STGW60H65FB
STGWT60H65FB

650 V, 60 A high speed trench gate field-stop IGBT

Datasheet - production data

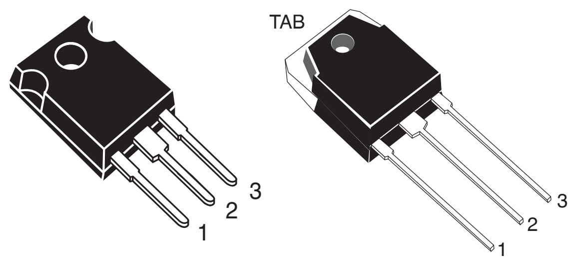
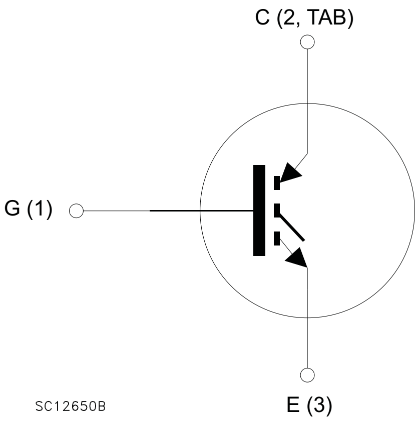


Figure 1. Internal schematic diagram



Features

- Maximum junction temperature: T_J = 175 °C
- High speed switching series
- Minimized tail current
- Very low saturation voltage: $V_{CE(sat)}$ = 1.6 V (typ.) @ I_C = 60 A
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Lead free package

Applications

- Photovoltaic inverters
- High frequency converters

Description

This device is an IGBT developed using an advanced proprietary trench gate and field stop structure. The device is part of the improved "H" series of IGBTs, which represent an optimum compromise between conduction and switching losses to maximize the efficiency of high frequency converters. Furthermore, a slightly positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

Table 1. Device summary

Order code	Marking	Package	Packaging
STGW60H65FB	GW60H65FB	TO-247	Tube
STGWT60H65FB	GWT60H65FB	TO-3P	Tube

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	650	V
I_C	Continuous collector current at T_C = 25 °C	80(1)	A
I_C	Continuous collector current at T_C = 100 °C	60	A
I_{CP}(2)	Pulsed collector current	240	A
V_{GE}	Gate-emitter voltage	±20	V
I_{FP}(2)	Pulsed forward current	240	A
P_{TOT}	Total dissipation at T_C = 25 °C	375	W
T_{STG}	Storage temperature range	- 55 to 150	°C
T_J	Operating junction temperature	- 40 to 175	°C

1. Current level is limited by bond wires.
2. Pulse width limited by maximum junction temperature.

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case	0.4	°C/W
R_{thJA}	Thermal resistance junction-ambient	50	°C/W

2 Electrical characteristics

T_J = 25 °C unless otherwise specified.

Table 4. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage (V_{GE} = 0)	I_C = 2 mA	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 60 A		1.60	2.30	V
		V_{GE} = 15 V, I_C = 60 A T_J = 125 °C		1.75		
		V_{GE} = 15 V, I_C = 60 A T_J = 175 °C		1.85		
$V_{GE(th)}$	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} = 650 V			25	μA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} = ± 20 V			250	nA

Table 5. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0	-	7792	-	pF
C_{oes}	Output capacitance		-	262	-	pF
C_{res}	Reverse transfer capacitance		-	158	-	pF
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 60 A, V_{GE} = 15 V, see *Figure 22*	-	306	-	nC
Q_{ge}	Gate-emitter charge		-	126	-	nC
Q_{gc}	Gate-collector charge		-	58	-	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 = 60 A, R_G = 5 Ω, V_{GE} = 15 V, see *Figure 21*	-	51		ns
t_r	Current rise time		-	22	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	2218		A/μs
$t_{d(off)}$	Turn-off delay time			160		ns
t_f	Current fall time		-	18	-	ns
E_{on} (1)	Turn-on switching losses		-	1086	-	μJ
E_{off} (2)	Turn-off switching losses		-	626	-	μJ
E_{ts}	Total switching losses		-	1712	-	μJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 60 A, R_G = 5 Ω, V_{GE} = 15 V, T_J = 175 °C, see *Figure 21*	-	50		ns
t_r	Current rise time		-	30	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	2050		A/μs
$t_{d(off)}$	Turn-off delay time			184		ns
t_f	Current fall time		-	117	-	ns
E_{on} (1)	Turn-on switching losses		-	2350	-	μJ
E_{off} (2)	Turn-off switching losses		-	1017	-	μJ
E_{ts}	Total switching losses		-	3367	-	μJ

1. Energy losses include reverse recovery of the external diode. The diode is the same of the co-packed STGW60H65DFB.
2. Turn-off losses include also the tail of the collector current.

2.1 Electrical characteristics (curve)

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

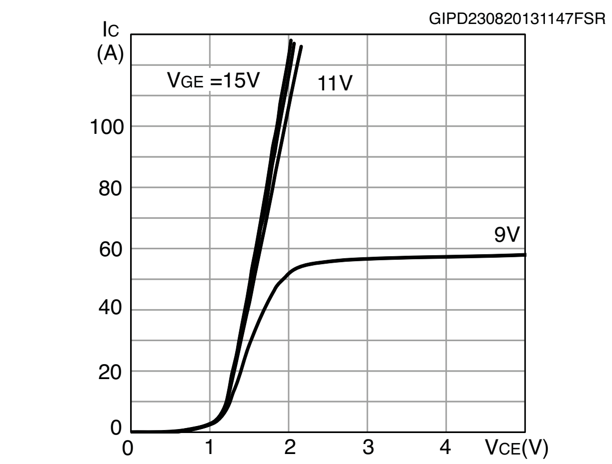


Figure 3. Output characteristics (T_J = 175°C)

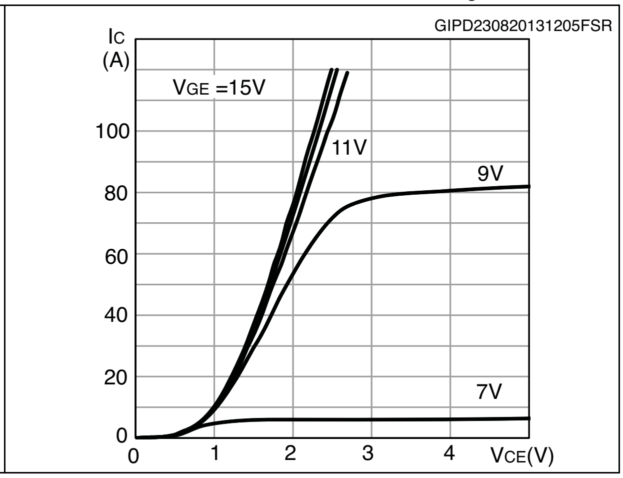


Figure 4. Transfer characteristics

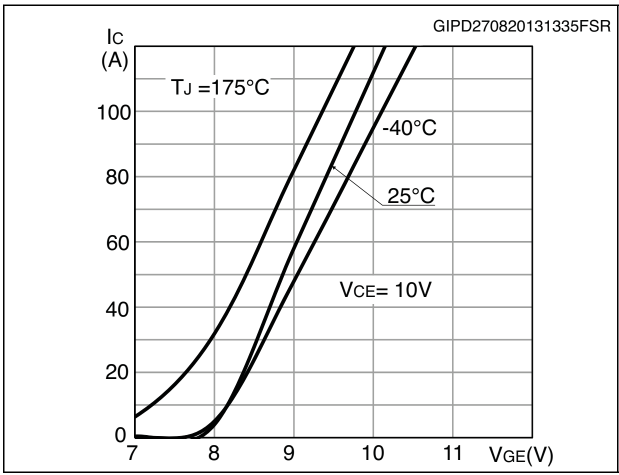


Figure 5. Collector current vs. case temperature

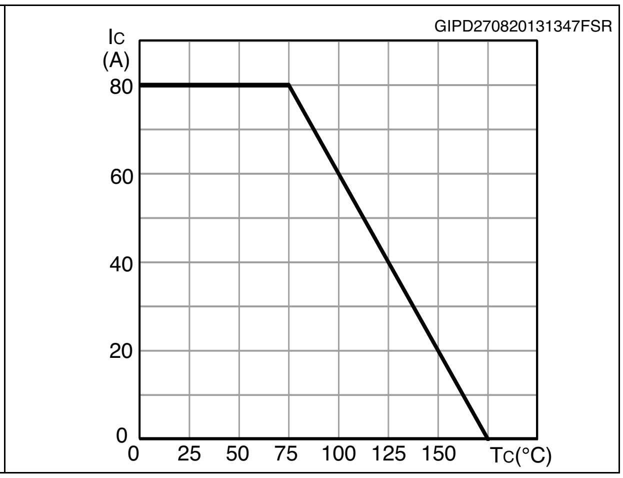


Figure 6. Power dissipation vs. case temperature

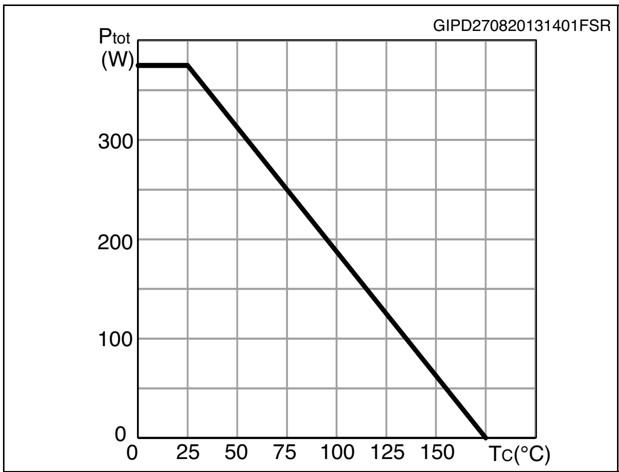


Figure 7. $V_{CE(sat)}$ vs. junction temperature

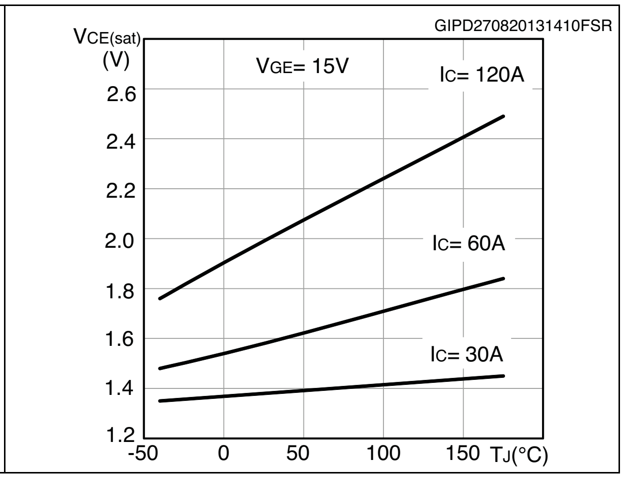


Figure 8. $V_{CE(sat)}$ vs. collector current

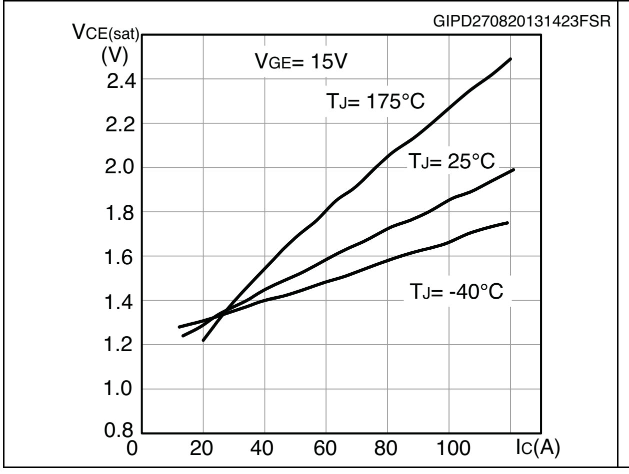


Figure 9. Forward bias safe operating area

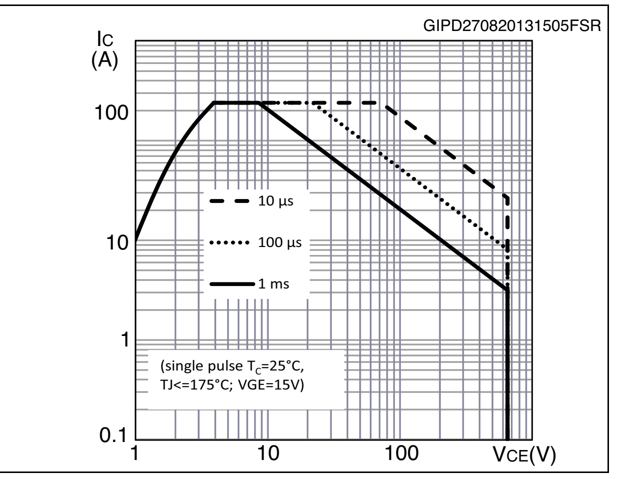


Figure 10. Thermal impedance

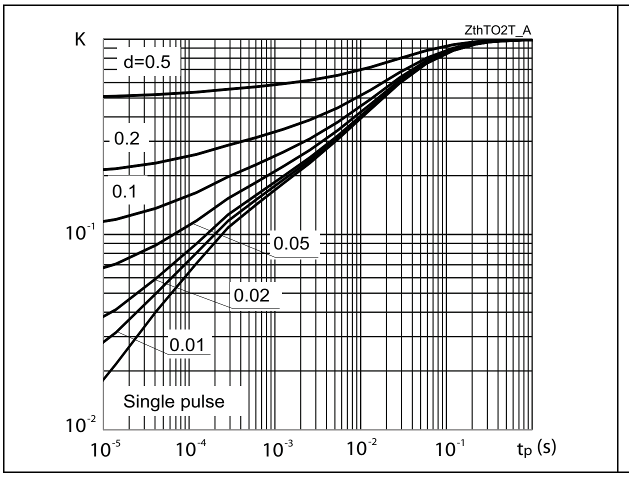


Figure 11. Normalized BV_{CES} vs. junction temperature

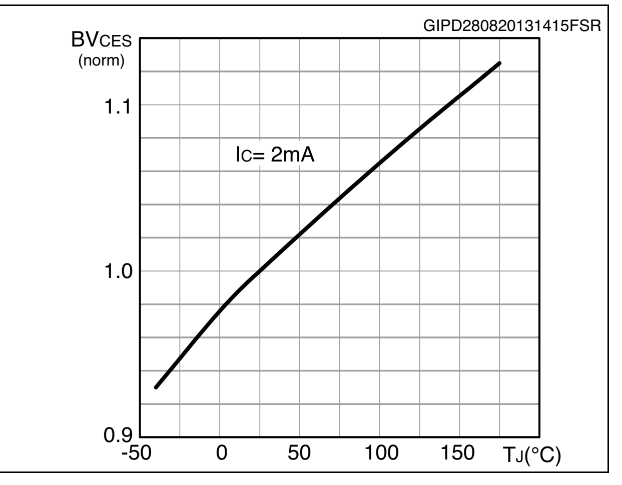


Figure 12. Normalized $V_{GE(th)}$ vs. junction temperature

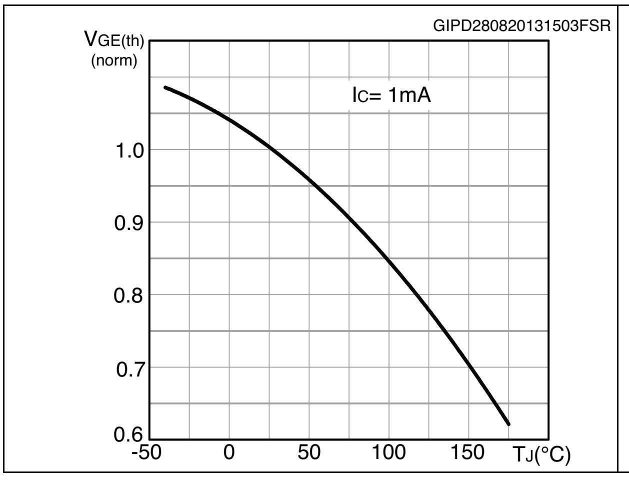
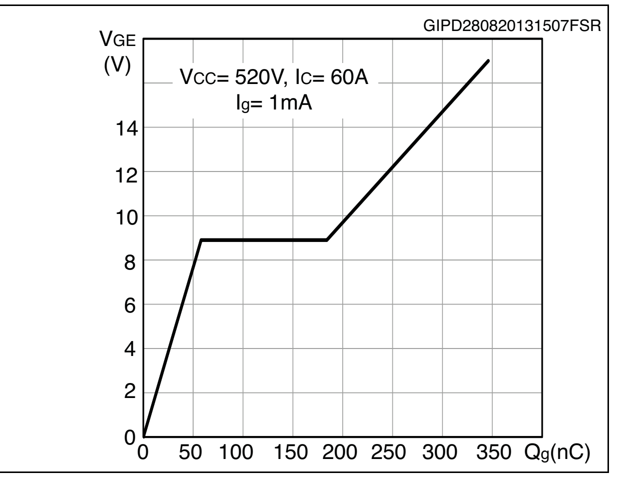


Figure 13. Gate charge vs. gate-emitter voltage



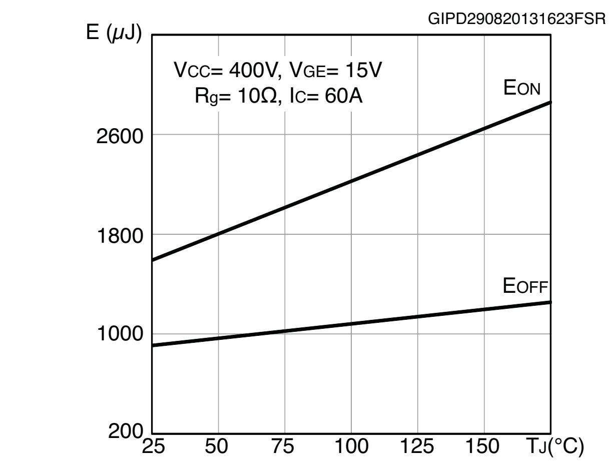


Figure 14. Switching losses vs temperature

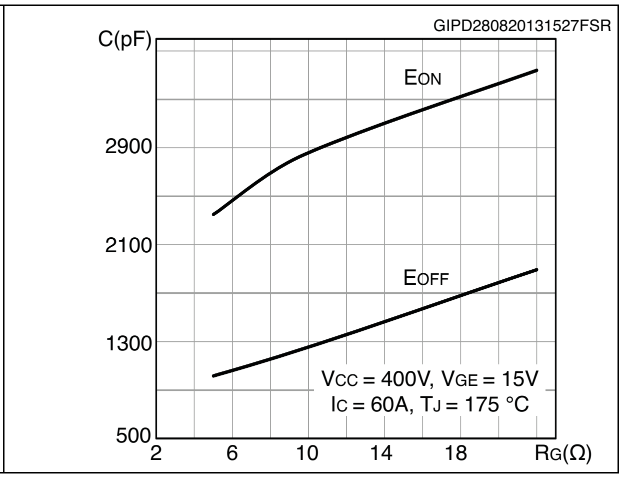


Figure 15. Switching losses vs gate resistance

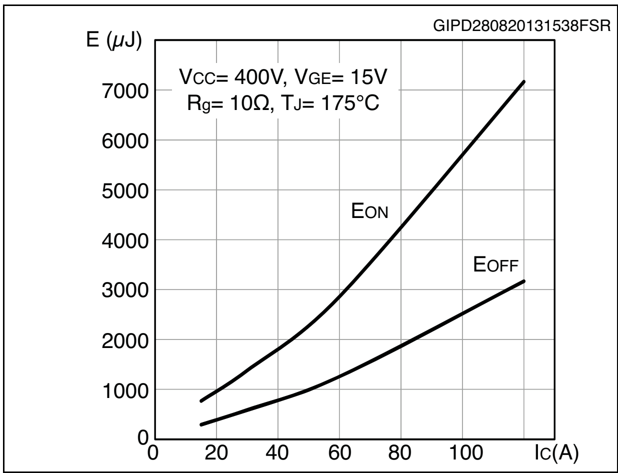


Figure 16. Switching losses vs collector current

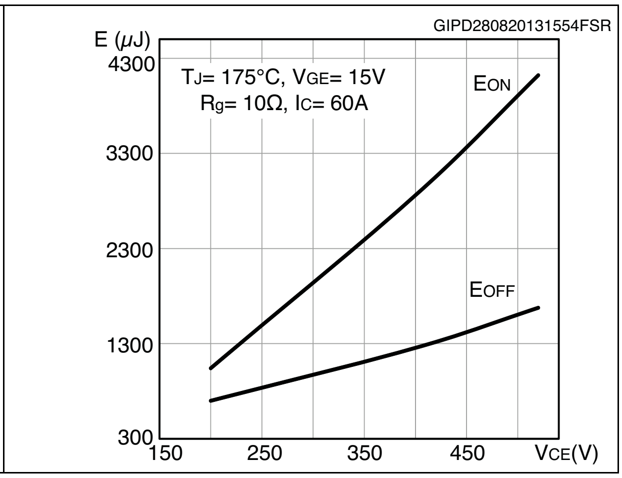


Figure 17. Switching losses vs collector emitter voltage

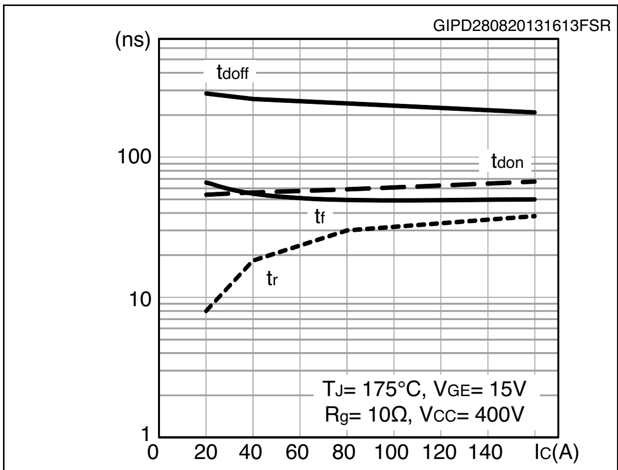


Figure 18. Switching times vs collector current

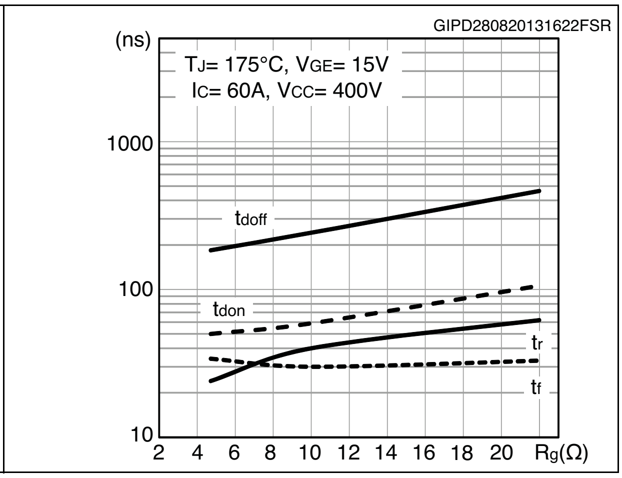
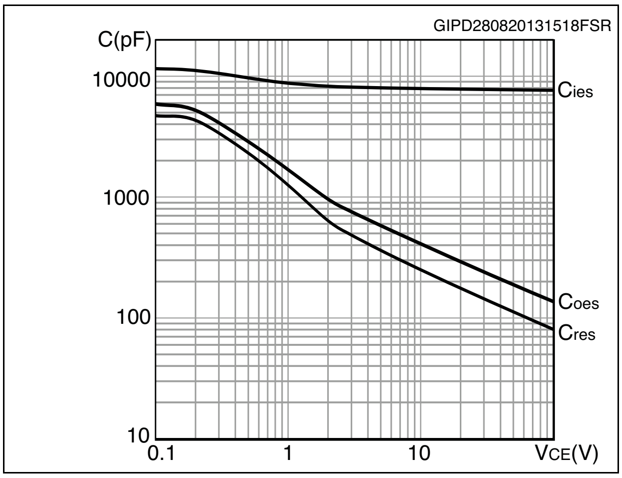


Figure 19. Switching times vs gate resistance

Figure 20. Capacitance variations



3 Test circuits

Figure 21. Test circuit for inductive load switching

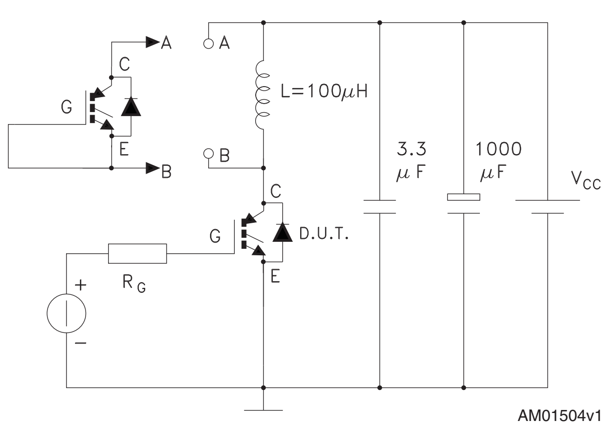


Figure 22. Gate charge test circuit

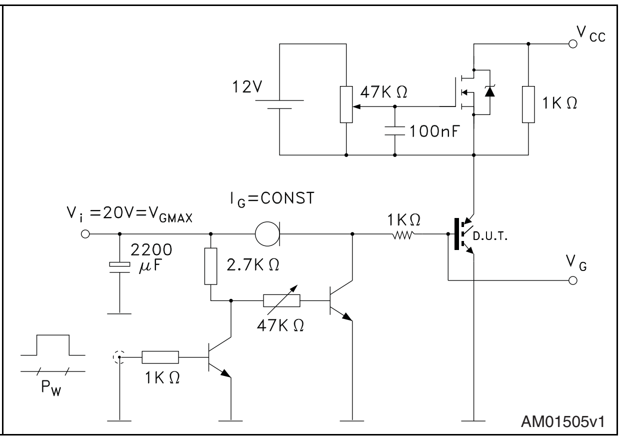
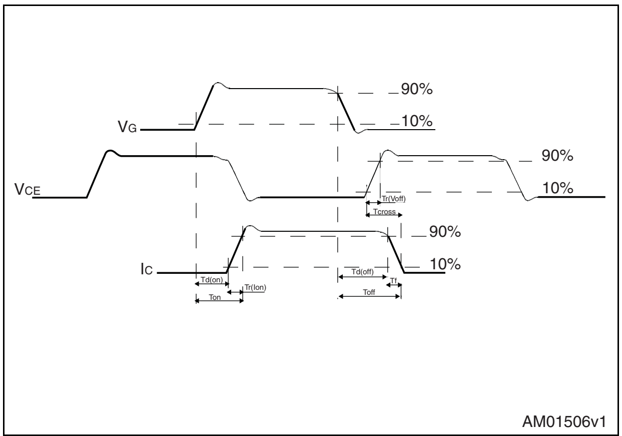


Figure 23. Switching waveform



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 7. 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

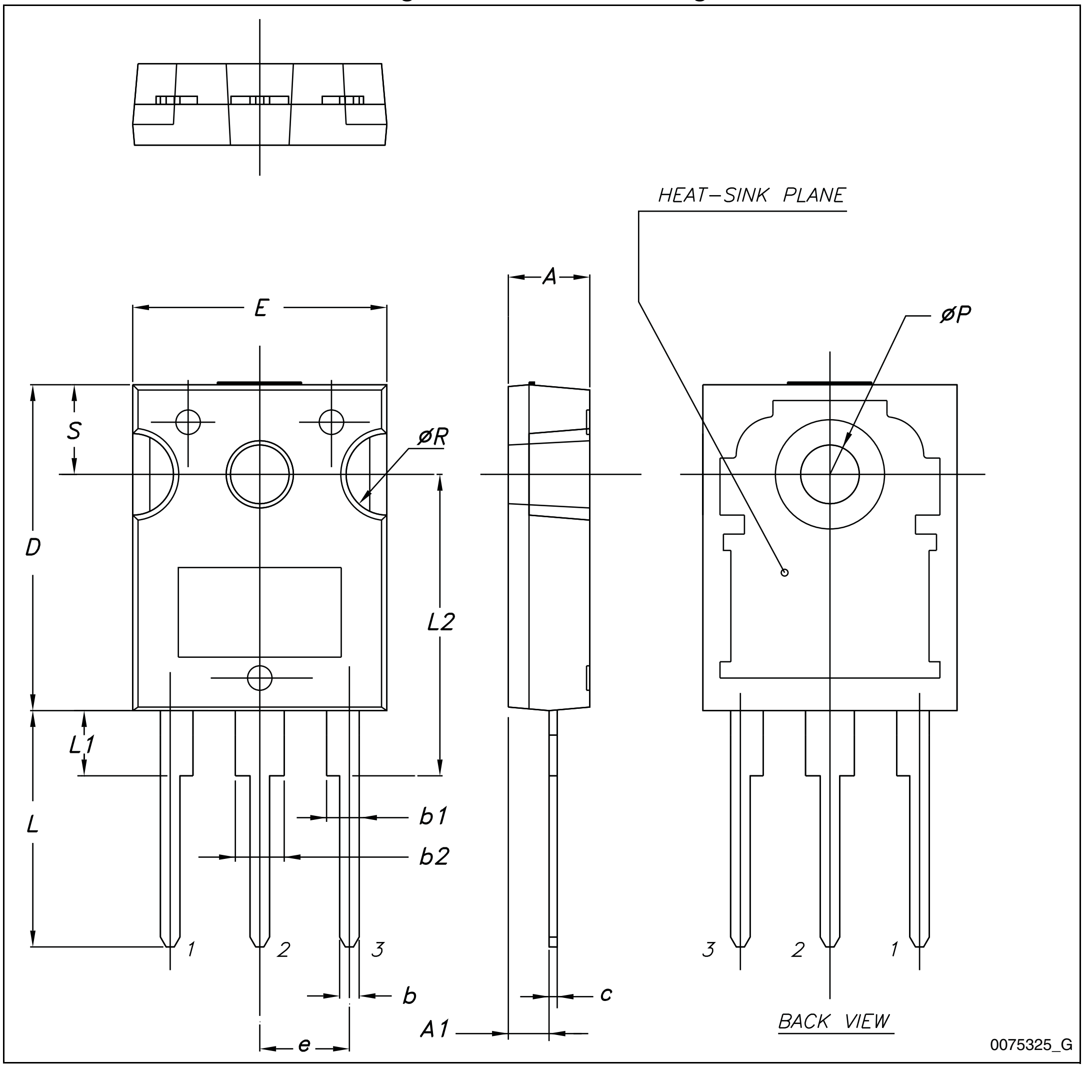
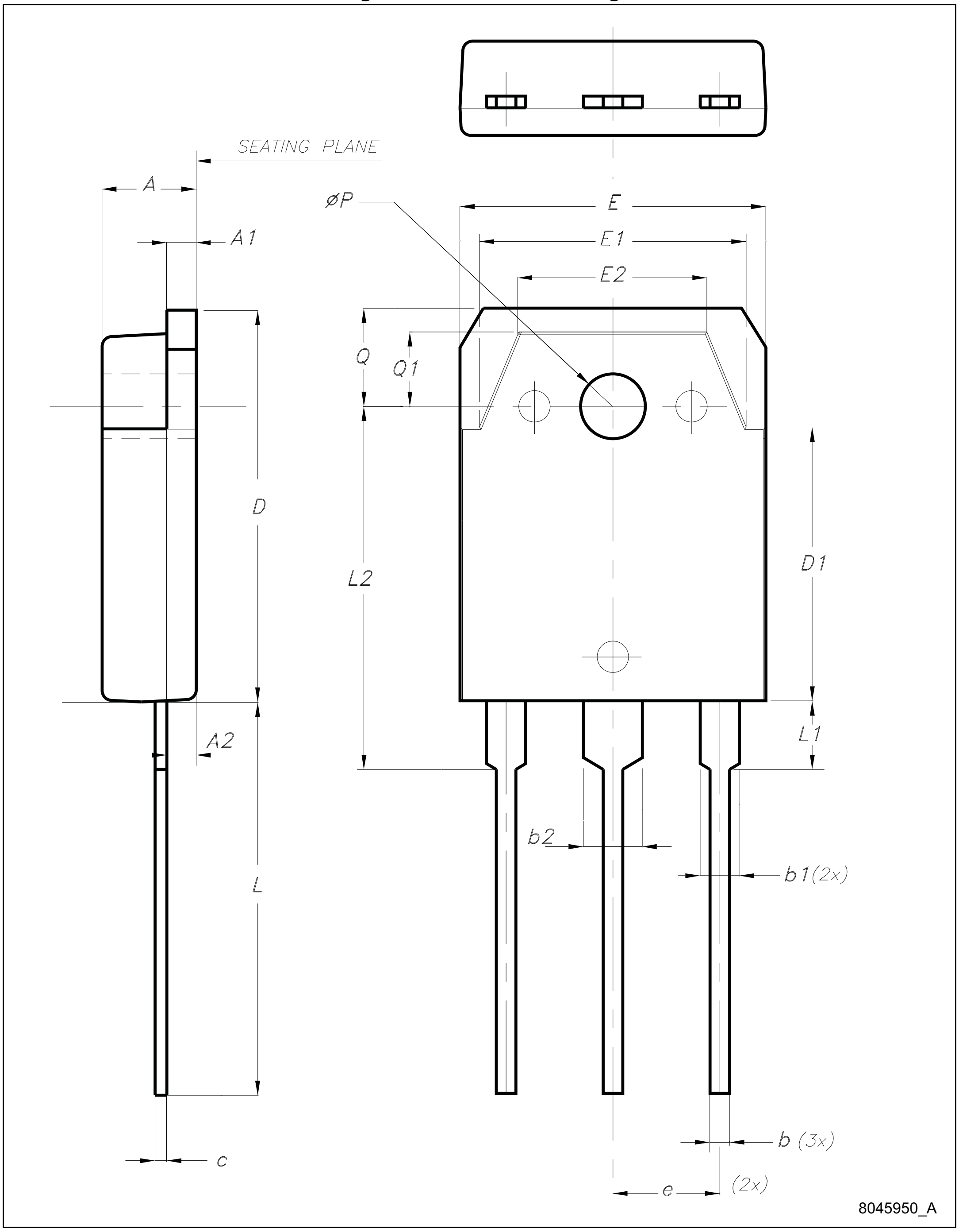


Table 8. TO-3P mechanical data

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 9. Document revision history

Date	Revision	Changes
30-Aug-2013	1	Initial release.