Qualcomm

RF360
Europe GmbH

Data sheet

BAW Tx post PA filter

Small cell & femtocell
TD-LTE band 41 (2515-2675 MHz)

Part number:	B9685
Ordering code:	B39262B9685P810
Date:	June 09, 2021
Version:	2.0

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Anzinger Straße 13
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Table of contents

1 Application

- Low-loss BAW filter for LTE small cell and femtocell systems (Band 41 CMCC)
- Usable pass band: 160.0 MHz
- High power durability

2 Features

- Industrial grade qualified family
- Package size $2.0_{\pm 0.1}$ mm × $1.6_{\pm 0.1}$ mm
- Package height 0.45 mm (max.)
- Approximate weight 5 mg
- RoHS compatible
- Package for Surface Mount Technology (SMT)
- Ni/Au-plated terminals
- Electrostatic Sensitive Device (ESD)
- Moisture Sensitivity Level 2a (MSL2a)

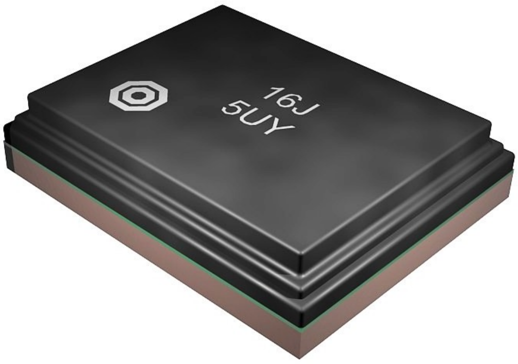

Figure 1: Picture of component with example of product marking.

3 Package

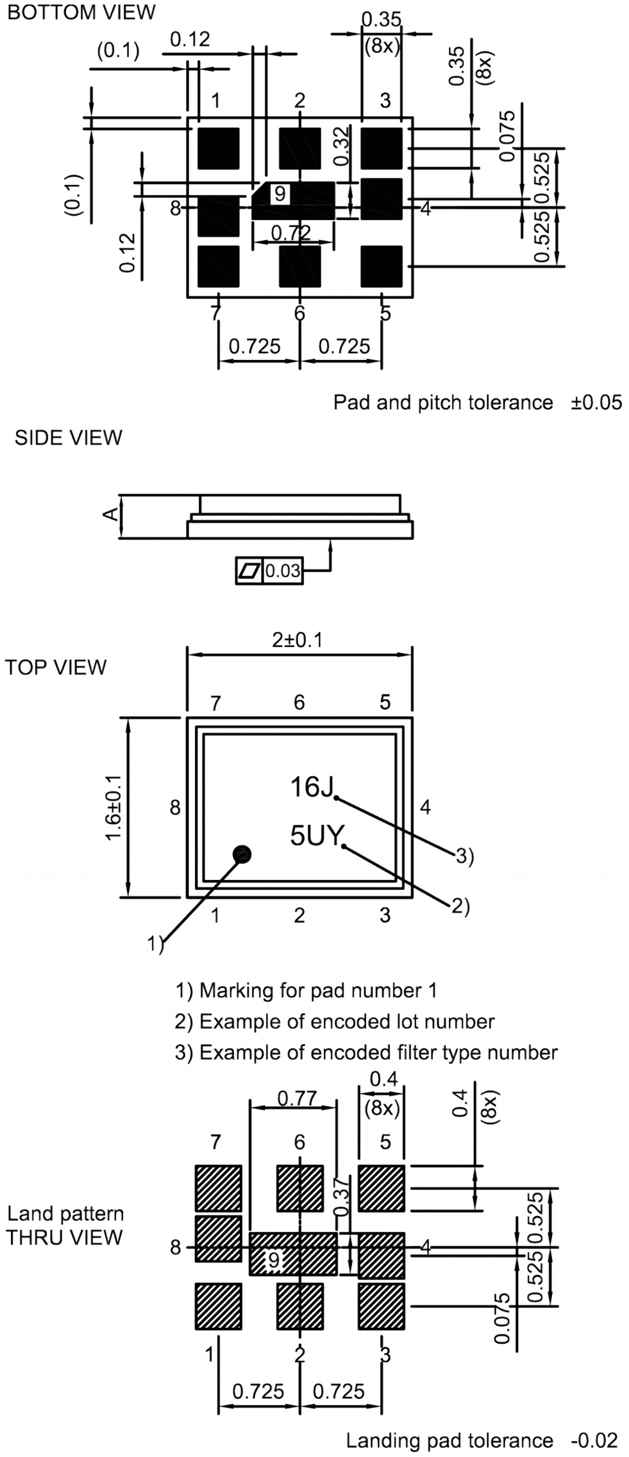

Figure 2: Drawing of package with package height A = 0.45 mm (max.). See Sec. Package information (p. 22).

4 Pin configuration

■ 1	Input
■ 5	Output
■ 2, 3, 4, 6, 7, 8	Ground

5 Matching circuit

- L_{p1} = 4.7 nH
- L_{p5} = 6.0 nH

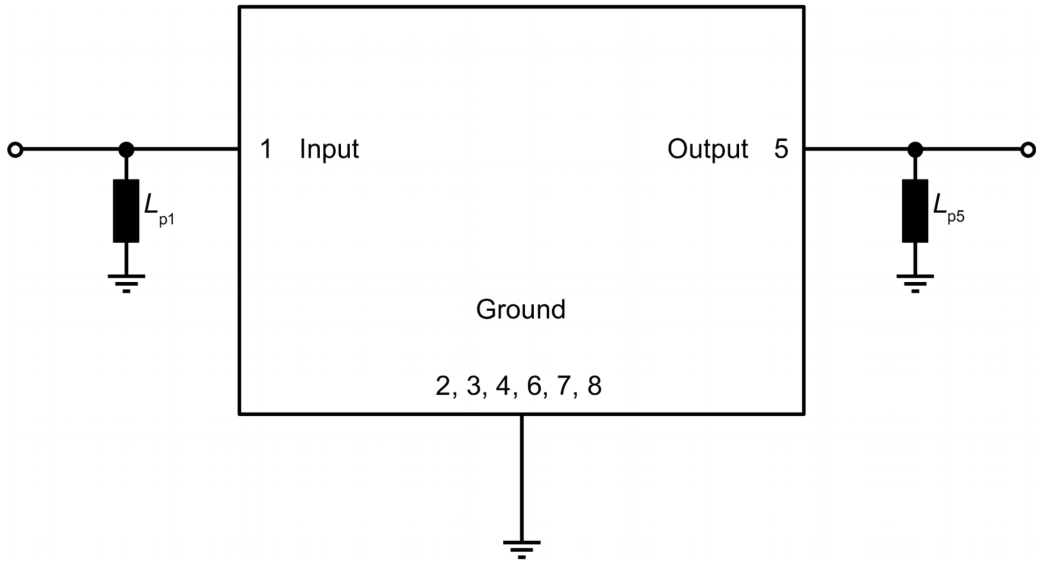

Figure 3: Schematic of matching circuit.

6 Characteristics

Temperature range for specification	T_{SPEC}	= −10 °C ... +85 °C
Input terminating impedance	Z_{IN}	= 50 Ω // 4.7 nH[1)]
Output terminating impedance	Z_{OUT}	= 50 Ω // 6.0 nH[1)]

Characteristics				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Insertion attenuation							
	2515 ... 2520	MHz	α_{INT} [2)]	—	2.5	3.2	dB
	2520 ... 2675	MHz	α_{INT} [2)]	—	2.2	2.6	dB
	2515 ... 2675	MHz	α_{INT} [3)]	—	2.0	2.5	dB
	2515 ... 2675	MHz	α_{INT} [4)]	—	1.2	2.0	dB
Maximum insertion attenuation			α_{max}				
	2515 ... 2520	MHz		—	2.7	3.0[5), 6)]	dB
	2520 ... 2675	MHz		—	2.3	2.8	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	2515 ... 2520	MHz		—	1.8	2.1[5), 7)]	dB
	2520 ... 2675	MHz		—	1.5	2.0	dB
Maximum VSWR			$VSWR_{max}$				
@ input port	2515 ... 2675	MHz		—	1.5	2.0	
@ output port	2515 ... 2675	MHz		—	1.5	2.0	
Attenuation			α_{WLAN} [8)]				
WLAN ch1	2403.1 ... 2420.9	MHz		45	56	—	dB
WLAN ch2	2408.1 ... 2425.9	MHz		45	54	—	dB
WLAN ch3	2413.1 ... 2430.9	MHz		45	54	—	dB
WLAN ch4	2418.1 ... 2435.9	MHz		45	53	—	dB
WLAN ch5	2423.1 ... 2440.9	MHz		45	53	—	dB
WLAN ch6	2428.1 ... 2445.9	MHz		45	53	—	dB
WLAN ch7	2433.1 ... 2450.9	MHz		45	53	—	dB
WLAN ch8	2438.1 ... 2455.9	MHz		45	54	—	dB
WLAN ch9	2443.1 ... 2460.9	MHz		45	56	—	dB
WLAN ch10	2448.1 ... 2465.9	MHz		45	58	—	dB
WLAN ch11	2453.1 ... 2470.9	MHz		45	59	—	dB
WLAN ch12	2458.1 ... 2475.9	MHz		42	56	—	dB
WLAN ch13	2463.1 ... 2480.9	MHz		40	50	—	dB
Minimum attenuation			α_{min}				
	10 ... 960	MHz		42	48	—	dB
	960 ... 1400	MHz		34	39	—	dB
	1400 ... 1710	MHz		24	34	—	dB
	1710 ... 1785	MHz		34	37	—	dB
	1785 ... 1805	MHz		34	37	—	dB
	1805 ... 1880	MHz		34	37	—	dB
	1880 ... 1920	MHz		34	37	—	dB

Characteristics			min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
	1920 ... 2000	MHz	34	37	—	dB
	2000 ... 2200	MHz	34	38	—	dB
	2200 ... 2300	MHz	37	39	—	dB
	2300 ... 2400	MHz	40	43	—	dB
	2400 ... 2470	MHz	45	52	—	dB
	2470 ... 2475	MHz	43	51	—	dB
	2475 ... 2483.5	MHz	23	35	—	dB
	2720 ... 2730	MHz	16[5), 9)]	28	—	dB
	2730 ... 2750	MHz	20	73	—	dB
	2750 ... 2775	MHz	39	75	—	dB
	2775 ... 2900	MHz	39	46	—	dB
	2900 ... 3300	MHz	39	42	—	dB
	3300 ... 3600	MHz	35	42	—	dB
	3600 ... 3800	MHz	30	43	—	dB
	3800 ... 3900	MHz	40	47	—	dB
	3900 ... 5000	MHz	40	43	—	dB
	5000 ... 5150	MHz	36	42	—	dB
	5150 ... 5850	MHz	28	39	—	dB
	5850 ... 6000	MHz	28	38	—	dB

1) See Sec. Matching circuit (p. 6).
2) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.
3) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 18 MHz of LTE 20 MHz (100 RB) channels.
4) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 90 MHz of LTE 100 MHz (500 RB) channels.
5) Valid for temperature T = +55°C..+85°C.
6) Max=3.5 dB for temperature T = -10°C..+85°C.
7) Max=2.6 dB for temperature T = -10°C..+85°C.
8) Average over each WLAN channel with band width of 17.8 MHz.
9) Max=9 dB for temperature T = -10°C..+85°C.

Temperature range for specification	T_{SPEC}	= −40 °C ... +95 °C
Input terminating impedance	Z_{IN}	= 50 Ω // 4.7 nH[1)]
Output terminating impedance	Z_{OUT}	= 50 Ω // 6.0 nH[1)]

Characteristics				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Insertion attenuation							
	2515 ... 2520	MHz	α_{INT} [2)]	—	2.5	3.6	dB
	2520 ... 2675	MHz	α_{INT} [2)]	—	2.2	3.1	dB
	2515 ... 2675	MHz	α_{INT} [3)]	—	2.0	2.9	dB
	2515 ... 2675	MHz	α_{INT} [4)]	—	1.2	2.0	dB
Maximum insertion attenuation			α_{max}				
	2515 ... 2520	MHz		—	2.7	3.9	dB
	2520 ... 2675	MHz		—	2.3	3.3	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	2515 ... 2520	MHz		—	1.7	3.0	dB
	2520 ... 2675	MHz		—	1.5	2.5	dB
Maximum VSWR			$VSWR_{max}$				
@ input port	2515 ... 2675	MHz		—	1.5	2.2	
@ output port	2515 ... 2675	MHz		—	1.5	2.2	
Attenuation			α_{WLAN} [5)]				
	2403.1 ... 2420.9	MHz		45	56	—	dB
	2408.1 ... 2425.9	MHz		45	54	—	dB
	2413.1 ... 2430.9	MHz		45	54	—	dB
	2418.1 ... 2435.9	MHz		45	53	—	dB
	2423.1 ... 2440.9	MHz		45	53	—	dB
	2428.1 ... 2445.9	MHz		45	53	—	dB
	2433.1 ... 2450.9	MHz		45	53	—	dB
	2438.1 ... 2455.9	MHz		45	54	—	dB
	2443.1 ... 2460.9	MHz		45	56	—	dB
	2448.1 ... 2465.9	MHz		45	58	—	dB
	2453.1 ... 2470.9	MHz		45	59	—	dB
	2458.1 ... 2475.9	MHz		37	56	—	dB
	2463.1 ... 2480.9	MHz		35	50	—	dB
Minimum attenuation			α_{min}				
	10 ... 960	MHz		42	48	—	dB
	960 ... 1400	MHz		34	39	—	dB
	1400 ... 1710	MHz		24	34	—	dB
	1710 ... 1785	MHz		34	37	—	dB
	1785 ... 1805	MHz		34	37	—	dB
	1805 ... 1880	MHz		34	37	—	dB
	1880 ... 1920	MHz		34	37	—	dB
	1920 ... 2000	MHz		34	37	—	dB

Characteristics			min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
	2000 ... 2200	MHz	34	38	—	dB
	2200 ... 2300	MHz	37	39	—	dB
	2300 ... 2400	MHz	40	43	—	dB
	2400 ... 2470	MHz	42	52	—	dB
	2470 ... 2475	MHz	40	51	—	dB
	2475 ... 2483.5	MHz	21	35	—	dB
	2720 ... 2730	MHz	6	28	—	dB
	2730 ... 2750	MHz	16	73	—	dB
	2750 ... 2775	MHz	39	75	—	dB
	2775 ... 2900	MHz	39	46	—	dB
	2900 ... 3300	MHz	39	42	—	dB
	3300 ... 3600	MHz	35	42	—	dB
	3600 ... 3800	MHz	30	43	—	dB
	3800 ... 3900	MHz	40	47	—	dB
	3900 ... 5000	MHz	40	43	—	dB
	5000 ... 5150	MHz	36	42	—	dB
	5150 ... 5850	MHz	28	39	—	dB
	5850 ... 6000	MHz	28	38	—	dB

1) See Sec. Matching circuit (p. 6).

2) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.

3) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 18 MHz of LTE 20 MHz (100 RB) channels.

4) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 90 MHz of LTE 100 MHz (500 RB) channels.

5) Average over each WLAN channel with band width of 17.8 MHz.

7 Maximum ratings

Operable temperature	T_{OP} = −40 °C ... +95 °C	
Storage temperature	T_{STG}[1)] = −40 °C ... +95 °C	
DC voltage	$\|V_{DC}\|$[2)] = 0 V (max.)	
ESD voltage		
	V_{ESD}[3)] = 150 V (max.)	Machine model.
	V_{ESD}[4)] = 250 V (max.)	Human body model.
Input power	P_{IN}	
@ input port: 2515 ... 2675 MHz	31 dBm	5 MHz TD-LTE downlink signal duty cycle 80% for 100000 h @ 55 °C. P_{IN} 31 dBm ON state. Source and load impedance 50Ω.[5), 6)]
@ input port: other frequency ranges	10 dBm	5 MHz TD-LTE downlink signal duty cycle 80% for 100000 h @ 55 °C. Source and load impedance 50Ω.

1) Not valid for packaging material. Storage temperature for packaging material is −25 °C to +40 °C.
2) In case of applied DC voltage blocking capacitors are mandatory.
3) According to JESD22-A115B (MM – Machine Model), 10 negative & 10 positive pulses.
4) According to JESD22-A114F (HBM – Human Body Model), 1 negative & 1 positive pulse.
5) Expected lifetime according to accelerated power durability tests, and wear out models.
6) Tspec is the ambient temperature of the PCB at component position. Specified min./max values from section 6 “characteristics” for maximum input power 31 dBm are valid for temperature up to 70°C.

8 Transmission coefficient

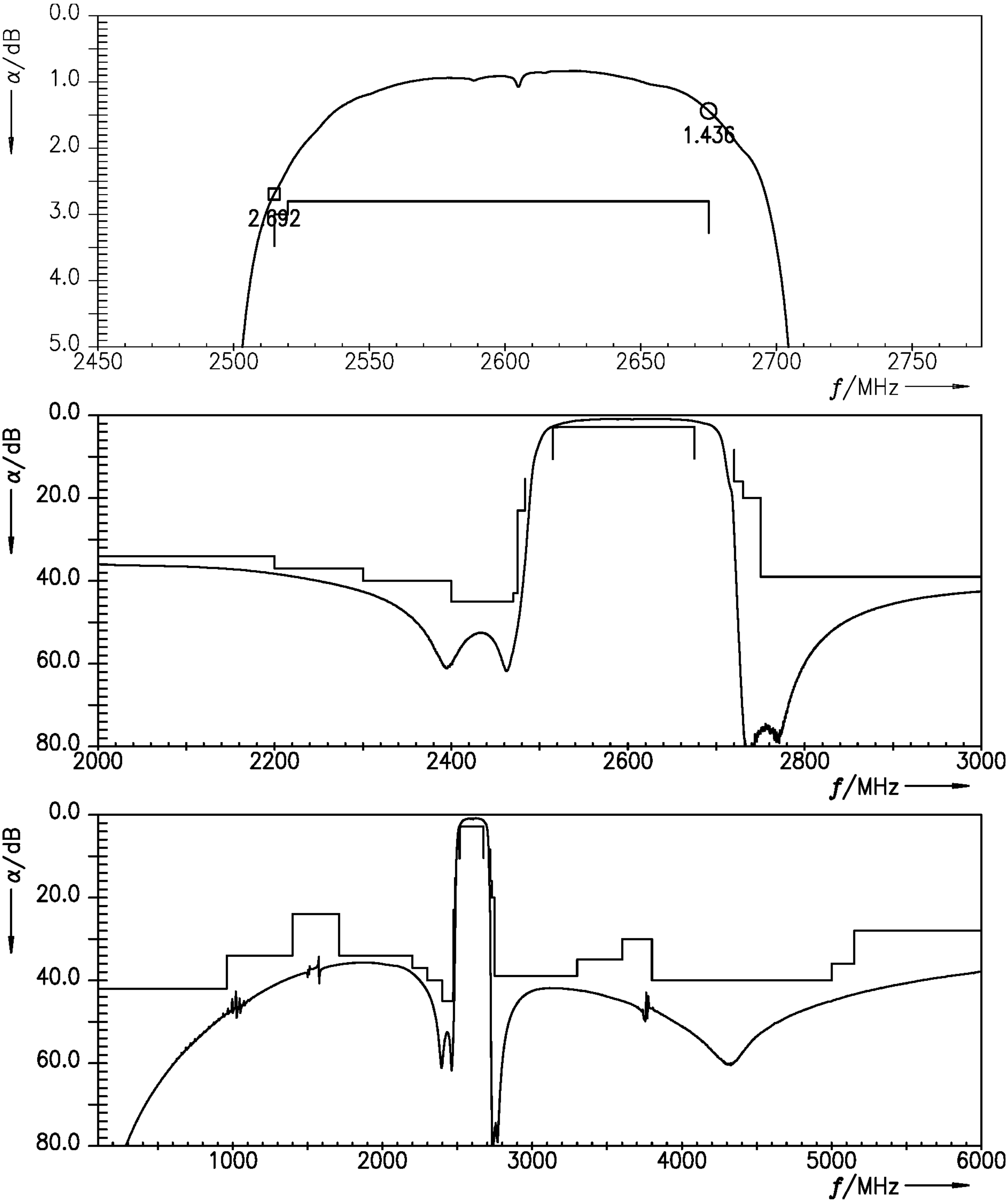

Figure 4: Attenuation.

9 Transmission coefficient (WLAN)

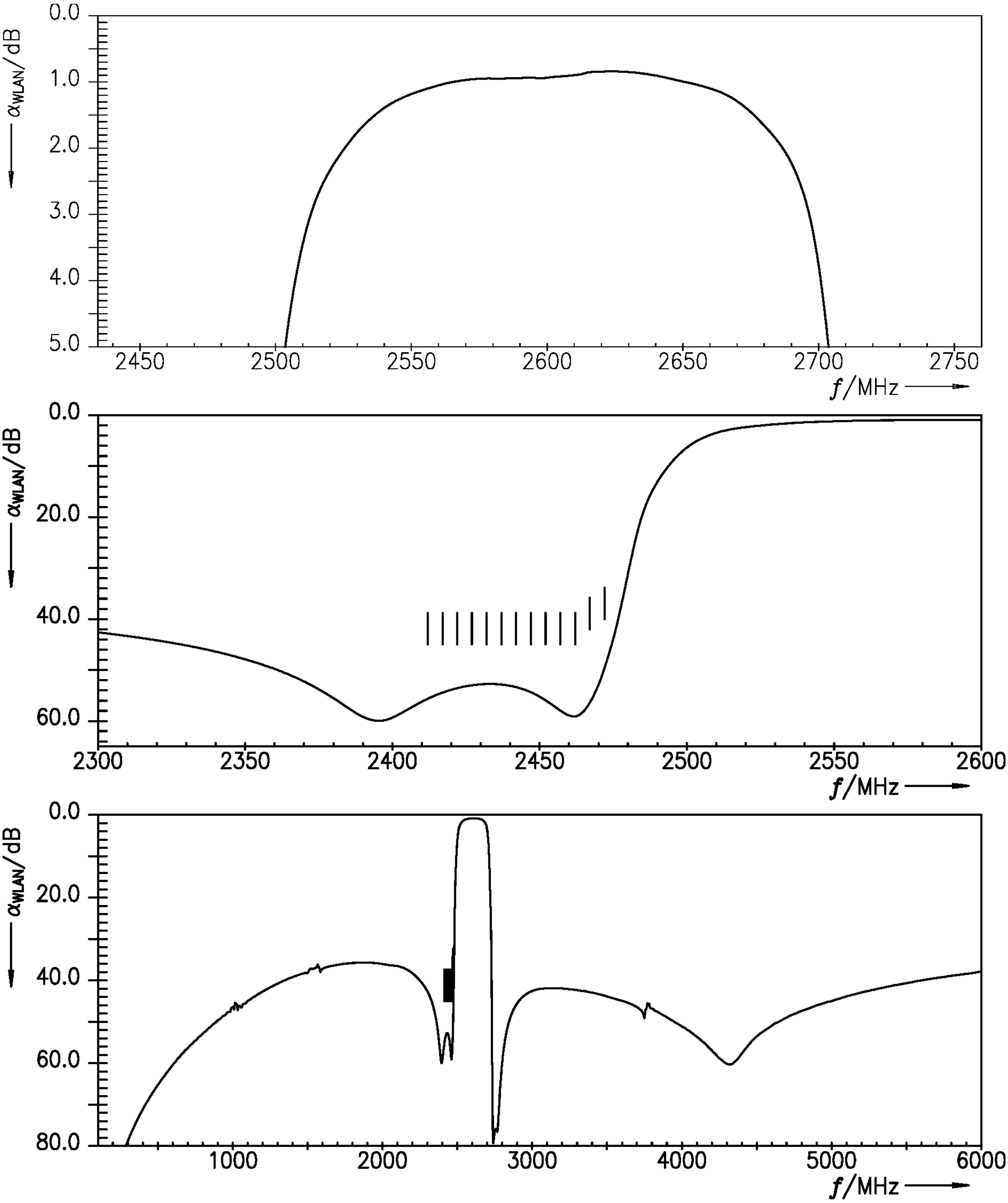

Figure 5: Attenuation (WLAN) (integration window = 17.8 MHz).

10 Reflection coefficients

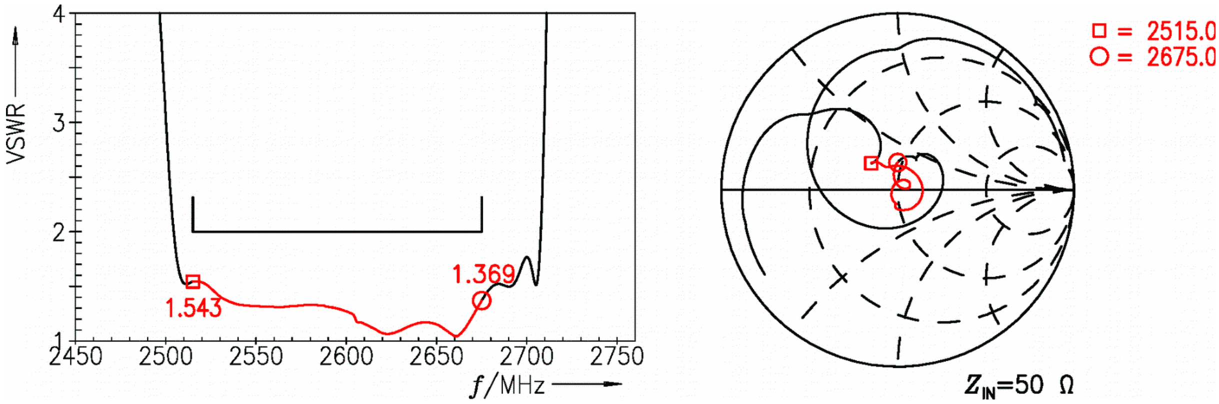

Figure 6: Reflection coefficient at input port.

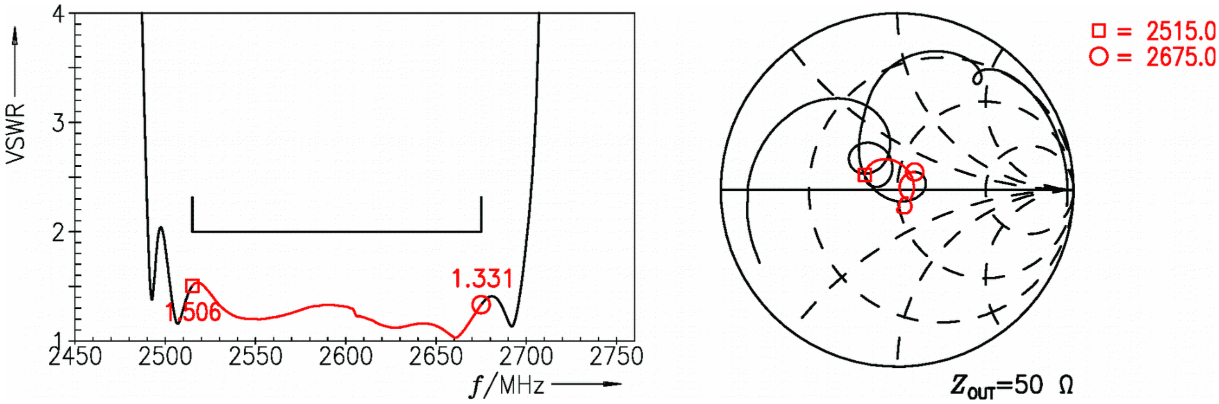

Figure 7: Reflection coefficient at output port.

11 Packing material

11.1 Tape

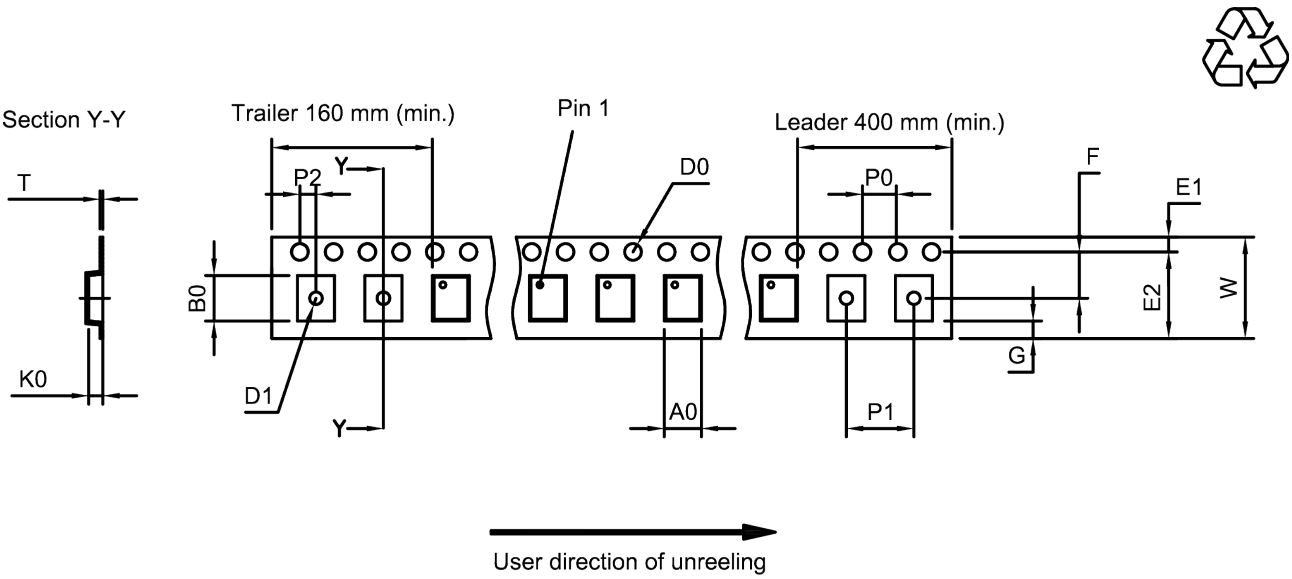

Figure 8: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

A_0	$1.8_{\pm 0.05}$ mm	E_2	6.25 mm (min.)	P_1	$4.0_{\pm 0.1}$ mm
B_0	$2.25_{\pm 0.05}$ mm	F	$3.5_{\pm 0.05}$ mm	P_2	$2.0_{\pm 0.05}$ mm
D_0	$1.5_{+0.1/-0}$ mm	G	0.75 mm (min.)	T	$0.25_{\pm 0.03}$ mm
D_1	1.0 mm (min.)	K_0	$0.6_{\pm 0.05}$ mm	W	$8.0_{+0.3/-0.1}$ mm
E_1	$1.75_{\pm 0.1}$ mm	P_0	$4.0_{\pm 0.1}$ mm		

Table 1: Tape dimensions.

11.2 Reel with diameter of 180 mm

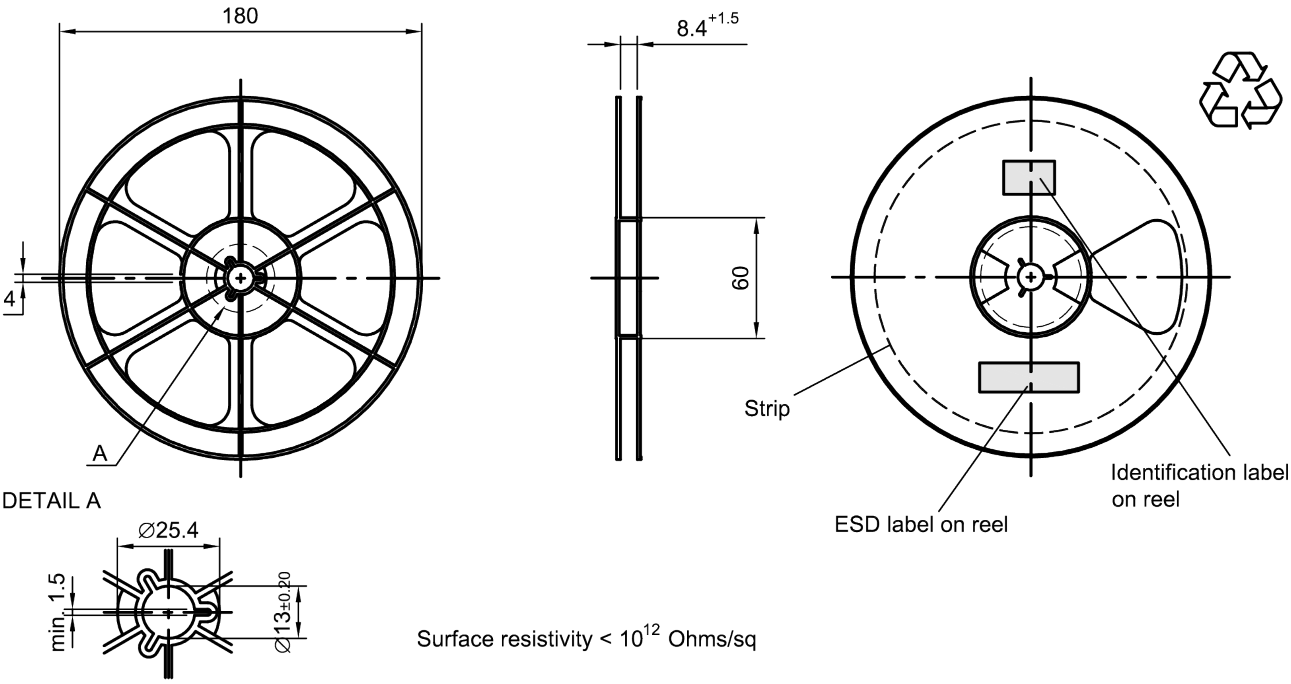

Figure 9: Drawing of reel (first-angle projection) with diameter of 180 mm.

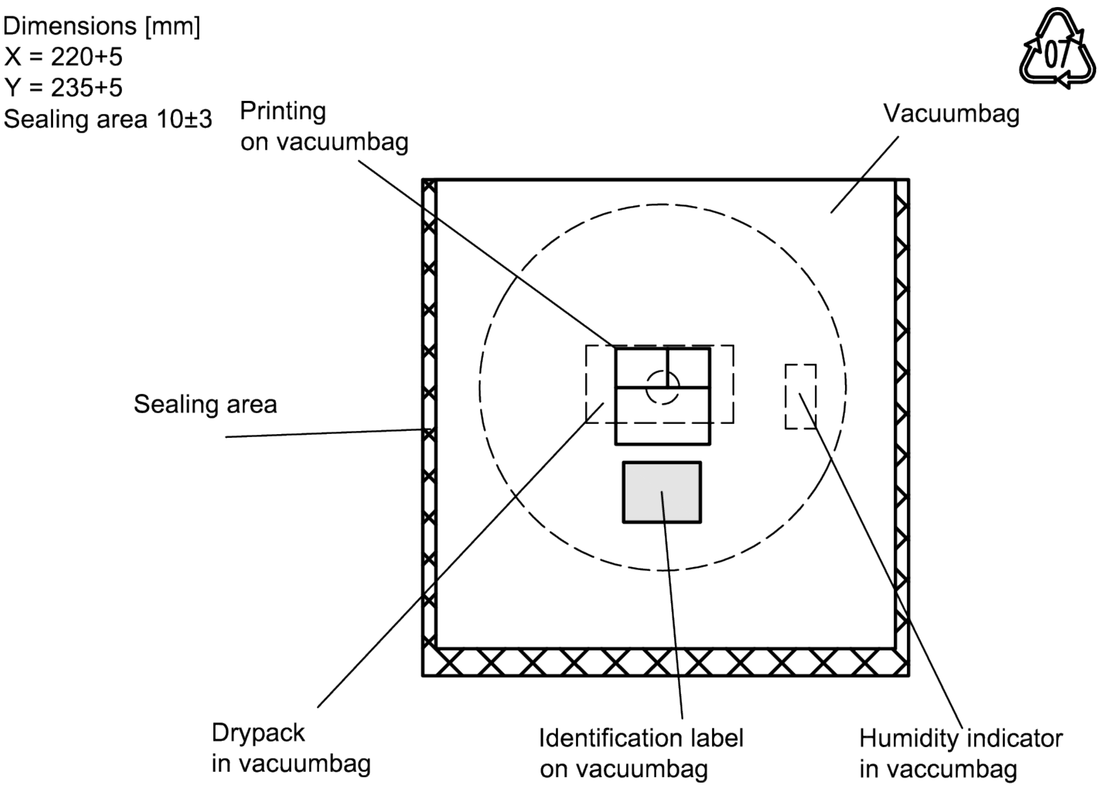

Figure 10: Drawing of moisture barrier bag (MBB) for reel with diameter of 180 mm.

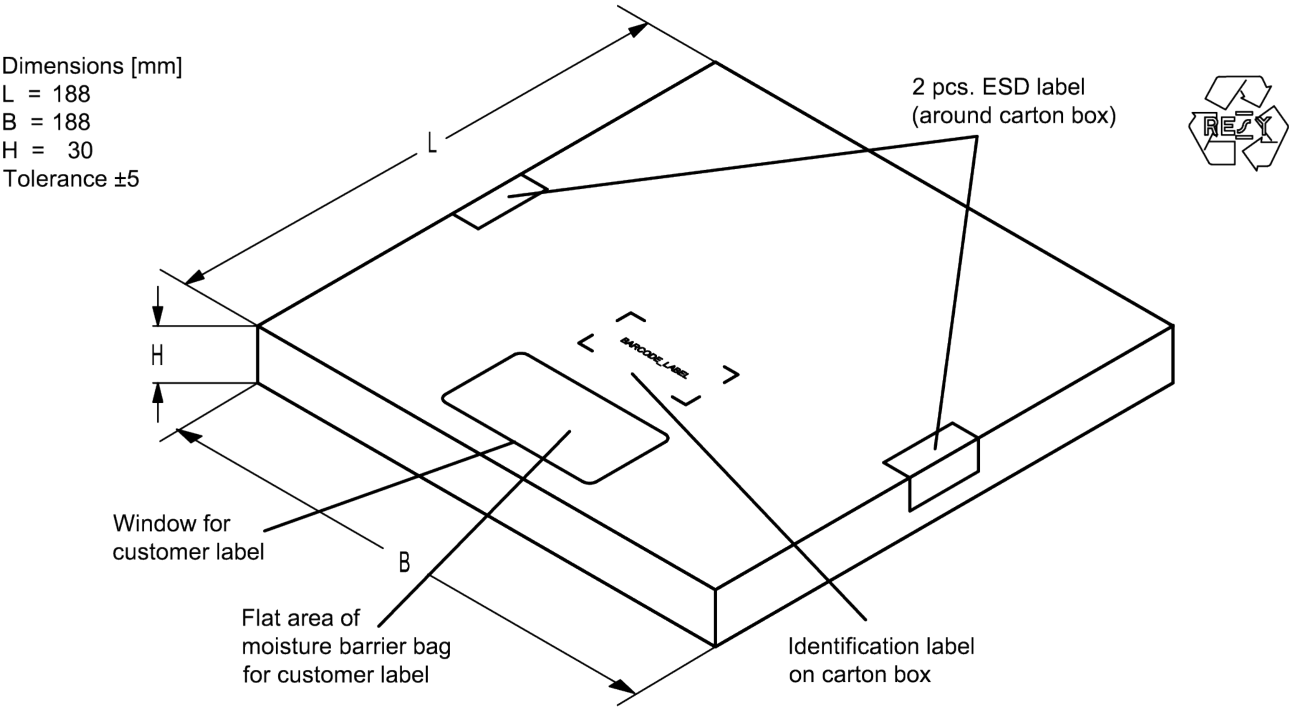

Figure 11: Drawing of folding box for reel with diameter of 180 mm.

11.3 Reel with diameter of 330 mm

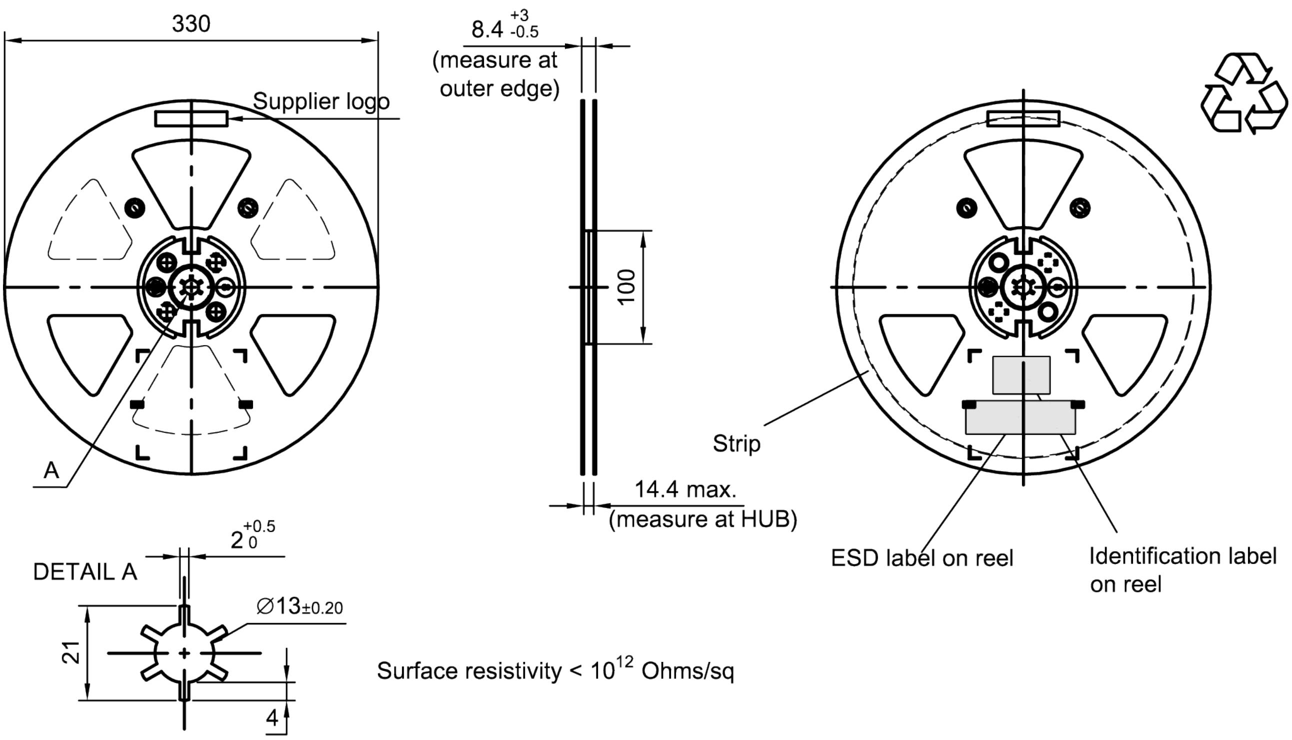

Figure 12: Drawing of reel (first-angle projection) with diameter of 330 mm.

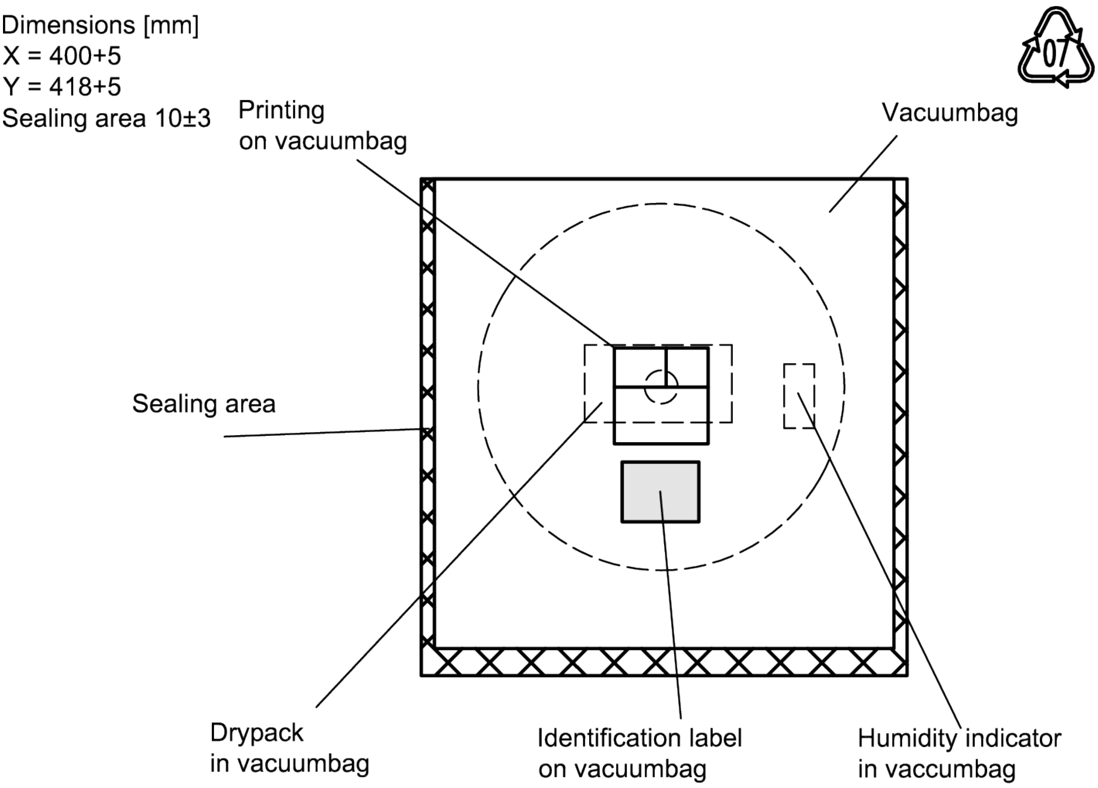

Figure 13: Drawing of moisture barrier bag (MBB) for reel with diameter of 330 mm.

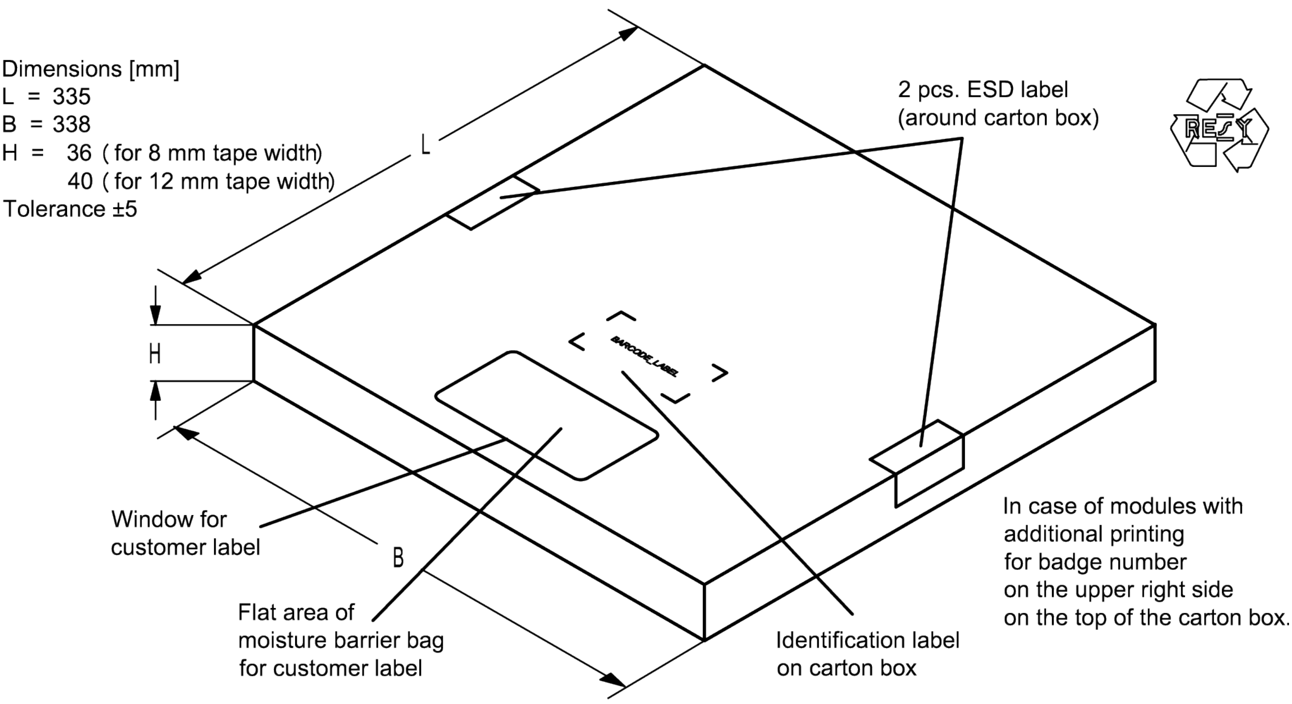

Figure 14: Drawing of folding box for reel with diameter of 330 mm.

12 Marking

Products are marked with product type number and lot number encoded according to Table 2:

- Type number:

  The 4 digit type number of the ordering code, e.g., B3xxxxB1234xxxx,
  is encoded by a special BASE32 code into a 3 digit marking.

  Example of decoding type number marking on device in decimal code.

  16J => **1234**

  1 x 32^2 + **6** x 32^1 + **18 (=J)** x 32^0 = **1234**

  The BASE32 code for product type B9685 is 9EN.

- Lot number:

  The last 5 digits of the lot number, e.g., **12345**,
  are encoded based on a special BASE47 code into a 3 digit marking.

  Example of decoding lot number marking on device in decimal code.

  5UY => **12345**

  5 x 47^2 + **27 (=U)** x 47^1 + **31 (=Y)** x 47^0 = **12345**

Adopted BASE32 code for type number			
Decimal value	Base32 code	Decimal value	Base32 code
0	0	16	G
1	1	17	H
2	2	18	J
3	3	19	K
4	4	20	M
5	5	21	N
6	6	22	P
7	7	23	Q
8	8	24	R
9	9	25	S
10	A	26	T
11	B	27	V
12	C	28	W
13	D	29	X
14	E	30	Y
15	F	31	Z

Adopted BASE47 code for lot number			
Decimal value	Base47 code	Decimal value	Base47 code
0	0	24	R
1	1	25	S
2	2	26	T
3	3	27	U
4	4	28	V
5	5	29	W
6	6	30	X
7	7	31	Y
8	8	32	Z
9	9	33	b
10	A	34	d
11	B	35	f
12	C	36	h
13	D	37	n
14	E	38	r
15	F	39	t
16	G	40	v
17	H	41	\
18	J	42	?
19	K	43	{
20	L	44	}
21	M	45	<
22	N	46	>
23	P		

Table 2: Lists for encoding and decoding of marking.

13 Soldering profile

The recommended soldering process is in accordance with IEC 60068-2-58 – 3rd edit and IPC/JEDEC J-STD-020B.

ramp rate	≤ 3 K/s
preheat	125 °C to 220 °C, 150 s to 210 s, 0.4 K/s to 1.0 K/s
T > 220 °C	30 s to 70 s
T > 230 °C	min. 10 s
T > 245 °C	max. 20 s
T ≥ 255 °C	–
peak temperature T_{peak}	250 °C +0/-5 °C
wetting temperature T_{min}	230 °C +5/-0 °C for 10 s ± 1 s
cooling rate	≤ 3 K/s
soldering temperature *T*	measured at solder pads

Table 3: Characteristics of recommended soldering profile for lead-free solder (Sn95.5Ag3.8Cu0.7).

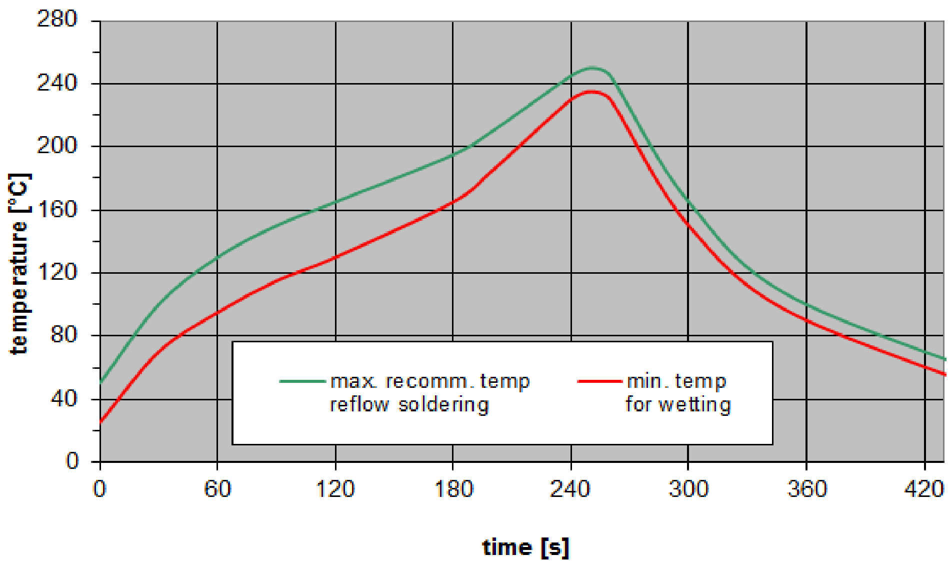

Figure 15: Recommended reflow profile for convection and infrared soldering – lead-free solder.

14 Annotations

14.1 RoHS compatibility

ROHS-compatible means that products are compatible with the requirements according to Art. 4 (substance restrictions) of Directive 2011/65/EU of the European Parliament and of the Council of June 8th, 2011, on the restriction of the use of certain hazardous substances in electrical and electronic equipment ("Directive") with due regard to the application of exemptions as per Annex III of the Directive in certain cases.

14.2 Scattering parameters (S-parameters)

The pin/port assignment is available in the headers of the S-parameter files. Please contact your local RF360 sales office.

14.3 Ordering codes and packing units

Ordering code	Packing unit
B39262B9685P810	5000 pcs

Table 4: Ordering codes and packing units.

15 Cautions and warnings

15.1 Display of ordering codes for RF360 products

The ordering code for one and the same product can be represented differently in data sheets, data books, other publications and the website of RF360, or in order-related documents such as shipping notes, order confirmations and product labels. The varying representations of the ordering codes are due to different processes employed and do not affect the specifications of the respective products. Detailed information can be found on the Internet under https://rffe.qualcomm.com/.

15.2 Material information

Due to technical requirements components may contain dangerous substances. For information on the type in question please also contact one of our sales offices.

For information on recycling of tapes and reels please contact one of our sales offices.

15.3 Moldability

Before using in overmolding environment, please contact your local RF360 sales office.

15.4 Package information

Landing area

The printed circuit board (PCB) land pattern (landing area) shown is based on RF360 internal development and empirical data and illustrated for example purposes, only. As customers' SMD assembly processes may have a plenty of variants and influence factors which are not under control or knowledge of RF360, additional careful process development on customer side is necessary and strongly recommended in order to achieve best soldering results tailored to the particular customer needs.

Dimensions

Unless otherwise specified all dimensions are understood using unit millimeter (mm).

Dimensions do not include burrs.

Projection method

Unless otherwise specified first-angle projection is applied.

16 ESD protection of SAW filters

SAW filters are **E**lectro **S**tatic **D**ischarge sensitive devices. To reduce the probability of damages caused by ESD, special matching topologies have to be applied.

In general, “ESD matching” has to be ensured at that filter port, where electrostatic discharge is expected.

Electrostatic discharges predominantly appear at the antenna input of RF receivers. Therefore, only the input matching of the SAW filter has to be designed to short circuit or to block the ESD pulse.

Below three figures show recommended “ESD matching” topologies.

For wide band filters the high-pass ESD matching structure needs to be at least of 3rd order to ensure a proper matching for any impedance value of antenna and SAW filter input. The required component values have to be determined from case to case.

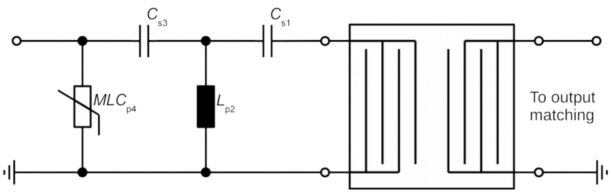

Figure 16: MLC varistor plus ESD matching.

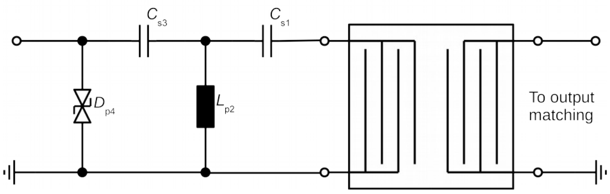

Figure 17: Suppressor diode plus ESD matching.

In cases where minor ESD occur, following simplified “ESD matching” topologies can be used alternatively.

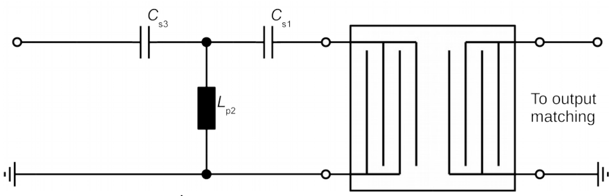

Figure 18: 3rd order high-pass structure for basic ESD protection.

In all three figures the shunt inductor L_{p2} could be replaced by a shorted microstrip with proper length and width. If this configuration is possible depends on the operating frequency and available PCB space.

Effectiveness of the applied ESD protection has to be checked according to relevant industry standards or customer specific requirements.

For further information, please refer to RF360 Application report: **“ESD protection for SAW filters”.** This report can be found under https://rffe.qualcomm.com.

17 Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application.** As a rule, RF360 Europe GmbH and its affiliates are either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an RF360 product with the properties described in the product specification is suitable for use in a particular customer application.
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