IGBT – Hybrid, Field Stop, Trench

650 V, 75 A, TO247

AFGHL75T65SQDC

Using the novel field stop 4th generation IGBT technology and the 1.5th generation SiC Schottky Diode technology, AFGHL75T65SQDC offers the optimum performance with both low conduction and switching losses for high efficiency operations in various applications, especially totem pole bridgeless PFC and Inverter.

Features

- Maximum Junction Temperature: T_J = 175°C
- Positive Temperature Co−efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(Sat)}$ = 1.6 V (Typ.) @ I_C = 75 A
- 100% of the Parts are Tested for I_{LM} (Note 2)
- Fast Switching
- Tight Parameter Distribution
- No Reverse Recovery/No Forward Recovery
- AEC−Q101 Qualified and PPAP Capable

Typical Applications

- Automotive
- On & Off Board Chargers
- DC−DC Converters
- PFC
- Industrial Inverter

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 (Note 1) @ T_C = 25°C @ T_C = 100°C	I_C	80 75	A
Pulsed Collector Current (Note 2)	I_{LM}	300	A
Pulsed Collector Current (Note 3)	I_{CM}	300	A
Diode Forward Current (Note 1) @ T_C = 25°C @ T_C = 100°C	I_F	35 20	A
Pulsed Diode Maximum Forward Current	I_{FM}	200	A
Maximum Power Dissipation @ T_C = 25°C @ T_C = 100°C	P_D	375 188	W
Operating Junction / Storage Temperature Range	T_J, T_{STG}	−55 to +175	°C
Maximum Lead Temp. for Soldering Purposes, 1/8″ from case for 10 seconds	T_L	265	°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. Value limited by bond wire
2. V_{CC} = 400 V, V_{GE} = 15 V, I_C = 300 A, R_G = 15 Ω, Inductive Load, 100% of the Parts are Tested.
3. Repetitive Rating: pulse width limited by max. Junction temperature

ON Semiconductor®

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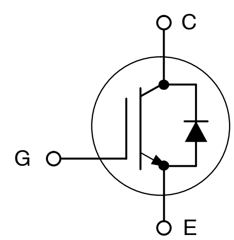
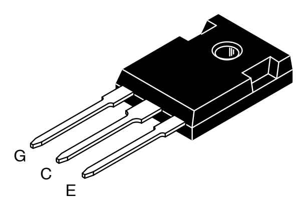
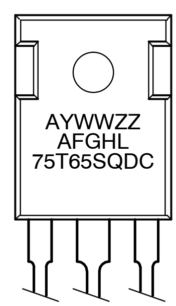
75 A, 650 V
V_{CESat} = 1.6 V (Typ.)





TO−247−3LD
CASE 340CX

MARKING DIAGRAM



A	=	Assembly Location
YWW	=	3−Digit Date Code
ZZ	=	2−Digit Lot Traceability Code
AFGHL75T65SQDC	=	Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping
AFGHL75T65SQDC	TO−247−3L	30 Units / Rail

January, 2021 − Rev. 1
Publication Order Number:
AFGHL75T65SQDC/D

THERMAL CHARACTERISTICS

Rating	Symbol	Max	Unit
Thermal resistance junction−to−case, for IGBT	$R_{\theta JC}$	0.4	°C/W
Thermal resistance junction−to−case, for Diode	$R_{\theta JC}$	1.55	°C/W
Thermal resistance junction−to−ambient	$R_{\theta JA}$	40	°C/W

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector−emitter breakdown voltage, gate−emitter short−circuited	V_{GE} = 0 V, I_C = 1 mA	BV_{CES}	650	–	–	V
Temperature Coefficient of Breakdown Voltage	V_{GE} = 0 V, I_C = 1 mA	$\frac{\Delta BV_{CES}}{\Delta T_J}$	–	0.6	–	V/°C
Collector−emitter cut−off current, gate−emitter short−circuited	V_{GE} = 0 V, V_{CE} = 650 V	I_{CES}	–	–	250	μA
Gate leakage current, collector−emitter short−circuited	V_{GE} = 20 V, V_{CE} = 0 V	I_{GES}	–	–	±400	nA
ON CHARACTERISTICS						
Gate−emitter threshold voltage	V_{GE} = V_{CE}, I_C = 75 mA	$V_{GE(th)}$	3.4	4.9	6.4	V
Collector−emitter saturation voltage	V_{GE} = 15 V, I_C = 75 A V_{GE} = 15 V, I_C = 75 A, T_J = 175°C	$V_{CE(sat)}$	– –	1.6 2.0	2.1 –	V
DYNAMIC CHARACTERISTICS						
Input capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz	C_{ies}	–	4574	–	pF
Output capacitance		C_{oes}	–	289.4	–	
Reverse transfer capacitance		C_{res}	–	11.2	–	
Gate charge total	V_{CE} = 400 V, I_C = 75 A, V_{GE} = 15 V	Q_g	–	139	–	nC
Gate−to−emitter charge		Q_{ge}	–	25	–	
Gate−to−collector charge		Q_{gc}	–	33	–	
SWITCHING CHARACTERISTICS, INDUCTIVE LOAD						
Turn−on delay time	T_C = 25°C, V_{CC} = 400 V, I_C = 37.5 A, R_G = 4.7 Ω, V_{GE} = 15 V, Inductive Load	$t_{d(on)}$	–	22.4	–	ns
Rise time		t_r	–	19.2	–	
Turn−off delay time		$t_{d(off)}$	–	116.8	–	
Fall time		t_f	–	9.6	–	
Turn−on switching loss		E_{on}	–	0.48	–	mJ
Turn−off switching loss		E_{off}	–	0.24	–	
Total switching loss		E_{ts}	–	0.72	–	
Turn−on delay time	T_C = 25°C, V_{CC} = 400 V, I_C = 75 A, R_G = 4.7 Ω, V_{GE} = 15 V, Inductive Load	$t_{d(on)}$	–	24	–	ns
Rise time		t_r	–	49.6	–	
Turn−off delay time		$t_{d(off)}$	–	107.2	–	
Fall time		t_f	–	70.4	–	
Turn−on switching loss		E_{on}	–	1.68	–	mJ
Turn−off switching loss		E_{off}	–	1.11	–	
Total switching loss		E_{ts}	–	2.79	–	

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
SWITCHING CHARACTERISTICS, INDUCTIVE LOAD						
Turn−on delay time	T_C = 175°C, V_{CC} = 400 V, I_C = 37.5 A, R_G = 4.7 Ω, V_{GE} = 15 V, Inductive Load	$t_{d(on)}$	–	20.8	–	ns
Rise time		t_r	–	22.4	–	
Turn−off delay time		$t_{d(off)}$	–	130	–	
Fall time		t_f	–	9.6	–	
Turn−on switching loss		E_{on}	–	0.53	–	mJ
Turn−off switching loss		E_{off}	–	0.44	–	
Total switching loss		E_{ts}	–	0.98	–	
Turn−on delay time	T_C = 175°C, V_{CC} = 400 V, I_C = 75 A, R_G = 4.7 Ω, V_{GE} = 15 V, Inductive Load	$t_{d(on)}$	–	24	–	ns
Rise time		t_r	–	49.6	–	
Turn−off delay time		$t_{d(off)}$	–	118	–	
Fall time		t_f	–	78.4	–	
Turn−on switching loss		E_{on}	–	1.76	–	mJ
Turn−off switching loss		E_{off}	–	1.42	–	
Total switching loss		E_{ts}	–	3.19	–	
DIODE CHARACTERISTICS						
Forward Voltage	I_F = 20 A	V_F	–	1.45	1.75	V
	I_F = 20 A, T_J = 175°C		–	1.80	–	
Total Capacitance	V_R = 400 V, f = 1 MHz	C	–	110	–	pF
	V_R = 600 V, f = 1 MHz		–	105	–	

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

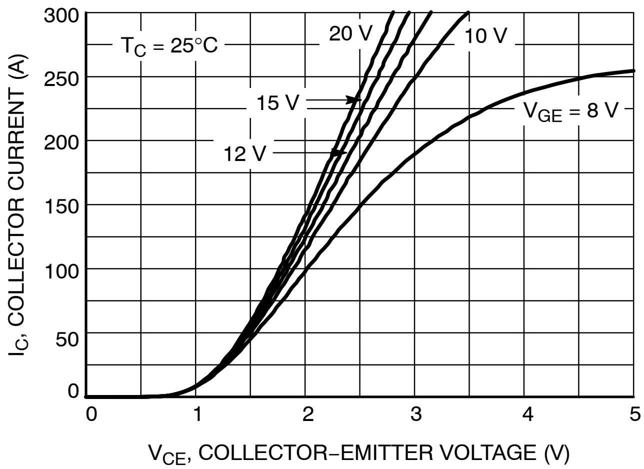


Figure 1. Typical Output Characteristics (Tc = 25°C)

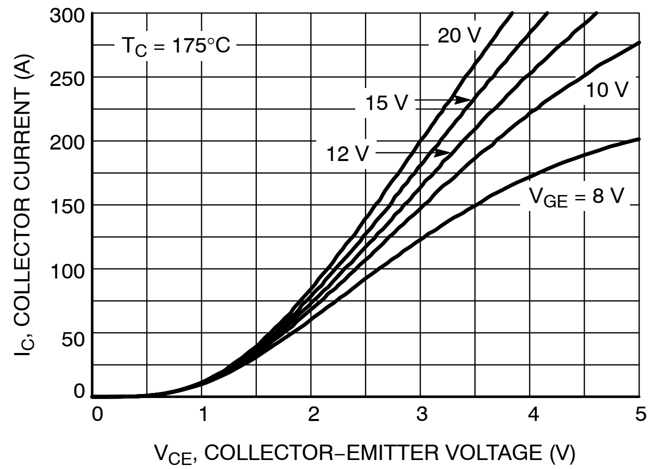


Figure 2. Typical Output Characteristics (Tc = 175°C)

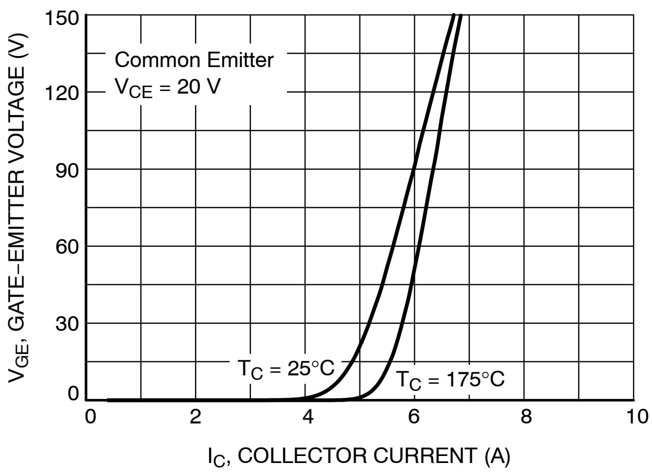


Figure 3. Transfer Characteristics

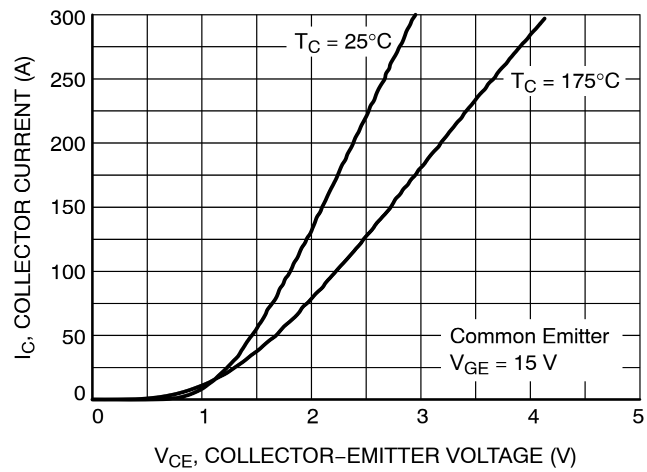


Figure 4. Typical Saturation Voltage Characteristics

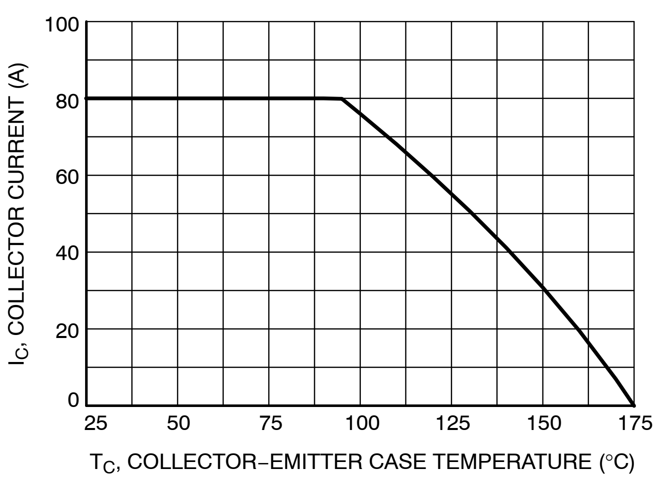


Figure 5. Collector Current Derating

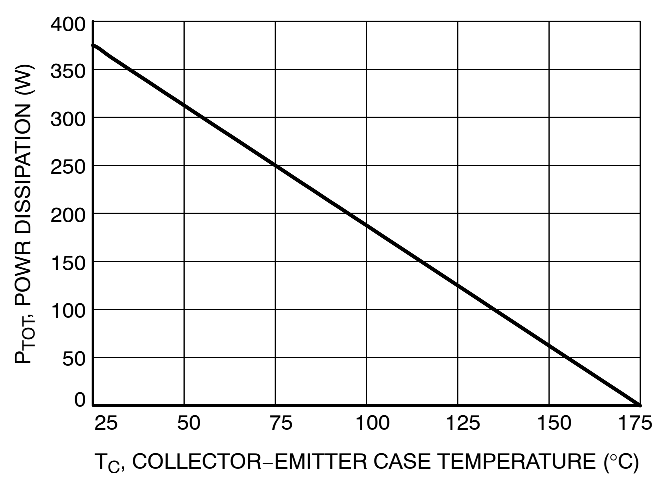


Figure 6. Power Dissipation

TYPICAL CHARACTERISTICS

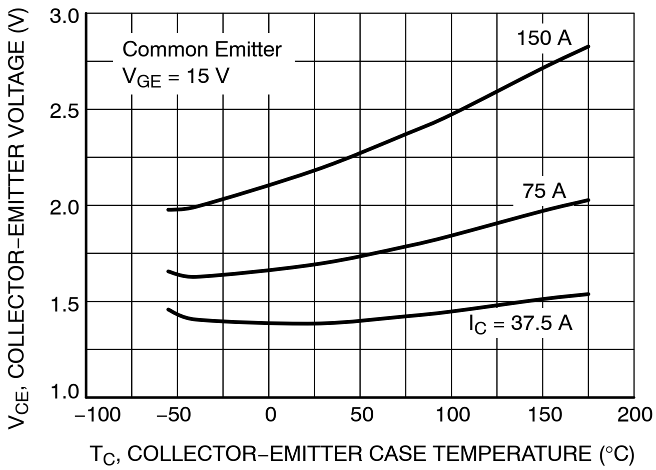


Figure 7. Saturation Voltage vs. Case Temperature at Variant Current Level

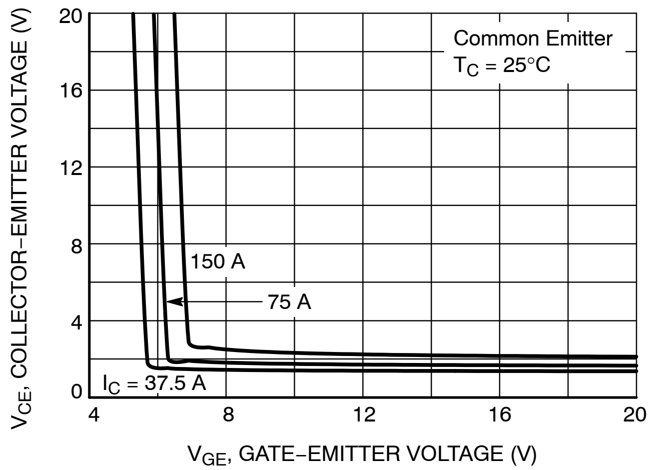


Figure 8. Saturation Voltage vs. VGE (Tc = 25°C)

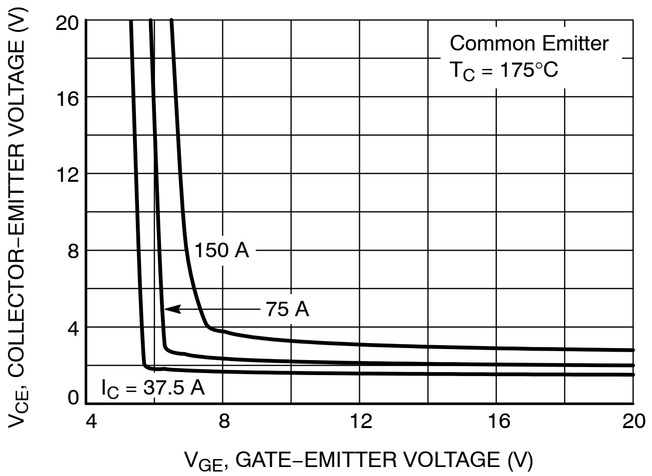


Figure 9. Saturation Voltage vs. VGE (Tc = 175°C)

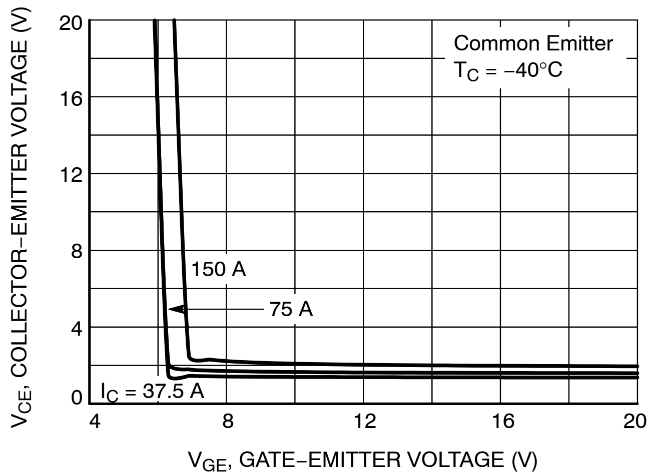


Figure 10. Saturation Voltage vs. VGE (Tc = −40°C)

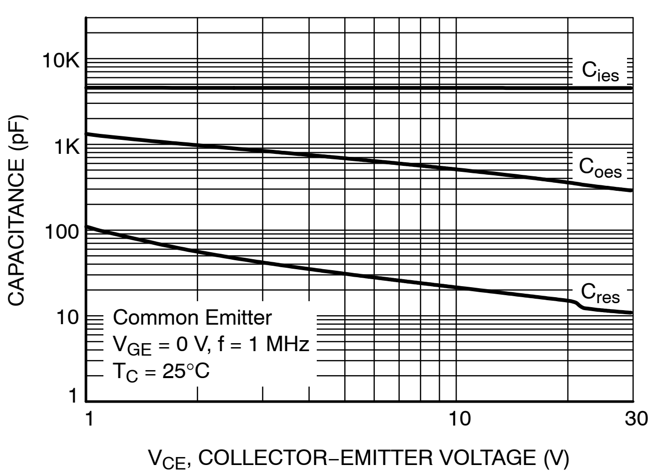


Figure 11. Capacitance Characteristics

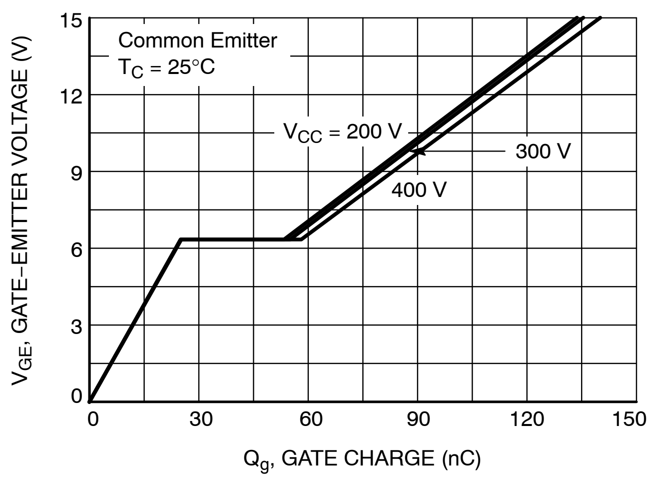


Figure 12. Gate Charge Characteristic (Tc = 25°C)

TYPICAL CHARACTERISTICS

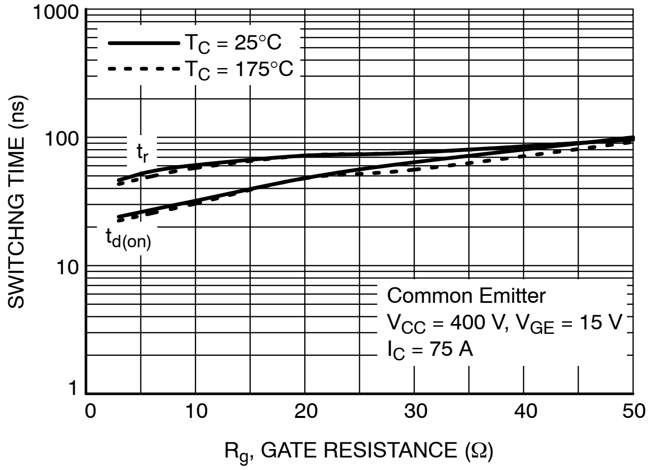


Figure 13. Turn−On Characteristics vs. Gate Resistance

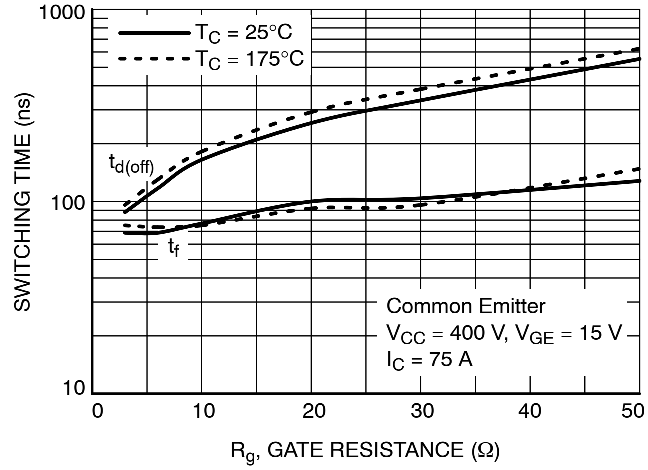


Figure 14. Turn−Off Characteristics vs. Gate Resistance

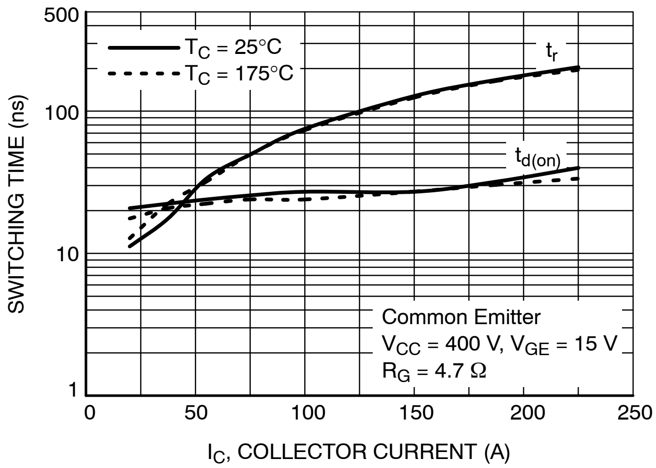


Figure 15. Turn−On Characteristics vs. Collector Current

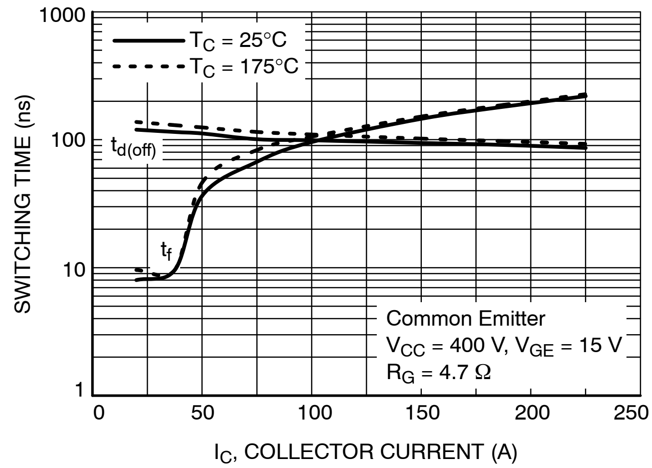


Figure 16. Turn−Off Characteristics vs. Collector Current

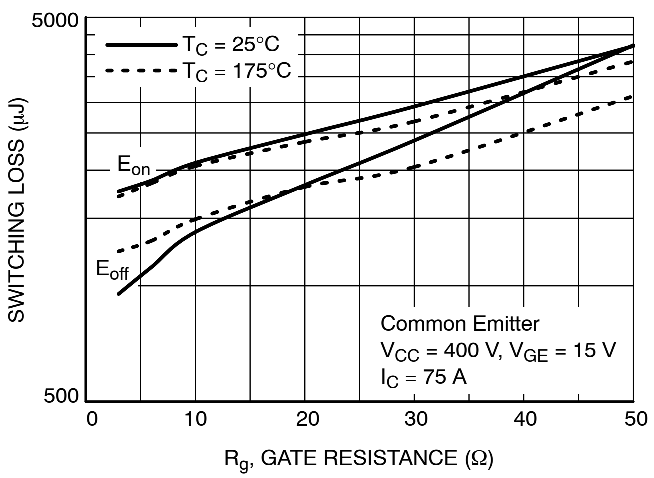


Figure 17. Switching Loss vs. Gate Resistance

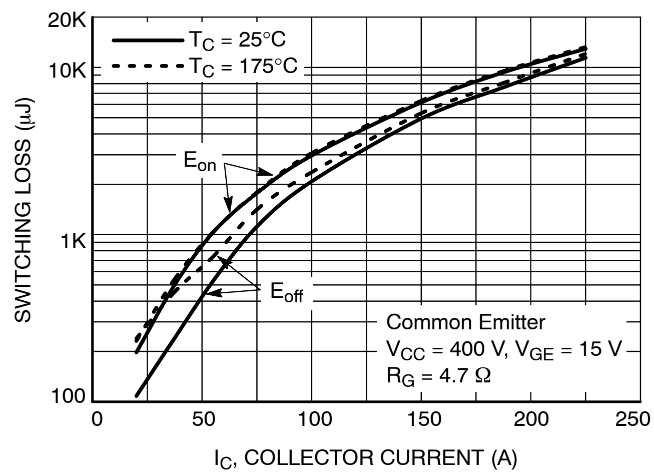


Figure 18. Switching Loss vs. Collector Current

TYPICAL CHARACTERISTICS

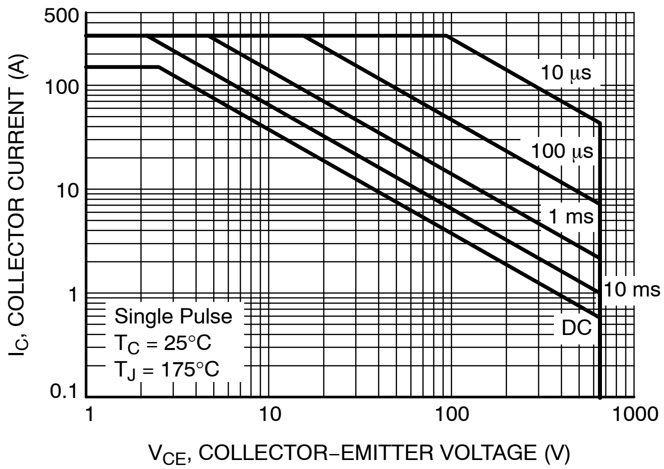


Figure 19. SOA Characteristics (FBSOA)

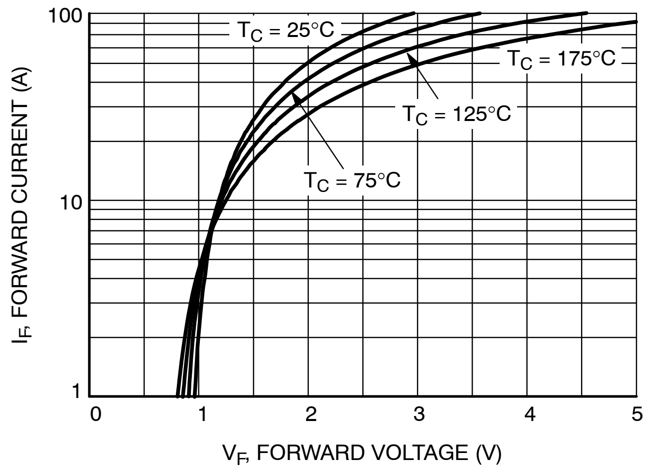


Figure 20. (Diode) Forward Characteristics vs. (Normal I−V)

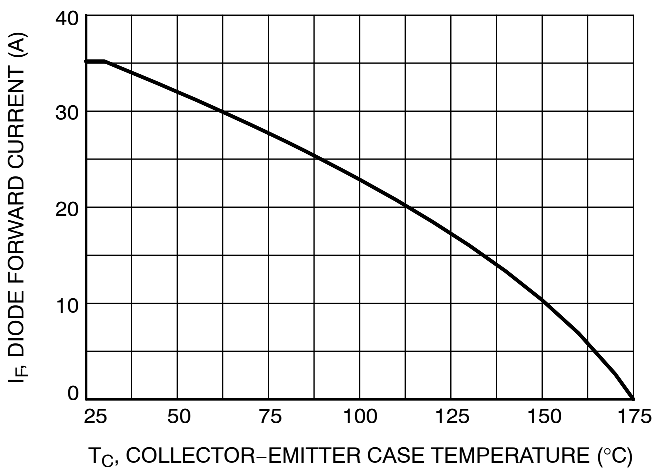


Figure 21. (Diode) Forward Current Derating

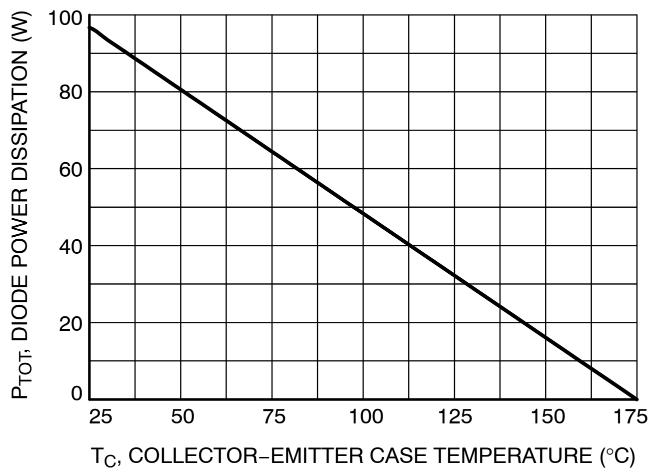


Figure 22. (Diode) Power Derating

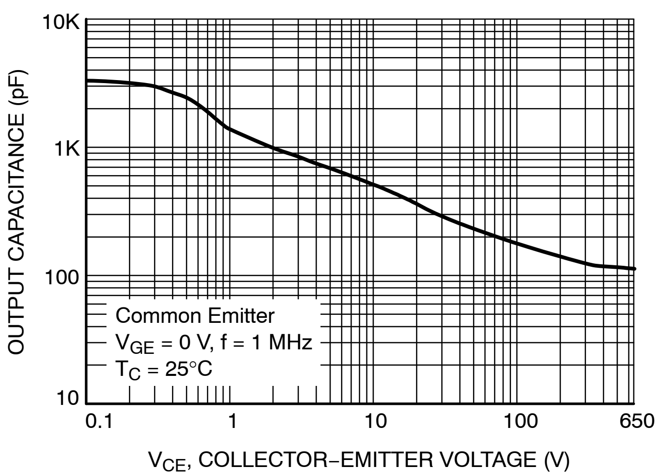


Figure 23. (Diode) Output Capacitance (Coes) vs. Reverse Voltage

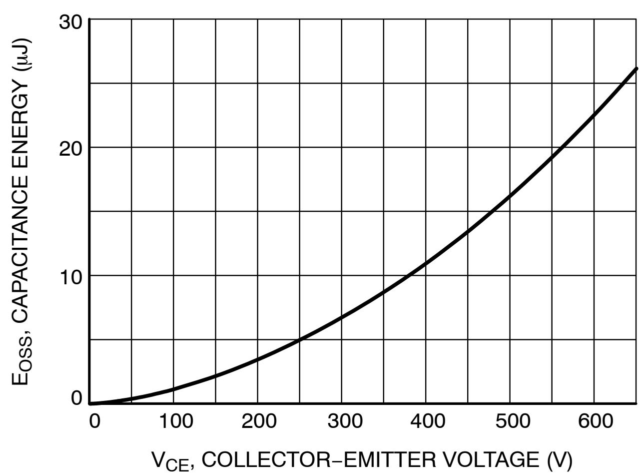


Figure 24. (Diode) Output Capacitance Stored Energy

TYPICAL CHARACTERISTICS

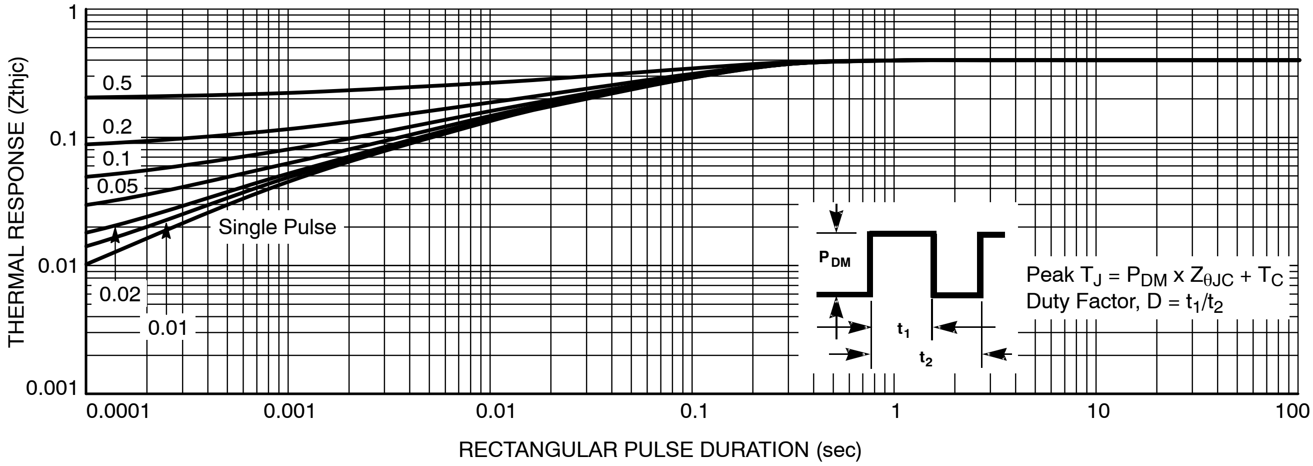


Figure 25. Transient Thermal Impedance of IGBT

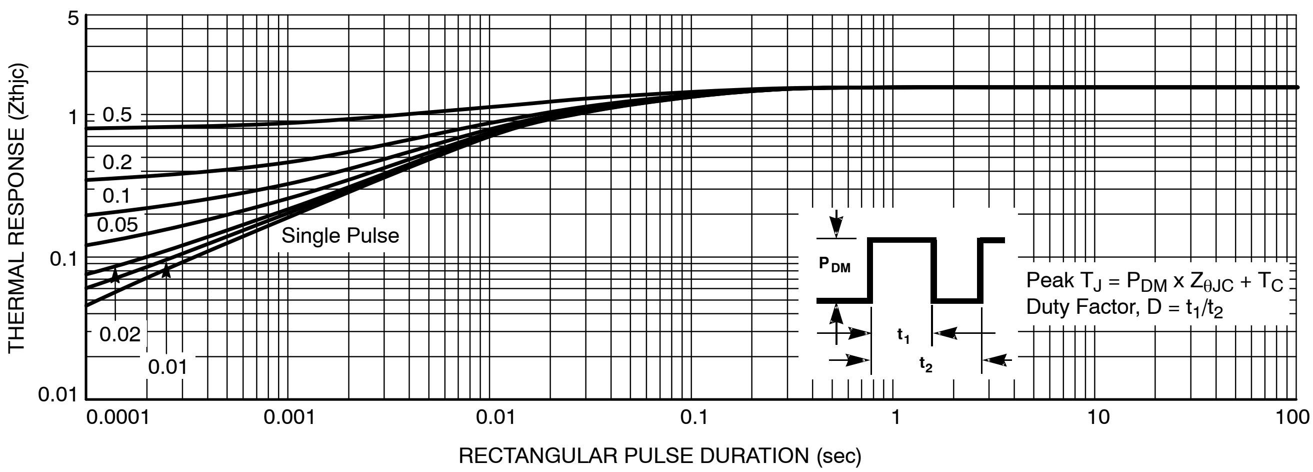
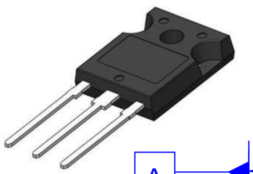
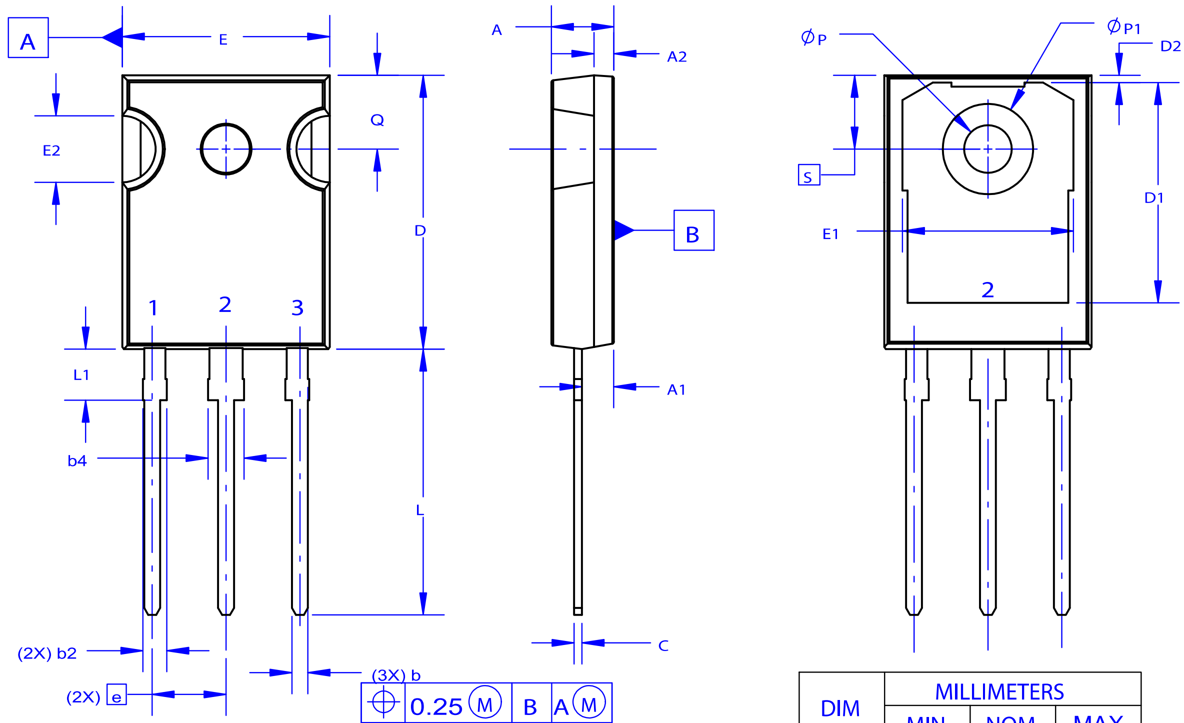


Figure 26. Transient Thermal Impedance of Diode



TO−247−3LD
CASE 340CX
ISSUE A

DATE 06 JUL 2020

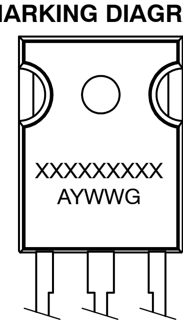


NOTES: UNLESS OTHERWISE SPECIFIED.

A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.58	4.70	4.82
A1	2.20	2.40	2.60
A2	1.40	1.50	1.60
D	20.32	20.57	20.82
E	15.37	15.62	15.87
E2	4.96	5.08	5.20
e	~	5.56	~
L	19.75	20.00	20.25
L1	3.69	3.81	3.93
ØP	3.51	3.58	3.65
Q	5.34	5.46	5.58
S	5.34	5.46	5.58
b	1.17	1.26	1.35
b2	1.53	1.65	1.77
b4	2.42	2.54	2.66
c	0.51	0.61	0.71
D1	13.08	~	~
D2	0.51	0.93	1.35
E1	12.81	~	~
ØP1	6.60	6.80	7.00

GENERIC
MARKING DIAGRAM*



XXXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
G = Pb−Free Package

*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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