STGW35HF60WDI

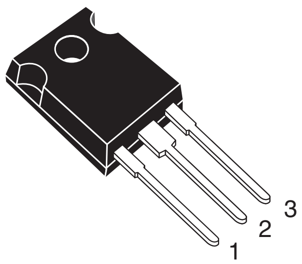
35 A, 600 V ultrafast IGBT with low drop diode

Features

- Improved E_{off} at elevated temperature
- Low C_{RES} / C_{IES} ratio (no cross-conduction susceptibility)
- Low V_F soft recovery antiparallel diode

Applications

- Welding
- Induction heating
- Resonant converters



TO-247

Description

This ultrafast IGBT is developed using a new planar technology to yield a device with tighter switching energy variation (E_{off}) versus temperature. The suffix "W" denotes a subset of products designed for high switching frequency operation (over 100 kHz).

Figure 1. Internal schematic diagram

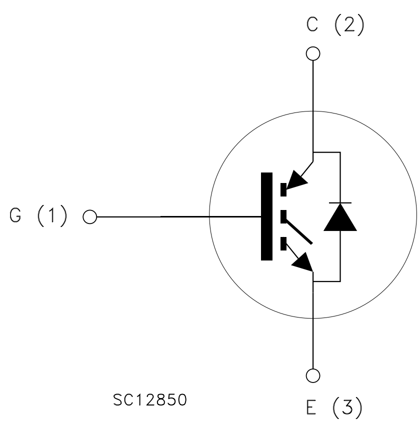


Table 1. Device summary

Order code	Marking	Package	Packaging
STGW35HF60WDI	GW35HF60WDI	TO-247	Tube
STGWA35HF60WDI	35HF60WDI	TO-247 long leads	

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-247	TO-247 long leads	
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	600		V
I_C (1)	Continuous collector current at T_C = 25 °C	60	70	A
I_C (1)	Continuous collector current at T_C = 100 °C	35	40	A
I_{CL} (2)	Turn-off latching current	80		A
I_{CP} (3)	Pulsed collector current	150		A
V_{GE}	Gate-emitter voltage	± 20		V
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	130		A
P_{TOT}	Total dissipation at T_C = 25 °C	200	260	W
T_{stg}	Storage temperature	– 55 to 150		°C
T_j	Operating junction temperature			

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}), V_{GE} = 15 V, R_G = 10 Ω, T_J = 150 °C

Table 3. Thermal data

Symbol	Parameter	Value		Unit
		TO-247	TO-247 long leads	
$R_{thj\text{-}case}$	Thermal resistance junction-case IGBT	0.63	0.48	°C/W
	Thermal resistance junction-case diode	1.5		°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	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C= 20 A V_{GE} = 15V, I_C = 20 A,T_J= 125 °C		1.9 1.65	2.5	V V
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 1 mA	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			250 1	µA mA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} = ±20 V			± 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} = 25 V, f = 1 MHz, V_{GE} = 0	-	2400 235 50	-	pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 390 V, I_C = 20 A, V_{GE} = 15 V, *(see Figure 17)*	-	140 13 52	-	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} = 390 V, I_C = 20 A R_G = 10 Ω, V_{GE} = 15 V, *(see Figure 16)*	-	30 15 1650	-	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 = 10 Ω, V_{GE} = 15 V, T_J = 125 °C *(see Figure 16)*	-	30 15 1600	-	ns ns A/µs

Table 6. Switching on/off (inductive load)

$t_r(V_{off})$ $t_d(_{off})$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 390 V, I_C = 20 A, R_{GE} = 10 Ω, V_{GE} = 15 V *(see Figure 16)*	-	30 175 40	-	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} = 390 V, I_C = 20 A, R_{GE} = 10 Ω, V_{GE} =15 V, T_J = 125 °C *(see Figure 16)*	-	50 225 70	-	ns ns ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{off}	Turn-off switching losses	V_{CC} = 390 V, I_C = 20 A R_G = 10 Ω, V_{GE} = 15 V, *(see Figure 18)*	-	185		µJ
E_{off}	Turn-off switching losses	V_{CC} = 390 V, I_C = 20 A R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °C, *(see Figure 18)*	-	350	530	µJ

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	-	1.3 1.1	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 = 50 V, di/dt = 100 A/µs *(see Figure 19)*	-	85 240 5.2	-	ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 20 A,V_R = 50 V, T_J =125 °C, di/dt = 100 A/µs *(see Figure 19)*	-	230 930 8.7	-	ns nC A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

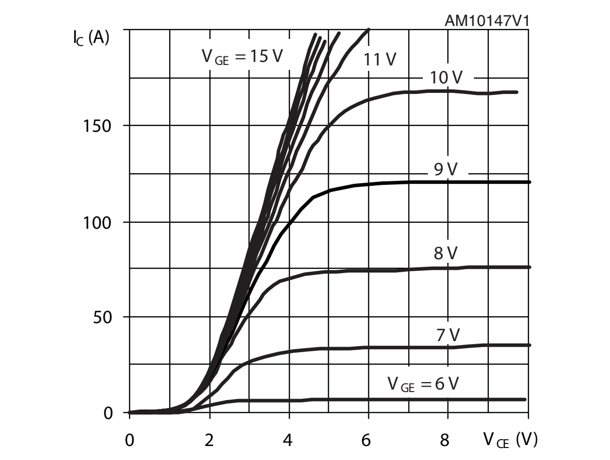


Figure 3. Transfer characteristics

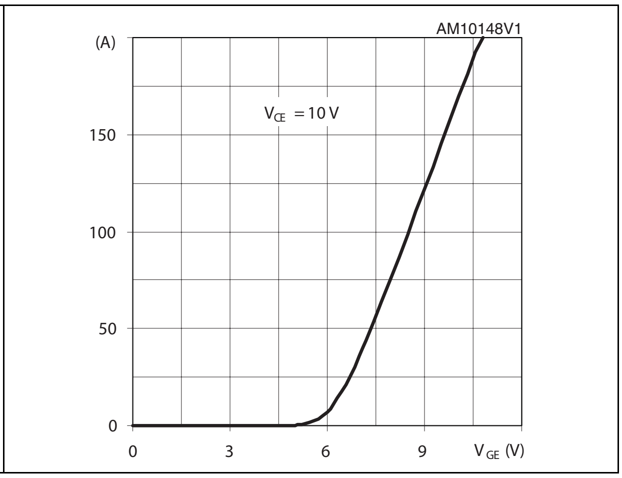


Figure 4. Normalized $V_{CE(sat)}$ vs. I_C

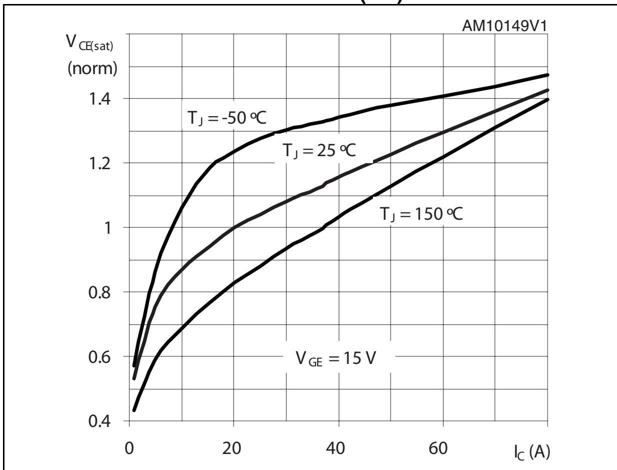


Figure 5. Normalized $V_{CE(sat)}$ vs. temperature

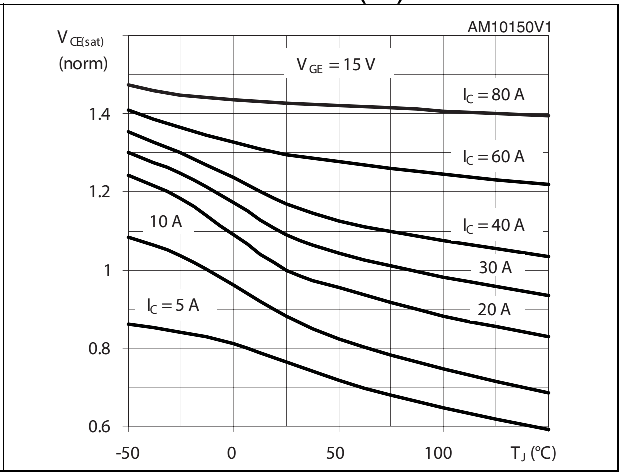


Figure 6. Normalized breakdown voltage vs. temperature

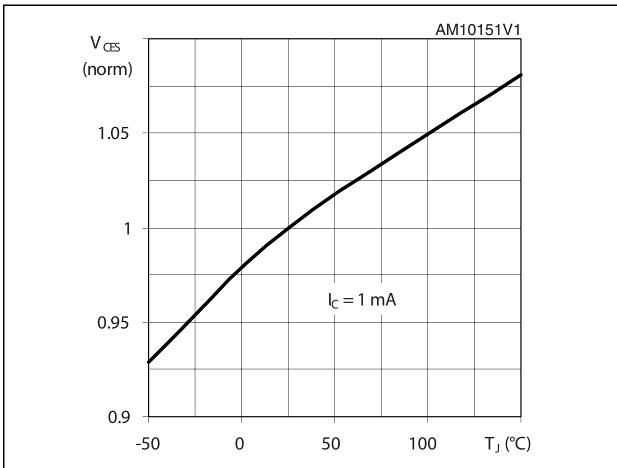


Figure 7. Normalized gate threshold voltage vs. temperature

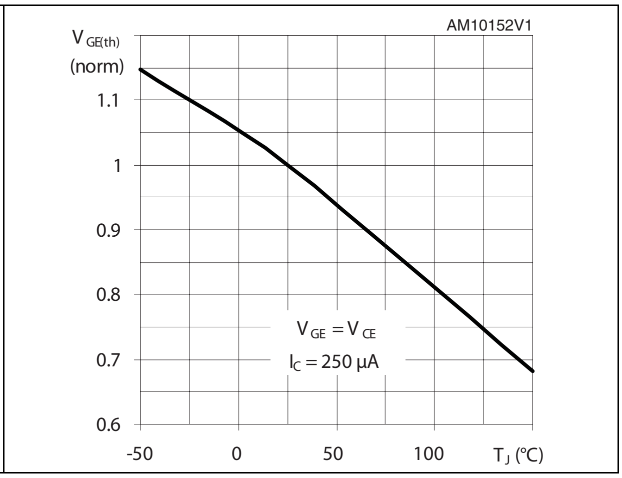


Figure 8. Gate charge vs. gate-emitter voltage

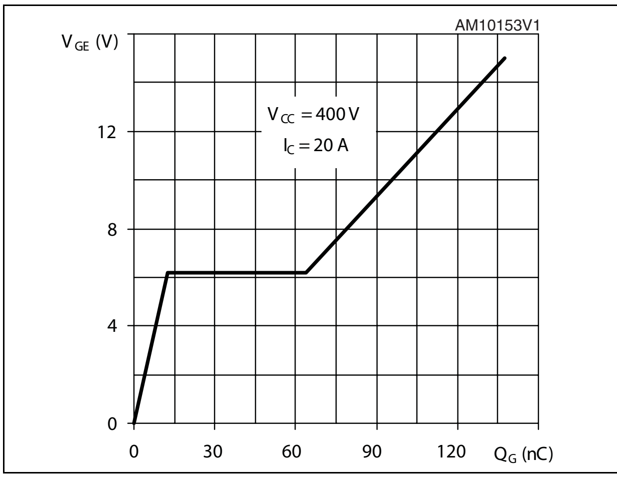


Figure 9. Capacitance variations

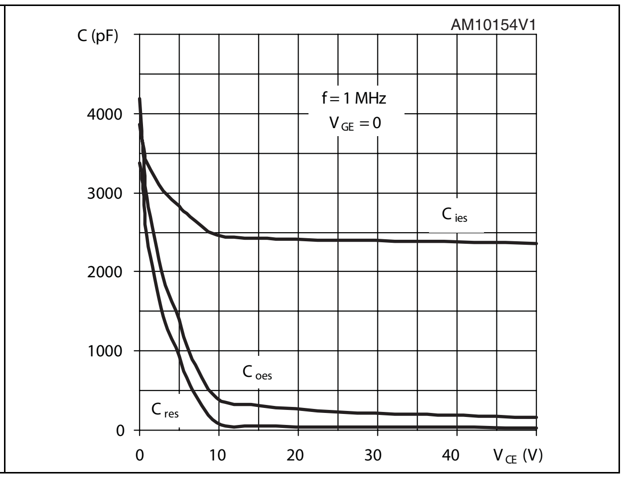


Figure 10. Switching losses vs temperature

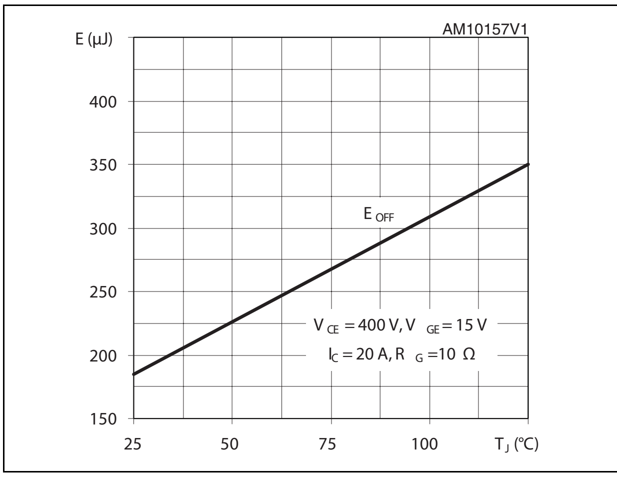


Figure 11. Switching losses vs gate resistance

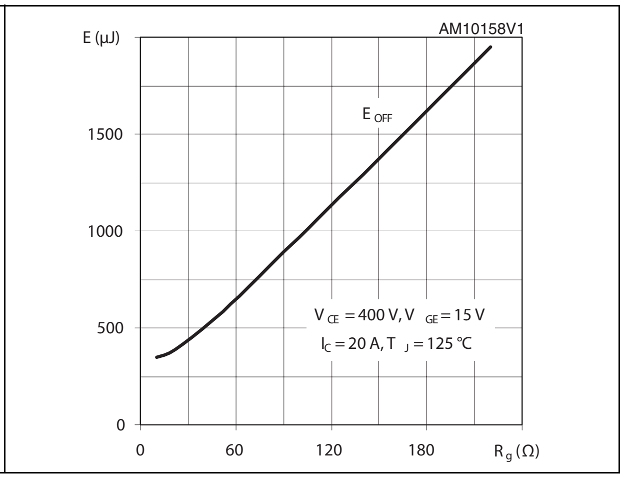


Figure 12. Switching losses vs collector current

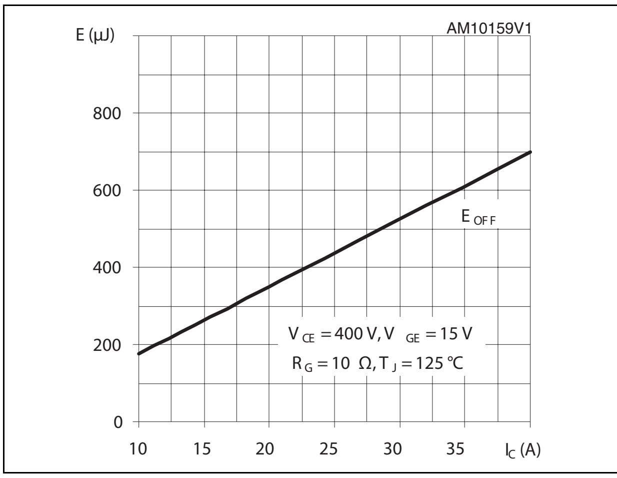


Figure 13. Diode forward on voltage

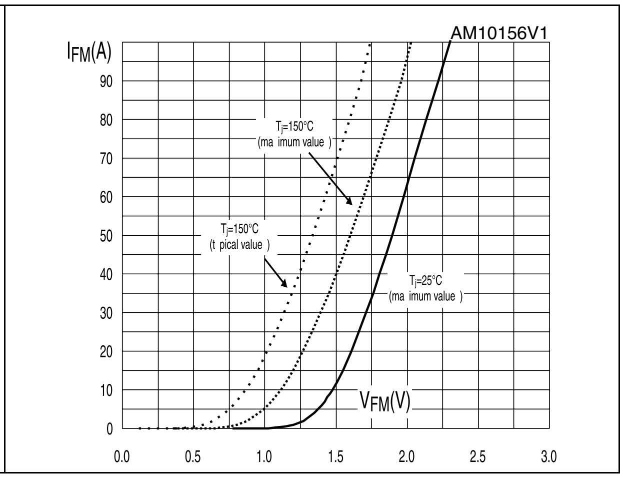


Figure 14. Turn-off SOA

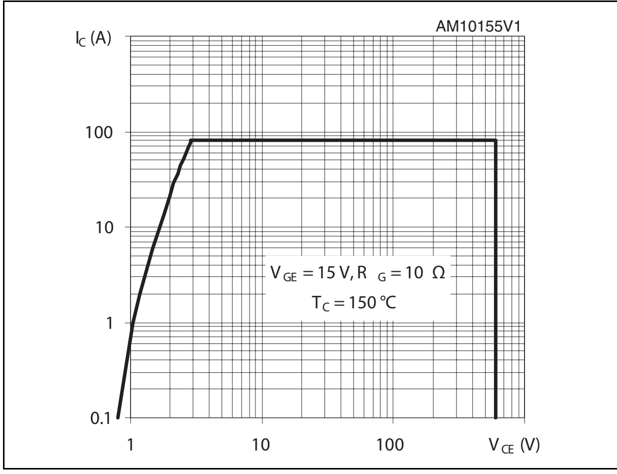
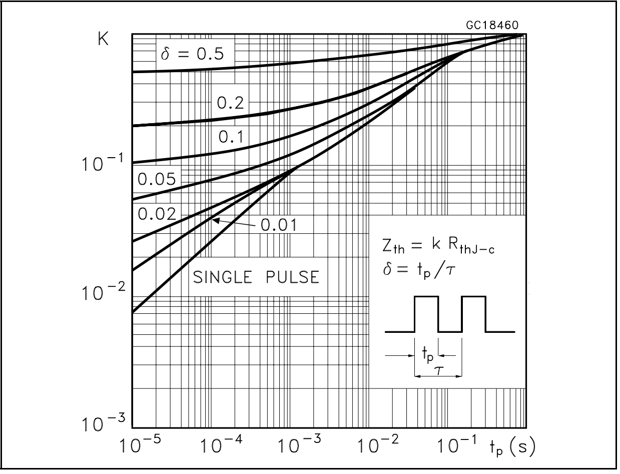


Figure 15. Thermal impedance



3 Test circuits

Figure 16. Test circuit for inductive load switching

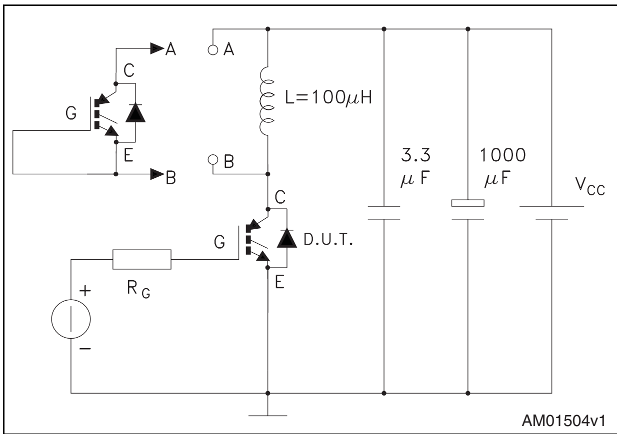


Figure 17. Gate charge test circuit

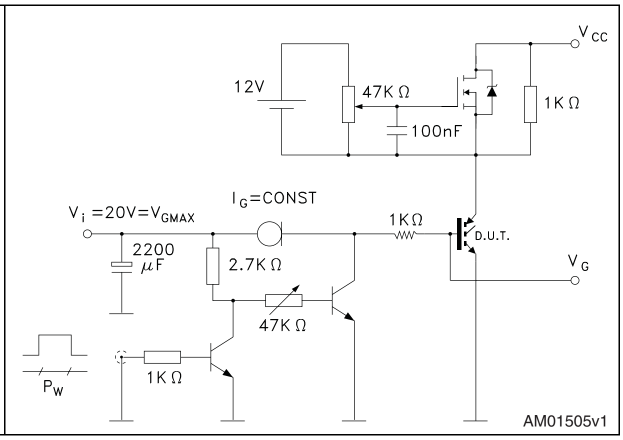


Figure 18. Switching waveform

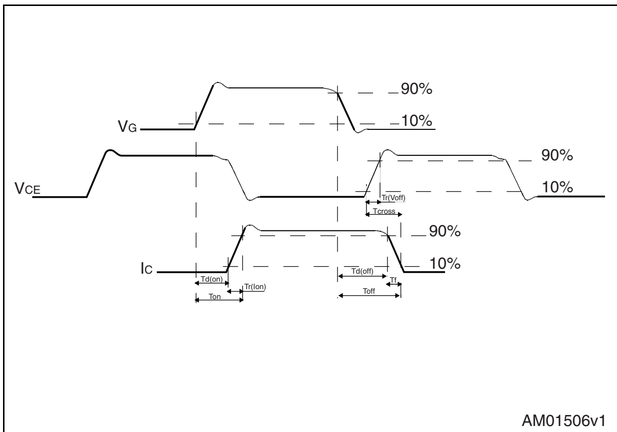
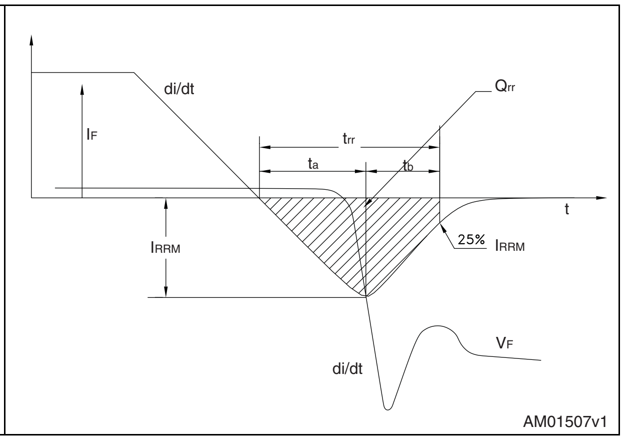


Figure 19. Diode recovery time waveform



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		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
∅P	3.55		3.65
∅R	4.50		5.50
S		5.50	

Figure 20. TO-247 drawing

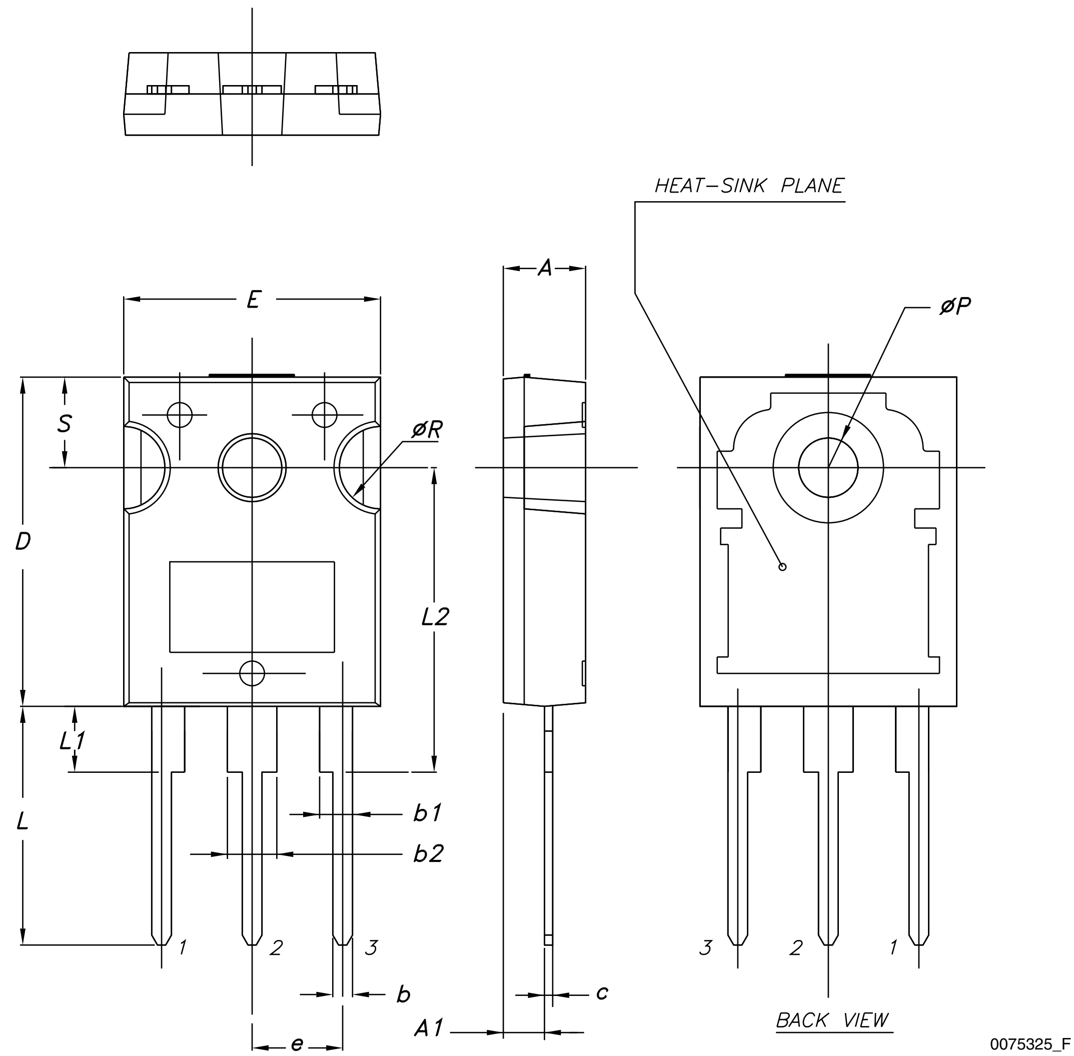
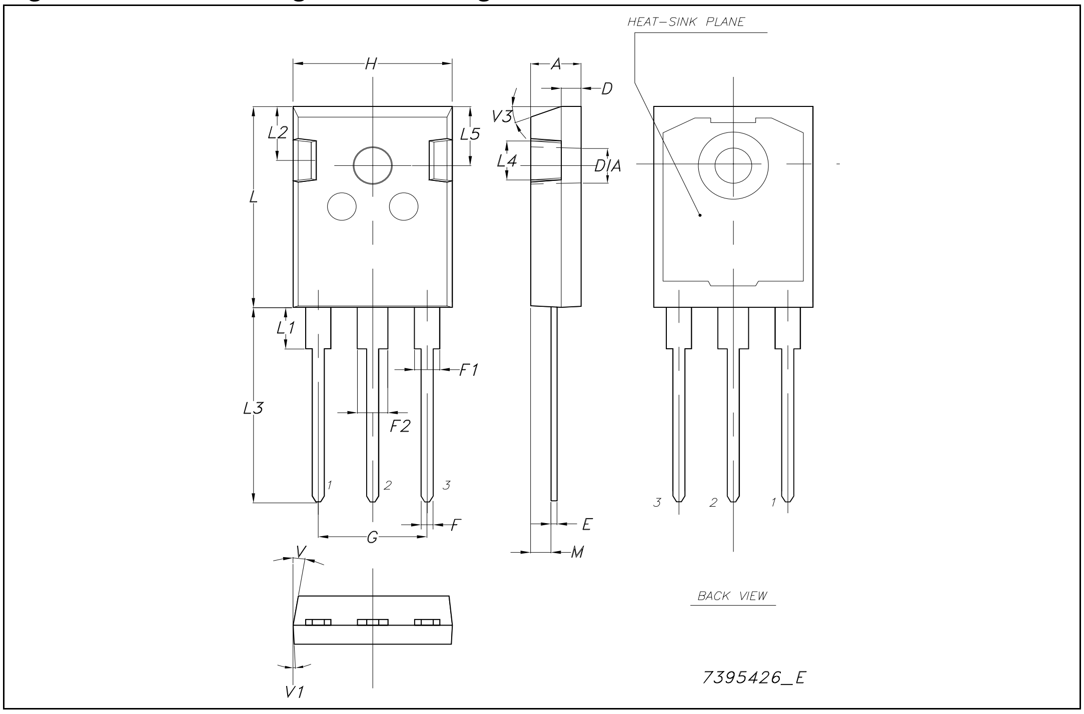


Table 10. TO-247 long leads mechanical data

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
03-Aug-2009	1	Initial release.
02-Sep-2009	2	Minor text changes throughout the document Removed watermark.
25-Aug-2011	3	Inserted new *Section 2.1: Electrical characteristics (curves)*. Updated *Section 4: Package mechanical data*. Minor text changes.