STGFW80V60F, STGW80V60F, STGWT80V60F

Trench gate field-stop IGBT, V series 600 V, 80 A very high speed

Datasheet - production data

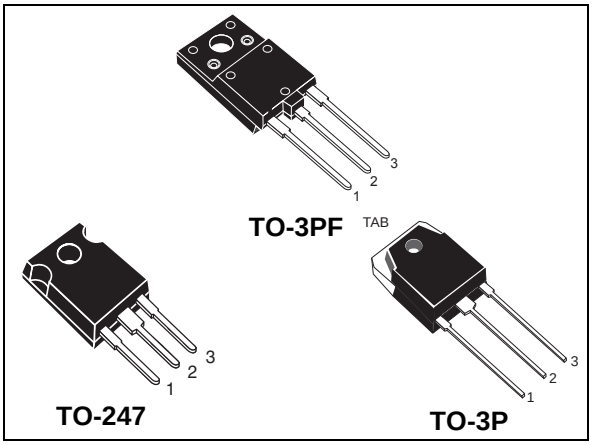
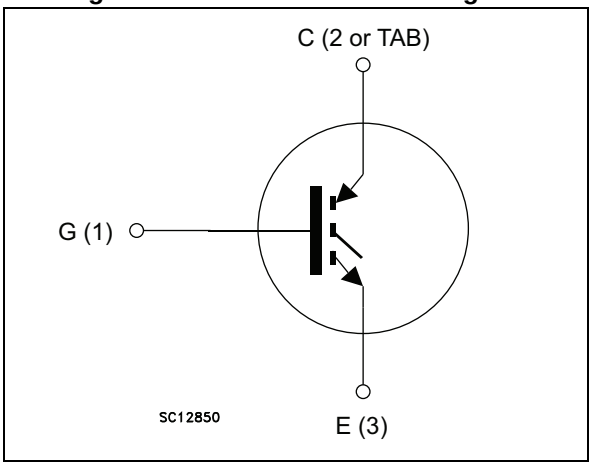


Figure 1. Internal schematic diagram



Features

- Maximum junction temperature: T_J = 175 °C
- Tail-less switching off
- $V_{CE(sat)}$ = 1.85 V (typ.) @ I_C = 80 A
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance

Applications

- Photovoltaic inverters
- Uninterruptible power supply
- Welding
- Power factor correction
- Very high frequency converters

Description

This device is an IGBT developed using an advanced proprietary trench gate field stop structure. The device is part of the V series of IGBTs, which represent an optimum compromise between conduction and switching losses to maximize the efficiency of very high frequency converters. Furthermore, a 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
STGFW80V60F	GFW80V60F	TO-3PF	Tube
STGW80V60F	GW80V60F	TO-247	Tube
STGWT80V60F	GWT80V60F	TO-3P	Tube

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-247 TO-3P	TO-3PF	
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	600		V
I_C	Continuous collector current at T_C = 25 °C	120(1)		A
I_C	Continuous collector current at T_C = 100 °C	80		A
I_{CP}(2)	Pulsed collector current	240		A
V_{GE}	Gate-emitter voltage	±20		V
P_{TOT}	Total dissipation at T_C = 25 °C	469	79	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; Tc = 25 °C)		3.5	kV
T_{STG}	Storage temperature range	- 55 to 150		°C
T_J	Operating junction temperature	- 55 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
		TO-247 TO-3P	TO-3PF	
R_{thJC}	Thermal resistance junction-case	0.32	1.9	°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	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 80 A		1.85	2.3	V
		V_{GE} = 15 V, I_C = 80 A T_J = 125 °C		2.15		
		V_{GE} = 15 V, I_C = 80 A T_J = 175 °C		2.4		
$V_{GE(th)}$	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			100	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	-	10800	-	nF
C_{oes}	Output capacitance		-	390	-	pF
C_{res}	Reverse transfer capacitance		-	220	-	pF
Q_g	Total gate charge	V_{CC} = 480 V, I_C = 80 A, V_{GE} = 15 V, see *Figure 28*	-	448	-	nC
Q_{ge}	Gate-emitter charge		-	76	-	nC
Q_{gc}	Gate-collector charge		-	184	-	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 = 80 A, R_G = 10 Ω, V_{GE} = 15 V, see *Figure 27*	-	60	-	ns
t_r	Current rise time		-	30	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	2200	-	A/µs
$t_{d(off)}$	Turn-off delay time		-	220	-	ns
t_f	Current fall time		-	17	-	ns
E_{on}(1)	Turn-on switching losses		-	1.8	-	mJ
E_{off}(2)	Turn-off switching losses		-	1	-	mJ
E_{ts}	Total switching losses		-	2.8	-	mJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 80 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 175 °C, see *Figure 27*	-	60	-	ns
t_r	Current rise time		-	30	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	2100	-	A/µs
$t_{d(off)}$	Turn-off delay time		-	240	-	ns
t_f	Current fall time		-	22	-	ns
E_{on}(1)	Turn-on switching losses		-	3.8	-	mJ
E_{off}(2)	Turn-off switching losses		-	1.25	-	mJ
E_{ts}	Total switching losses		-	5.05	-	mJ

1. Energy loss include reverse recovery of the external diode. The diode is the same of the co-packed STGW80V60DF
2. Turn-off losses include also the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 2. Power dissipation vs. case temperature for TO-247 and TO-3P

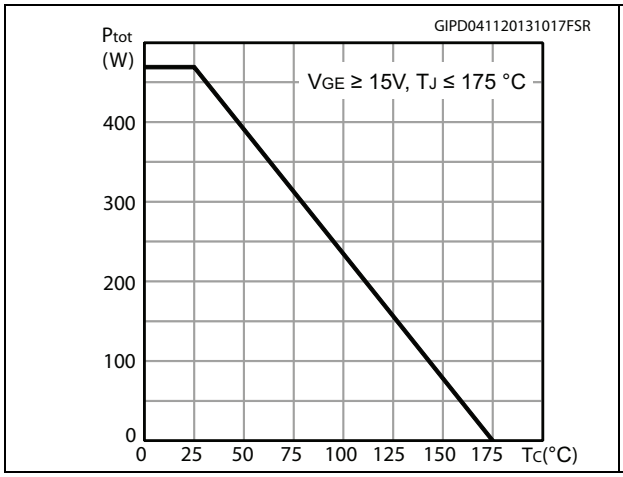


Figure 3. Collector current vs. case temperature for TO-247 and TO-3P

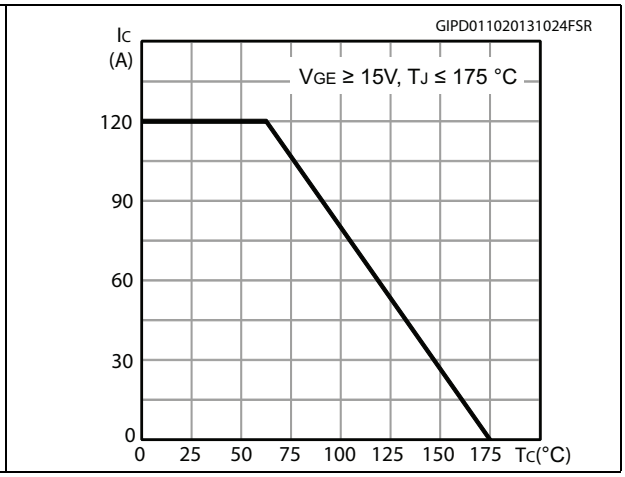


Figure 4. Power dissipation vs. case temperature for TO-3PF

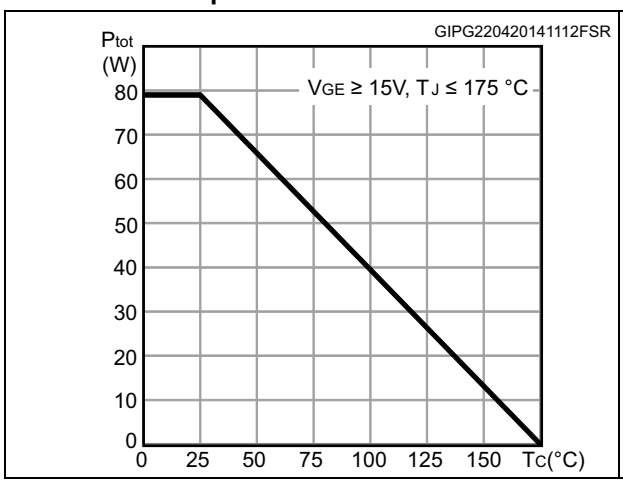


Figure 5. Collector current vs. case temperature for TO-3PF

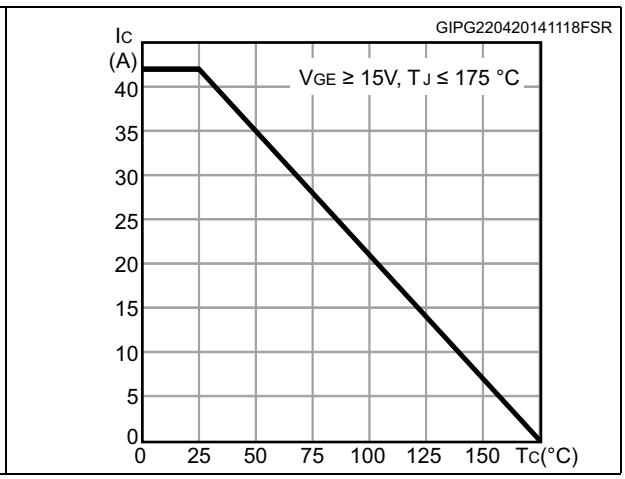


Figure 6. Output characteristics (T_J = 25°C)

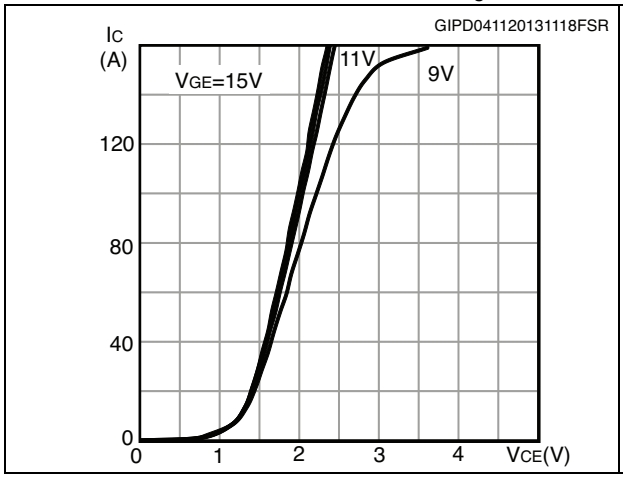


Figure 7. Output characteristics (T_J = 175°C)

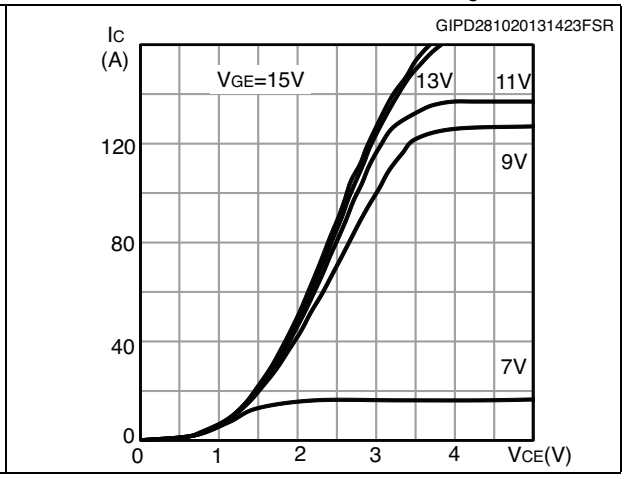


Figure 8. $V_{CE(sat)}$ vs. junction temperature

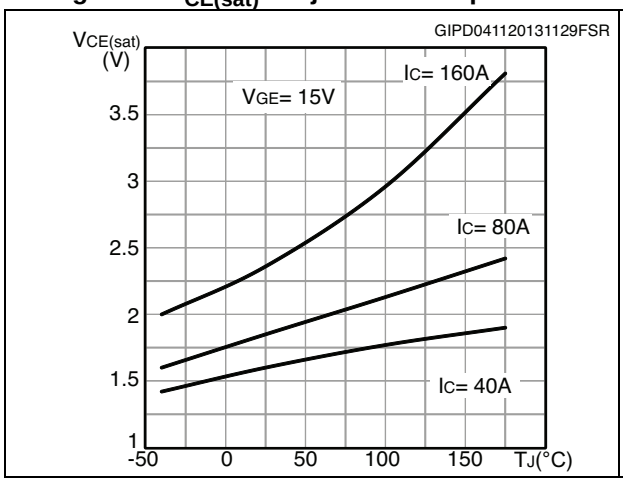


Figure 9. $V_{CE(sat)}$ vs. collector current

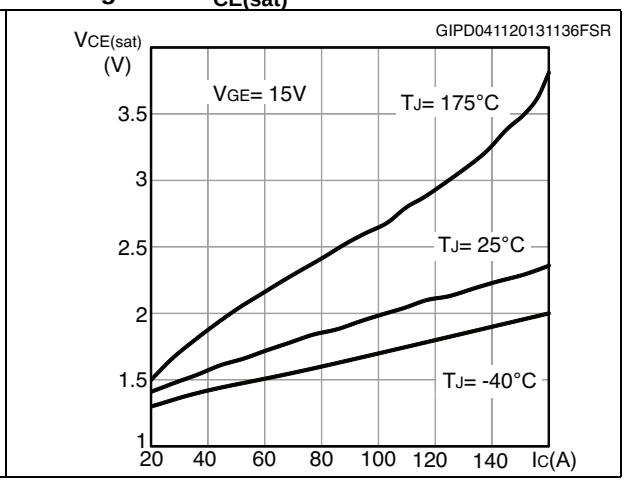


Figure 10. Collector current vs. switching frequency for TO-247 and TO-3P

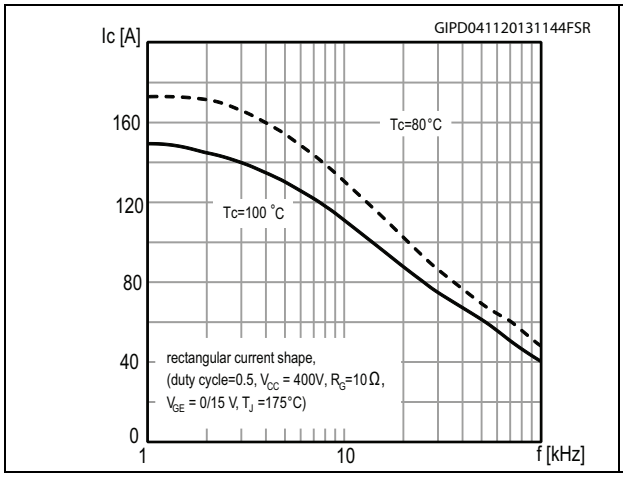


Figure 11. Collector current vs. switching frequency for TO-3PF

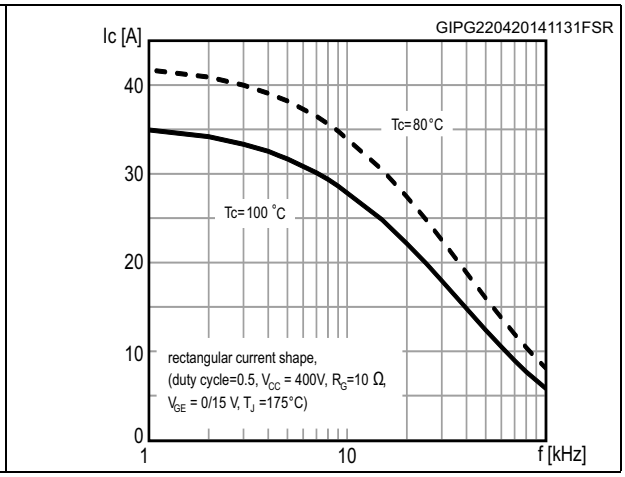


Figure 12. Forward bias safe operating area for TO-247 and TO-3P

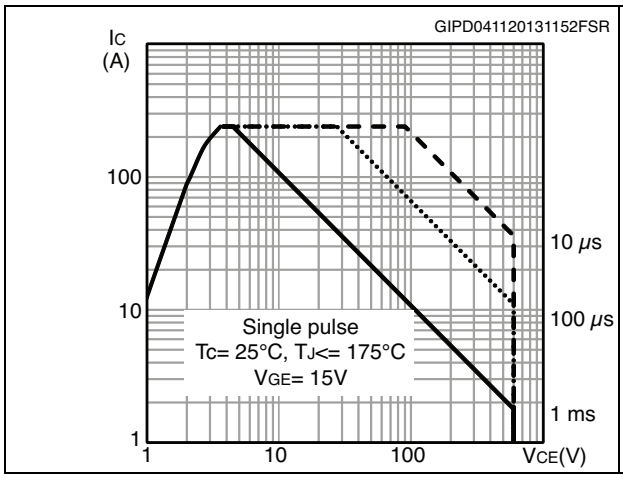


Figure 13. Forward bias safe operating area for TO-3PF

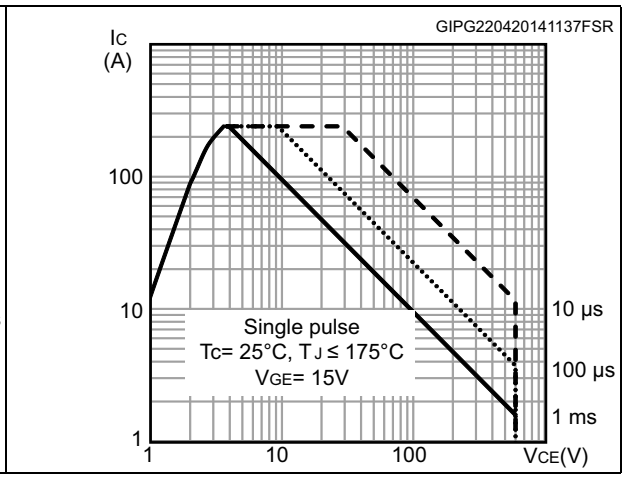


Figure 14. Normalized $V_{GE(th)}$ vs junction temperature

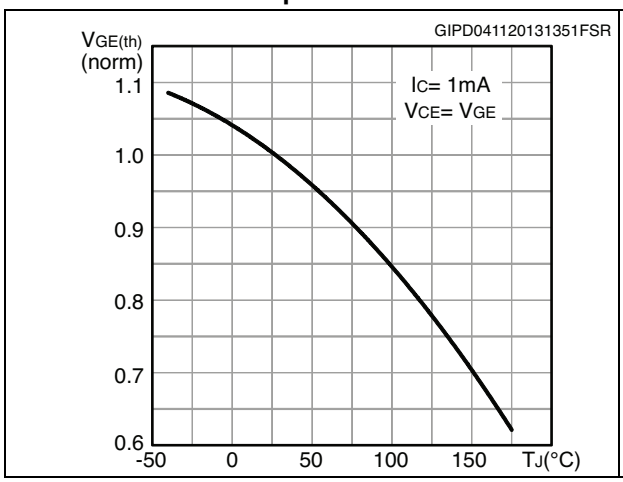


Figure 15. Normalized $V_{(BR)CES}$ vs. junction temperature

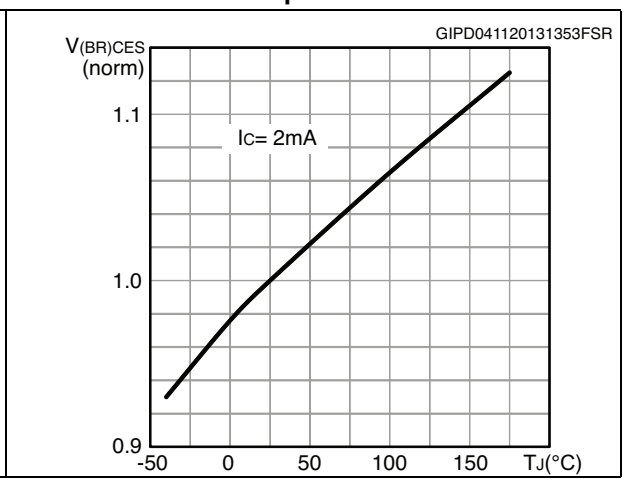


Figure 16. Capacitance variation

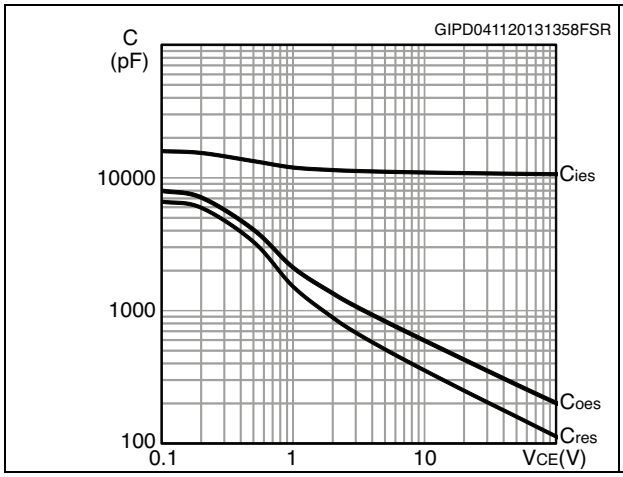


Figure 17. Gate charge vs. gate-emitter voltage

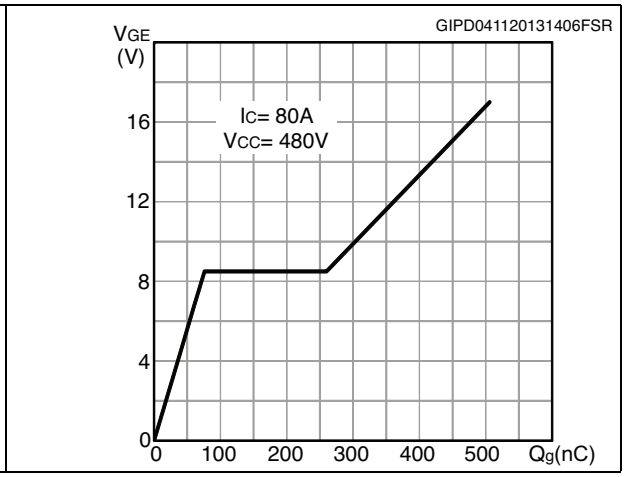


Figure 18. Switching loss vs collector current

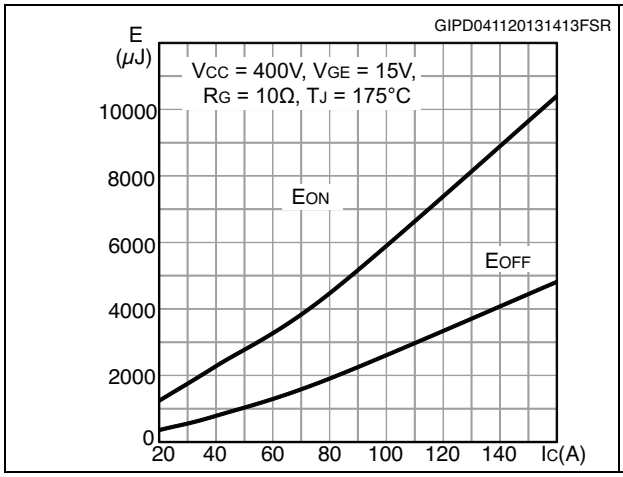


Figure 19. Switching loss vs gate resistance

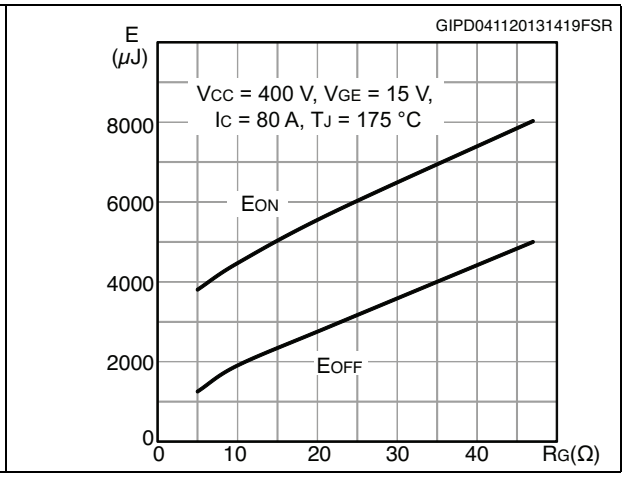


Figure 20. Switching loss vs temperature

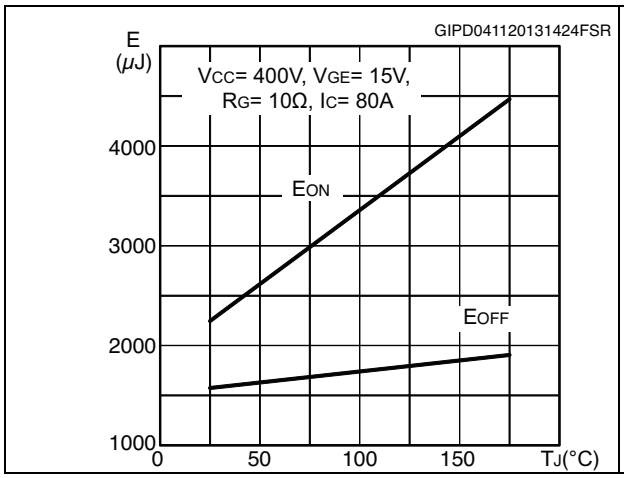


Figure 21. Switching loss vs collector-emitter voltage

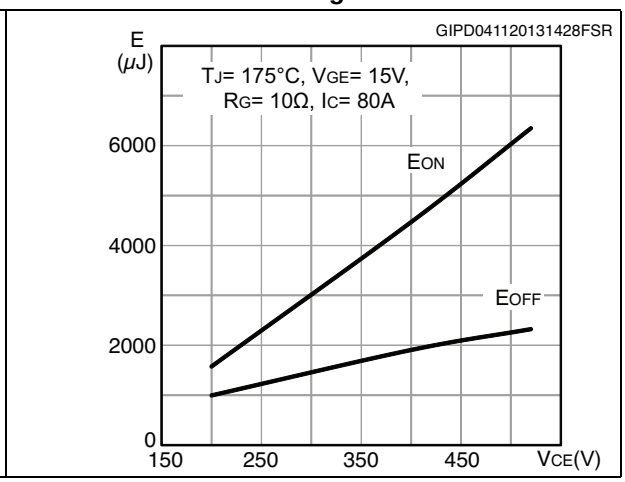


Figure 22. Switching times vs. collector current

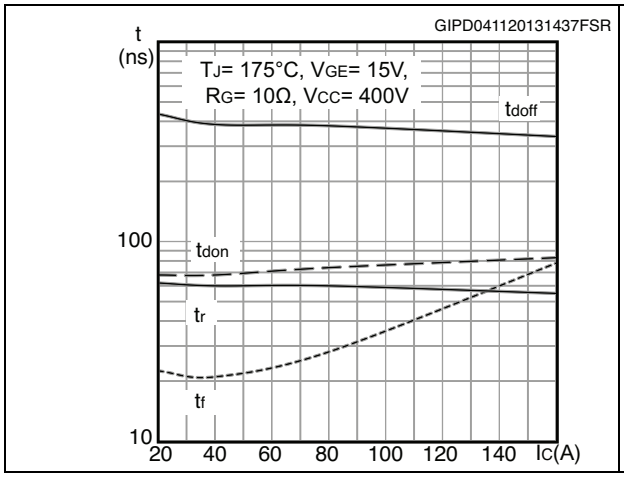


Figure 23. Switching times vs. gate resistance

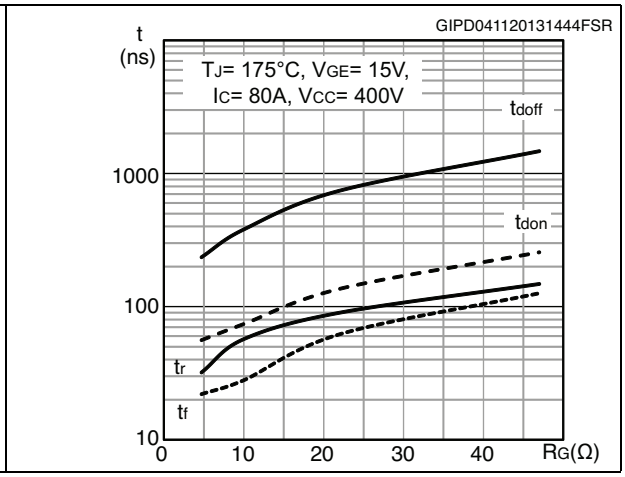


Figure 24. Transfer characteristics

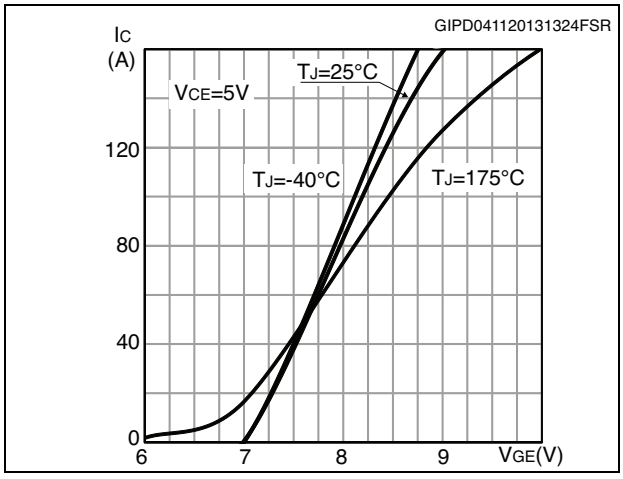


Figure 25. Thermal impedance for TO-247 and TO-3P

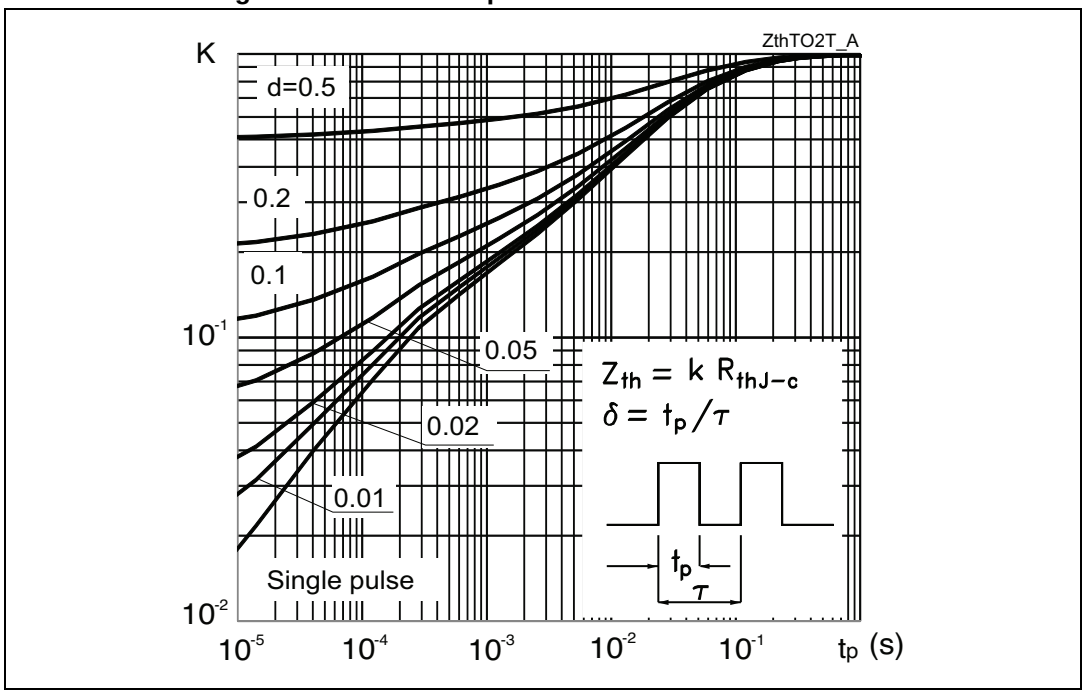
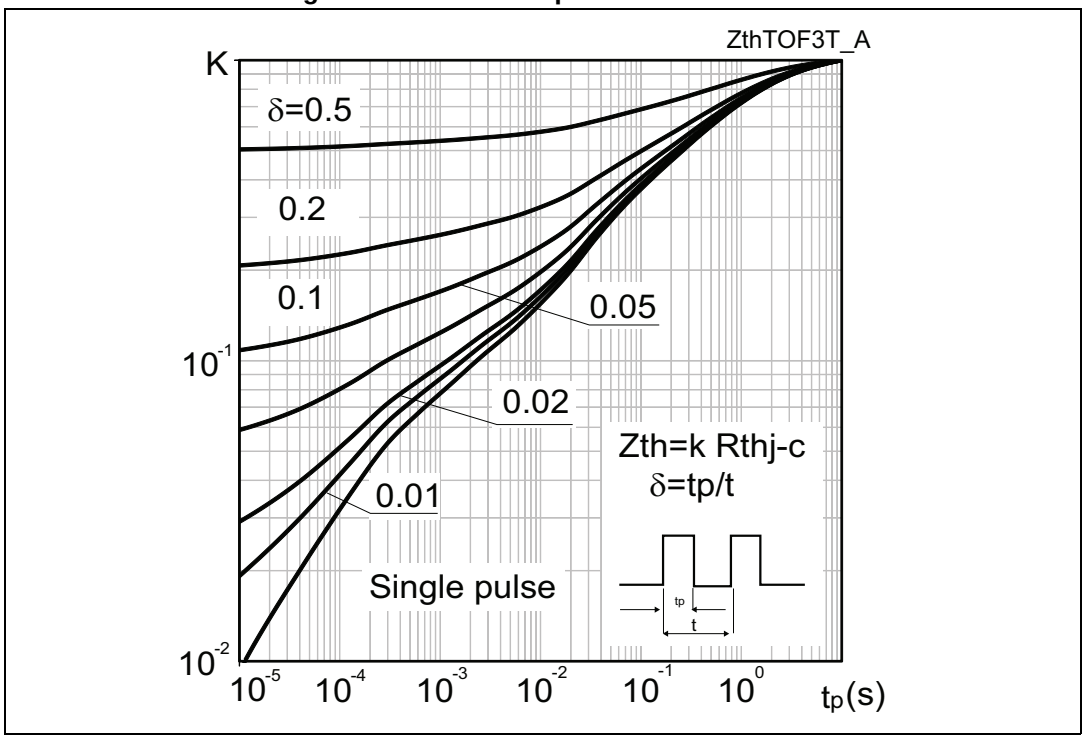


Figure 26. Thermal impedance for TO-3PF



3 Test circuits

Figure 27. Test circuit for inductive load switching

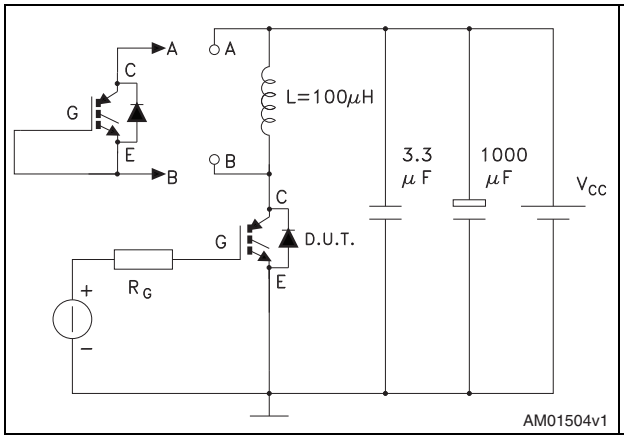


Figure 28. Gate charge test circuit

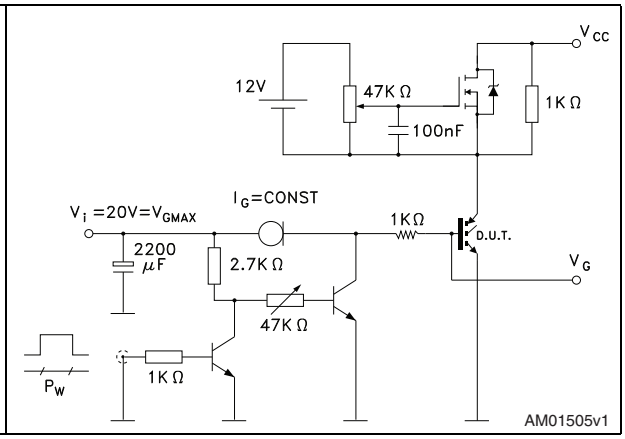
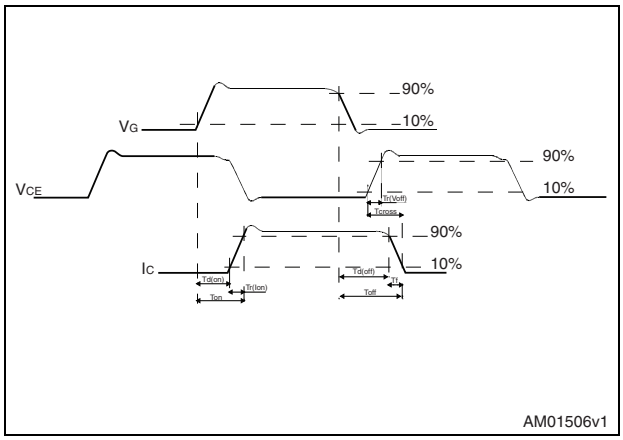


Figure 29. Switching waveform



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, STGFW80V60F

Figure 30. TO-3PF drawing

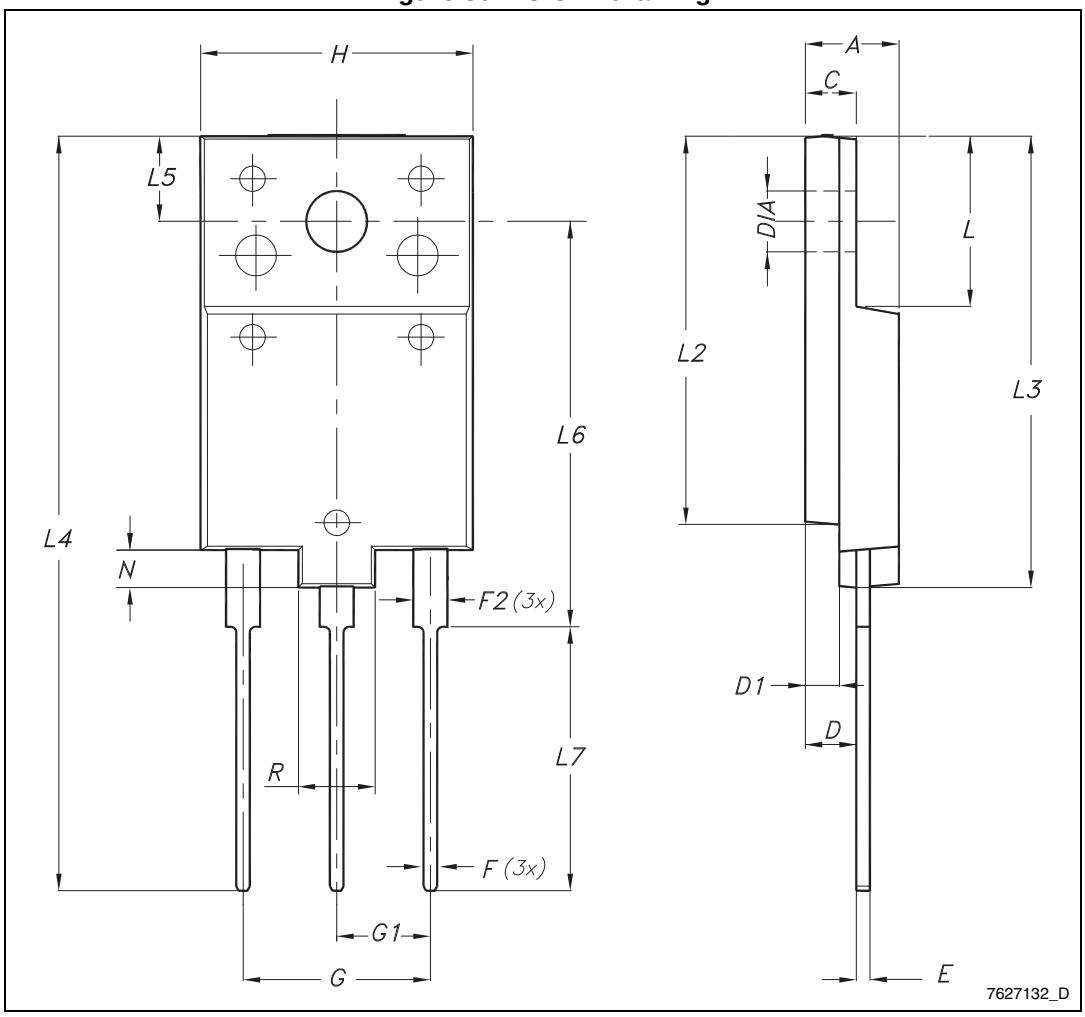


Table 7. TO-3PF mechanical data

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, STGW80V60F

Figure 31. TO-247 drawing

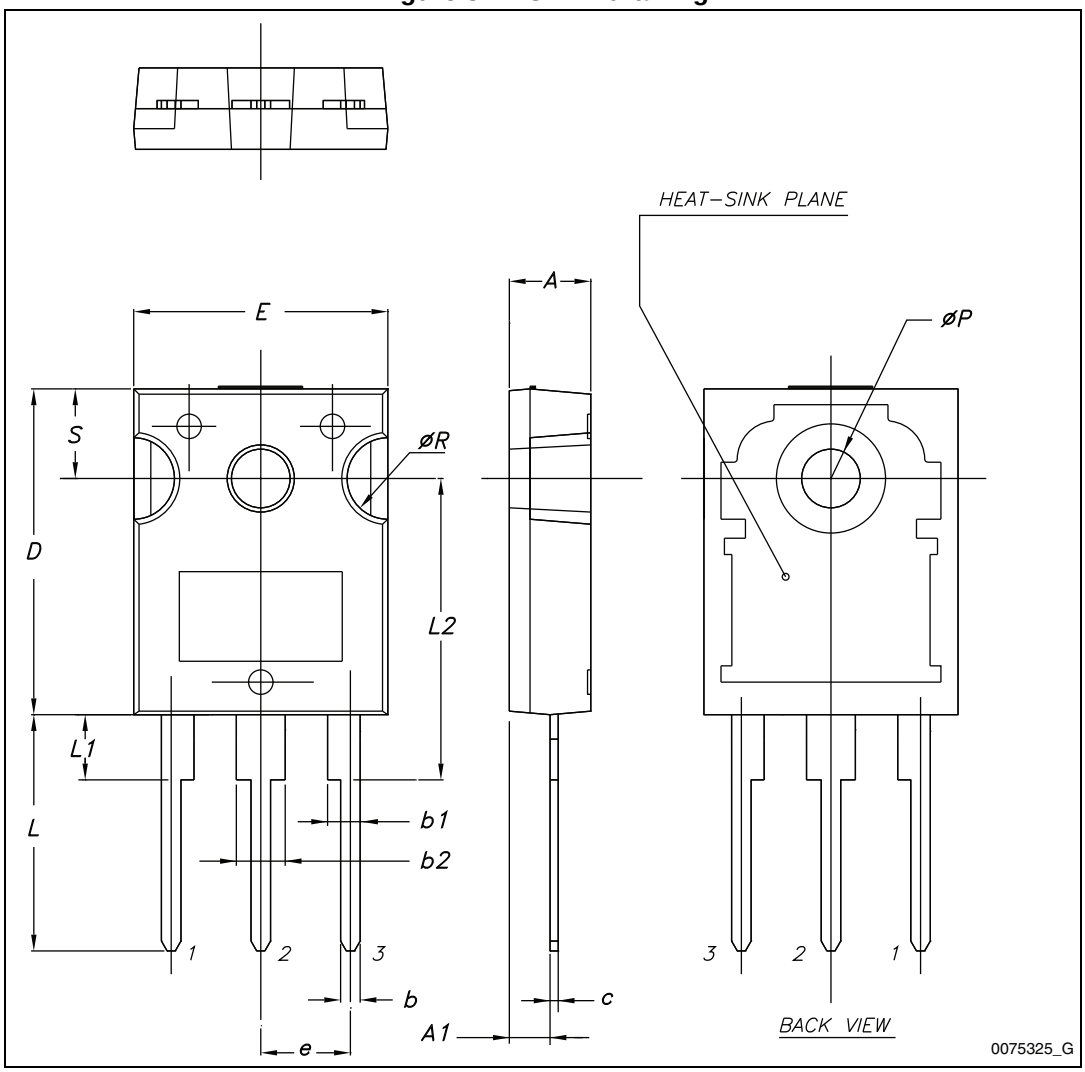


Table 8. TO-247 mechanical data

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, STGWT80V60F

Figure 32. TO-3P drawing

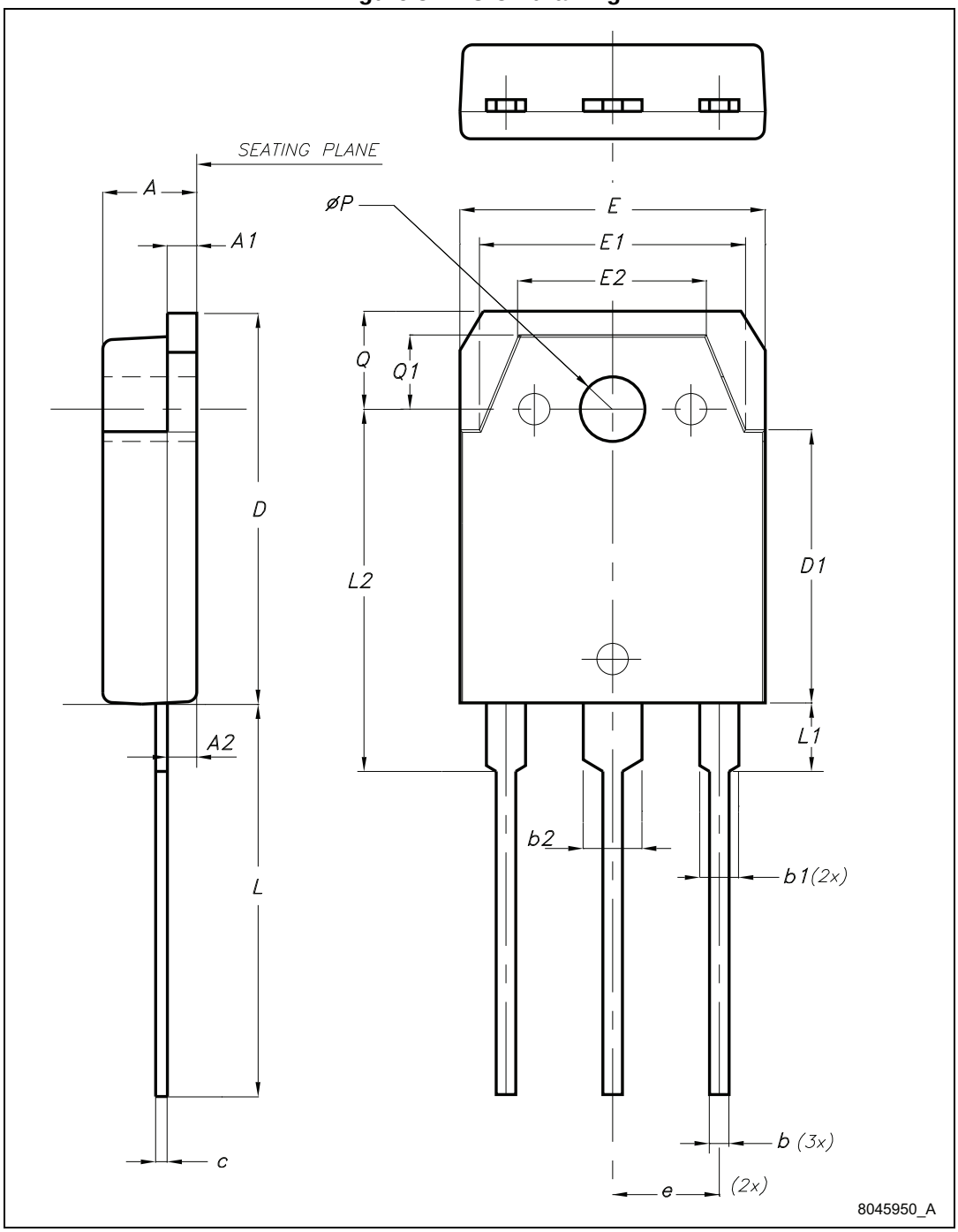


Table 9. TO-3P mechanical data

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	

5 Revision history

Table 10. Document revision history

Date	Revision	Changes
22-May-2014	1	Initial release.

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