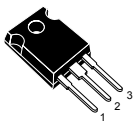
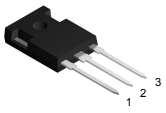
STGW30M65DF2, STGWA30M65DF2

Datasheet

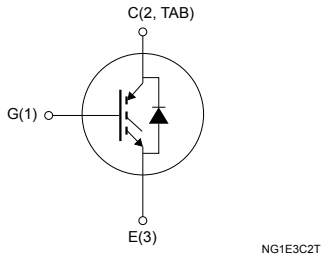
Trench gate field-stop 650 V, 30 A low-loss M series IGBTs in TO-247 and TO-247 long leads packages



TO-247



TO-247 long leads



Features

- 6 µs of minimum short-circuit withstand time
- Low $V_{CE(sat)}$ = 1.55 V (typ.) @ I_C = 30 A
- Tight parameter distribution
- Safer paralleling
- Low thermal resistance
- Soft and very fast-recovery antiparallel diode

Applications

- Motor control
- UPS
- PFC

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
STGW30M65DF2
STGWA30M65DF2

Product summary	
Order code	**STGW30M65DF2**
Marking	G30M65DF2
Package	TO-247
Packing	Tube
Order code	**STGWA30M65DF2**
Marking	G30M65DF2
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 V)	650	V
I_C	Continuous collector current at T_C = 25 °C	60	A
	Continuous collector current at T_C = 100 °C	30	
I_{CP}(1)	Pulsed collector current	120	A
V_{GE}	Gate-emitter voltage	±20	V
I_F	Continuous forward current at T_C = 25 °C	60	A
	Continuous forward current at T_C = 100 °C	30	
I_{FP}(1)	Pulsed collector current	120	A
P_{TOT}	Total power dissipation at T_C = 25 °C	258	W
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	°C

1. *Pulse width limited by maximum junction temperature.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case, IGBT	0.58	°C/W
	Thermal resistance, junction-to-case, diode	1.47	
R_{thJA}	Thermal resistance, junction-to-ambient	50	°C/W

2 Electrical characteristics

T_J = 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 = 30 A		1.55	2.0	V
		V_{GE} = 15 V, I_C = 30 A, T_J = 125 °C		1.95		
		V_{GE} = 15 V, I_C = 30 A, T_J = 175 °C		2.1		
V_F	Forward on-voltage	I_F = 30 A		1.86	2.65	V
		I_F = 30 A, T_J = 125 °C		1.6		
		I_F = 30 A, T_J = 175 °C		1.5		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 500 µA	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	nA

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	-	2490	-	pF
C_{oes}	Output capacitance		-	143	-	pF
C_{res}	Reverse transfer capacitance		-	46	-	pF
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 30 A, V_{GE} = 0 to 15 V (see Figure 29. Gate charge test circuit)	-	80	-	nC
Q_{ge}	Gate-emitter charge		-	18	-	nC
Q_{gc}	Gate-collector charge		-	32	-	nC

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 = 30 A, V_{GE} = 15 V, R_G = 10 Ω (see Figure 28. Test circuit for inductive load switching)		31.6	-	ns
t_r	Current rise time			13.4	-	ns
di/dt(on)	Turn-on current slope			1791	-	A/µs
$t_{d(off)}$	Turn-off delay time			115	-	ns
t_f	Current fall time			110	-	ns
E_{on} (1)	Turn-on switching energy			0.3	-	mJ
E_{off} (2)	Turn-off switching energy			0.96	-	mJ
E_{ts}	Total switching energy			1.26	-	mJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 30 A, V_{GE} = 15 V, R_G = 10 Ω, T_J = 175 °C (see Figure 28. Test circuit for inductive load switching)		30	-	ns
t_r	Current rise time			17	-	ns
di/dt(on)	Turn-on current slope			1435	-	A/µs
$t_{d(off)}$	Turn-off delay time			116	-	ns
t_f	Current fall time			194	-	ns
E_{on} (1)	Turn-on switching energy			0.67	-	mJ
E_{off} (2)	Turn-off switching energy			1.36	-	mJ
E_{ts}	Total switching energy			2.03	-	mJ
t_{sc}	Short-circuit withstand time	V_{CC} = 400 V, V_{GE} = 13 V, starting $T_J \leq$ 150 °C	10		-	µs
		V_{CC} = 400 V, V_{GE} = 15 V, starting $T_J \leq$ 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 = 30 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/µs (see Figure 28. Test circuit for inductive load switching)	-	140	-	ns
Q_{rr}	Reverse recovery charge		-	880	-	nC
I_{rrm}	Reverse recovery current		-	17	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	650	-	A/µs
E_{rr}	Reverse recovery energy		-	115	-	µJ
t_{rr}	Reverse recovery time	I_F = 30 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 1000 A/µs, T_J = 175 °C (see Figure 28. Test circuit for inductive load switching)	-	244	-	ns
Q_{rr}	Reverse recovery charge		-	2743	-	nC
I_{rrm}	Reverse recovery current		-	25	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	220	-	A/µs
E_{rr}	Reverse recovery energy		-	320	-	µJ

2.1 Electrical characteristics (curves)

Figure 1. Total power dissipation vs temperature

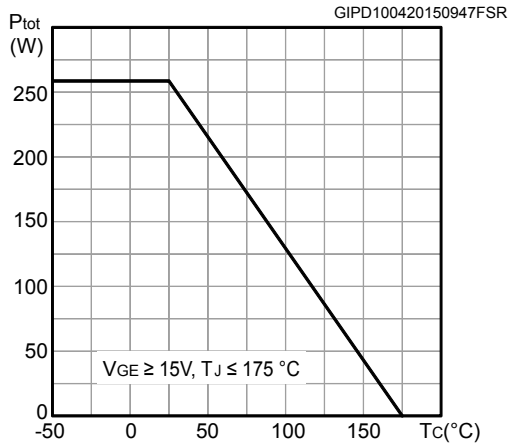


Figure 2. Maximum continuous collector current vs case temperature

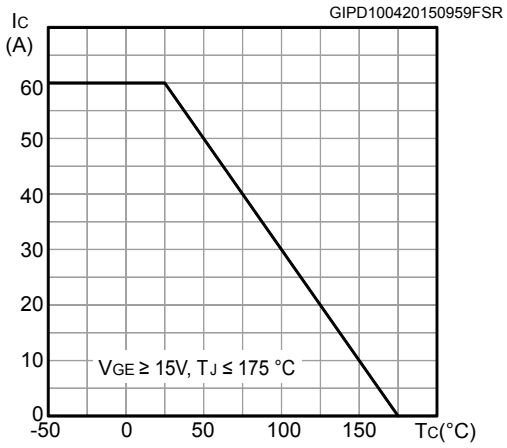


Figure 3. Typical output characteristics (T_J = 25 °C)

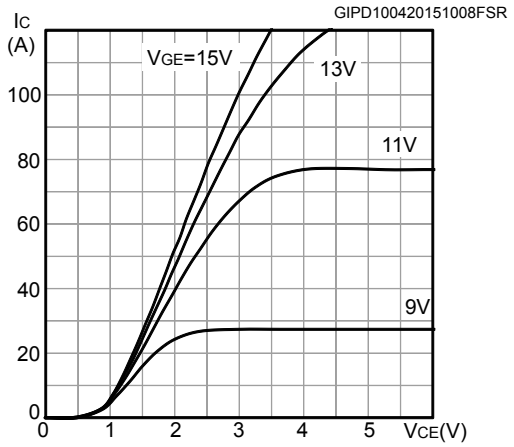


Figure 4. Typical output characteristics (T_J = 175 °C)

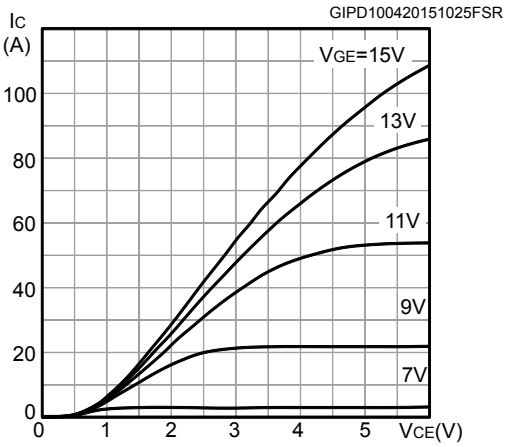


Figure 5. Typical transfer characteristics

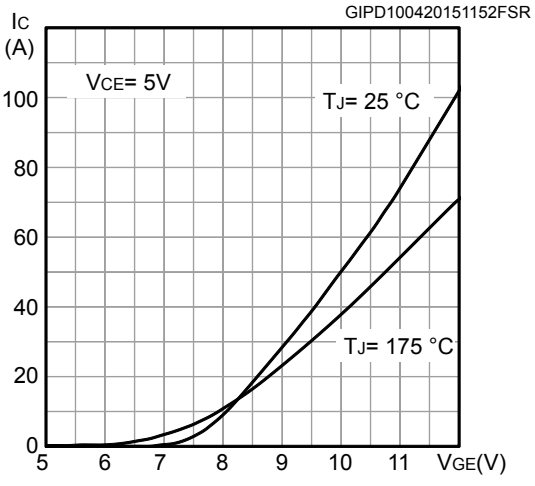


Figure 6. Typical $V_{CE(sat)}$ vs temperature

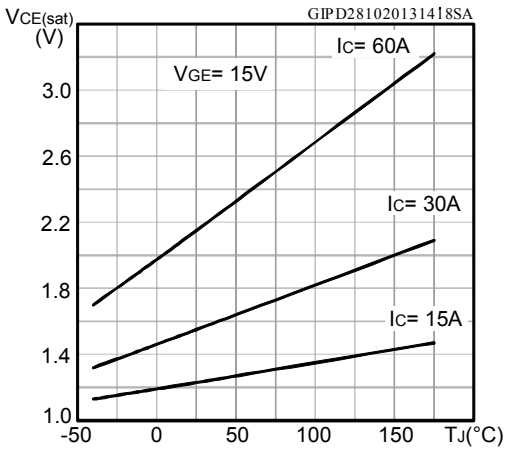


Figure 7. Typical $V_{CE(sat)}$ vs collector current

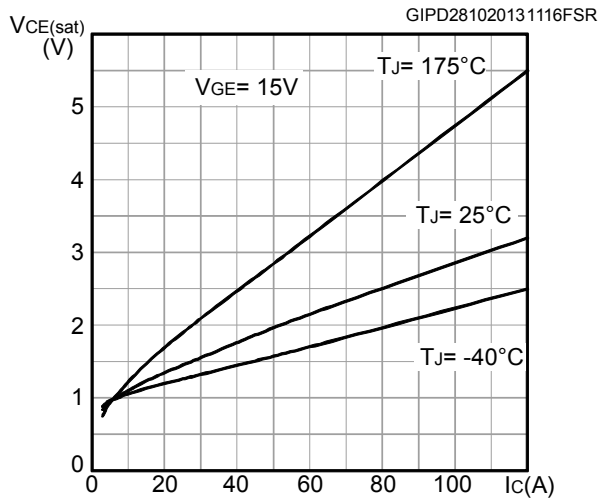


Figure 8. Forward bias safe operating area

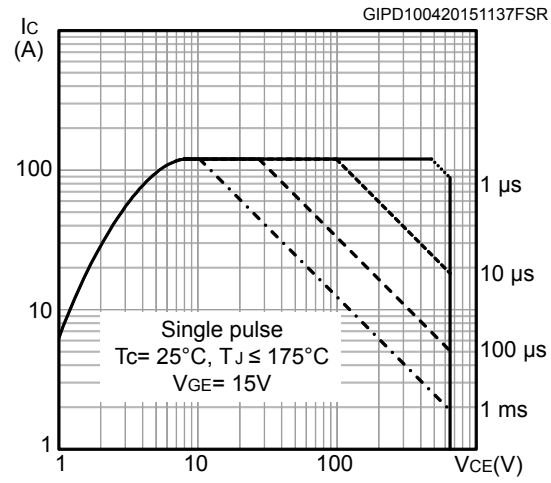


Figure 9. Diode typical forward characteristics

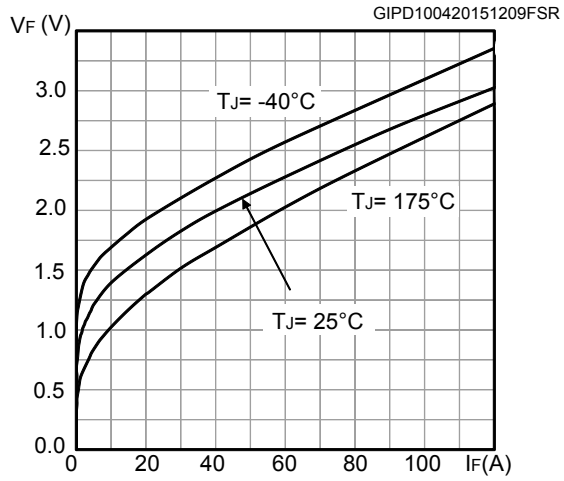


Figure 10. Normalized $V_{GE(th)}$ vs temperature

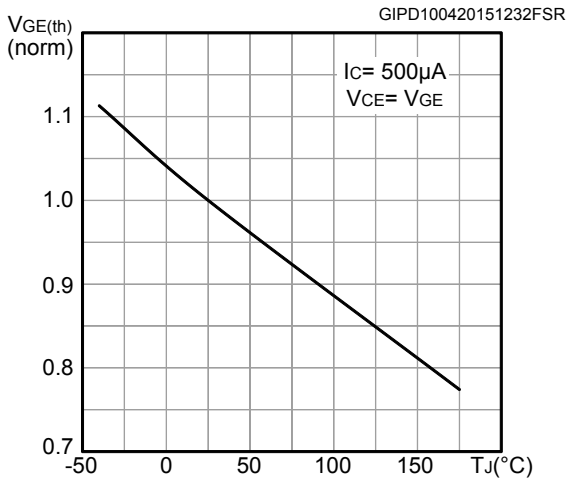


Figure 11. Normalized $V_{(BR)CES}$ vs temperature

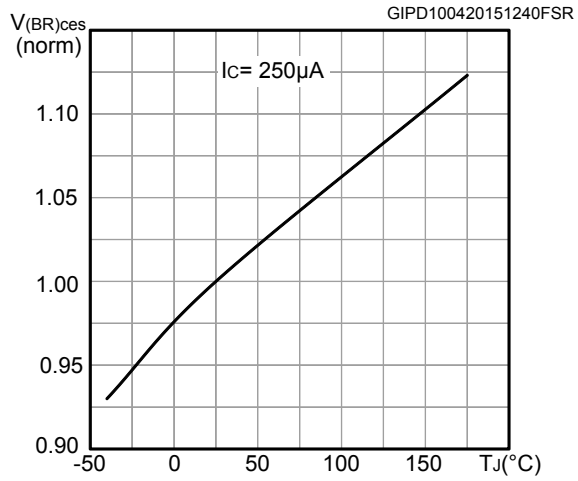


Figure 12. Typical capacitance characteristics

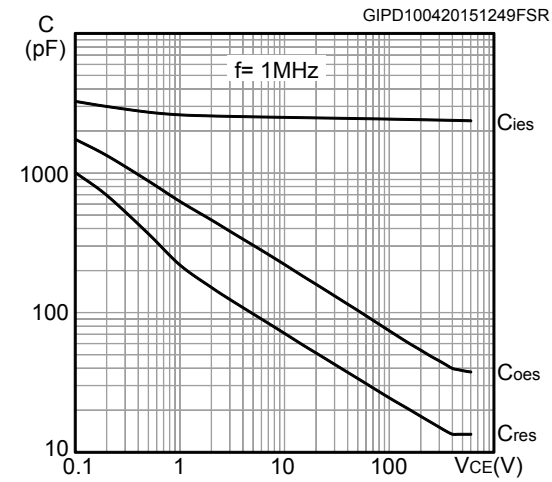


Figure 13. Typical gate charge characteristics

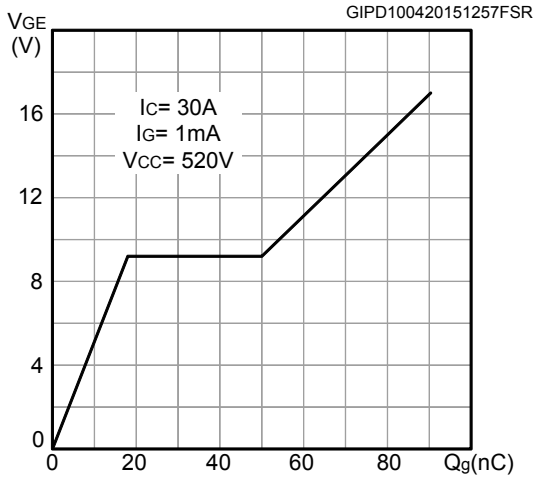


Figure 14. Typical switching energy vs collector current

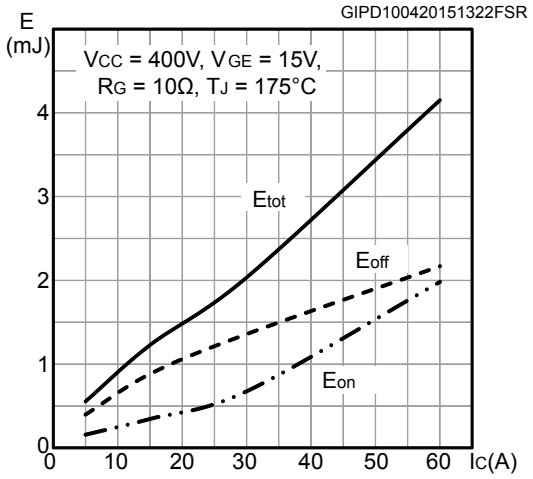


Figure 15. Typical switching energy vs temperature

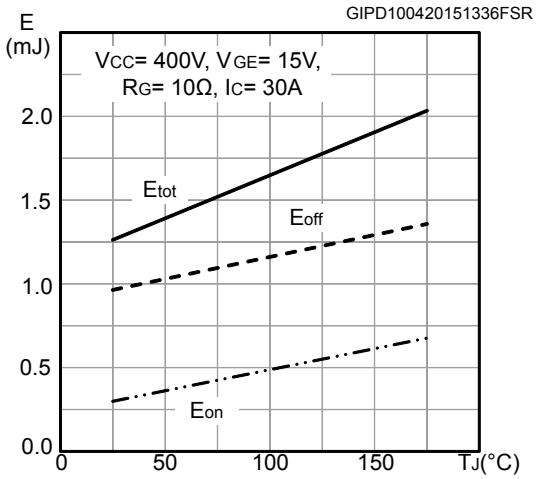


Figure 16. Typical switching energy vs R_G

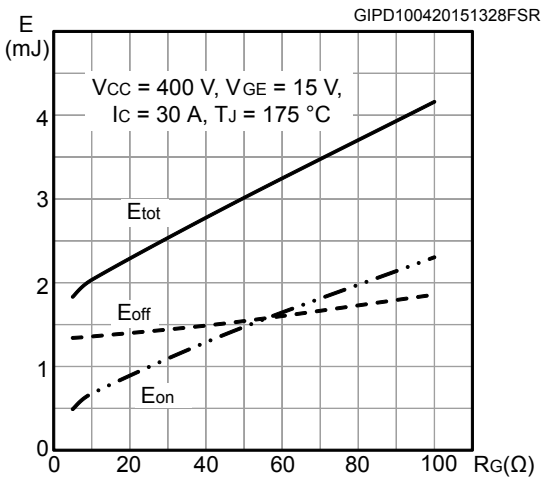


Figure 17. Switching energy vs. collector emitter voltage

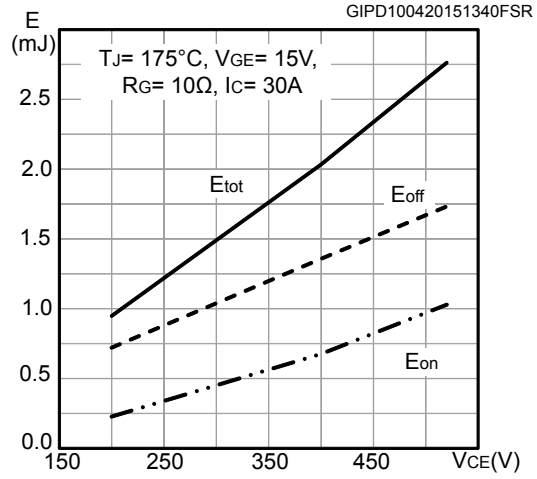


Figure 18. Short-circuit time and current vs. V_{GE}

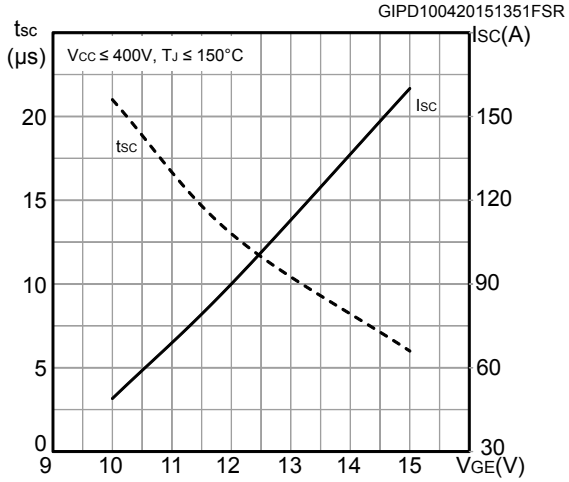


Figure 19. Collector current vs switching frequency

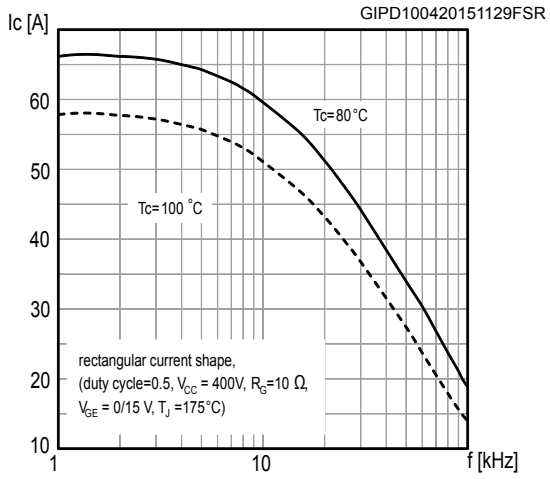


Figure 20. Typical switching times vs collector current

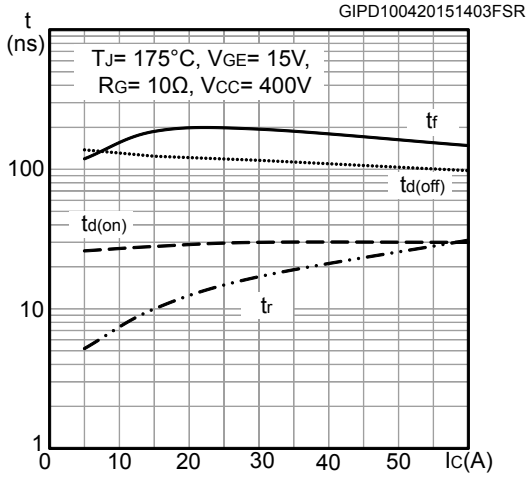


Figure 21. Typical switching times vs gate resistance

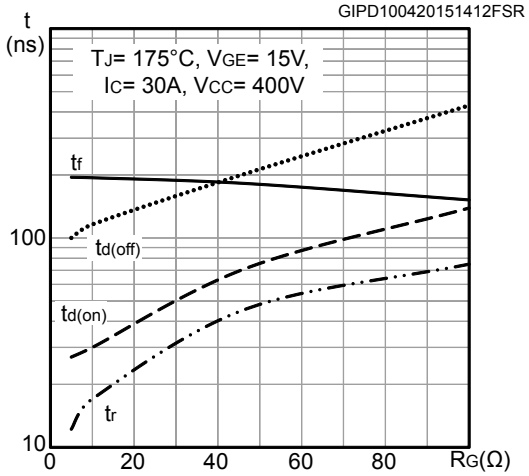


Figure 22. Typical reverse recovery current vs diode current slope

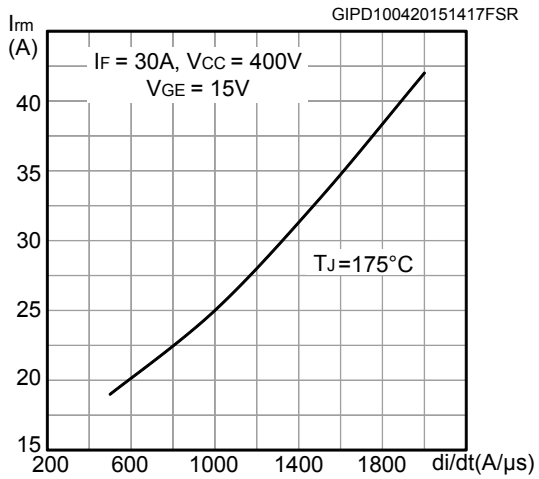


Figure 23. Typical reverse recovery time vs diode current slope

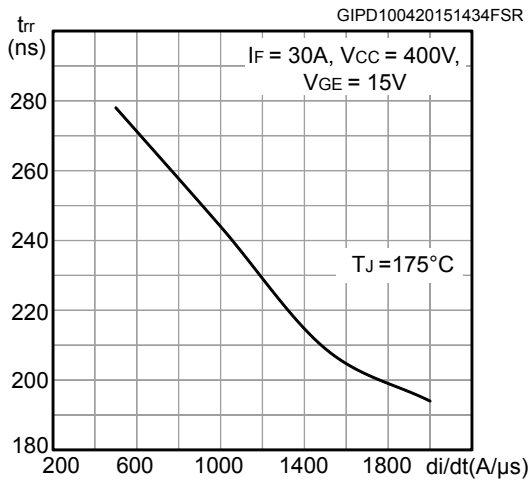


Figure 24. Typical reverse recovery charge vs diode current slope

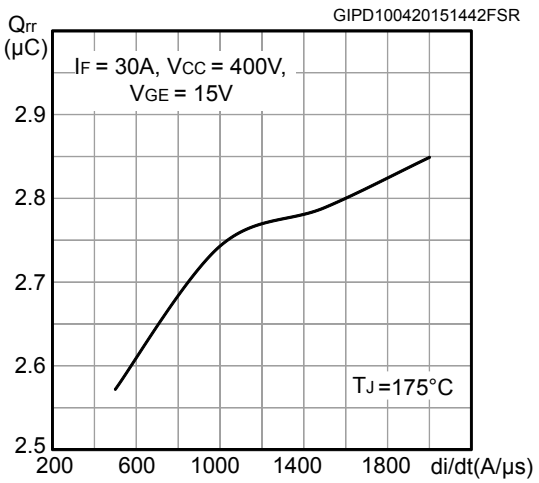


Figure 25. Typical reverse recovery energy vs diode current slope

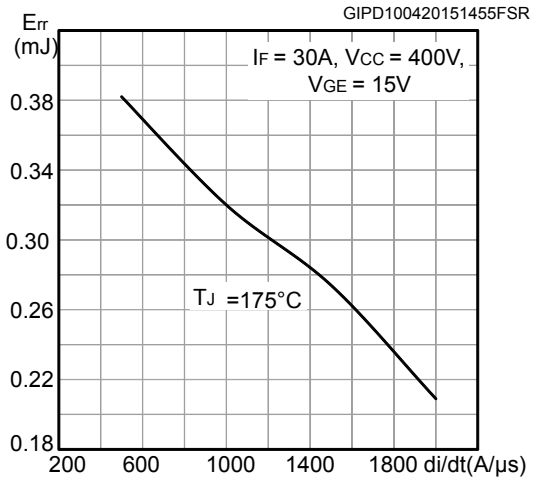


Figure 26. Normalized transient thermal impedance for IGBT

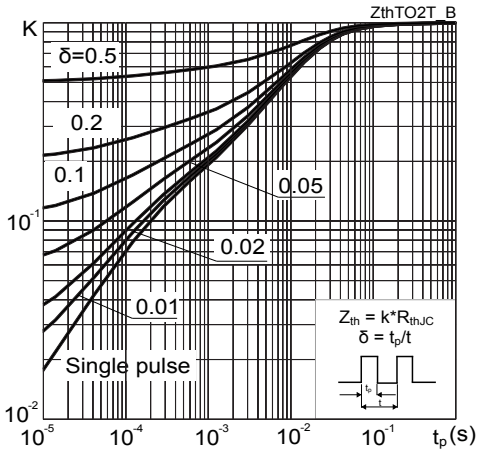
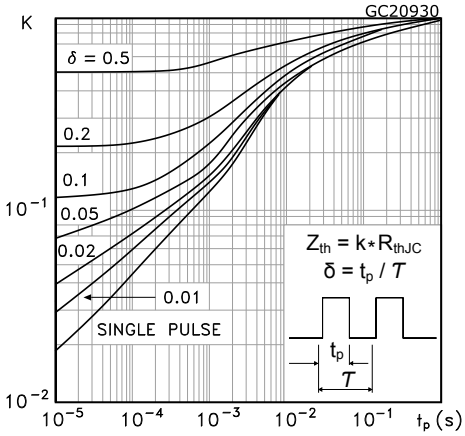


Figure 27. Normalized transient thermal impedance for diode



3 Test circuits

Figure 28. Test circuit for inductive load switching

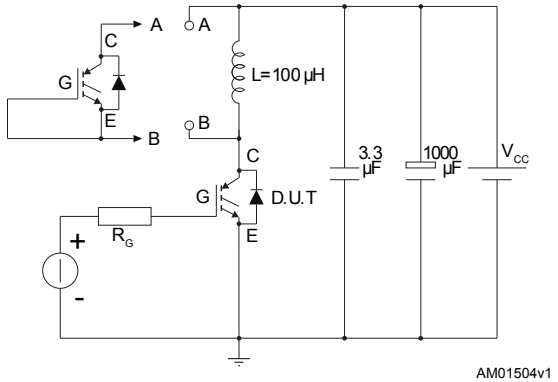


Figure 29. Gate charge test circuit

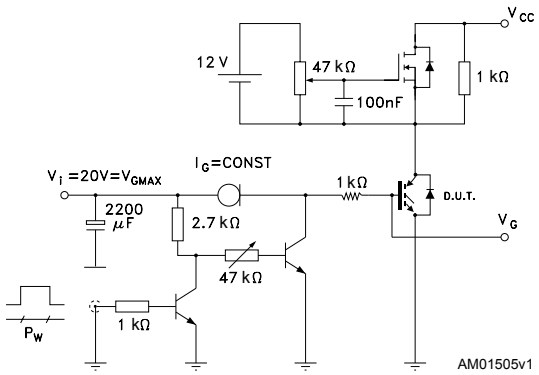


Figure 30. Switching waveform

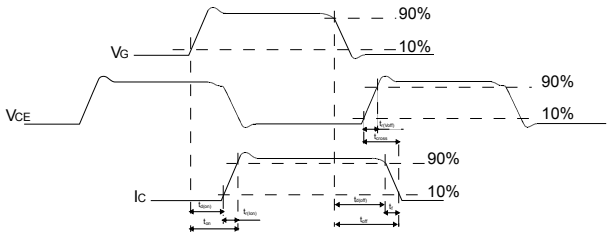
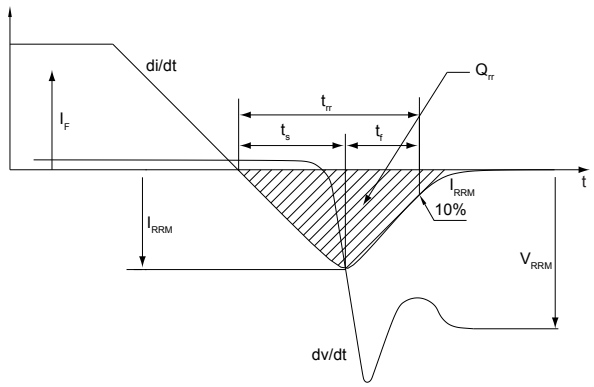


Figure 31. Diode reverse recovery waveform

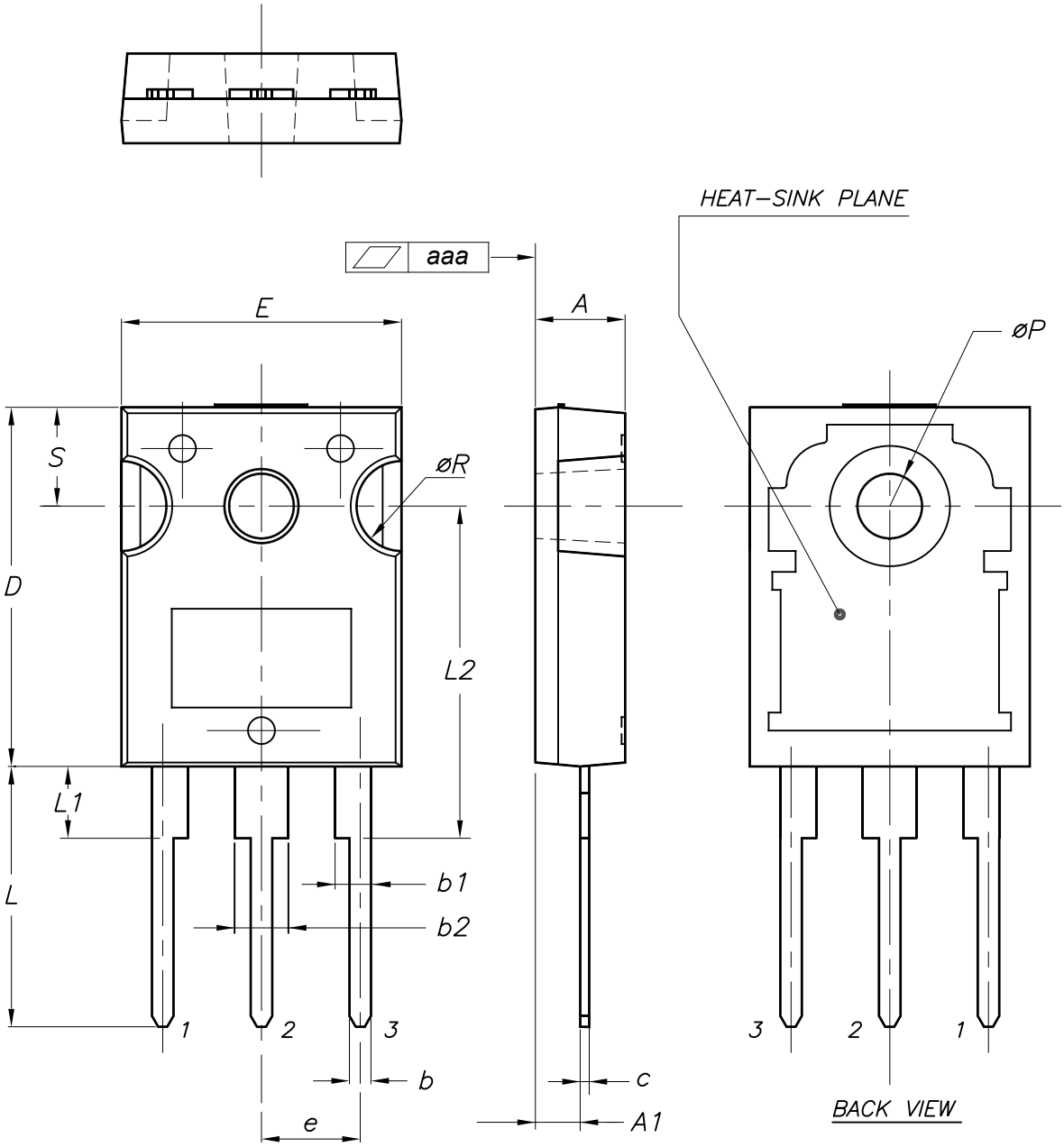


4 Package information

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



0075325_10

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**

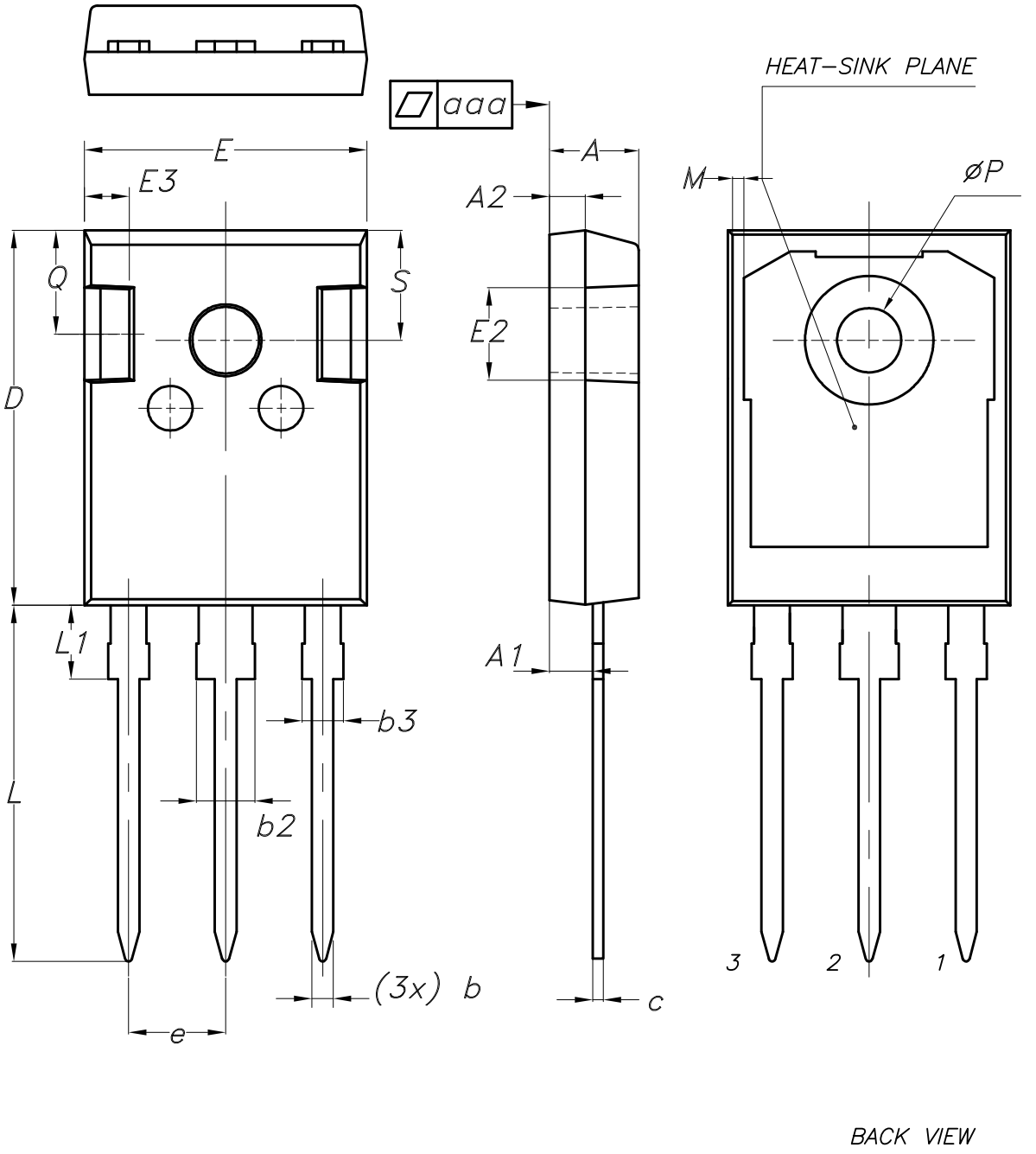


Table 8. **TO-247 long leads package mechanical data**

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
04-May-2015	1	First release.
14-Sep-2015	2	Updated features in cover page and added new t_{SC} condition in in *Table 6: "IGBT switching characteristics (inductive load)"*.
18-Dec-2015	3	Added part number STGW30M65DF2 Added *Section 4.1: "TO-247 package information"* Minor text changes.
20-May-2016	4	Updated features in cover page. Minor text changes
11-Apr-2017	5	Updated document title. Updated *Table 4: "Static characteristics"*, *Table 6: "IGBT switching characteristics (inductive load)"* and *Table 7: "Diode switching characteristics (inductive load)"*. Updated *Section 4: "Package information"*. Minor text changes
08-Nov-2024	6	Updated Section 4.1: TO-247 package information and Section 4.2: TO-247 long leads package information. Minor text changes.

Contents