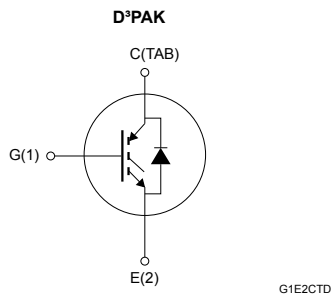
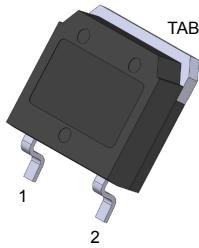


Trench gate field-stop 1200 V, 25 A low-loss M series IGBT in a D<sup>3</sup>PAK package


### Features

- 10  $\mu$ s of short-circuit withstand time
- $V_{CE(sat)} = 1.85$  V (typ.) @  $I_C = 25$  A
- Tight parameters distribution
- Safer paralleling
- Low thermal resistance
- Soft and very 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 low-loss and short-circuit functionality are essential. Furthermore, the positive  $V_{CE(sat)}$  temperature coefficient and tight parameter distribution result in safer paralleling operation.

#### Product status

STGA25M120DF3

#### Product summary

<b>Order code</b>	STGA25M120DF3
<b>Marking</b>	G25M120DF3
<b>Package</b>	D <sup>3</sup> PAK
<b>Packing</b>	Tape and reel

# 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
$I_C$	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
$I_F$	Continuous forward current at $T_C = 25$ °C	50	A
$I_F$	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 limited by maximum junction temperature.

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance junction-case IGBT	0.4	°C/W
$R_{thJC}$	Thermal resistance junction-case diode	0.96	°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	$V_{GE} = 0\text{ V}, I_C = 2\text{ mA}$	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		
		$V_{GE} = 15\text{ V}, I_C = 50\text{ A}, T_J = 175\text{ °C}$		2.2		
$V_F$	Forward on-voltage	$I_F = 25\text{ A}$		2.95	4.1	V
		$I_F = 25\text{ A}, T_J = 125\text{ °C}$		2.25		
		$I_F = 25\text{ A}, T_J = 175\text{ °C}$		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	$V_{CE} = 0\text{ V}, V_{GE} = \pm 20\text{ V}$			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 Figure 29. Gate charge test circuit)	-	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	$V_{CE} = 600\text{ V}, I_C = 25\text{ A}, V_{GE} = 15\text{ V}, R_G = 15\text{ }\Omega$ (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/ $\mu\text{s}$
$t_{d(off)}$	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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit	
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 600\text{ V}$ , $I_C = 25\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 15\ \Omega$ , $T_J = 175\text{ }^\circ\text{C}$ (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/ $\mu\text{s}$
$t_{d(off)}$	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		-	$\mu\text{s}$	

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

## 2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs. case temperature

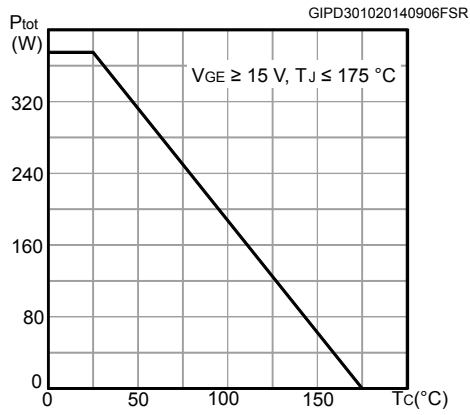


Figure 2. Collector current vs. case temperature

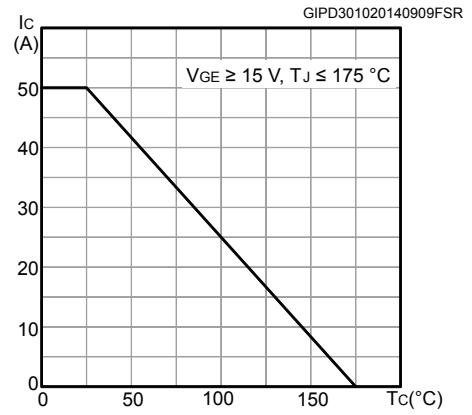


Figure 3. Output characteristics ( $T_J = 25\text{ °C}$ )

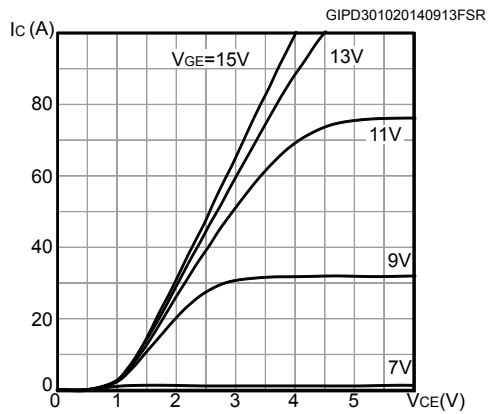


Figure 4. Output characteristics ( $T_J = 175\text{ °C}$ )

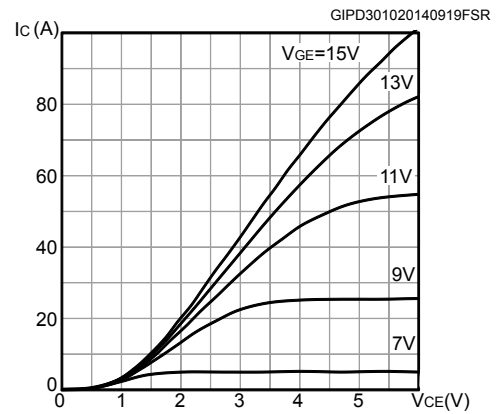


Figure 5.  $V_{CE(sat)}$  vs. junction temperature

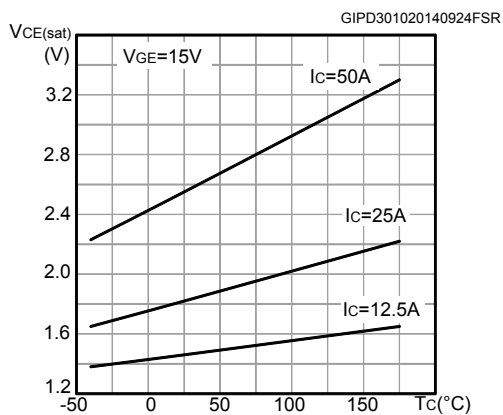
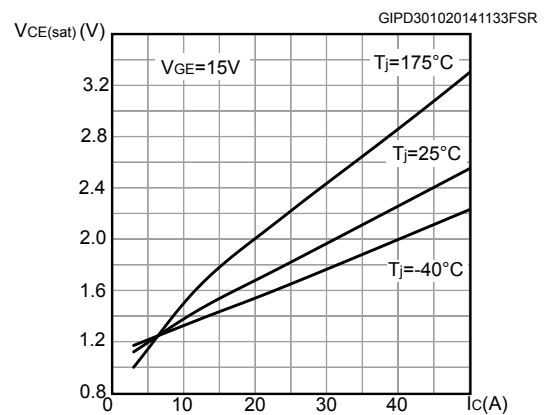
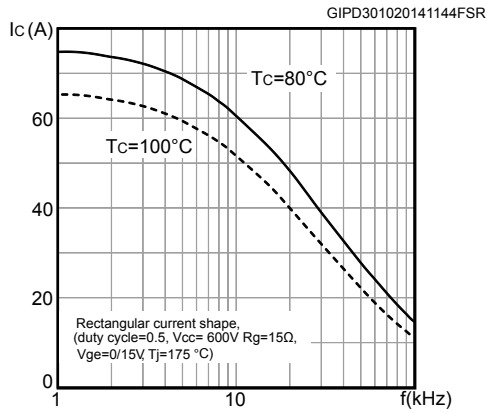


Figure 6.  $V_{CE(sat)}$  vs. collector current

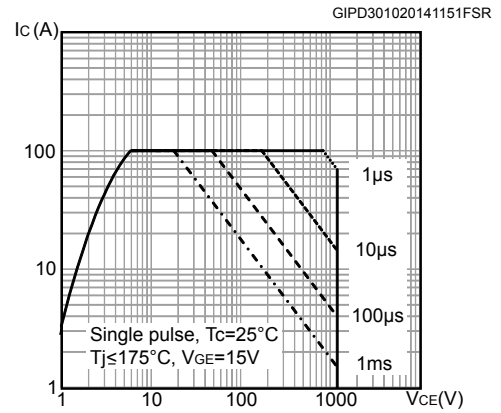


Prerelease product(s)

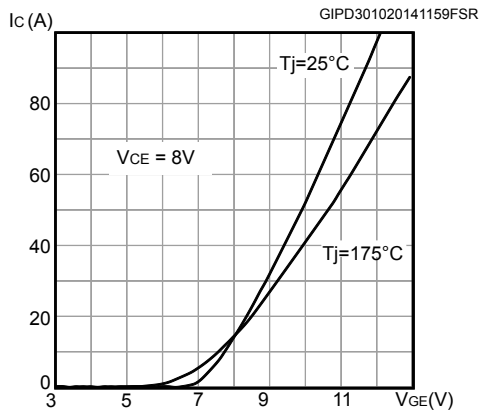
**Figure 7. Collector current vs. switching frequency**



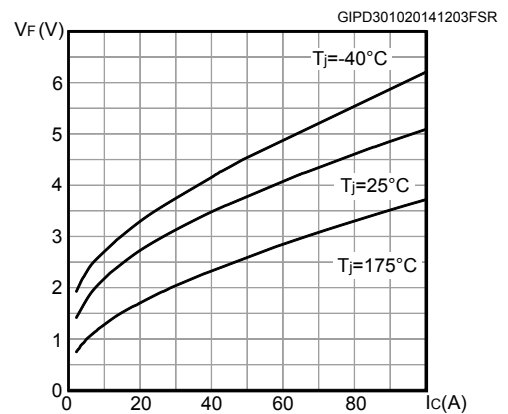
**Figure 8. Forward bias safe operating area**



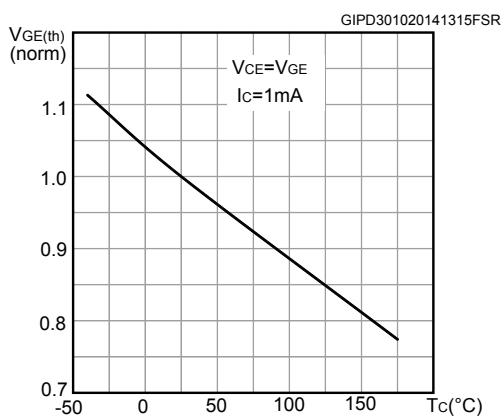
**Figure 9. Transfer characteristics**



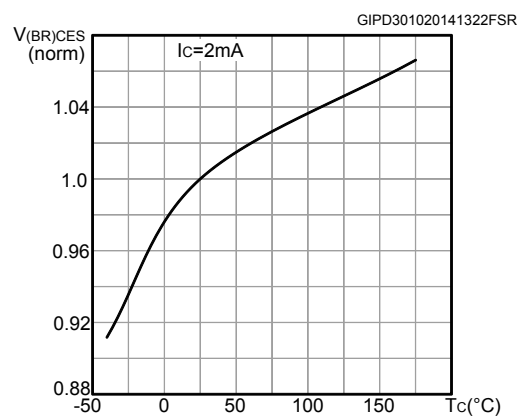
**Figure 10. Diode  $V_f$  vs. forward current**



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

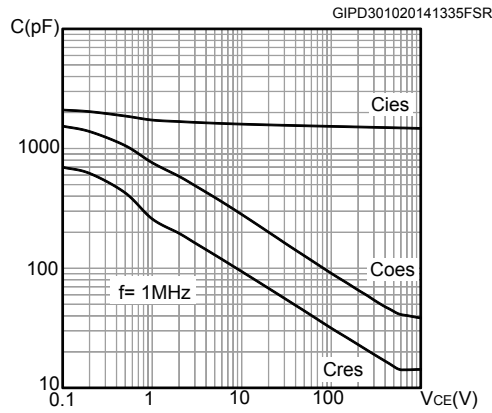


**Figure 12. Normalized  $V_{(BR)CES}$  vs. junction temperature**

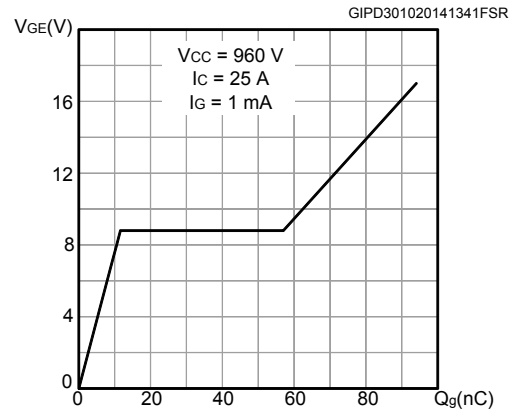


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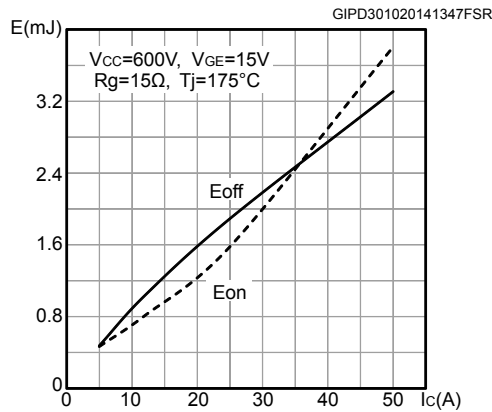
**Figure 13. Capacitance variations**



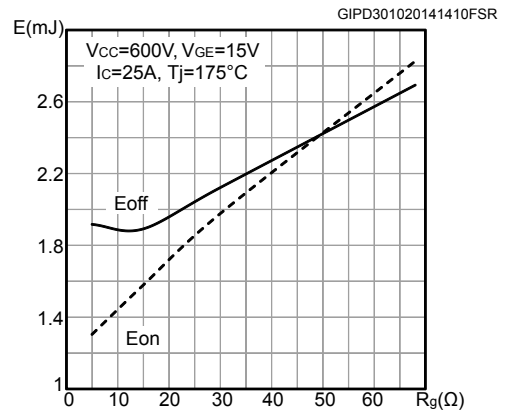
**Figure 14. Gate charge vs. gate-emitter voltage**



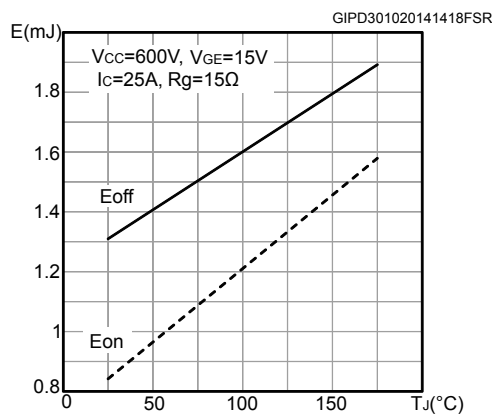
**Figure 15. Switching energy vs. collector current**



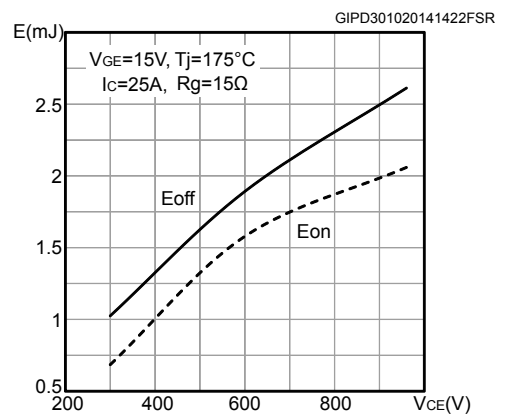
**Figure 16. Switching energy vs. gate resistance**



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



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



Prerelease product(s)

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

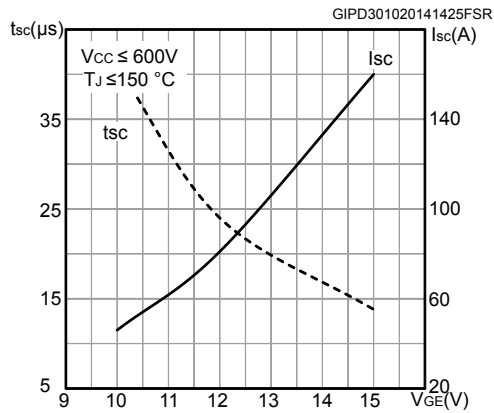


Figure 20. Switching times vs. collector current

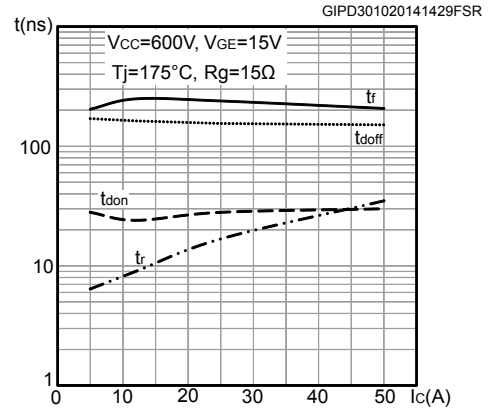


Figure 21. Switching times vs. gate resistance

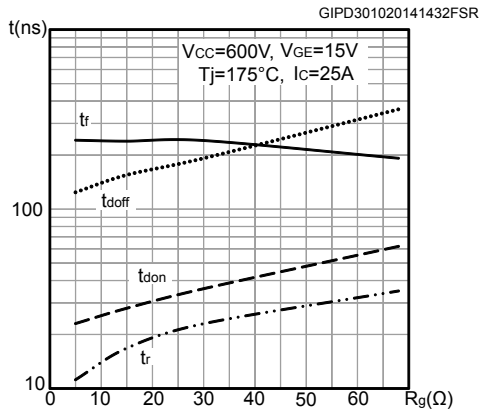


Figure 22. Reverse recovery current vs. diode current slope

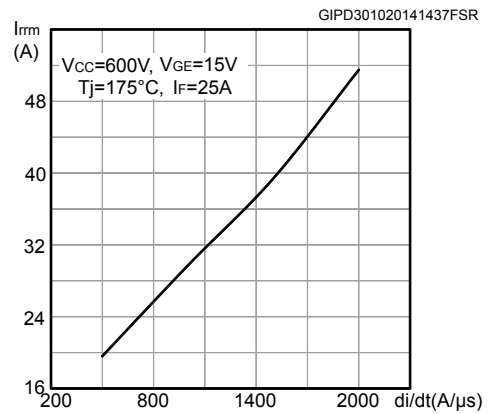


Figure 23. Reverse recovery time vs. diode current slope

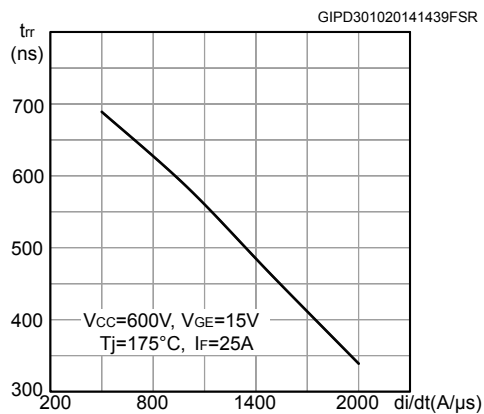
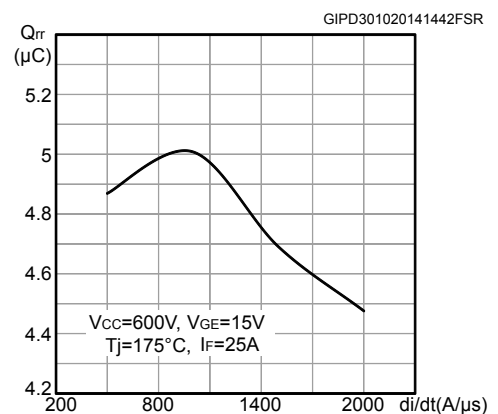


Figure 24. Reverse recovery charge vs. diode current slope



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Figure 25. Reverse recovery energy vs. diode current slope

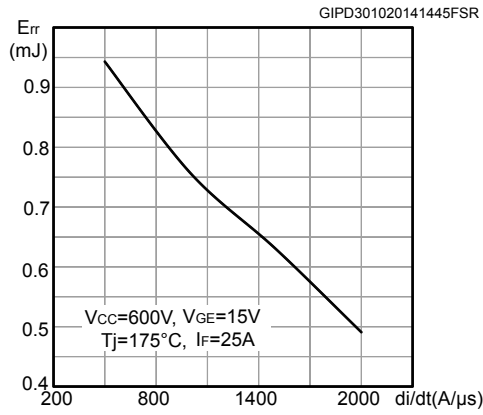
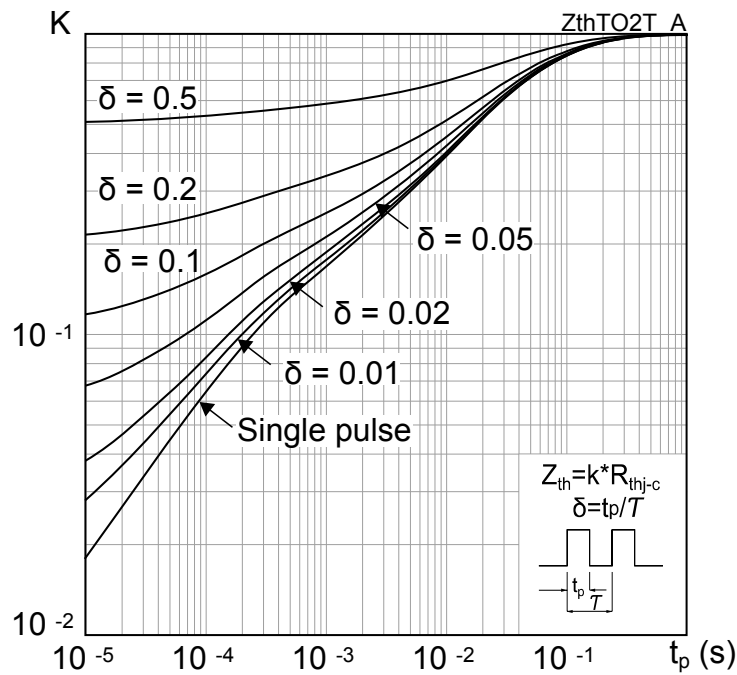
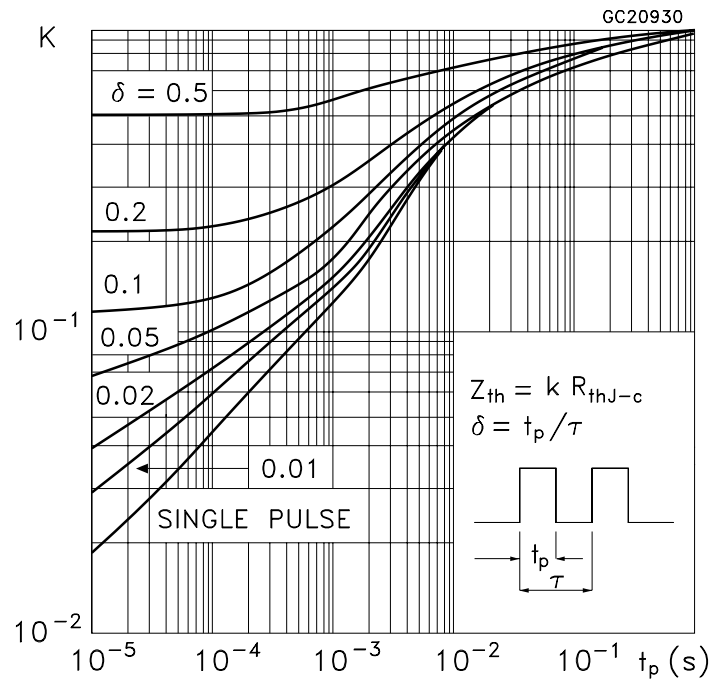


Figure 26. Thermal impedance for IGBT



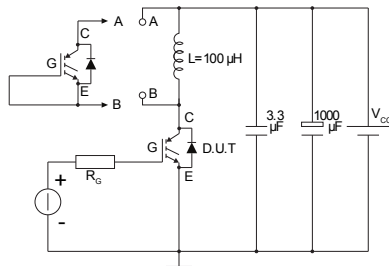
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Figure 27. Thermal impedance for diode

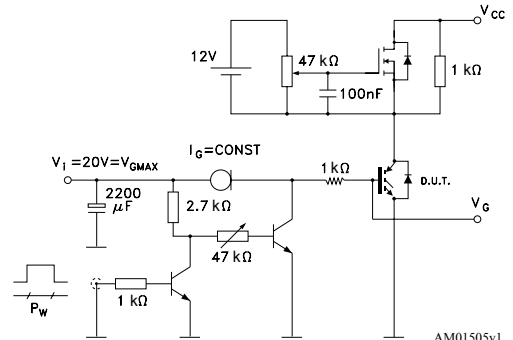


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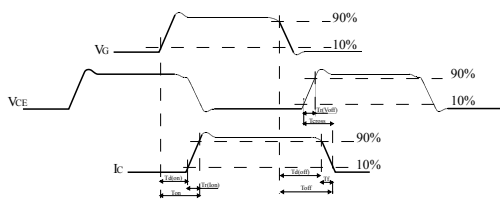
### 3 Test circuits

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


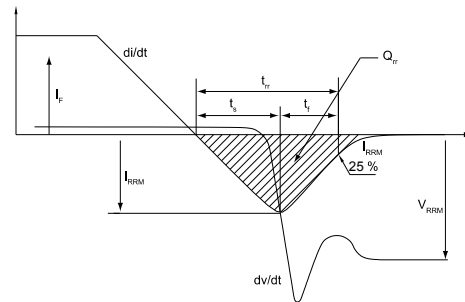
AM01504v1

**Figure 29. Gate charge test circuit**


AM01505v1

**Figure 30. Switching waveform**


AM01506v1

**Figure 31. Diode reverse recovery waveform**


AM01507v1

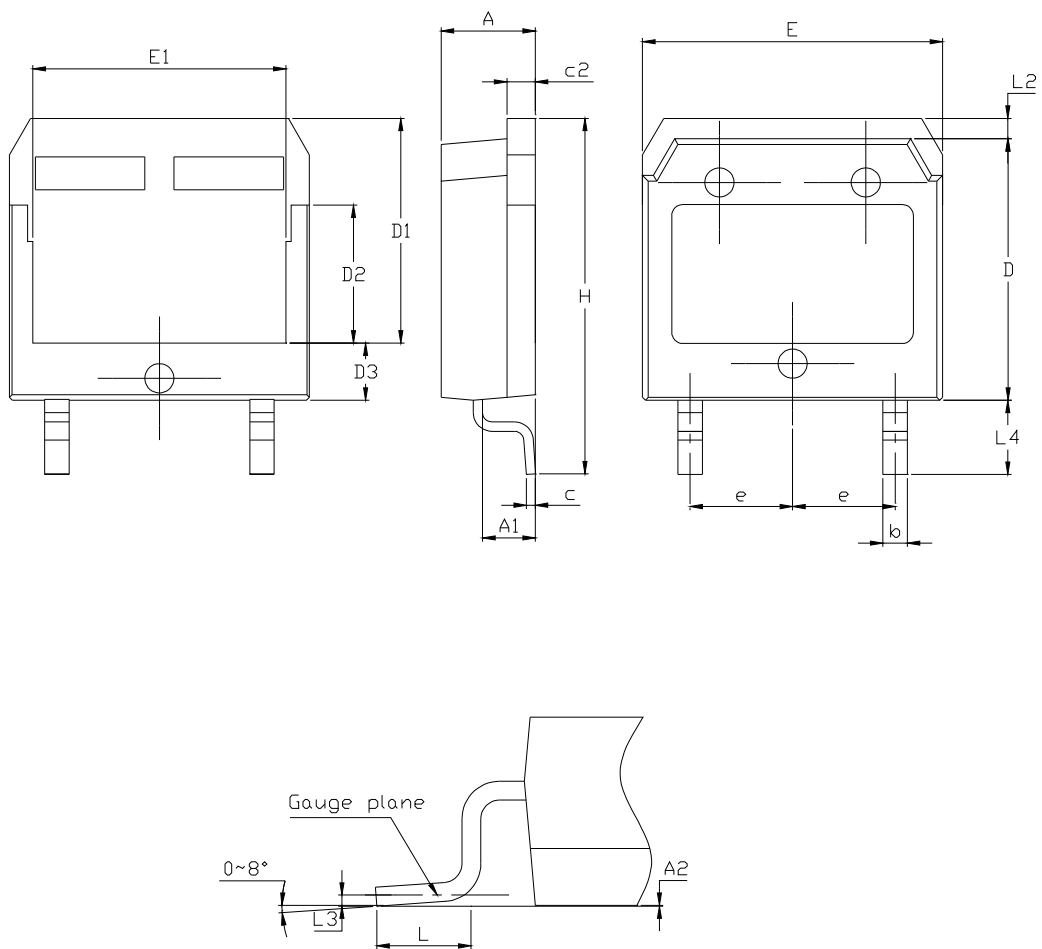
Prerelease product(s)

## 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 D<sup>3</sup>PAK (TO-268) package information

Figure 32. D<sup>3</sup>PAK (TO-268) package outline



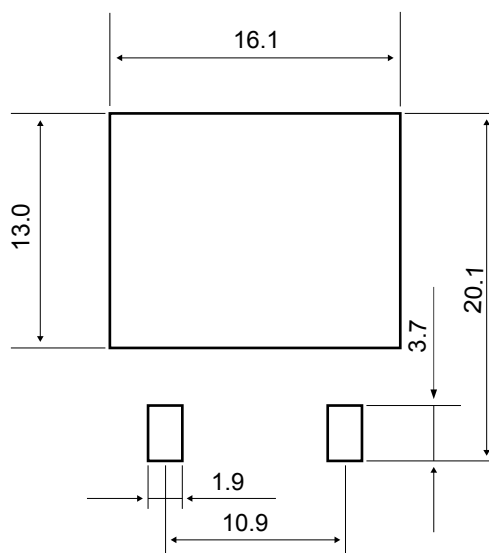
8506701\_1

Table 7. D<sup>3</sup>PAK (TO-268) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.90		5.10
A1	2.70		2.90
A2	0.02		0.25
b	1.15		1.45

Dim.	mm		
	Min.	Typ.	Max.
C	0.40		0.65
C2	1.45		1.61
D	13.80		14.00
D1	11.80		12.10
D2	7.50		7.80
D3	2.90		3.20
E	15.85		16.05
E1	13.30		13.60
e		5.45	
H	18.70		19.10
L	1.70		2.00
L2	1.00		1.15
L3		0.25	
L4	3.80		4.10

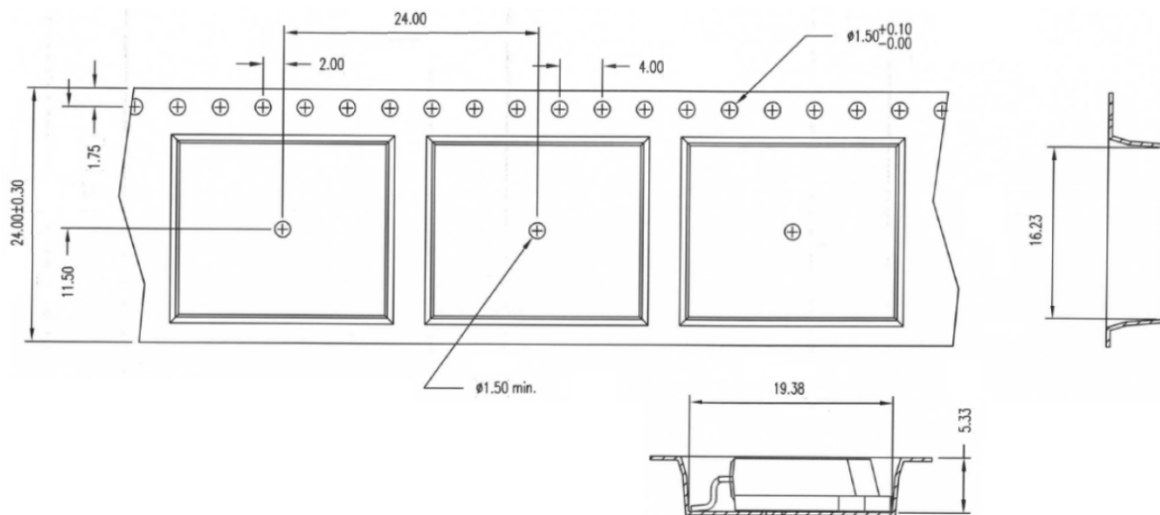
**Figure 33. D<sup>3</sup>PAK (TO-268) recommended footprint (dimensions are in mm)**



D3PAK\_8506701\_1

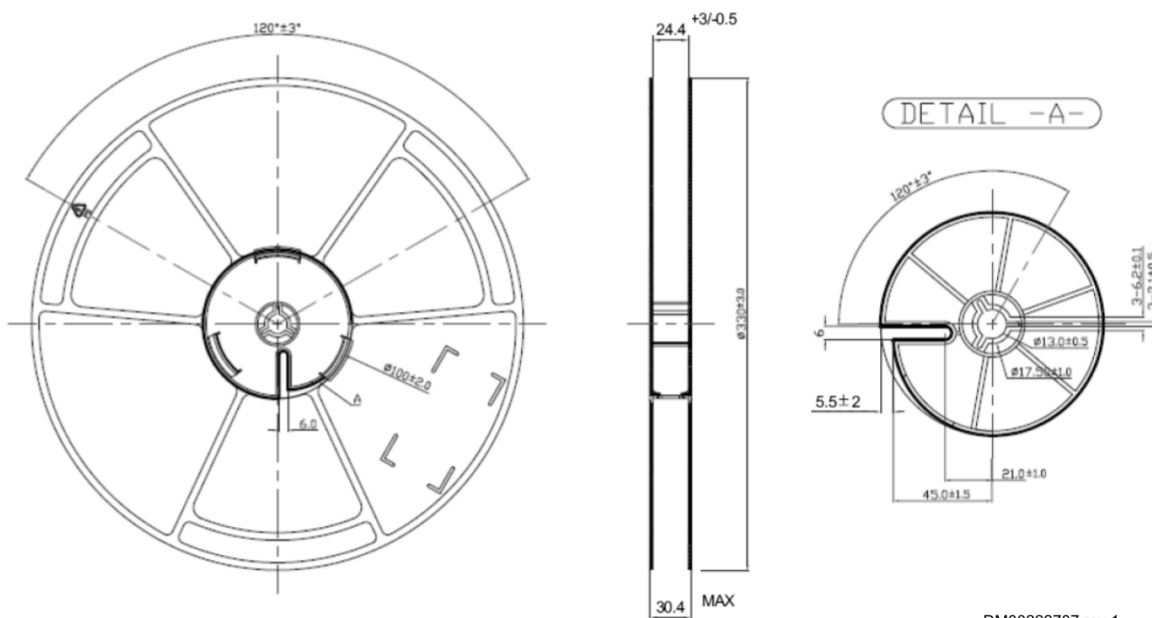
## 4.2 D<sup>3</sup>PAK (TO-268) packing information

Figure 34. D<sup>3</sup>PAK (TO-268) tape outline (dimensions are in mm)



DM00222707 rev 1

Figure 35. D<sup>3</sup>PAK (TO-268) reel outline (dimensions are in mm)



DM00222707 rev 1

Prerelease product(s)

## Revision history

**Table 8. Document revision history**

Date	Revision	Changes
06-Mar-2018	1	Initial release. The document status is production data.

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