IGBT – Field Stop, Trench

650 V, 50 A

FGH4L50T65SQD

Description

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

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 = 50 A
- 100% of the Parts are Tested for I_{LM}
- High Input Impedance
- Fast Switching
- Tight Parameter Distribution
- This Device is Pb−Free and is RoHS Compliant

Applications

- Solar Inverter, UPS, Welder, Telecom, ESS, PFC

ON Semiconductor®

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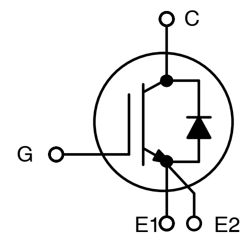
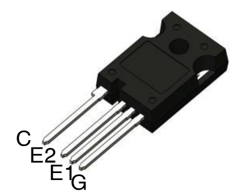
V_{CES}	I_C
650 V	50 A

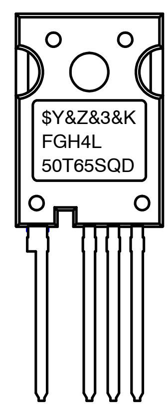


E1: Kelvin Emitter
E2: Power Emitter



TO−247−4LD
CASE 340CJ

MARKING DIAGRAM



$Y	= ON Semiconductor Logo
&Z	= Assembly Plant Code
&3	= Numeric Date Code
&K	= Lot Code
FGH4L50T65SQD	= Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping
FGH4L50T65SQD	TO−247−4LD	30 Units / Rail

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July, 2021 − Rev. 0

Publication Order Number:
FGH4L50T65SQD/D

ABSOLUTE MAXIMUM RATINGS

Symbol	Rating	Value	Unit
V_{CES}	Collector to Emitter Voltage	650	V
V_{GES}	Gate to Emitter Voltage	+20	V
	Transient Gate to Emitter Voltage	+30	V
I_C	Collector Current (Note 1) T_C = 25°C T_C = 100°C	 80 50	A
I_{LM}	Pulsed Collector Current (Note 2), T_C = 25°C	200	A
I_{CM}	Pulsed Collector Current (Note 3)	200	A
I_F	Diode Forward Current (Note 1) T_C = 25°C T_C = 100°C	 40 30	A
IFM	Pulsed Diode Maximum Forward Current	200	A
P_D	Maximum Power Dissipation T_C = 25°C T_C = 100°C	 268 134	W
T_J	Operating Junction Temperature	−55 to +175	°C
TSTG	Storage Temperature Range	−55 to +175	°C
T_L	Maximum Lead Temp. for Soldering Purposes, 1/8” from Case for 5 Seconds	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 = 200 A, R_G = 15 Ω, Inductive Load.
3. Repetitive rating: Pulse width limited by max. junction temperature.

THERMAL CHARACTERISTICS

Symbol	Characteristics	Value	Unit
$R_{\theta JC}$ (IGBT)	Thermal Resistance, Junction to Case, Max.	0.56	°C/W
$R_{\theta JC}$ (Diode)	Thermal Resistance, Junction to Case, Max.	1.25	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	°C/W

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
BV_{CES}	Collector to Emitter Breakdown Voltage	V_{GE} = 0 V, I_C = 1 mA	650	–	–	V
$\Delta BV_{CES} / \Delta T_J$	Temperature Coefficient of Breakdown Voltage	V_{GE} = 0 V, I_C = 1 mA	–	0.6	–	V/°C
I_{CES}	Collector Cut−Off Current	V_{CE} = V_{CES}, V_{GE} = 0 V	–	–	250	μA
I_{GES}	G−E Leakage Current	V_{GE} = V_{GES}, V_{CE} = 0 V	–	–	±400	nA
ON CHARACTERISTICS						
$V_{GE(th)}$	G−E Threshold Voltage	I_C = 50 mA, V_{CE} = V_{GE}	2.6	4.5	6.4	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 50 A, V_{GE} = 15 V	–	1.6	2.1	V
		I_C = 50 A, V_{GE} = 15 V, T_J = 175°C	–	1.92	–	V
DYNAMIC CHARACTERISTICS						
C_{ies}	Input Capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1MHz	–	3070	–	pF
C_{oes}	Output Capacitance		–	84	–	pF
C_{res}	Reverse Transfer Capacitance		–	10	–	pF

ELECTRICAL CHARACTERISTICS OF THE IGBT (T_J = 25°C unless otherwise noted) (continued)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
SWITCHING CHARACTERISTICS, INDUCTIVE LOAD						
$T_{d(on)}$	Turn−On Delay Time	V_{CC} = 400 V, I_C = 25 A, R_G = 15 Ω, V_{GE} = 15 V, Inductive Load, T_J = 25°C	–	22.40	–	ns
T_r	Rise Time		–	11.20	–	ns
$T_{d(off)}$	Turn−Off Delay Time		–	162	–	ns
T_f	Fall Time		–	8	–	ns
E_{on}	Turn−On Switching Loss		–	0.28	–	mJ
E_{off}	Turn−Off Switching Loss		–	0.20	–	mJ
E_{ts}	Total Switching Loss		–	0.48	–	mJ
$T_{d(on)}$	Turn−On Delay Time	V_{CC} = 400 V, I_C = 50 A, R_G = 15 Ω, V_{GE} = 15 V, Inductive Load, T_J = 25°C	–	24	–	ns
T_r	Rise Time		–	20.80	–	ns
$T_{d(off)}$	Turn−Off Delay Time		–	158.40	–	ns
T_f	Fall Time		–	11.20	–	ns
E_{on}	Turn−On Switching Loss		–	0.66	–	mJ
E_{off}	Turn−Off Switching Loss		–	0.44	–	mJ
E_{ts}	Total Switching Loss		–	1.10	–	mJ
$T_{d(on)}$	Turn−On Delay Time	V_{CC} = 400 V, I_C = 25 A, R_G = 15 Ω, V_{GE} = 15 V, Inductive Load, T_J = 175°C	–	19.20	–	ns
T_r	Rise Time		–	16	–	ns
$T_{d(off)}$	Turn−Off Delay Time		–	178	–	ns
T_f	Fall Time		–	6.40	–	ns
E_{on}	Turn−On Switching Loss		–	0.59	–	mJ
E_{off}	Turn−Off Switching Loss		–	0.32	–	mJ
E_{ts}	Total Switching Loss		–	0.91	–	mJ
$T_{d(on)}$	Turn−On Delay Time	V_{CC} = 400 V, I_C = 50 A, R_G = 15 Ω, V_{GE} = 15 V, Inductive Load, T_J = 175°C	–	22.40	–	ns
T_r	Rise Time		–	26.40	–	ns
$T_{d(off)}$	Turn−Off Delay Time		–	168	–	ns
T_f	Fall Time		–	11.20	–	ns
E_{on}	Turn−On Switching Loss		–	1.16	–	mJ
E_{off}	Turn−Off Switching Loss		–	0.68	–	mJ
E_{ts}	Total Switching Loss		–	1.84	–	mJ
Q_g	Total Gate Charge	V_{CE} = 400 V, I_C = 50 A, V_{GE} = 15 V	–	92	–	nC
Q_{ge}	Gate to Emitter Charge		–	17	–	nC
Q_{gc}	Gate to Collector Charge		–	21	–	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.

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

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
V_{FM}	Diode Forward Voltage	I_F = 30 A	T_J = 25°C	–	2.1	2.6	V
			T_J = 175°C	–	1.8	–	

DIODE SWITCHING CHARACTERISTICS, INDUCTIVE LOAD

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
E_{rec}	Reverse Recovery Energy	T_J = 25°C, V_{CE} = 400 V, I_F = 15 A, di_F/dt = 1000 A/μs	–	11	–	μJ
T_{rr}	Diode Reverse Recovery Time		–	25	–	ns
Q_{rr}	Diode Reverse Recovery Charge		–	175	–	nC
I_{rr}	Diode Reverse Recovery Current		–	14	–	A
E_{rec}	Reverse Recovery Energy	T_J = 25°C, V_{CE} = 400 V, I_F = 30 A, di_F/dt = 1000 A/μs	–	11	–	μJ
T_{rr}	Diode Reverse Recovery Time		–	29	–	ns
Q_{rr}	Diode Reverse Recovery Charge		–	205	–	nC
I_{rr}	Diode Reverse Recovery Current		–	14	–	A
E_{rec}	Reverse Recovery Energy	T_J = 175°C, V_{CE} = 400 V, I_F = 15 A, di_F/dt = 1000 A/μs	–	98	–	μJ
T_{rr}	Diode Reverse Recovery Time		–	70	–	ns
Q_{rr}	Diode Reverse Recovery Charge		–	830	–	nC
I_{rr}	Diode Reverse Recovery Current		–	23	–	A
E_{rec}	Reverse Recovery Energy	T_J = 175°C, V_{CE} = 400 V, I_F = 30 A, di_F/dt = 1000 A/μs	–	112	–	μJ
T_{rr}	Diode Reverse Recovery Time		–	89	–	ns
Q_{rr}	Diode Reverse Recovery Charge		–	1031	–	nC
I_{rr}	Diode Reverse Recovery Current		–	23	–	A

TYPICAL CHARACTERISTICS

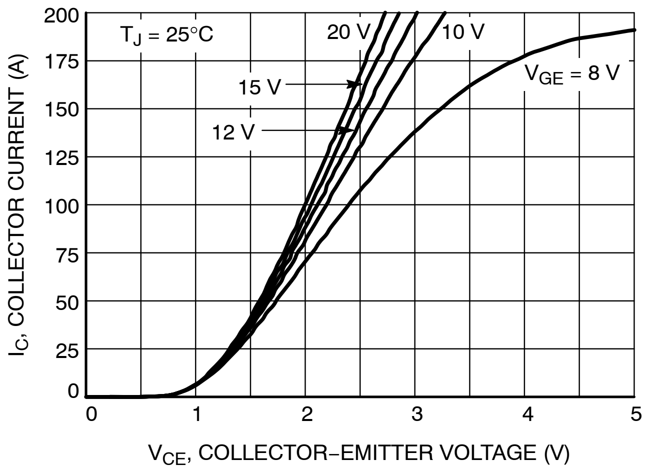


Figure 1. Typical Output Characteristics

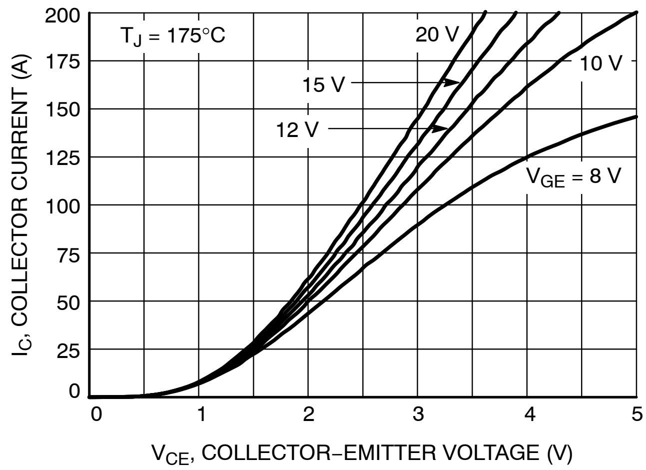


Figure 2. Typical Output Characteristics

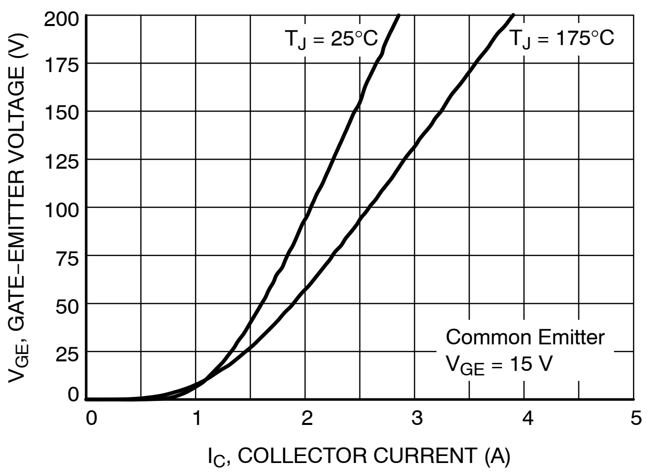


Figure 3. Typical Saturation Voltage Characteristics

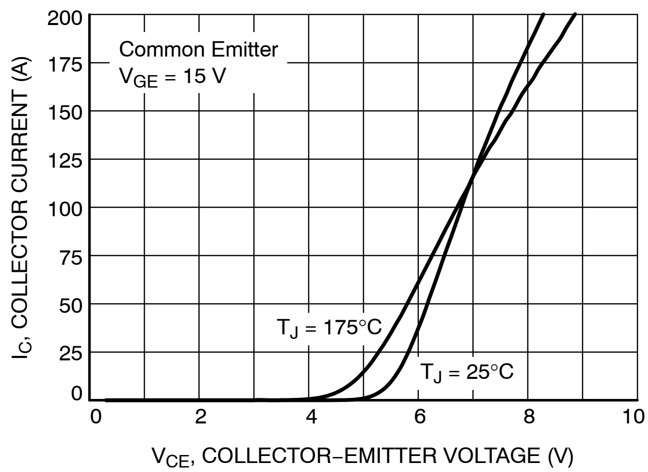


Figure 4. Typical Transfer Characteristics

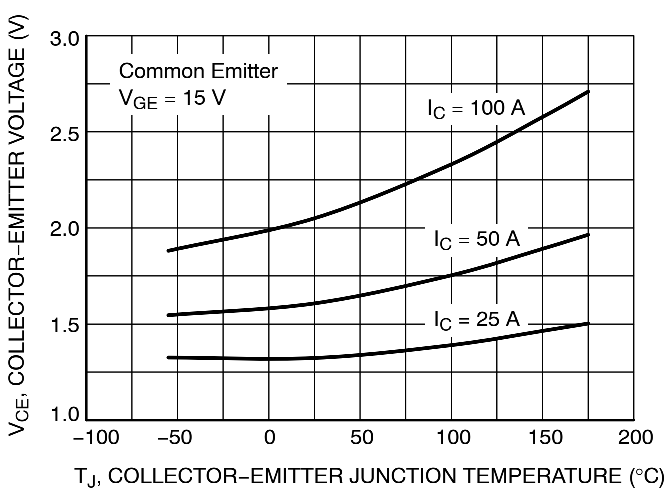


Figure 5. Saturation Voltage vs. Junction Temperature

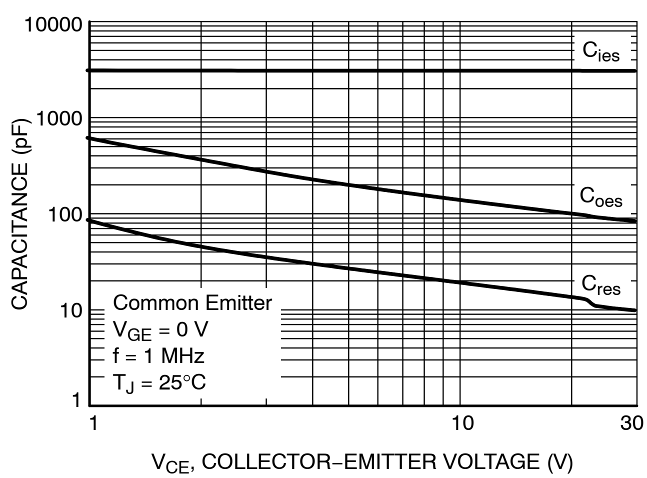


Figure 6. Capacitance Characteristics

TYPICAL CHARACTERISTICS

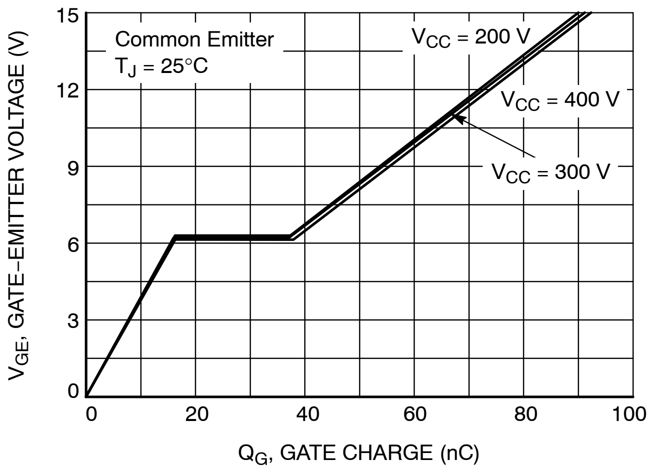


Figure 7. Gate Charge Characteristic

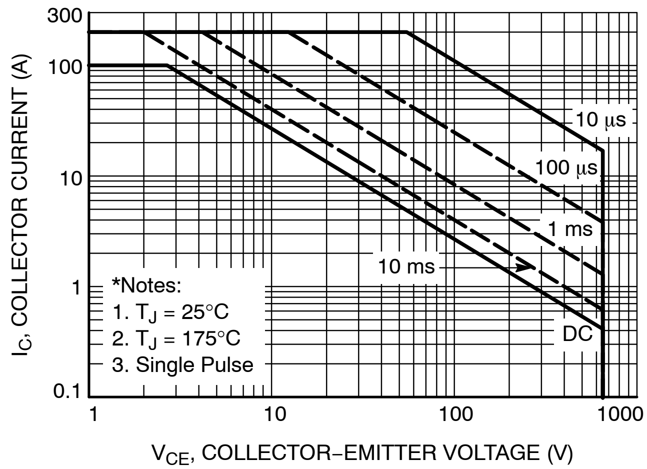


Figure 8. SOA Characteristics (FBSOA)

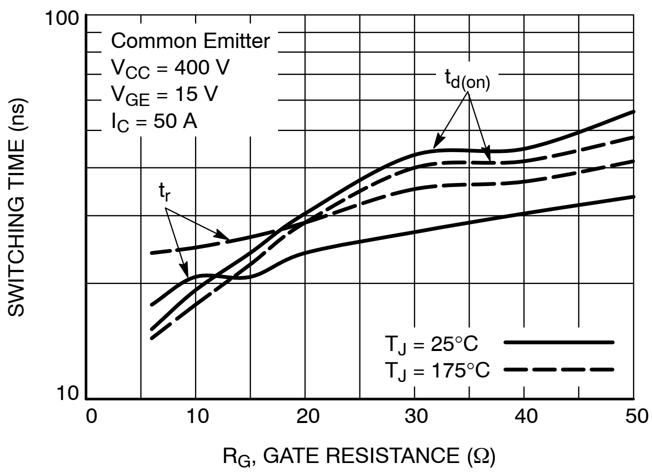


Figure 9. Turn−On Characteristics vs. Gate Resistance

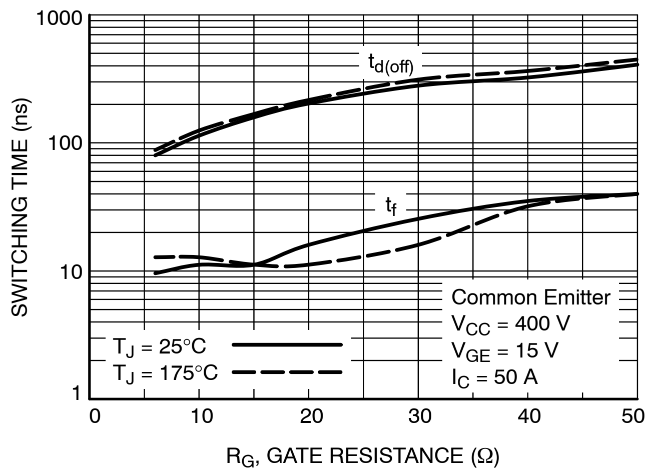


Figure 10. Turn−Off Characteristics vs. Gate Resistance

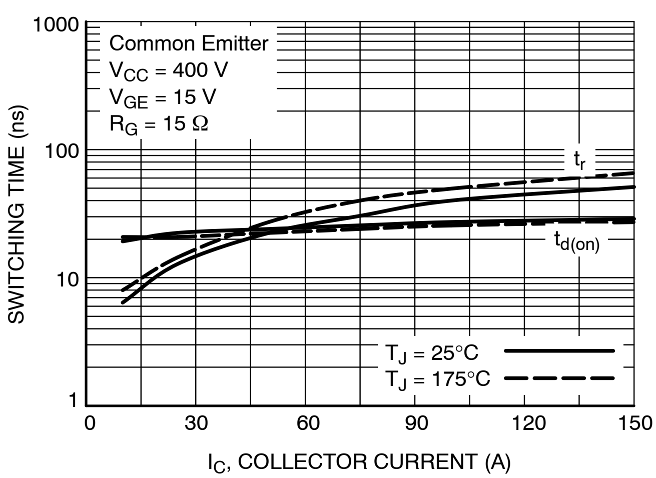


Figure 11. Turn−On Characteristics vs. Collector Current

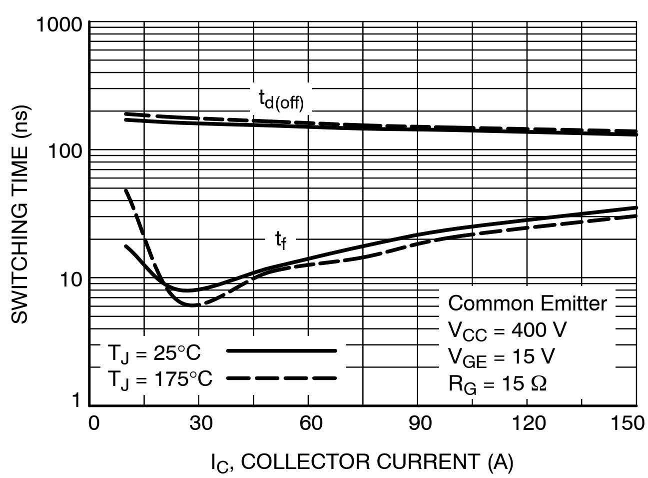


Figure 12. Turn−Off Characteristics vs. Collector Current

TYPICAL CHARACTERISTICS

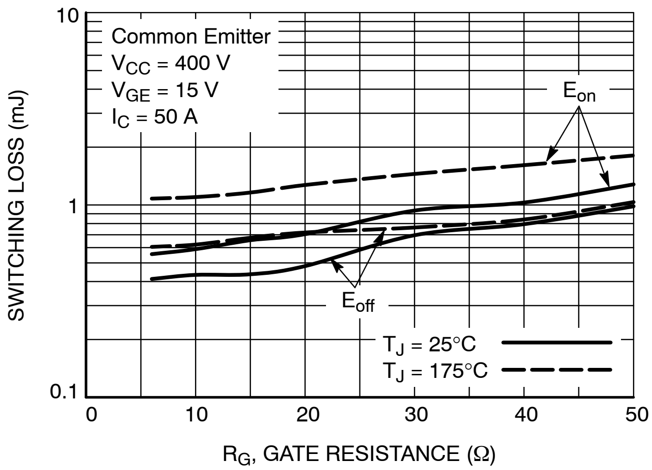


Figure 13. Switching Loss vs. Gate Resistance

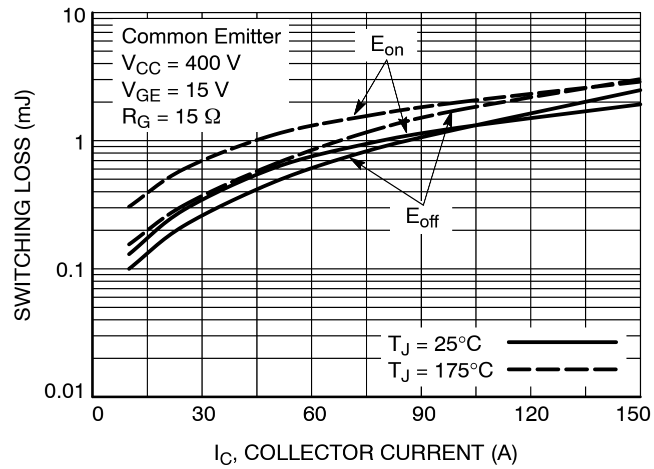


Figure 14. Switching Loss vs. Collector Current

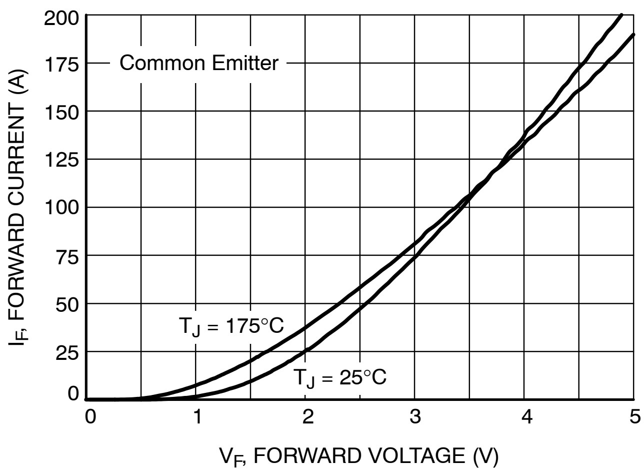


Figure 15. (Diode) Forward Characteristics

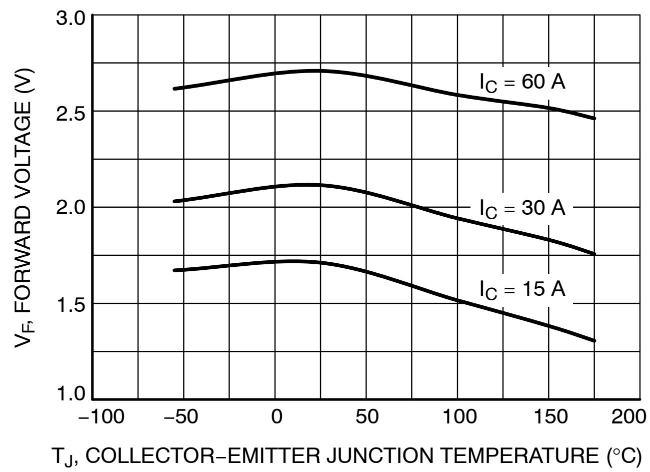


Figure 16. (Diode) Forward Voltage vs. Junction Temperature

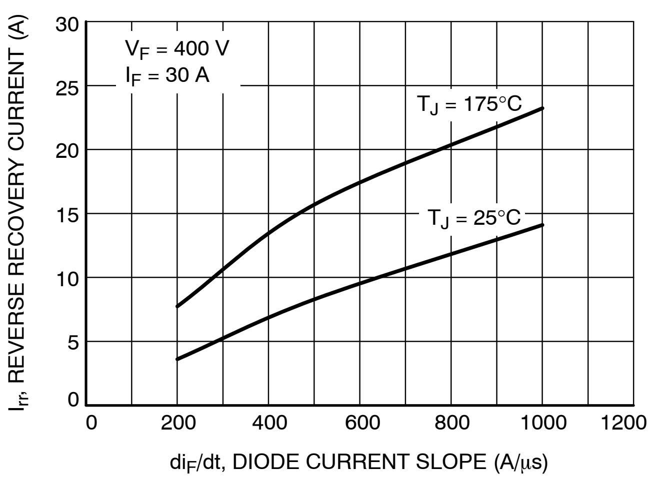


Figure 17. Reverse Recovery Current (I_{rr})

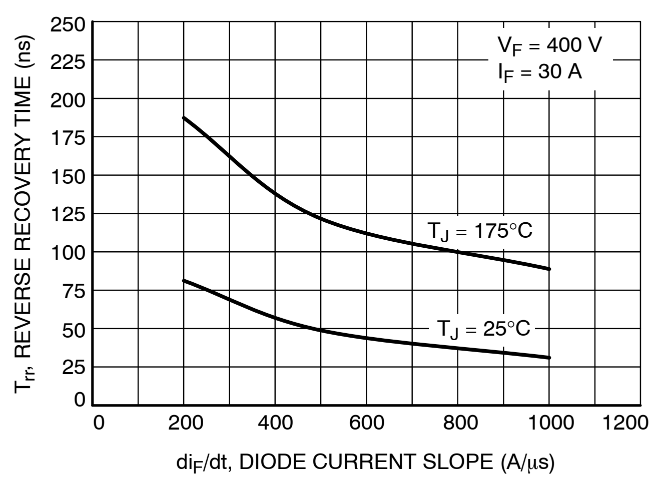


Figure 18. Reverse Recovery Time (T_{rr})

TYPICAL CHARACTERISTICS

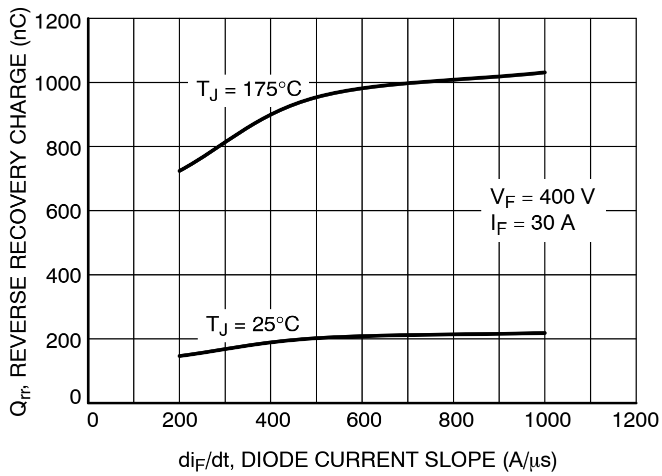


Figure 19. Stored Charge (Q_{rr})

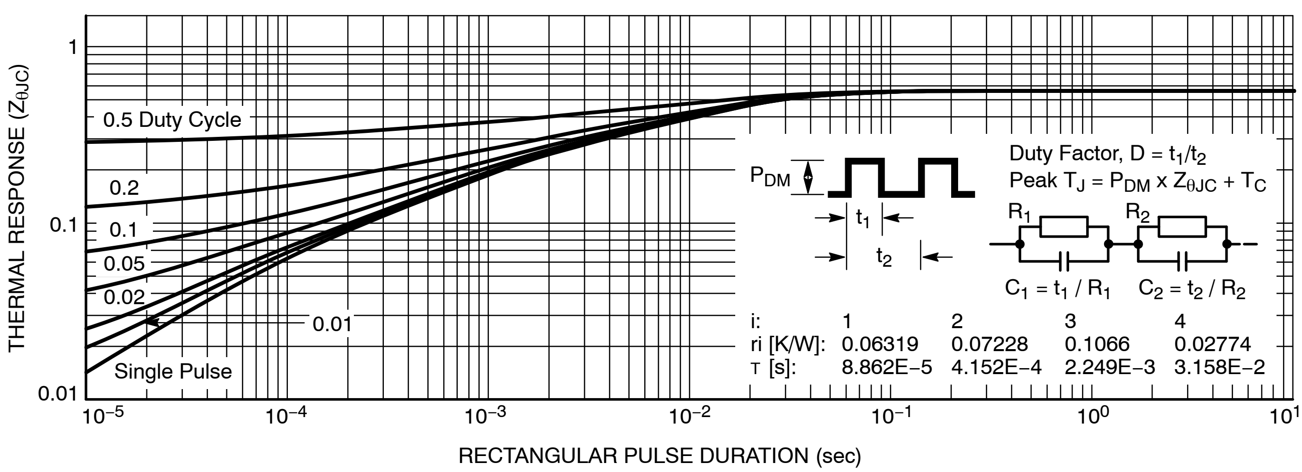


Figure 20. Transient Thermal Impedance of IGBT

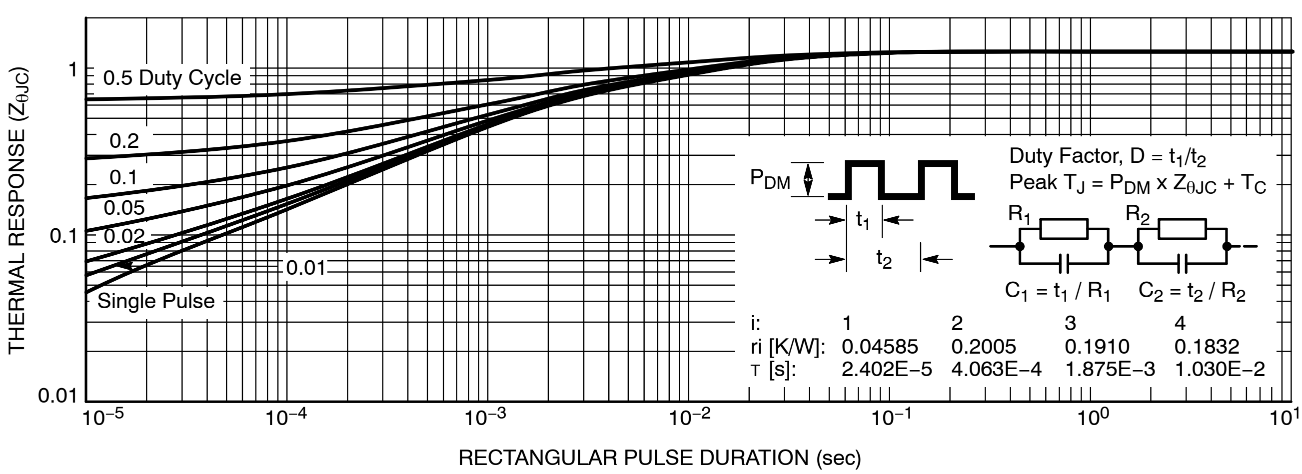
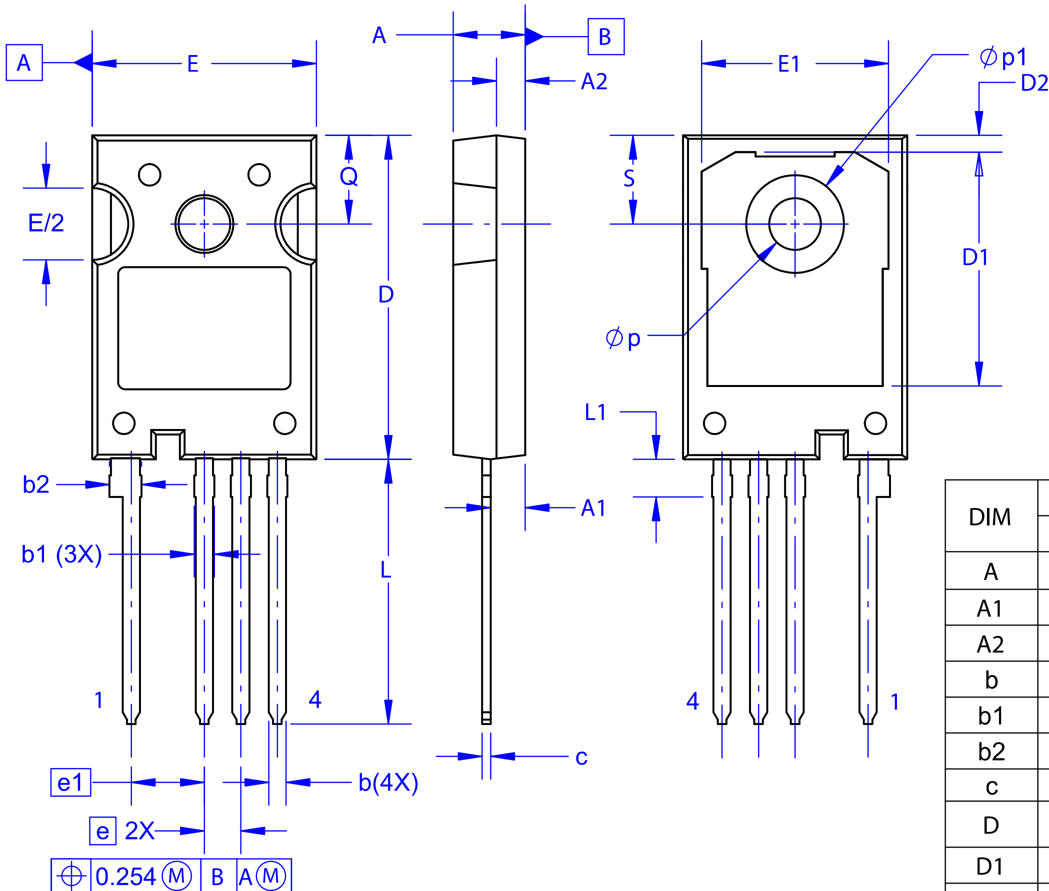


Figure 21. Transient Thermal Impedance of Diode

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.

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