

### Features

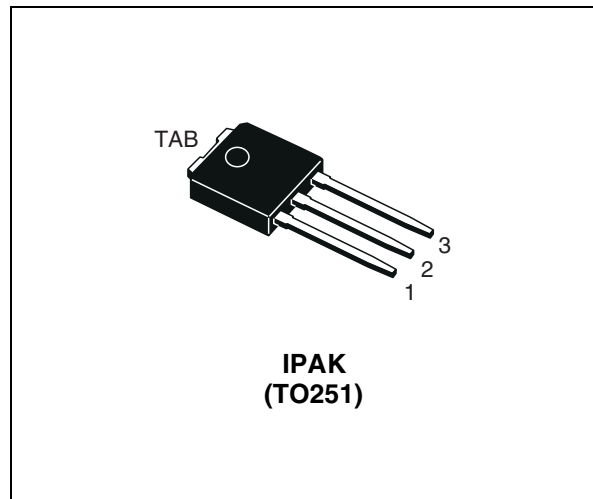
- High voltage capability
- High speed

### Applications

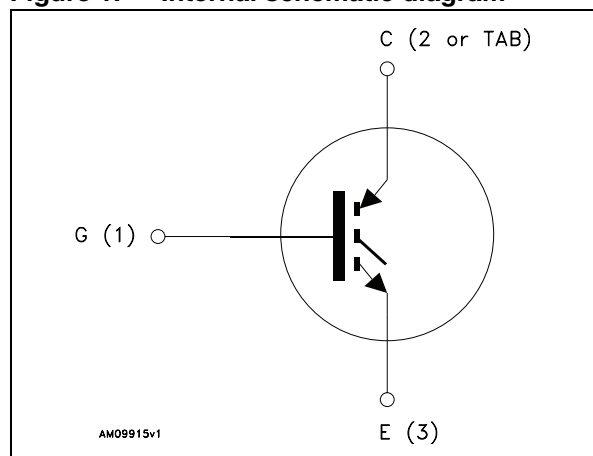
- Home appliance
- Lighting

### Description

This device is a very fast IGBT developed using advanced PowerMESH™ technology. This process guarantees an excellent trade-off between switching performance and low on-state behavior. This device is well-suited for resonant or soft-switching applications.



**Figure 1. Internal schematic diagram**



**Table 1. Device summary**

Order code	Marking	Package	Packaging
STGD3NC120H-1	GD3NC120H	IPAK (TO251)	Tube

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ )	1200	V
$I_C^{(1)}$	Continuous collector current at $T_C = 25\text{ °C}$	16	A
$I_C^{(1)}$	Continuous collector current at $T_C = 100\text{ °C}$	9	A
$I_{CL}^{(2)}$	Turn-off latching current	14	A
$I_{CP}^{(3)}$	Pulsed collector current	20	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	105	W
$T_J$	Operating junction temperature	-55 to 150	°C

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

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance junction-case IGBT	1.2	°C/W
$R_{thJA}$	Thermal resistance junction-ambient	100	°C/W

## 2 Electrical characteristics

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

**Table 4. Static electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ( $V_{GE} = 0$ )	$I_C = 1\text{ mA}$	1200			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 3\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 3\text{ A}, T_J = 125\text{ °C}$		2.3 2.2	2.8	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}$	2		5	V
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = 1200\text{ V}$ $V_{CE} = 1200\text{ V}, T_J = 125\text{ °C}$			50 1	$\mu\text{A}$ mA
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{ V}$			$\pm 100$	nA
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE} = 25\text{ V}, I_C = 3\text{ A}$		4		S

1. Pulse duration: 300  $\mu\text{s}$ , duty cycle 1.5%

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0$		470		pF
$C_{oes}$	Output capacitance		-	45	-	pF
$C_{res}$	Reverse transfer capacitance			6		pF
$Q_g$	Total gate charge	$V_{CE} = 960\text{ V},$ $I_C = 3\text{ A}, V_{GE} = 15\text{ V}$		24		nC
$Q_{ge}$	Gate-emitter charge		-	3	-	nC
$Q_{gc}$	Gate-collector charge			10		nC

**Table 6. Switching on/off (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 800\text{ V}, I_C = 3\text{ A}$	-	15	-	ns
$t_r$	Current rise time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ (see Figure 18)	-	3.5	-	ns
$(di/dt)_{on}$	Turn-on current slope			880		A/ $\mu$ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 800\text{ V}, I_C = 3\text{ A}$	-	14.5	-	ns
$t_r$	Current rise time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ $T_J = 125\text{ }^\circ\text{C}$ (see Figure 18)	-	4	-	ns
$(di/dt)_{on}$	Turn-on current slope			770		A/ $\mu$ s
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 800\text{ V}, I_C = 3\text{ A}$	-	72	-	ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ (see Figure 18)	-	118	-	ns
$t_f$	Current fall time			250		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 800\text{ V}, I_C = 3\text{ A}$	-	132	-	ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ $T_J = 125\text{ }^\circ\text{C}$ (see Figure 18)	-	210	-	ns
$t_f$	Current fall time			470		ns

**Table 7. Switching energy (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 800\text{ V}, I_C = 3\text{ A}$	-	236	-	$\mu$ J
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ (see Figure 18)	-	290	-	$\mu$ J
$E_{ts}$	Total switching losses			526		$\mu$ J
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 800\text{ V}, I_C = 3\text{ A}$	-	360	-	$\mu$ J
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ $T_J = 125\text{ }^\circ\text{C}$ (see Figure 18)	-	620	-	$\mu$ J
$E_{ts}$	Total switching losses			980		$\mu$ J

1.  $E_{on}$  is the turn-on losses when a typical diode is used in the test circuit in figure 2. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs & Diode are at the same temperature (25 °C and 125 °C)
2. Turn-off losses include also the tail of the collector current

## 2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

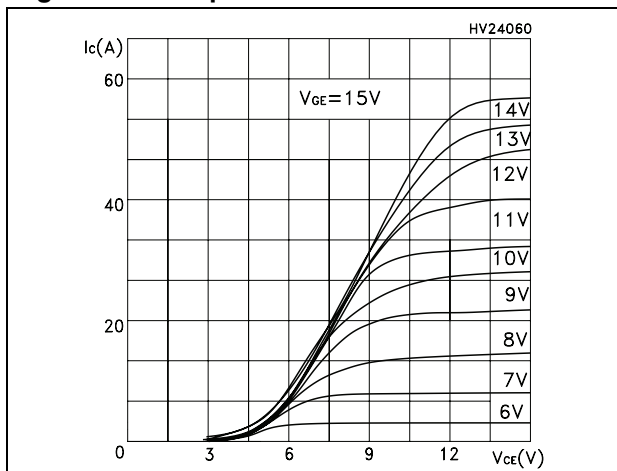


Figure 3. Transfer characteristics

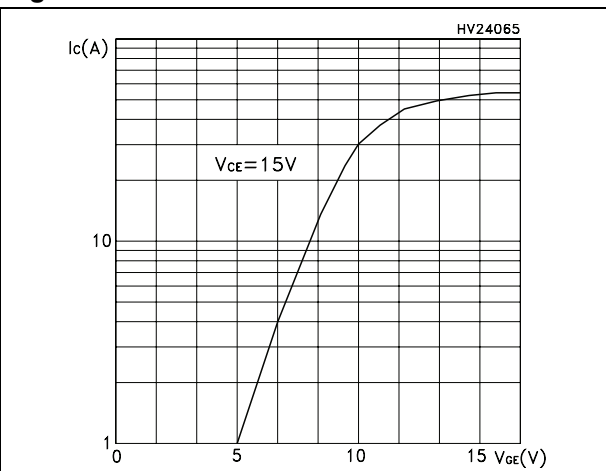


Figure 4. Transconductance

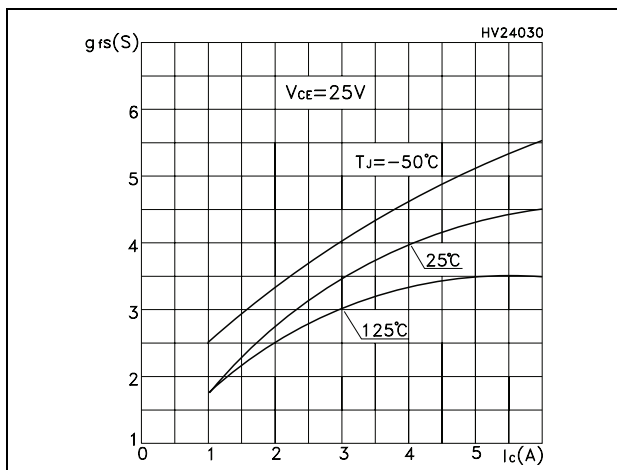


Figure 5. Collector-emitter on voltage vs. temperature

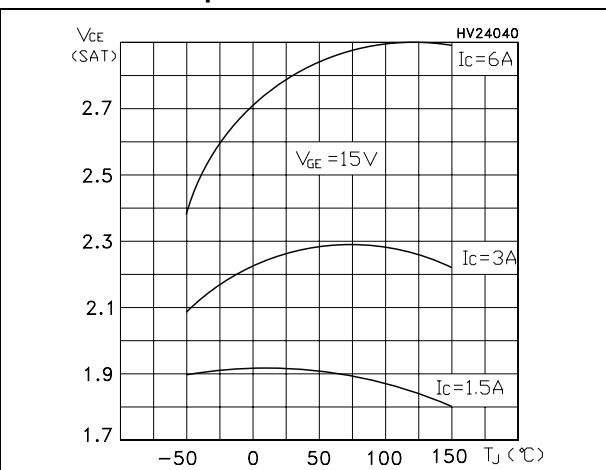


Figure 6. Collector-emitter on voltage vs. collector current

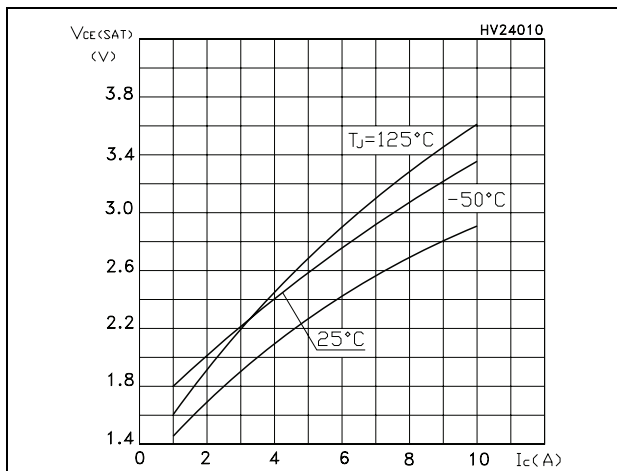
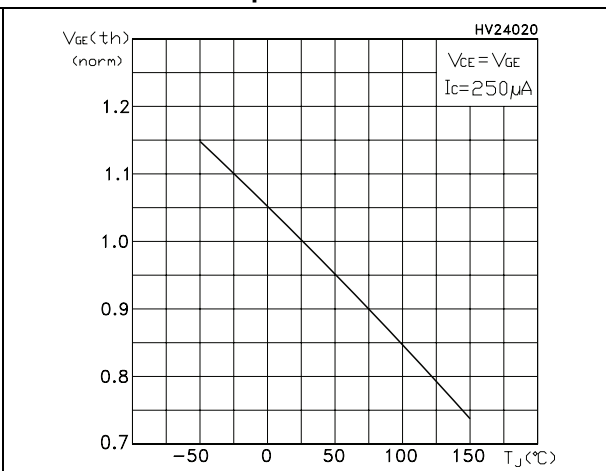
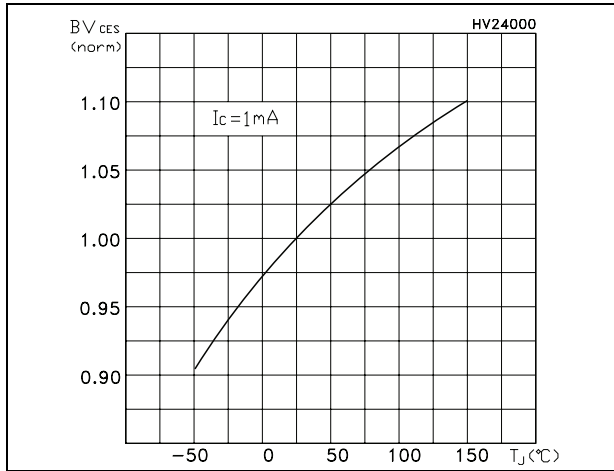


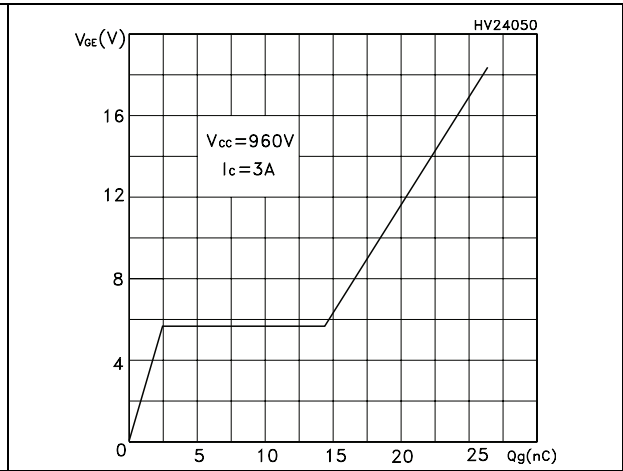
Figure 7. Normalized gate threshold voltage vs. temperature



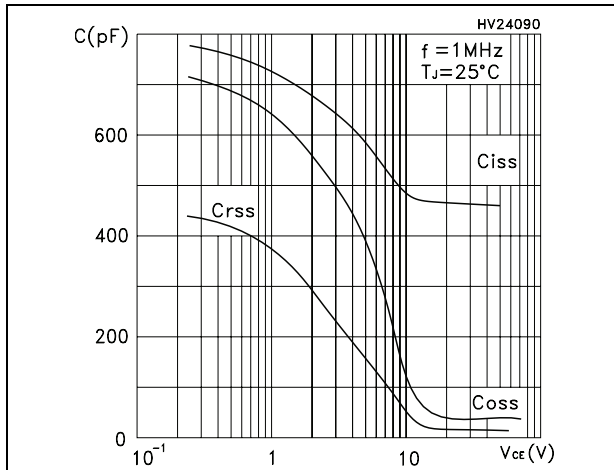
**Figure 8. Normalized breakdown voltage vs. temperature**



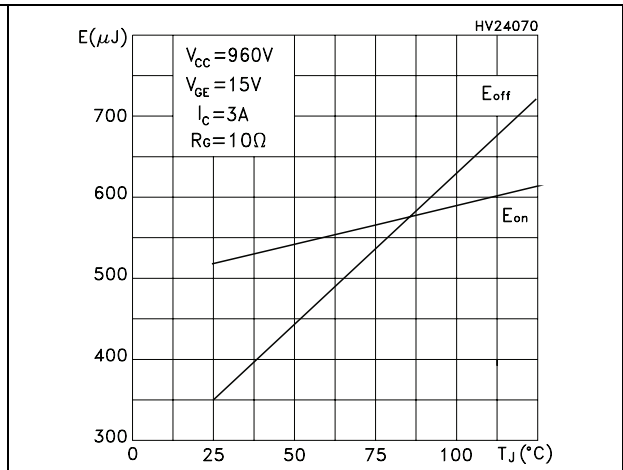
**Figure 9. Gate charge vs. gate-source voltage**



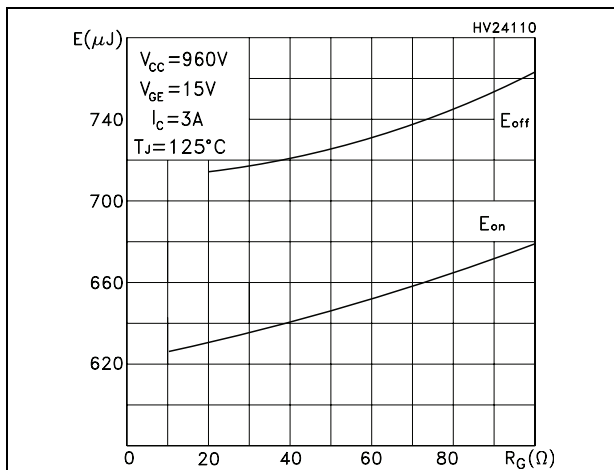
**Figure 10. Capacitance variations**



**Figure 11. Switching losses vs. temperature**



**Figure 12. Switching losses vs. gate resistance**



**Figure 13. Switching losses vs. collector current**

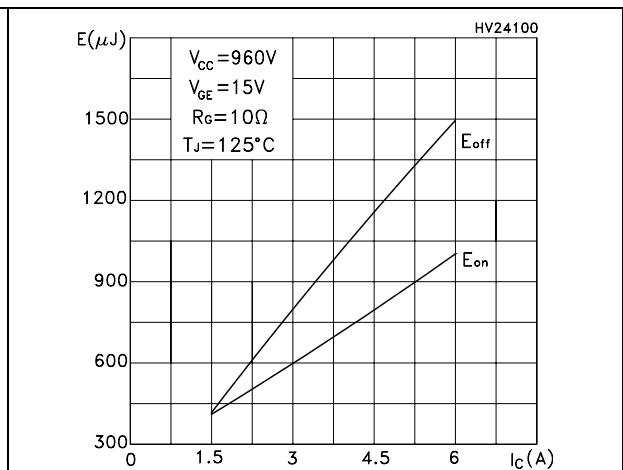


Figure 14. Power losses @  $I_C = 3\text{ A}$

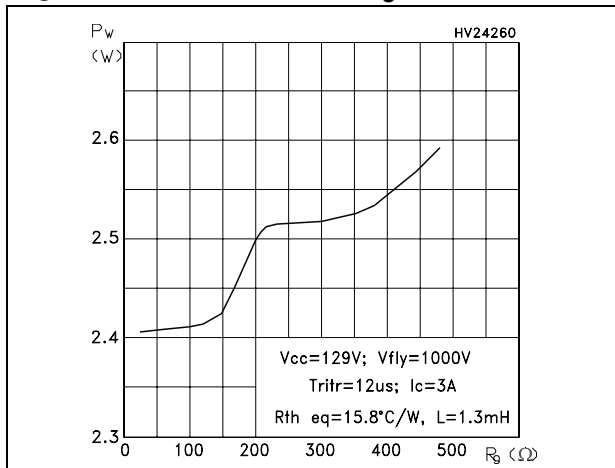


Figure 15. Power losses @  $I_C = 2\text{ A}$

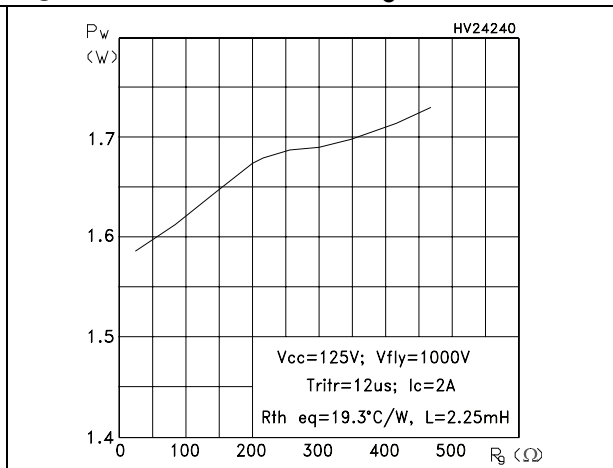


Figure 16. Turn-off SOA

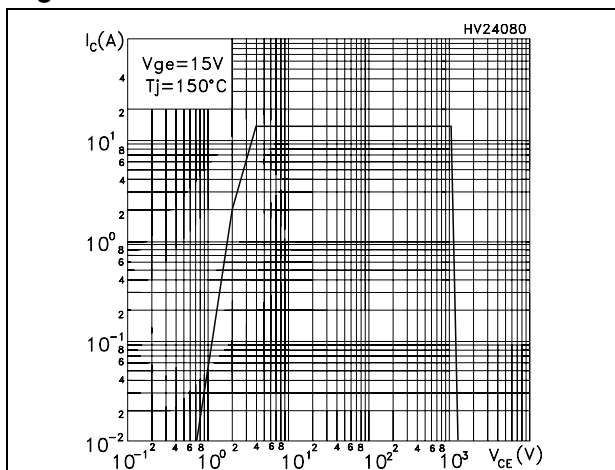
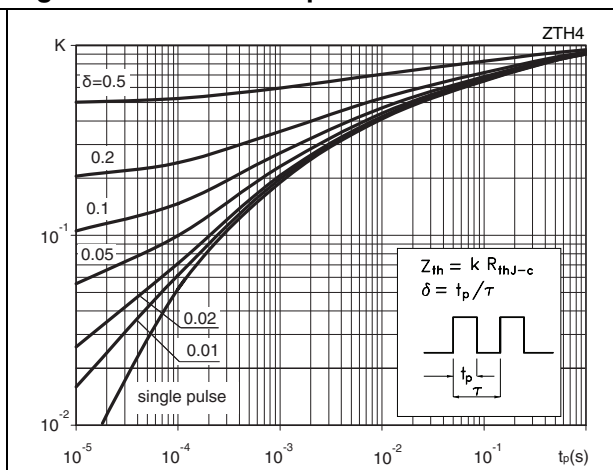


Figure 17. Thermal impedance





### 3 Test circuit

Figure 18. Test circuit for inductive load switching

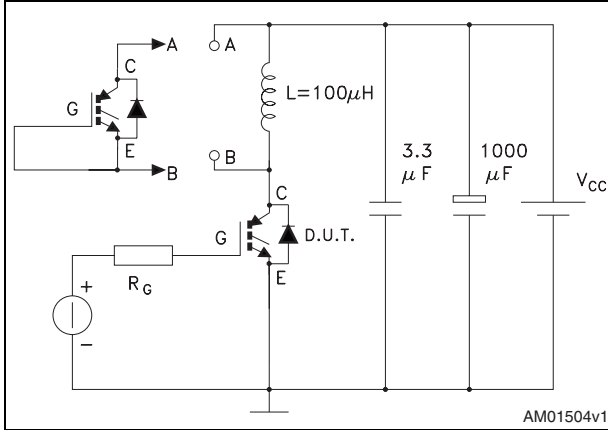


Figure 19. Gate charge test circuit

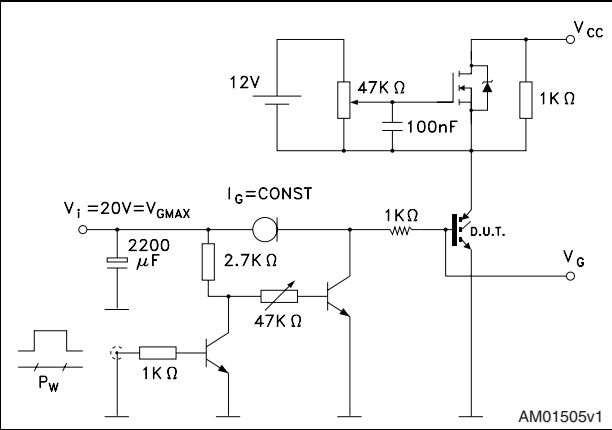
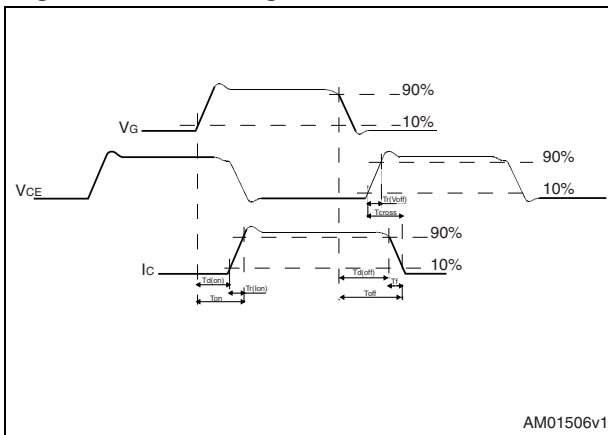


Figure 20. Switching waveform



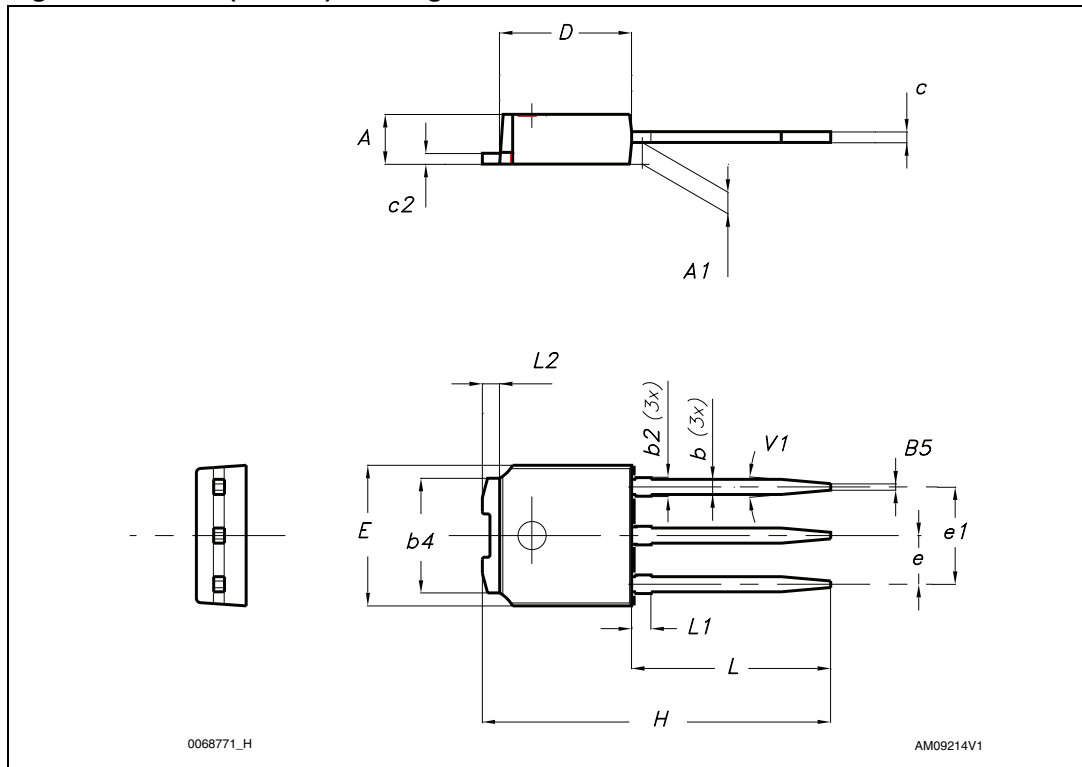
## 4 Package mechanical data

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. IPAK (TO-251) mechanical data**

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
B5		0.3	
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
e		2.28	
e1	4.40		4.60
H		16.10	
L	9.00		9.40
L1	0.80		1.20
L2		0.80	1.00
V1		10 °	

Figure 21. IPAK (TO-251) drawing



## 5 Revision history

**Table 9. Document revision history**

Date	Revision	Changes
27-Jun-2012	1	First release.

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