1200V 4.6mΩ Half-Bridge SiC Module

SiCPAK™ G Series

Trench-Assisted Planar Technology

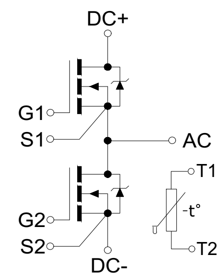
V_{DS}	=	1200 V
$R_{DS(ON)}$	=	4.6 mΩ
$I_{D,DC\,(65°C)}$	=	216 A

Built for Performance and Endurance

- Epoxy-resin potting and trench-assisted planar SiC MOSFET technology for long-lasting reliability
- Engineered and qualified to withstand harsh stress, temperature variations, and power cycling
- Low on-resistance $R_{DS(ON)}$ across temperature
- Optimized switching speed and balanced Q_{GD}/Q_{GS} for faster, cleaner, and efficient switching performance
- Stable and consistent $V_{GS,th}$ for excellent current sharing and reliable switching
- Outstanding short-circuit & avalanche (UIS) performance
- THB (HV-H3TRB) qualification at module-level & die-level
- Optional pre-applied Thermal Interface Material (TIM), "-T" orderable part number suffix

Package

SiCPAK™ G



Applications

- EV Road Side Chargers
- Solar Inverters
- Energy Storage Systems (ESS)
- Uninterrupted Power Supplies (UPS)
- Motor Control and Drives
- Smard Grid and Distributed Generation
- Induction Heating and Welding

Absolute Maximum (per Switch Position) (At T_C = 25°C Unless Otherwise Stated)

Parameter	Symbol	Conditions	Values	Unit	Note
Drain-Source Voltage	$V_{DS,max}$	V_{GS} = 0 V, I_D = 100 µA	1200	V	
Gate-Source Voltage (Dynamic)	$V_{GS,max}$	Transient	-10/+22	V	
Gate-Source Voltage (Operation)	$V_{GS,op}$	Static	-5/+18	V	Note 1
Virtual Junction Temperature	T_j	Operation	-40 to 175	°C	
Power Dissipation	P_D	T_H = 65°C, $T_{j,op}$ ≤ 175°C	444	W	Fig. 17
		T_H = 120°C, $T_{j,op}$ ≤ 175°C	222		
DC Continuous Drain Current	$I_{D,DC}$	T_H = 65°C, $T_{j,op}$ ≤ 175°C, V_{GS} = 18 V	216	A	Fig. 16
		T_H = 120°C, $T_{j,op}$ ≤ 175°C, V_{GS} = 18 V	153		

NOTE: This datasheet provides preliminary specifications. Parameters, conditions and values are subject to change.

Note 1: Recommended operating (static) on-state gate voltage is +15V to +18V and off-state gate voltage is -5V to -3V

Electrical Characteristics (per Switch Position) (At T_C = 25°C Unless Otherwise Stated)

Parameter	Symbol	Conditions	Values Min.	Values Typ.	Values Max.	Unit	Note
Drain-Source Breakdown Voltage	V_{DSS}	V_{GS} = 0 V, I_D = 100 µA	1200			V	
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 1200 V, V_{GS} = 0 V		1		µA	
Gate Source Leakage Current	I_{GSS}	V_{GS} = 22V, V_{DS} = 0V			100	nA	
		V_{GS} = -10V, V_{DS} = 0V			-100		
Gate Threshold Voltage	$V_{GS,th}$	V_{DS} = V_{GS}, I_D = 140 mA	2.2	2.7	4.3	V	Note 2
		V_{DS} = V_{GS}, I_D = 140 mA, T_j = 175°C		2.0			
Drain-Source On-State Resistance	$R_{DS(ON)}$	V_{GS} = 18V, I_D = 180 A		4.6	6.2	mΩ	Note 3,4
		V_{GS} = 18V, I_D = 180 A, T_j = 175°C		7.88			Fig. 6-9
Input Capacitance	C_{iss}	V_{DS} = 800V, V_{GS} = 0V f = 100kHz, V_{AC} = 25mV		19700		pF	Fig. 12
Output Capacitance	C_{oss}			728			
Reverse Transfer Capacitance	C_{rss}			47			
Internal Gate Resistance	$R_{G,int}$	V_{GS} = 18V, f = 500kHz, V_{AC} = 25mV		0.33		Ω	
Gate-Source Charge	Q_{GS}	V_{DS} = 800V, V_{GS} = +18/-5V I_D = 180 A Per JEDEC JEP-192		224		nC	Fig. 11
Gate-Drain Charge	Q_{GD}			156			
Total Gate Charge	Q_G			784			
Turn-On Switching Energy (Body Diode)	E_{On}	T_j = 25°C, V_{GS} = -5/+18V, $R_{G(ext)}$ = 1 Ω, L = 60 µH, I_D = 200 A, V_{DD} = 800 V		3579		µJ	Fig. 24-27
Turn-Off Switching Energy (Body Diode)	E_{Off}			1089			
Rise Time	t_r	V_{DD} = 800 V, V_{GS} = -5/+18V $R_{G(ext)}$ = 1 Ω, L = 60 µH, I_D = 200 A Timing relative to V_{DS}, Inductive load		15		ns	Fig. 26
Fall Time	t_f			30			

Body Diode Characteristics (per Switch Position) (At T_j = 25°C unless otherwise specified)

Parameter	Symbol	Conditions	Values Min.	Values Typ.	Values Max.	Unit	Note
Diode Forward Voltage	V_{SD}	V_{GS} = -5V, I_{SD} = 90 A		4.5		V	Fig. 18,19
		V_{GS} = -5V, I_{SD} = 90 A, T_j = 175°C		4.1			
DC Continuous Diode Current	I_{SD}	T_H = 65 °C, $T_{j,op}$ ≤ 175 °C, V_{GS} = -5 V		84		A	
		T_H = 120 °C, $T_{j,op}$ ≤ 175 °C, V_{GS} = -5 V		55			

NOTE: This datasheet provides preliminary specifications. Parameters, conditions and values are subject to change.

Note 2: Tested after applying +25V for 80ms
Note 3: Device(Die) ON State resistance only: Package resistance reported separately in module characteristics
Note 4: Total effective resistance per switch postition (HS or LS) = MOSFET $R_{DS(ON)}$ + package resistance by switch position

Module Characteristics

Parameter	Symbol	Conditions	Values Min.	Values Typ.	Values Max.	Unit	Note
Thermal Resistance, Junction - Heatsink	R_{thJHS}	per switch TIM = 100 µm , λ = 4.4 W/(m.K)		0.22		°C/W	Fig. 14
Case Temperature	T_C		-40		150	°C	
Stray Inductance	L_{stray}	Between DC+ and DC- f = 10 MHz		4.34		nH	
Package Resistance, HS	R_{HS}	T_C = 125 °C		0.68		mΩ	Note 4
Package Resistance, LS	R_{LS}	T_C = 125 °C		0.8		mΩ	Note 4
Weight	W			48.3		g	
Case Isolation Voltage	V_{iso}	AC 50 Hz, 60s		4000		V	
Comparative Tracking Index	CTI	Epoxy-resin EMC		200			
Creepage Distance		Terminal to Terminal Terminal to Heatsink		6.4 12.7		mm	

NTC-Thermistor Characteristics

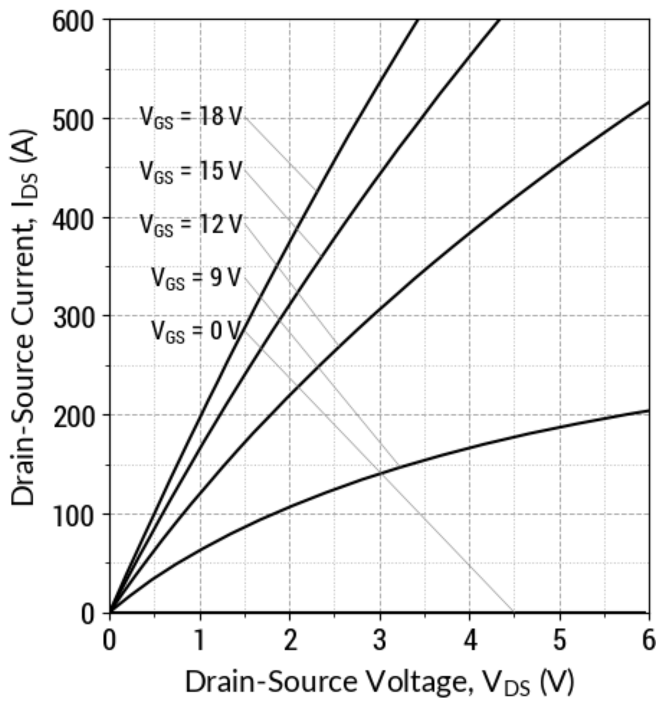
Parameter	Symbol	Conditions	Values Min.	Values Typ.	Values Max.	Unit	Note
Rated Resistance	$R_{NTC,25}$	T_{NTC} = 25 °C		5		kΩ	
Resistance Tolerance	ΔR/R	T_{NTC} = 25 °C	-5		+5	%	
Power Dissipation	$P_{NTC,25}$	T_{NTC} = 25 °C			20	mW	
Beta Value (B-value)	B_{25}/B_{50}	T_2 = 50 °C		3375		K	
	B_{25}/B_{80}	T_2 = 80 °C		3410		K	
	B_{25}/B_{100}	T_2 = 100 °C		3435		K	

Product Ordering Information

Orderable Part number (OPN)	Package	Packing Method
G3F05MT12GB2	SiCPAK™ G	Box (Qty - 12)
G3F05MT12GB2-T	SiCPAK™ G with TIM	Box (Qty - 12)

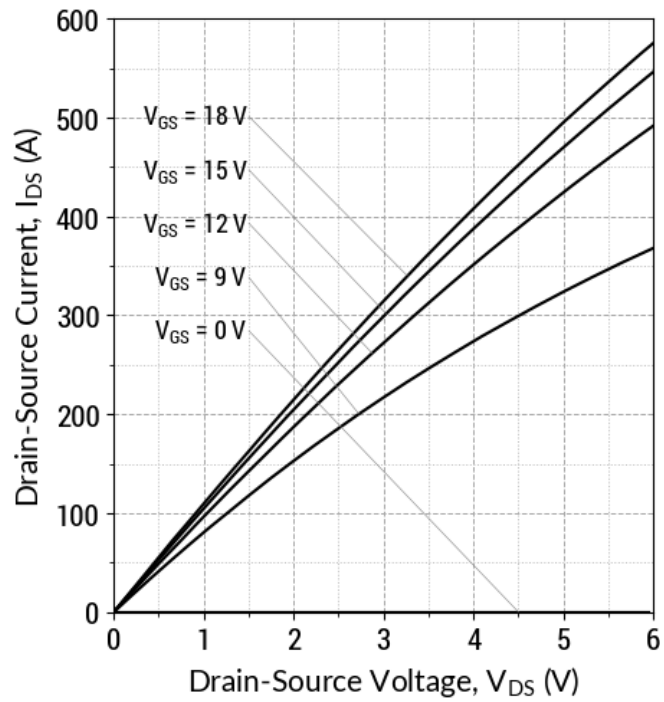
Note 4: Total effective resistance per switch postition (HS or LS) = MOSFET $R_{DS(ON)}$ + package resistance by switch position

Fig 1: Typical Output Characteristics (T_j = 25°C)



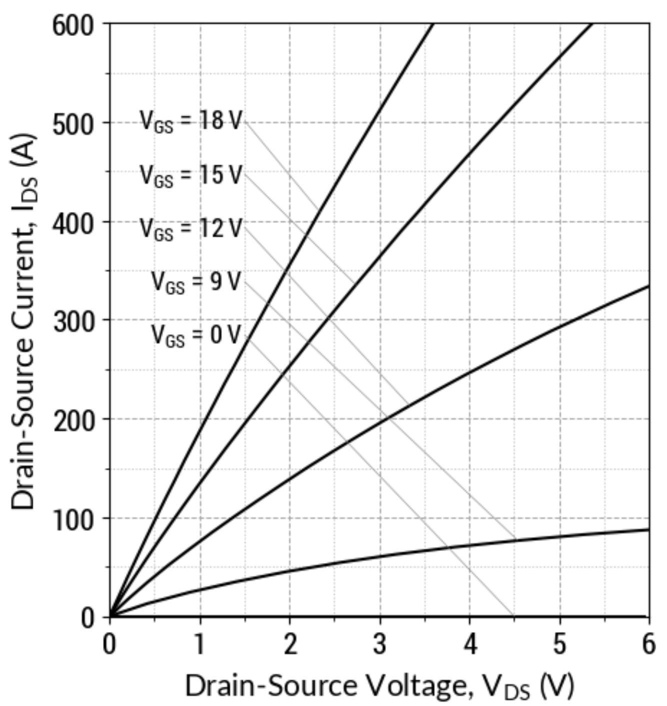
$I_D = f(V_{DS}, V_{GS})$; t_P = 50 µs

Fig 2: Typical Output Characteristics (T_j = 175°C)



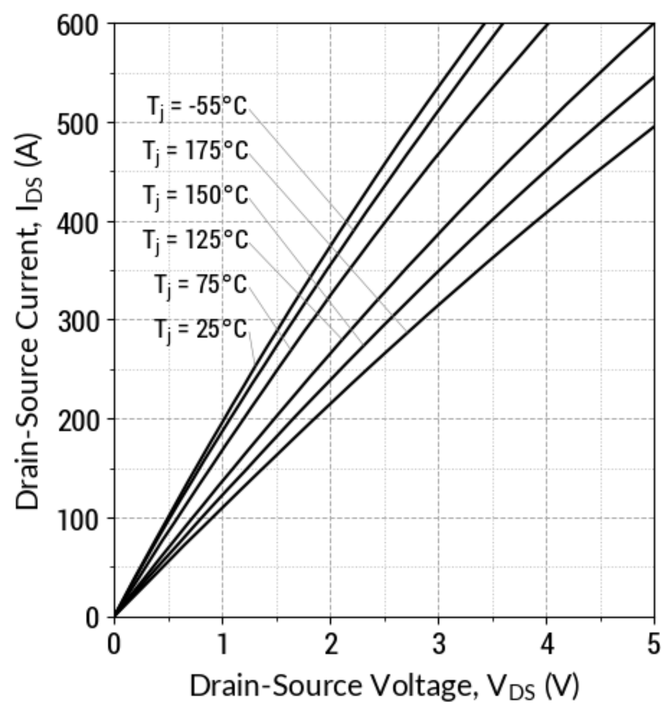
$I_D = f(V_{DS}, V_{GS})$; t_P = 50 µs

Fig 3: Typical Output Characteristics (T_j = -55°C)



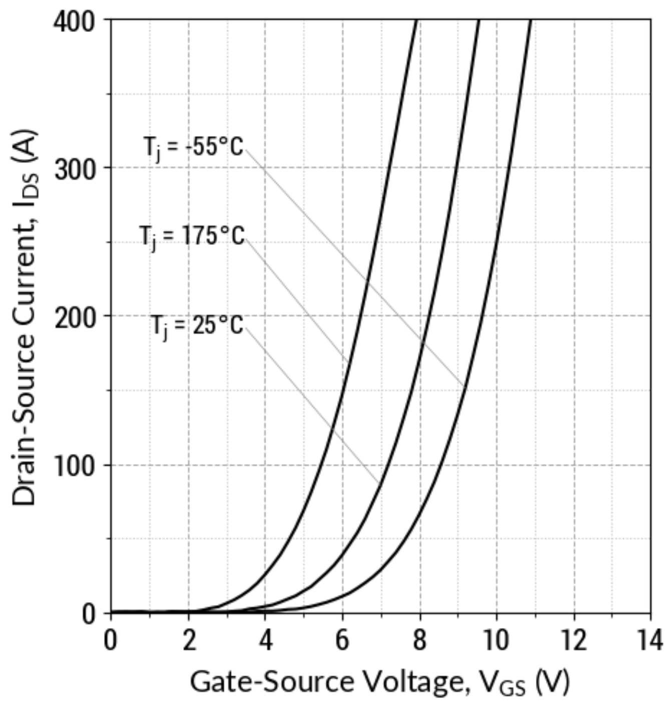
$I_D = f(V_{DS}, V_{GS})$; t_P = 50 µs

Fig 4: Typical Output Characteristics (V_{GS} = 18 V)



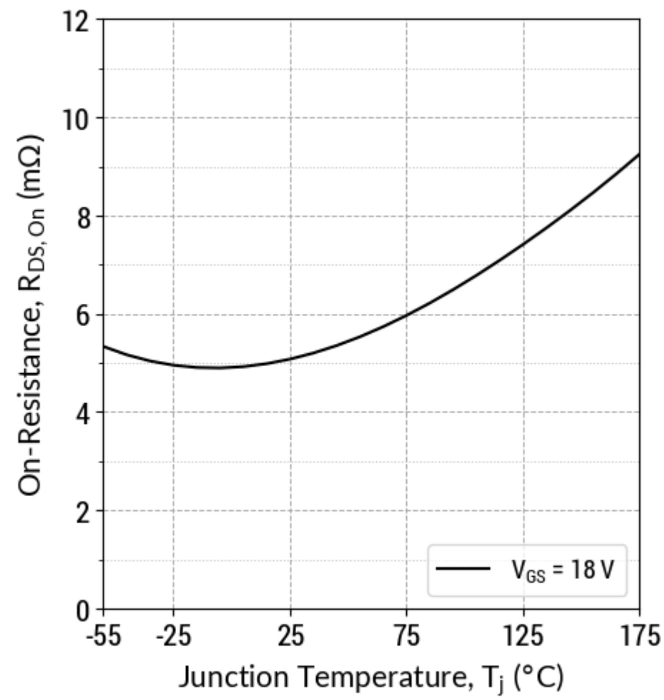
$I_D = f(V_{DS}, T_j)$; t_P = 50 µs

Fig 5: Typical Transfer Characteristics (V_{DS} = 10 V)



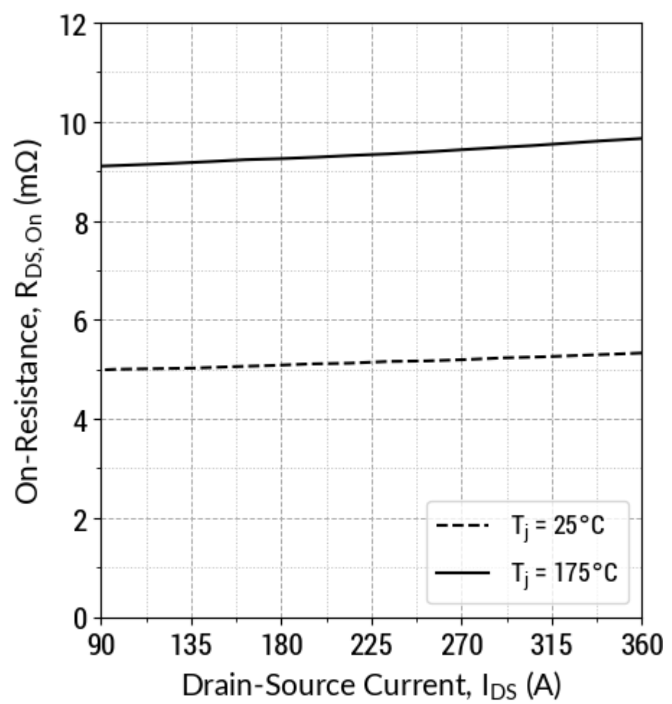
$I_D = f(V_{GS}, T_j)$; t_P = 100 µs

Fig 6: Typical $R_{DS(ON)}$ v/s Temperature



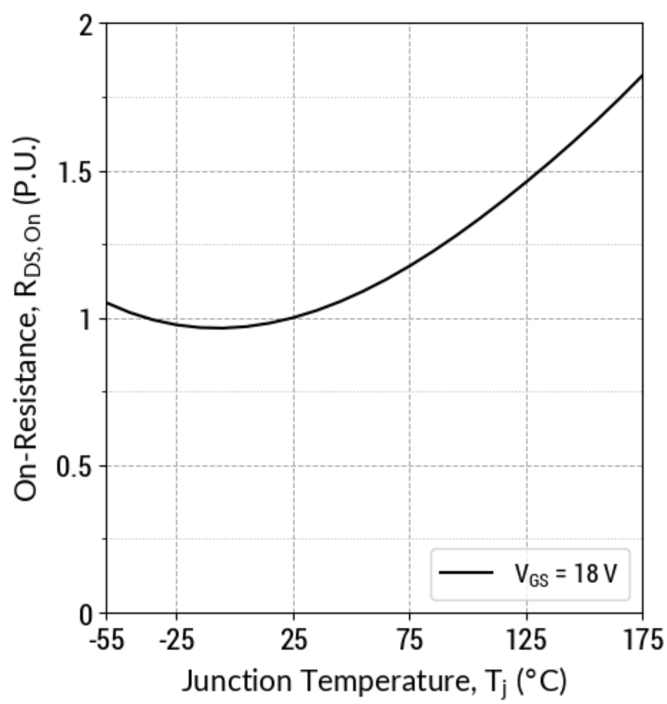
$R_{DS(ON)} = f(T_j, V_{GS})$; t_P = 50 µs; I_D = 180 A

Fig 7: Typical $R_{DS(ON)}$ v/s Drain Current



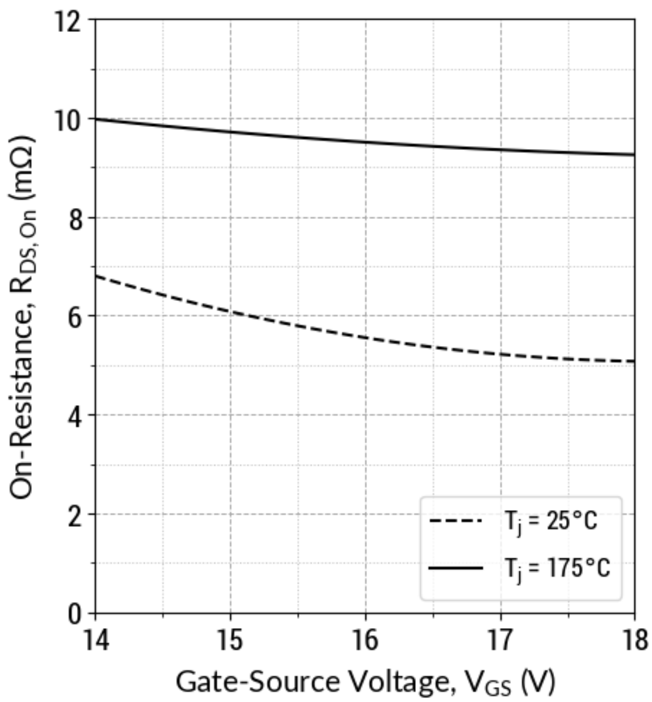
$R_{DS(ON)} = f(T_j, I_D)$; t_P = 50 µs; V_{GS} = 18 V

Fig 8: Typical Normalized $R_{DS(ON)}$ v/s Temperature



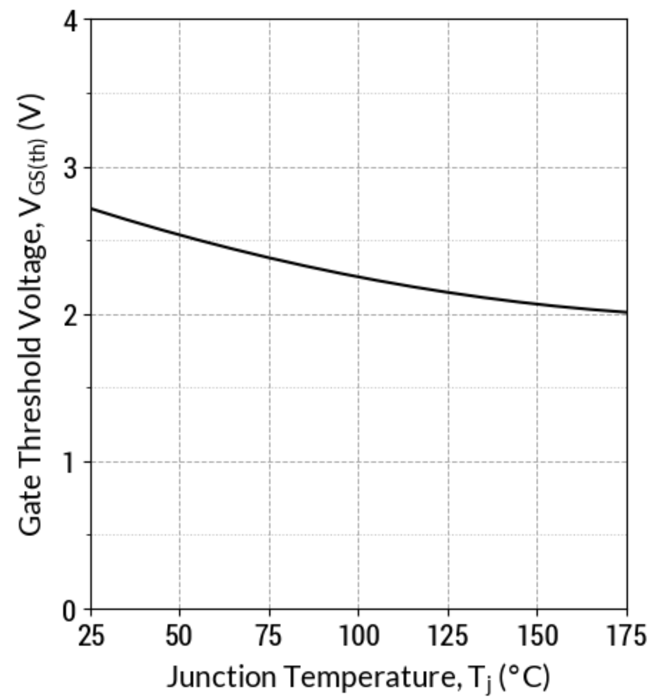
$R_{DS(ON)} = f(T_j)$; t_P = 50 µs; I_D = 180 A

Fig 9: Typical $R_{DS(ON)}$ v/s Gate Voltage



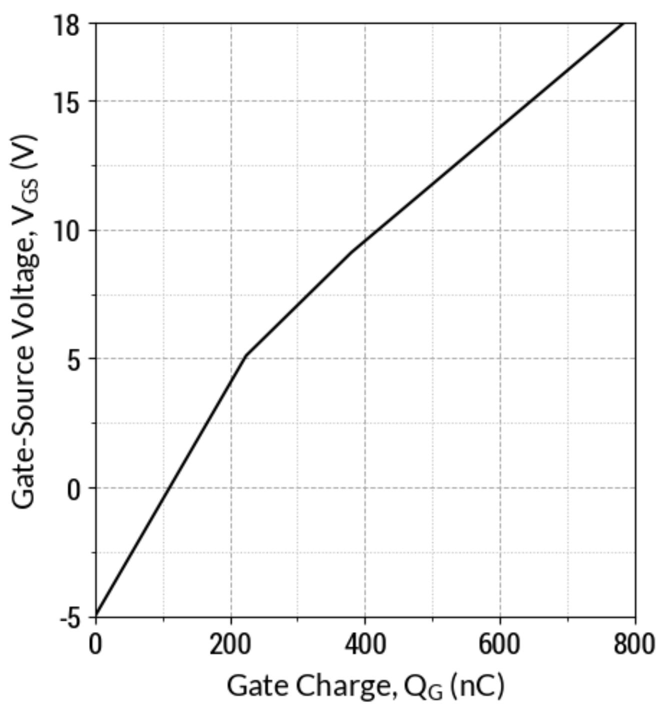
$R_{DS(ON)} = f(T_j,V_{GS})$; t_P = 50 µs; I_D = 180 A

Fig 10: Typical Threshold Voltage Characteristics



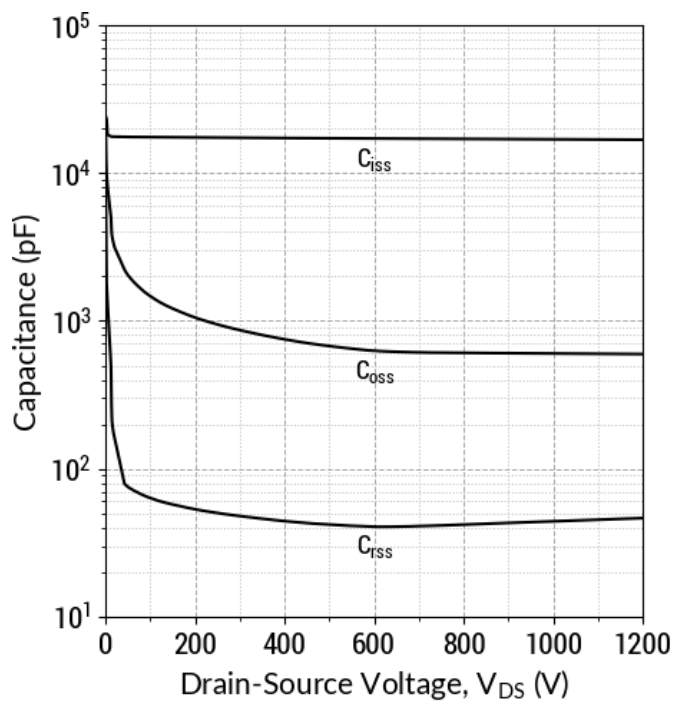
$V_{GS(th)} = f(T_j)$; $V_{DS} = V_{GS}$; I_D = 140 mA

Fig 11: Typical Gate Charge Characteristics



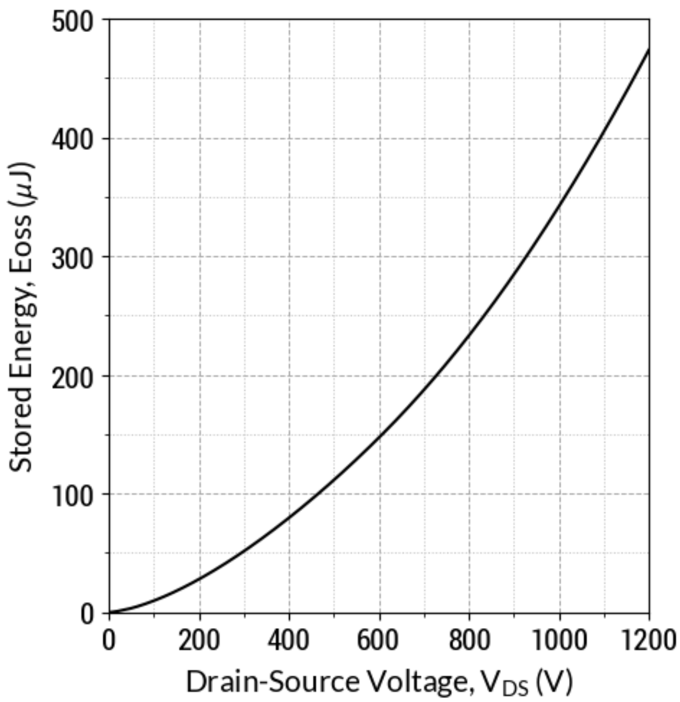
I_D = 180 A; V_{DS} = 800 V; T_c = 25°C

Fig 12: Typical Capacitance v/s Drain-Source Voltage



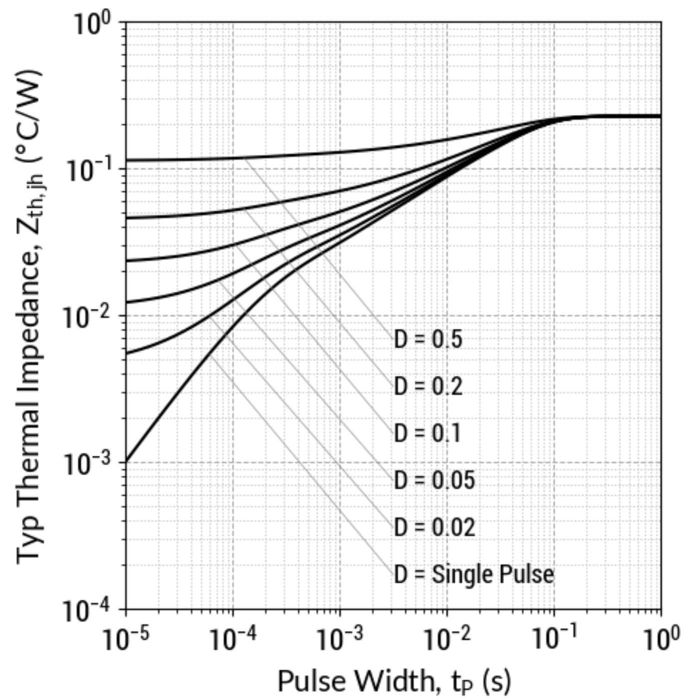
f = 500 KHz; V_{AC} = 25mV

Fig 13: Output Capacitor Stored Energy



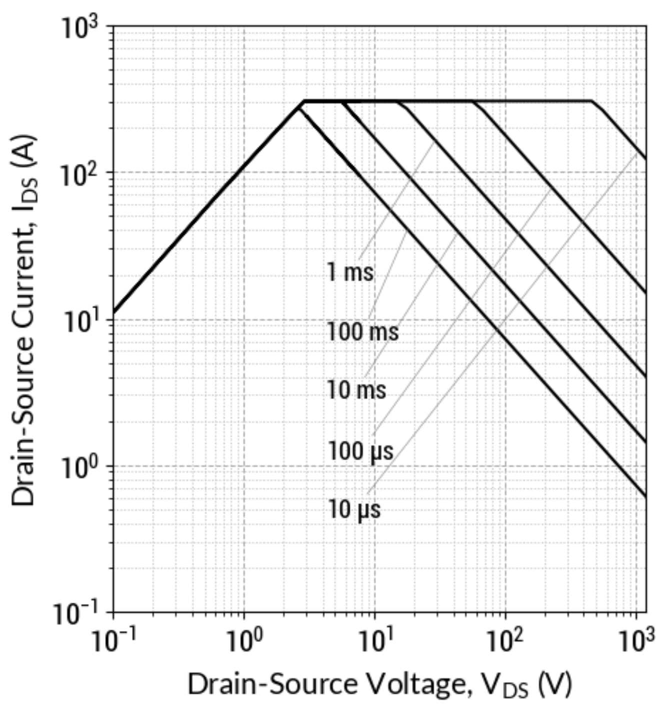
$E_{oss} = f(V_{DS})$

Fig 14: Typical Transient Thermal Impedance



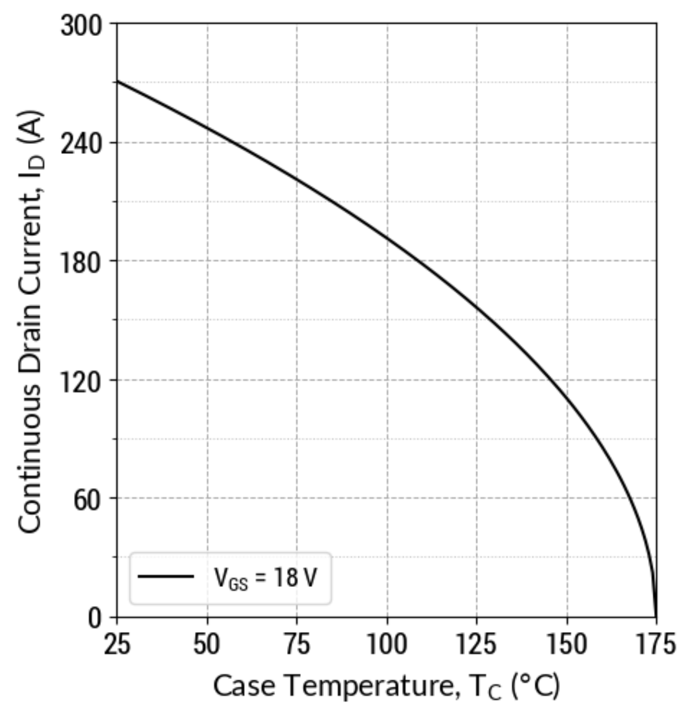
$Z_{th,jh} = f(t_P, D)$; $D = t_P/T$

Fig 15: Safe Operating Area (T_c = 25°C)



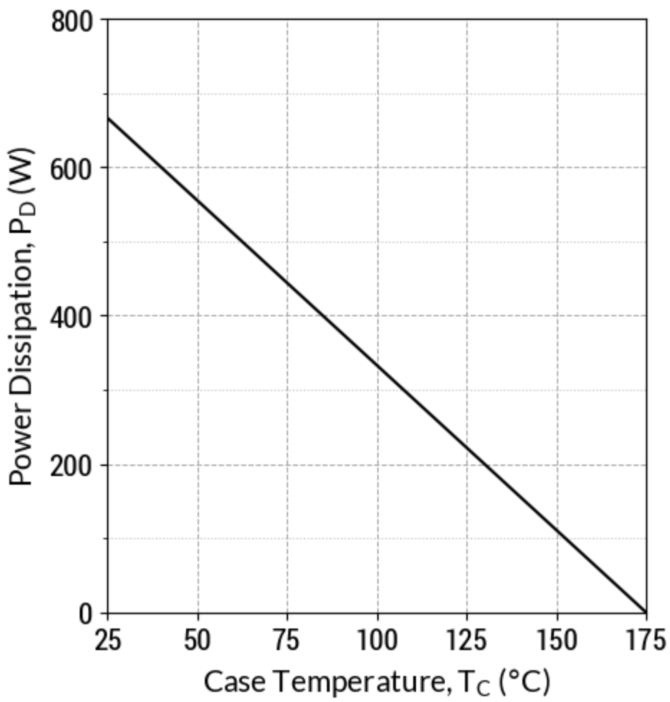
$I_D = f(V_{DS}, t_P)$; $T_j \leq 175°C$; D = 0

Fig 16: Current De-rating Curve



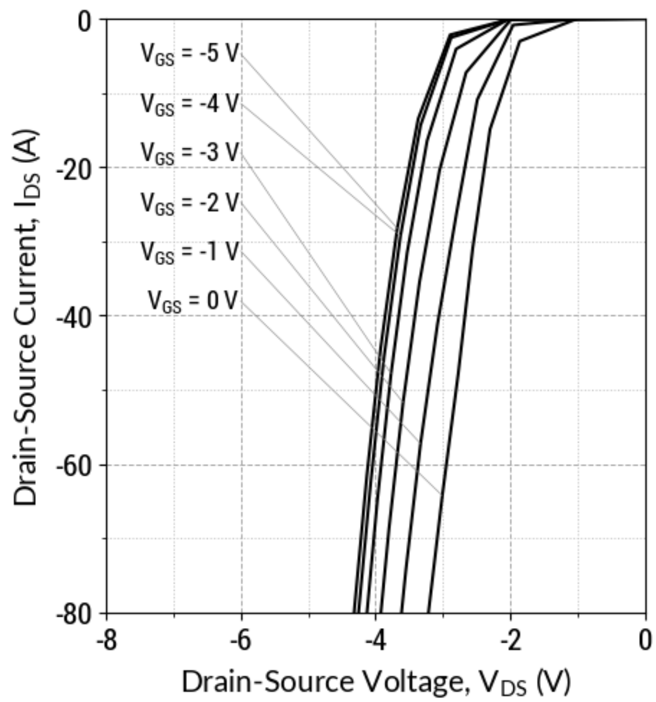
$I_D = f(T_C)$; $T_j \leq 175°C$

Fig 17: Power De-rating Curve



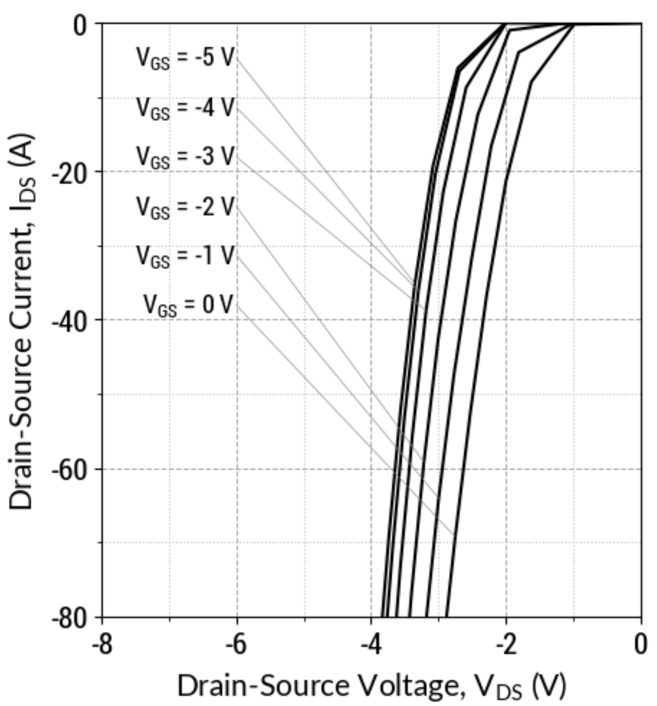
$P_D = f(T_C)$; $T_j \leq 175°C$

Fig 18: Typical Body Diode Characteristics (T_j = 25°C)



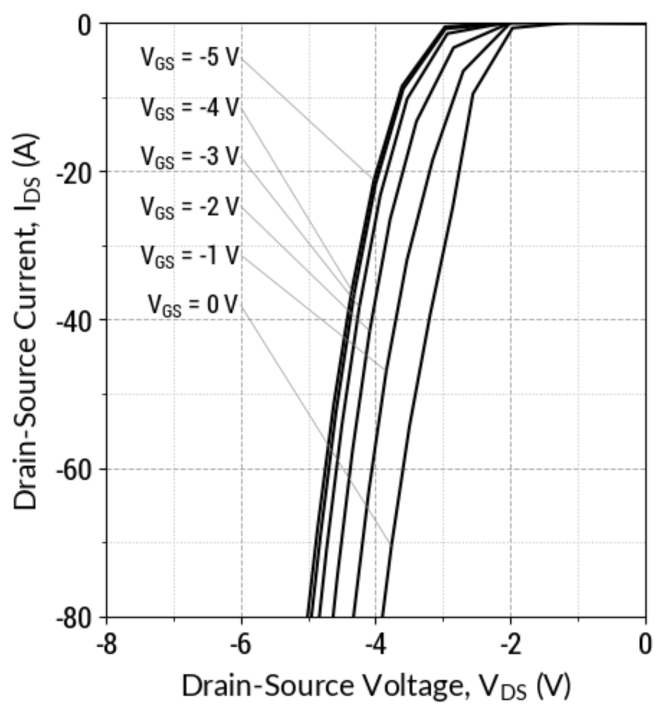
$I_D = f(V_{DS}, V_{GS})$; t_P = 50 µs

Fig 19: Typical Body Diode Characteristics (T_j = 175°C)



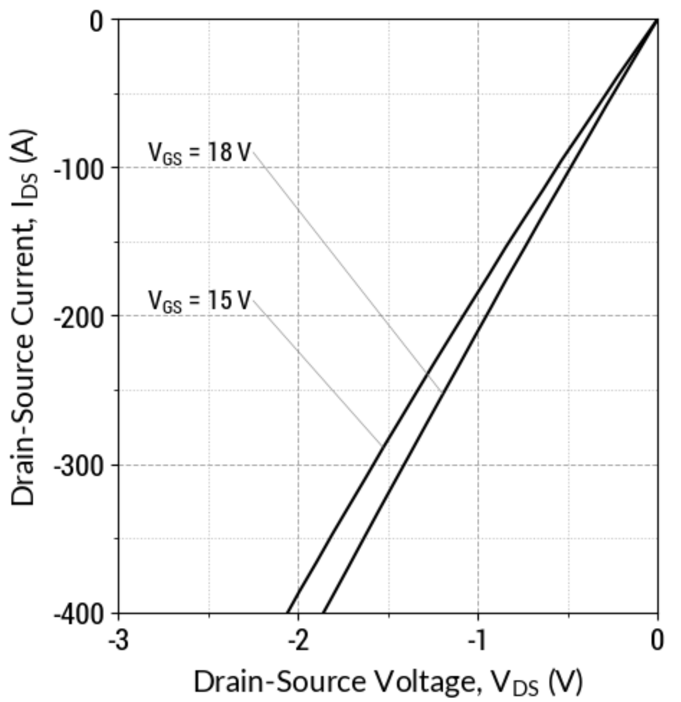
$I_D = f(V_{DS}, V_{GS})$; t_P = 50 µs

Fig 20: Typical Body Diode Characteristics (T_j = -55°C)



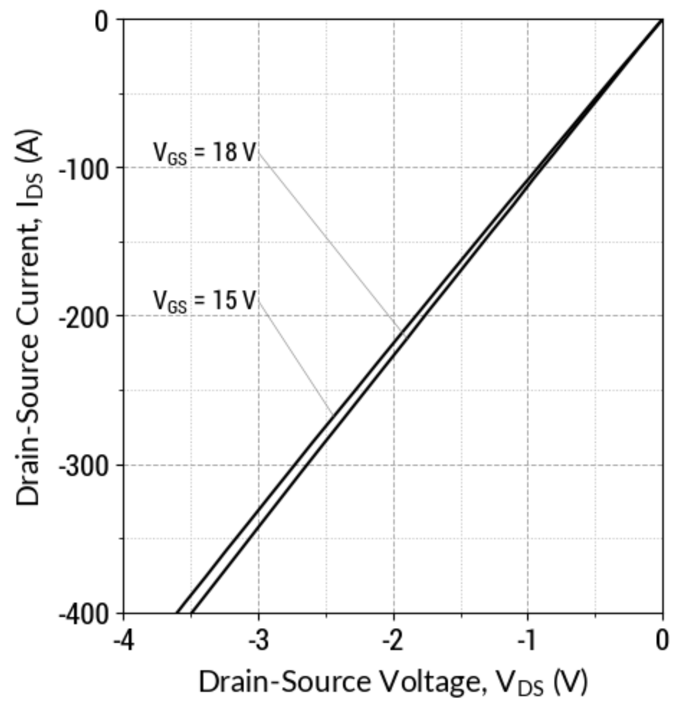
$I_D = f(V_{DS}, V_{GS})$; t_P = 50 µs

Fig 21: Typical Third Quadrant Characteristics (T_j = 25°C)



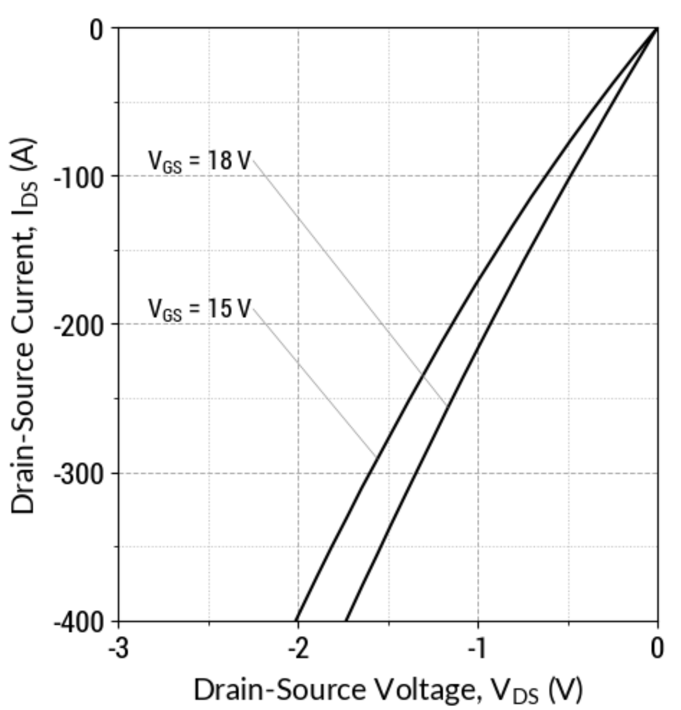
$I_D = f(V_{DS}, V_{GS})$; t_P = 50 µs

Fig 22: Typical Third Quadrant Characteristics (T_j = 175°C)



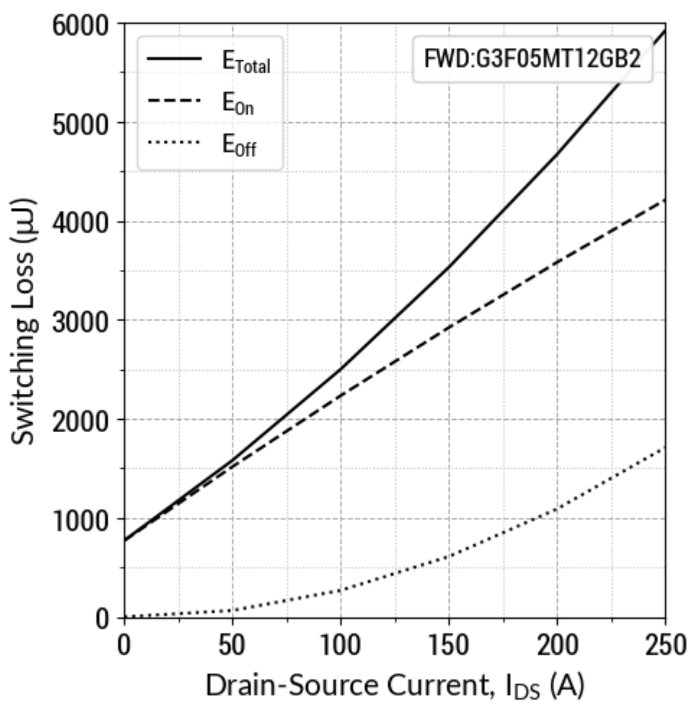
$I_D = f(V_{DS}, V_{GS})$; t_P = 50 µs

Fig 23: Typical Third Quadrant Characteristics (T_j = -55°C)



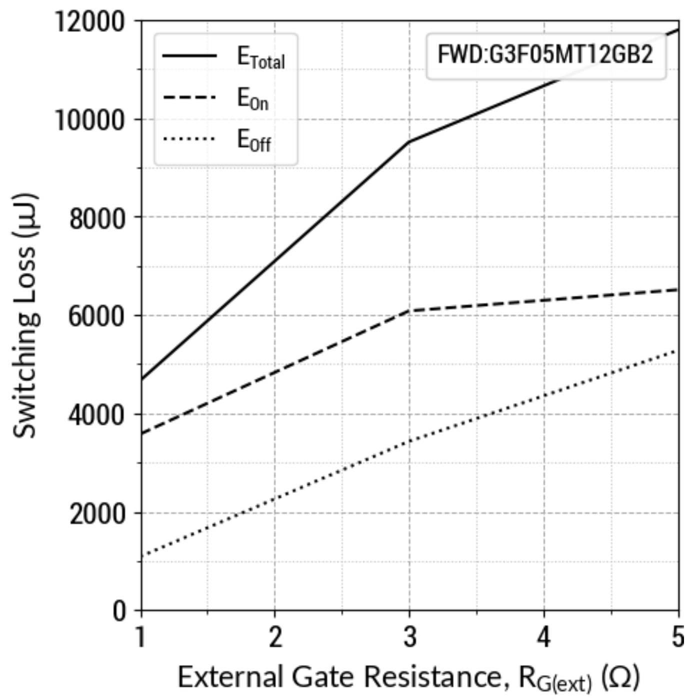
$I_D = f(V_{DS}, V_{GS})$; t_P = 50 µs

Fig 24: Inductive Switching Energy v/s Drain Current (V_{DD} = 800V)



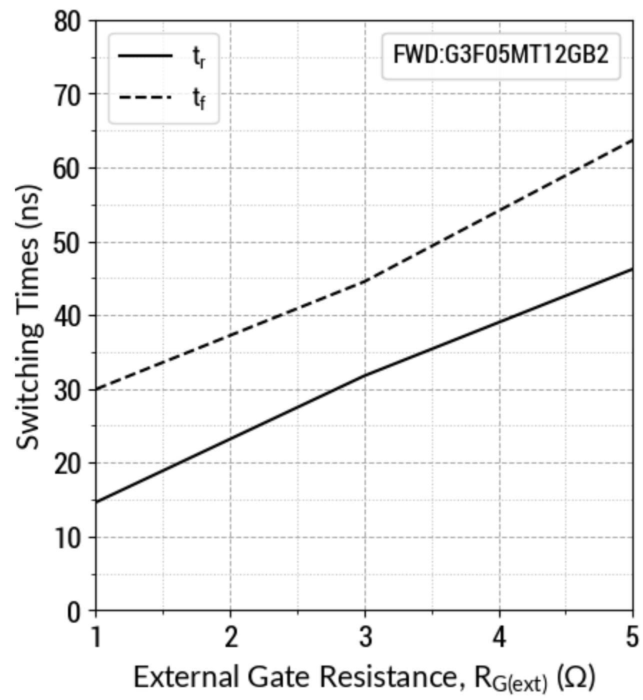
T_j = 25°C; V_{GS} = -5/+18V; $R_{G(on)}$ = 1 Ω; $R_{G(off)}$ = 1 Ω; L = 60µH

Fig 25: Inductive Switching Energy v/s $R_{G(ext)}$ (V_{DD} = 800V)



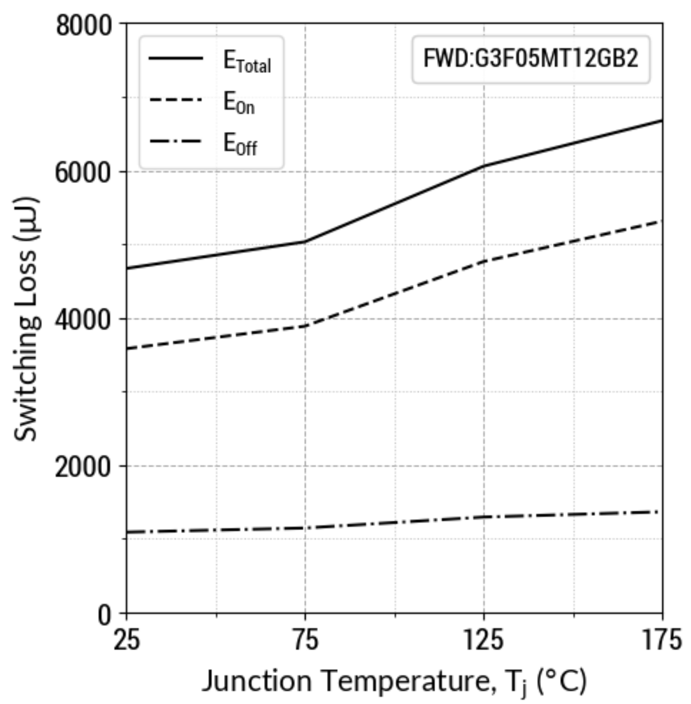
T_j = 25°C; V_{GS} = -5/+18V; I_{DS} = 200 A; L = 60µH

Fig 26: Switching Time v/s $R_{G(ext)}$ (V_{DD} = 800V)



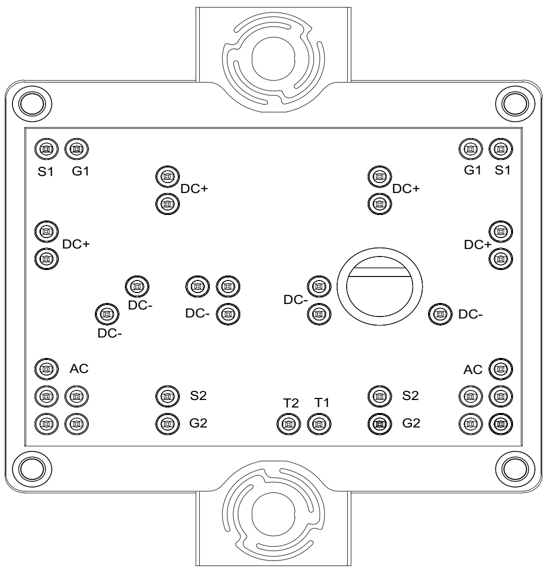
T_j = 25°C; V_{GS} = -5/+18V; I_{DS} = 200 A; L = 60µH

Fig 27: Inductive Switching Energy v/s Temperature (V_{DD} = 800V)

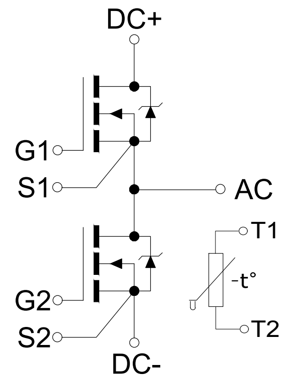


V_{GS} = -5/+18V; $R_{G(on)}$ = 1 Ω; $R_{G(off)}$ = 1 Ω; I_{DS} = 200 A; L = 60µH

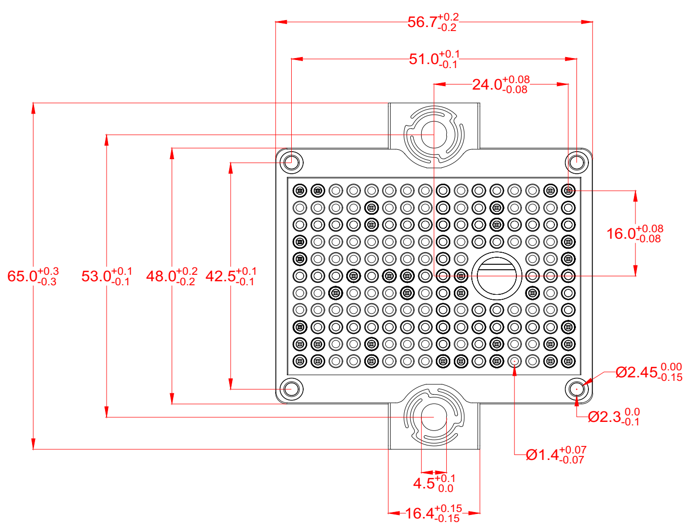
Pinout and Package Dimensions

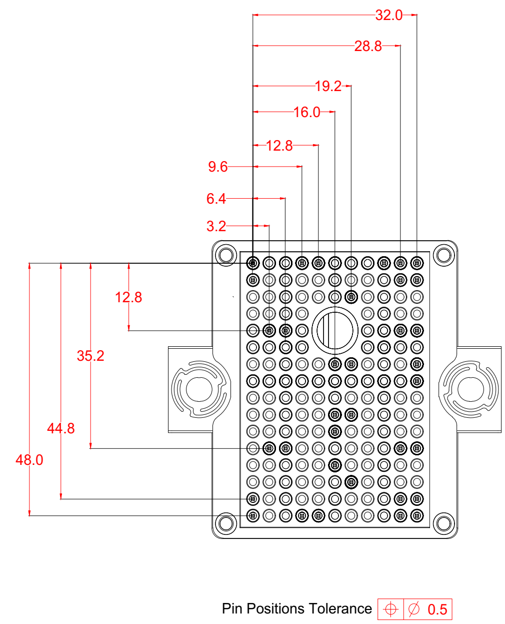


TOP VIEW



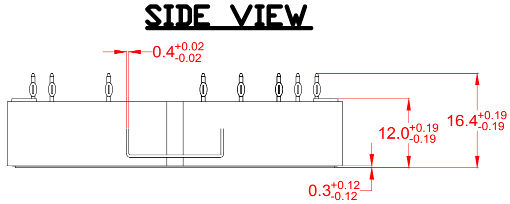
TOP VIEW

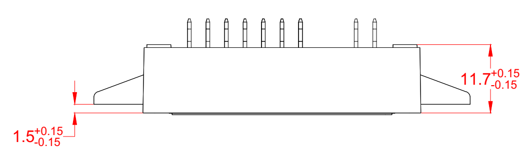




SIDE VIEW

SIDE VIEW





NOTES

1. Controlled dimension is millimeter (mm)
2. Dimensions do not include material protrusions

IMPORTANT NOTICES AND DISCLAIMERS

EXCEPT TO THE EXTENT THAT INFORMATION IN THIS DATA SHEET IS EXPRESSLY AND SPECIFICALLY WARRANTED IN WRITING BY NAVITAS SEMICONDUCTOR ("**NAVITAS**"), EITHER PURSUANT TO THE TERMS AND CONDITIONS OF THE LIMITED WARRANTY CONTAINED IN NAVITAS' STANDARD TERMS AND CONDITIONS OF SALE OR A WRITTEN AGREEMENT SIGNED BY AN AUTHORIZED NAVITAS REPRESENTATIVE, (1) ALL INFORMATION IN THIS DATA SHEET OR OTHER RELIABILITY AND TECHNICAL DATA, AND ANY OTHER DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE OR TOOLS, SAFETY INFORMATION AND OTHER RESOURCES, ARE PROVIDED "AS IS" AND WITH ALL FAULTS; AND (2) NAVITAS MAKES NO WARRANTIES OR REPRESENTATIONS AS TO ANY SUCH INFORMATION OR RESOURCES, IN THIS DATA SHEET OR OTHERWISE, AND HEREBY DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS.

CUSTOMER RESPONSIBILITIES. This data sheet and other design resources and information provided by Navitas are intended only for technically trained and skilled developers designing with Navitas- or GeneSiC-branded products ("**Products**"). Performance specifications and the operating parameters of Products described herein are determined in the independent state and may not perform the same way when installed in customer products. The customer (or other user of this data sheet) is solely responsible for (a) designing, validating and testing the products and systems in which Products are incorporated; (b) designing, validating and testing the application in which Products are incorporated; (c) ensuring the application meets applicable standards and any safety, security, regulatory or other requirements; (d) evaluating the suitability of Products for the intended application and the completeness of the information in this data sheet with respect to such application; (e) procuring and/or developing production firmware, if applicable; and (f) completing system qualification, compliance and safety testing, EMC testing, and any automotive, high-reliability or other system qualifications that apply.

NON-AUTHORIZED USES OF PRODUCTS. Except to the extent expressly provided in a writing signed by an authorized Navitas representative, Products are not designed, authorized or warranted for use in extreme or hazardous conditions; aircraft navigation, communication or control systems; aircraft power and propulsion systems; air traffic control systems; military, weapons, space-based or nuclear applications; life-support devices or systems, including but not limited to devices implanted into the human body and emergency medical equipment; or applications where product failure could lead to death, personal injury or severe property or environmental damage. The customer or other persons using Products in such applications without Navitas' agreement or acknowledgement, as set forth in a writing signed by an authorized Navitas representative, do so entirely at their own risk and agree to fully indemnify Navitas for any damages resulting from such improper use. In order to minimize risks associated with such applications, you should provide adequate design and operating safeguards.

CHANGES TO, AND USE OF, THIS DATA SHEET. This data sheet and accompanying information and resources are subject to change without notice. Navitas grants you permission to use this data sheet and accompanying resources only for the development of an application that uses the Products described herein and subject to the notices and disclaimers set forth above. Any other use, reproduction or display of this data sheet or accompanying resources and information is prohibited. No license is granted to any Navitas intellectual property right or to any third-party intellectual property right. Navitas disclaims any responsibility for, and you will fully indemnify Navitas and its representatives against, any claims, damages, costs, losses and liabilities arising out of your use of this data sheet and any accompanying resources and information.

TERMS AND CONDITIONS. All purchases and sales of Products are subject to Navitas' Standard Terms and Conditions of Sale, including the limited warranty contained therein, unless other terms and conditions have been agreed in a writing signed by an authorized Navitas representative. This data sheet, and Navitas' provision of this data sheet or other information and resources, do not expand or otherwise alter those terms and conditions.