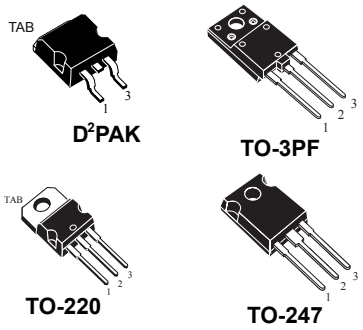
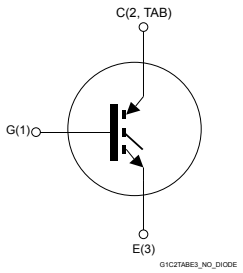
STGB40V60F, STGFW40V60F
STGP40V60F, STGW40V60F

Datasheet

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





Features

- Maximum junction temperature: T_J = 175 °C
- Tail-less switching off
- $V_{CE(sat)}$ = 1.8 V (typ.) @ I_C = 40 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
		D²PAK, TO-247, TO-3P	TO-3PF	
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	600		V
I_C	Continuous collector current at T_C = 25 °C	80		A
	Continuous collector current at T_C = 100 °C	40		A
I_{CP}(1)	Pulsed collector current	160		A
V_{GE}	Gate-emitter voltage	±20		V
P_{TOT}	Total power dissipation at T_C = 25 °C	283	98.5	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T_C = 25 °C)		3.5	kV
T_{stg}	Storage temperature range	-55 to 150		°C
T_J	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_{thJC}	Thermal resistance, junction-to-case	0.53	1.52	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	50		°C/W

2 Electrical characteristics

T_J = 25 °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 V, I_C = 2 mA	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 40 A		1.8	2.3	V
		V_{GE} = 15 V, I_C = 40 A, T_J = 125 °C		2.15		
		V_{GE} = 15 V, I_C = 40 A, T_J = 175 °C		2.35		
$V_{GE(th)}$	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, V_{CE} = 600 V			25	µA
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = ±20 V			±250	nA

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0 V	-	5400	-	pF
C_{oes}	Output capacitance		-	220	-	pF
C_{res}	Reverse transfer capacitance		-	180	-	pF
Q_g	Total gate charge	V_{CC} = 480 V, I_C = 40 A, V_{GE} = 0 to 15 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 V, I_C = 40 A, R_G = 10 Ω, V_{GE} = 15 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/µs
$t_{d(off)}$	Turn-off delay time		-	208	-	ns
t_f	Current fall time		-	20	-	ns
E_{on} (1)	Turn-on switching energy		-	456	-	µJ
E_{off} (2)	Turn-off switching energy		-	411	-	µJ
E_{ts}	Total switching energy		-	867	-	µJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 40 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 175 °C (see Figure 27. Test circuit for inductive load switching)	-	52	-	ns
t_r	Current rise time		-	21	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1538	-	A/µs
$t_{d(off)}$	Turn-off-delay time		-	220	-	ns
t_f	Current fall time		-	21	-	ns
E_{on} (1)	Turn-on switching energy		-	1330	-	µJ
E_{off} (2)	Turn-off switching energy		-	560	-	µJ
E_{ts}	Total switching energy		-	1890	-	µJ

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 D²PAK, TO-247 and TO-3P

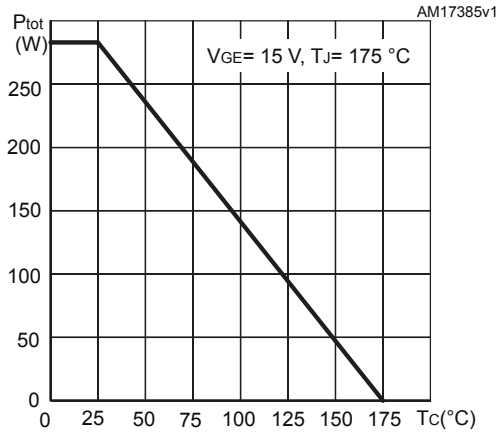


Figure 2. Collector current vs case temperature for D²PAK, TO-247 and TO-3P

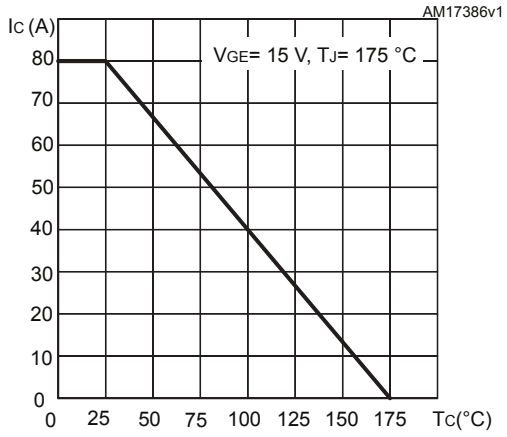


Figure 3. Power dissipation vs case temperature for TO-3PF

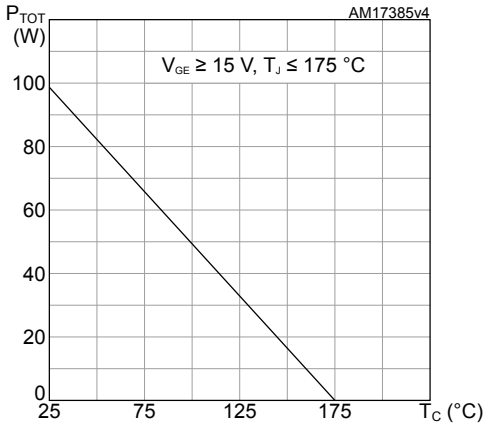


Figure 4. Collector current vs case temperature for TO-3PF

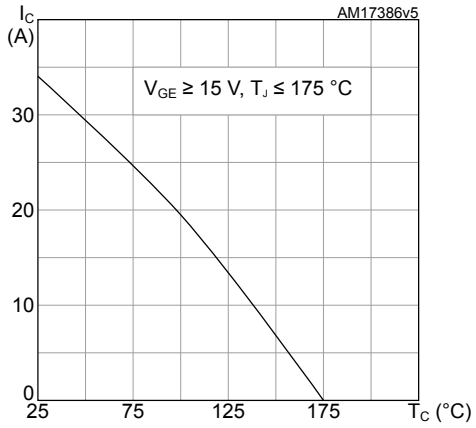


Figure 5. Output characteristics (T_J = 25 °C)

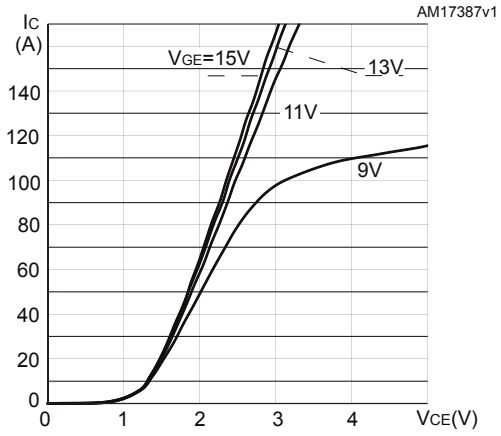


Figure 6. Output characteristics (T_J = 175 °C)

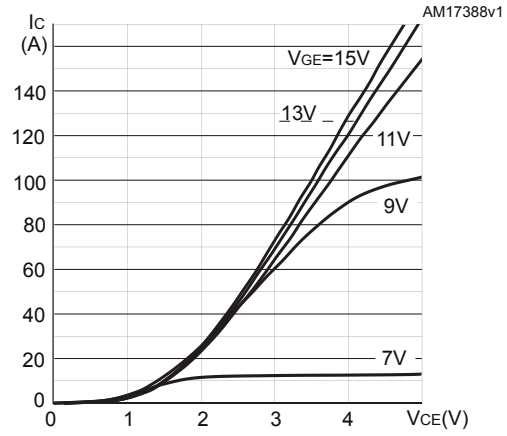


Figure 7. $V_{CE}(sat)$ vs junction temperature

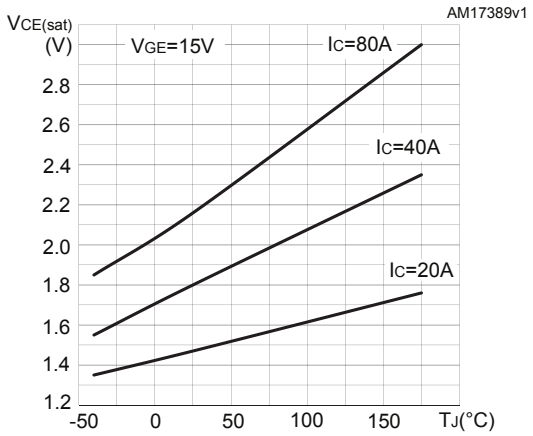


Figure 8. $V_{CE}(sat)$ vs collector current

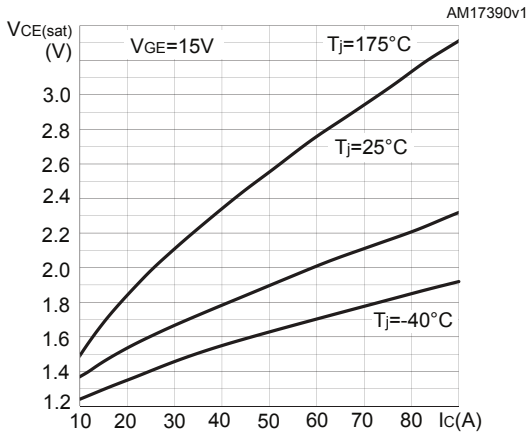


Figure 9. Collector current vs switching frequency for D²PAK, TO-247 and TO-3P

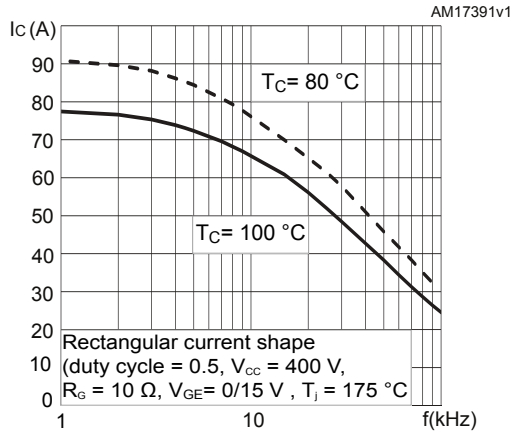


Figure 10. Collector current vs switching frequency for TO-3PF

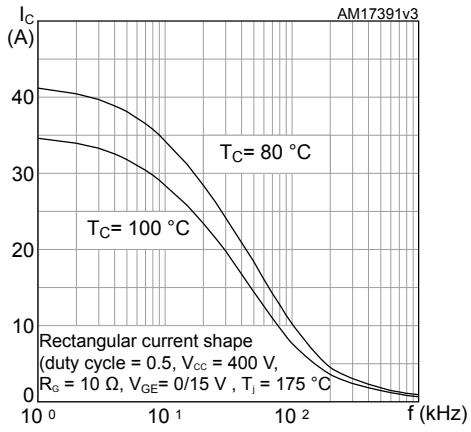


Figure 11. Forward bias safe operating area for D²PAK, TO-247 and TO-3P

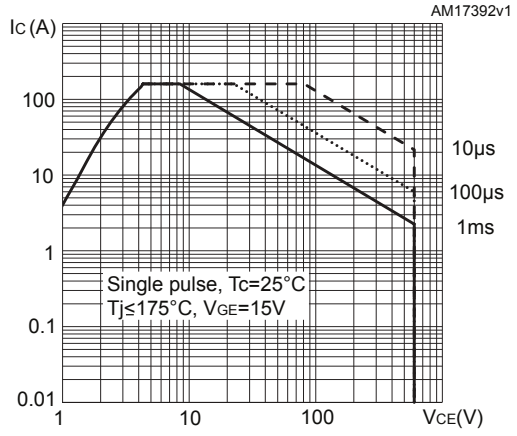


Figure 12. Forward bias safe operating area for TO-3PF

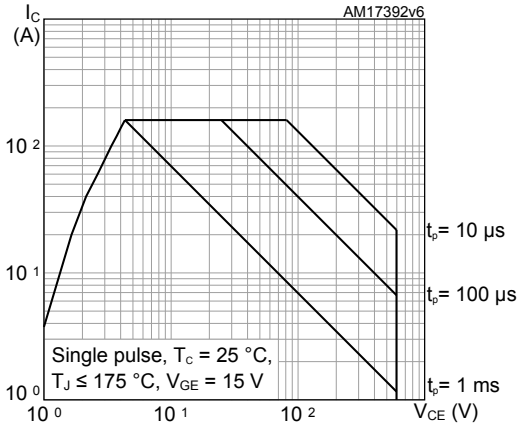


Figure 13. Transfer characteristics

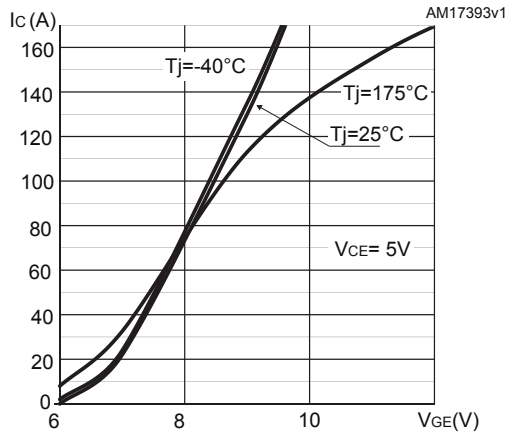


Figure 14. Normalized $V_{GE(th)}$ vs junction temperature

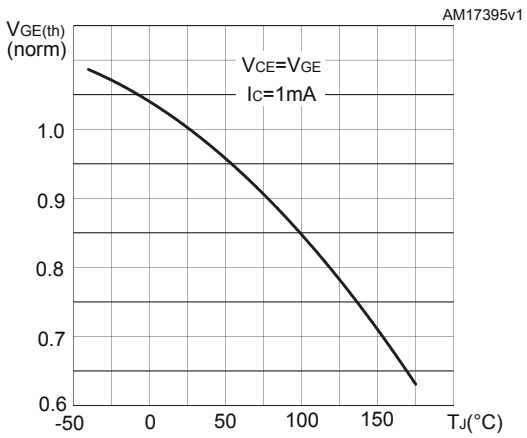


Figure 15. Normalized $V_{(BR)CES}$ vs junction temperature

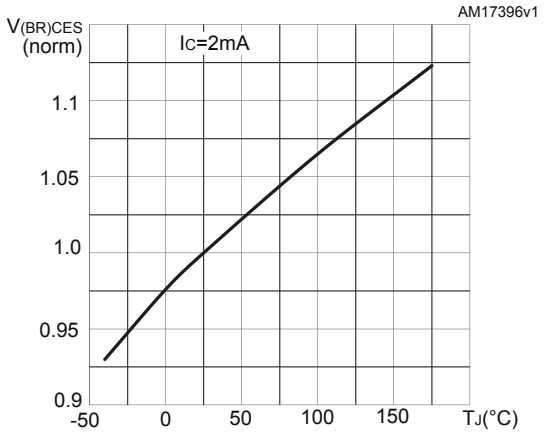


Figure 16. Capacitance variations

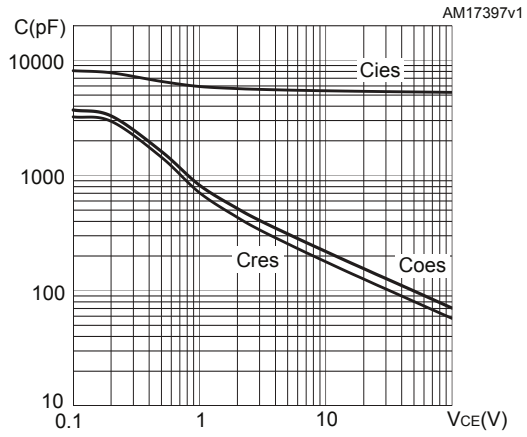


Figure 17. Gate charge vs gate-emitter voltage

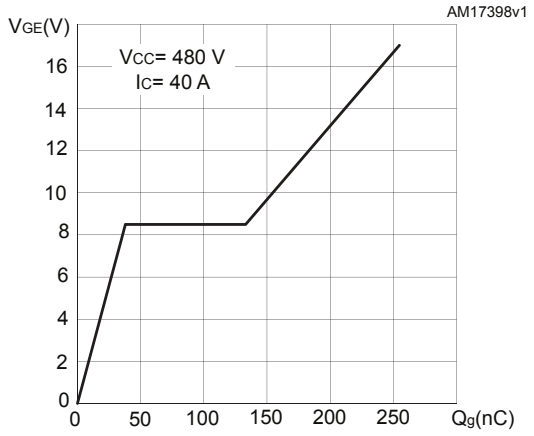


Figure 18. Switching energy vs collector current

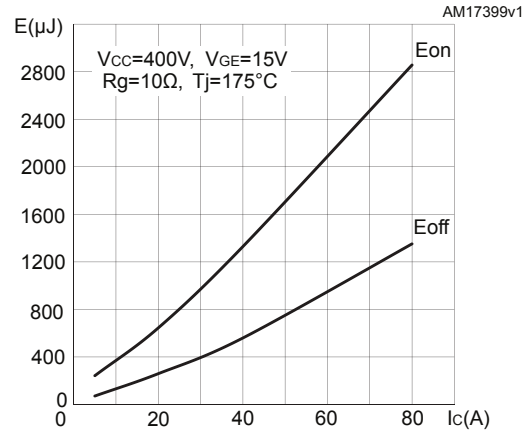


Figure 19. Switching energy vs gate resistance

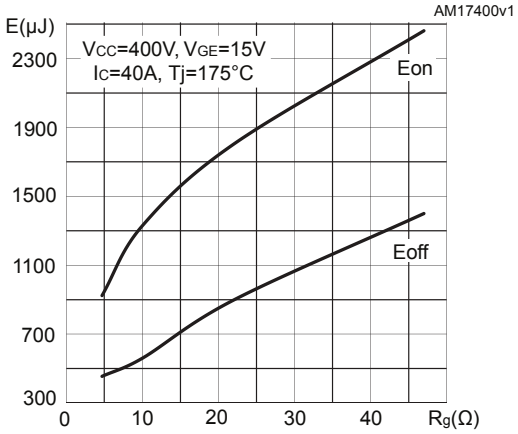


Figure 20. Switching energy vs junction temperature

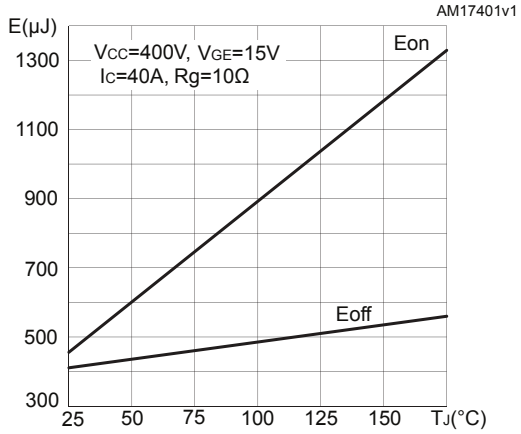


Figure 21. Switching energy vs collector emitter voltage

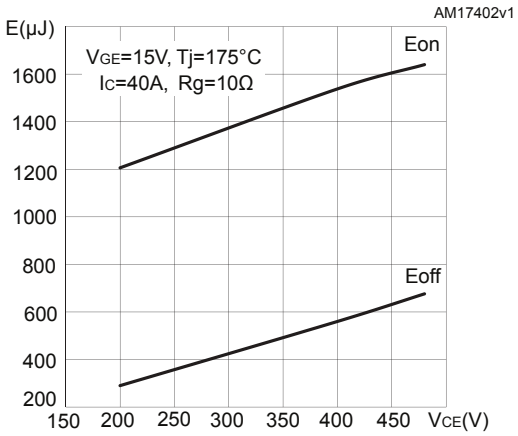


Figure 22. Switching times vs collector current

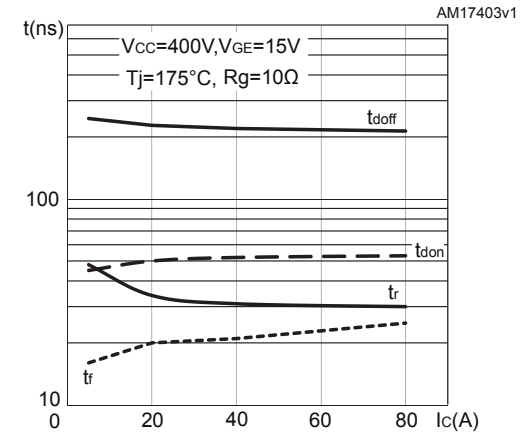


Figure 23. Switching times vs gate resistance

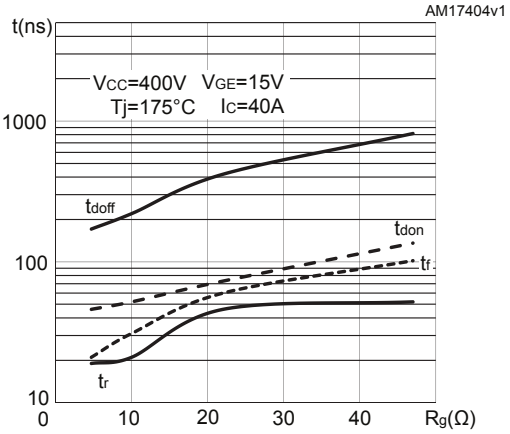


Figure 24. Thermal impedance for D²PAK, TO-247 and TO-3P

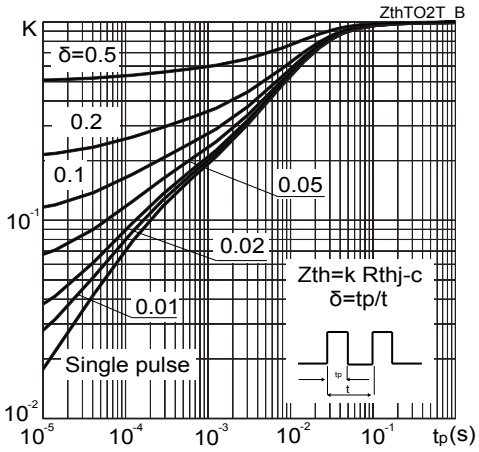
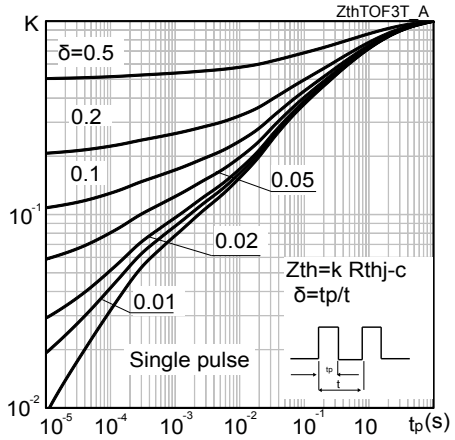


Figure 25. Thermal impedance for TO-3PF



3 Test circuits

Figure 26. Test circuit for inductive load switching

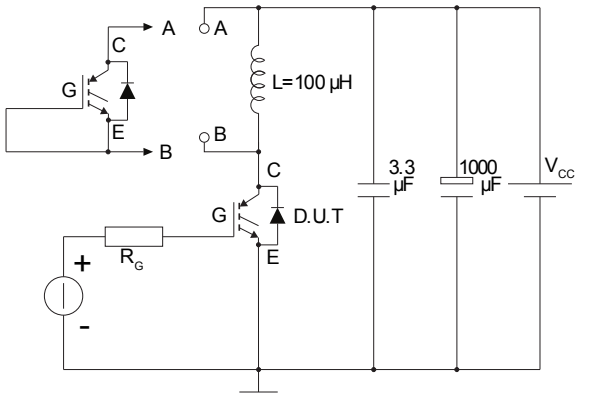


Figure 27. Gate charge test circuit

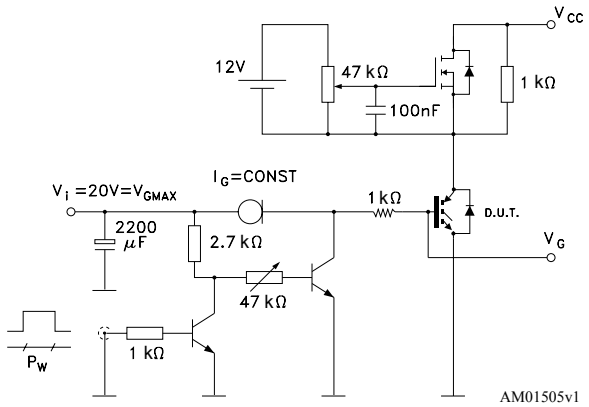
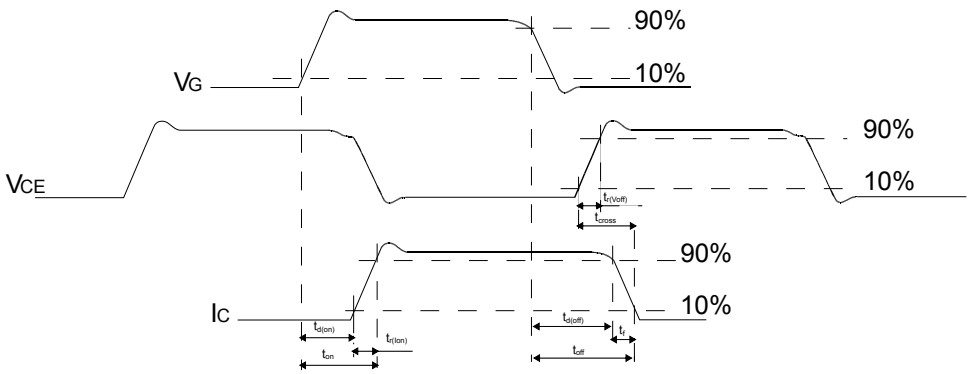


Figure 28. Switching waveform

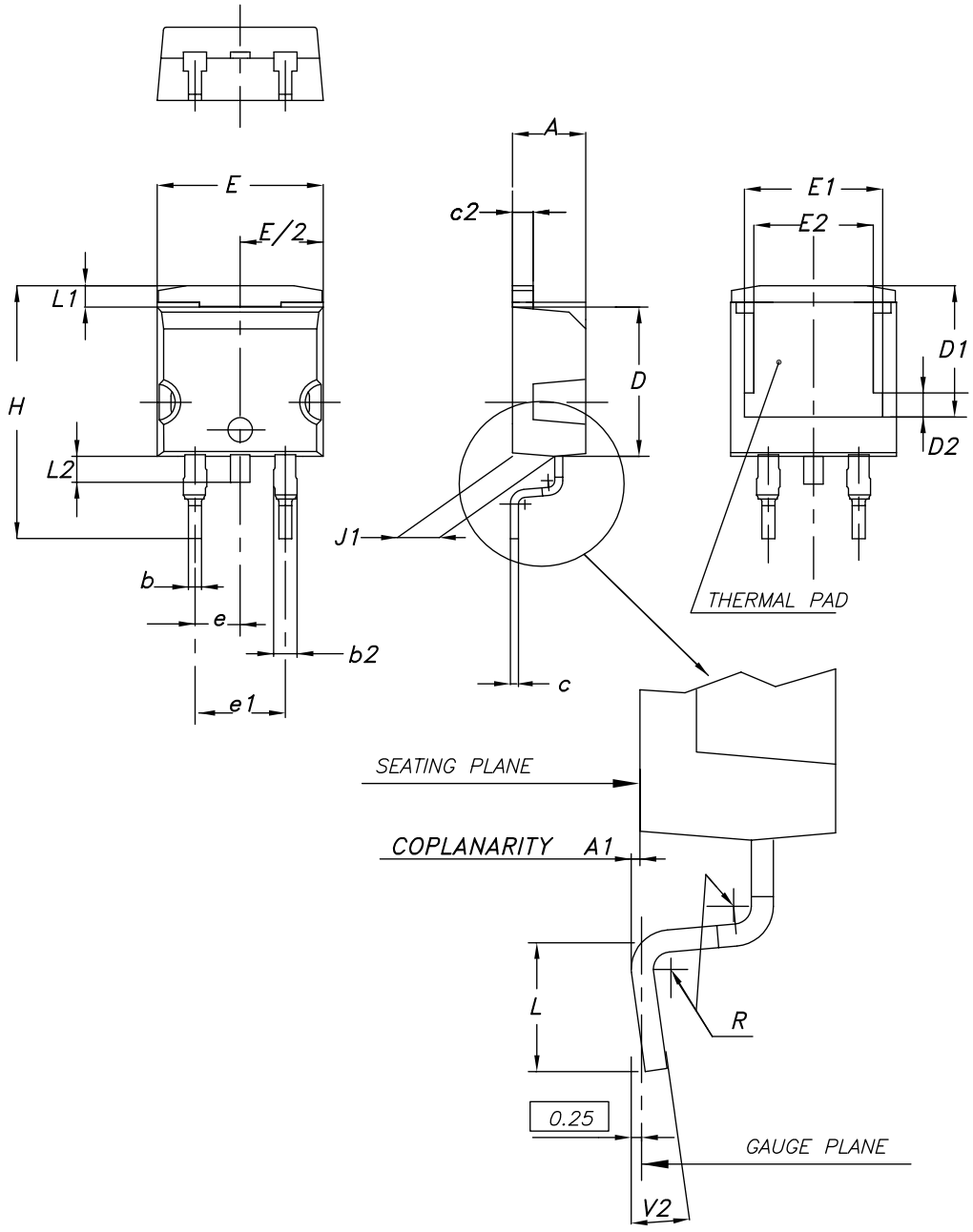


4 Package information

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. ECOPACK is an ST trademark.

4.1 D²PAK (TO-263) type A2 package information

Figure 29. **D²PAK (TO-263) type A2 package outline**

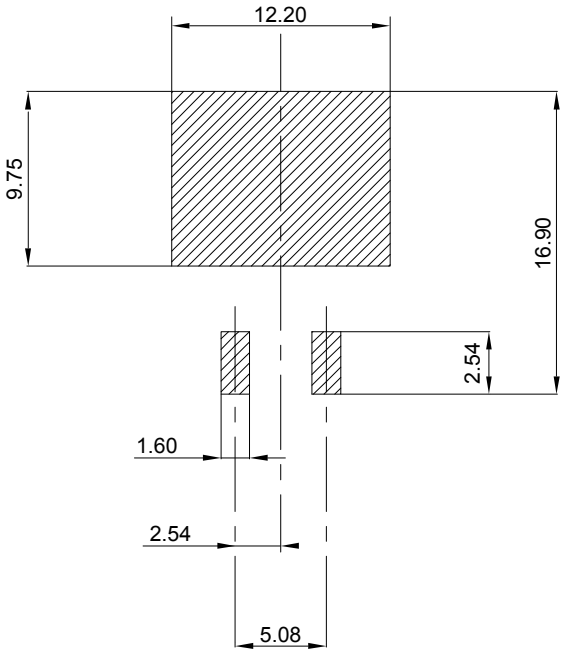


0079457_A2_26

Table 6. **D²PAK (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. **D²PAK (TO-263) recommended footprint (dimensions are in mm)**



Footprint_26

4.1.1 D²PAK packing information

Figure 31. D²PAK tape outline

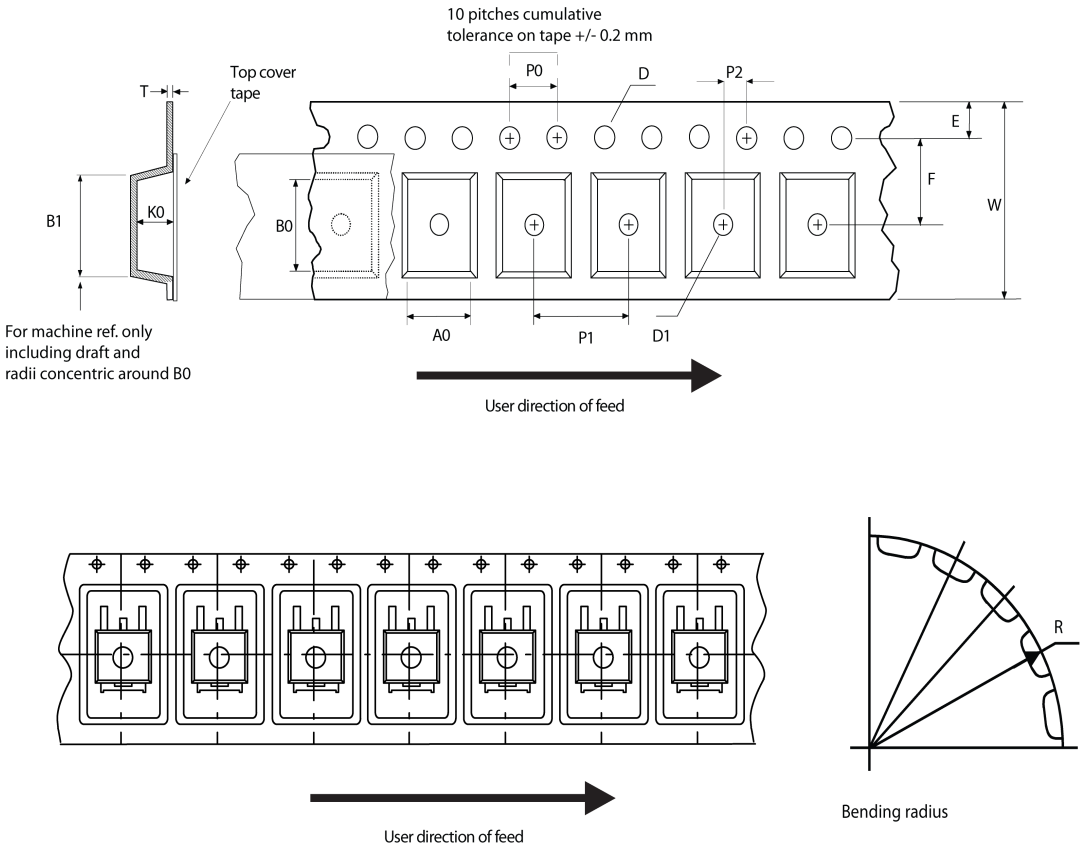
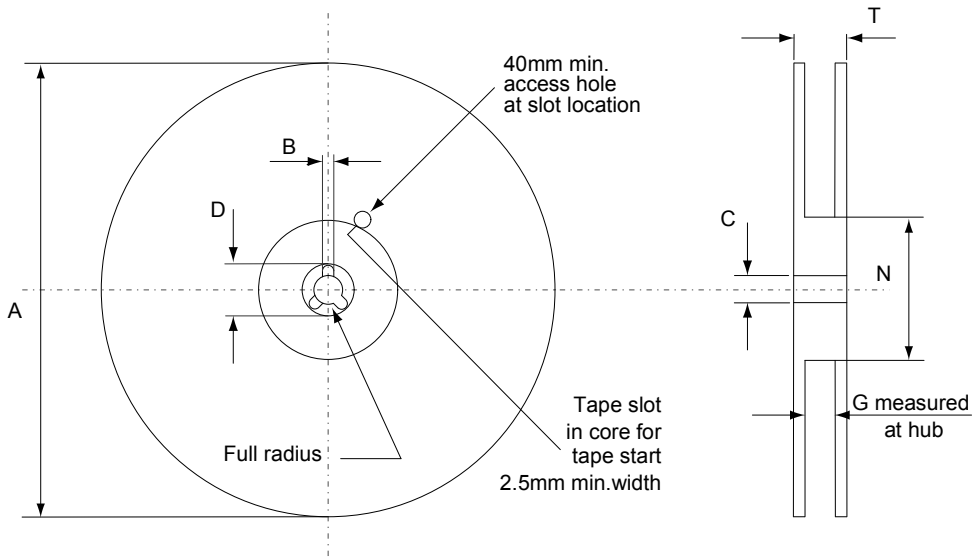


Figure 32. **D²PAK reel outline**



AM06038v1

Table 7. **D²PAK 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**

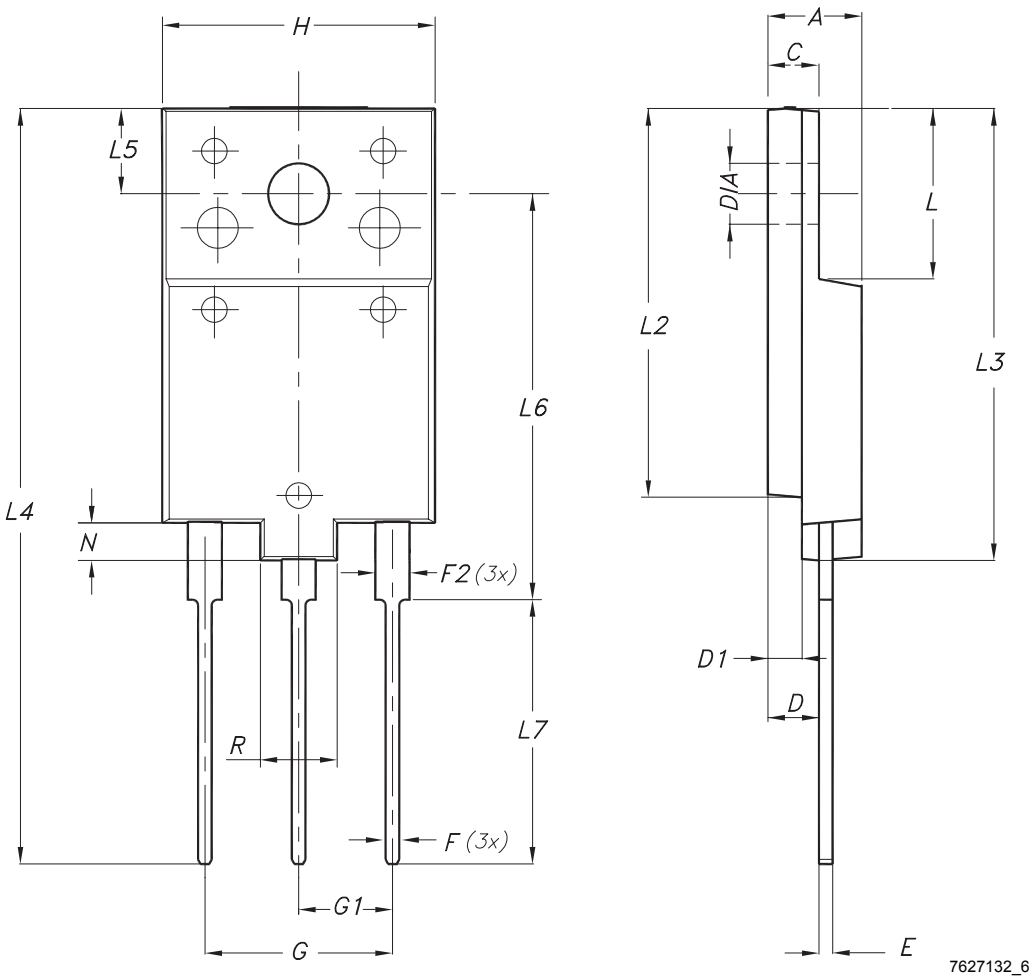


Table 8. **TO-3PF mechanical data**

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**

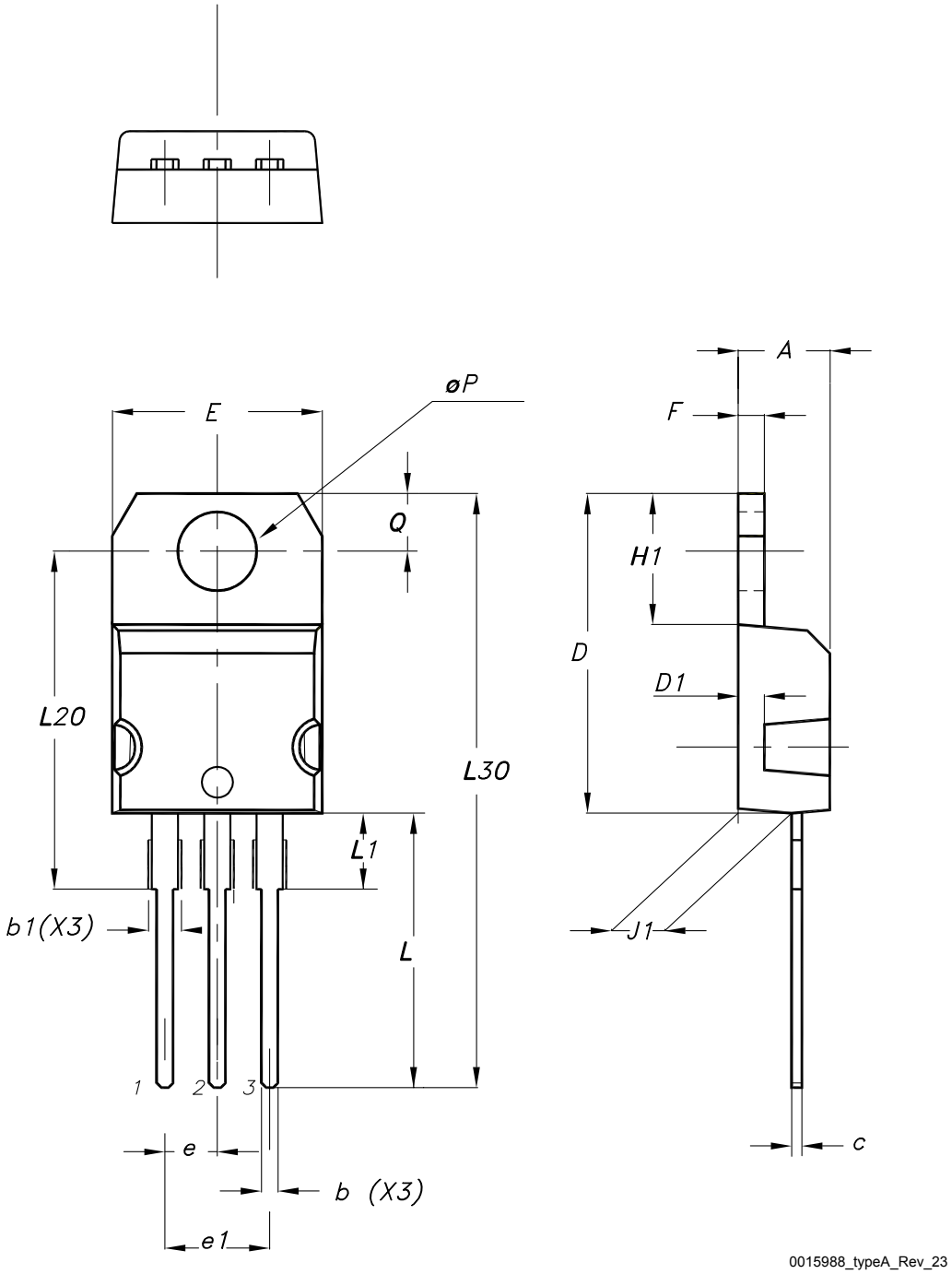


Table 9. **TO-220 type A package mechanical data**

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**

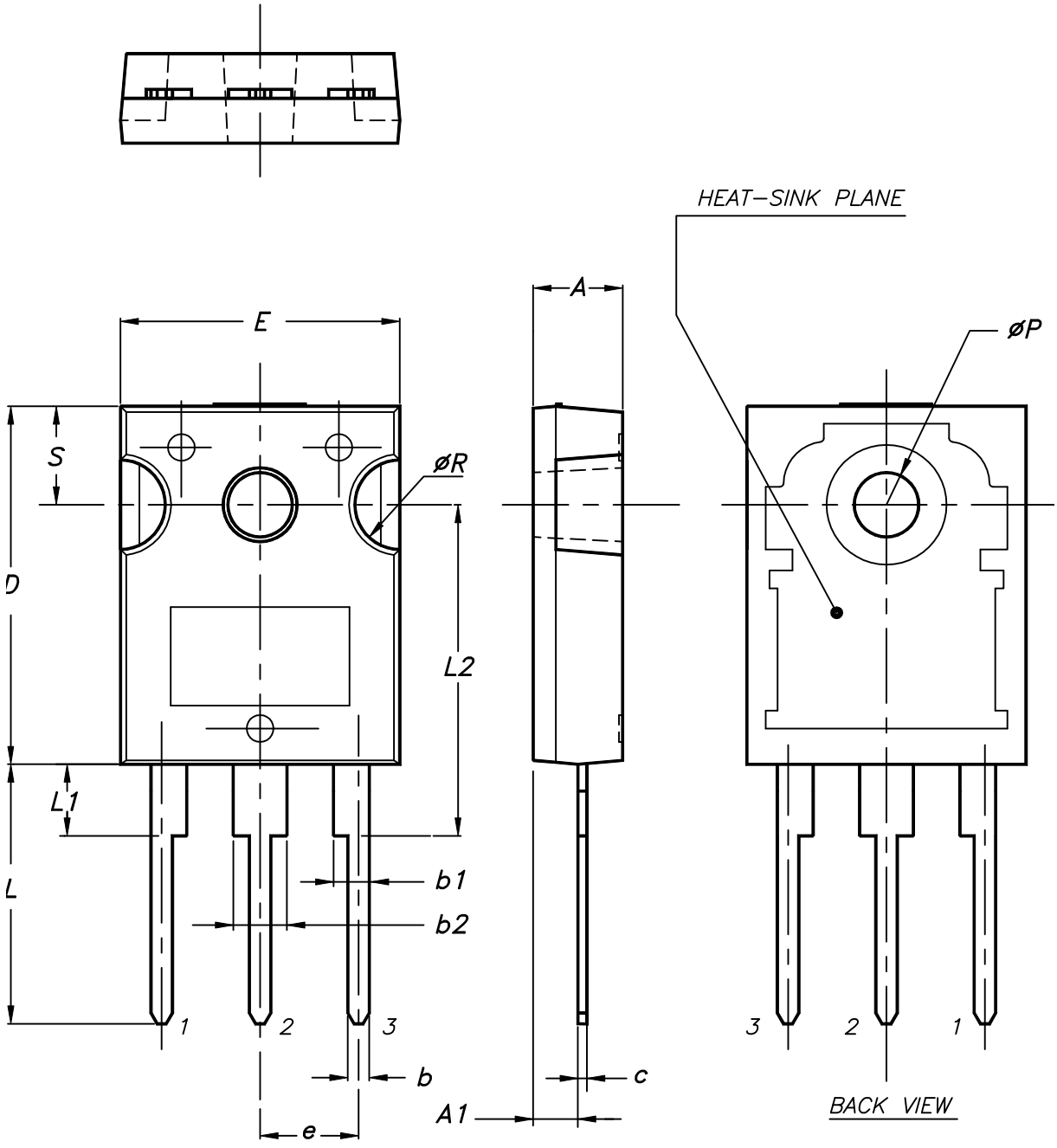


Table 10. **TO-247 package mechanical data**

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

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