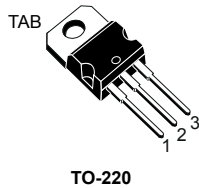
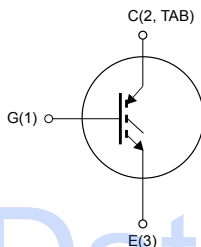


## Trench gate field-stop, 1200 V, 15 A, low-loss M series IGBT in a TO-220 package



TO-220



G1C2TE3

## Features

- 10  $\mu$ 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

<b>Order code</b>	STGP15M120F3
<b>Marking</b>	G15M120F3
<b>Package</b>	TO-220
<b>Packing</b>	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	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$ , $V_{GE} = \pm 20\text{ V}$			$\pm 250$	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	$V_{CC} = 960\text{ V}$ , $I_C = 15\text{ A}$ , $V_{GE} = 0\text{ to }15\text{ V}$ (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)**

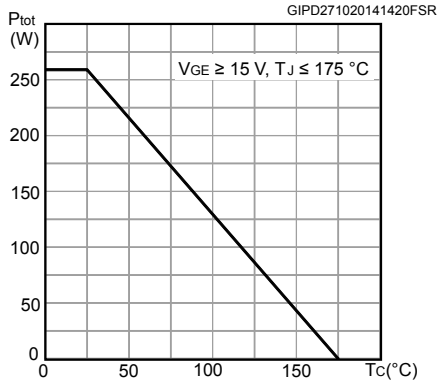
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 600\text{ V}$ , $I_C = 15\text{ A}$ , $V_{GE} = 15\text{ V}$ , $R_G = 22\text{ }\Omega$ , (see Figure 22. Test circuit for inductive load switching)	-	26	-	ns
$t_r$	Current rise time		-	12	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1000	-	A/ $\mu\text{s}$
$t_{d(off)}$	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/ $\mu\text{s}$
$t_{d(off)}$	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		-	$\mu\text{s}$

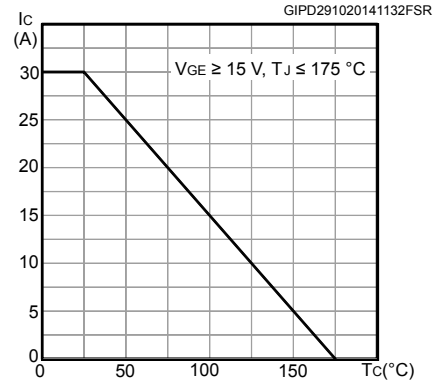
1. Including the recovery of the external diode. The diode is the same of the co-packed STGWA15M120DF3 device.
2. Including the tail of the collector current.

## 2.1 Electrical characteristics (curves)

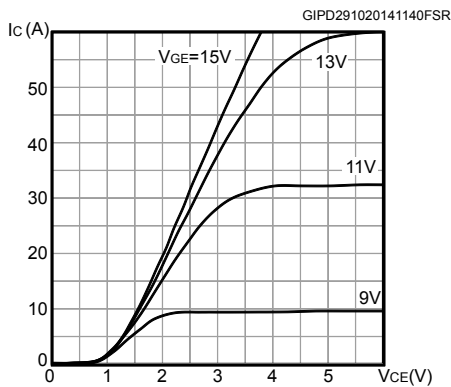
**Figure 1. Power dissipation vs case temperature**



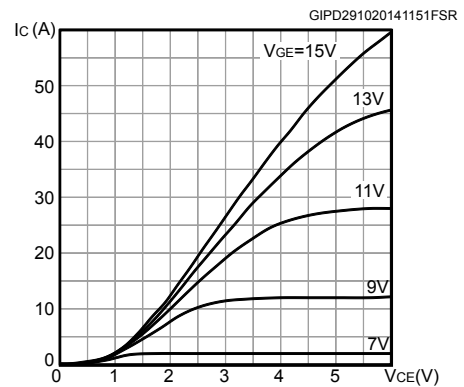
**Figure 2. Collector current vs case temperature**



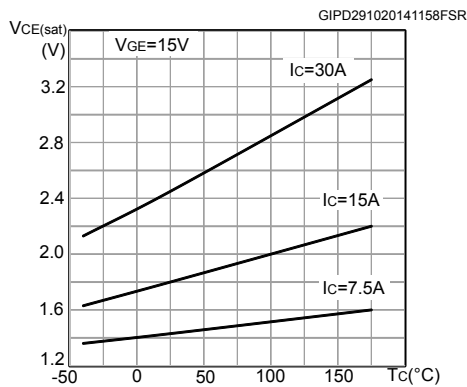
**Figure 3. Output characteristics ( $T_J = 25^\circ C$ )**



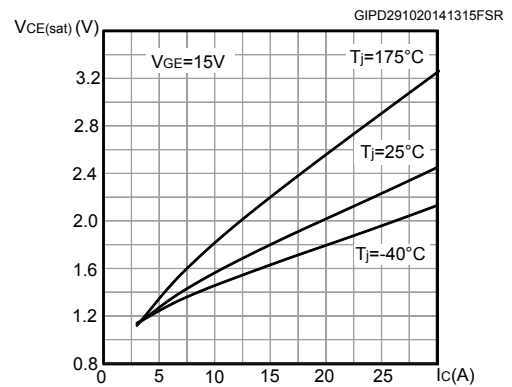
**Figure 4. Output characteristics ( $T_J = 175^\circ C$ )**



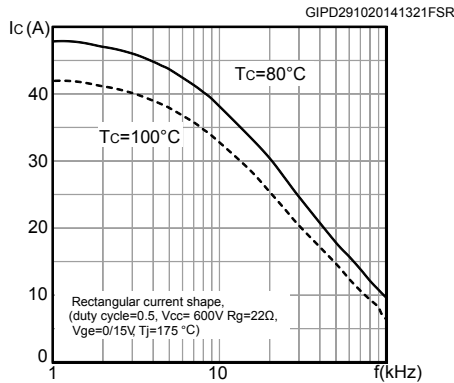
**Figure 5.  $V_{CE(sat)}$  vs junction temperature**



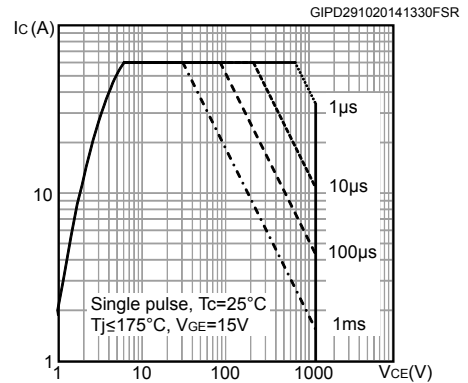
**Figure 6.  $V_{CE(sat)}$  vs collector current**



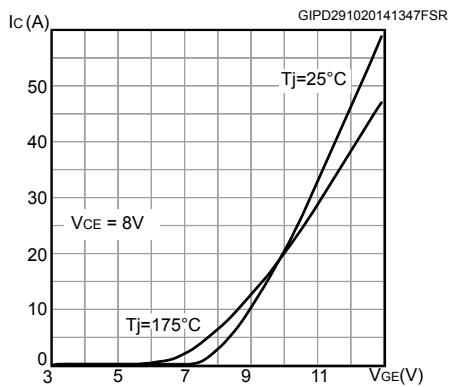
**Figure 7. Collector current vs switching frequency**



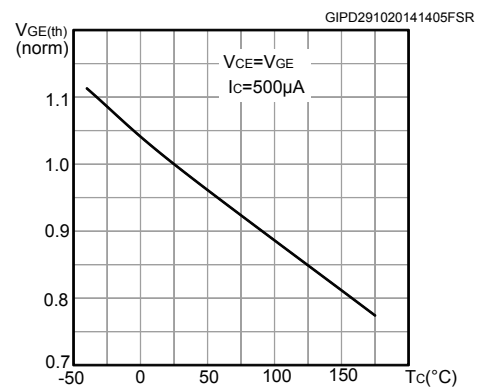
**Figure 8. Safe operating area**



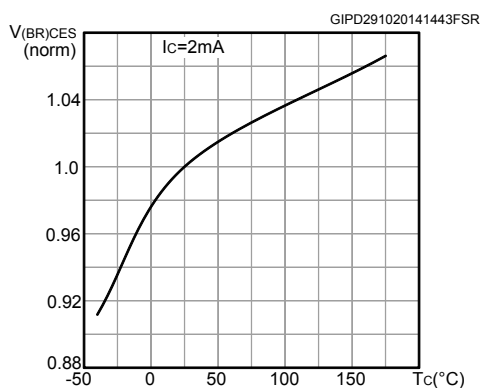
**Figure 9. Transfer characteristics**



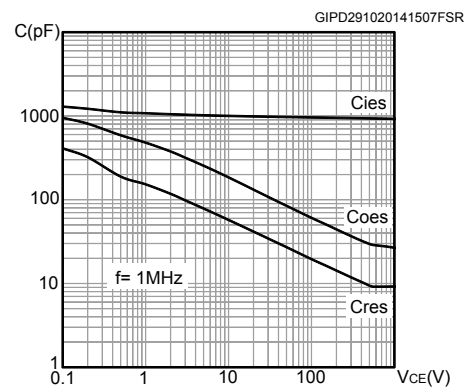
**Figure 10. Normalized  $V_{GE(th)}$  vs junction temperature**



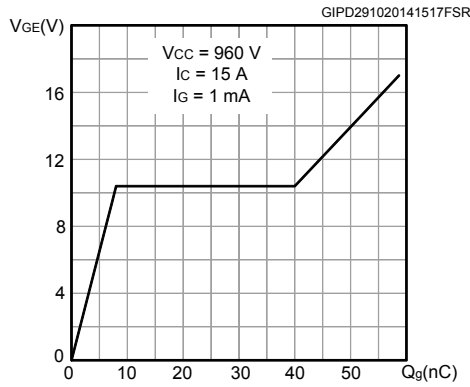
**Figure 11. Normalized  $V_{(BR)CES}$  vs junction temperature**



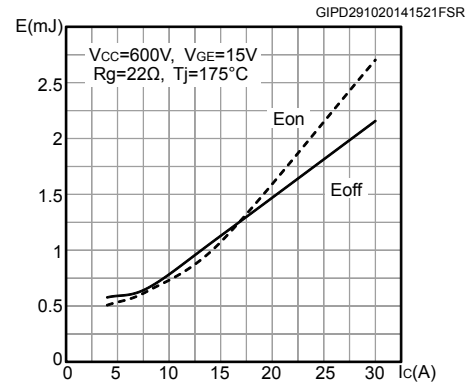
**Figure 12. Capacitance variations**



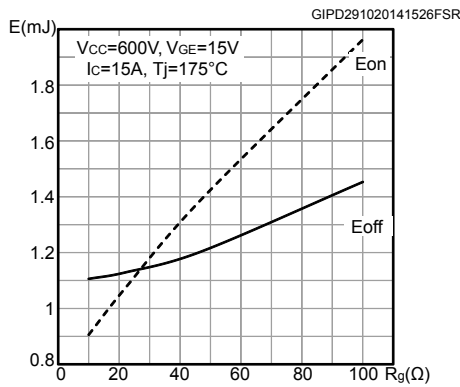
**Figure 13. Gate charge vs gate-emitter voltage**



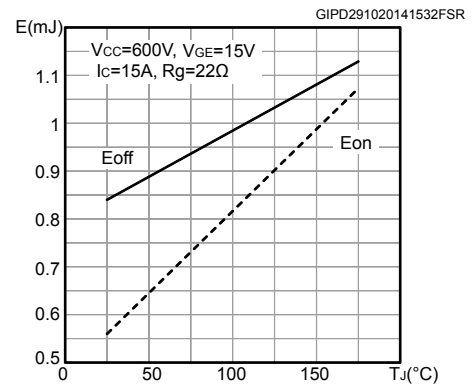
**Figure 14. Switching energy vs collector current**



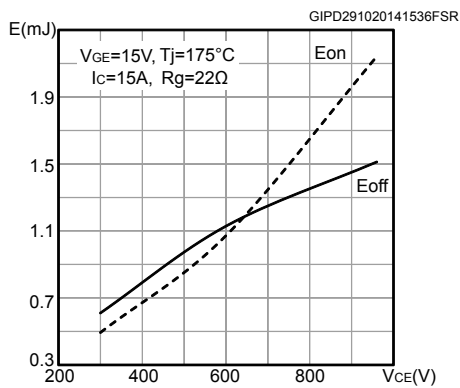
**Figure 15. Switching energy vs gate resistance**



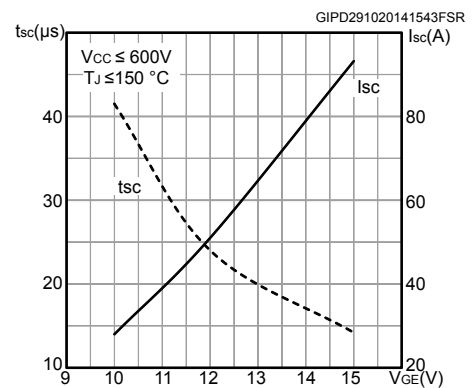
**Figure 16. Switching energy vs junction temperature**



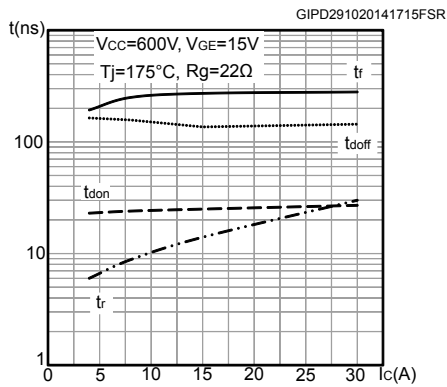
**Figure 17. Switching energy vs collector emitter voltage**



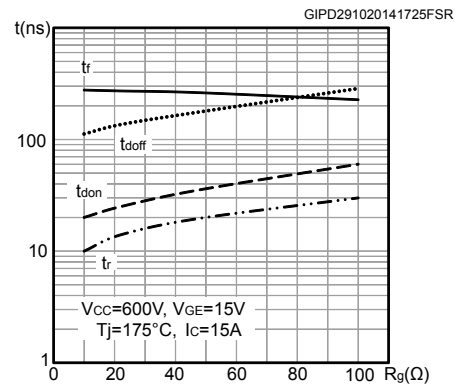
**Figure 18. Short-circuit time and current vs VGE**



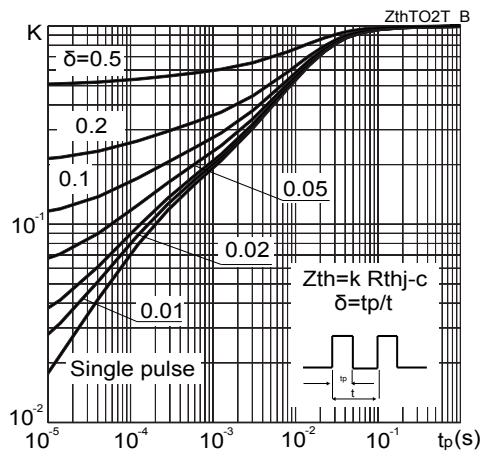
**Figure 19. Switching times vs collector current**



**Figure 20. Switching times vs gate resistance**

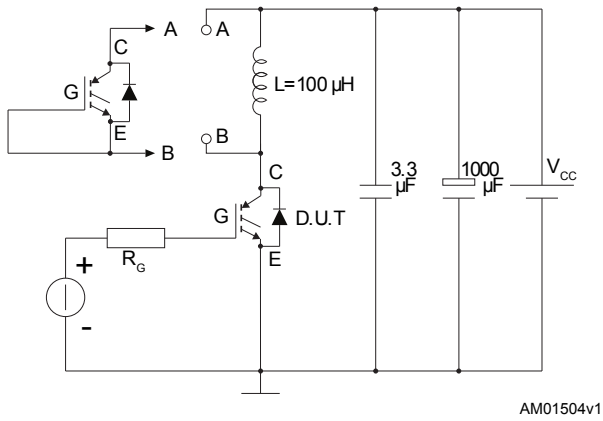
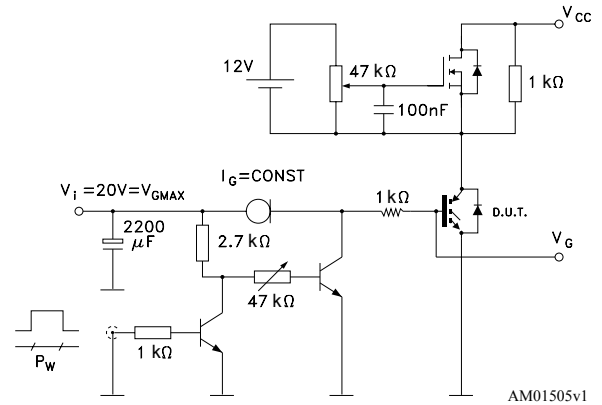
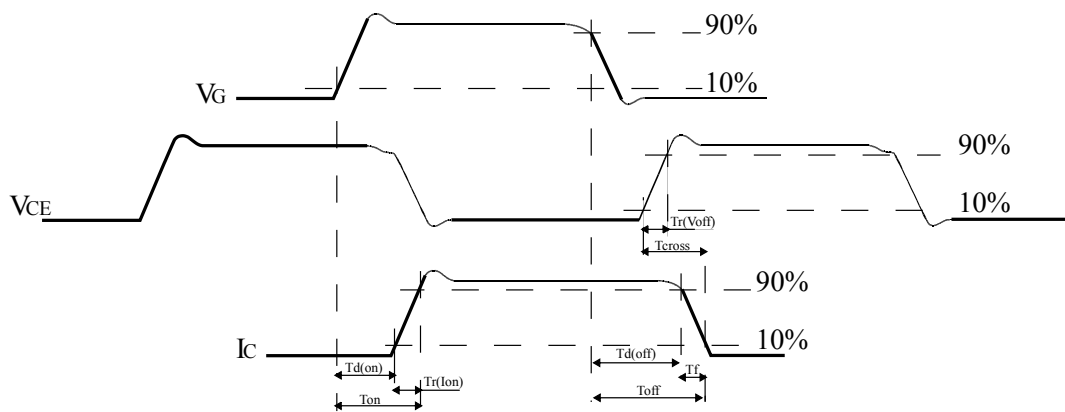


**Figure 21. Thermal impedance**





### 3 Test circuits

**Figure 22. Test circuit for inductive load switching**

**Figure 23. Gate charge test circuit**

**Figure 24. Switching waveform**


AM01506v1

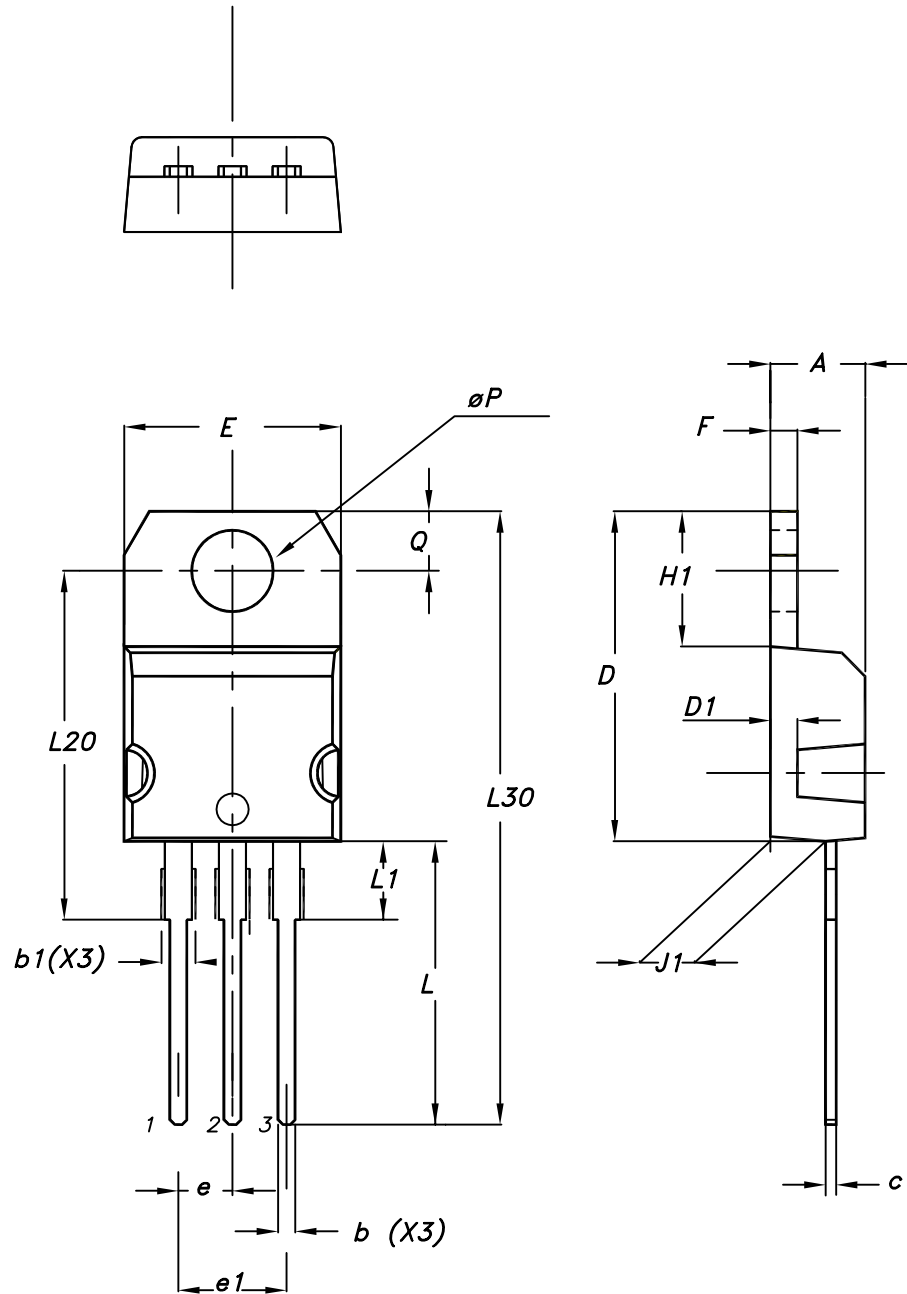
## 4 Package information

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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 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 <a href="#">Section 2.1 Electrical characteristics (curves)</a> . Updated <a href="#">Section 4.1 TO-220 type A package information</a> . Minor text changes
01-Aug-2018	3	Updated <a href="#">Table 5. Switching characteristics (inductive load)</a> .

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