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STGW20H60DF, STGWT20H60DF

600 V, 20 A high speed trench gate field-stop IGBT

Datasheet - production data

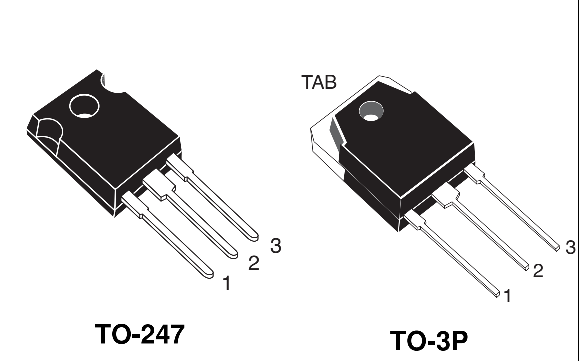
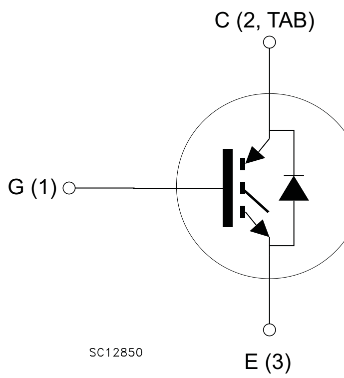


Figure 1. Internal schematic diagram



Features

- High speed switching
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Short-circuit rated
- Ultrafast soft recovery antiparallel diode

Applications

- Motor control
- UPS, PFC

Description

This device is an IGBT developed using an advanced proprietary trench gate and field stop structure. This IGBT series offers the optimum compromise between conduction and switching losses, maximizing the efficiency of very high frequency converters. Furthermore, a positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in easier paralleling operation.

Table 1. Device summary

Order codes	Marking	Packages	Packaging
STGW20H60DF	GW20H60DF	TO-247	Tube
STGWT20H60DF	GWT20H60DF	TO-3P	Tube

Contents

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	40	A
	Continuous collector current at T_C = 100 °C	20	A
I_{CP} (1)	Pulsed collector current	80	A
V_{GE}	Gate-emitter voltage	±20	V
I_F	Continuous forward current T_C = 25 °C	40	A
	Continuous forward current at T_C = 100 °C	20	
I_{FP} (2)	Pulsed forward current	80	A
P_{TOT}	Total dissipation at T_C = 25 °C	167	W
T_{STG}	Storage temperature range	- 55 to 150	°C
T_J	Operating junction temperature	- 55 to 175	

1. Limited by maximum junction temperature.
2. 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	0.9	°C/W
R_{thJC}	Thermal resistance junction-case diode	2.5	°C/W
R_{thJA}	Thermal resistance junction-ambient	62.5	°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 = 20 A		1.6	2.0	V
		V_{GE} = 15 V, I_C = 20 A T_J = 125 °C		1.75		
		V_{GE} = 15 V, I_C = 20 A T_J = 175 °C		1.8		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 1 mA	5	6	7	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}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0	-	2750	-	pF
C_{oes}	Output capacitance		-	110	-	pF
C_{res}	Reverse transfer capacitance		-	65	-	pF
Q_g	Total gate charge	V_{CC} = 400 V, I_C = 20 A, V_{GE} = 15 V	-	115	-	nC
Q_{ge}	Gate-emitter charge		-	22	-	nC
Q_{gc}	Gate-collector charge		-	45	-	nC

Table 6. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V		42.5	-	ns
t_r	Current rise time			11.9	-	ns
(di/dt)on	Turn-on current slope			1345	-	A/μs
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V T_J = 175 °C		42.5	-	ns
t_r	Current rise time			13.4		ns
(di/dt)on	Turn-on current slope			1180		A/μs
$t_{r(Voff)}$	Off voltage rise time	V_{CE} = 400 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V		20	-	ns
$t_{d(off)}$	Turn-off delay time			177	-	ns
t_f	Current fall time			55	-	ns
$t_{r(Voff)}$	Off voltage rise time	V_{CE} = 400 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V T_J = 175 °C		26	-	ns
$t_{d(off)}$	Turn-off delay time			173	-	ns
t_f	Current fall time			86	-	ns
t_{sc}	Short-circuit withstand time	$V_{CC} \leq$ 360 V, V_{GE} = 15 V	3	5	-	μs

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Eon (1)	Turn-on switching losses	V_{CE} = 400 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V	-	209	-	μJ
E_{off} (2)	Turn-off switching losses		-	261	-	μJ
E_{ts}	Total switching losses		-	470	-	μJ
Eon (1)	Turn-on switching losses	V_{CE} = 400 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V T_J = 175 °C	-	480	-	μJ
E_{off} (2)	Turn-off switching losses		-	416	-	μJ
E_{ts}	Total switching losses		-	896	-	μJ

1. Energy losses include reverse recovery of the diode.
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 A I_F = 20 A, T_J = 175 °C	-	1.8 1.3	2.2	V V
t_{rr}	Reverse recovery time	V_r = 60 V; IF = 20 A; di_F/dt = 100 A / µs	-	90	-	ns
Q_{rr}	Reverse recovery charge			110		nC
I_{rrm}	Reverse recovery current			2.4		A
t_{rr}	Reverse recovery time	V_r = 60 V; IF = 20 A; di_F/dt = 100 A / µs T_J = 175 °C	-	180	-	ns
Q_{rr}	Reverse recovery charge		-	466	-	nC
I_{rrm}	Reverse recovery current		-	5.2	-	A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics (T_J = 25°C)

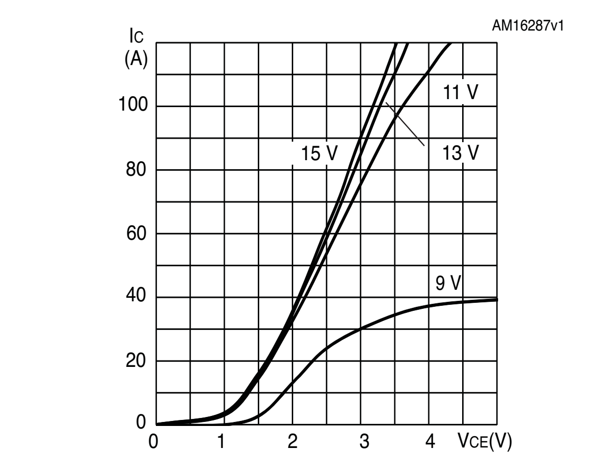


Figure 3. Output characteristics (T_J = 175°C)

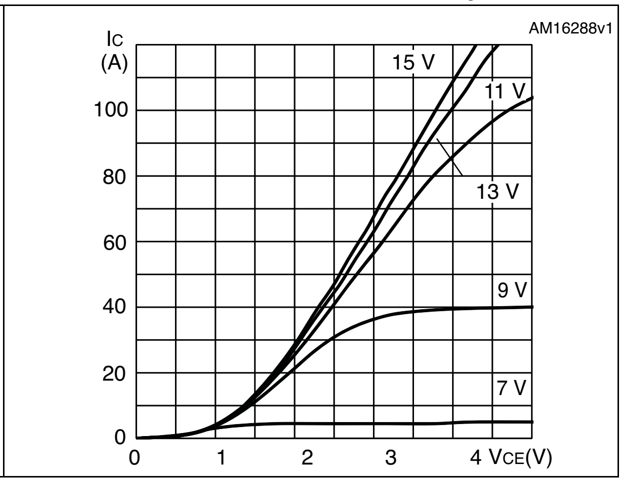


Figure 4. Transfer characteristics

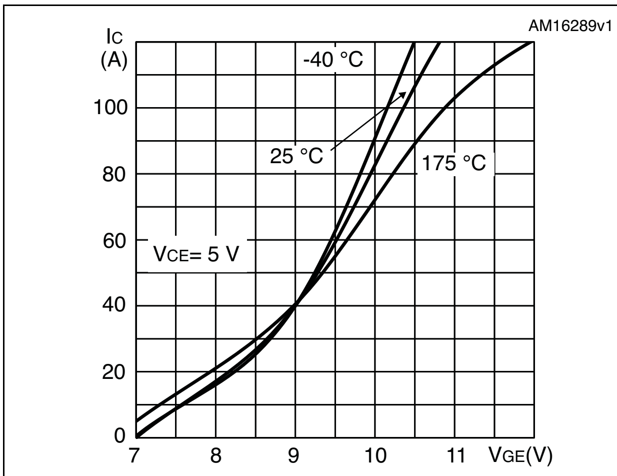


Figure 5. Normalized $V_{GE(th)}$ vs junction temperature

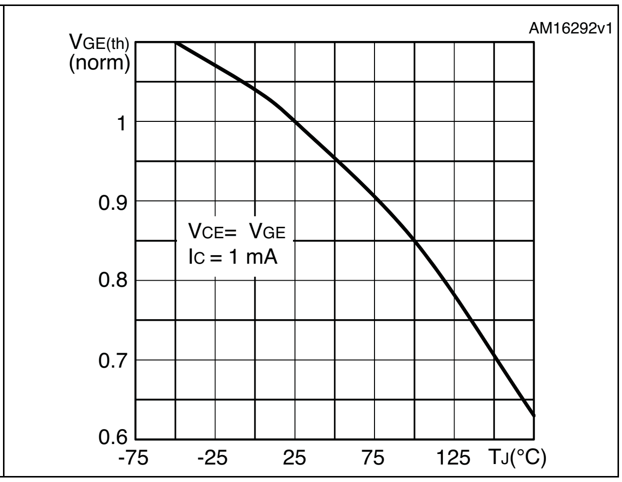


Figure 6. Collector current vs. case temperature

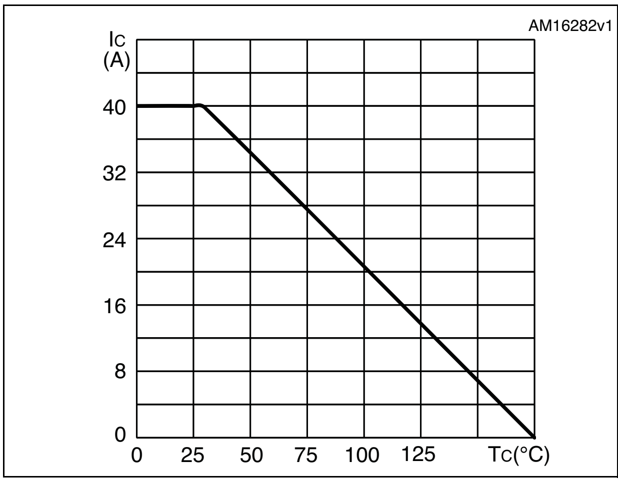


Figure 7. Collector current vs. frequency

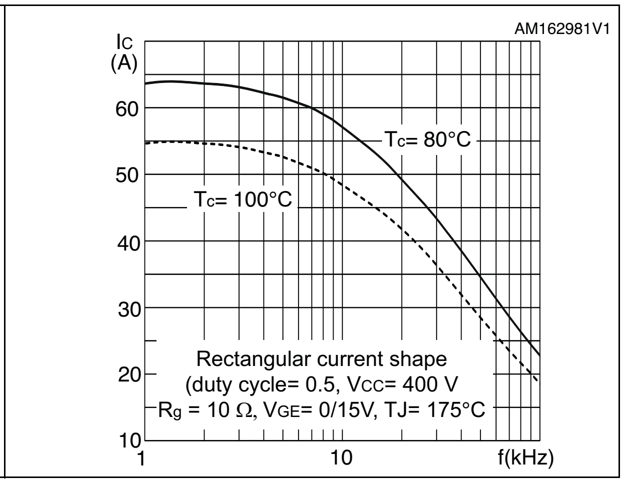


Figure 8. $V_{CE(sat)}$ vs. junction temperature

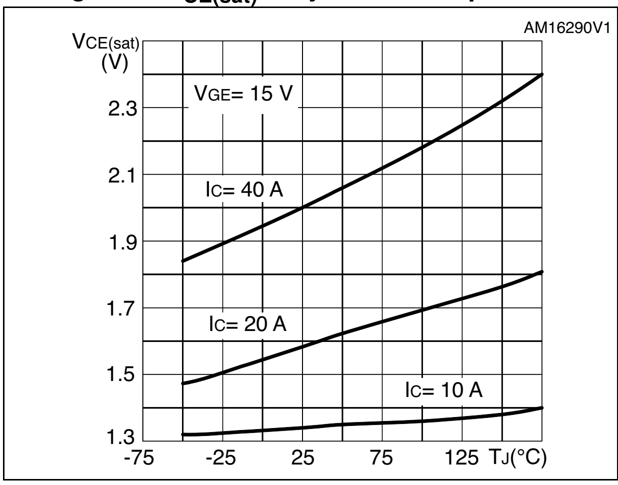


Figure 9. $V_{CE(sat)}$ vs. collector current

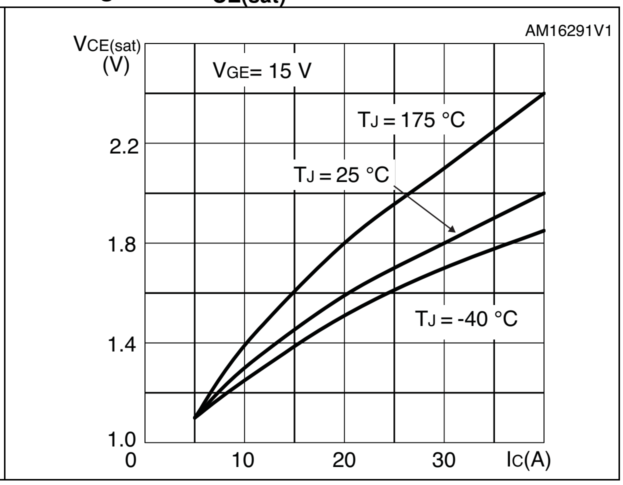


Figure 10. Forward bias safe operating area

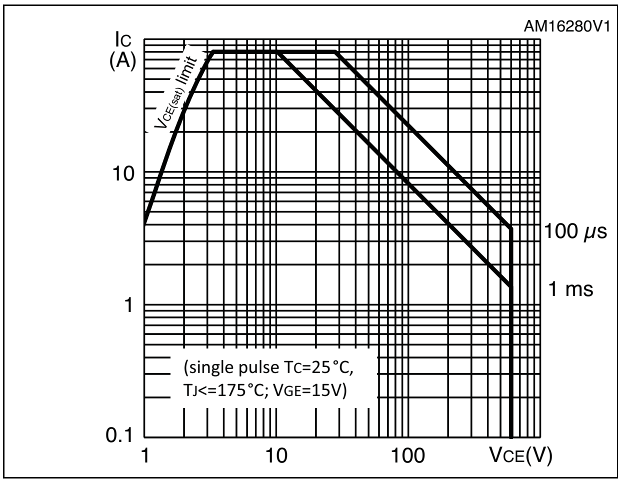


Figure 11. Thermal impedance

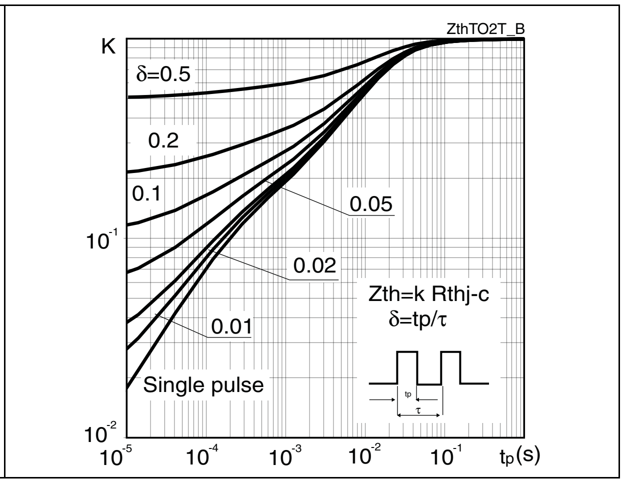


Figure 12. Diode V_F vs. forward current

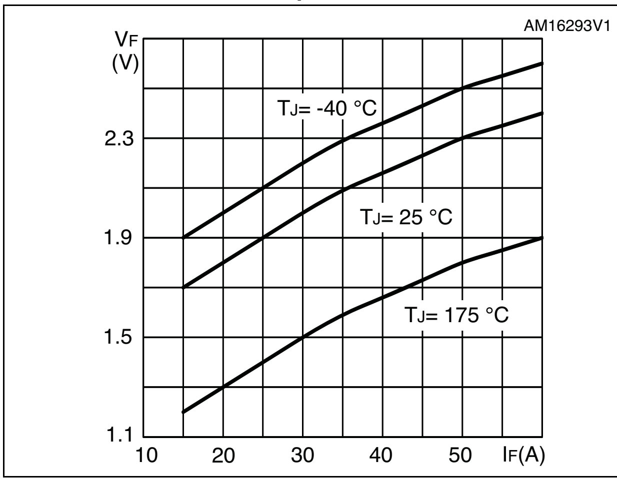


Figure 13. Gate charge vs. gate-emitter voltage

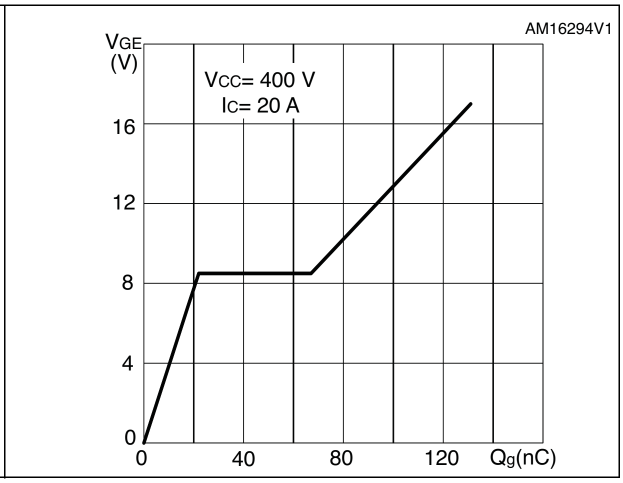


Figure 14. Capacitance variations vs. V_{CE}

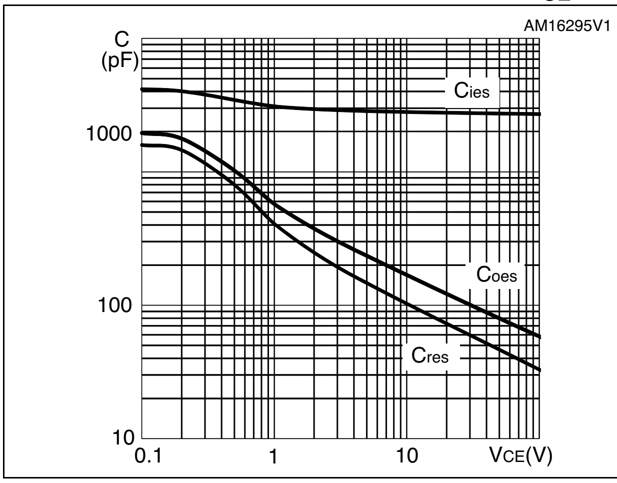


Figure 15. Switching losses vs. gate resistance

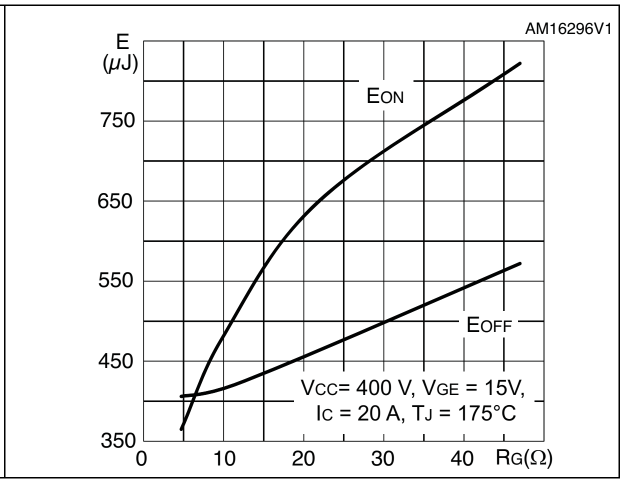


Figure 16. Switching losses vs. collector current

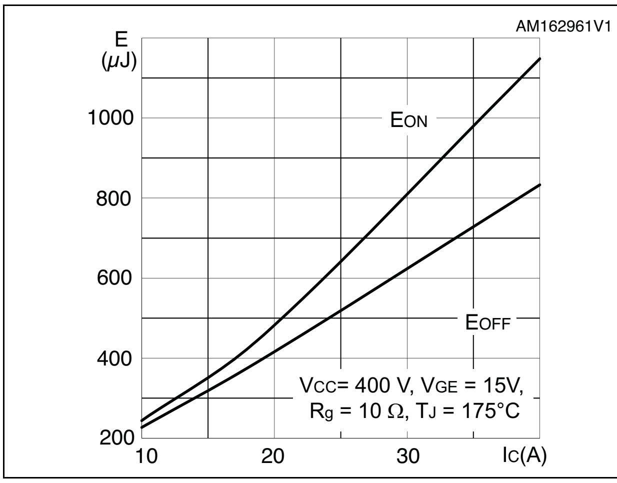
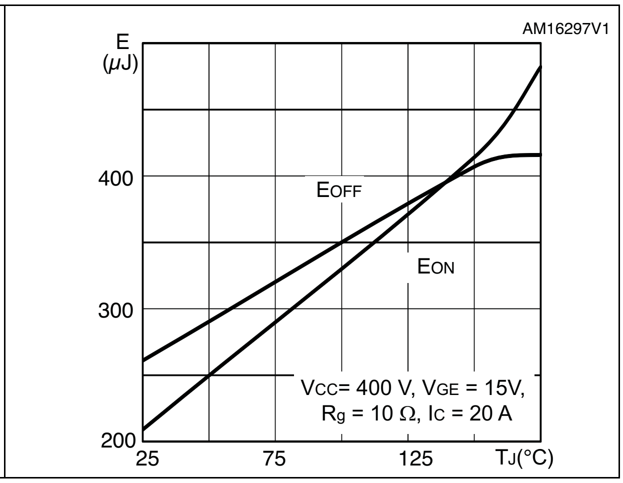


Figure 17. Switching losses vs. temperature



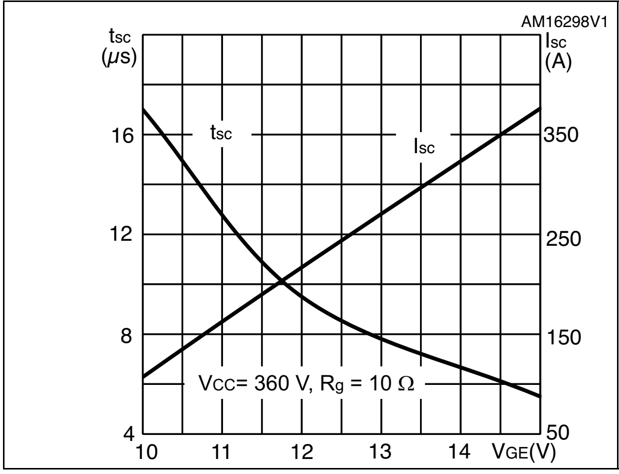


Figure 18. Short-circuit time and current vs. V_{GE}

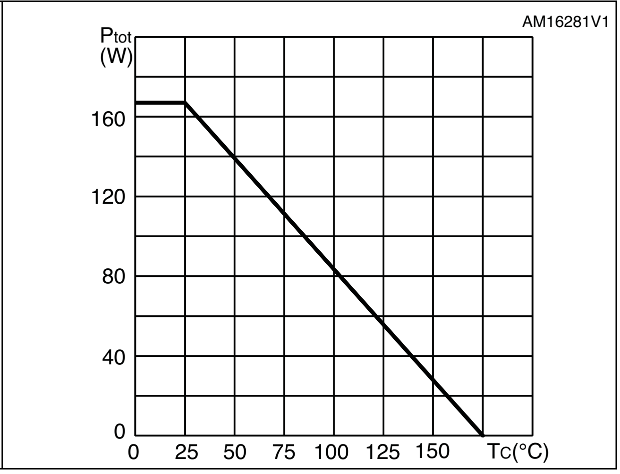


Figure 19. Power dissipation vs. case temperature

3 Test circuits

Figure 20. Test circuit for inductive load switching

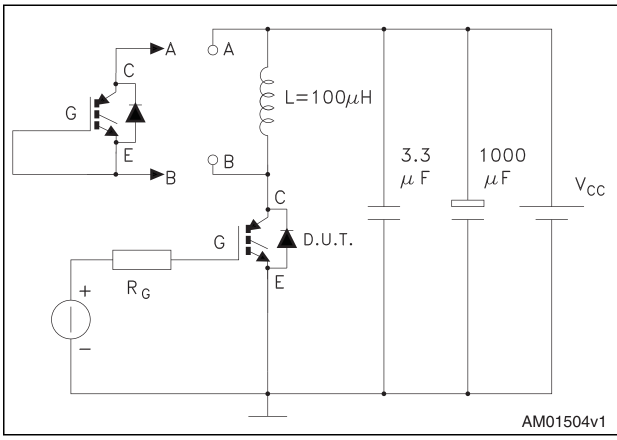


Figure 21. Gate charge test circuit

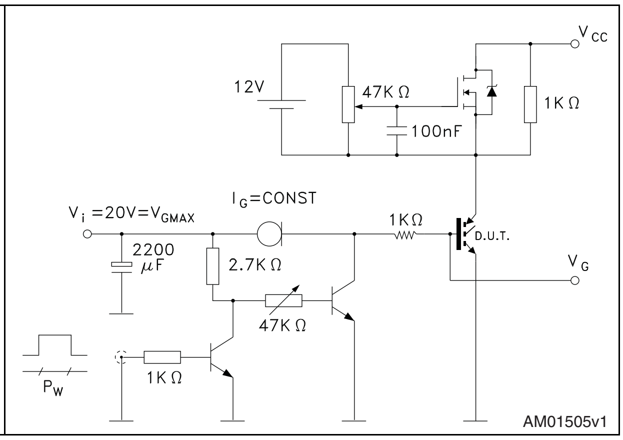


Figure 22. Switching waveform

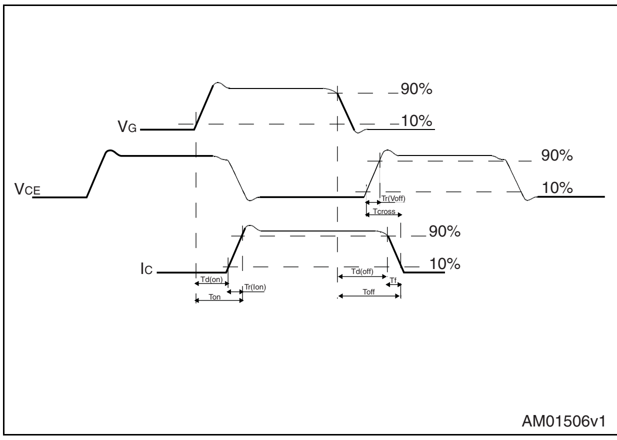
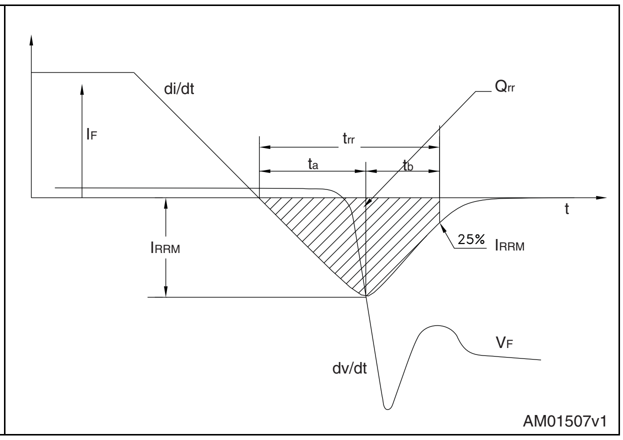


Figure 23. Diode recovery time waveform



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	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
∅P	3.55		3.65
∅R	4.50		5.50
S	5.30	5.50	5.70

Figure 24. TO-247 drawing

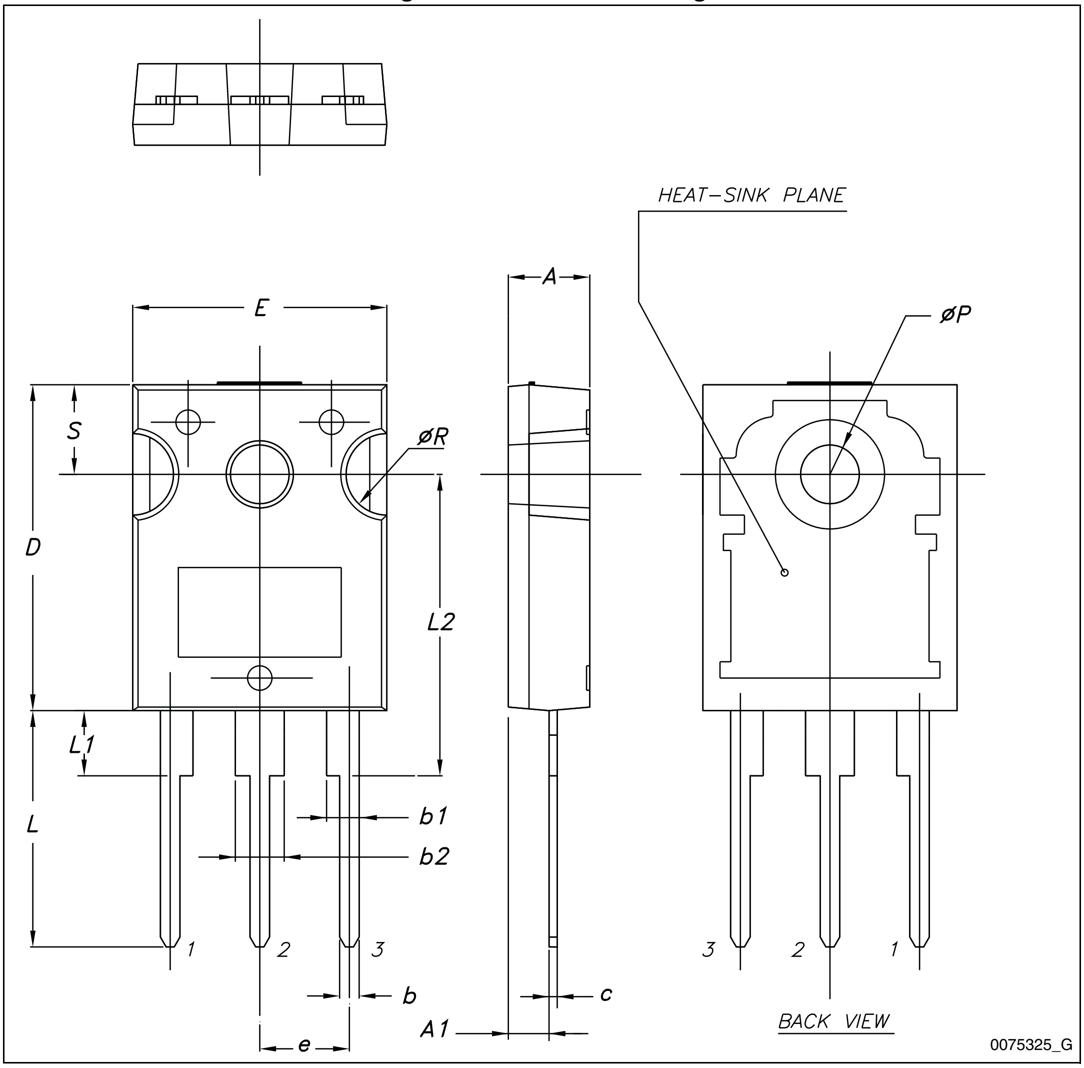
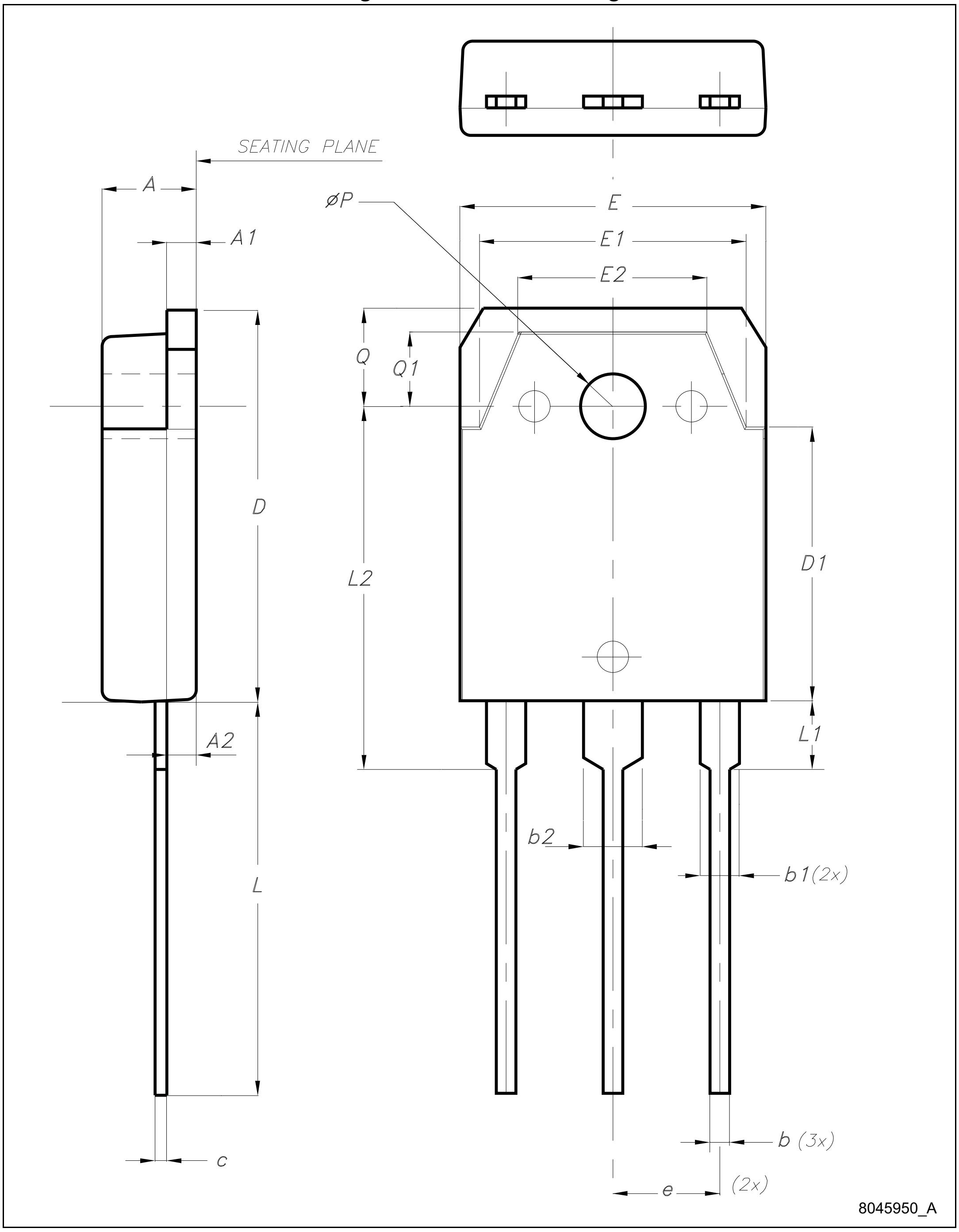


Table 10. TO-3P mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.60		5
A1	1.45	1.50	1.65
A2	1.20	1.40	1.60
b	0.80	1	1.20
b1	1.80		2.20
b2	2.80		3.20
c	0.55	0.60	0.75
D	19.70	19.90	20.10
D1		13.90	
E	15.40		15.80
E1		13.60	
E2		9.60	
e	5.15	5.45	5.75
L	19.50	20	20.50
L1		3.50	
L2	18.20	18.40	18.60
øP	3.10		3.30
Q		5	
Q1		3.80	

Figure 25. TO-3P drawing



5 Revision history

Table 11. Document revision history

Date	Revision	Changes
06-Jun-2013	1	Initial release.