

1200V 9.3mΩ Half-Bridge SiC Module

SiCPAK™ F Series

Trench-Assisted Planar Technology

V_{DS}	=	1200 V
$R_{DS(ON)}$	=	9.3 mΩ
$I_{D,DC} (65^{\circ}\text{C})$	=	109 A

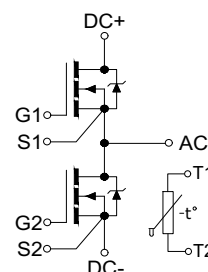
Built for Performance and Endurance

- 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™ F



Applications

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

Absolute Maximum (per Switch Position) (At $T_C = 25^{\circ}\text{C}$ Unless Otherwise Stated)

Parameter	Symbol	Conditions	Values	Unit	Note
Drain-Source Voltage	$V_{DS,max}$	$V_{GS} = 0\text{ V}, I_D = 100\text{ }\mu\text{A}$	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	$^{\circ}\text{C}$	
Power Dissipation	P_D	$T_H = 65^{\circ}\text{C}, T_{j,op} \leq 175^{\circ}\text{C}$	238	W	Fig. 17
		$T_H = 120^{\circ}\text{C}, T_{j,op} \leq 175^{\circ}\text{C}$	119		
DC Continuous Drain Current	$I_{D,DC}$	$T_H = 65^{\circ}\text{C}, T_{j,op} \leq 175^{\circ}\text{C}, V_{GS} = 18\text{ V}$	109	A	Fig. 16
		$T_H = 120^{\circ}\text{C}, T_{j,op} \leq 175^{\circ}\text{C}, V_{GS} = 18\text{ V}$	77		

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



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Electrical Characteristics (per Switch Position) (At $T_C = 25^\circ\text{C}$ Unless Otherwise Stated)

Parameter	Symbol	Conditions	Values			Unit	Note
			Min.	Typ.	Max.		
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0\text{ V}, I_D = 100\text{ }\mu\text{A}$	1200			V	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$		1		μA	
Gate Source Leakage Current	I_{GSS}	$V_{GS} = 22\text{ V}, V_{DS} = 0\text{ V}$ $V_{GS} = -10\text{ V}, V_{DS} = 0\text{ V}$			100 -100	nA	
Gate Threshold Voltage	$V_{GS,th}$	$V_{DS} = V_{GS}, I_D = 70\text{ mA}$ $V_{DS} = V_{GS}, I_D = 70\text{ mA}, T_j = 175^\circ\text{C}$	2.2	2.7 2.0	4.3	V	Note 2
Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS} = 18\text{ V}, I_D = 90\text{ A}$ $V_{GS} = 18\text{ V}, I_D = 90\text{ A}, T_j = 175^\circ\text{C}$		9.25 16.65	12.5	m Ω	Note 3,4 Fig. 6-9
Input Capacitance	C_{iss}			9850			
Output Capacitance	C_{oss}	$V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}$ $f = 100\text{ kHz}, V_{AC} = 25\text{ mV}$		364		pF	Fig. 12
Reverse Transfer Capacitance	C_{rss}			23			
Internal Gate Resistance	$R_{G,int}$	$V_{GS} = 18\text{ V}, f = 500\text{ kHz}, V_{AC} = 25\text{ mV}$		0.65		Ω	
Gate-Source Charge	Q_{GS}	$V_{DS} = 800\text{ V}, V_{GS} = +18/-5\text{ V}$		112			
Gate-Drain Charge	Q_{GD}	$I_D = 90\text{ A}$		78		nC	Fig. 11
Total Gate Charge	Q_G	Per JEDEC JEP-192		392			
Turn-On Switching Energy (Body Diode)	E_{on}	$T_j = 25^\circ\text{C}, V_{GS} = -5/+18\text{ V}, R_{G(ext)} = 4.7\text{ }\Omega, L = 60\text{ }\mu\text{H}, I_D = 120\text{ A}, V_{DD} = 800\text{ V}$		2695		μJ	Fig. 24-27
Turn-Off Switching Energy (Body Diode)	E_{off}			203			
Rise Time	t_r	$V_{DD} = 800\text{ V}, V_{GS} = -5/+18\text{ V}$		24			
Fall Time	t_f	$R_{G(ext)} = 4.7\text{ }\Omega, L = 60\text{ }\mu\text{H}, I_D = 120\text{ A}$ Timing relative to V_{DS} , Inductive load		29		ns	Fig. 26

Body Diode Characteristics (per Switch Position) (At $T_j = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Conditions	Values			Unit	Note
			Min.	Typ.	Max.		
Diode Forward Voltage	V_{SD}	$V_{GS} = -5\text{ V}, I_{SD} = 45\text{ A}$ $V_{GS} = -5\text{ V}, I_{SD} = 45\text{ A}, T_j = 175^\circ\text{C}$		4.5 4.1		V	Fig. 18,19
DC Continuous Diode Current	I_{SD}	$T_H = 65^\circ\text{C}, T_{j,op} \leq 175^\circ\text{C}, V_{GS} = -5\text{ V}$ $T_H = 120^\circ\text{C}, T_{j,op} \leq 175^\circ\text{C}, V_{GS} = -5\text{ V}$		56 37		A	

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 position (HS or LS) = MOSFET $R_{DS(ON)}$ + package resistance by switch position

Module Characteristics

Parameter	Symbol	Conditions	Values			Unit	Note
			Min.	Typ.	Max.		
Thermal Resistance, Junction - Heatsink	R_{thJHS}	TIM = 80 μm , $\lambda = 4.4 \text{ W/(m.K)}$ per switch		0.42		°C/W	Fig. 14
Case Temperature	T_C		-40		150	°C	
Stray Inductance	L_{stray}	Between DC+ and DC- $f = 10 \text{ MHz}$		7.43		nH	
Package Resistance, HS	R_{HS}	$T_C = 125^\circ\text{C}$		1.58		mΩ	Note 4
Package Resistance, LS	R_{LS}	$T_C = 125^\circ\text{C}$		1.48			
Weight	W			28.1		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		6.4		mm	
		Terminal to Heatsink		12.7			

NTC-Thermistor Characteristics

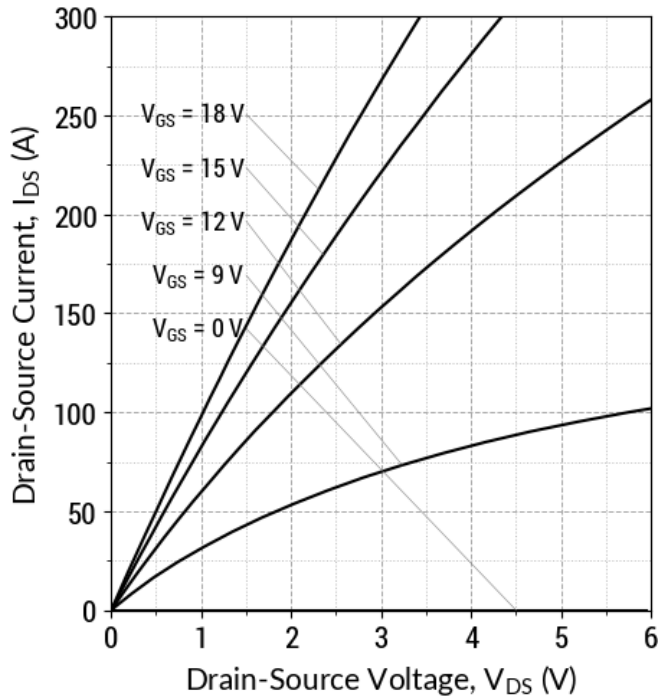
Parameter	Symbol	Conditions	Values			Unit	Note
			Min.	Typ.	Max.		
Rated Resistance	$R_{NTC,25}$	$T_{NTC} = 25^\circ\text{C}$		5		kΩ	
Resistance Tolerance	$\Delta R/R$	$T_{NTC} = 25^\circ\text{C}$	-5		+5	%	
Power Dissipation	$P_{NTC,25}$	$T_{NTC} = 25^\circ\text{C}$			20	mW	
Beta Value (B-value)	$B_{25/B50}$	$T_2 = 50^\circ\text{C}$		3375		K	
	$B_{25/B80}$	$T_2 = 80^\circ\text{C}$		3410			
	$B_{25/B100}$	$T_2 = 100^\circ\text{C}$		3435			

Product Ordering Information

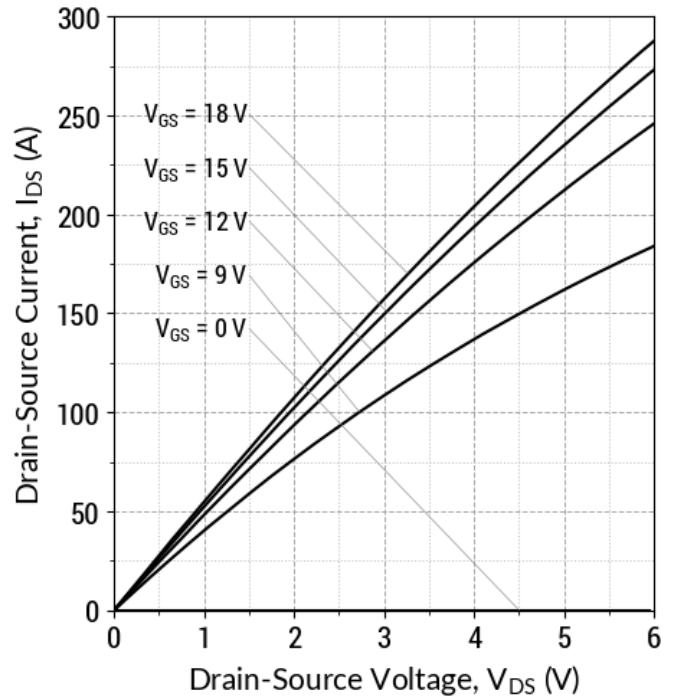
Orderable Part number (OPN)	Package	Packing Method
G3F09MT12FB2	SiCPAK™ F	Box (Qty - 12)
G3F09MT12FB2-T	SiCPAK™ F with TIM	Box (Qty - 12)

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

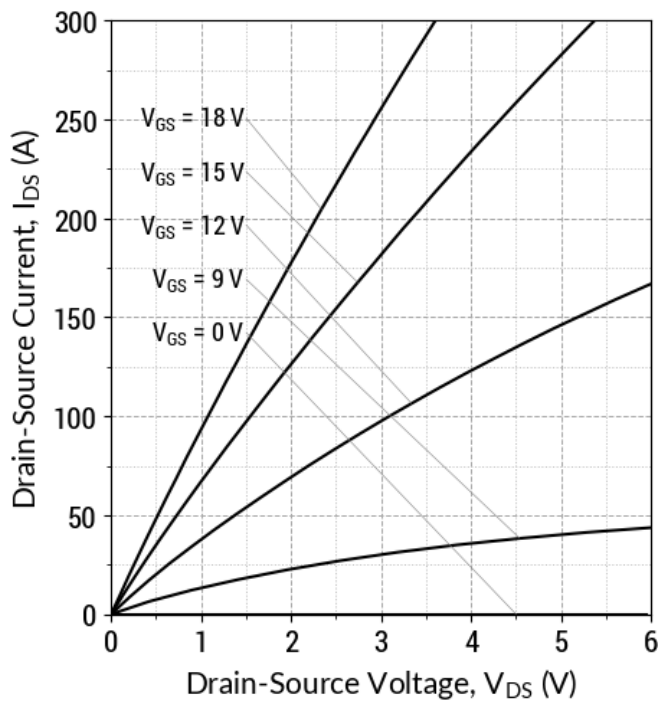
Note 4: Total effective resistance per switch position (HS or LS) = MOSFET $R_{DS(ON)}$ + package resistance by switch position

Fig 1: Typical Output Characteristics ($T_j = 25^\circ\text{C}$)

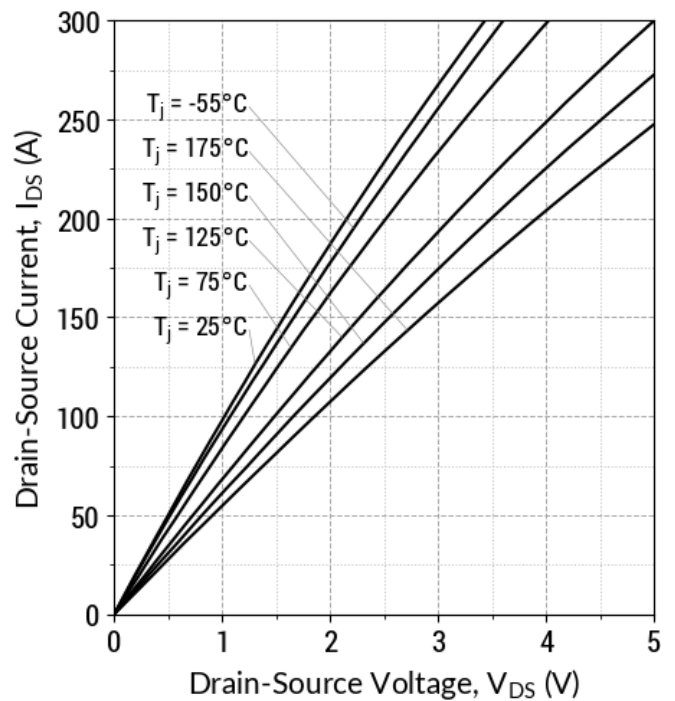
$$I_D = f(V_{DS}, V_{GS}); t_P = 50\ \mu\text{s}$$

Fig 2: Typical Output Characteristics ($T_j = 175^\circ\text{C}$)

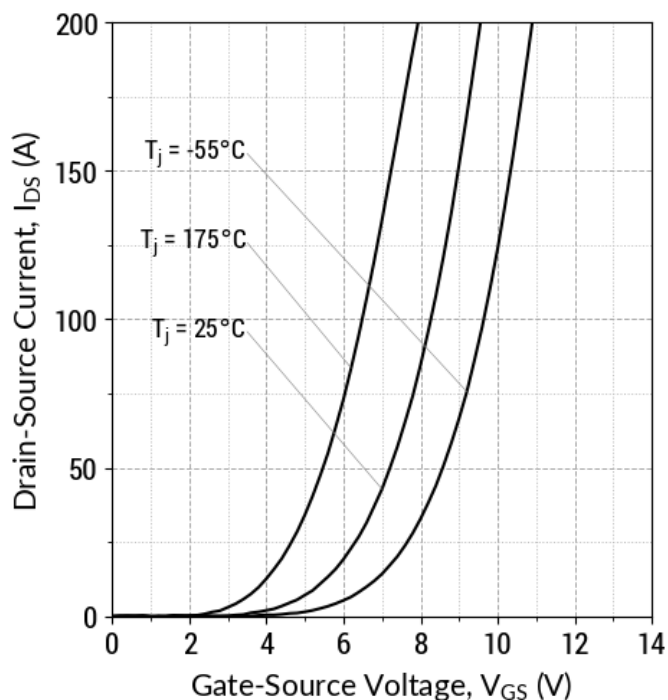
$$I_D = f(V_{DS}, V_{GS}); t_P = 50\ \mu\text{s}$$

Fig 3: Typical Output Characteristics ($T_j = -55^\circ\text{C}$)

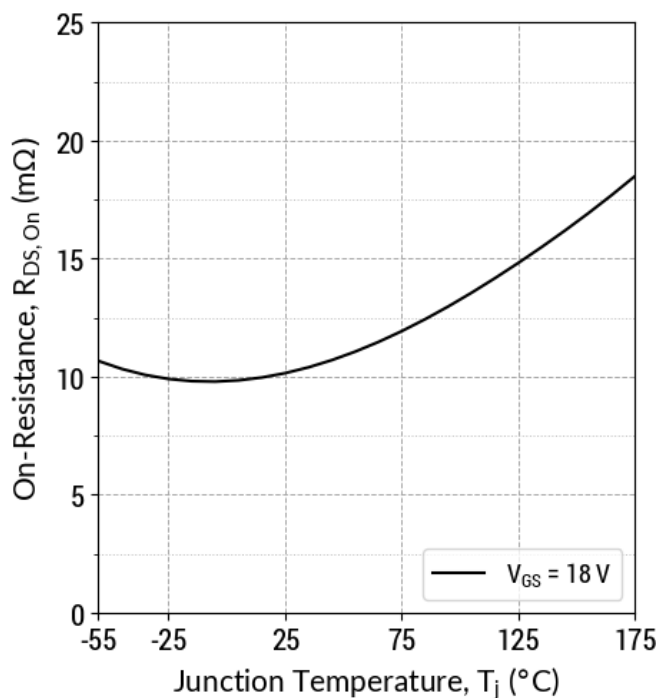
$$I_D = f(V_{DS}, V_{GS}); t_P = 50\ \mu\text{s}$$

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

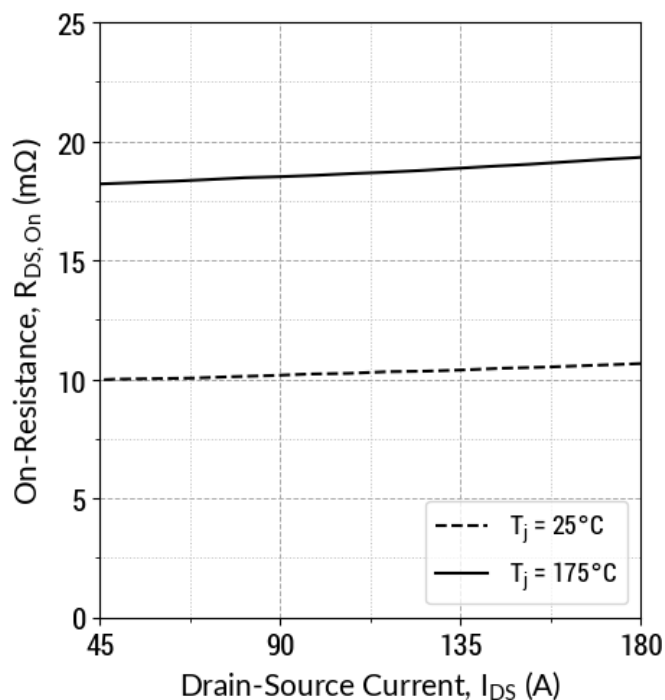
$$I_D = f(V_{DS}, T_j); t_P = 50\ \mu\text{s}$$

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

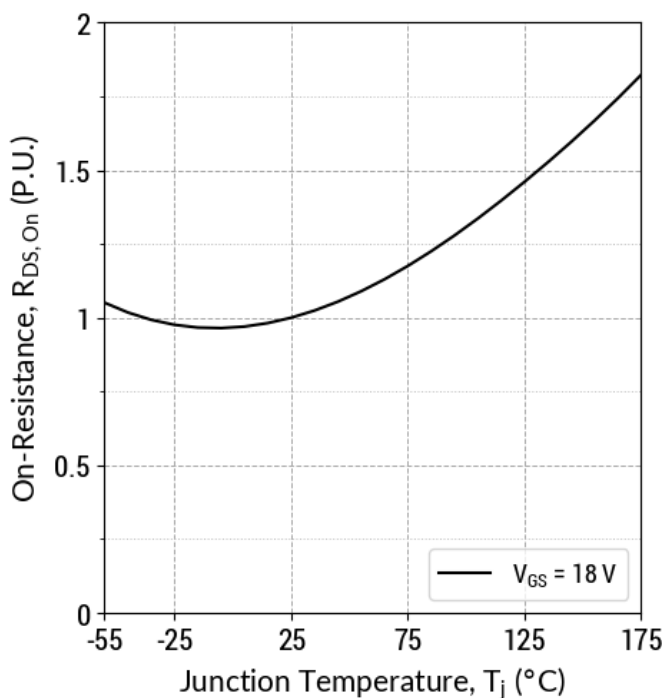
$$I_D = f(V_{GS}, T_j); t_P = 100\ \mu\text{s}$$

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

$$R_{DS(ON)} = f(T_j, V_{GS}); t_P = 50\ \mu\text{s}; I_D = 90\text{ A}$$

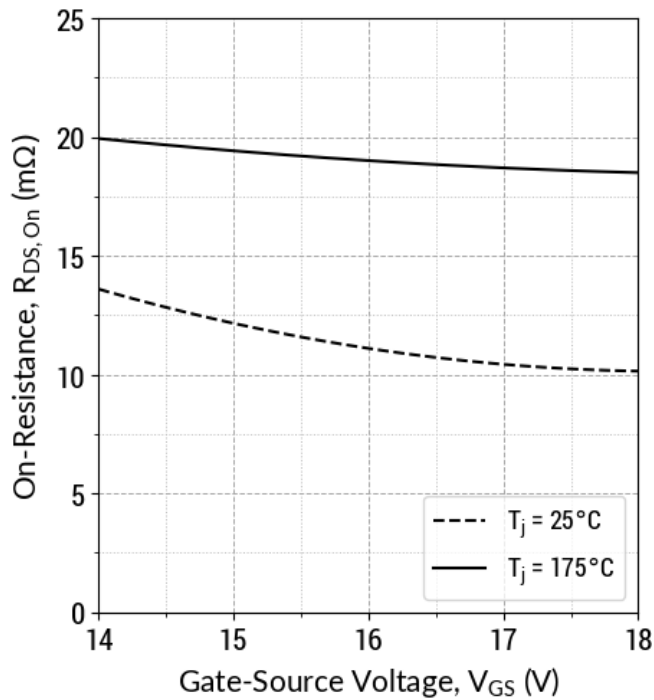
Fig 7: Typical $R_{DS(ON)}$ v/s Drain Current

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

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

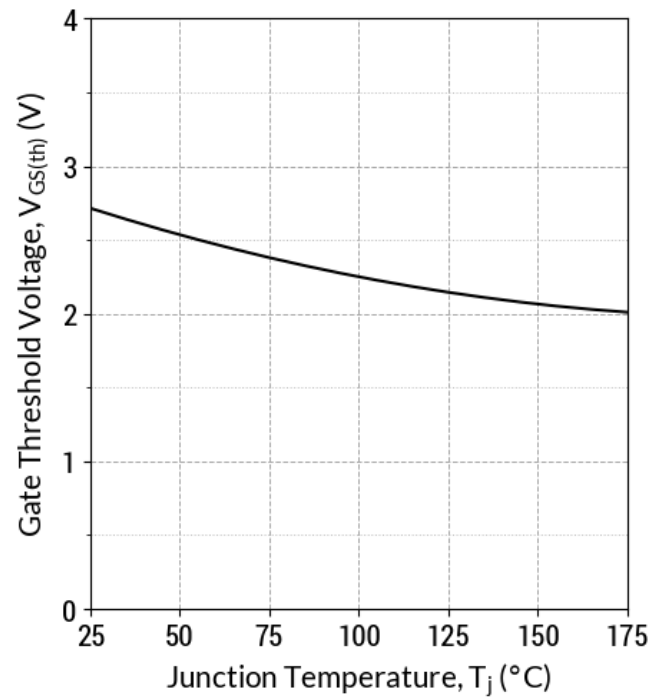
$$R_{DS(ON)} = f(T_j); t_P = 50\ \mu\text{s}; I_D = 90\text{ A}$$

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



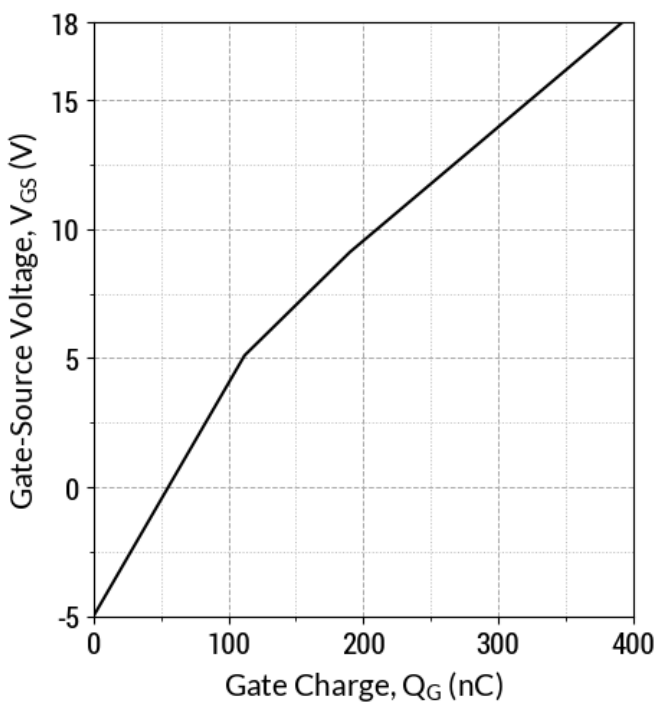
$$R_{DS(ON)} = f(T_j, V_{GS}); t_p = 50 \mu\text{s}; I_D = 90 \text{ A}$$

Fig 10: Typical Threshold Voltage Characteristics



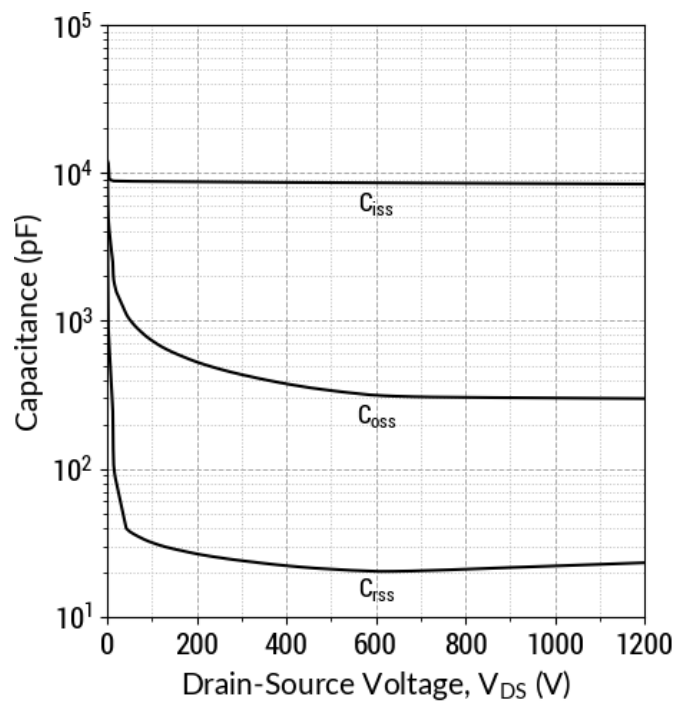
$$V_{GS(th)} = f(T_j); V_{DS} = V_{GS}; I_D = 70 \text{ mA}$$

Fig 11: Typical Gate Charge Characteristics



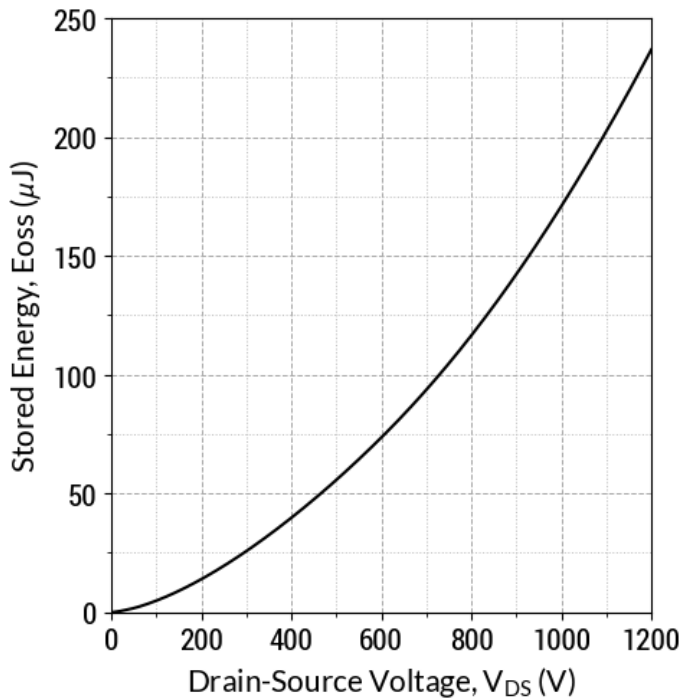
$$I_D = 90 \text{ A}; V_{DS} = 800 \text{ V}; T_c = 25^\circ\text{C}$$

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



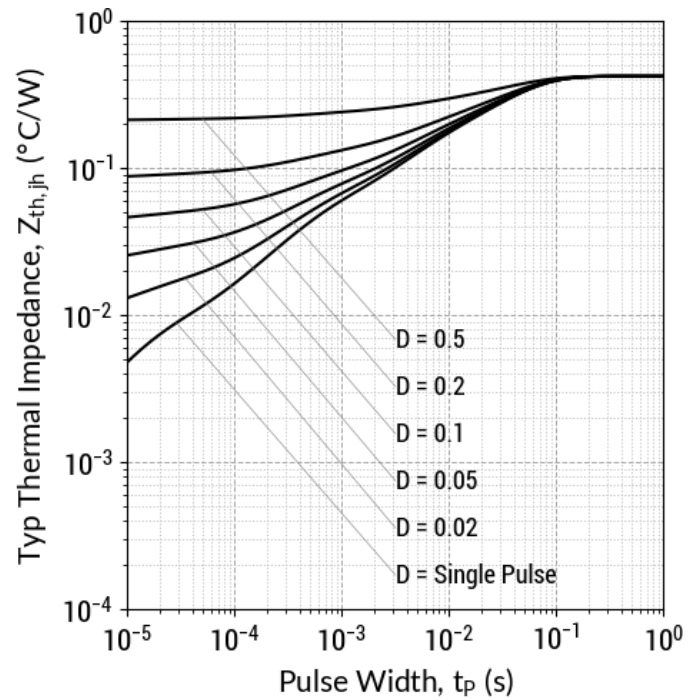
$$f = 500 \text{ KHz}; V_{AC} = 25 \text{ mV}$$

Fig 13: Output Capacitor Stored Energy



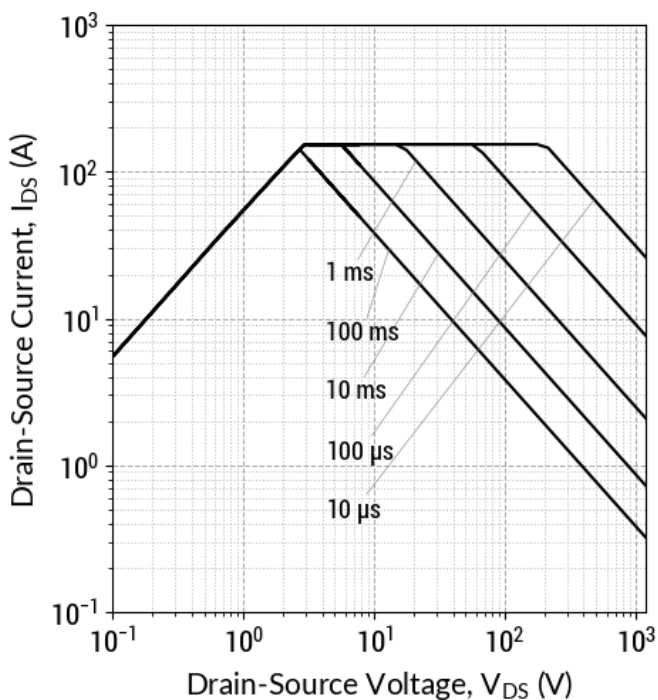
$$E_{oss} = f(V_{DS})$$

Fig 14: Typical Transient Thermal Impedance



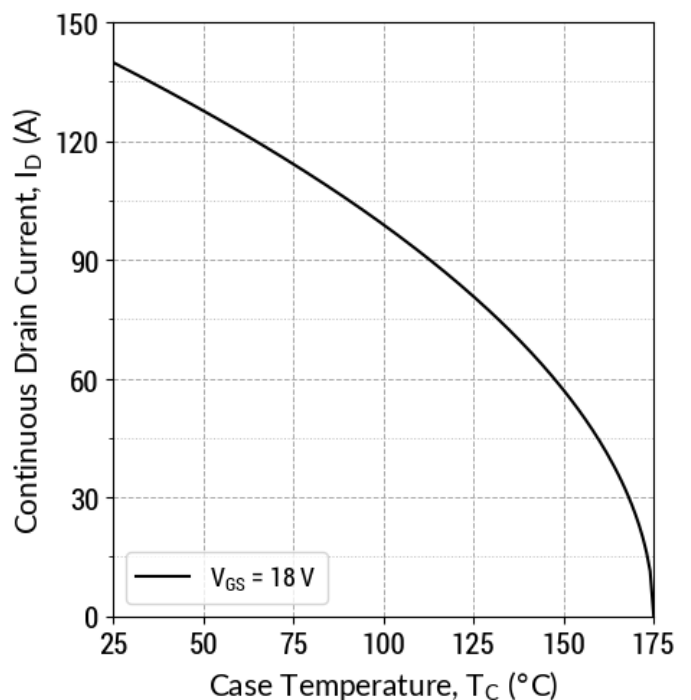
$$Z_{th,jh} = f(t_p, D); D = t_p/T$$

Fig 15: Safe Operating Area ($T_c = 25^{\circ}C$)



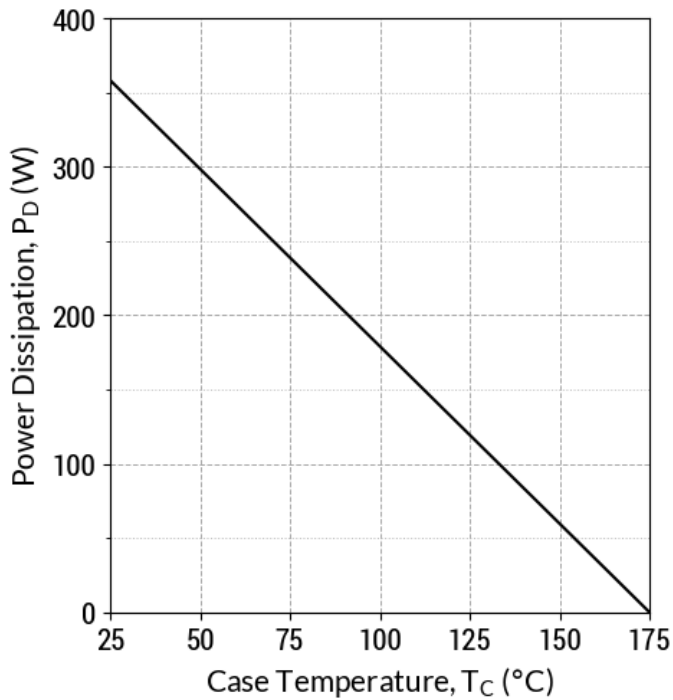
$$I_D = f(V_{DS}, t_p); T_j \leq 175^{\circ}C; D = 0$$

Fig 16: Current De-rating Curve



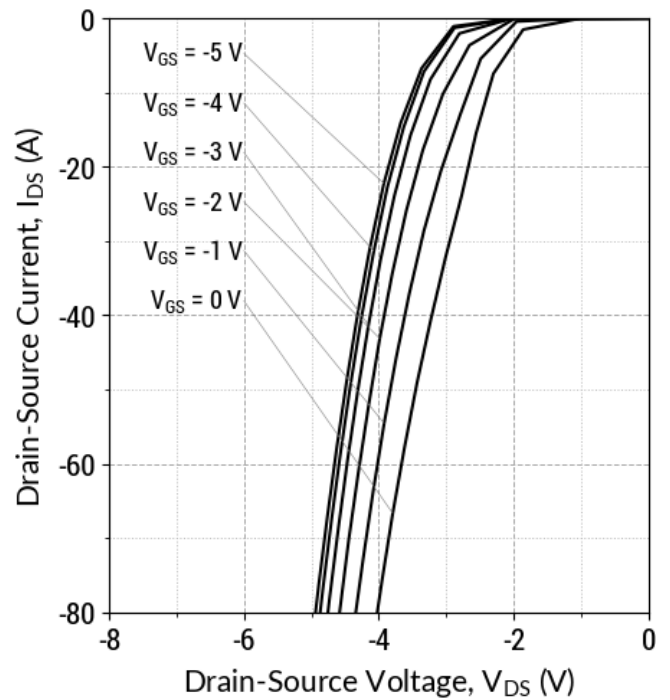
$$I_D = f(T_C); T_j \leq 175^{\circ}C$$

Fig 17: Power De-rating Curve



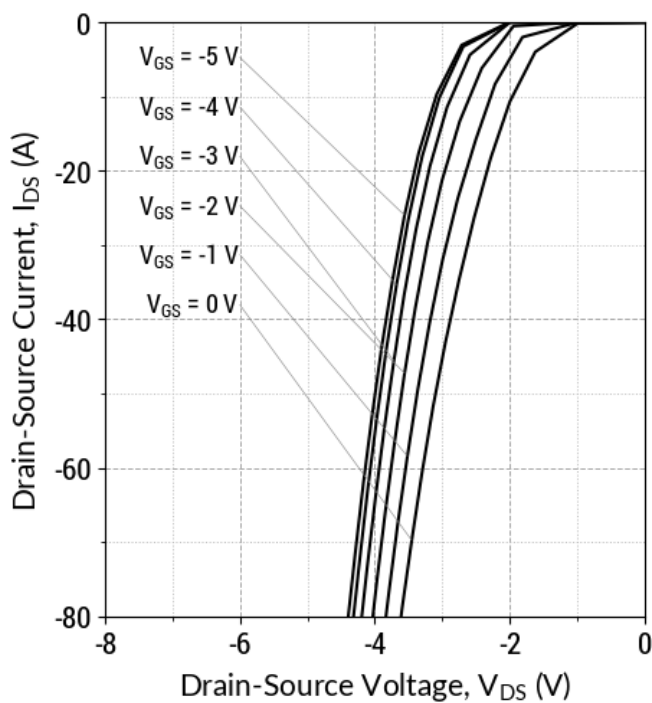
$$P_D = f(T_C); T_j \leq 175^\circ\text{C}$$

Fig 18: Typical Body Diode Characteristics ($T_j = 25^\circ\text{C}$)



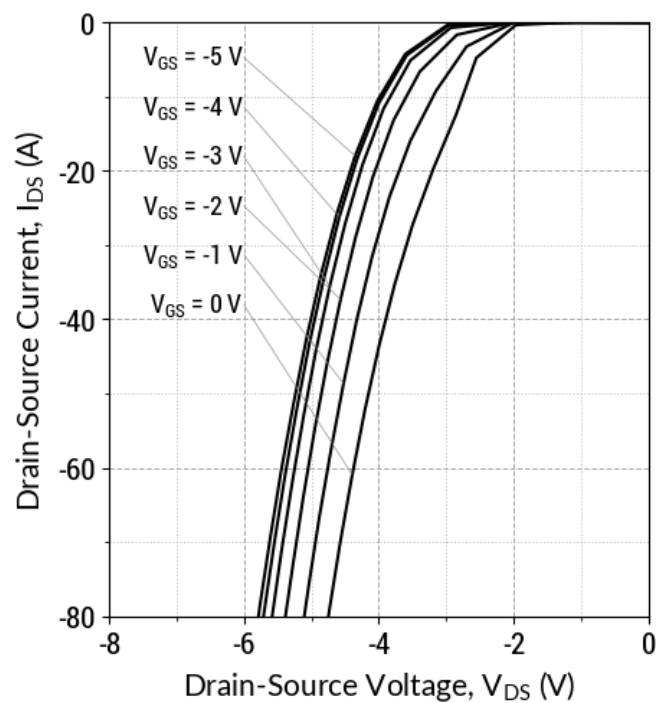
$$I_D = f(V_{DS}, V_{GS}); t_P = 50\text{ }\mu\text{s}$$

Fig 19: Typical Body Diode Characteristics ($T_j = 175^\circ\text{C}$)



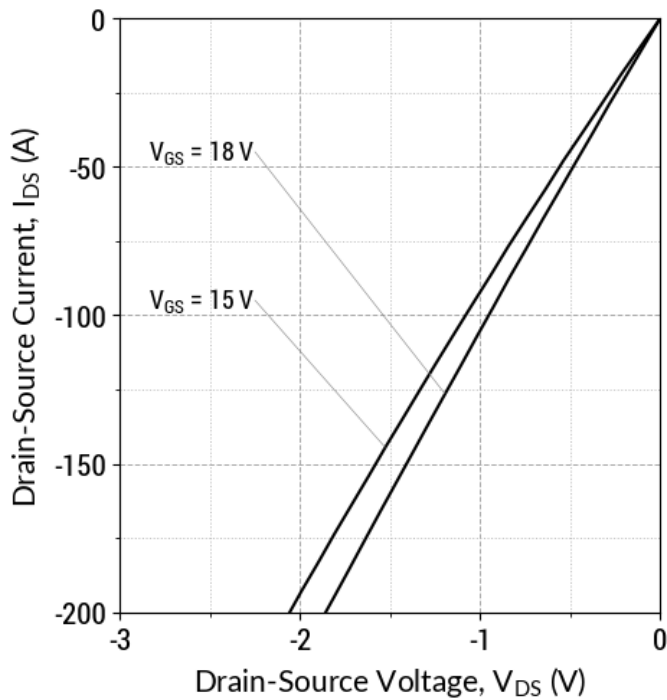
$$I_D = f(V_{DS}, V_{GS}); t_P = 50\text{ }\mu\text{s}$$

Fig 20: Typical Body Diode Characteristics ($T_j = -55^\circ\text{C}$)



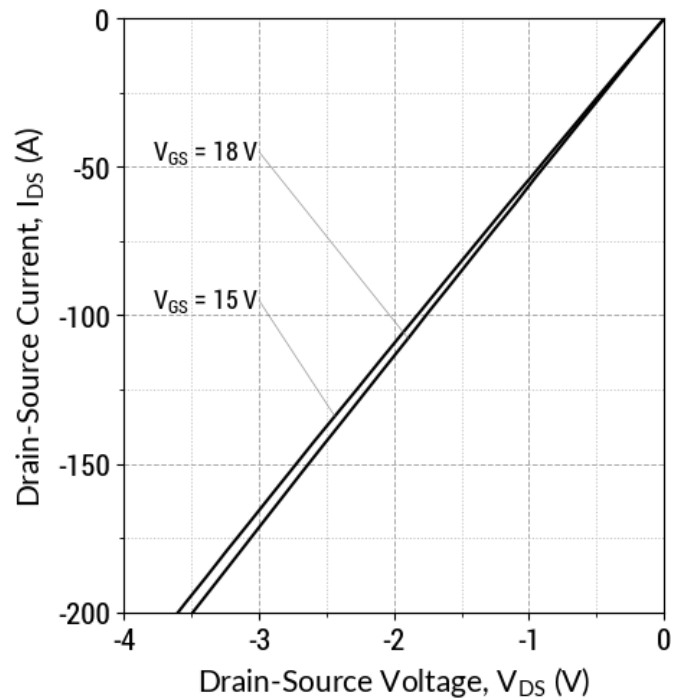
$$I_D = f(V_{DS}, V_{GS}); t_P = 50\text{ }\mu\text{s}$$

Fig 21: Typical Third Quadrant Characteristics ($T_j = 25^\circ\text{C}$)



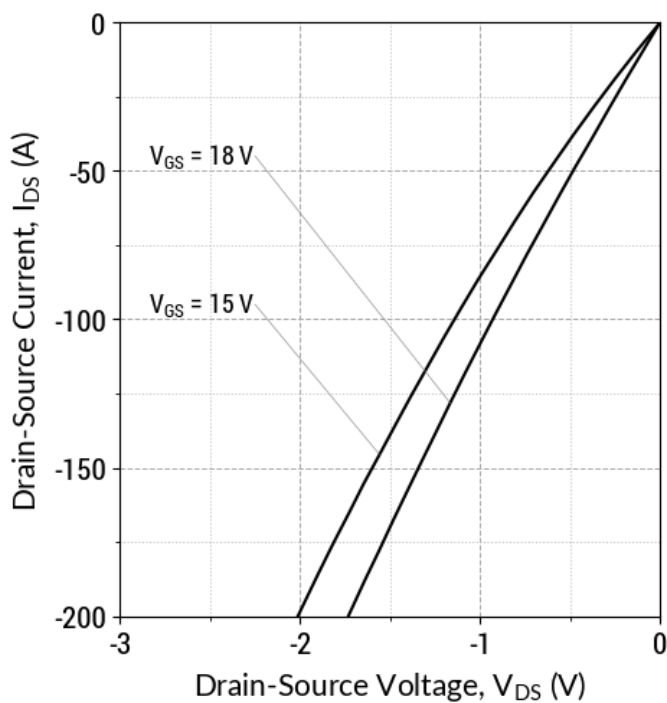
$$I_D = f(V_{DS}, V_{GS}); t_P = 50 \mu\text{s}$$

Fig 22: Typical Third Quadrant Characteristics ($T_j = 175^\circ\text{C}$)



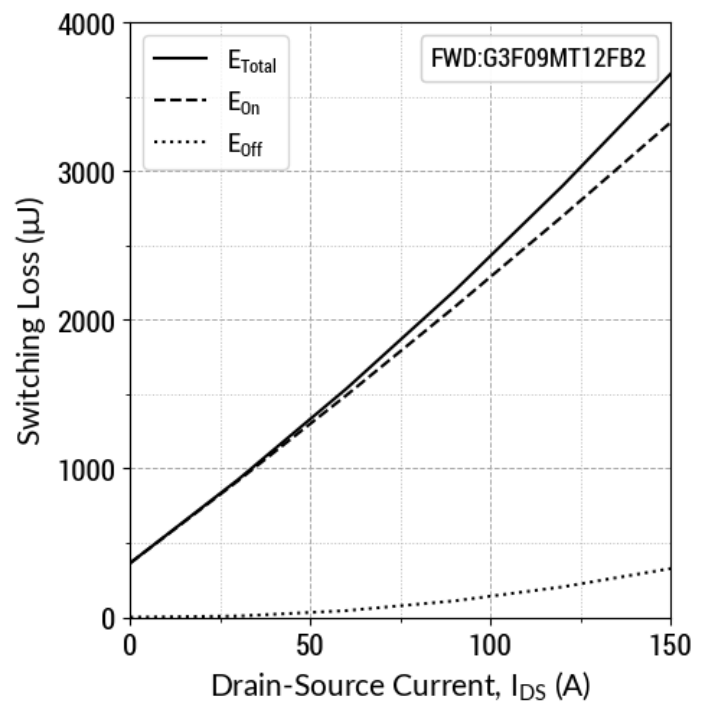
$$I_D = f(V_{DS}, V_{GS}); t_P = 50 \mu\text{s}$$

Fig 23: Typical Third Quadrant Characteristics ($T_j = -55^\circ\text{C}$)



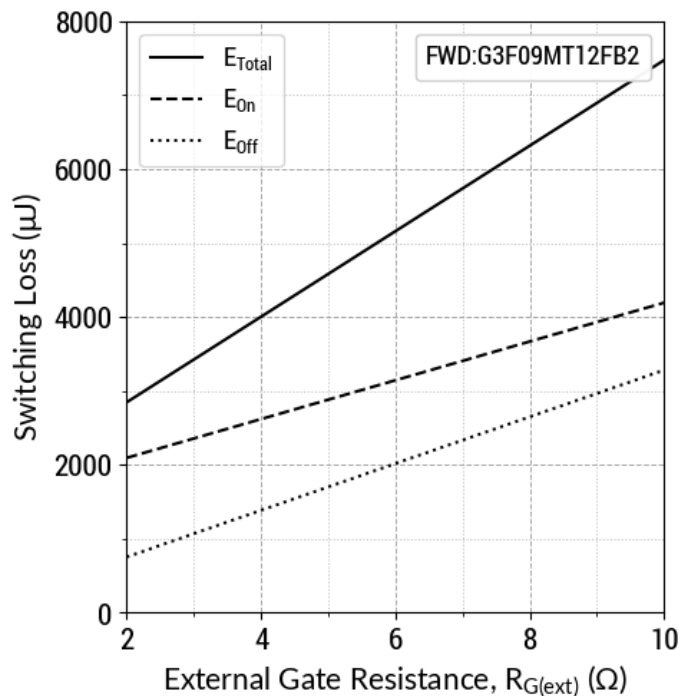
$$I_D = f(V_{DS}, V_{GS}); t_P = 50 \mu\text{s}$$

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



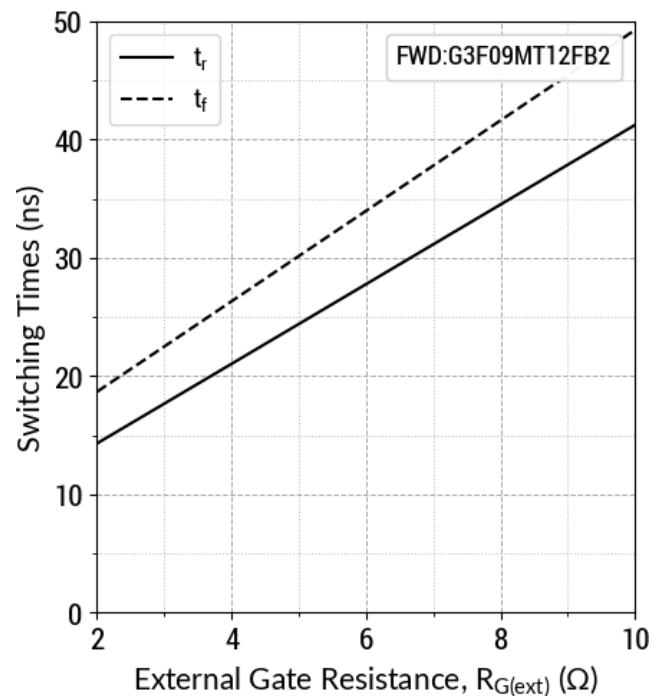
$$T_j = 25^\circ\text{C}; V_{GS} = -5/+18\text{V}; R_{G(\text{on})} = 4.7 \Omega; R_{G(\text{off})} = 0 \Omega; L = 60 \mu\text{H}$$

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



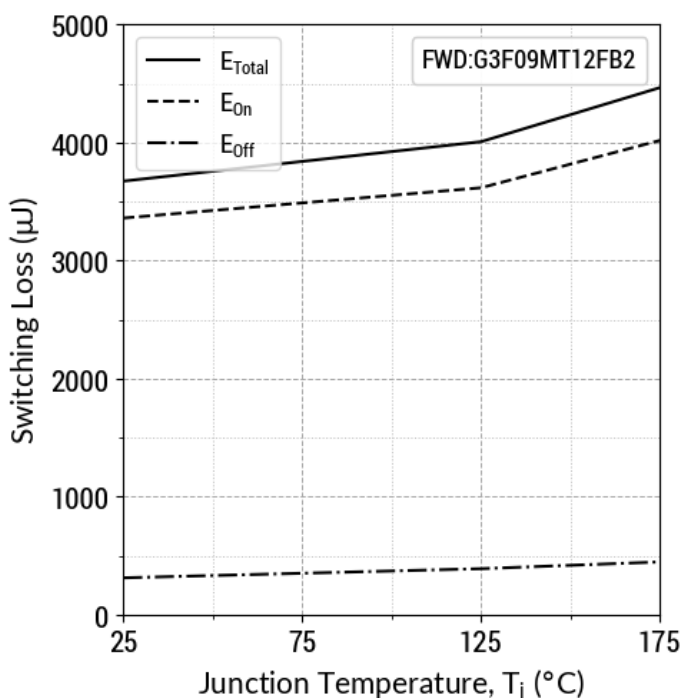
$T_j = 25^\circ C$; $V_{GS} = -5/+18V$; $I_{DS} = 120 A$; $L = 60\mu H$

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



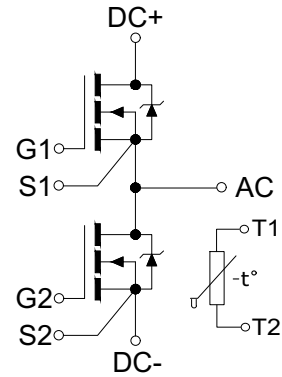
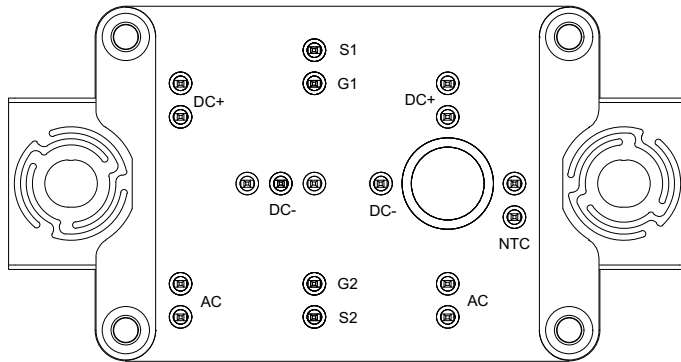
$T_j = 25^\circ C$; $V_{GS} = -5/+18V$; $I_{DS} = 120 A$; $L = 60\mu H$

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

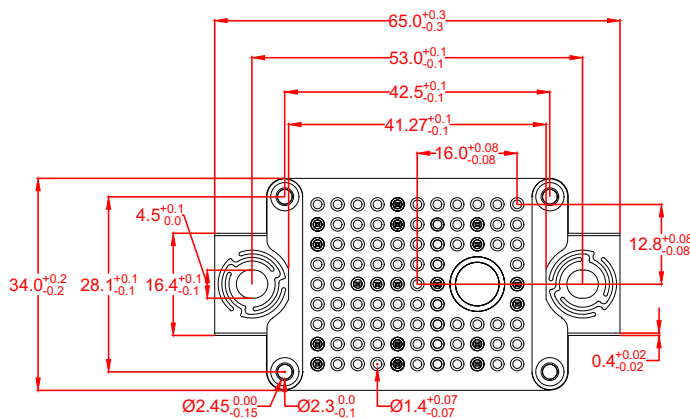


$V_{GS} = -5/+18V$; $R_{G(on)} = 4.7 \Omega$; $R_{G(off)} = 0 \Omega$; $I_{DS} = 120 A$; $L = 60\mu H$

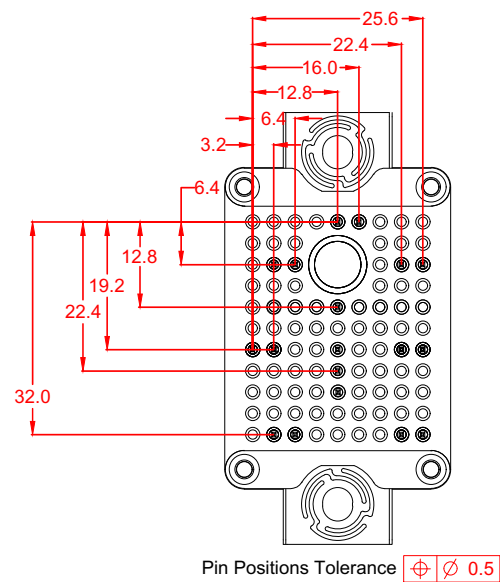
Pinout and Package Dimensions



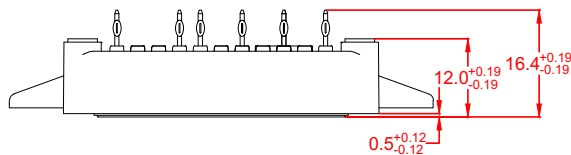
TOP VIEW



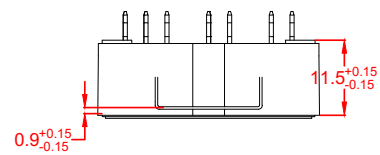
TOP VIEW



SIDE VIEW



SIDE VIEW



NOTES

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

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