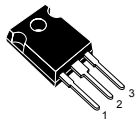
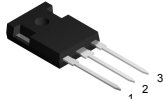




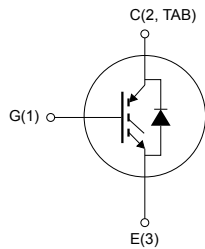
Trench gate field-stop 650 V, 75 A low-loss M series IGBT in a TO-247 and TO-247 long leads packages



TO-247



TO-247 long leads



NG1E3C2T



Features

- Maximum junction temperature: $T_J = 175\text{ }^{\circ}\text{C}$
- 6 μs of minimum short-circuit withstand time
- $V_{CE(sat)} = 1.65\text{ V (typ.) @ } I_C = 75\text{ A}$
- 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.

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

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GE} = 0\text{ V}$)	650	V
$I_C^{(1)}$	Continuous collector current at $T_C = 25\text{ °C}$	120	A
I_C	Continuous collector current at $T_C = 100\text{ °C}$	75	A
$I_{CP}^{(2)}$	Pulsed collector current	225	A
V_{GE}	Gate-emitter voltage	± 20	V
$I_F^{(1)}$	Continuous forward current at $T_C = 25\text{ °C}$	120	A
I_F	Continuous forward current at $T_C = 100\text{ °C}$	75	A
$I_{FP}^{(2)}$	Pulsed forward current	225	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ °C}$	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

$T_C = 25\text{ °C}$ unless otherwise specified

Table 3. Static characteristics

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

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	6290	-	pF
C_{oes}	Output capacitance		-	390	-	
C_{res}	Reverse transfer capacitance		-	136	-	
Q_g	Total gate charge	$V_{CC} = 520\text{ V}$, $I_C = 75\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (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	$V_{CE} = 400\text{ V}$, $I_C = 75\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 3.3\ \Omega$ (see Figure 28)		47	-	ns
t_r	Current rise time			22.4	-	ns
$(di/dt)_{on}$	Turn-on current slope			2680	-	A/ μ s
$t_{d(off)}$	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	$V_{CE} = 400\text{ V}$, $I_C = 75\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 3.3\ \Omega$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 28)		48	-	ns
t_r	Current rise time			25	-	ns
$(di/dt)_{on}$	Turn-on current slope			2420	-	A/ μ s
$t_{d(off)}$	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	$V_{CC} \leq 400\text{ V}$, $V_{GE} = 13\text{ V}$, $T_{Jstart} \leq 150\text{ }^\circ\text{C}$	10		-	μ s
		$V_{CC} \leq 400\text{ V}$, $V_{GE} = 15\text{ V}$, $T_{Jstart} \leq 150\text{ }^\circ\text{C}$	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	$I_F = 75\text{ A}$, $V_R = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$ (see Figure 28)	-	165	-	ns
Q_{rr}	Reverse recovery charge		-	1.72	-	μ C
I_{rrm}	Reverse recovery current		-	25	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	750	-	A/ μ s
E_{rr}	Reverse recovery energy		-	289	-	μ J
t_{rr}	Reverse recovery time	$I_F = 75\text{ A}$, $V_R = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 28)	-	256	-	ns
Q_{rr}	Reverse recovery charge		-	6.85	-	μ C
I_{rrm}	Reverse recovery current		-	48	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	300	-	A/ μ s
E_{rr}	Reverse recovery energy		-	1033	-	μ J

2.1 STGWA75M65DF2 electrical characteristics curve

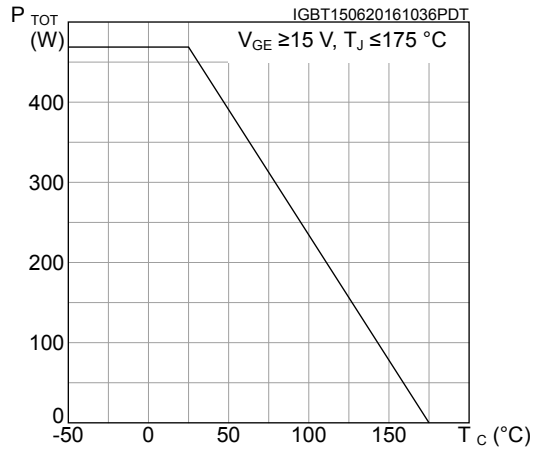
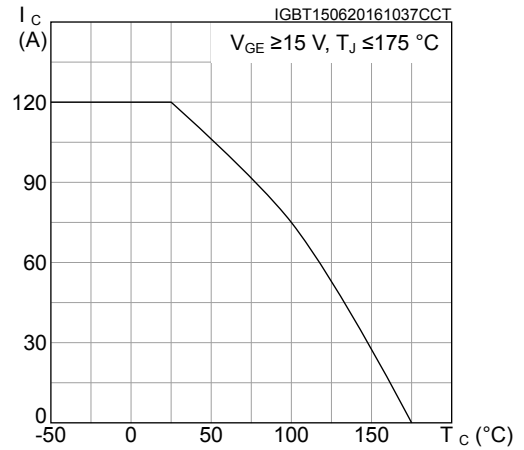
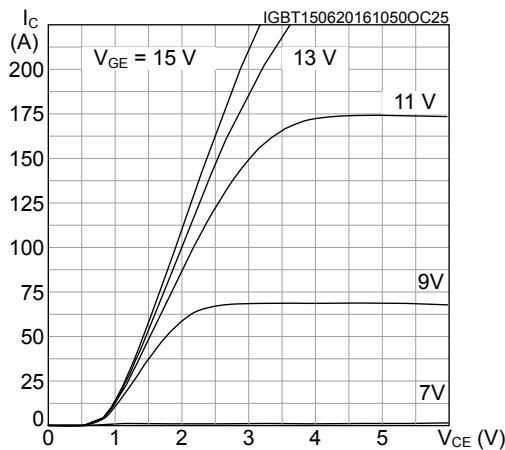
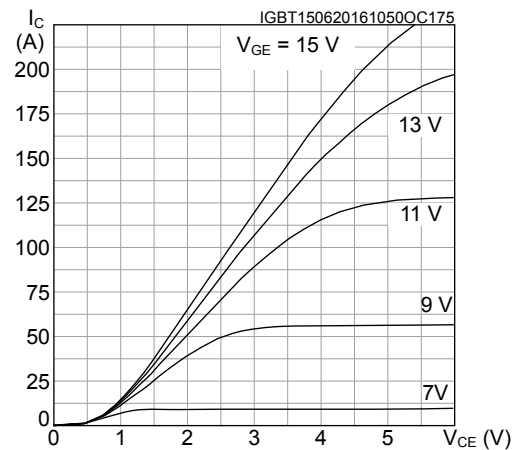
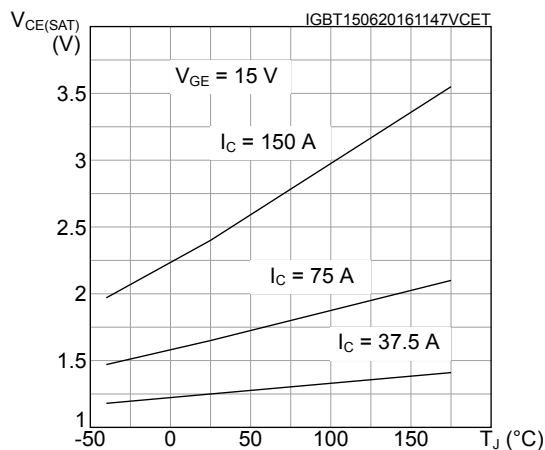
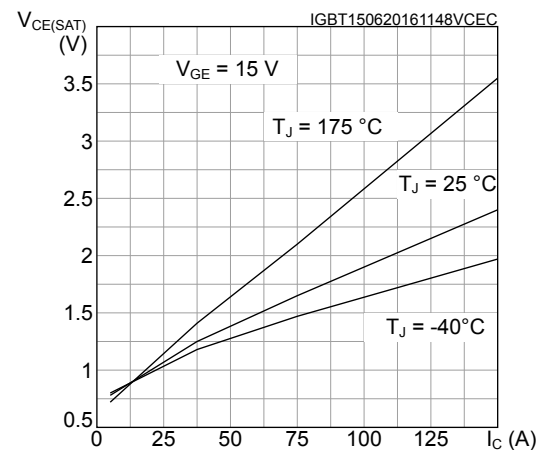
Figure 1. Power dissipation vs. case temperature

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


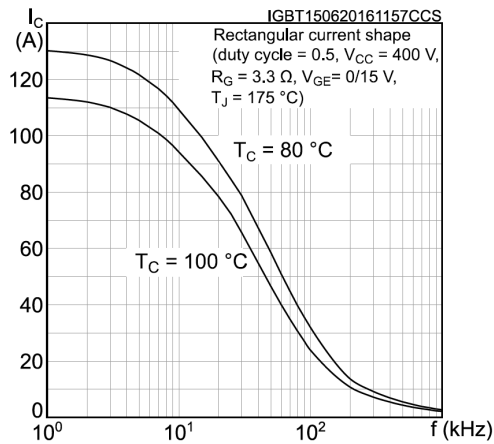
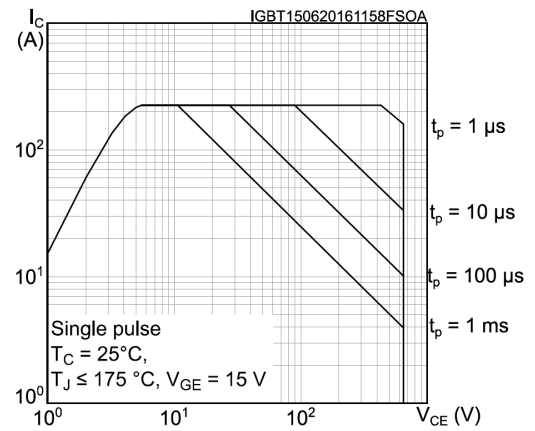
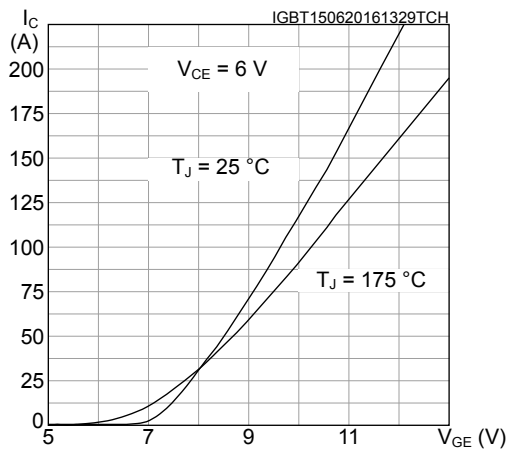
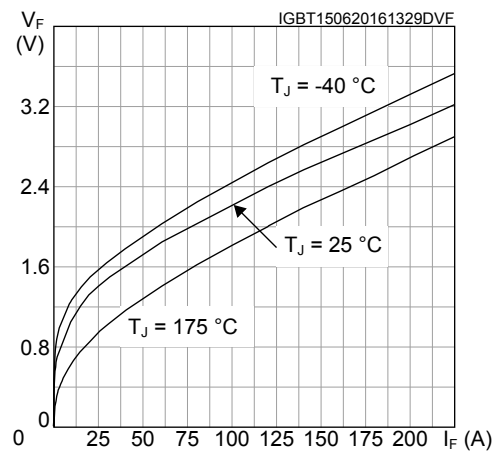
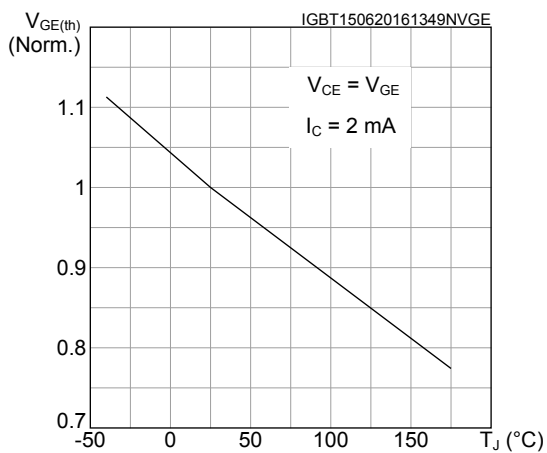
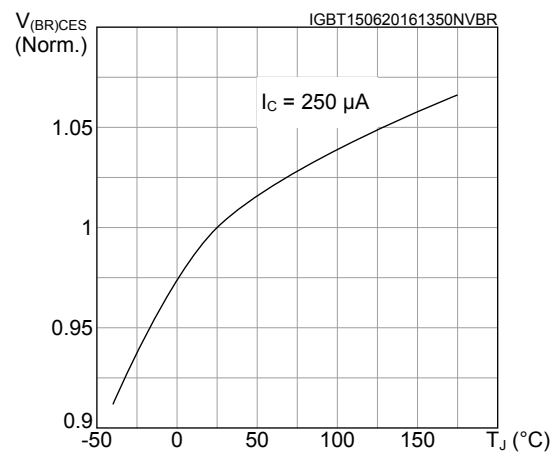
Figure 7. Collector current vs. switching frequency

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


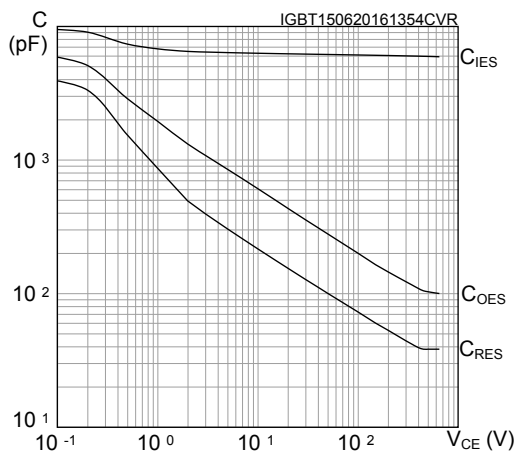
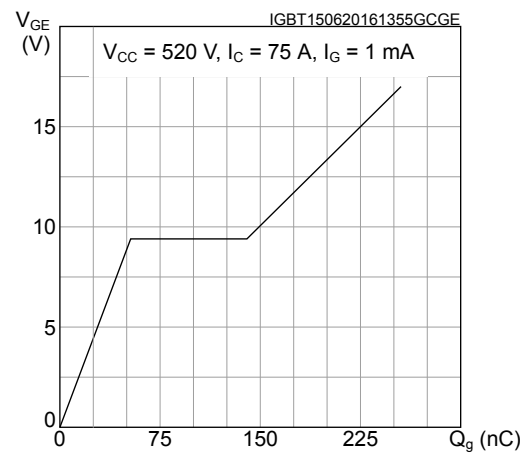
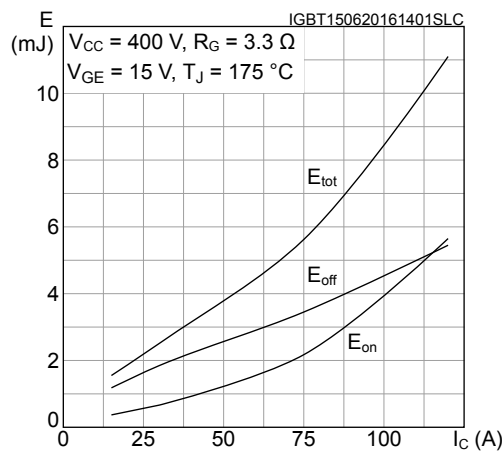
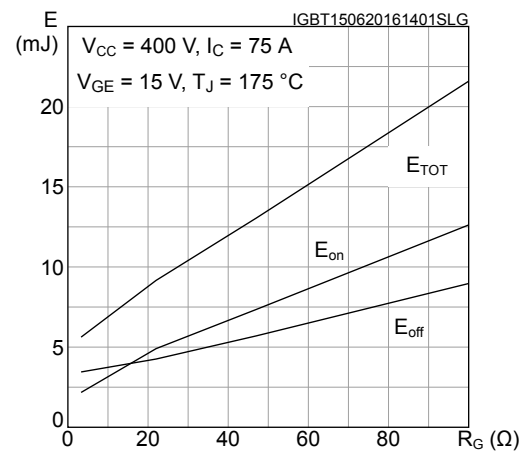
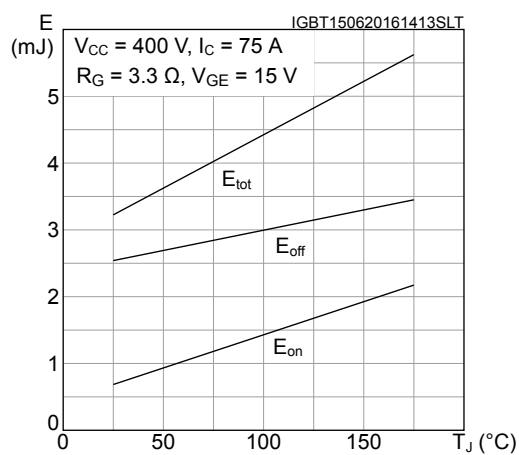
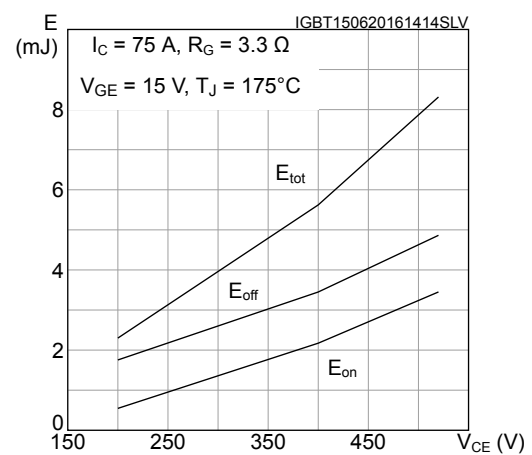
Figure 13. Capacitance variations

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


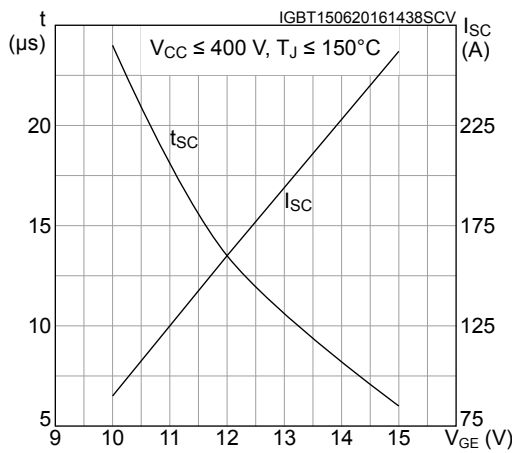
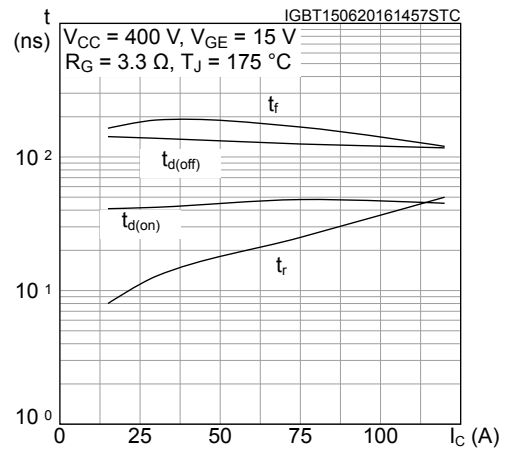
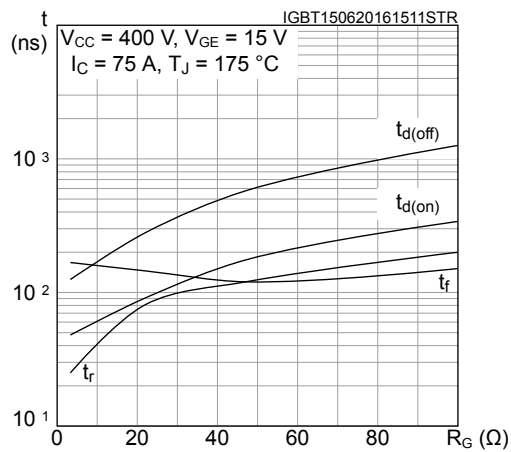
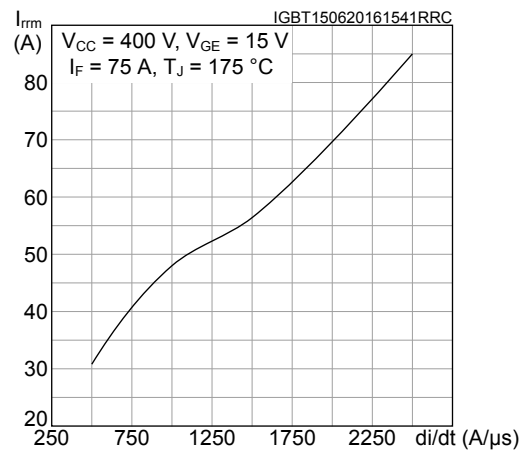
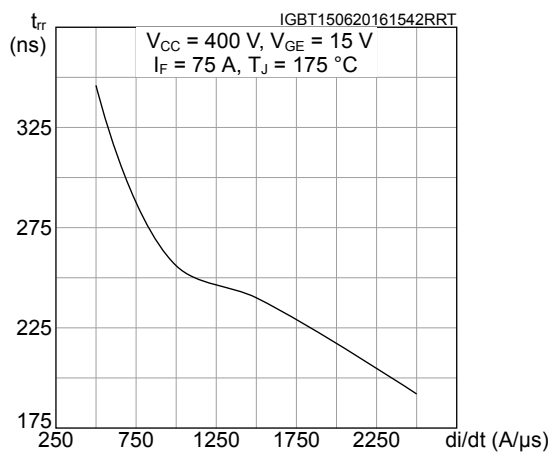
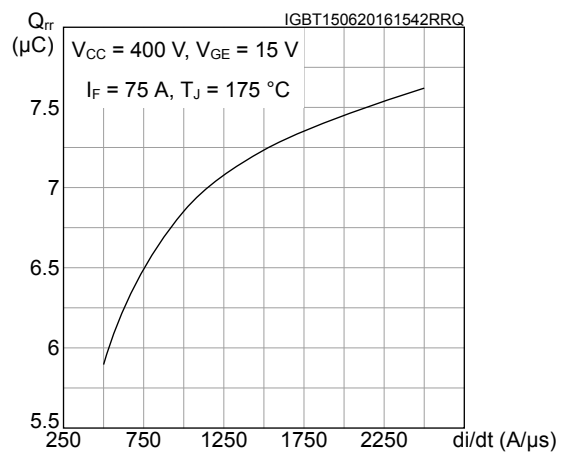
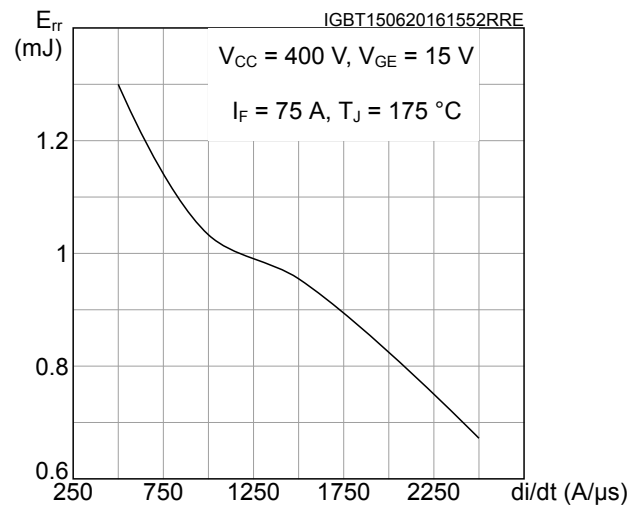
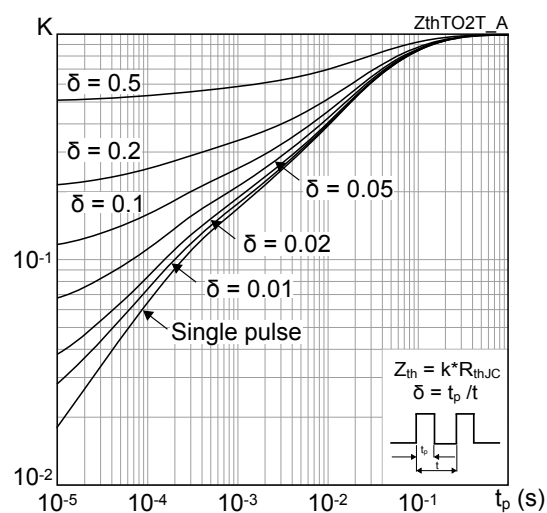
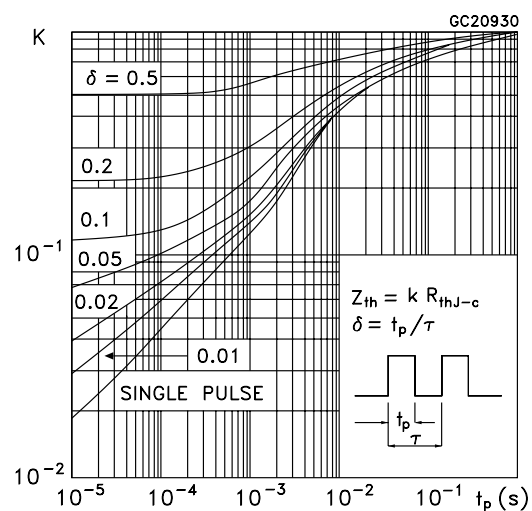
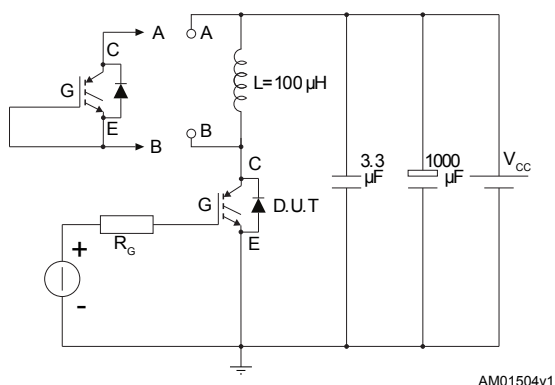
Figure 19. Short-circuit time and current vs. V_{GE}

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


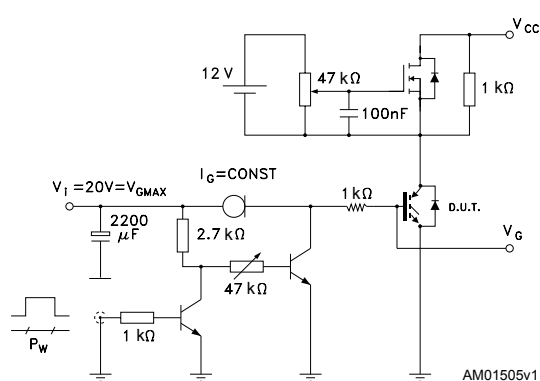
3 Test circuits

Figure 28. Test circuit for inductive load switching



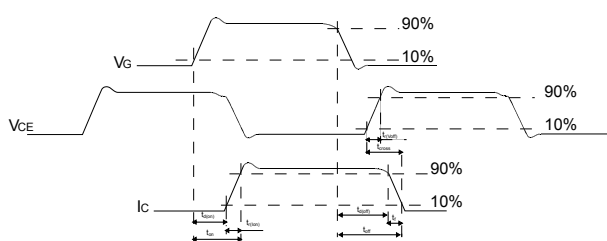
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Figure 29. Gate charge test circuit



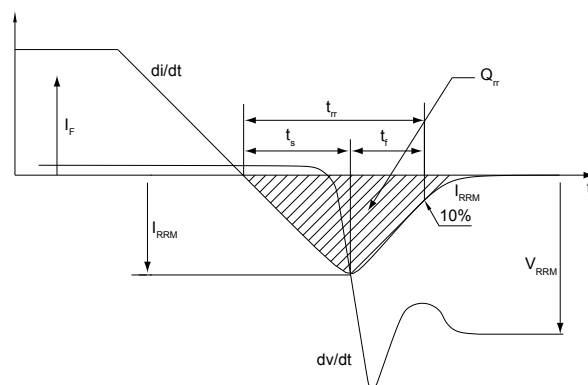
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Figure 30. Switching waveform



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Figure 31. Diode reverse recovery waveform



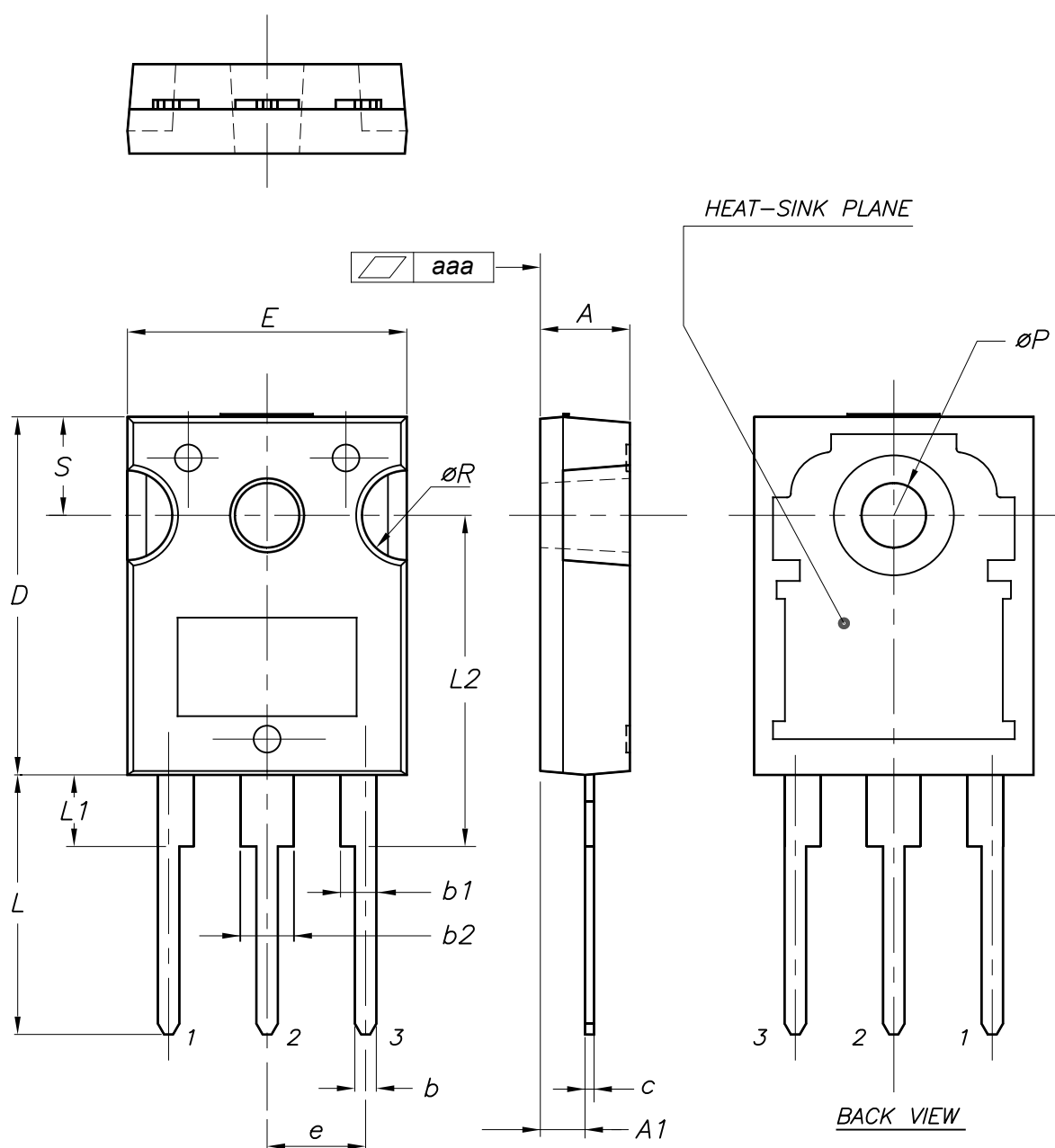
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4 Package information

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



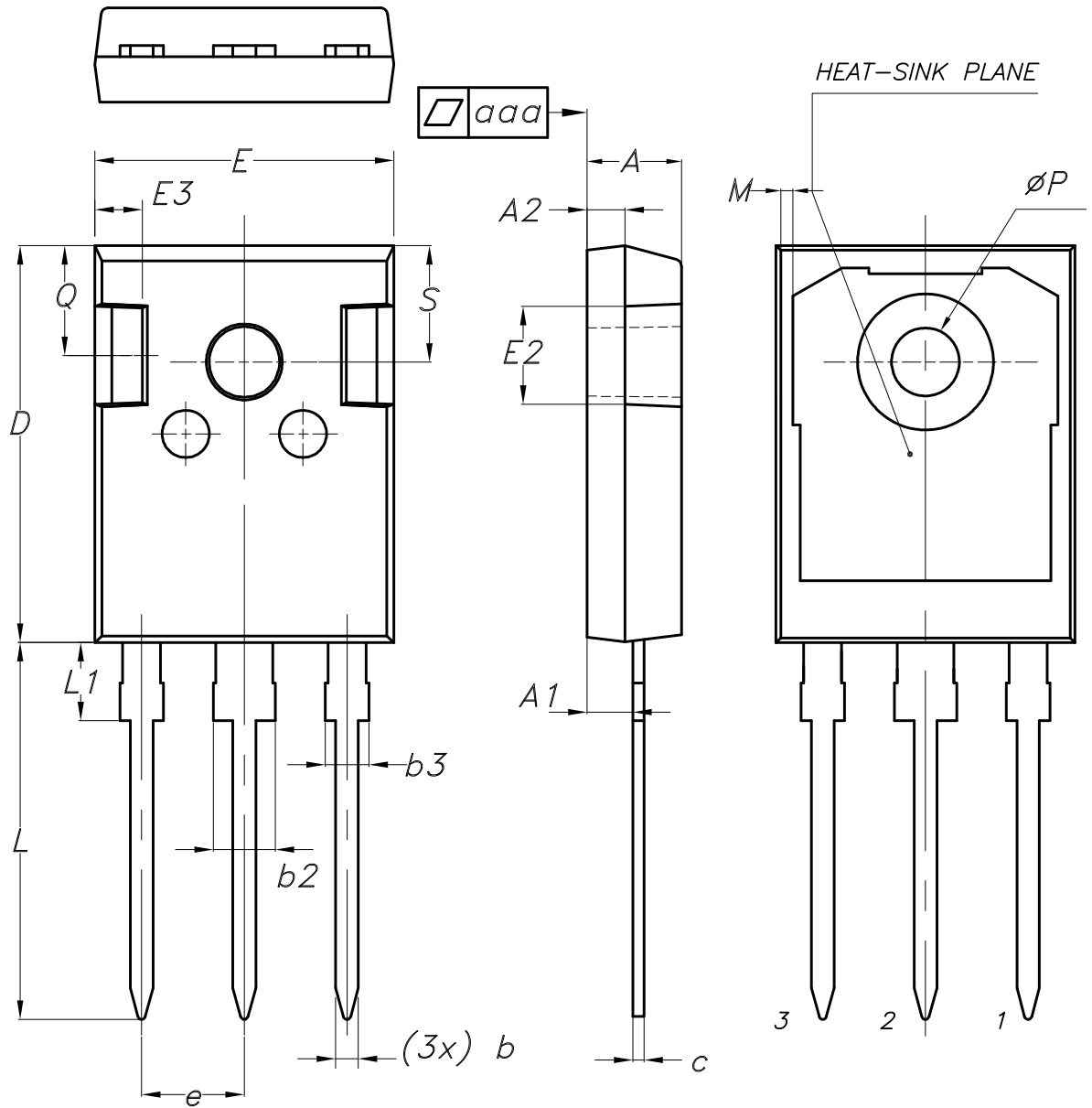
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Table 7. TO-247 package mechanical data

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



BACK VIEW

8463846_5

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 <i>Section 2.1: "Electrical characteristics (curves)"</i> . 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.



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