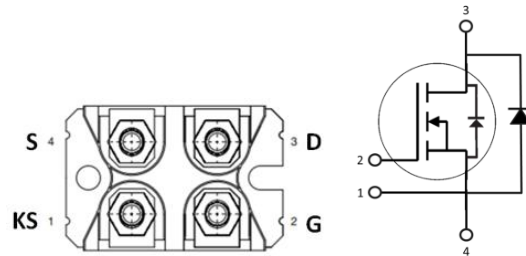
IV1Q12050MA1L – 1200V 50mΩ MOSFET + 20A SBD SiC MODULE

Features:

- High speed switching SiC MOSFET
- High operating junction temperature capability
- Kelvin gate input easing driver circuit design
- Freewheeling diode with zero reverse recovery

Package:



Applications:

- Photo voltaic inverters
- Multi-level converter
- High voltage AC/DC converters

Part Number	Package
IVST12050MA1L	sot227

Absolute Maximum Ratings (T_C=25°C unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
SiC MOSFET					
V_{DS}	Drain-Source voltage	1200	V	V_{GS}=0V, I_D=100μA	
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±0.5	V		
V_{GSoff}	Recommended turn-off voltage	-3.5 to -2	V		
I_D	Drain current (continuous)	64	A	V_{GS}=20V, T_C=25°C	Fig. 21
		45	A	V_{GS}=20V, T_C=100°C	
I_{DM}	Drain current (pulsed)	160	A	Pulse width limited by SOA	Fig. 24
P_{TOT}	Total power dissipation	413	W	T_C=25°C	Fig. 22
T_{stg}	Storage temperature range	-55 to 175	°C		
T_J	Operating junction temperature	-55 to 175	°C		
SiC SBD					
V_{RRM}	Reverse voltage (repetitive peak)	1200	V		
V_{DC}	DC blocking voltage	1200	V		
I_F	Forward current (continuous)	49.1	A	T_C=25°C	
		20	A	T_C=144°C	
I_{FSM}	Surge non-repetitive forward current	155	A	sine halfwave @Tc=25°C tp=10ms	

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I_{FRM}	Surge repetitive forward current (Freq=0.1Hz, 100cycles)	125	A	sine halfwave @T_{amb}=25°C t_p=10m	
$\int i^2dt$	I^2t value	120	A^2s	Tc=25°C t_p=10ms	

Thermal Data

Symbol	Parameter	Value	Unit	Note
$R_{\theta(J-C)}$	Thermal Resistance from Junction to Case	0.363*	°C/W	Per MOSFET Fig. 23
$R_{\theta(J-C)}$	Thermal Resistance from Junction to Case	0.700*	°C/W	Per SBD

* By simulation

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

Symbol	Parameter	Value			Unit	Test Conditions	Note
		Min.	Typ.	Max.			
I_{DSS}	Zero gate voltage drain current		5	100	μA	V_{DS}=1200V, V_{GS}=0V	
I_{GSS}	Gate leakage current			±100	nA	V_{DS}=0V, V_{GS}=-5~20V	
V_{TH}	Gate threshold voltage	1.8	3.2	5	V	V_{GS}=V_{DS}, I_D=6mA	Fig. 8, 9
			2.2			V_{GS}=V_{DS}, I_D=6mA @ T_C=175°C	
R_{ON}	Static drain-source on-resistance		50	65	mΩ	V_{GS}=20V, I_D=20A @T_J=25°C	Fig. 4, 5, 6, 7
			80		mΩ	V_{GS}=20V, I_D=20A @T_J=175°C	
C_{iss}	Input capacitance		2700		pF	V_{DS}=800V, V_{GS}=0V, f=100kHz, V_{AC}=25mV	Fig. 16
C_{oss}	Output capacitance		217		pF		
C_{rss}	Reverse transfer capacitance		16.6		pF		
E_{oss}	C_{oss} stored energy		81		μJ		Fig. 17
Q_g	Total gate charge		120		nC	V_{DS}=800V, I_D=20A, V_{GS}=-5 to 20V	Fig. 18
Q_{gs}	Gate-source charge		25		nC		
Q_{gd}	Gate-drain charge		48		nC		
R_g	Gate input resistance		2.8		Ω	f=1MHz	
E_{ON}	Turn-on switching energy		434.7		μJ	V_{DS}=800V I_{DS}=30A, V_{GS}=-3.5V~20V, $R_{G(ext)}$=3.3Ω, L=200μH	Fig. 19, 20
E_{OFF}	Turn-off switching energy		115.5		μJ		
$t_{d(on)}$	Turn-on delay time		12		ns		
t_r	Rise time		23.6		ns		
$t_{d(off)}$	Turn-off delay time		25.2		ns		
t_f	Fall time		18		ns		
SiC SBD							

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V_F	Forward Voltage		1.48	1.80	V	I_F = 20 A T_J=25°C	Fig. 25
			2.20	3.00		I_F = 20 A T_J=175°C	
I_R	Reverse Current		8	150	μA	V_R = 1200 V T_J=25°C	Fig. 26
			50	800		V_R = 1200 V T_J=175°C	
C	Total Capacitance		1180		pF	V_R = 1 V, T_J = 25°C, f = 1 MHz	Fig. 27
			144			V_R = 400 V, T_J = 25°C, f = 1 MHz	
			117			V_R = 800 V, T_J = 25°C, f = 1 MHz	
Q_C	Total Capacitive Charge		142		nC	V_R = 800 V, T_J = 25°C, $Q_c = \int_0^{VR} C(V)dV$	Fig. 28
E_C	Capacitance Stored Energy		44		μJ	V_R = 800 V, T_J = 25°C, $E_c = \int_0^{VR} C(V) \cdot VdV$	Fig. 29

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

Symbol	Parameter	Value			Unit	Test Conditions	Note
		Min.	Typ.	Max.			
V_{SD}	Diode forward voltage		4.9		V	I_{SD}=20A, V_{GS}=0V	Fig. 10, 11, 12
			4.4		V	I_{SD}=20A, V_{GS}=0V, T_J=175°C	
t_{rr}	Reverse recovery time		54.6		ns	V_{GS}=-3.5V/+20V, I_{SD}=30A, V_R=800V, di/dt=2000A/us, $R_{G(ext)}$=16Ω, L=270µH	
Q_{rr}	Reverse recovery charge		233		nC		
I_{RRM}	Peak reverse recovery current		17.2		A		

Module Characteristics

Symbol	Parameter	Conditions	Value			Unit
			Min.	Typ.	Max.	
V_{ISOL}	Isolation test voltage	RMS, f=50Hz, t=1min			2.5	kV
M	Terminal connection torque	Screw M4	1.1		1.5	N·m
	Mounting torque	Screw M4	1.1		1.5	N·m
G	Weight of module			27		g
	Creepage distance	Terminal to heatsink		10.61		mm
		Terminal to terminal		10.37		mm
	Clearance	Terminal to heatsink		6.7		mm
		Terminal to terminal		4.05		mm

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SiC MOSFET Typical Characteristics

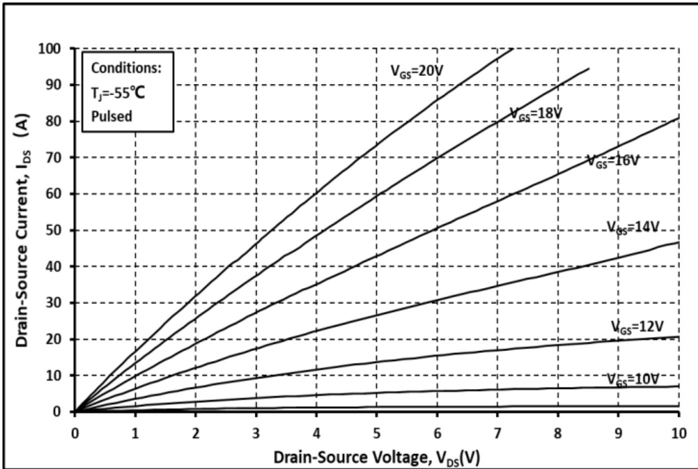

Fig. 1 Output Curve @ T_J=-55°C

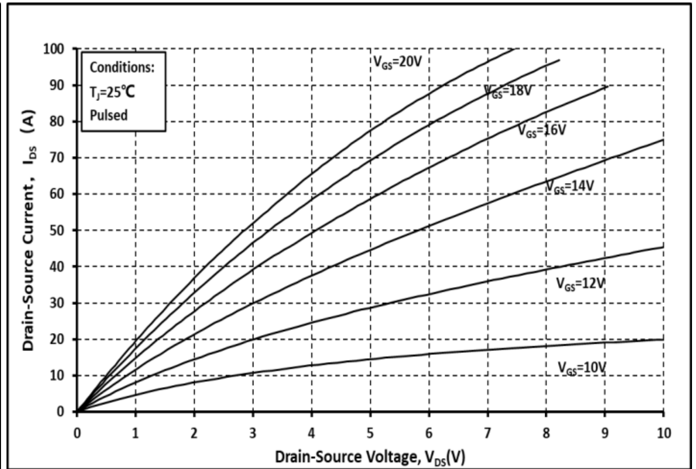

Fig. 2 Output Curve @ T_J=25°C

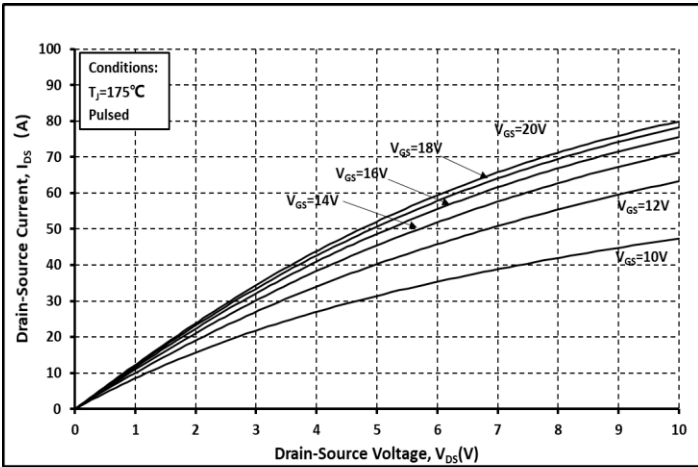

Fig. 3 Output Curve @ T_J=175°C

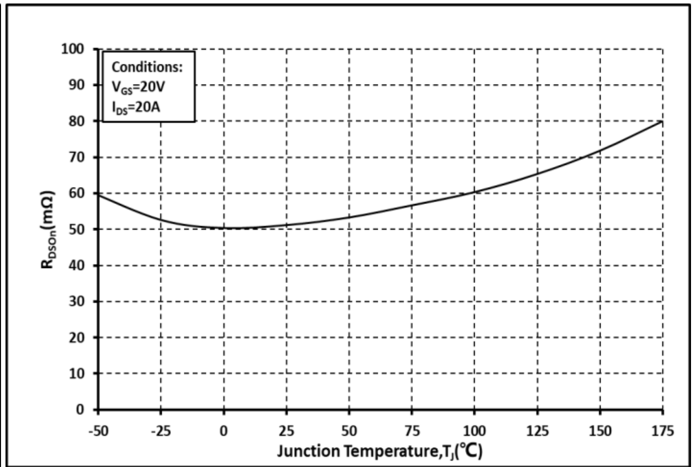

Fig. 4 Ron vs. Temperature

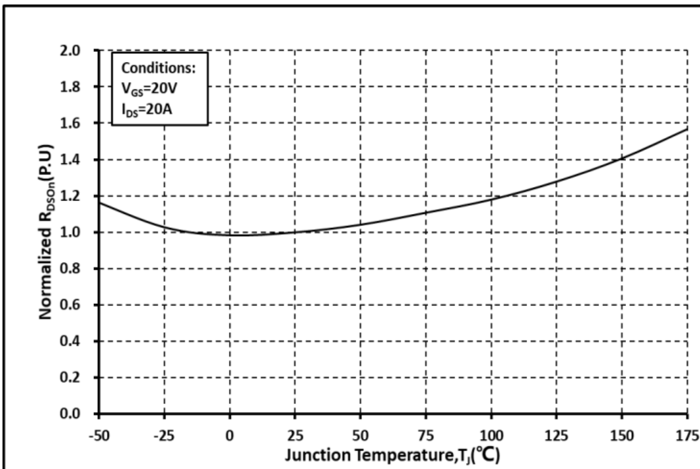

Fig. 5 Normalized Ron vs. Temperature

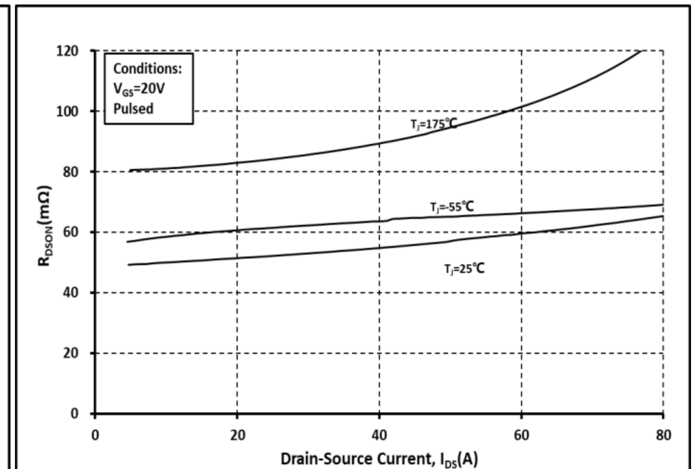

Fig. 6 Ron vs. I_{DS} @ Various Temperature

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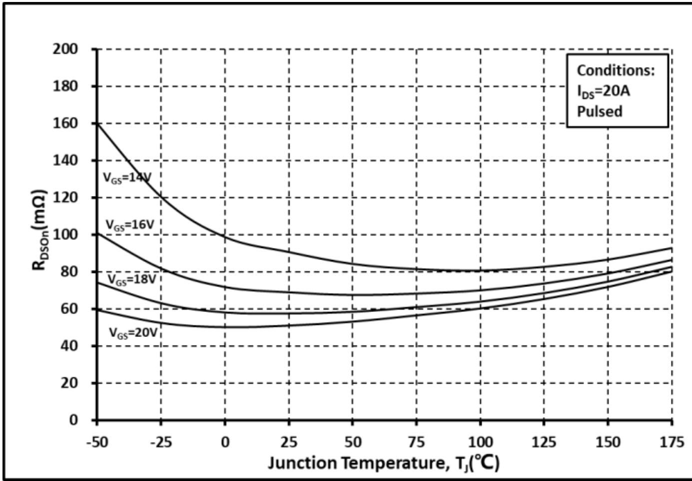


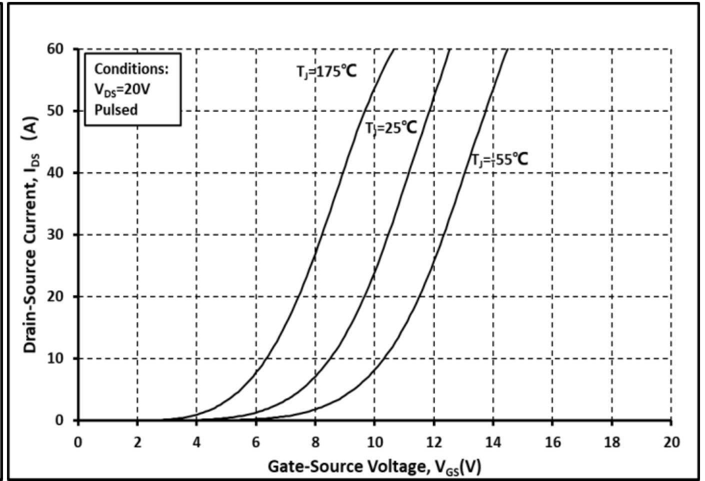
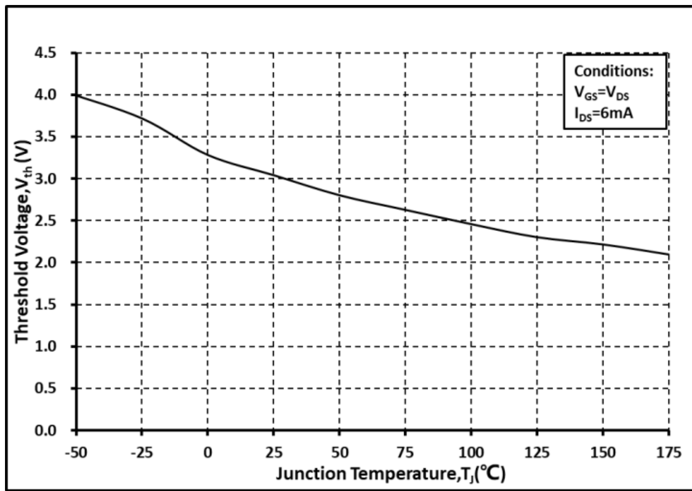


Fig. 7 Ron vs. Temperature @ Various V_{GS}

Fig. 8 Transfer Curves @ Various Temperature



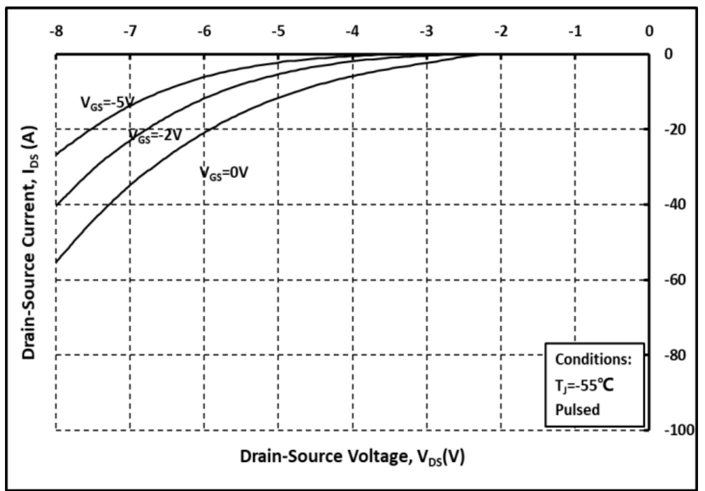
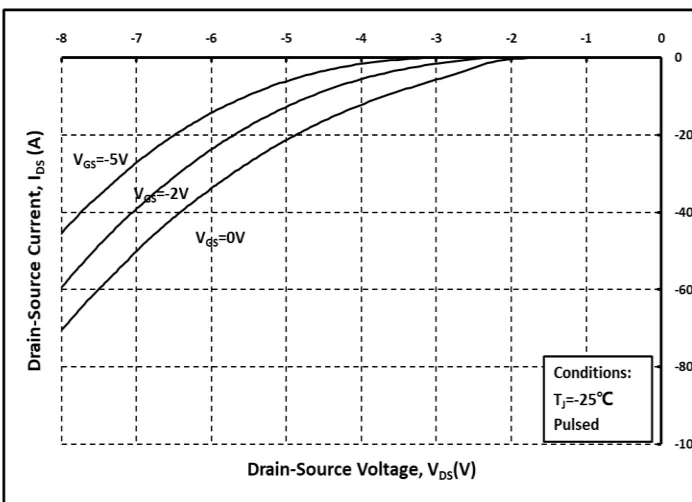


Fig. 9 Threshold Voltage vs. Temperature

Fig. 10 Body Diode Curves @ T_J=-55°C



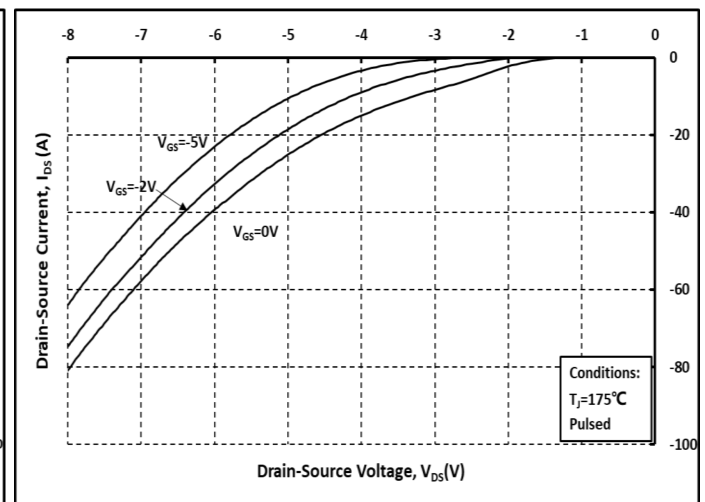


Fig. 11 Body Diode Curves @ T_J=25°C

Fig. 12 Body Diode Curves @ T_J=175°C

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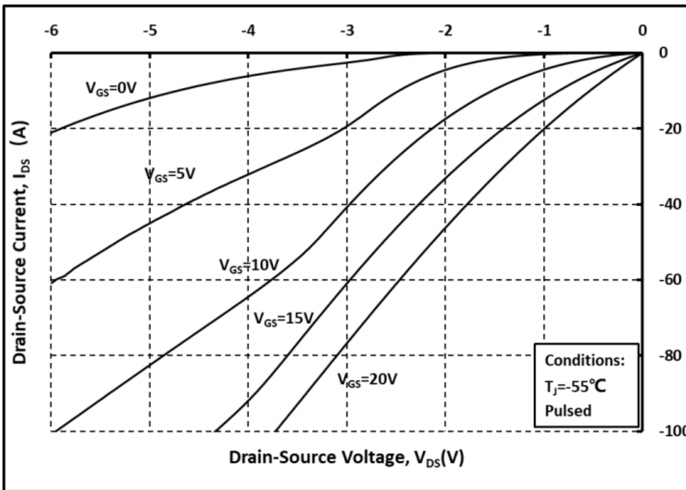

Fig. 13 3rd Quadrant Curves @ T_J=-55°C

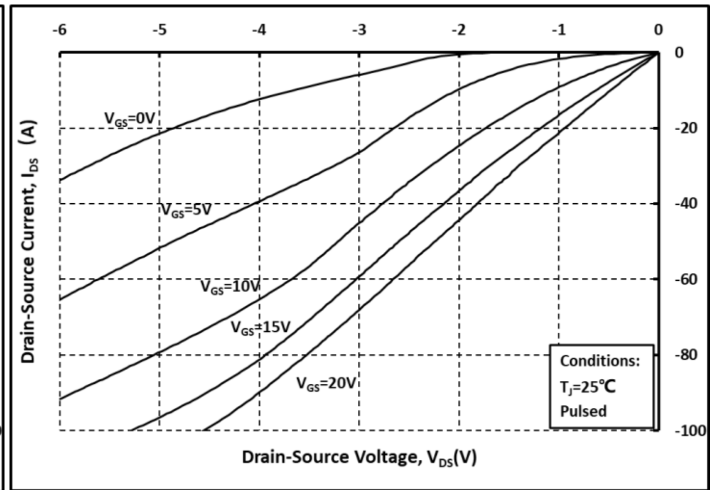

Fig. 14 3rd Quadrant Curves @ T_J=25°C

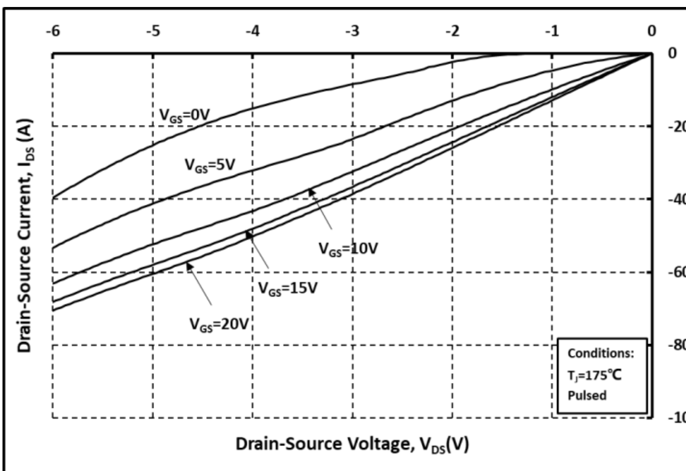

Fig. 15 3rd Quadrant Curves @ T_J=175°C

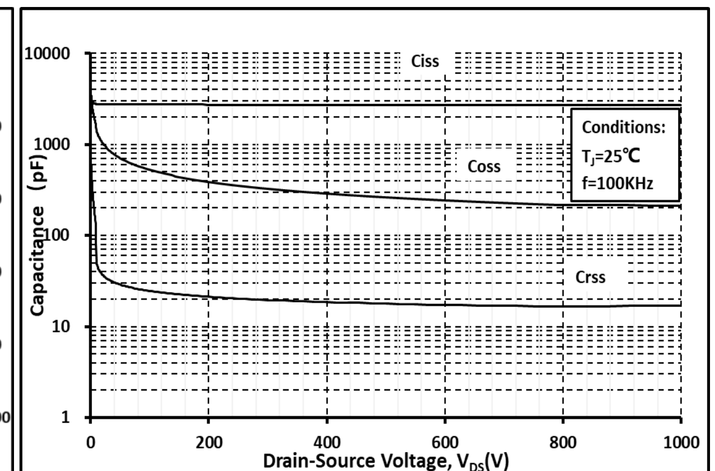

Fig. 16 Capacitance vs. V_{DS}

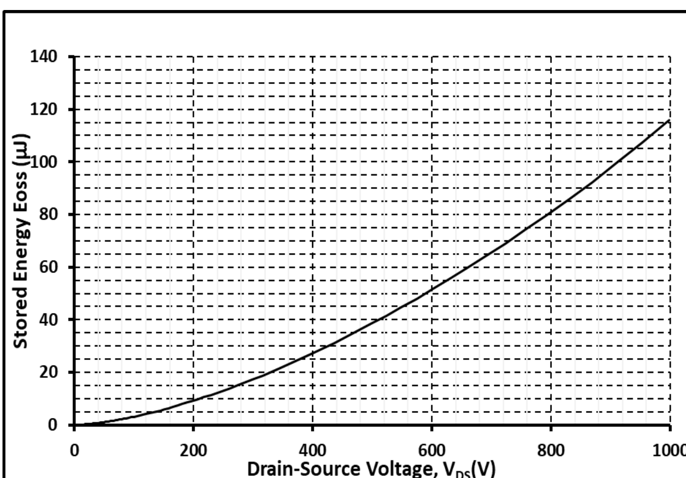

Fig. 17 Output Capacitor Stored Energy

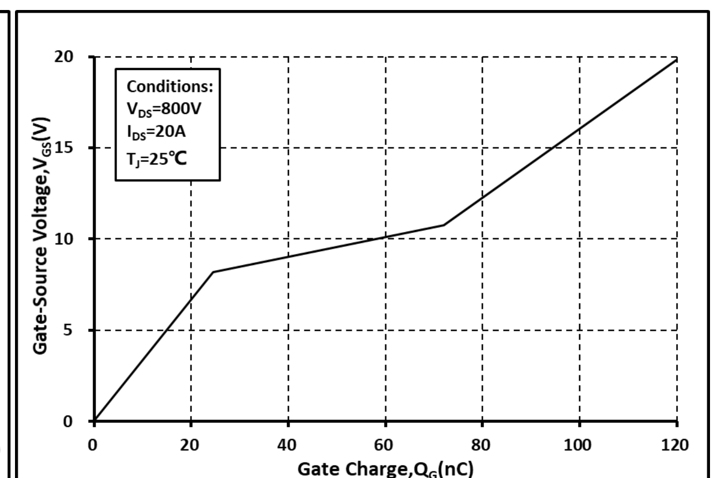

Fig. 18 Gate Charge Characteristics

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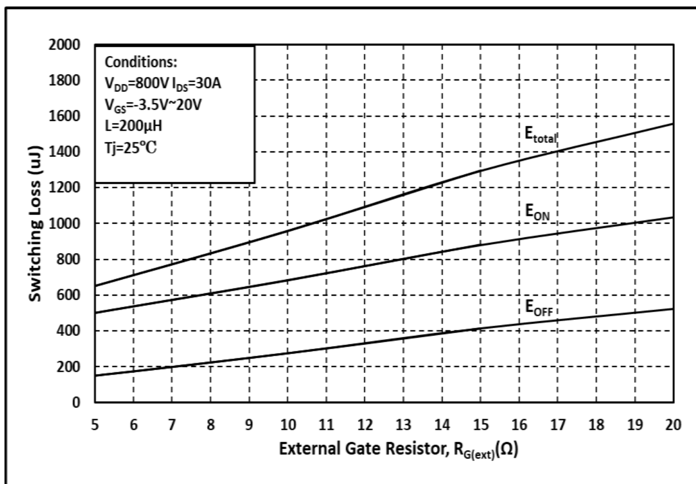

Fig. 19 Switching Energy vs. $R_{G(ext)}$

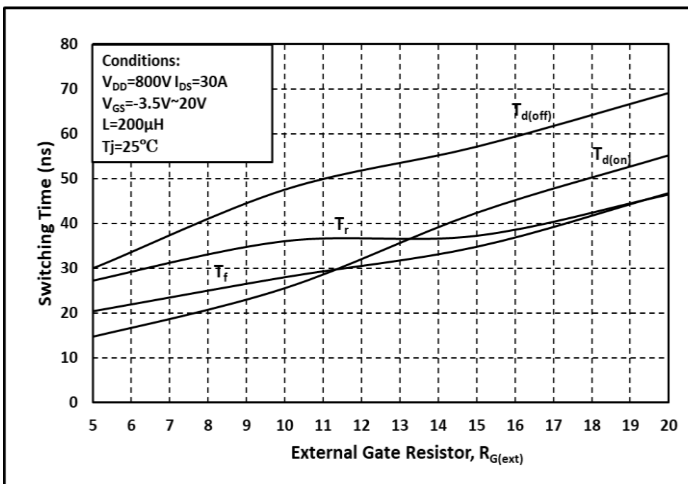

Fig. 20 Switching Times vs. $R_{G(ext)}$

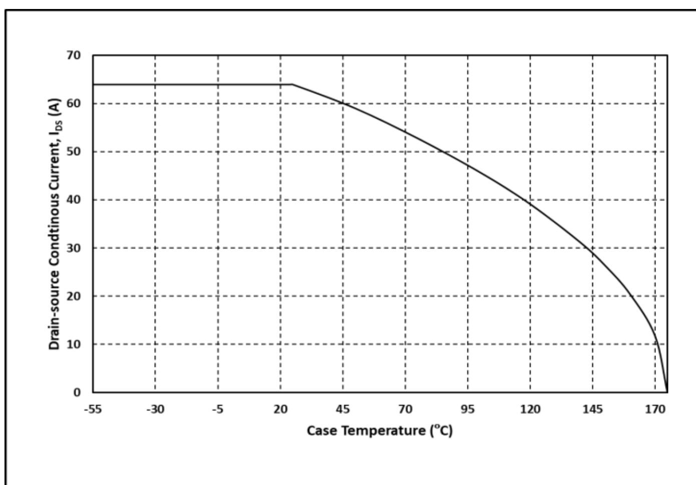

Fig. 21 Continuous Drain Current vs. Case Temperature

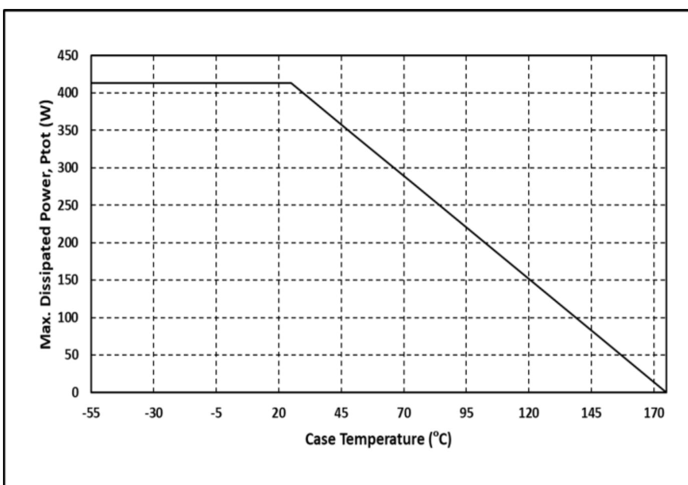

Fig. 22 Max. Power Dissipation Derating vs. Case Temperature

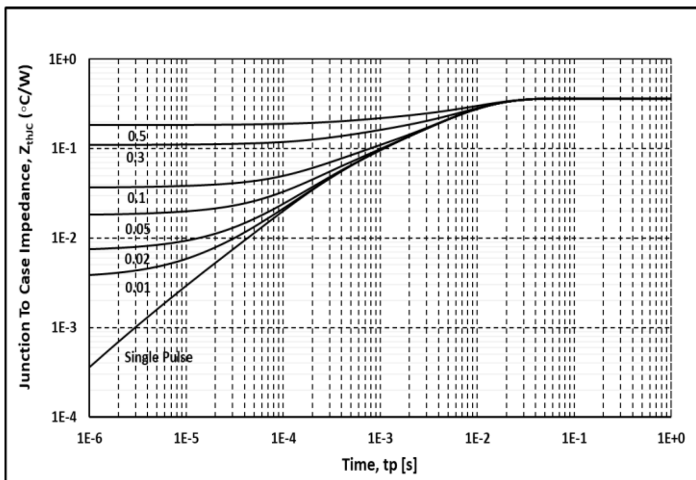

Fig. 23 Thermal Impedance

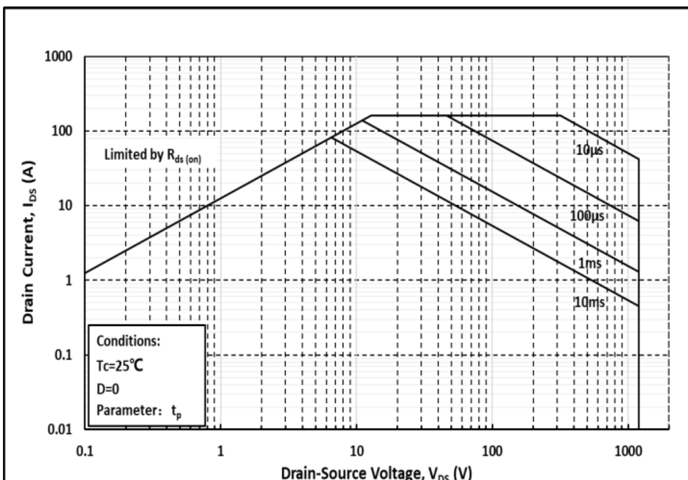

Fig. 24 Safe Operating Area

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SiC SBD Typical Characteristics

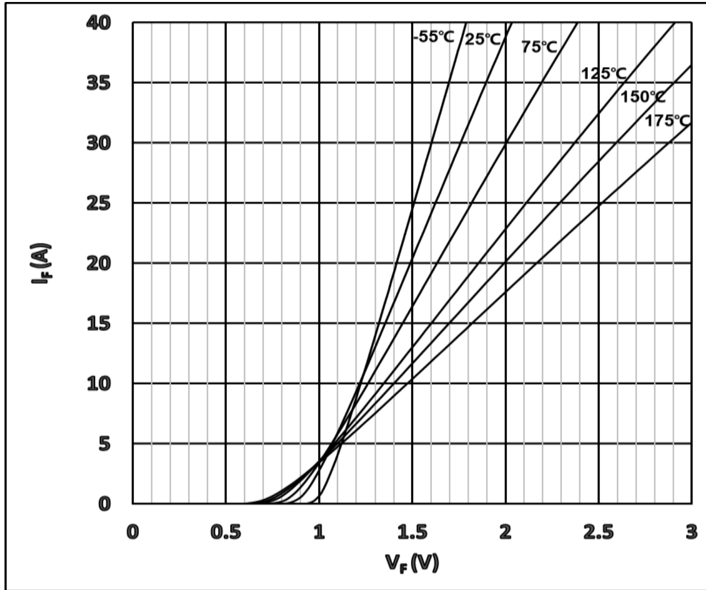

Figure 25. Typical Forward Characteristics

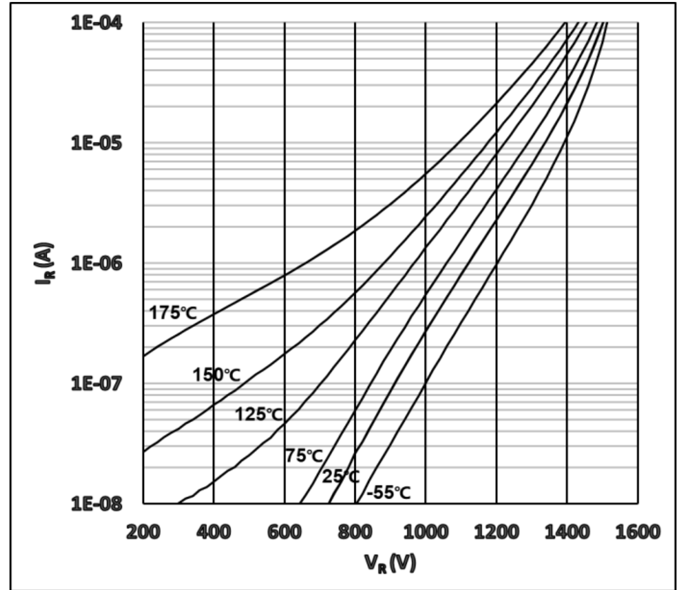

Figure 26. Typical Reverse Characteristics

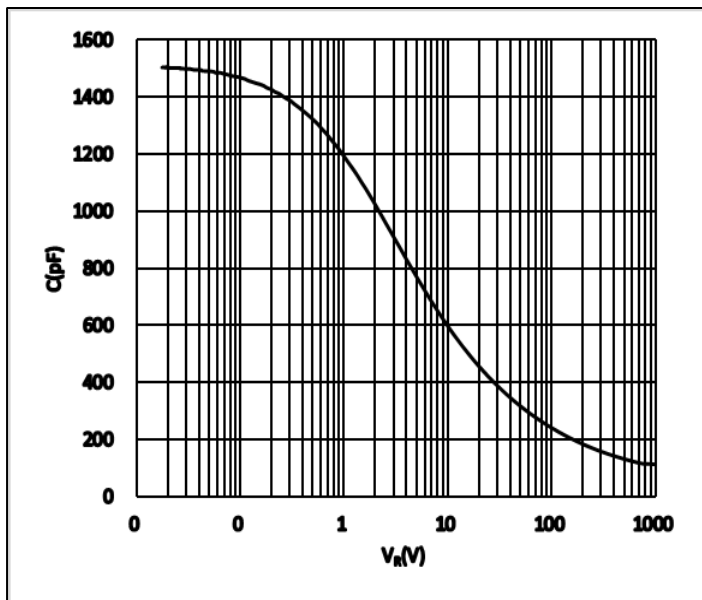

Figure 27. Capacitance vs. Reverse Voltage

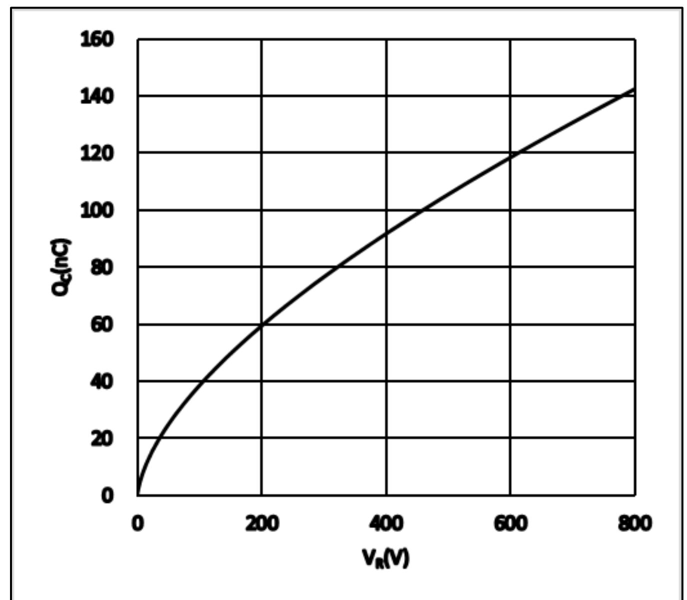

Figure 28. Recovery Charge vs. Reverse Voltage

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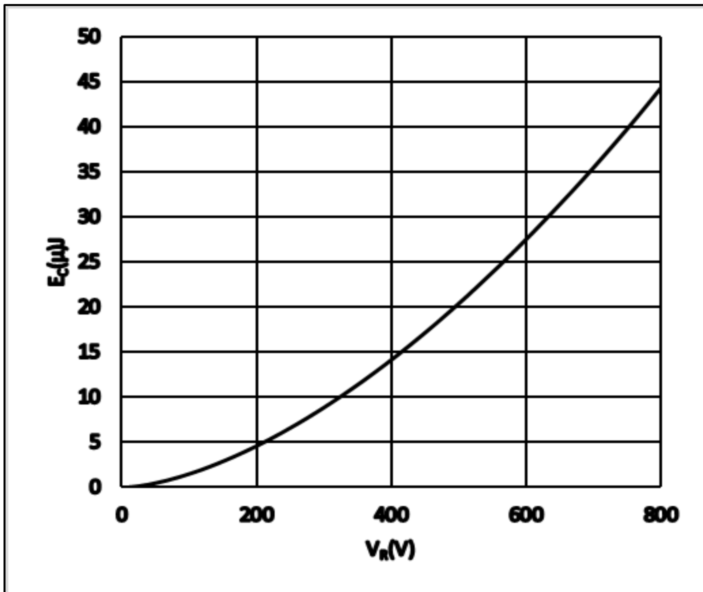

Figure 29. Capacitance Stored Energy

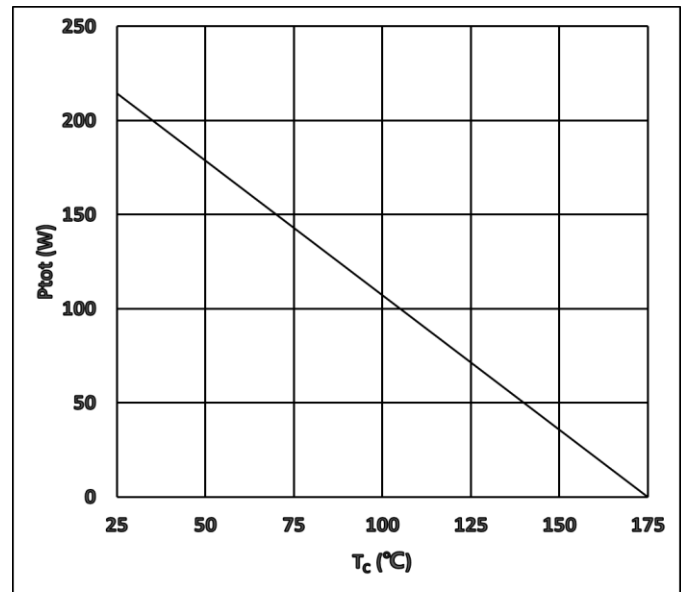

Figure 30. Power Derating

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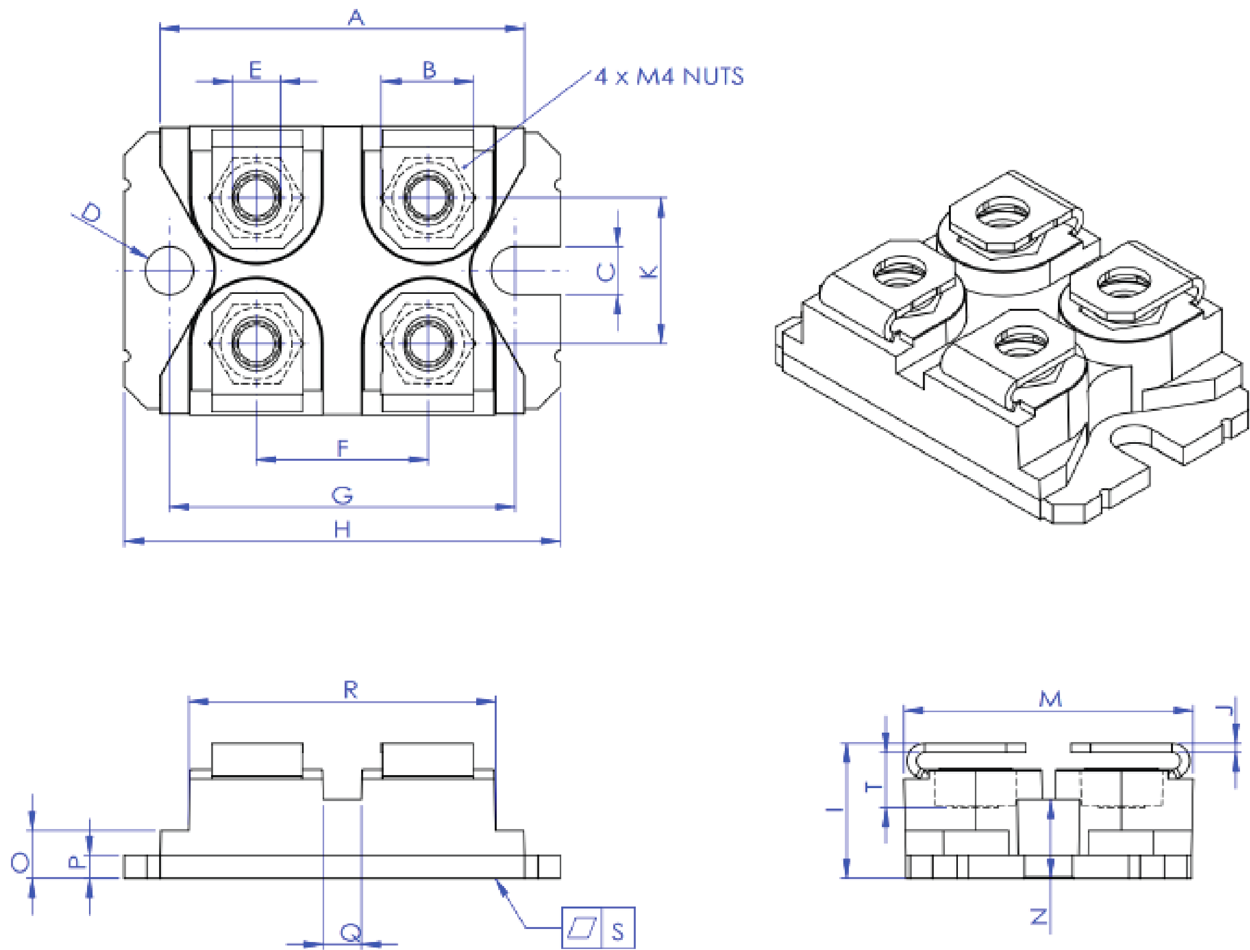
Package Dimensions



Dimension	Millmeter		Typical
	Min	Max	
A	31.50	32.00	31.70
B	7.70	8.30	8.00
C	4.10	4.30	4.20
D	4.10	4.30	4.20
E	4.10	4.30	4.20
F	14.90	15.15	15.0
G	29.80	30.40	30.10
H	37.80	38.30	38.05
I	11.80	12.30	12.05
J	0.75	0.85	0.80
K	12.50	13.00	12.75
M	25.00	25.50	25.30
N	6.75	7.10	6.90
O	4.00	4.40	4.20
P	1.90	2.10	2.00
Q	3.20	3.60	3.40
R	26.60	27.00	26.80
S	-0.03	0.10	0.01
T	4.85	5.25	5.05

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Notes

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