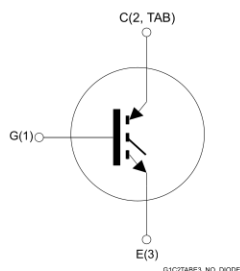
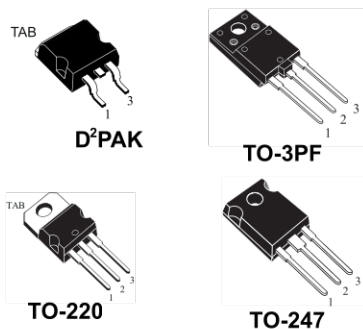


Trench gate field-stop IGBT, V series 600 V, 40 A very high speed



Features

- Maximum junction temperature: $T_J = 175\text{ }^{\circ}\text{C}$
- 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 ² PAK, 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

$T_J = 25\text{ °C}$ 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	μA
I_{GES}	Gate-emitter leakage current	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$			± 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/ μ 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	-	μ J
$E_{off}^{(2)}$	Turn-off switching energy		-	411	-	μ J
E_{ts}	Total switching energy		-	867	-	μ 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	-	ns
t_r	Current rise time		-	21	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1538	-	A/ μ 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	-	μ J
$E_{off}^{(2)}$	Turn-off switching energy		-	560	-	μ J
E_{ts}	Total switching energy		-	1890	-	μ 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 D²PAK, TO-247 and TO-3P

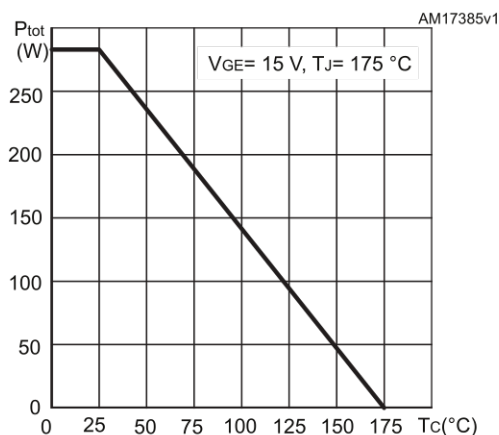


Figure 2. Collector current vs case temperature for D²PAK, TO-247 and TO-3P

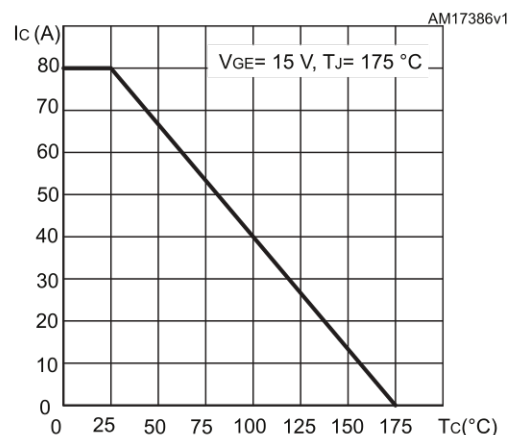


Figure 3. Power dissipation vs case temperature for TO-3PF

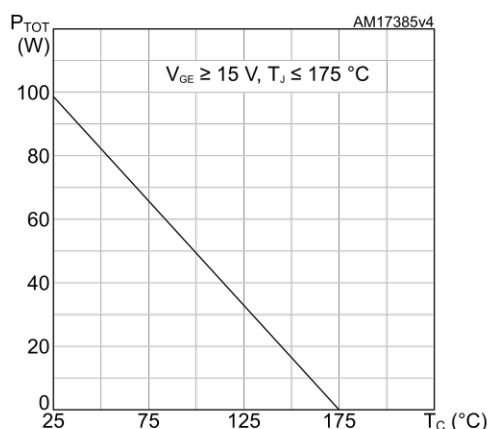


Figure 4. Collector current vs case temperature for TO-3PF

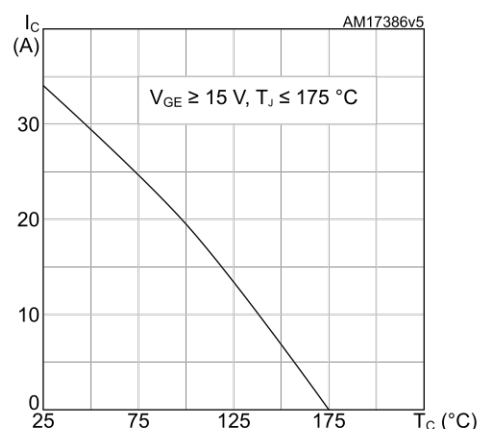


Figure 5. Output characteristics (T_J = 25 °C)

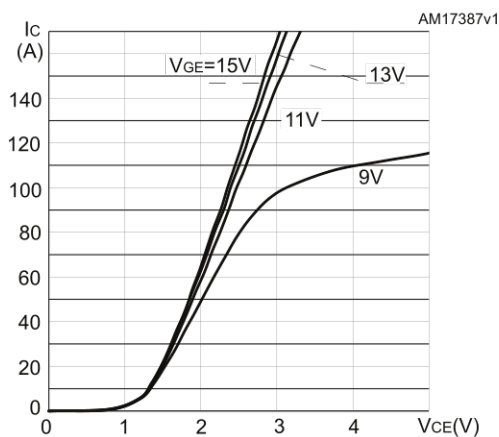


Figure 6. Output characteristics (T_J = 175 °C)

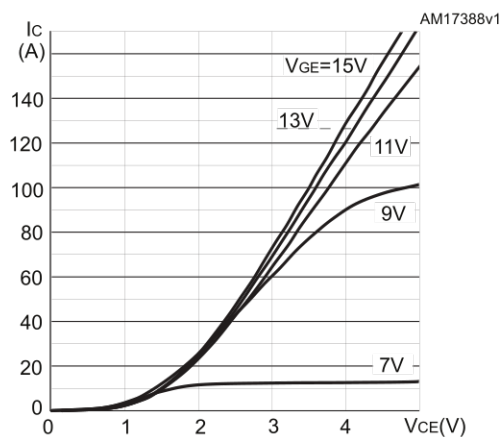


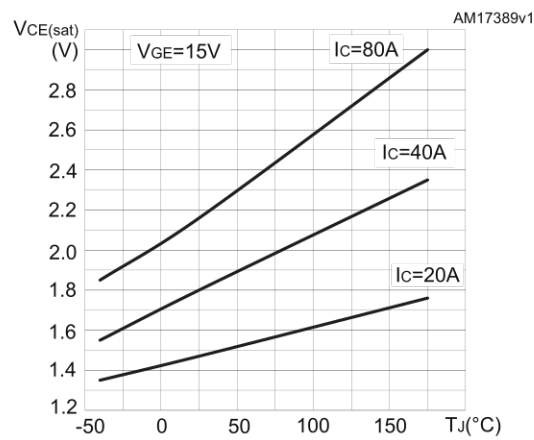
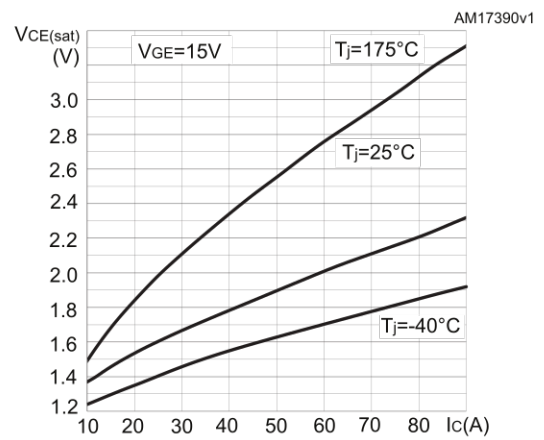
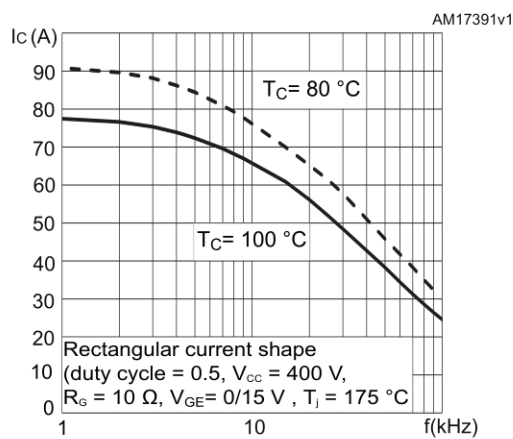
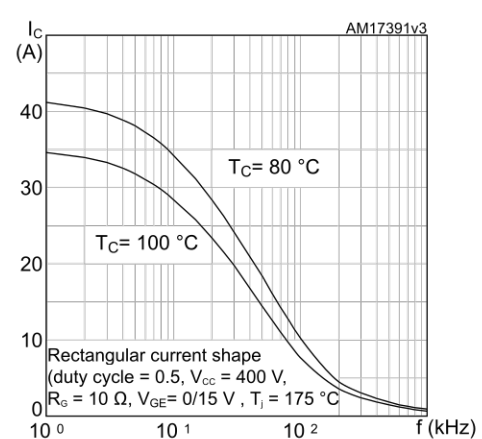
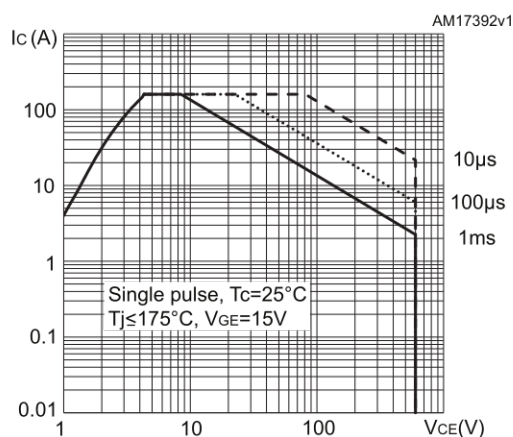
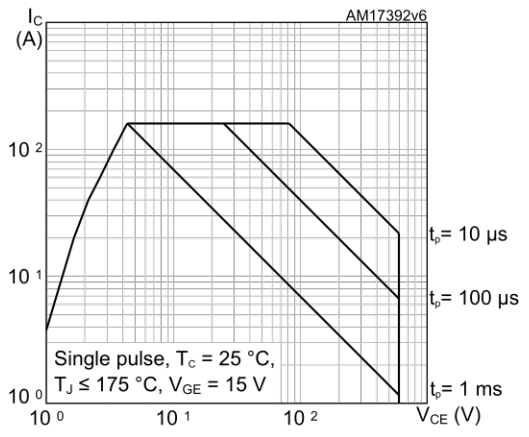
Figure 7. $V_{CE(sat)}$ vs junction temperature

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


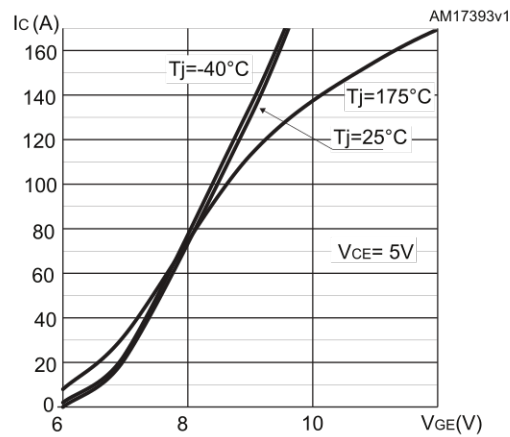
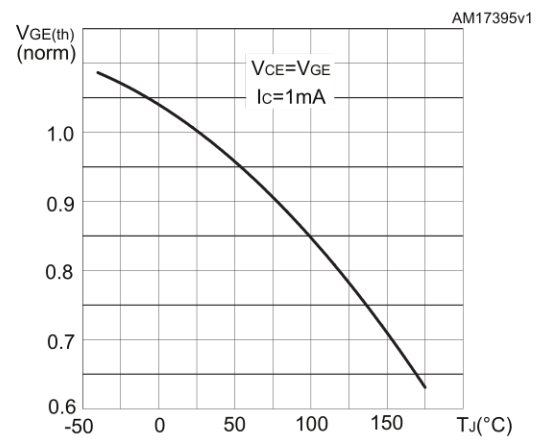
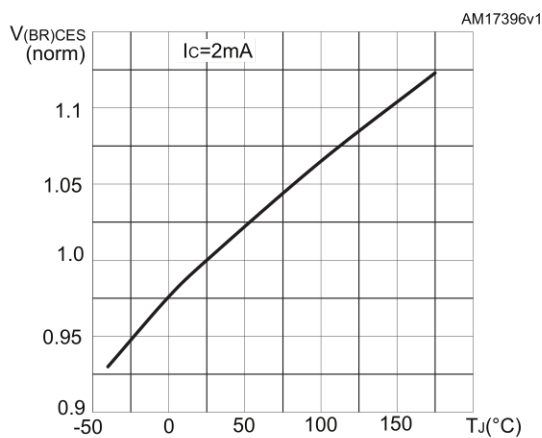
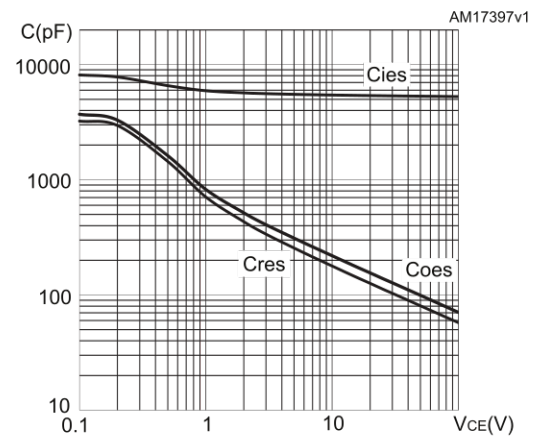
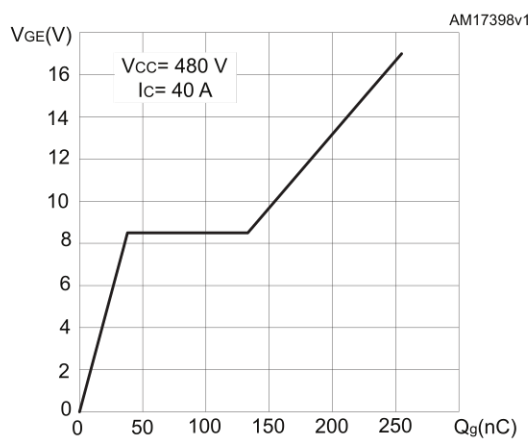
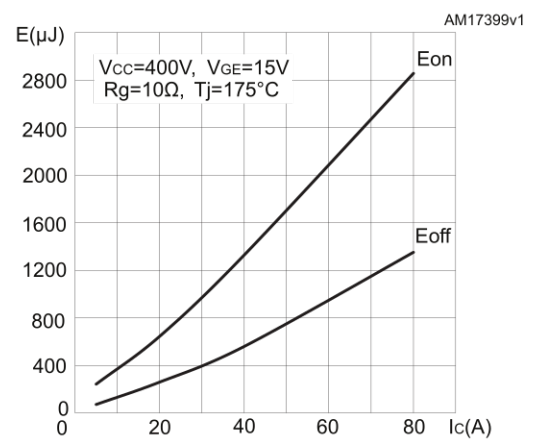
Figure 13. Transfer characteristics

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


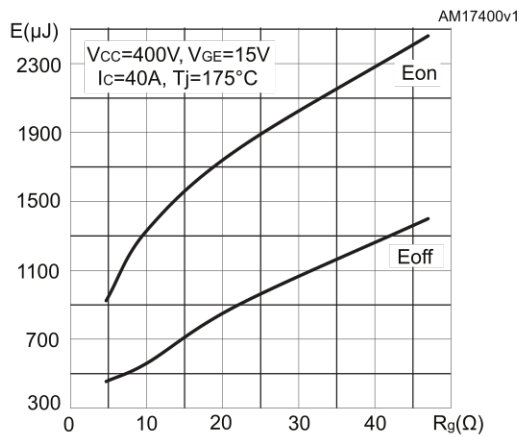
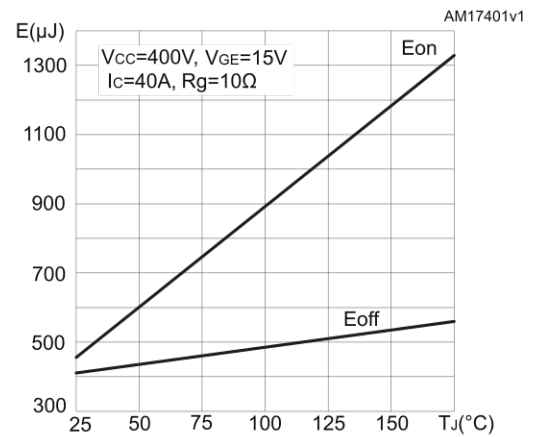
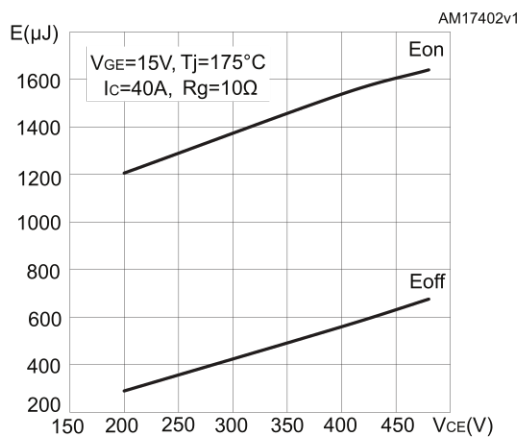
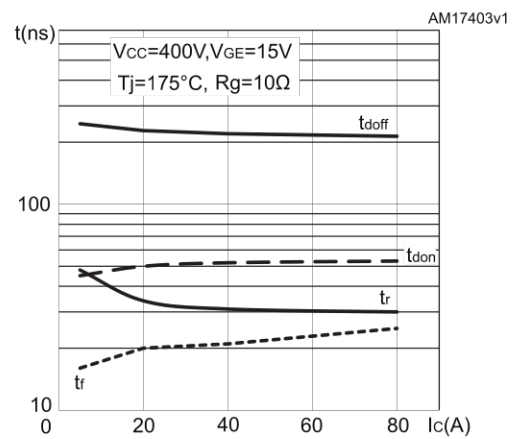
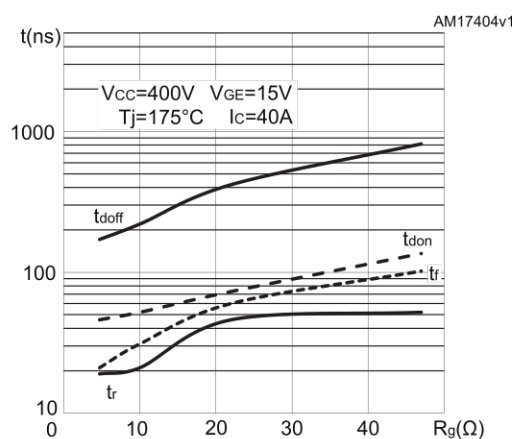
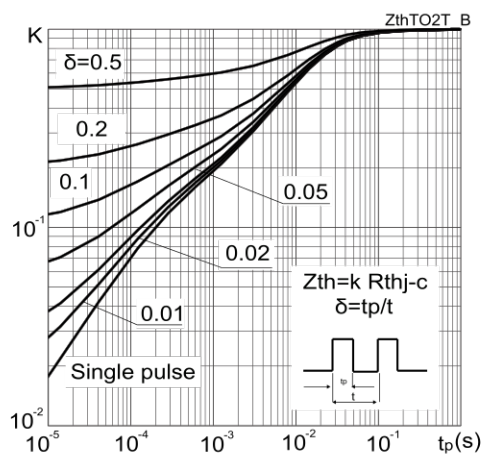
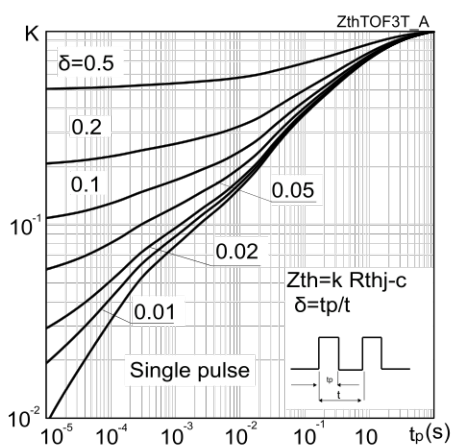
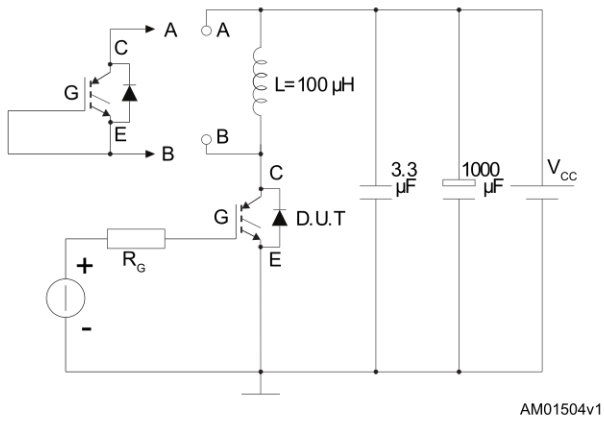
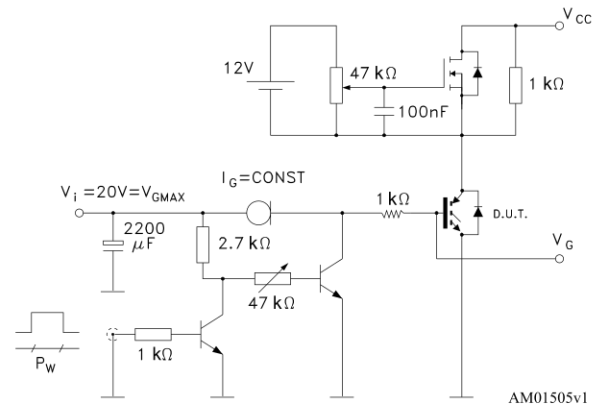
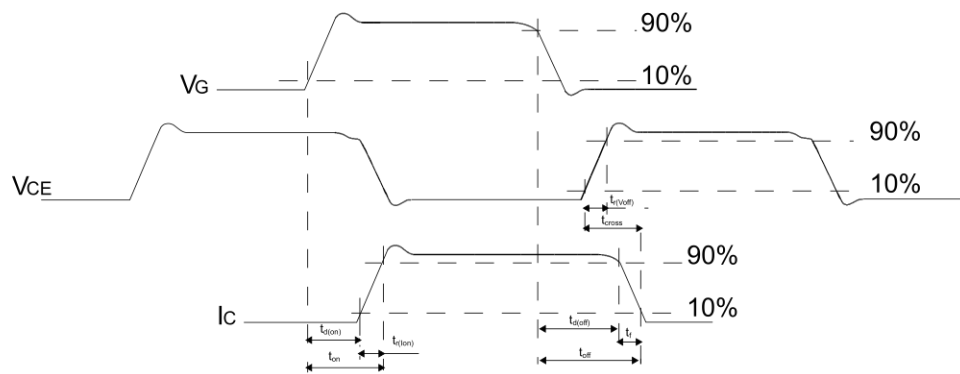
Figure 19. Switching energy vs gate resistance

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


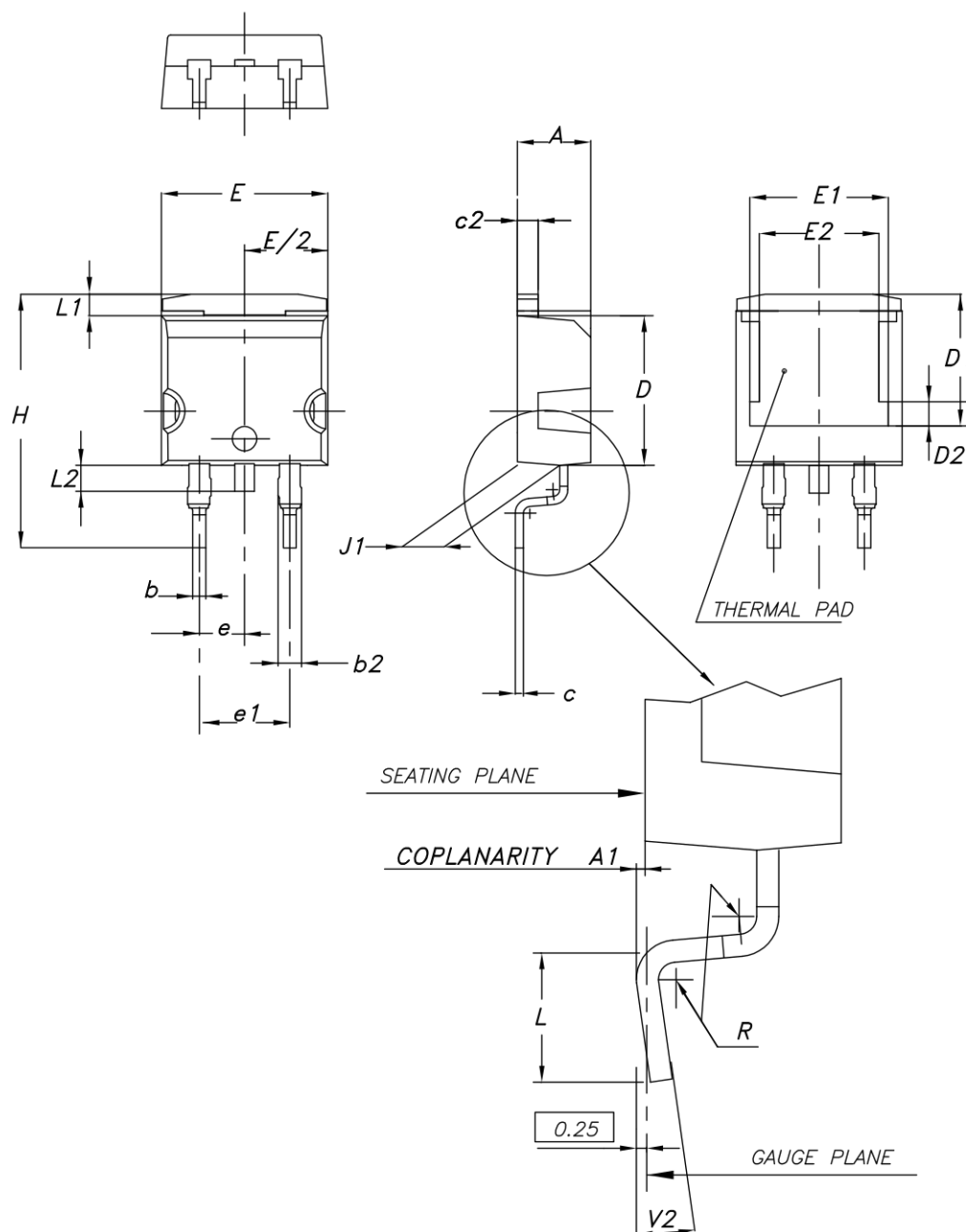
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4 Package information

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

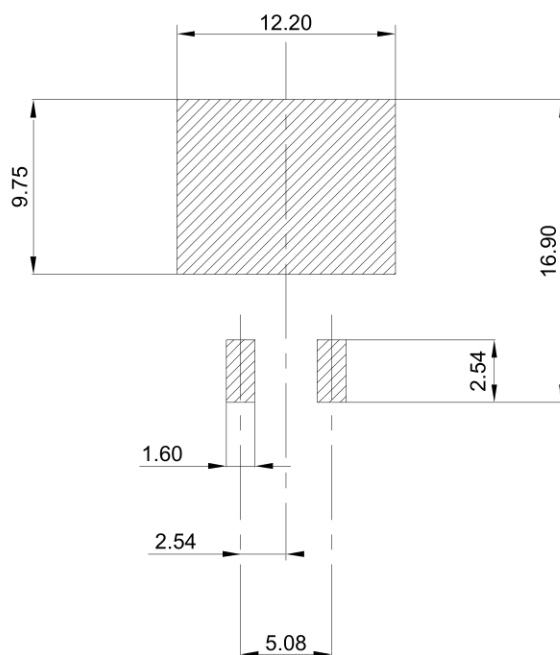


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Table 6. D²PAK (TO-263) type A2 package mechanical data

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

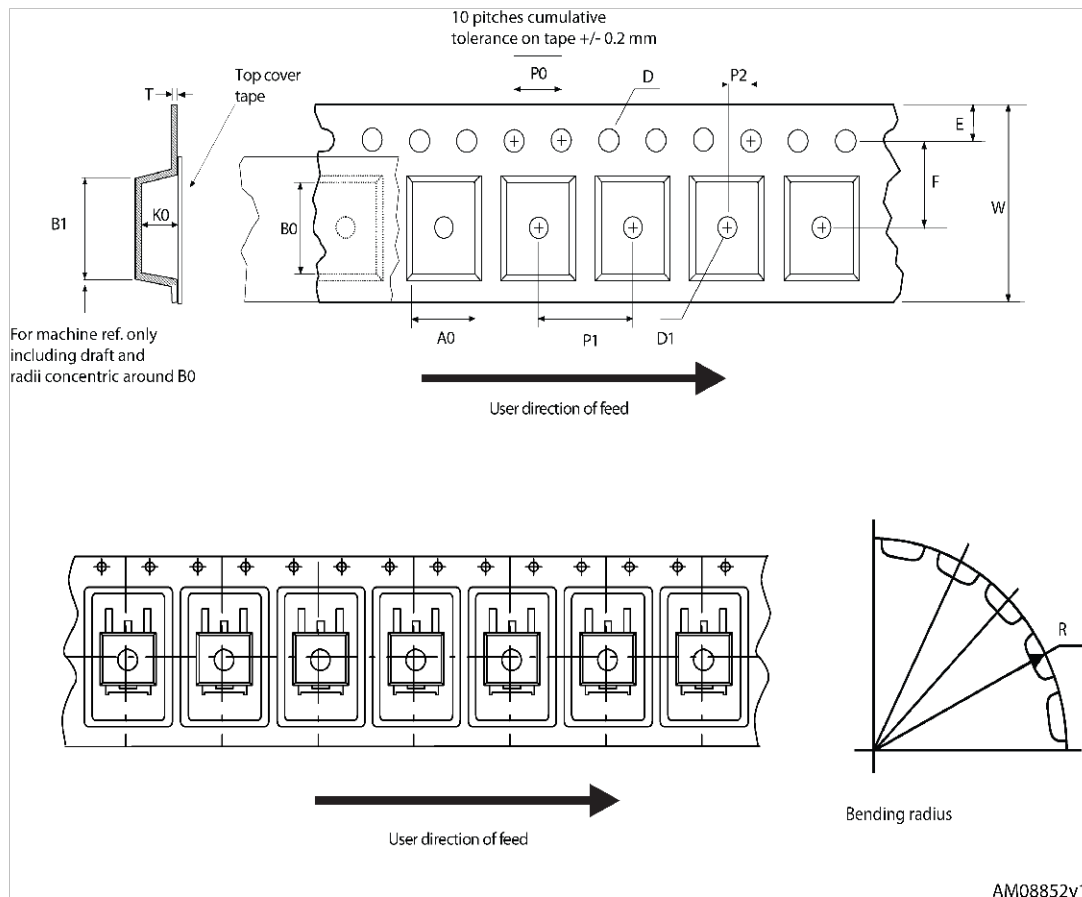
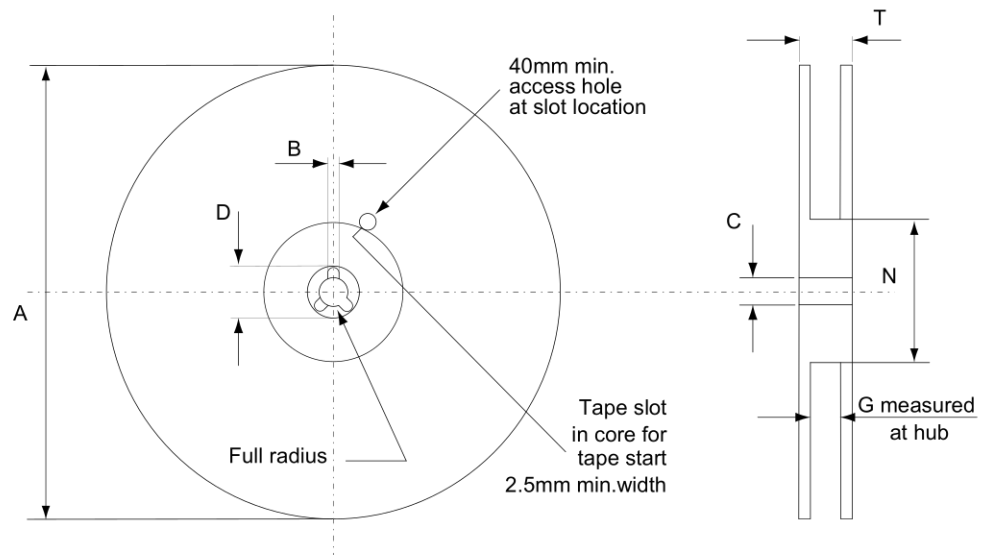


Figure 32. D²PAK reel outline



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

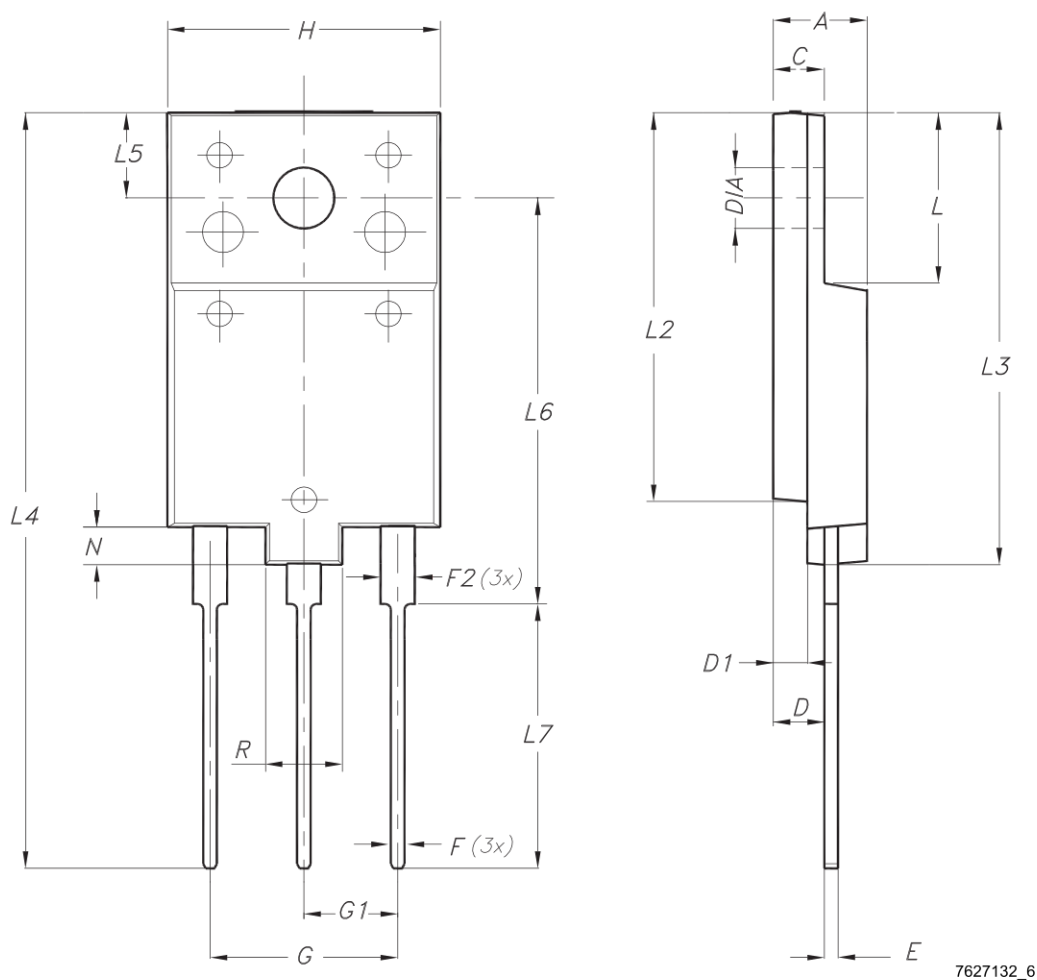
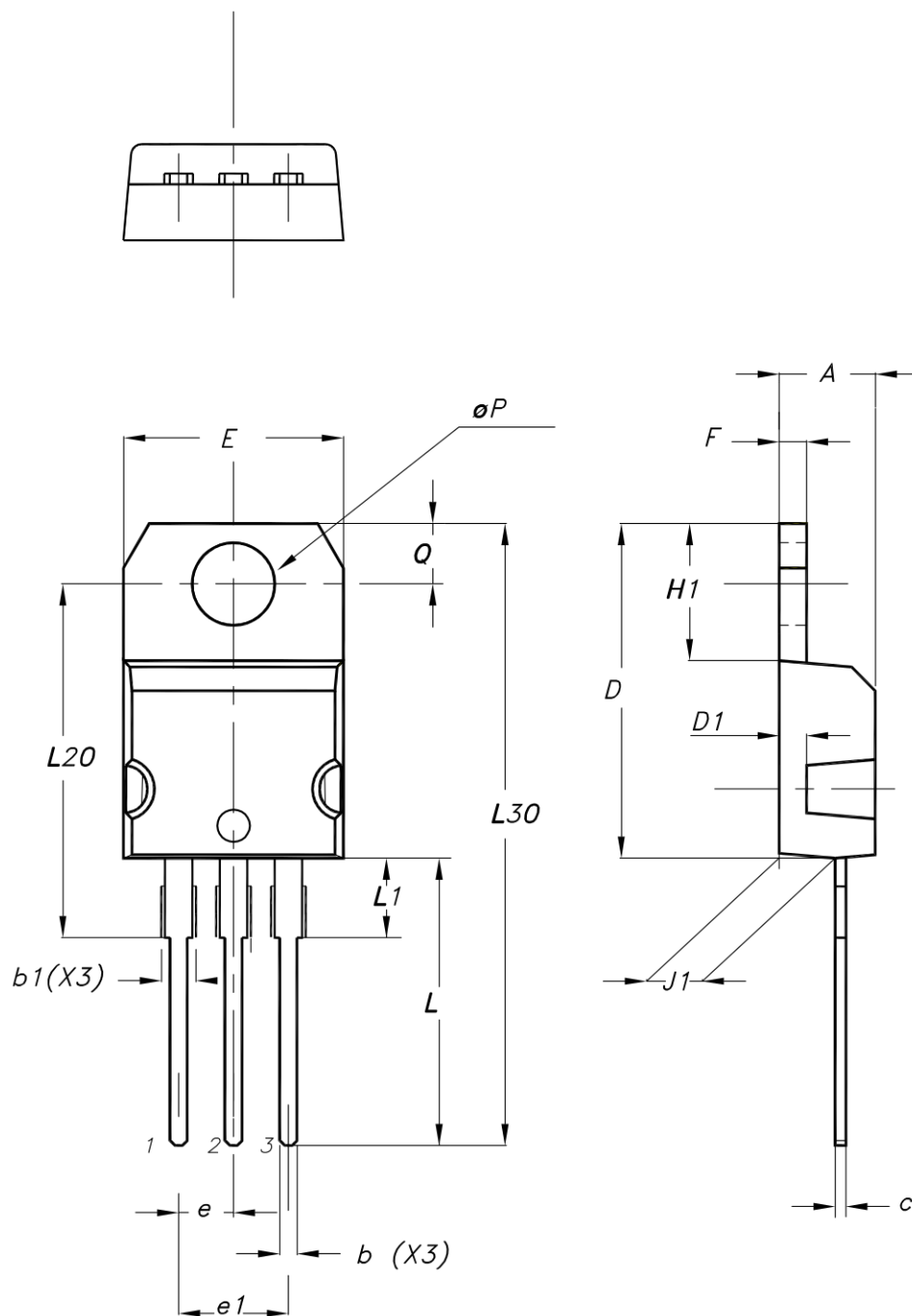


Table 8. TO-3PF mechanical data

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



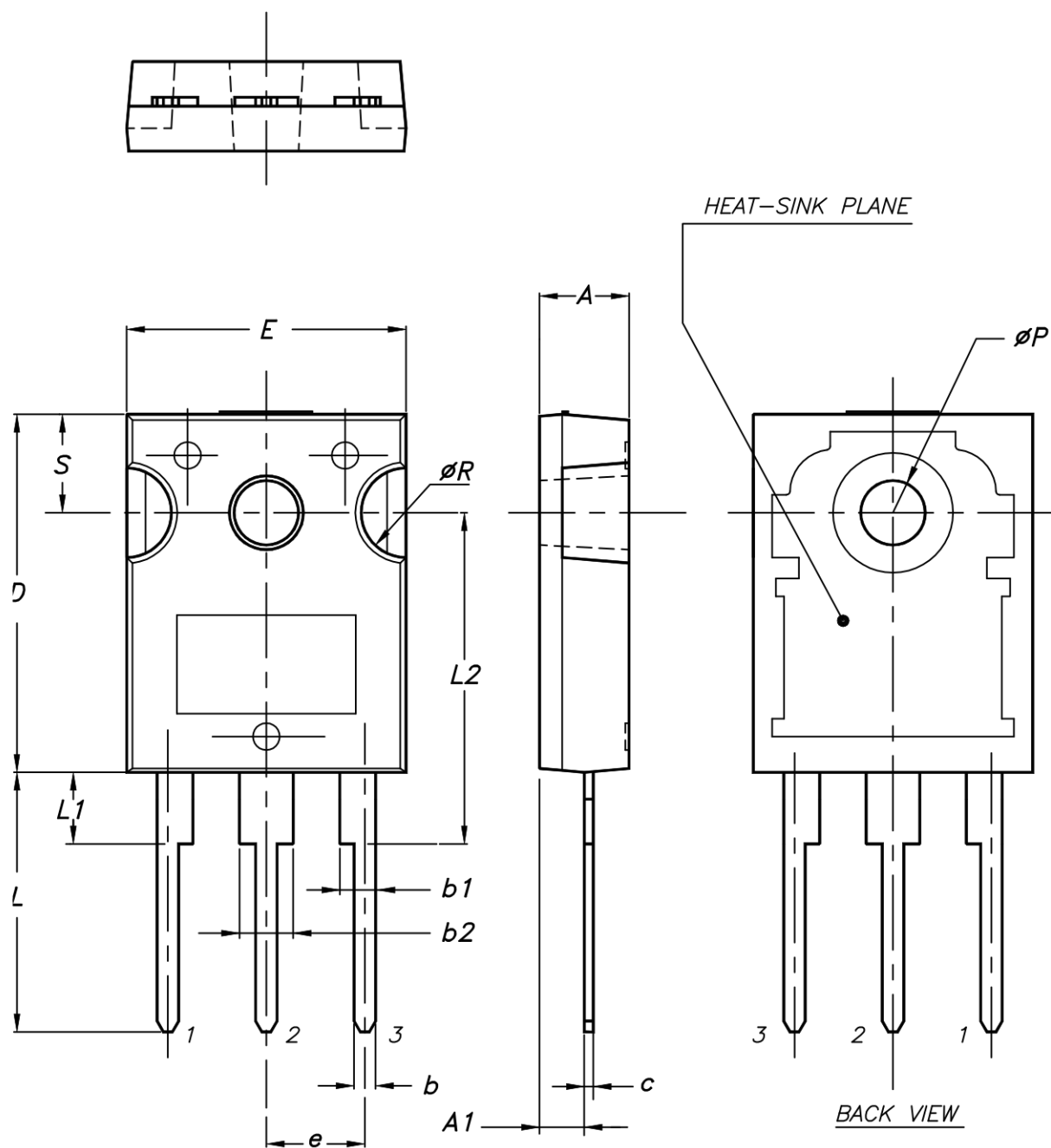
0015988_typeA_Rev_23

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 ² 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	Updated title, features and description in cover page. Added new device in TO-3PF. 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>. 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>. Minor text changes.
04-Mar-2021	3	Modified application section on cover page. Modified <i>Table 1. Absolute maximum ratings</i>, <i>Table 2. Thermal data</i>. 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>.

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