

### Features

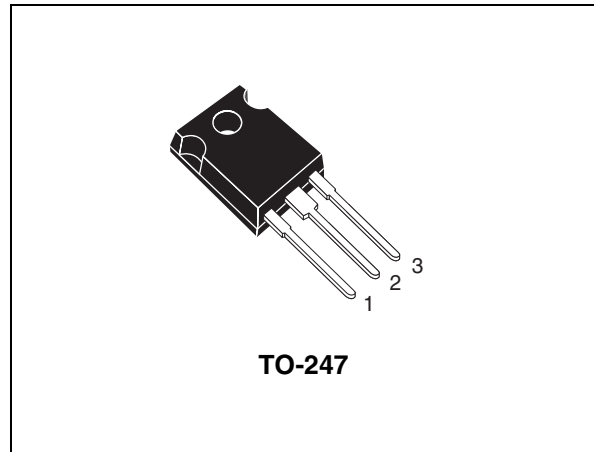
- Low on-losses
- High current capability
- Low gate charge
- Short circuit withstand time 10  $\mu$ s
- IGBT co-packaged with ultra fast free-wheeling diode

### Application

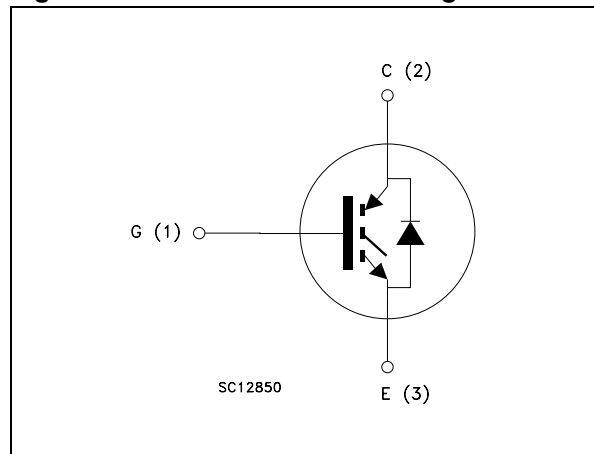
- Motor control

### 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
STGW40N120KD	GW40N120KD	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
$I_C^{(1)}$	Continuous collector current at $T_C = 25\text{ °C}$	80	A
$I_C^{(1)}$	Continuous collector current at $T_C = 100\text{ °C}$	40	A
$I_{CL}^{(2)}$	Turn-off latching current	85	A
$I_{CP}^{(3)}$	Pulsed collector current	120	A
$V_{GE}$	Gate-emitter voltage	$\pm 25$	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	$\mu\text{s}$
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	240	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	$^{\circ}\text{C}$

1. Calculated according to the iterative formula:

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

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 maximum junction temperature and turn-off within RBSOA

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case IGBT	0.42	$^{\circ}\text{C/W}$
$R_{thj-case}$	Thermal resistance junction-case diode	1.6	$^{\circ}\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient	50	$^{\circ}\text{C/W}$

## 2 Electrical characteristics

( $T_J = 25\text{ °C}$  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	$V_{GE} = 15\text{ V}, I_C = 30\text{ A}$		2.8	3.85	V
		$V_{GE} = 15\text{ V}, I_C = 30\text{ A}, T_J = 125\text{ °C}$		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 ( $V_{GE} = 0$ )	$V_{CE} = 1200\text{ V}$			500	$\mu\text{A}$
		$V_{CE} = 1200\text{ V}, T_J = 125\text{ °C}$			10	mA
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{ V}$			$\pm 100$	nA

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0$	-	2577	-	pF
$C_{oes}$	Output capacitance			196		
$C_{res}$	Reverse transfer capacitance			39.5		
$Q_g$	Total gate charge	$V_{CE} = 960\text{ V}, I_C = 30\text{ A}, V_{GE} = 15\text{ V}$	-	126	-	nC
$Q_{ge}$	Gate-emitter charge			22.2		nC
$Q_{gc}$	Gate-collector charge			67		nC

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 960\text{ V}$ , $I_C = 30\text{ A}$		48		ns
$t_r$	Current rise time	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ ,	-	40	-	ns
$(di/dt)_{on}$	Turn-on current slope	(see <a href="#">Figure 2</a> )		540		A/ $\mu$ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 960\text{ V}$ , $I_C = 30\text{ A}$		45		ns
$t_r$	Current rise time	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ ,	-	38	-	ns
$(di/dt)_{on}$	Turn-on current slope	$T_J = 125\text{ }^\circ\text{C}$ (see <a href="#">Figure 2</a> )		665		A/ $\mu$ s
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 960\text{ V}$ , $I_C = 30\text{ A}$		84		ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ ,	-	338	-	ns
$t_f$	Current fall time	(see <a href="#">Figure 2</a> )		210		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 960\text{ V}$ , $I_C = 30\text{ A}$		144		ns
$t_{d(off)}$	Turn-off delay time	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ ,	-	420	-	ns
$t_f$	Current fall time	$T_J = 125\text{ }^\circ\text{C}$ (see <a href="#">Figure 2</a> )		360		ns

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 960\text{ V}$ , $I_C = 30\text{ A}$		3.7		mJ
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ ,	-	5.7	-	mJ
$E_{ts}$	Total switching losses	(see <a href="#">Figure 2</a> )		9.4		mJ
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 960\text{ V}$ , $I_C = 30\text{ A}$		4.7		mJ
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ ,	-	9.3	-	mJ
$E_{ts}$	Total switching losses	$T_J = 125\text{ }^\circ\text{C}$ (see <a href="#">Figure 2</a> )		14		mJ

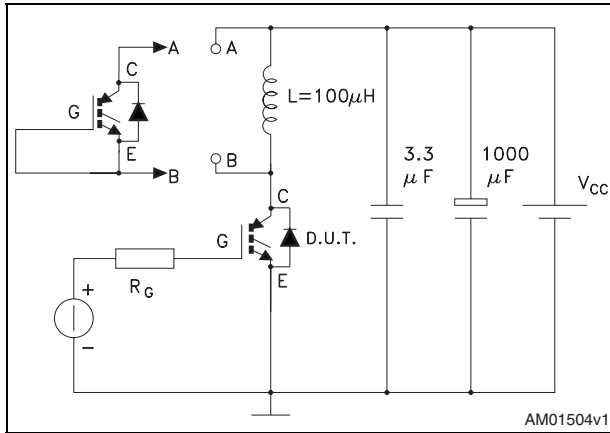
1.  $E_{on}$  is the turn-on losses when a typical diode is used in the test circuit in [Figure 2](#). If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs and diode are at the same temperature (25°C and 125°C)
2. Turn-off losses include also the tail of the collector current

**Table 8. Collector-emitter diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_F$	Forward on-voltage	$I_F = 20\text{ A}$		1.9		V
		$I_F = 20\text{ A}$ , $T_J = 125\text{ }^\circ\text{C}$		1.7		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 <a href="#">Figure 5</a> )		5.6		A
$t_{rr}$	Reverse recovery time	$I_F = 20\text{ A}$ , $V_R = 45\text{ V}$ ,		152		ns
$Q_{rr}$	Reverse recovery charge	$T_J = 125\text{ }^\circ\text{C}$ ,		722		nC
$I_{rrm}$	Reverse recovery current	$di/dt = 100\text{ A}/\mu\text{s}$	-	9	-	A
		(see <a href="#">Figure 5</a> )				

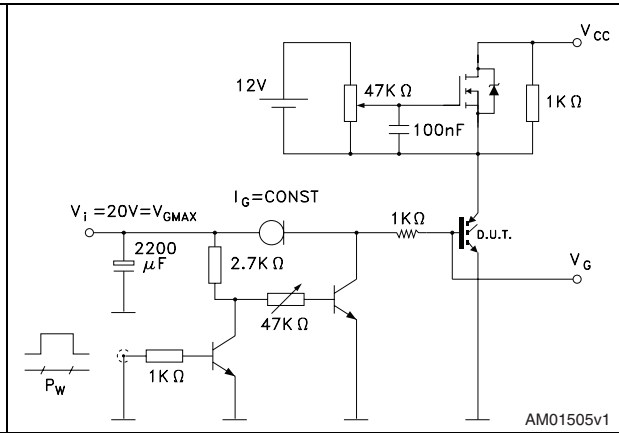
### 3 Test circuits

Figure 2. Test circuit for inductive load switching



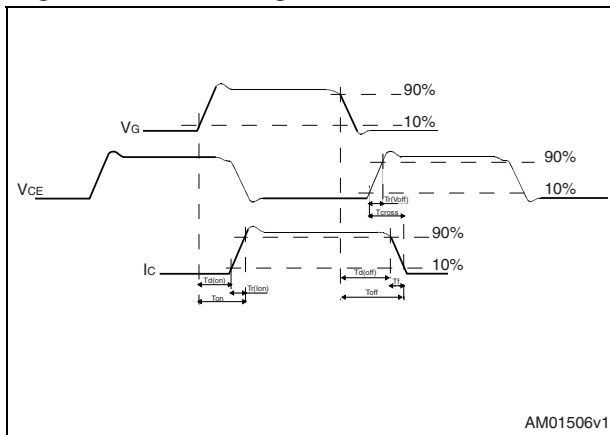
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Figure 3. Gate charge test circuit



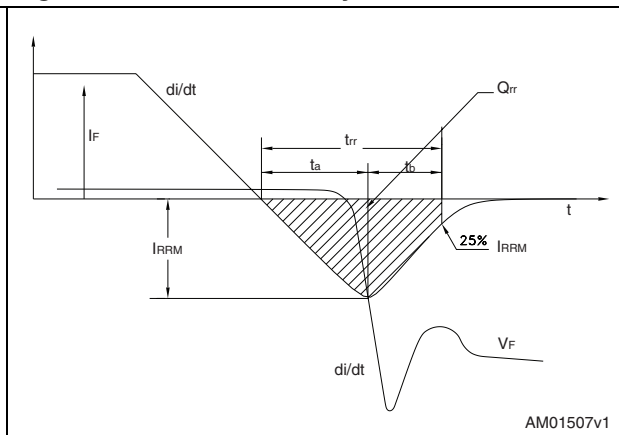
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Figure 4. Switching waveform



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Figure 5. Diode recovery time waveform



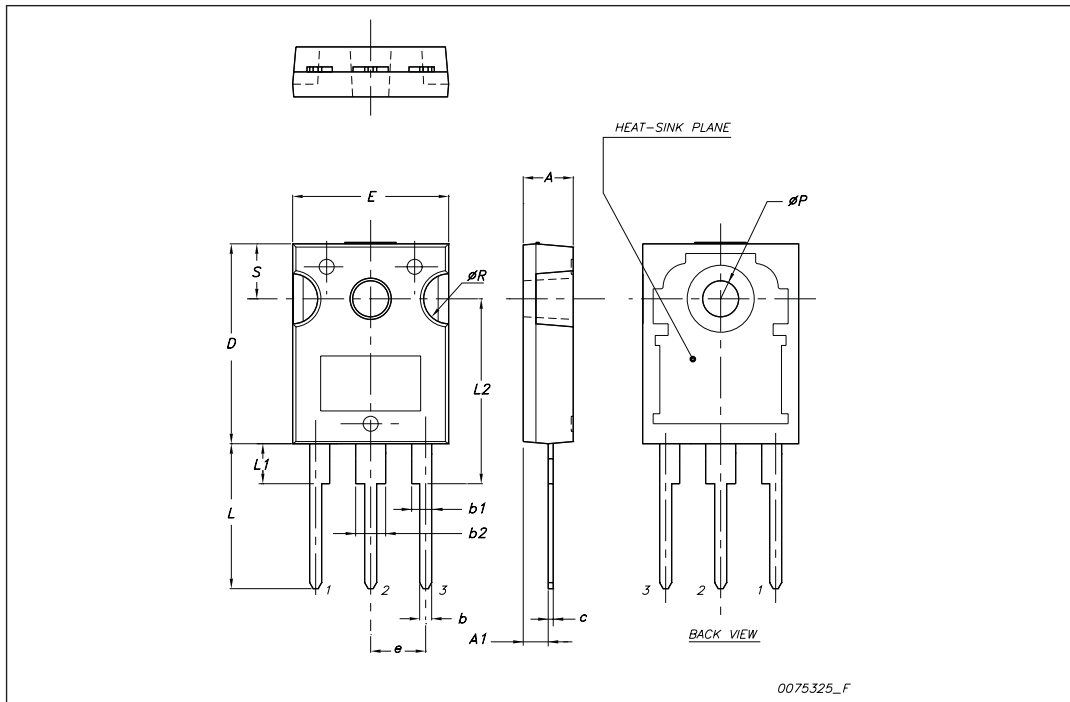
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## 4 Package mechanical data

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

**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
22-Jan-2009	1	Initial release
29-Jun-2009	2	Document status promoted from preliminary data to datasheet.
09-Jul-2009	3	Inserted dynamic values <a href="#">Table 5 on page 4</a> , <a href="#">Table 6 on page 5</a> and <a href="#">Table 7 on page 5</a> .

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