

38GHz

25GHz

23GHz

20GHz

19GHz



# Quick Installation Guide

IC: 8855A-CFIP24

FCC: W9Z-CFIP-24



Produced by  
SAF Tehnika



Produced  
in Europe



## IC Notice

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter IC: 8855A-CFIP24 has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

- Arkivator 24GHz 0.3m (1ft) High performance antenna (HAA2403)
- Arkivator 24GHz 0.6m (2ft) High performance antenna (HAA2406)
- Arkivator 24GHz 0.99m (3ft) High performance antenna (HAA2499)

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio (identifier le dispositif par son numéro de certification ou son numéro de modèle s'il fait partie du matériel de catégorie I) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

- Arkivator 24GHz 0.3m (1ft) Antenne haute performance (HAA2403)
- Arkivator 24GHz 0.6m (2ft) Antenne haute performance (HAA2406)
- Arkivator 24GHz 0.99m (3ft) Antenne haute performance (HAA2499)

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.





## FCC Notice

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

### **Federal Communication Commission Interference Statement**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

### **FCC Radiation Exposure Statement**

To comply with FCC Radio Frequency exposure requirements, a minimum separation distance of 45cm is required between the antenna and all occupational persons, and a minimum separation distance of 100cm is required between the antenna and all public persons.





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SAF Tehnika, JSC has no liability for typing errors in this document or damages of any kind that result from the use of this document.

To get up to date information about accessories and their availability, please contact sales representative.

**Note:** FODU/ODU does not contain serviceable parts. Warranty will not be applicable in the event FODU/ODU has been hermetically unsealed.

**Note:** SAF Tehnika, JSC is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

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## 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

In April 1998, ICNIRP (International Commission on Non-Ionizing Radiation Protection) published its 'Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300GHz)'. As shown in Table 2.2-1, the guidelines (Tables 6 and 7) specify the 'Reference levels on power density for occupational exposure and general public exposure to time-varying electric and magnetic fields (unperturbed rms values)' between 2 and 300 GHz.

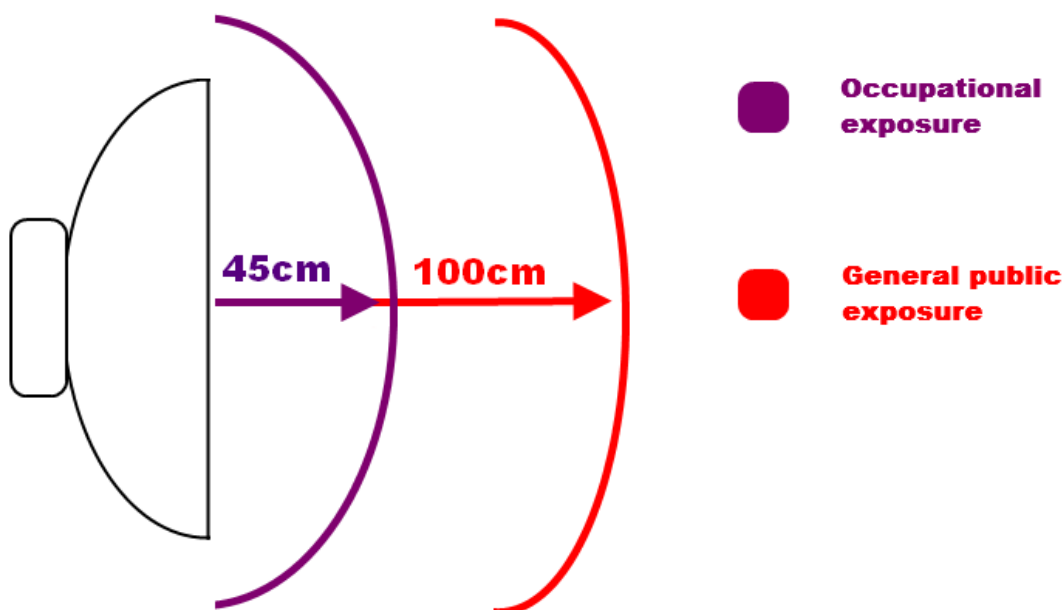


Figure 1 Microwave radiation



Table 1.1: ICNIRP Reference levels within the frequency range 24 GHz

Frequency range	Exposure characteristics	Equivalent plane wave power density Seq (W/m <sup>2</sup> )	Average time period (min)
24GHz	occupational 45cm	50	68/f <sup>1.05</sup> (f in GHz)
	general public 100cm	10	68/f <sup>1.05</sup> (f in GHz)
<p><b>Note:</b> For pulsed signals it is suggested that the peak equivalent plane wave power density, as averaged over the pulse width, does not exceed 1000 times the Seq exposure levels given in the table.</p> <p><b>Note:</b> Within the frequency range the 10 – 300 GHz the basic restrictions are identical to the reference levels.</p> <p>Remarks to the definition of basic restrictions:</p> <ol style="list-style-type: none"> <li>1. Power densities are to be averaged over any 20 cm<sup>2</sup> of exposed area and any 68/f<sup>1.05</sup> minute period (where f is in GHz) to compensate for progressively shorter penetration depth as the frequency increases.</li> <li>2. Spatial maximum power densities, averaged over 1 cm<sup>2</sup>, should not exceed 20 times the values above.</li> </ol>			

Compared to the ICNIRP restrictions, FCC CFR 47 specifies the Maximum Permissible Exposure (MPE) levels for occupational/controlled environment and general public/uncontrolled environment, as shown in Table 1.2.

Table 1.2: FCC MPE limits within the frequency range 1.5-100 GHz

Frequency range	Exposure characteristics	Equivalent plane wave power density Seq (W/m <sup>2</sup> )	Average time period (min)
24GHz	occupational 45cm	50	6
	general public 100cm	10	30

Quite a few other documents specify or refer to exposure limits comparable to those given above, e.g.:

- 1999/519/EC: Council Recommendation of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz)
- WHO: Environmental Health Criteria 137: 'Electromagnetic Fields (300 Hz to 300 GHz)'
- ANSI/IEEE C95.1, 1999: 'IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz'
- BRD, Bundesimmissionsschutzgesetz, 26. BImSchV Verordnung über elektromagnetische Felder
- Bundesamt für Umwelt, Wald und Landwirtschaft (BUWAL), Bern/Schweiz
- Schriftenreihe Umwelt Nr. 164, Luft, Mai 1992
- 'Messung nichtionisierender elektromagnetischer Strahlung, 1. Teil: Frequenzbereich 100 kHz bis 300 GHz'
- DIN VDE 0848-2, Entwurf, Oktober 1991:
- 'Sicherheit in elektrischen, magnetischen und elektromagnetischen Feldern, Teil 2: Schutz von Personen im Frequenzbereich von 30 kHz bis 300 GHz'
- ENV 50166-2, January 1995 (withdrawn in December 1999 by CENELEC)
- 'Human Exposure to Electromagnetic Fields (10 kHz – 300 GHz)'





## 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 FreeMile 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-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



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.



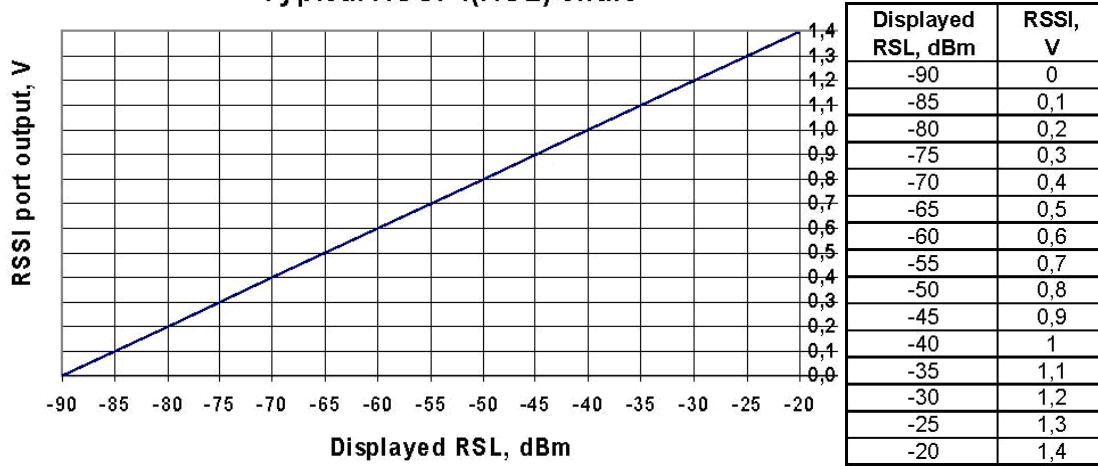


After the AGC voltages have been peaked on both ends of the link, observe the RSL indicated in Web management window. Ensure that the RSL is within +/- 2dB of calculated RSL.

### 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.

**Typical RSSI=f(RSL) chart**





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):

**SAF** Name: SAF  
IP: 192.168.205.10  
SN: 325570100003  
Uptime: 00:06:26

**SAF FreeMile - V1.53 2010.08.04**

Local system summary		Main status	Local	Remote
Rx level	-55 dBm	<b>Radio status</b>		
Rx quality		Radio side	Low	High
Rx modulation	32QAM	Tx power	-15 dBm	-15 dBm
<b>Remote system summary</b>		Rx level	-55 dBm	-59 dBm
Rx level	-59 dBm	Tx frequency	24095 MHz	24195 MHz
Rx quality		Rx frequency	24195 MHz	24095 MHz
Rx modulation	32QAM	<b>Modem configuration</b>		
Main page		Bandwidth	30 MHz	30 MHz
Spectrum analysis		Modulation	32QAM with ACM	32QAM with ACM
Configuration wizard		Ethernet capacity	40.7..100.0 Mbps	40.7..100.0 Mbps
Advanced		E1 channels	0	0
		<b>Modem status</b>		
		Modem status	ACQUIRE_LOCKED	ACQUIRE_LOCKED
		LDPC decoder stress	1.8e-07	7.0e-07
		Current modulation Rx / Tx	32QAM / 32QAM	32QAM / 32QAM
		Current Ethernet capacity Rx / Tx	100.0 / 100.0 Mbps	100.0 / 100.0 Mbps
		E1 status *	Ok	Ok
		<b>Diagnostics</b>		
		System temperature	+28.5 °C / +83.3 °F	+29.5 °C / +85.1 °F
		Tx polarization	 HORIZONTAL	 VERTICAL
		Name (serial number)	SAF (325570100003)	SAF (325560100004)
		Version string	V1.53 2010.08.04	V1.53 2010.08.04
		Loopback	none	
		<b>Radio configuration</b>		
		RSSI LED	<input checked="" type="radio"/> Enabled <input type="radio"/> Disabled	
		Radio antenna diameter	30 cm	Rollback on <input type="checkbox"/> <b>Apply</b> Apply for local and remote
		Tx power	-15 dBm	
		Tx channel selection	5 - 24095MHz	
		<b>Modem configuration</b>		
		Modem configuration	30MHz 100 Mbps	Rollback on <input type="checkbox"/> <b>Apply</b> Apply for local and remote
		<b>Save</b>		
		Save in local and remote		
		System returned:	Ok	

Note: Fields marked with \* are clickable.

Figure 6. Web Interface - main page

Otherwise please refer to “The SAF FreeMile Series Full Outdoor Unit Technical Description and Configuration Guide” or contact SAF Tehnika JSC support team [techsupport@saftehnika.com](mailto:techsupport@saftehnika.com)

## 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

