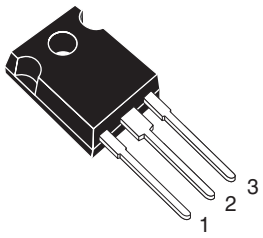
STGW50H60DF

50 A, 600 V field stop trench gate IGBT with Ultrafast diode

Datasheet – production data

Features

- High speed switching
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- 6 µs short-circuit withstand time
- Ultrafast soft recovery antiparallel diode
- Lead free package



TO-247

Applications

- Photovoltaic inverters
- Uninterruptible power supply
- Welding
- Power factor correction
- High switching frequency converters

Description

Using advanced proprietary trench gate and field stop structure, this IGBT leads to an optimized compromise between conduction and switching losses maximizing the efficiency for high switching frequency converters. Furthermore, a slightly positive $V_{CE(sat)}$ temperature coefficient and a very tight parameter distribution result in an easier paralleling operation.

Figure 1. Internal schematic diagram

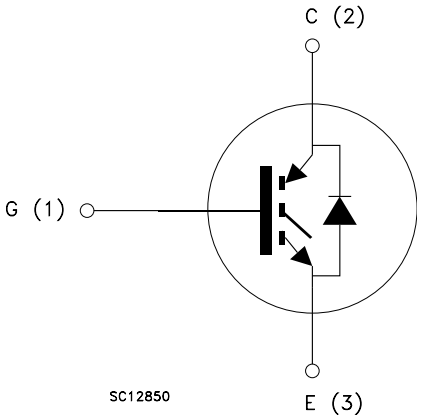


Table 1. Device summary

Order code	Marking	Package	Packaging
STGW50H60DF	GW50H60DF	TO-247	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	Continuous collector current at T_C = 25 °C	100	A
I_C	Continuous collector current at T_C = 100 °C	50	A
I_{CP} (1)	Pulsed collector current	200	A
V_{GE}	Gate-emitter voltage	±20	V
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
P_{TOT}	Total dissipation at T_C = 25 °C	360	W
t_{SC}	Short-circuit withstand time at V_{CC} = 400 V, V_{GE} = 15 V	6	µs
T_{STG}	Storage temperature range	- 55 to 150	°C
T_J	Operating junction temperature		

1. Pulse width limited by maximum junction temperature and turn-off within RBSOA

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case IGBT	0.35	°C/W
R_{thJC}	Thermal resistance junction-case diode	1.5	°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 = 2 mA	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 50 A		1.8		V
		V_{GE} = 15 V, I_C = 50 A T_J = 125 °C		2.0		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 1 mA		6.0		V
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE} = 600 V			25	µA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} = ± 20 V			250	nA

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	-	7150 275 140	-	pF pF pF
Q_g	Total gate charge	V_{CC} = 400 V, I_C = 50 A, V_{GE} = 15 V	-	217	-	nC
Q_{ge}	Gate-emitter charge		-	61	-	nC
Q_{gc}	Gate-collector charge		-	90	-	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_{CE} = 400 V, I_C = 50 A, R_G = 10 Ω, V_{GE} = 15 V	-	62 28 1800	-	ns ns A/µs
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	V_{CE} = 400 V, I_C = 50 A, R_G = 10 Ω, V_{GE} = 15 V T_J = 125 °C	-	62 29 1680	-	ns ns A/µs
$t_r(V_{off})$ $t_{d(off)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CE} = 400 V, I_C = 50 A, R_G = 10 Ω, V_{GE} = 15 V	-	34 178 40	-	ns ns ns
$t_r(V_{off})$ $t_{d(off)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CE} = 400 V, I_C = 50 A, R_G = 10 Ω, V_{GE} = 15 V T_J = 125 °C	-	45 205 80	-	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_{CE} = 400 V, I_C = 50 A, R_G = 10 Ω, V_{GE} = 15 V	-	0.89 0.86 1.75	-	mJ mJ mJ
E_{on} (1) E_{off} (2) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CE} = 400 V, I_C = 50 A, R_G = 10 Ω, V_{GE} = 15 V T_J = 125 °C	-	1.24 1.15 2.39	-	mJ mJ mJ

1. Eon is the turn-on losses when a typical diode is used in the test circuit in *Figure 20*. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs and 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 = 30 A I_F = 30 A, T_J = 125 °C	-	2 1.65	2.5	V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 30 A,V_R = 50 V, di/dt = 100 A/µs	-	55 110 3	-	ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 30 A,V_R = 50 V, di/dt = 100 A/µs, T_J =125 °C	-	140 400 5.5	-	ns nC A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics (T_J = -40 °C)

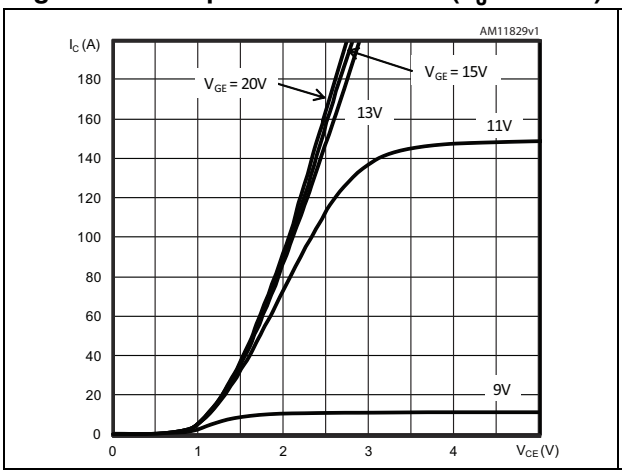


Figure 3. Output characteristics (T_J = 25 °C)

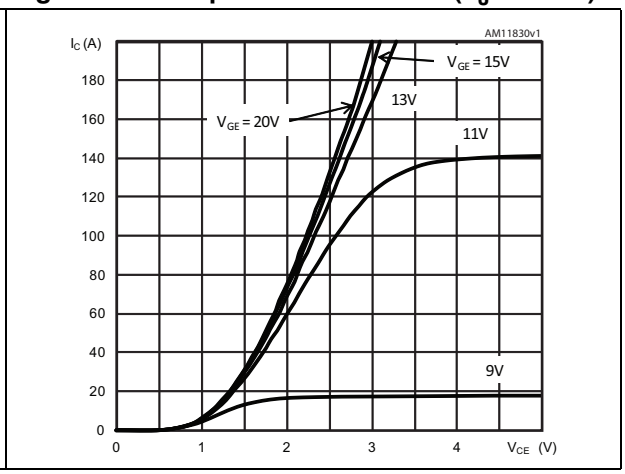


Figure 4. Output characteristics (T_J = 150 °C)

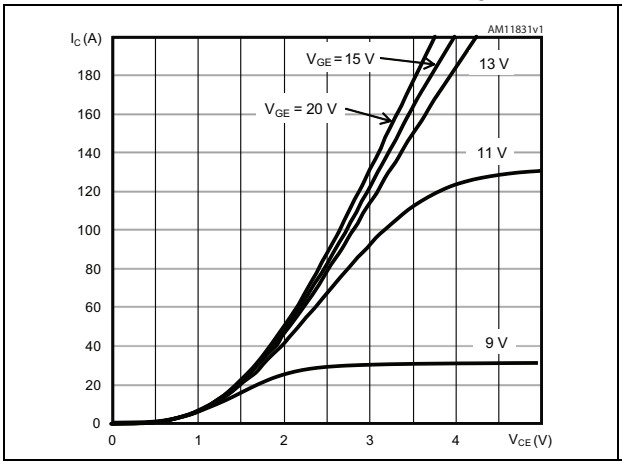


Figure 5. Transfer characteristics

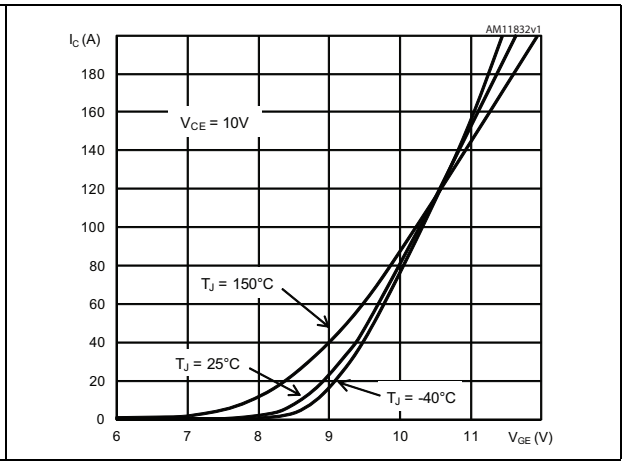


Figure 6. $V_{CE(SAT)}$ vs. junction temperature

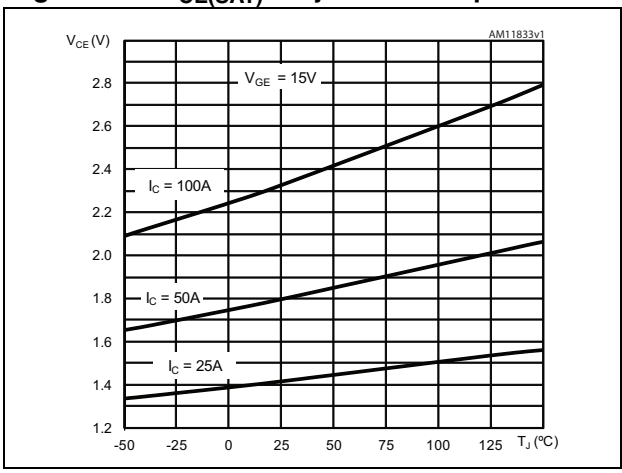


Figure 7. $V_{CE(SAT)}$ vs. collector current

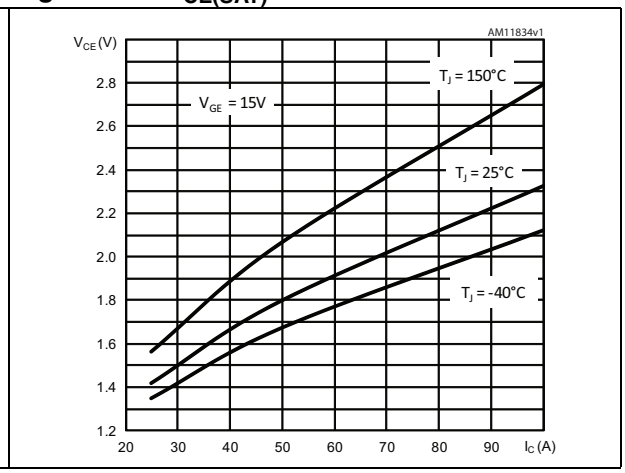


Figure 8. Normalized $V_{GE(th)}$ vs. junction temperature

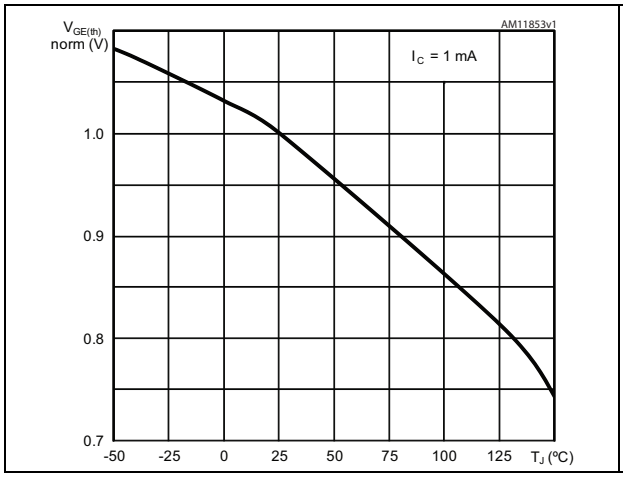


Figure 9. Gate charge vs. gate-emitter voltage

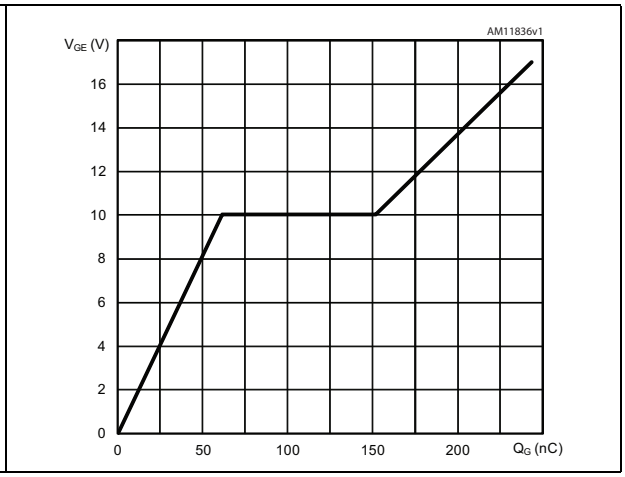


Figure 10. Capacitance variations (f = 1 MHz, V_{GE} = 0)

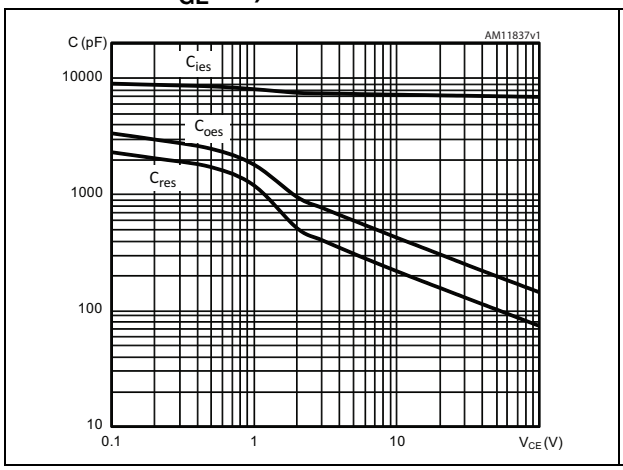


Figure 11. Switching losses vs. collector current

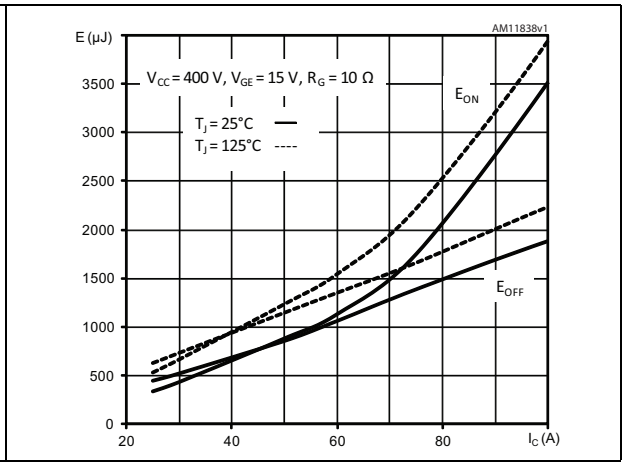


Figure 12. Switching losses vs. gate resistance

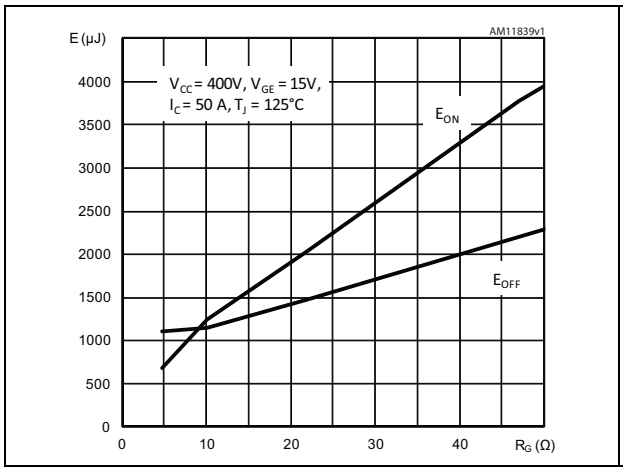


Figure 13. Switching losses vs. temperature

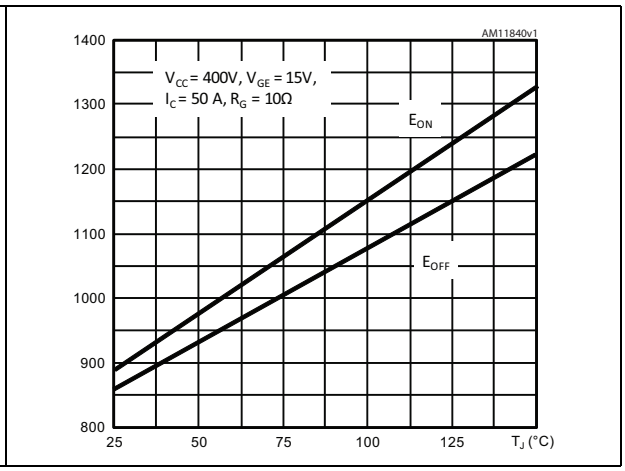


Figure 14. Turn-OFF SOA

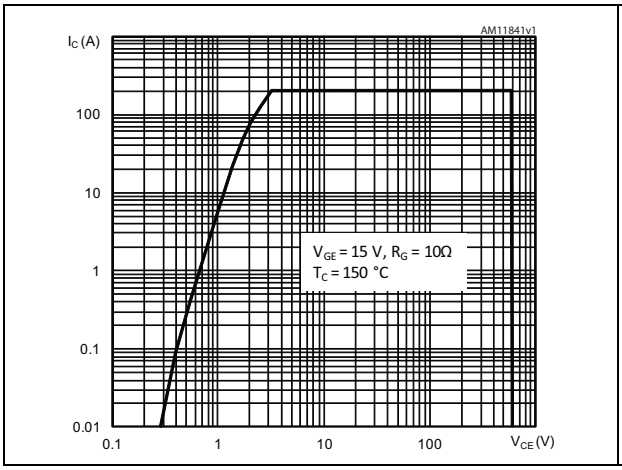


Figure 15. Short circuit time & current vs. V_{GE}

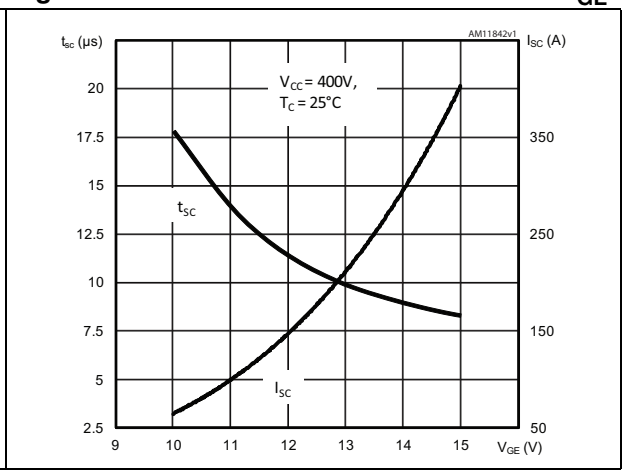


Figure 16. Diode forward current vs. forward voltage

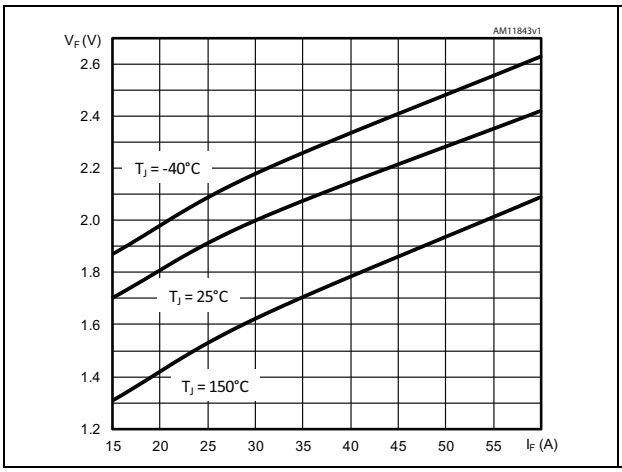


Figure 17. Diode forward current vs. junction temperature

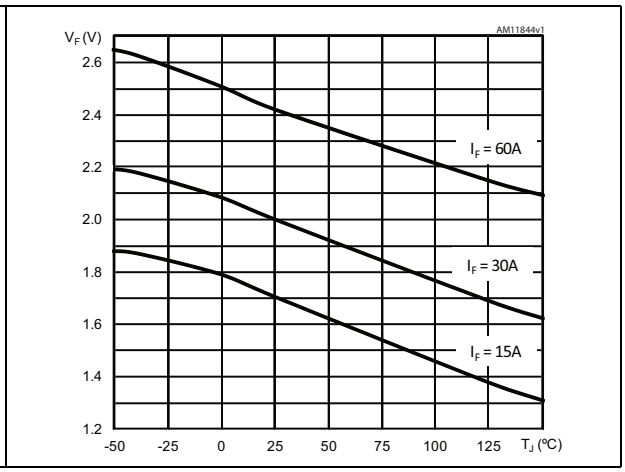


Figure 18. Maximum normalized Z_{th} junction to case (IGBT)

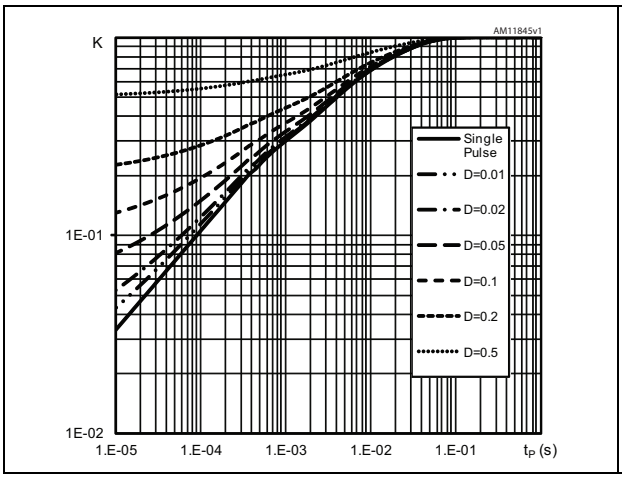
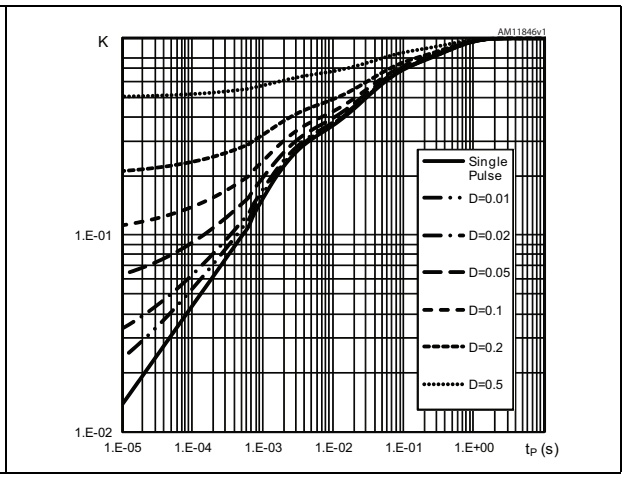


Figure 19. Maximum normalized Z_{th} junction to case (Diode)



3 Test circuits

Figure 20. Test circuit for inductive load switching

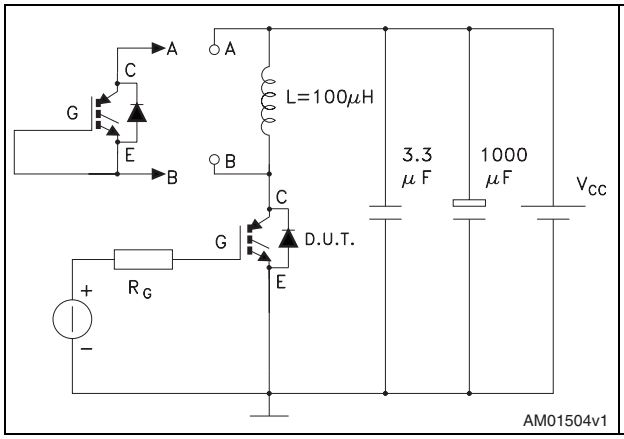


Figure 21. Gate charge test circuit

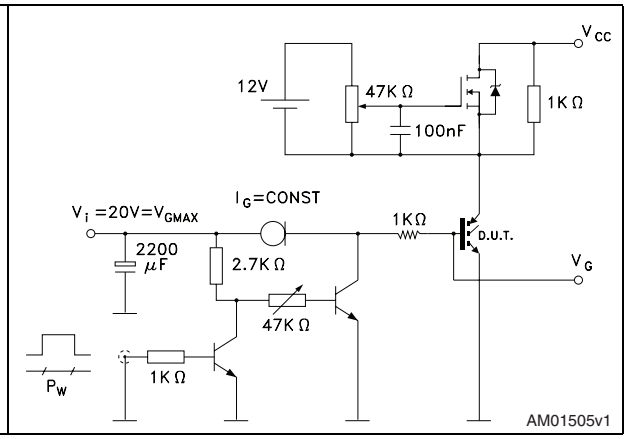


Figure 22. Switching waveform

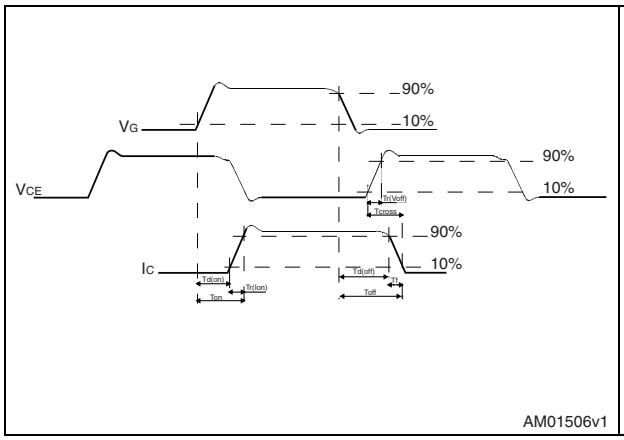
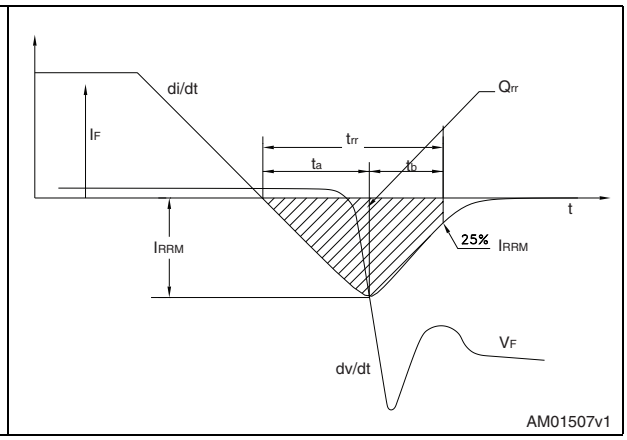


Figure 23. Diode recovery time waveform



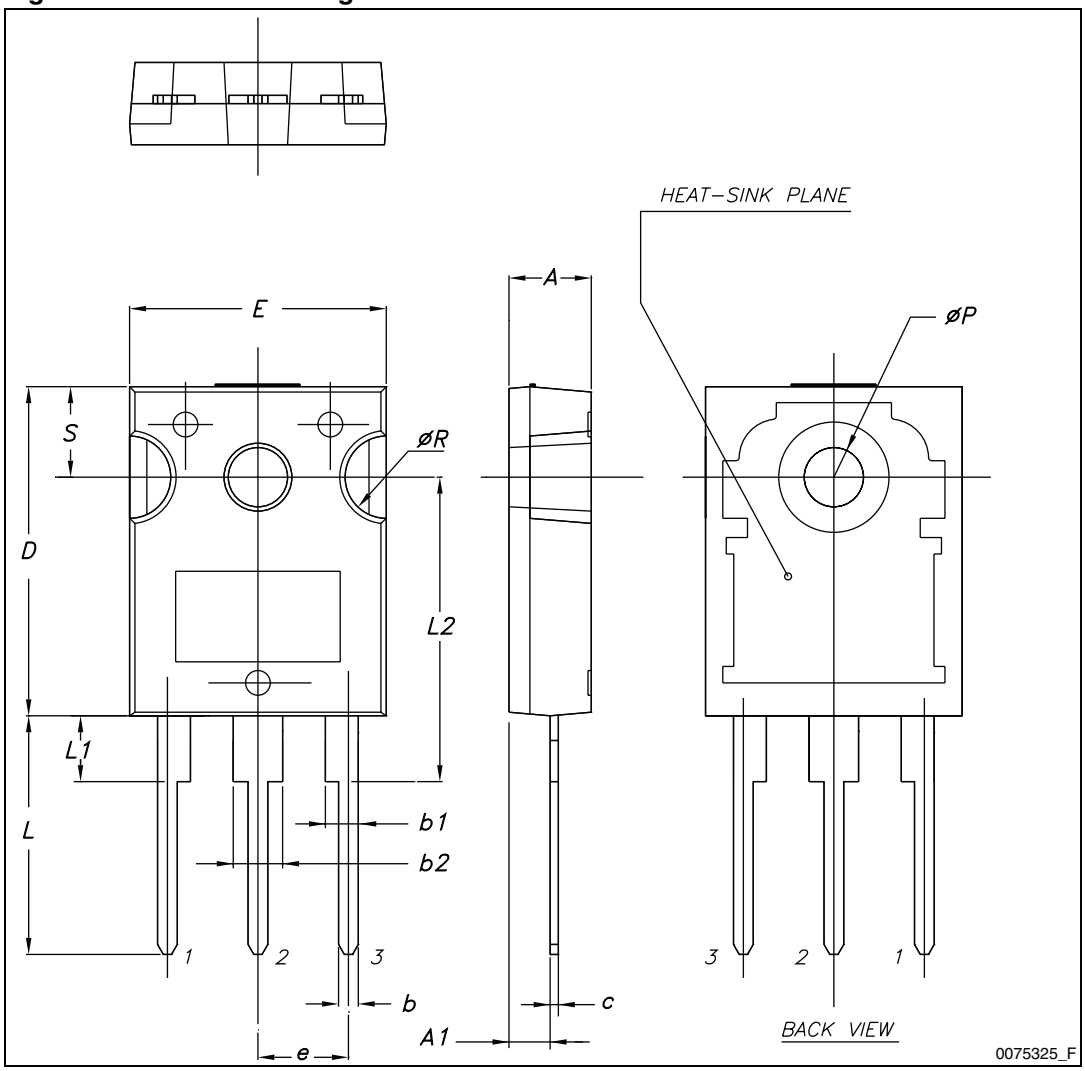
4 Package mechanical data

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 mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
∅P	3.55		3.65
∅R	4.50		5.50
S		5.50	

Figure 24. TO-247 drawing



5 Revision history

Table 10. Document revision history

Date	Revision	Changes
28-Apr-2011	1	Initial release.
26-Jul-2011	2	Added: t_{SC} and T_{STG} *Table 2 on page 2*. Updated: *Table 4*, *Table 5*, *Table 6 on page 3* and *Table 7 on page 4*.
12-Jan-2012	3	Document status promoted from preliminary data to datasheet.
10-Feb-2012	4	Added: *Section 2.1: Electrical characteristics (curves)*.
26-Jul-2012	5	Modified: *Figure 8 on page 6*.

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