

## **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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#### 1 Application

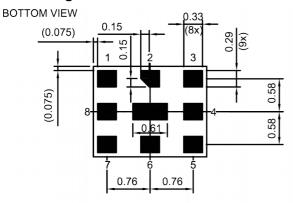
- Low-loss SAW triplexer for mobile telephone EN-DC 4G/5G Band 20 TX systems and combined B28ARX\_B20RX systems
- EN-DC 4G/5G band 20 uplink: 847 MHz (pass band 30 MHz)
- EN-DC 4G/5G bands 20 & 28a downlink: 789.5 MHz (pass band 63 MHz)
- Usable pass bands: 30 MHz for Band 28a and 30 MHz for Band 20
- Qualcomm® micro-Acoustic Power Management (MAPM)
- High out of band selectivity
- Low insertion attenuation
- Unbalanced to unbalanced operation
- Terminating impedances 50  $\Omega$

#### 2 Features

- Package size 2.0±0.05 mm × 1.6±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)



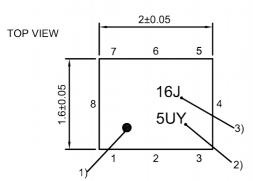
#### 3 Package



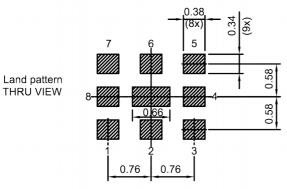
Pad and pitch tolerance ±0.05

SIDE VIEW





- 1) Marking for pad number 1
- 2) Example of encoded lot number
- 3) Example of encoded filter type number



Landing pad tolerance -0.02

**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)

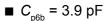
■ 2, 4, 5, 7, Ground 8, 9

Please read Cautions and warnings and Important notes at the end of this document.

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**Matching circuit** 



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5

■ 
$$L_{s3}$$
 = 5.2 nH

■ 
$$L_{p1}$$
 = 18.2 nH

■ 
$$L_{s6a}$$
 = 10.3 nH

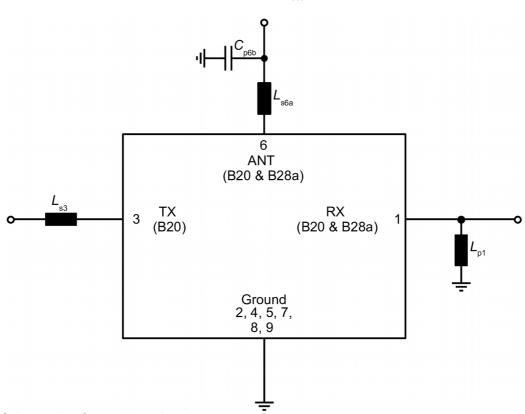


Figure 2: Schematic of matching circuit.

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



#### 6 Characteristics

#### 6.1 TX - ANT

Temperature range for specification  $T_{\text{SPEC}} = -30 \,^{\circ}\text{C} \dots + 85 \,^{\circ}\text{C}$ TX terminating impedance  $Z_{\text{TX}} = 50 \, \Omega + 5.2 \, \text{nH}^{1)}$ 

ANT terminating impedance  $Z_{ANT} = 50 \Omega$  with ext. circuitry.<sup>1)</sup> RX terminating impedance  $Z_{PX} = 50 \Omega$  // 18.2 nH<sup>1)</sup>

Characteristics TX – ANT				$\begin{array}{c} \text{min.} \\ \text{for } T_{\text{SPEC}} \end{array}$	<b>typ.</b> @ +25 °C	$\begin{array}{c} \text{max.} \\ \text{for } T_{\text{\tiny SPEC}} \end{array}$	
Center frequency			f <sub>C</sub>	_	847	_	MHz
Maximum insertion attenuation			$\alpha_{\text{INT,max}}^{\qquad 2)}$				
	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			$\boldsymbol{\alpha}_{\text{min}}$				
	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

<sup>1)</sup> See Sec. Matching circuit (p. 6).

Integrated attenuation  $\alpha_{\text{INT}}$ : Averaged power  $|S_{ii}|^2$  over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.

<sup>3)</sup> Over any 5 MHz.



## 6.2 ANT – RX

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 $\begin{array}{lll} \mbox{Temperature range for specification} & T_{\mbox{SPEC}} & = -30~{\rm ^{\circ}C}~...~+85~{\rm ^{\circ}C} \\ \mbox{TX terminating impedance} & Z_{\mbox{TX}} & = 50~\Omega~+5.2~{\rm nH^{1)}} \\ \mbox{ANT terminating impedance} & Z_{\mbox{ANT}} & = 50~\Omega~{\rm with~ext.~circuitry.^{1)}} \\ \mbox{RX terminating impedance} & Z_{\mbox{RX}} & = 50~\Omega~{\rm //~18.2~nH^{1)}} \\ \end{array}$ 

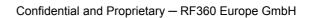
Characteristics ANT – RX				$\begin{array}{c} \textbf{min.} \\ \textbf{for } T_{\texttt{SPEC}} \end{array}$	<b>typ.</b> @ +25 °C	$\begin{array}{c} \text{max.} \\ \text{for } T_{\text{SPEC}} \end{array}$	
Center frequency			f <sub>C</sub>				
			· ·	_	806	_	MHz
				_	773	_	MHz
Maximum insertion attenuation							
	758 788	MHz	$\alpha_{\text{INT,max}}^{\qquad 2)}$	_	1.3	2.8	dB
	758 821	MHz	$\alpha_{\text{INT,max}}^{ 3)}$	_	1.8	2.44)	dB
	791 821	MHz	$\alpha_{\text{INT,max}}^{ 3)}$	_	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	$\boldsymbol{\alpha}_{min}$	30	40	_	dB
	41 65	MHz	$\boldsymbol{\alpha}_{\text{min}}$	50	70	_	dB
	703 733	MHz	$\alpha_{_{min}}$	45	48	_	dB
	733 748	MHz	$\alpha_{_{min}}$	5	12	_	dB
	832 862	MHz	$\boldsymbol{\alpha}_{\text{min}}$	45	59	_	dB
	832 862	MHz	$\alpha_{\text{INT,min}}^{3)}$	45	60	_	dB
	880 915	MHz	$\alpha_{_{min}}$	30	38	_	dB
	1516 1683	MHz	$\alpha_{_{min}}$	40	48	_	dB
	1710 1990	MHz	$\alpha_{min}$		59	_	dB
	2274 2463	MHz	$\alpha_{_{\min}}$	50	66	_	dB
	2400 2500	MHz	α <sub>min</sub>	50	72	_	dB
	2500 2690	MHz	$\alpha_{\min}$	50	70	_	dB
	3300 3800	MHz	$\alpha_{\min}$	50	64	_	dB
	3800 5950	MHz	$\alpha_{\min}$	40	53	_	dB

See Sec. Matching circuit (p. 6).

Integrated attenuation  $\alpha_{\text{INT}}$ : Averaged power  $|S_{ii}|^2$  over the center 2.7 MHz of LTE 3 MHz (15 RB) channels.

Integrated attenuation  $\alpha_{\text{INT}}^{(3)}$ : Averaged power  $|S_{ij}^{(2)}|^2$  over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.

Valid for typical temperature  $T = +25 \,^{\circ}$ C.





- <sup>5)</sup> Over any 3 MHz.
- 6) Over any 5 MHz.





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#### 6.3 TX - RX

Temperature range for specification = -30 °C ... +85 °C  $T_{\text{SPEC}}$ TX terminating impedance =  $50 \Omega + 5.2 \text{ nH}^{1)}$ ANT terminating impedance = 50  $\Omega$  with ext. circuitry.<sup>1)</sup> RX terminating impedance = 50  $\Omega$  // 18.2 nH<sup>1)</sup>

Characteristics TX – RX					<b>typ.</b> @ +25 °C	$\begin{array}{c} \text{max.} \\ \text{for } T_{\text{SPEC}} \end{array}$	
Minimum isolation			α <sub>INT,min</sub> <sup>2)</sup>				
	791 821	MHz		55	59	_	dB
	832 862	MHz		55	63	_	dB

See Sec. Matching circuit (p. 6).

Integrated attenuation  $\alpha_{\text{INT}}$ : Averaged power  $|S_{\parallel}|^2$  over the center 4.5 MHz of LTE 5 MHz (25 RB) channels.



#### 7 Maximum ratings

Operable temperature	T <sub>OP</sub> = −30 °C +85 °C	
Storage temperature	$T_{\rm STG}^{1)} = -40 ^{\circ}\text{C} \dots +85 ^{\circ}\text{C}$	
DC voltage	$ V_{DC}  = 5.0 \text{ V (max.)}$	
ESD voltage		
	$V_{\rm ESD}^{2)} = 500  \rm V  (max.)$	Human body model.
	$V_{\rm ESD}^{3)} = 700  \rm V  (max.)$	Charged device model.
	V <sub>ESD</sub> <sup>4)</sup> = 200 V (max.)	Machine model.
Input power	P <sub>IN</sub>	
@ 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.

Not valid for packaging material. Storage temperature for packaging material is −25 °C to +40 °C.

<sup>&</sup>lt;sup>2)</sup> According to JESD22-A114F (HBM – Human Body Model), 1 negative & 1 positive pulse.

<sup>3)</sup> According to JESD22-C101C (CDM – Field Induced Charged Device Model), 3 negative & 3 positive pulses.

<sup>&</sup>lt;sup>4)</sup> According to JESD22-A115B (MM – Machine Model), 10 negative & 10 positive pulses.



## 8 Transmission coefficients

## 8.1 TX - ANT 0.0 1.0 1.110 2.0 **.**660 3.0 4.0 5.0 830 840 860 880 820 850 870 $\widetilde{f}/\mathsf{MHz}$ 0.0 20.0 40.0 60.0 80.0 900 800 840 860 820 880 f/MHz 0.0 20.0 40.0 60.0 0.08 1000 2000 3000 4000 5000 6000 f/MHz

Figure 3: Attenuation TX – ANT.



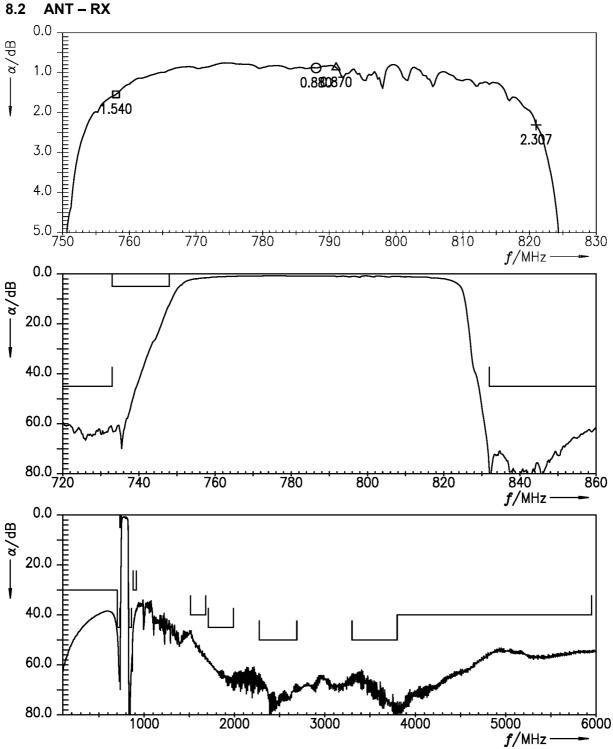


Figure 4: Attenuation ANT – RX.



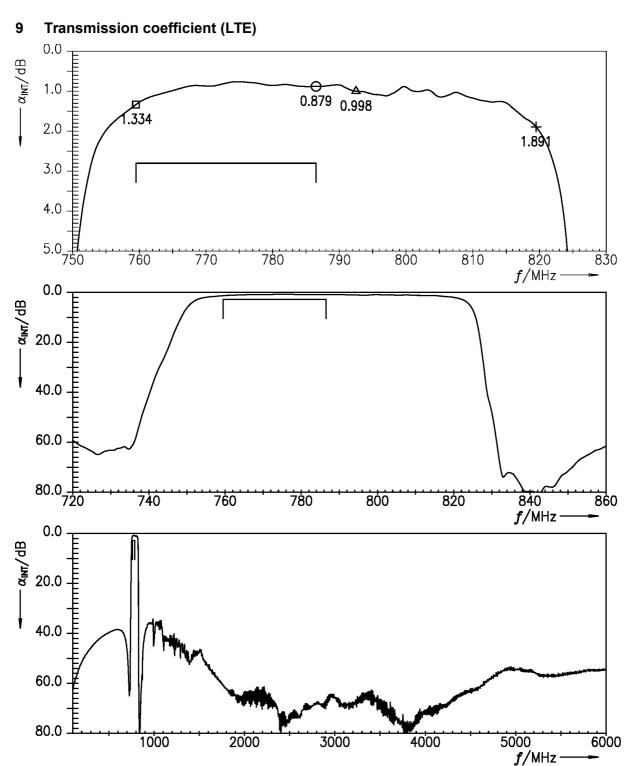


Figure 5: Attenuation (LTE) (integration window = 3 MHz) ANT – RX.



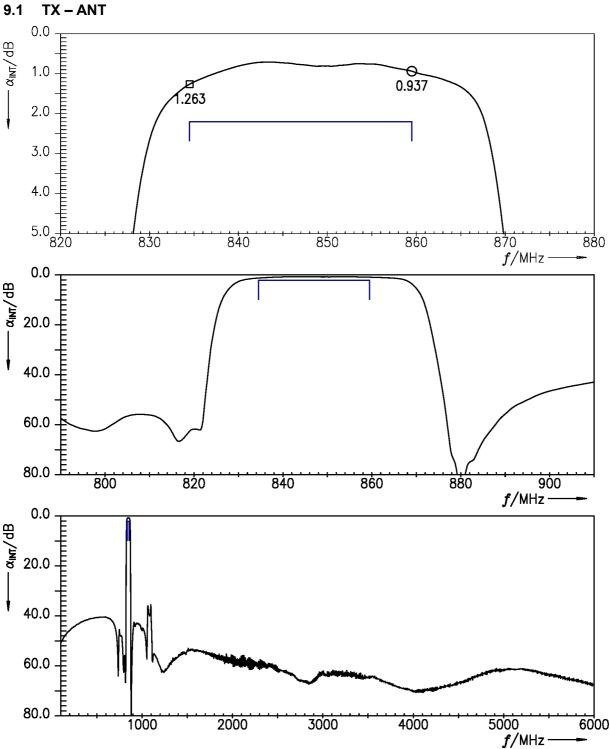


Figure 6: Attenuation (LTE) (integration window = 5 MHz) TX – ANT.



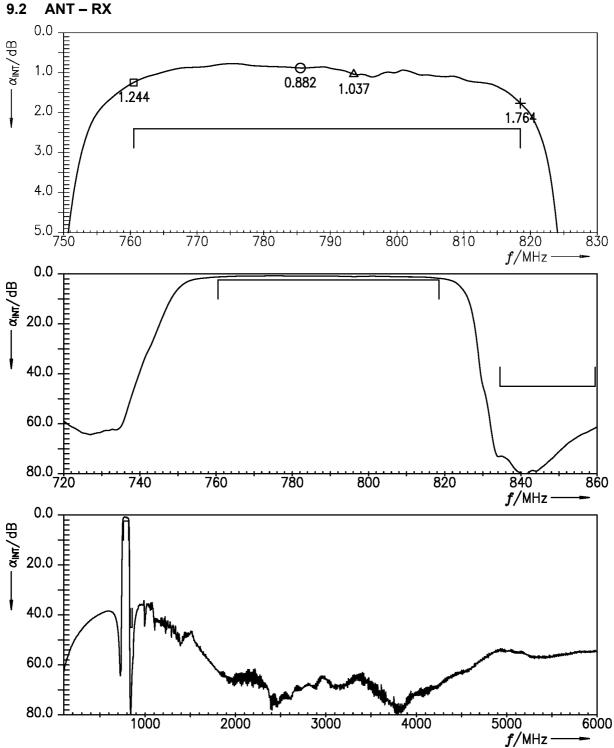


Figure 7: Attenuation (LTE) (integration window = 5 MHz) ANT – RX.



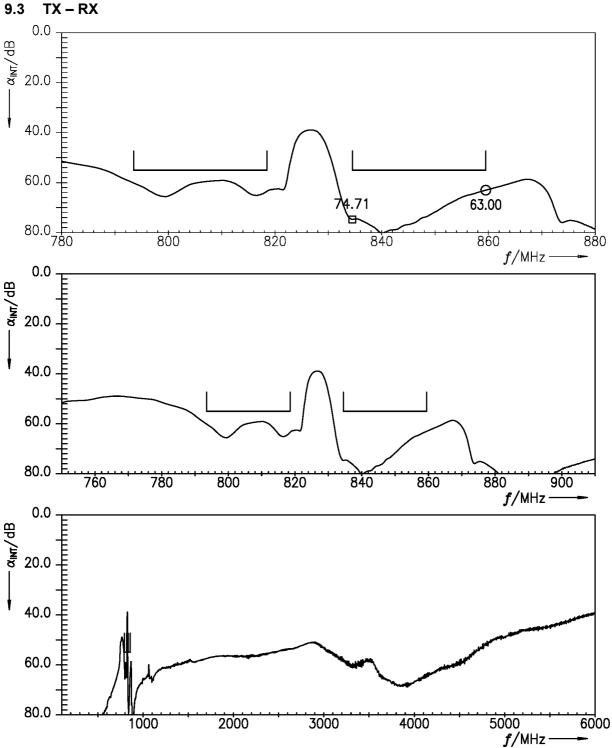
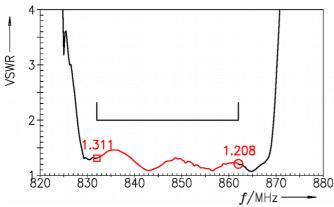


Figure 8: Isolation (LTE) (integration window = 5 MHz) TX – RX.



#### 10 Reflection coefficients



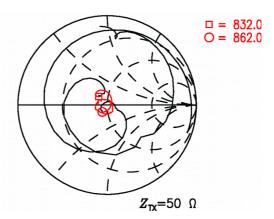
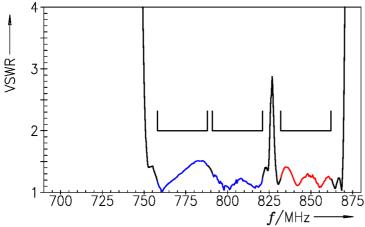


Figure 9: Reflection coefficient at TX port.



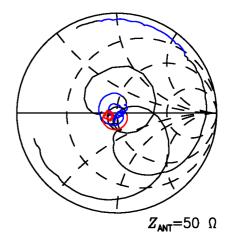
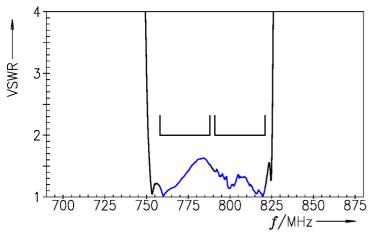


Figure 10: Reflection coefficient at ANT port.



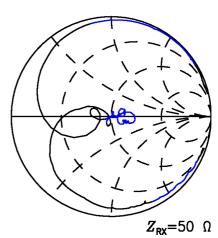


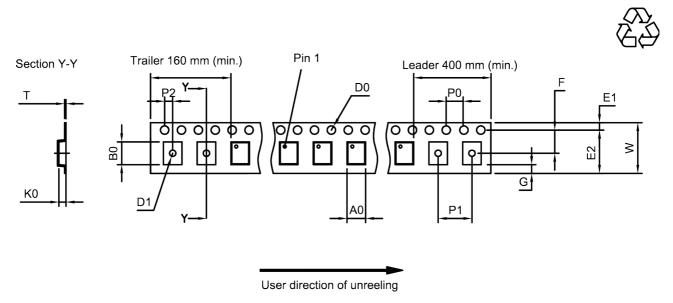
Figure 11: Reflection coefficient at RX port.



## 11 Packing material

#### 11.1 Tape

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**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 <sub>0</sub>	1.8±0.05 mm	E <sub>2</sub>	6.25 mm (min.)	P <sub>1</sub>	4.0±0.1 mm
B <sub>0</sub>	2.2±0.05 mm	F	3.5±0.05 mm	 P <sub>2</sub>	2.0±0.05 mm
D <sub>0</sub>	1.5+0.1/-0 mm	G	0.75 mm (min.)	Т	0.25±0.03 mm
D <sub>1</sub>	1.0+0.1/-0 mm	K <sub>0</sub>	0.8±0.05 mm	W	8.0+0.3/-0.1 mm
E <sub>1</sub>	1.75 <sub>±0.1</sub> mm	P <sub>0</sub>	4.0±0.1 mm		

Table 1: Tape dimensions.



#### 11.2 Reel with diameter of 180 mm

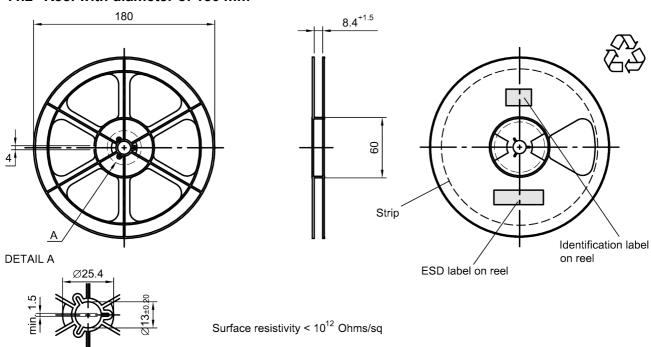


Figure 13: Drawing of reel (first-angle projection) with diameter of 180 mm.

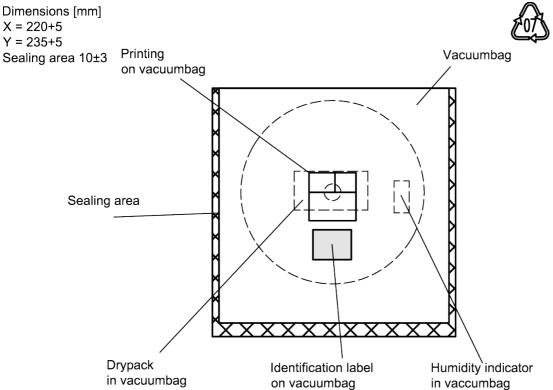


Figure 14: Drawing of moisture barrier bag (MBB) for reel with diameter of 180 mm.



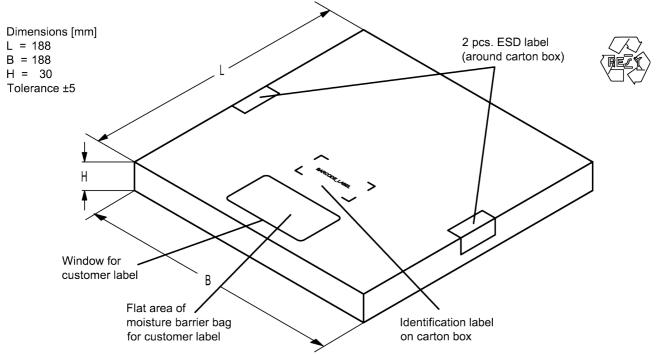
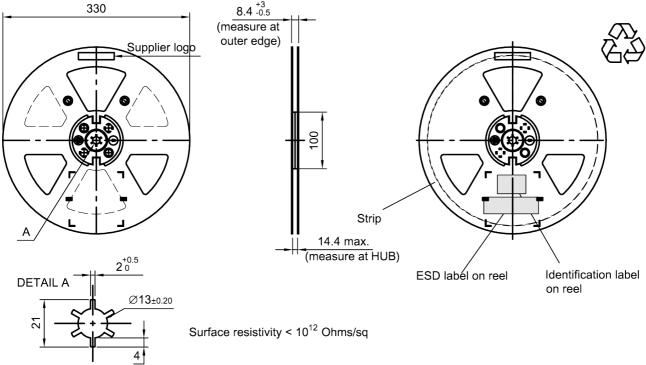


Figure 15: Drawing of folding box for reel with diameter of 180 mm.

#### 11.3 Reel with diameter of 330 mm



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



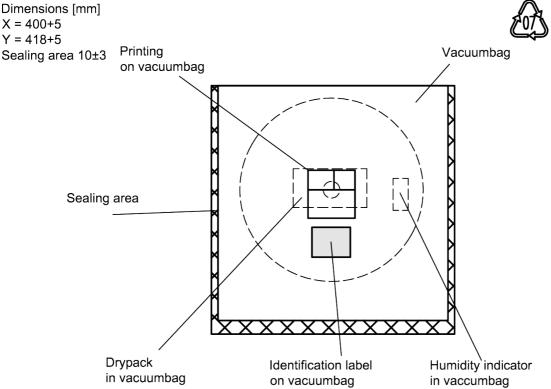


Figure 17: Drawing of moisture barrier bag (MBB) for reel with diameter of 330 mm.

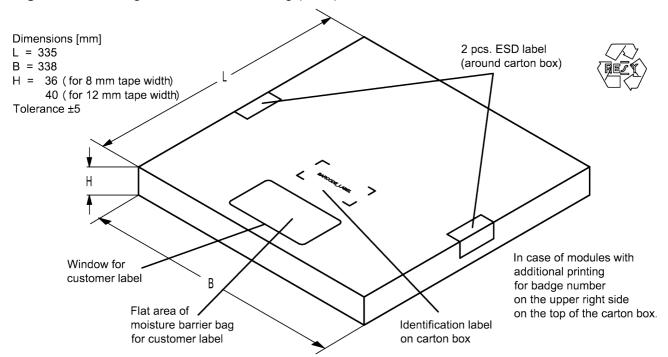


Figure 18: Drawing of folding box for reel with diameter of 330 mm.



#### 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., 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  $5 \times 47^2 + 27 (=U) \times 47^1 + 31 (=Y) \times 47^0 =$  12345

Adopted BASE32 code for type number				
Decimal	Base32	Decimal	Base32	
value	code	value	code	
0	0	16	G	
1	1	17	Н	
2	2	18	J	
3	3	19	K	
4	4	20	M	
5	5	21	N	
6	6	22	Р	
7	7	23	Q	
8	8	24	R	
9	9	25	S	
10	Α	26	Т	
11	В	27	V	
12	С	28	W	
13	D	29	X	
14	E	30	Y	
15	F	31	Z	

Adopted BASE47 code for lot number					
Decimal	Base47	Decimal	Base47		
value	code	value	code		
0	0	24	R		
1	1	25	S		
2	2	26	Т		
3	3	27	U		
4	4	28	V		
5	5	29	W		
6	6	30	Х		
7	7	31	Y		
8	8	32	Z		
9	9	33	b		
10	Α	34	d		
11	В	35	f		
12	С	36	h		
13	D	37	n		
14	E	38	r		
15	F	39	t		
16	G	40	V		
17	Н	41	\		
18	J	42	?		
19	K	43	{		
20	L	44	}		
21	М	45	<		
22	N	46	>		
23	Р				

**Table 2:** Lists for encoding and decoding of marking.

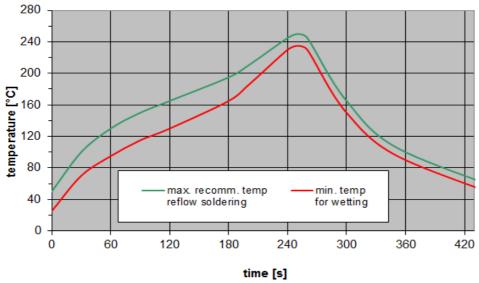


#### 13 Soldering profile

The recommended soldering process is in accordance with IEC  $60068-2-58-3^{rd}$  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
<i>T</i> ≥ 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 <i>T</i>	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 <a href="https://rffe.gualcomm.com/">https://rffe.gualcomm.com/</a>.

#### 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.
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