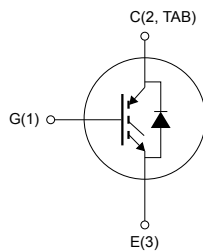


## Trench gate field-stop, 1200 V, 25 A, low-loss, M series IGBT in a TO-247 long leads package



TO-247 long leads



NG1E3C2T

### Features

- Maximum junction temperature:  $T_J = 175\text{ °C}$
- 10  $\mu\text{s}$  of short-circuit withstand time
- Low  $V_{CE(sat)} = 1.85\text{ V (typ.) @ } I_C = 25\text{ A}$
- Tight parameter distribution
- Positive  $V_{CE(sat)}$  temperature coefficient
- Low thermal resistance
- Soft- and fast-recovery antiparallel diode

### Applications

- Industrial drives
- UPS
- Solar
- Welding

### Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is 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 is essential. Furthermore, the positive  $V_{CE(sat)}$  temperature coefficient and the tight parameter distribution result in safer paralleling operation.

#### Product status link

[STGWA25M120DF3](#)

#### Product summary

<b>Order code</b>	STGWA25M120DF3
<b>Marking</b>	G25M120DF3
<b>Package</b>	TO-247 long leads
<b>Packing</b>	Tube

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ V)	1200	V
$I_C$	Continuous collector current at $T_C = 25$ °C	50	A
	Continuous collector current at $T_C = 100$ °C	25	A
$I_{CP}^{(1)}$	Pulsed collector current	100	A
$V_{GE}$	Gate-emitter voltage	±20	V
	Transient gate-emitter voltage	±30	V
$I_F$	Continuous forward current at $T_C = 25$ °C	50	A
	Continuous forward current at $T_C = 100$ °C	25	A
$I_{FP}^{(1)}$	Pulsed forward current	100	A
$P_{TOT}$	Total dissipation at $T_C = 25$ °C	375	W
$T_{STG}$	Storage temperature range	-55 to 150	°C
$T_J$	Operating junction temperature range	-55 to 175	°C

1. Pulse width is limited by maximum junction temperature.

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance junction-case IGBT	0.4	°C/W
	Thermal resistance junction-case diode	0.96	°C/W
$R_{thJA}$	Thermal resistance junction-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	$V_{GE} = 0\text{ V}, I_C = 2\text{ mA}$	1200			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 25\text{ A}$		1.85	2.3	V
		$V_{GE} = 15\text{ V}, I_C = 25\text{ A}, T_J = 125\text{ °C}$		2.1		
		$V_{GE} = 15\text{ V}, I_C = 25\text{ A}, T_J = 175\text{ °C}$		2.2		
$V_F$	Forward on-voltage	$I_F = 25\text{ A}$		2.95	4.1	V
		$I_F = 25\text{ A}, T_J = 125\text{ °C}$		2.95		
		$I_F = 25\text{ A}, T_J = 175\text{ °C}$		1.9		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$	5	6	7	V
$I_{CES}$	Collector cut-off current	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$			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	$V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0\text{ V}$	-	1550	-	pF
$C_{oes}$	Output capacitance		-	180	-	
$C_{res}$	Reverse transfer capacitance		-	65	-	
$Q_g$	Total gate charge	$V_{CC} = 960\text{ V}, I_C = 25\text{ A}, V_{GE} = 0\text{ to }15\text{ V}$ (see <a href="#">Figure 29. Gate charge test circuit</a> )	-	85	-	nC
$Q_{ge}$	Gate-emitter charge		-	11.5	-	
$Q_{gc}$	Gate-collector charge		-	45.5	-	

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit	
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 600\text{ V}$ , $I_C = 25\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 15\ \Omega$ (see Figure 28. Test circuit for inductive load switching)		28	-	ns	
$t_r$	Current rise time			15	-	ns	
$(di/dt)_{on}$	Turn-on current slope			1370	-	A/ $\mu$ s	
$t_{d(off)}$	Turn-off delay time			150	-	ns	
$t_f$	Current fall time			155	-	ns	
$E_{on}^{(1)}$	Turn-on switching energy			0.85	-	mJ	
$E_{off}^{(2)}$	Turn-off switching energy			1.3	-	mJ	
$E_{ts}$	Total switching energy			2.15	-	mJ	
$t_{d(on)}$	Turn-on delay time		$V_{CE} = 600\text{ V}$ , $I_C = 25\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 15\ \Omega$ , $T_J = 175\text{ }^\circ\text{C}$ (see Figure 28. Test circuit for inductive load switching)		28	-	ns
$t_r$	Current rise time				17	-	ns
$(di/dt)_{on}$	Turn-on current slope			1270	-	A/ $\mu$ s	
$t_{d(off)}$	Turn-off delay time			155	-	ns	
$t_f$	Current fall time			240	-	ns	
$E_{on}^{(1)}$	Turn-on switching energy			1.6	-	mJ	
$E_{off}^{(2)}$	Turn-off switching energy			1.9	-	mJ	
$E_{ts}$	Total switching energy			3.5	-	mJ	
$t_{sc}$	Short-circuit withstand time	$V_{CC} \leq 600\text{ V}$ , $V_{GE} = 15\text{ V}$ , $T_{Jstart} \leq 150\text{ }^\circ\text{C}$	10		-	$\mu$ s	

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	$I_F = 25\text{ A}$ , $V_R = 600\text{ V}$ , $V_{GE} = 15\text{ V}$ , $di/dt = 1000\text{ A}/\mu\text{s}$ (see Figure 28. Test circuit for inductive load switching)	-	265	-	ns	
$Q_{rr}$	Reverse recovery charge			-	1.2	-	$\mu$ C
$I_{rrm}$	Reverse recovery current			-	19	-	A
$dl_{rr}/dt$	Peak rate of fall of reverse recovery current during $t_b$			-	1090	-	A/ $\mu$ s
$E_{rr}$	Reverse recovery energy			-	0.22	-	$\mu$ J
$t_{rr}$	Reverse recovery time		$I_F = 25\text{ A}$ , $V_R = 600\text{ V}$ , $V_{GE} = 15\text{ V}$ , $T_J = 175\text{ }^\circ\text{C}$ , $di/dt = 1000\text{ A}/\mu\text{s}$ (see Figure 28. Test circuit for inductive load switching)	-	585	-	ns
$Q_{rr}$	Reverse recovery charge			-	5	-	$\mu$ C
$I_{rrm}$	Reverse recovery current			-	30	-	A
$dl_{rr}/dt$	Peak rate of fall of reverse recovery current during $t_b$			-	270	-	A/ $\mu$ s
$E_{rr}$	Reverse recovery energy			-	0.75	-	$\mu$ J

## 2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature

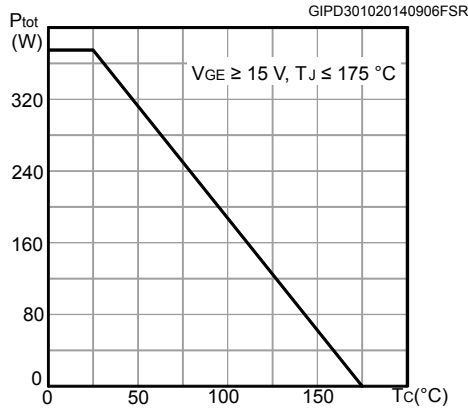


Figure 2. Collector current vs case temperature

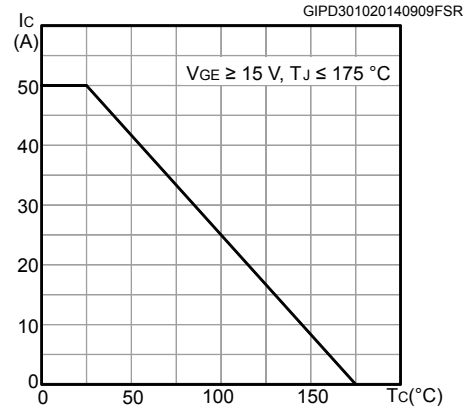


Figure 3. Output characteristics ( $T_J = 25\text{ °C}$ )

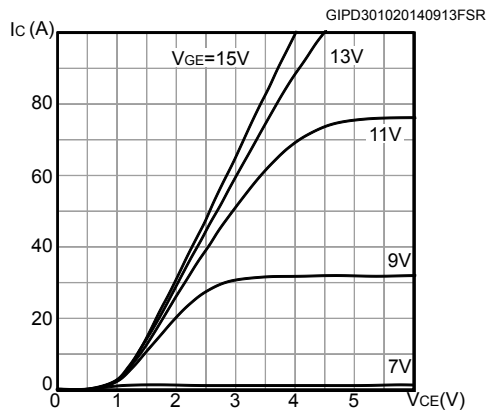


Figure 4. Output characteristics ( $T_J = 175\text{ °C}$ )

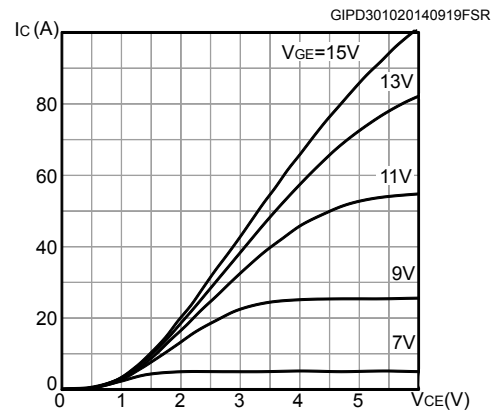


Figure 5.  $V_{CE(sat)}$  vs junction temperature

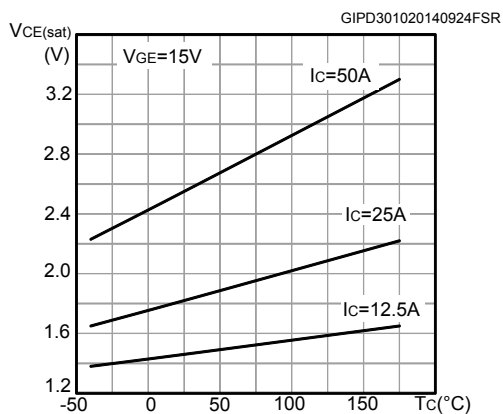
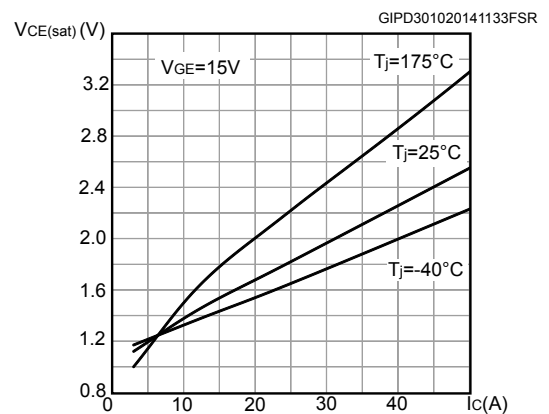
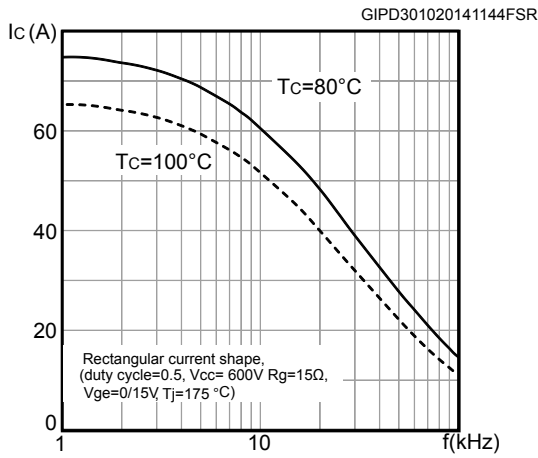


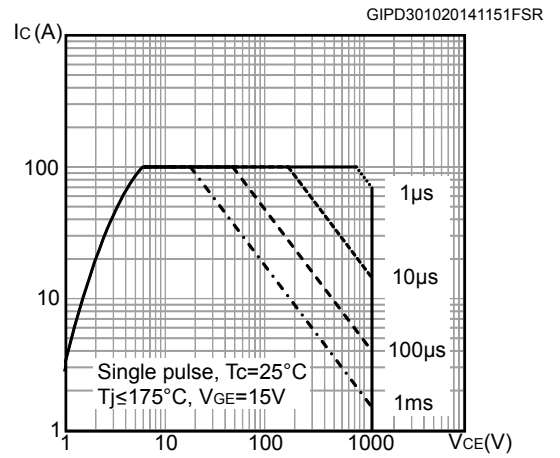
Figure 6.  $V_{CE(sat)}$  vs collector current



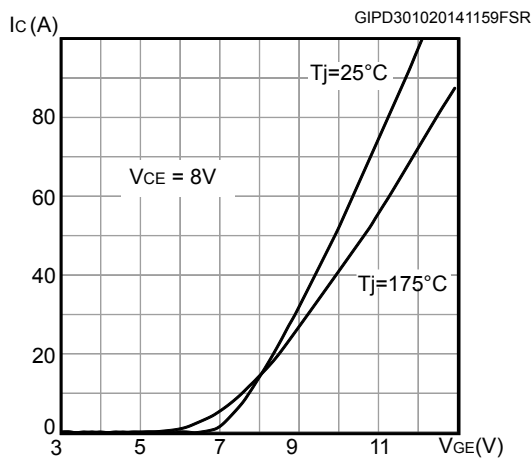
**Figure 7. Collector current vs switching frequency**



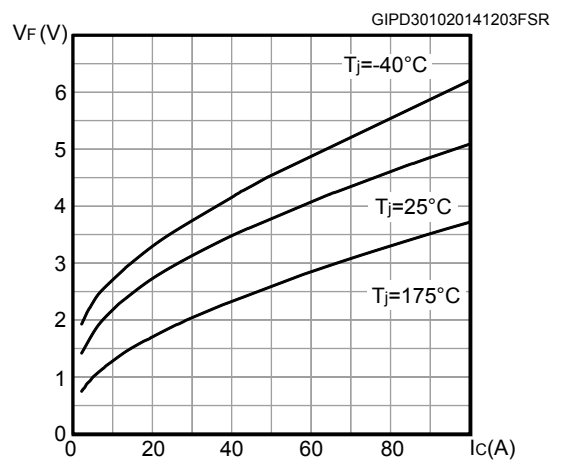
**Figure 8. Safe operating area**



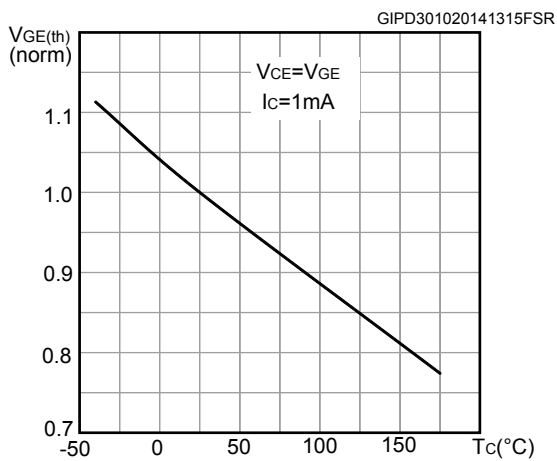
**Figure 9. Transfer characteristics**



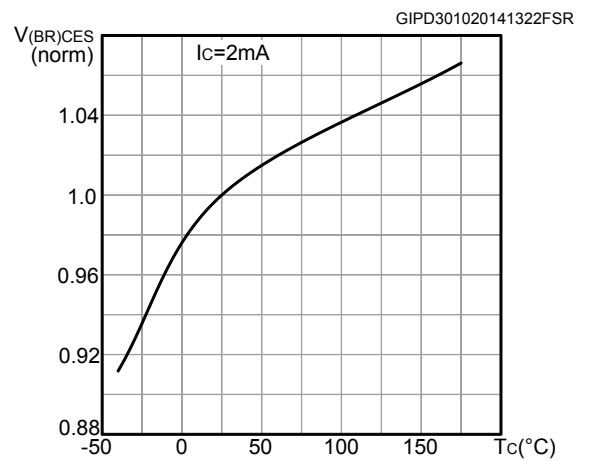
**Figure 10. Diode Vf vs forward current**



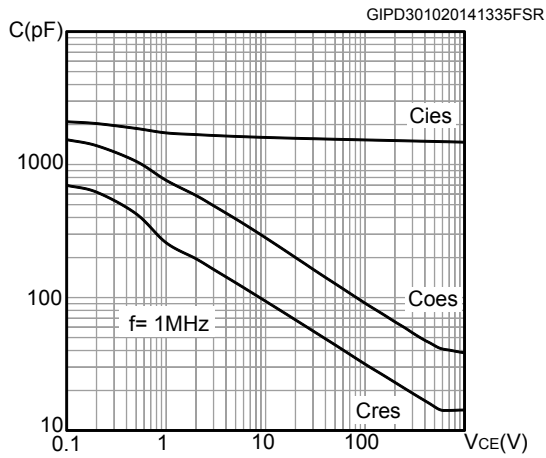
**Figure 11. Normalized Vge(th) vs junction temperature**



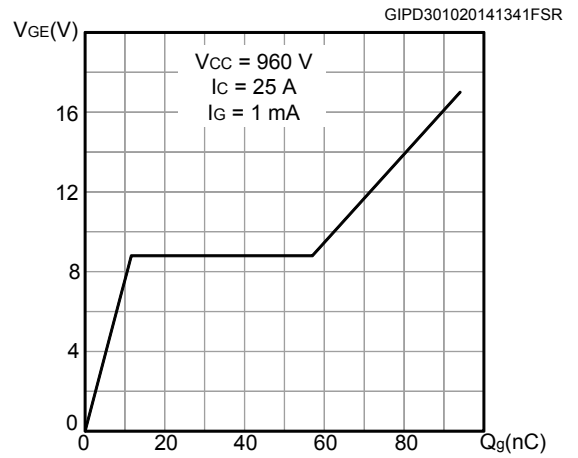
**Figure 12. Normalized V(BR)CES vs junction temperature**



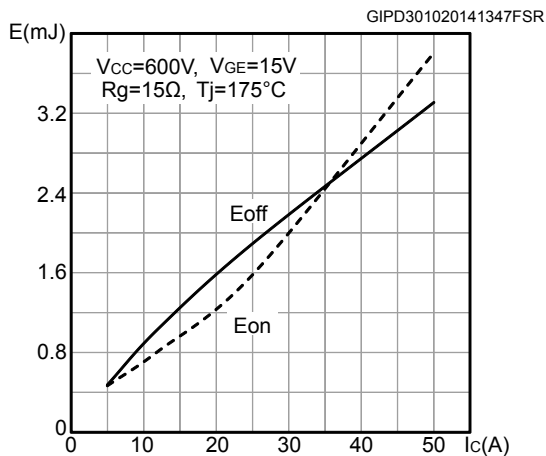
**Figure 13. Capacitance variations**



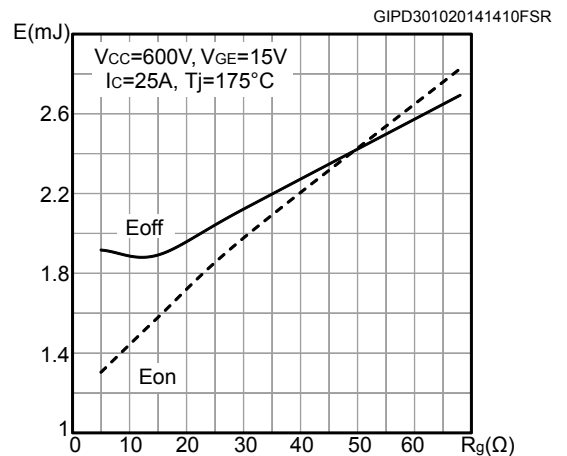
**Figure 14. Gate charge vs gate-emitter voltage**



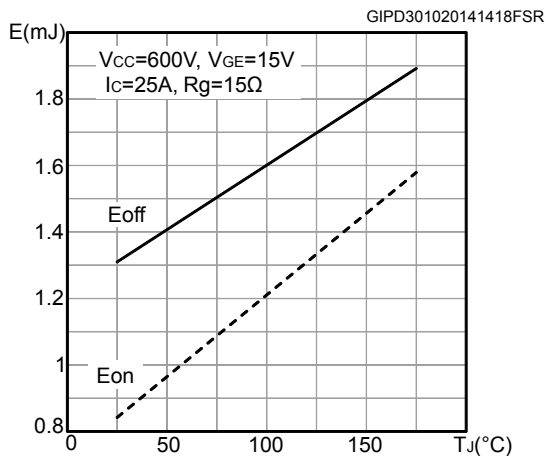
**Figure 15. Switching energy vs collector current**



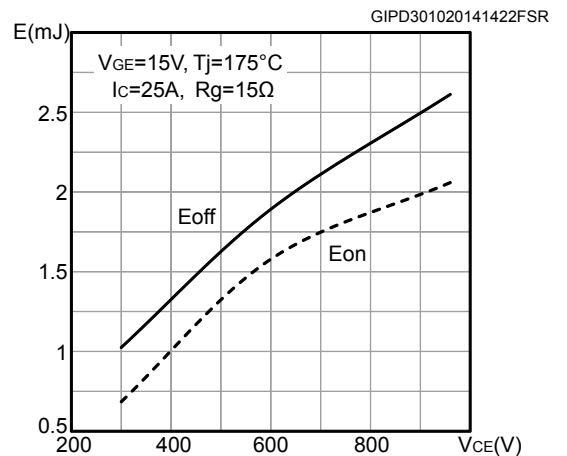
**Figure 16. Switching energy vs gate resistance**



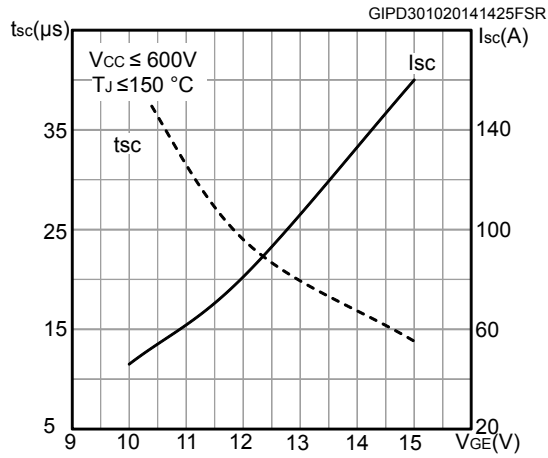
**Figure 17. Switching energy vs junction temperature**



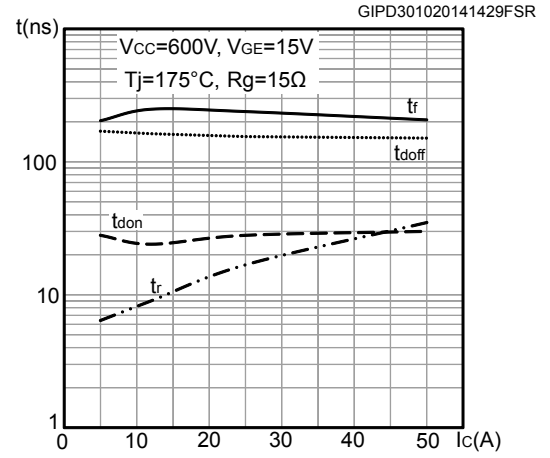
**Figure 18. Switching energy vs collector emitter voltage**



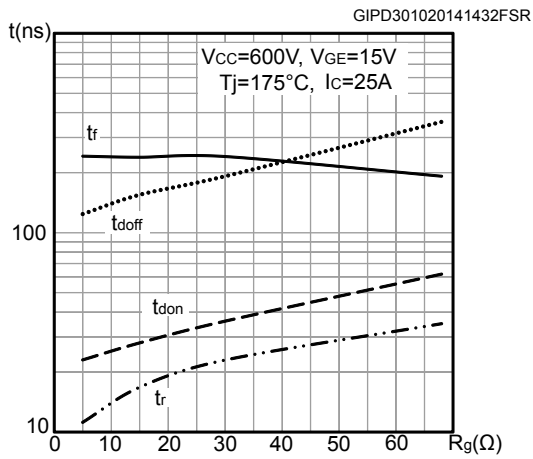
**Figure 19. Short-circuit time and current vs  $V_{GE}$**



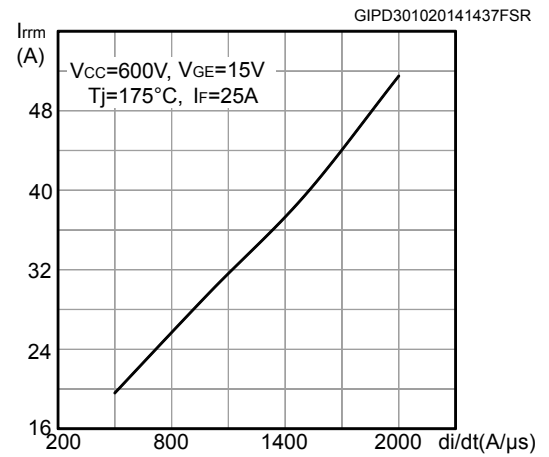
**Figure 20. Switching times vs collector current**



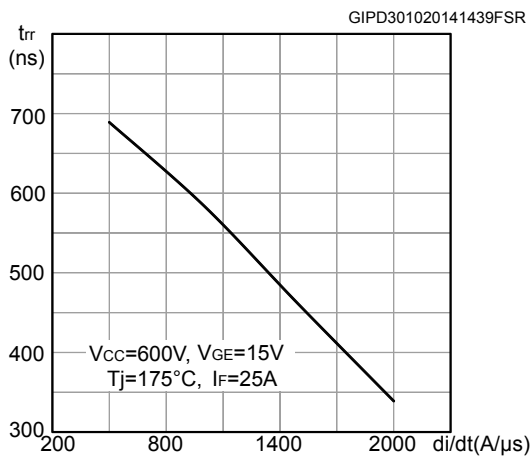
**Figure 21. Switching times vs gate resistance**



**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**

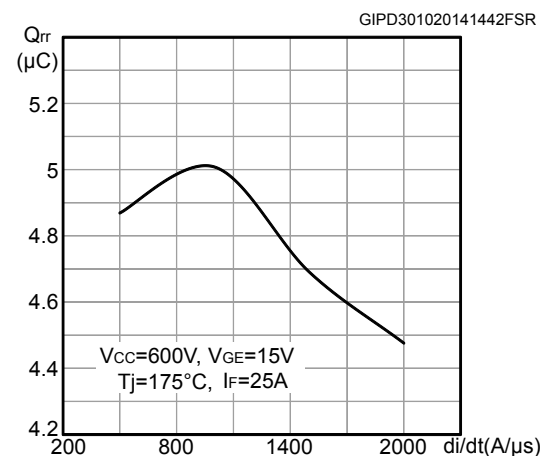




Figure 25. Reverse recovery energy vs diode current slope

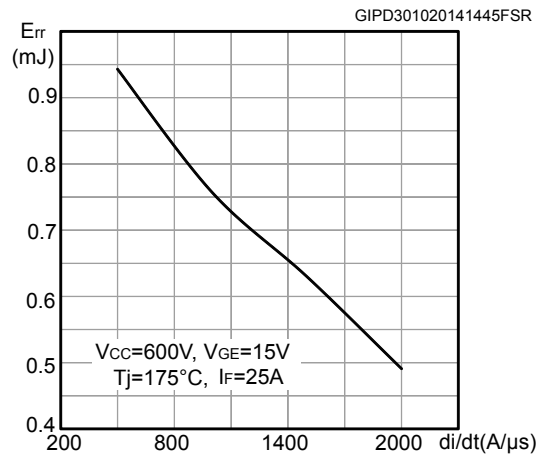


Figure 26. Thermal impedance for IGBT

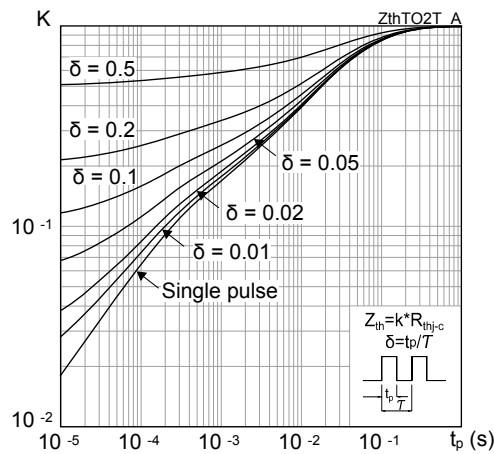
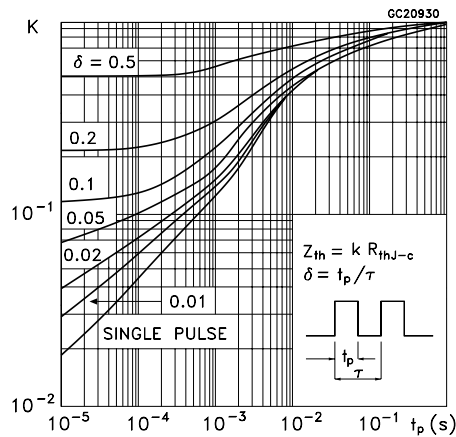
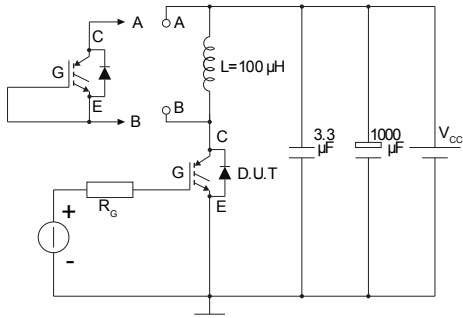


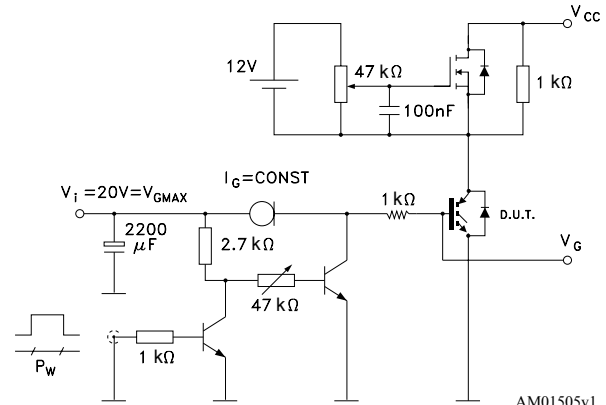
Figure 27. Thermal impedance for diode



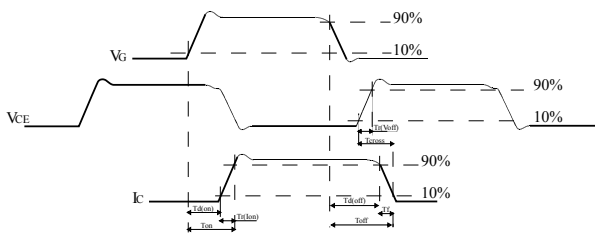
### 3 Test circuits

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


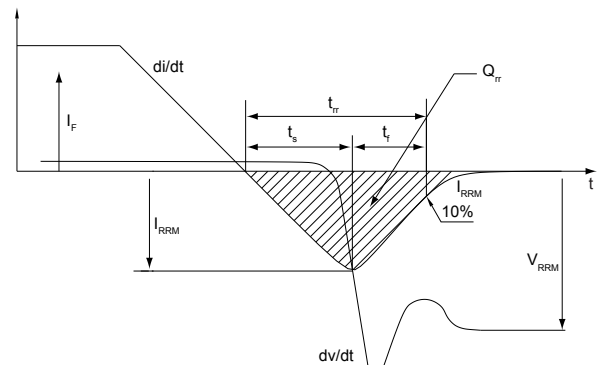
AM01504v1

**Figure 29. Gate charge test circuit**


AM01505v1

**Figure 30. Switching waveform**


AM01506v1

**Figure 31. Diode reverse recovery waveform**


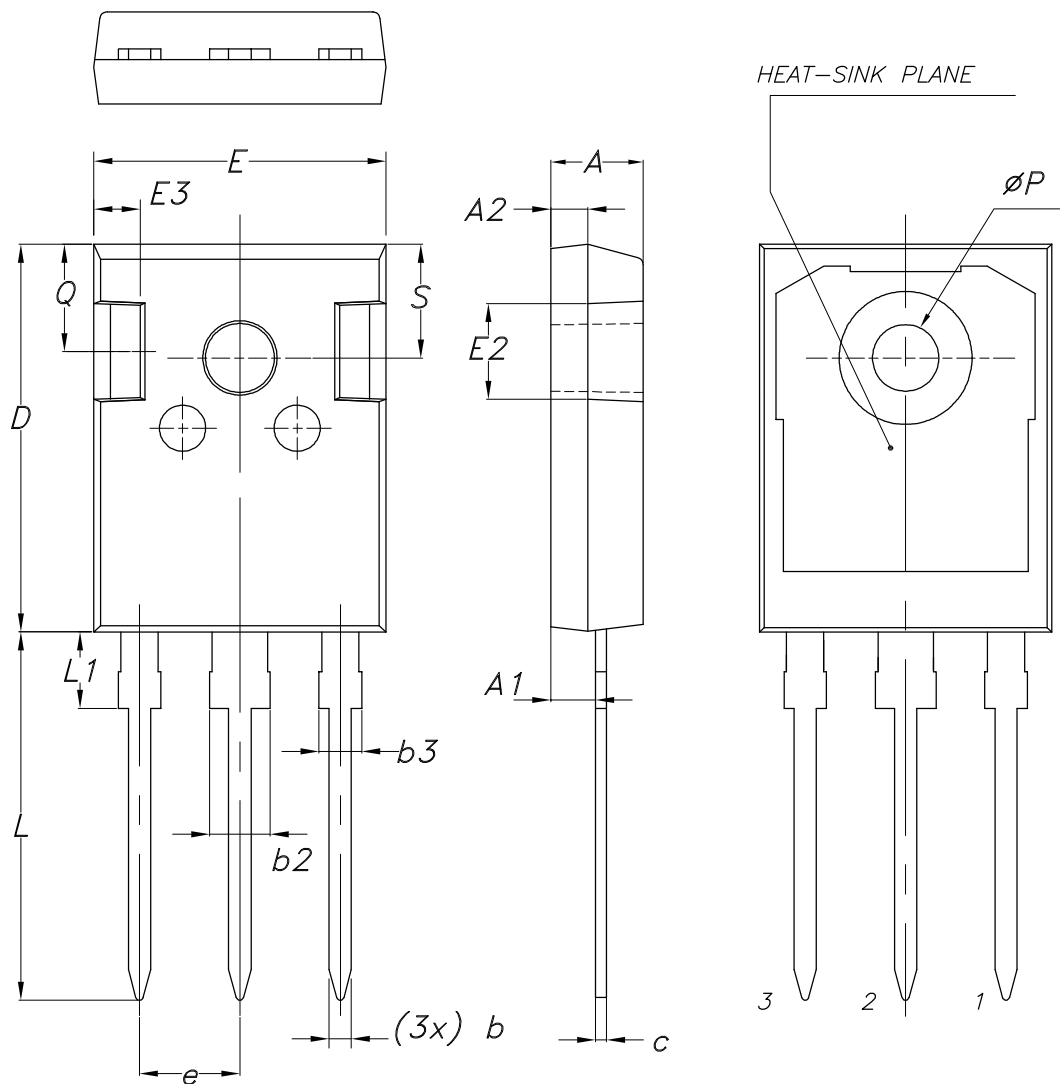
GADG180720171418SA

## 4 Package information

In order 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 long leads package information

Figure 32. TO-247 long leads package outline



8463846\_2\_F

**Table 7. 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
P	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25

## Revision history

**Table 8. Document revision history**

Date	Version	Changes
20-Jun-2018	1	Initial release. This part number was previously included in datasheet DS10300.

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[IHW20N65R5XKSA1](#) [IDW40E65D2FKSA1](#)