RF360
Europe GmbH

Data sheet

SAW duplexer

Small cell & femtocell
LTE band 71

Part number:	B8213
Ordering code:	B39681B8213P810
Date:	September 16, 2020
Version:	2.0

RF360 Europe GmbH, Anzinger Str. 13, München, Germany

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1 Application

- Low-loss SAW duplexer for LTE small cell & femtocell systems (Band 71)
- Usable pass band 35MHz
- Tx = Downlink = 617MHz – 652MHz
- Rx = Uplink = 663MHz – 698MHz

2 Features

- Package size $2.5_{\pm 0.1}$ mm × $2.0_{\pm 0.1}$ 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)

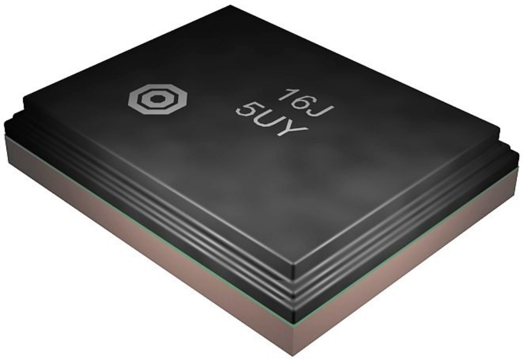
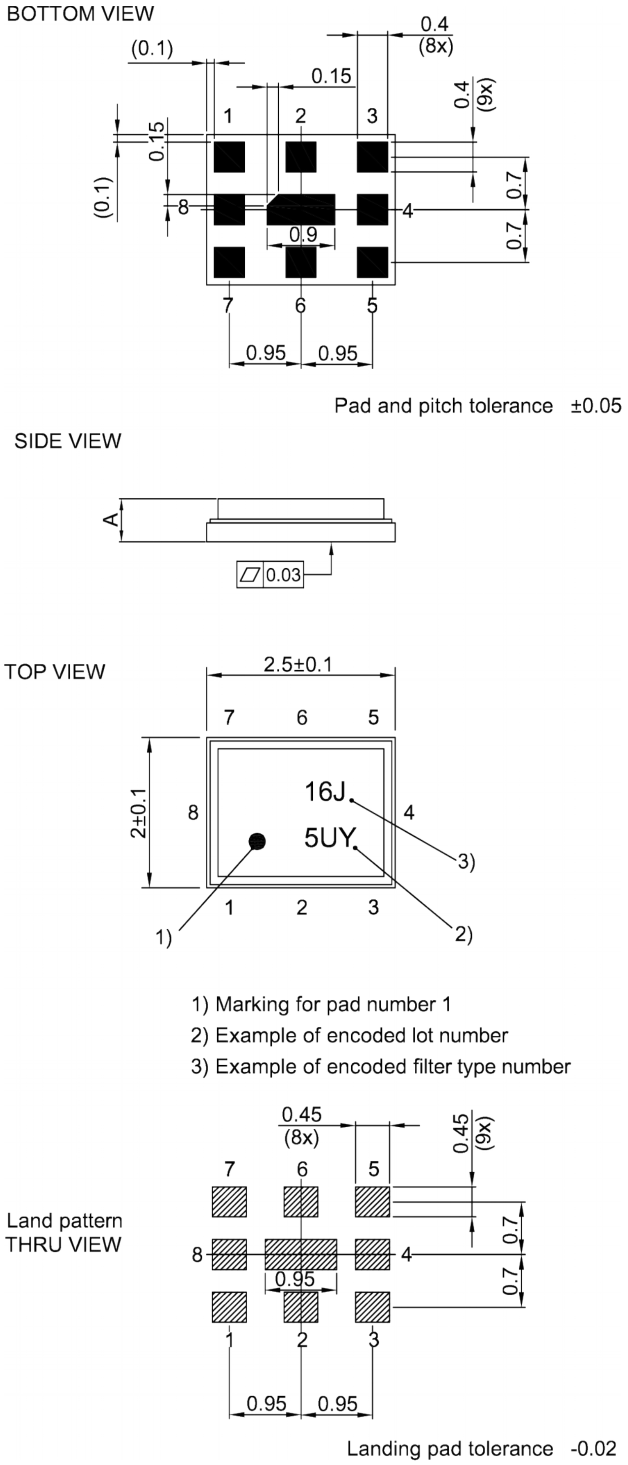


Figure 1: Picture of component with example of product marking.

3 Package



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

Figure 2: Drawing of package with package height A = 0.5 mm (max.). See Sec. Package information (p. 25).

4 Pin configuration

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

5 Matching circuit

- L_{p6} = 16 nH

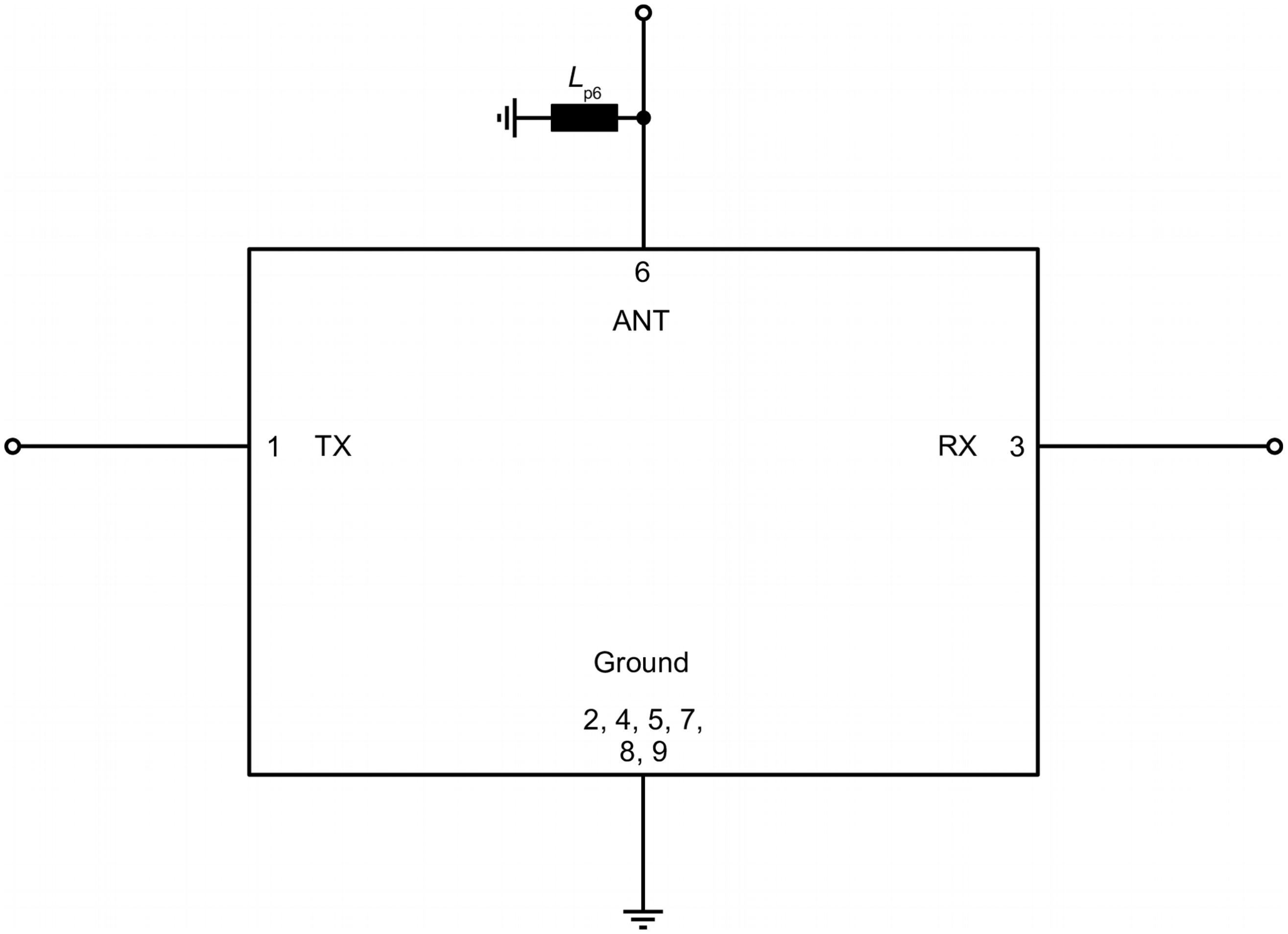


Figure 3: Schematic of matching circuit.

6 Characteristics

6.1 TX – ANT

Temperature range for specification T_{SPEC} = −10 °C ... +85 °C
TX terminating impedance Z_{TX} = 50 Ω
ANT terminating impedance Z_{ANT} = 50 Ω // 16 nH[1]
RX terminating impedance Z_{RX} = 50 Ω

Characteristics TX – ANT				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Center frequency			f_C	—	634.5	—	MHz
Insertion attenuation			α_{INT}				
	617 ... 622	MHz		—	1.1[2]	2.0[2]	dB
	622 ... 647	MHz		—	1.3[2]	2.0[2]	dB
	647 ... 652	MHz		—	1.6[2]	2.3[2]	dB
Maximum insertion attenuation			α_{max}				
	617.25 ... 651.75	MHz		—	2.0	3.3	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	617.25 ... 651.75	MHz		—	1.1	2.3	dB
Maximum VSWR			$VSWR_{max}$				
@ TX port	617.25 ... 651.75	MHz		—	1.7	2.4	
@ ANT port	617.25 ... 651.75	MHz		—	1.7	2.4	
Attenuation			α_{min}				
	10 ... 602	MHz		28	39	—	dB
	663 ... 698	MHz		45[2]	56[2]	—	dB
	698 ... 728	MHz		35	43	—	dB
	729 ... 768	MHz		35	39	—	dB
	814 ... 849	MHz		30	38	—	dB
	849 ... 894	MHz		20	32	—	dB
	1166 ... 1187	MHz		30	43	—	dB
	1559 ... 1606	MHz		30	51	—	dB
	1710 ... 1995	MHz		30	45	—	dB
	2305 ... 2690	MHz		30	41	—	dB
	3550 ... 3700	MHz		30	42	—	dB
	5150 ... 5850	MHz		7	11	—	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.

Temperature range for specification	T_{SPEC}	= −40 °C ... +95 °C
TX terminating impedance	Z_{TX}	= 50 Ω
ANT terminating impedance	Z_{ANT}	= 50 Ω // 16 nH[1]
RX terminating impedance	Z_{RX}	= 50 Ω

Characteristics TX – ANT				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Insertion attenuation			α_{INT}				
	617 ... 622	MHz		—	1.1[2]	3.0[2]	dB
	622 ... 647	MHz		—	1.3[2]	2.0[2]	dB
	647 ... 652	MHz		—	1.6[2]	3.0[2]	dB
Maximum insertion attenuation			α_{max}				
	617.25 ... 651.75	MHz		—	2.0	4.2	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	617.25 ... 651.75	MHz		—	1.1	3.9	dB
Maximum VSWR			$VSWR_{max}$				
@ TX port	617.25 ... 651.75	MHz		—	1.7	2.5	
@ ANT port	617.25 ... 651.75	MHz		—	1.7	2.5	
Attenuation			α_{min}				
	10 ... 602	MHz		25	39	—	dB
	663 ... 698	MHz		35[2]	56[2]	—	dB
	698 ... 728	MHz		35	43	—	dB
	729 ... 768	MHz		35	39	—	dB
	814 ... 849	MHz		30	38	—	dB
	849 ... 894	MHz		20	32	—	dB
	1166 ... 1187	MHz		30	43	—	dB
	1559 ... 1606	MHz		30	51	—	dB
	1710 ... 1995	MHz		28	45	—	dB
	2305 ... 2690	MHz		20	41	—	dB
	3550 ... 3700	MHz		20	42	—	dB
	5150 ... 5850	MHz		7	11	—	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.

6.2 ANT – RX

Temperature range for specification T_{SPEC} = −10 °C ... +85 °C
TX terminating impedance Z_{TX} = 50 Ω
ANT terminating impedance Z_{ANT} = 50 Ω // 16 nH[1)]
RX terminating impedance Z_{RX} = 50 Ω

Characteristics ANT – RX				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Center frequency			f_C	—	680.5	—	MHz
Insertion attenuation			α_{INT}				
	663 ... 668	MHz		—	1.8[2)]	3.0[2)]	dB
	668 ... 693	MHz		—	1.3[2)]	2.5[2)]	dB
	693 ... 698	MHz		—	1.3[2)]	2.5[2)]	dB
Maximum insertion attenuation			α_{max}				
	663.25 ... 665	MHz		—	2.3	4.7	dB
	665 ... 697.75	MHz		—	1.8	3.5	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	663.25 ... 665	MHz		—	1.4	3.7	dB
	665 ... 697.75	MHz		—	0.9	2.7	dB
Maximum VSWR			$VSWR_{max}$				
@ ANT port	663.25 ... 697.75	MHz		—	1.6	2.0	
@ RX port	663.25 ... 697.75	MHz		—	1.7	2.0	
Attenuation			α_{min}				
	10 ... 617	MHz		40	47	—	dB
	617 ... 652	MHz		50[2)]	59[2)]	—	dB
	717 ... 728	MHz		32	37	—	dB
	729 ... 768	MHz		40	52	—	dB
	814 ... 894	MHz		25	41	—	dB
	1710 ... 2690	MHz		45	57	—	dB
	3550 ... 3700	MHz		35	46	—	dB
	5150 ... 5850	MHz		12	22	—	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.

Temperature range for specification T_{SPEC} = −40 °C ... +95 °C
TX terminating impedance Z_{TX} = 50 Ω
ANT terminating impedance Z_{ANT} = 50 Ω // 16 nH[1]
RX terminating impedance Z_{RX} = 50 Ω

Characteristics ANT – RX				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Insertion attenuation			α_{INT}				
	663 ... 668	MHz		—	1.8[2]	3.5[2]	dB
	668 ... 693	MHz		—	1.3[2]	3.0[2]	dB
	693 ... 698	MHz		—	1.3[2]	3.0[2]	dB
Maximum insertion attenuation			α_{max}				
	663.25 ... 665	MHz		—	2.3	5.7	dB
	665 ... 697.75	MHz		—	1.8	4.5	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	663.25 ... 665	MHz		—	1.4	4.7	dB
	665 ... 697.75	MHz		—	0.9	3.7	dB
Maximum VSWR			$VSWR_{max}$				
@ ANT port	663.25 ... 697.75	MHz		—	1.6	2.3	
@ RX port	663.25 ... 697.75	MHz		—	1.7	2.3	
Attenuation			α_{min}				
	10 ... 617	MHz		40	47	—	dB
	617 ... 652	MHz		47[2]	59[2]	—	dB
	717 ... 728	MHz		30	37	—	dB
	729 ... 768	MHz		40	52	—	dB
	814 ... 894	MHz		25	41	—	dB
	1710 ... 2690	MHz		45	57	—	dB
	3550 ... 3700	MHz		35	46	—	dB
	5150 ... 5850	MHz		12	22	—	dB

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[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.

6.3 TX – RX

Temperature range for specification	T_{SPEC}	= −10 °C ... +85 °C
TX terminating impedance	Z_{TX}	= 50 Ω
ANT terminating impedance	Z_{ANT}	= 50 Ω // 16 nH[1)]
RX terminating impedance	Z_{RX}	= 50 Ω

Characteristics TX – RX				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Isolation			α_{INT}				
	617 ... 652	MHz		52[2)]	60[2)]	—	dB
	663 ... 668	MHz		50[2)]	58[2)]	—	dB
	668 ... 698	MHz		50[2)]	58[2)]	—	dB
Minimum isolation			α_{min}				
	617 ... 652	MHz		52	60	—	dB
	663 ... 665	MHz		47	57	—	dB
	665 ... 698	MHz		50	57	—	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.

Temperature range for specification T_{SPEC} = −40 °C ... +95 °C
TX terminating impedance Z_{TX} = 50 Ω
ANT terminating impedance Z_{ANT} = 50 Ω // 16 nH(1)
RX terminating impedance Z_{RX} = 50 Ω

Characteristics TX – RX				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Isolation			α_{INT}				
	617 ... 652	MHz		50(2)	60(2)	—	dB
	663 ... 668	MHz		45(2)	58(2)	—	dB
	668 ... 698	MHz		50(2)	58(2)	—	dB
Minimum isolation			α_{min}				
	617 ... 652	MHz		50	60	—	dB
	663 ... 665	MHz		35	57	—	dB
	665 ... 698	MHz		50	57	—	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.

7 Maximum ratings

Operable temperature	T_{OP} = −40 °C ... +95 °C	
Storage temperature	T_{STG} = −40 °C ... +95 °C[1]	
DC voltage	$\|V_{DC}\|$ = 0 V[2]	
ESD voltage	V_{ESD}	
	250 V (max.)[3]	Human body model.
	100 V (max.)[4]	Machine model.
Input power @ TX port: 617 ... 652 MHz	P_{IN} = 28 dBm[5), 6)]	5 MHz LTE downlink signal (25 RB) for 100000 h @ 55 °C.

[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-A114F (HBM – Human Body Model), 1 negative & 1 positive pulse.
[4] According to JESD22-A115B (MM – Machine Model), 10 negative & 10 positive pulses.
[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 28dBm are valid for temperature up to 55°C.

8 Transmission coefficients

8.1 TX – ANT

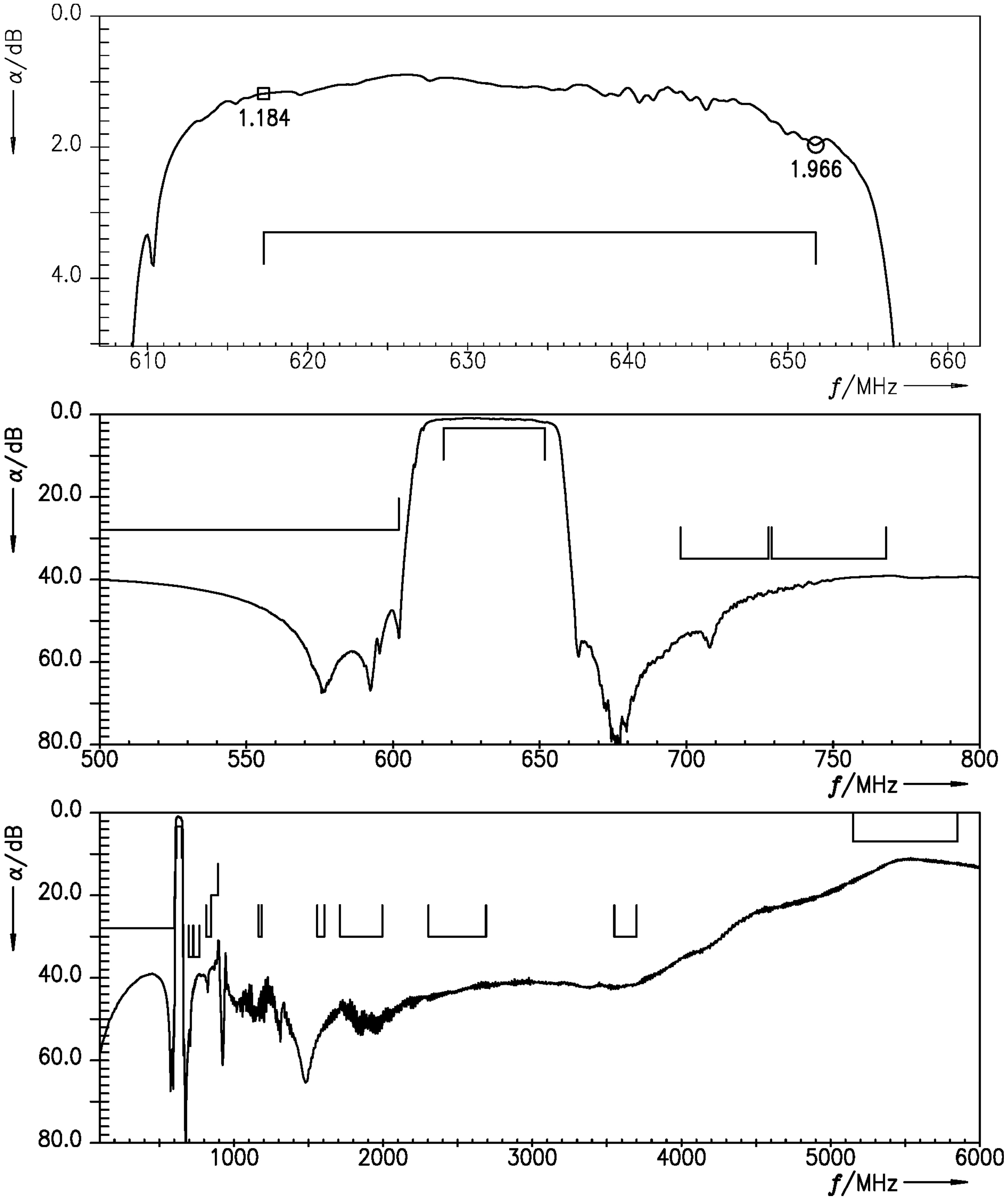


Figure 4: Attenuation TX – ANT.

8.2 ANT – RX

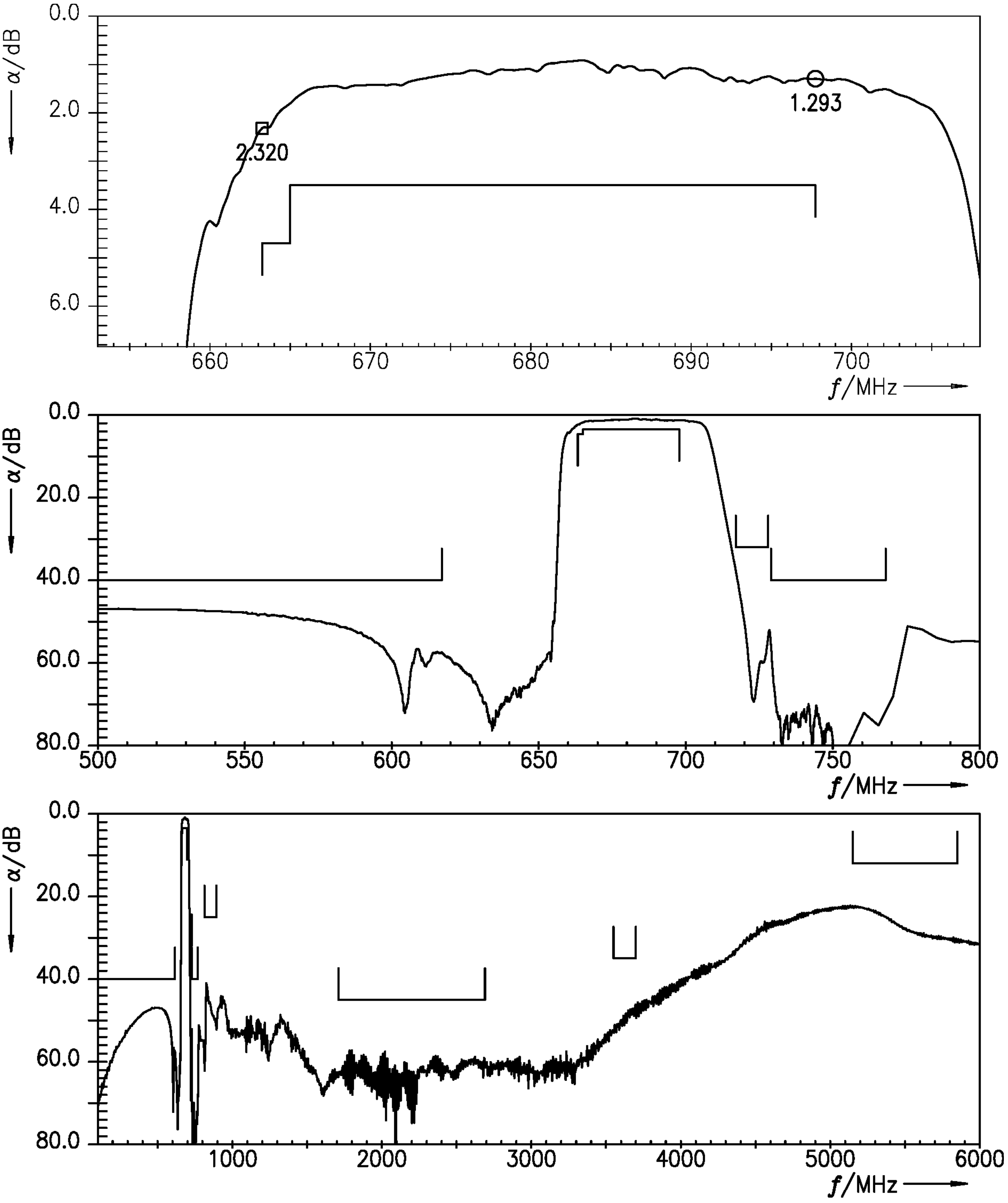


Figure 5: Attenuation ANT – RX.

8.3 TX – RX

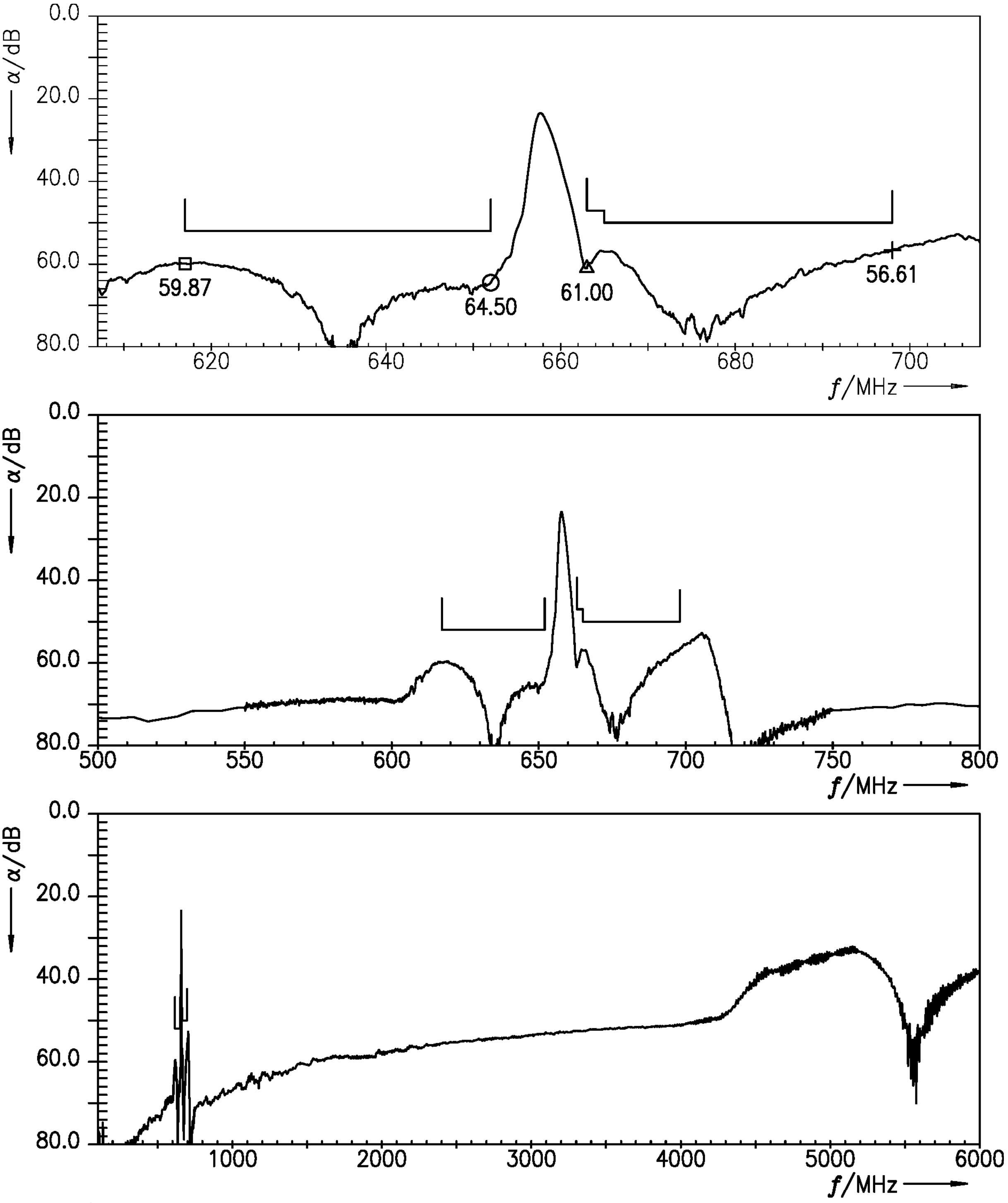


Figure 6: Isolation TX – RX.

9 Reflection coefficients

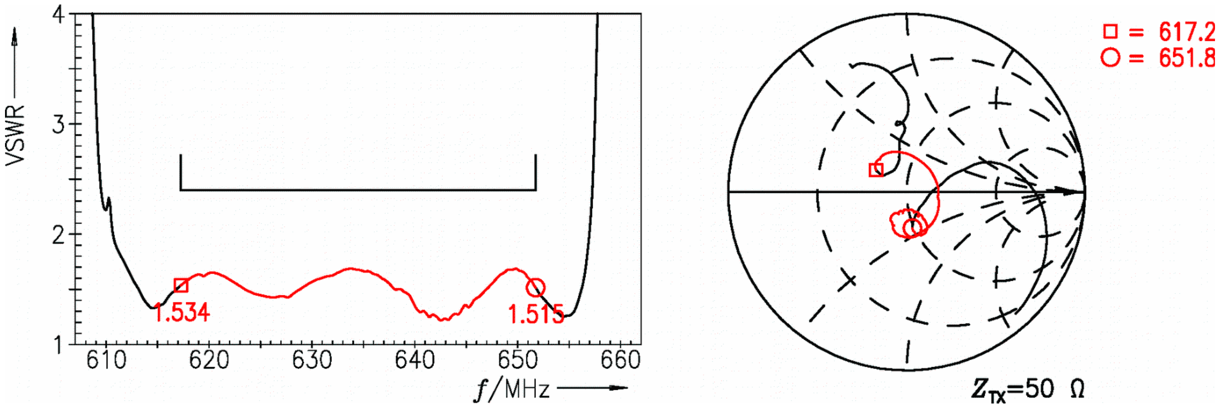


Figure 7: Reflection coefficient at TX port.

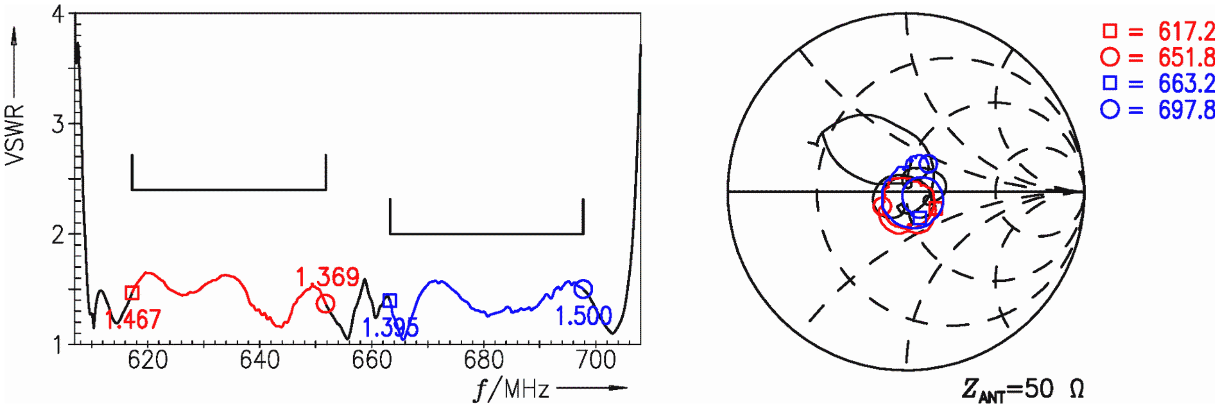


Figure 8: Reflection coefficient at ANT port.

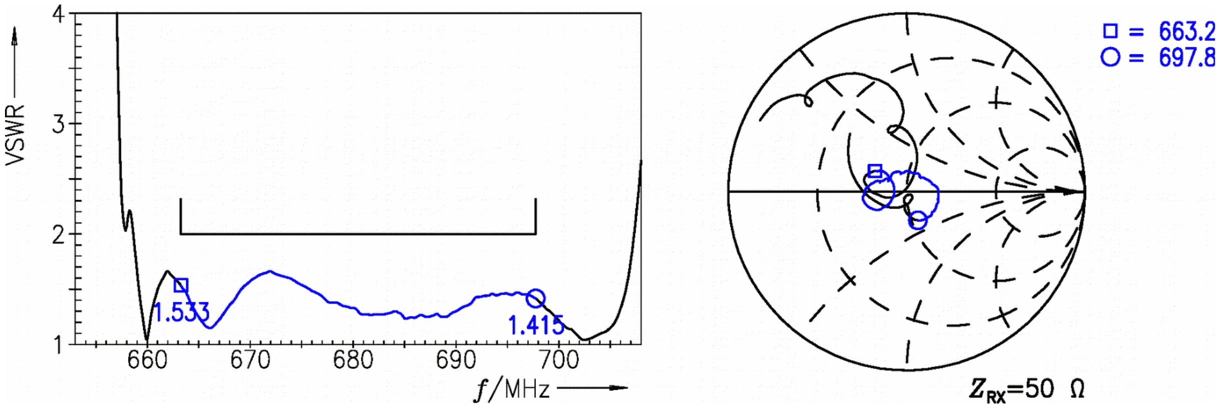


Figure 9: Reflection coefficient at RX port.

10 Packing material

10.1 Tape

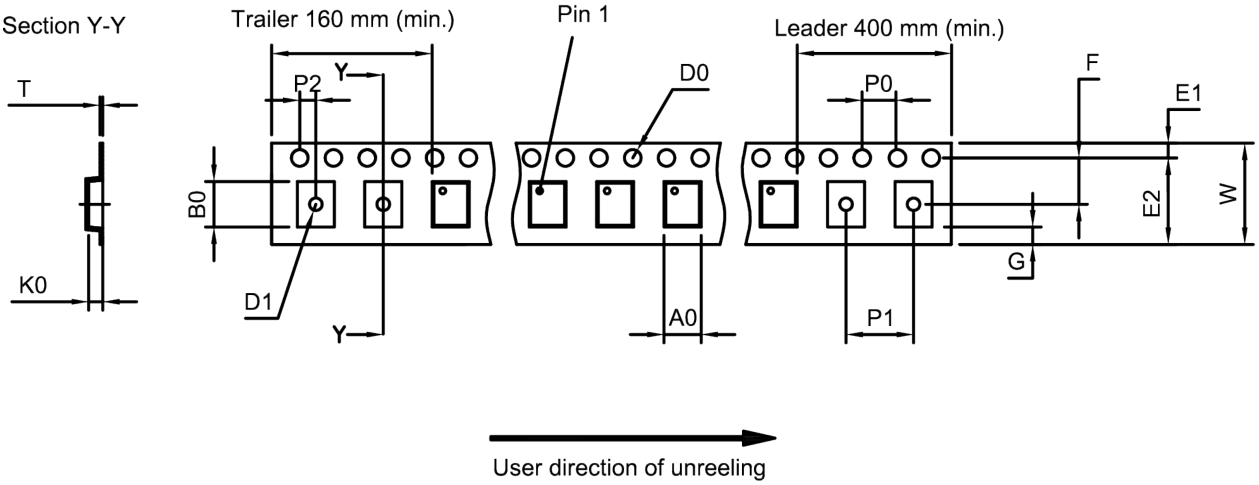


Figure 10: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

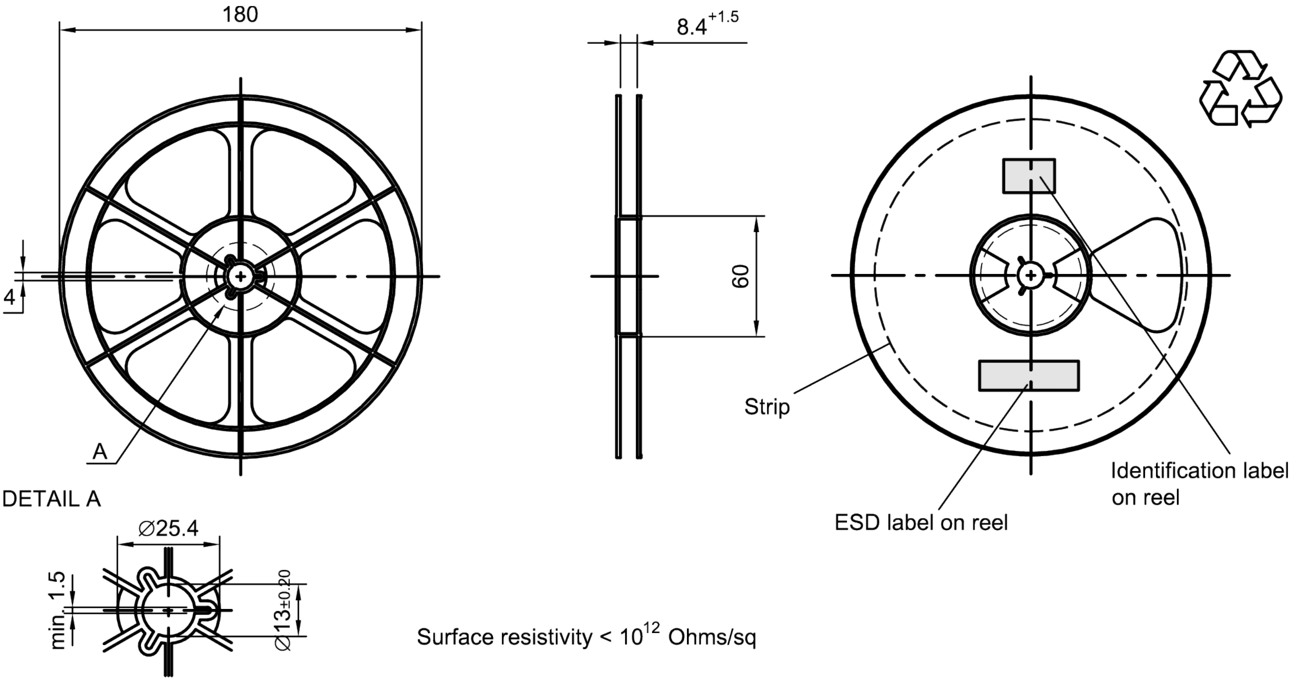
A_0	2.25±0.05 mm
B_0	2.75±0.05 mm
D_0	1.5+0.1/−0 mm
D_1	1.0 mm (min.)
E_1	1.75±0.1 mm

E_2	6.25 mm (min.)
F	3.5±0.05 mm
G	0.75 mm (min.)
K_0	0.6±0.05 mm
P_0	4.0±0.1 mm

P_1	4.0±0.1 mm
P_2	2.0±0.05 mm
T	0.25±0.03 mm
W	8.0+0.3/−0.1 mm

Table 1: Tape dimensions.

10.2 Reel with diameter of 180 mm



Surface resistivity < 10^{12} Ohms/sq

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

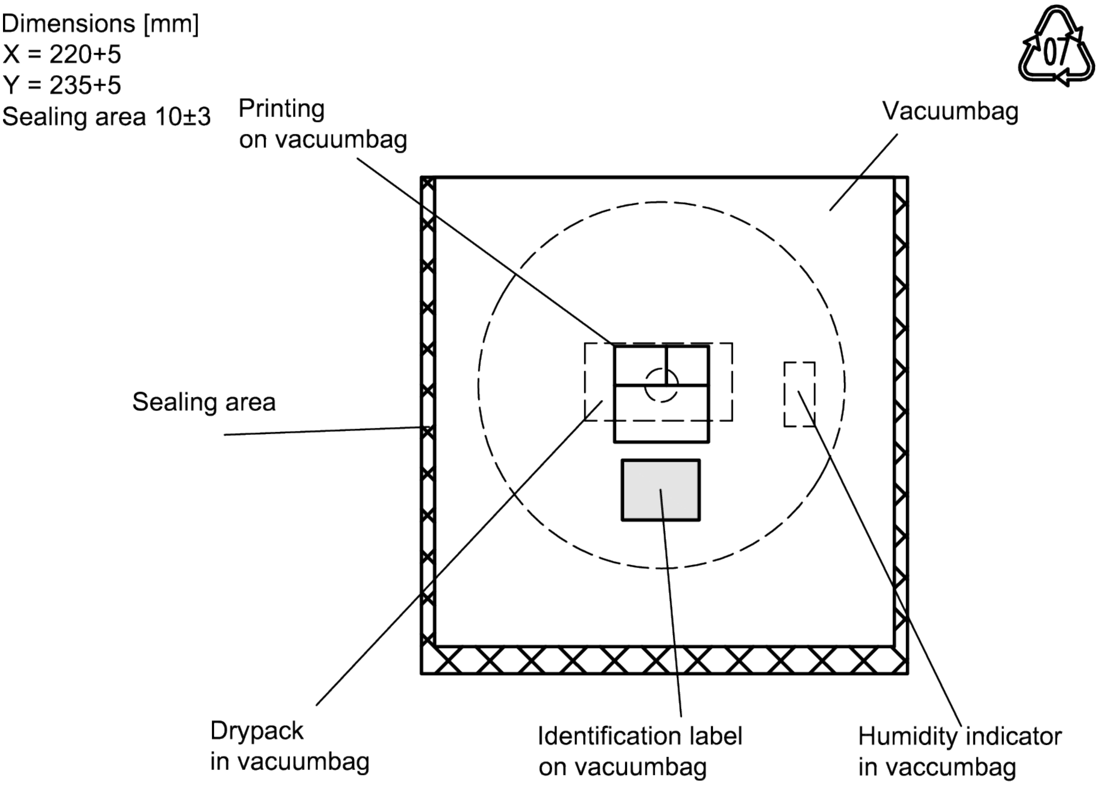

Dimensions [mm]
X = 220+5
Y = 235+5
Sealing area 10±3

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

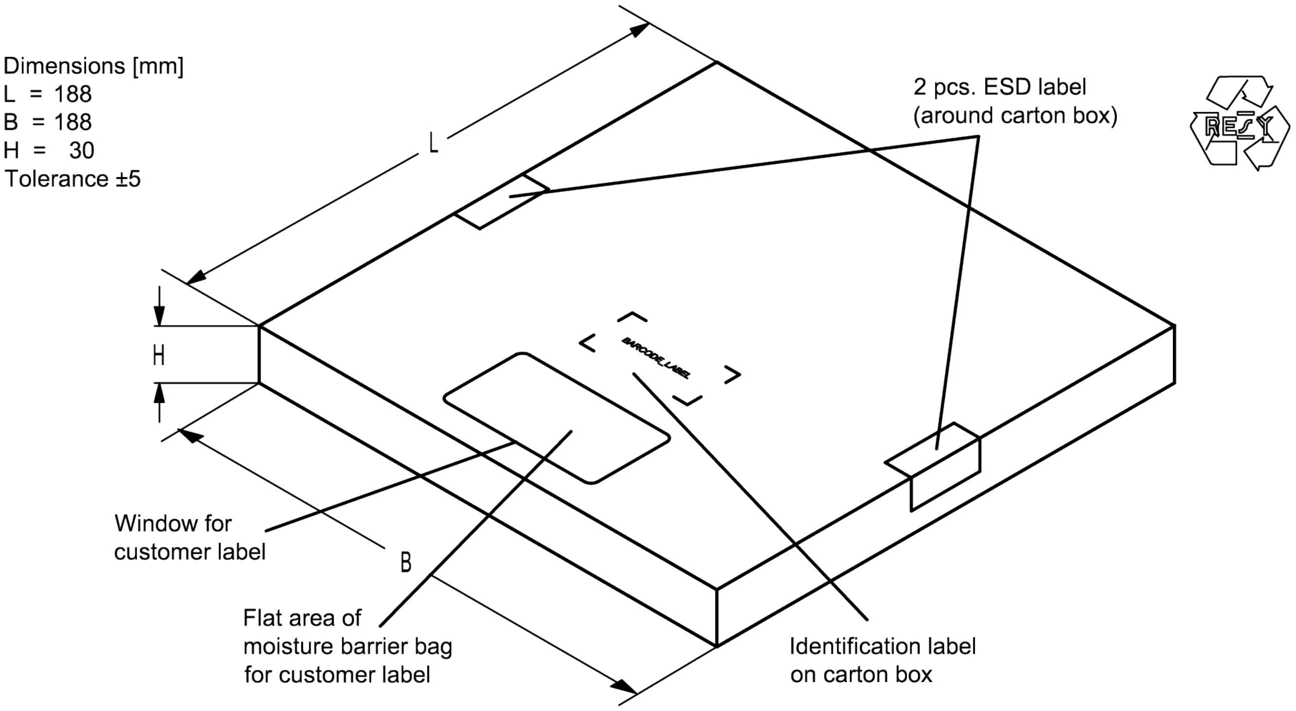


Figure 13: Drawing of folding box for reel with diameter of 180 mm.

10.3 Reel with diameter of 330 mm

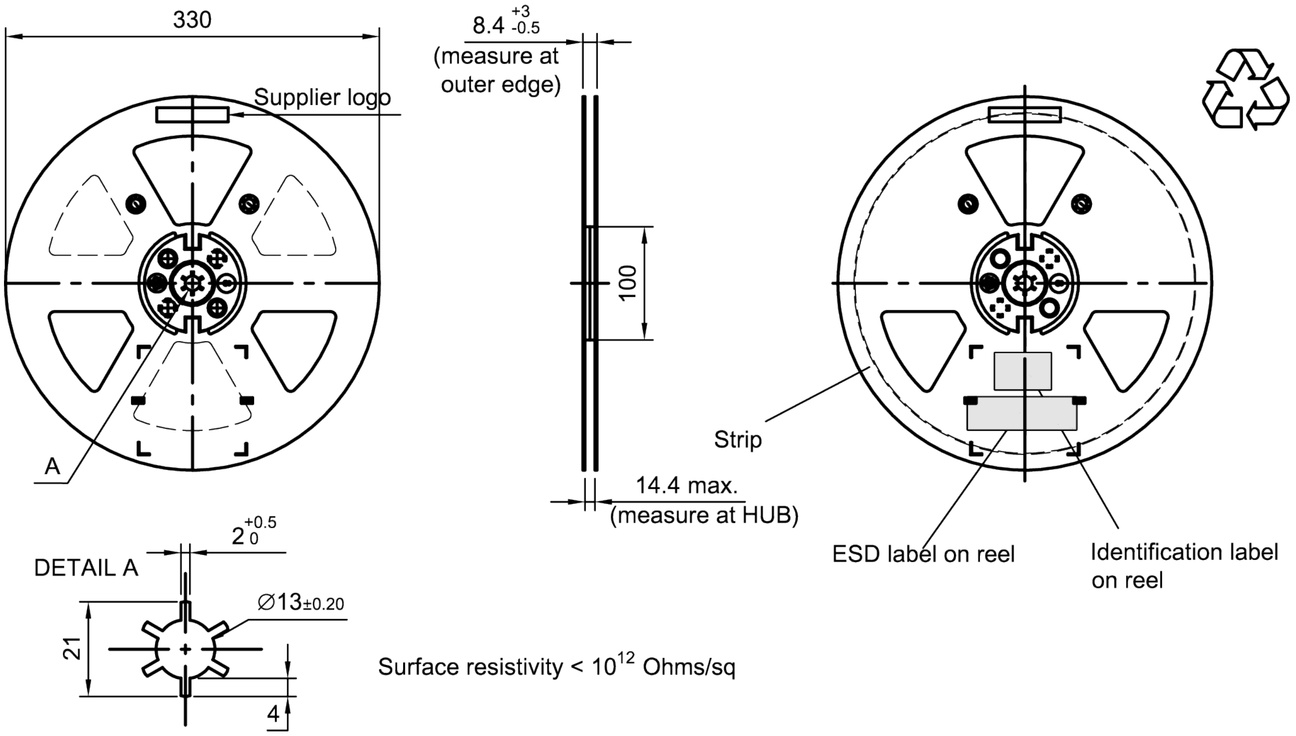


Figure 14: Drawing of reel (first-angle projection) with diameter of 330 mm.

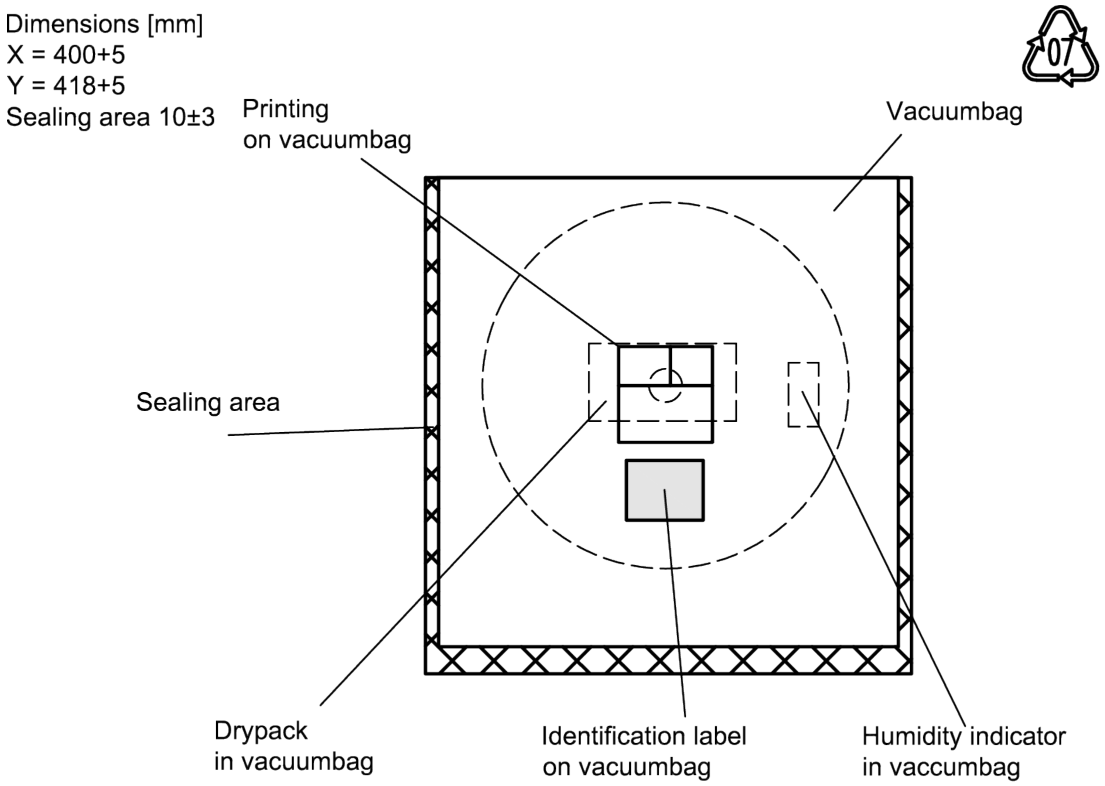


Figure 15: Drawing of moisture barrier bag (MBB) for reel with diameter of 330 mm.

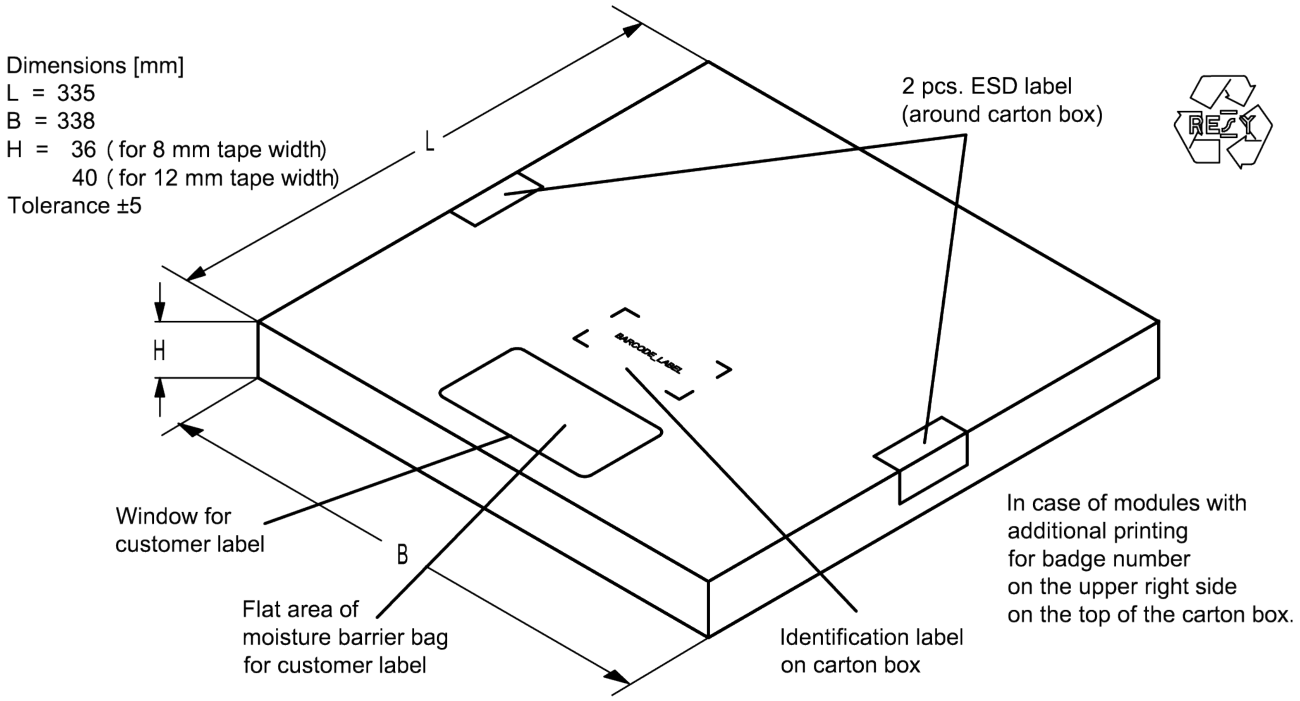


Figure 16: Drawing of folding box for reel with diameter of 330 mm.

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 x 32^2 + **6** x 32^1 + **18 (=J)** x 32^0 = **1234**
The BASE32 code for product type B8213 is 80N.

- 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.

12 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
$T \geq 255$ °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).

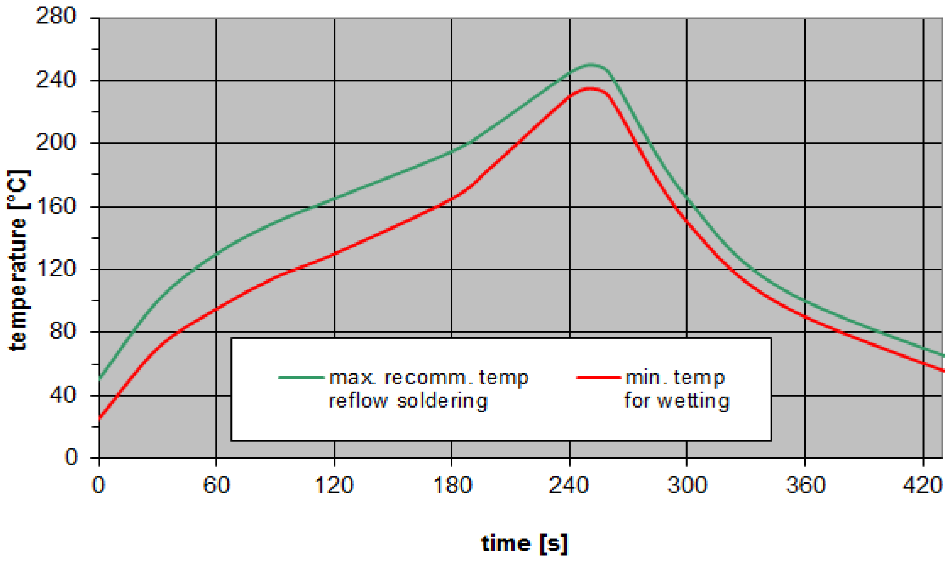


Figure 17: Recommended reflow profile for convection and infrared soldering – lead-free solder.

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 and packing units

Ordering code	Packing unit
B39681B8213P810	5000 pcs

Table 4: Ordering codes 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://rffe.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 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.

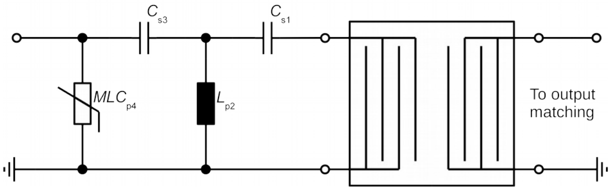


Figure 18: MLC varistor plus ESD matching.

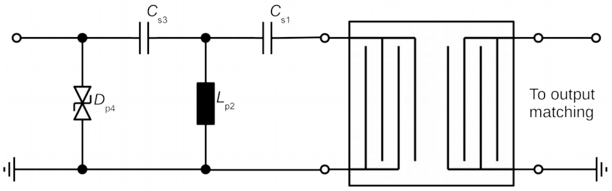


Figure 19: Suppressor diode plus ESD matching.

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

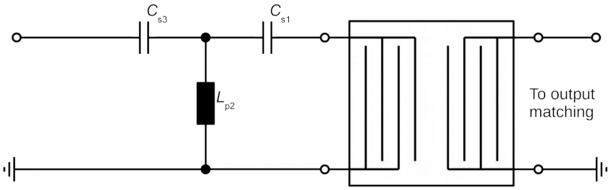


Figure 20: 3rd order high-pass structure for basic ESD protection.

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.

16 Important notes

The following applies to all products named in this publication:

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