



RF360  
Europe GmbH

## Data sheet

SAW duplexer  
Small cell & femtocell  
4G-LTE band 28

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RF360 Europe GmbH  
Anzinger Straße 13  
81671 Munich, Germany

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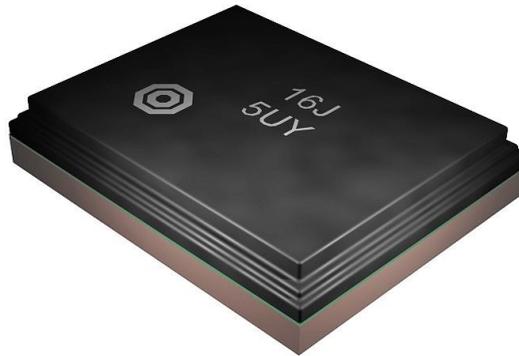
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## 1 Application

- Low-loss SAW duplexer for LTE small cell & femtocell systems (Band 28)
- Usable pass band 45MHz
- Tx = Downlink = 758MHz – 803MHz
- Rx = Uplink = 703MHz – 748MHz

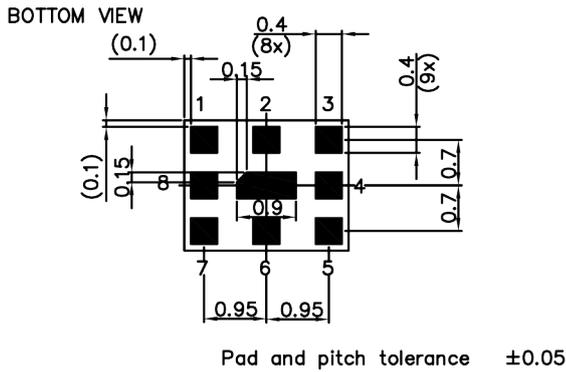
## 2 Features

- Package size  $2.5_{\pm 0.1}$  mm  $\times$   $2.0_{\pm 0.1}$  mm
- Package height 0.5 mm (max.)
- Approximate weight 0.01 g
- 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.

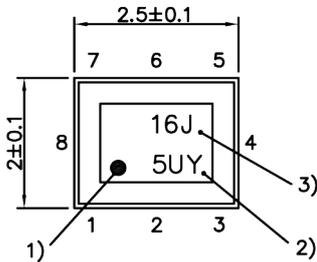
### 3 Package



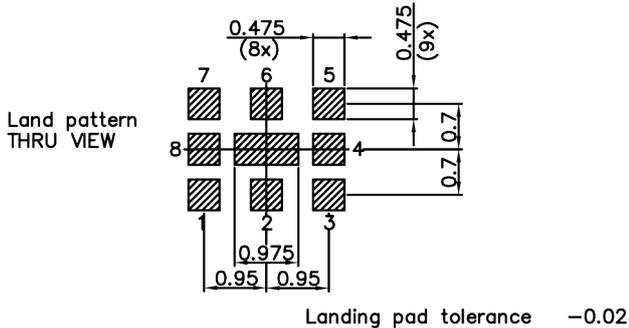
SIDE VIEW



TOP VIEW



- 1) Marking for pad number 1
- 2) Example of encoded lot number
- 3) Example of encoded filter type number



### 4 Pin configuration

- 1 TX
- 3 RX
- 6 ANT
- 2, 4, 5, 7, 8, 9 Ground

**Figure 2:** Drawing of package with package height A = 0.5 mm (max.). See Sec. Package information (p. 22).

5 Matching circuit

■  $L_{p1} = 18 \text{ nH}$

■  $L_{p3} = 22 \text{ nH}$

■  $L_{p6} = 18 \text{ nH}$

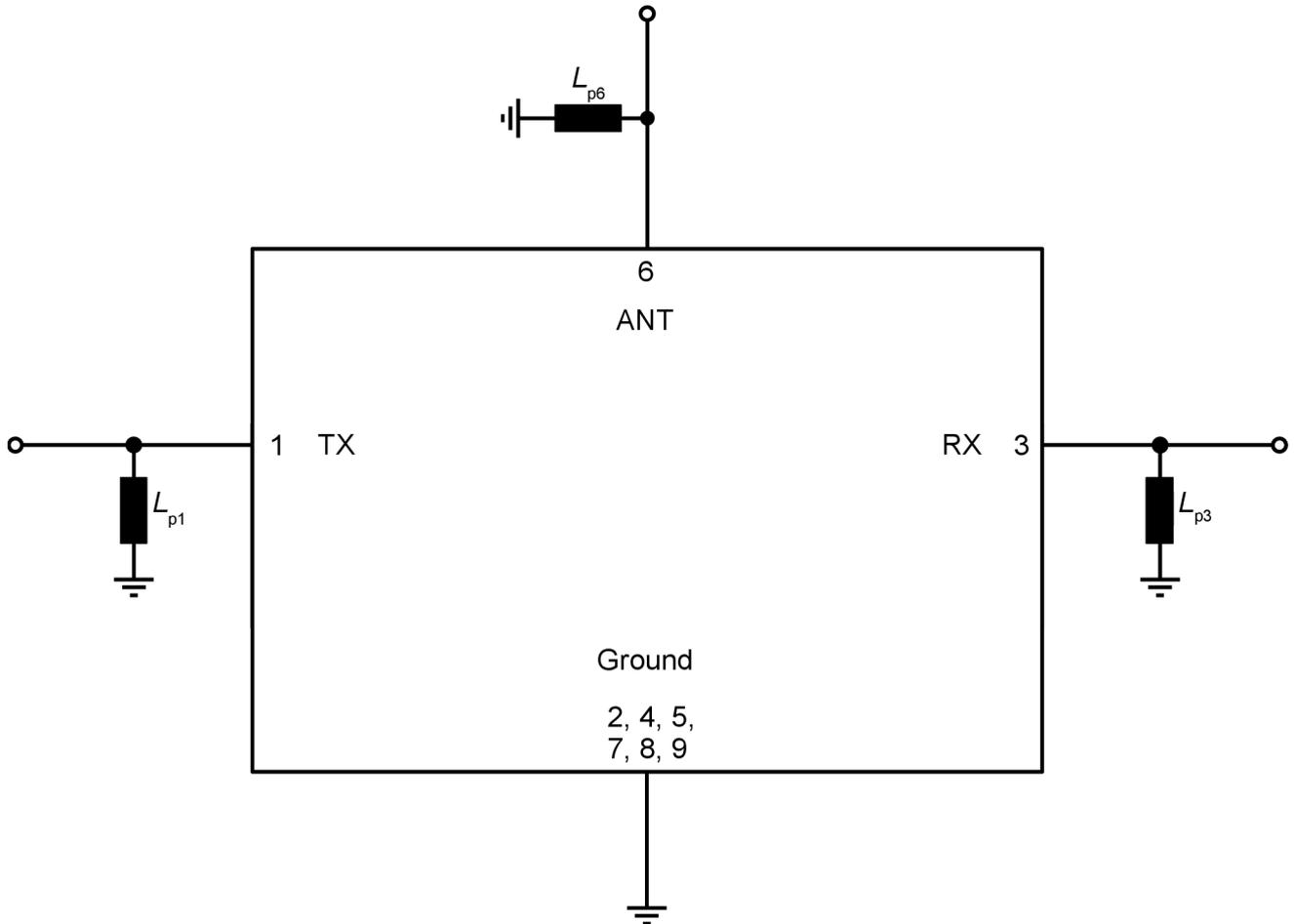


Figure 3: Schematic of matching circuit.

## 6 Characteristics

### 6.1 TX – ANT

Temperature range for specification	$T_{SPEC}$	= -10 °C ... +85 °C
TX terminating impedance	$Z_{TX}$	= 50 $\Omega$ // 18 nH <sup>1)</sup>
ANT terminating impedance	$Z_{ANT}$	= 50 $\Omega$ // 18 nH <sup>1)</sup>
RX terminating impedance	$Z_{RX}$	= 50 $\Omega$ // 22 nH <sup>1)</sup>

Characteristics TX – ANT				min. for $T_{SPEC}$	typ. @ +25 °C	max. for $T_{SPEC}$	
<b>Center frequency</b>			$f_C$	—	780.5	—	MHz
<b>Insertion attenuation</b>			$\alpha_{INT}$				
	758... 763	MHz		—	1.1 <sup>2)</sup>	3.5 <sup>2)</sup>	dB
	763... 803	MHz		—	0.9 <sup>2)</sup>	2.2 <sup>2)</sup>	dB
<b>Maximum insertion attenuation</b>			$\alpha_{max}$				
	758... 761	MHz		—	1.9	5.0 <sup>3)</sup>	dB
	761... 803	MHz		—	1.0	3.3	dB
<b>Amplitude ripple (p-p)</b>			$\Delta\alpha$				
	758... 761	MHz		—	1.6	4.5 <sup>3)</sup>	dB
	761... 803	MHz		—	0.7	2.8	dB
<b>Maximum VSWR</b>			$VSWR_{max}$				
@ TX port	758... 803	MHz		—	1.8	2.5	
@ ANT port	758... 803	MHz		—	1.8	2.5	
<b>Attenuation</b>			$\alpha_{min}$				
	100... 650	MHz		30	36	—	dB
	650... 680	MHz		20	41	—	dB
	703... 748	MHz		42 <sup>2)</sup>	53 <sup>2)</sup>	—	dB
	850... 1000	MHz		40	44	—	dB
	1000... 6000	MHz		10	18	—	dB

<sup>1)</sup> See Sec. Matching circuit (p. 6).

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

<sup>3)</sup> Valid for typical temperature  $T = +25$  °C.

## 6.2 ANT – RX

Temperature range for specification	$T_{SPEC}$	= -10 °C ... +85 °C
TX terminating impedance	$Z_{TX}$	= 50 $\Omega$ // 18 nH <sup>1)</sup>
ANT terminating impedance	$Z_{ANT}$	= 50 $\Omega$ // 18 nH <sup>1)</sup>
RX terminating impedance	$Z_{RX}$	= 50 $\Omega$ // 22 nH <sup>1)</sup>

Characteristics ANT – RX			min. for $T_{SPEC}$	typ. @ +25 °C	max. for $T_{SPEC}$	
<b>Center frequency</b>		$f_C$	—	725.5	—	MHz
<b>Insertion attenuation</b>	703... 748	MHz	$\alpha_{INT}$	—	1.1 <sup>2)</sup>	2.2 <sup>2)</sup> dB
<b>Maximum insertion attenuation</b>	703... 748	MHz	$\alpha_{max}$	—	1.6	3.3 dB
<b>Amplitude ripple (p-p)</b>	703... 748	MHz	$\Delta\alpha$	—	1.0	2.8 dB
<b>Maximum VSWR</b>			VSWR <sub>max</sub>			
@ ANT port	703... 748	MHz		—	1.8	2.5
@ RX port	703... 748	MHz		—	1.8	2.5
<b>Attenuation</b>			$\alpha_{min}$			
	100... 650	MHz		30	35	— dB
	650... 680	MHz		20	35	— dB
	758... 803	MHz		42 <sup>2)</sup>	51 <sup>2)</sup>	— dB
	810... 900	MHz		30	42	— dB
	900... 1000	MHz		30	42	— dB
	1000... 3000	MHz		25	34	— dB
	3000... 6000	MHz		5	10	— dB

<sup>1)</sup> See Sec. Matching circuit (p. 6).

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

### 6.3 TX – RX

Temperature range for specification	$T_{SPEC}$	= -10 °C ... +85 °C
TX terminating impedance	$Z_{TX}$	= 50 $\Omega$ // 18 nH <sup>1)</sup>
ANT terminating impedance	$Z_{ANT}$	= 50 $\Omega$ // 18 nH <sup>1)</sup>
RX terminating impedance	$Z_{RX}$	= 50 $\Omega$ // 22 nH <sup>1)</sup>

Characteristics TX – RX			min. for $T_{SPEC}$	typ. @ +25 °C	max. for $T_{SPEC}$		
<b>Isolation</b>		$\alpha_{INT}$					
			703... 748 MHz	43 <sup>2)</sup>	54 <sup>2)</sup>	—	dB
			758... 803 MHz	45 <sup>2)</sup>	53 <sup>2)</sup>	—	dB
<b>Minimum isolation</b>		$\alpha_{min}$					
			703... 748 MHz	43 <sup>3)</sup>	53	—	dB
			758... 803 MHz	43 <sup>3)</sup>	52	—	dB

<sup>1)</sup> See Sec. Matching circuit (p. 6).

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

<sup>3)</sup> Valid for temperature  $T = +25$  °C...+85 °C.

## 7 Maximum ratings

Operable temperature	$T_{OP} = -40\text{ °C} \dots +95\text{ °C}$	
Storage temperature	$T_{STG} = -40\text{ °C} \dots +95\text{ °C}^{1)}$	
DC voltage	$ V_{DC}  = 0\text{ V}^{2)}$	
ESD voltage	$V_{ESD}$	
	250 V (max.) <sup>3)</sup>	Human body model.
	100 V (max.) <sup>4)</sup>	Machine model.
Input power	$P_{IN}$	
@ TX port: 758 ... 803 MHz	28 dBm <sup>5)</sup>	5 MHz LTE downlink signal (25 RB) for 100000 h @ 55 °C.
@ RX port: 703 ... 748 MHz	28 dBm <sup>5)</sup>	5 MHz LTE uplink signal (25 RB) for 27000 h @ 55 °C.

<sup>1)</sup> Not valid for packaging material. Storage temperature for packaging material is -25 °C to +40 °C.

<sup>2)</sup> In case of applied DC voltage blocking capacitors are mandatory.

<sup>3)</sup> According to JESD22-A114F (HBM – Human Body Model), 1 negative & 1 positive pulse.

<sup>4)</sup> According to JESD22-A115B (MM – Machine Model), 10 negative & 10 positive pulses.

<sup>5)</sup> Expected lifetime according to accelerated power durability tests, and wear out models.

8 Transmission coefficients

8.1 TX – ANT

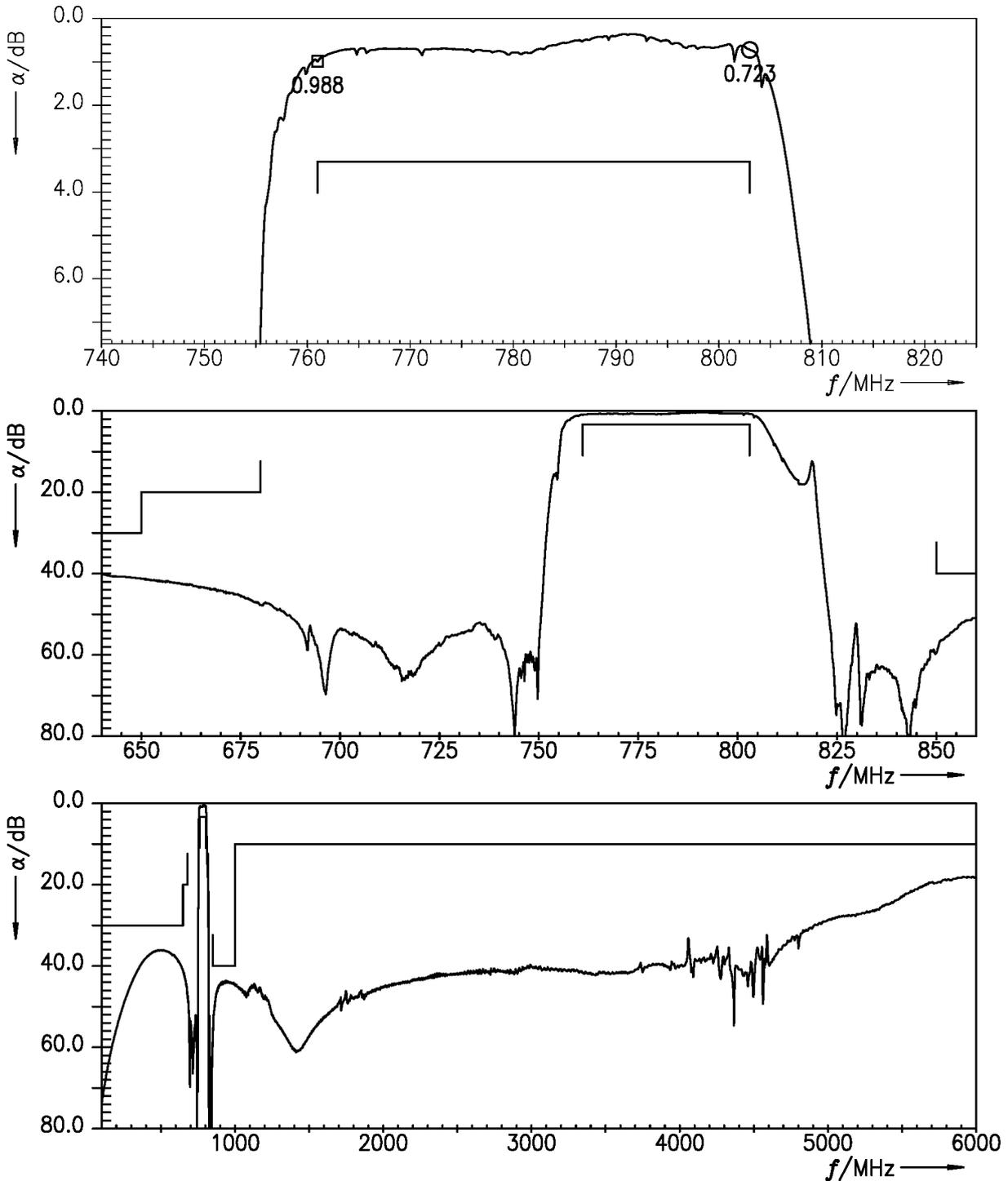


Figure 4: Attenuation TX – ANT.

8.2 ANT – RX

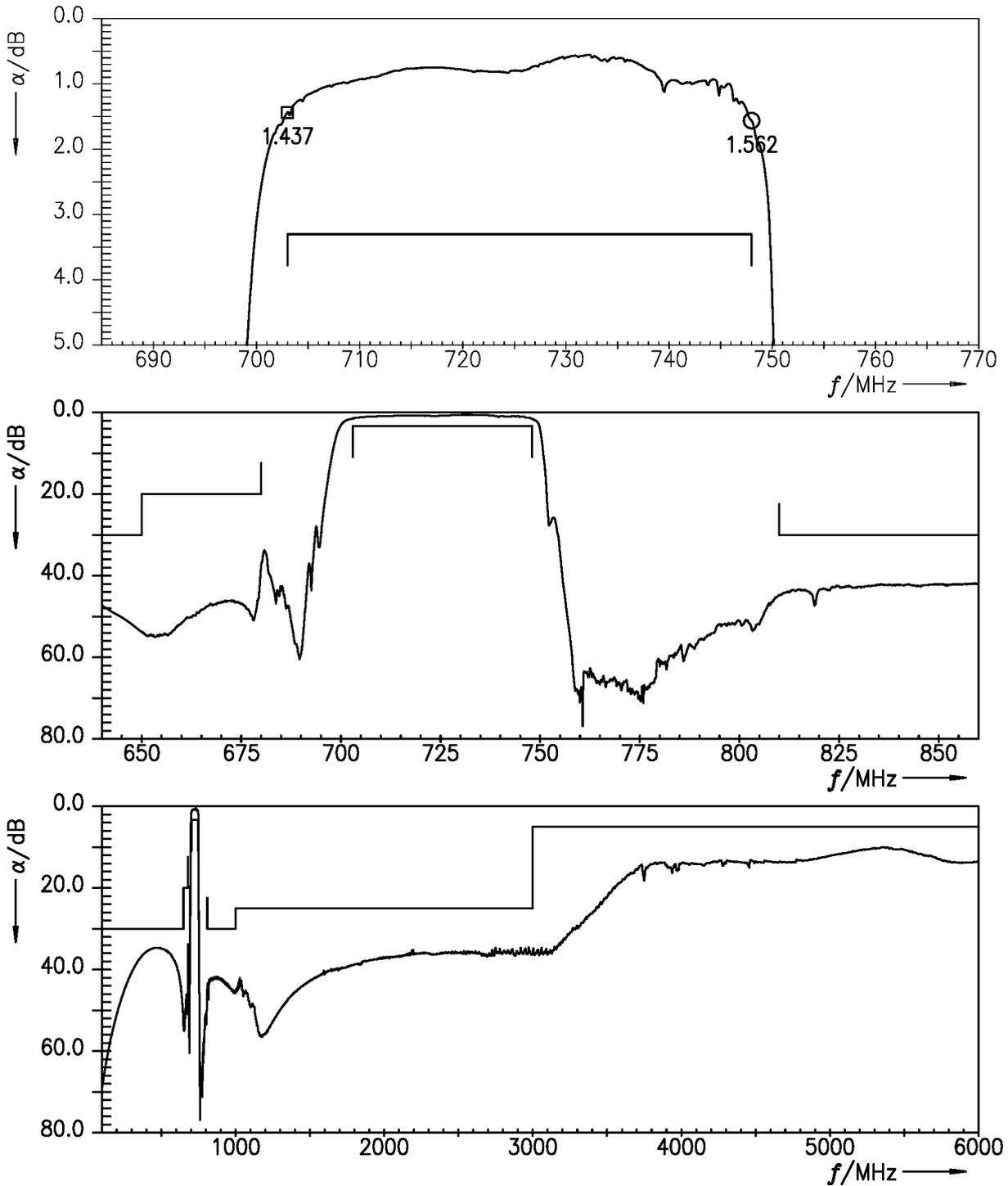


Figure 5: Attenuation ANT – RX.

8.3 TX – RX

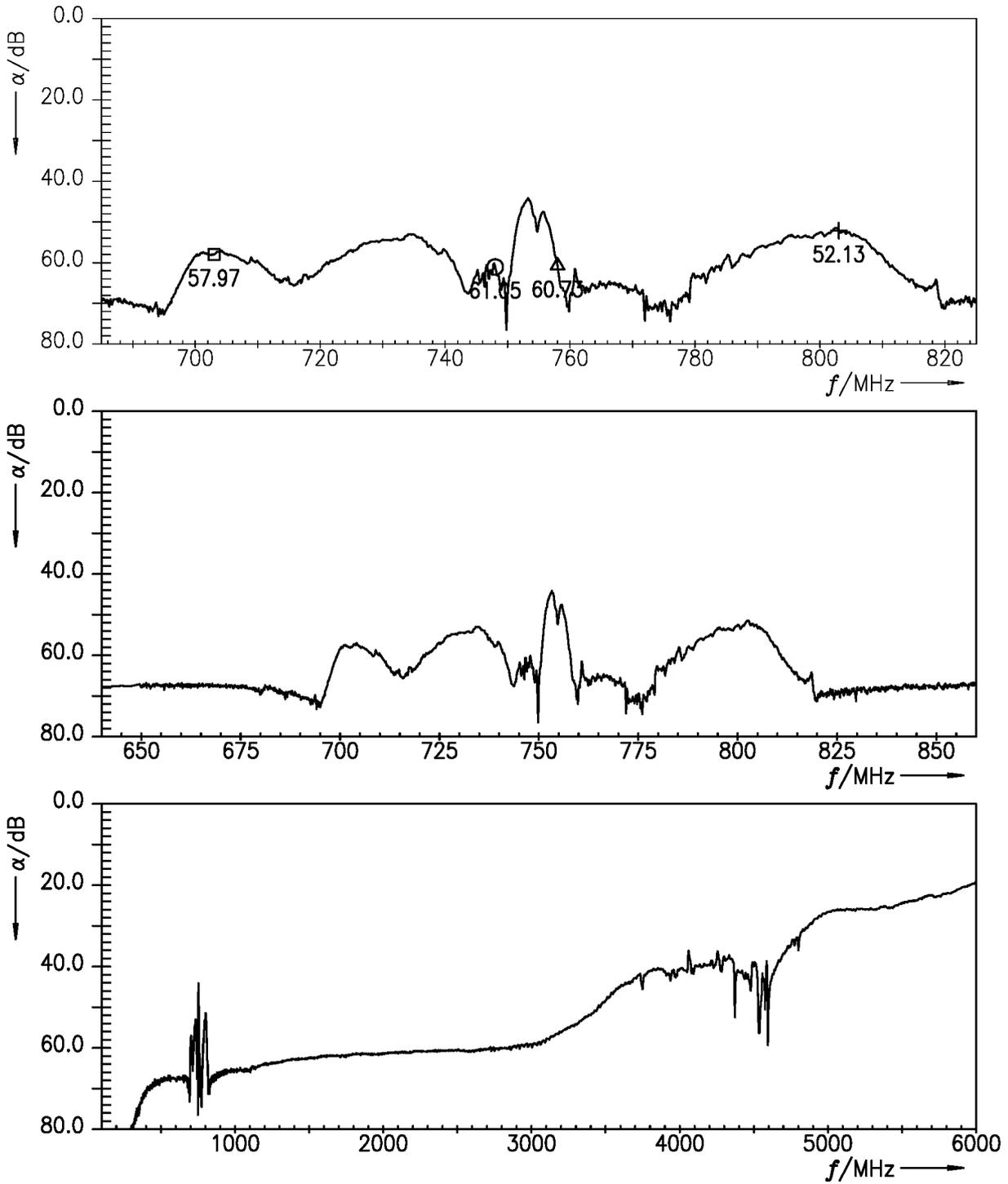


Figure 6: Isolation TX – RX.

9 Reflection coefficients

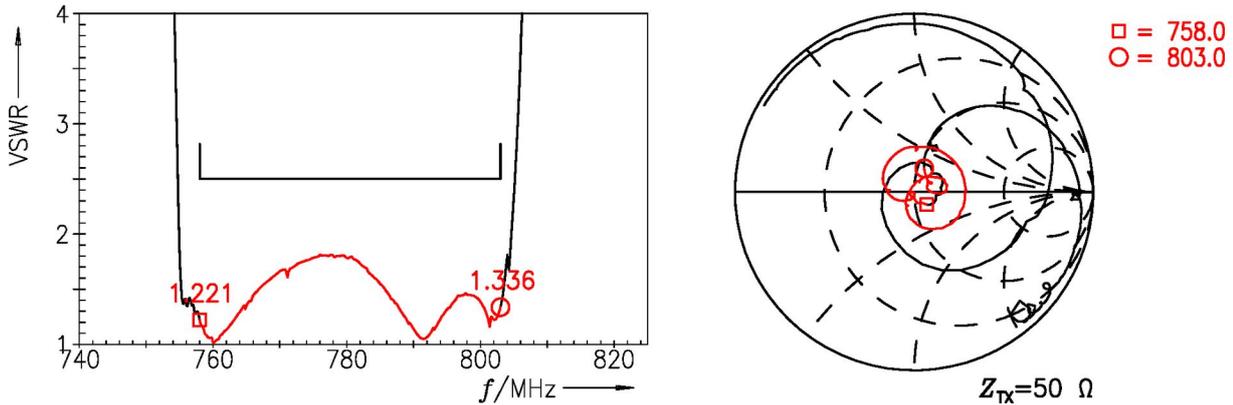


Figure 7: Reflection coefficient at TX port.

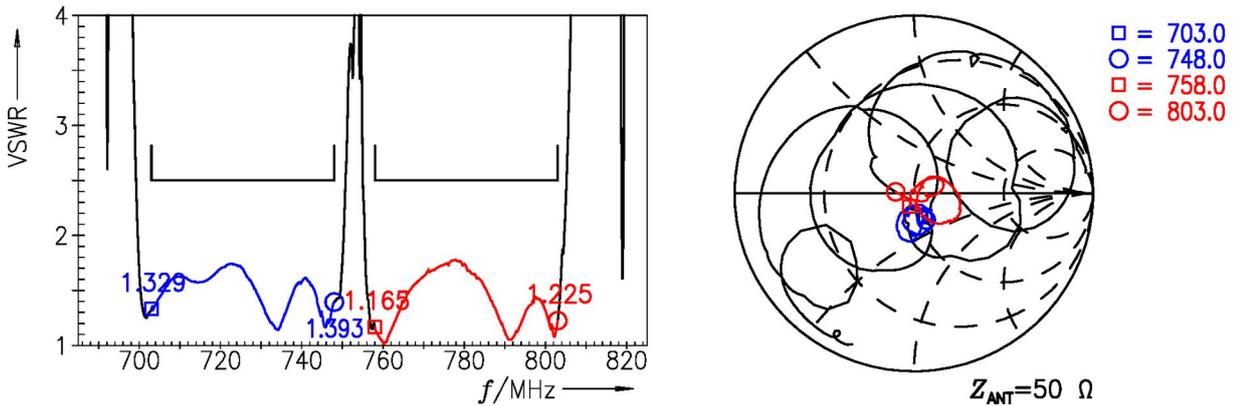


Figure 8: Reflection coefficient at ANT port (TX and RX frequencies).

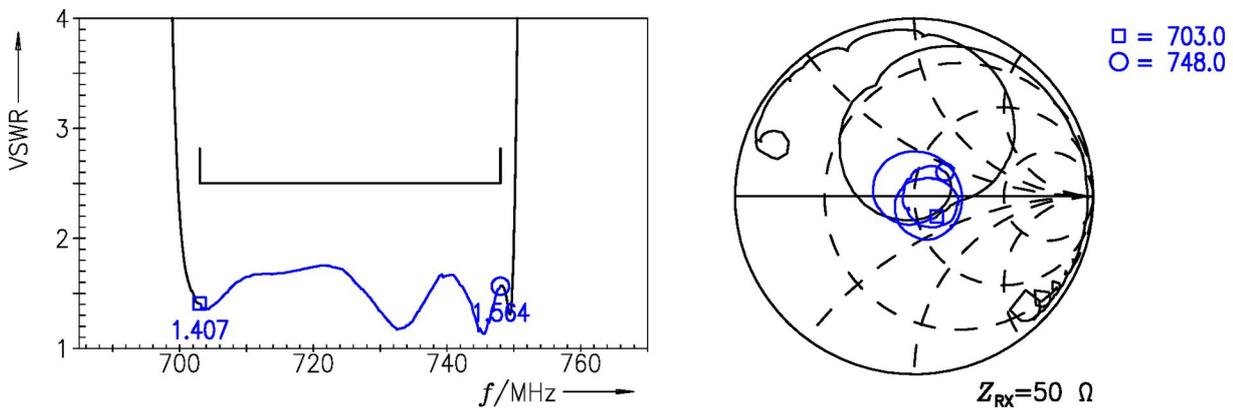
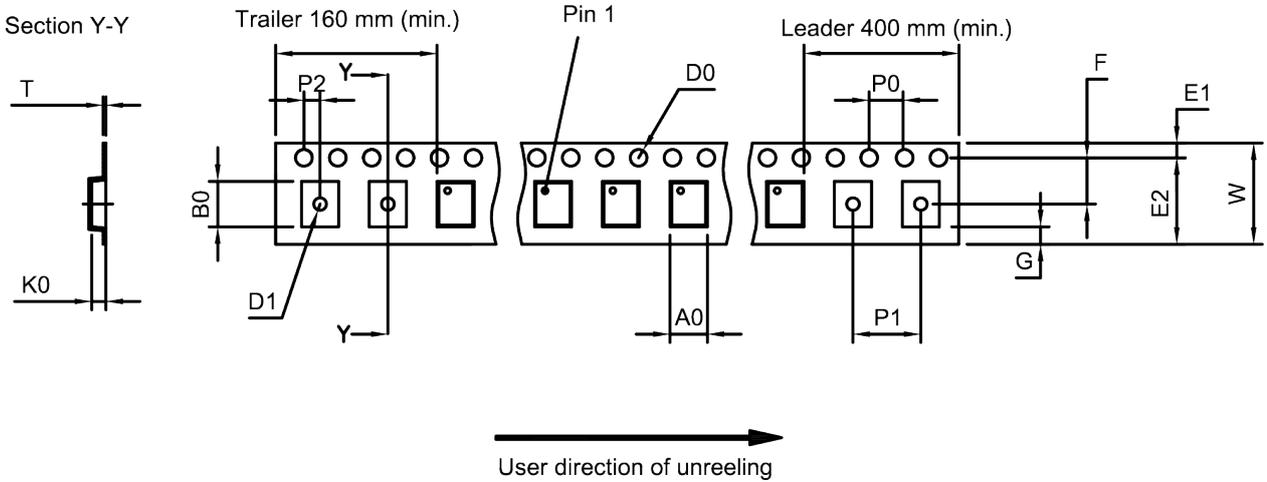


Figure 9: Reflection coefficient at RX port.

10 Packing material

10.1 Tape



**Figure 10:** Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

A <sub>0</sub>	2.2±0.05 mm	E <sub>2</sub>	6.25 mm (min.)	P <sub>1</sub>	4.0±0.1 mm
B <sub>0</sub>	2.7±0.05 mm	F	3.5±0.05 mm	P <sub>2</sub>	2.0±0.05 mm
D <sub>0</sub>	1.5+0.1/-0 mm	G	0.75 mm (min.)	T	0.25±0.03 mm
D <sub>1</sub>	1.0+0.1/-0 mm	K <sub>0</sub>	0.78±0.05 mm	W	8.0+0.3/-0.1 mm
E <sub>1</sub>	1.75±0.1 mm	P <sub>0</sub>	4.0±0.1 mm		

**Table 1:** Tape dimensions.

10.2 Reel with diameter of 180 mm

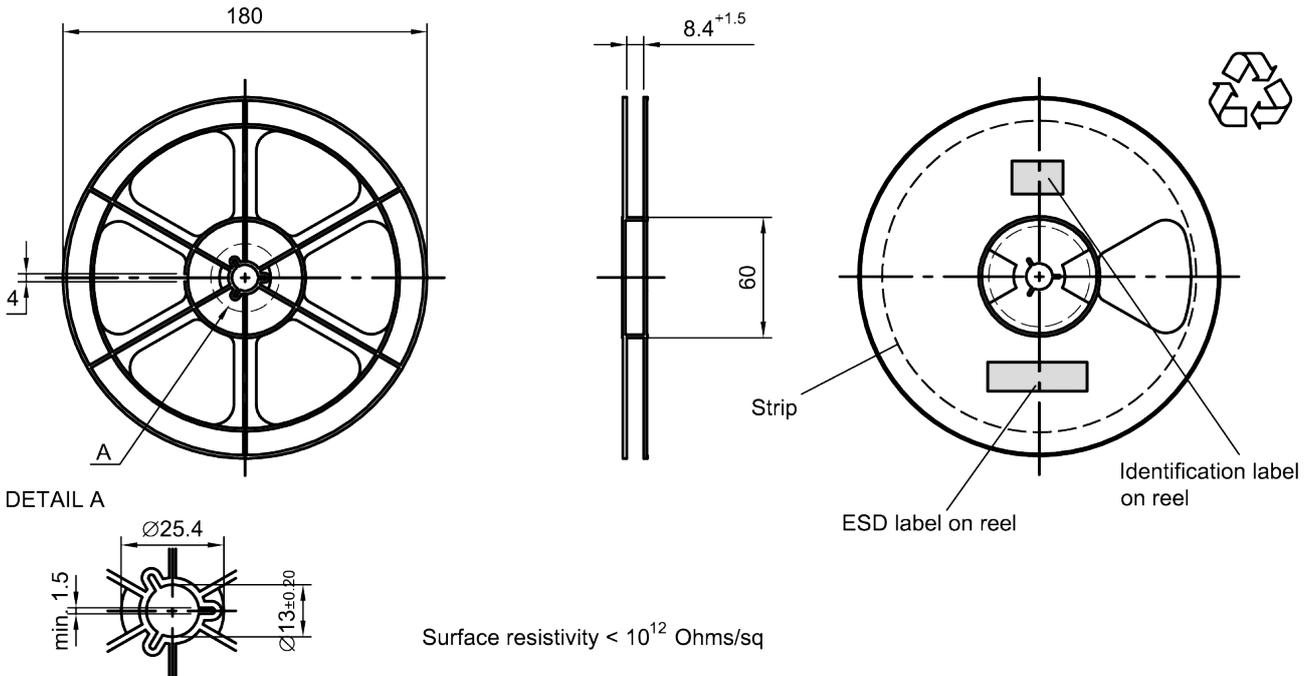


Figure 11: Drawing of reel (first-angle projection) with diameter of 180 mm.

Dimensions [mm]

X = 220+5

Y = 235+5

Sealing area 10±3

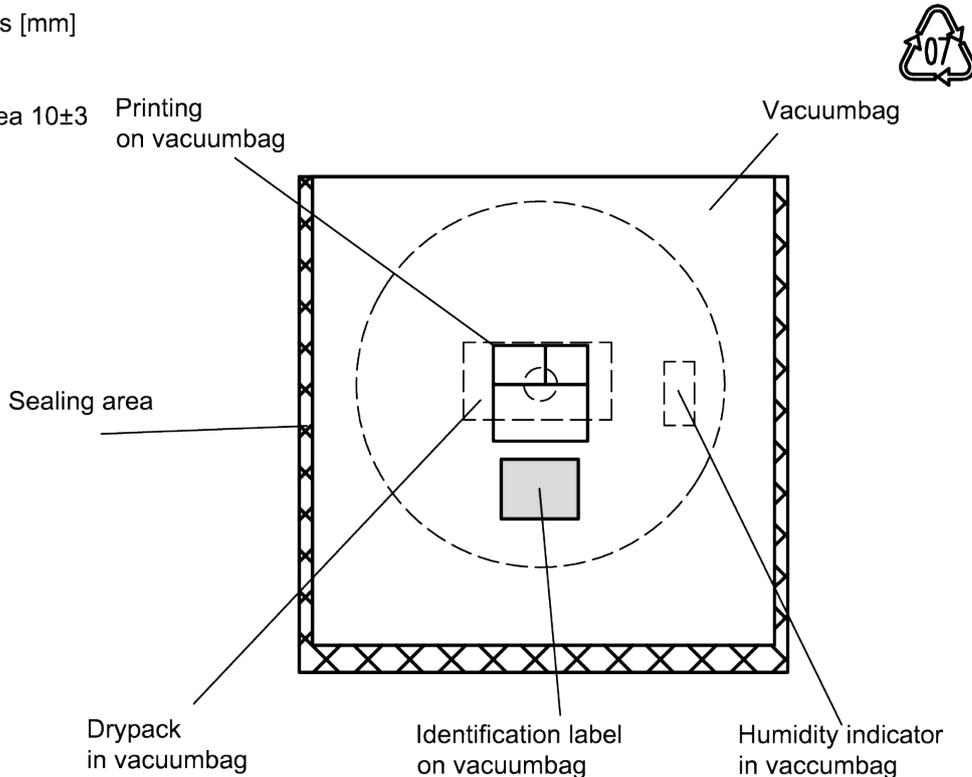


Figure 12: Drawing of moisture barrier bag (MBB) for reel with diameter of 180 mm.

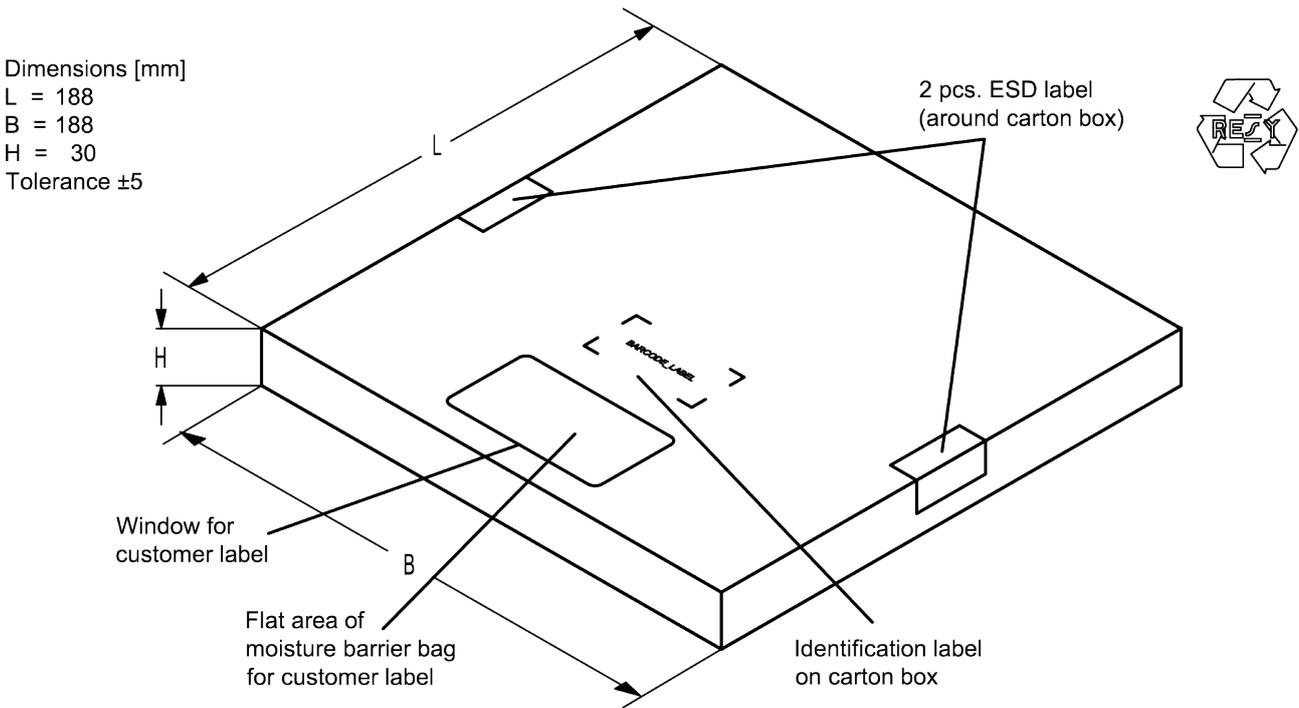


Figure 13: Drawing of folding box for reel with diameter of 180 mm.

### 10.3 Reel with diameter of 330 mm

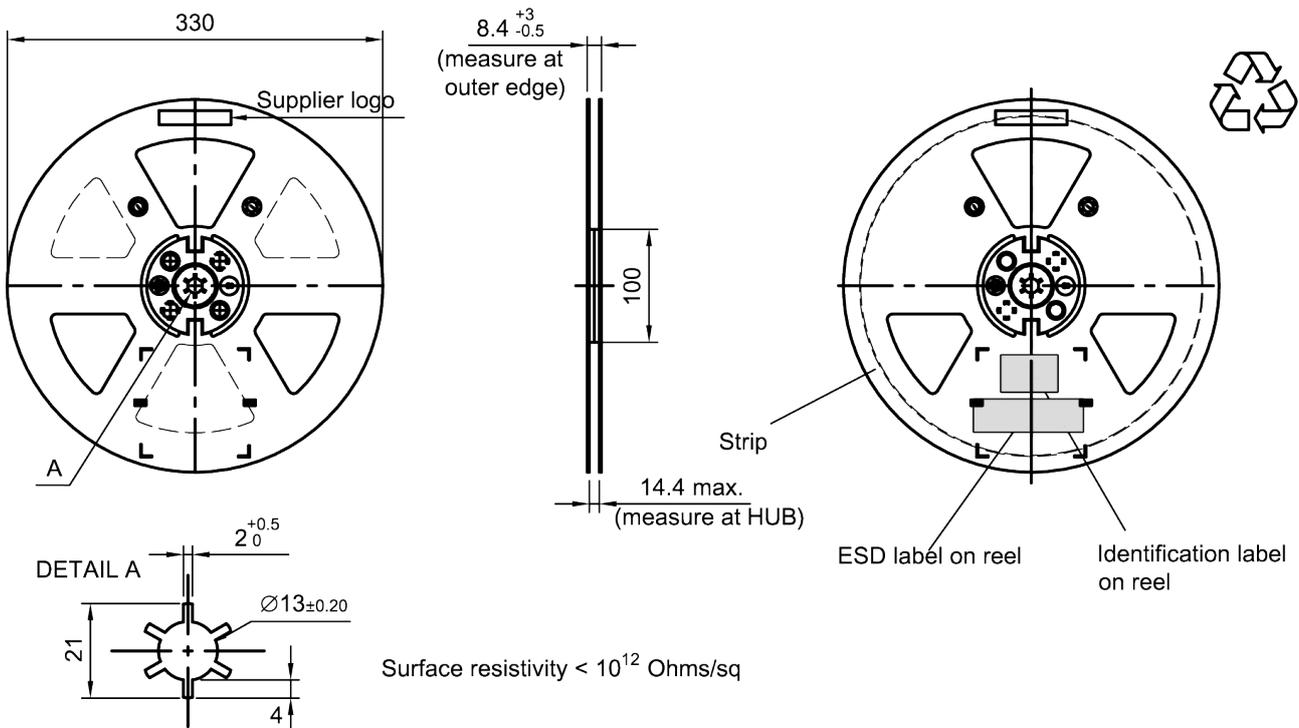


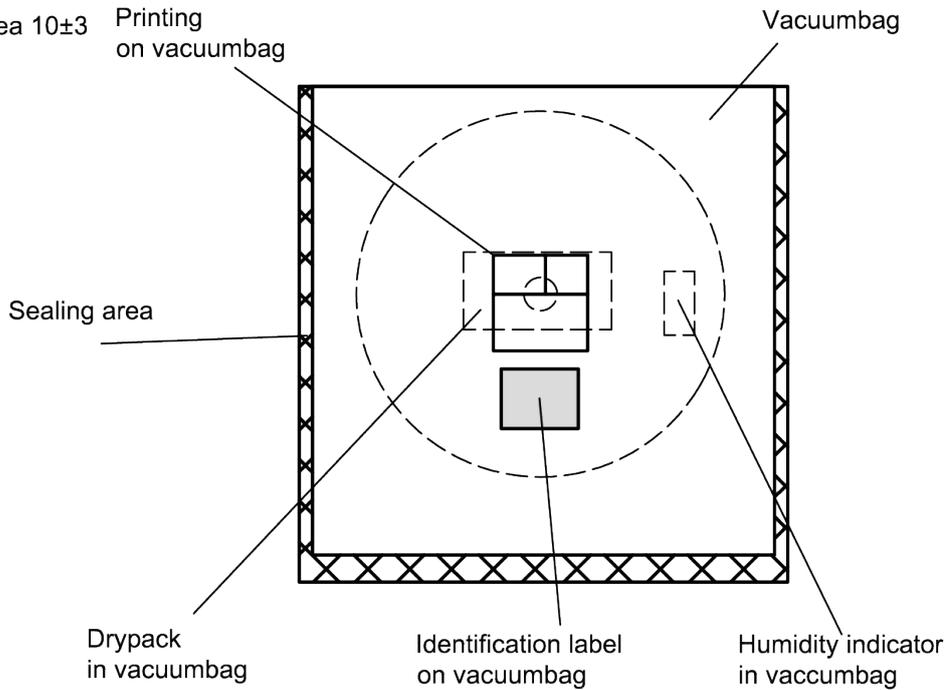
Figure 14: Drawing of reel (first-angle projection) with diameter of 330 mm.

Dimensions [mm]

X = 400+5

Y = 418+5

Sealing area 10±3



**Figure 15:** Drawing of moisture barrier bag (MBB) for reel with diameter of 330 mm.

Dimensions [mm]

L = 335

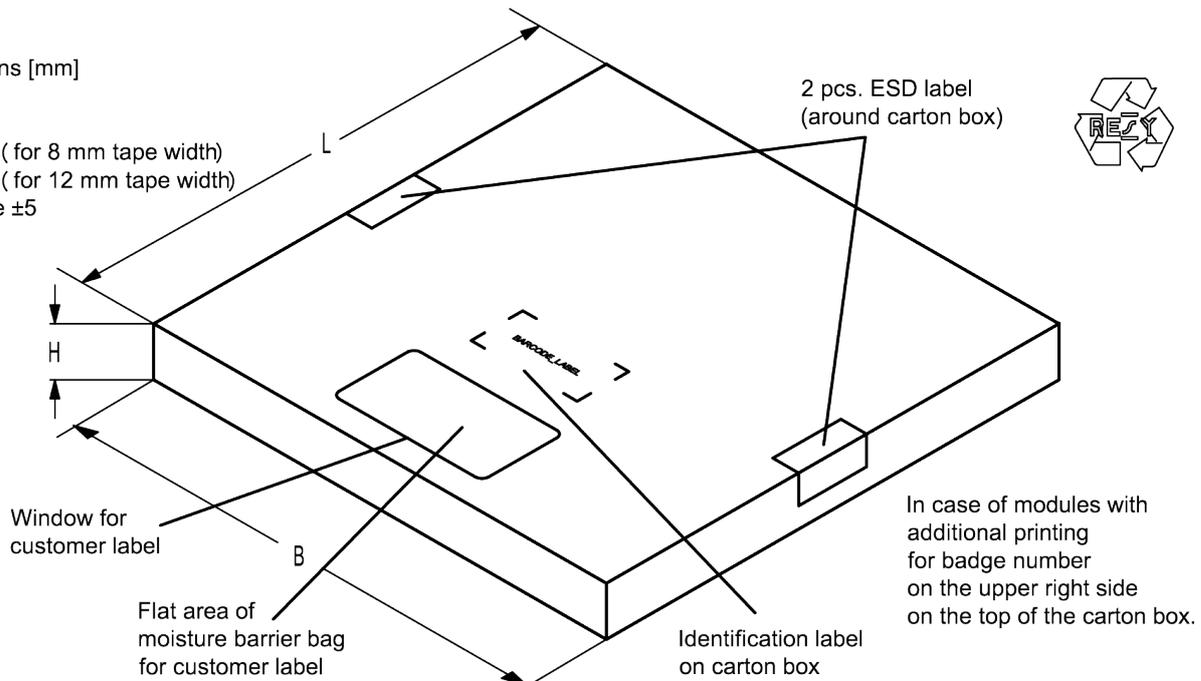
B = 338

H = 36 ( for 8 mm tape width)

40 ( for 12 mm tape width)

Tolerance ±5

2 pcs. ESD label  
(around carton box)



**Figure 16:** Drawing of folding box for reel with diameter of 330 mm.

**11 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., B3xxxxB**1234**xxxx,  
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**  
 $1 \times 32^2 + 6 \times 32^1 + 18 (=J) \times 32^0 =$  **1234**  
 The BASE32 code for product type B8216 is 80R.

■ 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**  
 $5 \times 47^2 + 27 (=U) \times 47^1 + 31 (=Y) \times 47^0 =$  **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		

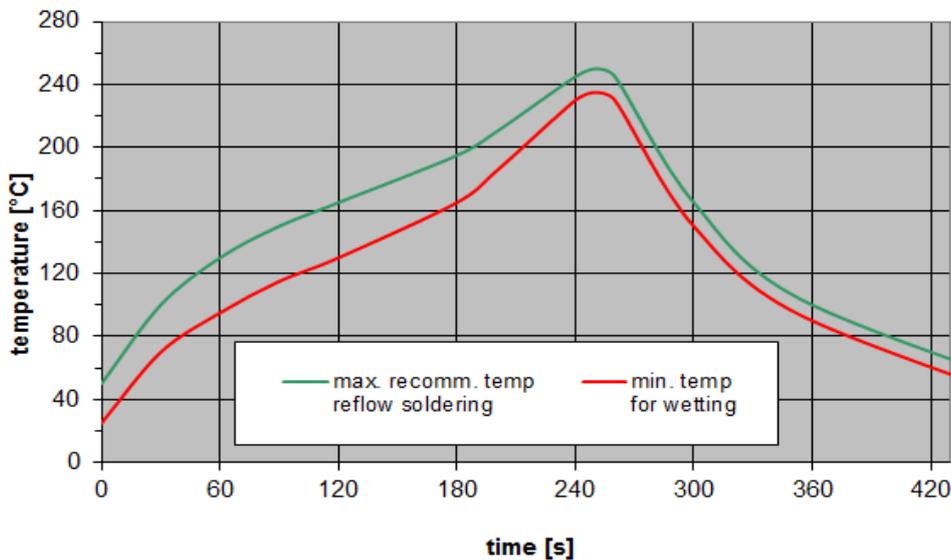
**Table 2:** Lists for encoding and decoding of marking.

## 12 Soldering profile

The recommended soldering process is in accordance with IEC 60068-2-58 – 3<sup>rd</sup> 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
$T > 220\text{ °C}$	30 s to 70 s
$T > 230\text{ °C}$	min. 10 s
$T > 245\text{ °C}$	max. 20 s
$T \geq 255\text{ °C}$	–
peak temperature $T_{\text{peak}}$	250 °C +0/-5 °C
wetting temperature $T_{\text{min}}$	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 17:** Recommended reflow profile for convection and infrared soldering – lead-free solder.

### 13 Annotations

#### 13.1 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.

#### 13.2 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.

#### 13.3 Ordering codes, product IDs, labels, and packing units

Ordering code	Product ID	RF360 label	Packing unit
B39781B8216P810	B39781-B8216-P810-S05	B39781B8216P810S 5	5000 pcs

**Table 4:** Ordering codes / product IDs and packing units.

## 14 Cautions and warnings

### 14.1 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://rfe.qualcomm.com/>.

### 14.2 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.

### 14.3 Moldability

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

### 14.4 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.

### 15 ESD protection of acoustic devices

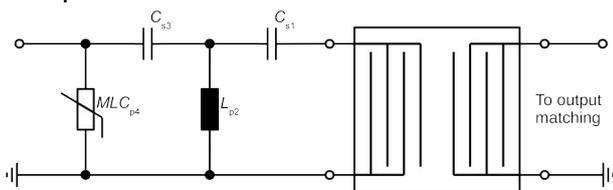
Acoustic devices are **Electro Static Discharge** sensitive devices. To reduce the probability of damages caused by ESD, special matching topologies must be applied.

In general, “ESD matching” must be ensured at that electrical port, where electrostatic discharge is expected.

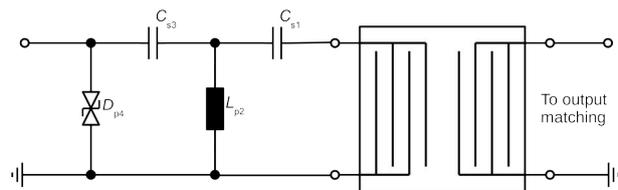
Electrostatic discharges predominantly appear at the antenna input of RF receivers. Therefore, only the input matching of the acoustic device must be designed to short circuit or to block the ESD pulse.

Below three figures show recommended “ESD matching” topologies.

For wide band acoustic devices the high-pass ESD matching structure needs to be at least of 3<sup>rd</sup> order to ensure a proper matching for any impedance value of antenna and input port. The required component values must be determined from case to case.

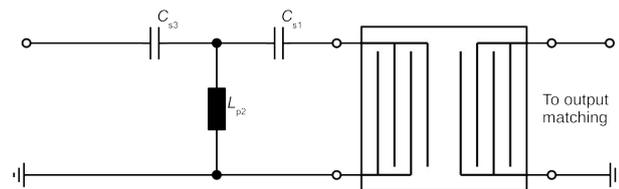


**Figure 18:** MLC varistor plus ESD matching.



**Figure 19:** Suppressor diode plus ESD matching.

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



**Figure 20:** 3<sup>rd</sup> 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://rfe.qualcomm.com>.

## 16 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.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified**. In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or life-saving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
3. **The warnings, cautions and product-specific notes must be observed.**
4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous)**. Useful information on this will be found in our Material Data Sheets on the Internet (<https://rfe.qualcomm.com>). Should you have any more detailed questions, please contact our sales offices.
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