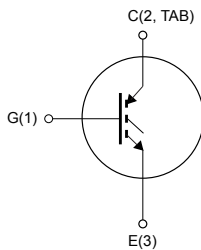


Trench gate field-stop, 1200 V, 15 A, low-loss M series IGBT in a TO-220 package



G1C2TE3

Features

- 10 μ s of minimum short-circuit withstand time
- $V_{CE(sat)} = 1.85$ V (typ.) @ $I_C = 15$ A
- Tight parameter distribution
- Positive $V_{CE(sat)}$ temperature coefficient
- Low thermal resistance
- Maximum junction temperature: $T_J = 175$ °C

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

[STGP15M120F3](#)

Product summary

Order code	STGP15M120F3
Marking	G15M120F3
Package	TO-220
Packing	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	30	A
	Continuous collector current at $T_C = 100$ °C	15	A
$I_{CP}^{(1)}$	Pulsed collector current	60	A
V_{GE}	Gate-emitter voltage	±20	V
P_{TOT}	Total dissipation at $T_C = 25$ °C	259	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	0.58	°C/W
R_{thJA}	Thermal resistance junction-ambient	62.5	

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	$V_{GE} = 15\text{ V}, I_C = 15\text{ A}$		1.85	2.3	V
		$V_{GE} = 15\text{ V}, I_C = 15\text{ A}, T_J = 125\text{ °C}$		2.1		
		$V_{GE} = 15\text{ V}, I_C = 30\text{ A}, T_J = 175\text{ °C}$		2.2		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 500\text{ }\mu\text{A}$	5	6	7	V
I_{CES}	Collector cut-off current	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$			25	μA
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	$V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0\text{ V}$	-	985	-	pF
C_{oes}	Output capacitance		-	118	-	pF
C_{res}	Reverse transfer capacitance		-	38	-	pF
Q_g	Total gate charge	$V_{CC} = 960\text{ V}, I_C = 15\text{ A}, V_{GE} = 0\text{ to }15\text{ V}$	-	53	-	nC
Q_{ge}	Gate-emitter charge	(see Figure 23. Gate charge test circuit)	-	8	-	nC
Q_{gc}	Gate-collector charge		-	32	-	nC

Table 5. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 600\text{ V}, I_C = 15\text{ A}, V_{GE} = 15\text{ V}, R_G = 22\text{ }\Omega$, (see Figure 22. Test circuit for inductive load switching)	-	26	-	ns
t_r	Current rise time		-	12	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1000	-	A/ μs
$t_{d(off)}$	Turn-off delay time		-	122	-	ns
t_f	Current fall time		-	163	-	ns
$E_{on}^{(1)}$	Turn-on switching energy		-	0.55	-	mJ
$E_{off}^{(2)}$	Turn-off switching energy		-	0.85	-	mJ
E_{ts}	Total switching energy		-	1.4	-	mJ

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 600\text{ V}$, $I_C = 15\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 22\ \Omega$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 22. Test circuit for inductive load switching)	-	25	-	ns
t_r	Current rise time		-	14	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	857	-	A/ μs
$t_{d(off)}$	Turn-off delay time		-	136	-	ns
t_f	Current fall time		-	270	-	ns
$E_{on}^{(1)}$	Turn-on switching energy		-	1.1	-	mJ
$E_{off}^{(2)}$	Turn-off switching energy		-	1.13	-	mJ
E_{ts}	Total switching energy	-	2.23	-	mJ	
t_{sc}	Short-circuit withstand time	$V_{CC} \leq 600\text{ V}$, $V_{GE} = 15\text{ V}$, $T_{Jstart} = 150\text{ }^\circ\text{C}$	10		-	μs

1. Including the recovery of the external diode. The diode is the same of the co-packed STGWA15M120DF3 device.
2. Including the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature

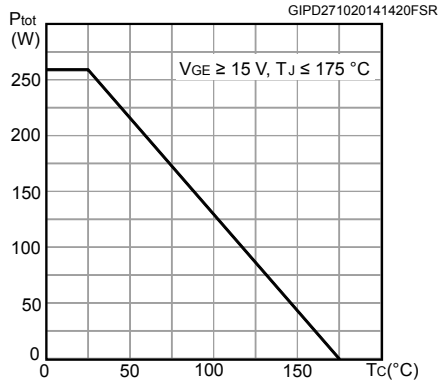


Figure 2. Collector current vs case temperature

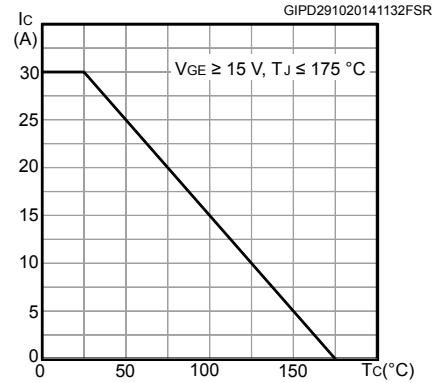


Figure 3. Output characteristics ($T_J = 25\text{ °C}$)

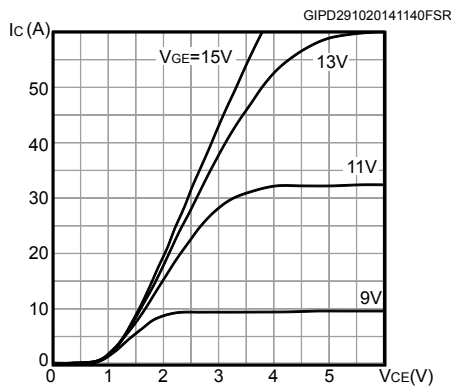


Figure 4. Output characteristics ($T_J = 175\text{ °C}$)

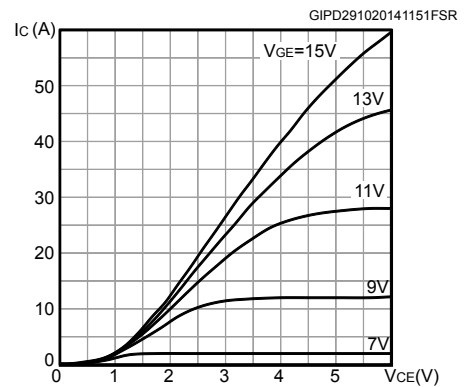


Figure 5. $V_{CE(sat)}$ vs junction temperature

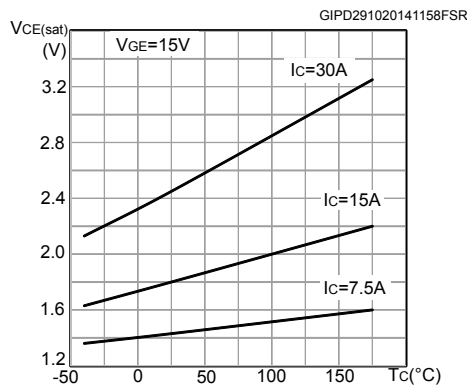


Figure 6. $V_{CE(sat)}$ vs collector current

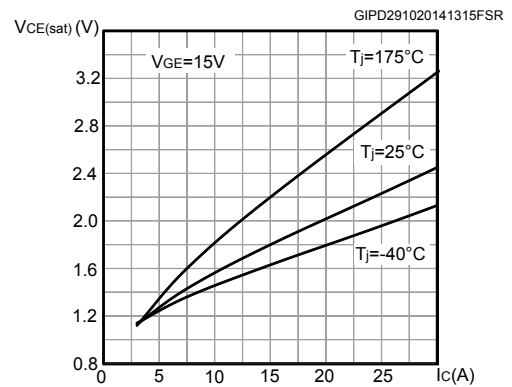


Figure 7. Collector current vs switching frequency

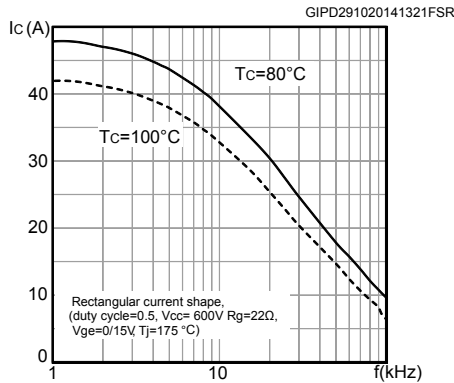


Figure 8. Safe operating area

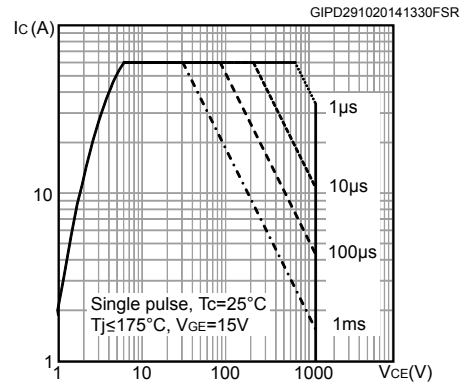


Figure 9. Transfer characteristics

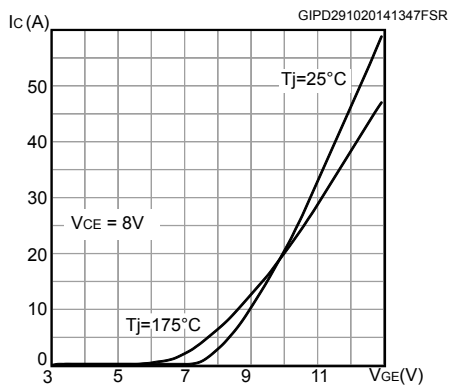


Figure 10. Normalized V_{GE(th)} vs junction temperature

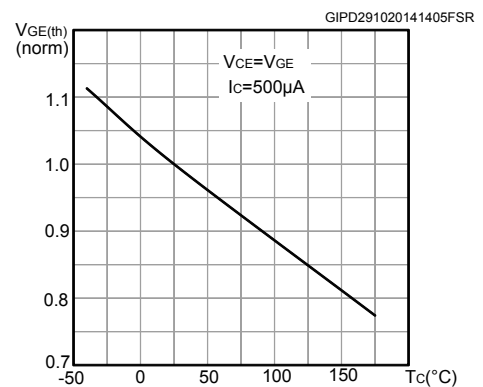


Figure 11. Normalized V_{(BR)CES} vs junction temperature

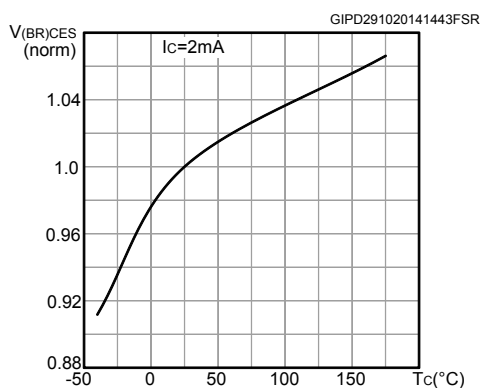


Figure 12. Capacitance variations

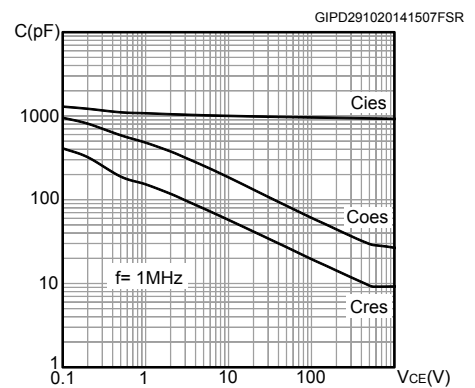


Figure 13. Gate charge vs gate-emitter voltage

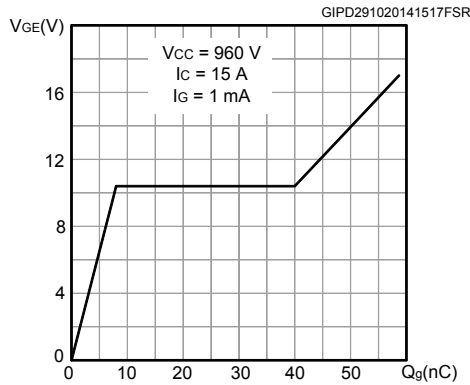


Figure 14. Switching energy vs collector current

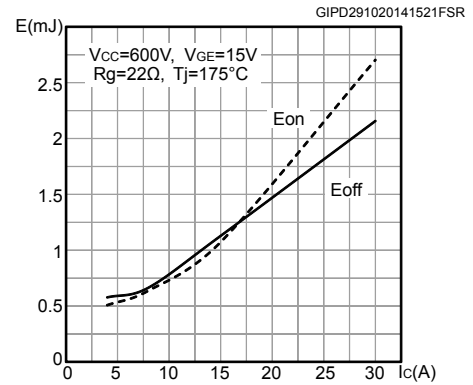


Figure 15. Switching energy vs gate resistance

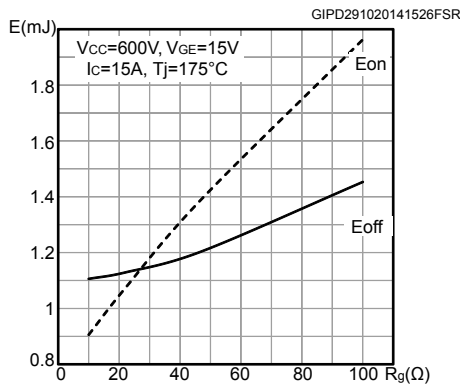


Figure 16. Switching energy vs junction temperature

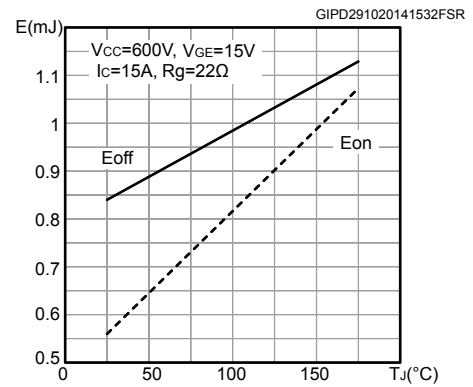


Figure 17. Switching energy vs collector emitter voltage

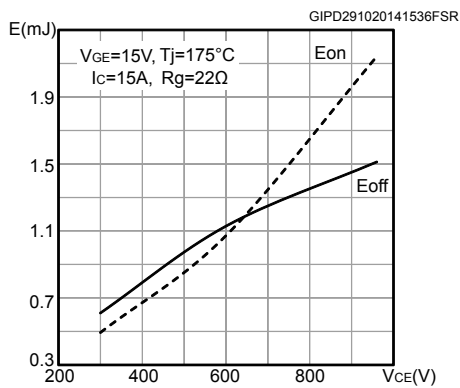


Figure 18. Short-circuit time and current vs VGE

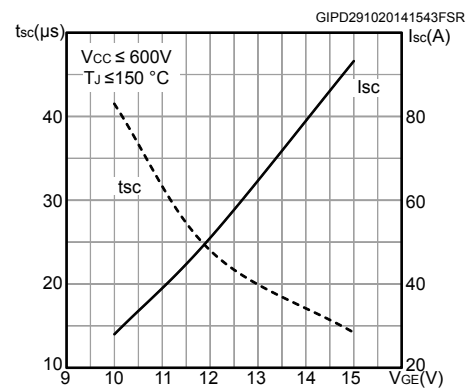


Figure 19. Switching times vs collector current

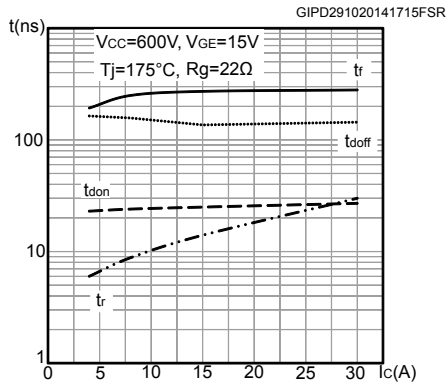


Figure 20. Switching times vs gate resistance

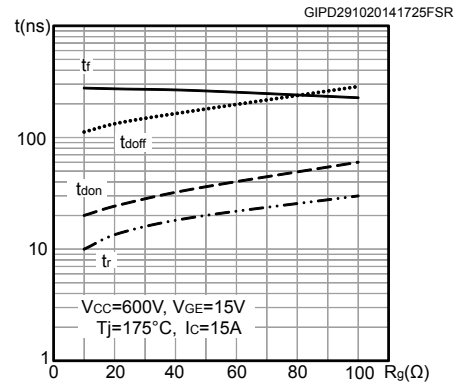
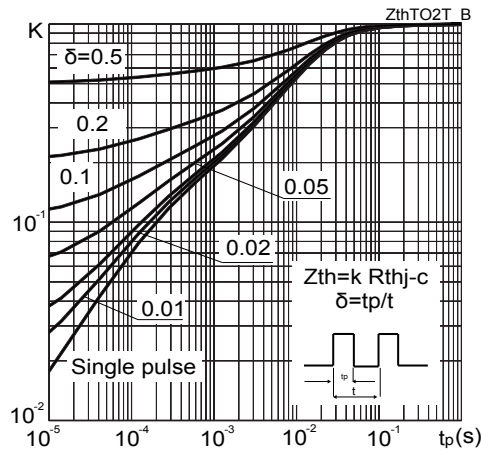
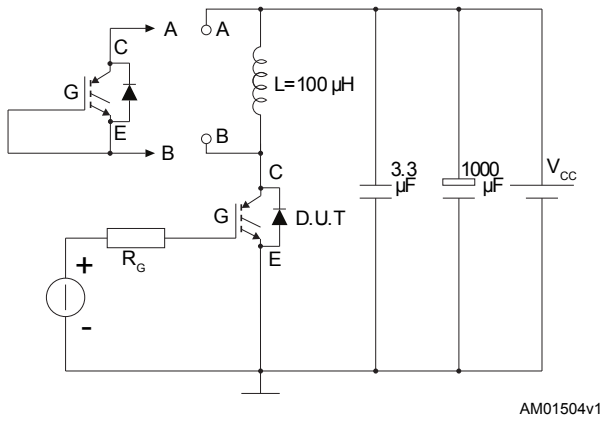
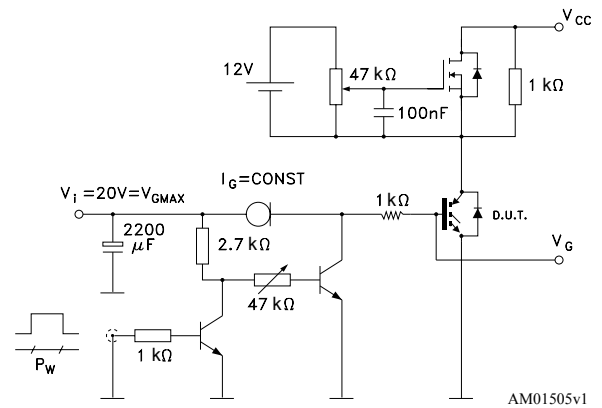
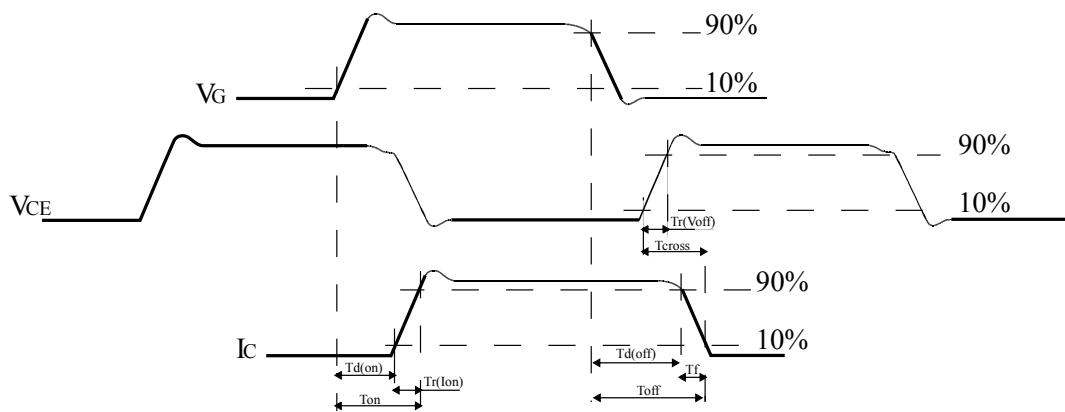


Figure 21. Thermal impedance



3 Test circuits

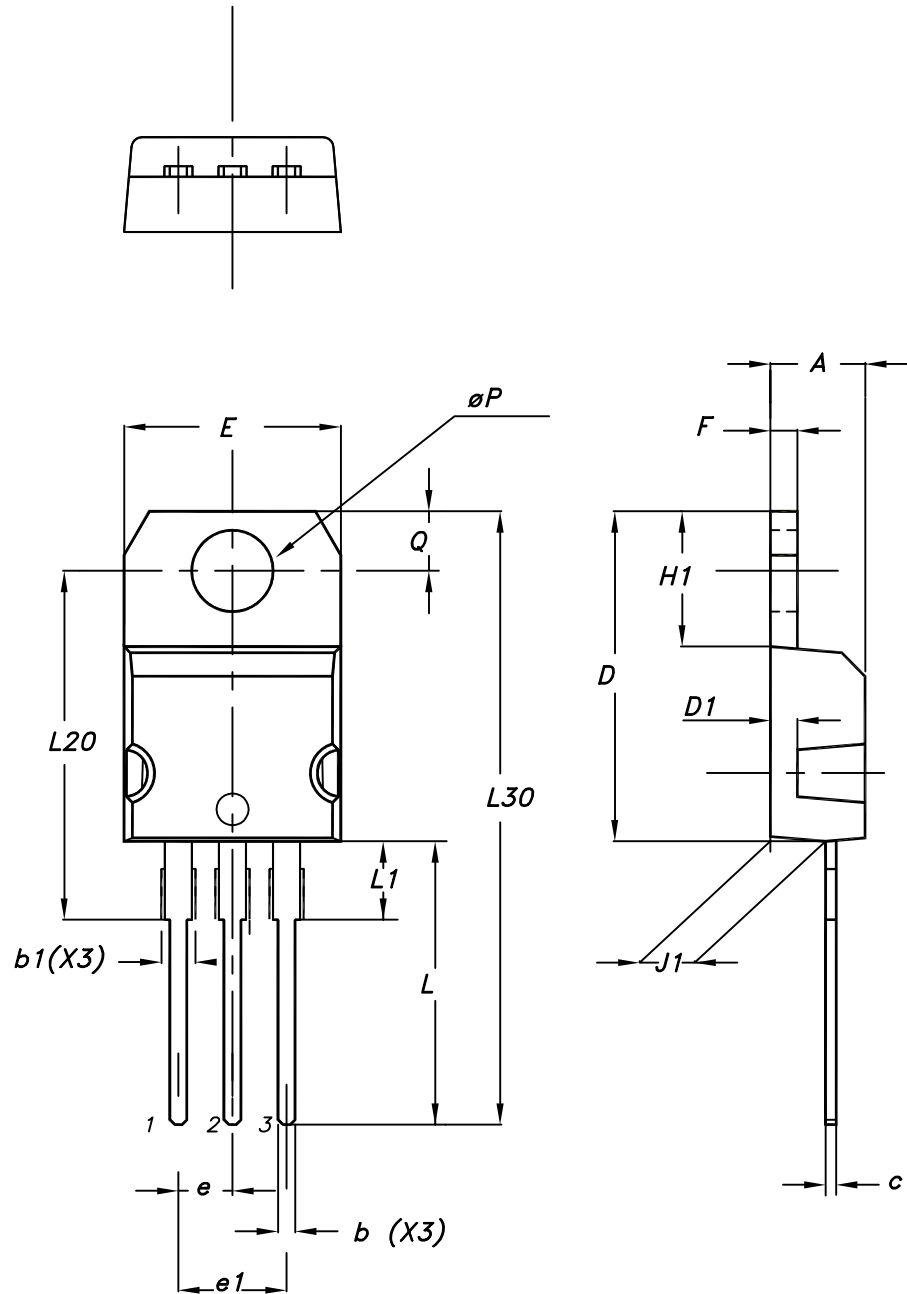
Figure 22. Test circuit for inductive load switching

Figure 23. Gate charge test circuit

Figure 24. Switching 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 TO-220 type A package information

Figure 25. TO-220 type A package outline



0015988_typeA_Rev_21

Table 6. TO-220 type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95

Revision history

Table 7. Document revision history

Date	Version	Changes
10-Sep-2015	1	Initial release.
17-Apr-2018	2	Removed maturity status indication from cover page. The document status is production data. Added Section 2.1 Electrical characteristics (curves) . Updated Section 4.1 TO-220 type A package information . Minor text changes
01-Aug-2018	3	Updated Table 5. Switching characteristics (inductive load) .

Contents

1	Electrical ratings	2
2	Electrical characteristics	3
2.1	Electrical characteristics (curves)	5
3	Test circuits	9
4	Package information	10
4.1	TO-220 type A package information	10
	Revision history	13

IMPORTANT NOTICE – PLEASE READ CAREFULLY

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2018 STMicroelectronics – All rights reserved