



# **SAF CFM-LM**

**Series Microwave Radio System Product  
Family**

## **Technical Description**

# **SAF CFM-LM Series Product Family Technical Description**

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# Table of Contents

## CHAPTER 1

|                                      |   |
|--------------------------------------|---|
| Introduction                         | 1 |
| CFM Radio in the Modern Market       | 2 |
| Typical Uses of the CFM Radio System | 2 |
| Abbreviations                        | 2 |

## CHAPTER 2

|                                   |   |
|-----------------------------------|---|
| CFM-LM Equipment                  | 3 |
| Overview                          | 3 |
| Main Features and Characteristics | 4 |
| Standards                         | 6 |
| Terminal and Site Configurations  | 8 |

## CHAPTER 3

|                               |    |
|-------------------------------|----|
| Outdoor Unit and Antenna      | 9  |
| General                       | 9  |
| Radio Unit                    | 10 |
| Frequency Channel Arrangement | 15 |
| Antenna Unit                  | 31 |

## CHAPTER 4

|                                          |    |
|------------------------------------------|----|
| Indoor Unit                              | 33 |
| General                                  | 33 |
| IDU Functional Design                    | 37 |
| Update of Management Controller Software | 39 |

## CHAPTER 5

|                             |    |
|-----------------------------|----|
| Cables                      | 40 |
| IDU-ODU Cable               | 40 |
| Cable for Antenna Alignment | 41 |
| Traffic Interface Cables    | 42 |
| Management Interface Cables | 42 |
| Power Cable                 | 42 |

## CHAPTER 6

|                     |    |
|---------------------|----|
| Management System   | 43 |
| General, Main Goals | 43 |
| Management Features | 45 |
| Loop Tests          | 48 |

## CHAPTER 7

|                                          |    |
|------------------------------------------|----|
| Accessories                              | 50 |
| Earthing Accessories                     | 50 |
| Performance and Availability Calculation |    |
| Tool                                     | 51 |
| Balancing Unit                           | 52 |

## CHAPTER 8

|                            |    |
|----------------------------|----|
| Technical Data             | 53 |
| General Parameters         | 53 |
| Mechanical Data            | 55 |
| Antenna Parameters         | 58 |
| Power Supply               | 59 |
| Environmental Requirements | 59 |
| References                 | 60 |
| SAF Tehnika A/S Contacts   | 60 |
| Index                      | 61 |

## 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 20<sup>th</sup> century and beginning of the 21<sup>st</sup> 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 has either SMB 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 V1.2.3                | 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 V2.2.2                | 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 v1.2.1 (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 V1.4.1 (2002-07)   | Parameters for digital radio systems operating in the frequency range 24,50 GHz to 29,50 GHz                                                                                                      |
| ETSI EN 301 128 v1.2.1             | Parameters for digital radio systems operating in 13 GHz, 15 GHz and 18 GHz bands                                                                                                                 |
| ETSI EN 301 126-1 V1.1.2 (1999-09) | Fixed Radio Systems; Conformance testing; Part 1: Point-to-Point equipment -Definitions, general requirements and test procedures                                                                 |
| ETSI EN 300 833 V1.3.1 (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                                                     |

**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)  | 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<br>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<br>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<br>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<br>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 |
|------------|--------------------|

## 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.

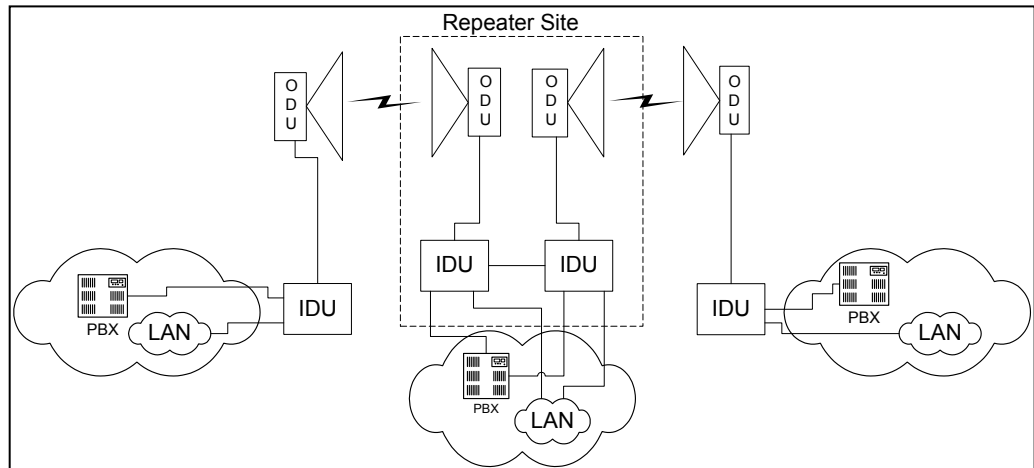


Figure 1. Typical configuration of the repeater site

## **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  $\Omega$  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).

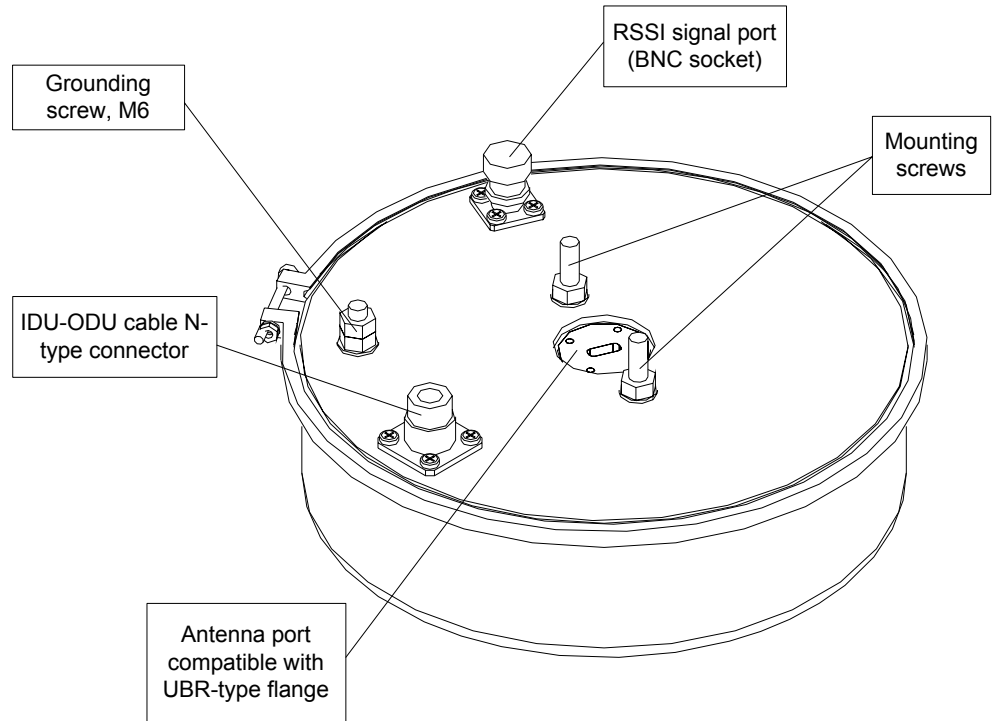


Figure 2. CFM-LM Radio Unit

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.

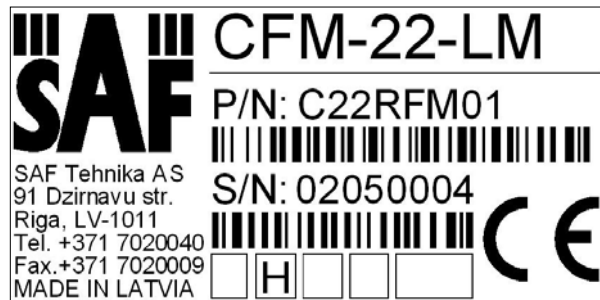


Figure 3. Label of the CFM-22-LM Radio

### 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

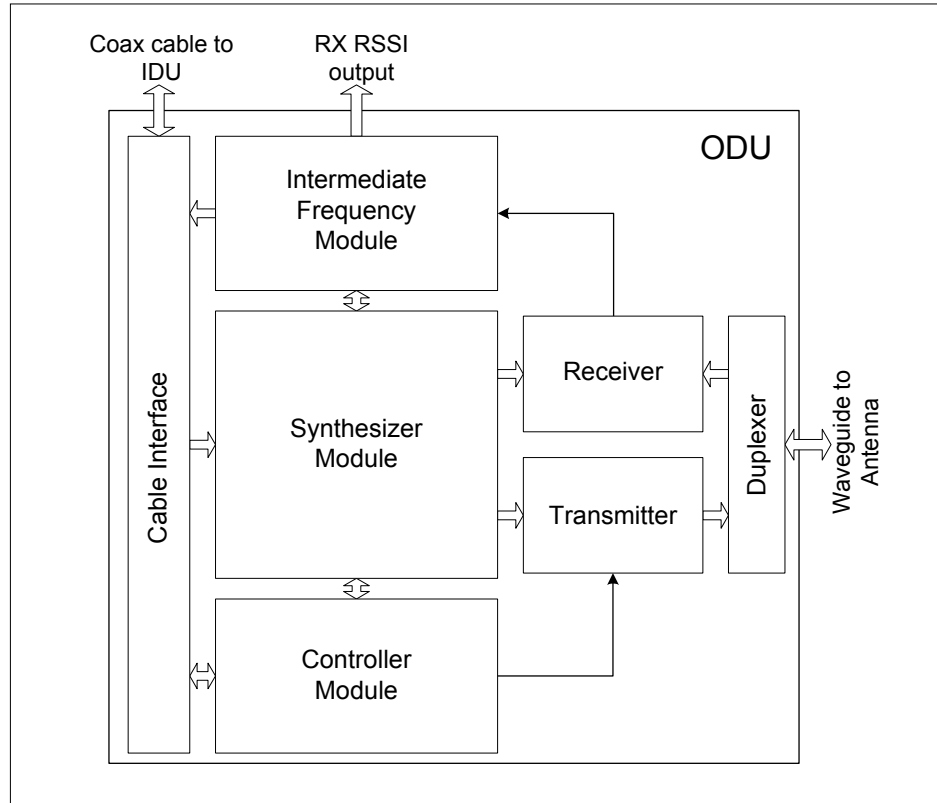


Figure 4. The CFM-LM radio unit block diagram

### **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 |                                      |         |         |

## OUTDOOR UNIT AND ANTENNA

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 |

## OUTDOOR UNIT AND ANTENNA

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 |

## OUTDOOR UNIT AND ANTENNA

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 |

## OUTDOOR UNIT AND ANTENNA

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 |    |         |         |

# **OUTDOOR UNIT AND ANTENNA**

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<br>channel<br>Nr. | Channels |        |        | LA       | HA       | ODU<br>channel<br>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 |

## OUTDOOR UNIT AND ANTENNA

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 |     |         |         |

## OUTDOOR UNIT AND ANTENNA

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 |

## OUTDOOR UNIT AND ANTENNA

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)

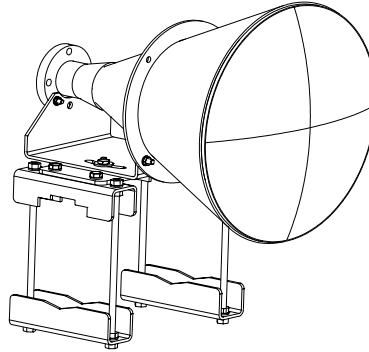


Figure 5. 25 cm Lens–Horn antenna

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  |

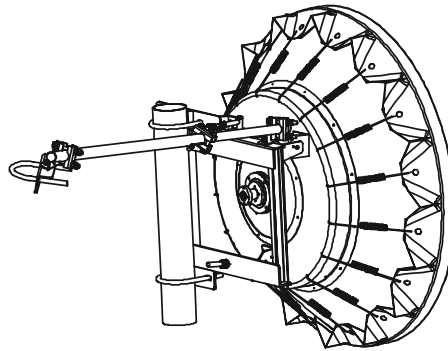


Figure 6. 120 cm parabolic antenna

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:

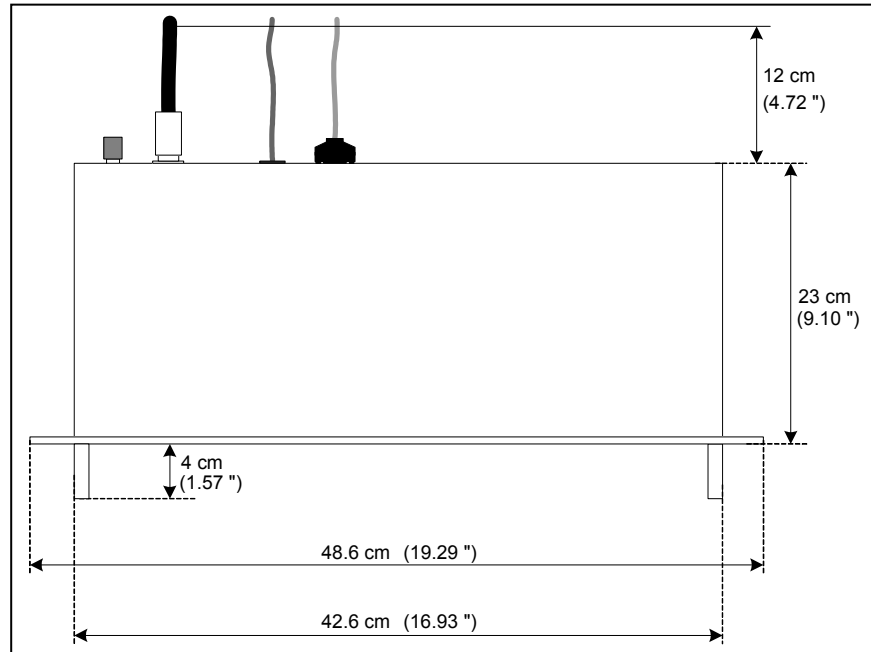
- RS232 serial management port, DB9 connector is located at the rear panel of the IDU,
- 10Base-T Ethernet management port, RJ-45 socket is located at the rear side of the IDU panel,
- Alarm port (optional), e.i., alarm relay *outputs* for power supply failure, Synch Lost alarm, Radio alarm, and transmitter 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 7. The CFM-8-REB IDU front panel

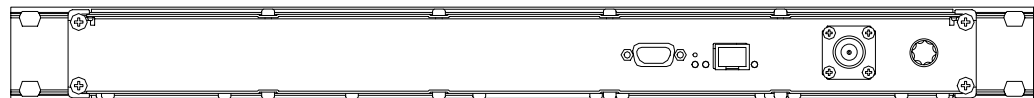


Figure 8. The rear panel of the CFM-8-REB IDU

## 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 9. 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.

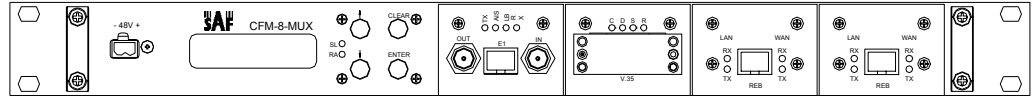


Figure 10. The CFM-8-MUX IDU front panel

### 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 SMB or RJ-45 connectors.

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

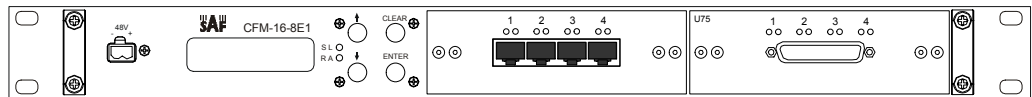


Figure 11. CFM-16-8E1 IDU front panel

### 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.

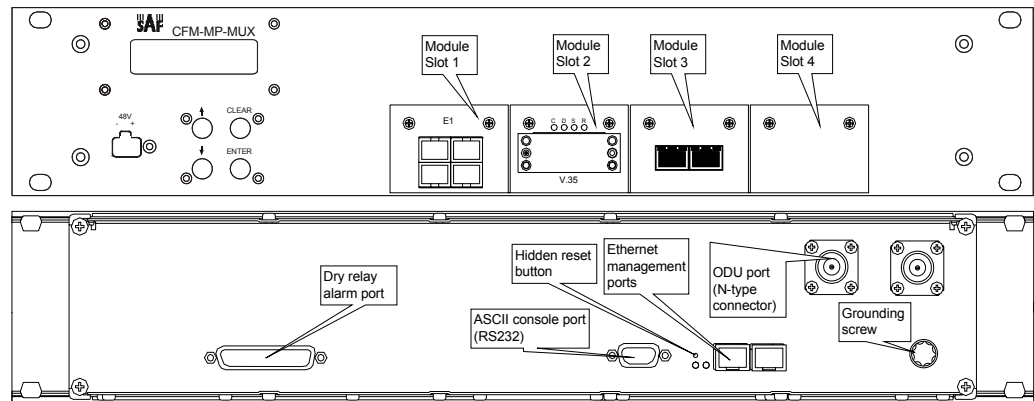


Figure 12. CFM-MP-MUX IDU front and rear panel

## IDU Functional Design

The CFM IDUs consist of the following functional blocks (see Figure 13 and Figure 14):

- 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

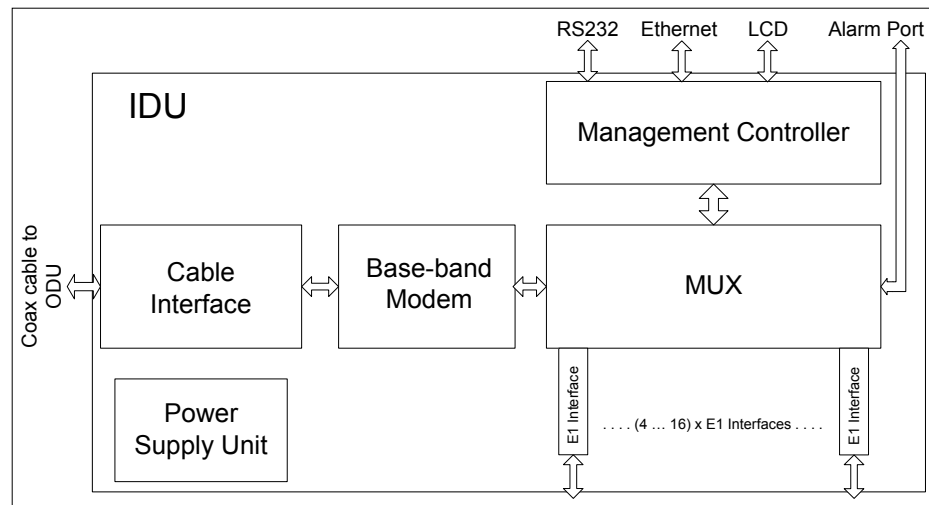


Figure 13. The CFM series E1 IDU block diagram

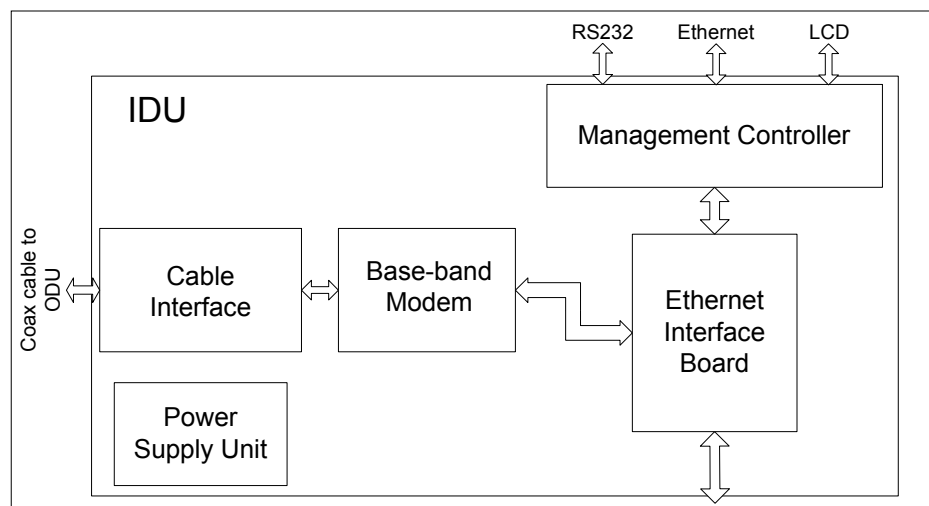


Figure 14. The CFM-8-REB IDU block diagram

### **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  $\Omega$  balanced interface on RJ-45 type connector and 75  $\Omega$  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.

## Update of 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 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 from any PC terminal program with text file loading functionality.

The instructions on performing the software upload are provided with the upgrade files. There is a special management software upgrade guide available from SAF Tehnika, 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  $\Omega$  coaxial cable intended to interconnect the Indoor Unit with the Outdoor Unit. Any type of 50  $\Omega$  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 15).



Figure 15. Cable for connection of voltmeter to the ODU RSSI port

### 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  $\Omega$  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 D-sub type.

## **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.

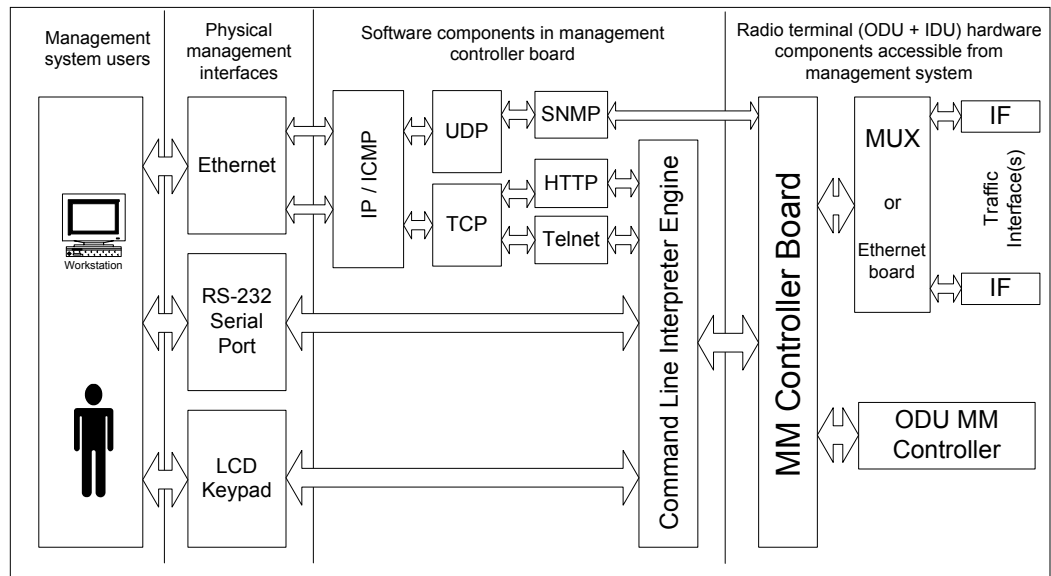
Current implementation of SNMP service is intended for data acquisition (collecting statistics) and management of the alarms.

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

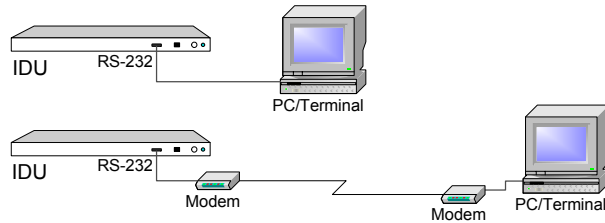


## Management Features

### 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 60.

## 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.

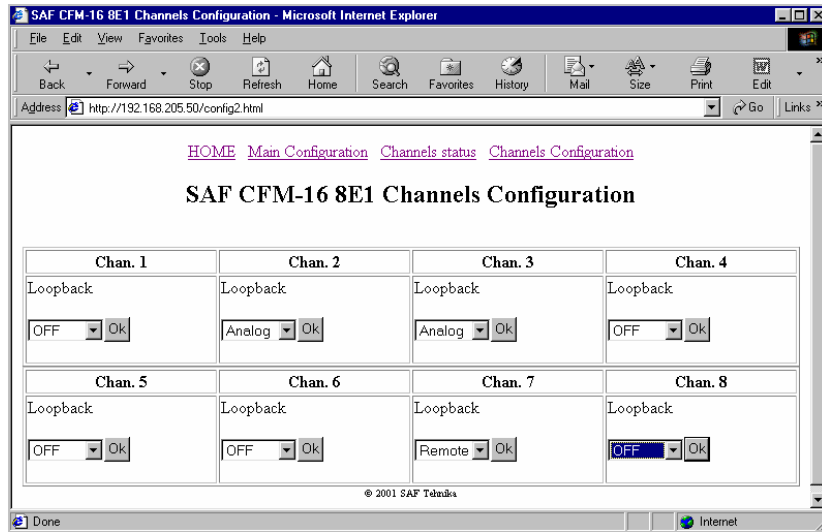


Figure 16. Web management interface: the CFM-16-8E1 IDU channels configuration window

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](http://www.saftehnika.com)
- From SAF Tehnika tech support, email: [techsupport@saftehnika.com](mailto: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.

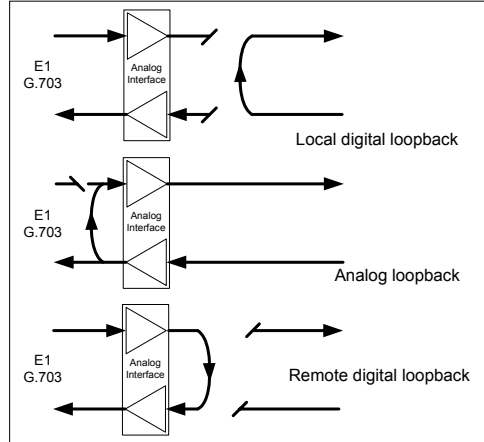


Figure 17. The interface loopbacks for the CFM-16-8E1 and the CFM-34-16E1 IDUs

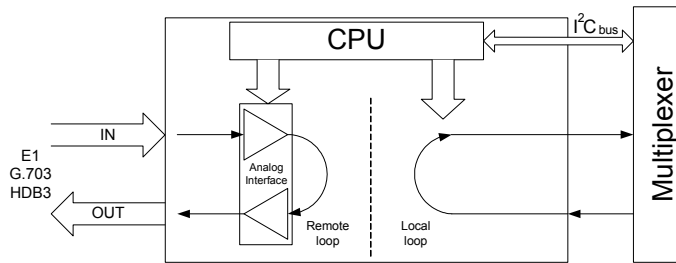


Figure 18. The E1 interface module digital loopback (for the modular IDUs equipped with the E1 interface module); the analog and remote interface loopbacks are similar to those for the CFM-16-8E1 and CFM-34-16E1 IDUs

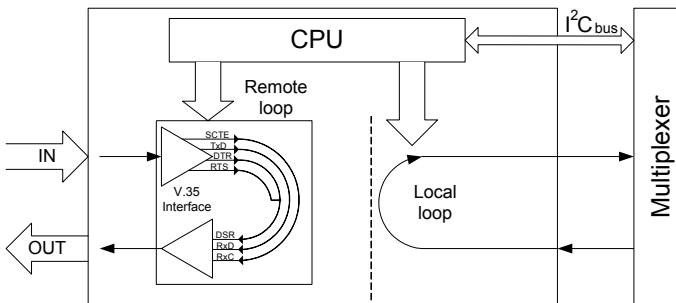


Figure 19. The V.35 interface module loopback (for the modular IDUs equipped with the E1 interface module)

## 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.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A                                           | B                 | C | D     | E | F                                                                          | G     | H | I | R | S | T | U |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-------------------|---|-------|---|----------------------------------------------------------------------------|-------|---|---|---|---|---|---|---------|-------|--------|------------------|----------|---------|-----------------------|---------|--------|-----------------------|---------|--------|-----------------------|---------|--------|--------------------|--------|--|----------|---------|---|-----------------------|--------|--------|-----------------------|--------|--------|-----------------------|--------|--------|
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Performance calculation tool for SAF</b> |                   |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Tehnika CFM-22L 8Mbps radio</b>          |                   |   |       |   |                                                                            | Date: |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Project:                                    | 23G / 4x2M / 0,3m |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                             |                   |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | SiteA:                                      |                   |   |       |   | SiteB:                                                                     |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                             | Distance:         |   |       |   | 10 km                                                                      |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                             |                   |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Pathdata</b>                             |                   |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Rain zone:                                  | e                 |   |       |   | <b>Rain zone</b><br>Enter rain zone<br>See rain zone maps (ITU-R PN.837-1) |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Terrainfactor:                              | 15 m              |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 11                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Climatic Factor:                            | 1                 |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>Equipment Data</b>                       |                   |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 13                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Output Power:                               | 15 dBm            |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 14                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Frequency:                                  | 23 GHz            |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Antenna TX:                                 | 0,6 m             |   | Gain: |   | 40,1 dBi                                                                   |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Antenna RX:                                 | 1,2 m             |   | Gain: |   | 46,1 dBi                                                                   |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 17                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | RX Threshold:                               |                   |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 18                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | at 10 <sup>-3</sup> :                       | -85 dBm           |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 19                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | at 10 <sup>-6</sup> :                       | -82 dBm           |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | at 10 <sup>-9</sup> :                       | -79 dBm           |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 21                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>Losses</b>                               |                   |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 22                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Atmospheric loss:                           | 0,22 dB/km        |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 23                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Unfaded RX-level:                           | 40,6 dBm          |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Fade Margin:                                |                   |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | at 10 <sup>-3</sup> :                       | 44,4 dB           |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 26                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | at 10 <sup>-6</sup> :                       | 41,4 dB           |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| 27                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | at 10 <sup>-9</sup> :                       | 38,4 dB           |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| <table border="1"> <thead> <tr> <th colspan="3">Results</th> </tr> <tr> <th>Availability (%)</th> <th>Vert/tot</th> <th>Hor/tot</th> </tr> </thead> <tbody> <tr> <td>at 10<sup>-3</sup>:</td> <td>99,999</td> <td>99,998</td> </tr> <tr> <td>at 10<sup>-6</sup>:</td> <td>99,9988</td> <td>99,998</td> </tr> <tr> <td>at 10<sup>-9</sup>:</td> <td>99,9985</td> <td>99,998</td> </tr> <tr> <th colspan="3">Unavailability (%)</th> </tr> <tr> <th>Vert/tot</th> <th>Hor/tot</th> <th></th> </tr> <tr> <td>at 10<sup>-3</sup>:</td> <td>0,001</td> <td>0,0018</td> </tr> <tr> <td>at 10<sup>-6</sup>:</td> <td>0,0012</td> <td>0,0021</td> </tr> <tr> <td>at 10<sup>-9</sup>:</td> <td>0,0015</td> <td>0,0025</td> </tr> </tbody> </table> |                                             |                   |   |       |   |                                                                            |       |   |   |   |   |   |   | Results |       |        | Availability (%) | Vert/tot | Hor/tot | at 10 <sup>-3</sup> : | 99,999  | 99,998 | at 10 <sup>-6</sup> : | 99,9988 | 99,998 | at 10 <sup>-9</sup> : | 99,9985 | 99,998 | Unavailability (%) |        |  | Vert/tot | Hor/tot |   | at 10 <sup>-3</sup> : | 0,001  | 0,0018 | at 10 <sup>-6</sup> : | 0,0012 | 0,0021 | at 10 <sup>-9</sup> : | 0,0015 | 0,0025 |
| Results                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                             |                   |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| Availability (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Vert/tot                                    | Hor/tot           |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| at 10 <sup>-3</sup> :                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 99,999                                      | 99,998            |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| at 10 <sup>-6</sup> :                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 99,9988                                     | 99,998            |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| at 10 <sup>-9</sup> :                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 99,9985                                     | 99,998            |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| Unavailability (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                             |                   |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| Vert/tot                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Hor/tot                                     |                   |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| at 10 <sup>-3</sup> :                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,001                                       | 0,0018            |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| at 10 <sup>-6</sup> :                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,0012                                      | 0,0021            |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| at 10 <sup>-9</sup> :                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0,0015                                      | 0,0025            |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| <table border="1"> <thead> <tr> <th>RainV</th> <th>RainH</th> <th>M.Path</th> </tr> </thead> <tbody> <tr> <td>99,999</td> <td>99,9982</td> <td>100</td> </tr> <tr> <td>99,9988</td> <td>99,9979</td> <td>100</td> </tr> <tr> <td>99,9985</td> <td>99,9975</td> <td>100</td> </tr> <tr> <th colspan="3">RainV</th> </tr> <tr> <th>RainH</th> <th>M.Path</th> <th></th> </tr> <tr> <td>0,001</td> <td>0,0018</td> <td>0</td> </tr> <tr> <td>0,0012</td> <td>0,0021</td> <td>0</td> </tr> <tr> <td>0,0015</td> <td>0,0025</td> <td>0</td> </tr> </tbody> </table>                                                                                                                                                                            |                                             |                   |   |       |   |                                                                            |       |   |   |   |   |   |   | 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      |                       |        |        |
| 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                 |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| <div> <span>Full Screen</span> <span>Close Full Screen</span> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                             |                   |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |
| <div> <span>Path calculation</span> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                             |                   |   |       |   |                                                                            |       |   |   |   |   |   |   |         |       |        |                  |          |         |                       |         |        |                       |         |        |                       |         |        |                    |        |  |          |         |   |                       |        |        |                       |        |        |                       |        |        |

## 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  $\Omega$  to 120  $\Omega$  and vice versa. The ports are independent.

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

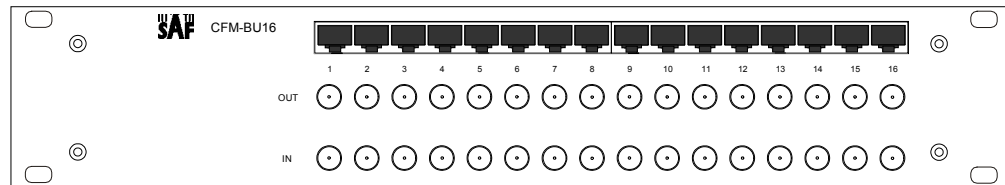


Figure 20. 16-port Balancing Unit

## Technical Data

### General Parameters

|                                                          |                                                                                                                                                                                                                                             |              |                                            |
|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------------------------------------|
| Frequency subbands and duplex shift                      | Refer to Chapter<br>ODU Characteristics, page 4                                                                                                                                                                                             |              |                                            |
| ODU and IDU Bit-rate/<br>Traffic interfaces              | For information about ODU supported bit rates and corresponding channel spacings, please refer to chapter<br>ODU Characteristics, 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 SMB 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)<br>Radio data rate 16 Mbps → 14 MHz (13.75 for CFM-18-LM ODU)<br>Radio data rate 8 Mbps → 7 MHz                                                                                  |              |                                            |
| Modulation                                               | 4 FSK                                                                                                                                                                                                                                       |              |                                            |
| Transmitter power                                        | Refer to Chapter<br>ODU Characteristics, page 4                                                                                                                                                                                             |              |                                            |
| Tx power attenuation                                     | 0...30 dB (1 dB step) for the CFM-15-LM and CFM-13-LM ODU;<br>0...29 dB (1 dB step) for the CFM-26-LM, CFM-22-LM and CFM-18-LM ODU;<br>0...37 dB (1 dB step) for the CFM-8-LM and CFM-7-LM ODU;<br>0...24 dB (1 dB step) for the CFM-38-LM. |              |                                            |
| Frequency stability                                      | +/- 10 PPM                                                                                                                                                                                                                                  |              |                                            |
| Max. input power at antenna port                         | +15 dBm                                                                                                                                                                                                                                     |              |                                            |

## TECHNICAL DATA

|                                                  |                                                                                                                                                                                                                                                       |                      |                      |
|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------|
| Receiver thresholds at antenna port (guaranteed) | Bit-rate: 8 Mbps                                                                                                                                                                                                                                      |                      |                      |
|                                                  |                                                                                                                                                                                                                                                       | BER 10 <sup>-6</sup> | BER 10 <sup>-3</sup> |
|                                                  | 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 <sup>-6</sup> | BER 10 <sup>-3</sup> |
|                                                  | 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 <sup>-6</sup> | BER 10 <sup>-3</sup> |
|                                                  | 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 <sup>-11</sup>                                                                                                                                                                                                                                    |                      |                      |
| Waveguide flange                                 | CFM-38-LM: UBR 320<br>CFM-26-LM: UBR 260<br>CFM-22-LM: UBR 220<br>CFM-18-LM: UBR 220<br>CFM-15-LM: UBR 140<br>CFM-13-LM: UBR 140<br>CFM-8-LM: UBR 84<br>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<br>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 mechanical data see page 55, for electrical data see page 58. Note: any other suitable antennas can be used apart from those described in Chapter <i>Antenna Unit</i> . |                      |                      |

Mechanical Data

Antenna

| Antenna                                       | Weight [kg]                   | Diameter [cm] |
|-----------------------------------------------|-------------------------------|---------------|
| 25 cm Lens-Horn antennas<br>(SAF)             | 4.0<br>(including mast mount) | 25            |
| 30 cm parabolic antennas<br>(COMHAT-PROVEXA)  | 2.0                           | 30            |
| 60 cm parabolic antennas<br>(COMHAT-PROVEXA)  | 4.1                           | 60            |
| 120 cm parabolic antennas<br>(COMHAT-PROVEXA) | 25.0                          | 120           |

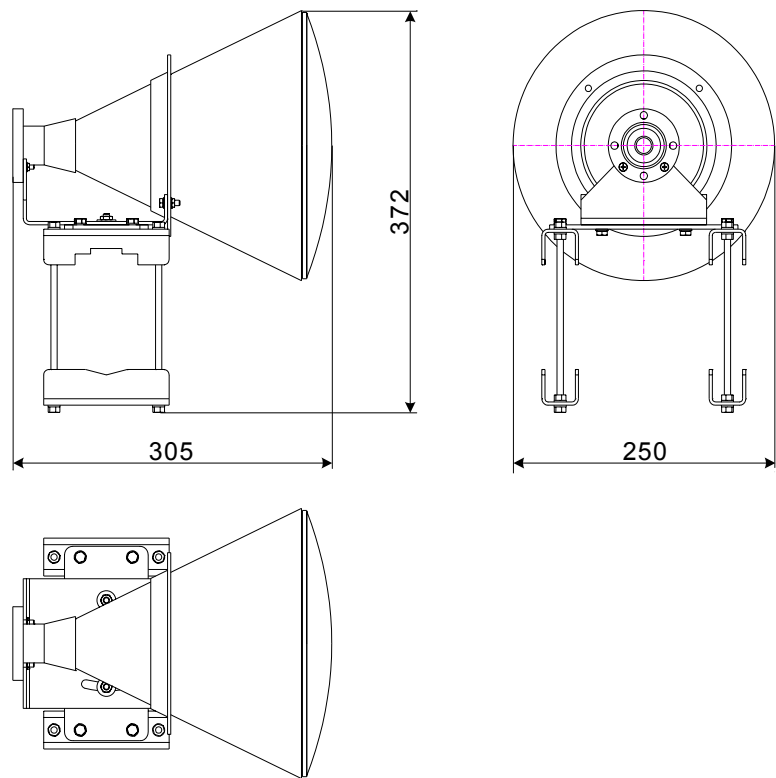


Figure 21. Dimensions of the SAF 25 cm Lens-Horn antenna

**TECHNICAL 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         |

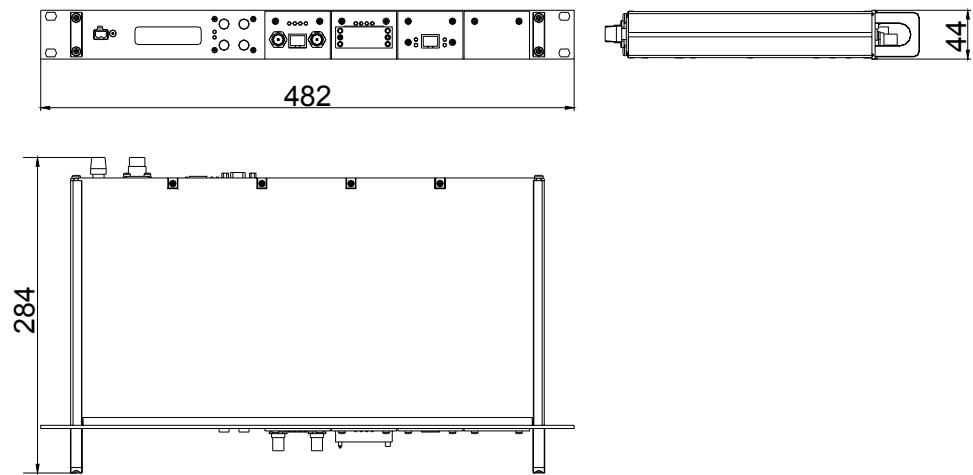


Figure 22. Dimensions of the IDU

**TECHNICAL DATA**

**ODU mechanical parameters**

|                 |            |
|-----------------|------------|
| Dimensions [mm] | Ø 280 x 85 |
| Weight [kg]     | 2,5        |

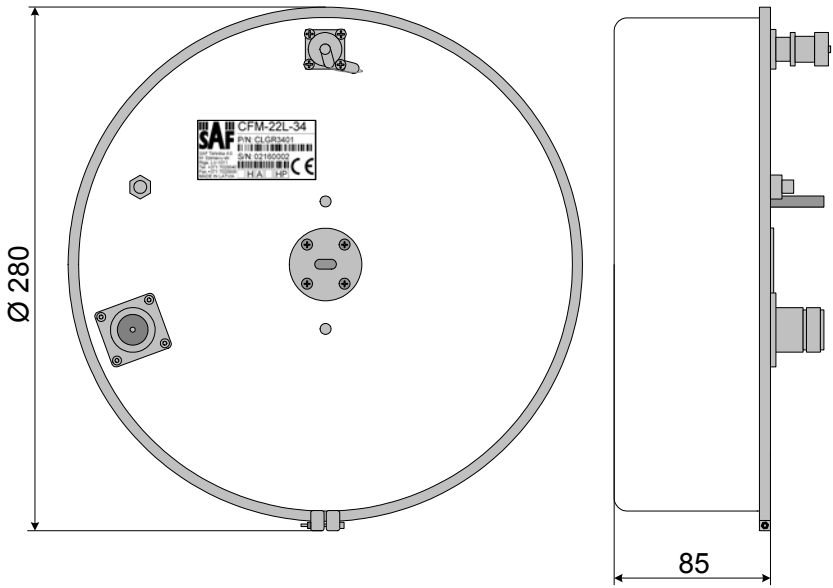


Figure 23. Dimensions of the CFM LM series ODU

## TECHNICAL DATA

### Antenna Parameters

- 25 cm Lens–Horn antenna: weights 4 kg including mast mount (alignment unit), should be mounted on vertical tubular mounts ranging from 70 to 135 mm in diameter (70 – 90 mm for older version 25 cm antennas).
- 30 cm parabolic antennas: weights 2 kg (3 kg shipping weight), should be mounted on tubular mounts ranging from 40 to 130 mm in diameter.
- 60 cm parabolic antennas: weights 4.1 kg (6 kg shipping weight), should be mounted on tubular mounts ranging from 40 to 130 mm in diameter.
- 120 cm parabolic antennas: weights 20 kg (40 kg shipping weight), should be mounted on tubular mounts ranging from 60 to 130 mm in diameter.

### Antenna Electrical Data

| Antenna                                   | Gain [dBi] / Lobewidth (3 dB) |                         |                         |                         |                         |                         |                         |                         |
|-------------------------------------------|-------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                                           | 7 GHz band                    | 8 GHz band              | 13 GHz band             | 15 GHz band             | 18 GHz band             | 23 GHz band             | 26 GHz band             | 38 GHz band             |
| 0.25 m Lens–Horn antennas (SAF)           | -                             | -                       | -                       | -                       | 29.9 / 4.6 <sup>0</sup> | 32.2 / 4.0 <sup>0</sup> | -                       | -                       |
| 0.3 m parabolic antennas (COMHAT-PROVEXA) | -                             | -                       | 30.2 / 5.2 <sup>0</sup> | 32.1 / 4.9 <sup>0</sup> | 32.9 / 4.1 <sup>0</sup> | 35.0 / 3.7 <sup>0</sup> | 35.9 / 3.1 <sup>0</sup> | 39.3 / 2.1 <sup>0</sup> |
| 0.6 m parabolic antennas                  | 30.2 / 5.6 <sup>0</sup>       | 30.9 / 4.5 <sup>0</sup> | 35.8 / 3.0 <sup>0</sup> | 36.5 / 2.8 <sup>0</sup> | 38.3 / 2.4 <sup>0</sup> | 39.9 / 2.0 <sup>0</sup> | 41.0 / 1.7 <sup>0</sup> | 44.3 / 1.2 <sup>0</sup> |
| 1.2 m parabolic antennas                  | 36.5 / 2.8 <sup>0</sup>       | 37.3 / 2.3 <sup>0</sup> | 41.5 / 1.5 <sup>0</sup> | 42.7 / 1.4 <sup>0</sup> | 44.3 / 1.2 <sup>0</sup> | 45.9 / 1.0 <sup>0</sup> | 46.8 / 0.9 <sup>0</sup> | -                       |
| 1.8 m parabolic antennas                  | 40.7 / 1.5 <sup>0</sup>       | 41.2 / 1.4 <sup>0</sup> | 45.5 / 0.9 <sup>0</sup> | 46.2 / 0.8 <sup>0</sup> | 48.1 / 0.7 <sup>0</sup> | 49.6 / 0.5 <sup>0</sup> | -                       | -                       |
| 2.4 m parabolic antennas                  | 43.1 / 1.1 <sup>0</sup>       | 43.6 / 1.0 <sup>0</sup> | 46.9 / 0.7 <sup>0</sup> | -                       | -                       | -                       | -                       | -                       |
| 3.0 m parabolic antennas                  | 45.1 / 0.9 <sup>0</sup>       | 45.6 / 0.8 <sup>0</sup> | -                       | -                       | -                       | -                       | -                       | -                       |

For additional information on electrical data please contact your SAF Tehnika representative or reseller.

### Antenna Environmental Requirements

| Antenna                                   | Operational temperature | Wind load [km/h]<br>Operational/Survival |
|-------------------------------------------|-------------------------|------------------------------------------|
| 0.25 m Lens–Horn antennas (SAF)           | -33 to +55 °C           | 200/250                                  |
| 0.3 m parabolic antennas (COMHAT-PROVEXA) | -40 to +55 °C           | 180/250                                  |
| 0.6 m parabolic antennas (COMHAT-PROVEXA) | -40 to +55 °C           | 180/250                                  |
| 1.2 m parabolic antennas (COMHAT-PROVEXA) | -40 to +55 °C           | 180/250                                  |
| 1.8 m parabolic antennas (COMHAT-PROVEXA) | -45 to +45 °C           | 144/200                                  |
| 2.4 m parabolic antennas (COMHAT-PROVEXA) | -45 to +45 °C           | 144/200                                  |
| 3.0 m parabolic antennas (COMHAT-PROVEXA) | -45 to +45 °C           | 144/200                                  |

For additional information on environmental requirements please contact your SAF Tehnika representative or reseller.

## 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 3.2 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/m<sup>2</sup>;
  - 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/m<sup>2</sup>;
  - 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>.

SAF Tehnika A/S technical support could be reached at:

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# Index

## A

**Abbreviations, 2**  
**Add/Drop, 8**  
**Antenna alignment, 40**  
**Antenna installation, 57**  
**Antenna parameters, 57**  
**Availability calculations, 50**

## B

**Background BER, 53**  
**Baseband loopback, 47**  
**Base-band modem, 37**

## C

**Cable interface, 37**  
**Cables, 39, 40, 41**  
**Channel spacing, 52**  
**Checking functions, 14**  
**Connectors/Sockets**  
    **IDU, 34, 35, 36**  
    **ODU, 10**

## D

**Dimensions**  
    **antenna, 54**  
    **IDU, 55**  
    **ODU, 53, 56**

## E

**Earthing accessories, 49**  
**Environmental parameters**  
    **humidity, 58**  
    **solar radiation, 58**  
    **temperature, 58**  
    **wind velocity, 58**  
**Ethernet management port, 44**

## F

**Flange, 10, 53**  
**Frequency subbands, 52**

## G

**Grounding, 49**

## I

**Indoor Unit, 1, 2, 33, 42, 58**  
**Interface cables, 41**  
**Interface Module, 37**

## L

**LCD, 42, 43, 45**  
**Lightning protection, 49**  
**Loop tests, 47**

## M

**Management controller, 37**  
**Management interfaces, 42, 43**  
**Management methods, 42, 43**  
**Modulation, 52**  
**Multiplexer, 37**

## O

**Operation and maintenance facilities, 4**  
**Outdoor part, 9**  
**Outdoor unit, 1, 2, 3, 4, 9, 10, 13, 14, 33, 37, 49, 52, 53, 56, 58**

## P

**PC requirements, 43**

**Performance calculations, 50**  
**Power, 14, 52, 53, 58**  
**Power cable, 41**  
**Power consumption, 58**  
**Power supply, 37, 53, 58**  
**Protected terminal (1+1), 8**

## R

**Radio unit, 1, 2, 3, 4, 9, 10, 13, 14, 33, 37, 49, 52, 53, 56, 58**  
**Receiver threshold, 53**  
**Remote Ethernet bridge IDU, 3**  
**Repeater site, 8**  
**RF loopback, 47**  
**RSSI Rx signal level-voltage relations, 10**

## S

**Serial management port, 44**  
**Slot, 35**  
**SNMP management, 46**  
**Software, 38**  
**Sub-band, 5, 14**

## T

**Technical support, 59**  
**Telnet, 37, 42, 43, 44**  
**Terminal, 1, 3, 8, 58**  
**Terminal configuration, 3, 8**  
**Tests, 47**  
**Traffic capacity, 4**  
**Traffic interfaces, 33, 37**

## U

**Unprotected terminal (1+0), 8**  
**Update, 38**

W

**Web interface, 45**

