IGBT - Power, Co-PAK N-Channel, Field Stop IV, MQ (Medium Speed), TO247-4L
650 V, 1.45 V, 50 A

FGH4L50T65MQDC50

BV$_{CES}$	V$_{CE(sat)}$	I$_C$
650 V	1.45 V	50 A

Using the novel field stop 4th generation IGBT technology and generation 1.5 SiC Schottky Diode technology in TO−247 4−lead package, FGH4L50T65MQDC50 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

- Positive Temperature Coefficient for Easy Parallel Operation
- High Current Capability
- 100% of the Parts are Tested for I$_{LM}$ (Note 2)
- Smooth and Optimized Switching
- Low Saturation Voltage: V$_{CE(Sat)}$ = 1.45 V (Typ.) @ I$_C$ = 50 A
- No Reverse Recovery / No Forward Recovery
- Tight Parameter Distribution
- RoHS Compliant

Applications

- Charging Station (EVSE)
- Solar Inverter
- UPS, ESS
- PFC, Converters

PIN CONNECTIONS

E1: Kelvin Emitter
E2: Power Emitter

TO−247−4LD
CASE 340CJ

MARKING DIAGRAM

$Y&Z&3&K
G50T65
MQDC50

$Y = **onsemi** Logo
&Z = Assembly Plant Code
&3 = 3−Digit Date Code
&K = 2−Digit Lot Traceability Code
G50T65MQDC50 = Specific Device Code

MAXIMUM RATINGS (T$_J$ = 25°C unless otherwise noted)

Parameter		Symbol	Value	Unit
Collector−to−Emitter Voltage		V$_{CES}$	650	V
Gate−to−Emitter Voltage		V$_{GES}$	±20	
Transient Gate−to−Emitter Voltage (t$_p$ < 0.5 μs, D < 0.001)			±30	
Collector Current	T$_C$ = 25°C (Note 1)	I$_C$	100	A
	T$_C$ = 100°C		50	
Power Dissipation	T$_C$ = 25°C	P$_D$	246	W
	T$_C$ = 100°C		123	
Pulsed Collector Current	T$_C$ = 25°C (Note 2)	I$_{LM}$	200	A
	T$_C$ = 25°C (Note 3)	I$_{CM}$	200	
Diode Forward Current	T$_C$ = 25°C (Note 1)	I$_F$	60	A
	T$_C$ = 100°C		50	
Pulsed Diode Maximum Forward Current	T$_C$ = 25°C	I$_{FM}$	200	A
Operating Junction and Storage Temperature Range		T$_J$, T$_{STG}$	−55 to +175	°C
Maximum Lead Temp. for Soldering Purposes (1/8″ from case for 5 s)		T$_L$	260	°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 limit by bond wire
2. V$_{CC}$ = 400 V, V$_{GE}$ = 15 V, I$_C$ = 200 A, Inductive Load, 100% tested
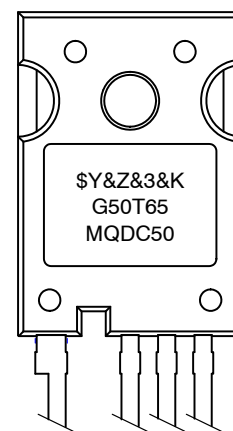3. Repetitive rating: pulse width limited by max. junction temperature

ORDERING INFORMATION

Device	Package	Shipping
FGH4L50T65MQDC50	TO−247 −4LD	30 Units / Tube

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal Resistance Junction−to−Case, for IGBT	$R_{\theta JC}$	0.61	°C/W
Thermal Resistance Junction−to−Case, for Diode	$R_{\theta JCD}$	0.70	
Thermal Resistance junction−to−Ambient	$R_{\theta JA}$	40	

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	$\dfrac{\Delta BV_{CES}}{\Delta T_J}$	–	0.5	–	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	$V_{GE(th)}$	3.0	4.5	6.0	V
Collector−emitter Saturation Voltage	V_{GE} = 15 V, I_C = 50 A, T_J = 25°C	$V_{CE(sat)}$	–	1.45	1.8	V
	V_{GE} = 15 V, I_C = 50 A, T_J = 175°C		–	1.65	–	
DYNAMIC CHARACTERISTICS						
Input Capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz	C_{ies}	–	3340	–	pF
Output Capacitance		C_{oes}	–	630	–	
Reverse Transfer Capacitance		C_{res}	–	10	–	
Gate Charge Total	V_{CE} = 400 V, I_C = 50 A, V_{GE} = 15 V	Q_g	–	102	–	nC
Gate−to−emitter Charge		Q_{ge}	–	19	–	
Gate−to−collector Charge		Q_{gc}	–	25	–	
SWITCHING CHARACTERISTICS, INDUCTIVE LOAD						
Turn−on Delay Time	T_J = 25°C, V_{CC} = 400 V, I_C = 25 A, R_G = 15 Ω, V_{GE} = 15 V, Inductive Load	$t_{d(on)}$	–	27	–	ns
Rise Time		t_r	–	10	–	
Turn−off Delay Time		$t_{d(off)}$	–	181	–	
Fall Time		t_f	–	21	–	
Turn−on Switching Loss		E_{on}	–	0.24	–	mJ
Turn−off Switching Loss		E_{off}	–	0.31	–	
Total Switching Loss		E_{ts}	–	0.55	–	
Turn−on Delay Time	T_J = 25°C, V_{CC} = 400 V, I_C = 50 A, R_G = 15 Ω, V_{GE} = 15 V, Inductive Load	$t_{d(on)}$	–	29	–	ns
Rise Time		t_r	–	21	–	
Turn−off Delay Time		$t_{d(off)}$	–	173	–	
Fall Time		t_f	–	18	–	
Turn−on Switching Loss		E_{on}	–	0.54	–	mJ
Turn−off Switching Loss		E_{off}	–	0.59	–	
Total Switching Loss		E_{ts}	–	1.13	–	

FGH4L50T65MQDC50

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_J = 175°C, V_{CC} = 400 V, I_C = 25 A, R_G = 15 Ω, V_{GE} = 15 V, Inductive Load	$t_{d(on)}$	–	24	–	ns
Rise Time		t_r	–	11	–	
Turn−off Delay Time		$t_{d(off)}$	–	197	–	
Fall Time		t_f	–	24	–	
Turn−on Switching Loss		E_{on}	–	0.31	–	mJ
Turn−off Switching Loss		E_{off}	–	0.51	–	
Total Switching Loss		E_{ts}	–	0.82	–	
Turn−on Delay Time	T_J = 175°C, V_{CC} = 400 V, I_C = 50 A, R_G = 15 Ω, V_{GE} = 15 V, Inductive Load	$t_{d(on)}$	–	26	–	ns
Rise Time		t_r	–	27	–	
Turn−off Delay Time		$t_{d(off)}$	–	186	–	
Fall Time		t_f	–	26	–	
Turn−on Switching Loss		E_{on}	–	0.74	–	mJ
Turn−off Switching Loss		E_{off}	–	0.97	–	
Total Switching Loss		E_{ts}	–	1.71	–	
DIODE CHARACTERISTICS						
Diode Forward Voltage	I_F = 50 A, T_J = 25°C	V_F	–	1.46	1.7	V
	I_F = 50 A, T_J = 175°C		–	1.83	–	
Total Capacitance	V_R = 400 V, f = 1 MHz, T_J = 25°C	C	–	210	–	pF
	V_R = 600 V, f = 1 MHz, T_J = 25°C		–	202	–	

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
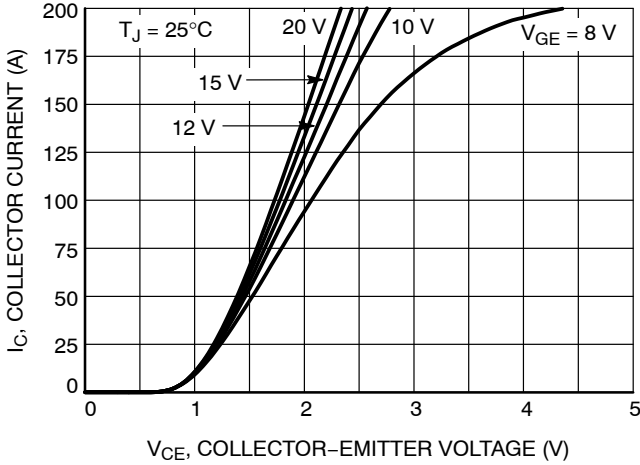
Figure 1. Typical Output Characteristics
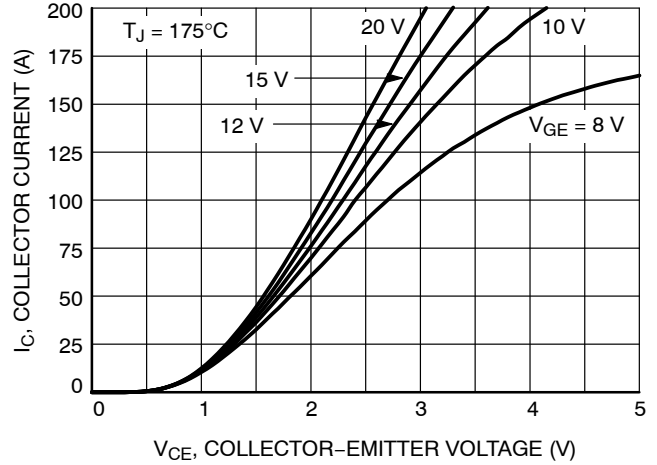
Figure 2. Typical Output Characteristics
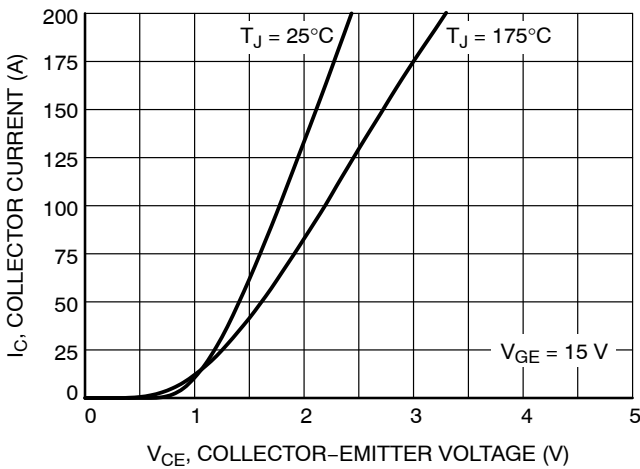
Figure 3. Typical Output Characteristics
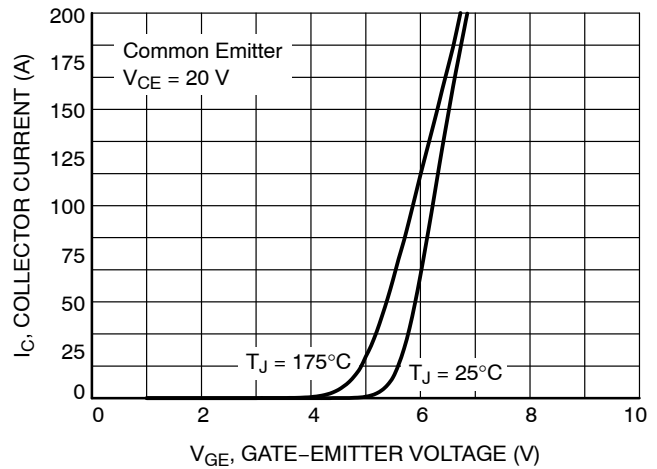
Figure 4. Transfer Characteristics
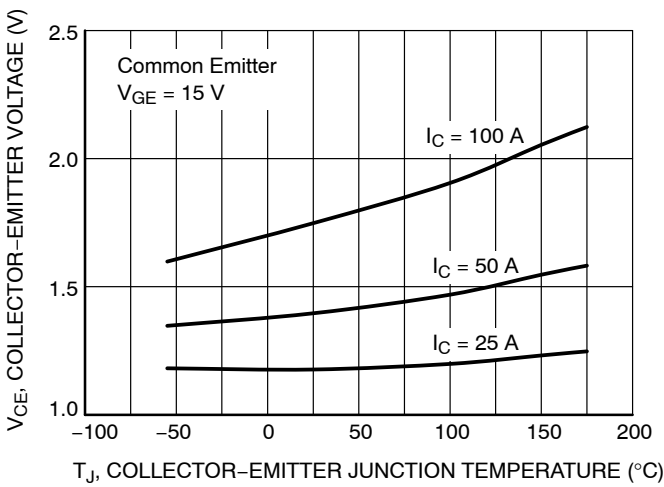
Figure 5. Saturation Voltage vs. Junction Temperature at Variant Current Level
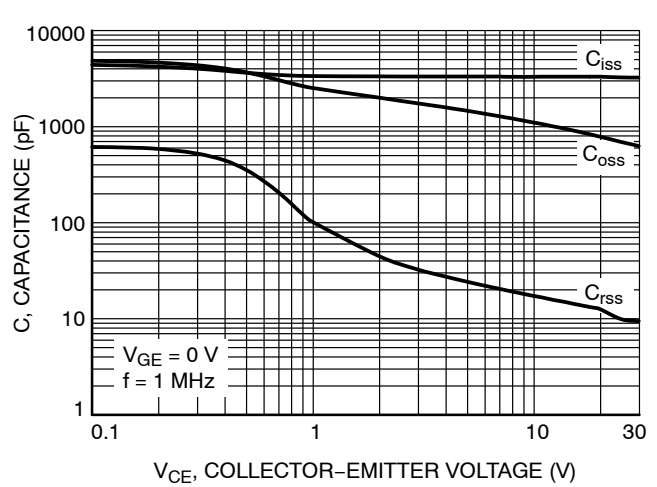
Figure 6. Capacitance Variation

TYPICAL CHARACTERISTICS
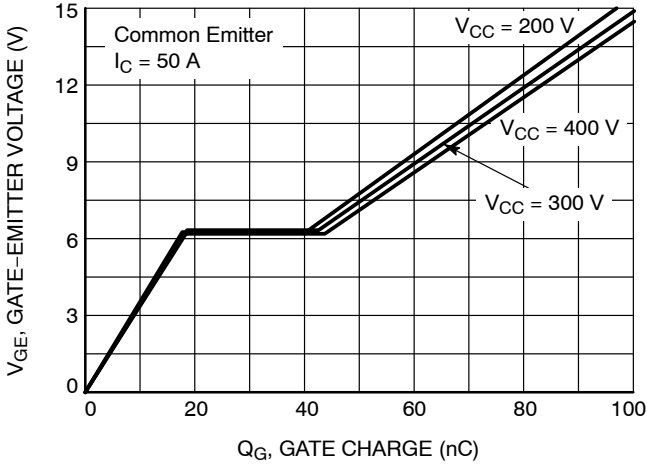
Figure 7. Gate Charge Characteristics
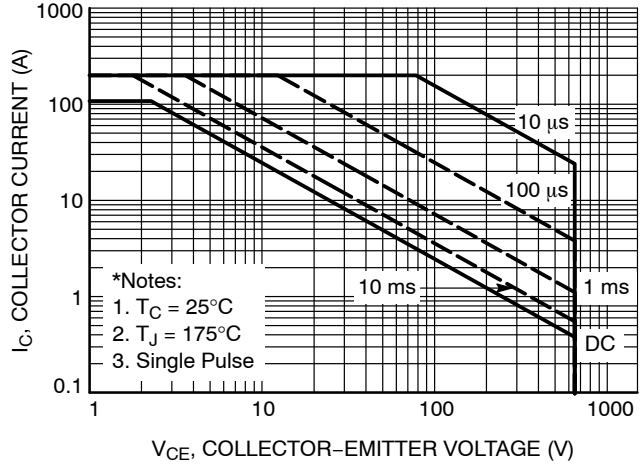
Figure 8. SOA Characteristics
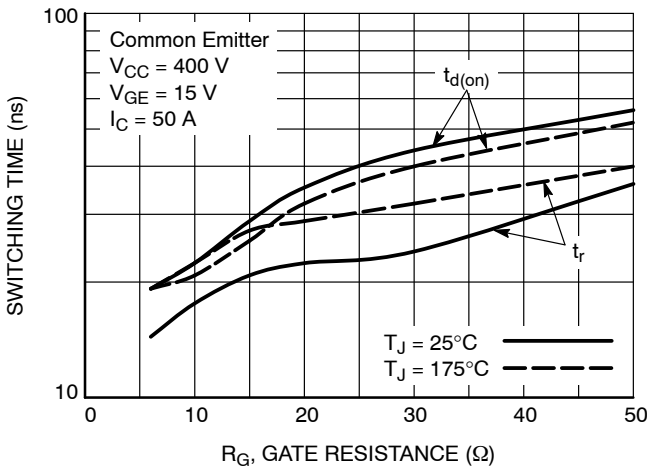
Figure 9. Turn–On Characteristics vs. Gate Resistance
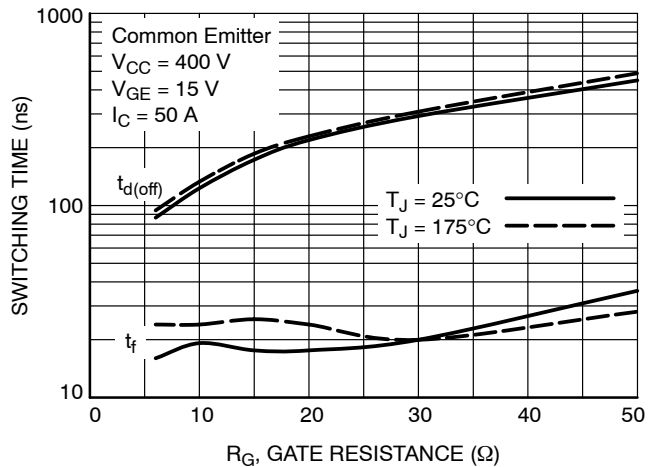
Figure 10. Turn–Off Characteristics vs. Gate Resistance
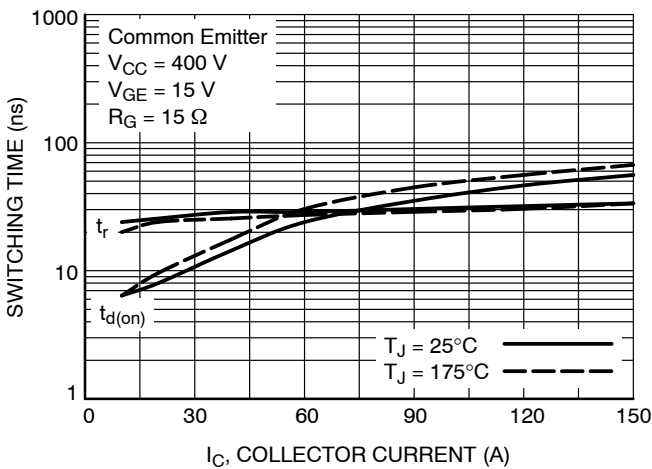
Figure 11. Turn–on Characteristics vs. Collector Current
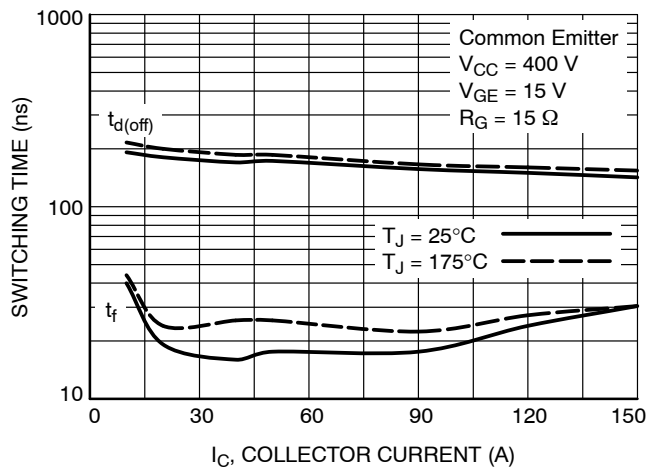
Figure 12. Turn–off Characteristics vs. Collector Current

TYPICAL CHARACTERISTICS

Common Emitter
V_{CC} = 400 V
V_{GE} = 15 V
I_C = 50 A

E_{off}

E_{on}

T_J = 25°C
T_J = 175°C
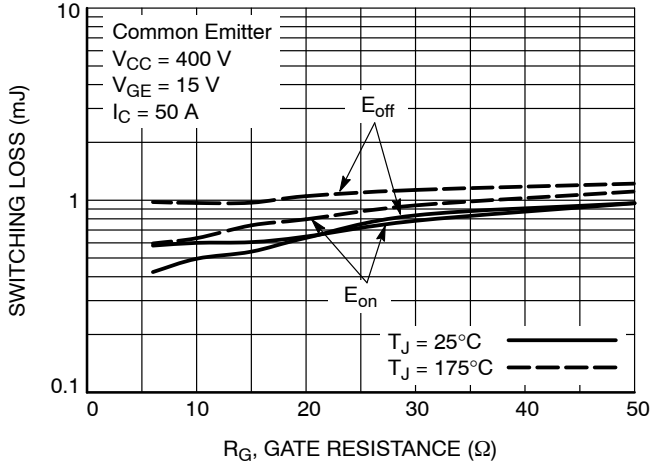
Figure 13. Switching Loss vs. Gate Resistance

Common Emitter
V_{CC} = 400 V
V_{GE} = 15 V
I_C = 50 A
R_G = 15 Ω

E_{off}

E_{on}

T_J = 25°C
T_J = 175°C
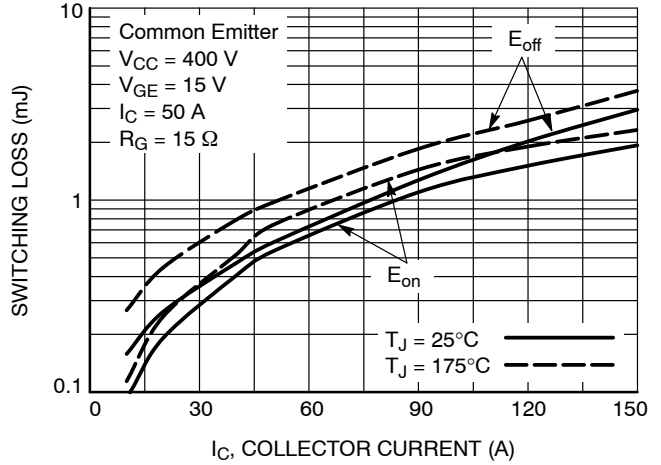
Figure 14. Switching Loss vs. Collector Current

T_J = 25°C

T_J = 175°C
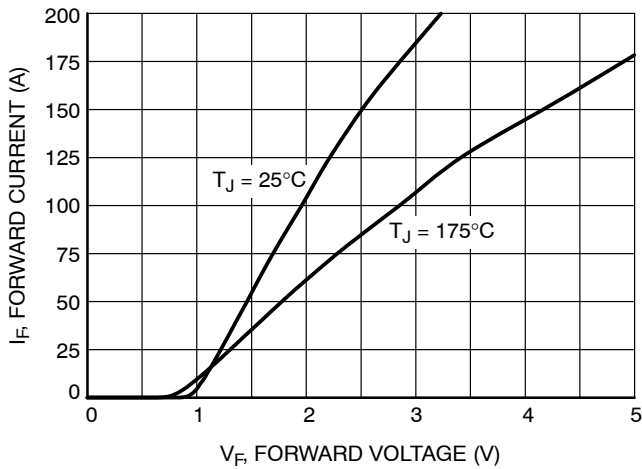
Figure 15. Forward Diode Characteristics

Common Emitter
V_{GE} = 0 V
f = 1 MHz
T_C = 25°C
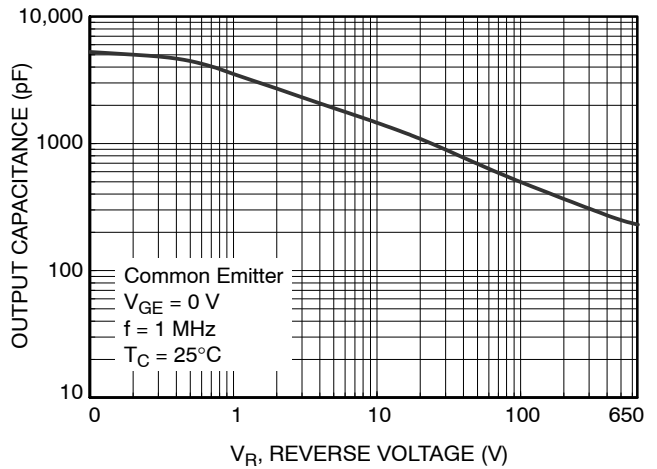
Figure 16. (Diode) Output Capacitance (Coes) vs. Reverse Voltage
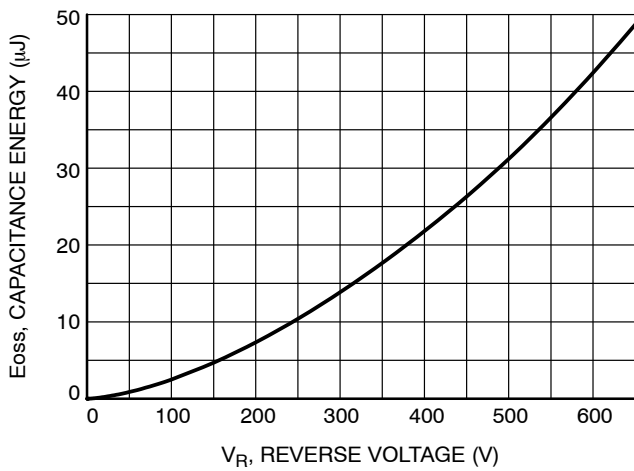
Figure 17. Output Capacitance Stored Energy

TYPICAL CHARACTERISTICS
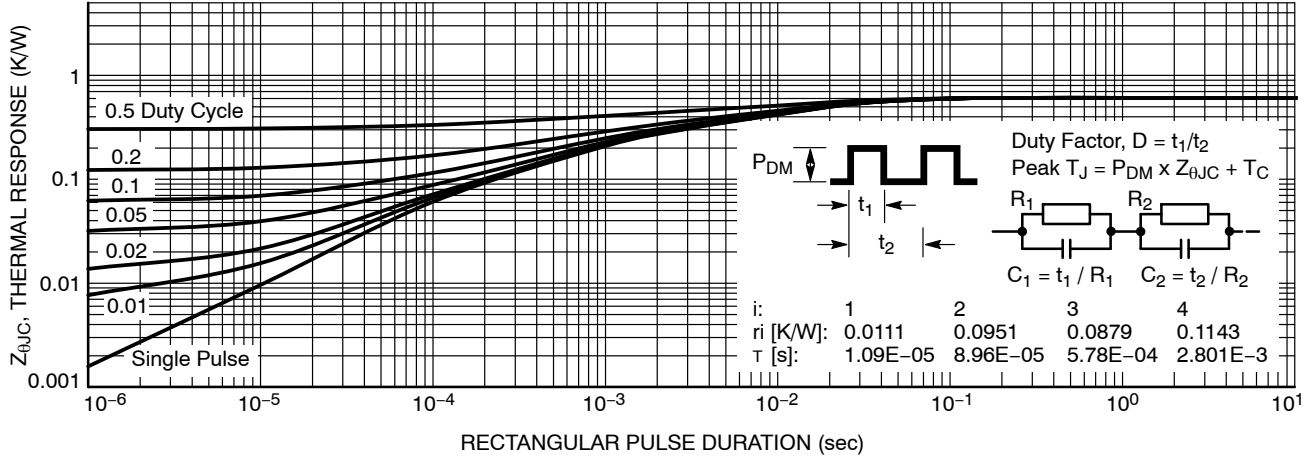
Figure 18. Transient Thermal Impedance of IGBT
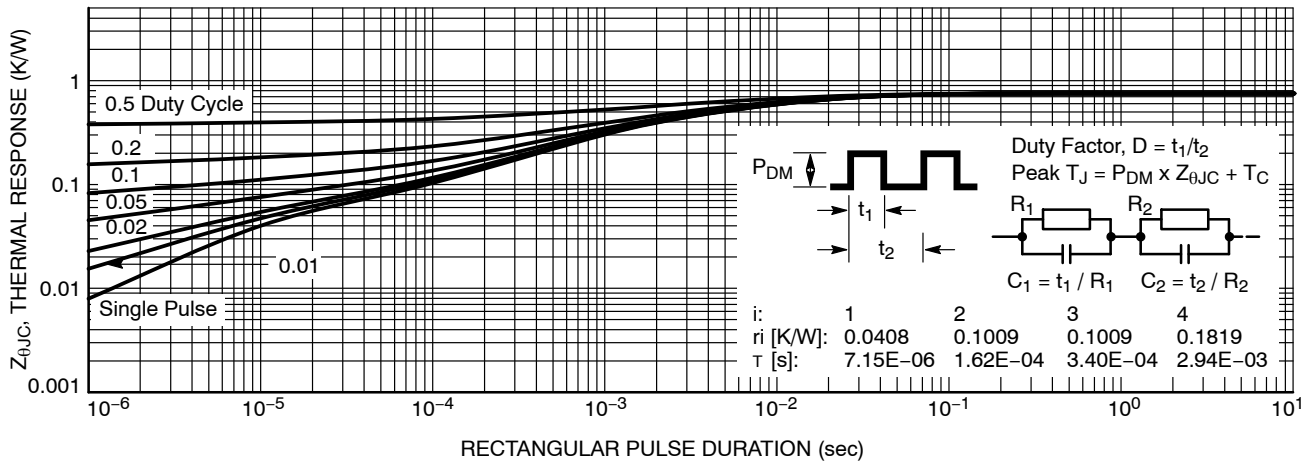
Figure 19. Transient Thermal Impedance of Diode

TO−247−4LD
CASE 340CJ
ISSUE A

DATE 16 SEP 2019

NOTES:

A. NO INDUSTRY STANDARD APPLIES TO THIS PACKAGE.
B. DIMENSIONS ARE EXCLUSIVE OF BURRS,MOLD
   FLASH,AND TIE BAR EXTRUSIONS.
C. ALL DIMENSIONS ARE IN MILLIMETERS.
D. DRAWING CONFORMS TO ASME Y14.5-2009.
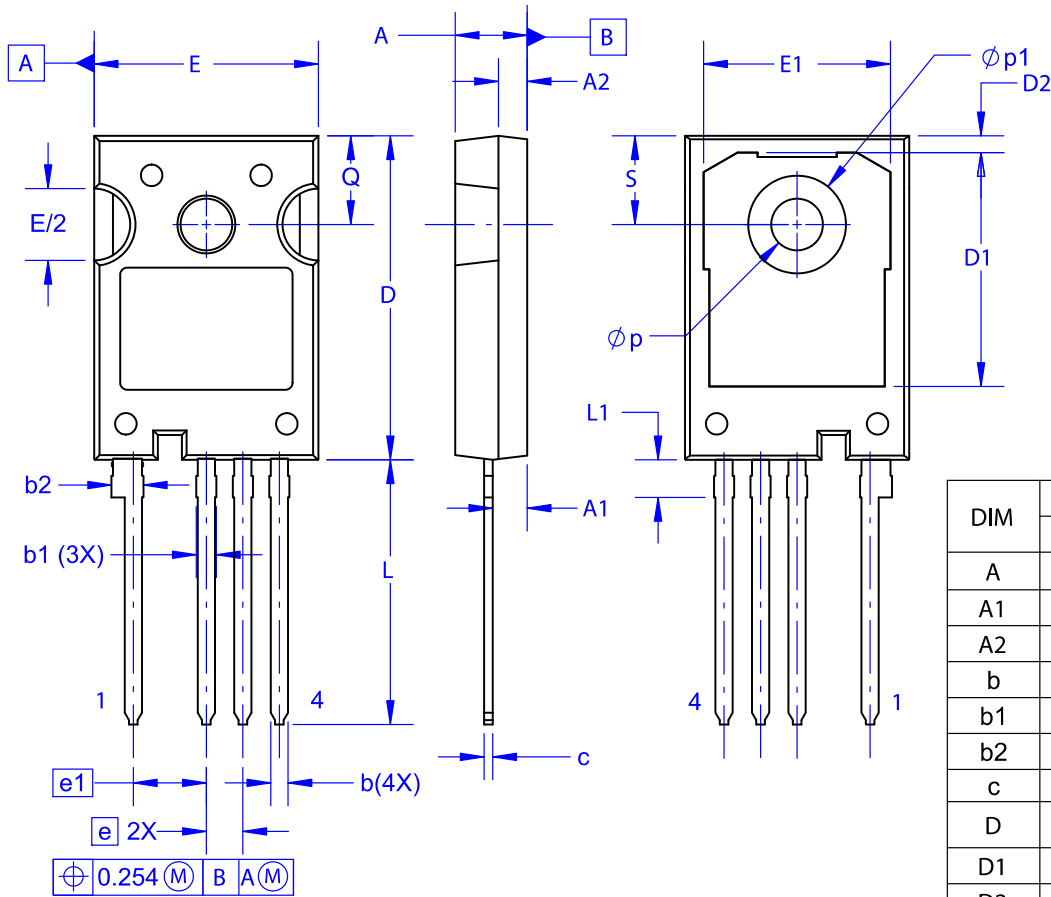
DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.10	2.40	2.70
A2	1.80	2.00	2.20
b	1.07	1.20	1.33
b1	1.20	1.40	1.60
b2	2.02	2.22	2.42
c	0.50	0.60	0.70
D	22.34	22.54	22.74
D1	16.00	16.25	16.50
D2	0.97	1.17	1.37
e	2.54 BSC		
e1	5.08 BSC		
E	15.40	15.60	15.80
E1	12.80	13.00	13.20
E/2	4.80	5.00	5.20
L	18.22	18.42	18.62
L1	2.42	2.62	2.82
p	3.40	3.60	3.80
p1	6.60	6.80	7.00
Q	5.97	6.17	6.37
S	5.97	6.17	6.37

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ADDITIONAL INFORMATION

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