



STGW40N120KD STGWA40N120KD

40 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.

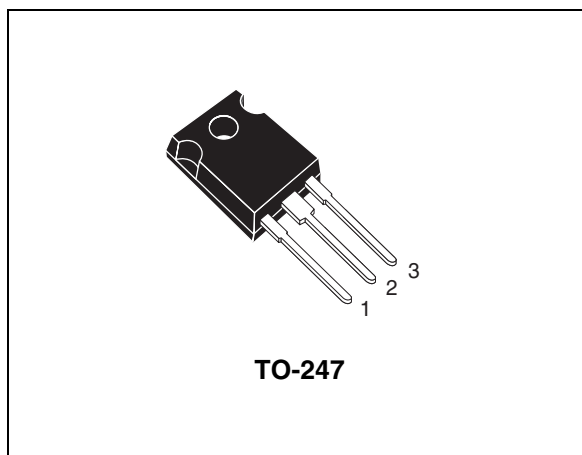


Figure 1. Internal schematic diagram

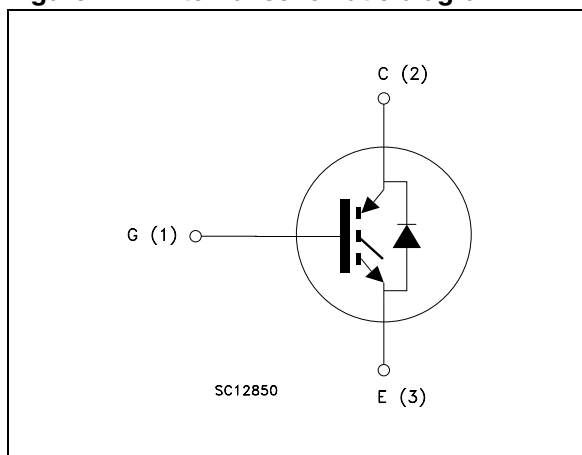


Table 1. Device summary

Order codes	Markings	Package	Packaging
STGW40N120KD	GW40N120KD	TO-247	Tube
STGWA40N120KD	GWA40N120KD	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
$I_C^{(1)}$	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	± 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 $T_C = 25\text{ °C}$	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

$T_J = 25\text{ }^{\circ}\text{C}$ 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	$V_{GE} = 15\text{ V}$, $I_C = 30\text{ A}$ $V_{GE} = 15\text{ V}$, $I_C = 30\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$		2.8 2.7	3.85	V 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 ($V_{GE} = 0$)	$V_{CE} = 1200\text{ V}$ $V_{CE} = 1200\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$			500 10	μA mA
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{ V}$			± 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		pF
C_{res}	Reverse transfer capacitance			39.5		pF
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	$V_{CC} = 960\text{ V}$, $I_C = 30\text{ A}$ $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$, (see Figure 16)	-	48	-	ns
t_r	Current rise time			40		ns
$(di/dt)_{on}$	Turn-on current slope			540		A/ μs
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 960\text{ V}$, $I_C = 30\text{ A}$ $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$ (see Figure 16)	-	45	-	ns
t_r	Current rise time			38		ns
$(di/dt)_{on}$	Turn-on current slope			665		A/ μs
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 960\text{ V}$, $I_C = 30\text{ A}$ $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$, (see Figure 16)	-	84	-	ns
$t_{d(off)}$	Turn-off delay time			338		ns
t_f	Current fall time			210		ns
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 960\text{ V}$, $I_C = 30\text{ A}$ $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$ (see Figure 16)	-	144	-	ns
$t_{d(off)}$	Turn-off delay time			420		ns
t_f	Current fall time			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	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, (see Figure 16)	-	5.7	-	mJ
E_{ts}	Total switching losses			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	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ °C}$ (see Figure 16)	-	9.3	-	mJ
E_{ts}	Total switching losses			14		mJ

1. E_{on} is the turn-on losses when a typical diode is used in the test circuit in [Figure 16](#). 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	$I_F = 20\text{ A}$ $I_F = 20\text{ A}$, $T_J = 125\text{ °C}$	-	1.9 1.7	-	V V
t_{rr}	Reverse recovery time	$I_F = 20\text{ A}$, $V_R = 45\text{ V}$, $di/dt = 100\text{ A}/\mu\text{s}$	-	84	-	ns
Q_{rr}	Reverse recovery charge	(see Figure 19)	-	235	-	nC
I_{rrm}	Reverse recovery current			5.6		A
t_{rr}	Reverse recovery time	$I_F = 20\text{ A}$, $V_R = 45\text{ V}$, $T_J = 125\text{ °C}$, $di/dt = 100\text{ A}/\mu\text{s}$	-	152	-	ns
Q_{rr}	Reverse recovery charge	(see Figure 19)		722		nC
I_{rrm}	Reverse recovery current			9		A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

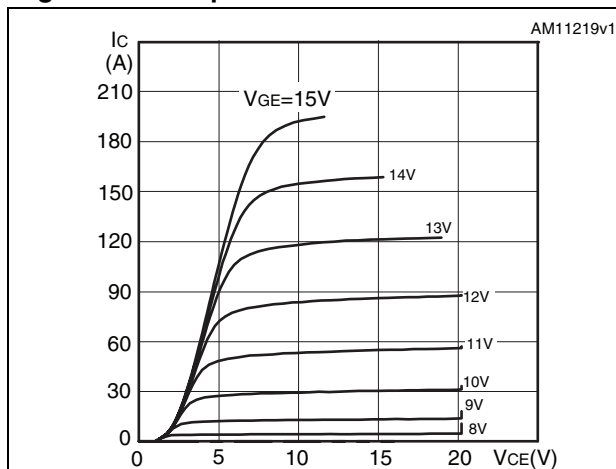


Figure 3. Transfer characteristics

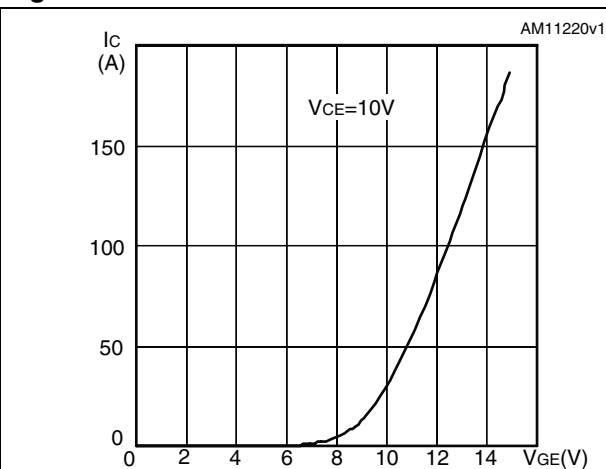


Figure 4. Collector-emitter on voltage vs. collector current

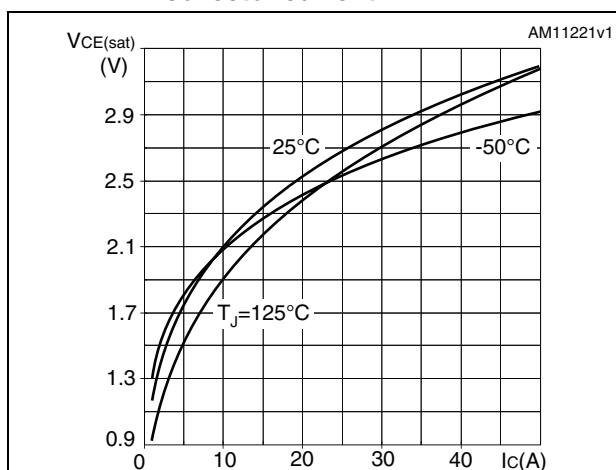


Figure 5. Collector-emitter on voltage vs. temperature

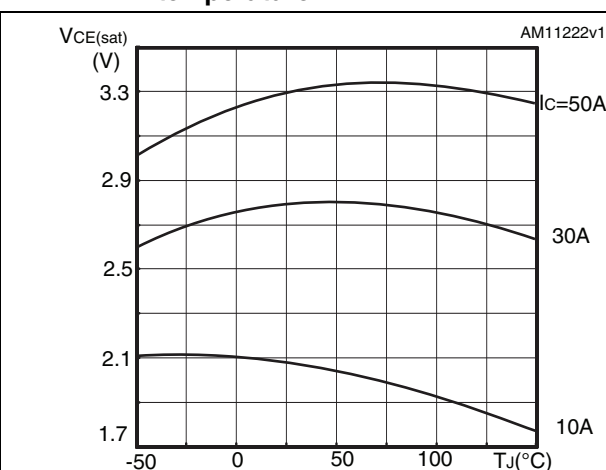


Figure 6. Gate charge vs. gate-source voltage

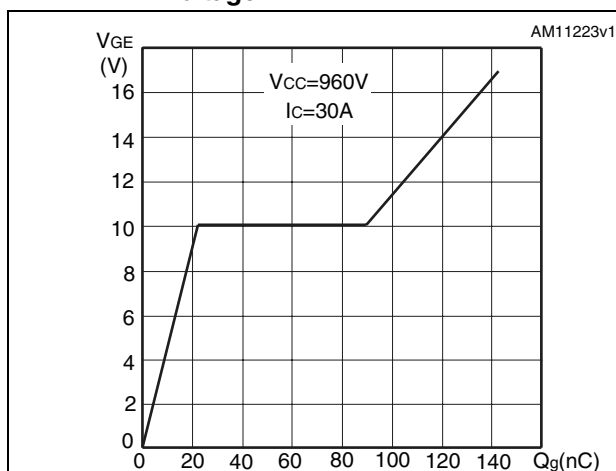


Figure 7. Capacitance variations

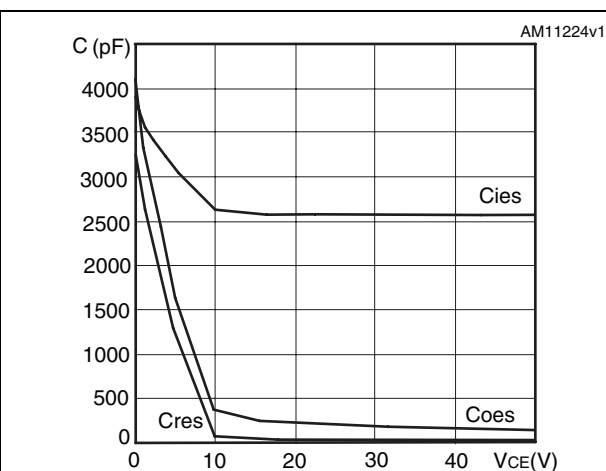


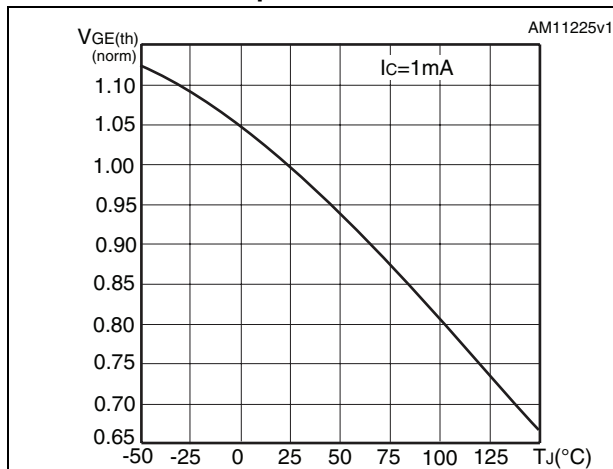
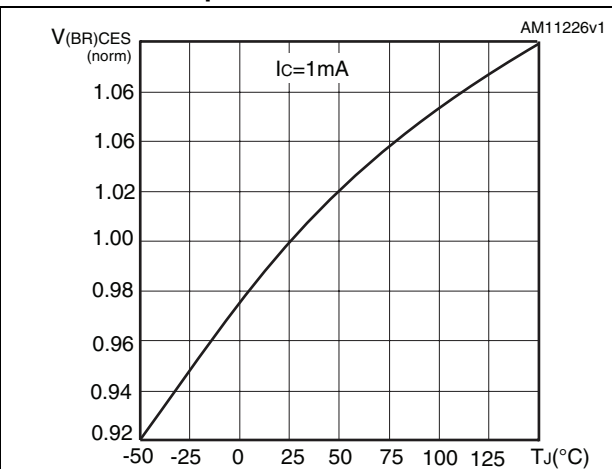
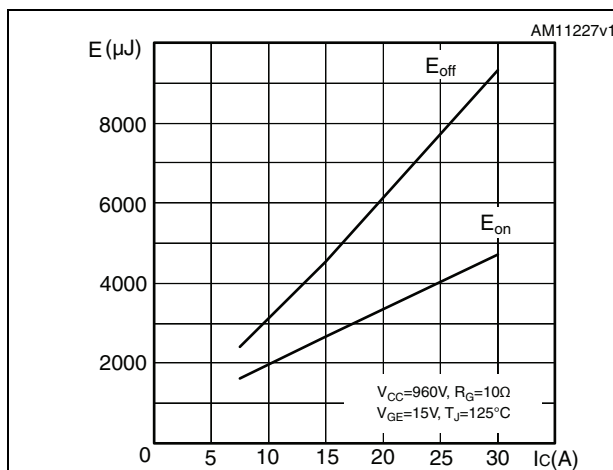
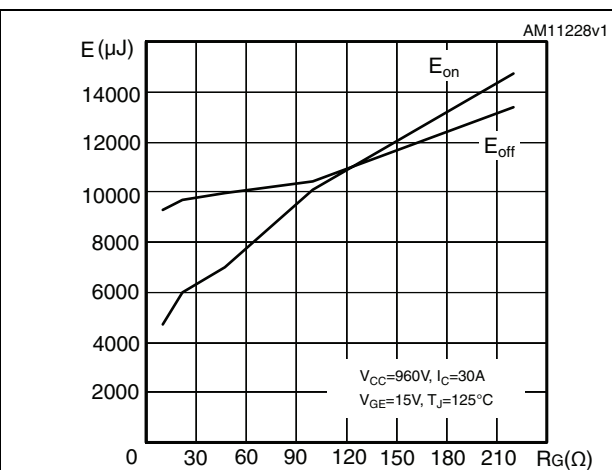
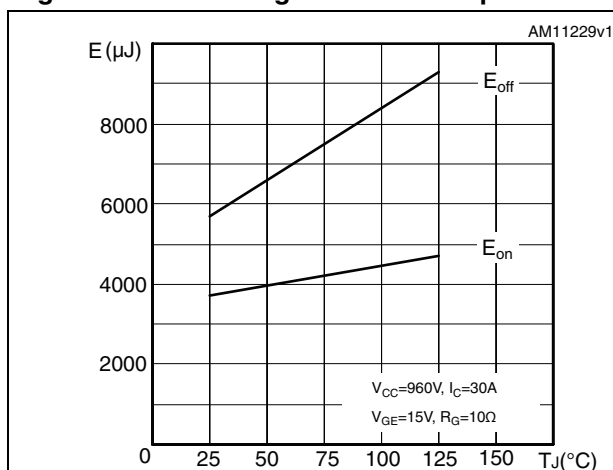
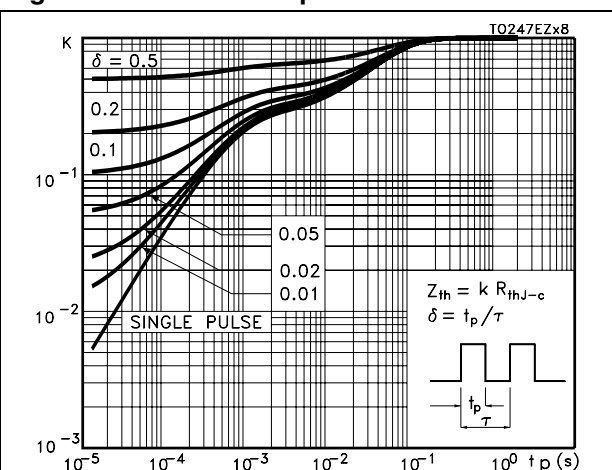
Figure 8. Normalized gate threshold voltage vs. temperature**Figure 9. Normalized breakdown voltage vs. temperature****Figure 10. Switching losses vs. collector current****Figure 11. Switching losses vs. gate resistance****Figure 12. Switching losses vs. temperature****Figure 13. Thermal impedance**

Figure 14. Turn-off SOA

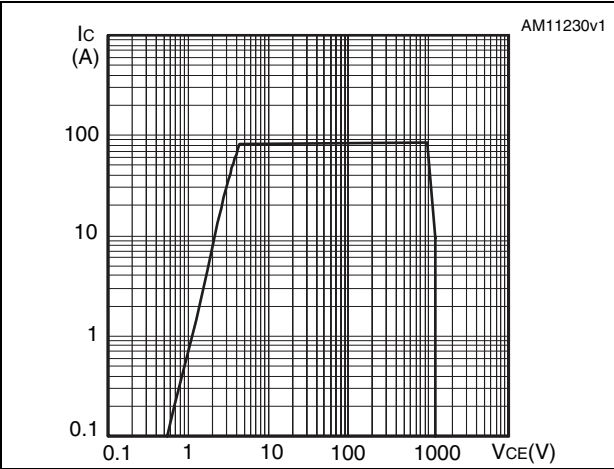
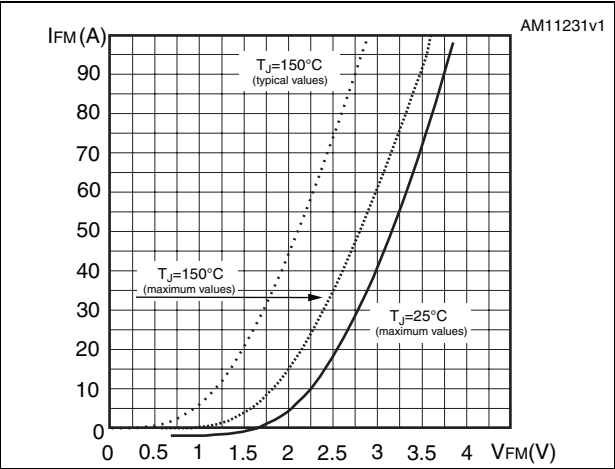


Figure 15. Forward voltage drop vs. forward current



3 Test circuits

Figure 16. Test circuit for inductive load switching

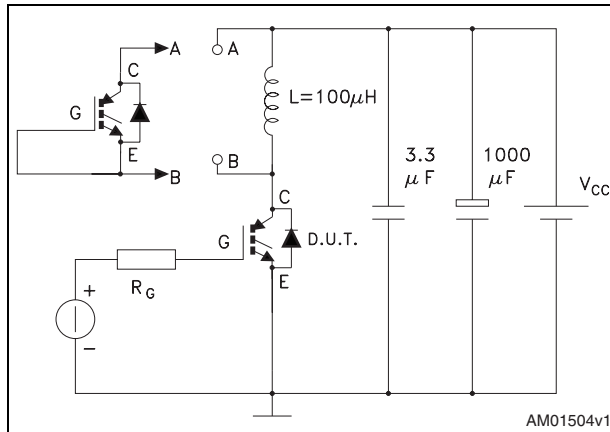


Figure 17. Gate charge test circuit

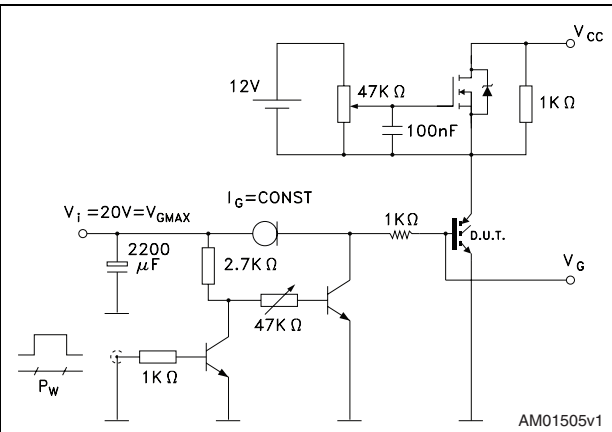


Figure 18. Switching waveform

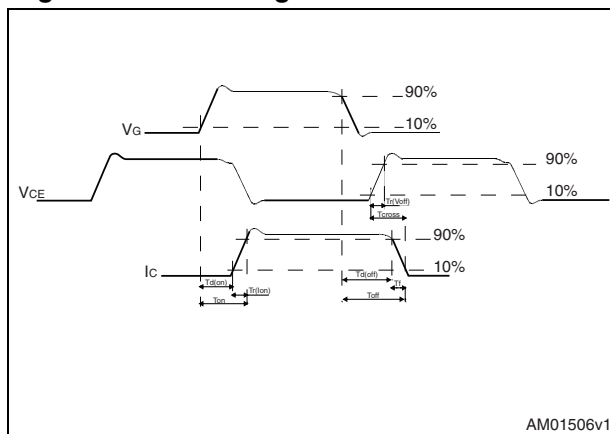
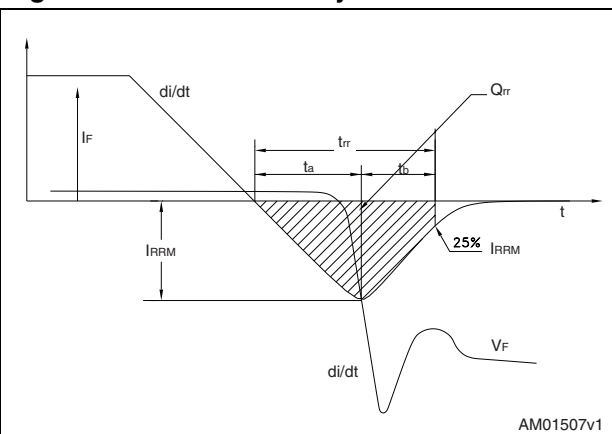


Figure 19. Diode recovery time waveform



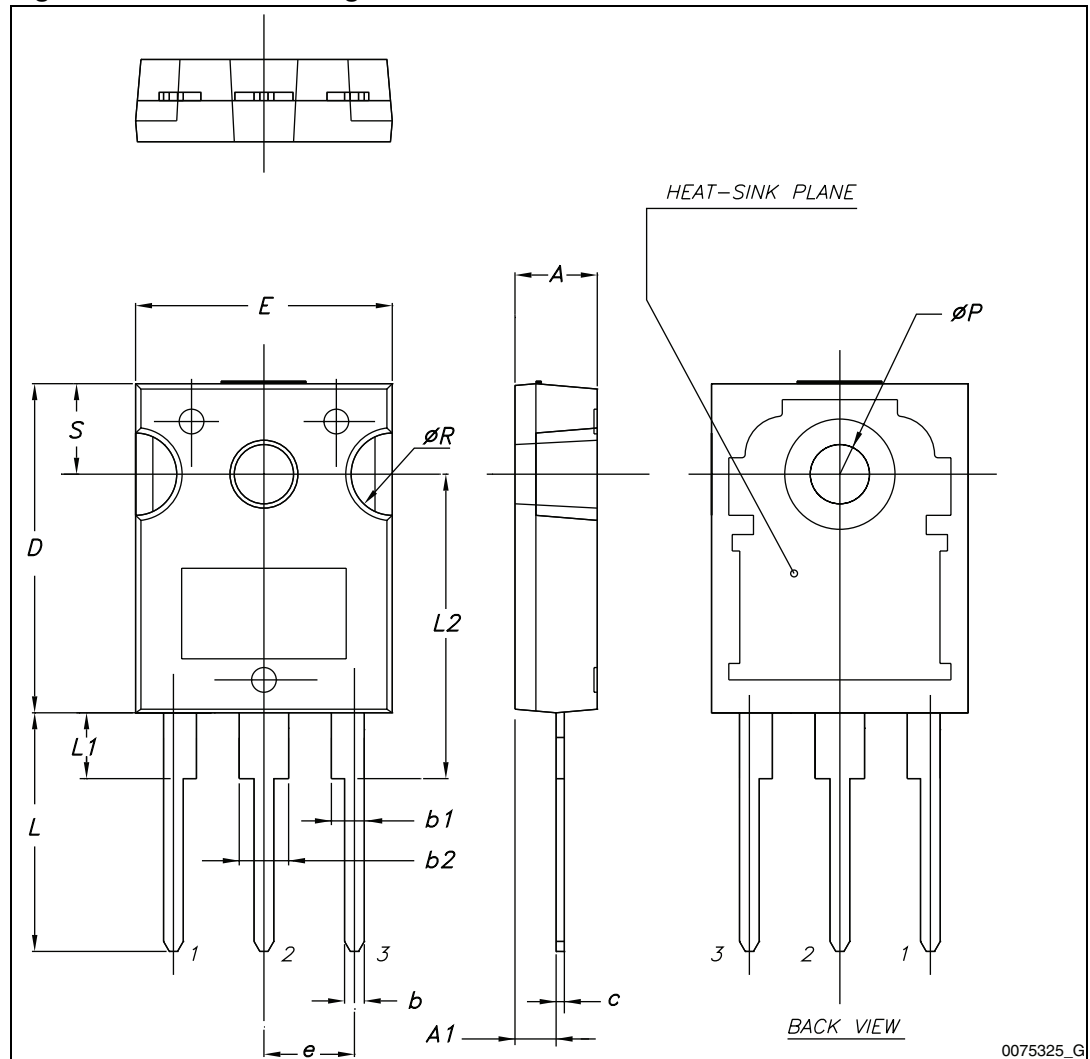
4 Package mechanical data

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 20. TO-247 drawing dimensions

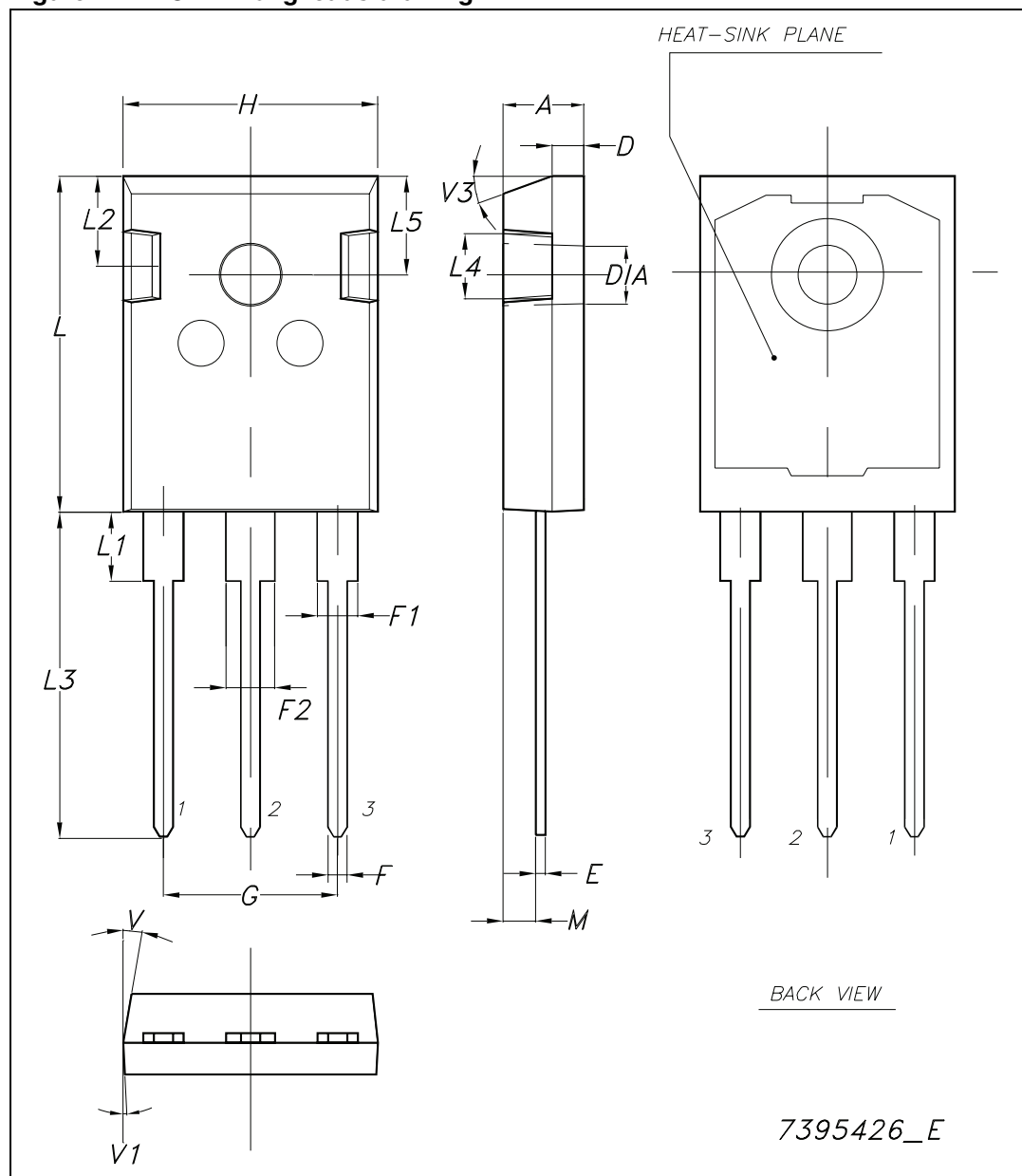


0075325_G

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 21. TO-247 long leads drawing



5 Revision history

Table 11. 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 Table 5 on page 4 , Table 6 on page 4 and Table 7 on page 5 .
11-Jan-2012	4	Added order code STGWA40N120KD Table 1 on page 1 , Section 2.1 on page 6 , mechanical data TO-247 long leads Table 10 on page 12 and Figure 21 on page 13 .
27-Feb-2012	5	Modified: Description on page 1 .

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