RF360
Europe GmbH

Data sheet

SAW triplexer
EN-DC 4G/5G band 20 + band 28a

Part number:	B8947
Ordering code:	B39861B8947L210
Date:	November 03, 2020
Version:	2.0

DCN: 80-PA243-524 Rev. A

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Table of contents

1 Application

- Low-loss SAW triplexer for mobile telephone EN-DC 4G/5G Band 20 TX systems and combined B28ARX_B20RX systems
- EN-DC 4G/5G band 20 uplink: 847 MHz (pass band 30 MHz)
- EN-DC 4G/5G bands 20 & 28a downlink: 789.5 MHz (pass band 63 MHz)
- Usable pass bands: 30 MHz for Band 28a and 30 MHz for Band 20
- Qualcomm® micro-Acoustic Power Management (MAPM)
- High out of band selectivity
- Low insertion attenuation
- Unbalanced to unbalanced operation
- Terminating impedances 50 Ω

2 Features

- Package size $2.0_{\pm 0.05}$ mm × $1.6_{\pm 0.05}$ mm
- Package height 0.65 mm (max.)
- Approximate weight 5 mg
- RoHS compatible
- Package for Surface Mount Technology (SMT)
- Ni/Au-plated terminals
- Electrostatic Sensitive Device (ESD)
- Moisture Sensitivity Level 3 (MSL3)

3 Package

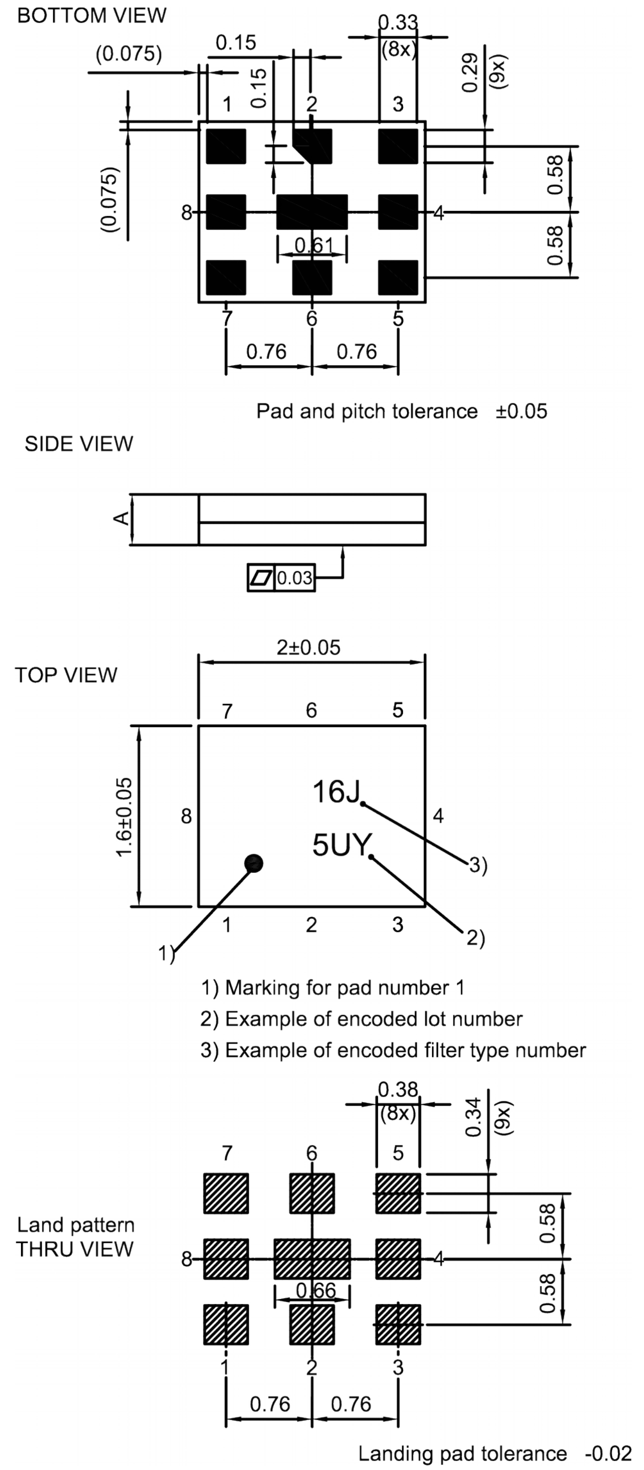

Figure 1: Drawing of package with package height A = 0.65 mm (max.). See Sec. Package information (p. 26).

4 Pin configuration

- 1 RX (B20 & B28a)
- 3 TX (B20)
- 6 ANT (B20 & B28a)
- 2, 4, 5, 7, 8, 9 Ground

5 Matching circuit

- C_{p6b} = 3.9 pF
- L_{p1} = 18.2 nH
- L_{s3} = 5.2 nH
- L_{s6a} = 10.3 nH

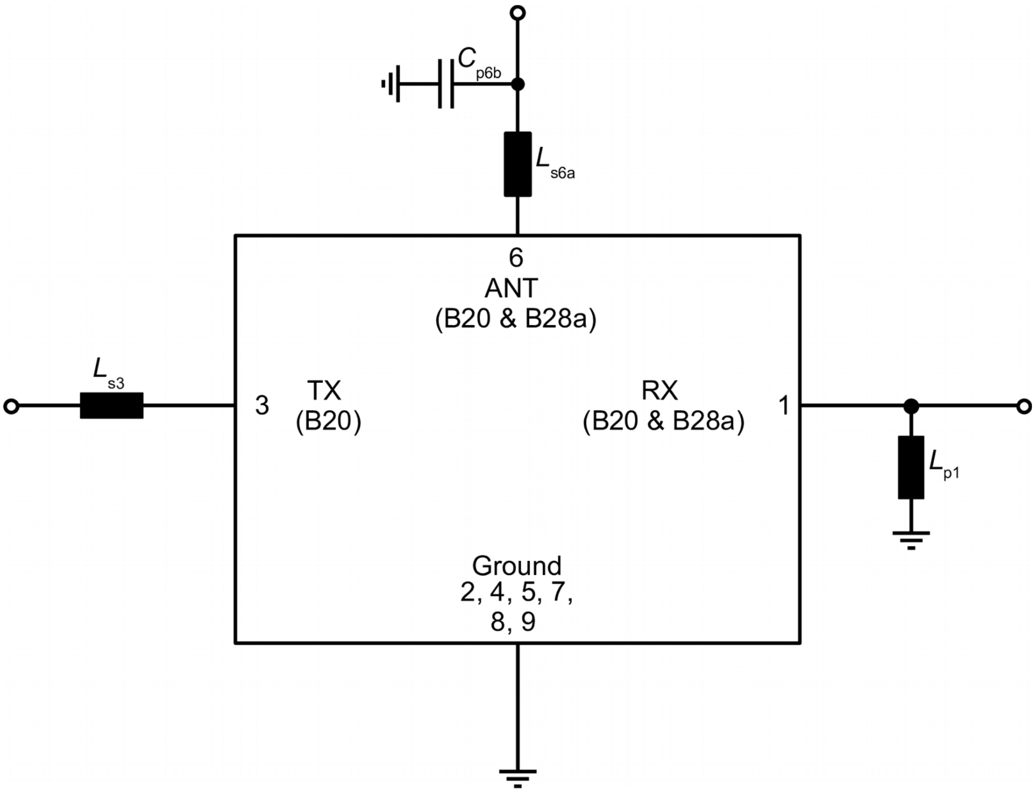

Figure 2: Schematic of matching circuit.

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

6 Characteristics

6.1 TX – ANT

Temperature range for specification	T_{SPEC}	= −30 °C ... +85 °C
TX terminating impedance	Z_{TX}	= 50 Ω + 5.2 nH[1)]
ANT terminating impedance	Z_{ANT}	= 50 Ω with ext. circuitry.[1)]
RX terminating impedance	Z_{RX}	= 50 Ω // 18.2 nH[1)]

Characteristics TX – ANT				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Center frequency			f_C	—	847	—	MHz
Maximum insertion attenuation			$\alpha_{INT,max}$ [2)]				
	832 ... 862	MHz		—	1.3	2.2	dB
Amplitude ripple (p-p)			$\Delta\alpha$ [3)]				
	832 ... 862	MHz		—	0.6	1.3	dB
Maximum VSWR			$VSWR_{max}$				
@ TX port	832 ... 862	MHz		—	1.4	2.0	
@ ANT port	832 ... 862	MHz		—	1.4	2.0	
Minimum attenuation			α_{min}				
	10 ... 758	MHz		36	40	—	dB
	703 ... 733	MHz		40	44	—	dB
	758 ... 788	MHz		44	48	—	dB
	791 ... 821	MHz		45	55	—	dB
	821 ... 827	MHz		2	5	—	dB
	880 ... 915	MHz		39	42	—	dB
	925 ... 960	MHz		40	43	—	dB
	1166.22 ... 1186.68	MHz		45	58	—	dB
	1226 ... 1250	MHz		50	61	—	dB
	1559 ... 1606	MHz		45	54	—	dB
	1664 ... 1724	MHz		45	54	—	dB
	1710 ... 2170	MHz		50	55	—	dB
	2400 ... 2500	MHz		50	60	—	dB
	2500 ... 2690	MHz		50	61	—	dB
	3300 ... 4900	MHz		45	64	—	dB
	4900 ... 5950	MHz		40	61	—	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) Over any 5 MHz.

6.2 ANT – RX

Temperature range for specification	T_{SPEC}	= −30 °C ... +85 °C
TX terminating impedance	Z_{TX}	= 50 Ω + 5.2 nH[1)]
ANT terminating impedance	Z_{ANT}	= 50 Ω with ext. circuitry.[1)]
RX terminating impedance	Z_{RX}	= 50 Ω // 18.2 nH[1)]

Characteristics ANT – RX				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Center frequency			f_C				
				—	806	—	MHz
				—	773	—	MHz
Maximum insertion attenuation							
	758 ... 788	MHz	$\alpha_{INT,max}$ 2)	—	1.3	2.8	dB
	758 ... 821	MHz	$\alpha_{INT,max}$ 3)	—	1.8	2.4[4)]	dB
	791 ... 821	MHz	$\alpha_{INT,max}$ 3)	—	1.8	2.8	dB
Amplitude ripple (p-p)							
	758 ... 788	MHz	$\Delta\alpha$ 5)	—	0.7	1.3	dB
	758 ... 821	MHz	$\Delta\alpha$ 6)	—	1.0	2.0	dB
	791 ... 821	MHz	$\Delta\alpha$ 6)	—	1.0	2.0	dB
Maximum VSWR			$VSWR_{max}$				
@ ANT port	758 ... 788	MHz		—	1.6	2.0	
	791 ... 821	MHz		—	1.5	2.0	
@ RX port	758 ... 788	MHz		—	1.5	2.0	
	791 ... 821	MHz		—	1.4	2.0	
Minimum attenuation							
	10 ... 703	MHz	α_{min}	30	40	—	dB
	41 ... 65	MHz	α_{min}	50	70	—	dB
	703 ... 733	MHz	α_{min}	45	48	—	dB
	733 ... 748	MHz	α_{min}	5	12	—	dB
	832 ... 862	MHz	α_{min}	45	59	—	dB
	832 ... 862	MHz	$\alpha_{INT,min}$ 3)	45	60	—	dB
	880 ... 915	MHz	α_{min}	30	38	—	dB
	1516 ... 1683	MHz	α_{min}	40	48	—	dB
	1710 ... 1990	MHz	α_{min}	45	59	—	dB
	2274 ... 2463	MHz	α_{min}	50	66	—	dB
	2400 ... 2500	MHz	α_{min}	50	72	—	dB
	2500 ... 2690	MHz	α_{min}	50	70	—	dB
	3300 ... 3800	MHz	α_{min}	50	64	—	dB
	3800 ... 5950	MHz	α_{min}	40	53	—	dB

1) See Sec. Matching circuit (p. 6).
2) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 2.7 MHz of LTE 3 MHz (15 RB) channels.
3) Integrated attenuation α_{INT}: Averaged power $|S_{ij}|^2$ over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.
4) Valid for typical temperature T = +25 °C.

5) Over any 3 MHz.
6) Over any 5 MHz.

6.3 TX – RX

Temperature range for specification	T_{SPEC}	= −30 °C ... +85 °C
TX terminating impedance	Z_{TX}	= 50 Ω + 5.2 nH[1)]
ANT terminating impedance	Z_{ANT}	= 50 Ω with ext. circuitry.[1)]
RX terminating impedance	Z_{RX}	= 50 Ω // 18.2 nH[1)]

Characteristics TX – RX				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Minimum isolation			$\alpha_{INT,min}$ [2)]				
	791 ... 821	MHz		55	59	—	dB
	832 ... 862	MHz		55	63	—	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} = −30 °C ... +85 °C	
Storage temperature	T_{STG} [1)] = −40 °C ... +85 °C	
DC voltage	$\|V_{DC}\|$ = 5.0 V (max.)	
ESD voltage		
	V_{ESD} [2)] = 500 V (max.)	Human body model.
	V_{ESD} [3)] = 700 V (max.)	Charged device model.
	V_{ESD} [4)] = 200 V (max.)	Machine model.
Input power	P_{IN}	
@ TX port: 832 ... 862 MHz	30 dBm	Continuous wave for 5000 h @ 50 °C.
@ TX port: 832 ... 862 MHz	29 dBm	5 MHz LTE uplink signal (1 RB UP) for 5000 h @ 85 °C.
@ TX port: 832 ... 862 MHz	30 dBm	5 MHz LTE uplink signal (1 RB UP) for 2 h @ 85 °C.

1) Not valid for packaging material. Storage temperature for packaging material is −25 °C to +40 °C.
2) According to JESD22-A114F (HBM – Human Body Model), 1 negative & 1 positive pulse.
3) According to JESD22-C101C (CDM – Field Induced Charged Device Model), 3 negative & 3 positive pulses.
4) According to JESD22-A115B (MM – Machine Model), 10 negative & 10 positive pulses.

8 Transmission coefficients

8.1 TX – ANT

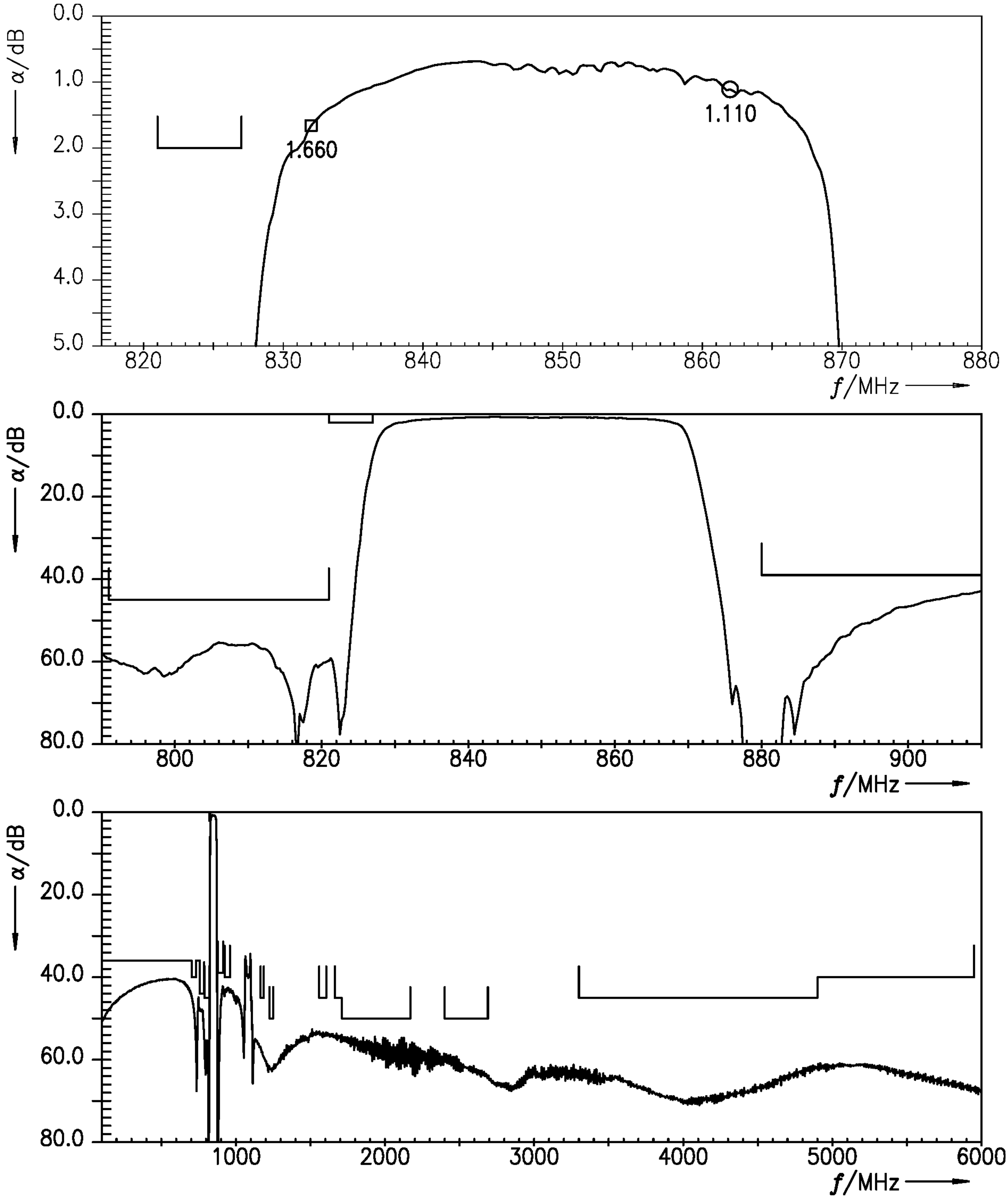

Figure 3: Attenuation TX – ANT.

8.2 ANT – RX

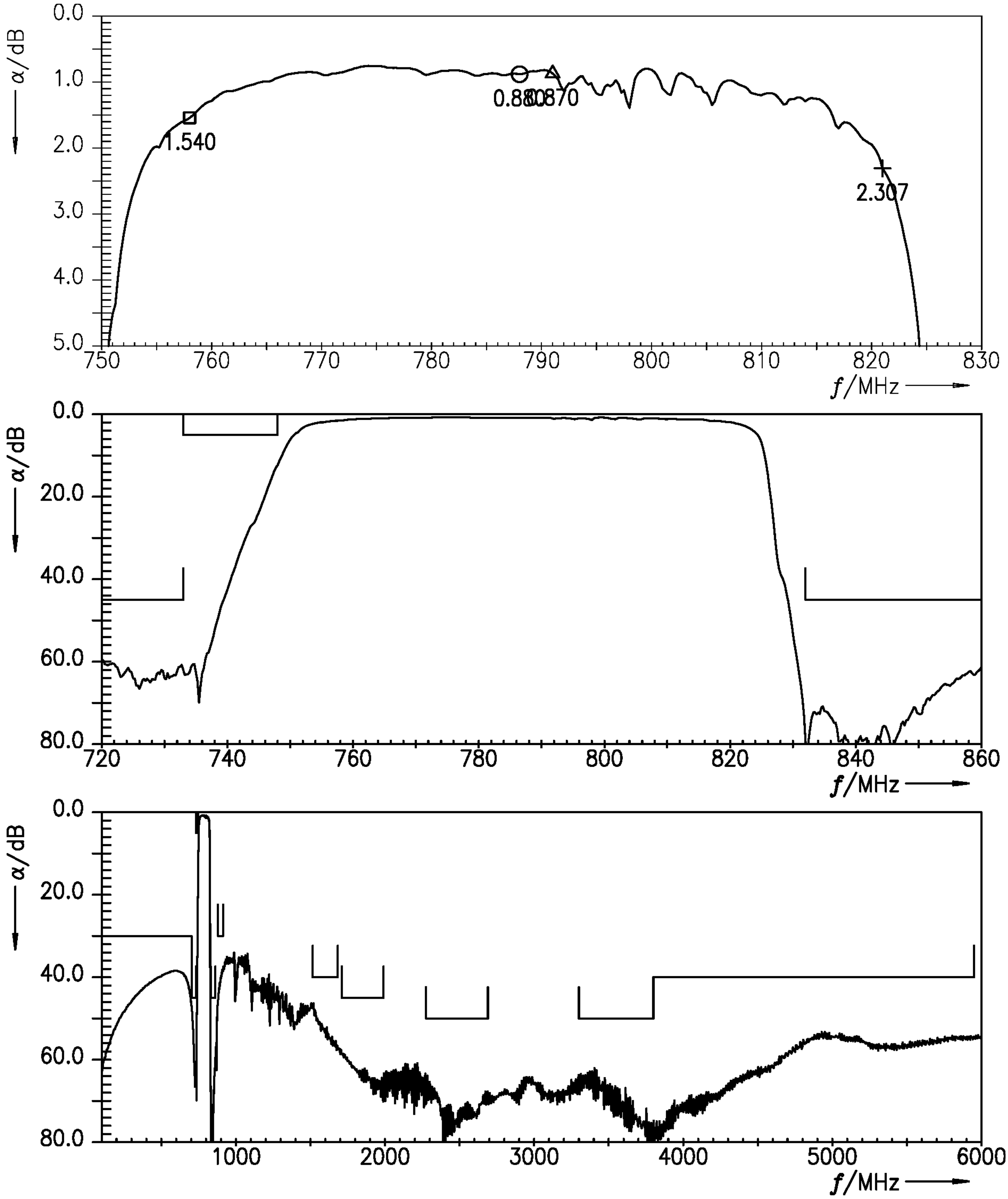

Figure 4: Attenuation ANT – RX.

9 Transmission coefficient (LTE)

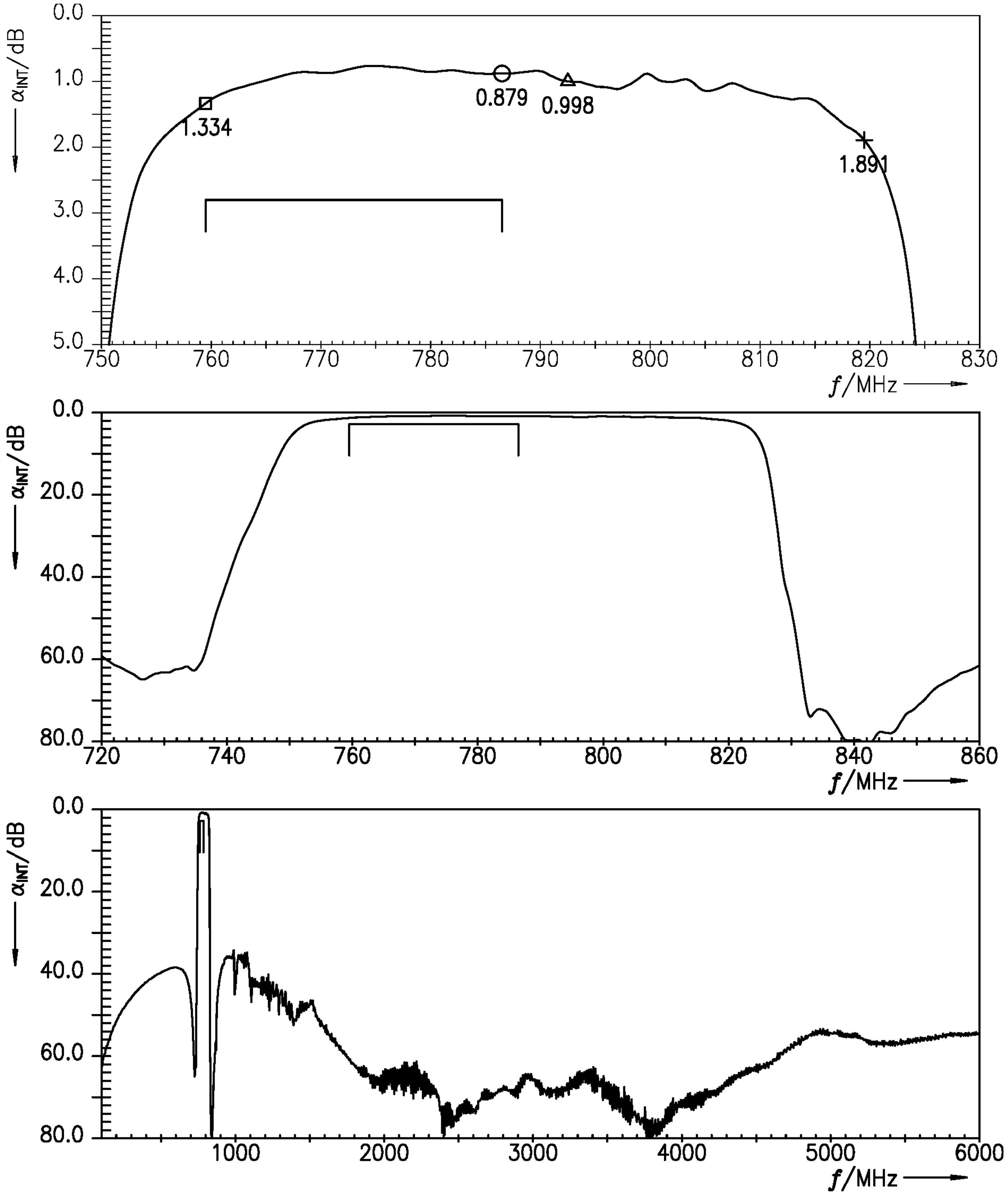

Figure 5: Attenuation (LTE) (integration window = 3 MHz) ANT – RX.

9.1 TX – ANT

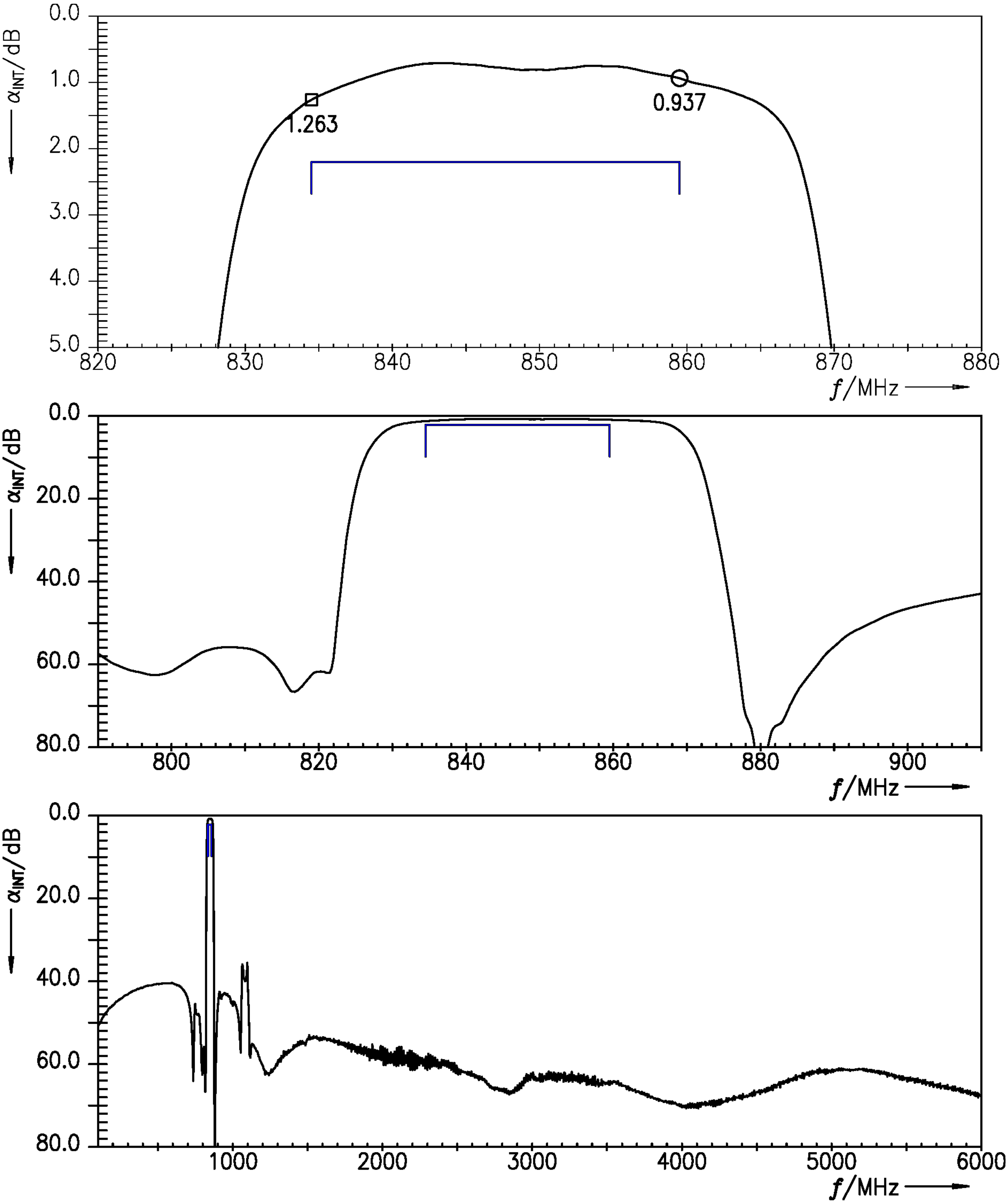

Figure 6: Attenuation (LTE) (integration window = 5 MHz) TX – ANT.

9.2 ANT – RX

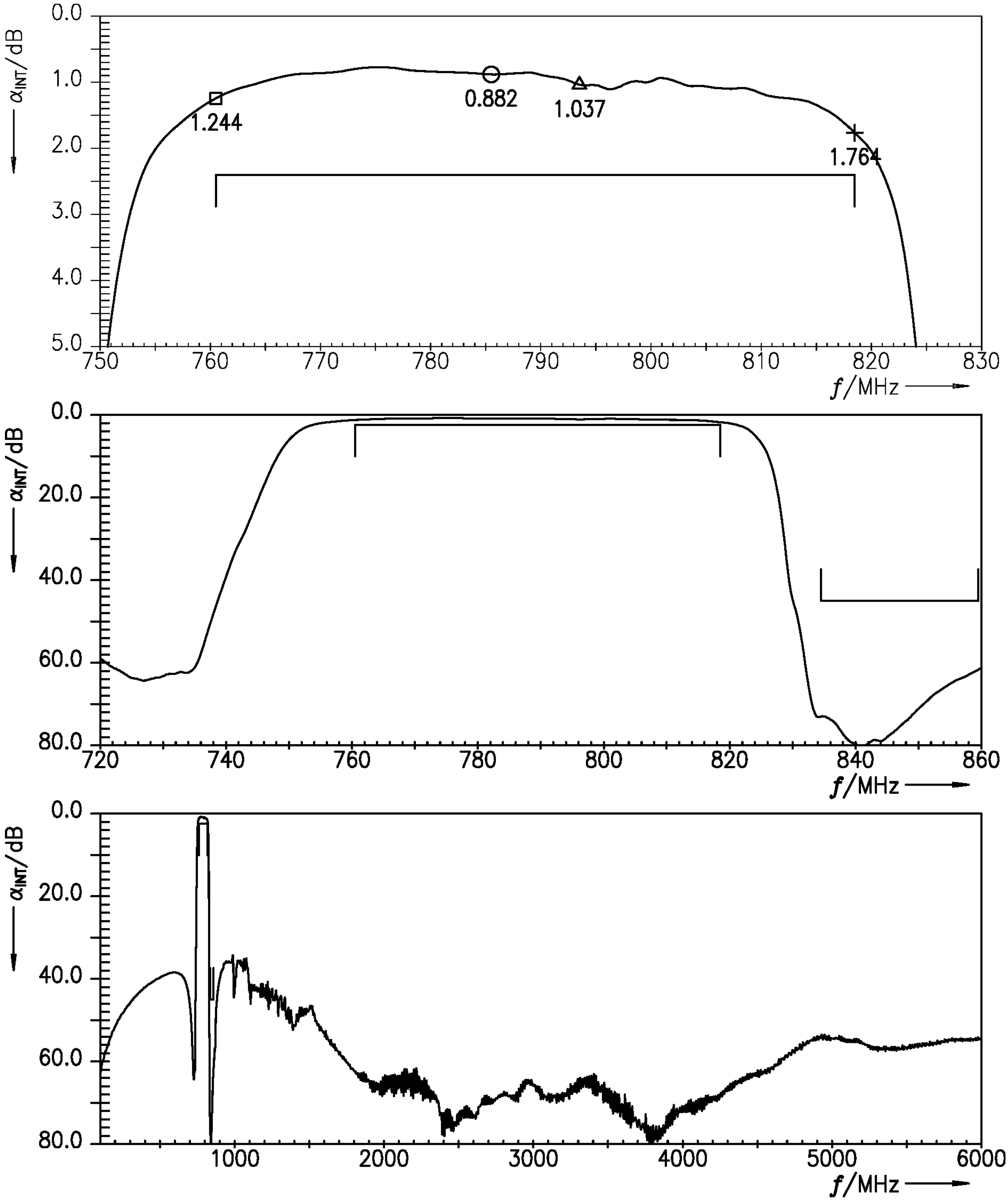

Figure 7: Attenuation (LTE) (integration window = 5 MHz) ANT – RX.

9.3 TX – RX

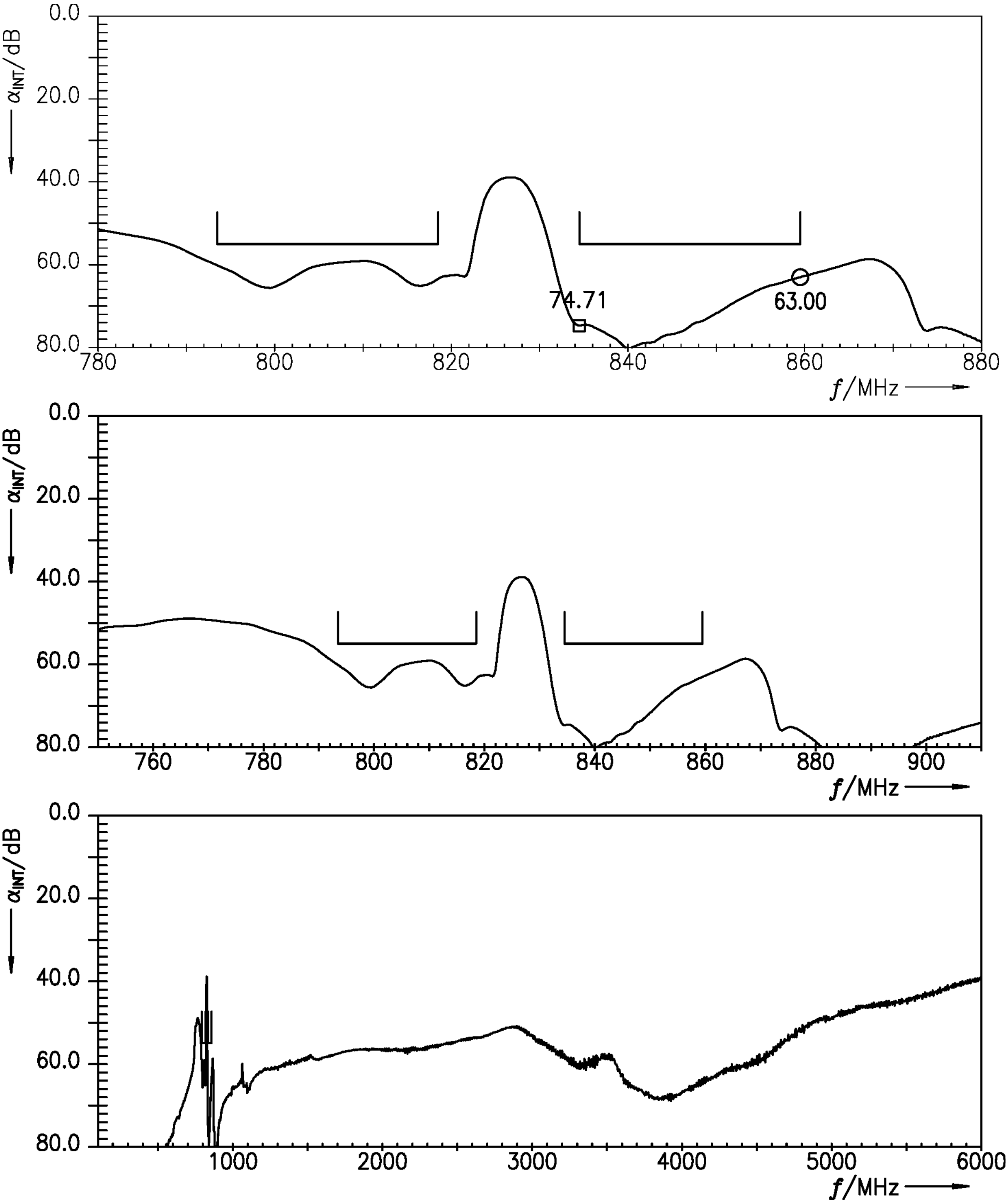

Figure 8: Isolation (LTE) (integration window = 5 MHz) TX – RX.

10 Reflection coefficients

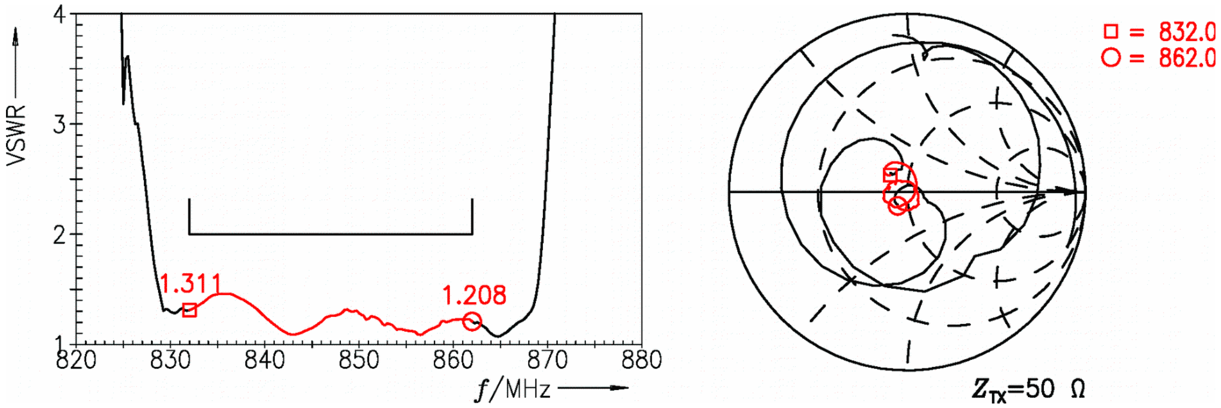

Figure 9: Reflection coefficient at TX port.

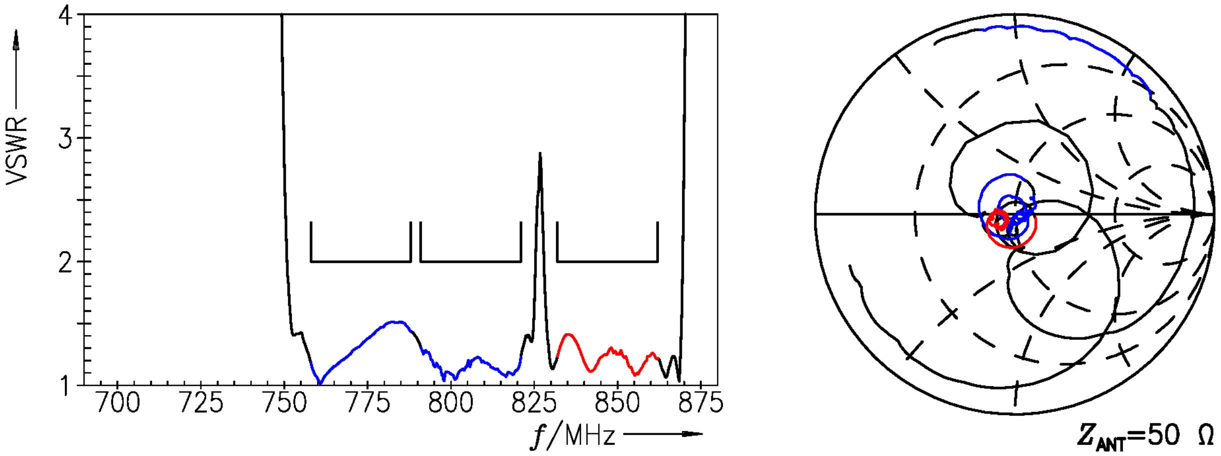

Figure 10: Reflection coefficient at ANT port.

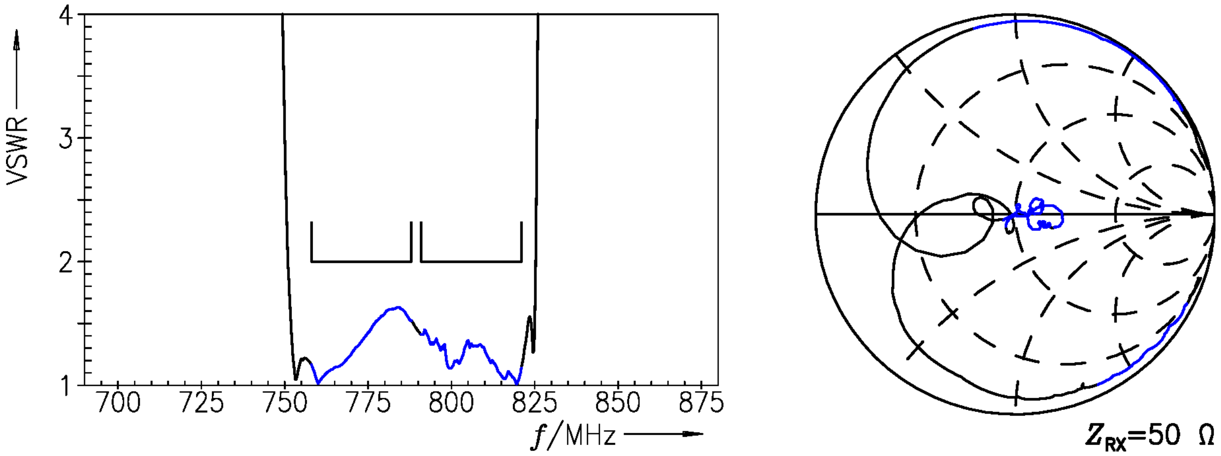

Figure 11: Reflection coefficient at RX port.

11 Packing material

11.1 Tape

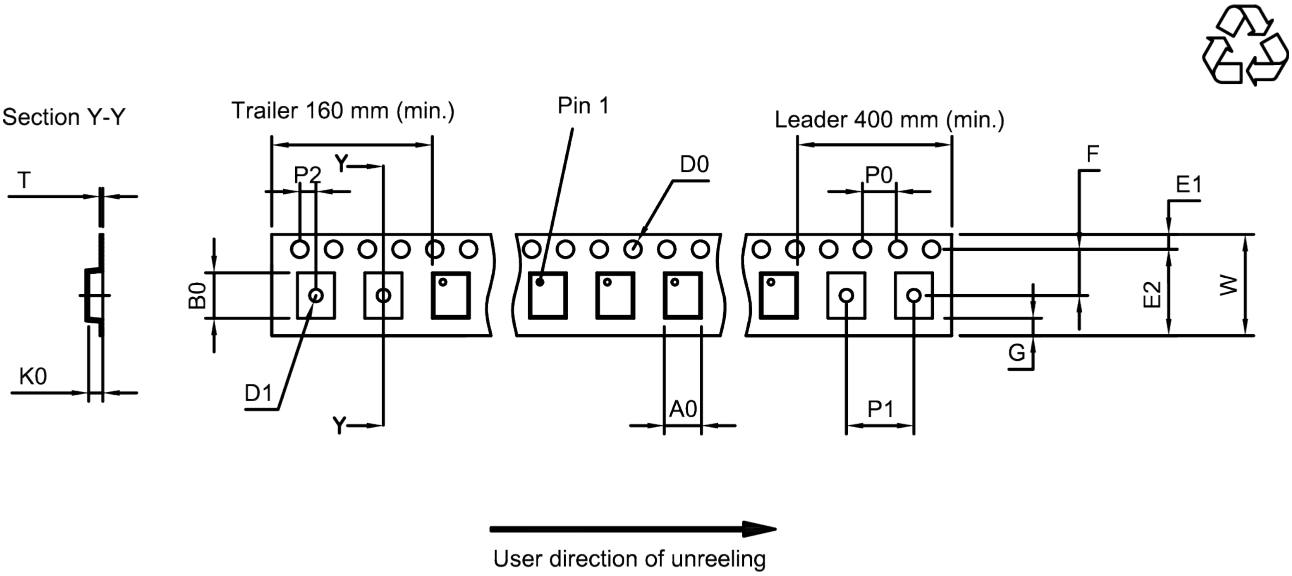

Figure 12: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

A_0	$1.8_{\pm 0.05}$ mm	E_2	6.25 mm (min.)	P_1	$4.0_{\pm 0.1}$ mm
B_0	$2.2_{\pm 0.05}$ 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	$1.0_{+0.1/-0}$ mm	K_0	$0.8_{\pm 0.05}$ 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.

11.2 Reel with diameter of 180 mm

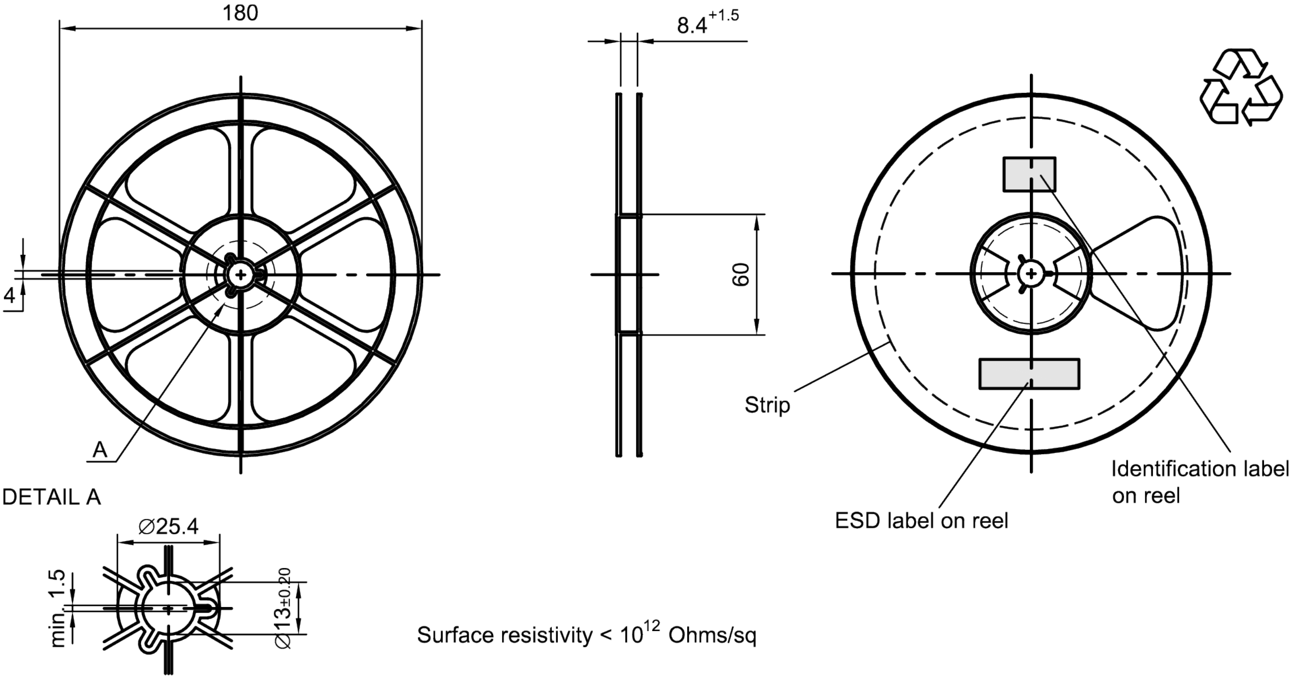

Figure 13: Drawing of reel (first-angle projection) with diameter of 180 mm.

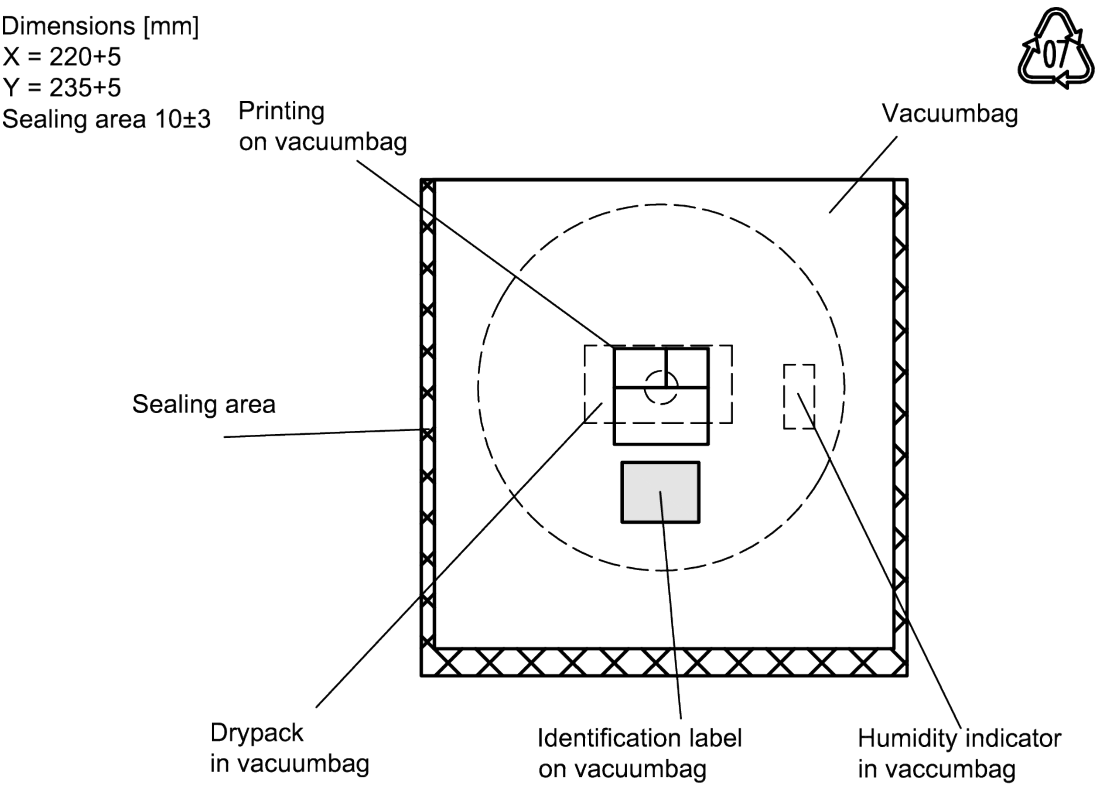

Figure 14: Drawing of moisture barrier bag (MBB) for reel with diameter of 180 mm.

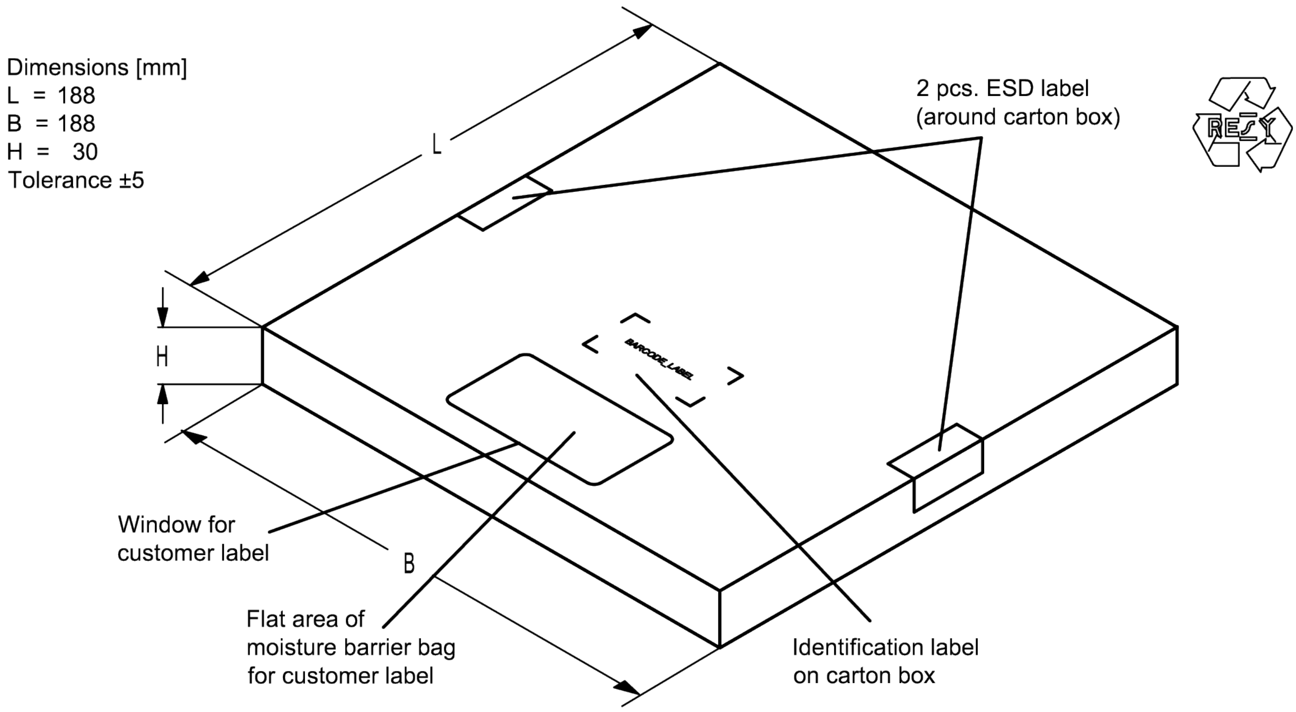

Figure 15: Drawing of folding box for reel with diameter of 180 mm.

11.3 Reel with diameter of 330 mm

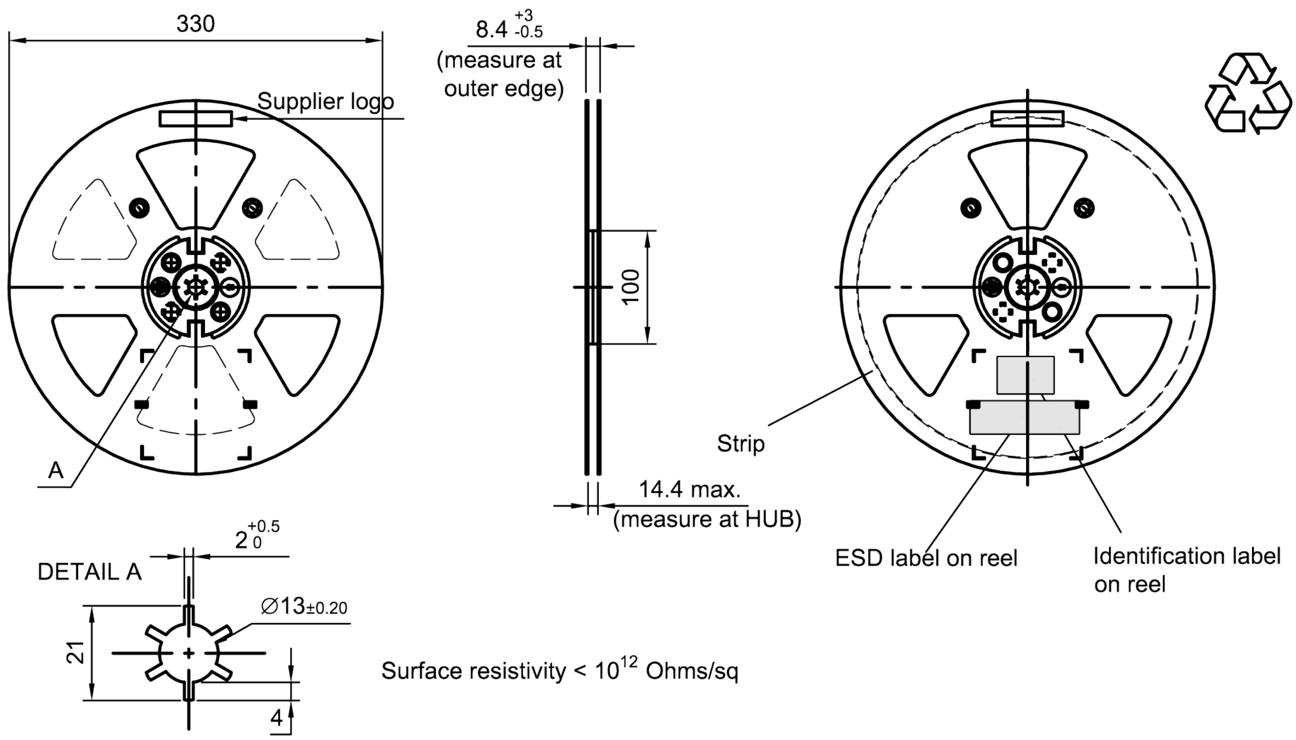

Figure 16: Drawing of reel (first-angle projection) with diameter of 330 mm.

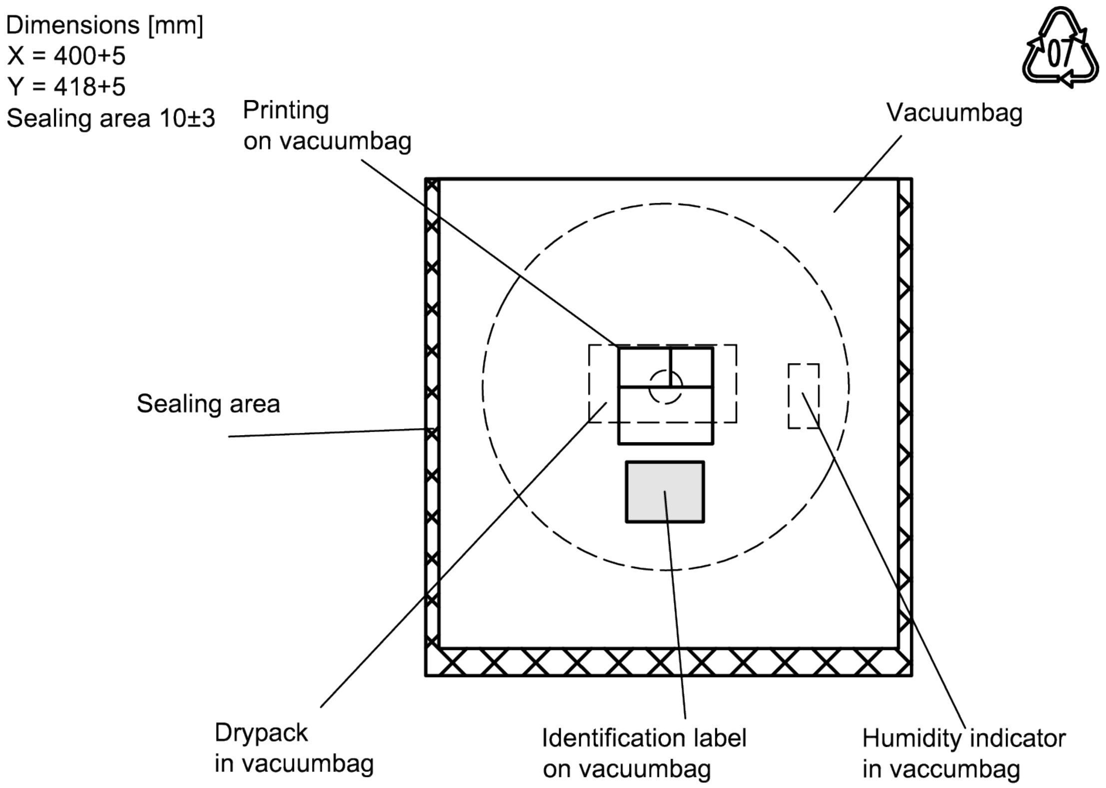

Figure 17: Drawing of moisture barrier bag (MBB) for reel with diameter of 330 mm.

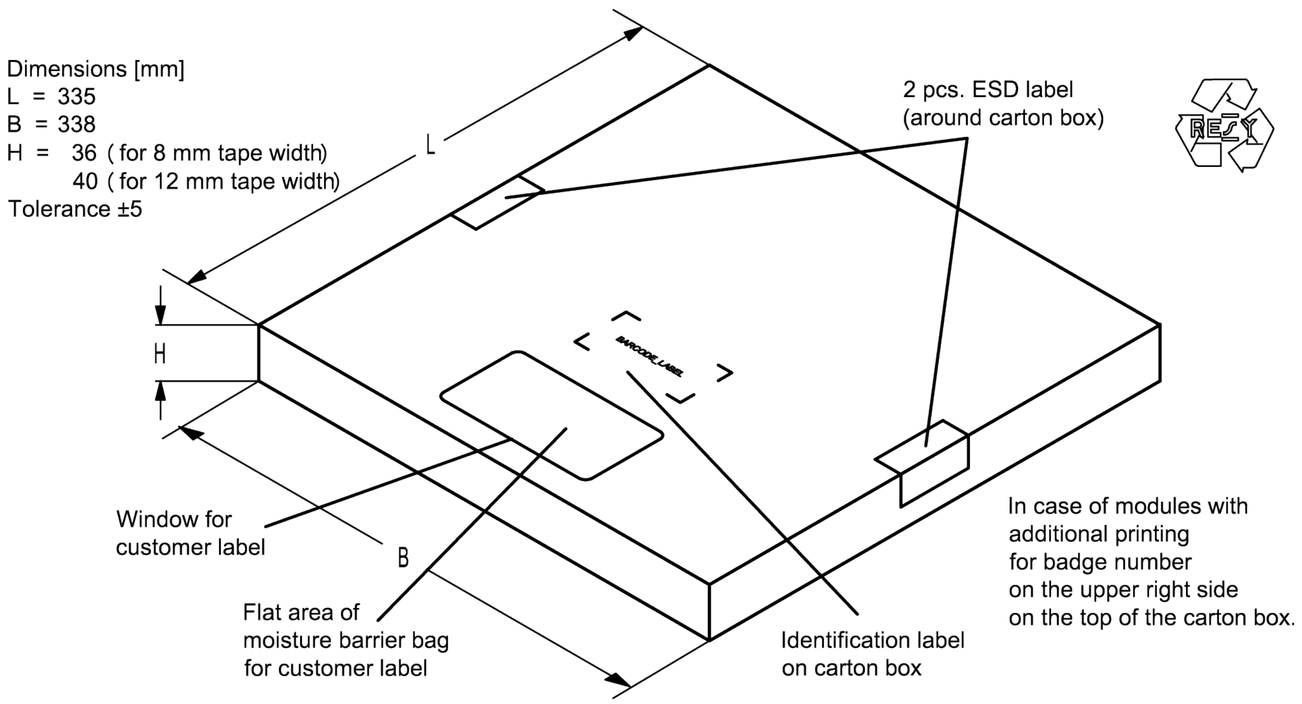

Figure 18: Drawing of folding box for reel with diameter of 330 mm.

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 => **1234**
  1 x 32^2 + **6** x 32^1 + **18 (=J)** x 32^0 = **1234**
  The BASE32 code for product type B8947 is 8QK.

- 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).

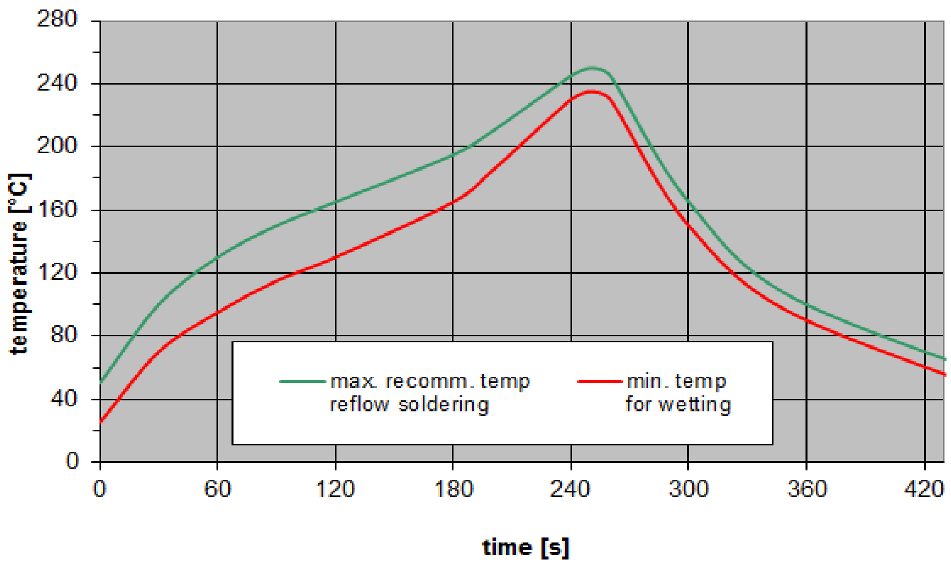

Figure 19: Recommended reflow profile for convection and infrared soldering – lead-free solder.

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 and packing units

Ordering code	Packing unit
B39861B8947L210S 5	5000 pcs

Table 4: Ordering codes 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 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://rffe.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.
   The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.