

### Features

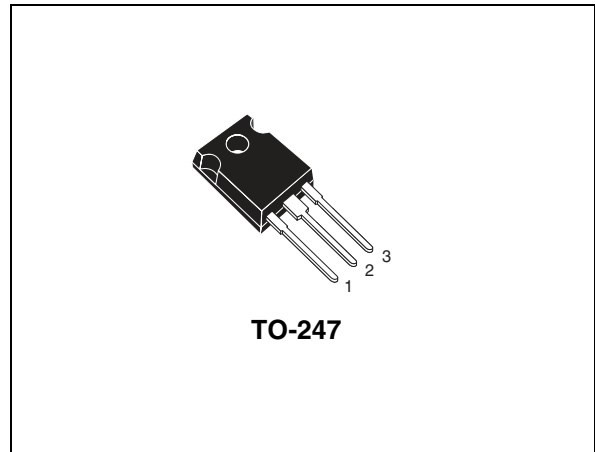
- Low saturation voltage
- High current capability
- Low switching loss
- Very soft ultra fast recovery antiparallel diode

### Applications

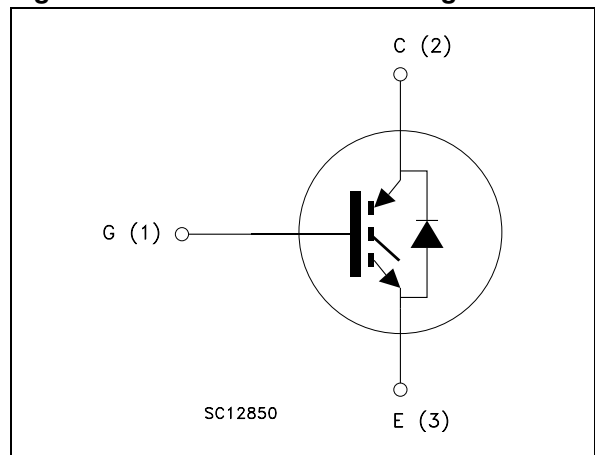
- Induction cooking, microwave oven
- Soft switching application

### Description

This IGBT utilizes the advanced PowerMESH™ process resulting in an excellent trade-off between switching performance and low on-state behavior. This device is well suited for the resonant or soft switching application.



**Figure 1. Internal schematic diagram**



**Table 1. Device summary**

Order code	Marking	Package	Packaging
STGW33IH120D	GW33IH120D	TO-247	Tube

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-emitter voltage ( $V_{GE} = 0$ )	1200	V
$I_C^{(1)}$	Collector current (continuous) at 25 °C	60	A
$I_C^{(1)}$	Collector current (continuous) at 100 °C	30	A
$I_{CL}^{(2)}$	Turn-off latching current	45	A
$I_{CP}^{(3)}$	Pulsed collector current	45	A
$V_{GE}$	Gate-emitter voltage	±25	V
$P_{TOT}$	Total dissipation at $T_C = 25$ °C	220	W
$I_F$	Diode RMS forward current at $T_C = 25$ °C	30	A
$I_{FSM}$	Surge non repetitive forward current $t_p = 10$ ms sinusoidal	100	A
$T_j$	Operating junction temperature	-55 to 150	°C

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C) \cdot I_C}$$

2.  $V_{clamp} = 80\%$  of  $V_{CES}$ ,  $T_j = 150$  °C,  $R_G = 10$  Ω,  $V_{GE} = 15$  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 max.	0.57	°C/W
$R_{thj-case}$	Thermal resistance junction-case diode max.	1.6	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient max.	50	°C/W

## 2 Electrical characteristics

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

**Table 4. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ( $V_{GE} = 0$ )	$I_C = 1\text{ mA}$	1200			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 20\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 20\text{ A}, T_C = 125\text{ °C}$		2.2 2.0	2.8	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$	3.75		5.75	V
$I_{CES}$	Collector-cut-off current ( $V_{GE} = 0$ )	$V_{CE} = 1200\text{ V}$ $V_{CE} = 1200\text{ V}, T_C = 125\text{ °C}$			500 10	$\mu\text{A}$ mA
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{ V}$			$\pm 100$	nA
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE} = 25\text{ V}, I_C = 20\text{ A}$		20		S

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

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0$		2900		pF
$C_{oes}$	Output capacitance			162		pF
$C_{res}$	Reverse transfer capacitance			30		pF
$Q_g$	Total gate charge	$V_{CE} = 960\text{ V},$ $I_C = 20\text{ A}, V_{GE} = 15\text{ V}$		127		nC
$Q_{ge}$	Gate-emitter charge			18		nC
$Q_{gc}$	Gate-collector charge			50		nC

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 960 \text{ V}, I_C = 20 \text{ A}$		46		ns
$t_r$	Current rise time	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$		10		ns
$(di/dt)_{on}$	Turn-on current slope	(see Figure 17)		1660		A/ $\mu\text{s}$
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 960 \text{ V}, I_C = 20 \text{ A}$		45		ns
$t_r$	Current rise time	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$		12		ns
$(di/dt)_{on}$	Turn-on current slope	$T_C = 125 \text{ }^\circ\text{C}$ (see Figure 17)		1500		A/ $\mu\text{s}$
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 960 \text{ V}, I_C = 20 \text{ A}$		102		ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$		284		ns
$t_f$	Current fall time	(see Figure 17)		180		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 960 \text{ V}, I_C = 20 \text{ A}$		200		ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$		424		ns
$t_f$	Current fall time	$T_C = 125 \text{ }^\circ\text{C}$ (see Figure 17)		316		ns

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 960 \text{ V}, I_C = 20 \text{ A}$		1.5		mJ
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$		3.4		mJ
$E_{ts}$	Total switching losses	(see Figure 17)		4.9		mJ
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 960 \text{ V}, I_C = 20 \text{ A}$		2.3		mJ
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$		6.4		mJ
$E_{ts}$	Total switching losses	$T_C = 125 \text{ }^\circ\text{C}$ (see Figure 17)		8.7		mJ

1.  $E_{on}$  is the turn-on losses when a typical diode is used in the test circuit in figure 2. 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	$I_F = 20$ A		1.9		V
		$I_F = 20$ A, $T_C = 125$ °C		1.7		V
$t_{rr}$	Reverse recovery time	$I_F = 20$ A, $V_R = 45$ V, $di/dt = 100$ A/ $\mu$ s (see Figure 20)		85		ns
$Q_{rr}$	Reverse recovery charge			235		nC
$I_{rrm}$	Reverse recovery current			5.6		A
$t_{rr}$	Reverse recovery time	$I_F = 20$ A, $V_R = 45$ V, $T_C = 125$ °C, $di/dt = 100$ A/ $\mu$ s (see Figure 20)		152		ns
$Q_{rr}$	Reverse recovery charge			722		nC
$I_{rrm}$	Reverse recovery current			9		A

## 2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

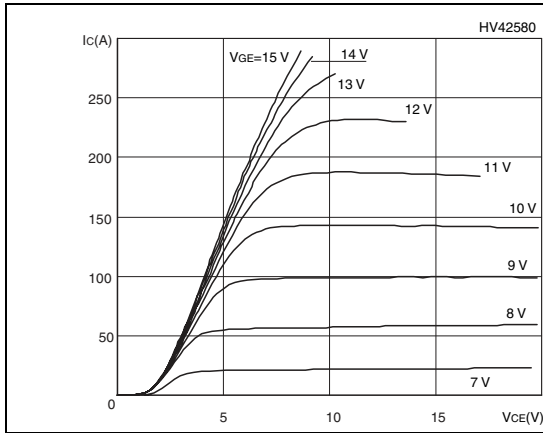


Figure 3. Transfer characteristics

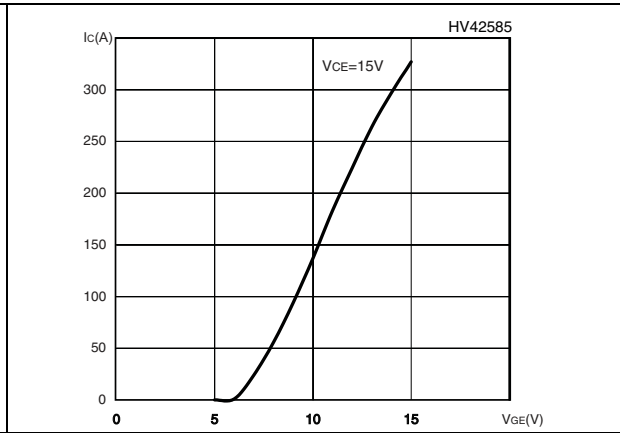


Figure 4. Transconductance

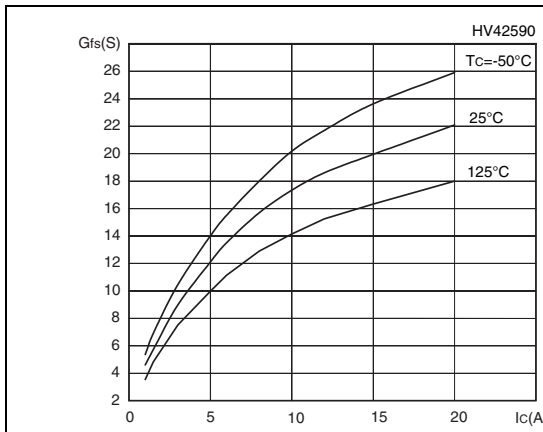


Figure 5. Collector-emitter on voltage vs temperature

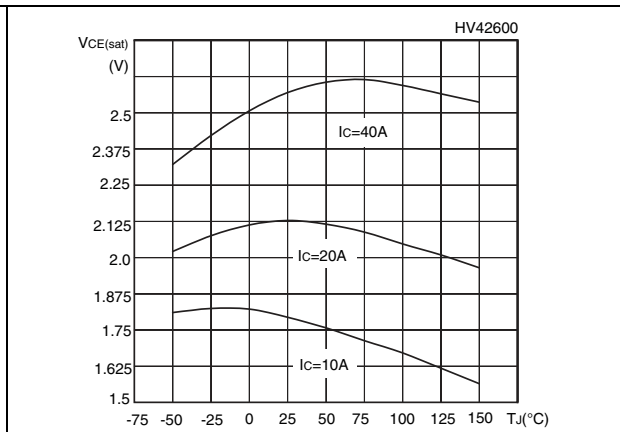


Figure 6. Gate charge vs gate-source voltage

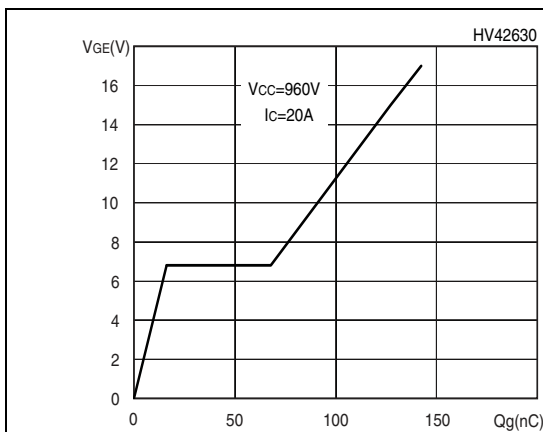


Figure 7. Capacitance variations

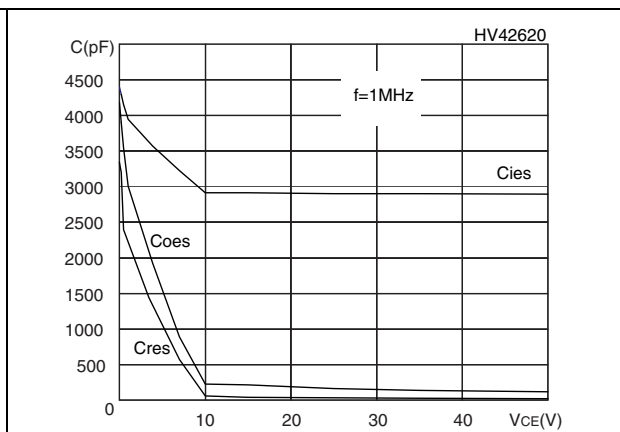


Figure 8. Normalized gate threshold voltage vs temperature

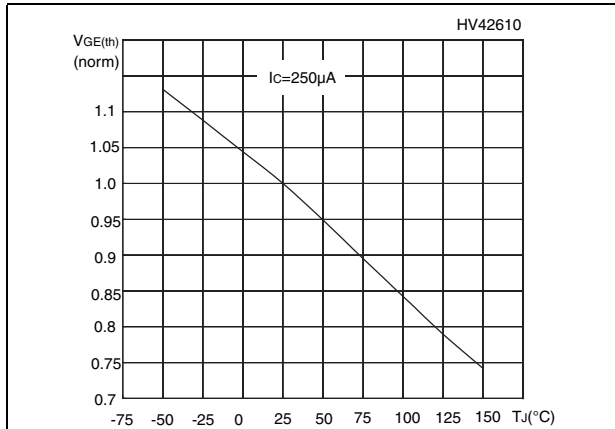


Figure 9. Collector-emitter on voltage vs collector current

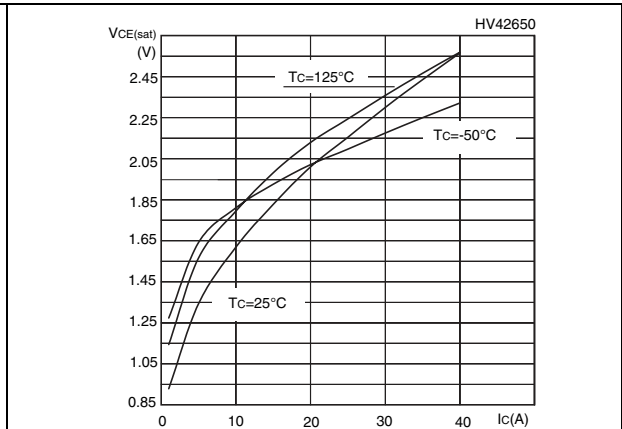


Figure 10. Normalized breakdown voltage vs temperature

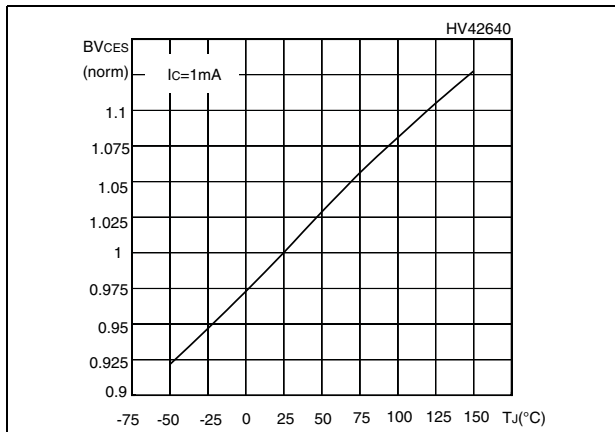


Figure 11. Switching losses vs temperature

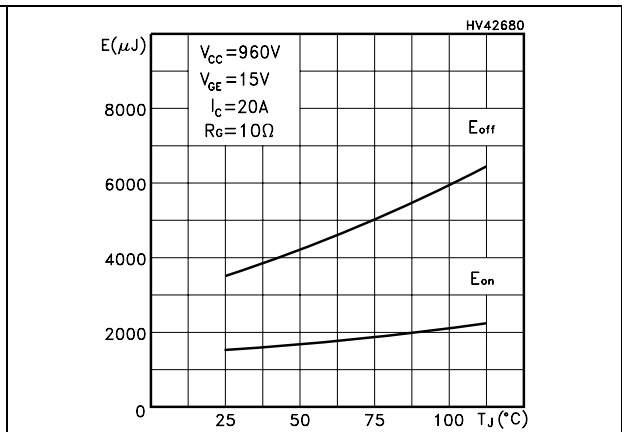


Figure 12. Switching losses vs gate resistance

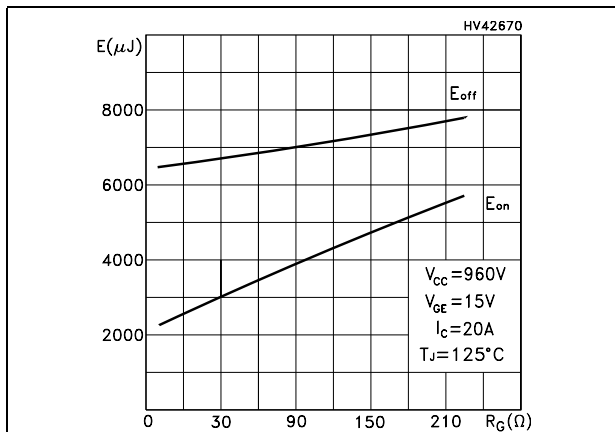


Figure 13. Switching losses vs collector current

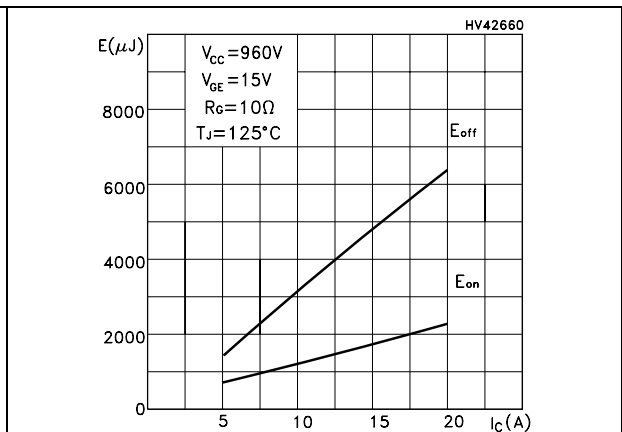




Figure 14. Thermal impedance

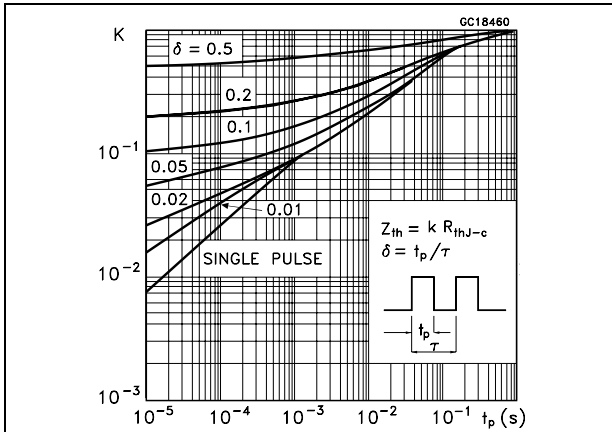


Figure 15. Turn-off SOA

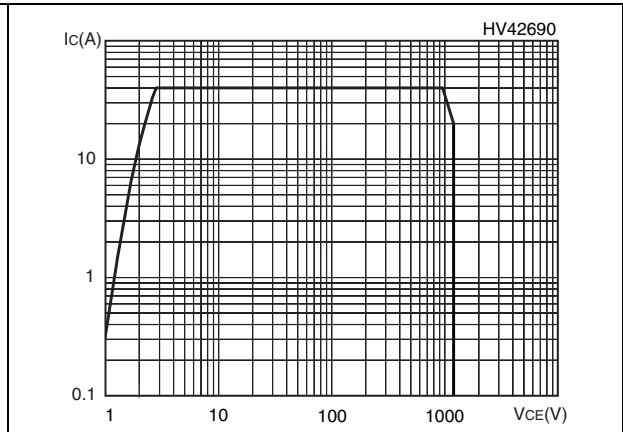
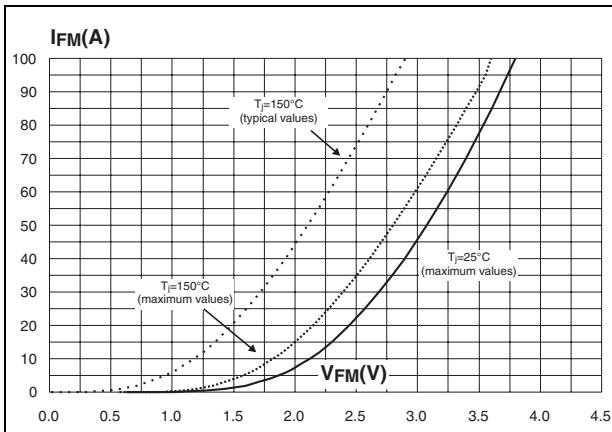


Figure 16. Emitter-collector diode characteristics



### 3 Test circuit

Figure 17. Test circuit for inductive load switching

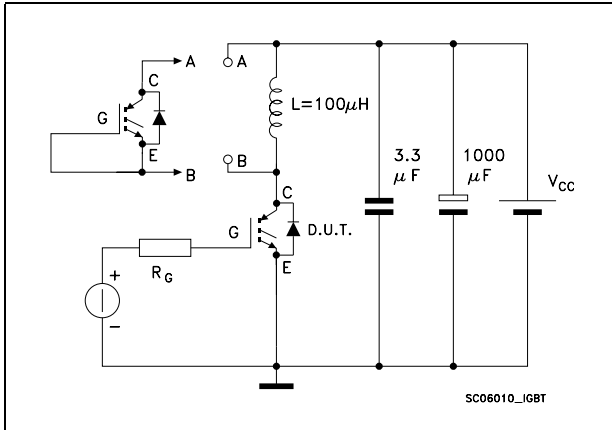


Figure 19. Switching waveform

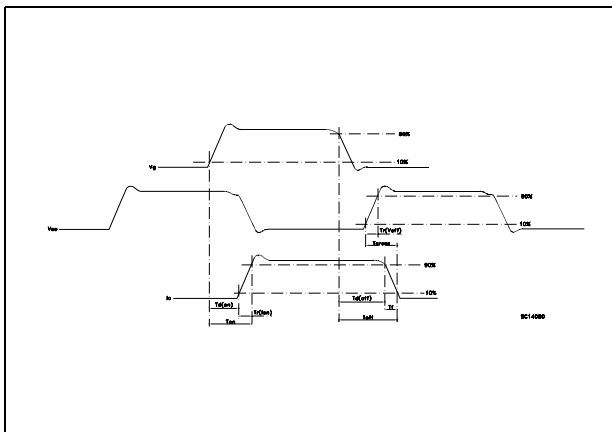


Figure 18. Gate charge test circuit

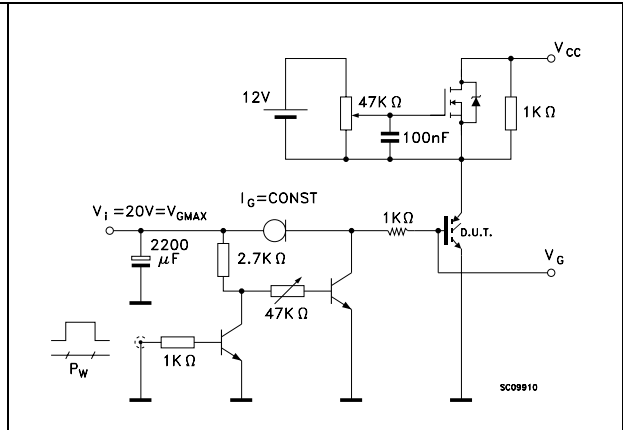
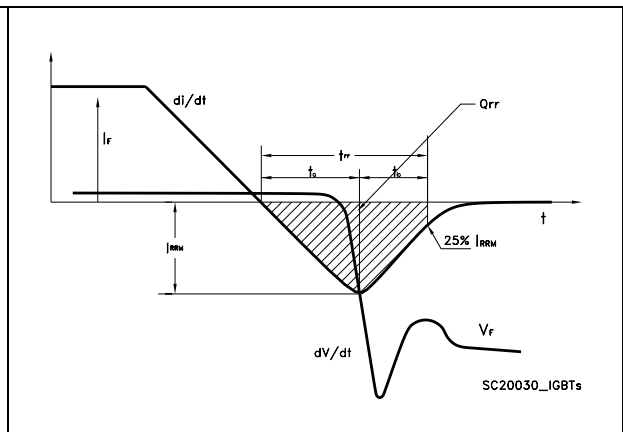


Figure 20. Diode recovery time waveform

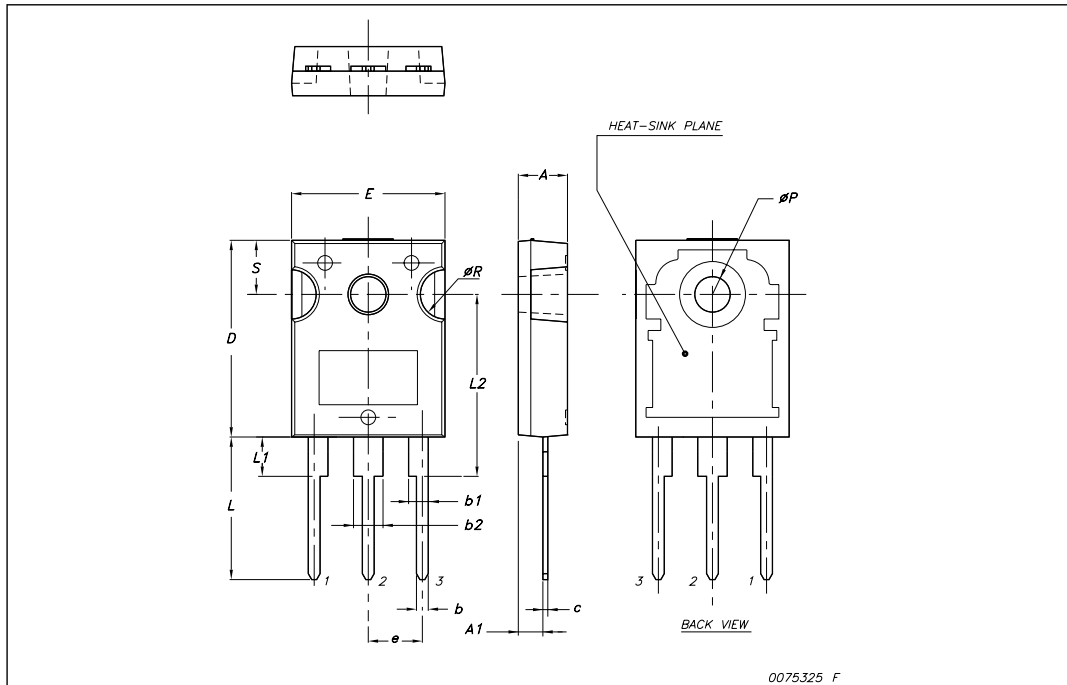


## 4 Package mechanical data

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)

**TO-247 Mechanical data**

Dim.	mm.		
	Min.	Typ	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
øP	3.55		3.65
øR	4.50		5.50
S		5.50	



## 5 Revision history

Table 9. Document revision history

Date	Revision	Changes
12-Mar-2008	1	Initial release

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