



# THE DATASHEET OF STGW45NC60WD



### Features

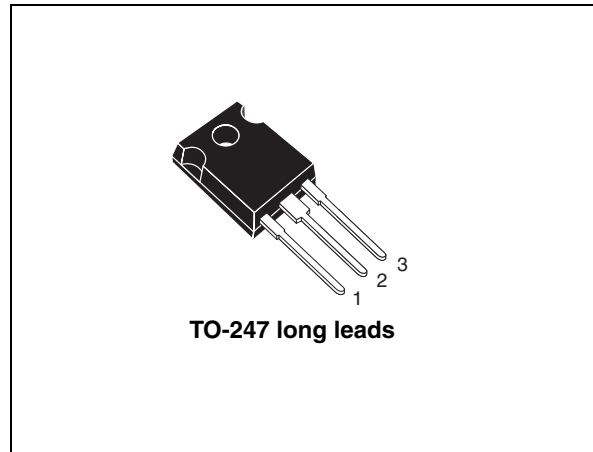
- Low  $C_{RES} / C_{IES}$  ratio (no cross conduction susceptibility)
- Very soft ultra fast recovery anti parallel diode

### Applications

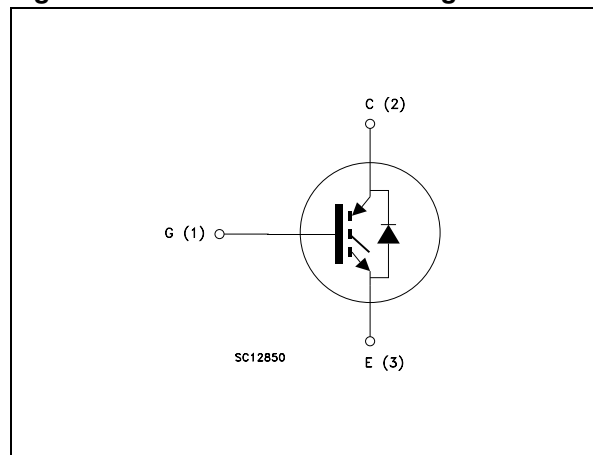
- High frequency inverters, UPS
- Motor drivers
- HF, SMPS and PFC in both hard switch and resonant topologies
- Welding
- Induction heating

### Description

This IGBT utilizes the advanced Power MESH™ process resulting in an excellent trade-off between switching performance and low on-state behavior.



**Figure 1. Internal schematic diagram**



**Table 1. Device summary**

Order code	Marking	Package	Packaging
STGW45NC60WD	GW45NC60WD	TO-247 long leads	Tube

## Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GS} = 0$ )	600	V
$I_C^{(1)}$	Collector current (continuous) at $T_C=25\text{ }^\circ\text{C}$	90	A
$I_C^{(1)}$	Collector current (continuous) at $T_C=100\text{ }^\circ\text{C}$	45	A
$I_{CL}^{(2)}$	Turn-off latching current	230	A
$I_{CP}^{(3)}$	Pulsed collector current	230	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$I_F$	Diode RMS forward current at $T_C=25\text{ }^\circ\text{C}$	30	A
$I_{FSM}$	Surge non repetitive forward current $t_p=10\text{ ms}$ sinusoidal	120	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	285	W
$T_j$	Operating junction temperature	- 55 to 150	$^\circ\text{C}$

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.  $V_{clamp} = 80\% V_{CES}$ ,  $T_j = 150\text{ }^\circ\text{C}$ ,  $R_G = 10\ \Omega$ ,  $V_{GE} = 15\text{ V}$

3. Pulse width limited by max junction temperature allowed

**Table 3. Thermal resistance**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case IGBT	0.437	$^\circ\text{C/W}$
$R_{thj-case}$	Thermal resistance junction-case diode	1.5	$^\circ\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	50	$^\circ\text{C/W}$

## 2 Electrical characteristics

( $T_{CASE} = 25\text{ °C}$  unless otherwise specified)

**Table 4. Static (electrical characteristics)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ( $V_{GE} = 0$ )	$I_C = 1\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$ , $I_C = 30\text{ A}$ $V_{GE} = 15\text{ V}$ , $I_C = 30\text{ A}$ , $T_C = 125\text{ °C}$		2.1 1.9	2.6	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$ , $I_C = 250\text{ }\mu\text{A}$	3.75		5.75	V
$I_{CES}$	Collector-emitter leakage current ( $V_{GE} = 0$ )	$V_{CE} = 600\text{ V}$ $V_{CE} = 600\text{ V}$ , $T_C = 125\text{ °C}$			500 5	$\mu\text{A}$ mA
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{ V}$			$\pm 100$	nA
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE} = 15\text{ V}$ , $I_C = 30\text{ A}$		20		S

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

**Table 5. Dynamic (electrical characteristics)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GE} = 0$		2900		pF
$C_{oes}$	Output capacitance			298		pF
$C_{res}$	Reverse transfer capacitance			59		pF
$Q_g$	Total gate charge	$V_{CE} = 390\text{ V}$ , $I_C = 30\text{ A}$ ,		126		nC
$Q_{ge}$	Gate-emitter charge	$V_{GE} = 15\text{ V}$ ,		16		nC
$Q_{gc}$	Gate-collector charge	(see Figure 18)		46		nC

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}, I_C = 30\text{ A}$		33		ns
$t_r$	Current rise time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$		12		ns
$(di/dt)_{on}$	Turn-on current slope	(see Figure 17)		2600		A/ $\mu$ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}, I_C = 30\text{ A}$		32		ns
$t_r$	Current rise time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$		14		ns
$(di/dt)_{on}$	Turn-on current slope	$T_C = 125\text{ }^\circ\text{C}$ (see Figure 17)		2300		A/ $\mu$ s
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390\text{ V}, I_C = 30\text{ A},$		26		ns
$t_{d(off)}$	Turn-off delay time	$R_{GE} = 10\ \Omega, V_{GE} = 15\text{ V},$		168		ns
$t_f$	Current fall time	(see Figure 17)		36		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390\text{ V}, I_C = 30\text{ A},$		54		ns
$t_{d(off)}$	Turn-off delay time	$R_{GE} = 10\ \Omega, V_{GE} = 15\text{ V},$		213		ns
$t_f$	Current fall time	$T_C = 125\text{ }^\circ\text{C}$ (see Figure 17)		67		ns

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 390\text{ V}, I_C = 30\text{ A}$		302		$\mu$ J
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$		349		$\mu$ J
$E_{is}$	Total switching losses	(see Figure 17)		651		$\mu$ J
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 390\text{ V}, I_C = 30\text{ A}$		553		$\mu$ J
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$		750		$\mu$ J
$E_{is}$	Total switching losses	$T_C = 125\text{ }^\circ\text{C}$ (see Figure 17)		1303		$\mu$ J

1.  $E_{on}$  is the turn-on losses when a typical diode is used in the test circuit in Figure 20.  $E_{on}$  include diode recovery energy. 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

Table 8. Collector-emitter diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
$V_F$	Forward on-voltage	$I_F = 30\text{ A}$ $I_F = 30\text{ A}, T_C = 125\text{ °C}$		2.4		V
				1.8		V
$t_{rr}$	Reverse recovery time	$I_F = 30\text{ A}, V_R = 50\text{ V},$ $di/dt = 100\text{ A}/\mu\text{s}$ <i>(see Figure 20)</i>		45		ns
$Q_{rr}$	Reverse recovery charge			56		nC
$I_{rrm}$	Reverse recovery current			2.55		A
$t_{rr}$	Reverse recovery time	$I_F = 30\text{ A}, V_R = 50\text{ V},$ $T_C = 125\text{ °C},$ $di/dt = 100\text{ A}/\mu\text{s}$ <i>(see Figure 20)</i>		100		ns
$Q_{rr}$	Reverse recovery charge			290		nC
$I_{rrm}$	Reverse recovery current			5.8		A

## 2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

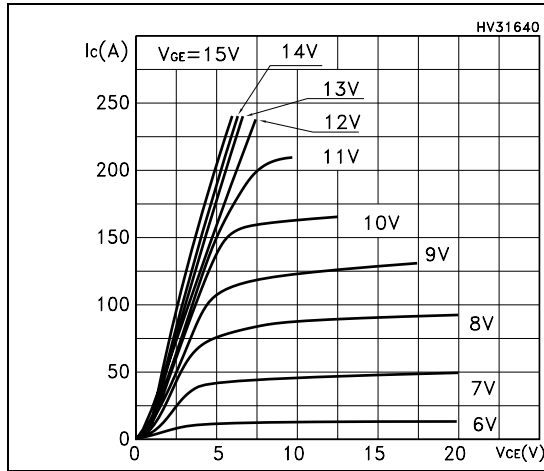


Figure 3. Transfer characteristics

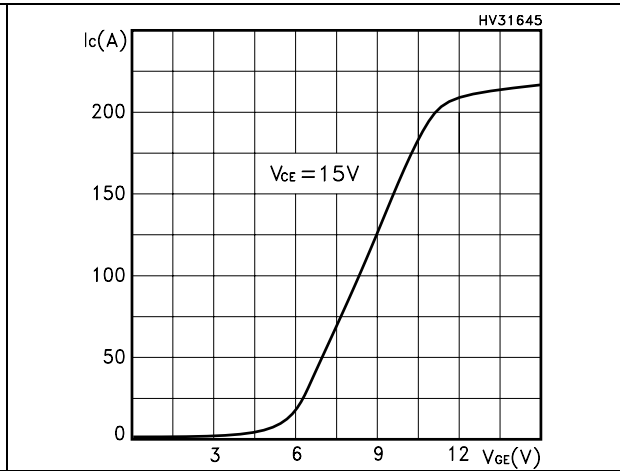


Figure 4. Transconductance

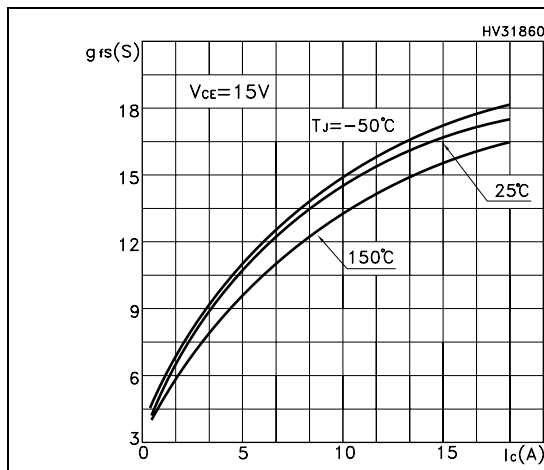


Figure 5. Collector-emitter on voltage vs temperature

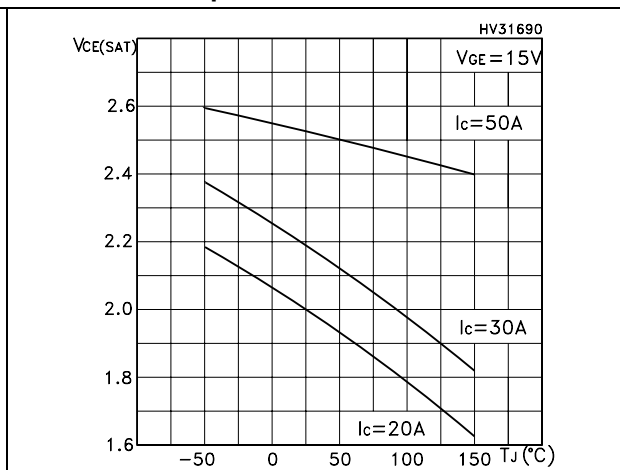


Figure 6. Collector-emitter on voltage vs collector current

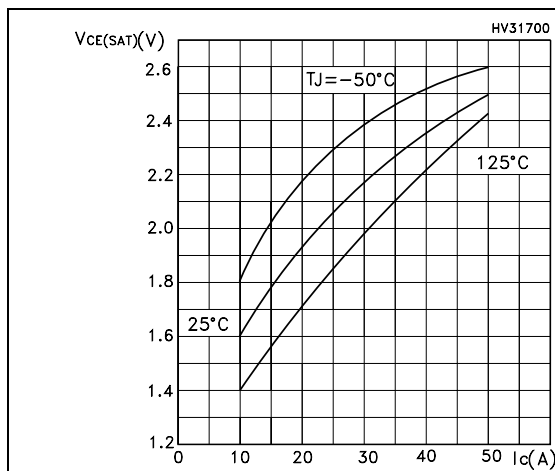


Figure 7. Normalized gate threshold vs temperature

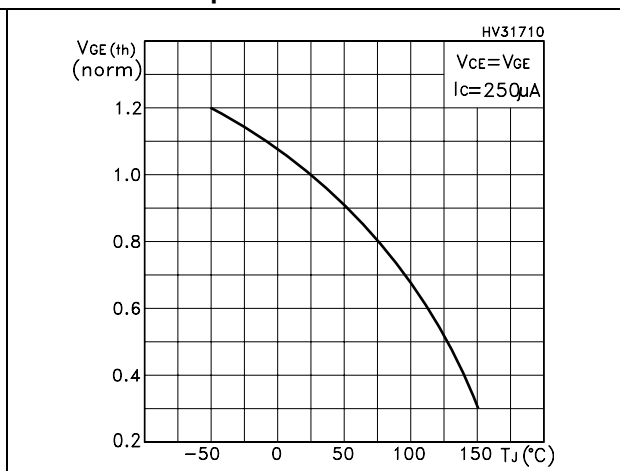


Figure 8. Normalized breakdown voltage vs temperature

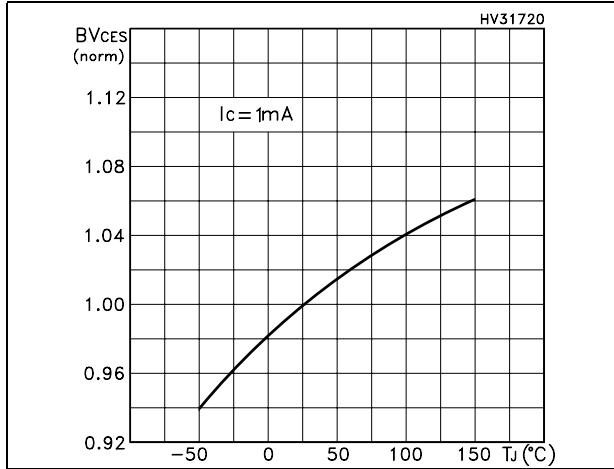


Figure 9. Gate charge vs gate-emitter voltage

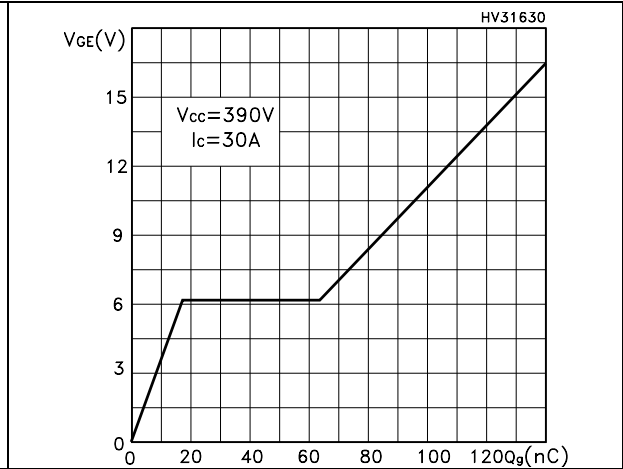


Figure 10. Capacitance variations

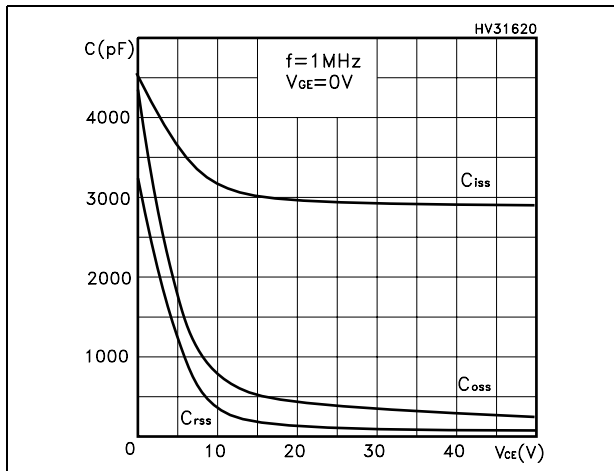


Figure 11. Switching losses vs temperature

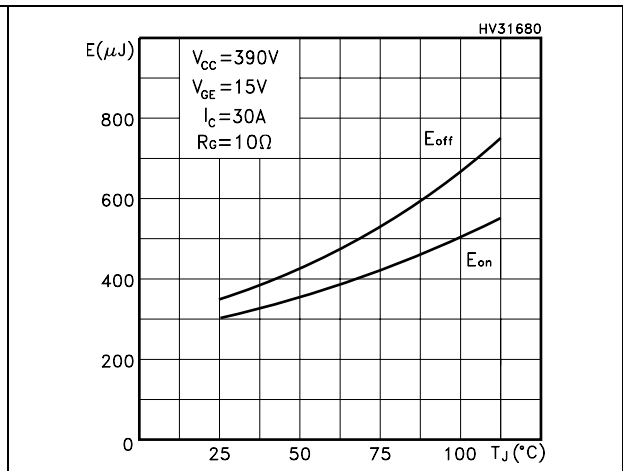


Figure 12. Switching losses vs gate resistance

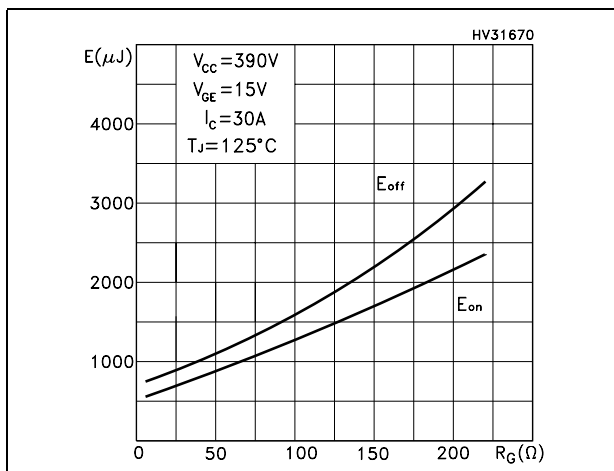


Figure 13. Switching losses vs collector current

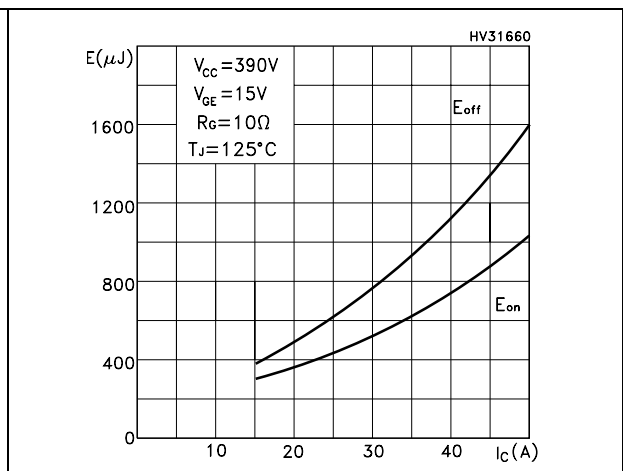


Figure 14. Thermal impedance

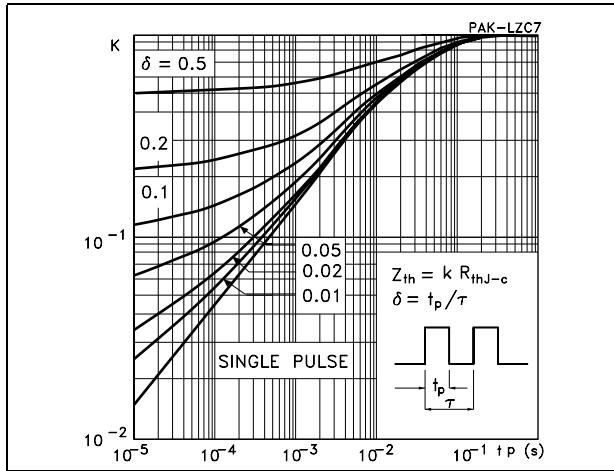


Figure 15. Turn-off SOA

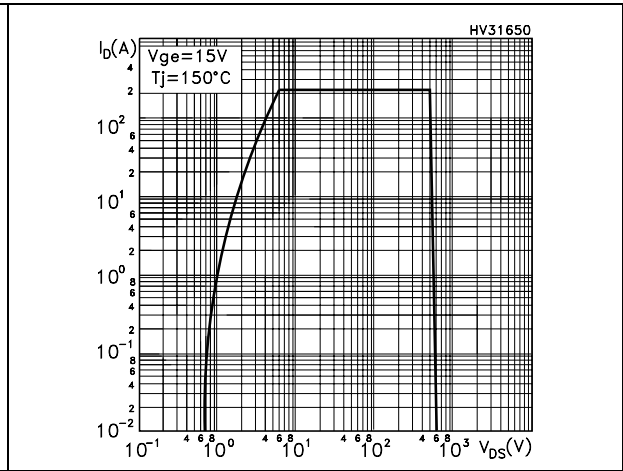
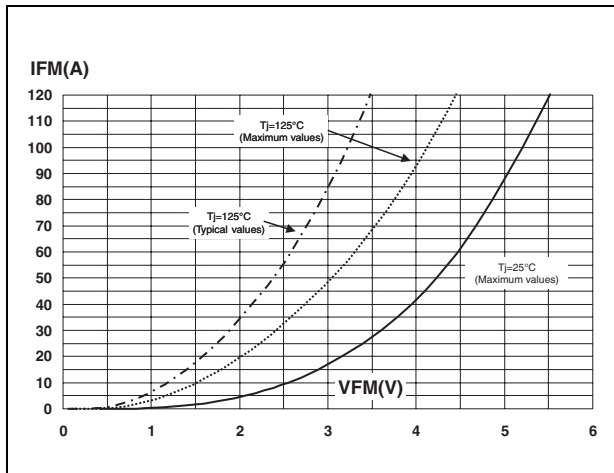


Figure 16. Emitter-collector diode characteristics



### 3 Test circuit

Figure 17. Test circuit for inductive load switching

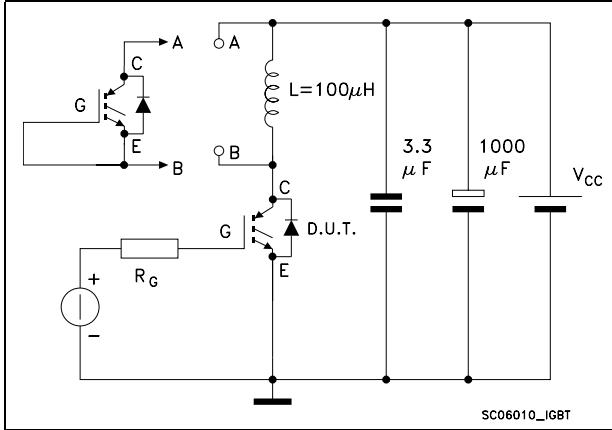


Figure 18. Gate charge test circuit

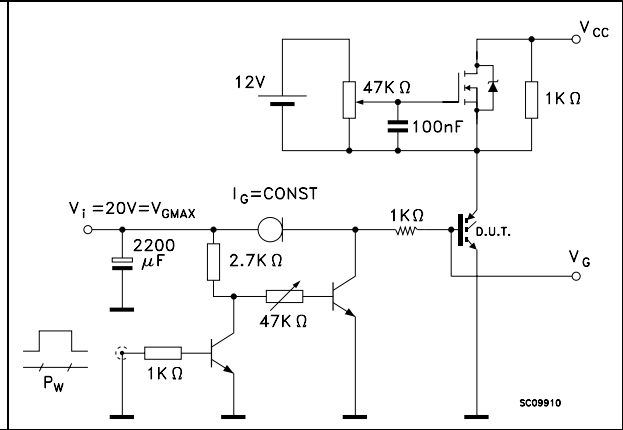


Figure 19. Switching waveforms

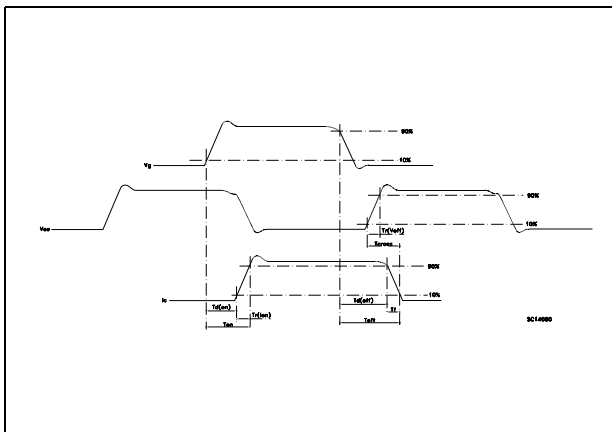
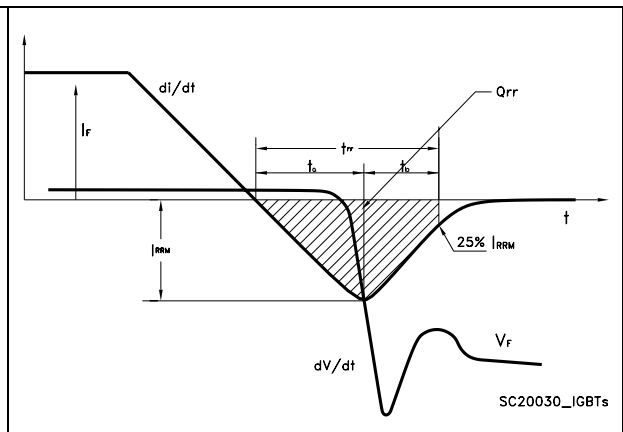


Figure 20. Diode recovery times waveform

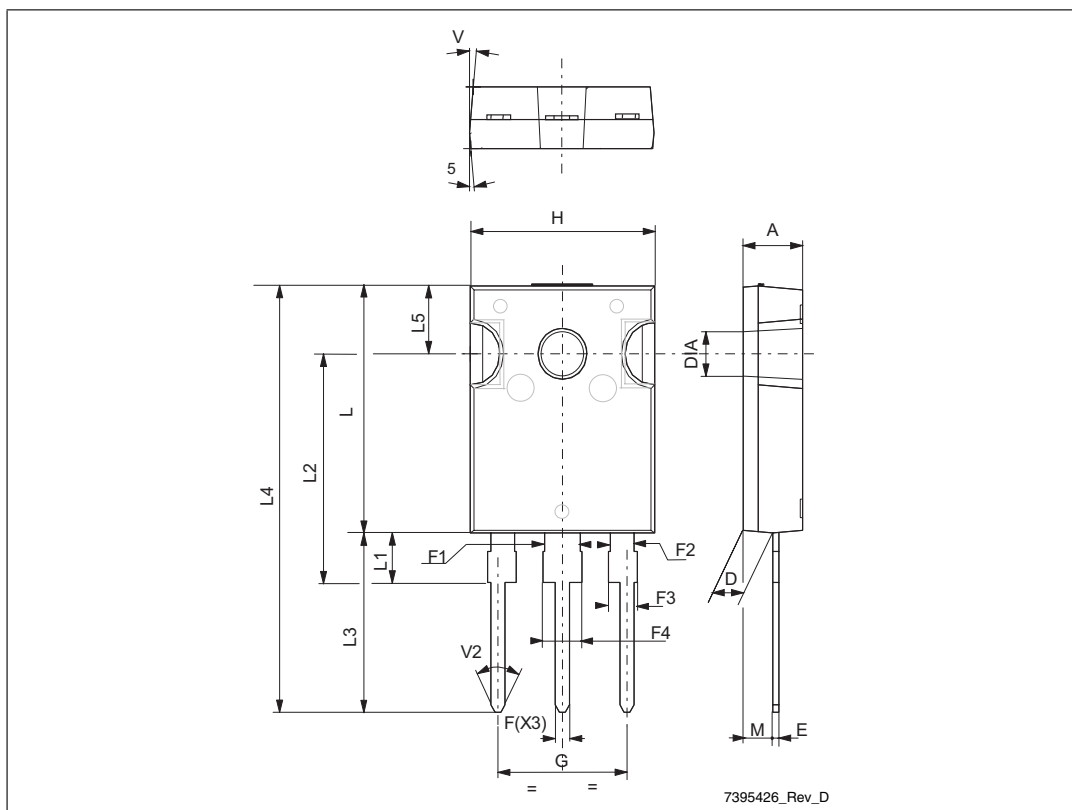


## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com)

TO-247 long leads mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.16
D	2.2		2.6
E	0.4		0.8
F	1		1.4
F1		3	
F2		2	
F3	1.9		2.4
F4	3		3.4
G		10.9	
H	15.45		16.03
L	19.85		21.09
L1	3.7		4.3
L2	18.3		19.13
L3	14.2		20.3
L4	34.05		41.38
L5	5.35		6.3
M	2		3
V		5°	
V2		60°	
DIAM	3.55		3.65



## 5 Revision history

**Table 9. Document revision history**

Date	Revision	Changes
05-Jun-2008	1	First release

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