onsemi

DATA SHEET
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Field Stop Trench IGBT

40 A, 650 V

FGHL40T65LQDT

Field stop 4th generation Low $V_{CE(Sat)}$ IGBT technology and Full current rated copak Diode technology.

Features

- Maximum Junction Temperature: T_J = 175°C
- Positive Temperature Co−efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(Sat)}$ = 1.15 V (Typ.) @ I_C = 40 A
- 100% of the Parts are Tested for I_{LM} (Note 2)
- Smooth and Optimized Switching
- Tight Parameter Distribution
- RoHS Compliant

Typical Applications

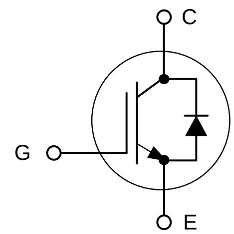
- Solar Inverter
- UPS, ESS
- PFC, Converters

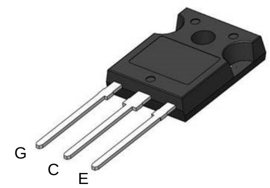
MAXIMUM RATINGS

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	60 40	A
Pulsed Collector Current (Note 2)		I_{LM}	160	A
Pulsed Collector Current (Note 3)		I_{CM}	160	A
Diode Forward Current	@ T_C = 25°C @ T_C = 100°C	I_F	60 40	A
Pulsed Diode Maximum Forward Current		I_{FM}	160	A
Maximum Power Dissipation	@ T_C = 25°C @ T_C = 100°C	P_D	273 136	W
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 = 160 A, Inductive Load, 100% tested
3. Repetitive rating: pulse width limited by max. junction temperature

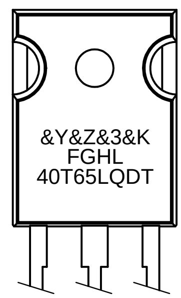
40 A, 650 V
$V_{CE(Sat)}$ = 1.15 V





TO−247−3L
CASE 340CX

MARKING DIAGRAM



&Y = **onsemi** Logo
&Z = Assembly Plant Code
&3 = 3−Digit Date Code
&K = 2−Digit Lot Traceability Code
FGHL40T65LQDT = Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping
FGHL40T65LQDT	TO−247−3L	450 Units/Tube

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal resistance junction−to−case, for IGBT	$R_{\theta JC}$	0.55	°C/W
Thermal resistance junction−to−case, for Diode	$R_{\theta JC}$	0.91	°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 to Emitter breakdown voltage	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 to Emitter cut−off current	V_{GE} = 0 V, V_{CE} = 650 V	I_{CES}	–	–	250	μA
Gate leakage current	V_{GE} = 20 V, V_{CE} = 0 V	I_{GES}	–	–	±400	nA
ON CHARACTERISTICS						
Gate to Emitter Threshold Voltage	$V_{GE} = V_{CE}$, I_C = 40 mA	$V_{GE(th)}$	3.0	4.5	6.0	V
Collector to Emitter Saturation Voltage	V_{GE} = 15 V, I_C = 40 A, T_J = 25°C V_{GE} = 15 V, I_C = 40 A, T_J = 175°C	$V_{CE(sat)}$	– –	1.15 1.22	1.35 –	V
DYNAMIC CHARACTERISTICS						
Input capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz	C_{ies}	–	8263	–	pF
Output capacitance		C_{oes}	–	93	–	
Reverse transfer capacitance		C_{res}	–	41	–	
Gate charge total	V_{CE} = 400 V, I_C = 40 A, V_{GE} = 15 V	Q_g	–	414	–	nC
Gate−to−emitter charge		Q_{ge}	–	43	–	
Gate−to−collector charge		Q_{gc}	–	134	–	
SWITCHING CHARACTERISTICS, INDUCTIVE LOAD						
Turn−on delay time	T_J = 25°C, V_{CC} = 400 V, I_C = 20 A, R_G = 4.7 Ω, V_{GE} = 15 V	$t_{d(on)}$	–	24	–	ns
Rise time		t_r	–	12	–	
Turn−off delay time		$t_{d(off)}$	–	336	–	
Fall time		t_f	–	128	–	
Turn−on switching loss		E_{on}	–	0.31	–	mJ
Turn−off switching loss		E_{off}	–	0.66	–	
Total switching loss		E_{ts}	–	0.97	–	
Turn−on delay time	T_J = 25°C, V_{CC} = 400 V, I_C = 40 A, R_G = 4.7 Ω, V_{GE} = 15 V	$t_{d(on)}$	–	28	–	ns
Rise time		t_r	–	24	–	
Turn−off delay time		$t_{d(off)}$	–	328	–	
Fall time		t_f	–	108	–	
Turn−on switching loss		E_{on}	–	0.75	–	mJ
Turn−off switching loss		E_{off}	–	1.19	–	
Total switching loss		E_{ts}	–	1.94	–	

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 = 20 A, R_G = 4.7 Ω, V_{GE} = 15 V	$t_{d(on)}$	−	24	−	ns
Rise time		t_r	−	13	−	
Turn−off delay time		$t_{d(off)}$	−	364	−	
Fall time		t_f	−	200	−	
Turn−on switching loss		E_{on}	−	0.62	−	mJ
Turn−off switching loss		E_{off}	−	1.03	−	
Total switching loss		E_{ts}	−	1.64	−	
Turn−on delay time	T_J = 175°C, V_{CC} = 400 V, I_C = 40 A, R_G = 4.7 Ω, V_{GE} = 15 V	$t_{d(on)}$	−	28	−	ns
Rise time		t_r	−	24	−	
Turn−off delay time		$t_{d(off)}$	−	360	−	
Fall time		t_f	−	160	−	
Turn−on switching loss		E_{on}	−	1.16	−	mJ
Turn−off switching loss		E_{off}	−	1.84	−	
Total switching loss		E_{ts}	−	3.00	−	
DIODE CHARACTERISTICS						
Diode Forward Voltage	I_F = 40 A, T_J = 25°C	V_{FM}	−	1.7	2.15	V
	I_F = 40 A, T_J = 175°C		−	1.65	−	
Reverse Recovery Energy	T_J = 25°C, V_R = 400 V, I_F = 20 A, di_F/dt = 1000 A/μs	E_{rec}	−	55	−	μJ
Reverse Recovery Time		T_{rr}	−	42	−	ns
Reverse Recovery Charge		Q_{rr}	−	322	−	nC
Reverse Recovery Current		I_{rr}	−	16	−	A
Reverse Recovery Energy	T_J = 25°C, V_R = 400 V, I_F = 40 A, di_F/dt = 1000 A/μs	E_{rec}	−	116	−	μJ
Reverse Recovery Time		T_{rr}	−	84	−	ns
Reverse Recovery Charge		Q_{rr}	−	648	−	nC
Reverse Recovery Current		I_{rr}	−	16	−	A
Reverse Recovery Energy	T_J = 175°C, V_R = 400 V, I_F = 20 A, di_F/dt = 1000 A/μs	E_{rec}	−	320	−	μJ
Reverse Recovery Time		T_{rr}	−	98	−	ns
Reverse Recovery Charge		Q_{rr}	−	1262	−	nC
Reverse Recovery Current		I_{rr}	−	26	−	A
Reverse Recovery Energy	T_J = 175°C, V_R = 400 V, I_F = 40 A, di_F/dt = 1000 A/μs	E_{rec}	−	464	−	μJ
Reverse Recovery Time		T_{rr}	−	126	−	ns
Reverse Recovery Charge		Q_{rr}	−	1652	−	nC
Reverse Recovery Current		I_{rr}	−	26	−	A

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

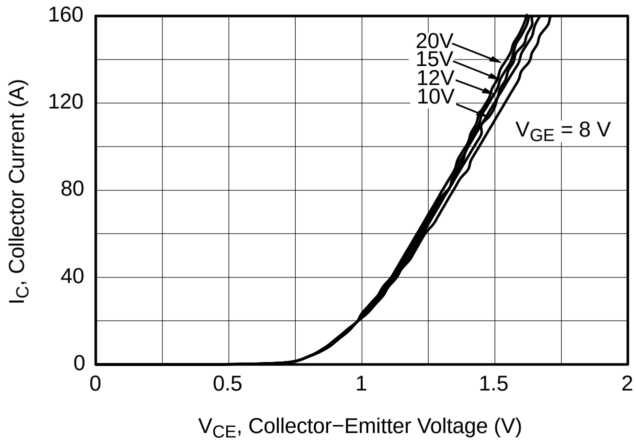


Figure 1. Typical Output Characteristics (T_J = 25°C)

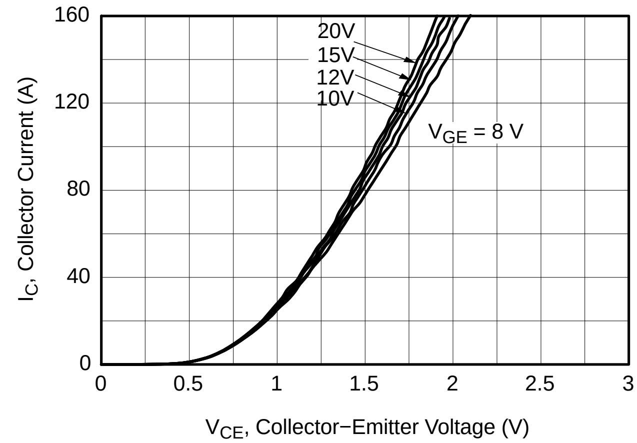


Figure 2. Typical Output Characteristics (T_J = 175°C)

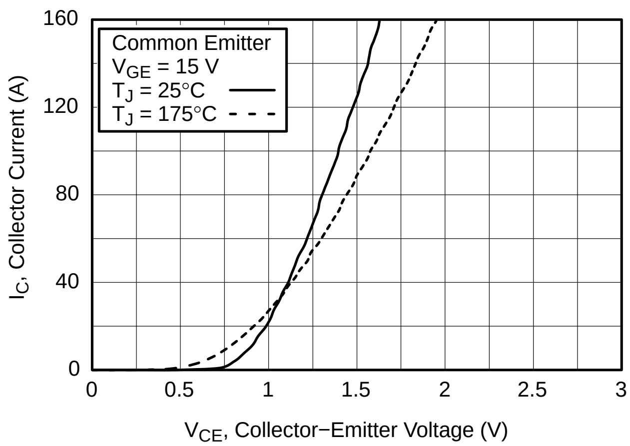


Figure 3. Typical Saturation Voltage Characteristics

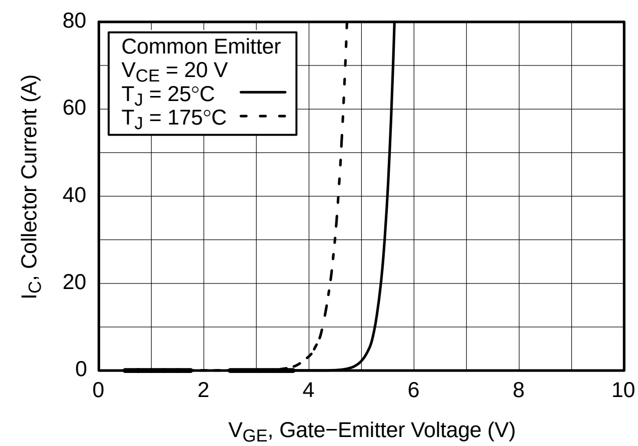


Figure 4. Typical Transfer Characteristics

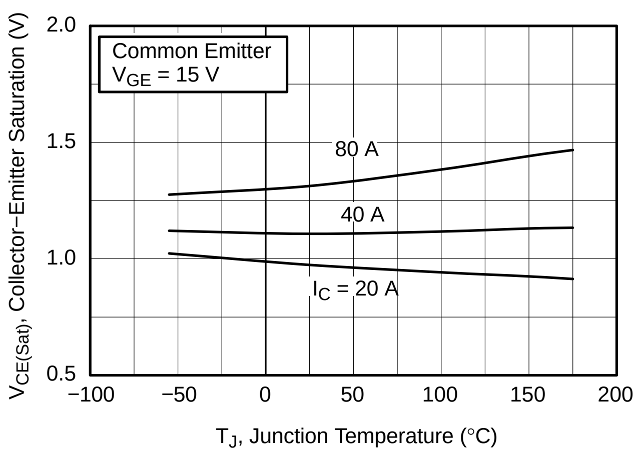


Figure 5. Saturation Voltage vs. Junction Temperature

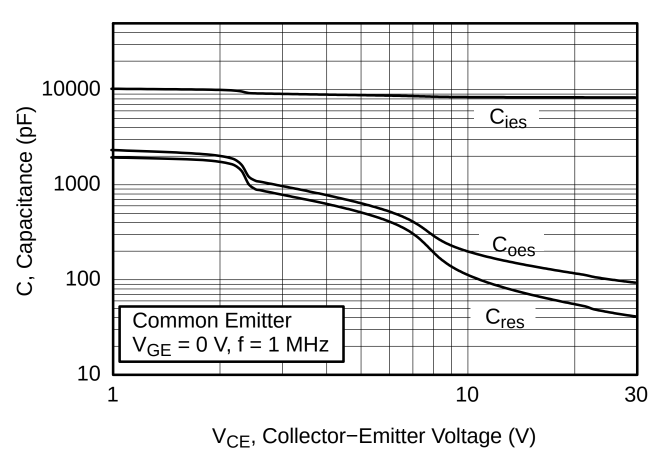


Figure 6. Capacitance Characteristics

TYPICAL CHARACTERISTICS (continued)

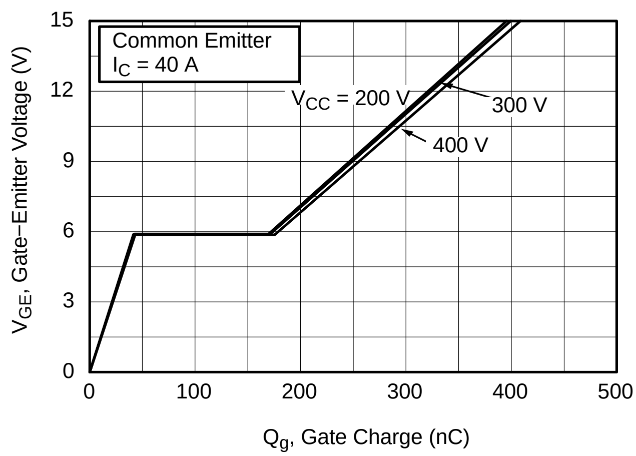


Figure 7. Gate Charge Characteristics

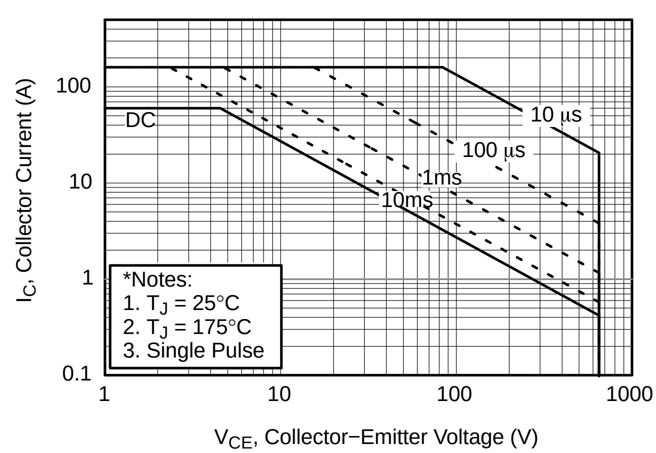


Figure 8. SOA Characteristics

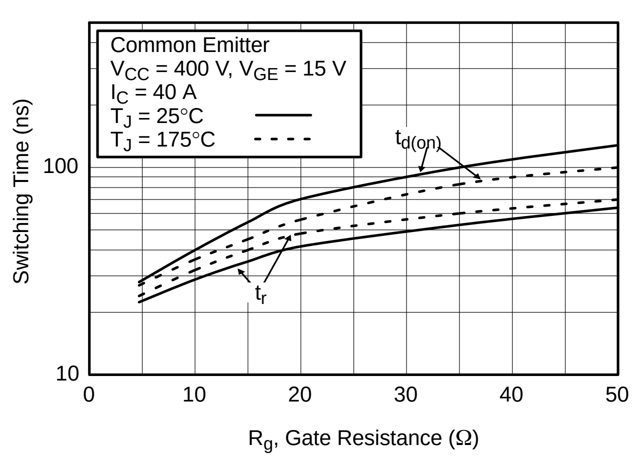


Figure 9. Turn−On Characteristics vs. Gate Resistance

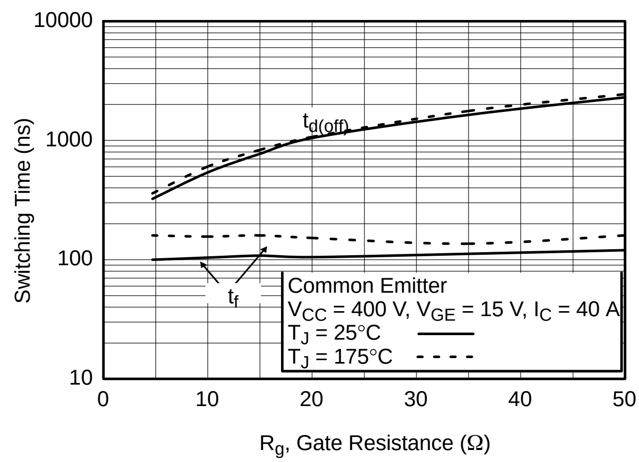


Figure 10. Turn−Off Characteristics vs. Gate Resistance

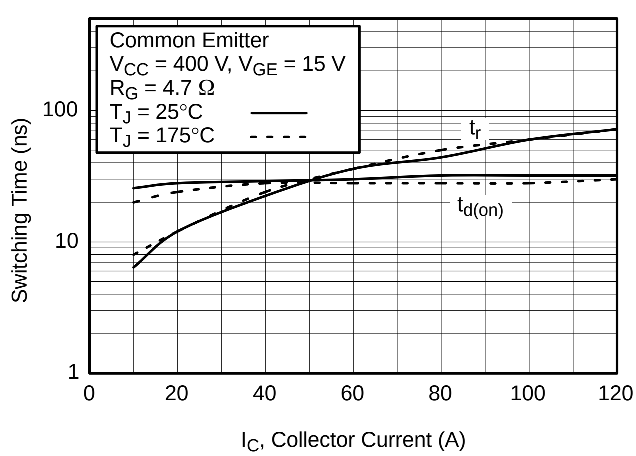


Figure 11. Turn−On Characteristics vs. Collector Current

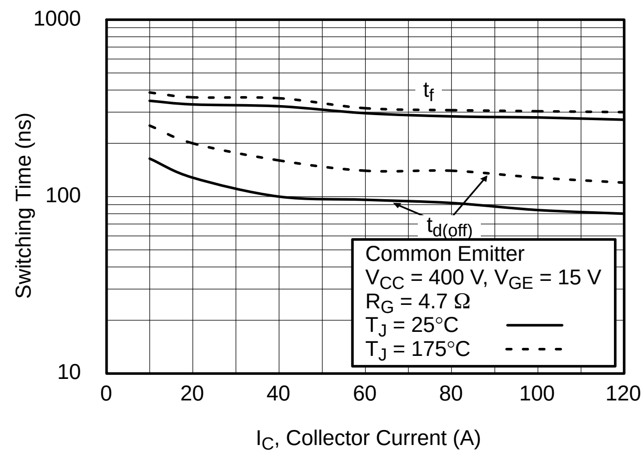


Figure 12. Turn−Off Characteristics vs. Collector Current

TYPICAL CHARACTERISTICS (continued)

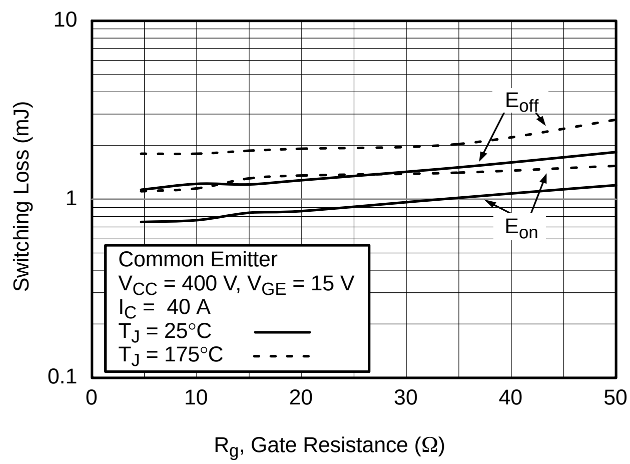


Figure 13. Switching Loss vs. Gate Resistance

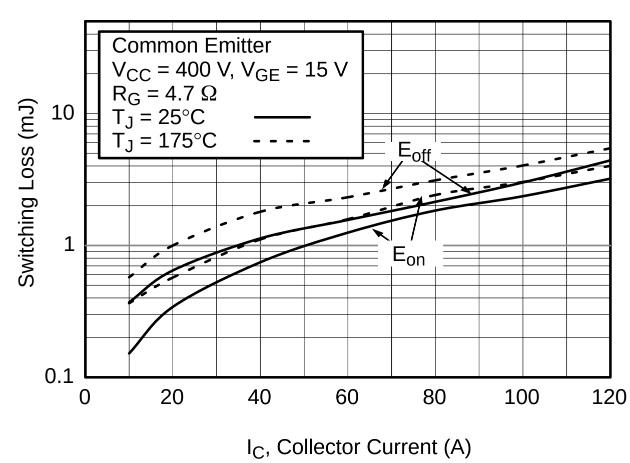


Figure 14. Switching Loss vs. Collector Current

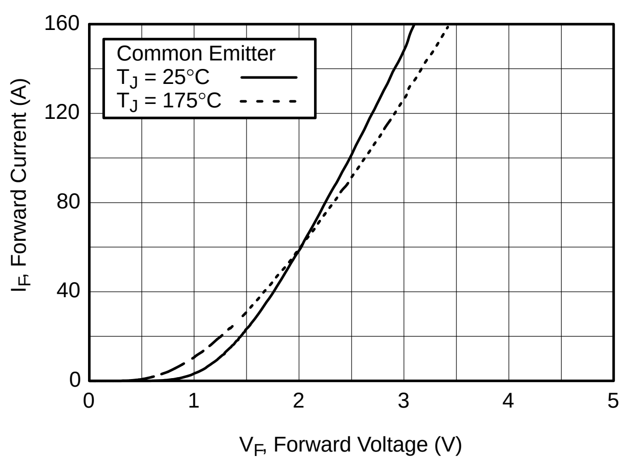


Figure 15. Forward Characteristics

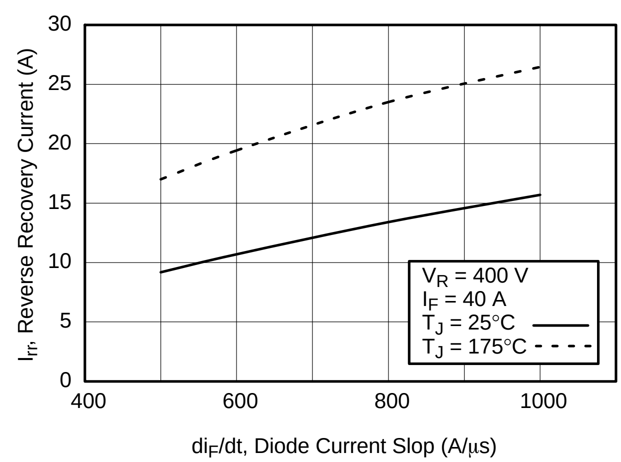


Figure 16. Reverse Recovery Current

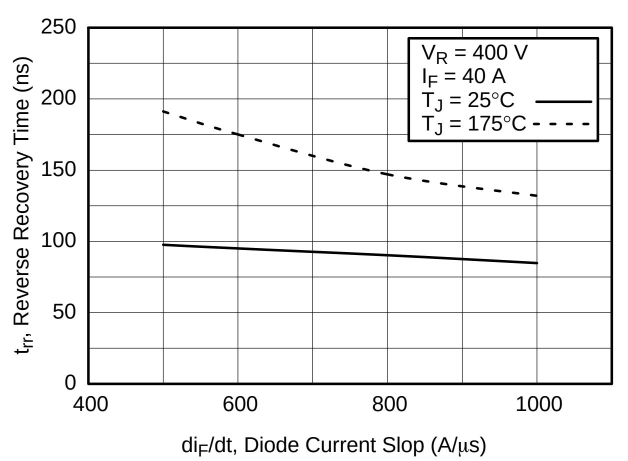


Figure 17. Reverse Recovery Time

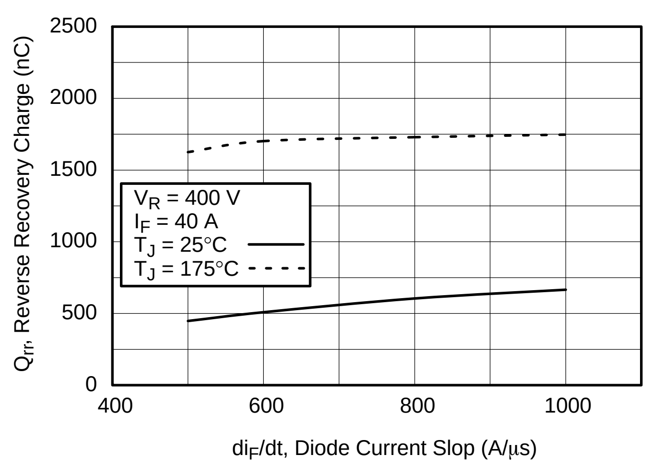


Figure 18. Stored Charge

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

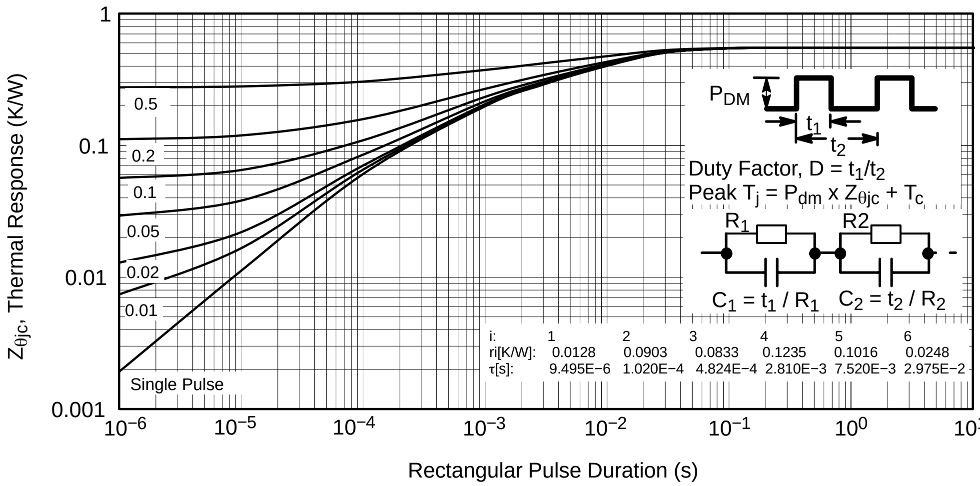


Figure 19. Transient Thermal Impedance of IGBT

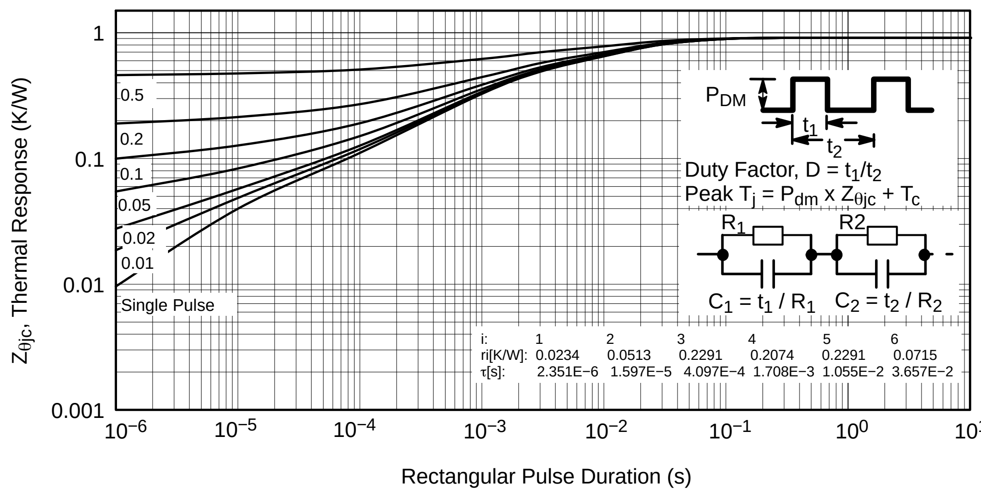
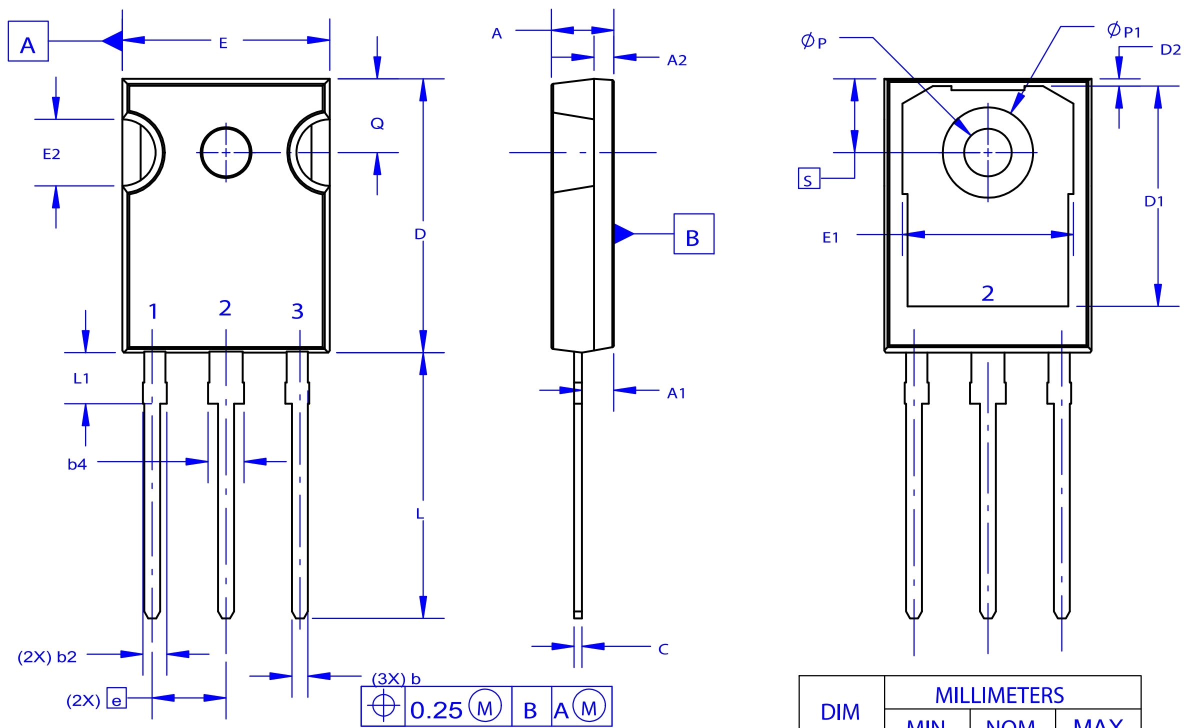


Figure 20. Transient Thermal Impedance of Diode

PACKAGE DIMENSIONS

TO−247−3LD
CASE 340CX
ISSUE A



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
∅P	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	~	~
∅P1	6.60	6.80	7.00

PUBLICATION ORDERING INFORMATION

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