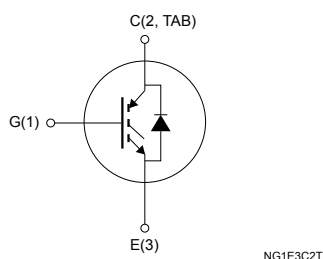
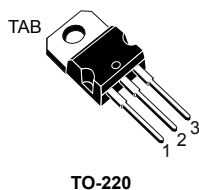


Trench gate field-stop 650 V, 20 A, soft-switching IH series IGBT in a TO-220 package



Features

- Designed for soft-commutation
- Maximum junction temperature: $T_J = 175\text{ }^{\circ}\text{C}$
- $V_{CE(sat)} = 1.55\text{ V (typ.) @ } I_C = 20\text{ A}$
- Minimized tail current
- Tight parameter distribution
- Low thermal resistance
- Low drop voltage freewheeling co-packaged diode
- Positive $V_{CE(sat)}$ temperature coefficient

Applications

- Induction heating
- Resonant converters
- Microwave ovens

Description

The newest IGBT 650 V soft-switching IH series has been developed using an advanced proprietary trench gate field-stop structure, whose performance is optimized both in conduction and switching losses for soft commutation. A freewheeling diode with a low drop forward voltage is included. The result is a product specifically designed to maximize efficiency for any resonant and soft-switching applications.



Product status link

[STGP20IH65DF](#)

Product summary

Order code	STGP20IH65DF
Marking	G20IH65DF
Package	TO-220
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GE} = 0\text{ V}$)	650	V
I_C	Continuous collector current at $T_C = 25\text{ °C}$	40	A
	Continuous collector current at $T_C = 100\text{ °C}$	20	
$I_{CP}^{(1)}$	Pulsed collector current	60	
V_{GE}	Gate-emitter voltage	± 20	V
	Transient gate-emitter voltage ($t_p \leq 10\text{ }\mu\text{s}$)	± 30	
I_F	Continuous forward current at $T_C = 25\text{ °C}$	20	A
	Continuous forward current at $T_C = 100\text{ °C}$	10	
$I_{FP}^{(1)}$	Pulsed forward current	60	
P_{TOT}	Total power dissipation at $T_C = 25\text{ °C}$	159	W
T_{STG}	Storage temperature range	- 55 to 150	°C
T_J	Operating junction temperature range	- 55 to 175	

1. Pulse width limited by maximum junction temperature.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case IGBT	0.94	°C/W
	Thermal resistance, junction-to-case diode	2.08	
R_{thJA}	Thermal resistance, junction-to-ambient	62.5	

2 Electrical characteristics

$T_C = 25\text{ }^{\circ}\text{C}$ 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	$V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$		1.55	2.05	V
		$V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$		1.80		
		$V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$, $T_J = 175\text{ }^{\circ}\text{C}$		1.95		
V_F	Forward on-voltage	$I_F = 10\text{ A}$		1.50	2.15	V
		$I_F = 10\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$		1.35		
		$I_F = 10\text{ A}$, $T_J = 175\text{ }^{\circ}\text{C}$		1.25		
		$I_F = 20\text{ A}$		1.85		
$V_{GE(th)}$	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	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	1000	-	pF
C_{oes}	Output capacitance		-	62	-	
C_{res}	Reverse transfer capacitance		-	25	-	
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 23. Gate charge test circuit)	-	56	-	nC
Q_{ge}	Gate-emitter charge		-	9.6	-	
Q_{gc}	Gate-collector charge		-	26.5	-	

Table 5. IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$	Turn-off delay time	$V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 22\ \Omega$ (see Figure 21. Test circuit for inductive load switching)	-	121	-	ns
t_f	Current fall time		-	38	-	
$t_{d(off)}$	Turn-off delay time	$V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$, $R_G = 22\ \Omega$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 21. Test circuit for inductive load switching)	-	140	-	
t_f	Current fall time		-	90	-	

Table 6. IGBT switching characteristics (capacitive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{off}^{(1)}$	Turn-off switching energy	$V_{CC} = 320\text{ V}$, $R_G = 10\ \Omega$, $I_C = 20\text{ A}$, $L = 100\ \mu\text{H}$, $C_{snub} = 22\text{ nF}$ (see Figure 22. Test circuit for snubbed inductive load switching)	-	110	-	μJ
		$V_{CC} = 320\text{ V}$, $R_G = 10\ \Omega$, $I_C = 20\text{ A}$, $L = 100\ \mu\text{H}$, $C_{snub} = 22\text{ nF}$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 22. Test circuit for snubbed inductive load switching)	-	230	-	

1. Including the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature

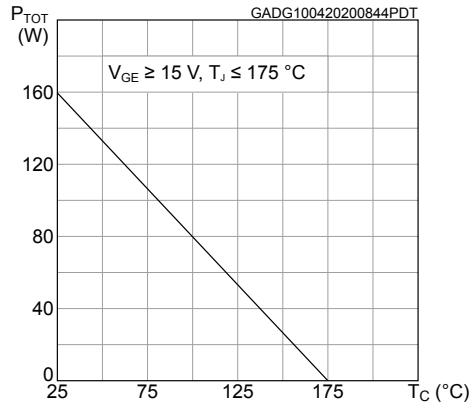


Figure 2. Collector current vs case temperature

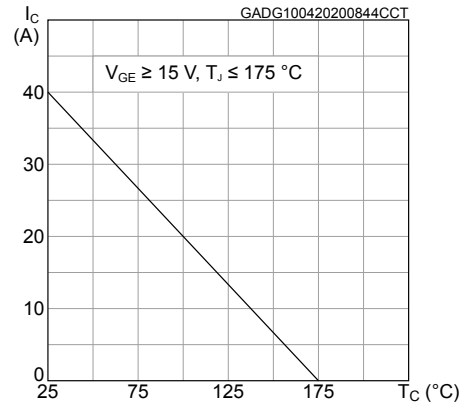


Figure 3. Output characteristics ($T_J = 25$ °C)

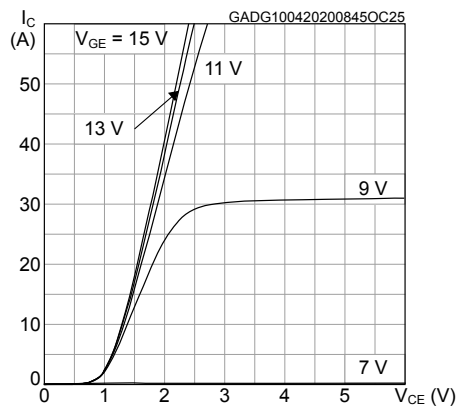


Figure 4. Output characteristics ($T_J = 175$ °C)

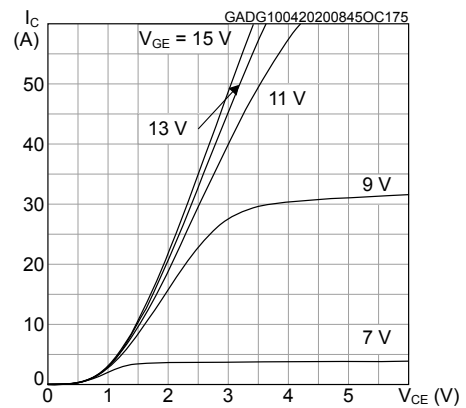


Figure 5. $V_{CE(sat)}$ vs junction temperature

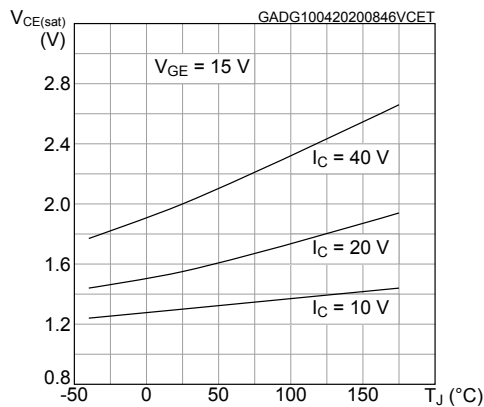


Figure 6. $V_{CE(sat)}$ vs collector current

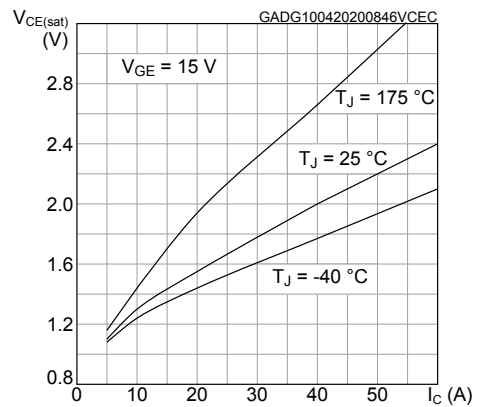


Figure 7. Forward bias safe operating area

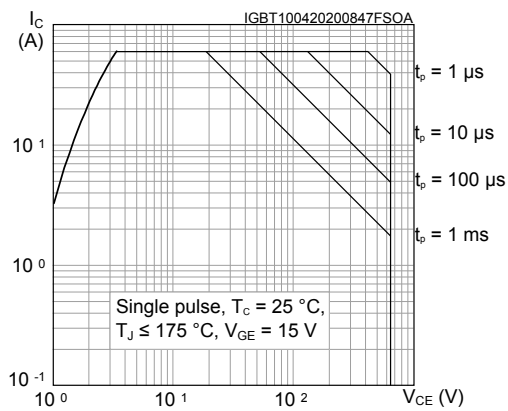


Figure 8. Transfer characteristics

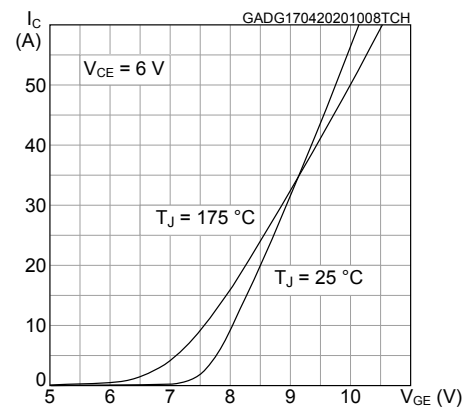


Figure 9. Diode V_F vs forward current

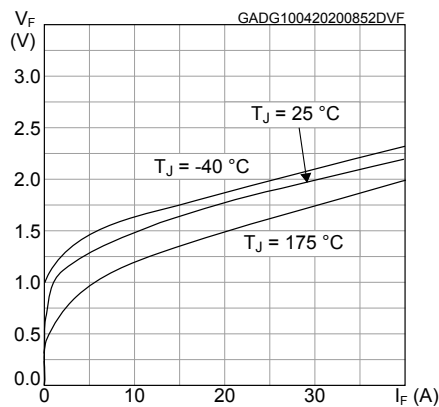


Figure 10. Normalized V_GE(th) vs junction temperature

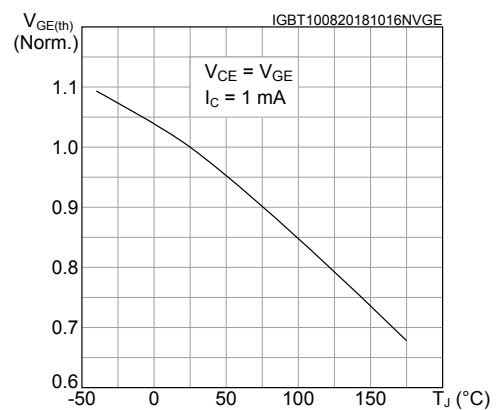


Figure 11. Normalized V_(BR)CES vs junction temperature

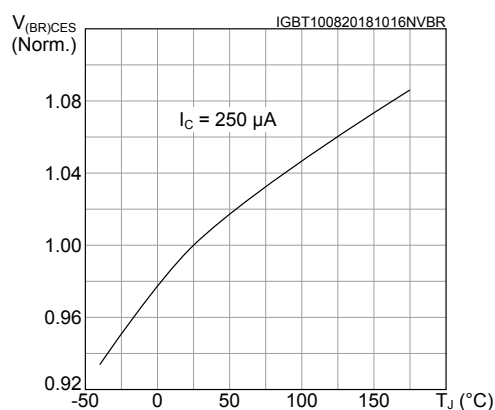


Figure 12. Capacitance variations

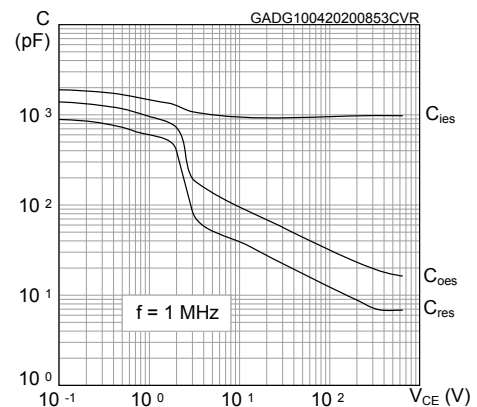


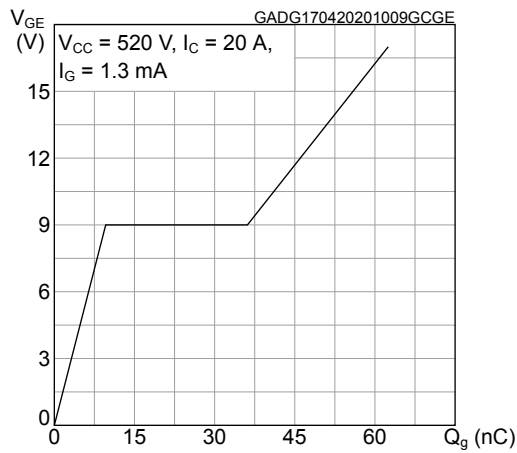
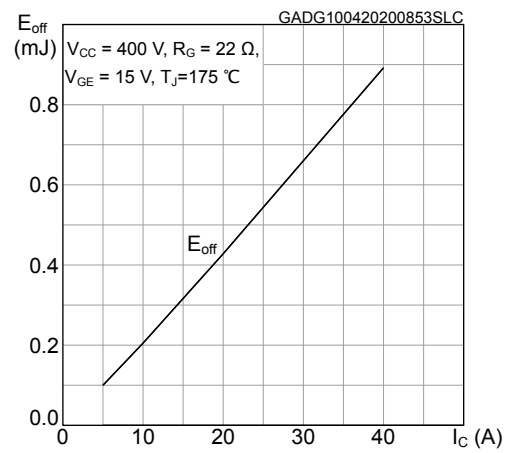
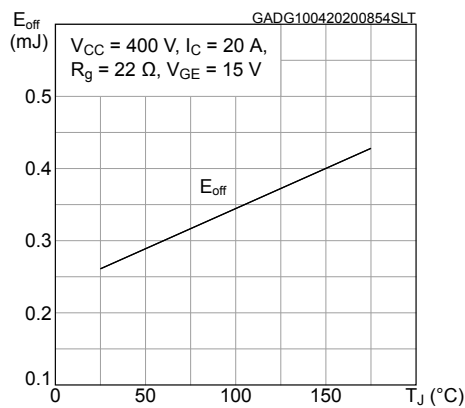
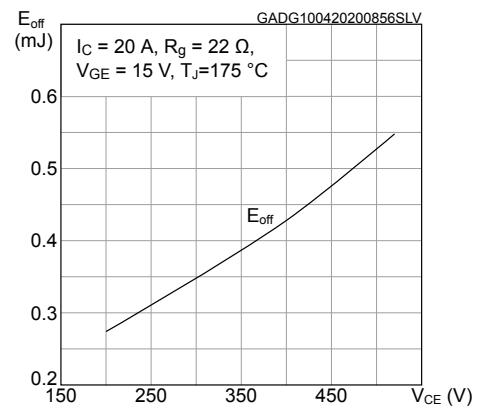
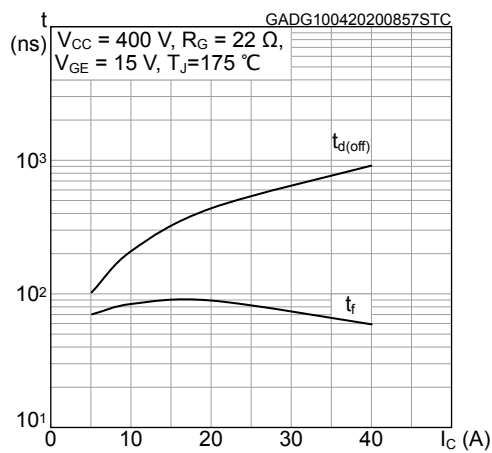
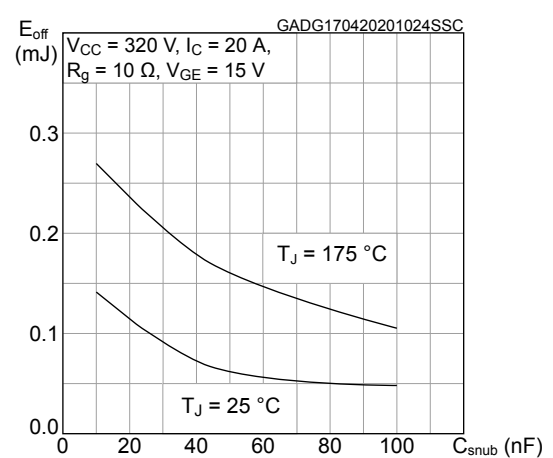
Figure 13. Gate charge vs gate-emitter voltage

Figure 14. Switching energy vs collector current

Figure 15. Switching energy vs temperature

Figure 16. Switching energy vs collector emitter voltage

Figure 17. Switching times vs collector current

Figure 18. Switching energy vs snubber capacitance


Figure 19. Thermal impedance for IGBT

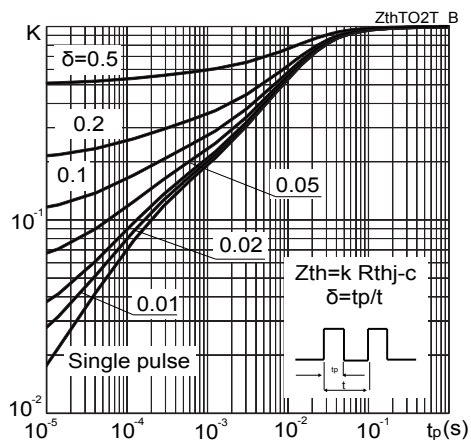
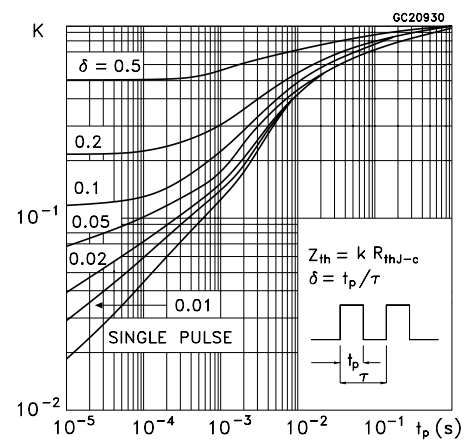


Figure 20. Thermal impedance for diode



3 Test circuits

Figure 21. Test circuit for inductive load switching

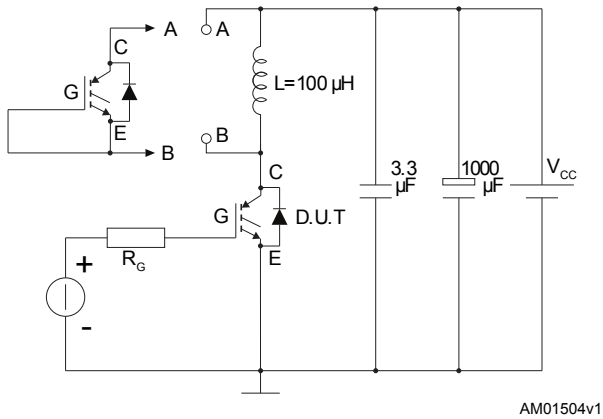


Figure 22. Test circuit for snubbed inductive load switching

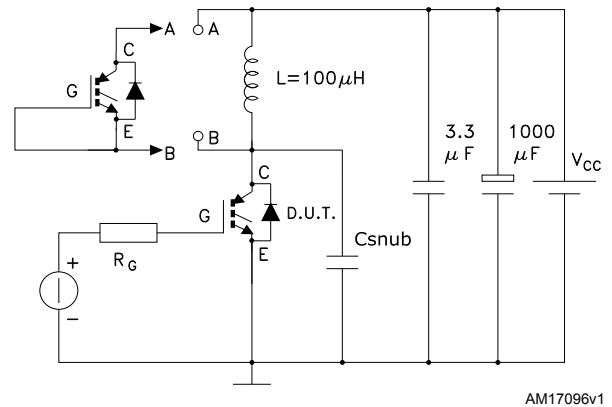


Figure 23. Gate charge test circuit

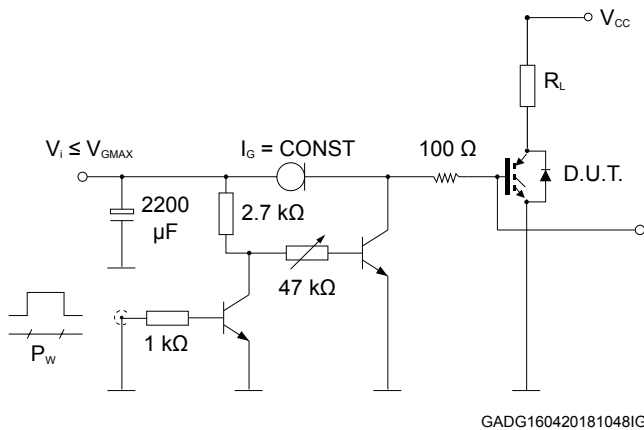
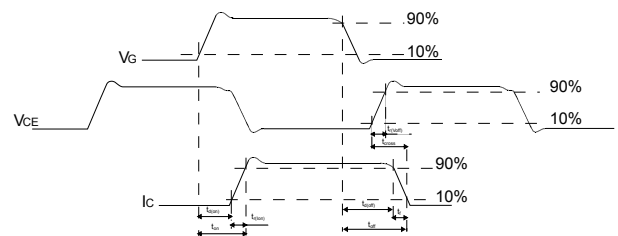


Figure 24. Switching waveform

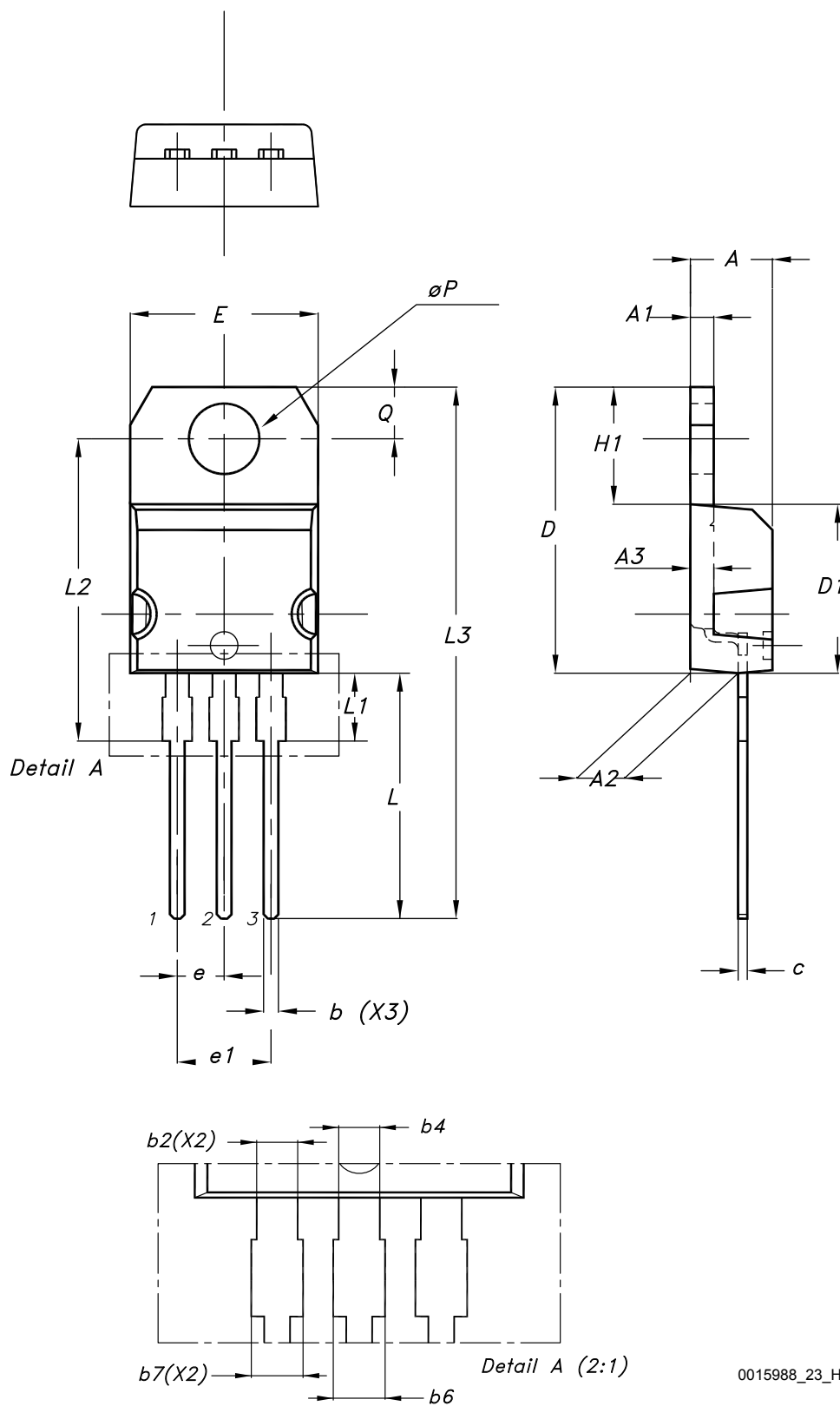


4 Package information

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 H package information

Figure 25. TO-220 type H package outline



0015988_23_H

Table 7. TO-220 type H mechanical data

Dim.	Milimeters		
	Min.	Typ.	Max.
A	4.40	4.45	4.50
A1	1.22		1.32
A2	2.49	2.59	2.69
A3	1.17	1.27	1.37
b	0.78		0.87
b2	1.25		1.34
b4	1.20		1.29
b6			1.50
b7			1.45
c	0.49		0.56
D	15.40	15.50	15.60
D1	9.05	9.15	9.25
E	10.08	10.18	10.28
e	2.44	2.54	2.64
e1	4.98	5.08	5.18
H1	6.25	6.35	6.45
L	13.20	13.40	13.60
L1	3.50	3.70	3.90
L2	16.30	16.40	16.50
L3	28.70	28.90	29.10
øP	3.75	3.80	3.85
Q	2.70	2.80	2.90
Slug flatness		0.03	0.10

Revision history

Table 8. Document revision history

Date	Revision	Changes
02-Mar-2021	1	First release.

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-247 long leads package information	11
	Revision history	13

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