STGW30NC60VD

40 A, 600 V, very fast IGBT with Ultrafast diode

Features

- High current capability
- High frequency operation up to 50 KHz
- Very soft ultra fast recovery antiparallel diode

Applications

- High frequency inverters, UPS
- Motor drive
- SMPS and PFC in both hard switch and resonant topologies

Description

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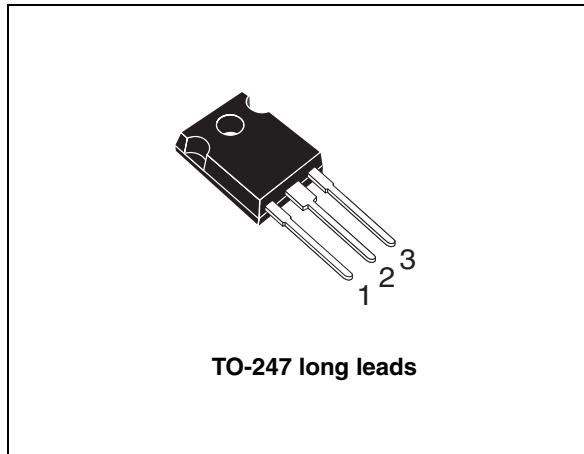

TO-247 long leads

Figure 1.   Internal schematic diagram
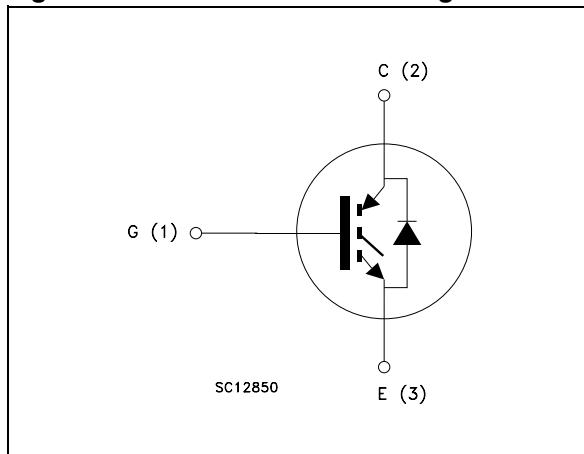
Table 1.   Device summary

Order code	Marking	Package	Packaging
STGW30NC60VD	GW30NC60VD	TO-247 long leads	Tube

Contents

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]	Continuous collector current at T_C = 25 °C	80	A
I_C [1]	Continuous collector current at T_C = 100 °C	40	A
I_{CP} [2]	Pulsed collector current	150	A
I_{CL}[3]	Turn-off latching current	100	A
V_{GE}	Gate-emitter voltage	± 20	V
I_F	Diode RMS forward current at T_C = 25 °C	30	A
I_{FSM}	Surge not repetitive forward current t_P = 10 ms sinusoidal	120	A
P_{TOT}	Total dissipation at T_C = 25 °C	250	W
T_J	Operating junction temperature	– 55 to 150	°C
T_{STG}	Storage temperature		
T_L	Maximum lead temperature for soldering purpose for 10 sec	300	°C

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{j(max)} - T_C}{R_{thj-c} \times V_{CE(sat)(max)}(T_{j(max)}, I_C(T_C))}$$

2. Pulse width limited by maximum junction temperature and turn-off within RBSOA

3. V_{clamp} = 80 % V_{CES}, T_J = 150 °C, R_G = 10 Ω, V_{GE} = 15 V

Table 3.   Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case IGBT	0.5	°C/W
	Thermal resistance junction-case diode	1.5	°C/W
R_{thJA}	Thermal resistance junction-ambient	50	°C/W

2 Electrical characteristics

T_J = 25 °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 mA	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE}= 15 V, I_C=20 A V_{GE}= 15 V, I_C=40 A V_{GE}= 15 V, I_C=80 A,T_j=100 °C V_{GE}= 15 V, I_C=20 A,T_j=125 °C		1.8 2.1 2.9 1.7	2.5	V
$V_{GE(th)}$	Gate threshold voltage	V_{CE}= V_{GE}, I_C= 250 μA	3.75		5.75	V
I_{CES}	Collector-cut-off current (V_{GE} = 0)	V_{CE} = 600 V V_{CE}= 600 V, T_j= 125 °C			10 1	μA mA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} = ± 20V			±100	nA
g_{fs}	Forward transconductance	V_{CE} = 15 V, I_C= 20 A		15		S

Table 5.   Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies} C_{oes} C_{res}	Input capacitance Output capacitance Reverse transfer capacitance	V_{CE} = 25V, f = 1 MHz, V_{GE}= 0	-	2200 225 50	-	pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 390V, I_C = 20A, V_{GE} = 15V, *(see Figure 18)*	-	100 16 45	140	nC nC nC

Table 6.   Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $(di/dt)_{onf}$	Turn-on delay time Current rise time Turn-on current slope	V_{CC}=390 V, I_C= 20 A, R_G=3.3 Ω, V_{GE}=15V *(see Figure 17)*	-	31 11 1600	-	ns ns A/μs
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	V_{CC}=390 V, I_C= 20 A, R_G=3.3 Ω, V_{GE}=15 V T_j=125°C *(see Figure 17)*	-	31 11.5 1500	-	ns ns A/μs

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

$t_{r(Voff)}$	Off voltage rise time	V_{CC}=390 V, I_C= 20 A,		28		ns
$t_{d(off)}$	Turn-off delay time	R_G=3.3 Ω, V_{GE}=15 V	-	100	-	ns
t_f	Current fall time	*(see Figure 17)*		75		ns
$t_{r(Voff)}$	Off voltage rise time	V_{CC}=390 V, I_C= 20 A,		66		ns
$t_{d(off)}$	Turn-off delay time	R_G=3.3 Ω, V_{GE}=15 V	-	150	-	ns
t_f	Current fall time	T_j=125°C *(see Figure 17)*		130		ns

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on} [1]	Turn-on switching losses	V_{CC}=390 V, I_C= 20 A,		220	300	µJ
E_{off}	Turn-off switching losses	R_G=3.3 Ω, V_{GE}=15 V,	-	330	450	µJ
E_{ts}	Total switching losses	*(see Figure 19)*		550	750	µJ
E_{on} [1]	Turn-on switching losses	V_{CC}=390 V, I_C= 20 A,		450		µJ
E_{off}	Turn-off switching losses	R_G=3.3 Ω, V_{GE}=15 V,	-	770	-	µJ
E_{ts}	Total switching losses	Tj= 125°C *(see Figure 19)*		1220		µJ

1. Eon is the turn-on losses when a typical diode is used in the test circuit in *Figure 19*. Eon include diode recovery energy. If the IGBT is offered in a package with a co-pak diode, the co-pack diode is used as external diode. IGBTs & Diode are at the same temperature (25°C and 125°C)

Table 8. **Collector-emitter diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F	Forward on-voltage	I_F = 20 A	-	1.8	2.3	V
		I_F = 20 A, T_j = 125°C		1.4		V
t_{rr}	Reverse recovery time	I_F = 20 A, V_R = 40 V,		44		ns
Q_{rr}	Reverse recovery charge	T_j = 25°C, di/dt =100 A/µs	-	66	-	nC
I_{rrm}	Reverse recovery current	*(see Figure 20)*		3		A
t_{rr}	Reverse recovery time	I_F = 2 0A, V_R = 40 V,		88		ns
Q_{rr}	Reverse recovery charge	T_j = 125°C,	-	237	-	nC
I_{rrm}	Reverse recovery current	di/dt =100 A/µs *(see Figure 20)*		5.4		A

2.1 Electrical characteristics (curves)

**Figure 2.   Output characteristics**
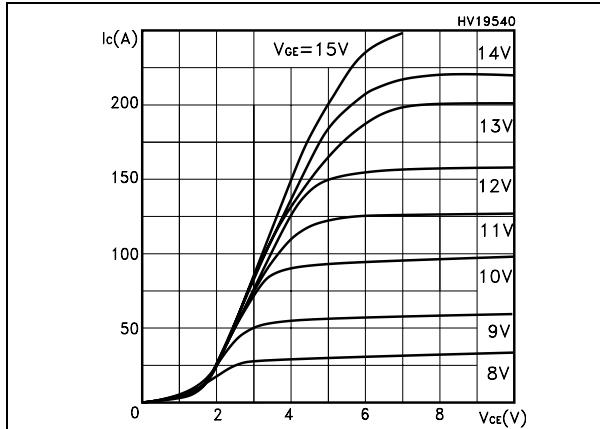
Figure 3.   Transfer characteristics
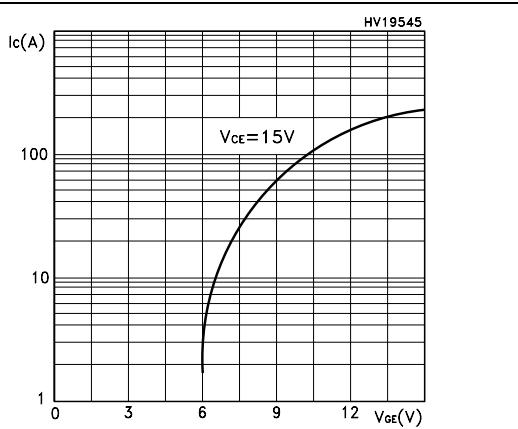

**Figure 4.   Trans conductance**
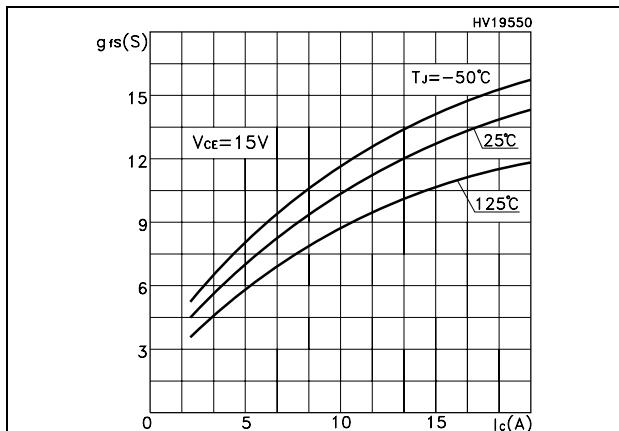
Figure 5.   Collector-emitter on voltage vs temperature
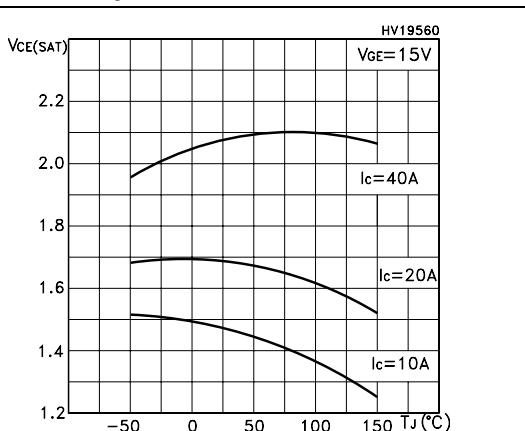

**Figure 6.   Collector-emitter on voltage vs collector current**
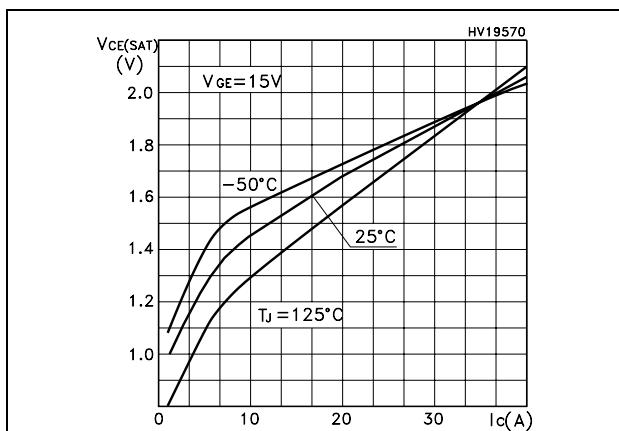

Figure 7.   Normalized gate threshold vs temperature
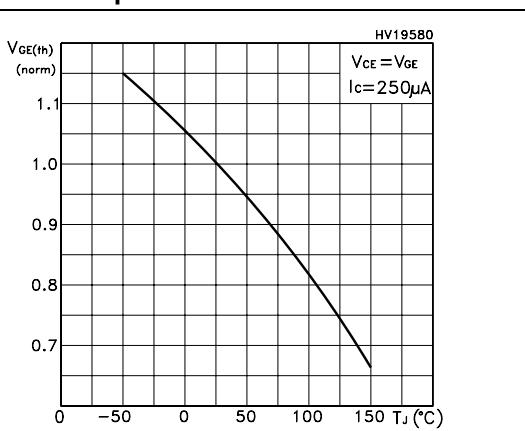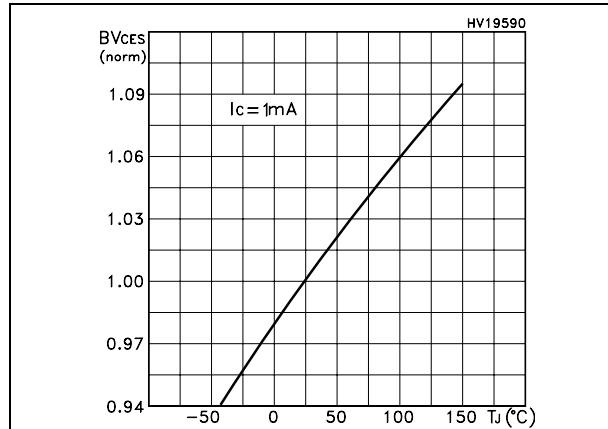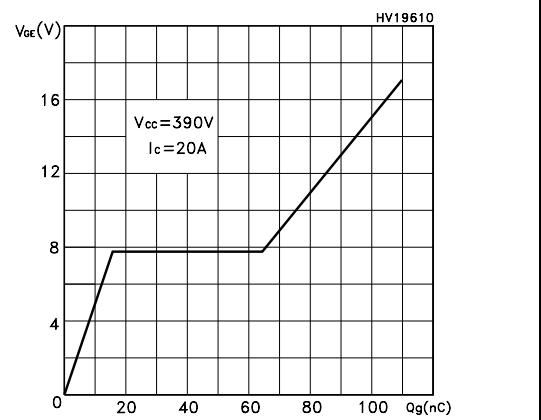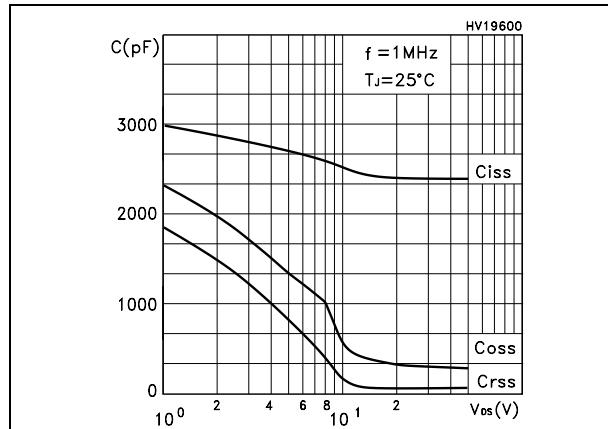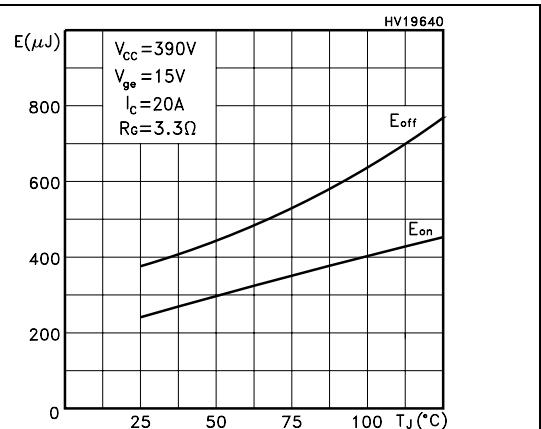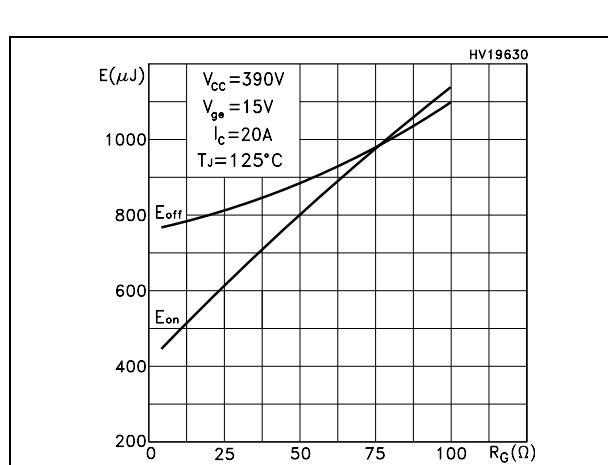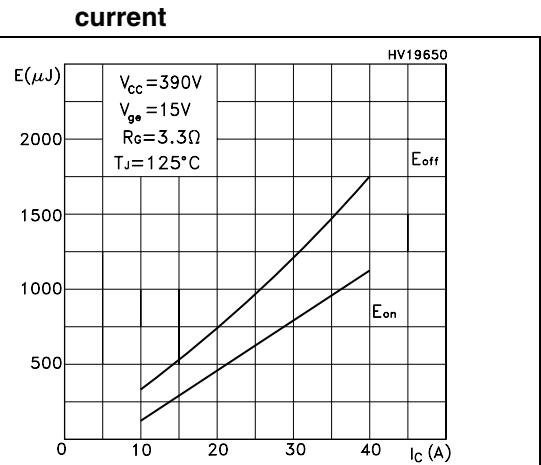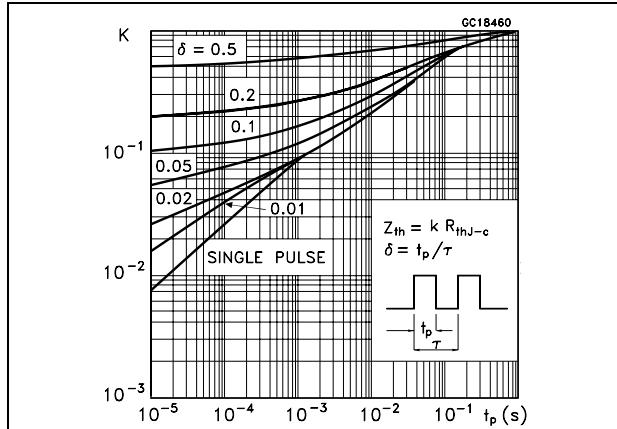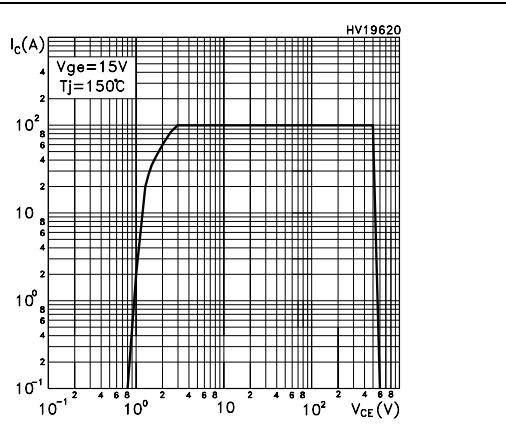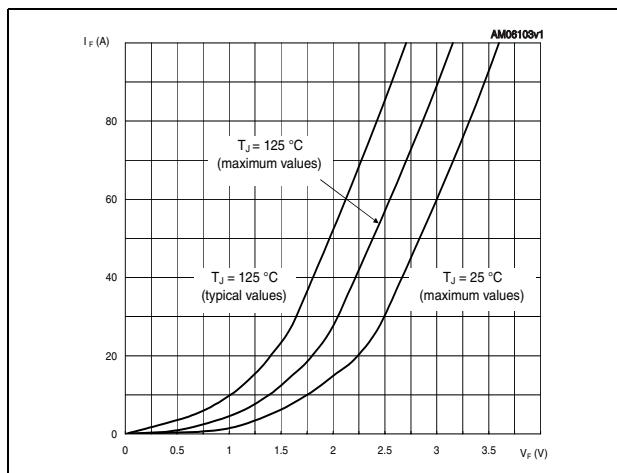
Figure 8. Normalized breakdown voltage vs temperature


Figure 9. Gate charge vs. gate-emitter voltage


Figure 10. Capacitance variations

**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 circuits

Figure 17.   Test circuit for inductive load switching
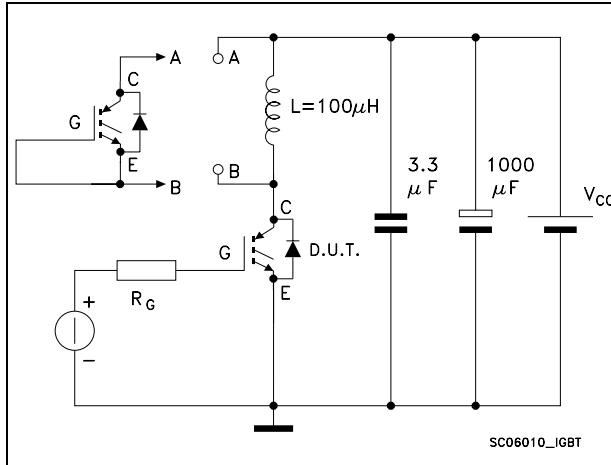
Figure 18.   Gate charge test circuit
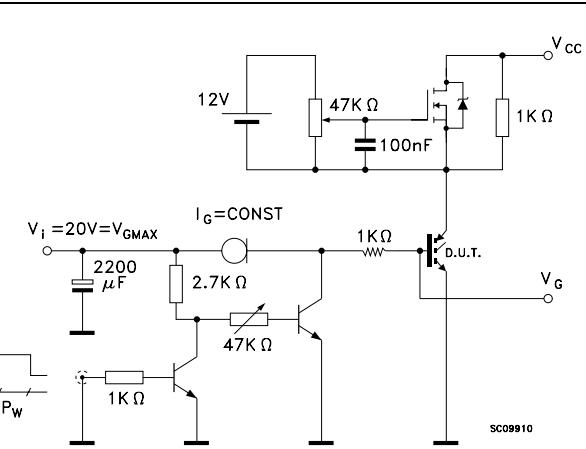

Figure 19.   Switching waveforms
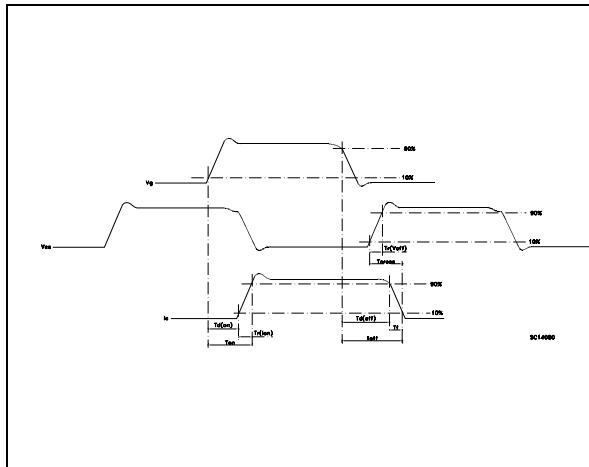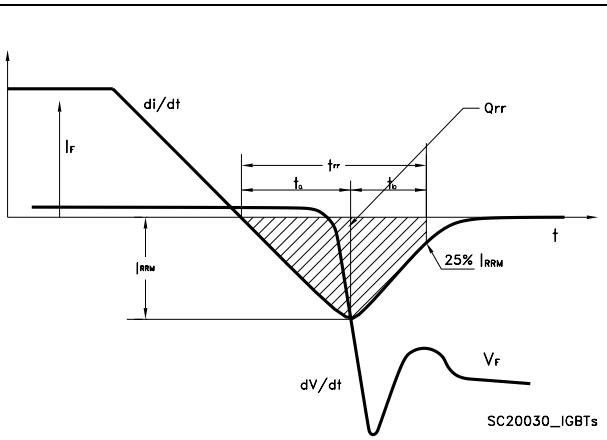
**Figure 20.   Diode recovery times waveform**
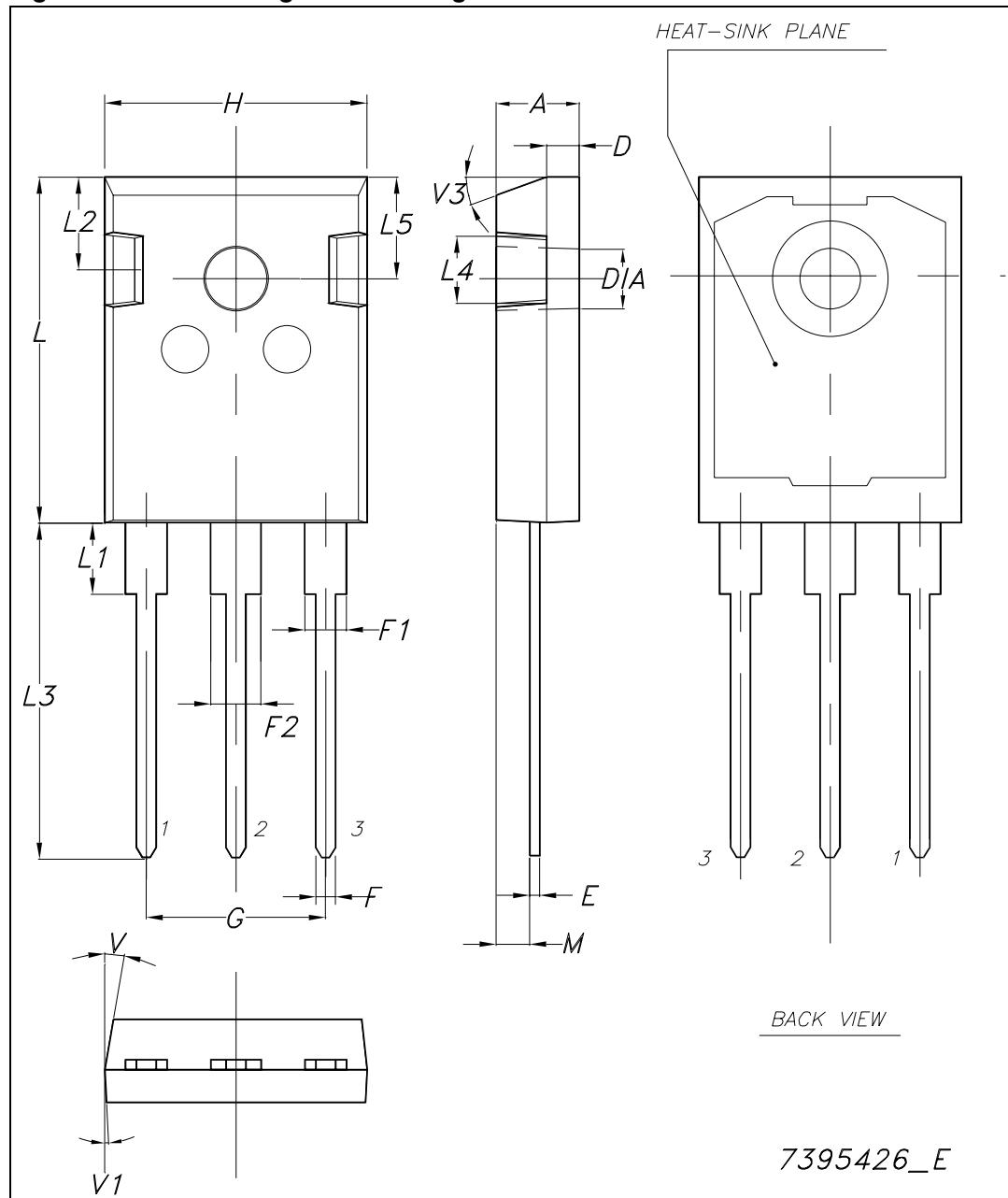
4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

Table 9.   TO-247 long leads mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
A	4.90		5.15
D	1.85		2.10
E	0.55		0.67
F	1.07		1.32
F1	1.90		2.38
F2	2.87		3.38
G	10.90 BSC		
H	15.77		16.02
L	20.82		21.07
L1	4.16		4.47
L2	5.49		5.74
L3	20.05		20.30
L4	3.68		3.93
L5	6.04		6.29
M	2.27		2.52
V		10°	
V1		3°	
V3		20°	
Dia.	3.55		3.66

Figure 21.   TO-247 long leads drawing

5   Revision history

Table 10.   Document revision history

Date	Revision	Changes
12-Feb-2007	1	First release.
19-Feb-2007	2	*Figure 6* has been updated
12-Mar-2010	3	Inserted I_{FSM} parameter on *Table 2: Absolute maximum ratings*. Updated *Figure 16: Emitter-collector diode characteristics* and package mechanical data.
03-Jan-2011	4	Updated *Table 4: Static*, *Table 8: Collector-emitter diode* and *Figure 14: Thermal impedance*.
23-Feb-2011	5	Added T_L row *Table 2 on page 3*.

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