RF360 Europe GmbH

A Qualcomm – TDK Joint Venture

Data sheet

SAW duplexer

LTE band 1 + LTE band 3

Series/type:	B1203
Ordering code:	B39212B1203L210
Date:	November 07, 2018
Version:	2.0

DCN: 80-PA243-264 Rev. A

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

Table of contents

1 Application

- Low-loss SAW multiplexer for mobile telephone LTE Band 1 and Band 3 systems, also suitable for WCDMA applications
- Usable pass bands: 60 MHz for Band 1 and 75 MHz for Band 3
- High out of band selectivity
- High TX-RX isolation
- Unbalanced to unbalanced operation
- Terminating impedances 50 Ω

2 Features

- Package size $2.5_{\pm 0.05}$ mm × $2.0_{\pm 0.05}$ mm
- Package height 0.7 mm (max.)
- Approximate weight 9 mg
- RoHS compatible
- Package for Surface Mount Technology (SMT)
- Ni/Au-plated terminals
- Electrostatic Sensitive Device (ESD)
- Moisture Sensitivity Level 3 (MSL3)

3 Package

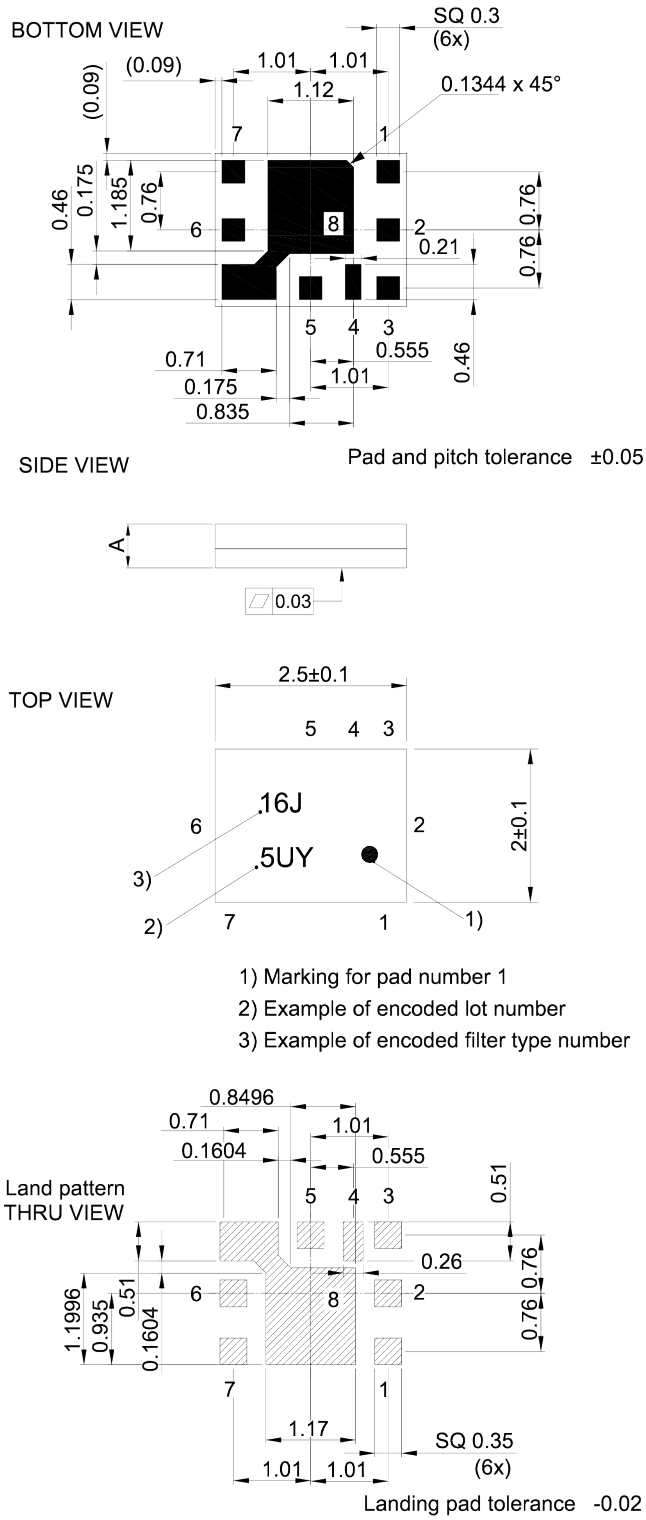

Figure 1: Drawing of package with package height A = 0.7 mm (max.). See Sec. Package information (p. 31).

4 Pin configuration

- 1 TX (B1)
- 2 TX (B3)
- 3 ANT (B1)
- 5 ANT (B3)
- 6 RX (B1)
- 7 RX (B3)
- 4, 8 Ground

5 Matching circuit

- L_{p1} = 7.3 nH
- L_{p3} = 2.7 nH
- L_{p5} = 2.6 nH
- L_{p6} = 10.3 nH
- L_{p7} = 12.5 nH
- L_{s2} = 2.2 nH

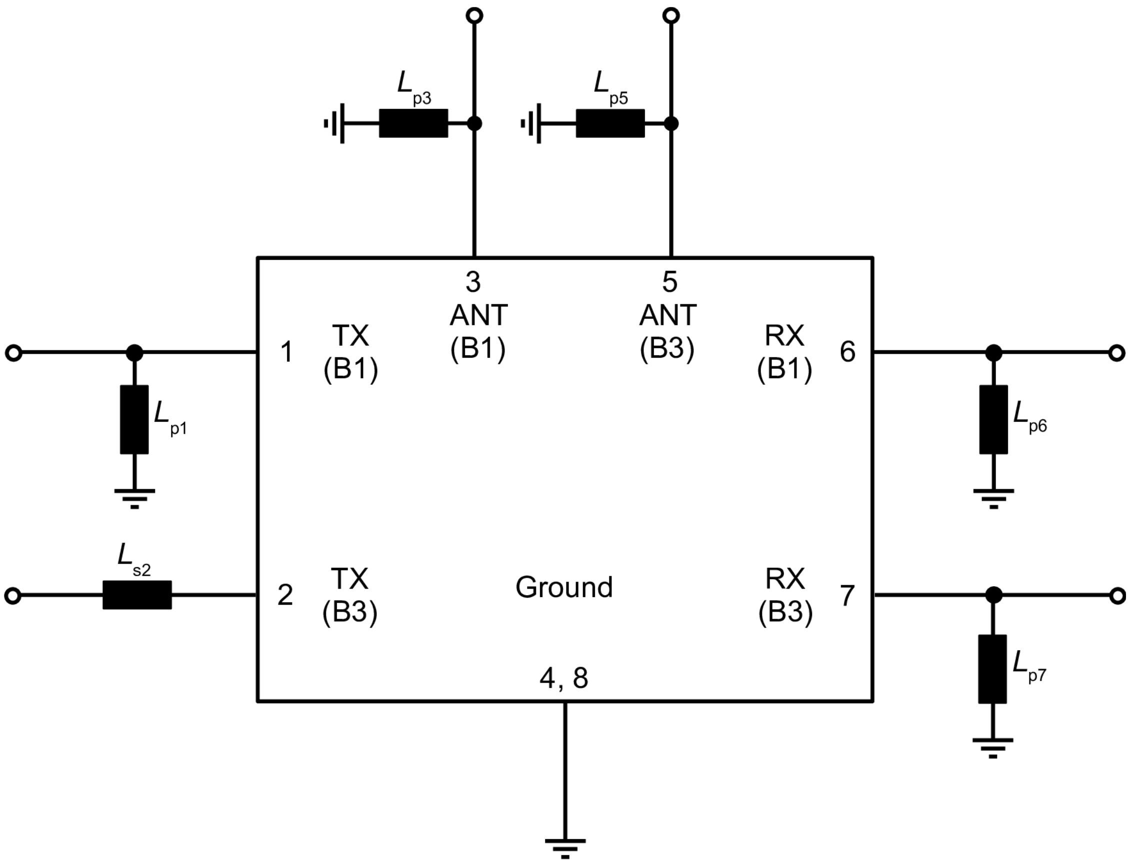

Figure 2: Schematic of matching circuit.

External shunt inductor for ESD protection is recommended at any ports towards antenna.

6 Characteristics LTE B1

6.1 TX – ANT

Temperature range for specification	T_{SPEC}	= −30 °C ... +85 °C
B1 TX terminating impedance	$Z_{B1\ TX}$	= 50 Ω with par. 7.3 nH[1)]
B1 ANT terminating impedance	$Z_{B1\ ANT}$	= 50 Ω with par. 2.7 nH[1)]
B1 RX terminating impedance	$Z_{B1\ RX}$	= 50 Ω with par. 10.3 nH[1)]

Characteristics LTE B1 TX – ANT				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency			f_C	—	1950	—	MHz
Maximum insertion attenuation			α_{max}				
	1920.25 ... 1979.75	MHz		—	1.5	2.1[2)]	dB
	1920.25 ... 1979.75	MHz		—	1.5	2.3	dB
Amplitude ripple (p-p)			$\Delta\alpha_{INT}$[3)]				
	1920 ... 1980	MHz		—	0.3	1.0	dB
Maximum VSWR			$VSWR_{max}$				
@ B1 TX port	1920.25 ... 1979.75	MHz		—	1.2	1.8	
@ B1 ANT port	1920.25 ... 1979.75	MHz		—	1.4	2.0	
Minimum attenuation							
	699 ... 960	MHz	α_{min}	35	45	—	dB
	1427 ... 1511	MHz	α_{min}	33	38	—	dB
	1559 ... 1605.89	MHz	α_{min}	33	39	—	dB
	1710 ... 1880	MHz	α_{min}	10	24	—	dB
	2010 ... 2025	MHz	α_{min}	10[2)]	11	—	dB
	2010 ... 2025	MHz	α_{min}	8[4)]	11	—	dB
	2010 ... 2025	MHz	α_{min}	4	11	—	dB
	2110 ... 2170	MHz	$\alpha_{INT,min}$[5)]	45	49	—	dB
	2400 ... 2483	MHz	α_{min}	28	32	—	dB
	2500 ... 2690	MHz	α_{min}	24	28	—	dB
	3840 ... 3960	MHz	α_{min}	20	31	—	dB
	5150 ... 5950	MHz	α_{min}	7	10	—	dB
	5760 ... 5940	MHz	α_{min}	7	10	—	dB

1) See Sec. Matching circuit (p. 6).
2) Valid for typical temperature T = +25 °C.
3) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 18 MHz of LTE 20 MHz (100 RB) channels.
4) Valid for temperature T = +15 °C...+85 °C.
5) 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}	= −30 °C ... +85 °C
B1 TX terminating impedance	$Z_{B1\ TX}$	= 50 Ω with par. 7.3 nH[1)]
B1 ANT terminating impedance	$Z_{B1\ ANT}$	= 50 Ω with par. 2.7 nH[1)]
B1 RX terminating impedance	$Z_{B1\ RX}$	= 50 Ω with par. 10.3 nH[1)]

Characteristics LTE B1 ANT – RX				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Center frequency			f_C	—	2140	—	MHz
Maximum insertion attenuation			α_{max}				
	2110.25 ... 2169.75	MHz		—	1.6	2.1[2)]	dB
	2110.25 ... 2169.75	MHz		—	1.6	2.5	dB
Amplitude ripple (p-p)			$\Delta\alpha_{INT}$[3)]				
	2110 ... 2170	MHz		—	0.2	1.0	dB
Maximum VSWR			$VSWR_{max}$				
@ B1 ANT port	2110.25 ... 2169.75	MHz		—	1.5	2.0	
@ B1 RX port	2110.25 ... 2169.75	MHz		—	1.5	2.0	
Minimum attenuation			α_{min}				
	190	MHz		50	92	—	dB
	699 ... 960	MHz		35	52	—	dB
	1427 ... 1511	MHz		35	45	—	dB
	1559 ... 1605.89	MHz		40	44	—	dB
	1710 ... 1910	MHz		35	44	—	dB
	1920.25 ... 1979.75	MHz		45	53	—	dB
	2400 ... 2483	MHz		35	41	—	dB
	2500 ... 2690	MHz		35	42	—	dB
	5150 ... 5950	MHz		27	34	—	dB

1) See Sec. Matching circuit (p. 6).
2) Valid for typical temperature T = +25 °C.
3) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 18 MHz of LTE 20 MHz (100 RB) channels.

6.3 TX – RX

Temperature range for specification	T_{SPEC}	= −30 °C ... +85 °C
B1 TX terminating impedance	$Z_{B1\ TX}$	= 50 Ω with par. 7.3 nH[1)]
B1 ANT terminating impedance	$Z_{B1\ ANT}$	= 50 Ω with par. 2.7 nH[1)]
B1 RX terminating impedance	$Z_{B1\ RX}$	= 50 Ω with par. 10.3 nH[1)]

Characteristics LTE B1 TX – RX				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Minimum isolation							
	1574 ... 1577	MHz	α_{min}	40	65	—	dB
	1805.15 ... 1879.85	MHz	α_{min}	55	66	—	dB
	1920 ... 1980	MHz	$\alpha_{INT,min}$ [2)]	52	56	—	dB
	2110 ... 2170	MHz	$\alpha_{INT,min}$ [2)]	50	57	—	dB
	3830 ... 3970	MHz	α_{min}	20	66	—	dB
	5750 ... 5950	MHz	α_{min}	20	35	—	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 Characteristics LTE B3

7.1 TX – ANT

Temperature range for specification	T_{SPEC}	= −30 °C ... +85 °C
B3 TX terminating impedance	$Z_{B3\ TX}$	= 50 Ω with ser. 2.2 nH[1)]
B3 ANT terminating impedance	$Z_{B3\ ANT}$	= 50 Ω with par. 2.6 nH[1)]
B3 RX terminating impedance	$Z_{B3\ RX}$	= 50 Ω with par. 12.5 nH[1)]

Characteristics LTE B3 TX – ANT				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency			f_C	—	1747.5	—	MHz
Maximum insertion attenuation			α_{max}				
	1710.15 ... 1784.85	MHz		—	1.9	2.9[2)]	dB
	1710.15 ... 1784.85	MHz		—	1.9	3.3	dB
Amplitude ripple (p-p)			$\Delta\alpha_{INT}$[3)]				
	1710 ... 1785	MHz		—	0.4	2.0	dB
Maximum VSWR			$VSWR_{max}$				
@ B3 TX port	1710.15 ... 1784.85	MHz		—	1.7	2.0	
@ B3 ANT port	1710.15 ... 1784.85	MHz		—	1.5	2.0	
Minimum attenuation			α_{min}				
	699 ... 960	MHz		35	41	—	dB
	1427 ... 1511	MHz		35	40	—	dB
	1559 ... 1605.89	MHz		30	40	—	dB
	1805.15 ... 1879.85	MHz		45[4)]	50	—	dB
	1805.15 ... 1879.85	MHz		40	50	—	dB
	1920 ... 2170	MHz		25	28	—	dB
	2300 ... 2400	MHz		32	40	—	dB
	2400 ... 2483	MHz		33	38	—	dB
	2500 ... 2690	MHz		30	37	—	dB
	3420 ... 3570	MHz		30	37	—	dB
	5130 ... 5355	MHz		15	23	—	dB
	5150 ... 5950	MHz		10	13	—	dB

1) See Sec. Matching circuit (p. 6).
2) Valid for typical temperature T = +25 °C.
3) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 18 MHz of LTE 20 MHz (100 RB) channels.
4) Valid for temperature T = 0 °C...+85 °C.

7.2 ANT – RX

Temperature range for specification	T_{SPEC}	= −30 °C ... +85 °C
B3 TX terminating impedance	$Z_{B3\ TX}$	= 50 Ω with ser. 2.2 nH[1)]
B3 ANT terminating impedance	$Z_{B3\ ANT}$	= 50 Ω with par. 2.6 nH[1)]
B3 RX terminating impedance	$Z_{B3\ RX}$	= 50 Ω with par. 12.5 nH[1)]

Characteristics LTE B3 ANT – RX				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Center frequency			f_C	—	1842.5	—	MHz
Maximum insertion attenuation			α_{max}				
	1805.15... 1879.85	MHz		—	2.7	3.6[2)]	dB
	1805.15... 1879.85	MHz		—	2.7	4.5	dB
Amplitude ripple (p-p)			$\Delta\alpha_{INT}$[3)]				
	1805... 1880	MHz		—	0.5	2.2	dB
Maximum VSWR			$VSWR_{max}$				
@ B3 ANT port	1805.15... 1879.85	MHz		—	1.6	2.0	
@ B3 RX port	1805.15... 1879.85	MHz		—	1.7	2.2[4)]	
	1805.15... 1879.85	MHz		—	1.7	2.5	
Minimum attenuation			α_{min}				
	95	MHz		50	107	—	dB
	699... 960	MHz		40	48	—	dB
	1427... 1511	MHz		35	42	—	dB
	1559... 1605.89	MHz		36	43	—	dB
	1710.15... 1784.85	MHz		45	56	—	dB
	1920... 2170	MHz		35	42	—	dB
	2300... 2400	MHz		35	39	—	dB
	2400... 2483	MHz		37	47	—	dB
	2500... 2690	MHz		40	48	—	dB
	5150... 5950	MHz		34	41	—	dB

1) See Sec. Matching circuit (p. 6).
2) Valid for typical temperature T = +25 °C.
3) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 18 MHz of LTE 20 MHz (100 RB) channels.
4) Valid for temperature T = −10 °C...+85 °C.

7.3 TX – RX

Temperature range for specification	T_{SPEC}	= −30 °C ... +85 °C
B3 TX terminating impedance	$Z_{B3\ TX}$	= 50 Ω with ser. 2.2 nH[1)]
B3 ANT terminating impedance	$Z_{B3\ ANT}$	= 50 Ω with par. 2.6 nH[1)]
B3 RX terminating impedance	$Z_{B3\ RX}$	= 50 Ω with par. 12.5 nH[1)]

Characteristics LTE B3 TX – RX				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Minimum isolation							
	1710 ... 1785	MHz	$\alpha_{INT,min}$[2)]	53	58	—	dB
	1710.15 ... 1784.85	MHz	α_{min}	53[3)]	58	—	dB
	1710.15 ... 1784.85	MHz	α_{min}	52	58	—	dB
	1805 ... 1880	MHz	$\alpha_{INT,min}$[2)]	51	54	—	dB
	1805.15 ... 1879.85	MHz	α_{min}	50	54	—	dB
	2110.25 ... 2169.75	MHz	α_{min}	58	68	—	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) Valid for typical temperature T = +25 °C.

8 Maximum ratings

Storage temperature	T_{STG}[1)] = −40 °C ... +85 °C	
DC voltage	$\|V_{DC}\|$[2)] = 0 V (max.)	
ESD voltage		
	V_{ESD}[3)] = 100 V (max.)	Machine model.
	V_{ESD}[4)] = 250 V (max.)	Human body model.
	V_{ESD}[5)] = 600 V (max.)	Charged device model.
Input power	P_{IN}	
@ B1 TX port: 1920.25 ... 1979.75 MHz	30 dBm	Continuous wave for 3000 h @ 50 °C.
@ B1 TX port: other frequency ranges	10 dBm	Continuous wave for 3000 h @ 50 °C.
@ B3 TX port: 1710.15 ... 1784.85 MHz	30 dBm	Continuous wave for 5000 h @ 50 °C.
@ B3 TX port: other frequency ranges	10 dBm	Continuous wave for 5000 h @ 50 °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-A115B (MM – Machine Model), 10 negative & 10 positive pulses.
4) According to JESD22-A114F (HBM – Human Body Model), 1 negative & 1 positive pulse.
5) According to JESD22-C101C (CDM – Field Induced Charged Device Model), 3 negative & 3 positive pulses.

9 Transmission coefficients LTE B1

9.1 TX – ANT

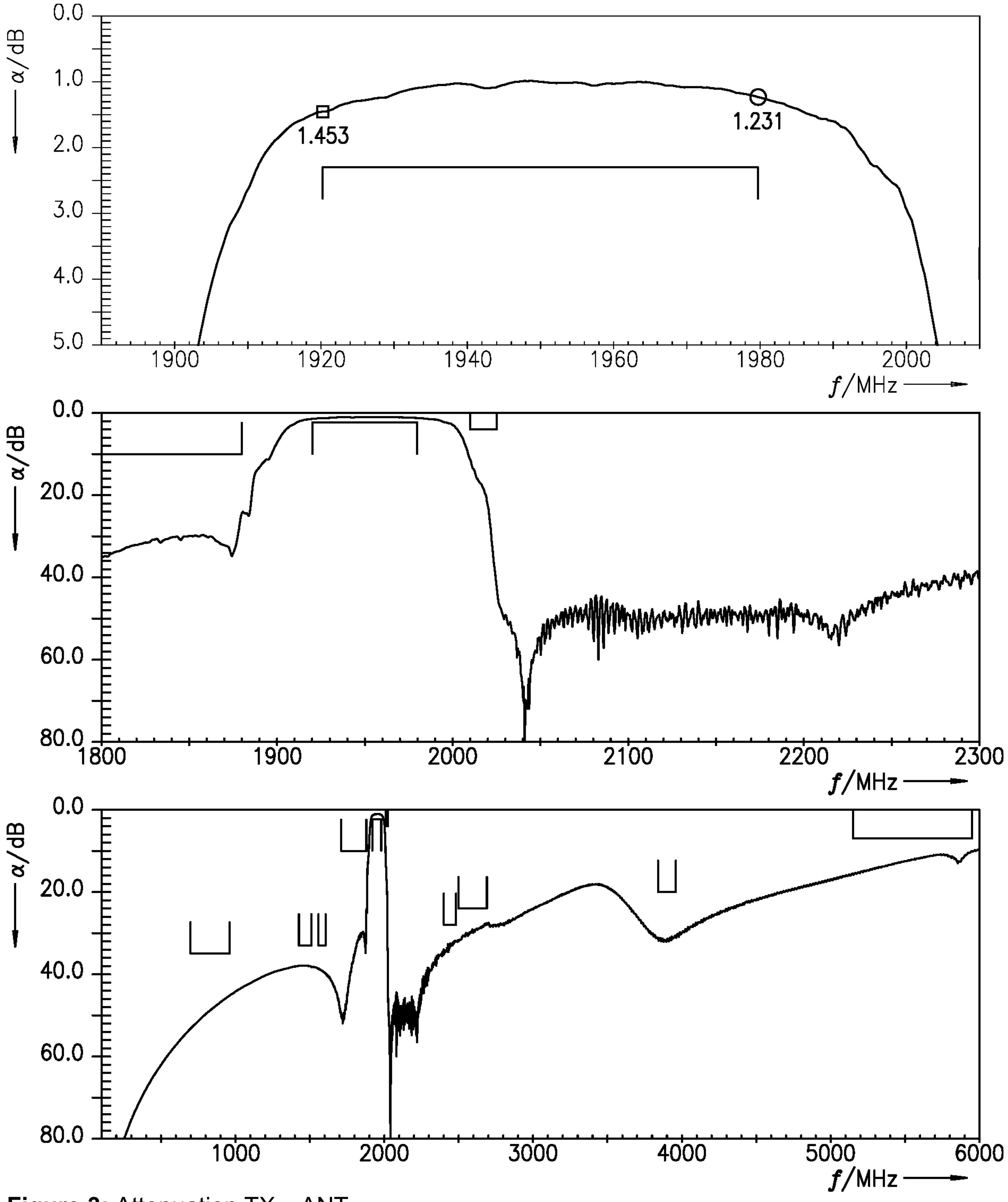

Figure 3: Attenuation TX – ANT.

9.2 ANT – RX

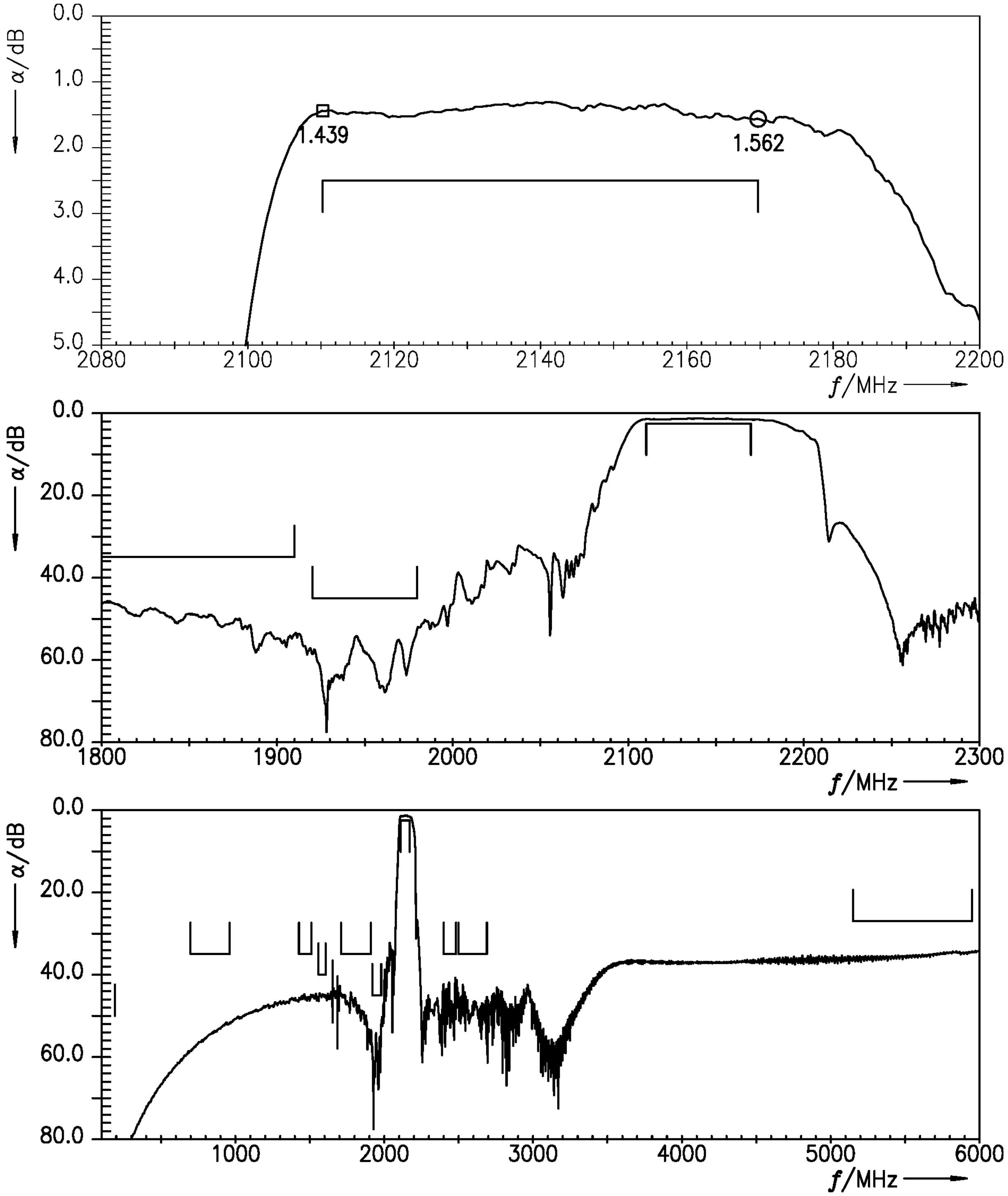

Figure 4: Attenuation ANT – RX.

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9.3 TX – RX

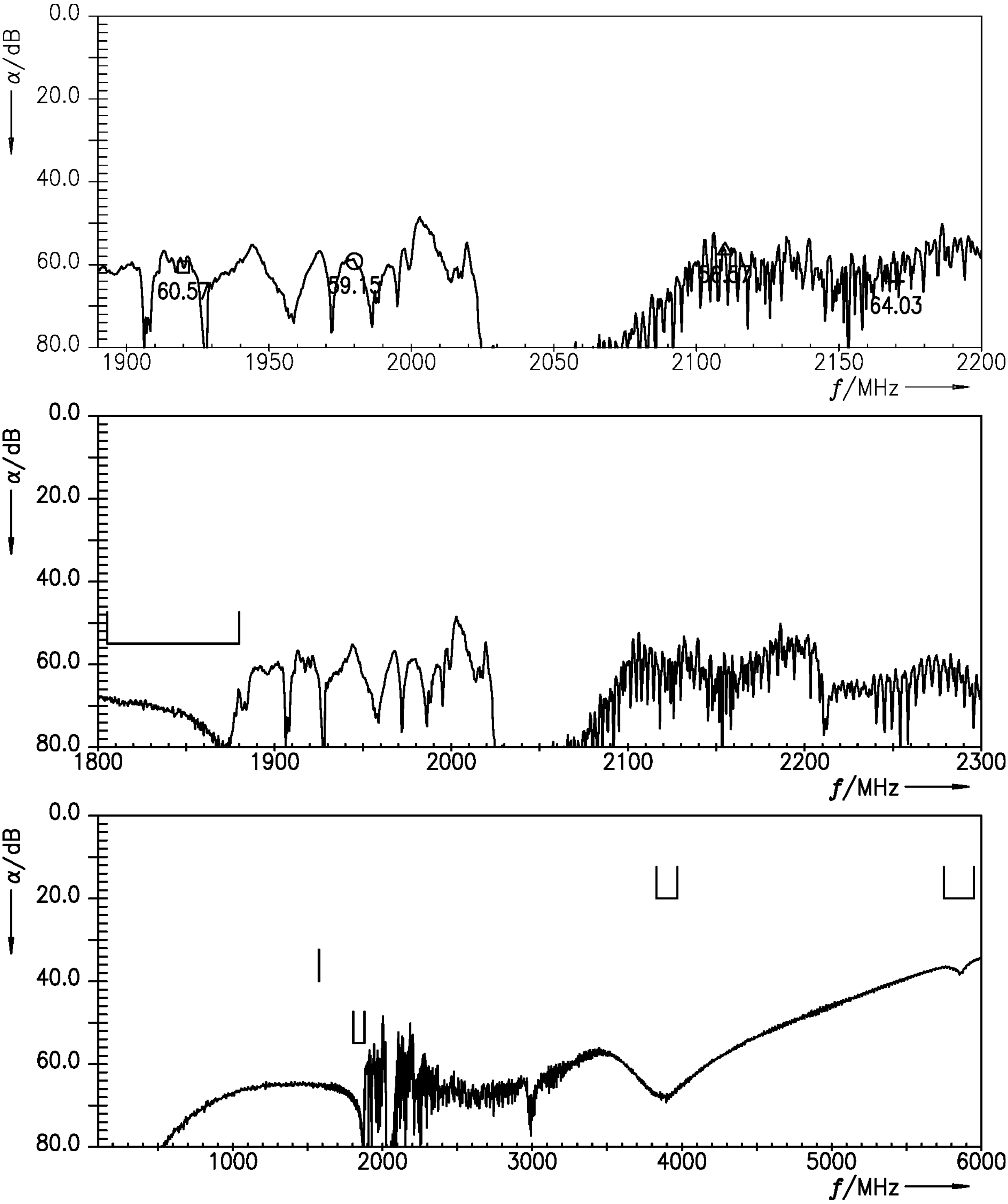

Figure 5: Isolation TX – RX.

10 Transmission coefficient (LTE) LTE B1

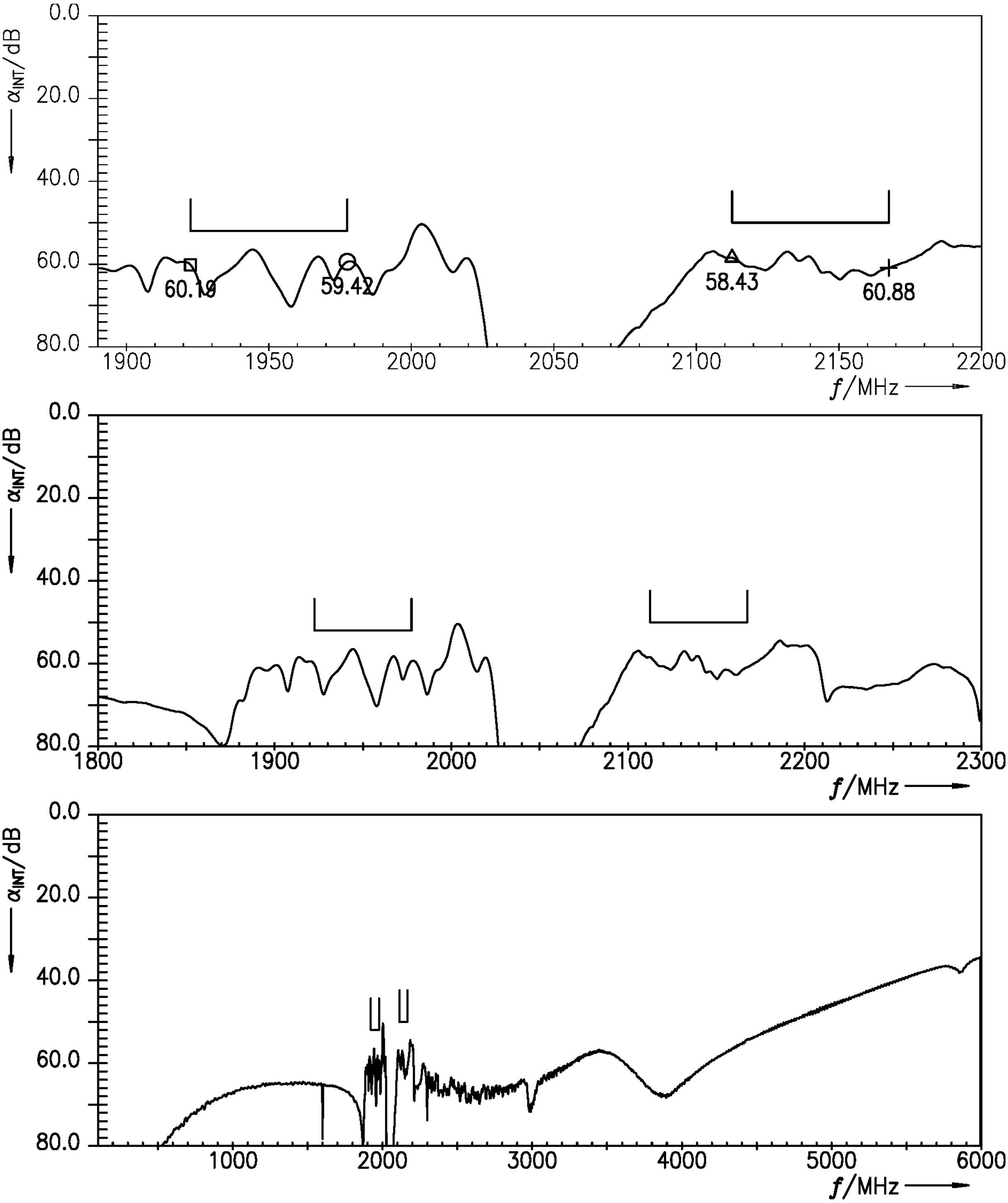

Figure 6: Isolation (LTE) (integration window = 5 MHz) LTE B1.

11 Reflection coefficients LTE B1

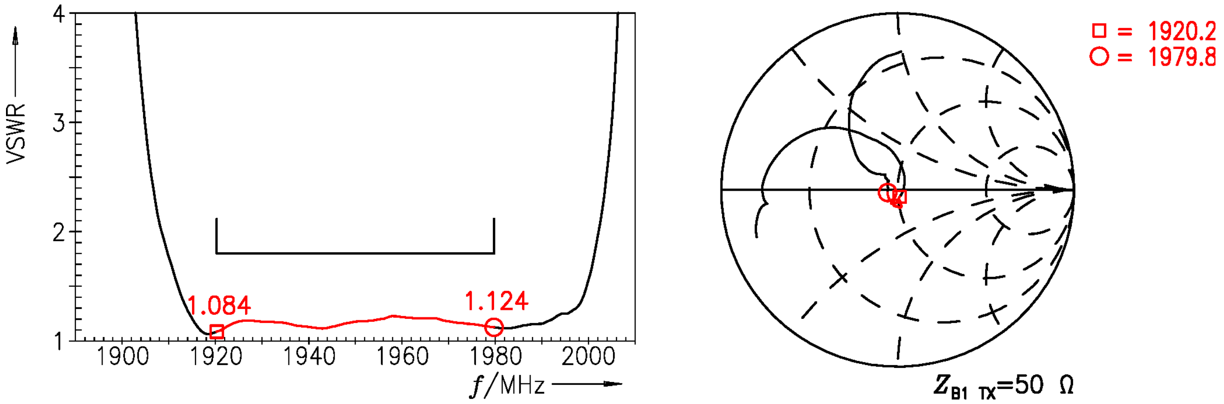

Figure 7: Reflection coefficient at B1 TX port.

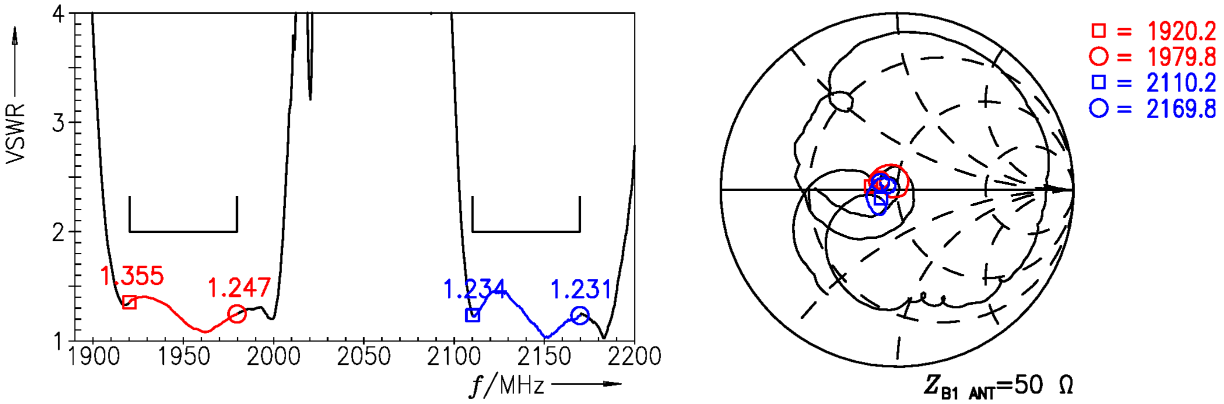

Figure 8: Reflection coefficient at B1 ANT port.

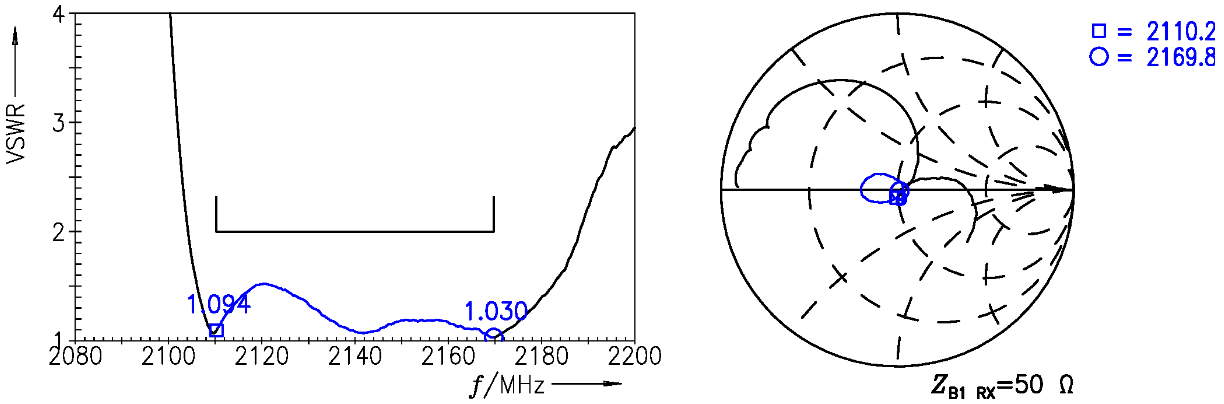

Figure 9: Reflection coefficient at B1 RX port.

12 Transmission coefficients LTE B3

12.1 TX – ANT

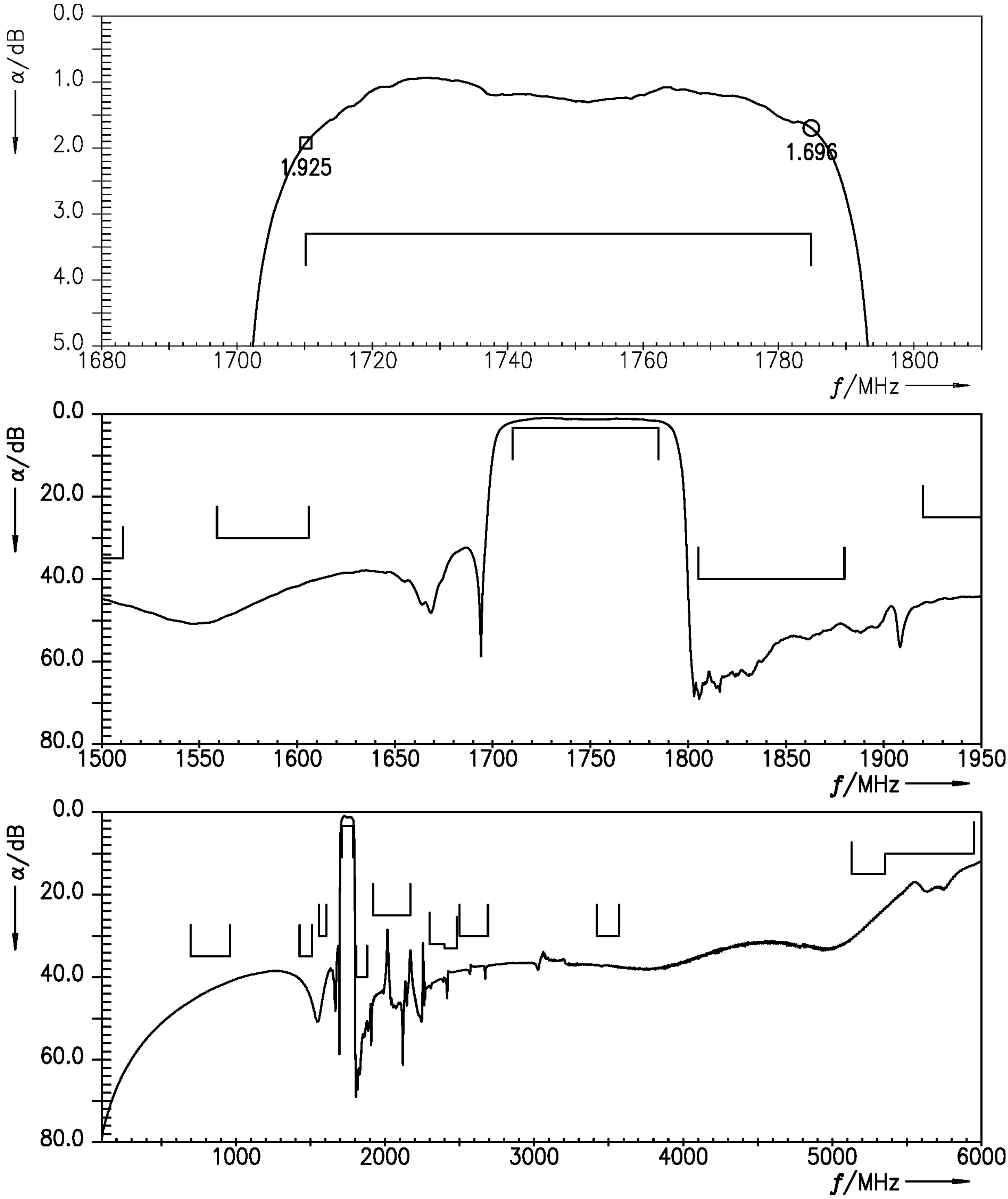

Figure 10: Attenuation TX – ANT.

12.2 ANT – RX

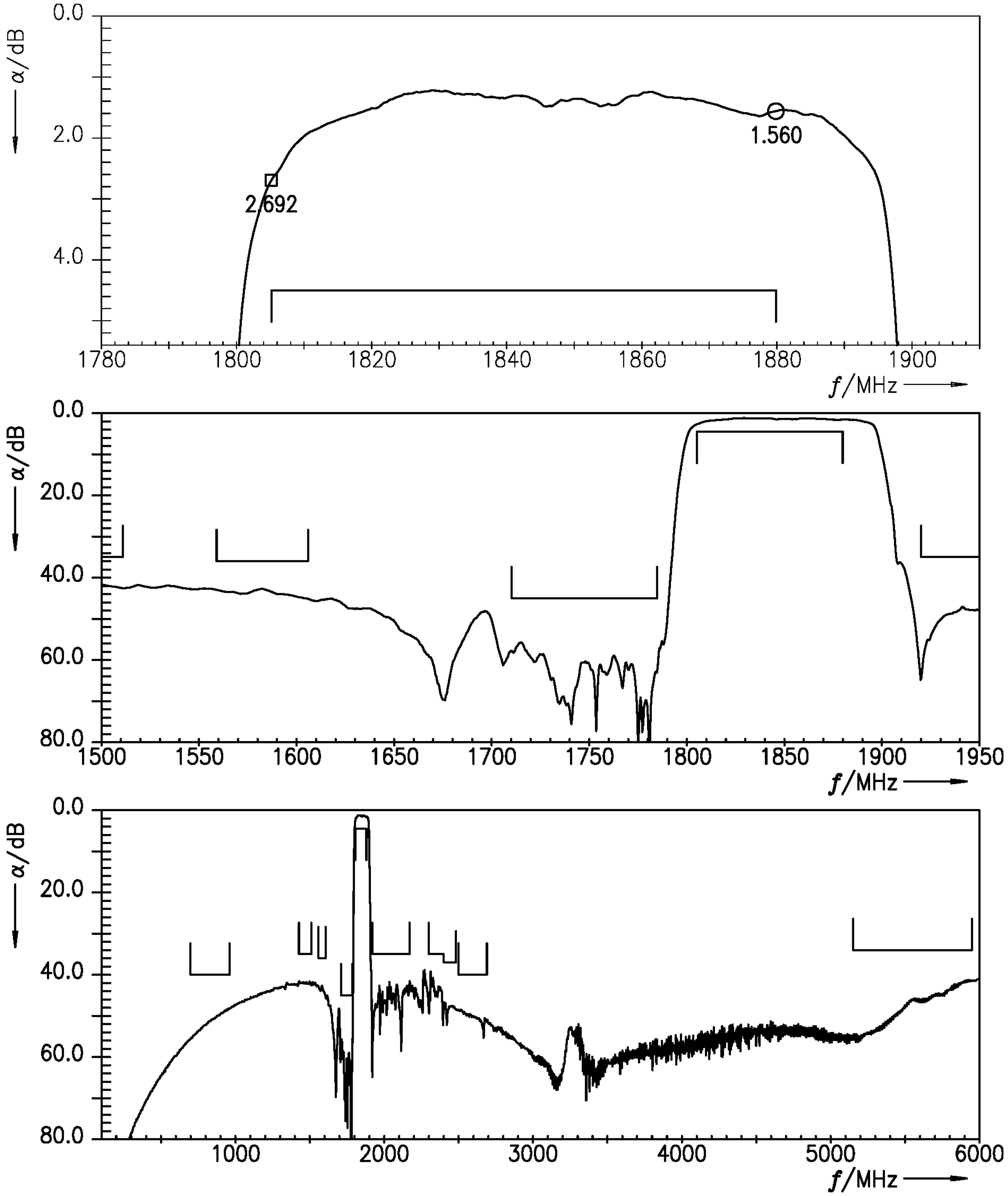

Figure 11: Attenuation ANT – RX.

12.3 TX – RX

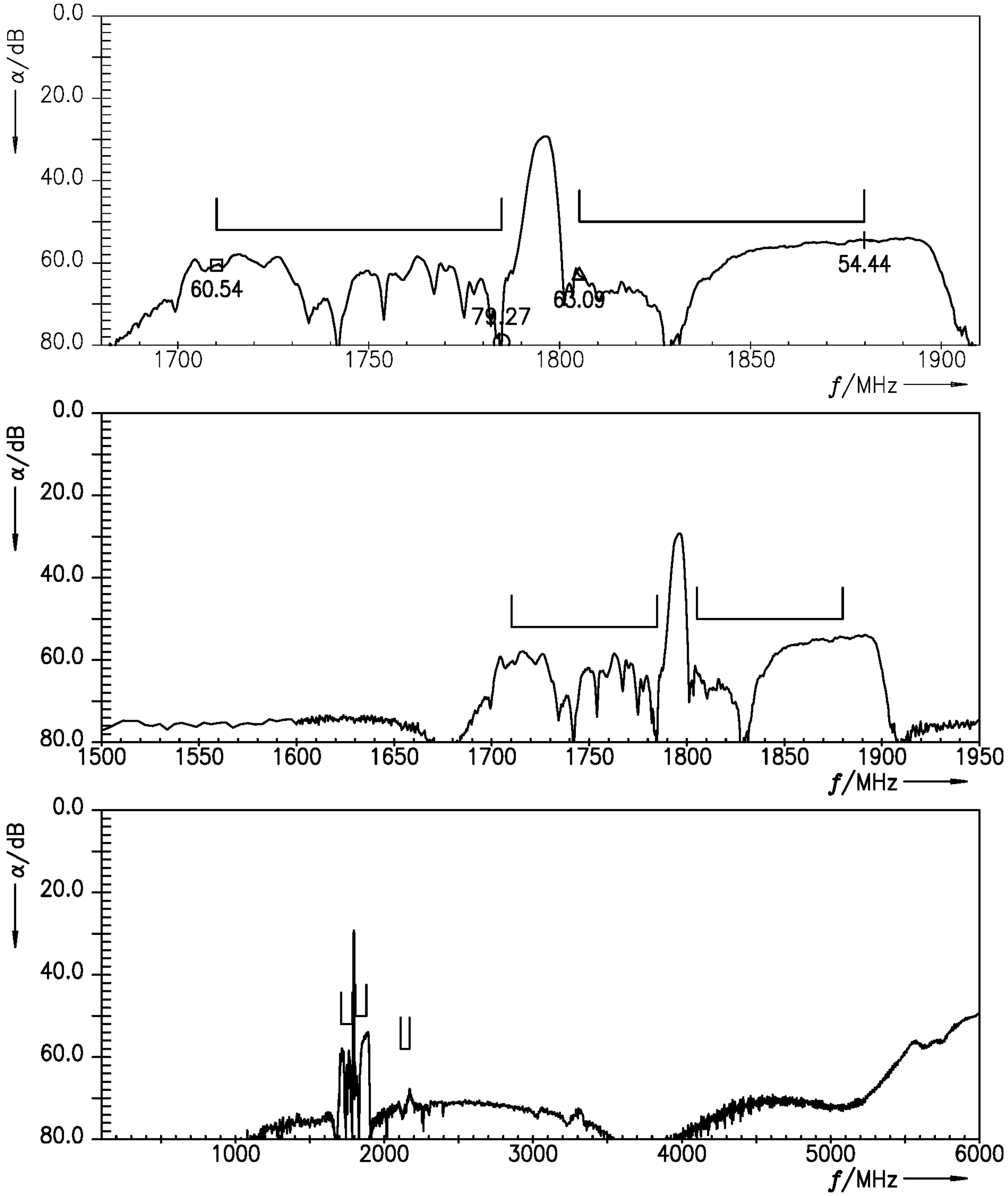

Figure 12: Isolation TX – RX.

13 Transmission coefficient (LTE) LTE B3

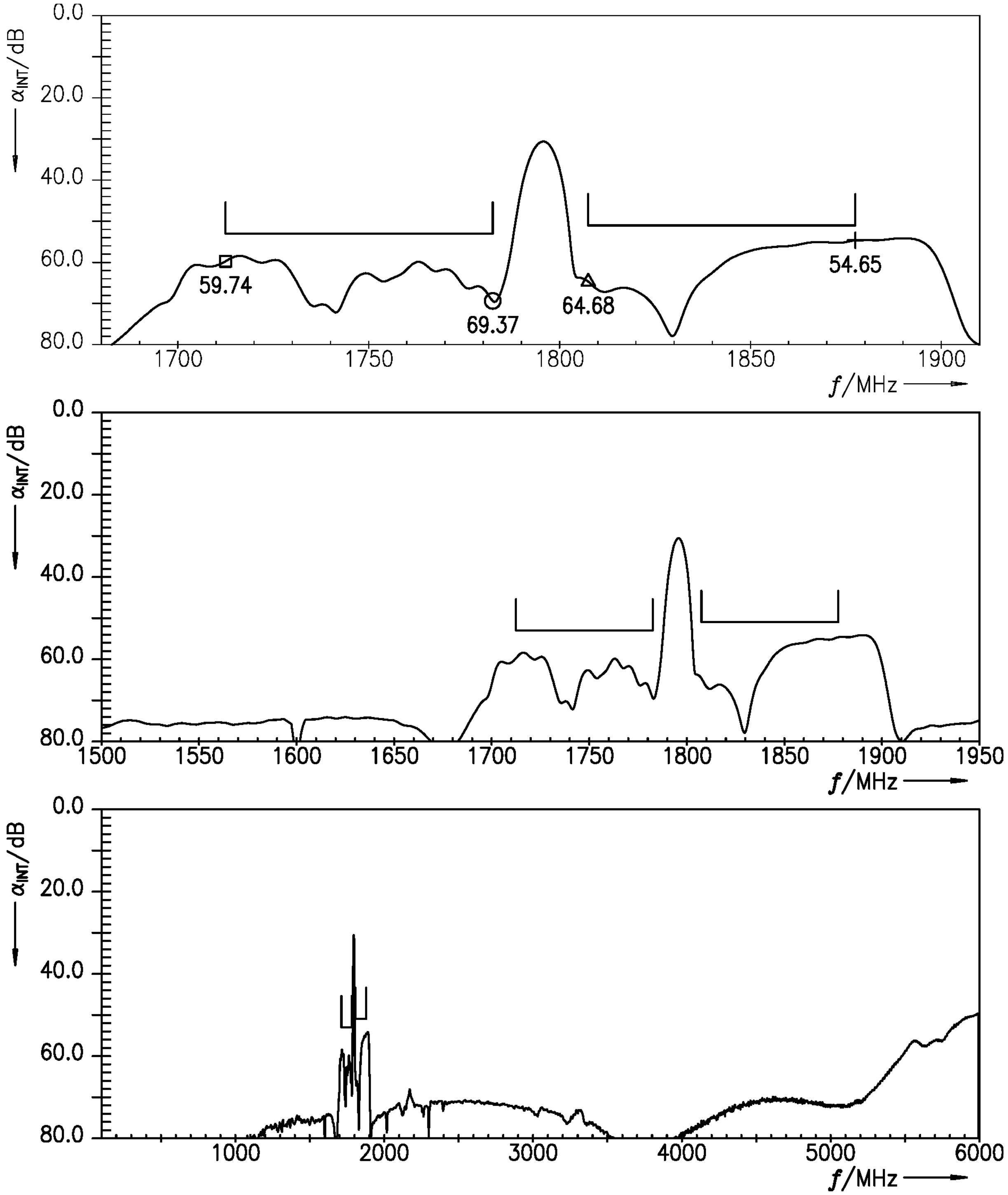

Figure 13: Isolation (LTE) (integration window = 5 MHz) LTE B3.

14 Reflection coefficients LTE B3

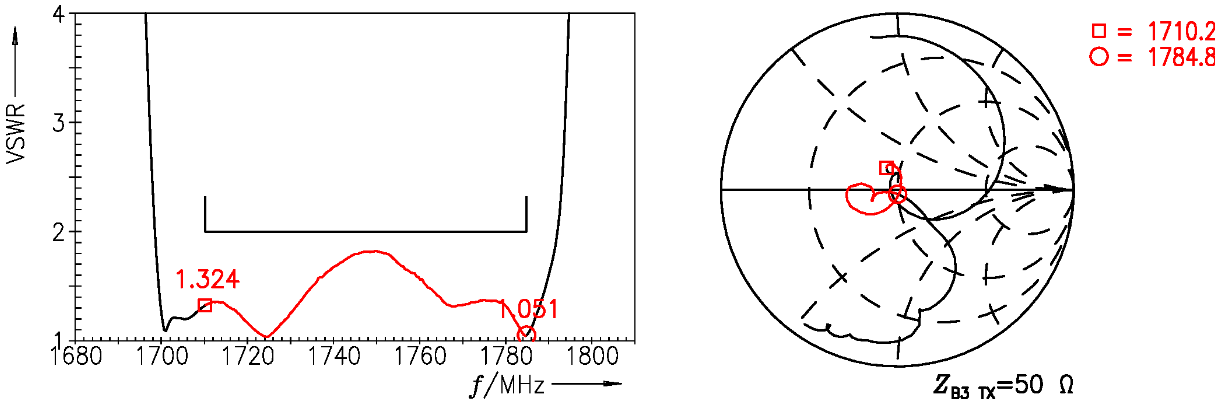

Figure 14: Reflection coefficient at B3 TX port.

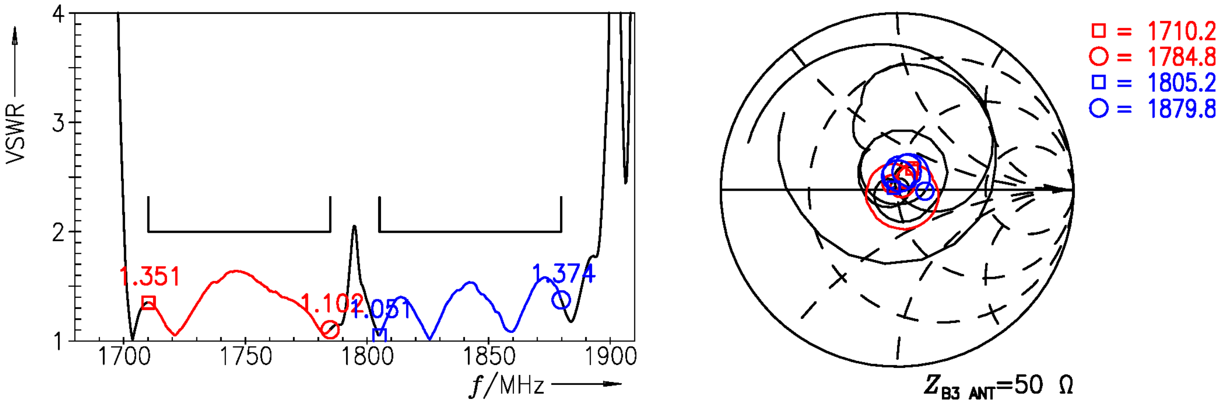

Figure 15: Reflection coefficient at B3 ANT port.

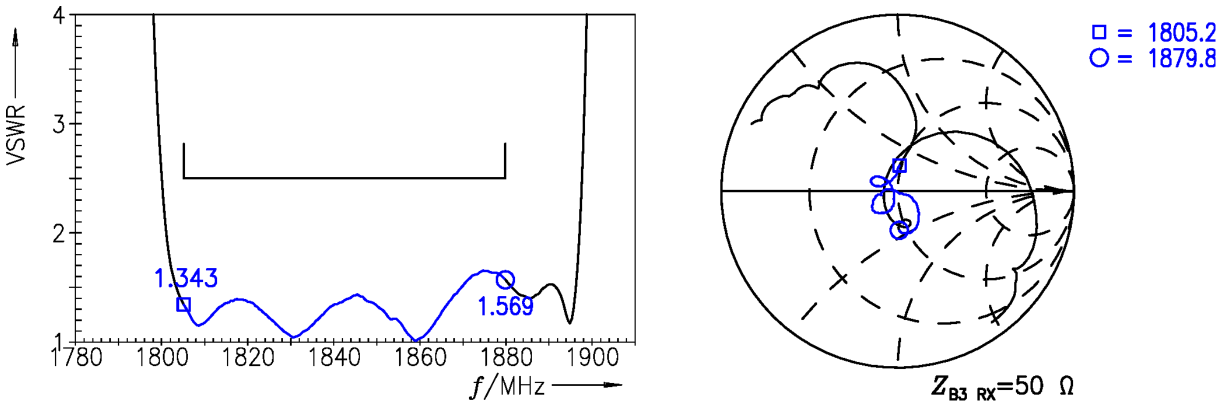

Figure 16: Reflection coefficient at B3 RX port.

15 Packing material

15.1 Tape

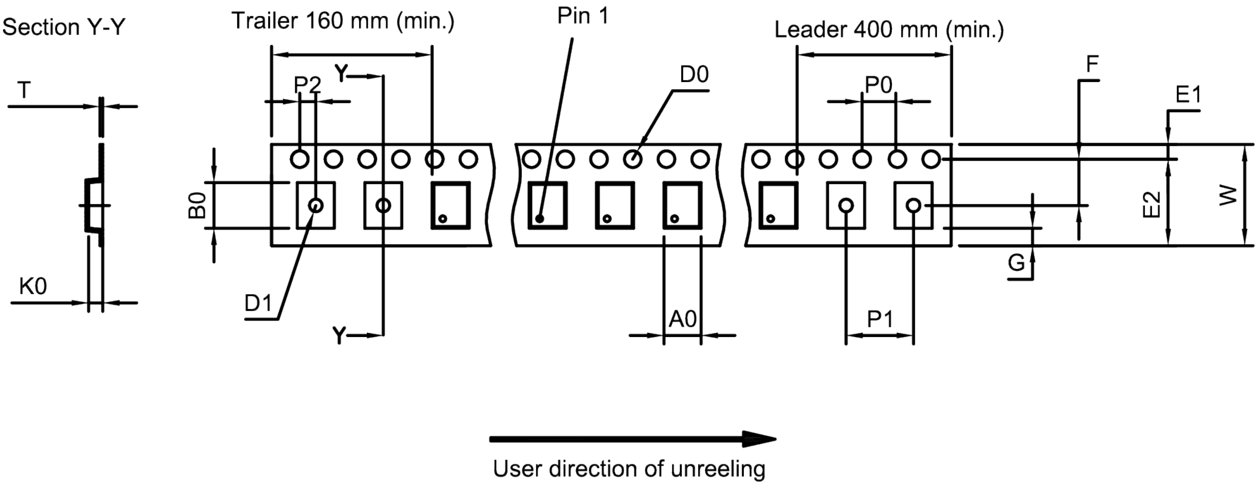

Figure 17: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

A_0	$2.3_{\pm 0.05}$ mm	E_2	6.25 mm (min.)	P_1	$4.0_{\pm 0.1}$ mm
B_0	$2.8_{\pm 0.05}$ 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	$0.85_{\pm 0.05}$ 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.

15.2 Reel with diameter of 180 mm

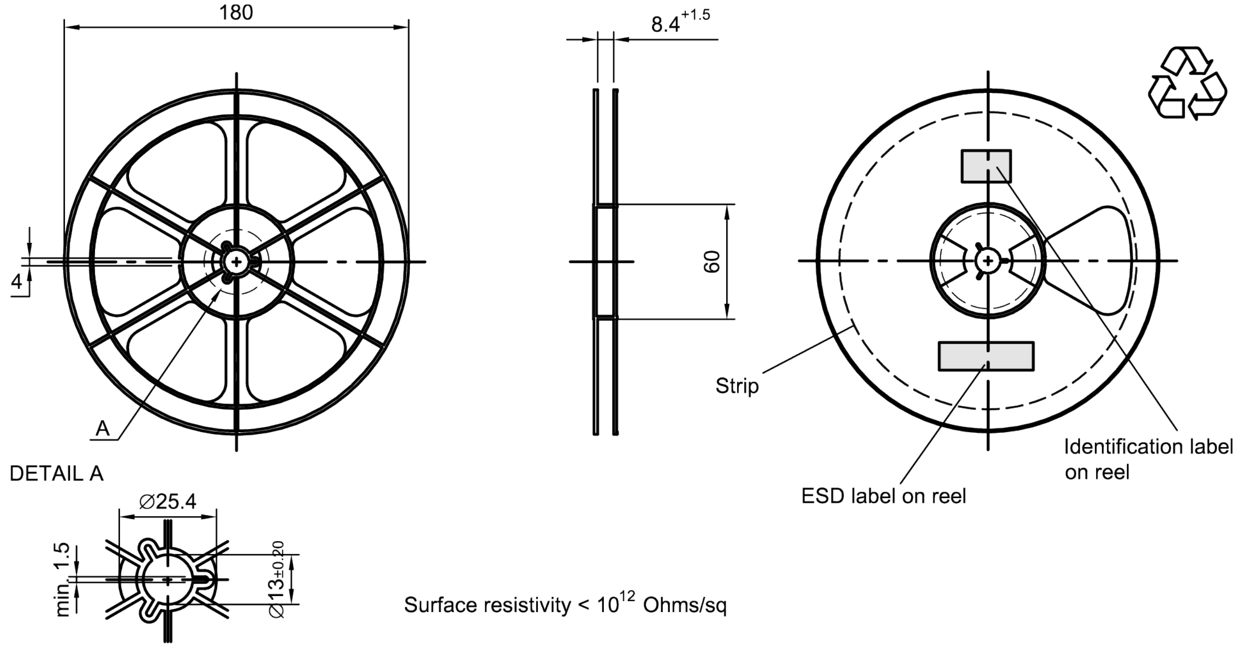

Figure 18: Drawing of reel (first-angle projection) with diameter of 180 mm.

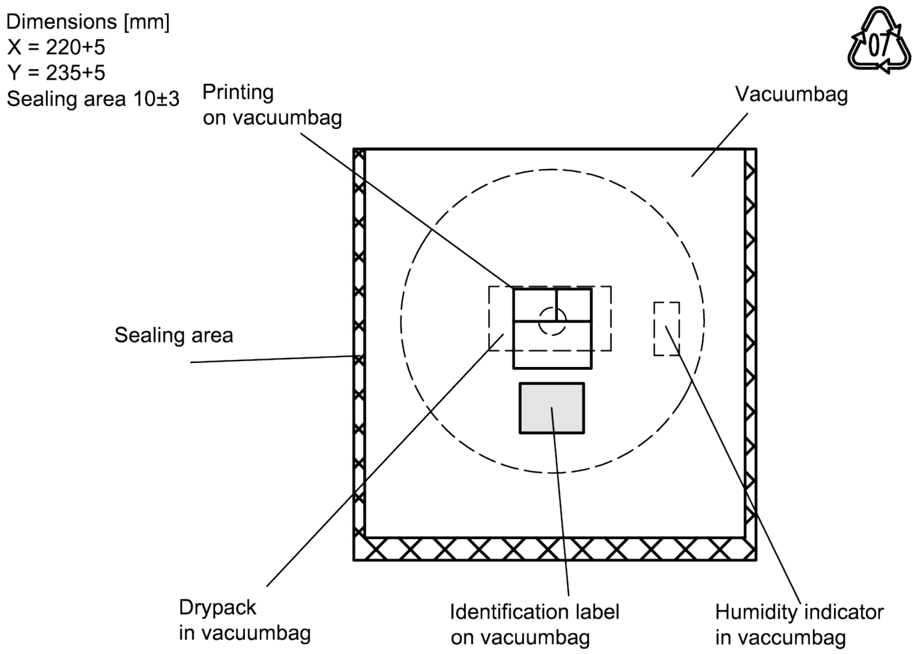

Figure 19: Drawing of moisture barrier bag (MBB) for reel with diameter of 180 mm.

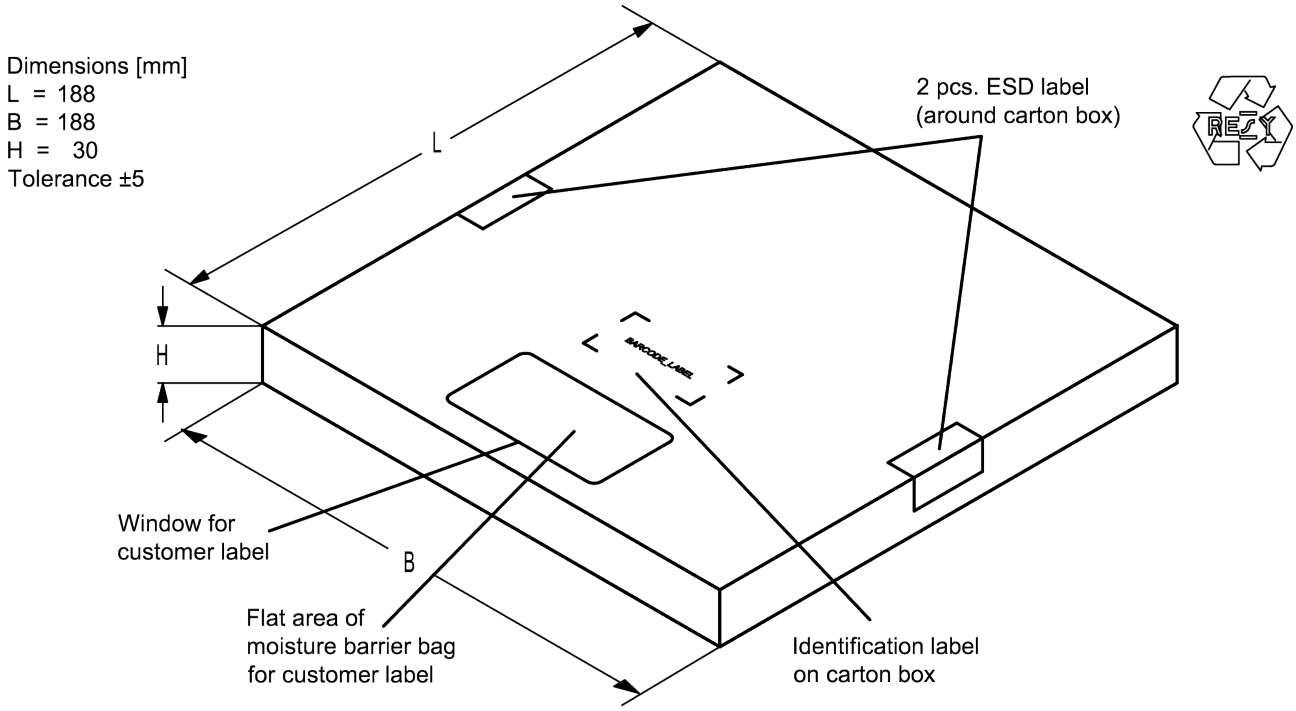

Figure 20: Drawing of folding box for reel with diameter of 180 mm.

15.3 Reel with diameter of 330 mm

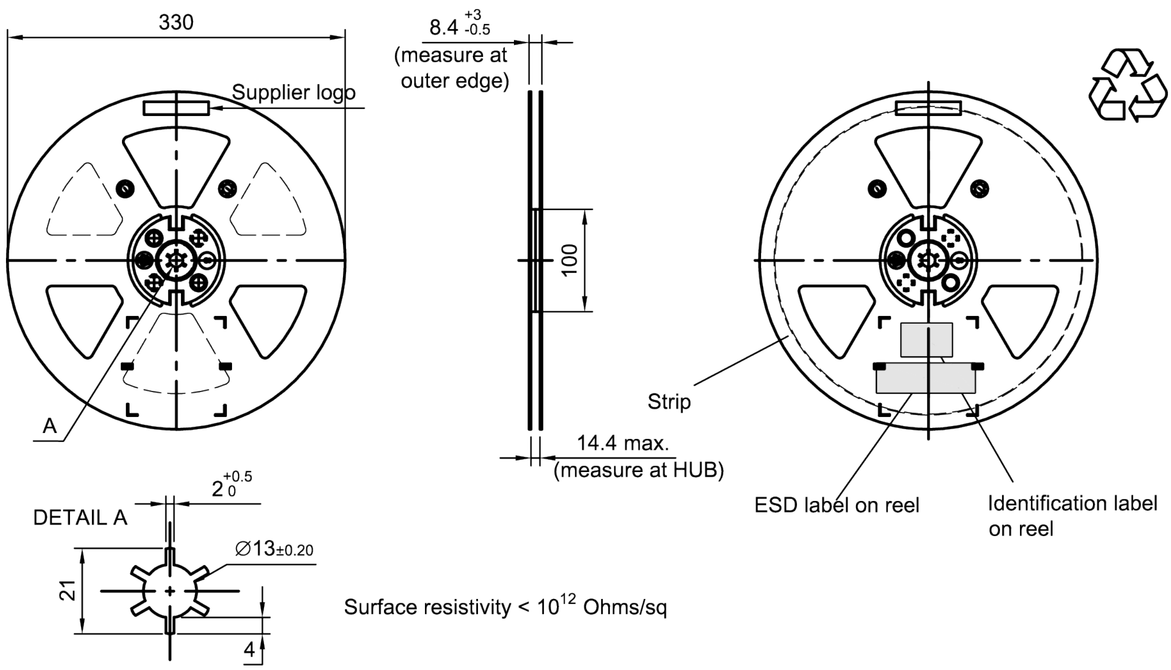

Figure 21: Drawing of reel (first-angle projection) with diameter of 330 mm.

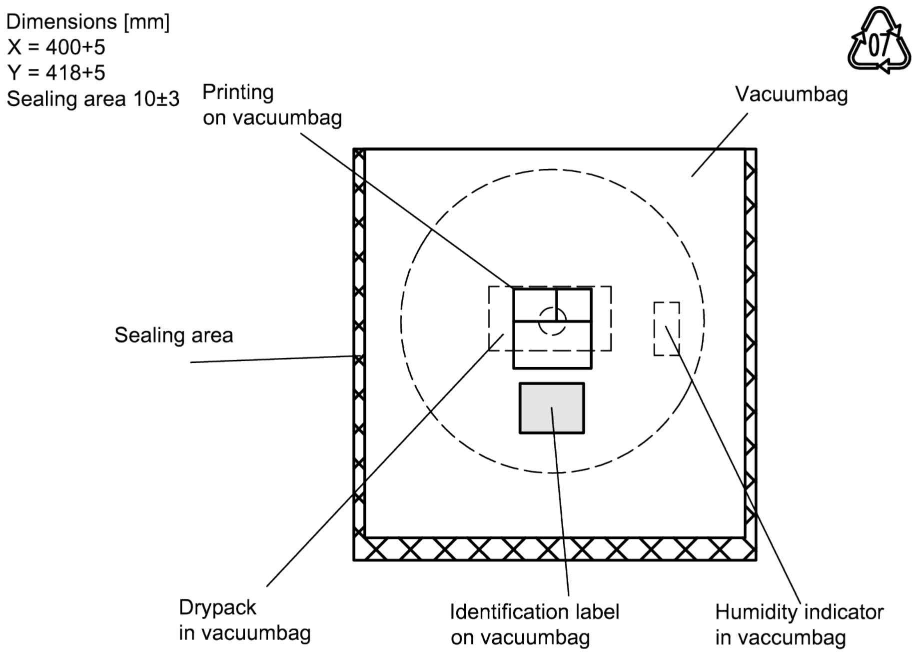

Figure 22: Drawing of moisture barrier bag (MBB) for reel with diameter of 330 mm.

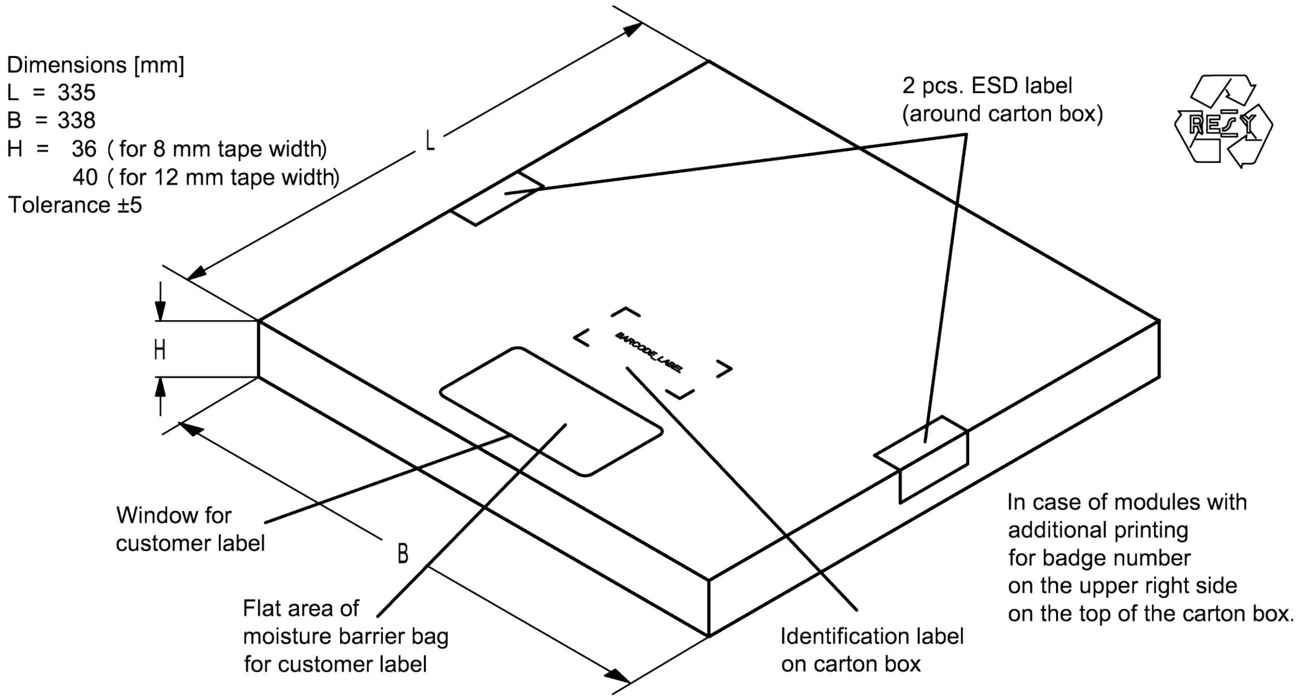

Figure 23: Drawing of folding box for reel with diameter of 330 mm.

16 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 B1203 is 15K.

- 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.

17 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).

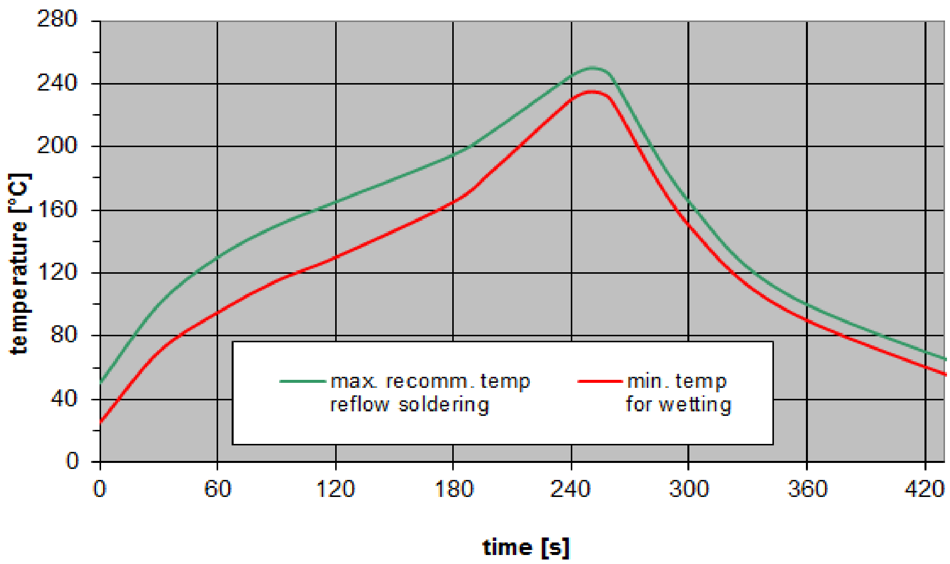

Figure 24: Recommended reflow profile for convection and infrared soldering – lead-free solder.

18 Annotations

18.1 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.

18.2 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.

18.3 Ordering codes and packing units

Ordering code	Packing unit
B39212B1203L210	15000 pcs
B39212B1203L210S 5	5000 pcs

Table 4: Ordering codes and packing units.

19 Cautions and warnings

19.1 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 www.rf360jv.com/orderingcodes.

19.2 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.

19.3 Moldability

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

19.4 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.

20 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 (www.rf360jv.com/material). 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.
   The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.