

Features

- Improved E_{off} at elevated temperature
- Minimal tail current
- Low conduction losses

Applications

- Welding
- High frequency converters
- Power factor correction

Description

This Ultrafast IGBT is developed using a new planar technology to yield a device with tighter switching energy variation (E_{off}) versus temperature. The suffix "W" denotes a subset of products designed for high switching frequency operation (over 100 kHz).

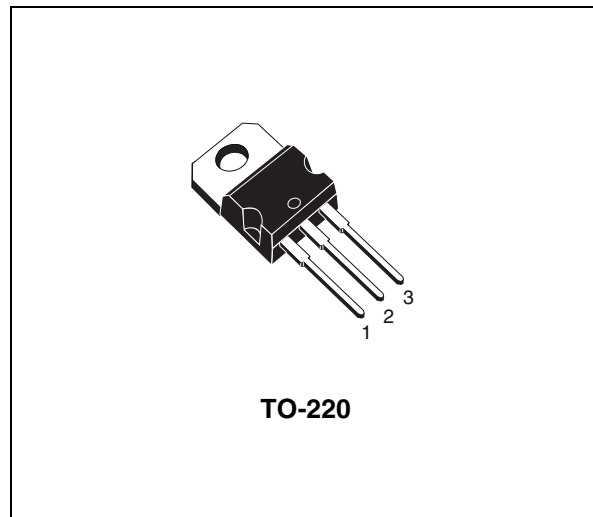


Figure 1. Internal schematic diagram

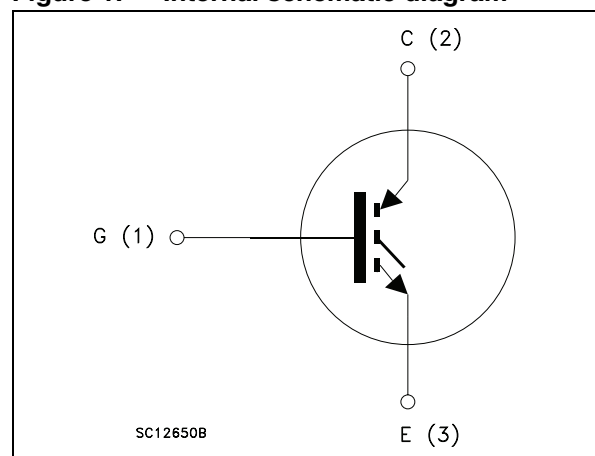


Table 1. Device summary

Order codes	Markings	Packages	Packaging
STGP35HF60W	GP35HF60W	TO-220	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GE} = 0$)	600	V
$I_C^{(1)}$	Continuous collector current at $T_C = 25\text{ °C}$	60	A
$I_C^{(1)}$	Continuous collector current at $T_C = 100\text{ °C}$	35	A
$I_{CP}^{(2)}$	Pulsed collector current	150	A
$I_{CL}^{(3)}$	Turn-off latching current	80	A
V_{GE}	Gate-emitter voltage	± 20	V
P_{TOT}	Total dissipation at $T_C = 25\text{ °C}$	200	W
T_{stg}	Storage temperature	- 55 to 150	°C
T_j	Operating junction temperature		

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{j(max)} - T_C}{R_{thj-c} \times V_{CE(sat)(max)}(T_{j(max)}, I_C(T_C))}$$

2. Pulse width limited by maximum junction temperature and turn-off within RBSOA
 3. $V_{CLAMP} = 80\% (V_{CES})$, $V_{GE} = 15\text{ V}$, $R_G = 10\ \Omega$, $T_J = 150\text{ °C}$

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case IGBT	0.63	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	62.5	°C/W

2 Electrical characteristics

T_J = 25 °C unless otherwise specified)

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V _{(BR)CES}	Collector-emitter breakdown voltage (V _{GE} = 0)	I _C = 1 mA	600			V
V _{CE(sat)}	Collector-emitter saturation voltage	V _{GE} = 15 V, I _C = 20 A			2.5	V
		V _{GE} = 15V, I _C = 20 A, T _J = 125 °C		1.65		
V _{GE(th)}	Gate threshold voltage	V _{CE} = V _{GE} , I _C = 1 mA	3.75		5.75	V
I _{CES}	Collector cut-off current (V _{GE} = 0)	V _{CE} = 600 V			250	μA
		V _{CE} = 600 V, T _J = 125 °C			1	mA
I _{GES}	Gate-emitter leakage current (V _{CE} = 0)	V _{GE} = ±20 V			± 100	nA

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C _{ies}	Input capacitance	V _{CE} = 25 V, f = 1 MHz, V _{GE} = 0	-	2400	-	pF
C _{oes}	Output capacitance			235		pF
C _{res}	Reverse transfer capacitance			50		pF
Q _g	Total gate charge	V _{CE} = 400 V, I _C = 20 A,	-	140	-	nC
Q _{ge}	Gate-emitter charge	V _{GE} = 15 V,		13		nC
Q _{gc}	Gate-collector charge	(see Figure 16)		52		nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, (see Figure 15)	-	30 15 1650	-	ns ns A/ μ s
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ (see Figure 15)	-	30 15 1600	-	ns ns A/ μ s
$t_r(V_{off})$ $t_{d(off)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$, $R_{GE} = 10\ \Omega$, $V_{GE} = 15\text{ V}$ (see Figure 15)	-	30 175 40	-	ns ns ns
$t_r(V_{off})$ $t_{d(off)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$, $R_{GE} = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ (see Figure 15)	-	50 225 70	-	ns ns ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$ E_{off} E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, (see Figure 17)	-	290 185 475		μ J μ J μ J
$E_{on}^{(1)}$ E_{off} E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ (see Figure 17)	-	420 350 770	530	μ J μ J μ J

1. E_{on} is the turn-on losses when a typical diode is used in the test circuit in [Figure 17](#). If the IGBT is offered in a package with a co-pak diode, the co-pak diode is used as external diode. IGBTs and diode are at the same temperature (25 °C and 125 °C). E_{on} include diode recovery energy.

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

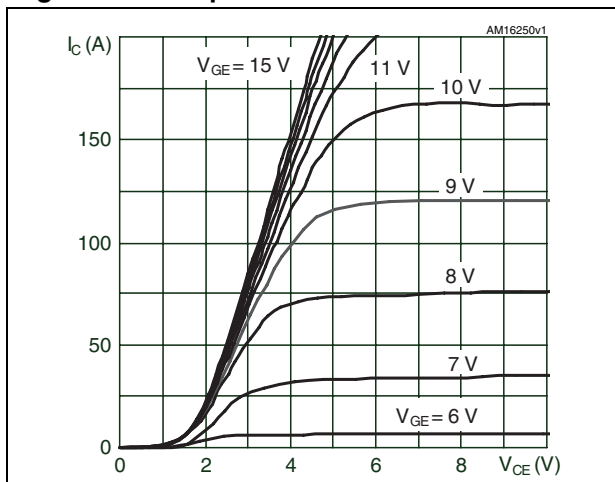


Figure 3. Transfer characteristics

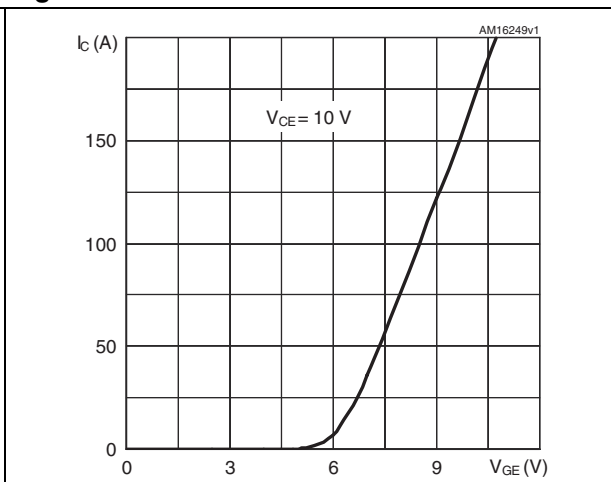


Figure 4. Normalized $V_{CE(sat)}$ vs. I_c

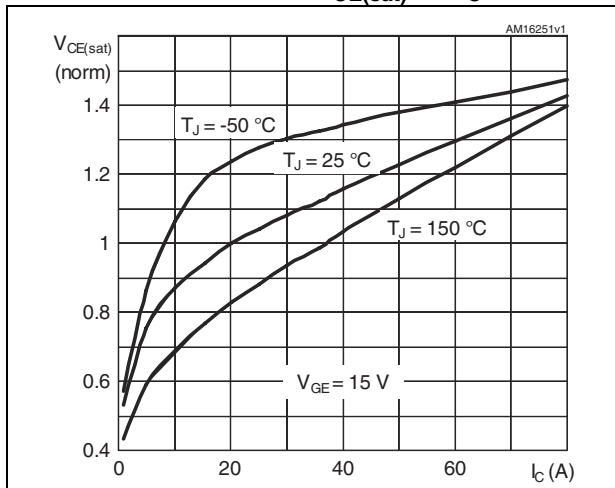


Figure 5. Normalized $V_{CE(sat)}$ vs. temperature

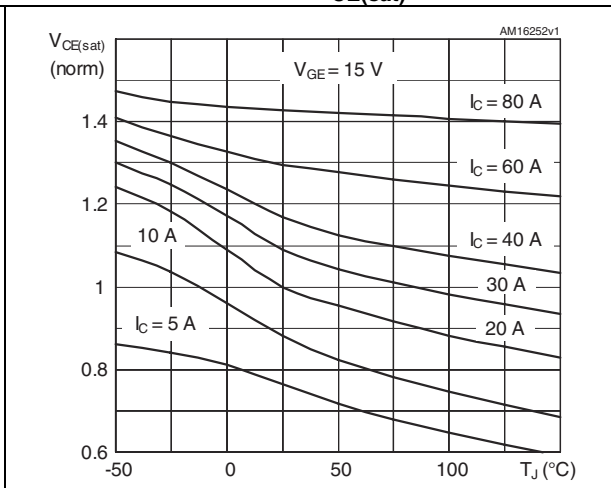


Figure 6. Normalized breakdown voltage vs. temperature

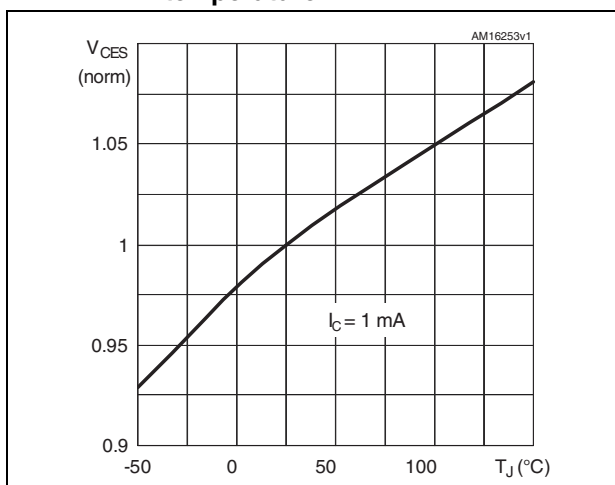


Figure 7. Normalized gate threshold voltage vs. temperature

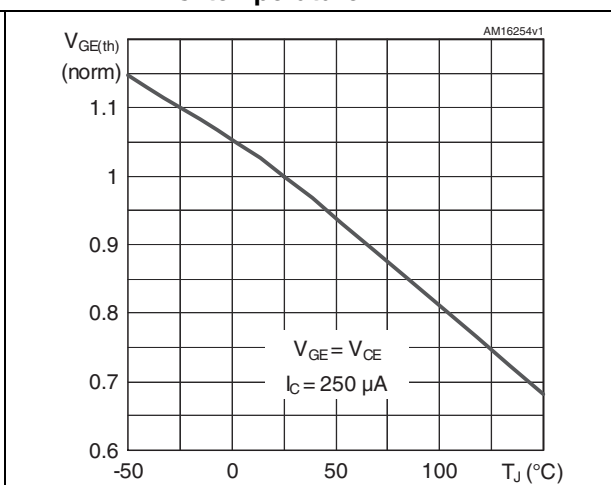


Figure 8. Gate charge vs. gate-emitter voltage

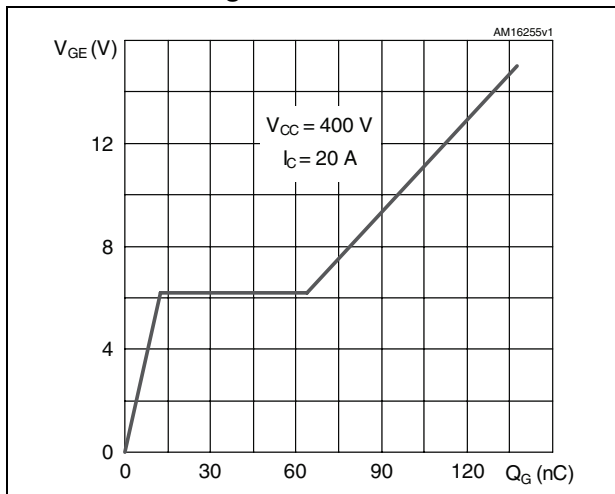


Figure 9. Capacitance variations

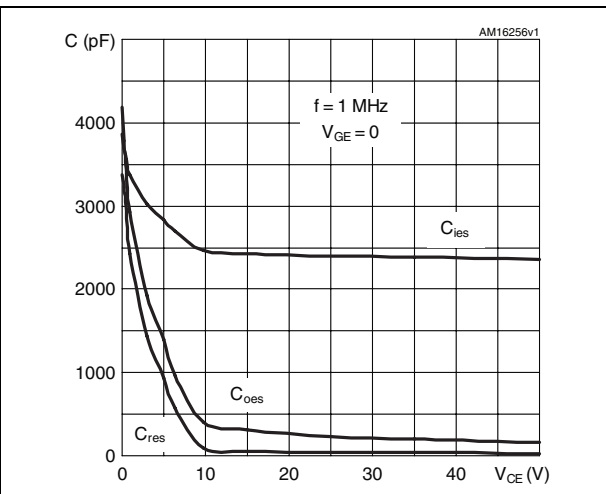


Figure 10. Switching losses vs. temperature

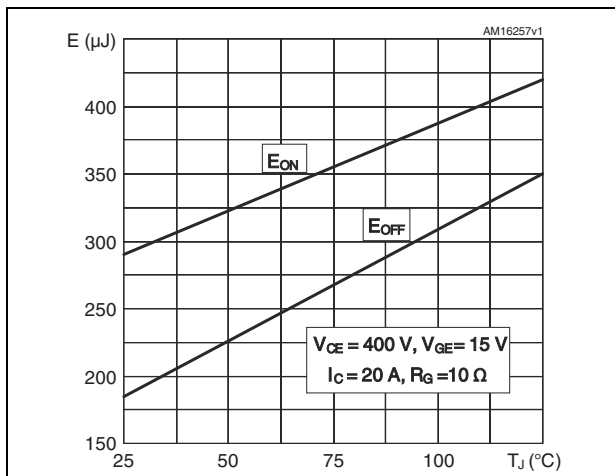


Figure 11. Switching losses vs. gate resistance

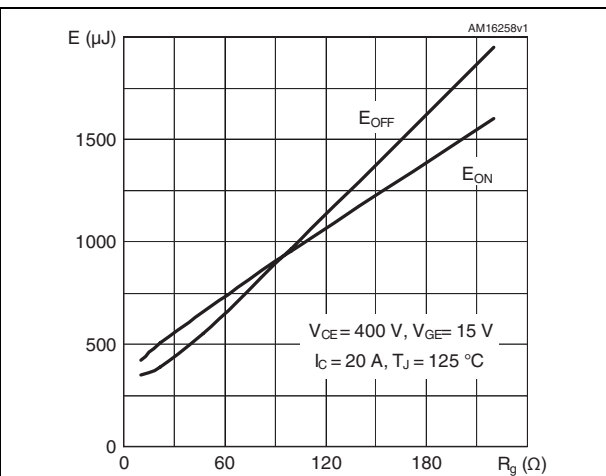


Figure 12. Switching losses vs. collector current

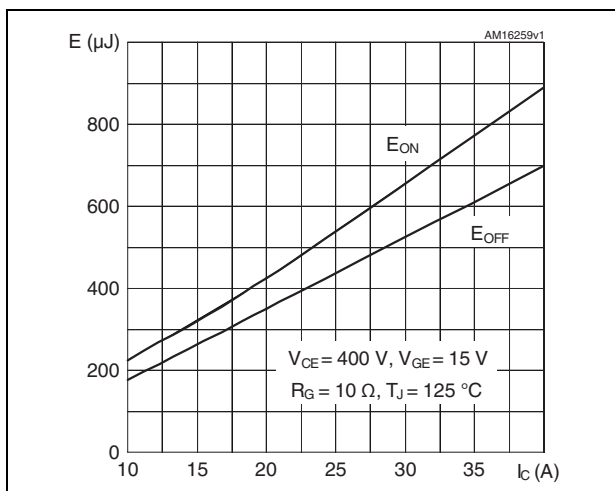


Figure 13. Turn-off SOA

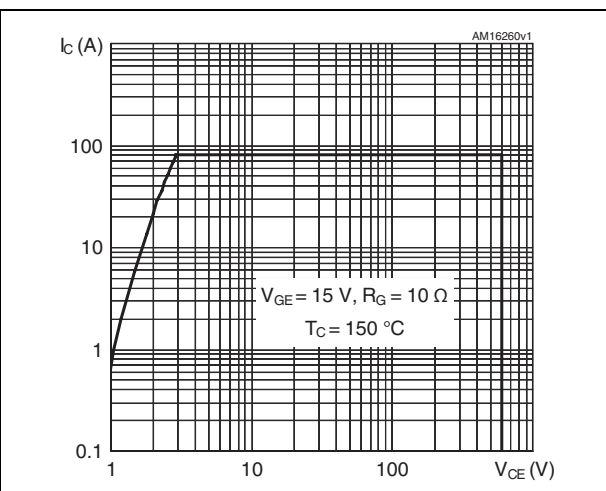
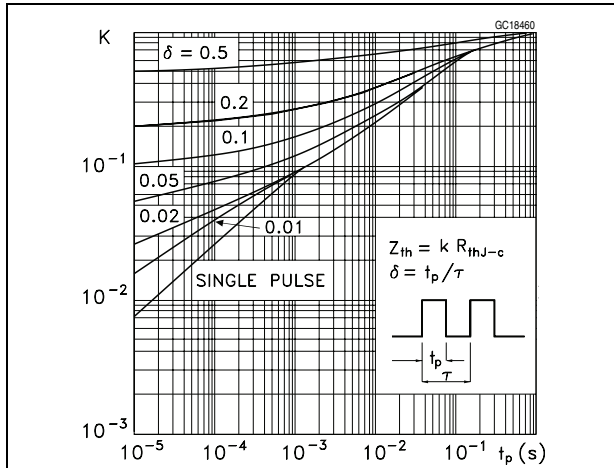


Figure 14. Thermal impedance



3 Test circuits

Figure 15. Test circuit for inductive load switching

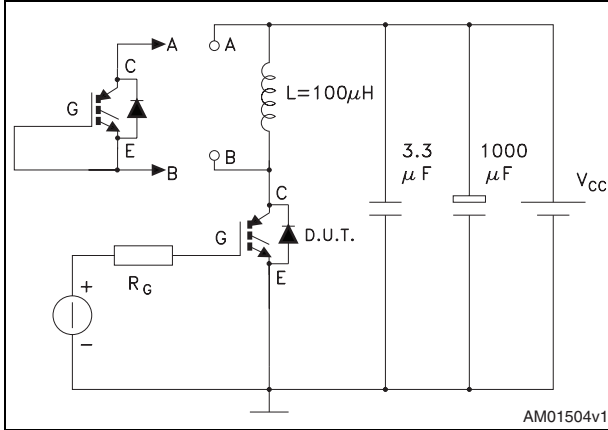


Figure 16. Gate charge test circuit

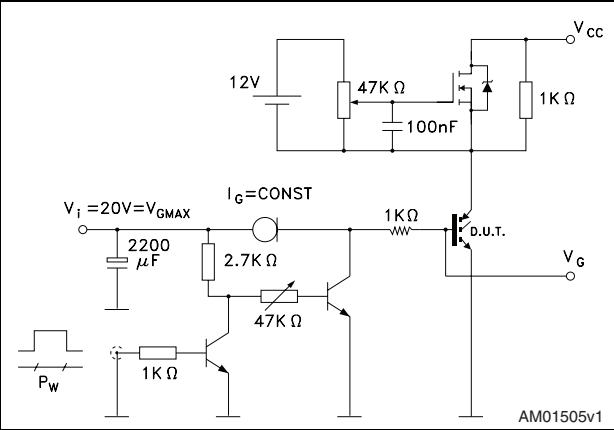
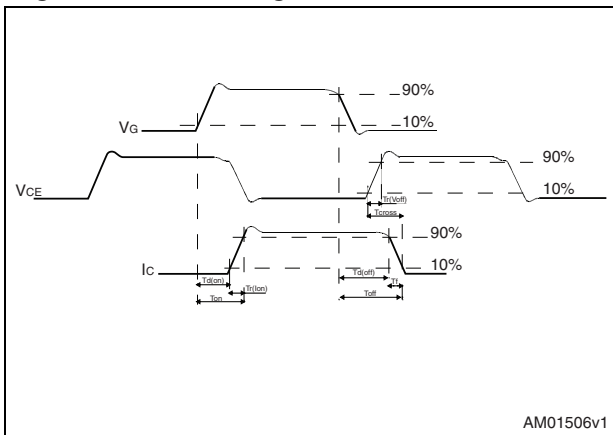


Figure 17. Switching waveform



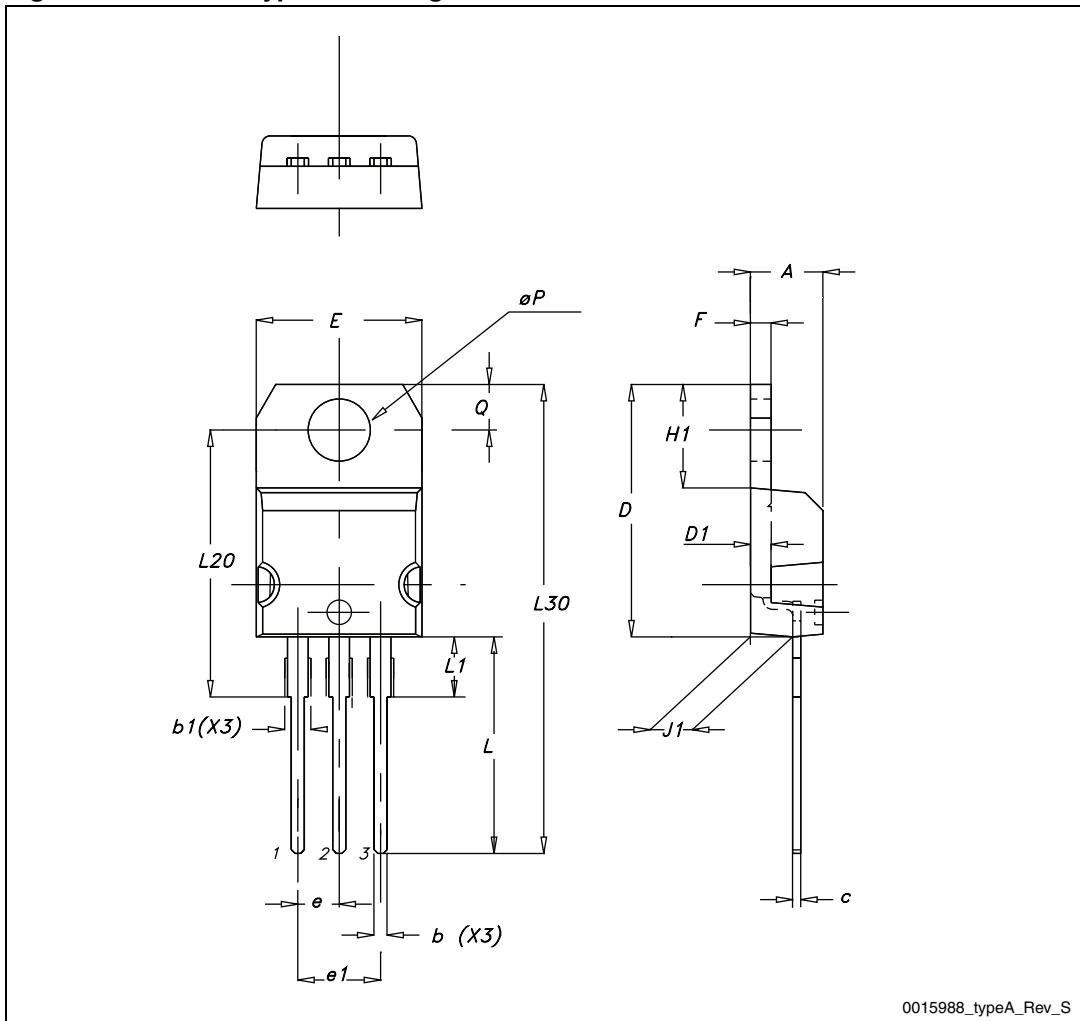
4 Package mechanical data

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.

Table 8. TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		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		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95

Figure 18. TO-220 type A drawing



5 Revision history

Table 9. Document revision history

Date	Revision	Changes
06-Nov-2012	1	Initial release.

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