STGWA19NC60HD

31 A, 600 V, very fast IGBT with Ultrafast diode

Features

- Low on-voltage drop ($V_{CE(sat)}$)
- Very soft Ultrafast recovery anti-parallel diode

Applications

- High frequency motor drives
- SMPS and PFC in both hard switch and resonant topologies

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.

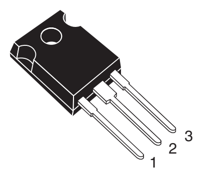

Figure 1. Internal schematic diagram

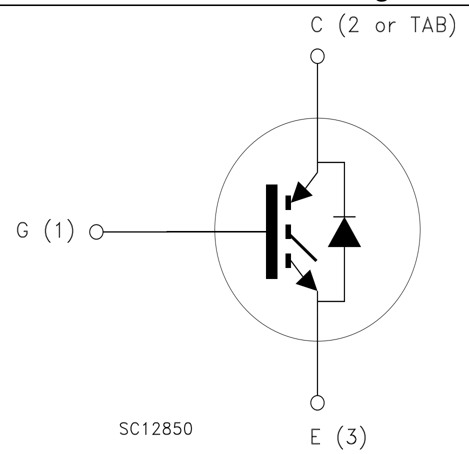

Table 1. Device summary

Part number	Marking	Package	Packaging
STGWA19NC60HD	GWA19NC60HD	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)	600	V
I_C (1)	Continuous collector current at T_C = 25 °C	52	A
I_C (1)	Continuous collector current at T_C = 100 °C	31	A
I_{CL} (2)	Turn-off latching current	40	A
I_{CP} (3)	Pulsed collector current	60	A
I_F	Diode RMS forward current at T_C = 25 °C	20	A
I_{FSM}	Surge not repetitive forward current t_p=10 ms sinusoidal	50	A
V_{GE}	Gate-emitter voltage	±20	V
P_{TOT}	Total dissipation at T_C = 25 °C	208	W
T_J	Operating junction temperature	- 55 to 150	°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%V_{CES}, T_J = 150 °C, R_G = 10 Ω, V_{GE} = 15 V
3. Pulse width limited by maximum permissible junction temperature and turn-off within RBSOA

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case IGBT	0.6	°C/W
	Thermal resistance junction-case diode	3	°C/W
R_{thJA}	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= 12 A V_{GE}= 15 V, I_C= 15 A V_{GE}= 15 V, I_C=30 A,T_J=100 °C V_{GE}= 15 V, I_C=12 A,T_J=125 °C		1.8 2 2.5 1.6	2.5	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_J= 125 °C			150 1	µA mA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE}= ±20 V			±100	nA
g_{fs} (1)	Forward transconductance	V_{CE} = 15 V, I_C= 12 A		5		S

1. Pulsed: pulse duration = 300 µs, duty cycle 1.5%

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	-	1180 130 36	-	pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 390 V, I_C = 5 A, V_{GE} = 15 V, *Figure 18*	-	53 10 23	-	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 = 12 A R_G= 10 Ω, V_{GE}= 15 V, *Figure 19*	-	25 7 1600	-	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 = 12 A R_G= 10 Ω, V_{GE}= 15 V, TJ = 125 °C *Figure 19*	-	24 8 1400	-	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 = 12 A R_G= 10 Ω, V_{GE}= 15 V, *Figure 19*	-	27 97 73	-	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 = 12 A R_G= 10 Ω, V_{GE}= 15 V, T_J = 125 °C *Figure 19*	-	58 144 128	-	ns ns ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on} E_{off}(1) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 390 V, I_C = 12 A R_G= 10 Ω, V_{GE}= 15 V, *Figure 19*	-	85 189 274	-	µJ µJ µJ
E_{on} E_{off}(1) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 390 V, I_C = 12 A R_G= 10 Ω, V_{GE}= 15 V, T_J = 125 °C *Figure 19*	-	187 407 594	-	µJ µJ µJ

1. 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 = 12 A I_F = 12 A, T_J = 125 °C	-	2.6 2.1	-	V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 12 A, V_R = 40 V, di/dt = 100 A/µs *Figure 20*	-	31 30 2	-	ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 12 A, V_R = 40 V, T_J =125 °C, di/dt = 100 A/µs *Figure 20*	-	59 102 4	-	ns nC A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

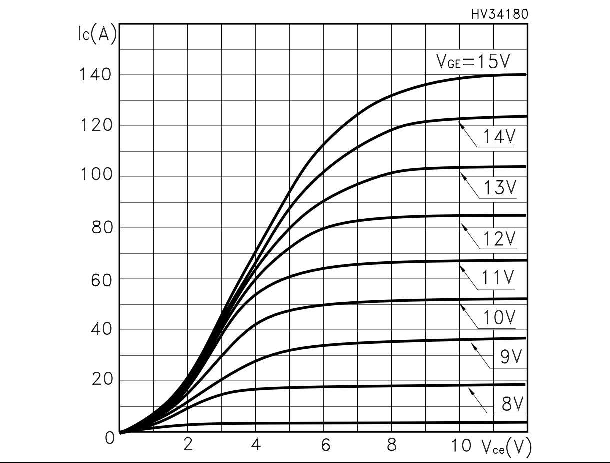


Figure 3. Transfer characteristics

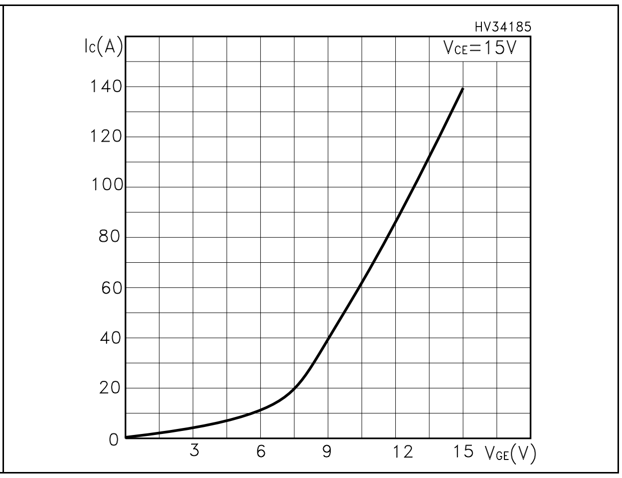


Figure 4. Transconductance

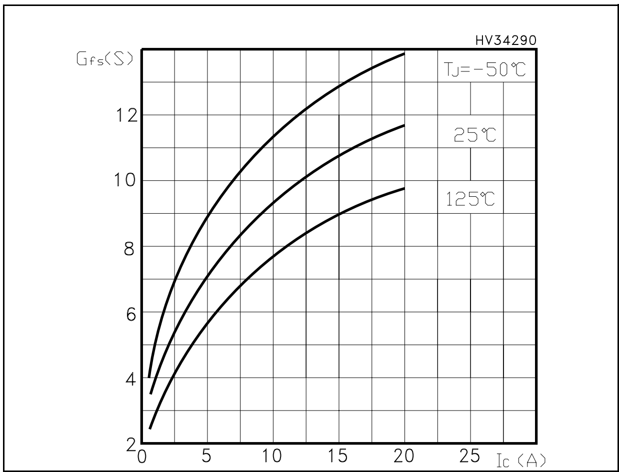


Figure 5. Collector-emitter on voltage vs. temperature

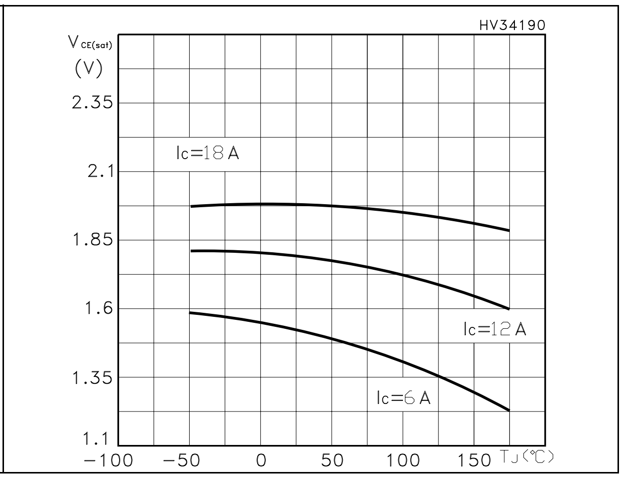


Figure 6. Gate charge vs. gate-source voltage

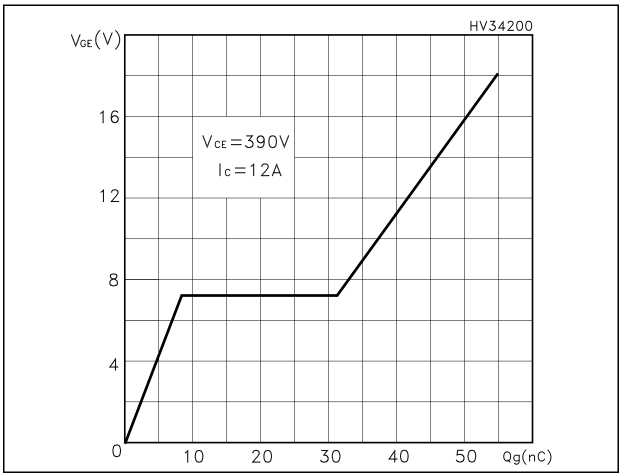


Figure 7. Capacitance variations

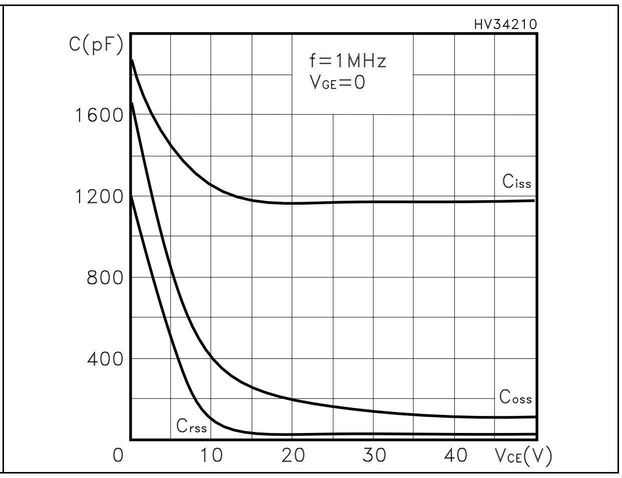


Figure 8. Normalized gate threshold voltage vs. temperature

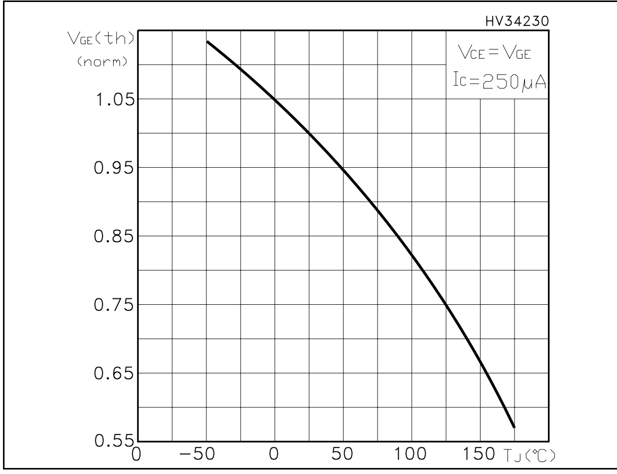


Figure 9. Collector-emitter on voltage vs. collector current

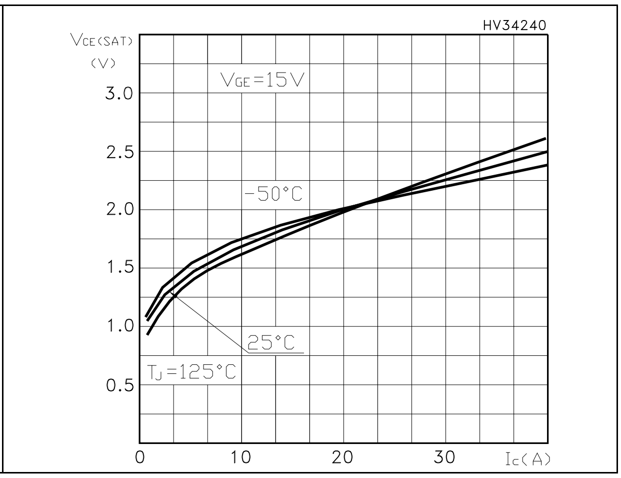


Figure 10. Normalized breakdown voltage vs temperature

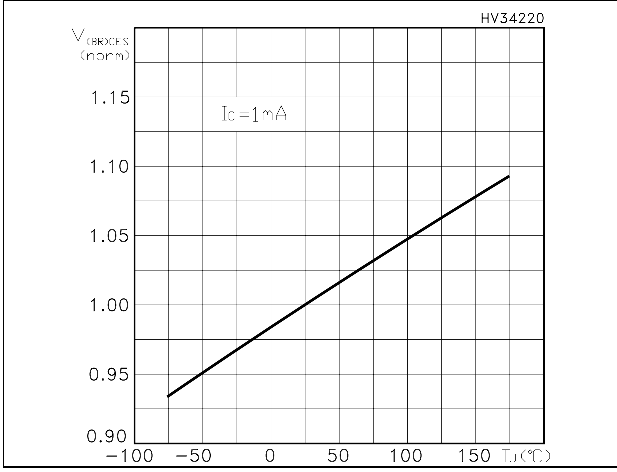


Figure 11. Switching losses vs. temperature

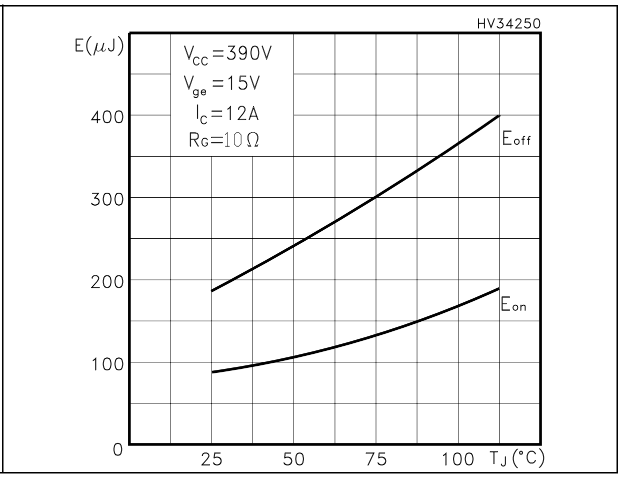


Figure 12. Switching losses vs. gate resistance

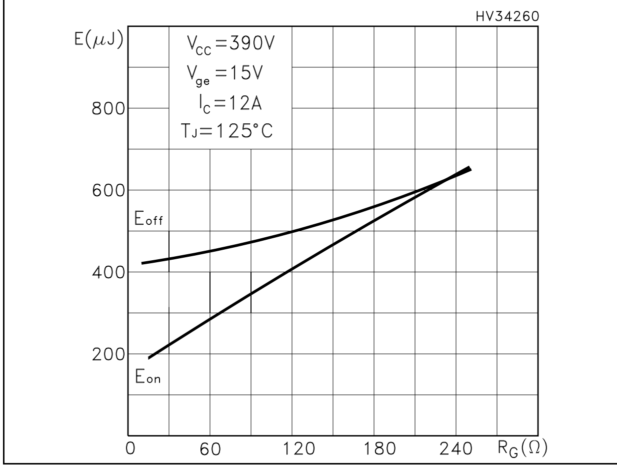


Figure 13. Switching losses vs. collector current

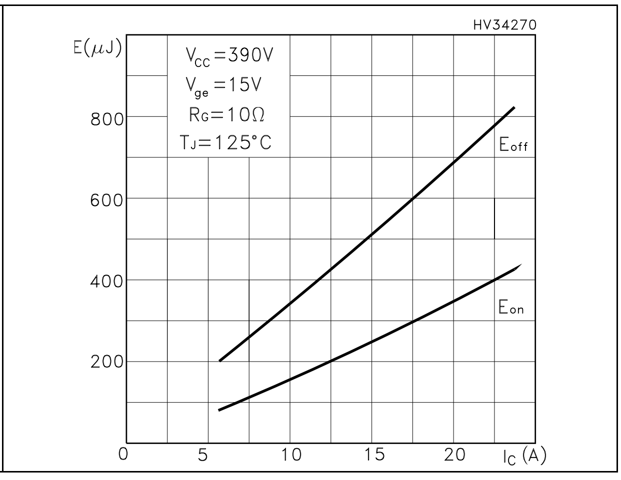


Figure 14. Turn-off SOA

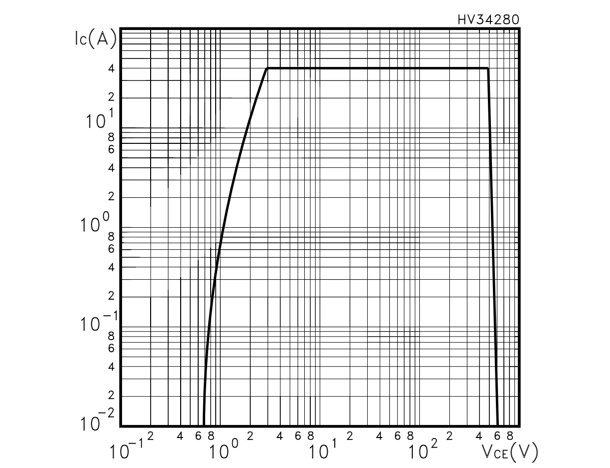


Figure 15. Thermal impedance

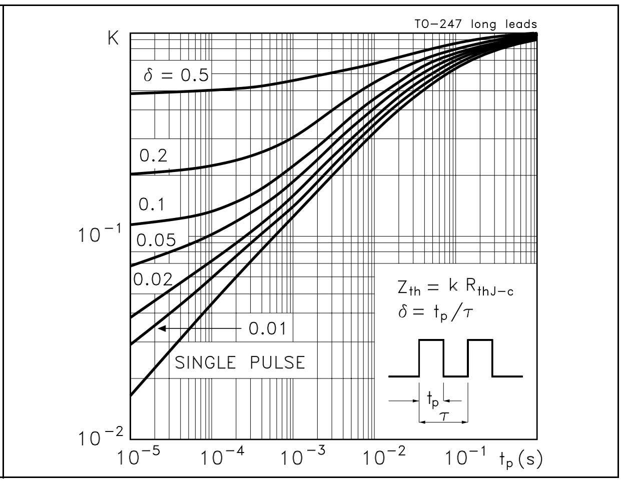
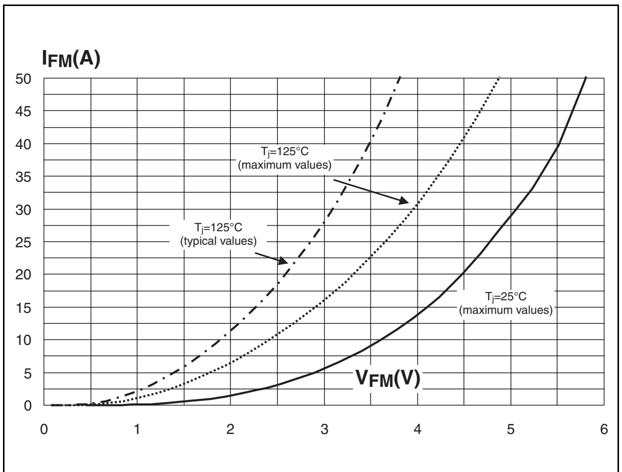


Figure 16. Forward voltage drop vs. forward current



3 Test circuits

Figure 17. Test circuit for inductive load switching

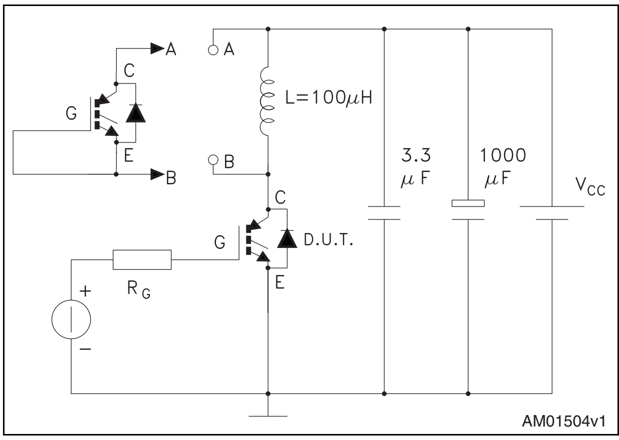


Figure 18. Gate charge test circuit

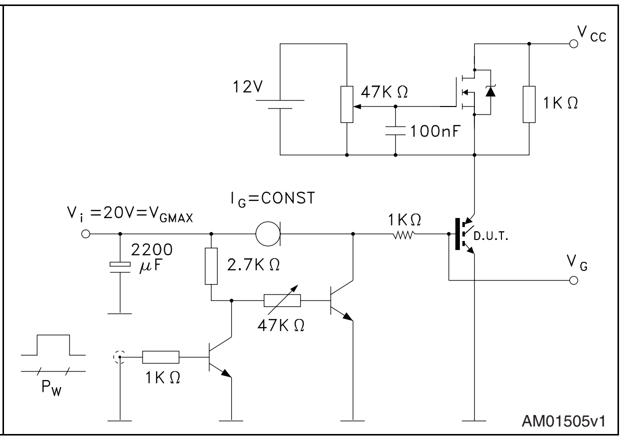


Figure 19. Switching waveform

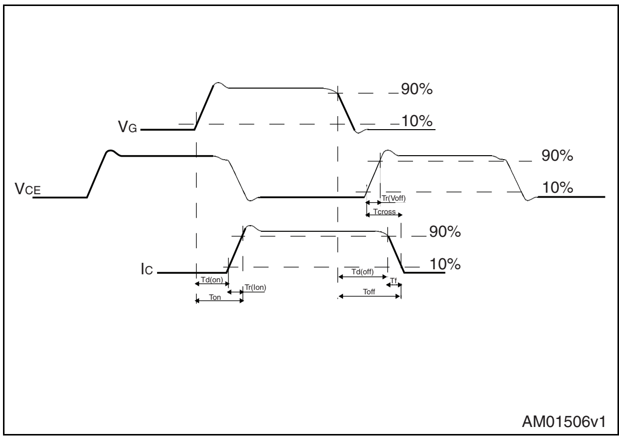
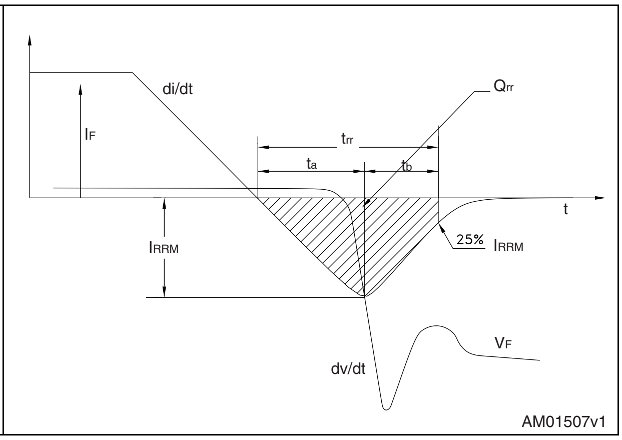


Figure 20. Diode recovery time waveform



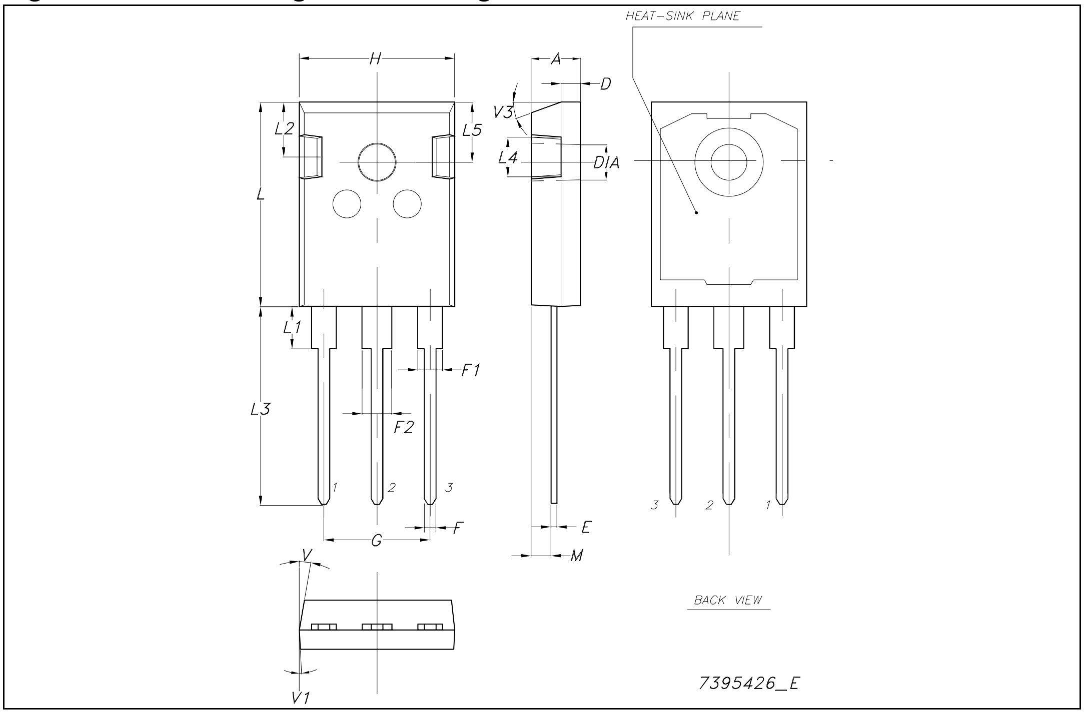
4 Package mechanical data

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 21. TO-247 long leads drawing



5 Revision history

Table 10. Document revision history

Date	Revision	Changes
14-Sep-2011	1	Initial release.

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