

## TECHNICAL REFERENCE

### Antenna Switch and Amplifier RBD121



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## CHAPTER 1

# GENERAL INFORMATION

This chapter provides general notes for the manual and Antenna Switch and Amplifier RBD121.

## About This Manual

This manual provides information for Switching Unit/Low Noise Amplifier RBD121.

## Contents of This Manual

This manual consists of the following chapters:

- Chapter 1, General Information, provides general notes for the manual and Antenna Switch and Amplifier RBD121.
- Chapter 2, Product Overview, introduces the features, advantages, and the product nomenclature.
- Chapter 3, Functional Description, describes the functionality of RBD121.
- Chapter 4, Operation, contains information that is needed to operate this product.
- Chapter 5, Technical data, provides the technical data for RBD121.
- Chapter 6, Parts List, provides the parts list for RBD121.
- Chapter 7, Troubleshooting, provides contact information for technical support.

## Version Information

**Table 1      Manual Revisions**

Manual Code	Description
M210723EN-B	September 2010. New template.
M210723EN-A	August 2005.

## Documentation Conventions

Throughout the manual, important safety considerations are highlighted as follows:

### **WARNING**

Warning alerts you to a serious hazard. If you do not read and follow instructions very carefully at this point, there is a risk of injury or even death.

### **CAUTION**

Caution warns you of a potential hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.

### **NOTE**

Note highlights important information on using the product.

## Safety

Antenna Amplifier and Switch RBD121 delivered to you has been tested for safety and approved as shipped from the factory. Note the following precautions:

### **WARNING**

Ground the product and verify outdoor installation grounding periodically to minimize shock hazard.

### **CAUTION**

Do not modify the unit. Improper modification can damage the product or lead to malfunction.

## ESD Protection

Electrostatic Discharge (ESD) can cause immediate or latent damage to electronic circuits. Vaisala products are adequately protected against ESD for their intended use. It is possible to damage the product, however, by delivering electrostatic discharges when touching, removing, or inserting any objects inside the equipment housing.

To make sure you are not delivering high static voltages yourself:

- Handle ESD sensitive components on a properly grounded and protected ESD workbench.
- When an ESD workbench is not available, ground yourself to the equipment chassis with a wrist strap and a resistive connection cord.
- If you are unable to take either of the above precautions, touch a conductive part of the equipment chassis with your other hand before touching ESD sensitive components.
- Always hold component boards by the edges and avoid touching the component contacts.

## Recycling



Recycle all applicable material.



Dispose of batteries and the unit according to statutory regulations. Do not dispose of with regular household refuse.

## Regulatory Compliances

Antenna Amplifier and Switch RBD121 complies with the following performance and environmental test standards:



## Trademarks

DigiCORA® and MARWIN® are registered trademarks of Vaisala Oyj.

Windows® is a registered trademark of Microsoft Corporation in the United States and/or other countries.

## Warranty

For certain products Vaisala normally gives a limited one-year warranty. Visit our Internet pages for more information and our standard warranty terms and conditions: [www.vaisala.com/services/warranty.html](http://www.vaisala.com/services/warranty.html).

Please observe that any such warranty may not be valid in case of damage due to normal wear and tear, exceptional operating conditions, negligent handling or installation, or unauthorized modifications. Please see the applicable supply contract or Conditions of Sale for details of the warranty for each product.



## CHAPTER 2

# PRODUCT OVERVIEW

This chapter introduces the features, advantages, and the product nomenclature.

### General

The RBD121 Switching Unit / Low Noise Amplifier is used in 400 MHz radiosonde antenna systems as an antenna selector and preamplifier.

The unit has seven inputs for 400 MHz antenna elements. Typical setup of antennas consists of an omnidirectional antenna and six directional antennas providing long range reception of the radiosonde signal.

The antenna input is selectable either automatically or manually.

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## CHAPTER 3

# FUNCTIONAL DESCRIPTION

This chapter describes the functionality of RBD121.

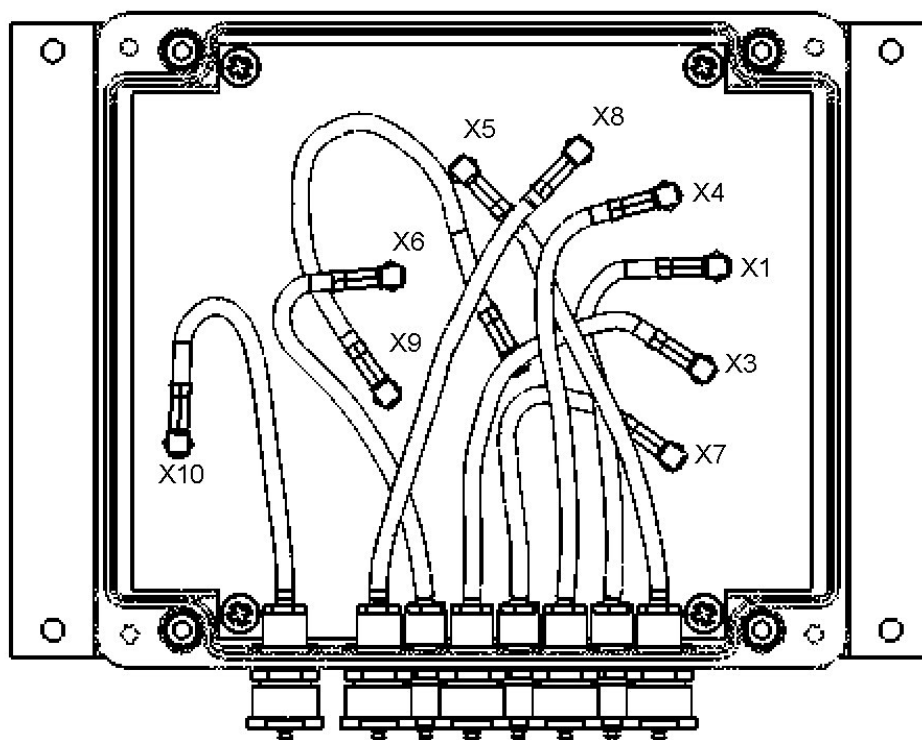
### General

Inside the unit box there is a component board, which consists of a diode switch and an antenna amplifier .

The switching unit has eight coaxial connectors. They are marked with OUT, NW, N, NE, SE, S, SW, and 90°.

On the PC board of RBD121, the connected cables are marked X1(90°), X7(SW), X6(S), X5(SE), X4(NE), X3(N), X8(NW), X10 (OUT) coming from the corresponding terminals at the outer edge of the box.

Figure 1 on page 10 shows the contents of an RBD121 unit box. Cabling and component layout can be seen in this figure.



**Figure 1**      **Cabling of RBD121 Unit Box**

## Diode Switch

The pin diodes V9 - V16 function as switching components of the diode switch. The diodes receive their control voltage from the switching transistors V1 - V8. When one of the transistors is driven to the ON state, current flows through the diode and its resistance is low and RF signal is connected to the connector X2 (output of the switch) from the corresponding antenna terminal X1 and X3- X8. For the purpose of clarity, the antenna terminals are also marked with cardinal points of the compass.

The control signals of the diodes and DC operating voltage are fed to the RBD121 unit through a coaxial antenna cable connected to OUTPUT. They are separated from the RF signal with inductor L5.

The transistors that control the diodes are connected to the outputs of the decade counter D1. The desired switch branch can be set to the ON state by controlling the counter contents. The counter is controlled with short interruptions in the DC supply voltage. A longer interruption (250 $\mu$ s) resets the counter and a shorter one (50  $\mu$ s) advances the counter.

Falling DC voltage triggers the monostable multivibrator D2-A. The output of D2-A controls the D2-B monostable component to the reset state for 200  $\mu$ s. Rising DC voltage advances counter D1. Rising DC

also controls monostable D2-B but if the duration of the interruption is less than 200  $\mu\text{s}$ , the D2-B output remains at the 0 state forced by D2-A. If the interruption exceeds 200  $\mu\text{s}$ , D2-A trigger is allowed and its output generates a reset pulse for counter D1.

The counter positions 0–6 control the corresponding antenna switch positions UP–NW. Counter position 7 controls the switch diode V16. The noise diode V18 is connected to this switch branch. The noise diode also receives current when the transistor V8 is conductive. The noise signal generated by the diode is used to test the LNA.

When activating the input voltage, the switch's 90° branch is set to the ON state. During power-up, capacitor C7 delays the rising of the amplifier A2's input voltage, causing a reset pulse to be sent to D1.

## Low Noise Amplifier

Together with the diode switch, the same PCB also has a low noise balanced amplifier made of PHEM transistors.

The DC supply (+12 V) required by the amplifier and the diode switch comes from the UHF receiver through a coaxial antenna cable.

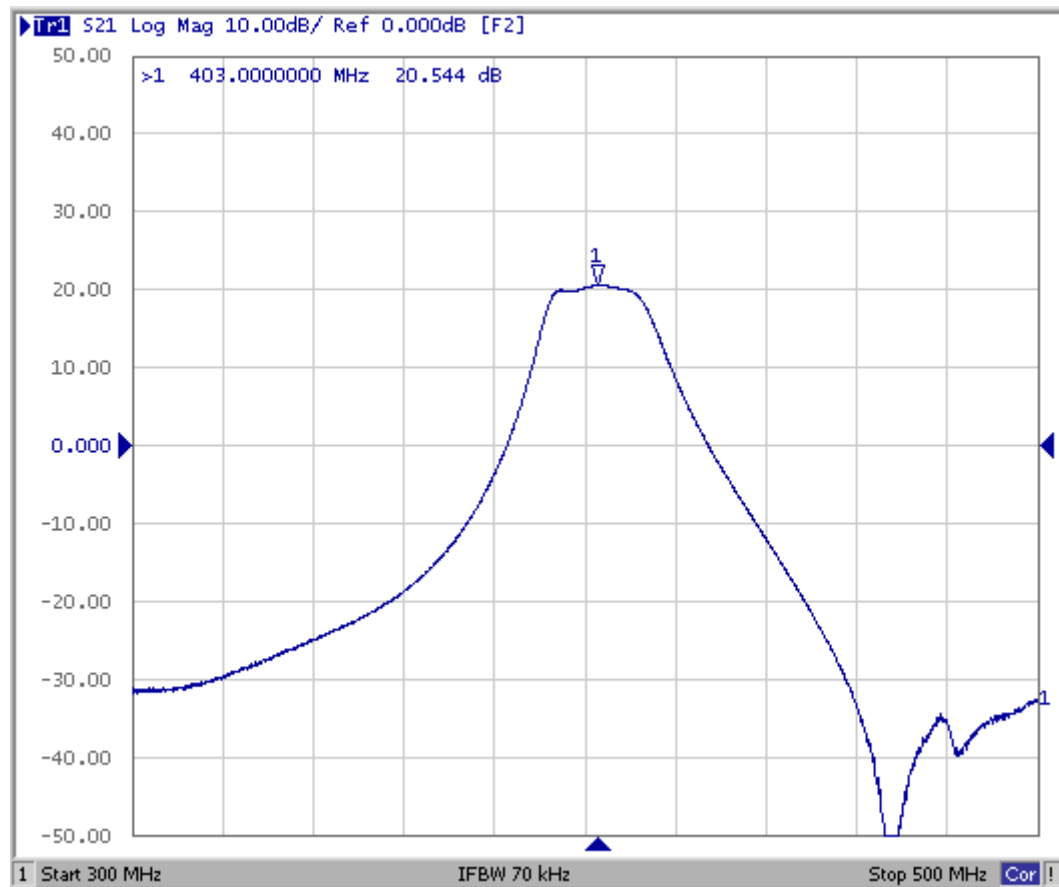
## Circuit Description

The balanced amplifier has two identical amplifier branches. The diode switch is used to bring the RF signal to the hybrid coupler A3 through a tri-state, ceramic coaxial band-pass filter Z1 tuned to the center frequency of 403 MHz. The hybrid coupler A3 splits the signal into two identical amplifier branches. (Below, references only to components of one branch.) The capacitor C39 connects the signal from the hybrid via matching inductor L14 and the microstrip to gate of the PHEM transistor V24. On transistor V17, the regulated bias voltage is taken to the gate through inductor L13. Coil L15 and the PCB-integrated capacitor connected serially with it form a feed-back connection, which compensates for the amplifier's harmonic signals. Resistor R45, capacitor C41 and the microstrip stub on the V24 drain stabilise the amplifier. The V24 current (60mA) goes through resistor R44. The voltage loss generated in the resistor controls the PHEM transistor's gate bias voltage regulator transistor V17, thus maintaining constant current. Diode V19 is used to compensate for the temperature dependence of transistor V17's emitter base voltage. Hybrid coupler A4 is used to combine the signals from the amplifier branches.

The +12VDC input from the receiver via the coaxial cable is taken through inductor L17 to voltage regulator A1, which generates a +7V

operating voltage for the LNA and the diode switch. Diode V20 separates capacitor C3 from the +12V input so that the voltage in input of amplifier A2-A is dropped during a voltage interruption generated for controlling the diode switch.

Figure 2 below shows a common frequency response curve measured of the RBD121.



**Figure 2**      **Frequency Response Curve of RBD121**

## CHAPTER 4

# OPERATION

This chapter contains information that is needed to operate this product.

### General

Antenna Amplifier and Switch RBD121 can be used in conjunction with Vaisala DigiCORA® Sounding System equipped with Vaisala Sounding Processing Subsystem SPS311, and with Vaisala MARWIN Sounding System MW32.

### Operation Modes

With RBD121 on, the antenna system is operated either automatically or manually. Refer to the appropriate sounding system User's Guide for details on manual and automatic operation modes.

In the automatic mode the antenna element giving the highest signal strength is connected for reception. The selection of the antenna element does not disturb the sounding.

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## CHAPTER 5

# TECHNICAL DATA

This chapter provides the technical data for RDB121.

## Specifications

**Table 2      RBD121 Specifications**

<b>Property</b>	<b>Description / Value</b>
Frequency range	400 - 406 MHz SWR 1.5 max
Noise figure	2 dB max
Gain	20 dB typical
Output impedance	50 $\Omega$ nominal
Power input	DC through RF cable +10..+12 V / 130mA typical
Connectors	Coaxial N-type female
Temperature range	-40 to +55 °C

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## CHAPTER 6

# PARTS LIST

This chapter provides the parts list for RBD121.

**Table 3      Antenna Switching and LNA Unit RBD121**

Ref.	Part No.	Description
<b>Semiconductors</b>		
V23-24	210652	2 ATF-54143
V1-8	15495	8 SST3904
V17, V21	11138	2 SST3906
V9-16	17096	8 BAT18
V19-20, V22, V25	15976	4 LL4148
V18	210627	1 ST-2
A1	19949	1 MIC29204BM
A2	16450	1 TLC272ID
D 1	15522	1 4017B
D2	16369S	1 4528B
<b>Capacitors</b>		
C3	25578	Tantal electrolytic capacitor 33u
C4, C37, C45	26835	Tantal electrolytic capacitor 10u
C7	15621	Surface mounted ceramic capacitor 100n
C1, C31, C35, C40, C43	15160	Surface mounted ceramic capacitor 10n
C2	16390	Surface mounted ceramic capacitor 2n2
C6, C12, C18-25, C34	15162	Surface mounted ceramic capacitor 1n
C36, C42, C44, C8-11, C13-14, C26-29	15489S	Surface mounted ceramic capacitor 120p
C5, C17, C30, C38-39	15163	Surface mounted ceramic capacitor 100p
C15-16, C32, C46-50	26225	Surface mounted ceramic capacitor 6p8
C33, C41	15804	Surface mounted ceramic capacitor 4p7
<b>Resistors</b>		
R7, R33	15878	10R
R37, R45	18714	17R8
R36, R44	18719	46R4
R39, R47	18147	51R
R30	18413	332R
R29	18117	1k0
R40	15592	1k5
R35, R43	18984	9k10
R5, R21-28	18123	10k0

R34, R42	18047S	12k
R32, R41	18607	15k
R38, R46	18411	33k2
R1-2	18599	39k2
R12, R31	18606	68k1
R4, R6, R9-10, R13-20	18127	100k
R3	18797	221k
R8	18128	274k
R11	18604	332k
R48	18131	2M2
<b>Cables</b>		
Cable 1		Internal connection cable (7 pcs.)
X1	12258	SMA-angle plug, Suhner type 16SMA-50-3-5C
X2	15298	N-type panel jack, Suhner type 24N-50-3-10C
1	3053	Coaxial cable RG58
Cable 2		Internal connection cable
X1, X2	12257	SMA-angle plug, Suhner type 16SMA-50-2-105C
1	2482	Coaxial cable RG188
<b>Connectors</b>		
X1-10	210914	SMA Connector PCB straight, Suhner type 82SMA-50-0-1
<b>Coils</b>		
L1-9, L12-13, L16-17	18637S	470nH
L10-11, L14-15	19239S	8nH
<b>Others</b>		
Z1	210637	Band-pass Filter, Temex CF12S3-403-A
A3-4	210646	Hybrid Coupler, Anaren 11303-3

## CHAPTER 7

# TROUBLESHOOTING

This chapter provides contact information for technical support.

## Technical Support

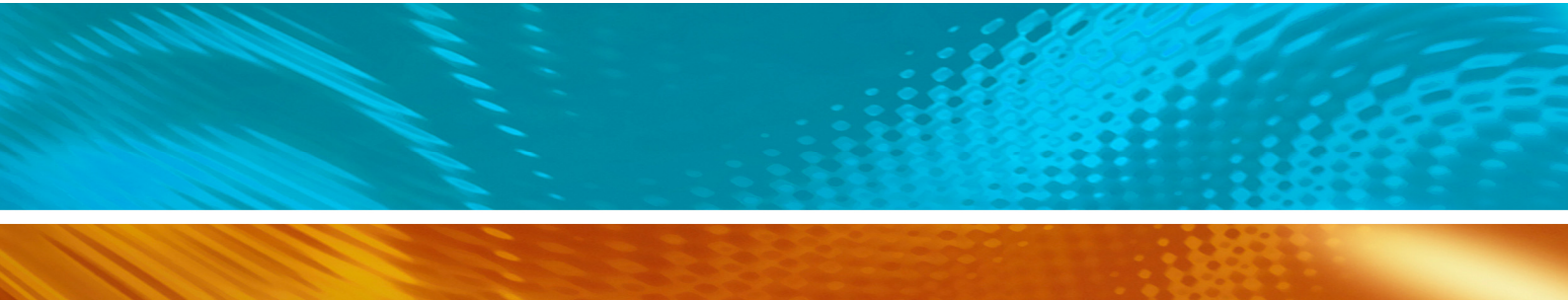
For technical questions, contact the Vaisala technical support by e-mail at [helpdesk@vaisala.com](mailto:helpdesk@vaisala.com). Provide at least the following supporting information:

- Name and model of the product in question
- Serial number of the product
- Name and location of the installation site
- Name and contact information of a technically competent person who can provide further information on the problem.

## Product Returns

If the product must be returned for service, see [www.vaisala.com/services/return.html](http://www.vaisala.com/services/return.html).

For contact information of Vaisala Service Centers, see [www.vaisala.com/services/servicecenters.html](http://www.vaisala.com/services/servicecenters.html).



[www.vaisala.com](http://www.vaisala.com)

