RF360 Europe GmbH
A Qualcomm – TDK Joint Venture

Preliminary data sheet

E-Duplexer
Small cell
LTE band 14

Series/type: D7909
Ordering code: [B39791D7909D310]

Date: April 18, 2019
Version: 1.0

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1 Application

- Enhanced Duplexer for LTE small cell system (Band 14)
- High isolation > 63 dB min
- Usable pass band 10 MHz
- Low VSWR
- RX = uplink = 788 – 798 MHz
- TX = downlink = 758 – 768 MHz

2 Features

- Package size $8.1_{\pm0.1}$ mm × $8.1_{\pm0.1}$ 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)

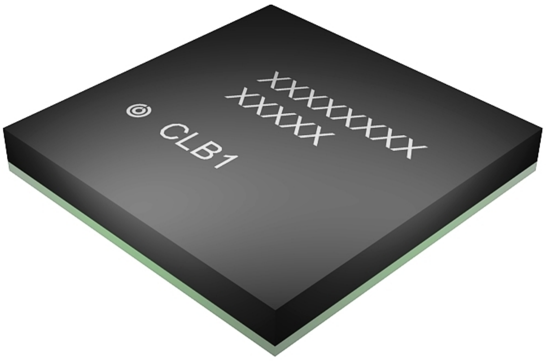
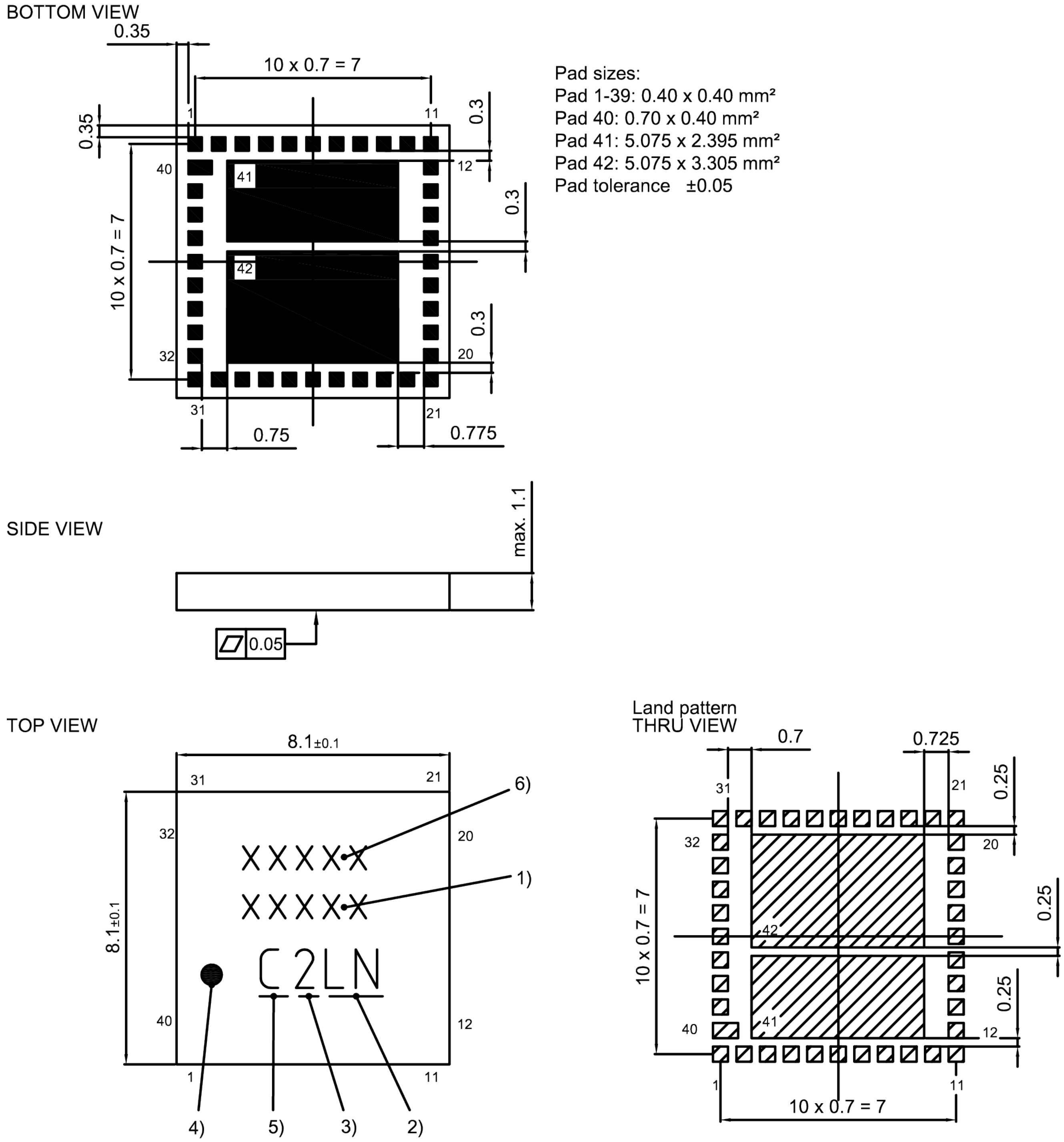


Figure 1: Picture of component with example of product marking.

3 Package



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

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

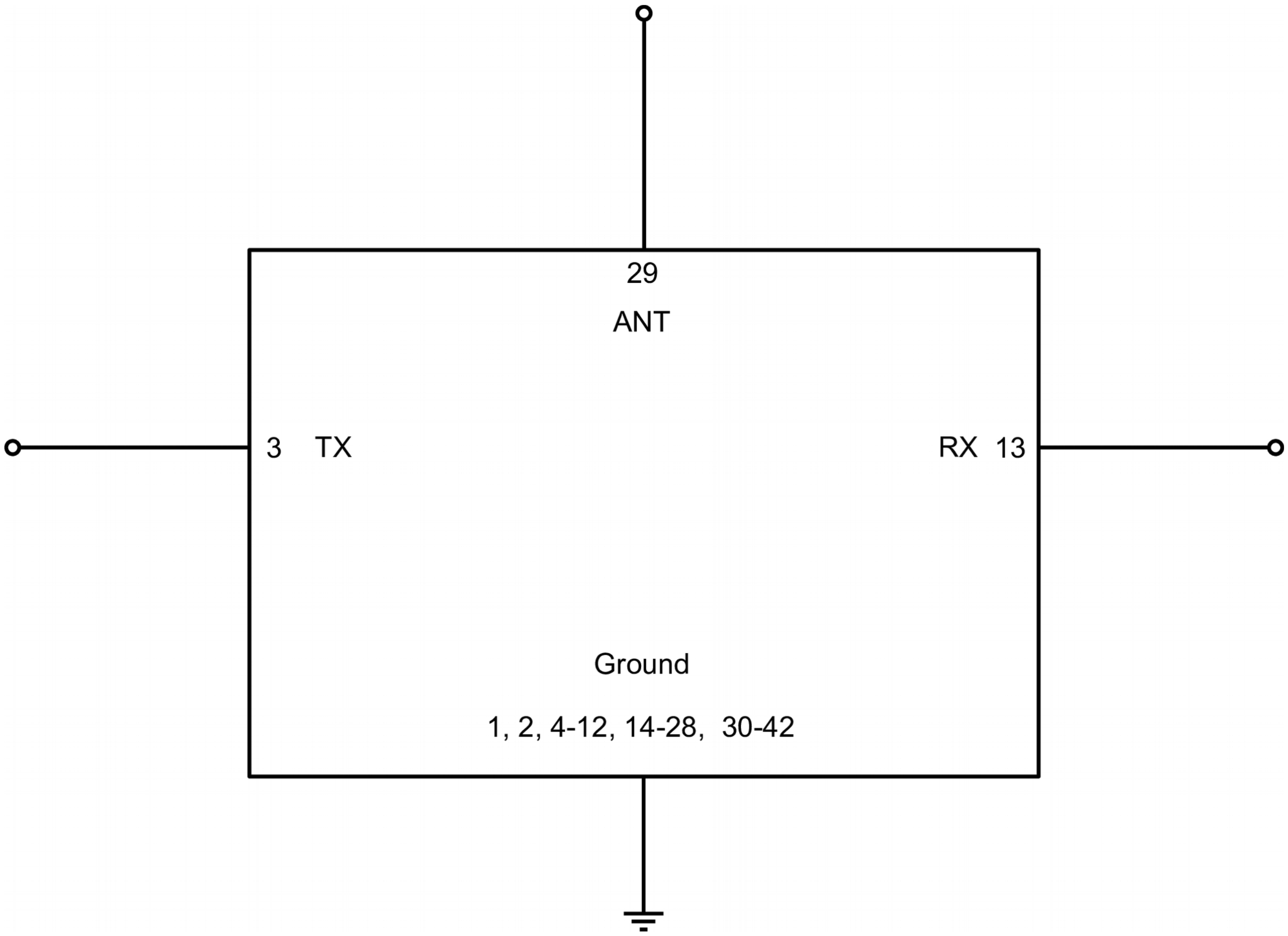


Figure 3: Schematic of matching circuit. No external matching components required.

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	—	763	—	MHz
Insertion attenuation			α_{INT}[1]				
	758 ... 768	MHz		—	1.7	2.4	dB
Maximum insertion attenuation			α_{max}				
	758 ... 768	MHz		—	1.9	2.7	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	758 ... 768	MHz		—	0.3	1.4	dB
Maximum VSWR			$VSWR_{max}$				
@ TX port	758 ... 768	MHz		—	1.2	1.7	
@ ANT port	758 ... 768	MHz		—	1.2	1.7	
Maximum error vector magnitude			EVM_{max}[2]				
	760.4 ... 765.6	MHz		—	1.1	3.5	%
Minimum attenuation			α_{min}				
	50 ... 698	MHz		37	41	—	dB
	698 ... 716	MHz		37	42	—	dB
	716 ... 728	MHz		37	44	—	dB
	788 ... 798	MHz		50	57	—	dB
	798 ... 805	MHz		45	61	—	dB
	818 ... 824	MHz		38	47	—	dB
	824 ... 849	MHz		38	44	—	dB
	1516 ... 1566	MHz		40	46	—	dB
	1710 ... 1755	MHz		40	47	—	dB
	1850 ... 1920	MHz		40	48	—	dB
	2274 ... 2304	MHz		35	47	—	dB
	2334 ... 2364	MHz		40	48	—	dB
	2500 ... 2690	MHz		40	49	—	dB
	3032 ... 3072	MHz		40	49	—	dB
	3500 ... 3700	MHz		40	45	—	dB
	5150 ... 5850	MHz		20	30	—	dB

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[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}	
Insertion attenuation			α_{INT} [1]				
	758 ... 768	MHz		—	1.7	2.4	dB
Maximum insertion attenuation			α_{max}				
	758 ... 768	MHz		—	1.9	2.8	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	758 ... 768	MHz		—	0.3	1.5	dB
Maximum VSWR			$VSWR_{max}$				
@ TX port	758 ... 768	MHz		—	1.2	1.7	
@ ANT port	758 ... 768	MHz		—	1.2	1.7	
Maximum error vector magnitude			EVM_{max} [2]				
	760.4 ... 765.6	MHz		—	1.1	3.5	%
Minimum attenuation			α_{min}				
	50 ... 698	MHz		37	41	—	dB
	698 ... 716	MHz		37	42	—	dB
	716 ... 728	MHz		37	44	—	dB
	788 ... 798	MHz		50	57	—	dB
	798 ... 805	MHz		45	61	—	dB
	818 ... 824	MHz		38	47	—	dB
	824 ... 849	MHz		38	44	—	dB
	1516 ... 1566	MHz		40	46	—	dB
	1710 ... 1755	MHz		40	47	—	dB
	1850 ... 1920	MHz		40	48	—	dB
	2274 ... 2304	MHz		35	47	—	dB
	2334 ... 2364	MHz		40	48	—	dB
	2500 ... 2690	MHz		40	49	—	dB
	3032 ... 3072	MHz		40	49	—	dB
	3500 ... 3700	MHz		40	45	—	dB
	5150 ... 5850	MHz		20	30	—	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	—	793	—	MHz
Insertion attenuation			α_{INT} 1)				
	788 ... 798	MHz		—	1.5	2.3	dB
Maximum insertion attenuation			α_{max}				
	788 ... 798	MHz		—	1.9	2.4	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	788 ... 798	MHz		—	0.5	1.2	dB
Maximum VSWR			$VSWR_{max}$				
@ ANT port	788 ... 798	MHz		—	1.3	1.7	
@ RX port	788 ... 798	MHz		—	1.2	1.7	
Maximum error vector magnitude			EVM_{max} 2)				
	790.4 ... 795.6	MHz		—	1.4	3.5	%
Minimum attenuation			α_{min}				
	50 ... 698	MHz		40	43	—	dB
	716 ... 728	MHz		40	46	—	dB
	728 ... 746	MHz		41	47	—	dB
	746 ... 758	MHz		45	55	—	dB
	758 ... 768	MHz		45	61	—	dB
	769 ... 775	MHz		43	55	—	dB
	869 ... 894	MHz		42	46	—	dB
	1576 ... 1596	MHz		45	57	—	dB
	1930 ... 1995	MHz		45	58	—	dB
	2110 ... 2200	MHz		40	53	—	dB
	2364 ... 2394	MHz		35	48	—	dB
	2400 ... 2500	MHz		35	47	—	dB
	2500 ... 2690	MHz		35	47	—	dB
	3152 ... 3192	MHz		35	44	—	dB
	3550 ... 3700	MHz		35	44	—	dB
	5150 ... 5850	MHz		30	42	—	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}	
Insertion attenuation			α_{INT}[1]				
	788 ... 798	MHz		—	1.5	2.3	dB
Maximum insertion attenuation			α_{max}				
	788 ... 798	MHz		—	1.9	2.5	dB
Amplitude ripple (p-p)			$\Delta\alpha$				
	788 ... 798	MHz		—	0.5	1.3	dB
Maximum VSWR			$VSWR_{max}$				
@ ANT port	788 ... 798	MHz		—	1.3	1.7	
@ RX port	788 ... 798	MHz		—	1.2	1.7	
Maximum error vector magnitude			EVM_{max}[2]				
	790.4 ... 795.6	MHz		—	1.4	3.5	%
Minimum attenuation			α_{min}				
	50 ... 698	MHz		40	43	—	dB
	716 ... 728	MHz		40	46	—	dB
	728 ... 746	MHz		41	47	—	dB
	746 ... 758	MHz		45	55	—	dB
	758 ... 768	MHz		45	61	—	dB
	769 ... 775	MHz		43	55	—	dB
	869 ... 894	MHz		42	46	—	dB
	1576 ... 1596	MHz		45	57	—	dB
	1930 ... 1995	MHz		45	58	—	dB
	2110 ... 2200	MHz		40	53	—	dB
	2364 ... 2394	MHz		35	48	—	dB
	2400 ... 2500	MHz		35	47	—	dB
	2500 ... 2690	MHz		35	47	—	dB
	3152 ... 3192	MHz		35	44	—	dB
	3550 ... 3700	MHz		35	44	—	dB
	5150 ... 5850	MHz		30	42	—	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]				
	758 ... 768	MHz		65	82	—	dB
	788 ... 798	MHz		65	77	—	dB
Minimum isolation			α_{min}				
	758 ... 768	MHz		63	79	—	dB
	788 ... 798	MHz		63	74	—	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)				
	758... 768	MHz		65	82	—	dB
	788... 798	MHz		65	77	—	dB
Minimum isolation			α_{min}				
	758... 768	MHz		63	79	—	dB
	788... 798	MHz		63	74	—	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	$\lvert V_{DC} \rvert$ 2) = 0 V (max.)	
ESD voltage		
	V_{ESD} 3) = 100 V (max.)	Machine model.
	V_{ESD} 4) = 100 V (max.)	Human body model.
Input power	P_{IN}	
@ TX port: 758 ... 768 MHz	31 dBm 5)	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.
@ RX port: 788 ... 798 MHz	27 dBm 5)	5 MHz LTE uplink signal (25 RB) for 100000 h @ 55 °C. P_{IN} average – 33 dBm peak. 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) 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 accelerated power durability simulations, and wear out models.

8 Transmission coefficients

8.1 TX – ANT

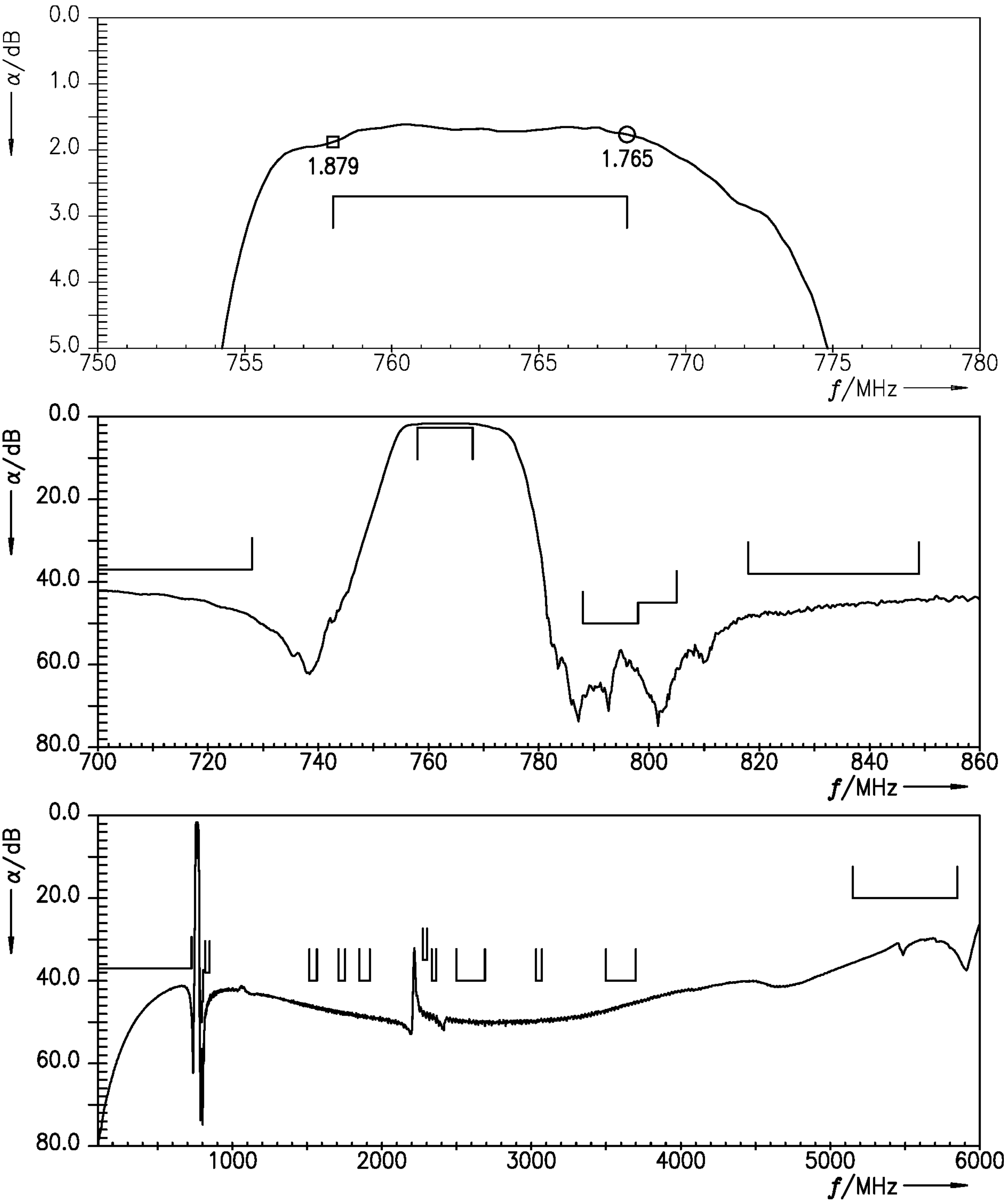


Figure 4: Attenuation TX – ANT.

8.2 ANT – RX

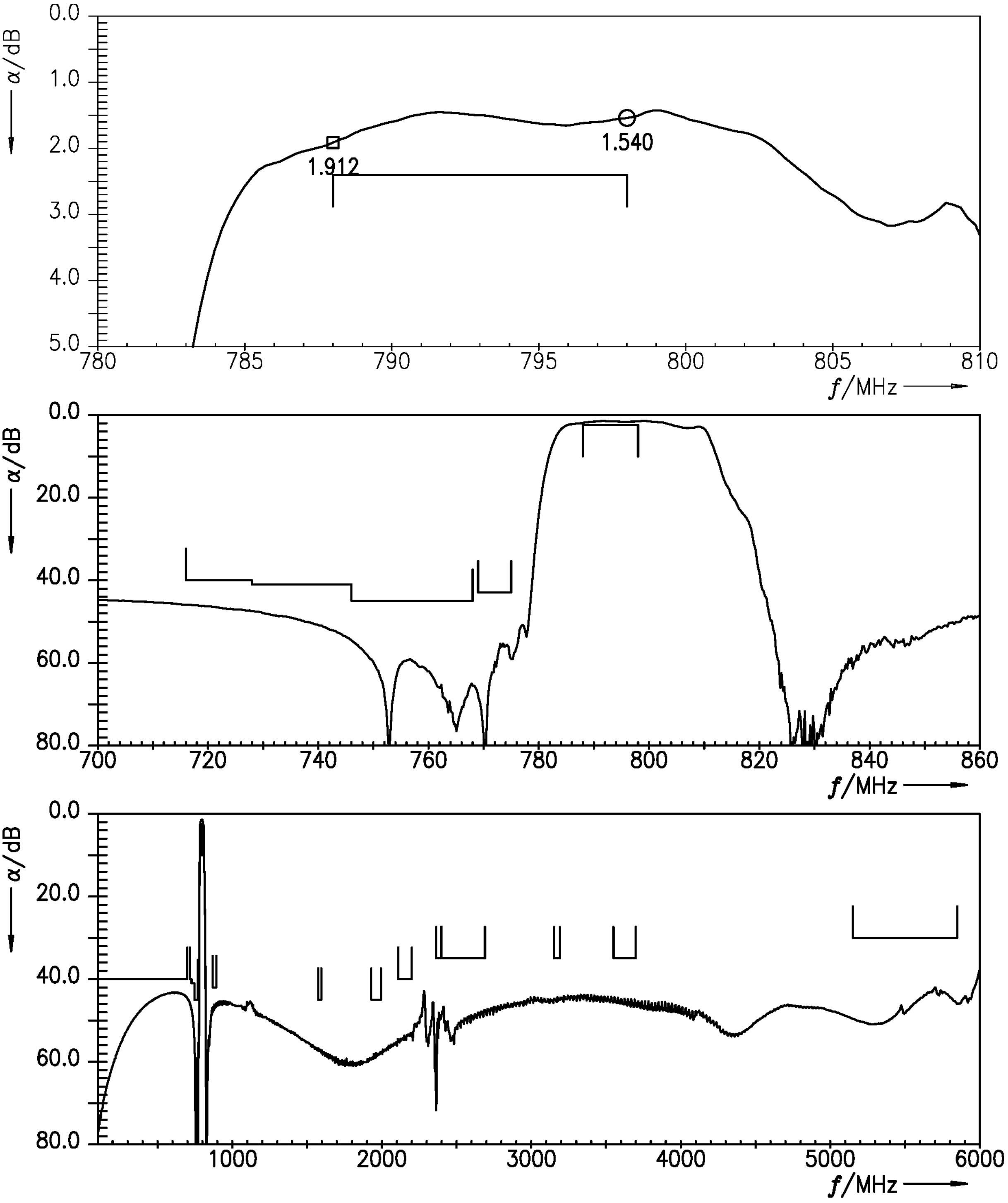


Figure 5: Attenuation ANT – RX.

8.3 TX – RX

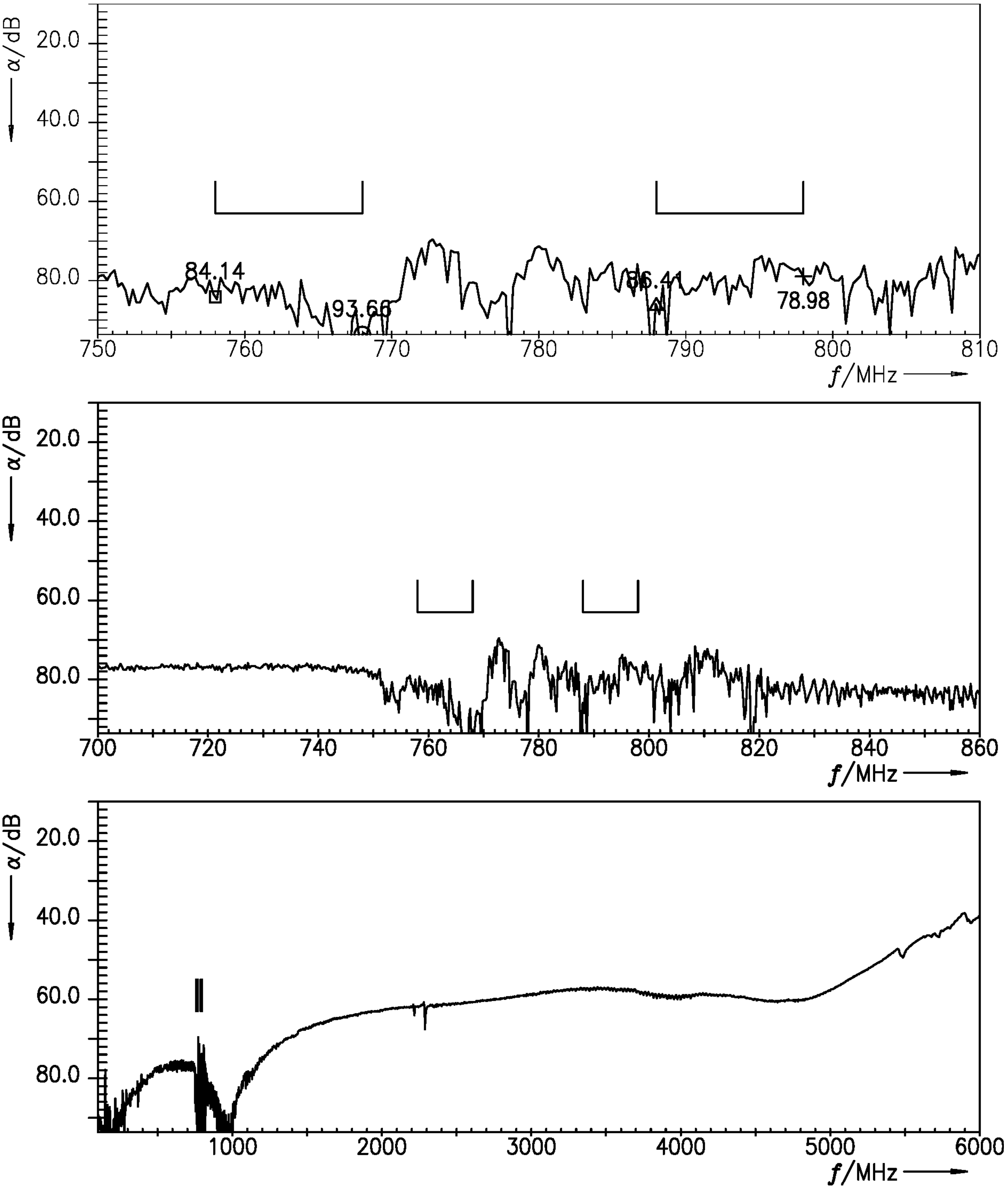


Figure 6: Isolation TX – RX.

9 Reflection coefficients

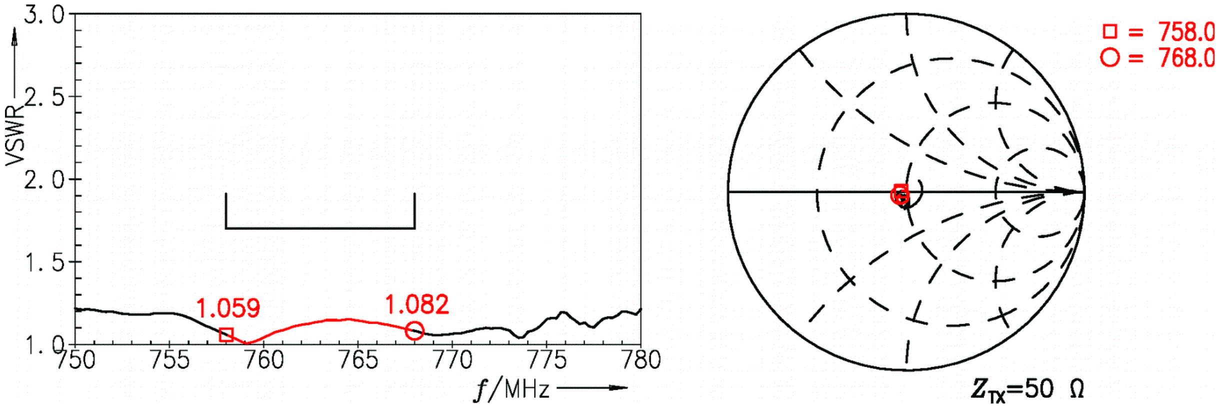


Figure 7: Reflection coefficient at TX port.

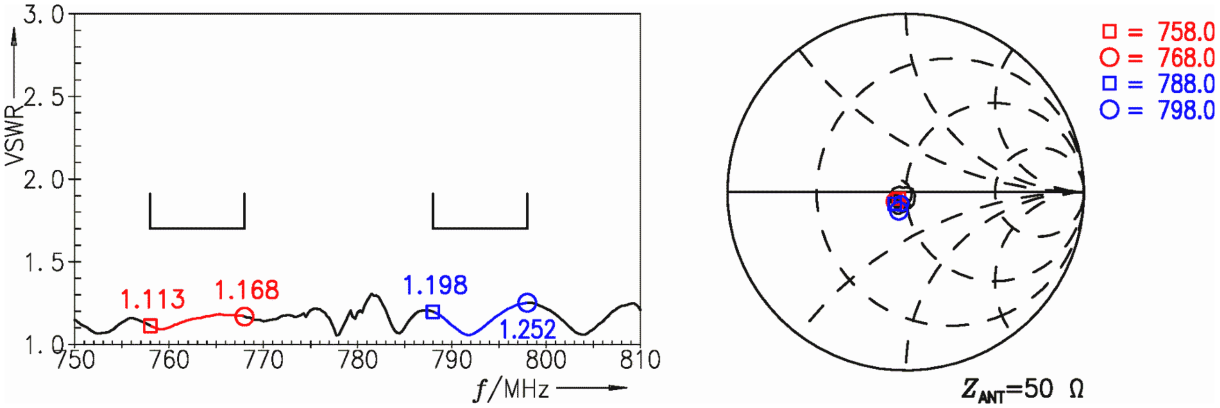


Figure 8: Reflection coefficient at ANT port.

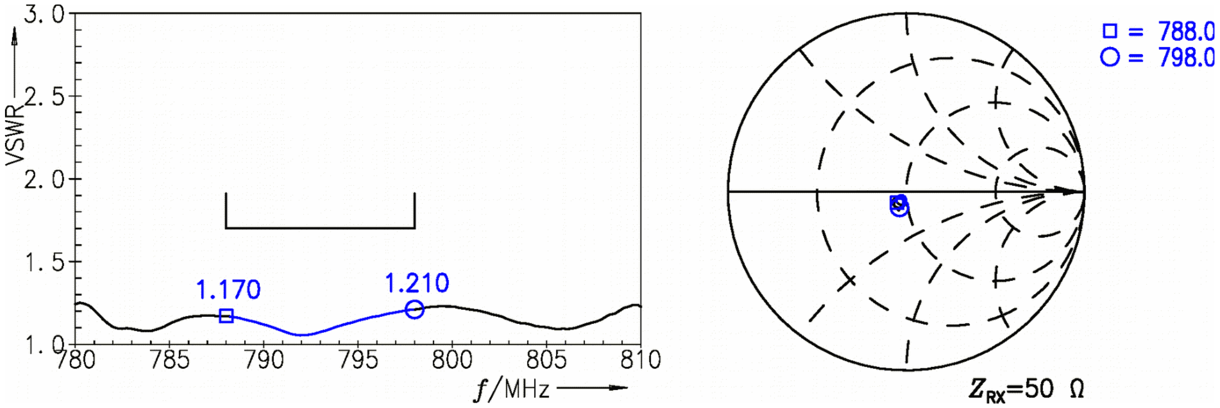


Figure 9: Reflection coefficient at RX port.

10 EVMs

10.1 TX – ANT

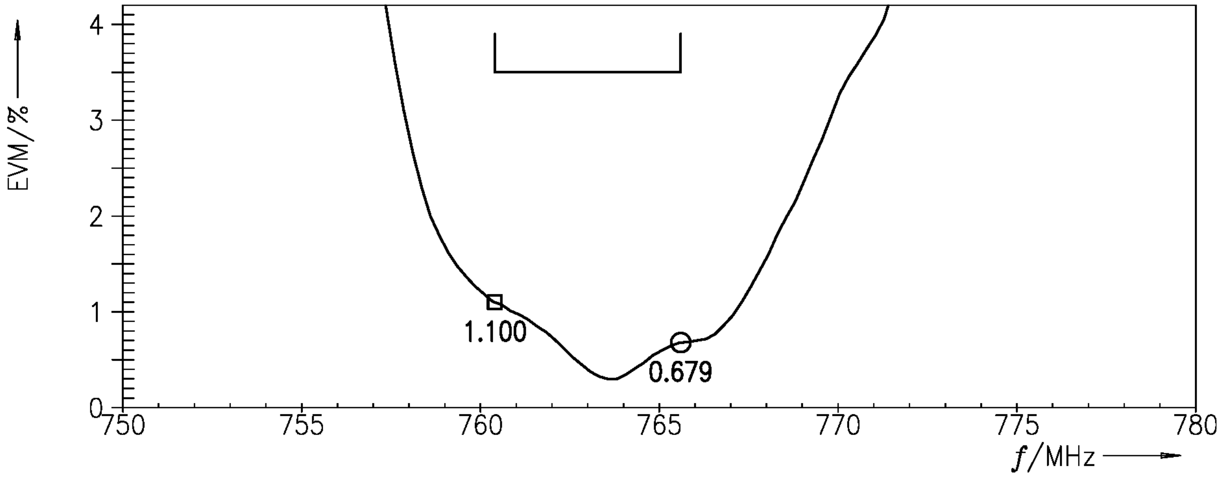


Figure 10: Error vector magnitude TX – ANT.

10.2 ANT – RX

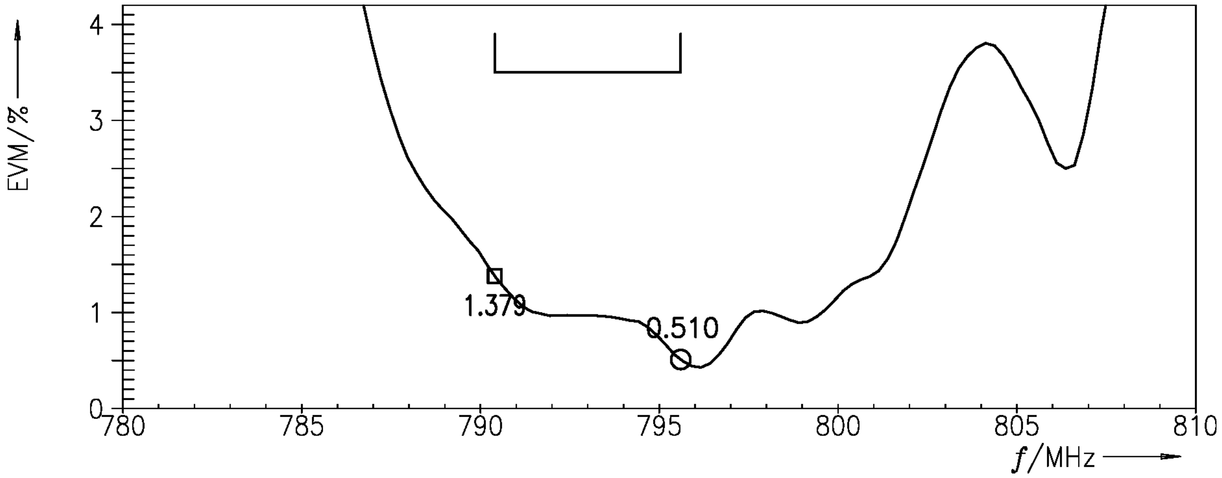


Figure 11: Error vector magnitude ANT – RX.

11 Packing material

11.1 Tape

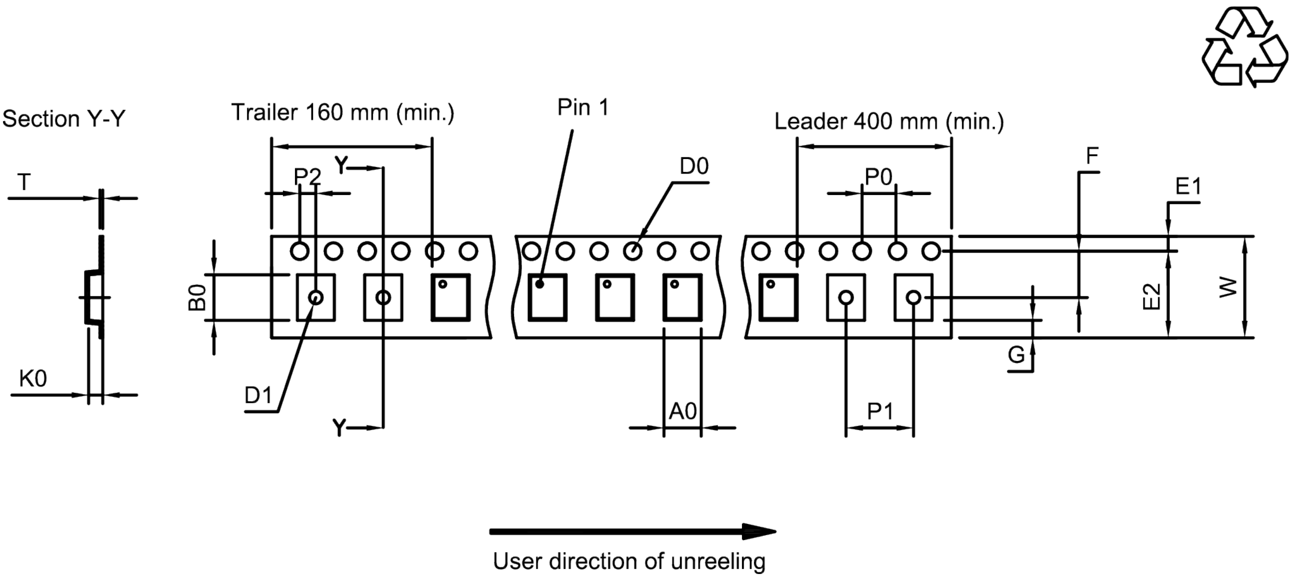
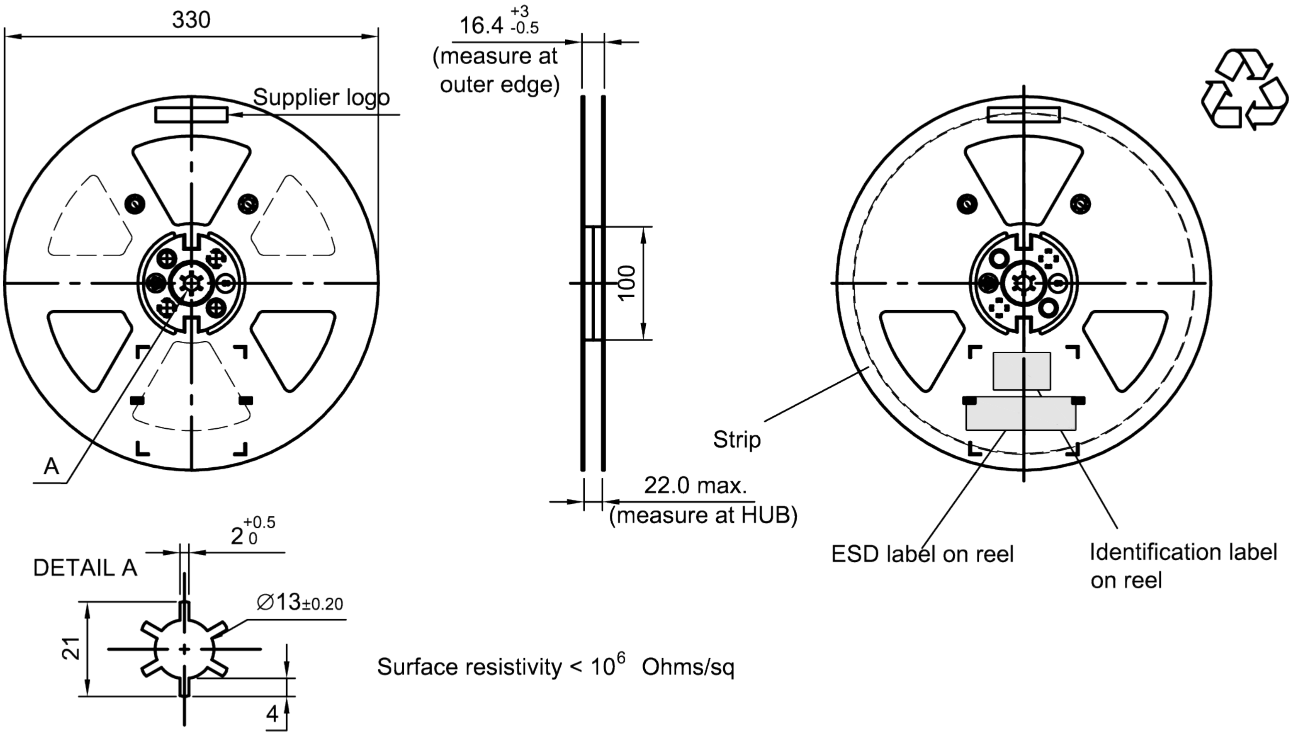


Figure 12: Drawing of tape (first-angle projection) for illustration only and not to scale. The valid tape dimensions are listed in Table 1.

A_0	8.4±0.05 mm	E_2	14.25 mm (min.)	P_1	12.0±0.1 mm
B_0	8.4±0.05 mm	F	7.5±0.1 mm	P_2	2.0±0.1 mm
D_0	1.5+0.1/−0 mm	G	0.75 mm (min.)	T	0.3±0.05 mm
D_1	1.5 mm (min.)	K_0	1.3±0.1 mm	W	16.0+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 330 mm



Surface resistivity < 10^6 Ohms/sq

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

Dimensions [mm]
X = 400+5
Y = 418+5
Sealing area 10±3

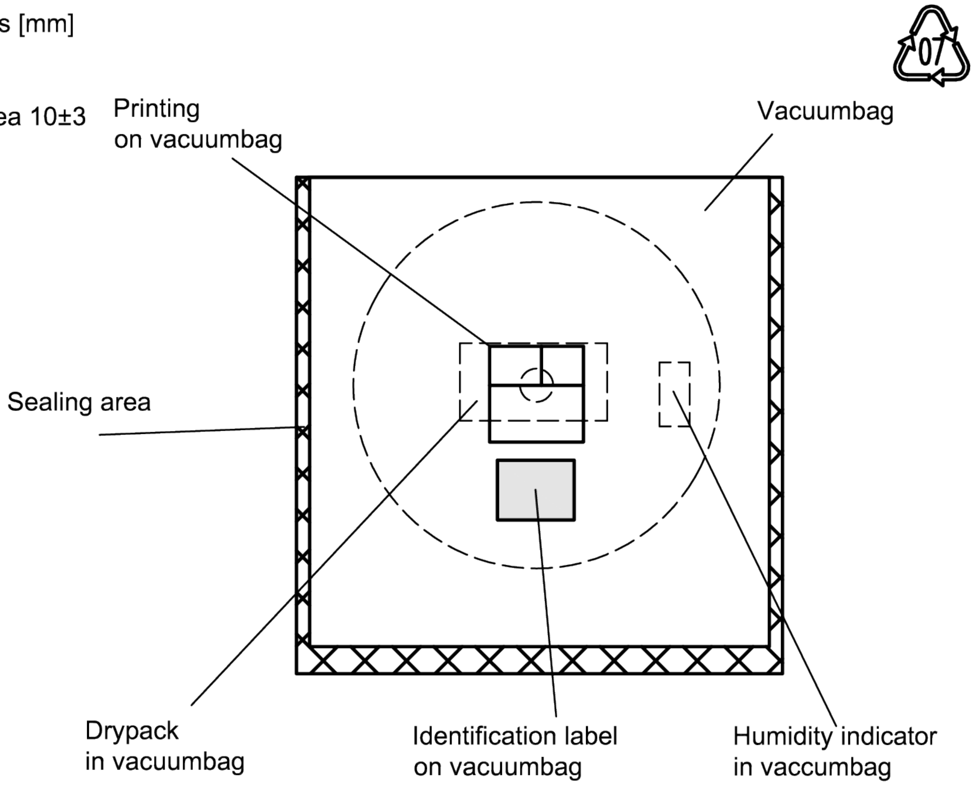


Figure 14: Drawing of moisture barrier bag (MBB) for reel with diameter of 330 mm.

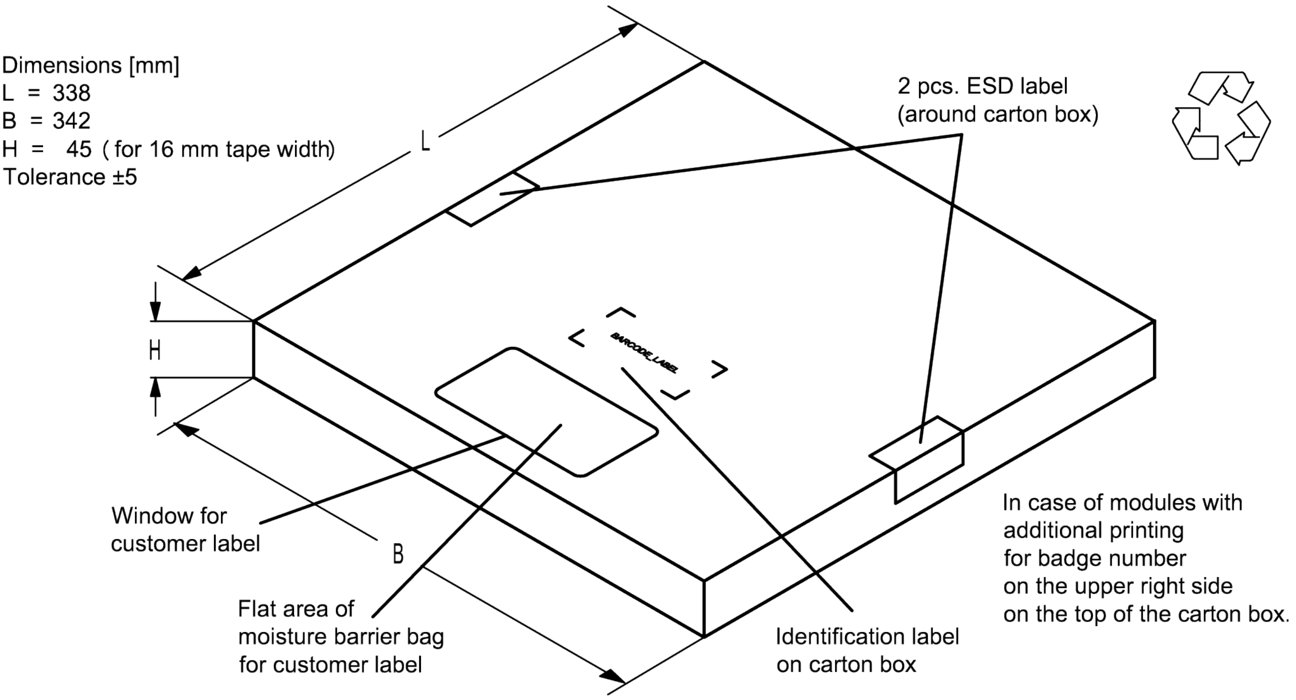


Figure 15: Drawing of folding box for reel with diameter of 330 mm.

12 Marking

Products are marked with tracking number (5 or 8 characters), type designator (5 characters), as well as production location and date code (4 characters). The marking corresponds to one of the following schemes:

XXXXX	5-character tracking number
XXXXX	5-character type designator
M5C6	1-character location code + 3-character date code (example)

Table 2: Marking for 5-character tracking number (standard).

XXXXXXXX	8-character tracking number
XXXXX	5-character type designator
M5C6	1-character location code + 3-character date code (example)

Table 3: Marking for 8-character tracking number.

??? XXXXXXXX	8-character tracking number
XXXXX	5-character type designator
M5C6	1-character location code + 3-character date code (example)

Table 4: Marking for 8-character tracking number with 4 lines.

- Tracking number: *t.b.d.*

- Type designator: The 5-character type designator of the ordering code is used for the marking.

  Example: B3xxxx**D1234**xxxx

- Production-location and date code: The production-location is encoded in the first character according to Table 5. The production date code is encoded in the last three characters according to Table 6.

Code:	M or no letter	J	C	H
Location:	Munich	Singapore	Wuxi	SAE, Hong Kong

Table 5: Production location code.

1st digit (day)						2nd digit (year)				3rd digit (month)			
Day	Code	Day	Code	Day	Code	Year	Code	Year	Code	Month	Code	Month	Code
1	1	11	A	21	M	2010	A	2022	P	Jan	1	Jul	7
2	2	12	B	22	N	2011	B	2023	R	Feb	2	Aug	8
3	3	13	C	23	P	2012	C	2024	S	Mar	3	Sep	9
4	4	14	D	24	R	2013	D	2025	T	Apr	4	Oct	0
5	5	15	E	25	S	2014	E	2026	U	May	5	Nov	N
6	6	16	F	26	T	2015	F	2027	V	Jun	6	Dec	D
7	7	17	H	27	U	2016	H	2028	W				
8	8	18	J	28	V	2017	J	2029	X				
9	9	19	K	29	W	2018	K	2030	Z				
10	0	20	L	30	X	2019	L	2031	A				
				31	Z	2020	M	2032	B				
						2021	N	and so on					

Table 6: Production date code.

Example of how to decode production location and date code:

Code: **M 5 C 6**

Location: M → Munich
Day: 5 → 5th
Year: C → 2012
Month: 6 → June

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 7: Characteristics of recommended soldering profile for lead-free solder (Sn95.5Ag3.8Cu0.7).

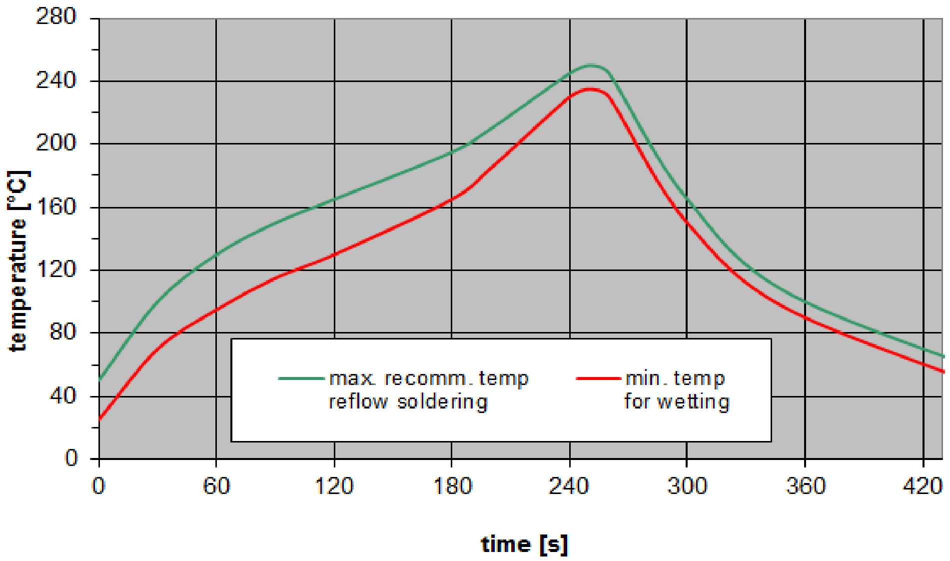


Figure 16: Recommended reflow profile for convection and infrared soldering – lead-free solder.

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.

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 www.rf360jv.com/orderingcodes.

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 Revision history

Changes compared to previously issued iteration.

Version	Detailed specification changes	Date
1.0	Initial release.	Apr 18, 2019

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 (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.