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STGW35NC120HD

32 A, 1200 V
very fast IGBT

Datasheet - production data

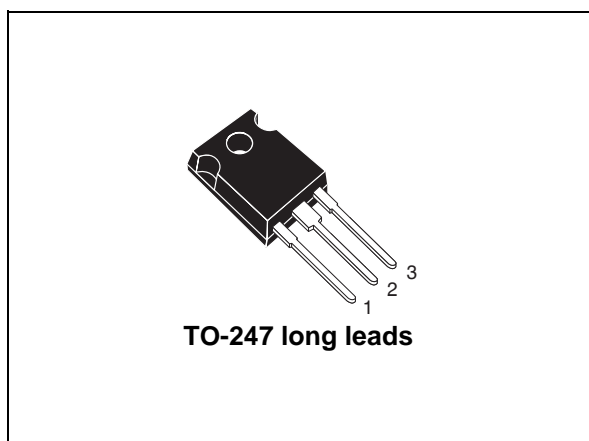
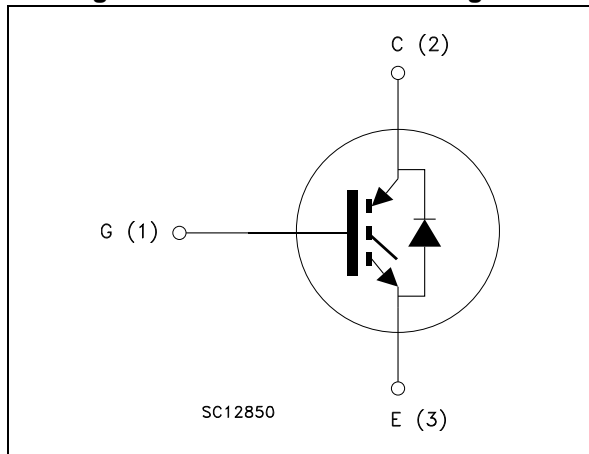


Figure 1. Internal schematic diagram



Features

- Low on-losses
- Low on-voltage drop ($V_{CE(sat)}$)
- High current capability
- IGBT co-packaged with ultrafast free-wheeling diode
- Low gate charge
- Ideal for soft switching application

Application

- Induction heating
- High frequency inverters
- UPS

Description

This IGBT utilizes the advanced PowerMESH™ process resulting in an excellent trade-off between switching performance and low on-state behavior.

Table 1. Device summary

Order code	Marking	Package	Packaging
STGW35NC120HD	GW35NC120HD	TO-247 long leads	Tube

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STGW35NC120HD

Electrical ratings

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 $T_C = 25\text{ °C}$	60	A
$I_C^{(1)}$	Continuous collector current at $T_C = 100\text{ °C}$	32	A
$I_{CL}^{(2)}$	Turn-off latching current	135	A
$I_{CP}^{(3)}$	Pulsed collector current	135	A
V_{GE}	Gate-emitter voltage	± 25	V
P_{TOT}	Total dissipation at $T_C = 25\text{ °C}$	235	W
I_F	Diode RMS forward current at $T_C = 25\text{ °C}$	30	A
I_{FSM}	Surge non repetitive forward current $t_p = 10\text{ ms}$ sinusoidal	100	A
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. $V_{clamp} = 80\%$ of V_{CES} , $T_j = 125\text{ °C}$, $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$

3. Pulse width limited by max. junction temperature allowed

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case IGBT	0.53	°C/W
	Thermal resistance junction-case diode	1.5	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	50	°C/W

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2 Electrical characteristics

($T_j = 25\text{ °C}$ unless otherwise specified)

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ($V_{GE} = 0$)	$I_C = 1\text{ mA}$	1200			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$, $T_j = 125\text{ °C}$		2.2 2.0	2.75	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 250\mu\text{A}$	3.75		5.75	V
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = 1200\text{ V}$ $V_{CE} = 1200\text{ V}$, $T_j = 125\text{ °C}$			500 10	μA mA
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{ V}$			± 100	nA
$g_{fs}^{(1)}$	Forward transconductance	$V_{CE} = 25\text{ V}$, $I_C = 20\text{ A}$		14		S

1. Pulse duration = 300 μs , duty cycle 1.5%

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0$	-	2510	-	pF
C_{oes}	Output capacitance		-	175	-	pF
C_{res}	Reverse transfer capacitance		-	30	-	pF
Q_g	Total gate charge	$V_{CE} = 960\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$	-	110	-	nC
Q_{ge}	Gate-emitter charge		-	16	-	nC
Q_{gc}	Gate-collector charge		-	49	-	nC

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Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 960\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, <i>Figure 17</i>	-	29	-	ns
t_r	Current rise time		-	11	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1820	-	A/ μ s
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 960\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 125\text{ }^\circ\text{C}$ <i>Figure 17</i>	-	27	-	ns
t_r	Current rise time		-	14	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1580	-	A/ μ s
$t_{r(Voff)}$	Off voltage rise time	$V_{CC} = 960\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, <i>Figure 17</i>	-	90	-	ns
$t_{d(off)}$	Turn-off delay time		-	275	-	ns
t_f	Current fall time		-	312	-	ns
$t_{r(Voff)}$	Off voltage rise time	$V_{CC} = 960\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 125\text{ }^\circ\text{C}$ <i>Figure 17</i>	-	150	-	ns
$t_{d(off)}$	Turn-off delay time		-	336	-	ns
t_f	Current fall time		-	592	-	ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 960\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, <i>Figure 17</i>	-	1660	-	μ J
$E_{off}^{(2)}$	Turn-off switching losses		-	4438	-	μ J
E_{ts}	Total switching losses		-	6098	-	μ J
$E_{on}^{(1)}$	Turn-on switching losses	$V_{CC} = 960\text{ V}$, $I_C = 20\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 125\text{ }^\circ\text{C}$ <i>Figure 17</i>	-	3015	-	μ J
$E_{off}^{(2)}$	Turn-off switching losses		-	6900	-	μ J
E_{ts}	Total switching losses		-	9915	-	μ J

1. E_{on} is the turn-on losses when a typical diode is used in the test circuit in figure 2. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs & Diode are at the same temperature (25 $^\circ\text{C}$ and 125 $^\circ\text{C}$)

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	$I_F = 20\text{ A}$ $I_F = 20\text{ A}$, $T_C = 125\text{ }^\circ\text{C}$	-	1.9 1.7	2.5	V V
t_{rr}	Reverse recovery time	$I_F = 20\text{ A}$, $V_R = 27\text{ V}$, $T_j = 125\text{ }^\circ\text{C}$, $di/dt = 100\text{ A}/\mu\text{s}$	-	152	-	ns
Q_{rr}	Reverse recovery charge	<i>Figure 20</i>	-	722	-	nC
I_{rrm}	Reverse recovery current		-	9	-	A

Electrical characteristics

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2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

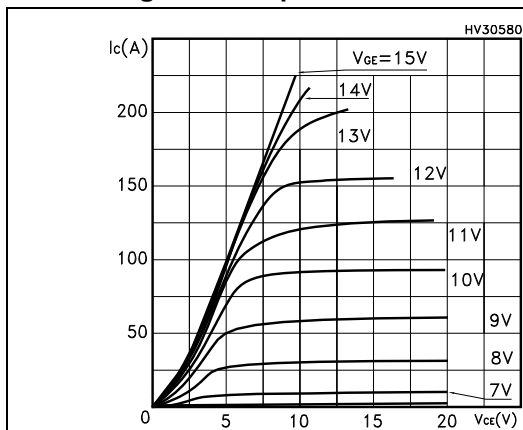


Figure 3. Transfer characteristics

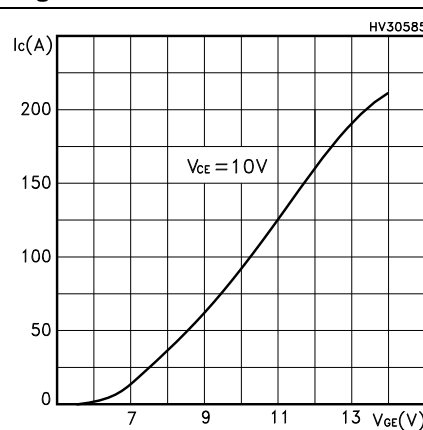


Figure 4. Transconductance

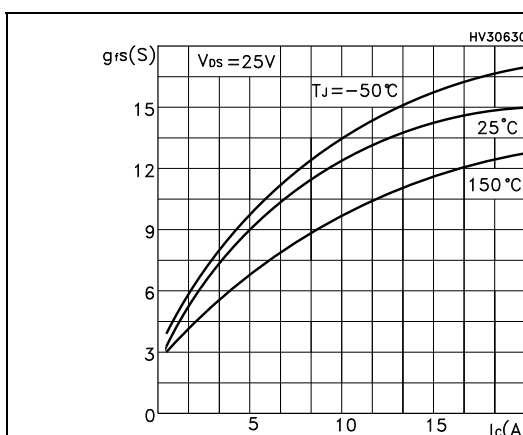


Figure 5. Collector-emitter on voltage vs. temperature

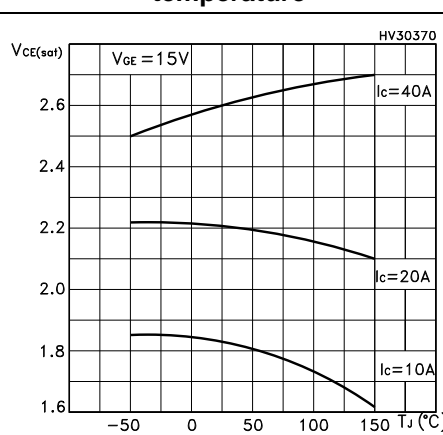


Figure 6. Gate charge vs. gate-source voltage

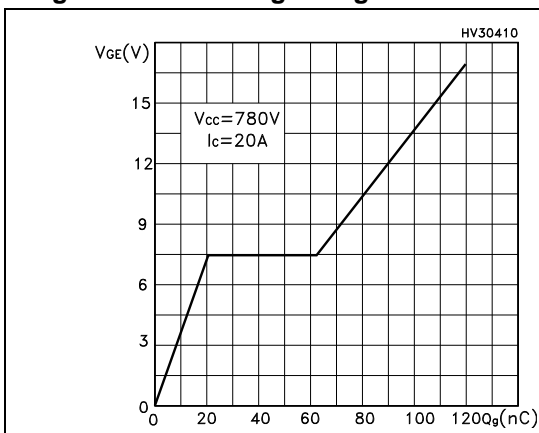
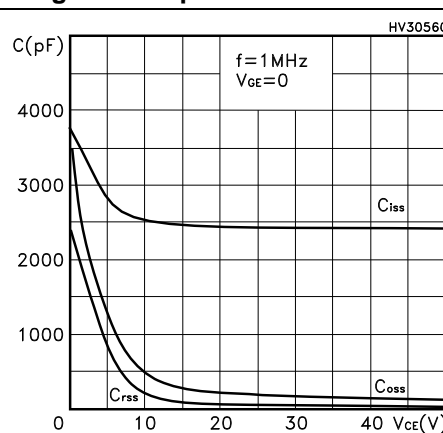


Figure 7. Capacitance variations



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Electrical characteristics

Figure 8. Normalized gate threshold voltage vs. temperature

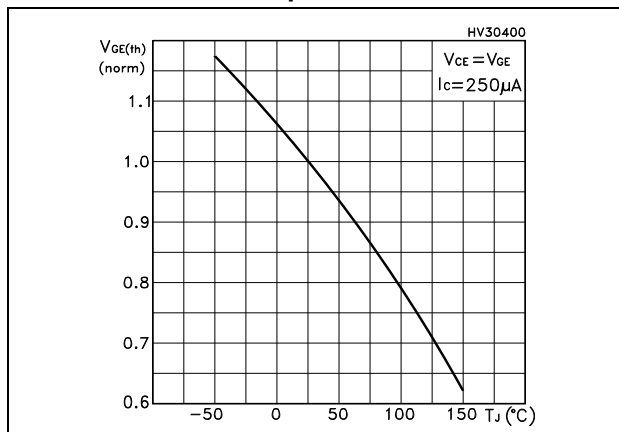


Figure 9. Collector-emitter on voltage vs. collector current

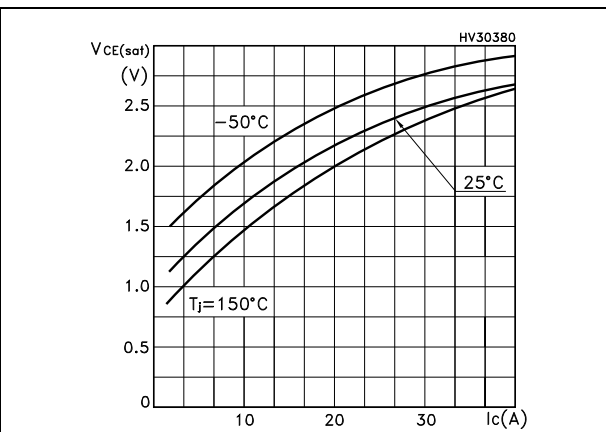


Figure 10. Normalized breakdown voltage vs. temperature

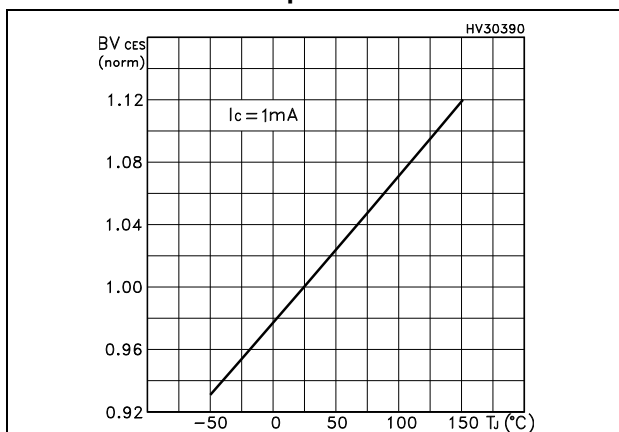


Figure 11. Switching losses vs. temperature

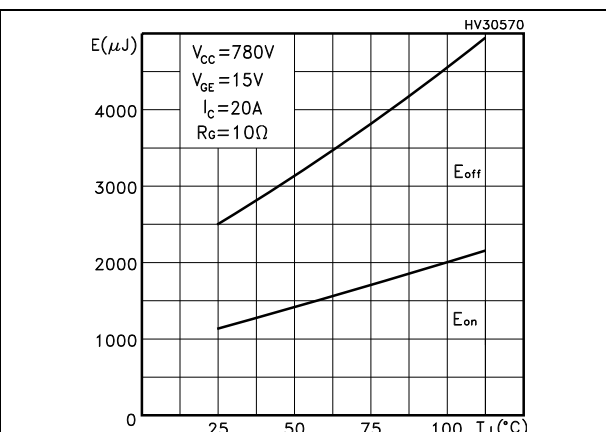
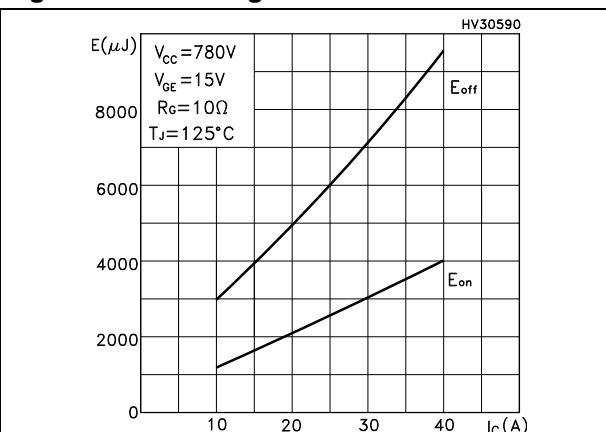
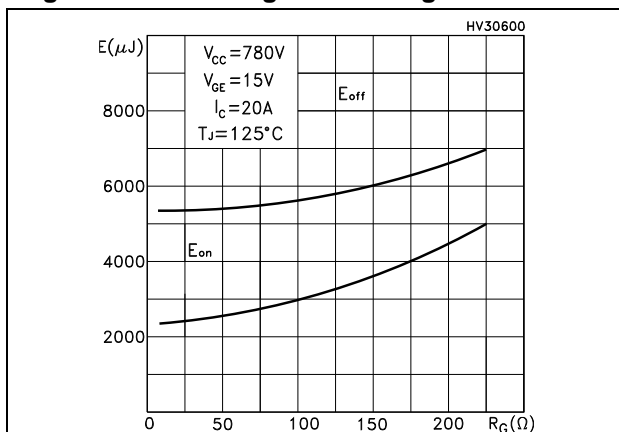


Figure 12. Switching losses vs. gate resistance **Figure 13. Switching losses vs. collector current**



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Figure 14. Thermal Impedance

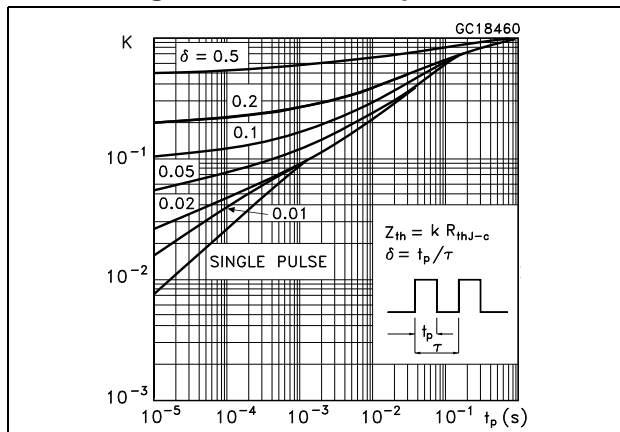


Figure 15. Reverse biased SOA

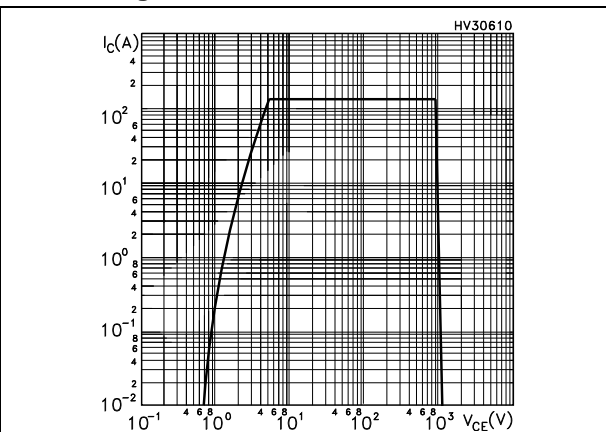
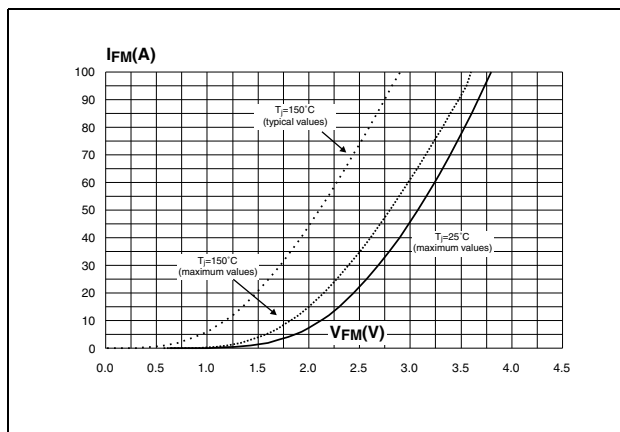


Figure 16. Forward voltage drop vs. forward current



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Test circuits

3 Test circuits

Figure 17. Test circuit for inductive load switching

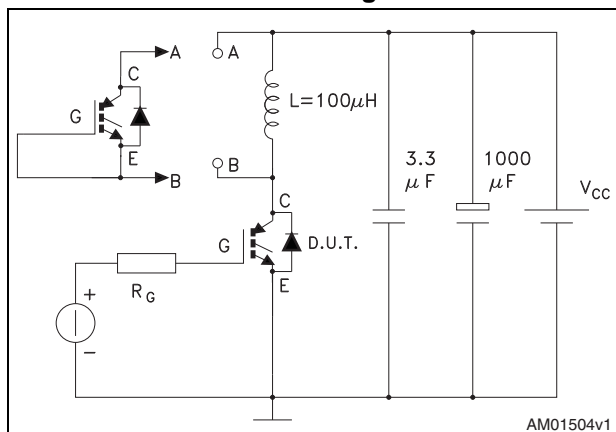


Figure 18. Gate charge test circuit

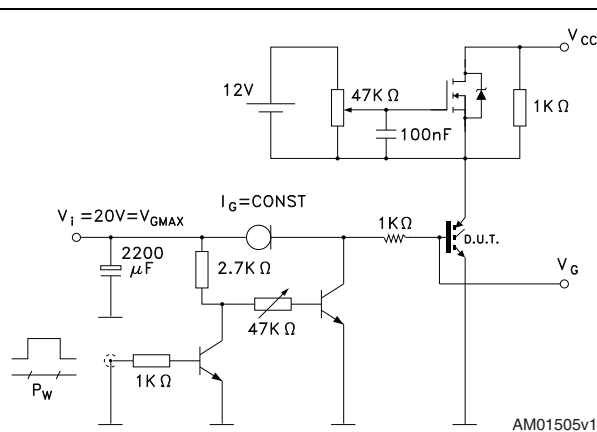


Figure 19. Switching waveform

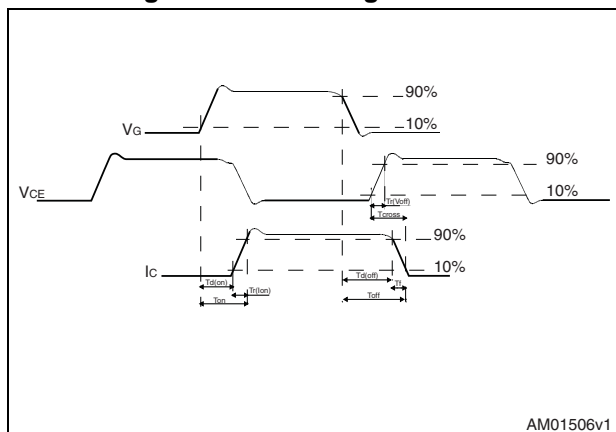
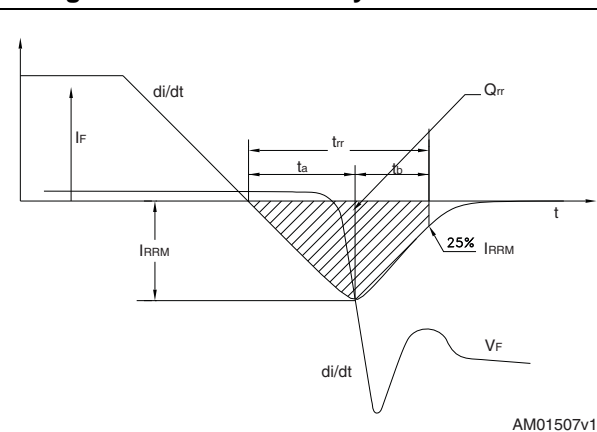


Figure 20. Diode recovery time waveform



Package mechanical data

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4 Package mechanical data

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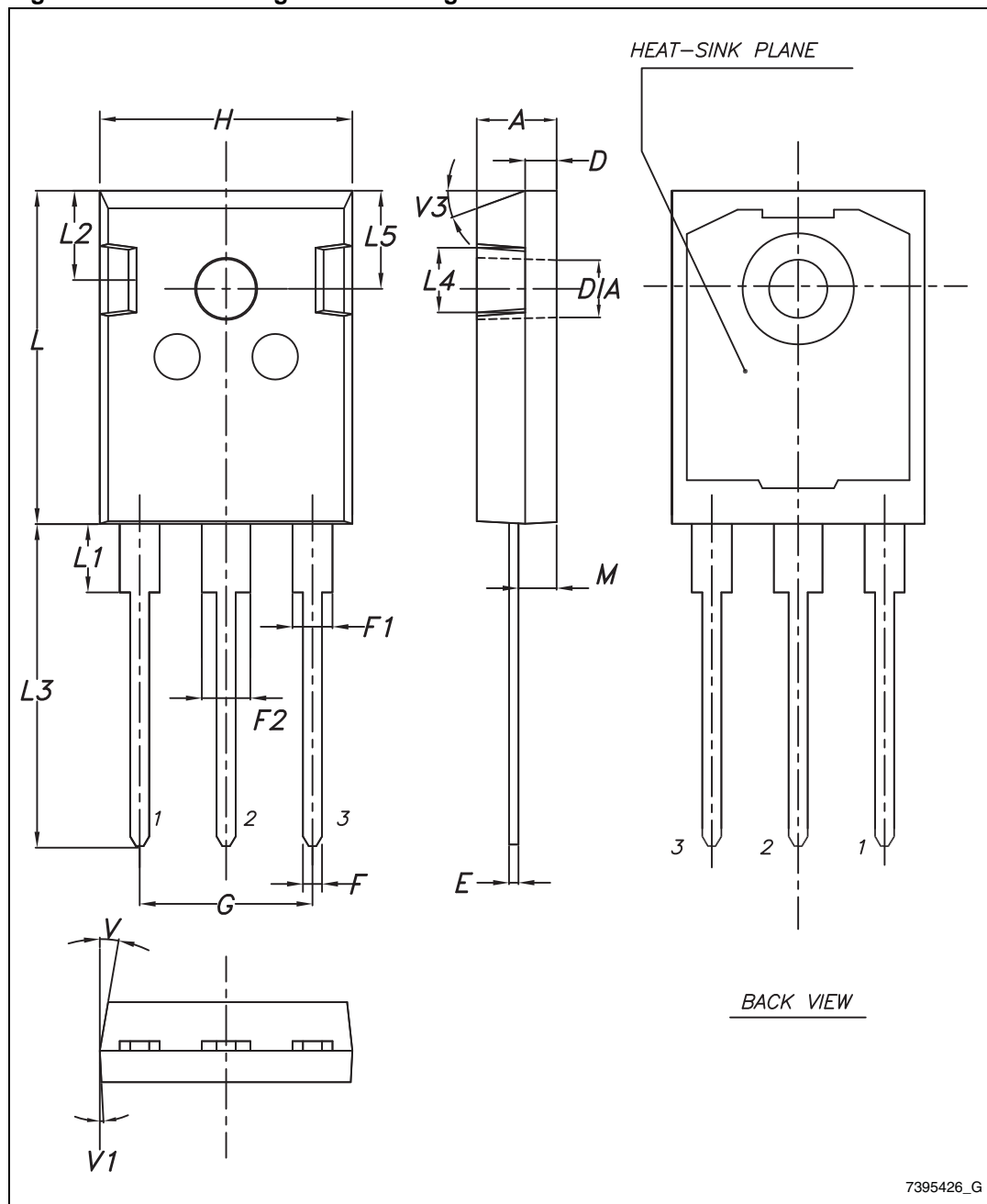
Table 9. TO-247 long leads mechanical data

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	2.25		2.55
V		10°	
V1		3°	
V3		20°	
Dia.	3.55		3.66

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Package mechanical data

Figure 21. TO-247 long leads drawing



5 Revision history

Table 10. Document revision history

Date	Revision	Changes
25-Jan-2008	1	First issue.
07-May-2009	2	Section 4: Package mechanical data has been updated.
12-Dec-2013	3	Updated Section 4: Package mechanical data . Minor text changes.

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