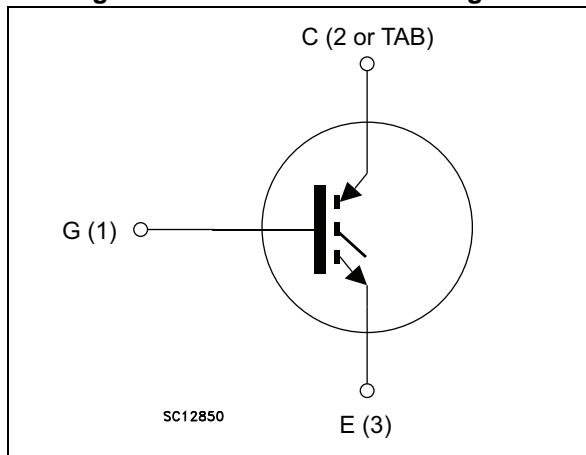


Figure 1. Internal schematic diagram



### Features

- Maximum junction temperature:  $T_J = 175\text{ }^\circ\text{C}$
- Tail-less switching off
- $V_{CE(sat)} = 1.85\text{ V (typ.) @ } I_C = 80\text{ A}$
- 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

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# 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 $T_C = 25\text{ °C}$	120 <sup>(1)</sup>		A
$I_C$	Continuous collector current at $T_C = 100\text{ °C}$	80		A
$I_{CP}$ <sup>(2)</sup>	Pulsed collector current	240		A
$V_{GE}$	Gate-emitter voltage	±20		V
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	469	79	W
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}$ ; $T_C = 25\text{ °C}$ )	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

$T_J = 25\text{ °C}$  unless otherwise specified.

**Table 4. Static characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ( $V_{GE} = 0$ )	$I_C = 2\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 80\text{ A}$		1.85	2.3	V
		$V_{GE} = 15\text{ V}, I_C = 80\text{ A}$ $T_J = 125\text{ °C}$		2.15		
		$V_{GE} = 15\text{ V}, I_C = 80\text{ A}$ $T_J = 175\text{ °C}$		2.4		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$	5	6	7	V
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = 600\text{ V}$			100	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{ V}$			250	nA

**Table 5. Dynamic characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz},$ $V_{GE} = 0$	-	10800	-	nF
$C_{oes}$	Output capacitance		-	390	-	pF
$C_{res}$	Reverse transfer capacitance		-	220	-	pF
$Q_g$	Total gate charge	$V_{CC} = 480\text{ V}, I_C = 80\text{ A},$ $V_{GE} = 15\text{ V},$ see <a href="#">Figure 28</a>	-	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	$V_{CE} = 400\text{ V}$ , $I_C = 80\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , see <a href="#">Figure 27</a>	-	60	-	ns
$t_r$	Current rise time		-	30	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	2200	-	A/ $\mu$ s
$t_{d(off)}$	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	$V_{CE} = 400\text{ V}$ , $I_C = 80\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 175\text{ }^\circ\text{C}$ , see <a href="#">Figure 27</a>	-	60	-	ns
$t_r$	Current rise time		-	30	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	2100	-	A/ $\mu$ s
$t_{d(off)}$	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

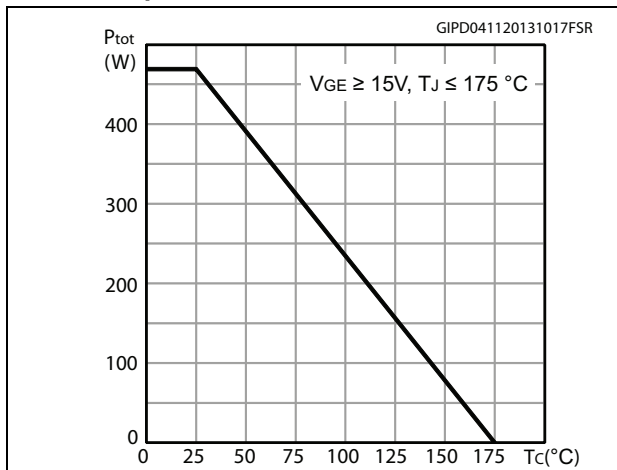


Figure 3. Collector current vs. case temperature for TO-247 and TO-3P

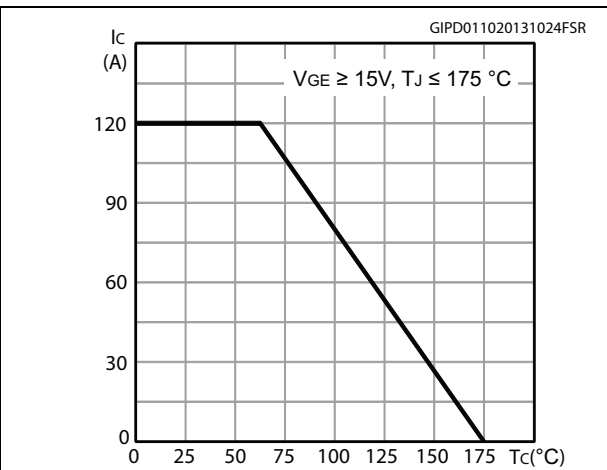


Figure 4. Power dissipation vs. case temperature for TO-3PF

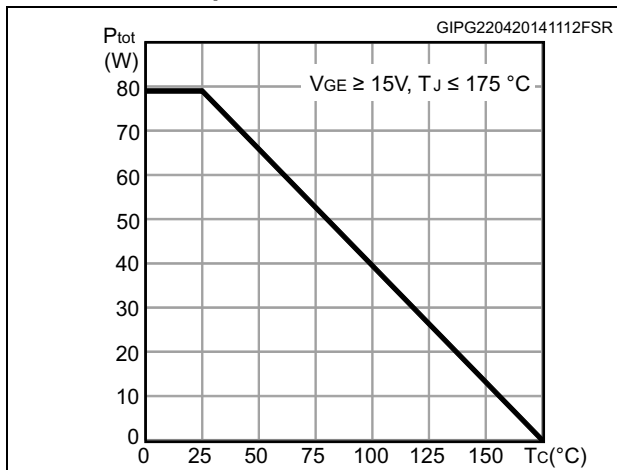


Figure 5. Collector current vs. case temperature for TO-3PF

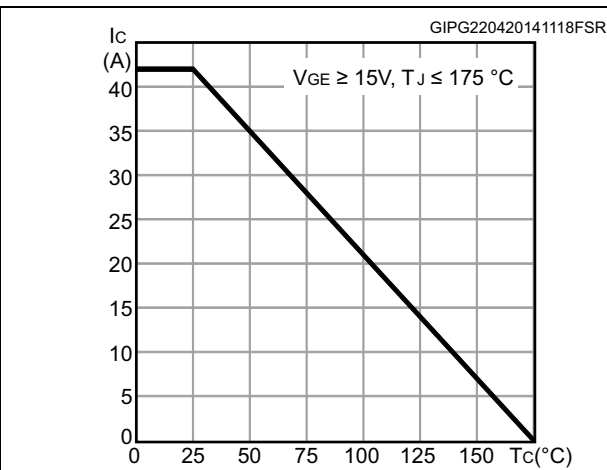


Figure 6. Output characteristics (T<sub>J</sub> = 25°C)

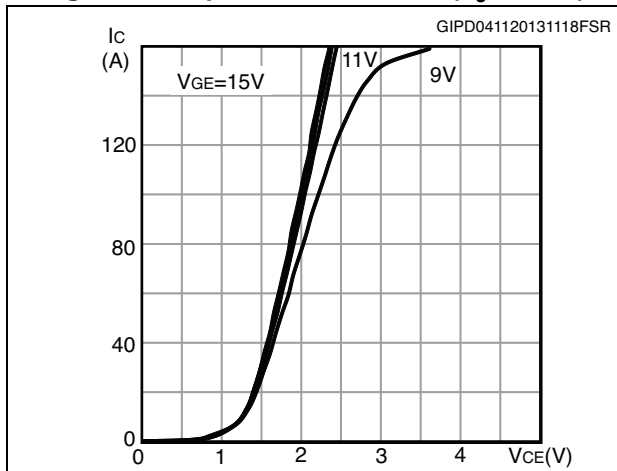


Figure 7. Output characteristics (T<sub>J</sub> = 175°C)

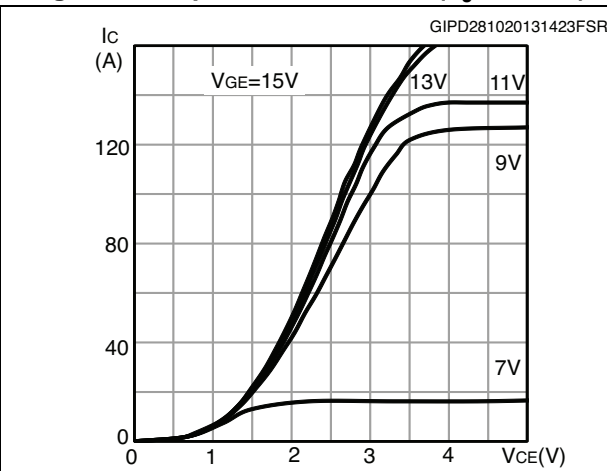


Figure 8.  $V_{CE(sat)}$  vs. junction temperature

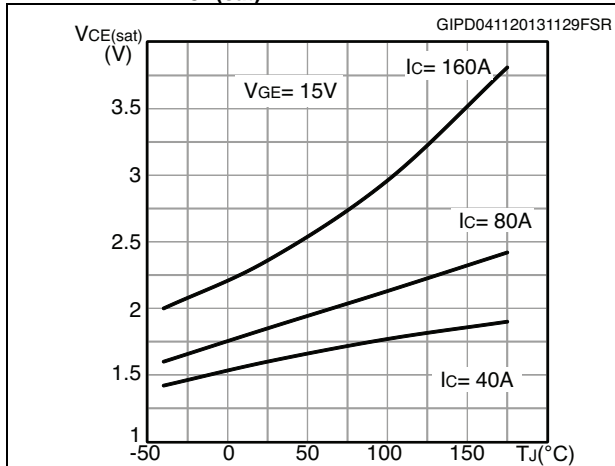


Figure 9.  $V_{CE(sat)}$  vs. collector current

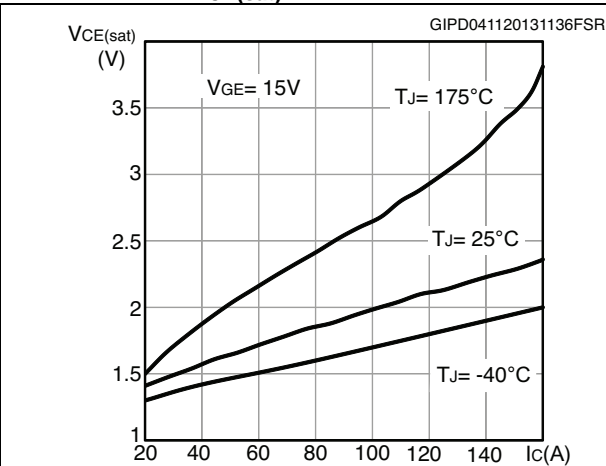


Figure 10. Collector current vs. switching frequency for TO-247 and TO-3P

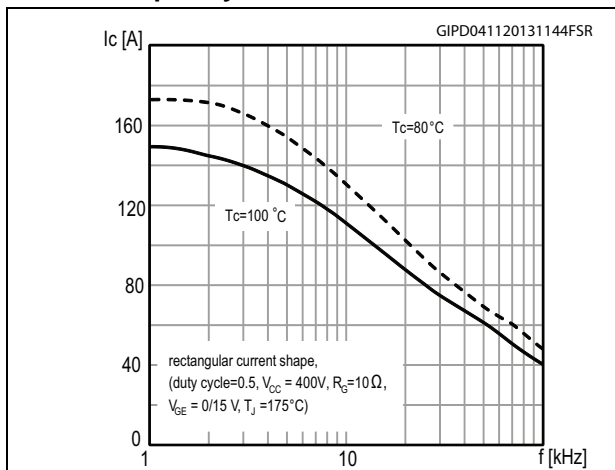


Figure 11. Collector current vs. switching frequency for TO-3PF

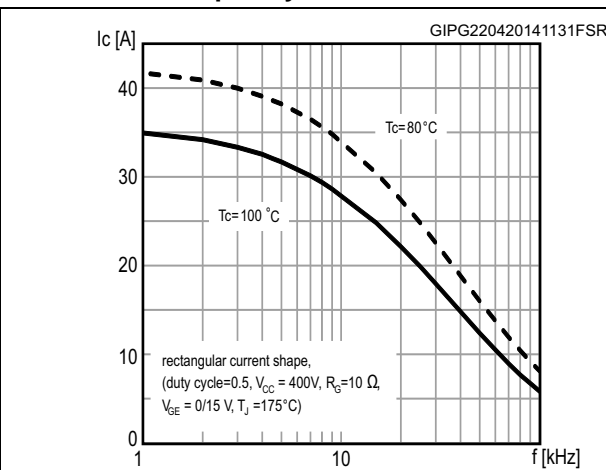


Figure 12. Forward bias safe operating area for TO-247 and TO-3P

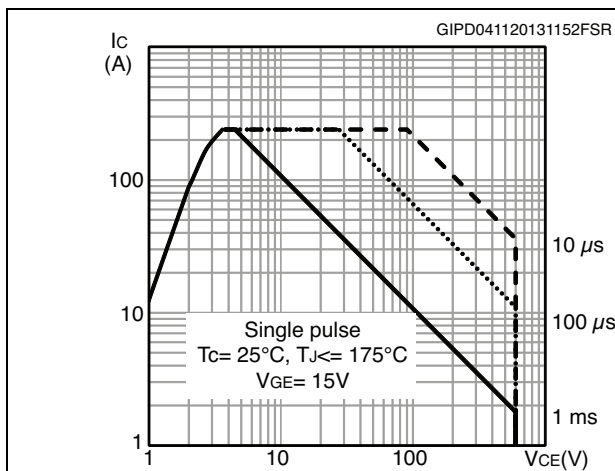


Figure 13. Forward bias safe operating area for TO-3PF

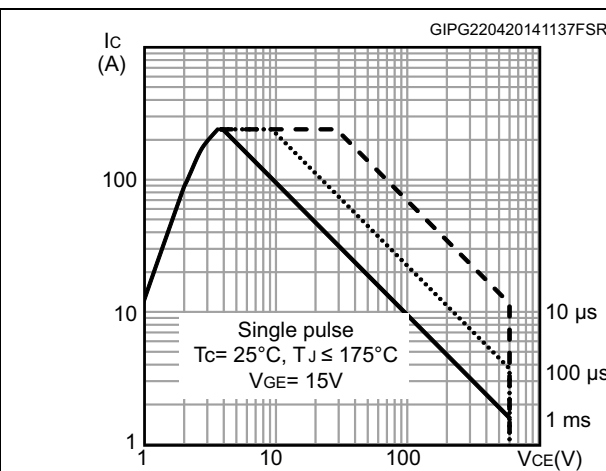


Figure 14. Normalized  $V_{GE(th)}$  vs junction temperature

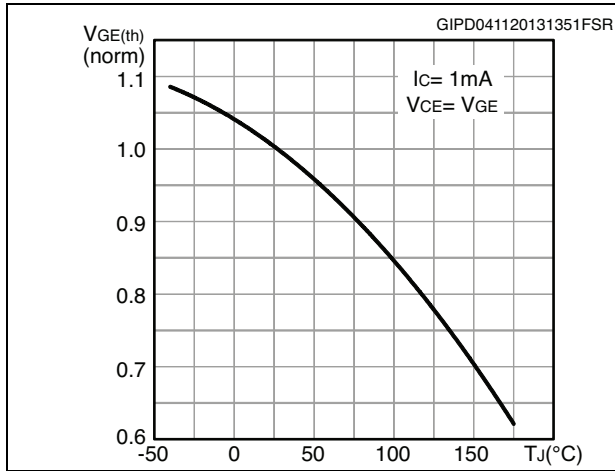


Figure 15. Normalized  $V_{(BR)CES}$  vs. junction temperature

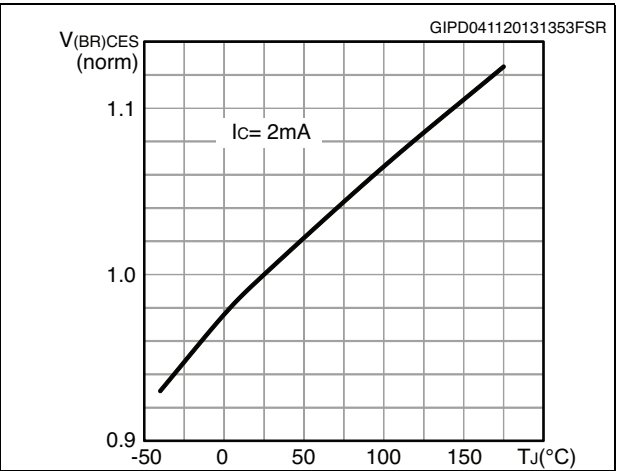


Figure 16. Capacitance variation

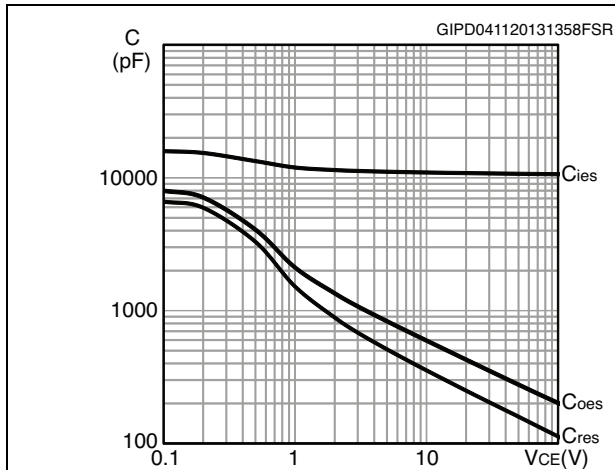


Figure 17. Gate charge vs. gate-emitter voltage

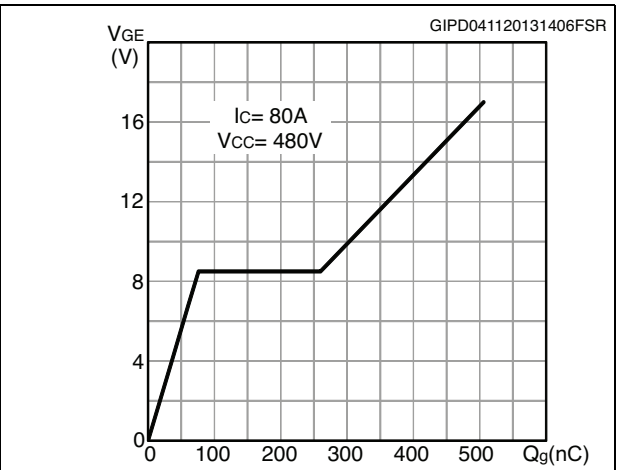


Figure 18. Switching loss vs collector current

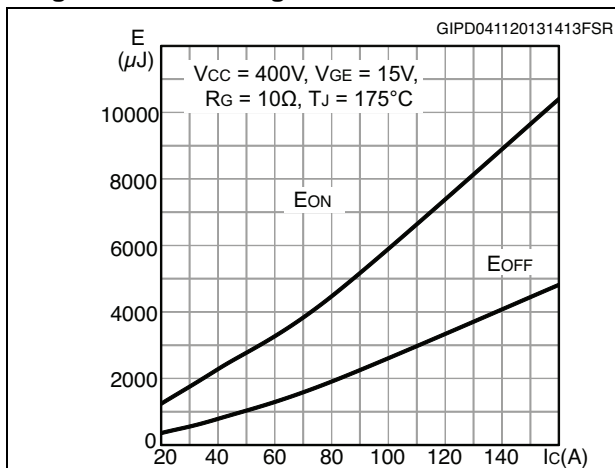


Figure 19. Switching loss vs gate resistance

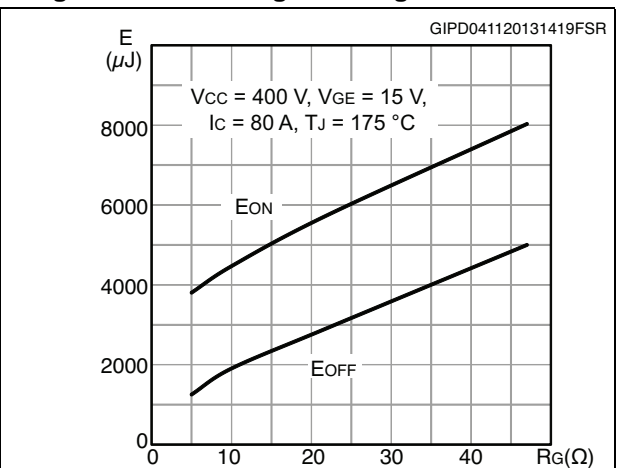




Figure 20. Switching loss vs temperature

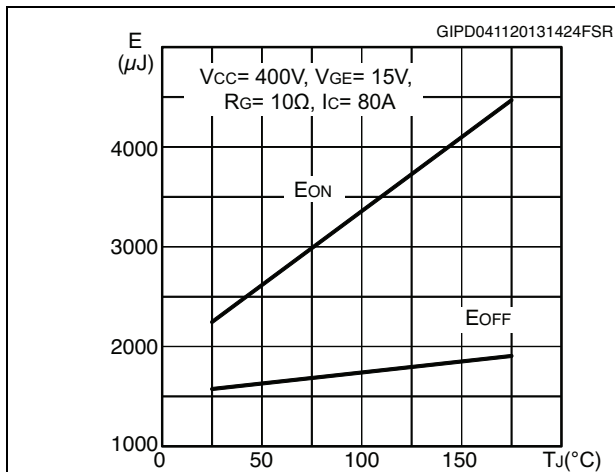


Figure 21. Switching loss vs collector-emitter voltage

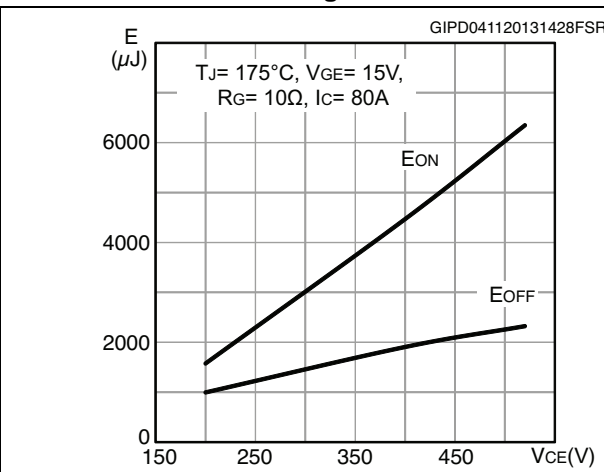


Figure 22. Switching times vs. collector current

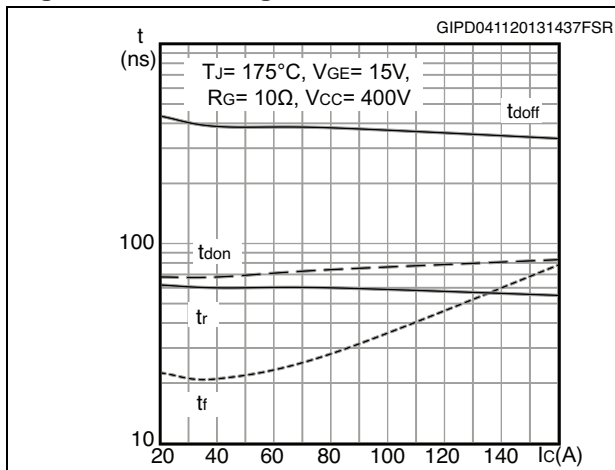


Figure 23. Switching times vs. gate resistance

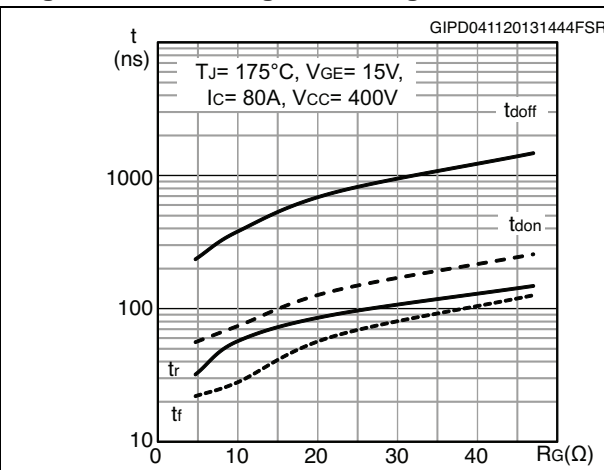


Figure 24. Transfer characteristics

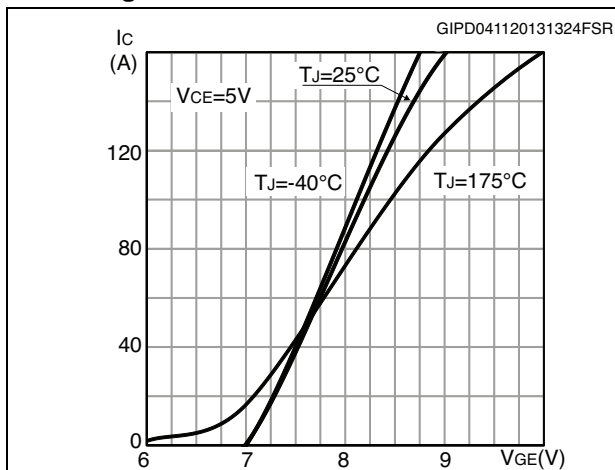


Figure 25. Thermal impedance for TO-247 and TO-3P

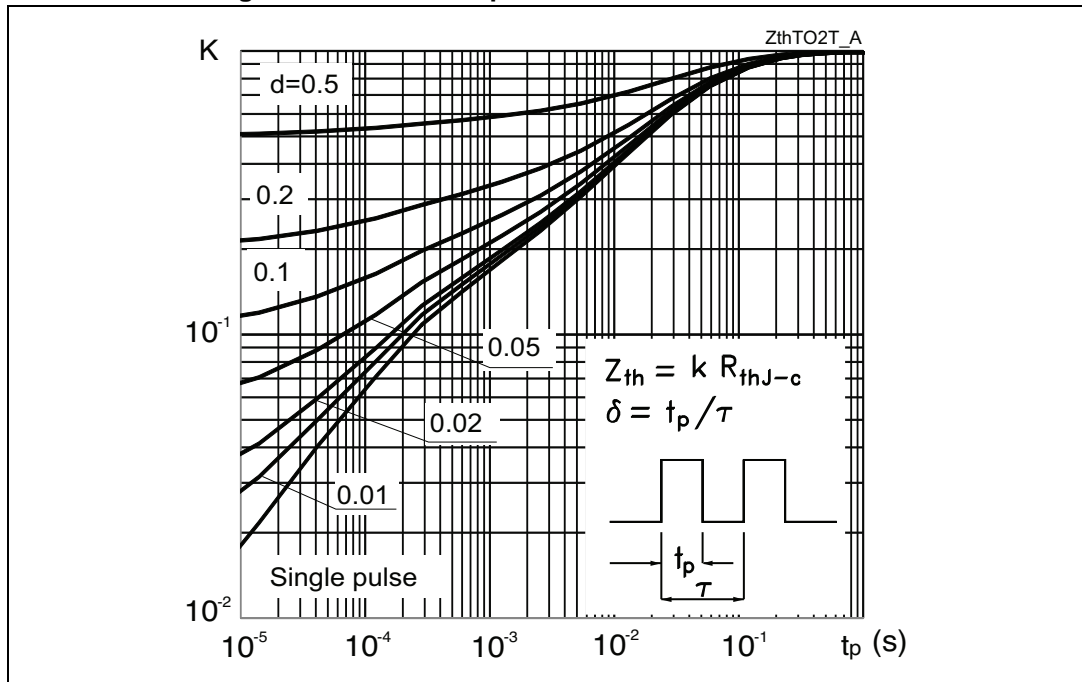
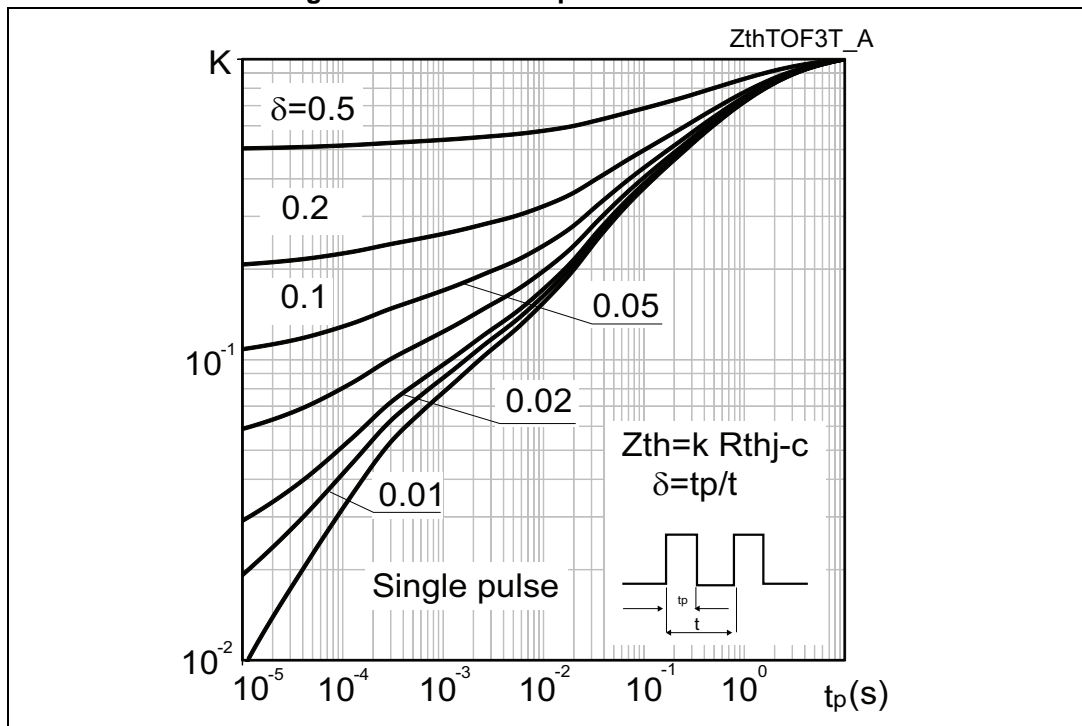


Figure 26. Thermal impedance for TO-3PF



### 3 Test circuits

Figure 27. Test circuit for inductive load switching

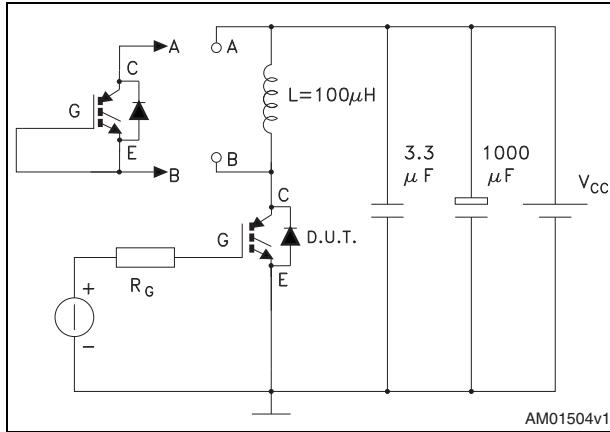


Figure 28. Gate charge test circuit

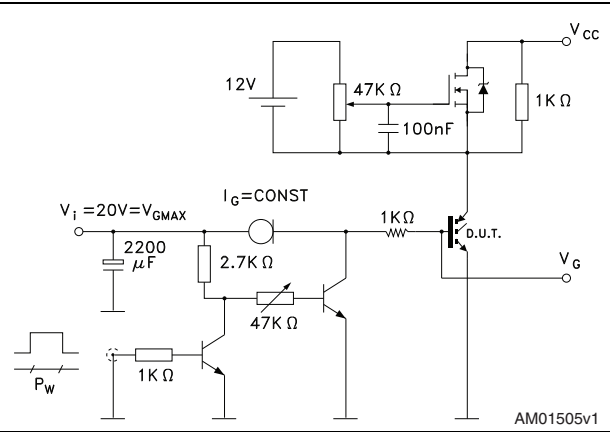
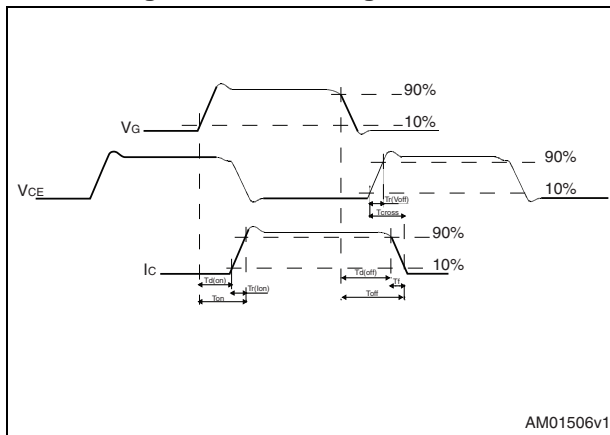


Figure 29. Switching waveform



## 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](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 TO-3PF, STGFW80V60F

Figure 30. TO-3PF drawing

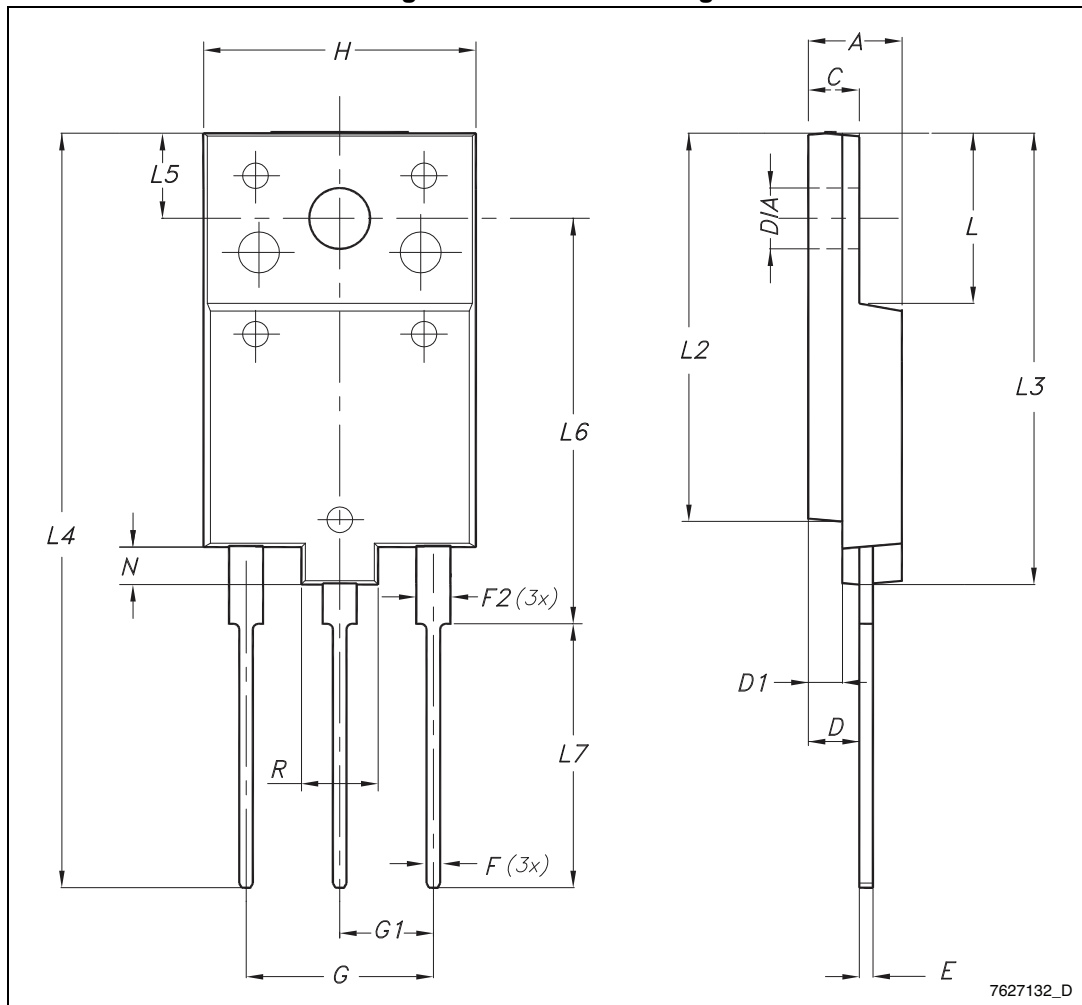


Table 7. TO-3PF mechanical data

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

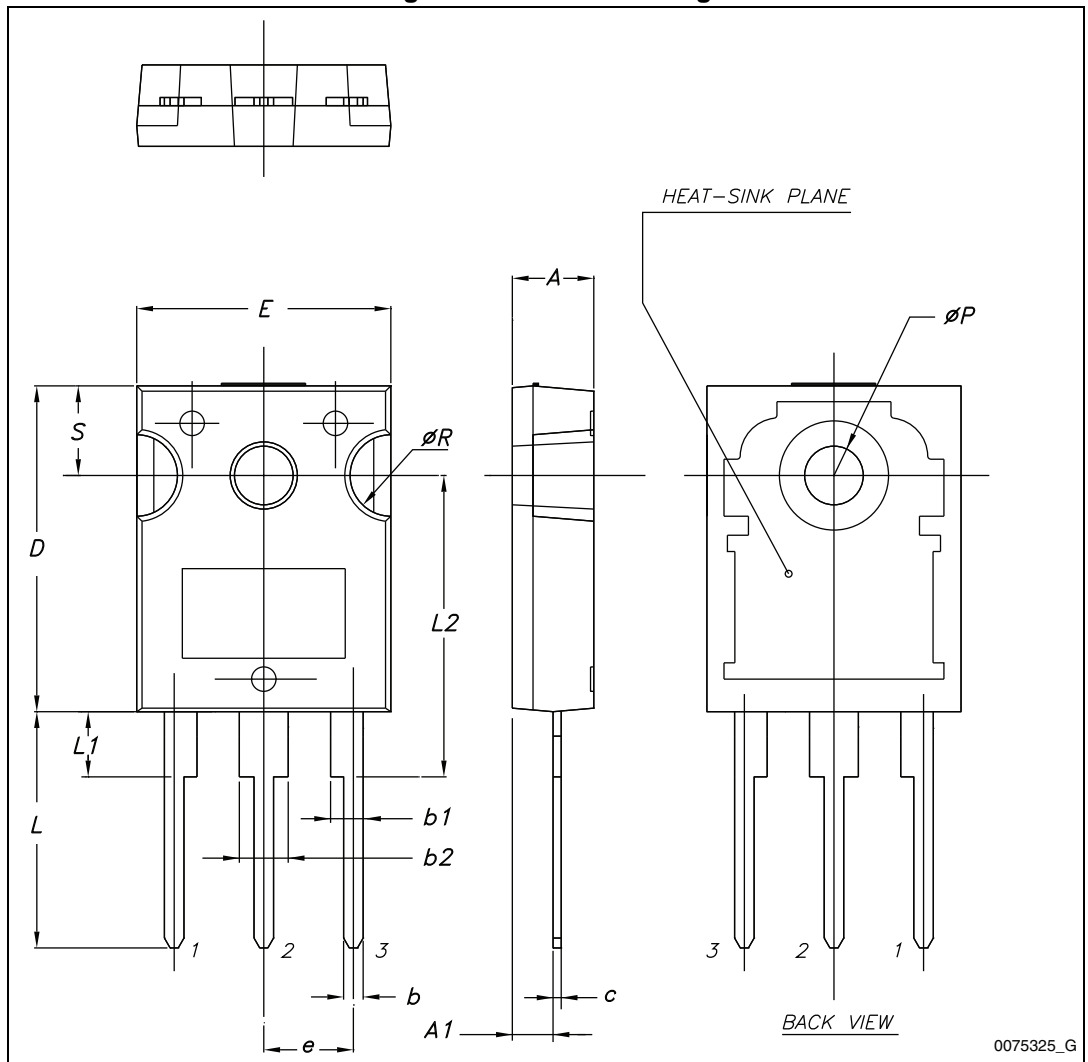


Table 8. TO-247 mechanical data

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	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

### 4.3 TO-3P, STGWT80V60F

Figure 32. TO-3P drawing

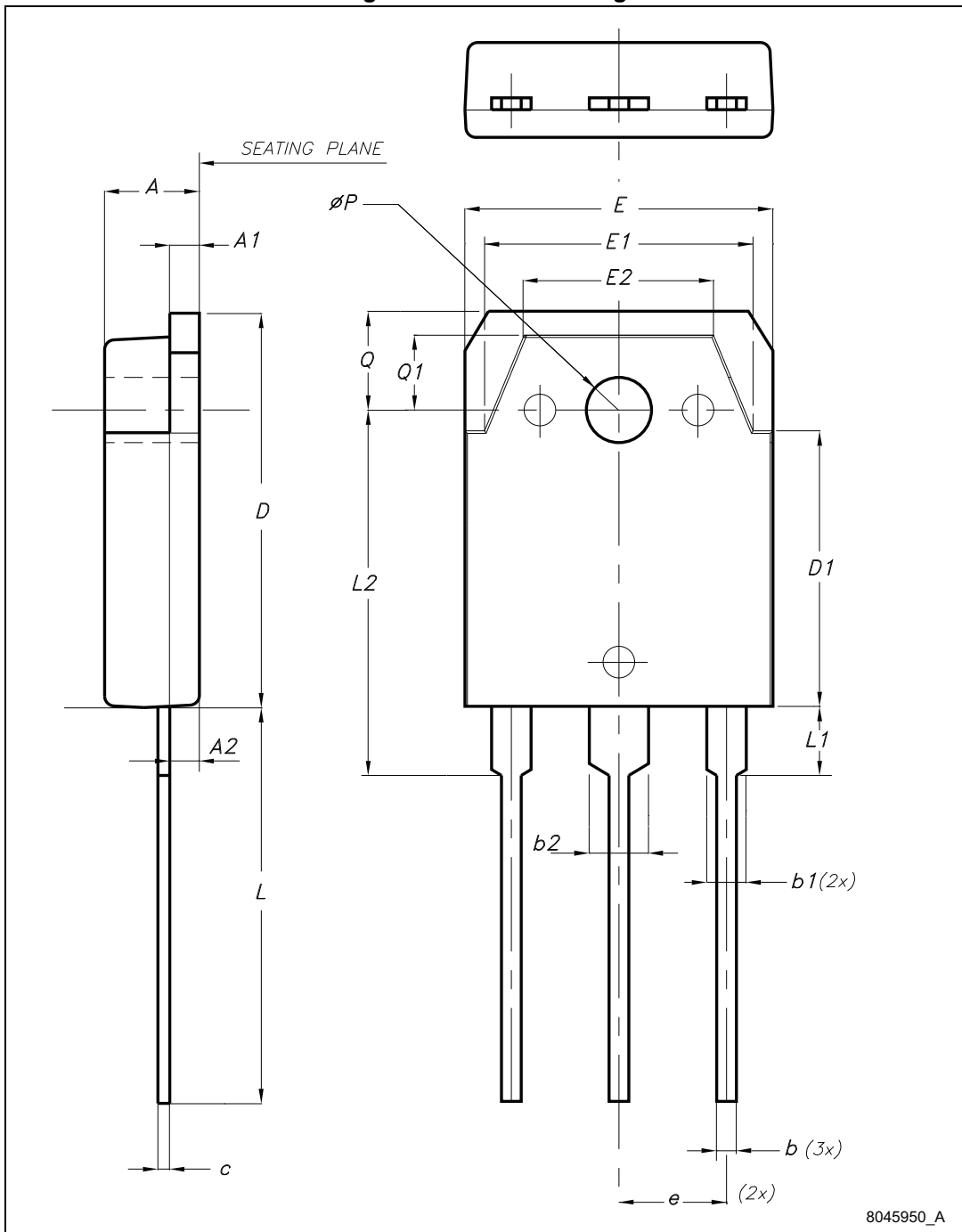




Table 9. TO-3P mechanical data

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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