Field Stop Trench IGBT With Soft Fast Recovery Diode

650 V, 120 A

FGY120T65SPD-F085

ON Semiconductor®

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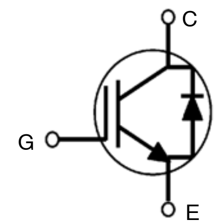
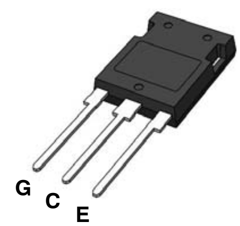




TO−247−3LD
CASE 340CU

Features

- Very Low Saturation Voltage : $V_{CE(sat)}$ = 1.5 V(Typ.) @ I_C = 120 A
- Maximum Junction Temperature : T_J = 175°C
- Positive Temperature Co−efficient
- Tight Parameter Distribution
- High Input Impedance
- 100% of the Parts are Dynamically Tested
- Short Circuit Ruggedness > 6 μs @ 25°C
- Copacked with Soft, Fast Recovery Extremefast Diode
- AEC−Q101 Qualified and PPAP Capable
- This is a Pb−Free Device

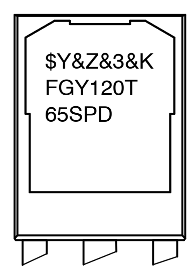
Benefits

- Very Low Conduction and Switching Losses for a High Efficiency Operation in Various Applications
- Rugged Transient Reliability
- Outstanding Parallel Operation Performance with Balance Current Sharing
- Low EMI

Applications

- Traction Inverter for HEV/EV
- Auxiliary DC/AC Converter
- Motor Drives
- Other Power−train Applications Requiring High Power Switch

MARKING DIAGRAM



$Y = ON Semiconductor Logo
&Z = Assembly Plant Code
&3 = Data Code (Year & Week)
&K = Lot
FGY120T65SPD= Specific Device Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

March, 2020 − Rev. 3
Publication Order Number:
FGY120T65SPD−F085/D

ABSOLUTE MAXIMUM RATINGS

Symbol	Description		Ratings	Units
V_{CES}	Collector to Emitter Voltage		650	V
VG_{ES}	Gate to Emitter Voltage		±20	V
	Transient Gate to Emitter Voltage		±30	V
I_C	Collector Current (Note 1)	@ $T_C = 25°C$	240	A
	Collector Current	@ $T_C = 100°C$	220	A
$I_{Nominal}$	Nominal Current		120	A
I_{CM}	Pulsed Collector Current		378	A
I_F	Diode Forward Current (Note 1)	@ $T_C = 25°C$	240	A
	Diode Forward Current	@ $T_C = 100°C$	188	A
P_D	Maximum Power Dissipation	@ $T_C = 25°C$	882	W
	Maximum Power Dissipation	@ $T_C = 100°C$	441	W
SCWT	Short Circuit Withstand Time	@ $T_C = 25°C$	6	μs
dV/dt	Voltage Transient Ruggedness (Note 2)		10	V/ns
T_J	Operating Junction Temperature		−55 to +175	°C
T_{stg}	Storage Temperature Range		−55 to +175	°C
T_L	Maximum Lead Temp. for soldering Purposes, 1/8” from case for 5 s		300	°C

1. Limited by bondwire
2. V_{CC} = 400 V, V_{GE} = 15 V, I_{CE} = 378 A, Inductive Load

THERMAL CHARACTERISTICS

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$(IGBT)	Thermal Resistance, Junction to Case	–	0.17	°C/W
$R_{\theta JC}$(Diode)	Thermal Resistance, Junction to Case	–	0.32	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	–	40	°C/W

PACKAGE MARKING AND ORDERING INFORMATION

Device Marking	Device	Package	Pacing Type	Qty per Tube
FGY120T65SPD	FGY120T65SPD−F085	TP−247	Tube	30ea

ELECTRICAL CHARACTERISTICS OF THE IGBT T_J = 25 °C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
OFF CHARACTERISTICS						
BV_{CES}	Collector to Emitter Breakdown Voltage	V_{GE} = 0 V, I_C = 1 mA	650	–	–	V
$\frac{\Delta BV_{CES}}{\Delta T_J}$	Temperature Coefficient of Breakdown Voltage	V_{GE} = 0 V, I_C = 1 mA	–	0.6	–	V/°C
I_{CES}	Collector Cut−Off Current	V_{CE} = V_{CES}, V_{GE} = 0 V	–	–	40	μA
I_{GES}	G−E Leakage Current	V_{GE} = V_{GES}, V_{CE} = 0 V	–	–	± 250	nA
ON CHARACTERISTICS						
$V_{GE(th)}$	G−E Threshold Voltage	I_C = 120 mA, V_{CE} = V_{GE}	4.2	5.4	6.2	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 120 A, V_{GE} = 15 V	–	1.5	1.85	V
		I_C = 120 A, V_{GE} = 15 V, T_J = 175°C	–	1.8	–	V
DYNAMIC CHARACTERISTICS						
C_{ies}	Input Capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz	–	6810	–	pF
C_{oes}	Output Capacitance		–	440	–	pF
C_{res}	Reverse Transfer Capacitance		–	50	–	pF
R_G	Internal Gate Resistance	f = 1 MHz	–	3	–	Ω
SWITCHING CHARACTERISTICS						
$T_{d(on)}$	Turn−On Delay Time	V_{CC} = 400 V, I_C = 120 A, R_G = 5 Ω, V_{GE} = 15 V, Inductive Load, T_J = 25°C	–	53	–	ns
T_r	Rise Time		–	134	–	ns
$T_{d(off)}$	Turn−Off Delay Time		–	102	–	ns
T_f	Fall Time		–	115	–	ns
E_{on}	Turn−On Switching Loss		–	6.8	–	mJ
E_{off}	Turn−Off Switching Loss		–	3.5	–	mJ
E_{ts}	Total Switching Loss		–	10.3	–	mJ
$T_{d(on)}$	Turn−On Delay Time	V_{CC} = 400 V, I_C = 120 A, R_G = 5 Ω, V_{GE} = 15 V, Inductive Load, T_J = 175°C	–	50	–	ns
T_r	Rise Time		–	133	–	ns
$T_{d(off)}$	Turn−Off Delay Time		–	109	–	ns
T_f	Fall Time		–	138	–	ns
E_{on}	Turn−On Switching Loss		–	9.8	–	mJ
E_{off}	Turn−Off Switching Loss		–	4.0	–	mJ
E_{ts}	Total Switching Loss		–	13.8	–	mJ
Q_g	Total Gate Charge	V_{CE} = 400 V, I_C = 120 A, V_{GE} = 15 V	–	162	243	nC
Q_{ge}	Gate to Emitter Charge		–	49	–	nC
Q_{gc}	Gate to Collector Charge		–	47	–	nC

ELECTRICAL CHARACTERISTICS OF THE DIODE T_J = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions		Min.	Typ.	Max	Units
V_{FM}	Diode Forward Voltage	I_F = 120 A	T_J = 25°C	–	1.3	1.6	V
			T_J = 175°C	–	1.2	–	
E_{rec}	Reverse Recovery Energy	V_{CE} = 400V, I_F = 120 A, dI_F/dt = 1000 A/μs	T_J = 25°C	–	450	–	μJ
			T_J = 175°C	–	3000	–	
T_{rr}	Diode Reverse Recovery Time		T_J = 25°C	–	123	–	ns
			T_J = 175°C	–	240	–	
Q_{rr}	Diode Reverse Recovery Charge		T_J = 25°C	–	2.8	–	μC
			T_J = 175°C	–	12.2	–	

TYPICAL PERFORMANCE CHARACTERISTICS

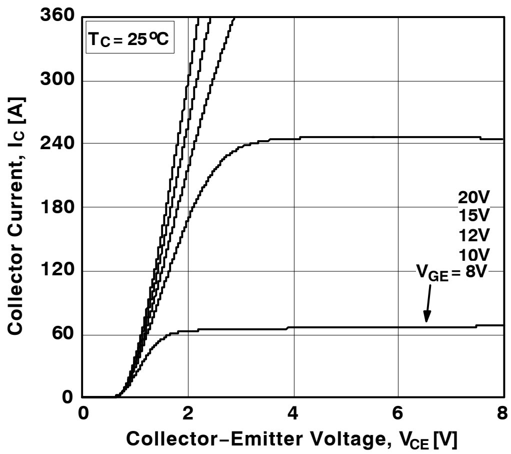


Figure 1. Typical Output Characteristics

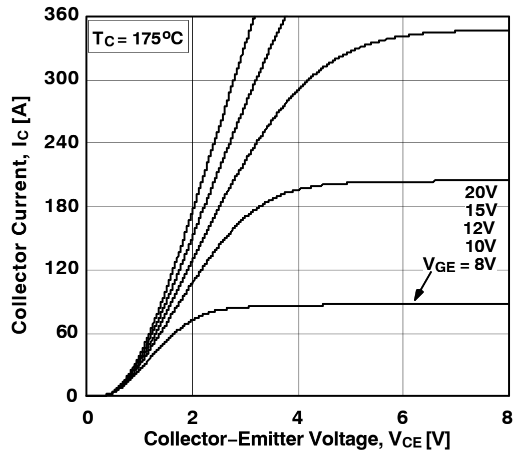


Figure 2. Typical Output Characteristics

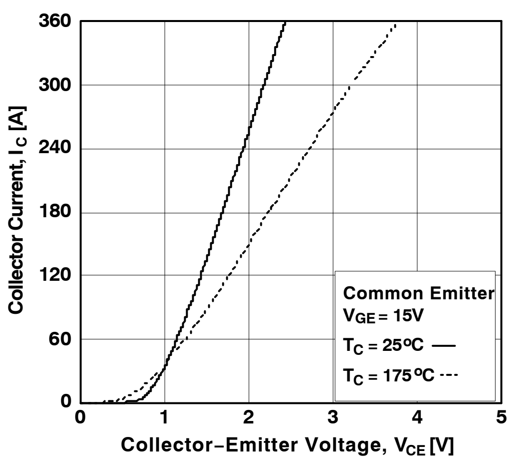


Figure 3. Typical Saturation Voltage Characteristics

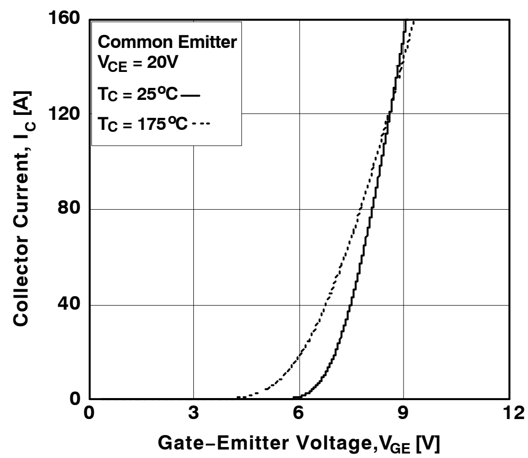


Figure 4. Transfer Characteristics

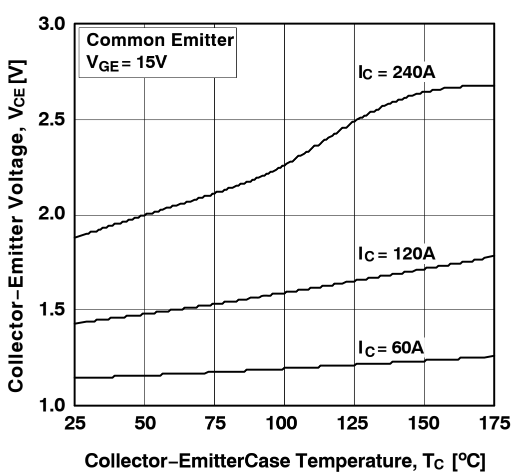


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

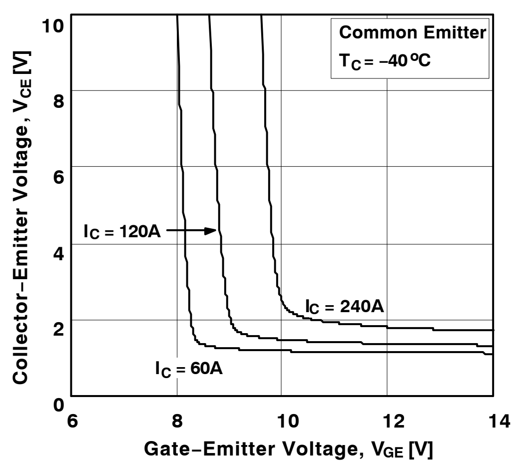


Figure 6. Saturation Voltage vs. V_{GE}

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

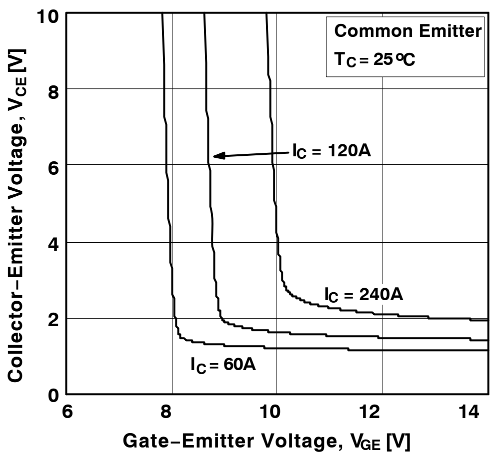


Figure 7. Saturation Voltage vs. V_{GE}

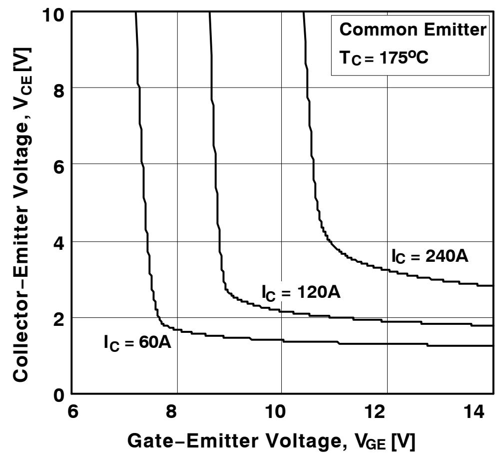


Figure 8. Saturation Voltage vs. V_{GE}

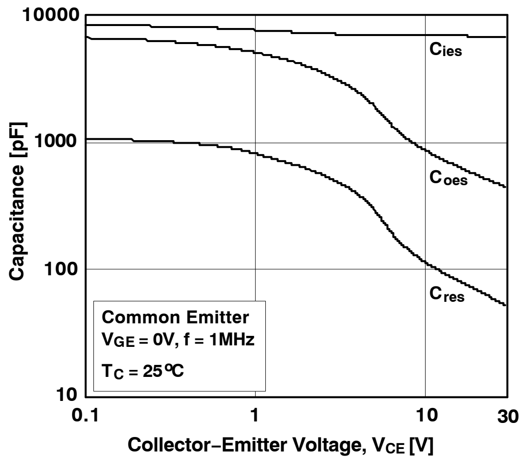


Figure 9. Capacitance Characteristics

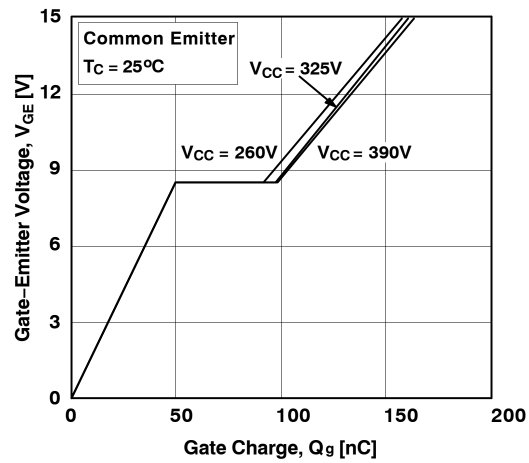


Figure 10. Gate charge Characteristics

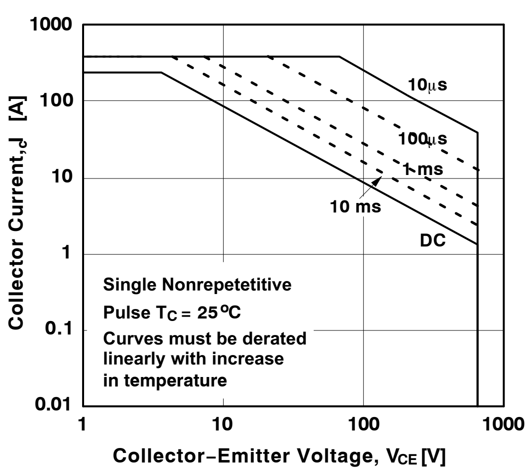


Figure 11. SOA Characteristics

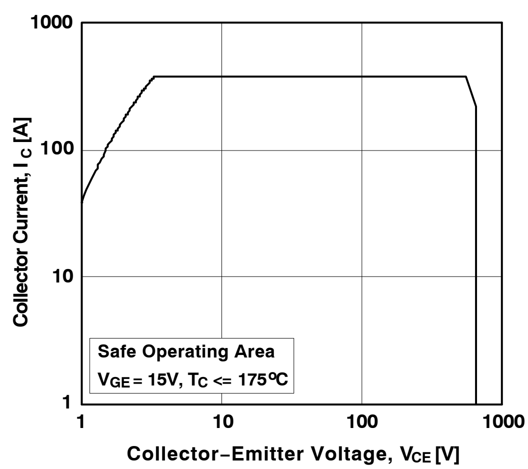


Figure 12. Turn off Switching SOA Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

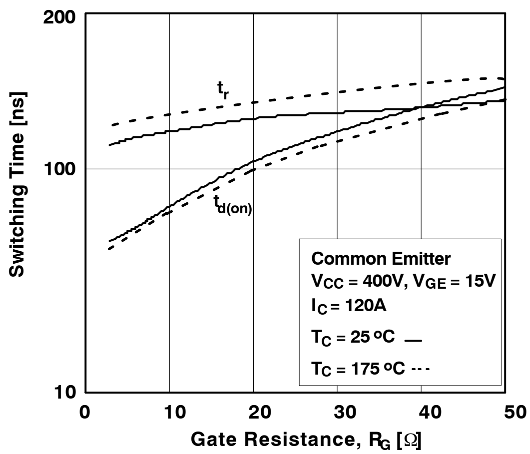


Figure 13. Turn−on Characteristics vs. Gate Resistance

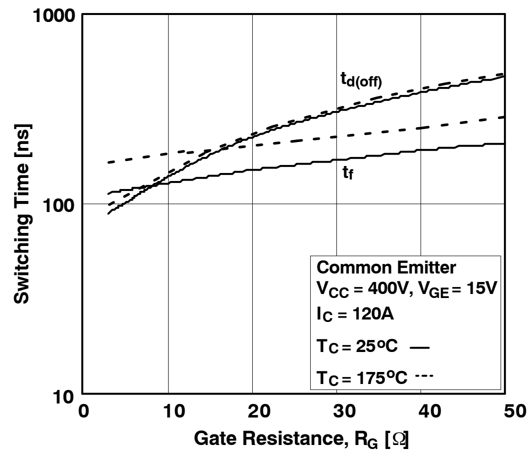


Figure 14. Turn−off Characteristics vs. Gate Resistance

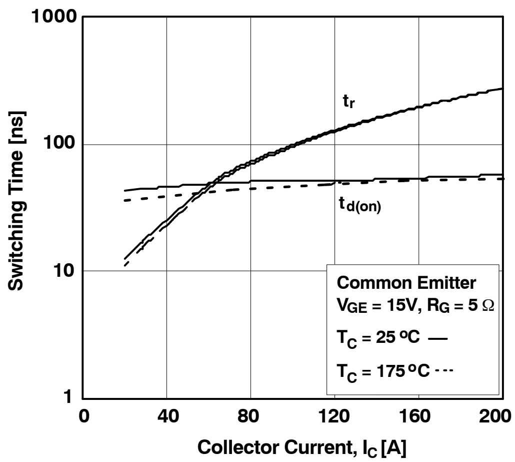


Figure 15. Turn−on Characteristics vs. Collector Current

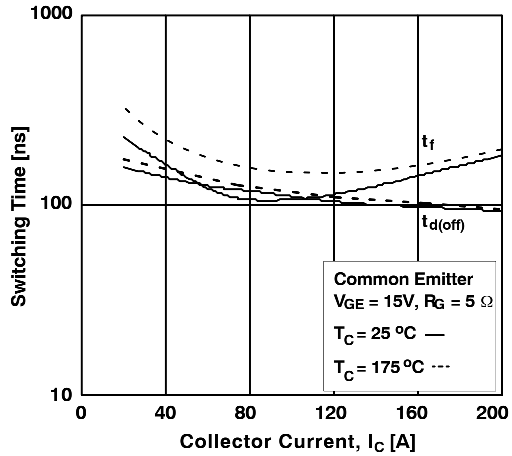


Figure 16. Turn−off Characteristics vs. Collector Current

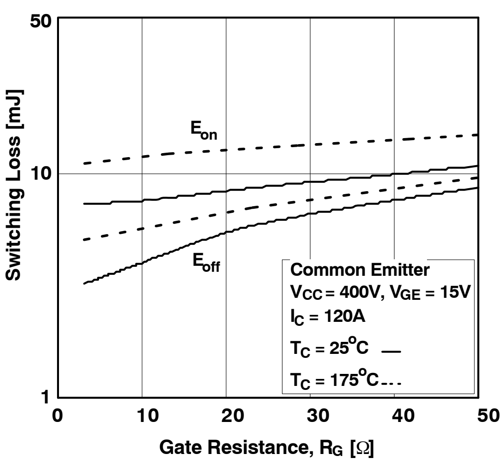


Figure 17. Switching Loss vs Gate Resistance

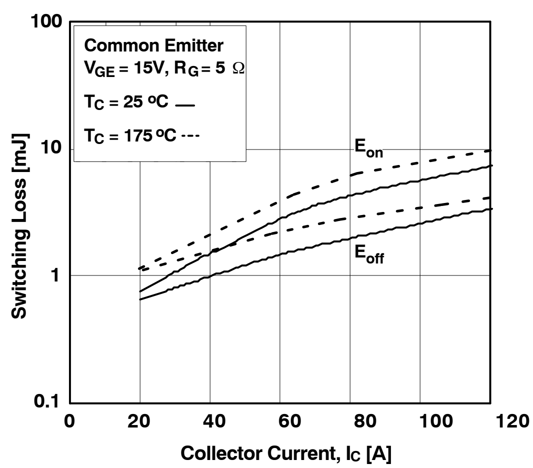


Figure 18. Switching Loss vs Collector Current

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

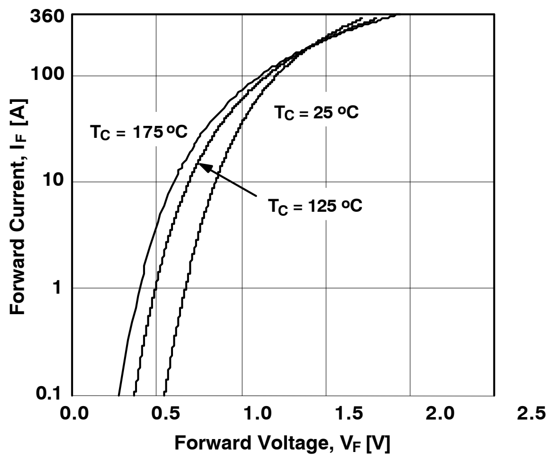


Figure 19. Forward Characteristics

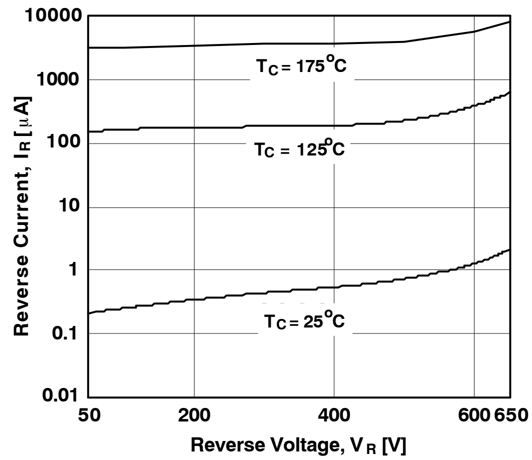


Figure 20. Reverse Current

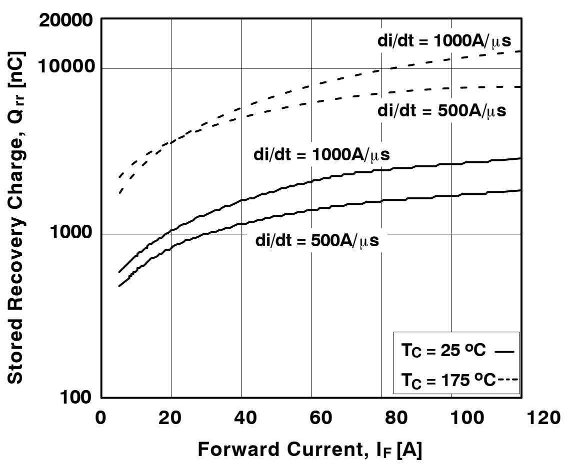


Figure 21. Stored Charge

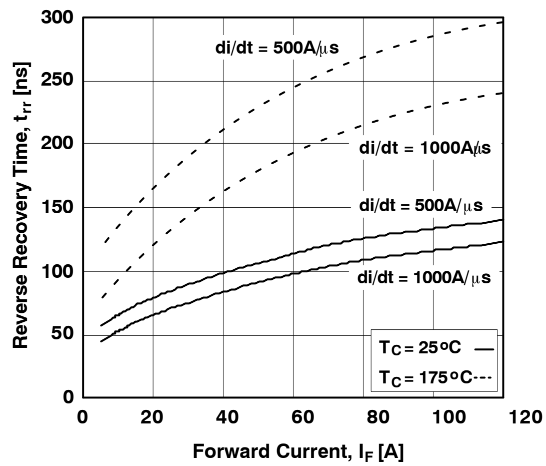


Figure 22. Reverse Recovery Time

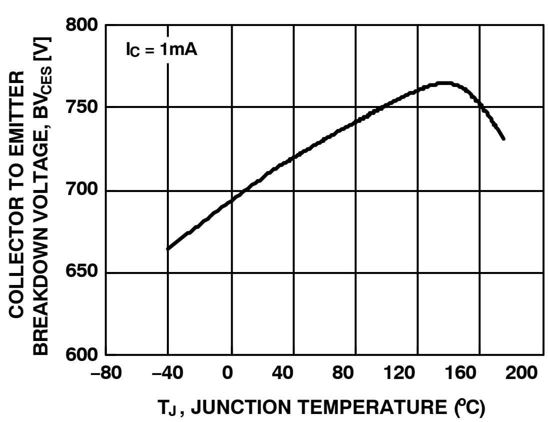


Figure 23. Collector to Emitter Breakdown Voltage vs. Junction Temperature

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

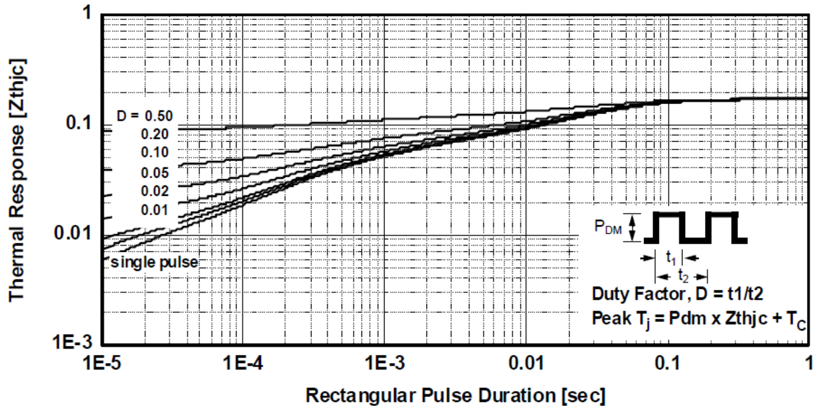


Figure 24. Transient Thermal Impedance of IGBT

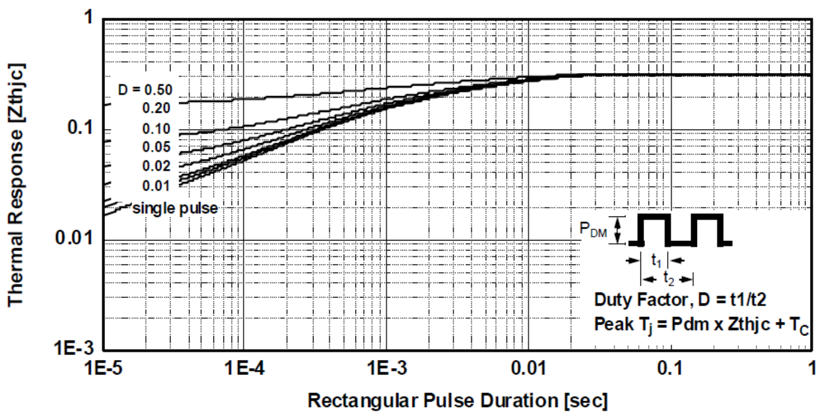


Figure 25. Transient Thermal Impedance of Diode

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ISSUE A

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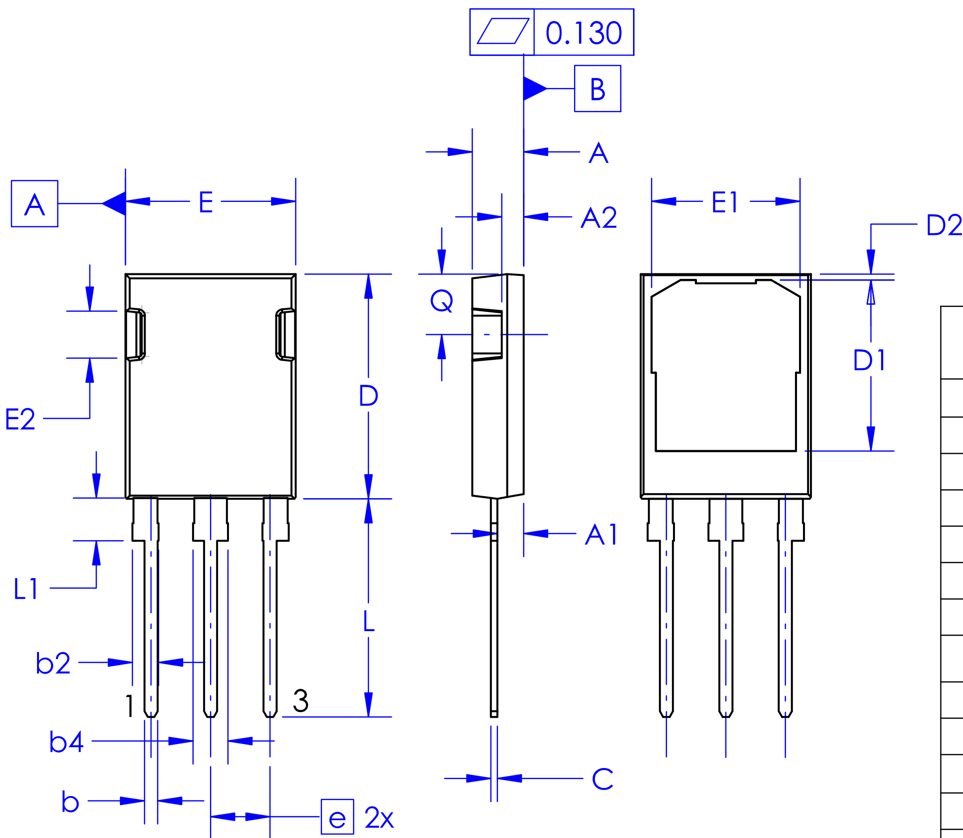

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.50	4.70	4.90
A1	2.10	2.40	2.70
A2	1.70	2.00	2.30
b	1.00	1.20	1.400
b2	2.20	2.40	2.60
b4	3.00	3.20	3.40
c	0.40	0.60	0.80
D	20.40	20.60	20.80
D1	15.47	15.67	15.87
D2	0.25	0.55	0.85
e	5.45 BSC		
E	15.40	15.60	15.80
E1	13.40	13.60	13.80
E2	4.12	4.30	4.52
L	19.70	20.00	20.30
L1	3.65	3.85	4.05
Q	5.35	5.55	5.75

NOTES:

A. NO INDUSTRY STANDARDS APPLIES TO THIS PACKAGE.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
D. DRAWING CONFORMS TO ASME Y14.5-2009.

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DESCRIPTION:	TO−247−3LD	PAGE 1 OF 1

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