STGFW20H65FB, STGW20H65FB, STGWT20H65FB

Trench gate field-stop IGBT, HB series 650 V, 20 A high speed

Datasheet - production data

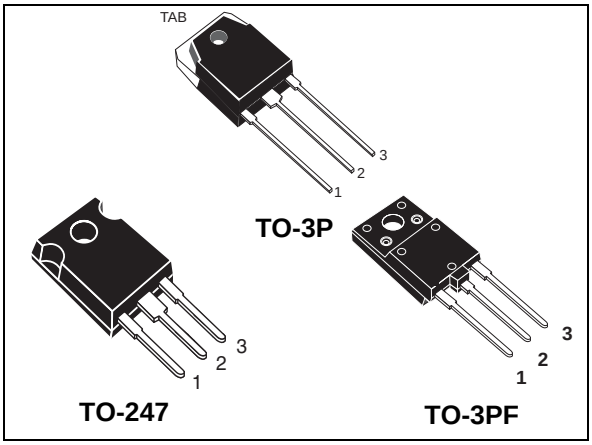
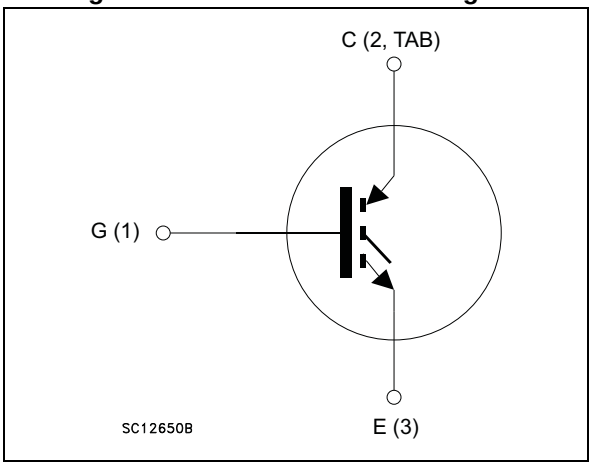


Figure 1. Internal schematic diagram



Features

- Maximum junction temperature: T_J = 175 °C
- High speed switching series
- Minimized tail current
- $V_{CE(sat)}$ = 1.55 V (typ.) @ I_C = 20 A
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Lead free package

Applications

- Photovoltaic inverters
- High frequency converters

Description

These devices are IGBTs developed using an advanced proprietary trench gate and field-stop structure. The device is part of the new HB series of IGBTs, which represent an optimum compromise between conduction and switching losses to maximize the efficiency of any frequency converter. Furthermore, a slightly positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STGFW20H65FB	GFW20H65FB	TO-3PF	Tube
STGW20H65FB	GW20H65FB	TO-247	Tube
STGWT20H65FB	GWT20H65FB	TO-3P	Tube

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-247 TO-3P	TO-3PFP	
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	650		V
I_C	Continuous collector current at T_C = 25 °C	40		A
I_C	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
P_{TOT}	Total dissipation at T_C = 25 °C	168	52	W
T_{STG}	Storage temperature range	- 55 to 150		°C
T_J	Operating junction temperature	- 55 to 175		°C

1. Pulse width limited by maximum junction temperature.

Table 3. Thermal data

Symbol	Parameter	Value		Unit
		TO-3PF	TO-247 TO-3P	
R_{thJC}	Thermal resistance junction-case	2.9	0.9	°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 = 20 A		1.55	2	V
		V_{GE} = 15 V, I_C = 20 A T_J = 125 °C		1.65		
		V_{GE} = 15 V, I_C = 20 A T_J = 175 °C		1.75		
$V_{GE(th)}$	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} = 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	-	2764	-	pF
C_{oes}	Output capacitance		-	80	-	pF
C_{res}	Reverse transfer capacitance		-	60	-	pF
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 20 A, V_{GE} = 15 V, see *Figure 27*	-	120	-	nC
Q_{ge}	Gate-emitter charge		-	20	-	nC
Q_{gc}	Gate-collector charge		-	50	-	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, see *Figure 26*	-	30	-	ns
t_r	Current rise time		-	11	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1400	-	A/µs
$t_{d(off)}$	Turn-off delay time			139	-	ns
t_f	Current fall time		-	20	-	ns
E_{on} (1)	Turn-on switching losses		-	77	-	µJ
E_{off} (2)	Turn-off switching losses		-	170	-	µJ
E_{ts}	Total switching losses		-	247	-	µJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 175 °C, see *Figure 26*	-	29	-	ns
t_r	Current rise time		-	12	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1352	-	A/µs
$t_{d(off)}$	Turn-off delay time		-	147	-	ns
t_f	Current fall time		-	38	-	ns
E_{on} (1)	Turn-on switching losses		-	88	-	µJ
E_{off} (2)	Turn-off switching losses		-	353	-	µJ
E_{ts}	Total switching losses		-	441	-	µJ

1. Energy losses include reverse recovery of the external diode. Turn-on times and energy have been measured applying as freewheeling an external SiC diode STPSC206W
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)

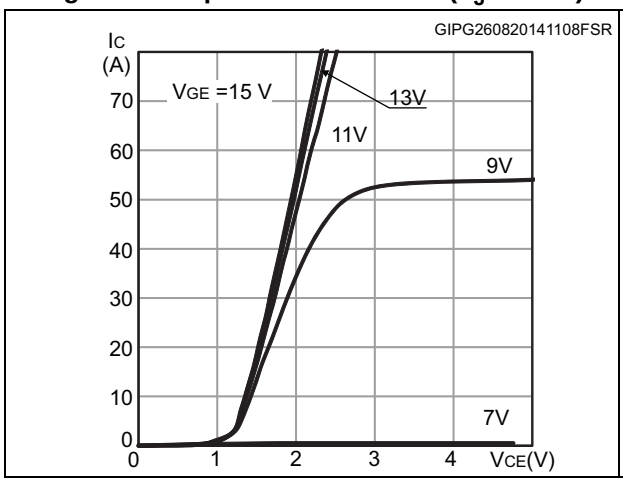


Figure 3. Output characteristics (T_J = 175°C)

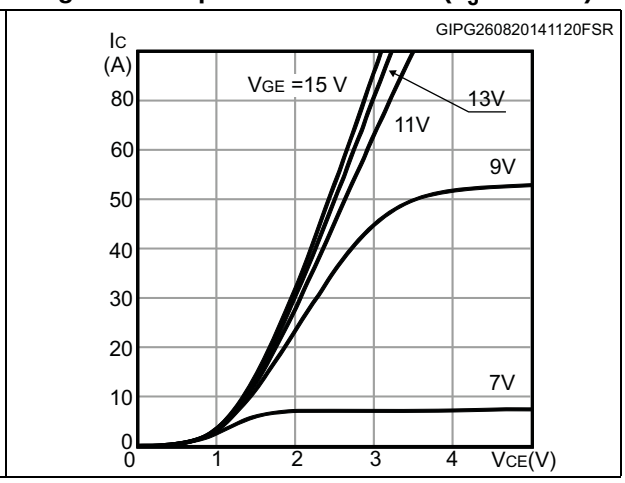


Figure 4. Transfer characteristics

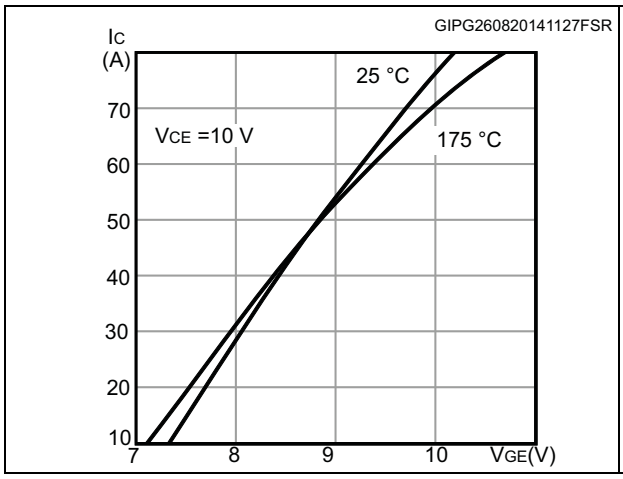


Figure 5. Collector current vs. case temperature for TO-247 and TO-3P

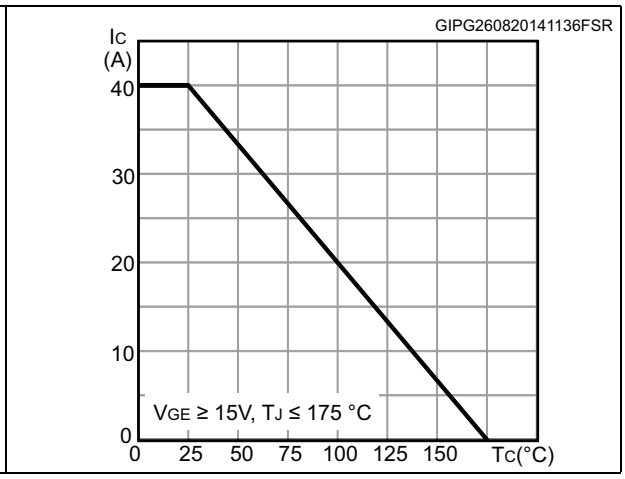


Figure 6. Collector current vs. case temperature for TO-3PF

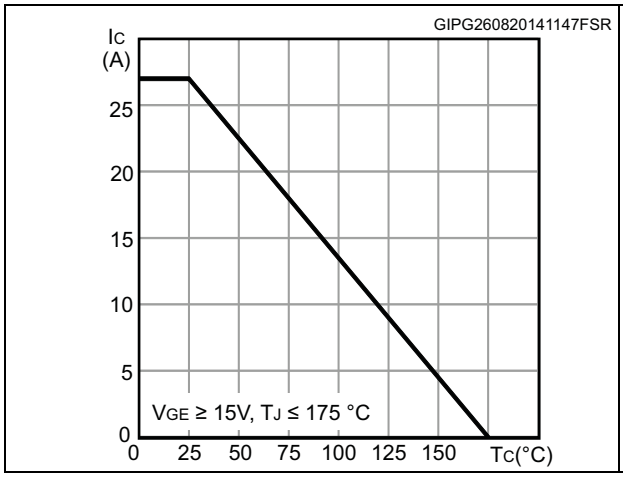


Figure 7. $V_{CE(sat)}$ vs. junction temperature

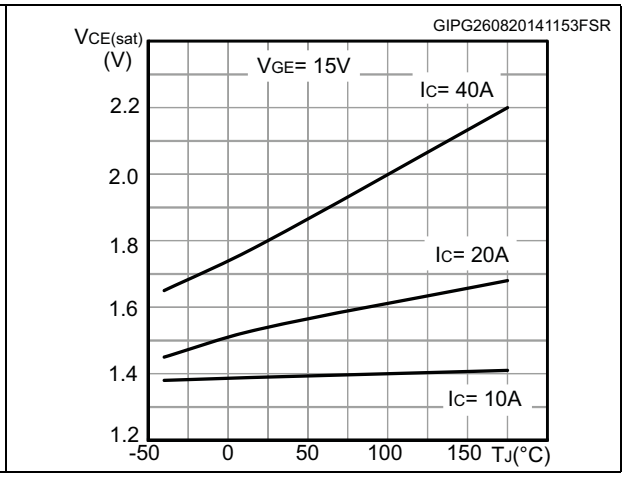


Figure 8. Power dissipation vs. case temperature for TO-247 and TO-3P

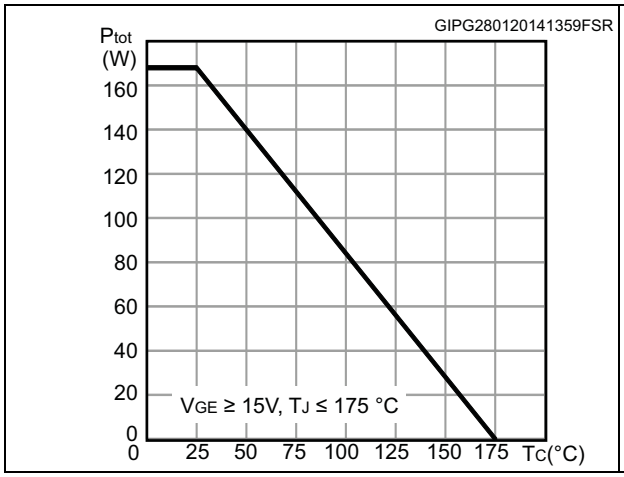


Figure 9. Power dissipation vs. case temperature for TO-3PF

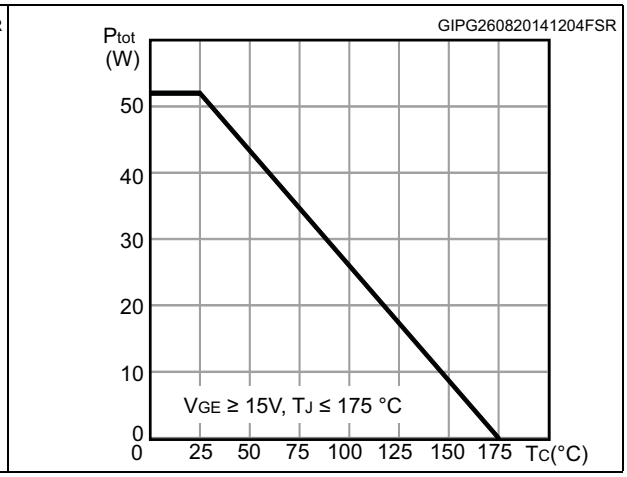


Figure 10. Forward bias safe operating area for TO-247 and TO-3P

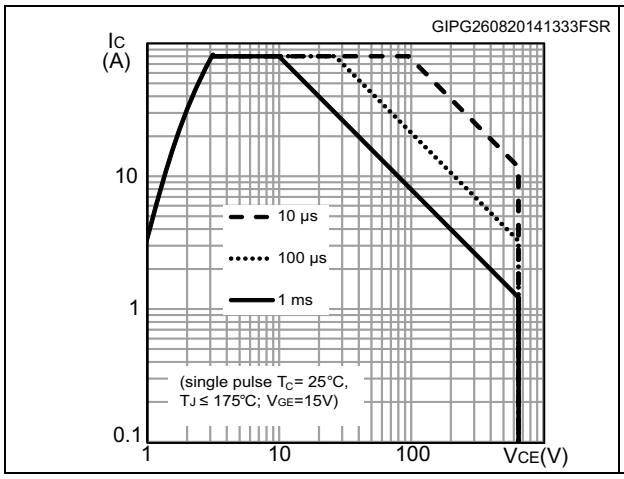


Figure 11. Forward bias safe operating area for TO-3PF

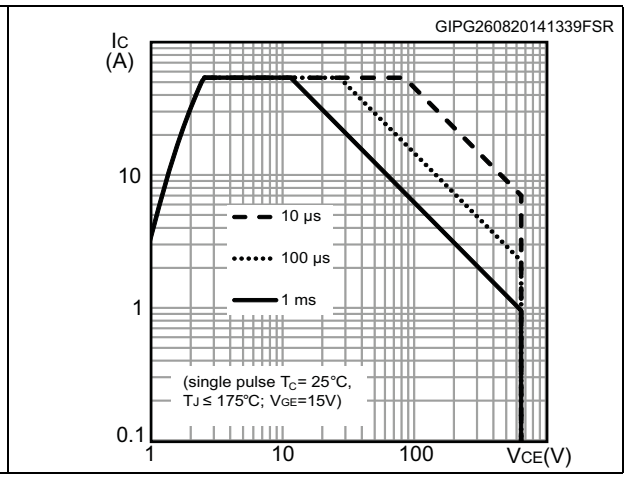


Figure 12. Collector current vs. switching frequency for TO-247 and TO-3P

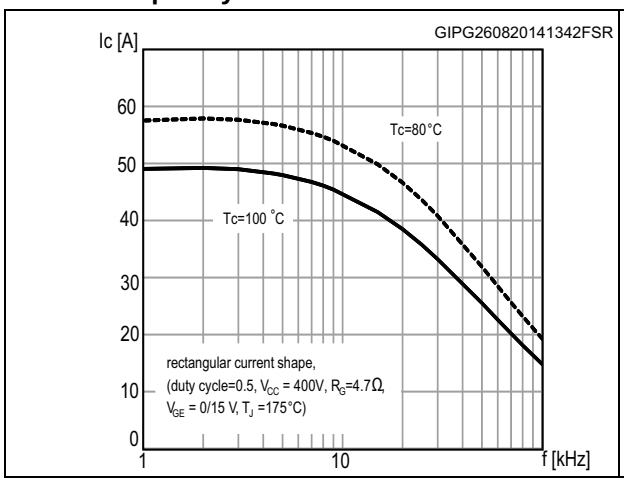


Figure 13. Collector current vs. switching frequency for TO-3PF

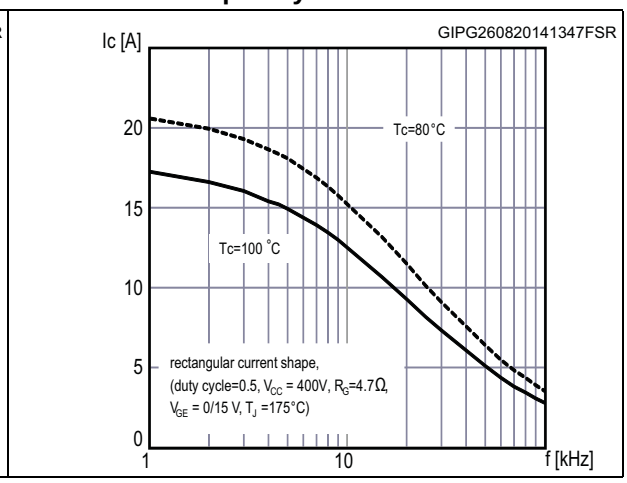


Figure 14. Normalized $V_{GE(th)}$ vs. junction temperature

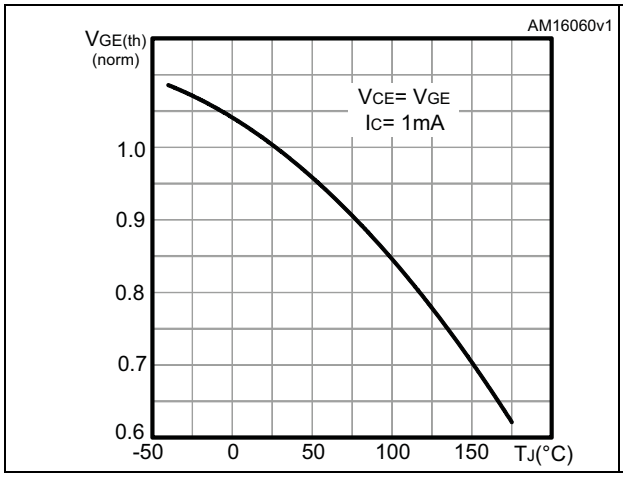


Figure 15. Normalized $V_{(BR)CES}$ vs. junction temperature

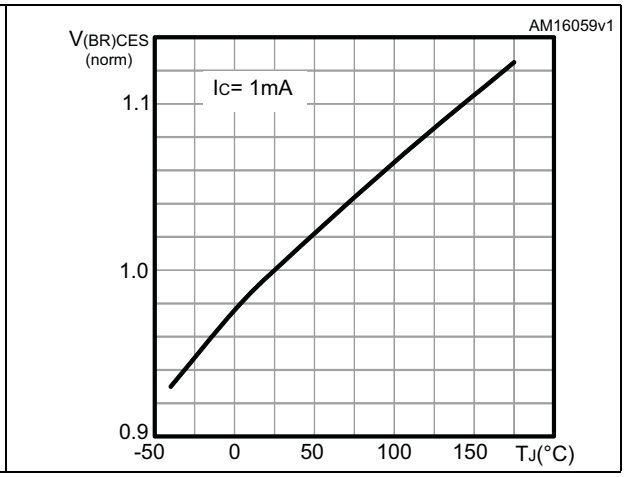


Figure 16. Switching losses vs temperature

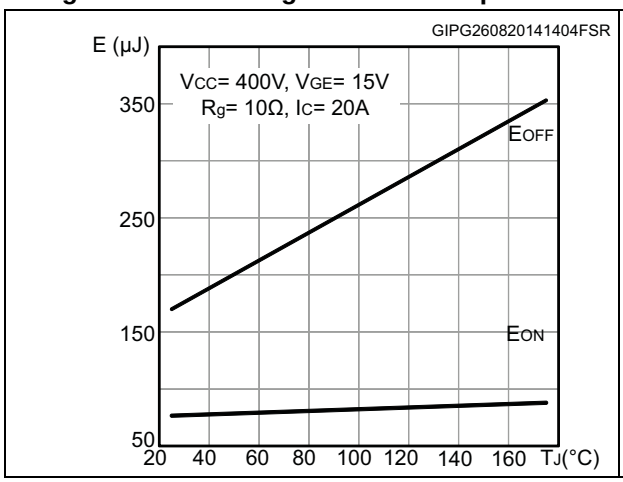


Figure 17. Switching losses vs gate resistance

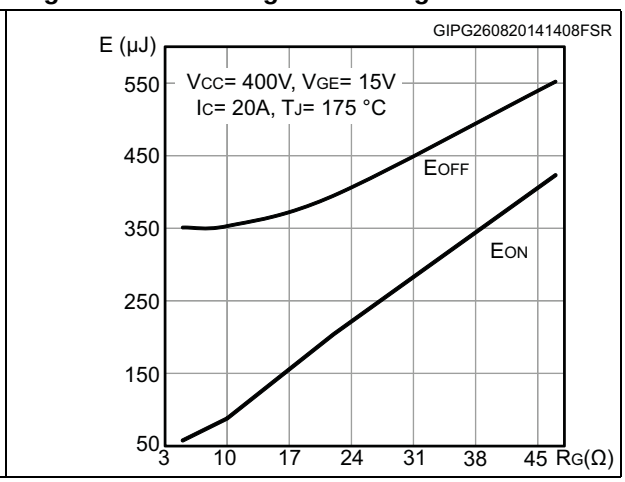


Figure 18. Switching losses vs collector current

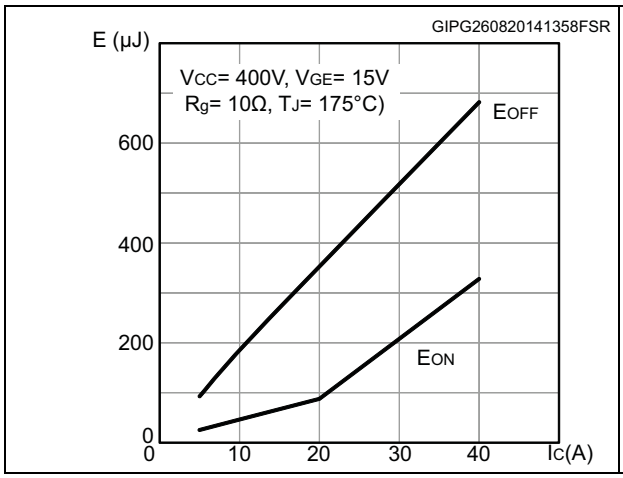


Figure 19. Switching losses vs collector emitter voltage

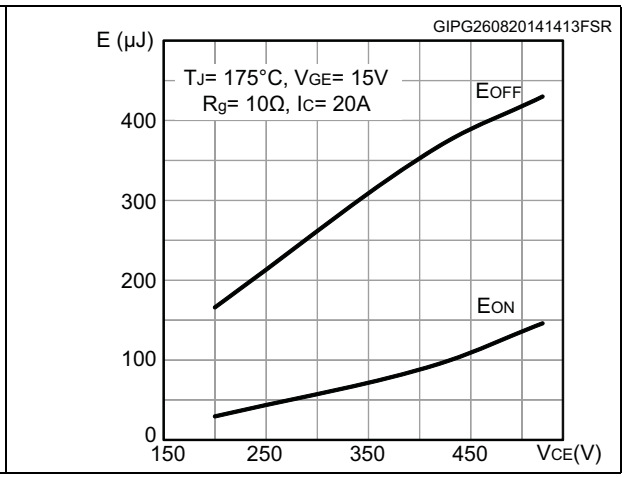


Figure 20. Switching times vs collector current

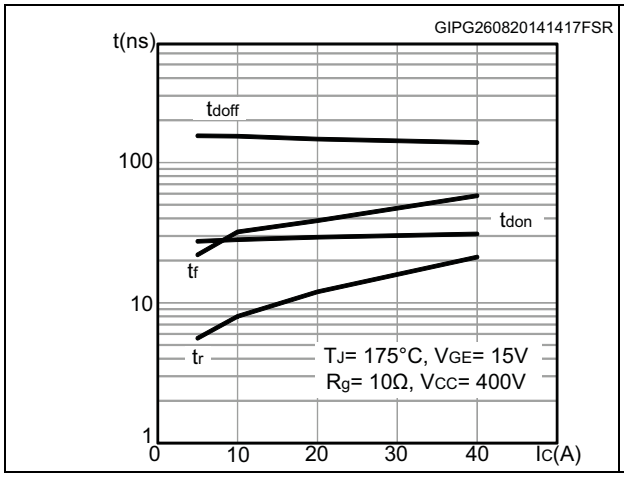


Figure 21. Switching times vs gate resistance

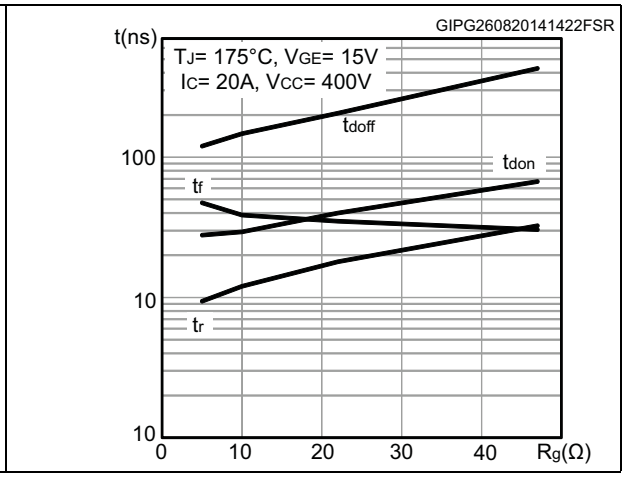


Figure 22. Capacitance variations

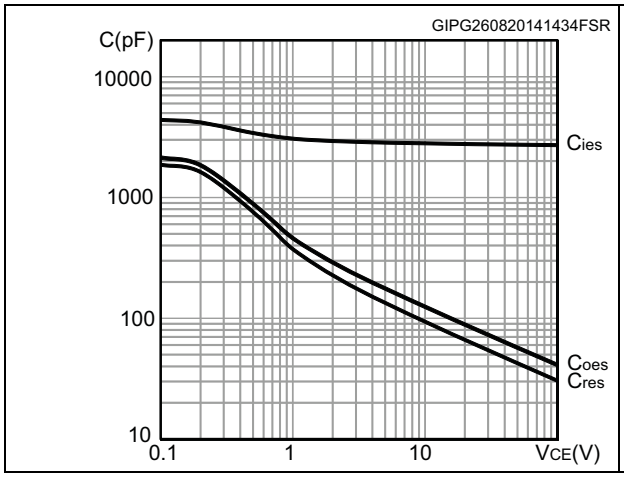


Figure 23. Gate charge vs. gate-emitter voltage

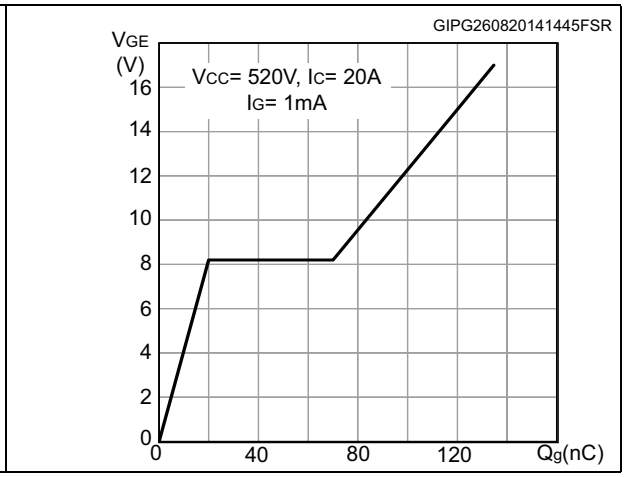


Figure 24. Thermal impedance for TO-247 and TO-3P

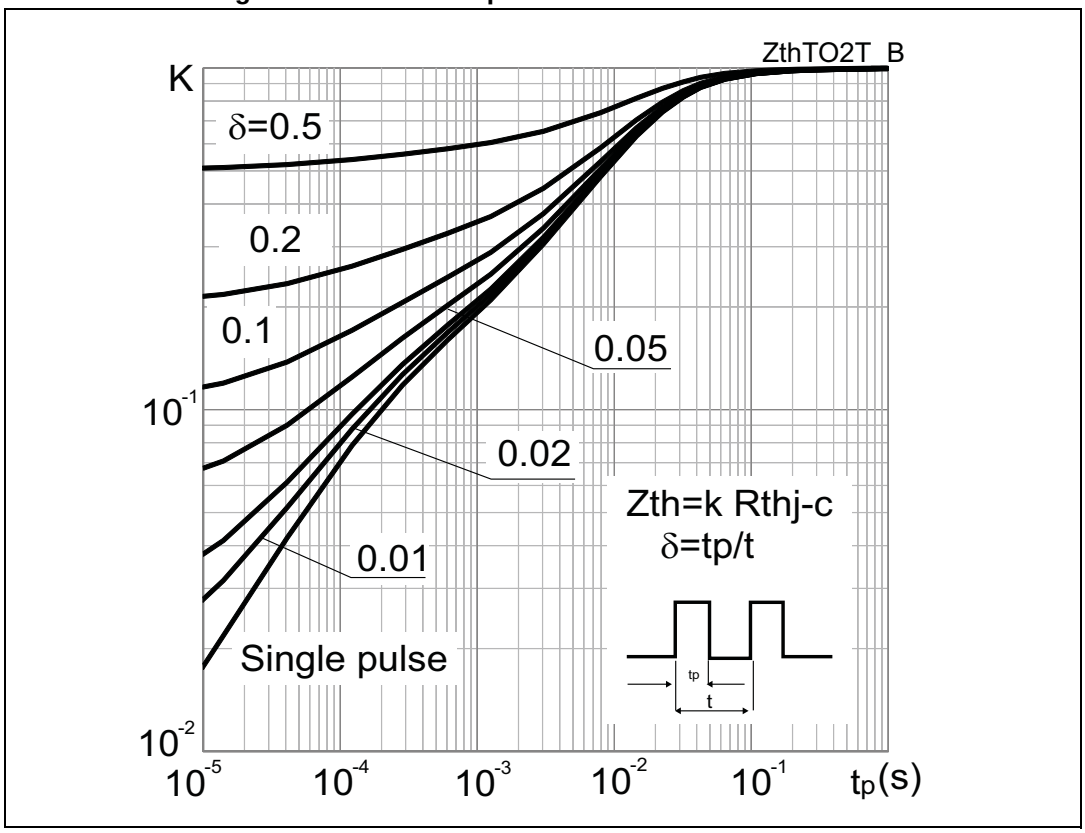
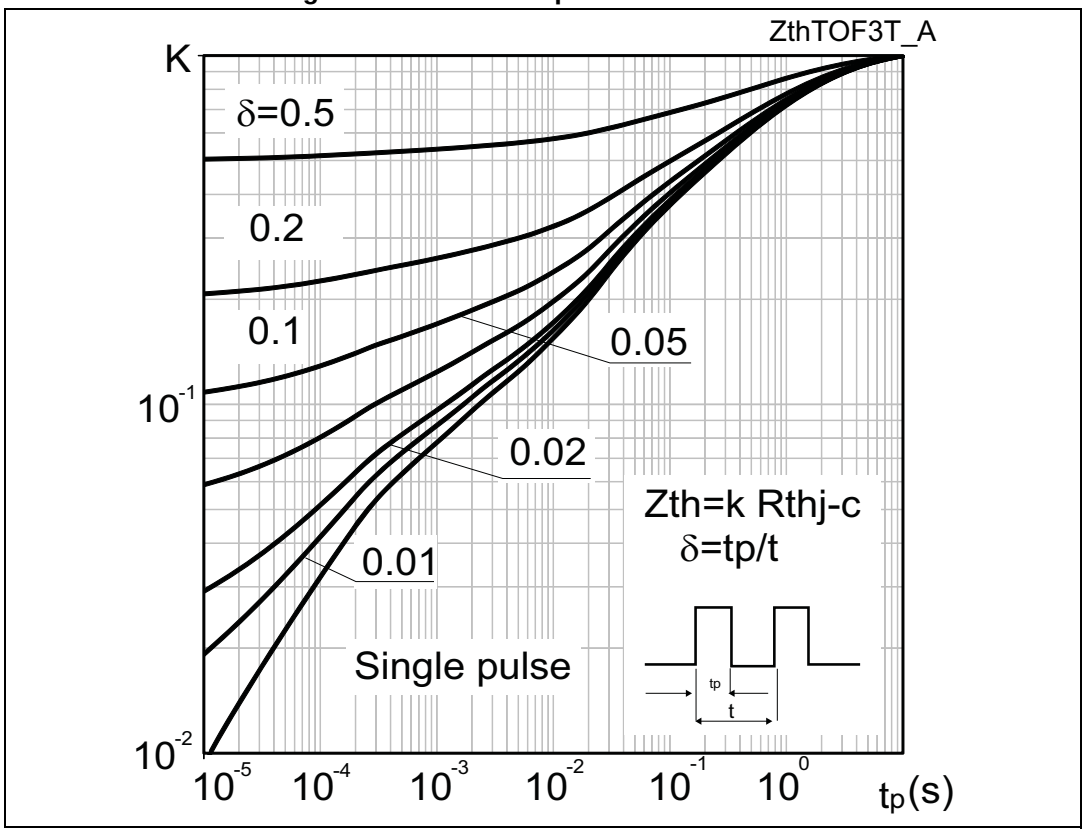


Figure 25. Thermal impedance for TO-3PF



3 Test circuits

Figure 26. Test circuit for inductive load switching

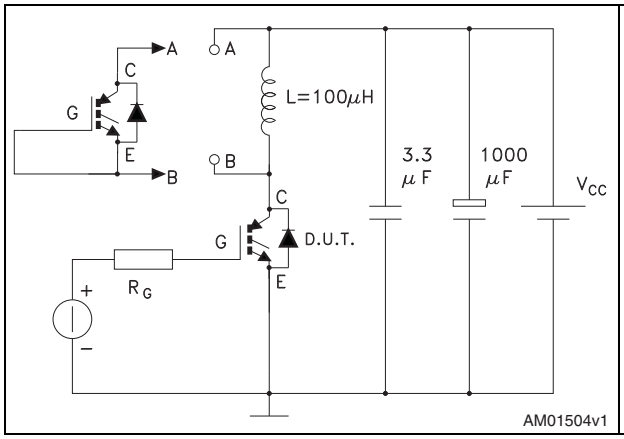


Figure 27. Gate charge test circuit

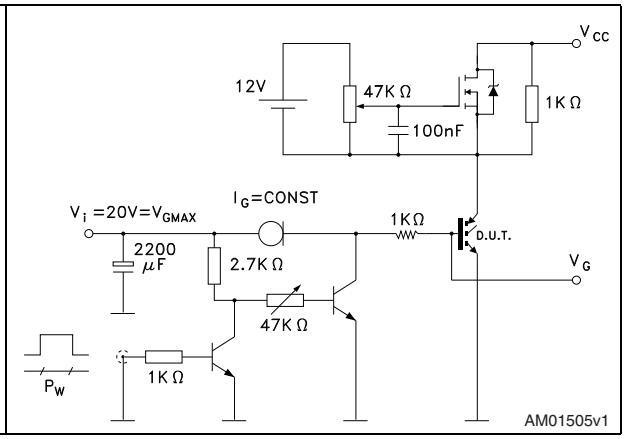
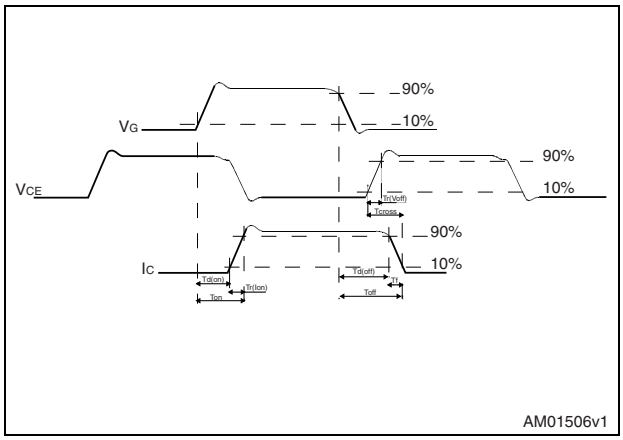


Figure 28. Switching waveform



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.

4.1 TO-3PF, STGFW20H65FB

Figure 29. TO-3PF drawing

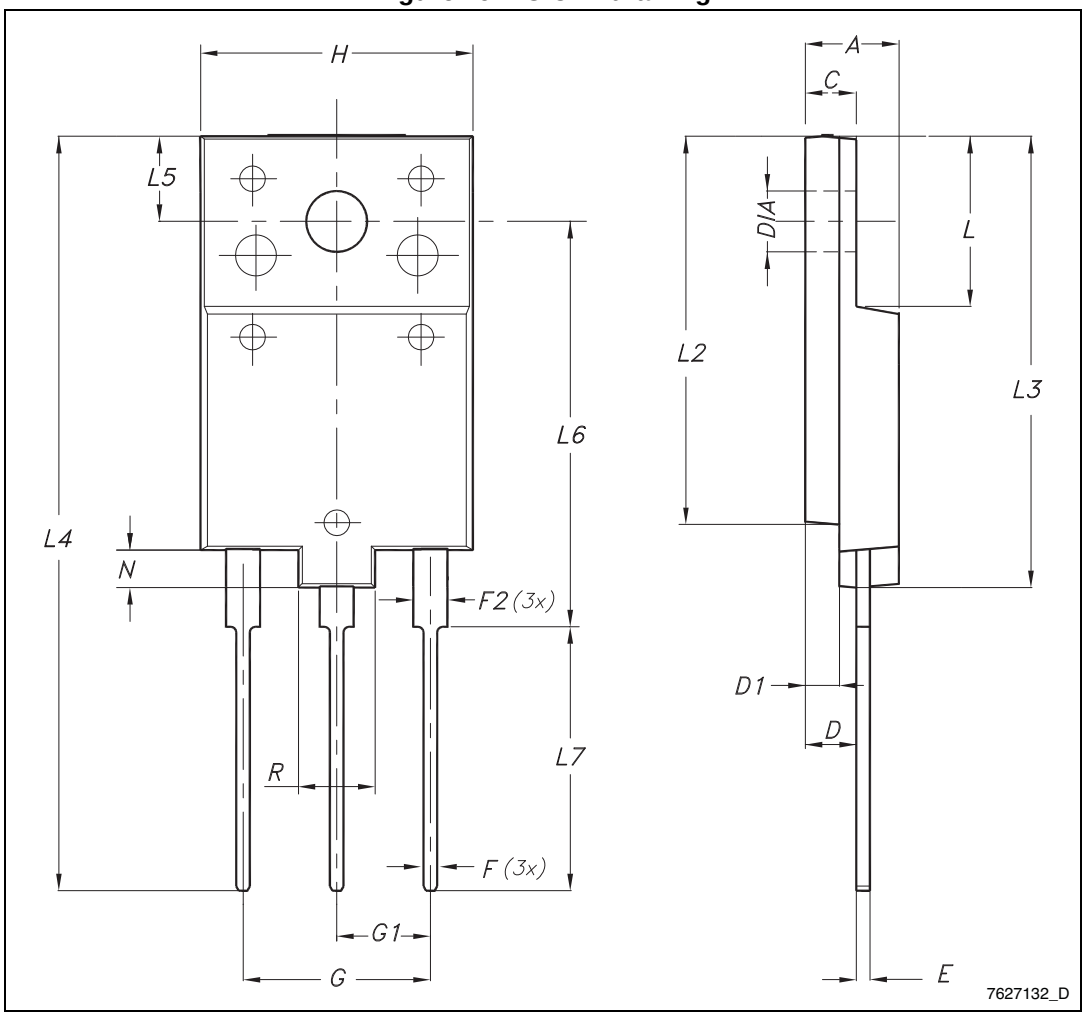


Table 7. TO-3PF mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	5.30		5.70
C	2.80		3.20
D	3.10		3.50
D1	1.80		2.20
E	0.80		1.10
F	0.65		0.95
F2	1.80		2.20
G	10.30		11.50
G1		5.45	
H	15.30		15.70
L	9.80	10	10.20
L2	22.80		23.20
L3	26.30		26.70
L4	43.20		44.40
L5	4.30		4.70
L6	24.30		24.70
L7	14.60		15
N	1.80		2.20
R	3.80		4.20
Dia	3.40		3.80

4.2 TO-247, STGW20H65FB

Figure 30. TO-247 drawing

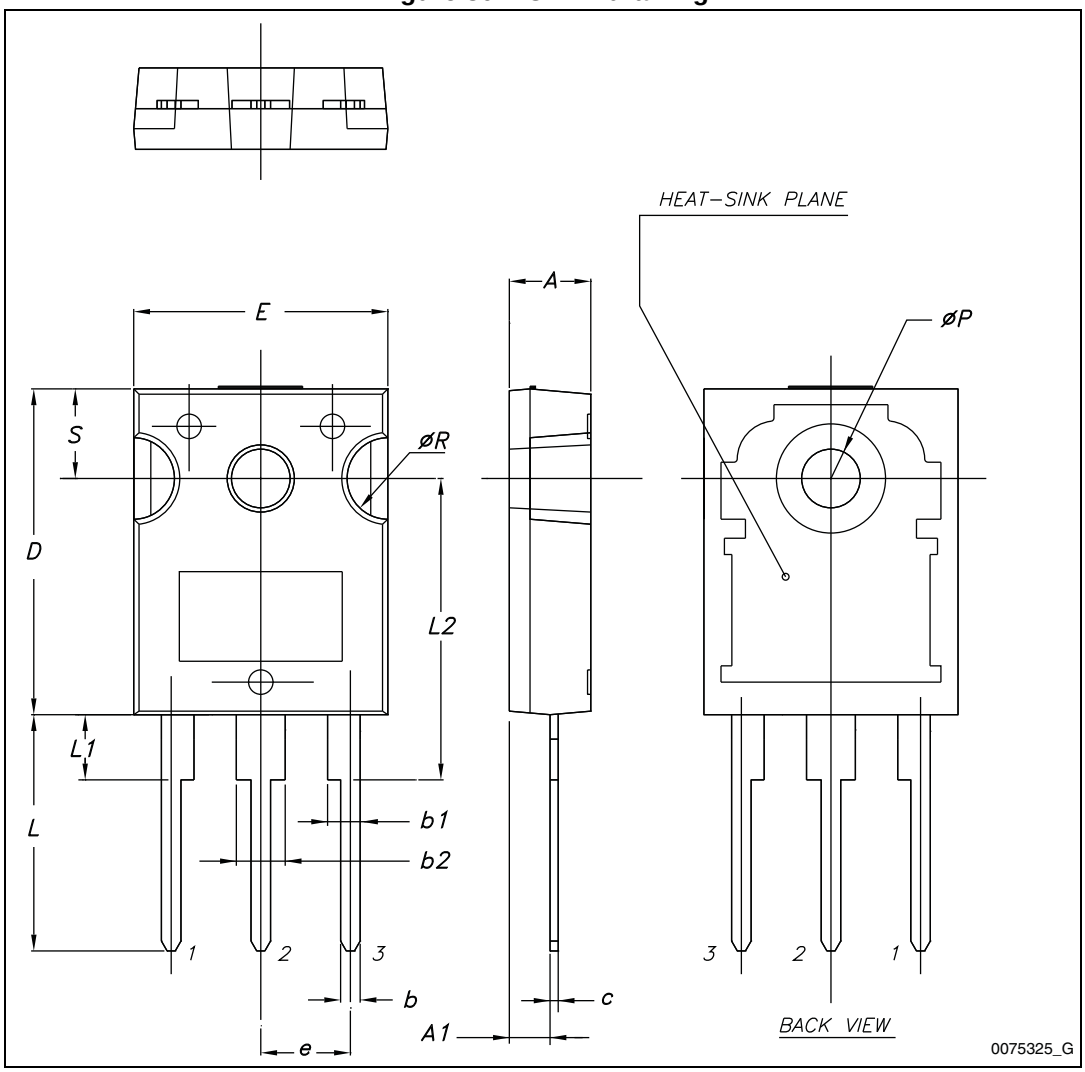


Table 8. TO-247 mechanical data

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

4.3 TO-3P, STGWT20H65FB

Figure 31. TO-3P drawing

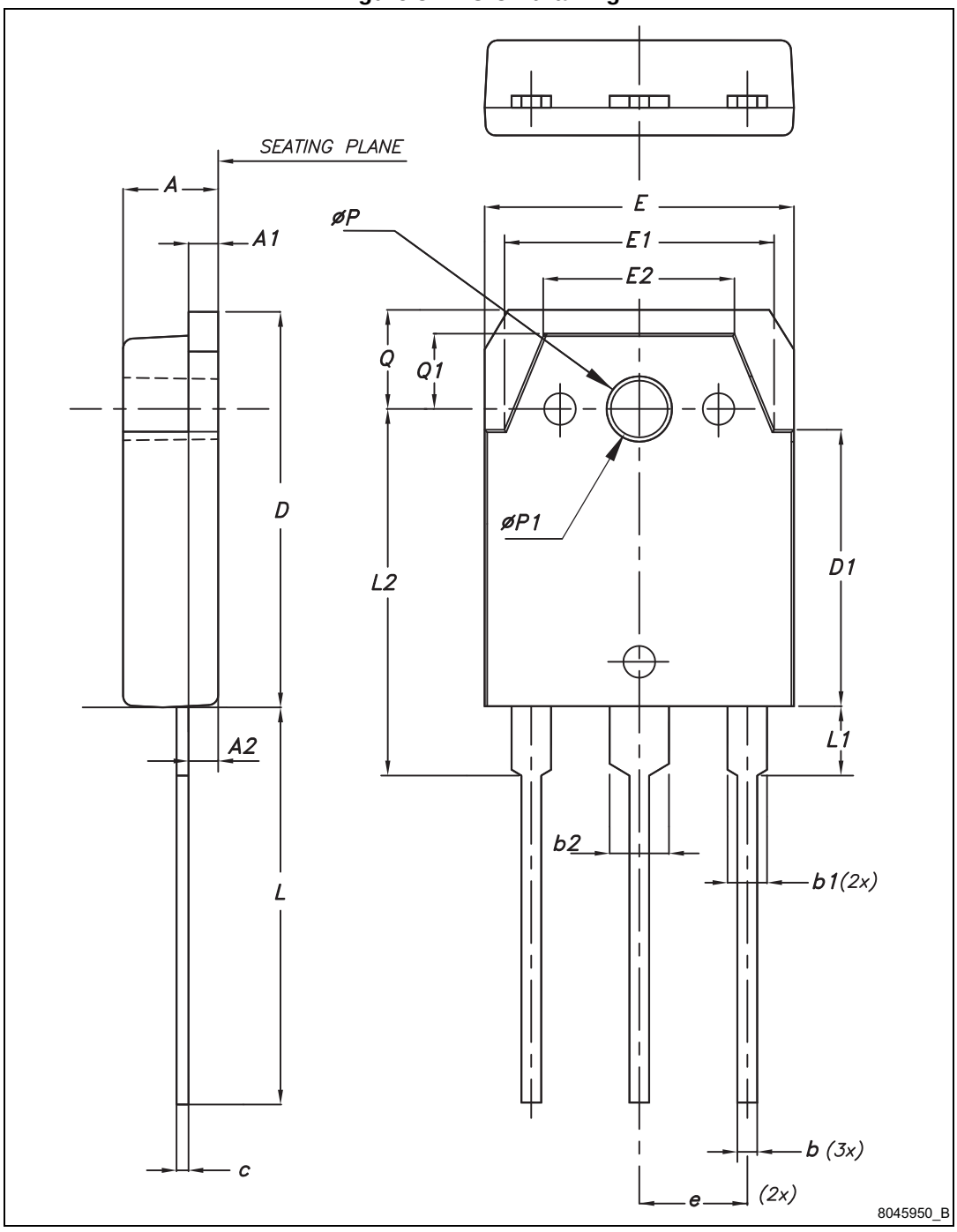


Table 9. TO-3P mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.60	4.80	5
A1	1.45	1.50	1.65
A2	1.20	1.40	1.60
b	0.80	1.00	1.20
b1	1.80	2.00	2.20
b2	2.80	3.00	3.20
c	0.55	0.60	0.75
D	19.70	19.90	20.10
D1	13.70	13.90	14.10
E	15.40	15.60	15.80
E1	13.40	13.60	13.80
E2	9.40	9.60	9.90
e	5.15	5.45	5.75
L	19.80	20	20.20
L1	3.30	3.50	3.70
L2	18.20	18.40	18.60
øP	3.30	3.40	3.50
øP1	3.10	3.20	3.30
Q	4.80	5	5.20
Q1	3.60	3.80	4

5 Revision history

Table 10. Document revision history

Date	Revision	Changes
28-Aug-2014	1	Initial release.