



RF360
Europe GmbH

Data sheet

SAW duplexer
Small cell & femtocell
4G-LTE band 1

Part number: B8203
Ordering code: B39212B8203P810

Date: May 24, 2023
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1 Application

- Low-loss SAW duplexer for LTE small cell & femtocell systems (Band 1)
- 4G-LTE band 1 downlink (TX): 2140 MHz (pass band 60 MHz)
- 4G-LTE band 1 uplink (RX): 1950 MHz (pass band 60 MHz)
- Usable pass band 60 MHz
- DECT Europe rejection
- Rx = uplink = 1920 – 1980 MHz
- Tx = downlink = 2110 – 2170 MHz

2 Features

- Industrial grade qualified family
- Package size 2.5 ± 0.1 mm \times 2.0 ± 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)

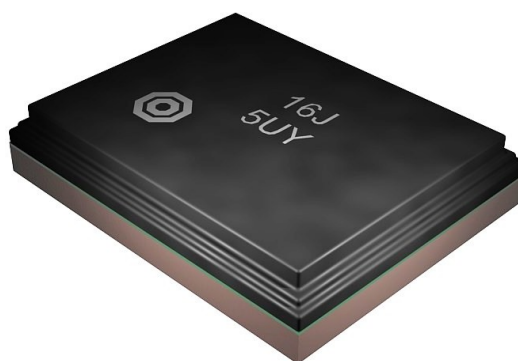
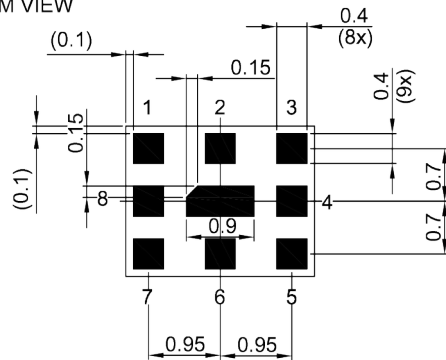


Figure 1: Picture of component with example of product marking.

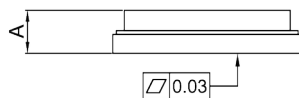
3 Package

BOTTOM VIEW

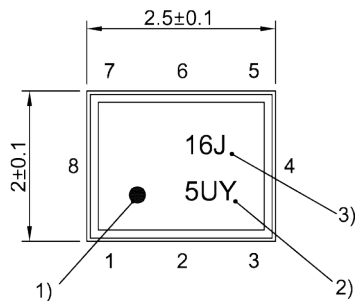


Pad and pitch tolerance ± 0.05

SIDE VIEW

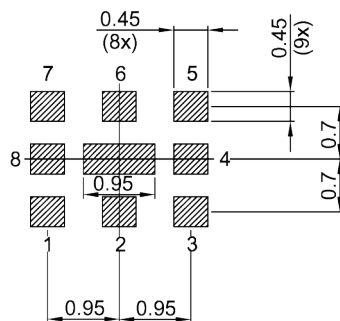


TOP VIEW



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

Land pattern
THRU VIEW



Landing pad tolerance -0.02

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. 27).

5 Matching circuit

■ $L_{p6} = 2.7 \text{ nH}$

■ $L_{s3} = 3.0 \text{ nH}$

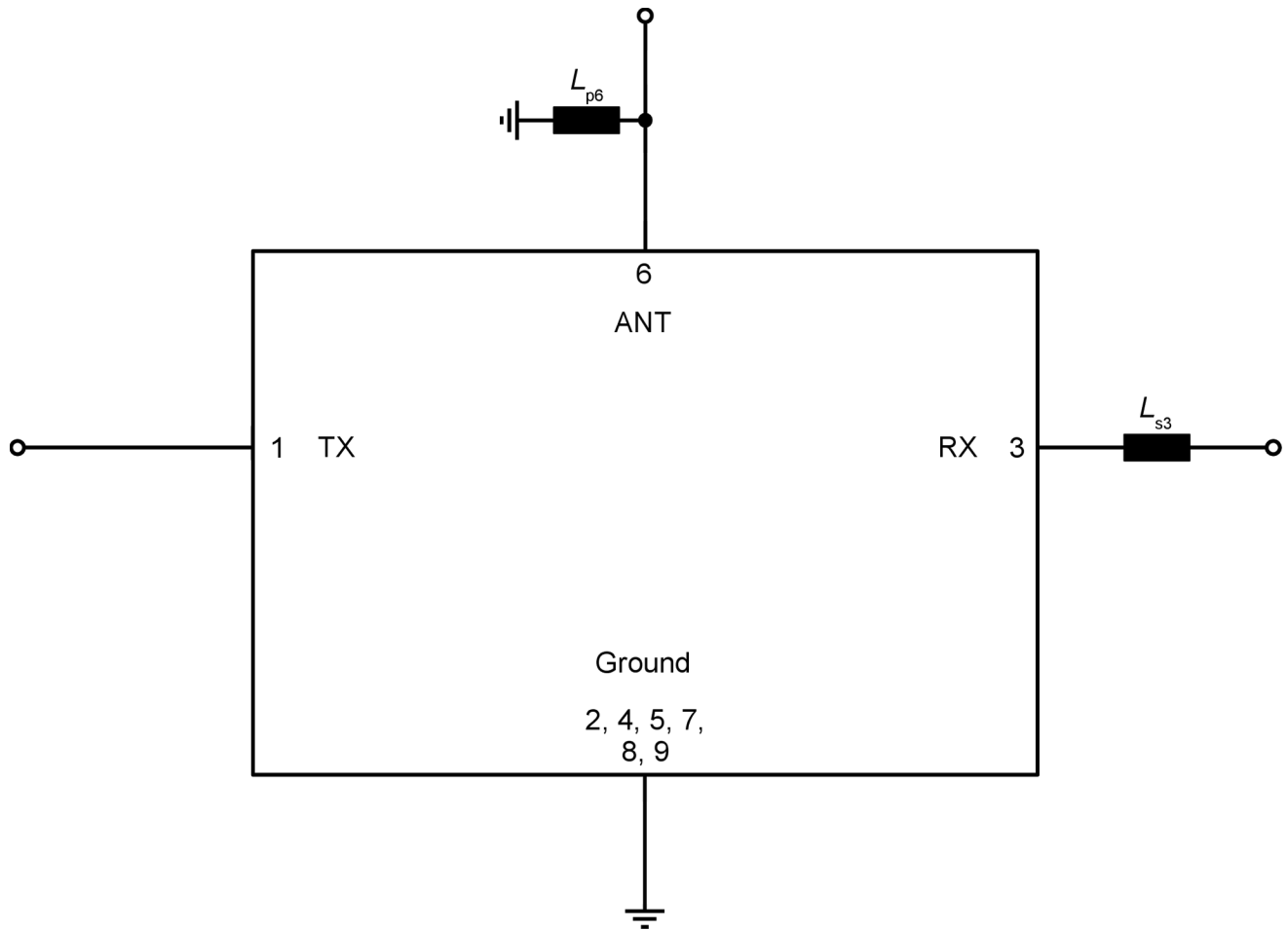


Figure 3: Schematic of matching circuit.

6 Characteristics

6.1 TX – ANT

Temperature range for specification	T_{SPEC}	= -10 °C ... +85 °C
TX terminating impedance	Z_{TX}	= 50 Ω
ANT terminating impedance	Z_{ANT}	= 50 Ω // 2.7 nH ¹⁾
RX terminating impedance	Z_{RX}	= 50 Ω + 3.0 nH ¹⁾

Characteristics TX – ANT				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency			f_C	—	2140	—	MHz
Maximum insertion attenuation	2110 ... 2170	MHz	α_{max}	—	1.6	2.5	dB
Amplitude ripple (p-p)	2110 ... 2170	MHz	$\Delta\alpha$	—	0.5	1.5	dB
Insertion attenuation	2110 ... 2115	MHz	$\alpha_{INT}^{2)}$	—	1.5	2.4	dB
	2115 ... 2165	MHz		—	1.4	2.1	dB
	2165 ... 2170	MHz		—	1.4	2.4	dB
Maximum VSWR			VSWR _{max}				
@ TX port	2110 ... 2170	MHz		—	1.6	2.0	
@ ANT port	2110 ... 2170	MHz		—	1.8	2.2	
Maximum error vector magnitude	2112.5 ... 2167.5	MHz	EVM _{max} ³⁾	—	0.5	1.5	%
Minimum attenuation	10 ... 843	MHz	α_{min}	40	43	—	dB
	843 ... 894	MHz		40	43	—	dB
	1574 ... 1606	MHz		34	39	—	dB
	1710 ... 1785	MHz		36	43	—	dB
	1805 ... 1880	MHz		41	48	—	dB
	1920 ... 1980	MHz		50	56	—	dB
	1980 ... 2025	MHz		28	34	—	dB
	2025 ... 2070	MHz		13	15	—	dB
	2300 ... 2400	MHz		45	51	—	dB
	2400 ... 2500	MHz		46	53	—	dB
	2500 ... 2620	MHz		49	53	—	dB
	2620 ... 2690	MHz		49	52	—	dB
	4220 ... 4340	MHz		7	10	—	dB
	5150 ... 5850	MHz		6	9	—	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⁾ Error Vector Magnitude (EVM) based on definition in 3GPP TS 25.141.

Temperature range for specification	T_{SPEC}	= -40 °C ... +95 °C
TX terminating impedance	Z_{TX}	= 50 Ω
ANT terminating impedance	Z_{ANT}	= 50 Ω // 2.7 nH ¹⁾
RX terminating impedance	Z_{RX}	= 50 Ω + 3.0 nH ¹⁾

Characteristics TX – ANT				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency			f_c	—	2140	—	MHz
Maximum insertion attenuation	2110... 2170	MHz	α_{max}	—	1.6	2.9	dB
Amplitude ripple (p-p)	2110... 2170	MHz	$\Delta\alpha$	—	0.5	1.6	dB
Insertion attenuation	2110... 2115	MHz	$\alpha_{\text{INT}}^{2)}$	—	1.5	2.6	dB
	2115... 2165	MHz		—	1.4	2.4	dB
	2165... 2170	MHz		—	1.4	2.6	dB
Maximum VSWR			VSWR _{max}				
@ TX port	2110... 2170	MHz		—	1.6	2.0	
@ ANT port	2110... 2170	MHz		—	1.8	2.2	
Maximum error vector magnitude	2112.5... 2167.5	MHz	EVM _{max} ³⁾	—	0.5	1.5	%
Minimum attenuation	10... 843	MHz	α_{min}	40	43	—	dB
	843... 894	MHz		40	43	—	dB
	1574... 1606	MHz		34	39	—	dB
	1710... 1785	MHz		36	43	—	dB
	1805... 1880	MHz		41	48	—	dB
	1920... 1980	MHz		50	56	—	dB
	1980... 2025	MHz		28	34	—	dB
	2025... 2070	MHz		13	15	—	dB
	2300... 2400	MHz		45	51	—	dB
	2400... 2500	MHz		46	53	—	dB
	2500... 2620	MHz		49	53	—	dB
	2620... 2690	MHz		49	52	—	dB
	4220... 4340	MHz		7	10	—	dB
	5150... 5850	MHz		6	9	—	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⁾ Error Vector Magnitude (EVM) based on definition in 3GPP TS 25.141.

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 // 2.7 nH ¹⁾
RX terminating impedance	Z_{RX}	= 50 Ω + 3.0 nH ¹⁾

Characteristics ANT – RX				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency			f_C	—	1950	—	MHz
Maximum insertion attenuation			α_{max}	—	2.1	3.0	dB
	1920... 1980	MHz		—	2.1	3.0	dB
Amplitude ripple (p-p)			$\Delta\alpha$	—	0.7	2.2	dB
	1920... 1980	MHz		—	0.7	2.2	dB
Insertion attenuation			$\alpha_{INT}^{2)}$	—	1.9	2.5	dB
	1920... 1925	MHz		—	1.9	2.5	dB
	1925... 1975	MHz		—	1.8	2.4	dB
	1975... 1980	MHz		—	2.0	2.7	dB
Maximum VSWR			VSWR _{max}	—	1.8	2.1	
@ ANT port	1920... 1980	MHz		—	1.8	2.1	
@ RX port	1920... 1980	MHz		—	1.6	2.0	
Maximum error vector magnitude			EVM _{max} ³⁾	—	0.9	3.0	%
	1922.5... 1977.5	MHz		—	0.9	3.0	%
Minimum attenuation			α_{min}	42	49	—	dB
	10... 1710	MHz		42	49	—	dB
	1710... 1785	MHz		42	52	—	dB
	1805... 1880	MHz		26	29	—	dB
	1880... 1900	MHz		4	9	—	dB
	2000... 2010	MHz		7	16	—	dB
	2010... 2110	MHz		19	33	—	dB
	2110... 2170	MHz		51	55	—	dB
	2300... 2400	MHz		51	57	—	dB
	2400... 2500	MHz		48	55	—	dB
	2500... 2750	MHz		41	45	—	dB
	2750... 3400	MHz		45	52	—	dB
	3400... 3800	MHz		46	50	—	dB
	4220... 4340	MHz		45	49	—	dB
	5150... 5850	MHz		42	52	—	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⁾ Error Vector Magnitude (EVM) based on definition in 3GPP TS 25.141.

Temperature range for specification	T_{SPEC}	= -40 °C ... +95 °C
TX terminating impedance	Z_{TX}	= 50 Ω
ANT terminating impedance	Z_{ANT}	= 50 Ω // 2.7 nH ¹⁾
RX terminating impedance	Z_{RX}	= 50 Ω + 3.0 nH ¹⁾

Characteristics ANT – RX				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency			f_c	—	1950	—	MHz
Maximum insertion attenuation	1920... 1980	MHz	α_{max}	—	2.1	3.3	dB
Amplitude ripple (p-p)	1920... 1980	MHz	$\Delta\alpha$	—	0.7	2.6	dB
Insertion attenuation	1920... 1925	MHz	$\alpha_{\text{INT}}^{2)}$	—	1.9	2.8	dB
	1925... 1975	MHz		—	1.8	2.4	dB
	1975... 1980	MHz		—	2.0	2.9	dB
Maximum VSWR			VSWR _{max}				
@ ANT port	1920... 1980	MHz		—	1.8	2.1	
@ RX port	1920... 1980	MHz		—	1.6	2.0	
Maximum error vector magnitude	1922.5... 1977.5	MHz	EVM _{max} ³⁾	—	0.9	3.0	%
Minimum attenuation	10... 1710	MHz	α_{min}	42	49	—	dB
	1710... 1785	MHz		42	52	—	dB
	1805... 1880	MHz		26	29	—	dB
	1880... 1900	MHz		3	9	—	dB
	2000... 2010	MHz		3	16	—	dB
	2010... 2110	MHz		13	33	—	dB
	2110... 2170	MHz		51	55	—	dB
	2300... 2400	MHz		51	57	—	dB
	2400... 2500	MHz		48	55	—	dB
	2500... 2750	MHz		41	45	—	dB
	2750... 3400	MHz		45	52	—	dB
	3400... 3800	MHz		46	50	—	dB
	4220... 4340	MHz		45	49	—	dB
	5150... 5850	MHz		42	52	—	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⁾ Error Vector Magnitude (EVM) based on definition in 3GPP TS 25.141.

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 // 2.7 nH ¹⁾
RX terminating impedance	Z_{RX}	= 50 Ω + 3.0 nH ¹⁾

Characteristics TX – RX				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Isolation	1920... 1980 MHz	MHz	$\alpha_{INT}^{2)}$	54	57	—	dB
				55	60	—	dB
Minimum isolation	1920... 1980 MHz	MHz	α_{min}	54	58	—	dB
				48	50	—	dB
				55	59	—	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 // 2.7 nH ¹⁾
RX terminating impedance	Z_{RX}	= 50 Ω + 3.0 nH ¹⁾

Characteristics TX – RX			min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Isolation	1920... 1980	MHz	α_{INT} ²⁾	54	57	— dB
		2110... 2170		53	60	— dB
	Minimum isolation		α_{min}			
	1920... 1980	MHz		54	58	— dB
	1980... 2110	MHz		48	50	— dB
	2110... 2170	MHz		52	59	— 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	$T_{OP} = -40\text{ °C} \dots +95\text{ °C}$	
Storage temperature	$T_{STG}^{1)} = -40\text{ °C} \dots +95\text{ °C}$	
DC voltage	$ V_{DC} ^{2)} = 0\text{ V}$	
ESD voltage		
	$V_{ESD}^{3)} = 150\text{ V}$	Machine model.
	$V_{ESD}^{4)} = 250\text{ V}$	Human body model.
Input power	P_{IN}	
@ TX port: 2110 ... 2170 MHz	30 dBm ⁵⁾	5 MHz LTE downlink signal (25 RB) for 100000 h @ 55 °C. P_{IN} 30 dBm average – 41 dBm peak. Source and load impedance 50Ω.
@ TX port: other frequency ranges	10 dBm	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 power durability tests, and wear out models.

8 Transmission coefficients

8.1 TX – ANT

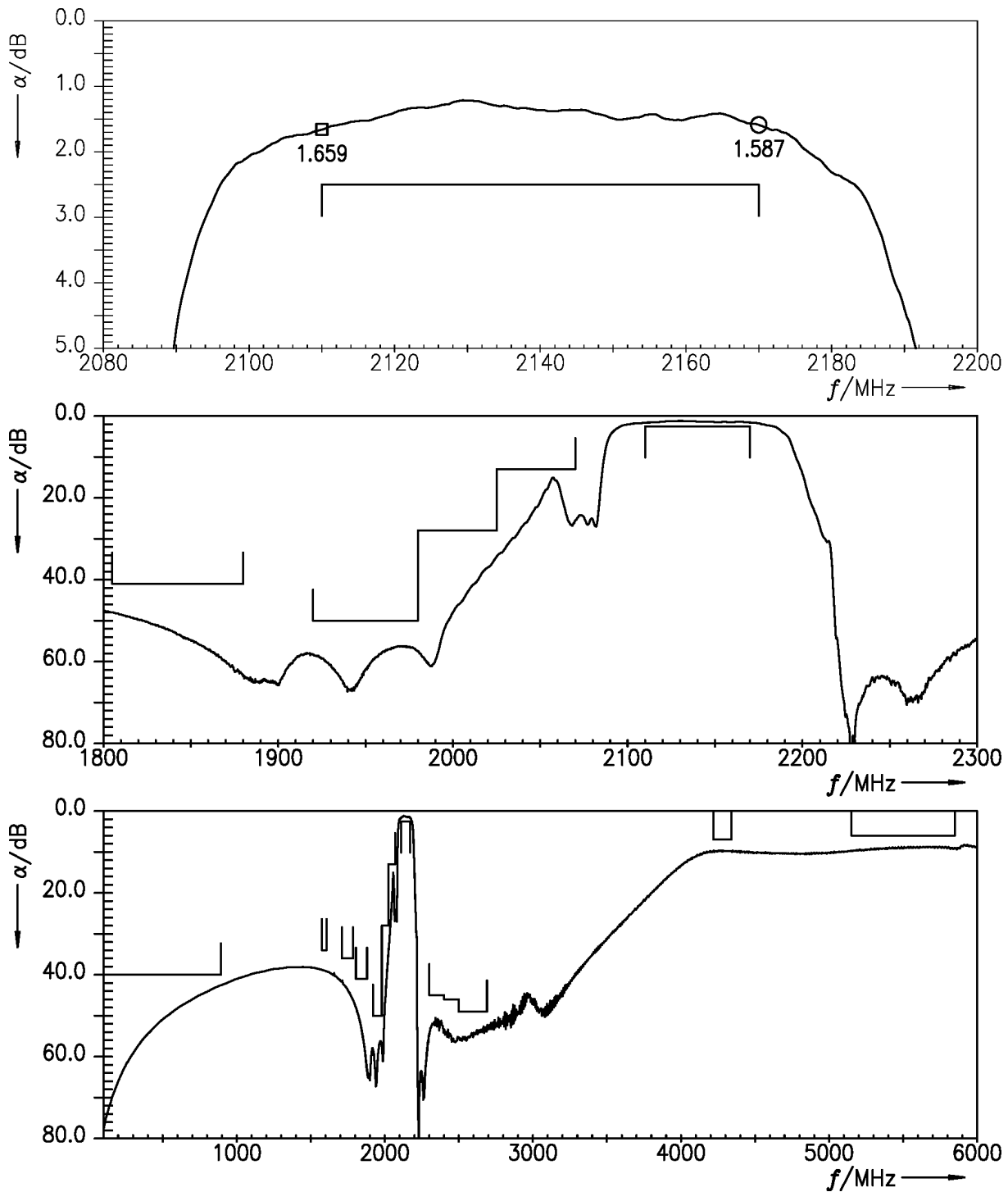


Figure 4: Attenuation TX – ANT.

8.2 ANT – RX

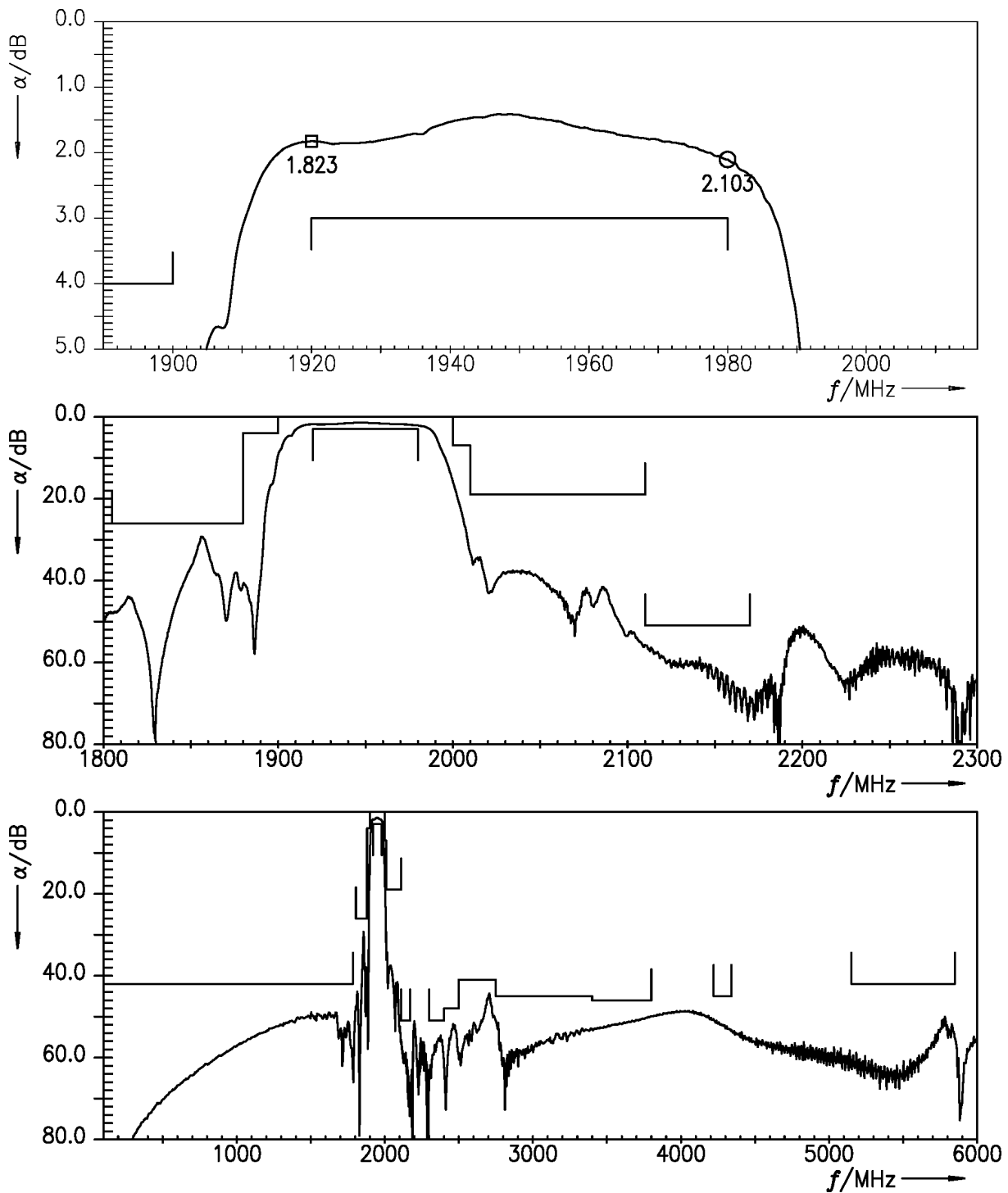


Figure 5: Attenuation ANT – RX.

8.3 TX – RX

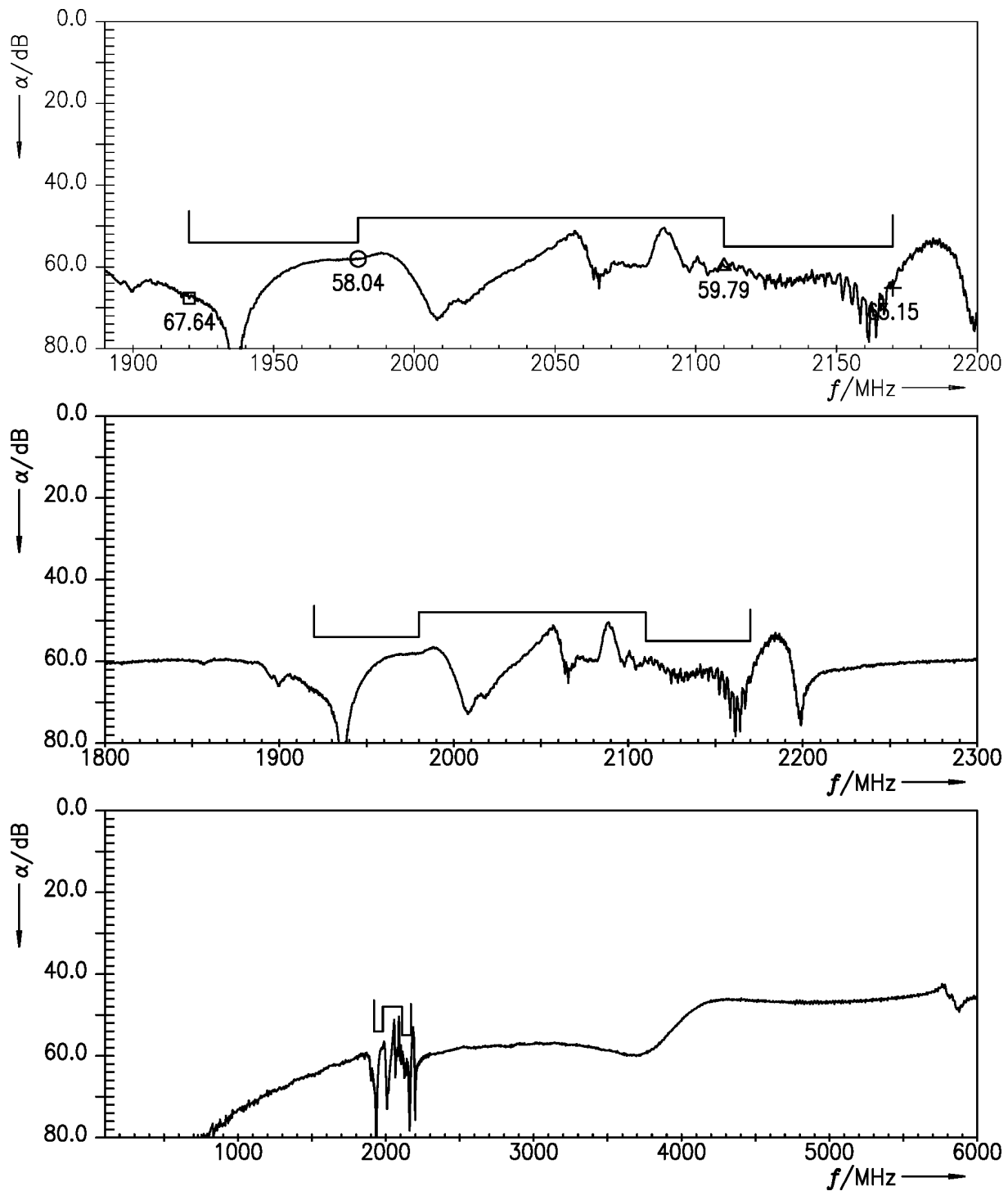


Figure 6: Isolation TX – RX.

9 Reflection coefficients

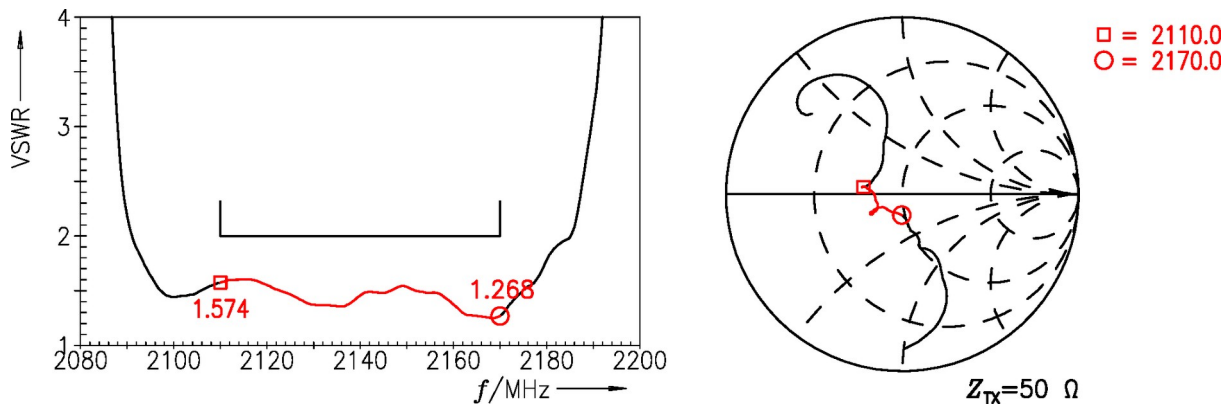


Figure 7: Reflection coefficient at TX port.

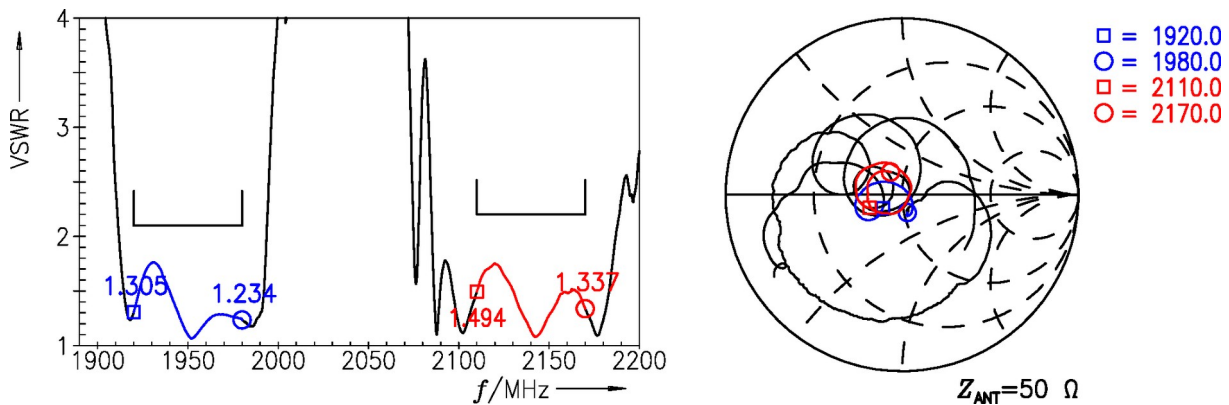


Figure 8: Reflection coefficient at ANT port (TX and RX frequencies).

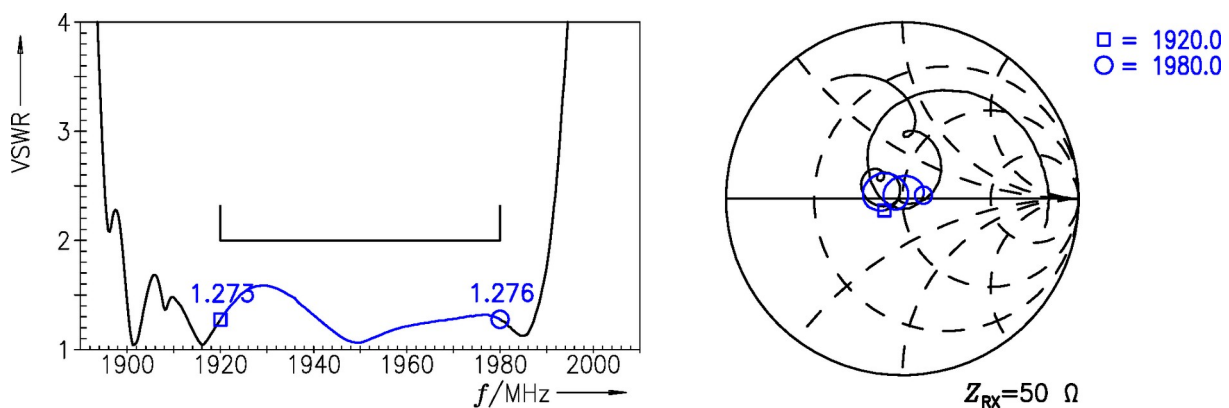
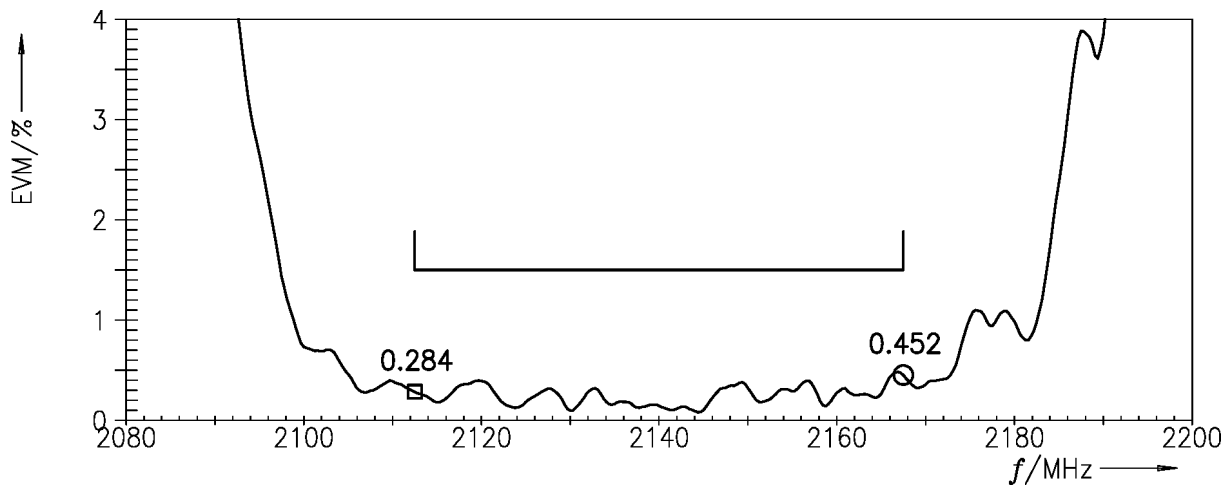
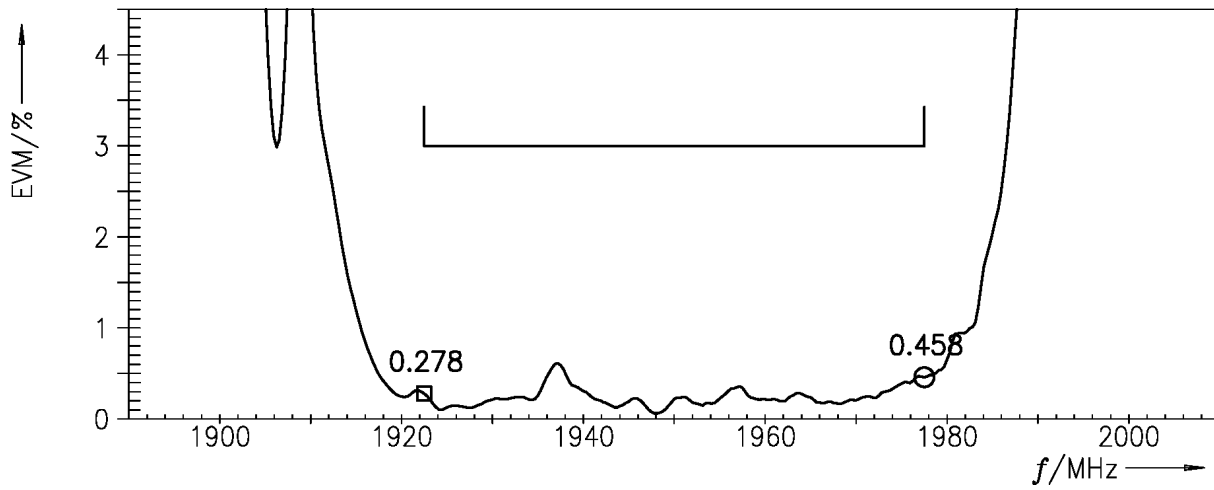


Figure 9: Reflection coefficient at RX port.

10 EVMs**10.1 TX – ANT****Figure 10:** Error vector magnitude TX – ANT.

10.2 ANT – RX

**Figure 11:** Error vector magnitude ANT – RX.

11 Packing material

11.1 Tape

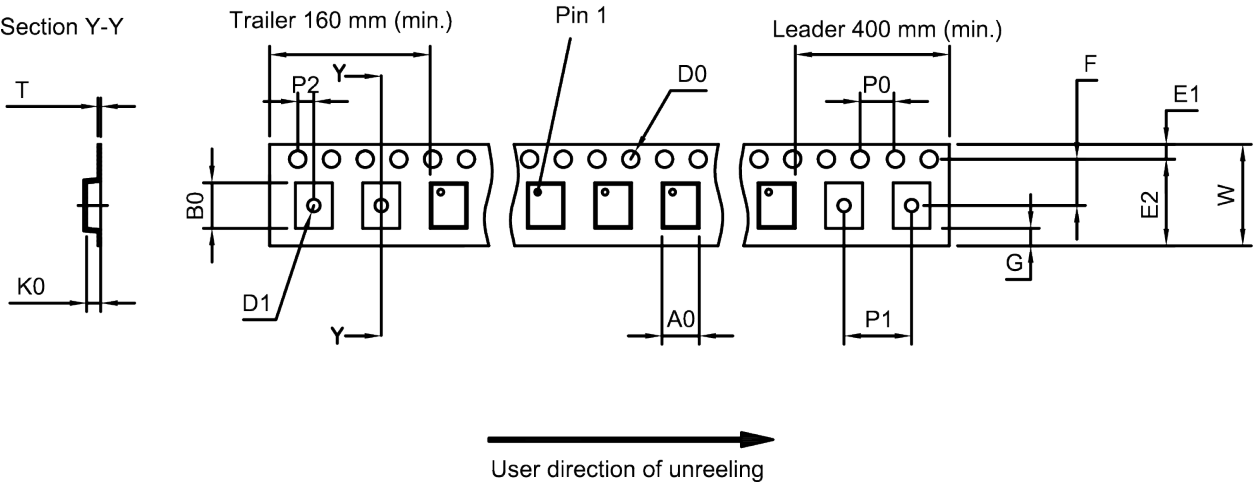


Figure 12: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

A ₀	2.25±0.05 mm	E ₂	6.25 mm (min.)	P ₁	4.0±0.1 mm
B ₀	2.75±0.05 mm	F	3.5±0.05 mm	P ₂	2.0±0.05 mm
D ₀	1.5+0.1/-0 mm	G	0.75 mm (min.)	T	0.25±0.03 mm
D ₁	1.0 mm (min.)	K ₀	0.6±0.05 mm	W	8.0+0.3/-0.1 mm
E ₁	1.75±0.1 mm	P ₀	4.0±0.1 mm		

Table 1: Tape dimensions.

11.2 Reel with diameter of 180 mm

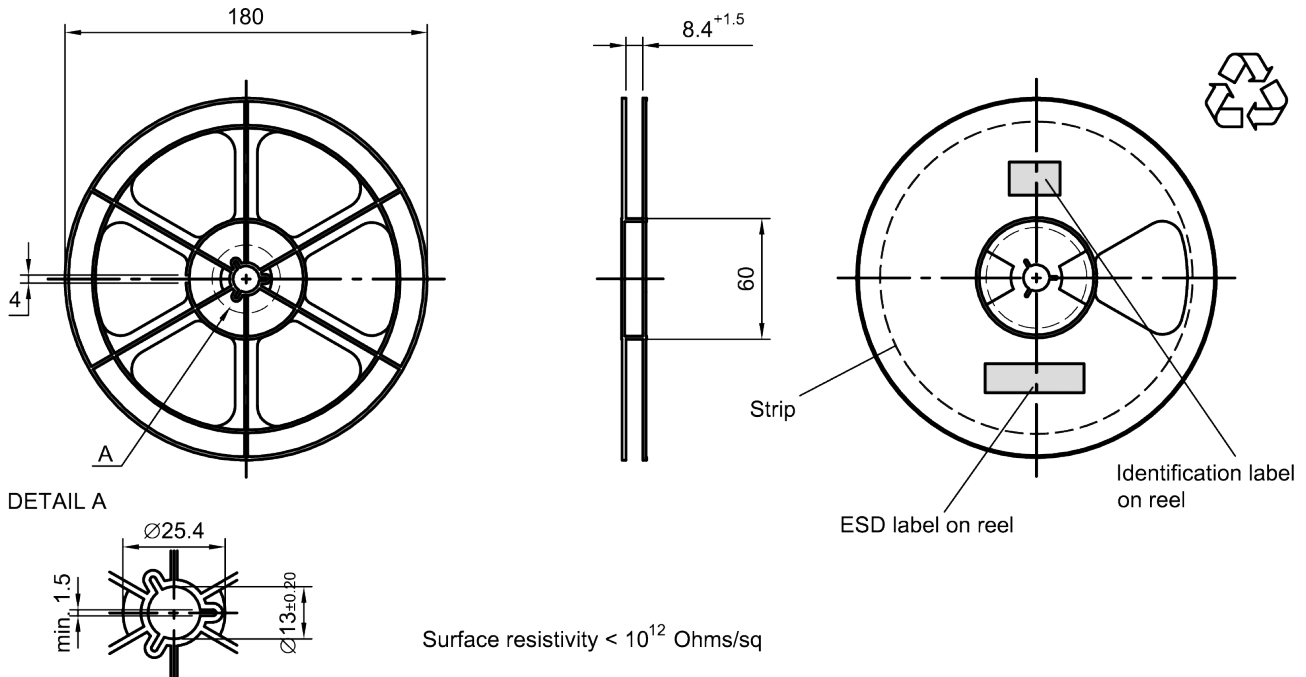


Figure 13: Drawing of reel (first-angle projection) with diameter of 180 mm.

Dimensions [mm]

X = 220+5

Y = 235+5

Sealing area 10±3

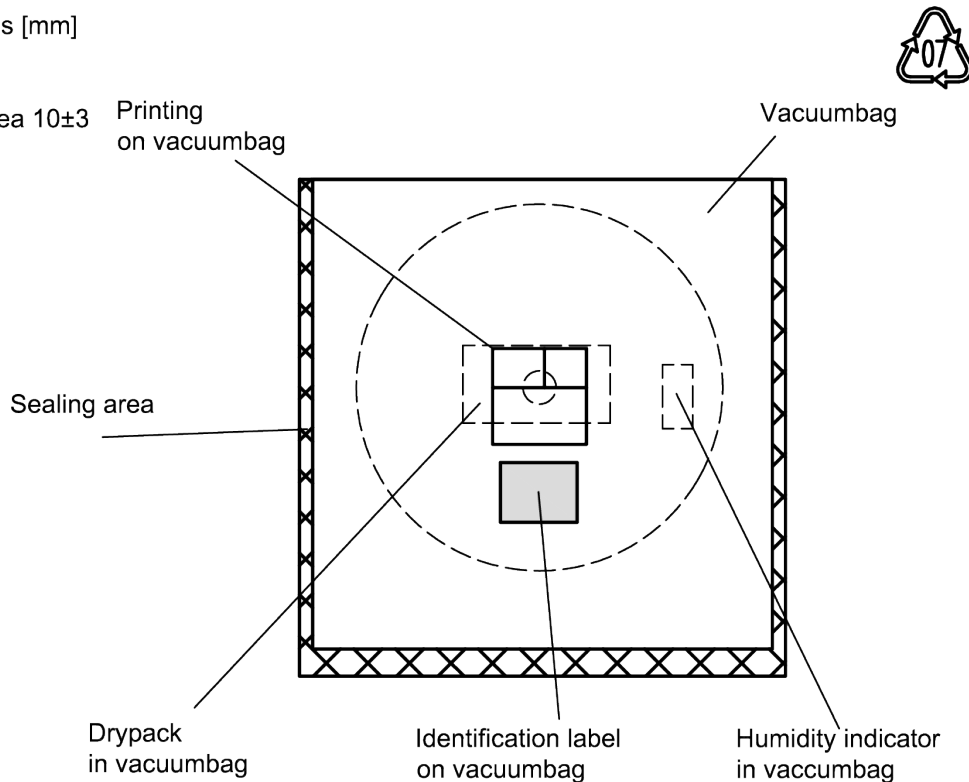


Figure 14: Drawing of moisture barrier bag (MBB) for reel with diameter of 180 mm.

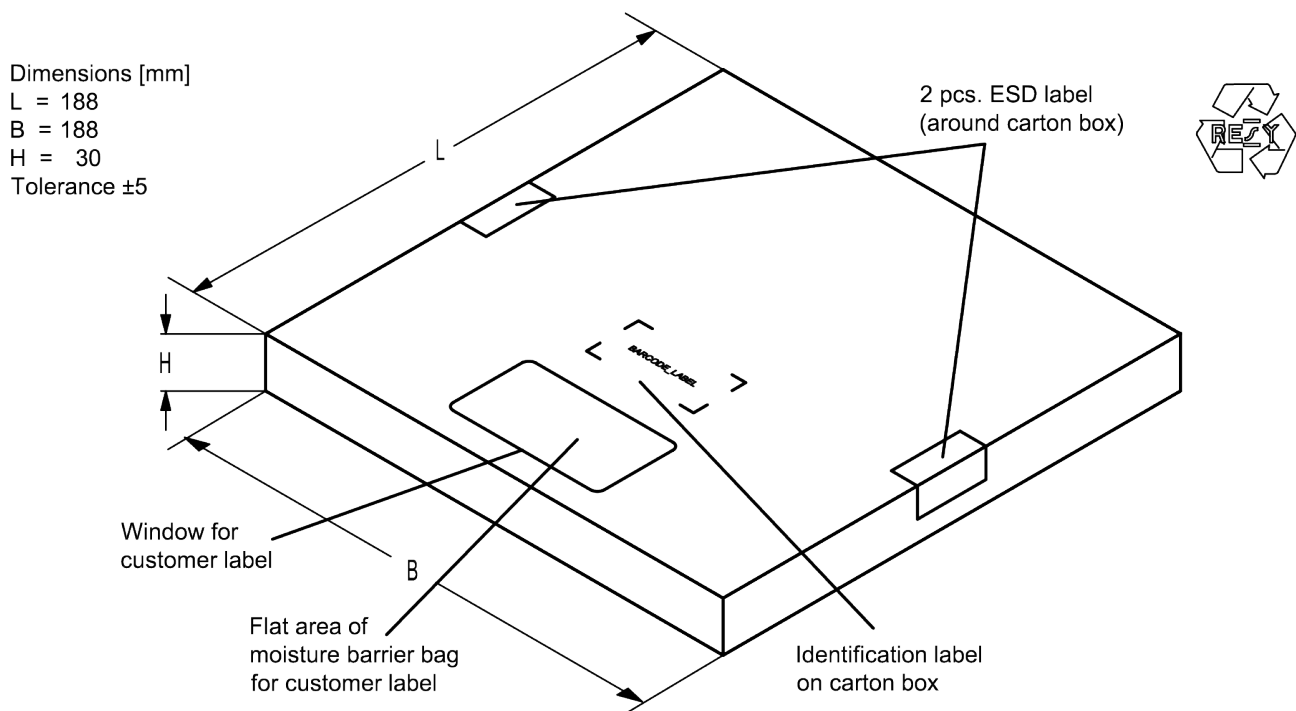


Figure 15: Drawing of folding box for reel with diameter of 180 mm.

11.3 Reel with diameter of 330 mm

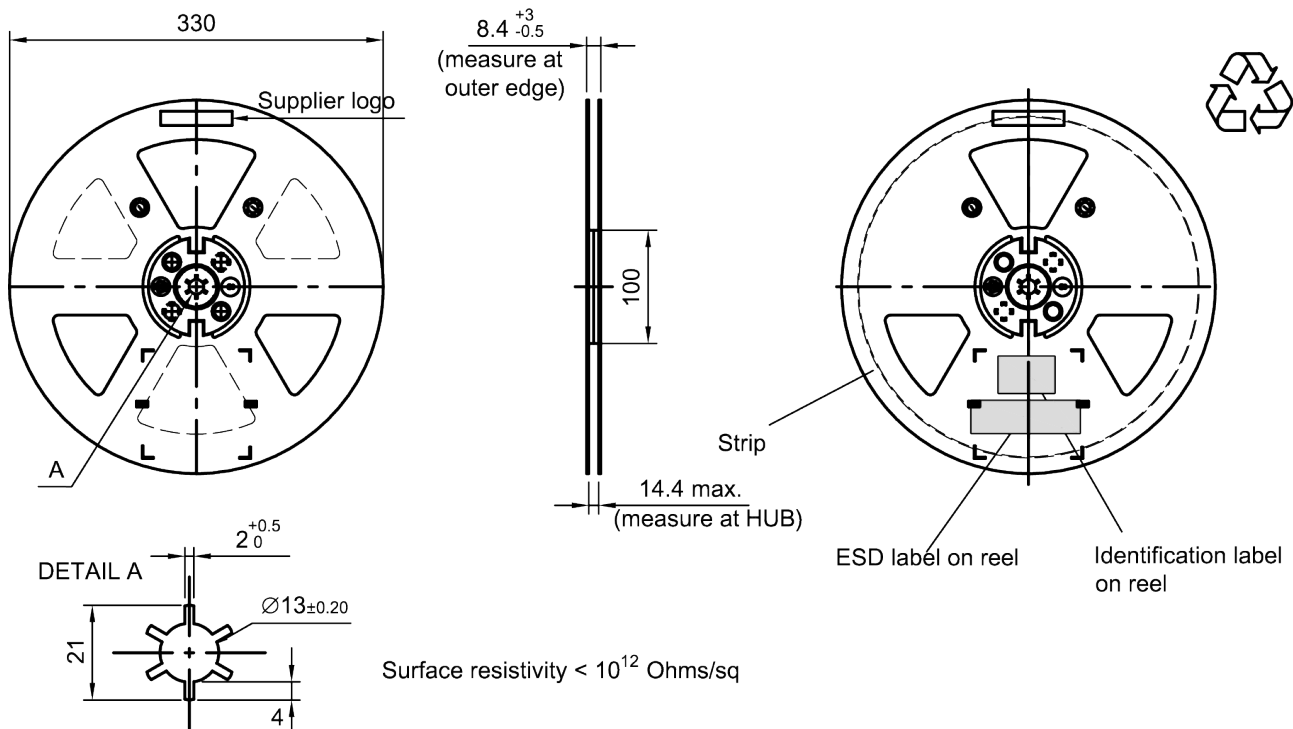


Figure 16: Drawing of reel (first-angle projection) with diameter of 330 mm.

Dimensions [mm]

X = 400+5

Y = 418+5

Sealing area 10±3

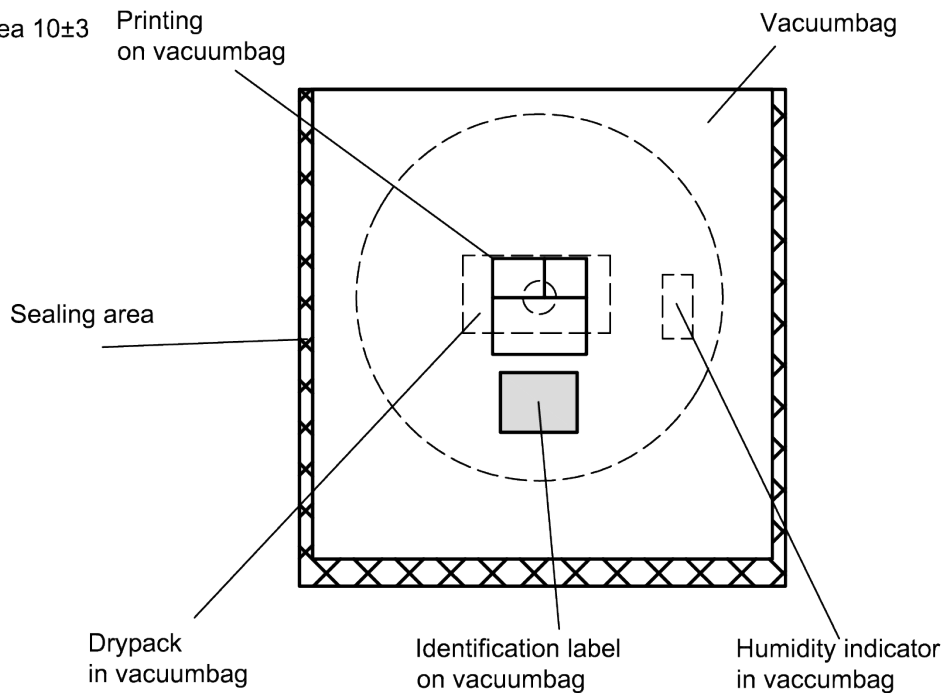


Figure 17: Drawing of moisture barrier bag (MBB) for reel with diameter of 330 mm.

Dimensions [mm]

L = 335

B = 338

H = 36 (for 8 mm tape width)

40 (for 12 mm tape width)

Tolerance ±5

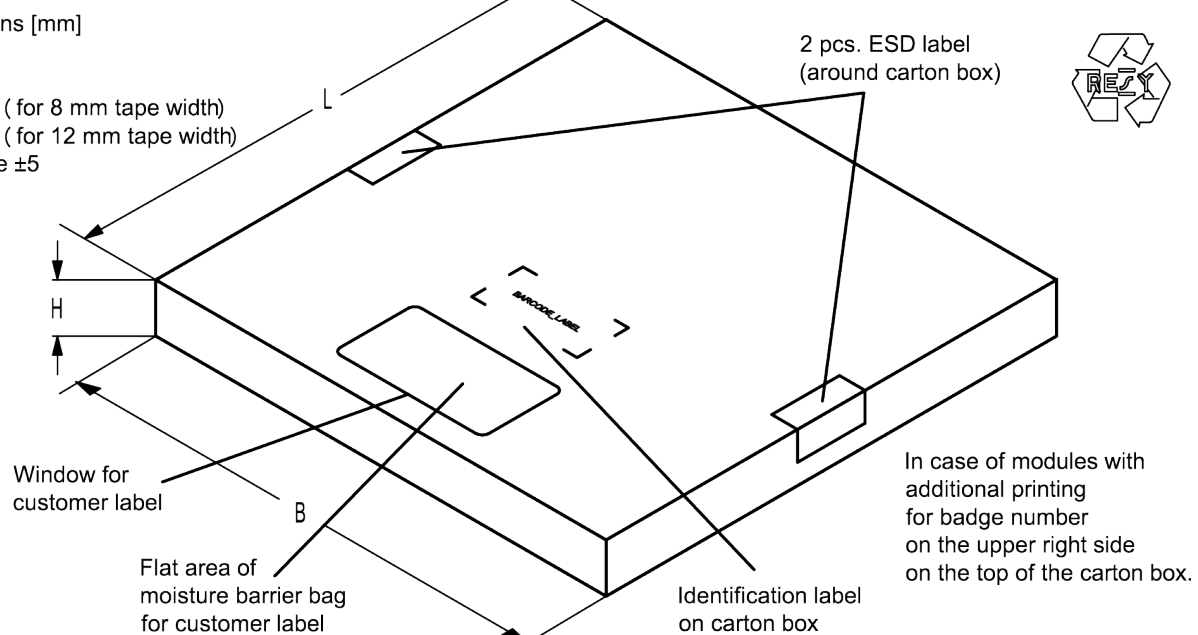


Figure 18: Drawing of folding box for reel with diameter of 330 mm.

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., 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 \Rightarrow **1234**
 $1 \times 32^2 + 6 \times 32^1 + 18 (=J) \times 32^0 =$ **1234**
 The BASE32 code for product type B8203 is 80B.

■ 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 \Rightarrow **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.

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
$T \geq 255$ °C	–
peak temperature T_{peak}	250 °C ± 5 °C
wetting temperature T_{min}	230 °C ± 5 °C for 10 ± 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).

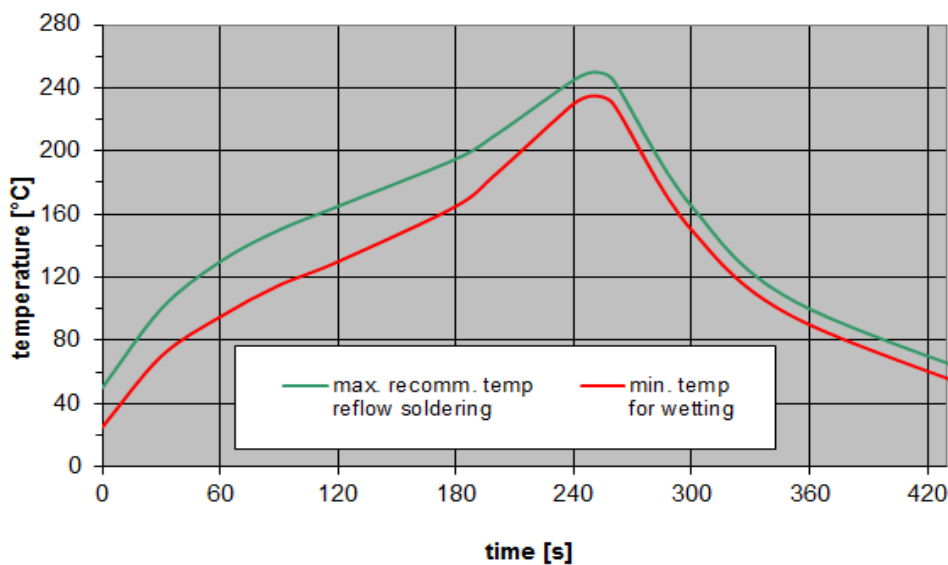


Figure 19: Recommended reflow profile for convection and infrared soldering – lead-free solder.

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, product IDs, labels, and packing units

Ordering code	Product ID	RF360 label	Packing unit
B39212B8203P810	B39212-B8203-P810	B39212B8203P810	5000 pcs

Table 4: Ordering codes / product IDs 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 acoustic devices

Acoustic devices are **E**lectro **S**tatic **D**ischarge 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 3rd 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.

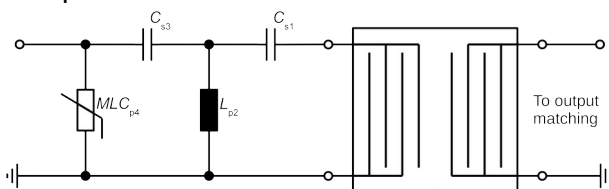


Figure 20: MLC varistor plus ESD matching.

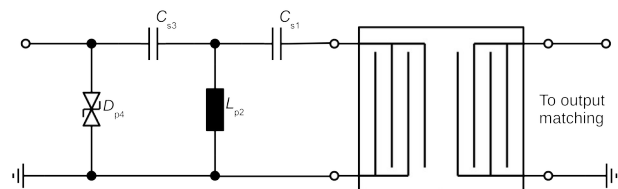


Figure 21: Suppressor diode plus ESD matching.

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

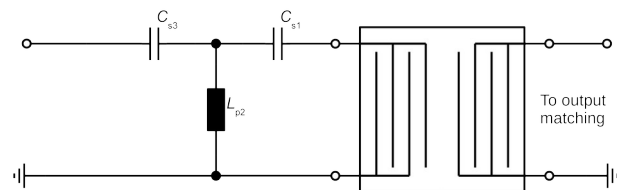


Figure 22: 3rd order high-pass structure for basic ESD protection.

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.
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.
5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order. We also **reserve the right to discontinue production and delivery of products**. Consequently, we cannot guarantee that all products named in this publication will always be available.
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