STGW40N120KD
STGWA40N120KD

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

Features

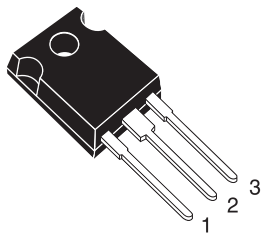
- Low on-losses
- High current capability
- Low gate charge
- Short circuit withstand time 10 µs
- IGBT co-packaged with Ultrafast free-wheeling diode

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.



TO-247

Figure 1. Internal schematic diagram

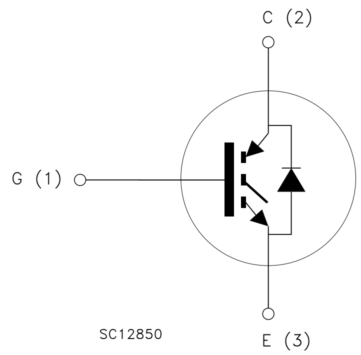


Table 1. Device summary

Order codes	Markings	Package	Packaging
STGW40N120KD	GW40N120KD	TO-247	Tube
STGWA40N120KD	GWA40N120KD	TO-247 long leads	Tube

Contents

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 °C	80	A
I_C (1)	Continuous collector current at T_C= 100 °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 °C, R_G = 10 Ω, V_{GE} = 12 V	10	µs
P_{TOT}	Total dissipation at T_C = 25 °C	240	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 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. Vclamp = 80% of V_{CES}, T_j =125 °C, R_G=10 Ω, V_{GE}=15 V
3. Pulse width limited by maximum junction temperature and turn-off within RBSOA

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case IGBT	0.42	°C/W
$R_{thj\text{-}case}$	Thermal resistance junction-case diode	1.6	°C/W
$R_{thj\text{-}amb}$	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	1200			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE}= 15 V, I_C= 30 A V_{GE}= 15 V, I_C= 30 A, T_J =125 °C		2.8 2.7	3.85	V V
$V_{GE(th)}$	Gate threshold voltage	V_{CE}= V_{GE}, I_C= 1mA	4.5		6.5	V
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE} =1200 V V_{CE} =1200 V, T_J =125 °C			500 10	µA mA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} =± 20 V			± 100	nA

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} = 25 V, f = 1 MHz, V_{GE}=0	-	2577 196 39.5	-	pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 960 V, I_C= 30 A,V_{GE}=15 V	-	126 22.2 67	-	nC nC nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	V_{CC} = 960 V, I_C = 30 A R_G= 10 Ω, V_{GE}= 15 V, *(see Figure 16)*	-	48 40 540	-	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} = 960 V, I_C = 30 A R_G= 10 Ω, V_{GE}= 15 V, T_J = 125 °C *(see Figure 16)*	-	45 38 665	-	ns ns A/µs
$t_r(V_{off})$ $t_d(_{off})$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 960 V, I_C = 30 A R_G= 10 Ω, V_{GE}= 15 V, *(see Figure 16)*	-	84 338 210	-	ns ns ns
$t_r(V_{off})$ $t_d(_{off})$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 960 V, I_C = 30 A R_G= 10 Ω, V_{GE}= 15 V, T_J = 125 °C *(see Figure 16)*	-	144 420 360	-	ns ns ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Eon [(1)] E_{off} [(2)] E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 960 V, I_C = 30 A R_G= 10 Ω, V_{GE}= 15 V, *(see Figure 16)*	-	3.7 5.7 9.4	-	mJ mJ mJ
Eon [(1)] E_{off} [(2)] E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 960 V, I_C = 30 A R_G= 10 Ω, V_{GE}= 15 V, T_J = 125 °C *(see Figure 16)*	-	4.7 9.3 14	-	mJ mJ mJ

1. Eon 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 A I_F = 20 A, T_J = 125 °C	-	1.9 1.7	-	V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 20 A, V_R = 45 V, di/dt = 100 A/µs *(see Figure 19)*	-	84 235 5.6	-	ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 20 A, V_R = 45 V, T_J = 125 °C, di/dt = 100 A/µs *(see Figure 19)*	-	152 722 9	-	ns nC A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

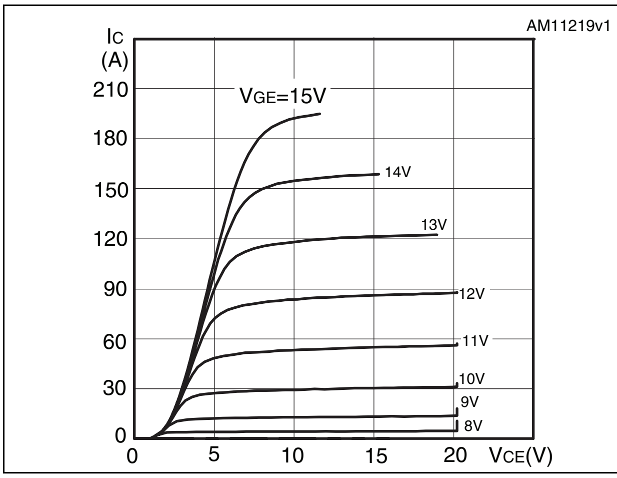


Figure 3. Transfer characteristics

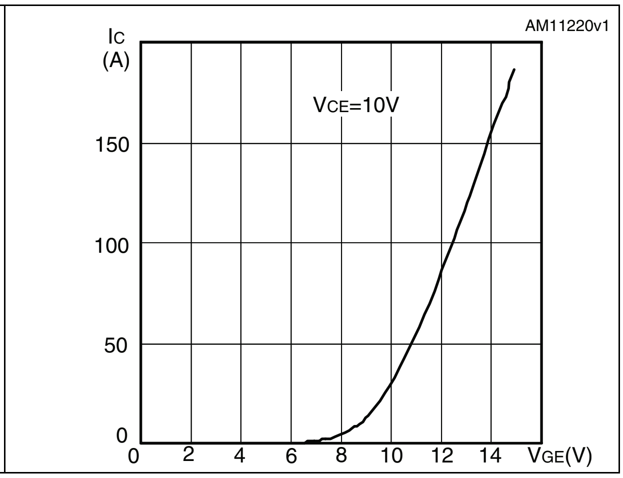


Figure 4. Collector-emitter on voltage vs. collector current

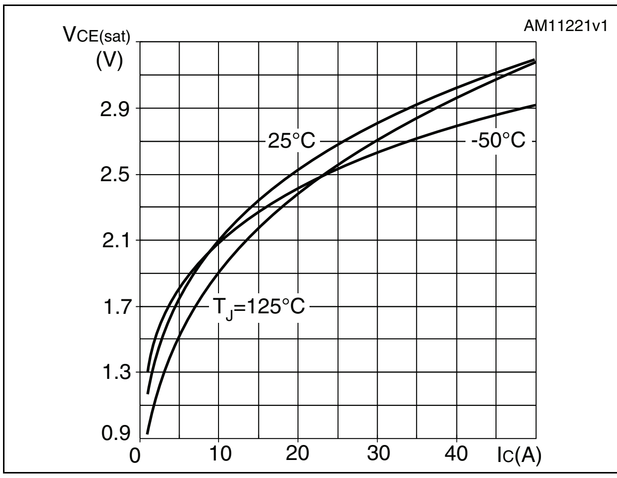


Figure 5. Collector-emitter on voltage vs. temperature

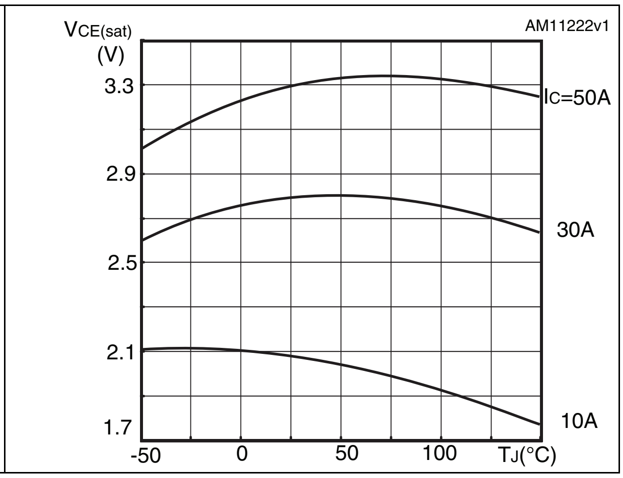


Figure 6. Gate charge vs. gate-source voltage

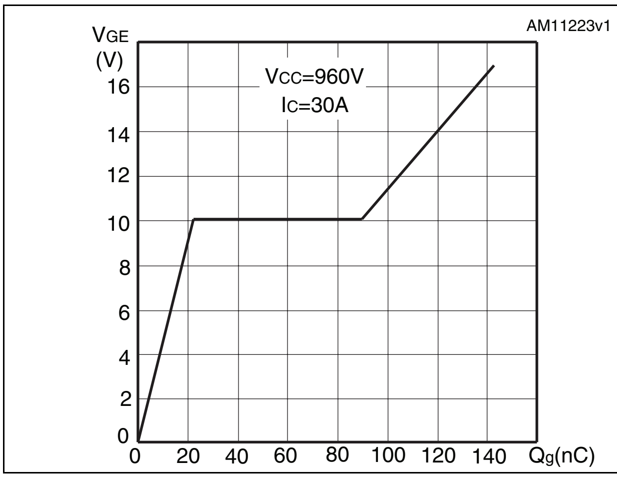


Figure 7. Capacitance variations

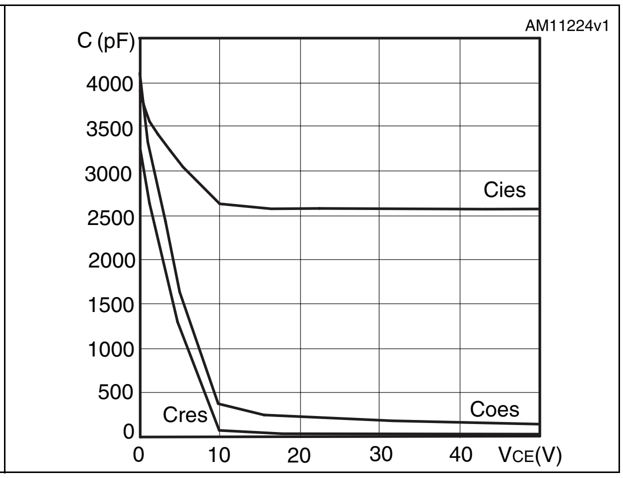


Figure 8. Normalized gate threshold voltage vs. temperature

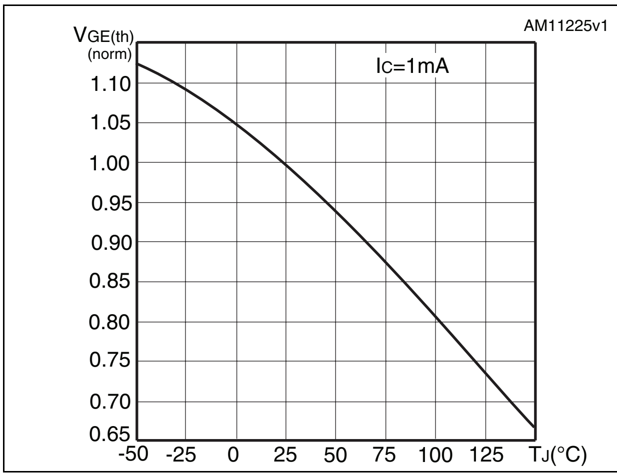


Figure 9. Normalized breakdown voltage vs. temperature

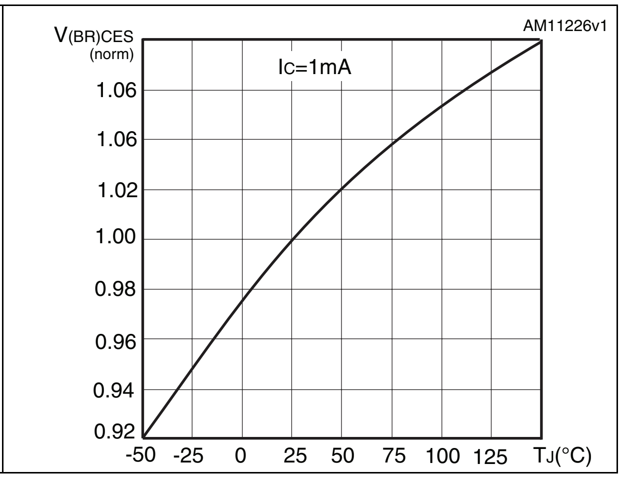


Figure 10. Switching losses vs. collector current

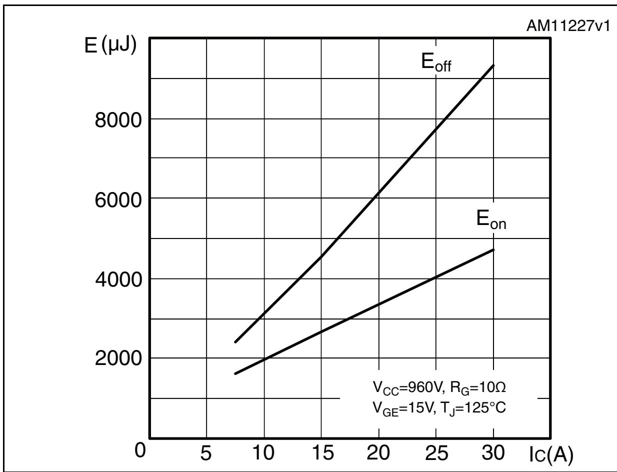


Figure 11. Switching losses vs. gate resistance

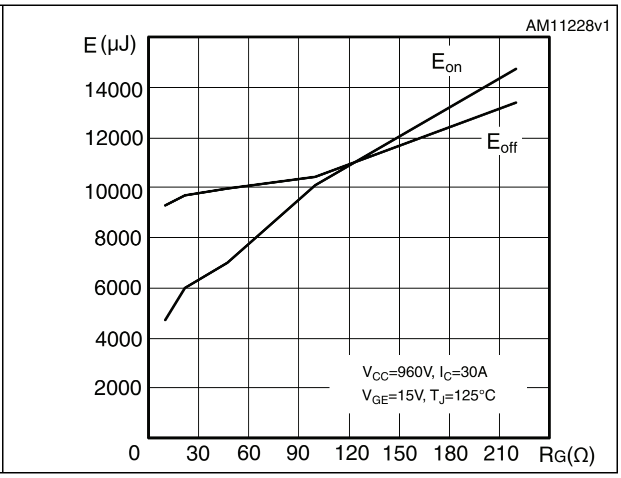


Figure 12. Switching losses vs. temperature

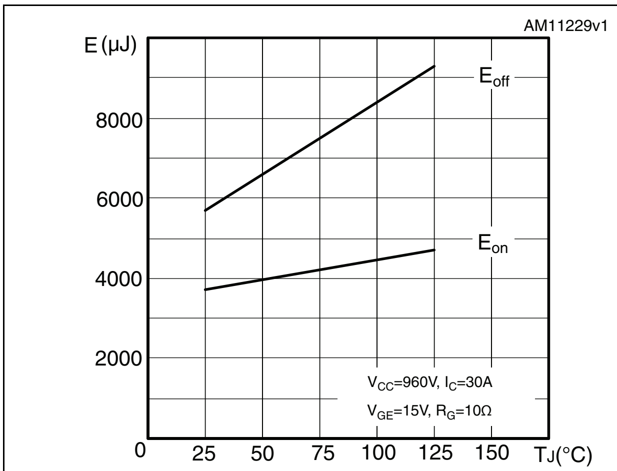


Figure 13. Thermal impedance

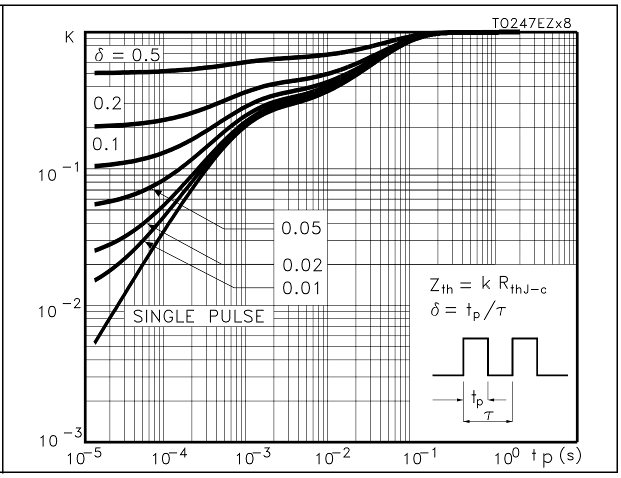


Figure 14. Turn-off SOA

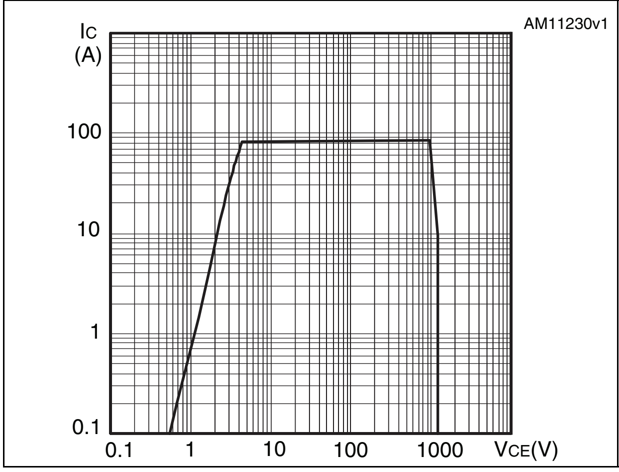
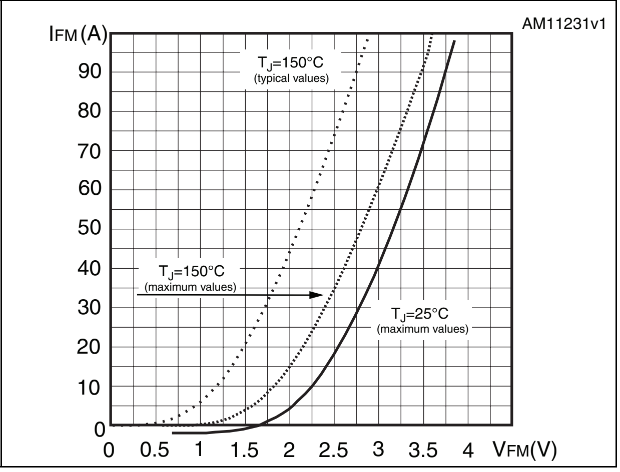


Figure 15. Forward voltage drop vs. forward current



3 Test circuits

Figure 16. Test circuit for inductive load switching

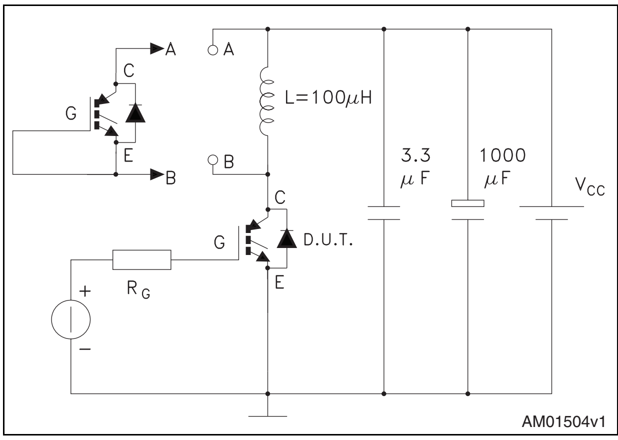


Figure 17. Gate charge test circuit

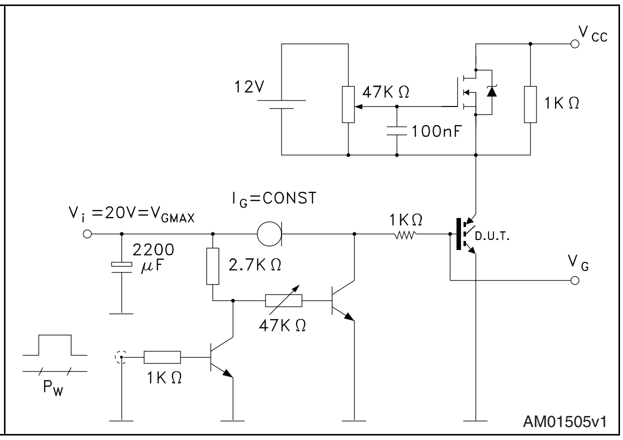


Figure 18. Switching waveform

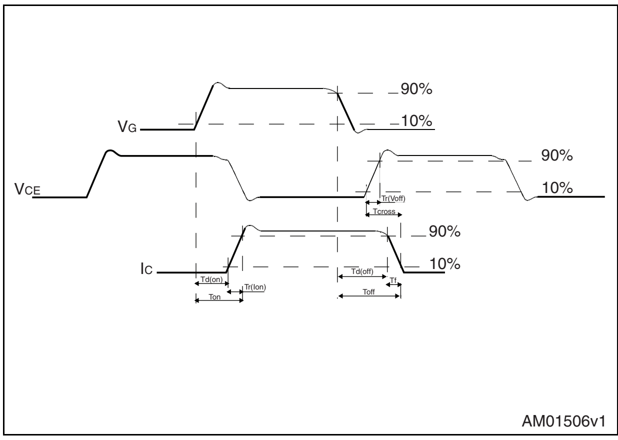
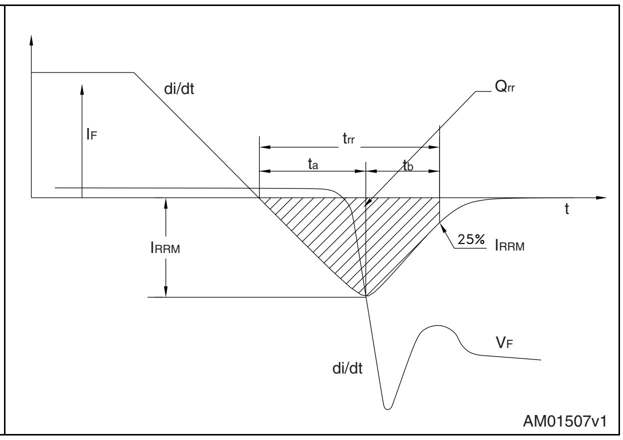


Figure 19. Diode recovery time waveform



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	
∅P	3.55		3.65
∅R	4.50		5.50
S	5.30	5.50	5.70

Figure 20. TO-247 drawing dimensions

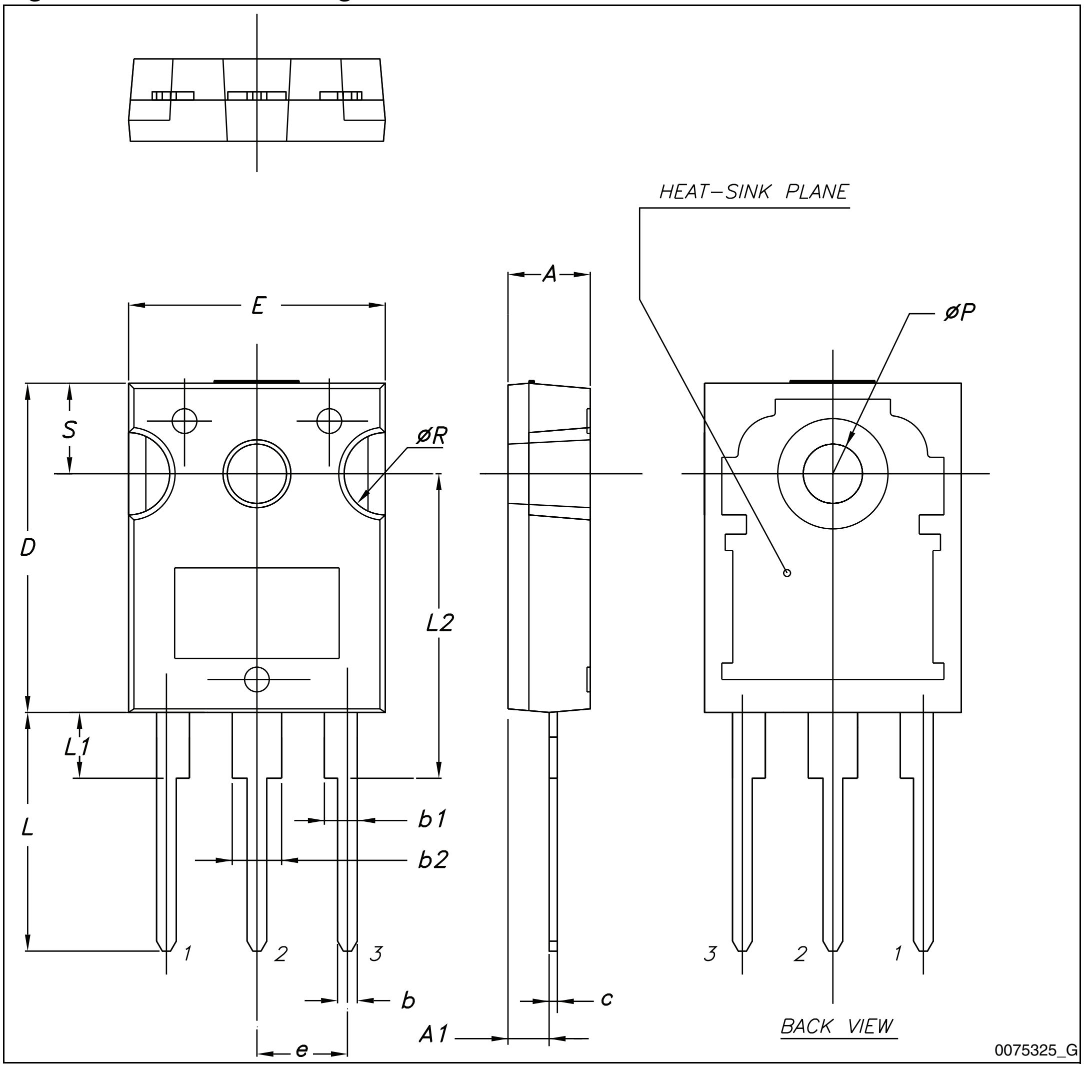
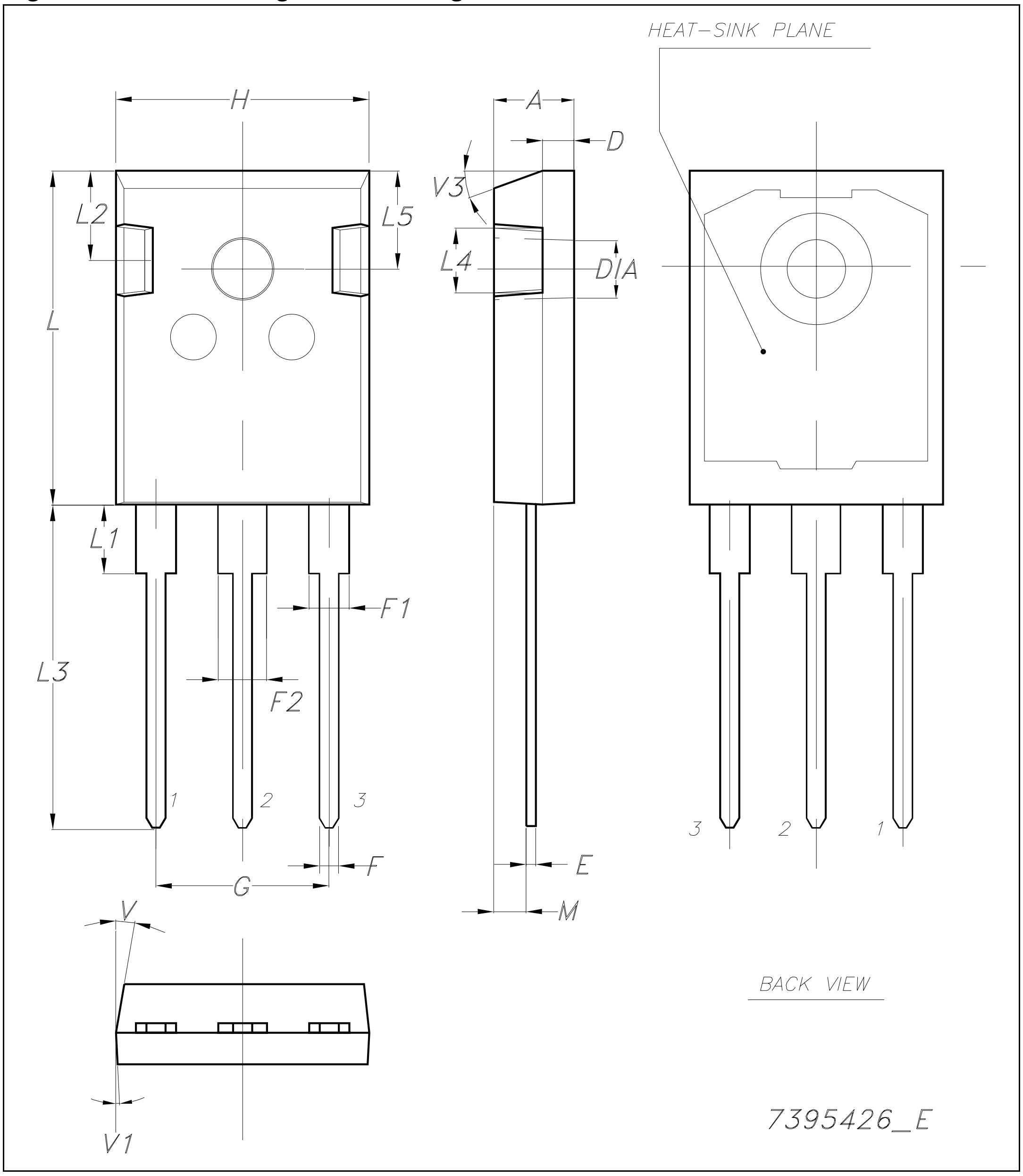


Table 10. TO-247 long leads mechanical data

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*.