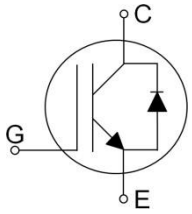
Features

- 650V 40A IGBT
- Field Stop Trench IGBT Technology
- Low Conduction Loss
- Positive Temperature Coefficient
- Easy Parallel Operation
- RoHS Compliant
- JEDEC Qualification
- 175℃ Operating Temperature

TO-247





Applications

Inverter, Solar, UPS, Welder

Device	Package	Marking	Remark
TGH40N65F3F	TO-247	TGH40N65F3F	RoHS

Absolute Maximum Ratings

Parameter		Symbol	Value	Unit
Collector-Emitter Voltage		V_{CES}	650	V
Gate-Emitter Voltage		V_{GES}	±25	V
Transient Gate-Emitter Voltage (t_p ≤ 10μs, D < 0.010)			±30	V
Continuous Collector Current	T_C = 25 ℃	I_C	78	A
	T_C = 100 ℃		55	A
Pulsed Collector Current (Note1)		I_{CM}	160	A
Diode Continuous Forward Current	T_C = 100 ℃	I_F	40	A
Diode Pulsed Forward Current (Note1)		I_{FM}	160	A
Power Dissipation	T_C = 25 ℃	P_D	234	W
	T_C = 100 ℃		117	W
Operating Junction Temperature		T_{vj}	-55 ~ 175	℃
Storage Temperature Range		T_{STG}	-55 ~ 150	℃
Maximum lead temperature for soldering purposes, 1/8” from case for 5 seconds		T_L	270	℃

Notes :
(1) Repetitive rating : Pulse width limited by maximum junction temperature.

Thermal Characteristics

Parameter	Symbol	Value	Unit
Maximum Thermal resistance, Junction-to-Case	$R_{\theta JC}$ (IGBT)	0.64	℃/W
Maximum Thermal resistance, Junction-to-Case	$R_{\theta JC}$ (DIODE)	1.07	℃/W
Maximum Thermal resistance, Junction-to-Ambient	$R_{\theta JA}$	40	℃/W

Electrical Characteristics of the IGBT T_{vj}=25℃, unless otherwise noted

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
OFF						
Collector – Emitter Breakdown Voltage	BV_{CES}	V_{GE} = 0V, I_C = 1mA	650	--	--	V
Zero Gate Voltage Collector Current	I_{CES}	V_{CE} = 650V, V_{GE} = 0V	--	--	300	μA
Gate – Emitter Leakage Current	I_{GES}	V_{CE} = 0V, V_{GE} = ±30V	--	--	±100	nA
Integrated Gate Resistance	$R_{G(int)}$	f = 1MHz, Open Collector	--	2.1	--	Ω
ON						
Gate – Emitter Threshold Voltage	$V_{GE(TH)}$	V_{GE} = V_{CE}, I_C = 1mA	4.5	5.2	6.5	V
Collector – Emitter Saturation Voltage	$V_{CE(SAT)}$	V_{GE} = 15V, I_C = 40A, T_{vj} = 25 ℃	--	1.45	1.85	V
		V_{GE} = 15V, I_C = 40A, T_{vj} = 125 ℃	--	1.73	--	V
		V_{GE} = 15V, I_C = 40A, T_{vj} = 175 ℃	--	1.88	--	V
DYNAMIC						
Input Capacitance	C_{IES}	V_{CE} = 25V V_{GE} = 0V f = 1MHz	--	2161	--	pF
Output Capacitance	C_{OES}		--	84	--	pF
Reverse Transfer Capacitance	C_{RES}		--	14	--	pF
Total Gate Charge	Q_g	V_{CC} = 520V, I_C = 40A V_{GE} = 15V	--	97	--	nC
Gate-Emitter Charge	Q_{ge}		--	17	--	nC
Gate-Collector Charge	Q_{gc}		--	43	--	nC
SWITCHING (Note 2)						
Turn-On Delay Time	$t_{d(on)}$	V_{CC} = 400V, I_C = 20A R_G = 5.1Ω, V_{GE} = 15V Inductive Load, T_{vj} = 25 ℃	--	6	--	ns
Rise Time	t_r		--	5	--	ns
Turn-Off Delay Time	$t_{d(off)}$		--	134	--	ns
Fall Time	t_f		--	8	--	ns
Turn-On Switching Loss	E_{ON}		--	0.6	--	mJ
Turn-Off Switching Loss	E_{OFF}		--	0.18	--	mJ
Total Switching Loss	E_{TS}		--	0.78	--	mJ
Turn-On Delay Time	$t_{d(on)}$	V_{CC} = 400V, I_C = 40A R_G = 5.1Ω, V_{GE} = 15V Inductive Load, T_{vj} = 25 ℃	--	8	--	ns
Rise Time	t_r		--	20	--	ns
Turn-Off Delay Time	$t_{d(off)}$		--	107	--	ns
Fall Time	t_f		--	20	--	ns
Turn-On Switching Loss	E_{ON}		--	1.29	--	mJ
Turn-Off Switching Loss	E_{OFF}		--	0.31	--	mJ
Total Switching Loss	E_{TS}		--	1.60	--	mJ

Electrical Characteristics of the IGBT

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
SWITCHING (Note 2)						
Turn-On Delay Time	$t_{d(on)}$	V_{CC} = 400V, I_C = 20A R_G = 5.1Ω, V_{GE} = 15V Inductive Load, T_{vj} = 175 ℃	--	5	--	ns
Rise Time	t_r		--	7	--	ns
Turn-Off Delay Time	$t_{d(off)}$		--	188	--	ns
Fall Time	t_f		--	21	--	ns
Turn-On Switching Loss	E_{ON}		--	0.61	--	mJ
Turn-Off Switching Loss	E_{OFF}		--	0.34	--	mJ
Total Switching Loss	E_{TS}		--	0.95	--	mJ
Turn-On Delay Time	$t_{d(on)}$	V_{CC} = 400V, I_C = 40A R_G = 5.1Ω, V_{GE} = 15V Inductive Load, T_{vj} = 175 ℃	--	6	--	ns
Rise Time	t_r		--	15	--	ns
Turn-Off Delay Time	$t_{d(off)}$		--	147	--	ns
Fall Time	t_f		--	43	--	ns
Turn-On Switching Loss	E_{ON}		--	1.30	--	mJ
Turn-Off Switching Loss	E_{OFF}		--	0.61	--	mJ
Total Switching Loss	E_{TS}		--	1.91	--	mJ

Notes :
(2) Not subject to production test – verified by design/characterization

Electrical Characteristics of the DIODE T_{vj}=25℃, unless otherwise noted

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
Diode Forward Voltage	V_{FM}	I_F = 20A, T_{vj} = 25 ℃	--	1.45	--	V
		I_F = 20A, T_{vj} = 125 ℃	--	1.24	--	V
		I_F = 20A, T_{vj} = 175 ℃	--	1.13	--	V
		I_F = 40A, T_{vj} = 25 ℃	--	1.65	--	V
		I_F = 40A, T_{vj} = 125 ℃	--	1.49	--	V
		I_F = 40A, T_{vj} = 175 ℃	--	1.40	--	V
Reverse Recovery Time	t_{rr}	I_F = 20A, V_R=400V di/dt = 200A/μs, T_{vj} = 25 ℃	--	164	--	ns
Reverse Recovery Current	I_{rr}		--	4.4	--	A
Reverse Recovery Charge	Q_{rr}		--	0.29	--	μC
Reverse Recovery Time	t_{rr}	I_F = 20A, V_R=400V di/dt = 200A/μs, T_{vj} = 175 ℃	--	263	--	ns
Reverse Recovery Current	I_{rr}		--	10.5	--	A
Reverse Recovery Charge	Q_{rr}		--	1.46	--	μC
Reverse Recovery Time	t_{rr}	I_F = 40A, V_R=400V di/dt = 200A/μs, T_{vj} = 25 ℃	--	192	--	ns
Reverse Recovery Current	I_{rr}		--	4.9	--	A
Reverse Recovery Charge	Q_{rr}		--	0.35	--	μC
Reverse Recovery Time	t_{rr}	I_F = 40A, V_R=400V di/dt = 200A/μs, T_{vj} = 175 ℃	--	324	--	ns
Reverse Recovery Current	I_{rr}		--	11.5	--	A
Reverse Recovery Charge	Q_{rr}		--	1.86	--	μC

IGBT Characteristics

Fig. 1 IGBT Output Characteristics (T_{vj}=25℃)

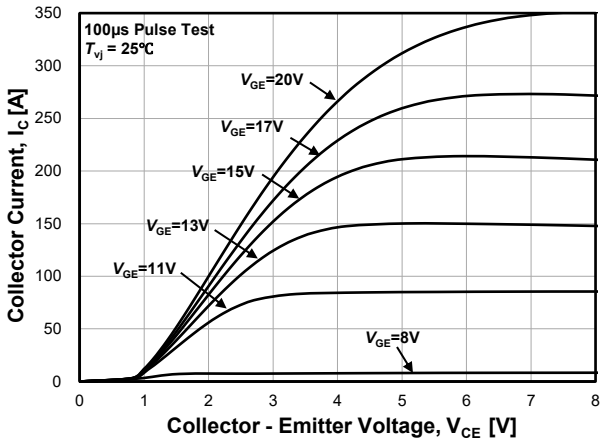


Fig. 2 IGBT Output Characteristics (T_{vj}=175℃)

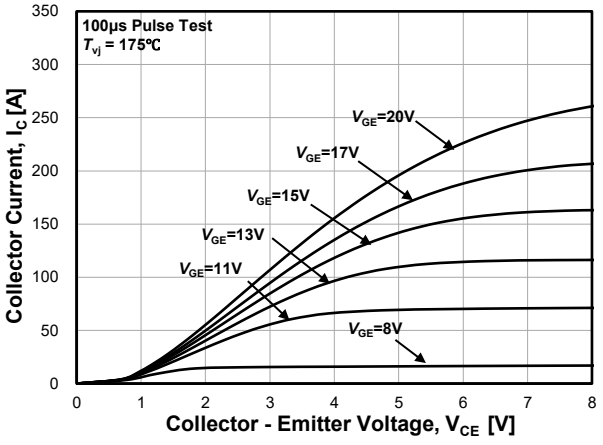


Fig. 3 IGBT Saturation Voltage vs. Junction Temperature

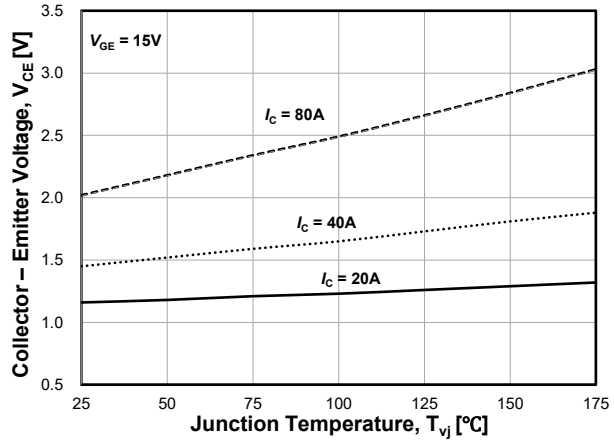


Fig. 4 Collector Current vs. Gate Voltage

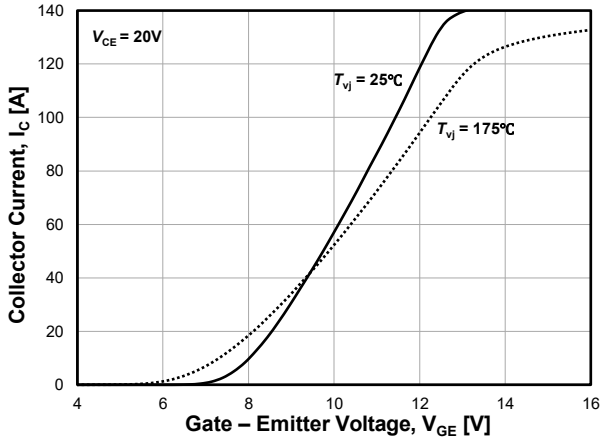


Fig. 5 IGBT Capacitance Characteristics

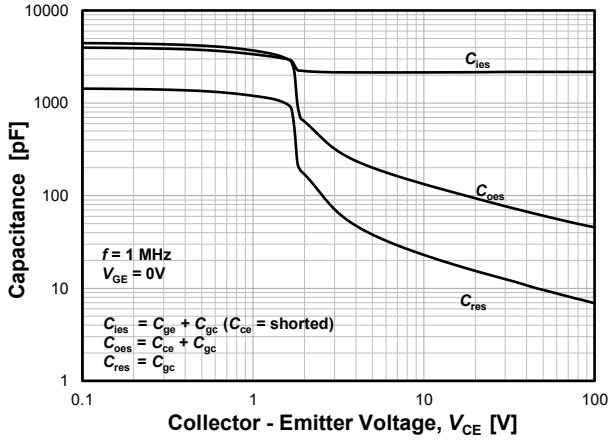
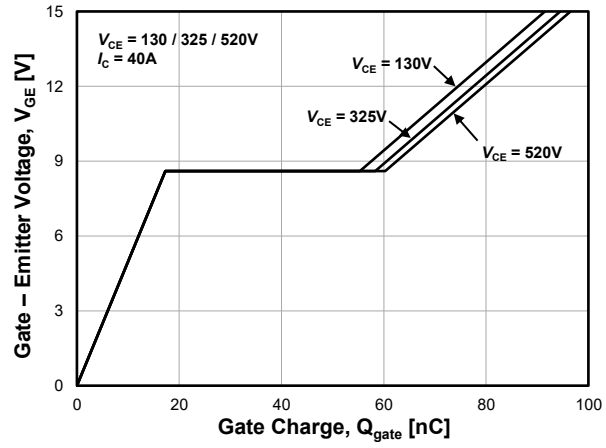


Fig. 6 Gate Charge Characteristics



IGBT Characteristics

Fig. 7 Gate-emitter threshold voltage vs. Junction Temperature

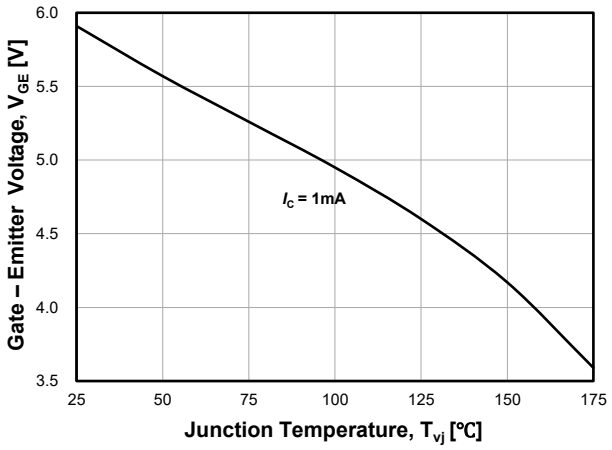


Fig. 8 IGBT Transient Thermal Impedance

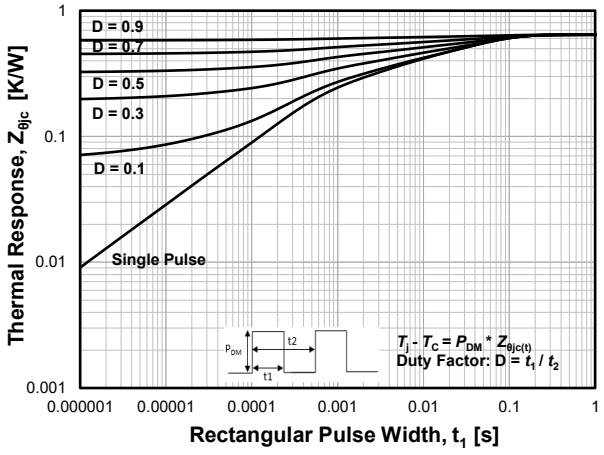


Fig. 9 Load Current vs. Frequency

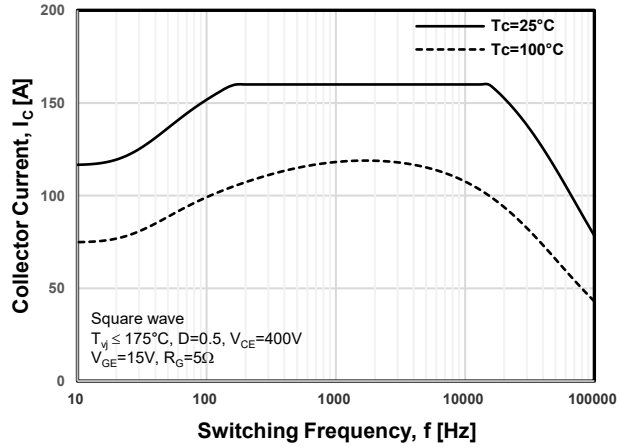


Fig. 10 FBSOA

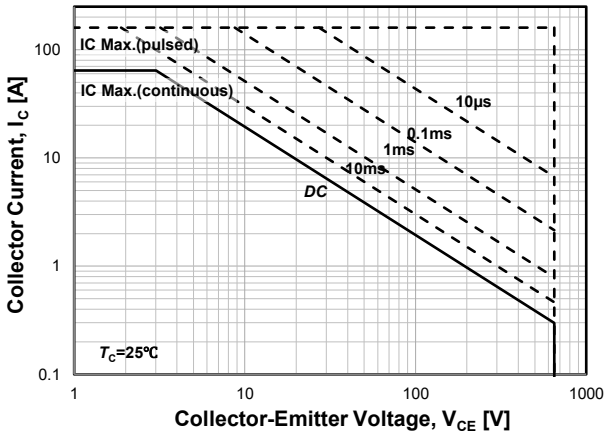


Fig. 11 Power Dissipation vs. Junction Temperature

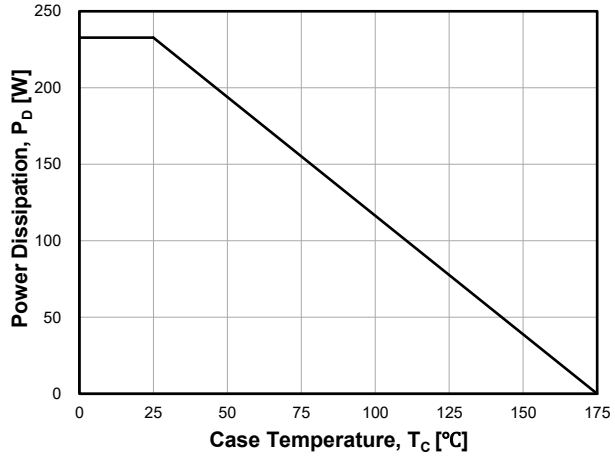
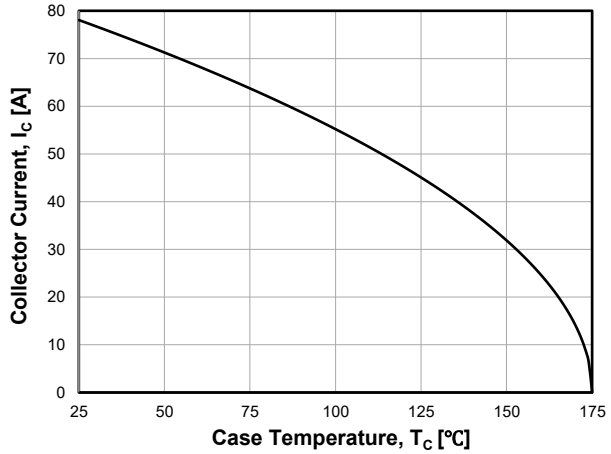


Fig. 12 Collector Current vs. Junction Temperature



IGBT Characteristics

Fig. 13 Switching Time vs. Gate Resistor

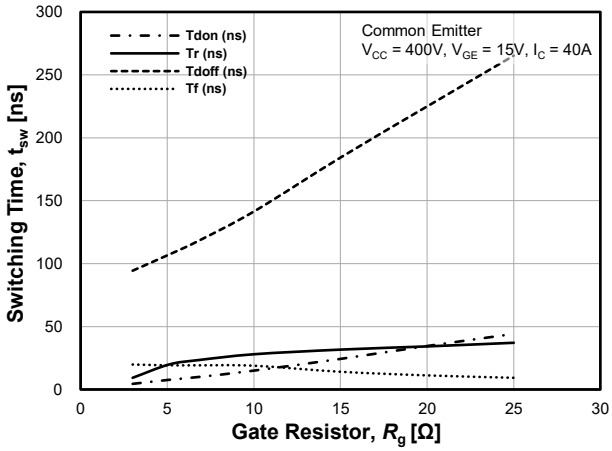


Fig. 14 Switching Loss vs. Gate Resistor

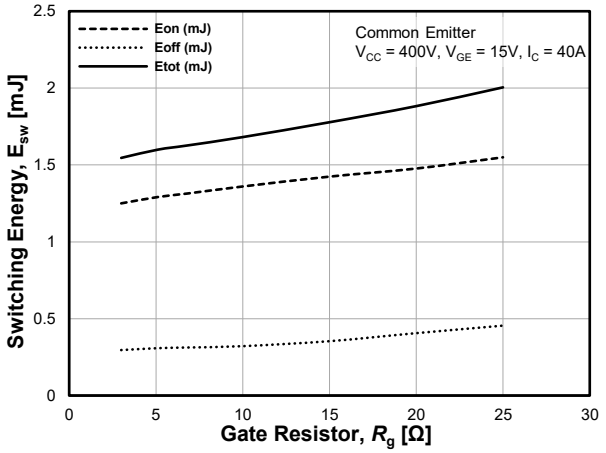


Fig. 15 Switching Time vs. Collector Current

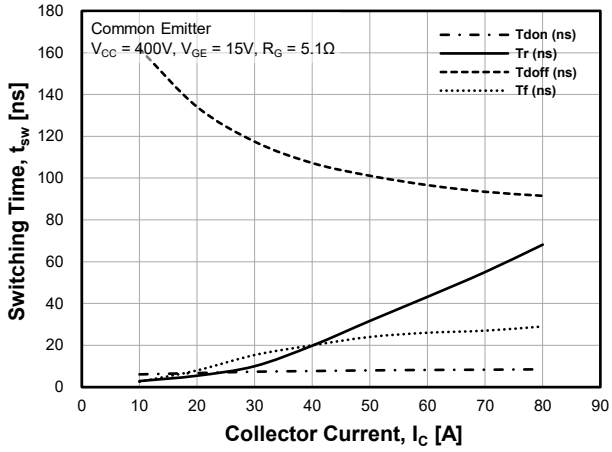


Fig. 16 Switching Loss vs. Collector Current

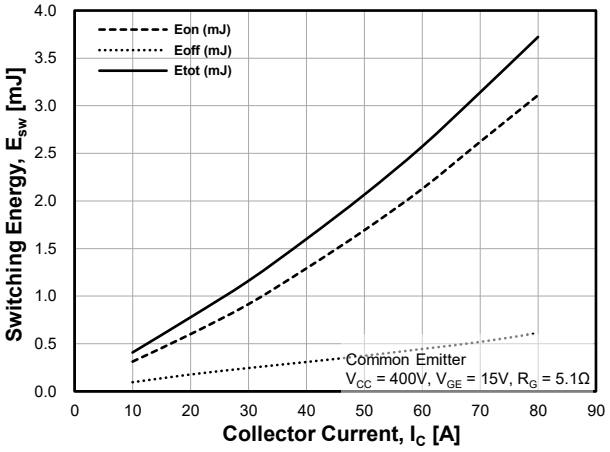


Fig. 17 Switching Time vs. Junction Temperature

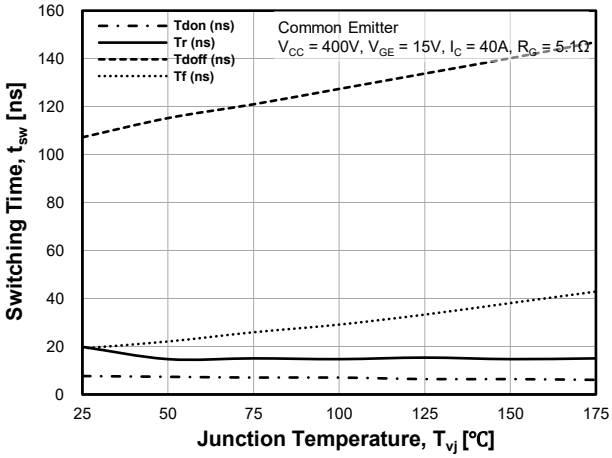
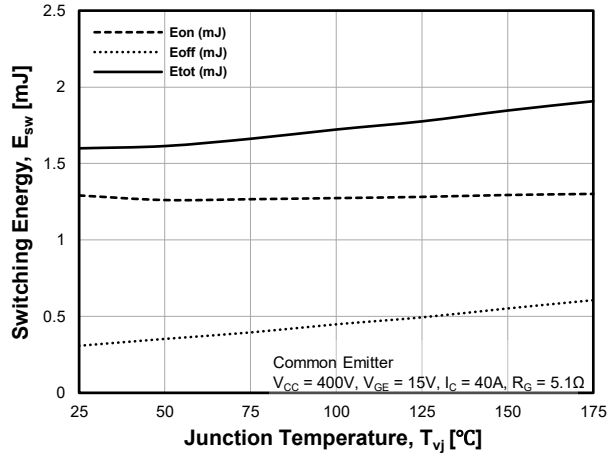


Fig. 18 Switching Loss vs. Junction Temperature



IGBT Characteristics

Fig. 19 Switching Time vs. Collector - Emitter Voltage

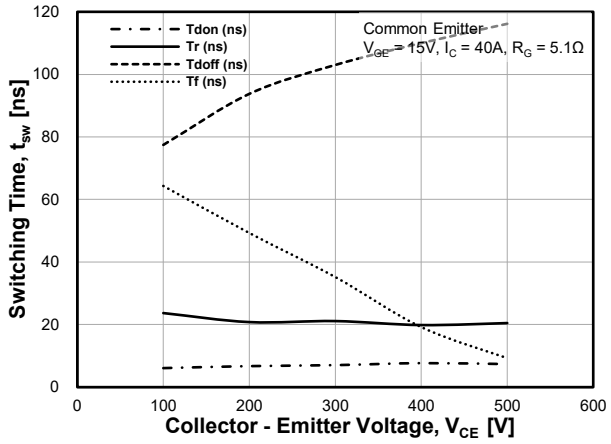
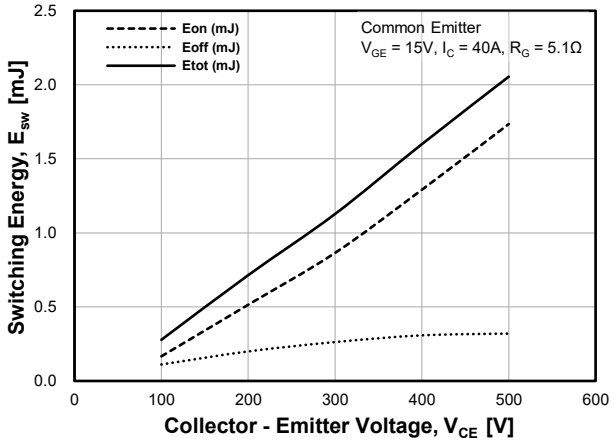


Fig. 20 Switching Loss vs. Collector - Emitter Voltage



DIODE Characteristics

Fig. 21 Diode Conduction Characteristics

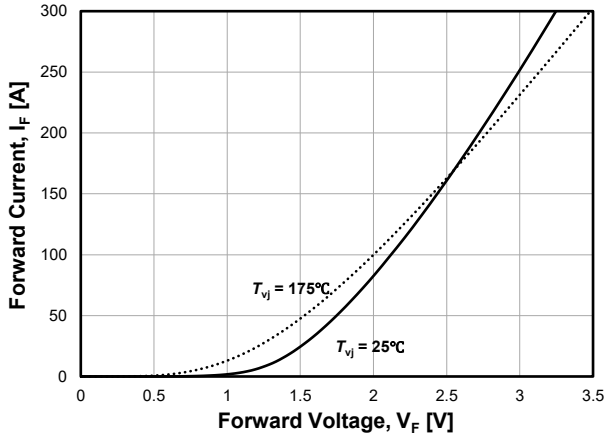


Fig. 22 Reverse Recovery Current vs. Forward Current

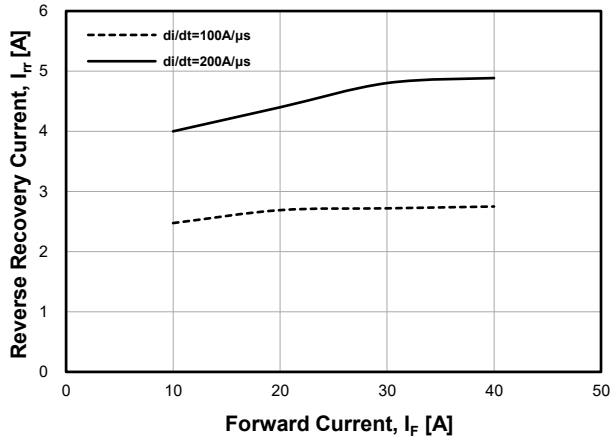


Fig. 23 Reverse Recovery Time vs. Forward Current

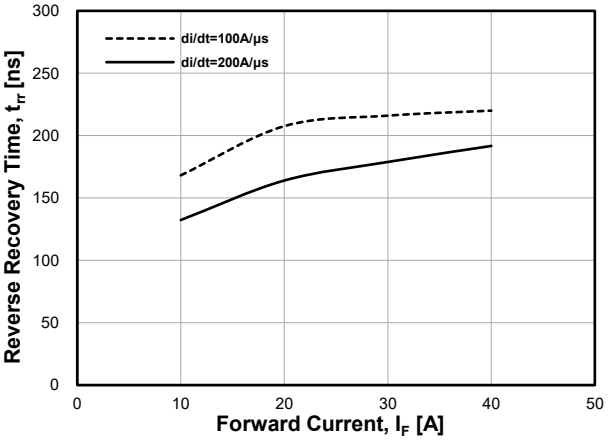
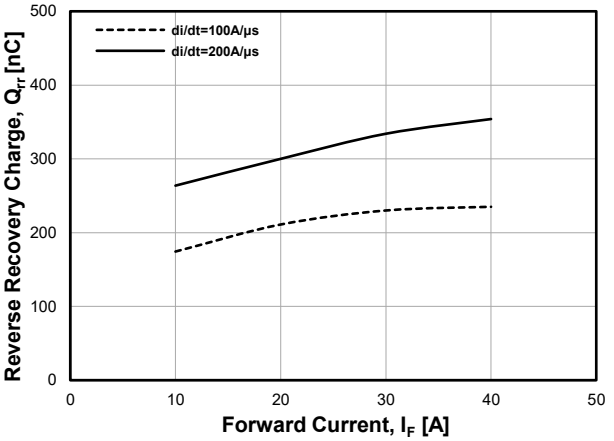
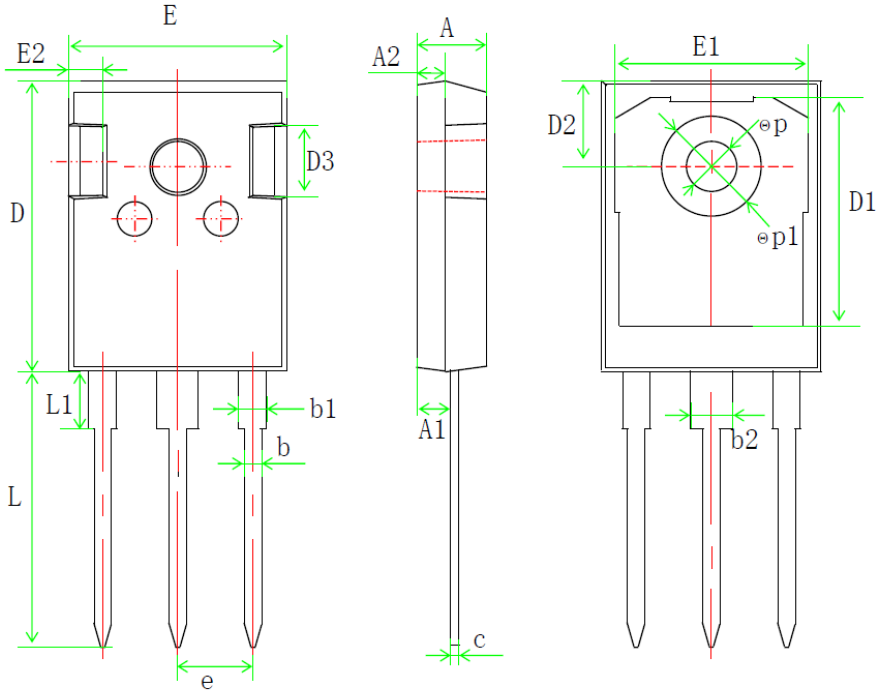


Fig. 24 Reverse Recovery Charge vs. Forward Current



TO-247-3L OUTLINE



SYMBOL	Mechanical Dimensions/mm			SYMBOL	Mechanical Dimensions/mm			SYMBOL	Mechanical Dimensions/mm		
	MIN	NOM	MAX		MIN	NOM	MAX		MIN	NOM	MAX
A	4.80	5.00	5.20	D	20.70	21.00	21.30	E1	13.00	13.30	13.60
A1	2.21	2.41	2.61	D1	16.25	16.55	16.85	E2	2.3	2.5	2.7
A2	1.85	2.00	2.15	D2	5.95	6.15	6.35	L	19.42	19.92	20.42
b	1.10	1.20	1.36	D3	4.8	5.0	5.2	L1	4.03	4.13	4.43
b1	1.90	2.00	2.21	e	5.29	5.44	5.59	Θp	3.45	3.60	3.75
b2	2.85	3.00	3.21	E	15.50	15.80	16.10	Θp1			7.4
c	0.45	0.60	0.75								

NAME	TO-247-3L OUTLINE	UNIT	mm	DESIGNED	sn	THIRD ANGLE SYSTEM
DWGNO		PAGE	1 OF 1	CHECKED		
VERSION	Ver2.0	ISSUE DATE		APPROVED		

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