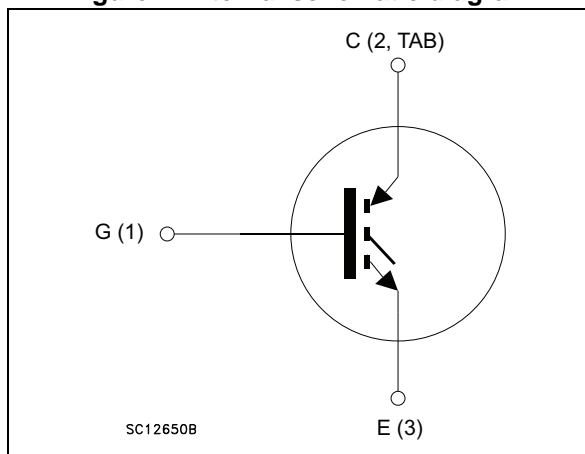


Figure 1. Internal schematic diagram



### Features

- Maximum junction temperature:  $T_J = 175\text{ }^\circ\text{C}$
- High speed switching series
- Minimized tail current
- $V_{CE(sat)} = 1.55\text{ V (typ.) @ } I_C = 30\text{ A}$
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance

### 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 code	Marking	Package	Packing
STGFW30H65FB	GFW30H65FB	TO-3PF	Tube
STGW30H65FB	GW30H65FB	TO-247	Tube
STGWT30H65FB	GWT30H65FB	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 ( $V_{GE} = 0$ )	650		V
$I_C$	Continuous collector current at $T_C = 25\text{ °C}$	60		A
$I_C$	Continuous collector current at $T_C = 100\text{ °C}$	30		A
$I_{CP}^{(1)}$	Pulsed collector current	120		A
$V_{GE}$	Gate-emitter voltage	$\pm 20$		V
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	260	58	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. 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	2.60	0.58	°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 ( $V_{GE} = 0$ )	$I_C = 2\text{ mA}$	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 30\text{ A}$		1.55	2	V
		$V_{GE} = 15\text{ V}, I_C = 30\text{ A}$ $T_J = 125\text{ °C}$		1.65		
		$V_{GE} = 15\text{ V}, I_C = 30\text{ A}$ $T_J = 175\text{ °C}$		1.75		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$	5	6	7	V
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = 650\text{ V}$			25	$\mu\text{A}$
$I_{GES}$	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	$V_{CE} = 25\text{ V}, f = 1\text{ MHz},$ $V_{GE} = 0$	-	3659	-	pF
$C_{oes}$	Output capacitance		-	101	-	pF
$C_{res}$	Reverse transfer capacitance		-	76	-	pF
$Q_g$	Total gate charge	$V_{CC} = 520\text{ V}, I_C = 30\text{ A},$ $V_{GE} = 15\text{ V},$ see <a href="#">Figure 28</a>	-	149	-	nC
$Q_{ge}$	Gate-emitter charge		-	25	-	nC
$Q_{gc}$	Gate-collector charge		-	62	-	nC

Table 6. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , see <a href="#">Figure 27</a>	-	37	-	ns
$t_r$	Current rise time		-	14.6	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1643	-	A/ $\mu$ s
$t_{d(off)}$	Turn-off delay time		-	146	-	ns
$t_f$	Current fall time		-	23	-	ns
$E_{on}^{(1)}$	Turn-on switching losses		-	151	-	$\mu$ J
$E_{off}^{(2)}$	Turn-off switching losses		-	293	-	$\mu$ J
$E_{ts}$	Total switching losses		-	444	-	$\mu$ J
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$ , $I_C = 30\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 175\text{ }^\circ\text{C}$ , see <a href="#">Figure 27</a>	-	35	-	ns
$t_r$	Current rise time		-	16.1	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1496	-	A/ $\mu$ s
$t_{d(off)}$	Turn-off delay time		-	158	-	ns
$t_f$	Current fall time		-	65	-	ns
$E_{on}^{(1)}$	Turn-on switching losses		-	175	-	$\mu$ J
$E_{off}^{(2)}$	Turn-off switching losses		-	572	-	$\mu$ J
$E_{ts}$	Total switching losses		-	747	-	$\mu$ J

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 (curves)

Figure 2. Output characteristics ( $T_J = 25^\circ\text{C}$ )

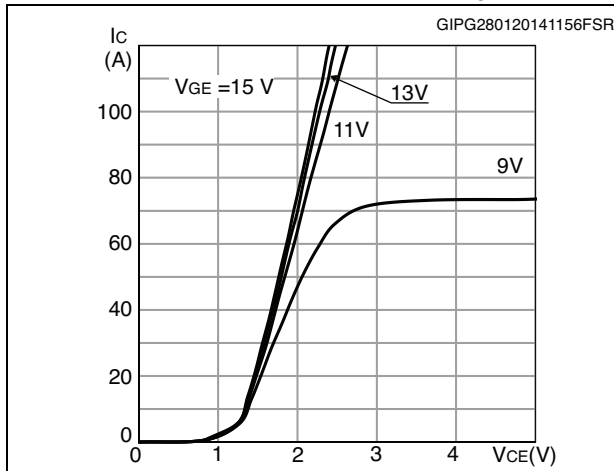


Figure 3. Output characteristics ( $T_J = 175^\circ\text{C}$ )

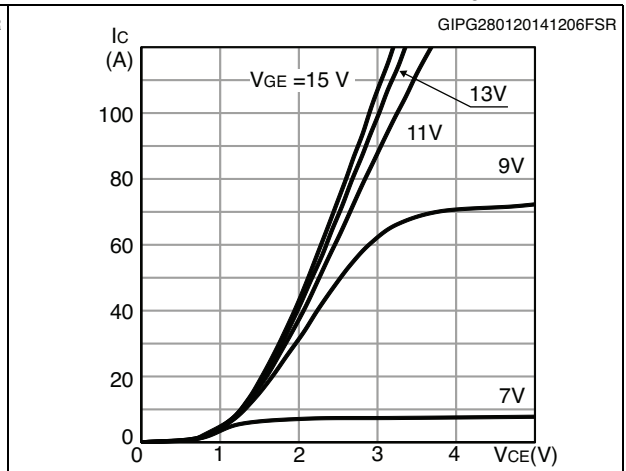


Figure 4. Transfer characteristics

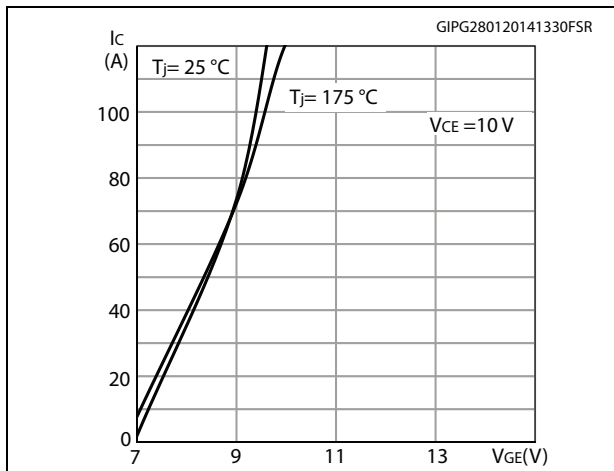


Figure 5. Collector current vs. case temperature for TO-247 and TO-3P

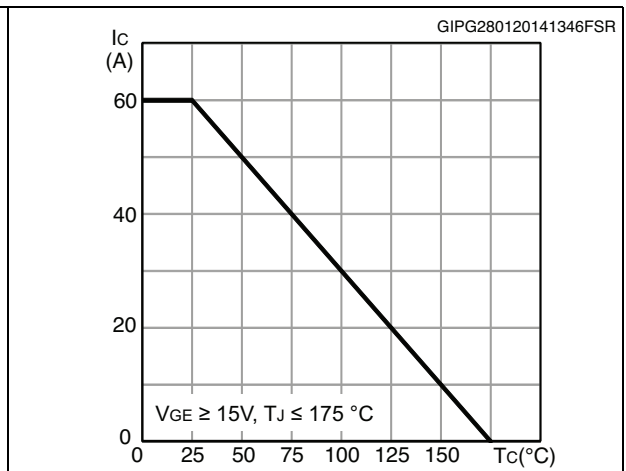


Figure 6. Collector current vs. case temperature for TO-3PF

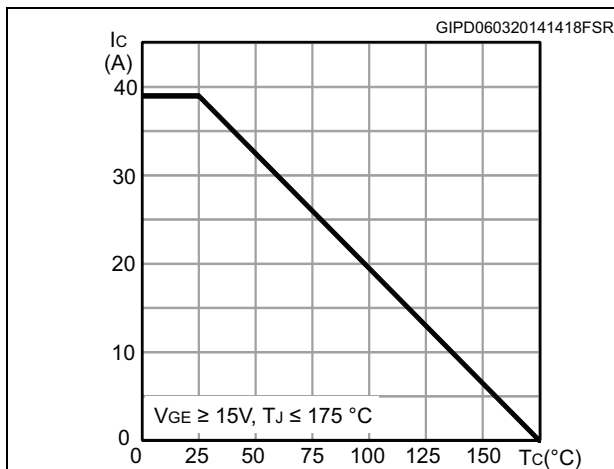


Figure 7.  $V_{CE(sat)}$  vs. junction temperature

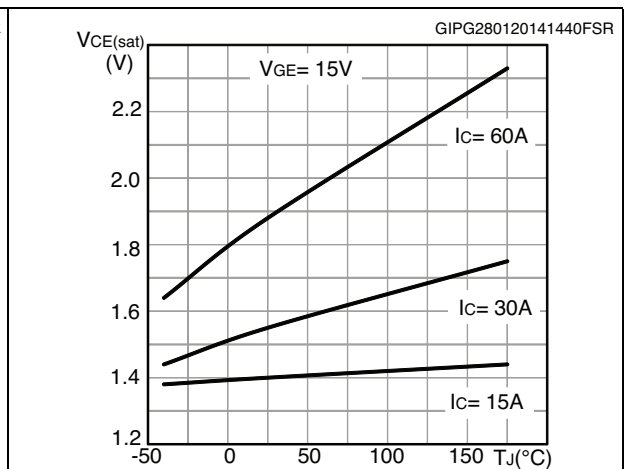


Figure 8. Power dissipation vs. case temperature for TO-247 and TO-3P

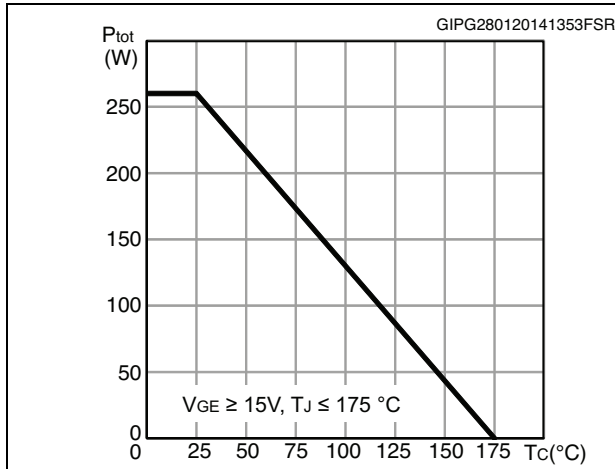


Figure 9. Power dissipation vs. case temperature for TO-3PF

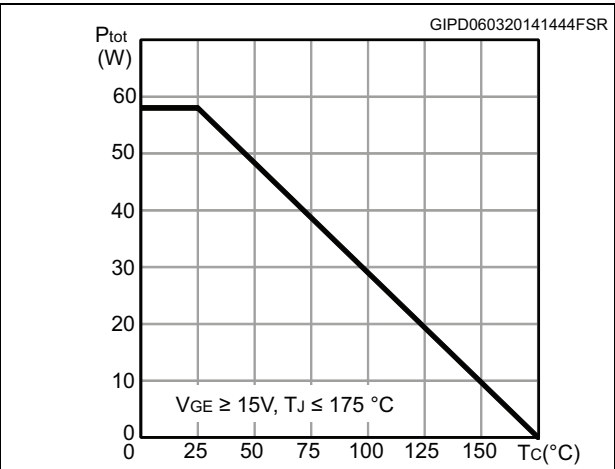


Figure 10. Forward bias safe operating area for TO-247 and TO-3P

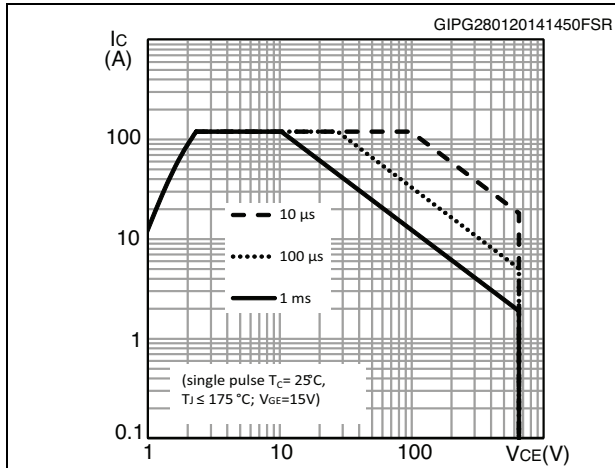


Figure 11. Forward bias safe operating area for TO-3PF

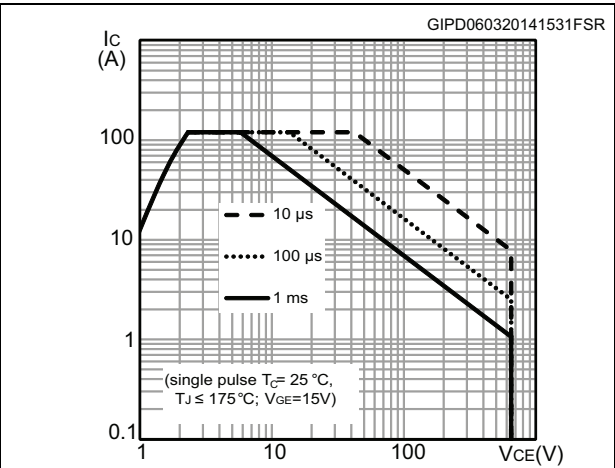


Figure 12. Collector current vs. switching frequency for TO-247 and TO-3P

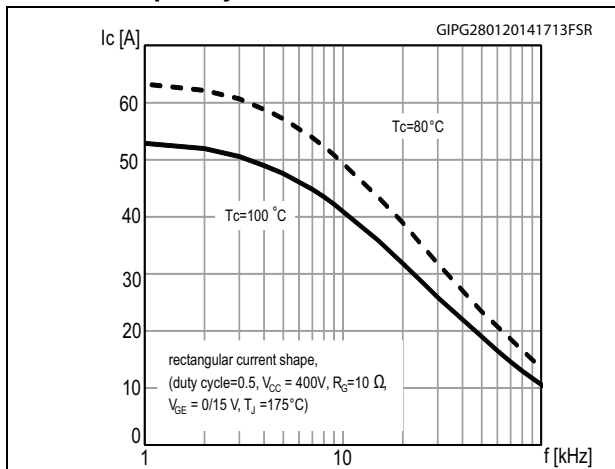


Figure 13. Collector current vs. switching frequency for TO-3PF

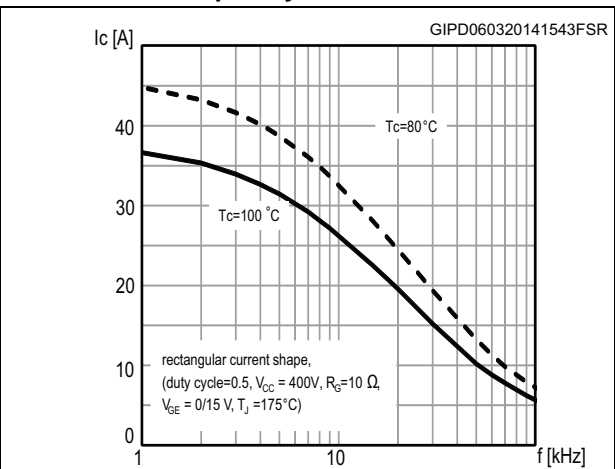


Figure 14. Normalized  $V_{GE(th)}$  vs. junction temperature

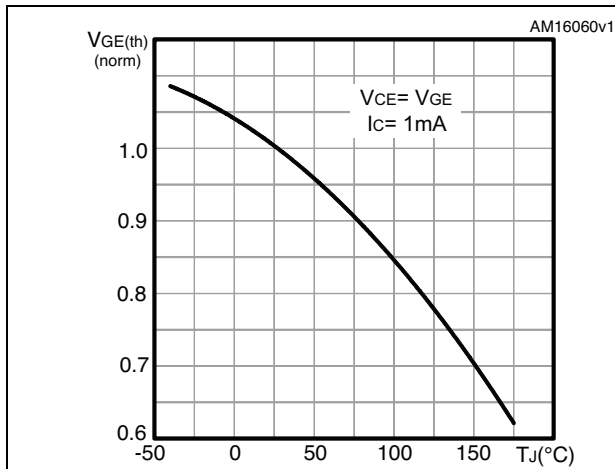


Figure 15. Normalized  $V_{(BR)CES}$  vs. junction temperature

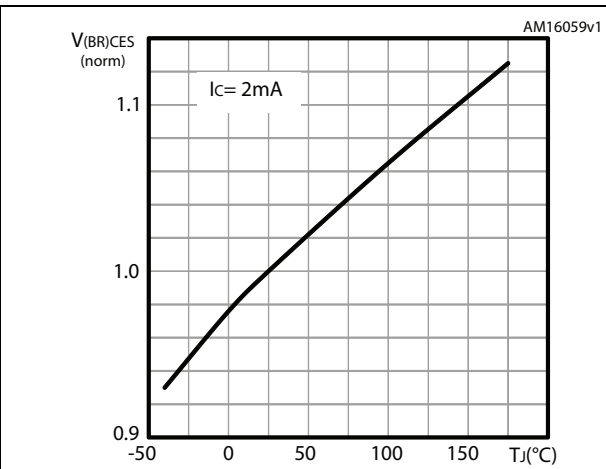


Figure 16. Switching losses vs temperature

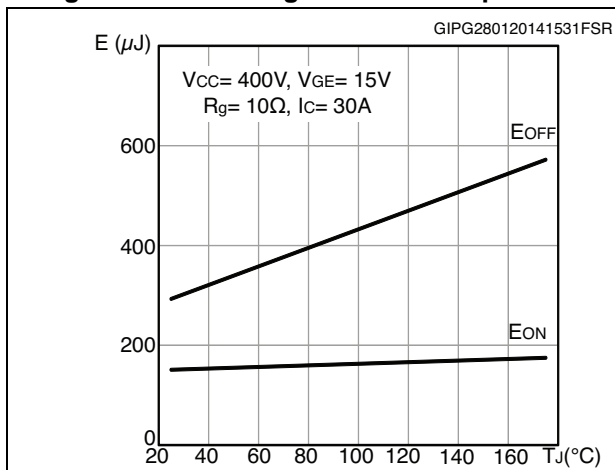


Figure 17. Switching losses vs gate resistance

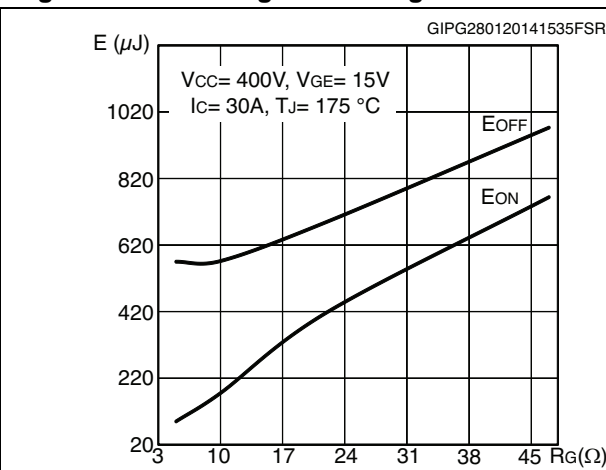


Figure 18. Switching losses vs collector current

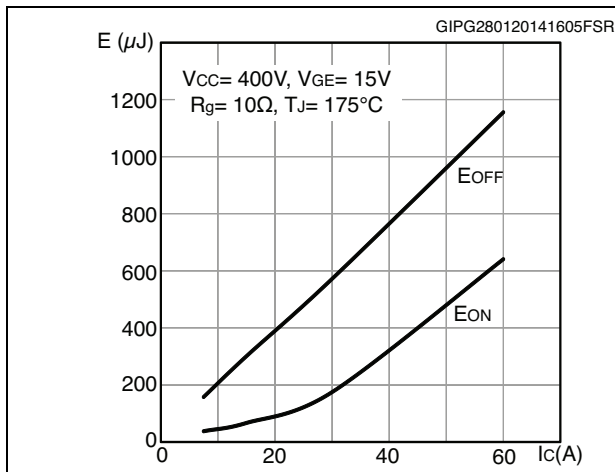


Figure 19. Switching losses vs collector emitter voltage

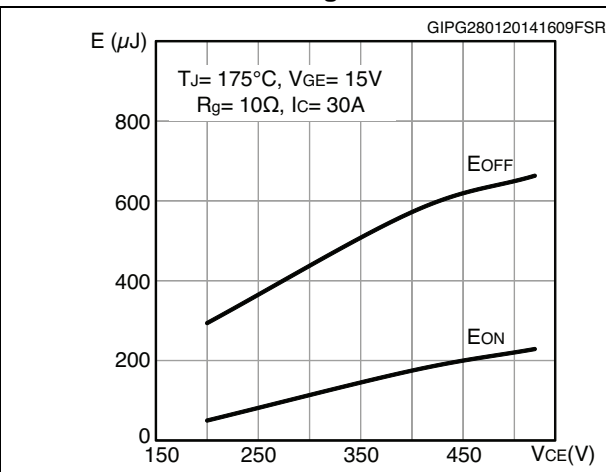




Figure 20. Switching times vs collector current

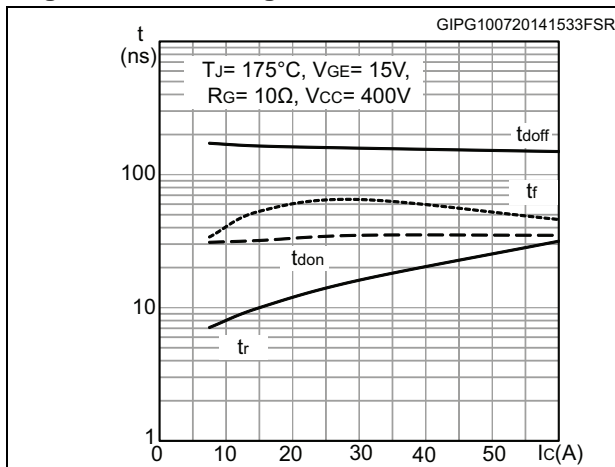


Figure 21. Switching times vs gate resistance

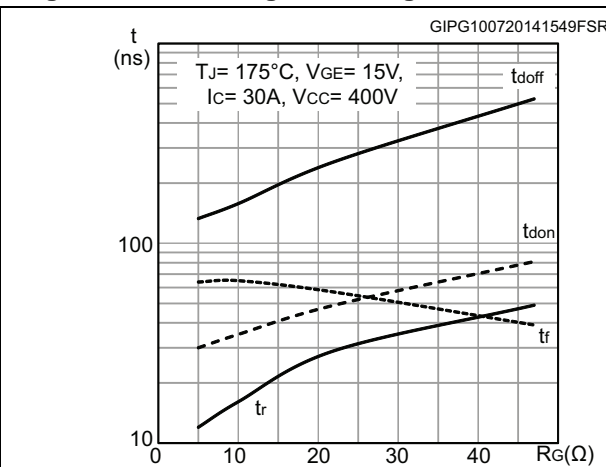


Figure 22. Capacitance variations

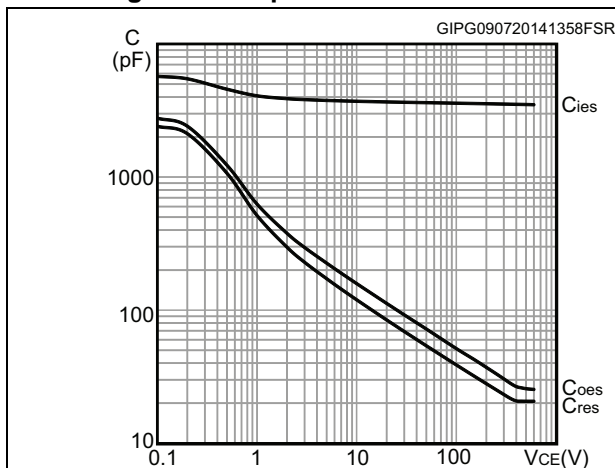


Figure 23.  $V_{CE(sat)}$  vs. collector current

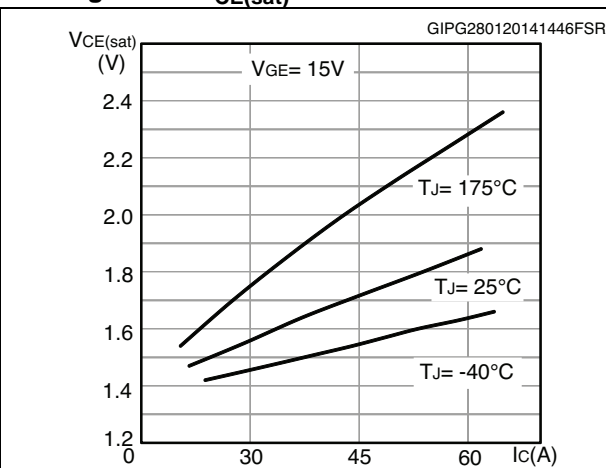


Figure 24. Gate charge vs. gate-emitter voltage

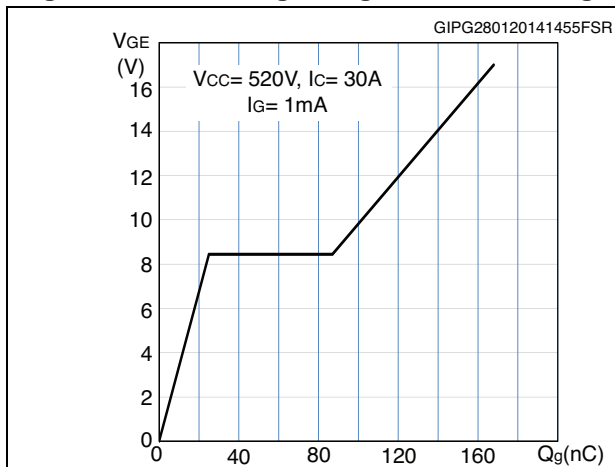


Figure 25. Thermal impedance for TO-247 and TO-3P

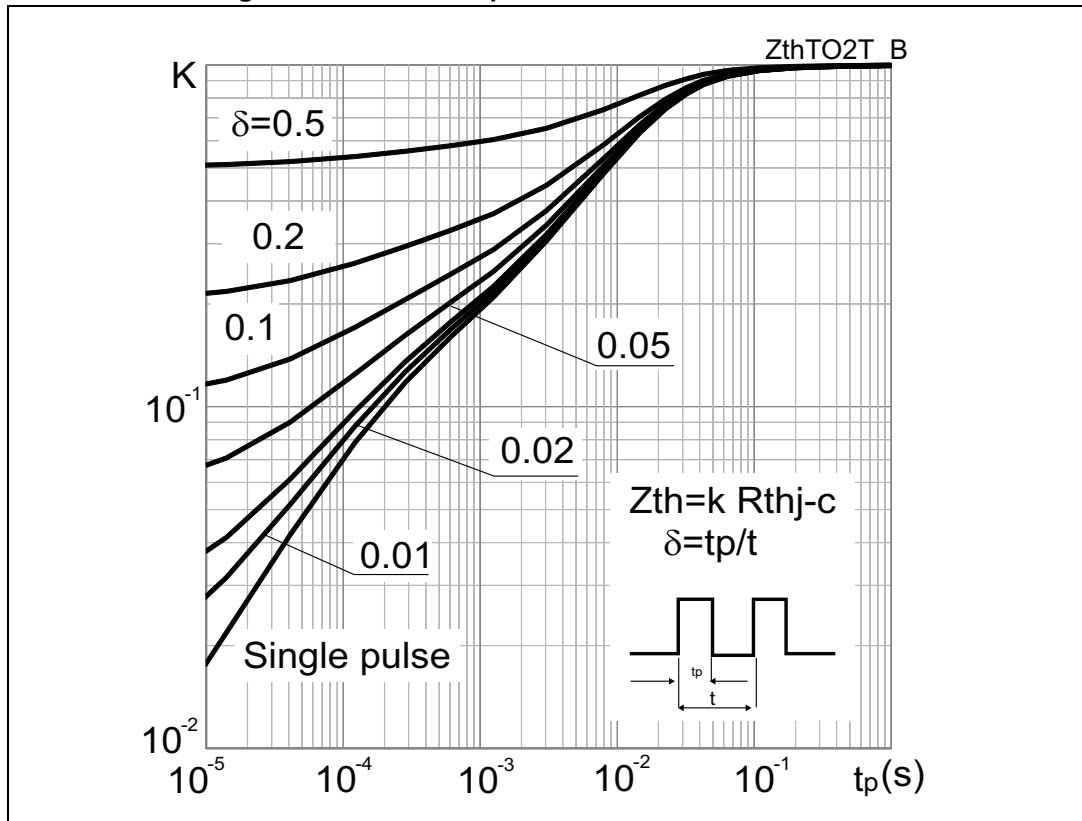
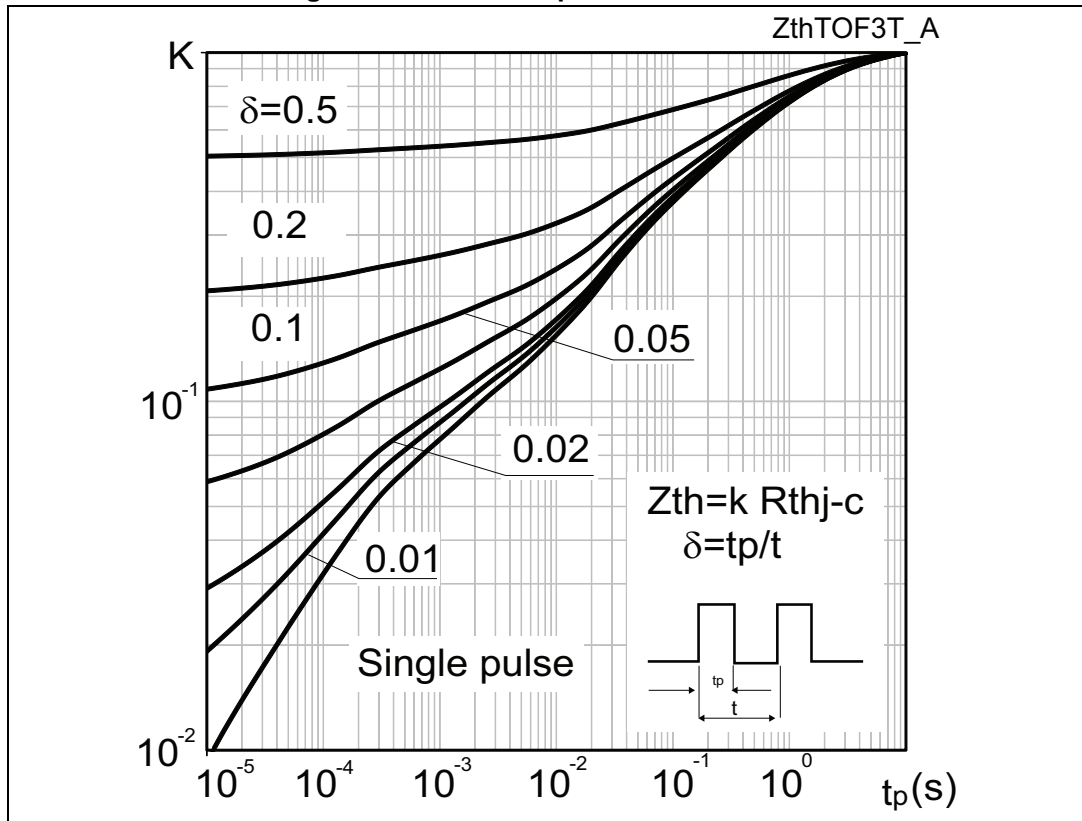


Figure 26. Thermal impedance for TO-3PF



### 3 Test circuits

Figure 27. Test circuit for inductive load switching

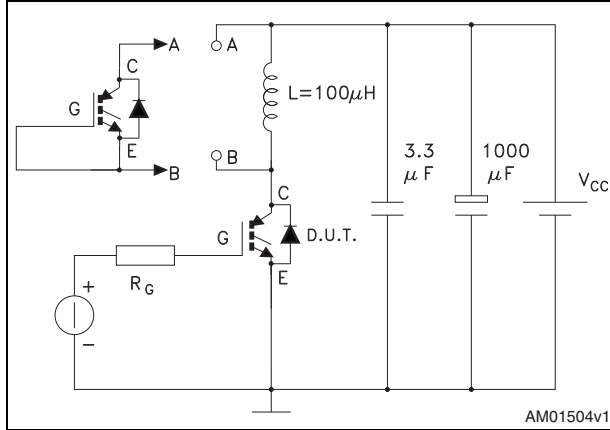


Figure 28. Gate charge test circuit

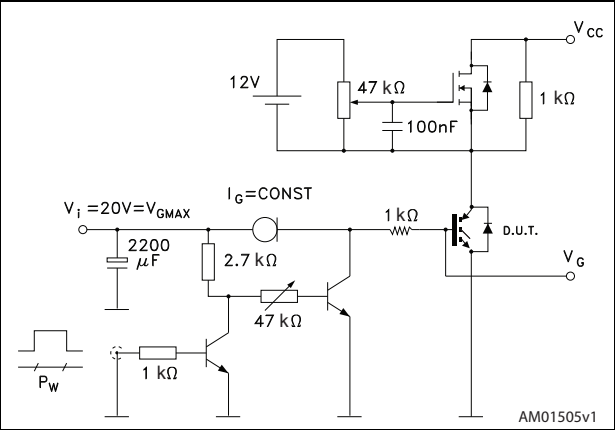
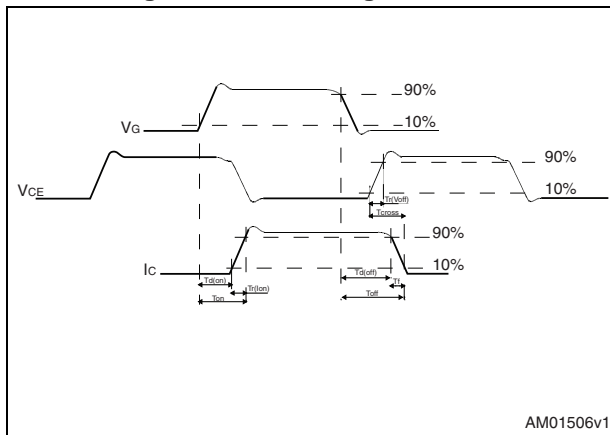


Figure 29. Switching waveform



## 4 Package information

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 package information

Figure 30. TO-3PF package outline

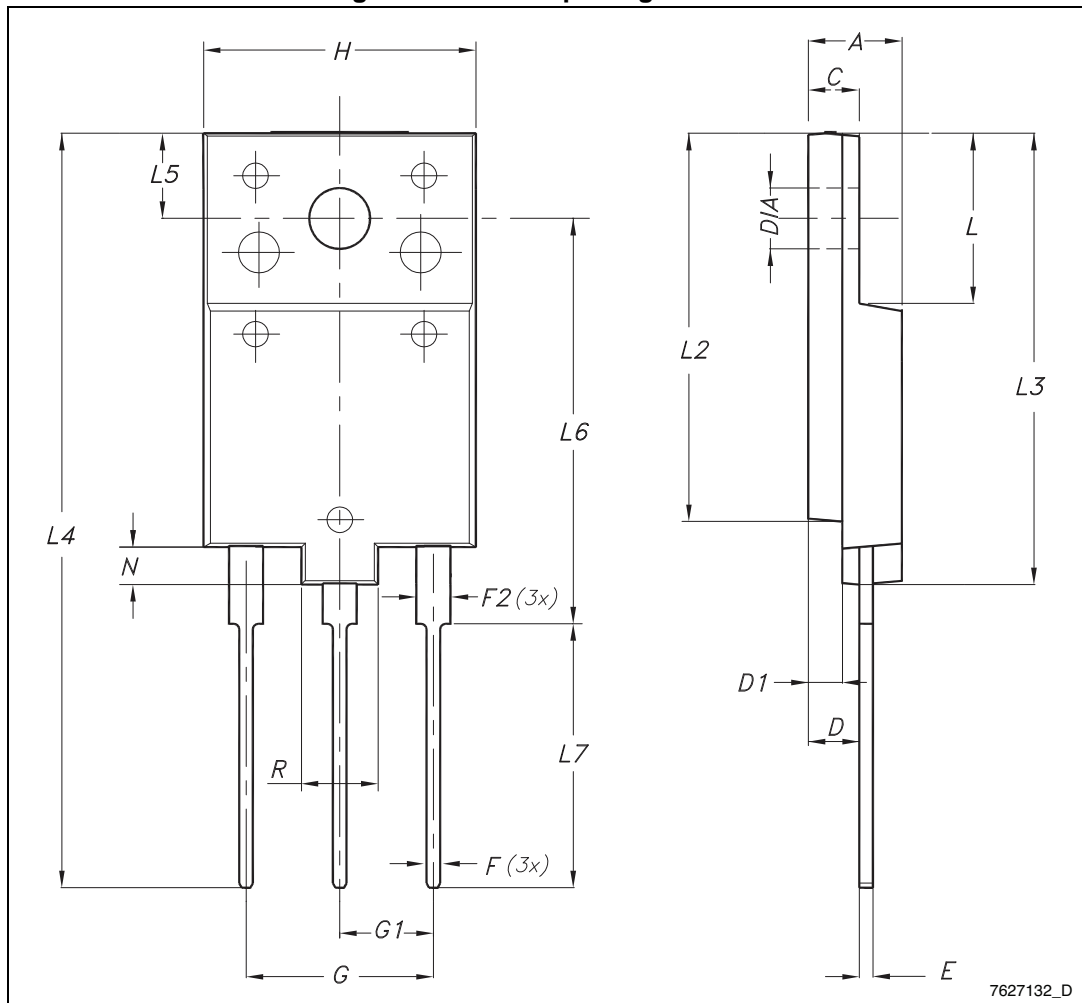


Table 7. TO-3PF package mechanical data

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 package information

Figure 31. TO-247 package outline

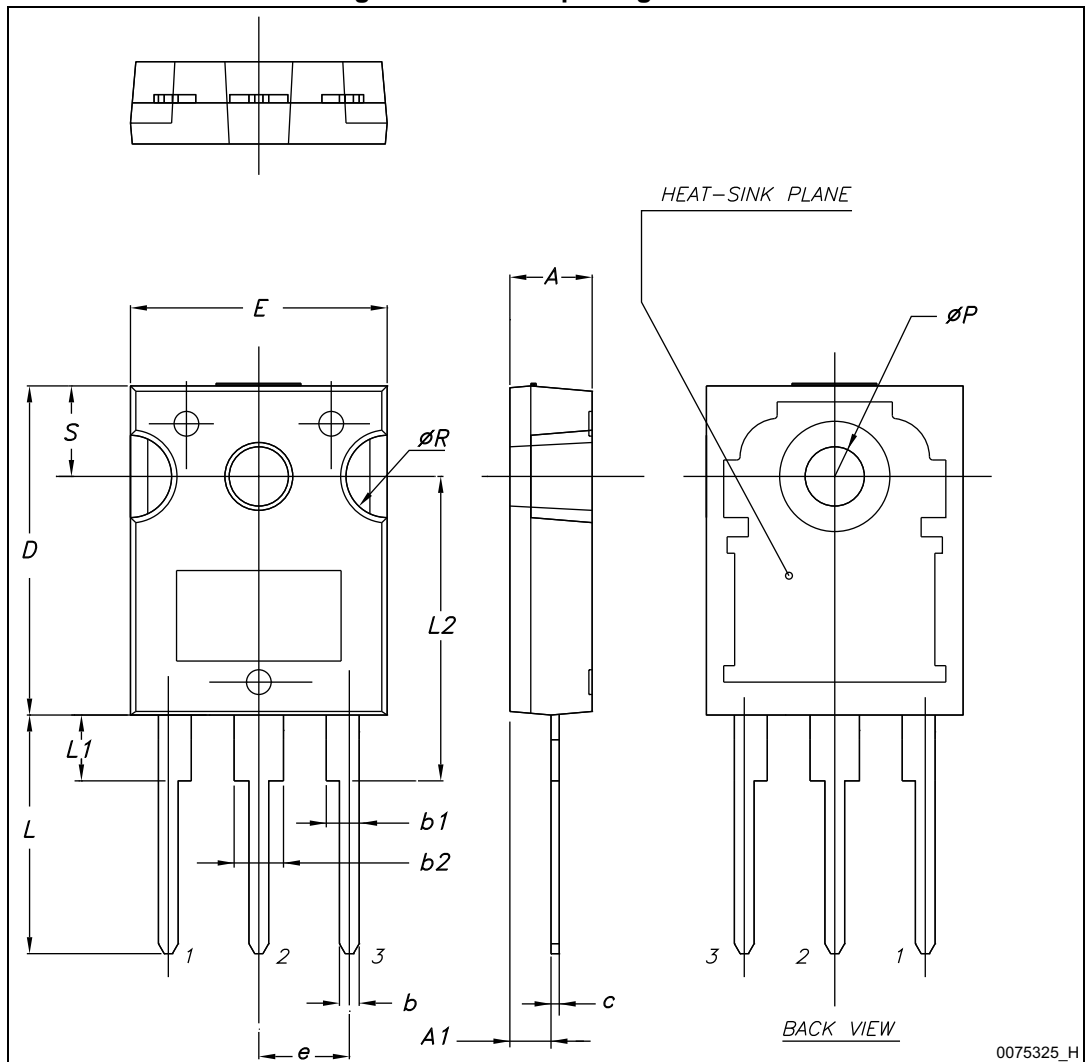


Table 8. TO-247 package mechanical data

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 package information

Figure 32. TO-3P package outline

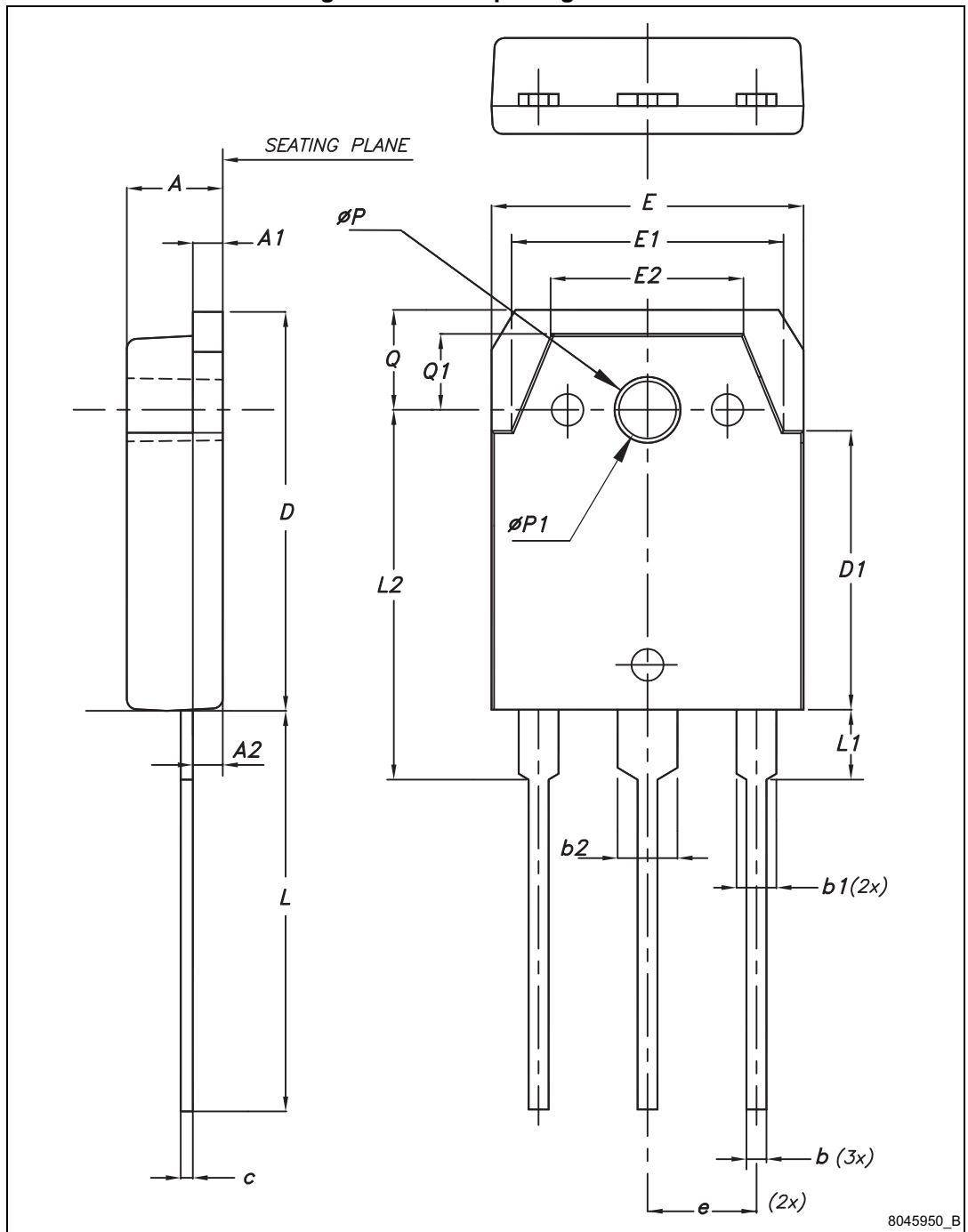


Table 9. TO-3P package mechanical data

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-Jan-2014	1	Initial release.
24-Feb-2014	2	Updated units in <a href="#">Table 6: Switching characteristics (inductive load)</a> for $E_{ts}$ , and updated note 1. Update <a href="#">Figure 16: Switching losses vs temperature</a> , <a href="#">Figure 17: Switching losses vs gate resistance</a> and <a href="#">Figure 18: Switching losses vs collector current</a> . Updated title and features in cover page. Minor text changes.
10-Mar-2014	3	Added device in TO-3PF. Updated <a href="#">Table 1: Device summary</a> , <a href="#">Table 2: Absolute maximum ratings</a> , <a href="#">Table 3: Thermal data</a> . Added <a href="#">Figure 6: Collector current vs. case temperature for TO-3PF</a> , <a href="#">Figure 9: Power dissipation vs. case temperature for TO-3PF</a> , <a href="#">Figure 11: Forward bias safe operating area for TO-3PF</a> and <a href="#">Figure 26: Thermal impedance for TO-3PF</a> . Updated <a href="#">Section 4: Package information</a> .
20-May-2014	4	Updated <a href="#">Table 2: Absolute maximum ratings</a> .
28-Jul-2015	5	Text and formatting changes throughout document Updated <a href="#">Table 2: Absolute maximum ratings</a> Updated <a href="#">Section 2.1: Electrical characteristics (curves)</a> Updated <a href="#">Section 3: Test circuits</a> Updated <a href="#">Section 4.2: TO-247 package information</a> Updated <a href="#">Section 4.3: TO-3P package information</a>

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