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# STGE50NC60WD

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

## Features

Type	V <sub>CES</sub>	V <sub>CE(sat)</sub> (Max) @25°C	I <sub>C</sub> @100°C
STGE50NC60WD	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 “W” identifies a family optimized for very high frequency applications.

## Applications

- Very high frequency inverters
- HF, SMPS and PFC in both hard switching and resonant topologies
- UPS
- Motor drivers
- Welding

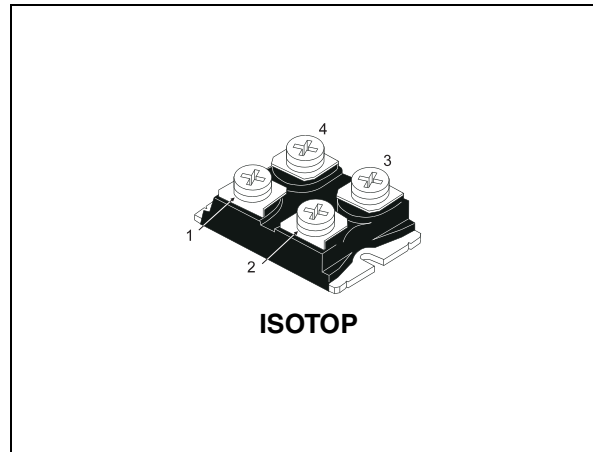


Figure 1. Internal schematic diagram

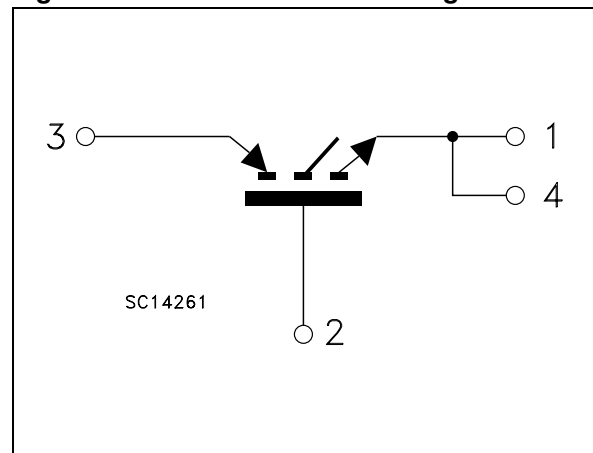


Table 1. Device summary

Order code	Marking	Package	Packaging
STGE50NC60WD	GE50NC60WD	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 (s <sub>GS</sub> = 0)	600	V
I <sub>C</sub> <sup>(1)</sup>	Collector current (continuous) at T <sub>C</sub> = 25°C	100	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)	250	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

( $T_J = 25\text{ }^\circ\text{C}$  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	$V_{GE} = 15\text{ V}$ , $I_C = 40\text{ A}$ $V_{GE} = 15\text{ V}$ , $I_C = 40\text{ A}$ , $T_C = 125\text{ }^\circ\text{C}$		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 cut-off current ( $V_{GE} = 0$ )	$V_{CE} = \text{Max rating}$ , $T_C = 25\text{ }^\circ\text{C}$ $V_{CE} = \text{Max rating}$ , $T_C = 125\text{ }^\circ\text{C}$			500 5	$\mu\text{A}$ 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	$V_{CE} = 15\text{ V}$ , $I_C = 40\text{ A}$		25		S

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GE} = 0$		4700		pF
$C_{oes}$	Output capacitance			410		pF
$C_{res}$	Reverse transfer capacitance			90		pF
$Q_g$	Total gate charge	$V_{CE} = 390\text{ V}$ , $I_C = 40\text{ A}$ ,		195		nC
$Q_{ge}$	Gate-emitter charge	$V_{GE} = 15\text{ V}$ ,		32		nC
$Q_{gc}$	Gate-collector charge	<a href="#">Figure 17</a>		82		nC



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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390V, I_C = 40A$		52		ns
$t_r$	Current rise time	$R_G = 3.3\Omega, V_{GE} = 15V,$		17		ns
$(di/dt)_{on}$	Turn-on current slope	<i>Figure 16, Figure 18</i>		2400		A/ $\mu$ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390V, I_C = 40A$		50		ns
$t_r$	Current rise time	$R_G = 3.3\Omega, V_{GE} = 15V,$		19		ns
$(di/dt)_{on}$	Turn-on current slope	$T_j = 125^\circ C$ <i>Figure 16, Figure 18</i>		2020		A/ $\mu$ s
$t_{r(Voff)}$	Off voltage rise time	$V_{CC} = 390V, I_C = 40A$		31		ns
$t_{d(Voff)}$	Turn-off delay time	$R_G = 3.3\Omega, V_{GE} = 15V,$		240		ns
$t_f$	Current fall time	<i>Figure 16, Figure 18</i>		35		ns
$t_{r(Voff)}$	Off voltage rise time	$V_{CC} = 390V, I_C = 40A$		59		ns
$t_{d(Voff)}$	Turn-off delay time	$R_G = 3.3\Omega, V_{GE} = 15V,$		280		ns
$t_f$	Current fall time	$T_j = 125^\circ C$ <i>Figure 16, Figure 18</i>		63		ns

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 390V, I_C = 40A$		365	470	$\mu$ J
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 3.3\Omega, V_{GE} = 15V,$		560	790	$\mu$ J
$E_{ts}$	Total switching losses	<i>Figure 18</i>		925	1260	$\mu$ J
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 390V, I_C = 40A$		635		$\mu$ J
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 3.3\Omega, V_{GE} = 15V,$		910		$\mu$ J
$E_{ts}$	Total switching losses	$T_j = 125^\circ C$ <i>Figure 18</i>		1545		$\mu$ 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	$I_f = 15A$		1.5	2.9	V
		$I_f = 15A, T_j = 125^\circ C$		1.2		V
		$I_f = 40A, T_j = 125^\circ C$		1.35		V
$t_{rr}$	Reverse recovery time	$I_f = 40A, V_R = 50V,$ $T_j = 25^\circ C, di/dt = 100 A/\mu s$ <i>Figure 19</i>		55		ns
$Q_{rr}$	Reverse recovery charge			100		nC
$I_{rrm}$	Reverse recovery current			3.6		A
$t_{rr}$	Reverse recovery time	$I_f = 40A, V_R = 50V,$ $T_j = 125^\circ C, di/dt = 100A/\mu s$ <i>Figure 19</i>		164		ns
$Q_{rr}$	Reverse recovery charge			525		nC
$I_{rrm}$	Reverse recovery current			6.4		A

## 2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

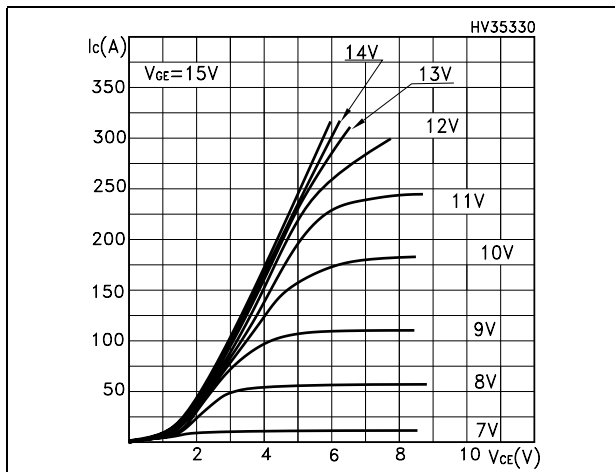


Figure 3. Transfer characteristics

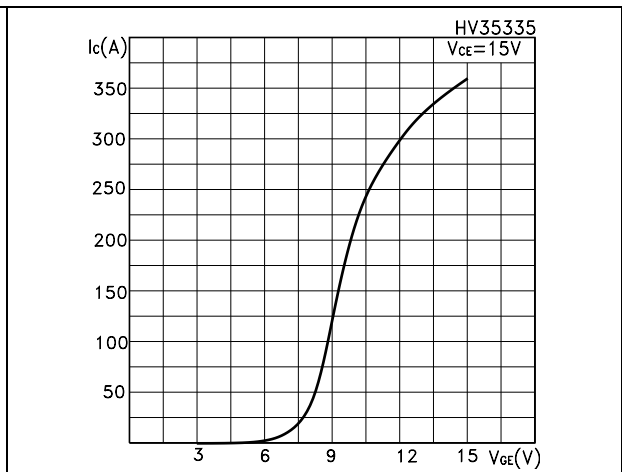


Figure 4. Transconductance

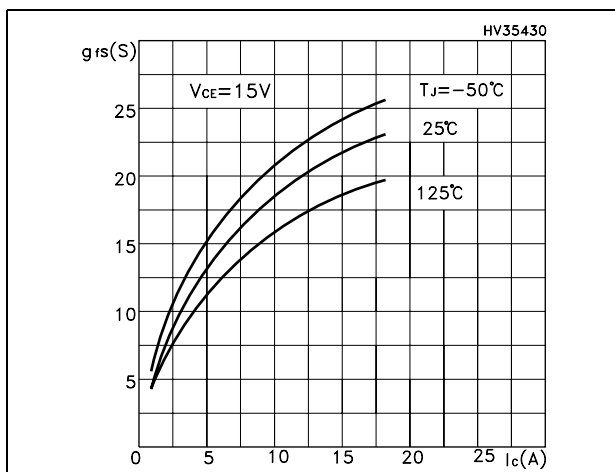


Figure 5. Collector-emitter on voltage vs temperature

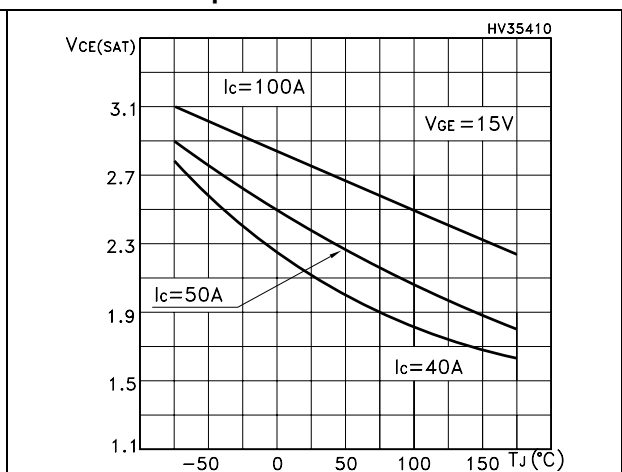


Figure 6. Gate charge vs gate-source voltage

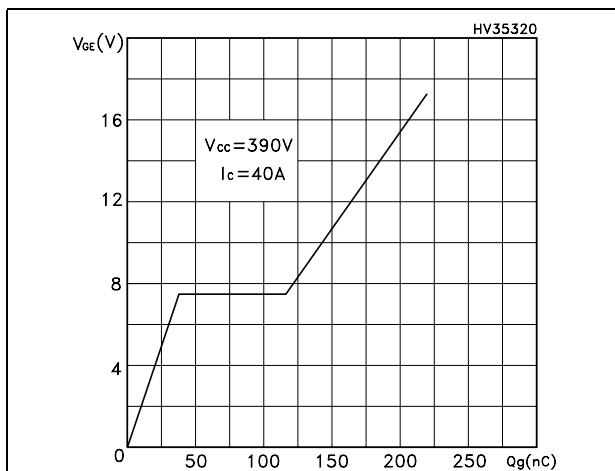


Figure 7. Capacitance variations

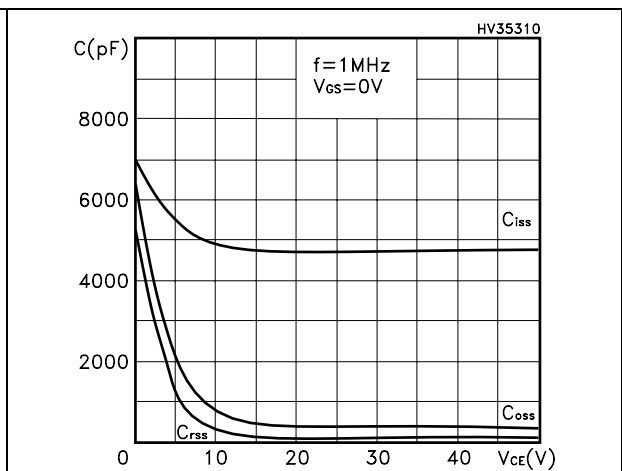




Figure 8. Normalized gate threshold voltage vs temperature

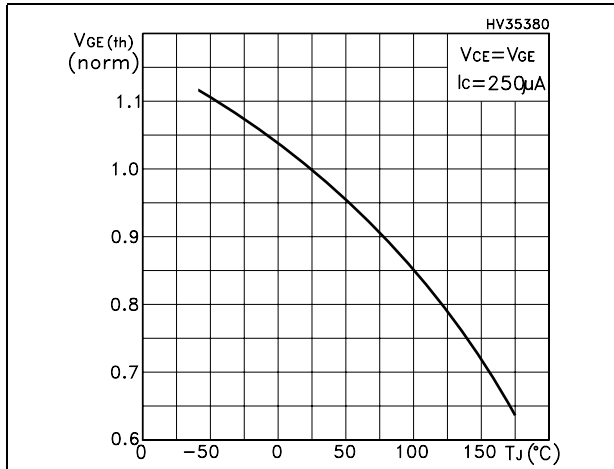


Figure 9. Collector-emitter on voltage vs collector current

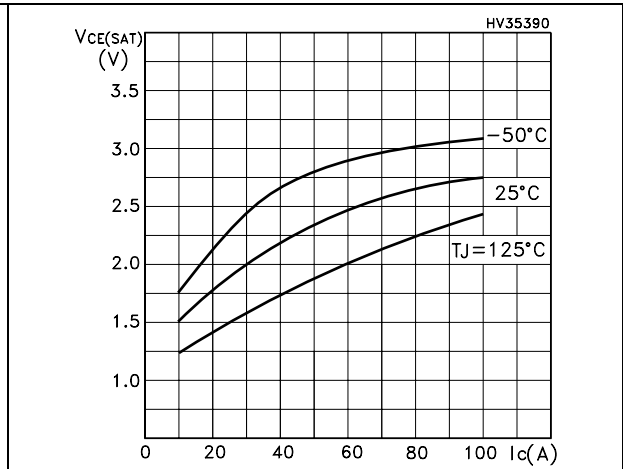


Figure 10. Normalized breakdown voltage vs temperature

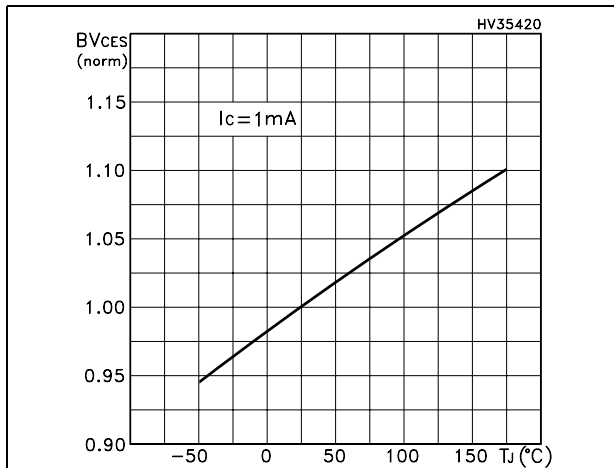


Figure 11. Switching losses vs temperature

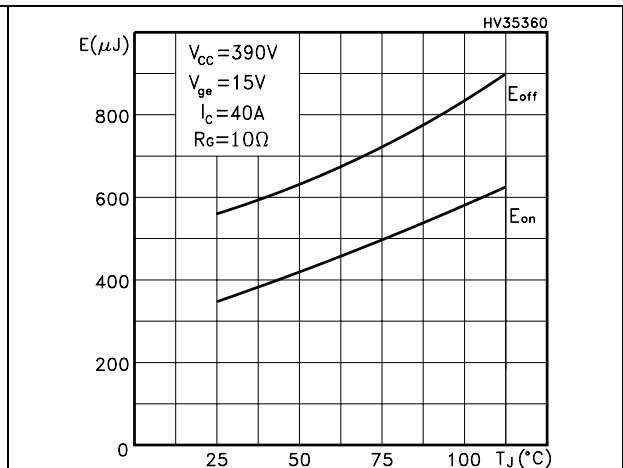


Figure 12. Switching losses vs gate resistance

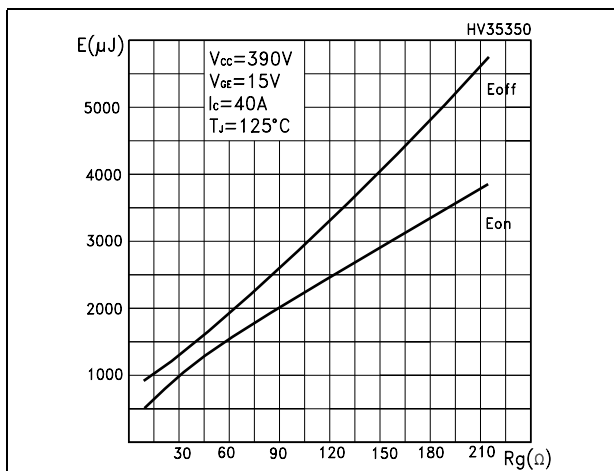


Figure 13. Switching losses vs collector current

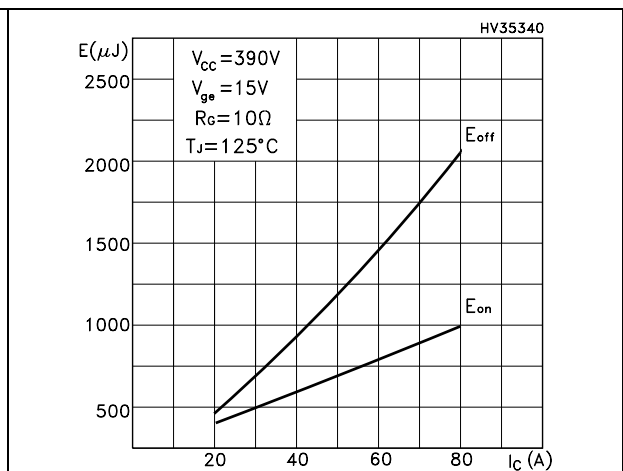


Figure 14. Turn-off SOA

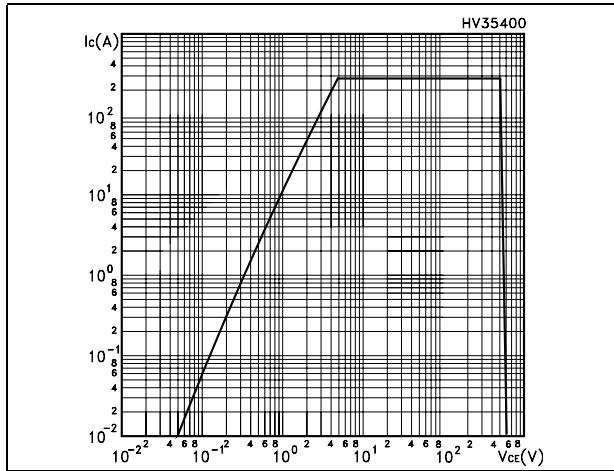
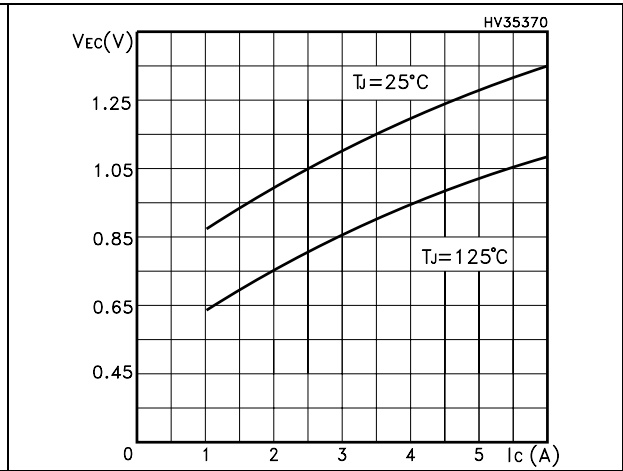


Figure 15. Emitter-collector diode characteristics



### 3 Test circuit

Figure 16. Test circuit for inductive load switching

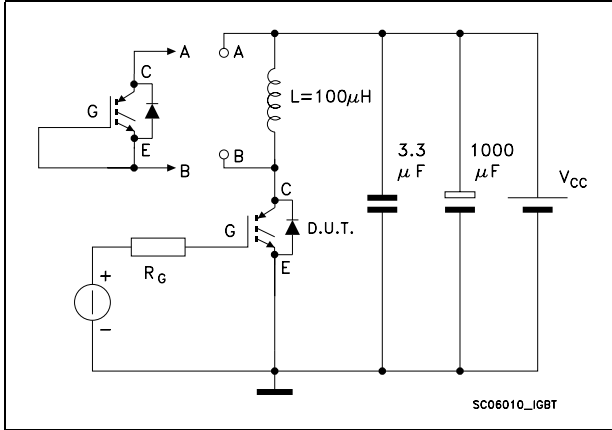


Figure 17. Gate charge test circuit

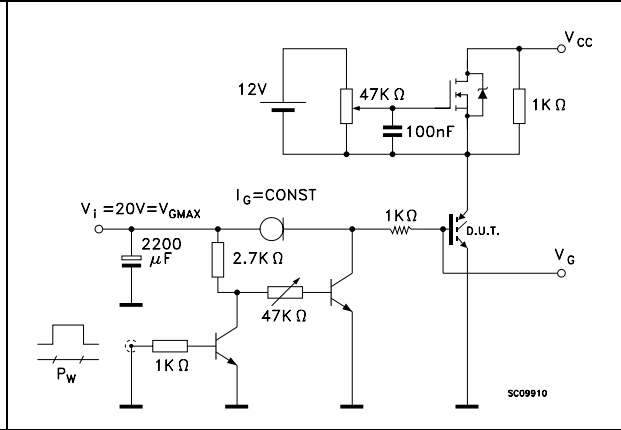


Figure 18. Switching waveform

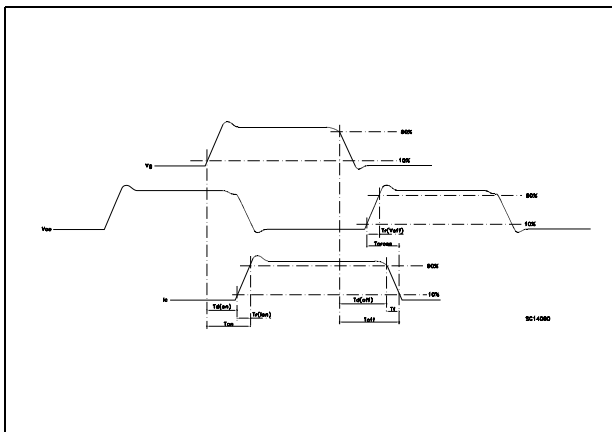
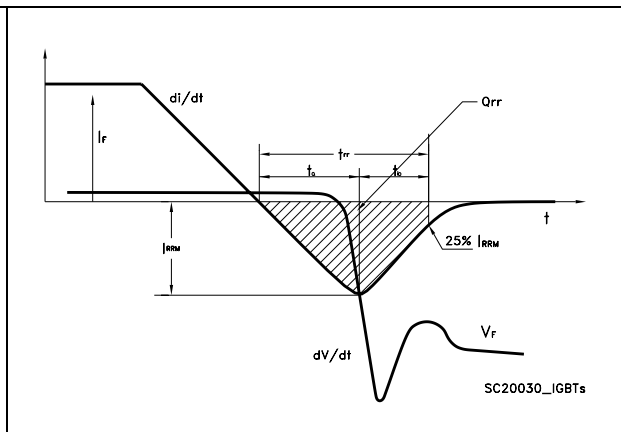


Figure 19. Diode recovery time waveform

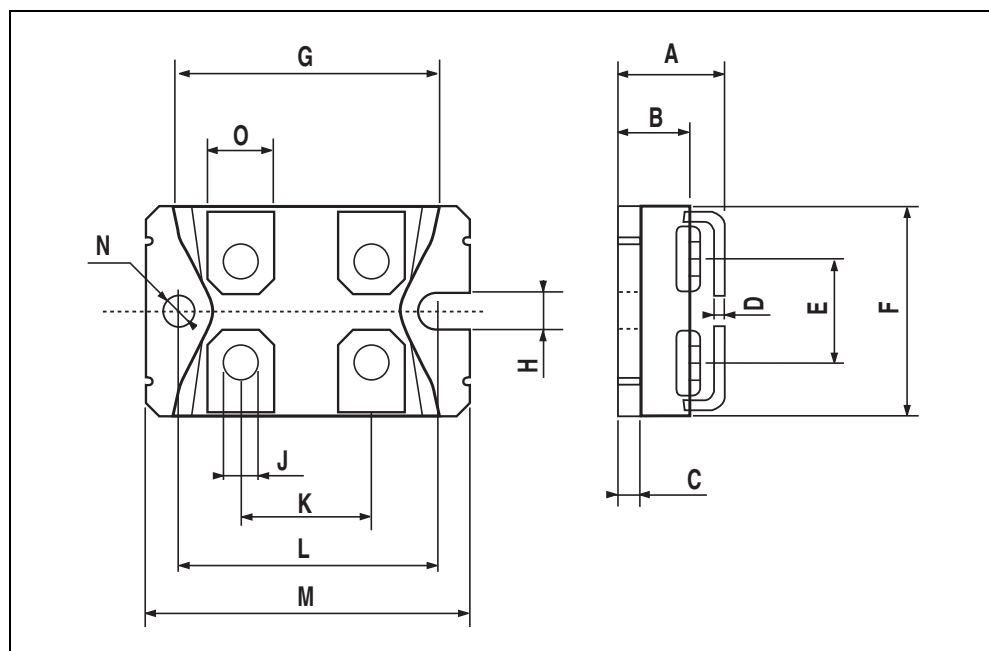


## 4 Package mechanical data

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
07-May-2006	1	First release
24-Jul-2007	2	New <a href="#">Figure 1: Internal schematic diagram</a>

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