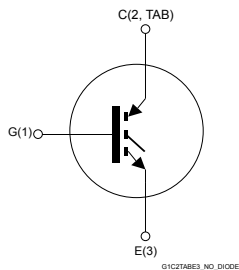
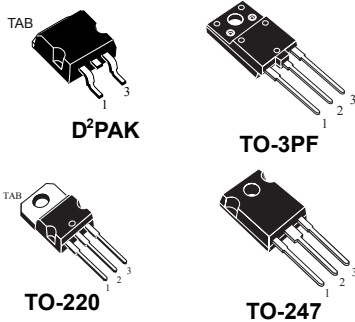


## Trench gate field-stop IGBT, V series 600 V, 40 A very high speed



### Features

- Maximum junction temperature:  $T_J = 175\text{ °C}$
- Tail-less switching off
- $V_{CE(sat)} = 1.8\text{ V (typ.) @ } I_C = 40\text{ A}$
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance

### Applications

- Welding
- Power factor correction
- UPS
- Solar inverters
- Chargers

### Description

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

#### Product status links

[STGB40V60F](#)

[STGFW40V60F](#)

[STGP40V60F](#)

[STGW40V60F](#)

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		D <sup>2</sup> PAK, TO-247, TO-3P	TO-3PF	
V <sub>CES</sub>	Collector-emitter voltage (V <sub>GE</sub> = 0 V)	600		V
I <sub>C</sub>	Continuous collector current at T <sub>C</sub> = 25 °C	80		A
	Continuous collector current at T <sub>C</sub> = 100 °C	40		A
I <sub>CP</sub> <sup>(1)</sup>	Pulsed collector current	160		A
V <sub>GE</sub>	Gate-emitter voltage	±20		V
P <sub>TOT</sub>	Total power dissipation at T <sub>C</sub> = 25 °C	283	98.5	W
V <sub>ISO</sub>	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T <sub>C</sub> = 25 °C)		3.5	kV
T <sub>stg</sub>	Storage temperature range	-55 to 150		°C
T <sub>J</sub>	Operating junction temperature range	-55 to 175		°C

1. Pulse width is limited by maximum junction temperature.

**Table 2. Thermal data**

Symbol	Parameter	Value		Unit
		TO-247, TO-3P	TO-3PF	
R <sub>thJC</sub>	Thermal resistance, junction-to-case	0.53	1.52	°C/W
R <sub>thJA</sub>	Thermal resistance, junction-to-ambient	50		°C/W

## 2 Electrical characteristics

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

**Table 3. Static characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}$ , $I_C = 2\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$ , $I_C = 40\text{ A}$		1.8	2.3	V
		$V_{GE} = 15\text{ V}$ , $I_C = 40\text{ A}$ , $T_J = 125\text{ °C}$		2.15		
		$V_{GE} = 15\text{ V}$ , $I_C = 40\text{ A}$ , $T_J = 175\text{ °C}$		2.35		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$ , $I_C = 1\text{ mA}$	5	6	7	V
$I_{CES}$	Collector cut-off current	$V_{GE} = 0\text{ V}$ , $V_{CE} = 600\text{ V}$			25	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$ , $V_{GE} = \pm 20\text{ V}$			$\pm 250$	nA

**Table 4. Dynamic characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GE} = 0\text{ V}$	-	5400	-	pF
$C_{oes}$	Output capacitance		-	220	-	pF
$C_{res}$	Reverse transfer capacitance		-	180	-	pF
$Q_g$	Total gate charge	$V_{CC} = 480\text{ V}$ , $I_C = 40\text{ A}$ , $V_{GE} = 0\text{ to }15\text{ V}$ (see Figure 28. Gate charge test circuit)	-	226	-	nC
$Q_{ge}$	Gate-emitter charge		-	38	-	nC
$Q_{gc}$	Gate-collector charge		-	95	-	nC

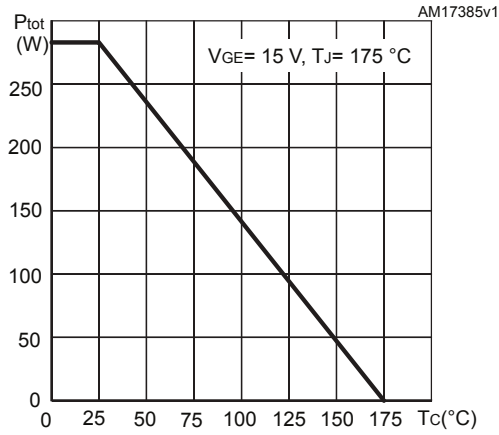
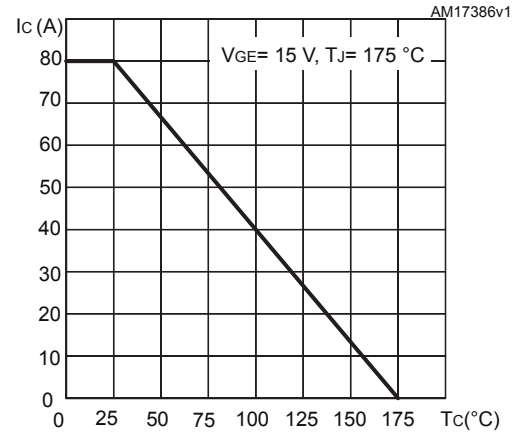
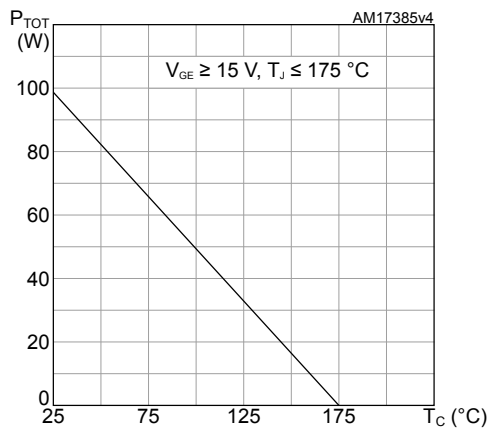
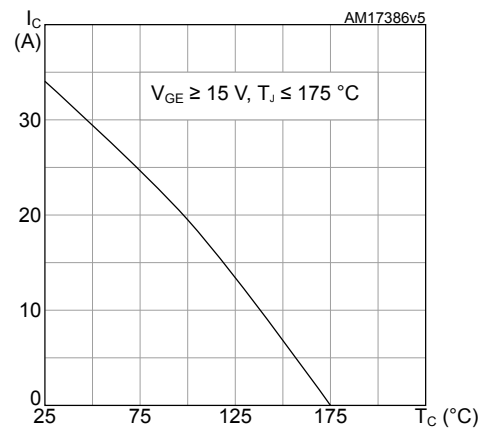
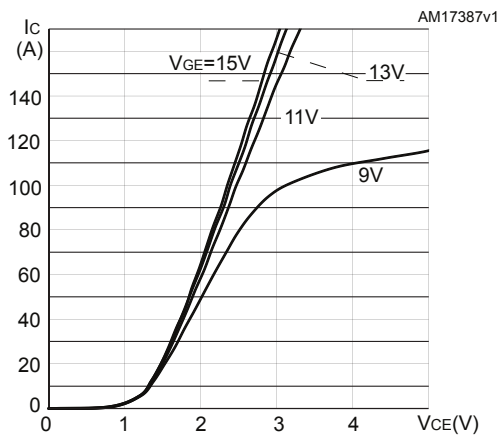
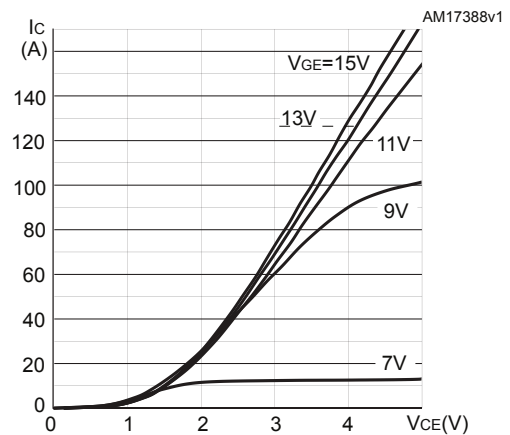
**Table 5. Switching characteristics (inductive load)**

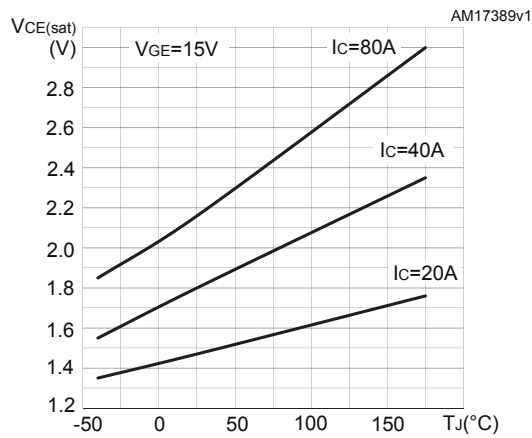
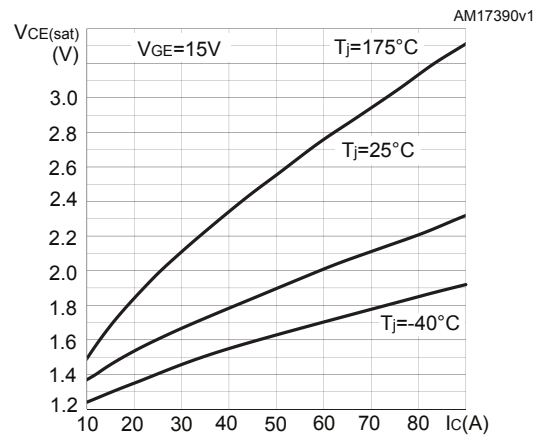
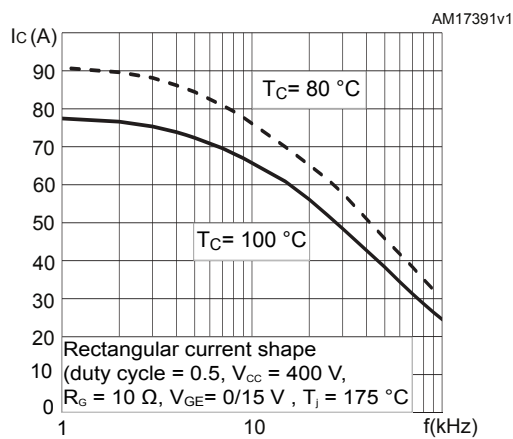
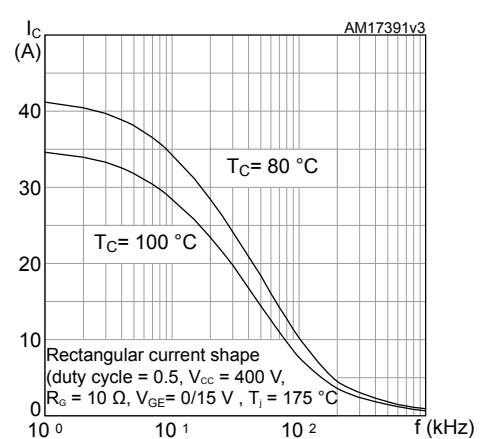
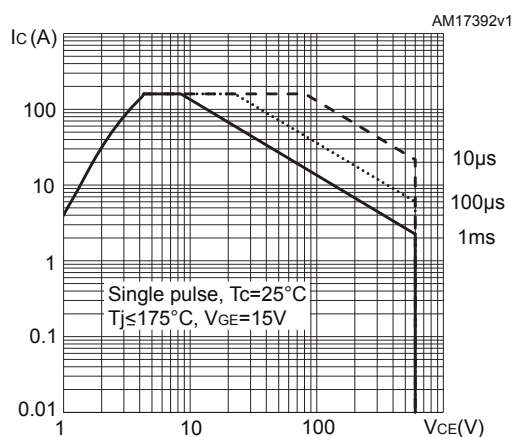
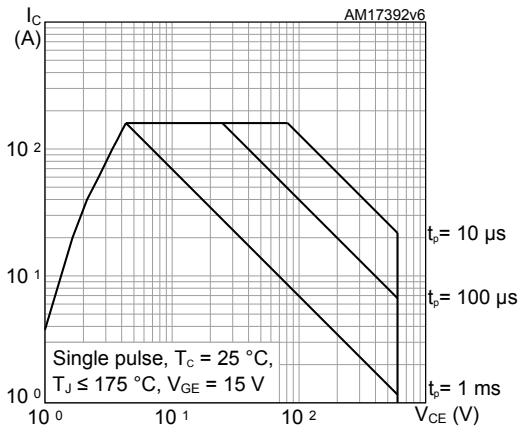
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$ , $I_C = 40\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ (see Figure 27. Test circuit for inductive load switching)	-	52	-	ns
$t_r$	Current rise time		-	17	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1850	-	A/ $\mu$ s
$t_{d(off)}$	Turn-off delay time		-	208	-	ns
$t_f$	Current fall time		-	20	-	ns
$E_{on}^{(1)}$	Turn-on switching energy		-	456	-	$\mu$ J
$E_{off}^{(2)}$	Turn-off switching energy		-	411	-	$\mu$ J
$E_{ts}$	Total switching energy		-	867	-	$\mu$ J
$t_{d(on)}$	Turn-on delay time		$V_{CE} = 400\text{ V}$ , $I_C = 40\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 175\text{ }^\circ\text{C}$ (see Figure 27. Test circuit for inductive load switching)	-	52	-
$t_r$	Current rise time	-		21	-	ns
$(di/dt)_{on}$	Turn-on current slope	-		1538	-	A/ $\mu$ s
$t_{d(off)}$	Turn-off-delay time	-		220	-	ns
$t_f$	Current fall time	-		21	-	ns
$E_{on}^{(1)}$	Turn-on switching energy	-		1330	-	$\mu$ J
$E_{off}^{(2)}$	Turn-off switching energy	-		560	-	$\mu$ J
$E_{ts}$	Total switching energy	-		1890	-	$\mu$ J

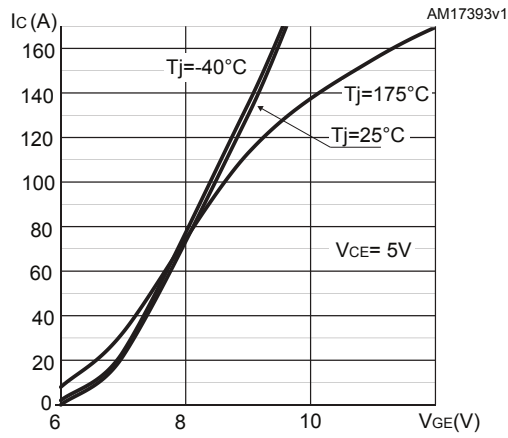
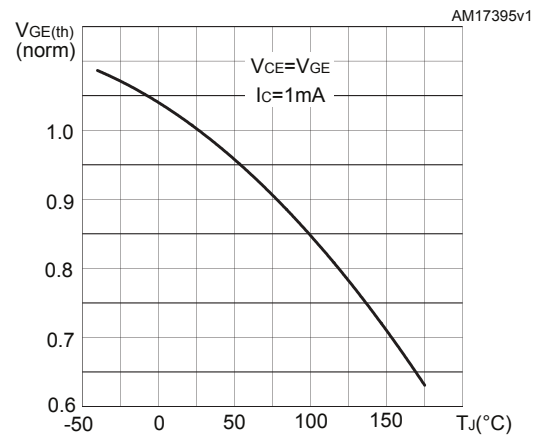
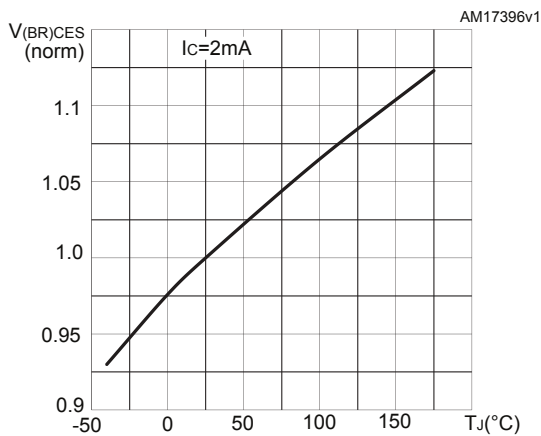
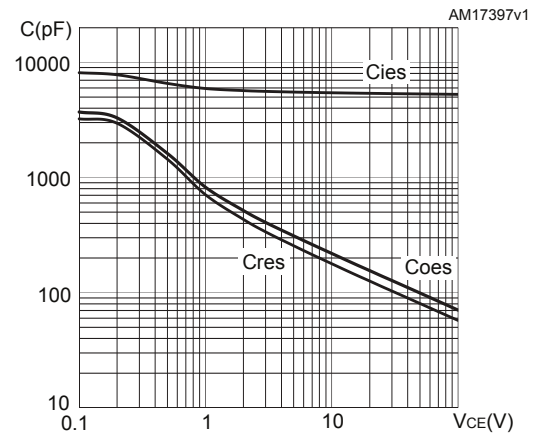
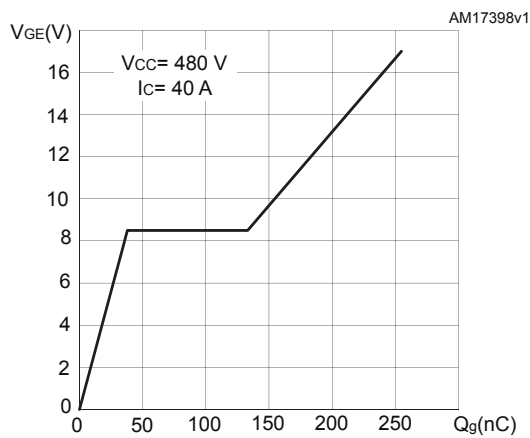
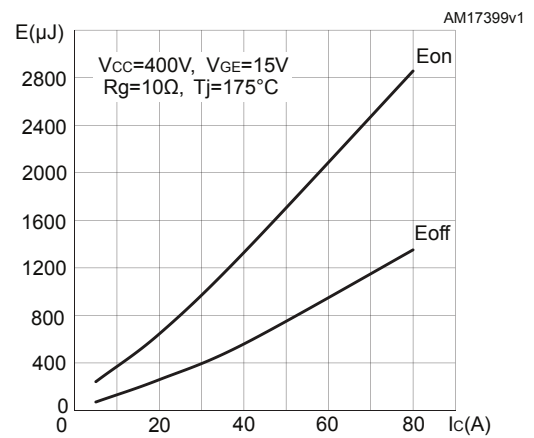
1. Including the reverse recovery of the external diode. The diode is the same of the co-packed STGW40V60DF.

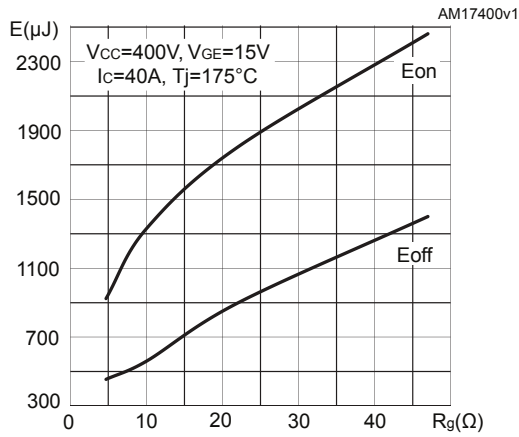
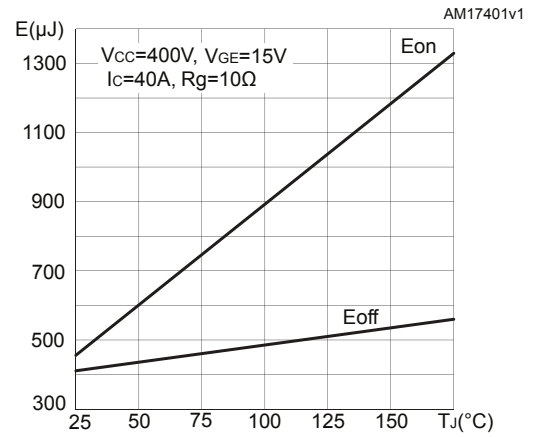
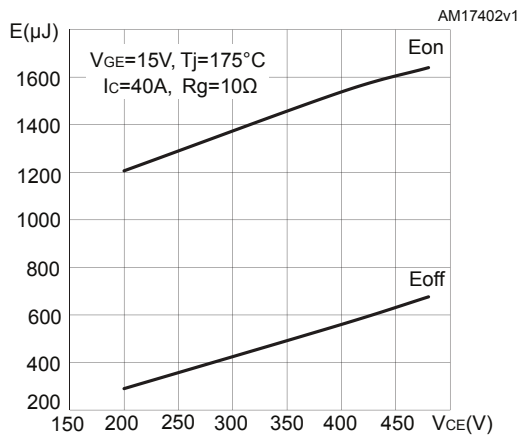
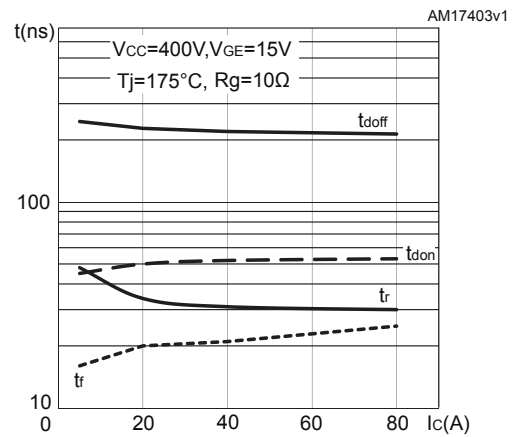
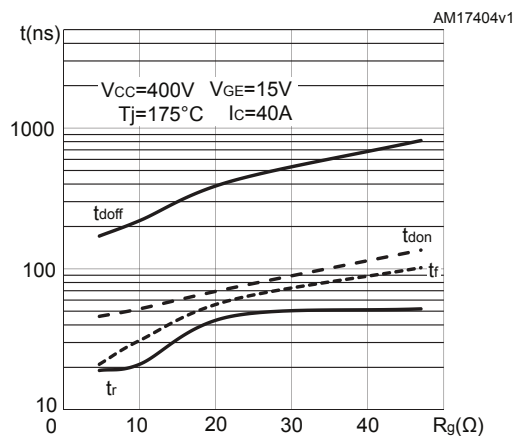
2. Including the tail of the collector current.

## 2.1 Electrical characteristics (curves)

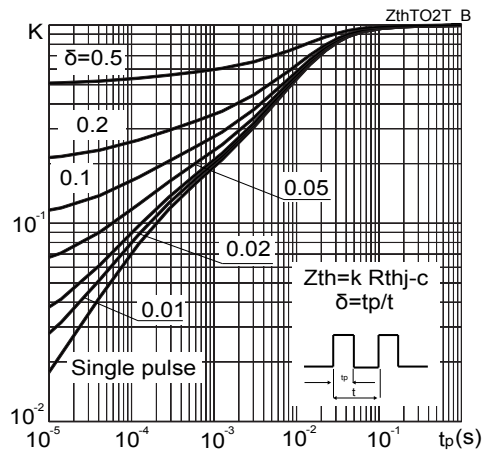
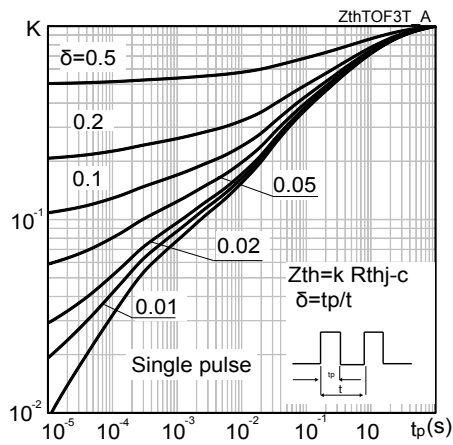
**Figure 1. Power dissipation vs case temperature for D<sup>2</sup>PAK, TO-247 and TO-3P**

**Figure 2. Collector current vs case temperature for D<sup>2</sup>PAK, TO-247 and TO-3P**

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

**Figure 4. Collector current vs case temperature for TO-3PF**

**Figure 5. Output characteristics (T<sub>J</sub> = 25 °C)**

**Figure 6. Output characteristics (T<sub>J</sub> = 175 °C)**


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

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

**Figure 9. Collector current vs switching frequency for D<sup>2</sup>PAK, TO-247 and TO-3P**

**Figure 10. Collector current vs switching frequency for TO-3PF**

**Figure 11. Forward bias safe operating area for D<sup>2</sup>PAK, TO-247 and TO-3P**

**Figure 12. Forward bias safe operating area for TO-3PF**


**Figure 13. Transfer characteristics**

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

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

**Figure 16. Capacitance variations**

**Figure 17. Gate charge vs gate-emitter voltage**

**Figure 18. Switching energy vs collector current**


**Figure 19. Switching energy vs gate resistance**

**Figure 20. Switching energy vs junction temperature**

**Figure 21. Switching energy vs collector emitter voltage**

**Figure 22. Switching times vs collector current**

**Figure 23. Switching times vs gate resistance**




**Figure 24. Thermal impedance for D<sup>2</sup>PAK, TO-247 and TO-3P**

**Figure 25. Thermal impedance for TO-3PF**


### 3 Test circuits

Figure 26. Test circuit for inductive load switching

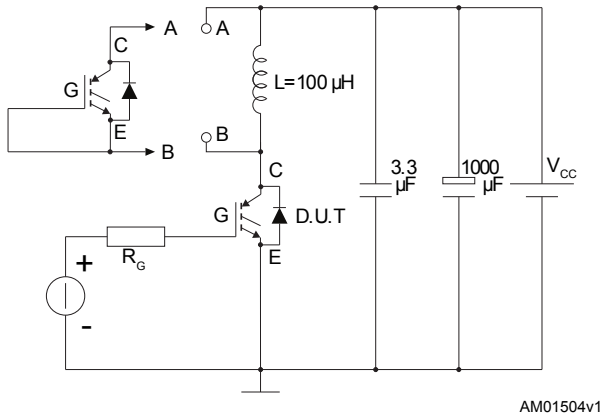


Figure 27. Gate charge test circuit

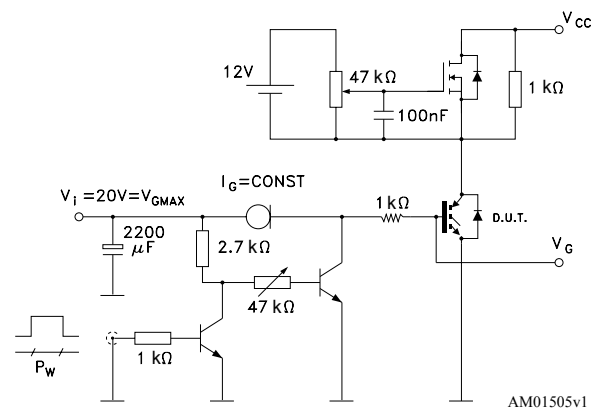
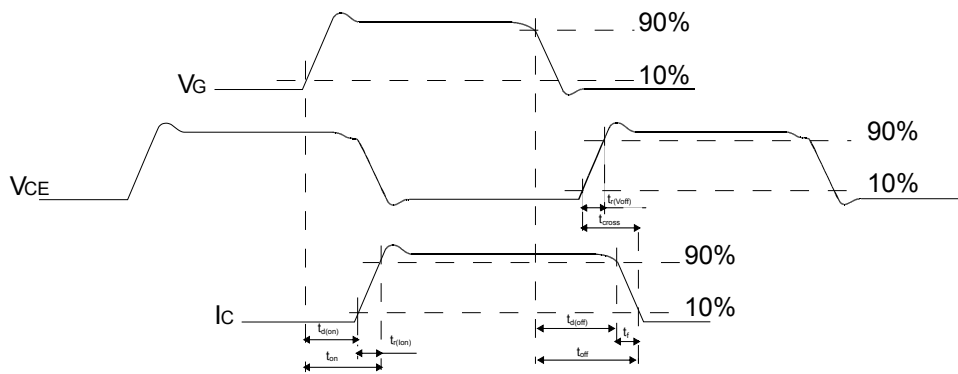


Figure 28. Switching waveform



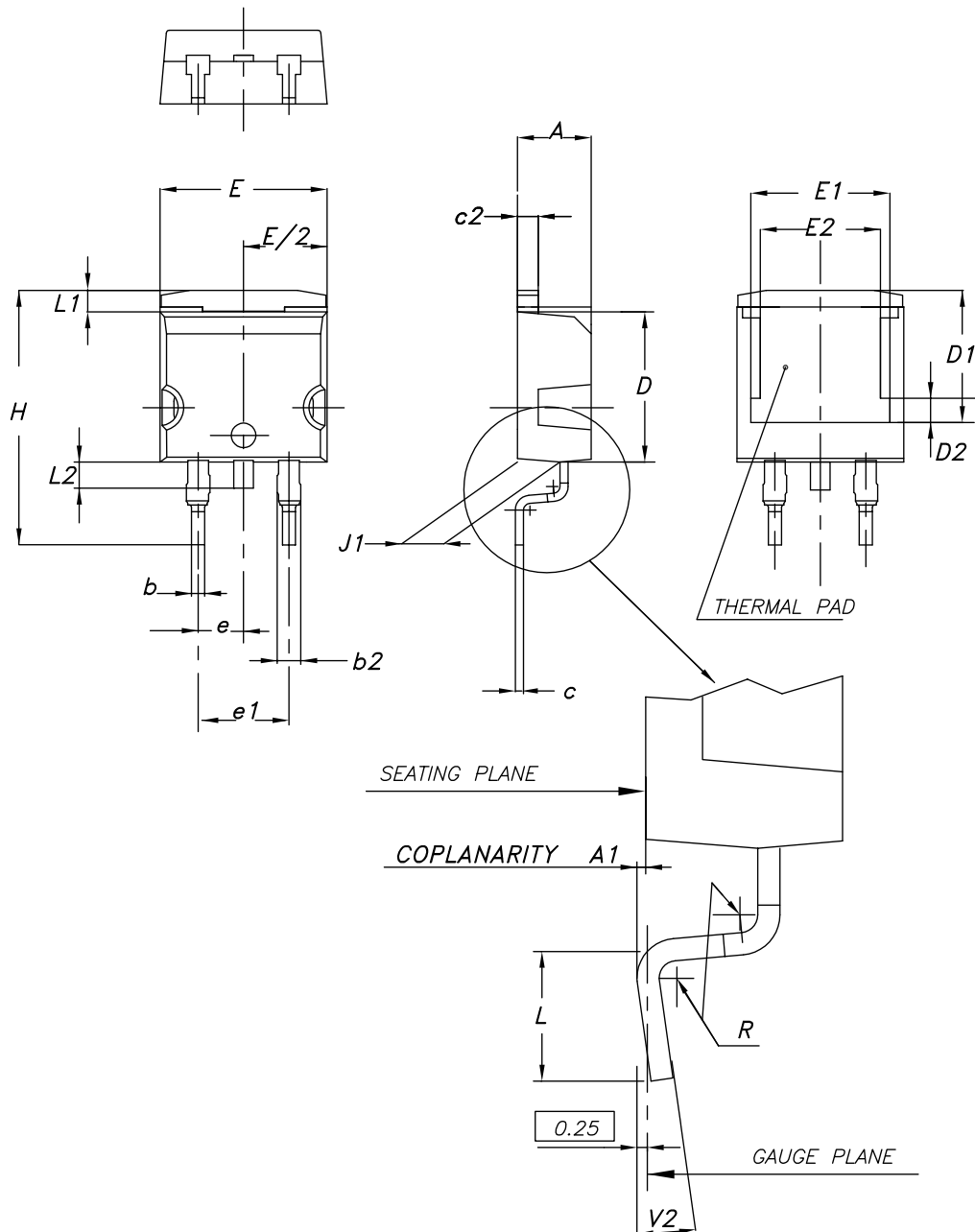
AM01506v1

## 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 D<sup>2</sup>PAK (TO-263) type A2 package information

**Figure 29. D<sup>2</sup>PAK (TO-263) type A2 package outline**

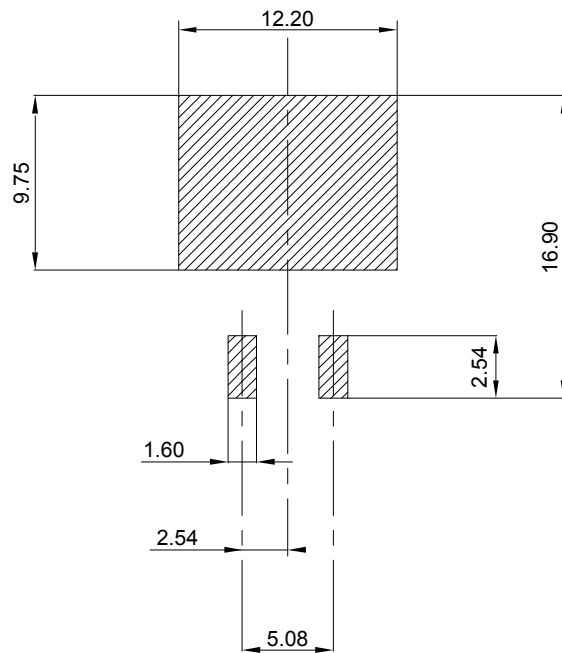


0079457\_A2\_26

**Table 6. D<sup>2</sup>PAK (TO-263) type A2 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10.00		10.40
E1	8.70	8.90	9.10
E2	7.30	7.50	7.70
e		2.54	
e1	4.88		5.28
H	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

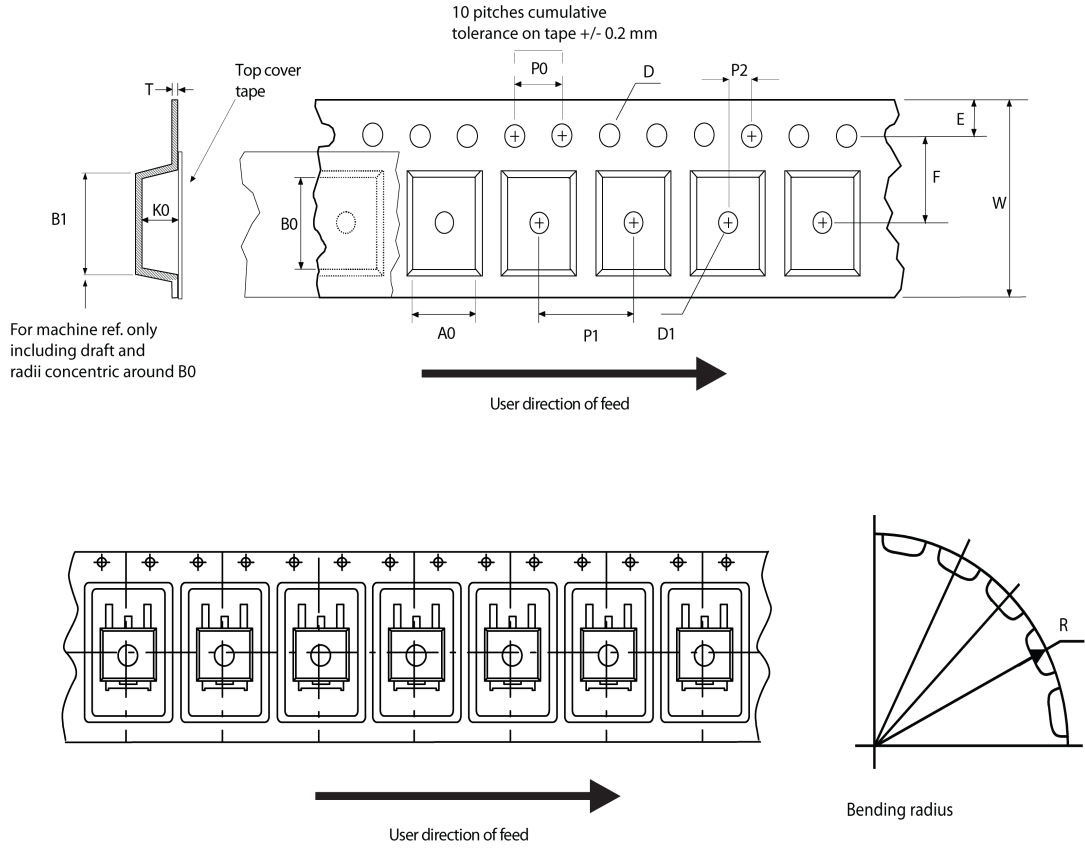
Figure 30. D<sup>2</sup>PAK (TO-263) recommended footprint (dimensions are in mm)



Footprint\_26

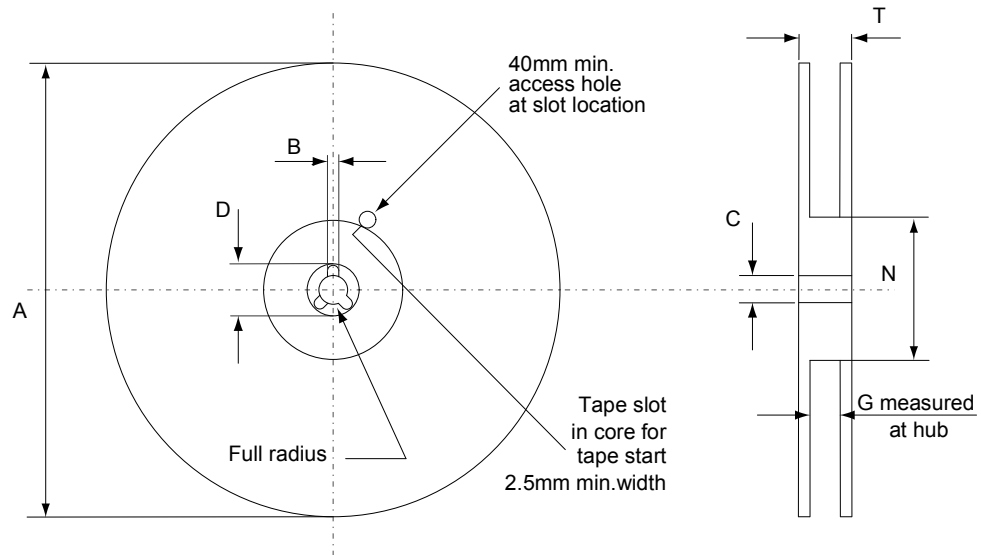
4.1.1 D<sup>2</sup>PAK packing information

Figure 31. D<sup>2</sup>PAK tape outline



AM08852v1

Figure 32. D<sup>2</sup>PAK reel outline



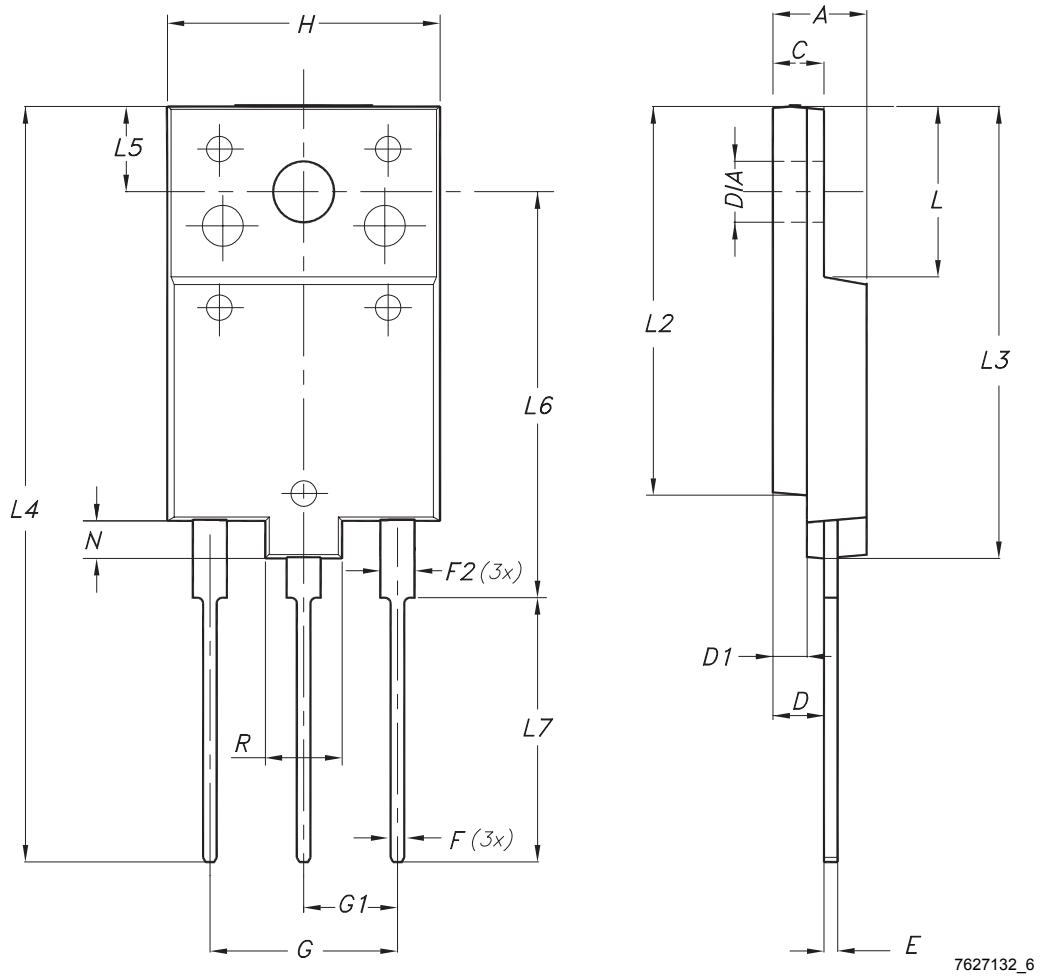
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Table 7. D<sup>2</sup>PAK tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1	Base quantity		1000
P2	1.9	2.1	Bulk quantity		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

## 4.2 TO-3PF package information

Figure 33. TO-3PF package outline



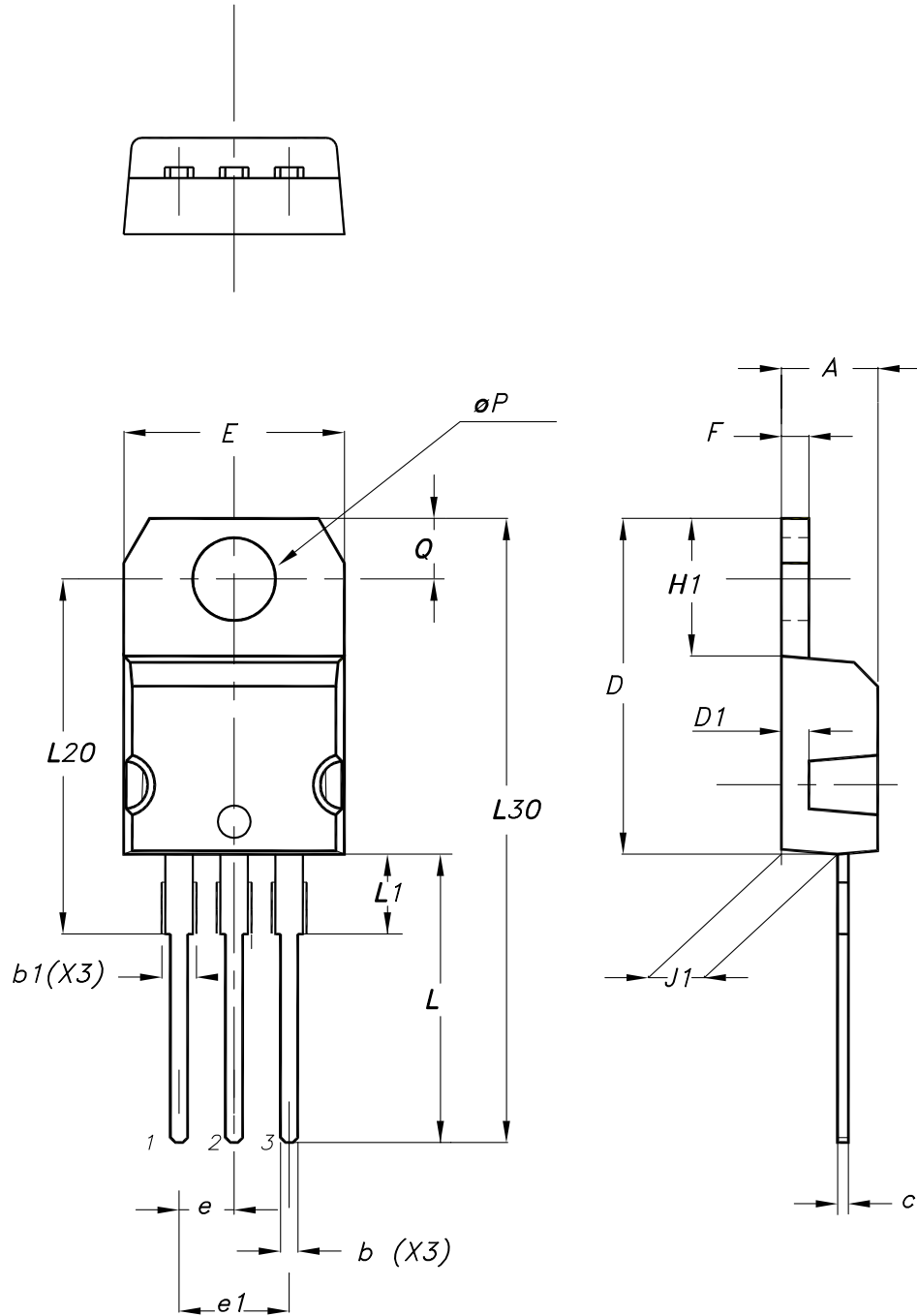


**Table 8. TO-3PF mechanical data**

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	10.00	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		15.00
N	1.80		2.20
R	3.80		4.20
Dia	3.40		3.80

### 4.3 TO-220 type A package information

Figure 34. TO-220 type A package outline



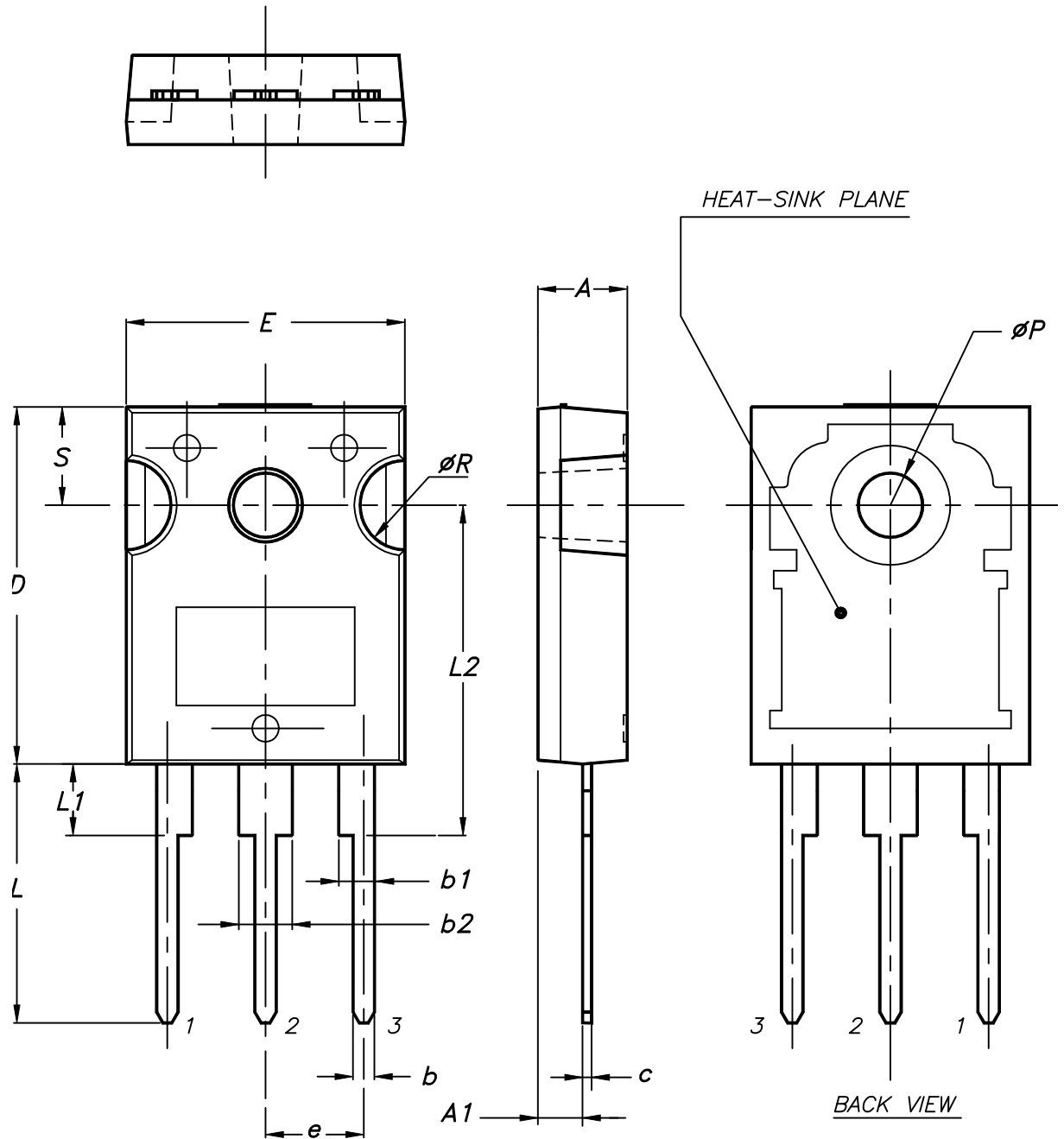
0015988\_typeA\_Rev\_23

**Table 9. TO-220 type A package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95
Slug flatness		0.03	0.10

#### 4.4 TO-247 package information

Figure 35. TO-247 package outline



0075325\_9

**Table 10. 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

## 5 Ordering information

**Table 11. Order codes**

Order code	Marking	Package	Packing
STGB40V60F	GB40V60F	D <sup>2</sup> PAK	Tape and reel
STGFW40V60F	GFW40V60F	TO-3PF	Tube
STGP40V60F	GP40V60F	TO-220	
STGW40V60F	GW40V60F	TO-247	

## Revision history

**Table 12. Document revision history**

Date	Revision	Changes
04-Jun-2013	1	Initial release
23-Apr-2014	2	<p>Updated title, features and description in cover page.</p> <p>Added new device in TO-3PF.</p> <p>Updated <i>Table 1: Device summary</i>, <i>Table 2: Absolute maximum ratings</i> <i>Table 3: Thermal data</i> and <i>Section 4: Package mechanical data</i>.</p> <p>Added <i>Figure 4: Power dissipation vs. case temperature for TO-3PF</i>, <i>Figure 5: Collector current vs. case temperature for TO-3PF</i>, <i>Figure 11: Collector current vs. switching frequency for TO-3PF</i> and <i>Figure 12: Forward bias safe operating area for D2PAK, TO-247 and TO-3P</i>.</p> <p>Minor text changes.</p>
04-Mar-2021	3	<p>Modified application section on cover page.</p> <p>Modified <i>Table 1. Absolute maximum ratings</i>, <i>Table 2. Thermal data</i>.</p> <p>Modified <i>Figure 4. Power dissipation vs case temperature for TO-3PF</i>, <i>Figure 5. Collector current vs case temperature for TO-3PF</i>, <i>Figure 11. Collector current vs switching frequency for TO-3PF</i> and <i>Figure 13. Forward bias safe operating area for TO-3PF</i>.</p>

## Contents

<b>1</b>	<b>Electrical ratings</b> .....	<b>2</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>3</b>
<b>2.1</b>	Electrical characteristics (curves) .....	<b>5</b>
<b>3</b>	<b>Test circuits</b> .....	<b>10</b>
<b>4</b>	<b>Package information</b> .....	<b>11</b>
<b>4.1</b>	D <sup>2</sup> PAK (TO-263) type A2 package information .....	11
<b>4.1.1</b>	D <sup>2</sup> PAK packing information .....	14
<b>4.2</b>	TO-3PF package information .....	16
<b>4.3</b>	TO-220 type A package information .....	18
<b>4.4</b>	TO-247 package information .....	20
<b>5</b>	<b>Ordering information</b> .....	<b>22</b>
	<b>Revision history</b> .....	<b>23</b>





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