Qualcomm
RF360
Europe GmbH

Data sheet

E-duplexer

Small cell
4G-LTE band 1

Part number:	D7910
Ordering code:	B39212D7910D310
Date:	May 24, 2023
Version:	2.1

DCN: 80-PA243-757 Rev. B

RF360 Europe GmbH
Anzinger Straße 13
81671 Munich, Germany

Table of contents

1 Application

- Enhanced Duplexer for LTE small cell system (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)
- High isolation > 60 dB min
- Usable pass band 60 MHz
- Low VSWR

2 Features

- Package size 8.1$_{\pm 0.1}$ mm × 8.1$_{\pm 0.1}$ mm
- Package height 1.1 mm (max.)
- Approximate weight 0.2 g
- RoHS compatible
- Package for Surface Mount Technology (SMT)
- Ni/Au-plated terminals
- Electrostatic Sensitive Device (ESD)
- Moisture Sensitivity Level 3 (MSL3)

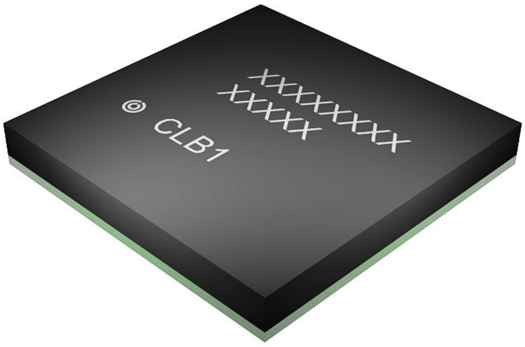

Figure 1: Picture of component with example of product marking.

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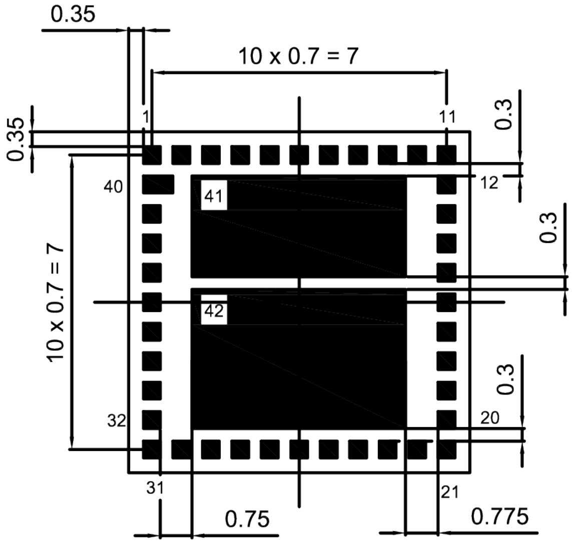
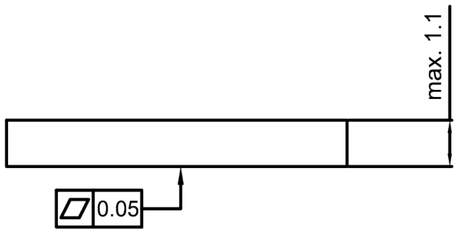
3 Package

BOTTOM VIEW

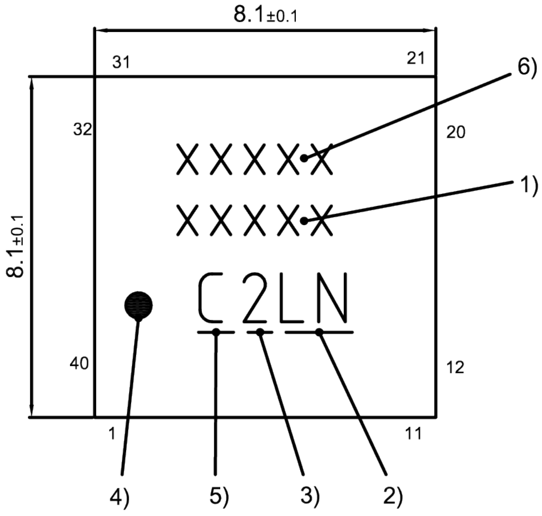


Pad sizes:
Pad 1-39: 0.40 x 0.40 mm²
Pad 40: 0.70 x 0.40 mm²
Pad 41: 5.075 x 2.395 mm²
Pad 42: 5.075 x 3.305 mm²
Pad tolerance ±0.05

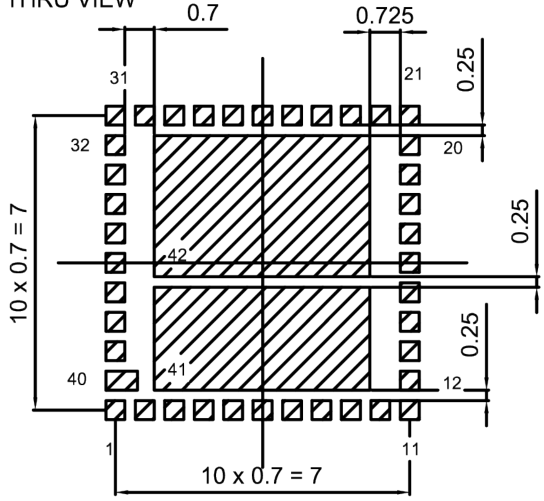
SIDE VIEW



TOP VIEW



Land pattern
THRU VIEW



6) Tracking ID (5 - 8 digits)
5) Indicating production site C=Wxi)
4) Marking for pad number
3) Date code acc. EPCOS (day)
2) Date code acc. to EN60062 (year, month)
1) Position for type designation

Landing pad sizes:
Pad 1-39: 0.45 x 0.45 mm²
Pad 40: 0.70 x 0.40 mm²
Pad 41: 5.125 x 2.445 mm²
Pad 42: 5.125 x 3.355 mm²
Landing pad tolerance -0.02

Figure 2: Drawing of package with package height A = 1.1 mm (max.). See Sec. Package information (p. 27).

4 Pin configuration

- 3 TX
- 13 RX
- 29 ANT
- 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42 Ground

5 Matching circuit

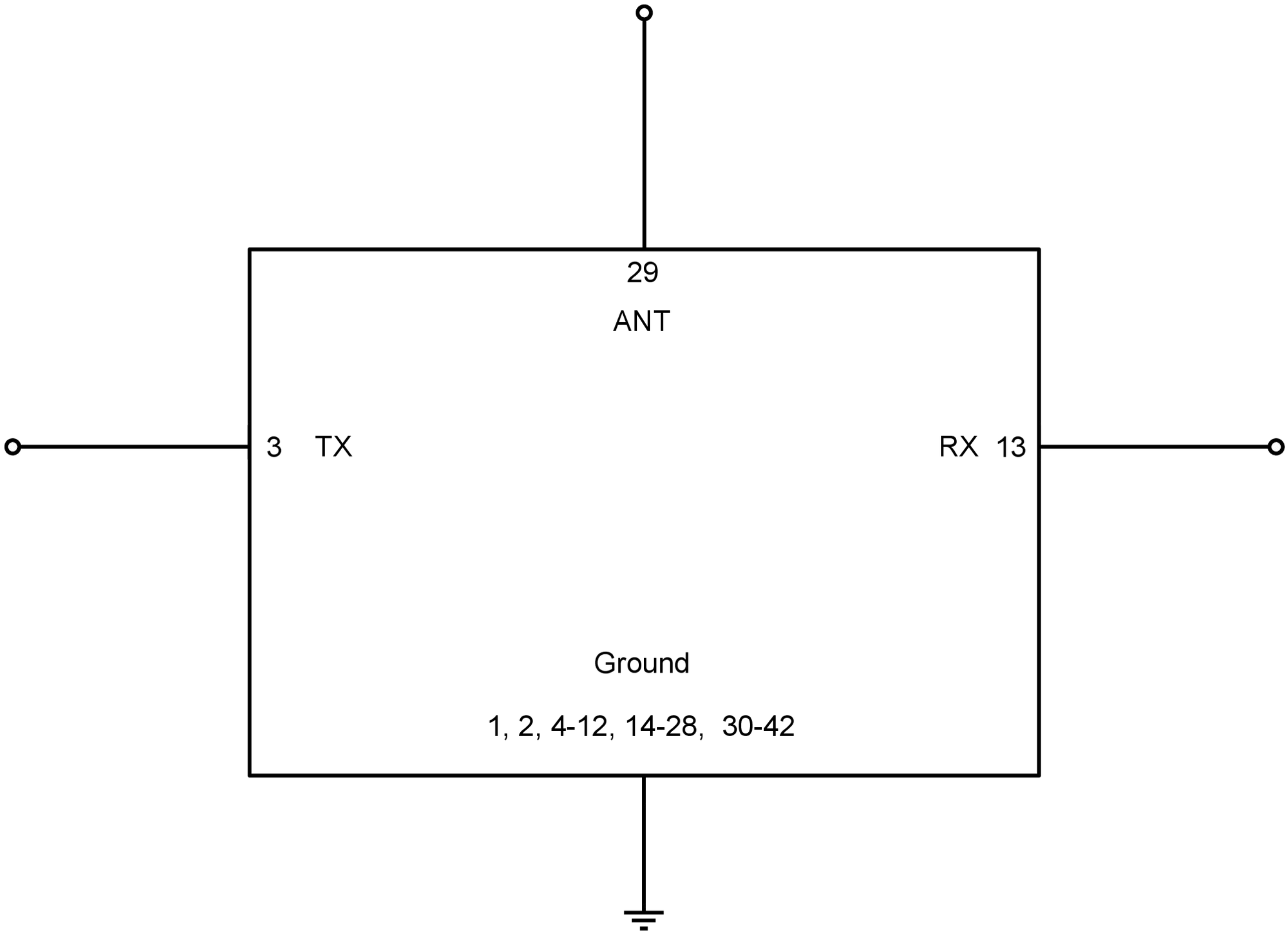


Figure 3: Schematic of matching circuit. No external matching components required.

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
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	—	2140	—	MHz
Insertion attenuation			α_{INT} 1)				
	2110 ... 2115	MHz		—	2.6	3.3	dB
	2115 ... 2165	MHz		—	2.5	3.4	dB
	2165 ... 2170	MHz		—	2.5	3.4	dB
Maximum insertion attenuation			α_{max}				
	2110 ... 2165	MHz		—	2.6	3.5	dB
	2165 ... 2170	MHz		—	2.6	4.0	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	2110 ... 2170	MHz		—	0.6	2.0	dB
Maximum VSWR			$VSWR_{max}$				
@ TX port	2110 ... 2170	MHz		—	1.4	1.8	
@ ANT port	2110 ... 2170	MHz		—	1.3	1.8	
Maximum error vector magnitude			EVM_{max} 2)				
	2112.4 ... 2167.6	MHz		—	0.7	2.0	%
Minimum attenuation			α_{min}				
	10 ... 1920	MHz		35	40	—	dB
	1916.8 ... 1985	MHz		47	54	—	dB
	2246.8 ... 2400	MHz		40	54	—	dB
	2500 ... 3000	MHz		30	47	—	dB
	3000 ... 3600	MHz		20	29	—	dB
	3600 ... 3800	MHz		15	21	—	dB
	3800 ... 4220	MHz		8	11	—	dB
	4340 ... 5000	MHz		8	11	—	dB
	5000 ... 6000	MHz		8	14	—	dB

1) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.
2) 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
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	—	2140	—	MHz
Insertion attenuation			α_{INT} 1)				
	2110 ... 2115	MHz		—	2.6	3.7	dB
	2115 ... 2165	MHz		—	2.5	3.6	dB
	2165 ... 2170	MHz		—	2.5	3.7	dB
Maximum insertion attenuation			α_{max}				
	2110 ... 2165	MHz		—	2.6	3.9	dB
	2165 ... 2170	MHz		—	2.6	4.2	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	2110 ... 2170	MHz		—	0.6	2.7	dB
Maximum VSWR			$VSWR_{max}$				
@ TX port	2110 ... 2170	MHz		—	1.4	1.8	
@ ANT port	2110 ... 2170	MHz		—	1.3	1.8	
Maximum error vector magnitude			EVM_{max} 2)				
	2112.4 ... 2167.6	MHz		—	0.7	2.5	%
Minimum attenuation			α_{min}				
	10 ... 1920	MHz		35	40	—	dB
	1916.8 ... 1985	MHz		45	54	—	dB
	2246.8 ... 2400	MHz		40	54	—	dB
	2500 ... 3000	MHz		30	47	—	dB
	3000 ... 3600	MHz		20	29	—	dB
	3600 ... 3800	MHz		15	21	—	dB
	3800 ... 4220	MHz		8	11	—	dB
	4340 ... 5000	MHz		8	11	—	dB
	5000 ... 6000	MHz		8	14	—	dB

1) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.
2) 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
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	—	1950	—	MHz
Insertion attenuation			α_{INT} 1)				
	1920 ... 1925	MHz		—	3.0	3.6	dB
	1925 ... 1975	MHz		—	2.8	3.6	dB
	1975 ... 1980	MHz		—	2.9	3.9	dB
Maximum insertion attenuation			α_{max}				
	1920 ... 1975	MHz		—	3.0	3.7	dB
	1975 ... 1980	MHz		—	3.1	4.2	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	1920 ... 1980	MHz		—	0.7	2.2	dB
Maximum VSWR			$VSWR_{max}$				
@ ANT port	1920 ... 1980	MHz		—	1.2	1.8	
@ RX port	1920 ... 1980	MHz		—	1.2	1.8	
Maximum error vector magnitude			EVM_{max} 2)				
	1922.4 ... 1977.6	MHz		—	0.7	2.5	%
Minimum attenuation			α_{min}				
	10 ... 1800	MHz		35	50	—	dB
	1785 ... 1880	MHz		23	28	—	dB
	1880 ... 1900	MHz		6	10	—	dB
	1900 ... 1903	MHz		3.5	7	—	dB
	1997 ... 2110	MHz		3.5	12	—	dB
	2110 ... 2175	MHz		50	61	—	dB
	2255 ... 2400	MHz		35	59	—	dB
	2400 ... 2500	MHz		35	56	—	dB
	2500 ... 3840	MHz		35	47	—	dB
	3840 ... 3960	MHz		35	53	—	dB
	3960 ... 5000	MHz		35	51	—	dB
	5000 ... 5760	MHz		35	49	—	dB
	5760 ... 5940	MHz		35	48	—	dB

1) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.
2) 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
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	—	1950	—	MHz
Insertion attenuation			α_{INT} 1)				
	1920 ... 1925	MHz		—	3.0	3.7	dB
	1925 ... 1975	MHz		—	2.8	3.7	dB
	1975 ... 1980	MHz		—	2.9	4.0	dB
Maximum insertion attenuation			α_{max}				
	1920 ... 1975	MHz		—	3.0	3.9	dB
	1975 ... 1980	MHz		—	3.1	4.5	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	1920 ... 1980	MHz		—	0.7	2.2	dB
Maximum VSWR			$VSWR_{max}$				
@ ANT port	1920 ... 1980	MHz		—	1.2	1.8	
@ RX port	1920 ... 1980	MHz		—	1.2	1.8	
Maximum error vector magnitude			EVM_{max} 2)				
	1922.4 ... 1977.6	MHz		—	0.7	3.0	%
Minimum attenuation			α_{min}				
	10 ... 1800	MHz		35	50	—	dB
	1785 ... 1880	MHz		23	28	—	dB
	1880 ... 1900	MHz		5	10	—	dB
	1900 ... 1903	MHz		3	7	—	dB
	1997 ... 2110	MHz		3	12	—	dB
	2110 ... 2175	MHz		47	61	—	dB
	2255 ... 2400	MHz		35	59	—	dB
	2400 ... 2500	MHz		35	56	—	dB
	2500 ... 3840	MHz		35	47	—	dB
	3840 ... 3960	MHz		35	53	—	dB
	3960 ... 5000	MHz		35	51	—	dB
	5000 ... 5760	MHz		35	49	—	dB
	5760 ... 5940	MHz		35	48	—	dB

1) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.
2) 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
RX terminating impedance	Z_{RX}	= 50 Ω

Characteristics TX – RX				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Isolation			α_{INT} [1)]				
	1920 ... 1980	MHz		62	71	—	dB
	2110 ... 2170	MHz		62	66	—	dB
Minimum isolation			α_{min}				
	1920 ... 1980	MHz		61	71	—	dB
	2110 ... 2170	MHz		60	64	—	dB

1) 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
RX terminating impedance	Z_{RX}	= 50 Ω

Characteristics TX – RX				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Isolation			α_{INT} [1)]				
	1920 ... 1980	MHz		62	71	—	dB
	2110 ... 2170	MHz		62	66	—	dB
Minimum isolation			α_{min}				
	1920 ... 1980	MHz		61	71	—	dB
	2110 ... 2170	MHz		60	64	—	dB

1) 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} [1] = −40 °C ... +95 °C	
DC voltage	$\|V_{DC}\|$ [2] = 0 V (max.)	
Input power	P_{IN}	
@ TX port: 2110 ... 2170 MHz	31 dBm[3]	5 MHz LTE downlink signal (25 RB) for 100000 h @ 55 °C. P_{IN} average – 42 dBm peak. Source and load impedance 50 Ω.
@ TX port: other frequency ranges	10 dBm	Source and load impedance 50 Ω.

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) Expected lifetime according to power durability simulations, and wear out models.

8 Transmission coefficients

8.1 TX – ANT

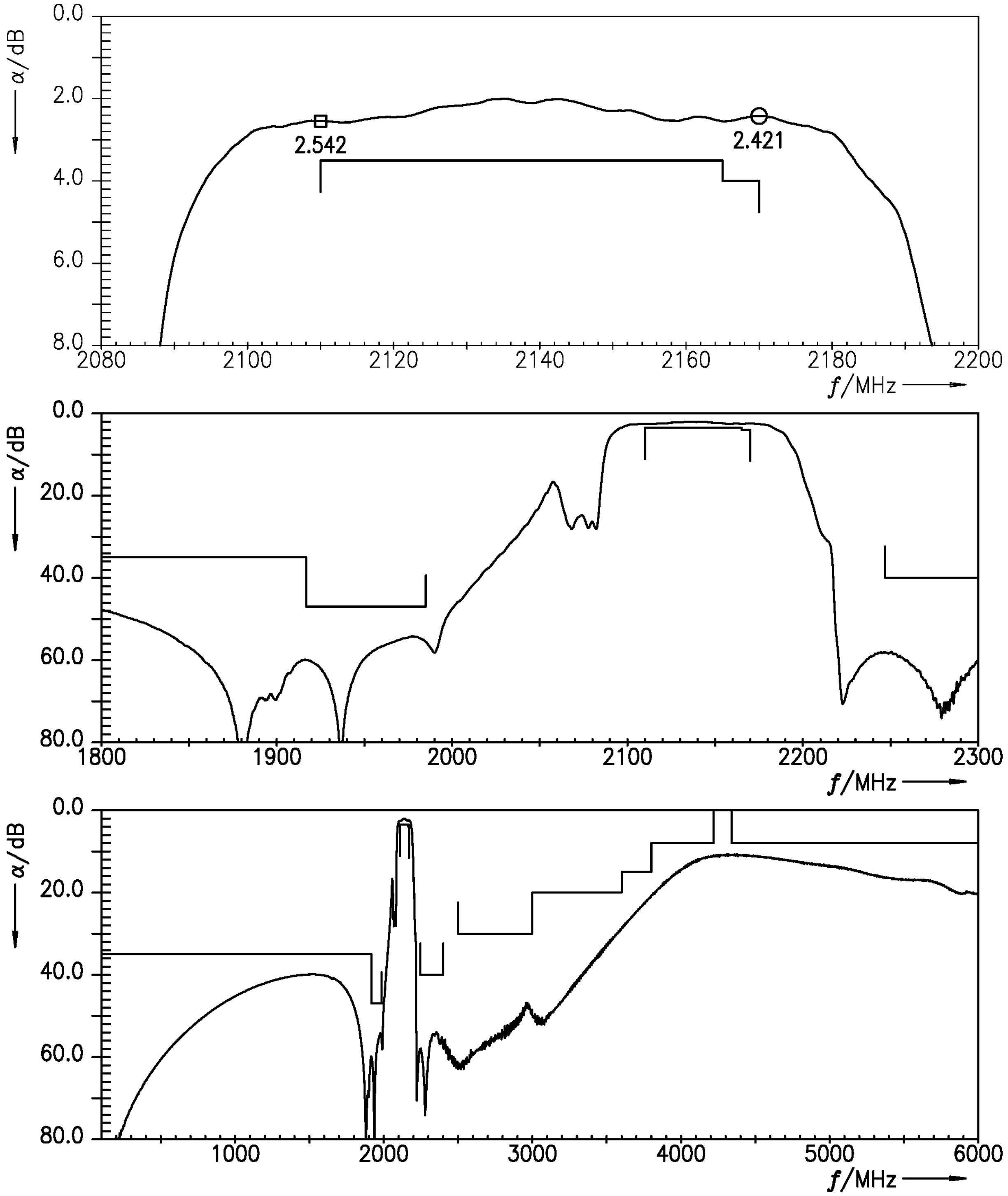


Figure 4: Attenuation TX – ANT.

8.2 ANT – RX

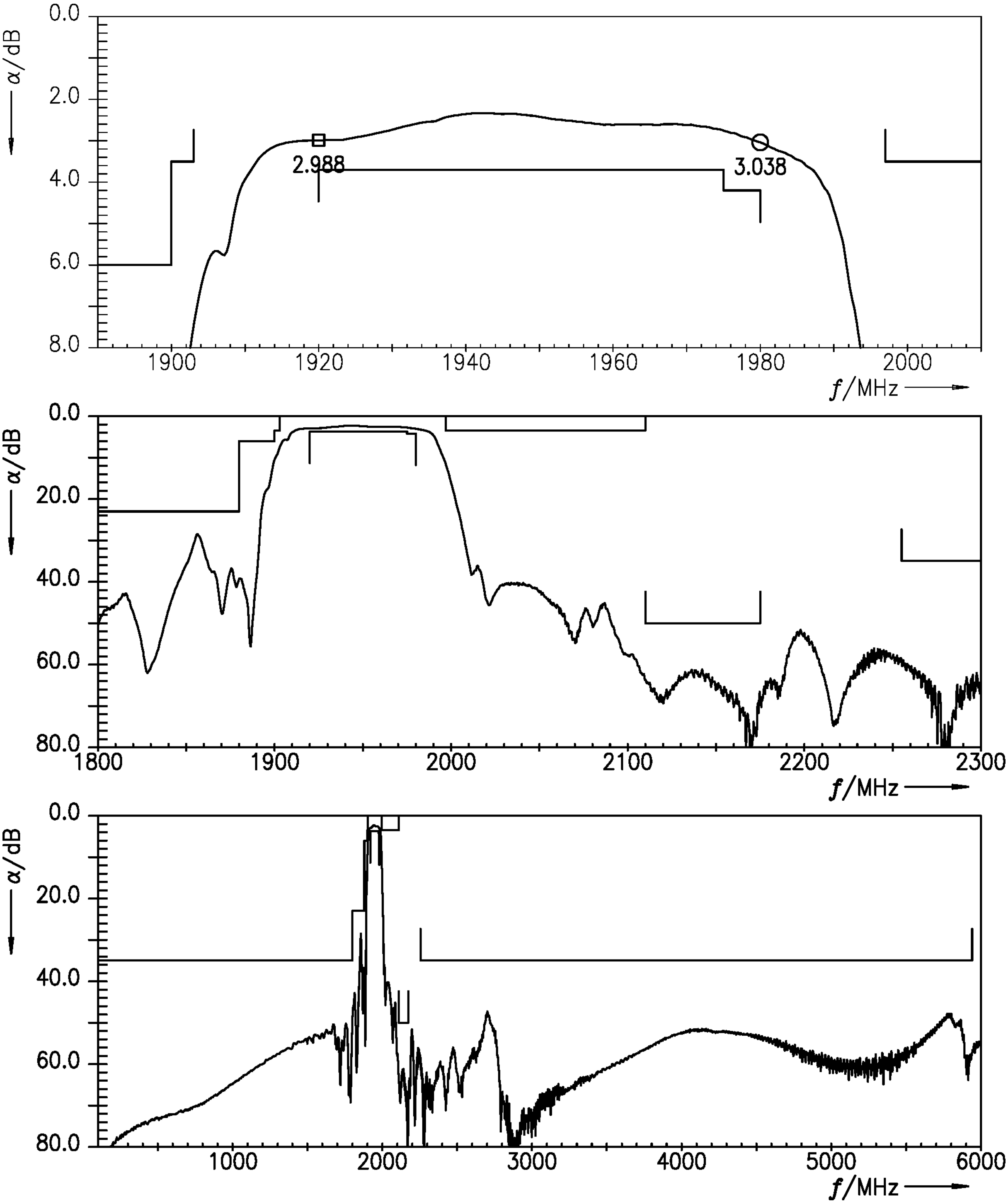


Figure 5: Attenuation ANT – RX.

8.3 TX – RX

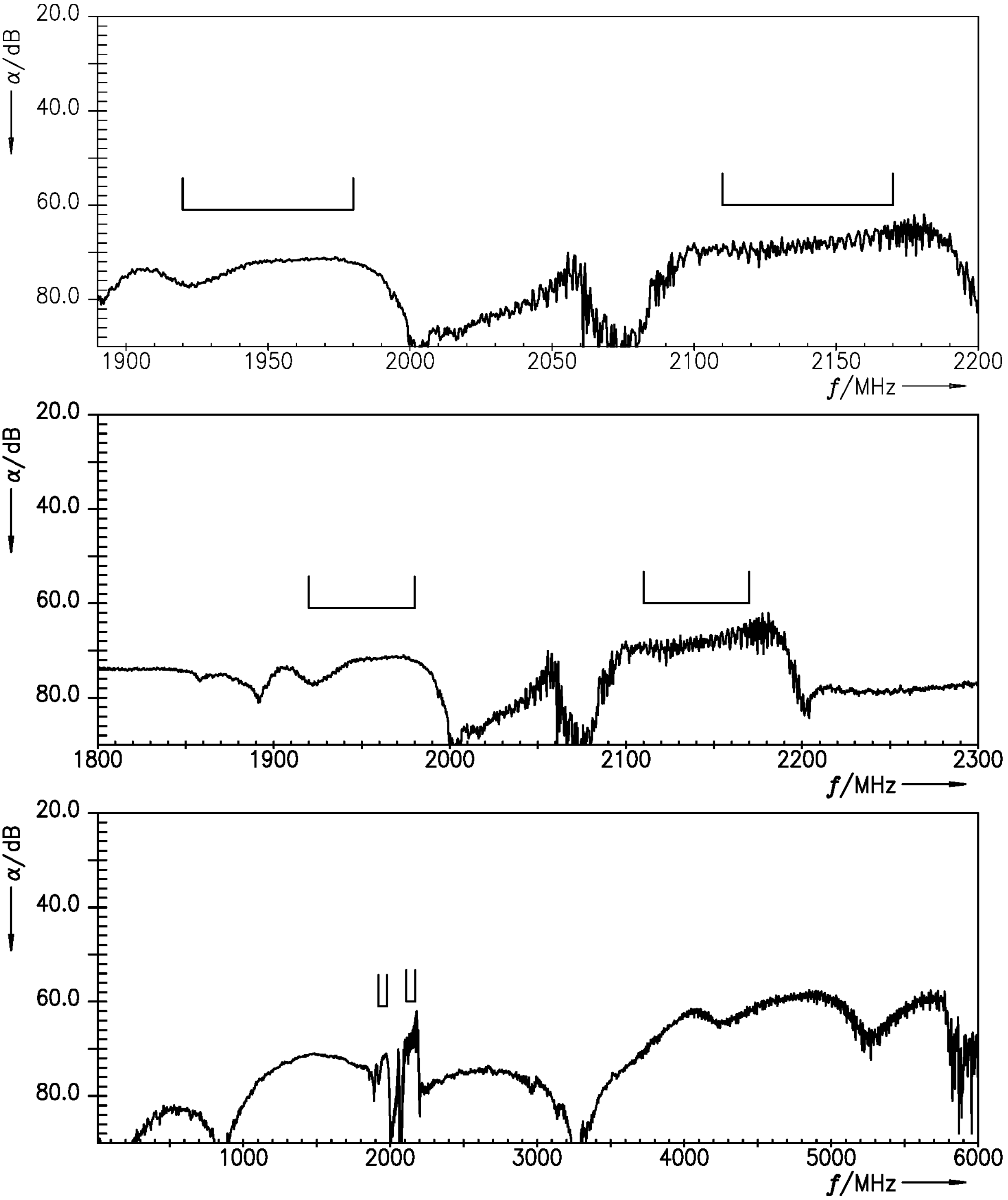


Figure 6: Isolation TX – RX.

9 Reflection coefficients

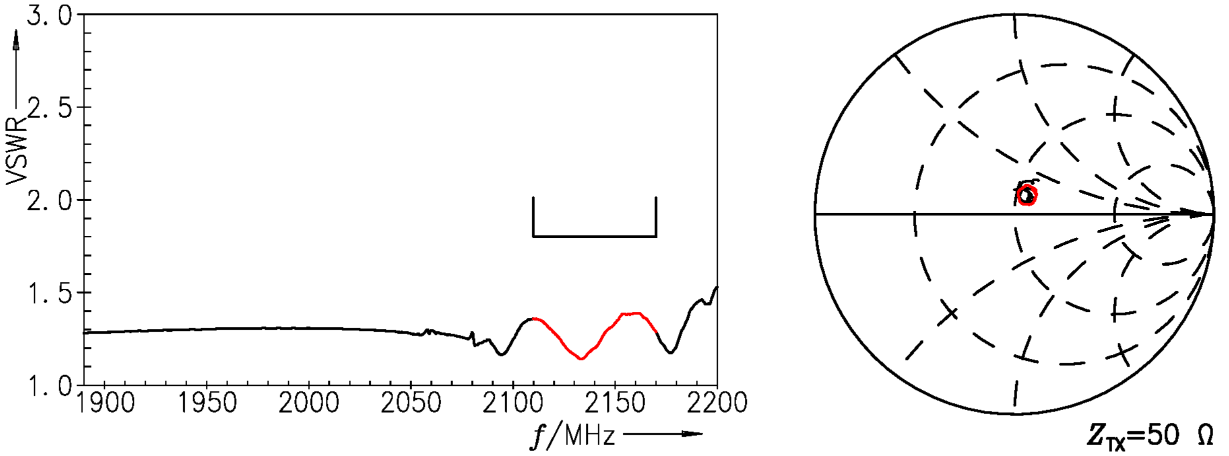


Figure 7: Reflection coefficient at TX port.

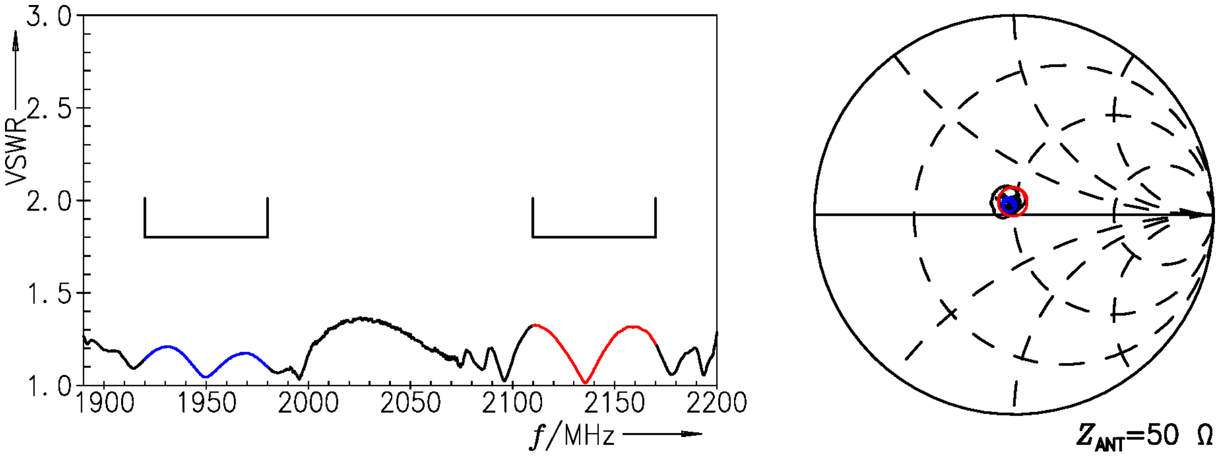


Figure 8: Reflection coefficient at ANT port (TX and RX frequencies).

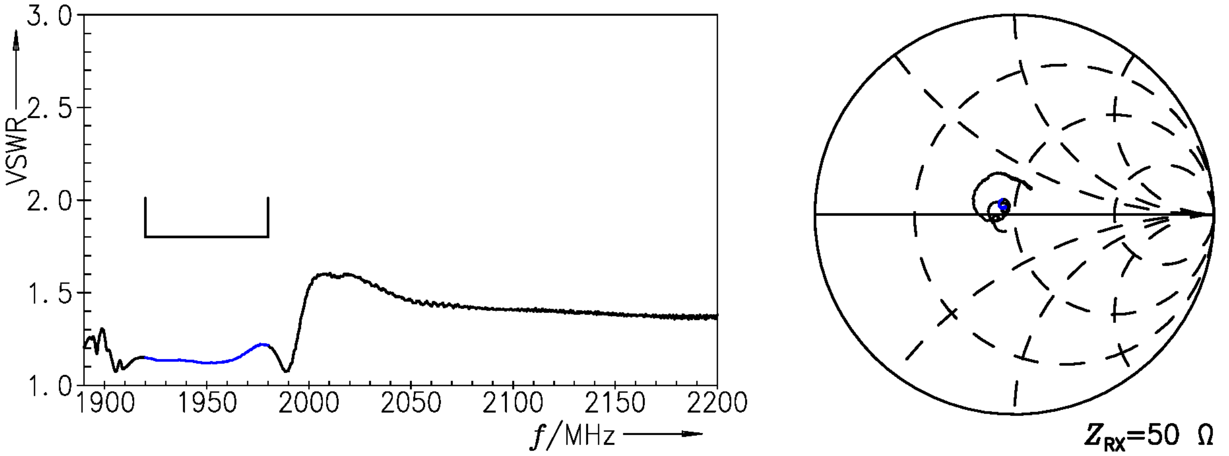


Figure 9: Reflection coefficient at RX port.

10 EVMs

10.1 TX – ANT

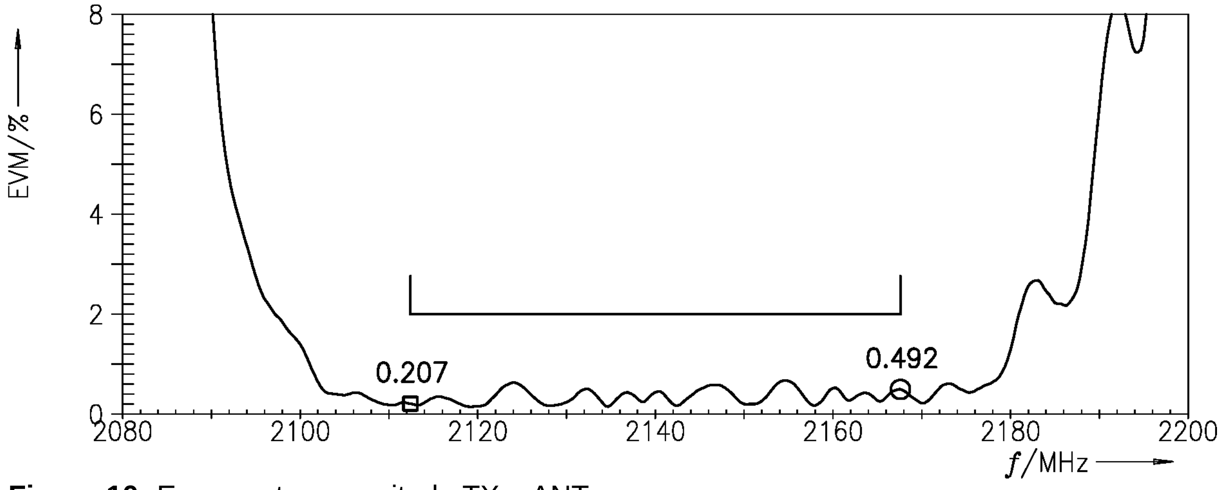


Figure 10: Error vector magnitude TX – ANT.

10.2 ANT – RX

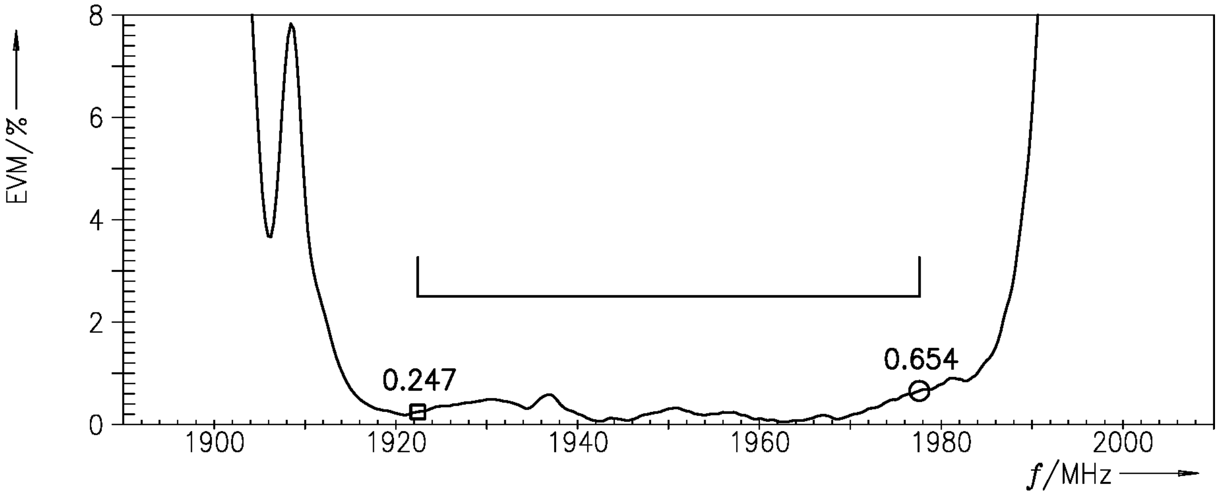


Figure 11: Error vector magnitude ANT – RX.

11 Packing material

11.1 Tape

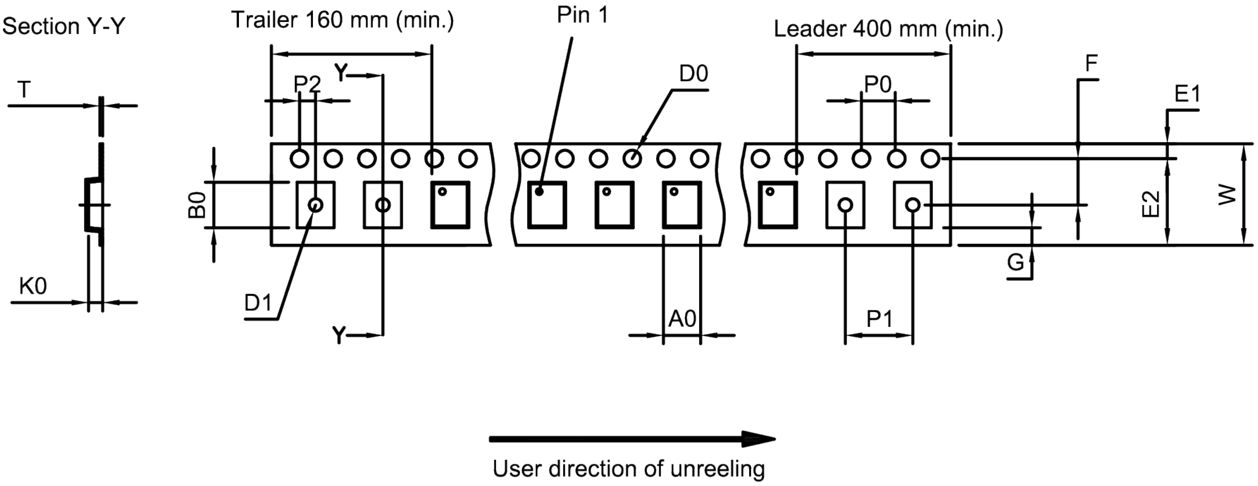


Figure 12: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

A_0	$8.4_{\pm 0.05}$ mm
B_0	$8.4_{\pm 0.05}$ mm
D_0	$1.5_{+0.1/-0}$ mm
D_1	1.5 mm (min.)
E_1	$1.75_{\pm 0.1}$ mm

E_2	14.25 mm (min.)
F	$7.5_{\pm 0.1}$ mm
G	0.75 mm (min.)
K_0	$1.3_{\pm 0.1}$ mm
P_0	$4.0_{\pm 0.1}$ mm

P_1	$12.0_{\pm 0.1}$ mm
P_2	$2.0_{\pm 0.1}$ mm
T	$0.3_{\pm 0.05}$ mm
W	$16.0_{+0.3/-0.1}$ mm

Table 1: Tape dimensions.

11.2 Reel with diameter of 330 mm

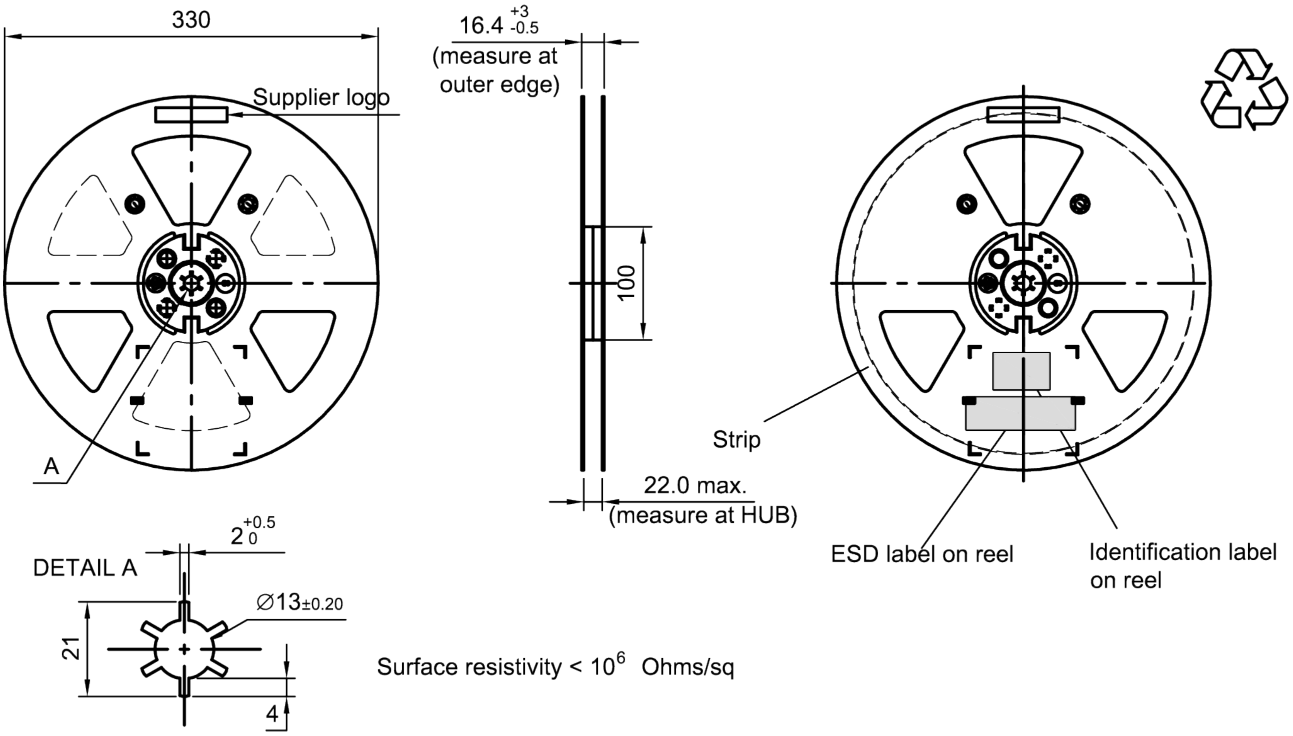


Figure 13: Drawing of reel (first-angle projection) with diameter of 330 mm.

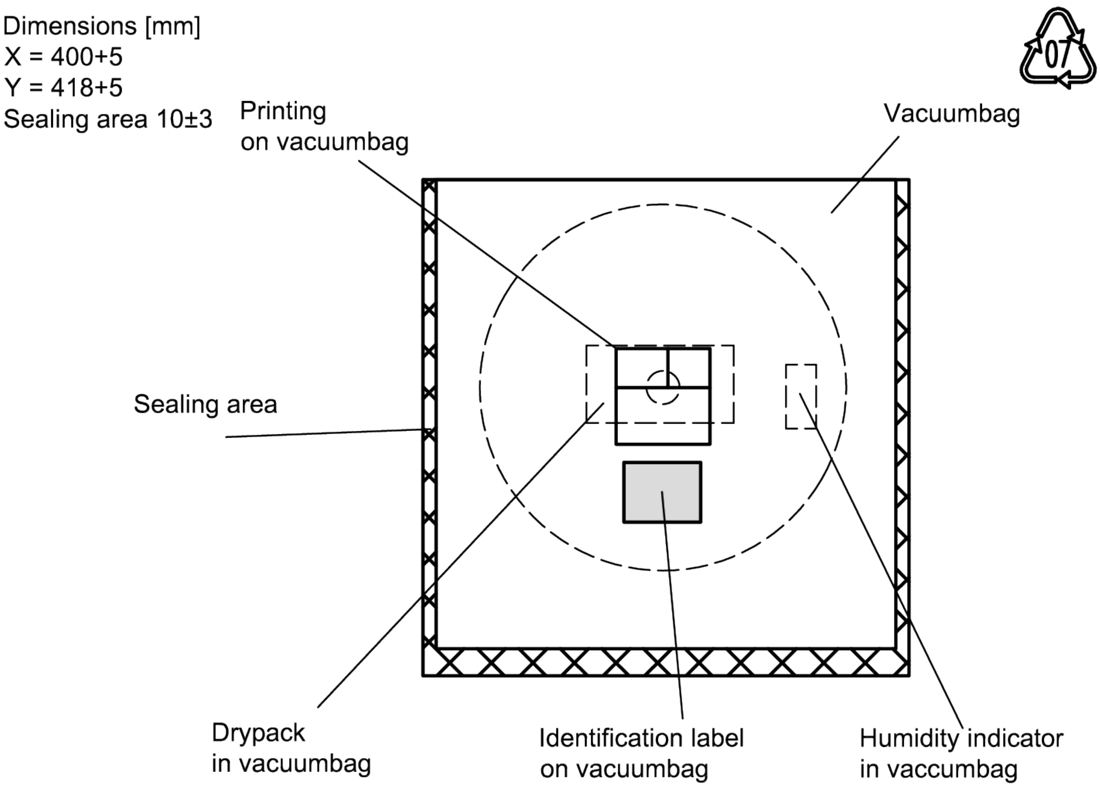


Figure 14: Drawing of moisture barrier bag (MBB) for reel with diameter of 330 mm.

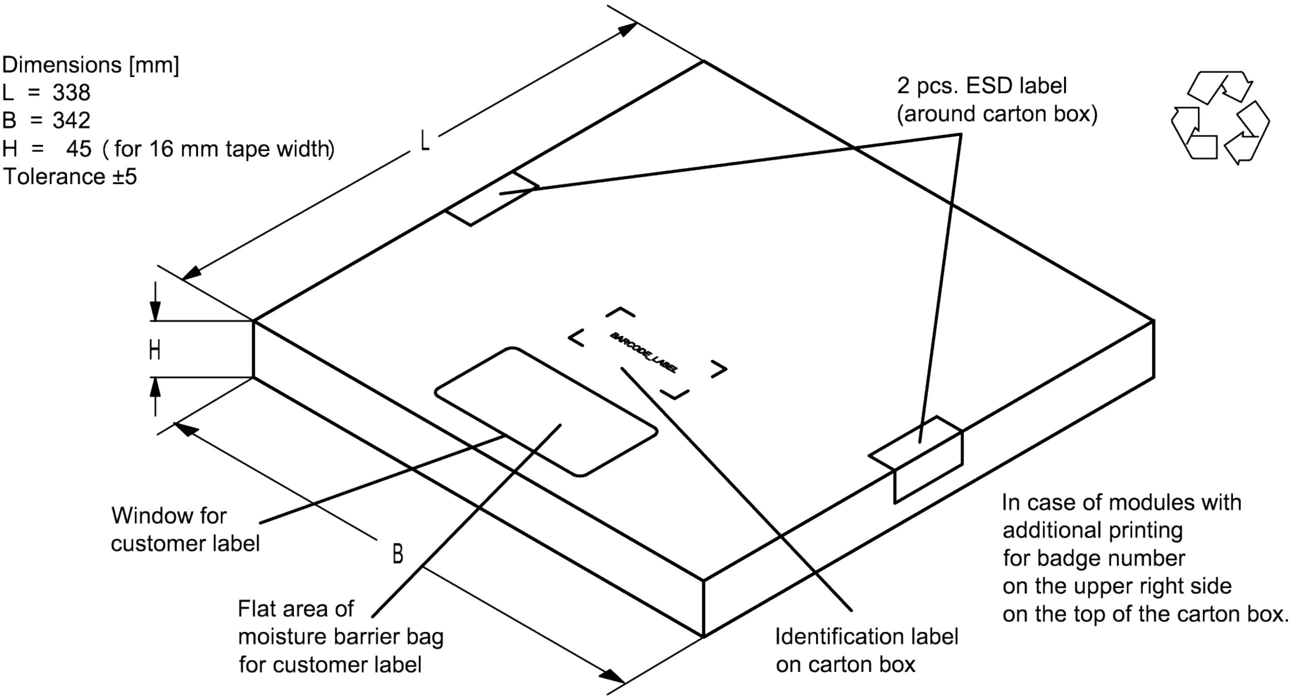


Figure 15: Drawing of folding box for reel with diameter of 330 mm.

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<u>**1234**</u>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 D7910 is 7Q6.

- 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).

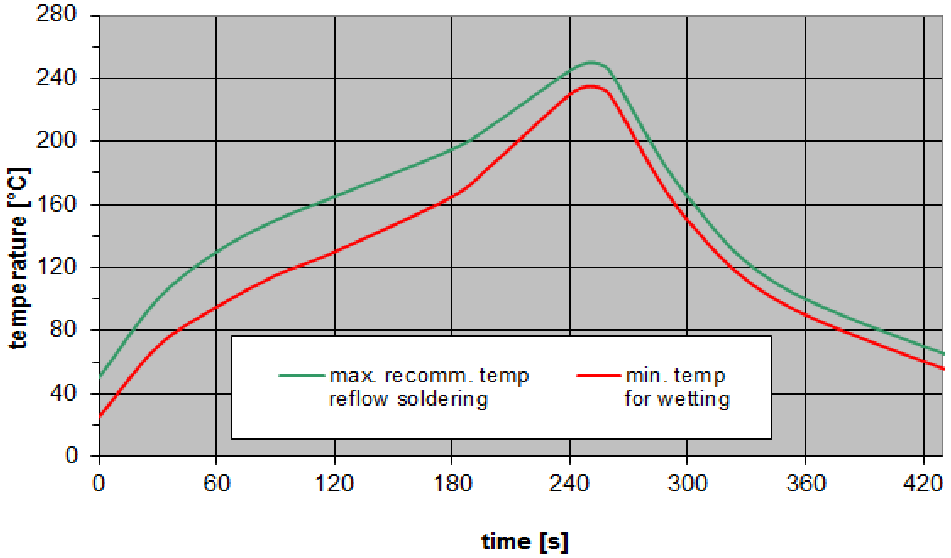


Figure 16: Recommended reflow profile for convection and infrared soldering – lead-free solder.

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
B39212D7910D310	B39212-D7910-D310	B39212D7910D310	3000 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).

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.

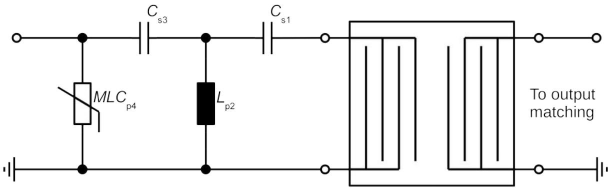


Figure 17: MLC varistor plus ESD matching.

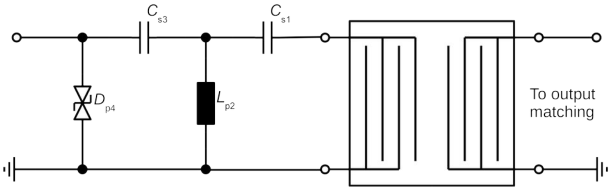


Figure 18: Suppressor diode plus ESD matching.

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

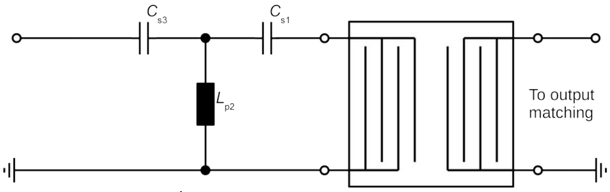


Figure 19: 3rd order high-pass structure for basic ESD protection.

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.

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