

High speed 650V Field Stop Trench IGBT co-packed with fast and soft recovery anti-parallel diode

V_{CE}	650 V	I_c	40 A
V_{CEsat}	1.65 V	E_{OFF}	0.39 mJ

Features

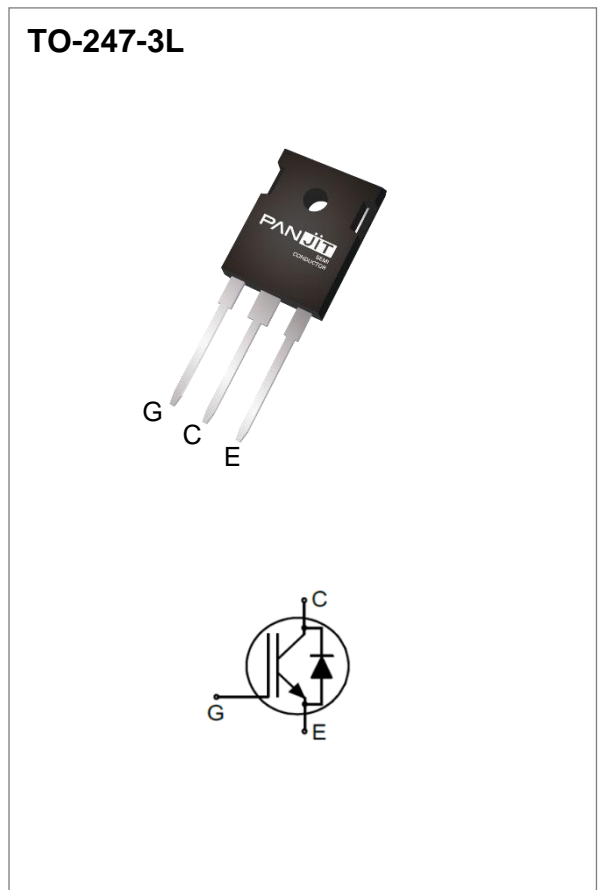
- Superior high speed switching IGBT
- Low saturation voltage 1.65V at T_{VJ} 25 °C
- Co-packed with low Q_{rr} and soft recovery diode
- Maximum junction temperature T_{VJ} 175 °C
- Easy paralleling usage due to positive coefficient V_{CEsat}
- Lead free in compliance with EU RoHS 2.0
- Green molding compound as per IEC 61249 standard

Mechanical Data

- Case: TO-247-3L molded plastic
- Terminals: Solderable per MIL-STD-750, Method 2026
- Approx. Weight: 6.157grams

Application

- UPS
- PV Inverter
- EV Charger
- Welding machine
- Home appliance



Maximum Ratings

PARAMETER	SYMBOL	LIMIT	UNITS
Collector-Emitter Voltage	V _{CE}	650	V
Gate-Emitter Voltage	V _{GE}	± 20	V
DC Collector Current @ T _C = 25°C	I _c	76	A
DC Collector Current @ T _C = 100°C	I _c	46	A
Pulsed Collector Current, t _P limited by T _{VJmax}	I _{Cpulse}	120	A
Turn-off safe operating area V _{CC} ≤ 400 V, V _{CE,peak} < 650 V, V _{GE} = 0/15 V, R _{Goff} ≥ 10 Ω, T _{VJ} ≤ 175 °C	-	120	A
Diode Forward Current @ T _C = 25°C	I _F	40	A
Diode Forward Current @ T _C = 100°C	I _F	20	A

PARAMETER	SYMBOL	LIMIT	UNITS
Pulsed Diode Current, t_p limited by T_{VJmax}	I_{Fpulse}	120	A
Power Dissipation @ $T_C = 25^\circ C$	P_{total}	220	W
Power Dissipation @ $T_C = 100^\circ C$		110	
Operating Junction Temperature Range	T_{VJ}	-40 to +175	$^\circ C$
Storage Temperature Range	T_{STG}	-55 to +150	$^\circ C$
Soldering Temperature, 1/8" from case for 5 seconds	T_{SLD}	260	$^\circ C$

Typical Ratings

PARAMETER	SYMBOL	TYP.	UNITS
Non-Repetitive Forward Surge Current (Half-Sine Pulse, $t_p = 8.3$ ms, $T_C = 25^\circ C$)	I_{FM}	350	A
(Half-Sine Pulse, $t_p = 8.3$ ms, $T_C = 150^\circ C$)		295	
Internal emitter inductance measured 5mm(0.197 in.) from case	L_E	13	nH

Thermal Resistance

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNITS
Thermal Resistance Junction to Case, for IGBT	$R_{\theta JC}$	-	-	-	0.68	$^\circ C/W$
Thermal Resistance Junction to Case, for Diode	$R_{\theta JC}$	-	-	-	0.68	$^\circ C/W$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	-	-	-	40	$^\circ C/W$

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

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNITS
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Static Characteristic

Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	$V_{GE} = 0V, I_C = 0.5mA$	650	-	-	V
Collector-Emitter Saturation Voltage	V_{CEsat}	$V_{GE} = 15V, I_C = 40A$ $T_{VJ} = 25\text{ }^{\circ}\text{C}$ $T_{VJ} = 125\text{ }^{\circ}\text{C}$ $T_{VJ} = 175\text{ }^{\circ}\text{C}$	-	1.65	2.25	
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	$I_C = 40mA, V_{CE} = V_{GE}$	3.0	4.5	6.0	V
Collector-Emitter Cut Off Current	I_{CES}	$V_{GE} = 0V, V_{CE} = 650V$	-	-	80	μA
Gate-Emitter Leakage Current	I_{GES}	$V_{GE} = 20V, V_{CE} = 0V$	-	-	200	nA
Transconductance	g_{fs}	$V_{CE} = 20V, I_C = 40A$	-	29	-	S

Dynamic Characteristic

Input Capacitance	C_{ies}	$V_{CE} = 25V, V_{GE} = 0V$ $f = 1MHz$	-	1840	-	pF
Output Capacitance	C_{oes}		-	95	-	
Reverse Transfer Capacitance	C_{res}		-	13	-	
Gate Charge	Q_G	$V_{CE} = 520V, I_C = 40A$ $V_{GE} = 15V$	-	65	-	nC

Switching Characteristic, Inductive Load

Turn-On Delay Time	$t_{d(on)}$	$T_{VJ} = 25\text{ }^{\circ}\text{C}$ $V_{CC} = 400V, I_C = 20A$ $V_{GE} = 0 / 15V$ $R_G = 10\Omega$	-	14	-	ns
Rise Time	t_r		-	14	-	ns
Turn-Off Delay Time	$t_{d(off)}$		-	96	-	ns
Fall Time	t_f		-	16	-	ns
Turn-On Energy	E_{on}		-	0.33	-	mJ
Turn-Off Energy	E_{off}		-	0.12	-	mJ
Total Switching Energy	E_{ts}		-	0.45	-	mJ
Turn-On Delay Time	$t_{d(on)}$	$T_{VJ} = 25\text{ }^{\circ}\text{C}$ $V_{CC} = 400V, I_C = 40A$ $V_{GE} = 0 / 15V$ $R_G = 10\Omega$	-	15	-	ns
Rise Time	t_r		-	31	-	ns
Turn-Off Delay Time	$t_{d(off)}$		-	86	-	ns
Fall Time	t_f		-	38	-	ns
Turn-On Energy	E_{on}		-	0.75	-	mJ
Turn-Off Energy	E_{off}		-	0.39	-	mJ
Total Switching Energy	E_{ts}		-	1.14	-	mJ

Turn-On Delay Time	$t_{d(on)}$	$T_{VJ} = 175^{\circ}\text{C}$ $V_{CC} = 400\text{V}, I_C = 20\text{A}$ $V_{GE} = 0 / 15\text{V}$ $R_G = 10\Omega$	-	13	-	ns
Rise Time	t_r		-	14	-	ns
Turn-Off Delay Time	$t_{d(off)}$		-	123	-	ns
Fall Time	t_f		-	17	-	ns
Turn-On Energy	E_{on}		-	0.59	-	mJ
Turn-Off Energy	E_{off}		-	0.22	-	mJ
Total Switching Energy	E_{ts}		-	0.81	-	mJ
Turn-On Delay Time	$t_{d(on)}$	$T_{VJ} = 175^{\circ}\text{C}$ $V_{CC} = 400\text{V}, I_C = 40\text{A}$ $V_{GE} = 0 / 15\text{V}$ $R_G = 10\Omega$	-	15	-	ns
Rise Time	t_r		-	31	-	ns
Turn-Off Delay Time	$t_{d(off)}$		-	103	-	ns
Fall Time	t_f		-	33	-	ns
Turn-On Energy	E_{on}		-	1.21	-	mJ
Turn-Off Energy	E_{off}		-	0.49	-	mJ
Total Switching Energy	E_{ts}		-	1.70	-	mJ

Diode Characteristic

Diode Forward Voltage	V_F	$V_{GE} = 0\text{V}, I_F = 20\text{A}$ $T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$ $T_{VJ} = 175^{\circ}\text{C}$	-	1.60	-	V
Reverse Recovery Time	t_{rr}	$I_F = 20\text{A}, V_R = 400\text{V},$ $di/dt = 1000\text{A}/\mu\text{s},$ $T_{VJ} = 25^{\circ}\text{C}$	-	64	-	ns
Reverse Recovery Charge	Q_{rr}		-	400	-	nC
Reverse Recovery Current	I_{rrm}		-	13	-	A
Reverse Recovery Energy	E_{rec}		-	56	-	μJ
Diode peak rate of fall of reverse recovery current	dI_{rr}/dt		-	597	-	$\text{A}/\mu\text{s}$
Reverse Recovery Time	t_{rr}	$I_F = 20\text{A}, V_R = 400\text{V},$ $di/dt = 1000\text{A}/\mu\text{s},$ $T_{VJ} = 175^{\circ}\text{C}$	-	80	-	ns
Reverse Recovery Charge	Q_{rr}		-	746	-	nC
Reverse Recovery Current	I_{rrm}		-	18	-	A
Reverse Recovery Energy	E_{rec}		-	122	-	μJ
Diode peak rate of fall of reverse recovery current	dI_{rr}/dt		-	465	-	$\text{A}/\mu\text{s}$

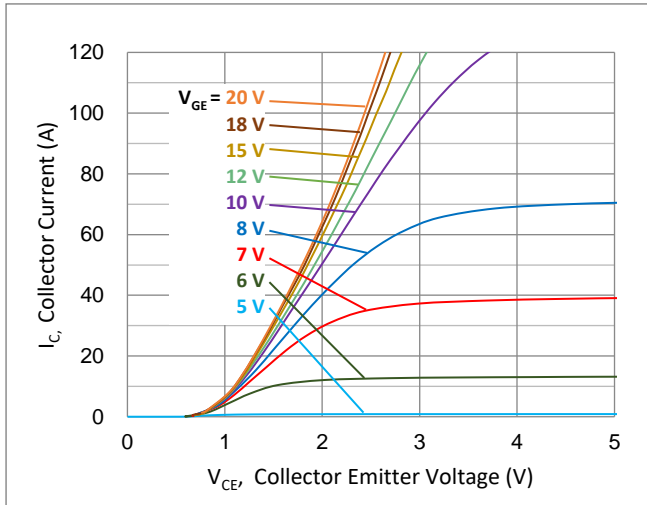


Fig.1 Typical Output Characteristic ($T_{vj} = 25^\circ\text{C}$)

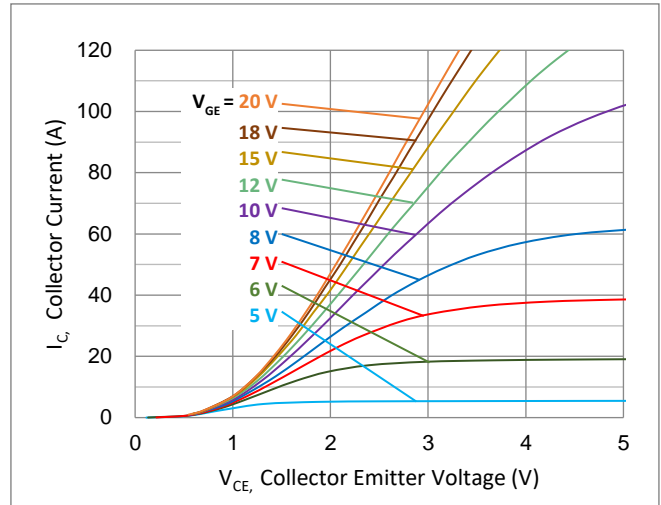


Fig.2 Typical Output Characteristic ($T_{vj} = 175^\circ\text{C}$)

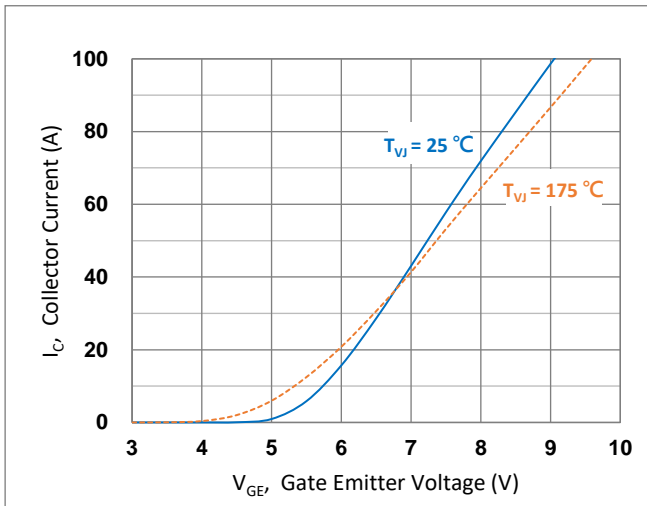


Fig.3 Typical Transfer Characteristic ($V_{CE} = 20\text{V}$)

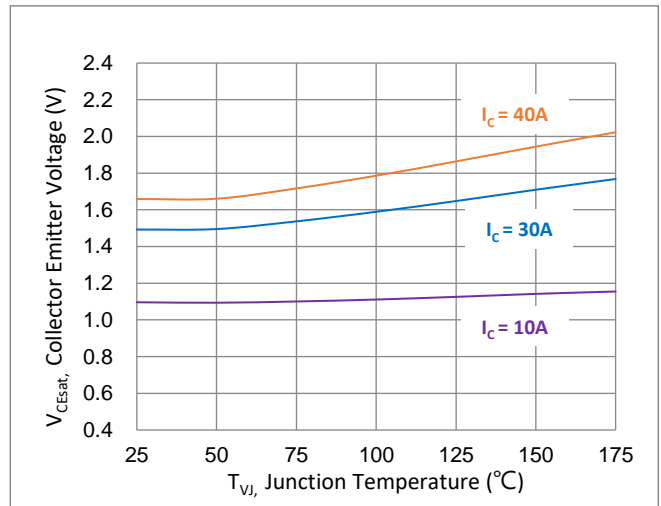


Fig.4 V_{CEsat} vs. T_{vj}

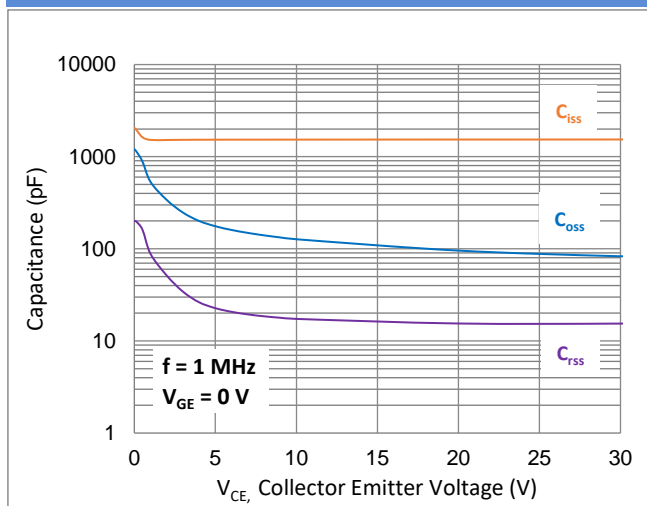


Fig.5 Typical Capacitance

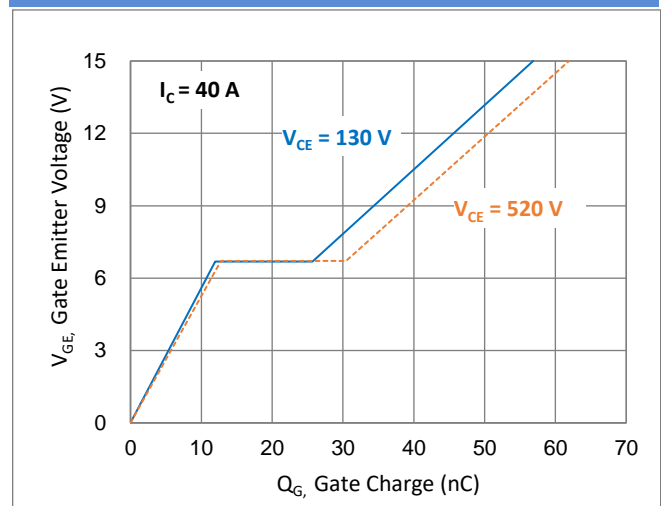


Fig.6 Typical Gate Charge

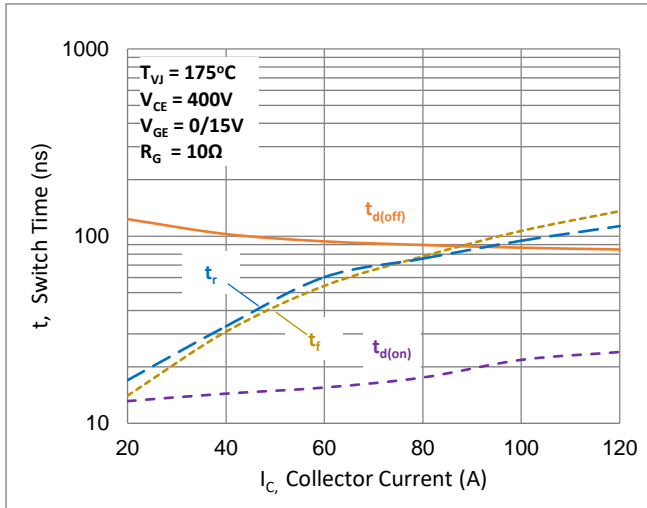


Fig.7 Typical Switching Time vs. I_c

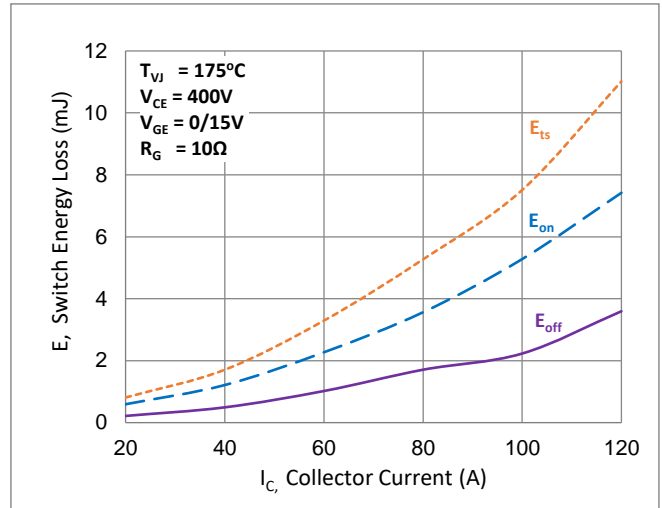


Fig.8 Typical Switching Energy Loss vs. I_c

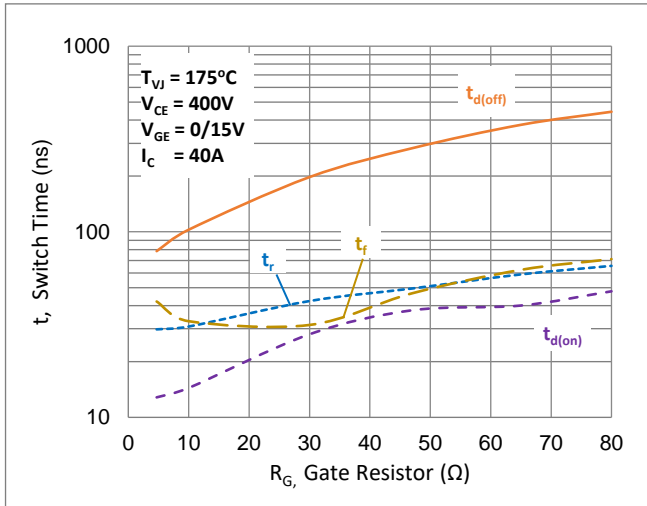


Fig.9 Typical Switching Time vs. R_g

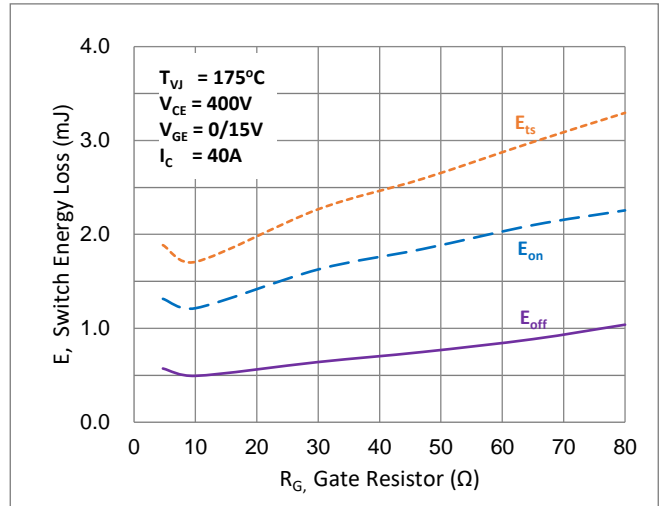


Fig.10 Typical Switching Energy Loss vs. R_g

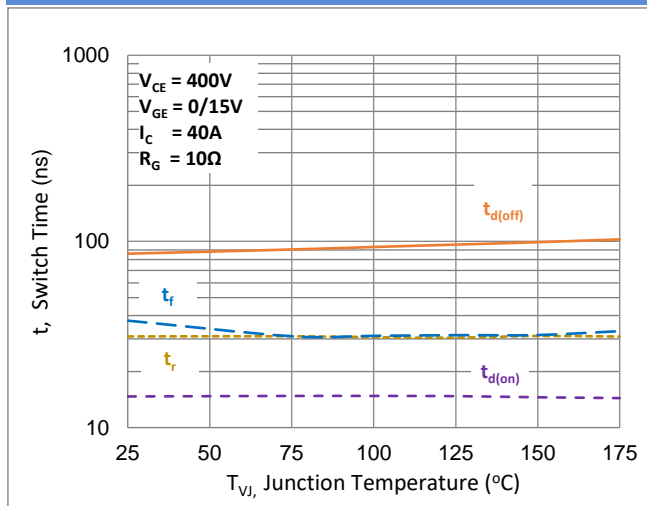


Fig.11 Typical Switching Time vs. T_{vj}

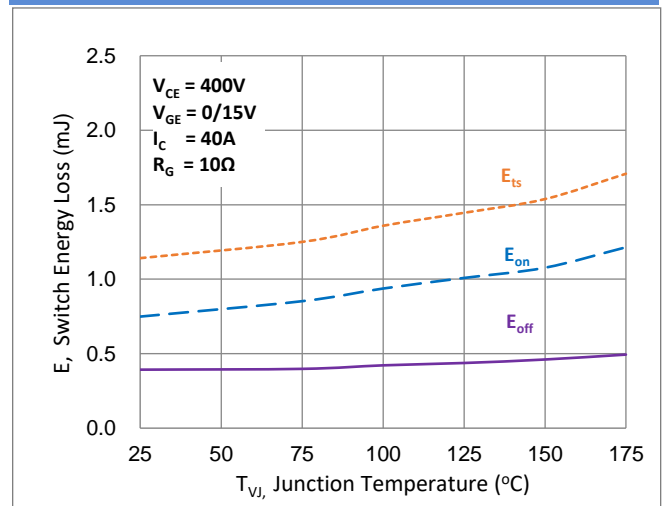


Fig.12 Typical Switching Energy Loss vs. T_{vj}

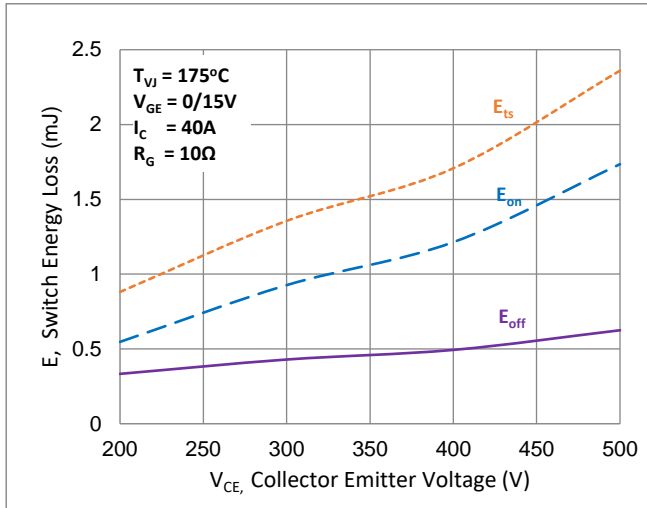


Fig.13 Typical Switching Energy Loss vs. V_{CE}

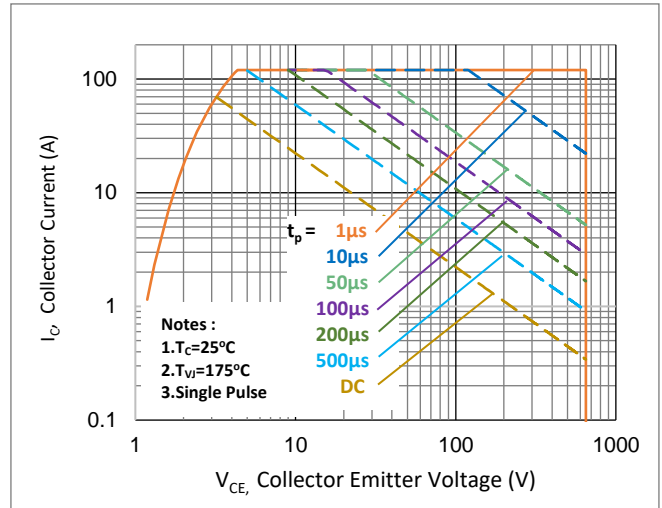


Fig.14 SOA Characteristic

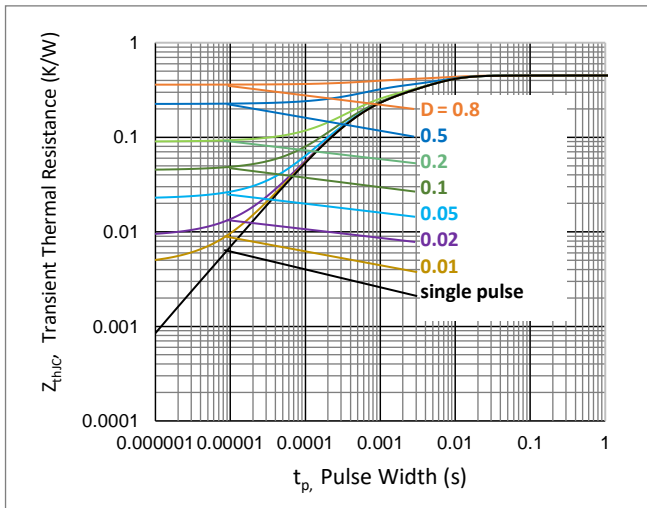


Fig.15 IGBT Thermal Impedance

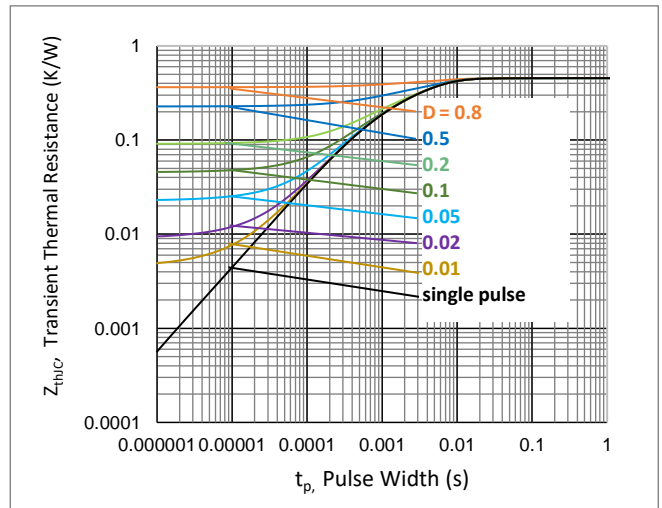


Fig.16 Diode Thermal Impedance

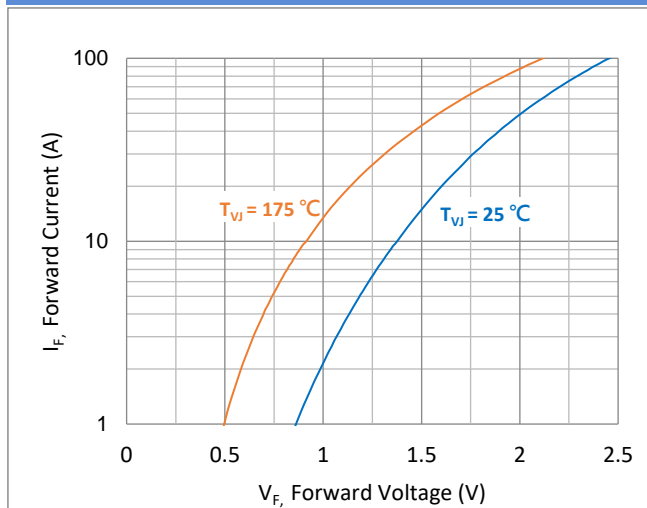


Fig.17 Typical Diode Forward Characteristic

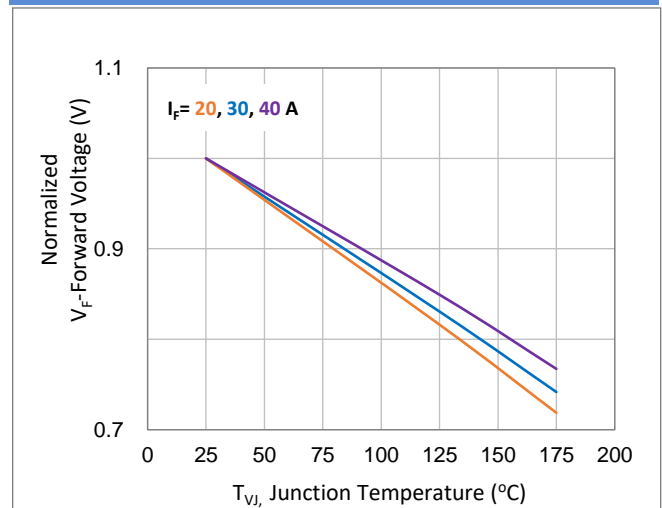


Fig.18 Diode Forward Voltage vs. T_{vj}

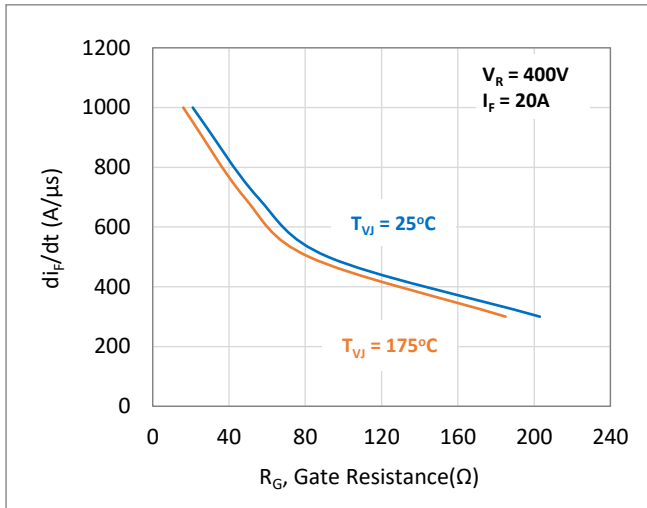


Fig.19 Typical Diode Current Slope vs. R_G

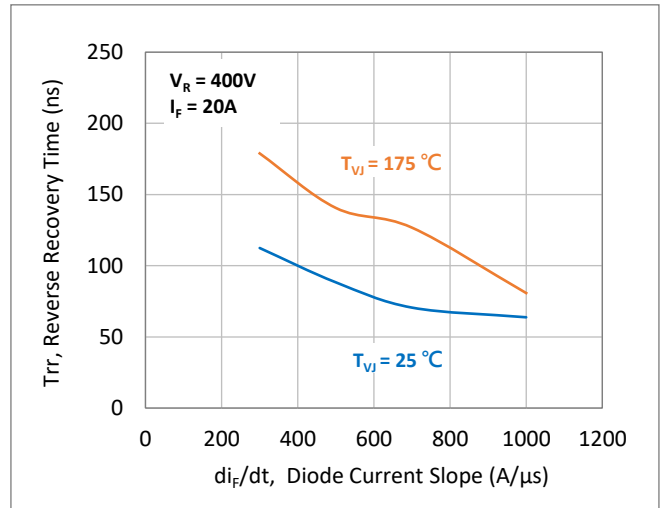


Fig.20 Typical Reverse Recovery Time vs di_F/dt

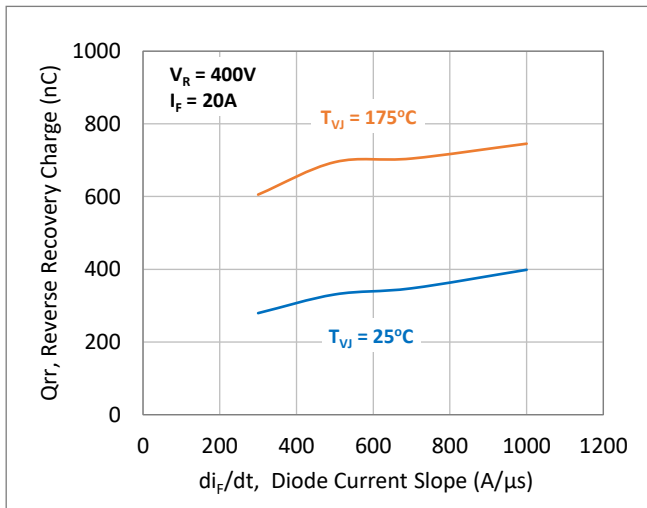


Fig.21 Typical Reverse Recovery Charge vs di_F/dt

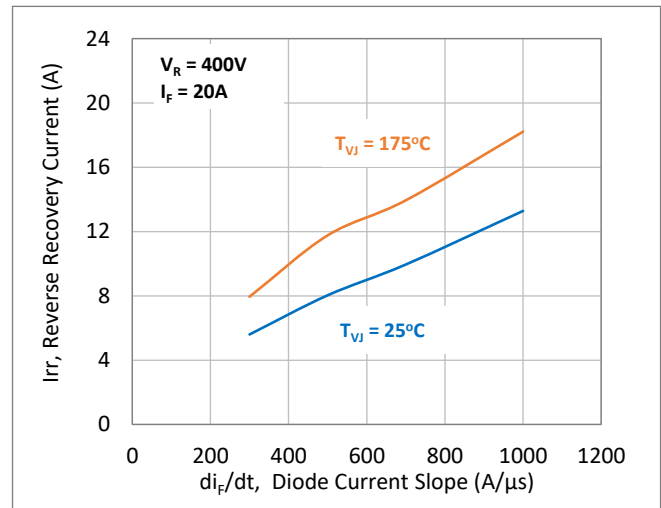


Fig.22 Typical Reverse Recovery Current vs di_F/dt

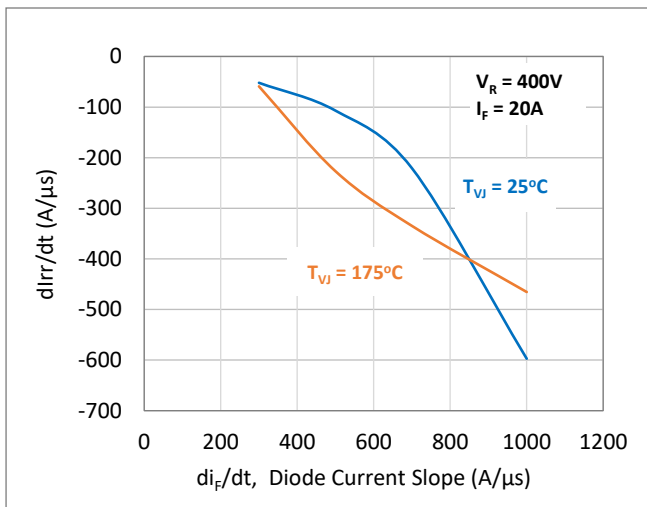


Fig.23 $dlrr/dt$ vs. di_F/dt

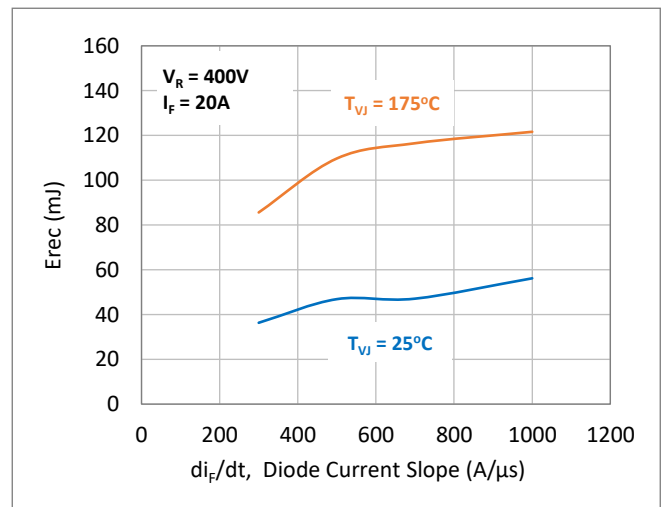
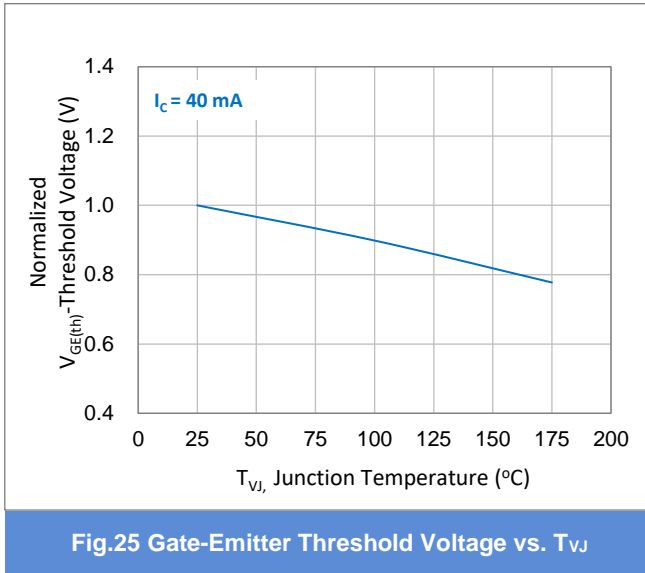


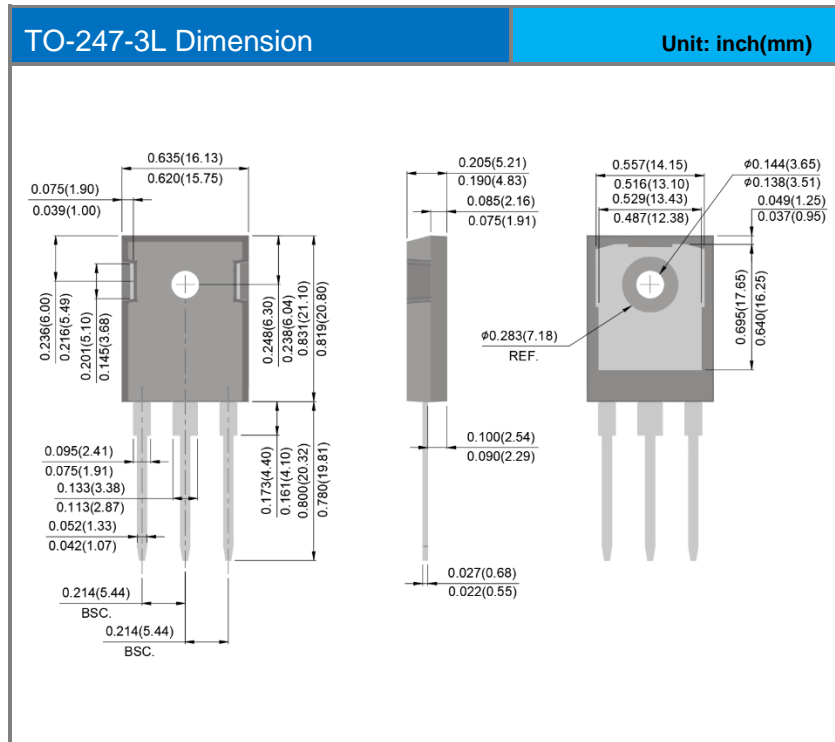
Fig.24 Typical reverse energy losses vs. di_F/dt



Product and Packing Information

Part No.	Package Type	Packing Type	Marking
PTGH4065S1	TO-247-3L	30pcs / Tube	TGH4065S1

Packaging Information



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