SAF FreeMile™

38GHz

25GHz

23GHz

20GHz

Quick Installation Guide

19GHz

Produced by SAF Tehnika

Produced in Europe

Table of Contents

1 Introduction

This manual describes the installation procedure of SAF FreeMile series microwave radio link consisting of Full Outdoor Units (FODUs).

1.1 List of Abbreviations

128QAM – 128-Quadrature Amplitude Modulation
16APSK – 16-Amplitude and Phase Shift Keying
32APSK – 32-Amplitude and Phase Shift Keying
64QAM – 64-Quadrature Amplitude Modulation
AC – Alternating Current
ACM – Adaptive Coding and Modulation
AGC – Automatic Gain Control
ASCII - American Standard Code for Information Interchange
BNC connector - Bayonet Neill-Concelman coaxial connector
DC – Direct Current
FODU – Full Outdoor Unit
FTP – File Transfer Protocol
GUI – Graphical User Interface
IEEE - Institute of Electrical and Electronics Engineers
QPSK - Quadrature Phase-Shift Keying
RSL – Received Signal Level
RSSI – Received Signal Strength Indicator
Rx - Receive
SNMP - Simple Network Management Protocol

TCP/IP – Internet Protocol Suite (Transmission Control Protocol / Internet Protocol)

Tx - Transmission

1.2 Safety Precautions

- Installation and service must be done by personnel having appropriate technical training and experience necessary to be aware of hazards during installation and/or service. The installation and/or service must be done under measures to minimize any danger to the involved person or any other person.
- Use the necessary safety devices when working on or around the mast. Be aware of the risk of falling objects. Consider the safety catch when hoisting the antenna and radio.
- Do not use any components (screws, nuts, etc.) other than those delivered together with the SAF Tehnika JSC microwave radio equipment or recommended by SAF Tehnika JSC.

1.2.1 Electrical Safety

- The equipment meets the requirements for class I EN 60950 (protection against electric shock).
- All external circuits are TNV-1 (as defined in EN 60950).
- All equipment must be grounded before the power cable is connected.
- For electrical safety the DC power supply shall have reinforced insulation to the mains supply.

1.2.2 Microwave Radiation

- The transmitter should be switched off before disassembling the equipment to avoid microwave radiation.

No dangerous levels of microwave radiation exist outside the antenna while in operation when the antenna is connected to the radio, yet any part of the body shall not be exposed to the radiation in front of the open radio waveguide output closer than 20 cm while radio transmitter is turned on.

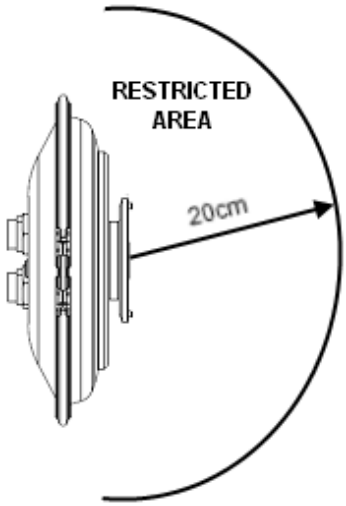


Figure 1.

2 Getting Started

2.1.1 Unpacking and Inventory

There are two types of packages, - the box for transportation and the commercial package. SAF FreeMile FODUs are packed in commercial packages whereas commercial boxes are packed in transportation boxes.

Transportation package for two SAF FreeMile FODUs contains two trading packages for SAF FreeMile FODU.

2.1.2 Contents of Transportation Package for SAF FreeMile FODU link

- SAF FreeMile Full Outdoor Unit, 2 pcs.
- Sealing for RJ45 connectors, 1 pcs.;
- Documentation and software DVD (optional);
- RJ-45 connectors for SAF FreeMile, 2 pcs. (upon order);
- Grounding screw, 2 pcs.;
- Installation instruction, 1 pcs.

2.1.3 Package Weight and Dimensions

The following table lists all the included packages and their weight and dimensions.

Package type	Weight of empty package [g]	Dimensions [mm]
Commercial package for SAF FreeMile FODU	486	532x365x75
Transporting package for SAF reeMile FODUs	700	562x385x283

2.1 Required Installation Tools

2.1.1 SAF FreeMile FODU Installation Tools

- Power supply unit, injector and Ethernet cable (Cat.5e);
- Necessary tools for assembling the cables and connectors – RJ45 crimping tool.

2.1.2 Antenna Installation Tools

- Voltmeter/multimeter with corresponding BNC adapter;
- Mounting bracket and necessary wrenches (13, 16 and 17mm), nuts, screws and clamps;
- Grounding cable;
- Binoculars and compass for clear sight installation.

2.2 Labels

2.2.1 SAF FreeMile FODU Label

The label can be found on the front side of the unit.

The label contains the following information (see the sample in the picture below):

- Model name ("FreeMile-xx"), where xx stands for frequency band:
- SAF FreeMile-17 for 17GHz FreeMile FODU
- SAF FreeMile-24 for 24GHz FreeMile FODU
- Product Number (Z24FEE01L): product number contains information of the band side (L, H) in which SAF FreeMile FODU operates.
- Unit Serial Number (325570100003); the serial number uniquely identifies SAF FreeMile FODU.

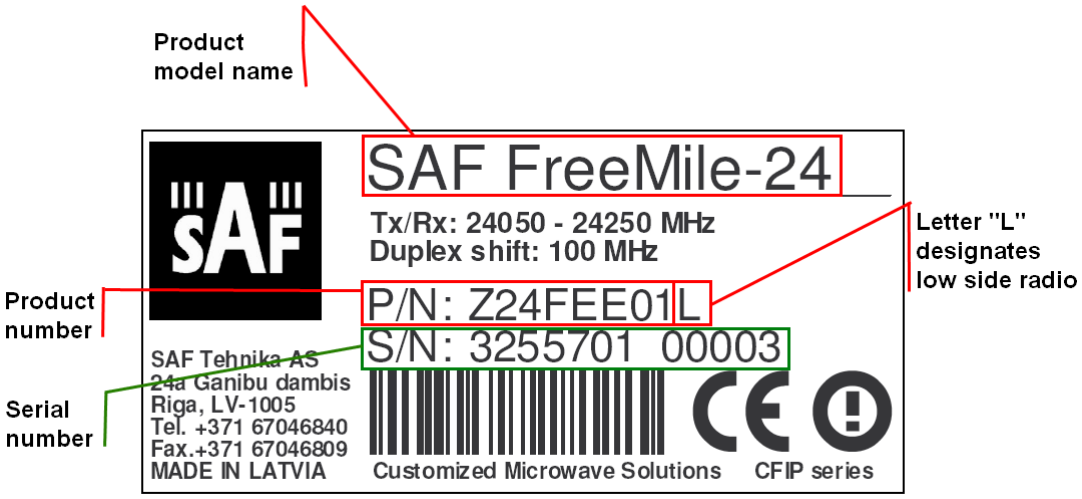


Figure 2. *Label of the SAF FREEMILE-24 FODU Low band side*

3 Installing SAF FreeMile Full Outdoor Unit (FODU) radio link

The installation of SAF FreeMile FODU link involves the following steps:

3.1. Initial equipment setup at the customer's premises

- Unpack all equipment;
- Visually investigate the equipment;
- Prepare necessary cables and tools;

3.2. Polarization Considerations

The position of the SAF FreeMile FODU determines the polarization of the radio signal. The label can be used as the indicator, see Figure 4.

***Figure 3**. SAF FreeMile set to vertical polarization*

(!) Note that SAF FreeMile utilizes both polarizations, and radios must be installed with 90 degrees offset regarding remote side. This can be verified in *Main status* Tx polarization row or on the label.

3.3. Attaching SAF FreeMile Full Outdoor Unit to Antenna

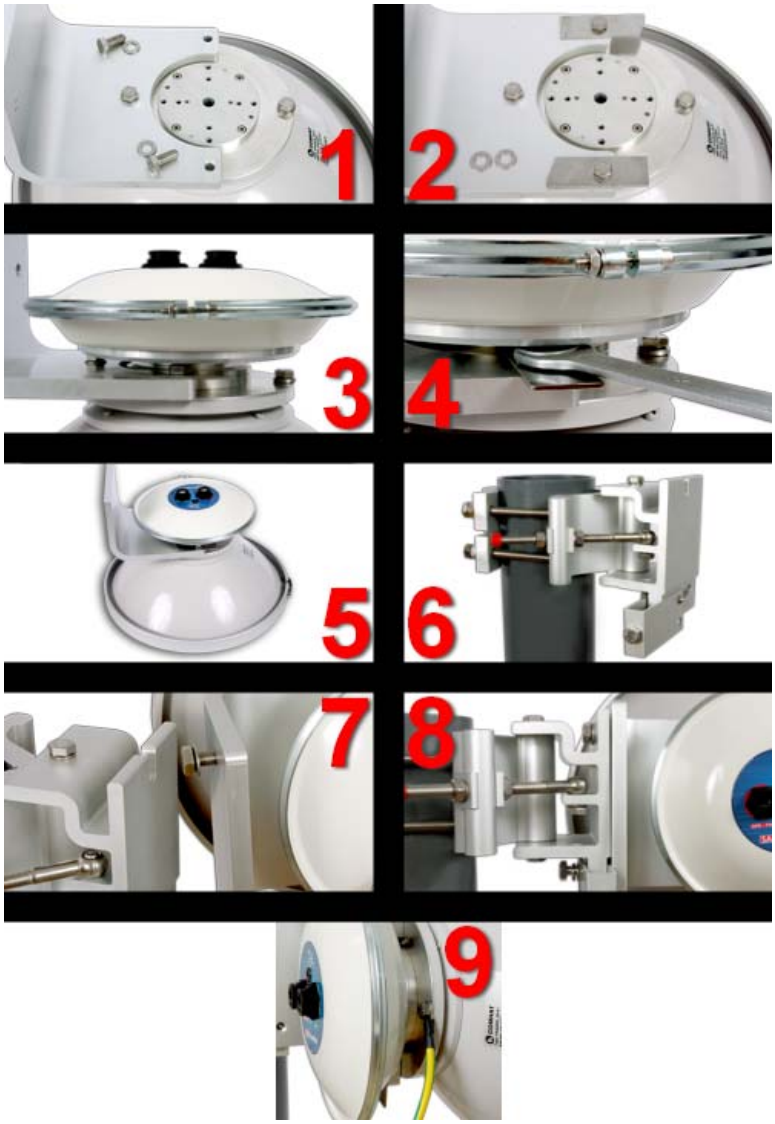


***Figure 4**. Attaching SAF FreeMile Full Outdoor Unit to Antenna*

Fig. 4(1). Attach antenna to the angle of mounting bracket using only one screw (in the picture above). For two opposite screws both washers should be taken out.

Fig. 4(2). Connect lockings using screws. Make sure lockings can be turned.

Note that washers shouldn't be used.

Fig. 4(3). Attach FODU to the antenna. Use guidance pins to choose required polarization. Arrow sign on the label indicates horizontal or vertical polarization.

Note that polarizations should be opposite for both sides of the link!

Fig. 4(4). Fasten lockings with screws using 13mm wrench as shown in the picture below.

Fig. 4(5). Assembled antenna, FODU and angle bracket should look like it is shown in the picture above.

Fig. 4(6). Fasten mount to the mast. Note that U-type alignment bolt should be placed below the structure as shown in figure!

Fig. 4(7). Attach angle to the mounting bracket according to U-shaped notch as shown in the picture above.

Fig. 4(8). Finished antenna and FODU mounting to the mast.

Fig. 4(9). Attach grounding cable to fourth screw on antenna which is unused. Grounding cable should be connected to ground circuit and accordingly fixed.

(!) Mounting locks may differ from the ones shown in the image.

(!) SAF FreeMile utilizes both polarizations, thus one unit should be installed with horizontal arrow indicator, second unit – with vertical (see Figure 5).

3.4. Assembling SAF FreeMile FODU Ethernet cable connector

(!) Attention! Be aware that length of RJ45 connectors may vary! This is the reason why weatherproof connector enclosure has room for longest possible RJ45 connector.

This instruction will show you how to correctly assemble weathered connector and have best possible connection of RJ45 connector with socket.

Figure 5. *Assembling Ethernet weatherproof connector*

Fig. 5(1). Put rubber sealing inside the connector as shown. Fastening screw should be placed on the front part of connector.

Fig. 5(2). Put connector parts on the cable.

Fig. 5(3). Stick the rubber gasket on the connector.

Fig. 5(4). Plug RJ45 connector into the Ethernet socket.

Fig. 5(5). Fix the connector to the socket with screw.

Note that cable sealing screw is still not fixed at this moment.

Fig. 5(6). Push the RJ45 connector into the socket by pushing the cable and at the same time seal and fix the cable using cable sealing screw.

Fig. 5(7). Assembled cable. Fix the cable to the mast as close as possible to FODU. Do not bend it! The radius of bending should not be less than 10cm.

Fig. 5(8). Example of correct positioning of RJ45 connector during weatherproof connector assembly.

Fig. 5(9). Example of incorrect position of connector – improper alignment.
Note, that it is too deep in the connector.

3.5. Initial configuration

In order to perform initial configuration you will need a laptop with LAN card, 2 Category 5e Ethernet cables and a Power over Ethernet injector.

- Your connected laptop should be in the same subnet with manageable SAF FreeMile, so you can "see" them; that is why, the laptop Ethernet port settings should be set as follows: (in 'Microsoft Windows' go to *Control panel* → *Network Connections* → *Local Area Connection* → *Properties* → *Internet Protocol (TCP/IP)* → *Properties*):
  - IP address 192.168.205.1;
  - Net mask 255.255.255.0;
  - everything else is blank.
- You must have PoE (Power over Ethernet) injector with the minimum of 20W power supply to connect the laptop to the SAF FreeMile FODU. Power over Ethernet injector can be purchased from SAF Tehnika JSC as optional accessory.
- To know IP address, side value should be read from the label. See Chapter 2.3 for details.
  - If Low Side -> IP: 192.168.205.10
  - If High Side -> IP: 192.168.205.11
- Connect to SAF FreeMile FODU by entering IP address in the browser address line - by default 192.168.205.10 for the low side and 192.168.205.11 for the high side.

(!) Default username for Web, Telnet and FTP access is admin and password is *changeme.*

- It is recommended to use the following or later versions of web-browsers:
  - IE v. 6.0
  - Mozilla Firefox v. 2.0.0.11
  - Safari v. 3.0
  - Opera v. 9.50

3.5.1. Initial configuration with Web GUI

Initial configuration in Web GUI should be done individually for each SAF FreeMile FODU.

STEP 1
First step is to choose your antenna size (30 or 60cm) in Main page „Radio configuration". Press „Apply" button. Note that "Apply for local and remote" button will not operate until microwave link is established.

STEP 2
Run „Spectrum analysis" while second unit is not transmitting in order to check availability of required channel as well as overall interference

STEP 3
Judging upon observed interference, choose free channel in 30MHz or change channel bandwidth to 10MHz and change modem configuration if required.

STEP 4
Activate Tx power by choosing Tx power value in Main page „Radio configuration" and pressing „Apply" button.

STEP 5
All configuration steps should be repeated for the second SAF FreeMile unit.

Only after initial configuration execution the antennas have to be aligned as described in the following section.

3.6. Antenna Alignment

3.6.1. Calculating Expected Received Signal Level (RSL)

The expected RSL (receive signal level) can be calculated using "path calculator" provided by SAF Tehnika JSC.

3.6.2. Alignment Procedure

The antenna alignment procedure can be made easier by placing one person at each antenna location during alignment process. However, alignment should be performed on one antenna at a time, each person alternatively turns antenna until the RSL is optimized.

The following steps are required to properly align the antennas:

1. Start at one end of the link; observe LED blinking – more frequent blinking indicates stronger Rx level. Then connect a voltmeter to the E1 port on the SAF FreeMile FODU. RSSI voltage is available on pins 1, 2, 3 and 6. Ensure the voltmeter is set to DC voltage and set on a range 0 – 2 volts.
2. Loosen the antenna hardware that is used for securing the antenna movement in the azimuth directions.
3. Roughly aim the antenna directing the main lobe of the far-end antenna.
4. Slowly sweep the antenna while observing the readings on the voltmeter. The higher is the voltage, the higher is the RSL.
5. Secure the azimuth adjustment hardware once main lobe is found and the highest signal level is achieved.
6. Loosen the antenna hardware that is used for securing the antenna movement in the

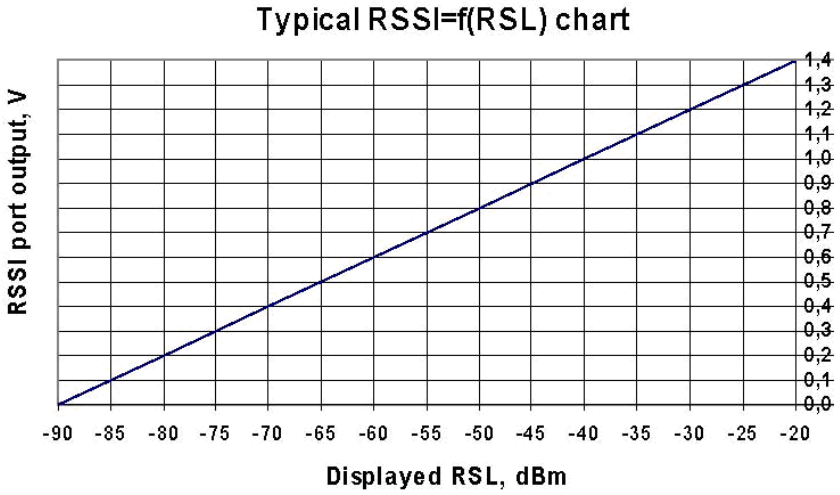
elevation direction. Slowly sweep the antenna while observing the voltmeter. Once the signal is peaked, the elevation adjustment hardware can be secured.

7. Perform steps 1 through 6 on the opposite end of the link until the signal level is peaked for both azimuth and elevation.

After the AGC voltages have been peaked on both ends of the link, observe the RSL indicated in Web management window. Ensure that the RSL is within +/- 5dB of calculated RSL.

3.6.3. RSSI Readings

To aid in the antenna alignment process, the following chart and table shows typical relationship of the RSL (Rx level) vs. RSSI port output voltage (RSSI – Received Signal Strength Indicator). The evaluated Rx level has the error +/-2 dBm.



Displayed RSL, dBm	RSSI, V
-90	0
-85	0,1
-80	0,2
-75	0,3
-70	0,4
-65	0,5
-60	0,6
-55	0,7
-50	0,8
-45	0,9
-40	1
-35	1,1
-30	1,2
-25	1,3
-20	1,4

If everything was configured correct and RSL after antenna alignment at both sites complies with pre-calculated RSL, you will see a screen similar to this (without alarm indications):

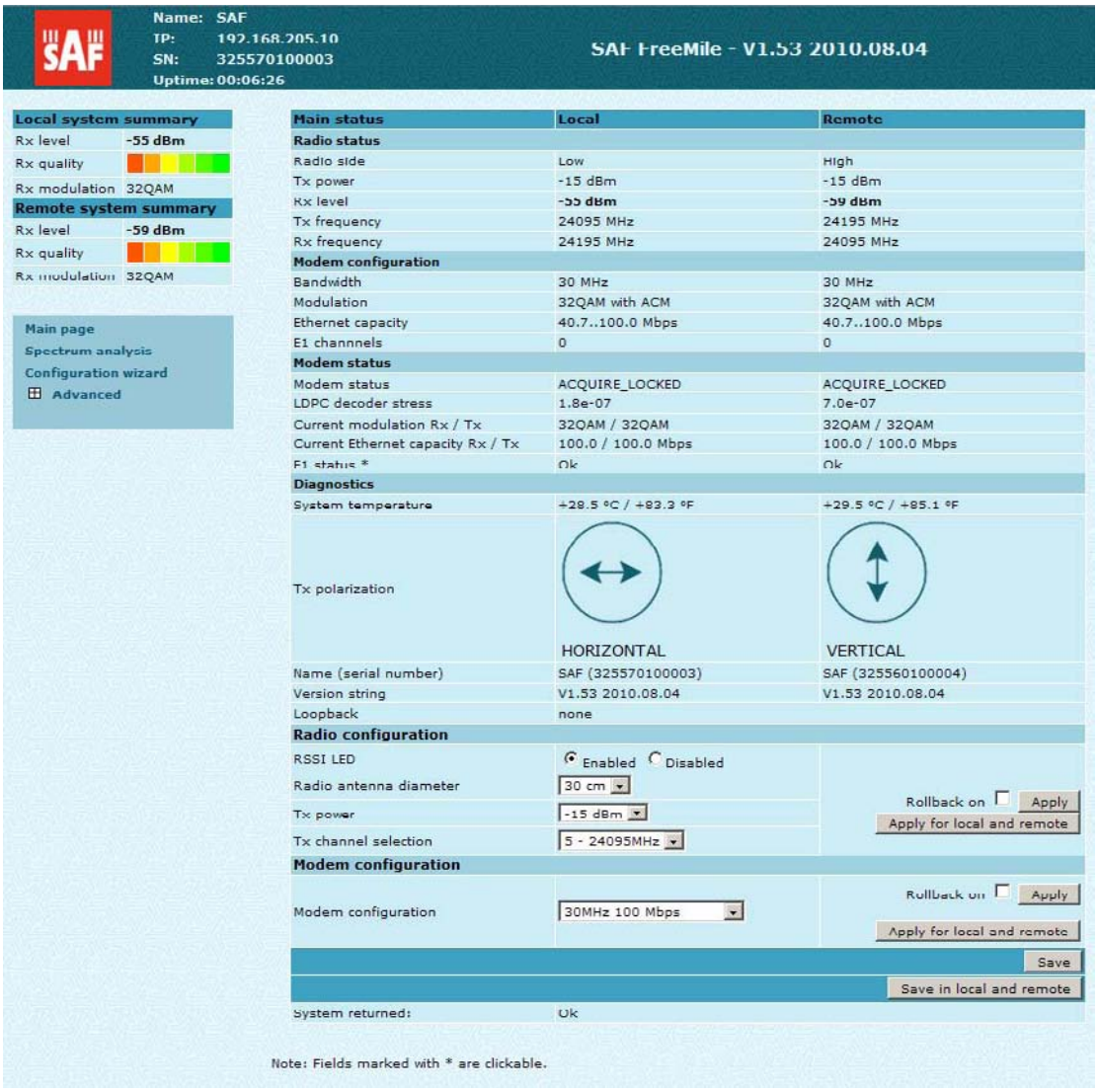


Figure 6. *Web Interface - main page*

References

All the documents comprised in this chapter can be ordered from SAF Tehnika JSC or its sales representatives.

• Technical Descriptions

Available technical descriptions:

The SAF FreeMile Series Full Outdoor Unit Technical Description and Configuration Guide - a generic technical description of the SAF FREEMILE series products, it comprises the installation and commissioning issues and accessories, functional description, technical data, a.o