Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	600	V
I_C (1)	Collector current (continuous) at 25 °C	60	A
I_C (1)	Collector current (continuous) at 100 °C	30	A
I_{CL} (2)	Turn-off latching current	100	A
I_{CP} (3)	Pulsed collector current	100	A
V_{GE}	Gate-emitter voltage	± 20	V
P_{TOT}	Total dissipation at T_C = 25 °C	200	W
T_j	Operating junction temperature	– 55 to 150	°C

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C, I_C)}$$

2. Vclamp = 80%(V_{CES}), T_j =150 °C, R_G=10 Ω, V_{GE}=15 V
3. Pulse width limited by max junction temperature allowed

Table 3. Thermal resistance

Symbol	Parameter	Value		Unit
		TO-247	TO-220 D²PAK	
$R_{thj\text{-}case}$	Thermal resistance junction-case max	0.62		°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max	50	62.5	°C/W

2 Electrical characteristics

(T_{CASE}=25°C unless otherwise specified)

Table 4. Static electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage (V_{GE} = 0)	I_C = 1 mA	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE}=15 V, I_C= 20 A V_{GE}=15 V, I_C= 20 A,T_C= 125 °C		1.8 1.7	2.5	V V
$V_{GE(th)}$	Gate threshold voltage	V_{CE}= V_{GE}, I_C= 250 µA	3.75		5.75	V
I_{CES}	Collector-emitter cut-off current (V_{GE} = 0)	V_{CE} = 600 V V_{CE} = 600 V, Tc=125 °C			10 1	µA mA
I_{GES}	Gate-emitter cut-off current (V_{CE} = 0)	V_{GE} = ±20 V			± 100	nA
g_{fs} (1)	Forward transconductance	V_{CE} = 15 V, I_C= 20 A		15		S

1. Pulse duration = 300 µs, duty cycle 1.5%

Table 5. Dynamic electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE}=0	-	2200	-	pF
C_{oes}	Output capacitance		-	225	-	pF
C_{res}	Reverse transfer capacitance		-	50	-	pF
Q_g	Total gate charge	V_{CE} = 390 V, I_C = 20 A, V_{GE} = 15 V, *(see Figure 17)*	-	100	-	nC
Q_{ge}	Gate-emitter charge		-	16	-	nC
Q_{gc}	Gate-collector charge		-	45	-	nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CC} = 390 V, I_C = 20 A R_G= 3.3 Ω, V_{GE}= 15 V, *(see Figure 16)*	-	31	-	ns
t_r	Current rise time		-	11	-	ns
(di/dt)on	Turn-on current slope		-	1600	-	A/µs
$t_{d(on)}$	Turn-on delay time	V_{CC} = 390 V, I_C = 20 A R_G= 3.3 Ω, V_{GE}= 15 V, T_C= 125 °C *(see Figure 16)*	-	31	-	ns
t_r	Current rise time		-	11.5	-	ns
(di/dt)on	Turn-on current slope		-	1500	-	A/µs
$t_{r(Voff)}$	Off voltage rise time	V_{cc} = 390 V, I_C = 20 A, R_G = 3.3 Ω, V_{GE} = 15 V *(see Figure 18)*	-	28	-	ns
$t_{d(off)}$	Turn-off delay time		-	100	-	ns
t_f	Current fall time		-	75	-	ns
$t_{r(Voff)}$	Off voltage rise time	V_{cc} = 390 V, I_C = 20 A, R_G=3.3 Ω, V_{GE} =15 V, T_C=125 °C *(see Figure 18)*	-	66	-	ns
$t_{d(off)}$	Turn-off delay time		-	150	-	ns
t_f	Current fall time		-	130	-	ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on}	Turn-on switching losses	V_{CC} = 390 V, I_C = 20 A R_G= 3.3 Ω, V_{GE}= 15 V, *(see Figure 18)*	-	220	-	µJ
E_{off}(1)	Turn-off switching losses		-	330	-	µJ
E_{ts}	Total switching losses		-	550	-	µJ
E_{on}	Turn-on switching losses	V_{CC} = 390 V, I_C = 20 A R_G= 3.3 Ω, V_{GE}= 15 V, T_C= 125 °C *(see Figure 18)*	-	450	-	µJ
E_{off}(1)	Turn-off switching losses		-	770	-	µJ
E_{ts}	Total switching losses		-	1220	-	µJ

1. Turn-off losses include also the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

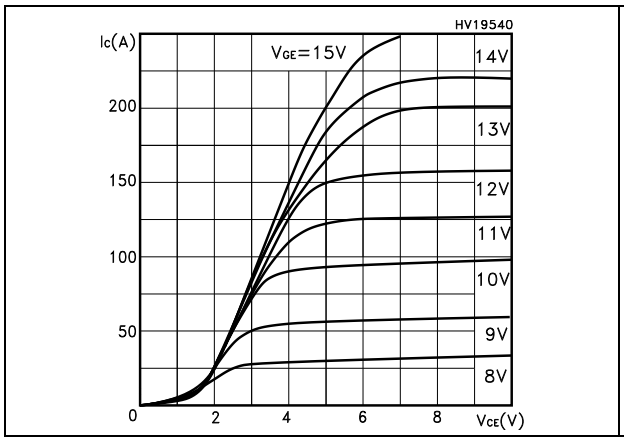


Figure 3. Transfer characteristics

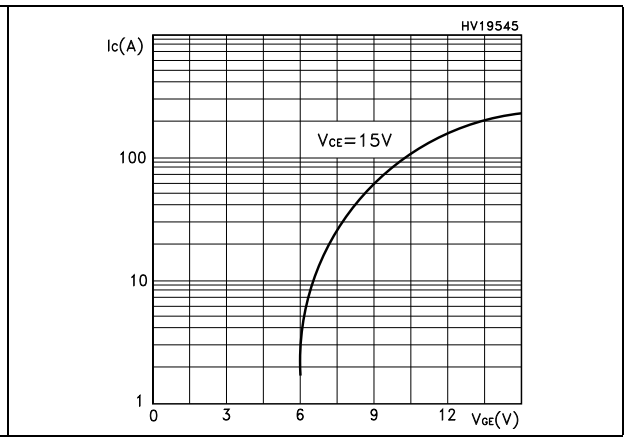


Figure 4. Transconductance

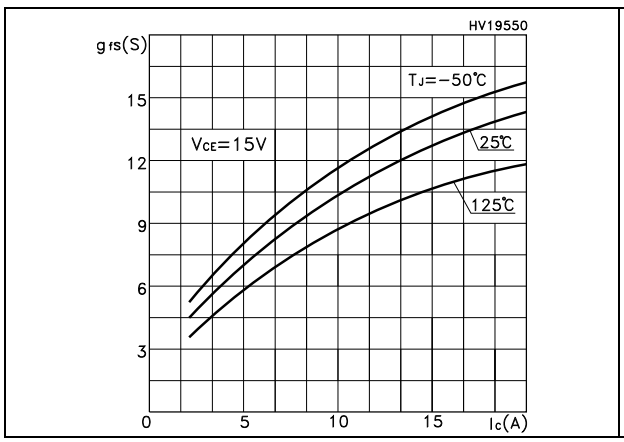


Figure 5. Collector-emitter on voltage vs temperature

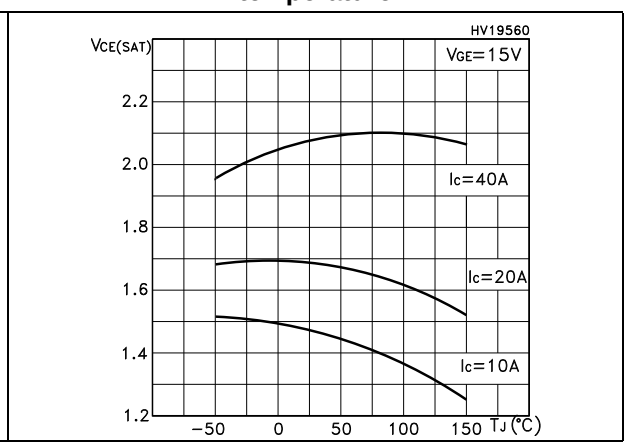


Figure 6. Gate charge vs gate-source voltage

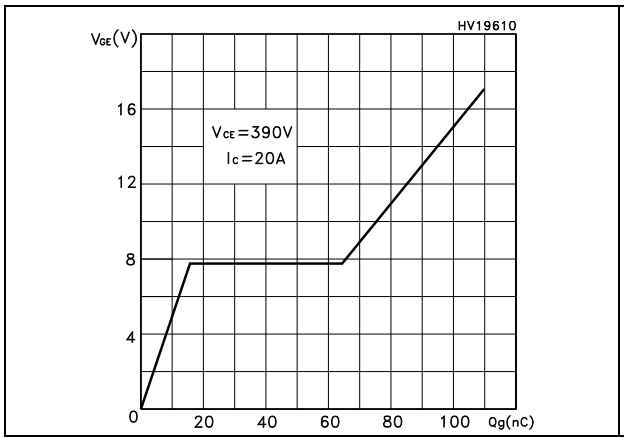


Figure 7. Capacitance variations

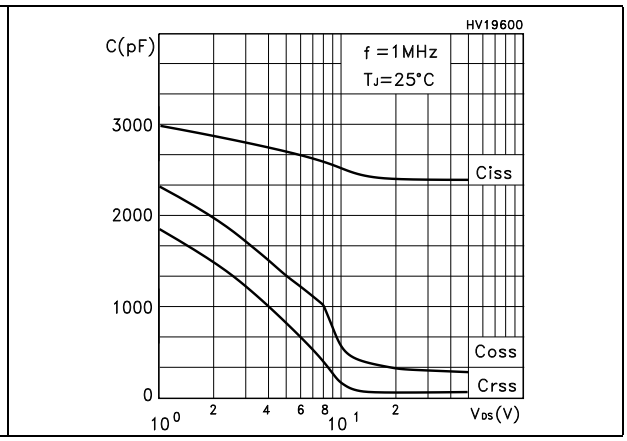


Figure 8. Normalized gate threshold voltage vs temperature

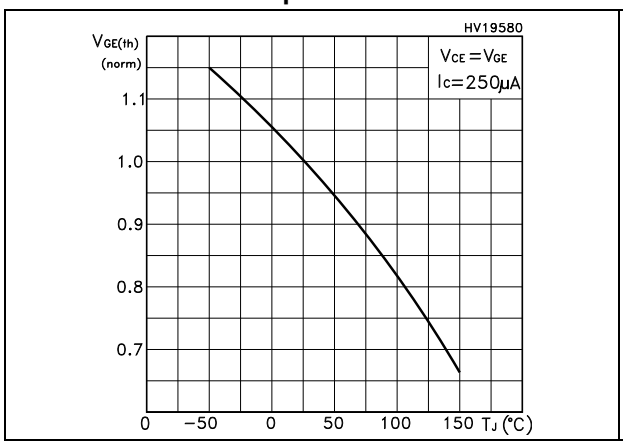


Figure 9. Collector-emitter on voltage vs collector current

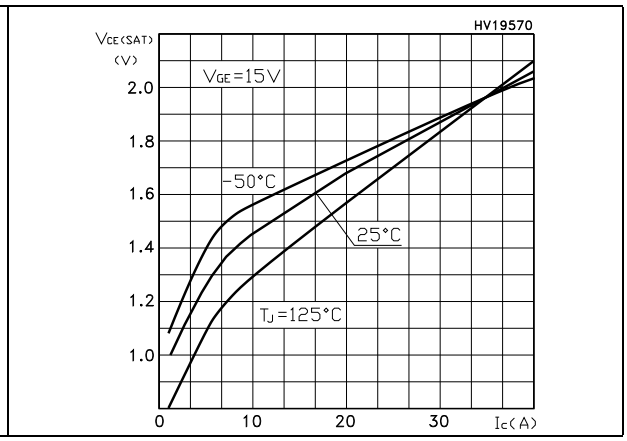


Figure 10. Normalized breakdown voltage vs temperature

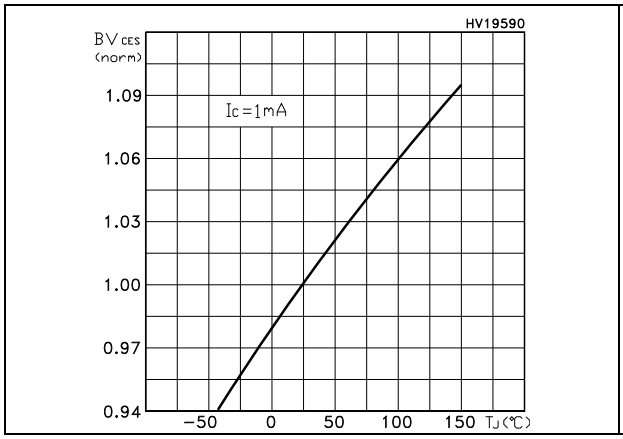


Figure 11. Switching losses vs temperature

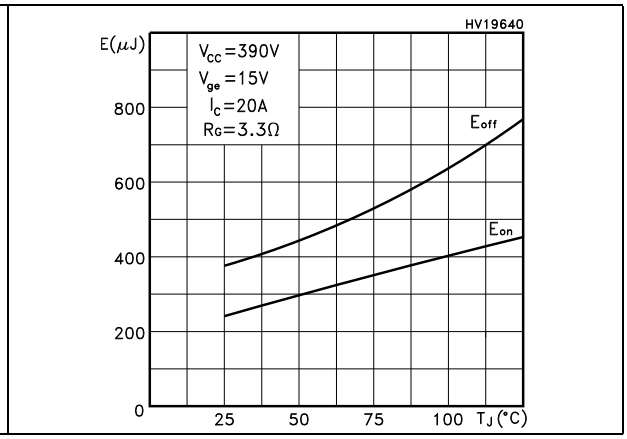


Figure 12. Switching losses vs gate resistance

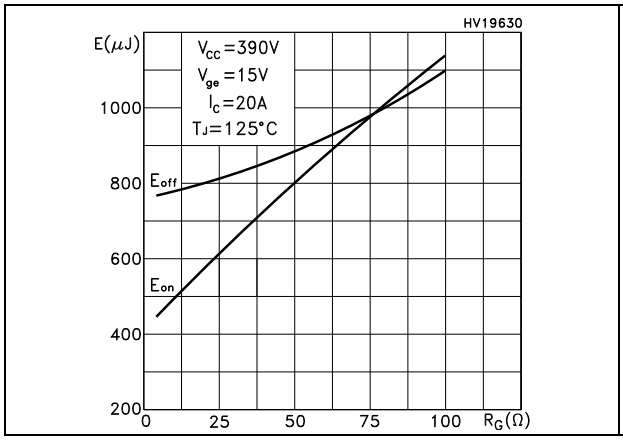


Figure 13. Switching losses vs collector current

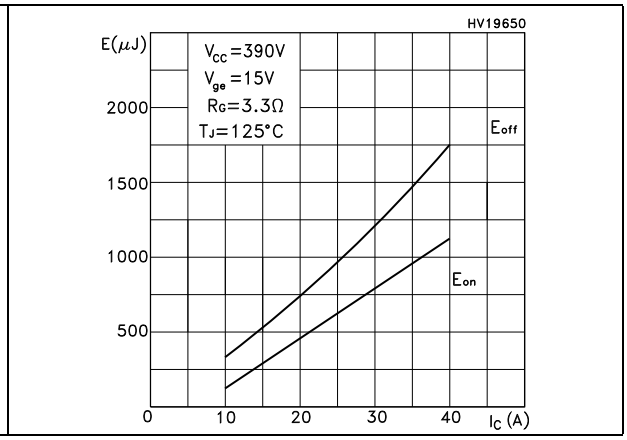


Figure 14. Thermal impedance

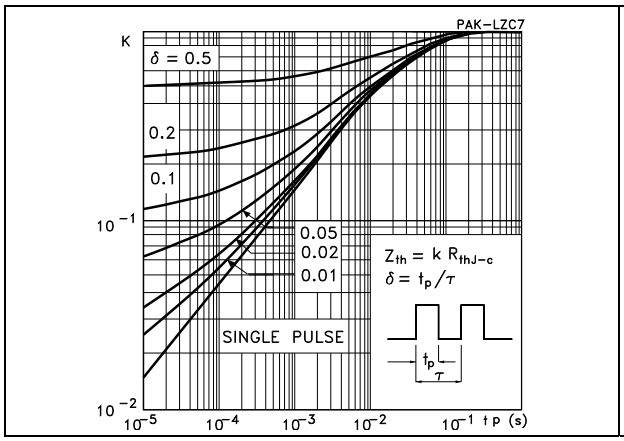
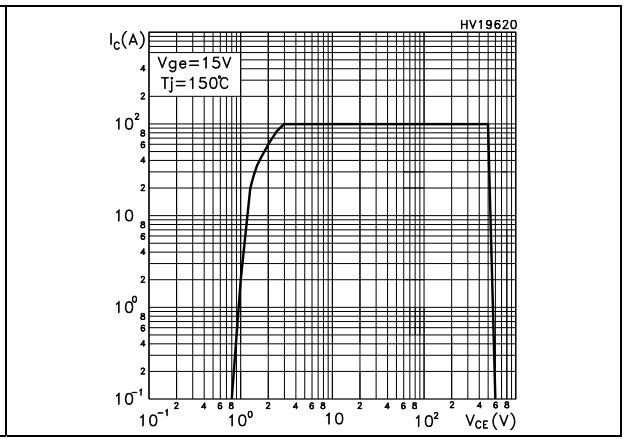


Figure 15. Turn-off SOA



3 Test circuits

Figure 16. Test circuit for inductive load switching

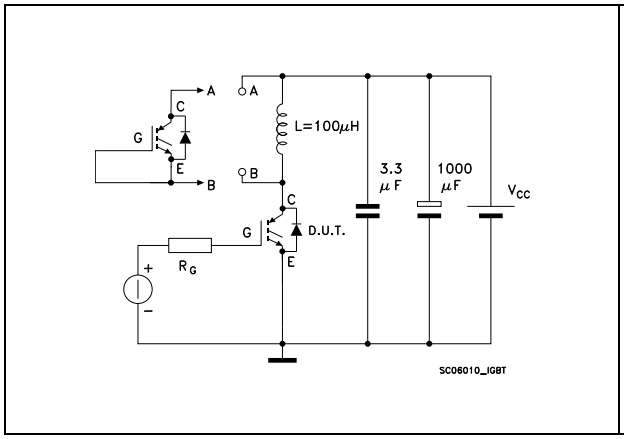


Figure 17. Gate charge test circuit

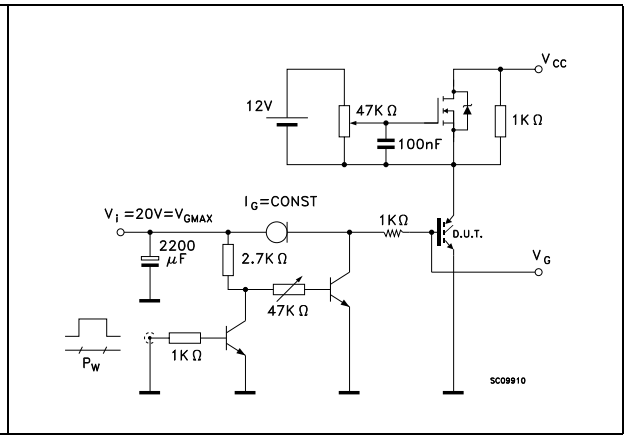
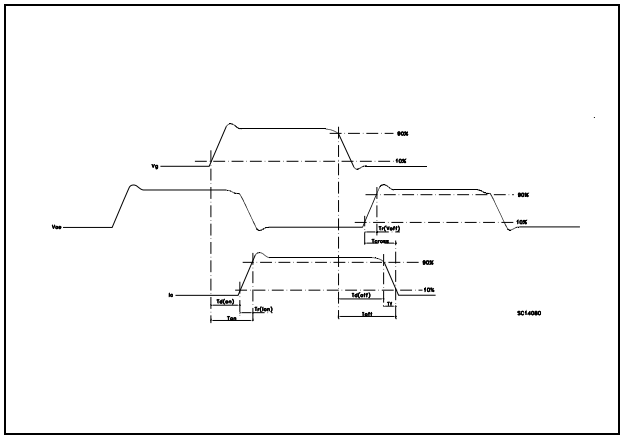


Figure 18. Switching waveform



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 type A package information

Figure 19. D²PAK (TO-263) type A package outline

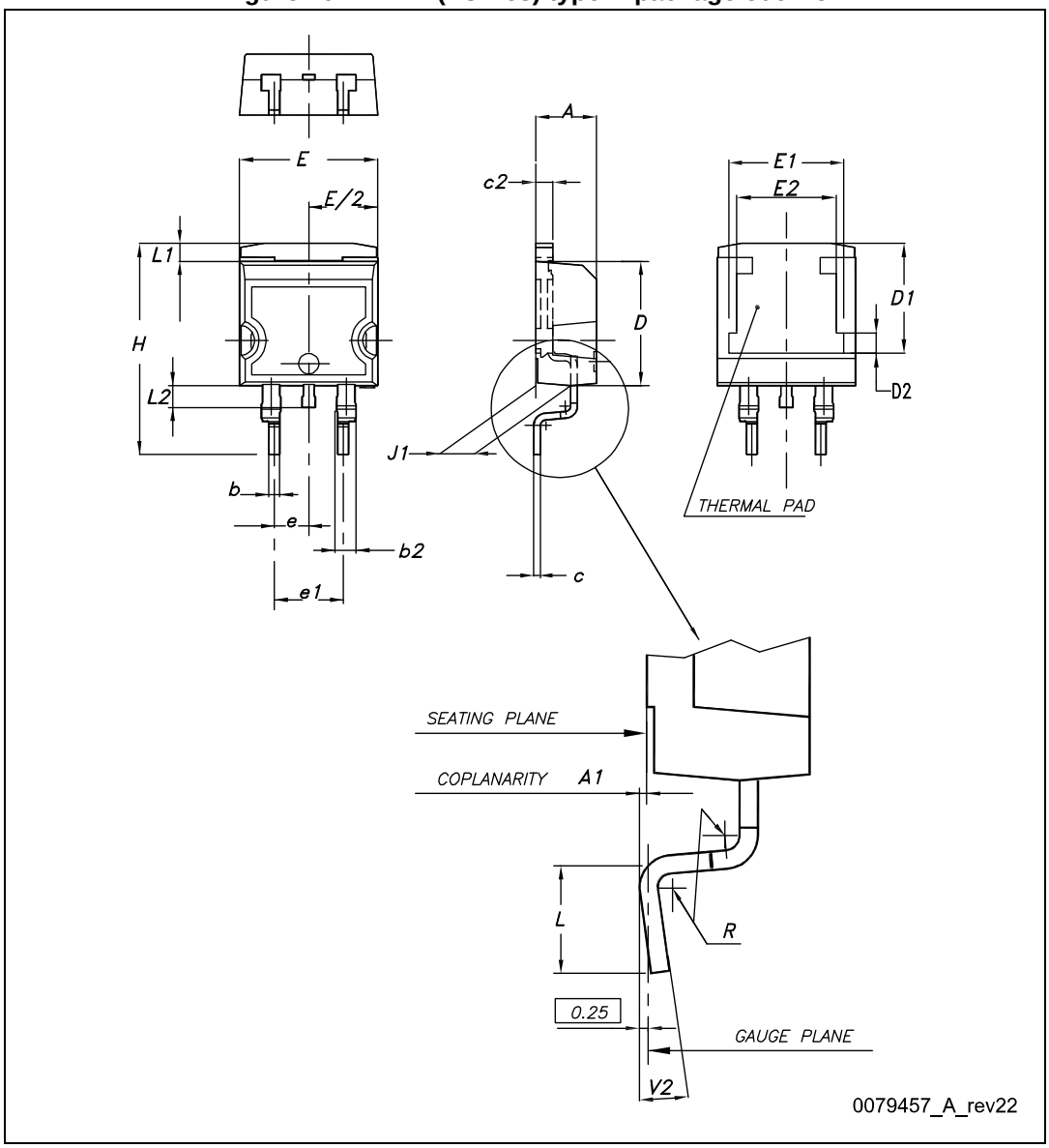
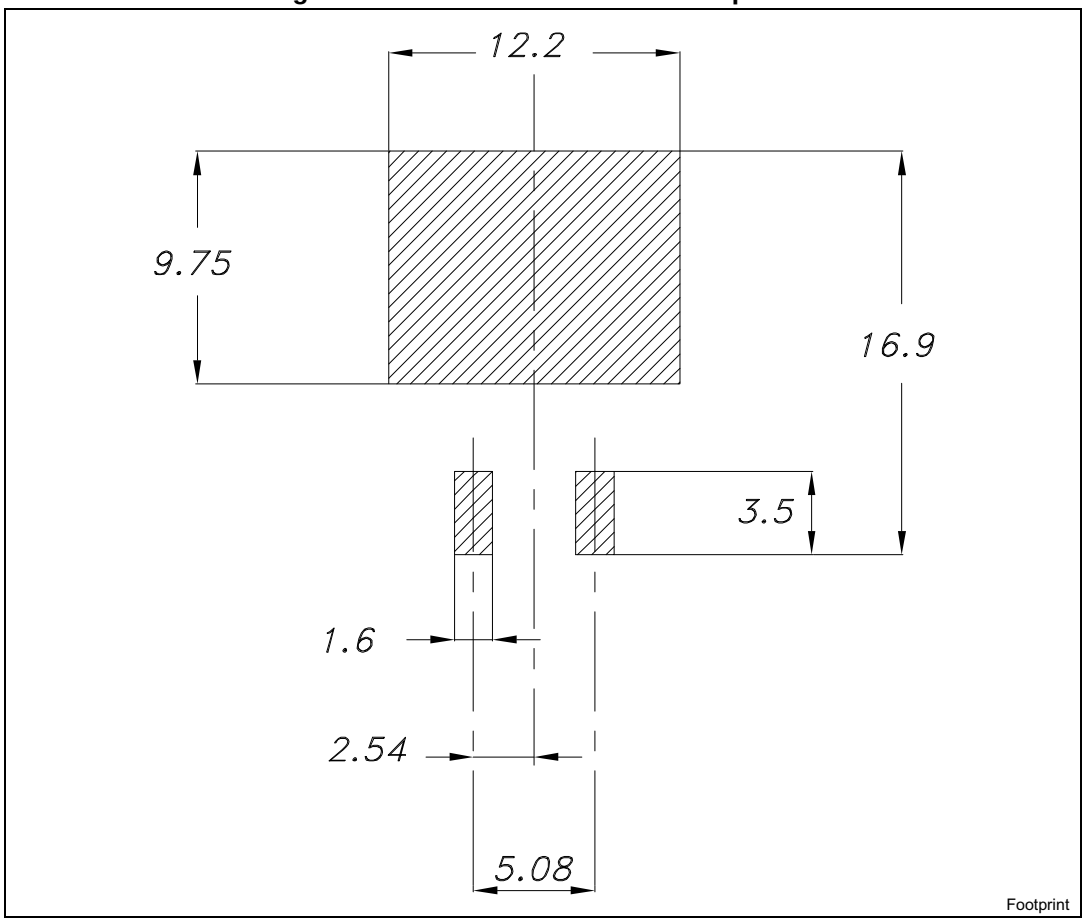


Table 8. D²PAK (TO-263) type A mechanical data

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		10.40
E1	8.50	8.70	8.90
E2	6.85	7.05	7.25
e		2.54	
e1	4.88		5.28
H	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°

Figure 20. D²PAK recommended footprint(a)



a. All dimension are in millimeters

4.2 TO-220 type A package information

Figure 21. TO-220 type A package outline

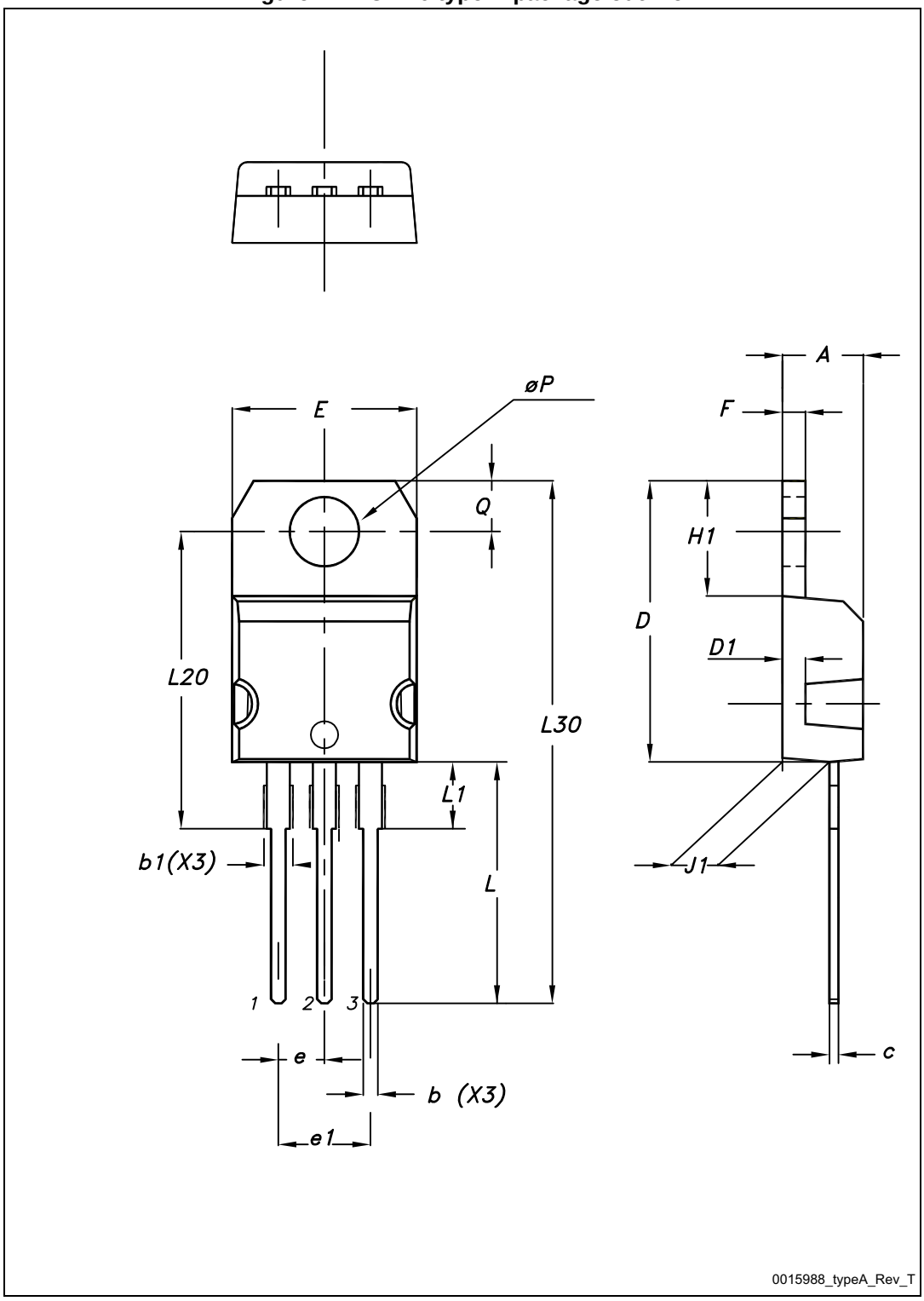


Table 9. TO-220 type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		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		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95

4.3 TO-247 package information

Figure 22. TO-247 package outline

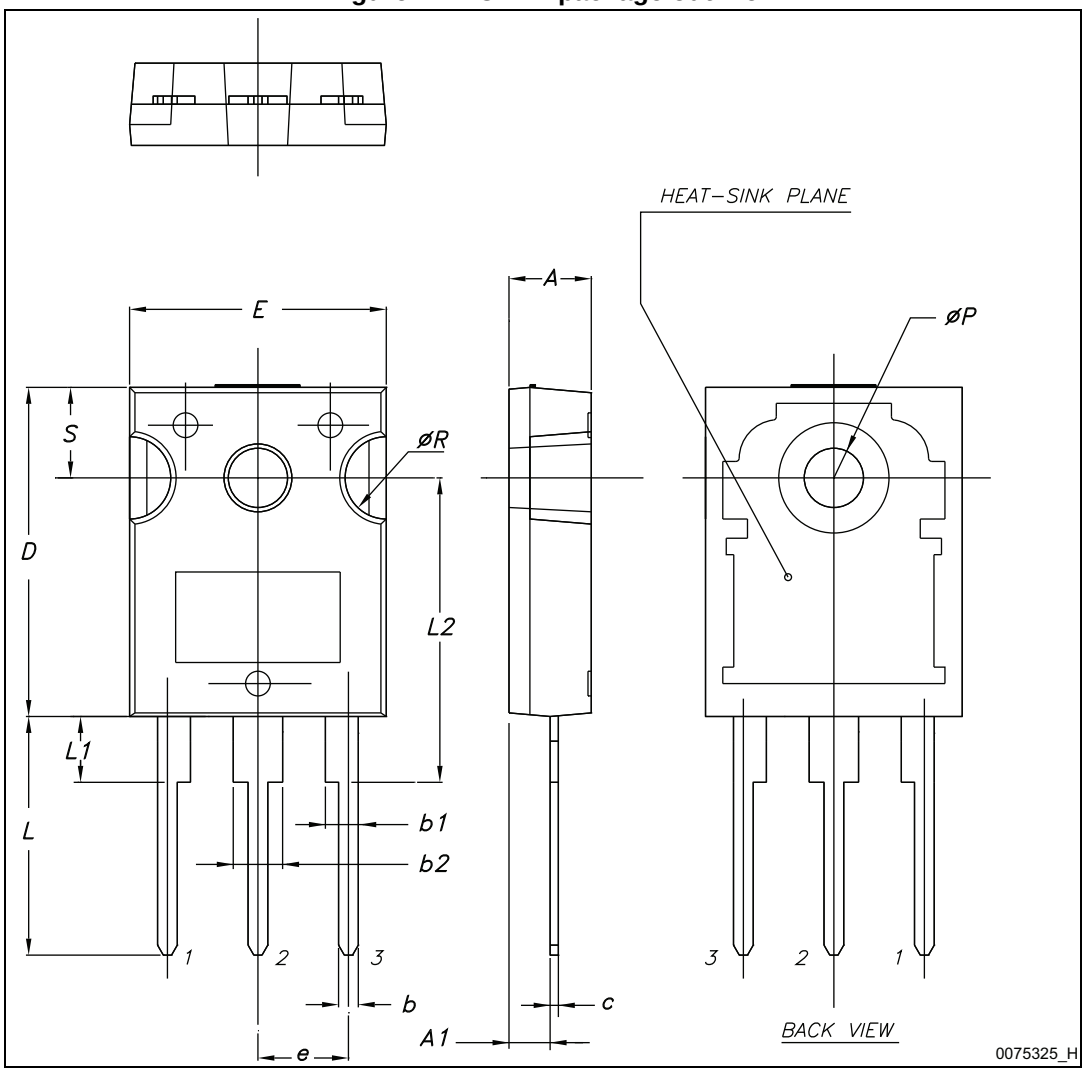


Table 10. TO-247 package mechanical data

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	
∅P	3.55		3.65
∅R	4.50		5.50
S	5.30	5.50	5.70

5 Packing information

Figure 23. Tape

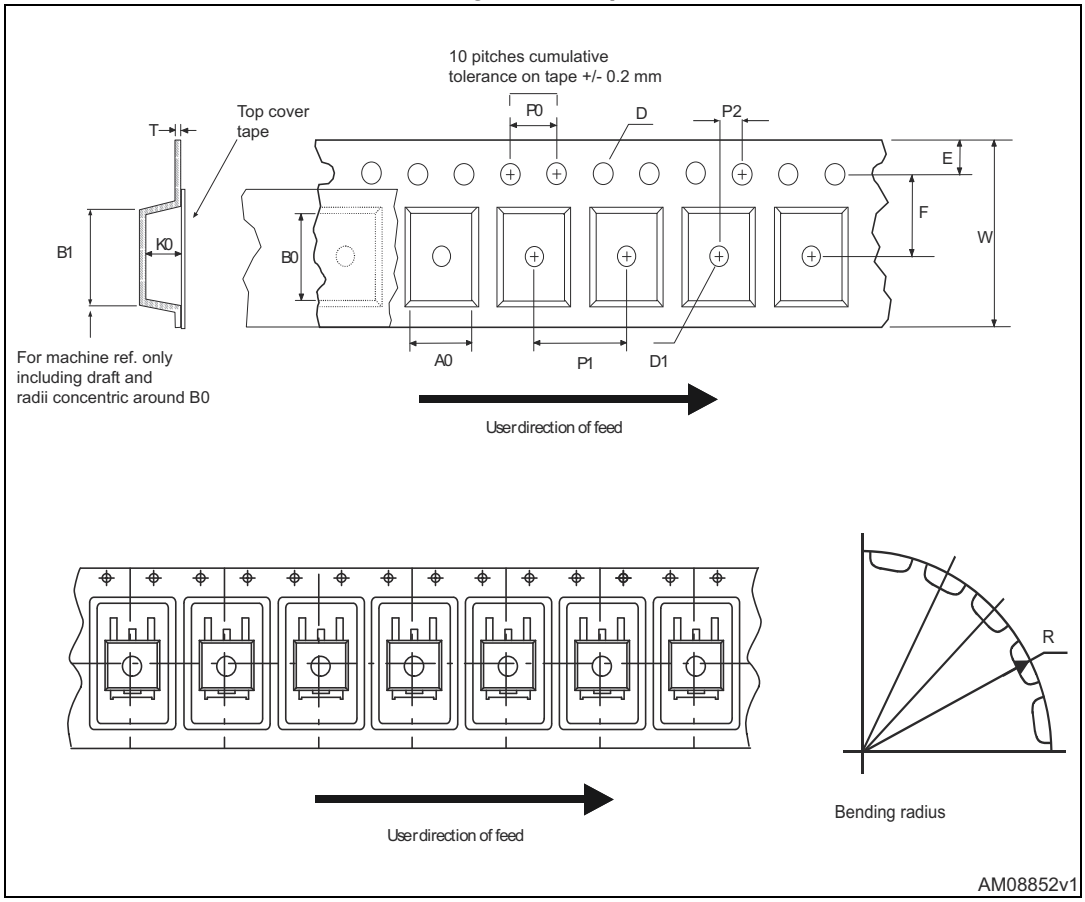


Figure 24. Reel

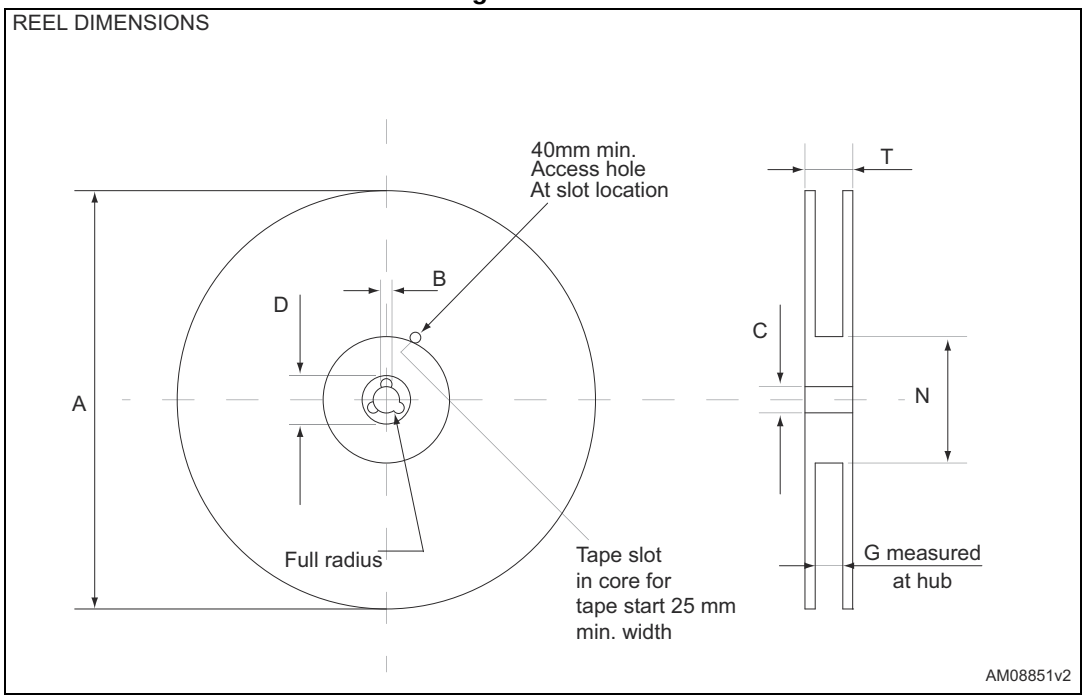


Table 11. D²PAK (TO-263) tape and reel mechanical data

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 qty		1000
P2	1.9	2.1	Bulk qty		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

6 Revision history

Table 12. Document revision history

Date	Revision	Changes
07-Jun-2004	4	Stylesheet update. No content change
14-May-2008	5	Inserted D²PAK
18-Jun-2015	6	Updated *Table 1: Device summary*. Updated *Section 4: Package information* and *Section 5: Packing information*.