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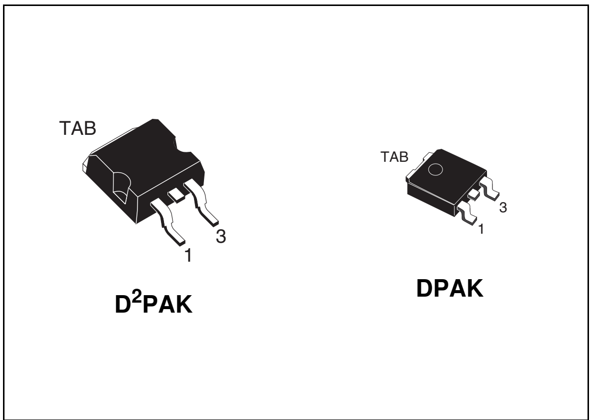
STGB20N40LZ, STGD20N40LZ

Automotive-grade 390 V internally clamped IGBT
E_{SCIS} 300 mJ

Datasheet - production data



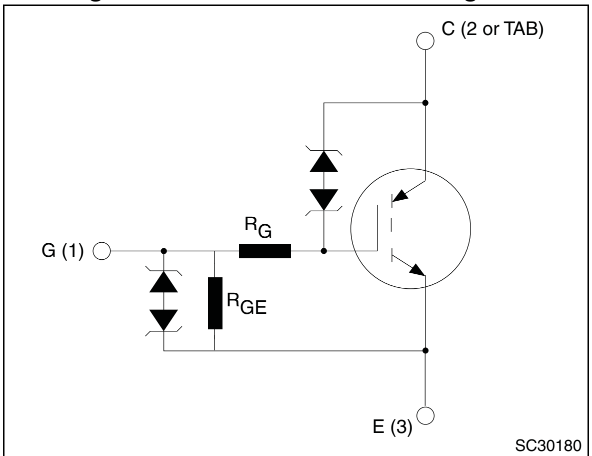
Features

- Designed for automotive applications and AEC-Q101 qualified
- ESD gate-emitter protection
- Gate-collector high voltage clamping
- Logic level gate drive
- Low saturation voltage
- High pulsed current capability
- Gate and gate-emitter resistor

Applications

- Pencil coil electronic ignition driver

Figure 1. Internal schematic diagram



Description

This application-specific IGBT utilizes the most advanced PowerMESH™ technology. The built-in Zener diodes between gate-collector and gate-emitter provide overvoltage protection capabilities. The device also exhibits low on-state voltage drop and low threshold drive for use in automotive ignition systems.

Table 1. Device summary

Order codes	Marking	Packages	Packaging
STGB20N40LZ	GB20N40LZ	D^2PAK	Tape and reel
STGD20N40LZ	GD20N40LZ	DPAK	Tape and reel

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		DPAK	D^2PAK	
V_{CES}	Collector-emitter voltage (v_{GE} = 0)	$V_{CES(clamped)}$		V
V_{ECS}	Emitter collector voltage (V_{GE} = 0)	20		V
I_C	Collector current (continuous) at T_C = 100 °C	25		A
I_{CP} (1)	Pulsed collector current	40		A
V_{GE}	Gate-emitter voltage	$V_{GE(clamped)}$		V
P_{TOT}	Total dissipation at T_C = 25 °C	125	150	W
E_{SCIS}	Single pulse energy T_C = 25 °C, L = 3 mH, V_{CC} = 50 V	300		mJ
E_{SCIS}	Single pulse energy T_C =150 °C, L = 3 mH, V_{CC} = 50 V	180		mJ
ESD	Human body model, R= 1.5 kΩ, C = 100 pF	8		kV
	Machine model, R = 0, C = 100 pF	600		V
	Charged device model	4		kV
T_{stg}	Storage temperature	– 55 to 175		°C
T_j	Operating junction temperature			

1. Pulse width limited by maximum junction temperature.

Table 3. Thermal data

Symbol	Parameter	Value		Unit
		DPAK	D^2PAK	
$R_{thj-case}$	Thermal resistance junction-case	1.2	1	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	100	62.5	°C/W

2 Electrical characteristics

T_J = 25 °C unless otherwise specified.

Table 4. Static electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{CES(clamped)}$	Collector emitter clamped voltage (V_{GE} = 0)	I_C = 2 mA		390		V
		I_C = 2 mA, T_J = - 40 °C to 175 °C	365		425	V
V_{ECS}	Emitter collector break-down voltage (V_{GE} = 0)	I_C = 75 mA		28		V
		I_C = 75 mA T_J = - 40 °C to 175 °C	20			V
$V_{GE(clamped)}$	Gate emitter clamped voltage	I_G = ±2 mA T_J = - 40 °C to 175 °C	12		16	V
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE} = 15 V, T_J = 175 °C			20	µA
		V_{CE} = 200 V, T_J = 175 °C			100	µA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} = ±10 V		625		µA
		V_{GE} = ±10 V T_J = - 40 °C to 175 °C	450		900	µA
R_{GE}	Gate emitter resistance		11	16	22	kΩ
R_G	Gate resistance			100		Ω
$V_{GE(th)}$	Gate threshold voltage	V_{GE} =V_{CE}, I_C = 1 mA	1.5	1.95	2.5	V
		V_{GE} =V_{CE}, I_C = 1 mA, T_J = 175 °C	0.85	1.3	1.7	V
$V_{CE(sat)}$	Collector emitter saturation voltage	V_{GE} = 4.5 V, I_C = 10 A, T_J = 175 °C		1.5	1.8	V
		V_{GE} = 4 V, I_C = 6 A,		1.30	1.6	V
g_{fe}	Forward transconductance	V_{CE} = 25 V, I_C = 10 A		10.3		S

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	-	910	-	pF
C_{oes}	Output capacitance		-	70	-	pF
C_{res}	Reverse transfer capacitance		-	10	-	pF
Q_g	Gate charge	V_{CE} = 280 V, I_C = 10 A, V_{GE} = 5 V	-	24	-	nC

Table 6. Switching on/off

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r	Resistive load Turn-on delay time Rise time	V_{CC} = 14 V, Rg= 1kΩ, R_L = 1 Ω, V_{GE} = 5 V	-	0.7 4	-	µs µs
$t_{d(on)}$ t_r	Resistive load Turn-on delay time Rise time	V_{CC} = 14 V, Rg= 1kΩ, R_L = 1 Ω, V_{GE} = 5 V, T_J = 150 °C	-	0.7 4.5	-	µs µs
$t_{d(off)}$ t_f dv/dt	Inductive load Turn-off delay time Fall time Turn-off voltage slope	V_{CC} = 300 V, L = 1 mH I_C = 10 A, V_{GE} = 5 V, Rg= 1kΩ,	-	4.3 1.5 165	-	µs µs V/µs
$t_{d(off)}$ t_f dv/dt	Inductive load Turn-off delay time Fall time Turn-off voltage slope	V_{CC} = 300 V, L = 1 mH I_C = 10 A, V_{GE} = 5 V, Rg= 1kΩ, T_J = 150 °C	-	4.7 3.5 115	-	µs µs V/µs

2.1 Electrical characteristics (curves)

Figure 2. Collector-emitter on voltage vs temperature (V_{ge}= 4.5 V)

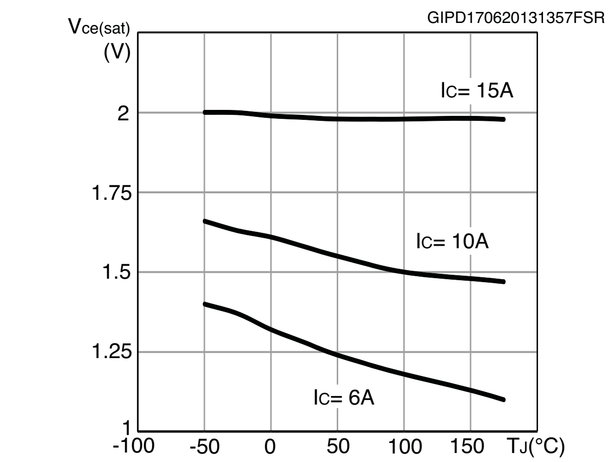


Figure 3. Collector-emitter on voltage vs temperature (I_C= 6 A)

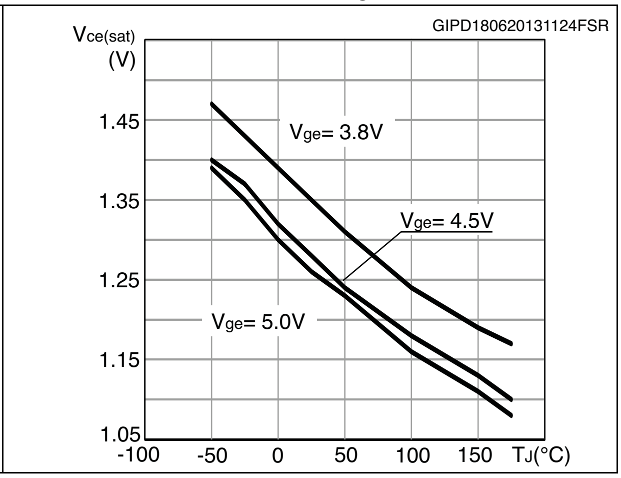


Figure 4. Collector-emitter on voltage vs temperature (I_C= 10 A)

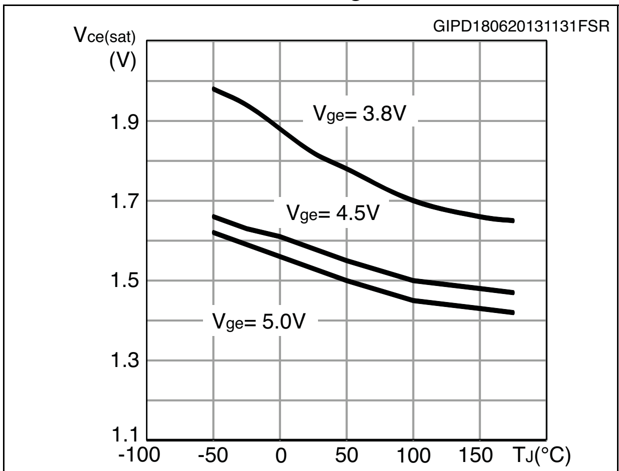


Figure 5. Self clamped inductive switch

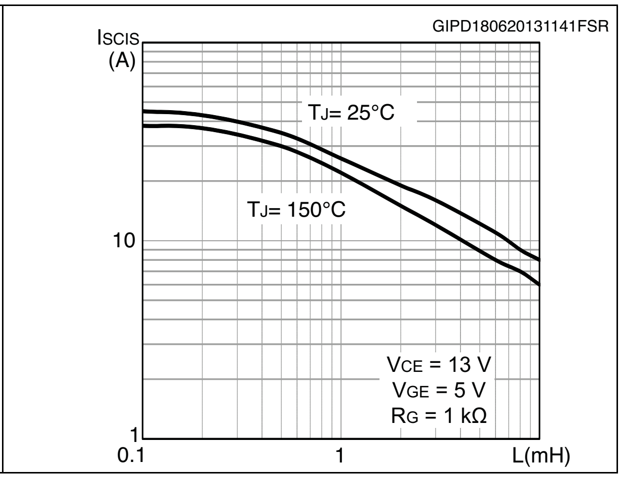


Figure 6. Output characteristics (T_J= 25 °C)

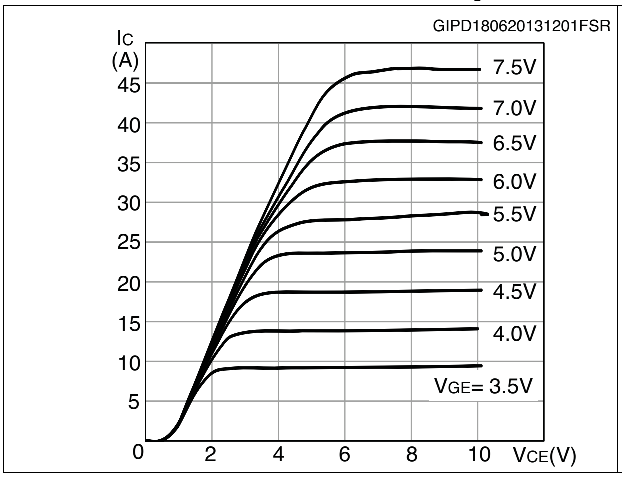


Figure 7. Output characteristics (T_J= -40 °C)

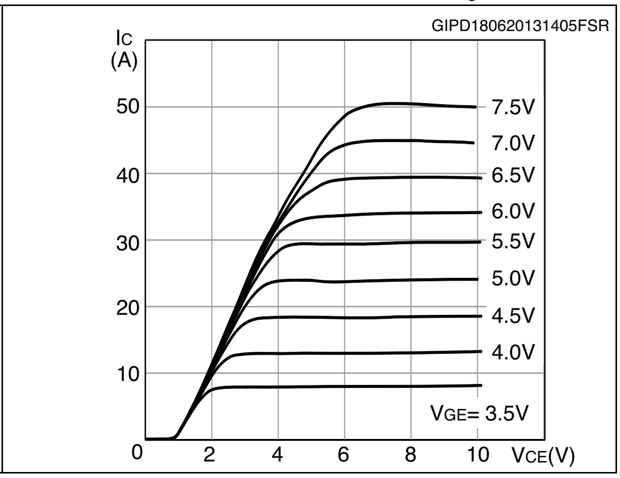


Figure 8. Output characteristics (T_J= 175 °C)

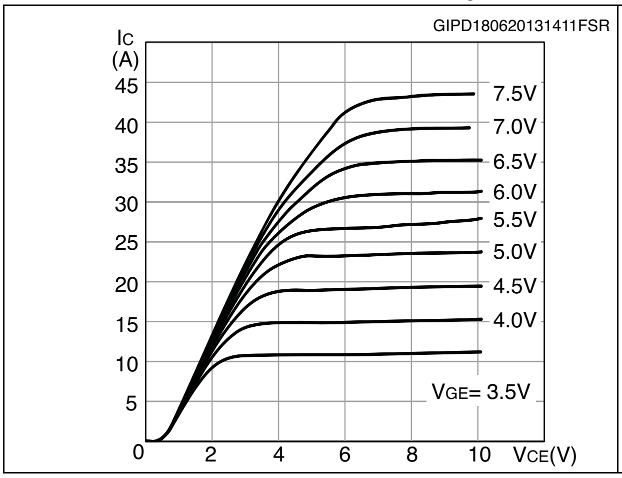


Figure 9. Transfer characteristics

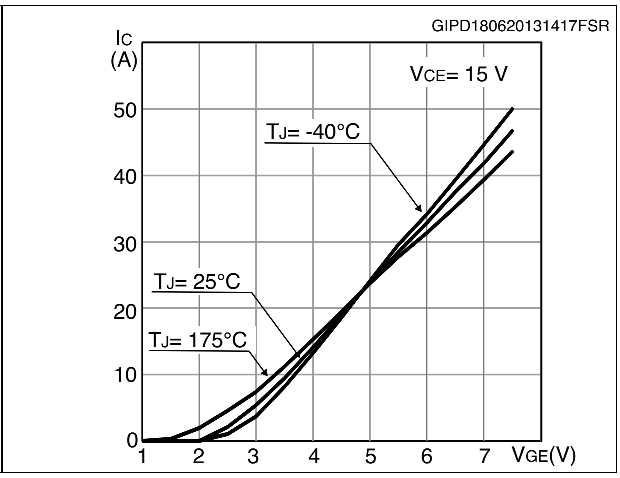


Figure 10. Collector cut-off current vs. temperature

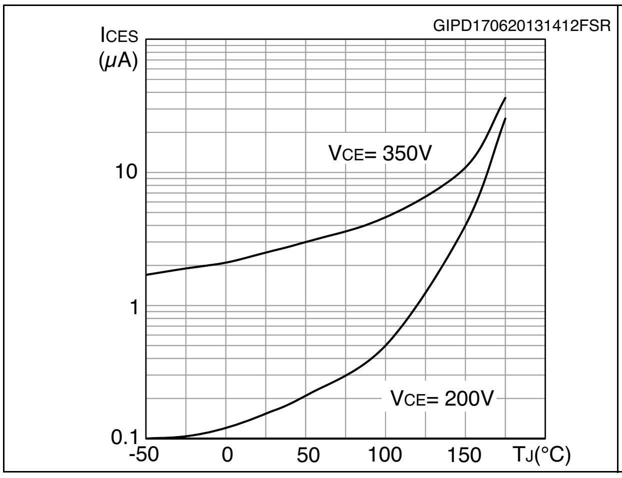


Figure 11. Normalized collector emitter voltage vs temperature

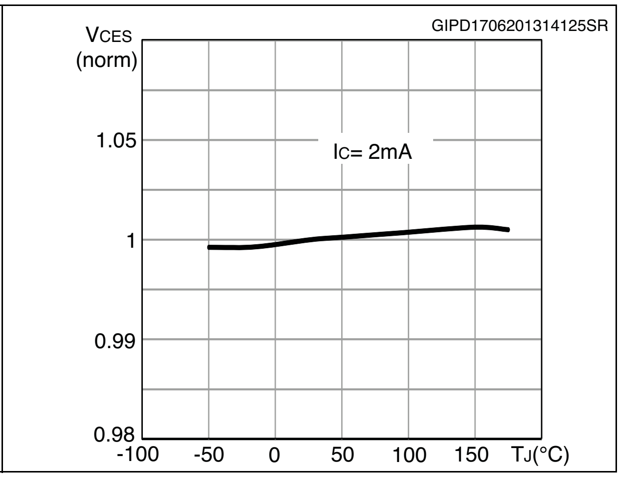


Figure 12. Normalized gate threshold voltage vs temperature

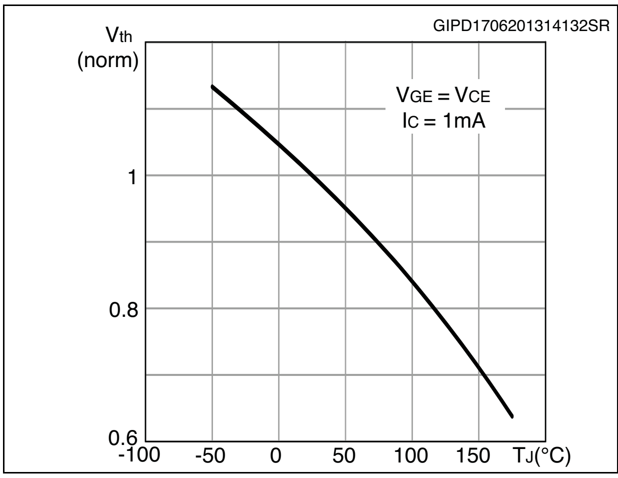


Figure 13. Normalized collector emitter on-voltage vs temperature

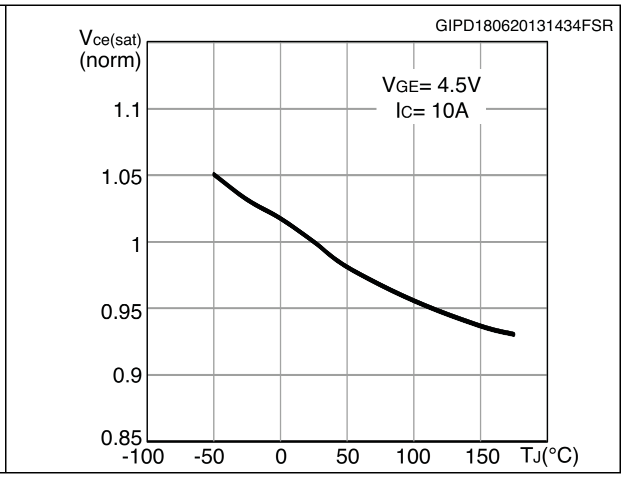


Figure 14. Thermal impedance for D²PAK

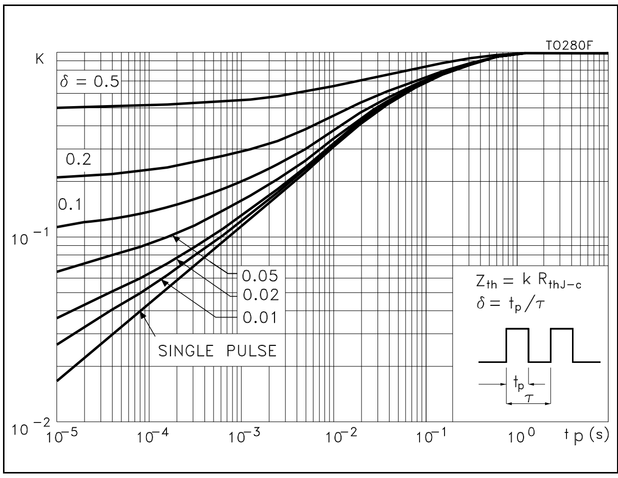
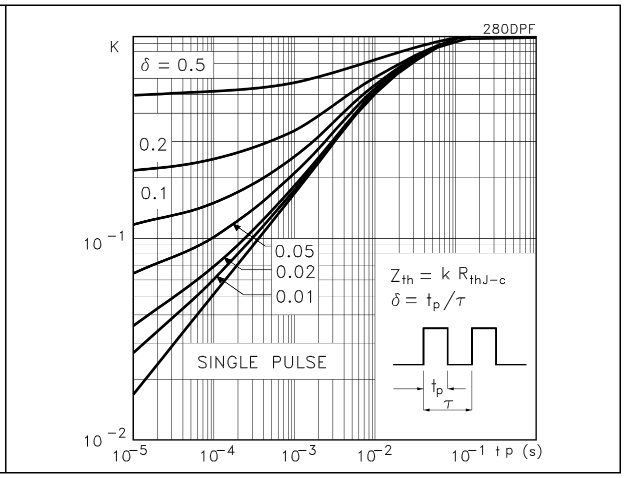


Figure 15. Thermal impedance for DPAK



3 Test circuits

Figure 16. Inductive load switching and E_{SCIS} test circuit

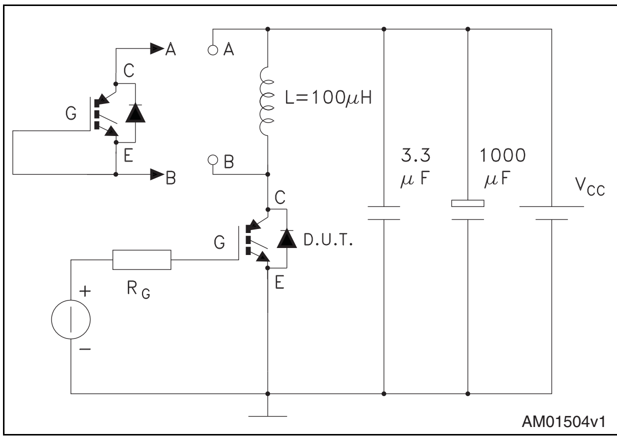


Figure 17. Resistive load switching

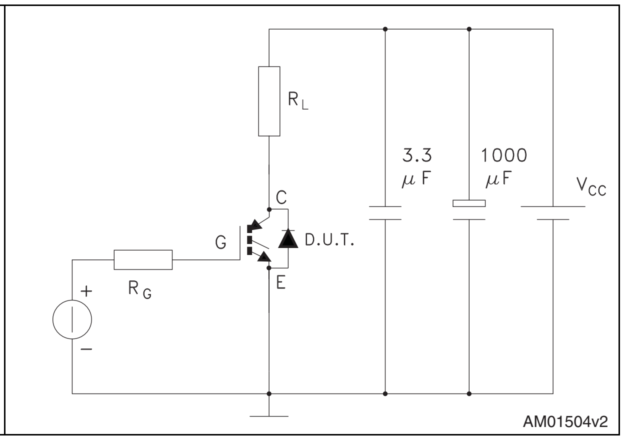


Figure 18. Gate charge test circuit

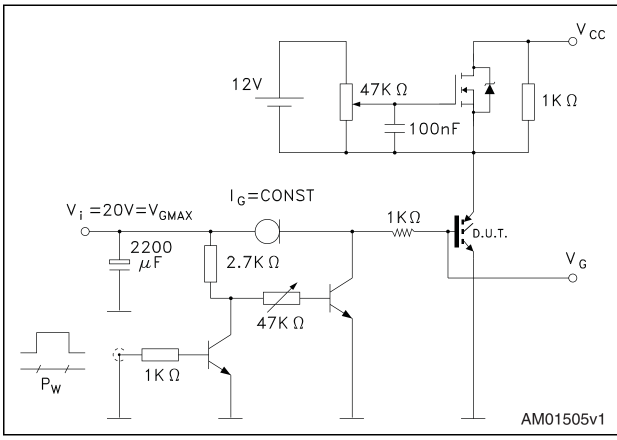
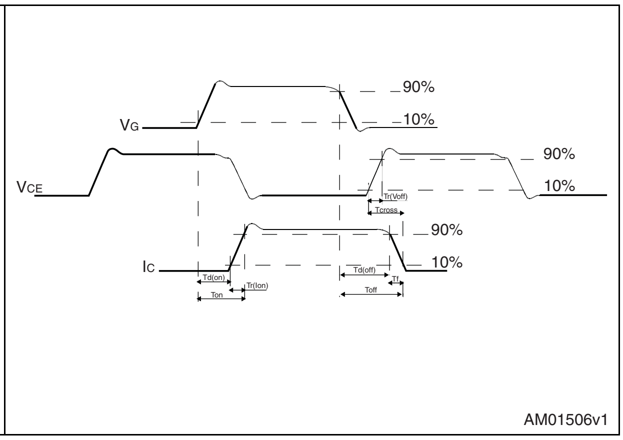


Figure 19. Switching waveform



4 Package mechanical data

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.

Figure 20. D²PAK (TO-263) drawing

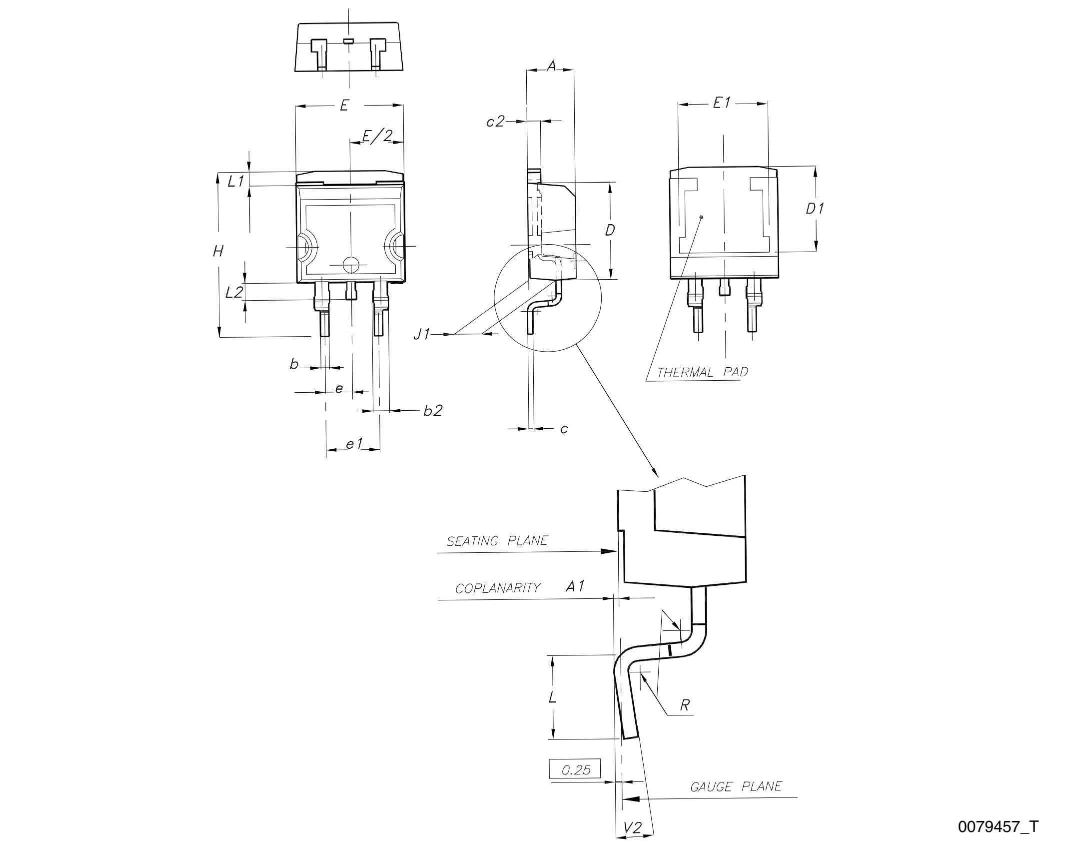
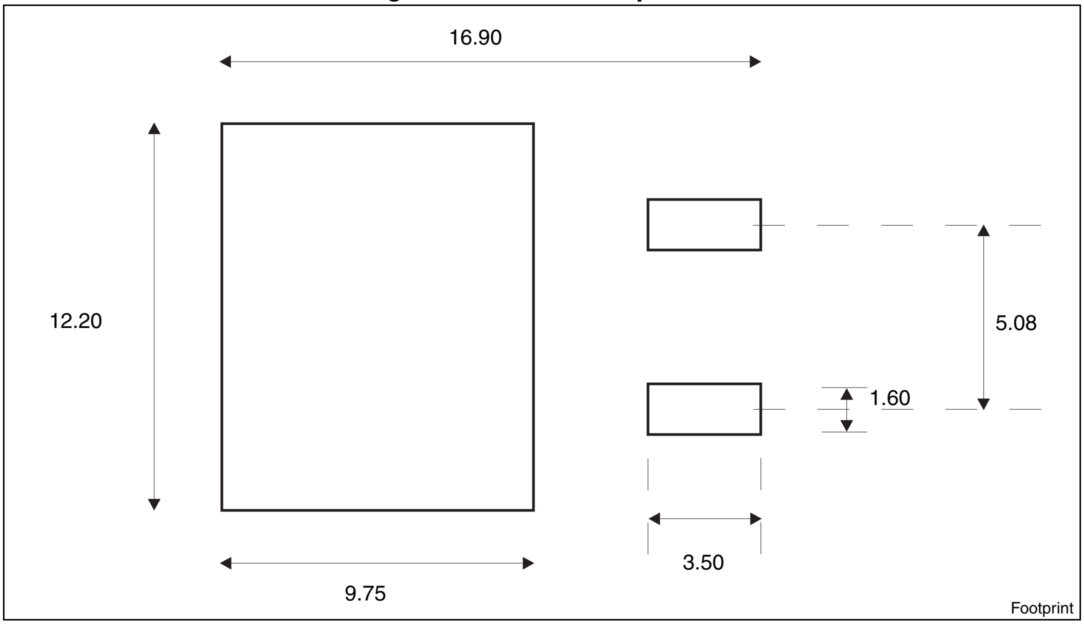


Table 7. D^2PAK (TO-263) mechanical data

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		
E	10		10.40
E1	8.50		
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 21. D^2PAK footprint[(a)]



a. All dimension are in millimeters

Figure 22. DPAK (TO-252) type A drawing

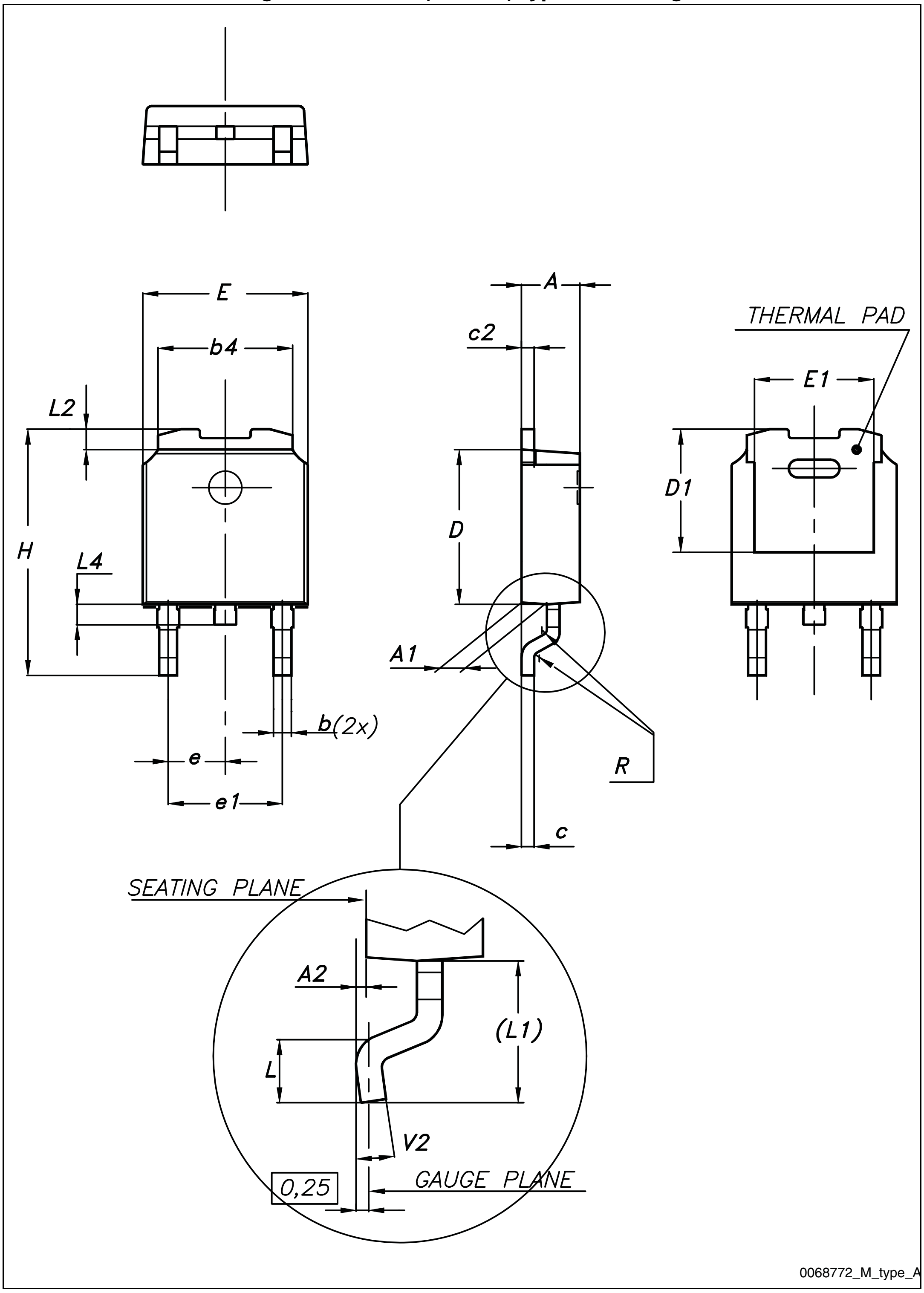
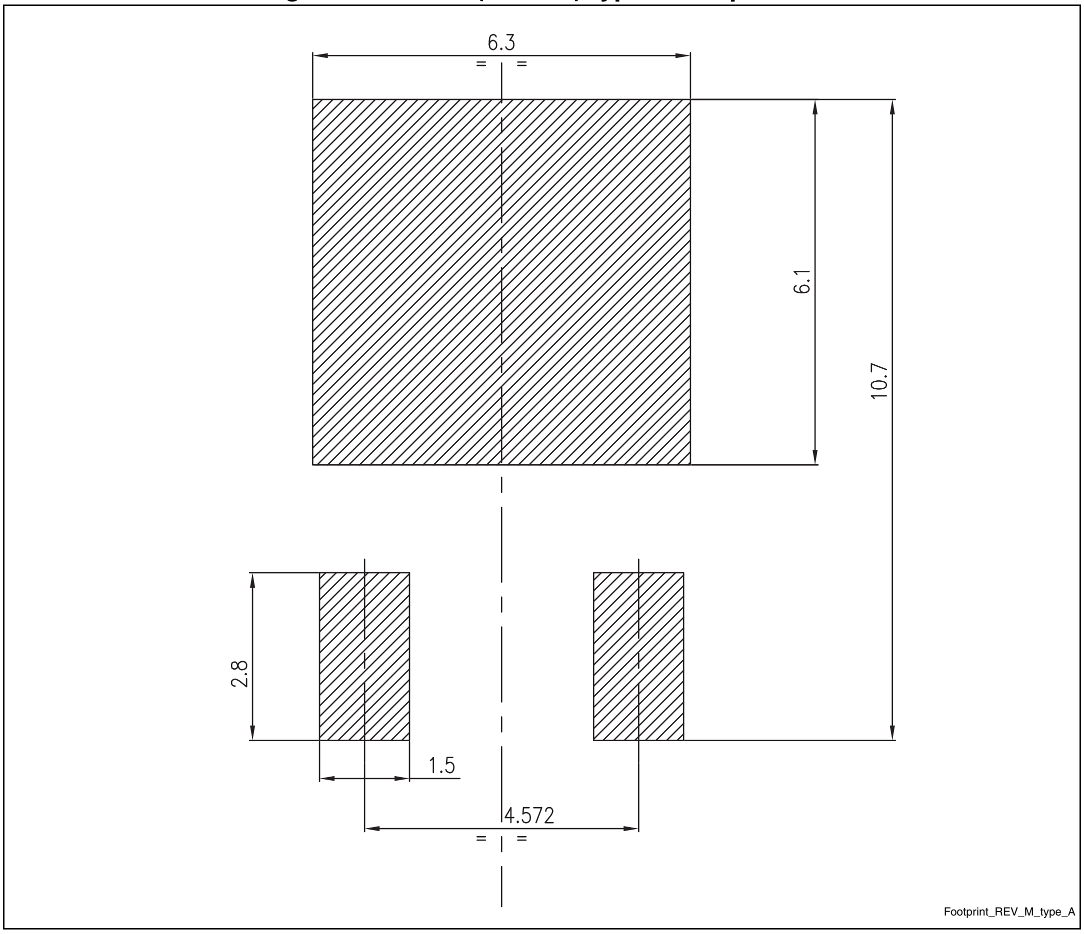


Table 8. DPAK (TO-252) type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
(L1)		2.80	
L2		0.80	
L4	0.60		1.00
R		0.20	
V2	0°		8°

Figure 23. DPAK (TO-252) type A footprint [b]



b. All dimensions are in millimeters

5 Packaging mechanical data

Figure 24. Tape drawing

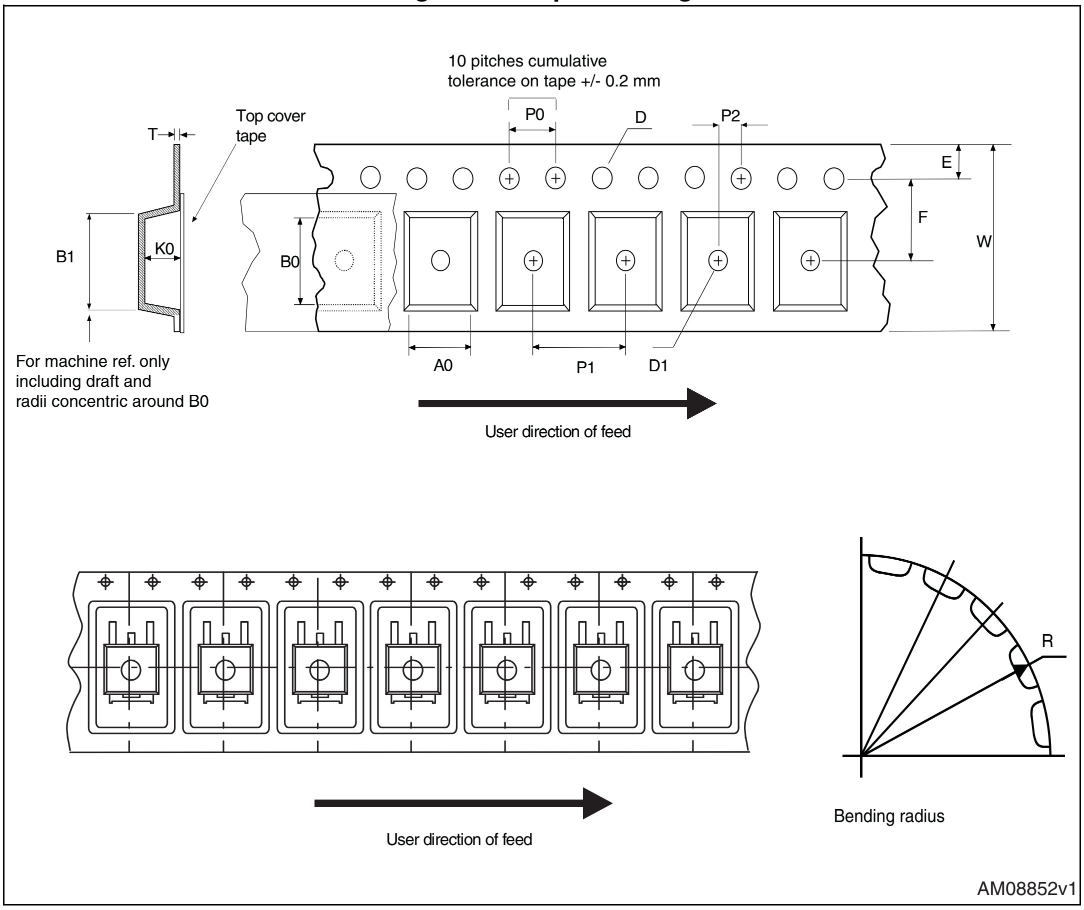


Figure 25. Reel drawing

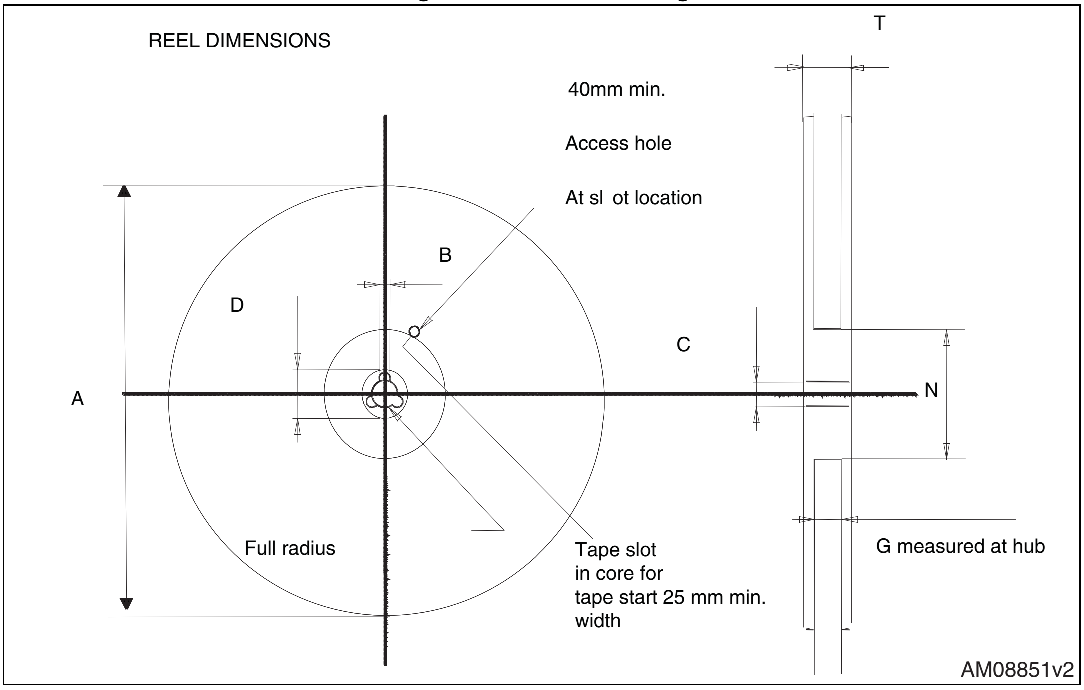


Table 9. D²PAK (TO-263) tape and reel mechanical data

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			

Table 10. DPAK (TO-252) tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	6.8	7	A		330
B0	10.4	10.6	B	1.5	
B1		12.1	C	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
E	1.65	1.85	N	50	
F	7.4	7.6	T		22.4
K0	2.55	2.75			
P0	3.9	4.1	Base qty.		2500
P1	7.9	8.1	Bulk qty.		2500
P2	1.9	2.1			
R	40				
T	0.25	0.35			
W	15.7	16.3			

6 Revision history

Table 11. Document revision history

Date	Revision	Changes
08-Feb-2013	1	Initial release.
24-Jun-2013	2	Added device in D^2PAK. Modified *Table 1: Device summary*. Added *Section 2.1: Electrical characteristics (curves)*. Updated *Section 4: Package mechanical data* and *Section 5: Packaging mechanical data*. Minor text changes.
25-Sep-2013	3	Updated $t_{d(on)}$ value for resistive load in *Table 6: Switching on/off*. Updated mechanical data for DPAK. Minor text changes.
14-Jan-2014	4	Modified title in cover page. Added: E_{SCIS} in *Table 2*, V_{ECS} and g_{fs} values in *Table 4*. Modified minimum value of $V_{GE(clamped)}$ in *Table 4* Updated *Section 4: Package mechanical data* Modified order codes in *Table 1.* Minor text changes.
4-Jun-2014	5	Updated features in cover page.