



# STGY40NC60VD

N-channel 600V - 50A - Max247  
Very fast PowerMESH™ IGBT

## Features

Type	V <sub>CES</sub>	V <sub>CE(sat)</sub> (max)@25°C	I <sub>c</sub> @100°C
STGY40NC60VD	600V	< 2.5V	50A

- High current capability
- High frequency operation up to 50kHz
- Low C<sub>RES</sub> / C<sub>IES</sub> ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode

## 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 “V” identifies a family optimized for very high frequency applications.

## Applications

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

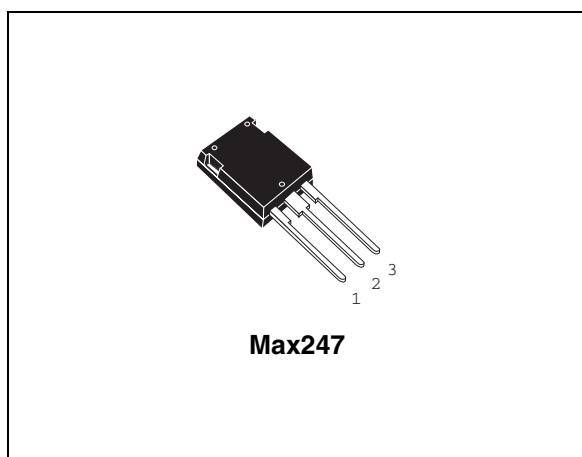


Figure 1. Internal schematic diagram

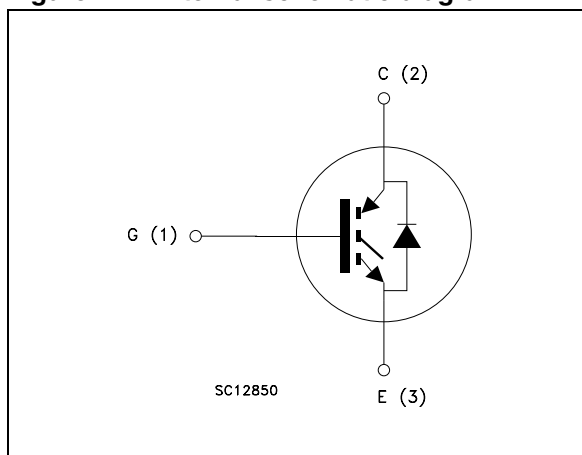


Table 1. Device summary

Order code	Marking	Package	Packaging
STGY40NC60VD	GY40NC60VD	Max247	Tube

# Contents

<b>1</b>	<b>Electrical ratings</b> .....	<b>3</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>4</b>
	2.1 Electrical characteristics (curves) .....	7
<b>3</b>	<b>Test circuit</b> .....	<b>10</b>
<b>4</b>	<b>Package mechanical data</b> .....	<b>11</b>
<b>5</b>	<b>Revision history</b> .....	<b>13</b>

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GS} = 0$ )	600	V
$I_C^{(1)}$	Collector current (continuous) at $T_C = 25^\circ\text{C}$	80	A
$I_C^{(1)}$	Collector current (continuous) at $T_C = 100^\circ\text{C}$	50	A
$I_{CL}^{(2)}$	Turn-off SOA minimum current	200	A
$I_F$	Diode RMS forward current at $T_C = 25^\circ\text{C}$	30	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$P_{TOT}$	Total dissipation at $T_C = 25^\circ\text{C}$	260	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. Pulse width limited by max junction temperature

**Table 2. Thermal resistance**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max IGBT	0.48	$^\circ\text{C/W}$
$R_{thj-case}$	Thermal resistance junction-case max diode	1.5	$^\circ\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	50	$^\circ\text{C/W}$
$T_L$	Maximum lead temperature for soldering purpose (1.6mm from case, for 10 sec) typ.	300	$^\circ\text{C}$

## 2 Electrical characteristics

( $T_{CASE}=25^{\circ}C$  unless otherwise specified)

**Table 3. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{BR(CES)}$	Collector-emitter breakdown voltage	$I_C = 1mA, V_{GE} = 0$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15V, I_C = 40A$ $V_{GE} = 15V, I_C = 40A, T_C = 125^{\circ}C$		1.9 1.7	2.5	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 250\mu A$	3.75		5.75	V
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = \text{Max rating}, T_C = 25^{\circ}C$ $V_{CE} = \text{Max rating}, T_C = 125^{\circ}C$			10 1	$\mu A$ mA
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20V, V_{CE} = 0$			$\pm 100$	nA
$g_{fs}$	Forward transconductance	$V_{CE} = 15V, I_C = 20A$		20		S

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25V, f = 1MHz,$ $V_{GE} = 0$		4550		pF
$C_{oes}$	Output capacitance			350		pF
$C_{res}$	Reverse transfer capacitance			105		pF
$Q_g$	Total gate charge	$V_{CE} = 390V, I_C = 40A,$		214		nC
$Q_{ge}$	Gate-emitter charge	$V_{GE} = 15V,$		30		nC
$Q_{gc}$	Gate-collector charge	<a href="#">Figure 17</a>		96		nC

**Table 5. 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	$V_{CC} = 390V, I_C = 40A$ $R_G = 3.3\Omega, V_{GE} = 15V,$ <i>Figure 18, Figure 16</i>		43 17 2060		ns ns A/ $\mu$ s
$t_{d(on)}$ $t_r$ $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 390V, I_C = 40A$ $R_G = 3.3\Omega, V_{GE} = 15V,$ $T_J = 125^\circ C$ <i>Figure 18, Figure 16</i>		42 19 1900		ns ns A/ $\mu$ s
$t_{r(Voff)}$ $t_{d(Voff)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390V, I_C = 40A$ $R_G = 3.3\Omega, V_{GE} = 15V,$ <i>Figure 18, Figure 16</i>		25 140 45		ns ns ns
$t_{r(Voff)}$ $t_{d(Voff)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390V, I_C = 40A$ $R_G = 3.3\Omega, V_{GE} = 15V,$ $T_J = 125^\circ C$ <i>Figure 18, Figure 16</i>		60 170 77		ns ns ns

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}$ $E_{off}^{(1)}$ $E_{ts}$	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390V, I_C = 40A$ $R_G = 3.3\Omega, V_{GE} = 15V,$ <i>Figure 16</i>		330 720 1050	450 970 1420	$\mu$ J $\mu$ J $\mu$ J
$E_{on}$ $E_{off}^{(1)}$ $E_{ts}$	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390V, I_C = 40A$ $R_G = 3.3\Omega, V_{GE} = 15V,$ $T_J = 125^\circ C$ <i>Figure 16</i>		640 1400 2040		$\mu$ J $\mu$ J $\mu$ J

1. 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	$I_f = 20A$		1.5	2.2	V
		$I_f = 20A, T_j = 125^\circ C$		1		V
$t_{rr}$	Reverse recovery time	$I_f = 20A, V_R = 40V,$ $T_j = 25^\circ C, di/dt = 100 A/\mu s$		44		ns
$Q_{rr}$	Reverse recovery charge	$T_j = 25^\circ C, di/dt = 100 A/\mu s$		66		nC
$I_{rrm}$	Reverse recovery current	<a href="#">Figure 19</a>		3		A
$t_{rr}$	Reverse recovery time	$I_f = 40A, V_R = 50V,$ $T_j = 125^\circ C, di/dt = 100A/\mu s$		88		ns
$Q_{rr}$	Reverse recovery charge	$T_j = 125^\circ C, di/dt = 100A/\mu s$		237		nC
$I_{rrm}$	Reverse recovery current	<a href="#">Figure 19</a>		5.4		A

## 2.1 Electrical characteristics (curves)

Figure 1. Output characteristics

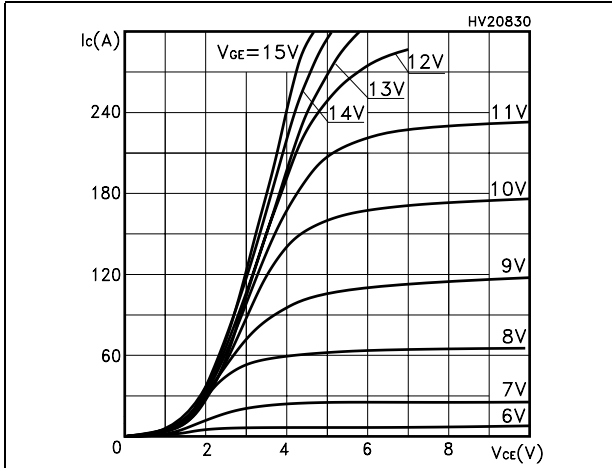


Figure 2. Transfer characteristics

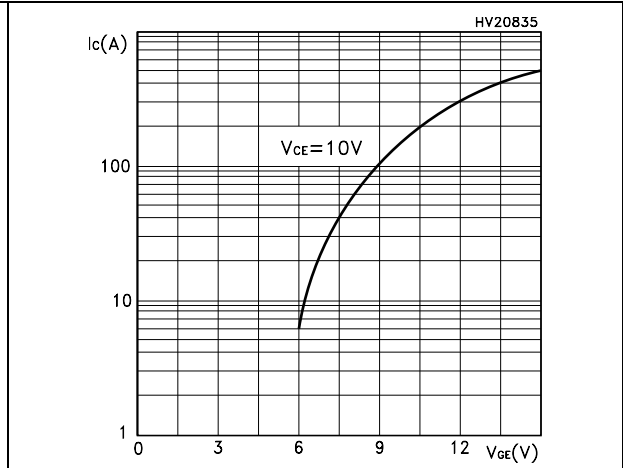


Figure 3. Transconductance

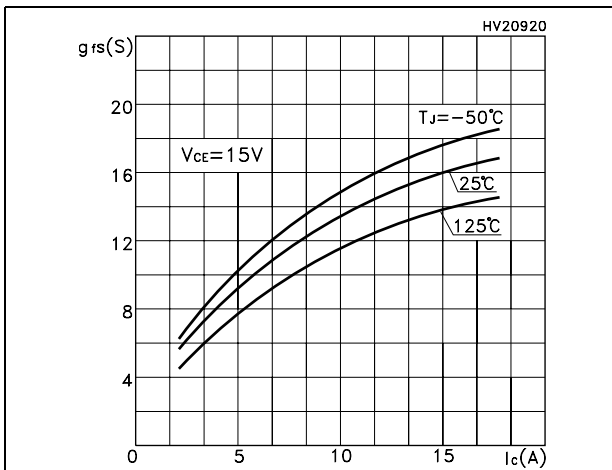


Figure 4. Collector-emitter on voltage vs temperature

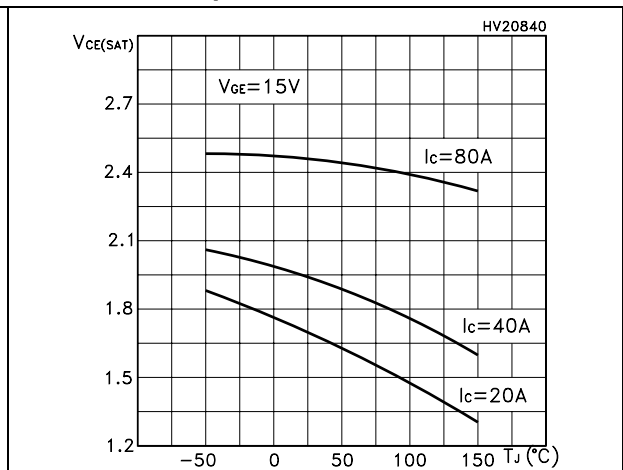


Figure 5. Gate charge vs gate-source voltage

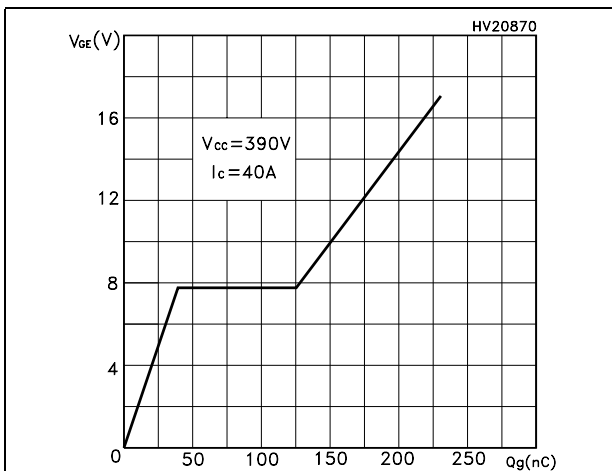
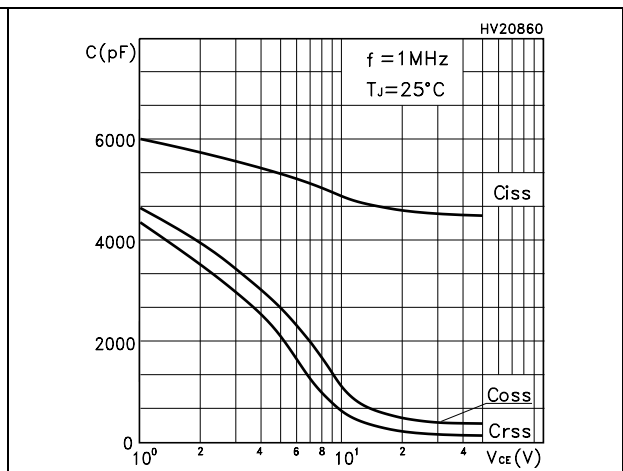
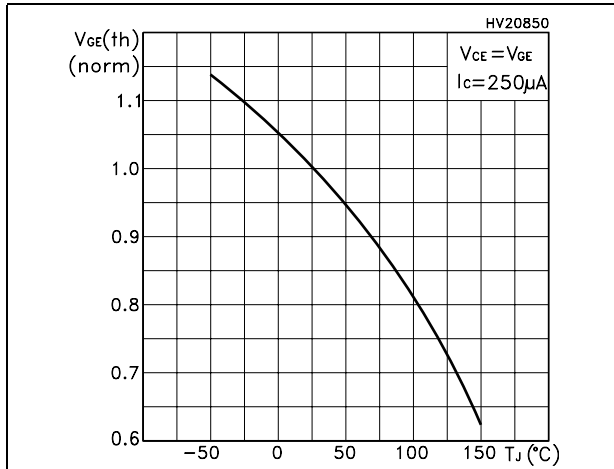


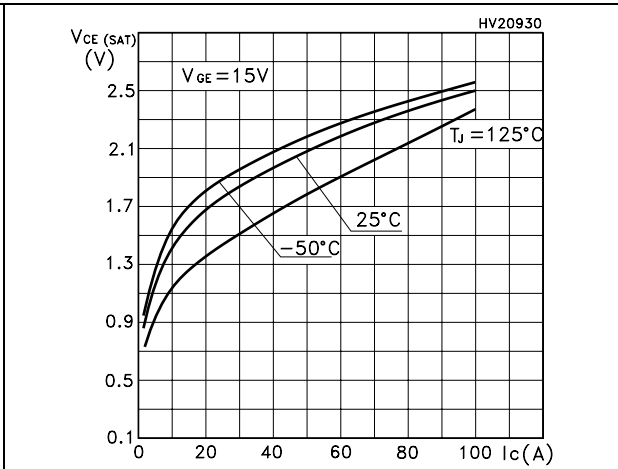
Figure 6. Capacitance variations



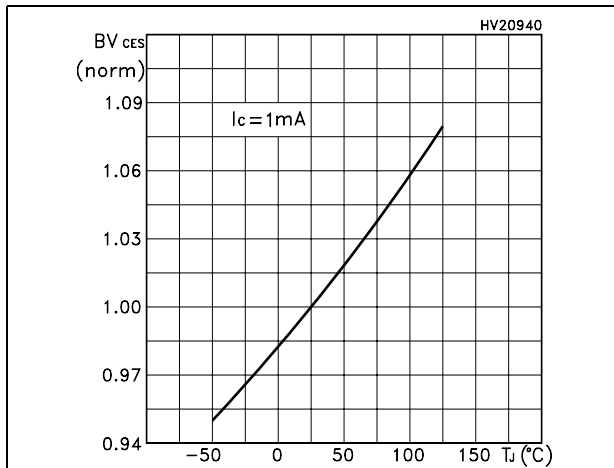
**Figure 7. Normalized gate threshold voltage vs temperature**



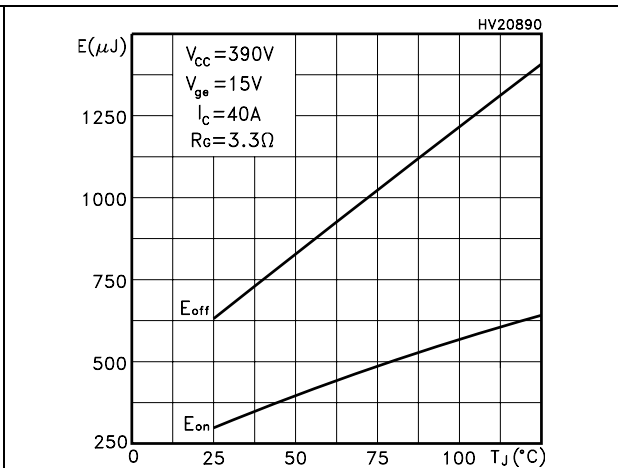
**Figure 8. Collector-emitter on voltage vs collector current**



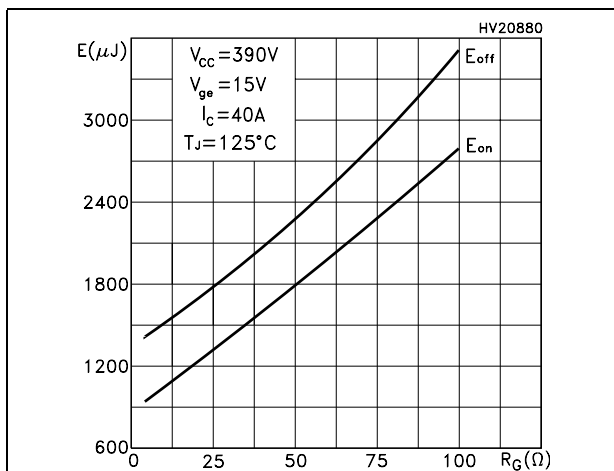
**Figure 9. Normalized breakdown voltage vs temperature**



**Figure 10. Switching losses vs temperature**



**Figure 11. Switching losses vs gate resistance**



**Figure 12. Switching losses vs collector current**

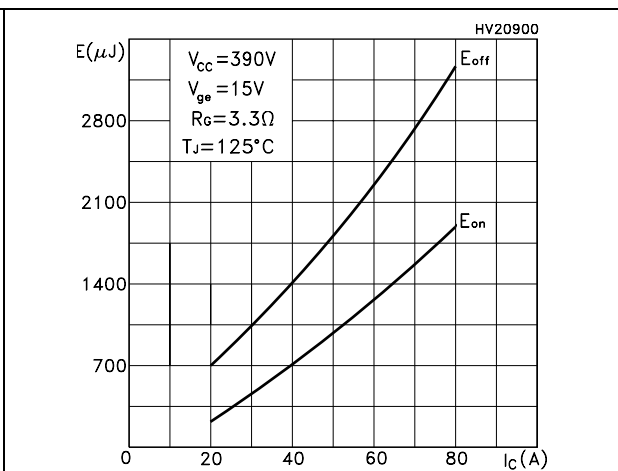




Figure 13. Turn-off SOA

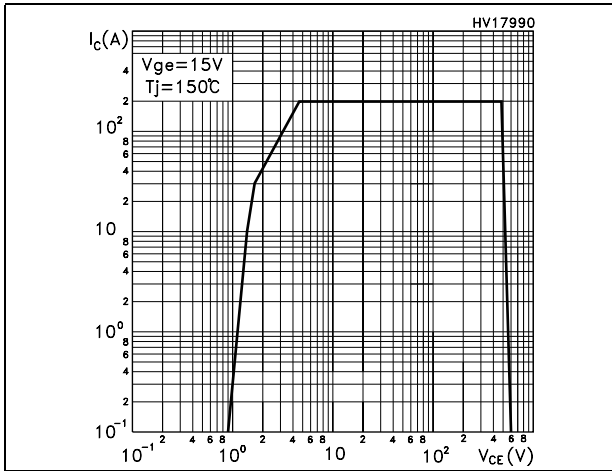


Figure 14. Thermal impedance

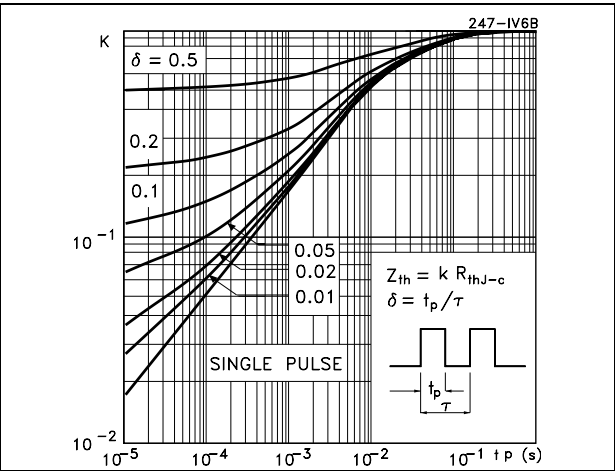
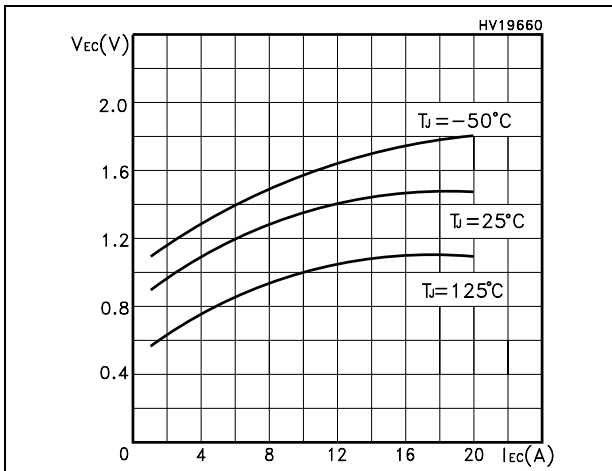


Figure 15. Emitter-collector diode characteristics



### 3 Test circuit

Figure 16. Test circuit for inductive load switching

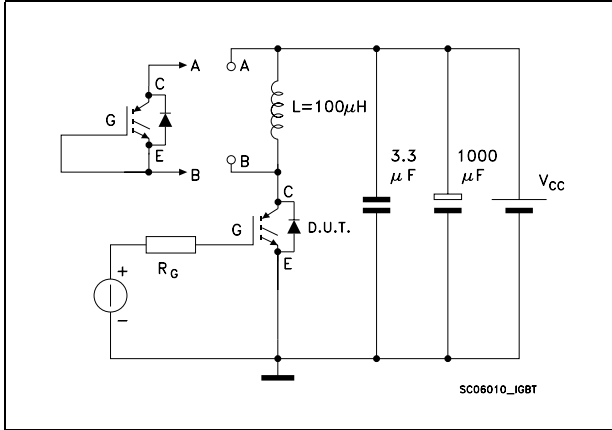


Figure 17. Gate charge test circuit

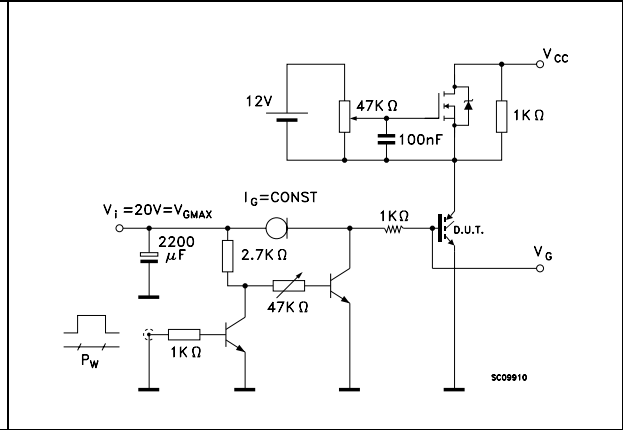


Figure 18. Switching waveform

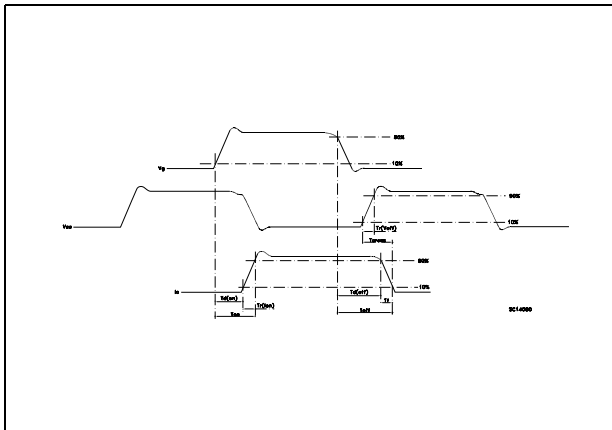
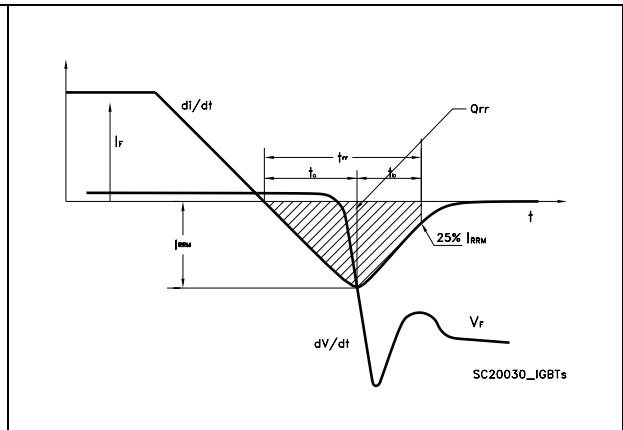


Figure 19. Diode recovery time waveform

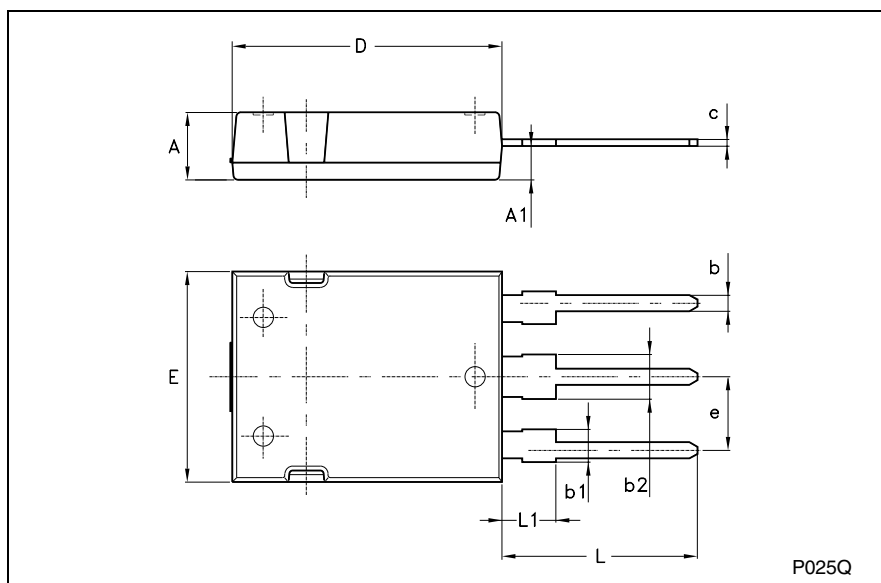


## 4 Package mechanical data

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)

**Max247 MECHANICAL DATA**

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.70		5.30			
A1	2.20		2.60			
b	1.00		1.40			
b1	2.00		2.40			
b2	3.00		3.40			
c	0.40		0.80			
D	19.70		20.30			
e	5.35		5.55			
E	15.30		15.90			
L	14.20		15.20			
L1	3.70		4.30			



## 5 Revision history

**Table 8. Revision history**

Date	Revision	Changes
07-Jun-2004	7	Initial electronic version.
14-Jul-2004	8	<i>Figure 15</i> has been update
13-Jul-2007	9	The document has been reformatted, corrected error on <i>Table 4</i>

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