STGWA60NC60WDR

60 A, 600 V, ultrafast IGBT

Features

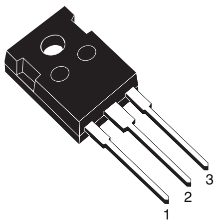
- Very high frequency operation
- Low C_{RES} / C_{IES} ratio (no cross-conduction susceptibility)
- Very soft ultrafast recovery antiparallel diode

Applications

- Welding
- Power factor correction
- SMPS
- High frequency inverter/converter

Description

This device is an ultrafast IGBT. It utilizes the advanced Power MESH™ process resulting in an excellent trade-off between switching performance and low on-state behavior.



TO-247 long leads

Figure 1. Internal schematic diagram

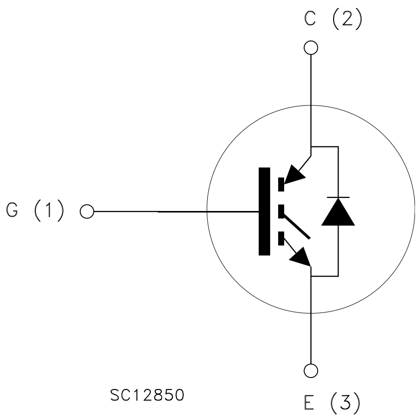


Table 1. Device summary

Order code	Marking	Package	Packaging
STGWA60NC60WDR	GWA60NC60WDR	TO-247 long leads	Tube

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	600	V
I_C (1)	Collector current (continuous) at T_C = 25 °C	130	A
I_C (1)	Collector current (continuous) at T_C = 100 °C	60	A
I_{CL} (2)	Turn-off latching current	250	A
I_{CP} (3)	Pulsed collector current	250	A
I_F	Diode RMS forward current at T_C = 25 °C	30	A
I_{FSM}	Surge not repetitive forward current (t_p = 10 ms sinusoidal)	120	A
V_{GE}	Gate-emitter voltage	± 20	V
P_{TOT}	Total dissipation at T_C = 25 °C	340	W
T_j	Operating junction temperature	- 55 to 150	°C

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C, I_C)}$$

2. V_{clamp} = 480 V, T_J = 150 °C, R_G = 10 Ω, V_{GE} = 15 V
3. Pulse width limited by max. temperature allowed

Table 3. Thermal resistance

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case IGBT max.	0.35	°C/W
$R_{thj\text{-}case}$	Thermal resistance junction-case diode max.	1.25	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max.	50	°C/W

2 Electrical characteristics

T_{CASE} = 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 = 40 A V_{GE} = 15 V, I_C = 40 A,T_C=125 °C		2.1 1.9	2.6	V V
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 250 µA	3.75		5.75	V
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE} = 600 V V_{CE} = 600 V,T_C= 125 °C			500 5	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 = 40 A		25		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		4700 410 90		pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 390 V, I_C = 40 A, V_{GE} = 15 V, *Figure 16*		195 32 82		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 = 40 A R_G= 10 Ω, V_{GE} = 15 V, *Figure 17*, *Figure 15*		40 30 1039		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 = 40 A R_G= 10 Ω, V_{GE} = 15 V, T_C = 125 °C *Figure 17*, *Figure 15*		37 32 990		ns ns A/µs
$t_{r(Voff)}$ $t_{d(Voff)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 390 V, I_C = 40 A R_G= 10 Ω, V_{GE} = 15 V, *Figure 17*, *Figure 15*		31 240 35		ns ns ns
$t_{r(Voff)}$ $t_{d(Voff)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 390 V, I_C = 40 A R_G= 10 Ω, V_{GE} = 15 V, T_C = 125 °C *Figure 17*, *Figure 15*		59 280 63		ns ns ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on}(1) E_{off}(2) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 390 V, I_C = 40 A R_G= 10 Ω, V_{GE} = 15 V, *Figure 15*		743 560 925		µJ µJ µJ
E_{on}(1) E_{off}(2) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 390 V, I_C = 40 A R_G= 10 Ω, V_{GE} = 15 V, T_C = 125 °C *Figure 15*		917 910 1545		µJ µJ µJ

1. Eon is the tun-on losses when a typical diode is used in the test circuit in *Figure 18* If the IGBT is offered in a package with a co-pak diode, the co-pack diode is used as external diode. IGBTs & 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 = 40 A I_F = 40 A, T_C = 125 °C		3.2 2.2		V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 40 A,V_R = 50 V, di/dt = 100 A/µs *Figure 18*		42 55 2.6		ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 40 A,V_R = 50 V, T_C =125 °C, di/dt = 100 A/µs (*Figure 18*)		141 324 4.6		ns nC A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

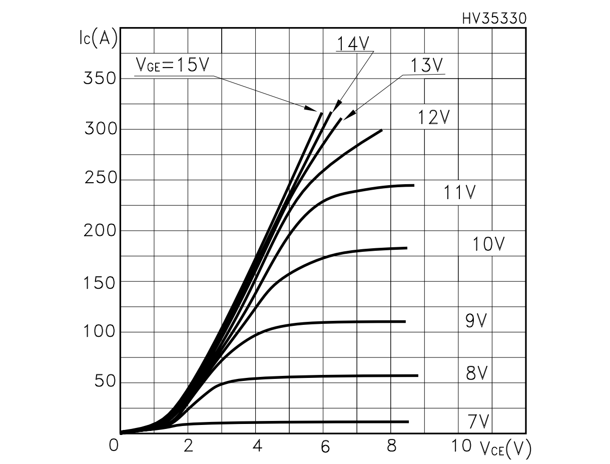


Figure 3. Transfer characteristics

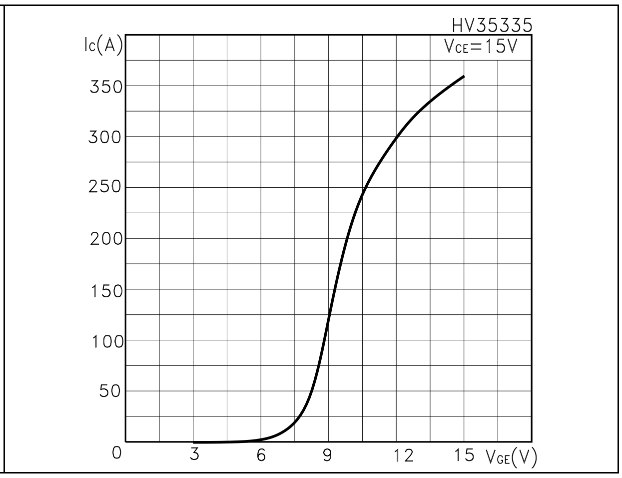


Figure 4. Transconductance

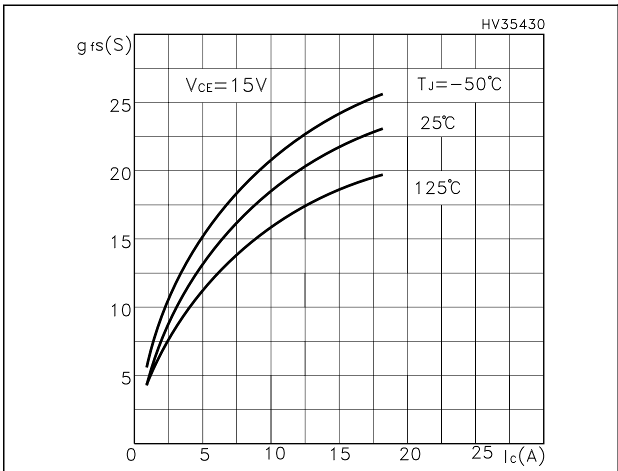


Figure 5. Collector-emitter on voltage vs. temperature

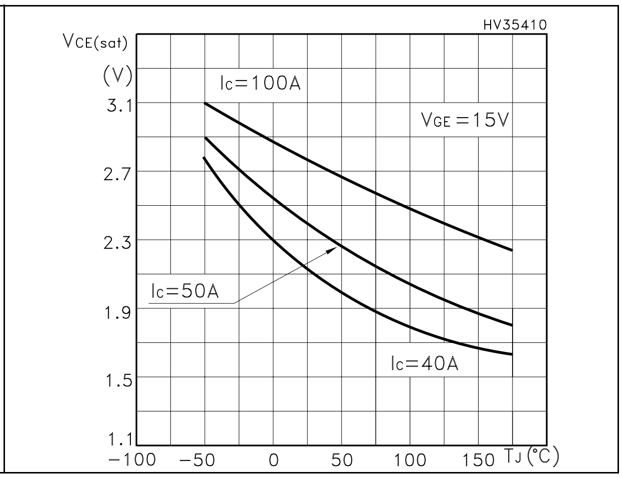


Figure 6. Gate charge vs. gate-source voltage

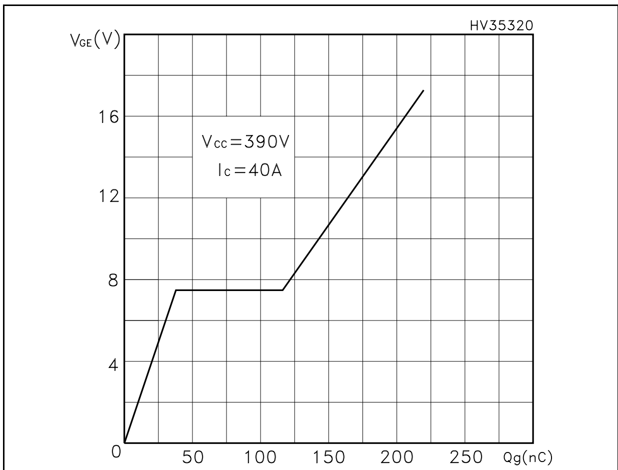


Figure 7. Capacitance variations

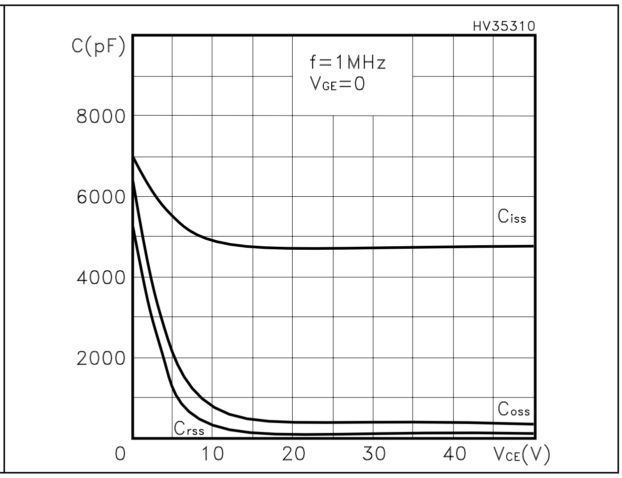


Figure 8. Normalized gate threshold voltage vs. temperature

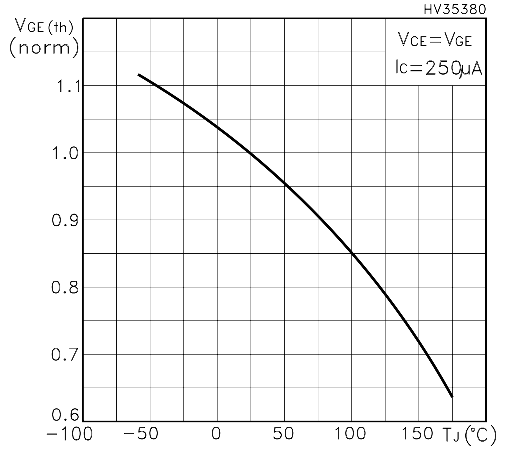


Figure 9. Collector-emitter on voltage vs. collector current

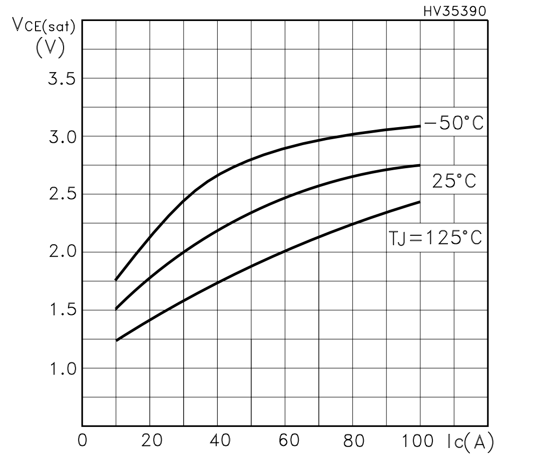
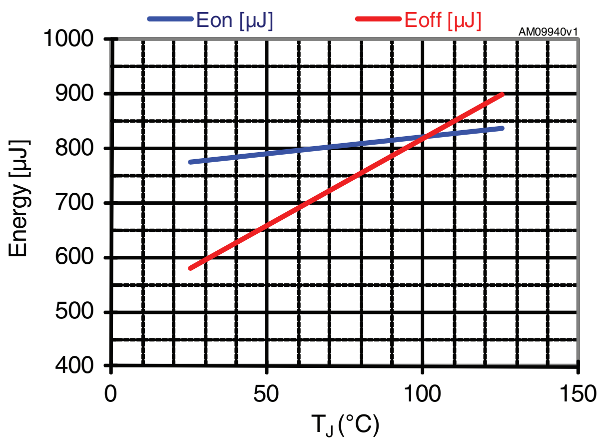
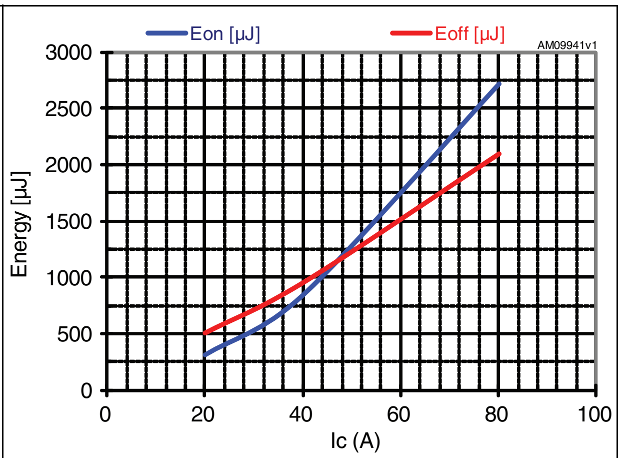


Figure 10. Normalized breakdown voltage vs. temperature



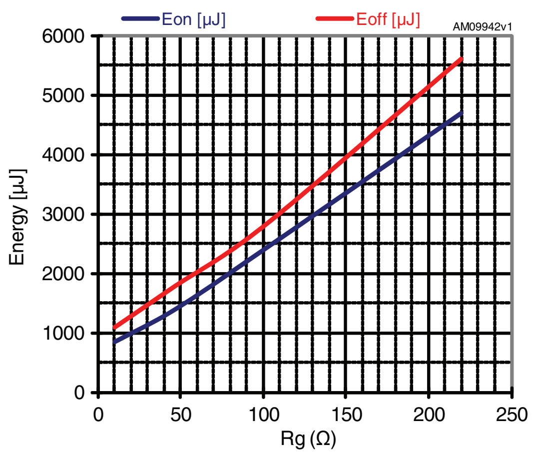
Ic = 40 A; V_{CC} = 390 V; Rg(Ω) = 10; V_{GE} = 15 V

Figure 11. Switching losses vs. I_C



V_{CC} = 390 V; Rg(Ω) = 10; V_{GE} = 15 V; T_J = 125 °C

Figure 12. Switching losses vs. gate resistance



V_{CC} = 390 V;I_C = 40 A; V_{GE} = 15 V; T_J = 125 °C

Figure 13. Turn-off SOA

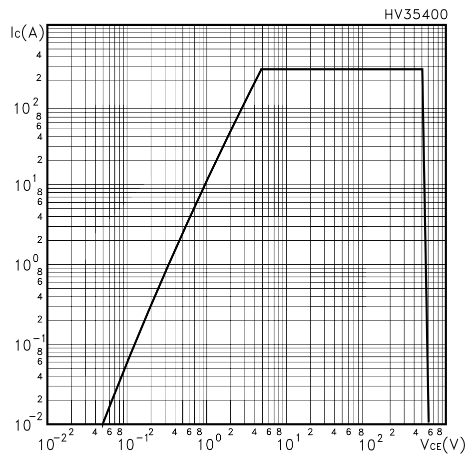
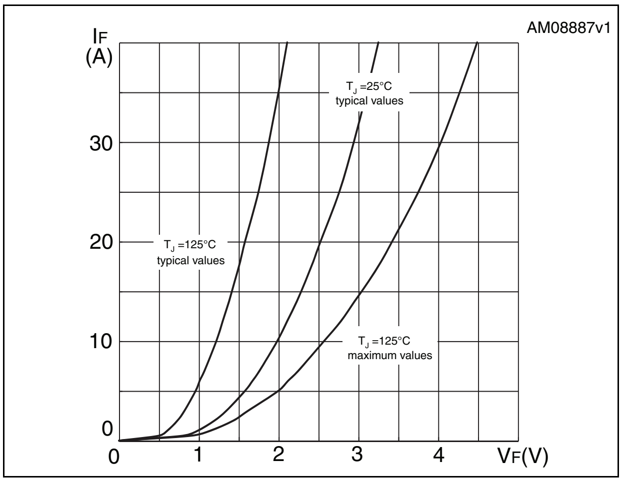


Figure 14. Forward voltage drop vs. forward current



3 Test circuit

Figure 15. Test circuit for inductive load switching

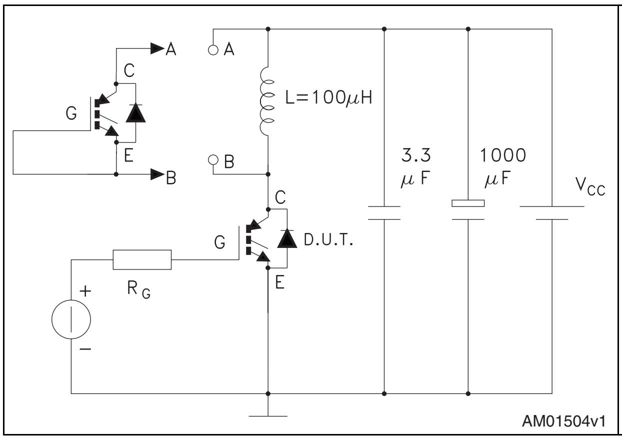


Figure 16. Gate charge test circuit

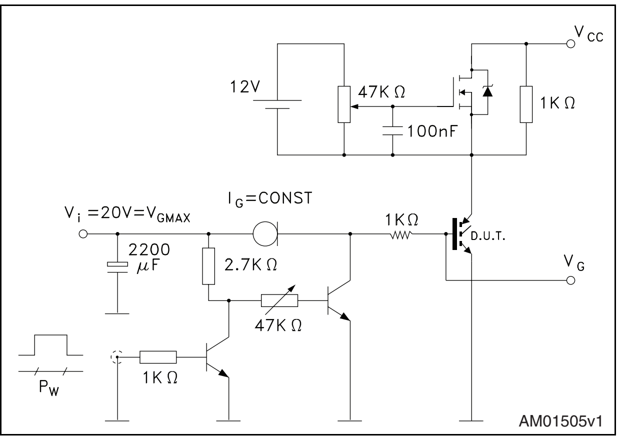


Figure 17. Switching waveform

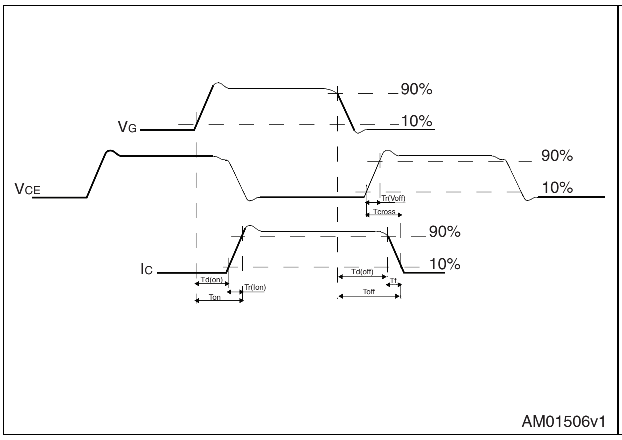
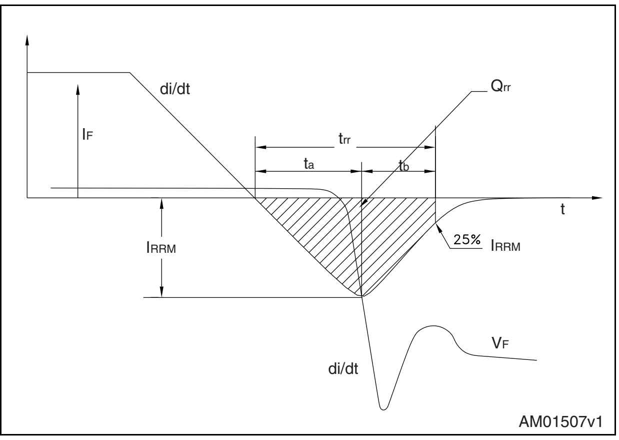


Figure 18. Diode recovery time waveform



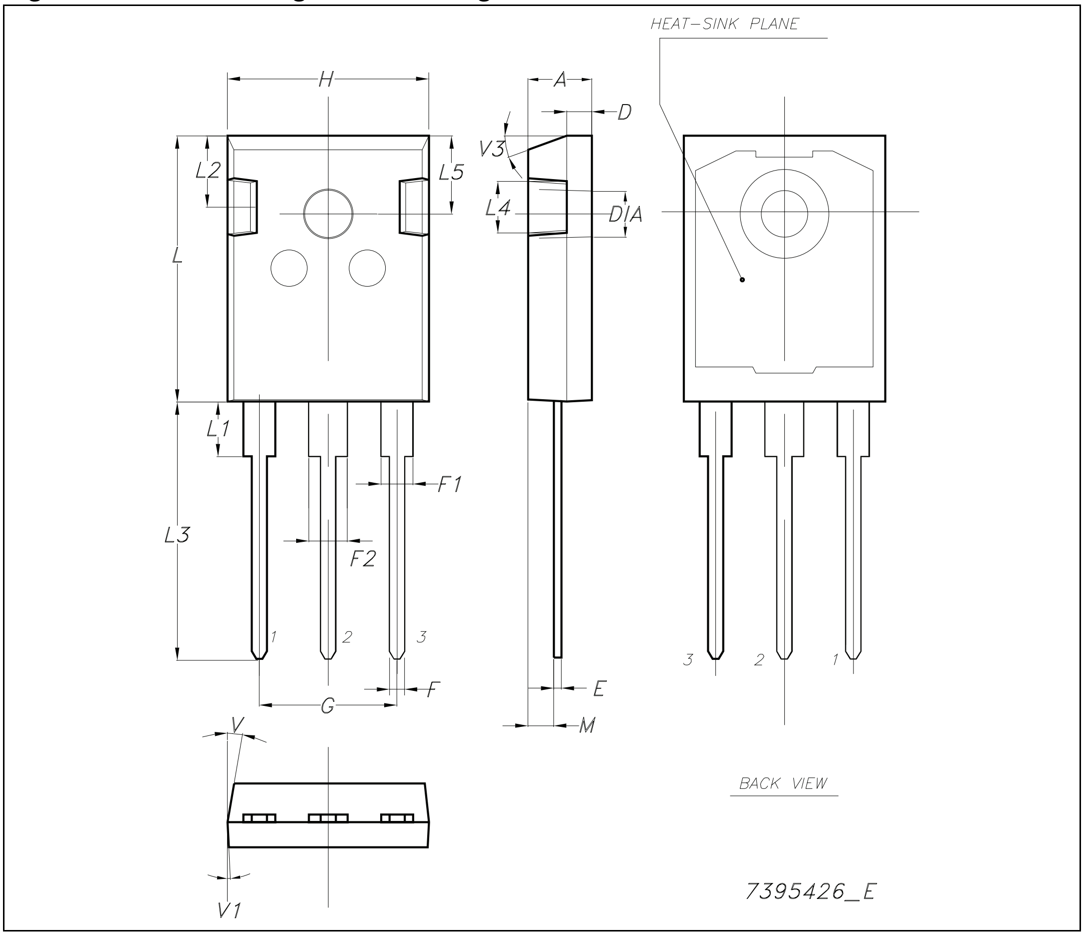
4 Package mechanical data

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 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 19. TO-247 long leads drawing



5 Revision history

Table 10. Document revision history

Date	Revision	Changes
20-Jul-2011	1	Initial release.