

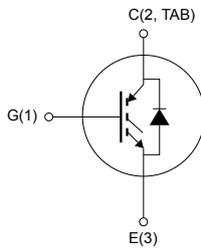
## Trench gate field-stop 650 V, 30 A low-loss M series IGBTs in TO-247 and TO-247 long leads packages



TO-247



TO-247 long leads



NG1E3C2T



### Features

- 6  $\mu$ s 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

$T_J = 25\text{ °C}$  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	$V_{GE} = 15\text{ V}$ , $I_C = 30\text{ A}$		1.55	2.0	V
		$V_{GE} = 15\text{ V}$ , $I_C = 30\text{ A}$ , $T_J = 125\text{ °C}$		1.95		
		$V_{GE} = 15\text{ V}$ , $I_C = 30\text{ A}$ , $T_J = 175\text{ °C}$		2.1		
$V_F$	Forward on-voltage	$I_F = 30\text{ A}$		1.86	2.65	V
		$I_F = 30\text{ A}$ , $T_J = 125\text{ °C}$		1.6		
		$I_F = 30\text{ A}$ , $T_J = 175\text{ °C}$		1.5		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$ , $I_C = 500\text{ }\mu\text{A}$	5	6	7	V
$I_{CES}$	Collector cut-off current	$V_{GE} = 0\text{ V}$ , $V_{CE} = 650\text{ V}$			25	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$ , $V_{GE} = \pm 20\text{ V}$			$\pm 250$	nA

**Table 4. Dynamic characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GE} = 0\text{ V}$	-	2490	-	pF
$C_{oes}$	Output capacitance		-	143	-	pF
$C_{res}$	Reverse transfer capacitance		-	46	-	pF
$Q_g$	Total gate charge	$V_{CC} = 520\text{ V}$ , $I_C = 30\text{ A}$ , $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 29. Gate charge test circuit)	-	80	-	nC
$Q_{ge}$	Gate-emitter charge		-	18	-	nC
$Q_{gc}$	Gate-collector charge		-	32	-	nC

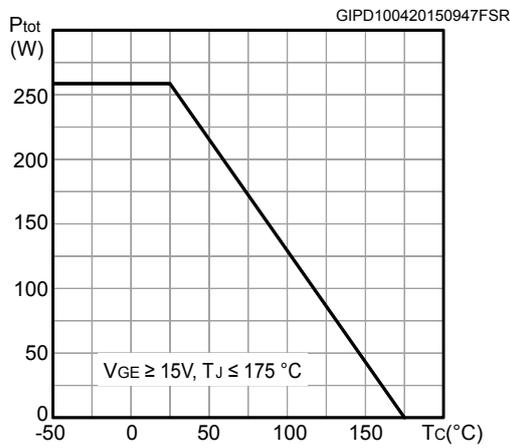
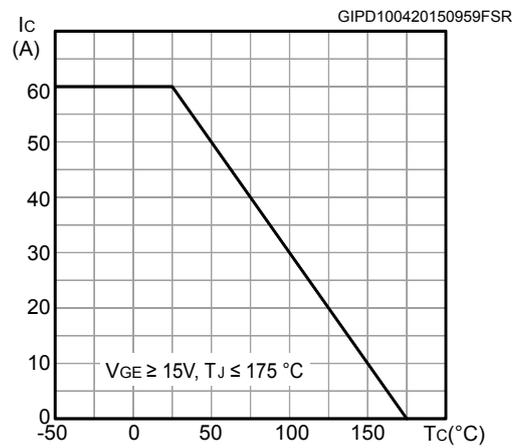
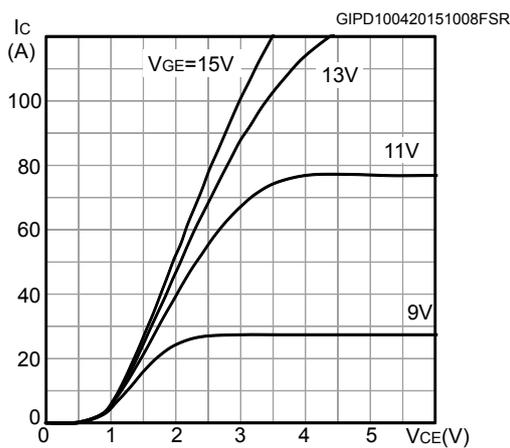
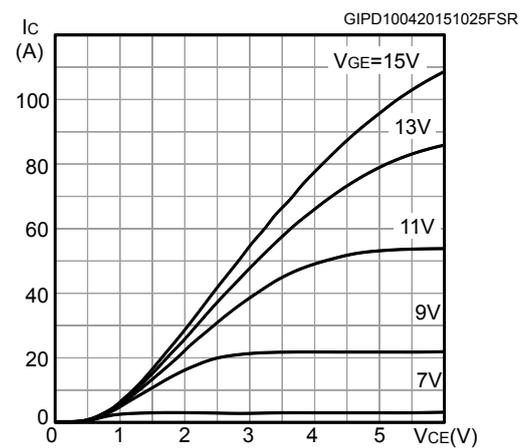
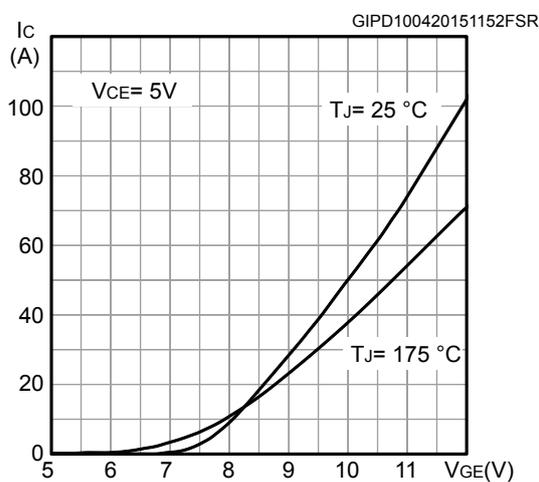
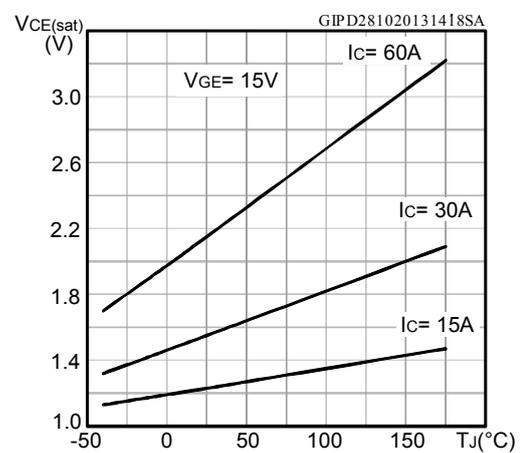
**Table 5. IGBT switching characteristics (inductive load)**

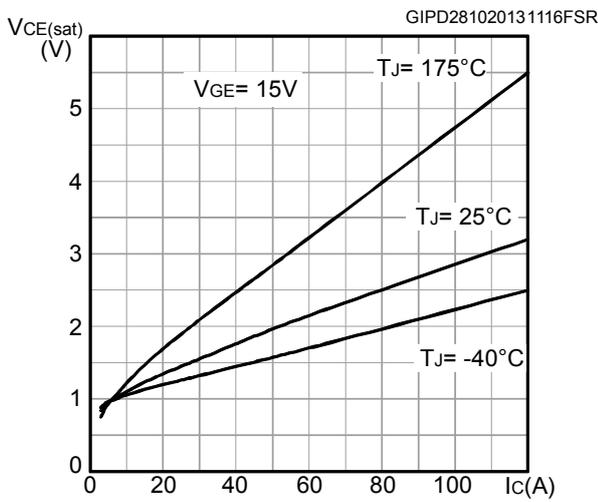
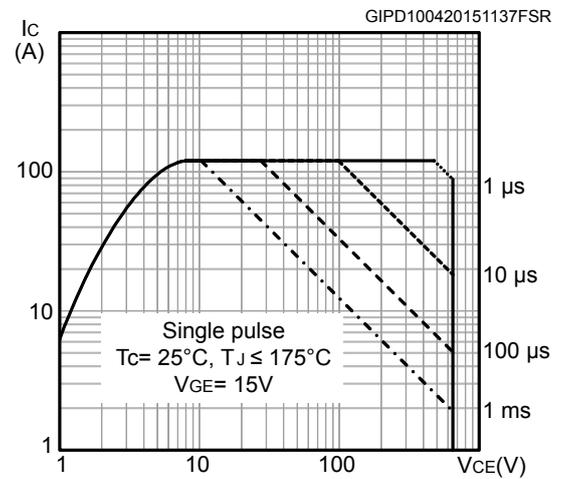
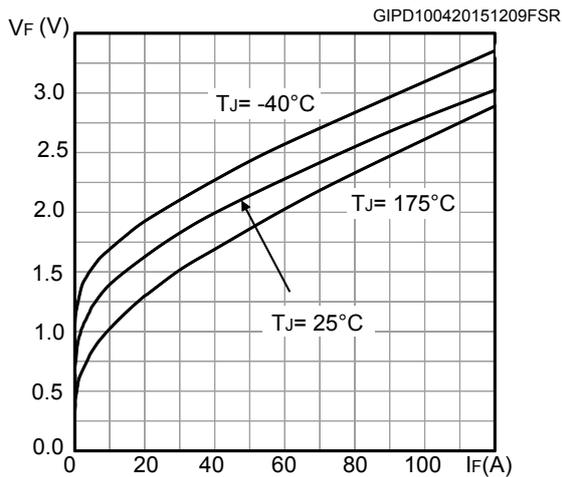
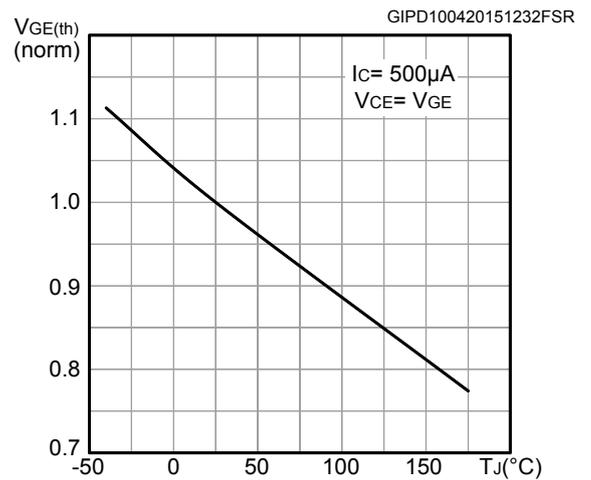
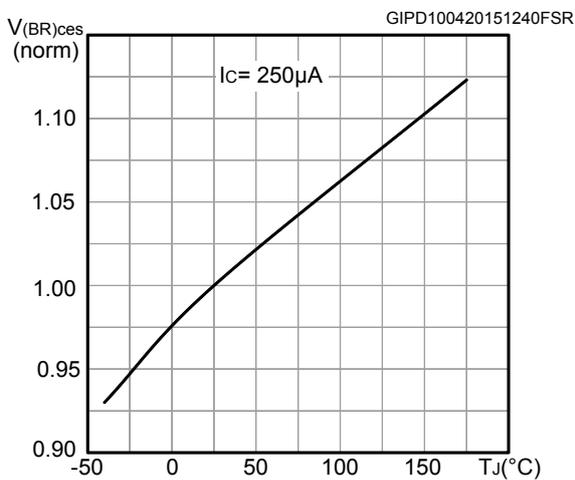
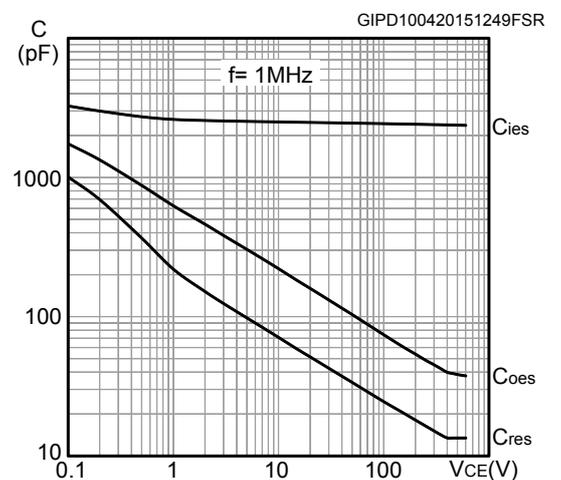
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 10\ \Omega$ (see Figure 28. Test circuit for inductive load switching)		31.6	-	ns
$t_r$	Current rise time			13.4	-	ns
$di/dt(on)$	Turn-on current slope			1791	-	A/ $\mu$ s
$t_{d(off)}$	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	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 10\ \Omega$ , $T_J = 175\text{ }^\circ\text{C}$ (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/ $\mu$ s
$t_{d(off)}$	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	$V_{CC} = 400\text{ V}$ , $V_{GE} = 13\text{ V}$ , starting $T_J \leq 150\text{ }^\circ\text{C}$	10		-	$\mu$ s
		$V_{CC} = 400\text{ V}$ , $V_{GE} = 15\text{ V}$ , starting $T_J \leq 150\text{ }^\circ\text{C}$	6		-	

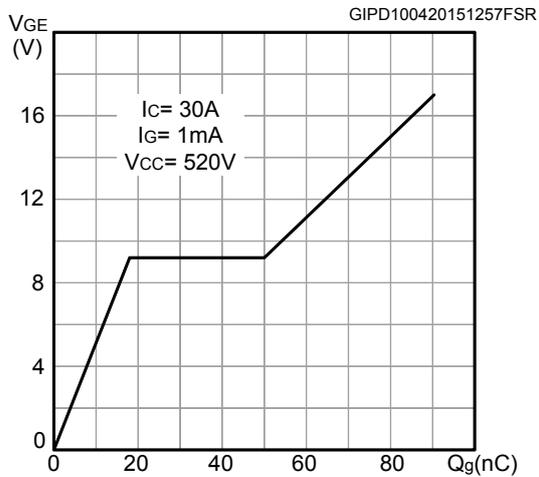
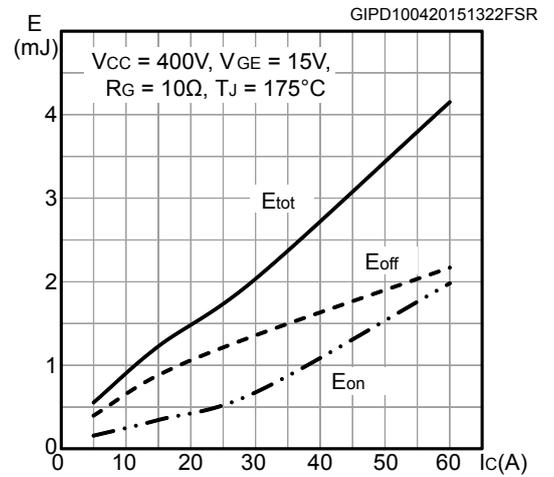
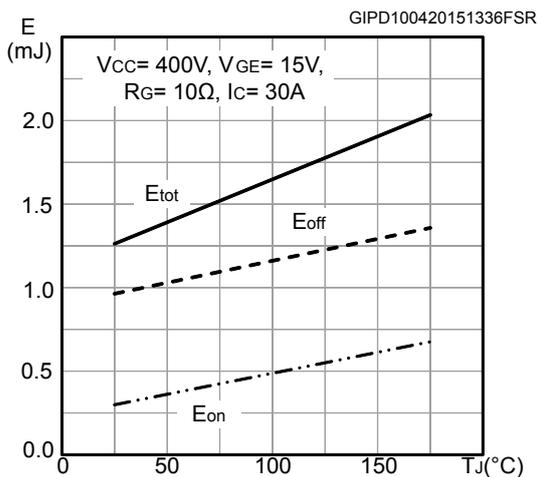
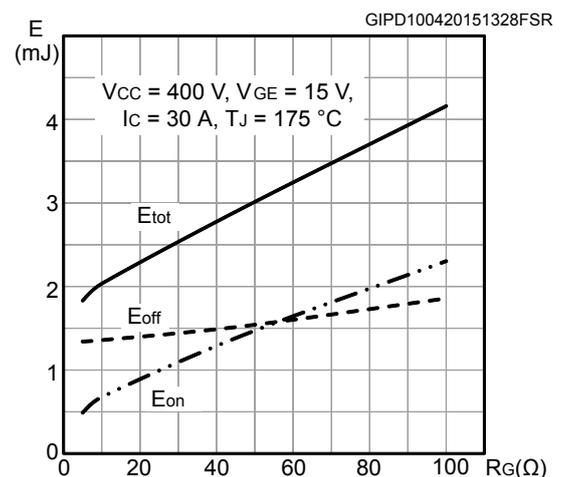
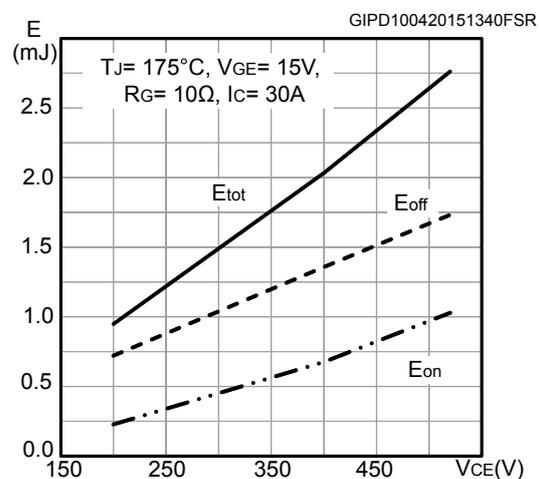
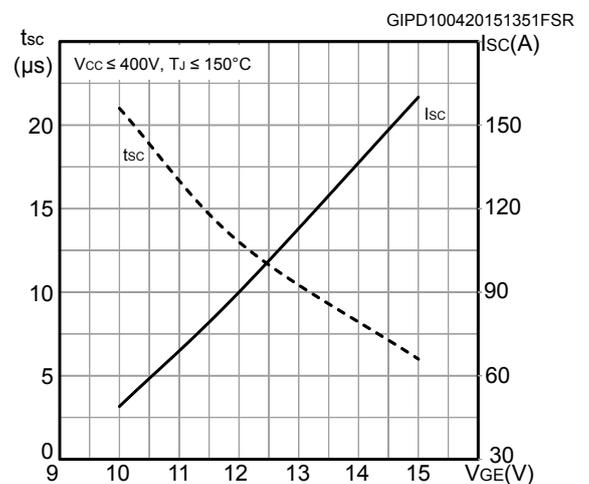
1. Including the reverse recovery of the diode.
2. Including the tail of the collector current.

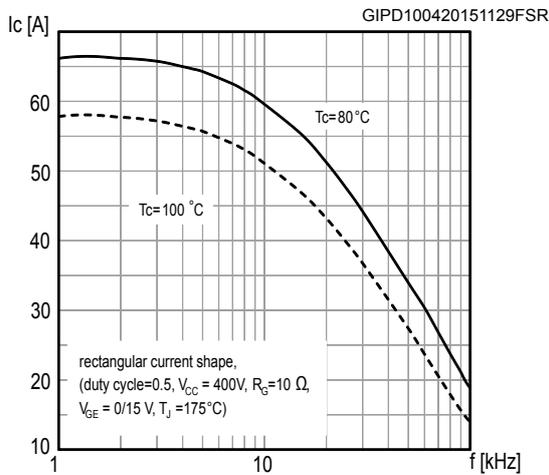
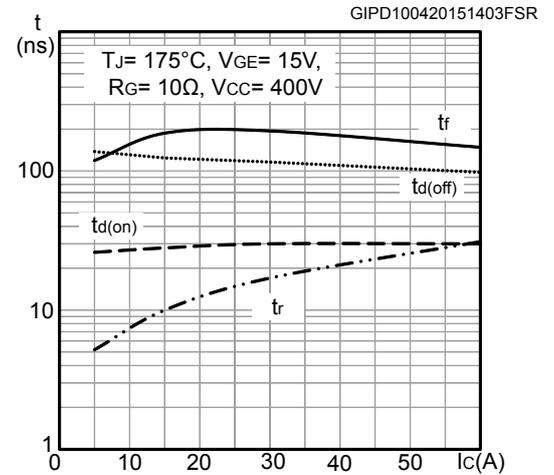
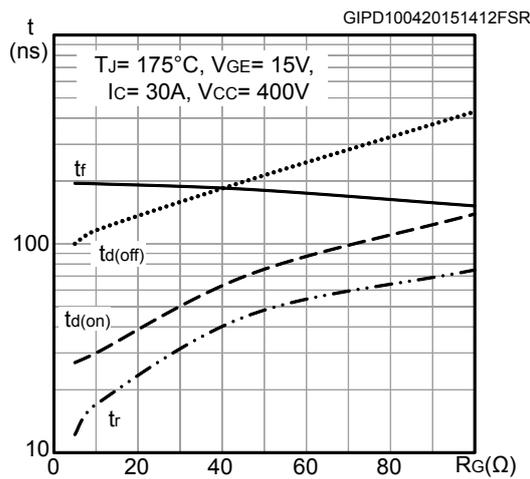
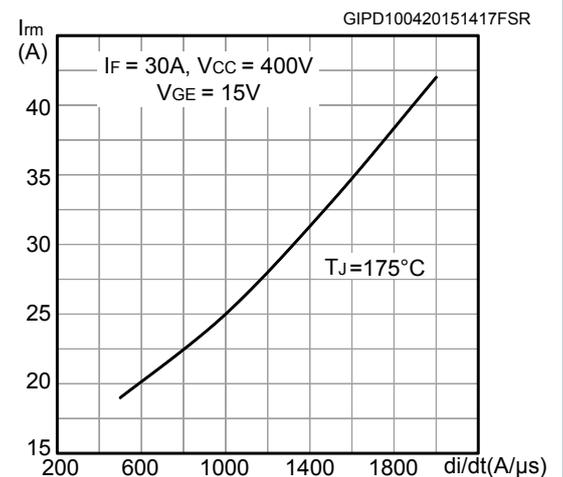
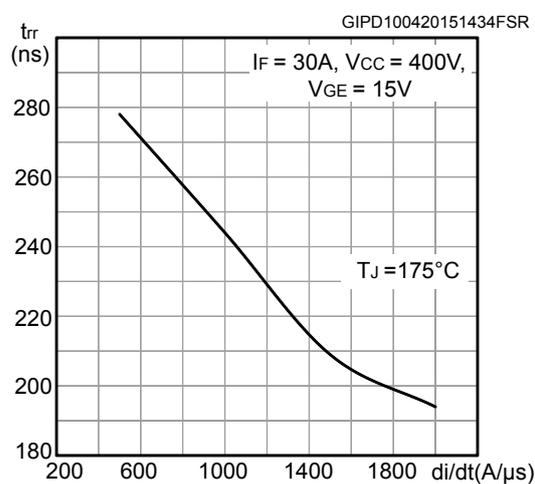
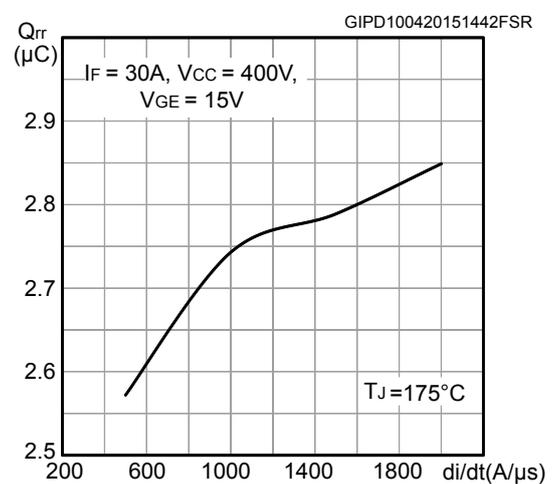
**Table 6. Diode switching characteristics (inductive load)**

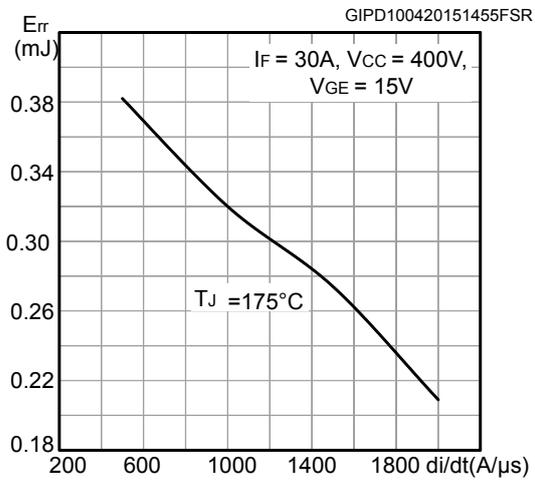
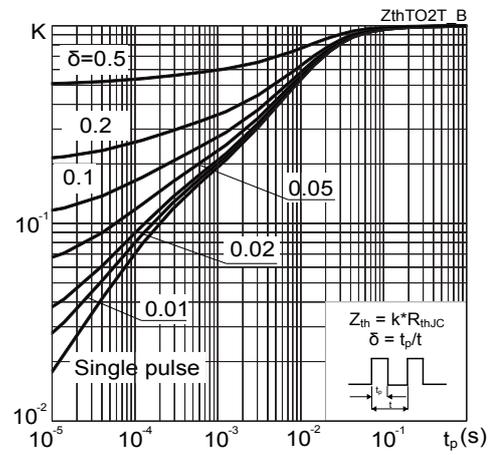
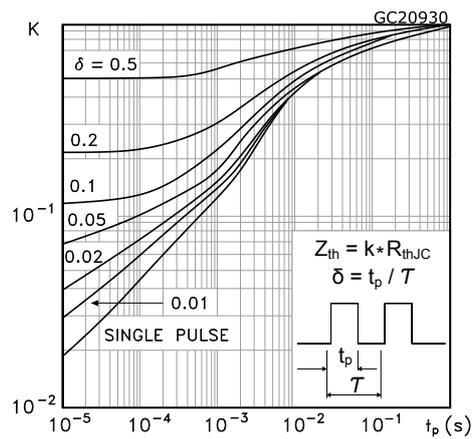
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit	
$t_{rr}$	Reverse recovery time	$I_F = 30\text{ A}$ , $V_R = 400\text{ V}$ , $V_{GE} = 15\text{ V}$ , $di/dt = 1000\text{ A}/\mu\text{s}$ (see Figure 28. Test circuit for inductive load switching)	-	140	-	ns	
$Q_{rr}$	Reverse recovery charge			-	880	-	nC
$I_{rrm}$	Reverse recovery current			-	17	-	A
$dI_{rr}/dt$	Peak rate of fall of reverse recovery current during $t_b$			-	650	-	A/ $\mu$ s
$E_{rr}$	Reverse recovery energy			-	115	-	$\mu$ J
$t_{rr}$	Reverse recovery time	$I_F = 30\text{ A}$ , $V_R = 400\text{ V}$ , $V_{GE} = 15\text{ V}$ , $di/dt = 1000\text{ A}/\mu\text{s}$ , $T_J = 175\text{ }^\circ\text{C}$ (see Figure 28. 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/ $\mu$ s
$E_{rr}$	Reverse recovery energy			-	320	-	$\mu$ J

**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 ( $T_J = 25^\circ\text{C}$ )**

**Figure 4. Typical output characteristics ( $T_J = 175^\circ\text{C}$ )**

**Figure 5. Typical transfer characteristics**

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


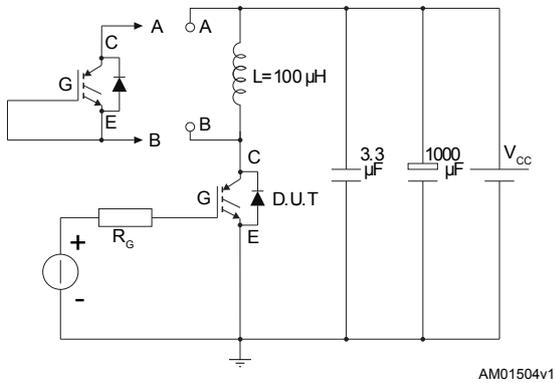
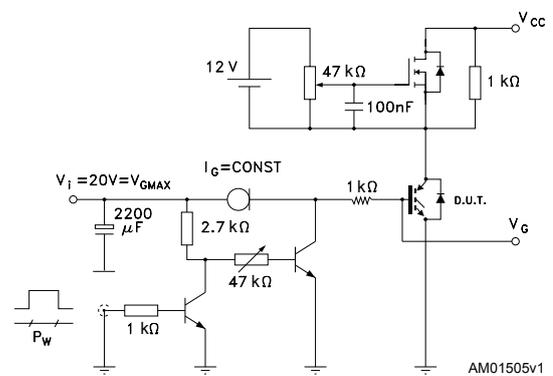
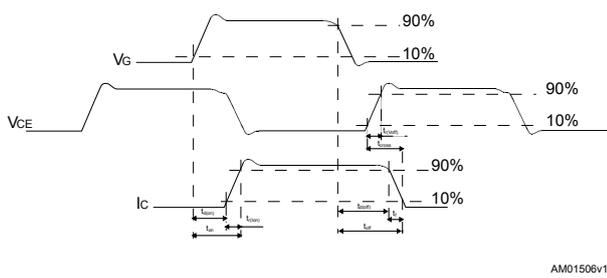
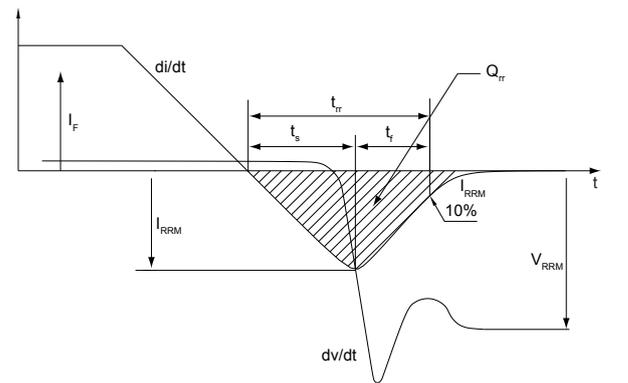
**Figure 7. Typical  $V_{CE(sat)}$  vs collector current**

**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

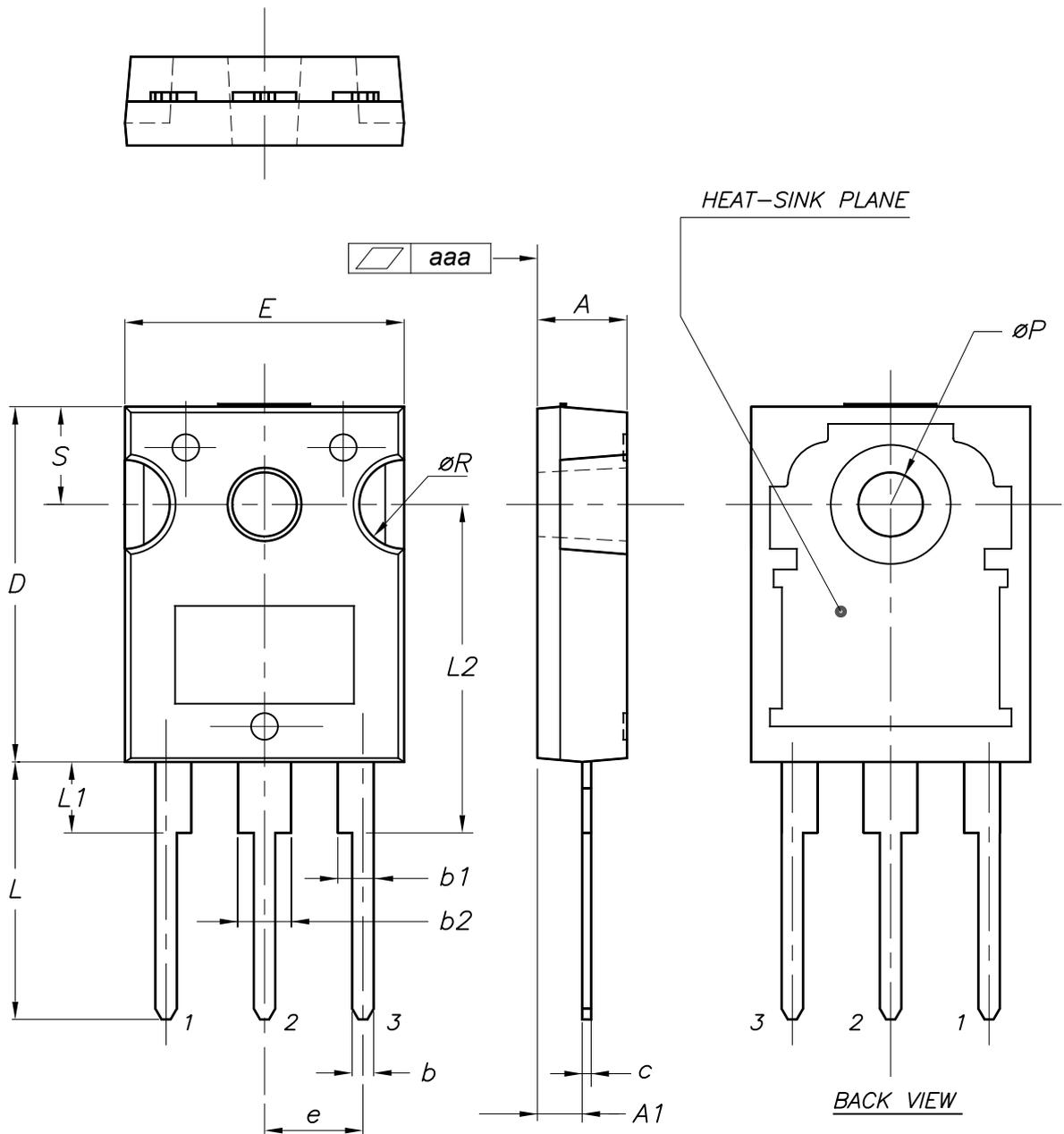
**Figure 28. Test circuit for inductive load switching**

**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](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 TO-247 package information

Figure 32. TO-247 package outline



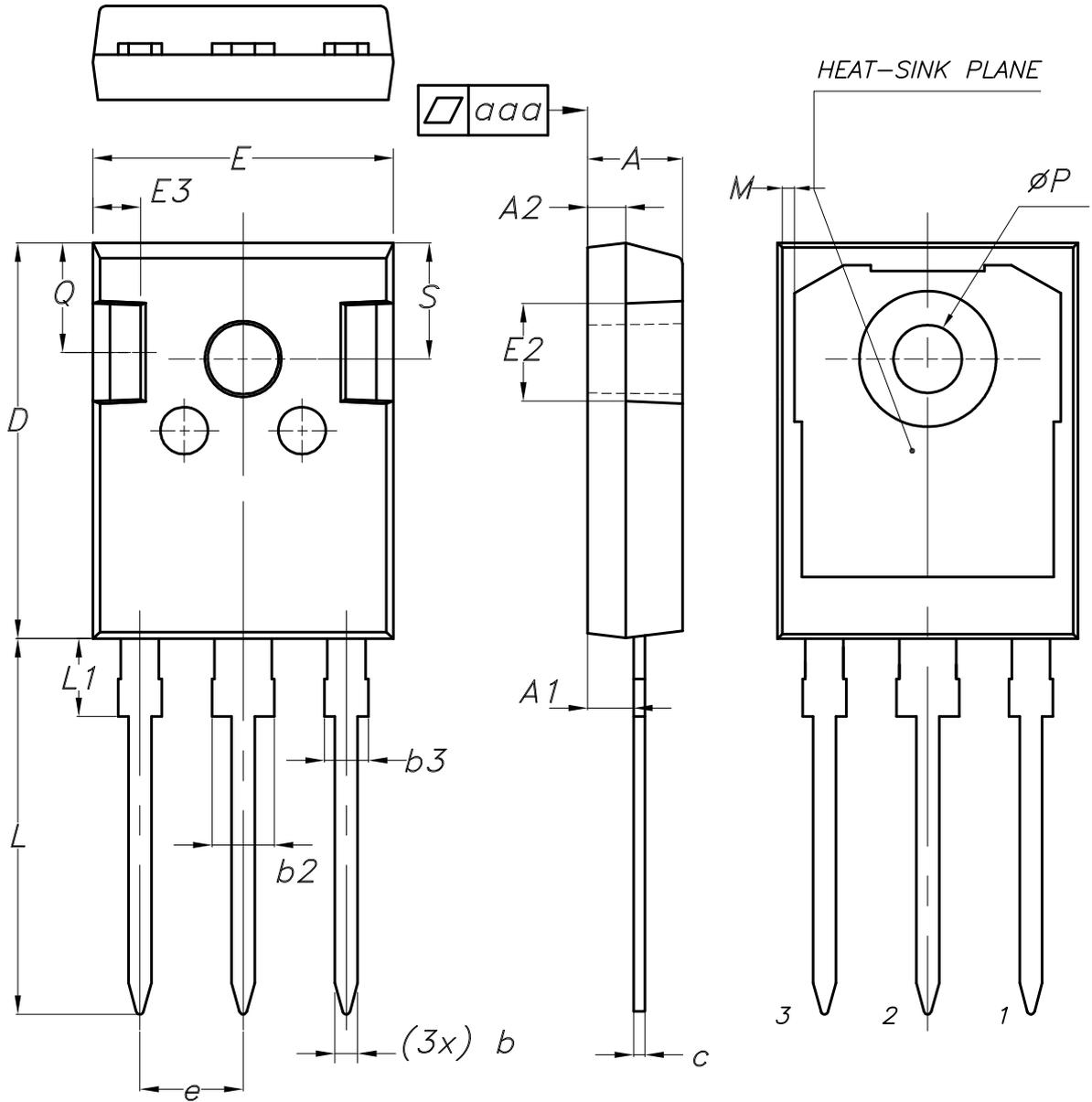
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**Table 7. TO-247 package mechanical data**

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



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