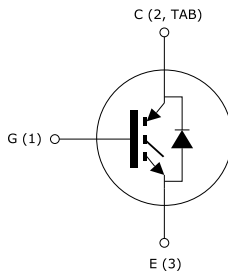
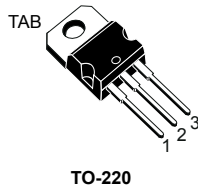


## Trench gate field-stop 600 V, 30 A high speed IGBT



### Features

- High speed switching
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Short circuit rated
- Ultrafast soft recovery antiparallel diode

### Applications

- Inverter
- UPS
- PFC

### Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. This IGBT series offers the optimum compromise between conduction and switching losses, maximizing the efficiency of high frequency converters. Furthermore, the positive  $V_{CE(sat)}$  temperature coefficient and the tight parameter distribution result in safer paralleling operation.



#### Product status link

[STGP30H60DF](#)

#### Product summary

<b>Order code</b>	STGP30H60DF
<b>Marking</b>	GP30H60DF
<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)	600	V
$I_C$	Continuous collector current at $T_C = 25$ °C	60	A
	Continuous collector current at $T_C = 100$ °C	30	
$I_{CP}^{(1)}$	Pulsed collector current	120	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$I_F$	Continuous forward current at $T_C = 25$ °C	60	A
	Continuous forward current at $T_C = 100$ °C	30	
$I_{FP}^{(1)}$	Pulsed forward current	120	A
$P_{TOT}$	Total power dissipation at $T_C = 25$ °C	260	W
$T_{stg}$	Storage temperature range	- 55 to 150	°C
$T_J$	Operating junction temperature range	- 55 to 175	°C

1. Pulse width limited by maximum junction temperature and turn-off within RBSOA.

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance junction-case IGBT	0.58	°C/W
	Thermal resistance junction-case diode	2.5	
$R_{thJA}$	Thermal resistance junction-ambient	62.5	°C/W

## 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	$V_{GE} = 0\text{ V}$ , $I_C = 2\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$ , $I_C = 30\text{ A}$		2.0	2.4	V
		$V_{GE} = 15\text{ V}$ , $I_C = 30\text{ A}$ , $T_J = 175\text{ °C}$		2.4		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$ , $I_C = 1\text{ mA}$	5	6	7	V
$I_{CES}$	Collector cut-off current	$V_{GE} = 0\text{ V}$ , $V_{CE} = 600\text{ V}$			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	$V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GE} = 0\text{ V}$	-	3600	-	pF
$C_{oes}$	Output capacitance		-	130	-	pF
$C_{res}$	Reverse transfer capacitance		-	65	-	pF
$Q_g$	Total gate charge	$V_{CC} = 400\text{ V}$ , $I_C = 30\text{ A}$ , $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 20. Gate charge test circuit)	-	105	-	nC
$Q_{ge}$	Gate-emitter charge		-	30	-	nC
$Q_{gc}$	Gate-collector charge		-	35	-	nC

**Table 5. Switching characteristics (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ ,		50	-	ns
$t_r$	Current rise time	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$		15	-	ns
$(di/dt)_{on}$	Turn-on current slope	(see Figure 19. Test circuit for inductive load switching)		1600	-	A/ $\mu$ s
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ ,		47	-	ns
$t_r$	Current rise time	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 175\text{ }^\circ\text{C}$		17	-	ns
$(di/dt)_{on}$	Turn-on current slope	(see Figure 19. Test circuit for inductive load switching)		1400	-	A/ $\mu$ s
$t_r(V_{off})$	Off voltage rise time	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ ,		20	-	ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$		160	-	ns
$t_f$	Current fall time	(see Figure 19. Test circuit for inductive load switching)		60	-	ns
$t_r(V_{off})$	Off voltage rise time	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ ,		22	-	ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 175\text{ }^\circ\text{C}$		146	-	ns
$t_f$	Current fall time	(see Figure 19. Test circuit for inductive load switching)		88	-	ns
tsc	Short circuit withstand time	$V_{CC} \leq 360\text{ V}$ , $V_{GE} = 15\text{ V}$	3	6	-	$\mu$ s

**Table 6. Switching energy (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ ,	-	0.35	-	mJ
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$	-	0.40	-	mJ
$E_{ts}$	Total switching losses	(see Figure 19. Test circuit for inductive load switching)	-	0.75	-	mJ
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ ,	-	0.84	-	mJ
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 175\text{ }^\circ\text{C}$	-	0.61	-	mJ
$E_{ts}$	Total switching losses	(see Figure 19. Test circuit for inductive load switching)	-	1.45	-	mJ

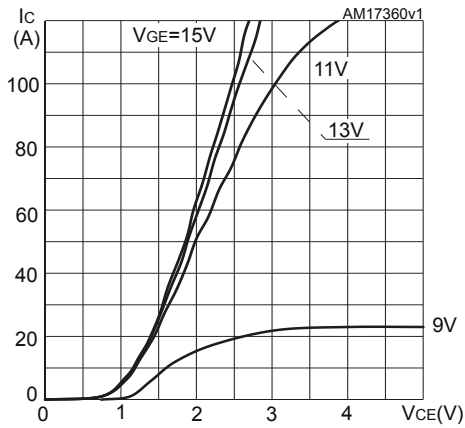
1. Energy losses include reverse recovery of the diode.
2. Turn-off losses include also the tail of the collector current.

**Table 7. Collector-emitter diode**

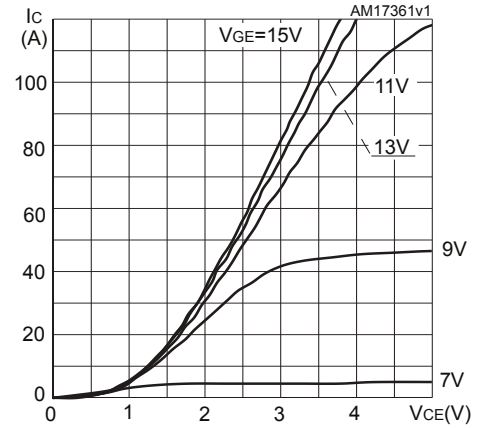
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_F$	Forward on-voltage	$I_F = 30\text{ A}$	-	2.0	2.3	V
		$I_F = 30\text{ A}, T_J = 175\text{ °C}$	-	1.5		
$t_{rr}$	Reverse recovery time	$V_r = 400\text{ V}, I_F = 30\text{ A},$ $di_F/dt = 100\text{ A}/\mu\text{s}$	-	110		ns
$Q_{rr}$	Reverse recovery charge		-	136		nC
$I_{rrm}$	Reverse recovery current		-	2.5		A
$t_{rr}$	Reverse recovery time	$V_r = 400\text{ V}, I_F = 30\text{ A},$ $di_F/dt = 100\text{ A}/\mu\text{s}, T_J = 175\text{ °C}$	-	190		ns
$Q_{rr}$	Reverse recovery charge		-	506		nC
$I_{rrm}$	Reverse recovery current		-	5.3		A

## 2.1 Electrical characteristics (curves)

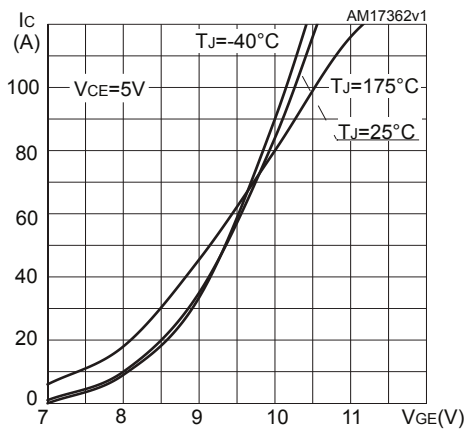
**Figure 1. Output characteristics ( $T_J = 25^\circ\text{C}$ )**



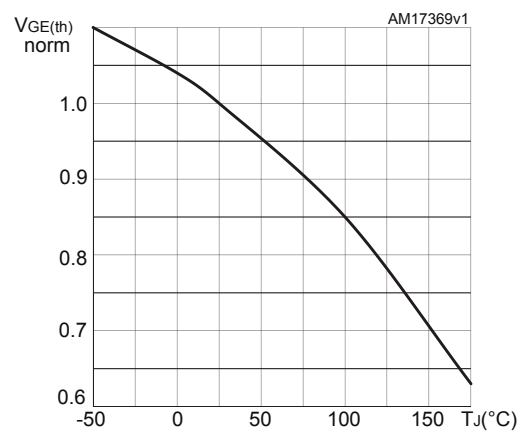
**Figure 2. Output characteristics ( $T_J = 175^\circ\text{C}$ )**



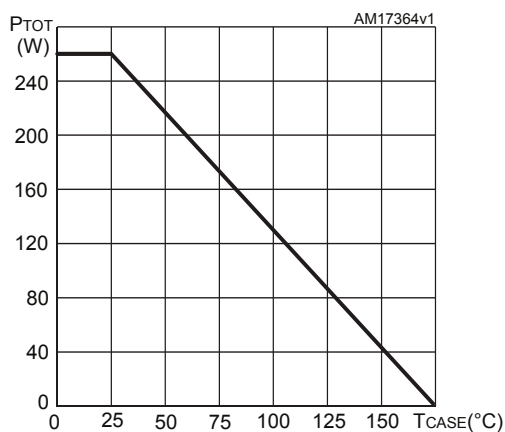
**Figure 3. Transfer characteristics**



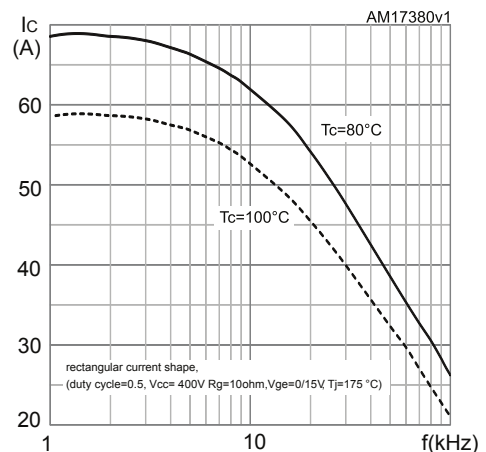
**Figure 4. Normalized  $V_{GE(th)}$  vs junction temperature**



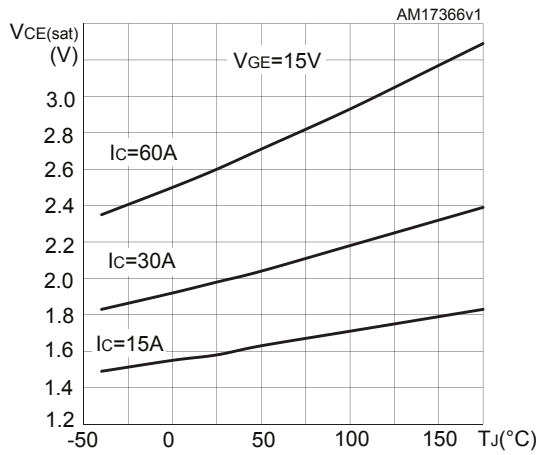
**Figure 5. Power dissipation vs case temperature**



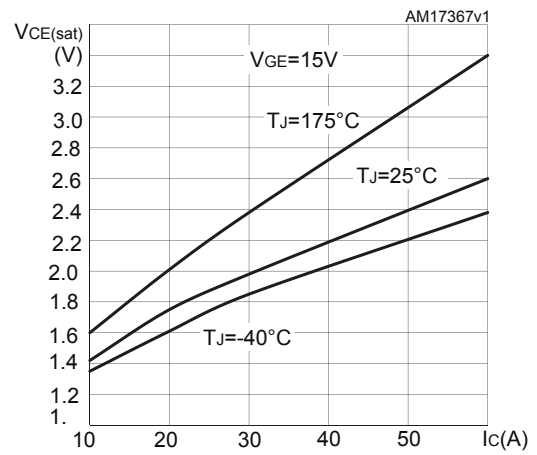
**Figure 6. Collector current vs switching frequency**



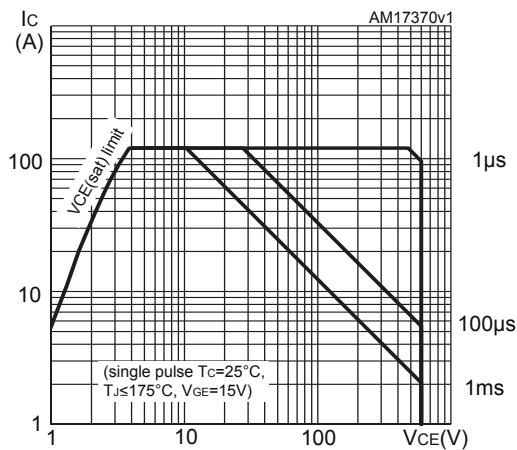
**Figure 7.  $V_{CE(sat)}$  vs junction temperature**



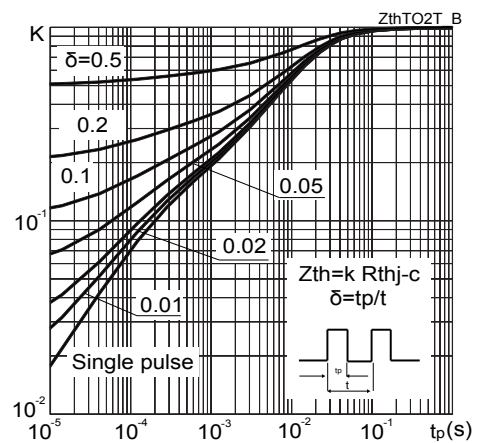
**Figure 8.  $V_{CE(sat)}$  vs collector current**



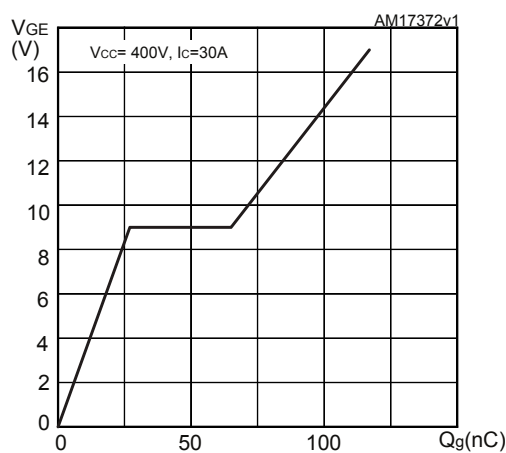
**Figure 9. Forward bias safe operating area**



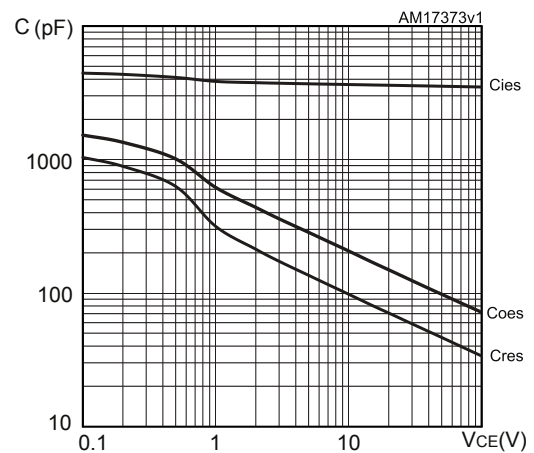
**Figure 10. Thermal impedance**



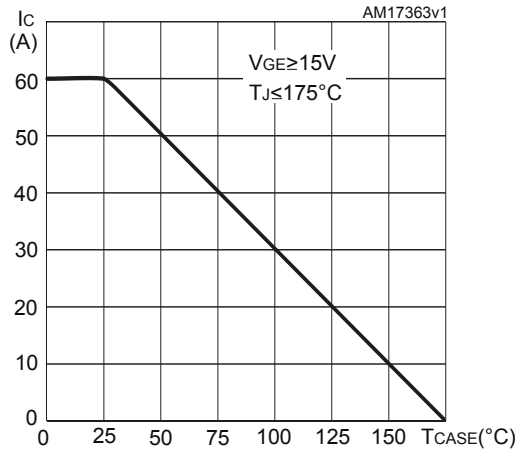
**Figure 11. Gate charge vs gate-emitter voltage**



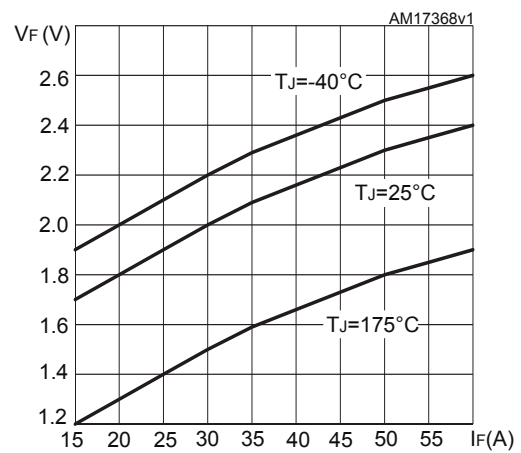
**Figure 12. Capacitance variations**



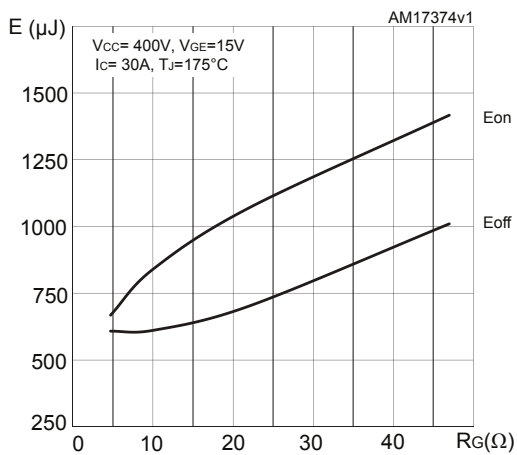
**Figure 13. Collector current vs case temperature**



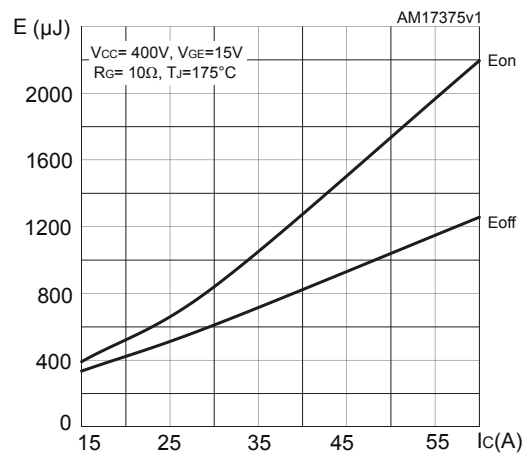
**Figure 14. Diode V<sub>F</sub> vs forward current**



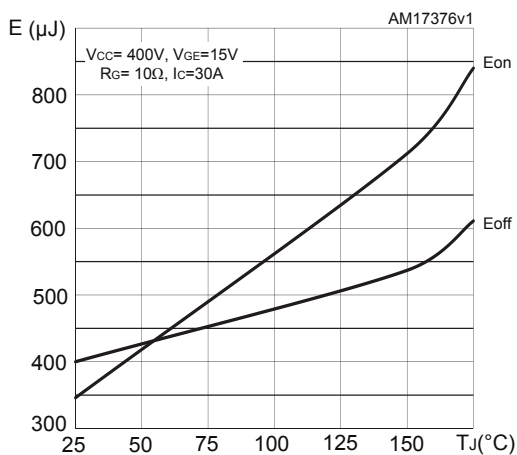
**Figure 15. Switching losses vs gate resistance**



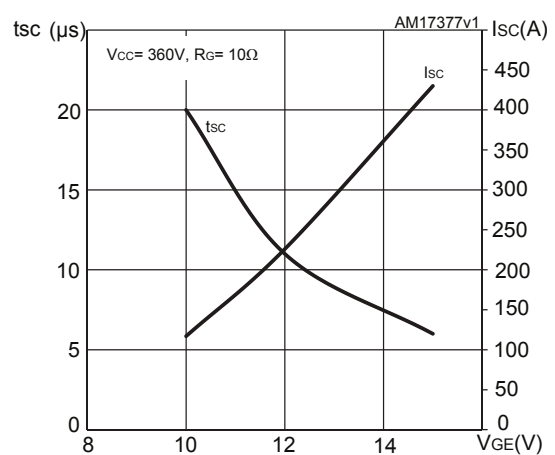
**Figure 16. Switching losses vs collector current**



**Figure 17. Switching energy vs temperature**



**Figure 18. Short circuit time & current vs. V<sub>GE</sub>**





### 3 Test circuits

Figure 19. Test circuit for inductive load switching

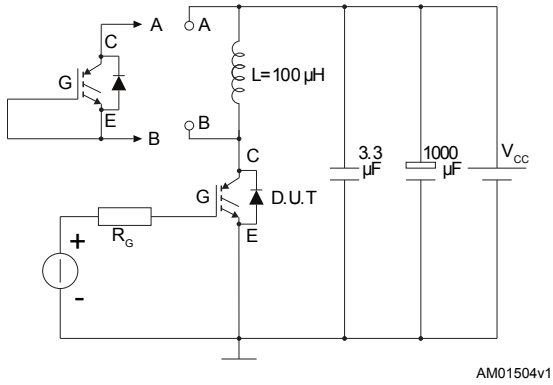


Figure 20. Gate charge test circuit

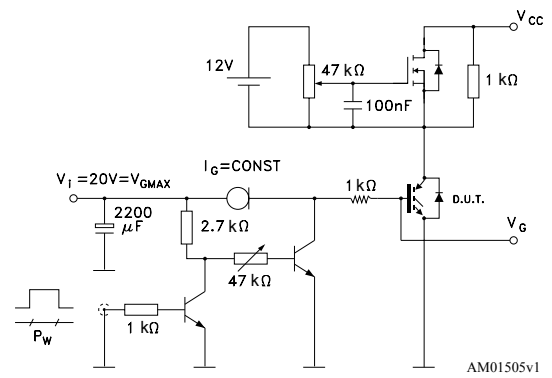


Figure 21. Switching waveform

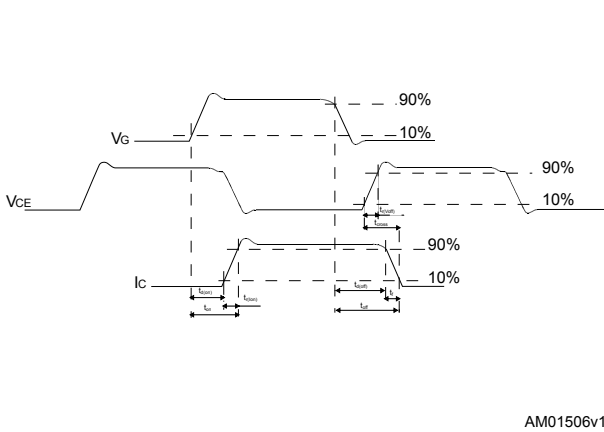
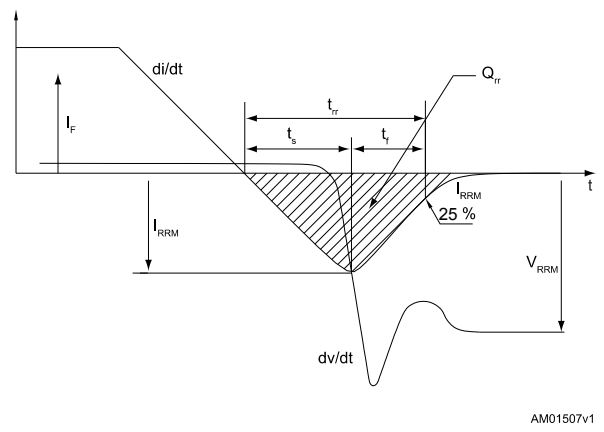


Figure 22. Diode reverse recovery waveform

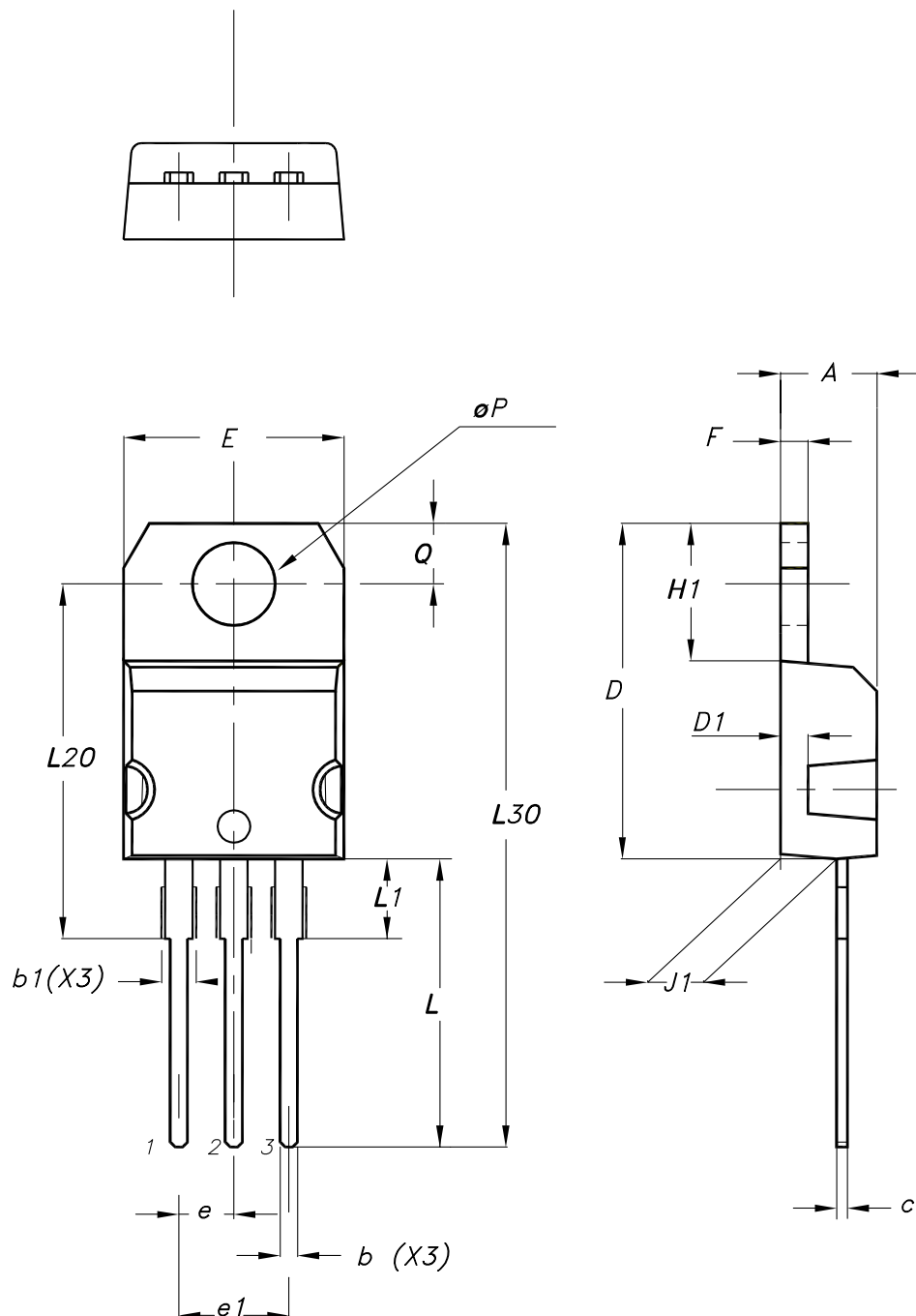


## 4 Package information

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](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 TO-220 type A package information

Figure 23. TO-220 type A package outline



0015988\_typeA\_Rev\_23

**Table 8. 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 9. Document revision history**

Date	Revision	Changes
14-Oct-2011	1	Initial release.
03-Oct-2012	2	Document status promoted from target specification to preliminary data.
20-Mar-2013	3	Document status promoted from preliminary data to production data. Added new root part number STGF30H60DF in TO-220FP package. Added new root part number STGW30H60DF in TO-247 package.
24-Sep-2020	4	The part numbers STGB30H60DF, STGF30H60DF and STGW30H60DF have been moved to a separate datasheet and the document has been updated accordingly. Updated <a href="#">Table 5. Switching characteristics (inductive load)</a> and <a href="#">Table 7. Collector-emitter diode</a> . Minor text changes.

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