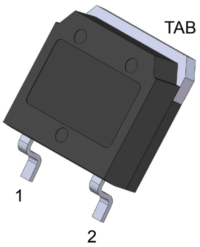
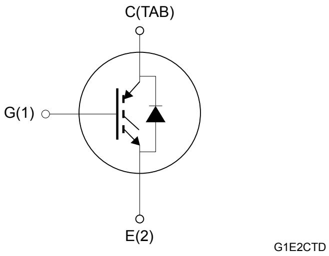
Trench gate field-stop 1200 V, 25 A low-loss M series IGBT in a D^{3}PAK package



D³PAK



Features

- 10 µs 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	
Order code	STGA25M120DF3
Marking	G25M120DF3
Package	D^{3}PAK
Packing	Tape and reel

Prerelease product(s)

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 maximium 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 °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 = 2 mA	1200			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 25 A		1.85	2.3	V
		V_{GE} = 15 V, I_C = 25 A, T_J = 125 °C		2.1		
		V_{GE} = 15 V, I_C = 50 A, T_J = 175 °C		2.2		
V_F	Forward on-voltage	I_F = 25 A		2.95	4.1	V
		I_F = 25 A, T_J = 125 °C		2.25		
		I_F = 25 A, T_J = 175 °C		1.9		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 1 mA	5	6	7	V
I_{CES}	Collector cut-off current	V_{GE} = 0 V, V_{CE} = 1200 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	-	1550	-	pF
C_{oes}	Output capacitance		-	180	-	
C_{res}	Reverse transfer capacitance		-	65	-	
Q_g	Total gate charge	V_{CC} = 960 V, I_C = 25 A, V_{GE} = 0 to 15 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 V, I_C = 25 A, V_{GE} = 15 V, R_G = 15 Ω (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/µs
$t_{d(off)}$	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 V, I_C = 25 A, V_{GE} = 15 V, R_G = 15 Ω, T_J = 175 °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/μs
$t_{d(off)}$	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} ≤ 600 V, V_{GE} = 15 V, T_{Jstart} ≤ 150 °C	10		-	μs

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

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs. case temperature

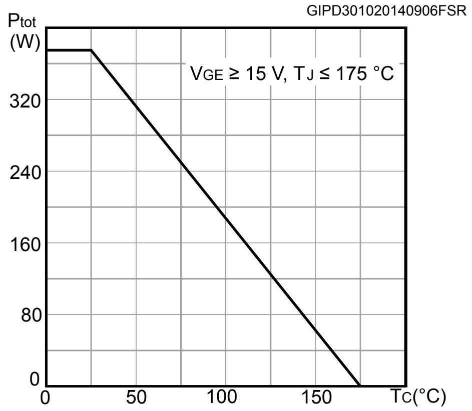


Figure 2. Collector current vs. case temperature

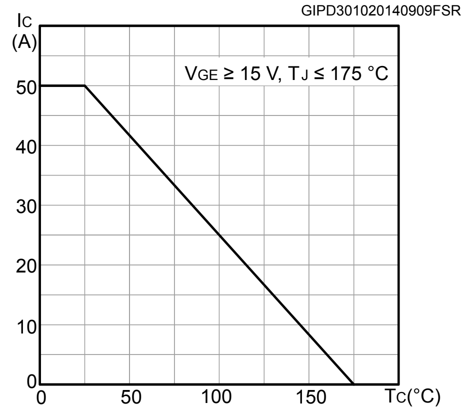


Figure 3. Output characteristics (T_J = 25 °C)

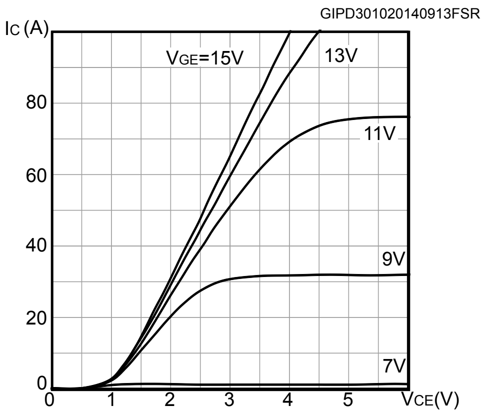


Figure 4. Output characteristics (T_J = 175 °C)

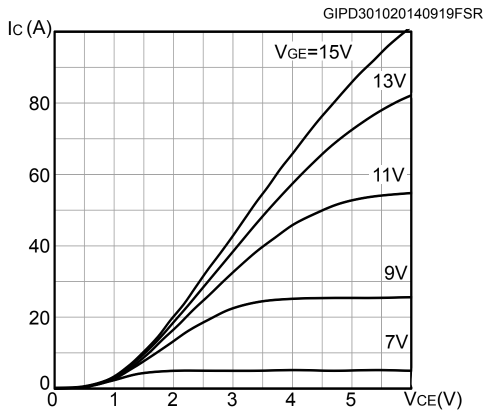


Figure 5. $V_{CE(sat)}$ vs. junction temperature

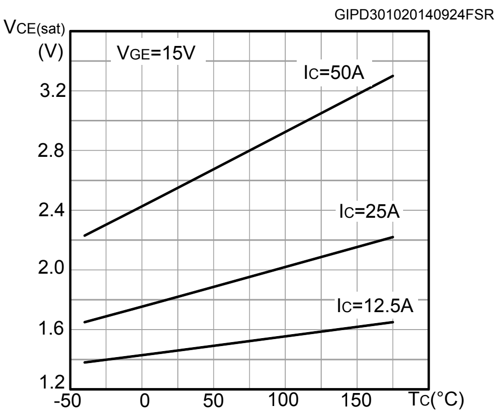


Figure 6. $V_{CE(sat)}$ vs. collector current

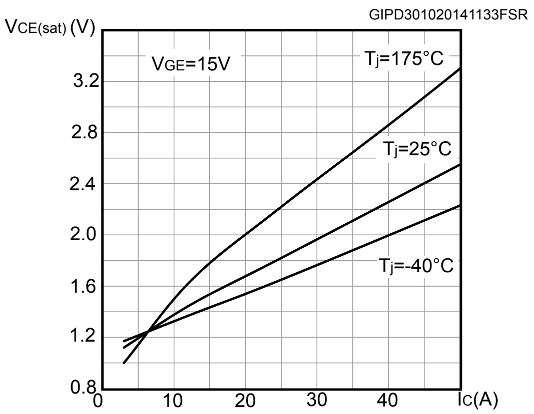


Figure 7. Collector current vs. switching frequency

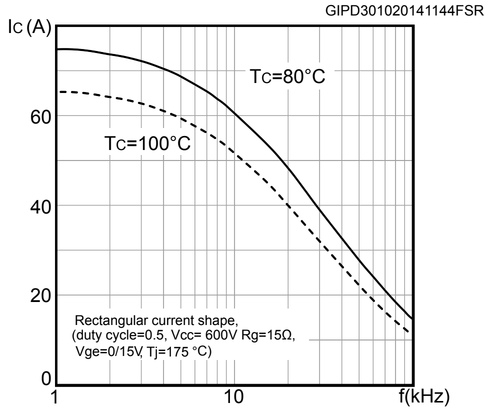


Figure 8. Forward bias safe operating area

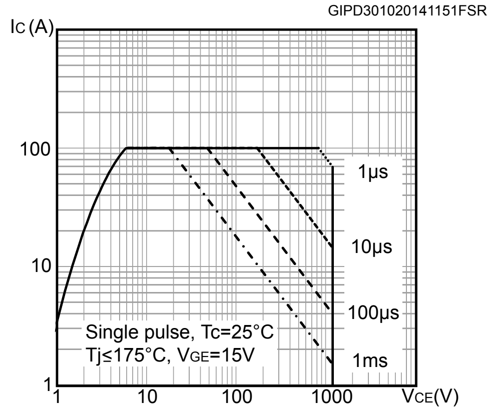


Figure 9. Transfer characteristics

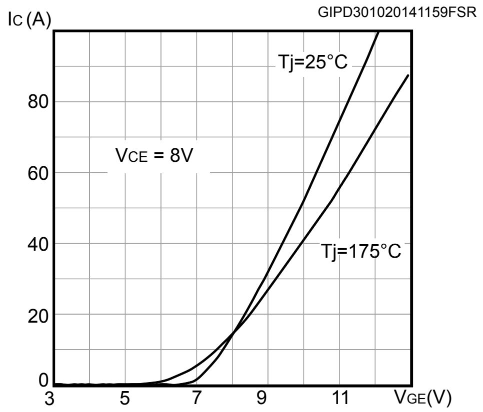


Figure 10. Diode V_F vs. forward current

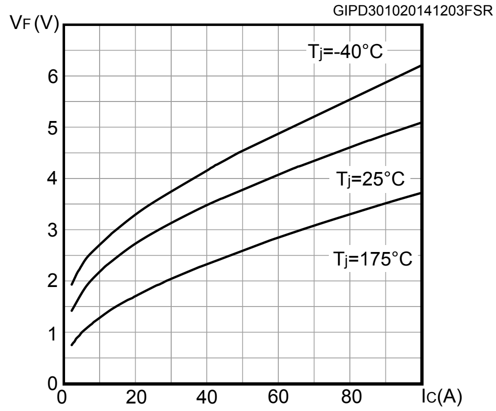


Figure 11. Normalized $V_{GE(th)}$ vs. junction temperature

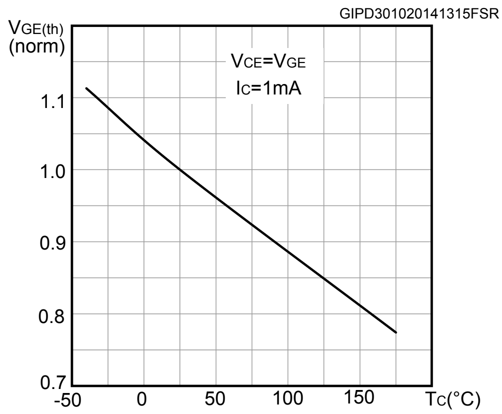


Figure 12. Normalized $V_{(BR)CES}$ vs. junction temperature

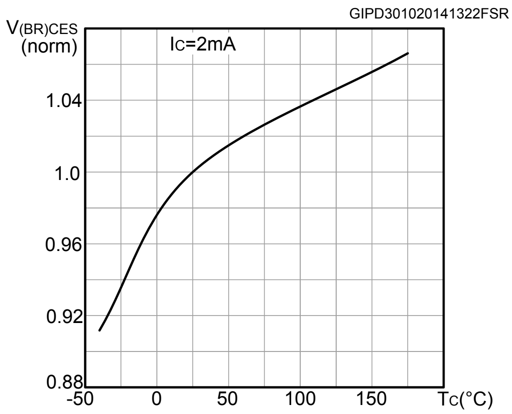


Figure 13. Capacitance variations

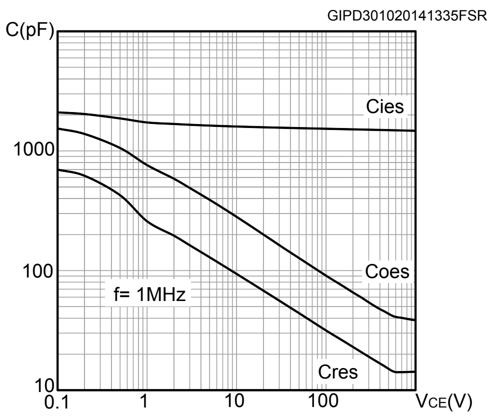


Figure 14. Gate charge vs. gate-emitter voltage

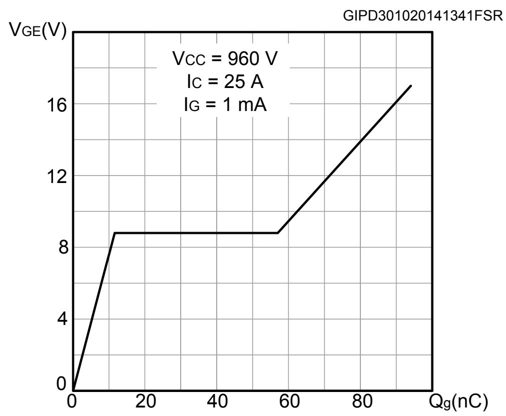


Figure 15. Switching energy vs. collector current

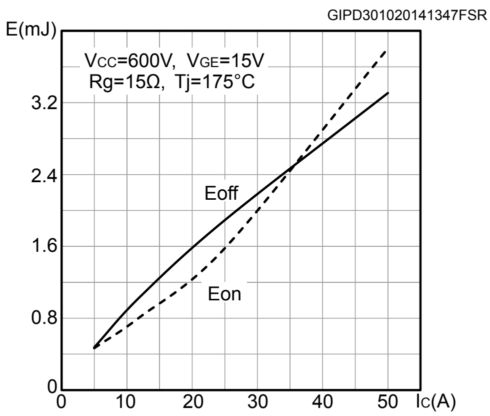


Figure 16. Switching energy vs. gate resistance

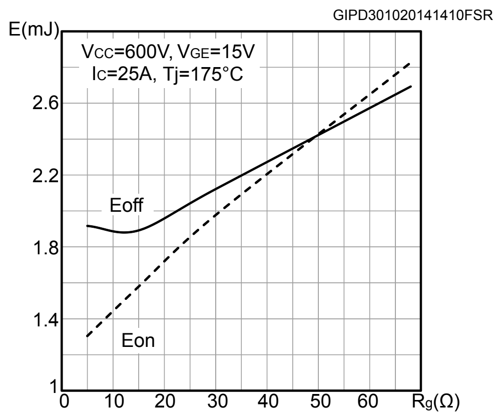


Figure 17. Switching energy vs. temperature

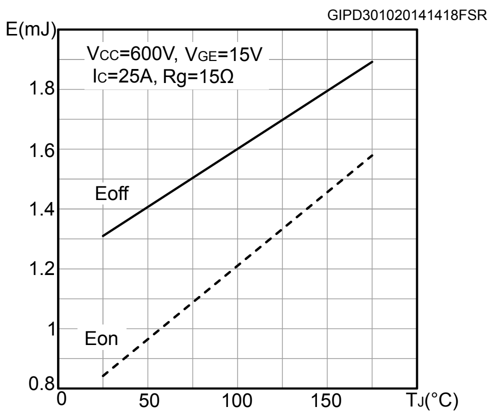


Figure 18. Switching energy vs. collector emitter voltage

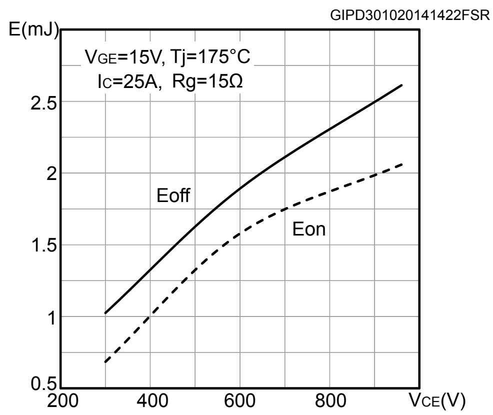


Figure 19. Short-circuit time and current vs. V_{GE}

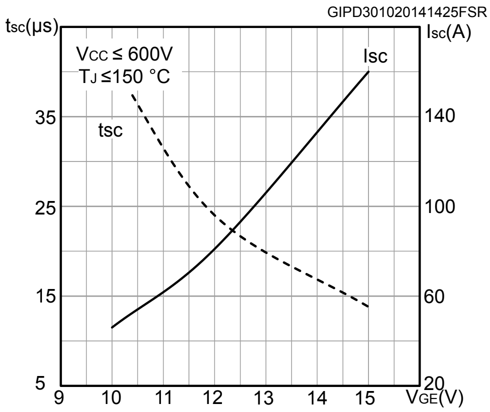


Figure 20. Switching times vs. collector current

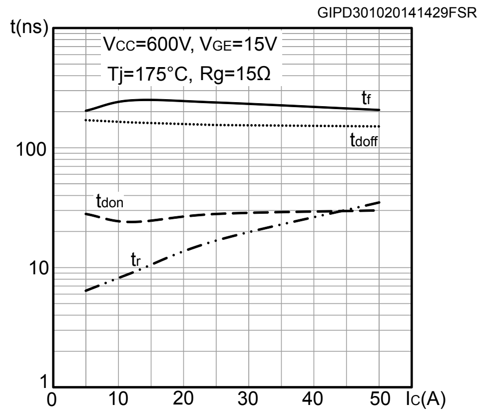


Figure 21. Switching times vs. gate resistance

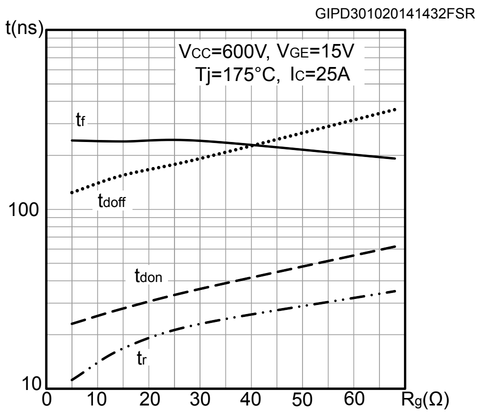


Figure 22. Reverse recovery current vs. diode current slope

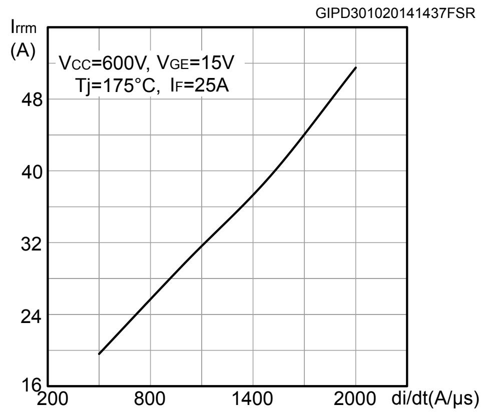


Figure 23. Reverse recovery time vs. diode current slope

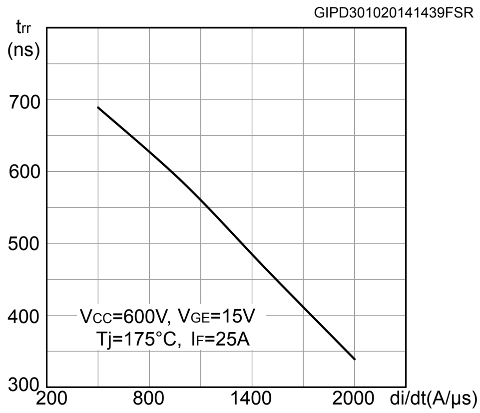
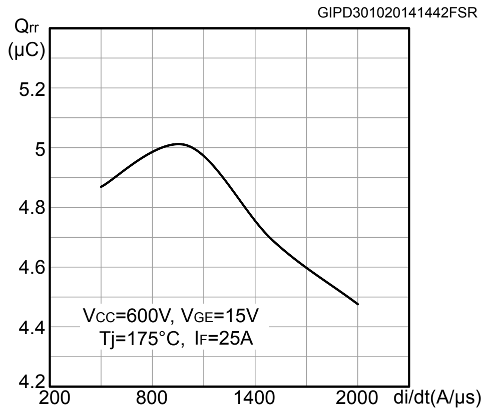


Figure 24. Reverse recovery charge vs. diode current slope



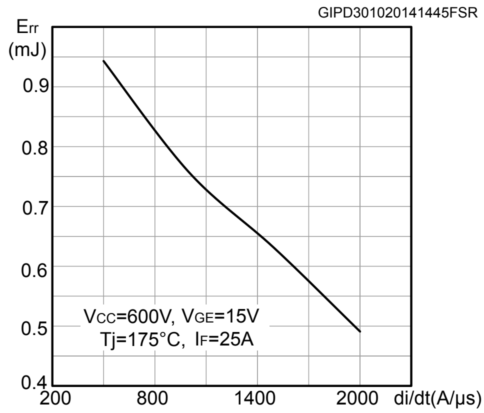


Figure 25. Reverse recovery energy vs. diode current slope

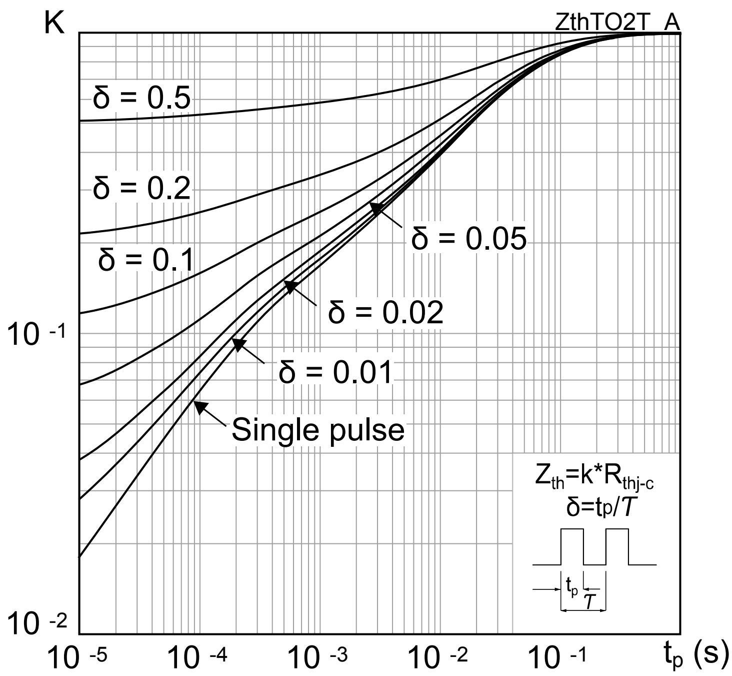
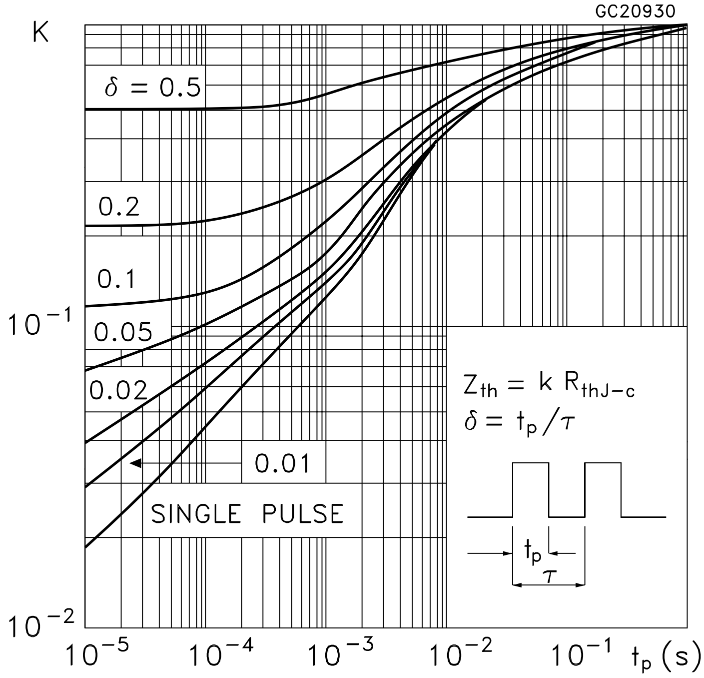


Figure 26. Thermal impedance for IGBT

Figure 27. Thermal impedance for diode



3 Test circuits

Figure 28. Test circuit for inductive load switching

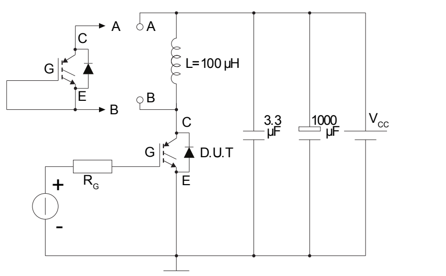


Figure 29. Gate charge test circuit

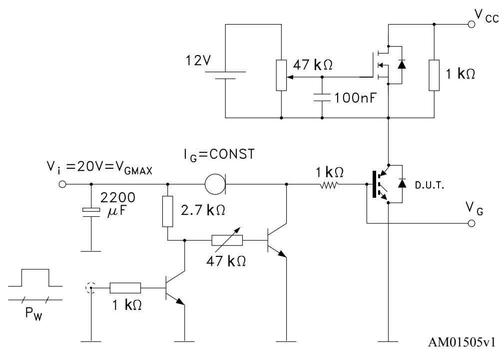


Figure 30. Switching waveform

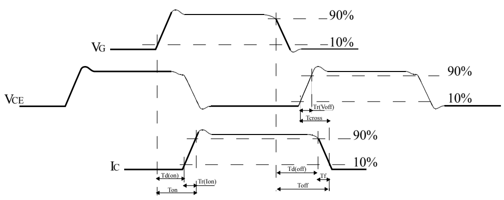
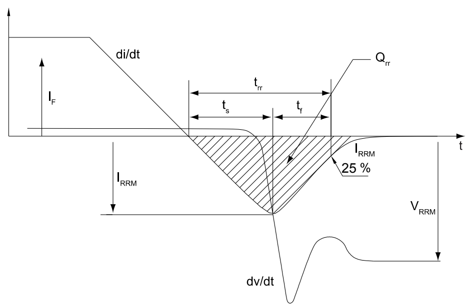


Figure 31. Diode reverse recovery waveform



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. ECOPACK® is an ST trademark.

4.1 D³PAK (TO-268) package information

Figure 32. D³PAK (TO-268) package outline

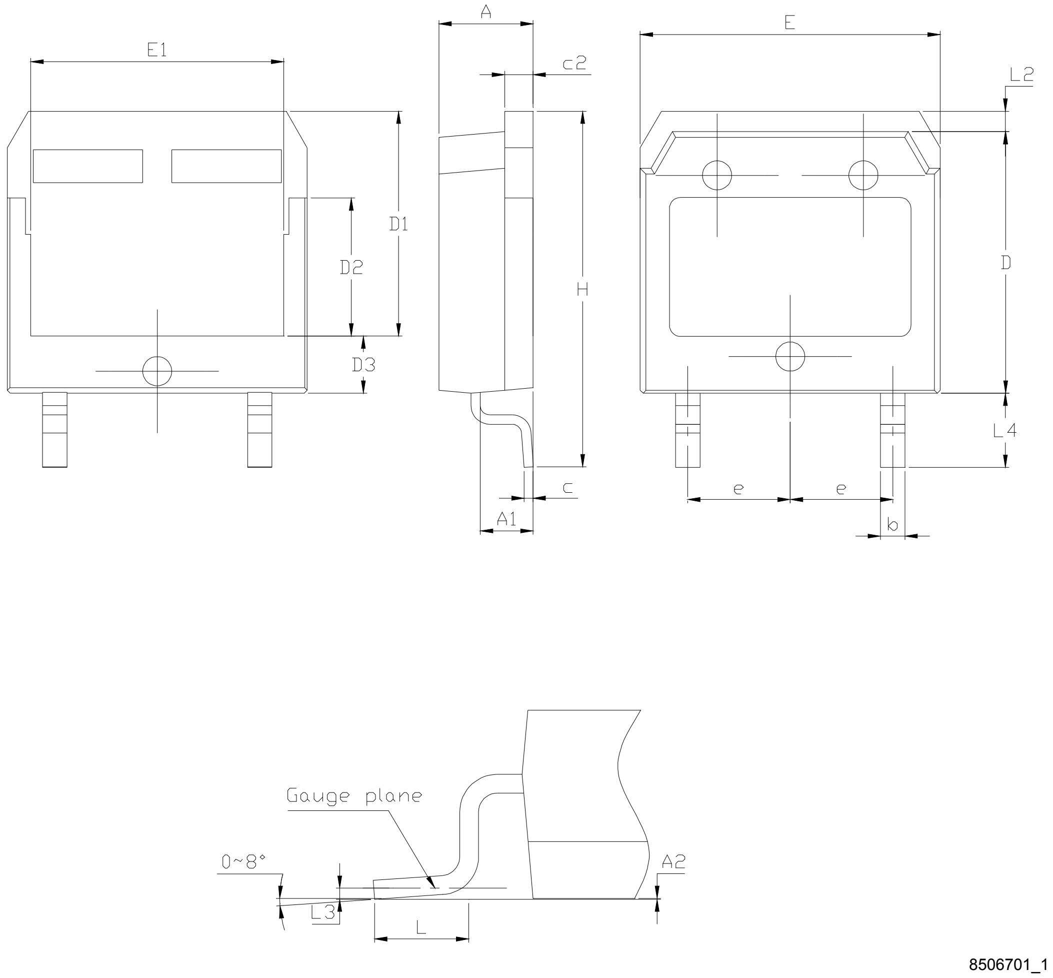
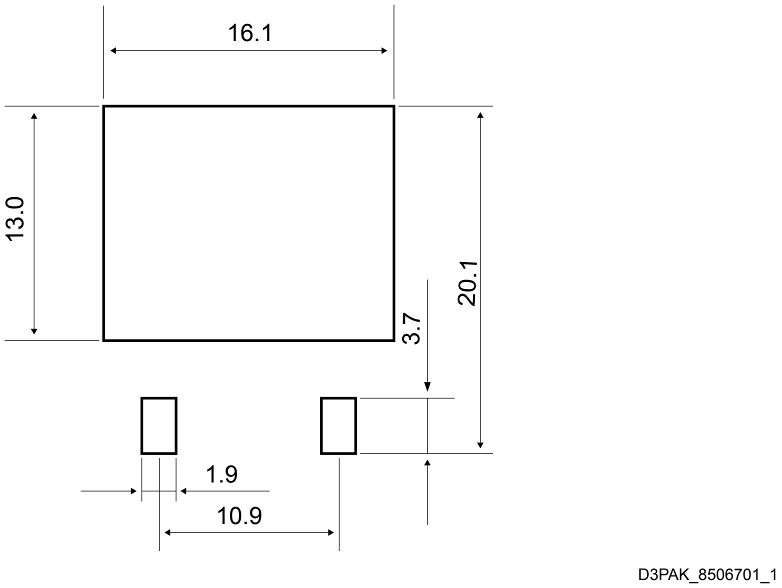


Table 7. D³PAK (TO-268) mechanical data

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. D³PAK (TO-268) recommended footprint (dimensions are in mm)



4.2 D³PAK (TO-268) packing information

Figure 34. D³PAK (TO-268) tape outline (dimensions are in mm)

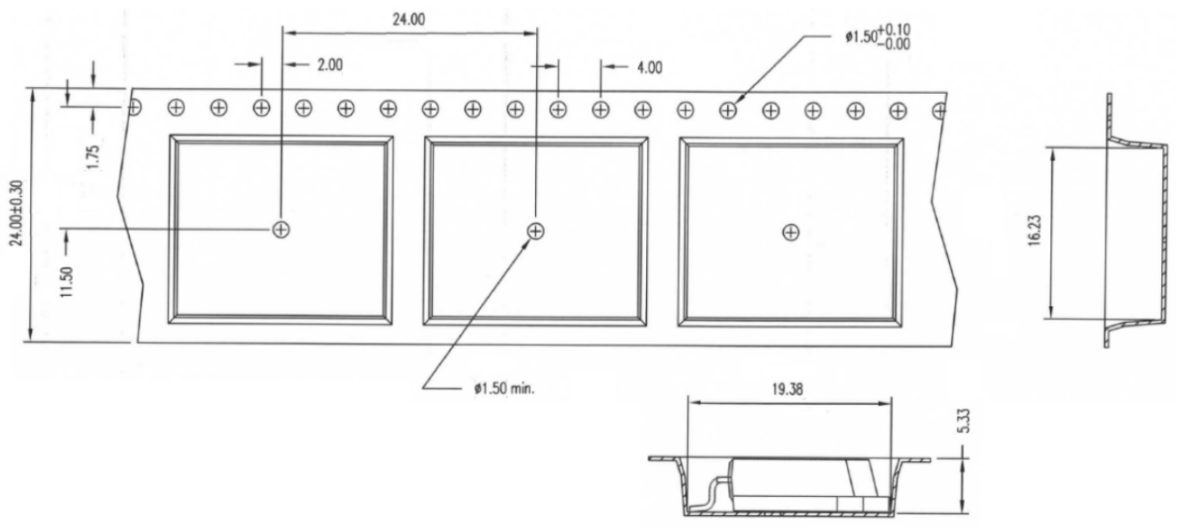
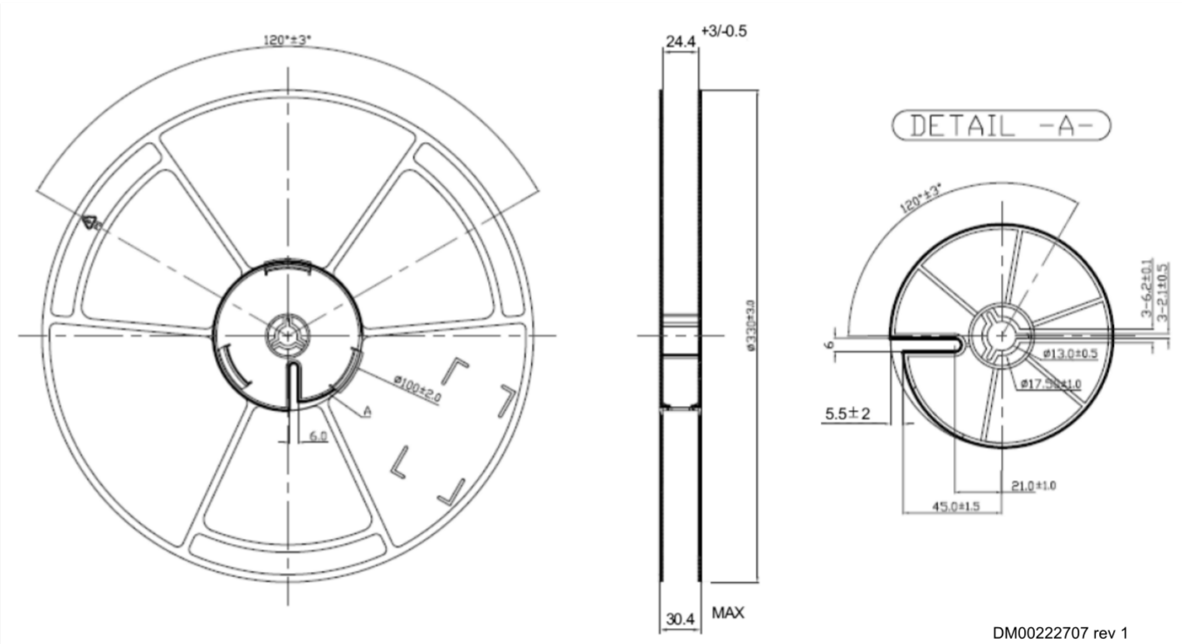


Figure 35. D³PAK (TO-268) reel outline (dimensions are in mm)



Revision history

Table 8. Document revision history

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

Contents