

### Features

- Low on-voltage drop ( $V_{CE(sat)}$ )
- Low  $C_{res} / C_{ies}$  ratio (no cross conduction susceptibility)
- Short circuit withstand time 10  $\mu$ s
- IGBT co-packaged with ultra fast free-wheeling diode

### Applications

- High frequency inverters
- Motor drivers

### Description

This IGBT utilizes the advanced PowerMESH™ process resulting in an excellent trade-off between switching performance and low on-state behavior.

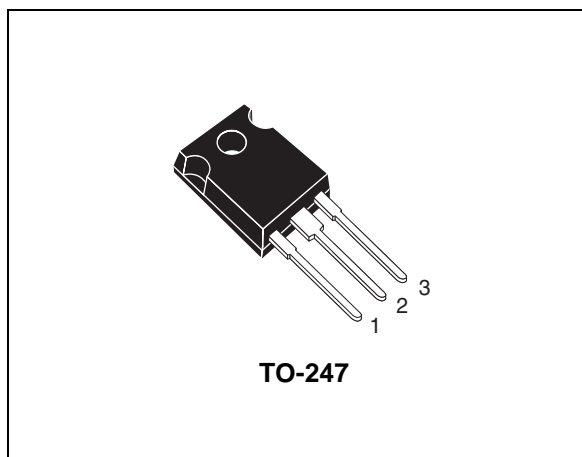


Figure 1. Internal schematic diagram

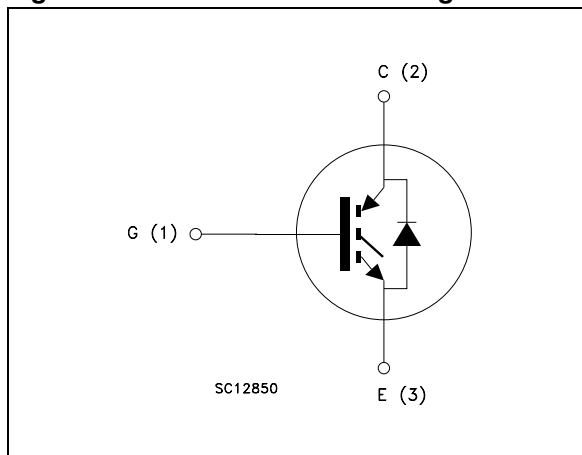


Table 1. Device summary

Order code	Marking	Package	Packaging
STGW30NC60KD	GW30NC60KD	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 ( $V_{GE} = 0$ )	600	V
$I_C^{(1)}$	Collector current (continuous) at $T_C = 25\text{ °C}$	60	A
$I_C^{(1)}$	Collector current (continuous) at $T_C = 100\text{ °C}$	28	A
$I_{CL}^{(2)}$	Turn-off latching current	125	A
$I_{CP}^{(3)}$	Pulsed collector current	125	A
$V_{GE}$	Gate-emitter voltage	$\pm 20$	V
$I_F$	Diode RMS forward current at $T_C = 25\text{ °C}$	30	A
$I_{FSM}$	Surge non repetitive forward current $t_p = 10\text{ ms}$ sinusoidal	120	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	200	W
$t_{scw}$	Short circuit withstand time, $V_{CE} = 0.5 V_{(BR)CES}$ $T_j = 125\text{ °C}$ , $R_G = 10\ \Omega$ , $V_{GE} = 12\text{ V}$	10	$\mu\text{s}$
$T_j$	Operating junction temperature	- 55 to 150	$^{\circ}\text{C}$

1. Calculated according to the iterative formula:

$$I_c(T_c) = \frac{T_{J(MAX)} - T_c}{R_{thj-c} \times V_{CE(sat)(MAX)} \cdot (T_c, I_c)}$$

2.  $V_{clamp} = 80\% \cdot (V_{CES})$ ,  $T_j = 150\text{ °C}$ ,  $R_G = 10\ \Omega$ ,  $V_{GE} = 15\text{ V}$

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.	0.625	$^{\circ}\text{C/W}$
	Thermal resistance junction-case diode max.	1.5	$^{\circ}\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	50	$^{\circ}\text{C/W}$

## 2 Electrical characteristics

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

**Table 4. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ( $V_{GE}=0$ )	$I_C=1\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE}=15\text{ V}$ , $I_C=20\text{ A}$		2.1	2.7	V
		$V_{GE}=15\text{ V}$ , $I_C=20\text{ A}$ , $T_C=125^{\circ}\text{C}$		1.9		V
$I_{CES}$	Collector cut-off current ( $V_{GE}=0$ )	$V_{CE}=600\text{ V}$			150	$\mu\text{A}$
		$V_{CE}=600\text{ V}$ , $T_C=125^{\circ}\text{C}$			1	$\text{mA}$
$V_{GE(th)}$	Gate threshold voltage	$V_{CE}=V_{GE}$ , $I_C=250\text{ }\mu\text{A}$	4.5		6.5	V
$I_{GES}$	Gate-emitter cut-off current ( $V_{CE}=0$ )	$V_{GE}=\pm 20\text{ V}$			$\pm 100$	$\text{nA}$
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE}=15\text{ V}$ , $I_C=20\text{ A}$		15		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	$V_{CE}=25\text{ V}$ , $f=1\text{ MHz}$ , $V_{GE}=0$		2170		$\text{pF}$
$C_{oes}$	Output capacitance			230		$\text{pF}$
$C_{res}$	Reverse transfer capacitance			46		$\text{pF}$
$Q_g$	Total gate charge	$V_{CE}=480\text{ V}$ , $I_C=20\text{ A}$ ,		96		$\text{nC}$
$Q_{ge}$	Gate-emitter charge	$V_{GE}=15\text{ V}$		18		$\text{nC}$
$Q_{gc}$	Gate-collector charge	(see Figure 18)		46		$\text{nC}$

**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	$V_{CC} = 480\text{ V}$ , $I_C = 20\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , (see Figure 17)		29 12 1520		ns ns A/ $\mu$ s
$t_{d(on)}$ $t_r$ $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 480\text{ V}$ , $I_C = 20\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_C = 125\text{ }^\circ\text{C}$ (see Figure 17)		27 14 1360		ns ns A/ $\mu$ s
$t_r(V_{off})$ $t_{d(off)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 480\text{ V}$ , $I_C = 20\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , (see Figure 17)		36 120 85		ns ns ns
$t_r(V_{off})$ $t_{d(off)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 480\text{ V}$ , $I_C = 20\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ $T_C = 125\text{ }^\circ\text{C}$ (see Figure 17)		75 160 130		ns ns ns

**Table 7. 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	$V_{CC} = 480\text{ V}$ , $I_C = 20\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , (see Figure 17)		350 435 785		$\mu$ J $\mu$ J $\mu$ J
$E_{on}$ $E_{off}^{(1)}$ $E_{ts}$	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 480\text{ V}$ , $I_C = 20\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_C = 125\text{ }^\circ\text{C}$ (see Figure 17)		590 845 1435		$\mu$ J $\mu$ J $\mu$ J

1. 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	$I_F = 20\text{ A}$ $I_F = 20\text{ A}, T_C = 125\text{ °C}$		2.6 1.6	3.1	V V
$t_{rr}$ $Q_{rr}$ $I_{rrm}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F = 20\text{ A}, V_R = 50\text{ V},$ $di/dt = 100\text{ A}/\mu\text{s}$ (see Figure 20)		40 50 2.5		ns nC A
$t_{rr}$ $Q_{rr}$ $I_{rrm}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F = 20\text{ A}, V_R = 50\text{ V},$ $T_C = 125\text{ °C}, di/dt = 100\text{ A}/\mu\text{s}$ (see Figure 20)		80 180 4.5		ns nC A

## 2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

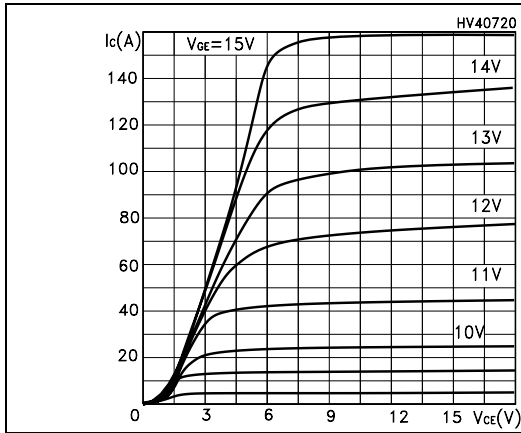


Figure 3. Transfer characteristics

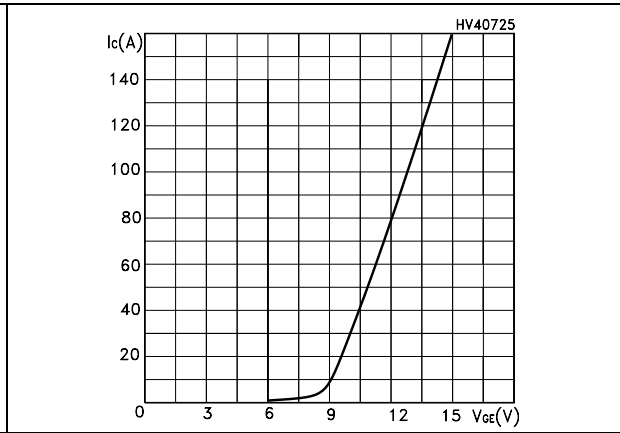


Figure 4. Transconductance

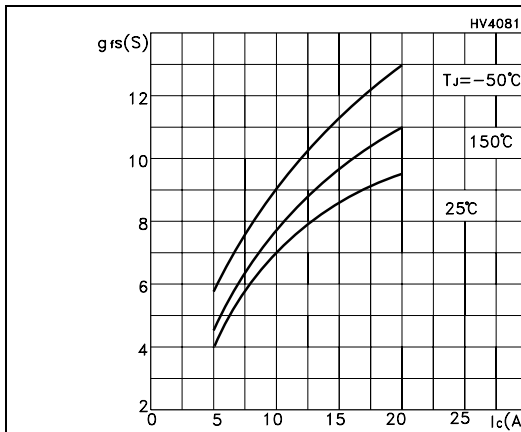


Figure 5. Collector-emitter on voltage vs temperature

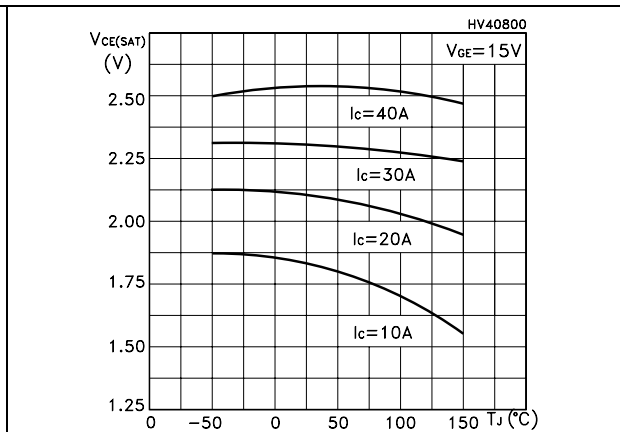


Figure 6. Gate charge vs gate-source voltage

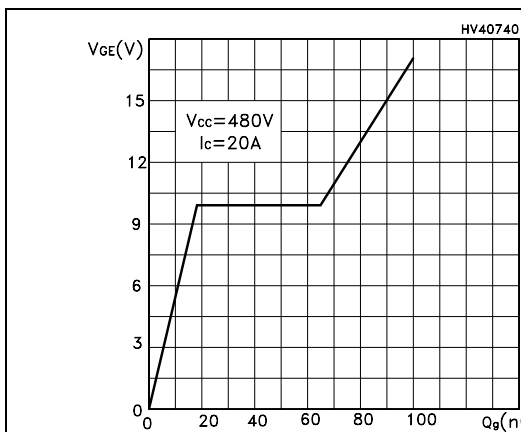


Figure 7. Capacitance variations

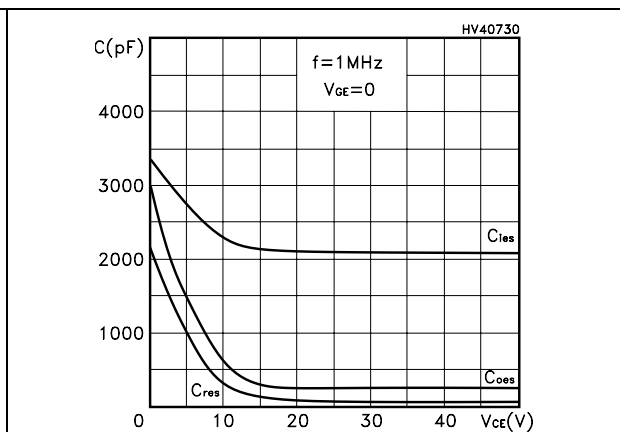


Figure 8. Normalized gate threshold voltage vs temperature

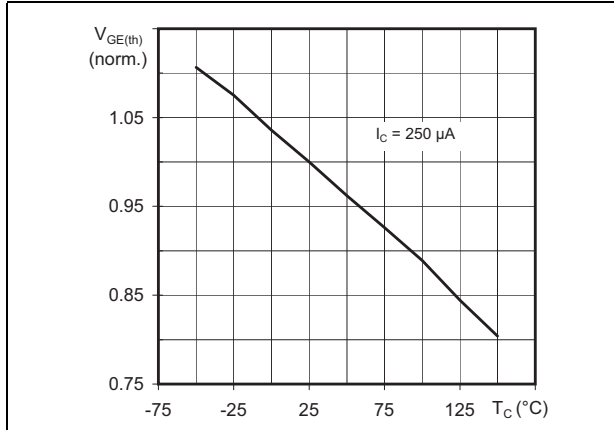


Figure 9. Collector-emitter on voltage vs collector current

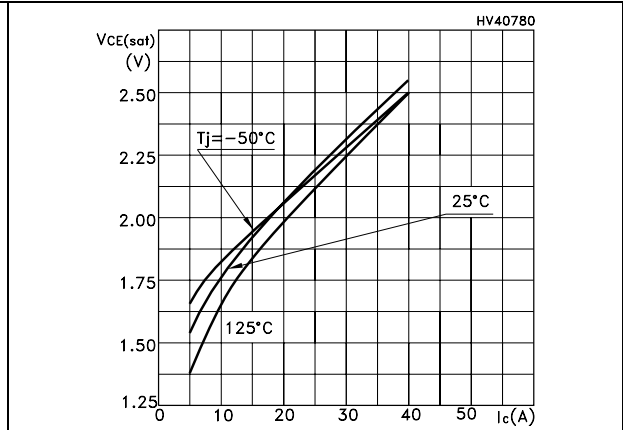


Figure 10. Normalized breakdown voltage vs temperature

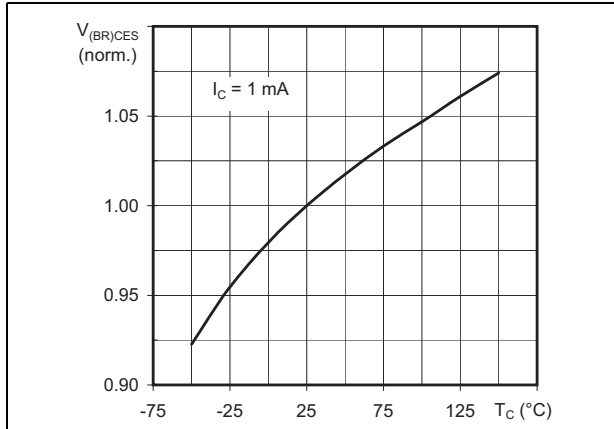


Figure 11. Switching losses vs temperature

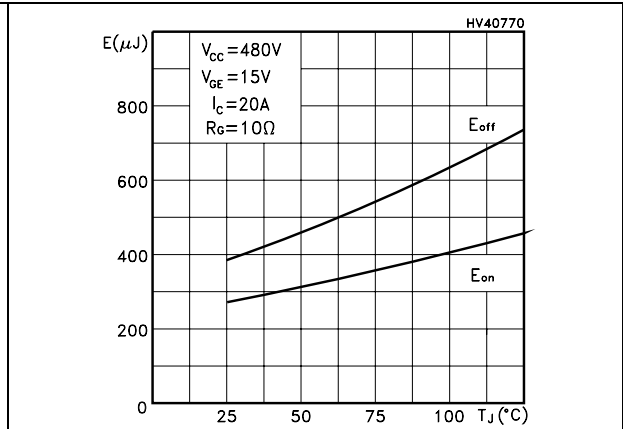


Figure 12. Switching losses vs gate resistance

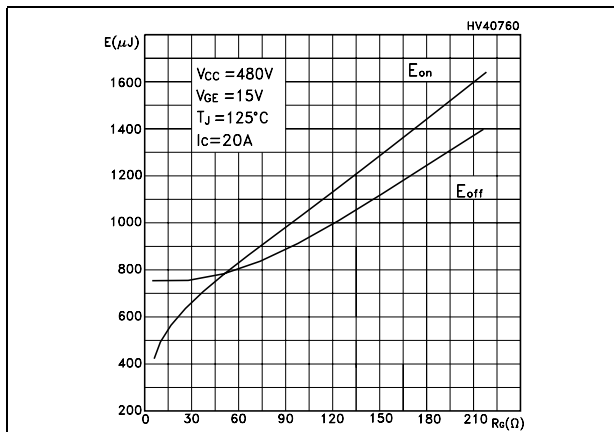


Figure 13. Switching losses vs collector current

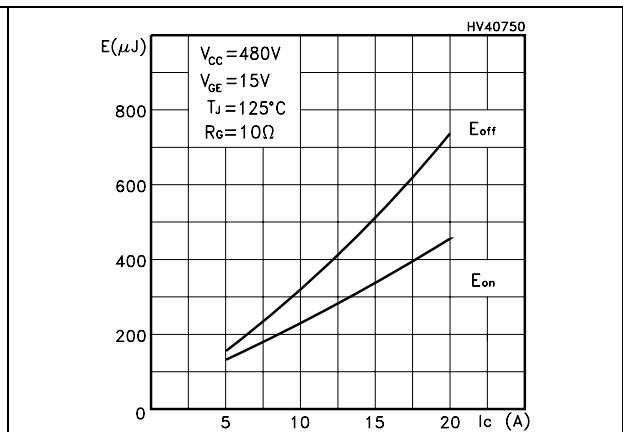




Figure 14. Thermal Impedance

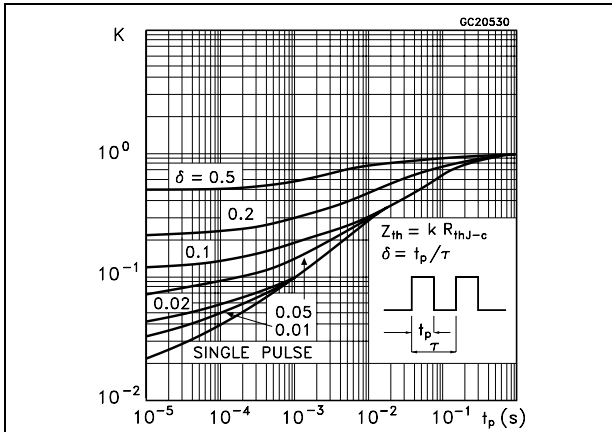


Figure 15. Turn-off SOA

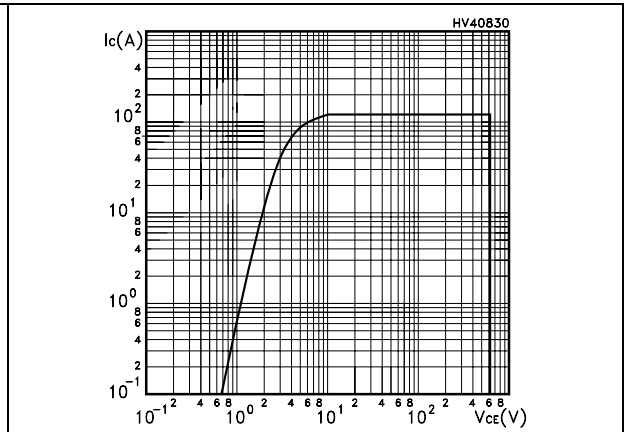
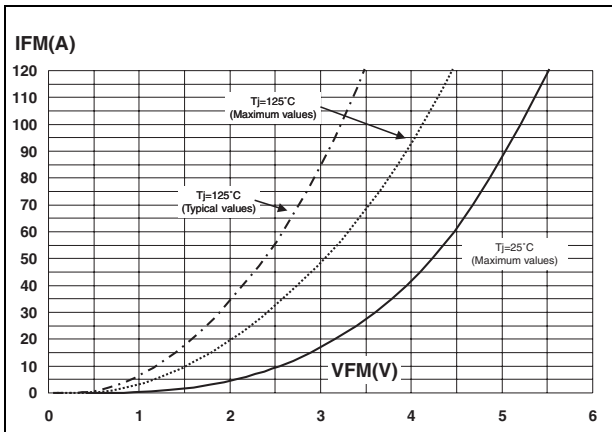


Figure 16. Forward voltage drop versus forward current



### 3 Test circuit

Figure 17. Test circuit for inductive load switching

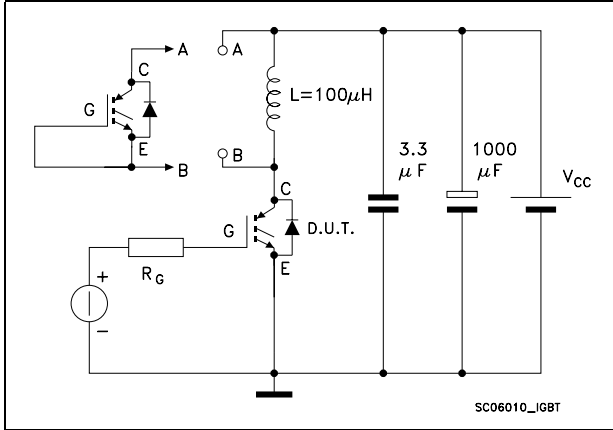


Figure 18. Gate charge test circuit

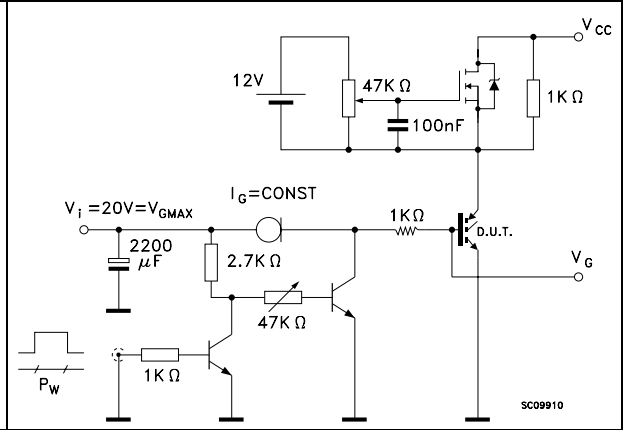


Figure 19. Switching waveforms

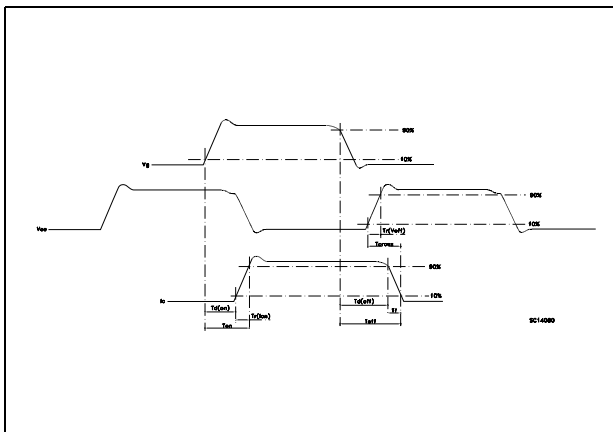
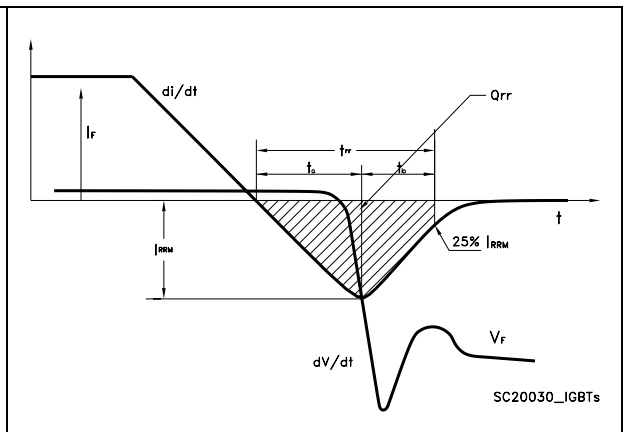


Figure 20. Diode recovery times waveform

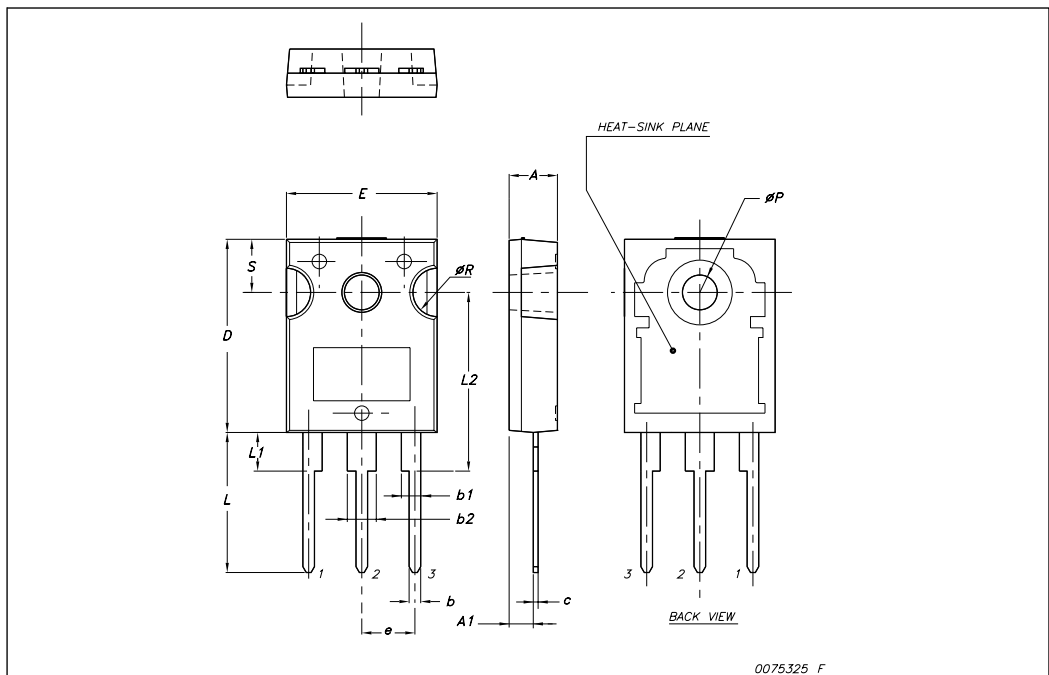


## 4 Package mechanical data

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
24-Oct-2007	1	Initial release
07-Mar-2008	2	Updated <a href="#">Figure 15: Turn-off SOA</a>

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