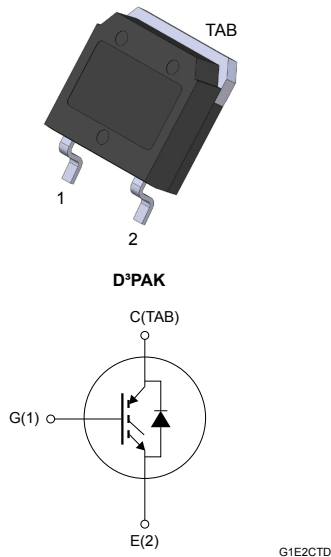


Trench gate field-stop 650 V, 30 A low-loss M series IGBT in a D³PAK package


Features

- 6 μ s of minimum short-circuit withstand time
- $V_{CE(sat)} = 1.55$ V (typ.) @ $I_C = 30$ A
- Tight parameters distribution
- Positive $V_{CE(sat)}$ temperature coefficient
- Low thermal resistance
- Soft and very fast recovery antiparallel diode
- Maximum junction temperature: $T_J = 175$ °C

Applications

- Motor control
- UPS
- PFC
- General purpose inverter

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	
STGA30M65DF2	
Product summary	
Order code	STGA30M65DF2
Marking	G30M65DF2
Package	D ³ PAK
Packing	Tape and reel

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
I_C	Continuous collector current at $T_C = 100$ °C	30	A
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
I_F	Continuous forward current at $T_C = 100$ °C	30	A
I_{FP} ⁽¹⁾	Pulsed forward current	120	A
P_{TOT}	Total 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-case IGBT	0.58	°C/W
R_{thJC}	Thermal resistance junction-case diode	1.47	°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	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$	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	$I_F = 30\text{ A}$		1.85	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	μA
I_{GES}	Gate-emitter leakage current	$V_{CE} = 0\text{ V}, V_{GE} = \pm 20\text{ V}$			± 250	μA

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	-	μF
C_{oes}	Output capacitance		-	143	-	
C_{res}	Reverse transfer capacitance		-	46	-	
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	-	
Q_{gc}	Gate-collector charge		-	32	-	

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/ μ 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/ μ 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	$V_{CC} \leq 400\text{ V}$, $V_{GE} = 13\text{ V}$, $T_{Jstart} = 150\text{ }^\circ\text{C}$		10		-	μ s
		$V_{CC} \leq 400\text{ V}$, $V_{GE} = 15\text{ V}$, $T_{Jstart} = 150\text{ }^\circ\text{C}$	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/ μ s
E_{rr}	Reverse recovery energy		-	115	-	μ 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/ μ s
E_{rr}	Reverse recovery energy		-	320	-	μ J

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs. case temperature

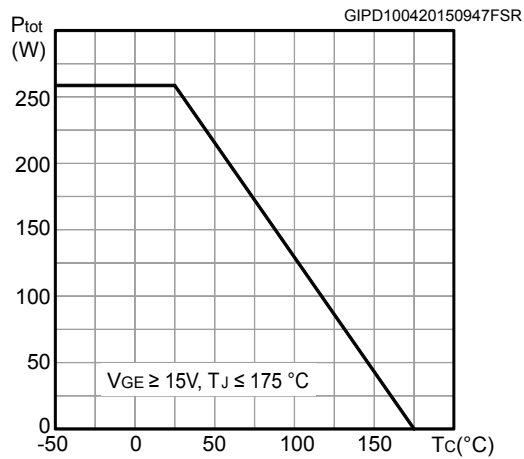


Figure 2. Collector current vs. case temperature

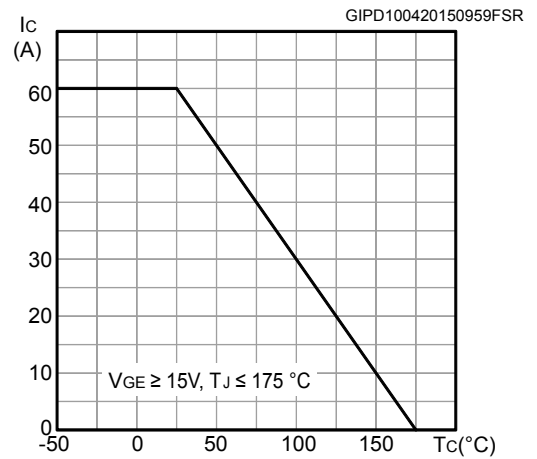


Figure 3. Output characteristics ($T_J = 25^\circ\text{C}$)

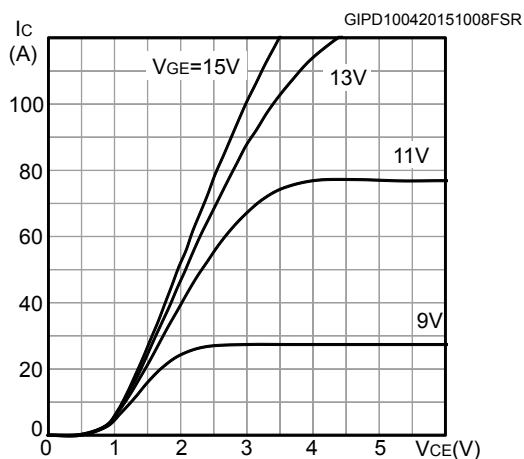


Figure 4. Output characteristics ($T_J = 175^\circ\text{C}$)

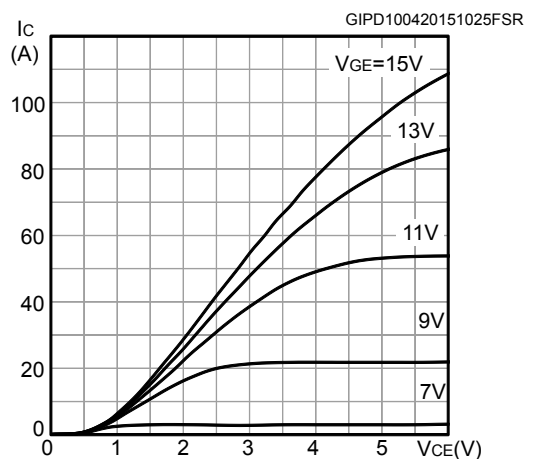


Figure 5. $V_{CE(sat)}$ vs. junction temperature

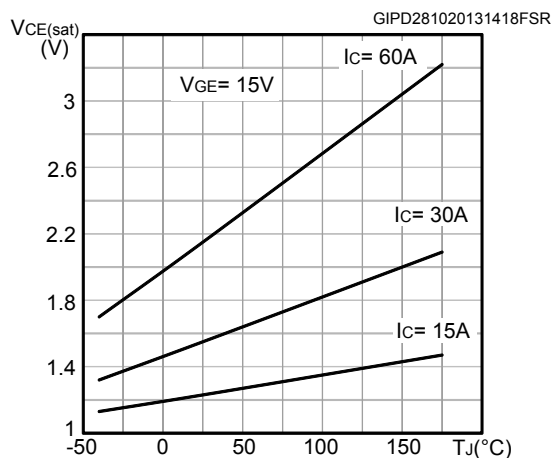


Figure 6. $V_{CE(sat)}$ vs. collector current

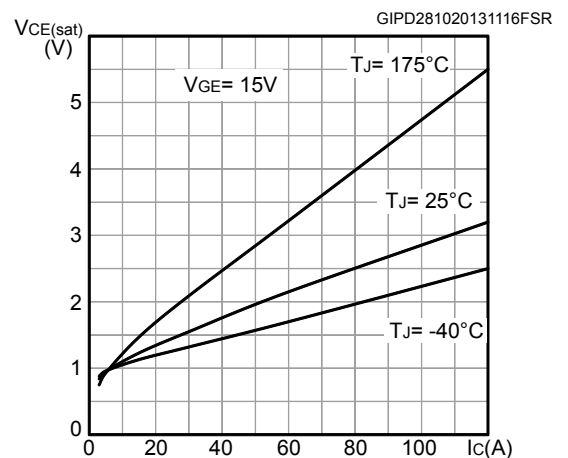


Figure 7. Collector current vs. switching frequency

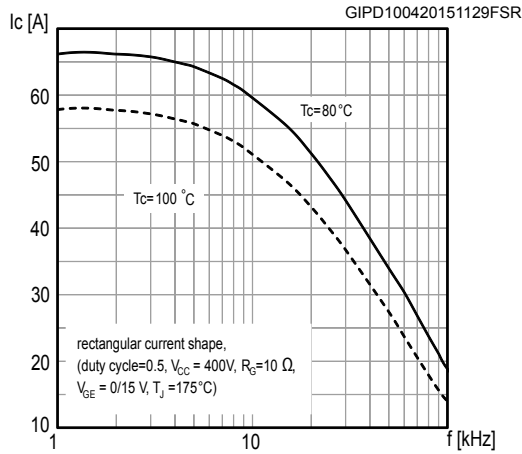


Figure 8. Forward bias safe operating area

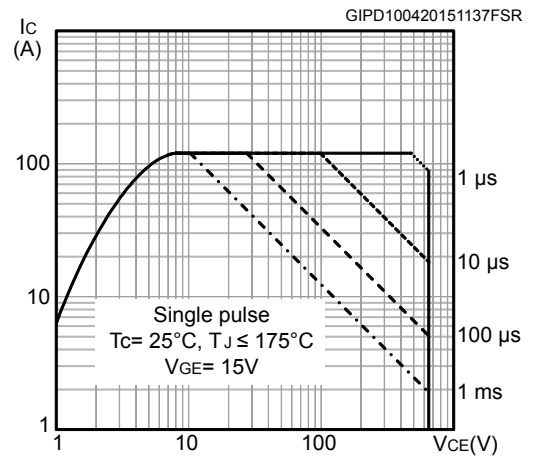


Figure 9. Transfer characteristics

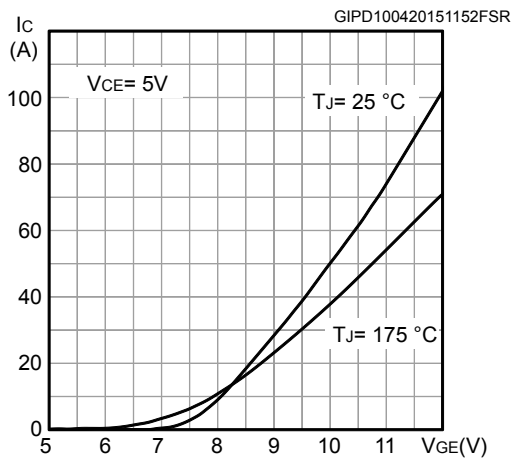


Figure 10. Diode Vf vs. forward current

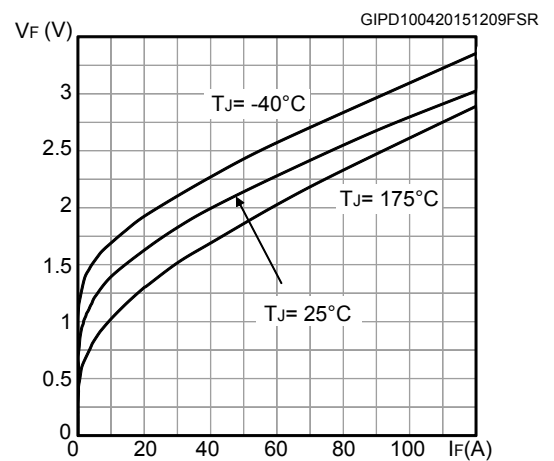


Figure 11. Normalized Vge(th) vs. junction temperature

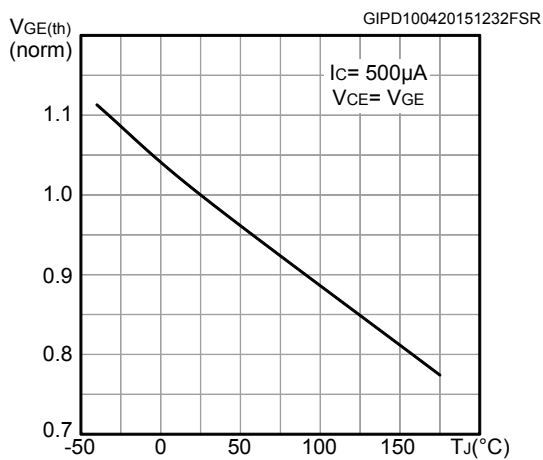
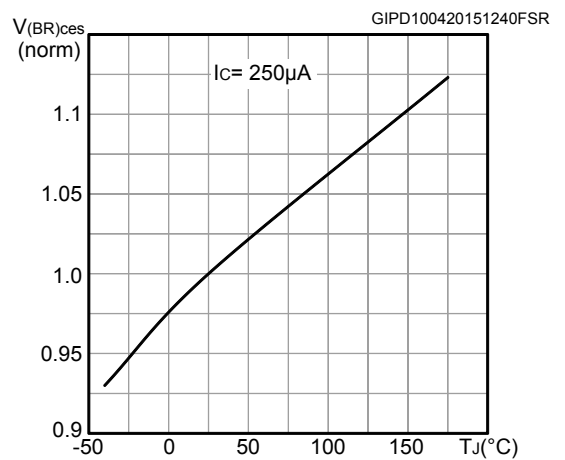


Figure 12. Normalized V(BR)ces vs. junction temperature



Prerelease product(s)

Figure 13. Capacitance variations

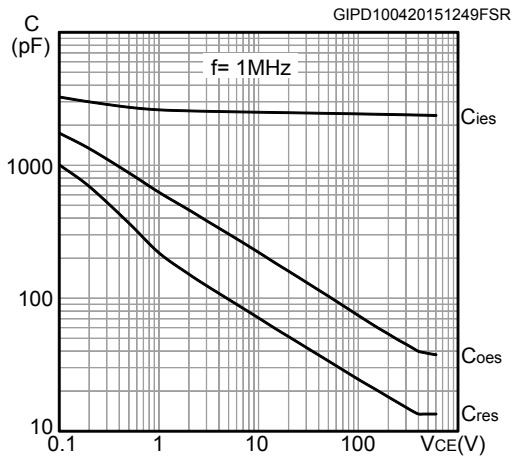


Figure 14. Gate charge vs. gate-emitter voltage

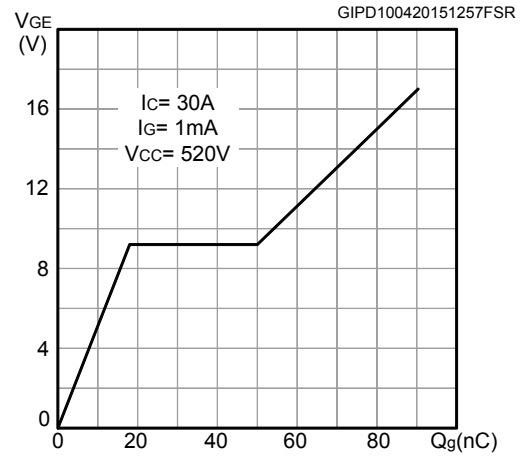


Figure 15. Switching energy vs. collector current

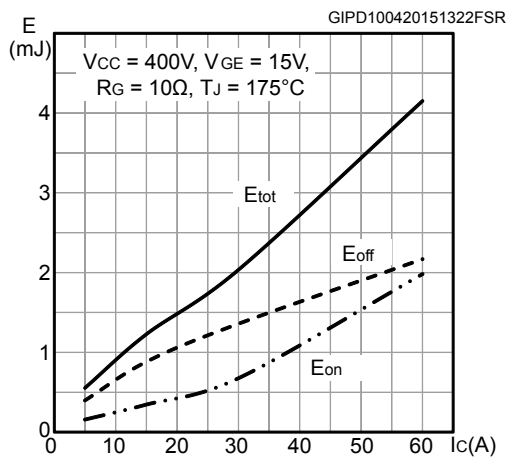


Figure 16. Switching energy vs. gate resistance

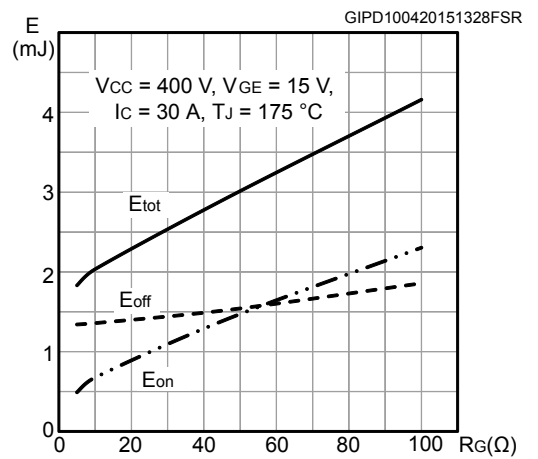


Figure 17. Switching energy vs. temperature

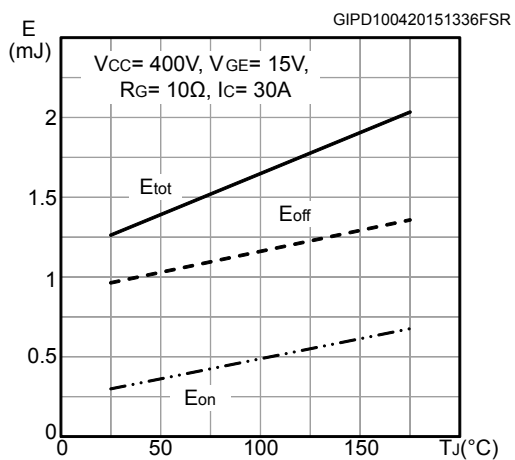
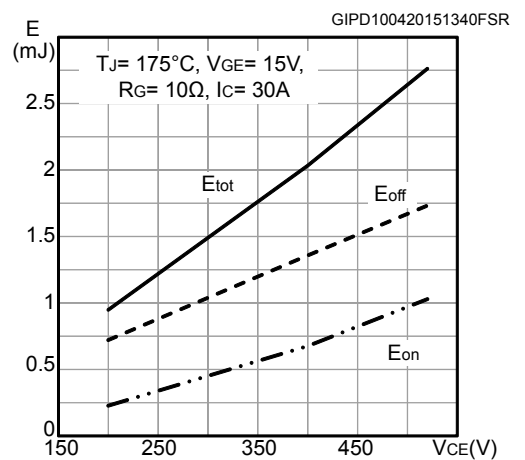


Figure 18. Switching energy vs. collector emitter voltage



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

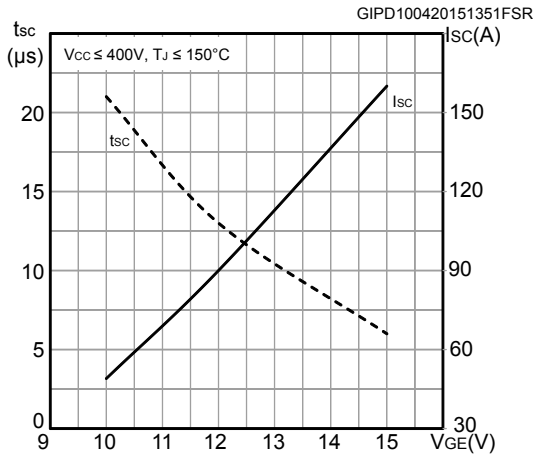


Figure 20. Switching times vs. collector current

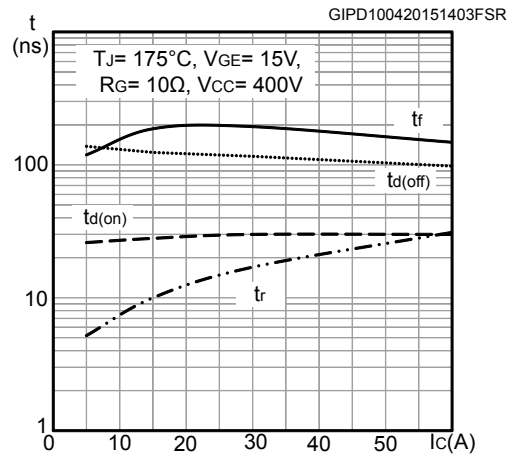


Figure 21. Switching times vs. gate resistance

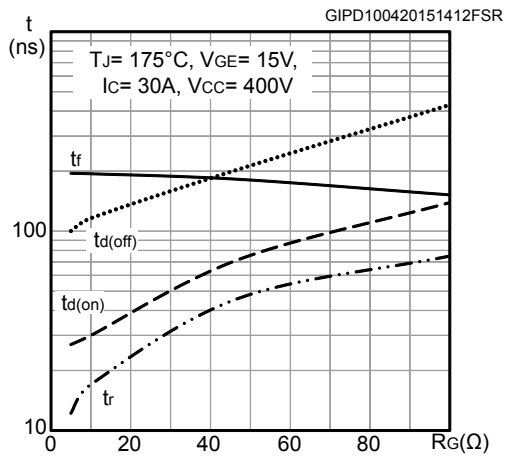


Figure 22. Reverse recovery current vs. diode current slope

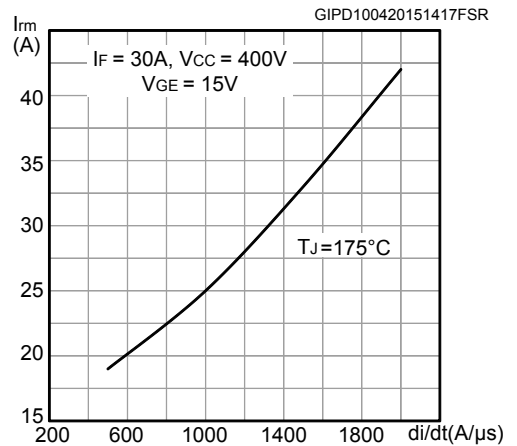


Figure 23. Reverse recovery time vs. diode current slope

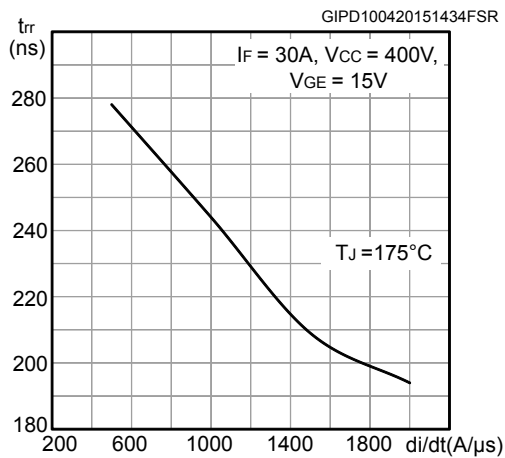
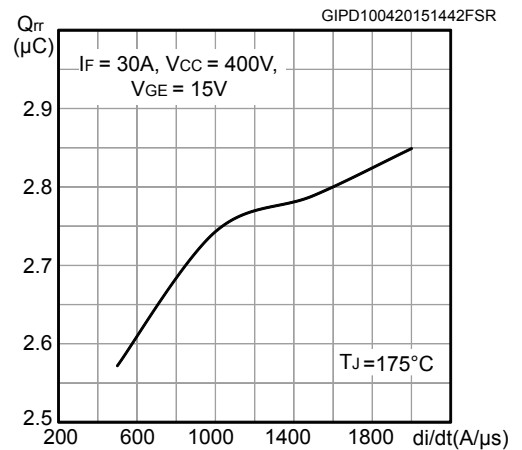


Figure 24. Reverse recovery charge vs. diode current slope



Prerelease product(s)

Figure 25. Reverse recovery energy vs. diode current slope

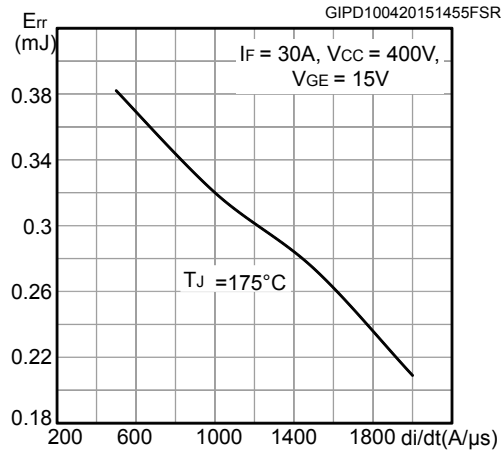
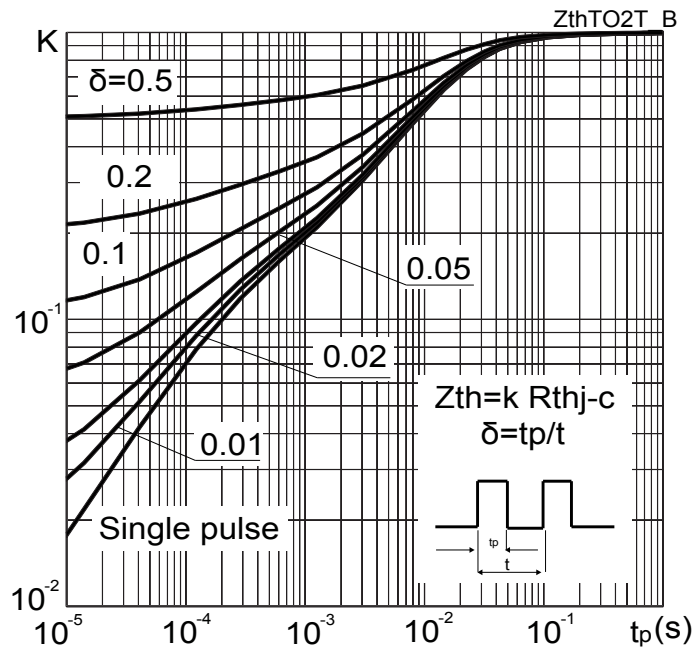
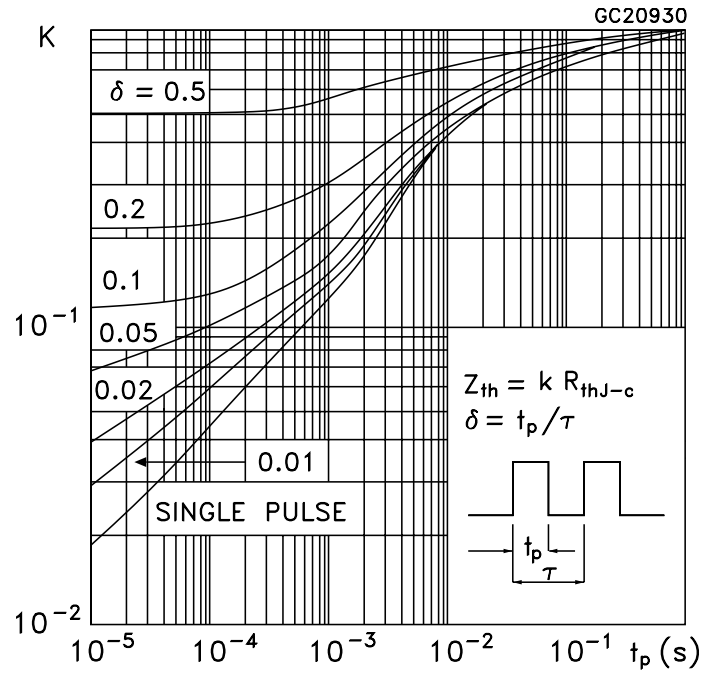


Figure 26. Thermal impedance for IGBT



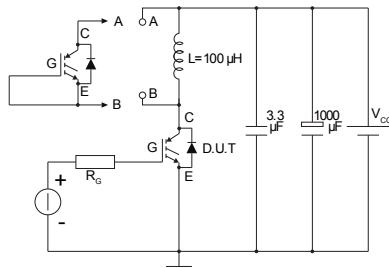
Prerelease product(s)

Figure 27. Thermal impedance for diode

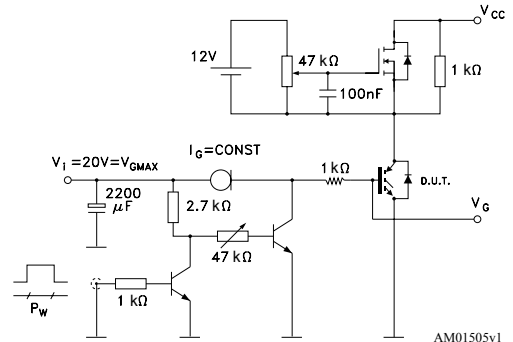


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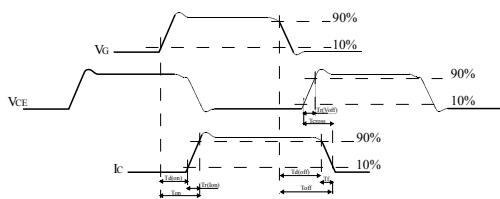
3 Test circuits

Figure 28. Test circuit for inductive load switching


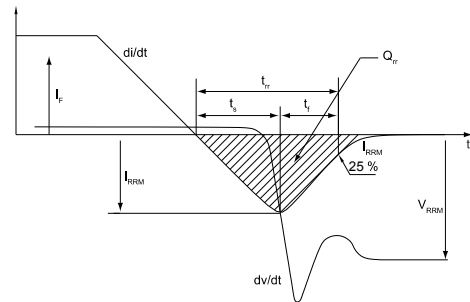
AM01504v1

Figure 29. Gate charge test circuit


AM01505v1

Figure 30. Switching waveform


AM01506v1

Figure 31. Diode reverse recovery waveform


AM01507v1

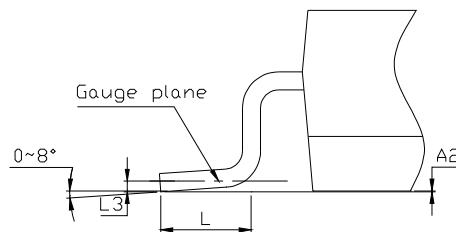
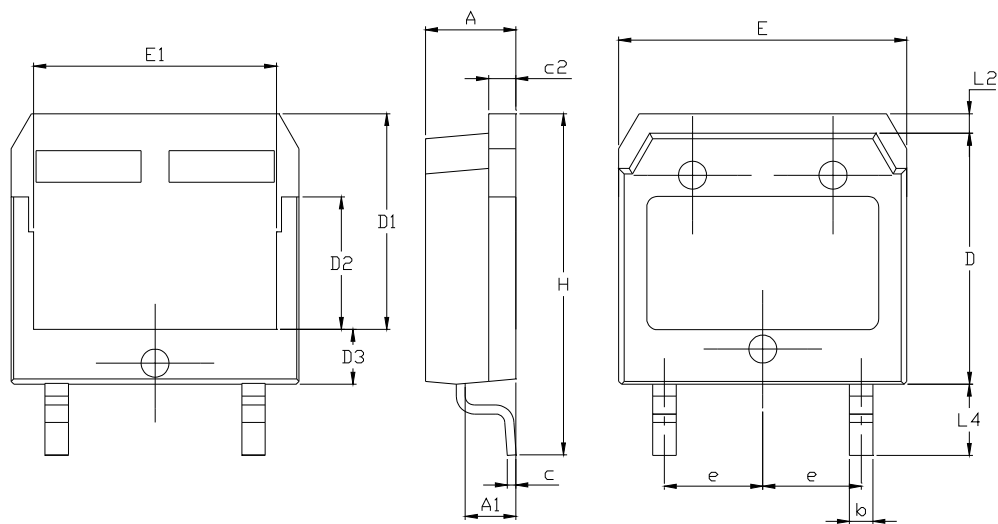
Prerelease product(s)

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. ECOPACK® is an ST trademark.

4.1 D³PAK (TO-263) type A package information

Figure 32. D³PAK (TO-268) package outline

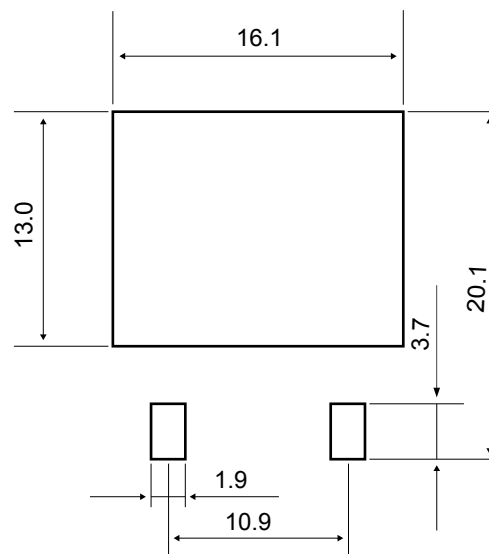


8506701_1

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
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)

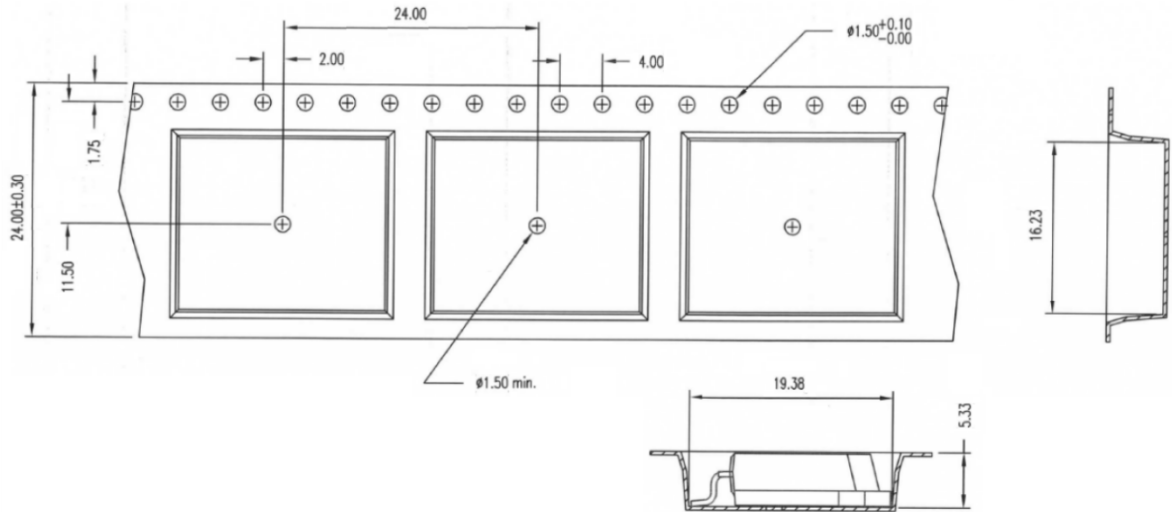


D3PAK_8506701_1

Prerelease product(s)

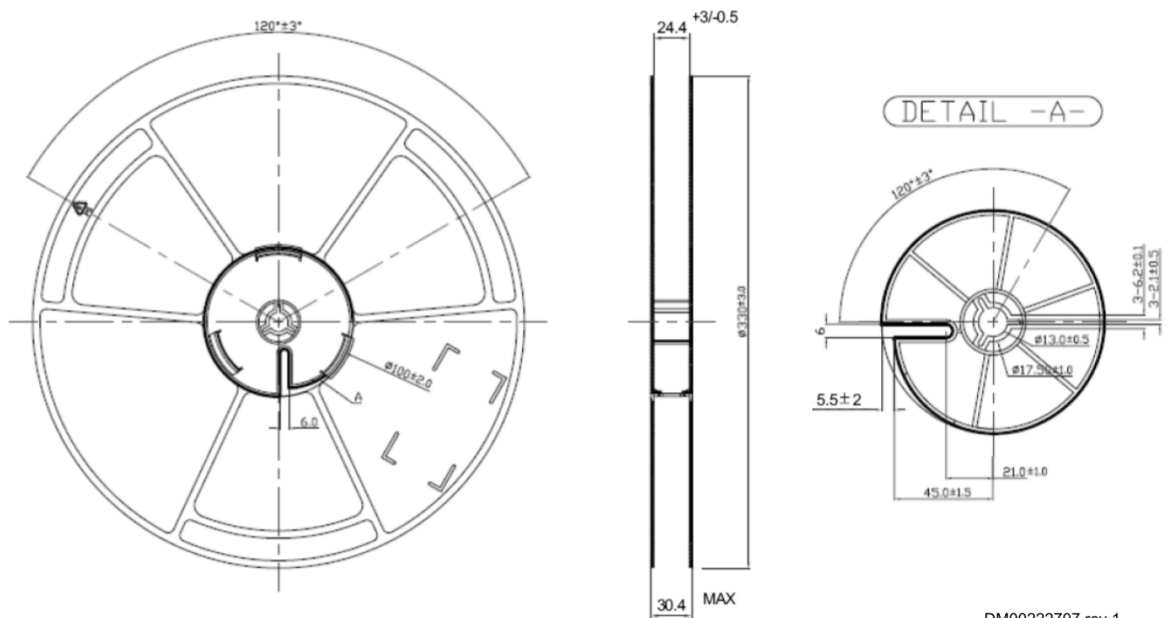
4.2 D2PAK (TO-263) type A packing information

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



DM00222707 rev 1

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



DM00222707 rev 1

Prerelease product(s)

Revision history

Table 8. Document revision history

Date	Revision	Changes
10-Apr-2018	1	Initial release. The document status is preliminary data.

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4	Package information	12
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