



# STGW19NC60WD STGP19NC60WD

N-channel 600V - 19A - TO-220 - TO-247  
Ultra fast PowerMESH™ IGBT

## Features

Type	V <sub>CE(S)</sub>	V <sub>CE(sat)</sub> (max)@25°C	I <sub>C</sub> @100°C
STGP19NC60WD	600V	< 2.5V	22A
STGW19NC60WD	600V	< 2.5V	23A

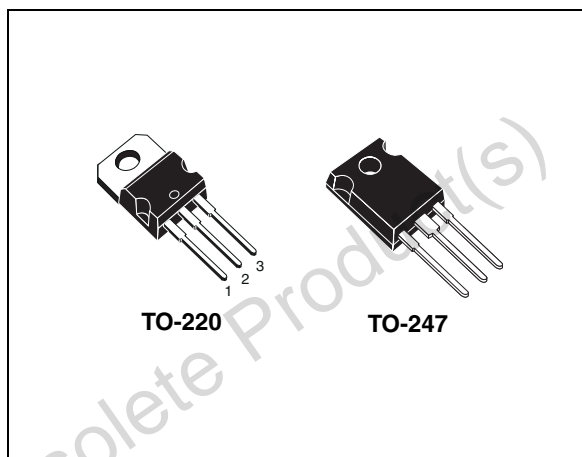
- High frequency operation
- Low C<sub>RES</sub> / C<sub>IES</sub> ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode

## Description

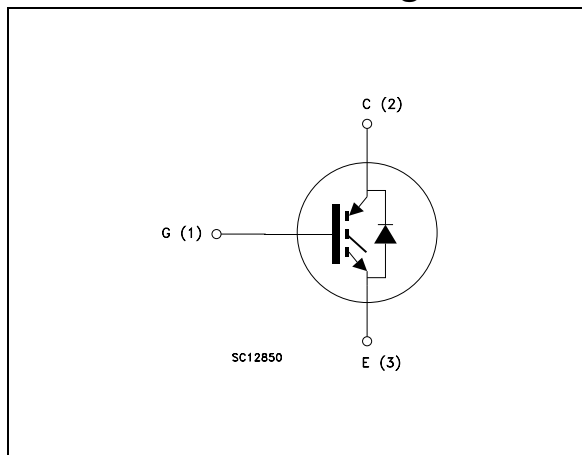
Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix "W" identifies a family optimized for very high frequency application.

## Applications

- High frequency motor controls, inverters, UPS
- HF, SMPS and PFC in both hard switch and resonant topologies



## Internal schematic diagram



## Order code

Part number	Marking	Package	Packaging
STGP19NC60WD	GP19NC60WD	TO-220	Tube
STGW19NC60WD	GW19NC60WD	TO-247	Tube

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Obsolete Product(s) - Obsolete Product(s)

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		TO-220	TO-247	
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	40	42	A
I <sub>C</sub> <sup>(1)</sup>	Collector current (continuous) at T <sub>C</sub> = 100°C	22	23	A
I <sub>CL</sub> <sup>(2)</sup>	Collector current (pulsed)	35		A
I <sub>F</sub>	Diode RMS forward current at T <sub>C</sub> = 25°C	12		A
V <sub>GE</sub>	Gate-emitter voltage	±20		V
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25°C	125		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. V<sub>clamp</sub>=480V, T<sub>j</sub>=150°C, R<sub>G</sub>=10Ω, V<sub>GE</sub>=15V

**Table 2. Thermal resistance**

Symbol	Parameter	Value		Unit
		TO-220	TO-247	
R <sub>thj-case</sub>	Thermal resistance junction-case max	1	0.95	°C/W
	Thermal resistance junction-case max diode	2.25	2.5	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient max	62.5		°C/W

## 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	$V_{GE} = 15V, I_C = 12A$ $V_{GE} = 15V, I_C = 12A, T_C = 125^{\circ}C$		2.1 1.8	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 ( $V_{GE} = 0$ )	$V_{CE} = \text{Max rating}, T_C = 25^{\circ}C$ $V_{CE} = \text{Max rating}, T_C = 125^{\circ}C$			150 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	$V_{CE} = 15V, I_C = 12A$		10		S

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25V, f = 1MHz,$ $V_{GE} = 0$		1180		pF
$C_{oes}$	Output capacitance			130		pF
$C_{res}$	Reverse transfer capacitance			26		pF
$Q_g$	Total gate charge	$V_{CE} = 390V, I_C = 5A,$		53		nC
$Q_{ge}$	Gate-emitter charge	$V_{GE} = 15V,$		10		nC
$Q_{gc}$	Gate-collector charge	<a href="#">Figure 16</a>		21		nC

**Table 5. Switching on/off (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390V, I_C = 12A$		25		ns
$t_r$	Current rise time	$R_G = 10\Omega, V_{GE} = 15V,$		7		ns
$(di/dt)_{on}$	Turn-on current slope	<i>Figure 17</i>		1600		A/ $\mu$ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390V, I_C = 12A$		25		ns
$t_r$	Current rise time	$R_G = 10\Omega, V_{GE} = 15V,$		8		ns
$(di/dt)_{on}$	Turn-on current slope	$T_j = 125^\circ C$ <i>Figure 17</i>		1400		A/ $\mu$ s
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390V, I_C = 12A$		22		ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10\Omega, V_{GE} = 15V,$		90		ns
$t_f$	Current fall time	<i>Figure 17</i>		43		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390V, I_C = 12A$		47		ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10\Omega, V_{GE} = 15V,$		127		ns
$t_f$	Current fall time	$T_j = 125^\circ C$ <i>Figure 17</i>		77		ns

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 390V, I_C = 12A$		81		$\mu$ J
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\Omega, V_{GE} = 15V,$		125		$\mu$ J
$E_{ts}$	Total switching losses	<i>Figure 17</i>		206		$\mu$ J
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 390V, I_C = 12A$		161		$\mu$ J
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\Omega, V_{GE} = 15V,$		255		$\mu$ J
$E_{ts}$	Total switching losses	$T_j = 125^\circ C$ <i>Figure 17</i>		416		$\mu$ J

1.  $E_{on}$  is the turn-on losses when a typical diode is used in the test circuit in *Figure 15*. 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 7. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_f$	Forward on-voltage	$I_f = 12A$		1.9	2.5	V
		$I_f = 12A, T_j = 125^\circ C$		1.5		V
$t_{rr}$	Reverse recovery time	$I_f = 12A, V_R = 50V,$ $T_j = 25^\circ C, di/dt = 100 A/\mu s$		31		ns
$Q_{rr}$	Reverse recovery charge	$T_j = 25^\circ C, di/dt = 100 A/\mu s$		30		nC
$I_{rrm}$	Reverse recovery current	<a href="#">Figure 18</a>		2		A
$t_{rr}$	Reverse recovery time	$I_f = 12A, V_R = 50V,$ $T_j = 125^\circ C, di/dt = 100A/\mu s$		59		ns
$Q_{rr}$	Reverse recovery charge	$T_j = 125^\circ C, di/dt = 100A/\mu s$		102		nC
$I_{rrm}$	Reverse recovery current	<a href="#">Figure 18</a>		4		A

## 2.1 Electrical characteristics (curves)

Figure 1. Output characteristics

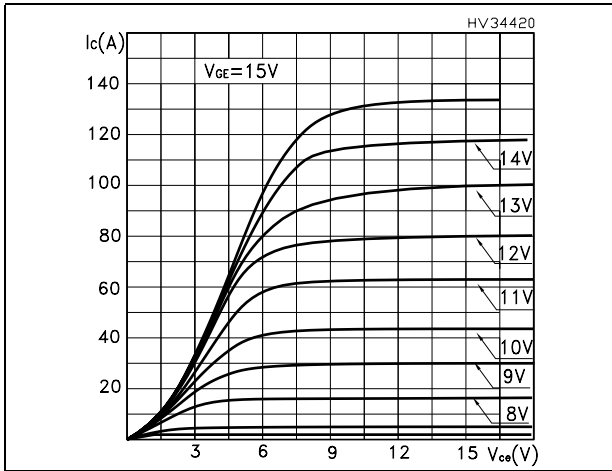


Figure 2. Transfer characteristics

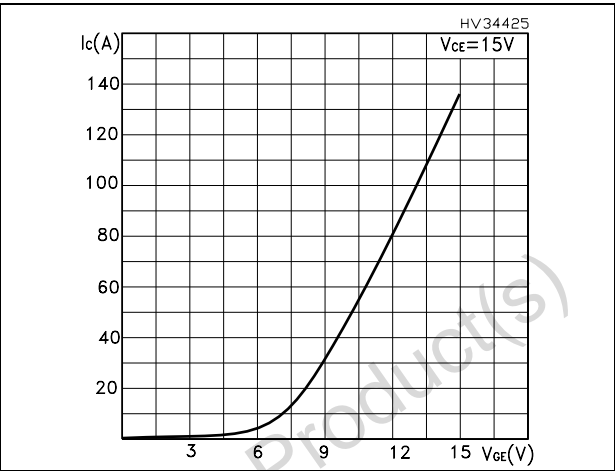


Figure 3. Transconductance

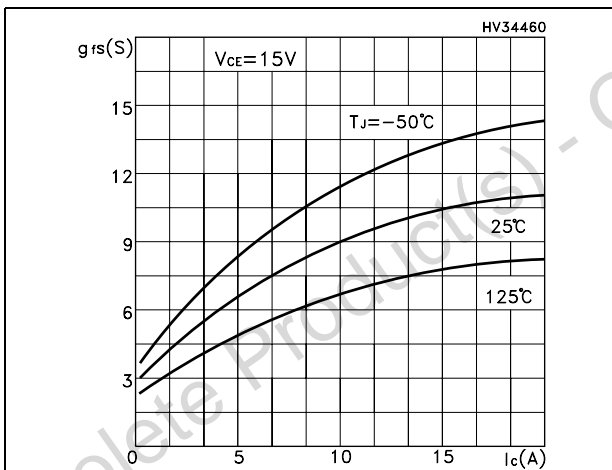


Figure 4. Collector-emitter on voltage vs temperature

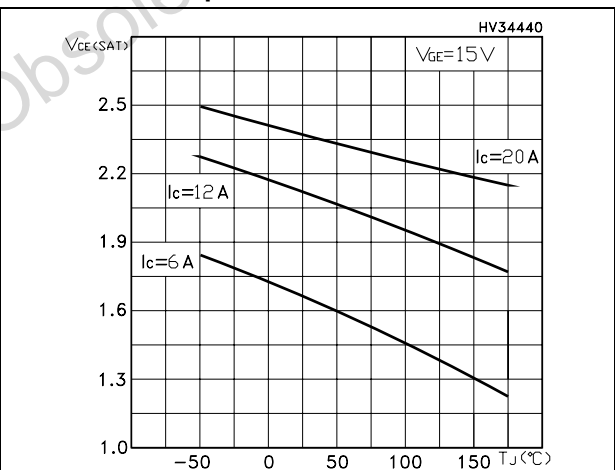


Figure 5. Gate charge vs gate-source voltage Figure 6. Capacitance variations

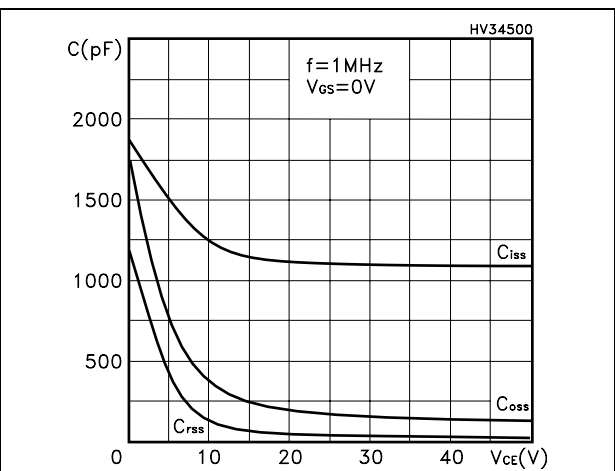
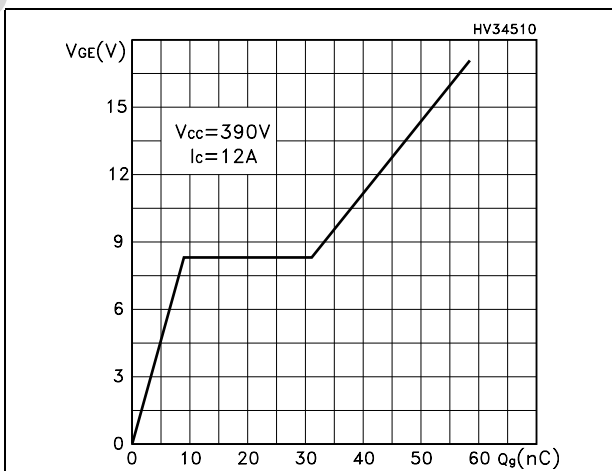


Figure 7. Normalized gate threshold voltage vs temperature

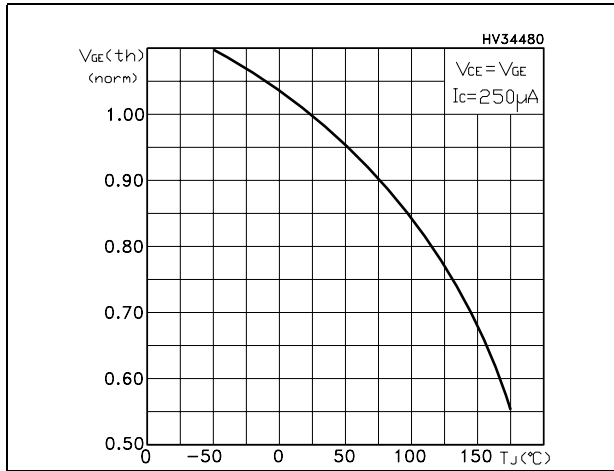


Figure 8. Collector-emitter on voltage vs collector current

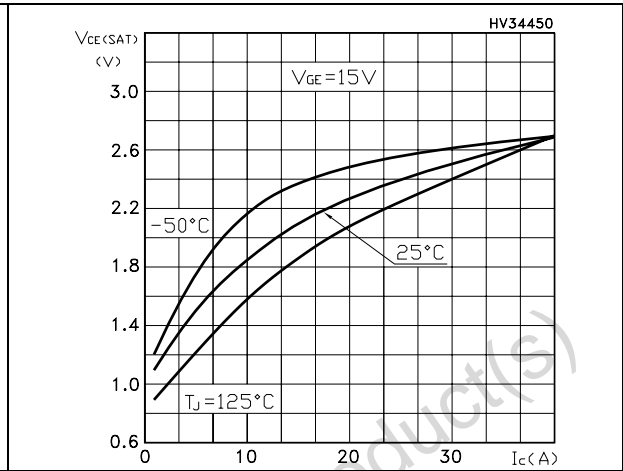


Figure 9. Normalized breakdown voltage vs temperature

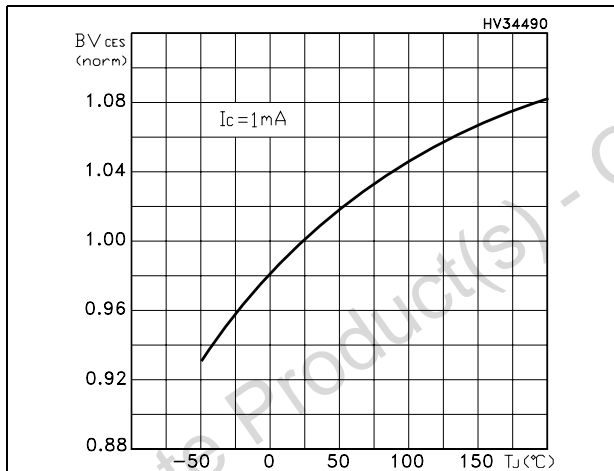


Figure 10. Switching losses vs temperature

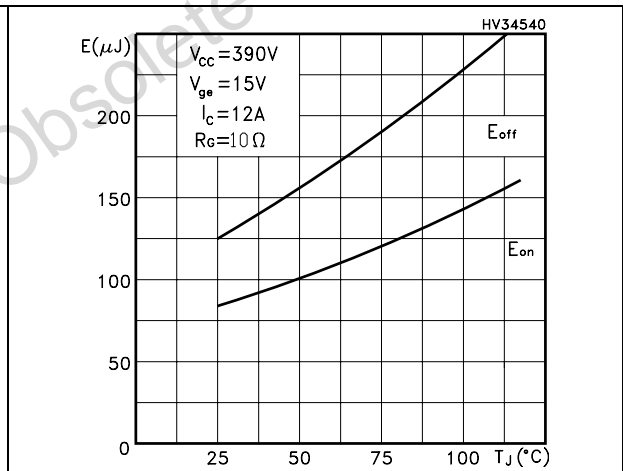


Figure 11. Switching losses vs gate resistance

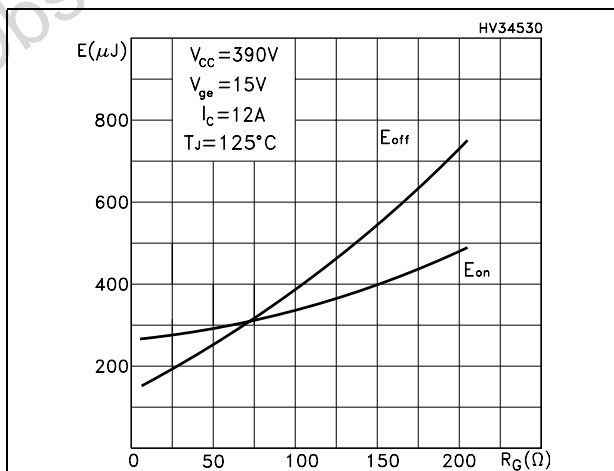


Figure 12. Switching losses vs collector current

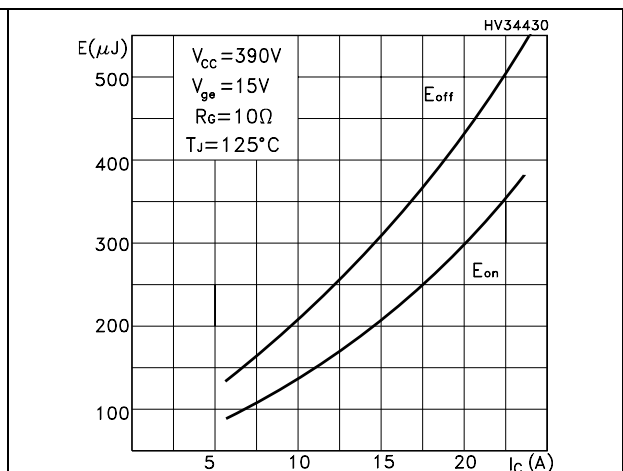




Figure 13. Turn-off SOA

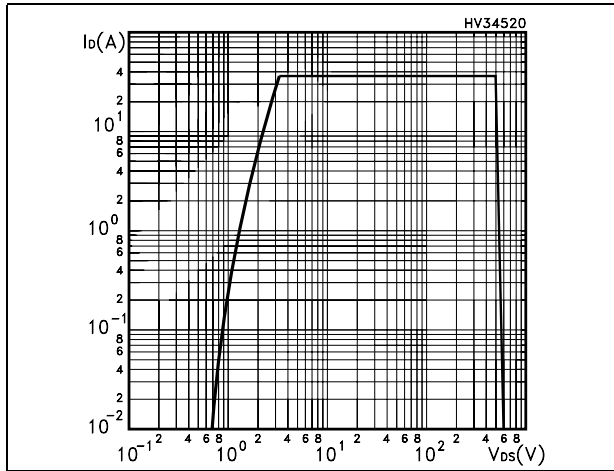
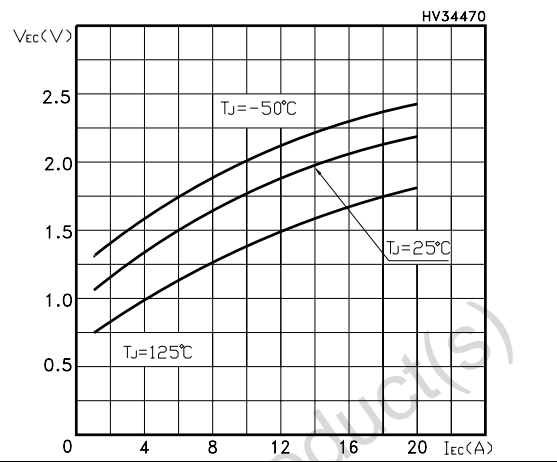


Figure 14. Emitter-collector diode characteristics



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### 3 Test circuit

Figure 15. Test circuit for inductive load switching

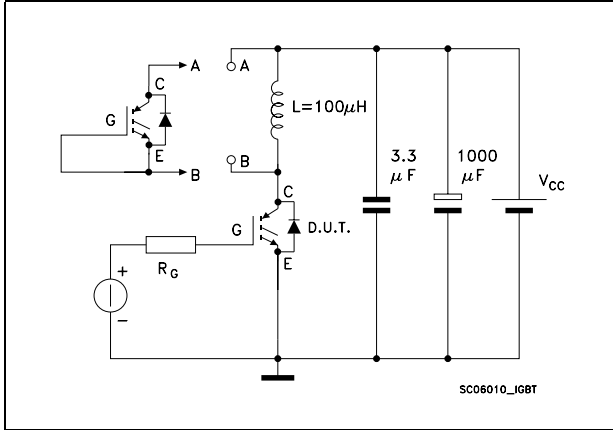


Figure 16. Gate charge test circuit

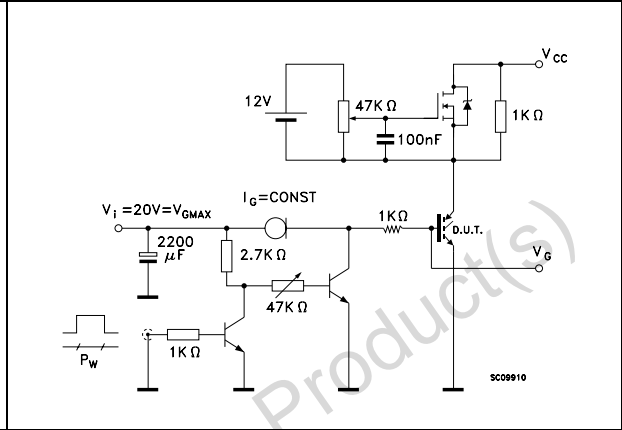


Figure 17. Switching waveform

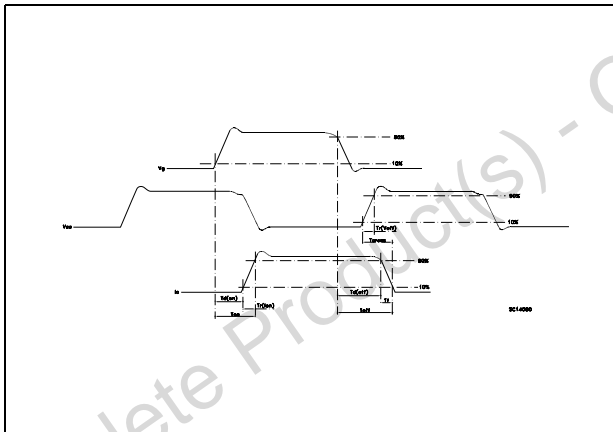
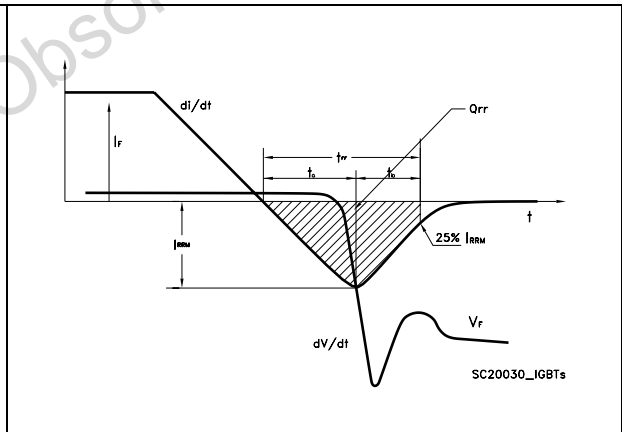


Figure 18. Diode recovery time waveform



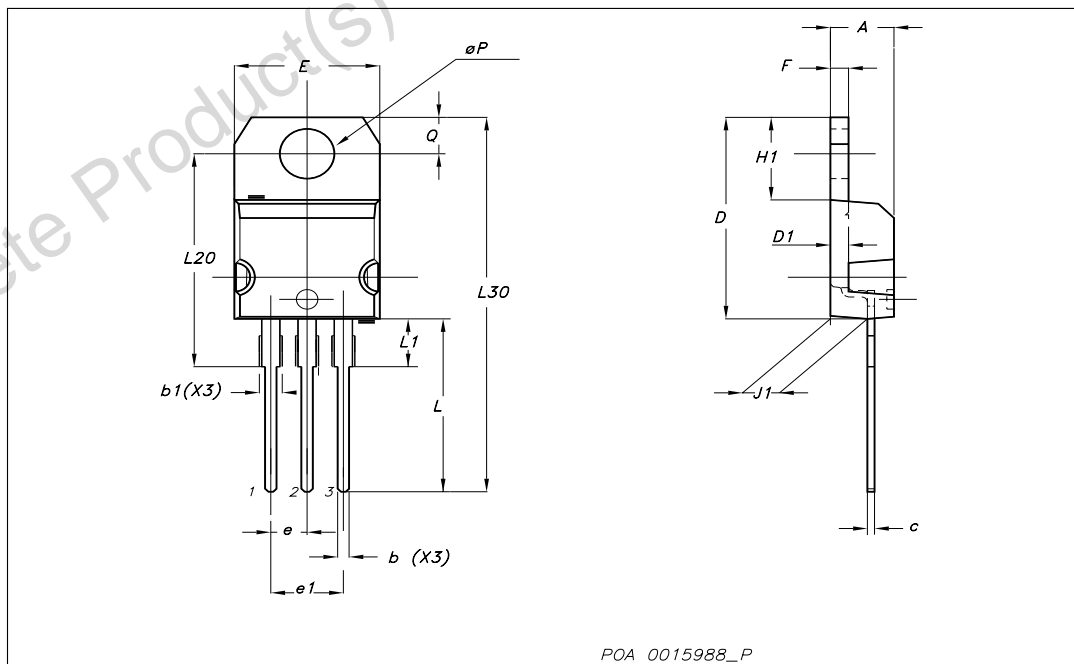
## 4 Package mechanical data

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)

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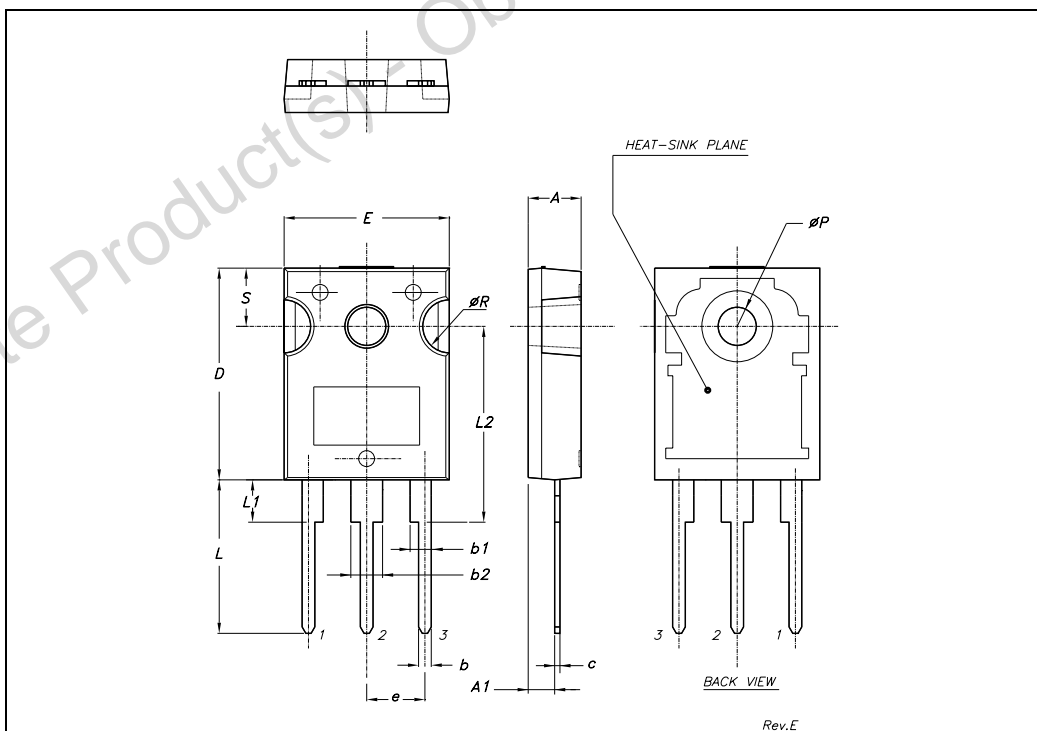
TO-220 mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.051
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
∅P	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



**TO-247 MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.85		5.15	0.19		0.20
A1	2.20		2.60	0.086		0.102
b	1.0		1.40	0.039		0.055
b1	2.0		2.40	0.079		0.094
b2	3.0		3.40	0.118		0.134
c	0.40		0.80	0.015		0.03
D	19.85		20.15	0.781		0.793
E	15.45		15.75	0.608		0.620
e		5.45			0.214	
L	14.20		14.80	0.560		0.582
L1	3.70		4.30	0.14		0.17
L2		18.50			0.728	
øP	3.55		3.65	0.140		0.143
øR	4.50		5.50	0.177		0.216
S		5.50			0.216	



## 5 Revision history

**Table 8. Revision history**

Date	Revision	Changes
04-Oct-2006	1	Initial release.
13-Apr-2007	2	Final version
08-May-2007	3	Added TO-247

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