Hybrid IGBT, 50 A, 650 V

AFGHL50T65SQDC

Using the novel field stop 4th generation IGBT technology and the 1.5th generation SiC Schottky Diode technology, AFGHL50T65SQDC 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

- AEC−Q101 Qualified
- 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 = 50 A
- Fast Switching
- Tighten Parameter Distribution
- No Reverse Recovery/No Forward Recovery

Typical Applications

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

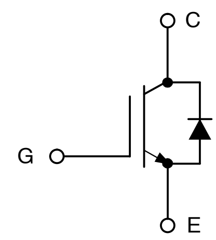
MAXIMUM RATINGS

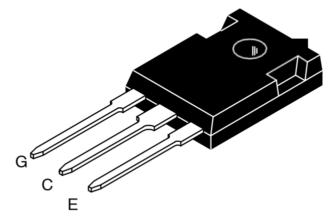
Rating	Symbol	Value	Unit
Collector to Emitter Voltage	V_{CES}	650	V
Gate to Emitter Voltage Transient Gate to Emitter Voltage	V_{GES}	±20 ±30	V
Collector Current @T_C = 25°C @T_C = 100°C	I_C	100 50	A
Pulsed Collector Current (Note 1)	I_{LM}	200	A
Pulsed Collector Current (Note 2)	I_{CM}	200	A
Diode Forward Current @T_C = 25°C @T_C = 100°C	I_F	40 20	A
Pulsed Diode Maximum Forward Current	I_{FM}	200	A
Maximum Power Dissipation @T_C = 25°C @T_C = 100°C	P_D	238 119	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 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. V_{CC} = 400 V, V_{GE} = 15 V, I_C = 200 A, R_G = 26 Ω, Inductive Load, 100% Tested.
2. Repetitive Rating: pulse width limited by max. Junction temperature.

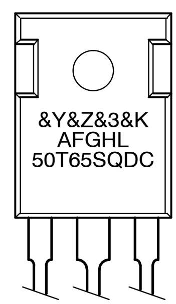
50 A, 650 V
V_{CESat} = 1.6 V (Typ.)





TO−247−3L
CASE 340CX

MARKING DIAGRAM



&Y = **onsemi** Logo
&Z = Assembly Plant Code
&3 = 3−Digit Data Code
&K = 2−Digit Lot Traceability Code
AFGHL50T65SQDC = Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping
AFGHL50T65SQDC	TO−247−3L	30 Units / Rail

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal resistance junction−to−case, for IGBT	$R_{\theta JC}$	0.63	°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 = 50 mA	$V_{GE(th)}$	3.4	4.9	6.4	V
Collector−emitter saturation voltage	V_{GE} = 15 V, I_C = 50 A	$V_{CE(sat)}$	–	1.6	2.1	V
	V_{GE} = 15 V, I_C = 50 A, T_J = 175°C		–	1.9	–	
DYNAMIC CHARACTERISTICS						
Input capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz	C_{ies}	–	3098	–	pF
Output capacitance		C_{oes}	–	265	–	
Reverse transfer capacitance		C_{res}	–	9	–	
Gate charge total	V_{CE} = 400 V, I_C = 50 V, V_{GE} = 15 V	Q_g	–	94	–	nC
Gate to emitter charge		Q_{ge}	–	18	–	
Gate to collector charge		Q_{gc}	–	23	–	
SWITCHING CHARACTERISTICS						
Turn−on delay time	T_J = 25°C, VCC = 400 V, IC = 12.5 A, R_G = 4.7 Ω, V_{GE} = 15 V, Inductive Load	$t_{d(on)}$	–	17.6	–	ns
Rise time		t_r	–	6.4	–	
Turn−off delay time		$t_{d(off)}$	–	94.4	–	
Fall time		t_f	–	14.4	–	
Turn−on switching loss		E_{on}	–	131	–	μJ
Turn−off switching loss		E_{off}	–	96	–	
Total switching loss		E_{ts}	–	227	–	
Turn−on delay time	T_J = 25°C, VCC = 400 V, IC = 25 A, R_G = 4.7 Ω, V_{GE} = 15 V, Inductive Load	$t_{d(on)}$	–	19.2	–	ns
Rise time		t_r	–	11.2	–	
Turn−off delay time		$td_{(off)}$	–	89.6	–	
Fall time		t_f	–	6.4	–	
Turn−on switching loss		Eon	–	311	–	μJ
Turn−off switching loss		Eoff	–	141	–	
Total switching loss		Ets	–	452	–	

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

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Unit
SWITCHING CHARACTERISTICS						
Turn–on delay time	T_J = 175°C VCC = 400 V, IC = 12.5 A R_G = 4.7 Ω V_{GE} = 15 V Inductive Load	$t_{d(on)}$	–	16	–	ns
Rise time		t_r	–	8	–	
Turn–off delay time		$t_{d(off)}$	–	107.2	–	
Fall time		t_f	–	53.6	–	
Turn–on switching loss		E_{on}	–	157	–	μJ
Turn–off switching loss		E_{off}	–	193	–	
Total switching loss		E_{ts}	–	350	–	
Turn–on delay time	T_J = 175°C VCC = 400 V, IC = 25 A R_G = 4.7 Ω V_{GE} = 15 V Inductive Load	$t_{d(on)}$	–	17.6	–	ns
Rise time		t_r	–	14.4	–	
Turn–off delay time		$t_{d(off)}$	–	99.2	–	
Fall time		t_f	–	9.6	–	
Turn–on switching loss		E_{on}	–	350	–	μJ
Turn–off switching loss		E_{off}	–	328	–	
Total switching loss		E_{ts}	–	678	–	
DIODE CHARACTERISTICS						
Forward voltage	I_F = 20 A I_F = 20 A, T_J = 175°C	V_F	–	1.45 1.83	1.75 –	V
Total Capacitance	V_R = 400 V, f = 1 MHz	C	–	103	–	pF
	V_R = 600 V, f = 1 MHz		–	99	–	

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

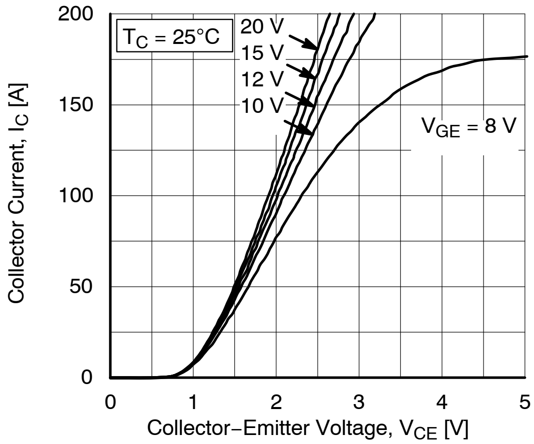


Figure 1. Typical Output Characteristics (T$_C$ = 25°C)

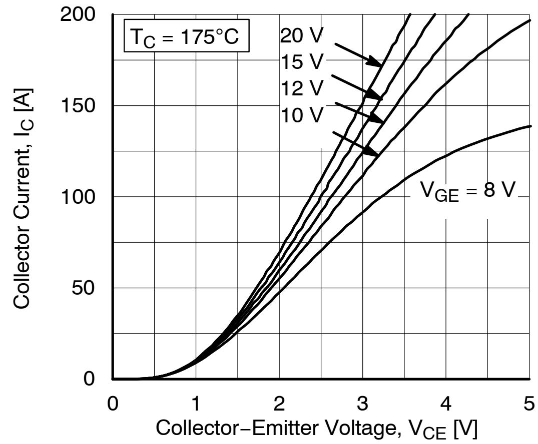


Figure 2. Typical Output Characteristics (T$_C$ = 175°C)

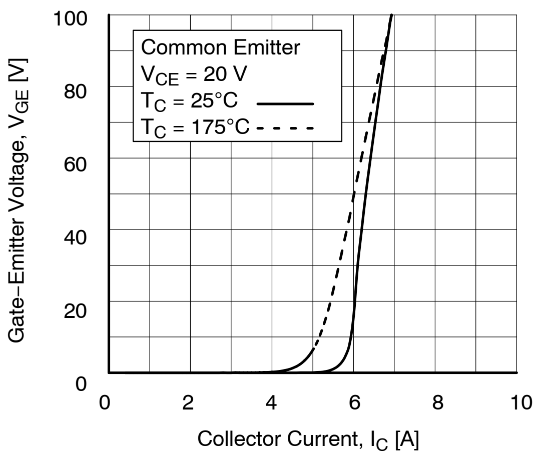


Figure 3. Transfer Characteristics

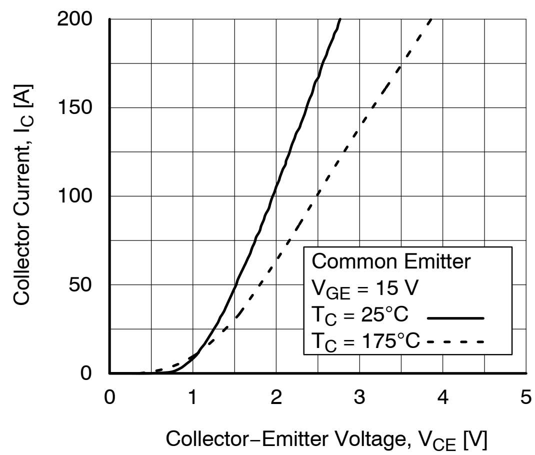


Figure 4. Typical Saturation Voltage Characteristics

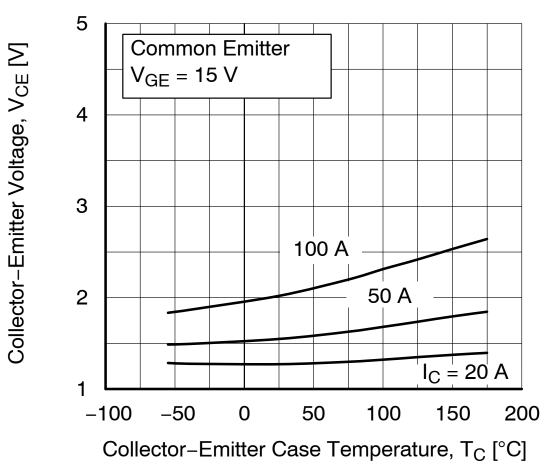


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

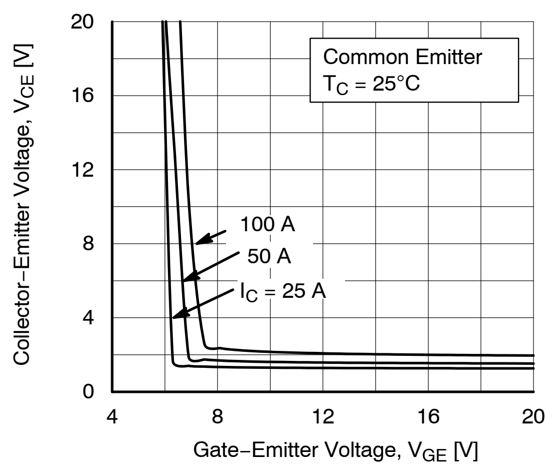


Figure 6. Saturation Voltage vs. V$_{GE}$ (T$_C$ = 25°C)

TYPICAL CHARACTERISTICS (continued)

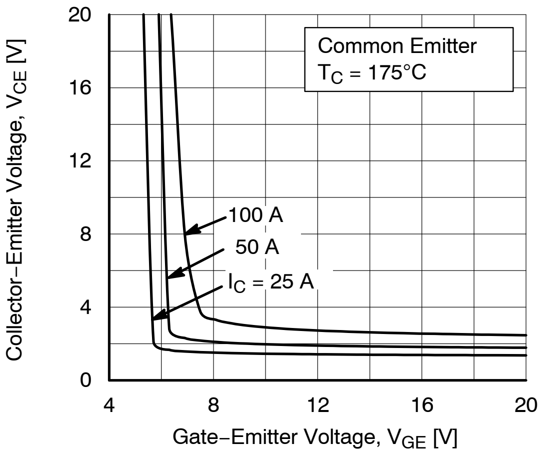


Figure 7. Saturation Voltage vs. V_{GE} (T_C = 175°C)

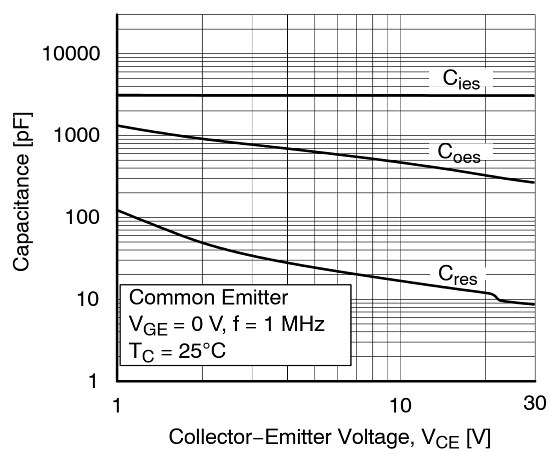


Figure 8. Capacitance Characteristics

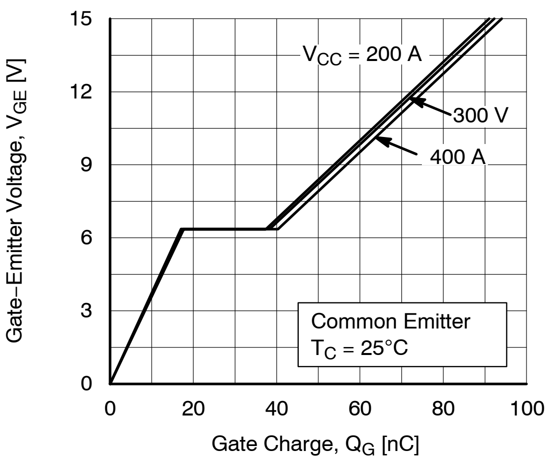


Figure 9. Gate Charge Characteristics (T_C = 25°C)

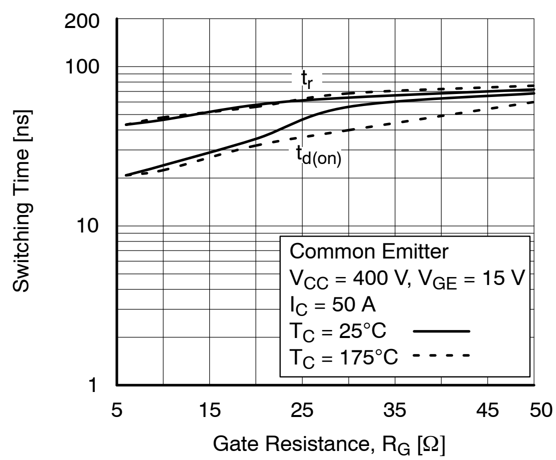


Figure 10. Turn−on Characteristics vs. Gate Resistance

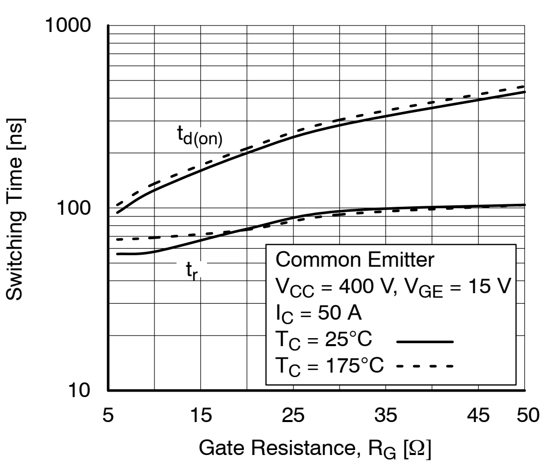


Figure 11. Turn−Off Characteristics vs. Resistance

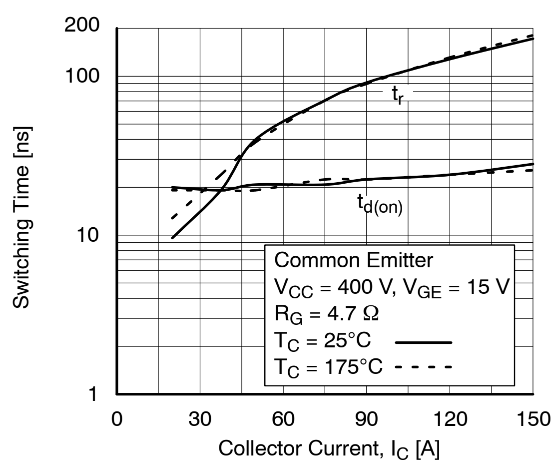


Figure 12. Turn−On Characteristics vs. Collector Current

TYPICAL CHARACTERISTICS (continued)

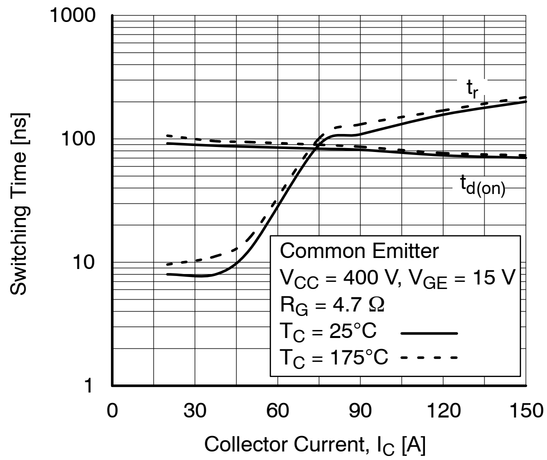


Figure 13. Turn−Off Characteristics vs. Collector Current

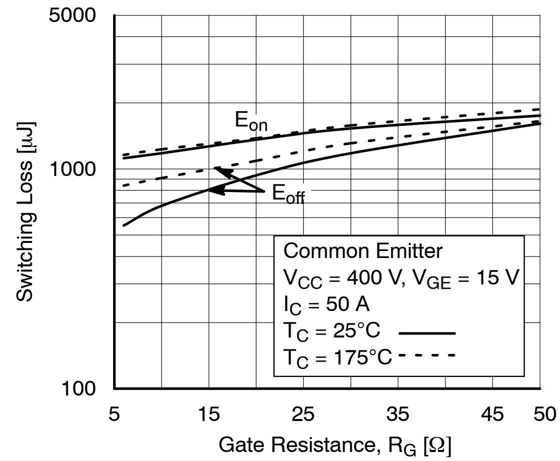


Figure 14. Switching Loss vs. Gate Resistance

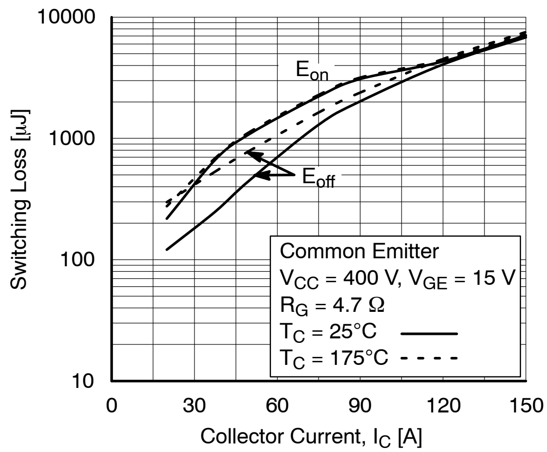


Figure 15. Switching Loss vs. Collector Current

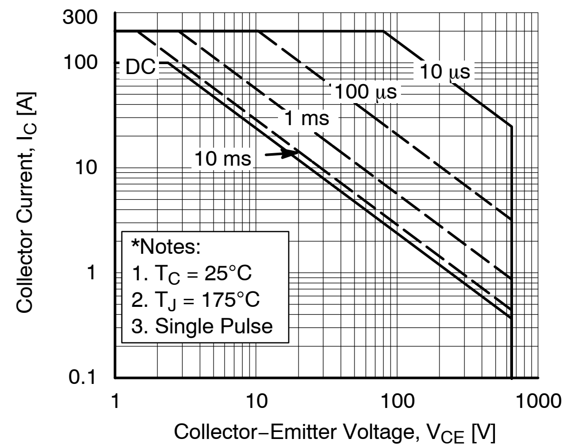


Figure 16. SOA Characteristics (FBSOA)

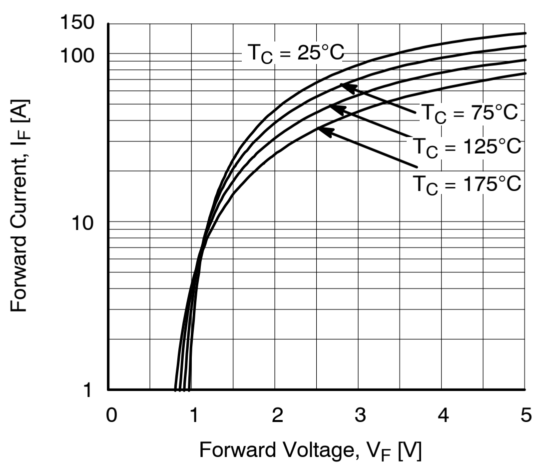


Figure 17. (Diode) Forward Characteristics vs. (Normal I−V)

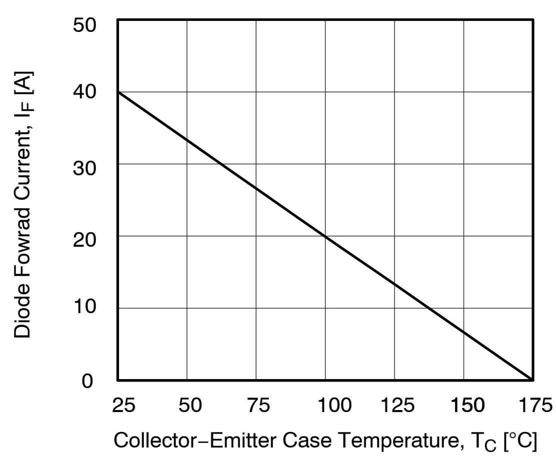


Figure 18. (Diode) Current Derating

TYPICAL CHARACTERISTICS (continued)

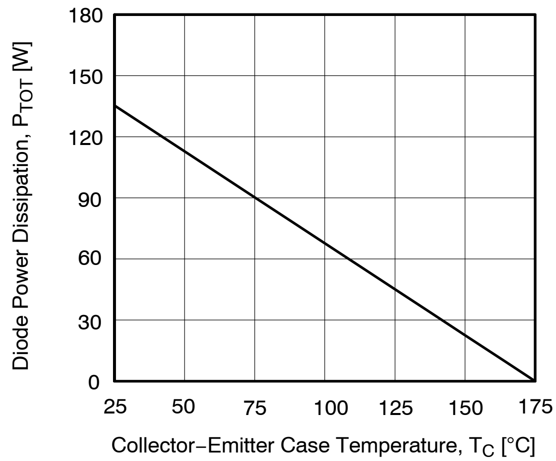


Figure 19. (Diode) Power Derating

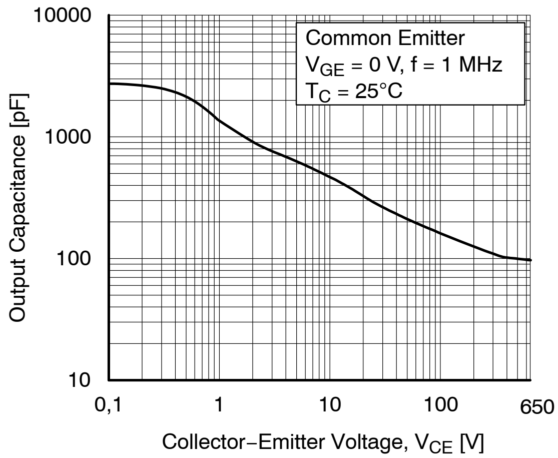


Figure 20. (Diode) Output Capacitance (Coes) vs. Reverse Voltage

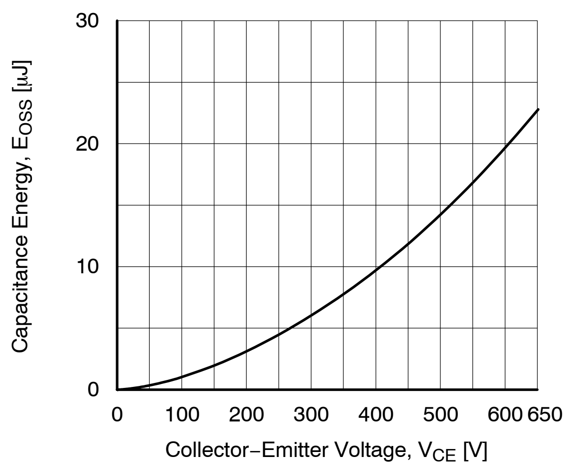


Figure 21. Output Capacitance Stored Energy

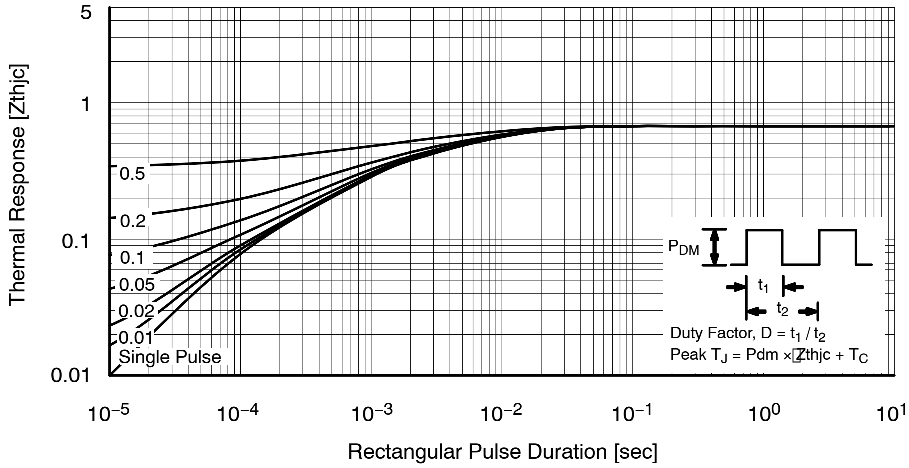


Figure 22. Transient Thermal Impedance of IGBT

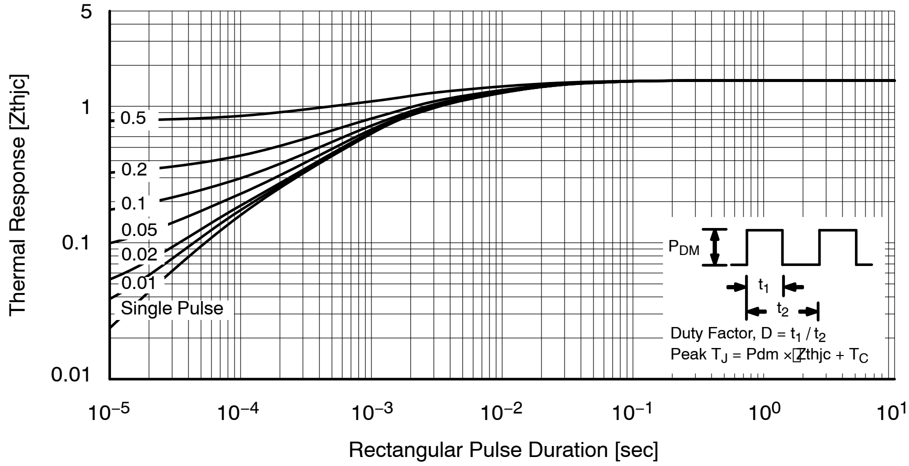
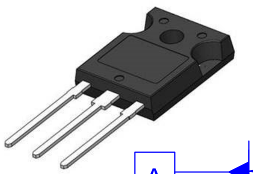
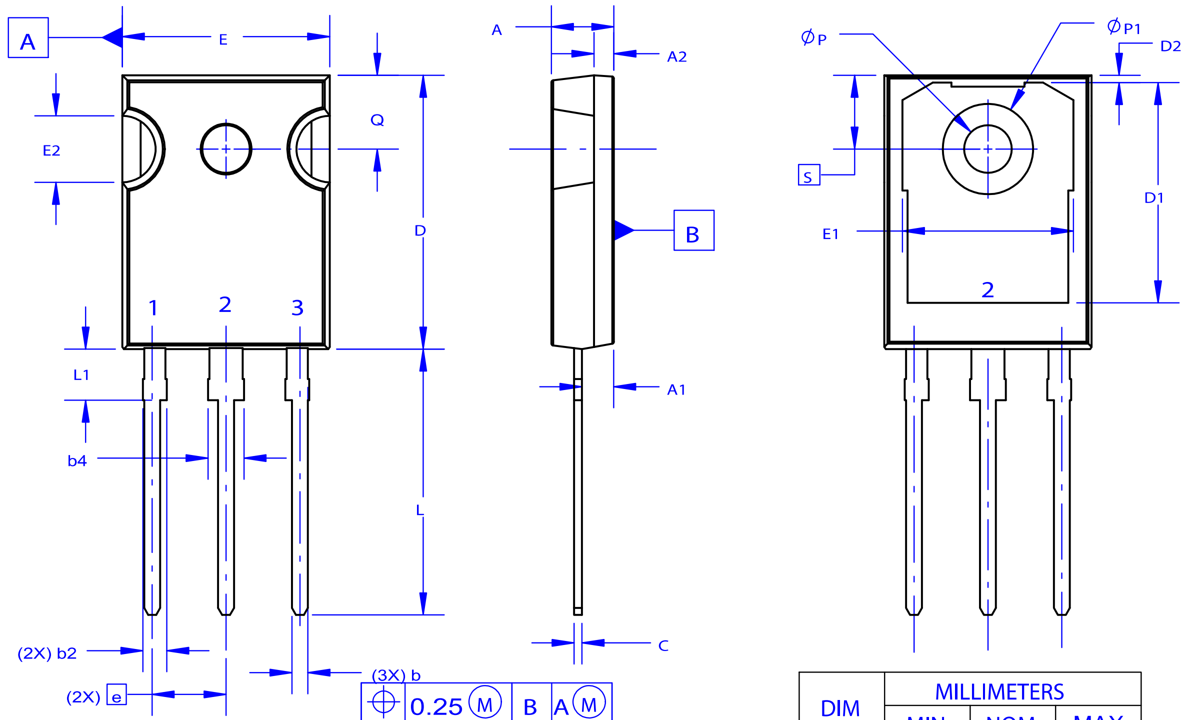


Figure 23. Transient Thermal Impedance of Diode



TO−247−3LD
CASE 340CX
ISSUE A

DATE 06 JUL 2020

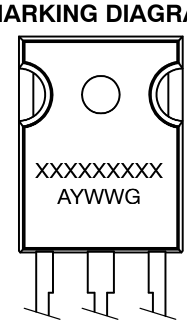


NOTES: UNLESS OTHERWISE SPECIFIED.

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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