

## IV1B12013HA1L – 1200V 13mohm SiC MODULE

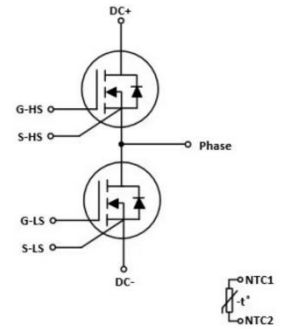
### Features

- High blocking voltage with low on-resistance
- High speed switching with low capacitance
- High operating junction temperature capability
- Very fast and robust intrinsic body diode

### Applications

- Solar applications
- UPS system
- Motor drivers
- High voltage DC/DC converters

### Package



### Marking Diagram

IV1B12013HA1L	Specific Device Code	
YYWWZ-XXXXX	YY	Year
	WW	Work Week
	Z	Assembly Location
	XXXXX	Lot Traceability

### Absolute Maximum Ratings ( $T_c=25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
$V_{DS}$	Drain-Source voltage	1200	V		
$V_{GSmax}(DC)$	Maximum DC voltage	-5 to 22	V	Static (DC)	
$V_{GSmax}(Spike)$	Maximum spike voltage	-10 to 25	V	<1% duty cycle, and pulse width<200ns	
$V_{GSon}$	Recommended turn-on voltage	$20\pm 0.5$	V		
$V_{GSoff}$	Recommended turn-off voltage	-3.5 to -2	V		
$I_D$	Drain current (continuous)	96	A	$V_{GS}=20V, T_h=50^\circ\text{C}, T_{vj}\leq 150^\circ\text{C}$	
		102	A	$V_{GS}=20V, T_h=50^\circ\text{C}, T_{vj}\leq 175^\circ\text{C}$	
$I_{DM}$	Drain current (pulsed)	204	A	Pulse width limited by SOA	Fig.26
$P_{TOT}$	Total power dissipation	210	W	$T_{vj}\leq 150^\circ\text{C}$	Fig.24
$T_{stg}$	Storage temperature range	-40 to 150	$^\circ\text{C}$		
$T_j$	Maximum virtual junction temperature under switching conditions	-40 to 150	$^\circ\text{C}$	Operation	
		-55 to 175	$^\circ\text{C}$	Intermittent with reduced life	

### Thermal Data

Symbol	Parameter	Value	Unit	Note
$R_{\theta(J-H)}$	Thermal Resistance from Junction to Heatsink	0.596	$^\circ\text{C}/\text{W}$	Fig.25

**Electrical Characteristics** ( $T_c=25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Value			Unit	Test Conditions	Note
		Min.	Typ.	Max.			
$I_{DSS}$	Zero gate voltage drain current		10	200	$\mu\text{A}$	$V_{DS}=1200\text{V}, V_{GS}=0\text{V}$	
$I_{GSS}$	Gate leakage current			$\pm 200$	$\text{nA}$	$V_{DS}=0\text{V}, V_{GS}=-5\sim 20\text{V}$	
$V_{TH}$	Gate threshold voltage	1.8	3.2	5	$\text{V}$	$V_{GS}=V_{DS}, I_D=24\text{mA}$	Fig.9
			2.3			$V_{GS}=V_{DS}, I_D=24\text{mA}$ @ $T_c=150^\circ\text{C}$	
$R_{ON}$	Static drain-source on-resistance		12.5	16.3	$\text{m}\Omega$	$V_{GS}=20\text{V}, I_D=80\text{A}$ @ $T_j=25^\circ\text{C}$	Fig.4-7
			18		$\text{m}\Omega$	$V_{GS}=20\text{V}, I_D=80\text{A}$ @ $T_j=150^\circ\text{C}$	
$C_{iss}$	Input capacitance		11		$\text{nF}$	$V_{DS}=800\text{V}, V_{GS}=0\text{V},$ $f=100\text{kHz}, V_{AC}=25\text{mV}$	Fig.16
$C_{oss}$	Output capacitance		507		$\text{pF}$		
$C_{rss}$	Reverse transfer capacitance		31		$\text{pF}$		
$E_{oss}$	$C_{oss}$ stored energy		203		$\mu\text{J}$		Fig.17
$Q_g$	Total gate charge		480		$\text{nC}$	$V_{DS}=800\text{V}, I_D=80\text{A},$ $V_{GS}=-5\text{ to }20\text{V}$	Fig.18
$Q_{gs}$	Gate-source charge		100		$\text{nC}$		
$Q_{gd}$	Gate-drain charge		192		$\text{nC}$		
$R_g$	Gate input resistance		1.0		$\Omega$	$f=100\text{kHz}$	
$E_{ON}$	Turn-on switching energy		783		$\mu\text{J}$	$V_{DS}=600\text{V}, I_D=60\text{A},$ $V_{GS}=-5\text{ to }20\text{V},$ $R_{G(\text{ext})on} / R_{G(\text{ext})off}$ $=2.5\Omega/1.43\Omega,$ $L=120\ \mu\text{H}$	Fig.19-22
$E_{OFF}$	Turn-off switching energy		182		$\mu\text{J}$		
$t_{d(on)}$	Turn-on delay time		30		$\text{ns}$		
$t_r$	Rise time		5.9				
$t_{d(off)}$	Turn-off delay time		37				
$t_f$	Fall time		21				
$L_{sCE}$	Stray inductance		7.6		$\text{nH}$		

**Reverse Diode Characteristics** ( $T_c=25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Value			Unit	Test Conditions	Note
		Min.	Typ.	Max.			
$V_{SD}$	Diode forward voltage		4.9		V	$I_{SD}=80\text{A}, V_{GS}=0\text{V}$	Fig.10-12
			4.5		V	$I_{SD}=80\text{A}, V_{GS}=0\text{V}, T_J=150^\circ\text{C}$	
$t_{rr}$	Reverse recovery time		17.4		ns	$V_{GS}=-5\text{V}/+20\text{V},$ $I_{SD}=60\text{A}, V_R=600\text{V},$ $di/dt=13.28\text{A/ns},$	
$Q_{rr}$	Reverse recovery charge		1095		nC		
$I_{RRM}$	Peak reverse recovery current		114		A	$R_{G(ext)}=2.5\Omega, L=120\mu\text{H}$	

**NTC Thermistor Characteristics**

Symbol	Parameter	Value			Unit	Test Conditions	Note
		Min.	Typ.	Max.			
$R_{NTC}$	Rated Resistance		5		k $\Omega$	$T_{NTC}=25^\circ\text{C}$	Fig.27
$\Delta R/R$	Resistance Tolerance at 25 $^\circ\text{C}$	-5		5	%		
$\beta_{25/50}$	Beta Value		3380		K	$\pm 1\%$	
$P_{max}$	Power Dissipation		5		mW		

## Typical Performance (curves)

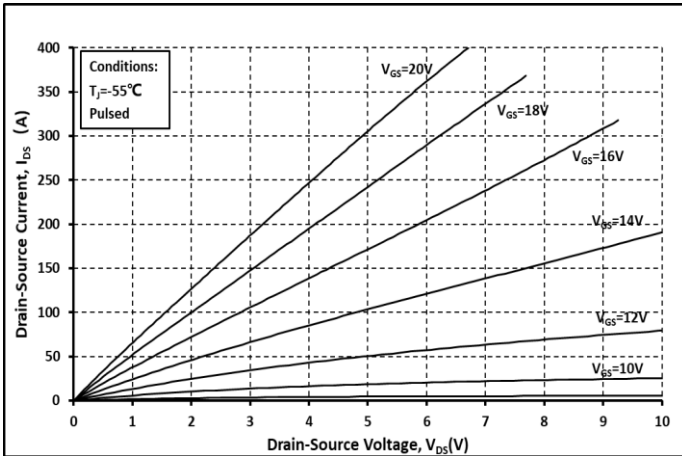


Fig. 1 Output Curve @  $T_j = -55^\circ\text{C}$

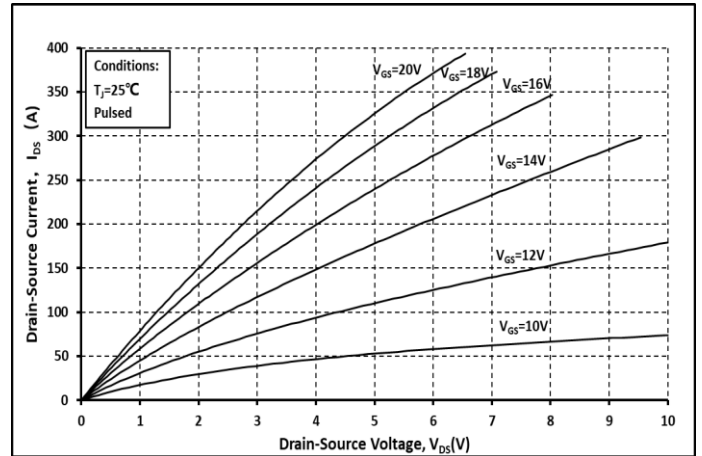


Fig. 2 Output Curve @  $T_j = 25^\circ\text{C}$

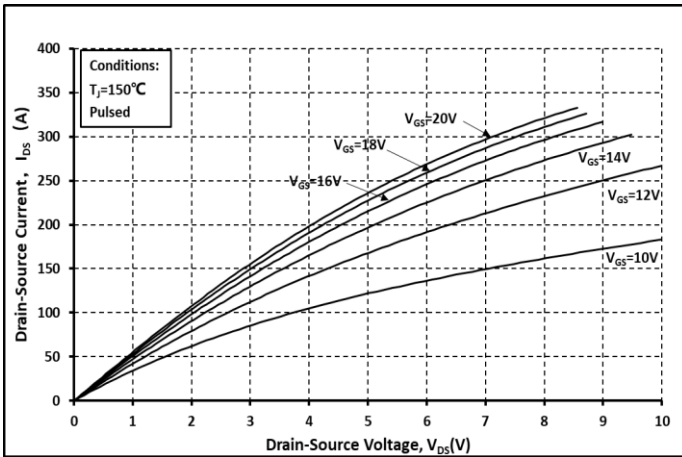


Fig. 3 Output Curve @  $T_j = 150^\circ\text{C}$

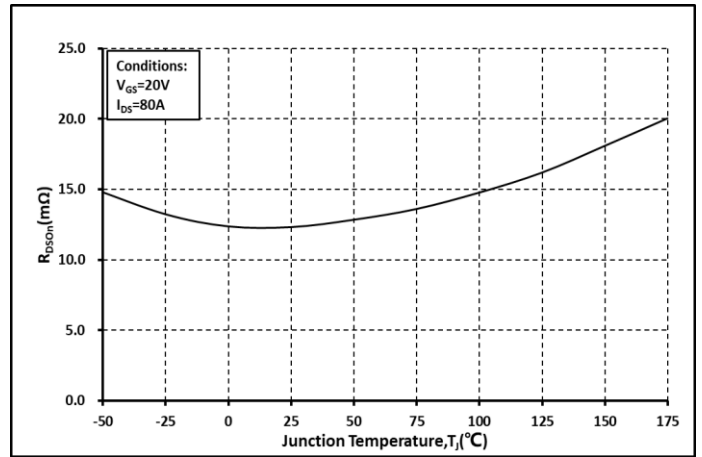


Fig. 4  $R_{on}$  vs. Temperature

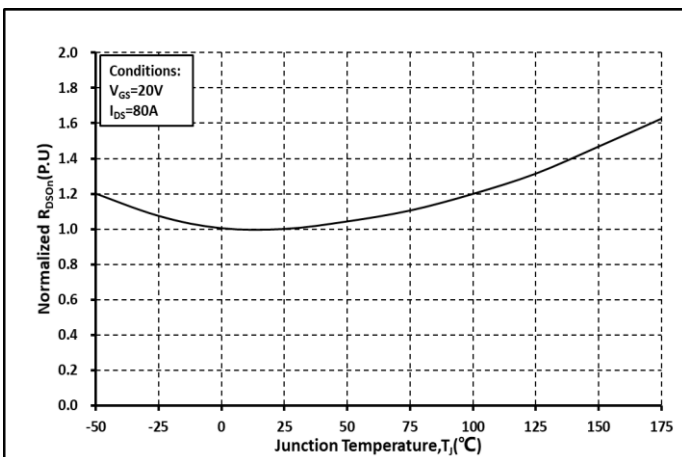


Fig. 5 Normalized  $R_{on}$  vs. Temperature

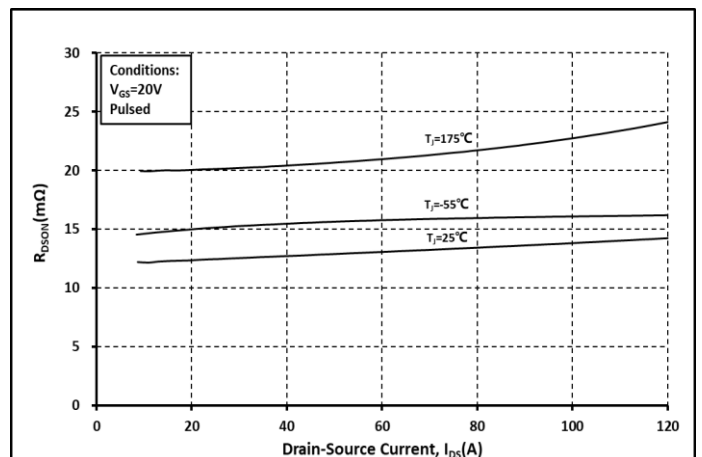


Fig. 6  $R_{on}$  vs.  $I_{bs}$  @ Various Temperature

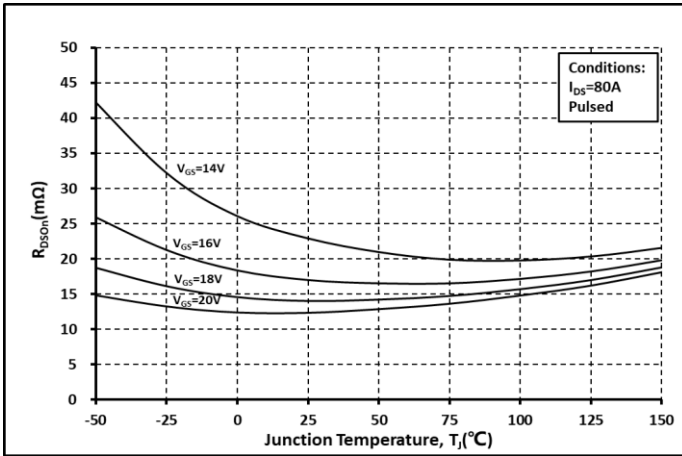


Fig. 7 Ron vs. Temperature @ Various  $V_{GS}$

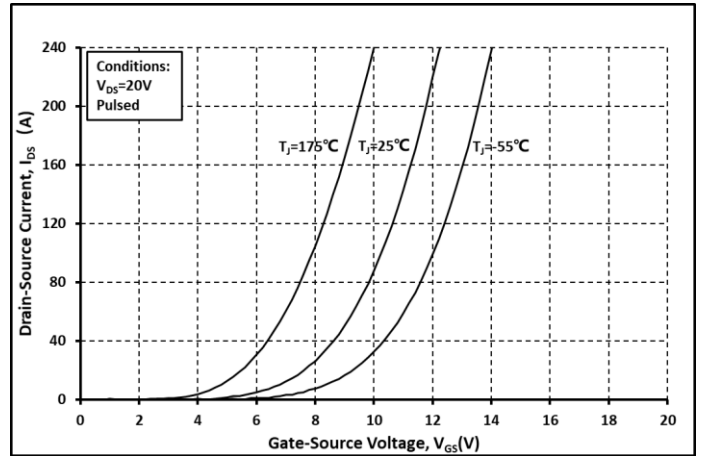


Fig. 8 Transfer Curves @ Various Temperature

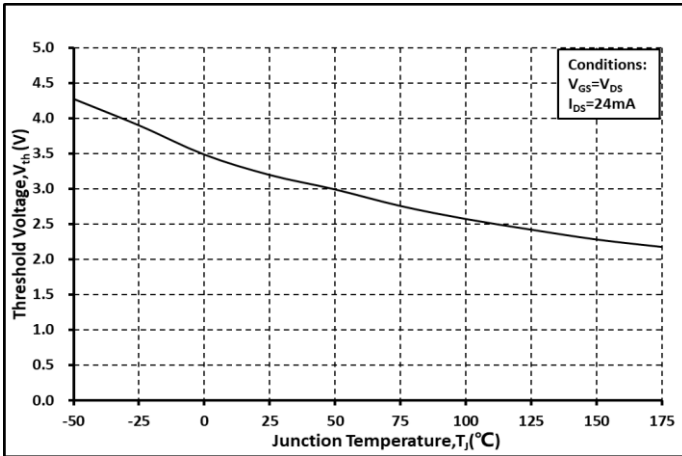


Fig. 9 Threshold Voltage vs. Temperature

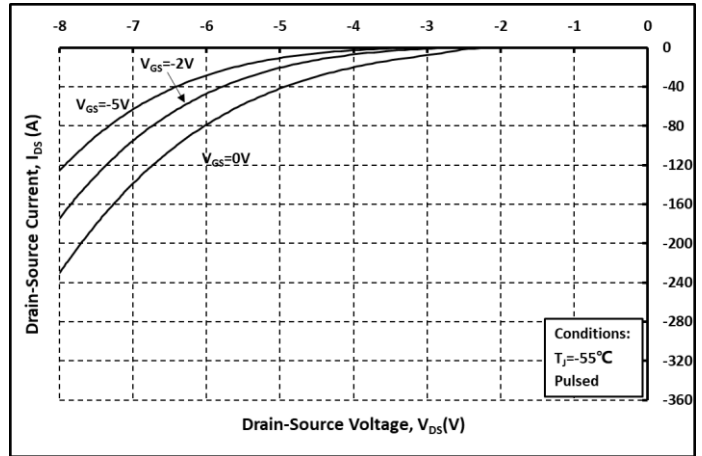


Fig. 10 Body Diode Curves @  $T_J = -55^\circ\text{C}$

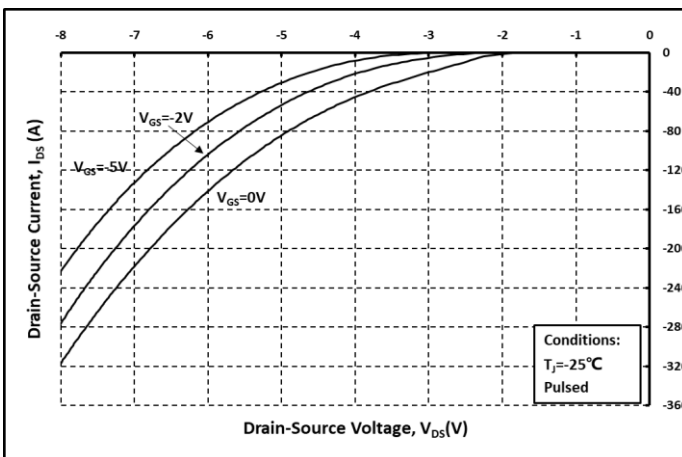


Fig. 11 Body Diode Curves @  $T_J = 25^\circ\text{C}$

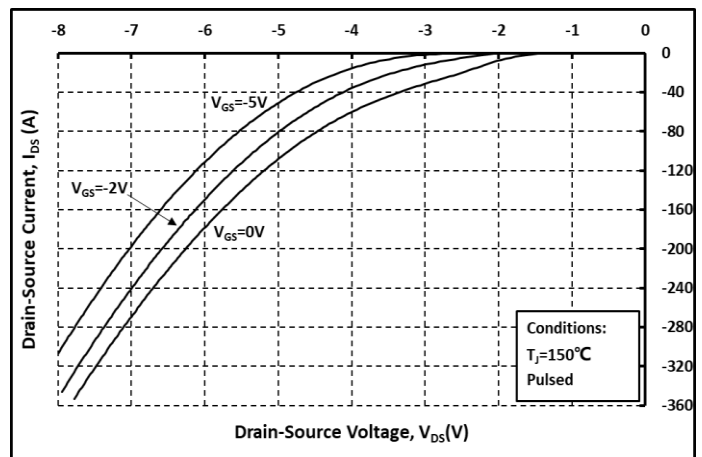


Fig. 12 Body Diode Curves @  $T_J = 150^\circ\text{C}$

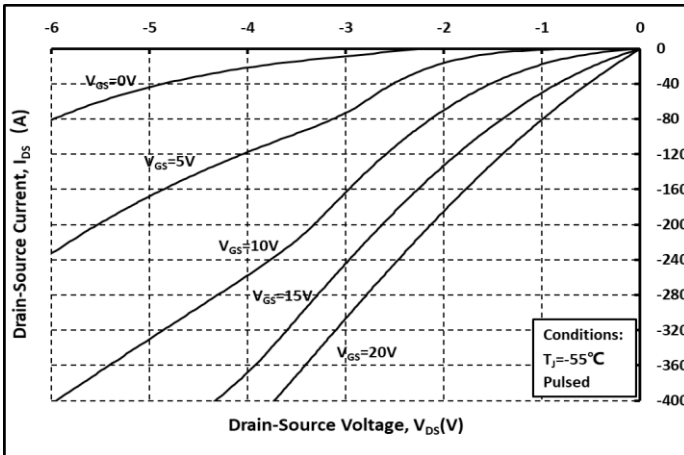


Fig. 13 3<sup>rd</sup> Quadrant Curves @  $T_j = -55^\circ\text{C}$

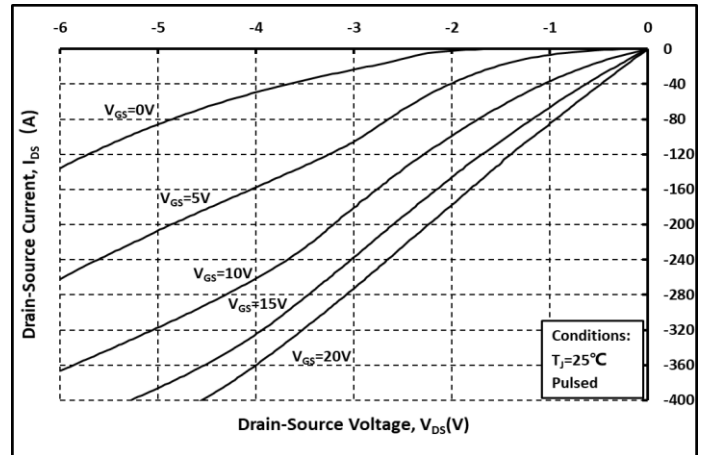


Fig. 14 3<sup>rd</sup> Quadrant Curves @  $T_j = 25^\circ\text{C}$

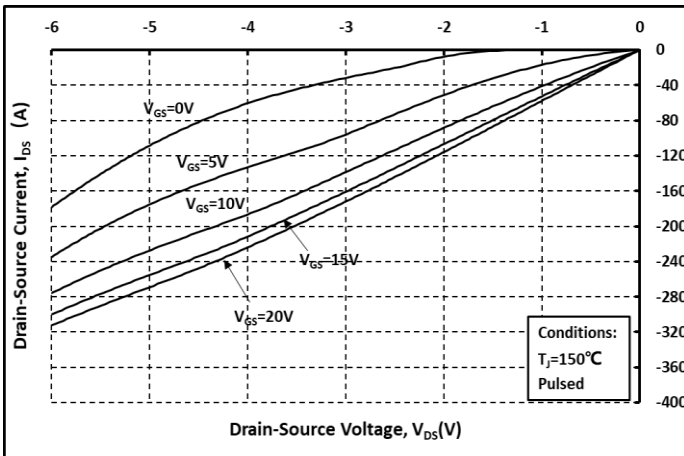


Fig. 15 3<sup>rd</sup> Quadrant Curves @  $T_j = 150^\circ\text{C}$

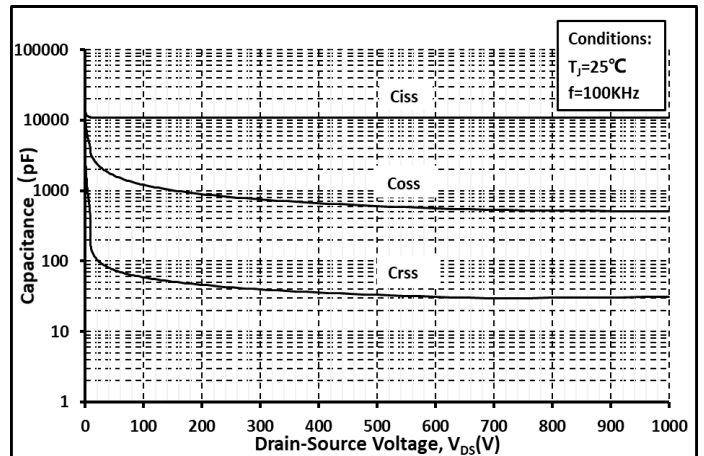


Fig. 16 Capacitance vs.  $V_{DS}$

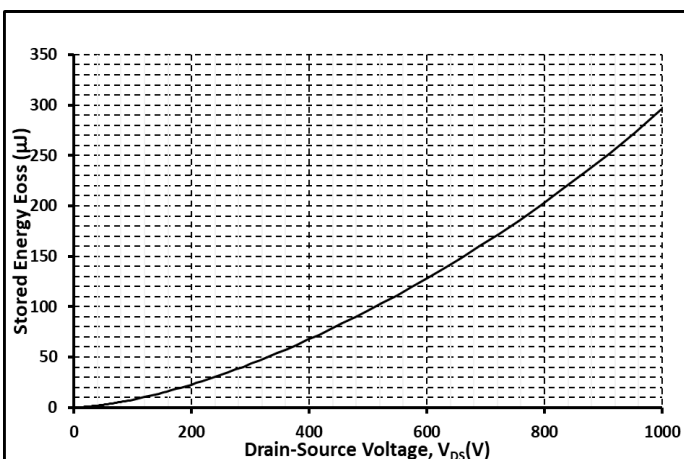


Fig. 17 Output Capacitor Stored Energy

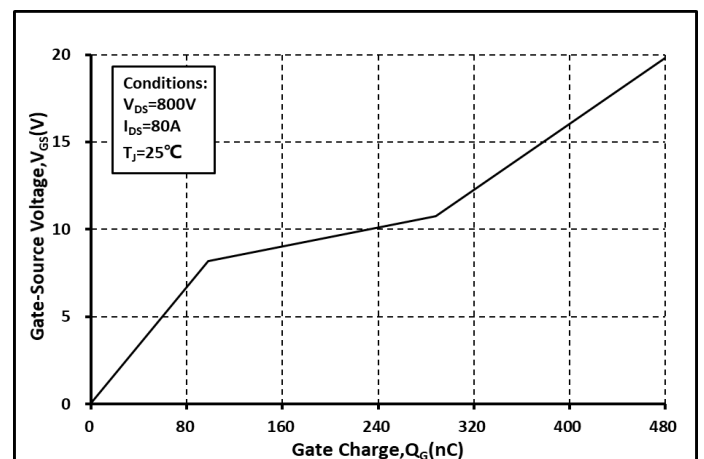


Fig. 18 Gate Charge Characteristics

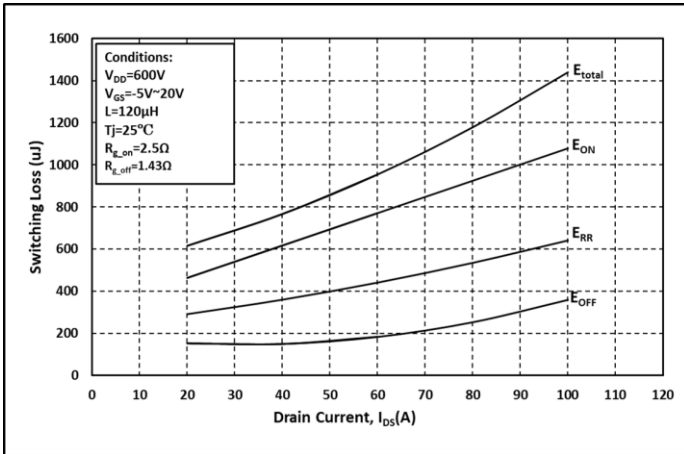


Fig. 19 Switching Energy vs. Drain Current

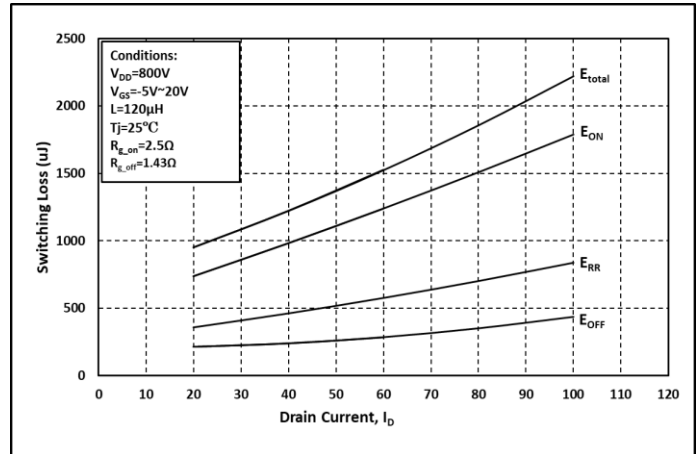


Fig. 20 Switching Energy vs. Drain Current

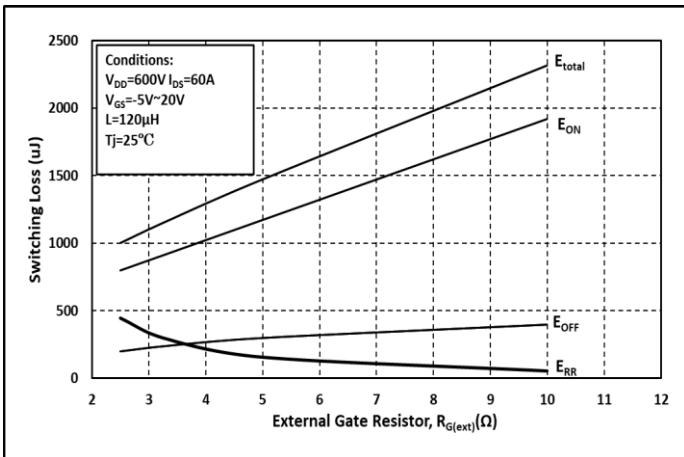


Fig. 21 Switching Energy vs.  $R_{G(ext)}$

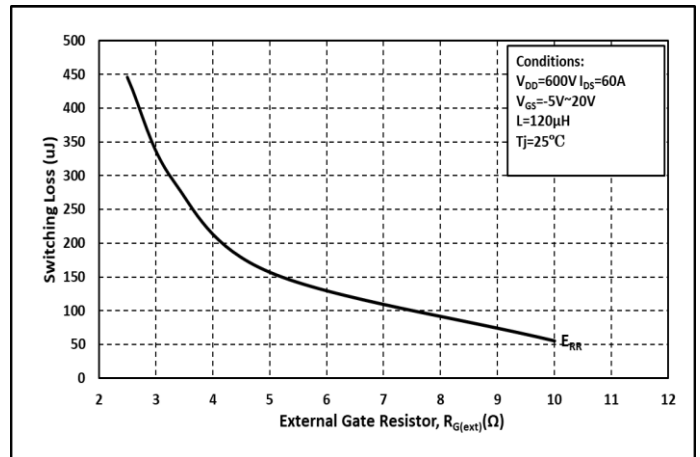


Fig. 22 Reverse Recovery Energy vs.  $R_{G(ext)}$

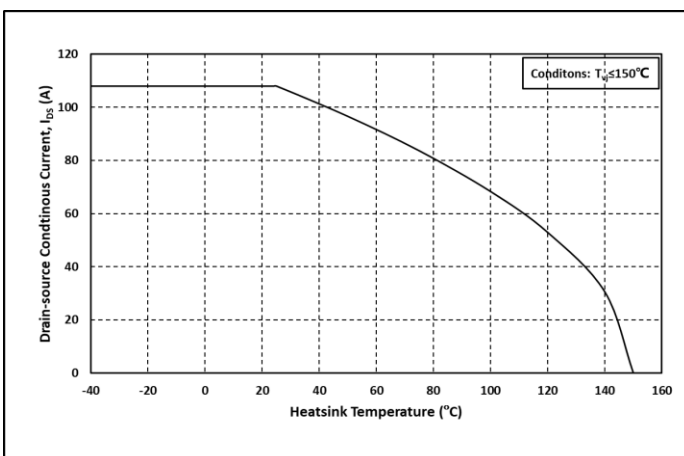


Fig. 23 Continuous Drain Current vs. Heatsink Temperature

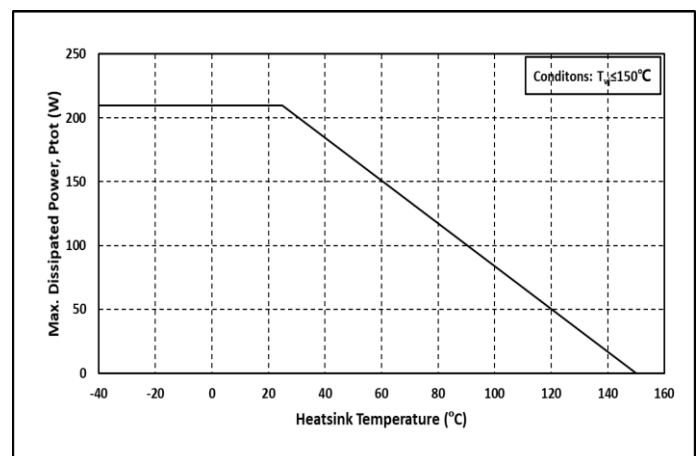


Fig. 24 Max. Power Dissipation Derating vs. Heatsink Temperature



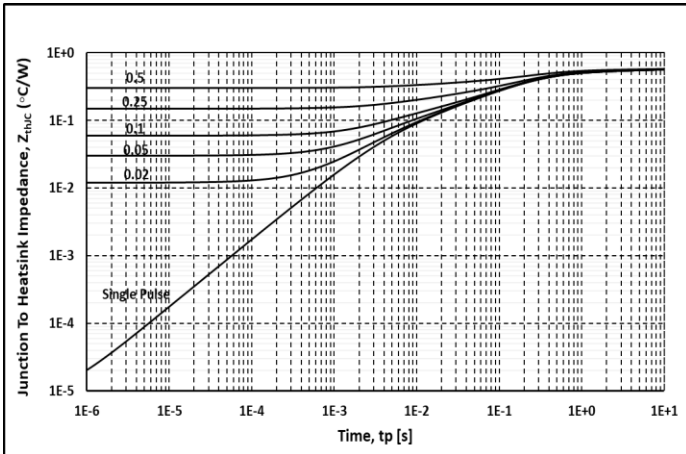


Fig. 25 Thermal Impedance

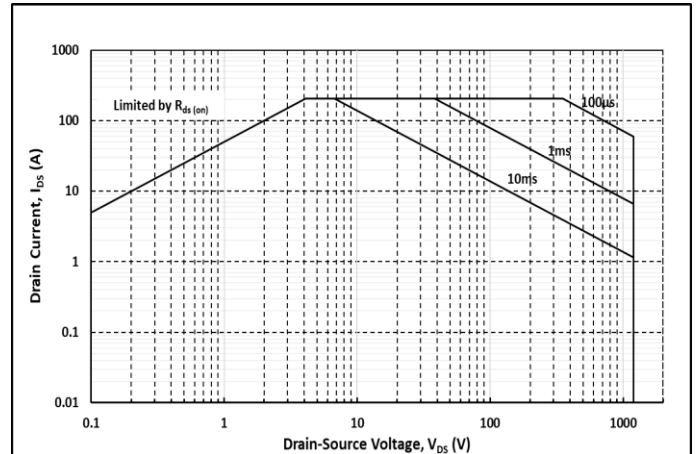


Fig. 26 Safe Operating Area

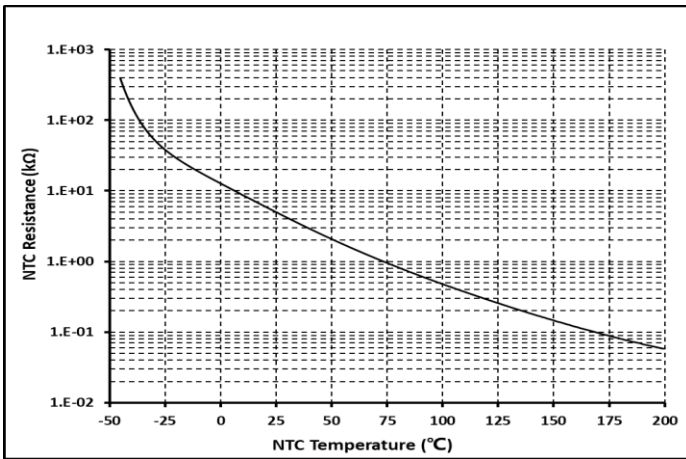
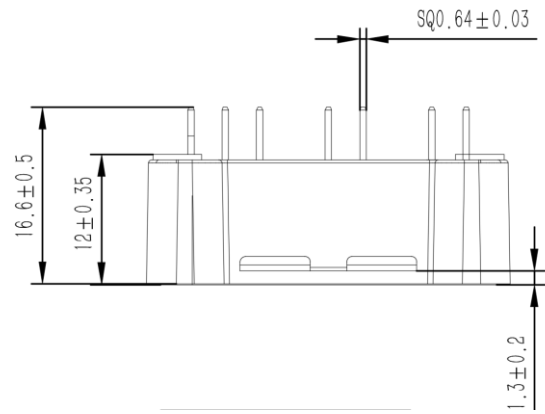
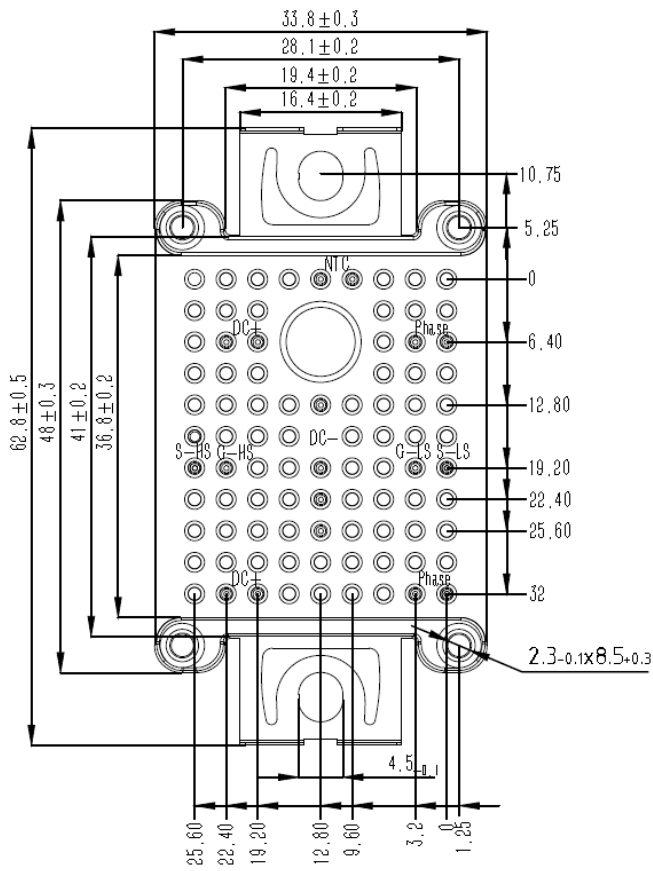


Fig. 27 NTC Resistance vs. Temperature



# Package Dimensions (mm)



## Notes

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