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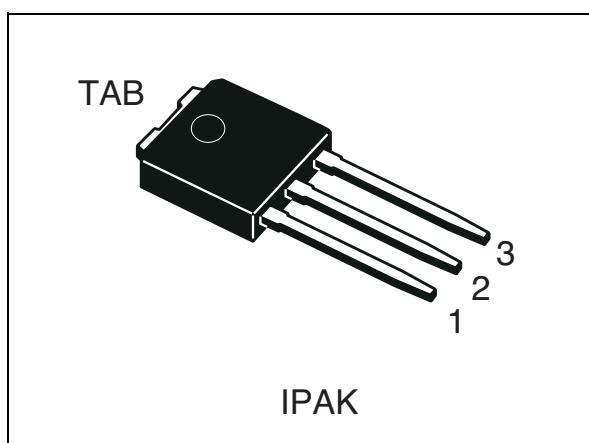
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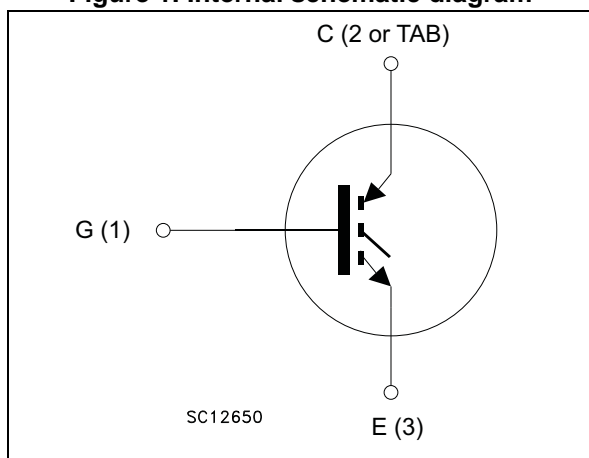
# STGD6NC60H-1

## N-channel 600 V, 7 A - IPAK Very fast PowerMESH™ IGBT

Datasheet - production data



**Figure 1. Internal schematic diagram**



### Features

Type	V <sub>CE</sub>	V <sub>CE(sat)</sub> max @25°C	I <sub>C</sub> @100°C
STGD6NC60H	600V	<2.5V	7A

- Low on voltage drop (V<sub>cesat</sub>)
- Low C<sub>RES</sub> / C<sub>IES</sub> ratio (no cross-conduction susceptibility)
- High frequency operation

### Description

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix H identifies a family optimized for high frequency application in order to achieve very high switching performances (reduced t<sub>fall</sub>) maintaining a low voltage drop.

### Applications

- High frequency inverters
- SMPS and PFC in both hard switch and resonant topologies
- Motor drivers

**Table 1. Device summary**

Part number	Marking	Package	Packaging
STGD6NC60H-1	GD6NC60H	IPAK	Tube

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## Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
V <sub>CES</sub>	Collector-emitter voltage (V <sub>GS</sub> = 0)	600	V
I <sub>C</sub> <sup>(1)</sup>	Collector current (continuous) at T <sub>C</sub> = 25°C	15	A
I <sub>C</sub> <sup>(1)</sup>	Collector current (continuous) at T <sub>C</sub> = 100°C	7	A
I <sub>CM</sub> <sup>(2)</sup>	Collector current (pulsed)	21	A
V <sub>GE</sub>	Gate-emitter voltage	±20	V
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25°C	62.5	W
T <sub>stg</sub>	Storage temperature	- 55 to 150	°C
T <sub>j</sub>	Operating junction temperature		
T <sub>l</sub>	Maximum lead temperature for soldering purpose (for 10sec. 1.6 mm from case)	300	°C

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C, I_C)}$$

2. Pulse width limited by max junction temperature

**Table 3. Thermal resistance**

Symbol	Parameter	Value	Unit
R <sub>thj-case</sub>	Thermal resistance junction-case max	2	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient max	100	°C/W

Electrical characteristics

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## 2 Electrical characteristics

(T<sub>CASE</sub>=25°C unless otherwise specified)

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>BR(CES)</sub>	Collector-emitter breakdown voltage	I <sub>C</sub> = 1mA, V <sub>GE</sub> = 0	600			V
V <sub>CE(sat)</sub>	Collector-emitter saturation voltage	V <sub>GE</sub> = 15V, I <sub>C</sub> = 3A		1.9	2.5	V
		V <sub>GE</sub> = 15V, I <sub>C</sub> = 3A, T <sub>C</sub> = 125°C		1.7		V
V <sub>GE(th)</sub>	Gate threshold voltage	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250 μA	3.75		5.75	V
I <sub>CES</sub>	Collector cut-off current (V <sub>GE</sub> = 0)	V <sub>CE</sub> = 600V			10	μA
		V <sub>CE</sub> = 600V, T <sub>C</sub> = 125°C			1	mA
I <sub>GES</sub>	Gate-emitter leakage current (V <sub>CE</sub> = 0)	V <sub>GE</sub> = ±20V, V <sub>CE</sub> = 0			±100	nA
g <sub>fs</sub>	Forward transconductance	V <sub>CE</sub> = 15V, I <sub>C</sub> = 3A		3		S

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C <sub>ies</sub>	Input capacitance	V <sub>CE</sub> = 25V, f = 1MHz, V <sub>GE</sub> = 0	-	205	-	pF
C <sub>oes</sub>	Output capacitance		-	32	-	pF
C <sub>res</sub>	Reverse transfer capacitance		-	5.5	-	pF
Q <sub>g</sub>	Total gate charge	V <sub>CE</sub> = 390V, I <sub>C</sub> = 3A, V <sub>GE</sub> = 15V, (see Figure 17)	-	13.6	-	nC
Q <sub>ge</sub>	Gate-emitter charge			3.4		nC
Q <sub>gc</sub>	Gate-collector charge			5.1		nC
I <sub>CL</sub>	Turn-off SOA minimum current	V <sub>clamp</sub> =390V, T <sub>j</sub> =150°C, R <sub>C</sub> =10Ω, V <sub>GE</sub> =15V	-	19	-	A

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390V, I_C = 3A$ $R_G = 10\Omega, V_{GE} = 15V,$ (see Figure 18)	-	12	-	ns
$t_r$	Current rise time		-	5	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	612	-	A/ $\mu s$
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390V, I_C = 3A$ $R_G = 10\Omega, V_{GE} = 15V,$ $T_j = 125^\circ C$ (see Figure 18)	-	13	-	ns
$t_r$	Current rise time		-	4.3	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	560	-	A/ $\mu s$
$t_{r(Voff)}$	Off voltage rise time	$V_{CC} = 390V, I_C = 3A,$ $R_{GE} = 10\Omega, V_{GE} = 15V$ (see Figure 18)	-	40	-	ns
$t_{d(off)}$	Turn-off delay time		-	76	-	ns
$t_f$	Current fall time		-	100	-	ns
$t_{r(Voff)}$	Off voltage rise time	$V_{CC} = 390V, I_C = 3A,$ $R_{GE} = 10\Omega, V_{GE} = 15V,$ $T_j = 125^\circ C$ (see Figure 18)	-	60	-	ns
$t_{d(off)}$	Turn-off delay time		-	98	-	ns
$t_f$	Current fall time		-	124	-	ns

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 390V, I_C = 3A$ $R_G = 10\Omega, V_{GE} = 15V$ (see Figure 18)	-	20	-	$\mu J$
$E_{off}^{(2)}$	Turn-off switching losses		-	68	-	$\mu J$
$E_{ts}$	Total switching losses		-	88	-	$\mu J$
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 390V, I_C = 3A$ $R_G = 10\Omega, V_{GE} = 15V, T_j = 125^\circ C$ (see Figure 18)	-	37	-	$\mu J$
$E_{off}^{(2)}$	Turn-off switching losses		-	93	-	$\mu J$
$E_{ts}$	Total switching losses		-	130	-	$\mu J$

- $E_{on}$  is the turn-on losses when a typical diode is used in the test circuit in Figure 18. If the IGBT is offered in a package with a co-pak diode, the co-pak diode is used as external diode. IGBTs & Diode are at the same temperature (25°C and 125°C)
- Turn-off losses include also the tail of the collector current

Electrical characteristics

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2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

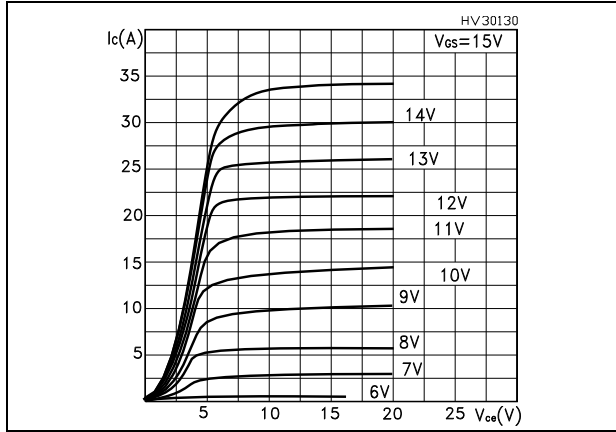


Figure 3. Transfer characteristics

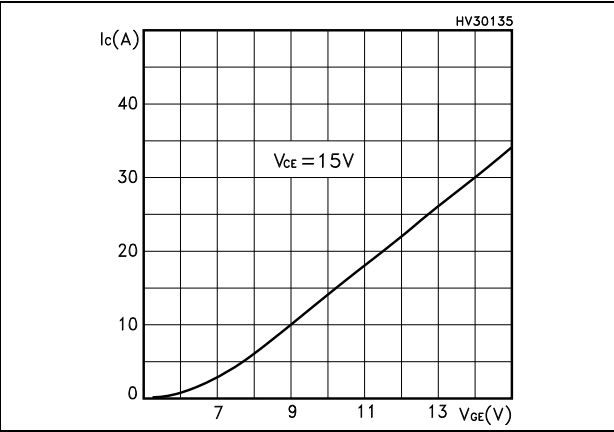


Figure 4. Transconductance

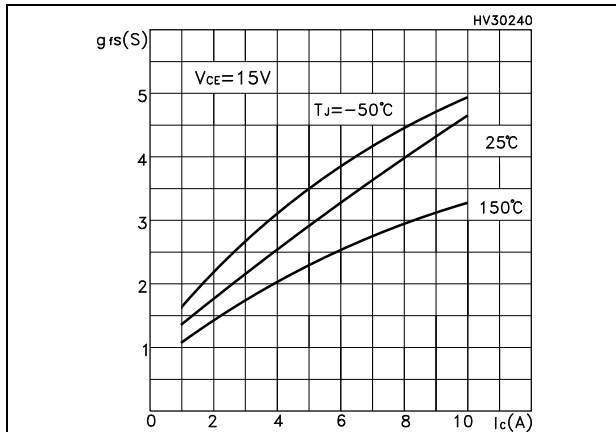


Figure 5. Collector-emitter on voltage vs temperature

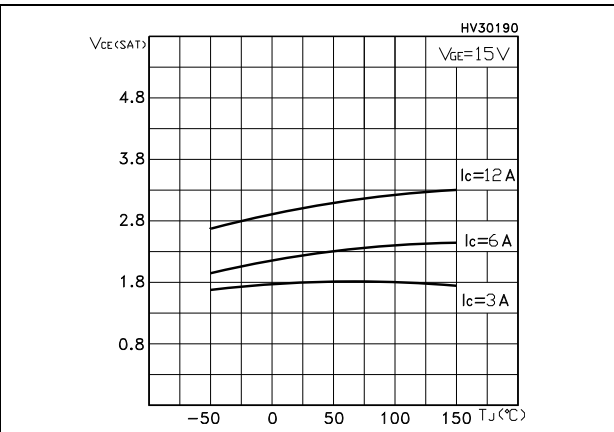


Figure 6. Gate charge vs gate-source voltage

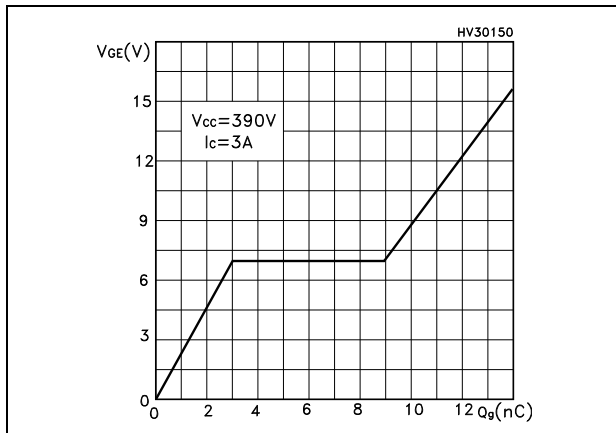
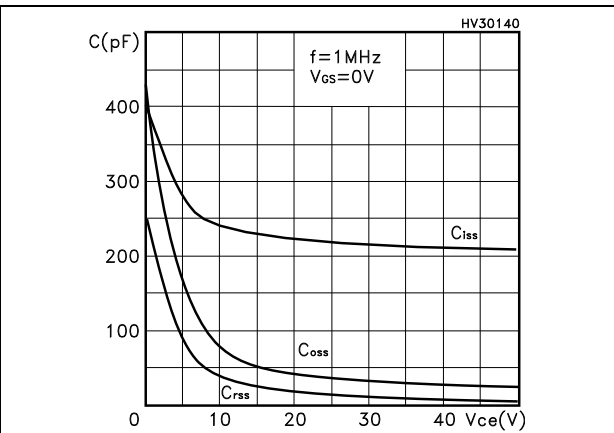


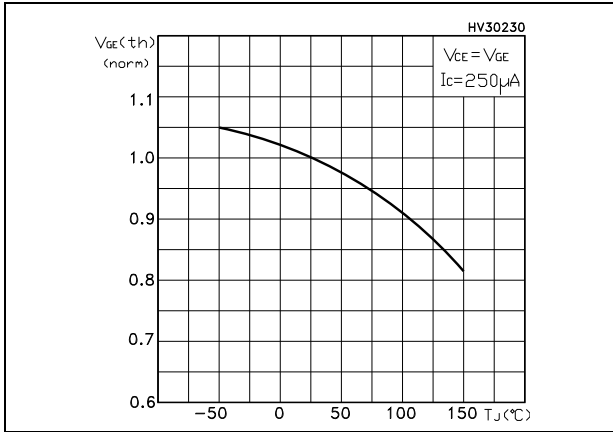
Figure 7. Capacitance variations



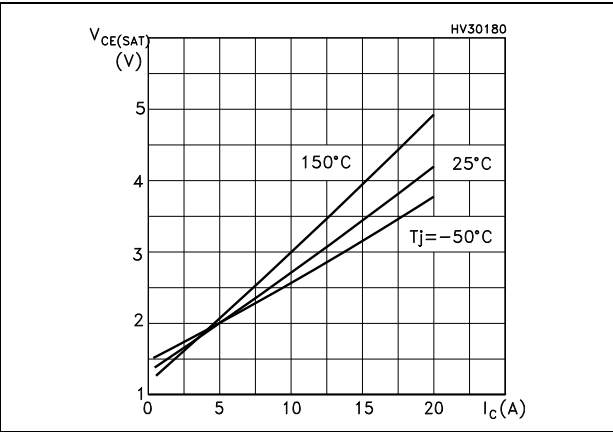
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**Electrical characteristics**

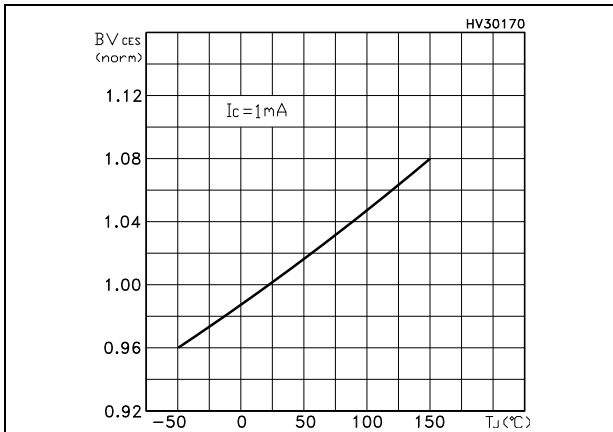
**Figure 8. Normalized gate threshold voltage vs temperature**



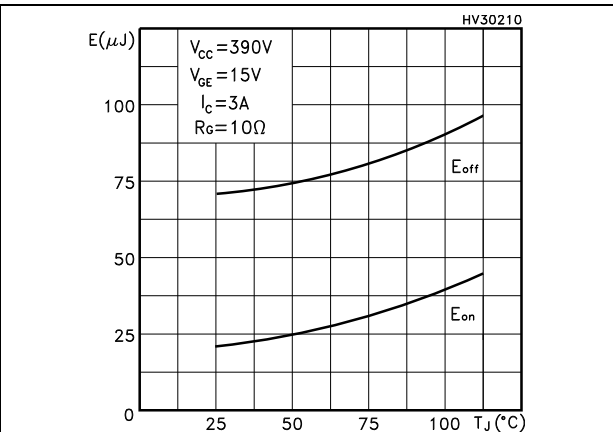
**Figure 9. Collector-emitter on voltage vs collector current**



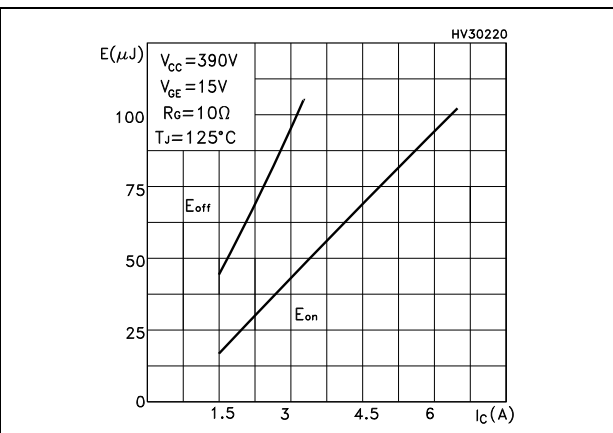
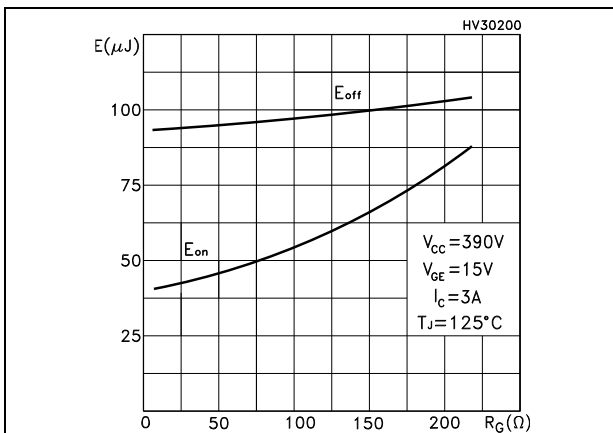
**Figure 10. Normalized breakdown voltage vs temperature**



**Figure 11. Switching losses vs temperature**



**Figure 12. Switching losses vs gate resistance**      **Figure 13. Switching losses vs collector current**

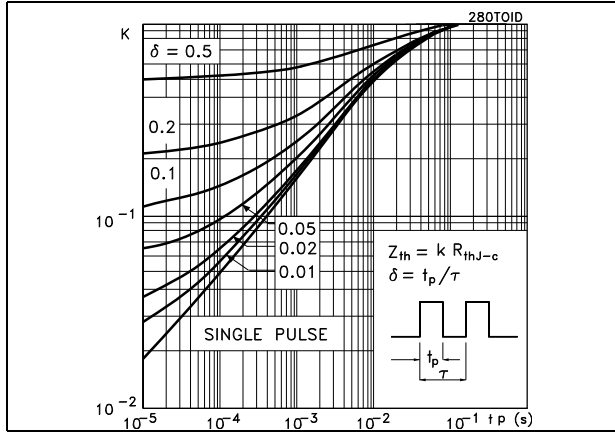




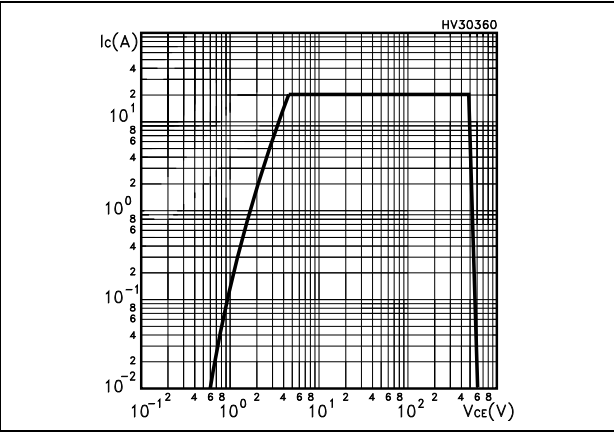
**Electrical characteristics**

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**Figure 14. Thermal impedance**



**Figure 15. Turn-off SOA**

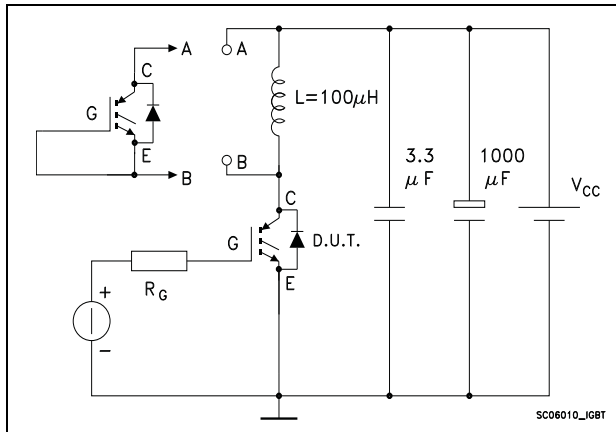


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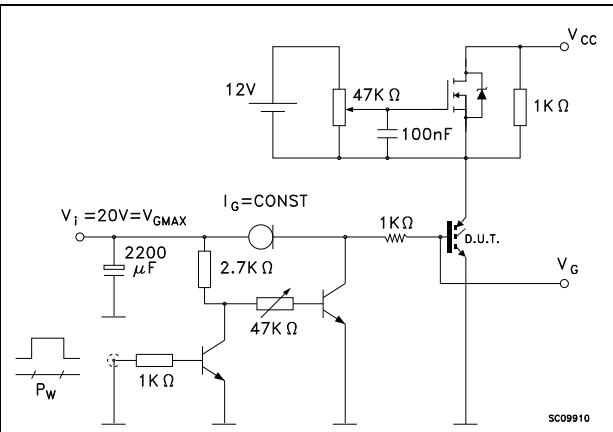
**Test circuit**

**3 Test circuit**

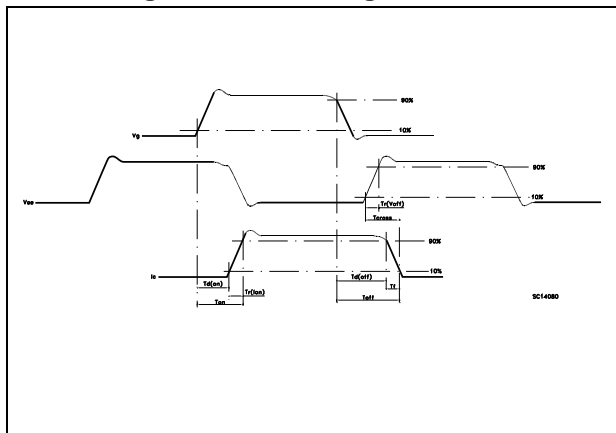
**Figure 16. Test circuit for inductive load switching**



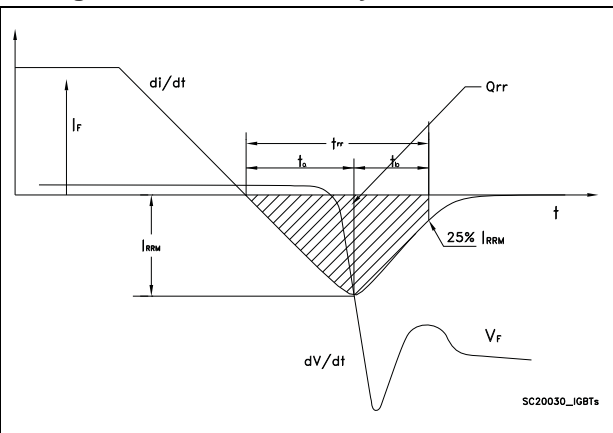
**Figure 17. Gate charge test circuit**



**Figure 18. Switching waveform**



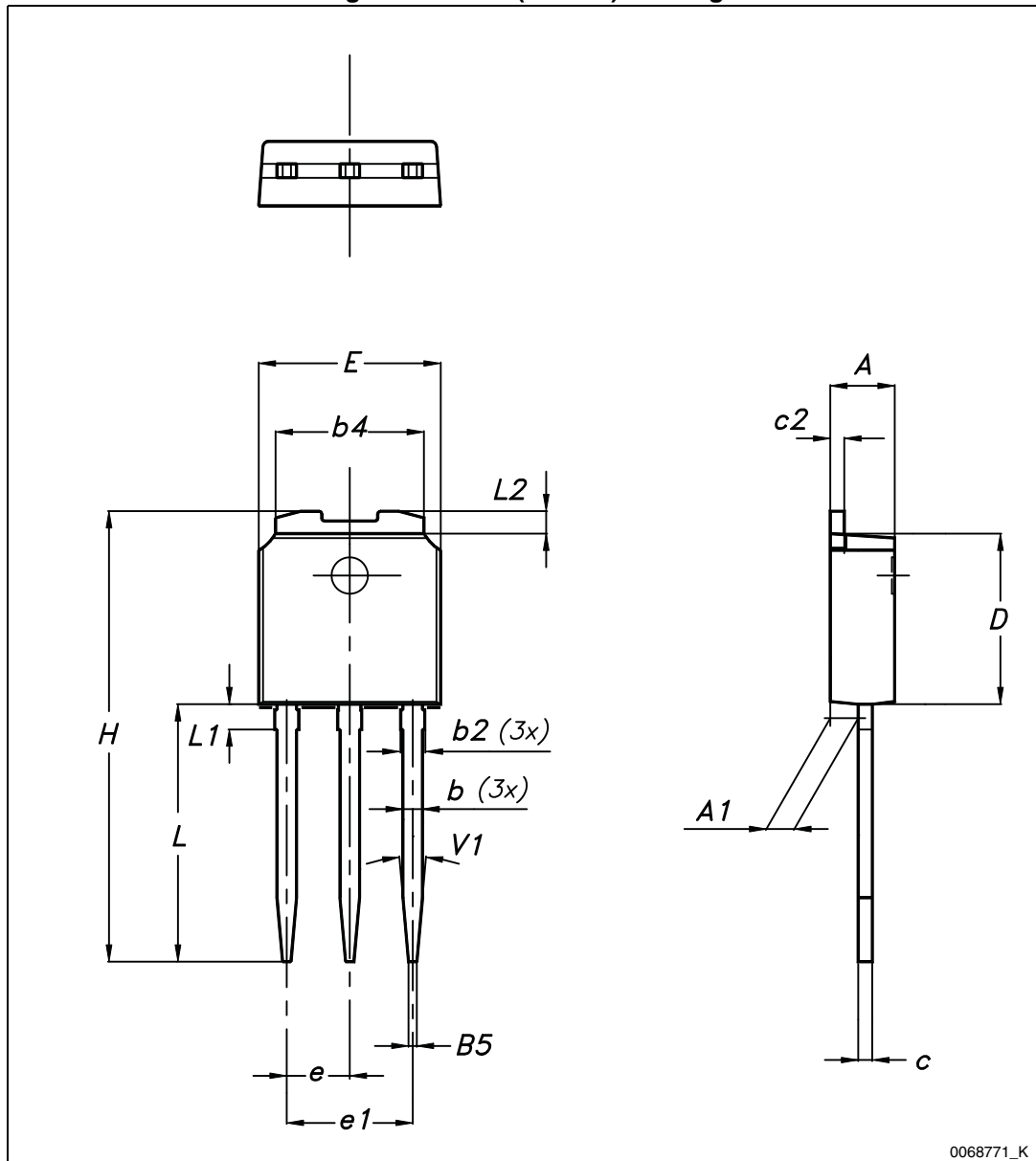
**Figure 19. Diode recovery time waveform**



## 4 Package mechanical data

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Figure 20. IPAK (TO-251) drawing



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**Package mechanical data**

**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		0.30	
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°	

## 5 Revision history

Table 9. Revision history

Date	Revision	Changes
08-Apr-2014	1	First release.

**STGD6NC60H-1**

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