Qualcomm

RF360
Europe GmbH

Data sheet

SAW multiplexer
EN-DC 4G/5G bands 20 + 28a

Series/type:	M5006
Ordering code:	B39851M5006D310
Date:	November 06, 2019
Version:	2.0

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1 Application

- Low-loss SAW multiplexer for mobile telephone EN-DC 4G/5G Band 28a systems and EN-DC 4G/5G Band 20 systems
- Usable pass bands: 30 MHz for Band 28a and 30 MHz for Band 20
- High out of band selectivity
- Low insertion attenuation
- Unbalanced to unbalanced operation
- Terminating impedances 50 Ω

2 Features

- Package size $2.5_{\pm 0.1}$ mm × $2.0_{\pm 0.1}$ mm
- Package height $0.58_{\pm 0.036}$ mm
- 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

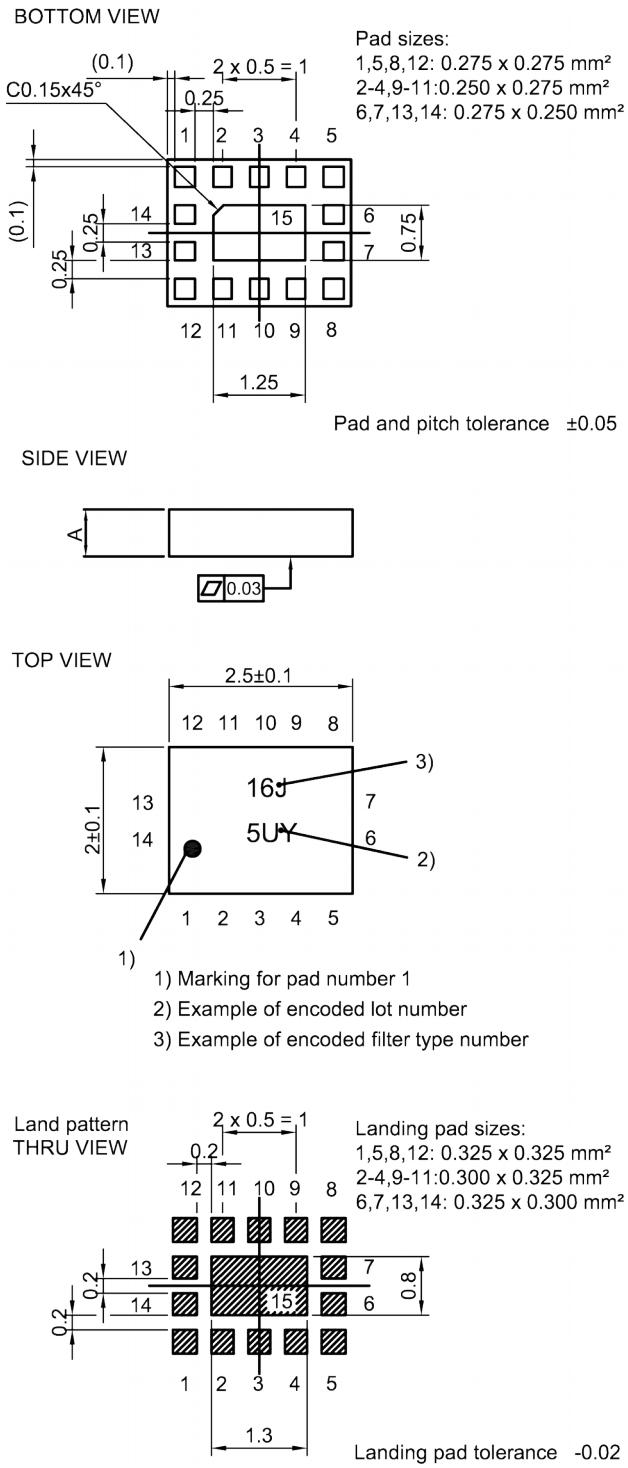

Figure 1: Drawing of package with package height A = 0.58±0.036 mm. See Sec. Package information (p. 32).

4 Pin configuration

- 1 RX (B20 & B28a)
- 5 TX (B20)
- 8 TX (B28a)
- 10 ANT (B20 & B28a)
- 2, 3, 4, 6, 7, 9, 11, 12, 13, 14, 15 Ground

5 Matching circuit

- C_{p10b} = 5.6 pF
- L_{p1} = 12.4 nH
- L_{s5} = 4.1 nH
- L_{s8} = 10.4 nH
- L_{s10a} = 10.6 nH

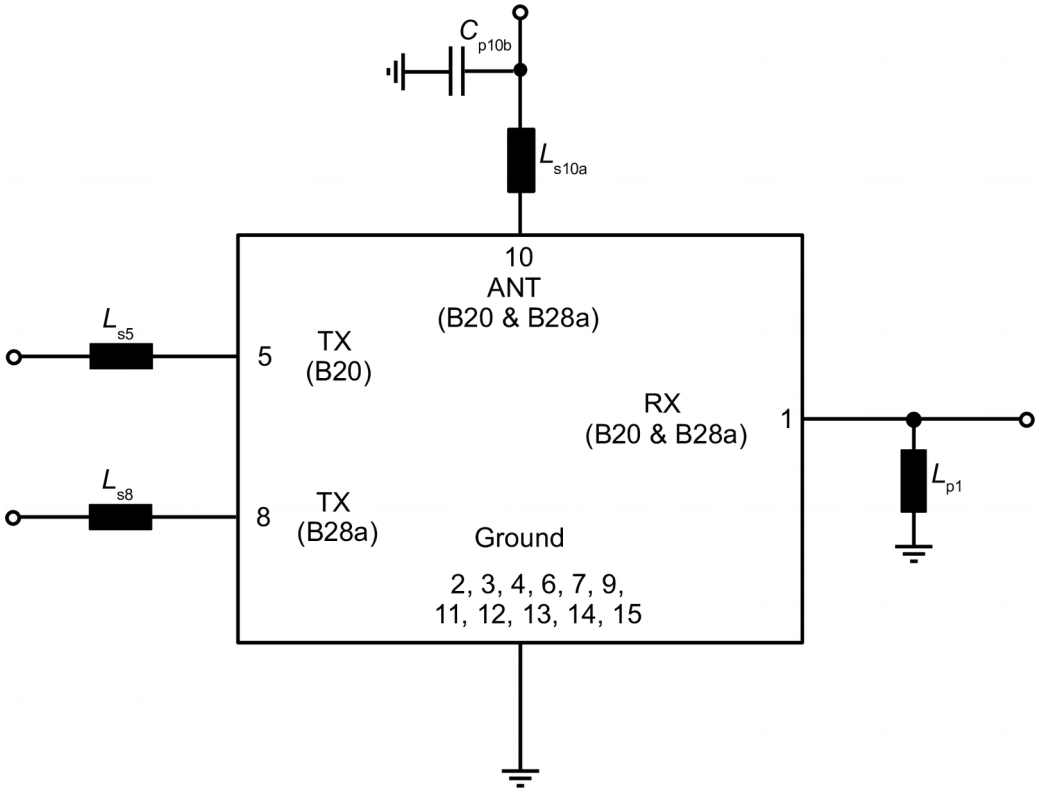

Figure 2: Schematic of matching circuit.

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

6 Characteristics EN-DC 4G/5G B20

6.1 TX – ANT

Temperature range for specification T_{SPEC} = −30 °C ... +85 °C
B20 TX terminating impedance $Z_{B20\ TX}$ = 50 Ω + 4.1 nH[1)]
ANT terminating impedance Z_{ANT} = 50 Ω with ext. circuitry.[1)]
RX terminating impedance Z_{RX} = 50 Ω // 12.4 nH[1)]

Characteristics EN-DC 4G/5G B20 TX – ANT			min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency			—	847	—	MHz
Insertion Loss		[2)]				
	832... 862	MHz	—	1.2	2.0[3)]	dB
	832... 862	MHz	—	1.2	2.5	dB
Amplitude Ripple (p-p)		[4)]				
	832... 862	MHz	—	0.7	1.5	dB
VSWR						
@ B20 TX port	832... 862	MHz	—	1.4	2.0	
@ ANT port	832... 862	MHz	—	1.5	2.0	
Attenuation						
	10... 758	MHz	40	44	—	dB
	703... 733	MHz	45	49	—	dB
	758... 788	MHz	45	57	—	dB
	791... 821	MHz	45	57	—	dB
	880... 915	MHz	40	45	—	dB
	925... 960	MHz	40	46	—	dB
	1166.22... 1186.68	MHz	45	61	—	dB
	1559... 1606	MHz	50	68	—	dB
	1664... 1724	MHz	50	70	—	dB
	1710... 2170	MHz	50	66	—	dB
	2400... 2500	MHz	50	70	—	dB
	2500... 2690	MHz	50	72	—	dB
	3300... 4900	MHz	40	50	—	dB
	4900... 5950	MHz	40	65	—	dB

1) See Sec. Matching circuit (p. 6).
2) Integrated attenuation: 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.
4) Over any 5 MHz.

6.2 ANT – RX

Temperature range for specification	T_{SPEC}	= −30 °C ... +85 °C
B20 TX terminating impedance	$Z_{B20\ TX}$	= 50 Ω + 4.1 nH[1)]
ANT terminating impedance	Z_{ANT}	= 50 Ω with ext. circuitry.[1)]
RX terminating impedance	Z_{RX}	= 50 Ω // 12.4 nH[1)]

Characteristics EN-DC 4G/5G B20 & EN-DC 4G/5G B28a ANT – RX				**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Center frequency							
				—	806	—	MHz
				—	773	—	MHz
Insertion Loss							
	758... 788	MHz	2)	—	1.5	2.9	dB
	758... 821	MHz	3)	—	1.8	2.5[4)]	dB
	791... 821	MHz	3)	—	1.8	2.9	dB
Amplitude Ripple (p-p)			5)				
	758... 788	MHz		—	0.6	1.3	dB
	758... 821	MHz		—	0.7	2.0	dB
	791... 821	MHz		—	0.7	2.0	dB
VSWR							
@ ANT port	758... 788	MHz		—	1.6	2.0	
	791... 821	MHz		—	1.6	2.0	
@ RX port	758... 788	MHz		—	1.5	2.0	
	791... 821	MHz		—	1.5	2.0	
Attenuation							
	10... 703	MHz		30	37	—	dB
	41... 65	MHz		50	72	—	dB
	703... 733	MHz		45	58	—	dB
	733... 748	MHz		5	10	—	dB
	832... 862	MHz		35	55	—	dB
	880... 915	MHz		30	36	—	dB
	1516... 1683	MHz		40	59	—	dB
	1710... 1990	MHz		45	53	—	dB
	2274... 2463	MHz		50	65	—	dB
	2400... 2500	MHz		50	72	—	dB
	2500... 2690	MHz		50	72	—	dB
	3300... 3800	MHz		50	69	—	dB
	3800... 5950	MHz		40	46	—	dB

1) See Sec. Matching circuit (p. 6).
2) Integrated attenuation: Averaged power $|S_{ij}|^2$ over the center 2.7 MHz of LTE 3 MHz (15 RB) channels.
3) Integrated attenuation: 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 5 MHz.

6.3 TX – RX

Temperature range for specification	T_{SPEC}	= −30 °C ... +85 °C
B20 TX terminating impedance	$Z_{B20\ TX}$	= 50 Ω + 4.1 nH[1)]
ANT terminating impedance	Z_{ANT}	= 50 Ω with ext. circuitry.[1)]
RX terminating impedance	Z_{RX}	= 50 Ω // 12.4 nH[1)]

Characteristics EN-DC 4G/5G B20 TX – RX			**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Isolation [2)]						
	758... 788	MHz	55	59	—	dB
	791... 821	MHz	55	58	—	dB
	832... 857	MHz	55	58	—	dB
	847... 862	MHz	53	56	—	dB

1) See Sec. Matching circuit (p. 6).
2) Integrated attenuation: Averaged power $|S_{ij}|^2$ over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.

7 Characteristics EN-DC 4G/5G B28a

7.1 TX – ANT

Temperature range for specification T_{SPEC} = −30 °C ... +85 °C
B28a TX terminating impedance $Z_{B28a\ TX}$ = 50 Ω + 10.4 nH[1)]
ANT terminating impedance Z_{ANT} = 50 Ω with ext. circuitry.[1)]
RX terminating impedance Z_{RX} = 50 Ω // 12.4 nH[1)]

Characteristics EN-DC 4G/5G B28a TX – ANT				min. for T_{SPEC}	typ. @ +25 °C	max. for T_{SPEC}	
Center frequency				—	718	—	MHz
Insertion Loss			2)				
	703... 733	MHz		—	1.1	2.0[3)]	dB
	703... 733	MHz		—	1.1	2.2	dB
Amplitude Ripple (p-p)			4)				
	703... 733	MHz		—	0.7	1.4	dB
VSWR							
@ B28a TX port	703... 733	MHz		—	1.6	2.0	
@ ANT port	703... 733	MHz		—	1.6	2.0	
Attenuation							
	10... 670	MHz		35	43	—	dB
	470... 694	MHz	5)	12	38	—	dB
	692... 698	MHz	6)	7	19	—	dB
	758... 788	MHz		45	58	—	dB
	773... 803	MHz		45	57	—	dB
	791... 821	MHz		45	56	—	dB
	832... 862	MHz		45	52	—	dB
	859... 894	MHz		35	40	—	dB
	880... 915	MHz		35	40	—	dB
	925... 960	MHz		35	53	—	dB
	1166.22... 1186.68	MHz		35	44	—	dB
	1225... 1250	MHz		35	45	—	dB
	1406... 1466	MHz		40	47	—	dB
	1559... 1606	MHz		43	48	—	dB
	2400... 2700	MHz		40	48	—	dB
	2812... 2932	MHz		40	49	—	dB
	3300... 4900	MHz		40	66	—	dB
	4900... 5950	MHz		40	83	—	dB

1) See Sec. Matching circuit (p. 6).
2) Integrated attenuation: Averaged power $|S_{ij}|^2$ over the center 2.7 MHz of LTE 3 MHz (15 RB) channels.
3) Valid for typical temperature T = +25 °C.
4) Over any 5 MHz.
5) Integrated attenuation: Averaged power $|S_{ij}|^2$ over the center 7.2 MHz of LTE 8 MHz (40 RB) channels.
6) Integrated attenuation: Averaged power $|S_{ij}|^2$ over the center 5.4 MHz of LTE 6 MHz (30 RB) channels.

7.2 TX – RX

Temperature range for specification	T_{SPEC}	= −30 °C ... +85 °C
B28a TX terminating impedance	$Z_{B28a\ TX}$	= 50 Ω + 10.4 nH[1)]
ANT terminating impedance	Z_{ANT}	= 50 Ω with ext. circuitry.[1)]
RX terminating impedance	Z_{RX}	= 50 Ω // 12.4 nH[1)]

Characteristics EN-DC 4G/5G B28a TX – RX			**min.** for T_{SPEC}	**typ.** @ +25 °C	**max.** for T_{SPEC}	
Isolation [2)]						
	703... 733	MHz	55	60	—	dB
	758... 788	MHz	55	62	—	dB
	791... 821	MHz	55	63	—	dB

1) See Sec. Matching circuit (p. 6).
2) Integrated attenuation: Averaged power $|S_{ij}|^2$ over the center 2.7 MHz of LTE 3 MHz (15 RB) channels.

8 Maximum ratings

Operable temperature	T_{OP} = −30 °C ... +85 °C	
Storage temperature	T_{STG} [1] = −40 °C ... +85 °C	
DC voltage	$\lvert V_{DC}\rvert$ [2] = 0 V	
ESD voltage		
	V_{ESD} [3] = 250 V	Human body model.
	V_{ESD} [4] = 1000 V	Charged device model.
	V_{ESD} [5] = 100 V	Machine model.
Input power	P_{IN}	
@ B20 TX port: 832 ... 862 MHz	30 dBm	Continuous wave for 3000 h @ 50 °C.
@ B20 TX port: 832 ... 862 MHz	29 dBm	Continuous wave for 5000 h @ 85 °C.
@ B20 TX port: 832 ... 862 MHz	30 dBm	Continuous wave for 2 h @ 85 °C.
@ B20 TX port: 832 ... 862 MHz	29 dBm	5 MHz LTE uplink signal (1 RB UP) for 5000 h @ 85 °C.
@ B20 TX port: 832 ... 862 MHz	30 dBm	5 MHz LTE uplink signal (1 RB UP) for 2 h @ 85 °C.
@ B28a TX port: 703 ... 733 MHz	30 dBm	Continuous wave for 3000 h @ 50 °C.
@ B28a TX port: 703 ... 733 MHz	29 dBm	Continuous wave for 5000 h @ 85 °C.
@ B28a TX port: 703 ... 733 MHz	30 dBm	Continuous wave for 2 h @ 85 °C.
@ B28a TX port: 703 ... 733 MHz	29 dBm	3 MHz LTE uplink signal (1 RB UP) for 5000 h @ 85 °C.
@ B28a TX port: 703 ... 733 MHz	30 dBm	3 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] 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-C101C (CDM – Field Induced Charged Device Model), 3 negative & 3 positive pulses.
[5] According to JESD22-A115B (MM – Machine Model), 10 negative & 10 positive pulses.

9 Transmission coefficients EN-DC 4G/5G B20

9.1 TX – ANT

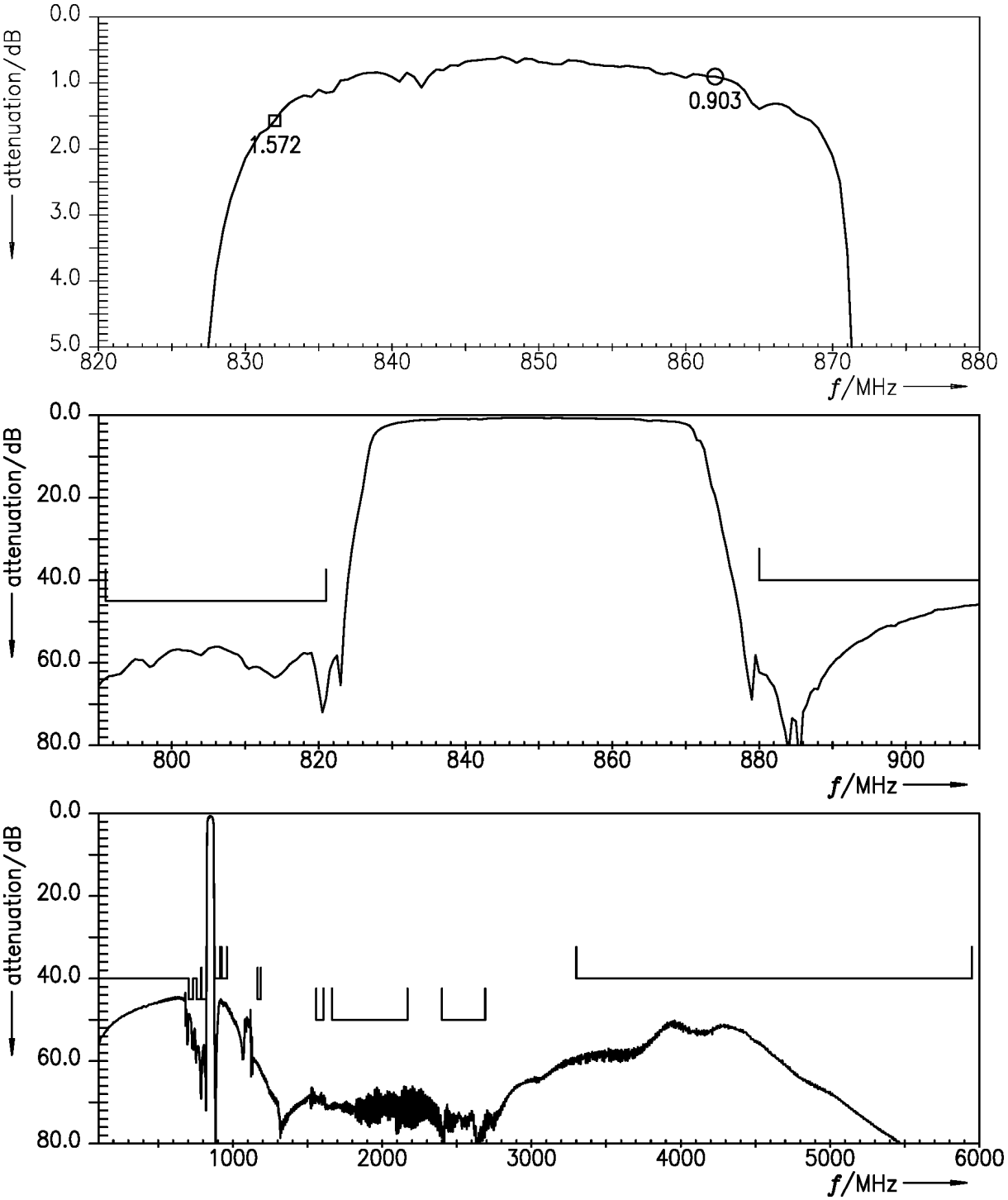

Figure 3: Attenuation TX – ANT.

9.2 ANT – RX

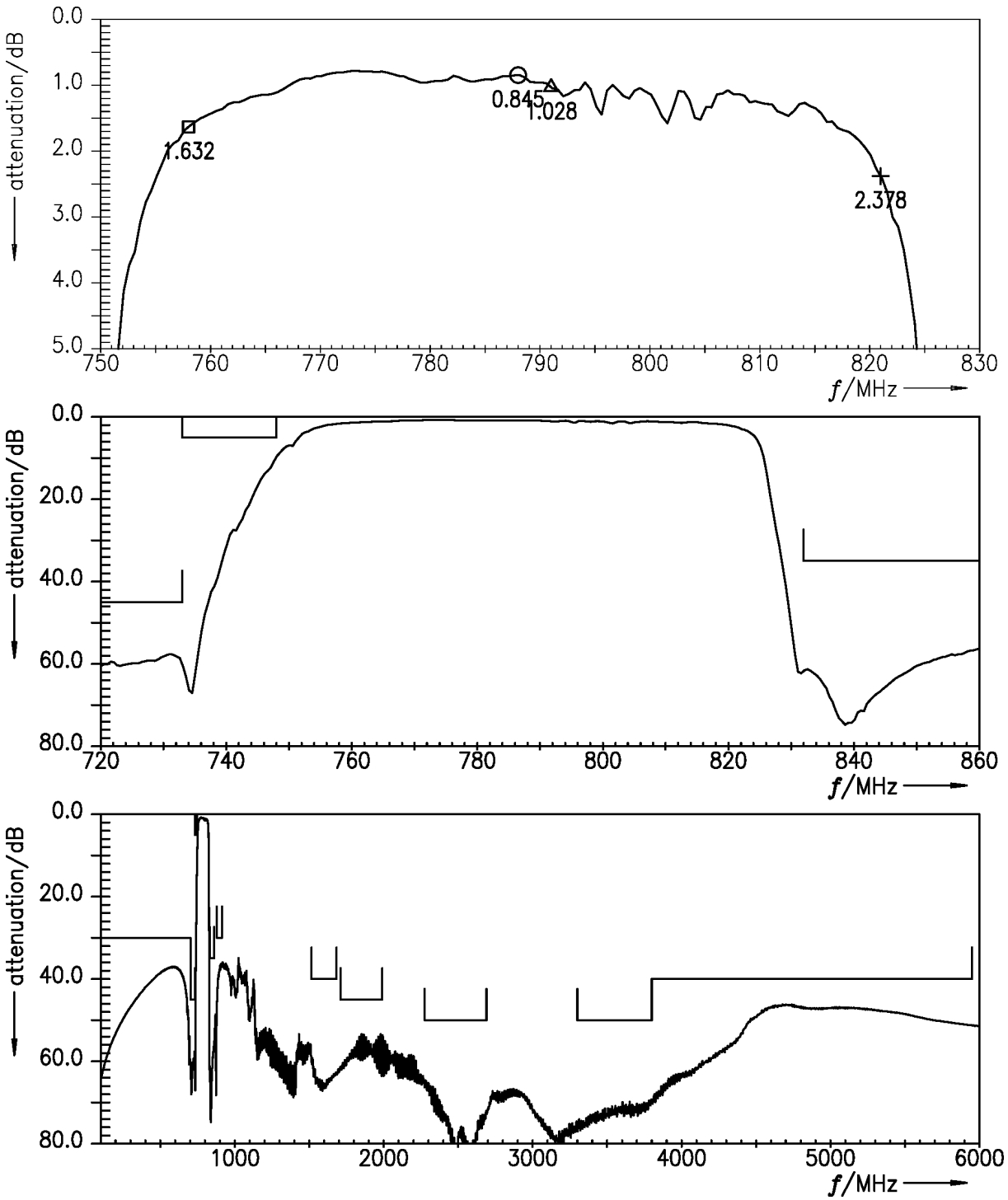

Figure 4: Attenuation ANT – RX.

10 Transmission coefficient (LTE) EN-DC 4G/5G B20

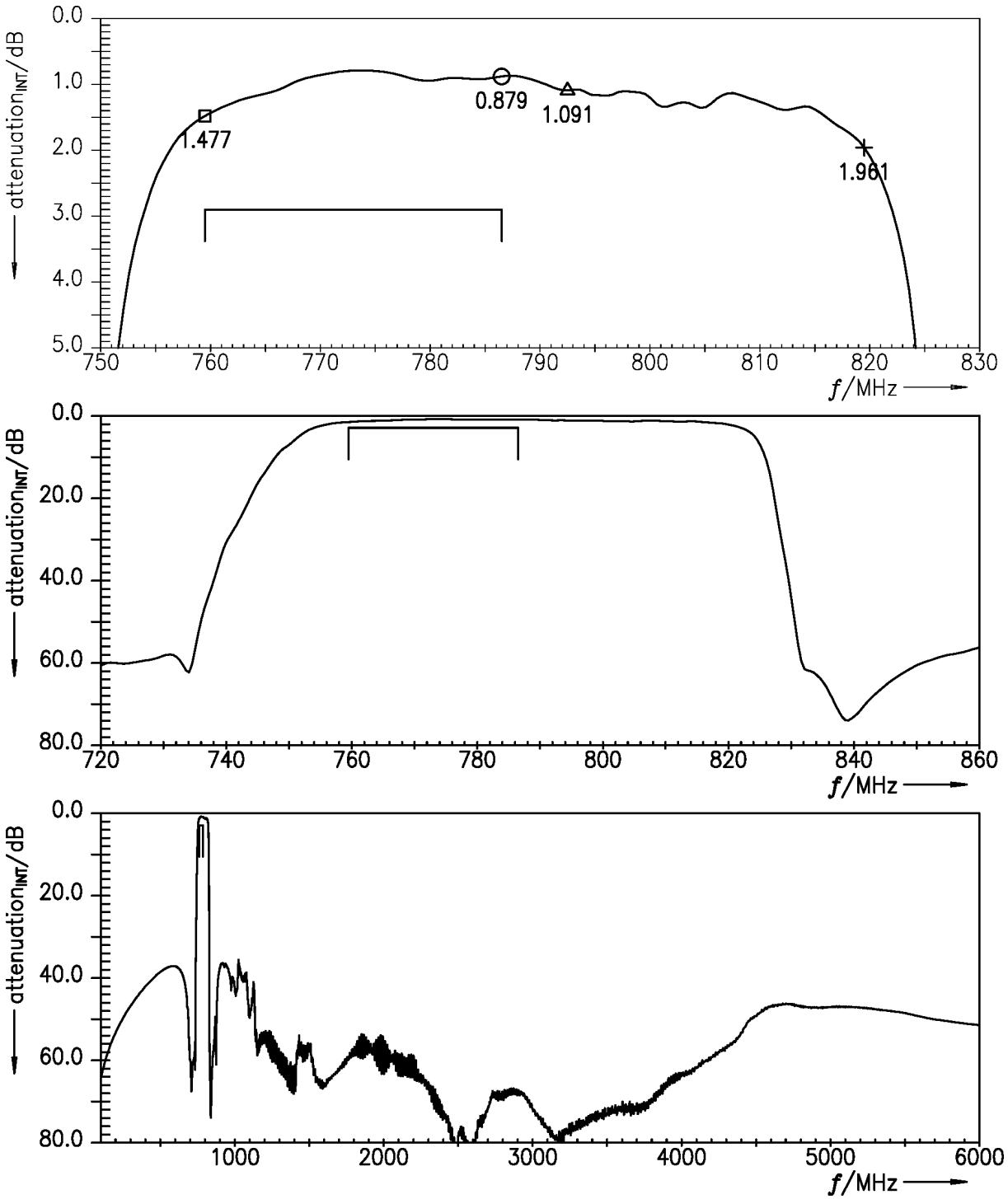

Figure 5: Attenuation (LTE) (integration window = 3 MHz) ANT – RX.

10.1 TX – ANT

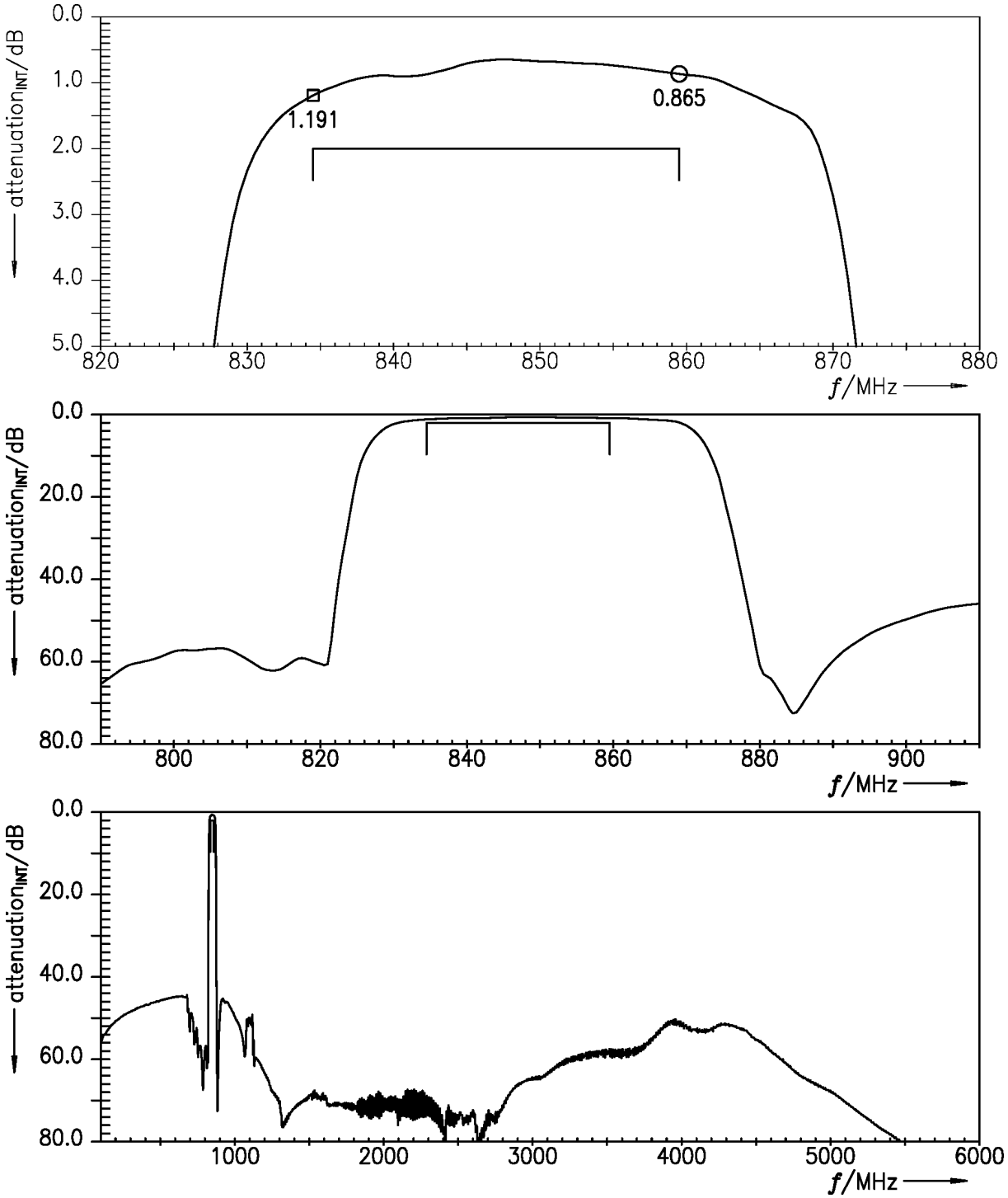

Figure 6: Attenuation (LTE) (integration window = 5 MHz) TX – ANT.

10.2 ANT – RX

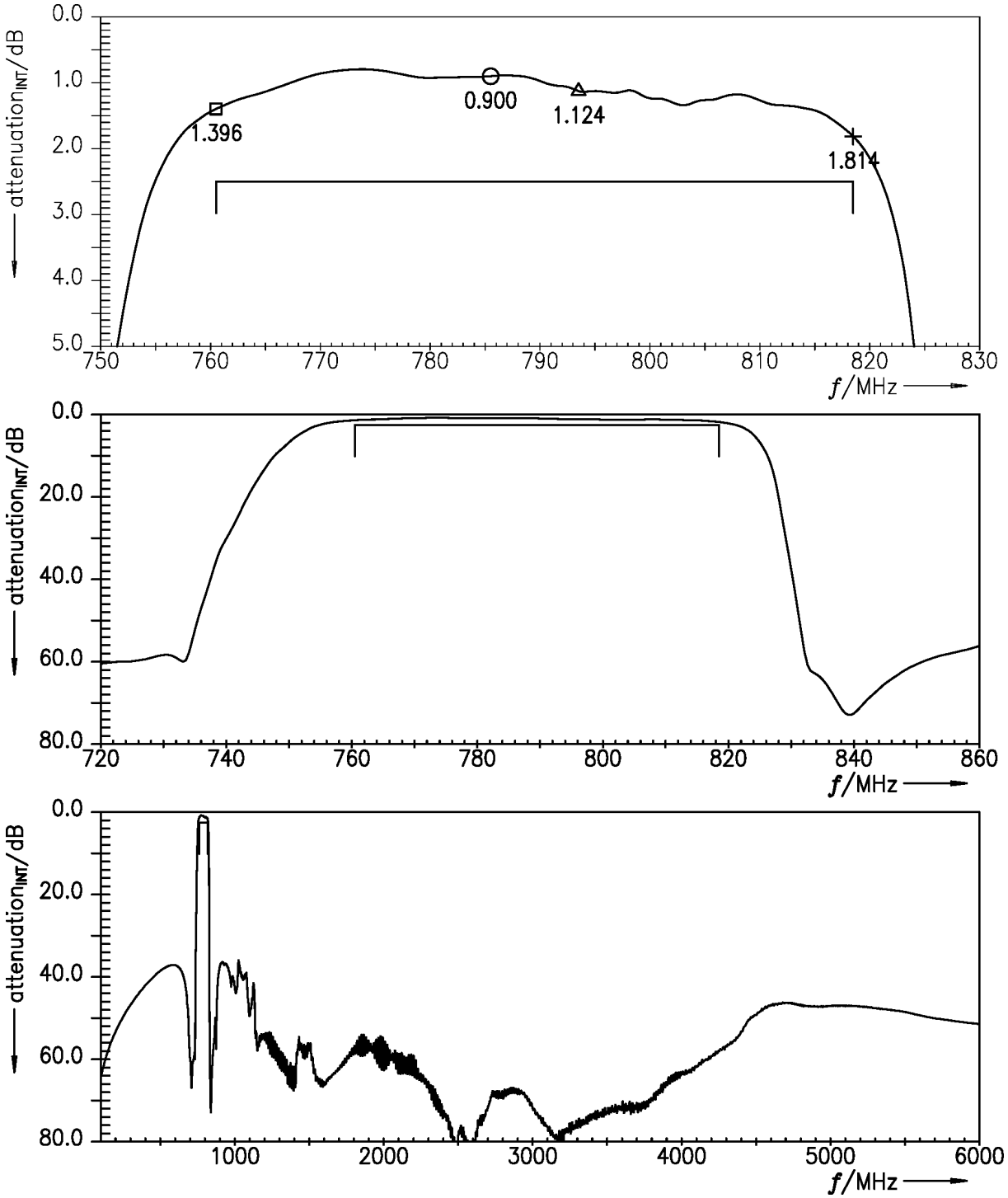

Figure 7: Attenuation (LTE) (integration window = 5 MHz) ANT – RX.

10.3 TX – RX

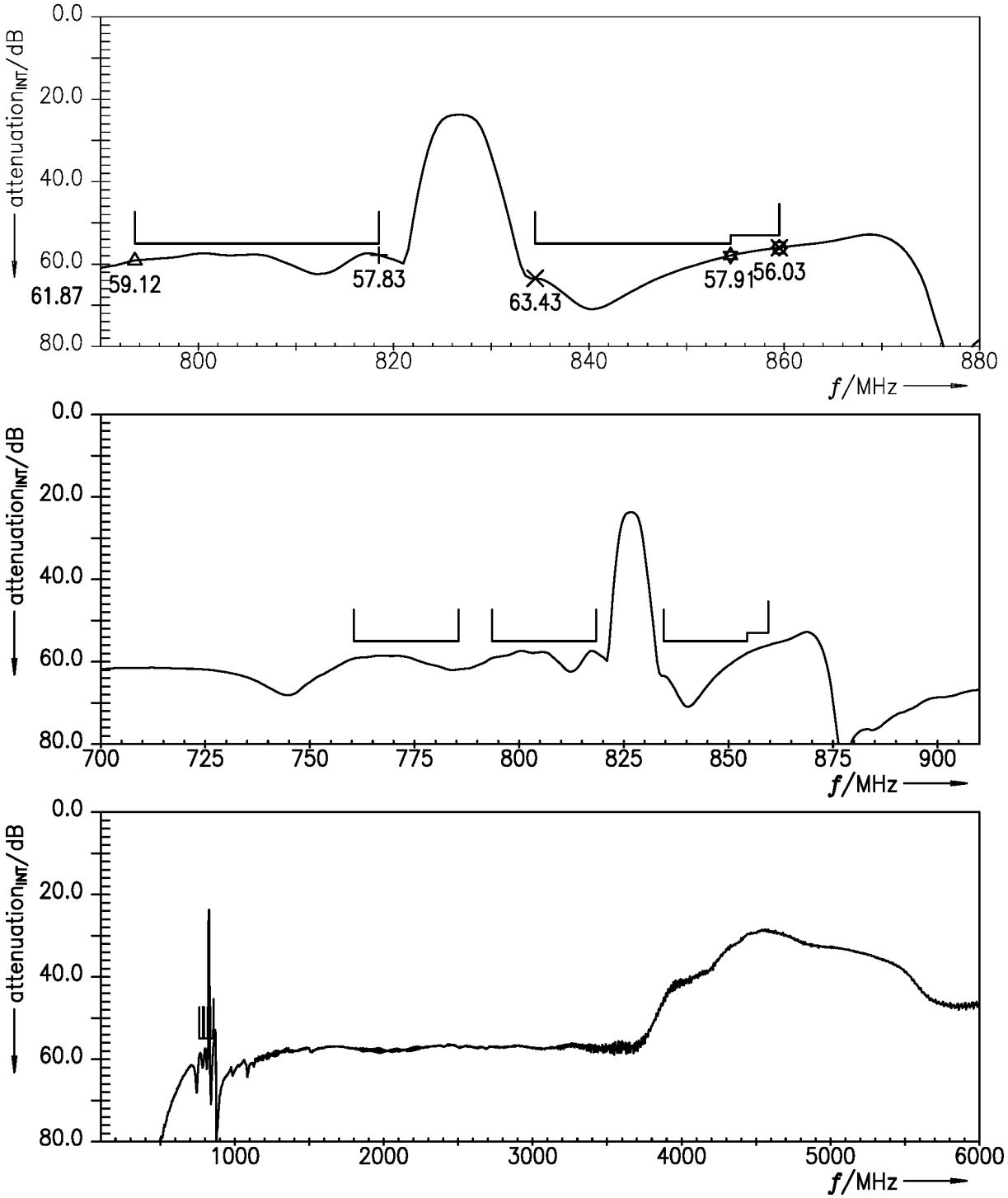

Figure 8: Isolation (LTE) (integration window = 5 MHz) TX – RX.

11 Reflection coefficients EN-DC 4G/5G B20

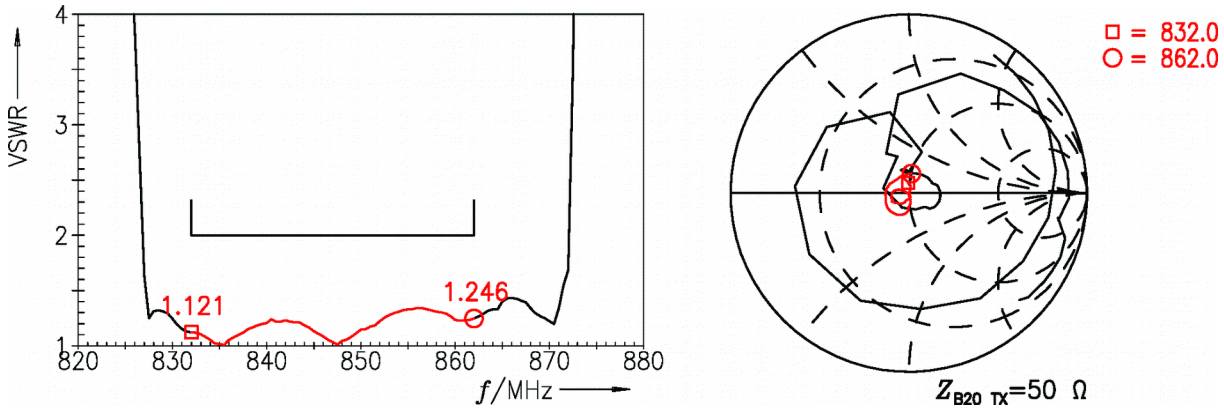

Figure 9: Reflection coefficient at B20 TX port.

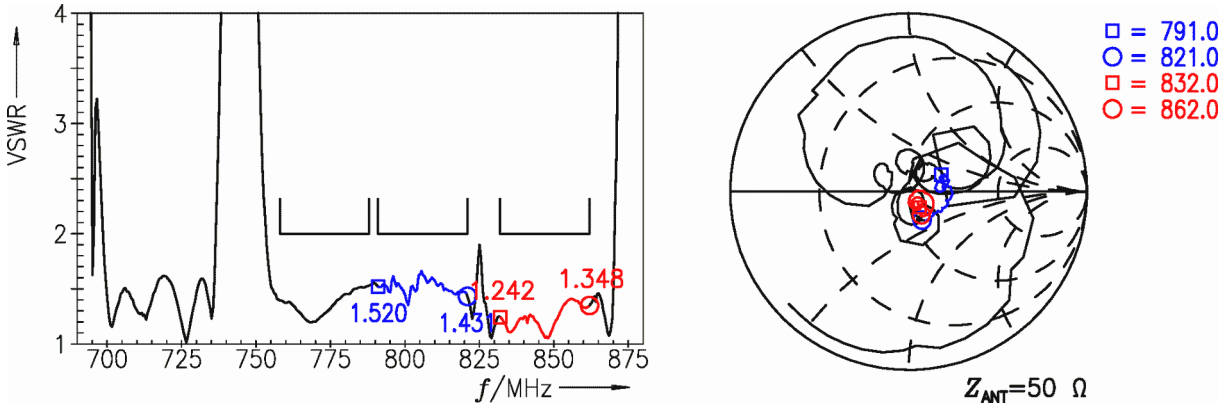

Figure 10: Reflection coefficient at ANT port.

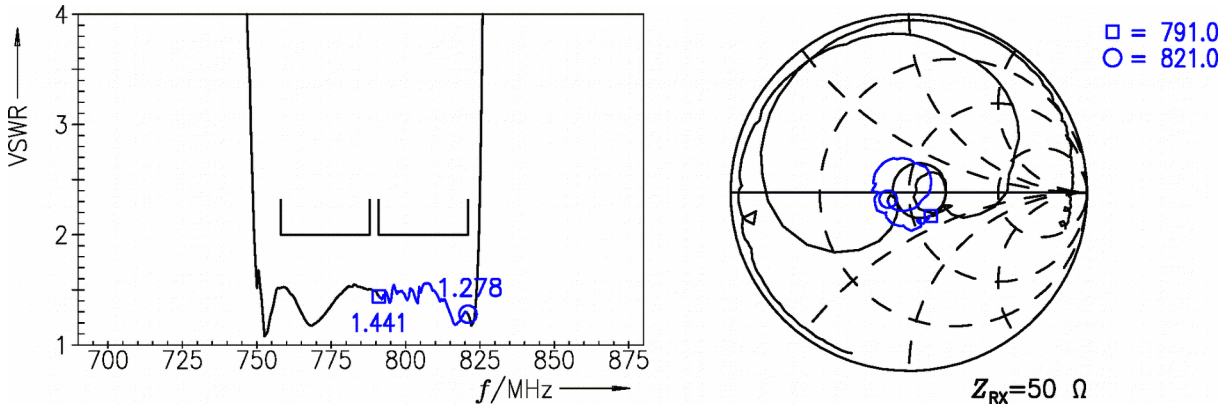

Figure 11: Reflection coefficient at RX port.

12 Transmission coefficient EN-DC 4G/5G B28a

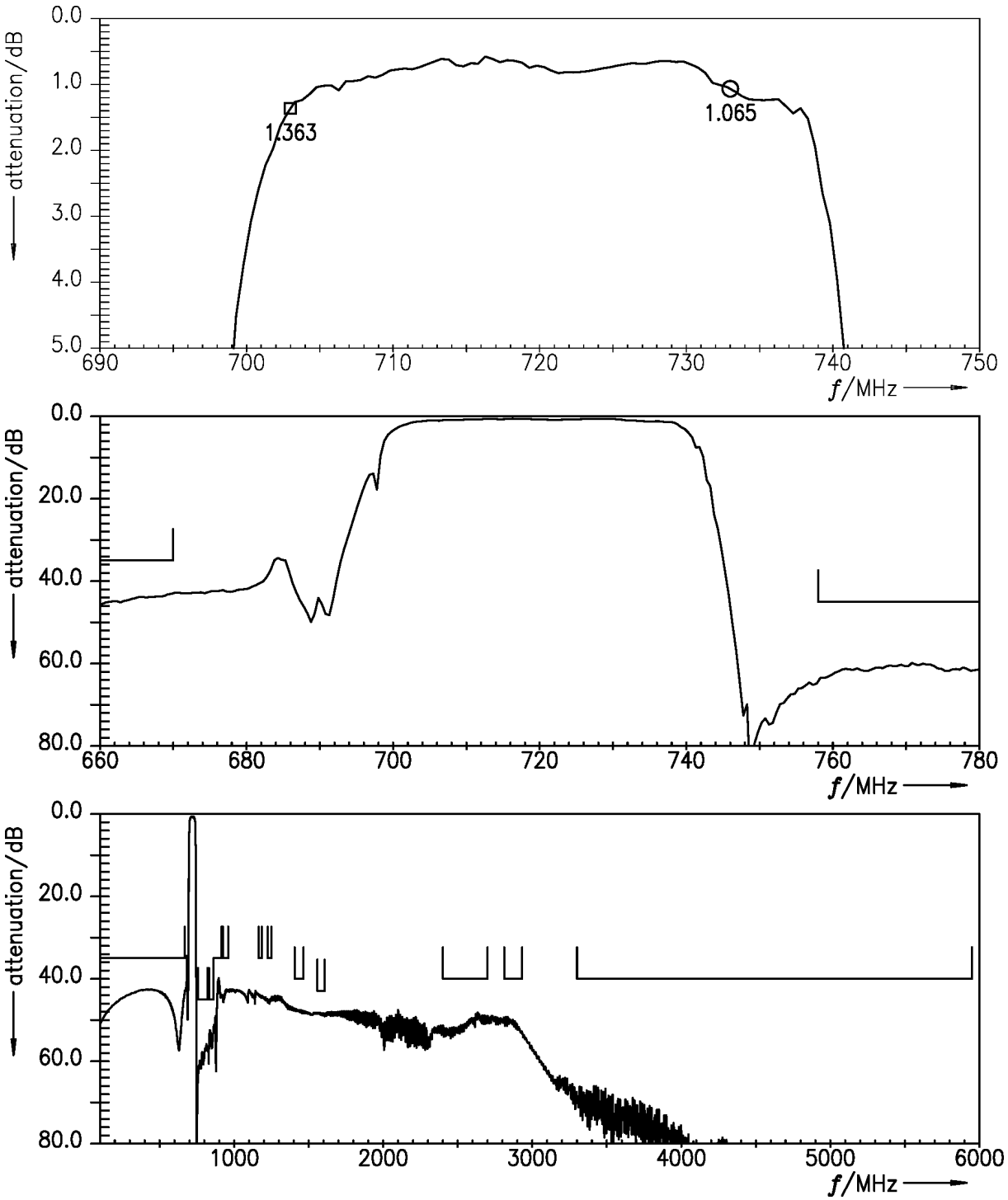

Figure 12: Attenuation TX – ANT.

13 Transmission coefficients (LTE) EN-DC 4G/5G B28a

13.1 TX – ANT

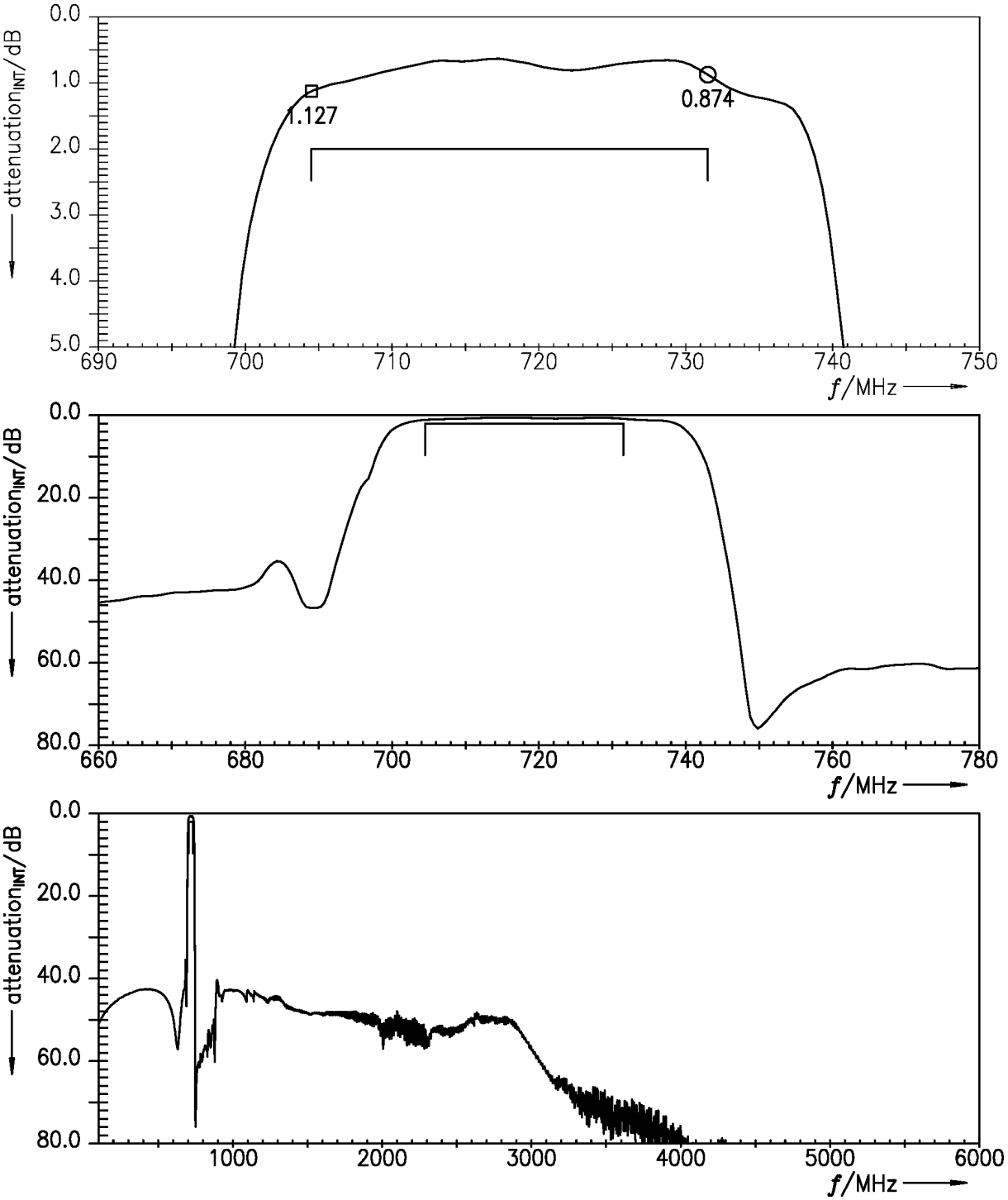

Figure 13: Attenuation (LTE) (integration window = 3 MHz) TX – ANT.

13.2 TX – RX

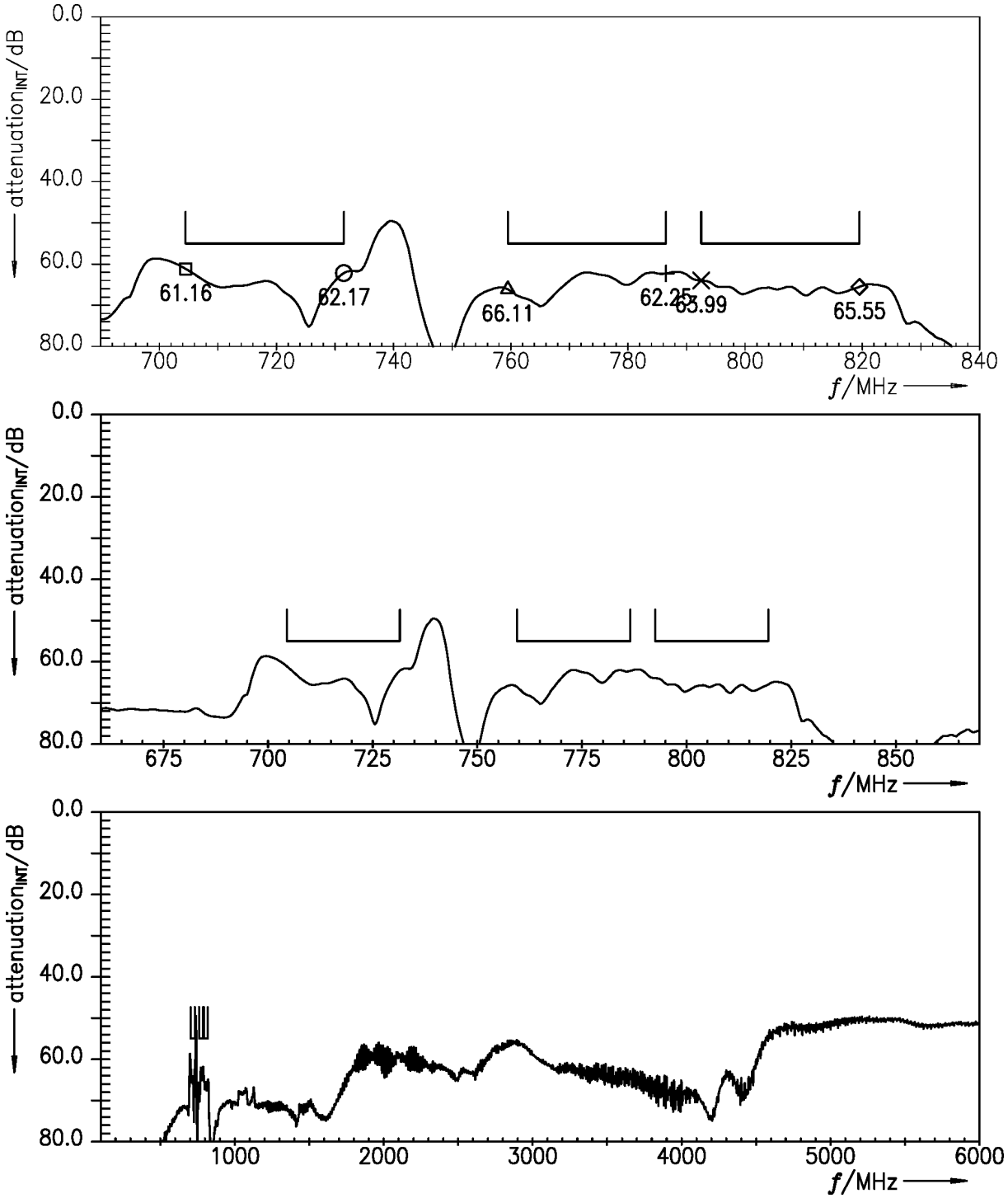

Figure 14: Isolation (LTE) (integration window = 3 MHz) TX – RX.

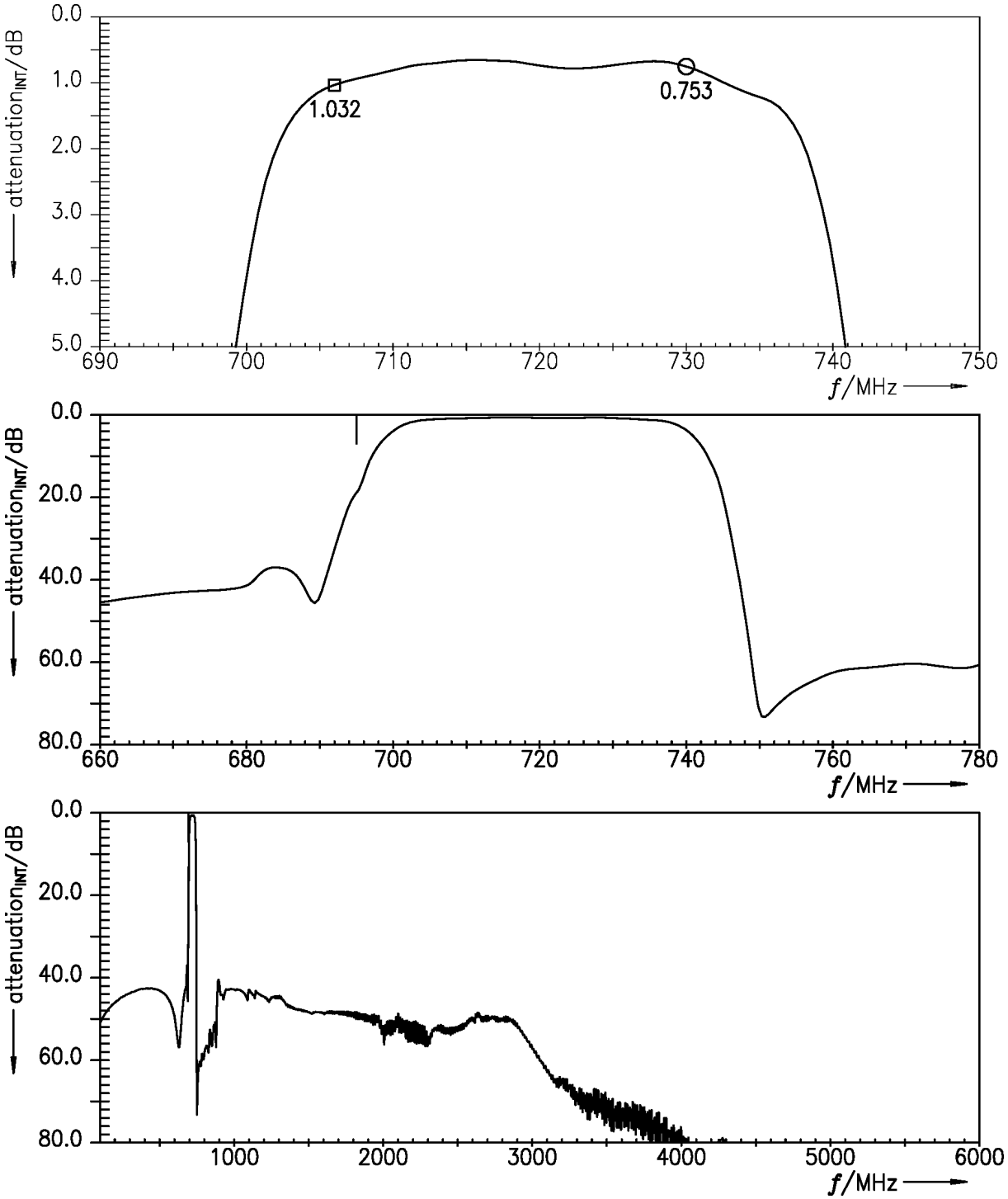

Figure 15: Attenuation (LTE) (integration window = 6 MHz) TX – ANT.

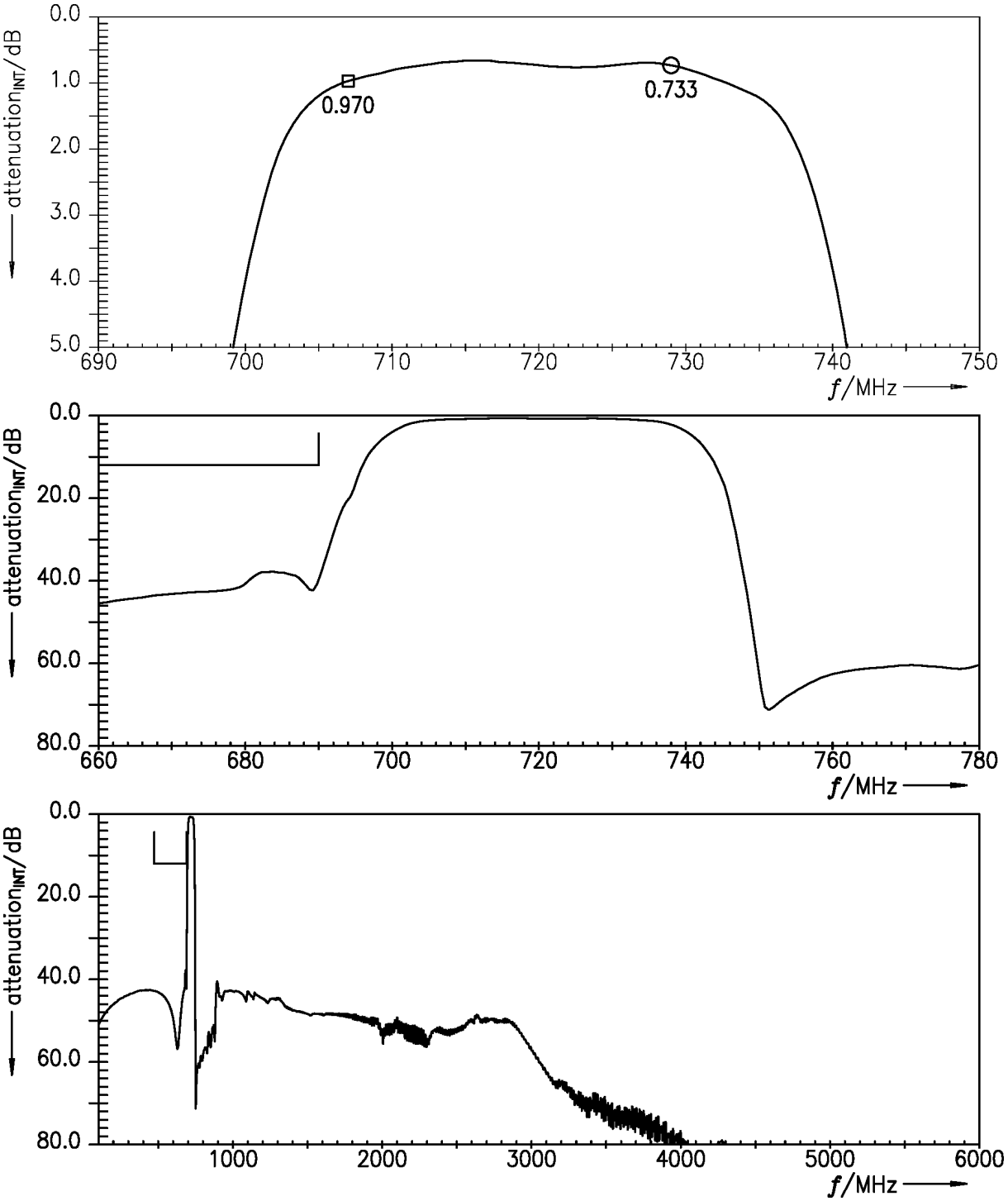

Figure 16: Attenuation (LTE) (integration window = 8 MHz) TX – ANT.

14 Reflection coefficients EN-DC 4G/5G B28a

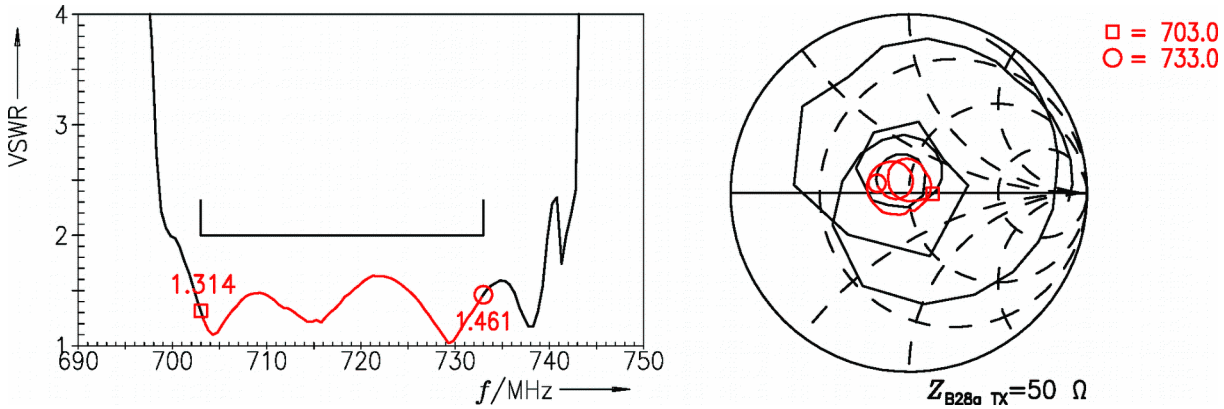

Figure 17: Reflection coefficient at B28a TX port.

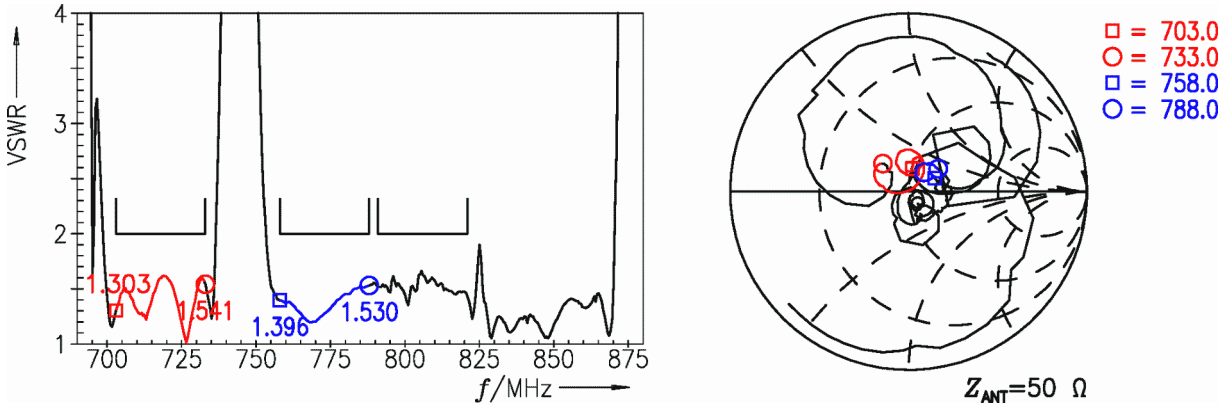

Figure 18: Reflection coefficient at ANT port.

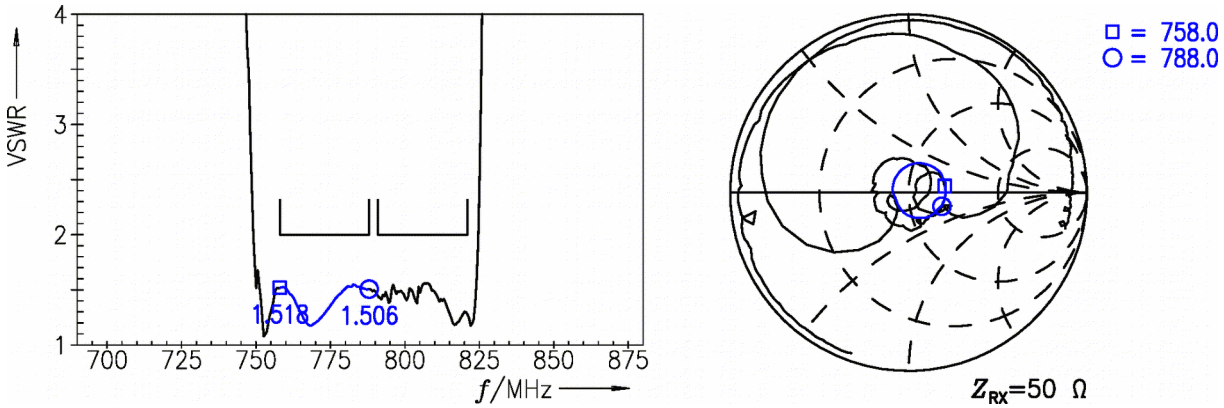

Figure 19: Reflection coefficient at RX port.

15 Packing material

15.1 Tape

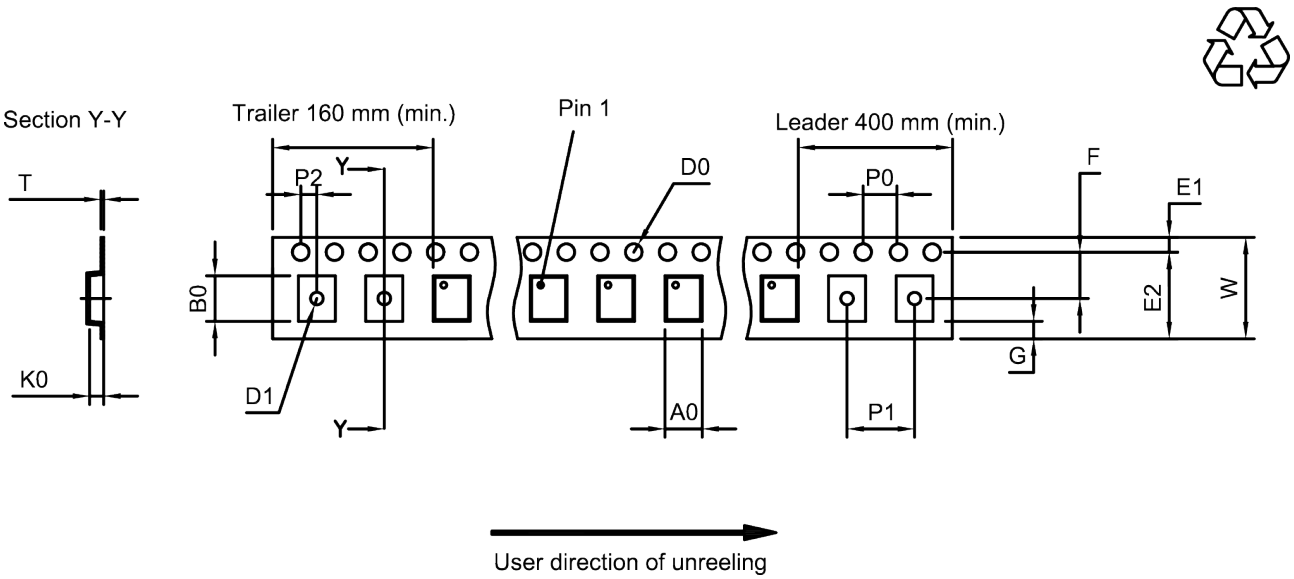

Figure 20: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

A_0	$2.25_{\pm 0.05}$ mm
B_0	$2.75_{\pm 0.05}$ 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	$10.25^{+0.2/-0}$ mm
F	$5.5_{\pm 0.05}$ mm
G	0.75 mm (min.)
K_0	$0.84_{\pm 0.1}$ mm
P_0	$4.0_{\pm 0.1}$ mm

P_1	$4.0_{\pm 0.1}$ mm
P_2	$2.0_{\pm 0.05}$ mm
T	$0.3_{\pm 0.03}$ mm
W	$12.0^{+0.3/-0.1}$ mm

Table 1: Tape dimensions.

15.2 Reel with diameter of 180 mm

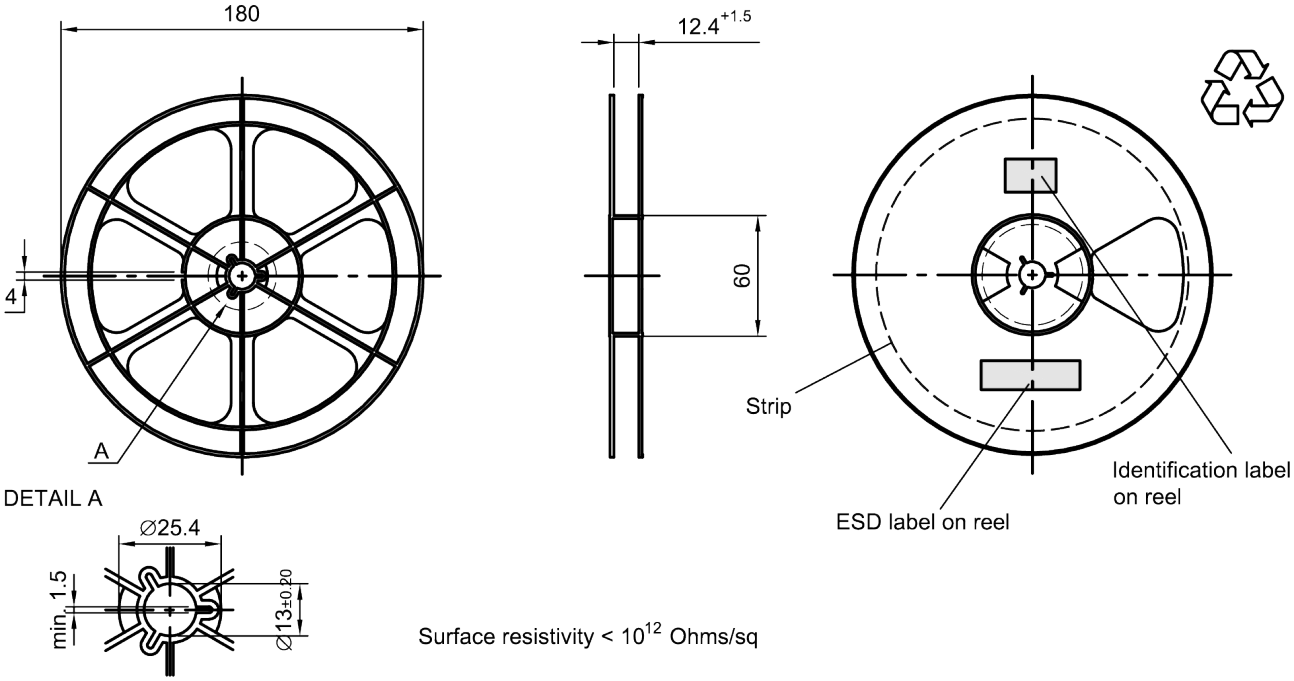

Figure 21: Drawing of reel (first-angle projection) with diameter of 180 mm.

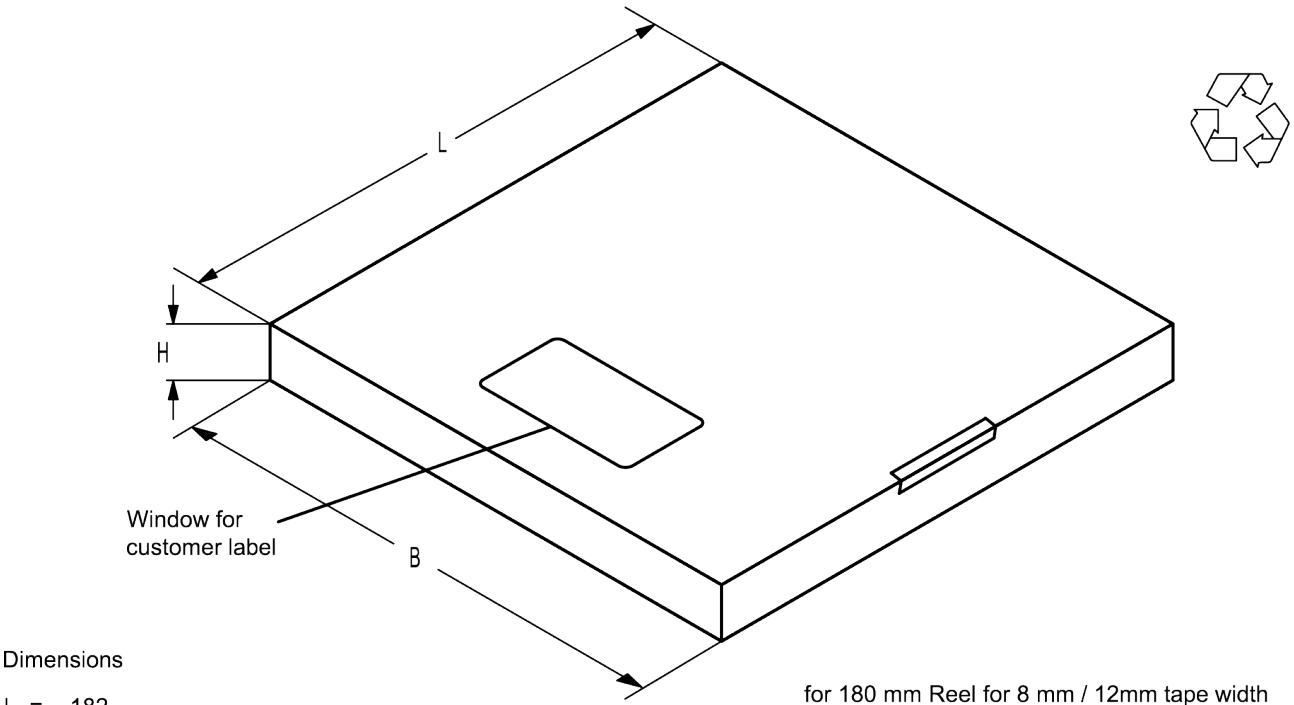

Figure 22: Drawing of folding box for reel with diameter of 180 mm.

15.3 Reel with diameter of 330 mm

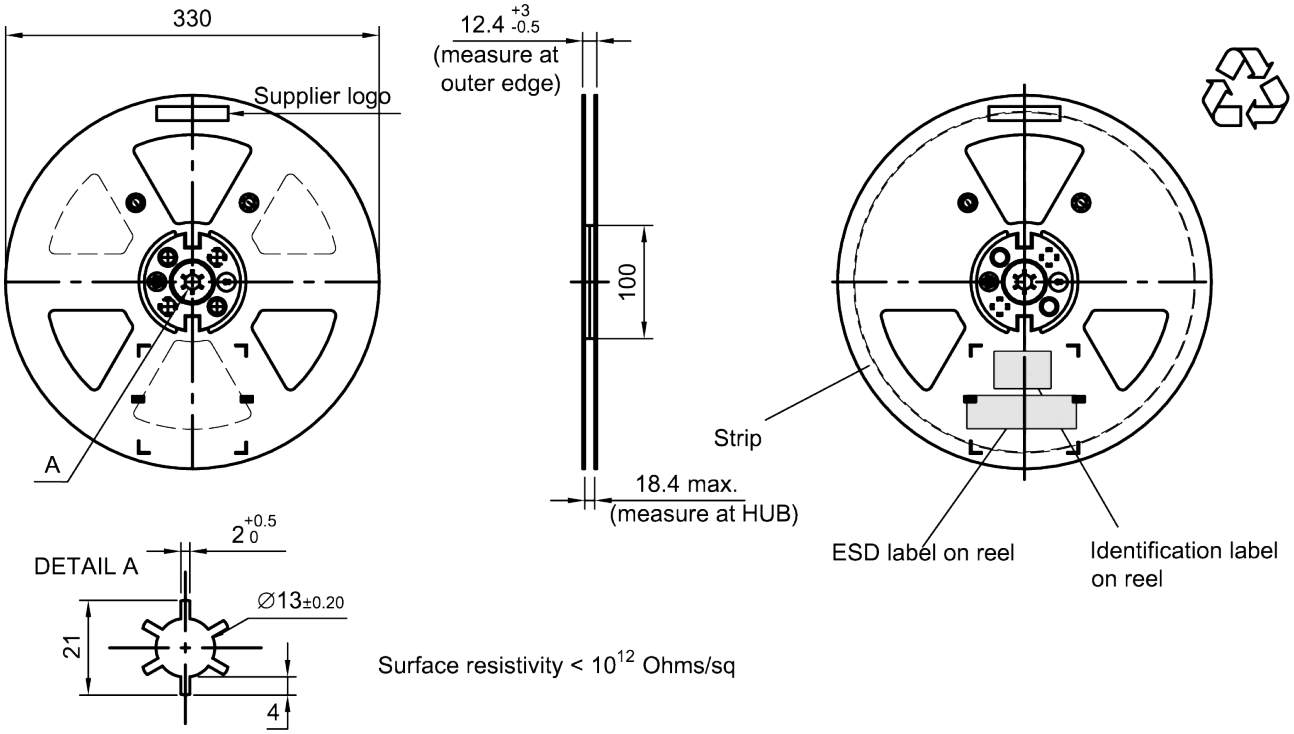

Figure 23: Drawing of reel (first-angle projection) with diameter of 330 mm.

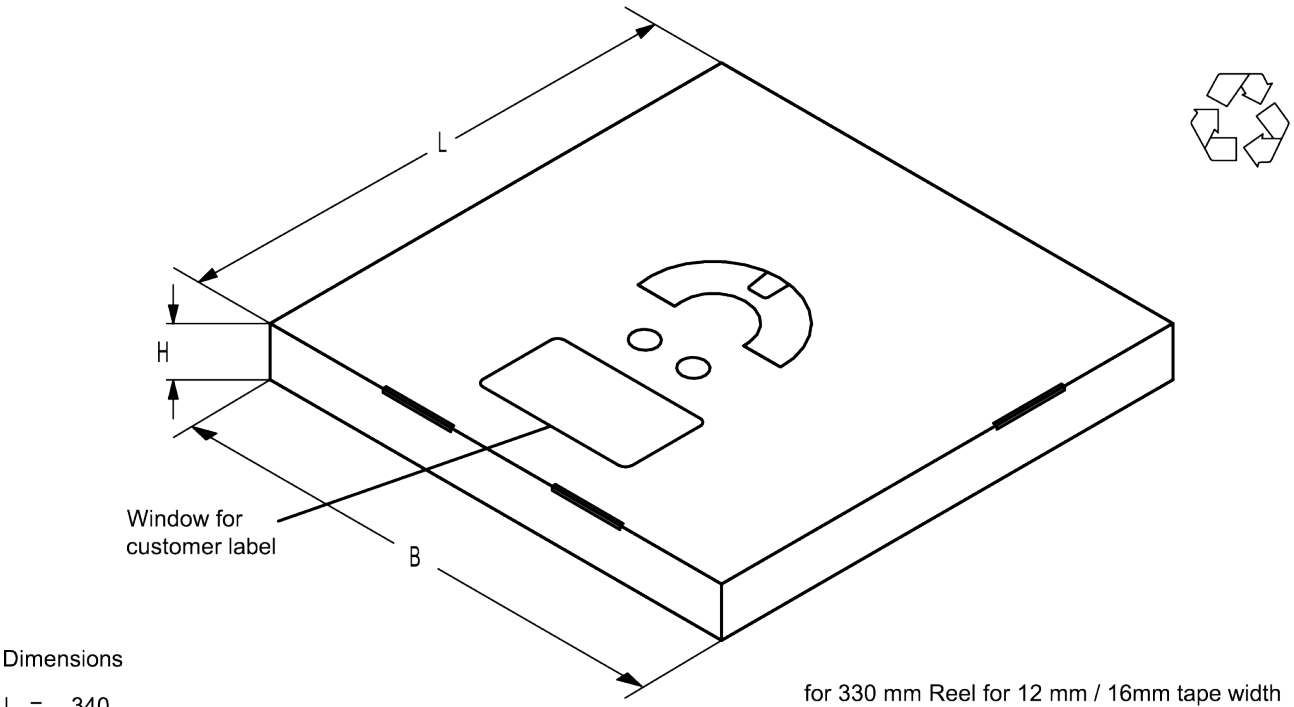

Figure 24: Drawing of folding box for reel with diameter of 330 mm.

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 M5006 is 4WE.

- 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).

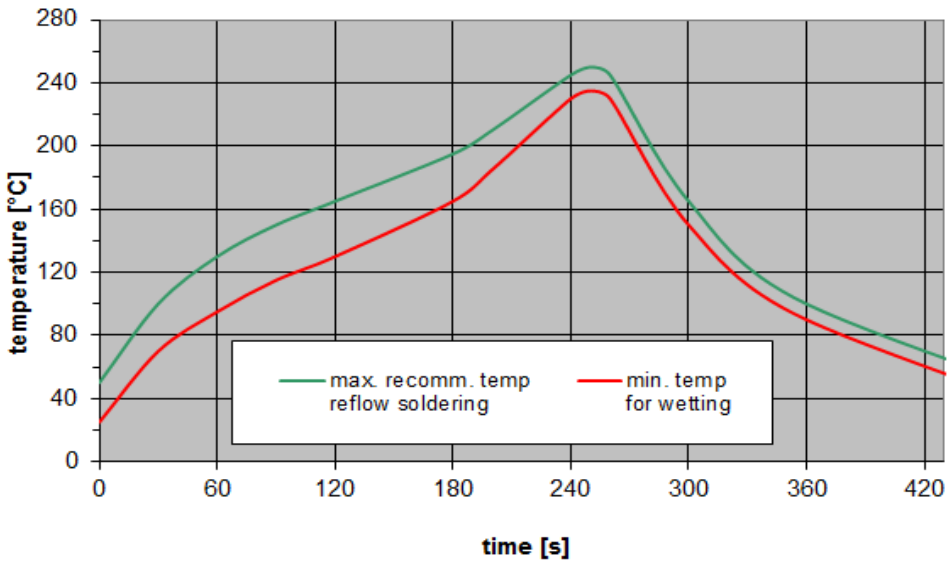

Figure 25: Recommended reflow profile for convection and infrared soldering – lead-free solder.

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
B39851M5006D310	10000 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 https://rffe.qualcomm.com/.

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 (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.

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