



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.

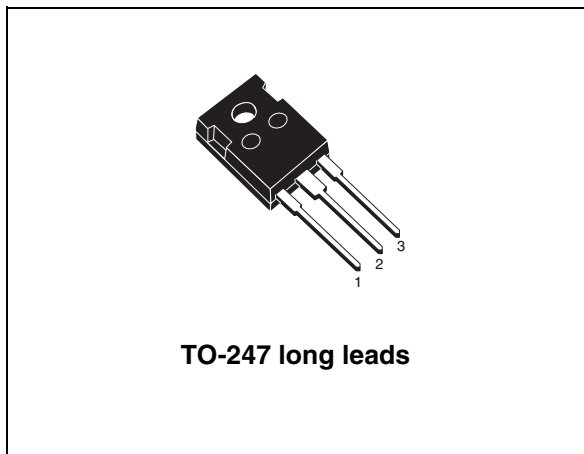


Figure 1. Internal schematic diagram

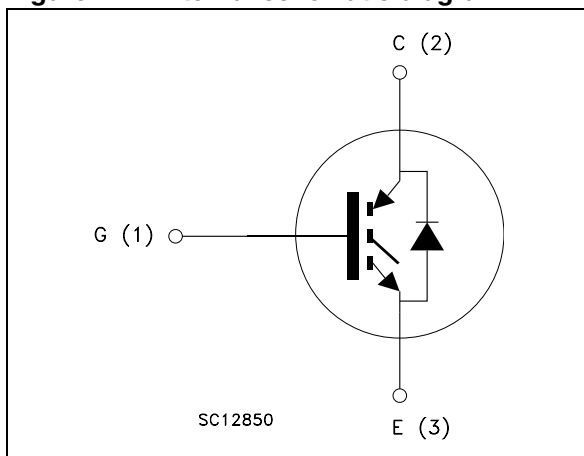


Table 1. Device summary

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 $T_C = 25\text{ °C}$	130	A
$I_C^{(1)}$	Collector current (continuous) at $T_C = 100\text{ °C}$	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 $T_C = 25\text{ °C}$	30	A
I_{FSM}	Surge not repetitive forward current ($t_p = 10\text{ ms}$ sinusoidal)	120	A
V_{GE}	Gate-emitter voltage	± 20	V
P_{TOT}	Total dissipation at $T_C = 25\text{ °C}$	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. $V_{clamp} = 480\text{ V}$, $T_J = 150\text{ °C}$, $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$

3. Pulse width limited by max. temperature allowed

Table 3. Thermal resistance

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

2 Electrical characteristics

$T_{CASE} = 25\text{ °C}$ unless otherwise specified

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ($V_{GE} = 0$)	$I_C = 1\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_C = 125\text{ °C}$		2.1 1.9	2.6	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}$	3.75		5.75	V
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = 600\text{ V}$ $V_{CE} = 600\text{ V}, T_C = 125\text{ °C}$			500 5	μA mA
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{ V}$			± 100	nA
g_{fs}	Forward transconductance	$V_{CE} = 15\text{ V}, I_C = 40\text{ A}$		25		S

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz},$ $V_{GE} = 0$		4700		pF
C_{oes}	Output capacitance			410		pF
C_{res}	Reverse transfer capacitance			90		pF
Q_g	Total gate charge	$V_{CE} = 390\text{ V}, I_C = 40\text{ A},$		195		nC
Q_{ge}	Gate-emitter charge	$V_{GE} = 15\text{ V},$		32		nC
Q_{gc}	Gate-collector charge	Figure 16		82		nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}$, $I_C = 40\text{ A}$		40		ns
t_r	Current rise time	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,		30		ns
$(di/dt)_{on}$	Turn-on current slope	Figure 17 , Figure 15		1039		A/ μ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}$, $I_C = 40\text{ A}$		37		ns
t_r	Current rise time	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,		32		ns
$(di/dt)_{on}$	Turn-on current slope	$T_C = 125\text{ }^\circ\text{C}$ Figure 17 , Figure 15		990		A/ μ s
$t_{r(Voff)}$	Off voltage rise time	$V_{CC} = 390\text{ V}$, $I_C = 40\text{ A}$		31		ns
$t_{d(Voff)}$	Turn-off delay time	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,		240		ns
t_f	Current fall time	Figure 17 , Figure 15		35		ns
$t_{r(Voff)}$	Off voltage rise time	$V_{CC} = 390\text{ V}$, $I_C = 40\text{ A}$		59		ns
$t_{d(Voff)}$	Turn-off delay time	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,		280		ns
t_f	Current fall time	$T_C = 125\text{ }^\circ\text{C}$ Figure 17 , Figure 15		63		ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 390\text{ V}$, $I_C = 40\text{ A}$		743		μ J
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,		560		μ J
E_{ts}	Total switching losses	Figure 15		925		μ J
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 390\text{ V}$, $I_C = 40\text{ A}$		917		μ J
$E_{off}^{(2)}$	Turn-off switching losses	$R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$,		910		μ J
E_{ts}	Total switching losses	$T_C = 125\text{ }^\circ\text{C}$ Figure 15		1545		μ J

1. E_{on} is the turn-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-pak 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	$I_F = 40\text{ A}$ $I_F = 40\text{ A}$, $T_C = 125\text{ }^\circ\text{C}$		3.2 2.2		V V
t_{rr}	Reverse recovery time	$I_F = 40\text{ A}$, $V_R = 50\text{ V}$,		42		ns
Q_{rr}	Reverse recovery charge	$di/dt = 100\text{ A}/\mu\text{s}$		55		nC
I_{rrm}	Reverse recovery current	Figure 18		2.6		A
t_{rr}	Reverse recovery time	$I_F = 40\text{ A}$, $V_R = 50\text{ V}$,		141		ns
Q_{rr}	Reverse recovery charge	$T_C = 125\text{ }^\circ\text{C}$,		324		nC
I_{rrm}	Reverse recovery current	$di/dt = 100\text{ A}/\mu\text{s}$ (Figure 18)		4.6		A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

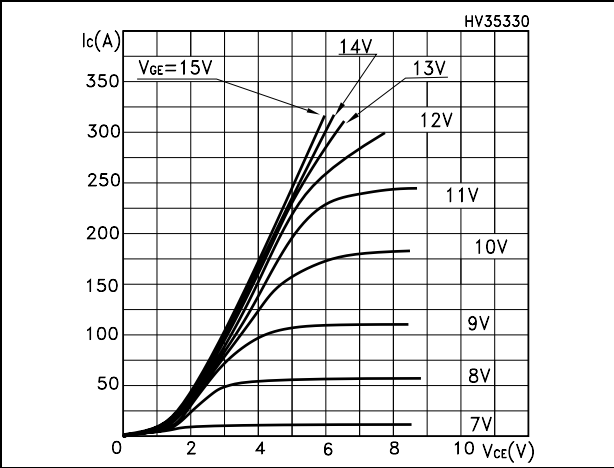


Figure 3. Transfer characteristics

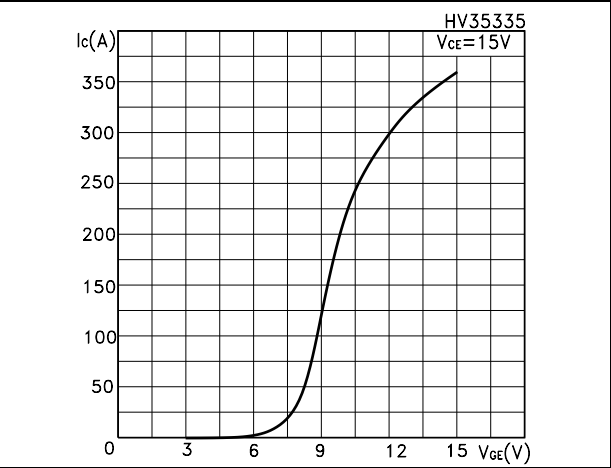


Figure 4. Transconductance

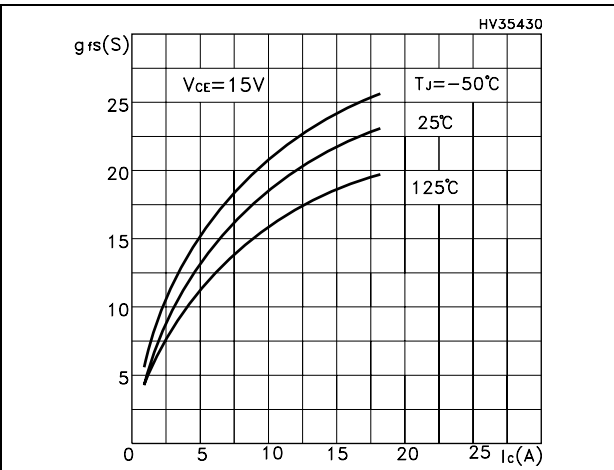


Figure 5. Collector-emitter on voltage vs. temperature

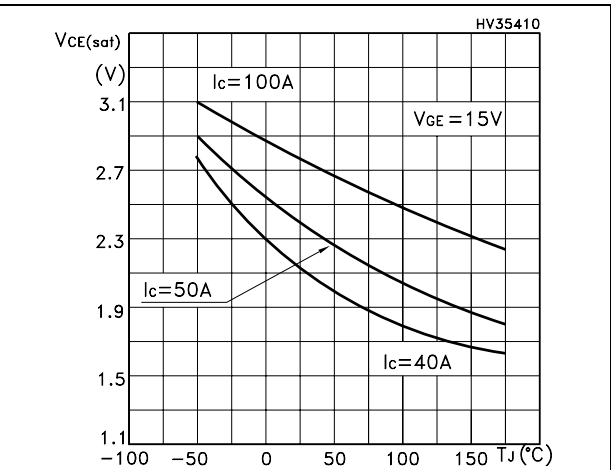


Figure 6. Gate charge vs. gate-source voltage

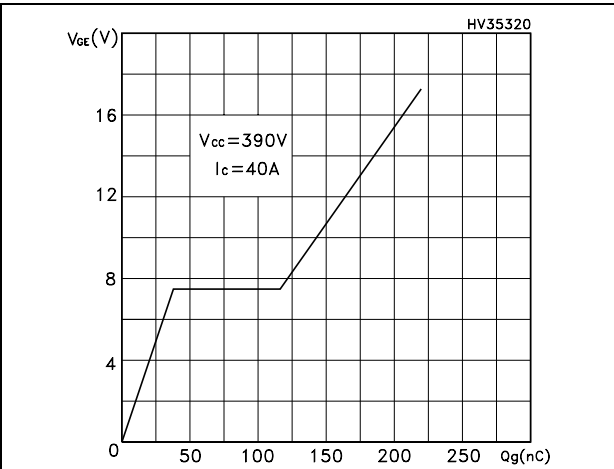


Figure 7. Capacitance variations

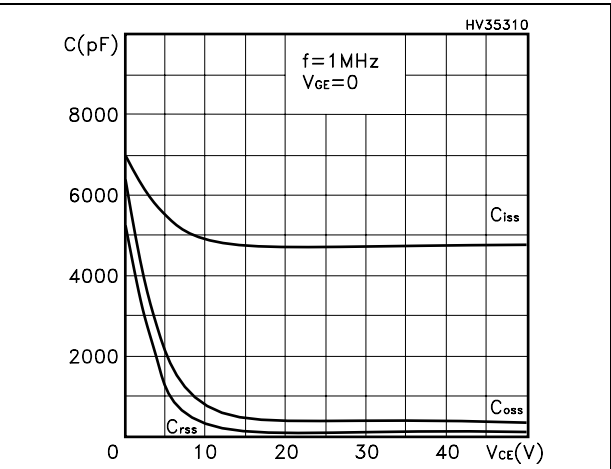


Figure 8. Normalized gate threshold voltage vs. temperature

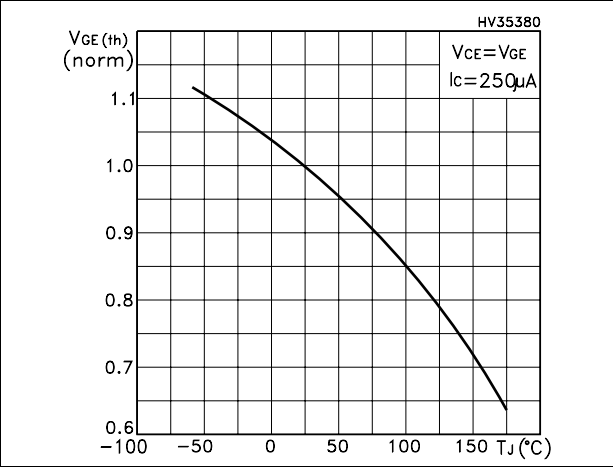


Figure 9. Collector-emitter on voltage vs. collector current

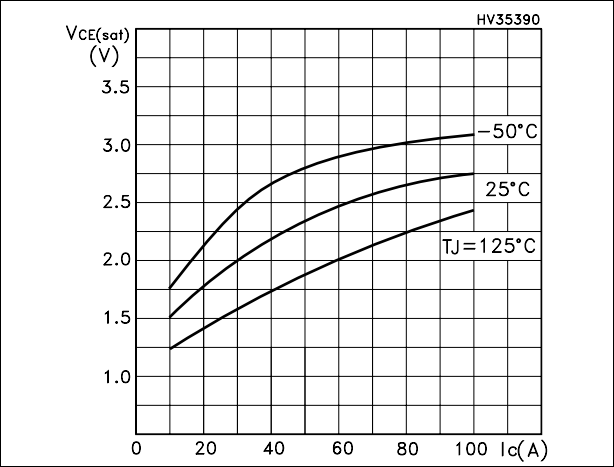


Figure 10. Normalized breakdown voltage vs. temperature

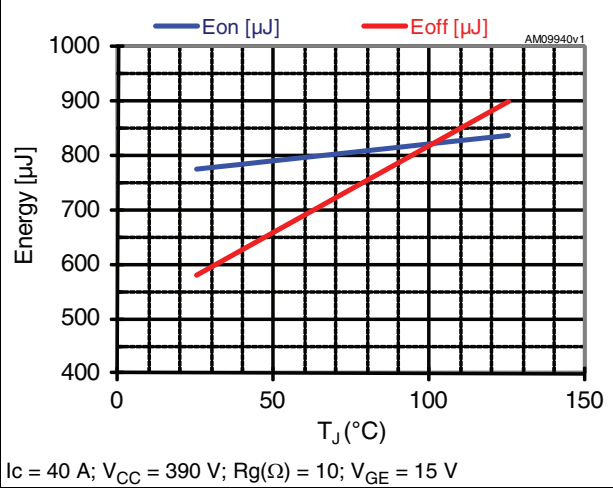


Figure 11. Switching losses vs. IC

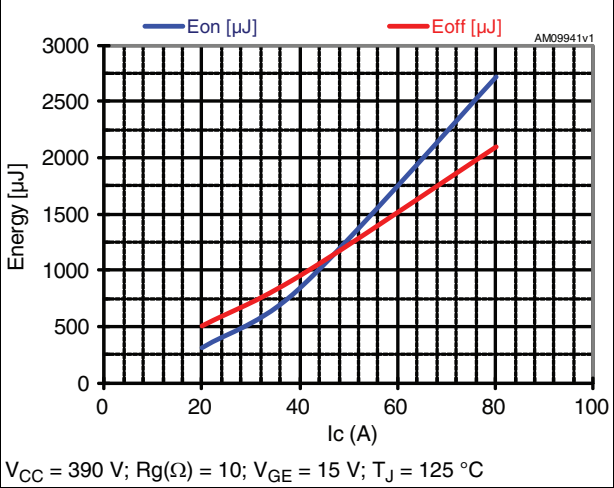


Figure 12. Switching losses vs. gate resistance

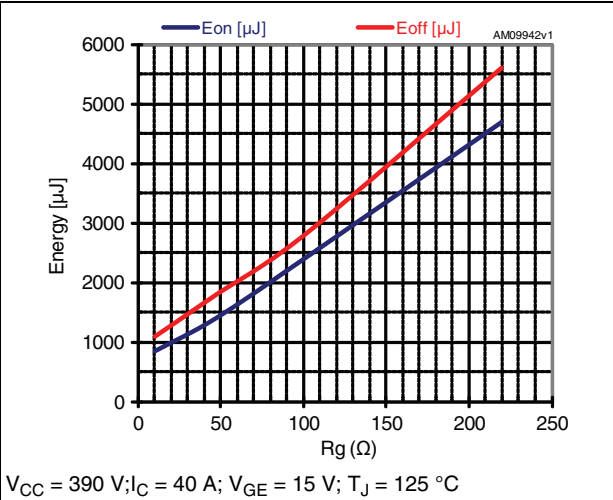


Figure 13. Turn-off SOA

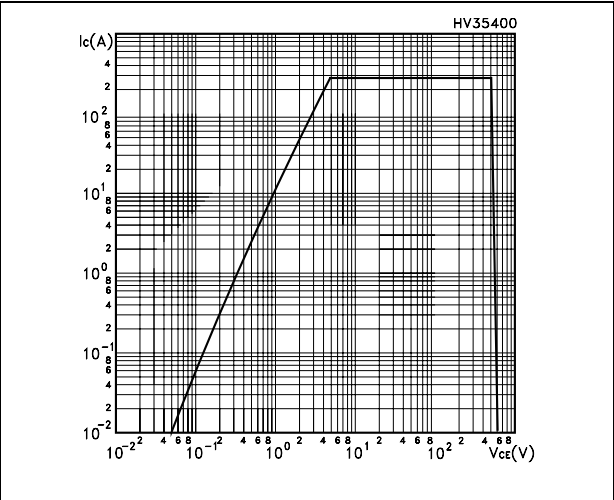
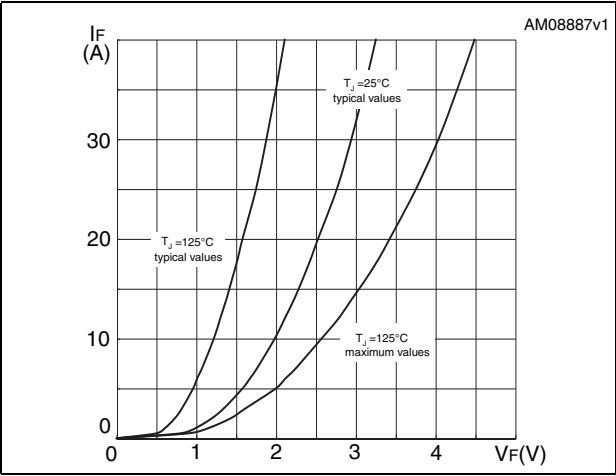


Figure 14. Forward voltage drop vs. forward current



3 Test circuit

Figure 15. Test circuit for inductive load switching

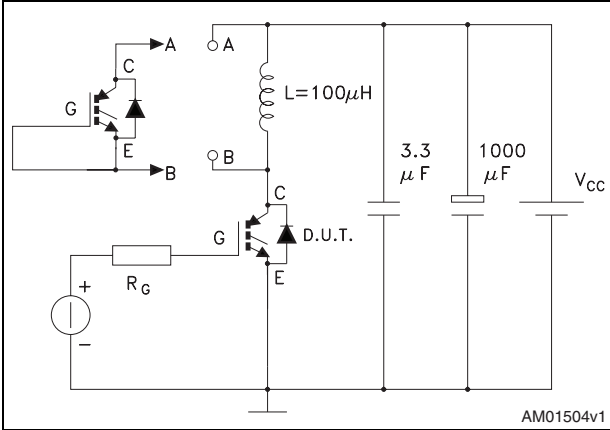


Figure 16. Gate charge test circuit

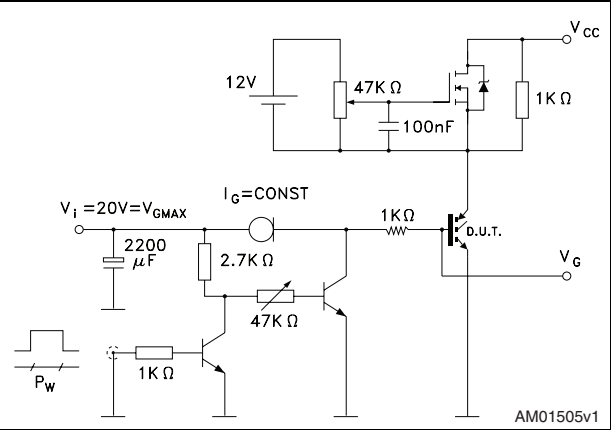


Figure 17. Switching waveform

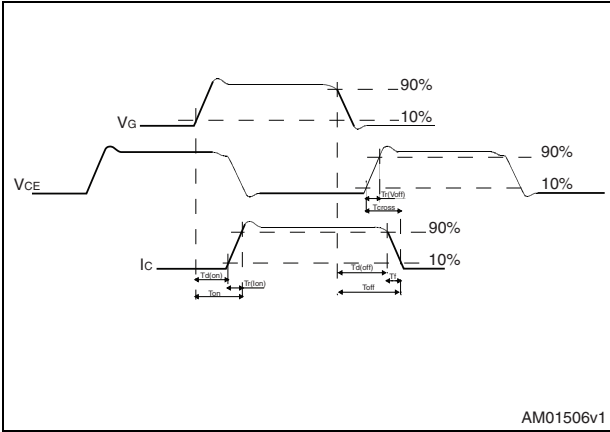
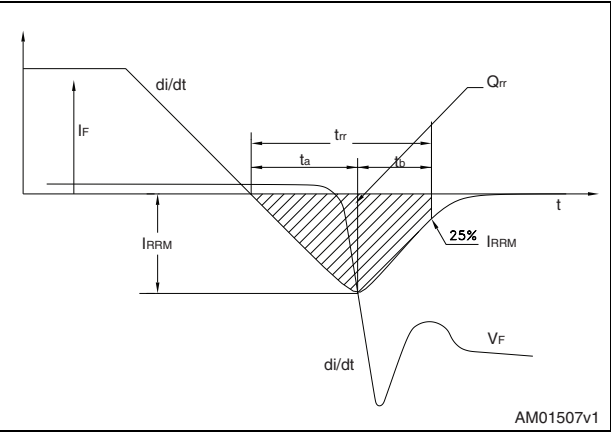


Figure 18. Diode recovery time waveform



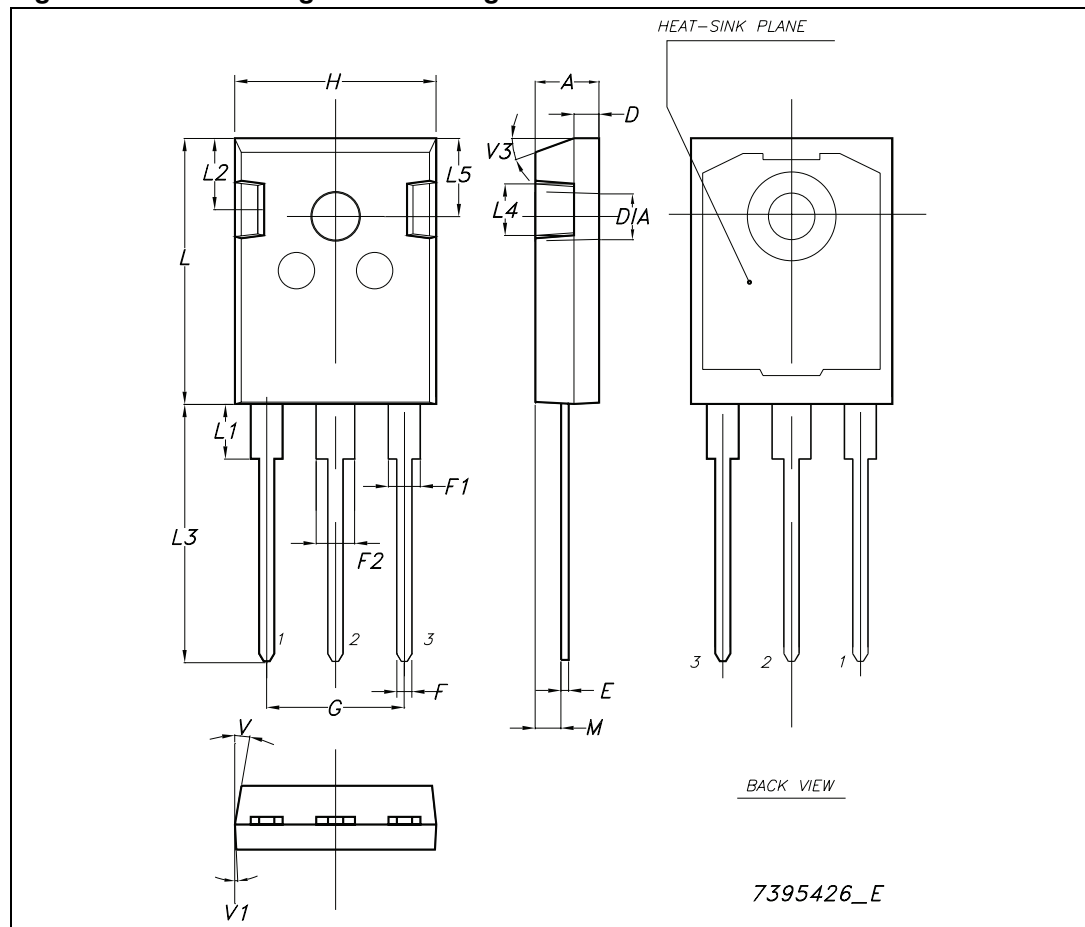
4 Package mechanical data

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.

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