	2.540 BSC		
A2	2.560	2.760	2.960	e1	5.080 BSC		
b	0.700	0.800	0.950	L	12.680	12.980	13.280
b1	1.180	1.280	1.430	L1	2.780	2.930	3.080
b2	1.250	1.350	1.550	F3	3.150	3.300	3.450
c	0.400	0.500	0.650	Φ	3.030	3.180	3.480
D	15.570	15.870	16.170	Φ3	3.180	3.480	3.630
H	6.700 REF						

Marking



GTSF20N065

650-V Hybrid IGBT with Built-In SiC-SBD

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

Symbol	Parameter	Value	Units
V_{CE}	Collector-Emitter Voltage, Tvj ≥25°C	650	V
I_C	DC Collector current, Tc = 25°C	40	A
	DC Collector current, Tc = 100°C	20	
$I_{C\ pulse}$	Pulsed collector current, tp ≤ 1ms	60	A
I_F	Diode forward current, Tc = 25°C	20	A
	Diode forward current, Tc = 100°C	10	
$I_{F\ pulse}$	Diode pulsed current, tp ≤ 1ms	30	A
V_{GE}	Gate-Emitter voltage Transient Gate-Emitter voltage (tp ≤10μs, D < 0.010)	±20	V
P_{tot}	Power Dissipation (T_C =25°C)	47	W
T_{VJ}	Operating Junction Temperature	-55…150	°C
T_{STG}	Storage Temperature	-55…150	°C

Thermal Resistance Ratings

Symbol	Parameter	Maximum	Units
$R_{\theta JA}$	Maximum Junction-to-Ambient	65	°C/W
$R_{\theta JC}$	IGBT Maximum Junction-to-Case	2.8	°C/W
$R_{\theta JC}$	SBD Maximum Junction-to-Case	3.7	°C/W

GTSF20N065

650-V Hybrid IGBT with Built-In SiC-SBD

Static Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GE\ (th)}$	Gate-emitter threshold voltage	V_{CE}=V_{GE}, I_C=250μA	5.0	5.8	6.5	V
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE}=0V, I_C=500uA	650	-	-	V
$V_{CE(on)}$	Collector-Emitter saturation voltage	V_{GE}=15V, I_C=20A Tvj=25°C	-	1.6	2.0	V
		V_{GE}=15V, I_C=20A Tvj=150°C	-	1.75	2.2	
$R_{CE(on)}$	Collector-Emitter saturation resistor	V_{GE}=15V, I_C=20A Tvj=25°C	-	80	-	mΩ
V_F	Diode Forward Voltage	V_{GE}=0V, I_F=10A Tvj=25°C	-	1.6	2.0	V
		V_{GE}=0V, I_F=10A Tvj= 125°C	-	1.4	-	
I_{GES}	Gate-Emitter leakage current	V_{CE}=0V, V_{GE}=±20V	-	-	±200	nA
I_{CES}	Zero gate voltage collector current	V_{CE}=650V, V_{GE}=0V Tvj=25°C	-	-	25	uA
		V_{CE}=650V, V_{GE}=0V Tvj=175°C	-	-	250	

IGBT AC Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
C_{IES}	Input Capacitance	V_{CE}=25 V, V_{GE}=0 V, f=1MHz	-	1500	-	pF
C_{OES}	Output Capacitance		-	128	-	
C_{RES}	Reverse Transfer Capacitance		-	28.7	-	
Q_g	Total Gate Charge	V_{CC}=400 V_{GE}=15V, I_C=20A	-	43.9	-	nC
$t_{d(on)}$	Turn-On Delay Time	V_{CE}=400 V, V_{GE}=15V, I_C=20A R_{Gon} = 10Ω	-	16	-	ns
t_r	Rise Time		-	56	-	
$t_{d(off)}$	Turn-Off Delay Time		-	52	-	
t_f	Fall Time		-	82	-	
E_{on}	Turn-On Switching Energy		-	0.79	-	mJ
E_{off}	Turn-Off Switching Energy		-	0.3	-	

Diode AC Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
I_{rrm}	Diode peak reverse recovery current	V_{CE}=400 V, V_{GE}=0V, I_F = 10A, dIEC/dt=100A/μs	-	2.7	-	A
Q_{rr}	Diode reverse recovery Charge		-	33	-	nC
t_{rr}	Diode reverse recovery time		-	26	-	ns

GTSF20N065

650-V Hybrid IGBT with Built-In SiC-SBD

- **Typical Electrical Characteristics**

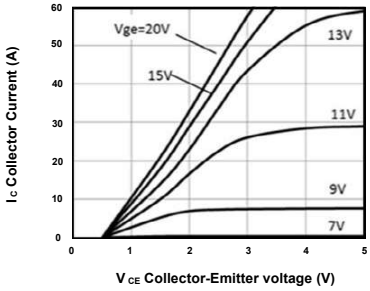


FIG.1-Output Characteristics Tvj = 25°C

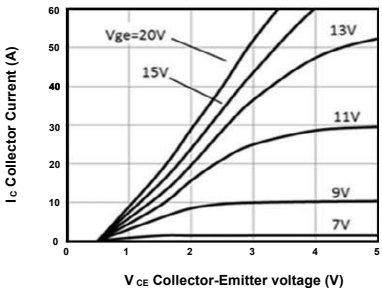


FIG.2- Output Characteristics Tvj = 175°C

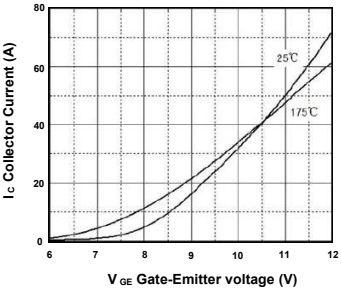


FIG.3- Transfer Characteristics

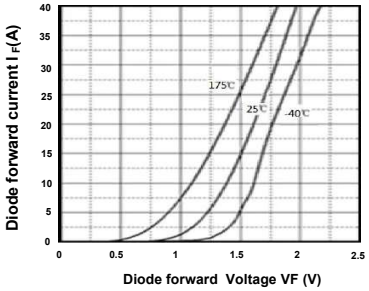


FIG.4- Diode forward Characteristics

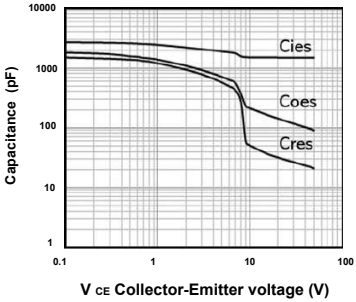


FIG.5- Capacitance

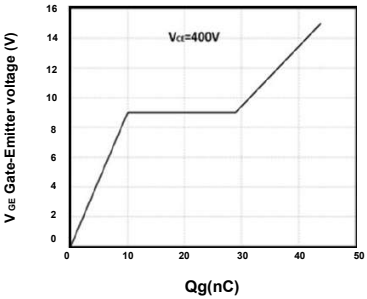


Fig.6- Gate-Charge Characteristics

GTSF20N065

650-V Hybrid IGBT with Built-In SiC-SBD

- **Typical Electrical Characteristics**

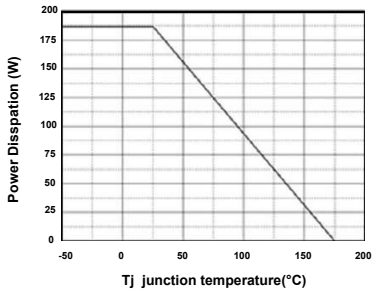


FIG.7- Power Disspation vs Junction Temperature

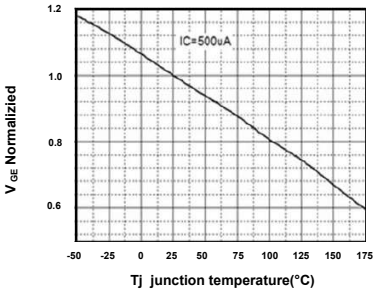


FIG.8- V_{GE} Normalized vs Junction temperature

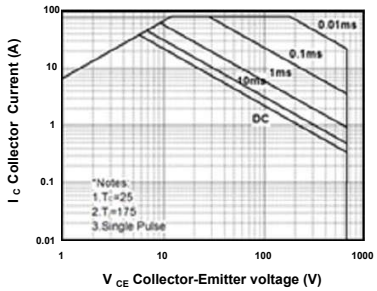


FIG.9- Safe Operation Area

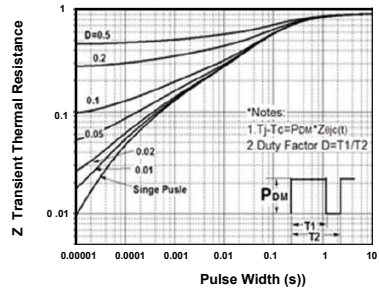


FIG.10- Transient Thermal Impedance for IGBT

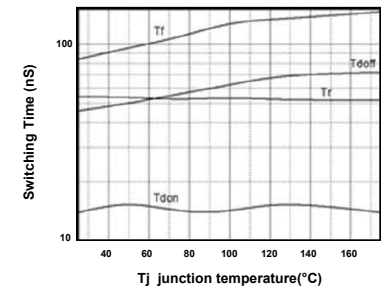


FIG.11- Switching Time vs Junction Temperature

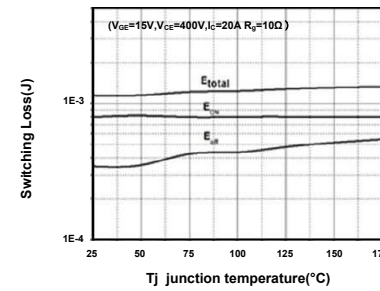


FIG.12- Switching Loss vs Junction Temperature

GTSM20N065

650-V Hybrid IGBT with Built-In SiC-SBD

Features

- High efficiency in hard switching and resonant topologies
- Easy paralleling capability due to positive temperature coefficient in VCE(on)
- Pb-free lead plating
- RoHS compliant

Benefits

- Low EMI
- Low Gate Charge QG
- Low Switching Loss & Soft Switching
- Built in No Recovery Silicon Carbide SBD
- Higher Switching Frequency up to 150kHz

Typical Applications

- Industrial UPS
- Charger
- Energy Storage
- Three-level Solar String Inverter
- Welding
- Inductive cooking
- Inverterized microwave ovens
- High power converters
- Soft switching applications

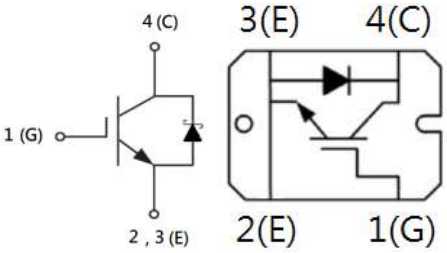
Package type：SOT-227

Packing & Order Information

100/Box

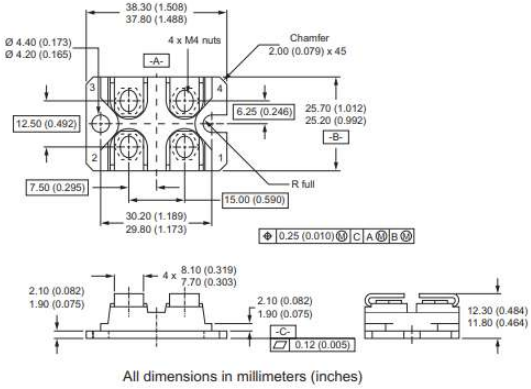
RoHS Compliant

Graphic Symbol



V_{CE}(on) typ. = 1.6V & R_{CE}(on) typ. = 80mΩ
@ V_{GE} = 15V, I_C = 20A
Equivalent MOSFET Parameters
R_{DS}(on) typ. = 80mΩ
@ V_{GS} = 15V, I_D = 20A

Package Dimension



All dimensions in millimeters (inches)

Marking

GTSM20N065

650-V Hybrid IGBT with Built-In SiC-SBD

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

Symbol	Parameter	Value	Units
V_{CE}	Collector-Emitter Voltage, Tvj ≥25°C	650	V
I_C	DC Collector current, Tc = 25°C	40	A
	DC Collector current, Tc = 100°C	20	
$I_{C\ pulse}$	Pulsed collector current, tp ≤ 1ms	80	A
I_F	Diode forward current, Tc = 25°C	20	A
	Diode forward current, Tc = 100°C	10	
$I_{F\ pulse}$	Diode pulsed current, tp ≤ 1ms	40	A
V_{GE}	Gate-Emitter voltage Transient Gate-Emitter voltage (tp ≤10μs, D < 0.010)	±20	V
P_{tot}	Power Dissipation (T_C =25°C)	137	W
T_{VJ}	Operating Junction Temperature	-55…175	°C
T_{STG}	Storage Temperature	-55…175	°C

Thermal Resistance Ratings

Symbol	Parameter	Maximum	Units
$R_{\theta JA}$	Maximum Junction-to-Ambient	0.32	°C/W
$R_{\theta JC}$	IGBT Maximum Junction-to-Case	0.8	°C/W
$R_{\theta JC}$	SBD Maximum Junction-to-Case	1.3	°C/W

GTSM20N065

650-V Hybrid IGBT with Built-In SiC-SBD

Static Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GE\ (th)}$	Gate-emitter threshold voltage	V_{CE} =V_{GE}, I_C =250μA	5.0	5.8	6.5	V
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE} =0V, I_C =500uA	650	-	-	V
$V_{CE(on)}$	Collector-Emitter saturation voltage	V_{GE} =15V, I_C =20A ,Tvj=25°C	-	1.6	2.0	V
		V_{GE} =15V, I_C =20A ,Tvj=150°C	-	1.75	2.2	
$R_{CE(on)}$	Collector-Emitter saturation resistor	V_{GE} =15V, I_C =20A ,Tvj=25°C	-	80	-	mΩ
		V_{GE} =15V, I_C =20A ,Tvj=150°C	-	88	-	
V_F	Diode Forward Voltage	V_{GE} =0V, I_F =10A Tvj=25°C	-	1.6	2.0	V
		V_{GE} =0V, I_F =10A Tvj= 125°C	-	1.4	-	
I_{GES}	Gate-Emitter leakage current	V_{CE} =0V, V_{GE} =±20V	-	-	±200	nA
I_{CES}	Zero gate voltage collector current	V_{CE} =650V, V_{GE} =0V Tvj=25°C	-	-	25	uA
		V_{CE} =650V, V_{GE} =0V Tvj=175°C	-	-	250	

IGBT AC Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
C_{IES}	Input Capacitance	V_{CE}=25 V, V_{GE}=0 V, f=1MHz	-	1500	-	pF
C_{OES}	Output Capacitance		-	128	-	
C_{RES}	Reverse Transfer Capacitance		-	28.7	-	
Q_g	Total Gate Charge	V_{CC}=400 V_{GE}=15V, I_C =20A	-	43.9	-	nC
$t_{d(on)}$	Turn-On Delay Time	V_{CE}=400 V, V_{GE}=15V, I_C =20A R_{Gon} = 10Ω	-	16	-	ns
t_r	Rise Time		-	56	-	
$t_{d(off)}$	Turn-Off Delay Time		-	52	-	
t_f	Fall Time		-	82	-	
E_{on}	Turn-On Switching Energy		-	0.79	-	mJ
E_{off}	Turn-Off Switching Energy		-	0.3	-	

Diode AC Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
I_{rrm}	Diode peak reverse recovery current	V_{CE}=400 V, V_{GE}=0V, I_F = 10A, dIEC/dt=100A/μs	-	2.7	-	A
Q_{rr}	Diode reverse recovery Charge		-	33	-	nC
t_{rr}	Diode reverse recovery time		-	26	-	ns

GTSM20N065

650-V Hybrid IGBT with Built-In SiC-SBD

- **Typical Electrical Characteristics**

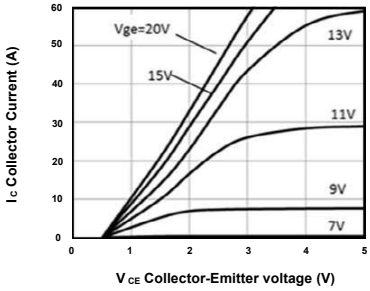


FIG.1-Output Characteristics Tvj = 25°C

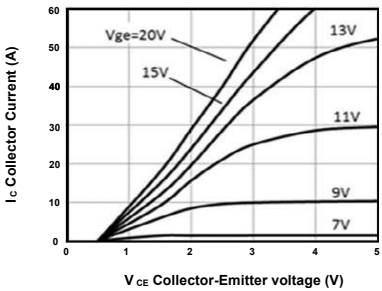


FIG.2- Output Characteristics Tvj = 175°C

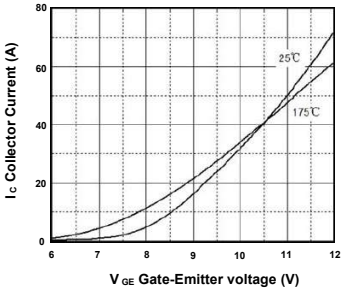


FIG.3- Transfer Characteristics

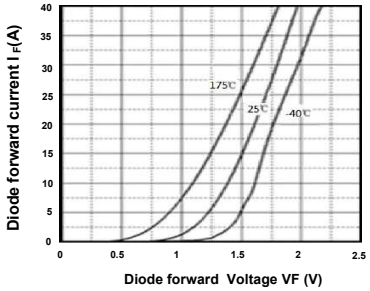


FIG.4- Diode forward Characteristics

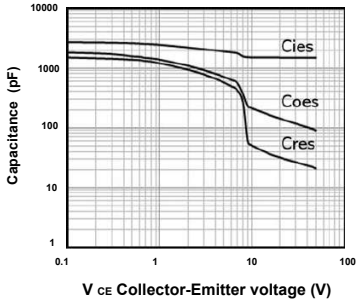


FIG.5- Capacitance

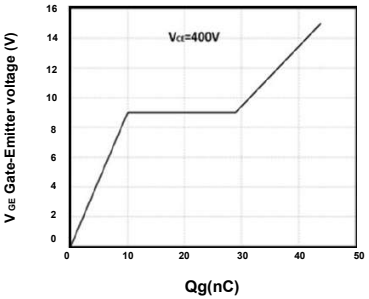


Fig.6- Gate-Charge Characteristics

GTSM20N065

650-V Hybrid IGBT with Built-In SiC-SBD

- **Typical Electrical Characteristics**

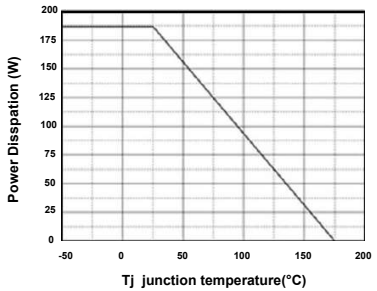


FIG.7- Power Disspation vs Junction Temperature

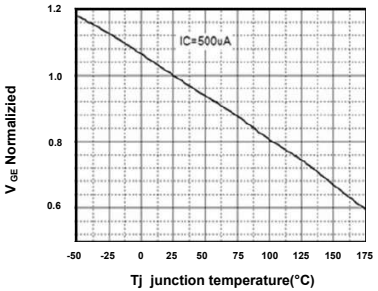


FIG.8- V_{GE} Normalized vs Junction temperature

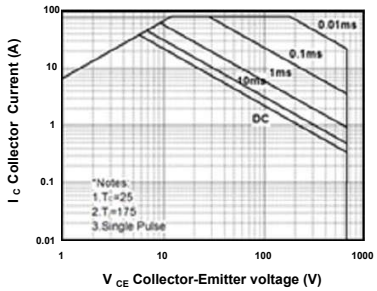


FIG.9- Safe Operation Area

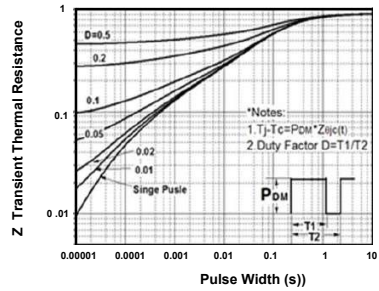


FIG.10- Transient Thermal Impedance for IGBT

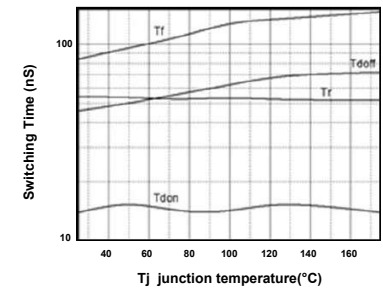


FIG.11- Switching Time vs Junction Temperature

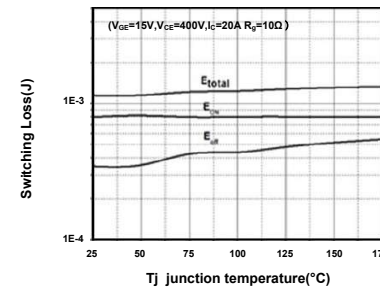


FIG.12- Switching Loss vs Junction Temperature

GTSM40N065D

650-V Hybrid IGBT with Built-In SiC-SBD

Features

- High efficiency in hard switching and resonant topologies
- Easy paralleling capability due to positive temperature coefficient in VCE(on)
- Pb-free lead plating
- RoHS compliant

Benefits

- Low EMI
- Low Gate Charge QG
- Low Switching Loss & Soft Switching
- Built in No Recovery Silicon Carbide SBD
- Higher Switching Frequency up to 150kHz

Typical Applications

- Industrial UPS
- Charger
- Energy Storage
- Three-level Solar String Inverter
- Welding
- Inductive cooking
- Inverterized microwave ovens
- High power converters
- Soft switching applications

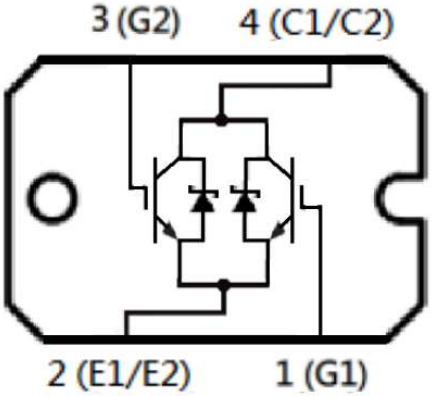
Package type : SOT-227

Packing & Order Information

100/Box

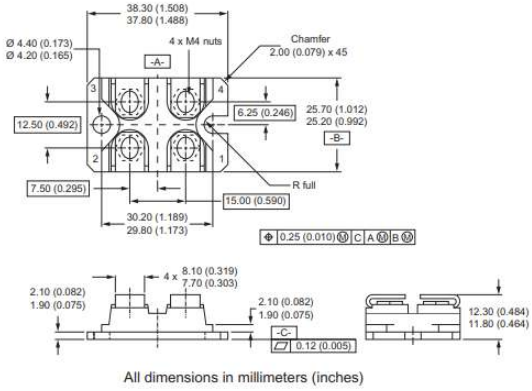
RoHS Compliant

Graphic Symbol



V_{CE}(on) typ. = 1.6V & R_{CE}(on) typ. = 40mΩ
@ V_{GE} = 15V, I_C = 40A
Equivalent MOSFET Parameters
R_{DS}(on) typ. = 40mΩ
@ V_{GS} = 15V, I_D = 40A

Package Dimension



All dimensions in millimeters (inches)

Marking

GTSM40N065D

650-V Hybrid IGBT with Built-In SiC-SBD

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings			
Symbol	**Parameter**	**Value**	**Units**
V_{CE}	Collector-Emitter Voltage, Tvj ≥25°C	650	V
I_C	DC Collector current, Tc = 25°C	60	A
	DC Collector current, Tc = 100°C	40	
$I_{C\ pulse}$	Pulsed collector current, tp ≤ 1ms	140	A
I_F	Diode forward current, Tc = 25°C	40	A
	Diode forward current, Tc = 100°C	20	
$I_{F\ pulse}$	Diode pulsed current, tp ≤ 1ms	80	A
V_{GE}	Gate-Emitter voltage Transient Gate-Emitter voltage (tp ≤10μs, D < 0.010)	±20	V
P_{tot}	Power Dissipation (T_C =25°C)	260	W
T_{VJ}	Operating Junction Temperature	-55…175	°C
T_{STG}	Storage Temperature	-55…175	°C

Thermal Resistance Ratings			
Symbol	**Parameter**	**Maximum**	**Units**
$R_{\theta JA}$	Maximum Junction-to-Ambient	0.32	°C/W
$R_{\theta JC}$	IGBT Maximum Junction-to-Case	0.8	°C/W
$R_{\theta JC}$	SBD Maximum Junction-to-Case	1.3	°C/W

GTSM40N065D

650-V Hybrid IGBT with Built-In SiC-SBD

Static Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GE\ (th)}$	Gate-emitter threshold voltage	V_{CE} =V_{GE}, I_C =250μA	5.0	5.8	6.5	V
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE} =0V, I_C =500uA	650	-	-	V
$V_{CE(on)}$	Collector-Emitter saturation voltage	V_{GE} =15V, I_C =40A , Tvj=25°C	-	1.6	2.0	V
		V_{GE} =15V, I_C =40A,Tvj=150°C	-	1.75	2.2	
$R_{CE(on)}$	Collector-Emitter saturation resistor	V_{GE} =15V, I_C =40A, Tvj=25°C	-	40	-	mΩ
		V_{GE} =15V, I_C =40A,Tvj=150°C	-	44	-	
V_F	Diode Forward Voltage	V_{GE} =0V, I_F =20A ,Tvj=25°C	-	1.6	2.0	V
		V_{GE} =0V, I_F =20A, Tvj= 125°C	-	1.4	-	
I_{GES}	Gate-Emitter leakage current	V_{CE} =0V, V_{GE} =±20V	-	-	±200	nA
I_{CES}	Zero gate voltage collector current	V_{CE} =650V, V_{GE} =0V, Tvj=25°C	-	-	50	uA
		V_{CE} =650V, V_{GE} =0V, Tvj=150°C	-	80	-	

IGBT AC Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
C_{IES}	Input Capacitance	V_{CE}=25 V, V_{GE}=0 V, f=1MHz	-	3000	-	pF
C_{OES}	Output Capacitance		-	250	-	
C_{RES}	Reverse Transfer Capacitance		-	55	-	
Q_g	Total Gate Charge	V_{CC}=400 V_{GE}=15V, I_C=40A	-	110	-	nC
$t_{d(on)}$	Turn-On Delay Time	V_{CE}=400 V, V_{GE}=15V, I_C =40A R_{Gon} = 10Ω	-	16	-	ns
t_r	Rise Time		-	56	-	
$t_{d(off)}$	Turn-Off Delay Time		-	52	-	
t_f	Fall Time		-	82	-	
E_{on}	Turn-On Switching Energy		-	0.79	-	mJ
E_{off}	Turn-Off Switching Energy		-	0.3	-	

Diode AC Electrical Characteristics, (T_{VJ}=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
I_{rrm}	Diode peak reverse recovery current	V_{CE}=400 V, V_{GE}=0V, I_F = 20A, dIEC/dt=100A/μs	-	5.4	-	A
Q_{rr}	Diode reverse recovery Charge		-	73	-	nC
t_{rr}	Diode reverse recovery time		-	26	-	ns

GTSM40N065D

650-V Hybrid IGBT with Built-In SiC-SBD

- **Typical Electrical Characteristics**

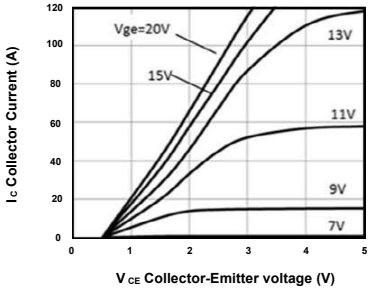


FIG.1-Output Characteristics Tvj = 25°C

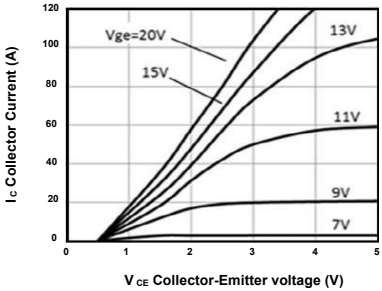


FIG.2- Output Characteristics Tvj = 175°C

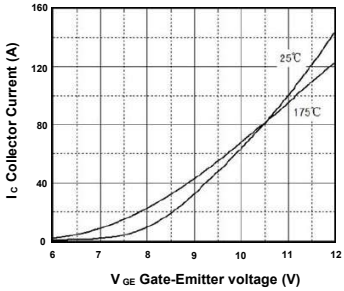


FIG.3- Transfer Characteristics

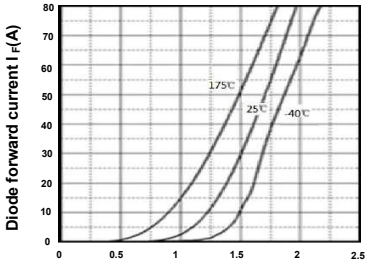


FIG.4- Diode forward Characteristics

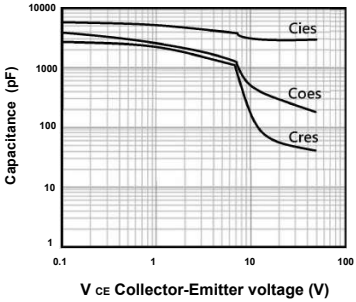


FIG.5- Capacitance

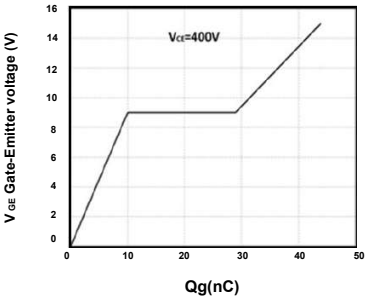


Fig.6- Gate-Charge Characteristics

GTSM40N065D

650-V Hybrid IGBT with Built-In SiC-SBD

- **Typical Electrical Characteristics**

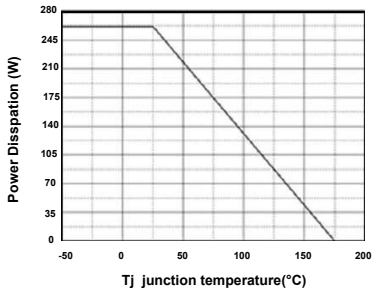


FIG.7- Power Disspation vs Junction Temperature

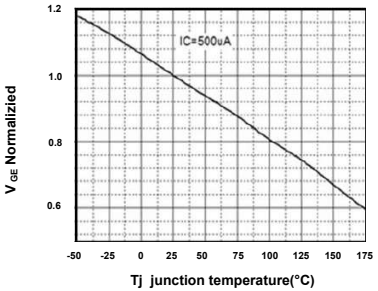


FIG.8- V_{GE} Normalized vs Junction temperature

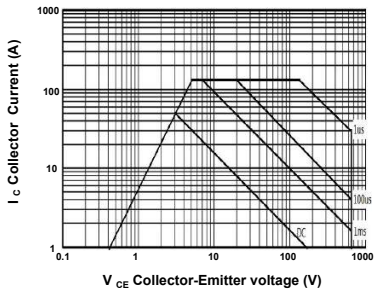


FIG.9- Safe Operation Area

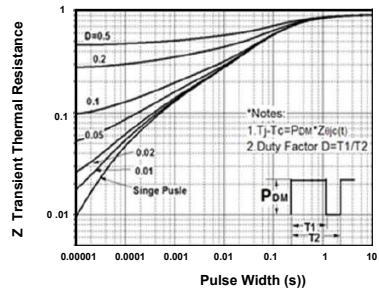


FIG.10- Transient Thermal Impedance for IGBT

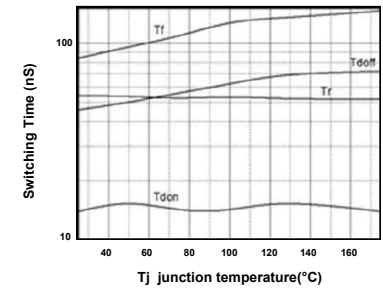


FIG.11- Switching Time vs Junction Temperature

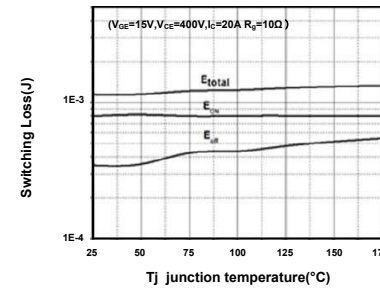


FIG.12- Switching Loss vs Junction Temperature

With me,
Power for you.

2
SiC MOSFET

SiC MOSFET can provide increased power density and higher reliability compared to Si MOSFET.

All products are available in industrial grade and automotive grade.

CMS120N037W

SiC N-Channel 1200-V (D-S) MOSFET

Features

- High speed switching
- High blocking voltage
- Fast reverse recovery

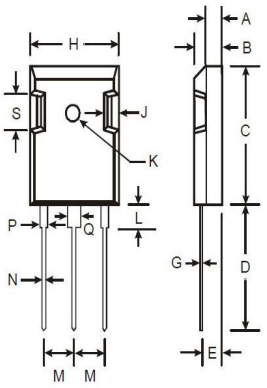
Benefits

- Low capacitance
- High system efficiency
- Easy to parallel Applications

Typical Applications

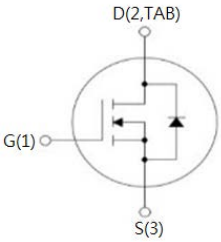
- Solar inverters
- Switch mode power supplies, UPS
- Induction heating and welding
- EV charging stations
- High voltage DC/DC converters
- Motor drive

Package Dimension

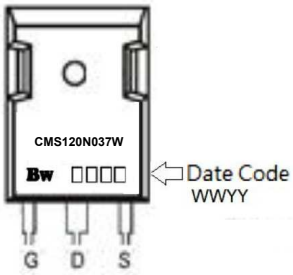


TO247		
Dim	Min	Max
A	1.9	2.1
B	4.85	5.15
C	20.3	21.75
D	19.60	20.1
E	2.2	2.6
G	0.51	0.76
H	15.45	16.25
J	1.93	2.18
K	2.9∅	3.2∅
L	3.78	4.38
M	5.2	5.7
N	1.0	1.4
P	1.8	2.2
Q	2.8	3.2
S	4.4 Typ	
All Dimensions in mm		

Package type：TO-247



Marking



RoHS Compliant

CMS120N037W

SiC N-Channel 1200-V (D-S) MOSFET

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings			
Symbol	**Parameter**	**Value**	**Units**
V_{DS}	Drain-Source Voltage	1200	V
I_D	Continuous Drain Current (T_C =25°C)	63	A
	Continuous Drain Current(T_C =100°C)	47	A
$I_{D,pulse}$	Pulsed Drain Current	160	A
P_{tot}	Power Dissipation (T_C =25°C)	322	W
E_{AS}	Single Pulse Avalanche Energy, I_{AS}=28A ,V=50V, L =1mH	400	mJ
T_J/T_{STG}	Operating Junction and Storage Temperature	-55…175	°C

Thermal Resistance Ratings			
Symbol	**Parameter**	**Maximum**	**Units**
$R_{\theta JA}$	Maximum Junction-to-Ambient	40	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case	047	°C/W

Static Electrical Characteristics, (T_J=25°C unless otherwise specified)						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS} =V_{GS}, I_D =10mA	2.0	2.4	4.0	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V, I_D =1mA	1200	-	-	V
I_{GSS}+	Gate-Source Leakage Current	V_{DS} =0V, V_{GS} =20V	-	<10	100	nA
I_{GSS}-		V_{DS} =0V, V_{GS} =-5V	-	-	-100	
I_{DSS}	Drain-Source Leakage Current	V_{DS} =1200V, V_{GS} =0V	-	-	1.0	μA
		V_{DS} =1200V, V_{GS} =0V, T_J =175°C	-	1.0	-	
$R_{DS\ (on)}$	Static Drain-Source On-Resistance	V_{GS} =20V, I_D =40A	-	37	52	mΩ
		V_{GS} =20V, I_D =20A	-	35	45	
		V_{GS} =20V, I_D =40A, T_J =125°C	-	56	-	
		V_{GS} =20V, I_D =40A, T_J =175°C	-	73	-	
R_g	Gate Input Resistance	f =1MHz,V_{AC} =25mV, D-S short	-	1.9	-	Ω

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SiC N-Channel 1200-V (D-S) MOSFET

AC Electrical Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Q_g	Total Gate Charge	V_{DD}=800 V,	-	118	-	nC
Q_{gs}	Gate-Source Charge	I_{DS}=20 A,	-	51	-	
Q_{gd}	Gate-Drain Charge	V_{GS}=-5/20V	-	10	-	
$t_{d(on)}$	Turn-On Delay Time	V_{DD}=800 V, I_{DS}=40 A,	-	14	-	ns
t_r	Rise Time	$R_{G(ext)}$=2.5 Ω, V_{GS}=-5/+20 V,	-	5	-	
$t_{d(off)}$	Turn-Off Delay Time	L=273 μH	-	23	-	
t_f	Fall Time		-	14	-	
C_{ISS}	Input Capacitance	V_{GS}=0 V, V_{DS}=1000 V,	-	3192	-	pF
C_{OSS}	Output Capacitance	f=200 kHz, V_{AC}=25mV	-	132	-	
C_{RSS}	Reverse Transfer Capacitance		-	7	-	
E_{oss}	Coss Stored Energy		-	77	-	μJ
E_{on}	Turn-On Switching Energy	V_{DD}=800 V, I_{DS}=40 A,	-	339	-	
E_{off}	Turn-Off Switching Energy	$R_{G(ext)}$=2.5 Ω, V_{GS}=-5/+20 V,	-	70	-	
E_{tot}	Total Switching Energy	L=273 μH	-	409	-	

Body Diode Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
I_S	Max Continuous Diode Forward Current	V_{GS}=-5 V, T_C=25 °C	-	-	74	A
V_{SD}	Diode Forward Voltage	V_{GS}=-5 V, I_S=20 A	-	3.8	-	V
t_{rr}	Reverse Recovery Time	I_S=40 A, V_R=800 V,	-	11	-	ns
Q_{rr}	Reverse Recovery Charge	V_{GS}=-5 V, di/dt=9.6 A/ns	-	316	-	nC
I_{rrm}	Peak Reverse Recovery Current		-	46	-	A

CMS120N037W

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

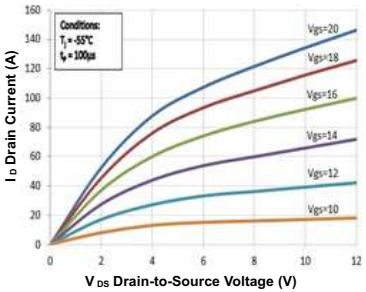

FIG.1-Output Characteristics T_J=-55°C

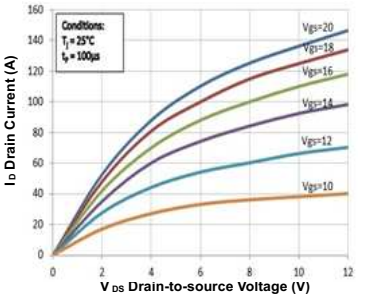

FIG.2- Output Characteristics T_J=25°C

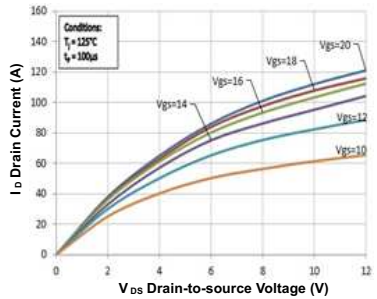

FIG.3- Output Characteristics T_J=125°C

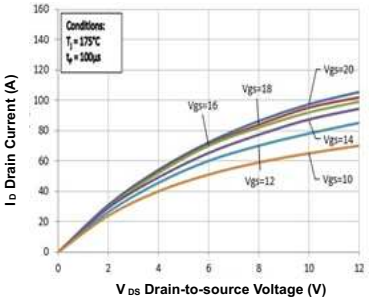

FIG.4- Output Characteristics T_J=175°C

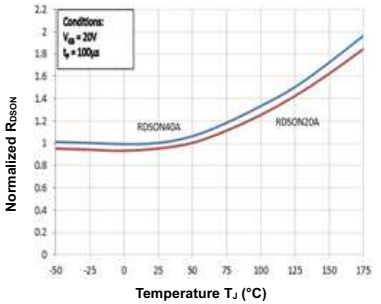

FIG.5-Normalized R_{DSON} vs. Temperature T_J

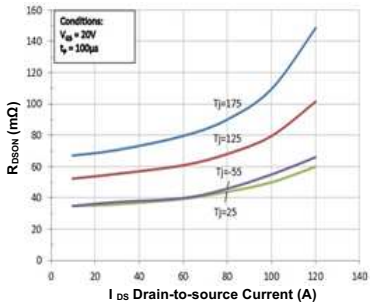

FIG.6- On-Resistance vs. Drain Current For Various Temperature

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SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

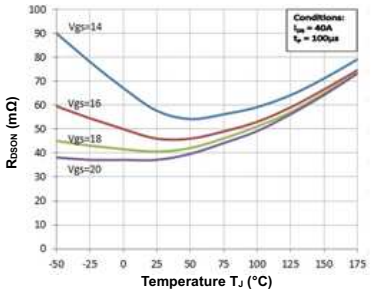

FIG.7- On-Resistance vs. Temperature For Various Gate Voltages

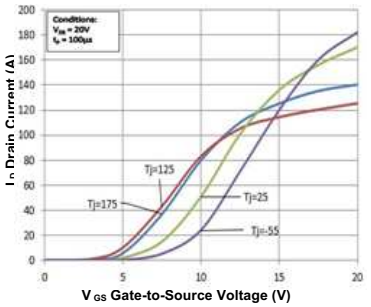

FIG.8-Transfer Characteristic for Various Junction Temperatures

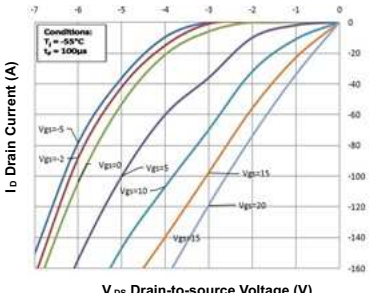

FIG.9- Body Diode Characteristics at T_J=-55°C

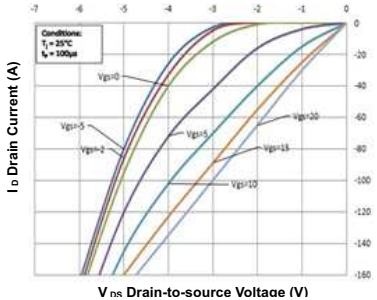

FIG.10- Body Diode Characteristics at T_J=25°C

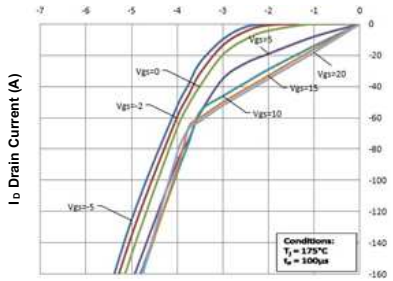

FIG.11- Body Diode Characteristics at T_J=175°C

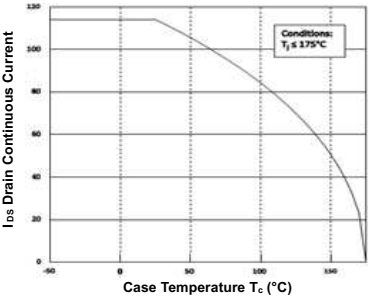

FIG.12- Continuous Drain Current Derating vs. Tc

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SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

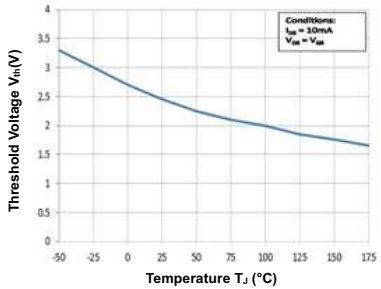

FIG.13-Threshold Voltage vs. Temperature

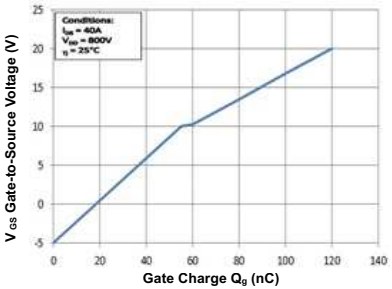

FIG.12- Gate Charge Characteristics

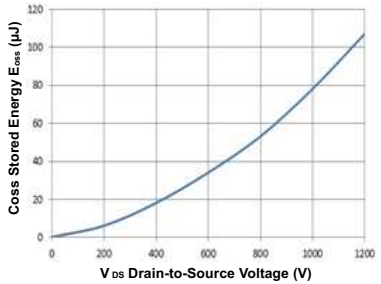

FIG.15- Output Capacitor Stored Energy

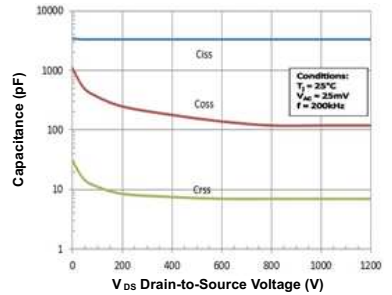

FIG.16- Capacitance vs Drain-Source Voltage

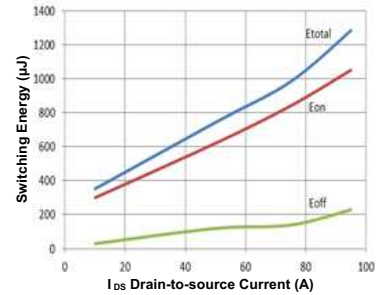

FIG.17- Clamped Inductive Switching Energy vs. Drain Current Various

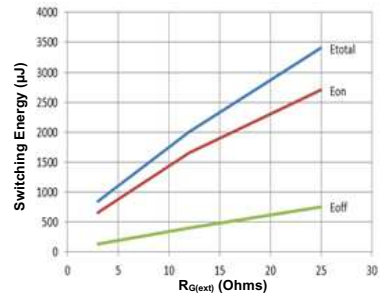

FIG.18- Clamped Inductive Switching Energy vs. $R_{G(ext)}$

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SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

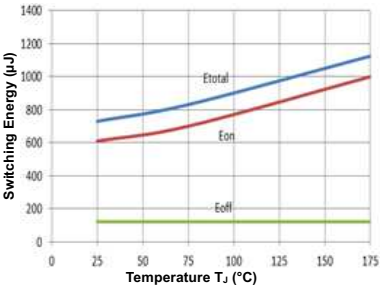

FIG.19-Clamped Inductive Switching Energy vs. Temperature

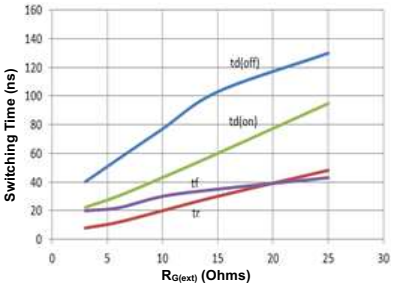

FIG.20- Switching Times vs $R_{G(ext)}$

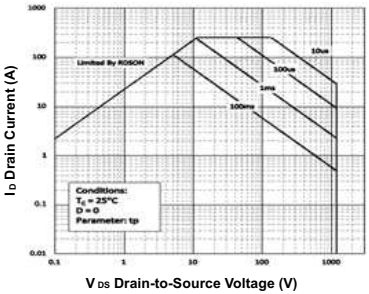

FIG.21- Safe Operating Area

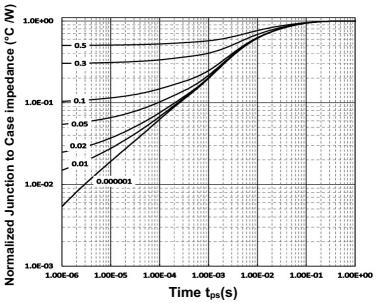

FIG.22- Transient Thermal impedance (Junction to Case)

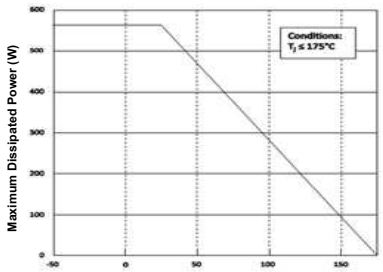

FIG.23- Maximum Power Dissipation Derating vs Case Temperature

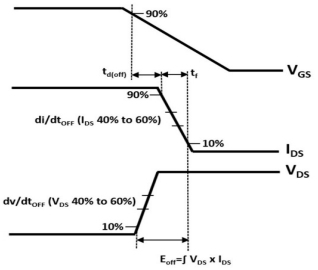

FIG.24- Turn-off Transient Definitions

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SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

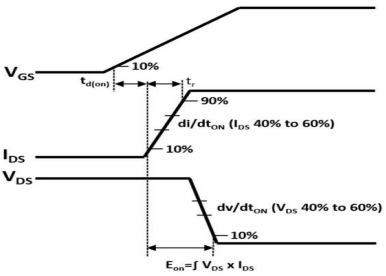

FIG.25-Turn-on Transient Definitions

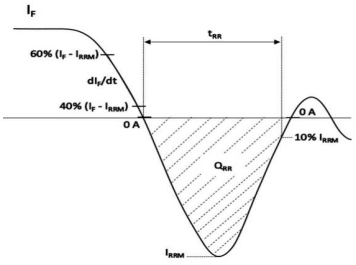

FIG.26- Reverse Recovery Definitions

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SiC N-Channel 1200-V (D-S) MOSFET

Features

- High speed switching
- High blocking voltage
- Fast reverse recovery

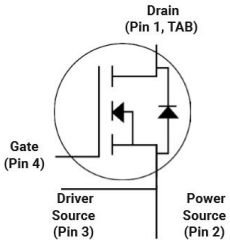
Benefits

- Low capacitance
- High system efficiency
- Easy to parallel Applications

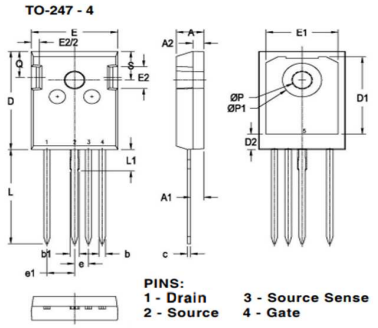
Typical Applications

- Solar inverters
- Switch mode power supplies, UPS
- Induction heating and welding
- EV charging stations
- High voltage DC/DC converters
- Motor drive

Package type：TO-247-4

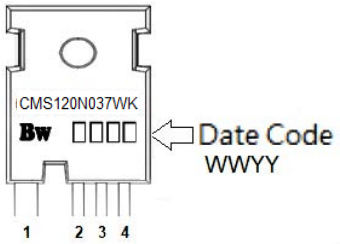


Package Dimension



SYM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.189	.205	4.80	5.20
A1	.090	.098	2.30	2.50
A2	.075	.083	1.90	2.10
b	.043	.055	1.10	1.40
b1	.063	.071	1.60	1.80
c	.020	.031	0.50	0.80
D	.819	.839	20.80	21.30
D1	.630	.670	16.00	17.00
D2	.118	.138	3.00	3.50
E	.620	.636	15.75	16.15
E1	.531	.559	13.50	14.20
E2	.169	.193	4.30	4.90
e	.100 BSC		2.54 BSC	
e1	.200 BSC		5.08 BSC	
L	.780	.799	19.80	20.30
L1	.157	.177	4.00	4.50
ØP	.140	.144	3.55	3.65
ØP1	.280	.287	7.10	7.30
Q	.213	.236	5.40	6.00
S	.242 BSC		6.15 BSC	

Marking



RoHS Compliant

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SiC N-Channel 1200-V (D-S) MOSFET

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings			
Symbol	**Parameter**	**Value**	**Units**
V_{DS}	Drain-Source Voltage	1200	V
I_D	Continuous Drain Current (T_C =25°C)	63	A
	Continuous Drain Current(T_C =100°C)	47	A
$I_{D,pulse}$	Pulsed Drain Current	160	A
P_{tot}	Power Dissipation (T_C =25°C)	322	W
E_{AS}	Single Pulse Avalanche Energy, I_{AS}=28A ,V=50V, L =1mH	400	mJ
T_J/T_{STG}	Operating Junction and Storage Temperature	-55…175	°C

Thermal Resistance Ratings			
Symbol	**Parameter**	**Maximum**	**Units**
$R_{\theta JA}$	Maximum Junction-to-Ambient	40	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case	047	°C/W

Static Electrical Characteristics, (T_J=25°C unless otherwise specified)						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS} =V_{GS}, I_D =10mA	2.0	2.4	4.0	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V, I_D =1mA	1200	-	-	V
I_{GSS}+	Gate-Source Leakage Current	V_{DS} =0V, V_{GS} =20V	-	<10	100	nA
I_{GSS}-		V_{DS} =0V, V_{GS} =-5V	-	-	-100	
I_{DSS}	Drain-Source Leakage Current	V_{DS} =1200V, V_{GS} =0V	-	-	1.0	μA
		V_{DS} =1200V, V_{GS} =0V, T_J =175°C	-	1.0	-	
$R_{DS\ (on)}$	Static Drain-Source On-Resistance	V_{GS} =20V, I_D =40A	-	37	52	mΩ
		V_{GS} =20V, I_D =20A	-	35	45	
		V_{GS} =20V, I_D =40A, T_J =125°C	-	56	-	
		V_{GS} =20V, I_D =40A, T_J =175°C	-	73	-	
R_g	Gate Input Resistance	f =1MHz,V_{AC} =25mV, D-S short	-	1.9	-	Ω

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SiC N-Channel 1200-V (D-S) MOSFET

AC Electrical Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Q_g	Total Gate Charge	V_{DD}=800 V,	-	118	-	nC
Q_{gs}	Gate-Source Charge	I_{DS}=20 A,	-	51	-	
Q_{gd}	Gate-Drain Charge	V_{GS}=-5/20V	-	10	-	
$t_{d(on)}$	Turn-On Delay Time	V_{DD}=800 V, I_{DS}=40 A,	-	14	-	ns
t_r	Rise Time	$R_{G(ext)}$=2.5 Ω, V_{GS}=-5/+20 V,	-	5	-	
$t_{d(off)}$	Turn-Off Delay Time	L=273 μH	-	23	-	
t_f	Fall Time		-	14	-	
C_{ISS}	Input Capacitance	V_{GS}=0 V, V_{DS}=1000 V,	-	3192	-	pF
C_{OSS}	Output Capacitance	f=200 kHz, V_{AC}=25mV	-	132	-	
C_{RSS}	Reverse Transfer Capacitance		-	7	-	
E_{oss}	Coss Stored Energy		-	77	-	μJ
E_{on}	Turn-On Switching Energy	V_{DD}=800 V, I_{DS}=40 A,	-	339	-	
E_{off}	Turn-Off Switching Energy	$R_{G(ext)}$=2.5 Ω, V_{GS}=-5/+20 V,	-	70	-	
E_{tot}	Total Switching Energy	L=273 μH	-	409	-	

Body Diode Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
I_S	Max Continuous Diode Forward Current	V_{GS}=-5 V, T_C=25 °C	-	-	74	A
V_{SD}	Diode Forward Voltage	V_{GS}=-5 V, I_S=20 A	-	3.8	-	V
t_{rr}	Reverse Recovery Time	I_S=40 A, V_R=800 V,	-	11	-	ns
Q_{rr}	Reverse Recovery Charge	V_{GS}=-5 V, di/dt=9.6 A/ns	-	316	-	nC
I_{rrm}	Peak Reverse Recovery Current		-	46	-	A

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SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

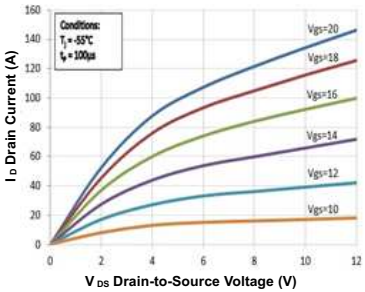


FIG.1-Output Characteristics T_J=-55°C

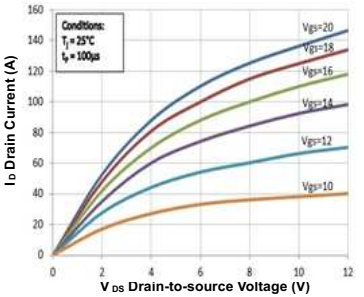


FIG.2- Output Characteristics T_J=25°C

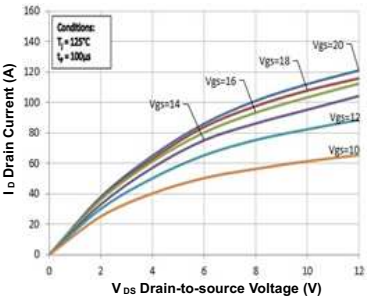


FIG.3- Output Characteristics T_J=125°C

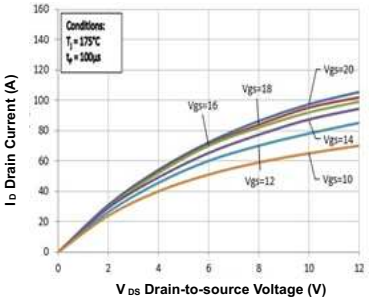


FIG.4- Output Characteristics T_J=175°C

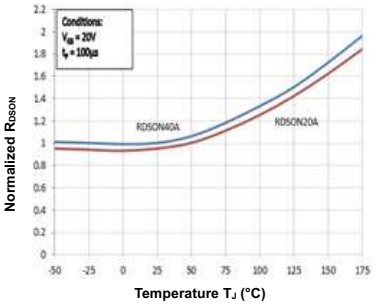


FIG.5-Normalized R_{DSON} vs. Temperature T_J

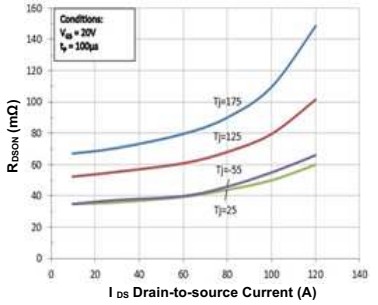


FIG.6- On-Resistance vs. Drain Current For Various Temperature

CMS120N037WK

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

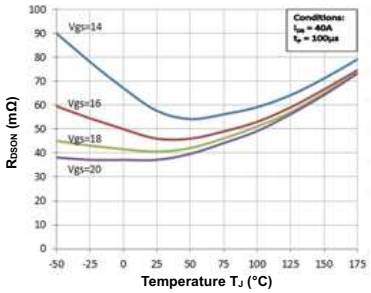


FIG.7- On-Resistance vs. Temperature For Various Gate Voltages

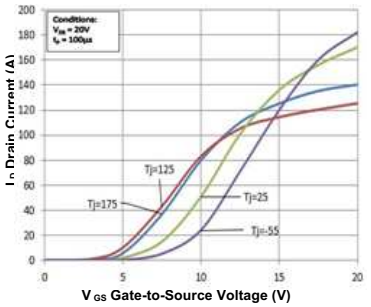


FIG.8-Transfer Characteristic for Various Junction Temperatures

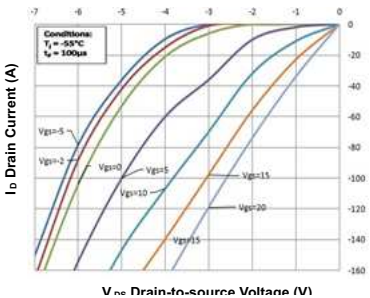


FIG.9- Body Diode Characteristics at T_J=-55°C

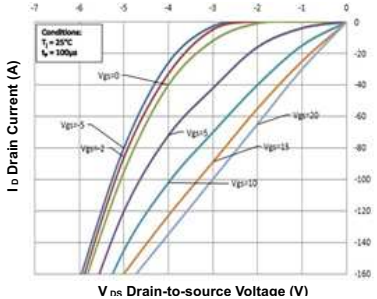


FIG.10- Body Diode Characteristics at T_J=25°C

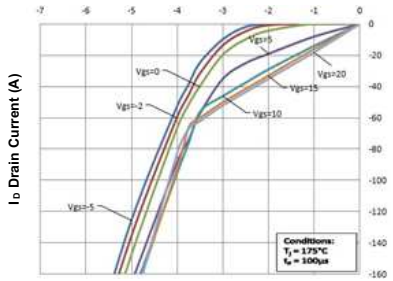


FIG.11- Body Diode Characteristics at T_J=175°C

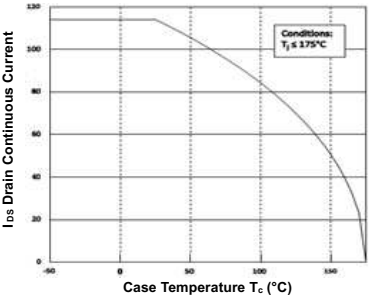


FIG.12- Continuous Drain Current Derating vs. Tc

CMS120N037WK

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

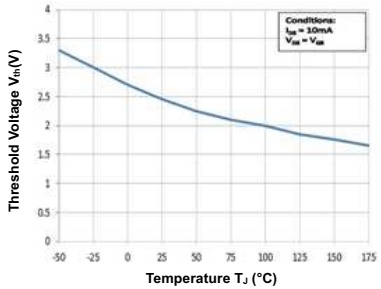


FIG.13-Threshold Voltage vs. Temperature

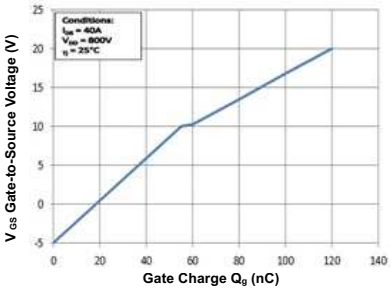


FIG.12- Gate Charge Characteristics

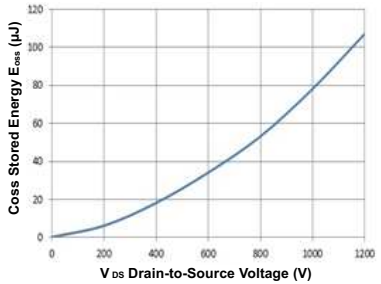


FIG.15- Output Capacitor Stored Energy

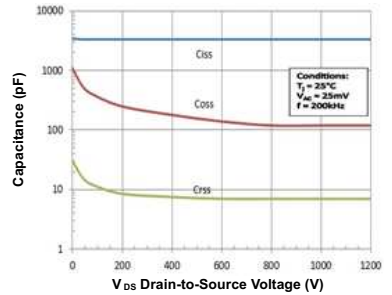


FIG.16- Capacitance vs Drain-Source Voltage

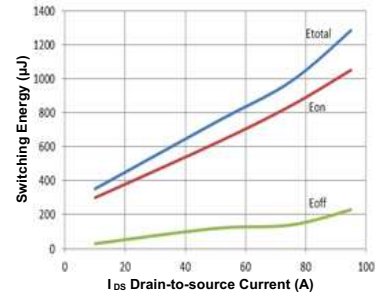


FIG.17- Clamped Inductive Switching Energy vs. Drain Current Various

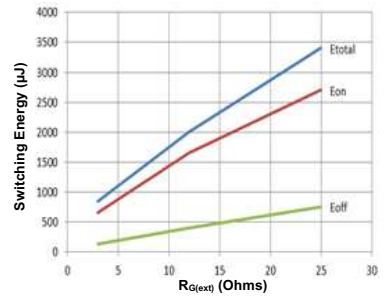


FIG.18- Clamped Inductive Switching Energy vs. $R_{G(ext)}$

CMS120N037WK

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

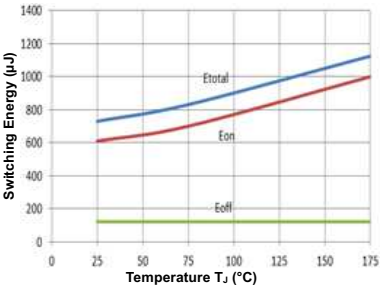


FIG.19-Clamped Inductive Switching Energy vs. Temperature

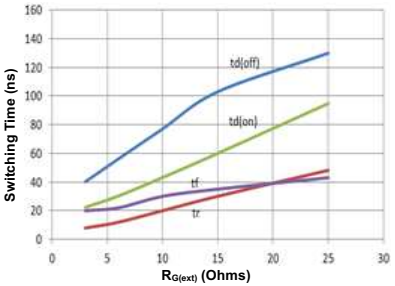


FIG.20- Switching Times vs $R_{G(ext)}$

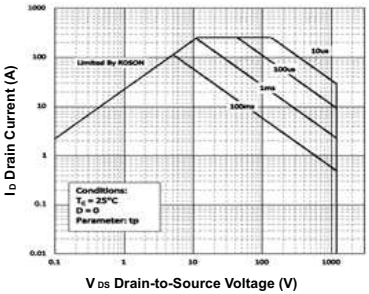


FIG.21- Safe Operating Area

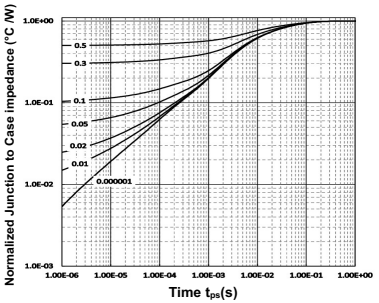


FIG.22- Transient Thermal impedance (Junction to Case)

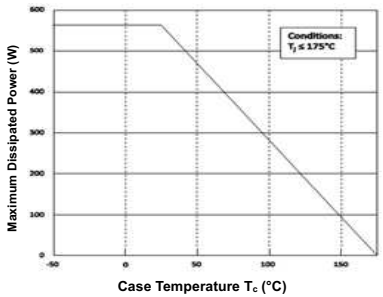


FIG.23- Maximum Power Dissipation Derating vs Case Temperature

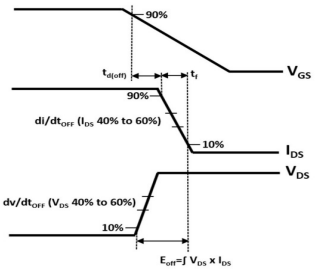


FIG.24- Turn-off Transient Definitions

CMS120N037WK

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

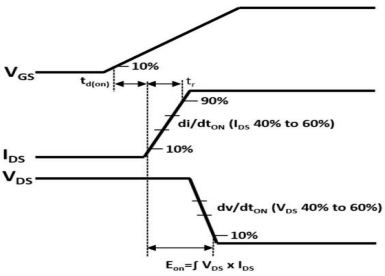


FIG.25-Turn-on Transient Definitions

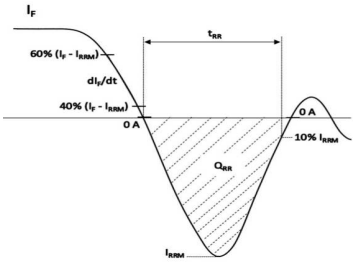


FIG.26- Reverse Recovery Definitions

CMS120N080B

SiC N-Channel 1200-V (D-S) MOSFET

Features

- High speed switching
- High blocking voltage
- Fast reverse recovery

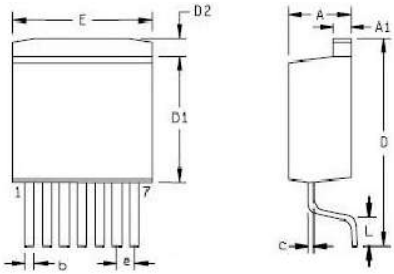
Benefits

- Low capacitance
- High system efficiency
- Easy to parallel Applications

Typical Applications

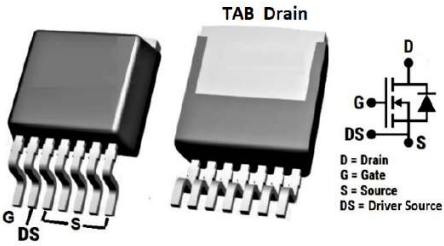
- Solar inverters
- Switch mode power supplies, UPS
- Induction heating and welding
- EV charging stations
- High voltage DC/DC converters
- Motor drive

Package Dimension

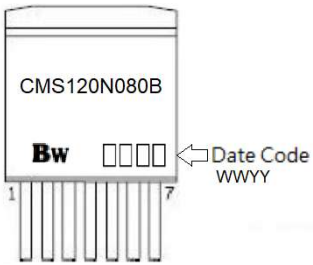


Symbol	Dimensions Millimeters		Symbol	Dimensions Millimeters	
	Min	Max		Min	Max
A	4.40	4.64	D1	8.38	8.89
A1	1.22	1.32	D2	---	1.27
b	0.56	0.81	e	---	1.27
c	0.38	0.76	E	10.04	10.41
D	---	14.35	L	---	1.98

Package type：TO-263-7



Marking



RoHS Compliant

CMS120N080B

SiC N-Channel 1200-V (D-S) MOSFET

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings			
Symbol	**Parameter**	**Value**	**Units**
V_{DS}	Drain-Source Voltage	1200	V
V_{GS}	Gate-Source Voltage	-5/20	V
I_D	Continuous Drain Current (T_C =25°C)	35	A
	Continuous Drain Current(T_C =100°C)	25	A
$I_{D,pulse}$	Pulsed Drain Current	80	A
P_{tot}	Power Dissipation (T_C =25°C)	188	W
E_{AS}	Single Pulse Avalanche Energy, I_{AS}=20A ,V=50V, L =1mH	200	mJ
T_J/T_{STG}	Operating Junction and Storage Temperature	-55…175	°C

Thermal Resistance Ratings			
Symbol	**Parameter**	**Maximum**	**Units**
$R_{\theta JA}$	Maximum Junction-to-Ambient	40	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case	0.8	°C/W

Static Electrical Characteristics, (T_J=25°C unless otherwise specified)						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS} =V_{GS}, I_D =10mA	2.0	2.8	4.0	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V, I_D =1mA	1200	-	-	V
I_{GSS}+	Gate-Source Leakage Current	V_{DS} =0V, V_{GS} =20V	-	0.1	100	nA
I_{GSS}-		V_{DS} =0V, V_{GS} =-5V	-	-	-100	
I_{DSS}	Drain-Source Leakage Current	V_{DS} =1200V, V_{GS} =0V	-	-	1.0	μA
		V_{DS} =1200V, V_{GS} =0V, T_J =175°C	-	1.0	-	
$R_{DS\ (on)}$	Static Drain-Source On-Resistance	V_{GS} =20V, I_D =20A	-	77	100	mΩ
		V_{GS} =20V, I_D =10A	-	71	90	
		V_{GS} =20V, I_D =20A, T_J =125°C	-	106	-	
		V_{GS} =20V, I_D =20A, T_J =175°C	-	134	-	
R_g	Gate Input Resistance	f =1MHz,V_{AC} =25mV, D-S short	-	3.0	-	Ω

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SiC N-Channel 1200-V (D-S) MOSFET

AC Electrical Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Q_g	Total Gate Charge	V_{DD}=800 V,	-	61	-	nC
Q_{gs}	Gate-Source Charge	I_{DS}=20 A,	-	24	-	
Q_{gd}	Gate-Drain Charge	V_{GS}=-5/20V	-	14	-	
$t_{d(on)}$	Turn-On Delay Time	V_{DD}=800 V, I_{DS}=20 A,	-	9	-	ns
t_r	Rise Time	$R_{G(ext)}$=2.5 Ω, V_{GS}=-5/+20 V,	-	4	-	
$t_{d(off)}$	Turn-Off Delay Time	L=975 μH	-	15	-	
t_f	Fall Time		-	10	-	
C_{ISS}	Input Capacitance	V_{GS}=0 V, V_{DS}=1000 V,	-	1377	-	pF
C_{OSS}	Output Capacitance	f=200 kHz, V_{AC}=25mV	-	62	-	
C_{RSS}	Reverse Transfer Capacitance		-	4	-	
E_{oss}	Coss Stored Energy		-	38	-	μJ
E_{on}	Turn-On Switching Energy	V_{DD}=800 V, I_{DS}=20 A,	-	208	-	
E_{off}	Turn-Off Switching Energy	$R_{G(ext)}$=2.5 Ω, V_{GS}=-5/+20 V,	-	25	-	
E_{tot}	Total Switching Energy	L=975 μH	-	233	-	

Body Diode Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
I_S	Max Continuous Diode Forward Current	V_{GS}=-5 V, T_C=25 °C	-	-	43	A
V_{SD}	Diode Forward Voltage	V_{GS}=-5 V, I_S=10 A	-	3.8	-	V
t_{rr}	Reverse Recovery Time	I_S=20 A, V_R=800 V,	-	8	-	ns
Q_{rr}	Reverse Recovery Charge	V_{GS}=-5 V, di/dt=8 A/μs	-	130	-	nC
I_{rrm}	Peak Reverse Recovery Current		-	29	-	A

CMS120N080B

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

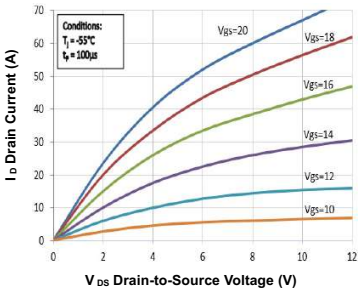

FIG.1-Output Characteristics T_J=-55°C

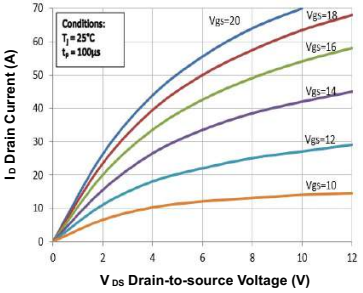

FIG.2- Output Characteristics T_J=25°C

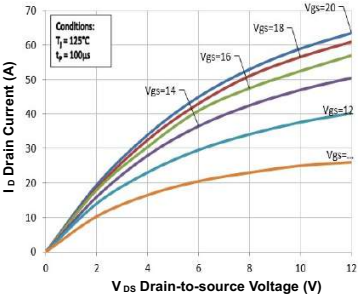

FIG.3- Output Characteristics T_J=125°C

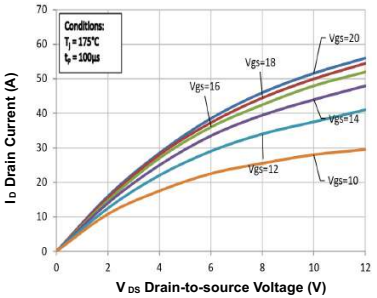

FIG.4- Output Characteristics T_J=175°C

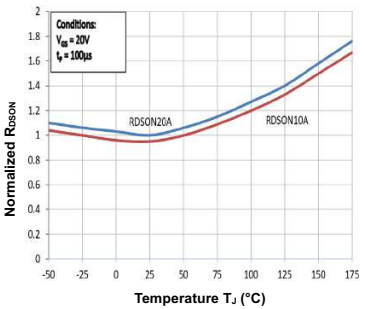

FIG.5-Normalized R_{DSON} vs. Temperature T_J

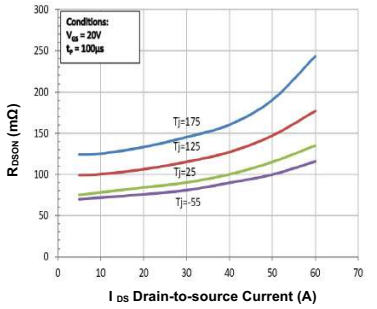

FIG.6- On-Resistance vs. Drain Current For Various Temperature

CMS120N080B

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

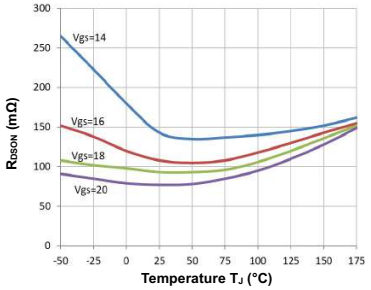

FIG.7- On-Resistance vs. Temperature For Various Gate Voltages

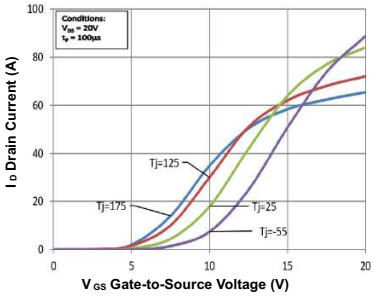

FIG.8-Transfer Characteristic for Various Junction Temperatures

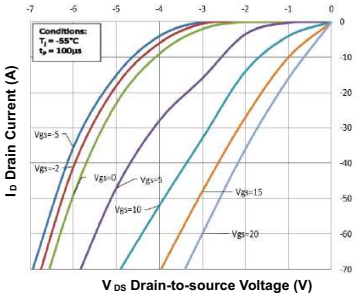

FIG.9- Body Diode Characteristics at T_J=-55°C

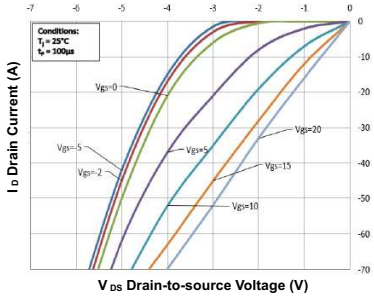

FIG.10- Body Diode Characteristics at T_J=25°C

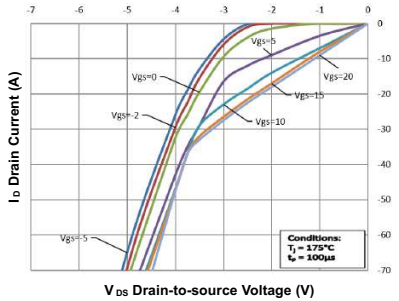

FIG.11- Body Diode Characteristics at T_J=175°C

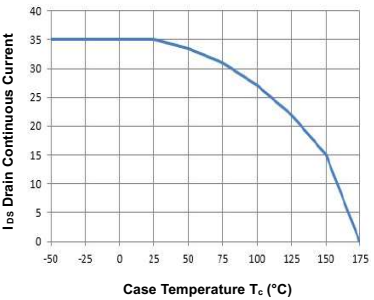

FIG.12- Continuous Drain Current Derating vs. Tc

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SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

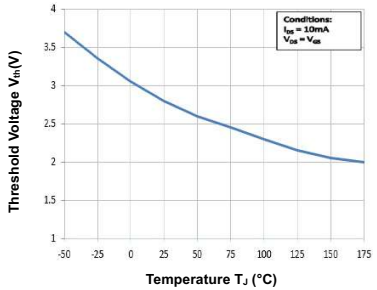


FIG.13-Threshold Voltage vs. Temperature

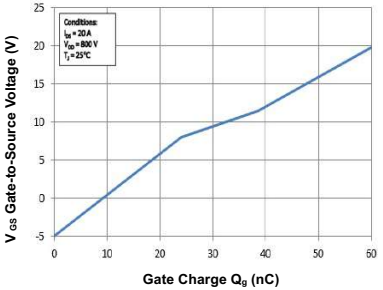


FIG.12- Gate Charge Characteristics

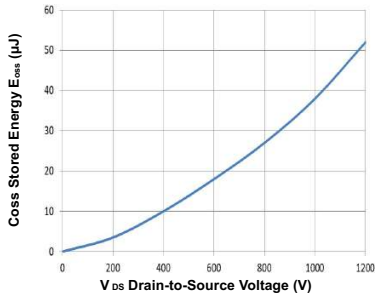


FIG.15- Output Capacitor Stored Energy

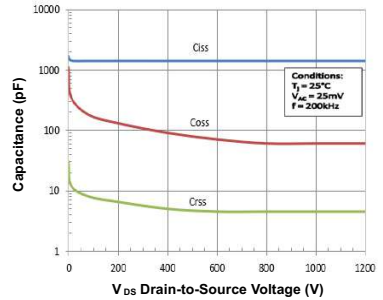


FIG.16- Capacitance vs Drain-Source Voltage

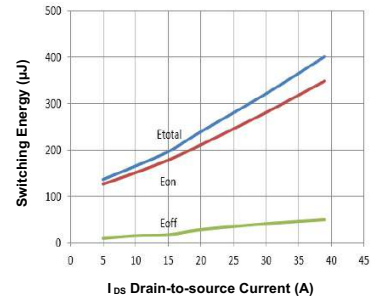


FIG.17- Clamped Inductive Switching Energy vs. Drain Current Various

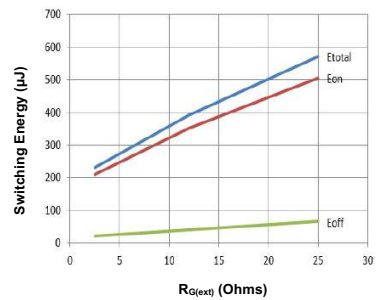


FIG.18- Clamped Inductive Switching Energy vs. $R_{G(ext)}$

CMS120N080B

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

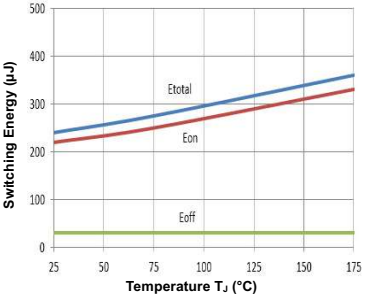


FIG.19-Clamped Inductive Switching Energy vs. Temperature

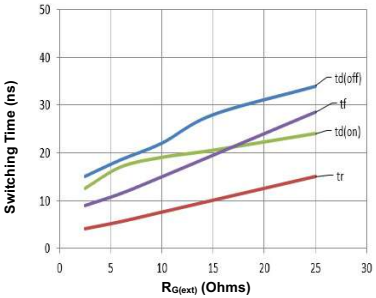


FIG.20- Switching Times vs $R_{G(ext)}$

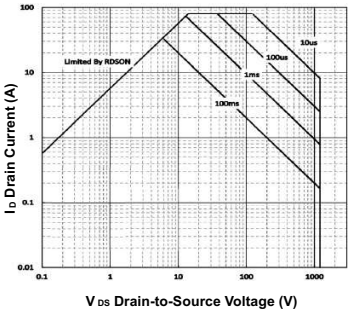


FIG.21- Safe Operating Area

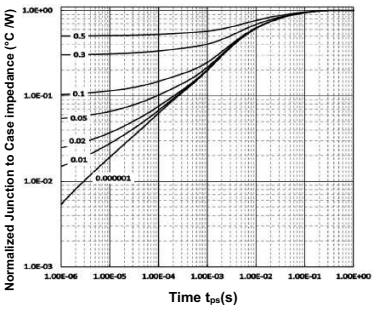


FIG.22- Transient Thermal impedance (Junction to Case)

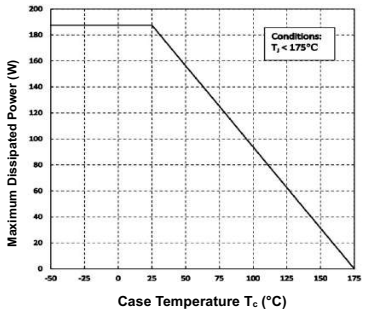


FIG.23- Maximum Power Dissipation Derating vs Case Temperature

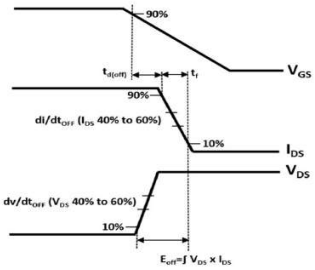


FIG.24- Turn-off Transient Definitions

CMS120N080B

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

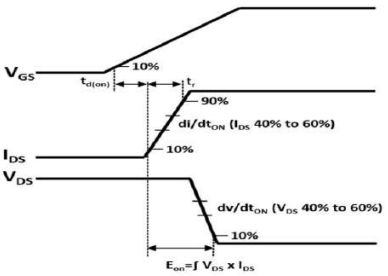


FIG.25-Turn-on Transient Definitions

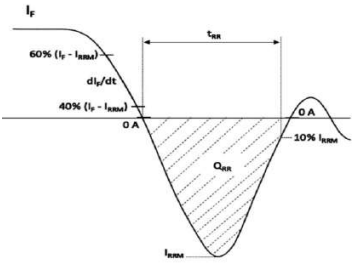


FIG.26- Reverse Recovery Definitions

CMS120N080W

SiC N-Channel 1200-V (D-S) MOSFET

Features

- High speed switching
- High blocking voltage
- Fast reverse recovery

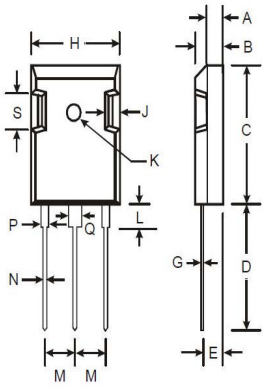
Benefits

- Low capacitance
- High system efficiency
- Easy to parallel Applications

Typical Applications

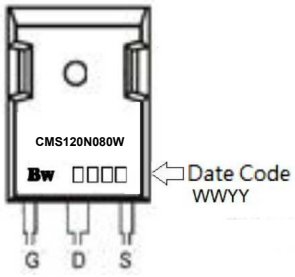
- Solar inverters
- Switch mode power supplies, UPS
- Induction heating and welding
- EV charging stations
- High voltage DC/DC converters
- Motor drive

Package Dimension

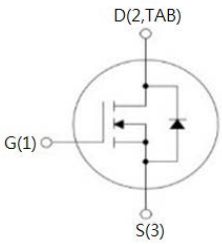


TO247		
Dim	Min	Max
A	1.9	2.1
B	4.85	5.15
C	20.3	21.75
D	19.60	20.1
E	2.2	2.6
G	0.51	0.76
H	15.45	16.25
J	1.93	2.18
K	2.9∅	3.2∅
L	3.78	4.38
M	5.2	5.7
N	1.0	1.4
P	1.8	2.2
Q	2.8	3.2
S	4.4 Typ	
All Dimensions in mm		

Marking



Package type：TO-247



RoHS Compliant

CMS120N080W

SiC N-Channel 1200-V (D-S) MOSFET

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings			
Symbol	**Parameter**	**Value**	**Units**
V_{DS}	Drain-Source Voltage	1200	V
V_{GS}	Gate-Source Voltage	-5/20	V
I_D	Continuous Drain Current (T_C =25°C)	34	A
	Continuous Drain Current(T_C =100°C)	25	A
$I_{D,pulse}$	Pulsed Drain Current	80	A
P_{tot}	Power Dissipation (T_C =25°C)	188	W
E_{AS}	Single Pulse Avalanche Energy, I_{AS}=20A ,V=50V, L =1mH	200	mJ
T_J/T_{STG}	Operating Junction and Storage Temperature	-55…175	°C

Thermal Resistance Ratings			
Symbol	**Parameter**	**Maximum**	**Units**
$R_{\theta JA}$	Maximum Junction-to-Ambient	40	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case	0.8	°C/W

Static Electrical Characteristics, (T_J=25°C unless otherwise specified)						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
$V_{GS\,(th)}$	Gate Threshold Voltage	V_{DS} =V_{GS}, I_D =10mA	2.0	2.8	4.0	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V, I_D =1mA	1200	-	-	V
I_{GSS}+	Gate-Source Leakage Current	V_{DS} =0V, V_{GS} =20V	-	0.1	100	nA
I_{GSS}-		V_{DS} =0V, V_{GS} =-5V	-	-	-100	
I_{DSS}	Drain-Source Leakage Current	V_{DS} =1200V, V_{GS} =0V	-	-	1.0	μA
		V_{DS} =1200V, V_{GS} =0V, T_J =175°C	-	1.0	-	
$R_{DS\,(on)}$	Static Drain-Source On-Resistance	V_{GS} =20V, I_D =20A	-	77	100	mΩ
		V_{GS} =20V, I_D =10A	-	71	90	
		V_{GS} =20V, I_D =20A, T_J =125°C	-	106	-	
		V_{GS} =20V, I_D =20A, T_J =175°C	-	134	-	
R_g	Gate Input Resistance	f =1MHz,V_{AC} =25mV, D-S short	-	3.0	-	Ω

CMS120N080W

SiC N-Channel 1200-V (D-S) MOSFET

AC Electrical Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Q_g	Total Gate Charge	V_{DD}=800 V,	-	58	-	nC
Q_{gs}	Gate-Source Charge	I_{DS}=20 A,	-	19	-	
Q_{gd}	Gate-Drain (“Miller”) Charge	V_{GS}=-5/20V	-	18	-	
$t_{d(on)}$	Turn-On Delay Time	V_{DD}=800 V, I_{DS}=20 A,	-	10	-	ns
t_r	Rise Time	$R_{G(ext)}$=2.5 Ω, V_{GS}=-5/+20 V,	-	6	-	
$t_{d(off)}$	Turn-Off Delay Time	L=975 μH	-	16	-	
t_f	Fall Time		-	10	-	
C_{ISS}	Input Capacitance	V_{GS}=0 V, V_{DS}=1000 V,	-	1377	-	pF
C_{OSS}	Output Capacitance	f=200 kHz, V_{AC}=25mV	-	62	-	
C_{RSS}	Reverse Transfer Capacitance		-	4	-	
E_{oss}	Coss Stored Energy		-	38	-	μJ
E_{on}	Turn-On Switching Energy	V_{DD}=800 V, I_{DS}=20 A,	-	410	-	
E_{off}	Turn-Off Switching Energy	$R_{G(ext)}$=2.5 Ω, V_{GS}=-5/+20 V,	-	22	-	
E_{tot}	Total Switching Energy	L=975 μH	-	432	-	

Body Diode Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
I_S	Max Continuous Diode Forward Current	V_{GS}=-5 V, T_C=25 °C	-	-	43	A
V_{SD}	Diode Forward Voltage	V_{GS}=-5 V, I_S=10 A	-	3.8	-	V
t_{rr}	Reverse Recovery Time	I_S=20 A, V_R=800 V,	-	26	-	ns
Q_{rr}	Reverse Recovery Charge	V_{GS}=-5 V, di/dt=3500 A/μs	-	124	-	nC
I_{rrm}	Peak Reverse Recovery Current		-	8	-	A

CMS120N080W

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

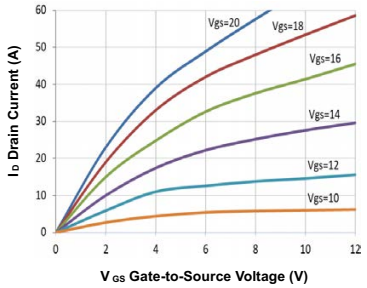


FIG.1-Output Characteristics T_J=-55°C

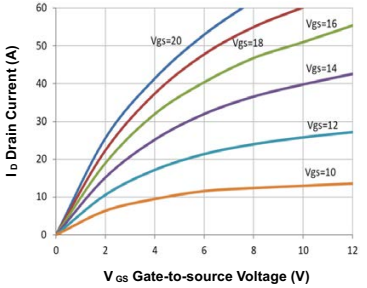


FIG.2- Output Characteristics T_J=25°C

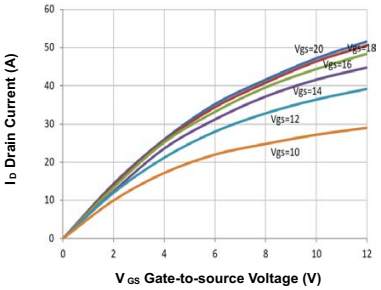


FIG.3- Output Characteristics T_J=175°C

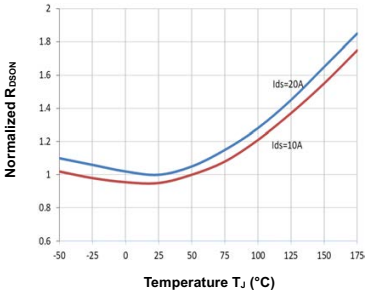


FIG.4-Normalized R_{DSON} vs. Temperature T_J

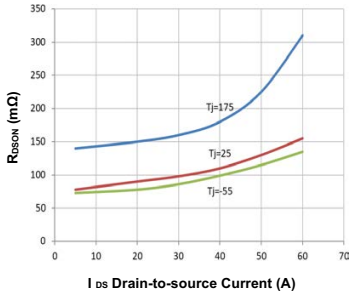


FIG.5- On-Resistance vs. Drain Current For Various Temperature

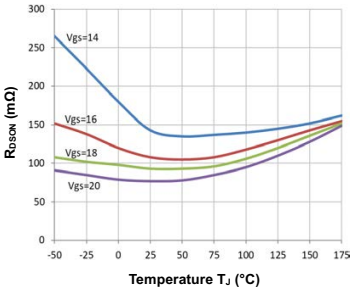


FIG.6- On-Resistance vs. Temperature For Various Gate Voltages

CMS120N080W

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

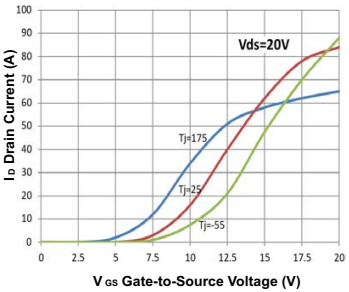


FIG.7-Transfer Characteristic for Various Junction Temperatures

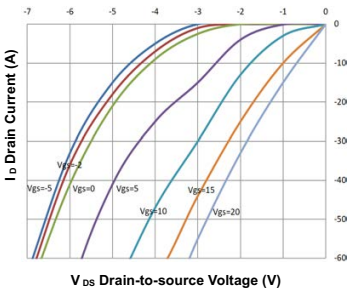


FIG.8- Body Diode Characteristics at T_J=-55°C

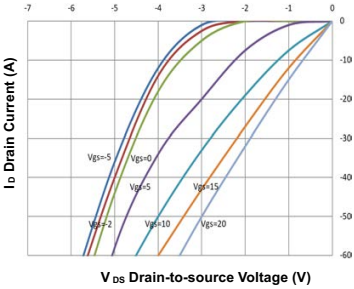


FIG.9- Body Diode Characteristics at T_J=25°C

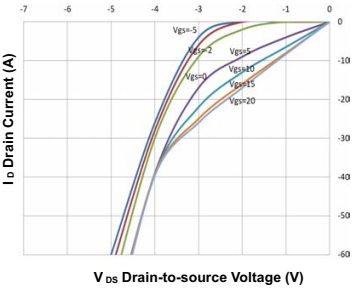


FIG.10- Body Diode Characteristics at T_J=175°C

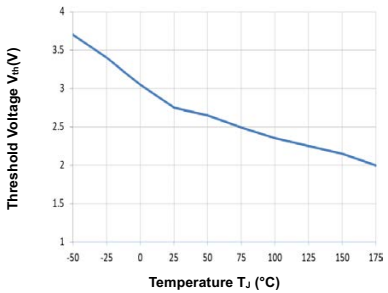


FIG.11-Threshold Voltage vs. Temperature

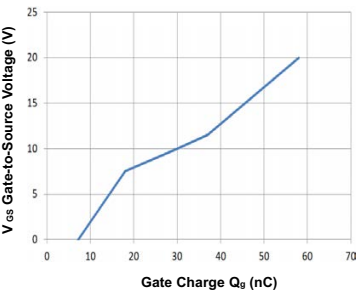


FIG.12- Gate Charge Characteristics

CMS120N080W

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

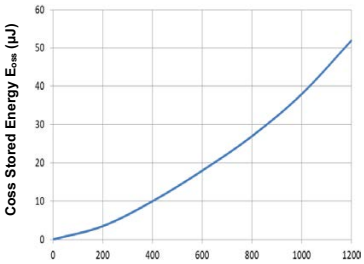


FIG.13- Output Capacitor Stored Energy

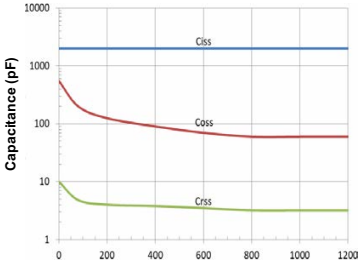


FIG.14- Capacitance vs Drain-Source Voltage

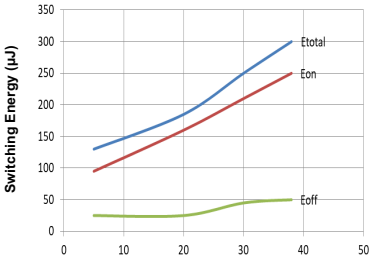


FIG.15- Clamped Inductive Switching Energy vs. Drain Current

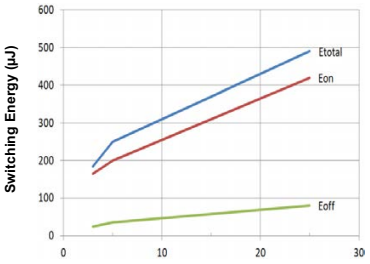


FIG.16- Clamped Inductive Switching Energy vs. $R_{G(ext)}$

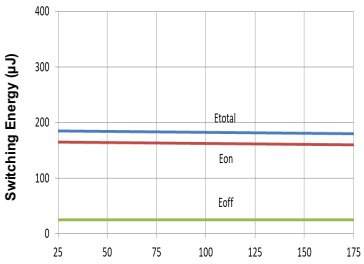


FIG.17-Clamped Inductive Switching Energy vs. Temperature

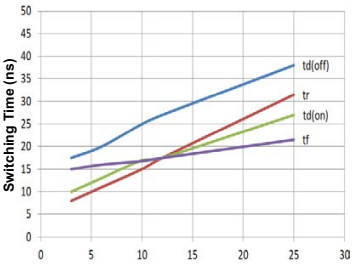


FIG.18- Switching Times vs $R_{G(ext)}$

CMS120N080W

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

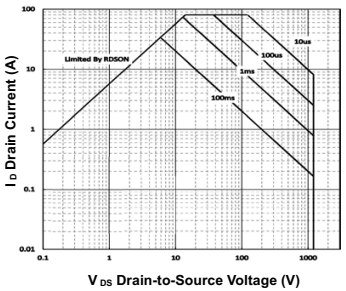


FIG.19- Safe Operating Area

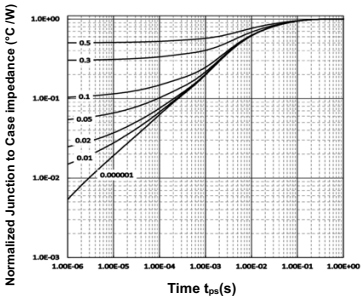


FIG.20- Transient Thermal impedance (Junction to Case)

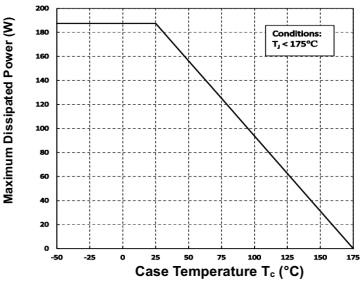


FIG.21- Maximum Power Dissipation Derating vs Case Temperature

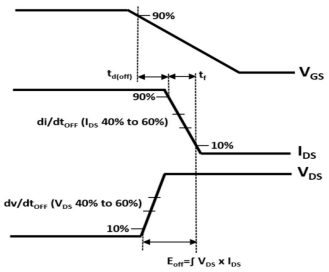


FIG.22- Turn-off Transient Definitions

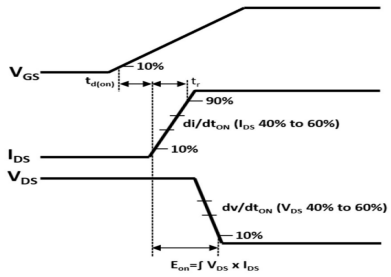


FIG.23-Turn-on Transient Definitions

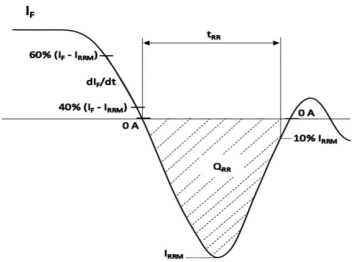


FIG.24- Reverse Recovery Definitions

CMS120N080WK

SiC N-Channel 1200-V (D-S) MOSFET

Features

- High speed switching
- High blocking voltage
- Fast reverse recovery

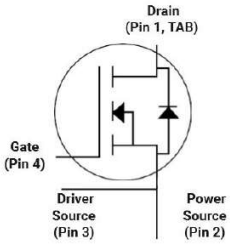
Benefits

- Low capacitance
- High system efficiency
- Easy to parallel Applications

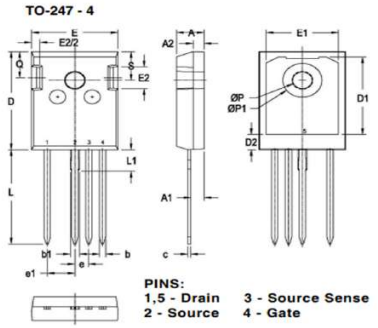
Typical Applications

- Solar inverters
- Switch mode power supplies, UPS
- Induction heating and welding
- EV charging stations
- High voltage DC/DC converters
- Motor drive

Package type：TO-247-4

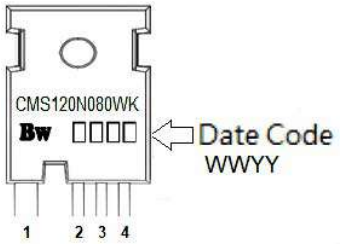


Package Dimension



SYM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.189	.205	4.80	5.20
A1	.090	.098	2.30	2.50
A2	.075	.083	1.90	2.10
b	.043	.055	1.10	1.40
b1	.063	.071	1.60	1.80
c	.020	.031	0.50	0.80
D	.819	.839	20.80	21.30
D1	.630	.670	16.00	17.00
D2	.118	.138	3.00	3.50
E	.620	.636	15.75	16.15
E1	.531	.559	13.50	14.20
E2	.169	.193	4.30	4.90
e	.100 BSC		2.54 BSC	
e1	.200 BSC		5.08 BSC	
L	.780	.799	19.80	20.30
L1	.157	.177	4.00	4.50
ØP	.140	.144	3.55	3.65
ØP1	.280	.287	7.10	7.30
Q	.213	.236	5.40	6.00
S	.242 BSC		6.15 BSC	

Marking



RoHS Compliant

CMS120N080WK

SiC N-Channel 1200-V (D-S) MOSFET

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings			
Symbol	**Parameter**	**Value**	**Units**
V_{DS}	Drain-Source Voltage	1200	V
V_{GS}	Gate-Source Voltage	-5/20	V
I_D	Continuous Drain Current (T_C =25°C)	35	A
	Continuous Drain Current(T_C =100°C)	25	A
$I_{D,pulse}$	Pulsed Drain Current	80	A
P_{tot}	Power Dissipation (T_C =25°C)	188	W
E_{AS}	Single Pulse Avalanche Energy, I_{AS}=20A ,V=50V, L =1mH	200	mJ
T_J/T_{STG}	Operating Junction and Storage Temperature	-55…175	°C

Thermal Resistance Ratings			
Symbol	**Parameter**	**Maximum**	**Units**
$R_{\theta JA}$	Maximum Junction-to-Ambient	40	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case	0.8	°C/W

Static Electrical Characteristics, (T_J=25°C unless otherwise specified)						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS} =V_{GS}, I_D =10mA	2.0	2.8	4.0	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V, I_D =1mA	1200	-	-	V
I_{GSS}+	Gate-Source Leakage Current	V_{DS} =0V, V_{GS} =20V	-	0.1	100	nA
I_{GSS}-		V_{DS} =0V, V_{GS} =-5V	-	-	-100	
I_{DSS}	Drain-Source Leakage Current	V_{DS} =1200V, V_{GS} =0V	-	-	1.0	μA
		V_{DS} =1200V, V_{GS} =0V, T_J =175°C	-	1.0	-	
$R_{DS\ (on)}$	Static Drain-Source On-Resistance	V_{GS} =20V, I_D =20A	-	77	100	mΩ
		V_{GS} =20V, I_D =10A	-	71	90	
		V_{GS} =20V, I_D =20A, T_J =125°C	-	106	-	
		V_{GS} =20V, I_D =20A, T_J =175°C	-	134	-	
R_g	Gate Input Resistance	f =1MHz,V_{AC} =25mV, D-S short	-	3.0	-	Ω

CMS120N080WK

SiC N-Channel 1200-V (D-S) MOSFET

AC Electrical Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Q_g	Total Gate Charge	V_{DD}=800 V,	-	61	-	nC
Q_{gs}	Gate-Source Charge	I_{DS}=20 A,	-	24	-	
Q_{gd}	Gate-Drain Charge	V_{GS}=-5/20V	-	14	-	
$t_{d(on)}$	Turn-On Delay Time	V_{DD}=800 V, I_{DS}=20 A,	-	9	-	ns
t_r	Rise Time	$R_{G(ext)}$=2.5 Ω, V_{GS}=-5/+20 V,	-	4	-	
$t_{d(off)}$	Turn-Off Delay Time	L=975 μH	-	15	-	
t_f	Fall Time		-	10	-	
C_{ISS}	Input Capacitance	V_{GS}=0 V, V_{DS}=1000 V,	-	1377	-	pF
C_{OSS}	Output Capacitance	f=200 kHz, V_{AC}=25mV	-	62	-	
C_{RSS}	Reverse Transfer Capacitance		-	4	-	
E_{oss}	Coss Stored Energy		-	38	-	μJ
E_{on}	Turn-On Switching Energy	V_{DD}=800 V, I_{DS}=20 A,	-	208	-	
E_{off}	Turn-Off Switching Energy	$R_{G(ext)}$=2.5 Ω, V_{GS}=-5/+20 V,	-	25	-	
E_{tot}	Total Switching Energy	L=975 μH	-	233	-	

Body Diode Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
I_S	Max Continuous Diode Forward Current	V_{GS}=-5 V, T_C=25 °C	-	-	43	A
V_{SD}	Diode Forward Voltage	V_{GS}=-5 V, I_S=10 A	-	3.8	-	V
t_{rr}	Reverse Recovery Time	I_S=20 A, V_R=800 V,	-	8	-	ns
Q_{rr}	Reverse Recovery Charge	V_{GS}=-5 V, di/dt=8 A/μs	-	130	-	nC
I_{rrm}	Peak Reverse Recovery Current		-	29	-	A

CMS120N080WK

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

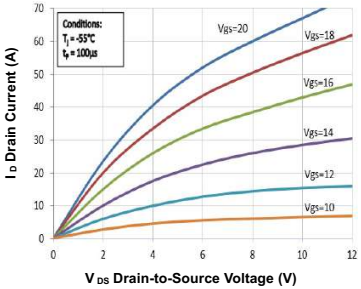


FIG.1-Output Characteristics T_J=-55°C

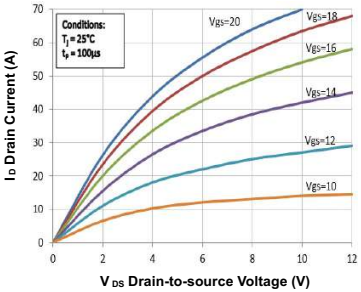


FIG.2- Output Characteristics T_J=25°C

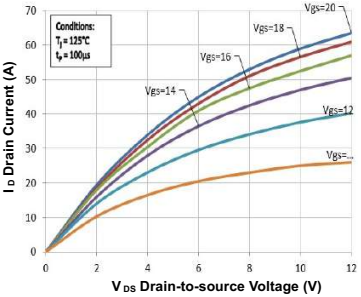


FIG.3- Output Characteristics T_J=125°C

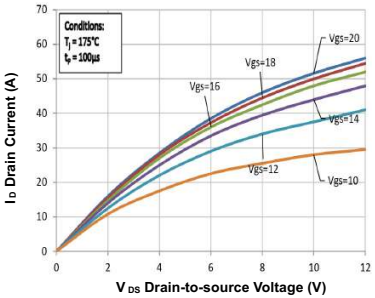


FIG.4- Output Characteristics T_J=175°C

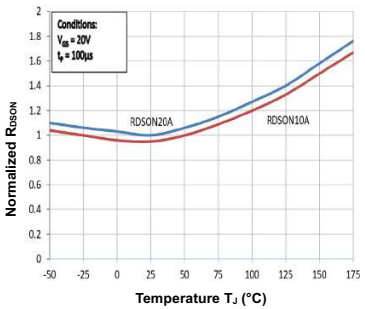


FIG.5-Normalized R_{DSON} vs. Temperature T_J

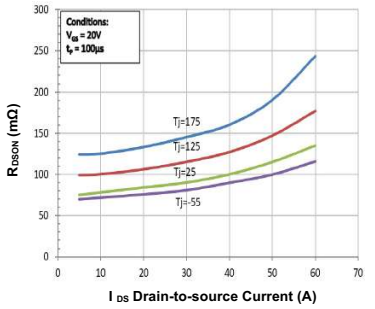


FIG.6- On-Resistance vs. Drain Current For Various Temperature

CMS120N080WK

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

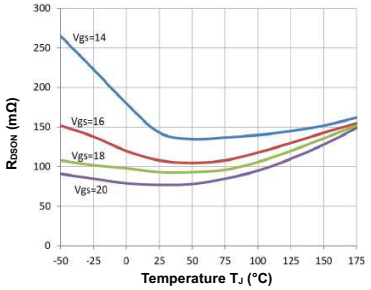


FIG.7- On-Resistance vs. Temperature For Various Gate Voltages

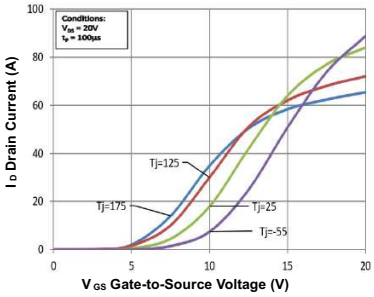


FIG.8-Transfer Characteristic for Various Junction Temperatures

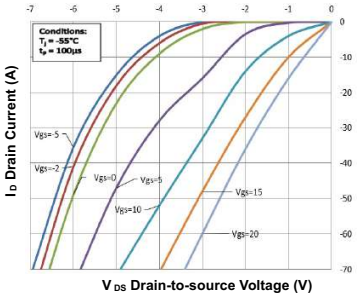


FIG.9- Body Diode Characteristics at T_J=-55°C

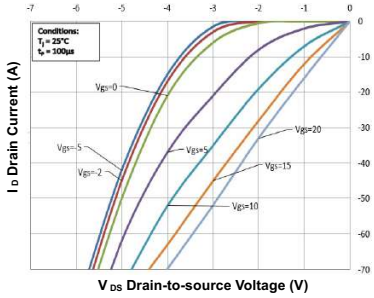


FIG.10- Body Diode Characteristics at T_J=25°C

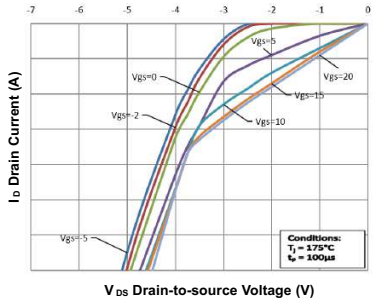


FIG.11- Body Diode Characteristics at T_J=175°C

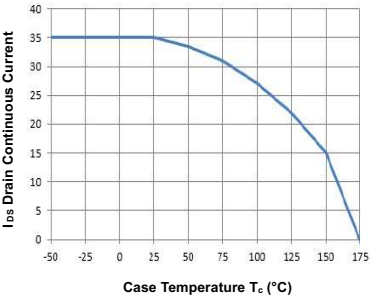


FIG.12- Continuous Drain Current Derating vs. Tc

CMS120N080WK

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

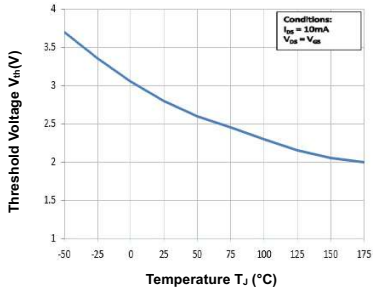


FIG.13-Threshold Voltage vs. Temperature

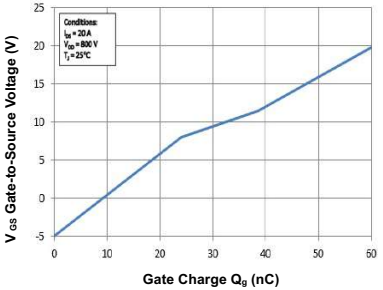


FIG.12- Gate Charge Characteristics

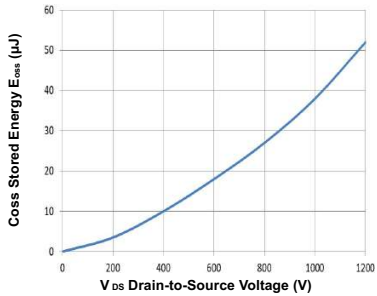


FIG.15- Output Capacitor Stored Energy

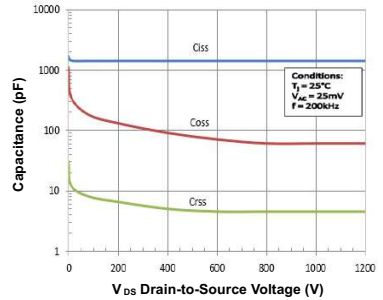


FIG.16- Capacitance vs Drain-Source Voltage

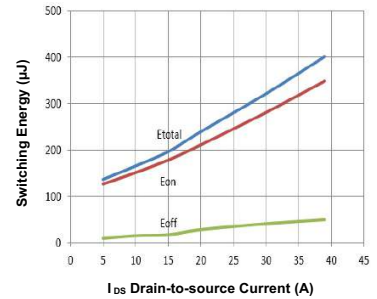


FIG.17- Clamped Inductive Switching Energy vs. Drain Current Various

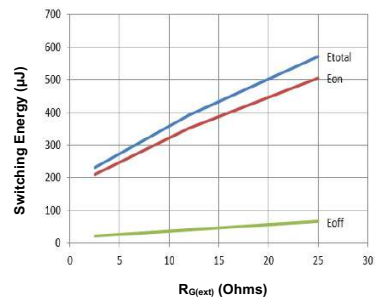


FIG.18- Clamped Inductive Switching Energy vs. $R_{G(ext)}$

CMS120N080WK

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

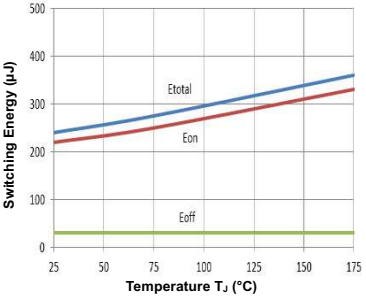


FIG.19-Clamped Inductive Switching Energy vs. Temperature

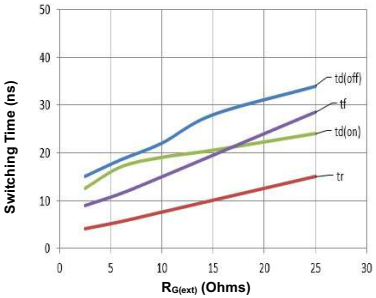


FIG.20- Switching Times vs $R_{G(ext)}$

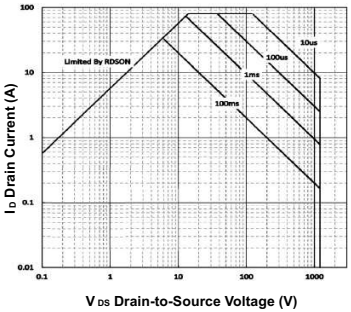


FIG.21- Safe Operating Area

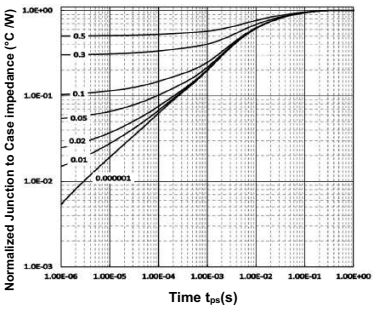


FIG.22- Transient Thermal impedance (Junction to Case)

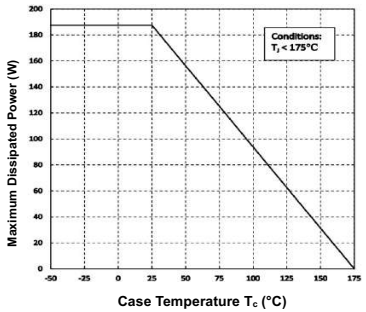


FIG.23- Maximum Power Dissipation Derating vs Case Temperature

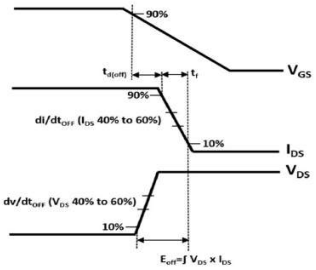


FIG.24- Turn-off Transient Definitions

CMS120N080WK

SiC N-Channel 1200-V (D-S) MOSFET

- **Typical Electrical Characteristics**

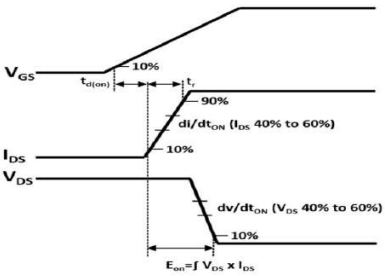


FIG.25-Turn-on Transient Definitions

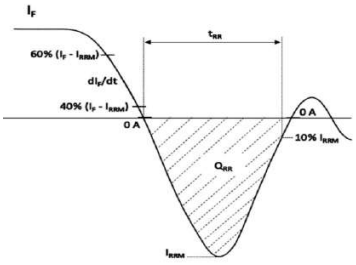


FIG.26- Reverse Recovery Definitions

With me,
Power for you.

3 GaN

In addition to traditional GaN HEMT, we use the special package design to get the same pin assignment, so it can Pin to Pin to replace Cool MOSFET (Super Junction).

All products are available in industrial grade and automotive grade.

HMP065N180C

650-V Cascode GaN HEMT

Description

These GaN HEMT utilize a GaN transistor technologys to provide low RDS(on) and using the Cascode in the TO220 pacakge to realize the normal-off high electron mobility transistor.

Also provides high breakdown voltage, high current and high operating speed which is suitable for high power applications.

Features

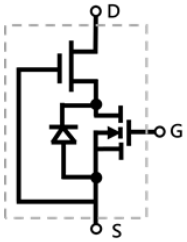
- Gate drive voltage compatibility (-20V to 20V)
- High operating frequency
- Low Q_{rr}

Typical Applications

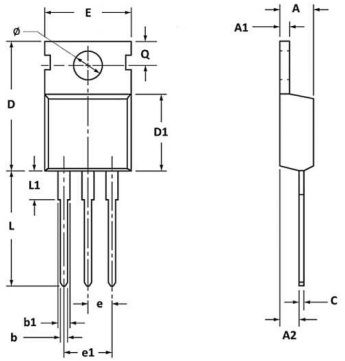
- Switch Mode Power Supplies (SMPS)
- AC-DC/ DC-DC Converters
- Motor Drives

Package type：TO220

Graphic Symbol

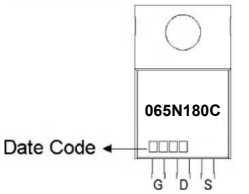


Package Dimension



SYMBOL	DIMENSION (mm)		SYMBOL	DIMENSION (mm)	
	MIN.	MAX.		MIN.	MAX.
A	4.20	4.80	E	9.70	10.40
A1	1.10	1.50	e	2.54(ref.)	
A2	2.20	3.00	e1	5.08(ref.)	
b	0.60	1.00	L	12.70	14.50
b1	1.20	1.80	L1	2.60	4.10
C	0.30	0.65	Φ	3.40	4.00
D	14.30	16.00	Q	2.50	3.00
D1	8.30	9.40			

Marking



RoHS Compliant

HMP065N180C

650-V Cascode GaN HEMT

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings			
Symbol	**Parameter**	**Value**	**Units**
V_{DS}	Drain-Source Voltage	650	V
V_{GS}	Gate-Source Voltage	-20 / +20	V
P_{tot}	Total Power dissipation @T_C =25°C	83	W
I_D	Continuous Drain Current at T_C =25°C	16.1	A
	Continuous Drain Current at T_C =100°C	11.3	A
$I_{D\ pulse}$	Pulse Drain Current (Pulse width =10 μs)[2]	60.4	A
T_J/T_{STG}	Operating Junction and Storage Temperature	-55…150	°C
T_{SOLD}	Soldering peak temperature	260	°C

Notes

1. In off-state, spike duty cycle D<0.01, spike duration <1 μs
2. Value is not tested to full current in production.

Thermal Resistance Ratings			
Symbol	**Parameter**	**Maximum**	**Units**
$R_{\theta JA}$	Maximum Junction-to-Ambient	50	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case	1.5	°C/W

HMP065N180C

650-V Cascode GaN HEMT

Static Electrical Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS} =10V, I_D =1mA	-	1.7	3.0	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V	650	-	-	V
I_{DSS}	Drain-Source Leakage Current	V_{DS} =650V, V_{GS} =0V, T_J =25°C	-	2.5	30	μA
		V_{DS} =650V, V_{GS} =0V, T_J =150°C	-	10	-	
$R_{DS\ (on)}$	Static Drain-Source On-Resistance	V_{GS} =10V, I_D =5A, T_J =25°C	-	146	180	mΩ
		V_{GS} =10V, I_D =5A, T_J =150°C	-	296	-	
I_{GSS}	Gate-Source Leakage Current	V_{GS} =+/- 20V	-	-	+/-100	nA

AC Electrical Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
C_{ISS}	Input Capacitance	V_{GS}=0 V, V_{DS}=400 V, f=100kHz	-	846	-	pF
C_{OSS}	Output Capacitance		-	23.2	-	
C_{RSS}	Reverse Transfer Capacitance		-	4.2	-	
Q_g	Total Gate Charge	V_{DS} = 400V, V_{GS} = 0 to 10V, I_{DS}=5A	-	8.3	-	nC
Q_{GS}	Gate-Source Charge		-	2.7	-	
Q_{OSS}	Output Charge	V_{GS}=0V, V_{DS}=0~400V	-	33	-	
Q_{RR}	Reverse Recovery Charge	I_S=5V, V_{DS}=0V	-	48	-	
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 400 V, V_{GS} = 0 to 10V, I_{DS} = 2A, R_G(on) = 25 Ω,	-	10	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	20	-	
P_D	Maximum power dissipation	Tc =25°C	-	83	-	W

HMP065N180C

650-V Cascode GaN HEMT

- **Typical Electrical Characteristics**

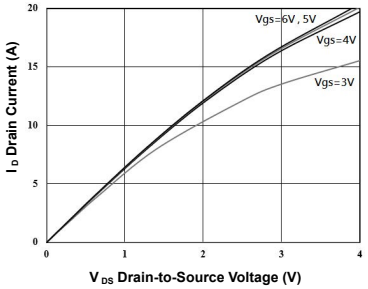


FIG.1-Output Characteristics T_J=25°C

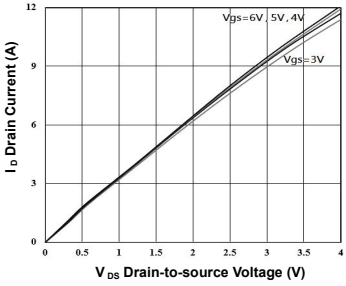


FIG.2- Output Characteristics T_J=150°C

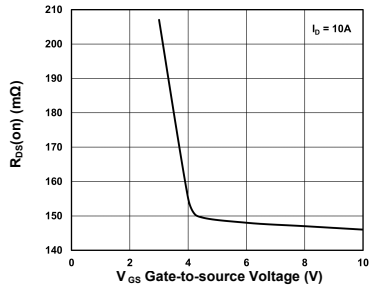


FIG.3- Resistance vs V_{GS}

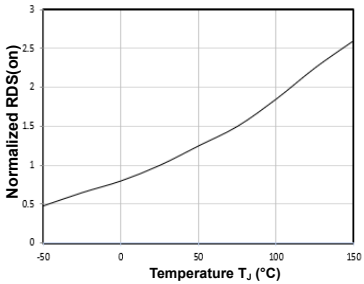


FIG.4- Normalized RDS(on) vs. Temperature

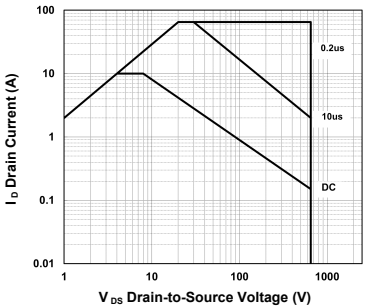


FIG.5- Safe Operating Area

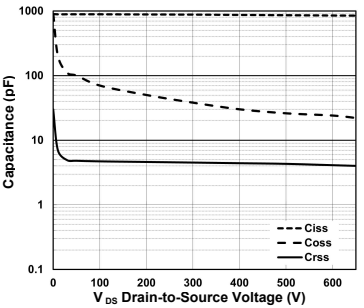


FIG.6- Capacitance vs Drain-Source Voltage

HMP065N180C

650-V Cascode GaN HEMT

- **Typical Electrical Characteristics**

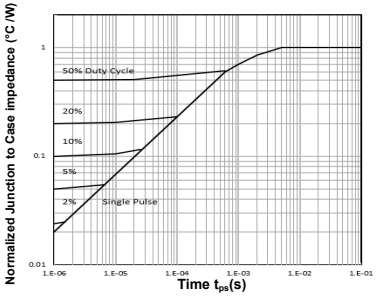


FIG.7- Transient Thermal impedance (Junction to Case)

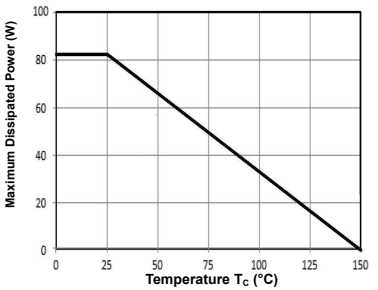


FIG.8- Maximum Power Dissipation Derating vs Case Temperature

HMHC065N185C

650-V Cascode GaN HEMT

Description

These miniature surface mount GaN HEMT utilize a GaN transistor technologys to provide low RDS(on) and using the Cascode in the DFN pacakge to realize the normal-off high electron mobility transistor.

Also provides high breakdown voltage, high current and high operating speed which is suitable for high power applications.

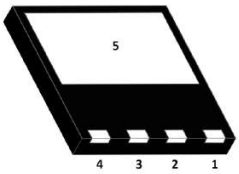
Features

- Gate drive voltage compatibility (-20V to 20V)
- High operating frequency
- Low Q_{rr}

Typical Applications

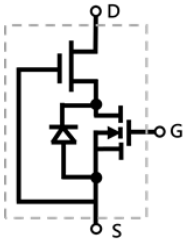
- Switch Mode Power Supplies (SMPS)
- AC-DC/ DC-DC Converters
- Motor Drives

Package type：DFN 8X8

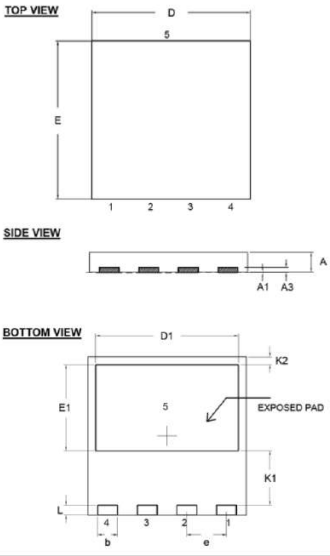


Gate: 1
Driver Source: 2
Power Source: 3, 4
Drain: 5

Graphic Symbol

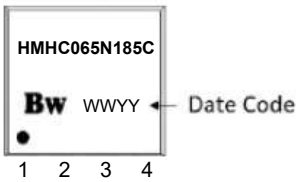


Package Dimension



SYMBOL	Dimension (mm)	
	Min	Max
A	1.20	1.30
A1	--	0.05
A3	0.06 ~ 0.25 REF	
D	7.90	8.10
E	7.90	8.10
D1	7.10	7.30
E1	4.25	4.45
b	0.90	1.10
L	0.40	0.60
K1	2.65	2.85
K2	0.30	0.50
e	2.00 BSC	

Marking



RoHS Compliant

HMHC065N185C

650-V Cascode GaN HEMT

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings			
Symbol	**Parameter**	**Value**	**Units**
V_{DS}	Drain-Source Voltage	650	V
$V_{(TR)DSS}$	Transient drain to source voltage[1]	800	V
V_{GS}	Gate-Source Voltage	-20 / +20	V
I_D	Continuous Drain Current at T_C =25°C	15	A
	Continuous Drain Current at T_C =100°C	10	A
$I_{D\ pulse}$	Pulse Drain Current (Pulse width =10 μs)[2]	45	A
T_J/T_{STG}	Operating Junction and Storage Temperature	-55…150	°C
T_{SOLD}	Soldering peak temperature	260	°C

Notes

1. In off-state, spike duty cycle D<0.01, spike duration <1 μs
2. Value is not tested to full current in production.

Thermal Resistance Ratings			
Symbol	**Parameter**	**Maximum**	**Units**
$R_{\theta JA}$	Maximum Junction-to-Ambient	54	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case	1.5	°C/W

HMHC065N185C

650-V Cascode GaN HEMT

Static Electrical Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GS\,(th)}$	Gate Threshold Voltage	V_{DS} =10V, I_D =1mA	-	1.8	3.0	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V	650	-	-	V
I_{DSS}	Drain-Source Leakage Current	V_{DS} =650V, V_{GS} =0V, T_J =25°C	-	2.5	30	μA
		V_{DS} =650V, V_{GS} =0V, T_J =150°C	-	10	-	
$R_{DS\,(on)}$	Static Drain-Source On-Resistance	V_{GS} =10V, I_D =5A, T_J =25°C	-	150	185	mΩ
		V_{GS} =10V, I_D =5A, T_J =150°C	-	302	-	
I_{GSS}	Gate-Source Leakage Current	V_{GS} =+/- 20V	-	-	+/-100	nA

AC Electrical Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
C_{ISS}	Input Capacitance	V_{GS}=0 V, V_{DS}=400 V, f=100kHz	-	830	-	pF
C_{OSS}	Output Capacitance		-	22	-	
C_{RSS}	Reverse Transfer Capacitance		-	3.9	-	
Q_g	Total Gate Charge	V_{DS} = 400V, V_{GS} = 0 to 10V, I_{DS}=5A	-	8.6	-	nC
Q_{GS}	Gate-Source Charge		-	2.7	-	
Q_{OSS}	Output Charge	V_{GS}=0V, V_{DS}=0~400V	-	33	-	
Q_{RR}	Reverse Recovery Charge	I_S=5V, V_{DS}=0V	-	48	-	
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 400 V, V_{GS} = 0 to 10V, I_{DS} = 2A, R_G(on) = 25 Ω,	-	10	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	20	-	
P_D	Maximum power dissipation	Tc =25°C	-	83	-	W

HMHC065N185C

650-V Cascode GaN HEMT

- **Typical Electrical Characteristics**

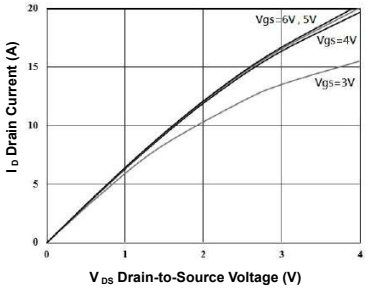


FIG.1-Output Characteristics T_J=25°C

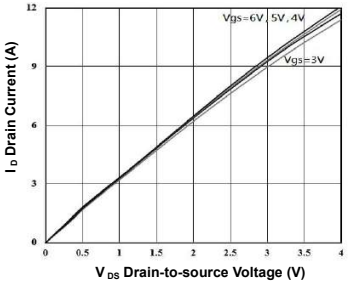


FIG.2- Output Characteristics T_J=150°C

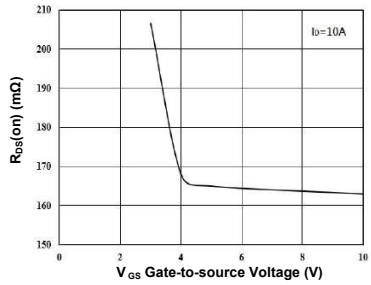


FIG.3- Resistance vs V_{GS}

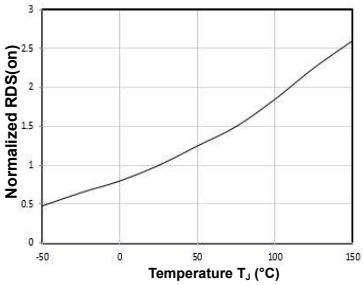


FIG.4- Normalized RDS(on) vs. Temperature

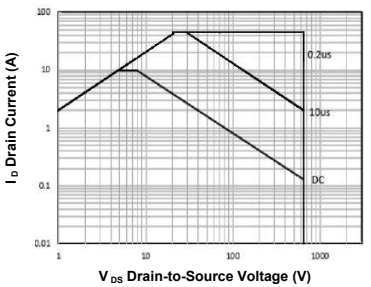


FIG.5- Safe Operating Area

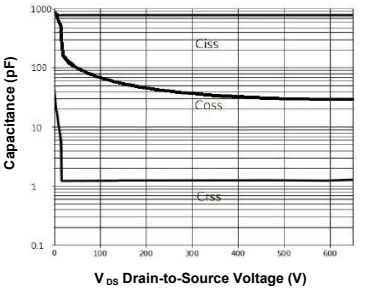


FIG.6- Capacitance vs Drain-Source Voltage

HMHC065N185C

650-V Cascode GaN HEMT

- **Typical Electrical Characteristics**

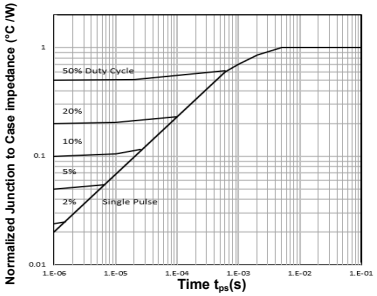


FIG.7- Transient Thermal impedance (Junction to Case)

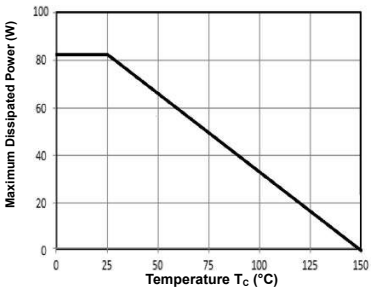
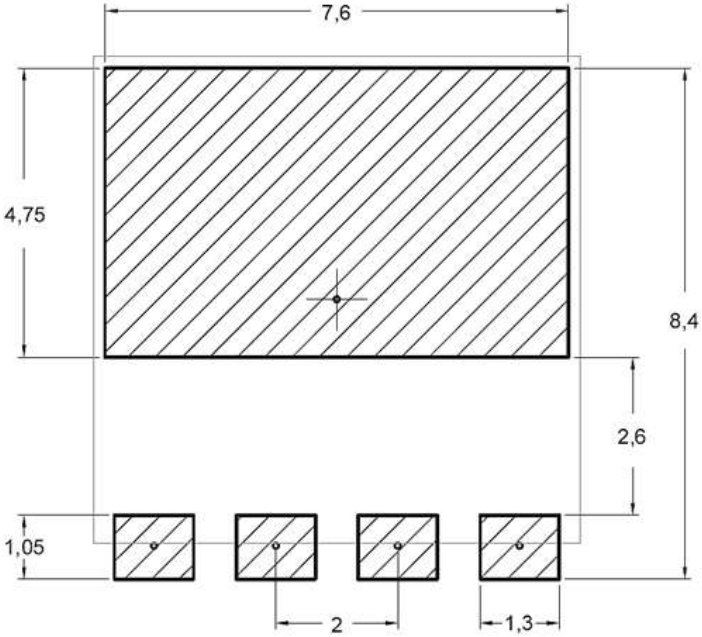


FIG.8- Maximum Power Dissipation Derating vs Case Temperature

DFN-8X8 Recommended PCB Soldering Footprint

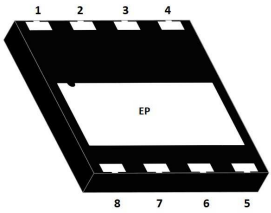


HMHL065N170CI DFN 8x8 Integrated Cascode GaN

Description

HMHL065N170CI is an integrated D-mode Cascode GaN power transistor which possesses benefits of Cascode GaN and modified switching performance. HMHL065N170CI provides high breakdown voltage, high current and high operating speed which is suitable for high power applications.

HMHL065N170CI (DFN 8x8x1.3)



AVDD: 5
RSET: 6
PWM: 7
VDD: 8

Drain: 1, 2, 3, 4
Source: EP

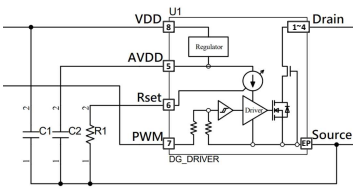
Key Specifications

Part Number	HMHL065N170CI
V_{DSS}, min.	650V
$V_{(TR)DSS}$, min.	800V
$R_{DS(ON)}$, typ.	170mΩ
Package	DFN 8 x 8 mm

Features

- Gate drive voltage compatibility (up to 30V)
- High operating frequency
- Zero reverse recovery loss
- Wide Vcc Range (10V~30V)
- 5 V / 15 V input-compatible
- Programmable turn-on dv/dt
- 1 MHz operation

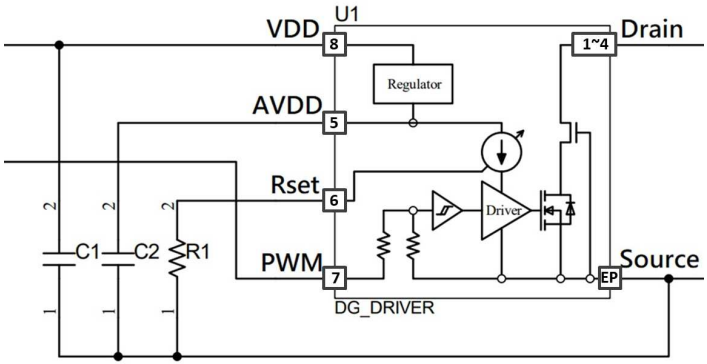
Typical Application Circuit



Applications

- Switch Mode Power Supplies (SMPS)
- AC-DC/ DC-DC Converters
- Motor Drives

1- Pin Description



Pin No.	Symbol	Description
1~4	Drain	Connect to the drain terminal of Cascode GaN
5	AV_{DD}	Gate driver supply voltage.
6	R_{SET}	dv/dt setting pin.
7	PWM	PWM input.
8	V_{DD}/Vin	Supply voltage
EP	Source	Connect to the source terminal of Cascode GaN

2- Electrical Characteristics

➢ **Table 1 Absolute maximum ratings**

Symbol	Parameter	Value	Unit
V_{DSS}	Drain-source voltage	650	V
$V_{(TR)DSS}$	Transient drain to source voltage[a]	800	V
V_{DD}	Supply Voltage	40	V
V_{PWM}	PWM Voltage	30	V
V_{AVDD}	Internal Operating Voltage	7	V
V_{RSET}	Slew rate setting Voltage	7	V
P_{tot}	Total power dissipation @T_C = 25°C	60	W

I_D	Drain current (continuous) at T_C = 25°C operation		8	A
	Drain current (continuous) at T_C = 100°C operation		5	A
I_{DM}	Pulsed drain current (pulse width: 100□s)		13	A
T_c	Operating temperature	Case	-55 to +150	°C
T_J		Junction	-55 to +150	°C
T_S	Storage temperature		-55 to +150	°C
T_{SOLD}	Soldering peak temperature[b]		260	°C

a. In off-state, spike duty cycle D<0.01, spike duration <1□s
b. For 10 sec., 1.6mm from the case

➢ Table 2 Thermal Characteristics

Symbol	Parameter	Value	Unit
$R_{\Theta JA}$	Thermal resistance junction-ambient	38	°C/W
$R_{\Theta JC}$	Thermal resistance junction-case	2.0	°C/W

➢ Table 3 Electrical Characteristics

Vin=15V, Vds=400V,Fsw=1MHz, Rset=10kΩ，T_{CASE} = 25 °C unless otherwise stated

Symbol	Parameter	Conditions	Values			Unit
			min.	typ.	max.	
$V_{(BL)DSS}$	Drain-source voltage	V_{GS}=0V	650	-	-	V
V_{DD}	VIN Operating Voltage		8		30	V
I_Q	VIN Quiescent Current	V_{PWM}=0V		0.1	0.3	mA
I_Q	VIN Operating Current	F_{SW}= 500kHz, C_{OUT}= 100pF		1	3	mA
V_{AVDD}	Internal Operating Voltage		4.8	5.0	5.2	V
V_{PWMH}	PWM Logic High Threshold				4	V
V_{PWML}	PWM Logic Low Threshold		1			V
V_{PWM_HYS}	PWM Input Logic Hysteresis			3		V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS}=10V, I_D=5A, T_J=25 °C	-	170	240	mΩ
		V_{GS}=10V, I_D=5A, T_J=150 °C	-	330	-	
I_{DSS}	Drain-source leakage current	V_{GS} =0V, V_{DS} =650V, T_J=25°C	-	2.2	12	□A
		V_{GS} =0V, V_{DS} =650V, T_J=150°C	-	100	-	
$t_{D(on)}$	Turn-On Propagation Delay	PWM=0 to 5V	-	15	-	ns
$t_{D(off)}$	Turn-Off Propagation Delay	PWM=0 to 5V	-	25	-	
T_R	Drain Rise Time	PWM=0 to 5V		5		ns
T_F	Drain Fall Time	PWM=0 to 5V		5		ns
F_{SW}	Switching Frequency				1	MHz
t_{PW}	Pulse Width		0.05			us
Q_{RR}	Reverse recovery charge	V_{GS} =-10V, V_{DS} =0V	-		-	nC

Recommended Operating Conditions

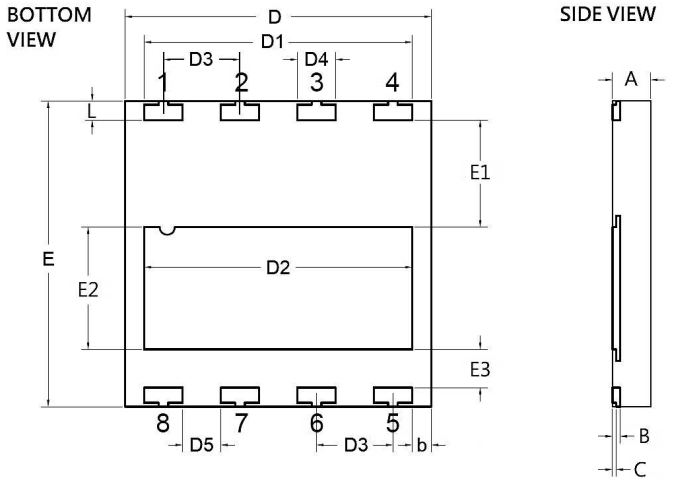
Parameter	Symbol	Value	Unit
Supply Voltage	V_{DD}	10~30	V
PWM Voltage	V_{PWM}	5/15	V
Internal Operating Voltage	V_{AVDD}	5.6	V
Slew rate setting resistor	R_{SET}	10K~100K	Ω
Operating Ambient Temperature	T_{OP}	-40~125	°C

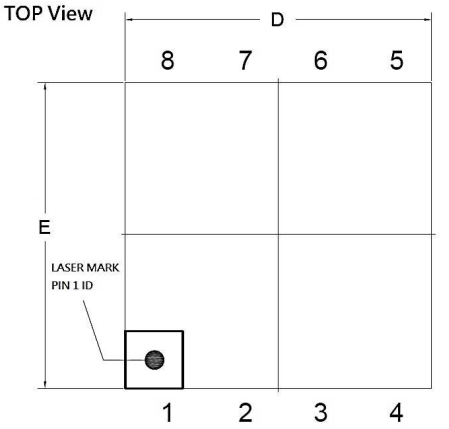
Recommended Component Values

The following table shows the recommended component values for the external C_{VDD}, R_{PWM}, C_{PWM}, C_{AVDD}, and R_{SET}. These components should be placed as close as possible to the power device.

Parameter	Symbol	Min	Typ	Max	Unit
VDD capacitor	CVDD		0.1		uF
VAVDD capacitor	CAVDD		0.022		uF
Gate driver turn-on current set resistor	RSET	10		100	KΩ
PWM filter resistor	RPWM		100		Ω
PWM filter capacitor	CPWM		100		pF

3- Package Outline Dimensions

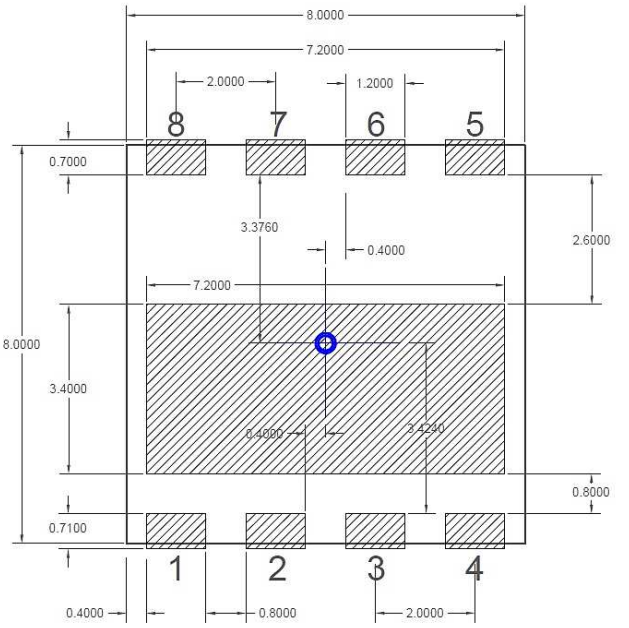




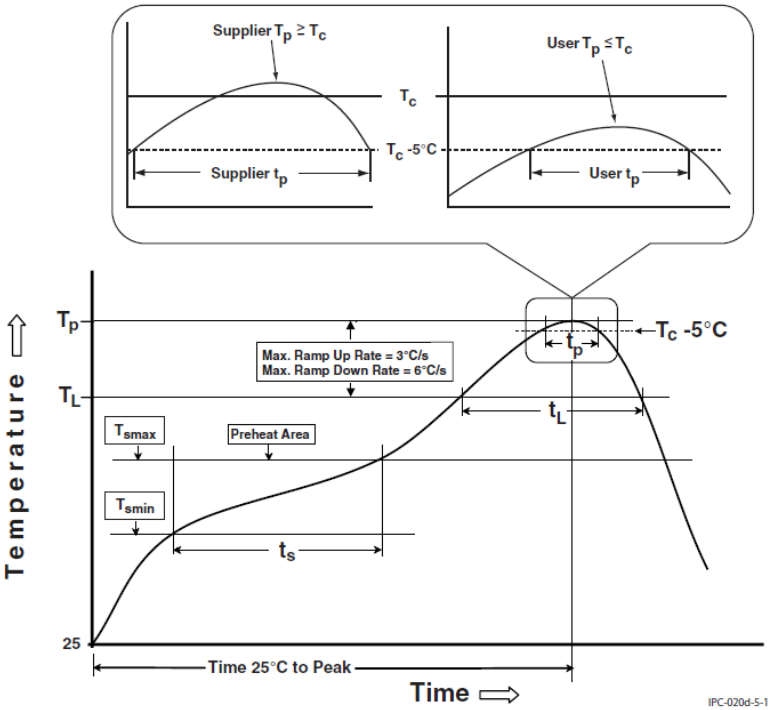
➢ **Table 4 Dimension**

SYMBOL	DIMENSION (IN MM)			SYMBOL	DIMENSION (IN MM)		
	MINIMUM	MOMINAL	MAXIMUM		MINIMUM	MOMINAL	MAXIMUM
A	1.20	1.30	1.40	-	-	-	-
B	--	0.203	--	-	-	-	-
C	--	0.100	--	-	-	-	-
D	7.90	8.00	8.10	E	7.90	8.00	8.10
D1	6.90	7.00	7.10	E1	2.70	2.80	2.90
D2	6.90	7.00	7.10	E2	3.10	3.20	3.30
D3		2.00 BSC		E3	0.90	1.00	1.10
D4	0.95	1.00	1.05	L	0.40	0.50	0.60
D5	0.95	1.00	1.05	-	-	-	-
b	0.40	0.50	0.60	-	-	-	-

DFN-8X8 Recommended PCB Soldering Footprint



Reflow Soldering Profile



HMHL065N185C

650-V Cascode GaN HEMT

Description

These miniature surface mount GaN HEMT utilize a GaN transistor technologys to provide low RDS(on) and using the Cascode in the DFN pacakge to realize the normal-off high electron mobility transistor.

Also provides high breakdown voltage, high current and high operating speed which is suitable for high power applications.

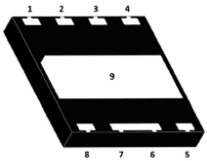
Features

- Gate drive voltage compatibility (-20V to 20V)
- High operating frequency
- Low Q_{rr}

Typical Applications

- Switch Mode Power Supplies (SMPS)
- AC-DC/ DC-DC Converters
- Motor Drives

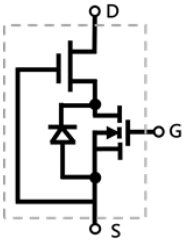
Package type：DFN 8X8



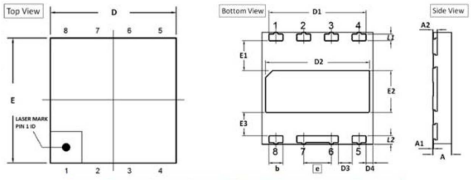
Drain: 1, 2, 3, 4
Source: 5, 6, 7, 9
Gate: 8

RoHS Compliant

Graphic Symbol

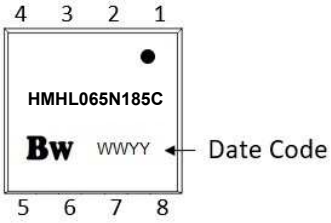


Package Dimension



SYMBOL	DIMENSION(unit : mm)			SYMBOL	DIMENSION(unit : mm)		
	MIN	TYP	MAX		MIN	TYP	MAX
A	1.20	1.25	1.30	e	2.00 BSC		
A1	--	0.02	0.05	E	7.90	8.00	8.10
A2	0.203 REF			E1	2.00	2.10	2.20
b	0.95	1.00	1.05	E2	2.90	3.00	3.10
D	7.90	8.00	8.10	E3	1.60	1.70	1.80
D1	6.90	7.00	7.10	L1	0.38	0.48	0.58
D2	7.40	7.50	7.60	L2	0.50	0.60	0.70
D3	0.90	1.00	1.10				
D4	0.40	0.50	0.60				

Marking



HMHL065N185C

650-V Cascode GaN HEMT

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings			
Symbol	**Parameter**	**Value**	**Units**
V_{DS}	Drain-Source Voltage	650	V
$V_{(TR)DSS}$	Transient drain to source voltage[1]	800	V
V_{GS}	Gate-Source Voltage	-20 / +20	V
I_D	Continuous Drain Current at T_C =25°C	12	A
	Continuous Drain Current at T_C =100°C	8	A
$I_{D\ pulse}$	Pulse Drain Current (Pulse width =10 μs)[2]	21	A
T_J/T_{STG}	Operating Junction and Storage Temperature	-55…150	°C
T_{SOLD}	Soldering peak temperature	260	°C

Notes

1. In off-state, spike duty cycle D<0.01, spike duration <1 μs
2. Value is not tested to full current in production.

Thermal Resistance Ratings			
Symbol	**Parameter**	**Maximum**	**Units**
$R_{\theta JA}$	Maximum Junction-to-Ambient	54	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case	2.8	°C/W

HMHL065N185C

650-V Cascode GaN HEMT

Static Electrical Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS} =10V, I_D =1mA	-	1.7	2.2	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V	650	-	-	V
I_{DSS}	Drain-Source Leakage Current	V_{DS} =650V, V_{GS} =0V, T_J =25°C	-	2.5	30	μA
		V_{DS} =650V, V_{GS} =0V, T_J =150°C	-	10	-	
$R_{DS\ (on)}$	Static Drain-Source On-Resistance	V_{GS} =6V, I_D =5A, T_J =25°C	-	150	185	mΩ
		V_{GS} =6V, I_D =5A, T_J =150°C	-	302	-	
I_{GSS}	Gate-Source Leakage Current	V_{GS} =+/- 20V	-	-	+/-100	nA

AC Electrical Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
C_{ISS}	Input Capacitance	V_{GS}=0 V, V_{DS}=400 V, f=100kHz	-	505	-	pF
C_{OSS}	Output Capacitance		-	29	-	
C_{RSS}	Reverse Transfer Capacitance		-	1	-	
Q_g	Total Gate Charge	VDS = 400V, VGS = 0 to 10V, IDS=5A	-	10	-	nC
Q_{GS}	Gate-Source Charge		-	4.3	-	
Q_{OSS}	Output Charge	VGS=0V, VDS=0~400V	-	36	-	
Q_{RR}	Reverse Recovery Charge	IS=5V, VDS=0V	-	46	-	
$t_{d(on)}$	Turn-On Delay Time	VDD = 400 V, VGS = 0 to 10V, IDS = 2A, RG(on) = 25 Ω,	-	9	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	20	-	

HMHL065N185C

650-V Cascode GaN HEMT

- **Typical Electrical Characteristics**

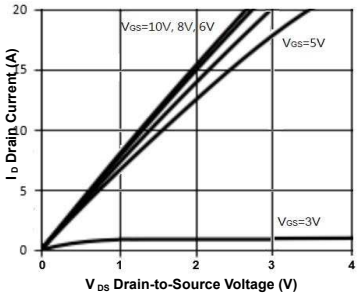


FIG.1-Output Characteristics T_J=25°C

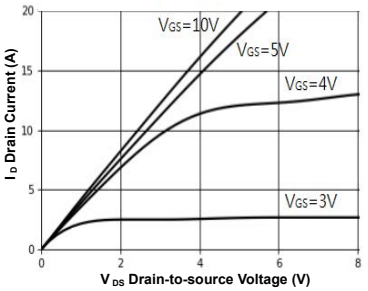


FIG.2- Output Characteristics T_J=150°C

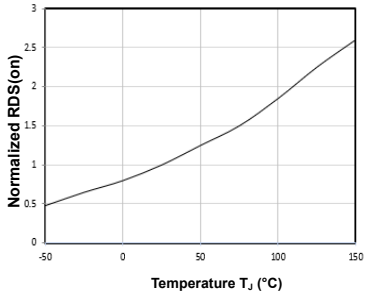


FIG.3- Normalized RDS(on) vs. Temperature

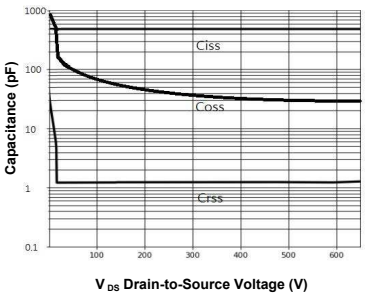


FIG.4- Capacitance vs Drain-Source Voltage

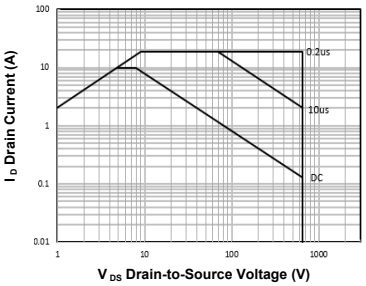


FIG.5- Safe Operating Area

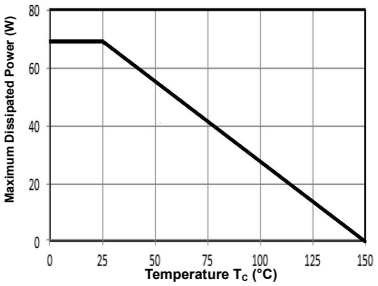


FIG.6- Maximum Power Dissipation Derating vs Case Temperature

HMHL065N185C

650-V Cascode GaN HEMT

- **Typical Electrical Characteristics**

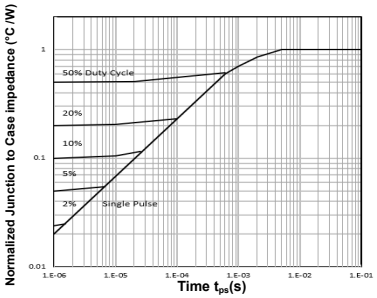


FIG.7- Transient Thermal impedance (Junction to Case)

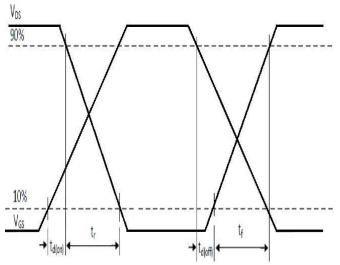
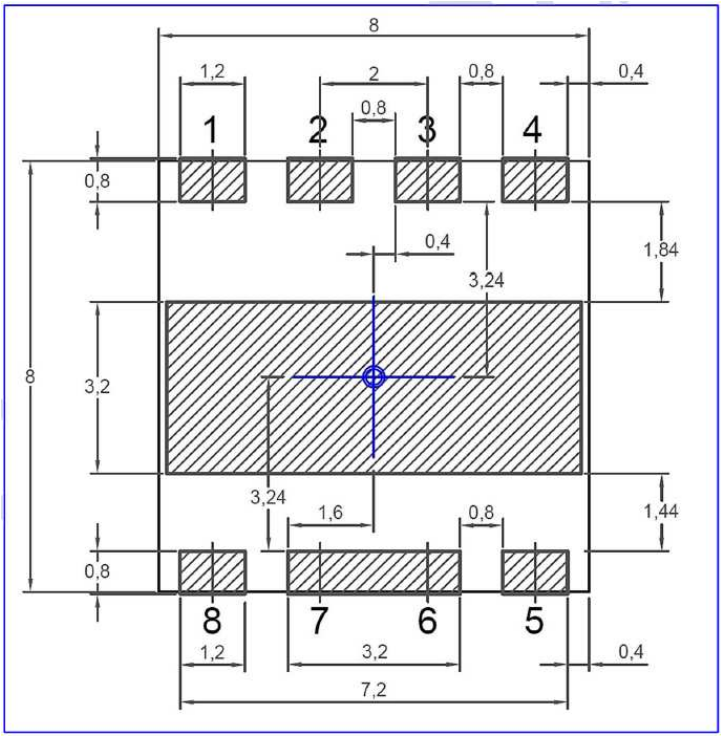


FIG.8- Switching Time Waveforms

HMHL065N185C

650-V Cascode GaN HEMT

DFN-8X8 Recommended PCB Soldering Footprint



HMHL065N210E

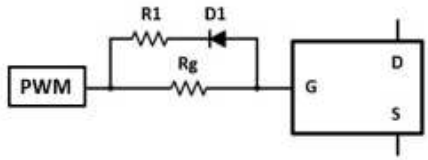
650-V GaN E-mode Power Transistor

Description

GaN based power transistor which possesses not only enhancement mode (e-mode) GaN's benefits but also compatibility.

This GaN provides low RDS(on) in the DFN package to realize the normal-off high electron mobility transistor. Also provides high breakdown voltage, high current and high operating speed which is suitable for high power applications.

Typical Application Circuit



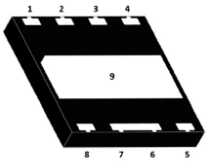
Features

- Gate drive voltage compatibility (-10V to 18V)
- High operating frequency
- Zero reverse recovery loss

Typical Applications

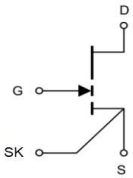
- Switch Mode Power Supplies (SMPS)
- AC-DC/ DC-DC Converters
- Motor Drives

Package type：DFN 8X8

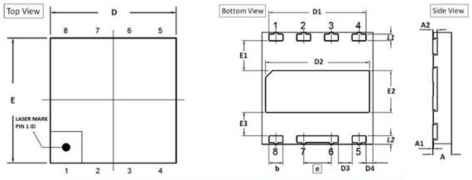


Drain: 1, 2, 3, 4
Source: 5, 6, 7, 9
Gate: 8

Graphic Symbol

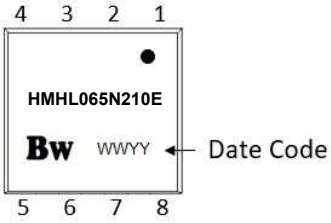


Package Dimension



SYMBOL	DIMENSION(unit : mm)			SYMBOL	DIMENSION(unit : mm)		
	MIN	TYP	MAX		MIN	TYP	MAX
A	1.20	1.25	1.30	e	2.00 BSC		
A1	--	0.02	0.05	E	7.90	8.00	8.10
A2	0.203 REF			E1	2.00	2.10	2.20
b	0.95	1.00	1.05	E2	2.90	3.00	3.10
D	7.90	8.00	8.10	E3	1.60	1.70	1.80
D1	6.90	7.00	7.10	L1	0.38	0.48	0.58
D2	7.40	7.50	7.60	L2	0.50	0.60	0.70
D3	0.90	1.00	1.10				
D4	0.40	0.50	0.60				

Marking



RoHS Compliant

HMHL065N210E

650-V GaN E -mode Power Transistor

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings			
Symbol	**Parameter**	**Value**	**Units**
V_{DS}	Drain-Source Voltage	650	V
$V_{(TR)DSS}$	Transient drain to source voltage[1]	800	V
V_{GS}	Gate-Source Voltage	-10 / +18	V
I_D	Continuous Drain Current at T_C =25°C	10	A
	Continuous Drain Current at T_C =100°C	6	A
$I_{D\ pulse}$	Pulse Drain Current (Pulse width =10 μs)[2]	20	A
P_D	Power Dissipation (T_C =25°C)	70	W
T_J/T_{STG}	Operating Junction and Storage Temperature	-55…150	°C
T_{SOLD}	Soldering peak temperature	260	°C

Notes

1. In off-state, spike duty cycle D<0.01, spike duration <1 μs
2. Value is not tested to full current in production.

Thermal Resistance Ratings			
Symbol	**Parameter**	**Maximum**	**Units**
$R_{\theta JA}$	Maximum Junction-to-Ambient	50	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case	2.5	°C/W

HMHL065N210E

650-V GaN E -mode Power Transistor

Static Electrical Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS} =10V, I_D =1mA	1.2	1.6	2.0	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V	650	-	-	V
I_{DSS}	Drain-Source Leakage Current	V_{DS} =650V, V_{GS} =0V, T_J =25°C	-	0.5	12	μA
		V_{DS} =650V, V_{GS} =0V, T_J =150°C	-	100	-	
$R_{DS\ (on)}$	Static Drain-Source On-Resistance	V_{GS} =10V, I_D =5A, T_J =25°C	-	150	210	mΩ
		V_{GS} =10V, I_D =5A, T_J =150°C	-	320	-	

AC Electrical Characteristics, (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
C_{ISS}	Input Capacitance	V_{GS}=0 V, V_{DS}=400 V, f=100kHz	-	80	-	pF
C_{OSS}	Output Capacitance		-	50	-	
C_{RSS}	Reverse Transfer Capacitance		-	1	-	
Q_g	Total Gate Charge	VDS = 400V, VGS = 0 to 10V, IDS=10A	-	2.6	-	nC
Q_{GS}	Gate-Source Charge		-	1	-	
Q_{OSS}	Output Charge	VGS=0V, VDS=0~400V	-	20	-	
Q_{RR}	Reverse Recovery Charge	VGS=-10V, VDS=0V	-	0	-	
$t_{d(on)}$	Turn-On Delay Time	VDD = 400 V, VGS = 0 to 12 V, IDS = 7 A, RG(on) = 25 Ω,	-	3	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	7	-	

HMHL065N210E

650-V GaN E -mode Power Transistor

- **Typical Electrical Characteristics**

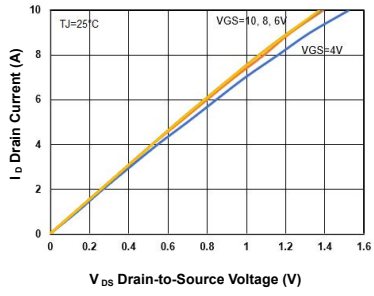


FIG.1-Output Characteristics T_J=25°C

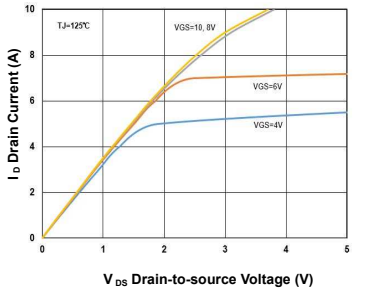


FIG.2- Output Characteristics T_J=125°C

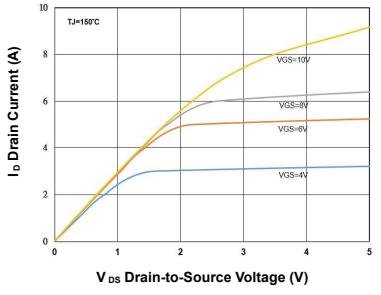


FIG.3-Output Characteristics T_J=150°C

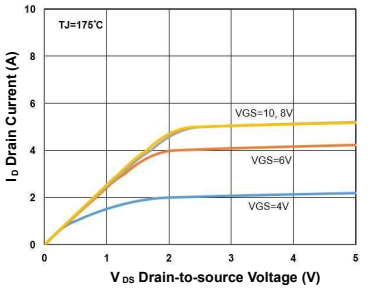


FIG.4- Output Characteristics T_J=175°C

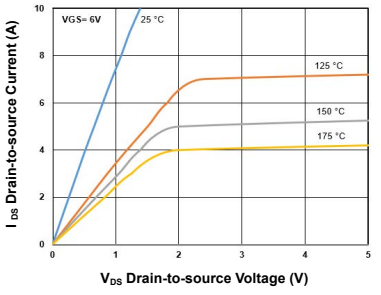


FIG.5-Drain Current vs Drain voltage For Various Temperature

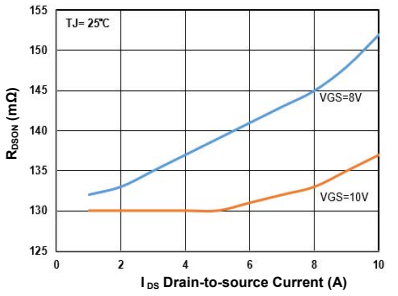


FIG.6- On-Resistance vs. Drain Current TJ=25°C

HMHL065N210E

650-V GaN E -mode Power Transistor

- **Typical Electrical Characteristics**

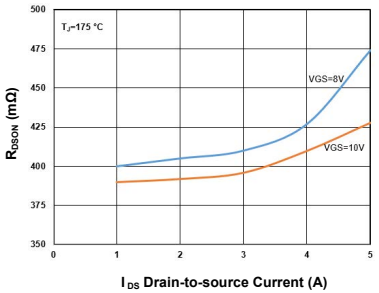


FIG.7- On-Resistance vs. Drain Current TJ=175°C

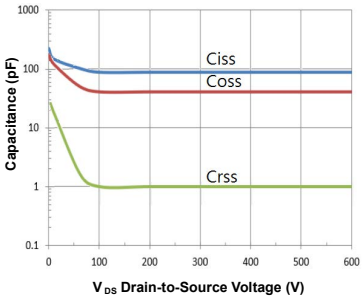


FIG.8- Capacitance vs Drain-Source Voltage

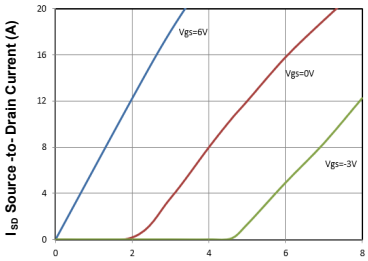


FIG.9- Reverse Conduction Characteristics at T_J=25°C

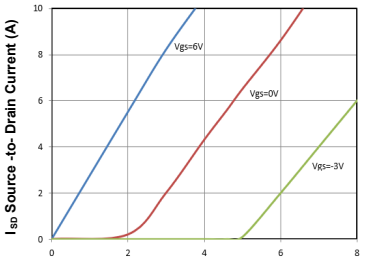


FIG.10- Reverse Conduction Characteristics at T_J=150°C

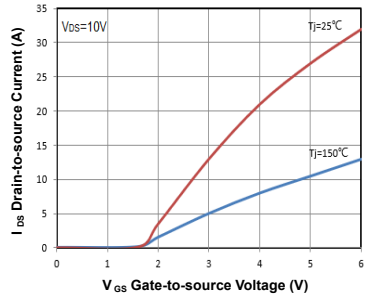


FIG.11-Drain Current vs. Gate voltage For Various Temperature

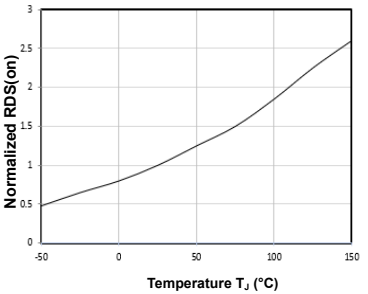


FIG.12- Normalized RDS(on) vs. Temperature

HMHL065N210E

650-V GaN E -mode Power Transistor

- **Typical Electrical Characteristics**

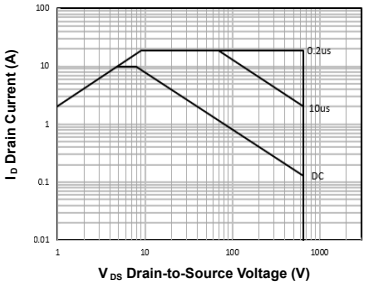


FIG.13- Safe Operating Area

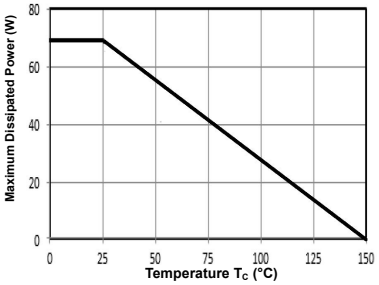


FIG.14- Maximum Power Dissipation Derating vs Case Temperature

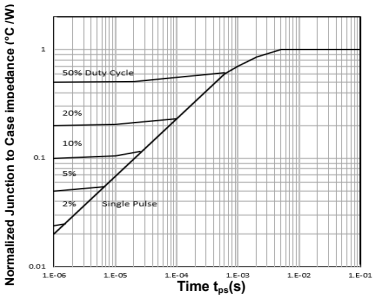


FIG.15- Transient Thermal impedance (Junction to Case)

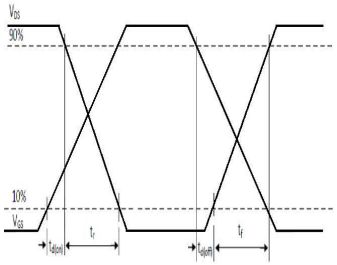
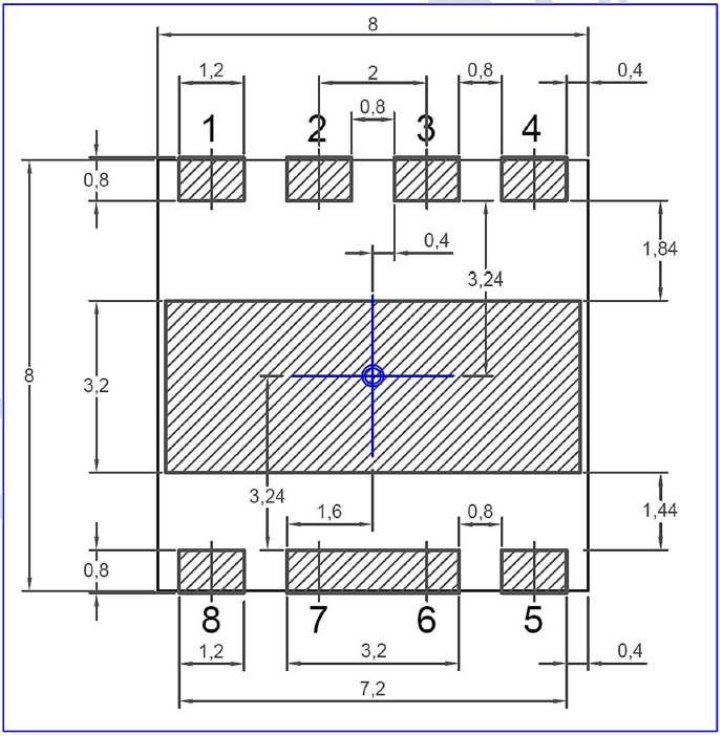


FIG.16- Switching Time Waveforms

HMHL065N210E

650-V GaN E -mode Power Transistor

DFN-8X8 Recommended PCB Soldering Footprint



With me,
Power for you.

4

MOSFET

High Power Density

High current and low RDS (on) products.
Series products are under continuous development.

All products are available in industrial grade and automotive grade.

Brückewell

MSH40N065

N-Channel 40-V (D-S) MOSFET

Description

The device is using trench DMOS technology. This advanced technology has been especially tailored to minimize $R_{DS(ON)}$, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency fast switching applications.

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

Features

- $R_{DS(ON)}$ =6.5mΩ@ V_{GS} =10V
- Fast switching
- Improve dv/dt Capability
- 100% EAS Guaranteed
- Green Device Available

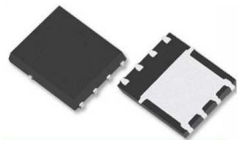
Typical Applications

- MB / VGA / Vcore
- POL Applications
- SMPS 2nd SR

Package type : PDFN 5X6

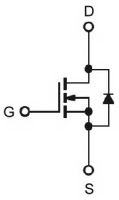
Packing & Order Information

3,000/Reel

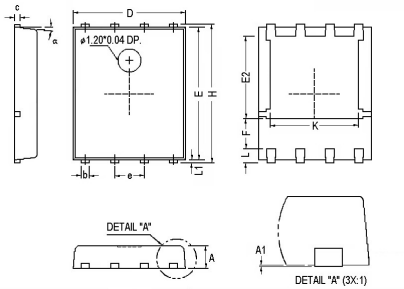


RoHS Compliant

Graphic Symbol

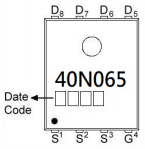


Package Dimension



REF.	Millimeter			REF.	Millimeter		
	Min.	Nom.	Max.		Min.	Nom.	Max.
A	0.85	1.00	1.15	E	5.70	-	5.90
A1	0.00	-	0.10	e	-	1.27	-
b	0.30	-	0.51	H	5.90	-	6.20
c	0.20	-	0.30	L	-	0.60	-
D	4.80	-	5.00	L1	0.06	-	0.20
F	1.10 Ref.			α	0°	-	12°
E2	3.50 Ref.			K	3.70	3.90	4.10

Marking



Brückewell

MSH40N065

N-Channel 40-V (D-S) MOSFET

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings			
Symbol	**Parameter**	**Value**	**Units**
V_{DS}	Drain-Source Voltage	40	V
V_{GS}	Gate-Source Voltage	±20	V
I_D	Continuous Drain Current[1] (T_C=25°C)	75	A
	Continuous Drain Current[1] (T_C=100°C)	45	A
I_{DM}	Pulsed Drain Current[1,2]	300	A
I_{AS}	Single Pulse Avalanche Current, L =0.1mH[3]	39	A
E_{AS}	Single Pulse Avalanche Energy, L =0.1mH[3]	76	mJ
P_D	Power Dissipation[4] (T_C=25°C)	83	W
	Power Dissipation[4] (T_A=25°C)	2	W
T_J/T_{STG}	Operating Junction and Storage Temperature	-55 to +150	°C

Thermal Resistance Ratings			
Symbol	**Parameter**	**Maximum**	**Units**
$R_{\theta JA}$	Maximum Junction-to-Ambient[1]	62.5	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case[1]	1.5	°C/W

Electrical Characteristics (T_J=25°C unless otherwise specified)						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS}=V_{GS}, I_D=250μA	1.2	1.6	2.5	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS}=0V, I_D=250μA	40	-	-	V
g_{fs}	Forward Transconductance	V_{DS}=3V, I_D=4.5A	-	16	-	S
I_{GSS}	Gate-Source Leakage Current	V_{DS}=0V, V_{GS}=±20V	-	-	±100	nA
I_{DSS}	Drain-Source Leakage Current	V_{DS}=40V, V_{GS}=0V, T_J=25°C	-	-	1	μA
		V_{DS}=32V, V_{GS}=0V, T_J=125°C			10	
$R_{DS\ (on)}$	Static Drain-Source On-Resistance[2]	V_{GS}=10V, I_D=20A	-	5.6	6.5	mΩ
		V_{GS}=4.5V, I_D=10A	-	6.9	8.5	
EAS	Single Pulse Avalanche Energy[5]	V_{DD}=25V, L =0.1mH, I_{AS}=25A	31	-	-	mJ
V_{SD}	Diode Forward Voltage[2]	I_S=20A, V_{GS}=0V, T_J=25°C	-	-	1.2	V
I_S	Continuous Source Current[1,6]	V_G=V_D=0V, Force Current	-	-	75	A
I_{SM}	Pulsed Source Current[2,6]		-	-	150	

Notes

1. The data tested by surface mounted on a 1 inch^2 FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
3. The EAS data shows maximum rating. The test condition is V_{DD}=25V, V_{GS}=10V, L=0.1mH, I_{AS}=39A.
4. The power dissipation is limited by 150℃ 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.

MSH40N065

N-Channel 40-V (D-S) MOSFET

Dynamic						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
Q_g	Total Gate Charge[2]	V_{DS} =20V I_D =10A V_{GS} =4.5V	--	16.2	--	nC
Q_{gs}	Gate-Source Charge		--	3.85	--	
Q_{gd}	Gate-Drain Charge		--	6.05	--	
$t_{d(on)}$	Turn-On Delay Time[2]	V_{DS} =15V I_D =1A V_{GS} =10V R_G =6Ω	--	13.6	--	ns
t_r	Rise Time		--	2.5	--	
$t_{d(off)}$	Turn-Off Delay Time		--	68	--	
t_f	Fall Time		--	5	--	
C_{ISS}	Input Capacitance	V_{DS} =25V V_{GS} =0V f =1.0MHz	--	1540	--	pF
C_{OSS}	Output Capacitance		--	171	--	
C_{RSS}	Reverse Transfer Capacitance		--	115	--	
Rg	Gate Resistance	V_{GS} =V_{DS} =0V, f =1.0MHz	--	1.4	--	Ω

MSH40N065

N-Channel 40-V (D-S) MOSFET

- **Typical Electrical Characteristics**

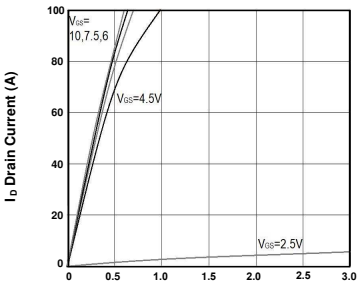


FIG.1-Typical Output Characteristics

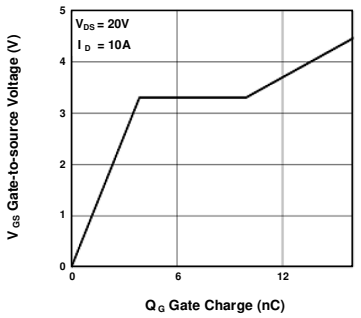


FIG.2-Gate Charge Characteristics

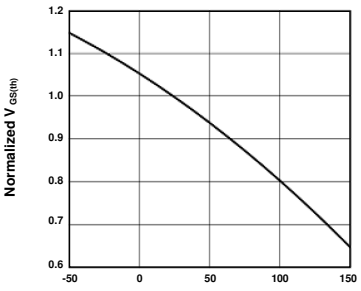


FIG.3-Normalized $V_{GS(th)}$ vs. T_J

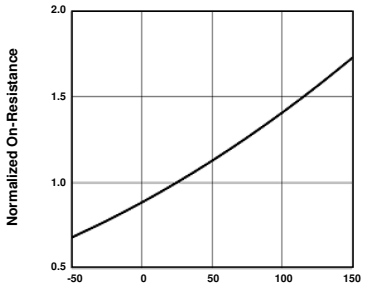


FIG.4-Normalized R_{DSON} vs. T_J

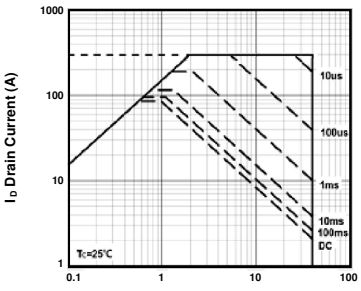


FIG.5-Safe Operating Area

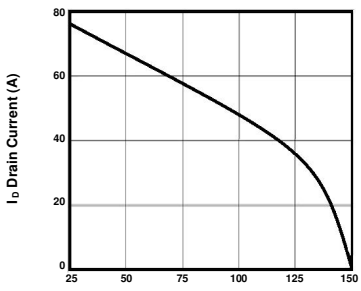


FIG.6-Drain Current vs. T_C

MSH40N065

N-Channel 40-V (D-S) MOSFET

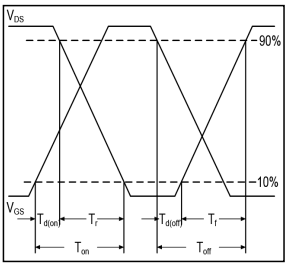


FIG.7-Switching Time Waveform

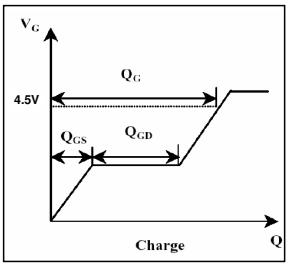


FIG.8-Gate Charge Waveform

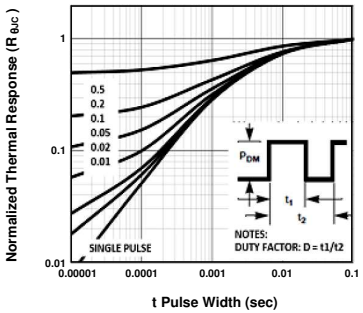


FIG.9-Transient Thermal Impedance

MSH40N032

N-Channel 40-V (D-S) MOSFET

Description

The device is using trench DMOS technology. This advanced technology has been especially tailored to minimize $R_{DS(ON)}$, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency fast switching applications.

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

Features

- $R_{DS(ON)}$ =3.2mΩ @ V_{GS} =10V
- Low Gate Charge
- Excellent dv/dt Capability
- 100% EAS Guaranteed
- Green Device Available

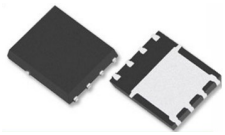
Typical Applications

- Power Management in Desktop Computer
- DC/DC converters
- Synchronous rectifier applications

Package type：PDFN 5X6

Packing & Order Information

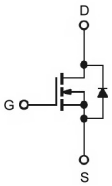
3,000/Reel



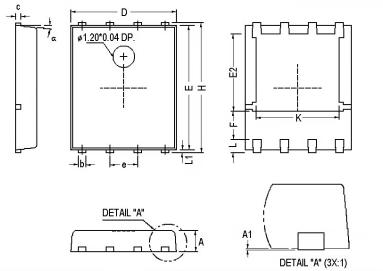
AEC-Q101 Qualified Available

RoHS Compliant

Graphic Symbol

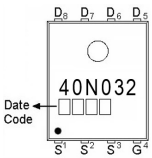


Package Dimension



REF.	Millimeter			REF.	Millimeter		
	Min.	Nom.	Max.		Min.	Nom.	Max.
A	0.85	1.00	1.15	E	5.70	-	5.90
A1	0.00	-	0.10	e	-	1.27	-
b	0.30	-	0.51	H	5.90	-	6.20
c	0.20	-	0.30	L	-	0.60	-
D	4.80	-	5.00	L1	0.06	-	0.20
F	1.10 Ref.			α	0°	-	12°
E2	3.50 Ref.			K	3.70	3.90	4.10

Marking



MSH40N032

N-Channel 40-V (D-S) MOSFET

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

Symbol	Parameter	Value	Units
V_{DS}	Drain-Source Voltage	40	V
V_{GS}	Gate-Source Voltage	±20	V
I_D	Continuous Drain Current[1] (T_C =25°C)	90	A
	Continuous Drain Current[1] (T_C =100°C)	72	A
I_{DM}	Pulsed Drain Current[1,2]	240	A
I_{AS}	Single Pulse Avalanche Current, L =0.1mH[3]	54	A
E_{AS}	Single Pulse Avalanche Energy, L =0.1mH[3]	145	mJ
P_D	Power Dissipation[4] (T_C =25°C)	50	W
T_J/T_{STG}	Operating Junction and Storage Temperature	-55 to 150	°C

Thermal Resistance Ratings

Symbol	Parameter	Maximum	Units
$R_{\theta JA}$	Maximum Junction-to-Ambient[1]	55	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case[1]	2.5	°C/W

Electrical Characteristics (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS} =V_{GS}, I_D =250μA	1.2	-	2.2	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V, I_D =250μA	40	-	-	V
I_{GSS}	Gate-Source Leakage Current	V_{DS} =0V, V_{GS} =±20V	-	-	±100	nA
I_{DSS}	Drain-Source Leakage Current	V_{DS} =40V, V_{GS} =0V, T_J =25°C	-	-	1	μA
		V_{DS} =40V, V_{GS} =0V, T_J =55°C			5	
$R_{DS\ (on)}$	Static Drain-Source On-Resistance[2]	V_{GS} =10V, I_D =20A	-	2.5	3.2	mΩ
		V_{GS} =4.5V, I_D =15A	-	3.8	5.3	
EAS	Single Pulse Avalanche Energy[5]	V_{DD} =25V, L =0.1mH, I_{AS} =25A	31	-	-	mJ
V_{SD}	Diode Forward Voltage[2]	I_S =1A, V_{GS} =0V, T_J =25°C	-	-	1.0	V
I_S	Continuous Source Current[1,6]	V_G =V_D =0V, Force Current	-	-	30	A
I_{SM}	Pulsed Source Current[2,6]		-	-	60	

MSH40N032

N-Channel 40-V (D-S) MOSFET

Dynamic						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
Q_g	Total Gate Charge[2]	V_{DS} =20V	--	22.7	--	nC
Q_{gs}	Gate-Source Charge	I_D =20A	--	7.5	--	
Q_{gd}	Gate-Drain Charge	V_{GS} =10V	--	5.5	--	
$t_{d(on)}$	Turn-On Delay Time[2]	V_{DS} =20V	--	10	--	ns
t_r	Rise Time	I_D =20A	--	5	--	
$t_{d(off)}$	Turn-Off Delay Time	V_{GS} =10V	--	33	--	
t_f	Fall Time	R_G =3Ω	--	6.5	--	
C_{ISS}	Input Capacitance	V_{DS} =20V	--	2648	--	pF
C_{OSS}	Output Capacitance	V_{GS} =0V	--	899	--	
C_{RSS}	Reverse Transfer Capacitance	f =1.0MHz	--	71	--	
Rg	Gate Resistance	V_{DS} =0V, V_{GS} =0V, f =1.0MHz		1.5		Ω

Notes

1. The data tested by surface mounted on a 1 inch^2 FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
3. The EAS data shows maximum rating. The test condition is V_{DD}=25V, V_{GS}=10V, L=0.1mH, I_{AS}=54A.
4. The power dissipation is limited by 150℃ 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.

MSH40N032

N-Channel 40-V (D-S) MOSFET

- **Typical Electrical Characteristics**

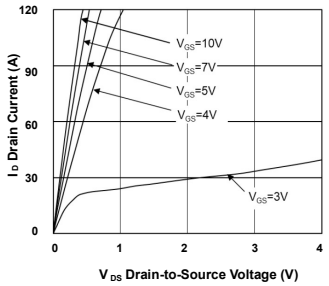


FIG.1-Typical Output Characteristics

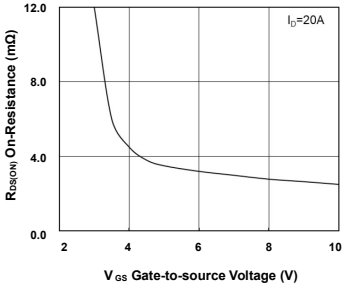


FIG.2-On-Resistance vs. G-S Voltage

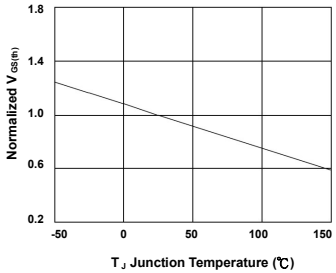


FIG.3-Normalized $V_{GS(th)}$ vs. T_J

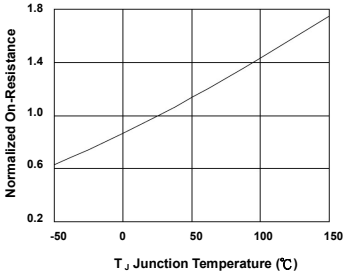


FIG.4-Normalized R_{DSON} vs. T_J

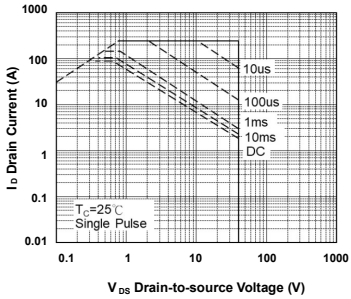


FIG.5-Safe Operating Area

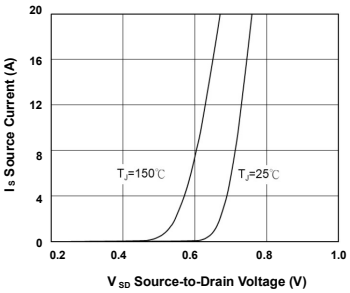


FIG.6-Source Drain Forward Characteristics

MSH40N032

N-Channel 40-V (D-S) MOSFET

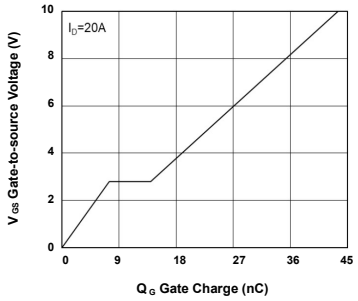


FIG.7-Gate Charge Characteristics

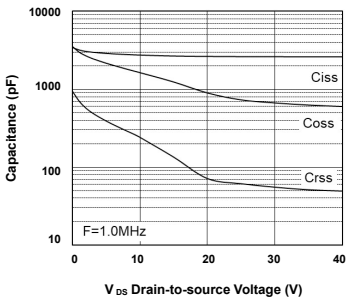


FIG.8-Capacitance Characteristics

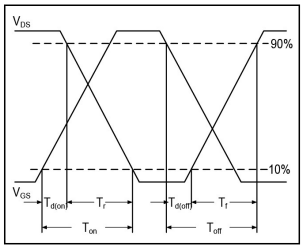


FIG.9-Switching Time Waveform

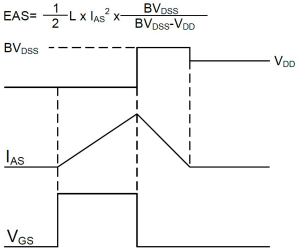


FIG.10-Unclamped Inductive Switching Waveform

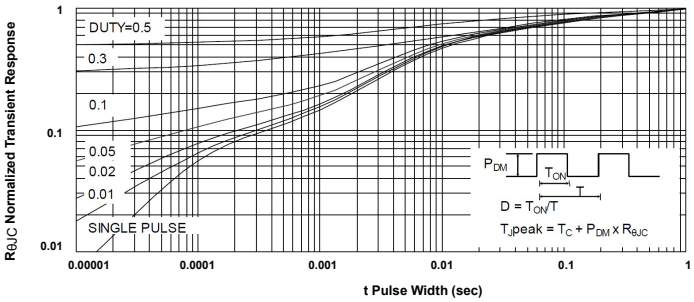


FIG.11-Normalized Maximum Transient Thermal Impedance

MSH40N020

N-Channel 40-V (D-S) MOSFET

Description

The device is using trench DMOS technology. This advanced technology has been especially tailored to minimize $R_{DS(ON)}$, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency fast switching applications.

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

Features

- $R_{DS(ON)}$ =2.0mΩ @ V_{GS} =10V
- Super Low Gate Charge
- 100% EAS Guaranteed
- Green Device Available

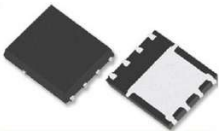
Typical Applications

- Power Management in Desktop Computer
- High Frequency Switching
- Synchronous rectifier applications

Package type：PDFN 5X6

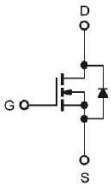
Packing & Order Information

3,000/Reel

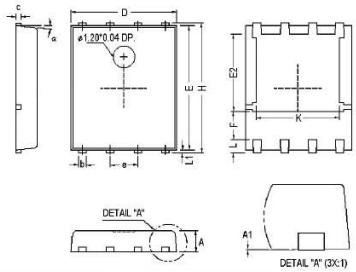


RoHS Compliant

Graphic Symbol

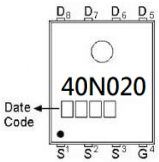


Package Dimension



REF.	Millimeter			REF.	Millimeter		
	Min.	Nom.	Max.		Min.	Nom.	Max.
A	0.85	1.00	1.15	E	5.70	-	5.90
A1	0.00	-	0.10	e	-	1.27	-
b	0.30	-	0.51	H	5.90	-	6.20
c	0.20	-	0.30	L	-	0.60	-
D	4.80	-	5.00	L1	0.06	-	0.20
F	1.10 Ref.			α	0°	-	12°
E2	3.50 Ref.			K	3.70	3.90	4.10

Marking



Brückewell

MSH40N020

N-Channel 40-V (D-S) MOSFET

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

Symbol	Parameter	Value	Units
V_{DS}	Drain-Source Voltage	40	V
V_{GS}	Gate-Source Voltage	±20	V
I_D	Continuous Drain Current[1] (T_C =25°C)	160	A
	Continuous Drain Current[1] (T_C =100°C)	100	A
I_{DM}	Pulsed Drain Current[1,2]	640	A
I_{AS}	Single Pulse Avalanche Current, L =0.5mH[3]	39	A
E_{AS}	Single Pulse Avalanche Energy, L =0.5mH[3]	380	mJ
P_D	Power Dissipation[4] (T_C =25°C)	96	W
T_J/T_{STG}	Operating Junction and Storage Temperature	-55 to 150	°C

Thermal Resistance Ratings

Symbol	Parameter	Maximum	Units
$R_{\theta JA}$	Maximum Junction-to-Ambient[1]	56	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case[1]	1.6	°C/W

Electrical Characteristics (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS} =V_{GS}, I_D =250μA	1.2	1.6	2.2	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V, I_D =250μA	40	-	-	V
I_{GSS}	Gate-Source Leakage Current	V_{DS} =0V, V_{GS} =±20V	-	-	±100	nA
I_{DSS}	Drain-Source Leakage Current	V_{DS} =32V, V_{GS} =0V, T_J =25°C	-	-	1	μA
		V_{DS} =32V, V_{GS} =0V, T_J =55°C			10	
$R_{DS\ (on)}$	Static Drain-Source On-Resistance[2]	V_{GS} =10V, I_D =20A	-	1.5	2.0	mΩ
		V_{GS} =4.5V, I_D =20A	-	2.1	2.9	
EAS	Single Pulse Avalanche Energy[5]	V_{DD} =25V, L =0.5mH, I_{AS} =25A	156	-	-	mJ
V_{SD}	Diode Forward Voltage[2]	I_S =1A, V_{GS} =0V, T_J =25°C	-	-	1.2	V
I_S	Continuous Source Current[1,6]	V_G =V_D =0V, Force Current	-	-	160	A
I_{SM}	Pulsed Source Current[2,6]		-	-	320	

MSH40N020

N-Channel 40-V (D-S) MOSFET

Dynamic						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
Q_g	Total Gate Charge[2]	V_{DS} =20V	--	51.8	--	nC
Q_{gs}	Gate-Source Charge	I_D =20A	--	10	--	
Q_{gd}	Gate-Drain Charge	V_{GS} =10V	--	7.8	--	
$t_{d(on)}$	Turn-On Delay Time[2]	V_{DS} =20V	--	15.2	--	ns
t_r	Rise Time	R_L =1Ω	--	7.6	--	
$t_{d(off)}$	Turn-Off Delay Time	V_{GS} =10V	--	48.5	--	
t_f	Fall Time	R_G =3Ω	--	13.6	--	
C_{ISS}	Input Capacitance	V_{DS} =20V	--	3572	--	pF
C_{OSS}	Output Capacitance	V_{GS} =0V	--	1719	--	
C_{RSS}	Reverse Transfer Capacitance	f =1.0MHz	--	102	--	
Rg	Gate Resistance	V_{DS} =0V, V_{GS} =0V, f =1.0MHz		1.9		Ω

Notes

1. The data tested by surface mounted on a 1 inch^2 FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
3. The EAS data shows maximum rating. The test condition is V_{DD}=25V, V_{GS}=10V, L=0.5mH, I_{AS}=40A.
4. The power dissipation is limited by 150℃ 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.

MSH40N020

N-Channel 40-V (D-S) MOSFET

- **Typical Electrical Characteristics**

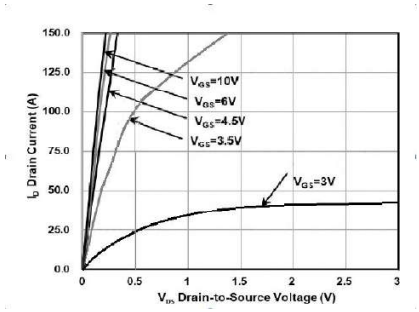


FIG.1-Typical Output Characteristics

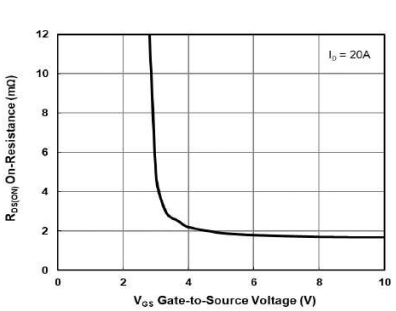


FIG.2-On-Resistance vs. G-S Voltage

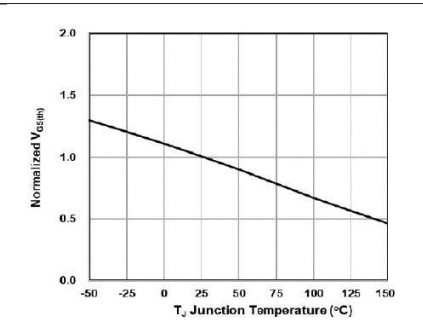


FIG.3-Normalized $V_{GS(th)}$ vs. T_J

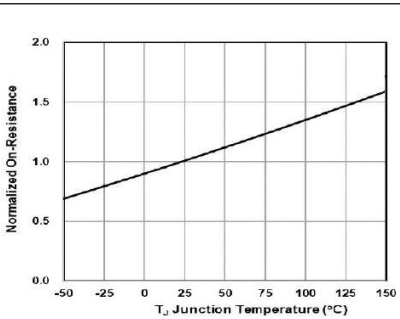


FIG.4-Normalized R_{DSON} vs. T_J

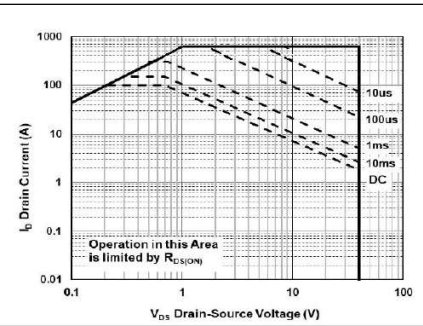


FIG.5-Safe Operating Area

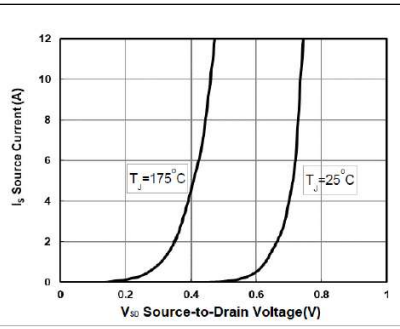


FIG.6-Source Drain Forward Characteristics

MSH40N020

N-Channel 40-V (D-S) MOSFET

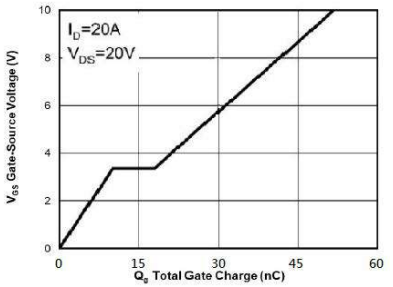


FIG.7-Gate Charge Characteristics

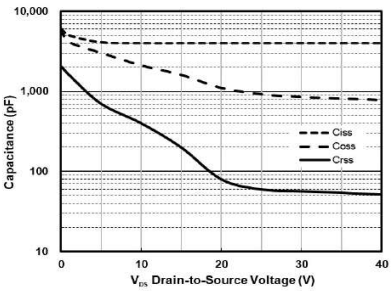


FIG.8-Capacitance Characteristics

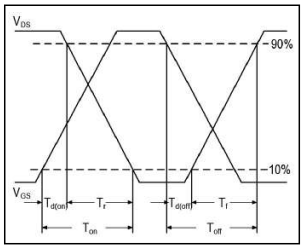


FIG.9-Switching Time Waveform

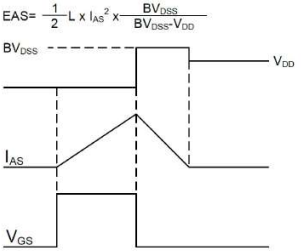


FIG.10-Unclamped Inductive Switching Waveform

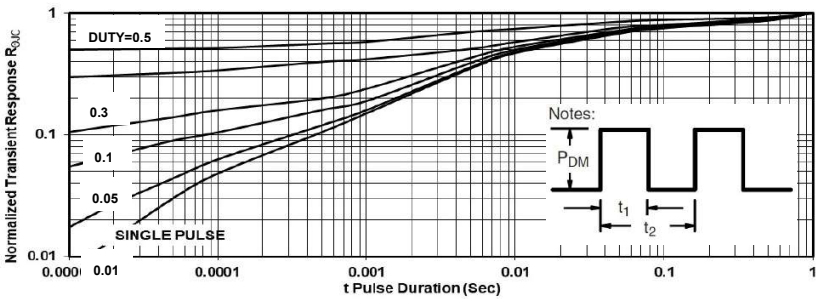


FIG.11-Normalized Maximum Transient Thermal Impedance

MSH40N01

N-Channel 40-V (D-S) MOSFET

Description

The device is using trench DMOS technology. This advanced technology has been especially tailored to minimize $R_{DS(ON)}$, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency fast switching applications.

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

Features

- $R_{DS(ON)}$ =1.7mΩ @ V_{GS} =10V
- Super Low Gate Charge
- 100% EAS Guaranteed
- Green Device Available
- AEC-Q101 Qualification Available

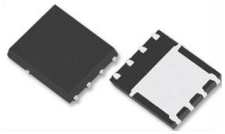
Typical Applications

- Power Management in Desktop Computer
- High Frequency Switching
- Synchronous rectifier applications

Package type： PDFN 5X6

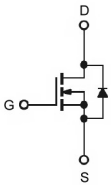
Packing & Order Information

3,000/Reel

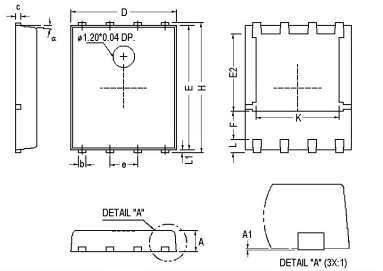


RoHS Compliant

Graphic Symbol

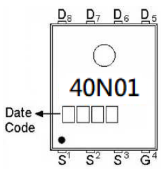


Package Dimension



REF.	Millimeter			REF.	Millimeter		
	Min.	Nom.	Max.		Min.	Nom.	Max.
A	0.85	1.00	1.15	E	5.70	-	5.90
A1	0.00	-	0.10	e	-	1.27	-
b	0.30	-	0.51	H	5.90	-	6.20
c	0.20	-	0.30	L	-	0.60	-
D	4.80	-	5.00	L1	0.06	-	0.20
F	1.10 Ref.			α	0°	-	12°
E2	3.50 Ref.			K	3.70	3.90	4.10

Marking



Brückewell

MSH40N01

N-Channel 40-V (D-S) MOSFET

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

Symbol	Parameter	Value	Units
V_{DS}	Drain-Source Voltage	40	V
V_{GS}	Gate-Source Voltage	±20	V
I_D	Continuous Drain Current[1] (T_C =25°C)	180	A
	Continuous Drain Current[1] (T_C =100°C)	125	A
I_{DM}	Pulsed Drain Current[1,2]	700	A
I_{AS}	Single Pulse Avalanche Current, L =0.1mH[3]	80	A
E_{AS}	Single Pulse Avalanche Energy, L =0.1mH[3]	320	mJ
P_D	Power Dissipation[4] (T_C =25°C)	98	W
T_J/T_{STG}	Operating Junction and Storage Temperature	-55 to 150	°C

Thermal Resistance Ratings

Symbol	Parameter	Maximum	Units
$R_{\theta JA}$	Maximum Junction-to-Ambient[1]	45	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case[1]	1.4	°C/W

Electrical Characteristics (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} =V_{GS}, I_D =250μA	1.2	1.6	2.2	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V, I_D =250μA	40	-	-	V
I_{GSS}	Gate-Source Leakage Current	V_{DS} =0V, V_{GS} =±20V	-	-	±100	nA
I_{DSS}	Drain-Source Leakage Current	V_{DS} =32V, V_{GS} =0V, T_J =25°C	-	-	1	μA
		V_{DS} =32V, V_{GS} =0V, T_J =55°C			5	
$R_{DS(on)}$	Static Drain-Source On-Resistance[2]	V_{GS} =10V, I_D =50A	-	1.4	1.7	mΩ
		V_{GS} =4.5V, I_D =50A	-	2.1	2.6	
EAS	Single Pulse Avalanche Energy[5]	V_{DD} =25V, L =0.1mH, I_{AS} =60A	180	-	-	mJ
V_{SD}	Diode Forward Voltage[2]	I_S =1A, V_{GS} =0V, T_J =25°C	-	-	1.2	V
I_S	Continuous Source Current[1,6]	V_G =V_D =0V, Force Current	-	-	180	A
I_{SM}	Pulsed Source Current[2,6]		-	-	400	

MSH40N01

N-Channel 40-V (D-S) MOSFET

Dynamic						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
Q_g	Total Gate Charge[2]	V_{DS} =15V	--	45	--	nC
Q_{gs}	Gate-Source Charge	I_D =20A	--	12	--	
Q_{gd}	Gate-Drain Charge	V_{GS} =10V	--	18.5	--	
$t_{d(on)}$	Turn-On Delay Time[2]	V_{DS} =15V	--	18.5	--	ns
t_r	Rise Time	I_D =20A	--	9	--	
$t_{d(off)}$	Turn-Off Delay Time	V_{GS} =10V	--	58.5	--	
t_f	Fall Time	R_G =3.3Ω	--	32	--	
C_{ISS}	Input Capacitance	V_{DS} =20V	--	3972	--	pF
C_{OSS}	Output Capacitance	V_{GS} =0V	--	1119	--	
C_{RSS}	Reverse Transfer Capacitance	f =1.0MHz	--	82	--	
Rg	Gate Resistance	V_{DS} =0V, V_{GS} =0V, f =1.0MHz	--	1.0	--	Ω

Notes

1. The data tested by surface mounted on a 1 inch^2 FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
3. The EAS data shows maximum rating. The test condition is V_{DD}=25V, V_{GS}=10V, L=0.1mH, I_{AS}=80A.
4. The power dissipation is limited by 150℃ 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.

MSH40N01

N-Channel 40-V (D-S) MOSFET

- **Typical Electrical Characteristics**

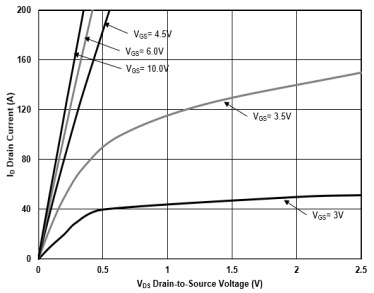


FIG.1-Typical Output Characteristics

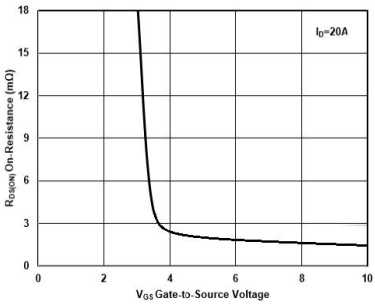


FIG.2-On-Resistance vs. G-S Voltage

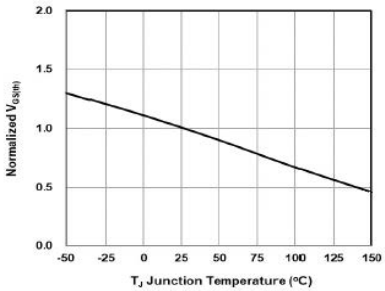


FIG.3-Normalized $V_{GS(th)}$ vs. T_J

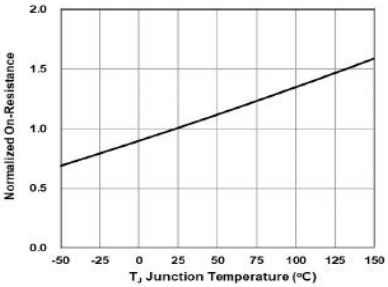


FIG.4-Normalized R_{DSON} vs. T_J

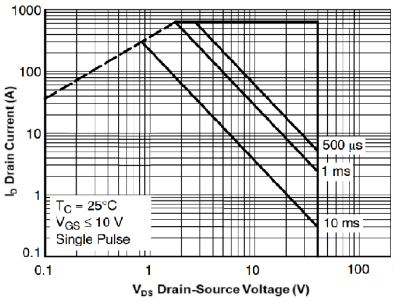


FIG.5-Safe Operating Area

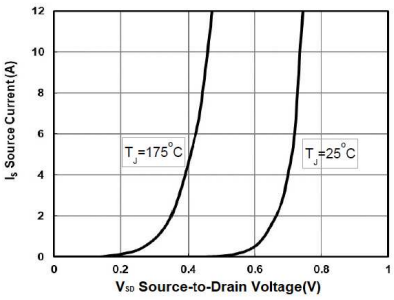


FIG.6-Source Drain Forward Characteristics

MSH40N01

N-Channel 40-V (D-S) MOSFET

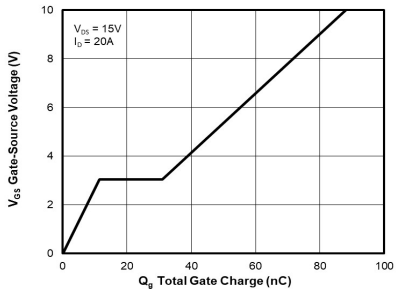


FIG.7-Gate Charge Characteristics

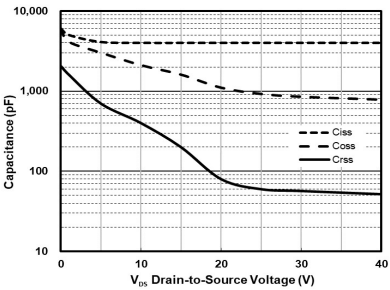


FIG.8-Capacitance Characteristics

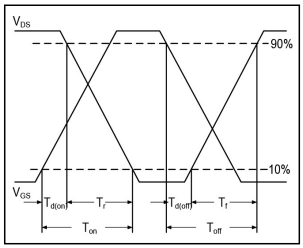


FIG.9-Switching Time Waveform

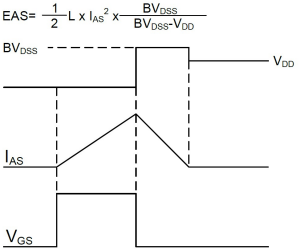


FIG.10-Unclamped Inductive Switching Waveform

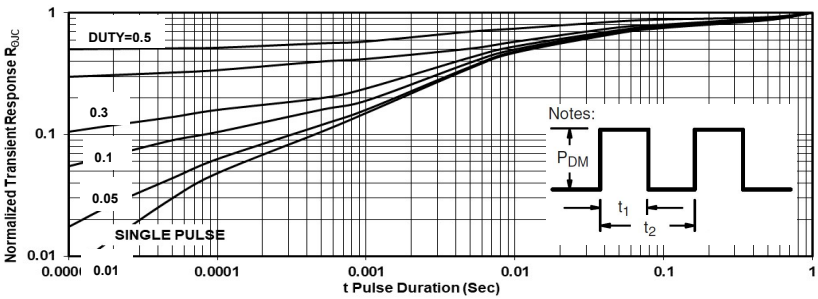


FIG.11-Normalized Maximum Transient Thermal Impedance

MSH40N02

N-Channel 40-V (D-S) MOSFET

Description

The device is using trench DMOS technology. This advanced technology has been especially tailored to minimize $R_{DS(ON)}$, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency fast switching applications.

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

Features

- $R_{DS(ON)}$ =1mΩ @ V_{GS} =10V
- Super Low Gate Charge
- Excellent dv/dt Capability
- 100% EAS Guaranteed
- Green Device Available

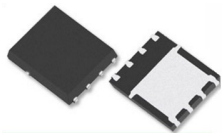
Typical Applications

- Power Management in Desktop Computer
- High Frequency Switching
- Synchronous rectifier applications

Package type：PDFN 5X6

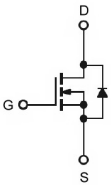
Packing & Order Information

3,000/Reel

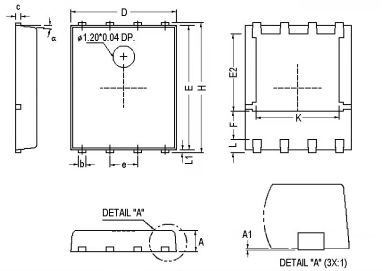


RoHS Compliant

Graphic Symbol

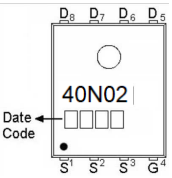


Package Dimension



REF.	Millimeter			REF.	Millimeter		
	Min.	Nom.	Max.		Min.	Nom.	Max.
A	0.85	1.00	1.15	E	5.70	-	5.90
A1	0.00	-	0.10	e	-	1.27	-
b	0.30	-	0.51	H	5.90	-	6.20
c	0.20	-	0.30	L	-	0.60	-
D	4.80	-	5.00	L1	0.06	-	0.20
F	1.10 Ref.			α	0°	-	12°
E2	3.50 Ref.			K	3.70	3.90	4.10

Marking



Brückewell

MSH40N02

N-Channel 40-V (D-S) MOSFET

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

Symbol	Parameter	Value	Units
V_{DS}	Drain-Source Voltage	40	V
V_{GS}	Gate-Source Voltage	±20	V
I_D	Continuous Drain Current[1] (T_C =25°C)	250	A
	Continuous Drain Current[1] (T_C =100°C)	150	A
I_{DM}	Pulsed Drain Current[1,2]	880	A
I_{AS}	Single Pulse Avalanche Current, L =0.1mH[3]	104	A
E_{AS}	Single Pulse Avalanche Energy, L =0.1mH[3]	540	mJ
P_D	Power Dissipation[4] (T_C =25°C)	160	W
T_J/T_{STG}	Operating Junction and Storage Temperature	-55 to 150	°C

Thermal Resistance Ratings

Symbol	Parameter	Maximum	Units
$R_{\theta JA}$	Maximum Junction-to-Ambient[1]	62	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case[1]	1.4	°C/W

Electrical Characteristics (T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS} =V_{GS}, I_D =250μA	1.2	1.7	2.2	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V, I_D =250μA	40	-	-	V
I_{GSS}	Gate-Source Leakage Current	V_{DS} =0V, V_{GS} =±20V	-	-	±150	nA
I_{DSS}	Drain-Source Leakage Current	V_{DS} =32V, V_{GS} =0V, T_J =25°C	-	-	1	μA
		V_{DS} =32V, V_{GS} =0V, T_J =55°C			5	
$R_{DS\ (on)}$	Static Drain-Source On-Resistance[2]	V_{GS} =10V, I_D =20A	-	0.8	1.0	mΩ
		V_{GS} =4.5V, I_D =20A	-	1.2	2.0	
EAS	Single Pulse Avalanche Energy[5]	V_{DD} =25V, L =0.1mH, I_{AS} =75A	281	-	-	mJ
V_{SD}	Diode Forward Voltage[2]	I_S =1A, V_{GS} =0V, T_J =25°C	-	-	1.2	V
I_S	Continuous Source Current[1,6]	V_G =V_D =0V, Force Current	-	-	220	A
I_{SM}	Pulsed Source Current[2,6]		-	-	440	

Notes

1. The data tested by surface mounted on a 1 inch² FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
3. The EAS data shows maximum rating. The test condition is V_{DD}=25V, V_{GS}=10V, L=0.1mH, I_{AS}=104A.
4. The power dissipation is limited by 150℃ 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.

MSH40N02

N-Channel 40-V (D-S) MOSFET

Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Q_g	Total Gate Charge[2]	V_{DS} =20V	--	126	--	nC
Q_{gs}	Gate-Source Charge	I_D =20A	--	17	--	
Q_{gd}	Gate-Drain Charge	V_{GS} =10V	--	28	--	
$t_{d(on)}$	Turn-On Delay Time[2]	V_{DS} =20V	--	15	--	ns
t_r	Rise Time	I_D =20A	--	41	--	
$t_{d(off)}$	Turn-Off Delay Time	V_{GS} =10V	--	58	--	
t_f	Fall Time	R_G =1.5Ω	--	30	--	
C_{ISS}	Input Capacitance	V_{DS} =20V	--	6780	--	pF
C_{OSS}	Output Capacitance	V_{GS} =0V	--	2100	--	
C_{RSS}	Reverse Transfer Capacitance	f =1.0MHz	--	225	--	
Rg	Gate Resistance	V_{DS} =0V, V_{GS} =0V, f =1.0MHz	--	1.3	--	Ω

MSH40N02

N-Channel 40-V (D-S) MOSFET

- **Typical Electrical Characteristics**

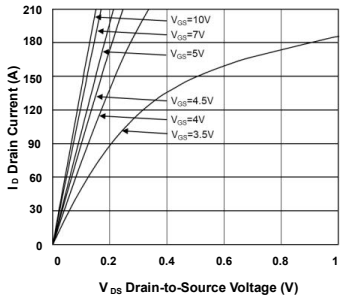


FIG.1-Typical Output Characteristics

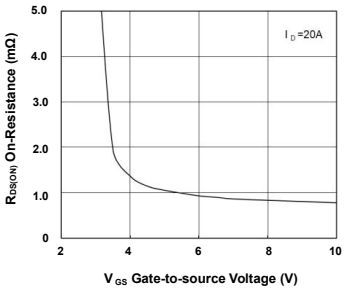


FIG.2-On-Resistance vs. G-S Voltage

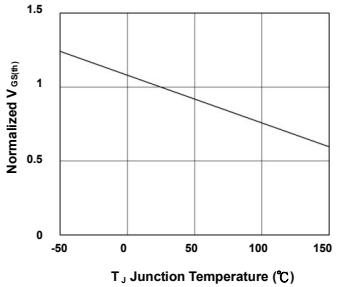


FIG.3-Normalized $V_{GS(th)}$ vs. T_J

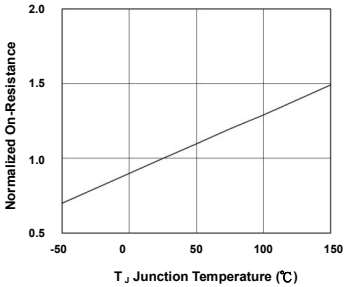


FIG.4-Normalized R_{DSON} vs. T_J

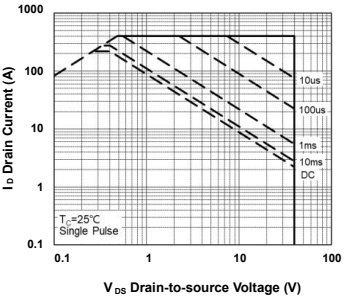


FIG.5-Safe Operating Area

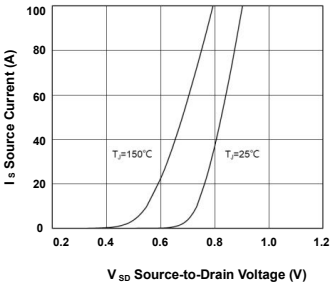


FIG.6-Source Drain Forward Characteristics

MSH40N02

N-Channel 40-V (D-S) MOSFET

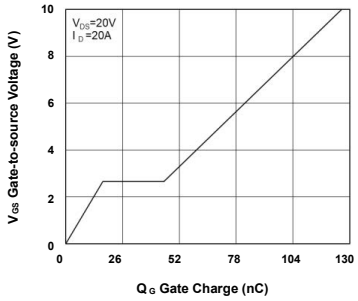


FIG.7-Gate Charge Characteristics

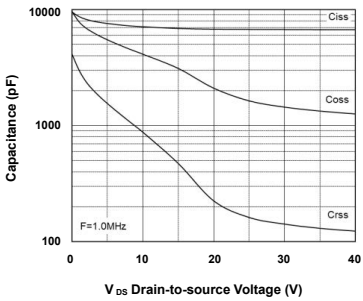


FIG.8-Capacitance Characteristics

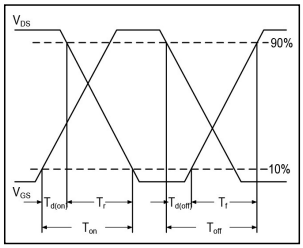


FIG.9-Switching Time Waveform

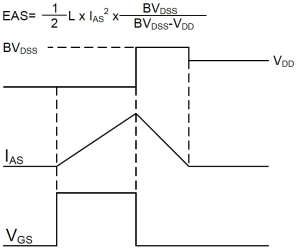


FIG.10-Unclamped Inductive Switching Waveform

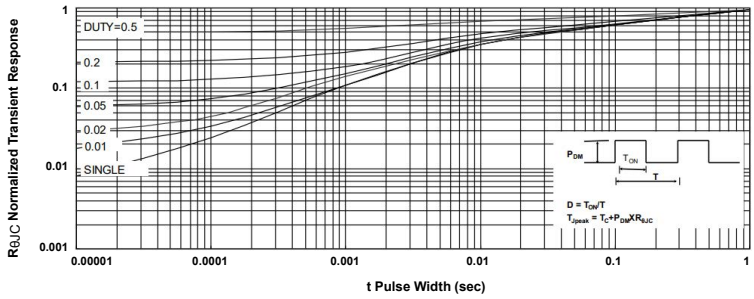


FIG.11-Normalized Maximum Transient Thermal Impedance

With me,
Power for you.

4 MOSFET

Cooling server and Fan application

All products are available in industrial grade and automotive grade.

MSH60C20D

N & P-Channel 60-V (D-S) MOSFET

Description

The device is the highest performance trench N-ch and P-ch MOSFETs with extreme high cell density, which provide excellent $R_{DS(ON)}$ and gate charge for most of the synchronous buck converter applications.

The device meets the RoHS and Green Product requirement, 100% E_{AS} guaranteed with full function reliability approved.

Features

- Suit for 4.5V Gate Drive Applications
- Super Low Gate Charge
- Excellent CdV/dt effect decline
- 100% E_{AS} Guaranteed
- Green Device Available

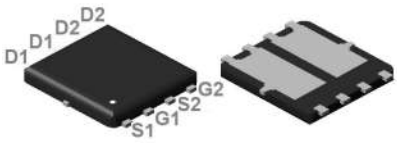
Typical Applications

- DC Fan
- Motor Drive Applications
- Networking
- Half / Full Bridge Topology

Package type：PDFN 5X6 Dual

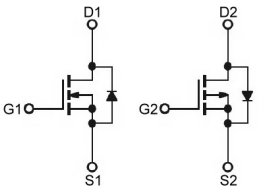
Packing & Order Information

3,000/Reel

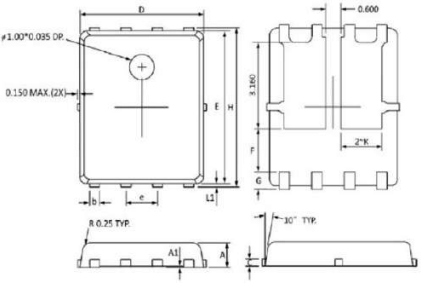


RoHS Compliant

Graphic Symbol

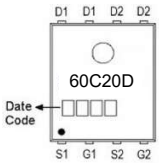


Package Dimension



REF.	Millimeter			REF.	Millimeter		
	Min.	Nom.	Max.		Min.	Nom.	Max.
A	0.90	1.00	1.10	E	5.70	-	5.90
A1	0.00	-	0.05	e	-	1.27	-
b	0.33	-	0.51	H	5.90	-	6.20
c	0.20	-	0.30	G	0.50	-	0.70
D	4.80	-	5.00	L1	0.06	-	0.20
F	1.6 Ref.			K	-	1.60	-

Marking



MSH60C20D

N & P-Channel 60-V (D-S) MOSFET **MAXIMUM**

RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings (unless otherwise specified)

Symbol	Parameter	Value		Units
		N-ch	P-ch	
V_{DS}	Drain-Source Voltage	60	-60	V
V_{GS}	Gate-Source Voltage	±20	±20	V
I_D	Continuous Drain Current[1] (T_A=25°C)	27	-25	A
	Continuous Drain Current[1] (T_A=70°C)	19	-16	A
I_{DM}	Pulsed Drain Current[2] (T_A=25°C)	80	-58	A
I_{AS}	Single Pulse Avalanche Current, L =0.1mH[3]	28	-28	A
E_{AS}	Single Pulse Avalanche Energy, L =0.1mH[3]	39.2	39.2	mJ
P_D	Power Dissipation[3] (T_C=25°C)	42		W
T_J/T_{STG}	Operating Junction and Storage Temperature	-55 to +150		°C

Thermal Resistance Ratings

Symbol	Parameter	Maximum	Units
$R_{\theta JA}$	Maximum Junction-to-Ambient[1]	62	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case[1]	3	°C/W

Electrical Characteristics(T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Ch	Min.	Typ.	Max.	Units
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS}=V_{GS}, I_D=250μA V_{DS}=V_{GS}, I_D=-250μA	N P	1.0 -1.0	1.6 -1.6	2.5 -2.5	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS}=0V, I_D=250μA V_{GS}=0V, I_D=-250μA	N P	60 -60	-	-	V
g_{fs}	Forward Transconductance	V_{DS}=5V, I_D=8A V_{DS}=-5V, I_D=-20A	N P	-	45 30	-	S
I_{GSS}	Gate-Source Leakage Current	V_{DS}=0V, V_{GS}=±20V	N P	-	-	±100	nA
I_{DSS}	Drain-Source Leakage Current	V_{DS}=48V, V_{GS}=0V, T_J=25°C V_{DS}=48V, V_{GS}=0V, T_J=55°C V_{DS}=-48V, V_{GS}=0V, T_J=25°C V_{DS}=-48V, V_{GS}=0V, T_J=55°C	N P	-	-	1 5 -1 -5	μA
$R_{DS\ (on)}$	Static Drain-Source On-Resistance[2]	V_{GS}=10V, I_D=15A V_{GS}=4.5V, I_D=10A V_{GS}=-10V, I_D=-12A V_{GS}=-4.5V, I_D=-8A	N P	-	16 20 30 38	20 24 35 55	mΩ
E_{AS}	Single Pulse Avalanche Energy[5]	V_{DD}=25V, L =0.1mH, I_{AS}=20A V_{DD}=-25V, L =0.1mH, I_{AS}=-20A	N P	20 20	-	-	mJ
V_{SD}	Diode Forward Voltage[2]	I_S=1A, V_{GS}=0V, T_J=25°C I_S=-1A, V_{GS}=0V, T_J=25°C	N P	-	-	1.2 -1.2	V
I_S	Continuous Source Current[14] **(Diode)**	V_G=V_D=0V, Force Current	N P	-	-	23 -23	A

MSH60C20D

N & P-Channel 60-V (D-S) MOSFET

Dynamic and switching Characteristics

Symbol	Parameter	Test Conditions	Ch	Min.	Typ.	Max.	Units
Q_g	Total Gate Charge[2]	N-Ch V_{DS}=30V, I_D=8A, V_{GS}=4.5V P-Ch V_{DS}=-15V, I_D=-15A, V_{GS}=-4.5V	N P	--	19.3 24	--	nC
Q_{gs}	Gate-Source Charge		N P	--	7.1 8.6	--	
Q_{gd}	Gate-Drain Charge		N P	--	7.6 7.3	--	
$t_{d(on)}$	Turn-On Delay Time[2]	N-Ch V_{DS}=30V, I_D=8A, V_{GS}=10V, R_G=3.3Ω P-Ch V_{DS}=-15V, I_D=-15A, V_{GS}=-10V R_G=3.3Ω	N P	--	7.2 9	-- --	ns
t_r	Rise Time		N P	--	50 70.7	-- --	
$t_{d(off)}$	Turn-Off Delay Time		N P	--	36.4 60	-- --	
t_f	Fall Time		N P	--	7.6 20.4	-- --	
C_{ISS}	Input Capacitance	N-Ch V_{DS}=15V, V_{GS}=0V, f=1.0MHz P-Ch V_{DS}=-15V, V_{GS}=0V, f=1.0MHz	N P	-- --	2423 2217	-- --	pF
C_{OSS}	Output Capacitance		N P	-- --	145 310	-- --	
C_{RSS}	Reverse Transfer Capacitance		N P	-- --	97 238	--	

Notes

1. The data tested by surface mounted on a 1 inch^2 FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
3. The EAS data shows maximum rating. The test condition is N-ch V_{DD}=25V, V_{GS}=10V, L=0.1mH, I_{AS}=28A, P-ch V_{DD}=-25V, V_{GS}=-10V, L=0.1mH, I_{AS}=-28A.
4. The power dissipation is limited by 150℃ junction temperature.
5. The Min. value is 100% E_{AS} 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.

MSH60C20D

N & P-Channel 60-V (D-S) MOSFET

- **Typical Electrical Characteristics N-Channel**

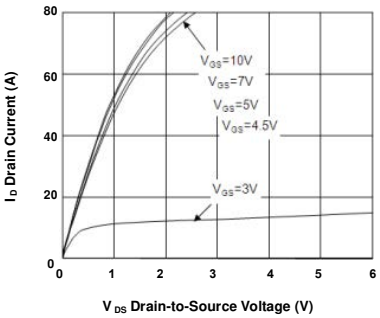


FIG.1-Typical Output Characteristics

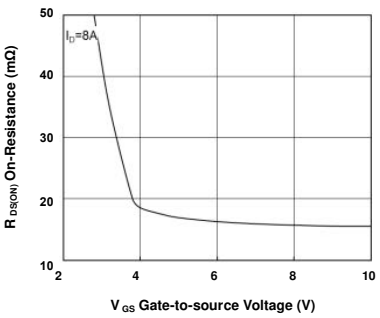


FIG.2-On-Resistance vs. G-S Voltage

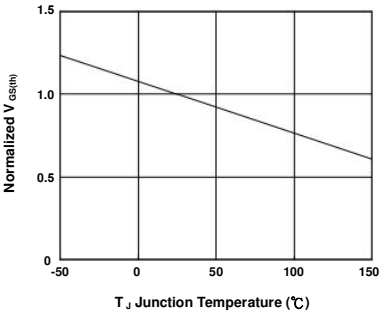


FIG.3-Normalized $V_{GS(th)}$ vs. T_J

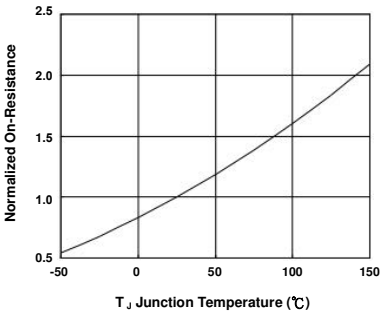


FIG.4-Normalized R_{DSON} vs. T_J

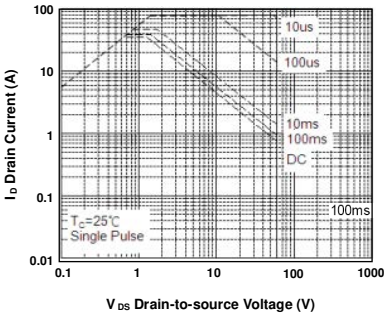


FIG.5-Safe Operating Area

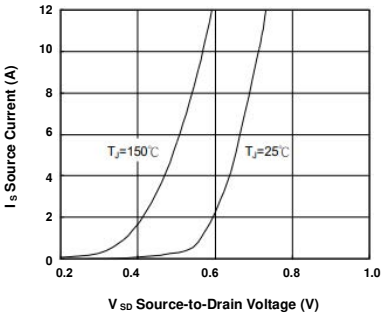


FIG.6-Forward Characteristics of Reverse

MSH60C20D

N & P-Channel 60-V (D-S) MOSFET

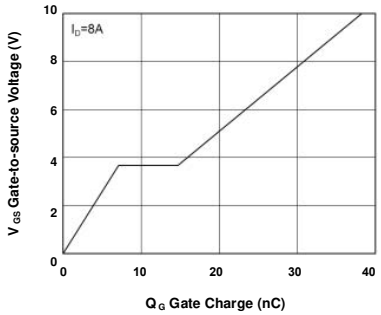


FIG.7-Gate Charge Characteristics

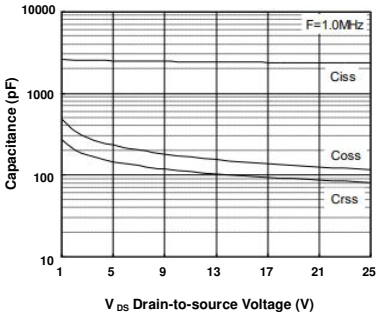


FIG.8-Capacitance Characteristics

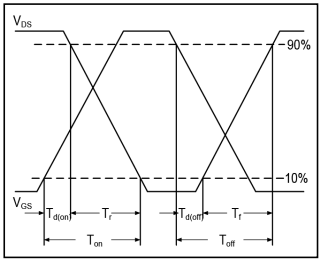


FIG.9-Switching Time Waveform

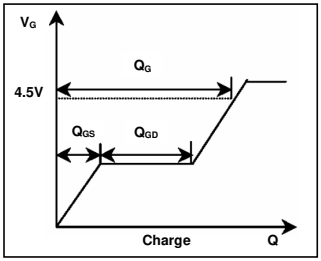


FIG.10-Gate Charge Waveform

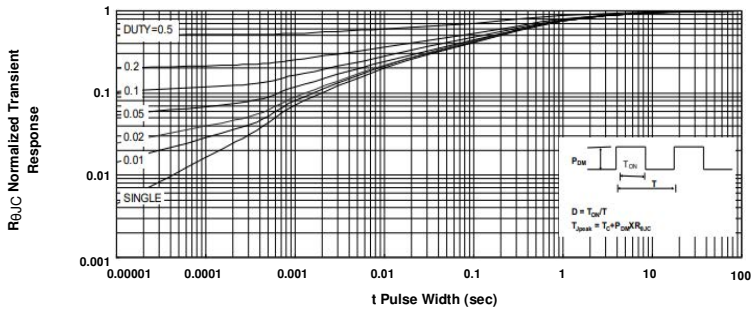


FIG.11-Normalized Maximum Transient Thermal Impedance

MSH60C20D

N & P-Channel 60-V (D-S) MOSFET

Typical Electrical Characteristics P-Channel

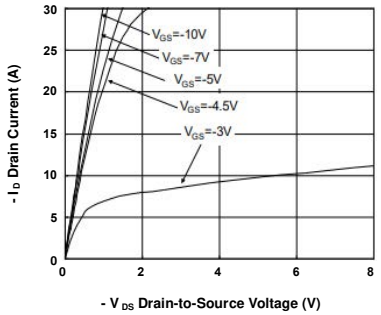


FIG.1-Typical Output Characteristics

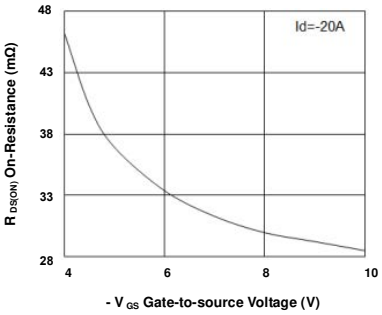


FIG.2-On-Resistance vs. G-S Voltage

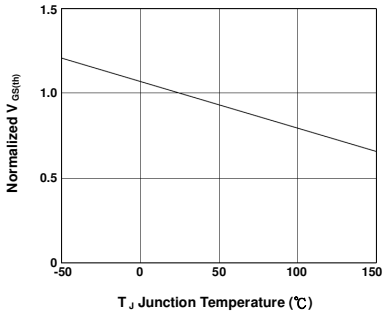


FIG.3-Normalized $V_{GS(th)}$ vs. T_J

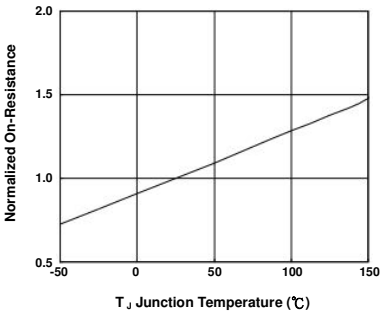


FIG.4-Normalized R_{DSON} vs. T_J

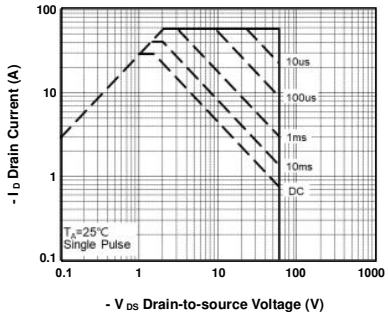


FIG.5-Safe Operating Area

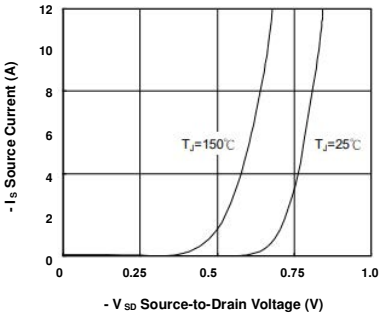


FIG.6-Forward Characteristics of Reverse

MSH60C20D

N & P-Channel 60-V (D-S) MOSFET

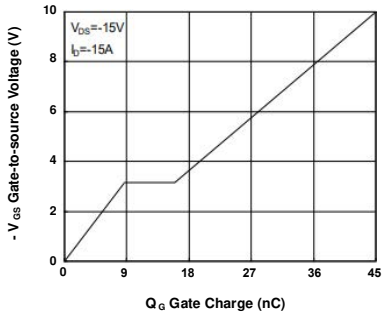


FIG.7-Gate Charge Characteristics

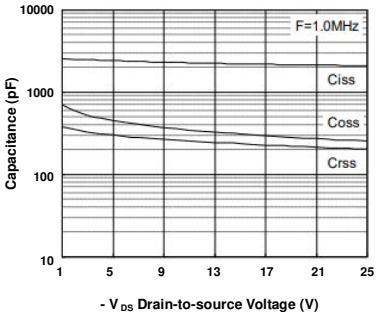


FIG.8-Capacitance Characteristics

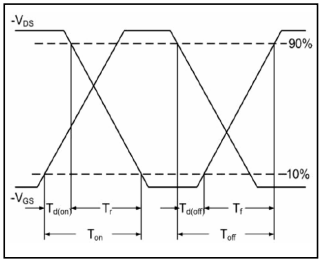


FIG.9-Switching Time Waveform

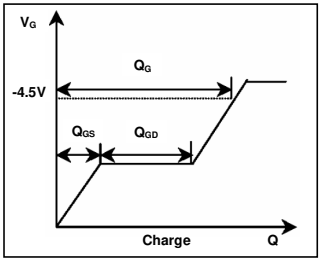


FIG.10-Gate Charge Waveform

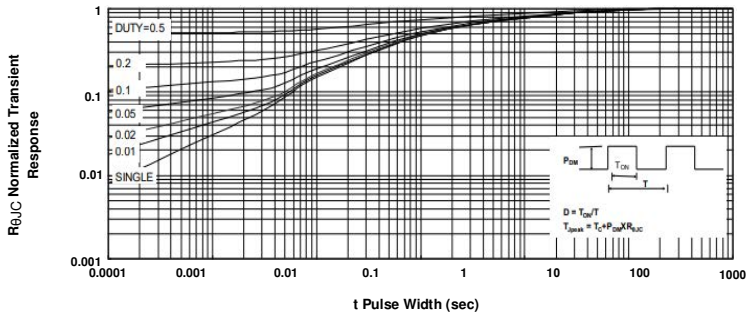


FIG.11-Normalized Maximum Transient Thermal Impedance

MSH100N055D

N-Channel 100-V (D-S) MOSFET

Description

The device is the highest performance trench N-ch MOSFETs with extreme high cell density, which provide excellent $R_{DS(ON)}$ and gate charge for most of the synchronous buck converter applications.

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

Features

- $R_{DS(ON)}$ =55mΩ@ V_{GS} =10V
- Super Low Gate Charge
- Excellent CdV/dt effect decline
- 100% EAS Guaranteed
- Green Device Available

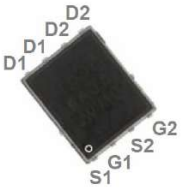
Typical Applications

- Networking
- Load Switch
- LED Applications

Package type：PDFN 5X6 Dual

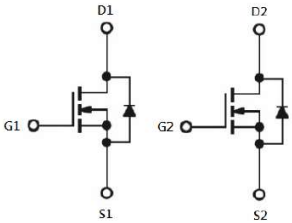
Packing & Order Information

3,000/Reel

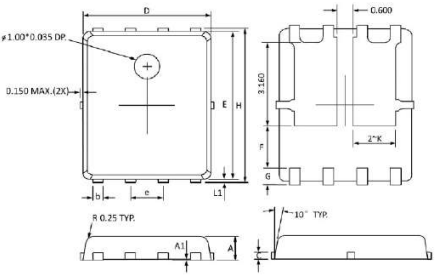


RoHS Compliant

Graphic Symbol

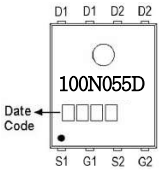


Package Dimension



REF.	Millimeter			REF.	Millimeter		
	Min.	Nom.	Max.		Min.	Nom.	Max.
A	0.90	1.00	1.10	E	5.70	-	5.90
A1	0.00	-	0.05	e	-	1.27	-
b	0.33	-	0.51	H	5.90	-	6.20
c	0.20	-	0.30	G	0.50	-	0.70
D	4.80	-	5.00	L1	0.06	-	0.20
F	1.6 Ref.			K	-	1.60	-

Marking



MSH100N055D

N-Channel 100-V (D-S) MOSFET

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings			
Symbol	**Parameter**	**Value**	**Units**
V_{DS}	Drain-Source Voltage	100	V
V_{GS}	Gate-Source Voltage	±20	V
I_D	Continuous Drain Current[1] (T_C=25°C)	17	A
	Continuous Drain Current[1] (T_C=100°C)	11	A
I_{DM}	Pulsed Drain Current[1,2]	35	A
I_{AS}	Single Pulse Avalanche Current, L =0.1mH[3]	20	A
E_{AS}	Single Pulse Avalanche Energy, L =0.1mH[3]	20	mJ
P_D	Power Dissipation[4] (T_C=25°C)	25	W
	Power Dissipation[4] (T_A=25°C)	3	W
T_J/T_{STG}	Operating Junction and Storage Temperature	-55 to +150	°C

Thermal Resistance Ratings			
Symbol	**Parameter**	**Maximum**	**Units**
$R_{\theta JA}$	Maximum Junction-to-Ambient[1]	62.5	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case[1]	4.2	°C/W

Electrical Characteristics (T_J=25°C unless otherwise specified)						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS} =V_{GS}, I_D =250μA	1.0	1.7	2.5	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V, I_D =250μA	100	-	-	V
I_{GSS}	Gate-Source Leakage Current	V_{DS} =0V, V_{GS} =±20V	-	-	±100	nA
I_{DSS}	Drain-Source Leakage Current	V_{DS} =80V, V_{GS} =0V, T_J =25°C V_{DS} =80V, V_{GS} =0V, T_J =55°C	-	-	1 5	μA
$R_{DS\ (on)}$	Static Drain-Source On-Resistance[2]	V_{GS} =10V, I_D =10A V_{GS} =4.5V, I_D =5A	- -	45 57	55 70	mΩ
EAS	Single Pulse Avalanche Energy[5]	V_{DD} =25V, L =0.1mH, I_{AS} =16A	12.8	-	-	mJ
V_{SD}	Diode Forward Voltage[2]	I_S =10A, V_{GS} =0V, T_J =25°C	-	-	1.2	V
I_S	Continuous Source Current[1,6]	V_G =V_D =0V, Force Current	-	-	15	A
I_{SM}	Pulsed Source Current[2,6]		-	-	30	

Notes

1. The data tested by surface mounted on a 1 inch^2 FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
3. The EAS data shows maximum rating. The test condition is V_{DD}=25V, V_{GS}=10V, L=0.1mH, I_{AS}=20A.
4. The power dissipation is limited by 150℃ 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.

MSH100N055D

N-Channel 100-V (D-S) MOSFET

Dynamic						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
Q_g	Total Gate Charge[2]	V_{DS} =50V	--	7.9	--	nC
Q_{gs}	Gate-Source Charge	I_D =10A	--	2.8	--	
Q_{gd}	Gate-Drain ("Miller") Charge	V_{GS} =10V	--	2.1	--	
$t_{d(on)}$	Turn-On Delay Time[2]	V_{DS} =50V	--	5	--	ns
t_r	Rise Time	I_D =1A	--	10	--	
$t_{d(off)}$	Turn-Off Delay Time	V_{GS} =10V	--	19	--	
t_f	Fall Time	R_G =3Ω	--	7.6	--	
C_{ISS}	Input Capacitance	V_{DS} =50V	--	410	--	pF
C_{OSS}	Output Capacitance	V_{GS} =0V	--	64	--	
C_{RSS}	Reverse Transfer Capacitance	f =1.0MHz	--	5	--	
Rg	Gate Resistance	V_{GS} =V_{DS} =0V, f =1.0MHz	--	2.5	--	Ω

MSH100N055D

N-Channel 100-V (D-S) MOSFET

- **Typical Electrical Characteristics**

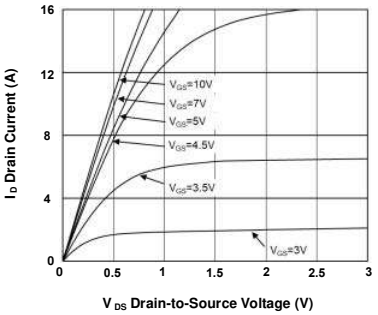


FIG.1-Typical Output Characteristics

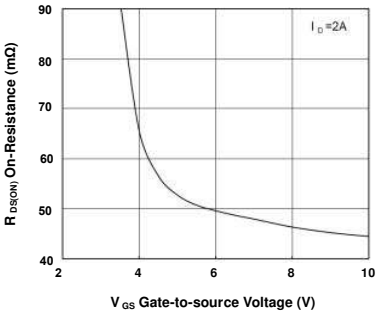


FIG.2-On-Resistance vs. G-S Voltage

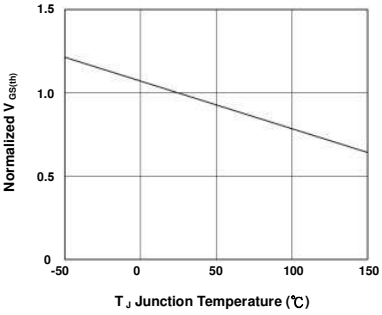


FIG.3-Normalized $V_{GS(th)}$ vs. T_J

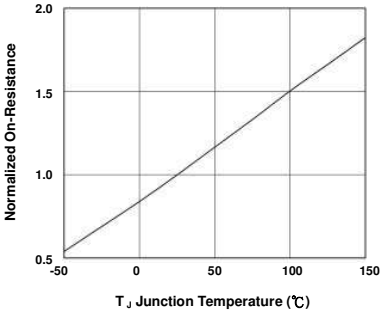


FIG.4-Normalized R_{DSON} vs. T_J

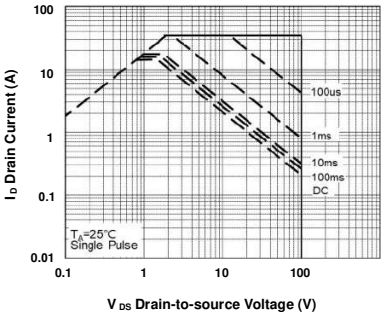


FIG.5-Safe Operating Area

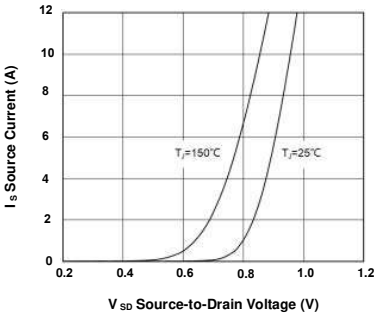


FIG.6-Forward Characteristics of Reverse

MSH100N055D

N-Channel 100-V (D-S) MOSFET

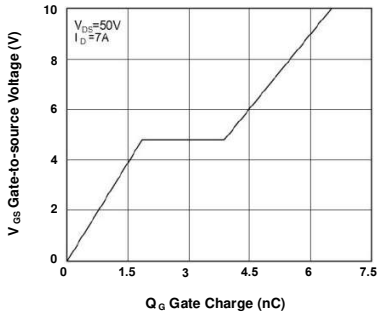


FIG.7-Gate Charge Characteristics

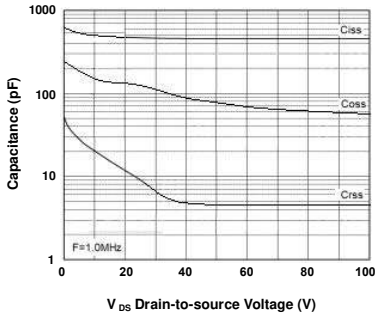


FIG.8-Capacitance Characteristics

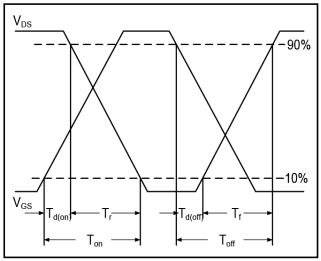


FIG.9-Switching Time Waveform

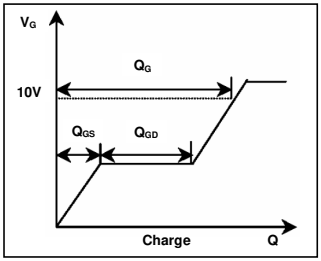


FIG.10-Gate Charge Waveform

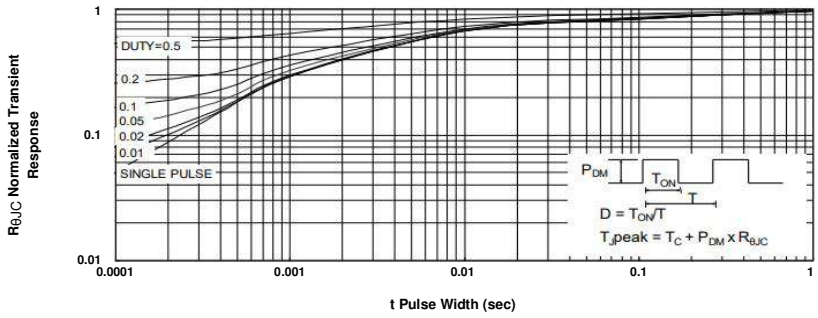


FIG.11-Normalized Maximum Transient Thermal Impedance

MSH100N020D

N-Channel 100-V (D-S) MOSFET

Description

The device is the highest performance trench N-ch MOSFETs with extreme high cell density, which provide excellent $R_{DS(ON)}$ and gate charge for most of the synchronous buck converter applications.

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

Features

- $R_{DS(ON)}$ =19.5mΩ@ V_{GS} =10V
- Super Low Gate Charge
- Excellent CdV/dt effect decline
- 100% EAS Guaranteed
- Green Device Available

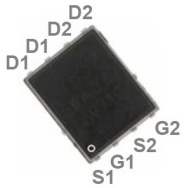
Typical Applications

- Networking
- Load Switch
- LED Applications

Package type：PDFN 5X6 Dual

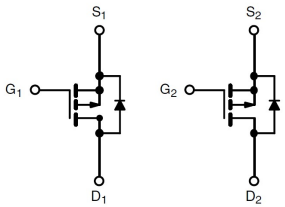
Packing & Order Information

3,000/Reel

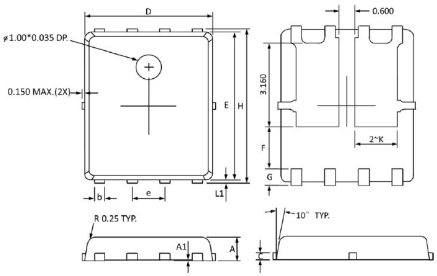


RoHS Compliant

Graphic Symbol

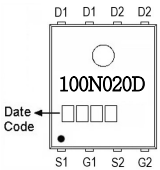


Package Dimension



REF.	Millimeter			REF.	Millimeter		
	Min.	Nom.	Max.		Min.	Nom.	Max.
A	0.90	1.00	1.10	E	5.70	-	5.90
A1	0.00	-	0.05	e	-	1.27	-
b	0.33	-	0.51	H	5.90	-	6.20
c	0.20	-	0.30	G	0.50	-	0.70
D	4.80	-	5.00	L1	0.06	-	0.20
F	1.6 Ref.			K	-	1.60	-

Marking



MSH100N020D

N-Channel 100-V (D-S) MOSFET

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings			
Symbol	**Parameter**	**Value**	**Units**
V_{DS}	Drain-Source Voltage	100	V
V_{GS}	Gate-Source Voltage	±20	V
I_D	Continuous Drain Current[1] (T_C=25°C)	28.5	A
	Continuous Drain Current[1] (T_C=100°C)	20	A
I_{DM}	Pulsed Drain Current[1,2]	90	A
I_{AS}	Single Pulse Avalanche Current, L =0.1mH[3]	30	A
E_{AS}	Single Pulse Avalanche Energy, L =0.1mH[3]	45	mJ
P_D	Power Dissipation[4] (T_C=25°C)	30	W
	Power Dissipation[4] (T_A=25°C)	2	W
T_J/T_{STG}	Operating Junction and Storage Temperature	-55 to +150	°C

Thermal Resistance Ratings			
Symbol	**Parameter**	**Maximum**	**Units**
$R_{\theta JA}$	Maximum Junction-to-Ambient[1]	62.5	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case[1]	4.2	°C/W

Electrical Characteristics (T_J=25°C unless otherwise specified)						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS} =V_{GS}, I_D =250μA	1.0	1.7	2.5	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V, I_D =250μA	100	-	-	V
I_{GSS}	Gate-Source Leakage Current	V_{DS} =0V, V_{GS} =±20V	-	-	±100	nA
I_{DSS}	Drain-Source Leakage Current	V_{DS} =80V, V_{GS} =0V, T_J =25°C V_{DS} =80V, V_{GS} =0V, T_J =55°C	-	-	1 5	μA
$R_{DS\ (on)}$	Static Drain-Source On-Resistance[2]	V_{GS} =10V, I_D =10A V_{GS} =4.5V, I_D =10A	- -	16.5 22	19.5 29	mΩ
EAS	Single Pulse Avalanche Energy[5]	V_{DD} =25V, L =0.1mH, I_{AS} =22A	24	-	-	mJ
V_{SD}	Diode Forward Voltage[2]	I_S =10A, V_{GS} =0V, T_J =25°C	-	-	1.2	V
I_S	Continuous Source Current[1,6]	V_G =V_D =0V, Force Current	-	-	28.5	A
I_{SM}	Pulsed Source Current[2,6]		-	-	60	

Notes

1. The data tested by surface mounted on a 1 inch^2 FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
3. The EAS data shows maximum rating. The test condition is V_{DD}=25V, V_{GS}=10V, L=0.1mH, I_{AS}=30A.
4. The power dissipation is limited by 150℃ 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.

MSH100N020D

N-Channel 100-V (D-S) MOSFET

Dynamic						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
Q_g	Total Gate Charge[2]	V_{DS} =50V	--	17.9	--	nC
Q_{gs}	Gate-Source Charge	I_D =10A	--	2.8	--	
Q_{gd}	Gate-Drain ("Miller") Charge	V_{GS} =10V	--	5.1	--	
$t_{d(on)}$	Turn-On Delay Time[2]	V_{DS} =30V	--	13	--	ns
t_r	Rise Time	I_D =1A	--	6	--	
$t_{d(off)}$	Turn-Off Delay Time	V_{GS} =10V	--	30	--	
t_f	Fall Time	R_G =6Ω	--	29	--	
C_{ISS}	Input Capacitance	V_{DS} =50V	--	849	--	pF
C_{OSS}	Output Capacitance	V_{GS} =0V	--	185	--	
C_{RSS}	Reverse Transfer Capacitance	f =1.0MHz	--	8	--	
Rg	Gate Resistance	V_{GS} =V_{DS} =0V, f =1.0MHz	--	0.8	--	Ω

MSH100N020D

N-Channel 100-V (D-S) MOSFET

- **Typical Electrical Characteristics**

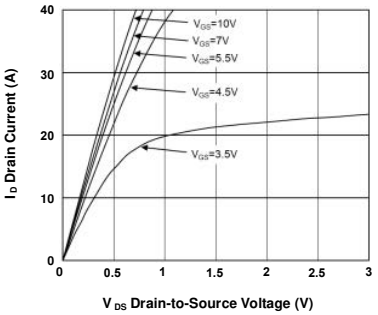


FIG.1-Typical Output Characteristics

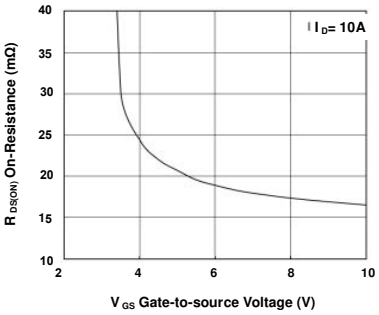


FIG.2-On-Resistance vs. G-S Voltage

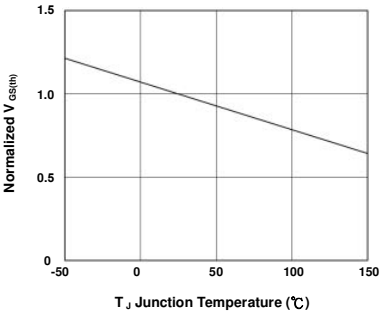


FIG.3-Normalized $V_{GS(th)}$ vs. T_J

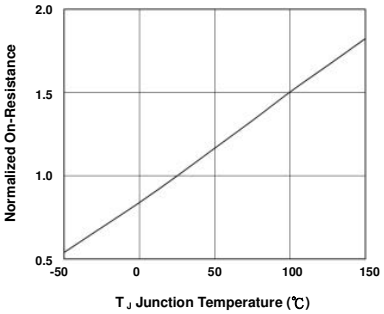


FIG.4-Normalized R_{DSON} vs. T_J

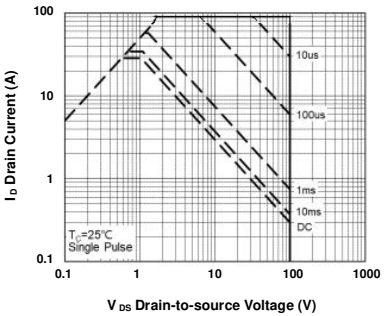


FIG.5-Safe Operating Area

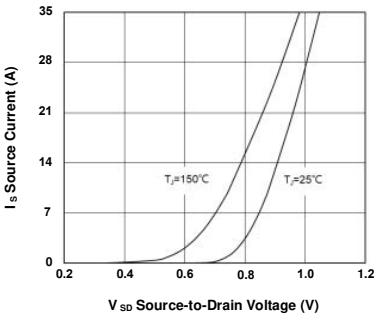


FIG.6-Forward Characteristics of Reverse

MSH100N020D

N-Channel 100-V (D-S) MOSFET

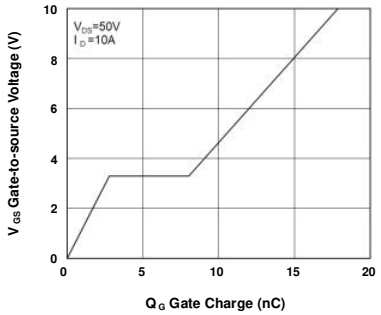


FIG.7-Gate Charge Characteristics

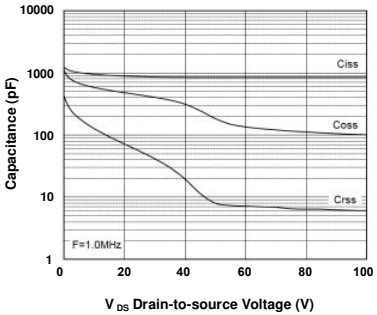


FIG.8-Capacitance Characteristics

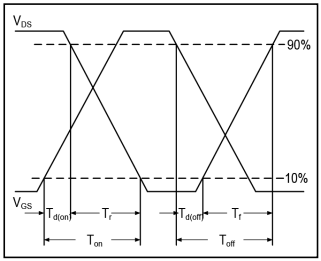


FIG.9-Switching Time Waveform

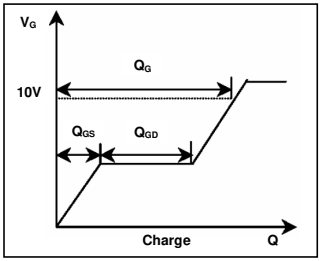


FIG.10-Gate Charge Waveform

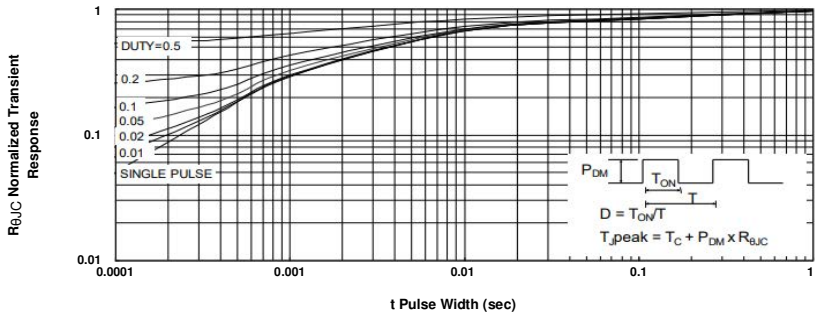


FIG.11-Normalized Maximum Transient Thermal Impedance

MSQ60C04D

N & P-Channel 60-V (D-S) MOSFET

Description

The device is the highest performance trench N-ch and P-ch MOSFETs with extreme high cell density, which provide excellent $R_{DS(ON)}$ and gate charge for most of the synchronous buck converter applications.

The device meets the RoHS and Green Product requirement, 100% E_{AS} guaranteed with full function reliability approved.

Features

- Suit for 4.5V Gate Drive Applications
- Super Low Gate Charge
- Excellent CdV/dt effect decline
- 100% EAS Guaranteed
- Green Device Available

Typical Applications

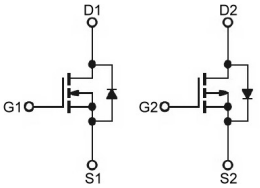
- DC Fan
- Motor Drive Applications
- Networking
- Half / Full Bridge Topology

Package type：SOP-8

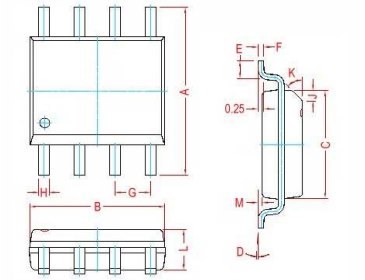
Packing & Order Information 3,000/Reel

RoHS Compliant

Graphic Symbol

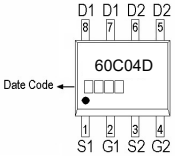


Package Dimension



REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	5.80	6.20	M	0.10	0.25
B	4.80	5.00	H	0.35	0.51
C	3.80	4.00	L	1.35	1.75
D	0°	8°	J	0.40 Ref.	
E	0.40	0.90	K	45° Ref.	
F	0.19	0.26	G	1.27 Typ.	

Marking



MSQ60C04D

N & P-Channel 60-V (D-S) MOSFET **MAXIMUM**

RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings (unless otherwise specified)

Symbol	Parameter	Value		Units
		N-ch	P-ch	
V_{DS}	Drain-Source Voltage	60	-60	V
V_{GS}	Gate-Source Voltage	±20	±20	V
I_D	Continuous Drain Current[1] (T_A=25°C)	5	-3.8	A
	Continuous Drain Current[1] (T_A=70°C)	4	-3.2	A
I_{DM}	Pulsed Drain Current[2] (T_A=25°C)	20	-15	A
I_{AS}	Single Pulse Avalanche Current, L =0.1mH[3]	21	-24	A
E_{AS}	Single Pulse Avalanche Energy, L =0.1mH[3]	22	28.8	mJ
P_D	Power Dissipation[3] (T_C=25°C)	2		W
T_J/T_{STG}	Operating Junction and Storage Temperature	-55 to +150		°C

Thermal Resistance Ratings

Symbol	Parameter	Maximum	Units
$R_{\theta JA}$	Maximum Junction-to-Ambient[1]	85	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case[1]	62.5	°C/W

Electrical Characteristics(T_J=25°C unless otherwise specified)

Symbol	Parameter	Test Conditions	Ch	Min.	Typ.	Max.	Units
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS}=V_{GS}, I_D=250μA V_{DS}=V_{GS}, I_D=-250μA	N P	1.0 -1.0	1.6 -1.7	2.5 -2.5	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS}=0V, I_D=250μA V_{GS}=0V, I_D=-250μA	N P	60 -60	-	-	V
g_{fs}	Forward Transconductance	V_{DS}=5V, I_D=4A V_{DS}=-5V, I_D=-3A	N P	-	5 5.4	-	S
I_{GSS}	Gate-Source Leakage Current	V_{DS}=0V, V_{GS}=±20V	N P	-	-	±100	nA
I_{DSS}	Drain-Source Leakage Current	V_{DS}=48V, V_{GS}=0V, T_J=25°C V_{DS}=48V, V_{GS}=0V, T_J=55°C V_{DS}=-48V, V_{GS}=0V, T_J=25°C V_{DS}=-48V, V_{GS}=0V, T_J=55°C	N P	-	-	1 5 -1 -5	μA
$R_{DS\ (on)}$	Static Drain-Source On-Resistance[2]	V_{GS}=10V, I_D=5A V_{GS}=4.5V, I_D=4A V_{GS}=-10V, I_D=-3.5A V_{GS}=-4.5V, I_D=-3A	N P	-	39 43 72 90	56 60 90 120	mΩ
E_{AS}	Single Pulse Avalanche Energy[5]	V_{DD}=25V, L =0.1mH, I_{AS}=16A V_{DD}=-25V, L =0.1mH, I_{AS}=-16A	N P	11 11	-	-	mJ
V_{SD}	Diode Forward Voltage[2]	I_S=1A, V_{GS}=0V, T_J=25°C I_S=-1A, V_{GS}=0V, T_J=25°C	N P	-	-	1.2 -1.2	V
I_S	Continuous Source Current[14] **(Diode)**	V_G=V_D=0V, Force Current	N P	-	-	2.5 -2.5	A

MSQ60C04D

N & P-Channel 60-V (D-S) MOSFET

Dynamic and switching Characteristics

Symbol	Parameter	Test Conditions	Ch	Min.	Typ.	Max.	Units
Q_g	Total Gate Charge[2]	N-Ch V_{DS}=48V, I_D=4A, V_{GS}=4.5V P-Ch V_{DS}=-48V, I_D=-3A, V_{GS}=-4.5V	N P	--	19 12	--	nC
Q_{gs}	Gate-Source Charge		N P	--	2.6 2.2	--	
Q_{gd}	Gate-Drain Charge		N P	--	4.1 6.3	--	
$t_{d(on)}$	Turn-On Delay Time[2]	N-Ch V_{DS}=30V, I_D=4A, V_{GS}=10V, R_G=3.3Ω P-Ch V_{DS}=-15V, I_D=-1A, V_{GS}=-10V R_G=3.3Ω	N P	--	3 9.2	-- --	ns
t_r	Rise Time		N P	--	34 20.1	-- --	
$t_{d(off)}$	Turn-Off Delay Time		N P	--	23 46.7	-- --	
t_f	Fall Time		N P	--	6 9.4	-- --	
C_{ISS}	Input Capacitance	N-Ch V_{DS}=15V, V_{GS}=0V, f=1.0MHz P-Ch V_{DS}=-15V, V_{GS}=0V, f=1.0MHz	N P	-- --	1027 1137	-- --	pF
C_{OSS}	Output Capacitance		N P	-- --	65 76	-- --	
C_{RSS}	Reverse Transfer Capacitance		N P	-- --	46 50	--	

Notes

1. The data tested by surface mounted on a 1 inch^2 FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
3. The EAS data shows maximum rating. The test condition is N-ch V_{DD}=25V, V_{GS}=10V, L=0.1mH, I_{AS}=21A, P-ch V_{DD}=-25V, V_{GS}=-10V, L=0.1mH, I_{AS}=-24A.
4. The power dissipation is limited by 150℃ junction temperature.
5. The Min. value is 100% E_{AS} 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.

MSQ60C04D

N & P-Channel 60-V (D-S) MOSFET

- **Typical Electrical Characteristics N-Channel**

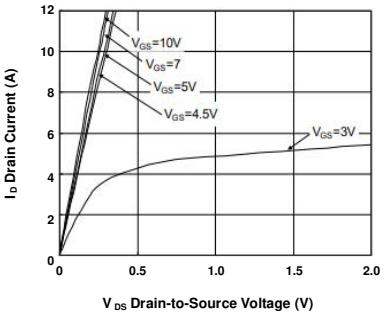


FIG.1-Typical Output Characteristics

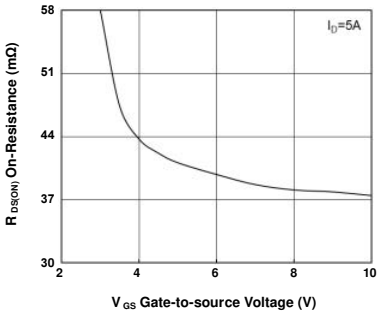


FIG.2-On-Resistance vs. G-S Voltage

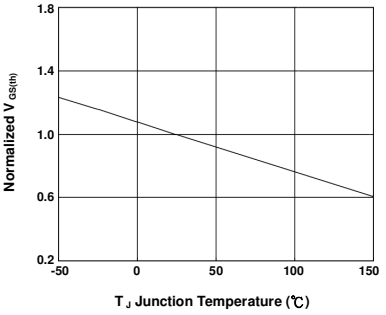


FIG.3-Normalized $V_{GS(th)}$ vs. T_J

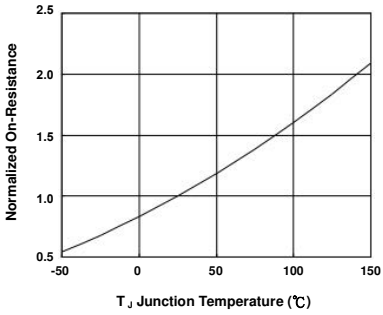


FIG.4-Normalized R_{DSON} vs. T_J

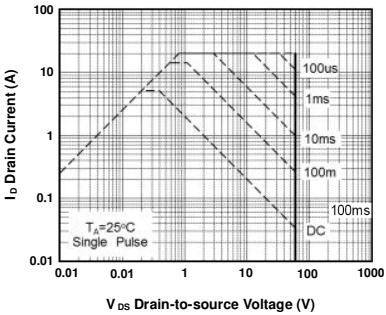


FIG.5-Safe Operating Area

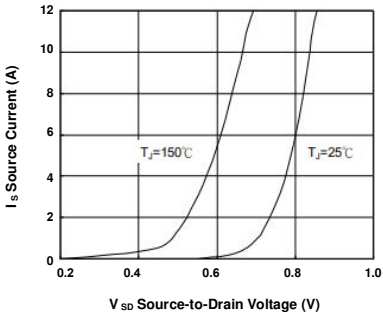


FIG.6-Forward Characteristics of Reverse

MSQ60C04D

N & P-Channel 60-V (D-S) MOSFET

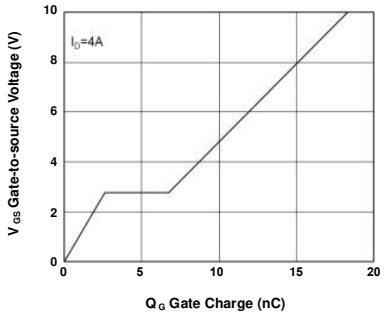


FIG.7-Gate Charge Characteristics

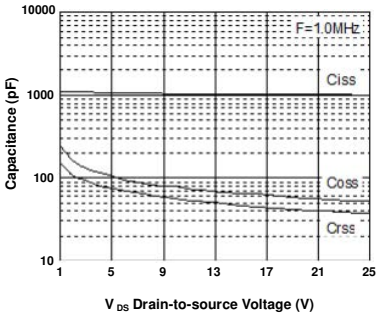


FIG.8-Capacitance Characteristics

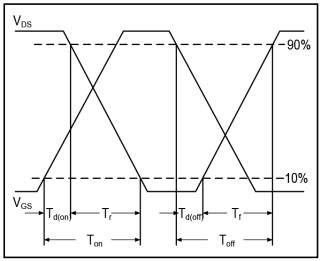


FIG.9-Switching Time Waveform

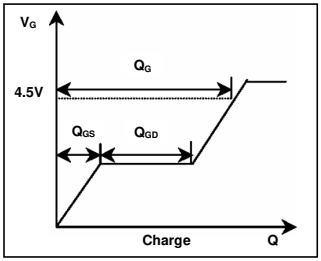


FIG.10-Gate Charge Waveform

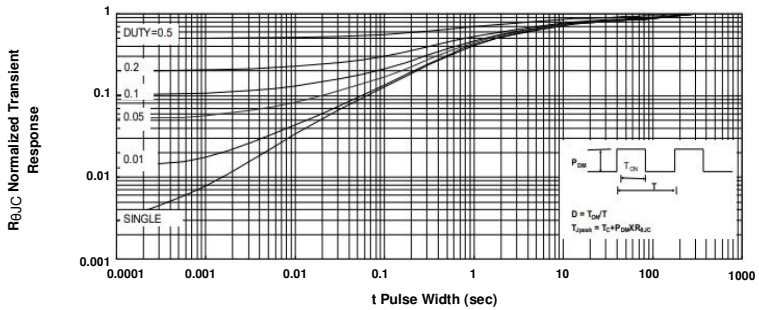


FIG.11-Normalized Maximum Transient Thermal Impedance

MSQ60C04D

N & P-Channel 60-V (D-S) MOSFET

Typical Electrical Characteristics P-Channel

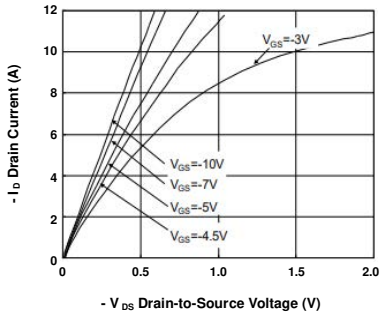


FIG.1-Typical Output Characteristics

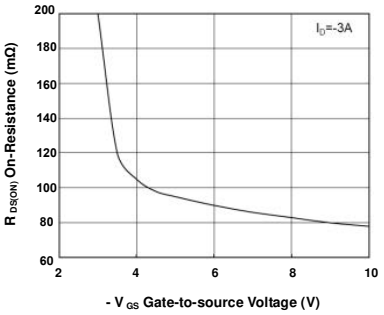


FIG.2-On-Resistance vs. G-S Voltage

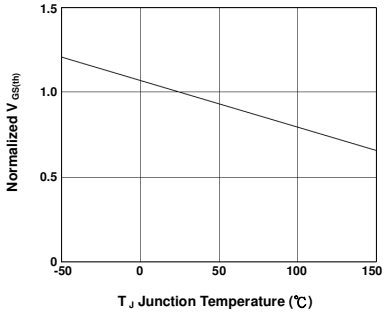


FIG.3-Normalized $V_{GS(th)}$ vs. T_J

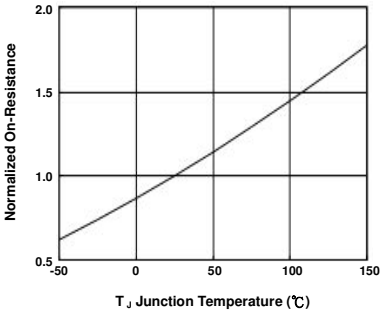


FIG.4-Normalized R_{DSON} vs. T_J

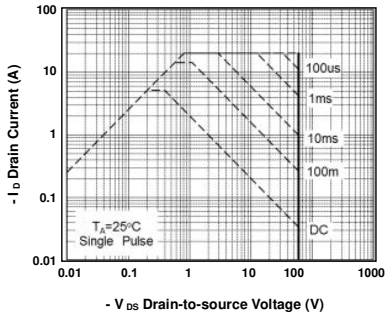


FIG.5-Safe Operating Area

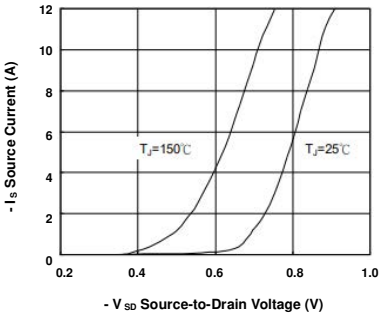


FIG.6-Forward Characteristics of Reverse

MSQ60C04D

N & P-Channel 60-V (D-S) MOSFET

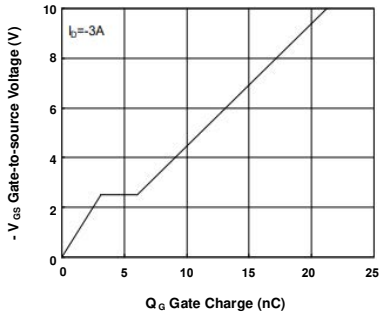


FIG.7-Gate Charge Characteristics

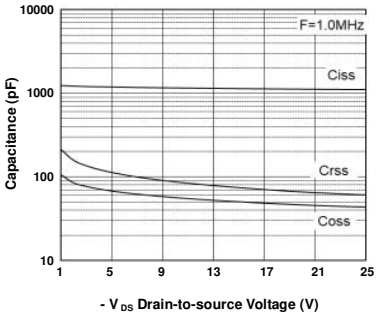


FIG.8-Capacitance Characteristics

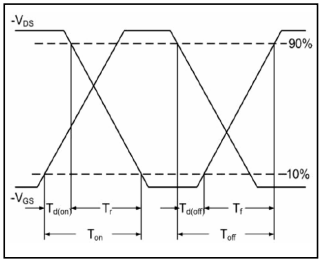


FIG.9-Switching Time Waveform

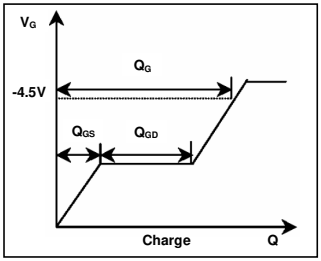


FIG.10-Gate Charge Waveform

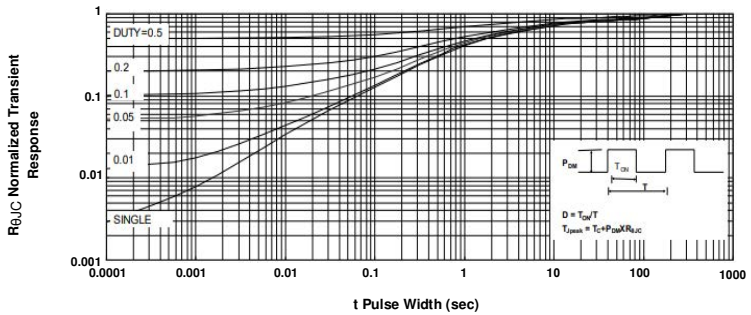


FIG.11-Normalized Maximum Transient Thermal Impedance

With me,
Power for you.

4

MOSFET

IPM_DFN14X12

The six chips are packaged together, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode.

All products are available in industrial grade and automotive grade.

MSIE40N90-6

Full bridge N Channel 40-V (D-S) MOSFET

Description

The device is using trench DMOS technology. This advanced technology has been especially tailored to minimize $R_{DS(ON)}$, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency fast switching applications.

Features

- $R_{DS(ON)}$ =7.5mΩ @ V_{GS} =10V
- Fast switching
- Improve dv/dt Capability ●

100% EAS Guaranteed

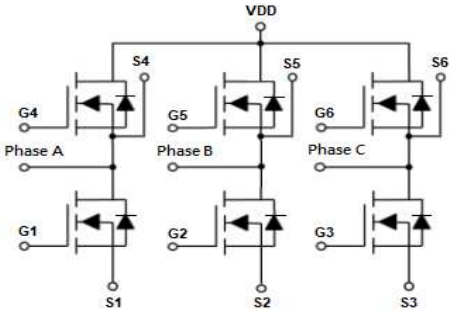
- Green Device Available

Typical Applications

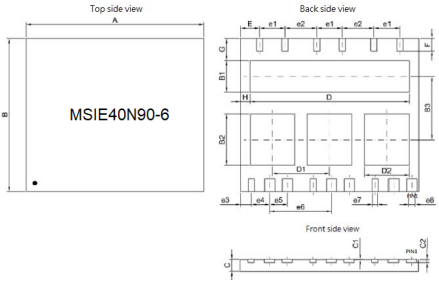
- 3 phase Motor Driver
- 3 phase Invertor
- Full bridge module

Package type：PDFN 14 x 12

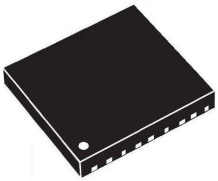
Graphic Symbol

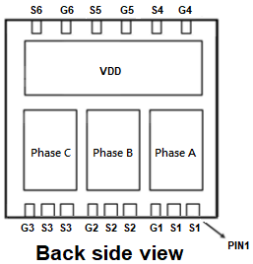


Package Dimension



Packing Information

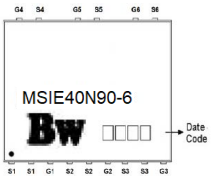




Back side view

SYMBOL	Dimensions (unit:mm)			SYMBOL	Dimensions (unit:mm)		
	MIN.	NOM.	MAX.		MIN.	NOM.	MAX.
A	13.90	14.00	14.10	e1		2.00 BSC	
B	11.90	12.00	12.10	e2		2.50 BSC	
B1	2.45	2.50	2.55	e3		0.85 BSC	
B2	3.95	4.00	4.05	e4		1.45 BSC	
B3	4.90	4.95	5.00	e5		1.40 BSC	
C	0.90	0.95	1.00	e6		4.87 BSC	
C1	0.00	0.02	0.05	e7	0.45	0.50	0.55
C2		0.254 REF		e8	0.75	0.80	0.85
D	12.45	12.50	12.55	F	0.95	1.00	1.05
D1	4.45	4.50	4.55	G	1.70	1.75	1.80
D2	3.45	3.50	3.55	H	0.70	0.75	0.08
E	1.45	1.50	1.55				

Marking



AEC-Q101 Qualification Available

RoHS Compliant

MSIE40N90-6

Full bridge N Channel 40-V (D-S) MOSFET

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings (Tc=25°C unless otherwise noted)			
Symbol	**Parameter**	**Value**	**Unit**
V_{DS}	Drain-Source Voltage	40	V
V_{GS}	Gate-Source Voltage	±20	V
I_D	Continuous Drain Current @ T_C=25°C	90	A
	Continuous Drain Current @ T_C=70°C	65	A
I_{DM}	Pulsed Drain Current[2]	250	A
I_{AS}	Single Pulse Avalanche Current[3]	65	A
E_{AS}	Single Pulse Avalanche Energy[3]	211	mJ
P_D	Power Dissipation (T_C=25°C)	85	W
T_j, T_{stg}	Operating Junction and Storage Temperature	-55~+175	°C

Thermal Resistance Ratings			
Symbol	**Parameter**	**Value**	**Unit**
$R_{\theta JA}$	Maximum Junction-to-Ambient[1]	60	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case	1.4	°C/W

Electrical Characteristics (T_J=25°C unless otherwise specified)						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS} =V_{GS}, I_D =250μA	1.2	1.9	2.5	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V, I_D =250μA	40	-	-	V
I_{GSS}	Gate-Source Leakage Current	V_{DS} =0V, V_{GS} =±20V	-	-	±100	nA
I_{DSS}	Drain-Source Leakage Current	V_{DS} =32V, V_{GS} =0V, T_J =25°C	-	-	1	μA
		V_{DS} =32V, V_{GS} =0V, T_J =55°C			5	
$R_{DS\ (on)}$	Static Drain-Source On-Resistance[2]	V_{GS} =10V, I_D =20A	-	5.5	7.5	mΩ
		V_{GS} =4.5V, I_D =20A	-	8.5	12	
EAS	Single Pulse Avalanche Energy[5]	V_{DD} =25V, L =0.1mH, I_{AS} =45A	101	-	-	mJ
V_{SD}	Diode Forward Voltage[2]	I_S =1A, V_{GS} =0V, T_J =25°C	-	-	1.2	V
I_S	Continuous Source Current[1,6]	V_G =V_D =0V, Force Current	-	-	80	A
I_{SM}	Pulsed Source Current[2,6]		-	-	250	

MSIE40N90-6

Full bridge N Channel 40-V (D-S) MOSFET

Dynamic						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
Q_g	Total Gate Charge[2]	V_{DS} =20V	--	20	--	nC
Q_{gs}	Gate-Source Charge	I_D =15A	--	4	--	
Q_{gd}	Gate-Drain Charge	V_{GS} =10V	--	4.7	--	
$t_{d(on)}$	Turn-On Delay Time[2]	V_{DS} =20V	--	11.5	--	ns
t_r	Rise Time	I_D =15A	--	9	--	
$t_{d(off)}$	Turn-Off Delay Time	V_{GS} =10V	--	24	--	
t_f	Fall Time	R_G =3Ω	--	15	--	
C_{ISS}	Input Capacitance	V_{DS} =20V	--	1078	--	pF
C_{OSS}	Output Capacitance	V_{GS} =0V	--	483	--	
C_{RSS}	Reverse Transfer Capacitance	f =1.0MHz	--	49	--	
Rg	Gate Resistance	V_{DS} =0V, V_{GS} =0V, f =1.0MHz		1.9		Ω

Notes

1. The data tested by surface mounted on a 1 inch^2 FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
3. The EAS data shows maximum rating. The test condition is V_{DD}=25V, V_{GS}=10V, L=0.1 mH, I_{AS}=65A.
4. The power dissipation is limited by 175℃ 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.

MSIE40N90-6

Full bridge N Channel 40-V (D-S) MOSFET

- **Typical Electrical Characteristics**

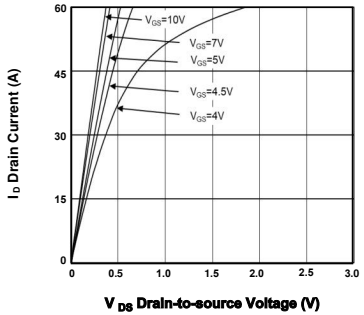


FIG.1-Typical Output Characteristics

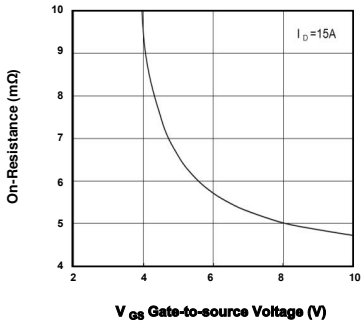


FIG.2-On-Resistance vs G-S Voltage

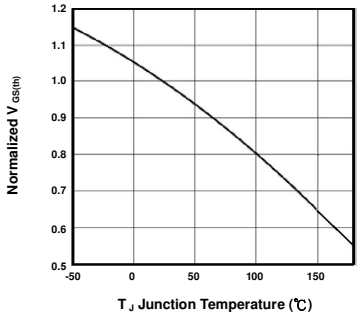


FIG.3-Normalized $V_{GS(th)}$ vs. T_J

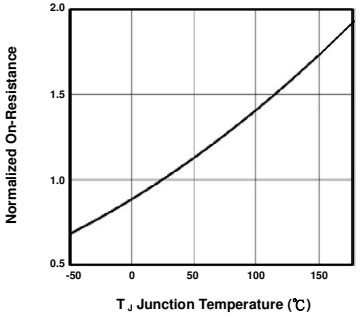


FIG.4-Normalized R_{DSON} vs. T_J

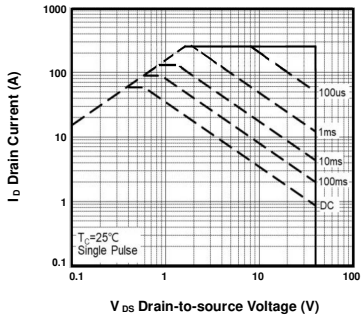


FIG.5-Safe Operating Area

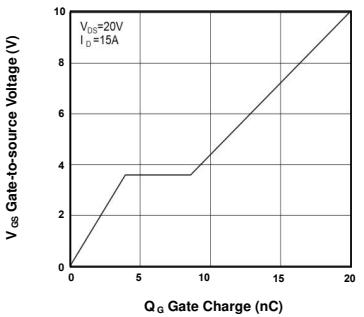


FIG.6-Gate Charge Characteristics

MSIE40N90-6

Full bridge N Channel 40-V (D-S) MOSFET

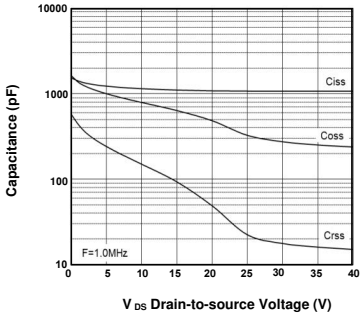


FIG.7- Capacitance

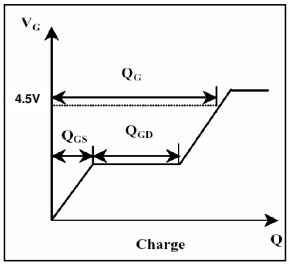


FIG.8-Gate Charge Waveform

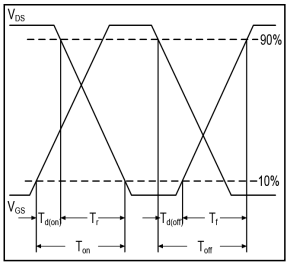


FIG.9-Switching Time Waveform

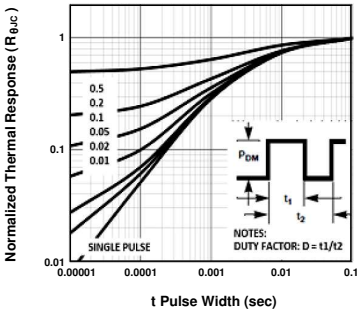


FIG.10-Transient Thermal Impedance

MSIE40N150-6

Full bridge N Channel 40-V (D-S) MOSFET

Description

The device is using trench DMOS technology. This advanced technology has been especially tailored to minimize $R_{DS(ON)}$, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency fast switching applications.

Features

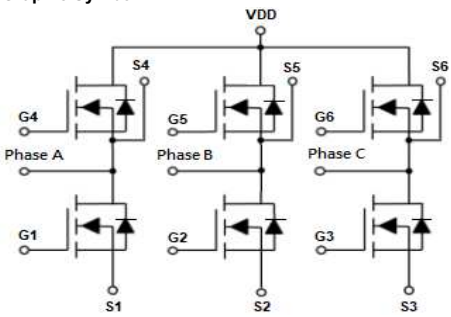
- $R_{DS(ON)}$ =2.6mΩ @ V_{GS} =10V
- Fast switching
- Improve dv/dt Capability
- 100% EAS Guaranteed
- Green Device Available

Typical Applications

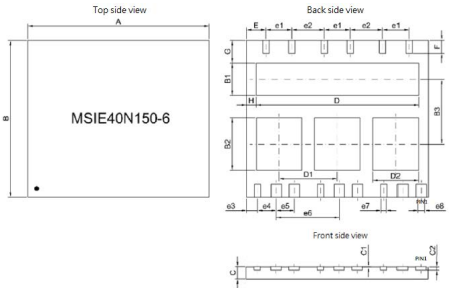
- 3 phase Motor Driver
- 3 phase Invertor
- Full bridge module

Package type：PDFN 14 x 12

Graphic Symbol

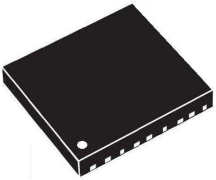


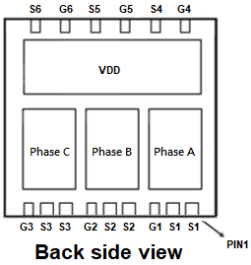
Package Dimension



SYMBOL	Dimensions (unit:mm)			SYMBOL	Dimensions (unit:mm)		
	MIN.	NOM.	MAX.		MIN.	NOM.	MAX.
A	13.90	14.00	14.10	e1		2.00 BSC	
B	11.90	12.00	12.10	e2		2.50 BSC	
B1	2.45	2.50	2.55	e3		0.85 BSC	
B2	3.95	4.00	4.05	e4		1.45 BSC	
B3	4.90	4.95	5.00	e5		1.40 BSC	
C	0.90	0.95	1.00	e6		4.87 BSC	
C1	0.00	0.02	0.05	e7	0.45	0.50	0.55
C2		0.254 REF		e8	0.75	0.80	0.85
D	12.45	12.50	12.55	F	0.95	1.00	1.05
D1	4.45	4.50	4.55	G	1.70	1.75	1.80
D2	3.45	3.50	3.55	H	0.70	0.75	0.08
E	1.45	1.50	1.55				

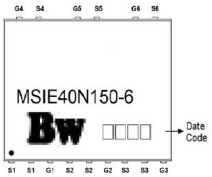
Packing Information





Back side view

Marking



AEC-Q101 Qualification Available

RoHS Compliant

MSIE40N150-6

Full bridge N Channel 40-V (D-S) MOSFET

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings (Tc=25°C unless otherwise noted)			
Symbol	**Parameter**	**Value**	**Unit**
V_{DS}	Drain-Source Voltage	40	V
V_{GS}	Gate-Source Voltage	±20	V
I_D	Continuous Drain Current @ T_C=25°C	150	A
	Continuous Drain Current @ T_C=70°C	125	A
I_{DM}	Pulsed Drain Current[2]	600	A
I_{AS}	Single Pulse Avalanche Current[3]	90	A
E_{AS}	Single Pulse Avalanche Energy[3]	405	mJ
P_D	Power Dissipation (T_C=25°C)	85	W
T_j, T_{stg}	Operating Junction and Storage Temperature	-55~+175	°C

Thermal Resistance Ratings			
Symbol	**Parameter**	**Value**	**Unit**
$R_{\theta JA}$	Maximum Junction-to-Ambient[1]	60	°C/W
$R_{\theta JC}$	Maximum Junction-to-Case	1.4	°C/W

Electrical Characteristics (T_J=25°C unless otherwise specified)						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS} =V_{GS}, I_D =250μA	1.2	-	2.2	V
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} =0V, I_D =250μA	40	-	-	V
I_{GSS}	Gate-Source Leakage Current	V_{DS} =0V, V_{GS} =±20V	-	-	±100	nA
I_{DSS}	Drain-Source Leakage Current	V_{DS} =32V, V_{GS} =0V, T_J =25°C	-	-	1	μA
		V_{DS} =32V, V_{GS} =0V, T_J =55°C			5	
$R_{DS\ (on)}$	Static Drain-Source On-Resistance[2]	V_{GS} =10V, I_D =20A	-	2.2	2.6	mΩ
		V_{GS} =4.5V, I_D =20A	-	2.8	3.6	
EAS	Single Pulse Avalanche Energy[5]	V_{DD} =25V, L =0.1mH, I_{AS} =60A	180	-	-	mJ
V_{SD}	Diode Forward Voltage[2]	I_S =1A, V_{GS} =0V, T_J =25°C	-	-	1.2	V
I_S	Continuous Source Current[1,6]	V_G =V_D =0V, Force Current	-	-	150	A
I_{SM}	Pulsed Source Current[2,6]		-	-	450	

MSIE40N150-6

Full bridge N Channel 40-V (D-S) MOSFET

Dynamic						
Symbol	**Parameter**	**Test Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
Q_g	Total Gate Charge[2]	V_{DS} =15V	--	45	--	nC
Q_{gs}	Gate-Source Charge	I_D =20A	--	12	--	
Q_{gd}	Gate-Drain Charge	V_{GS} =10V	--	18.5	--	
$t_{d(on)}$	Turn-On Delay Time[2]	V_{DS} =15V	--	18.5	--	ns
t_r	Rise Time	I_D =20A	--	9	--	
$t_{d(off)}$	Turn-Off Delay Time	V_{GS} =10V	--	58.5	--	
t_f	Fall Time	R_G =3.3Ω	--	32	--	
C_{ISS}	Input Capacitance	V_{DS} =20V	--	3972	--	pF
C_{OSS}	Output Capacitance	V_{GS} =0V	--	1119	--	
C_{RSS}	Reverse Transfer Capacitance	f =1.0MHz	--	82	--	
Rg	Gate Resistance	V_{DS} =0V, V_{GS} =0V, f =1.0MHz		1.0		Ω

Notes

1. The data tested by surface mounted on a 1 inch^2 FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
3. The EAS data shows maximum rating. The test condition is V_{DD}=25V, V_{GS}=10V, L=0.1 mH, I_{AS}=90A.
4. The power dissipation is limited by 175℃ 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.

MSIE40N150-6

Full bridge N Channel 40-V (D-S) MOSFET

- **Typical Electrical Characteristics**

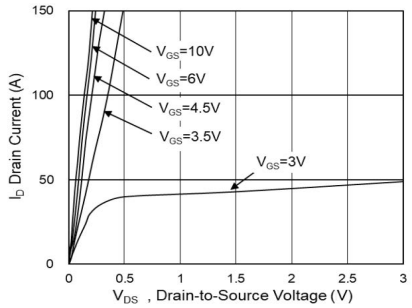


FIG.1-Typical Output Characteristics

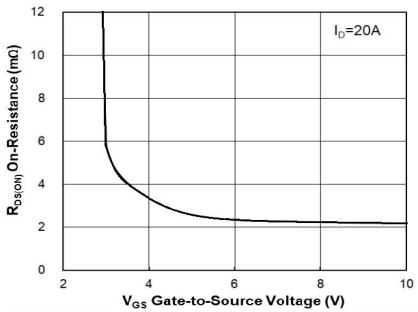


FIG.2-On-Resistance vs. G-S Voltage

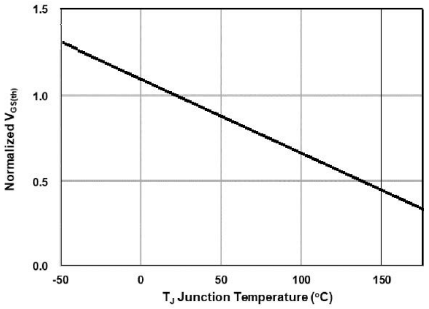


FIG.3-Normalized $V_{GS(th)}$ vs. T_J

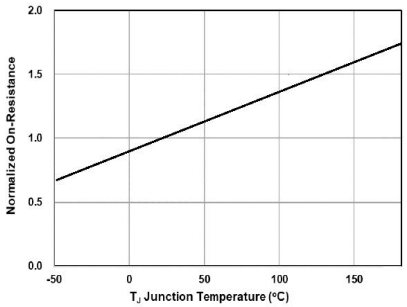


FIG.4-Normalized R_{DSON} vs. T_J

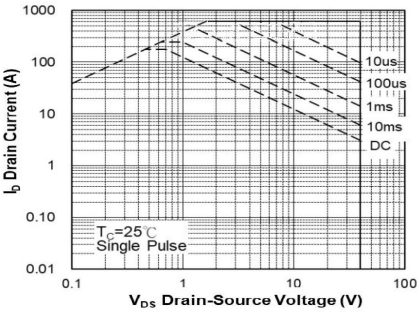


FIG.5-Safe Operating Area

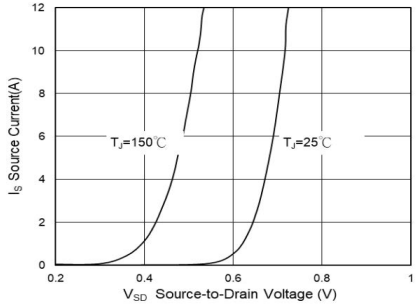


FIG.6-Source Drain Forward Characteristics

MSIE40N150-6

Full bridge N Channel 40-V (D-S) MOSFET

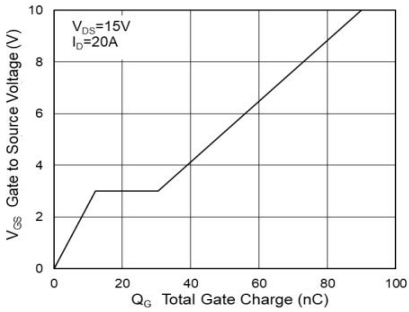


FIG.7-Gate Charge Characteristics

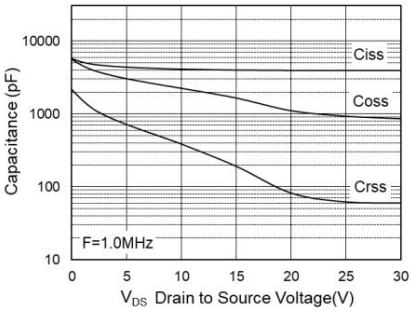


FIG.8-Capacitance Characteristics

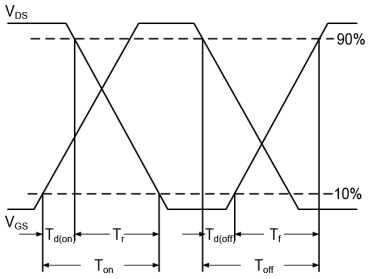


FIG.9-Switching Time Waveform

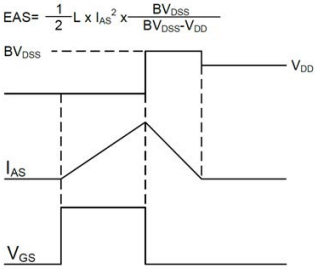


FIG.10-Unclamped Inductive Switching Waveform

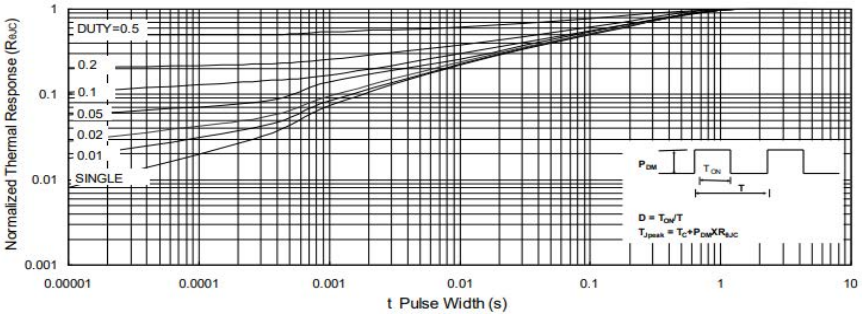


FIG.11-Normalized Maximum Transient Thermal Impedance

MSIE40N150-6

Full bridge N Channel 40-V (D-S) MOSFET

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With me,
Power for you.

5

Isolated Dual-Channel Gate Driver

IGD8233 Series is the top choice for replacing scarce materials.

All products are available in industrial grade and automotive grade.

IGD8233 Series

High Reliability Isolated Dual-Channel Gate Driver

IGD8233 is 4.0A sourcing and 6.0A sinking peak output current with rail-to-rail dual-channel isolated gate driver. It includes the programmable deadtime and DIS for disabling the output. The driver can be configured as dual high/low side or half bridge driver. It has 5kVRMS isolation in SOW16 package. The high CMTI, low propagation delay features perfectly suite the high speed MOSFET, IGBT and SiC gate driver applications.

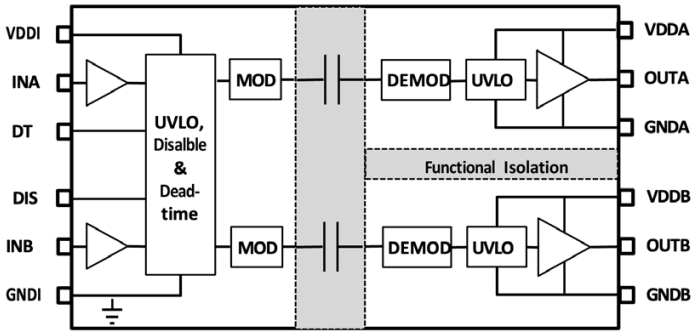
1. Features

- 4.0A peak source and 6.0A peak sink output current
- Input side supply voltage: 2.7V to 5.5V
- Driver side supply voltage: up to 30V with UVLO
- Rail-to-rail output voltage
- ±200kV/us minimum common mode rejection at VCM=1500V
- 25ns typical propagation delay
- Minimum input pulse width 20ns
- UVLO with hysteresis
- Programmable deadtime
- DIS function for disabling the out puts.
- 5ns maximum delay matching
- Operation temperature range: -40℃ to 105℃
- Safety certifications: (Planned)
  - 5kVRMS isolation for 1 minute per UL 1577 with SOW16 package
  - DIN EN IEC 60747-17 (VDE 0884-17):2021-10

2. Applications

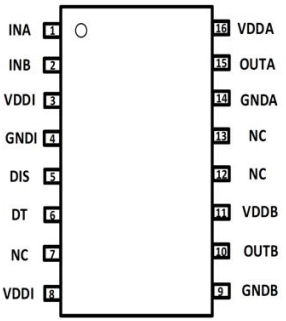
- IGBT/MOSFET gate drive
- AC & Brushless DC Motor Drives
- Renewable energy inverters
- AC/DC or DC/DC power supplies
- Industrial inverters
- Switching power supply

3. Functional Diagram



4. Pin Definition

No.	Symbol	Description
1	INA	TTL/CMOS compatible input signal for channel A with internal pull down to GND.
2	INB	TTL/CMOS compatible input signal for channel B with internal pull down to GND.
3,8	VDDI	Input side supply voltage.
4	GND	Input side ground reference.
5	DISABLE	Disable the isolator inputs and driver outputs if asserted high, enable if asserted low or left open
6	DT	Programmable deadtime control.
9	GNDB	Ground for output channel B
10	OUTB	Output gate driver for channel B
11	VDDB	Supply voltage for channel B
14	GNDA	Ground for output channel A
15	OUTA	Output gate driver for channel A
16	VDDA	Supply voltage for channel A
7,12,13	NC	Not connected



SOW16/SOP16 Package

5. Product Family

Part Number	Peak Current	UVLO	DT	DIS	Package
IGD8233AW	+4.0A/-6.0A	6.5V/6.85V	Y	Y	SOW16
IGD 8233BW	+4.0A/-6.0A	8.5V/8.0V	Y	Y	SOW16
IGD 8233CW	+4.0A/-6.0A	13.2V/12.2V	Y	Y	SOW16
IGD 8233AS	+4.0A/-6.0A	6.5V/6.85V	Y	Y	SOP16
IGD 8233BS	+4.0A/-6.0A	8.5V/8.0V	Y	Y	SOP16
IGD 8233CS	+4.0A/-6.0A	13.2V/12.2V	Y	Y	SOP16

6. Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Input Side Supply Voltage	VDDI to GNDI	-0.3	6	V
Input Signal Voltage	V_{IA}, V_{IB}, V_{DIS}	-0.3	6	
Output Side Supply Voltage	VDDA to GNDA, VDDB to GNDB	-0.3	30	
Channel A to Channel B Isolation Voltage	V_{ISOAB}	-	1500	
Electrostatic discharge	HBM	-4000	4000	
	CDM	-1500	1500	
Storage Temperature	T_S	-65	+150	℃
Junction Temperature	T_j	-40	+150	℃

Note : VDDI, VIA, VIB, VDIS are reference to GNDI; VDDA, VOUTA is referenced to GNDA; VDDB, VOUTB is referenced to GNDB.

7. Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Unit
Input Side Supply Voltage	VDDI to GNDI	3.0	5.5	V
Input Signal Voltage	V_{IA}, V_{IB}, V_{DIS}	3.0	5.5	
Output Supply Voltage	VDDA to GNDA, VDDB to GNDB	7	20	
Input Signal Voltage	INA, INB, DIS,DT	0	V_{VDDI}	
Junction Temperature	T_j	-40	150	
Operating Temperature	T_A	-40	125	℃

NOTE: Operation beyond recommended operating conditions may cause long term reliability issue or even damage to the IC.

8. Electrical Characteristics (DC)

VDDI=3.3V or 5V, VDDA=VDDB=12V for IGD8233A/B, VDDA=VDDB=15V for RM8233C, Ta=-40~125℃. Unless otherwise noted, typical values are tested at Ta=25℃

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Current leakage characteristics						
VDDI Quiescent Current	I_{VDDIQ}	-	0.4	2	mA	INA=0, INB=0
VDDI Operating Current	I_{VDDI}	-	11		mA	Input frequency 500kHz
VDDA/B Quiescent Current, per Channel	I_{VDDAQ}, I_{VDDBQ}	-	1.5	2.5	mA	INA=0,INB=0, VDDx=12V for 6V, 8V UVLO; VDDx=15V for 13V UVLO
VDDA/B Operation Current, per Channel	I_{VDDA}, I_{VDDB}	-	2.6	-	mA	100pF, 500KHz, VDDx=12V for 6V, 8V UVLO; VDDx=15V for 13V UVLO
UVLO						
VDDI UVLO Rising Threshold	V_{VDDI_ON}	2.35	2.55	2.75	V	
VDDI UVLO Falling Threshold	V_{VDDI_OFF}	2.15	2.35	2.55		
VDDI UVLO Hysteresis	V_{VDDI_HYS}	-	0.2	-		
VDDA/B UVLO Rising Threshold	V_{VDDO_ON}	5.7	6.15	6.5		IGD8233A(6V)
VDDA/B UVLO Falling Threshold	V_{VDDO_OFF}	5.4	5.85	6.2		
VDDA/B UVLO Hysteresis	V_{VDDO_HYS}	-	0.3	-		
VDDA/B UVLO Rising Threshold	V_{VDDO_ON}	7.5	8.0	8.5		IGD 8233B(8V)
VDDA/B UVLO Falling Threshold	V_{VDDO_OFF}	7.0	7.5	8.0		
VDDA/B UVLO Hysteresis	V_{VDDO_HYS}	-	0.5	-		
VDDA/B UVLO Rising Threshold	V_{VDDO_ON}	12.7	13.2	13.7		IGD 8233C(13V)
VDDA/B UVLO Falling Threshold	V_{VDDO_OFF}	11.7	12.2	12.7		
VDDA/B UVLO Hysteresis	V_{VDDO_HYS}	-	1	-		

Input Side Characteristic						
Input Pin Pull Down Resistance, INA, INB	R_{INA_PD}, R_{INB_PD},	-	100	-	kΩ	
Input Pin Pull Down Resistance, DIS(EN)	R_{DIS_PD}	-	100	-	kΩ	
Logic High Input Threshold	V_{INA_H}, V_{INB_H}, V_{DIS_H}	-	1.45	2	V	
Logic Low Input Threshold	V_{INA_L}, V_{INB_L}, V_{DIS_L}	0.8	1.3	-		
Input Hysteresis	V_{INA_HYS}, V_{INB_HYS}, V_{DIS_HYS}	-	0.15	-		
Output Side Characteristic						
	V_{VDDA-}					

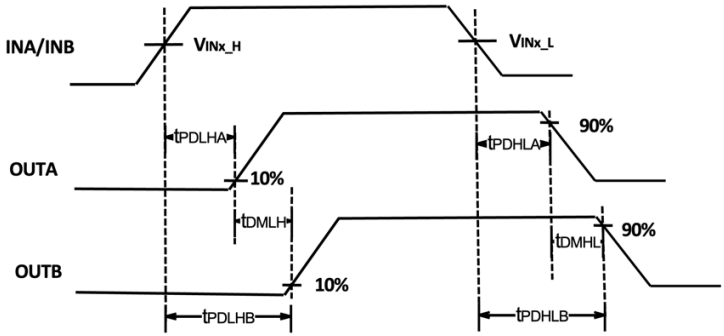
Logic High Output Voltage	V_{OUTA_H}, V_{VDDB-} V_{OUTB_H},	-	0.34	-	V	I_{out}=100mA
Logic Low Output Voltage	V_{OUTA_L}, V_{OUTB_L}	-	55	-	mV	I_{out}=100mA
Output Source Resistance	R_{OUTA_H}, R_{OUTB_H}	-	3.4	-	Ω	I_{out}=100mA
Output Sink Resistance	R_{OUTA_L}, R_{OUTB_L}	-	0.55	-	Ω	I_{out}=100mA
Peak Output Source Current	I_{OUTA+}, I_{OUTB+}	-	+4.0	-	A	VDDx=15V
Peak Output Sink Current	I_{OUTA-}, I_{OUTB-}	-	-6.0	-	A	VDDx=15V

9. Switching Characteristics (AC)

VDDI=3.3V or 5V, VDDA=VDDB=12V for RM8233A/B, VDDA=VDDB=15V for IGD8233C, Ta=25℃.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Turn On Propagation Delay Time	t_{PDLH}	10	25	35	ns	$C_{OUTA/B}$=1 nF
Turn Off Propagation Delay Time	t_{PDHL}	10	25	35		$C_{OUTA/B}$=1 nF
Output Rise Time (20% to 80%)	t_R	-	7	16		$C_{OUTA/B}$=1.8nF, verified by design
Output Fall Time (90% to 10%)	t_F	-	6	12		$C_{OUTA/B}$=1.8nF, verified by design
Minimum Pulse Width	t_{PWmin}	-	10	15		$C_{OUTA/B}$=0 pF
Pulse Width Distortion $\lvert t_{PDHL}- t_{PDLH}\rvert$	t_{PWD}	-	-	6		
Channel to Channel Delay Matching	t_{DMLH}, t_{DMHL}	-	-	5		
Programmed Deadtime	t_{DT}	160	200	240		t_{DT}(ns)=10*R(KΩ); Test for R=20KΩ
Shutdown Time from Disable True	t_{DIS}	-	-	40		
Recovery Time from Disable False	T_{EN}	-	-	40		
VDDI Power-up Time Delay (Time from VDDI=VDDI_ON to OUTA/B=INA/B)	t_{start_VDDI}	-	8.5	15	us	INA or INB tied to VDDI
VDDA/B Power-up Time Delay (Time from VDDA/B=2V to OUTA/B=INA/B)	t_{start_VDDA}, t_{start_VDDB}	-	18	30	us	INA or INB tied to VDDI $C_{OUTA/B}$=1.8nF
High Level Common Mode Transient Immunity	$CMTI_H$	100	150	-	kV/us	
Low Level Common Mode Transient Immunity	$CMTI_L$	100	150	-	kV/us	

Propagation Delay and Delay Match Time



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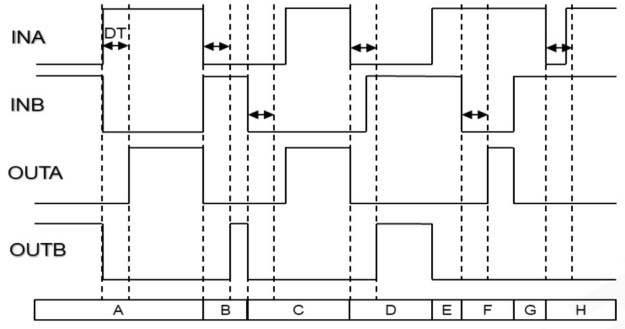
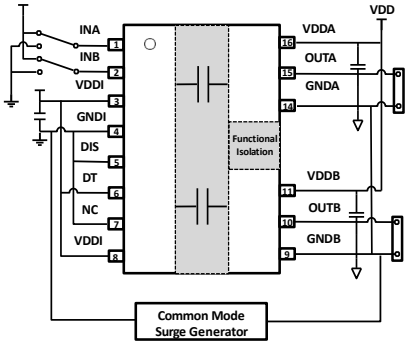
Input and Output Logic with Programmed Deadtime



CMTI Test Circuit



10. Feature Description

IGD8233 is a flexible dual channel isolated gate driver that can drive IGBTs and MOSFETs. It has 4.0A peak output current capability with maxim output driver supply voltage of 30V. It has many features that allow it to integrate well with control circuitry and protect the gates it drives such as: resistor programmable dead time control, an DIS pin, and under voltage lock out (UVLO) for both input and output voltages.

Under Voltage Lockout

The IGD8233 has under voltage lock out (UVLO) protection feature on each driver power supply voltage between the VDDA (VDDB) and GNDA (GNDB) pins. When the VDDx voltage is lower than VUVLO_VDDX_R, during device start up or lower than VUVLO_VDDX_F, after starting up, the VDDA (VDDB) UVLO feature holds the driver output low, regardless of the status of the input pins. A hysteresis on the UVLO feature prevents glitch when there is noise from the power supply. The IGD8233 also monitors the input power supply and there is an internal under voltage lock out protection feature on the VDDI. The driver outputs (OUTA and OUTB) are hold low when the voltage on the VDDI is lower than VUVLO_VDDI_R during start up or lower than VUVLO_VDDI_F after starting up. There is a hysteresis on the VDDI UVLO feature to prevent glitch due the noise on the VDDI power supply.

Disable Input Function

When the DIS is pulled high, the OUTA and OUTB are pulled low regardless of the states of INA and INB. When the DIS pin is pulled low, the VOA and VOB are allowed for normal operation and controlled by the INA and INB.

The DIS input has no effect if VDDI is below its UVLO threshold and OUTA, OUTB remain low. There is an internal pull-down resistor on the DIS pin.

Control Input and Output Logic

The INA and INB input controls the corresponding output channel, OUTA and OUTB. A logic high signal on INA (INB) causes the output of OUTA (OUTB) to go high. And a logic low on INA (INB) causes the output of OUTA (OUTB) to go low.

Truth table

INA	INB	DIS	VDDI UVLO	VDDA UVLO	VDDB UVLO	OUTA	OUTB	Notes
H	L	L	NO	NO	X	H	L	
L	H	L	NO	X	NO	L	H	
L	L	L	NO	X	X	L	L	
H	H	L	NO	NO	NO	H	H	Dual driver
H	H	L	NO	NO	NO	L	L	Half bridge
X	X	H	NO	NO	NO	L	L	Device disabled
X	X	X	YES	NO	NO	L	L	VDDI UVLO activated
X	H	L	NO	YES	X	L	X	VDDA UVLO activated
H	X	L	NO	NO	YES	X	L	VDDB UVLO activated

Dead-time Program

For the high side/low side configuration driver, there is a dead-time between OUTA and OUTB. The dead-time delay (tDT) is programmed by a resistor (RDT) connected from the DT input to ground and it can be calculated with below equation.

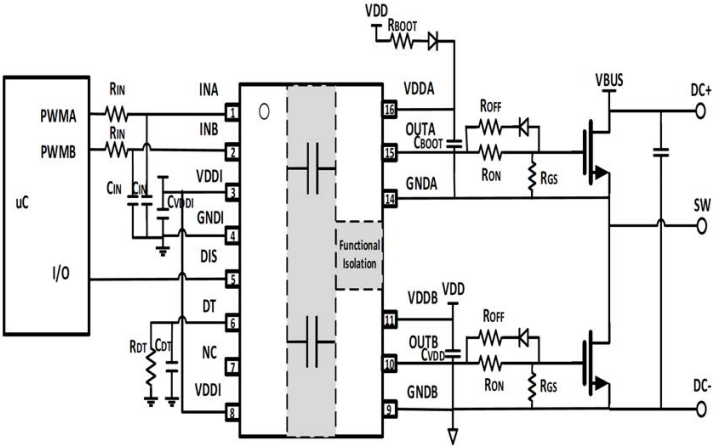
$$tDT\ [\mathrm{ns}] \approx 10\times RDT\ [\mathrm{k\Omega}]$$

Here, tDT is the dead-time delay, RDT is the resistance value between DT and ground.

The DT pin can be connected to VDDI or left floating to provide a nominal dead time at approximately 10 ns.

A bypassing capacitor is recommended to be put between DT and GNDI to achieve better noise immunity.

11. Application Information



Recommended Design

Parameter	Value	Units
VDDI	5	V
VDDA/VDDB	12	V
Input signal amplitude	5	V
Switching frequency(fs)	10~100	KHz
Dead time	200	nS
RDT	20	kΩ
CDT	2.2	nF
RIN	51	Ω
CIN	33	pF
RON	10	Ω
ROFF	-	Ω
RBOOT	22	Ω
RGS	10	kΩ
CVDDI	10	uF
CVDD	10	uF
CBOOT	10	uF

12. Insulation Characteristics

SOW16 Insulation Characteristics

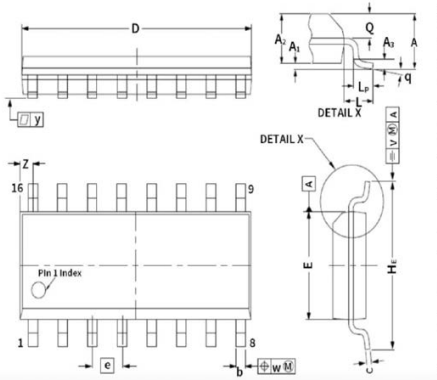
	Value	Note
Installation class:		
mains≤ 150Vrms	I-IV	
mains≤ 300Vrms	I-IV	
mains≤ 600Vrms	I-IV	
mains≤ 1000Vrms	I-III	
climatic class	40/125/21	
pollution degree	2	
Clearance (mm)	8	
Creepage (mm)	8	
DTI(um)	>20	
CTI	600	
DIN EN IEC 60747-17 (VDE 0884-17):2021-10		
V_{IORM} (Vpeak)	1420	
V_{PR} (Vpeak)	2272	Method A, VPR = 1.6xV_{IORM}, 1s ,qpd< 5pC
V_{PR} (Vpeak)	2663	Method B, VPR = 1.875xV_{IORM}, 1s ,qpd< 5pC
V_{IOTM} (Vpeak)	5000	
V_{IOSM} (Vpeak)	5000	
RIO (ohms)	>10e9	
UL1577		
V_{ISO} 1min (Vrms)	5700	
V_{ISO} 1s (Vrms)	6840	

SOP16 Insulation Characteristics

	Value	Note
Installation class:		
mains≤ 150Vrms	I-IV	
mains≤ 300Vrms	I-IV	
mains≤ 600Vrms	I-IV	
mains≤ 1000Vrms	I-III	
climatic class	40/125/21	
pollution degree	2	
Clearance (mm)	8	
Creepage (mm)	8	
DTI(um)	>20	
CTI	600	
DIN EN IEC 60747-17 (VDE 0884-17):2021-10		
V_{IORM} (Vpeak)	900	
V_{PR} (Vpeak)	1440	Method A, VPR = 1.6xV_{IORM}, 1s ,qpd< 5pC
V_{PR} (Vpeak)	1687	Method B, VPR = 1.875xV_{IORM}, 1s ,qpd< 5pC
V_{IOTM} (Vpeak)	3000	
V_{IOSM} (Vpeak)	3000	
RIO (ohms)	>10e9	
UL1577		
V_{ISO} 1min (Vrms)	3000	
V_{ISO} 1s (Vrms)	4200	

13. Package Information

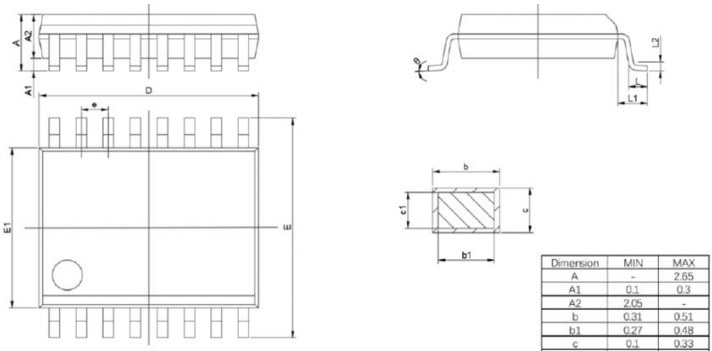
SOP16 package



* CONTROLLING DIMENSION:MM

SYMBOL	MILLIMETER			INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	---	---	1.75	---	---	0.069
A1	0.10	---	0.25	0.004	---	0.010
A2	1.25	---	1.45	0.049	---	0.057
b	0.36	---	0.49	0.014	---	0.019
c	0.19	---	0.25	0.007	---	0.010
D	9.80	9.90	10.0	0.386	0.390	0.394
E	3.80	3.90	4.00	0.150	0.154	0.158
HE	5.80	---	6.20	0.228	---	0.244
Q	0.60	---	0.70	0.024	---	0.028
e	1.27 bsc			0.050 bsc		
L	1.05 bsc			0.041 bsc		
Lp	0.40	---	1.00	0.016	---	0.039
Y	---	0.10	---	---	0.004	---
A3	---	0.25	---	---	0.010	---
Z	0.30		0.70	0.012		0.028
θ	0°	---	8°	0°	---	8°

SOW16 package



Dimension	MIN	MAX
A	-	2.65
A1	0.1	0.3
A2	2.05	-
b	0.31	0.51
b1	0.27	0.48
c	0.1	0.33
c1	0.1	0.3
E	10.3BASIC	
E1	7.5BASIC	
e	1.27BASIC	
L	0.4	1.27
L1	1.4REF	
L2	0.25BASIC	
θ	0	8
D	10.3	

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Contacts

Address

13F., No. 251, Dong Sec. 1, Guangming 6th Rd.,
Zhubei City, Hsinchu County, 302044 Taiwan

Web

www.bruckewell-semi.com

TEL

+886-3-6673276