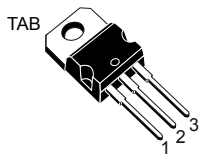
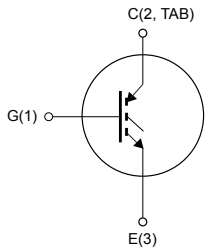
Trench gate field-stop, 1200 V, 15 A, low-loss M series IGBT in a TO-220 package



TO-220



G1C2TE3

Features

- 10 µs 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 °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 = 15 A		1.85	2.3	V
		V_{GE} = 15 V, I_C = 15 A, T_J = 125 °C		2.1		
		V_{GE} = 15 V, I_C = 30 A, T_J = 175 °C		2.2		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 500 µA	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	-	985	-	pF
C_{oes}	Output capacitance		-	118	-	pF
C_{res}	Reverse transfer capacitance		-	38	-	pF
Q_g	Total gate charge	V_{CC} = 960 V, I_C = 15 A, V_{GE} = 0 to 15 V (see Figure 23. Gate charge test circuit)	-	53	-	nC
Q_{ge}	Gate-emitter charge		-	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 V, I_C = 15 A, V_{GE} = 15 V, R_G = 22 Ω, (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 V, I_C = 15 A, V_{GE} = 15 V, R_G = 22 Ω, T_J = 175 °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} ≤ 600 V, V_{GE} = 15 V, T_{Jstart} = 150 °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

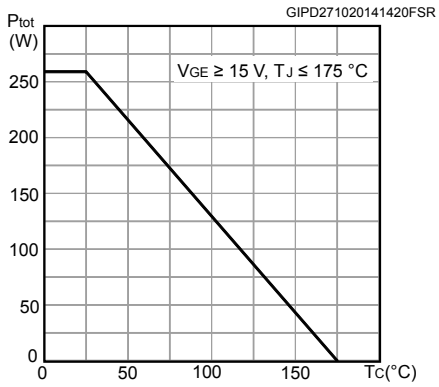


Figure 2. Collector current vs case temperature

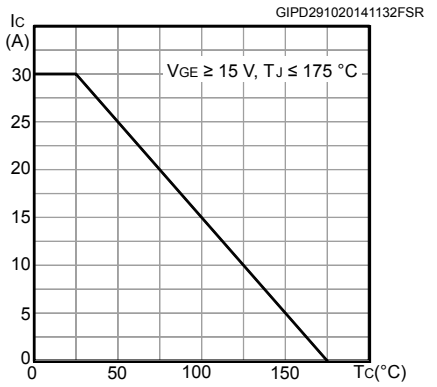


Figure 3. Output characteristics (T_J = 25 °C)

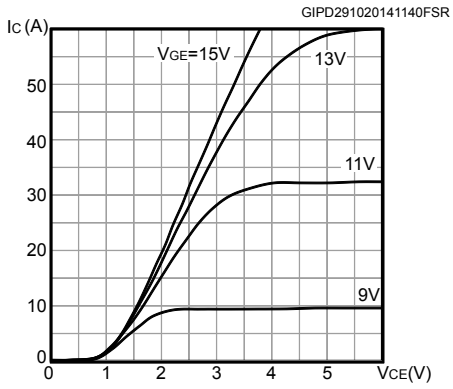


Figure 4. Output characteristics (T_J = 175°C)

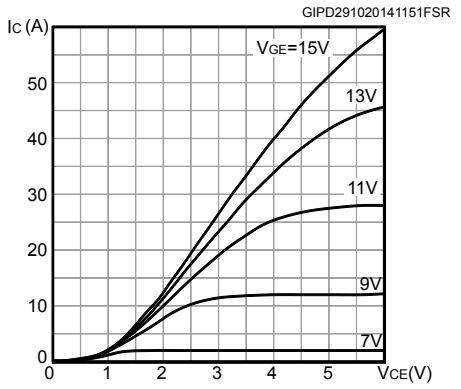


Figure 5. $V_{CE(sat)}$ vs junction temperature

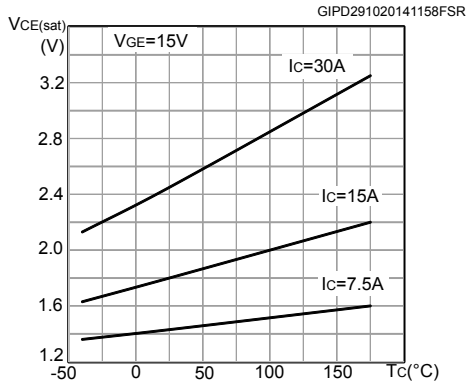


Figure 6. $V_{CE(sat)}$ vs collector current

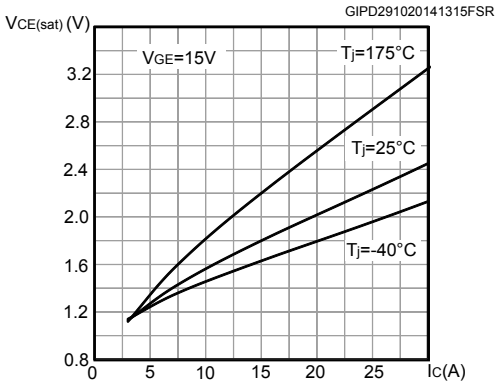


Figure 7. Collector current vs switching frequency

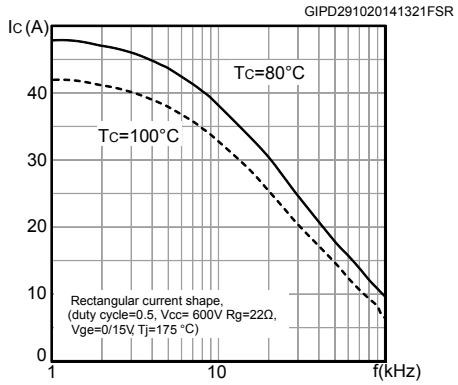


Figure 8. Safe operating area

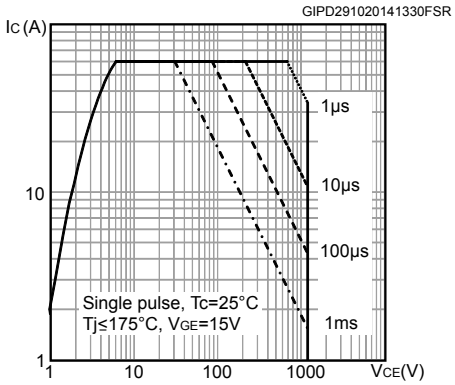


Figure 9. Transfer characteristics

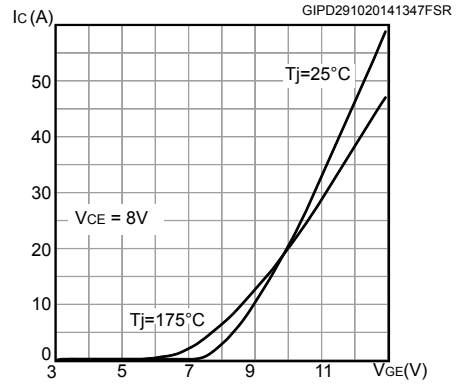


Figure 10. Normalized $V_{GE(th)}$ vs junction temperature

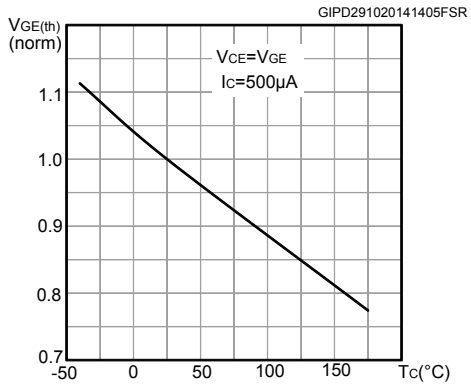


Figure 11. Normalized $V_{(BR)CES}$ vs junction temperature

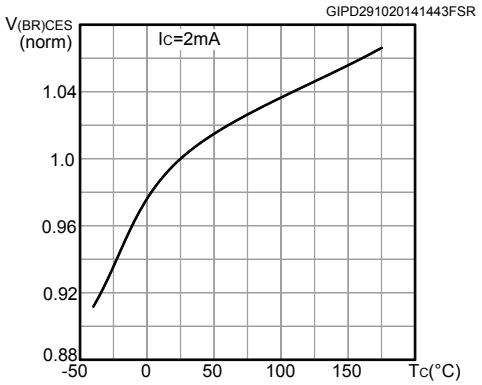


Figure 12. Capacitance variations

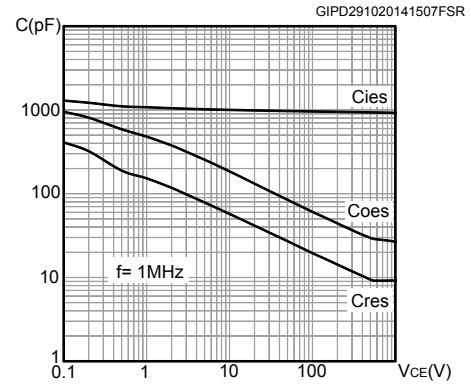


Figure 13. Gate charge vs gate-emitter voltage

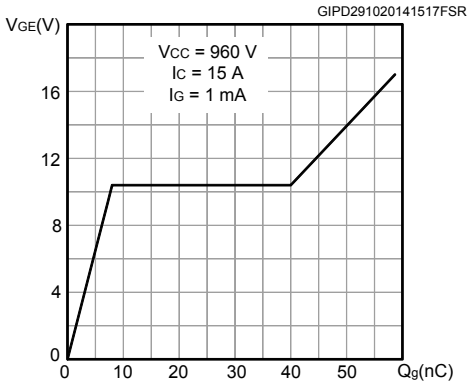


Figure 14. Switching energy vs collector current

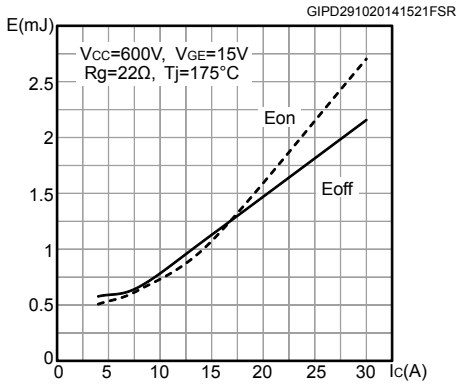


Figure 15. Switching energy vs gate resistance

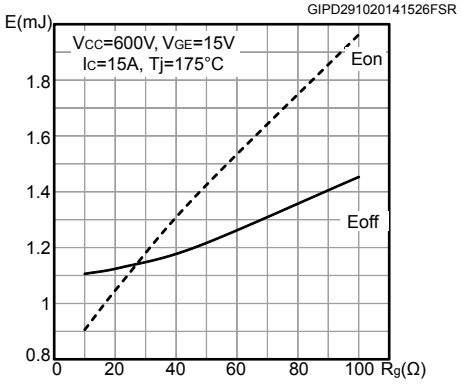


Figure 16. Switching energy vs junction temperature

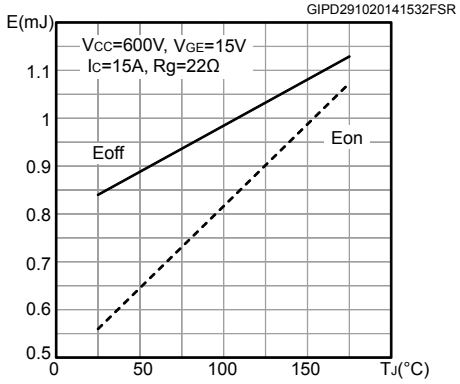


Figure 17. Switching energy vs collector emitter voltage

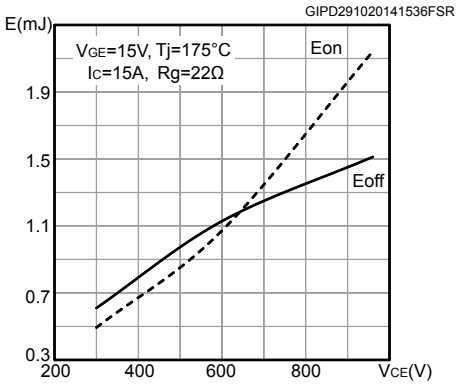


Figure 18. Short-circuit time and current vs V_{GE}

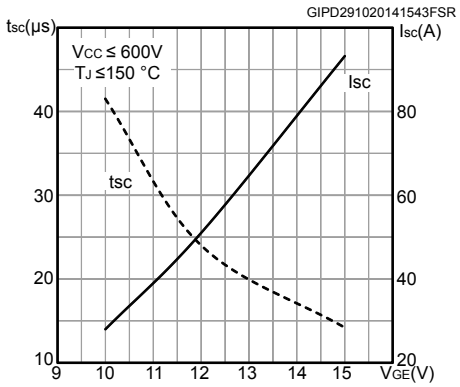


Figure 19. Switching times vs collector current

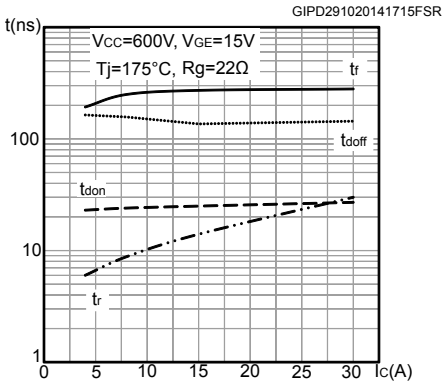


Figure 20. Switching times vs gate resistance

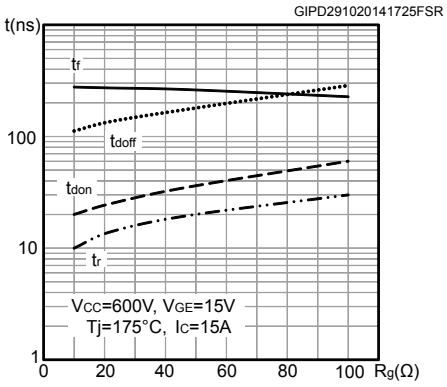
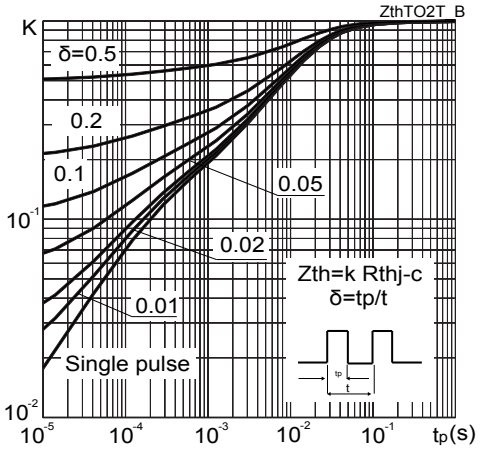


Figure 21. Thermal impedance



3 Test circuits

Figure 22. Test circuit for inductive load switching

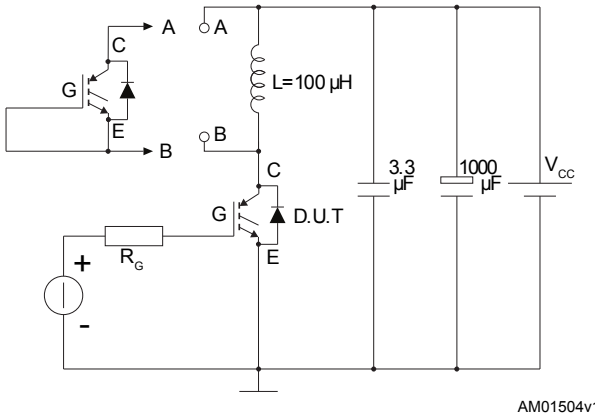


Figure 23. Gate charge test circuit

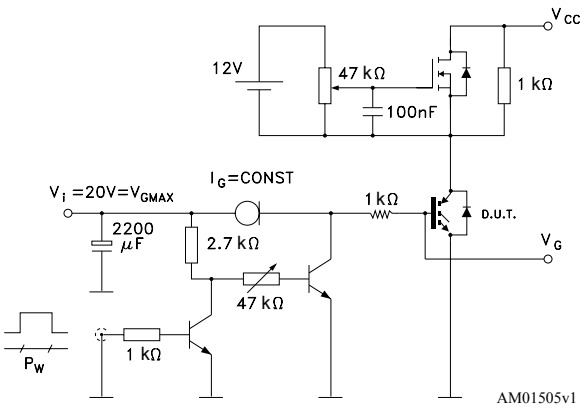
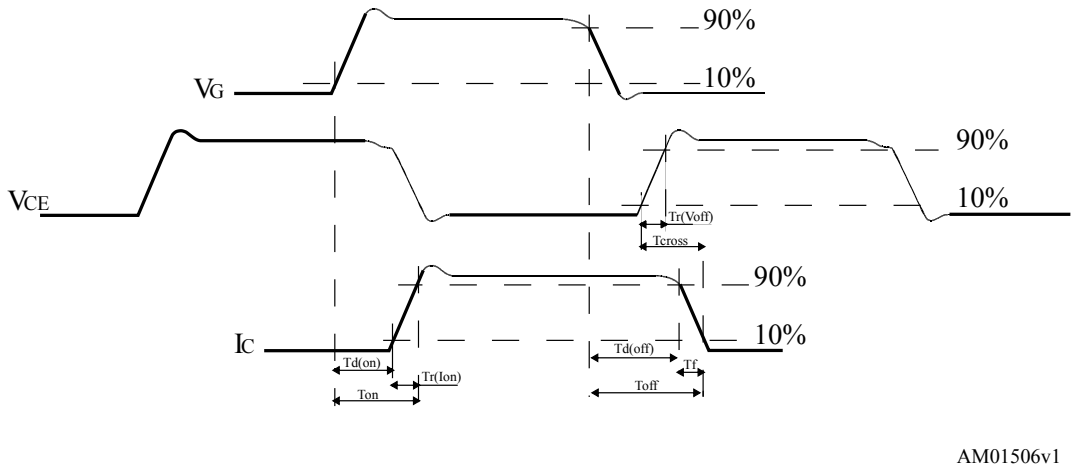


Figure 24. Switching waveform

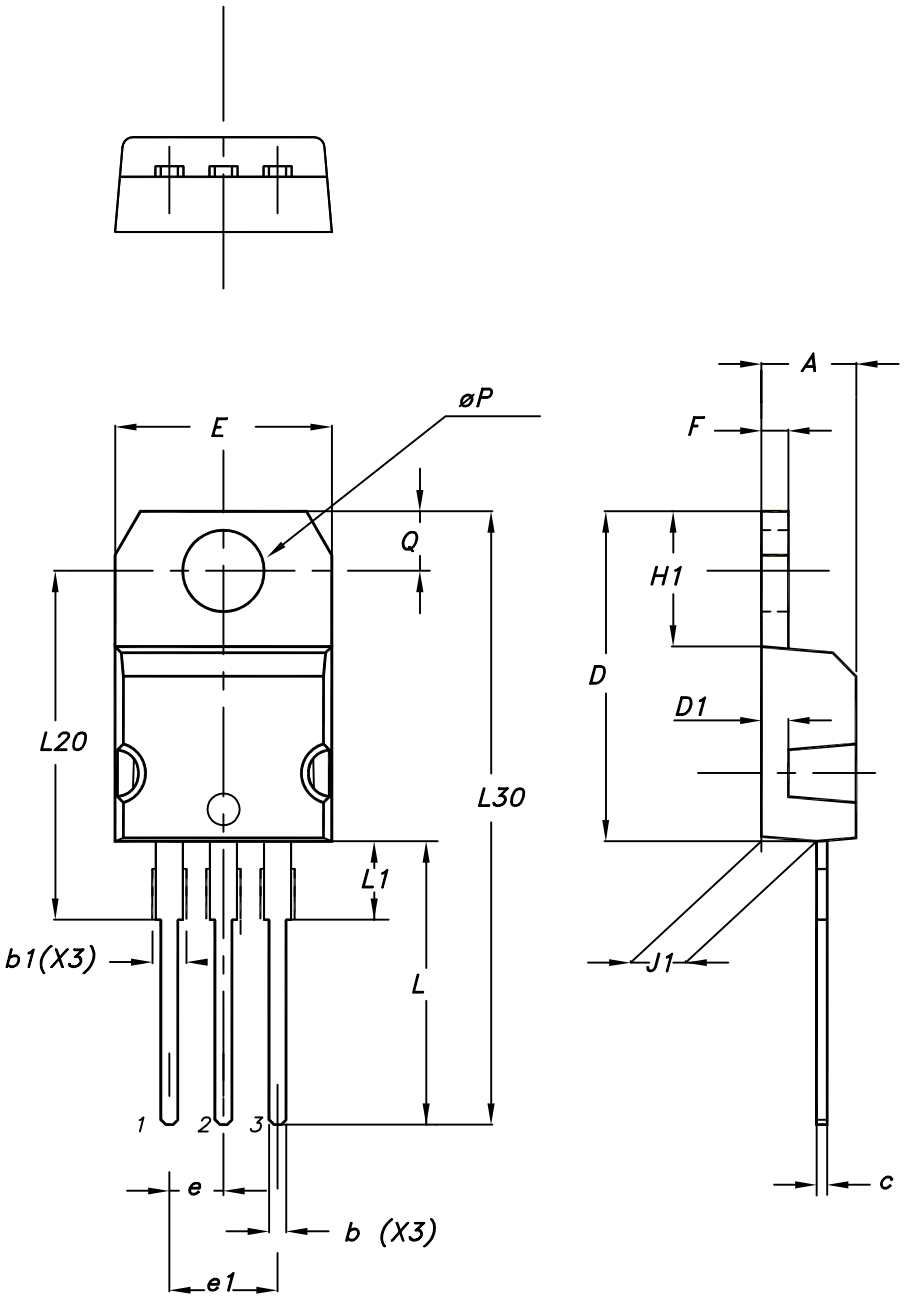


4 Package information

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).

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