

### Features

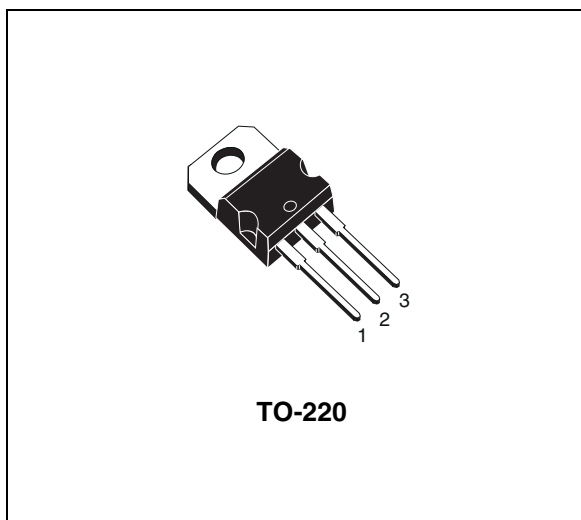
- Improved  $E_{off}$  at elevated temperature
- Minimal tail current
- Low conduction losses

### Applications

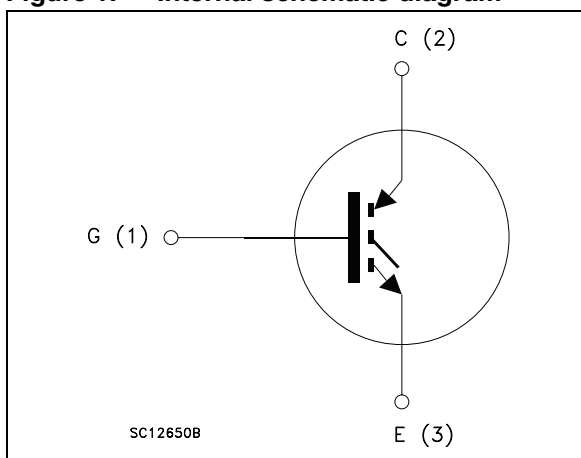
- Welding
- High frequency converters
- Power factor correction

### 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

## Contents

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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	$\pm 20$	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

$T_J = 25\text{ °C}$  unless otherwise specified)

**Table 4. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ( $V_{GE} = 0$ )	$I_C = 1\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 20\text{ A}$			2.5	V
		$V_{GE} = 15\text{ V}, I_C = 20\text{ A}, T_J = 125\text{ °C}$		1.65		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$	3.75		5.75	V
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = 600\text{ V}$			250	$\mu\text{A}$
		$V_{CE} = 600\text{ V}, T_J = 125\text{ °C}$			1	mA
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{ V}$			$\pm 100$	nA

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$ $C_{oes}$ $C_{res}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz},$ $V_{GE} = 0$	-	2400	-	pF
	Output capacitance			235		
	Reverse transfer capacitance			50		
$Q_g$ $Q_{ge}$ $Q_{gc}$	Total gate charge	$V_{CE} = 400\text{ V}, I_C = 20\text{ A},$ $V_{GE} = 15\text{ V},$ (see <a href="#">Figure 16</a> )	-	140	-	nC
	Gate-emitter charge			13		nC
	Gate-collector charge			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 <a href="#">Figure 15</a> )	-	30 15 1650	-	ns ns A/ $\mu$ 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 <a href="#">Figure 15</a> )	-	30 15 1600	-	ns ns A/ $\mu$ 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 <a href="#">Figure 15</a> )	-	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 <a href="#">Figure 15</a> )	-	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 <a href="#">Figure 17</a> )	-	290 185 475		$\mu$ J $\mu$ J $\mu$ 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 <a href="#">Figure 17</a> )	-	420 350 770	530	$\mu$ J $\mu$ J $\mu$ 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

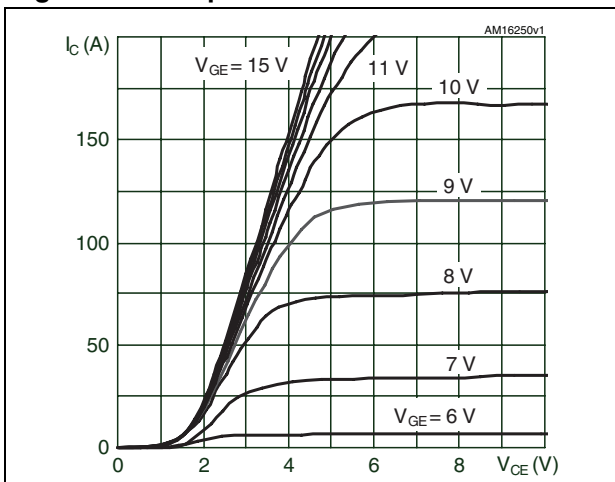


Figure 3. Transfer characteristics

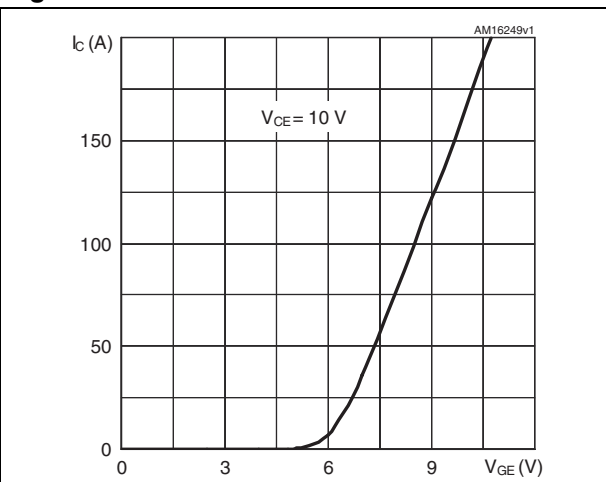


Figure 4. Normalized  $V_{CE(sat)}$  vs.  $I_C$

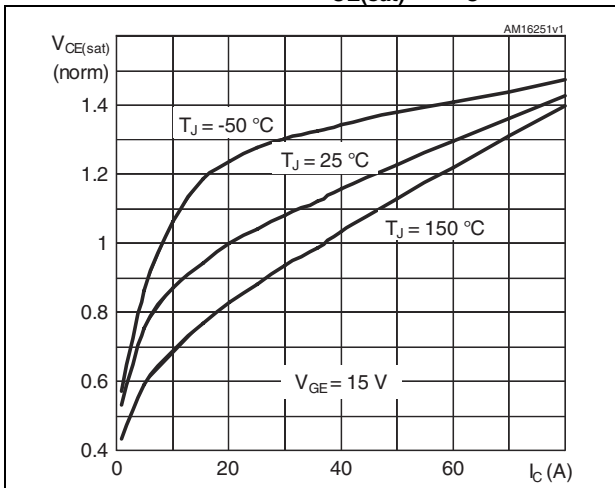


Figure 5. Normalized  $V_{CE(sat)}$  vs. temperature

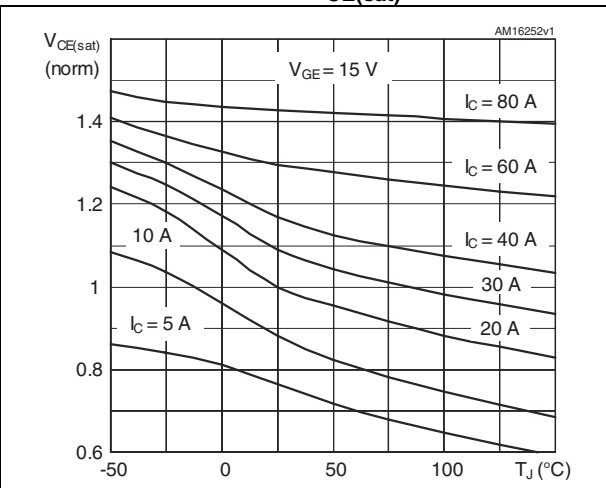


Figure 6. Normalized breakdown voltage vs. temperature

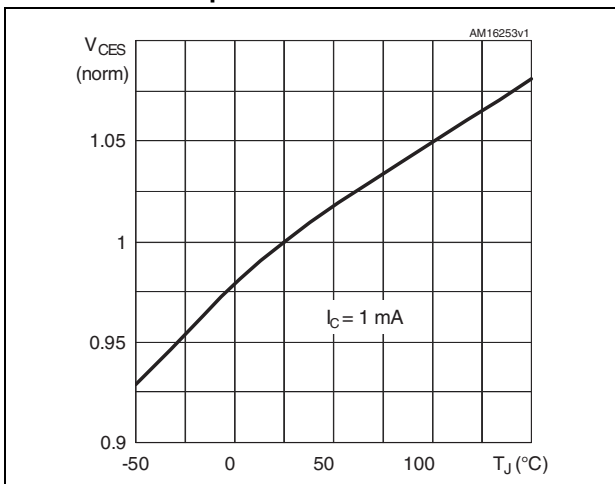


Figure 7. Normalized gate threshold voltage vs. temperature

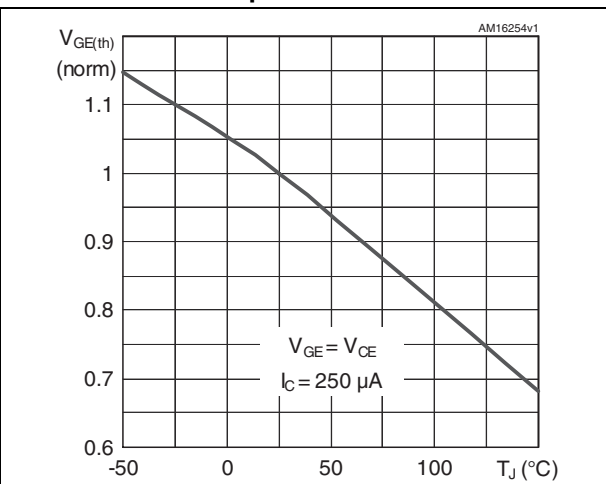


Figure 8. Gate charge vs. gate-emitter voltage

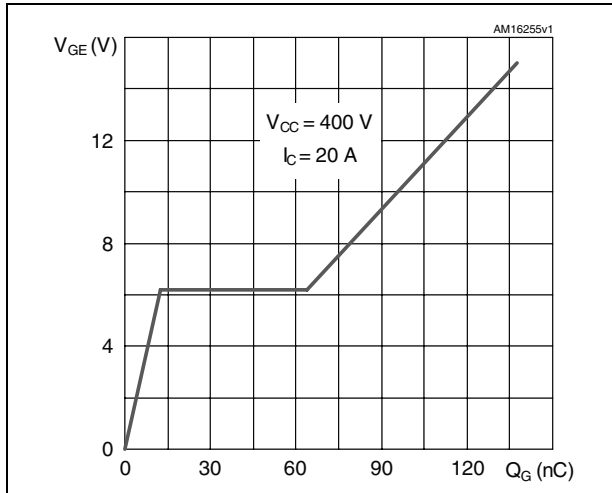


Figure 9. Capacitance variations

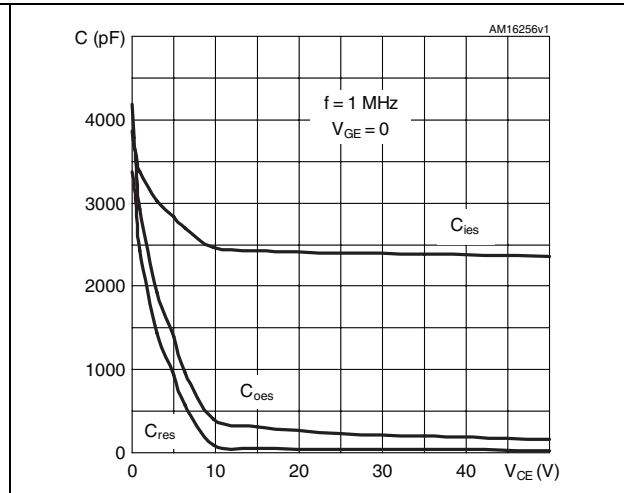


Figure 10. Switching losses vs. temperature

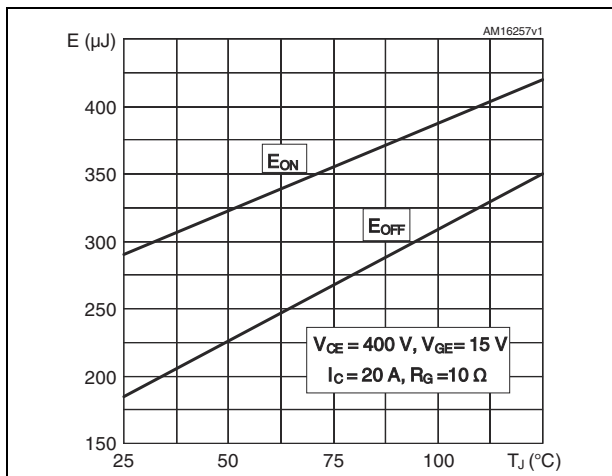


Figure 11. Switching losses vs. gate resistance

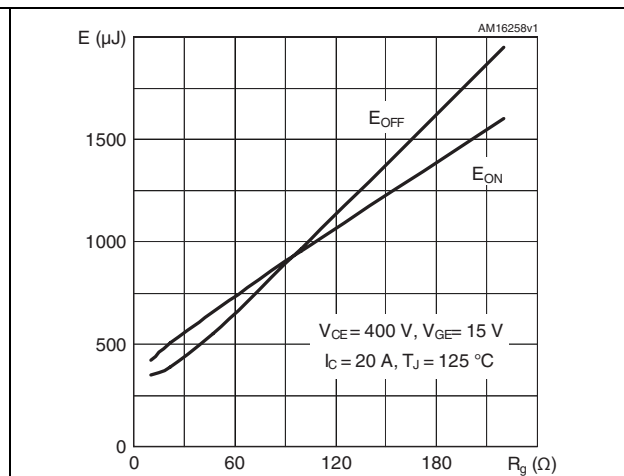


Figure 12. Switching losses vs. collector current

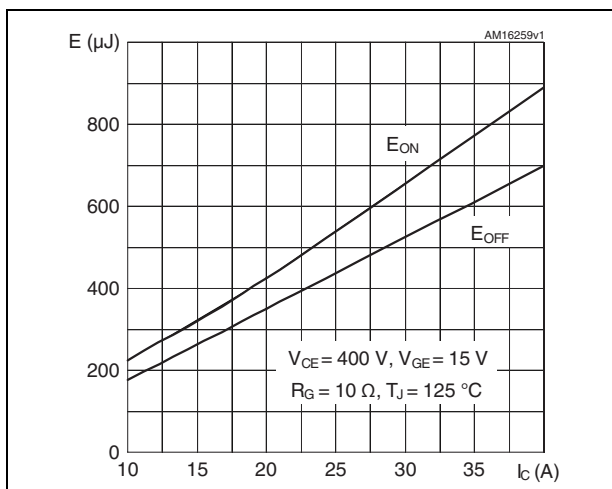


Figure 13. Turn-off SOA

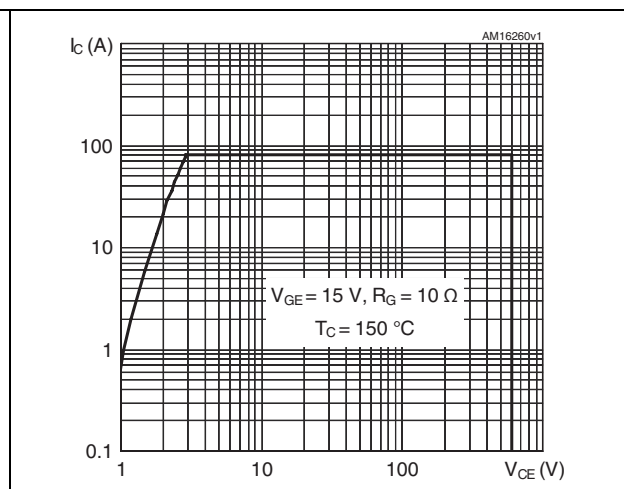
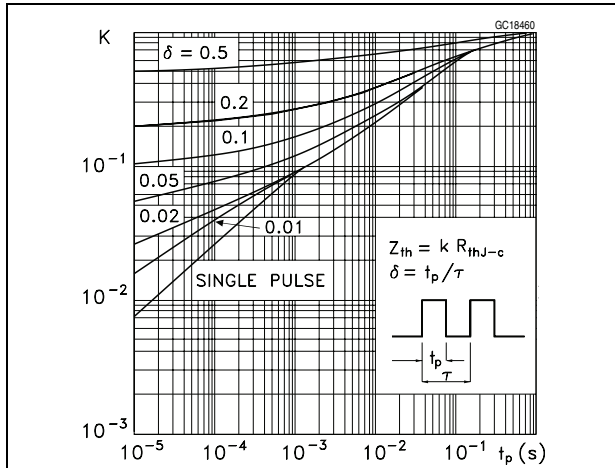


Figure 14. Thermal impedance



### 3 Test circuits

Figure 15. Test circuit for inductive load switching

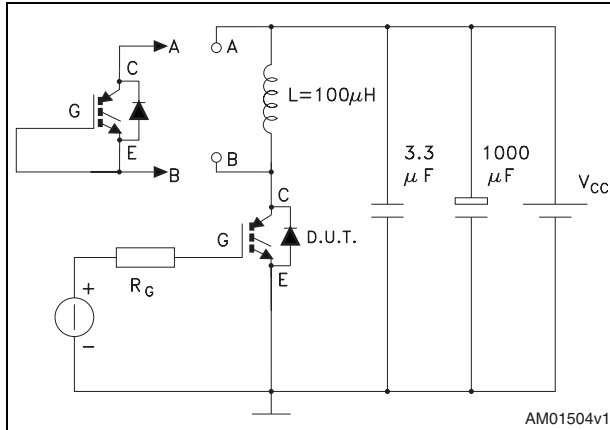


Figure 16. Gate charge test circuit

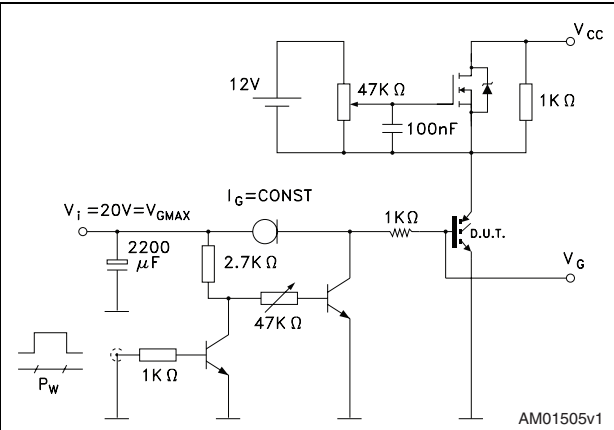
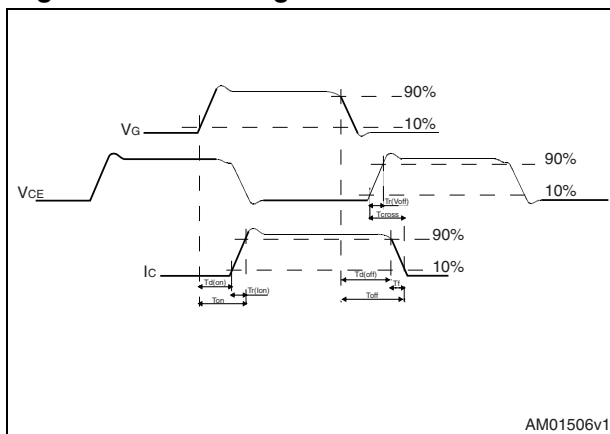


Figure 17. Switching waveform



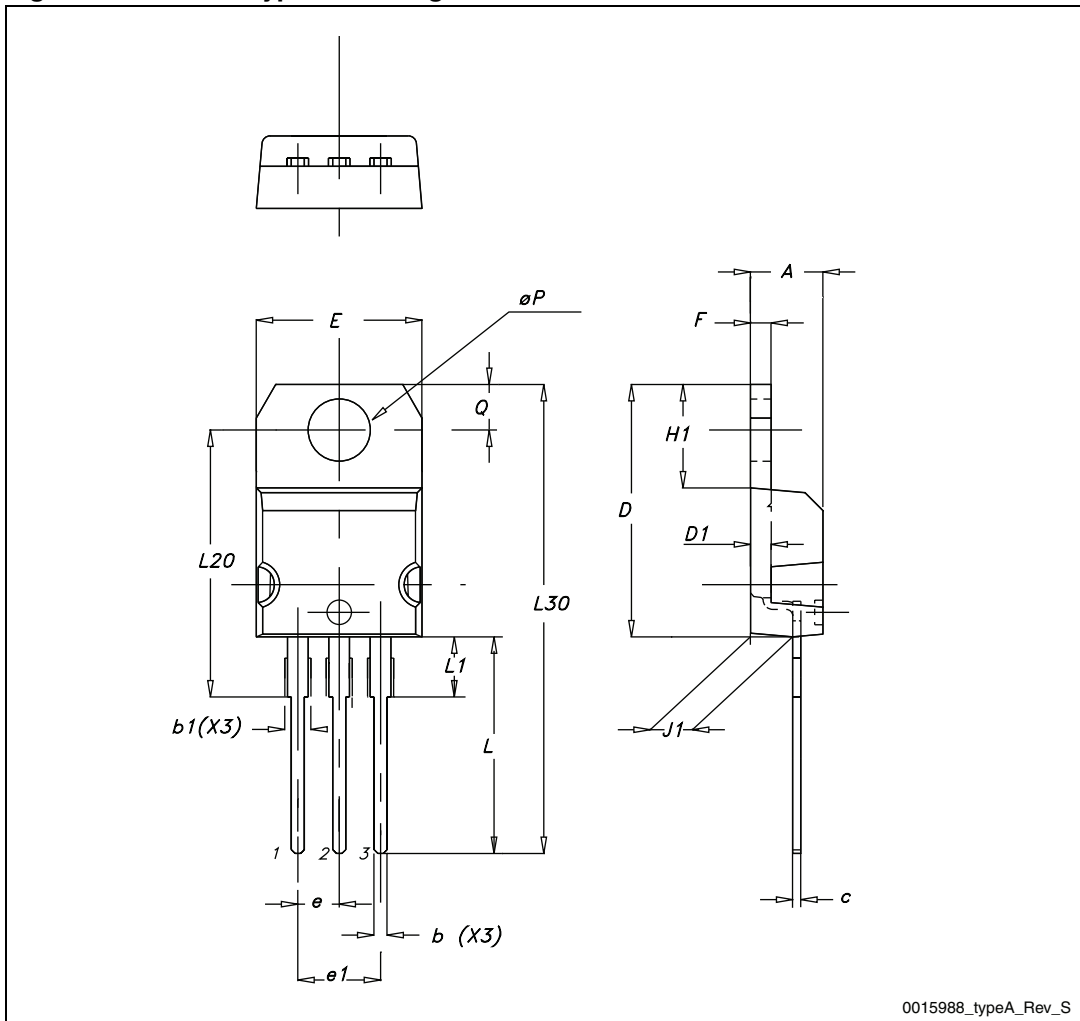
## 4 Package mechanical data

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](http://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	
ØP	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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