

### Features

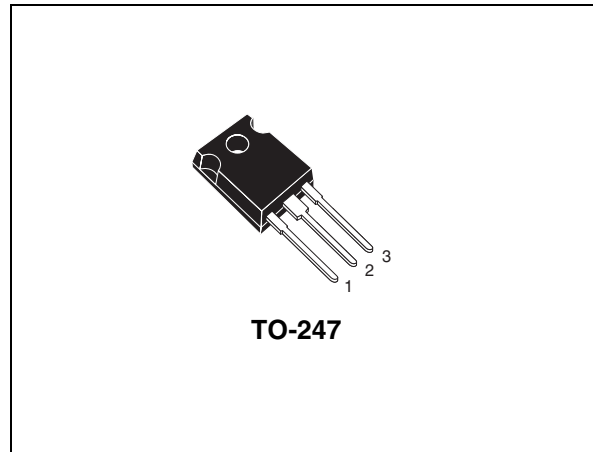
- Low on-losses
- Low on-voltage drop ( $V_{CE(sat)}$ )
- High current capability
- High input impedance (voltage driven)
- Low gate charge
- Ideal for soft switching application

### Application

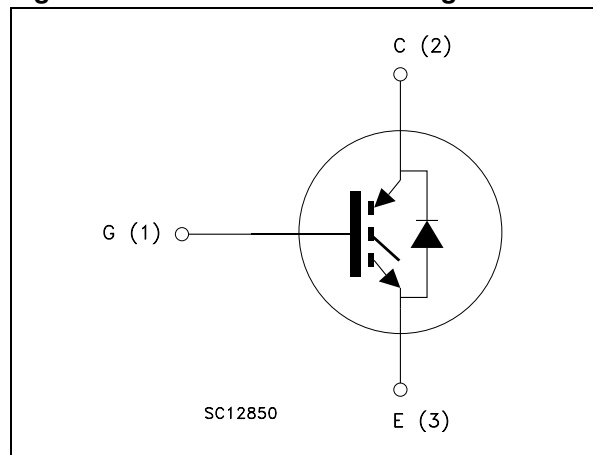
- Induction heating

### 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
STGW35NC120HD	GW35NC120HD	TO-247	Tube

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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	58	A
$I_C^{(1)}$	Collector current (continuous) at 100 °C	34	A
$I_{CL}^{(2)}$	Turn-off latching current	135	A
$I_{CP}^{(3)}$	Pulsed collector current	135	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
$T_{stg}$	Storage 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.  $V_{clamp} = 80\%$  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	Min.	Typ.	Max.	Unit
$R_{thj-case}$	Thermal resistance junction-case IGBT			0.562	°C/W
	Thermal resistance junction-case diode			1.5	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient			50	°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 ( $V_{GE} = 0$ )	$I_C = 1 \text{ mA}$	1200			V
$V_{CE(SAT)}$	Collector-emitter saturation voltage	$V_{GE} = 15 \text{ V}, I_C = 20 \text{ A},$ $V_{GE} = 15 \text{ V}, I_C = 20 \text{ A}, T_C = 125^{\circ}\text{C}$		2.2 2.0	2.75	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 250\mu\text{A}$	3.75		5.75	V
$I_{CES}$	Collector-emitter leakage current ( $V_{GE} = 0$ )	$V_{CE} = 1200 \text{ V}$ $V_{CE} = 1200 \text{ V}, T_C = 125^{\circ}\text{C}$			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	$V_{CE} = 25 \text{ V}, I_C = 20 \text{ A}$		14		S

1. 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	$V_{CE} = 25 \text{ V}, f = 1 \text{ MHz}, V_{GE} = 0$		2510		pF
$C_{oes}$	Output capacitance			175		pF
$C_{res}$	Reverse transfer capacitance			30		pF
$Q_g$	Total gate charge	$V_{CE} = 960 \text{ V},$ $I_C = 20 \text{ A}, V_{GE} = 15 \text{ V}$		110	120	nC
$Q_{ge}$	Gate-emitter charge			16		nC
$Q_{gc}$	Gate-collector charge			49		nC

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 960\text{ V}, I_C = 20\text{ A}$		29		ns
$t_r$	Current rise time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$		11		ns
$(di/dt)_{on}$	Turn-on current slope	(see Figure 17)		1820		A/ $\mu$ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 960\text{ V}, I_C = 20\text{ A}$		27		ns
$t_r$	Current rise time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$		14		ns
$(di/dt)_{on}$	Turn-on current slope	$T_C = 125\text{ }^\circ\text{C}$ (see Figure 17)		1580		A/ $\mu$ s
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 960\text{ V}, I_C = 20\text{ A}$		90		ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$		275		ns
$t_f$	Current fall time	(see Figure 17)		312		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 960\text{ V}, I_C = 20\text{ A}$		150		ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$		336		ns
$t_f$	Current fall time	$T_C = 125\text{ }^\circ\text{C}$ (see Figure 17)		592		ns

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 960\text{ V}, I_C = 20\text{ A}$		1660		$\mu$ J
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$		4438		$\mu$ J
$E_{ts}$	Total switching losses	(see Figure 17)		6098		$\mu$ J
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 960\text{ V}, I_C = 20\text{ A}$		3015		$\mu$ J
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$		6900		$\mu$ J
$E_{ts}$	Total switching losses	$T_C = 125\text{ }^\circ\text{C}$ (see Figure 17)		9915		$\mu$ J

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	$I_F = 20\text{ A}$		1.9	2.5	V
		$I_F = 20\text{ A}, T_C = 125\text{ }^\circ\text{C}$		1.7		V
$t_{rr}$	Reverse recovery time	$I_F = 20\text{ A}, V_R = 27\text{ V},$		152		ns
$Q_{rr}$	Reverse recovery charge	$T_C = 125\text{ }^\circ\text{C}, di/dt = 100\text{ A}/\mu\text{s}$		722		nC
$I_{rrm}$	Reverse recovery current	(see Figure 20)		9		A

## 2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

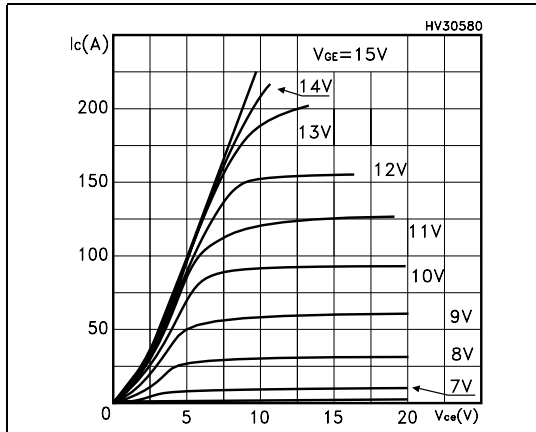


Figure 3. Transfer characteristics

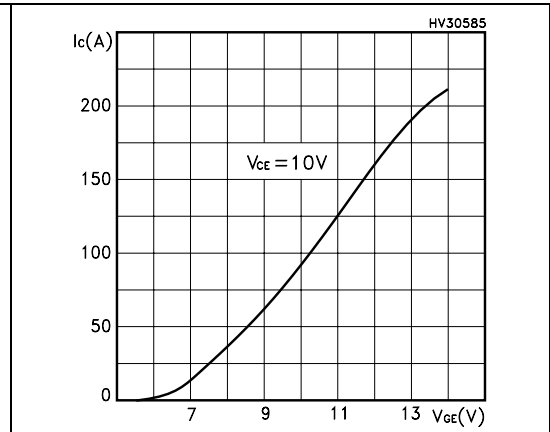


Figure 4. Transconductance

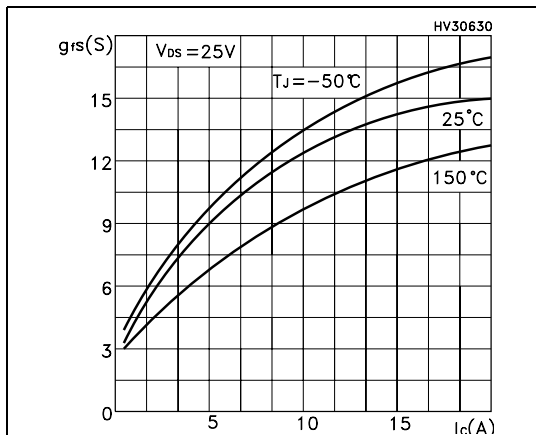


Figure 5. Collector-emitter on voltage vs. temperature

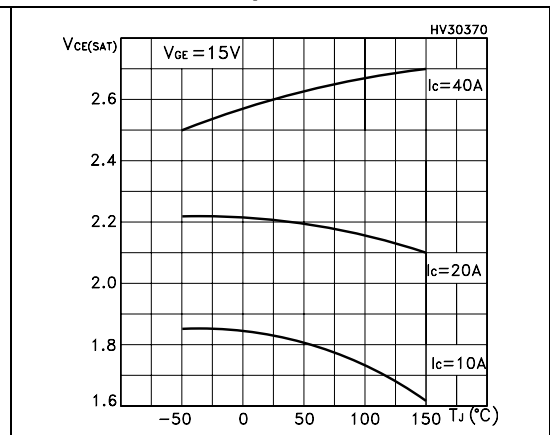


Figure 6. Gate charge vs. gate-source voltage

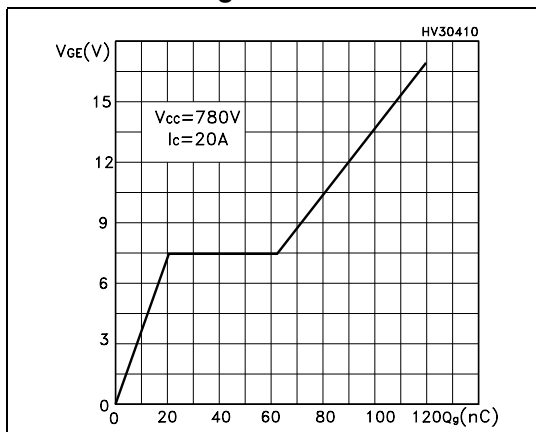
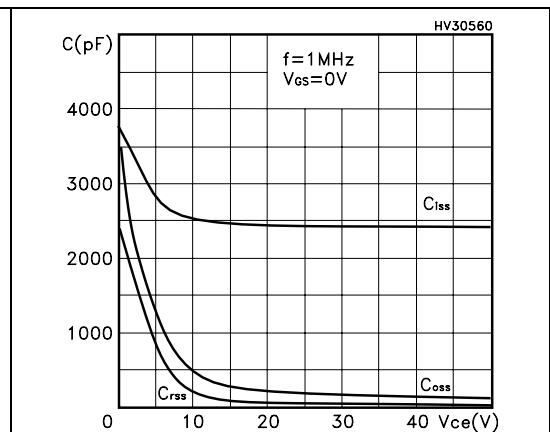
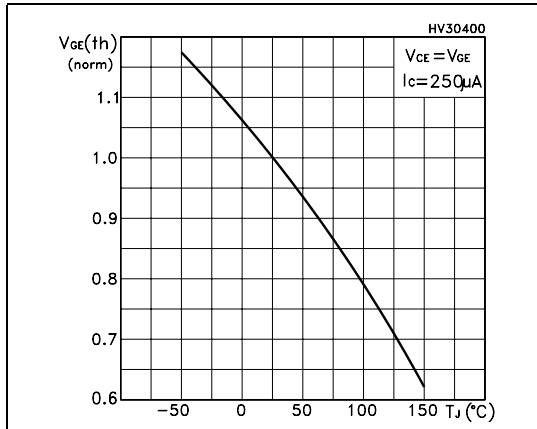


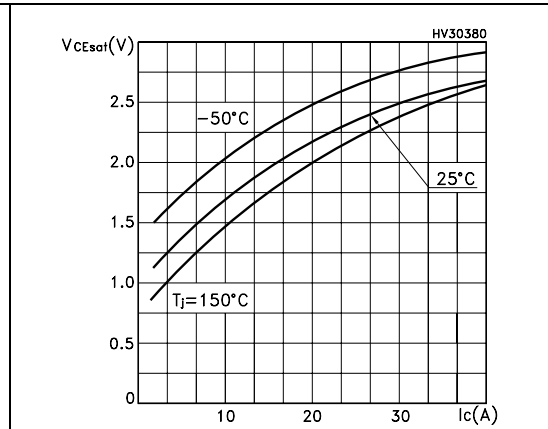
Figure 7. Capacitance variations



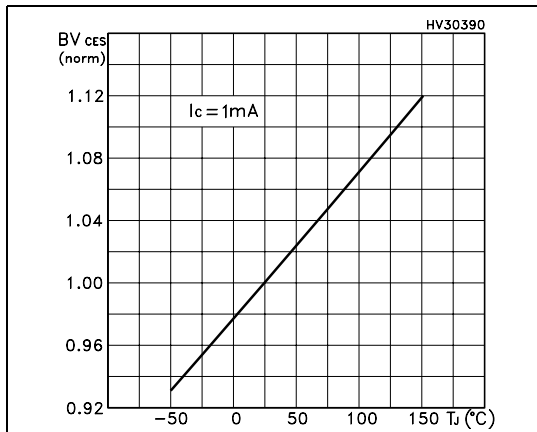
**Figure 8. Normalized gate threshold voltage vs. temperature**



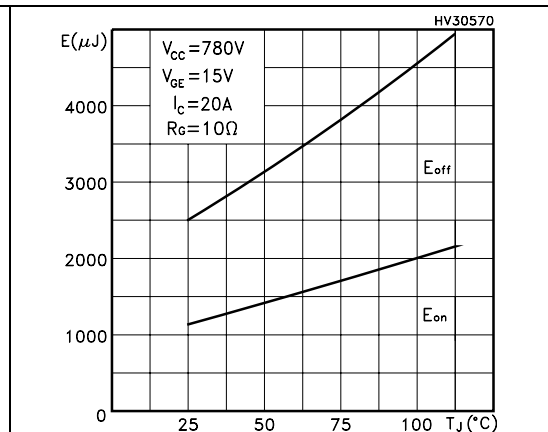
**Figure 9. Collector-emitter on voltage vs. collector current**



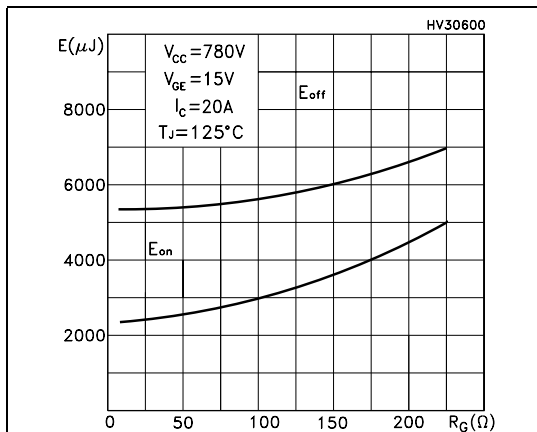
**Figure 10. Normalized breakdown voltage vs. temperature**



**Figure 11. Switching losses vs. temperature**



**Figure 12. Switching losses vs. gate resistance**



**Figure 13. Switching losses vs. collector current**

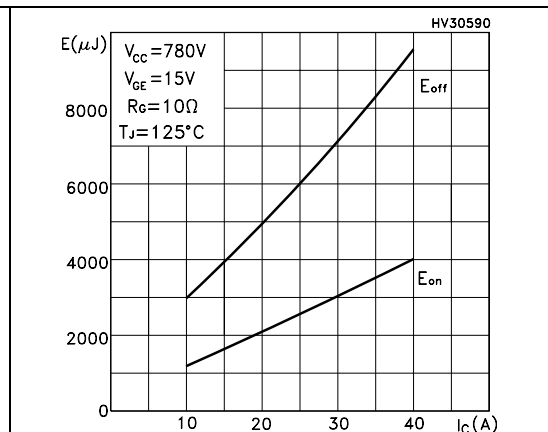


Figure 14. Thermal Impedance

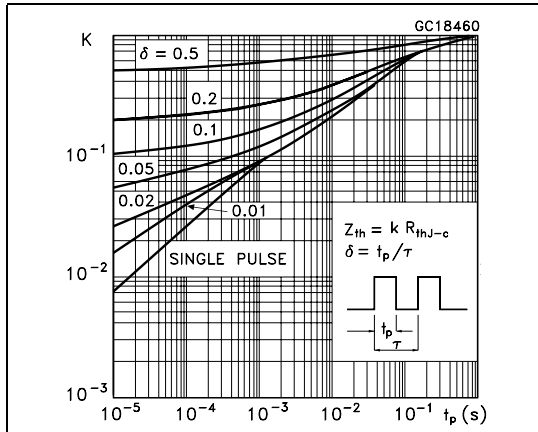


Figure 15. Turn-off SOA

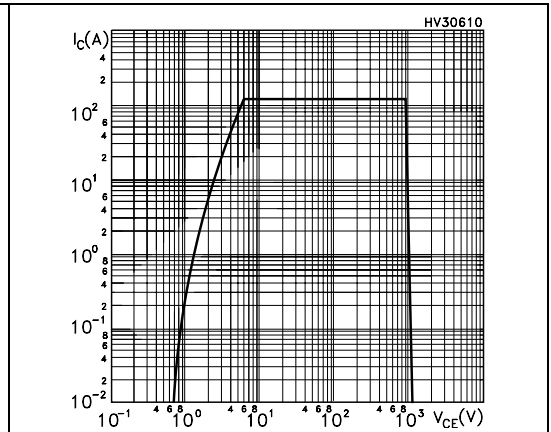
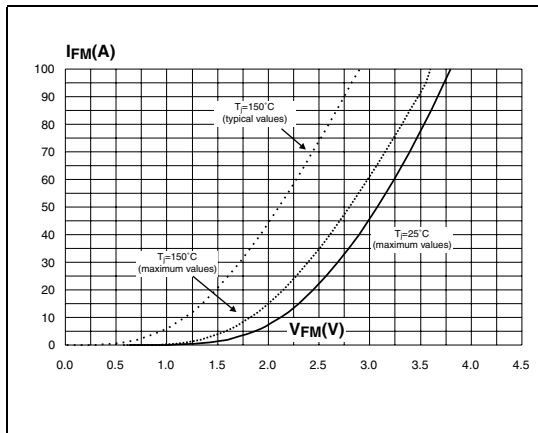


Figure 16. Forward voltage drop vs. forward current





### 3 Test circuit

Figure 17. Test circuit for inductive load switching

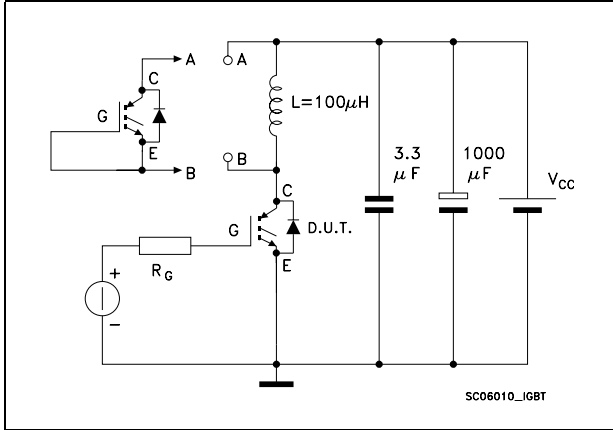


Figure 19. Switching waveform

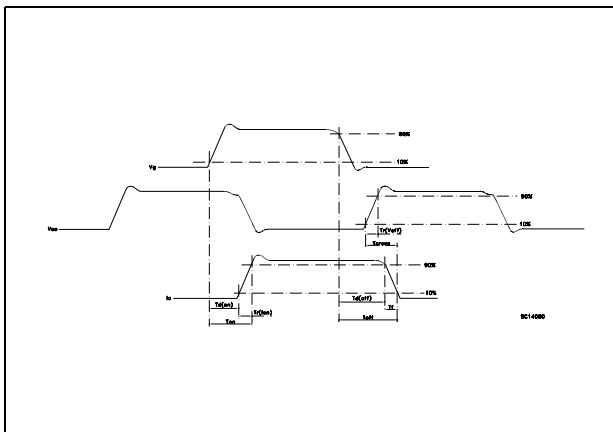


Figure 18. Gate charge test circuit

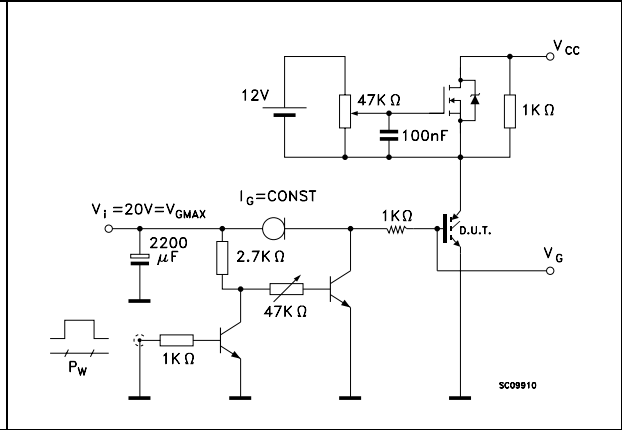
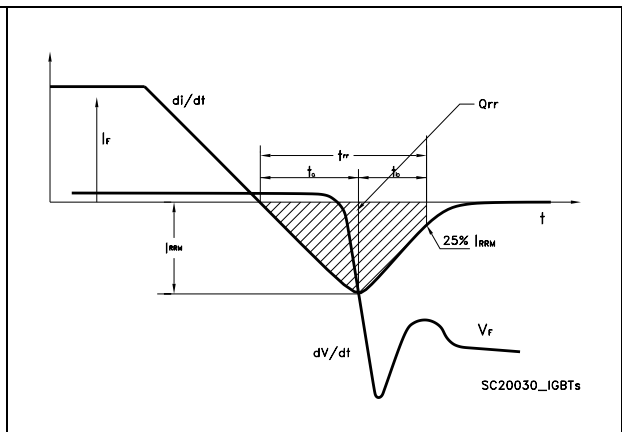


Figure 20. Diode recovery time waveform

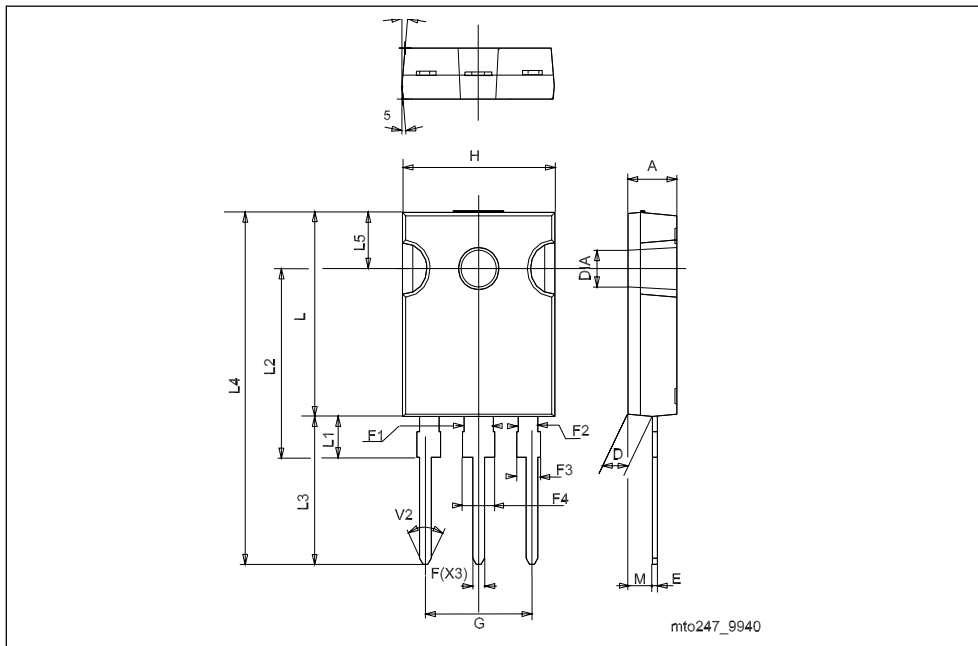


## 4 Package mechanical data

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.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.90		5.16	0.193		0.203
D	2.35		2.45	0.093		0.096
E	0.6		0.76	0.024		0.030
F	1.2		1.33	0.047		0.052
F1		3			0.118	
F2		2			0.078	
F3	1.9		2.13	0.075		0.084
F4	3.04		3.2	0.120		0.126
G		10.90			0.429	
H	15.77		16.03	0.621		0.631
L	20.83		21.09	0.820		0.830
L1	3.93		4.45	0.155		0.175
L2	18.72		19.18	0.737		0.755
L3	20.04		20.31	0.789		0.800
L4	40.88		41.40	1.609		1.630
L5	6.04		6.30	0.238		0.248
M	2		3		0.078	0.118
V		5°			5°	
V2		60°			60°	
Diam	3.56		3.66	0.140		0.144



## 5 Revision history

**Table 9. Document revision history**

Date	Revision	Changes
25-Jan-2008	1	First issue.

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