

30 A, 1200 V short circuit rugged IGBT with Ultrafast diode

Features

- Low on-losses
- High current capability
- Low gate charge
- Short circuit withstand time 10 μ s
- IGBT co-packaged with Ultrafast free-wheeling diode

Applications

- Motor control

Description

This high voltage and short-circuit rugged IGBT utilizes the advanced PowerMESH™ process resulting in an excellent trade-off between switching performance and low ON-state behavior.

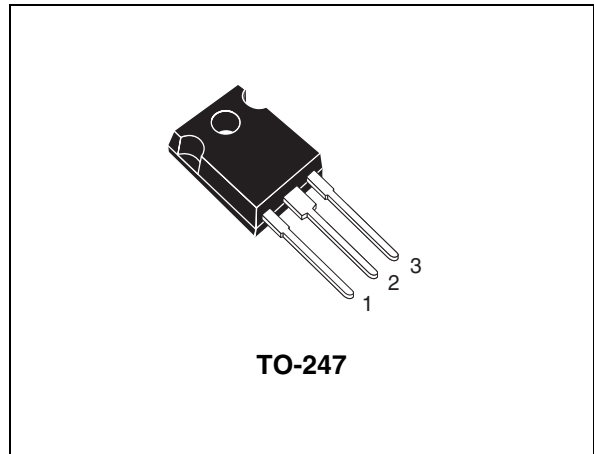


Figure 1. Internal schematic diagram

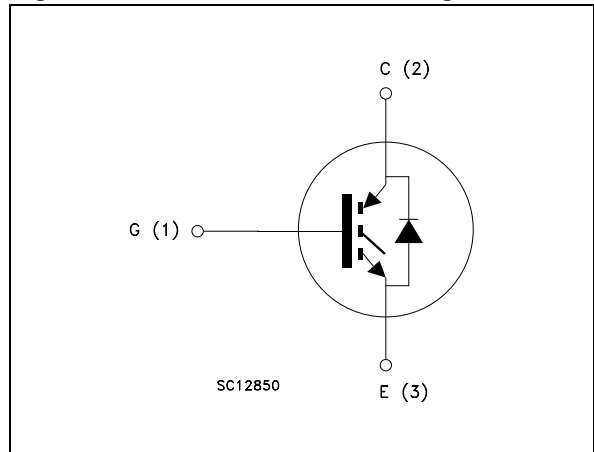


Table 1. Device summary

Order codes	Markings	Package	Packaging
STGW30N120KD	GW30N120KD	TO-247	Tube
STGWA30N120KD	GWA30N120KD	TO-247 long leads	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	60	A
$I_C^{(1)}$	Collector current (continuous) at 100 °C	30	A
$I_{CL}^{(2)}$	Turn-off latching current	100	A
$I_{CP}^{(3)}$	Pulsed collector current	100	A
V_{GE}	Gate-emitter voltage	±25	V
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	µs
P_{TOT}	Total dissipation at $T_C = 25\text{ °C}$	220	W
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	100	A
T_j	Operating junction temperature	- 55 to 125	°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. $V_{clamp} = 80\%$ of V_{CES} , $T_j = 125\text{ °C}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$
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.	0.45	°C/W
$R_{thj-case}$	Thermal resistance junction-case diode max.	1.6	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient IGBT 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	$V_{GE} = 15\text{ V}, I_C = 20\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 20\text{ A},$ $T_C = 125\text{ °C}$		2.8	3.85	V
				2.7		V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$	4.5		6.5	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	μA mA
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{ V}$			± 100	nA
g_{fs}	Forward transconductance	$V_{CE} = 25\text{ V}, I_C = 20\text{ A}$		20		S

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0$		2520		pF
C_{oes}	Output capacitance			170		pF
C_{res}	Reverse transfer capacitance			33		pF
Q_g	Total gate charge	$V_{CE} = 960\text{ V},$ $I_C = 20\text{ A}, V_{GE} = 15\text{ V}$		105		nC
Q_{ge}	Gate-emitter charge			21		nC
Q_{gc}	Gate-collector charge			56		nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 960\text{ V}, I_C = 20\text{ A}$		36		ns
t_r	Current rise time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$ (see Figure 17)		22		ns
$(di/dt)_{on}$	Turn-on current slope			840		A/ μ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 960\text{ V}, I_C = 20\text{ A}$		35		ns
t_r	Current rise time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$		22		ns
$(di/dt)_{on}$	Turn-on current slope	$T_C = 125\text{ }^\circ\text{C}$ (see Figure 17)		760		A/ μ s
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 960\text{ V}, I_C = 20\text{ A}$		70		ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$		251		ns
t_f	Current fall time	(see Figure 17)		260		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 960\text{ V}, I_C = 20\text{ A}$		140		ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$		324		ns
t_f	Current fall time	$T_C = 125\text{ }^\circ\text{C}$ (see Figure 17)		432		ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 960\text{ V}, I_C = 20\text{ A}$		2.4		mJ
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$		4.3		mJ
E_{ts}	Total switching losses	(see Figure 17)		6.7		mJ
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 960\text{ V}, I_C = 20\text{ A}$		3.9		mJ
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\ \Omega, V_{GE} = 15\text{ V},$		5.8		mJ
E_{ts}	Total switching losses	$T_C = 125\text{ }^\circ\text{C}$ (see Figure 17)		9.7		mJ

1. E_{on} is the turn-on losses when a typical diode is used in the test circuit in Figure 17. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs and 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		V V
t_{rr}	Reverse recovery time	$I_F = 20\text{ A}, V_R = 45\text{ V},$		84		ns
Q_{rr}	Reverse recovery charge	$di/dt = 100\text{ A}/\mu\text{s}$		235		nC
I_{rrm}	Reverse recovery current	(see Figure 20)		5.6		A
t_{rr}	Reverse recovery time	$I_F = 20\text{ A}, V_R = 45\text{ V},$ $T_C = 125\text{ }^\circ\text{C},$		152		ns
Q_{rr}	Reverse recovery charge	$di/dt = 100\text{ A}/\mu\text{s}$		722		nC
I_{rrm}	Reverse recovery current	(see Figure 20)		9		A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

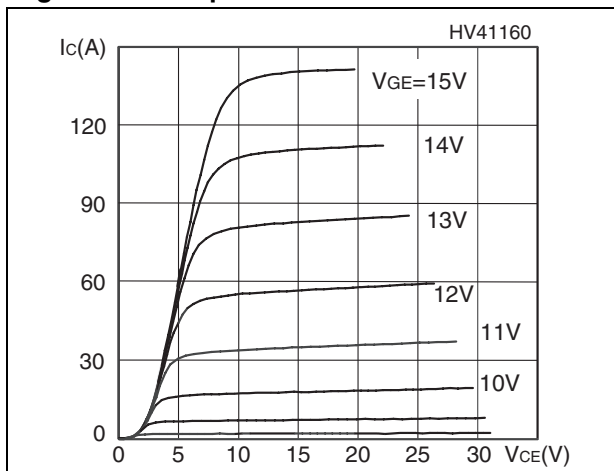


Figure 3. Transfer characteristics

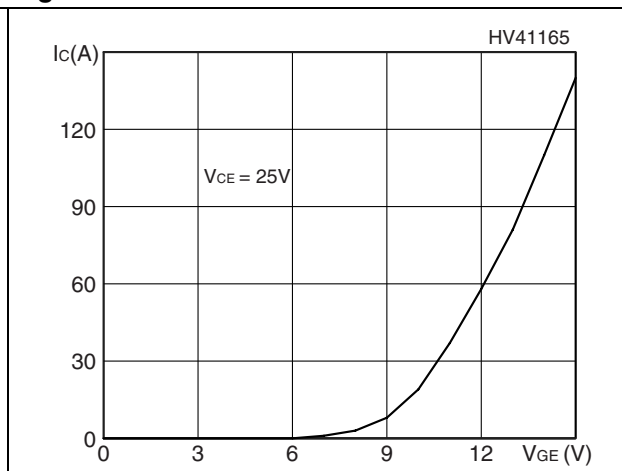


Figure 4. Transconductance

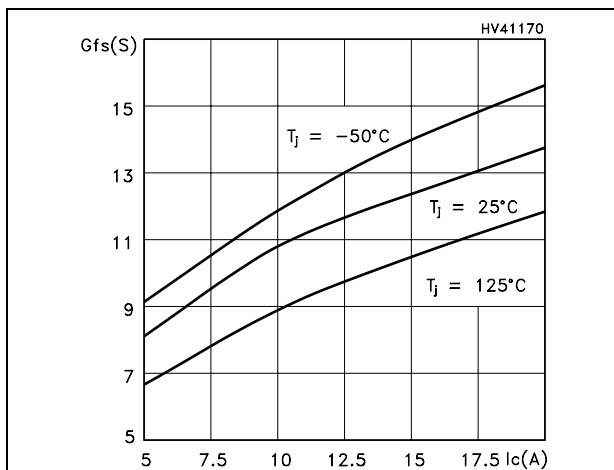


Figure 5. Collector-emitter on voltage vs. temperature

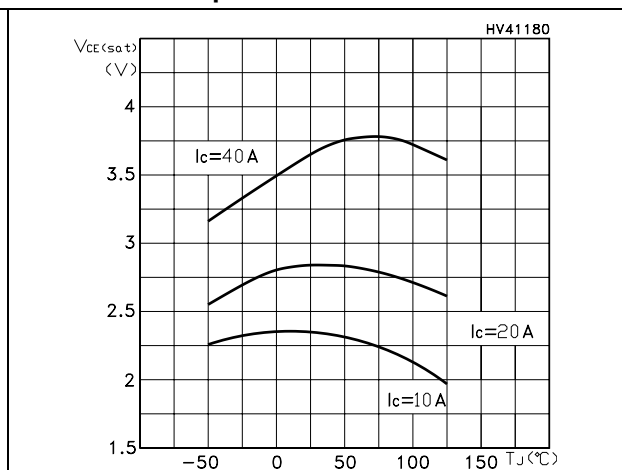


Figure 6. Gate charge vs. gate-source voltage

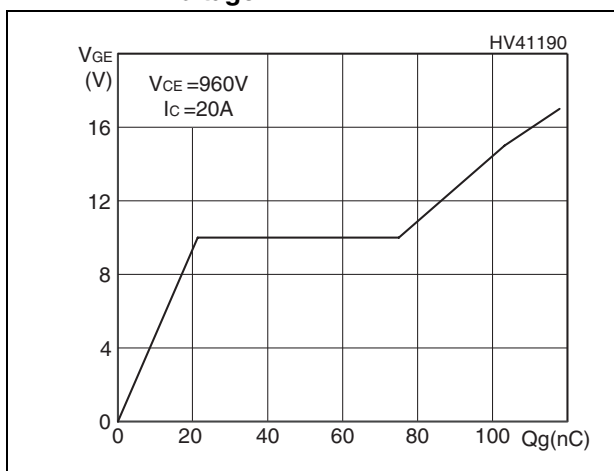


Figure 7. Capacitance variations

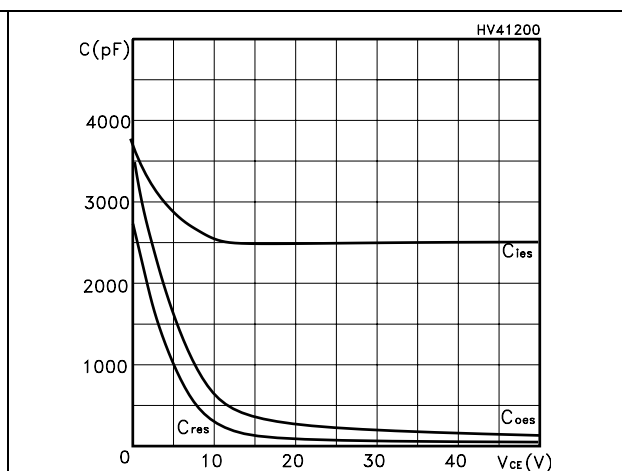


Figure 8. Normalized gate threshold voltage vs. temperature

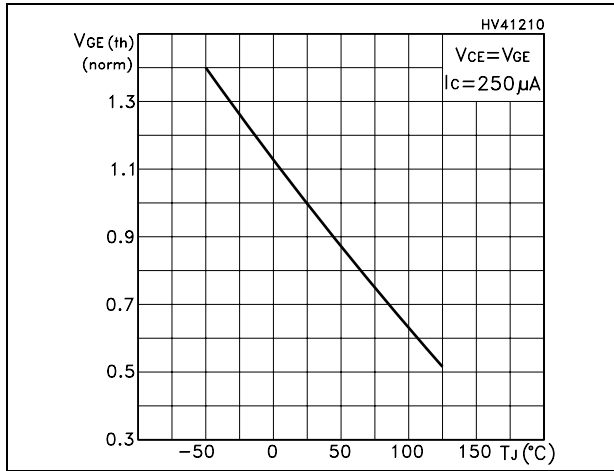


Figure 9. Collector-emitter on voltage vs. collector current

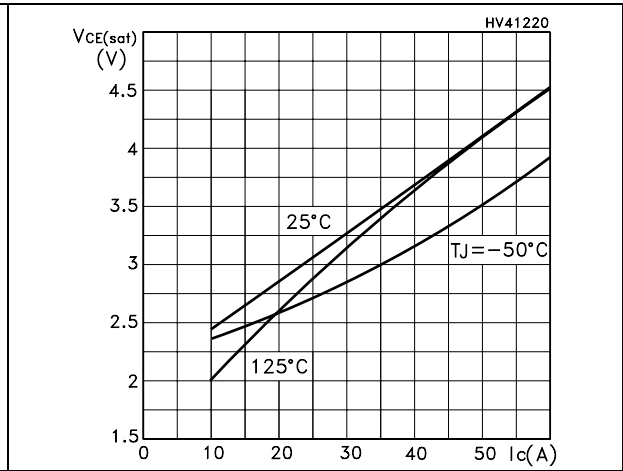


Figure 10. Normalized breakdown voltage vs. temperature

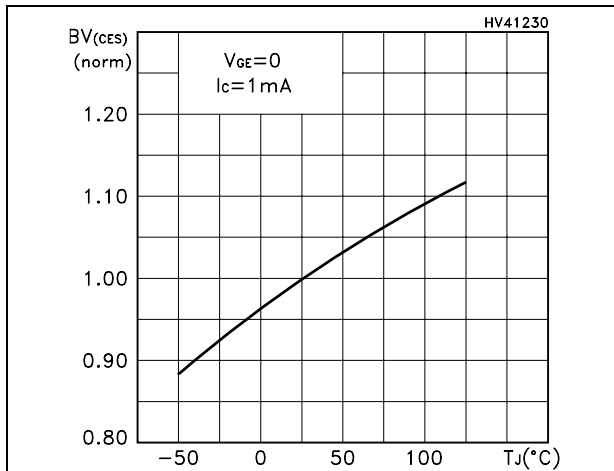


Figure 11. Switching losses vs. temperature

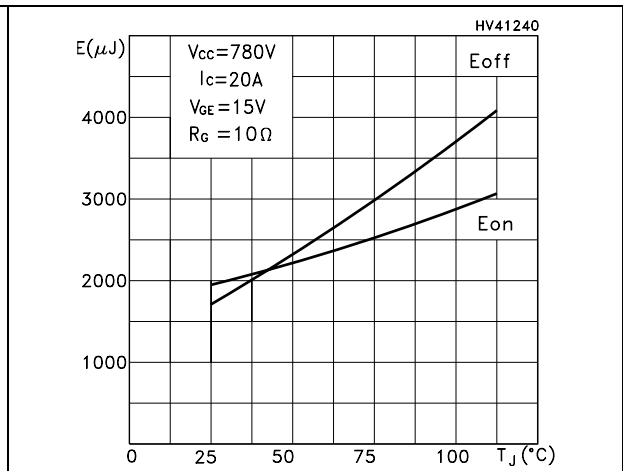


Figure 12. Switching losses vs. gate resistance

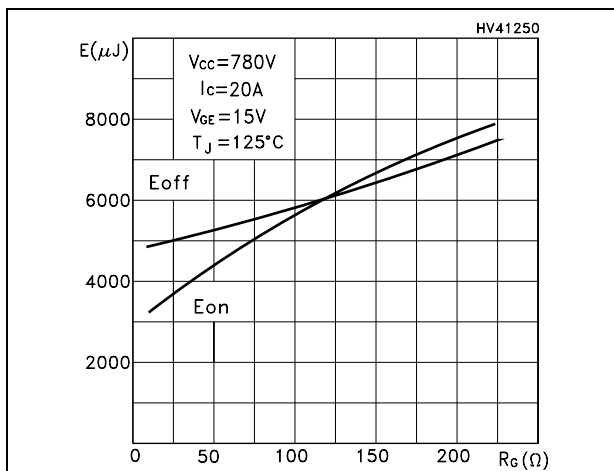


Figure 13. Switching losses vs. collector current

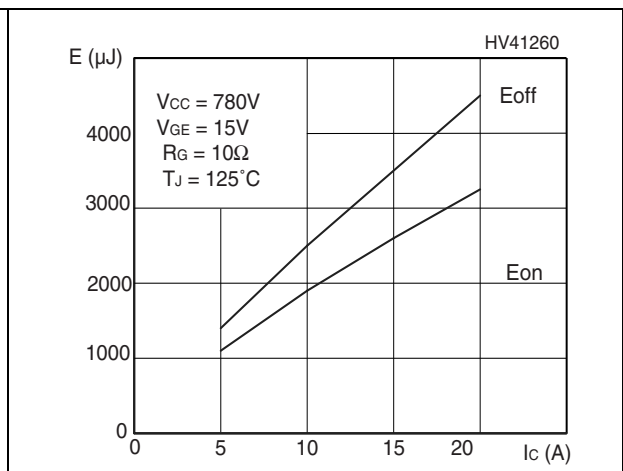


Figure 14. Thermal impedance

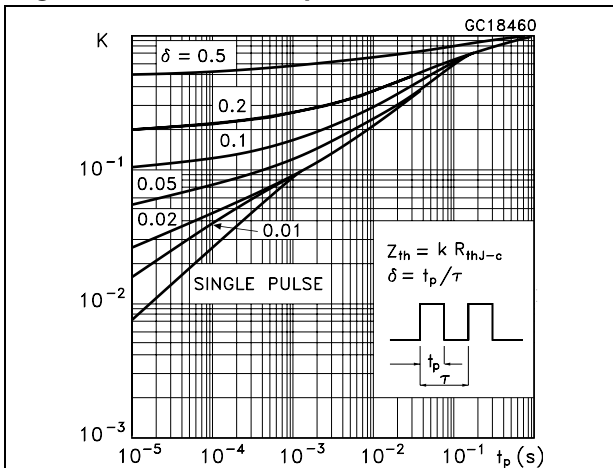


Figure 15. Turn-off SOA

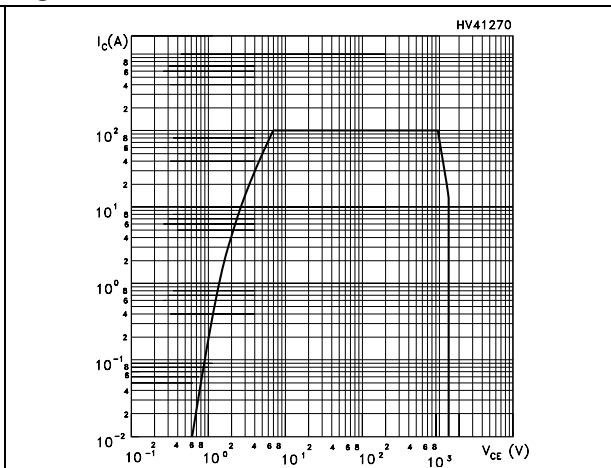
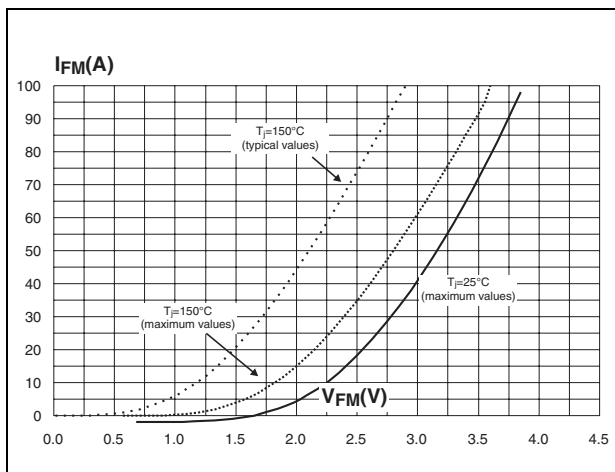


Figure 16. Forward voltage drop vs. forward current



3 Test circuit

Figure 17. Test circuit for inductive load switching

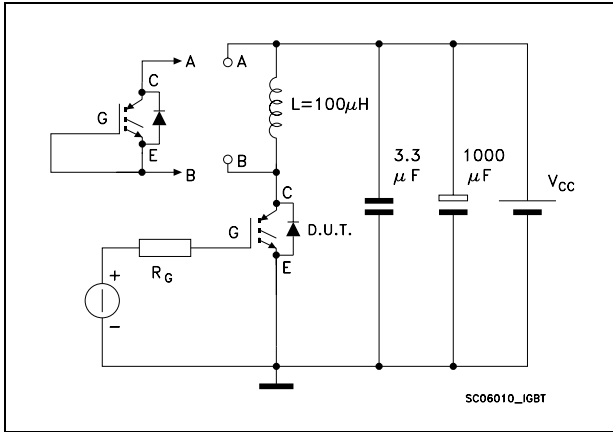


Figure 18. Gate charge test circuit

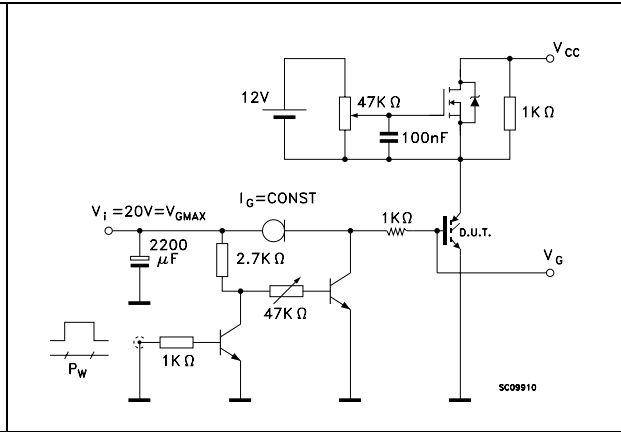


Figure 19. Switching waveform

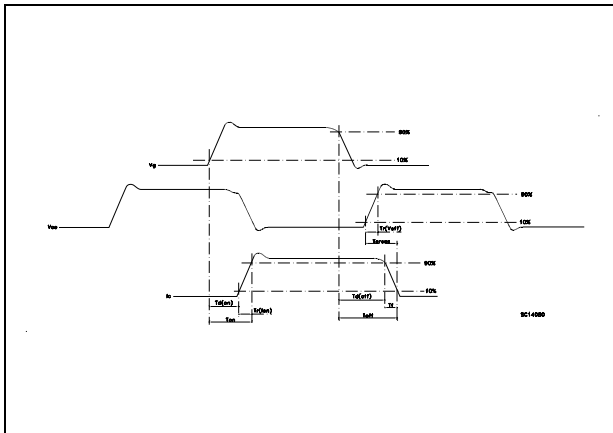
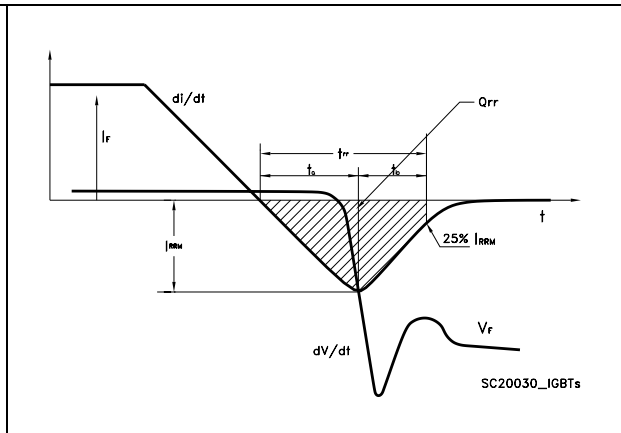


Figure 20. Diode recovery time waveform



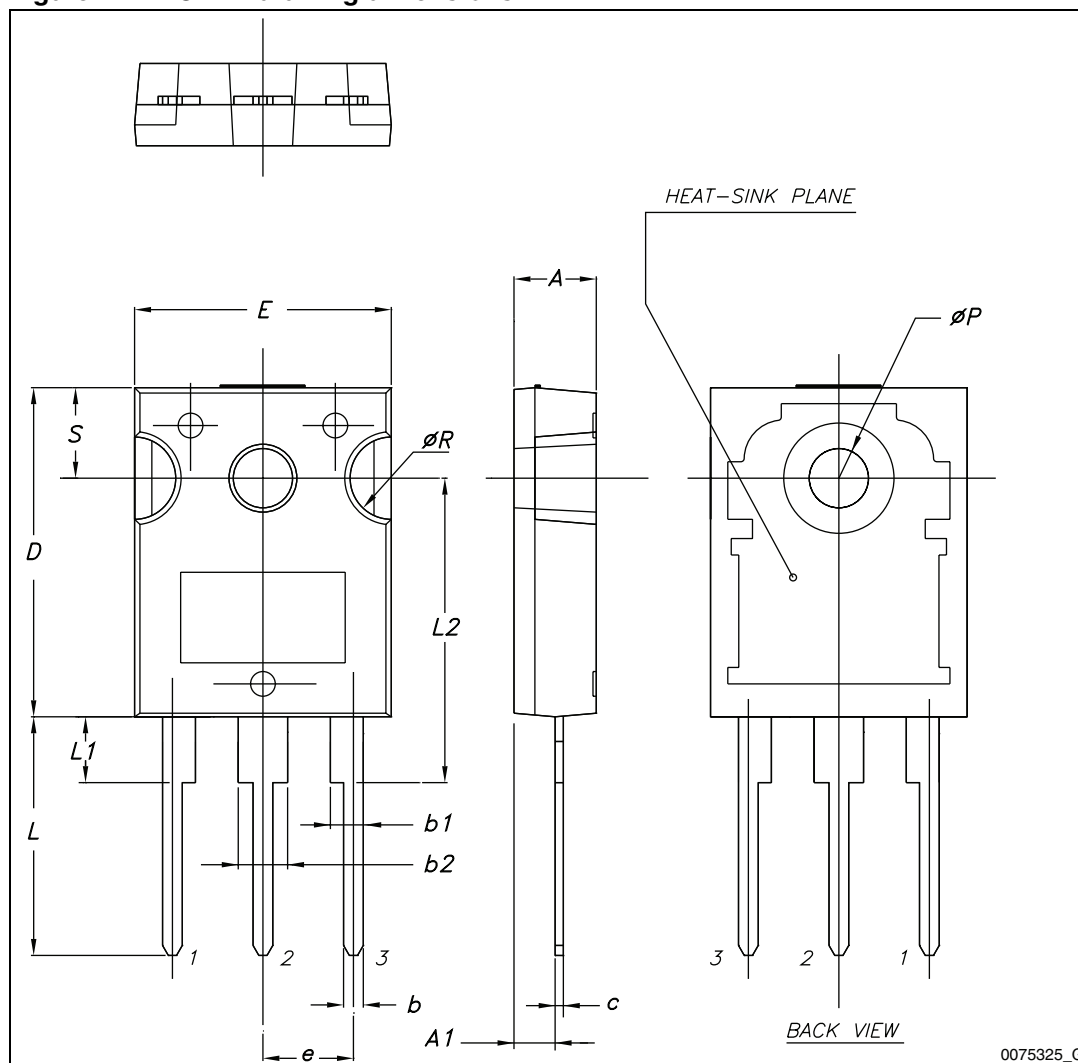
4 Package mechanical data

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 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	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

Figure 21. TO-247 drawing dimensions

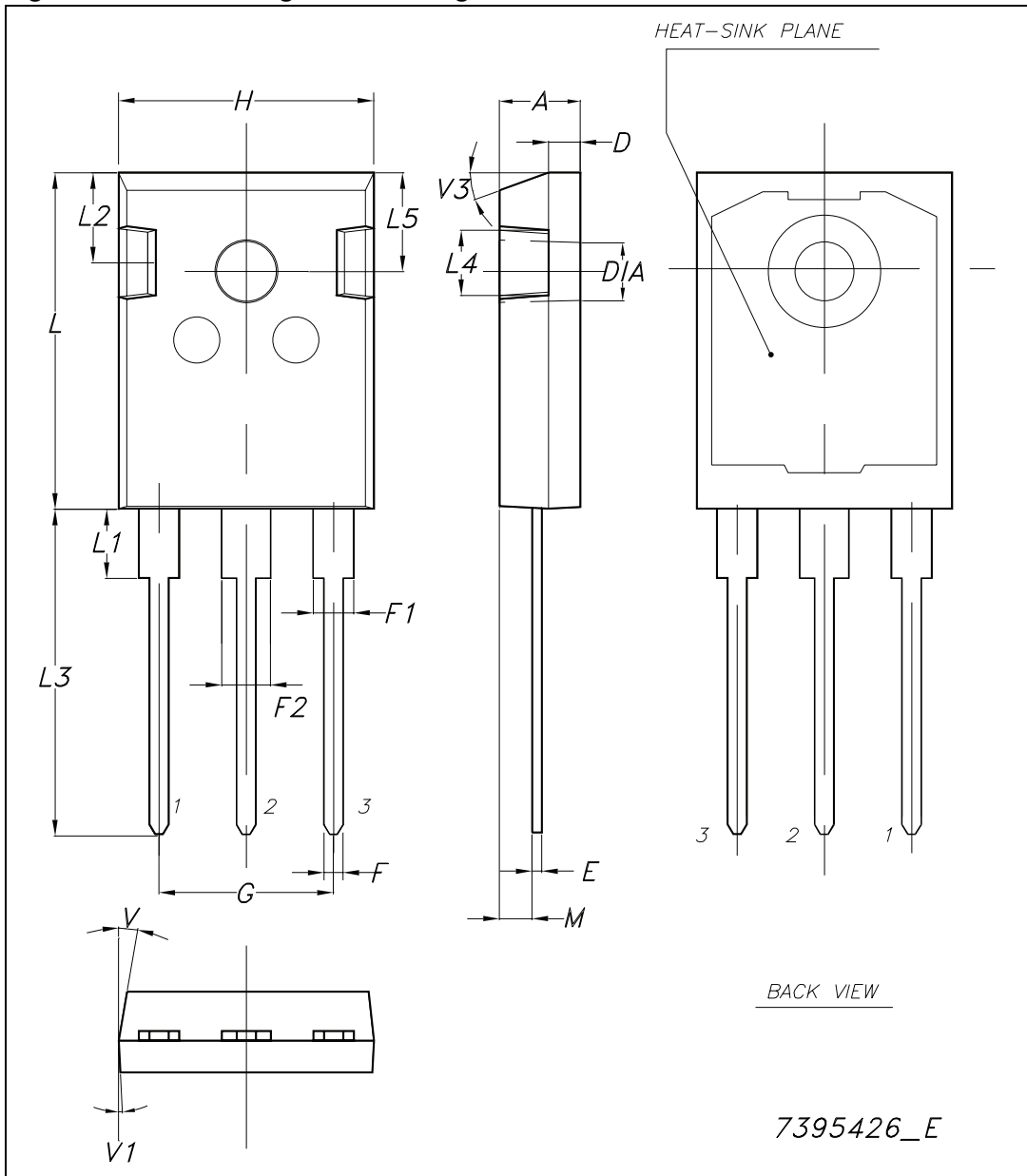


0075325_G

Table 10. 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 22. TO-247 long leads drawing



5 Revision history

Table 11. Document revision history

Date	Revision	Changes
29-Jan-2008	1	Initial release
18-Jun-2008	2	Update values in Table 2
02-Dec-2008	3	Update P_{TOT} and $R_{thj-case}$ value (see Table 2 and Table 3)
17-Jan-2012	4	Added order code STGWA30N120KD Table 1 on page 1 , mechanical data TO-247 long leads Table 10 on page 12 and Figure 22 on page 13 .
27-Feb-2012	5	Modified: Description on page 1 .

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