

Field Stop Trench IGBT, 30 A, 650 V

FGAF30S65AQ

Using novel field stop IGBT technology, ON Semiconductor's new series of field stop 4th generation of RC IGBTs offer the optimum performance for PFC applications and welder where low conduction and switching losses are essential.

Features

- Maximum Junction Temperature: $T_J = 175^{\circ}\text{C}$
- Positive Temperature Co-efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(\text{Sat})} = 1.4\text{ V (Typ.)}$ @ $I_C = 30\text{ A}$
- 100% of the Parts Tested for I_{LM} (Note 1)
- High Input Impedance
- Fast Switching
- Tighten Parameter Distribution
- IGBT with Monolithic Reverse Conducting Diode
- This Device is Pb-Free and is RoHS Compliant

Typical Applications

- PFC, Welder

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector to Emitter Voltage	V_{CES}	650	V
Gate to Emitter Voltage Transient Gate to Emitter Voltage	V_{GES}	± 20 ± 30	V
Collector Current @ $T_C = 25^{\circ}\text{C}$ @ $T_C = 100^{\circ}\text{C}$	I_C	60 30	A
Pulsed Collector Current (Note 1)	I_{LM}	90	A
Pulsed Collector Current (Note 2)	I_{CM}	90	A
Diode Forward Current @ $T_C = 25^{\circ}\text{C}$ @ $T_C = 100^{\circ}\text{C}$	I_F	30 15	A
Pulsed Diode Maximum Forward Current	I_{FM}	90	A
Maximum Power Dissipation @ $T_C = 25^{\circ}\text{C}$ @ $T_C = 100^{\circ}\text{C}$	P_D	83 42	W
Operating Junction / Storage Temperature Range	T_J, T_{STG}	-55 to $+175$	$^{\circ}\text{C}$
Maximum Lead Temp. for Soldering Purposes, 1/8" from case for 5 seconds	T_L	260	$^{\circ}\text{C}$

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. $V_{CC} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 90\text{ A}$, $R_G = 13\ \Omega$, Inductive Load, 100% Tested
2. Repetitive rating: pulse width limited by max. Junction temperature

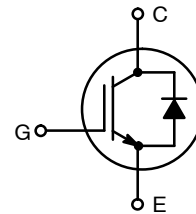


ON Semiconductor®

www.onsemi.com

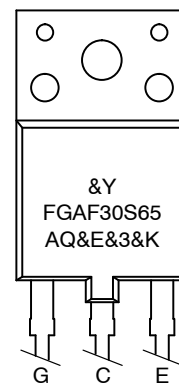
30 A, 650 V

$V_{CE(\text{sat})} = 1.4\text{ V (Typ.)}$



**TO-3PF
CASE 340AH**

MARKING DIAGRAM



&Y = ON Semiconductor Logo
&E = Designate space on marking
&3 = 3-Digit Data Code
&K = 2-Digit Lot Traceability Code
FGAF30S65AQ = Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping
FGAF30S65AQ	TO-3PF-3L	30 Units / Rail

FGAF30S65AQ

Table 1. THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case, for IGBT	$R_{\theta JC}$	1.8	°C/W
Thermal Resistance, Junction-to-Case, for Diode	$R_{\theta JC}$	2.3	°C/W
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	40	°C/W

Table 2. ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
-----------	-----------------	--------	-----	-----	-----	------

OFF CHARACTERISTIC

Collector-emitter breakdown voltage, gate-emitter short-circuited	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	BV_{CES}	650	–	–	V
Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	$\Delta BV_{CES} / \Delta T_J$	–	0.5	–	V/°C
Collector-emitter cut-off current, gate-emitter short-circuited	$V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}$	I_{CES}	–	–	250	μA
Gate leakage current, collector-emitter short-circuited	$V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$	I_{GES}	–	–	±400	nA

ON CHARACTERISTIC

Gate-emitter threshold voltage	$V_{GE} = V_{CE}, I_C = 30\text{ mA}$	$V_{GE(th)}$	2.6	5.3	6.6	V
Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 30\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 30\text{ A}, T_J = 175^\circ\text{C}$	$V_{CE(sat)}$	– –	1.4 1.7	2.1 –	V

DYNAMIC CHARACTERISTIC

Input capacitance	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	C_{ies}	–	1959	–	pF
Output capacitance		C_{oes}	–	29	–	
Reverse transfer capacitance		C_{res}	–	8	–	
Gate charge total	$V_{CE} = 400\text{ V}, I_C = 30\text{ A}, V_{GE} = 15\text{ V}$	Q_g	–	58	–	nC
Gate to emitter charge		Q_{ge}	–	13	–	
Gate to collector charge		Q_{gc}	–	17	–	

SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

Turn-on delay time	$T_J = 25^\circ\text{C}$ $V_{CC} = 400\text{ V}, I_C = 7.5\text{ A}$ $R_g = 13\ \Omega$ $V_{GE} = 15\text{ V}$ Inductive Load	$t_{d(on)}$	–	17.6	–	ns
Rise time		t_r	–	6	–	
Turn-off delay time		$t_{d(off)}$	–	97	–	
Fall time		t_f	–	44	–	
Turn-on switching loss		E_{on}	–	295	–	μJ
Turn-off switching loss		E_{off}	–	82	–	
Total switching loss		E_{ts}	–	377	–	
Turn-on delay time	$T_J = 25^\circ\text{C}$ $V_{CC} = 400\text{ V}, I_C = 15\text{ A}$ $R_g = 13\ \Omega$ $V_{GE} = 15\text{ V}$ Inductive Load	$t_{d(on)}$	–	18	–	ns
Rise time		t_r	–	11	–	
Turn-off delay time		$t_{d(off)}$	–	92	–	
Fall time		t_f	–	24	–	
Turn-on switching loss		E_{on}	–	515	–	μJ
Turn-off switching loss		E_{off}	–	140	–	
Total switching loss		E_{ts}	–	655	–	

FGAF30S65AQ

Table 2. ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise specified)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
SWITCHING CHARACTERISTIC, INDUCTIVE LOAD						
Turn-on delay time	$T_J = 175^{\circ}\text{C}$ $V_{CC} = 400\text{ V}$, $I_C = 7.5\text{ A}$ $R_g = 13\ \Omega$ $V_{GE} = 15\text{ V}$ Inductive Load	$t_{d(\text{on})}$	–	17.6	–	ns
Rise time		t_r	–	6.4	–	
Turn-off delay time		$t_{d(\text{off})}$	–	110	–	
Fall time		t_f	–	56	–	
Turn-on switching loss		E_{on}	–	442	–	μJ
Turn-off switching loss		E_{off}	–	145	–	
Total switching loss		E_{ts}	–	587	–	
Turn-on delay time	$T_J = 175^{\circ}\text{C}$ $V_{CC} = 400\text{ V}$, $I_C = 15\text{ A}$ $R_g = 13\ \Omega$ $V_{GE} = 15\text{ V}$ Inductive Load	$t_{d(\text{on})}$	–	18	–	ns
Rise time		t_r	–	12	–	
Turn-off delay time		$t_{d(\text{off})}$	–	104	–	
Fall time		t_f	–	48	–	
Turn-on switching loss		E_{on}	–	741	–	μJ
Turn-off switching loss		E_{off}	–	274	–	
Total switching loss		E_{ts}	–	1015	–	
DIODE CHARACTERISTIC						
Forward Voltage	$I_F = 15\text{ A}$ $I_F = 15\text{ A}$, $T_J = 175^{\circ}\text{C}$	V_F	– –	1.3 1.3	1.6 –	V
Reverse Recovery Energy	$I_F = 15\text{ A}$, $di_F/dt = 200\text{ A}/\mu\text{s}$	E_{rec}	–	239	–	μJ
Diode Reverse Recovery Time	$I_F = 15\text{ A}$, $di_F/dt = 200\text{ A}/\mu\text{s}$ $I_F = 15\text{ A}$, $di_F/dt = 200\text{ A}/\mu\text{s}$, $T_J = 175^{\circ}\text{C}$	T_{rr}	–	267 347	–	nS
Diode Reverse Recovery Charge	$I_F = 15\text{ A}$, $di_F/dt = 200\text{ A}/\mu\text{s}$ $I_F = 15\text{ A}$, $di_F/dt = 200\text{ A}/\mu\text{s}$, $T_J = 175^{\circ}\text{C}$	Q_{rr}	–	1135 1873	–	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 CHARACTERISTICS

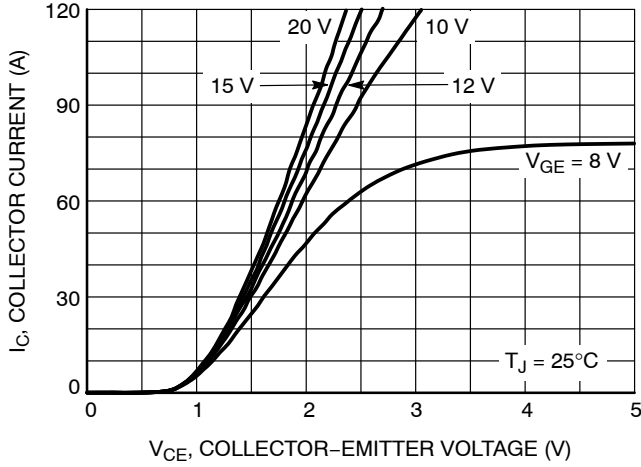


Figure 1. Typical Output Characteristics

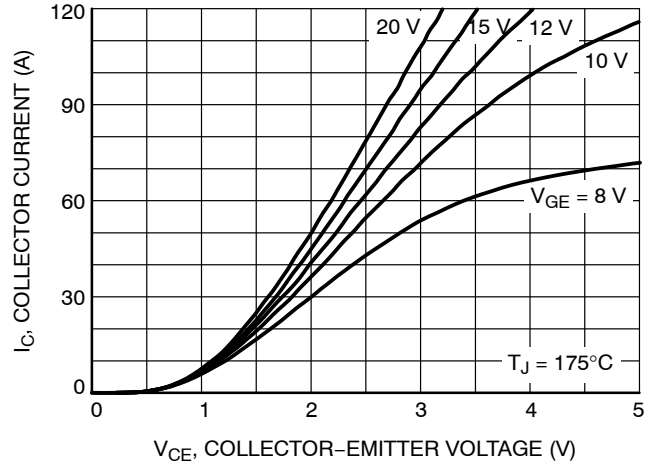


Figure 2. Typical Output Characteristics

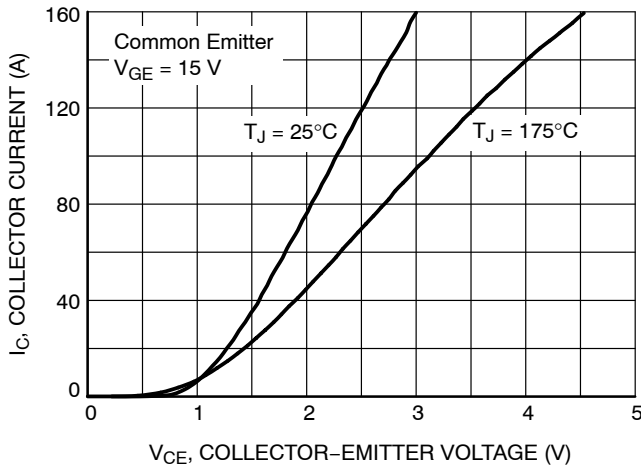


Figure 3. Typical Saturation Voltage Characteristics

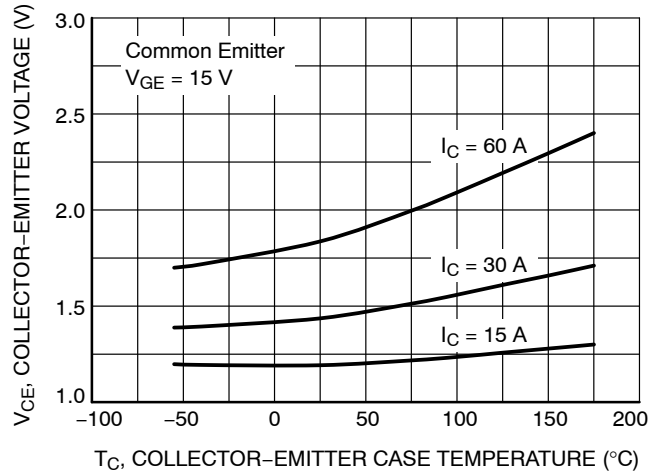


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

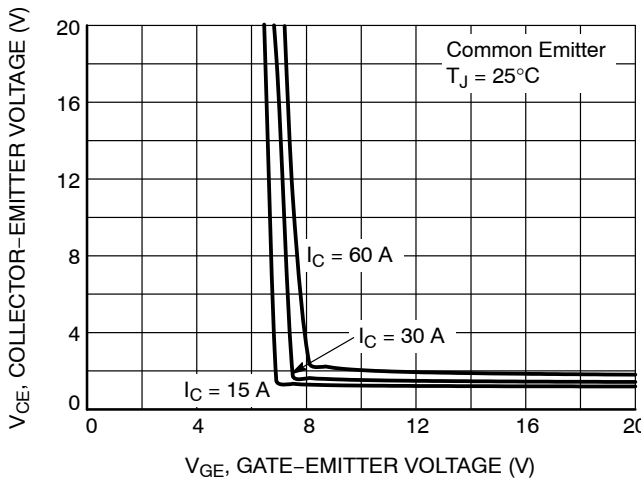


Figure 5. Saturation Voltage vs. V_{GE}

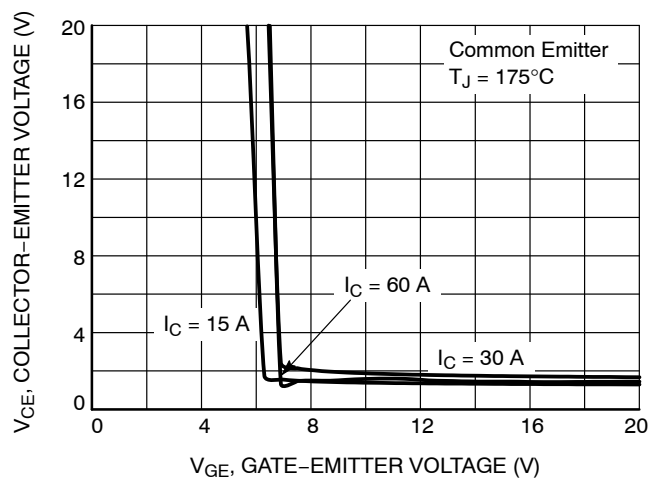


Figure 6. Saturation Voltage vs. V_{GE}

TYPICAL CHARACTERISTICS

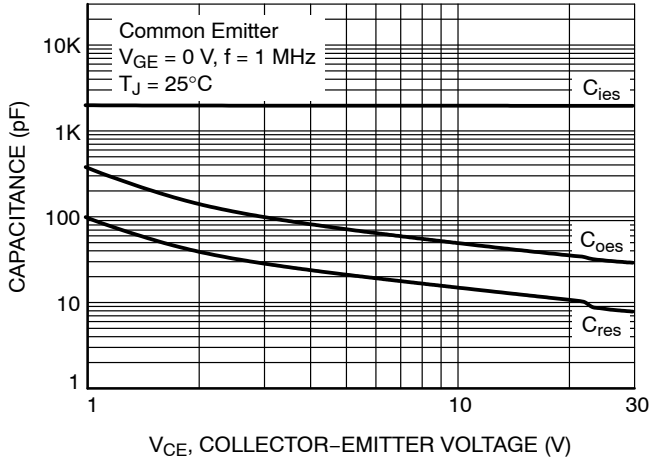


Figure 7. Capacitance Characteristics

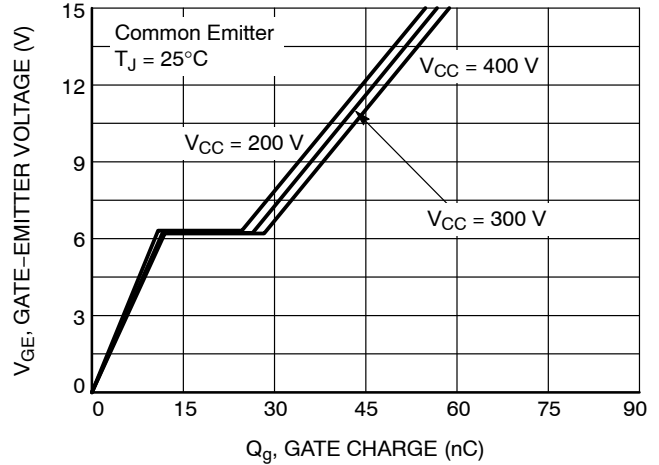


Figure 8. Gate Charge

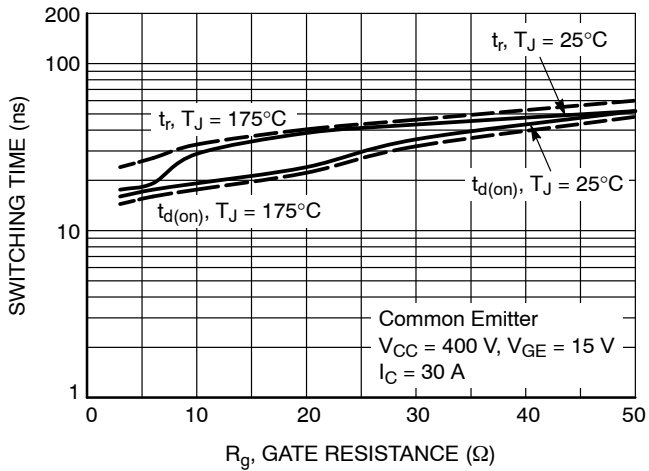


Figure 9. Turn-On Characteristics vs. Gate Resistance

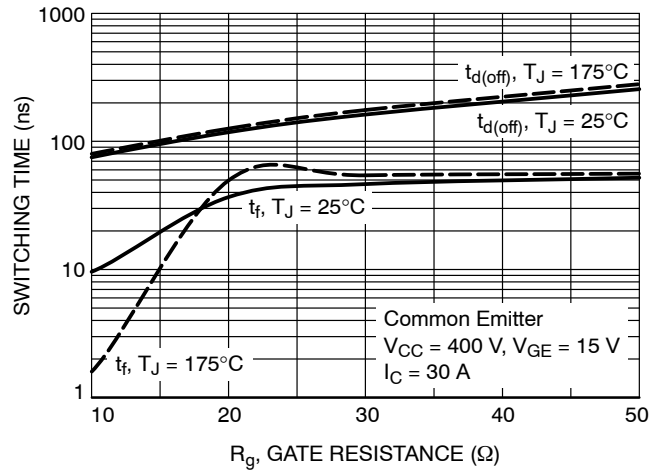


Figure 10. Turn-Off Characteristics vs. Gate Resistance

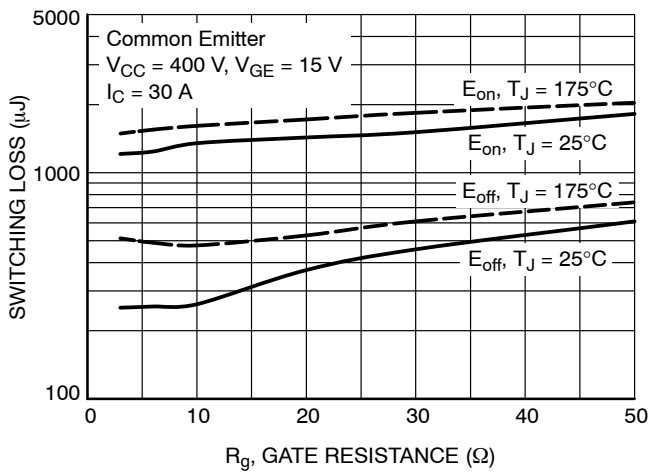


Figure 11. Switching Loss vs. Gate Resistance

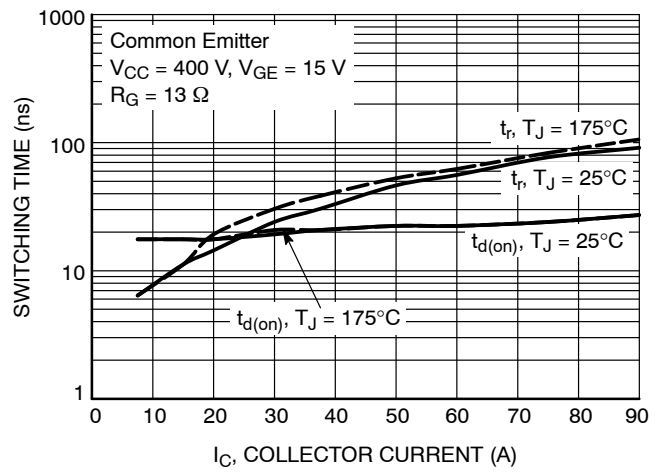


Figure 12. Turn-On Characteristics vs. Collector Current

TYPICAL CHARACTERISTICS

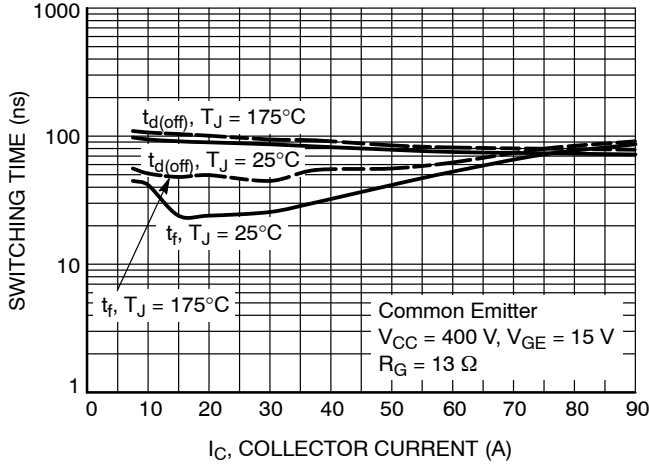


Figure 13. Turn-Off Characteristics vs. Collector Current

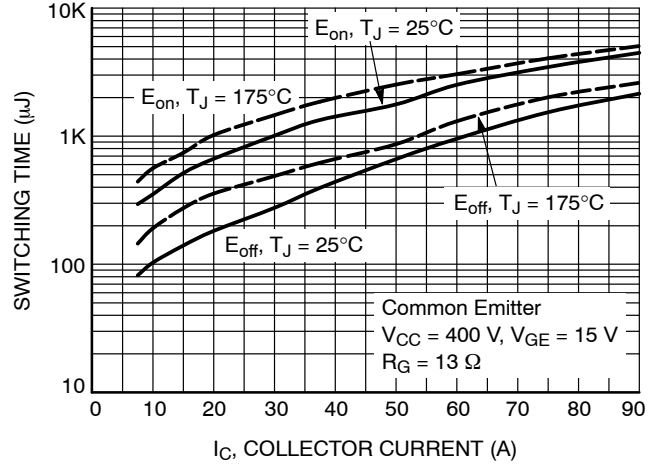


Figure 14. Switching Loss vs. Collector Current

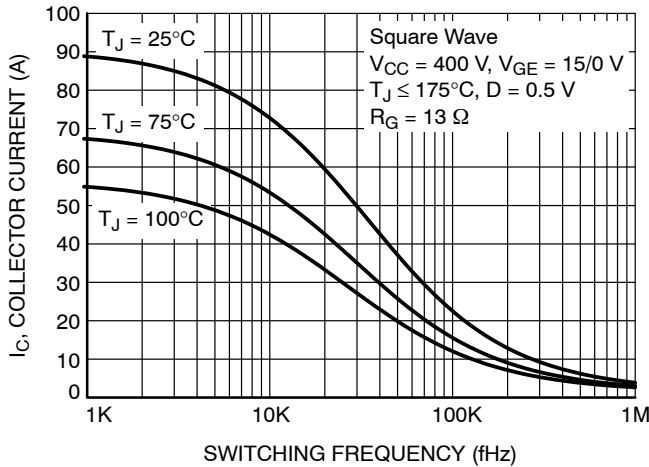


Figure 15. Load Current vs. Frequency

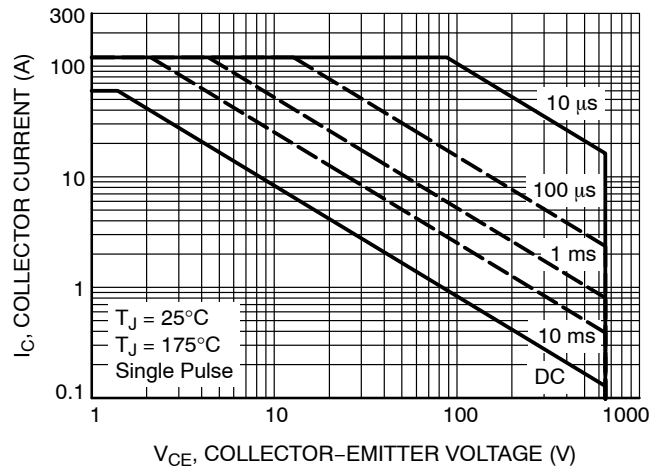


Figure 16. SOA Characteristics (FBSOA)

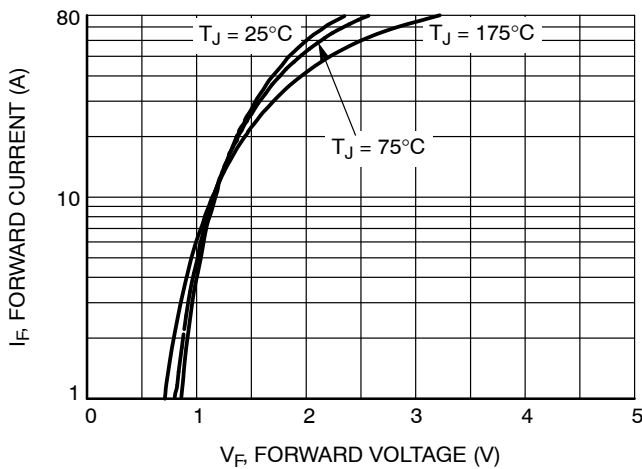


Figure 17. Forward Characteristics

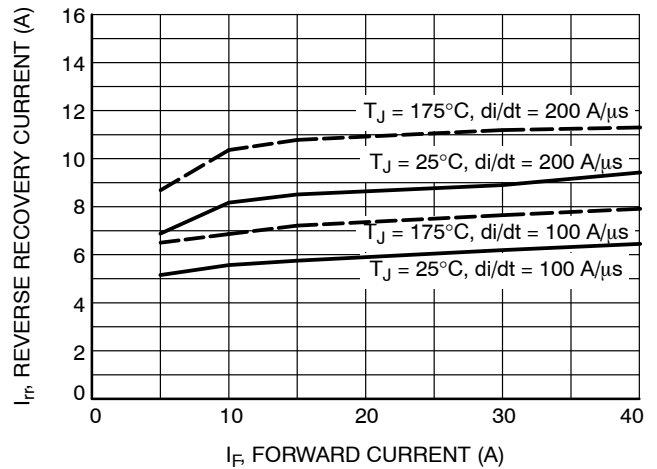


Figure 18. Reverse Recovery Current

TYPICAL CHARACTERISTICS

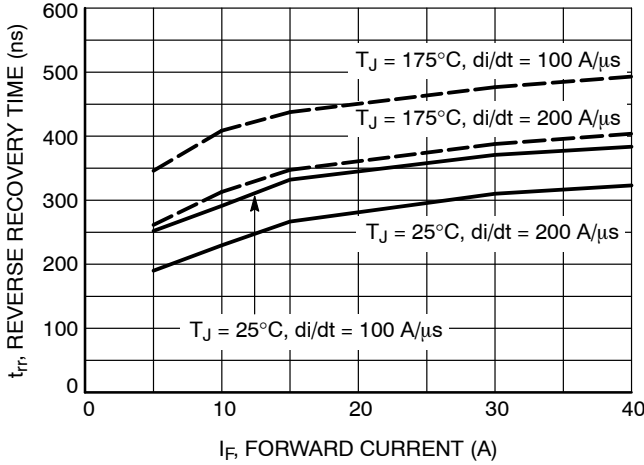


Figure 19. Reverse Recovery Time

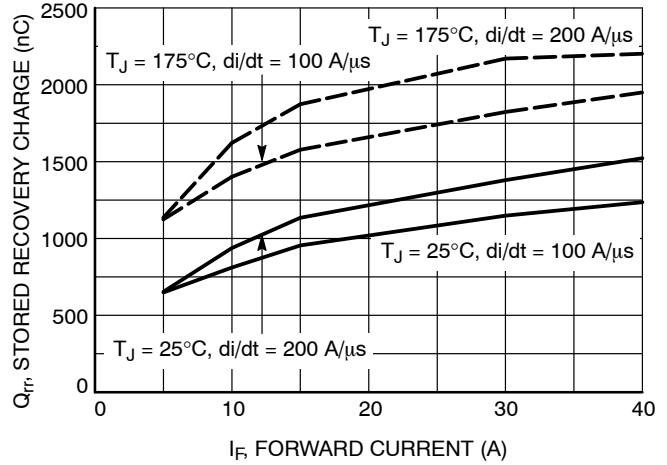


Figure 20. Stored Charge

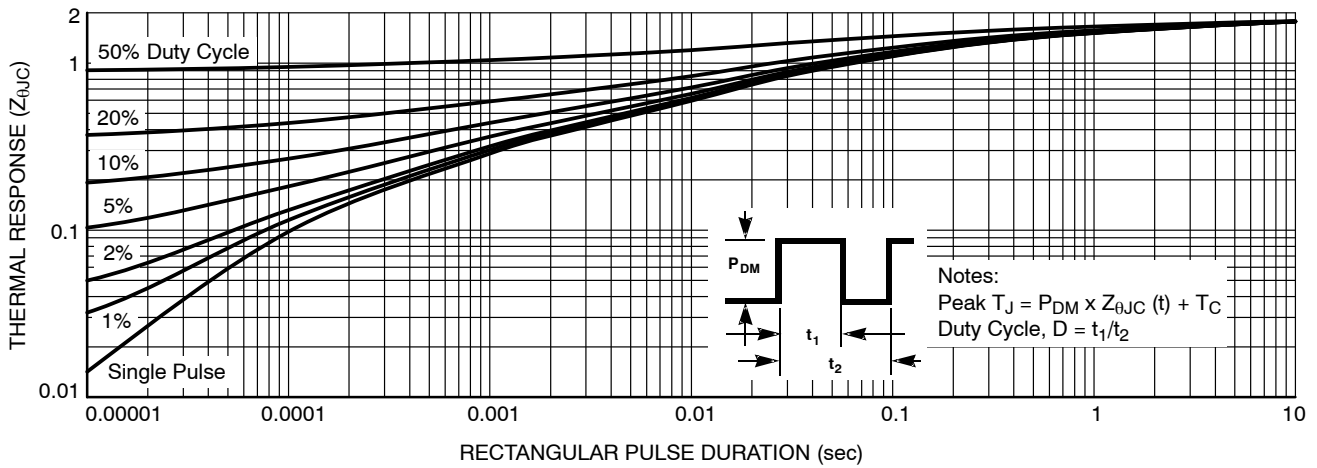


Figure 21. Transient Thermal Impedance of IGBT

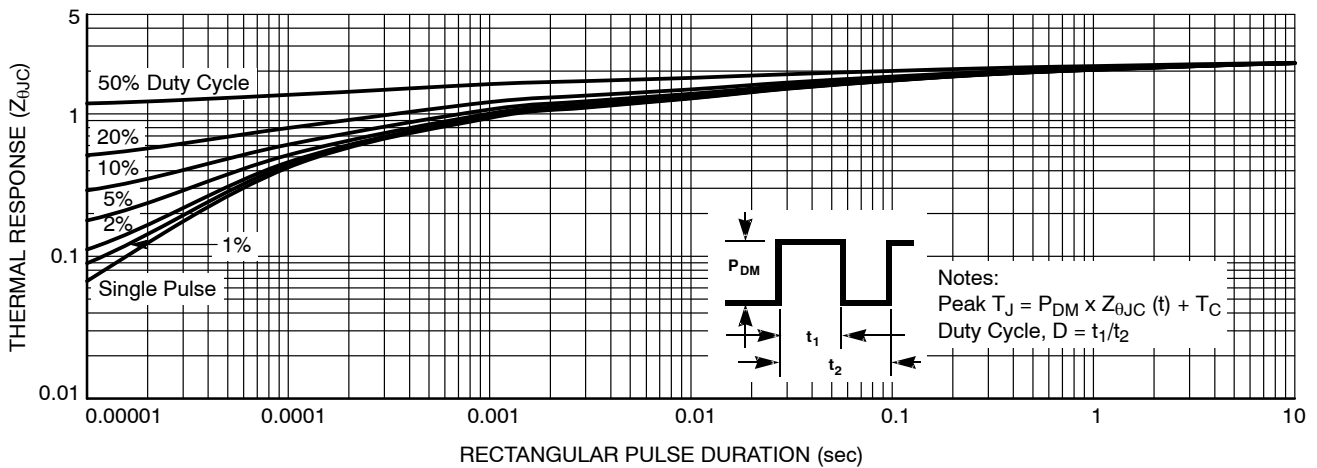
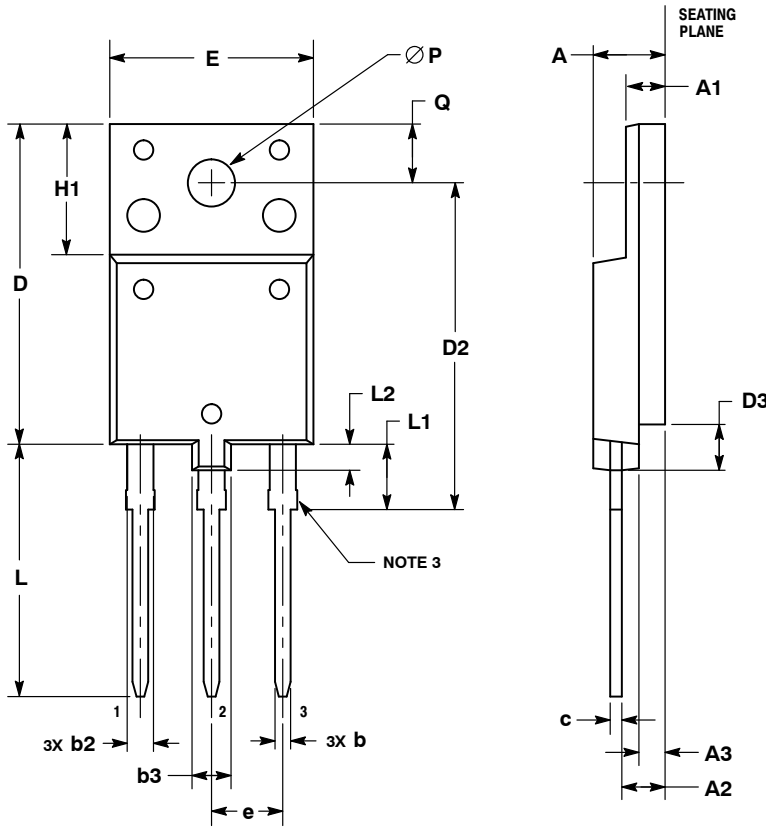


Figure 22. Transient Thermal Impedance of Diode

FGAF30S65AQ

PACKAGE DIMENSIONS

TO-3PF-3L CASE 340AH ISSUE A



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. CONTOUR UNCONTROLLED IN THIS AREA (6 PLACES).
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR GATE PROTRUSIONS. MOLD FLASH AND GATE PROTRUSIONS NOT TO EXCEED 0.13 PER SIDE. THESE DIMENSIONS ARE TO BE MEASURED AT THE OUTERMOST EXTREME OF THE PLASTIC BODY.
5. DIMENSION b2 DOES NOT INCLUDE DAMBAR PROTRUSION. LEAD WIDTH INCLUDING PROTRUSION SHALL NOT EXCEED 2.20.

DIM	MILLIMETERS	
	MIN	MAX
A	5.30	5.70
A1	2.80	3.20
A2	3.10	3.50
A3	1.80	2.20
b	0.65	0.95
b2	1.90	2.15
b3	3.80	4.20
c	0.80	1.10
D	24.30	24.70
D2	24.70	25.30
D3	3.30	3.70
E	15.30	15.70
e	5.35	5.55
H1	9.80	10.20
L	19.10	19.50
L1	4.80	5.20
L2	1.90	2.20
P	3.40	3.80
Q	4.30	4.70

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative