

IGBT - Field Stop, Trench

650 V, 40 A

FGB40T65SPD-F085

General Description

Using the novel field stop 3rd generation IGBT technology, FGH40T65SPD-F085 offers the optimum performance with both low conduction loss and switching loss for a high efficiency operation in various applications, while provides 50 V higher blocking voltage and rugged high current switching reliability. Meanwhile, this part also offers an advantage of outstanding performance in parallel operation.

Features

- Low Saturation Voltage: $V_{CE(sat)} = 2.0 \text{ V (Typ.) @ } I_C = 40 \text{ A}$
- 100% of the Parts are Dynamically Tested *
- Short Circuit Ruggedness $> 5 \mu\text{s @ } 25^\circ\text{C}$
- Maximum Junction Temperature : $T_J = 175^\circ\text{C}$
- Fast Switching
- Tight Parameter Distribution
- Positive Temperature Coefficient for Easy Parallel Operation
- Copacked with Soft, Fast Recovery Diode
- AEC-Q101 Qualified and PPAP Capable
- This Device is Pb-Free and are RoHS Compliant

* $V_{CC} = 400 \text{ V}$, $V_{GE} = 15 \text{ V}$, $I_C = 120 \text{ A}$, $R_G = 20 \Omega$, Inductive Load

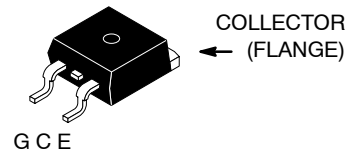
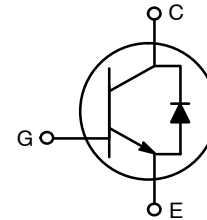
Applications

- Onboard Charger
- AirCon Compressor
- PTC Heater
- Motor Drivers
- Other Automotive Power-train and Auxiliary Applications



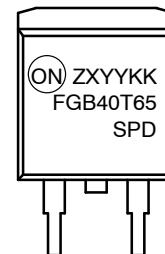
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D²PAK-3 (TO-263, 3-LEAD)
CASE 418AJ

MARKING DIAGRAM



FGB40T65SPD = Specific Device Code
Z = Assembly Plant Code
XYY = 3-Digit Data Code
KK = 2-Digits Lot Run Traceability

ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

FGB40T65SPD-F085

ABSOLUTE MAXIMUM RATINGS

Symbol	Description	Ratings	Unit
V_{CES}	Collector to Emitter Voltage	650	V
V_{GES}	Gate to Emitter Voltage	± 20	V
	Transient Gate to Emitter Voltage	± 30	V
I_C	Collector Current @ $T_C = 25^\circ\text{C}$	80	A
	Collector Current @ $T_C = 100^\circ\text{C}$	40	A
I_{CM}	Pulsed Collector Current (Note 1)	120	A
I_F	Diode Forward Current @ $T_C = 25^\circ\text{C}$	40	A
	Diode Forward Current @ $T_C = 100^\circ\text{C}$	20	A
I_{FM}	Pulsed Diode Maximum Forward Current (Note 1)	120	A
P_D	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$	267	W
	Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$	134	W
SCWT	Short Circuit Withstand Time @ $T_C = 25^\circ\text{C}$	5	μs
T_J	Operating Junction Temperature	-55 to +175	$^\circ\text{C}$
T_{stg}	Storage Temperature Range	-55 to +175	$^\circ\text{C}$
T_L	Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds	300	$^\circ\text{C}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Repetitive rating: pulse width limited by max. junction temperature

ELECTRICAL CHARACTERISTICS OF THE IGBT ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

BV_{CES}	Collector to Emitter Breakdown Voltage	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	650	-	-	V
$\frac{\Delta BV_{CES}}{\Delta T_J}$	Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	-	0.6	-	$\text{V}/^\circ\text{C}$
I_{CES}	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0\text{ V}$	-	-	250	μA
I_{GES}	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0\text{ V}$	-	-	± 400	nA

ON CHARACTERISTICS

$V_{GE(th)}$	G-E Threshold Voltage	$I_C = 40\text{ mA}, V_{CE} = V_{GE}$	4.0	5.8	7.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	-	2.0	2.4	V
		$I_C = 40\text{ A}, V_{GE} = 15\text{ V}, T_C = 175^\circ\text{C}$	-	2.9	-	V

DYNAMIC CHARACTERISTICS

C_{ies}	Input Capacitance	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	-	1520	-	pF
C_{oes}	Output Capacitance		-	92	-	pF
C_{res}	Reverse Transfer Capacitance		-	15	-	pF

SWITCHING CHARACTERISTICS

$T_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400\text{ V}, I_C = 40\text{ A}, R_G = 6\ \Omega,$ $V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 25^\circ\text{C}$	-	18	-	ns
T_r	Rise Time		-	26	-	ns
$T_{d(off)}$	Turn-Off Delay Time		-	35	-	ns
T_f	Fall Time		-	10	-	ns
E_{on}	Turn-On Switching Loss		-	0.97	-	mJ
E_{off}	Turn-Off Switching Loss		-	0.28	-	mJ
E_{ts}	Total Switching Loss		-	1.25	-	mJ

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ELECTRICAL CHARACTERISTICS OF THE IGBT ($T_C = 25^\circ\text{C}$ unless otherwise noted) (continued)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
SWITCHING CHARACTERISTICS						
$T_{d(on)}$	Turn-On Delay Time	$V_{CC} = 400\text{ V}$, $I_C = 40\text{ A}$, $R_G = 6\ \Omega$, $V_{GE} = 15\text{ V}$, Inductive Load, $T_C = 175^\circ\text{C}$	-	14	-	ns
T_r	Rise Time		-	35	-	ns
$T_{d(off)}$	Turn-Off Delay Time		-	38	-	ns
T_f	Fall Time		-	13	-	ns
E_{on}	Turn-On Switching Loss		-	1.61	-	mJ
E_{off}	Turn-Off Switching Loss		-	0.47	-	mJ
E_{ts}	Total Switching Loss		-	2.08	-	mJ
T_{SC}	Short Circuit Withstand Time	$V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$	5	-	-	μs
Q_g	Total Gate Charge	$V_{CE} = 400\text{ V}$, $I_C = 40\text{ A}$, $V_{GE} = 15\text{ V}$	-	36	-	nC
Q_{ge}	Gate to Emitter Charge		-	12	-	nC
Q_{gc}	Gate to Collector Charge		-	11	-	nC

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

ELECTRICAL CHARACTERISTICS OF THE DIODE ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit	
V_{FM}	Diode Forward Voltage	$I_F = 20\text{ A}$	$T_C = 25^\circ\text{C}$	-	2.0	2.7	V
			$T_C = 175^\circ\text{C}$	-	1.8	-	
E_{rec}	Reverse Recovery Energy	$I_F = 20\text{ A}$, $di_F/dt = 200\text{ A}/\mu\text{s}$	$T_C = 175^\circ\text{C}$	-	51	-	μJ
T_{rr}	Diode Reverse Recovery Time		$T_C = 25^\circ\text{C}$	-	34	-	ns
			$T_C = 175^\circ\text{C}$	-	206	-	
Q_{rr}	Diode Reverse Recovery Charge		$T_C = 25^\circ\text{C}$	-	56	-	nC
		$T_C = 175^\circ\text{C}$	-	731	-		

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

THERMAL CHARACTERISTICS

Symbol	Parameter	Typ	Max	Unit
$R_{\theta JC}(\text{IGBT})$	Thermal Resistance, Junction to Case	-	0.56	$^\circ\text{C}/\text{W}$
$R_{\theta JC}(\text{Diode})$	Thermal Resistance, Junction to Case	-	1.71	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	40	$^\circ\text{C}/\text{W}$

TYPICAL PERFORMANCE CHARACTERISTICS

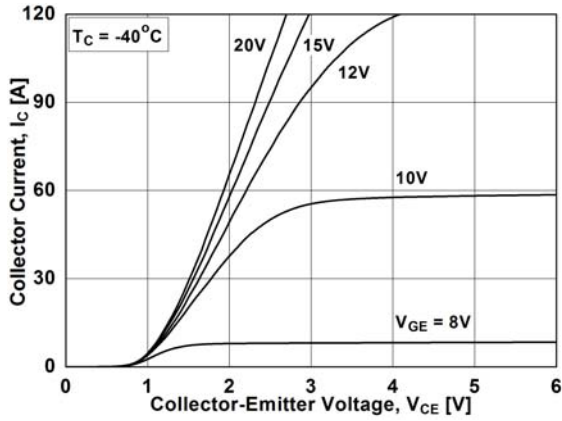


Figure 1. Typical Output Characteristics

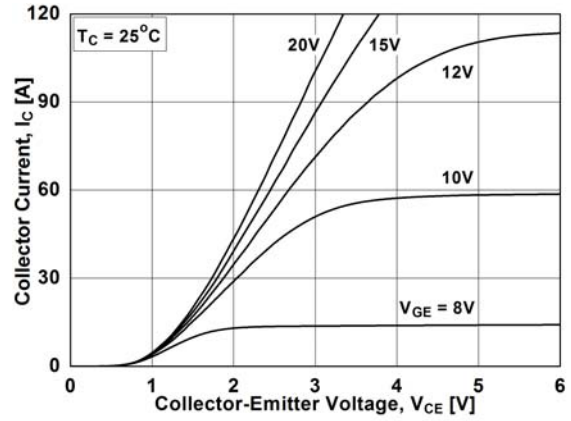


Figure 2. Typical Output Characteristics

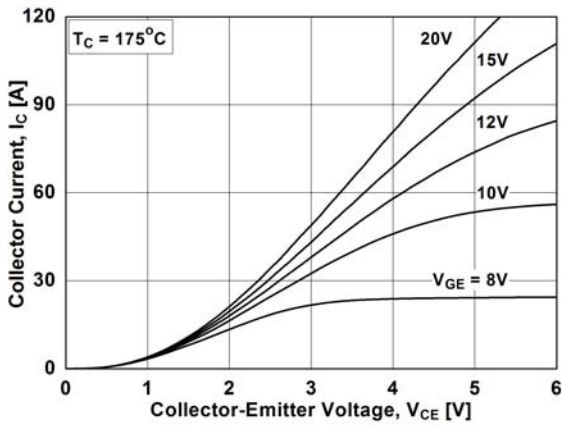


Figure 3. Typical Output Characteristics

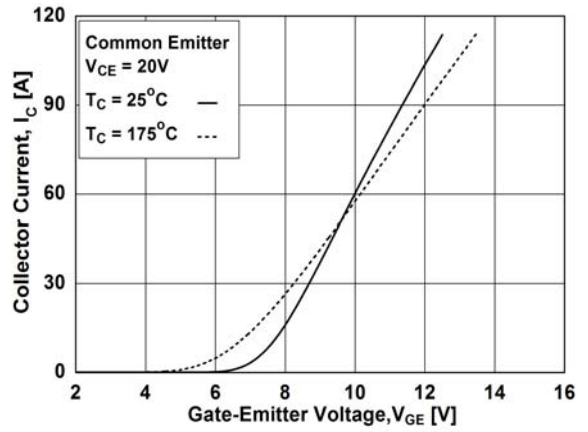


Figure 4. Transfer Characteristic

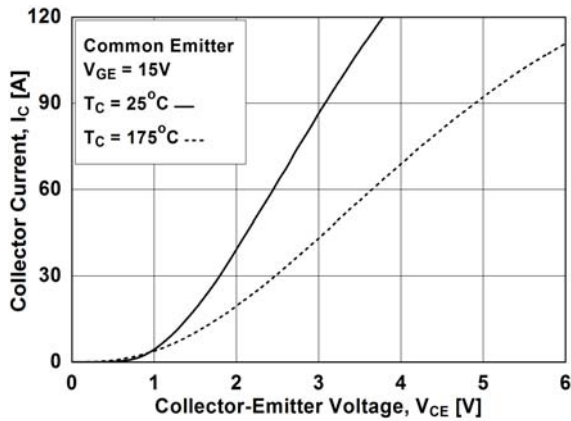


Figure 5. Typical Saturation Voltage

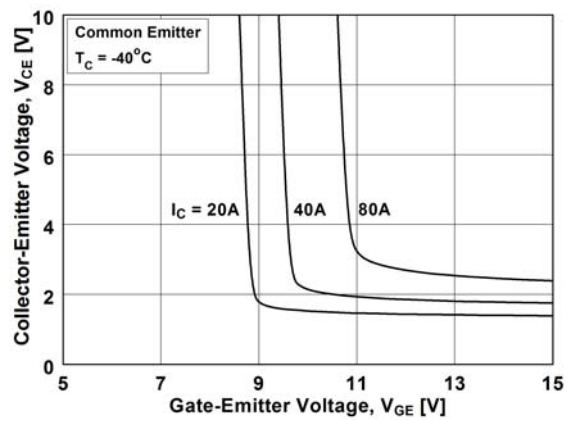


Figure 6. Saturation Voltage vs. V_{GE} Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

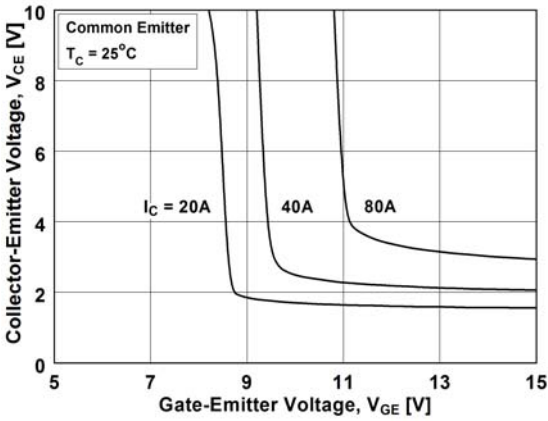


Figure 7. Saturation Voltage vs. V_{GE}

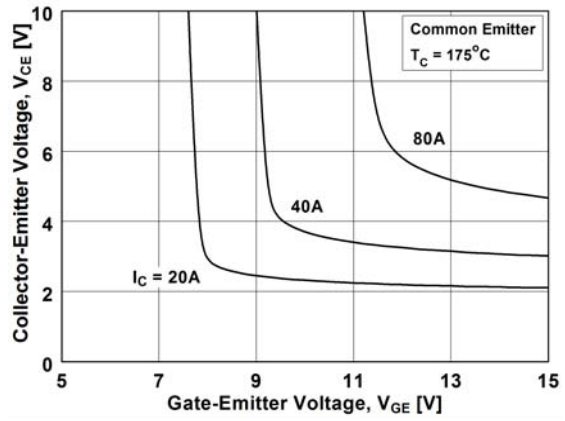


Figure 8. Saturation Voltage vs. V_{GE}

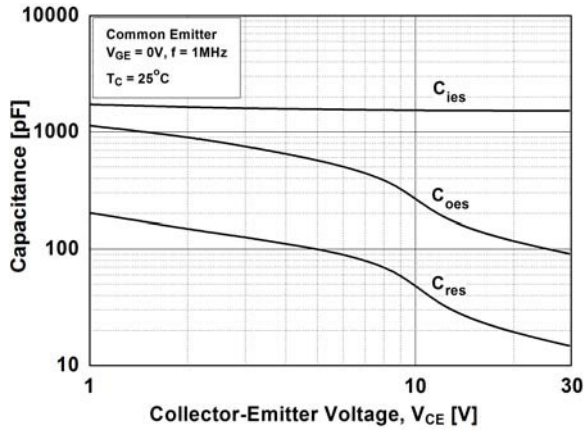


Figure 9. Capacitance Characteristics

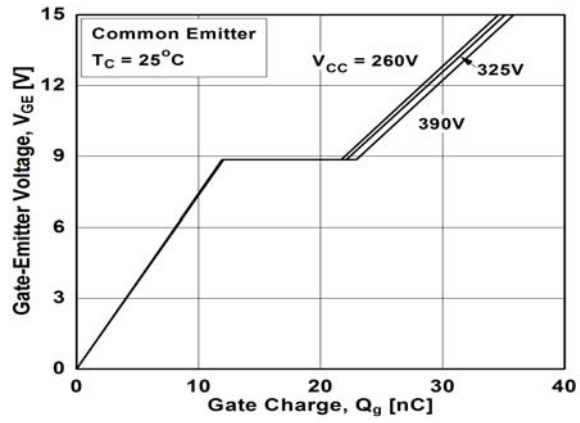


Figure 10. Gate Charge Characteristics

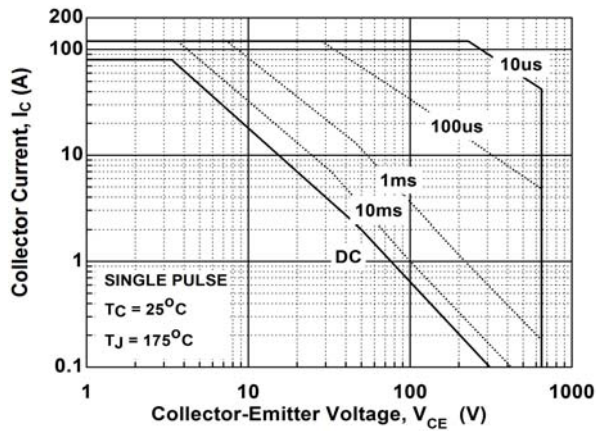


Figure 11. SOA Characteristics

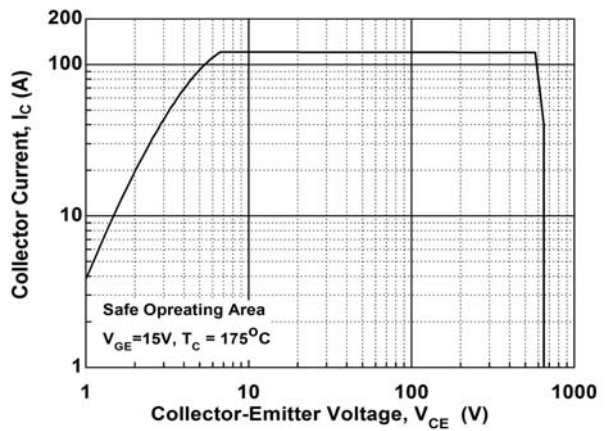


Figure 12. Turn Off Switching SOA Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

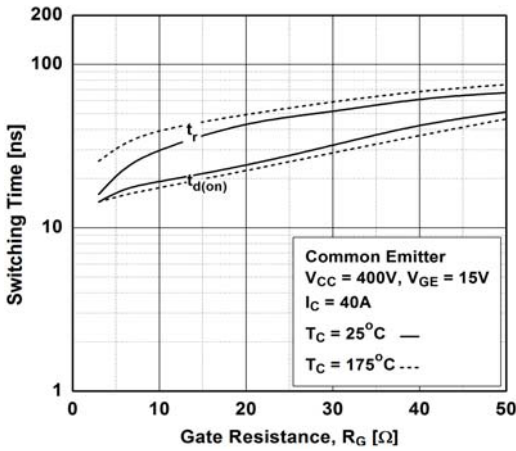


Figure 13. Turn-on Characteristics vs. Gate Resistance

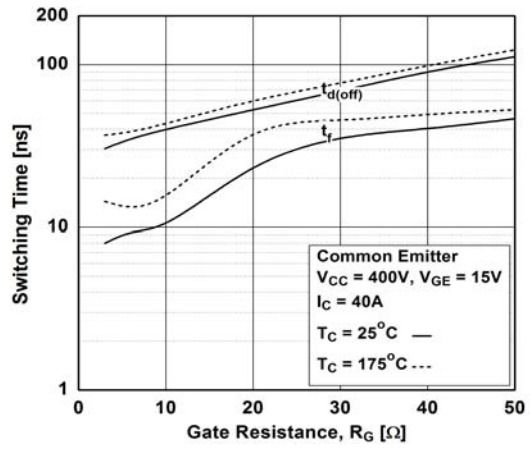


Figure 14. Turn-off Characteristics vs. Gate Resistance

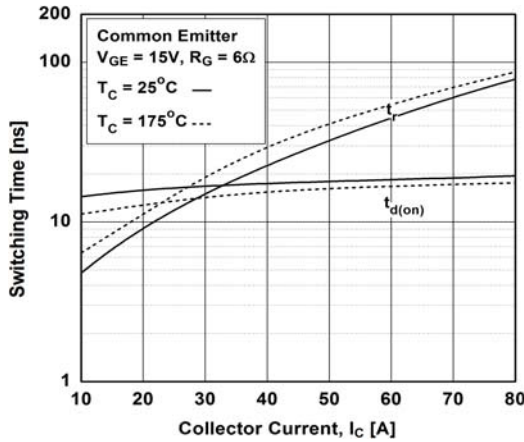


Figure 15. Turn-on Characteristics vs. Collector Current

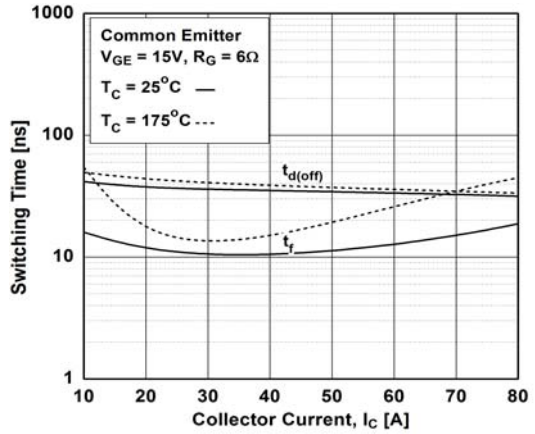


Figure 16. Turn-off Characteristics vs. Collector Current

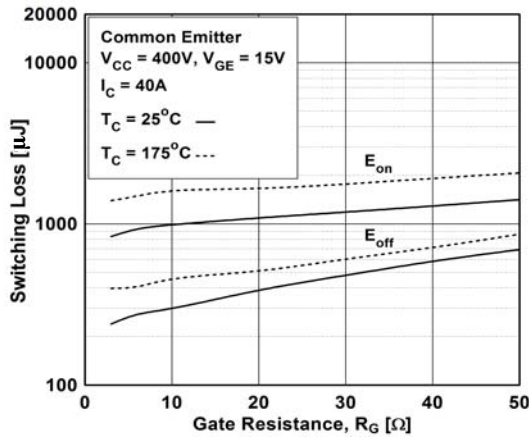


Figure 17. Switching Loss vs. Gate Resistance

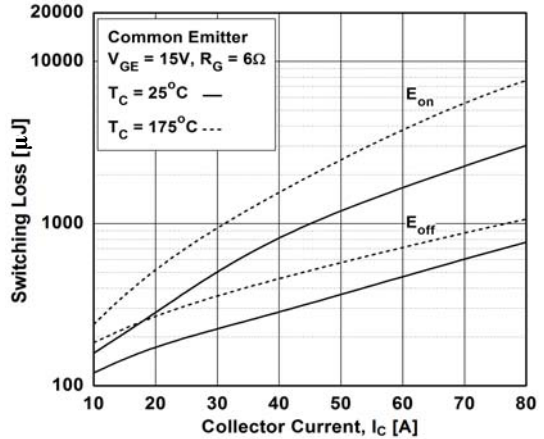


Figure 18. Switching Loss vs. Collector Current

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

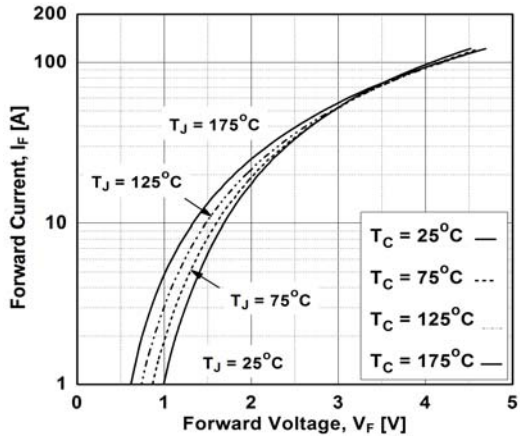


Figure 19. Forward Characteristics

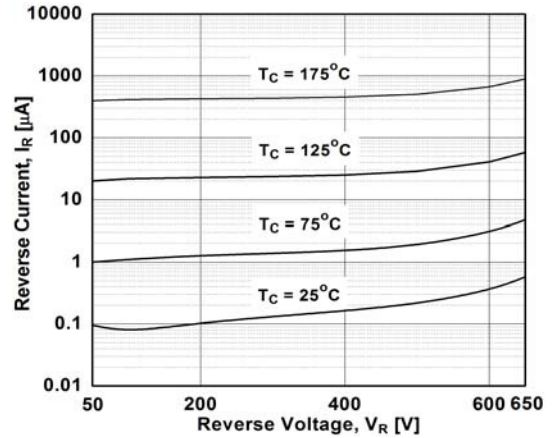


Figure 20. Reverse Current

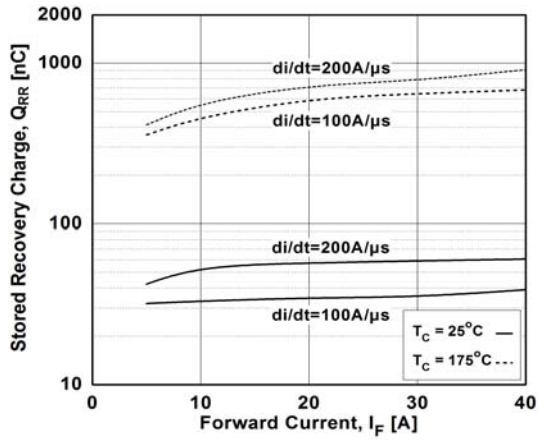


Figure 21. Stored Charge

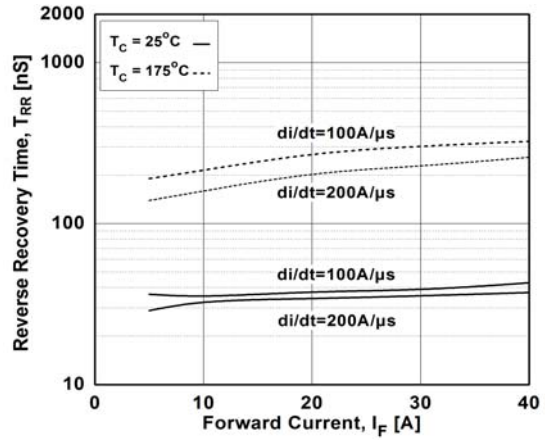


Figure 22. Reverse Recovery Time

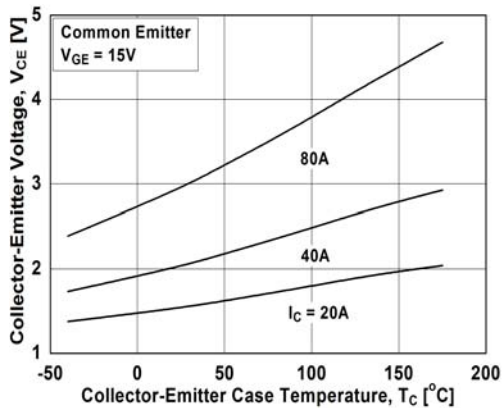


Figure 23. Saturation Voltage vs. Case Temperature at Variant Current Level

FGB40T65SPD-F085

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

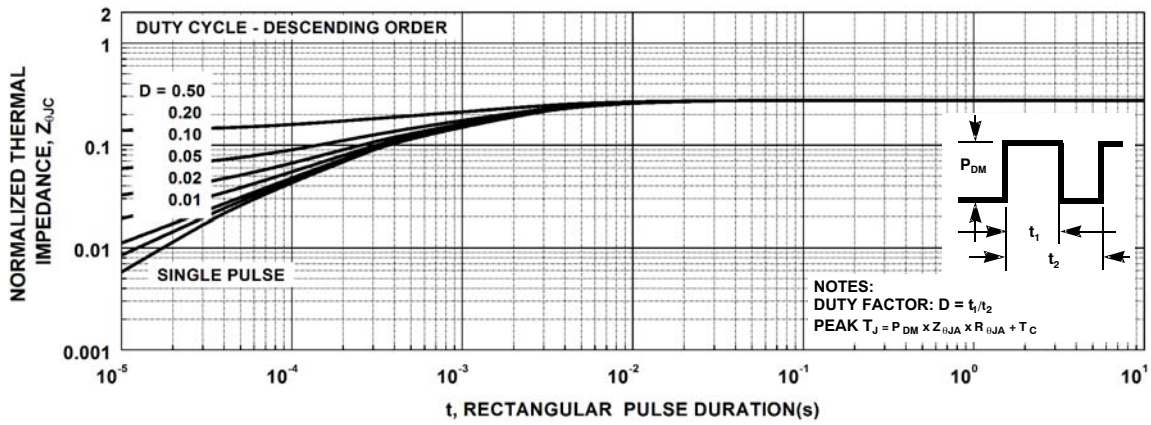


Figure 24. Transient Thermal Impedance of IGBT

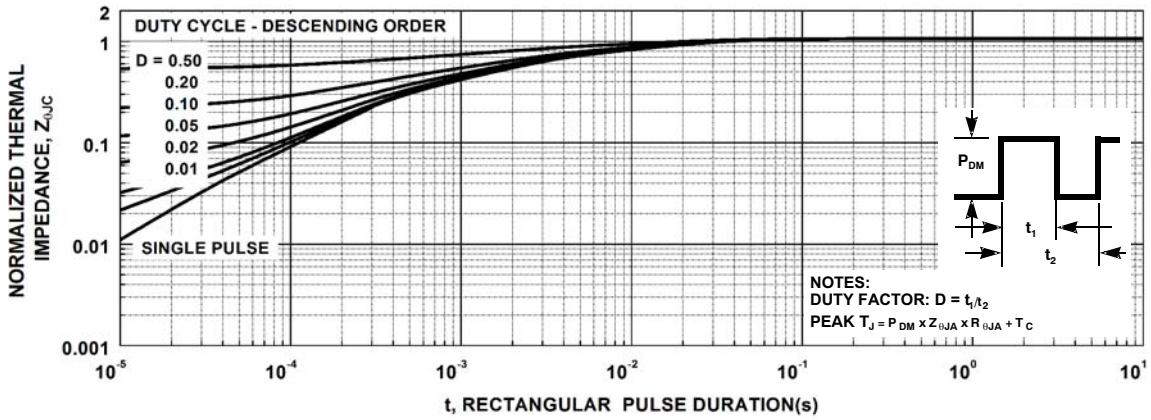
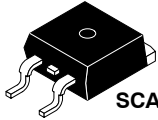


Figure 25. Transient Thermal Impedance of Diode

PACKAGE MARKING AND ORDERING INFORMATION

Device Marking	Device	Package	Reel Size	Tape Width	Shipping†
FGB40T65SPD	FGB40T65SPD-F085	D ² PAK-3 (TO-263, 3-LEAD) (Pb-Free)	-	-	800 / Tape & Reel

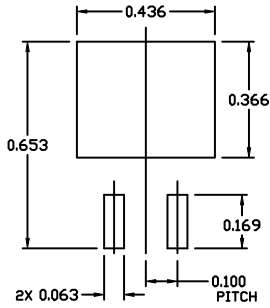
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



SCALE 1:1

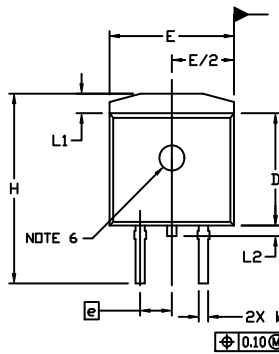
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CASE 418AJ
ISSUE F

DATE 11 MAR 2021



RECOMMENDED
MOUNTING FOOTPRINT

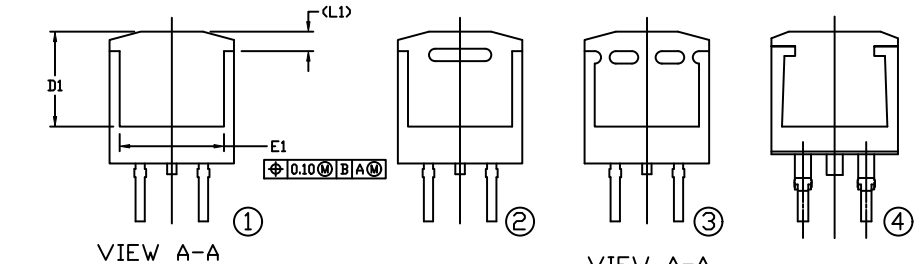
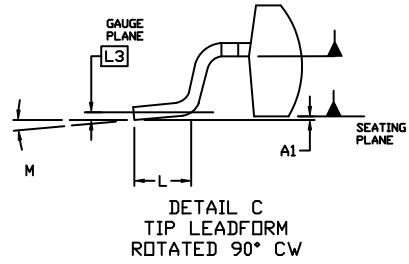
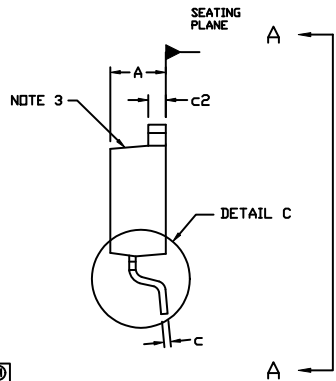
For additional information on our Pb-free strategy and soldering details, please download the IN Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D.



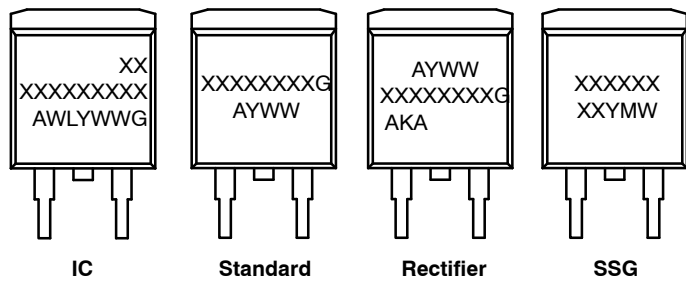
NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
- CONTROLLING DIMENSION: INCHES
- CHAMFER OPTIONAL.
- DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005 PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
- THERMAL PAD CONTOUR IS OPTIONAL WITHIN DIMENSIONS E, L1, D1, AND E1.
- OPTIONAL MOLD FEATURE.
- ①, ② ... OPTIONAL CONSTRUCTION FEATURE CALL OUTS.

DIM	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.160	0.190	4.06	4.83
A1	0.000	0.010	0.00	0.25
b	0.020	0.039	0.51	0.99
c	0.012	0.029	0.30	0.74
c2	0.045	0.065	1.14	1.65
D	0.330	0.380	8.38	9.65
D1	0.260	---	6.60	---
E	0.380	0.420	9.65	10.67
E1	0.245	---	6.22	---
e	0.100 BSC	---	2.54 BSC	---
H	0.575	0.625	14.60	15.88
L	0.070	0.110	1.78	2.79
L1	---	0.066	---	1.68
L2	---	0.070	---	1.78
L3	0.010 BSC	---	0.25 BSC	---
M	0°	8°	0°	8°



GENERIC MARKING DIAGRAMS*



- XXXXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- Y = Year
- WW = Work Week
- W = Week Code (SSG)
- M = Month Code (SSG)
- G = Pb-Free Package
- AKA = Polarity Indicator

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

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