

11.10.2004

**7 GHz Circulator T55056.01
With
Nokia FlexiHopper Microwave Radio**

11.10.2004

The information in this document is subject to change without notice and describes only the product defined in the introduction of this document. This document is intended for the use of Nokia Networks' customers only for the purposes of the agreement under which the document is submitted, and no part of it may be reproduced or transmitted in any form or means without the prior written permission of Nokia Networks.

The document has been prepared to be used by professional and properly trained personnel, and the customer assumes full responsibility when using it. Nokia Networks welcomes customer comments as part of the process of continuous development and improvement of the documentation. The information or statements given in this document concerning the suitability, capacity, or performance of the mentioned hardware or software products cannot be considered binding but shall be defined in the agreement made between Nokia Networks and the customer. However, Nokia Networks has made all reasonable efforts to ensure that the instructions contained in the document are adequate and free of material errors and omissions. Nokia Networks will, if necessary explain issues, which may not be covered by the document. Nokia Networks' liability for any errors in the document is limited to the documentary correction of errors.

Nokia Networks WILL NOT BE RESPONSIBLE IN ANY EVENT FOR ERRORS IN THIS DOCUMENT OR FOR ANY DAMAGES, INCIDENTAL OR CONSEQUENTIAL (INCLUDING MONETARY LOSSES), that might arise from the use of this document or the information in it.

This document and the product it describes are considered protected by copyright according to the applicable laws. NOKIA logo is a registered trademark of Nokia Corporation. Other product names mentioned in this document may be trademarks of their respective companies, and they are mentioned for identification purposes only.

Copyright © Nokia Corporation 2004. All rights reserved.

04.10.2004

Table of contents

1. Purpose of the circulator	4
2. Basics of the Circulator	4
Type.....	6
2.1 Limitations and known features.....	7
2.1.1 Stopband distances from Tx/Rx-band	7
3. Allowed subbands combinations	8
4. Configuration Generally	10
5. CONFIGURATION of a frequency diversity hop using The circulator	11
5.1 Needed Equipment at one site	11
5.2 Installation instructions:	11
Connecting OU interfaces.....	12
6. Ordering.....	13
7. References	13

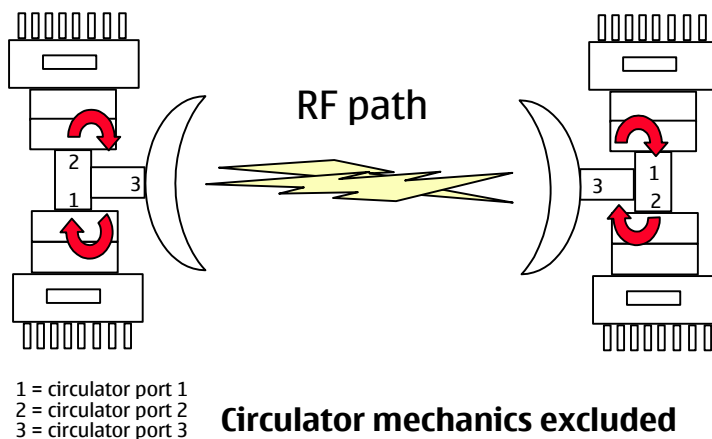
04.10.2004

1. PURPOSE OF THE CIRCULATOR

Circulator can be used in Frequency Diversity (FD) protection for Nokia FlexiHopper. The circulator makes it possible to use only one antenna with two outdoor units. Frequency diversity systems are used mainly under 15 GHz microwave radio links. This document describes only 7GHz solution.

2. BASICS OF THE CIRCULATOR

When using a circulator with two microwave radios, the transmitted or received signal of the radio in port 1 must be in stopband in port 2 and vice versa. The stopband causes the signal to reflect and continue to next port. This is essential in order to make circulator setup with microwave radios to work. Because of this there are allowed subbands (radio pairs) to be used with circulator setup. Circulation direction is port 3-1-2-3.



04.10.2004

Electrical and mechanical specifications and environmental requirements are presented in the table 1.

Table 1. Common specifications for circulator (7 GHz).

Electrical specifications		
Frequency range		7.1 – 7.75 GHz
Isolation		> 30 dB
Insertion Loss including both terminals		2.4 dB (quaranteed), minimum 0.7 dB *) NOTE
Return Loss		> 29 dB
RF leakage at 1 W		< -75 dB
Intermodulation (2 x 1 W)		< -70 dB
Mechanical specifications		
Waveguide size		153 IEC-R 84
Flanges		154 IEC-UBR 84 with M4 threads
Material		Aluminium
Colour		Matt gray (NCS-S 1500 N)
Finish outside		Polyester powder paint or Polyurethane wet paint (UV resistant)
Finish inside		Passivated RoHS compliant material
Dimensions (w x h x d)	Circulator	300 x 250 x 440 mm
	OU's included	550 x 280 x 460 mm
Weight	Circulator mechanics	6.0 kg
	OU's included	17.0 kg
Environmental specifications		
Mechanical vibration and shock		ETS 300 019-1-4.1E (4M5)

***) NOTE!** A flexible waveguide of 1m is normally used. In that case, add 0.3 + 0.3 dB to given values (including both terminals).

04.10.2004

Design compatibility:

Following version of Indoor can be used:

Release	Type	HW version	SW
	IFUE		P55234.01/ F3 or later
C4.6	FIU 19	T55200.01/ C	P55234.01/ F0 or later
C1.5	FIU 19E	T55300.01 / A	P55303.01 / C0 or later
C2.0	FIU 19E	T55300.01 / B	P55306.01 / A0 or later

Indoor units RRIC and FXC RRI do not support the use of frequency diversity.

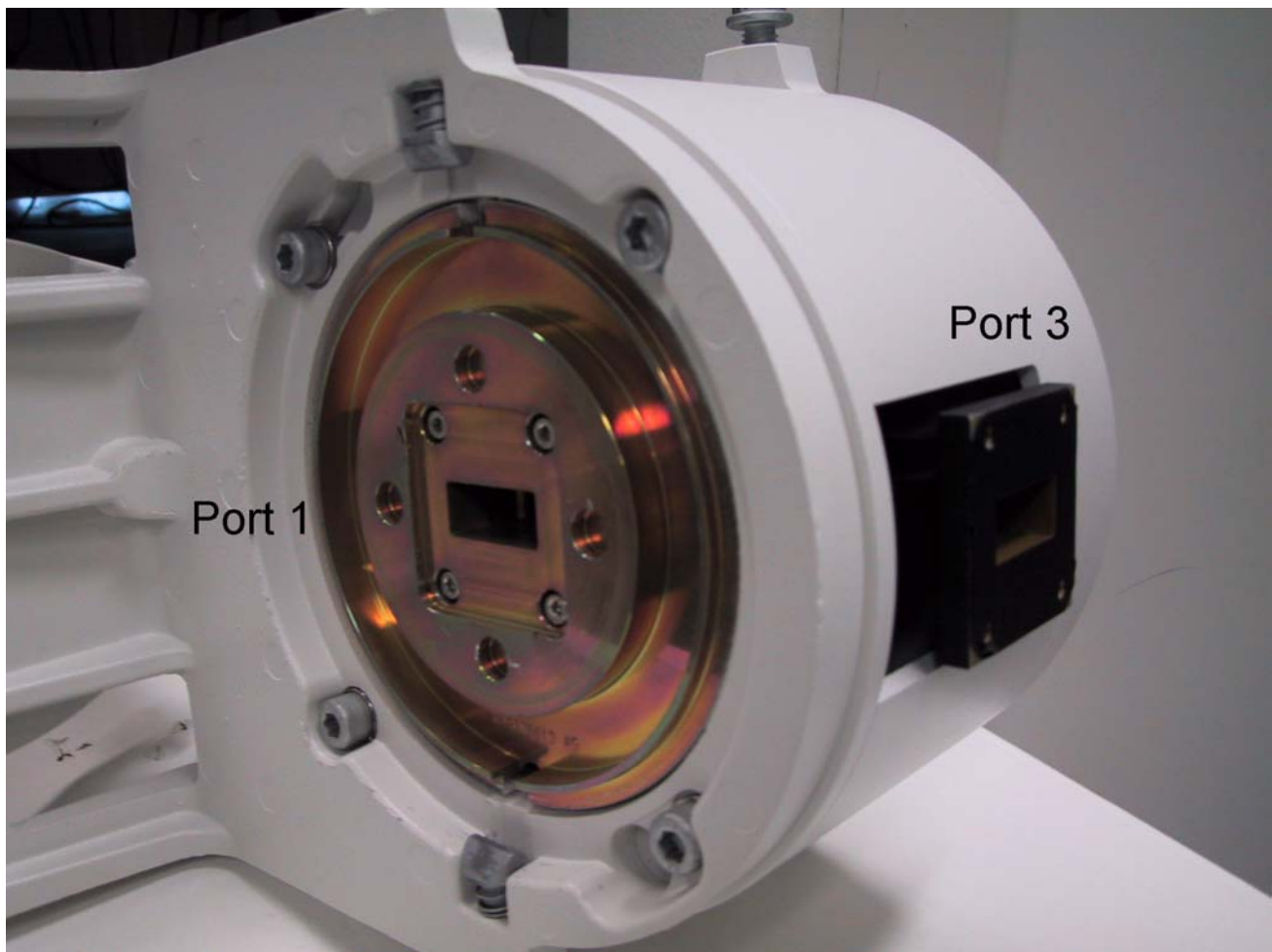


Figure 1. Circulator unit port 1 (OU) and port 3 (to antenna).

04.10.2004



Figure 2. Circulator unit bottom side and OU's attached.

2.1 Limitations and known features

2.1.1 Stopband distances from Tx/Rx-band

Calculated stopband frequencies of the antenna filter in duplex frequencies 161 MHz are presented in *table 2*:

Table 2 The antenna filter stopband frequencies.

Duplex frequency	Lower stopband distance from the Tx/Rx-band	Mid stopband distance from the Tx/Rx bands	Higher stopband distance from the Tx/Rx-band	Lower stopband (MHz)	Mid stopband (MHz)	Higher side (MHz)
161 MHz	~55 MHz	~42 MHz	~55 MHz	...7164	7317...7338	7491

The transmit frequency shall be at least 35 MHz from the other radios Tx/Rx-bands (stopband). From the system point of view, this is essential since

- the signal will be reflected from the antenna port back to next port in circulator,

04.10.2004

- the Tx/Rx-paths, especially the receiver of the microwave radio, will be protected against high transmitter power

3. ALLOWED SUBBANDS COMBINATIONS

Allowed subbands (radio pairs) to be used with circulator setup are presented in *table 3*. Please note that the circulator cannot be used with duplex frequencies 154 and 168 MHz at all.

The subband pairs with restrictions are not recommended to use, since in those cases using the wrong transmit frequency range can cause permanent damage to other radio in circulator setup. If needed further information in “restricted” situations, please contact to Nokia technical help desk.

	Band	Band with no restriction in capacity or frequencies	Band with Frequency or capacity restrictions exist. See tables below.
Duplex 161 MHz	A LO	I LO, J LO, K LO and L LO	-
	B LO	J LO, K LO and L LO	I LO note 1
	C LO	K LO and L LO	J LO note 2
	D LO	L LO	K LO note 3
	I LO	A LO	B LO note 1
	J LO	A LO and B LO	C LO note 2
	K LO	A LO, B LO and C LO	D LO note 3, M LO note 4
	L LO	A LO, B LO, C LO and D LO	M LO note 5
	M LO	-	K LO note 4, L LO note 5

Table 3. Allowed subbands to be used with circulator.

Upper bands (A HI, B HI...etc.) have the same combinations.

04.10.2004

Table 5.2. In the table the subband pairs and the frequency limits in every capacity are presented. The blank cell means that the capacity cannot be used.

Note 1								
Capacity	2x2		4x2		8x2		16x2	
MHz	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit
B LO	7150.75	7189.25	7152.50	7187.50	7156.00	7184.00	7163.00	7177.00
B HI	7311.75	7350.25	7313.50	7348.50	7317.00	7345.00	7324.00	7338.00
I LO	7431.75	7470.25	7433.50	7468.50	7437.00	7465.00	7444.00	7458.00
I HI	7592.75	7631.25	7594.50	7629.50	7598.00	7626.00	7605.00	7619.00

Note 2								
Capacity	2x2		4x2		8x2		16x2	
MHz	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit
C LO	7185.75	7224.25	7187.50	7222.50	7191.00	7219.00	7198.00	7212.00
C HI	7346.75	7385.25	7348.50	7383.50	7352.00	7380.00	7359.00	7373.00
J LO	7466.75	7505.25	7468.50	7503.50	7472.00	7500.00	7479.00	7493.00
J HI	7627.75	7666.25	7629.50	7664.50	7633.00	7661.00	7640.00	7654.00

Note 3								
Capacity	2x2		4x2		8x2		16x2	
MHz	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit
D LO	7220.75	7258.25	7222.50	7256.50	7226.00	7253.00	7233.00	7246.00
D HI	7381.75	7419.25	7383.50	7417.50	7387.00	7414.00	7394.00	7407.00
K LO	7501.75	7539.25	7503.50	7537.50	7507.00	7534.00	7514.00	7527.00
K HI	7662.75	7700.25	7664.50	7698.50	7668.00	7695.00	7675.00	7688.00

Note 4								
Capacity	2x2		4x2		8x2		16x2	
MHz	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit
M LO	7240.75	7258.25	7242.50	7256.50	NA	NA	NA	NA
M HI	7401.75	7419.25	7403.50	7417.50	NA	NA	NA	NA
K LO	7530.75	7539.25	7532.50	7537.50	NA	NA	NA	NA
K HI	7691.75	7700.25	7693.50	7698.50	NA	NA	NA	NA

Note 5								
Capacity	2x2		4x2		8x2		16x2	
MHz	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit	Lower limit	Upper limit
M LO	7240.75	7292.25	7242.50	7290.50	7246.00	7287.00	7253.00	7280.00
M HI	7401.75	7453.25	7403.50	7451.50	7407.00	7448.00	7414.00	7441.00
L LO	7530.75	7564.00	7532.50	7564.00	7536.00	7564.00	7543.00	7561.00
L HI	7691.75	7725.00	7693.50	7725.00	7697.00	7725.00	7704.00	7722.00

04.10.2004

4. CONFIGURATION GENERALLY

Operation mode settings in Hopper Manager.

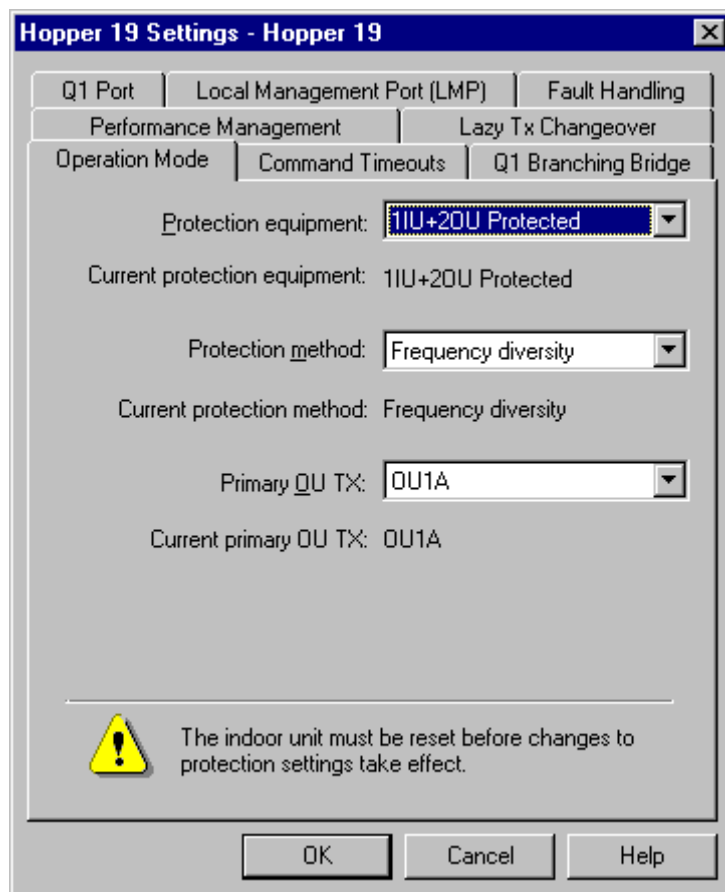
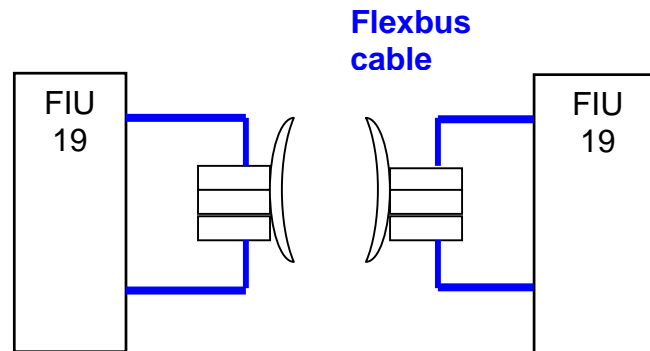


Figure 2. Protection method in HopperManager

04.10.2004

5. CONFIGURATION OF A FREQUENCY DIVERSITY HOP USING THE CIRCULATOR



5.1 Needed Equipment at one site

1. FIU 19 T55240.01 or FIU 19E T55340.01
2. Two Outdoor Units, Nokia FlexiHopper T55059.xx
3. Circulator T55056.01 (including mounting unit)
4. Waveguide T55054.12 (1m) or elliptical waveguide, if longer run is needed.
5. Alignment unit T55050.01 and Antenna. If a 20, 30 or 60 cm antenna is used, the antenna is mounted on the Nokia FlexiHopper alignment unit. If a 90, 120 or 180 cm antenna is used, the antenna is mounted on the antenna of the manufacturer's own alignment unit.

5.2 Installation instructions:

Installing the antenna

Follow the antenna manufacturer or Nokia alignment unit instructions.

Installing the circulator

The antenna is mounted on a separate alignment unit and the circulator is connected to the antenna with a waveguide. Outdoor units are mounted on the circulator port 1 and 2 with the handle and the connectors facing down.

To install the circulator assembly for the 7 GHz radios on a pole (diameter 50 – 125 mm). Circulator is put in about 300 mm lower and the opposite side of the pole than antenna.

1. Open the M8 nuts of the mast bolts and swing open the twin bolts.

04.10.2004

2. Push the mounting unit into place, so that the installation pole settles between the clamp and the counter support.
3. Close the twin bolts and tighten the nuts using a 13mm spanner. The torque is 20 Nm.



"133-004337_01
Installation 7-8 Circul



"133-004340_00
Frequency diversity -

Fixing the waveguide

Remove the protective tape from the waveguide flanges of the circulator. Do not peel off or damage the foil covering the waveguide opening. Fix the waveguide to the circulator port 3 with four M4x16 Allen screws. Tighten the screws with a 3 mm Allen key. The torque is 1.5 Nm. Fix the other end of the waveguide to the antenna in the same way. Use a gasket between the flanges.

Mounting the outdoor units on the circulator

Mount the outdoor units on the circulator port 1 and 2 in the same way as they are mounted on the alignment unit. In this case, the handles always face down.

NOTE! Radio pairs should be installed on same circulator port (e.g. C LO and C HI to port 1 and L LO and L HI to port 2)

To mount the outdoor units:

1. Check and clean, if necessary, the outdoor unit and the mounting ring of the alignment unit.
2. Unscrew the outdoor unit locking nuts (M8) out of the threads, so that the slide blocks can be drawn free from the screws
3. Remove the protecting tapes in the circulator port 1 and 2.
4. Push the lower edge of the V ring of the outdoor unit behind the slide block and push the upper edge so that it clicks behind the other slide block. Check that the (rectangular) outdoor unit guide pin fits into the corresponding guide hole.
5. Tighten both the OU locking nuts, first manually and then with a 13mm spanner. The torque is 4 Nm.

Connecting OU interfaces

Two cables need to be connected to the Nokia FlexiHopper outdoor unit:

1. A grounding wire
2. the IU-OU Flexbus cable.

04.10.2004

6. ORDERING

Please use Nokia configurator to obtain correct set of units & material for different site configurations.

7. REFERENCES

Nokia FlexiHopper Microwave Radiowith FIU 19/FIU 19E user manual C33513.8--J0