

### 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.

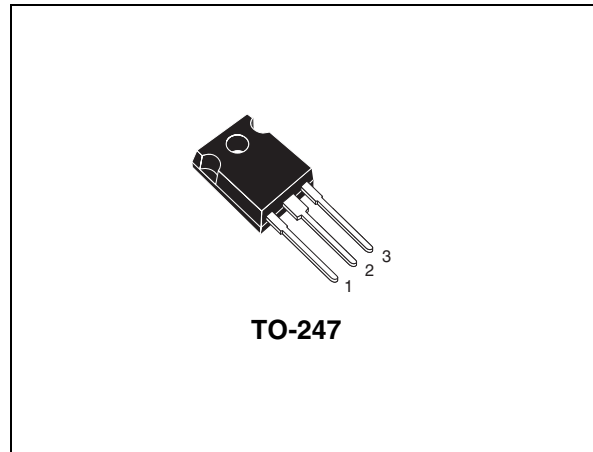


Figure 1. Internal schematic diagram

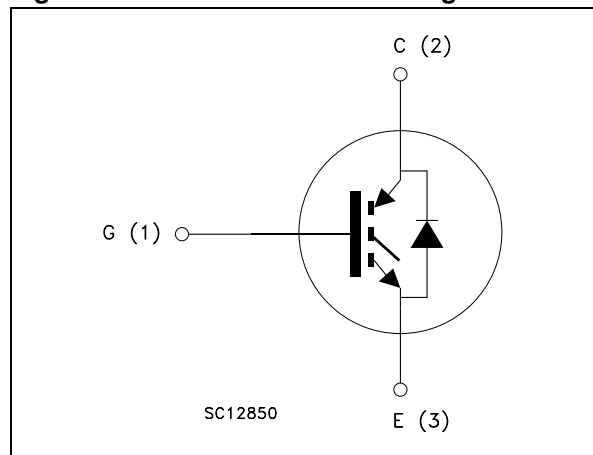


Table 1. Device summary

Order code	Marking	Package	Packaging
STGW35NC120HD	GW35NC120HD	TO-247	Tube

# Contents

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# 1 Electrical ratings

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**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

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( $T_{CASE}=25^{\circ}C$  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	$V_{GE} = 15 \text{ V}, I_C = 20 \text{ A},$ $V_{GE} = 15 \text{ V}, I_C = 20 \text{ A}, T_C = 125^{\circ}C$		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 ( $V_{GE} = 0$ )	$V_{CE} = 1200 \text{ V}$ $V_{CE} = 1200 \text{ V}, T_C = 125^{\circ}C$			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	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$ (see Figure 17)		11		ns
$(di/dt)_{on}$	Turn-on current slope			1820		A/ $\mu\text{s}$
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 960 \text{ V}, I_C = 20 \text{ A}$		27		ns
$t_r$	Current rise time	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$ $T_C = 125 \text{ }^\circ\text{C}$ (see Figure 17)		14		ns
$(di/dt)_{on}$	Turn-on current slope			1580		A/ $\mu\text{s}$
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 960 \text{ V}, I_C = 20 \text{ A}$		90		ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$ (see Figure 17)		275		ns
$t_f$	Current fall time			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	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$ $T_C = 125 \text{ }^\circ\text{C}$ (see Figure 17)		336		ns
$t_f$	Current fall time			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		$\mu\text{J}$
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$ (see Figure 17)		4438		$\mu\text{J}$
$E_{ts}$	Total switching losses			6098		$\mu\text{J}$
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 960 \text{ V}, I_C = 20 \text{ A}$		3015		$\mu\text{J}$
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10 \Omega, V_{GE} = 15 \text{ V},$ $T_C = 125 \text{ }^\circ\text{C}$ (see Figure 17)		6900		$\mu\text{J}$
$E_{ts}$	Total switching losses			9915		$\mu\text{J}$

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	$I_F = 20 \text{ A}$ $I_F = 20 \text{ A}, T_C = 125 \text{ }^\circ\text{C}$		1.9 1.7	2.5	V V
$t_{rr}$	Reverse recovery time	$I_F = 20 \text{ A}, V_R = 27 \text{ V},$ $T_C = 125 \text{ }^\circ\text{C}, di/dt = 100 \text{ A}/\mu\text{s}$ (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

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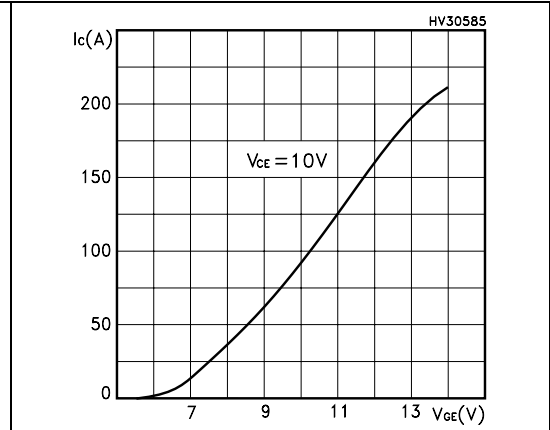
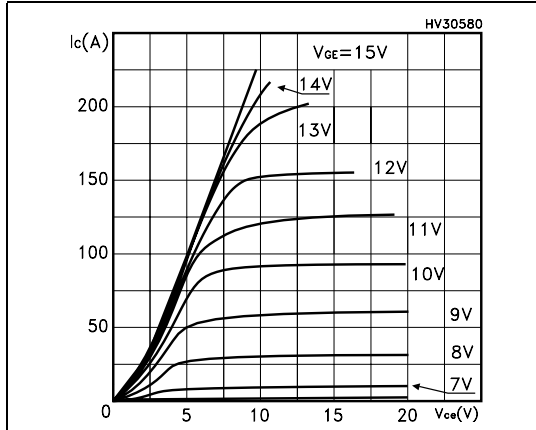


Figure 4. Transconductance

Figure 5. Collector-emitter on voltage vs. temperature

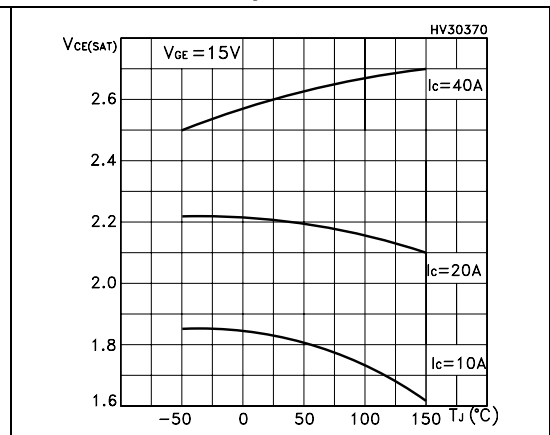
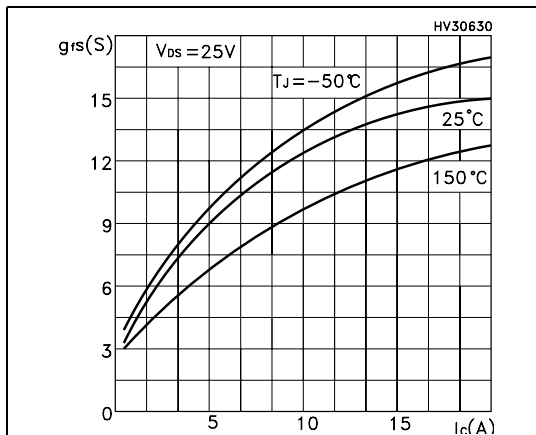
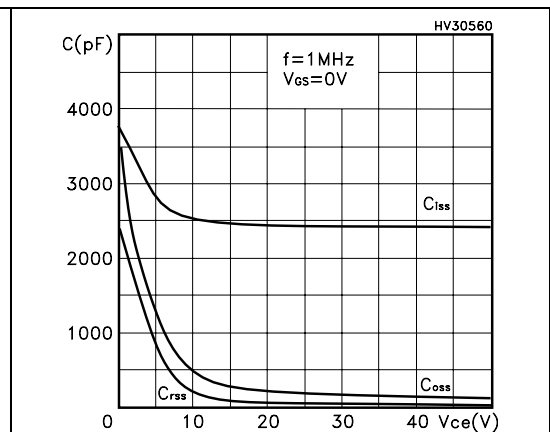
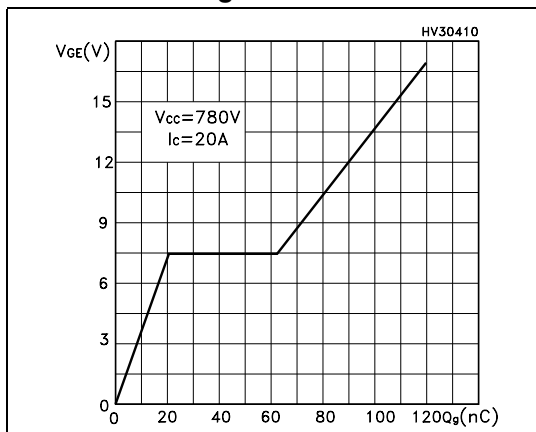


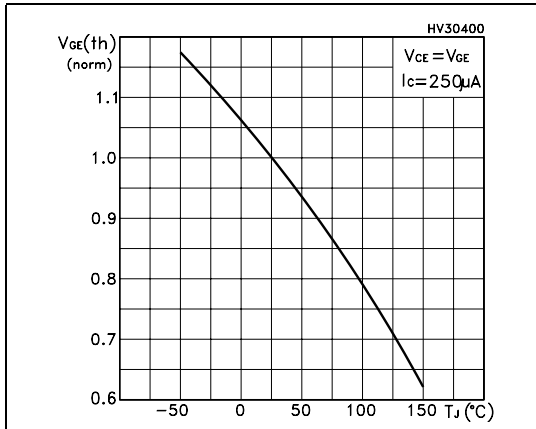
Figure 6. Gate charge vs. gate-source voltage

Figure 7. Capacitance variations

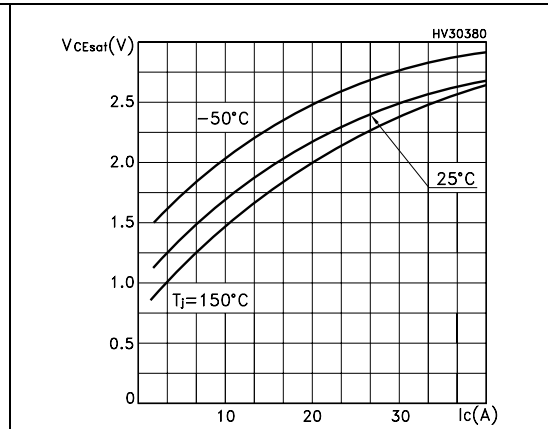


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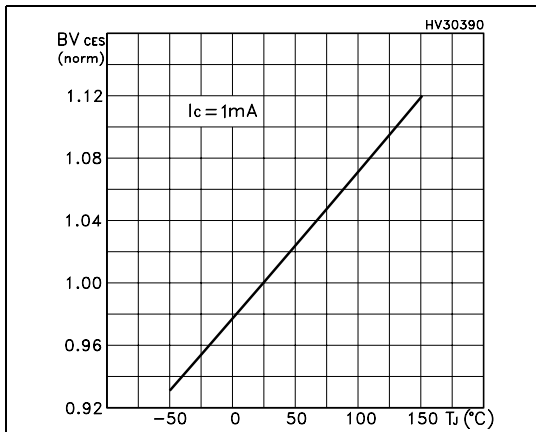
**Figure 8. Normalized gate threshold voltage vs. temperature**



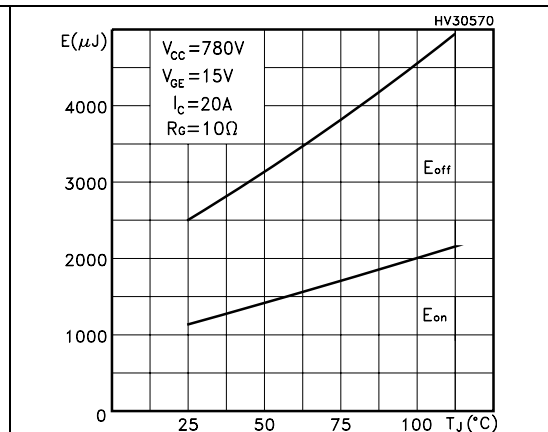
**Figure 9. Collector-emitter on voltage vs. collector current**



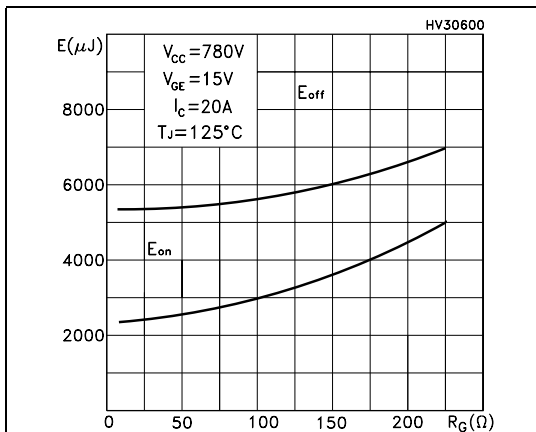
**Figure 10. Normalized breakdown voltage vs. temperature**



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



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



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

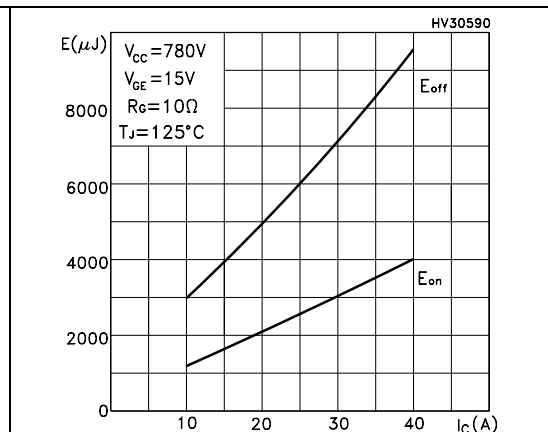


Figure 14. Thermal Impedance

Figure 15. Turn-off SOA

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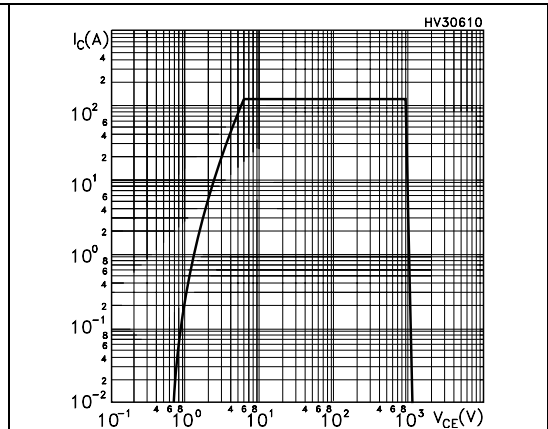
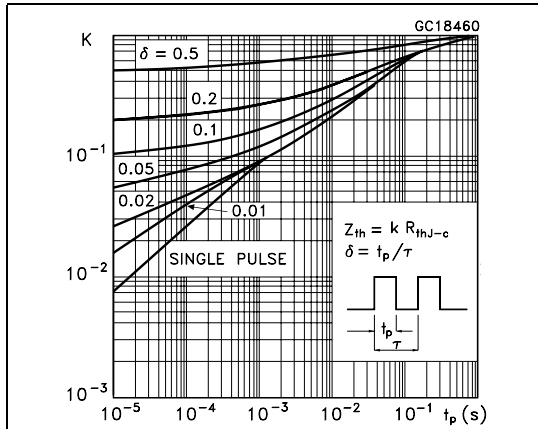
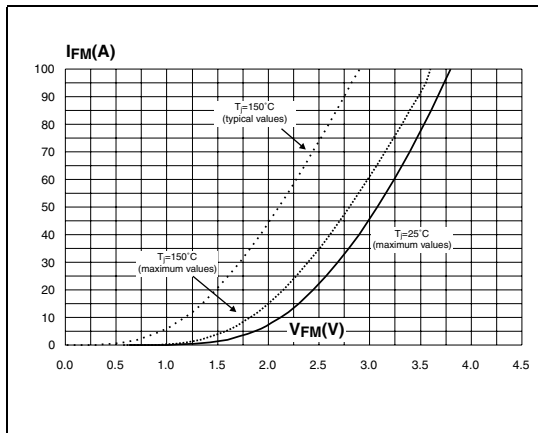


Figure 16. Forward voltage drop vs. forward current





### 3 Test circuit

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Figure 17. Test circuit for inductive load switching

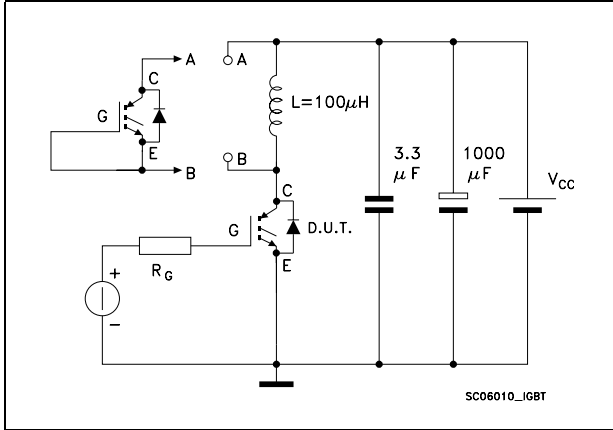


Figure 19. Switching waveform

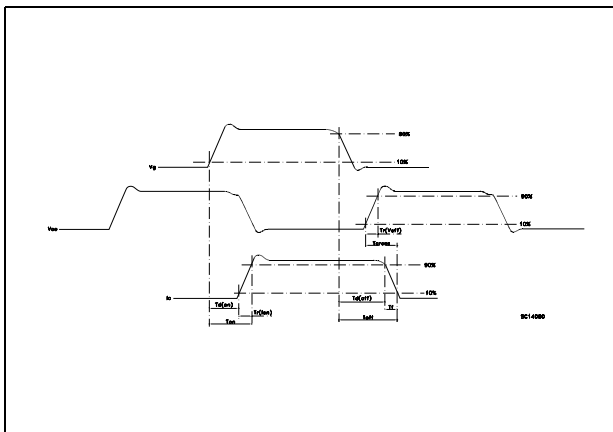


Figure 18. Gate charge test circuit

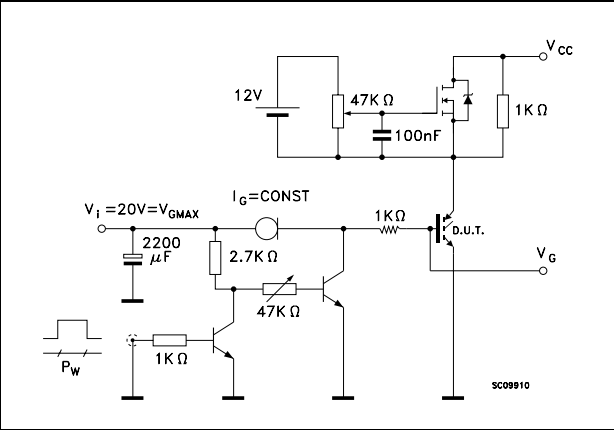
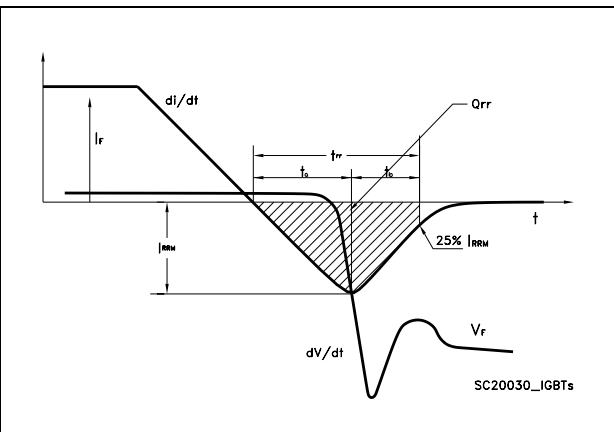


Figure 20. Diode recovery time waveform



## 4 Package mechanical data

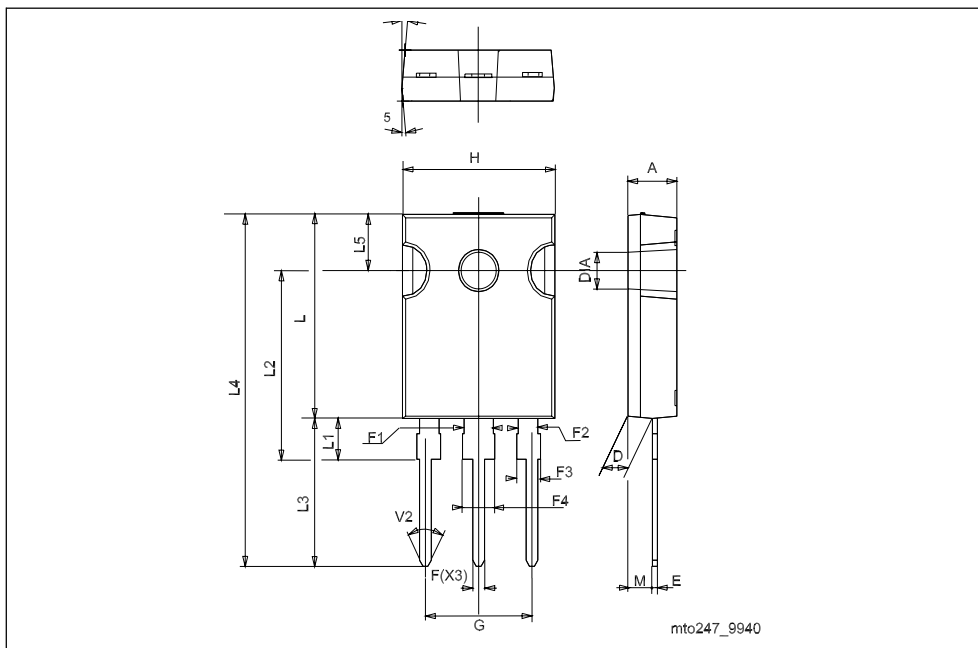
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**TO-247 MECHANICAL DATA**

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

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**Table 9. Document revision history**

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

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