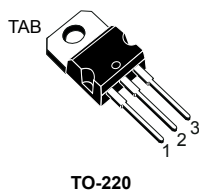


Trench gate field-stop, 650 V, 20 A, high-speed HB2 series IGBT in a TO-220 package



Features

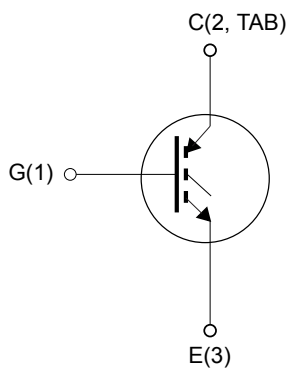
- Maximum junction temperature : $T_J = 175\text{ }^{\circ}\text{C}$
- Low $V_{CE(sat)} = 1.65\text{ V (typ.) @ } I_C = 20\text{ A}$
- Minimized tail current
- Tight parameter distribution
- Low thermal resistance
- Positive $V_{CE(sat)}$ temperature coefficient

Applications

- Welding
- Power factor correction
- UPS
- Solar inverters
- Chargers

Description

The newest IGBT 650 V HB2 series represents an evolution of the advanced proprietary trench gate field-stop structure. The performance of the HB2 series is optimized in terms of conduction, thanks to a better $V_{CE(sat)}$ behavior at low current values, as well as in terms of reduced switching energy. The result is a product specifically designed to maximize efficiency for a wide range of fast applications.



G1C2TE3



Product status link

[STGP20H65FB2](#)

Product summary

Order code	STGP20H65FB2
Marking	G20H65FB2
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)	650	V
I_C	Continuous collector current at $T_C = 25$ °C	40	A
	Continuous collector current at $T_C = 100$ °C	25	
I_{CP} ⁽¹⁾⁽²⁾	Pulsed collector current	60	
V_{GE}	Gate-emitter voltage	±20	V
	Transient gate-emitter voltage ($t_p \leq 10$ µs)	±30	
P_{TOT}	Total power dissipation at $T_C = 25$ °C	147	W
T_{stg}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range	-55 to 175	

1. Defined by design, not subject to production test.
2. Pulse width is limited by maximum junction temperature.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case	1.02	°C/W
R_{thJA}	Thermal resistance junction-ambient	62.5	

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	$V_{GE} = 0\text{ V}$, $I_C = 1\text{ mA}$	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$		1.65	2.1	V
		$V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$, $T_J = 125\text{ °C}$		1.95		
		$V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$, $T_J = 175\text{ °C}$		2.1		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 1\text{ mA}$	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	nA

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	1010	-	pF
C_{oes}	Output capacitance		-	81	-	
C_{res}	Reverse transfer capacitance		-	26	-	
Q_g	Total gate charge	$V_{CC} = 520\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 22. Gate charge test circuit)	-	56	-	nC
Q_{ge}	Gate-emitter charge		-	9.4	-	
Q_{gc}	Gate-collector charge		-	27.8	-	

Table 5. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$ (see Figure 21. Test circuit for inductive load switching)	-	16	-	ns
t_r	Current rise time		-	8	-	ns
$E_{on}^{(1)}$	Turn-on switching energy		-	265	-	μJ
$t_{d(off)}$	Turn-off delay time		-	78.8	-	ns
t_f	Current fall time		-	35	-	ns
$E_{off}^{(2)}$	Turn-off switching energy		-	214	-	μJ
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 21. Test circuit for inductive load switching)	-	17	-	ns
t_r	Current rise time		-	9	-	ns
$E_{on}^{(1)}$	Turn-on switching energy		-	556	-	μJ
$t_{d(off)}$	Turn-off delay time		-	98	-	ns
t_f	Current fall time		-	80	-	ns
$E_{off}^{(2)}$	Turn-off switching energy		-	378	-	μJ

1. Including the reverse recovery of the external diode. The diode is the same of the co-packed STGWA20H65DFB2.
2. Including the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature

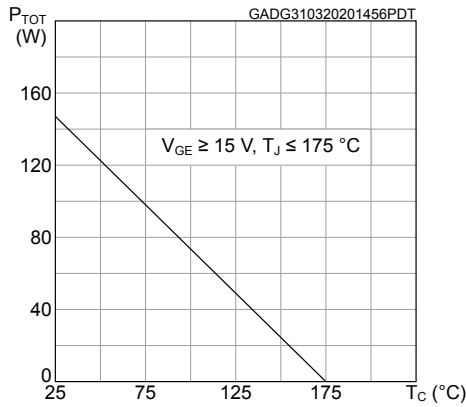


Figure 2. Collector current vs case temperature

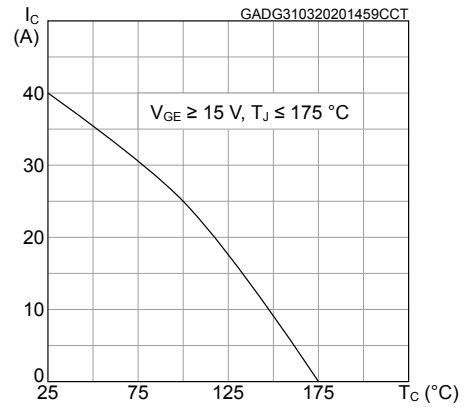


Figure 3. Output characteristics ($T_J = 25 \text{ }^{\circ}\text{C}$)

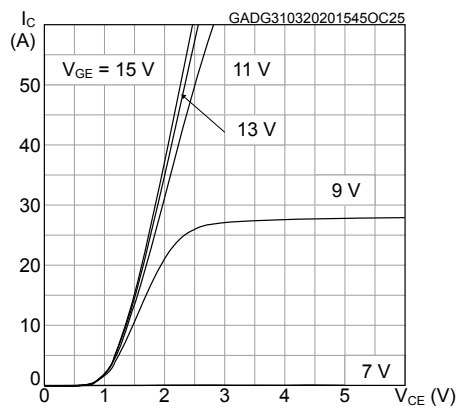


Figure 4. Output characteristics ($T_J = 175 \text{ }^{\circ}\text{C}$)

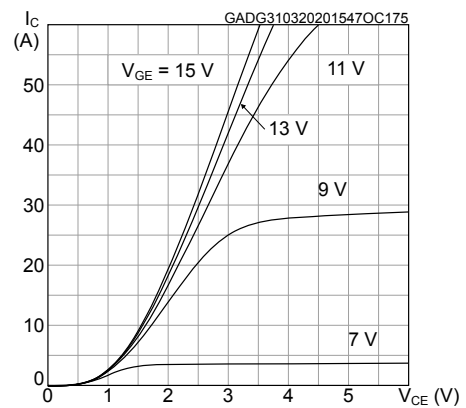


Figure 5. $V_{CE(sat)}$ vs junction temperature

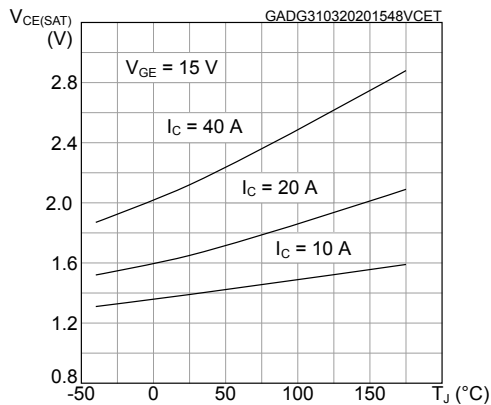


Figure 6. $V_{CE(sat)}$ vs collector current

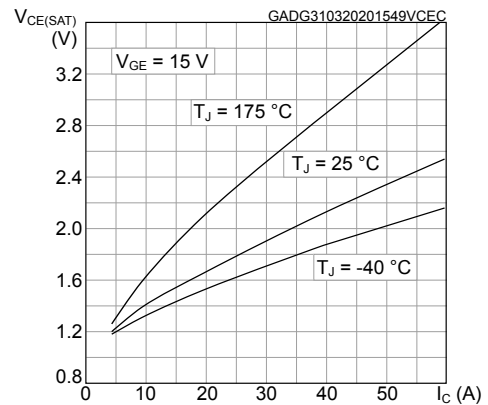


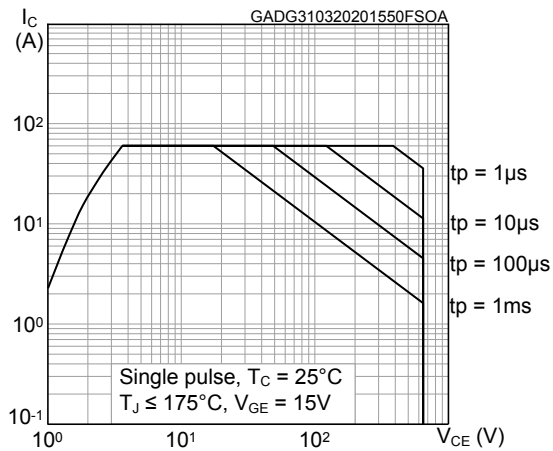
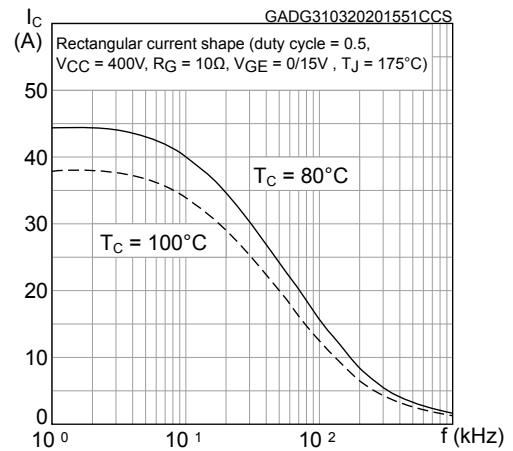
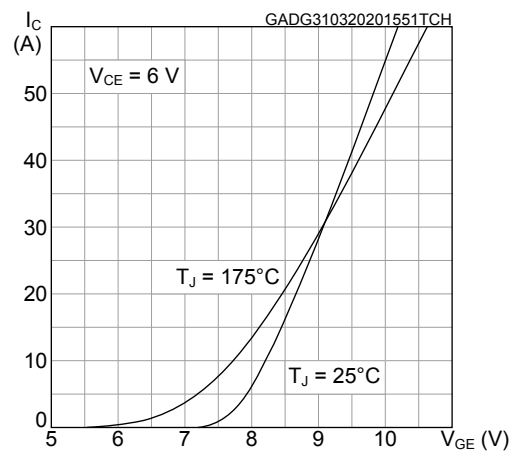
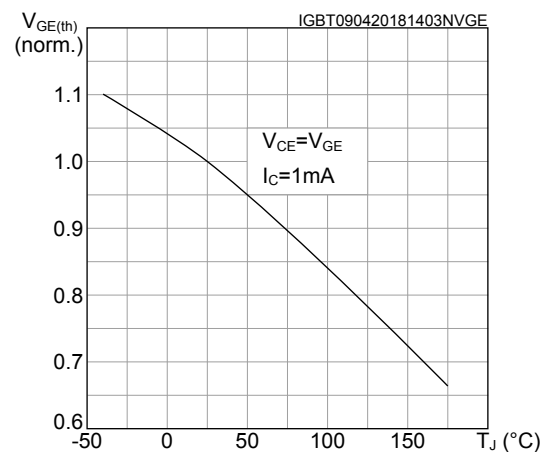
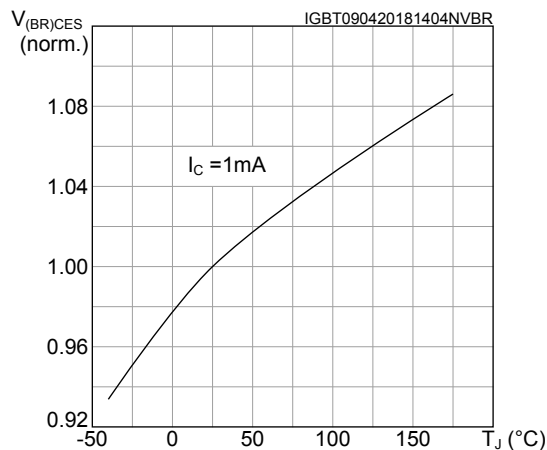
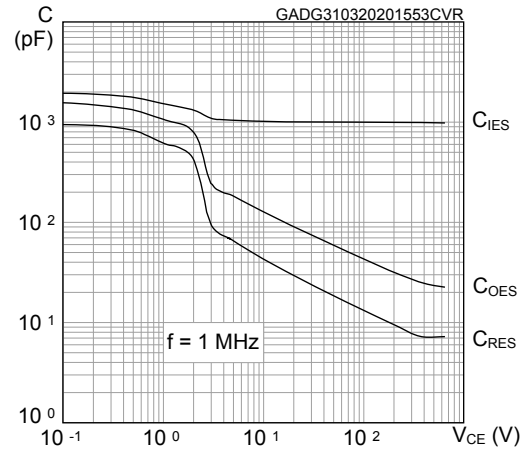
Figure 7. Forward bias safe operating area

Figure 8. Collector current vs switching frequency

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


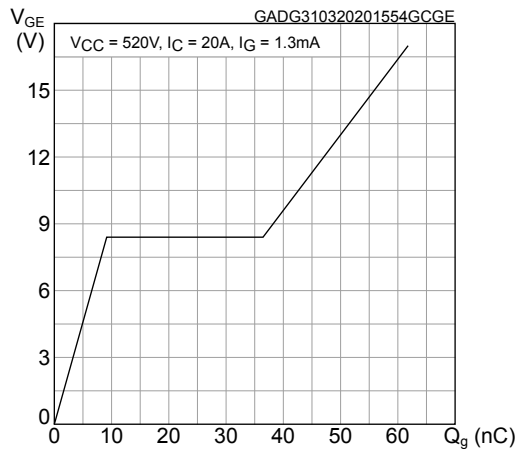
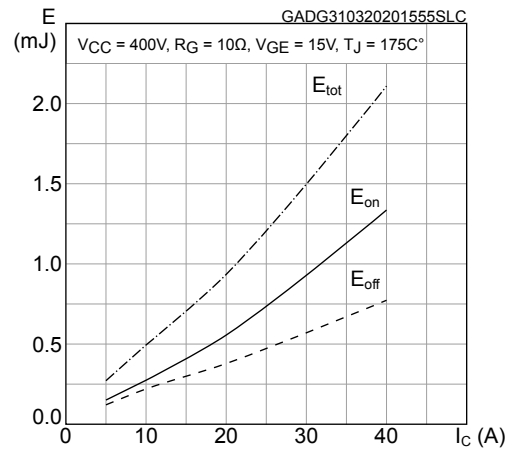
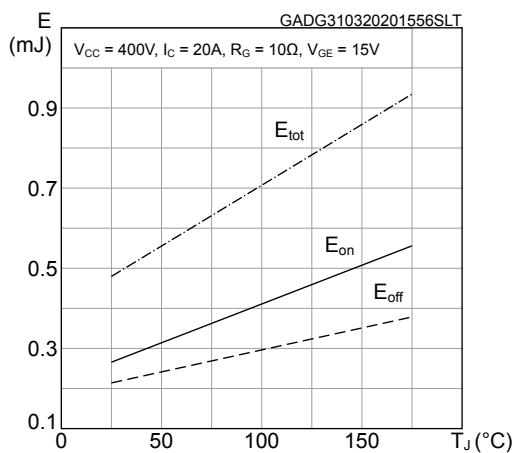
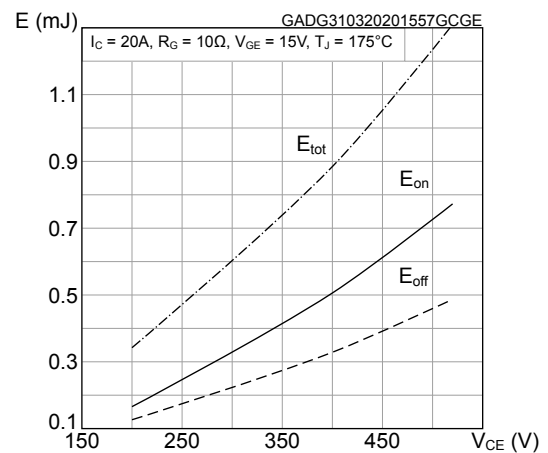
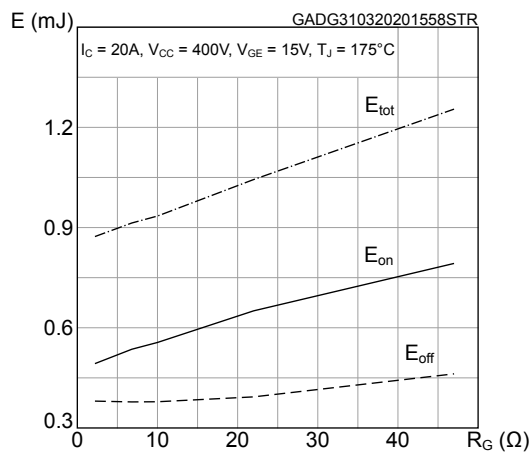
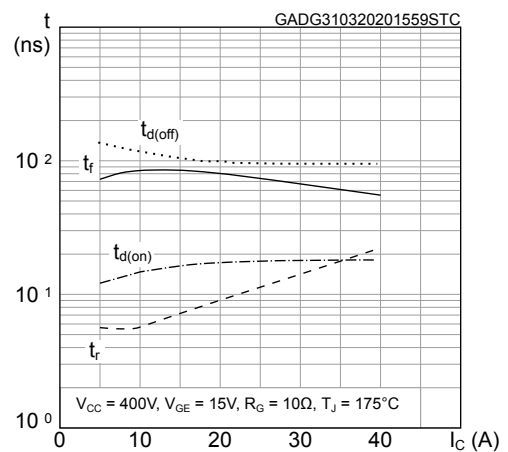
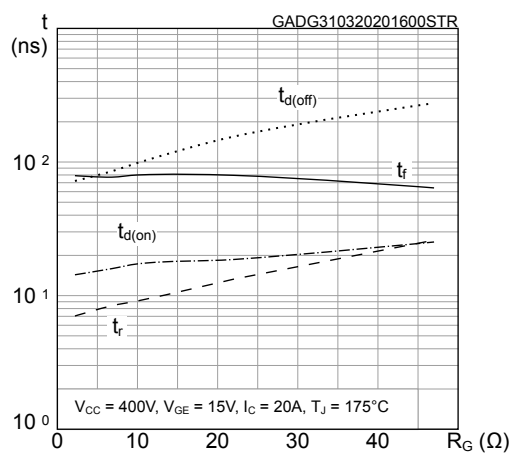
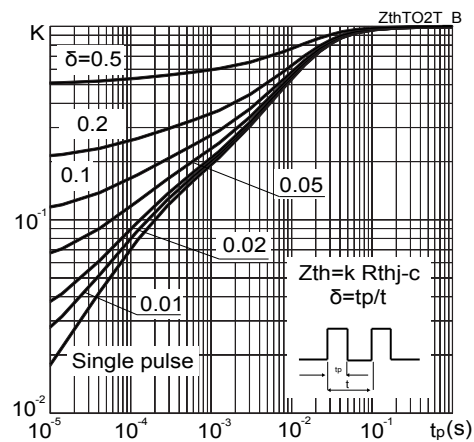
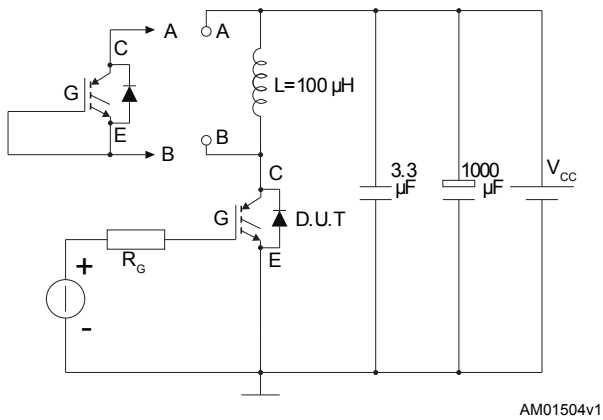
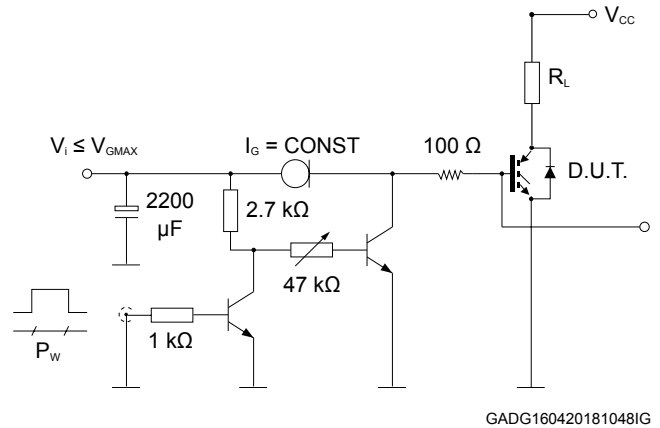
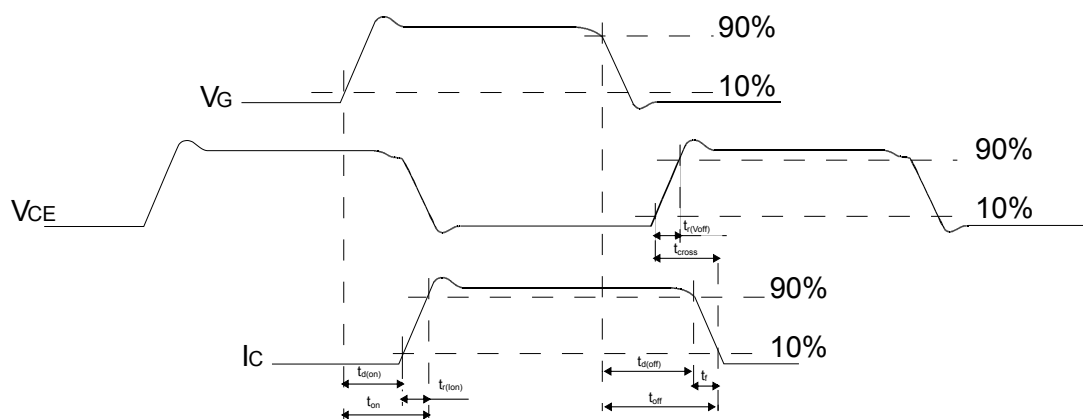
Figure 13. Gate charge vs gate-emitter voltage

Figure 14. Switching energy vs collector current

Figure 15. Switching energy vs temperature

Figure 16. Switching energy vs collector emitter voltage

Figure 17. Switching energy vs gate resistance

Figure 18. Switching times vs collector current


Figure 19. Switching times vs gate resistance

Figure 20. Thermal impedance


3 Test circuits

Figure 21. Test circuit for inductive load switching

Figure 22. Gate charge test circuit

Figure 23. Switching waveform


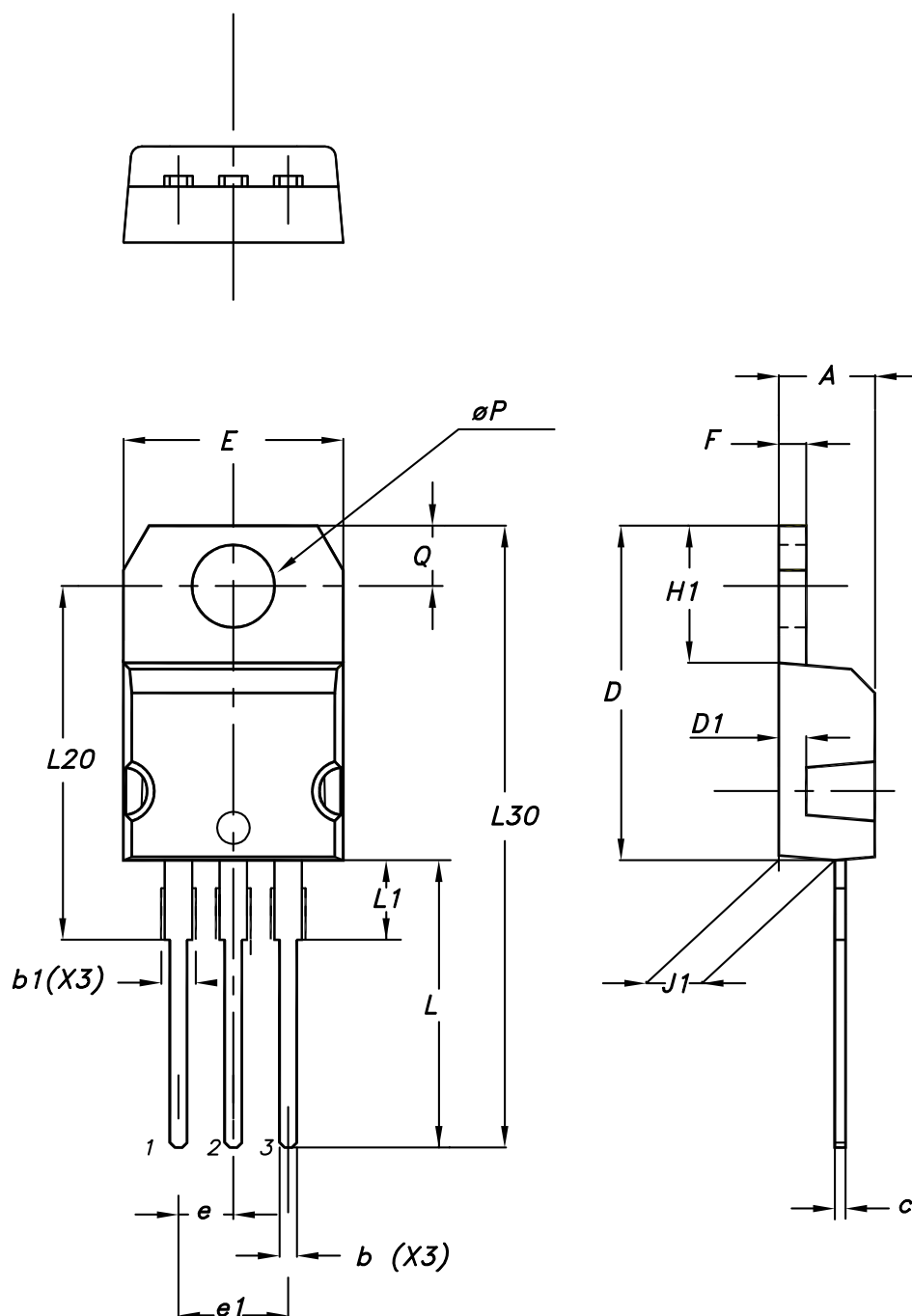
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4 Package information

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 24. TO-220 type A package outline



0015988_typeA_Rev_23

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
Slug flatness		0.03	0.10

Revision history

Table 7. Document revision history

Date	Version	Changes
20-May-2020	1	First release.

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