

# IGBT - Power, Co-PAK N-Channel, Field Stop IV, MQ (Medium Speed), TO247-4L

650 V, 1.45 V, 50 A

## FGH4L50T65MQDC50

Using the novel field stop 4th generation IGBT technology and the 1.5th generation 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:  $V_{CE(sat)} = 1.45\text{ V (Typ.) @ } I_C = 50\text{ A}$
- No Reserved Recovery / No Forward Recovery
- Tight Parameter Distribution
- RoHS Compliant

### Applications

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

### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

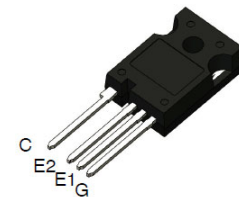
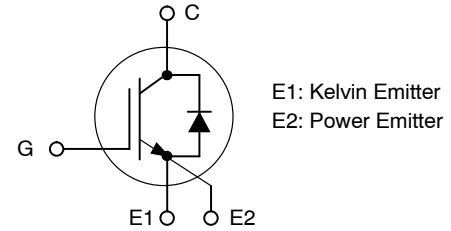
Parameter	Symbol	Value	Unit	
Collector-to-Emitter Voltage	$V_{CES}$	650	V	
Gate-to-Emitter Voltage	$V_{GES}$	$\pm 20$		
Transient Gate-to-Emitter Voltage ( $t_p < 0.5\ \mu\text{s}$ , $D < 0.001$ )		$\pm 30$		
Collector Current	$I_C$	$T_C = 25^\circ\text{C}$ (Note 1)	100	A
		$T_C = 100^\circ\text{C}$	50	
Power Dissipation	$P_D$	$T_C = 25^\circ\text{C}$	246	W
		$T_C = 100^\circ\text{C}$	123	
Pulsed Collector Current	$I_{LM}$	$T_C = 25^\circ\text{C}$ (Note 2)	200	A
		$T_C = 25^\circ\text{C}$ (Note 3)	$I_{CM}$	200
Diode Forward Current	$I_F$	$T_C = 25^\circ\text{C}$ (Note 1)	60	A
		$T_C = 100^\circ\text{C}$	50	
Pulsed Diode Maximum Forward Current	$I_{FM}$	200	A	
Operating Junction and 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 s)	$T_L$	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. Value limit by bond wire
2.  $V_{CC} = 400\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $I_C = 200\text{ A}$ , Inductive Load, 100% tested
3. Repetitive rating: pulse width limited by max. junction temperature

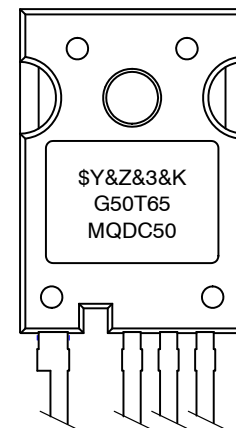
$BV_{CES}$	$V_{CE(sat)}$	$I_C$
650 V	1.45 V	50 A

### PIN CONNECTIONS



TO-247-4LD  
CASE 340CJ

### MARKING DIAGRAM



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

### ORDERING INFORMATION

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

# FGH4L50T65MQDC50

## THEMAL 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 ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

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	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	$\frac{\Delta BV_{CES}}{\Delta T_J}$	-	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 CHARACTERISTICS

Gate-emitter Threshold Voltage	$V_{GE} = V_{CE}, I_C = 50\text{ mA}$	$V_{GE(th)}$	3.0	4.5	6.0	V
Collector-emitter Saturation Voltage	$V_{GE} = 15\text{ V}, I_C = 50\text{ A}, T_J = 25^\circ\text{C}$	$V_{CE(sat)}$	-	1.45	1.8	V
	$V_{GE} = 15\text{ V}, I_C = 50\text{ A}, T_J = 175^\circ\text{C}$		-	1.65	-	

### DYNAMIC CHARACTERISTICS

Input Capacitance	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	$C_{ies}$	-	3340	-	pF
Output Capacitance		$C_{oes}$	-	630	-	
Reverse Transfer Capacitance		$C_{res}$	-	10	-	
Gate Charge Total	$V_{CE} = 400\text{ V}, I_C = 50\text{ A}, V_{GE} = 15\text{ V}$	$Q_g$	-	102	-	nC
Gate-to-emitter Charge		$Q_{ge}$	-	19	-	
Gate-to-collector Charge		$Q_{gc}$	-	25	-	

### SWITCHING CHARACTERISTICS, INDUCTIVE LOAD

Turn-on Delay Time	$T_J = 25^\circ\text{C}, V_{CC} = 400\text{ V}, I_C = 25\text{ A}, R_G = 15\ \Omega, V_{GE} = 15\text{ V}, \text{Inductive Load}$	$t_{d(on)}$	-	27	-	ns
Rise Time		$t_r$	-	10	-	
Turn-off Delay Time		$t_{d(off)}$	-	181	-	
Fall Time		$t_f$	-	21	-	mJ
Turn-on Switching Loss		$E_{on}$	-	0.24	-	
Turn-off Switching Loss		$E_{off}$	-	0.31	-	
Total Switching Loss		$E_{ts}$	-	0.55	-	
Turn-on Delay Time	$T_J = 25^\circ\text{C}, V_{CC} = 400\text{ V}, I_C = 50\text{ A}, R_G = 15\ \Omega, V_{GE} = 15\text{ V}, \text{Inductive Load}$	$t_{d(on)}$	-	29	-	ns
Rise Time		$t_r$	-	21	-	
Turn-off Delay Time		$t_{d(off)}$	-	173	-	
Fall Time		$t_f$	-	18	-	mJ
Turn-on Switching Loss		$E_{on}$	-	0.54	-	
Turn-off Switching Loss		$E_{off}$	-	0.59	-	
Total Switching Loss		$E_{ts}$	-	1.13	-	

# FGH4L50T65MQDC50

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
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### SWITCHING CHARACTERISTICS, INDUCTIVE LOAD

Turn-on Delay Time	$T_J = 175^\circ\text{C}, V_{CC} = 400\text{ V},$ $I_C = 25\text{ A}, R_G = 15\ \Omega,$ $V_{GE} = 15\text{ V},$ 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	$T_J = 175^\circ\text{C}, V_{CC} = 400\text{ V},$ $I_C = 50\text{ A}, R_G = 15\ \Omega,$ $V_{GE} = 15\text{ V},$ 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	$I_F = 50\text{ A}, T_J = 25^\circ\text{C}$	$V_F$	-	1.46	1.7	V
	$I_F = 50\text{ A}, T_J = 175^\circ\text{C}$		-	1.83	-	
Total Capacitance	$V_R = 400\text{ V}, f = 1\text{ MHz}, T_J = 25^\circ\text{C}$	C	-	210	-	pF
	$V_R = 600\text{ V}, f = 1\text{ MHz}, T_J = 25^\circ\text{C}$		-	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.

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## TYPICAL CHARACTERISTICS

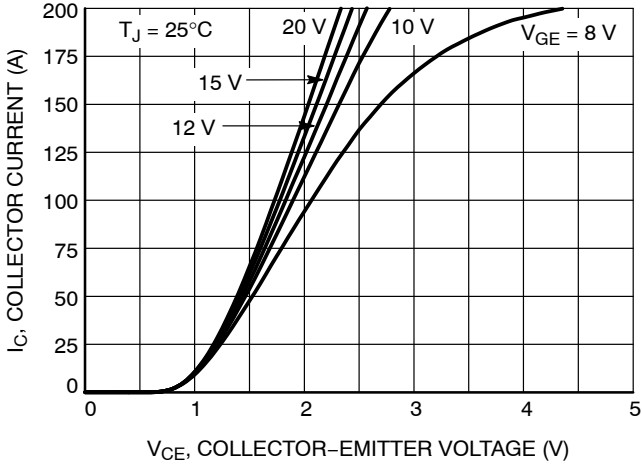


Figure 1. Typical Output Characteristics

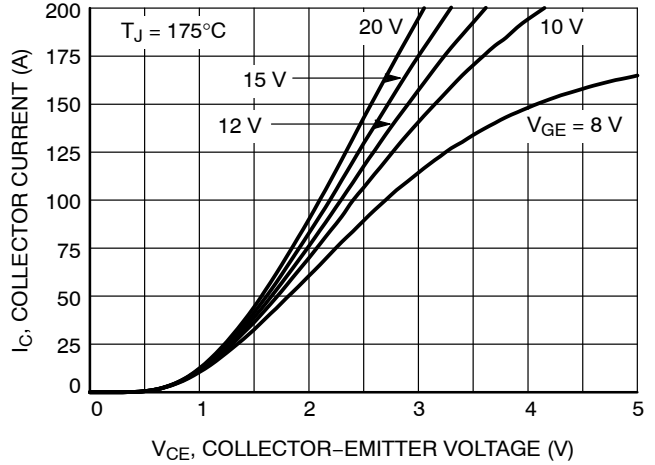


Figure 2. Typical Output Characteristics

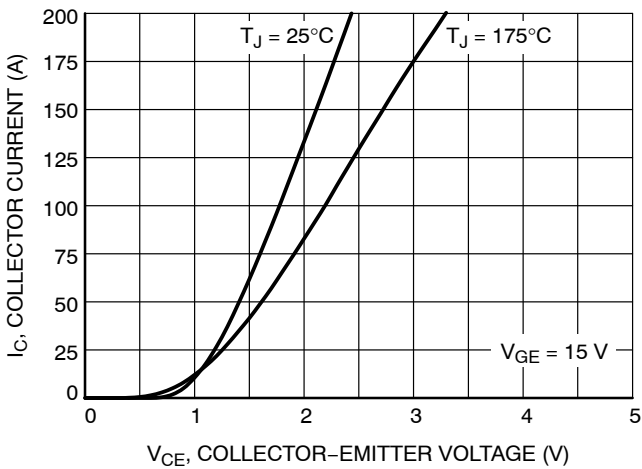


Figure 3. Typical Output Characteristics

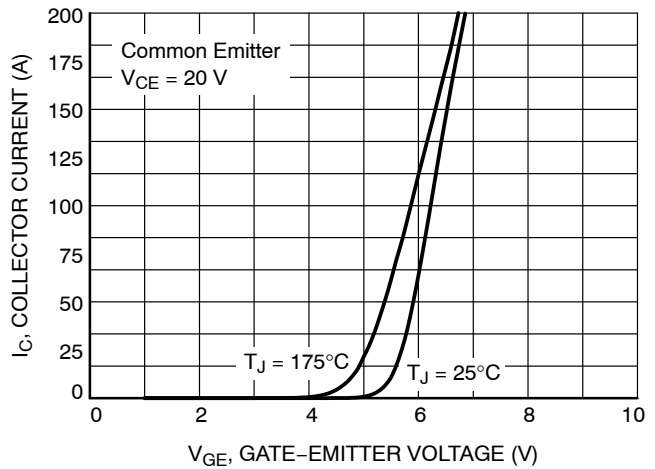


Figure 4. Transfer Characteristics

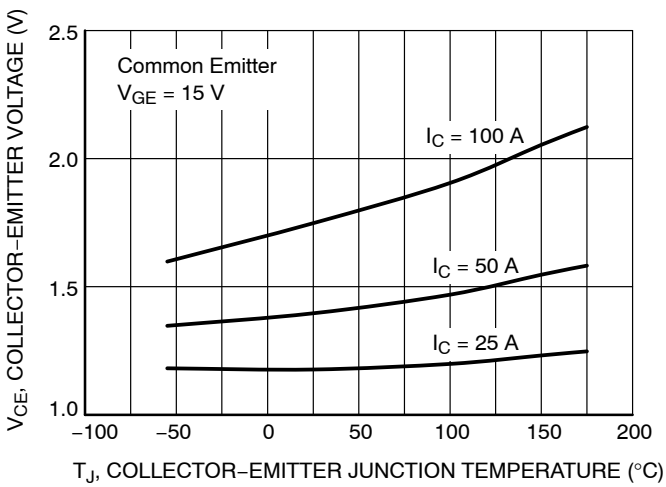


Figure 5. Saturation Voltage vs. Junction Temperature at Variant Current Level

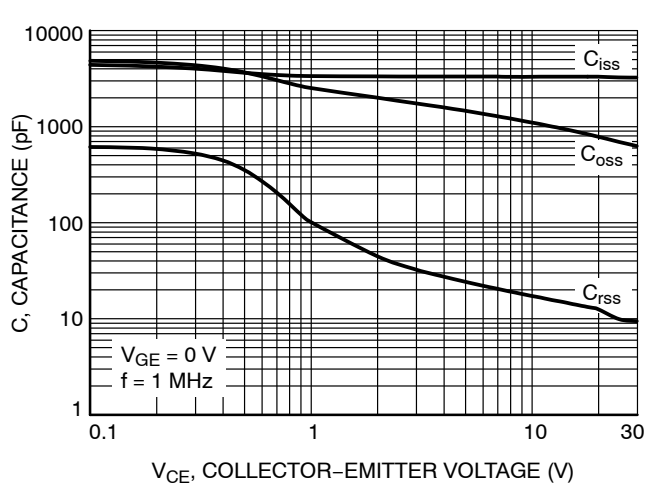


Figure 6. Capacitance Variation

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## TYPICAL CHARACTERISTICS

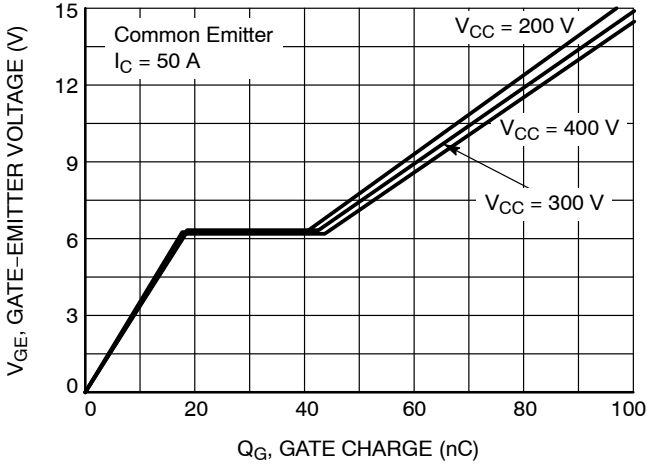


Figure 7. Gate Charge Characteristics

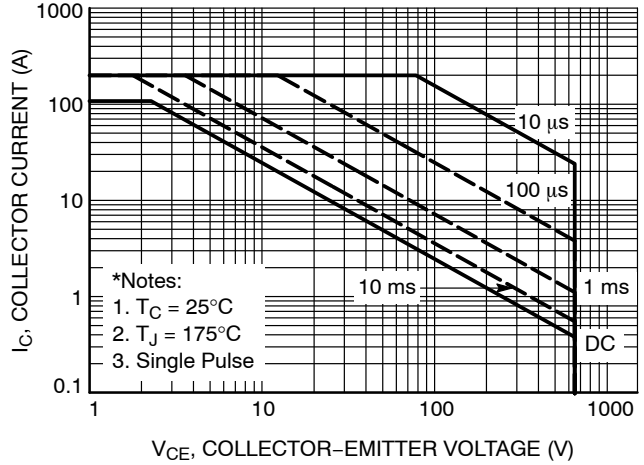


Figure 8. SOA Characteristics

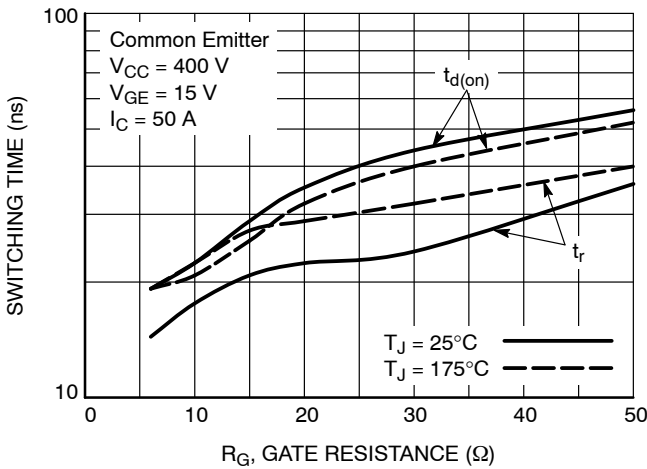


Figure 9. Turn-On Characteristics vs. Gate Resistance

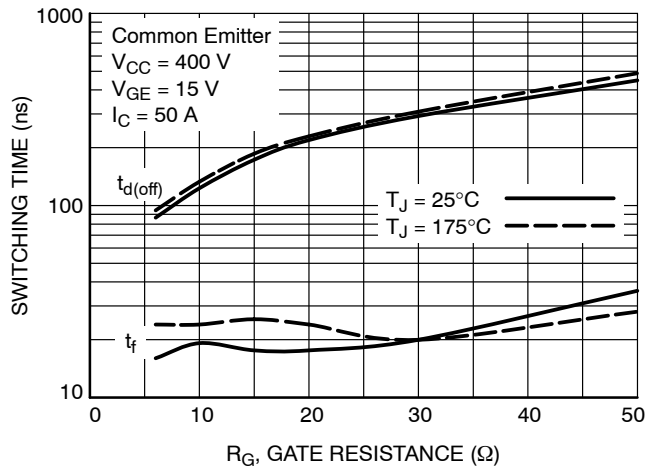


Figure 10. Turn-Off Characteristics vs. Gate Resistance

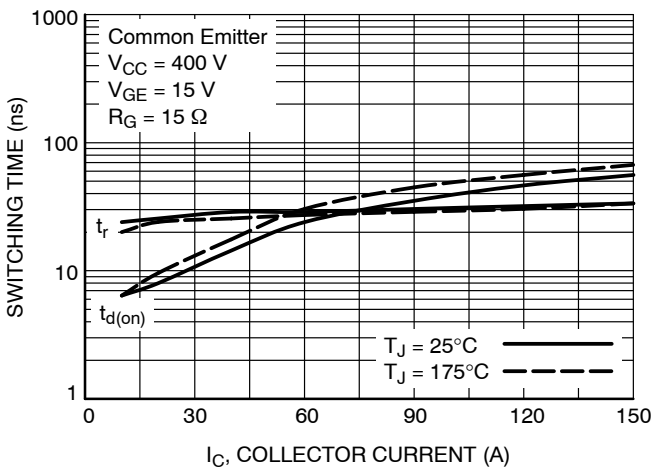


Figure 11. Switching Loss vs. Gate Resistance

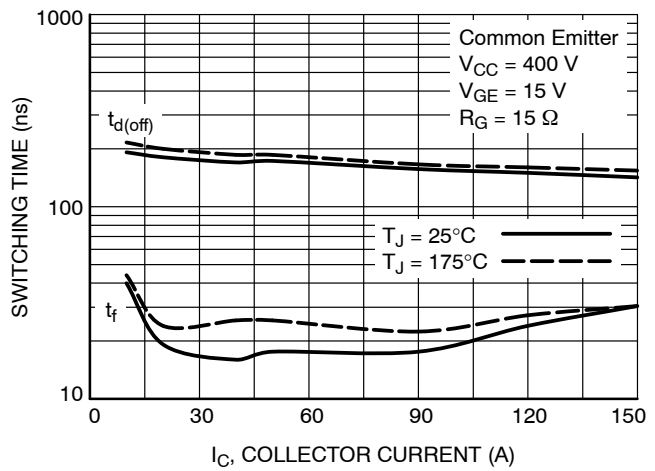


Figure 12. Turn-On Characteristics vs. Collector Current

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## TYPICAL CHARACTERISTICS

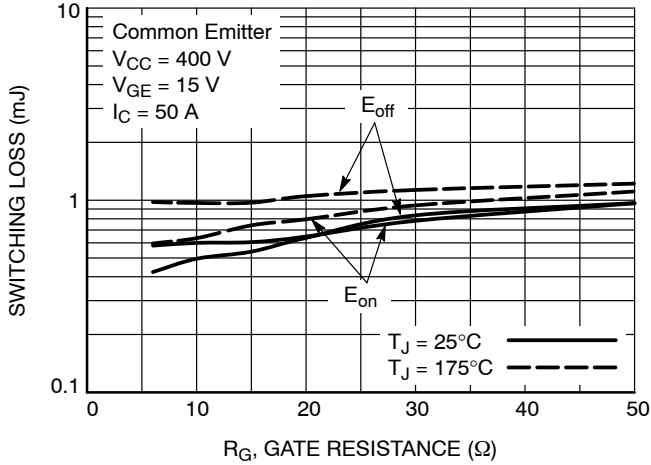


Figure 13. Turn-off Characteristics vs. Collector Current

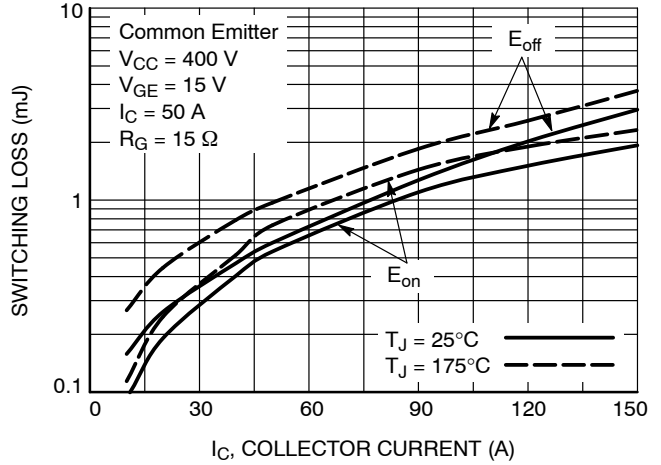


Figure 14. Switching Loss vs. Collector Current

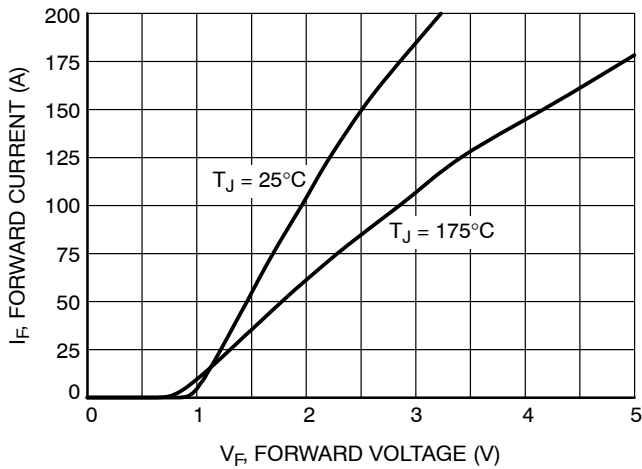


Figure 15. Forward Diode Characteristics

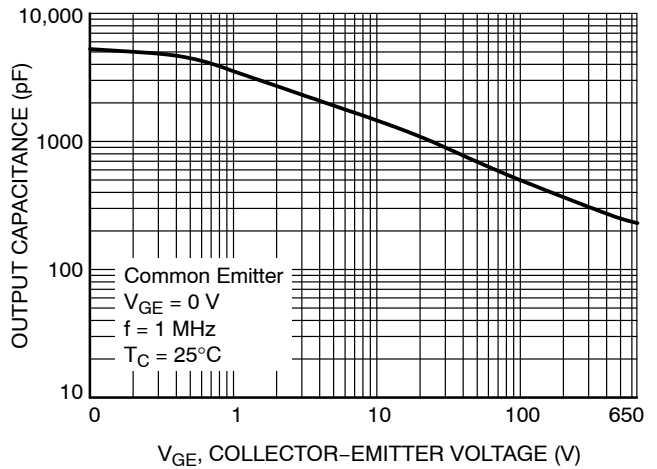


Figure 16. (Diode) Output Capacitance (Coes) vs. Reverse Voltage

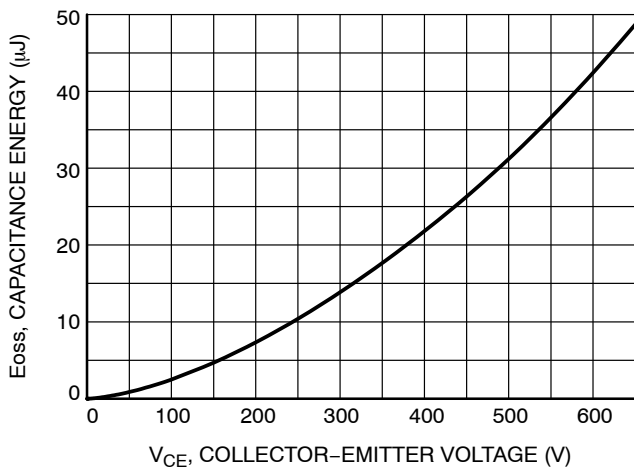


Figure 17. Output Capacitance Stored Energy

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## TYPICAL CHARACTERISTICS

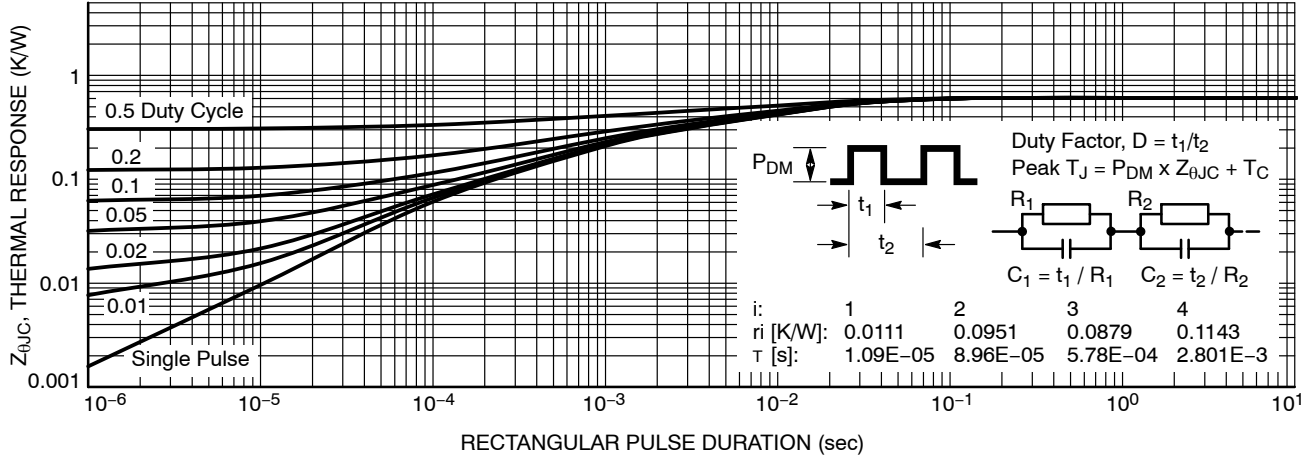


Figure 18. Transient Thermal Impedance of IGBT

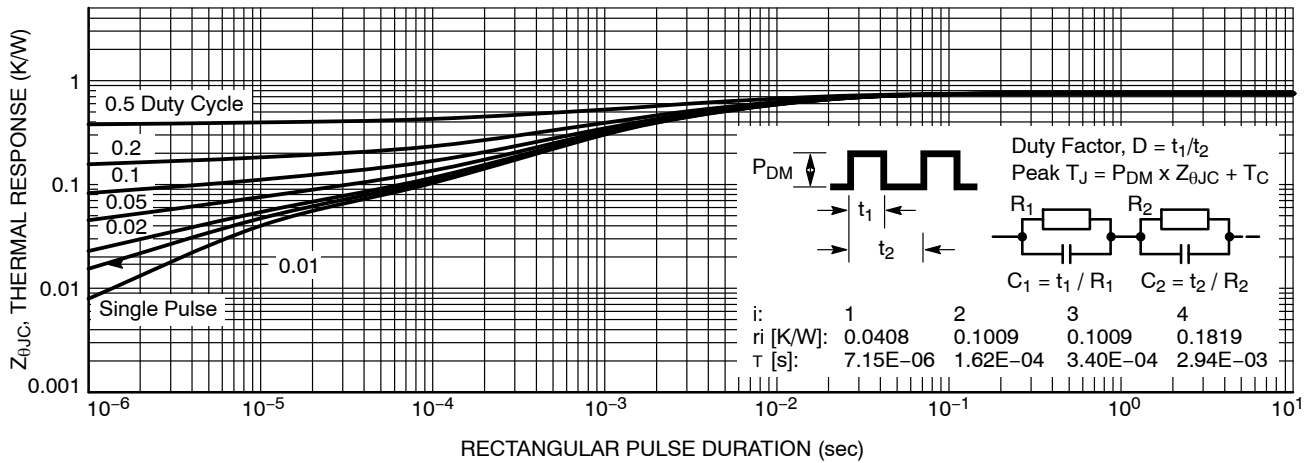
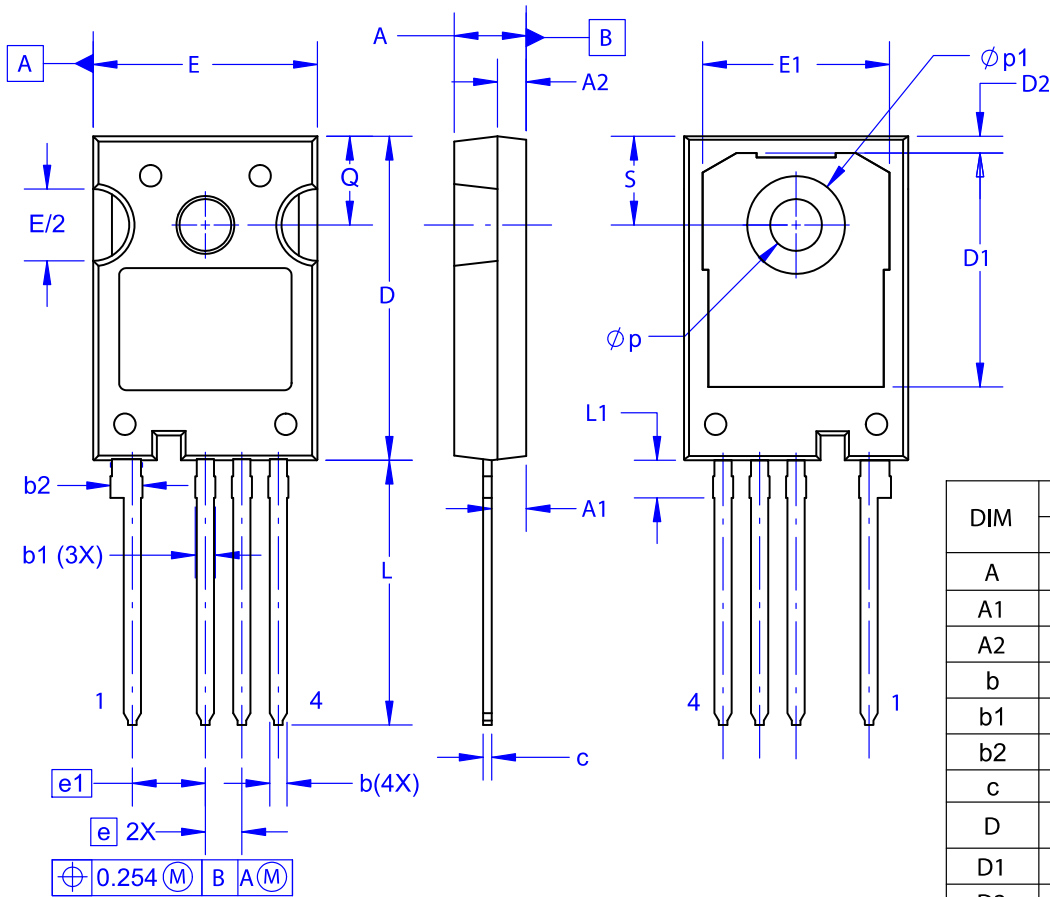


Figure 19. Transient Thermal Impedance of Diode

# FGH4L50T65MQDC50

## PACKAGE DIMENSIONS

TO-247-4LD  
CASE 340CJ  
ISSUE A



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

**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.



# FGH4L50T65MQDC50

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