Field Stop IGBT

600 V, 20 A

Product Preview

AFGB20N60SFD-BW

ON Semiconductor®

www.onsemi.com

BV_{CES}	$V_{CE(sat)}$ TYP	I_C MAX
650 V	1.6 V	120 A

General Description

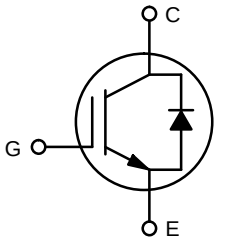
Using novel field−stop IGBT technology, ON Semiconductor's new series of field−stop IGBTs offers the optimum performance for automotive chargers, inverters, and other applications where low conduction and switching losses are essential.

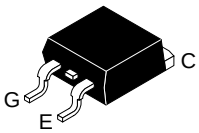
Features

- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)}$ = 2.2 V @ I_C = 20 A
- High Input Impedance
- Fast Switching
- AEC−Q101 Qualified to Automotive Requirements
- These Devices are Pb−Free and are RoHS Compliant

Typical Applications

- Inverters, SMPS, PFC, UPS
- Automotive Chargers, Converters, High Voltage Auxiliaries





D²PAK
3 LEAD
CASE xxx

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C unless otherwise stated)

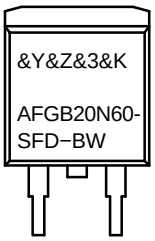
Parameter	Symbol	Value	Unit
Collector−to−Emitter Voltage	V_{CES}	600	V
Gate−to−Emitter Voltage	V_{GES}	±20	V
Collector Current (T_C = 25°C)	I_C	40	A
Collector Current (T_C = 100°C)		20	A
Pulsed Collector Current (Note 1)	I_{CM}	60	A
Diode Forward Current (T_C = 25°C)	I_F	20	A
Diode Forward Current (T_C = 100°C)		10	A
Pulsed Diode Maximum Forward Current (Note 1)	I_{FM}	60	A
Maximum Power Dissipation (T_C = 25°C)	P_D	208	W
Maximum Power Dissipation (T_C = 100°C)		83	W
Operating Junction and Storage Temperature Range	T_J, T_{STG}	−55 to +150	°C
Maximum Lead Temp. For Soldering Purposes, 1/8" from case for 5 seconds	T_L	300	°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

This document contains information on a product under development. ON Semiconductor reserves the right to change or discontinue this product without notice.

MARKING DIAGRAM



&Y = ON Semiconductor Logo
&Z = Assembly Plant Code
&3 = 3−Digit Date Code
&K = 2−Digit Lot Traceability Code
AFGB20N60SFD−BW = Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping†
AFGB20N60SFD−BW	D2PAK (TO−263)	800 Units / Tape & Reel

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

Table 1. THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
Thermal Resistance Junction−to−Case, for IGBT	$R_{\theta JC}$	0.6	°C/W
Thermal Resistance Junction−to−Case, for Diode	$R_{\theta JC}$	2.6	
Thermal Resistance Junction−to−Ambient (PCB Mount) (Note 2)	$R_{\theta JA}$	75	

2. $R_{\theta JC}$ for D2−PAK: according to Mil standard 883−1012 test method.
$R_{\theta JA}$ for D2−PAK: according to JESD51−2, test method environmental condition and JESD51−3,low effective thermal conductivity test board for leaded surface mount package. thermal measurements. JESD51−2: Integrated Circuits Thermal Test Method Environmental Conditions − Natural Convection (Still Air).

Table 2. ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise stated)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector−to−Emitter Breakdown Voltage	BV_{CES}	V_{GE} = 0 V, I_C = 250 μA	600	−	−	V
Temperature Coefficient of Breakdown Voltage	$\Delta BV_{CES}/\Delta T_J$	V_{GE} = 0 V, I_C = 250 μA	−	0.79	−	V/°C
Collector Cut−Off Current	I_{CES}	V_{CE} = V_{CES}, V_{GE} = 0 V	−	−	250	μA
		ICES at 80% *BVCES, 150°C	−	−	250	
G−E Leakage Current	I_{GES}	V_{GE} = V_{GES}, V_{CE} = 0 V	−	−	±400	nA
ON CHARACTERISTICS						
G−E Threshold Voltage	$V_{GE(th)}$	V_{GE} = V_{CE}, I_C = 250 μA	4.0	4.8	6.5	V
Collector−to−Emitter Saturation Voltage	$V_{CE(sat)}$	I_C = 20 A, V_{GE} = 15 V, T_C = 25°C	−	2.2	2.85	V
		I_C = 20 A, V_{GE} = 15 V, T_C = 125°C	−	2.4	−	V
DYNAMIC CHARACTERISTICS						
Input Capacitance	C_{ies}	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz	−	940	1250	pF
Output Capacitance	C_{oes}		−	110	146	
Reverse Transfer Capacitance	C_{res}		−	40	53	
SWITCHING CHARACTERISTICS						
Turn−On Delay Time	$t_{d(on)}$	V_{CC} = 400 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V, Inductive Load, T_C = 25°C	−	10	13	ns
Rise Time	t_r		−	16	21	ns
Turn−Off Delay Time	$t_{d(off)}$		−	90	120	ns
Fall Time	t_f		−	24	36	ns
Turn−On Switching Loss	E_{on}		−	0.31	0.41	mJ
Turn−Off Switching Loss	E_{off}		−	0.13	0.21	mJ
Total Switching Loss	E_{ts}		−	0.44	0.59	mJ
Turn−On Delay Time	$t_{d(on)}$	V_{CC} = 400 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V, Inductive Load, T_C = 125°C	−	12	16	ns
Rise Time	t_r		−	16	21	ns
Turn−Off Delay Time	$t_{d(off)}$		−	95	126	ns
Fall Time	t_f		−	28	43	ns
Turn−On Switching Loss	E_{on}		−	0.45	0.60	mJ
Turn−Off Switching Loss	E_{off}		−	0.21	0.38	mJ
Total Switching Loss	E_{ts}		−	0.66	0.88	mJ
Total Gate Charge	Q_g	V_{CE} = 400 V, I_C = 20 A, V_{GE} = 15 V	−	63	95	nC
Gate−to−Emitter Charge	Q_{ge}		−	7	11	nC
Gate−to−Collector Charge	Q_{gc}		−	32	48	nC

Table 2. ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise stated)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
DIODE CHARACTERISTICS						
Diode Forward Voltage	V_{FM}	I_F = 10 A, T_C = 25°C	−	1.9	2.5	V
		I_F = 10 A, T_C = 125°C	−	1.7	−	
Diode Reverse Recovery Time	t_{rr}	I_{ES} = 10 A dI_{ES}/dt = 200 A/μs, T_C = 25°C	−	111	−	ns
Diode Reverse Recovery Charge	Q_{rr}		−	174	244	nC
Diode Reverse Recovery Time	t_{rr}	I_{ES} = 10 A dI_{ES}/dt = 200 A/μs, T_C = 125°C	−	204	−	ns
Diode Reverse Recovery Charge	Q_{rr}		−	463	−	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.

TYPICAL PERFORMANCE CHARACTERISTICS

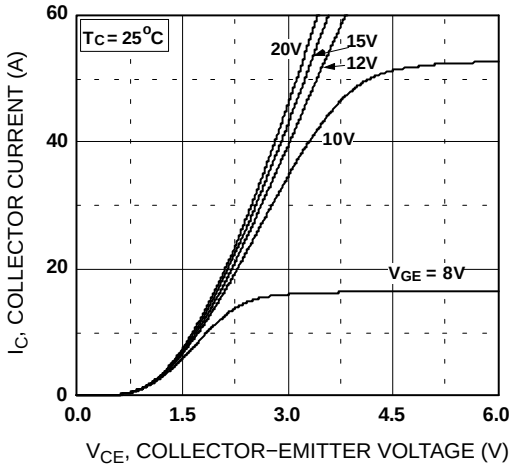


Figure 1. Typical Output Characteristics (25°C)

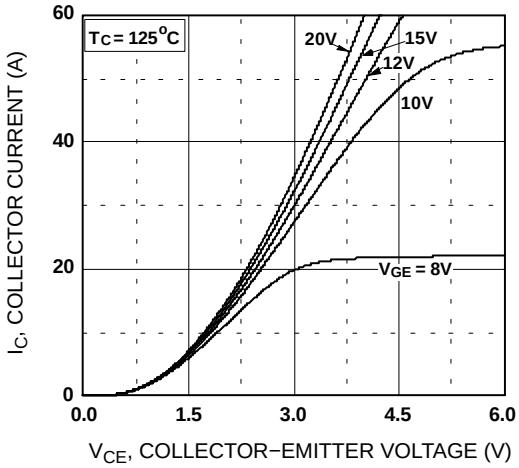


Figure 2. Typical Output Characteristics (125°C)

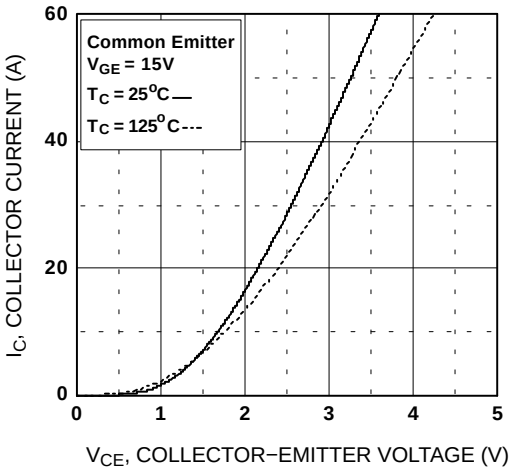


Figure 3. Typical Saturation Voltage Characteristics

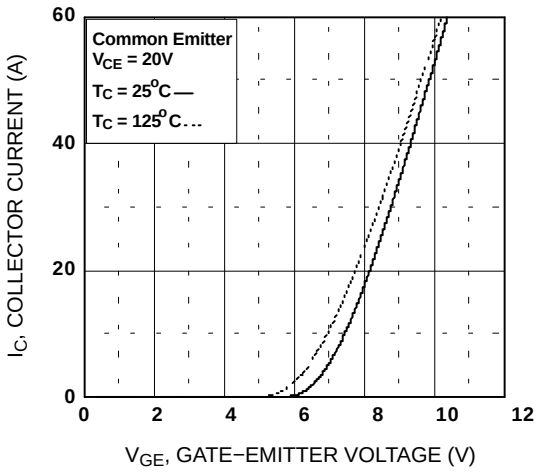


Figure 4. Transfer Characteristics

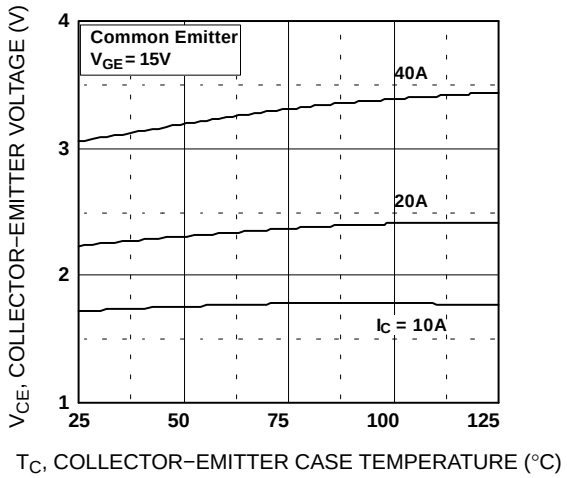


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

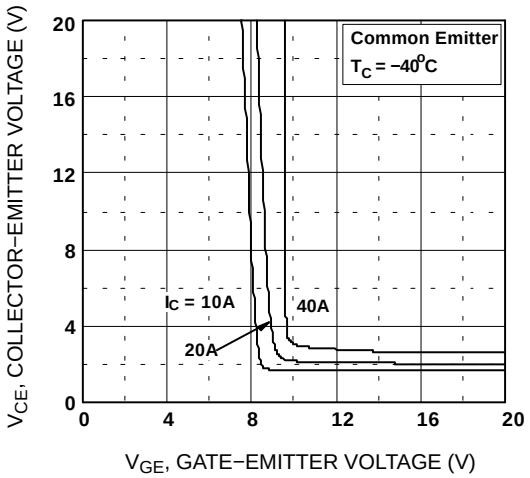


Figure 6. Saturation Voltage vs. V_{GE}

TYPICAL PERFORMANCE CHARACTERISTICS

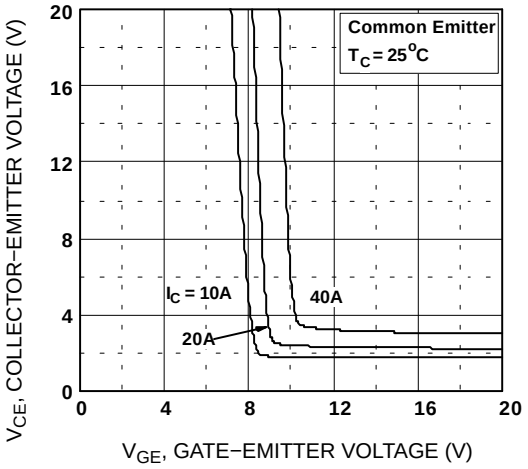


Figure 7. Saturation Voltage vs. V_{GE}

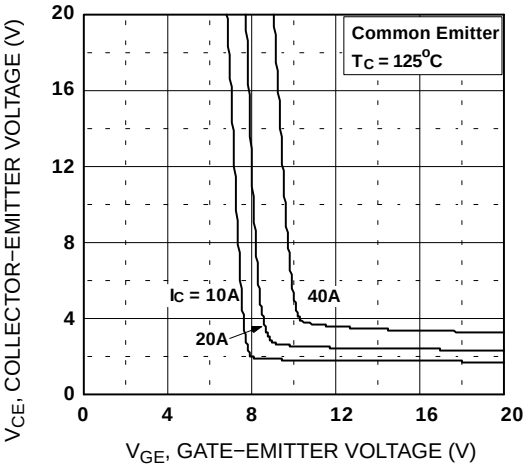


Figure 8. Saturation Voltage vs. V_{GE}

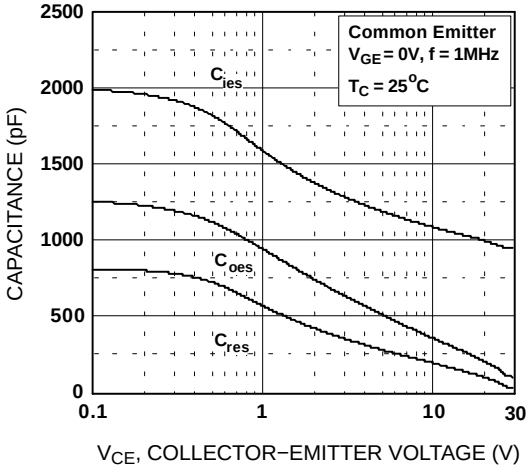


Figure 9. Capacitance Characteristics

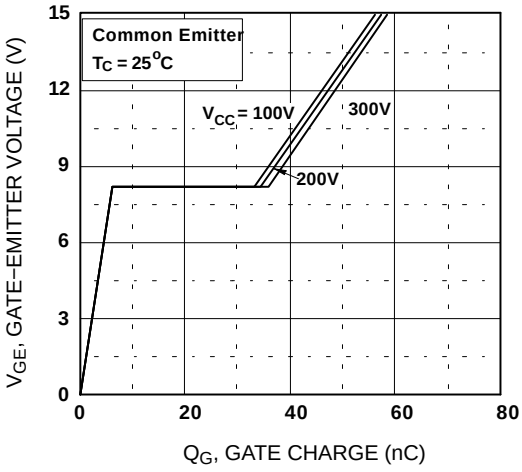


Figure 10. Gate Charge Characteristics

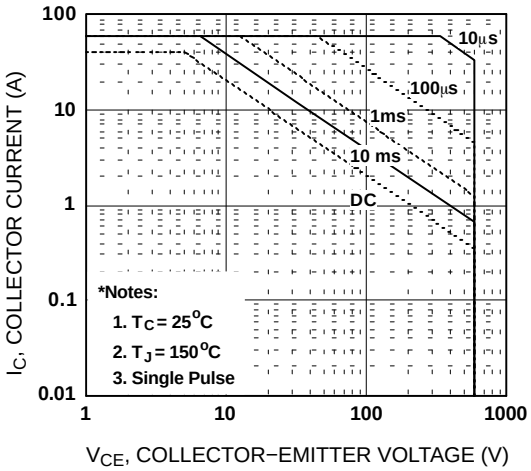


Figure 11. SOA Characteristics

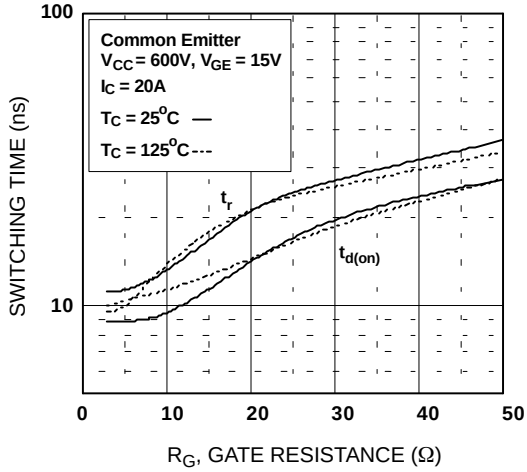


Figure 12. Turn−on Characteristics vs. Gate Resistance

TYPICAL PERFORMANCE CHARACTERISTICS

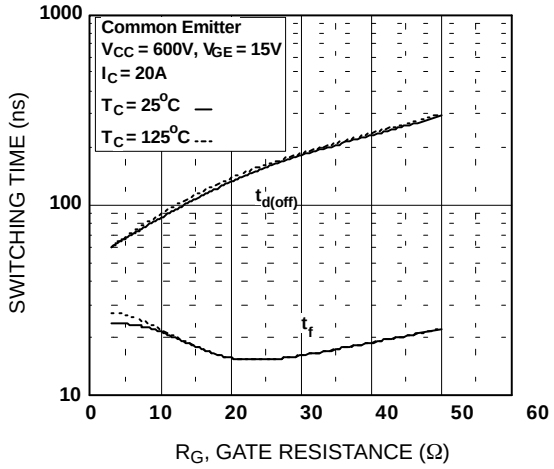


Figure 13. Turn−off Characteristics vs. Gate Resistance

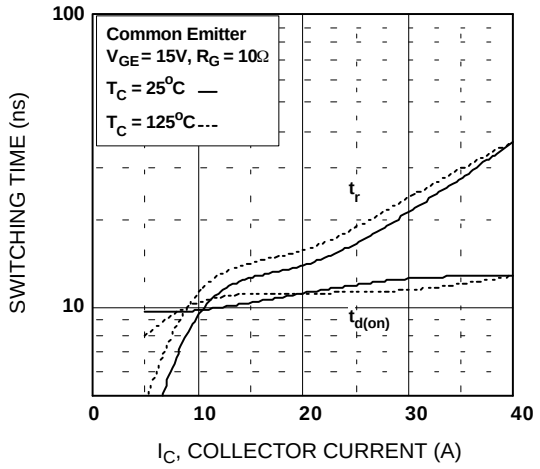


Figure 14. Turn−on Characteristics vs. Collector Current

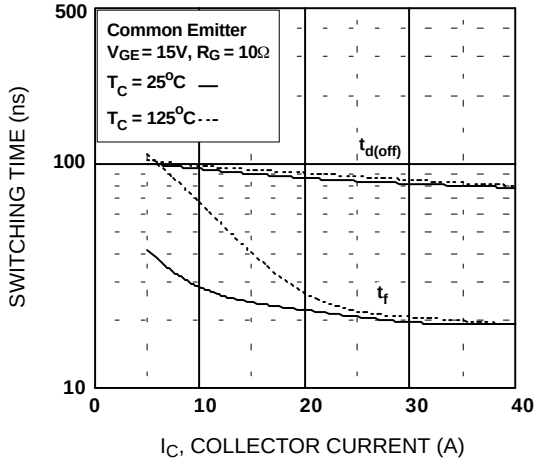


Figure 15. Turn−off Characteristics vs. Collector Current

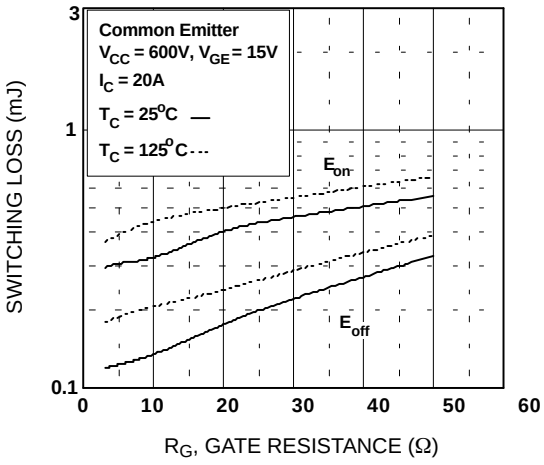


Figure 16. Switching Loss vs. Gate Resistance

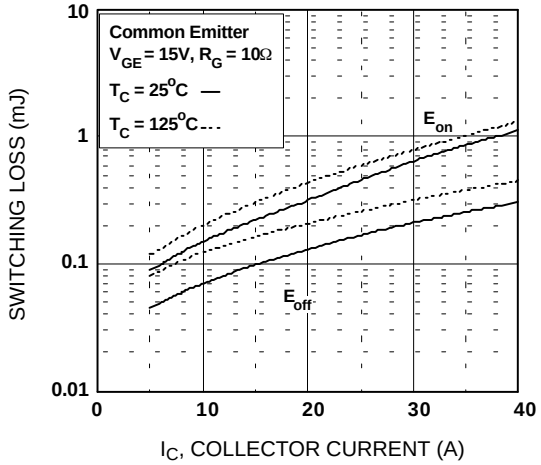


Figure 17. Switching Loss vs. Collector Current

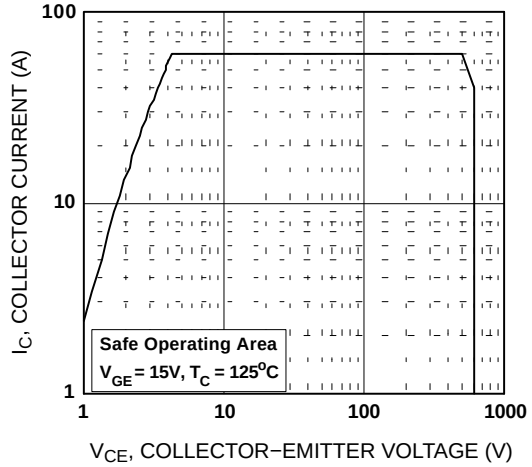


Figure 18. Turn off Switching SOA Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS

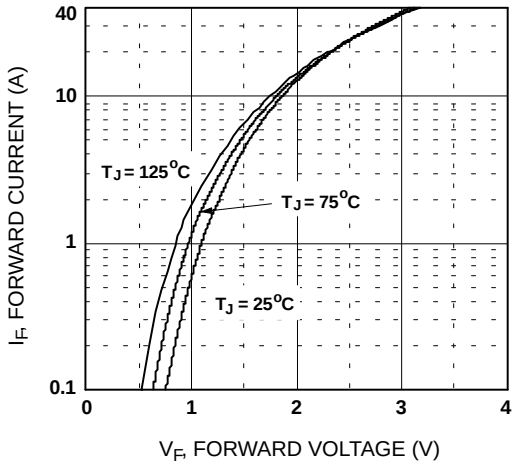


Figure 19. Forward Characteristics

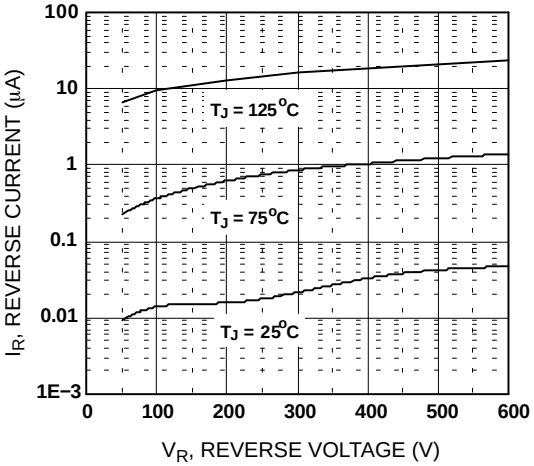


Figure 20. Typical Reverse Current vs. Reverse Voltage

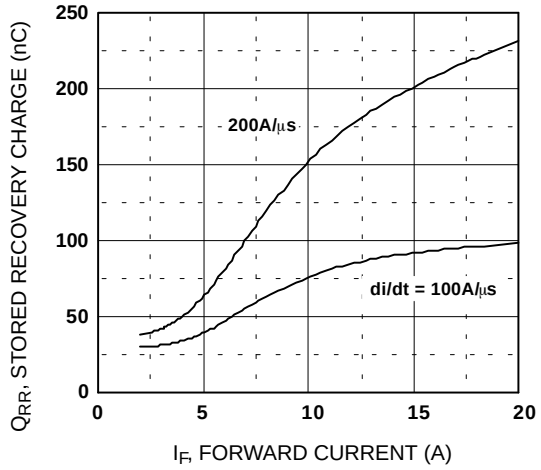


Figure 21. Stored Charge

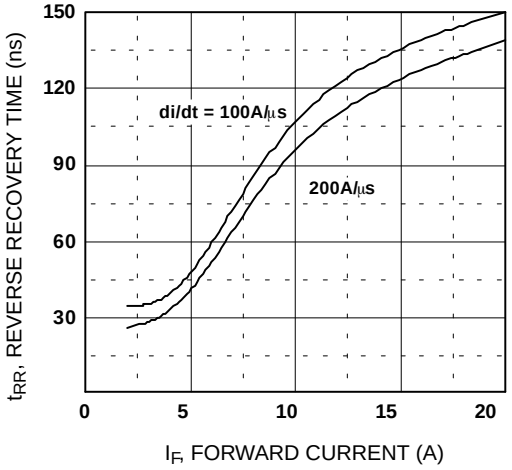


Figure 22. Reverse Recovery Time

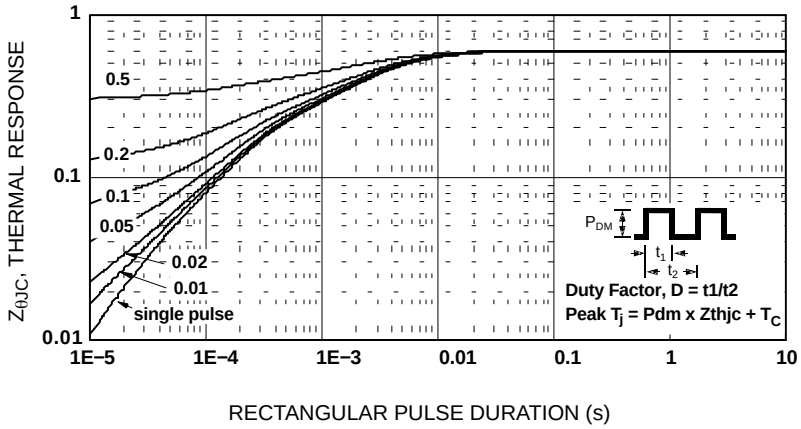
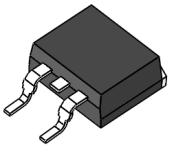


Figure 23. Transient Thermal Impedance of IGBT

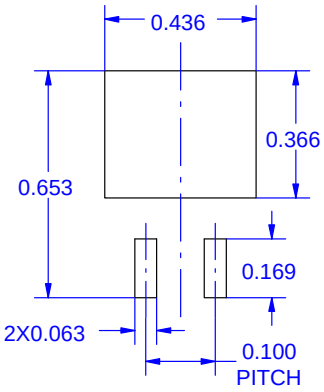
PACKAGE DIMENSIONS



D²PAK−3 (TO−263, 3−LEAD)
CASE xxx
ISSUE ?

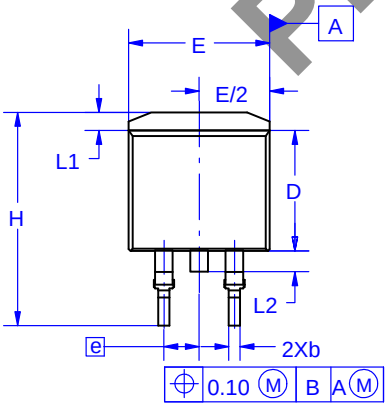
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.160	0.190	4.060	4.830
A1	0.000	0.010	0.000	0.250
b	0.020	0.039	0.510	0.990
c	0.013	0.019	0.327	0.487
c2	0.048	0.054	1.220	1.380
D	0.334	0.350	8.490	8.890
D1	0.260	−−−	6.600	−−−
E	0.380	0.420	9.650	10.670
E1	0.245	−−−	6.220	−−−
e	0.100 BSC		2.540 BSC	
H	0.575	0.625	14.600	15.880
L	0.070	0.110	1.780	2.790
L1	−−−	0.066	−−−	1.680
L2	−−−	0.070	−−−	1.780
L3	0.010 BSC		0.250 BSC	
M	−8	8·	−8	8·

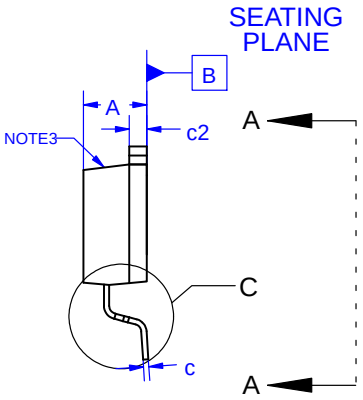
NOTES:
1.DIMENSIONING AND TOLERANCING PER ASME Y14.5M,2009.
2.CONTROLLING DIMENSION:INCHES
3.DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMS OF THE PLASTC BODY AT DATUM H.
4.THERMAL PAD CONTOUR IS OPTIONAL WITH DIMENSIONS E,L1,D1 AND E1.

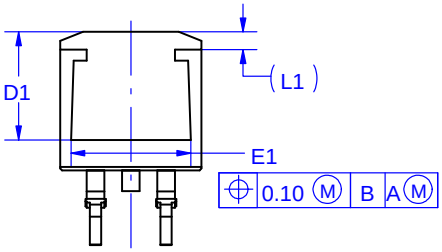


RECOMMENDED
MOUNTING FOOTPRINT

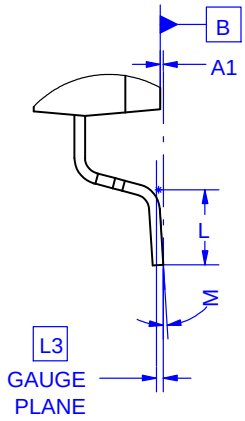
FOR additional information on our Pb−Free strategy and soldering,please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.







VIEW A−A



DETAIL C
SCALE 4 : 1

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Email Requests to: orderlit@onsemi.com

ON Semiconductor Website: www.onsemi.com

TECHNICAL SUPPORT
North American Technical Support:
Voice Mail: 1 800−282−9855 Toll Free USA/Canada
Phone: 011 421 33 790 2910

Europe, Middle East and Africa Technical Support:
Phone: 00421 33 790 2910
For additional information, please contact your local Sales Representative

◊