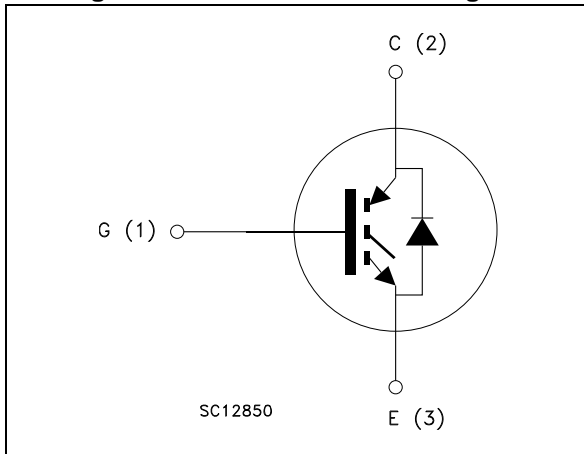


Figure 1. Internal schematic diagram



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

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
	2.1 Electrical characteristics (curves)	6
3	Test circuits	9
4	Package mechanical data	10
5	Revision history	12

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} , $T_j = 125\text{ °C}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$
 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

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

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

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

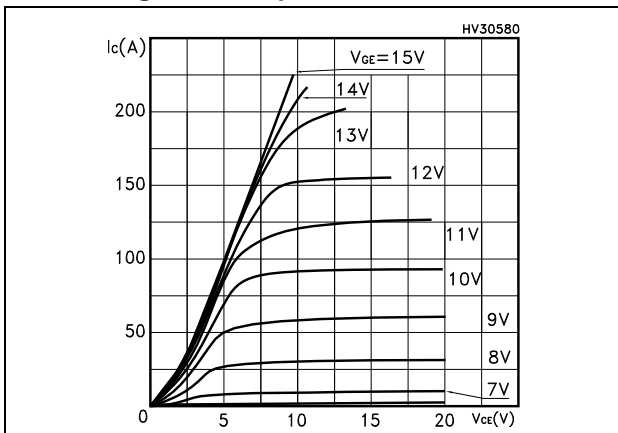


Figure 3. Transfer characteristics

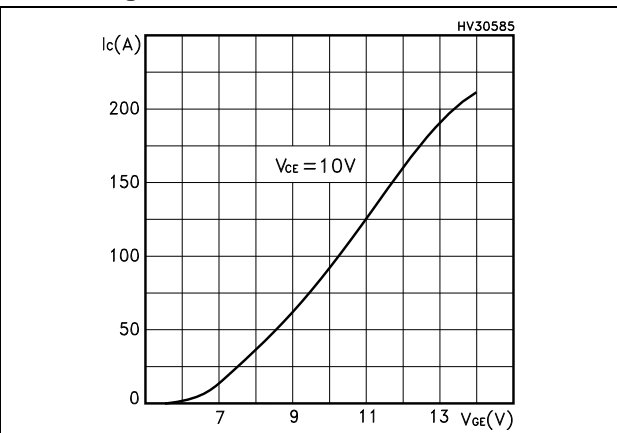


Figure 4. Transconductance

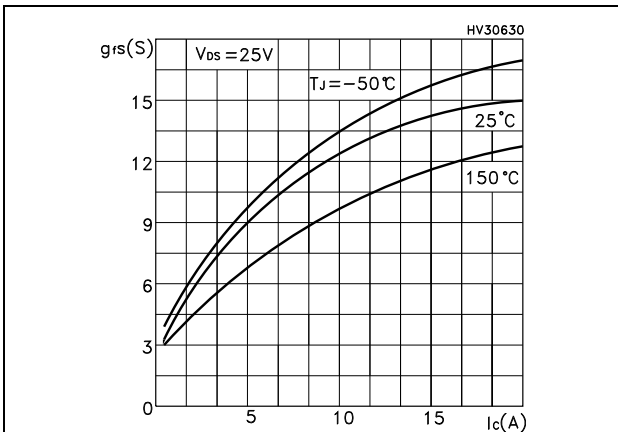


Figure 5. Collector-emitter on voltage vs. temperature

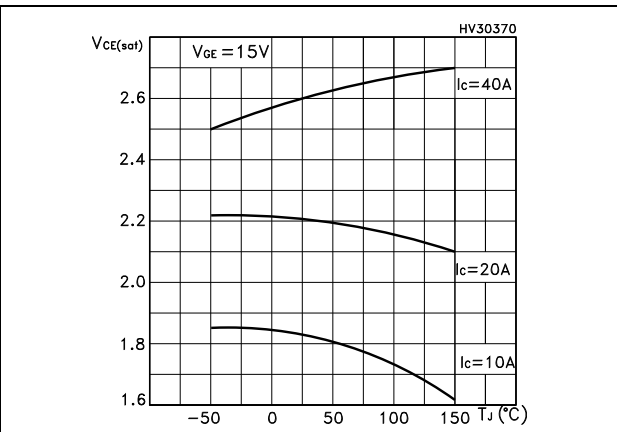


Figure 6. Gate charge vs. gate-source voltage

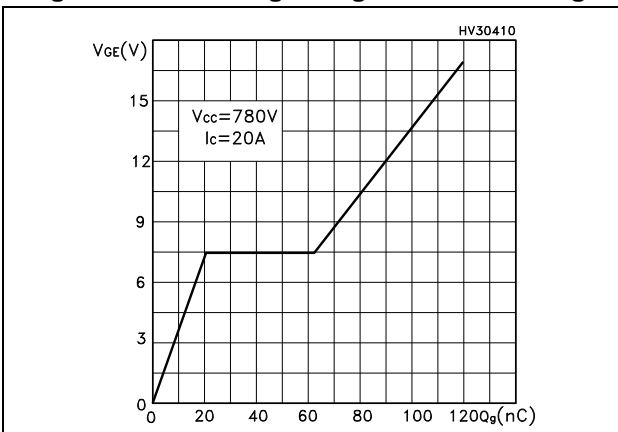


Figure 7. Capacitance variations

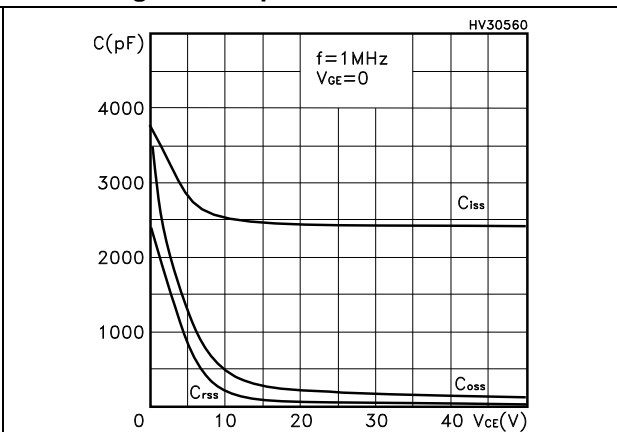


Figure 8. Normalized gate threshold voltage vs. temperature

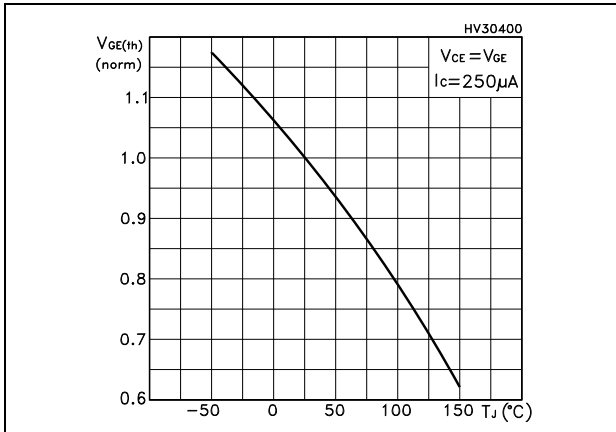


Figure 9. Collector-emitter on voltage vs. collector current

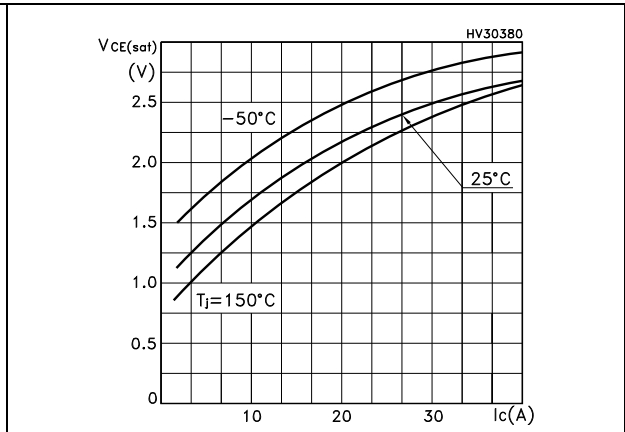


Figure 10. Normalized breakdown voltage vs. temperature

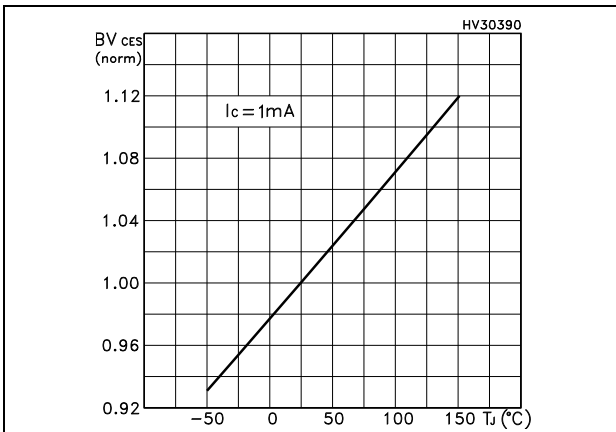


Figure 11. Switching losses vs. temperature

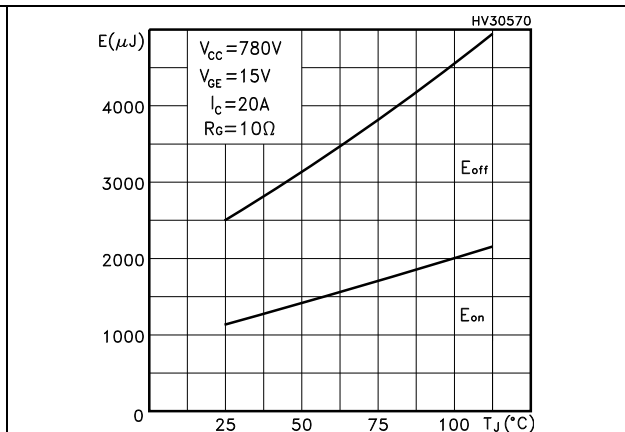


Figure 12. Switching losses vs. gate resistance Figure 13. Switching losses vs. collector current

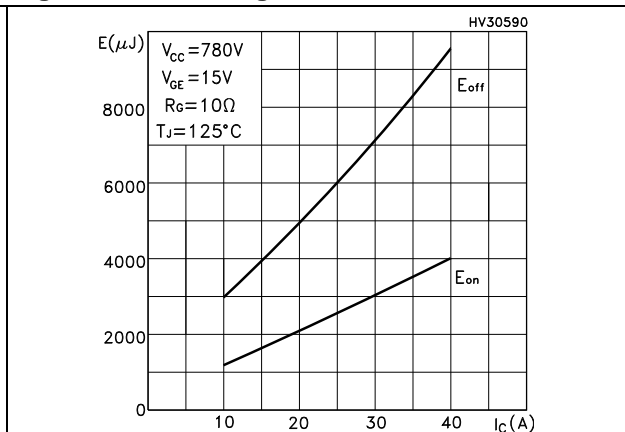
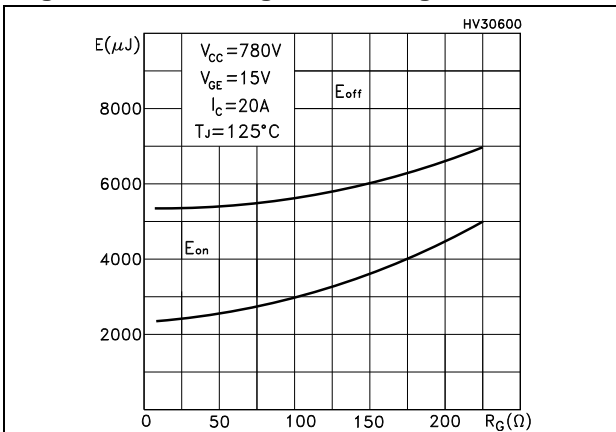


Figure 14. Thermal Impedance

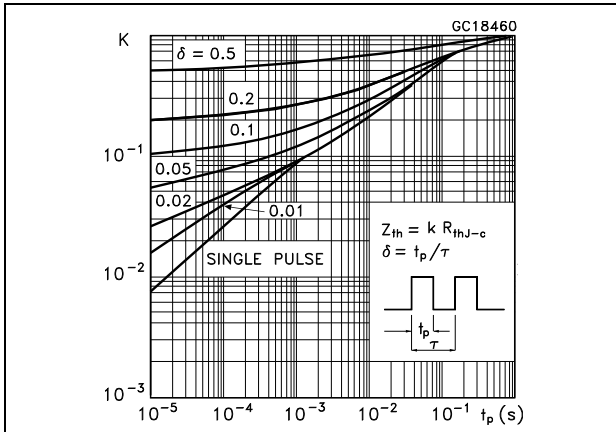


Figure 15. Reverse biased SOA

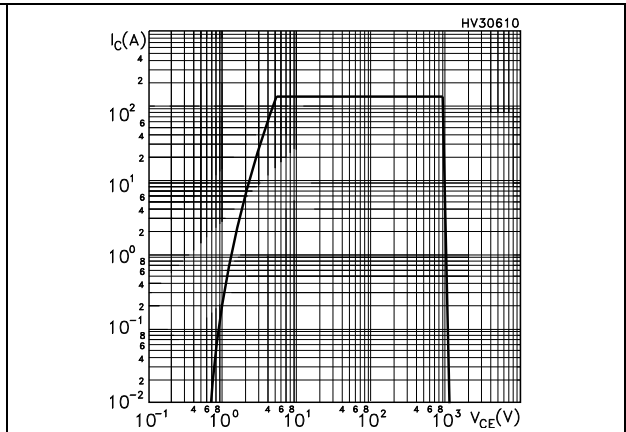
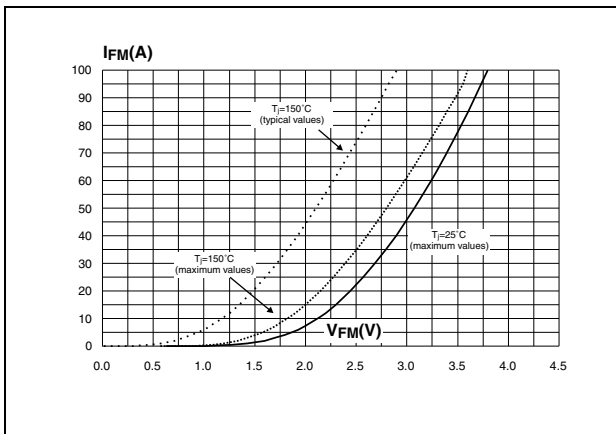


Figure 16. Forward voltage drop vs. forward current



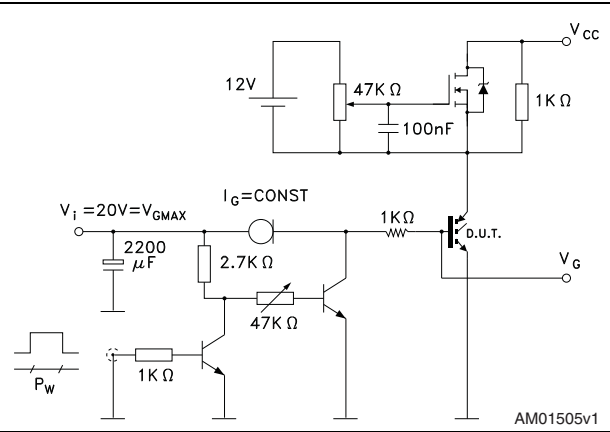
3 Test circuits

Figure 17. Test circuit for inductive load switching



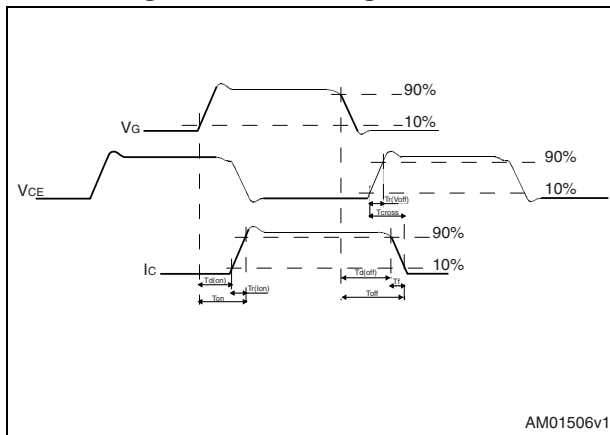
AM01504v1

Figure 18. Gate charge test circuit



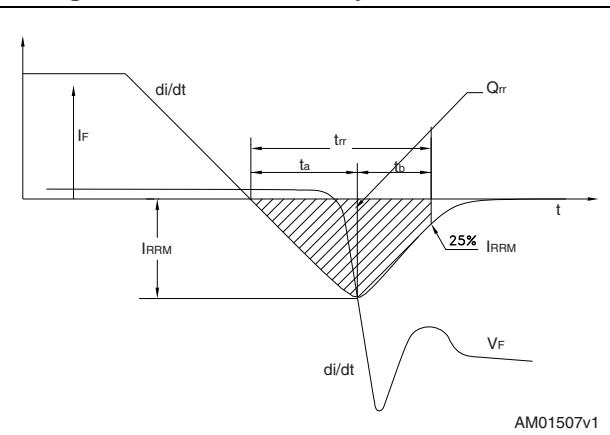
AM01505v1

Figure 19. Switching waveform



AM01506v1

Figure 20. Diode recovery time waveform



AM01507v1

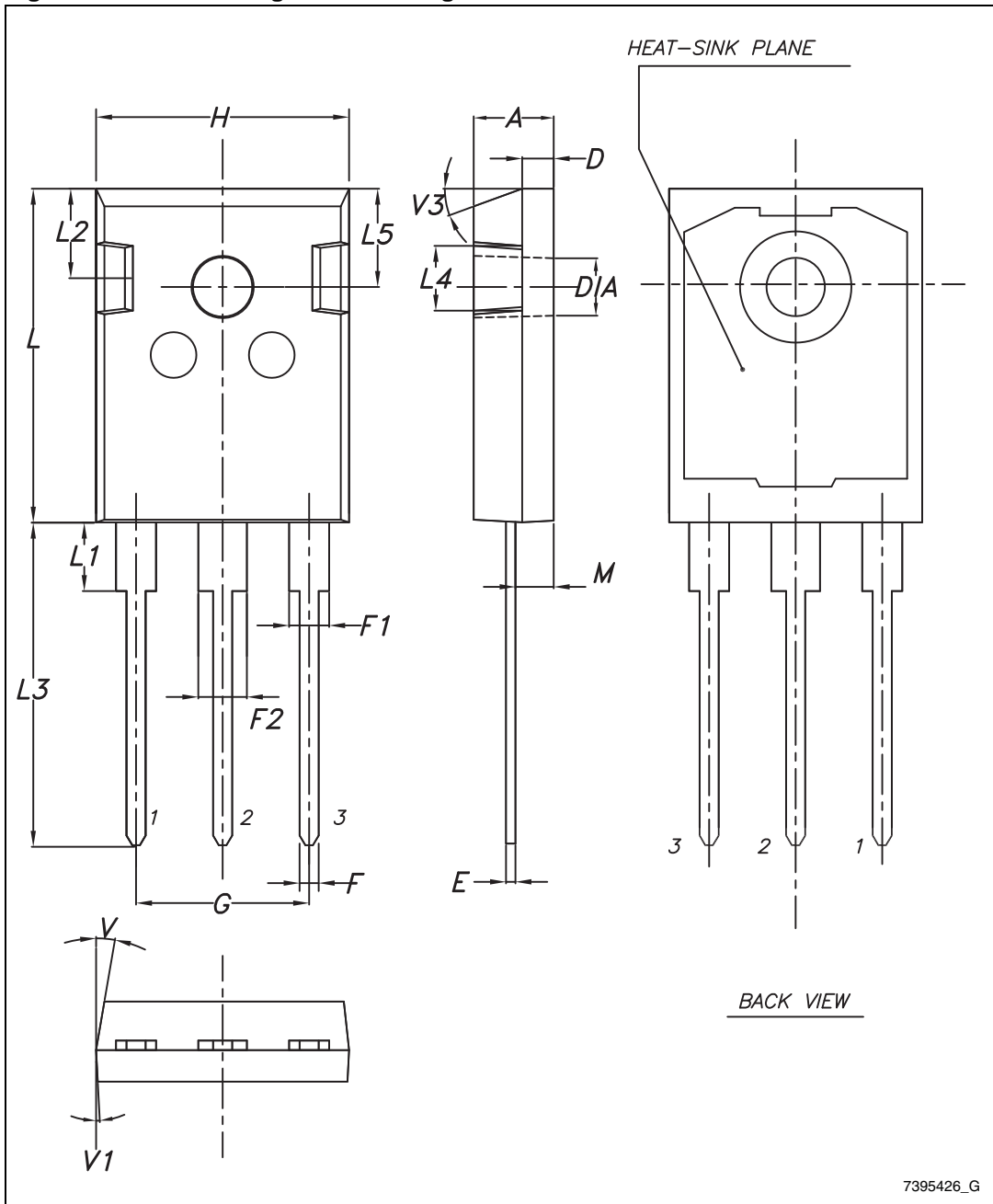
4 Package mechanical data

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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

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	<i>Section 4: Package mechanical data</i> has been updated.
12-Dec-2013	3	Updated <i>Section 4: Package mechanical data</i> . Minor text changes.

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