



# STGE50NC60VD

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

## Features

Type	V <sub>CES</sub>	V <sub>CE(sat)</sub> (Max) @25°C	I <sub>C</sub> @100°C
STGE50NC60VD	600V	2.5V	50A

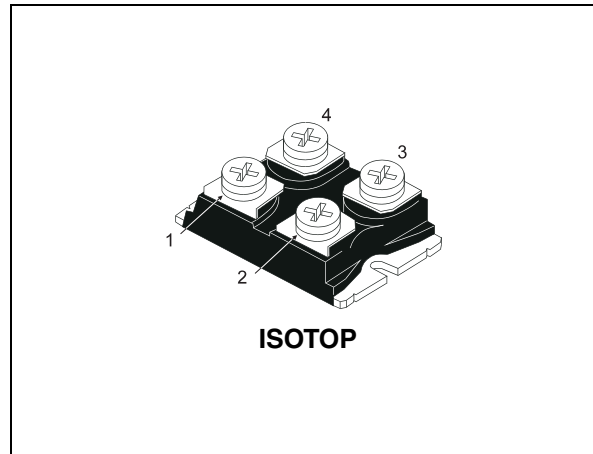
- High current capability
- High frequency operation
- Low C<sub>RES</sub>/C<sub>IES</sub> ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode

## Description

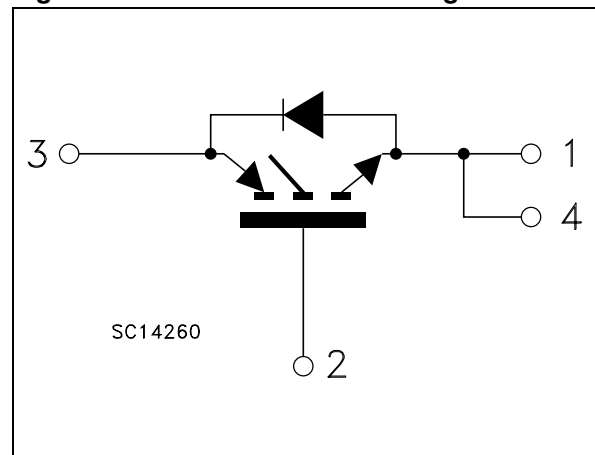
Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix “V” identifies a family optimized for high frequency.

## Applications

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



**Figure 1. Internal schematic diagram**



**Table 1. Device summary**

Order code	Marking	Package	Packaging
STGE50NC60VD	GE50NC60VD	ISOTOP	Tube

# 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	80	A
I <sub>C</sub> <sup>(1)</sup>	Collector current (continuous) at T <sub>C</sub> = 100°C	50	A
I <sub>CL</sub> <sup>(2)</sup>	Collector current (pulsed)	200	A
V <sub>GE</sub>	Gate-emitter voltage	± 20	V
I <sub>F</sub>	Diode RMS forward current at T <sub>C</sub> =25°C	30	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25°C	260	W
T <sub>stg</sub>	Storage temperature	-55 to 150	°C
T <sub>j</sub>	Operating junction temperature		

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 T<sub>jmax</sub>

**Table 3. Thermal resistance**

Symbol	Parameter	Min	Typ	Max	Unit
R <sub>thj-case</sub>	Thermal resistance junction-case (IGBT)	--	--	0.48	°C/W
R <sub>thj-case</sub>	Thermal resistance junction-case (diode)	--	--	1.5	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-amb	--	--	50	°C/W

## 2 Electrical characteristics

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

**Table 4. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{BR(CES)}$	Collector-emitter breakdown voltage	$I_C = 1\text{ mA}$ , $V_{GE} = 0$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$ , $I_C = 40\text{ A}$ $V_{GE} = 15\text{ V}$ , $I_C = 40\text{ A}$ , $T_C = 125\text{ °C}$		1.9 1.7	2.5	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 cut-off current ( $V_{GE} = 0$ )	$V_{CE} = \text{Max rating}$ , $T_C = 25\text{ °C}$ $V_{CE} = \text{Max rating}$ , $T_C = 125\text{ °C}$			150 1	$\mu\text{A}$ mA
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{ V}$ , $V_{CE} = 0$			$\pm 100$	nA
$g_{fs}$	Forward transconductance	$V_{CE} = 15\text{ V}$ , $I_C = 20\text{ A}$		20		S

**Table 5. Dynamic**

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

**Table 6. 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 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 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 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 16</i>		60 170 77		ns ns ns

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$ $E_{off}^{(2)}$ $E_{ts}$	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 18</i>		330 720 1050	450 970 1420	$\mu$ J $\mu$ J $\mu$ J
$E_{on}^{(1)}$ $E_{off}^{(2)}$ $E_{ts}$	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 18</i>		640 1400 2040		$\mu$ J $\mu$ J $\mu$ J

1.  $E_{on}$  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)
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	$I_f = 20A$		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	$I_f = 20A, V_R = 40V,$ $T_j = 125^\circ C, di/dt = 100A/\mu s$		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 2. Output characteristics

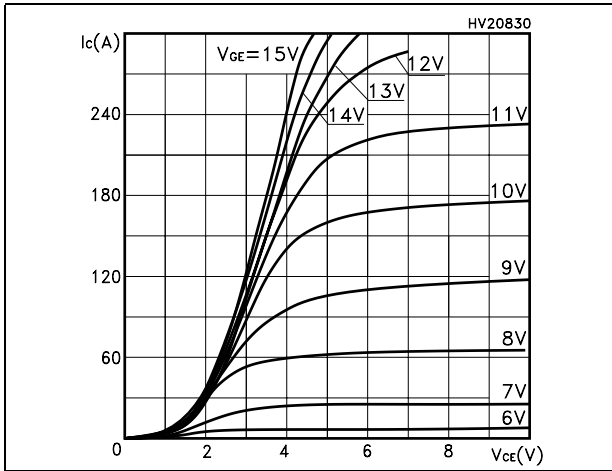


Figure 3. Transfer characteristics

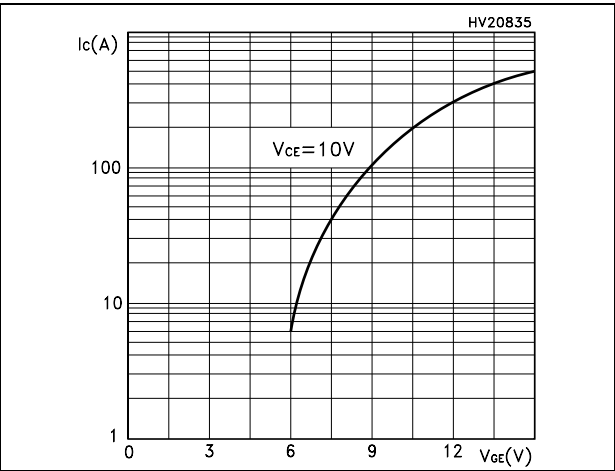


Figure 4. Transconductance

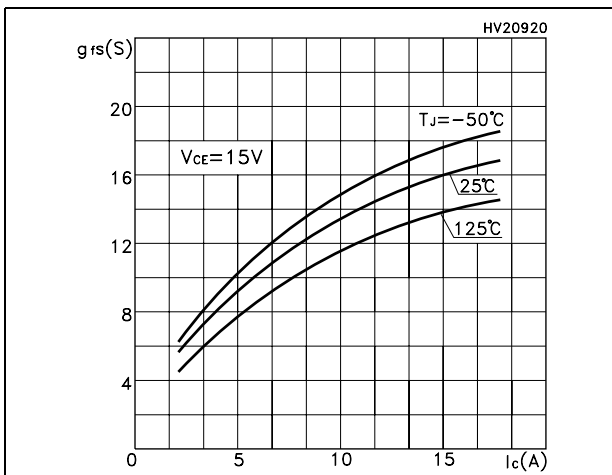


Figure 5. Collector-emitter on voltage vs temperature

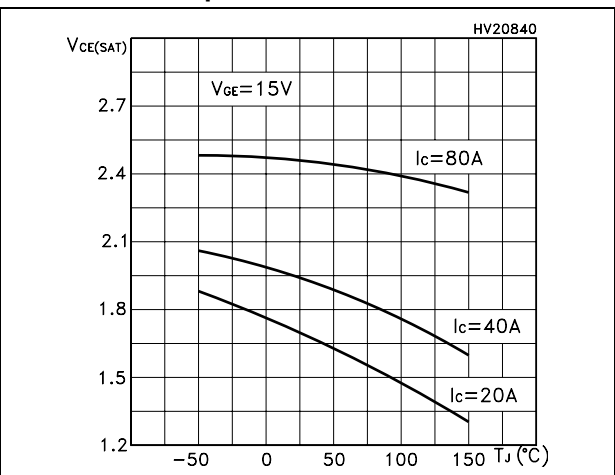


Figure 6. Collector-emitter on voltage vs collector current

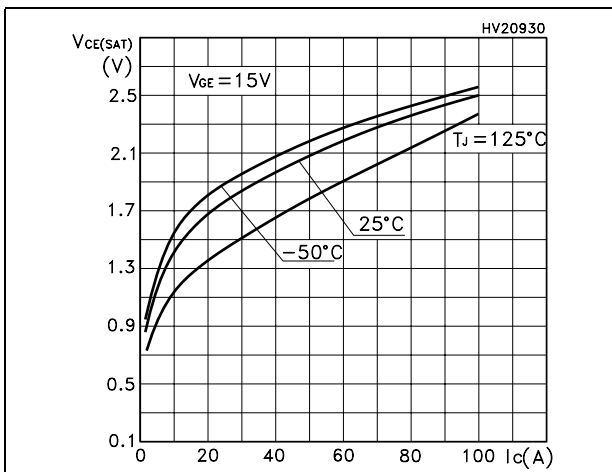


Figure 7. Normalized gate threshold vs temperature

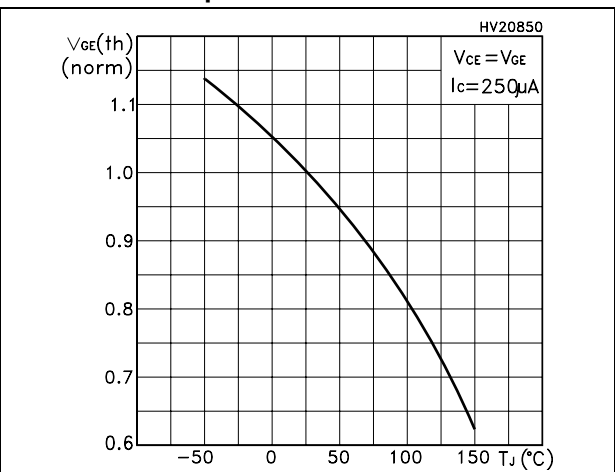


Figure 8. Normalized breakdown voltage vs temperature

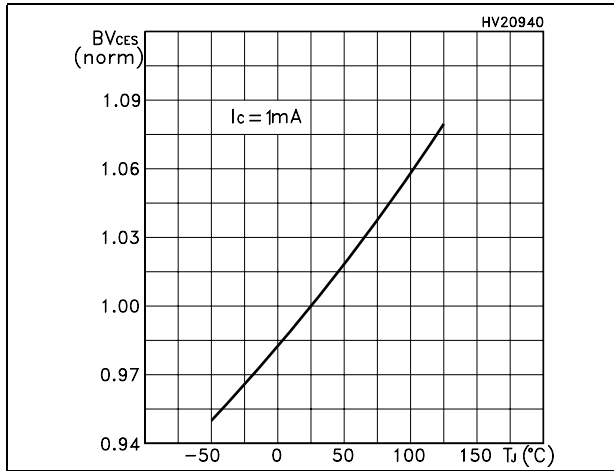


Figure 9. Gate charge vs gate-emitter voltage

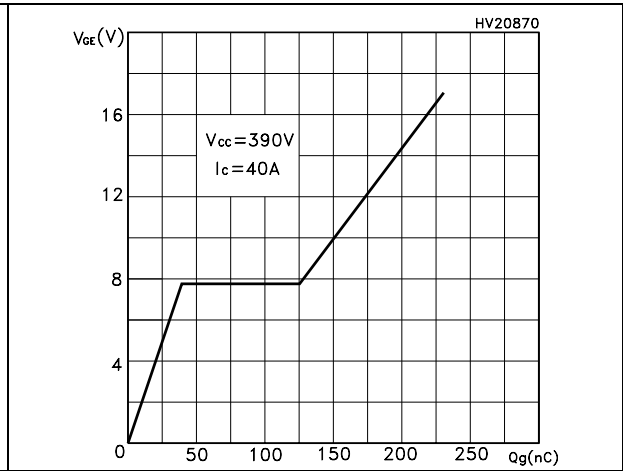


Figure 10. Capacitance variations

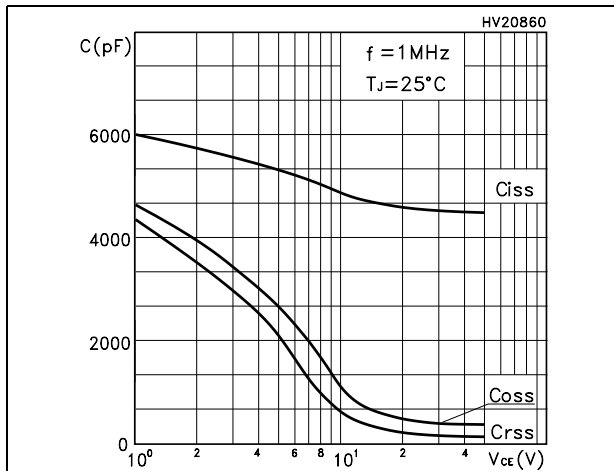


Figure 11. Total switching losses vs temperature

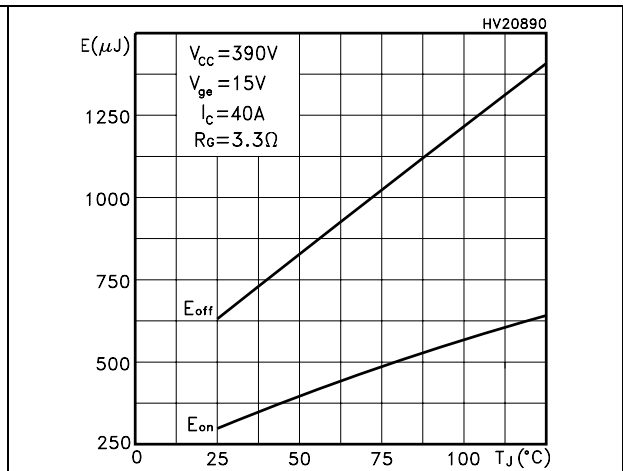


Figure 12. Total switching losses vs gate charge resistance

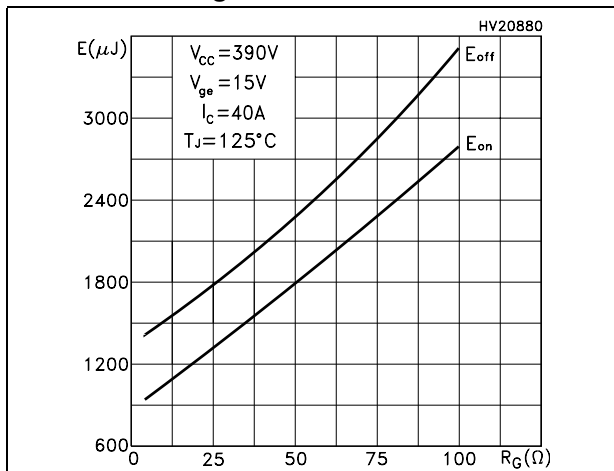


Figure 13. Total switching losses vs collector current

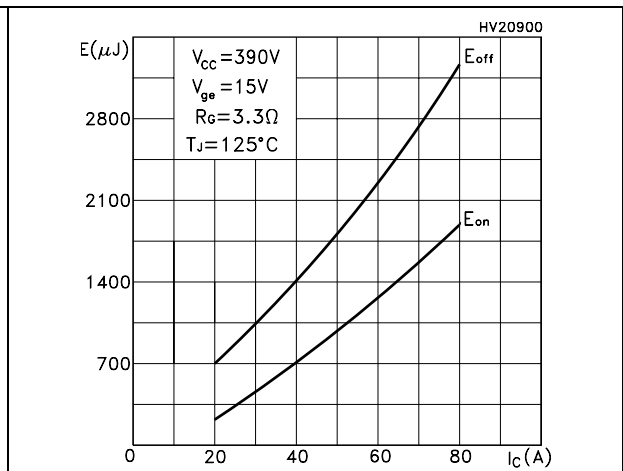




Figure 14. Turn-off SOA

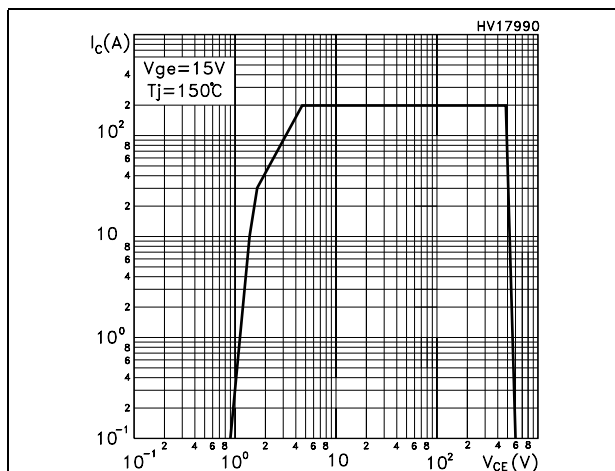
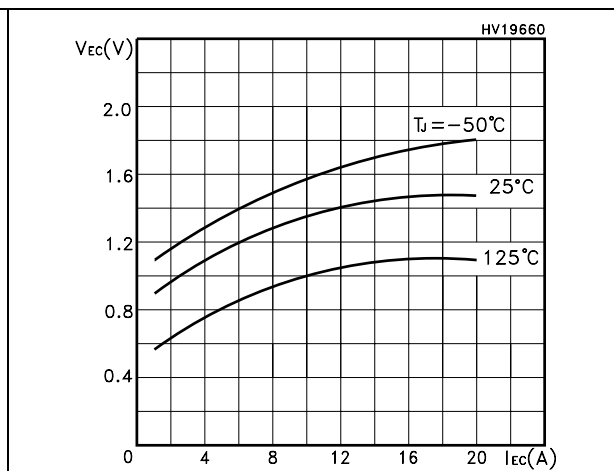


Figure 15. Emitter-collector diode characteristics



### 3 Test circuit

Figure 16. Test circuit for inductive load switching

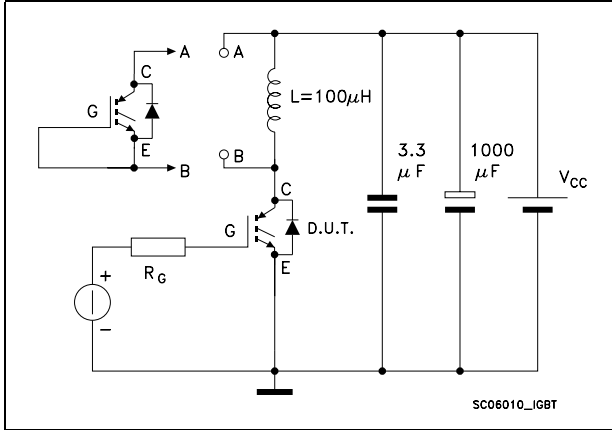


Figure 17. Gate charge test circuit

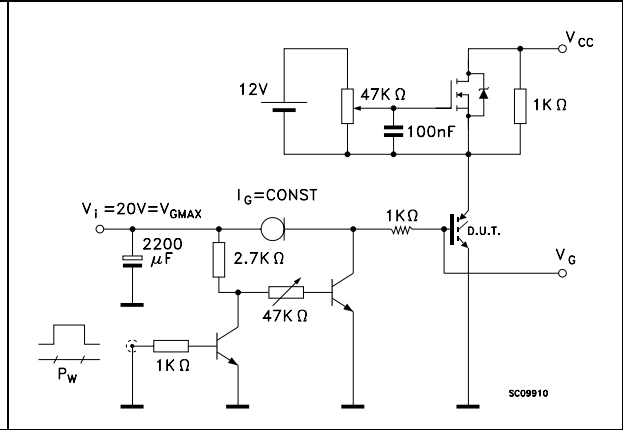


Figure 18. Switching waveform

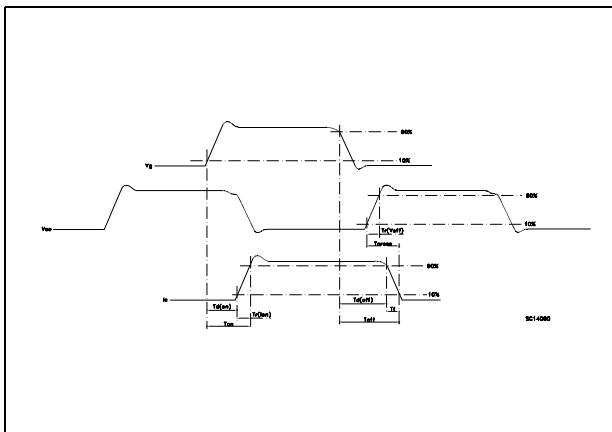
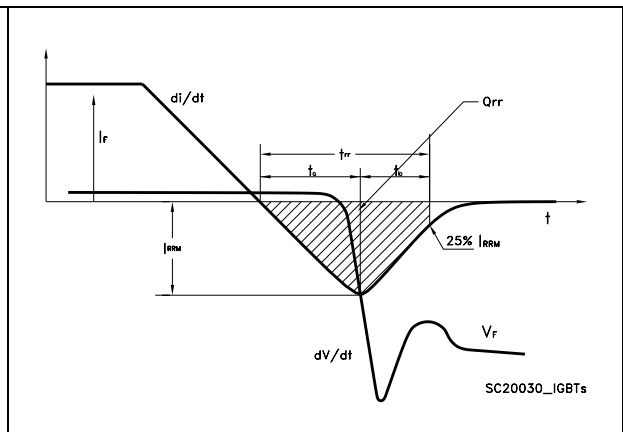


Figure 19. Diode recovery time waveform

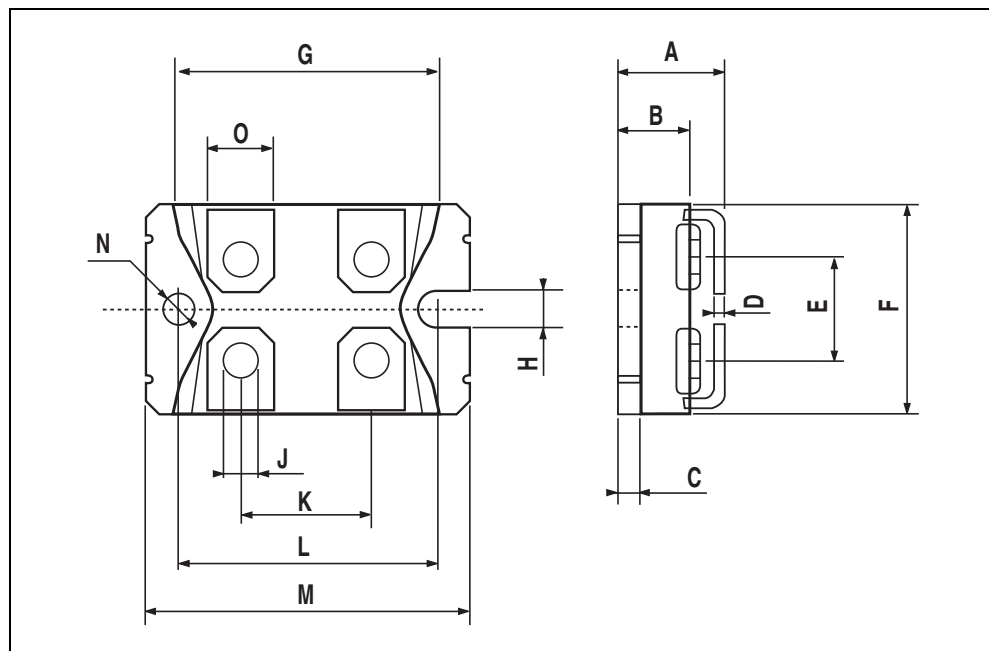


## 4 Package mechanical data

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)

**ISOTOP MECHANICAL DATA**

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	11.8		12.2	0.466		0.480
B	8.9		9.1	0.350		0.358
C	1.95		2.05	0.076		0.080
D	0.75		0.85	0.029		0.033
E	12.6		12.8	0.496		0.503
F	25.15		25.5	0.990		1.003
G	31.5		31.7	1.240		1.248
H	4			0.157		
J	4.1		4.3	0.161		0.169
K	14.9		15.1	0.586		0.594
L	30.1		30.3	1.185		1.193
M	37.8		38.2	1.488		1.503
N	4			0.157		
O	7.8		8.2	0.307		0.322



## 5 Revision History

Table 9. Revision history

Date	Revision	Changes
11-Oct-2006	1	First release
24-Jul-2007	2	Internal schematic diagram has been updated <a href="#">Figure 1</a>

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