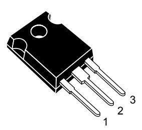
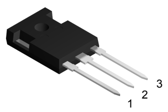
STGW75M65DF2, STGWA75M65DF2

Datasheet

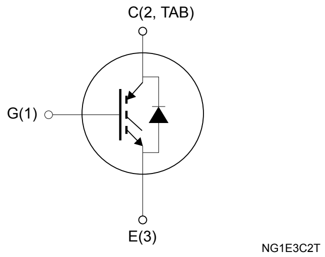
Trench gate field-stop 650 V, 75 A low-loss M series IGBT in a TO-247 and TO-247 long leads packages



TO-247



TO-247 long leads



Product status links
STGW75M65DF2
STGWA75M65DF2

Product summary	
Order code	**STGW75M65DF2**
Marking	G75M65DF2
Package	TO-247
Packing	Tube
Order code	**STGWA75M65DF2**
Marking	G75M65DF2
Package	TO-247 long leads
Packing	Tube

Features

- Maximum junction temperature: T_J = 175 °C
- 6 μs of minimum short-circuit withstand time
- $V_{CE(sat)}$ = 1.65 V (typ.) @ I_C = 75 A
- Tight parameter distribution
- Safer paralleling
- Positive $V_{CE(sat)}$ temperature coefficient
- Low thermal resistance
- Soft and very fast-recovery antiparallel diode

Applications

- Motor control
- UPS
- PFC
- General purpose inverter

Description

These devices are IGBTs developed using an advanced proprietary trench gate field-stop structure. The devices are part of the M series IGBTs, which represent an optimal balance between inverter system performance and efficiency where the low-loss and the short-circuit functionality are essential. Furthermore, the positive $V_{CE(sat)}$ temperature coefficient and the tight parameter distribution result in safer paralleling operation.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	650	V
I_C (1)	Continuous collector current at T_C = 25 °C	120	A
I_C	Continuous collector current at T_C = 100 °C	75	A
I_{CP} (2)	Pulsed collector current	225	A
V_{GE}	Gate-emitter voltage	±20	V
I_F (1)	Continuous forward current at T_C = 25 °C	120	A
I_F	Continuous forward current at T_C = 100 °C	75	A
I_{FP} (2)	Pulsed forward current	225	A
P_{TOT}	Total power dissipation at T_C = 25 °C	468	W
T_{STG}	Storage temperature range	- 55 to 150	°C
T_J	Operating junction temperature range	- 55 to 175	°C

1. *Limited by bonding wires.*
2. *Pulse width limited by maximum junction temperature.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case IGBT	0.32	°C/W
R_{thJC}	Thermal resistance junction-case diode	0.74	°C/W
R_{thJA}	Thermal resistance junction-ambient	50	°C/W

2 Electrical characteristics

T_C = 25 °C unless otherwise specified

Table 3. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE} = 0 V, I_C = 250 µA	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 75 A		1.65	2.1	V
		V_{GE} = 15 V, I_C = 75 A, T_J = 125 °C		1.95		
		V_{GE} = 15 V, I_C = 75 A, T_J = 175 °C		2.1		
V_F	Forward on-voltage	I_F = 75 A		2	2.85	V
		I_F =75 A, T_J = 125 °C		1.75		
		I_F = 75 A, T_J = 175 °C		1.6		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 2 mA	5	6	7	V
I_{CES}	Collector cut-off current	V_{GE} = 0 V, V_{CE} = 650 V			25	µA
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE}= ± 20 V			±250	µA

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0 V	-	6290	-	pF
C_{oes}	Output capacitance		-	390	-	
C_{res}	Reverse transfer capacitance		-	136	-	
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 75 A, V_{GE} = 0 to 15 V (see Figure 29)	-	225	-	nC
Q_{ge}	Gate-emitter charge		-	53	-	
Q_{gc}	Gate-collector charge		-	87	-	

Table 5. **IGBT switching characteristics (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 75 A, V_{GE} = 15 V, R_G = 3.3 Ω (see Figure 28)		47	-	ns
t_r	Current rise time			22.4	-	ns
$(di/dt)_{on}$	Turn-on current slope			2680	-	A/μs
$t_{d(off)}$	Turn-off-delay time			125	-	ns
t_f	Current fall time			93	-	ns
E_{on} (1)	Turn-on switching energy			0.69	-	mJ
E_{off} (2)	Turn-off switching energy			2.54	-	mJ
E_{ts}	Total switching energy			3.23	-	mJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 75 A, V_{GE} = 15 V, R_G = 3.3 Ω T_J = 175 °C (see Figure 28)		48	-	ns
t_r	Current rise time			25	-	ns
$(di/dt)_{on}$	Turn-on current slope			2420	-	A/μs
$t_{d(off)}$	Turn-off-delay time			125	-	ns
t_f	Current fall time			167	-	ns
E_{on} (1)	Turn-on switching energy			2.17	-	mJ
E_{off} (2)	Turn-off switching energy			3.45	-	mJ
E_{ts}	Total switching energy			5.62	-	mJ
t_{sc}	Short-circuit withstand time	V_{CC} ≤ 400 V, V_{GE} = 13 V, T_{Jstart} ≤ 150 °C	10		-	μs
		V_{CC} ≤ 400 V, V_{GE} = 15 V, T_{Jstart} ≤ 150 °C	6			

1. *Including the reverse recovery of the diode.*
2. *Including the tail of the collector current.*

Table 6. **Diode switching characteristics (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{rr}	Reverse recovery time	I_F = 75 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/μs (see Figure 28)	-	165	-	ns
Q_{rr}	Reverse recovery charge		-	1.72	-	μC
I_{rrm}	Reverse recovery current		-	25	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	750	-	A/μs
E_{rr}	Reverse recovery energy		-	289	-	μJ
t_{rr}	Reverse recovery time	I_F = 75 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/μs, T_J = 175 °C (see Figure 28)	-	256	-	ns
Q_{rr}	Reverse recovery charge		-	6.85	-	μC
I_{rrm}	Reverse recovery current		-	48	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	300	-	A/μs
E_{rr}	Reverse recovery energy		-	1033	-	μJ

2.1 STGWA75M65DF2 electrical characteristics curve

Figure 1. Power dissipation vs. case temperature

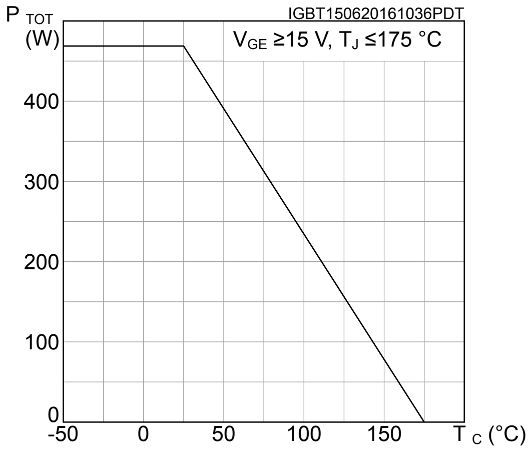


Figure 2. Collector current vs. case temperature

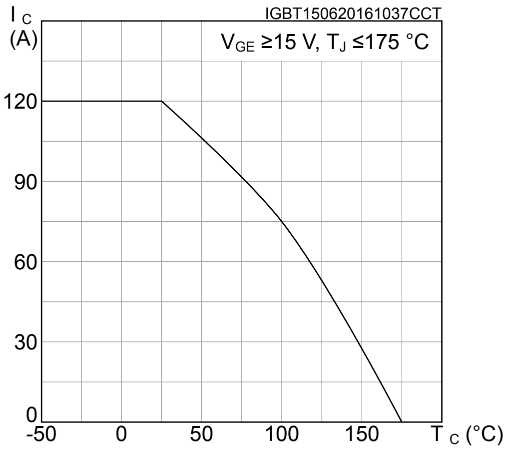


Figure 3. Output characteristics (T_J = 25 °C)

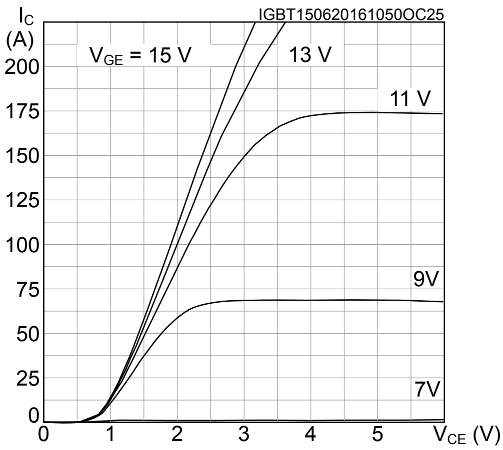


Figure 4. Output characteristics (T_J = 175 °C)

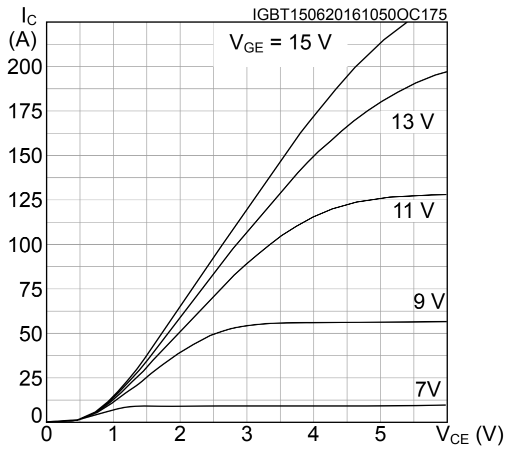


Figure 5. V_{CE}(sat) vs. junction temperature

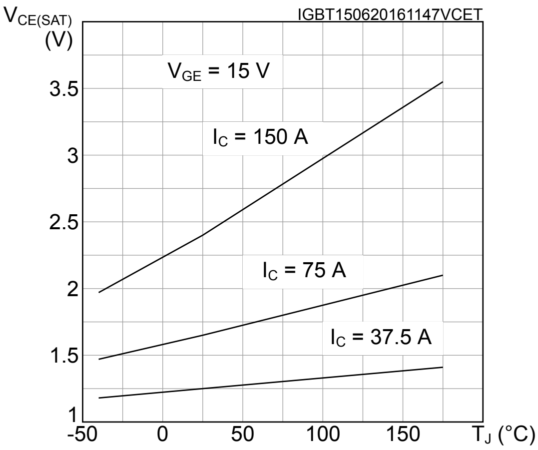


Figure 6. V_{CE}(sat) vs. collector current

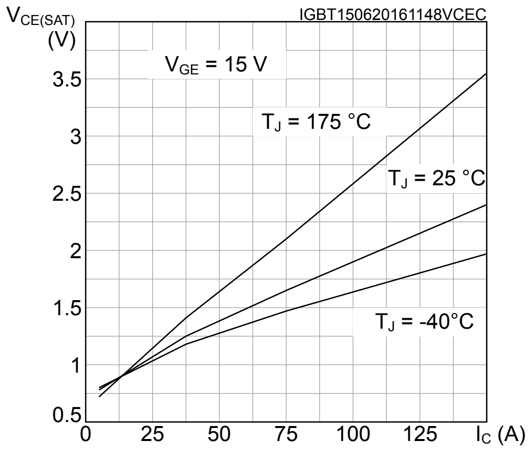


Figure 7. Collector current vs. switching frequency

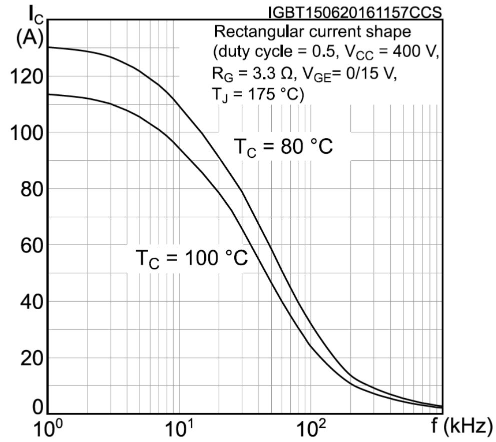


Figure 8. Forward bias safe operating area

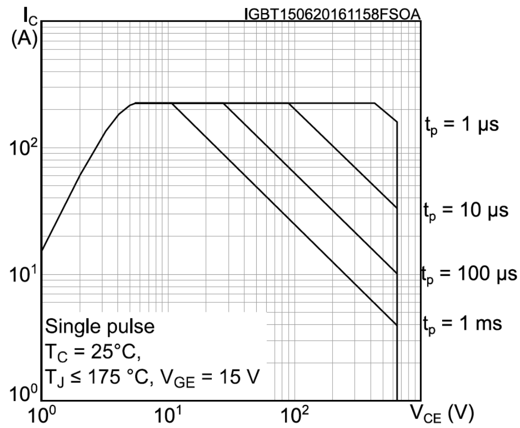


Figure 9. Transfer characteristics

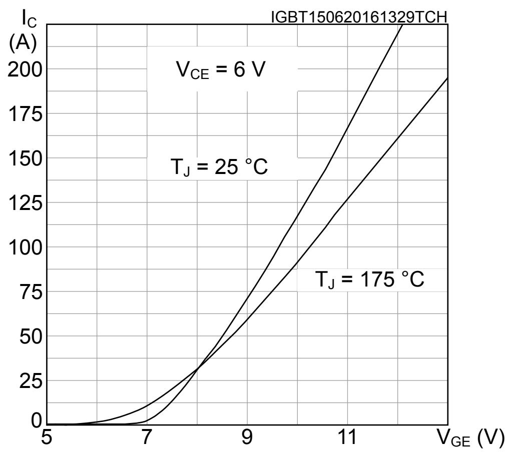


Figure 10. Diode V_F vs. forward current

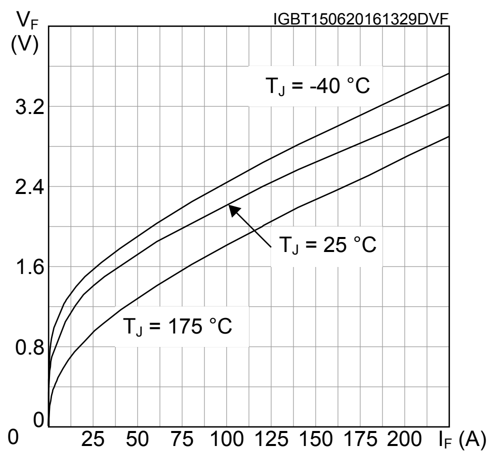


Figure 11. Normalized $V_{GE(th)}$ vs. junction temperature

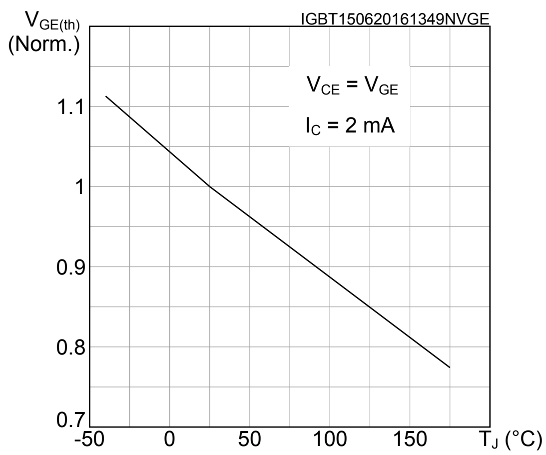


Figure 12. Normalized $V_{(BR)CES}$ vs. junction temperature

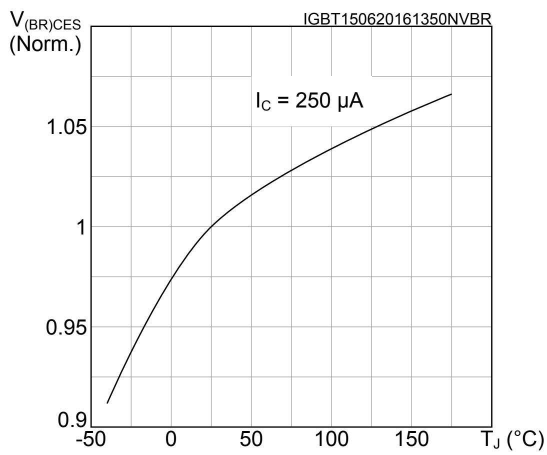


Figure 13. Capacitance variations

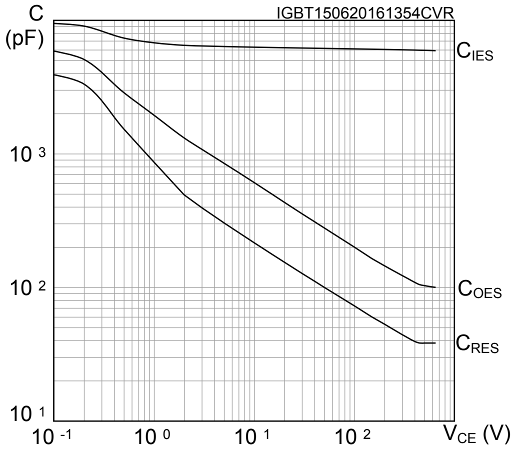


Figure 14. Gate charge vs. gate-emitter voltage

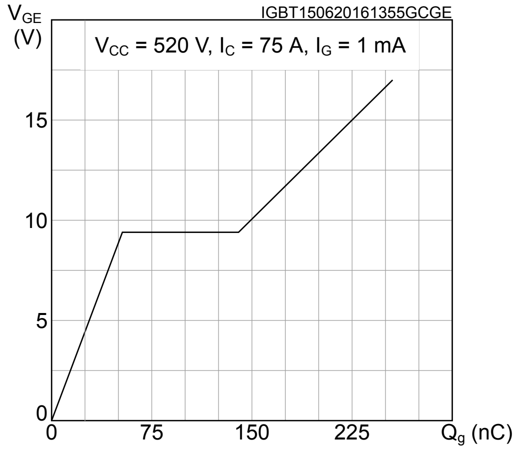


Figure 15. Switching energy vs. collector current

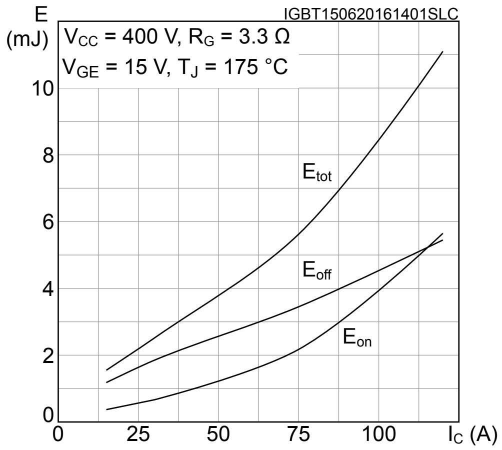


Figure 16. Switching energy vs. gate resistance

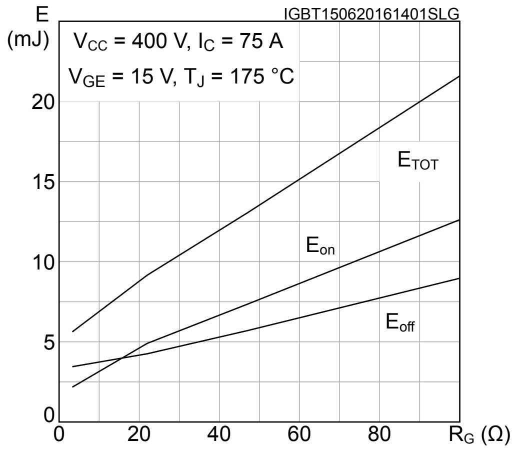


Figure 17. Switching energy vs. temperature

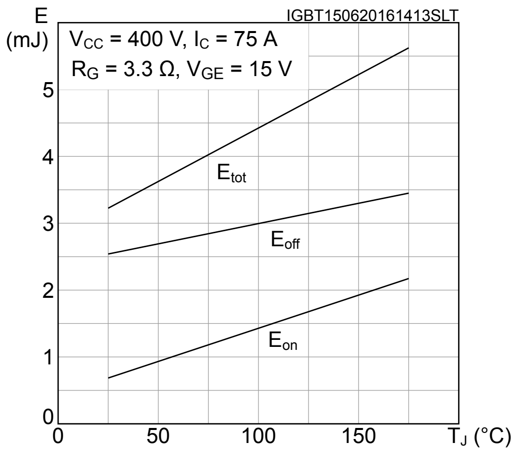


Figure 18. Switching energy vs. collector emitter voltage

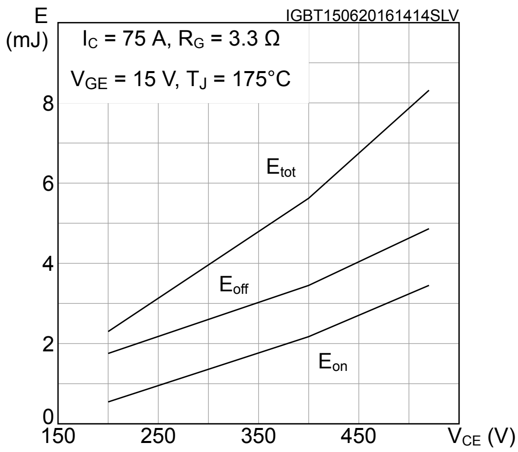


Figure 19. Short-circuit time and current vs. V_{GE}

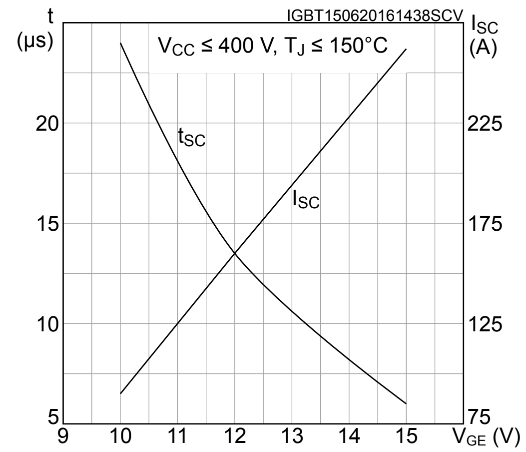


Figure 20. Switching times vs. collector current

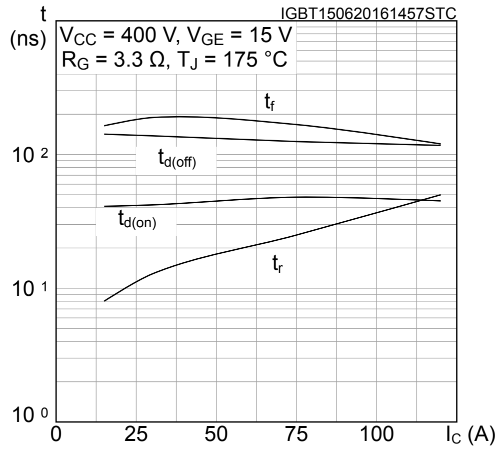


Figure 21. Switching times vs. gate resistance

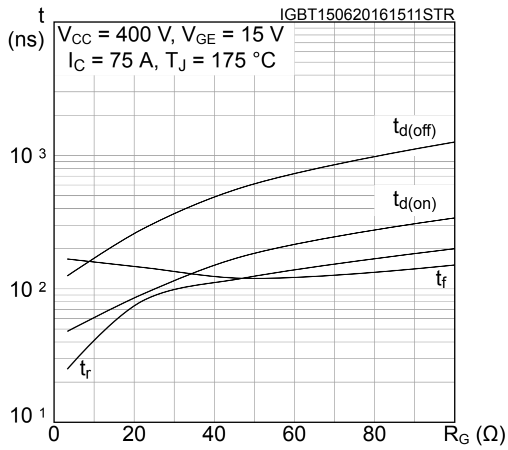


Figure 22. Reverse recovery current vs. diode current slope

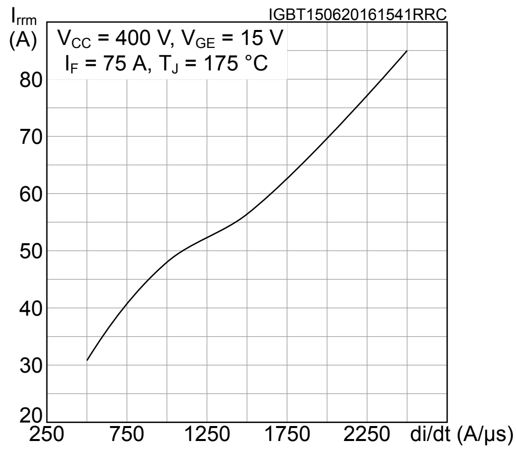


Figure 23. Reverse recovery time vs. diode current slope

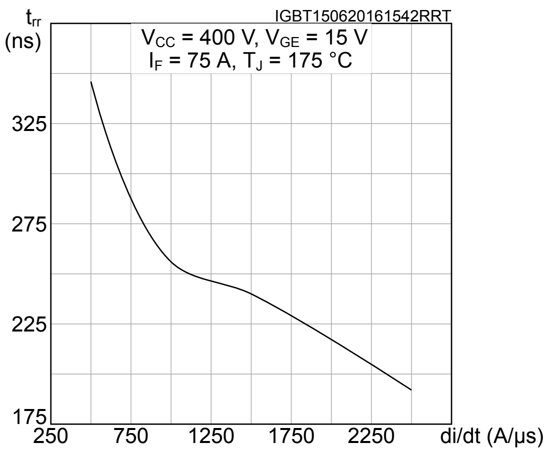


Figure 24. Reverse recovery charge vs. diode current slope

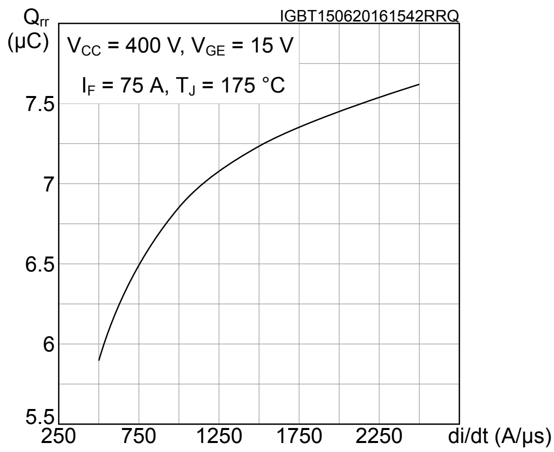


Figure 25. Reverse recovery energy vs. diode current slope

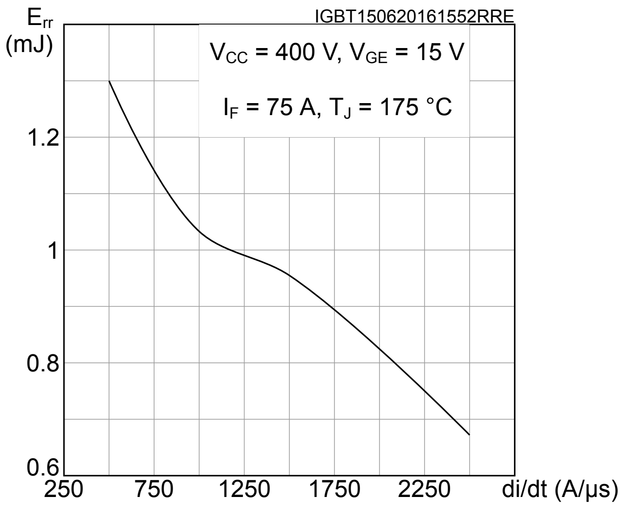


Figure 26. Thermal impedance for IGBT

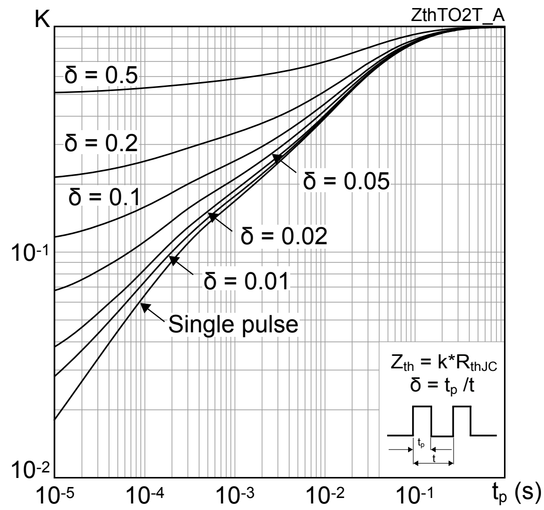
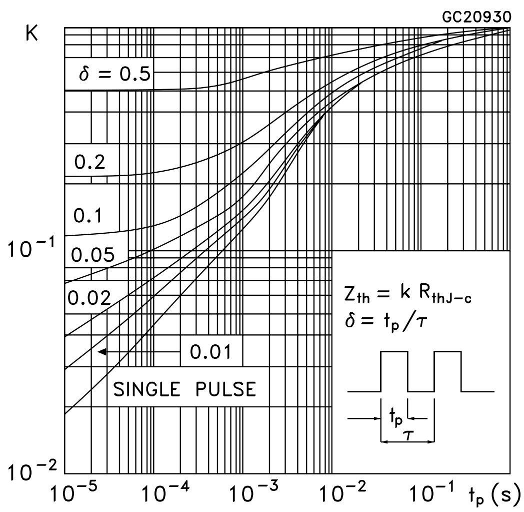


Figure 27. Thermal impedance for diode



3 Test circuits

Figure 28. Test circuit for inductive load switching

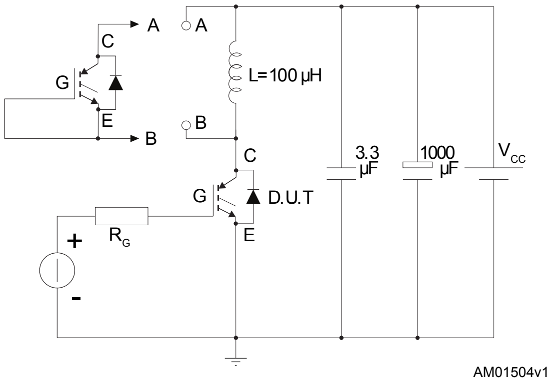


Figure 29. Gate charge test circuit

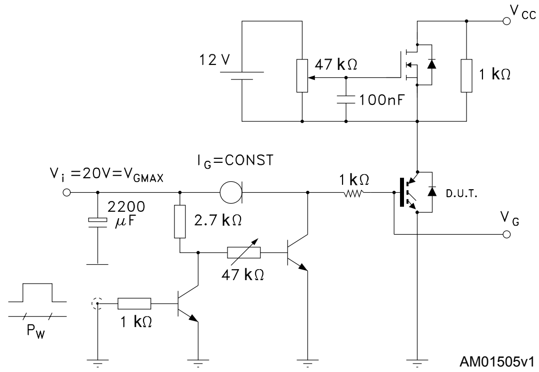


Figure 30. Switching waveform

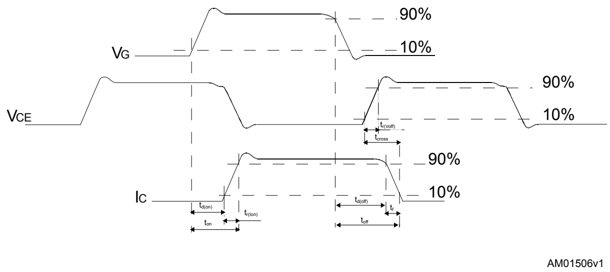
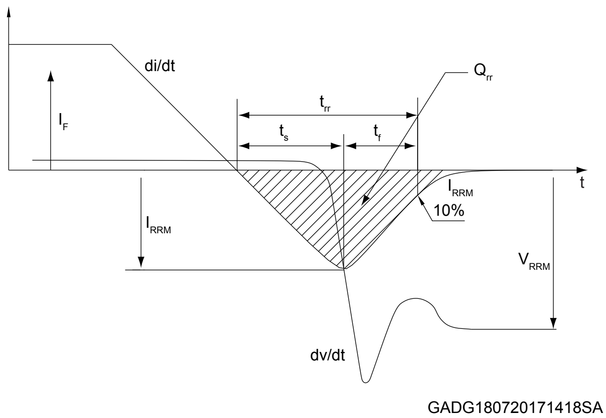


Figure 31. Diode reverse recovery waveform



4 Package information

To meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions, and product status are available at: www.st.com. ECOPACK is an ST trademark.

4.1 TO-247 package information

Figure 32. TO-247 package outline

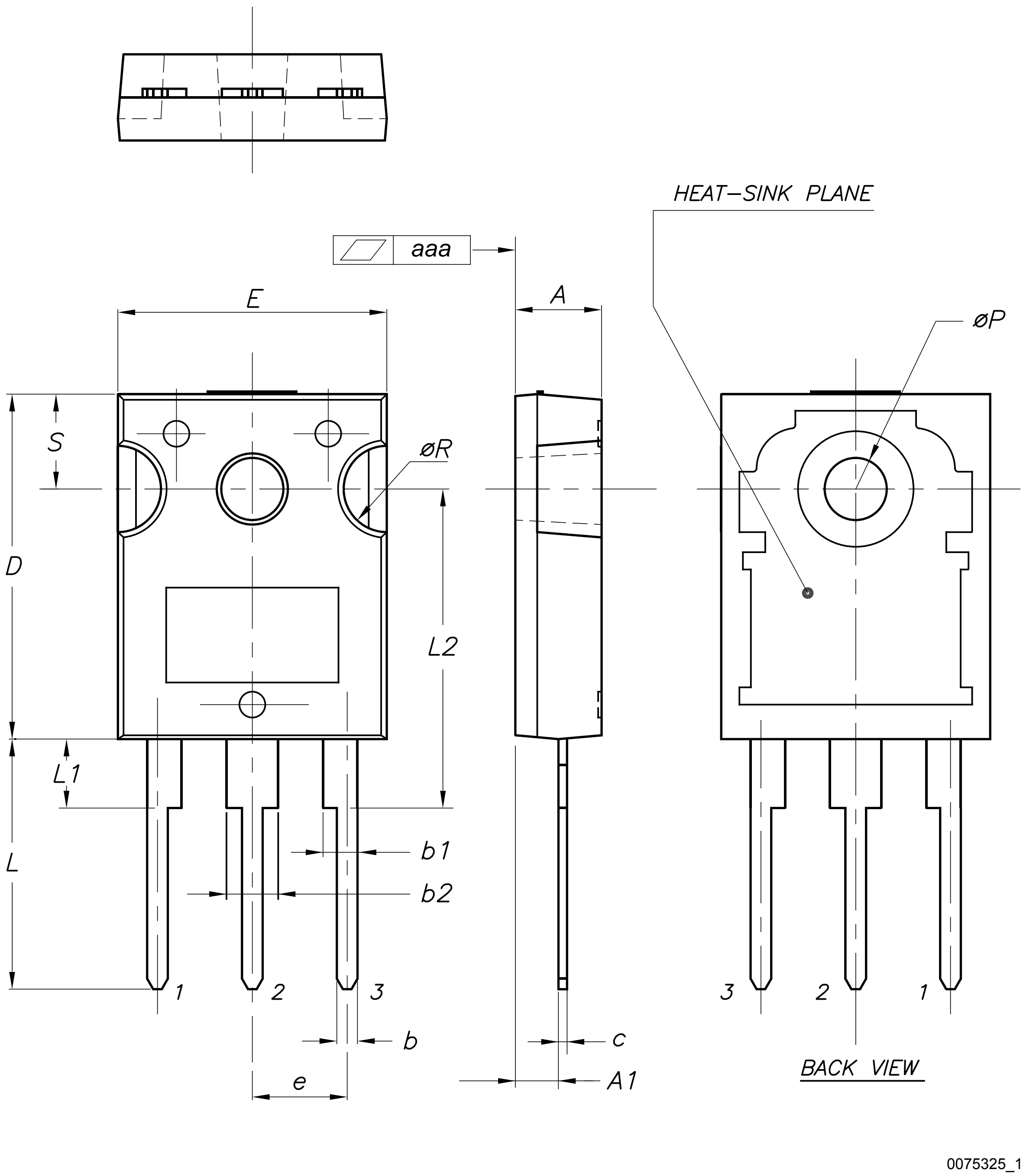


Table 7. **TO-247 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70
aaa		0.04	0.10

4.2 TO-247 long leads package information

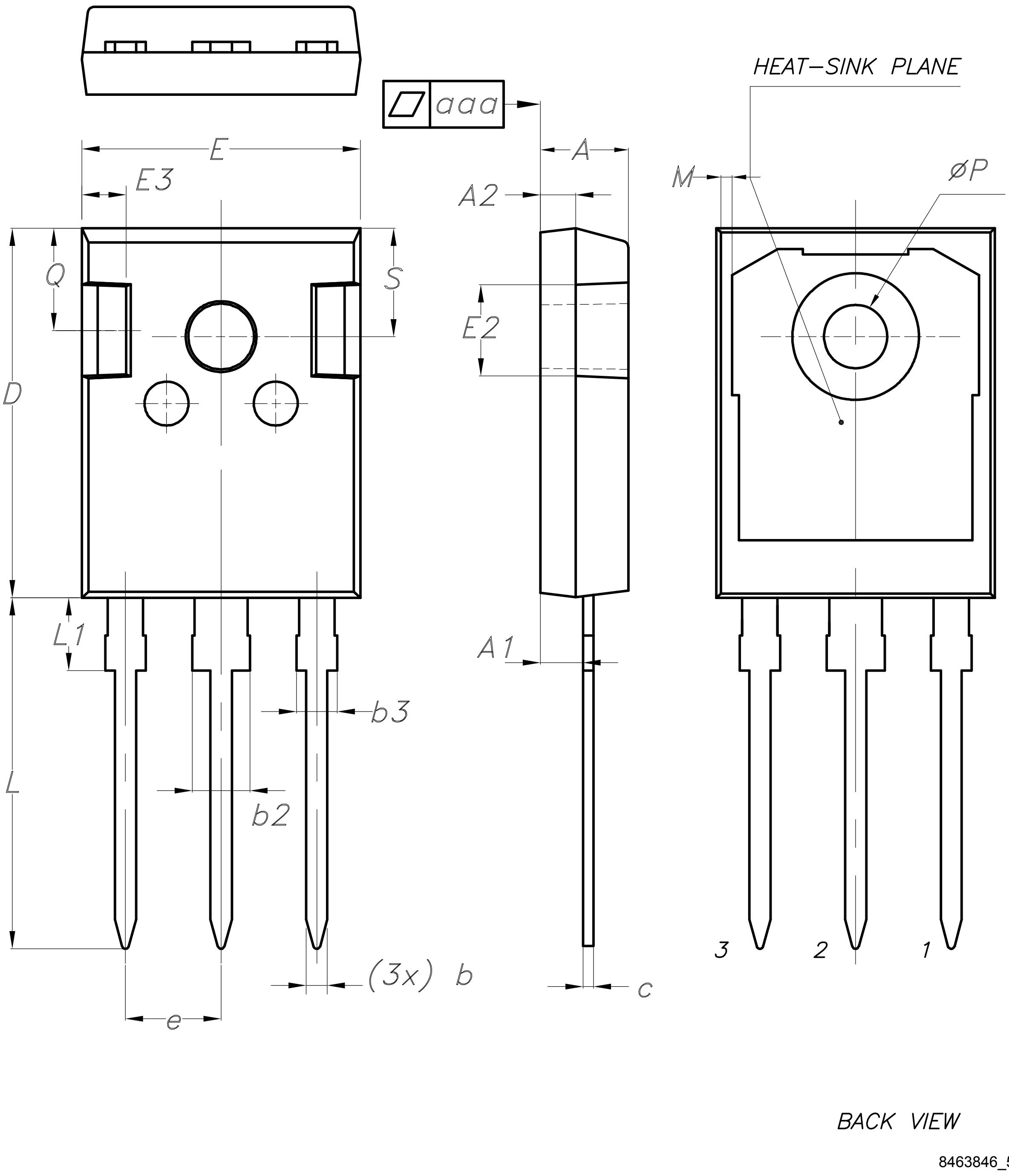


Figure 33. TO-247 long leads package outline

Table 8. TO-247 long leads package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
b	1.16		1.26
b2			3.25
b3			2.25
c	0.59		0.66
D	20.90	21.00	21.10
E	15.70	15.80	15.90
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	5.34	5.44	5.54
L	19.80	19.92	20.10
L1			4.30
M	0.35		0.95
P	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25
aaa		0.04	0.10

Revision history

Table 9. **Document revision history**

Date	Revision	Changes
02-Dec-2015	1	First release.
15-Jun-2016	2	Inserted device in TO-247 and document updated accordingly. Inserted *Section 2.1: "Electrical characteristics (curves)".* Document status promoted from preliminary to production data. Minor text changes.
03-May-2017	3	Modified: title, features and application on cover page. Modified Table 4: "Static characteristics", Table 7: "Diode switching characteristics (inductive load)" and Figure 13: "Normalized V(BR)CES vs. junction temperature ". Minor text changes.
20-Jan-2025	4	Updated Section 4.1: TO-247 package information, and Section 4.2: TO-247 long leads package information. Updated document title on cover page. Minor text changes.

Contents