



SAF CFM-LM

**Series Microwave Radio System Product
Family**

Technical Description

SAF CFM-LM Series Product Family Technical Description

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Introduction

Proprietary notice

The specifications or information contained in this document are subject to change without notice due to continuing design improvement. If there is any conflict between this document and compliance statements, the latter will supersede this document.

The CFM LM series digital microwave radio system is equipment designed for the transmission of digital signals using radio waves in conditions within the line of sight. The type “LM” denotes the model of the Radio Unit (or Outdoor Unit – ODU). There are LM and L4 type ODUs that work with LM and L4 type Indoor Units correspondingly (Indoor Unit – IDU). This particular document describes the LM series microwave radio system which includes LM ODU and IDUs that work with the LM ODU.

The following LM type ODUs are available:

- CFM-38-LM, operates in 38 GHz band, WAN data rates: 8, 16, 34 Mbps; the CFM-38-LM meets the requirements of ETSI EN 300 197 standard;
- CFM-26-LM, operates in 26 GHz band, WAN data rates: 8, 16, 34 Mbps; the CFM-26-LM meets the requirements of ETSI EN 300 431 standard;
- CFM-22-LM, operates in 23 GHz band, WAN data rates: 8, 16, 34 Mbps; the CFM-22-LM radio meets the requirements of ETSI EN 300 198 standard;
- CFM-18-LM, operates in 18 GHz band, WAN data rates: 8, 16, 34 Mbps; the CFM-18-LM meets the requirements of ETSI EN 301 128 standard;
- CFM-15-LM, operates in 15 GHz band, WAN data rates: 8, 16, 34 Mbps; the CFM-15-LM meets the requirements of ETSI EN 301 128 standard;
- CFM-13-LM, operates in 13 GHz band, WAN data rates: 8, 16, 34 Mbps; the CFM-13-LM meets the requirements of ETSI EN 301 128 standard;
- CFM-8-LM, operates in 8 GHz band, WAN data rates: 8, 16, 34 Mbps; the CFM-8-LM meets the requirements of ETSI EN 301 216 standard;
- CFM-7-LM, operates in 7 GHz band, WAN data rates: 8, 16, 34 Mbps; the CFM-7-LM meets the requirements of ETSI EN 301 216 standard.

Depending on the type of IDU, the WAN data rate is 8, 16 or 34 Mbps.

The CFM terminal consists of the Indoor Unit, typically mounted indoors, the Outdoor Unit, which is located outdoors and the antenna. The Radio Unit is typically located close by or directly attached to the antenna. The Indoor Unit and the Radio Unit are connected with a single coaxial cable, a sufficiently long cable can be used (for example, up to 100 m long RG-213, or up to 300 m long LMR-400 cable).

In order to implement a communication link, the CFM terminal must be positioned in both points to be linked.

The radio relay system has a simple and effective design ensuring low price and high reliability of the device. These features result also in a compactness and low power consumption.

CFM Radio in the Modern Market

The widespread and growing use of microwave radio equipment in modern voice and data networks well deserves to be called a phenomenon of the last decade of the 20th century and beginning of the 21st century. The reasons behind that are numerous, like:

- increased demand for high data rate channels,
- growing pressure on operators to shorten the deployment and commissioning times,
- ever shortening time of the return on investments,
- changing demands for the services from the customers.

All those issues are well solved by use of wireless systems.

SAF Tehnika believes that by cleverly integrating the latest achievements in radio technology and in components, we are delivering the solutions for operators enabling them to deploy new services and solve communication problems to customers, thus developing the market.

Typical Uses of the CFM Radio System

SAF Tehnika is delivering CFM radio system as a number of units, which enables great flexibility in configurations one could achieve.

By combining unified LM Radio Unit model with the choice from available LM Indoor Units it is possible to make the right configuration for wide range of data and voice transmission needs.

CFM radio systems are widely used in data networks of ISPs and other network operators:

- To connect customers with high bandwidth requirements (office buildings, bigger corporate customers) demanding higher than 2 Mbps connection speeds;
- To build medium capacity backbone connections between Points of Presence (POPs) of the operator.

CFM equipment is often used to create private networks:

- For the governmental institutions;
- For utility companies (electricity, heat, water, gas);
- Community networks within bigger cities and in countryside;
- For large companies with multiple manufacturing, office and other sites to connect in one network.

New uses for CFM equipment are emerging every day.

Abbreviations

AIS	Alarm Indicator Status
BU	Balancing Unit
BER	Bit Error Ratio
CLI	Command Line Interpreter
CPE	Customer Premises Equipment
ETS	European Telecommunications Standard (ETSI standard)
IDU	Indoor Unit
IF	Intermediate frequency
LAN	Local Area Network
MM	Management
MUX	Multiplexer
ODU	Outdoor Unit
REB	Remote Ethernet Bridge
RF	Radio frequency
WAN	Wide Area Network

CFM-LM Equipment

Overview

The CFM-LM digital microwave radio products can be employed in various modern applications including private data/voice networks, cellular networks, utility private networks, PBX trunk connectivity, access to high-speed networks of providers of data services (IP, FR, etc.).

The choice of antennas for the CFM-LM radio model solely depends on the availability requirements for particular installation or service type.

CFM-LM System Components:

The typical CFM-LM terminal configuration consists of an Indoor Unit, an Outdoor Unit and an antenna.

The Outdoor Unit is either directly connected to the antenna or installed separately. In the latter case a flexible waveguide is used to interconnect the ODU with the antenna.

The ODU is interconnected with the IDU with a single coaxial cable.

The following LM Indoor Unit models are available:

- The CFM-8-REB, - Remote Ethernet Bridge IDU, provides full radio capacity of 8 Mbps to 10Base-T UTP Ethernet interface on the LAN side;
- The CFM-34-REBM, - modular Fast Ethernet bridge IDU, provides 100Base-Tx UTP LAN interface plus two interface slots that can be equipped with two interface modules (V.35, E1 or 10Base-T Ethernet) providing additional traffic interfaces with a maximum capacity of 2 Mbps each;
- Modular multiplexer IDUs: the following multiplexer IDUs are available:
 - CFM-8-MUX, - modular IDU, can be equipped with 4 interface modules (V.35, E1 or 10Base-T Ethernet) providing maximum WAN data rate of 8 Mbps;
 - CFM-16-MUX, - modular IDU, can be equipped with 4 interface modules providing maximum WAN data rate of 16 Mbps;
- E1 Indoor Units: the following E1 interface IDUs are available:
 - CFM-8-4E1, - fixed configuration multiplexer, provides multiplexing of 4 E1 channels into a single 8 Mbps stream (8448 kbps total throughput, 8192 kbps payload);
 - CFM-16-8E1, - fixed configuration multiplexer, provides multiplexing of 8 E1 channels into a single 16 Mbps stream (16896 kbps total throughput, 16384 kbps payload);
 - CFM-34-16E1, - fixed configuration multiplexer, provides multiplexing of 16 E1 channels into a single 34 Mbps stream (34368 kbps total throughput, 32768 kbps payload);
- CFM-M-MUX, - modular IDU, can be equipped with 4 interface modules (V.35, E1, 4xE1 or 2-port 100Base-T), supports WAN data rates of 8 Mbps, 16 Mbps and 34 Mbps;
- CFM-MP-MUX, modular 1+1 IDU (2U high), can be equipped with 4 interface modules (V.35, E1, 4xE1 or 2-port 100Base-T), supports WAN data rates of 8 Mbps, 16 Mbps and 34 Mbps;

Main Features and Characteristics

Main Features

The CFM-LM microwave radio system offers the following operation and maintenance facilities:

- Radio performance monitoring,
- Near-end and far-end loopback tests,
- Software controlled parameters of the ODU and IDU.

The CFM-LM radio system offers a wide range of management capabilities including the remote adjustment control, monitoring and testing.

In order to locate faults, the service engineer can access the Operation & Maintenance channel using a PC with the appropriate software to perform loop tests. Loop tests are discussed in a greater detail in paragraph *Loop Tests*, page 48.

The management terminal can be connected to the IDU through RS232 or Ethernet ports. The local loop-back tests can also be performed from the local management interface on the IDU.

A wide range of parameters can be adjusted from the management terminal (PC) as well as through the IDU management interface, - LCD and keypad.

The radio unit and the antenna are easily installed on a wide range of support structures. Depending on the antenna used, the radio unit can be fitted directly to the antenna without a waveguide feeder, or it can be fitted separately and connected with antenna with a flexible waveguide. In either case the radio unit can be disconnected and replaced without affecting the antenna alignment.

The IDU unit is fitted in 19" rack or on the wall or desk.

The management facilities of all SAF Tehnika products are being continuously developed and improved making the setup, commissioning and maintenance easier.

IDU Characteristics

The CFM-8-REB Ethernet Bridge provides 10Base-T UTP traffic port on RJ-45 socket.

The CFM-34-REBM is modular Indoor Unit providing 10/100Base-Tx UTP traffic interface on RJ-45 socket and two 2 Mbps slots for additional traffic interface modules.

The CFM-8-MUX provides the WAN data rate of 8 Mbps.

The CFM-16-MUX provides the WAN data rate of 16 Mbps.

The CFM-M-MUX and the CFM-MP-MUX provides WAN data rates of 8, 16 and 34 Mbps, the data rate are software selectable.

The CFM-8-4E1 provides fixed 2 Mbps traffic capacity to each of two E1 interface ports, the ports are available with either RJ-45 socket or BNC connectors.

The CFM-16-8E1 is the fixed configuration multiplexer providing WAN data rate of 16 Mbps, the traffic interfaces are available with DB25 or RJ-45 port connectors.

The CFM-34-16E1 is the fixed configuration multiplexer providing WAN data rate of 34 Mbps, the traffic interfaces have RJ-45 port connectors.

ODU Characteristics

Covered frequency band

The CFM-38-LM radio covers 37.0 – 39.5 GHz band;

The CFM-26-LM radio covers 24.5 – 26.5 GHz band;

The CFM-22-LM radio covers 22.0 – 23.6 GHz band;

The CFM-18-LM radio covers 17.7 – 19.7 GHz band;

The CFM-15-LM radio covers 14.40 – 15.35 GHz band;

The CFM-13-LM radio covers 12.75 – 13.25 GHz band;

CFM-LM EQUIPMENT

The CFM-8-LM radio has various versions available:

- 7.900 – 8.400 GHz band,
- 8.275 – 8.500 GHz band;

The CFM-7-LM radio has various versions available:

- 7.125 – 7.425 GHz band,
- 7.425 – 7.725 GHz band.

The ODUs have various types regarding what frequency subband (A, B or C) within a band side (H or L) they cover; two types of ODUs must be combined for each hop:

- L and H ODUs: L type ODU transmitter operates in lower frequencies (L band side) and receiver works in upper frequencies, H type ODU is reverse to L type, - transmitter operates in upper side of the band and receiver operates in lower side;
- LA and HA ODUs: LA ODU transmitter operates in A subband of the L band side, HA ODU transmitter operates in A subband of the H band side;
- LB and HB ODUs;
- LC and HC ODUs;

The type of ODU depends on what frequency plan the ODU supports.

Duplex spacings

The width of the duplex spacing (difference in Tx and Rx frequencies) for the CFM-22-LM ODU is either 1008 MHz or 1232 MHz (two different versions of the CFM-22-LM ODU).

The duplex spacing of the CFM-7-LM radio is 154 MHz and 161 MHz.

The duplex spacing of the CFM-8-LM radio is 119 MHz and 266 MHz.

The duplex spacing of the CFM-13-LM radio is 266 MHz.

The duplex spacing of the CFM-15-LM radio is 728 MHz, 420 MHz, and 490 MHz.

The duplex spacing of the CFM-18-LM radio is 1010 MHz.

The duplex spacing of the CFM-22-LM radio is 1008 MHz or 1232 MHz.

The duplex spacing of the CFM-26-LM radio is 1008 MHz.

The duplex spacing of the CFM-38-LM radio is 1260 MHz.

Occupied bandwidth

Supported bandwidths and corresponding bit rates of the CFM-LM ODU are shown in the table below:

ODU	Bit rate			
	4 Mbps	8 Mbps	16 Mbps	34 Mbps
CFM-38-LM	n/a	7 MHz	14 MHz	28 MHz
CFM-26-LM	n/a	7 MHz	14 MHz	28 MHz
CFM-22-LM	n/a	7 MHz	14 MHz	28 MHz
CFM-18-LM	n/a	7 MHz	13.75 MHz	27.5 MHz
CFM-15-LM	n/a	7 MHz	14 MHz	28 MHz
CFM-13-LM	n/a	7 MHz	14 MHz	28 MHz
CFM-8-LM	n/a	7 MHz	14 MHz	28 MHz
CFM-7-LM	n/a	7 MHz	14 MHz	28 MHz

Transmitter power

The maximum transmit power for

- the CFM-38-LM ODU is 14 dBm,
- the CFM-26-LM ODU is 19 dBm,
- the CFM-22-LM ODU is 19 dBm,
- the CFM-18-LM ODU is 19 dBm,
- the CFM-15-LM ODU is 20 dBm,
- the CFM-13-LM ODU is 20 dBm,
- the CFM-8-LM ODU is 27 dBm,
- the CFM-7-LM ODU is 27 dBm.

The minimum transmit power for all radios is -10 dBm; the transmitter power can be changed from the minimum up to the maximum level in steps of 1 dB.

Standards

ETSI

ETSI EN 300 198	Transmission and Multiplexing (TM); Digital Radio Relay Systems (DRRS); Parameters for DRRS for the transmission of digital signals and analogue video signals operating at 23 GHz.
ETSI ETS 300 019	“Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment”.
ETSI ETS 300 132-2	“Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)”.
ETS 300 339	“Radio Equipment and Systems (RES); General Electro-Magnetic Compatibility (EMC) for radio equipment”.
ETS 300 385	“Radio Equipment and Systems (RES); Electro-Magnetic Compatibility (EMC) standard for digital fixed radio and ancillary with data rates at around 2 Mbit/s and above”.
EN 301 401	Attachment requirements for Data Terminal Equipment (DTE) to connect to public networks that have physical and electrical network presentations based upon the ITU-T V-series of Recommendations.
EN 300 324-1 v.1.2.3	V interfaces at the digital Local Exchange (LE); V5.1 interface for the support of Access Network (AN); Part 1: V5.1 interface specification.
EN 300 347-1 v.2.2.2	V interfaces at the digital Local Exchange (LE); V5.2 interface for the support of Access Network (AN); Part 1: V5.2 interface specification.
EN 301 216 v.1.2.1 (2001-07)	In the range 3 GHz to 11 GHz. Plesiochronous Digital Hierarchy (PDH); Low and medium capacity and STM-0 digital radio system operating in the frequency bands in the range 3 GHz to 11 GHz
ETSI EN 300 197 v.1.6.1	Parameters for radio systems for the transmission of digital signals operating at 38 GHz
ETSI EN 300 431 v.1.4.1 (2002-07)	Parameters for digital radio systems operating in the frequency range 24,50 GHz to 29,50 GHz
ETSI EN 301 128 v.1.2.1	Parameters for digital radio systems operating in 13 GHz, 15 GHz and 18 GHz bands
ETSI EN 301 126-1 v.1.1.2 (1999-09)	Fixed Radio Systems; Conformance testing; Part 1: Point-to-Point equipment -Definitions, general requirements and test procedures
ETSI EN 301 390 v.1.1.1 (2000-12)	Fixed Radio Systems; Point-to-Point and Point-to-Multipoint systems; Spurious emissions and receiver immunity at equipment \ antenna port of Digital Fixed Radio Systems
ETSI EN 300 833 v.1.3.1 (2001-08)	Fixed radio systems; Point-to-point antennas; Antennas for point-to-point fixed radio systems operating in the frequency band 3 GHz to 60 GHz
ETSI EN 301 489-1 v.1.2.2 (08-2000)	EMC standard
ETSI EN 301 489-1 v.1.2.2 (08-2000)	EMC standard
ETSI EN 301 751 v.1.2.1 final draft (2002-07)	Fixed radio systems; Point-to-Point equipment and antennas; Generic harmonized standard for point-to-Point digital Fixed radio systems and antennas covering the essential requirements under Article 3.2 of the Directive 1999/5/EC

CFM-LM EQUIPMENT**ITU-T**

ITU-T G.702	Digital hierarchy bit rates.
ITU-T G.703	Physical/electrical characteristics of hierarchical digital interfaces.
ITU-T G.742 (11/88)	Second order digital multiplex equipment operating at 8448 kbit/s and using positive justification.
ITU-T G.744 (11/88)	Second order PCM multiplex equipment operating at 8448 kbit/s.
ITU-T G.775 (10/98)	Loss of Signal (LOS), Alarm Indication Signal (AIS) and Remote Defect Indication (RDI) defect detection and clearance criteria for PDH signals.
ITU-T M.3400 (04/97)	TMN Management functions.
ITU-T M.3010 (05/96)	Principles for a TMN.
ITU-T G.775 (10/98)	Loss of Signal (LOS), Alarm Indication Signal (AIS) and Remote Defect Indication (RDI) defect detection and clearance criteria for PDH signals.
ITU-T G.821 (12/02)	Error performance of an international digital connection operating at a bit rate below the primary rate and forming part of an Integrated Services Digital Network.
ITU-T G.826 (08/96), refers to MP-MUX IDU	Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate.
ITU-T G.823 (03/93)	The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy.
ITU-T G.921	Digital sections based on the 2048 kbit/s hierarchy.

ITU-R

ITU-R F.385-6 Annex 1	7.425 – 7.725 GHz Duplex spacing 154 MHz
ITU-R F.385-6	7.125 – 7.425 GHz Duplex spacing 161 MHz 7.425 – 7.725 GHz Duplex spacing 161 MHz
ITU-R F.386-6 Annex 3 and Annex 4	8.275 – 8.500 GHz Duplex spacing 119/126 MHz 7.900 – 8.400 GHz Duplex spacing 266 MHz
ITU-R F.497-6	12.75 – 13.25 GHz Duplex spacing 266 MHz
ITU-R F.636-3	14.4 – 15.35 GHz Duplex spacing 490 MHz
ITU-R F.636-3	14.5 – 15.35 GHz Duplex spacing 420 MHz
ITU-R F.595-7	17.7 – 19.7 GHz Duplex spacing 1010 MHz
ITU-R F.637-3 Annex 1 and Annex 3	21.2 – 23.6 GHz Duplex spacing 1232 MHz 22.0 – 23.6 GHz Duplex spacing 1008 MHz
ITU-R F.748-2 Annex 1	24.5 – 26.5 GHz Duplex spacing 1008 MHz
ITU-R F.749-2 Annex 1	37.0 – 39.5 GHz Duplex spacing 1260 MHz

CEPT/ERC

CEPT/ERC Recommendation T/R 12-02 E	12.75 – 13.25 GHz Duplex spacing 266 MHz
CEPT/ERC Recommendation T/R 12-07 E	14.5 – 15.35 GHz Duplex spacing 728 MHz
CEPT/ERC Recommendation T/R 12-03 E	17.7 – 19.7 GHz Duplex spacing 1010 MHz
CEPT/ERC Recommendation T/R 13-02 E	22.0 – 23.6 GHz Duplex spacing 1008 MHz 24.5 – 26.5 GHz Duplex spacing 1008 MHz
CEPT/ERC Recommendation T/R 12-01 E	37.0 – 39.5 GHz Duplex spacing 1260 MHz
CEPT/ERC Recommendation 74-01E	Spurious emissions

IEEE

IEEE 802.3	Ethernet interface
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Terminal and Site Configurations

Unprotected Terminal (1+0)

Unprotected terminal configuration (1+0) consists of:

- One radio unit (ODU)
- One antenna
- One indoor unit

Protected Terminal (1+1)

The protected terminal configuration (1+1) is available using 1+1 IDUs, - CFM-MP-MUX. For more information on 1+1 configuration please refer to the *CFM-MP-MUX Indoor Unit Installation and Configuration Manual* (see chapter *References* for more information).

Repeater Site

At certain conditions it may become necessary to install one or more repeater sites. With the existing equipment it is possible to establish the repeater site by installing two complete CFM equipment sets (see Figure 1). This configuration allows the use of functions offered by the Service channel as well as the use of interfaces for data streams to be added or dropped in the both CFM IDUs at the repeater site.

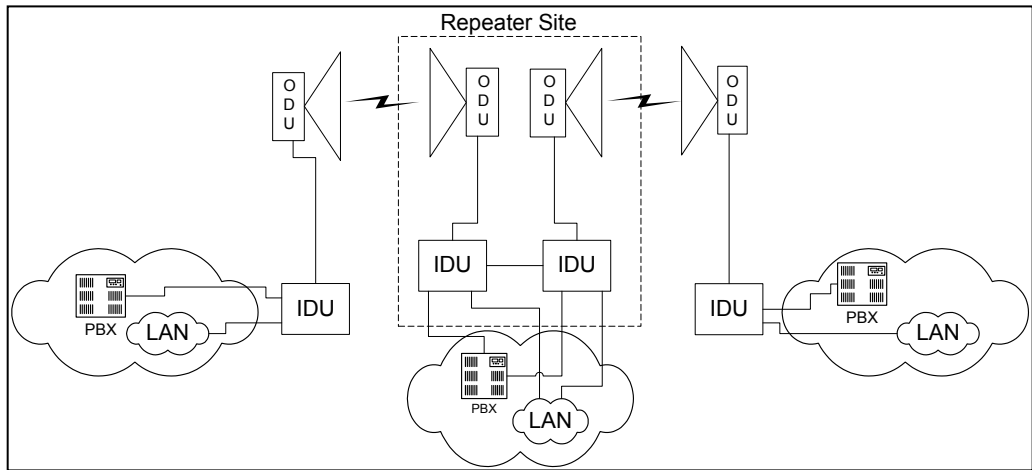


Figure 1. Typical configuration of the repeater site

Outdoor Unit and Antenna

General

The Outdoor Unit (ODU) and the antenna forms the outdoor part of the CFM site (one side of the hop). The Outdoor Unit is a radio unit which can be either directly connected to the antenna or installed separately using flexible waveguide. The Radio Unit is connected to the IDU using a single 50 Ω coaxial cable, for more detailed information on the IDU-ODU cable please refer to section *IDU-ODU Cable*, page 40.

Radio Unit

The CFM-LM Radio Unit is implemented as a weatherproof white circular housing weighting 2.5 kg.

There are following external features:

- UBR flange in the centre of the case for connection to the antenna,
- The interface for connection to the IDU (N-type socket),
- The test port for antenna alignment (BNC socket).

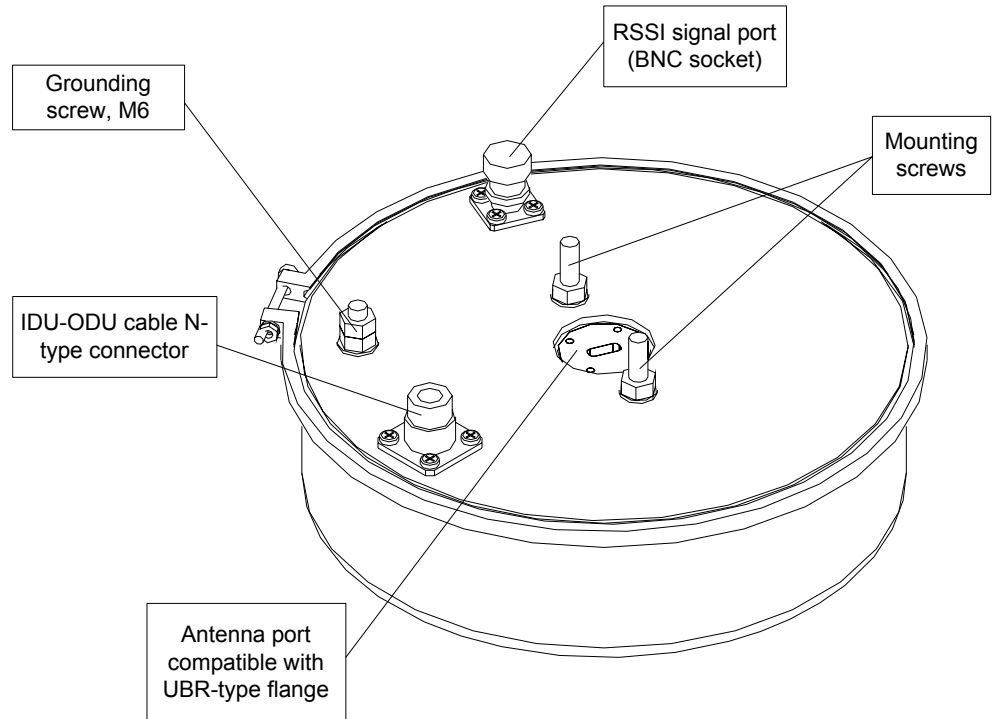


Figure 2. CFM-LM Radio Unit

For ODU technical parameters please refer to Chapter *Technical Data*, page 53.

Relation of RSSI Rx signal level and received power is specified in the configuration guide (see *References*)

The ODUs have the following **waveguide flanges**:

- CFM-7-LM: UBR 84,
- CFM-8-LM: UBR 84,
- CFM-13-LM: UBR 140,
- CFM-15-LM: UBR 140,
- CFM-18-LM: UBR 220,
- CFM-22-LM: UBR 220,
- CFM-26-LM: UBR 260,
- CFM-38-LM: UBR 320.

For information about frequency allocation refer to Chapter *Frequency Channel Arrangement*, page 15.

OUTDOOR UNIT AND ANTENNA

The ODU contains **temperature sensor** and condensing **moisture sensor**. These indications are accessible through all available management methods. The temperature sensor indicates the temperature within the ODU, - it is normally about 6°C higher than the outer temperature. As for the triggered moisture sensor, it is most likely that the ODU cover is opened. This is abnormal operational condition and should be averted as soon as possible.

Labelling

Each Outdoor Unit is labelled.

The ODU is uniquely identified by the combination of product number ("P/N") and serial number.

The label contains five squares (see figures below). One of the first two squares will have a letter L or H (other is blank) which denotes what band side the specific radio operates (Low or High). Either the third square or the fourth square will have letter A or B (the fourth square – letter A or the fifth square – letter B), which denotes the subband. The fifth square is blank.



Figure 3. Label of the CFM-22-LM Radio

OUTDOOR UNIT AND ANTENNA

ODU Functional Design

The radio unit consists of the following components (please refer to Figure 4):

- Cable interface
- IF module
- Receiver & Transmitter units
- Controller module
- Synthesizer module
- Duplexer

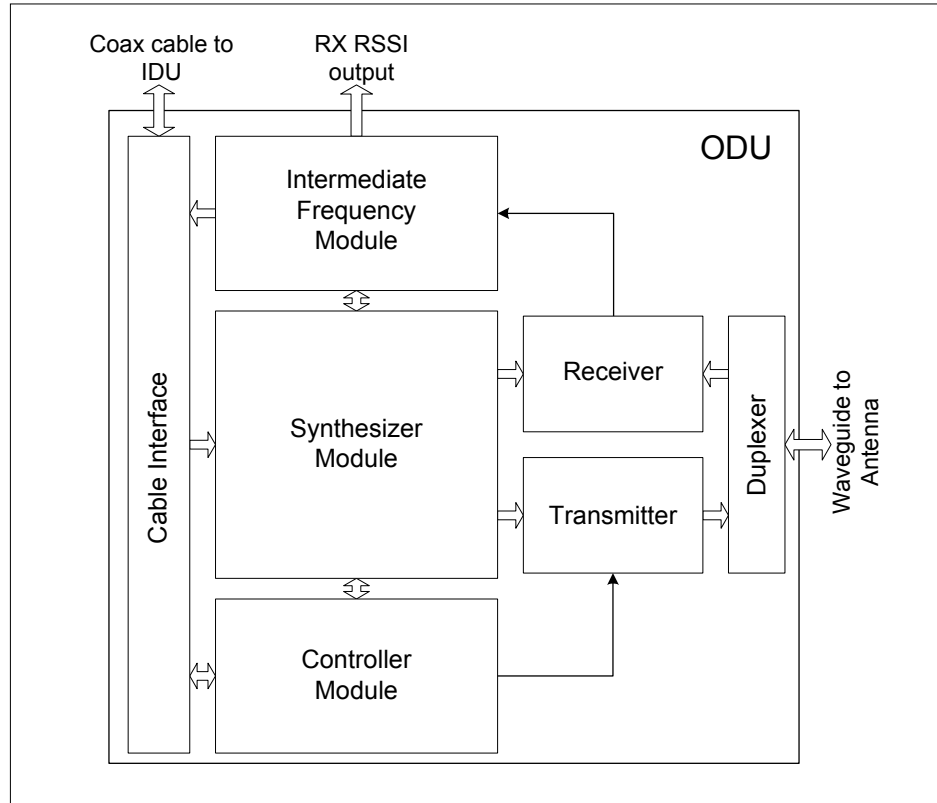


Figure 4. The CFM-LM radio unit block diagram

Cable Interface

There are two functions accomplished in the cable interface:

- The power supply of the radio unit,
- The provision of signal transportation to the IDU over the coaxial cable.

The supply voltage, which can be in the range from 20 to 60 V with both polarities in relation to the ground, is supplied from the IDU over the cable.

A 350 MHz frequency signal, modulated with the filtered data signal, is received from the IDU. The cable interface contains the FM demodulation unit. The data signal from the output of the FM demodulation unit is forwarded to the modulation input of the voltage-controlled oscillator in the transmitting part of the synthesizer module. Thus the data signal is transported from the IDU to the ODU. The cable can be so long until the maximum attenuation of the signal does not exceed 20 dB. The FM demodulators produce a voltage, which is proportional to the logarithm of the 350 MHz carrier power (cable RSSI). This voltage is supplied to the controller module and is used to check if the allowed length of the coaxial cable is not exceeded.

The transportation of the data signal from the ODU to the IDU is carried out as follows: limited (constant level) 140 MHz intermediate frequency signal is supplied to the coaxial cable through the amplifier and the band-pass filter in the cable interface. This signal is frequency-modulated (the modulation is performed in the transmitter of the opposite station) and the length of the cable has no effect on the transmitted data signal, unless the 20 dB attenuation limit is kept up. Since the filtration and restriction of the intermediate frequency signal is performed in the radio unit, the transportation of the signal to the IDU has no effect on the sensitivity of the receiver.

Additional data signal with a transmission rate of 9 kbps is transmitted over the same coaxial cable from the IDU to the ODU and vice versa. Both signals carry telemetry data between ODU and IDU. This is performed using two carriers with pulse-modulated amplitude. The data from the ODU to the IDU are transmitted on a 6 MHz carrier, but from the IDU to the ODU – on a 4.5 MHz carrier.

Intermediate Frequency Module

The IF module is used for the second conversion and filtering of the signal. The 1542 MHz intermediate frequency signal is passed to the IF block from the first converter in the receiver. Synthesized 1402 MHz oscillator jointly with a mixer transforms the first intermediate frequency into the second intermediate frequency of 140 MHz. The second IF signal is filtered with a surface acoustic waves (SAW) filter, after the filtering the signal arrives to the logarithmic amplifier that has a signal limiter at the output. The logarithmic amplifier has an additional function – an exact measurement of the power of the received signal. The direct voltage on the output of this amplifier is supplied to the controller module and is used for the measurements.

Synthesizer Module

The synthesizer module has two very similar frequency synthesizers. One synthesizer supplies the oscillator signal to the first mixer. The second has a modulation input and it supplies the signal to the transmitter. The synthesizers are based on the voltage-controlled oscillators (VCO). The frequency of VCOs is stabilized and modified, using a phase-locked loop (PLL).

Receiver

The receiver performs amplification of the received signal by means of a low-noise amplifier (LNA), which is a monolithic microwave integrated circuit (MMIC), enclosed in a special package. The signal after that is forwarded to the mirror-channel filter, which is installed with the purpose to reduce the noise factor of the receiver. From the point of view of the input signal, sufficient attenuation of the mirror channel is provided by the duplexer filter.

The amplified signal is passed to the subharmonic mixer, where it is converted to the frequency of 1542 MHz. This mixer is also a monolithic microwave integrated circuit.

RX block has a waveguide input.

Transmitter

In the transmitter, the output frequency of the synthesizer module is doubled and the resulting signal is amplified. Both functions are performed by one monolithic microwave integrated circuit. By switching on and off the supply voltage, it is possible to switch on and off the transmitter. TX block has a waveguide output.

Duplexer

The duplexer is intended for combining the signals from the transmitter and receiver into the single waveguide to the antenna. This device is a narrow-band waveguide filter with one common waveguide output. Tx frequency setting in one station should match Rx frequency at the other station and vice versa.

Controller Module

The controller module is intended to ensure the control and checking of the radio unit and a link with the IDU.

The control functions are intended for:

- Setting of the synthesizer frequencies
- Setting of the output power
- Switching the receiver on and off

The checking functions are provided for:

- Measuring the level of the received signal
- Measuring the signal attenuation in the cable
- Checking the synchronism of the synthesizers
- Measuring the temperature of the radio unit
- Checking the humidity in the radio unit

Settings of the frequency and transmitter power are accomplished from the IDU management interface or through the management console. The ODU has its own management controller and the memory for configuration storage. The configuration information is stored in the ODU management controller EPROM. Consequently, in the case of the ODU replacement, the current configuration of link may change therefore the new parameters should be set.

SAF Tehnika is shipping CFM-LM Outdoor Units with the following default settings:

- The transmitter is switched off (TxPower=off);
- The channel is set to one in the middle of the sub-band.

The Tx channel can be adjusted from the IDU or using other available management methods.

The arrangement of frequency channels is given in tables in Chapter *Frequency Channel Arrangement*.

Frequency Channel Arrangement

Table 1. Tx/Rx channel centre frequencies (3.5 MHz step) for the CFM-7-**LM** series Radio operating in 7 GHz band with the duplex shift of 154 MHz; the CFM-7-LM ODU operates with the channel spacings 7 MHz for 8 Mbps capacity, 14 MHz for 16 Mbps capacity and 28 MHz for 34 Mbps capacity; the plan corresponds to ITU-R recommendation F.385-6 Annex 1.

Centre frequencies in subbands A and B, MHz						Centre frequencies in subband C, MHz		
Channel Nr.	LA	HA	Channel Nr.	LB	HB	Channel Nr.	LC	HC
1	7428,00	7582,00	17	7484,00	7638,00	1	7512,00	7666,00
2	7431,50	7585,50	18	7487,50	7641,50	2	7515,50	7669,50
3	7435,00	7589,00	19	7491,00	7645,00	3	7519,00	7673,00
4	7438,50	7592,50	20	7494,50	7648,50	4	7522,50	7676,50
5	7442,00	7596,00	21	7498,00	7652,00	5	7526,00	7680,00
6	7445,50	7599,50	22	7501,50	7655,50	6	7529,50	7683,50
7	7449,00	7603,00	23	7505,00	7659,00	7	7533,00	7687,00
8	7452,50	7606,50	24	7508,50	7662,50	8	7536,50	7690,50
9	7456,00	7610,00	25	7512,00	7666,00	9	7540,00	7694,00
10	7459,50	7613,50	26	7515,50	7669,50	10	7543,50	7697,50
11	7463,00	7617,00	27	7519,00	7673,00	11	7547,00	7701,00
12	7466,50	7620,50	28	7522,50	7676,50	12	7550,50	7704,50
13	7470,00	7624,00	29	7526,00	7680,00	13	7554,00	7708,00
14	7473,50	7627,50	30	7529,50	7683,50	14	7557,50	7711,50
15	7477,00	7631,00	31	7533,00	7687,00	15	7561,00	7715,00
16	7480,50	7634,50	32	7536,50	7690,50	16	7564,50	7718,50
17	7484,00	7638,00	33	7540,00	7694,00	17	7568,00	7722,00

Table 2. Tx/Rx channel centre frequencies for the CFM-7-**LM** series Radio operating in 7 GHz band with the duplex shift of 161 MHz; the plan corresponds to ITU-R recommendation F.385-6.

Centre frequencies in subbands A and B, MHz						Centre frequencies in subband C, MHz		
Channel Nr.	LA	HA	Channel Nr.	LB	HB	Channel Nr.	LC	HC
1	7428,00	7589,00	9	7484,00	7645,00	14	7519,00	7680,00
2	7435,00	7596,00	10	7491,00	7652,00	15	7526,00	7687,00
3	7442,00	7603,00	11	7498,00	7659,00	16	7533,00	7694,00
4	7449,00	7610,00	12	7505,00	7666,00	17	7540,00	7701,00
5	7456,00	7617,00	13	7512,00	7673,00	18	7547,00	7708,00
6	7463,00	7624,00	14	7519,00	7680,00	19	7554,00	7715,00
7	7470,00	7631,00	15	7526,00	7687,00	20	7561,00	7722,00
8	7477,00	7638,00	16	7533,00	7694,00			

Table 3. Tx/Rx channel centre frequencies for the CFM-7-**LM** series Radio operating in 7 GHz band with the duplex shift of 161 MHz; the plan corresponds to ITU-R recommendation F.385-6.

Centre frequencies in subbands A and B, MHz						Centre frequencies in subband C, MHz		
Channel Nr.	LA	HA	Channel Nr.	LB	HB	Channel Nr.	LC	HC
1	7128,00	7289,00	9	7184,00	7345,00	14	7219,00	7380,00
2	7135,00	7296,00	10	7191,00	7352,00	15	7226,00	7387,00
3	7142,00	7303,00	11	7198,00	7359,00	16	7233,00	7394,00
4	7149,00	7310,00	12	7205,00	7366,00	17	7240,00	7401,00
5	7156,00	7317,00	13	7212,00	7373,00	18	7247,00	7408,00
6	7163,00	7324,00	14	7219,00	7380,00	19	7254,00	7415,00
7	7170,00	7331,00	15	7226,00	7387,00	20	7261,00	7422,00
8	7177,00	7338,00	16	7233,00	7394,00			

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Table 4. Tx/Rx channel centre frequencies (3.5 MHz step) for the CFM-8-LM series Radio operating in 8 GHz band with the duplex shift of 119 MHz; the CFM-8-LM ODU operates with the channel spacings 7 MHz for 8 Mbps capacity, 14 MHz for 16 Mbps capacity and 28 MHz for 34 Mbps capacity; the plan corresponds to ITU-R recommendation F.386-6 Annex 3.

Channel Nr.	LA	HA	Channel Nr.	LB	HB
1	8286,00	8405,00	14	8328,00	8447,00
2	8289,50	8408,50	15	8331,50	8450,50
3	8293,00	8412,00	16	8335,00	8454,00
4	8296,50	8415,50	17	8338,50	8457,50
5	8300,00	8419,00	18	8342,00	8461,00
6	8303,50	8422,50	19	8345,50	8464,50
7	8307,00	8426,00	20	8349,00	8468,00
8	8310,50	8429,50	21	8352,50	8471,50
9	8314,00	8433,00	22	8356,00	8475,00
10	8317,50	8436,50	23	8359,50	8478,50
11	8321,00	8440,00	24	8363,00	8482,00
12	8324,50	8443,50	25	8366,50	8485,50
13	8328,00	8447,00	26	8370,00	8489,00

Table 5. Tx/Rx channel centre frequencies (3.5 MHz step) for the CFM-8-LM series Radio operating in 8 GHz band with the duplex shift of 266 MHz; the CFM-8-LM ODU operates with the channel spacings 7 MHz for 8 Mbps capacity, 14 MHz for 16 Mbps capacity and 28 MHz for 34 Mbps capacity; the plan corresponds to ITU-R recommendation F.386-6 Annex 4.

Channel Nr.	Channel spacing, MHz			LA	HA	Channel Nr.	Channel spacing, MHz			LA	HA
	7	14	28				7	14	28		
1	1	1		7 912,0	8 178,0	17	17	9		8 024,0	8 290,0
2	2			7 919,0	8 185,0	18	18			8 031,0	8 297,0
3	3	2	1	7 926,0	8 192,0	19	19	10	5	8 038,0	8 304,0
4	4			7 933,0	8 199,0	20	20			8 045,0	8 311,0
5	5	3		7 940,0	8 206,0	21	21	11		8 052,0	8 318,0
6	6			7 947,0	8 213,0	22	22			8 059,0	8 325,0
7	7	4	2	7 954,0	8 220,0	23	23	12	6	8 066,0	8 332,0
8	8			7 961,0	8 227,0	24	24			8 073,0	8 339,0
9	9	5		7 968,0	8 234,0	25	25	13		8 080,0	8 346,0
10	10			7 975,0	8 241,0	26	26			8 087,0	8 353,0
11	11	6	3	7 982,0	8 248,0	27	27	14	7	8 094,0	8 360,0
12	12			7 989,0	8 255,0	28	28			8 101,0	8 367,0
13	13	7		7 996,0	8 262,0	29	29	15		8 108,0	8 374,0
14	14			8 003,0	8 269,0	30	30			8 115,0	8 381,0
15	15	8	4	8 010,0	8 276,0	31	31	16	8	8 122,0	8 388,0
16	16			8 017,0	8 283,0	32	32			8 129,0	8 395,0

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Table 6. Tx/Rx channel centre frequencies for the CFM-13-LM series Radio operating in 13 GHz band with the channel spacing of 7 MHz; duplex shift is 266 MHz; the plan corresponds to CEPT/ERC recommendation 12-02 E.

N	LA	HA	N	LB	HB
0	12754,5	13020,5	16	12866,5	13132,5
1	12761,5	13027,5	17	12873,5	13139,5
2	12768,5	13034,5	18	12880,5	13146,5
3	12775,5	13041,5	19	12887,5	13153,5
4	12782,5	13048,5	20	12894,5	13160,5
5	12789,5	13055,5	21	12901,5	13167,5
6	12796,5	13062,5	22	12908,5	13174,5
7	12803,5	13069,5	23	12915,5	13181,5
8	12810,5	13076,5	24	12922,5	13188,5
9	12817,5	13083,5	25	12929,5	13195,5
10	12824,5	13090,5	26	12936,5	13202,5
11	12831,5	13097,5	27	12943,5	13209,5
12	12838,5	13104,5	28	12950,5	13216,5
13	12845,5	13111,5	29	12957,5	13223,5
14	12852,5	13118,5	30	12964,5	13230,5
15	12859,5	13125,5	31	12971,5	13237,5

Table 7. Tx/Rx channel centre frequencies for the CFM-13-LM series Radio operating in 13 GHz band with the channel spacing of 14 MHz; duplex shift is 266 MHz; the plan corresponds to CEPT/ERC recommendation 12-02 E.

N	LA	HA	N	LB	HB
0	12758	13024	8	12870	13136
1	12772	13038	9	12884	13150
2	12786	13052	10	12898	13164
3	12800	13066	11	12912	13178
4	12814	13080	12	12926	13192
5	12828	13094	13	12940	13206
6	12842	13108	14	12954	13220
7	12856	13122	15	12968	13234

Table 8. Tx/Rx channel centre frequencies for the CFM-13-LM series Radio operating in 13 GHz band with the channel spacing of 28 MHz; duplex shift is 266 MHz; the plan corresponds to CEPT/ERC recommendation 12-02 E.

N	LA	HA	N	LB	HB
0	12765	13031	4	12877	13143
1	12793	13059	5	12905	13171
2	12821	13087	6	12933	13199
3	12849	13115	7	12961	13227

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Table 9. Tx/Rx channel centre frequencies for the CFM-15-LM series Radio operating in 15 GHz band with the channel spacing of 7 MHz; duplex shift is 728 MHz; the plan corresponds to CEPT/ERC recommendation 12-07 E.

N	L	H	N	L	H
0	14504,5	15232,5	8	14560,5	15288,5
1	14511,5	15239,5	9	14567,5	15295,5
2	14518,5	15246,5	10	14574,5	15302,5
3	14525,5	15253,5	11	14581,5	15309,5
4	14532,5	15260,5	12	14588,5	15316,5
5	14539,5	15267,5	13	14595,5	15323,5
6	14546,5	15274,5	14	14602,5	15330,5
7	14553,5	15281,5	15	14609,5	15337,5

Table 10. Tx/Rx channel centre frequencies for the CFM-15-LM series Radio operating in 15 GHz band with the channel spacing of 14 MHz; duplex shift is 728 MHz; the plan corresponds to CEPT/ERC recommendation 12-07 E.

N	L	H
0	14515	15243
1	14529	15257
2	14543	15271
3	14557	15285
4	14571	15299
5	14585	15313
6	14599	15327
7	14613	15341

Table 11. Tx/Rx channel centre frequencies for the CFM-15-LM series Radio operating in 15 GHz band with the channel spacing of 28 MHz; duplex shift is 728 MHz; the plan corresponds to CEPT/ERC recommendation 12-07 E.

N	L	H
0	14515	15243
1	14543	15271
2	14571	15299
3	14599	15327

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Table 12. Tx/Rx channel centre frequencies for the CFM-15-LM series Radio operating in 15 GHz band with the channel spacing of 7 MHz; duplex shift is 420 MHz; the plan corresponds to ITU-R recommendation F.636

N	LA	HA	N	LA	HA	N	LB	HB	N	LB	HB
0	14504,5	14924,5	15	14609,5	15029,5	30	14714,5	15134,5	45	14819,5	15239,5
1	14511,5	14931,5	16	14616,5	15036,5	31	14721,5	15141,5	46	14826,5	15246,5
2	14518,5	14938,5	17	14623,5	15043,5	32	14728,5	15148,5	47	14833,5	15253,5
3	14525,5	14945,5	18	14630,5	15050,5	33	14735,5	15155,5	48	14840,5	15260,5
4	14532,5	14952,5	19	14637,5	15057,5	34	14742,5	15162,5	49	14847,5	15267,5
5	14539,5	14959,5	20	14644,5	15064,5	35	14749,5	15169,5	50	14854,5	15274,5
6	14546,5	14966,5	21	14651,5	15071,5	36	14756,5	15176,5	51	14861,5	15281,5
7	14553,5	14973,5	22	14658,5	15078,5	37	14763,5	15183,5	52	14868,5	15288,5
8	14560,5	14980,5	23	14665,5	15085,5	38	14770,5	15190,5	53	14875,5	15295,5
9	14567,5	14987,5	24	14672,5	15092,5	39	14777,5	15197,5	54	14882,5	15302,5
10	14574,5	14994,5	25	14679,5	15099,5	40	14784,5	15204,5	55	14889,5	15309,5
11	14581,5	15001,5	26	14686,5	15106,5	41	14791,5	15211,5	56	14896,5	15316,5
12	14588,5	15008,5	27	14693,5	15113,5	42	14798,5	15218,5	57	14903,5	15323,5
13	14595,5	15015,5	28	14700,5	15120,5	43	14805,5	15225,5	58	14910,5	15330,5
14	14602,5	15022,5	29	14707,5	15127,5	44	14812,5	15232,5	59	14917,5	15337,5

Table 13. Tx/Rx channel centre frequencies for the CFM-15-LM series Radio operating in 15 GHz band with the channel spacing of 14 MHz; duplex shift is 420 MHz; the plan corresponds to ITU-R recommendation F.636

N	LA	HA	N	LB	HB
0	14515,0	14935,0	15	14725,0	15145,0
1	14529,0	14949,0	16	14739,0	15159,0
2	14543,0	14963,0	17	14753,0	15173,0
3	14557,0	14977,0	18	14767,0	15187,0
4	14571,0	14991,0	19	14781,0	15201,0
5	14585,0	15005,0	20	14795,0	15215,0
6	14599,0	15019,0	21	14809,0	15229,0
7	14613,0	15033,0	22	14823,0	15243,0
8	14627,0	15047,0	23	14837,0	15257,0
9	14641,0	15061,0	24	14851,0	15271,0
10	14655,0	15075,0	25	14865,0	15285,0
11	14669,0	15089,0	26	14879,0	15299,0
12	14683,0	15103,0	27	14893,0	15313,0
13	14697,0	15117,0	28	14907,0	15327,0
14	14711,0	15131,0	29	14921,0	15341,0

Table 14. Tx/Rx channel centre frequencies for the CFM-15-LM series Radio operating in 15 GHz band with the channel spacing of 28 MHz; duplex shift is 420 MHz; the plan corresponds to ITU-R recommendation F.636

N	LA	HA	N	LB	HB
0	14515,0	14935,0	8	14739,0	15159,0
1	14543,0	14963,0	9	14767,0	15187,0
2	14571,0	14991,0	10	14795,0	15215,0
3	14599,0	15019,0	11	14823,0	15243,0
4	14627,0	15047,0	12	14851,0	15271,0
5	14655,0	15075,0	13	14879,0	15299,0
6	14683,0	15103,0	14	14907,0	15327,0
7	14711,0	15131,0			

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Table 15. Tx/Rx channel centre frequencies for the CFM-15-LM series Radio operating in 15 GHz band with the channel spacing of 28 MHz; duplex shift is 490 MHz; the plan corresponds to ITU-R recommendation F.636.

ODU channel Nr.	Channels			LA	HA	ODU channel Nr.	Channels			LB	HB
	7 MHz	14 MHz	28 MHz				7 MHz	14 MHz	28 MHz		
1	1			14406,50	14896,50	65	33			14630,50	15120,50
2				14410,00	14900,00	66				14634,00	15124,00
3	2			14413,50	14903,50	67	34			14637,50	15127,50
4		1	1	14417,00	14907,00	68		17	9	14641,00	15131,00
5	3			14420,50	14910,50	69	35			14644,50	15134,50
6				14424,00	14914,00	70				14648,00	15138,00
7	4			14427,50	14917,50	71	36			14651,50	15141,50
8		2		14431,00	14921,00	72		18		14655,00	15145,00
9	5			14434,50	14924,50	73	37			14658,50	15148,50
10				14438,00	14928,00	74				14662,00	15152,00
11	6			14441,50	14931,50	75	38			14665,50	15155,50
12		3	2	14445,00	14935,00	76		19	10	14669,00	15159,00
13	7			14448,50	14938,50	77	39			14672,50	15162,50
14				14452,00	14942,00	78				14676,00	15166,00
15	8			14455,50	14945,50	79	40			14679,50	15169,50
16		4		14459,00	14949,00	80		20		14683,00	15173,00
17	9			14462,50	14952,50	81	41			14686,50	15176,50
18				14466,00	14956,00	82				14690,00	15180,00
19	10			14469,50	14959,50	83	42			14693,50	15183,50
20		5	3	14473,00	14963,00	84		21	11	14697,00	15187,00
21	11			14476,50	14966,50	85	43			14700,50	15190,50
22				14480,00	14970,00	86				14704,00	15194,00
23	12			14483,50	14973,50	87	44			14707,50	15197,50
24		6		14487,00	14977,00	88		22		14711,00	15201,00
25	13			14490,50	14980,50	89	45			14714,50	15204,50
26				14494,00	14984,00	90				14718,00	15208,00
27	14			14497,50	14987,50	91	46			14721,50	15211,50
28		7	4	14501,00	14991,00	92		23	12	14725,00	15215,00
29	15			14504,50	14994,50	93	47			14728,50	15218,50
30				14508,00	14998,00	94				14732,00	15222,00
31	16			14511,50	15001,50	95	48			14735,50	15225,50
32		8		14515,00	15005,00	96		24		14739,00	15229,00
33	17			14518,50	15008,50	97	49			14742,50	15232,50
34				14522,00	15012,00	98				14746,00	15236,00
35	18			14525,50	15015,50	99	50			14749,50	15239,50
36		9	5	14529,00	15019,00	100		25	13	14753,00	15243,00
37	19			14532,50	15022,50	101	51			14756,50	15246,50
38				14536,00	15026,00	102				14760,00	15250,00
39	20			14539,50	15029,50	103	52			14763,50	15253,50
40		10		14543,00	15033,00	104		26		14767,00	15257,00
41	21			14546,50	15036,50	105	53			14770,50	15260,50
42				14550,00	15040,00	106				14774,00	15264,00
43	22			14553,50	15043,50	107	54			14777,50	15267,50
44		11	6	14557,00	15047,00	108		27	14	14781,00	15271,00
45	23			14560,50	15050,50	109	55			14784,50	15274,50
46				14564,00	15054,00	110				14788,00	15278,00
47	24			14567,50	15057,50	111	56			14791,50	15281,50
48		12		14571,00	15061,00	112		28		14795,00	15285,00
49	25			14574,50	15064,50	113	57			14798,50	15288,50
50				14578,00	15068,00	114				14802,00	15292,00
51	26			14581,50	15071,50	115	58			14805,50	15295,50
52		13	7	14585,00	15075,00	116		29	15	14809,00	15299,00
53	27			14588,50	15078,50	117	59			14812,50	15302,50
54				14592,00	15082,00	118				14816,00	15306,00
55	28			14595,50	15085,50	119	60			14819,50	15309,50
56		14		14599,00	15089,00	120		30		14823,00	15313,00
57	29			14602,50	15092,50	121	61			14826,50	15316,50
58				14606,00	15096,00	122				14830,00	15320,00
59	30			14609,50	15099,50	123	62			14833,50	15323,50
60		15	8	14613,00	15103,00	124		31	16	14837,00	15327,00
61	31			14616,50	15106,50	125	63			14840,50	15330,50
62				14620,00	15110,00	126				14844,00	15334,00
63	32			14623,50	15113,50	127	64			14847,50	15337,50
64		16		14627,00	15117,00	128		32		14851,00	15341,00

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Table 16. Tx/Rx channel centre frequencies for the CFM-18-LM series Radio operating in 18 GHz band with the channel spacing of 13.75 MHz; duplex shift is 1010 MHz; the plan corresponds to CEPT/ERC recommendation 12-03 E.

N	LA	HA	N	LB	HB
0	17713,75	18723,75	35	18195,00	19205,00
1	17727,50	18737,50	36	18208,75	19218,75
2	17741,25	18751,25	37	18222,50	19232,50
3	17755,00	18765,00	38	18236,25	19246,25
4	17768,75	18778,75	39	18250,00	19260,00
5	17782,50	18792,50	40	18263,75	19273,75
6	17796,25	18806,25	41	18277,50	19287,50
7	17810,00	18820,00	42	18291,25	19301,25
8	17823,75	18833,75	43	18305,00	19315,00
9	17837,50	18847,50	44	18318,75	19328,75
10	17851,25	18861,25	45	18332,50	19342,50
11	17865,00	18875,00	46	18346,25	19356,25
12	17878,75	18888,75	47	18360,00	19370,00
13	17892,50	18902,50	48	18373,75	19383,75
14	17906,25	18916,25	49	18387,50	19397,50
15	17920,00	18930,00	50	18401,25	19411,25
16	17933,75	18943,75	51	18415,00	19425,00
17	17947,50	18957,50	52	18428,75	19438,75
18	17961,25	18971,25	53	18442,50	19452,50
19	17975,00	18985,00	54	18456,25	19466,25
20	17988,75	18998,75	55	18470,00	19480,00
21	18002,50	19012,50	56	18483,75	19493,75
22	18016,25	19026,25	57	18497,50	19507,50
23	18030,00	19040,00	58	18511,25	19521,25
24	18043,75	19053,75	59	18525,00	19535,00
25	18057,50	19067,50	60	18538,75	19548,75
26	18071,25	19081,25	61	18552,50	19562,50
27	18085,00	19095,00	62	18566,25	19576,25
28	18098,75	19108,75	63	18580,00	19590,00
29	18112,50	19122,50	64	18593,75	19603,75
30	18126,25	19136,25	65	18607,50	19617,50
31	18140,00	19150,00	66	18621,25	19631,25
32	18153,75	19163,75	67	18635,00	19645,00
33	18167,50	19177,50	68	18648,75	19658,75
34	18181,25	19191,25	69	18662,50	19672,50

Table 17. Tx/Rx channel centre frequencies for the CFM-18-LM series Radio operating in 18 GHz band with the channel spacing of 27.5 MHz; duplex shift is 1010 MHz; the plan corresponds to CEPT/ERC recommendation 12-03 E.

N	LA	HA	N	LB	HB
0	17727,5	18737,5	18	18222,5	19232,5
1	17755,0	18765,0	19	18250,0	19260,0
2	17782,5	18792,5	20	18277,5	19287,5
3	17810,0	18820,0	21	18305,0	19315,0
4	17837,5	18847,5	22	18332,5	19342,5
5	17865,0	18875,0	23	18360,0	19370,0
6	17892,5	18902,5	24	18387,5	19397,5
7	17920,0	18930,0	25	18415,0	19425,0
8	17947,5	18957,5	26	18442,5	19452,5
9	17975,0	18985,0	27	18470,0	19480,0
10	18002,5	19012,5	28	18497,5	19507,5
11	18030,0	19040,0	29	18525,0	19535,0
12	18057,5	19067,5	30	18552,5	19562,5
13	18085,0	19095,0	31	18580,0	19590,0
14	18112,5	19122,5	32	18607,5	19617,5
15	18140,0	19150,0	33	18635,0	19645,0
16	18167,5	19177,5	34	18662,5	19672,5
17	18195,0	19205,0			

OUTDOOR UNIT AND ANTENNA

Table 18. Tx/Rx channel centre frequencies for the CFM-18-LM series Radio operating in 18 GHz band with the channel spacing of 7.5 MHz; duplex shift is 1010 MHz; the plan corresponds to ITU-R recommendation F.595-7, Annex 4.

ODU channel Nr.	LA	HA	ODU channel Nr.	LA	HA	ODU channel Nr.	LB	HB	ODU channel Nr.	LB	HB
1	17710,00	18720,00	34	17957,50	18967,50	67	18205,00	19215,00	100	18452,50	19462,50
2	17717,50	18727,50	35	17965,00	18975,00	68	18212,50	19222,50	101	18460,00	19470,00
3	17725,00	18735,00	36	17972,50	18982,50	69	18220,00	19230,00	102	18467,50	19477,50
4	17732,50	18742,50	37	17980,00	18990,00	70	18227,50	19237,50	103	18475,00	19485,00
5	17740,00	18750,00	38	17987,50	18997,50	71	18235,00	19245,00	104	18482,50	19492,50
6	17747,50	18757,50	39	17995,00	19005,00	72	18242,50	19252,50	105	18490,00	19500,00
7	17755,00	18765,00	40	18002,50	19012,50	73	18250,00	19260,00	106	18497,50	19507,50
8	17762,50	18772,50	41	18010,00	19020,00	74	18257,50	19267,50	107	18505,00	19515,00
9	17770,00	18780,00	42	18017,50	19027,50	75	18265,00	19275,00	108	18512,50	19522,50
10	17777,50	18787,50	43	18025,00	19035,00	76	18272,50	19282,50	109	18520,00	19530,00
11	17785,00	18795,00	44	18032,50	19042,50	77	18280,00	19290,00	110	18527,50	19537,50
12	17792,50	18802,50	45	18040,00	19050,00	78	18287,50	19297,50	111	18535,00	19545,00
13	17800,00	18810,00	46	18047,50	19057,50	79	18295,00	19305,00	112	18542,50	19552,50
14	17807,50	18817,50	47	18055,00	19065,00	80	18302,50	19312,50	113	18550,00	19560,00
15	17815,00	18825,00	48	18062,50	19072,50	81	18310,00	19320,00	114	18557,50	19567,50
16	17822,50	18832,50	49	18070,00	19080,00	82	18317,50	19327,50	115	18565,00	19575,00
17	17830,00	18840,00	50	18077,50	19087,50	83	18325,00	19335,00	116	18572,50	19582,50
18	17837,50	18847,50	51	18085,00	19095,00	84	18332,50	19342,50	117	18580,00	19590,00
19	17845,00	18855,00	52	18092,50	19102,50	85	18340,00	19350,00	118	18587,50	19597,50
20	17852,50	18862,50	53	18100,00	19110,00	86	18347,50	19357,50	119	18595,00	19605,00
21	17860,00	18870,00	54	18107,50	19117,50	87	18355,00	19365,00	120	18602,50	19612,50
22	17867,50	18877,50	55	18115,00	19125,00	88	18362,50	19372,50	121	18610,00	19620,00
23	17875,00	18885,00	56	18122,50	19132,50	89	18370,00	19380,00	122	18617,50	19627,50
24	17882,50	18892,50	57	18130,00	19140,00	90	18377,50	19387,50	123	18625,00	19635,00
25	17890,00	18900,00	58	18137,50	19147,50	91	18385,00	19395,00	124	18632,50	19642,50
26	17897,50	18907,50	59	18145,00	19155,00	92	18392,50	19402,50	125	18640,00	19650,00
27	17905,00	18915,00	60	18152,50	19162,50	93	18400,00	19410,00	126	18647,50	19657,50
28	17912,50	18922,50	61	18160,00	19170,00	94	18407,50	19417,50	127	18655,00	19665,00
29	17920,00	18930,00	62	18167,50	19177,50	95	18415,00	19425,00	128	18662,50	19672,50
30	17927,50	18937,50	63	18175,00	19185,00	96	18422,50	19432,50	129	18670,00	19680,00
31	17935,00	18945,00	64	18182,50	19192,50	97	18430,00	19440,00	130	18677,50	19687,50
32	17942,50	18952,50	65	18190,00	19200,00	98	18437,50	19447,50	131	18685,00	19695,00
33	17950,00	18960,00	66	18197,50	19207,50	99	18445,00	19455,00			

OUTDOOR UNIT AND ANTENNA

Table 19. Tx/Rx channel centre frequencies for the CFM-22-LM series Radio operating in 23 GHz band with the channel spacing of 7 MHz and duplex shift of 1008 MHz; the plan corresponds to CEPT/ERC recommendation T/R 13-02 E, and ITU-R Rec. F.637-3, Annex 3.

N	L	H	N	L	H
2	22011,5	23019,5	86	22305,5	23313,5
4	22018,5	23026,5	88	22312,5	23320,5
6	22025,5	23033,5	90	22319,5	23327,5
8	22032,5	23040,5	92	22326,5	23334,5
10	22039,5	23047,5	94	22333,5	23341,5
12	22046,5	23054,5	96	22340,5	23348,5
14	22053,5	23061,5	98	22347,5	23355,5
16	22060,5	23068,5	100	22354,5	23362,5
18	22067,5	23075,5	102	22361,5	23369,5
20	22074,5	23082,5	104	22368,5	23376,5
22	22081,5	23089,5	106	22375,5	23383,5
24	22088,5	23096,5	108	22382,5	23390,5
26	22095,5	23103,5	110	22389,5	23397,5
28	22102,5	23110,5	112	22396,5	23404,5
30	22109,5	23117,5	114	22403,5	23411,5
32	22116,5	23124,5	116	22410,5	23418,5
34	22123,5	23131,5	118	22417,5	23425,5
36	22130,5	23138,5	120	22424,5	23432,5
38	22137,5	23145,5	122	22431,5	23439,5
40	22144,5	23152,5	124	22438,5	23446,5
42	22151,5	23159,5	126	22445,5	23453,5
44	22158,5	23166,5	128	22452,5	23460,5
46	22165,5	23173,5	130	22459,5	23467,5
48	22172,5	23180,5	132	22466,5	23474,5
50	22179,5	23187,5	134	22473,5	23481,5
52	22186,5	23194,5	136	22480,5	23488,5
54	22193,5	23201,5	138	22487,5	23495,5
56	22200,5	23208,5	140	22494,5	23502,5
58	22207,5	23215,5	142	22501,5	23509,5
60	22214,5	23222,5	144	22508,5	23516,5
62	22221,5	23229,5	146	22515,5	23523,5
64	22228,5	23236,5	148	22522,5	23530,5
66	22235,5	23243,5	150	22529,5	23537,5
68	22242,5	23250,5	152	22536,5	23544,5
70	22249,5	23257,5	154	22543,5	23551,5
72	22256,5	23264,5	156	22550,5	23558,5
74	22263,5	23271,5	158	22557,5	23565,5
76	22270,5	23278,5	160	22564,5	23572,5
78	22277,5	23285,5	162	22571,5	23579,5
80	22284,5	23292,5	164	22578,5	23586,5
82	22291,5	23299,5	166	22585,5	23593,5
84	22298,5	23306,5			

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Table 20. Tx/Rx channel centre frequencies for the CFM-22-LM series Radio operating in 23 GHz band with the channel spacing of 14 MHz and duplex shift of 1008 MHz; the plan corresponds to CEPT/ERC recommendation T/R 13-02 E, and ITU-R Rec. F.637-3, Annex 3.

N	L	H	N	L	H
3	22015	23023	87	22309	23317
7	22029	23037	91	22323	23331
11	22043	23051	95	22337	23345
15	22057	23065	99	22351	23359
19	22071	23079	103	22365	23373
23	22085	23093	107	22379	23387
27	22099	23107	111	22393	23401
31	22113	23121	115	22407	23415
35	22127	23135	119	22421	23429
39	22141	23149	123	22435	23443
43	22155	23163	127	22449	23457
47	22169	23177	131	22463	23471
51	22183	23191	135	22477	23485
55	22197	23205	139	22491	23499
59	22211	23219	143	22505	23513
63	22225	23233	147	22519	23527
67	22239	23247	151	22533	23541
71	22253	23261	155	22547	23555
75	22267	23275	159	22561	23569
79	22281	23289	163	22575	23583
83	22295	23303			

Table 21. Tx/Rx channel centre frequencies for the CFM-22-LM series Radio operating in 23 GHz band with the channel spacing of 28 MHz and duplex shift of 1008 MHz; the plan corresponds to CEPT/ERC recommendation T/R 13-02 E, and ITU-R Rec. F.637-3, Annex 3.

N	L	H	N	L	H
5	22022	23030	85	22302	23310
13	22050	23058	93	22330	23338
21	22078	23086	101	22358	23366
29	22106	23114	109	22386	23394
37	22134	23142	117	22414	23422
45	22162	23170	125	22442	23450
53	22190	23198	133	22470	23478
61	22218	23226	141	22498	23506
69	22246	23254	149	22526	23534
77	22274	23282	157	22554	23562

OUTDOOR UNIT AND ANTENNA

Table 22. Tx/Rx channel centre frequencies for the CFM-22-LM series Radio operating in 23 GHz band with the channel spacing of 7 MHz and duplex shift of 1232 MHz; the plan corresponds to ITU-R Rec. F.637-3, Annex 1.

N	LA	HA	N	LA	HA	N	LB	HB	N	LB	HB
0	21227,5	22459,5	40	21507,5	22739,5	80	21787,5	23019,5	120	22067,5	23299,5
1	21234,5	22466,5	41	21514,5	22746,5	81	21794,5	23026,5	121	22074,5	23306,5
2	21241,5	22473,5	42	21521,5	22753,5	82	21801,5	23033,5	122	22081,5	23313,5
3	21248,5	22480,5	43	21528,5	22760,5	83	21808,5	23040,5	123	22088,5	23320,5
4	21255,5	22487,5	44	21535,5	22767,5	84	21815,5	23047,5	124	22095,5	23327,5
5	21262,5	22494,5	45	21542,5	22774,5	85	21822,5	23054,5	125	22102,5	23334,5
6	21269,5	22501,5	46	21549,5	22781,5	86	21829,5	23061,5	126	22109,5	23341,5
7	21276,5	22508,5	47	21556,5	22788,5	87	21836,5	23068,5	127	22116,5	23348,5
8	21283,5	22515,5	48	21563,5	22795,5	88	21843,5	23075,5	128	22123,5	23355,5
9	21290,5	22522,5	49	21570,5	22802,5	89	21850,5	23082,5	129	22130,5	23362,5
10	21297,5	22529,5	50	21577,5	22809,5	90	21857,5	23089,5	130	22137,5	23369,5
11	21304,5	22536,5	51	21584,5	22816,5	91	21864,5	23096,5	131	22144,5	23376,5
12	21311,5	22543,5	52	21591,5	22823,5	92	21871,5	23103,5	132	22151,5	23383,5
13	21318,5	22550,5	53	21598,5	22830,5	93	21878,5	23110,5	133	22158,5	23390,5
14	21325,5	22557,5	54	21605,5	22837,5	94	21885,5	23117,5	134	22165,5	23397,5
15	21332,5	22564,5	55	21612,5	22844,5	95	21892,5	23124,5	135	22172,5	23404,5
16	21339,5	22571,5	56	21619,5	22851,5	96	21899,5	23131,5	136	22179,5	23411,5
17	21346,5	22578,5	57	21626,5	22858,5	97	21906,5	23138,5	137	22186,5	23418,5
18	21353,5	22585,5	58	21633,5	22865,5	98	21913,5	23145,5	138	22193,5	23425,5
19	21360,5	22592,5	59	21640,5	22872,5	99	21920,5	23152,5	139	22200,5	23432,5
20	21367,5	22599,5	60	21647,5	22879,5	100	21927,5	23159,5	140	22207,5	23439,5
21	21374,5	22606,5	61	21654,5	22886,5	101	21934,5	23166,5	141	22214,5	23446,5
22	21381,5	22613,5	62	21661,5	22893,5	102	21941,5	23173,5	142	22221,5	23453,5
23	21388,5	22620,5	63	21668,5	22900,5	103	21948,5	23180,5	143	22228,5	23460,5
24	21395,5	22627,5	64	21675,5	22907,5	104	21955,5	23187,5	144	22235,5	23467,5
25	21402,5	22634,5	65	21682,5	22914,5	105	21962,5	23194,5	145	22242,5	23474,5
26	21409,5	22641,5	66	21689,5	22921,5	106	21969,5	23201,5	146	22249,5	23481,5
27	21416,5	22648,5	67	21696,5	22928,5	107	21976,5	23208,5	147	22256,5	23488,5
28	21423,5	22655,5	68	21703,5	22935,5	108	21983,5	23215,5	148	22263,5	23495,5
29	21430,5	22662,5	69	21710,5	22942,5	109	21990,5	23222,5	149	22270,5	23502,5
30	21437,5	22669,5	70	21717,5	22949,5	110	21997,5	23229,5	150	22277,5	23509,5
31	21444,5	22676,5	71	21724,5	22956,5	111	22004,5	23236,5	151	22284,5	23516,5
32	21451,5	22683,5	72	21731,5	22963,5	112	22011,5	23243,5	152	22291,5	23523,5
33	21458,5	22690,5	73	21738,5	22970,5	113	22018,5	23250,5	153	22298,5	23530,5
34	21465,5	22697,5	74	21745,5	22977,5	114	22025,5	23257,5	154	22305,5	23537,5
35	21472,5	22704,5	75	21752,5	22984,5	115	22032,5	23264,5	155	22312,5	23544,5
36	21479,5	22711,5	76	21759,5	22991,5	116	22039,5	23271,5	156	22319,5	23551,5
37	21486,5	22718,5	77	21766,5	22998,5	117	22046,5	23278,5	157	22326,5	23558,5
38	21493,5	22725,5	78	21773,5	23005,5	118	22053,5	23285,5	158	22333,5	23565,5
39	21500,5	22732,5	79	21780,5	23012,5	119	22060,5	23292,5	159	22340,5	23572,5

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Table 23. Tx/Rx channel centre frequencies for the CFM-22-LM series Radio operating in 23 GHz band with the channel spacing of 14 MHz and duplex shift of 1232 MHz; the plan corresponds to ITU-R Rec. F.637-3, Annex 1.

N	LA	HA	N	LA	HA	N	LB	HB	N	LB	HB
0	21231	22463	20	21511	22743	40	21791	23023	60	22071	23303
1	21245	22477	21	21525	22757	41	21805	23037	61	22085	23317
2	21259	22491	22	21539	22771	42	21819	23051	62	22099	23331
3	21273	22505	23	21553	22785	43	21833	23065	63	22113	23345
4	21287	22519	24	21567	22799	44	21847	23079	64	22127	23359
5	21301	22533	25	21581	22813	45	21861	23093	65	22141	23373
6	21315	22547	26	21595	22827	46	21875	23107	66	22155	23387
7	21329	22561	27	21609	22841	47	21889	23121	67	22169	23401
8	21343	22575	28	21623	22855	48	21903	23135	68	22183	23415
9	21357	22589	29	21637	22869	49	21917	23149	69	22197	23429
10	21371	22603	30	21651	22883	50	21931	23163	70	22211	23443
11	21385	22617	31	21665	22897	51	21945	23177	71	22225	23457
12	21399	22631	32	21679	22911	52	21959	23191	72	22239	23471
13	21413	22645	33	21693	22925	53	21973	23205	73	22253	23485
14	21427	22659	34	21707	22939	54	21987	23219	74	22267	23499
15	21441	22673	35	21721	22953	55	22001	23233	75	22281	23513
16	21455	22687	36	21735	22967	56	22015	23247	76	22295	23527
17	21469	22701	37	21749	22981	57	22029	23261	77	22309	23541
18	21483	22715	38	21763	22995	58	22043	23275	78	22323	23555
19	21497	22729	39	21777	23009	59	22057	23289	79	22337	23569

Table 24. Tx/Rx channel centre frequencies for the CFM-22-LM series Radio operating in 23 GHz band with the channel spacing of 28 MHz and duplex shift of 1232 MHz; the plan corresponds to ITU-R Rec. F.637-3, Annex 1.

N	LA	HA	N	LB	HB
0	21238	22470	20	21798	23030
1	21266	22498	21	21826	23058
2	21294	22526	22	21854	23086
3	21322	22554	23	21882	23114
4	21350	22582	24	21910	23142
5	21378	22610	25	21938	23170
6	21406	22638	26	21966	23198
7	21434	22666	27	21994	23226
8	21462	22694	28	22022	23254
9	21490	22722	29	22050	23282
10	21518	22750	30	22078	23310
11	21546	22778	31	22106	23338
12	21574	22806	32	22134	23366
13	21602	22834	33	22162	23394
14	21630	22862	34	22190	23422
15	21658	22890	35	22218	23450
16	21686	22918	36	22246	23478
17	21714	22946	37	22274	23506
18	21742	22974	38	22302	23534
19	21770	23002	39	22330	23562

OUTDOOR UNIT AND ANTENNA

Table 25. Tx/Rx channel centre frequencies for the CFM-26-LM series Radio operating in 26 GHz band with the channel spacing of 7 MHz and duplex shift of 1008 MHz; the plan corresponds to CEPT/ERC recommendation T/R 13-02 E, and ITU-R Rec. F.748-2, Annex 1.

N	LA	HA	N	LA	HA	N	LB	HB	N	LB	HB
0	24552,5	25560,5	32	24776,5	25784,5	64	25000,5	26008,5	96	25224,5	26232,5
1	24559,5	25567,5	33	24783,5	25791,5	65	25007,5	26015,5	97	25231,5	26239,5
2	24566,5	25574,5	34	24790,5	25798,5	66	25014,5	26022,5	98	25238,5	26246,5
3	24573,5	25581,5	35	24797,5	25805,5	67	25021,5	26029,5	99	25245,5	26253,5
4	24580,5	25588,5	36	24804,5	25812,5	68	25028,5	26036,5	100	25252,5	26260,5
5	24587,5	25595,5	37	24811,5	25819,5	69	25035,5	26043,5	101	25259,5	26267,5
6	24594,5	25602,5	38	24818,5	25826,5	70	25042,5	26050,5	102	25266,5	26274,5
7	24601,5	25609,5	39	24825,5	25833,5	71	25049,5	26057,5	103	25273,5	26281,5
8	24608,5	25616,5	40	24832,5	25840,5	72	25056,5	26064,5	104	25280,5	26288,5
9	24615,5	25623,5	41	24839,5	25847,5	73	25063,5	26071,5	105	25287,5	26295,5
10	24622,5	25630,5	42	24846,5	25854,5	74	25070,5	26078,5	106	25294,5	26302,5
11	24629,5	25637,5	43	24853,5	25861,5	75	25077,5	26085,5	107	25301,5	26309,5
12	24636,5	25644,5	44	24860,5	25868,5	76	25084,5	26092,5	108	25308,5	26316,5
13	24643,5	25651,5	45	24867,5	25875,5	77	25091,5	26099,5	109	25315,5	26323,5
14	24650,5	25658,5	46	24874,5	25882,5	78	25098,5	26106,5	110	25322,5	26330,5
15	24657,5	25665,5	47	24881,5	25889,5	79	25105,5	26113,5	111	25329,5	26337,5
16	24664,5	25672,5	48	24888,5	25896,5	80	25112,5	26120,5	112	25336,5	26344,5
17	24671,5	25679,5	49	24895,5	25903,5	81	25119,5	26127,5	113	25343,5	26351,5
18	24678,5	25686,5	50	24902,5	25910,5	82	25126,5	26134,5	114	25350,5	26358,5
19	24685,5	25693,5	51	24909,5	25917,5	83	25133,5	26141,5	115	25357,5	26365,5
20	24692,5	25700,5	52	24916,5	25924,5	84	25140,5	26148,5	116	25364,5	26372,5
21	24699,5	25707,5	53	24923,5	25931,5	85	25147,5	26155,5	117	25371,5	26379,5
22	24706,5	25714,5	54	24930,5	25938,5	86	25154,5	26162,5	118	25378,5	26386,5
23	24713,5	25721,5	55	24937,5	25945,5	87	25161,5	26169,5	119	25385,5	26393,5
24	24720,5	25728,5	56	24944,5	25952,5	88	25168,5	26176,5	120	25392,5	26400,5
25	24727,5	25735,5	57	24951,5	25959,5	89	25175,5	26183,5	121	25399,5	26407,5
26	24734,5	25742,5	58	24958,5	25966,5	90	25182,5	26190,5	122	25406,5	26414,5
27	24741,5	25749,5	59	24965,5	25973,5	91	25189,5	26197,5	123	25413,5	26421,5
28	24748,5	25756,5	60	24972,5	25980,5	92	25196,5	26204,5	124	25420,5	26428,5
29	24755,5	25763,5	61	24979,5	25987,5	93	25203,5	26211,5	125	25427,5	26435,5
30	24762,5	25770,5	62	24986,5	25994,5	94	25210,5	26218,5	126	25434,5	26442,5
31	24769,5	25777,5	63	24993,5	26001,5	95	25217,5	26225,5	127	25441,5	26449,5

OUTDOOR UNIT AND ANTENNA

Table 26. Tx/Rx channel centre frequencies for the CFM-26-LM series Radio operating in 26 GHz band with the channel spacing of 14 MHz and duplex shift of 1008 MHz; the plan corresponds to CEPT/ERC recommendation T/R 13-02 E, and ITU-R Rec. F.748-2, Annex 1.

N	LA	HA	N	LB	HB
0	24556	25564	32	25004	26012
1	24570	25578	33	25018	26026
2	24584	25592	34	25032	26040
3	24598	25606	35	25046	26054
4	24612	25620	36	25060	26068
5	24626	25634	37	25074	26082
6	24640	25648	38	25088	26096
7	24654	25662	39	25102	26110
8	24668	25676	40	25116	26124
9	24682	25690	41	25130	26138
10	24696	25704	42	25144	26152
11	24710	25718	43	25158	26166
12	24724	25732	44	25172	26180
13	24738	25746	45	25186	26194
14	24752	25760	46	25200	26208
15	24766	25774	47	25214	26222
16	24780	25788	48	25228	26236
17	24794	25802	49	25242	26250
18	24808	25816	50	25256	26264
19	24822	25830	51	25270	26278
20	24836	25844	52	25284	26292
21	24850	25858	53	25298	26306
22	24864	25872	54	25312	26320
23	24878	25886	55	25326	26334
24	24892	25900	56	25340	26348
25	24906	25914	57	25354	26362
26	24920	25928	58	25368	26376
27	24934	25942	59	25382	26390
28	24948	25956	60	25396	26404
29	24962	25970	61	25410	26418
30	24976	25984	62	25424	26432
31	24990	25998	63	25438	26446

Table 27. Tx/Rx channel centre frequencies for the CFM-26-LM series Radio operating in 26 GHz band with the channel spacing of 28 MHz and duplex shift of 1008 MHz; the plan corresponds to CEPT/ERC recommendation T/R 13-02 E, and ITU-R Rec. F.748-2, Annex 1.

N	LA	HA	N	LB	HB
0	24563	25571	16	25011	26019
1	24591	25599	17	25039	26047
2	24619	25627	18	25067	26075
3	24647	25655	19	25095	26103
4	24675	25683	20	25123	26131
5	24703	25711	21	25151	26159
6	24731	25739	22	25179	26187
7	24759	25767	23	25207	26215
8	24787	25795	24	25235	26243
9	24815	25823	25	25263	26271
10	24843	25851	26	25291	26299
11	24871	25879	27	25319	26327
12	24899	25907	28	25347	26355
13	24927	25935	29	25375	26383
14	24955	25963	30	25403	26411
15	24983	25991	31	25431	26439

OUTDOOR UNIT AND ANTENNA

Table 28. Tx/Rx channel centre frequencies for the CFM-38-LM series Radio operating in 38 GHz band with the channel spacing of 7 MHz and duplex shift of 1260 MHz; the plan corresponds to CEPT/ERC recommendation T/R 12-01 E, and ITU-R Rec. F.749-2, Annex 1.

N	LA	HA	N	LA	HA	N	LB	HB	N	LB	HB
0	37061,5	38321,5	40	37341,5	38601,5	80	37621,5	38881,5	120	37901,5	39161,5
1	37068,5	38328,5	41	37348,5	38608,5	81	37628,5	38888,5	121	37908,5	39168,5
2	37075,5	38335,5	42	37355,5	38615,5	82	37635,5	38895,5	122	37915,5	39175,5
3	37082,5	38342,5	43	37362,5	38622,5	83	37642,5	38902,5	123	37922,5	39182,5
4	37089,5	38349,5	44	37369,5	38629,5	84	37649,5	38909,5	124	37929,5	39189,5
5	37096,5	38356,5	45	37376,5	38636,5	85	37656,5	38916,5	125	37936,5	39196,5
6	37103,5	38363,5	46	37383,5	38643,5	86	37663,5	38923,5	126	37943,5	39203,5
7	37110,5	38370,5	47	37390,5	38650,5	87	37670,5	38930,5	127	37950,5	39210,5
8	37117,5	38377,5	48	37397,5	38657,5	88	37677,5	38937,5	128	37957,5	39217,5
9	37124,5	38384,5	49	37404,5	38664,5	89	37684,5	38944,5	129	37964,5	39224,5
10	37131,5	38391,5	50	37411,5	38671,5	90	37691,5	38951,5	130	37971,5	39231,5
11	37138,5	38398,5	51	37418,5	38678,5	91	37698,5	38958,5	131	37978,5	39238,5
12	37145,5	38405,5	52	37425,5	38685,5	92	37705,5	38965,5	132	37985,5	39245,5
13	37152,5	38412,5	53	37432,5	38692,5	93	37712,5	38972,5	133	37992,5	39252,5
14	37159,5	38419,5	54	37439,5	38699,5	94	37719,5	38979,5	134	37999,5	39259,5
15	37166,5	38426,5	55	37446,5	38706,5	95	37726,5	38986,5	135	38006,5	39266,5
16	37173,5	38433,5	56	37453,5	38713,5	96	37733,5	38993,5	136	38013,5	39273,5
17	37180,5	38440,5	57	37460,5	38720,5	97	37740,5	39000,5	137	38020,5	39280,5
18	37187,5	38447,5	58	37467,5	38727,5	98	37747,5	39007,5	138	38027,5	39287,5
19	37194,5	38454,5	59	37474,5	38734,5	99	37754,5	39014,5	139	38034,5	39294,5
20	37201,5	38461,5	60	37481,5	38741,5	100	37761,5	39021,5	140	38041,5	39301,5
21	37208,5	38468,5	61	37488,5	38748,5	101	37768,5	39028,5	141	38048,5	39308,5
22	37215,5	38475,5	62	37495,5	38755,5	102	37775,5	39035,5	142	38055,5	39315,5
23	37222,5	38482,5	63	37502,5	38762,5	103	37782,5	39042,5	143	38062,5	39322,5
24	37229,5	38489,5	64	37509,5	38769,5	104	37789,5	39049,5	144	38069,5	39329,5
25	37236,5	38496,5	65	37516,5	38776,5	105	37796,5	39056,5	145	38076,5	39336,5
26	37243,5	38503,5	66	37523,5	38783,5	106	37803,5	39063,5	146	38083,5	39343,5
27	37250,5	38510,5	67	37530,5	38790,5	107	37810,5	39070,5	147	38090,5	39350,5
28	37257,5	38517,5	68	37537,5	38797,5	108	37817,5	39077,5	148	38097,5	39357,5
29	37264,5	38524,5	69	37544,5	38804,5	109	37824,5	39084,5	149	38104,5	39364,5
30	37271,5	38531,5	70	37551,5	38811,5	110	37831,5	39091,5	150	38111,5	39371,5
31	37278,5	38538,5	71	37558,5	38818,5	111	37838,5	39098,5	151	38118,5	39378,5
32	37285,5	38545,5	72	37565,5	38825,5	112	37845,5	39105,5	152	38125,5	39385,5
33	37292,5	38552,5	73	37572,5	38832,5	113	37852,5	39112,5	153	38132,5	39392,5
34	37299,5	38559,5	74	37579,5	38839,5	114	37859,5	39119,5	154	38139,5	39399,5
35	37306,5	38566,5	75	37586,5	38846,5	115	37866,5	39126,5	155	38146,5	39406,5
36	37313,5	38573,5	76	37593,5	38853,5	116	37873,5	39133,5	156	38153,5	39413,5
37	37320,5	38580,5	77	37600,5	38860,5	117	37880,5	39140,5	157	38160,5	39420,5
38	37327,5	38587,5	78	37607,5	38867,5	118	37887,5	39147,5	158	38167,5	39427,5
39	37334,5	38594,5	79	37614,5	38874,5	119	37894,5	39154,5	159	38174,5	39434,5

OUTDOOR UNIT AND ANTENNA

Table 29. Tx/Rx channel centre frequencies for the CFM-38-LM series Radio operating in 38 GHz band with the channel spacing of 14 MHz and duplex shift of 1260 MHz; the plan corresponds to CEPT/ERC recommendation T/R 12-01 E, and ITU-R Rec. F.749-2, Annex 1.

N	LA	HA	N	LA	HA	N	LB	HB	N	LB	HB
0	37065	38325	20	37345	38605	40	37625	38885	60	37905	39165
1	37079	38339	21	37359	38619	41	37639	38899	61	37919	39179
2	37093	38353	22	37373	38633	42	37653	38913	62	37933	39193
3	37107	38367	23	37387	38647	43	37667	38927	63	37947	39207
4	37121	38381	24	37401	38661	44	37681	38941	64	37961	39221
5	37135	38395	25	37415	38675	45	37695	38955	65	37975	39235
6	37149	38409	26	37429	38689	46	37709	38969	66	37989	39249
7	37163	38423	27	37443	38703	47	37723	38983	67	38003	39263
8	37177	38437	28	37457	38717	48	37737	38997	68	38017	39277
9	37191	38451	29	37471	38731	49	37751	39011	69	38031	39291
10	37205	38465	30	37485	38745	50	37765	39025	70	38045	39305
11	37219	38479	31	37499	38759	51	37779	39039	71	38059	39319
12	37233	38493	32	37513	38773	52	37793	39053	72	38073	39333
13	37247	38507	33	37527	38787	53	37807	39067	73	38087	39347
14	37261	38521	34	37541	38801	54	37821	39081	74	38101	39361
15	37275	38535	35	37555	38815	55	37835	39095	75	38115	39375
16	37289	38549	36	37569	38829	56	37849	39109	76	38129	39389
17	37303	38563	37	37583	38843	57	37863	39123	77	38143	39403
18	37317	38577	38	37597	38857	58	37877	39137	78	38157	39417
19	37331	38591	39	37611	38871	59	37891	39151	79	38171	39431

Table 30. Tx/Rx channel centre frequencies for the CFM-38-LM series Radio operating in 38 GHz band with the channel spacing of 28 MHz and duplex shift of 1260 MHz; the plan corresponds to CEPT/ERC recommendation T/R 12-01 E, and ITU-R Rec. F.749-2, Annex 1.

N	LA	HA	N	LB	HB
0	37072	38332	20	37632	38892
1	37100	38360	21	37660	38920
2	37128	38388	22	37688	38948
3	37156	38416	23	37716	38976
4	37184	38444	24	37744	39004
5	37212	38472	25	37772	39032
6	37240	38500	26	37800	39060
7	37268	38528	27	37828	39088
8	37296	38556	28	37856	39116
9	37324	38584	29	37884	39144
10	37352	38612	30	37912	39172
11	37380	38640	31	37940	39200
12	37408	38668	32	37968	39228
13	37436	38696	33	37996	39256
14	37464	38724	34	38024	39284
15	37492	38752	35	38052	39312
16	37520	38780	36	38080	39340
17	37548	38808	37	38108	39368
18	37576	38836	38	38136	39396
19	37604	38864	39	38164	39424

Antenna Unit

SAF Tehnika offers the following types of antennas for the CFM site installation according to availability and distance requirements:

- 25 cm Lens–Horn antennas (manufactured by SAF Tehnika)

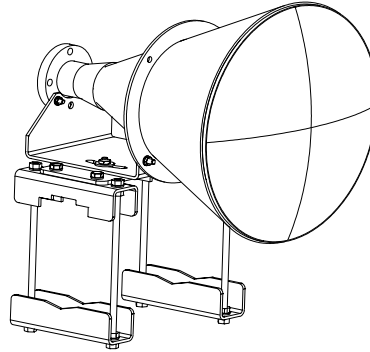


Figure 5. 25 cm Lens–Horn antenna

The following 25 cm Lens-Horn antennas are offered:

Model	Product code	Frequency range
CFM-18-ANT	C18A2501	17.7 – 19.7 GHz
CFM-22-ANT	C22A2502	21.2 – 23.6 GHz

- 30 cm parabolic antennas (manufactured by COMHAT-PROVEXA)

The following 30 cm parabolic antennas are offered:

Model	Product code	Frequency range
CFM-13-ANT	C13A3002	12.75 – 13.25 GHz
CFM-15-ANT	C15A3002	14.4 – 15.35 GHz
CFM-18-ANT	C18A3002	17.7 – 19.7 GHz
CFM-22-ANT	C22A3003	21.2 – 23.6 GHz
CFM-26-ANT	C26A3002	24.25 – 26.5 GHz
CFM-38-ANT	C38A3002	37.0 – 39.5 GHz

- 60 cm parabolic antennas (manufactured by COMHAT-PROVEXA)

The following 60 cm parabolic antennas are offered:

Model	Product code	Frequency range
CFM-7-ANT	C07A6002	7.1 – 7.9 GHz
CFM-8-ANT	C08A6002	7.7 – 8.5 GHz
CFM-13-ANT	C13A6002	12.75 – 13.25 GHz
CFM-15-ANT	C15A6002	14.4 – 15.35 GHz
CFM-18-ANT	C18A6002	17.7 – 19.7 GHz
CFM-22-ANT	C22A6003	21.2 – 23.6 GHz
CFM-26-ANT	C26A6002	24.25 – 26.5 GHz
CFM-38-ANT	C38A6002	37.0 – 39.5 GHz

OUTDOOR UNIT AND ANTENNA

- 120 cm parabolic antennas (manufactured by COMHAT-PROVEXA)
The following 120 cm parabolic antennas are offered:

Model	Product code	Frequency range
CFM-7-ANT	C07A1202	7.1 – 7.9 GHz
CFM-8-ANT	C08A1202	7.7 – 8.5 GHz
CFM-13-ANT	C13A1202	12.75 – 13.25 GHz
CFM-15-ANT	C15A1202	14.4 – 15.35 GHz
CFM-18-ANT	C18A1202	17.7 – 19.7 GHz
CFM-22-ANT	C22A1203	21.2 – 23.6 GHz
CFM-26-ANT	C26A1202	24.25 – 26.5 GHz

- 180 cm parabolic antennas (manufactured by COMHAT-PROVEXA)
The following 180 cm parabolic antennas are offered:

Model	Product code	Frequency range
CFM-7-ANT	C07A1802	7.125 – 7.750 GHz
CFM-8-ANT	C08A1802	7.75 – 8.50 GHz
CFM-13-ANT	C13A1802	12.75 – 13.25 GHz
CFM-15-ANT	C15A1802	14.4 – 15.35 GHz
CFM-18-ANT	C18A1802	17.7 – 19.7 GHz
CFM-22-ANT	C22A1803	21.2 – 23.6 GHz

- 240 cm parabolic antennas (manufactured by COMHAT-PROVEXA)
The following 240 cm parabolic antennas are offered:

Model	Product code	Frequency range
CFM-7-ANT	C07A2402	7.125 – 7.750 GHz
CFM-8-ANT	C08A2402	7.75 – 8.50 GHz
CFM-13-ANT	C13A2402	12.75 – 13.25 GHz

- 300 cm parabolic antennas (manufactured by COMHAT-PROVEXA)
The following 300 cm parabolic antennas are offered:

Model	Product code	Frequency range
CFM-7-ANT	C07A3002	7.125 – 7.750 GHz
CFM-8-ANT	C08A3002	7.75 – 8.50 GHz

As an alternative to antennas offered by SAF Tehnika, other antennas can be used.

For rough and fine antenna alignment adjustments, a voltmeter and the cable for connection of voltmeter to ODU is required, the RSSI port has a BNC socket.

All screws complemented with Lens–Horn antenna for connection and adjustment is in stainless steel and all nuts are in brass (stainless).

Indoor Unit

General

The Indoor Unit (IDU) is the mandatory component of the CFM-LM microwave radio system and it provides:

- Means of interconnecting the Outdoor Unit and the user equipment,
- Local and remote management functionality,
- Supply voltage to the ODU.

The following CFM-LM Indoor units are available:

- CFM-8-REB
- CFM-16-REBM , CFM-34-REBM
- CFM-8-MUX, CFM-16-MUX
- CFM-8-4E1, CFM-16-8E1, CFM-34-16E1
- CFM-M-MUX
- CFM-MP-MUX, supporting 1+1 link configurations.

The IDU is intended for installation in weather protected equipment shelters or inside buildings.

Each of the IDU terminals is implemented as 19” rack mountable aluminium 1U high unit (with the exception of 1+1 CFM-MP-MUX IDU, which is 2U high). The depth of the unit is 230 mm without front panel handles, 270 mm with handles.

All traffic interfaces are located on the front of the IDU.

The CFM series LM IDUs provide the following management ports:

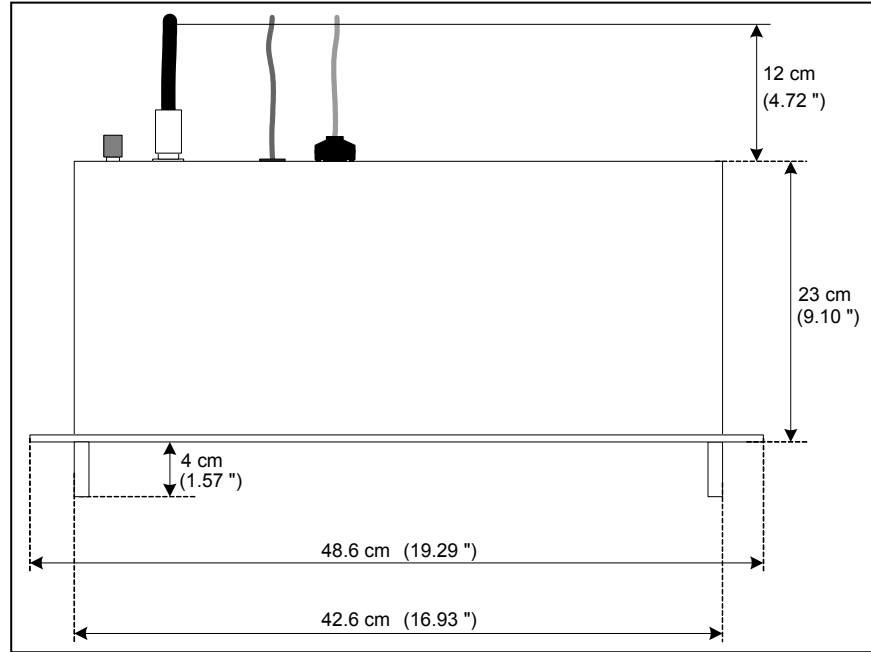
- RS232 serial management port, DB9 connector is located at the rear panel of the IDU,
- 10Base-T Ethernet management port, RJ-45 socket is located at the rear side of the IDU panel,
- Alarm port (optional), e.i., alarm relay *outputs* for power supply failure, Synch Lost alarm, Radio alarm, and transmitter PLL failure, as well as four additional *inputs* for user equipment.

INDOOR UNIT

A maximum of 350 mm deep rack is required for the IDU to be mounted, from mounting points of front panel including space behind the unit for cables to RF, Grounding point, Ethernet and Serial management interfaces.

Some space is required in front of the IDU for traffic interface cables, - as a minimum 5 cm from the front panel are needed for Ethernet patch-cable and E1 interface cable.

As a minimum of 10 cm to 12 cm of supplementary space is required (mainly depending on the RF cable type) behind the IDU for management interface cables and RF cable.



CFM-8-REB IDU

The Remote Ethernet Bridge IDU is fixed configuration Ethernet bridge, provides full radio capacity of 8 Mbps to 10Base-T UTP Ethernet interface on the LAN side.



Figure 6. The CFM-8-REB IDU front panel

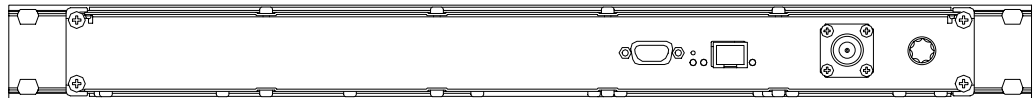


Figure 7. The rear panel of the CFM-8-REB IDU

INDOOR UNIT

CFM-16-REBM and CFM-34-REBM IDU

The Modular Fast Ethernet bridge IDU has the modular configuration and provides 100Base-Tx UTP LAN interface plus two interface slots that can be equipped with two interface modules (V.35, E1 or 10Base-T Ethernet) providing additional traffic interfaces with a maximum capacity of 2 Mbps each. The CFM-16-REBM provides WAN data rate of 16 Mbps, the CFM-34-REBM provides maximum WAN data rate of 34 Mbps.



Figure 8. The CFM-34-REBM IDU front panel

CFM-8-MUX and CFM-16-MUX IDU

The CFM-8-MUX and the CFM-16-MUX Indoor Units are modular and can be equipped with 4 interface modules (V.35, E1 or 10Base-T Ethernet), the CFM-8-MUX provides maximum WAN data rate of 8 Mbps, the CFM-16-MUX provides maximum WAN data rate of 16 Mbps.

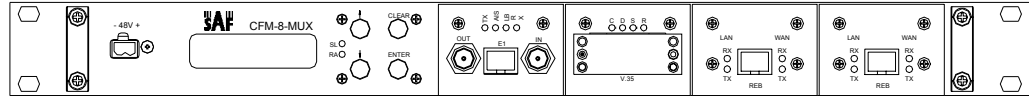


Figure 9. The CFM-8-MUX IDU front panel

CFM E1 Indoor Units

All CFM series E1 IDUs are fixed configuration multiplexers providing multiplexing of E1 channels into a single 34 Mbps stream.

The CFM-8-4E1 IDU provide 4 E1 channel ports on BNC and RJ-45 connectors.

The CFM-16-8E1 IDU provide 8 E1 channel ports on DB25 connector (4xE1 ports per DB25 connector) or RJ-45 connectors.

The CFM-34-16E1 IDU provide 4 E1 channel ports on RJ-45 connectors.

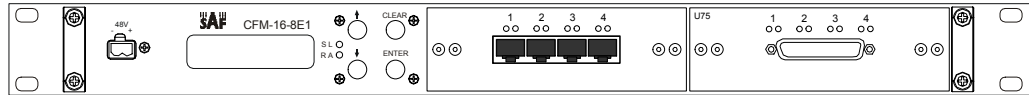


Figure 10. CFM-16-8E1 IDU front panel

CFM-M-MUX Indoor Unit

The CFM-M-MUX Indoor Unit is modular and can be equipped with 4 interface modules (V.35, E1, 4xE1 or 2-port 100Base-T Ethernet), supports WAN data rates of 8 Mbps, 16 Mbps and 34 Mbps, data rates are software selectable.

INDOOR UNIT

CFM-MP-MUX 1+1 Indoor Unit

The CFM-MP-MUX Indoor Unit is modular multiplexer with doubled Power Supply and Cable Interface circuitry, supports HSB, FD and SD 1+1 link configurations. The unit can be equipped with 4 interface modules (V.35, E1, 4xE1 or 2-port 100Base-T Ethernet), supports WAN data rates of 8 Mbps, 16 Mbps and 34 Mbps, data rates are software selectable. The CFM-MP-MUX IDU is 2U high.

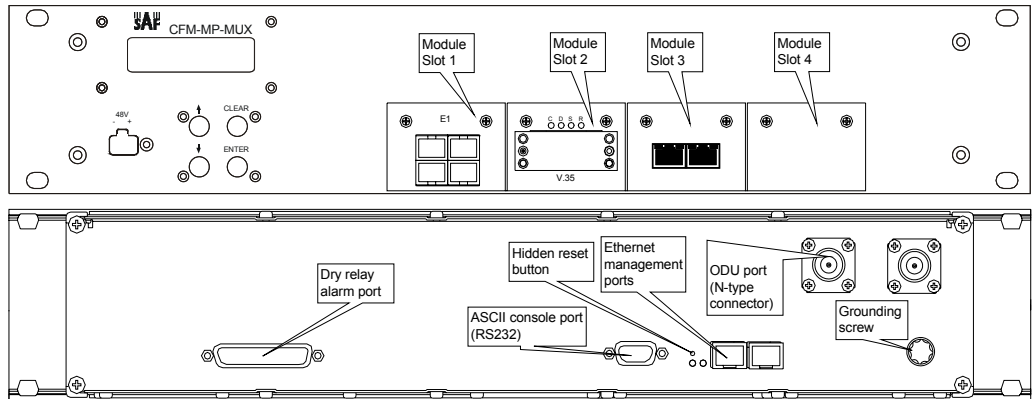


Figure 11. CFM-MP-MUX IDU front and rear panel

IDU Functional Design

The CFM IDUs consist of the following functional blocks (see Figure 12 and Figure 13):

- Cable interface
- Base-band modem
- Power supply unit
- Management controller
- Multiplexer (MUX) board (refers to the multiplexer, E1 and modular Fast Ethernet bridge IDUs only);
- Ethernet Interface board (refers to the CFM-8-REB only)
- Traffic interfaces

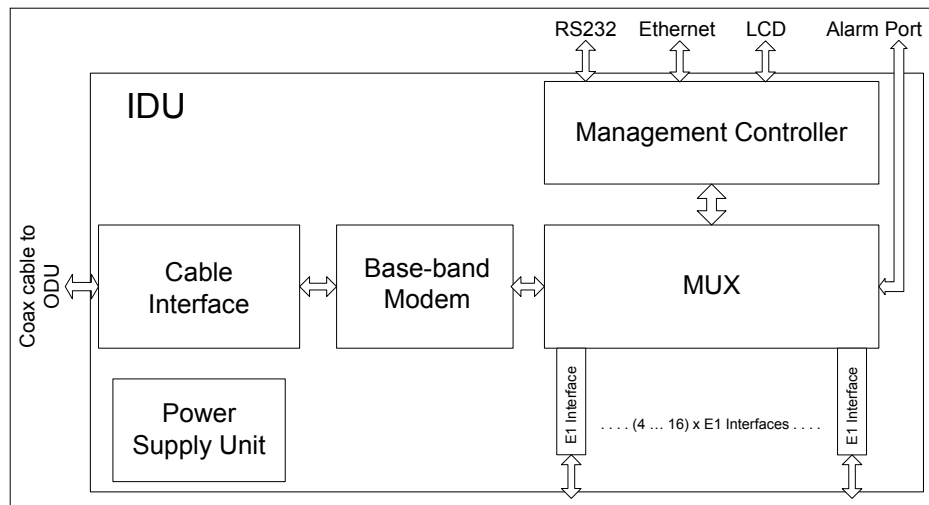


Figure 12. The CFM series E1 IDU block diagram

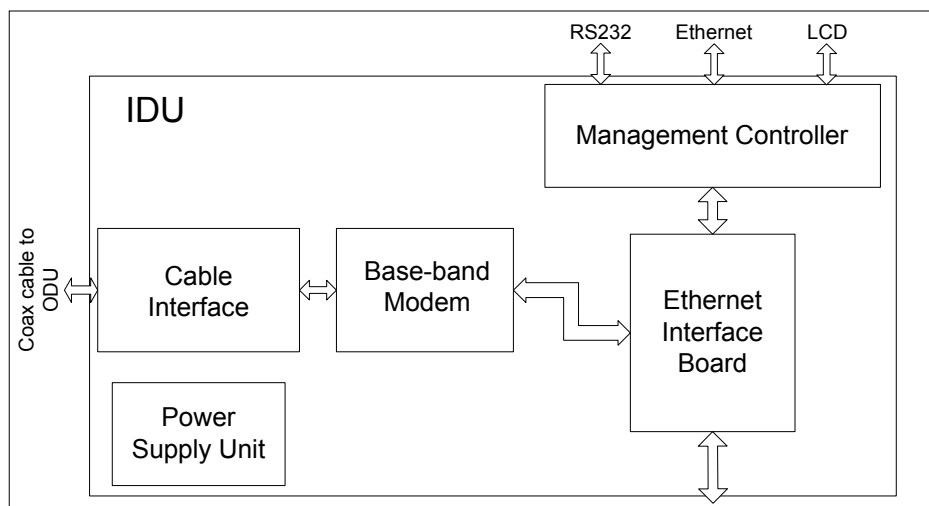


Figure 13. The CFM-8-REB IDU block diagram

Cable Interface

The cable interface provides the power supply voltages for all blocks and the ODU. Since the DC-DC of the power supply is isolated, the supply voltages of the device may be positive or negative in respect to the ground.

Like the ODU, the extra telemetry data flow is transmitted using the method of the pulse-amplitude modulation.

The received 140 MHz signal (from ODU) is demodulated in the frequency demodulator, from which the signal is fed to the MUX module.

From the MUX module the four level data signal is passed to the 350 MHz voltage controlled generator. The carrier-modified signal is passed through the buffer amplifier and the band pass filter to the cable, which is connected to the ODU.

Base-band Modem

Base-band modem performs coding, decoding and scrambling of the four level data signal.

Management Controller

The management controller provides the control of and checking of the IDU and ODU, as well as the management and monitoring functionality. Management controller contains TCP/IP stack and acts as an IP packet router for management traffic. There is Web page, SNMP agent and Telnet client/servers implemented providing comprehensive management functionality and allows to integrate the CFM equipment in any telecommunications network easily.

Multiplexer (MUX)

The multiplexer module performs multiplexing and demultiplexing of the WAN data channel into interface traffic channels and 16 kbps telemetry channel.

Traffic Interfaces

The traffic interface provide physical interface between user equipment and the multiplexer.

For modular IDUs (MUX and REBM type IDUs) special traffic interface modules are available:

- the **E1 interface module**: single E1 port module which terminates G.703 2 Mbps channel; the E1 interface module provides two types of traffic port connectors: 120 Ω balanced interface on RJ-45 type connector and 75 Ω unbalanced interface on BNC type connectors (a pair of coaxial cables with the BNC type connectors are required);
- the **V.35 interface module** is provided with M.34 standard connector. The V.35 module terminates 2, 4, 6 or 8 Mbps from multiplexer and provides user configurable data rates of 64 kbps, 128 kbps, 256 kbps, 512 kbps, 1024 kbps, 2048 kbps, 4 Mbps, 6 Mbps or 8 Mbps to single V.35 interface;
- the **Remote Ethernet Bridge module** (REB module). The REB module terminates 2 Mbps, 4 Mbps, 6 Mbps or 8 Mbps from multiplexer and provides single 10 Mbps 10Base-T Ethernet port on the LAN side. The REB interface module contains a complete filtering Ethernet bridge.

Ethernet Interface Board

The Ethernet interface board has a built in two-port packet switching engine. One of the ports is 10 Mbps on 10BaseT Ethernet interface (implemented as RJ-45 type connector). The other port is synchronous serial interface that is terminated in the baseband modem, hence the full capacity is terminated in the Ethernet interface board from the Radio Unit.

Updating Management Controller Software

The update of management controller software can be accomplished in two ways:

- Replacing the onboard Flash EPROM, or
- Upgrading Flash EPROM via RS232 serial port.

Upgrades to management software for management controller board are available as uploadable files (.hex extension) from SAF Tehnika, sales partners or Web site.

Upload functionality is provided through management controller software monitor and is available via RS-232 serial port.

Upload could be performed from PC/Laptop connected to serial port of IDU using 'SAF Firmware Uploader' program, found on the documentation CD, the instructions how to use this software can be found in its installation directory.

The update can also be performed using any terminal emulation software, capable to upload text files; the instructions how to update software using this method are given in 'Management Software Update Guide', see References.

Cables

In order to install the CFM site, the following types of cables are needed:

- IDU-ODU cable;
- Cable to digital multimeter for antenna alignment during the installation;
- Interface cables (E1, Ethernet, V.35);
- Power cable to the IDU.

In case of necessity, SAF Tehnika can offer the aforementioned types of cables.

IDU-ODU Cable

IDU-ODU cable is a 50 Ω coaxial cable intended to interconnect the Indoor Unit with the Outdoor Unit. Any type of 50 Ω cable of good quality can be used, the cable should be equipped with N-type male connectors on each end. There are two N-type male connectors included in each radio unit delivery that fit RG-213 cables or other cables with a surface diameter of 10 mm. As the attenuation of the cable is essential particularly at 350 MHz frequency, its usage is restricted, - the attenuation of the signal should not exceed 20 dB at 350 MHz. Commonly employing RG-213 type coaxial cable, its length may reach 100 m, LMR-400 type cable may usually reach up to 300 m in length.

CABLES

Cable for Antenna Alignment

To connect the digital multimeter to the ODU RSSI port in order to adjust the antenna alignment, a coaxial cable with BNC connector on one end and appropriate termination on other end can be used (see example in Figure 14).



Figure 14. Cable for connection of voltmeter to the ODU RSSI port

CABLES

Traffic Interface Cables

The following types of traffic interface cables could be used with CFM-LM IDU traffic interfaces:

- Cat3 unshielded twisted pair (UTP) or better for 10Base-T Ethernet;
Cat5 UTP or better for 100Base-Tx Ethernet connection;
- Cat3 UTP or better for the E1 balanced interfaces;
- Any 75 Ω coaxial cable with BNC connectors for the E1 unbalanced traffic port.

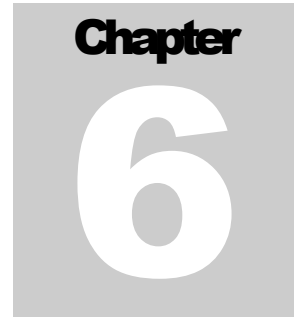
For cable connector pinouts please refer to the CFM product configuration guides, see References for more information.

Management Interface Cables

- Standard Ethernet patch cables should be used with management Ethernet port of the IDU;
- Any “straight through” or modem serial cable could be used with RS-232 management port of the IDU.

Power Cable

Due to low power consumption of the CFM terminals, there are no special requirements for the cable used to connect the IDU to the DC power source. Any 2 wire power cable of good quality which fits well in SAF Tehnika’s supplied 2 pole “screw on” power connector could be used. The power connector is of 2 pole, type 2ESDV-02.



Management System

General, Main Goals

The Management System offered by the CFM-LM microwave radio system provides feature rich functionality enabling easy integration of equipment into the modern telecommunication networks as well as ways to control and maintain the equipment within the network.

It conforms and is designed according to general principles of the digital network management.

The CFM equipment provides both local and remote management tools.

Each CFM LM Indoor Unit houses intelligent management controller providing several services:

- TCP/IP stack
- RIP II routing
- SNMP server
- Web server
- Telnet client and server
- Command Line Interpreter

TCP/IP packets are used as a main transport mechanism for the management information, each management controller acts as a TCP/IP router for management information, this way enabling a creation of routed TCP/IP network from the CFM and other equipment.

All CFM-LM product family Indoor Units comprise several physical management interfaces:

- LCD display and keypad
- Ethernet port
- RS232 serial port
- “Over the air” Service Channel multiplexed into data stream to and from radio for far side terminal access. This feature is not available for the CFM-8-REB IDU only.

MANAGEMENT SYSTEM

Several management methods are supported for easy and convenient managing of the equipment:

- Local management using LCD display and keypad;
- Local management using ASCII terminal attached to RS-232 management port of the IDU;
- Remote management using terminal connected through analog line and modem to the RS-232 serial management port of the IDU;
- Local or remote management over Ethernet management port of the IDU.

Consequently, the equipment can be managed:

- using LCD display and keypad,
- using Command Line Interface on Terminal and/or Telnet session (via RS232 and Ethernet console ports respectively),
- using IDU Web page.

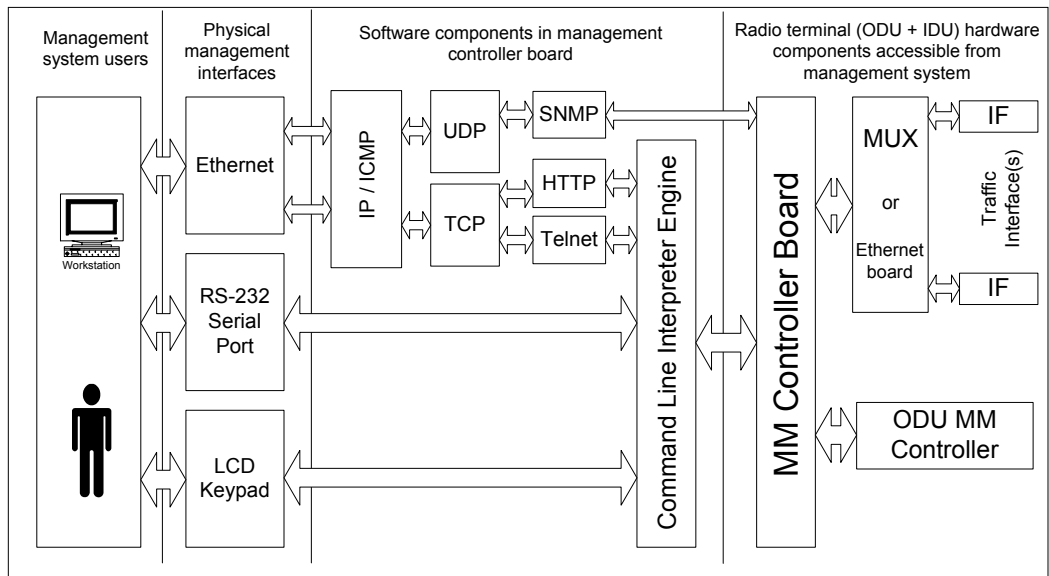
Current implementation of SNMP service is intended for data acquisition (collecting statistics) and management of the alarms.

SAF Tehnika provides private MIB and supports MIB-II RFC1213 standard MIB, this way enabling easy integration of the CFM equipment into any SNMP managed network (under any standards based SNMP management application or MIB browser), for example, HP Open View.

The CFM-LM offered management platform does not highlight special PC requirements. The customer should choose the appropriate software depending on the management method(s) he prefers. The following software categories could be used:

- Terminals (e.g., Hyper Terminal);
- Telnet browsers or SNMP management applications (e.g., HP Open View);
- Web browsers (MS Internet Explorer, Netscape Navigator or other).

Physical and Logical Management Interfaces

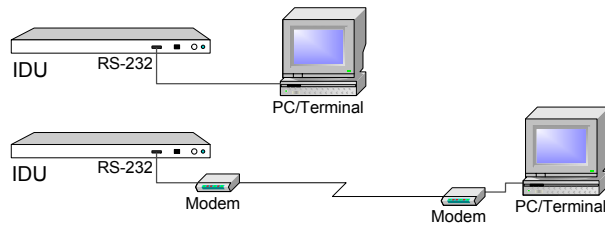


Management Features

RS-232 Serial Port

RS-232 serial management port of the IDU provides Terminal management via connected PC or other terminal device or modem. The terminal connected to the serial management port provides the same management functionality as Telnet console (refer to paragraph *Telnet/ASCII Console Command Interface*).

In order to interconnect the IDU and the Management Terminal directly through serial ports, a *straight through* modem cable is needed. The serial port of the Management Terminal should be configured as 19200 8-1-N, no data flow control.



If using modems, the management terminal is connected with the IDU remotely through a telephone line. In this case the modem, which is connected with the IDU should be set to *auto answer* mode.

Ethernet port

Ethernet port of the CFM-LM IDU is intended as main source of management connectivity and will provide the broadest range of management functionality:

- Web management via integrated Web server in the management software;
- SNMP management via integrated SNMP agent;
- Telnet server and CLI interface;

Ethernet interface could be used to connect IDU:

- To PC/Laptop to manage IDU,
- To LAN to constantly monitor IDU,
- To router or any other TCP/IP packet network termination unit to have IDU as part of network for management information.

Telnet/ASCII Console Command Interface

Telnet/Command Line Interface functionality and command system are described in the CFM-LM Indoor Unit Configuration Guides, please refer to *References*, page 58.

MANAGEMENT SYSTEM

Web Interface

The implementation of Web interface for the CFM-LM IDU provides configuration and monitoring capabilities similar to ones available using on LCD/Keypad and front panel LEDs. Currently the Web interface functionality is available through the Ethernet management port and/or service channel only.

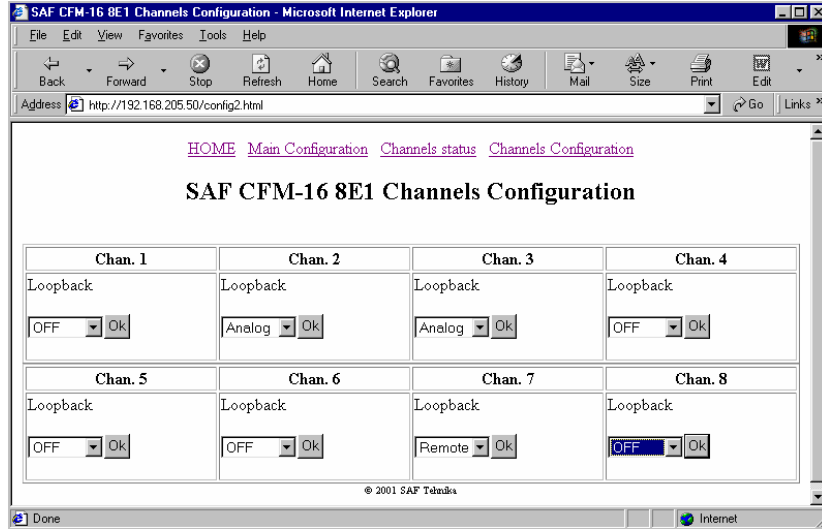


Figure 15. Web management interface: the CFM-16-8E1 IDU channels configuration window

Web interface is accessible by any standards based Web browser.

MANAGEMENT SYSTEM

SNMP Interface

SNMP management functionality is available from any SNMP browser, by means of compiling SAF MIB to browser's MIB base.

SAF MIB is available from:

- SAF Tehnika Web site, www.saftehnika.com
- From SAF Tehnika tech support, email: techsupport@saftehnika.com
- Contacting SAF Tehnika or distributors.

```
***** SNMP QUERY STARTED *****
sysDescr.0 (octets) SAF SNMP and WWW management
sysObjectID.0 (oid) saf
sysUpTime.0 (timeticks) 0 days 00h:33m:34s.90th (201490)
productDescr.0 (octets) SAF CFM-34-REBM
description.0 (octets) SAF 23GHz microwave radio
radioAlarm.0 (int32) on(1)
signalAlarm.0 (int32) none(0)
v_01.0 (octets) Tx=23362.5MHz
v_02.0 (octets) Rx=22354.5MHz
v_03.0 (octets) TxPower=+20dBm
v_05.0 (octets) RxLev=-109dBm
v_06.0 (octets) Cable=- 26dB
v_07.0 (octets) TxOut=Ok
v_08.0 (octets) TxPLL=Ok
v_09.0 (octets) RxPLL=Ok
v_10.0 (octets) t= 23C
v_11.0 (octets) Humidity=Low
v_12.0 (octets) Restart= 4
v_13.0 (octets) IDU t= 27C
v_14.0 (octets) RF Cable - OFF
***** SNMP QUERY FINISHED *****
```

Sample of SNMP query of the CFM LM IDU

Alarm Port

The alarm port is an optional feature.

The alarm port comprises:

- The set of *outputs* of relay switches for the CFM site supervision, the outputs are:
 - Power Alarm, - warns about any problems with DC power supply of the CFM site;
 - Synch Lost (SL) alarm, - this alarm triggers if multiplexer frame synchronization is lost;
 - Radio Alarm (RA), - warns about the problem with ODU and/or IDU-ODU cable and/or received signal level is too low;
 - TxPLL Alarm, - Tx Phase-locked Loop failure;
- The set of user *inputs*, these inputs are used to connect an external device that requires to be supervised.

The alarm port inputs and outputs can be supervised via SNMP manager and/or Web console.

The alarm port has a DB25 type connector and is located on the rear panel of the IDU.

For more detailed information about alarm port, please refer to the Configuration Guide, the available configuration guides for the CFM equipment are listed in Chapter References.

Loop Tests

Loop tests (loopbacks) are to be used for installation, fault tracing, performance or connectivity measurements and other.

Loopback tests are accessible using local and remote management methods (except for the Web terminal).

The following loopbacks are available:

- Baseband loopback
- Interface loopbacks
- RF (Radio) loopback (see notes below)

The RF and Base-band loopbacks can be set on a fixed time interval only.

Baseband loopback

Baseband loopback: The modulated signal on the baseband modem output is immediately looped back to the receiving device. There are two baseband loop tests available:

- Analog: The analog loopback is not dual;
- Digital: The digital loopback is dual.

Both Baseband loops can not be set simultaneously.

Radio loopback

RF loopback: the signal is transmitted (through the radio) and immediately received (with the same frequency) and looped back to the receiving device. This is the special operation mode, where the Rx frequency during the loopback test time is set equal to the Tx frequency. The RF loopback is not dual.

Interface loopbacks

The interface loop is set in the traffic interface module, - for MUX and REBM IDUs in the E1 and V.35 interfaces, for E1 IDUs – in the E1 transceiver chip.

The interface loopbacks are available for V.35 and E1 interfaces only, the loop test can not be set in the Ethernet interface.

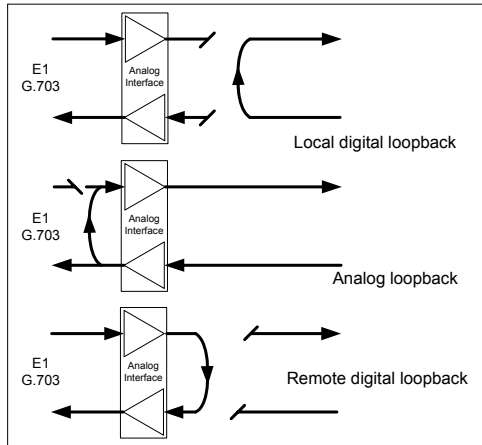


Figure 16. The interface loopbacks for the CFM-16-8E1 and the CFM-34-16E1 IDUs

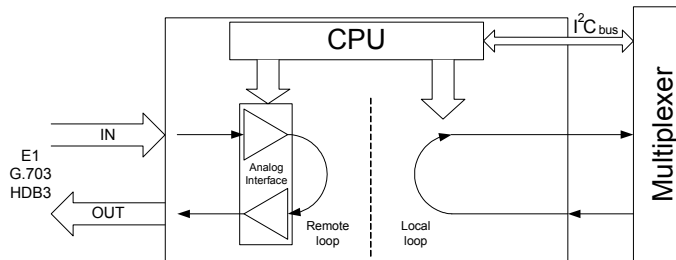


Figure 17. The E1 interface module digital loopback (for the modular IDUs equipped with the E1 interface module); the analog and remote interface loopbacks are similar to those for the CFM-16-8E1 and CFM-34-16E1 IDUs

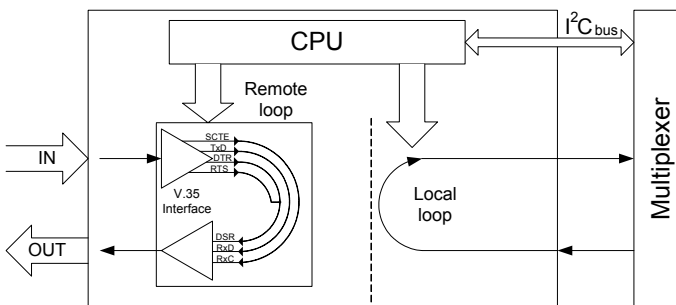
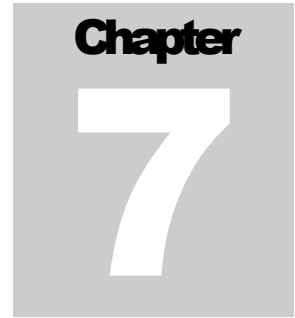


Figure 18. The V.35 interface module loopback (for the modular IDUs equipped with the E1 interface module)



Accessories

Earthing Accessories

SAF Tehnika does not supply any extra special earthing accessories due to the large variety of earthing circuits one could find at the installation sites.

! Since the IDU case is not grounded through the power connector, the IDU must be grounded using grounding screw (M6) located on the back panel of the IDU.

Please note that proper grounding of all the components is essential to achieve reliable operation and lightning protection. It is important to earth both the ODU and the IDU using the same earthing circuit.

It is recommended to earth the radio cable in its lower part and for longer cable every 50 meters. Both IDU and ODU units have a reasonable lightning and overvoltage protection built in. However it is essential to fit the lightning rod on the mast head, the equipment should be fitted on the mast so that it is located in the space contained by the 45 deg. cone, formed from the top of the lightning rod to the ground. It is unacceptable to fit the antenna on the very top of the mast.

Performance and Availability Calculation Tool

SAF Tehnika provides software (MS Excel workbook) to aid in the network planning considerations; it allows the user to determine the major parameters of Tx/Rx equipment according to the required availability, performance, and distance and path data.

Performance calculation tool for SAF Tehnika CFM-22L 8Mbps radio

Date: _____

Project: 23G / 4x2M / 0,3m

SiteA: _____ SiteB: _____

Distance: 10 km

Pathdata

Rain zone: e
 Terrainfactor: 15 m
 Climatic Factor: 1

Equipment Data

Output Power: 15 dBm
 Frequency: 23 GHz
 Antenna TX: 0,6 m Gain: 40,1 dBi
 Antenna RX: 1,2 m Gain: 46,1 dBi
 RX Threshold:
 at 10⁻³: -85 dBm
 at 10⁻⁶: -82 dBm
 at 10⁻⁹: -79 dBm

Losses

Atmospheric loss: 0,22 dB/km
 Unfaded RX-level: **40,6 dBm**
 Fade Margin:
 at 10⁻³: 44,4 dB
 at 10⁻⁶: 41,4 dB
 at 10⁻⁹: 38,4 dB

Results

Availability (%)	Vert/tot	Hor/tot
at 10 ⁻³ :	99,999	99,998
at 10 ⁻⁶ :	99,9988	99,998
at 10 ⁻⁹ :	99,9985	99,998

Unavailability (%)	Vert/tot	Hor/tot
at 10 ⁻³ :	0,001	0,0018
at 10 ⁻⁶ :	0,0012	0,0021
at 10 ⁻⁹ :	0,0015	0,0025

RainV	RainH	M.Path
99,999	99,9982	100
99,9988	99,9979	100
99,9985	99,9975	100

RainV	RainH	M.Path
0,001	0,0018	0
0,0012	0,0021	0
0,0015	0,0025	0

Full Screen | Close Full Screen

Path calculation

Balancing Unit

The Balancing Unit (BU) is a passive device intended to get over from one physical interface to other, - between RJ-45 and BNC interfaces; it can be used along with the E1 IDUs with one type of traffic interface (for example, CFM-8-4E1 IDU), e.g. RJ-45 or BNC (but not both).

The BU changes up to 16 E1 traffic ports from RJ-45 (symmetrical) electrical interface to BNC (asymmetrical) and vice versa, - converts the impedance from 75 Ω to 120 Ω and vice versa. The ports are independent.

The BU is 2U high rack mountable unit (depth: 0.34 m, weight: 0.83 kg).

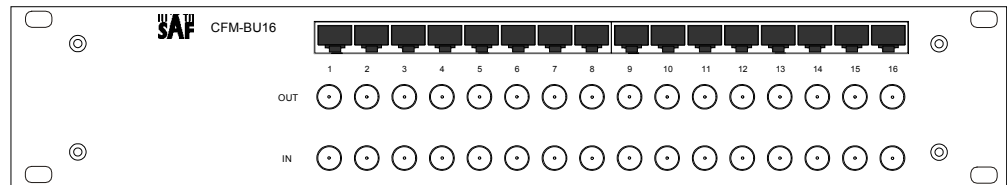


Figure 19. 16-port Balancing Unit

Technical Data

General Parameters

Frequency subbands and duplex shift	Refer to Chapter <i>ODU Characteristics</i> , page 4		
ODU and IDU Bit-rate/ Traffic interfaces	For information about ODU supported bit rates and corresponding channel spacings, please refer to chapter <i>ODU Characteristics</i> , page 4		
	IDU model	Bit-rate	Traffic interface
	CFM-8-4E1	4x2 Mbps	G.703 (RJ-45 and BNC connectors)
	CFM-16-8E1	8x2 Mbps	G.703 (RJ-45 or DB25 connectors)
	CFM-34-16E1	16x2 Mbps	G.703 (RJ-45 connectors)
	CFM-34-E3	34 Mbps	G.703 (BNC connectors)
	CFM-34-REBM	34 Mbps	10/100Base-Tx + 2x(E1 or 10Base-T or V.35)
	CFM-8-MUX	8 Mbps	3x(E1 or 10Base-T or V.35)
	CFM-16-MUX	16 Mbps	3x(E1 or 10Base-T or V.35)
	CFM-8-REB	8 Mbps	10Base-T UTP
Channel spacing (carrier spacing) on supported bit rates	Radio data rate 34 Mbps → 28 MHz (27.50 for CFM-18-LM ODU) Radio data rate 16 Mbps → 14 MHz (13.75 for CFM-18-LM ODU) Radio data rate 8 Mbps → 7 MHz		
Modulation	4 FSK		
Transmitter power	Refer to Chapter <i>ODU Characteristics</i> , page 4		
Tx power attenuation	0...30 dB (1 dB step) for the CFM-15-LM and CFM-13-LM ODU; 0...29 dB (1 dB step) for the CFM-26-LM, CFM-22-LM and CFM-18-LM ODU; 0...37 dB (1 dB step) for the CFM-8-LM and CFM-7-LM ODU; 0...24 dB (1 dB step) for the CFM-38-LM.		
Frequency stability	+/- 10 PPM		
Max. input power at antenna port	0 dBm		

TECHNICAL DATA

Receiver thresholds at antenna port (guaranteed)	Bit-rate: 8 Mbps		
		BER 10 ⁻⁶	BER 10 ⁻³
	CFM-7-LM ODU	-84.5 dBm	-87.5 dBm
	CFM-8-LM ODU	-84.5 dBm	-87.5 dBm
	CFM-13-LM ODU	-81 dBm	-84 dBm
	CFM-15-LM ODU	-81 dBm	-84 dBm
	CFM-18-LM ODU	-81 dBm	-84 dBm
	CFM-22-LM ODU	-80.5 dBm	-84 dBm
	CFM-26-LM ODU	-79 dBm	-84 dBm
	CFM-38-LM ODU	-76.5 dBm	-80 dBm
	Bit-rate: 16 Mbps		
		BER 10 ⁻⁶	BER 10 ⁻³
	CFM-7-LM ODU	-80 dBm	-84 dBm
	CFM-8-LM ODU	-80 dBm	-84 dBm
	CFM-13-LM ODU	-78 dBm	-81 dBm
	CFM-15-LM ODU	-78 dBm	-81 dBm
	CFM-18-LM ODU	-77 dBm	-80 dBm
	CFM-22-LM ODU	-78.5 dBm	-82 dBm
	CFM-26-LM ODU	-76 dBm	-81 dBm
	CFM-38-LM ODU	-73.5 dBm	-77 dBm
	Bit-rate: 34 Mbps		
		BER 10 ⁻⁶	BER 10 ⁻³
	CFM-7-LM ODU	-77 dBm	-81 dBm
	CFM-8-LM ODU	-77 dBm	-81 dBm
	CFM-13-LM ODU	-75 dBm	-78 dBm
	CFM-15-LM ODU	-75 dBm	-78 dBm
	CFM-18-LM ODU	-74 dBm	-77 dBm
CFM-22-LM ODU	-75.5 dBm	-79 dBm	
CFM-26-LM ODU	-73 dBm	-78 dBm	
CFM-38-LM ODU	-70.5 dBm	-74 dBm	
Background BER (ETS EN 300 198 method)	<10 ⁻¹¹		
Waveguide flange	CFM-38-LM: UBR 320 CFM-26-LM: UBR 260 CFM-22-LM: UBR 220 CFM-18-LM: UBR 220 CFM-15-LM: UBR 140 CFM-13-LM: UBR 140 CFM-8-LM: UBR 84 CFM-7-LM: UBR 84		
Cable (IDU - ODU): single coaxial	Up to 100 m of RG-213 or similar, w/ N-type connectors		
Ambient Temperature	ODU: -33 °C to +55 °C; IDU: -5 °C to +40 °C		
Power supply	20 ... 60 VDC, 24 W (IDU+ODU)		
Mechanical data	See Chapter <i>Mechanical Data</i>		
Antenna	The offered antennas are listed in Chapter <i>Antenna Unit</i> , page 31. For detailed information about antennas please refer to the corresponding antenna datasheet, antenna datasheets can be obtained from SAF Tehnika Web site, or by contacting SAF Tehnika representative. Note: any other suitable antennas can be used apart from those described in Chapter <i>Antenna Unit</i> .		

TECHNICAL DATA

Mechanical Data

IDU mechanical parameters

IDU model	Dimensions HxWxD [mm]	Weight [kg]
CFM-8-4E1	44x482x284	2.0
CFM-16-8E1	44x482x284	1.9
CFM-34-16E1	44x482x284	1.8
CFM-34-E3	44x482x284	1.7
CFM-34-REBM	44x482x284	2.1
CFM-8-MUX	44x482x284	1.7
CFM-16-MUX	44x482x284	1.8
CFM-8-REB	44x482x284	1.7
CFM-M-MUX	44x482x284	1.7
CFM-MP-MUX	88x482x284	2.8

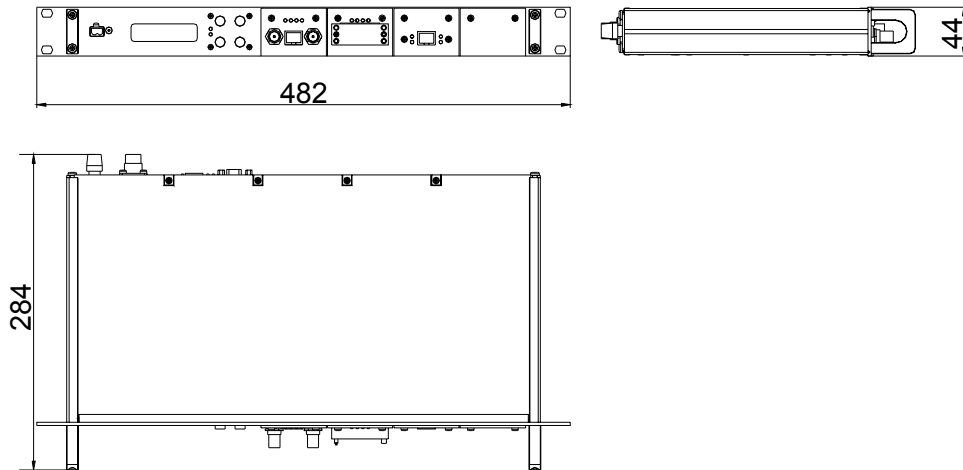


Figure 20. Dimensions of the IDU

TECHNICAL DATA

ODU mechanical parameters

Dimensions [mm]	Ø 280 x 85
Weight [kg]	2.5

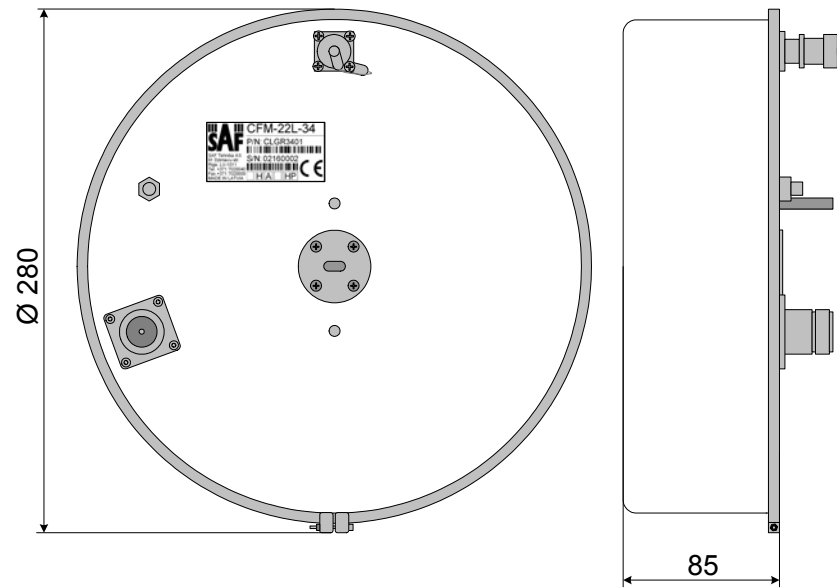


Figure 21. Dimensions of the CFM LM series ODU

Power Supply

The power consumption of the single terminal (ODU+IDU) is from 20 to 24 W, depending on IDU type and installed modules.

Each IDU supplies its own ODU.

The single terminal should be supplied with 20 – 60 VDC, either “+” or “-” pole can be grounded. The grounding connector is located at the rear side of each IDU. SAF Tehnika offers 220 V – 48 V power supply for the single IDU as the supplementary accessory.

Any other type of DC supply that complies the above mentioned requirements could be used.

Environmental Requirements

SAF Tehnika CFM-LM equipment fulfils subsets of ETS 300 019 standard as included in EN 300 198 radio standard:

- Indoor Unit is Climatic Class 3.1E compliant (according to ETSI ETS 300 019-1-3) and are intended to be operational in weather-protected locations (equipment rooms or shelters), with:
 - Temperature from –5 to +40 °C;
 - Humidity from 5% to 95%;
 - Solar radiation up to 700 W/m²;
 - Wind velocity up to 5 m/s (18 km/h).
- Outdoor Unit is Climatic Class 4.1 compliant (according to ETSI ETS 300 019-1-4) and can be used without performance degradation outdoors under the following conditions:
 - Temperature from –33 to +55 °C;
 - Humidity from 15% to 100%;
 - Solar radiation up to 1200 W/m²;
 - Wind velocity up to 50 m/s (180 km/h).

The IDU has the **IP 20** degree of protection according to IEC 60529 standard.

The ODU has the **IP 67** degree of protection according to IEC 60529 standard.

References

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

CFM LM/L4 series Outdoor Unit and Indoor Unit Technical Description

Besides this document, SAF Tehnika offers technical description of CFM-LM/L4 Radio and Indoor Unit in greater detail (IDU and ODU), which covers functional and framework aspects, technical data and more.

Configuration Guides

Configuration guides provide the necessary information regarding the installation and configuration of CFM products, these documents mostly describe the management system and methods to configure the equipment.

The following configuration guides are available:

- *CFM Series E1 Indoor Units: Management System Technical Description and Configuration Guide;*
- *CFM-34-REBM Modular Fast Ethernet Bridge: Indoor Unit Management System Technical Description and Configuration Guide;*
- *CFM-4-REB and CFM-8-REB Ethernet Bridge: Indoor Unit Management System Technical Description and Configuration Guide;*
- *CFM Modular Multiplexer: Indoor Unit Management System Technical Description and Configuration Guide.*
- *CFM-MP-MUX Indoor Unit Installation and Configuration Manual.*

Product Family Technical Descriptions

There are two technical descriptions available:

- *CFM LM Series Microwave Radio System Product Family: Technical Description* (this document);
- *CFM L4 Series Microwave Radio System Product Family: Technical Description*; This document is a generic technical description of the CFM-L4 radio and IDUs that are compatible with it, it comprises the installation and commissioning issues and respective accessories, functional descriptions, technical data, a.o.

Management Software Update Guide

This guide provides the user of the CFM series equipment with the information required to update the management software.

- *CFM Series Microwave Radio System Indoor Unit Management Software Update Guide*

All aforementioned documents are available for any of management software versions.

SAF Tehnika A/S Contacts

The most up to date contacts of SAF Tehnika A/S could be found at Web site <http://www.saftehnika.com>.

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