Contents

Section 1.
USER GUIDE

1 DECLARATION OF CONFORMITY ................................................................. 11

2 FIRST AID FOR ELECTRICAL SHOCK AND SAFETY RULES .................. 12
  2.1 FIRST AID FOR ELECTRICAL SHOCK ...................................................... 12
    2.1.1 Artificial respiration ........................................................................... 12
    2.1.2 Treatment of burns ............................................................................ 12
  2.2 SAFETY RULES ....................................................................................... 13
  2.3 CORRECT DISPOSAL OF THIS PRODUCT (Waste electrical & electronic equipment) .......................................................... 15
  2.4 INTERNAL BATTERY .............................................................................. 15

3 PURPOSE AND STRUCTURE OF THE MANUAL .............................................. 16
  3.1 PURPOSE OF THE MANUAL ................................................................. 16
  3.2 AUDIENCE BASIC KNOWLEDGE ......................................................... 16
  3.3 STRUCTURE OF THE MANUAL .............................................................. 16

Section 2.
DESCRIPTIONS AND SPECIFICATION ............................................................ 19

4 ABBREVIATION LIST ...................................................................................... 19
  4.1 ABBREVIATION LIST .............................................................................. 19

5 SYSTEM PRESENTATION .............................................................................. 21
  5.1 RECOMMENDATION .............................................................................. 21
  5.2 SYSTEM ARCHITECTURE ..................................................................... 21
  5.3 ALplus2 MODULAR IDU ...................................................................... 21
    5.3.1 LIM ............................................................................................... 22
    5.3.2 RIM ............................................................................................... 22
  5.4 ALCplus2 COMPACT IDU ................................................................. 22
  5.5 ALCplus2e COMPACT IDU .............................................................. 23
  5.6 ODU .................................................................................................... 24
  5.7 MANAGEMENT .................................................................................... 25
    5.7.1 Hardware platform .......................................................................... 25
    5.7.2 Management ports ........................................................................ 25
6 TECHNICAL SPECIFICATIONS ..................................................................................29

6.1 IDU CHARACTERISTICS.....................................................................................29

6.1.1 Traffic interfaces .....................................................................................29

6.1.1.1 2 Mbit/s (E1 G.703) ..................................................................29

6.1.1.2 STM1 electrical ............................................................................30

6.1.1.3 STM1 optical.............................................................................30

6.1.1.4 Ethernet interface ....................................................................31

6.1.2 Service channels .....................................................................................34

6.1.2.1 E1 (Connector name is 2 Mbit/s wayside) ....................................34

6.1.2.2 64 kbit/s codirectional...............................................................34

6.1.2.3 64 kbit/s contradirectional.........................................................35

6.1.2.4 9600 bit/s synch/asynch ...........................................................35

6.1.2.5 9600 or 2x4800 bit/s synch/asynch ............................................35

6.1.3 Modulation and channel bandwidth............................................................35

6.1.4 1+1 switching criteria ..............................................................................36

6.1.5 2x(1+1) switching criteria ........................................................................37

6.1.6 Cable Interface .......................................................................................37

6.1.7 Consumption and max current absorption ..................................................37

6.1.8 Fuses ....................................................................................................38

6.2 ODU CHARACTERISTICS ....................................................................................38

6.3 EQUIPMENT GENERAL CHARACTERISTICS............................................................39

6.3.1 Dimensions ............................................................................................39

6.3.2 Weight ..................................................................................................39

6.3.3 Environmental condition ..........................................................................39

7 ALplus2 IDU DESCRIPTION ......................................................................................41

7.1 CONFIGURATION ..............................................................................................41

7.1.1 ALplus2 block diagrams ...........................................................................41

7.1.2 Controller ..............................................................................................41

7.1.2.1 Service signals .........................................................................42

7.1.2.2 Firmware ................................................................................42

7.1.2.3 Web Lct ..................................................................................42

7.1.2.4 Controller LEDs ........................................................................42

7.1.2.5 SD memory card management...................................................43

7.1.3 LIM .......................................................................................................43

7.1.3.1 Switch for Ethernet ports...........................................................44

7.1.3.2 STM-1 synchronisation...............................................................45

7.1.3.3 LIM LEDs.................................................................................46

7.1.4 RIM .......................................................................................................46

7.1.4.1 Modulator................................................................................47

7.1.4.2 Demodulator ...........................................................................47

7.1.4.3 Adaptive code modulation .........................................................47

7.1.4.4 Power supply ...........................................................................49

7.1.4.5 Telemetry IDU/ODU..................................................................49

7.2 LOOPS ............................................................................................................49

7.2.1 Tributary ................................................................................................49

7.2.2 IDU loop ................................................................................................50
8 ALCplus2 IDU DESCRIPTION

8.1 CONFIGURATION

8.1.1 Switch for ethernet ports

8.1.2 Service channels

8.2 SYNCHRONIZATION

8.3 SD MEMORY CARD MANAGEMENT

8.4 ALC BLOCK DIAGRAMS

8.5 ALCplus2 NODE

8.5.1 Expansion from 2 to 3 nodals

8.5.2 Reduction from 3 to 2 nodes

8.6 LAG - LINK AGGREGATION

8.7 LINE PROTECTION THROUGH DISTRIBUTED ELP

8.8 ETHERNET OAM (Operation Administration and Maintenance)

9 ALCplus2E IDU DESCRIPTION

9.1 CONFIGURATION

9.1.1 Service channels

9.2 ALCplus2E BLOCK DIAGRAM

9.3 FREQUENCY REUSE

9.4 2x(1+1) XPIC CONFIGURATION

9.5 2+0 EST WEST CONFIGURATION

9.5.1 Selective E1 Protection

9.6 SYNCHRONIZATION

9.7 SWITCH FOR ETHERNET PORTS

10 ODU DESCRIPTION

10.1 ODU VERSIONS

10.1.1 AS ODU

10.1.2 ASN ODU

10.2 DESCRIPTION

10.3 CABLE INTERFACE

10.4 POWER SUPPLY

10.5 TX SECTION

10.5.1 ATPC operation

10.6 RX SECTION

10.7 1+1 Tx SYSTEM

Section 3.

INSTALLATION

11 INSTALLATION AND PROCEDURES FOR ENSURING THE ELECTROMAGNETIC COMPATIBILITY
11.1 GENERAL INFORMATION TO BE READ BEFORE THE INSTALLATION ......................... 91
11.2 GENERAL ............................................................................................................ 92
11.3 MECHANICAL INSTALLATION ............................................................................. 92
  11.3.1 IDU ............................................................................................................. 92
  11.3.2 IDU installation ........................................................................................... 92
11.4 ELECTRICAL WIRING ...................................................................................... 92
11.5 CONNECTIONS TO THE SUPPLY MAINS .......................................................... 94
11.6 IDU-ODU INTERCONNECTION CABLE ............................................................... 94
  11.6.1 Electrical characteristics ............................................................................. 94
  11.6.2 Connectors ................................................................................................... 94
  11.6.3 Max length .................................................................................................. 94
  11.6.4 Suggested cable .......................................................................................... 94
11.7 GROUNDING CONNECTION ............................................................................. 95
11.8 SURGE AND LIGHTNING PROTECTION ............................................................. 95

12 ALplus2 CONNECTORS ........................................................................................... 96
  12.1 IDU FRONT PANEL ............................................................................................ 96
  12.1.1 LIM connectors ............................................................................................ 96
  12.1.2 RIM connectors ........................................................................................... 96
  12.1.3 Controller connectors .................................................................................. 96
  12.2 IDU BODY CONNECTORS .................................................................................. 97

13 ALCplus2 CONNECTORS .......................................................................................... 103
  13.1 IDU FRONT PANEL .......................................................................................... 103
  13.2 ALCplus2 1+0/1+1 (GAI0157/GAI0152) ............................................................ 103
  13.3 ALCplus2 16E1 1+0/1+1 (GAI0155/GAI0156) .................................................... 104
  13.4 ALCplus2 NODAL 1+0/1+1 (GAI0163/GAI0162) .............................................. 104
  13.5 ALCplus2 32E1 1+0/1+1 (GAI0169/GAI0168) ................................................. 105

14 ALCplus2e CONNECTORS ....................................................................................... 106
  14.1 IDU FRONT PANEL ......................................................................................... 106
  14.2 ALCplus2e 1+0 (GAI0178), 2+0/1+1 (GAI0175), 2+0/XPIC (GAI0172) ........... 106
  14.3 ALCplus2e 18E1 2xSTM1 NODAL (GAI0176), 2+0/1+1 (GAI0173), 2+0/XPIC (GAI0170) .................................................. 107
  14.4 ALCplus2e 34E1 2xSTM1 1+0 (GAI0177), 2+0/1+1 (GAI0174), 2+0/XPIC (GAI0171) .................................................. 108

15 INSTALLATION NOTE ON FREQUENCY REUSE SYSTEMS (XPIC) ......................... 109
  15.1 FREQUENCY REUSE ...................................................................................... 109
  15.2 CHARACTERISTICS ...................................................................................... 109
    15.2.1 Antennas ................................................................................................. 109
    15.2.2 RF channel .............................................................................................. 109
    15.2.3 ATPC ..................................................................................................... 109
    15.2.4 IDU-ODU cable ...................................................................................... 109

16 INSTALLATION ONTO THE POLE OF THE ODU WITH SEPARATED ANTENNA .......... 110
  16.1 INSTALLATION KIT ......................................................................................... 110
  16.2 REQUIRED TOOLS FOR MOUNTING (NOT SUPPLIED) ............................. 111
  16.3 INSTALLATION PROCEDURE ....................................................................... 111
  16.4 GROUNDING ............................................................................................... 113

17 INSTALLATION ONTO THE WALL OF THE ODU WITH SEPARATED ANTENNA ........ 127
17.1 INSTALLATION KIT ..............................................................................................127
17.2 REQUIRED TOOLS FOR MOUNTING (NOT SUPPLIED) ...............................127
17.3 INSTALLATION PROCEDURE ..........................................................................128
17.4 GROUNDING ..................................................................................................130

18 INSTALLATION ONTO THE POLE OF THE ODU WITH INTEGRATED ANTENNA ....141
18.1 FOREWORD ....................................................................................................141
18.2 INSTALLATION KIT ..........................................................................................141
18.3 REQUIRED TOOLS FOR MOUNTING (NOT SUPPLIED) ...............................142
18.4 INSTALLATION PROCEDURE .........................................................................142
  18.4.1 Installation onto the pole of the support system and the antenna ...............142
  18.4.2 Installation of ODU ................................................................................143
  18.4.3 ODU installation ...................................................................................144
18.5 ANTENNA AIMING ........................................................................................144
18.6 COMPATIBILITY .............................................................................................144
18.7 GROUNDING ..................................................................................................145

19 INSTALLATION ONTO THE POLE OF THE ODU WITH INTEGRATED ANTENNA (KIT V32307, V32308, V32309) ........................................................................160
19.1 FOREWORD ....................................................................................................160
19.2 INSTALLATION KIT ..........................................................................................160
19.3 REQUIRED TOOLS FOR MOUNTING (NOT SUPPLIED) ...............................161
19.4 INSTALLATION PROCEDURE .........................................................................161
  19.4.1 Setting antenna polarization ................................................................161
  19.4.2 Installation of the centring ring on the antenna ......................................162
  19.4.3 Installation of 1+0 ODU support ............................................................162
  19.4.4 Installation onto the pole of the assembled structure .............................162
  19.4.5 Installation of ODU (on 1+0 support) ....................................................162
  19.4.6 Antenna aiming ....................................................................................163
  19.4.7 ODU grounding ...................................................................................163
19.5 1+1 MOUNTING PROCEDURES ....................................................................163
  19.5.1 Installation of Hybrid ............................................................................163
  19.5.2 Installation of ODUs (on hybrid for 1+1 version) .....................................164

20 INSTALLATION ONTO THE POLE OF THE ODU WITH RFS INTEGRATED ANTENNA...174
20.1 FOREWORD ....................................................................................................174
20.2 INSTALLATION KIT ..........................................................................................174
20.3 REQUIRED TOOLS FOR MOUNTING (NOT SUPPLIED) ...............................174
20.4 INSTALLATION PROCEDURE .........................................................................175
  20.5.1 Setting antenna polarization ................................................................175
  20.5.2 Installation of the centring ring on the antenna ......................................176
  20.5.3 Installation of 1+0 ODU support ............................................................176
  20.5.4 Installation onto the pole of the assembled structure .............................176
  20.5.5 Installation of ODU (on 1+0 support) ....................................................176
  20.5.6 Antenna aiming ....................................................................................177
  20.5.7 ODU grounding ...................................................................................177
20.6 1+1 MOUNTING PROCEDURES ....................................................................177
  20.6.1 Installation of Hybrid ............................................................................177
  20.6.2 Installation of ODUs (on hybrid for 1+1 version) .....................................177
21 INSTALLATION ONTO THE POLE OF ODU ASN WITH STANDARD LOCK ........................188
   21.1 ODU COUPLING KIT .....................................................................................188
       21.1.1 ODU AS ............................................................................................188
       21.1.2 ODU ASN ..........................................................................................188
           21.1.2.1 Fast lock coupling kit .............................................................188
           21.1.2.2 Standard coupling kit ...............................................................188
   21.2 INSTALLATION ONTO THE POLE OF THE ODU WITH INTEGRATED ANTENNA ....189
       21.2.1 ODU AS and ODU ASN (Fast Lock) ....................................................189
       21.2.2 ODU ASN (Standard Lock) ................................................................189
           21.2.2.1 1+0 ODU ..................................................................................189
           21.2.2.2 1+1 ODU ..................................................................................190
   21.3 INSTALLATION ONTO THE POLE OF THE ODU WITH SEPARATED ANTENNA ....190
       21.3.1 ODU AS and ODU ASN (Fast Lock) ....................................................190
       21.3.2 ODU ASN (Standard Lock) ................................................................190
           21.3.2.1 1+0 ODU ..................................................................................191
           21.3.2.2 1+1 ODU ..................................................................................192
           21.3.2.3 Waveguide towards the antenna ...............................................192

Section 4.
LINE-UP  .............................................................................................................201

22 LINE-UP OF THE RADIO HOP .........................................................................201
   22.1 LINE-UP OF THE RADIO HOP .................................................................201
       22.1.1 Equipment configuration ....................................................................201
       22.1.2 Antenna alignment and received field measurement .........................202
       22.1.3 Network element configuration ..........................................................202
       22.1.4 Few considerations about addresses ....................................................203
       22.1.5 Radio checks .......................................................................................203
       22.1.6 ACM setting .......................................................................................203

23 BACK UP FULL EQUIPMENT CONFIGURATION WITHOUT POSSIBILITY OF MODIFYING THE PARAMETERS ..............................................................206
   23.1 SCOPE .......................................................................................................206
   23.2 CONFIGURATION UPLOAD AND DOWNLOAD USING SCT ......................206
       23.2.1 Configuration upload .........................................................................206
       23.2.2 Configuration download .....................................................................206
   23.3 CONFIGURATION UPLOAD AND DOWNLOAD USING WEBLCT ..................207
       23.3.1 Configuration upload .........................................................................207
       23.3.2 Configuration download .....................................................................207
       23.3.3 SD Memory card ................................................................................207

24 LINE-UP FOR ETHERNET TRAFFIC ....................................................................208
   24.1 LAN SETUP ...............................................................................................208
   24.2 LOCAL LAN-1 PORT TO REMOTE LAN-1 PORT TRANSPARENT CONNECTION LAN PER PORT ..........................................................208
   24.3 FROM 3 PORT TO 3 PORT CONNECTIONS ..................................................213
   24.4 FROM 3 PORT TO 3 PORT CONNECTIONS ..................................................218
25 HOW TO CHANGE ADDRESS ON REMOTE EQUIPMENT WITHOUT LOSING THE CONNECTION ........................................ 223
   25.1 TOOLS ................................................................................................................ 223
   25.2 PROCEDURE .................................................................................................... 223

26 LINE-UP OF THE NODE WITH NODAL IDU ....................................................... 235
   26.1 OVERVIEW ...................................................................................................... 235
   26.2 NODE CONNECTIONS ..................................................................................... 235
   26.3 EQUIPMENT CONFIGURATION ..................................................................... 236
   26.4 TRIBUTARY CONFIGURATION ..................................................................... 237
   26.5 CONFIGURATION OF THE CROSS-CONNECTON MATRIX ........................... 238
      26.5.1 Tributary - Radio Cross-connection ..................................................... 238
      26.5.2 Tributary - Tributary Cross-connection ................................................. 238
   26.6 ETHERNET SWITCH ...................................................................................... 239

27 EXAMPLE OF ALCplus2 NODE EXPANSION ...................................................... 254
   27.1 INTRODUCTION ............................................................................................ 254
   27.2 PRECONDITIONS .......................................................................................... 254
   27.3 NBUS AND INTRA-NODE GE CABLING RULES ......................................... 256
   27.4 NODE EXPANSION FROM N TO N+K ELEMENTS ........................................ 257
      27.4.1 Step 1 ..................................................................................................... 257
      27.4.2 Step 2 ..................................................................................................... 257
      27.4.3 Step 3 (traffic affecting) ......................................................................... 257
      27.4.4 Step 4 ..................................................................................................... 258
      27.4.5 Step 5 (traffic affecting) ......................................................................... 258
   27.5 NODE REDUCTION FROM N+K TO N ELEMENTS ......................................... 259
      27.5.1 Step 1 (traffic affecting) ......................................................................... 259
      27.5.2 Step 2 ..................................................................................................... 259
      27.5.3 Step 3 (traffic affecting) ......................................................................... 259
      27.5.4 Step 4 ..................................................................................................... 259

28 LINE-UP RADIO TRUNKING (Link Aggregation Radio Side) ............................... 260
   28.1 RADIO TRUNKING MODE (INTERNAL PORT - PORT A) ............................. 260
      28.1.1 To verify the status of the internal port in relation to the trunking mode .... 260
      28.1.2 To enable/disable the Trunking mode for the internal port ...................... 261

29 LINE-UP LINE TRUNKING (Link Aggregation Line Side)...................................... 262
   29.1 LINE TRUNKING MODE ............................................................................... 262

30 LINE-UP OAM .................................................................................................... 264
   30.1 FM DOMAIN ................................................................................................. 264
   30.2 OAM-FM MA/MEP ....................................................................................... 265
   30.3 VLAN IDENTIFIER - VLAN NAME - ETHERNET SWITCH PORT ............... 266

31 LINE-UP ELP .................................................................................................... 267
   31.1 ETHERNET LINE PROTECTION (ELP) ....................................................... 267

32 LINE-UP ACL .................................................................................................. 268
   32.1 ACCESS CONTROL LIST (ACL) ............................................................... 268

33 LINE-UP SYNCHRONISATION ........................................................................... 270
   33.1 LINE-UP SYNCHRONISATION ................................................................. 270
Section 5. MAINTENANCE

34.1 GENERAL

34.2 FAULTY CONDITION

34.2.1 Front panel LEDs

34.2.2 SCT/WEBLCT alarm window

34.2.3 Direction of an alarm

34.2.4 Alarms group

34.3 ALARMS

34.3.1 Common alarms

34.3.2 ETH LAN alarms

34.3.3 LIM alarms

34.3.4 Node alarms

34.3.5 Performance Monitoring alarms

34.3.6 Plug-in alarms

34.3.7 Radio alarms

34.3.8 RIM alarms

34.3.9 RT alarms

34.3.10 SETS alarms

34.3.11 SNTP alarms

34.3.12 STM1 alarms

Section 6. PROGRAMMING AND SUPERVISION

35.1 GENERAL

35.2 WEBLCT

Section 7. COMPOSITION

36.1 GENERAL

36.2 IDU PART NUMBER

36.3 COMPOSITION OF THE INDOOR UNIT
Section 1.
USER GUIDE

1 DECLARATION OF CONFORMITY

SIAE Microelettronica S.p.A. declares that the products:
- digital radio relay system AS6 and ASN6
- digital radio relay system AS7 and ASN7
- digital radio relay system AS8 and ASN8
- digital radio relay system AS10 and ASN10
- digital radio relay system AS11 and ASN11
- digital radio relay system AS13 and ASN13
- digital radio relay system AS15 and ASN15
- digital radio relay system AS18 and ASN18
- digital radio relay system AS23 and ASN23
- digital radio relay system AS25 and ASN25
- digital radio relay system AS28 and ASN28
- digital radio relay system AS32 and ASN32
- digital radio relay system AS38 and ASN38

complies with the essential requirements of article 3 of the R&TTE Directive (1999/5/EC) and therefore is marked CE.

The following standards have been applied:
- EN 60950-1: 2006 “Safety of information technology equipment”.
- EN 301 489-4 V.1.3.1 (2002–8): “Electromagnetic compatibility and radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 4. Specific conditions for fixed radio links and ancillary equipment and services”
- ETSI EN 301 751 V.1.1. (2002–12): “Fixed Radio Systems; Point–to point equipment and antennas; generic harmonized standard for point–to–point digital fixed radio systems and antennas covering the essential requirements under article 3.2 of the 1999/5/EC Directive”. 
2 FIRST AID FOR ELECTRICAL SHOCK AND SAFETY RULES

2.1 FIRST AID FOR ELECTRICAL SHOCK

Do not touch the bare hands until the circuit has been opened. pen the circuit by switching off the line switches. If that is not possible protect yourself with dry material and free the patient from the conductor.

2.1.1 Artificial respiration

It is important to start mouth respiration at once and to call a doctor immediately. suggested procedure for mouth to mouth respiration method is described in the Tab.1.

2.1.2 Treatment of burns

This treatment should be used after the patient has regained consciousness. It can also be employed while artificial respiration is being applied (in this case there should be at least two persons present).

Warning

- Do not attempt to remove clothing from burnt sections
- Apply dry gauze on the burns
- Do not apply ointments or other oily substances.
### Tab.1 - Artificial respiration

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lay the patient on his back with his arms parallel to the body. If the patient is laying on an inclined plane, make sure that his stomach is slightly lower than his chest. Open the patient's mouth and check that there is no foreign matter in mouth (dentures, chewing gum, etc.).</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Kneel beside the patient level with his head. Put an hand under the patient’s head and one under his neck. <strong>Lift the patient’s head and let it recline backwards as far as possible.</strong></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Shift the hand from the patient’s neck to his chin and his mouth, the index along his jawbone, and keep the other fingers closed together. While performing these operations take a good supply of oxygen by taking deep breaths with your mouth open</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>With your thumb between the patient’s chin and mouth keep his lips together and blow into his nasal cavities</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>While performing these operations observe if the patient’s chest rises. If not it is possible that his nose is blocked: in that case open the patient’s mouth as much as possible by pressing on his chin with your hand, place your lips around his mouth and blow into his oral cavity. Observe if the patient’s chest heaves. This second method can be used instead of the first even when the patient’s nose is not obstructed, provided his nose is kept closed by pressing the nostrils together using the hand you were holding his head with. The patient’s head must be kept sloping backwards as much as possible.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Start with ten rapid expirations, hence continue at a rate of twelve/fifteen expirations per minute. Go on like this until the patient has regained consciousness, or until a doctor has ascertained his death.</td>
<td></td>
</tr>
</tbody>
</table>

### 2.2 SAFETY RULES

When the equipment units are provided with the plate, shown in Fig.1, it means that they contain components electrostatic charge sensitive.
In order to prevent the units from being damaged while handling, it is advisable to wear an elasticized band (Fig.2) around the wrist ground connected through coiled cord (Fig.3).

The units showing the label, shown in Fig.4, include laser diodes and the emitted power can be dangerous for eyes; avoid exposure in the direction of optical signal emission.
2.3 CORRECT DISPOSAL OF THIS PRODUCT (Waste electrical & electronic equipment)

(Applicable in the European Union and other European countries with separate collection systems). This marking of Fig.5 shown on the product or its literature, indicates that it should not be disposed with other household wastes at the end of its working life. To prevent possible harm to the environment or human health from uncontrolled waste disposal, please separate this from other types of wastes and recycle it responsibly to promote the sustainable reuse of material resources. Household users should contact either the retailer where they purchased this product, or their local government office, for details of where and how they can take this item for environmentally safe recycling. Business users should contact their supplier and check the terms and conditions of the purchase contract. This product should not be mixed with other commercial wastes for disposal.

Fig.5 - WEEE symbol - 2002/96/CE EN50419

2.4 INTERNAL BATTERY

Inside the equipment, in IDU unit, there is a lithium battery.

CAUTION: Risk of explosion if battery is replaced by an incorrect type. Dispose of used batteries according to law.
3 PURPOSE AND STRUCTURE OF THE MANUAL

3.1 PURPOSE OF THE MANUAL

The purpose of this manual consists in providing the user with information which permit to operate and maintain the ALS radio family.

Warning: This manual does not include information relevant to the SCT/LCT management program windows and relevant application. They will provided by the program itself as help-on line.

3.2 AUDIENCE BASIC KNOWLEDGE

The following knowledge and skills are required to operate the equipment:

- a basic understanding of microwave transmission
- installation and maintenance experience on digital radio system
- a good knowledge of IP/OSI networks and routing policy.

3.3 STRUCTURE OF THE MANUAL

The manual is subdivided into sections each of them developing a specific topic entitling the section. Each section consists of a set of chapters, enlarging the main subject master.

Section 1 – User Guide

It provides the information about the main safety rules and expounds the purpose and the structure of the manual.

Section 2 – Description and specifications

It traces the broad line of equipment operation and lists the main technical characteristics of the whole equipment and units it consists of. List of abbreviation meaning is also supplied.

Section 3 – Installation

The mechanical installation procedures are herein set down as well as the user electrical connections. The content of the tool kit (if supplied) is also listed.
Section 4 – Line–Up

Line–up procedures are described as well as checks to be carried out for the equipment correct operation. The list of the instruments to be used and their characteristics are also set down.

Section 4 – Maintenance

In this section a description of alarms is given in order to help operators to perform equipment maintenance and troubleshooting.

Section 6 – Programming and supervision

The ALS radio family is programmed and supervised using different software tools. Some of them are already available, some other will be available in the future.

This section lists the tools implemented and indicates if descriptions are already available.

Each description of software tools is supplied in a separated manual.

Section 7 – Composition

Position, part numbers of the components the equipment consist of, are shown in this section.

Section 8 – Lists and assistance

This section contains the lists of figures and tables and the assistance service information.
Section 2.
DESCRIPTIONS AND SPECIFICATION

4 ABBREVIATION LIST

4.1 ABBREVIATION LIST

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACM</td>
<td>Adaptive Code Modulation</td>
</tr>
<tr>
<td>AF</td>
<td>Assured Forwarding</td>
</tr>
<tr>
<td>AL</td>
<td>Access Link</td>
</tr>
<tr>
<td>ALS</td>
<td>Access Link Series</td>
</tr>
<tr>
<td>AIS</td>
<td>Alarm Indication Signal</td>
</tr>
<tr>
<td>ATPC</td>
<td>Automatic Transmit Power Control</td>
</tr>
<tr>
<td>BB</td>
<td>Baseband</td>
</tr>
<tr>
<td>BBER</td>
<td>Background Block Error Radio</td>
</tr>
<tr>
<td>BER</td>
<td>Bit Error Rate</td>
</tr>
<tr>
<td>CCM</td>
<td>Continuity Check Message</td>
</tr>
<tr>
<td>DSCP</td>
<td>Differentiated Service Code Point</td>
</tr>
<tr>
<td>DSP</td>
<td>Digital Signal Processing</td>
</tr>
<tr>
<td>E1</td>
<td>2 Mbit/s</td>
</tr>
<tr>
<td>EMC/EMI</td>
<td>Electromagnetic Compatibility/Electromagnetic Interference</td>
</tr>
<tr>
<td>EOC</td>
<td>Embedded Overhead Channel</td>
</tr>
<tr>
<td>ERC</td>
<td>European Radiocommunication Committee</td>
</tr>
<tr>
<td>ESD</td>
<td>Electrostatic Discharge</td>
</tr>
<tr>
<td>FEC</td>
<td>Forward Error Corrector</td>
</tr>
<tr>
<td>FEM</td>
<td>Fast Ethernet Module</td>
</tr>
</tbody>
</table>
- HDLC: High Level Data Link Control
- IDU: Indoor Unit
- IF: Intermediate Frequency
- IpToS: Type of Service IP
- LAN: Local Area Network
- LAPS: Link Access Procedure SDH
- LCT: Local Craft Terminal
- LIM: Line Interface Module
- LLF: Link Loss Forwarding
- LOF: Loss Of Frame
- LOS: Loss Of Signal
- MA: Maintenance Association
- MAC: Media Access Control
- MD: Maintenance Domain
- MDI: Medium Dependent Interface
- MDIX: Medium Dependent Interface Crossover
- MEP: Maintainane End Point
- MIB: Management Information Base
- MIP: Maintenance Intermediate Point
- MMIC: Monolithic Microwave Integrated Circuit
- MTBF: Mean Time Between Failure
- NE: Network Element
- OAM: Operation Administration and Maintenance
- ODU: Outdoor Unit
- OSI: Open System Interconnection
- PDH: Plesiochronous Digital Hierarchy
- PPI: Plesiochronous Physical Interface
- PPP: Point to Point Protocol
- PTOS: Priority Type Of Service
- RIM: Radio Interface Module
- SCT: Subnetwork Craft Terminal
- SNMP: Simple Network Management Protocol
- TOS: Type Of Service
- VID: Virtual LAN Identifier
- VLAN: Virtual LAN
- WFQ: Wait Fair Queue
- Wayside Traffic: Additional 2 Mbit/s Traffic
5 SYSTEM PRESENTATION

5.1 RECOMMENDATION

The equipment complies with the following international standards:

- EN 301 489–4 for EMC
- EN 302 217 for all frequency bands
- ITU–R recommendations for all frequency bands
- EN 300 132–2 characteristics for power supply
- EN 300 019 environmental characteristics (Operation class 3.2 for IDU and class 4.1 for ODU; storage: class 1.2; transport: class 2.3)
- EN 60950 for safety.

5.2 SYSTEM ARCHITECTURE

The ALS “plus2 family” is the new packet radio link from SIAE. These packet radio links are split mount equipment made up of:

- an indoor unit called IDU for 19” rack mounting that interfaces tributaries and supervises the full equipment
- an outdoor unit called ODU for pole or wall mounting with RF circuitry and antenna flange.

IDU units are available in the following versions:

- ALplus2: modular. Main circuits are divided in modules, replaceable in case of failure
- ALCplus2: compact. All the circuitry is housed in a single board
- ALCplus2e: compact. All the circuitry is housed in a single board.

ODU units are available in the following versions:

- AS (max capacity of 341 Mbit/s)
- ASN (max capacity of 341 Mbit/s)

5.3 ALplus2 MODULAR IDU

The unit is available in the following configurations:

- ALplus2 1+0 for E1 and Ethernet traffic (see Fig.6)
- ALplus2 1+1 for E1 and Ethernet traffic (see Fig.7)

The following modules make up the modular IDU.
## 5.3.1 LIM

The LIM interfaces the in (out) E1 streams and Ethernet traffic and, through a multiplexing (demultiplexing) and bit insertion (bit extraction) process, supplies (receives) the aggregate signal to the modulator (from the demodulator). In addition the LIM performs the digital processing of the QAM modulator.

Moreover the module duplicates the main signals at the Tx side and performs the changeover at the Rx side in the 1+1 version.

## 5.3.2 RIM

The RIM contains:

- the IF section of the programmable modemodulator (8 available profiles: 4QAM, 4QAM strong, 8PSK, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM)
- the power supply unit that processes the battery voltage to supply power to the IDU circuits and send the battery voltage towards the ODU
- the cable interface for the bidirectional communication between IDU and ODU via interconnecting cable
- thanks to ACM (Adaptive Code Modulation) actual modulation can be automatically changed according to available S/N.

## 5.3.3 Controller

The Controller performs the following operations:

- interfaces the service signals as 1x9600 bit/s or 2x4800 bit/s, 64 kbit/s, 2 Mbit/s (details are given in the system technical specification)
- contains the equipment software that permits to control and to manage all the equipment functionality through a main controller and associated peripherals distributed within IDU and ODU
- interfaces the SCT/LCT management system through Ethernet, RS232 and USB ports
- receive external alarms and route them to relay contact along with the internal alarms generated by the equipment.

## 5.4 ALCplus2 COMPACT IDU

The unit is available in the following configurations:

- ALCplus2 1+0 see Fig.8
- ALCplus2 1+1 see Fig.9
- ALCplus2 1+0 exp 16E1 see Fig.10
- ALCplus2 1+1 exp 16E1 see Fig.11
- ALCplus2 1+0 exp 32E1 see Fig.12
- ALCplus2 1+1 exp 32E1 see Fig.13
- ALCplus2 1+0 exp nodal see Fig.14
- ALCplus2 1+1 exp nodal see Fig.15

The compact IDU are made by a single board.
The line interfaces contain the tributary connectors and, by means of processes of multiplexing/demultiplexing and of bit insertion/extraction, provide/receive the aggregate signal to/from the modulator/demodulator. The line interfaces realize the digital processing for the QAM modulator and, in 1+1 configuration, duplicate the main signals on the transmission side and execute the switch on the reception side.

The interfaces to the ODU contain the interface of the cable for the bidirectional communication between ODU and IDU, and implement the IF section of the mod-demodulator. The power supply units of the IDU process the battery voltage and supply power to the circuits of IDU and ODU. The controller section of the radio contains the interfaces of the service channels, stores the firmware of the IDU, interfaces the SIAE management systems through dedicated supervision ports and forwards external and internal alarms to the relay contacts.

5.5 **ALCplus2e COMPACT IDU**

The unit is available in the following configurations listed in Tab.2.

<table>
<thead>
<tr>
<th>1+0</th>
<th>4GE 2xE1</th>
<th>2+0/1+1</th>
<th>4GE 2xE1</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPP</td>
<td>ALCplus2e 1+0 4GE 34xE1 2xSTM1 NODAL</td>
<td>EPP</td>
<td>ALCplus2e 2+0/1+1 4GE 34xE1 2xSTM1 NODAL</td>
</tr>
<tr>
<td></td>
<td>ALCplus2e 1+0 4GE 34xE1 2xSTM1 NODAL</td>
<td></td>
<td>ALCplus2e 2+0/1+1 4GE 34xE1 2xSTM1 NODAL</td>
</tr>
<tr>
<td></td>
<td>ALCplus2e 1+0 4GE 34xE1 2xSTM1 NODAL</td>
<td></td>
<td>ALCplus2e 2+0/1+1 4GE 34xE1 2xSTM1 NODAL</td>
</tr>
<tr>
<td></td>
<td>ALCplus2e 1+0 4GE 34xE1 2xSTM1 NODAL</td>
<td></td>
<td>ALCplus2e 2+0/1+1 4GE 34xE1 2xSTM1 NODAL</td>
</tr>
<tr>
<td></td>
<td>ALCplus2e 1+0 4GE 34xE1 2xSTM1 NODAL</td>
<td></td>
<td>ALCplus2e 2+0/1+1 4GE 34xE1 2xSTM1 NODAL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2+0 or 1+0 XPIC</th>
<th>4GE 2xE1</th>
<th>2+0 or 1+0 XPIC</th>
<th>4GE 2xE1</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPP</td>
<td>ALCplus2e 2+0 or 1+0 XPIC 4GE 2xE1</td>
<td>EPP</td>
<td>ALCplus2e 2+0 or 1+0 XPIC 4GE 2xE1</td>
</tr>
<tr>
<td></td>
<td>ALCplus2e 2+0 or 1+0 XPIC 4GE 18x1 E2 STM1 NODAL</td>
<td></td>
<td>ALCplus2e 2+0 or 1+0 XPIC 4GE 18x1 E2 STM1 NODAL</td>
</tr>
<tr>
<td></td>
<td>ALCplus2e 2+0 or 1+0 XPIC 4GE 18x1 E2 STM1 NODAL</td>
<td></td>
<td>ALCplus2e 2+0 or 1+0 XPIC 4GE 18x1 E2 STM1 NODAL</td>
</tr>
</tbody>
</table>

Tab.2 - ALCplus2e IDU configurations

See Fig.16
See Fig.17
See Fig.18
See Fig.19
See Fig.20
See Fig.21
See Fig.19
See Fig.20
See Fig.21
See Fig.19
See Fig.20
See Fig.21
The Compact IDU and EPP (Enhanced Packet Processing) are made of a single board and expansions like 34E1 2xSTM1 or 18E1 2xSTM1 NODAL.

The line interface contain the tributary connectors and, by means of processes of multiplexing/demultiplexing and of bit insertion/extraction, provide/receive the aggregate signal to/from the modulator/demodulator. The line interfaces realize the digital processing for the QAM modulator and, in 1+1 configuration, duplicate the main signals on the transmission side and execute the switch on the reception side.

The interfaces to the ODU contain the interface of the cable for the bidirectional communication between ODU and IDU, and implement the IF section of the modemodulator. The power supply units of the IDU process the battery voltage and supply power to the circuits of IDU and ODU.

The controller section of the radio contains the interfaces to internal circuits, stores the firmware of the IDU, interfaces the SIAE management systems through dedicated supervision ports and forwards external and internal alarms to the relay contacts.

The IDU ALCplus2e XPIC permits different transmission methods:

- ACAP Adjacent Channel Alternate Polarization
- ACCP Adjacent Channel Co Polarization
- CCDP Co Channel Dual Polarization

CCDP, with XPIC technology, in ALCplus2e IDU doubles the capacity of radio link, a clear advantage to the network operator at the dense frequency bands.

CCDP operation provides two parallel radio streams in the same RF channel with orthogonal polarizations, thus doubling the radio hop total capacity. Separate and independent signals are transmitted, over the same RF channel using a single antenna with a double polarization feeder. However, despite of the orthogonality of the two signals, some interference between the signals almost inevitably occurs, due to imperfect antenna isolation and channel degradation.

Each polarization demodulator path receives a large signal from the orthogonal polarization, causing cross-polarization interference. XPIC systems cancels this interference in order to demodulate both vertical and horizontal signal successfully. In XPIC technology, each polarization path receives both the polar and the cross-polar interference.

In ALCplus2e XPIC, the XPIC circuitry and ACM engine gives to the network operator high capacity and high availability.

### 5.6 ODU

The ODU unit contains IF and RF circuits that permits to transmit and receive the signals relevant the user traffic, the management and the telemetry and it is connected with its IDU unit through a single cable.

The ODU employs four different passband filters with the following bandwidth: 7, 14, 28 and 56 MHz. The ODU unit is available in two different versions: AS (only from hardware version 003) and ASN (optimized).

The configuration of the ODU can be 1+0 or 1+1 with integrated or separated antenna. In 1+1 configuration the antenna coupling is performed through a balanced or an unbalanced hybrid system (branching unit).
5.7 MANAGEMENT

ALplus2/ALCplus2/ALCplus2e equipment can be locally and remotely controlled via an internal dedicated application software called WEBLCT through Internet Browser and LAN connection. A serial/USB connection can be used through the Web Lct console, an application that can be downloaded from SIAE site (http://www.siaemic.com)

It provides a friendly graphic interface complying with current standard use of keyboard, mouse, windows and so on.

Other software available for management of a network of ALplus2/ALCplus2/ALCplus2e is SCT (Windows) and NMSSUX/NMSSLX (Unix/Linux).

5.7.1 Hardware platform

The hardware platform used by SCT/LCT is based on personal computer having at least following characteristics:

- microprocessor Pentium 4 or similar
- 1GB RAM
- windows compatible graphic monitor
- HD with 200 Mbyte of free space
- LAN or USB connection (or RS232 ALplus2 only)

5.7.2 Management ports

The SCT/LCT program is connected to the equipment via the following communication ports:

- MNGT/1 or MNGT/2 (Ethernet LAN 10BaseT)
- RS232 (asynchronous serial line) for ALplus2 only
- LCT (USB)
- Embedded Overhead Channel (EOC) embedded into the radio frame
- Embedded Overhead Channel (EOC) embedded into a 16 kbit/s or 4x16 kbit/s time slot of one of the 2 Mbit/s tributary signals
- In band management through traffic LAN (separated VLAN required)

5.7.2.1 MNGT/1 and MNGT/2

- LAN cable type: 802.3 10BaseT
- Connector: RJ45
- Connection to LAN: direct with a CAT5 Twisted Pair
- Protocol: TCP/IP or IPoverOSI
5.7.2.2 RS232

- Electrical interface: V.28
- Connector: SUB-D 9pin
- Asynchronous baud rate: 9600, 19200, 38400, 57600
- Protocol: PPP

5.7.2.3 LCT USB

- Electrical interface: USB 1.1 version
- Baud rate: 1.5 Mbit/s
- Protocol: PPP

5.7.3 Protocols

SNMP along with IP or OSI protocol stacks are used to reach and manage the equipment operation.
Fig.17 - ALCplus2e 1+0 4GE 34E1 2xSTM1

Fig.18 - ALCplus2e 1+0 4GE 18E1 2xSTM1 NODAL

Fig.19 - ALCplus2e 2+0/1+1 4GE 2xE1

Fig.20 - ALCplus2e 2+0/1+1 4GE 34xE1 2xSTM1

Fig.21 - ALCplus2e 2+0/1+1 4GE 18E1 2xSTM1 NODAL
6 TECHNICAL SPECIFICATIONS

6.1 IDU CHARACTERISTICS

In the following paragraphs are listed only the main characteristics of an IDU typology. Further information are included in the chapter relevant that IDU.

6.1.1 Traffic interfaces

- **ALplus2**, max transmitted capacity 341 Mbit/s:
  - 16 E1 G.703 75/120 Ohm (2SCSI connector, 8E1 each)
  - 2 STM1 (SFP connector)
  - 3 Ethernet ports: 2 RJ45, electrical (LAN1 and LAN2) and 2 SFP, optical (LAN1 and LAN3). LAN1 can be set electrical or optical.

- **ALCplus2**, max transmitted capacity 341 Mbit/s. Traffic options can vary depending on IDU version:
  - 18 E1 G.703 75/120 Ohm (2SCSI connectors, 8E1 each + 2RJ45)
  - 34 E1 G.703 75/120 Ohm (4SCSI connectors, 8E1 each + 2RJ45)
  - 2 STM1 (SFP connector)
  - 4 Ethernet ports: 4 RJ45, electrical (LAN1, LAN2, LAN3 and LAN4) and 2 SFP, optical (LAN3 and LAN4). LAN3 and LAN4 can be set electrical or optical
  - 2 BUS for traffic connections with other ALCplus2 IDUs (same version).

- **ALCplus2e**, max transmitted capacity 682 Mbit/s, 341 Mbit/s, per carrier (IDU 2+0/XPIC). Traffic options can vary depending on IDU version:
  - 18 E1 G.703 75/120 Ohm (2SCSI connectors, 8E1 each + 2RJ45)
  - 34 E1 G.703 75/120 Ohm (4SCSI connectors, 8E1 each + 2RJ45)
  - 2 STM1 (SFP connector)
  - 4 Ethernet ports: 4 RJ45, electrical (LAN1, LAN2, LAN3 and LAN4) and 2 SFP, optical (LAN3 and LAN4). LAN3 and LAN4 can be set electrical or optical
  - 2 BUS for traffic connections with other ALCplus2e IDUs (same version, TBA).

6.1.1.1 2 Mbit/s (E1 G.703)

**Input side**

- Bit rate: 2048 kbit/s ±50 ppm
- Line code: HDB3
- Rated impedance: 75 Ohm or 120 Ohm
- Rated level: 2.37 Vp/75 Ohm or 3 Vp/120 Ohm
Return loss
- 12 dB from 57 kHz to 102 kHz
- 18 dB from 102 kHz to 2048 kHz
- 14 dB from 2048 kHz to 3072 kHz

Max attenuation of the input cable
- 6 dB according to $\sqrt{f}$ trend

Accepted jitter
- see Tab. 2, CCITT Rec. G.823

Transfer function
- see Fig. 1, CCITT Rec. G.742

Connector type
- SCSI 50 pin

Output side

Bit rate
- 2048 kbit/s ±50 ppm

Rated impedance
- 75 Ohm or 120 Ohm

Rated level
- 2.37 Vp/75 Ohm or 3 Vp/120 Ohm

Output jitter
- according to G.742/G.823

Pulse shape
- see Fig. 15, CCITT Rec. G.703

Connector type
- SCSI 50 pin

6.1.1.2 STM1 electrical

Input side

Bit rate
- 155520 kbit/s ±4.6 ppm

Line code
- CMI

Rated impedance
- 75 Ohm

Rated level
- 1 Vpp ±0.1V

Return loss
- ≥ 15 dB from 8 MHz to 240 MHz

Max attenuation of the input cable
- 12.7 dB at 78 MHz ($\sqrt{f}$ trend)

Output side

Bit rate
- 155520 kbit/s ±4.6 ppm

Rated level
- 1 Vpp ±0.1 V

Pulse shape
- see Fig. 24 and Fig. 25 of ITU-T Rec. G.703

6.1.1.3 STM1 optical

The STM1 interface can be specialised for different applications, by simply equipping the STM1 interface with the appropriate pluggable optical or electrical transceiver. Optical interface has LC connectors. Electric interface has 1.0/2.3 connectors. The characteristics of all the possible optical interfaces are summarised in Tab. 3.
The LIM is provided with Automatic Laser Shutdown as prescribed by ITU-T G.664 Recommendation.

### 6.1.1.4 Ethernet Interface

- **Ethernet Connectors**
  - IEEE 802.3 10/100/1000 BaseT RJ45
  - IEEE 802.3 100/1000 BaseX LC

- **Ethernet Switch Functionality**
  - MAC Switching
  - MAC Learning
  - MAC Ageing
  - IEEE 802.1q VLAN
  - IEEE 802.3x Flow Control
  - IEEE 802.1p QoS
  - IP-V4 ToS/DSCP
  - IP-V6 TC/DSCP
  - IEEE 802.1D STP
  - IEEE 802.1W RSTP

- **Ethernet Latency**
  - \( \leq 2609 \mu s \) for standard frame sizes
  - \( \leq 11684 \mu s \) for Jumbo frame sizes

- **Guaranteed Ethernet Throughput (Mbit/s)**
  - See [Tab.4](#)

### Tab.4 - Guaranteed Ethernet Throughput (Mbit/s) for ALplus2/ALCplus2/ALCplus2e (Ethernet only)

<table>
<thead>
<tr>
<th>Bandwidth</th>
<th>Modulation</th>
<th>Frame Size (byte)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 MHz</td>
<td>4QAMs</td>
<td>64 128 256 512 1024 1518</td>
</tr>
<tr>
<td></td>
<td>4QAM</td>
<td>10.1 9.4 9.1 8.9 8.7 8.7</td>
</tr>
<tr>
<td></td>
<td>8PSK</td>
<td>12.5 11.6 11.2 11.0 10.8 10.7</td>
</tr>
<tr>
<td></td>
<td>16QAM</td>
<td>17.1 16.0 15.4 15.1 14.8 14.7</td>
</tr>
<tr>
<td></td>
<td>32QAM</td>
<td>24.3 22.7 21.8 21.4 21.0 20.9</td>
</tr>
<tr>
<td></td>
<td>64QAM</td>
<td>29.3 27.4 26.4 25.8 25.4 25.2</td>
</tr>
<tr>
<td></td>
<td>128QAM</td>
<td>36.3 33.8 32.6 31.9 31.3 31.2</td>
</tr>
<tr>
<td></td>
<td>256QAM</td>
<td>40.7 38.0 36.6 35.8 35.2 35.0</td>
</tr>
<tr>
<td></td>
<td>47.9 44.7 43.0 42.2 41.4 41.2</td>
<td></td>
</tr>
<tr>
<td>Bandwidth</td>
<td>Modul.</td>
<td>Frame size (byte)</td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
<td>-------------------</td>
</tr>
<tr>
<td>40 MHz</td>
<td>4QAMs</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>4QAM</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>8PSK</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>16QAM</td>
<td>136</td>
</tr>
<tr>
<td></td>
<td>32QAM</td>
<td>164</td>
</tr>
<tr>
<td></td>
<td>64QAM</td>
<td>202</td>
</tr>
<tr>
<td></td>
<td>128QAM</td>
<td>238</td>
</tr>
<tr>
<td></td>
<td>256QAM</td>
<td>277</td>
</tr>
</tbody>
</table>

- Estimated Ethernet throughput (Mbit/s) see Tab.5

Tab.5 - Estimated Ethernet throughput
Tab.6 - Guaranteed Ethernet Latency (ms) for ALplus2/ALCplus2/ALCplus2e (Ethernet only)

<table>
<thead>
<tr>
<th>Bandwidth</th>
<th>Modulation</th>
<th>Frame Size (byte)</th>
<th>64</th>
<th>128</th>
<th>256</th>
<th>512</th>
<th>1024</th>
<th>1518</th>
<th>10000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4QAMs</td>
<td></td>
<td>1.042</td>
<td>1.111</td>
<td>1.248</td>
<td>1.522</td>
<td>2.09</td>
<td>2.609</td>
<td>11.684</td>
</tr>
<tr>
<td></td>
<td>4QAM</td>
<td></td>
<td>0.844</td>
<td>0.900</td>
<td>1.011</td>
<td>1.233</td>
<td>1.693</td>
<td>2.113</td>
<td>9.465</td>
</tr>
<tr>
<td></td>
<td>8PSK</td>
<td></td>
<td>0.627</td>
<td>0.668</td>
<td>0.750</td>
<td>0.913</td>
<td>1.229</td>
<td>1.541</td>
<td>6.974</td>
</tr>
<tr>
<td></td>
<td>16QAM</td>
<td></td>
<td>0.477</td>
<td>0.505</td>
<td>0.560</td>
<td>0.67</td>
<td>0.895</td>
<td>1.115</td>
<td>4.755</td>
</tr>
<tr>
<td></td>
<td>32QAM</td>
<td></td>
<td>0.401</td>
<td>0.426</td>
<td>0.475</td>
<td>0.573</td>
<td>0.756</td>
<td>0.938</td>
<td>4.214</td>
</tr>
<tr>
<td></td>
<td>64QAM</td>
<td></td>
<td>0.477</td>
<td>0.496</td>
<td>0.533</td>
<td>0.607</td>
<td>0.768</td>
<td>0.908</td>
<td>3.35</td>
</tr>
<tr>
<td></td>
<td>128QAM</td>
<td></td>
<td>0.52</td>
<td>0.537</td>
<td>0.572</td>
<td>0.642</td>
<td>0.774</td>
<td>0.914</td>
<td>3.222</td>
</tr>
<tr>
<td></td>
<td>256QAM</td>
<td></td>
<td>0.507</td>
<td>0.521</td>
<td>0.550</td>
<td>0.608</td>
<td>0.726</td>
<td>0.845</td>
<td>2.761</td>
</tr>
<tr>
<td>14 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4QAMs</td>
<td></td>
<td>0.954</td>
<td>0.987</td>
<td>1.053</td>
<td>1.186</td>
<td>1.462</td>
<td>1.715</td>
<td>6.104</td>
</tr>
<tr>
<td></td>
<td>4QAM</td>
<td></td>
<td>0.8</td>
<td>0.828</td>
<td>0.884</td>
<td>0.995</td>
<td>1.226</td>
<td>1.439</td>
<td>5.12</td>
</tr>
<tr>
<td></td>
<td>8PSK</td>
<td></td>
<td>0.575</td>
<td>0.596</td>
<td>0.637</td>
<td>0.719</td>
<td>0.882</td>
<td>1.044</td>
<td>3.557</td>
</tr>
<tr>
<td></td>
<td>16QAM</td>
<td></td>
<td>0.418</td>
<td>0.432</td>
<td>0.461</td>
<td>0.518</td>
<td>0.639</td>
<td>0.757</td>
<td>2.634</td>
</tr>
<tr>
<td></td>
<td>32QAM</td>
<td></td>
<td>0.345</td>
<td>0.357</td>
<td>0.381</td>
<td>0.428</td>
<td>0.518</td>
<td>0.618</td>
<td>2.176</td>
</tr>
<tr>
<td></td>
<td>64QAM</td>
<td></td>
<td>0.439</td>
<td>0.449</td>
<td>0.469</td>
<td>0.51</td>
<td>0.59</td>
<td>0.669</td>
<td>2.02</td>
</tr>
<tr>
<td></td>
<td>128QAM</td>
<td></td>
<td>0.458</td>
<td>0.467</td>
<td>0.486</td>
<td>0.523</td>
<td>0.594</td>
<td>0.663</td>
<td>1.907</td>
</tr>
<tr>
<td></td>
<td>256QAM</td>
<td></td>
<td>0.444</td>
<td>0.452</td>
<td>0.468</td>
<td>0.499</td>
<td>0.557</td>
<td>0.623</td>
<td>1.656</td>
</tr>
<tr>
<td>28 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4QAMs</td>
<td></td>
<td>0.475</td>
<td>0.492</td>
<td>0.526</td>
<td>0.595</td>
<td>0.735</td>
<td>0.867</td>
<td>3.136</td>
</tr>
<tr>
<td></td>
<td>4QAM</td>
<td></td>
<td>0.406</td>
<td>0.421</td>
<td>0.450</td>
<td>0.508</td>
<td>0.628</td>
<td>0.74</td>
<td>2.677</td>
</tr>
<tr>
<td></td>
<td>8PSK</td>
<td></td>
<td>0.274</td>
<td>0.284</td>
<td>0.305</td>
<td>0.347</td>
<td>0.426</td>
<td>0.508</td>
<td>1.881</td>
</tr>
<tr>
<td></td>
<td>16QAM</td>
<td></td>
<td>0.214</td>
<td>0.222</td>
<td>0.238</td>
<td>0.271</td>
<td>0.334</td>
<td>0.395</td>
<td>1.483</td>
</tr>
<tr>
<td></td>
<td>32QAM</td>
<td></td>
<td>0.176</td>
<td>0.183</td>
<td>0.197</td>
<td>0.224</td>
<td>0.276</td>
<td>0.326</td>
<td>1.235</td>
</tr>
<tr>
<td></td>
<td>64QAM</td>
<td></td>
<td>0.227</td>
<td>0.232</td>
<td>0.243</td>
<td>0.265</td>
<td>0.311</td>
<td>0.356</td>
<td>1.067</td>
</tr>
<tr>
<td></td>
<td>128QAM</td>
<td></td>
<td>0.237</td>
<td>0.242</td>
<td>0.252</td>
<td>0.272</td>
<td>0.312</td>
<td>0.351</td>
<td>1.003</td>
</tr>
<tr>
<td></td>
<td>256QAM</td>
<td></td>
<td>0.231</td>
<td>0.236</td>
<td>0.246</td>
<td>0.265</td>
<td>0.298</td>
<td>0.333</td>
<td>0.982</td>
</tr>
<tr>
<td>56 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4QAMs</td>
<td></td>
<td>0.241</td>
<td>0.250</td>
<td>0.268</td>
<td>0.304</td>
<td>0.377</td>
<td>0.447</td>
<td>1.651</td>
</tr>
<tr>
<td></td>
<td>4QAM</td>
<td></td>
<td>0.207</td>
<td>0.215</td>
<td>0.230</td>
<td>0.261</td>
<td>0.324</td>
<td>0.384</td>
<td>1.418</td>
</tr>
<tr>
<td></td>
<td>8PSK</td>
<td></td>
<td>0.14</td>
<td>0.146</td>
<td>0.158</td>
<td>0.181</td>
<td>0.226</td>
<td>0.27</td>
<td>1.052</td>
</tr>
<tr>
<td></td>
<td>16QAM</td>
<td></td>
<td>0.112</td>
<td>0.117</td>
<td>0.126</td>
<td>0.144</td>
<td>0.179</td>
<td>0.214</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>32QAM</td>
<td></td>
<td>0.094</td>
<td>0.098</td>
<td>0.106</td>
<td>0.122</td>
<td>0.154</td>
<td>0.185</td>
<td>0.697</td>
</tr>
<tr>
<td></td>
<td>64QAM</td>
<td></td>
<td>0.125</td>
<td>0.129</td>
<td>0.137</td>
<td>0.152</td>
<td>0.178</td>
<td>0.205</td>
<td>0.71</td>
</tr>
<tr>
<td></td>
<td>128QAM</td>
<td></td>
<td>0.126</td>
<td>0.129</td>
<td>0.135</td>
<td>0.147</td>
<td>0.172</td>
<td>0.196</td>
<td>0.601</td>
</tr>
<tr>
<td></td>
<td>256QAM</td>
<td></td>
<td>0.121</td>
<td>0.124</td>
<td>0.129</td>
<td>0.14</td>
<td>0.162</td>
<td>0.183</td>
<td>0.549</td>
</tr>
</tbody>
</table>
6.1.2 Service channels

ALplus2 only.

Two service channels are available:

- V11 64 kbit/s co/contradirectional
- E1: configurable as Extra E1-1 or Extra E1-2 (connector name is "2 Mbit/s wayside" but is "in band").

6.1.2.1 E1 (Connector name is 2 Mbit/s wayside)

This E1 is "in band". Only the name is "wayside".

Input side

- Bit rate 2048 kbit/s ±50 ppm
- Line code HDB3
- Rated impedance 75 Ohm or 120 Ohm
- Rated level 2.37 Vp/75 Ohm or 3 Vp/120 Ohm
- Return loss 12 dB from 57 kHz to 102 kHz
- Output jitter according to G.742/G.823
- Pulse shape see Fig. 15, CCITT Rec. G.703
- Connector type RJ45 (in/out in the same conn.)

Output side

- Bit rate 2048 kbit/s ±50 ppm
- Rated impedance 75 Ohm or 120 Ohm
- Rated level 2.37 Vp/75 Ohm or 3 Vp/120 Ohm
- Output jitter according to G.742/G.823
- Pulse shape see Fig. 15, CCITT Rec. G.703
- Connector type RJ45 (in/out in the same conn.)

6.1.2.2 64 kbit/s codirectional

- Tolerance ± 100 ppm
- Coding synch + data + octet as per G.703
- Impedance 120 Ohm
- Max attenuation of the input cable 3 dB at 128 kHz
- User side CCITT Rec. G.703
- Input/output level 1 Vp/120 Ohm ±0.1 V
- Return loss see par. 1.2.1.3 in CCITT Rec. G.703
- Connector RJ45
6.1.2.3 64 kbit/s contradirectional

- Tolerance: ± 100 ppm
- Coding: clock and data on separate wires
- Impedance: 120 Ohm
- Max attenuation of the input cable: 3 dB at 128 kHz
- Equipment side: contradirectional
- Input/output level: 1 Vp/120 Ohm ±0.1 V
- Electrical interface: CCITT Rec. V.11
- Connector: RJ45

6.1.2.4 9600 bit/s synch/asynch

- Data interface: RS232
- Electrical interface: CCITT Rec. V.28
- Input speed: 9600 baud
- Control wires: DTR, DSR, DCD
- Connector: RJ45

6.1.2.5 9600 or 2x4800 bit/s synch/asynch

- Electrical interface: CCITT Rec. V.28
- Input speed: 4800 or 9600 bit/s
- Electrical interface: CCITT Rec. V.28
- Connector: RJ45

6.1.3 Modulation and channel bandwidth

- Carrier IF mo-demodulating frequency: Tx side 330 MHz, Rx side 140 MHz
- Type of modulation: 4QAM strong, 4QAM, 8PSK, 16QAM, 32QAM, 64QAM, 128QAM, 256 QAM
- Bandwidth: 7MHz, 14MHz, 28MHz, 56MHz
- Bandwidth ALCplus2e: 7MHz, 14MHz, 28MHz, 40MHz, 56MHz
- Modulation approach: ACM
- Modulating signal: depending on selected capacities
- Equalization: 24 taps
- Coding gain: 2.5 dB at $10^{-6}$, 1 dB at $10^{-3}$
- Correction: LDPC
6.1.4 1+1 switching criteria

Rx switch

Rx switch is hitless and the system has built in capabilities of minimizing errors during the detection time. Branch 1 is preferential and the system switches to branch 2 only when branch 1 is error affected. The switching facility provides automatic synchronization of the two incoming streams up to:

- dynamic difference ±100 bytes
- static delays ± 100 bytes.

Tab. 7 shows Rx Alarm Priority.

**Tab. 7 - Rx Alarm Priority**

<table>
<thead>
<tr>
<th>Levels</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority 1</td>
<td>Manual forcing (selectable by software)</td>
</tr>
<tr>
<td>Priority 2</td>
<td>CRC pulse from demodulator</td>
</tr>
</tbody>
</table>

Tx switch (1+1 hot stand-by)

Tx switch is not hitless. Maximum outage due to the Tx switching (sum of the maximum automatic change-over + Rx IDU resynchronisation time), with ACM (Adaptive Code and Modulation) activated, is shown in Tab. 8.

**Tab. 8 - Maximum outage due to the Tx switching**

<table>
<thead>
<tr>
<th>Bandwidth</th>
<th>Maximum outage due to the Tx switching (msec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 MHz</td>
<td>&lt; 1500</td>
</tr>
<tr>
<td>14 MHz</td>
<td>&lt; 1200</td>
</tr>
<tr>
<td>28 MHz</td>
<td>&lt; 900</td>
</tr>
<tr>
<td>56 MHz</td>
<td>&lt; 400</td>
</tr>
</tbody>
</table>

Tab. 9 shows Tx Alarm Priority.

**Tab. 9 - Tx Alarm Priority**

<table>
<thead>
<tr>
<th>Priority</th>
<th>Levels</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest</td>
<td>Priority 1</td>
<td>RIM PSU Alarm</td>
</tr>
<tr>
<td></td>
<td>Priority 2</td>
<td>Manual forcing (selectable by software)</td>
</tr>
<tr>
<td></td>
<td>Priority 3</td>
<td>Cable Short Alarm</td>
</tr>
<tr>
<td></td>
<td>Priority 3</td>
<td>Cable Open Alarm</td>
</tr>
<tr>
<td></td>
<td>Priority 3</td>
<td>Modulator Failure</td>
</tr>
<tr>
<td></td>
<td>Priority 3</td>
<td>ODU Unit Failure Alarm</td>
</tr>
<tr>
<td></td>
<td>Priority 3</td>
<td>VCO Failure Alarm</td>
</tr>
<tr>
<td></td>
<td>Priority 3</td>
<td>IF Unit Alarm</td>
</tr>
<tr>
<td></td>
<td>Priority 3</td>
<td>Tx Power Low Alarm</td>
</tr>
<tr>
<td></td>
<td>Priority 4</td>
<td>Request from Remote Terminal (both Receivers Alarmed)</td>
</tr>
<tr>
<td></td>
<td>Priority 5</td>
<td>Revertive Tx (preferential branch selectable by software)</td>
</tr>
</tbody>
</table>
6.1.5 2x(1+1) switching criteria

- Under development

6.1.6 Cable Interface

- Interconnection with ODU unit: single coaxial cable for both Tx and Rx
- Cable length: 300 m
- Cable rated impedance: 50 Ohm
- Signal running along the cable:
  - Tx nominal frequency: 330 MHz
  - Rx nominal frequency: 140 MHz
  - Telemetry IDU -> ODU: 17.5 MHz
  - Telemetry ODU <- IDU: 5.5 MHz
- In band management through traffic LAN or VLAN
- Transceiver management signals: 388 kbit/s bidirectional
- Remote power supply direct from battery voltage.

6.1.7 Consumption and max current absorption

In this paragraphs are listed the following three characteristics: the max current (I_{MAX}) at the power connector of the IDU alone, the max current (I_{MAX}) at the power connector of the IDU with the complete equipment (IDU 1+1 and relevant 2 ODUs) and the consumption of the IDU alone. The consumption of the complete equipment is described inside the ODU attachment (one for each frequency) with high precision, at this point we have considered the ODU with the higher consumption (about 25W) among all the available.

Indicated voltage is related to max current and max consumption.

N.B. The consumption of the complete equipment is described inside the ODU attachment (one for each frequency).

- ALplus2 I_{MAX} and consumption see Tab.10
- ALCplus2 I_{MAX} and consumption see Tab.10
- ALCplus2e I_{MAX} and consumption see Tab.10

The power supply connectors of ALplus2 are independent.

The power supply connectors of ALCplus2 and ALCplus2e are in parallel (through diode).

<table>
<thead>
<tr>
<th>IDU</th>
<th>I_{MAX} (IDU only)</th>
<th>I_{MAX} (IDU+ODUs)</th>
<th>Consumption (IDU only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALplus2 1+0</td>
<td>1.0 A (@40.8 Vdc)</td>
<td>1.7 A (@40.8 Vdc)</td>
<td>40 W (@57.6 Vdc)</td>
</tr>
<tr>
<td>ALplus2 1+1</td>
<td>1.2 A (@40.8 Vdc)</td>
<td>1.7 A (@40.8 Vdc)</td>
<td>48 W (@57.6 Vdc)</td>
</tr>
<tr>
<td>ALCplus2 1+0</td>
<td>0.81 A (@40.8 Vdc)</td>
<td>1.42 A (@40.8 Vdc)</td>
<td>33 W (@57.6 Vdc)</td>
</tr>
<tr>
<td>ALCplus2 1+1</td>
<td>0.92 A (@40.8 Vdc)</td>
<td>2.15 A (@40.8 Vdc)</td>
<td>38 W (@57.6 Vdc)</td>
</tr>
<tr>
<td>ALCplus2 1+0 exp 16E1</td>
<td>0.88 A (@40.8 Vdc)</td>
<td>1.5 A (@40.8 Vdc)</td>
<td>36 W (@57.6 Vdc)</td>
</tr>
</tbody>
</table>
6.1.8 Fuses

Power supply circuits are protected against overcurrent with fuses on supply line:

- **ALplus2**
  - Nominal current: 3 A
  - Nominal voltage: 125 Vac/dc
  - Type: timed
  - Dimensions: 6.10 mm x 2.59 mm

- **ALCplus2/ALCplus2e**
  - Accessible on the front panel
  - Nominal current: 3.15 A
  - Nominal voltage: 250 Vac/dc
  - Type: medium timed
  - Dimensions: 5 mm x 20 mm

### ODU CHARACTERISTICS

- Frequency range: see attachment relevant to ODU frequency
- RF channelling: see attachment relevant to ODU frequency

<table>
<thead>
<tr>
<th>IDU</th>
<th>$I_{\text{MAX}}$ (IDU only)</th>
<th>$I_{\text{MAX}}$ (IDU+ODUs)</th>
<th>Consumption (IDU only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALCplus2 1+0 exp nodal</td>
<td>0.91A (@40.8 Vdc)</td>
<td>1.52A (@40.8 Vdc)</td>
<td>37W (@57.6 Vdc)</td>
</tr>
<tr>
<td>ALCplus2 1+1 exp 16E1</td>
<td>1 A (@40.8 Vdc)</td>
<td>2.23A (@40.8 Vdc)</td>
<td>41W (@57.6 Vdc)</td>
</tr>
<tr>
<td>ALCplus2 1+1 exp nodal</td>
<td>1.1A (@40.8 Vdc)</td>
<td>2.33A (@40.8 Vdc)</td>
<td>45W (@57.6 Vdc)</td>
</tr>
<tr>
<td>ALCplus2e 1+0 2E1</td>
<td>1.22A (@40.8 Vdc)</td>
<td>1.8A (@40.8 Vdc)</td>
<td>50W (@57.6 Vdc)</td>
</tr>
<tr>
<td>ALCplus2e 1+0 34E1 2xSTM-1</td>
<td>1.42A (@40.8 Vdc)</td>
<td>2A (@40.8 Vdc)</td>
<td>58W (@57.6 Vdc)</td>
</tr>
<tr>
<td>ALCplus2e 1+0 18E1 2xSTM-1 nodal</td>
<td>1.42A (@40.8 Vdc)</td>
<td>2A (@40.8 Vdc)</td>
<td>58W (@57.6 Vdc)</td>
</tr>
<tr>
<td>ALCplus2e 2+0/1+1 2E1</td>
<td>1.35A (@40.8 Vdc)</td>
<td>2.55A (@40.8 Vdc)</td>
<td>55W (@57.6 Vdc)</td>
</tr>
<tr>
<td>ALCplus2e 2+0/1+1 34E1 2xSTM-1</td>
<td>1.54A (@40.8 Vdc)</td>
<td>2.75A (@40.8 Vdc)</td>
<td>63W (@57.6 Vdc)</td>
</tr>
<tr>
<td>ALCplus2e 2+0/1+1 18E1 2xSTM-1</td>
<td>1.54A (@40.8 Vdc)</td>
<td>2.75A (@40.8 Vdc)</td>
<td>63W (@57.6 Vdc)</td>
</tr>
<tr>
<td>ALCplus2e 2+0 2E1 XPIC</td>
<td>1.45A (@40.8 Vdc)</td>
<td>2.1A (@40.8 Vdc)</td>
<td>59W (@57.6 Vdc)</td>
</tr>
<tr>
<td>ALCplus2e 2+0 34E1 2xSTM-1</td>
<td>1.64A (@40.8 Vdc)</td>
<td>2.85A (@40.8 Vdc)</td>
<td>67W (@57.6 Vdc)</td>
</tr>
<tr>
<td>ALCplus2e 2+0 18E1 2xSTM-1 nodal</td>
<td>1.64A (@40.8 Vdc)</td>
<td>2.85A (@40.8 Vdc)</td>
<td>67W (@57.6 Vdc)</td>
</tr>
</tbody>
</table>
• Go-return frequency see attachment relevant to ODU frequency
• Frequency stability see attachment relevant to ODU frequency
• Spurious transmission see attachment relevant to ODU frequency
• Output power see attachment relevant to ODU frequency
• BER Rx threshold see attachment relevant to ODU frequency
• Max RF level in Rx for BER $10^{-3}$ see attachment relevant to ODU frequency
• Additional Tx and Rx losses for 1+1 version see attachment relevant to ODU frequency
• Antenna configuration see attachment relevant to ODU frequency
• Consumption see attachment relevant to ODU frequency

6.3 EQUIPMENT GENERAL CHARACTERISTICS

6.3.1 Dimensions

The dimensions of the unit are the following:

- IDU ALplus2 (1+0/1+1) 480mm x 45mm x 270mm (wxhxd)
- IDU ALCplus2/ALCplus2e (1+0/1+1, all versions) 480mm x 45mm x 213mm (wxhxd)
- ODU 1+0 ASN ODU version 254mm x 254mm x 114mm (wxhxd)
- ODU 1+0 AS ODU version 254mm x 254mm x 154mm (wxhxd)
- ODU 1+1 ASN ODU version 278mm x 254mm x 296mm (wxhxd)
- ODU 1+1 AS ODU version 358mm x 254mm x 296mm (wxhxd)

6.3.2 Weight

The weight of the units is the following:

- IDU ALplus2 (1+0/1+1) 3.5 kg
- IDU ALCplus2/ALCplus2e (1+0/1+1, all versions) 2.5 kg
- ODU AS (1+0) 5.5 kg
- ODU AS (1+1, with branching unit) 15.5 kg
- ODU ASN (1+0) 4.5 kg
- ODU (AS) (1+1 with branching unit) 13.5 kg

6.3.3 Environmental condition

- IDU operating temperature -5° C to +45° C
- ODU operating temperature -33° C to +45° C
- IDU survival temperature -10° C to +55° C
• ODU survival temperature: -40° C to +60° C
• ODU operating humidity: 95% at 35° C
• ODU operating condition: according to IP65
• ODU dissipation thermal resistance: 0.5° C/W
• ODU solar heat gain: < 5° C
• Wind speed (ODU with integrated antenna): < 200 km/h
• Storage condition: according to T.1.2 ETSI EN 300 019-1-1 (weather protected, not temperature controlled storage locations)
7  ALPLUS2 IDU DESCRIPTION

7.1  CONFIGURATION

The IDU of the ALplus2 is available in 1+0 and 1+1 configuration.

The IDU is made up by the following modules:

- Controller
- LIM
- RIM (one module in 1+0 configuration, two modules in 1+1 configuration).

7.1.1  ALplus2 block diagrams

In Fig.24 you can find the block diagram of ALplus2 with 16E1, version 1+0 and 1+1 configuration. In Fig.25 you can find the block diagram of Alplus2 with 16E1, 2x(1+0) configuration.

7.1.2  Controller

The module performs the following operations:

- communication management: it makes use of SNMP as management protocol and IP or IPoverOSI as communication protocol stacks. The interface ports for the equipment management are the following:
  - 2 LAN Ethernet 10BaseT (MNGT/1 and MNGT/2, both RJ45)
  - USB port
  - RS232 asynchronous used for SCT/NMS connection (using PPP protocol and baud rate speed up to 57600)
  - RS232 asynchronous used for connecting further NEs (using PPP protocol and baud rate speed up to 57600)
  - EOC embedded within the packet radio frame for connection to the remote NEs
  - EOC into a 16kbit/s or 64kbit/s of an E1 timeslot.
- WEB LCT interface can be used with EOC capacity equal or bigger than 64 kbit/s
- max 2 WEB LCT users can access the same controller
- log-in: the main controller manages the equipment or network login/logout by setting and then controlling the user ID and relevant password
- database (MIB): equipment configuration is stored in a non-volatile memory
- equipment configuration: the equipment is configured through stored configuration parameters or user commands
- alarm monitoring: acquisition, filtering and correlation of the alarms gathered logger and alarm sending to the connected managers: SCT/LCT - NMSSUX. Management of the alarm LEDs on the LIM front panel.
• user in and alarm out management: it receives external alarms and route them to relay contacts along with the internal alarms generated by the equipment
• performance monitoring: PM management as per Recc. G.828
• download: firmware, Web Lct and configuration file can be downloaded. Download activity is based on FTP protocol.

⚠ Lithium battery inside, refer to national rules for disposal.

7.1.2.1 Service signals

The controller offers an electrical interface to the following three service channels:
• 9600 baud/V.28 or 2x4800 baud/V.28 or 9600 baud V.28/RS232 synch/asynch channels
• 64 kbit/s/V.11 codirectional or contradirectional
• E1 wayside G.703.

Service signals connected to the controller modules are sent to the LIM module for MUX/DEMUX processing.

7.1.2.2 Firmware

Equipment software permits to control and manage all the equipment functionality and it is distributed on two hardware levels: main controller and ODU peripheral controllers.

Firmware can be updated through the Web Lct and it is stored in two different memory banks: one containing the running firmware and the other the stand-by firmware. This permits to download a new firmware release to the stand by bank without cutting the traffic. Bank switch enables the new release to be used.

7.1.2.3 Web Lct

The Web Lct allows the configuration and the management of the local equipment. When the remote one is configured properly, the whole radio link can be managed.

Web Lct runs on Internet Explorer and Firefox with Flash player plug-in. WLC is a utility to connect to ALplus2 with USB cable.

WLC and Flash player plug-in for IE and Firefox can be downloaded from the site www.siaemic.com after registration.

7.1.2.4 Controller LEDs

On Controller front panel are present four LEDs to summarize the terminal status:
• URG - red, ON with critical or major alarms active
• NURG - red, ON with minor or warning alarms active
• SW - red, ON with firmware mismatch alarm
• TEST - yellow, ON with at least a manual operation active.

Always on Controller front panel are present two Ethernet ports for management, MNGT1 and MNGT2, whose LEDs are:
• during the boot with Ethernet cable inserted:
  - green LED = ON
  - yellow LED = blinking
• during the boot without Ethernet cable inserted:
  - green LED = OFF
  - yellow LED = OFF
• in standard working condition:
  - green LED = ON -> LINK UP
  - green LED = OFF -> LINK DOWN
  - yellow LED = ON -> LINK 100BaseT
  - yellow LED = OFF -> LINK 10BaseT.

7.1.2.5 SD memory card management

On the Controller board is present a slot, not accessible from the external, for the insertion of a memory card.

The memory card allows the upload/download of the equipment configuration and the equipment firmware

- Memory card format: SD, SDHC
- Memory card capacity: up to 4 GB.

7.1.3 LIM

The LIM performs the following operations:

• multiplexing and demultiplexing (MUX/DEMUX process) of traffic (tributaries and Ethernet frames)
• aggregation of the multiplexed signals along with services through a Bit Insertion circuit and vice-versa. The aggregate frame contains:
  - the main signal from the MUX(s)
  - the framed service signal from the service MUX
  - the EOC signals for supervision message propagation towards the remote equipment
  - the frame alignment word (FAW)
  - the bits dedicated to the FEC
• switch functionality for Ethernet ports
• processing of the signals during mo-demodulation
• STM1 signal processing and RSOH management
• duplication of the digital processed signals to supply two RIMs in 1+1 configuration.

From the two RIMs the LIM receives I and Q analogue signals then digital converted for the following processing:

• clock recovery
• frequency and phase carrier locking
• baseband equalisation and filtering
• bit polarity decision
• differential decoding
• parallel to serial conversion to recover the aggregate signal at the receive side.
The aggregate signal is then sent to a frame alignment circuit and CRC analysis and then to the error corrector. The errors uncorrected by the FEC are properly counted to achieve:

- BER estimate measurement
- radio performances.

### 7.1.3.1 Switch for Ethernet ports

Inside LIM is present an Ethernet switch with 3 external ports (electrical 1000BaseT or optical 1000BaseX) and one internal. Only port 1 is present with both kind of interface, the port 2 is electrical and port 3 optical. The external interfaces (3 operational on 4 presents) are placed on the front panel. Internal port is represented by the local radio stream where through native Ethernet transport is connected with the remote equipment.

### Ethernet port LEDs

There are 2 LEDs:

- **Speed**
  - one blinking = 10BaseT
  - two blinking = 100BaseT
  - three blinking = 1000BaseT

- **LINK/ACT**
  - on = link up, no activity
  - off = link down
  - blinking = activity.

### Switch function

LIM can operate like a switch between two or more separated LANs with the following advantages:

- to connect two separate LANs
- to connect two LANs via radio within a complex digital network
- to keep separated the traffic into two LANs towards MAC filtering to get a total traffic greater than the traffic in a single LAN.

The switch realised into LIM/Ethernet module is transparent (IEEE 802.1d and 802.q) into the same Vlan described by VLAN Configuration Table.

It works at data link level, Layer 2 of OSI pile, and leave untouched Layer 3 and it takes care to send traffic from a local LAN to another one (Local and Remote).

Routing is only on the basic of Level 2 addresses, sublevel MAC.

The operation is the following: when a LAN port receives a MAC frame, on the basis of destination address, it decides which LAN to send it:

- if destination address is on originating LAN the frame is discarded
- if destination address is a known address (towards address learning procedure) and is present into local address table, the frame is sent only on destination LAN (MAC switching)
- otherwise the frame is sent to all ports with the same VLAN ID (flooding).

### Ethernet Full Duplex function

Full duplex mode can be activated into 10/100BaseT interfaces manually or with autonegotiation. 100BaseFx operates always into full duplex mode.
Link Loss Forwarding

Link Loss Forwarding (LLF) is an alarm status of Ethernet interface. LLF can be enabled or disabled.

If LLF is enabled, any linkdown alarm will generate the alarm status of Ethernet interface blocking any transmission to it. LLF can be enabled for each ports at front panel.

With LLF enabled the equipment connected (routers, switches so on) can be notified that radio link is not available and can temporarily re-route the traffic.

MDI/MDIX cross-over

The Ethernet electrical interface into FEM module can be defined by WebLct as MDI or MDIX to cross-over between pairs so that external cross-over cable is not required.

VLAN functionality

LIM Ethernet module works with IEEE 802.1q and 802.1p tag. Tag is made up with:

- a fixed word of 2 bytes
- 3 bits for priority according with 802.1p
- 1 fixed bit
- 12 bits VLAN identifier (VLAN ID) according with 802.1q.

Switch cross-connections are based on VLAN Configuration Table where input and output ports or only output ports should be defined for any used VID. VLAN ID (VID) has a range from 1 to 4095.

7.1.3.2 STM-1 synchronisation

Refer to Fig.22.

STM-1 frame generation requires that it is synchronised to a SDH network.

Into ALplus2 a synchronisation circuit, called SETS, gets the synchronisation signal from the following different sources:

- radio
- STM1
- tributary A/WST
- tributary B
- tributary n
- Lan3
- Lan4
- Internal source

As shown in Fig.22 the clocks extracted from the sources are sent to a selection circuit that chooses one of the signals depending on the control sent by a selection logic.

This latter acts on the base of alarm roots (LOS-loss of input signal, LTI-loss of timing input, LOF-loss of frame), on the base of assigned priority and manual forcing.

The selected clock drives an oscillator through a PLL circuit. The oscillator will generate the required synchronisation for the STM-1 frame generation. If no input signals are available the internal oscillator source is used for the local restart.
7.1.3.3 LIM LEDs

On LIM front panel are present two LEDs to describe the following aspect:
- PoE - green, ON if Power over Ethernet facility is active
- FAIL - red, ON if the boot of the module wasn’t successful.

7.1.4 RIM

The RIM consists of the following main circuits:
- IF part of the QAM modulator
- IF part of the QAM demodulator
- power supply
- telemetry IDU/ODU.
7.1.4.1 Modulator

Signals from LIM are connected to a programmable modulator. It consists of the following circuits:

- recovery low pass filter to eliminate signal periodicity
- two mixers for carrier amplitude and phase modulation process
- 330 MHz local oscillator
- a combiner circuit to generate the QAM modulation.

The obtained 330 MHz QAM modulated carrier is then sent to the cable interface for connection with ODU.

7.1.4.2 Demodulator

At the receive side, from the cable interface, the 140 MHz QAM modulated carrier is sent to the QAM demodulator passing through a cable equalizer circuit.

The QAM demodulator within the RIM converts the signal to be sent to the digital part of the demodulator within the LIM.

7.1.4.3 Adaptive code modulation

ACM profiles

In ALplus2/ALplus2 radio family uses Adaptive Code and Modulation (ACM) in order to employ the correct modulation profile depending on the Rx signal quality.

Available ACM profiles are the following:

- 4QAM strong
- 4QAM
- 8PSK
- 16QAM
- 32QAM
- 64QAM
- 128QAM
- 256QAM.

These profiles operate in an RF channel with the following bandwidth:

- 7 MHz
- 14 MHz
- 28 MHz
- 56 MHz.

ACM switching

The usage of the previous modulation profiles in a fixed channel bandwidth results in a variable capacity. The criteria defining the necessity of an ACM switching, upshift or downshift, is the Rx S/N ratio.

- Upshift - When there is an increase of received S/N, within the same Channel Spacing, the modulation complexity is increased in the direction from 4QAM strong to 256QAM increasing the spectral efficiency
• **Downshift** - When there is a decrease of received S/N, within the same Channel Spacing, the modulation is reduced in the direction from 256QAM to 4QAM strong reducing the spectral efficiency.

In order to configure properly the radio link using ACM facility, an optimization must be found between max traffic during good propagation conditions and max availability during bad propagation conditions. To obtain this purpose the ACM in ALplus2/ALCplus2 family can be configured via software setting the following parameters: ACM setting and Tx Power mode.

**ACM setting**

The ACM can vary modulation profiles between two extremes defined by the operator through software configuration: Upper Modulation and Lower Modulation.

• **Upper modulation** - When propagation into the given radio channel is in the better condition (high Rx S/N), the radio link is working at the maximum throughput defined at Upper Modulation: the highest modulation profile that ACM can employ.

• **Lower modulation** - When propagation into the given radio channel is in the worst condition (low Rx S/N), the radio link is working at the minimum throughput, defined at Lower Modulation: the lowest modulation profile that ACM can employ.

**Tx power mode**

Tx power mode can be set as Constant Peak or Constant Average (constant bolometer measurement).

• **Constant Peak** - Tx power is at maximum at 4QAM and at 256QAM is reduced (typical 4.5 dB) so the RF Tx amplifier can operate in better linear conditions.

• **Constant Average** - Tx power is the same at any modulation.

The **Tx Power mode** is set depending on the modulation license of the user and depending on the **Lower Modulation** that has been set.

For example:

In case of a 4QAM licence, all the other modulations must remain into the 4QAM mask. In this condition Tx power must be Constant Peak (Tx Power Constant Peak Mode = Enable): max Tx power at 4QAM and reduced power at all the other modulations.

In case of a 16QAM licence (or higher complexity) and Lower Modulation is set at 4QAM, the emitted spectrum must remain into the emitted spectrum defined for 16QAM even if the equipment is transmitting at 4QAM. In this case Tx power must be Constant Average (Tx Power Constant Peak Mode = Disable): Tx power is always the same at any modulation and typically is the Upper Modulation's power. As an alternative the Lower Modulation can be set at 16QAM so Tx power Constant Peak can be activated.

With Constant Average Tx power (Tx Power Constant Peak Mode = Disable), the Tx power at 4QAM and any other modulation is the same of Upper Modulation, so if Upper Modulation is 256QAM the output power at any modulation is the same of 256QAM which is 4.5 dB less than 4QAM. The result is that enabling 256QAM is a big advantage for traffic but less link budget margin at 4QAM.

**E1 priority**

E1 available tributaries belong to two groups.

One is Permanent E1 equal to High Priority E1 that will never be interrupted during modulation downshift. Downshift modulation will be limited to the minimum to obtain the selected Permanent E1.

The second group is Extra E1 equal to Low Priority, these tributaries will be interrupted progressively during modulation downshift. They will start to be cut from the highest e.g. tributaries 16th or 32nd up to the first.

In **Tab.11** it is reported the priority of tributaries, the lowest will be cut first.

**Ethernet traffic**

Once defined the bandwidth, Permanent E1 and Extra E1 at any modulation the amount of Ethernet capacity is the total radio capacity minus the Permanent + Extra E1 at any modulation.
7.1.4.4 Power supply

The -48 V battery voltage feeds the IDU and ODU circuitry. The service voltage for the IDU feeding are achieved through a DC/DC converter for +3.6 V generation and a step down circuit for -5 V.

Both voltages are protected against overvoltages and overcurrents. The same battery running through the interconnection cable gives the power to the ODU.

An electronic breaker protects the battery against cable failure.

7.1.4.5 Telemetry IDU/ODU

The dialogue IDU/ODU is made up by the main controller and associated peripherals within the ODU. Controls for ODU management and alarm reporting is performed making use of a bidirectional 388 kbit/s framed signals.

The transport along the interconnecting cable is carried out via two FSK modulated carriers:

- 17.5 MHz from IDU to ODU
- 5.5 MHz from ODU to IDU.

7.2 LOOPS

To control the IDU correct operation a set of local and remote loops are made available. The commands are forwarded by the WEBLCT/NMS program. Loop block diagram is shown by Fig.23.

7.2.1 Tributary

Tributary local loop

Each input tributary is routed directly to the tributary output upon receiving the command. The Tx line transmission is still on.

<table>
<thead>
<tr>
<th>Priority</th>
<th>ALplus2</th>
<th>ALCplus2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest</td>
<td>Permanent E1 never disappears</td>
<td>Permanent E1 never disappears</td>
</tr>
<tr>
<td>l</td>
<td>WST</td>
<td>Tributary A</td>
</tr>
<tr>
<td>l</td>
<td></td>
<td>Tributary B</td>
</tr>
<tr>
<td>l</td>
<td>E1 tributary n°1</td>
<td>E1 tributary n°1</td>
</tr>
<tr>
<td>l</td>
<td>E1 tributary n°16</td>
<td>E1 tributary n°16</td>
</tr>
<tr>
<td>l</td>
<td>E1 tributary n°32</td>
<td>E1 tributary n°32</td>
</tr>
<tr>
<td>Lowest</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Tributary remote loop

Each tributary directed towards the Rx output line is routed back to the Tx line. The Rx line is still on.

7.2.2 IDU loop

This kind of loop permits to check the full IDU operation. When activated, the modulator output is connected to demodulator input.

The loop is assured by converting the frequency of the modulator from 330 MHz to 140 MHz.
Fig. 23 - IDU loopback
Fig. 24 - ALplus2 with 16E1, 1+0 and 1+1 version, block diagram
Fig. 25 - ALPlus2 with 16E1, 2x(1+0) configuration, block diagram

- Permanent = High Priority
- Extra = Low Priority
8 ALCPLUS2 IDU DESCRIPTION

8.1 CONFIGURATION

The IDU of ALCplus2 is available in 1+0 and 1+1 configuration.

Into the IDU there are the following circuits:

- Controller
- LIM
- RIM (one circuit in 1+0 configuration, two circuits in 1+1 configuration).

The IDU of ALCplus2 is one RU subrack.

All the listed circuits are inserted into a single board.

Circuits for others 16xE1 or 32xE1 are inserted into the ALCplus2 IDU, one RU subrack, with exp16E1 or exp32E1 options.

Please refer to chapter 7 ALCplus2 IDU DESCRIPTION for any information relevant to functionalities of the listed circuits.

8.1.1 Switch for ethernet ports

Inside IDU is present an Ethernet switch with 4 external ports (electrical 1000BaseT or optical 1000BaseX) and one internal. Port 3 and Port 4 have both interfaces, Port 1 and Port 2 are electrical only.

The external interfaces (4 operational on 6 present) are placed on the front panel. Internal port is represented by the local radio stream where, through native Ethernet transport, is connected with the remote equipment.

For Ethernet switch functionalities, please refer to chapter 7 ALCplus2 IDU DESCRIPTION.

8.1.2 Service channels

No service channels ports are available for ALCplus2 IDU.
8.2 SYNCHRONIZATION

Refer to Fig.36.
STM-1 frame generation requires that it is synchronised to a SDH network.
Into ALplus2e a synchronisation circuit, called SETS, gets the synchronisation signal from the following different sources:

- radio A
- radio B
- STM1(1)
- STM1 (2)
- tributary A/B
- tributary A/B as T3
- tributary nE1
- node1
- node2
- Lan A (Lan1,2,3,4) Gbit Electrical
- Lan B (Lan1,2,3,4) Gbit Electrical
- Internal source

As shown in Fig.36 the clocks extracted from the sources are sent to a selection circuit that chooses one of the signals depending on the control sent by a selection logic.

This latter acts on the base of alarm roots (LOS-loss of input signal, LTI-loss of timing input, LOF-loss of frame), on the base of assigned priority and manual forcing.

The selected clock drives an oscillator through a PLL circuit. The oscillator will generate the required internal synchronisation signal T0.

Trib A or B selected as T3 can be the source of T4 signal (2MHz) for other equipment like for example into nodal structure.

If no input signals are available the internal oscillator source is used for the local restart of STM1 generation.

8.3 SD MEMORY CARD MANAGEMENT

On the front panel a protected slot for the insertion of a memory card is present.

The memory card allows the upload/download of the equipment configuration and the equipment firmware.

- Memory card format SD, SDHC
- Memory card capacity up to 4 GB.

8.4 ALC BLOCK DIAGRAMS

On Fig.31, Fig.32, Fig.33 and Fig.34 you can find block diagrams of ALCplus2 with 32E1 expansion, with 16E1 expansion and NBUS, with 16E1 expansion and without any expansion.
8.5 ALCPLUS2 NODE

A node can be made up of max 8 subracks of ALCplus2 IDU so that we can have:

- up to 8 maximum independent radio directions, with max 80E1 per direction
- up to 8 STM1 MST or MSP
- up to 8 x 16E1 = 128E1
- up to 8 x 2 x 1Gbit Lan ports.

On the front panel of ALCplus2 there are two "NBUS" ports (1 and 2) which must be connected to the other IDU subrack as in Fig.35 for E1 traffic and Ethernet traffic.

For Ethernet traffic Lan1 and Lan2 must be connected as in Fig.35. Lan1 and Lan2 connection can be made with normal Lan cables CAT5e/CAT6.

NBUS connection among the IDUs are made by cables of CAT7 quality, only by proprietary SIAE cable code F03580 to insert into the NBUS connectors (1 and 2) on the front panel.

Warning: for NBUS do not use normal Lan cables.

For any IDU into WebLct it is necessary to define how many IDU are into the Node from 2 to 8.

Into WebLct each IDU must be defined as node number 1, 2...8.

NBUS can operate in Protected mode or in Not Protected mode. Each NBUS carries 126 E1’s.

In case of Not Protected mode, all the 126 E1’s of the NBUS are used to connect a subrack to the others for a total amount of 252 E1 connections available on NBUSes from one IDU.

In case of Protected mode, the unused connections, are used as protection of the connections between the other IDUs; for example 63 E1’s are used between Node1 and Node2 and the other 63 E1’s are used as protection of the connections between the other nodes, the connections used as protection pass into others IDUs as passthrough without any need to be programmed.

The troubles in the connections between the NBUS buses are identified by alarms.

In case of protected modality, if the cable carrying the traffic is broken, an alarm is issued on the relevant NBUS port, the equipment software switches the traffic on the other operating NBUS cable.

For Ethernet traffic Lan1 and Lan2 must be connected as in Fig.35.

With SCT/LCT program it is possible to configure a Node made up of some Nodals so into the window of Node Manager it is possible to program only one big Crossconnect matrix for E1 and only one Ethernet switch for all Lan traffic.

The software hides all NBUS connection for E1 and Lan connection from an IDU to others IDUs, so to operate on one big Crossconnection matrix and one big Ethernet switch.

For any IDU the Node Manager shows for E1s 16E1, STM1 E1s, radio permanent E1, radio extra E1 and for Ethernet Lan3, Lan4, radio port Port A.

The Nodal equipment with SDH STM1 interface is a Regenerator Section Termination (RST) and a Multiplex Section Termination (MST) therefore it generates the STM-1 frame and has an internal synchronization circuit SETS. The synchronization of the Node is distributed on the NBUS.

The SETS circuit can be seen as a single circuit which provides to the synchronization of the eight subracks.

The SETS circuit can be disabled if only PDH interfaces are present in the node.

For each Nodal subrack, the STM-1 interface can be duplicated (1+1 MSP) for the possible protection of cable. The switching criteria in Rx are:

- Unequipped
- LOS
- LOF
- MSAIS
- TIM
- B2 excessive BER
- B2 degraded BER.
8.5.1 Expansion from 2 to 3 nodals

Suppose that the nodals 1 and 2 already exist and that you must add the nodal 3.
Disconnect the cable between NBUS1 nodal2 and NBUS2 nodal1, the traffic is automatically switched to the other cable, if necessary.
Disconnect the cable between LAN1 nodal2 and LAN2 nodal1, the traffic is automatically switched to the other cable, if necessary.
By WebLCT or SCT/LCT, re-program the nodal1 and nodal2 as node with 3 items.
By WebLCT or SCT/LCT, re-program the nodal3 as nodal3, protected and define the node with 3 items.
Connect the NBUS1 of the nodal2 with NBUS2 of nodal3, connect the NBUS1 of the nodal3 with NBUS2 of the nodal1 as in Fig.35.
Connect the LAN1 of the nodal2 with LAN2 of nodal3, connect the LAN1 of the nodal3 with LAN2 of the nodal1 as in Fig.35.
By SCT/LCT, with Nodal ALCplus2 Manager, Nodal Configuration add nodal3 IP address.
Program the interested cross-connections and Ethernet switch connections with external interfaces of nodal3, Node Manager will take care of connections on NBUSes and LAN1, 2.
The same procedure can be used even if the added node is different from nodal3.

8.5.2 Reduction from 3 to 2 nodes

Suppose that the nodals 1, 2 and 3 already exist and that the nodal 3 must be removed.
By SCT/LCT, with Nodal ALCplus2 Manager, delete all the cross-connections to the external interfaces of nodal3.
Remove the cables of the NBUS and LAN going to nodal3.
Connect nodal2 NBUS1 to nodal1 NBUS2 as in Fig.35.
Connect nodal2 LAN1 to nodal1 LAN2 as in Fig.35.
The same procedure can be used even if the deleted nodal is different from nodal3.

8.6 LAG - LINK AGGREGATION

Link Aggregation (LAG) is a feature available on SIAE ALCplus2 equipments that allows assigning up to four physical links to one logical link (trunk) that functions as a single, higher-speed link.
In SIAE equipment LAG is named Trunking and two different implementations are possible:
- Line trunking: it works by aggregating LAN interfaces.
- Radio trunking: it works by aggregating radio interfaces.
Radio Trunking is available only when the Nodal Ethernet functionality is enabled.
The nodal Ethernet configuration can be deployed on all the ALCplus2 IDU models.
More details about this implementation will be provided in next paragraph 8.5 ALCplus2 NODE.
8.6.1 Line Trunking

Line Trunking is available on the ALCplus2 IDU. SIAE ALCplus2 support IEEE 802.3ad LACP (Link Aggregation Control Protocol). See Fig.26.

Fig.26 - Enabling Line Aggregation, Enable trunk1

LACP allows a network device to negotiate an automatic bundling of links by sending LACP packets to the peer (directly connected device that also implements LACP). In addition to the increased capacity of the logical link, LACP provides additional advantages:

- failover detection when a link fails, allowing for a trunk reconfiguration in order to avoid systematic packet loss (after the reconfiguration the packets will be lost only if the throughput exceed the trunk capacity).
- it introduces an agreement between the two LACP peers before to start data transmission over the trunk. This prevent anomalous behaviour in case of cabling or configuration mistakes.

LACP works by sending frames (LACPDUs) over the links belonging to the trunk. Also the equipment deployed on the other end of the trunk will send LACP frames over the same links: this enables the two units to establish the trunk. LACP can be configured two modes: active or passive. In active mode it will always send frames along the configured links. SIAE ALCplus2 implements an "active" LACP.

Each IDU allows to define up to 4 different trunks on its LAN interfaces. A Line Trunk can aggregate up to 4 LAN interfaces with the following restrictions:

- all the LAN interfaces must be defined with the same speed (either 10, 100 or 1000 Mbit/s).
- all the LAN interfaces must be set in Full Duplex mode
- all the interfaces must belong to the same IDU, even if the IDU is deployed in Nodal Ethernet configuration.

When a Trunk is defined on SIAE ALCplus2, the end-to-end traffic is transmitted over all the aggregated lines. As a results, the overall capacity of the trunk can be theoretically equal to the number of aggregated lines multiplied by the capacity of a single line. In the example of Fig.27, four 100Mbs connection are grouped into the same trunk, carrying all the capacity in transit from a radio link to another. In this configuration, the theoretical maximum capacity that can transit on this trunk is 400 Mbit/s.
Fig. 27 - Line trunking

The packets carried by the trunk are assigned to each line depending on their Source MAC (SA) and Destination MAC (DA) Addresses (MAC hashing).

A possible problem that could occur when Link Aggregation protocols are used is a change in the transmission order of packets belonging to the same logical session. The MAC hashing method prevents such a problem: the traffic transmitted from one host to another one in the network (fixed SA and DA) is always sent over the same physical line of the trunk, avoiding any order change.

If a line of the trunk fails (for example due to a cable disconnection), the LACP protocol automatically reconfigure the trunk group into a lower order trunk. So doing, the traffic that before was carried over the failed line, now will be re-distributed over one of the remaining trunk lines, ensuring continuity to the traffic transmission. The typical LAG reconfiguration time in case of a LAN cable failure is below 1 second.

8.6.2 Radio Link Trunking

Radio Link Trunking is a feature available on SIAE ALCplus2 equipment when deployed in Nodal Ethernet configuration.

This feature allows to bundle up to 4 radio links to increase the capacity of an Ethernet connection between two radio sites (see Fig.28).
Each Nodal Ethernet stack can belong to one Radio Trunk. Each IDU of the trunk sends over the air only a portion of the traffic, according to the same hashing rule used for the line trunking (see paragraph 8.6.1 Line Trunking). The traffic received from the radio trunk is sent towards the IDU where is located the outgoing interface according to standard MAC learning/switching mechanisms.

Resiliency between the radio links aggregated into the trunk is managed by means of a proprietary protocol. If a radio link of the trunk fails (due to fading or equipment failure), this protocol automatically reconfigure the trunk group into a lower order trunk. In this way, the traffic that before was carried over the failed link, now will be re-distributed over one of the remaining trunk lines, ensuring continuity to the traffic transmission. The typical Radio Trunk reconfiguration time is about 600msec.

It is important to note that also if it could be possible to aggregate up to four 340Mbit/s radio links (by using 56 MHz frequency channel with 256 QAM modulation), the maximum capacity that can be carried over the radio link cannot exceed 1Gbit/s in each direction of transmission (referring to Fig.28, from Site A to Site B and vice-versa).

Regarding multicast/broadcast, the total traffic entering the stack (sum of the packets entering from LAN3/ LAN4 interfaces and from the radio ports) cannot exceed 1Gbit/s. This because also the traffic received from the radio trunk is flooded towards all the IDUs belonging to the Nodal Ethernet stack (MAC learning cannot be performed over multicast packets).

**Fig.28 - Radio trunking**
8.7 LINE PROTECTION THROUGH DISTRIBUTED ELP

ELP (Ethernet Line Protection) is a feature available on ALCplus2 IDU that allows to protect a GE interface against cable failure or accidental disconnection. With ELP it is possible to connect an ALCplus2 IDU to another network element by using two GE interfaces. Both interfaces are active but just one is enabled to forward and receive traffic (forwarding state), while the other does not allow any traffic to pass (blocking state). If the forwarding interface goes down, the other one passes to the forwarding state. The typical switching time is around 1.5 sec. This feature does not imply the use of any protocol, but is simply based on the status of the physical interfaces. As a consequence, no particular protocol support is required on the connected equipment: it is simply required to enable the two GE interfaces.

When the Nodal Ethernet configuration is used, ELP can be used to protect the traffic of two GE interfaces belonging to two different IDUs of the stack. In this way the traffic can be protected against IDU failure, in addition to the cable protection.

This feature is particularly useful when the Nodal stack is connected to an external equipment like a core router (see the example of the following Fig.29).

![Fig.29 - Line protection through distributed ELP](image)

It is recommended to disable any Spanning Tree protocol on the external equipment: this could cause longer traffic recovery times.
8.8 ETHERNET OAM (Operation Administration and Maintenance)

As native Ethernet is originally designed for LAN (Local Area Network), OAM is not included into the native Ethernet network equipment. In order to provide a carrier grade service, the OAM protocol can be used in any point-to-point Ethernet link (made up of a single radio link or many radio links). The aim of this protocol is to check and monitor the functionality of the service that the provider guarantees on the network.

8.8.1 Service Layer OAM

The Service Layer OAM fully monitors a customer End-to-End Ethernet Service. Two main standards cover this topic, the IEEE 802.1ag and ITU-T Y.1731.

The IEEE 802.1ag provides CFM (Connectivity Fault Management) useful for detecting, isolating and reporting connectivity faults. The ITU-T Y.1731 Standard comprehends the CFM plus some additional features, like RDI (Remote Defect Indicator) that allows to report back to the start of the chain the Alarm message.

SIAE ALCplus2 supports CFM according to both standards ITU-T Y.1731 and 802.1ag.

The IEEE 802.1ag and the ITU-T Y.1731 are End-to-End service, i.e. provides the tools to monitor the Ethernet Service regardless of the layers, Network Path and operators. Since the spectrum of application can include many applications a more hierarchical structure is needed.

The Standards define:

- Maintenance Domains (MD): these specify the Domains of operators, users and service providers. Levels from 0 to 7 are possible depending on the type of service to be monitored. Customer Domain is the higher which includes both ends of the Ethernet service (from one End user to the other End user). Standard Default values for Customer Domain are 7, 6 and 5. Service Provider Domains should have a MD lower than the Customer Domain since include the whole network except the End Users. Standard default values for Provider Domains are 3 and 4. Operator Domains are lower than Service Provider Domains since just a part of the network is included. Standard Default values for operator domains are 0, 1 and 2. A domain is transparent to all messages with higher priority while blocking all lower priority messages. Fig.30 shows the hierarchical structure of Maintenance Domains.
ALCplus2 equipment belongs to one Maintenance Domain.

At each end of the Maintenance Domain two MEPs (Maintenance End Point) will be specified. One MEP is local, the other one is in the remote equipment. The MEPs are "markers" that define the end of a domain and are in charge of originating OAM frames.

In a domain also MIPs (Maintenance Intermediate Points) can be specified. The MIPs are passive checkpoints. The MEPs and MIPs configuration are discussed in details in the following points. The choice of the domain that is the Domain Label (name) is left to the user. Particular attention must be paid to use exactly the same MD label (and level) in each equipment where the MD is specified, i.e. different equipment with same value of MD domain but different MD labels (or levels) belongs to different Domains.

- A Maintenance Association (MA) is one association which correlates the VLAN to the MD in which the MEPs and MIPs have to be defined. When a specified traffic needs to be monitored, then it is necessary to relay the VLAN to a Domain and to the corresponding MEPs or MIPs through the MA. Before creating the Maintenance Association, the VLAN, either SVLAN (Service VLAN Tag o Stacked VLAN Tag) or C-VLAN, has to be specified in the VLAN Table. In each SIAE equipment it is possible to set up to 32 different MA. Particular attention must be paid to use the same MA label in each equipment where the MA is specified, i.e. different MA labels on the same VLAN correspond to different MA associations.
At the Edge of a MD there are MEPs (Maintenance End Points) and in the middle there could be MIPs (Maintenance Intermediate Points). MEPs are the units in charge of managing the CFM to correctly monitor the status of the Ethernet service provided. MIPs are passive check-points that answer to polling coming from MEPs. MEPs will forward OAM messages coming from higher domains and will discard OAM messages generated from lower domains.

Each interface can be configured as MEP, Port A interface (radio interface) included. Once chosen the interface, depending on the network topology, the direction of the MEP has to be specified. Two Directions are possible, MEP "up" and MEP "Down". With MEP "Down" configured the OAM PDUs are sent from the interface in the direction outside the equipment, i.e. the OAM PDUs are sent from the interface on the cable toward next equipment. With MEP "Up" configured the OAM PDUs are sent from the interface toward the inside of the equipment and will follow the VLAN table previously configured. MEPs are distinguished from each other through a MEP ID, therefore MEPs belonging to same MA must have different MEP IDs. In order to configure a MIP the MA has to be enabled on the equipment. Up to 32 MIPs or MEPs can be configured on each equipment.

The protocols belonging to the Connectivity Fault Management implemented in SIAE equipment are following listed:

- Continuity Check Protocol: this protocol enables the sending of a periodic message (like a Heartbeat message) which enables the other MEPs deployed in the network to distinguish the status of a virtual connection. This message can only be originated by a MEP. Time between messages is adjustable with 1s, 10s, 1min, 10min. These messages do not trigger any automatic reply from the destination entity.

- LoopBack Protocol: it resembles an IP PING message; once this message is sent (e.g. MEP1 sends a Loopback Message to MEP2). MEP2 replies to MEP1 confirming therefore the status of the connection. This is done to check the status of the connection between the MEP originating the message and the MEP/MIP to which the message is addressed. This message can only be originated from one MEP and can be addressed to both MEPs or MIPs. ALCplus2: The number of Loopback Messages in ALCplus2 equipment is adjustable from 1 to 5 consecutive Loopbacks. In each equipment, it is possible for each MEP to check the presence of other MEPs in the same MA. This is done through the "Remote MEP" application which allows this acknowledgement and distinguishes the other MEP through means of MEP IDs and MAC address.

- Link Trace Protocol: This protocol sends a message similar to the LoopBack protocol. Every equipment that is reached by this message will answer to the sender providing its own MAC Address. In this way the sender is able to understand of which equipment the MA is composed. E.g. a MEP sends the Link Trace Message to another MEP belonging to the same Maintenance Association. The MIPs that are eventually deployed in the middle of the path will forward this message and answer to the initiating MEP with their own MAC Address. By doing so the initiating MEP knows the OAM-devices deployed in the path and their order.

- Remote Defect Indicator: This Feature allows a MEP, in presence of a fault or a defect, to send a RDI to inform the other MEPs, belonging to the same MA, of the presence of this Defect. The advantages of this procedure are to avoid multiple Alarms created by the same cause and to be able to check the status of other Remote MEPs. This RDI information is reported in the Continuity Check Message. ALCplus2: This feature is present in ALCplus2 equipment and the presence of this alarm can be checked as well in the Remote MEPs screen on the equipment.

### 8.8.2 OAM Example with ALCplus2

As an example, let's consider a network where a sequence of 8 SIAE ALCplus2 Radio links is deployed. In this case a Maintenance Domain, a VLAN and a Maintenance Association have to be defined. The VLAN carrying the traffic must be present in the VLAN table of each equipment.

Two MEPs at the end of the chains and a variable number of MIPs in the middle has to be defined with Continuity Check Message (CCM) enabled.

In case of defect or Ethernet problem, the Continuity Check Message will result in an "Inactive" status triggering one Alarm.

By logging on one MEP it is sufficient to configure the Loopback message and Link Trace Message correctly detects the location of the Bottleneck or defect related to this traffic. If More than one VLAN is present then more than one MA has to be defined.
8.8.3  Reset Switch

Reset Switch button forces factory default values into switch but this is true only at next restart.

8.8.4  MAC Table clear

This is a button to clear all the MAC Table.
MAC Learning on Port basis and MAC Learning on VID basis.
The purpose of these two selections is dividing the MAC table into some independent parts named FID (Forwarding Indication Database).
Fig. 31 - ALCplus2 with 32E1 expansion, STM-1, 1+0 and 1+1 version, block diagram

- Permanent = High Priority
- Extra = Low Priority
Fig.32 - ALCplus2 with 16E1 expansion, STM1, NBUS, 1+0 and 1+1 version, block diagram
Fig.33 - ALCplus2 with 2E1, 1+0 and 1+1 version, block diagram

Fig.34 - ALCplus2 with 16E1, 1+0 and 1+1 version, block diagram
Fig. 35 - Node block diagram in protected configuration
9 ALCPLUS2E IDU DESCRIPTION

9.1 CONFIGURATION

The IDU of ALCplus2e is available in the configurations

- 1+0 with XPIC
- 1+1 and 2x(1+1) with XPIC configuration and without XPIC configuration 2+0 East West.

Into the IDU there are the following circuits:

- Controller
- LIM
- RIM (one circuit in 1+0 configuration, two circuits in 1+1 configuration).

The IDU of ALCplus2e is one RU subrack.

All the listed circuits are inserted into a single board.

Please refer to chapters 7 ALCplus2 IDU DESCRIPTION and 8 ALCplus2 IDU DESCRIPTION for any information relevant to functionalities of the listed circuits.

9.1.1 Service channels

No service channels ports are available for ALCplus2e IDU.

9.2 ALCplus2E BLOCK DIAGRAM

On Fig.38 you can find block a diagram of ALCplus2e with 32E1 expansion.

9.2.1 ADAPTIVE CODE MODULATION - ACM PROFILES

In ALplus2e radio family uses Adaptive Code and Modulation (ACM) in order to employ the correct modulation profile depending on the Rx signal quality.

Available ACM profiles are the following:

- 4QAM strong
- 4QAM
- 8PSK
- 16QAM
- 32QAM
- 64QAM
- 128QAM
- 256QAM.

These profiles operate in an RF channel with the following bandwidth:
- 7 MHz
- 14 MHz
- 28 MHz
- 40 MHz
- 56 MHz.

With 1+0 configuration the E1 number is:
- Number of permanent (fixed) E1: max 80E1
- Number of extra (dynamical) E1: max 21E1
- Total number of E1 per direction: 82 E1
- Total number of E1 per unit: 82 E1.

9.3 FREQUENCY REUSE

The frequency reuse makes use of an XPIC circuit (Cross Polar Interference Canceller) and allows the coexistence of two radio bearer transmission on the same RF channel. Each radio bearer carries an individual radio frame up to 341 Mbit/s.

The system consists of two fully independent transceivers, and a crosspolarized antenna with polarization H connected to one transceiver and polarization V connected to the other transceiver.

The initial co-channel interference is featured by the antenna cross polar discrimination factor (example 29 dB). This value may be not sufficient for frequency reuse system making use of modulations $\geq$ 32QAM. After all, it may be impaired by the propagation condition giving rise to a BER degradation. To get a suitable discrimination value, an adaptive canceller, based on a fully numeric adaptive coefficient filter, must be used.

As shown in Fig.41 the received signals at the IF receiver outputs are processed by the demodulator placed on the copolar branch as well as by the canceller annexed to the demodulator processing the signals from the cross polar polarization. This process operates in baseband time domain.

An adaptive equalizer minimizes the intersymbolic interference within the copolar demodulator whereas a circuit similar to the equalizer, processes the signal on the cross route.

Such a signal, summed with the one available at the equalizer output permits the cancelling of the interference contained in the copolar signal. XPIC circuit is used into configuration 1+0 XPIC and 2x(1+1) XPIC.

IDU-ODU coaxial cable to ODU for vertical polarization and ODU for horizontal polarization should not differ more than 1.5 meters in length.


**9.4 2x(1+1) XPIC CONFIGURATION**

The 2x(1+1) XPIC configuration is made up of two IDU with XPIC and 4 ODU connected as in Fig. 39.

The following interfaces are available:
- 16E1+16E1 and 4E1
- 4xSTM1
- 4x1Gbit Ethernet

Cross connection is possible among STM1s that are connected to the same IDU shelf. However End-to-End VLAN and TDM management provisioning will be possible via NMS. Two XPIC IDUs that are configured in 2x(1+1) cannot be part of Node managed by SCT node.

In case of one IDU failure, TDM payload that is connected to it will be lost.

Number of permanent (fixed) E1: max 2x80E1
Number of extra (dynamic) E1: max 2x2E1
Total number of E1 per polarization: 82 E1
Total number of E1 per direction: 164 E1
Total number of E1 per unit: 164 E1.

**9.5 2+0 EST WEST CONFIGURATION**

The 2+0 Est West configuration is made up of one IDU and 2 ODUs connected as in Fig. 40.
One ODU to an antenna directed to Est, one ODU connected to an antenna directed to West.

The following interfaces are available:
- 16E1 and 2E1
- 2xSTM1
- 4x1Gbit Ethernet

Cross connection is possible among STM1s, 16E1, radio side E1s. At receiving end the IDU receives E1s from two ODUs Est and West and decides which is going to use on the basis of alarms.

Ethernet traffic may arrive from Est or West, switching between the two sides can be done with rapid spanning tree protocol, activated on both radio ports.

Number of permanent (fixed) E1: max 2x80E1
Number of extra (dynamic) E1: max 2x21E1
Total number of E1 for any direction: 82 E1
Total number of E1 per unit: 164 E1.

**9.5.1 Selective E1 Protection**

A selective E1 subset defined into WebLCT can be routed, for protection purposes, to both radio directions Vertical and Horizontal or Est and West.

With 1+0 XPIC configuration the ALCplu2e on the other side receives the two E1s and decides which one to select on the basis of alarms.

With 2x(1+0) Est West configuration, if the equipment is part of a loop, another same equipment is receiving the two E1s and on the basis of alarms decides which receiving E1 to select.
9.6 SYNCHRONIZATION

Refer to Fig.36.

STM-1 frame generation requires that it is synchronised to a SDH network.

Into ALplus2e a synchronisation circuit, called SETS, gets the synchronisation signal from the following different sources:

- radio A
- radio B
- STM1(1)
- STM1 (2)
- tributary A/B
- tributary A/B as T3
- tributary nE1
- node1
- node2
- Lan A (Lan1,2,3,4) Gbit Electrical, (LAN 3, 4) Gbit Optical
- Lan B (Lan1,2,3,4) Gbit Electrical, (LAN 3, 4) Gbit Optical
- Internal source

As shown in Fig.36 the clocks extracted from the sources are sent to a selection circuit that chooses one of the signals depending on the control sent by a selection logic.

This latter acts on the base of alarm roots (LOS-loss of input signal, LTI-loss of timing input, LOF-loss of frame), on the base of assigned priority and manual forcing.

The selected clock drives an oscillator through a PLL circuit. The oscillator will generate the required internal synchronisation signal T0.

Trib A or B selected as T3 can be the source of T4 signal (2MHz) for other equipment like for example into nodal structure.

If no input signals are available the internal oscillator source is used for the local restart of STM1 generation.

Synchronization quality is connected to synchronization source (SSM).

All ALCplus2e SSM characteristics will be available from second FW release.

ALCplus2e manages quality information (synchronization status message SSM) from the following sources:

- 2MHz: from TribA/B selected as T3
- E1: tribA or tribB for one 2Mbit/s within the 16 E1 available; quality info uses a spare bit of G.704 time slot 0 frame B.
- STM1: Quality info is into S1 byte
- Nodal interface: proprietary field into frame (to be announced)
- Ethernet (ITU G.8264): a dedicated slow protocol transfers quality info (second FW release)
- Radio: with a proprietary message.

ALCplus2e synchronization follows G813, G823, G8262 and G781.
9.7 SWITCH FOR ETHERNET PORTS

Into WebLCT Configurator, Ethernet switch can be set as Enhanced = Absent, in this case the ALCplus2e Ethernet functionalities are fully compatible to ALCplus2. With Enhanced = Present selection new Ethernet functionalities are present and are described in the following.

The external interfaces (4 operational on 6 present) are placed on the front panel. Internal port is represented by the local radio stream where, through native Ethernet transport, is connected with the remote equipment.

Inside IDU is present an Ethernet switch with 4 external ports (electrical 1000BaseT or optical 1000BaseX) and up two internal ports. Port 3 and Port 4 have both interfaces, Port 1 and Port 2 are electrical only.

The internal ports are represented by the local radio stream where through native Ethernet transport is connected with the remote equipment. There is one internal port for 1+0 and 1+1 radio configuration.

In XPIC and in 2+0 link configurations, two settings are available regarding the internal port:
- dual pipe - two internal ports (port A and port B), one for each polarization/direction
- single pipe - one internal port (port A) for both polarizations/directions.

For Ethernet switch functionalities, please refer to chapter 8 ALCplus2 IDU DESCRIPTION.

Other functionalities are:
- monitoring on service type (outer or inner VLAN TAG) counters based on CVLAN or SVLAN (second FW release)
- QinQ selective VLAN based selective VLAN + priority based, port based
- 8 queues scheduler on Radio Port, with priority managed on all 8 queues, it is possible to select whenever queue is full:
  - Tail Drop: last come packet is lost
  - Queue Drop: the queue is deleted, over a defined threshold all packets in the queue are discarded to limit latency time on traffic within this queue
- RED (Random Early Discard) random automatic discard of packets, over a defined threshold there is a defined high percentage of discarded, only for incoming packets to a port without CIR (that is all packets have same priority)

- WRED (Waited Random Early Discard) random automatic discard of packets, over a defined threshold there is a defined high percentage of discarded, only for incoming packets (green or yellow colored) to a port with CIR

- Drop profile settable
  - with MPLS incoming packets it is possible to remap Exp Bits MPLS to 802.1p Ethernet to manage MPLS priority on Radio Port.
  - frame fragmentation: packets exiting on radio port are fragmented to reduce Latency Time Jitter
  - CIR/EIR/Max rate management, at the input of any physical Lan port for the packets existing from radio port it is possible to define: CIR Committed Information Rate (minimum guaranteed rate), Excessive Information Rate (maximum bit rate if bandwidth is available) Max Rate (maximum bit rate, rate control) for any Lan port, for any CVLAN, for any SVLAN
  - VLAN re-writing with VLAN re-mapping
  - OAM 802.1ag

**LINK CONCATENATION**

Link Concatenation is a feature available on SIAE ALCplus2e equipments that allows assigning up to two physical links to one logical link that functions as a single, higher-speed link.

Link Concatenation works aggregating two radio interfaces. With XPIC it aggregates radio traffic from Vertical polarization and radio traffic from horizontal polarization. Traffic speed on the two polarization can be different.

Algorithm of packets distribution on the two radios are statistically and proportional to traffic capacity giving the maximum throughput from the two radios.

**ETHERNET FRAME FRAGMENTATION**

On radio side it is possible to enable the Packet Fragmentation at 256 or 512 bytes. Smaller packets give the benefit of lower delay variation (jitter) on the other packets maybe at higher priority.

**EPP**

Enhanced Packet Processing (EPP) is the possibility to compress the fixed field into the packets. Up to 68 byte of headers can be affected by compression algorithm giving a higher benefit to small packets.

**VLAN Rewriting**

In the direction from Lan ports to Radio ports the Vid of tagged packets can be rewritten according the maps defined into WebLCT.

Vlan rewriting is provided only if into 802.1q Management it is selected Fallback.

With Fallback, Traffic Treatment=Trasparent Port to Port Transport, Provider=Disable we can make a table with: Input CVLAN Vid to Output CVLAN Vid

With Fallback, Traffic Treatment=Trasparent Port to Port Transport, Provider=Enable C_Vid Based we can make a table with: Input CVLAN Vid to Output CVLAN Vid and output SVLAN Vid

With Fallback, Traffic Treatment=Trasparent Port to Port Transport, Provider=Enable C_Vid Priority we can make a table with: Input CVLAN Vid and Input priority to Output SVLAN Vid.
ENHANCED ETHERNET PRIORITIZATION BASED ON MPLS EXP BITS

In the direction from Lan ports to Radio ports MPLS packets are analyzed in their Exp (Experimental) 3 bits and sent into one of the 8 queues available to radio.

A programmable map into WebLCT defines for each value of Exp bits which queue (from 0 to 7 Max priority) the packet will enter.

Another programmable map into WebLCT defines for each value of Exp bits which value of 802.1p priority bit will be written into the Vlan Tag.

CIR/EIR RATE MANAGEMENT / INPUT FILTER POLICY (e.g. LAN1)

In the direction from Lan ports to Radio ports.

Some definitions:

- **UNI**: User Network Interface
- **CoS**: Class of Service
- **EVC**: Ethernet Virtual Connection
- **CIR**: Committed Information Rate
- **EIR**: Express Information Rate
- **CBS**: Committed Burst Size
- **EBS**: Excess Burst Size
- **CF**: Coupling Flag
- **CVID**: Customer VLAN Identifier
- **SVID**: Service VLAN Identifier

**Committed Information Rate (CIR):** The bandwidth that the service provider guarantees to the customer, regardless of network conditions.

**Excess Information Rate (EIR):** The bandwidth allowance for "best effort" delivery, for which service performance is not guaranteed and traffic may be dropped if the network is congested.

The combination of CIR and EIR rates is typically referred to as **PIR**, or **Peak Information Rate**, which represents the total burstable bandwidth sold to the customer.

**Committed Burst Size (CBS):** The maximum size, expressed in bytes, of a burst of back-to-back Ethernet frames for guaranteed delivery.

**Excess Burst Size (EBS):** The maximum size of a burst of back-to-back Ethernet frames permitted into the network without performance guarantees. EBS frames may be queued or discarded if bandwidth is not available.

According to MEF 10.2 (Metro Ethernet Forum) specifications, the “bandwidth profile” service attribute (Input Filter Policing), which includes some or all of the above categories, can be defined per UNI, per EVC or per CoS identifier (CoS ID; EVC.CoS). For any given frame, however, only one such model can apply. The service provider meets the bandwidth guarantees by reserving appropriate network resources and employing a two-rate/three-color (trTCM) rate-limitation methodology as part of its traffic engineering policy to ensure compliance by user traffic.

- Green = Transmitted: CIR and CBS.
- Yellow = Low Priority (dropped in case of congestion): EIR and EBS.
- Red = Dropped: traffic exceeding EIR and EBS is dropped.

<table>
<thead>
<tr>
<th>CIR (green)</th>
<th>EIR (yellow)</th>
<th>dropped (red)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBS (green)</td>
<td>EBS (yellow)</td>
<td>dropped (red)</td>
</tr>
</tbody>
</table>
For any port it is possible to add an Input Filter Policy table with the following selections:

- **Disable**
- **Uni Port Based**
- **EVC C_Vid Based**
- **COS C_Vid + Priority Based**
- **EVC S_Vid/C_Vid Based**
- **COS S_Vid/C_Vid + Priority Based**

According to the status of 802.1q Management > 802.1q settings:

- **Disable**: you can select only Uni Port Based with CIR, EIR, CBS, and EBS; Cf disable is ok.
- **Fallback**: two selections 1) EVC C_Vid Based: applied to a CVLAN C_Vid with CIR, EIR, CBS, and EBS; Cf disable is ok. 2) COS C_Vid + Priority Based: applied to a CVLAN C_Vid with priority range, CIR, EIR, CBS, and EBS; Cf disable is ok.
- **Secure**:
  - two selections 1) EVC S_Vid/C_Vid Based: applied to a SVLAN S_Vid and a CVLAN C_Vid with CIR, EIR, CBS, and EBS; Cf disable is ok. 2) COS S_Vid/C_Vid + Priority Based: applied to a SVLAN S_Vid and CVLAN C_Vid with priority range, CIR, EIR, CBS, and EBS; Cf disable is ok.

Into ALCplus2e there is a total of 64 instances of Input Filter Policing for all the four ports into any radio port. Any CVID can be used into only one port.

Into the same port the same CVID can be reused but with different priority.

**Priority Management (e.g. LAN1)**

In the direction from LAN ports to Radio ports, Priority Management is dependent on the status of 802.1q Management > 802.1q settings:

- **Disable**: you can select only Uni Port Based with CIR, EIR, CBS, and EBS; Cf disable is ok.
- **Fallback**: two selections 1) EVC C_Vid Based: applied to a CVLAN C_Vid with CIR, EIR, CBS, and EBS; Cf disable is ok. 2) COS C_Vid + Priority Based: applied to a CVLAN C_Vid with priority range, CIR, EIR, CBS, and EBS; Cf disable is ok.
- **Secure (C_Vid Filtering)**:
  - five selections 1) Port Default: priority defined by Default port Priority, all packets entering this port have the same priority; 2) Native 802.1p (C_Vid): priority defined by 802.1p field in the CVLAN C_Vid; 3) Native Tos/DSCP: priority defined by Level 3 IP TOS/DSCP; 4) Native MPLS: priority defined by MPLS Exp bits; 5) 802.1p(C_PCP) rewrite with MPLS: priority defined by PriorityLan to Radio > MPLS to 802.1p Rewrite (tab) map translation.
- **Secure (S_Vid Filtering, Provider=on)**:
  - six selections 1) Port Default: priority defined by Default port Priority, all packets entering this port have the same priority; 2) Native 802.1p (S_Vid): priority defined by 802.1p field in the SVLAN S_Vid; 3) Native TOS/DSCP: priority defined by Level 3 IP TOS/DSCP; 4) Native MPLS: priority defined by MPLS Exp bits; 5) 802.1p(C_PCP) rewrite (of SVLAN) with MPLS: priority defined by PriorityLan to Radio > MPLS to 802.1p Rewrite (tab) map translation; 6) 802.1p(S_PCP) rewrite (of SVLAN) with MPLS: priority defined by PriorityLan to Radio > MPLS to 802.1p Rewrite (tab) map translation.

**802.1q MANAGEMENT (e.g. Lan1)**

Direction from LAN ports to Radio ports. Here you can select the input 802.1q: Disable, Fallback, Secure mode.

You can select the Traffic Treatment with two possibilities: 1) Transparent Port to Port Transport; 2) Transparent Bridge Port Based.

1. **Transparent Port to Port Transport**: this is a setting for a simple application with 4 segregated connections Lan1 to remote Lan1, Lan2 to remote Lan2, Lan3 to remote Lan3, Lan4 to remote Lan4 with tagged and untagged traffic; some settings are needed locally and remote. Via radio (PortA) the QinQ is used. From this configuration it is possible to add VLAN tags into VLAN Configuration Table, prioritizing and OAM.

2. **Transparent Bridge Port Based**: this is a setting to create connections from radio port to Lan1,2,3,4 and from Lan1,2,3,4 to radio port.
With Provider> Enable C_Vid Based: into a tagged packet it is possible to rewrite from a defined Input C_Vid to a defined Output C_Vid and add an Output S_Vid (a Service Vlan Identifier).

With Provider> Enable C_Vid + Priority: into a tagged packet, with a defined Input C_Vid and a defined Input Priority it is possible to add an Output S_Vid (a Service Vlan Identifier).

A packet that locally is entering untagged, can be tagged on remote radio, with “Untag to Tag” checked.

Queue Management Lan to Radio (e.g. Port A Enh.)

On radio Port A (and PortB if configured as 2x(1+0)) there are 8 Queues. Queue 8 has maximum priority.

For each queue queue length 128/256/512/1024 Kbit can be defined. Small queues have lower delay. Larger queues have few drops.

Starting from lower priority queue, it is possible to use WFQ (Wait Fair Queue) exit policy. WFQ counts the number of transmitted packets. For each Queue set as WFQ the queue priority can be defined changing Weight value.

Drop type defines the drop policy, it can be:

- Tail: this is the simplest dropping policy, last packet is dropped if queue is full;
- Queue: if queue is full, all packets in the queue are dropped; packets are too old to be useful, so all packets in the queue are dropped to reduce time delay at minimum;

See Fig.37.

- RED (Random Early Drop): no packet are dropped until Average Queue Occupation % reaches $S_{min}(G, Green)$, packets are dropped randomly until a percentage of $P_{max}$ and an Occupation % of $S_{max}(G)$ limits are reached, all packets are dropped over an Occupation % higher than $S_{max}(G)$;
- RED Gentle (Enable): no packets are dropped until Average Queue Occupation % reaches $S_{min}(G, Green)$; with Average Queue Occupation % higher than $S_{min}(G)$ and lower than $S_{max}(G)$, packets are dropped randomly with a percentage defined by the straight line between $S_{min}(G)/0$ and $S_{max}(G)/P_{max}(G)$; with Average Queue Occupation % higher than $S_{max}(G)$ the percentage of randomly dropped packets is defined by the straight line between $S_{max}(G)/P_{max}(G)$ and $S_{gentle}(G)/100\%$;
- WRED (Weighted Random Early Drop): Weighted RED is a two line RED; one line for Green packets, one line for Yellow packets; Green and Yellow are defined by CIR and EIR into Input Filtering Policy (Lan1,2,3,4); no green packet is dropped until Average Queue Occupation % reaches $S_{min}(G, Green)$; no yellow packet is dropped until Average Queue Occupation % reaches $S_{min}(Y, Yellow)$;
with Average Queue Occupation % higher than Smin(G) and lower than Smax(G) green packets are dropped randomly with a percentage defined by the straight line between Smin(G)/0 and Smax(G)/Pmax(G);
with Average Queue Occupation % higher than Smin(Y) and lower than Smax(Y) yellow packets are dropped randomly with a percentage defined by the straight line between Smin(Y)/0 and Smax(Y)/Pmax(Y);
all green packets are dropped over an Occupation % higher than Smax(G);
all packets are dropped over an Occupation % higher than Smax(Y);

- WRED Gentle (Enable): Weighted RED is a two line RED; one line for Green packets, one line for Yellow packets; Green and Yellow are defined by CIR and EIR into Input Filtering Policy (Lan1,2,3,4);
  for Green packets no packet is dropped until Average Queue Occupation % reaches Smin(G);
  with Average Queue Occupation % higher than Smin(G) and lower than Smax(G) green packets are dropped randomly with a percentage defined by the straight line between Smin(G)/0 and Smax(G)/Pmax(G);
  with Average Queue Occupation % higher than Smax(G), the percentage of dropped green packets is defined by the straight line between Smax(G)/Pmax(G) and Sgentle(G)/100%;
  for Yellow packets no packet is dropped until Average Queue Occupation % reaches Smin(Y);
  with Average Queue Occupation % higher than Smin(Y) and lower than Smax(Y) green packets are dropped randomly with a percentage defined by the straight line between Smin(Y)/0 and Smax(Y)/Pmax(Y);
  with Average Queue Occupation % higher than Smax(Y), the percentage of dropped green packets is defined by the straight line between Smax(Y)/Pmax(Y) and Sgentle(Y)/100%;

WRED and WRED Gentle are very efficient to get the most from the radio link available traffic avoiding the "stop and go" behavior (SAW trend) typical of congested TCP/IP traffic.

**Warning:** RED and WRED impact only TCP/IP traffic, not UDP traffic.
Fig.38 - ALCplus2e block diagram

Fig.39 - ALCplus2e 2x(1+1) layout
Fig. 40 - ALCplus2e 2+0 layout

Fig. 41 - Frequency reuse system
10  ODU DESCRIPTION

10.1  ODU VERSIONS

Two ODU versions are available: AS and ASN.
In the following pages eventual differences are pointed out.
The ODU (refer to Fig.42) consists of a two shell aluminium mechanical structure, one shell housing all the ODU circuits, the other forming the covering plate.

On the ODU are accessible:

- the "N" type connector for cable interfacing IDU and ODU
- the "BNC" connector for connection to a multimeter with the purpose to measure the received field strength
- a ground bolt.

The 1+1 configuration consists of two 1+0 ODUs mechanically secured to a structure housing the hybrid (or branching unit) for the antenna connection.

10.1.1  AS ODU

The AS ODU is shown in Fig.42 (single ODU) and in Fig.43 (1+1 ODU with branching unit).
Electrical and mechanical characteristics are listed in a separate addendum relevant to ODU frequency.

10.1.2  ASN ODU

The ASN ODU is shown in Fig.42 (single ODU) and in Fig.43 (1+1 ODU with branching unit).
Electrical and mechanical characteristics are listed in a separate addendum relevant to ODU frequency.

10.2  DESCRIPTION

The blocks that arrange the ODU are the following:

- cable interface
- power supply
- Tx section
- Rx section
- 1+1 branching unit
10.3 CABLE INTERFACE

The cable interface permits to interface the cable interconnecting IDU to ODU and vice versa. It receives/transmits the following signals:

- 330 MHz (from IDU to ODU)
- 140 MHz (from ODU to IDU)
- 17.5 MHz (from IDU to ODU)
- 5.5 MHz (from ODU to IDU)
- remote power supply.

The 17.5 MHz and 5.5 MHz FSK modulated carriers carry the telemetry channel. This latter consists of two 388 kbit/s streams: one from IDU to ODU with the information to manage the ODU (RF power, RF frequency, capacity, etc...) while the other, from ODU to IDU, sends back to IDU measurements and alarms of the ODU. The ODU management is made by a µP.

10.4 POWER SUPPLY

The battery voltage is dropped from the cable interface and then sent to a DC/DC converter to generate three stabilized output voltages to be distributed to the ODU circuitry.

10.5 TX SECTION

Refer to block diagram shown in Fig.44.

The 330 MHz QAM modulated carrier from the cable interface (see chapter 10.3 CABLE INTERFACE) is forwarded to a mixer passing through a cable equalizer for cable loss compensation up to 40 dB at 330 MHz. The mixer and the following bandpass filter give rise to a second IF Tx carrier the frequency of which depends on the go/return frequency value. The mixer is of SHP type.

All the IF and RF local oscillators are µP controlled.

The IF carrier is converted to RF and then amplified making use of a MMIC circuit. The conversion mixer is SSB type with side band selection.

The power at the MMIC output can be manually attenuated by 40 dB, 1 dB step (20dB, 1dB step for ODU ASN).

The automatic adjustment is performed making use of an ATPC (see paragraph 10.5.1 ATPC operation for details). The regulated output power is kept constant against amplifier stage gain variation by a feedback including the AGC.

Before reaching the antenna side the RF signal at the output of MMIC passes through the following circuits:

- a decoupler plus detector diode to measure the output power
- a circulator to protect the amplifier stages against possible circuit mismatch.
- a ON/OFF switch for 1+1 operation
- an RF bandpass filter for antenna coupling.

A particular setting of Tx and Rx RF oscillators allows to obtain a RF Loop, managed by Controller module. The particular way used to perform the RF loop avoids the necessity to switch off the remote Transmitter. RF Loop is available in AS ODU only.
10.5.1 ATPC operation

The ATPC regulates the RF output power of the local transmitter depending on the value of the RF level at the remote terminal. This value has to be preset from the local terminal as threshold high and low. The difference between the two thresholds must be equal or higher than 3 dB.

As soon as the received level crosses the preset threshold level low (see Fig. 47) due to the increase of the hop attenuation, a microP at the received side of the remote terminal sends back to the local terminal a control to increase the transmitted power. The maximum ATPC range is 40 dB (ODU AS, 20 dB only in ODU ASN).

If the hop attenuation decreases and the threshold high is crossed then the control sent by the microP causes the output power to decrease.

10.6 RX SECTION

The RF signal from the Rx bandpass filter is sent to a low noise amplifier that improves the receiver sensitivity. The following down-converter translates the RF frequency to approximately 765 MHz. The conversion mixer is SSB type. The sideband selection is given through a µP control.

A second down converter generates the 140 MHz IF carrier to be sent to the demodulator within the IDU. The level of the IF carrier is kept constant to –5 dBm thank to the IF amplifier stages, AGC controlled, distributed in the IF chain.

Between two amplifiers a bandpass filter assures the required selectivity to the receiver. The filter is SAW type and the bandwidth depends on the transmitted capacity.

10.7 1+1 Tx SYSTEM

The two ODUs are coupled to the antenna side via a balanced or unbalanced hybrid.

1+1 Tx switching occurs in the 1+1 hot stand-by 1 antenna or 2 antennas versions as shown in Fig. 45 and Fig. 46.

The transmitter switchover is controlled by µProcessor and the attenuation of the stand-by transmitter is at least 50 dB.
Fig. 42 - AS and ASN ODUs
Fig. 43 - Final 1+1 assembly with AS and ASN ODU

Suncover (optional)
Fig. 44 - ODU block diagram
**Fig. 45 - 1+1 hot stand–by 1 antenna**

**Fig. 46 - 1+1 hot stand–by 2 antennas**
Fig. 47 - ATPC operation
Section 3.
INSTALLATION

11 INSTALLATION AND PROCEDURES FOR ENSURING THE ELECTROMAGNETIC COMPATIBILITY

11.1 GENERAL INFORMATION TO BE READ BEFORE THE INSTALLATION

The equipment is a split mount (indoor-outdoor) radio link system operating in the frequency ranges 4, 6, 7, 8, 13, 15, 18, 23, 25, 28 and 38 GHz, for low, medium and high transport capacity (from 4 up to 622 Mbit/s), designed to establish LAN-LAN connections and PDH/SDH access. For the details related to the actual used frequency band refer to the label on the equipment.

The system is provided with an integral antenna; however, in case its antenna is not used, it should be connected to an antenna conforming to the requirements of ETSI EN 302 217-4-2 for the relevant frequency band.

The equipment is composed by the following separate units:

- radio unit (outdoor) with or without integral antenna
- Baseband (indoor)

⚠️ This equipment makes use of non-harmonized frequency bands.
⚠️ Class 2 radio equipment subject to Authorisation of use. The equipment can operate only at the frequencies authorised by the relevant National Authority.
⚠️ The deployment and use of this equipment shall be made in agreement with the national regulation for the Protection from Exposure to Electromagnetic Field.
⚠️ The symbol indicates that, within the European Union, the product is subject to separate collection at the product end-of-life. Do not dispose of these products as unsorted municipal waste. For more information, please contact the relevant supplier for verifying the procedure of correct disposal.
11.2 GENERAL

The equipment consists of IDU and ODU(s) units and is mechanically made up of a wired 19" subrack (IDU) and a weather proof metallic container (ODU). The two units are shipped together in an appropriate cardboard box.

After unpacking, mechanical installation takes place followed by electrical connections as described in the following paragraphs.

11.3 MECHANICAL INSTALLATION

11.3.1 IDU

On their sides the subracks making up the several IDU versions are provided with two holes for the M6 screws fastening the subracks to a rack or to a 19" mechanical structure. The front of the IDU mechanical structure is provided with the holes at the sides. This permits to fasten the subrack to a 19" rack by means of 4 M6 screws.

11.3.2 IDU installation

ALPlus2 - To avoid overtemperature problems the free space below and above an IDU must be 22 mm (1/2RU) minimum.

ALCPlus2 - IDUs can be stacked.

11.4 ELECTRICAL WIRING

The electrical wiring must be done using appropriate cables thus assuring the equipment responds to the electromagnetic compatibility standards.

The cable terminates to flying connectors which have to be connected to the corresponding connectors on the equipment front.

Position and pin–out of the equipment connectors are available in this section.

Tab.12 shows the characteristics of the cables to be used and the flying connector types.
### Tab.12 - Characteristics of the cables

<table>
<thead>
<tr>
<th>Interconnecting points</th>
<th>Type of connector terminating the cable</th>
<th>Type of cable/conductor</th>
</tr>
</thead>
</table>
| Battery                | Polarized SUB–D 3W3 female connector    | Section of each wire ≥ 2.5 sq.mm  
|                        |                                        | a. For power cable length longer than 20 m. a section of 4 mm is required. |
| Tributary signals      | SCSI 50 pin male connector              | 8 conductor cable different for 75 Ohm and 120 Ohm signals |
| User input/alarm output| Female type D connector with 9 pins and shielded holder | 9 conductor cable with double brass sheath type interconductor DB28.25 or equivalent |
| LCT                    | USB B                                   | Standard “printer” cable b. Max length 2.5 m |
| NBUS                   | RJ45                                    | SIAE code F03471          |
| STM1                   | Plug-in                                 | Relevant to plug-in module |
| Optical LAN port       | Plug-in                                 | Relevant to plug-in module |
| Electrical LAN port    | RJ45                                    | Standard CAT5 cable       |
| RS232                  | Female type D connector with 9 pins and shielded holder | 9 conductor cable with double brass sheath type interconductor DB28.10 or equivalent |
| GND                    | Faston male type                        | Section area ≥ 6 sq. mm.   |
11.5 CONNECTIONS TO THE SUPPLY MAINS

During the final installation, the IDU must be protected by a magneto-thermal switch (not supplied with the equipment), whose characteristics must comply with the laws in force in one’s country.

The disconnection from the supply mains is made disconnecting the connector SUB-D 3W3 from the IDU.

11.6 IDU-ODU INTERCONNECTION CABLE

11.6.1 Electrical characteristics

- Cable type: coaxial
- Cable impedance: 50 ohm
- Insertion loss: 24 dB at 330 MHz
- Return loss (connectors included): better than 22 dB (from 100 MHz to 400 MHz)
- Max total DC resistance: 4 Ohm
- Shielding effectiveness: 90 dB

11.6.2 Connectors

N-type male connectors on both sides.

11.6.3 Max length

With the 1/4” cable, the max length is 300m for all modulation profile.

11.6.4 Suggested cable

Under development.
11.7 GROUNDING CONNECTION

Fig.48 and annexed legend show how to perform the grounding connections.

Legend

1. IDU grounding point, faston type. The cross section area of the cable used must be ≥ 4 sq. mm. The faston is available on the IDU both sides.
2. ODU grounding bolt. The cross section area of the cable used must be ≥ 16 sq. mm.
3. IDU–ODU interconnection cable type Celflex CUH 1/4” terminated with N–type male connectors at both sides.
4. Grounding kit type Cabel Metal or similar to connect the shield of interconnection cable.
5. Matching cable (tail) terminated with SMA male and N female connectors.
6. Battery grounding point of IDU to be connected to earth by means of a cable with a section area 2.5 sq. mm. Length ≤ 10 m.
7. Grounding cords connected to a real earth internal of station. The cross section area of the cable must be ≥ 16 sq. mm.

Fig.48 - Grounding connection

11.8 SURGE AND LIGHTNING PROTECTION

Gas dischargers are present both in IDU and ODU.

Characteristics

- DC spark-over voltage 150V ±20%
- Nominal impulse discharge current (wave 8/20 ms) 20kA
- Single impulse discharge current /wave 8/20 ms) 25kA
- Performances in accordance to EN 301 489.
12 ALPLUS2 CONNECTORS

12.1 IDU FRONT PANEL

The front panel of the ALplus2 modular IDU is made up by the front panels of the modules LIM, RIM and Controller. See Fig.49.

12.1.1 LIM connectors

- Ethernet port 1 electrical, 10/100/1000BaseT RJ45 (see Tab.13)
- Ethernet port 1, 100/1000BaseX SFP-LC
- Ethernet port 2 electrical, 10/100/1000BaseT RJ45 (see Tab.13)
- Ethernet port 3, 100/1000BaseX SFP-LC

Electrical port 1 and port 2 can be configured MDI or MDIX via WEBLCT.

- STM-1 1 in/out SFP
- STM-1 2 in/out SFP

SFP can be I.1, S1.1, L1.1, L1.2, electrical coaxial 1.0/2.3

- Trib 1-8, 75 Ohm and 120 Ohm E1 in/out 50 pin SCSI female (Tab.14 for 75Ohm and Tab.15 for 120Ohm)
- Trib 9-16, 75 Ohm and 120 Ohm E1 in/out 50 pin SCSI female (Tab.14 for 75Ohm and Tab.15 for 120Ohm)

E1, 75 Ohm and 120 Ohm interfaces are present in the same connector (different pins).

12.1.2 RIM connectors

- Connector for 50 Ohm interconnection to ODU SMA
- -48 Vdc power supply SUB-D 3W3 (pinout on the panel)

12.1.3 Controller connectors

- LCT, management USB type B (receptable)
- RS232, management SUB-D male 9 pin (see Tab.16)
- USER IN/OUT SUB-D male 9 pin (see Tab.17)
- MNGT/1, management RJ45 (see Tab.18)
• MNGT/2, management RJ45 (see Tab.18)
Port MNGT/1 and port MNGT/2 set MDI or MDIX status automatically.
• CH1 service channel not connected
• CH2 service channel RJ45 (see Tab.19)
• 2 Mbit/s wayside, 120 Ohm E1 in/out RJ45 (see Tab.20)

12.2 IDU BODY CONNECTORS

• Ground connection 6.3 mm male (Faston).

Fig.49 - IDU ALplus2 front panel

Tab.13 - 10/100/1000BaseT, RJ45

<table>
<thead>
<tr>
<th>Pin RJ45</th>
<th>Function 10/100BaseT</th>
<th>Function 1000BaseT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Twisted pair IN_P</td>
<td>BI_DB+</td>
</tr>
<tr>
<td>2</td>
<td>Twisted pair IN_N</td>
<td>BI_DB-</td>
</tr>
<tr>
<td>3</td>
<td>Twisted pair OUT_P</td>
<td>BI_DA+</td>
</tr>
<tr>
<td>4</td>
<td>nc</td>
<td>BI_DD+</td>
</tr>
<tr>
<td>5</td>
<td>nc</td>
<td>BI_DD-</td>
</tr>
<tr>
<td>6</td>
<td>Twisted pair OUT_N</td>
<td>BI_DA-</td>
</tr>
<tr>
<td>7</td>
<td>nc</td>
<td>BI_DC+</td>
</tr>
<tr>
<td>8</td>
<td>nc</td>
<td>BI_DC-</td>
</tr>
</tbody>
</table>
Tab.14 - 8xE1, 50 pin SCSI female 75 Ohm

<table>
<thead>
<tr>
<th>Pin</th>
<th>75 Ohm</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>Ground A</td>
</tr>
<tr>
<td>23</td>
<td>Tributary 1/9 input</td>
</tr>
<tr>
<td>50</td>
<td>Ground A</td>
</tr>
<tr>
<td>25</td>
<td>Tributary 1/9 output</td>
</tr>
<tr>
<td>47</td>
<td>Ground A</td>
</tr>
<tr>
<td>22</td>
<td>Tributary 2/10 input</td>
</tr>
<tr>
<td>45</td>
<td>Ground A</td>
</tr>
<tr>
<td>20</td>
<td>Tributary 2/10 output</td>
</tr>
<tr>
<td>42</td>
<td>Ground A</td>
</tr>
<tr>
<td>17</td>
<td>Tributary 3/11 input</td>
</tr>
<tr>
<td>43</td>
<td>Ground A</td>
</tr>
<tr>
<td>18</td>
<td>Tributary 3/11 output</td>
</tr>
<tr>
<td>40</td>
<td>Ground A</td>
</tr>
<tr>
<td>15</td>
<td>Tributary 4/12 input</td>
</tr>
<tr>
<td>39</td>
<td>Ground A</td>
</tr>
<tr>
<td>14</td>
<td>Tributary 4/12 output</td>
</tr>
<tr>
<td>36</td>
<td>Ground B</td>
</tr>
<tr>
<td>11</td>
<td>Tributary 5/13 input</td>
</tr>
<tr>
<td>37</td>
<td>Ground B</td>
</tr>
<tr>
<td>12</td>
<td>Tributary 5/13 output</td>
</tr>
<tr>
<td>34</td>
<td>Ground B</td>
</tr>
<tr>
<td>9</td>
<td>Tributary 6/14 input</td>
</tr>
<tr>
<td>33</td>
<td>Ground B</td>
</tr>
<tr>
<td>8</td>
<td>Tributary 6/14 output</td>
</tr>
<tr>
<td>29</td>
<td>Ground B</td>
</tr>
<tr>
<td>4</td>
<td>Tributary 7/15 input</td>
</tr>
<tr>
<td>31</td>
<td>Ground B</td>
</tr>
<tr>
<td>6</td>
<td>Tributary 7/15 output</td>
</tr>
<tr>
<td>28</td>
<td>Ground B</td>
</tr>
<tr>
<td>3</td>
<td>Tributary 8/16 input</td>
</tr>
<tr>
<td>26</td>
<td>Ground B</td>
</tr>
<tr>
<td>1</td>
<td>Tributary 8/16 output</td>
</tr>
</tbody>
</table>

**Note:** Join pin 44 with ground A pins, join pin 32 with ground B pins.

![Fig.50 - Pin-out Tributary 50 pin SCSI female](image)
<table>
<thead>
<tr>
<th>Pin</th>
<th>120 Ohm</th>
</tr>
</thead>
<tbody>
<tr>
<td>49</td>
<td>Tributary 1/9 input</td>
</tr>
<tr>
<td>23</td>
<td>Tributary 1/9 input</td>
</tr>
<tr>
<td>44</td>
<td>Ground A</td>
</tr>
<tr>
<td>24</td>
<td>Tributary 1/9 output</td>
</tr>
<tr>
<td>25</td>
<td>Tributary 1/9 output</td>
</tr>
<tr>
<td>44</td>
<td>Ground A</td>
</tr>
<tr>
<td>21</td>
<td>Tributary 2/10 input</td>
</tr>
<tr>
<td>22</td>
<td>Tributary 2/10 input</td>
</tr>
<tr>
<td>44</td>
<td>Ground A</td>
</tr>
<tr>
<td>46</td>
<td>Tributary 2/10 output</td>
</tr>
<tr>
<td>20</td>
<td>Tributary 2/10 output</td>
</tr>
<tr>
<td>44</td>
<td>Ground A</td>
</tr>
<tr>
<td>16</td>
<td>Tributary 3/11 input</td>
</tr>
<tr>
<td>17</td>
<td>Tributary 3/11 input</td>
</tr>
<tr>
<td>44</td>
<td>Ground A</td>
</tr>
<tr>
<td>19</td>
<td>Tributary 3/11 output</td>
</tr>
<tr>
<td>18</td>
<td>Tributary 3/11 output</td>
</tr>
<tr>
<td>44</td>
<td>Ground A</td>
</tr>
<tr>
<td>41</td>
<td>Tributary 4/12 input</td>
</tr>
<tr>
<td>15</td>
<td>Tributary 4/12 input</td>
</tr>
<tr>
<td>44</td>
<td>Ground A</td>
</tr>
<tr>
<td>13</td>
<td>Tributary 4/12 output</td>
</tr>
<tr>
<td>14</td>
<td>Tributary 4/12 output</td>
</tr>
<tr>
<td>44</td>
<td>Ground A</td>
</tr>
<tr>
<td>10</td>
<td>Tributary 5/13 input</td>
</tr>
<tr>
<td>11</td>
<td>Tributary 5/13 input</td>
</tr>
<tr>
<td>32</td>
<td>Ground B</td>
</tr>
<tr>
<td>38</td>
<td>Tributary 5/13 output</td>
</tr>
<tr>
<td>12</td>
<td>Tributary 5/13 output</td>
</tr>
<tr>
<td>32</td>
<td>Ground B</td>
</tr>
<tr>
<td>35</td>
<td>Tributary 6/14 input</td>
</tr>
<tr>
<td>9</td>
<td>Tributary 6/14 input</td>
</tr>
<tr>
<td>32</td>
<td>Ground B</td>
</tr>
<tr>
<td>7</td>
<td>Tributary 6/14 output</td>
</tr>
<tr>
<td>8</td>
<td>Tributary 6/14 output</td>
</tr>
<tr>
<td>32</td>
<td>Ground B</td>
</tr>
</tbody>
</table>
### Fig. 51 - Pin-out Tributary 50 pin SCSI female

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Tributary 7/15 input</td>
</tr>
<tr>
<td>4</td>
<td>Tributary 7/15 input</td>
</tr>
<tr>
<td>32</td>
<td>Ground A</td>
</tr>
<tr>
<td>30</td>
<td>Tributary 7/15 output</td>
</tr>
<tr>
<td>6</td>
<td>Tributary 7/15 output</td>
</tr>
<tr>
<td>32</td>
<td>Ground A</td>
</tr>
<tr>
<td>27</td>
<td>Tributary 8/16 input</td>
</tr>
<tr>
<td>3</td>
<td>Tributary 8/16 input</td>
</tr>
<tr>
<td>32</td>
<td>Ground A</td>
</tr>
<tr>
<td>2</td>
<td>Tributary 8/16 output</td>
</tr>
<tr>
<td>1</td>
<td>Tributary 8/16 output</td>
</tr>
<tr>
<td>32</td>
<td>Ground A</td>
</tr>
</tbody>
</table>

### Tab. 16 - RS232 SUB-D 9 pin male

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DCD (IN)</td>
</tr>
<tr>
<td>2</td>
<td>RD (IN)</td>
</tr>
<tr>
<td>3</td>
<td>TD (OUT)</td>
</tr>
<tr>
<td>4</td>
<td>DTR (OUT)</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
</tr>
<tr>
<td>6</td>
<td>Not connected</td>
</tr>
<tr>
<td>7</td>
<td>RTS (OUT)</td>
</tr>
<tr>
<td>8</td>
<td>CTS (IN)</td>
</tr>
<tr>
<td>9</td>
<td>Not connected</td>
</tr>
</tbody>
</table>
### Tab.17 - SUB-D 9 pin male USER IN/OUT)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C relay contact - branch 1</td>
</tr>
<tr>
<td>2</td>
<td>NA/NC relay contact - branch 1</td>
</tr>
<tr>
<td>3</td>
<td>C relay contact - branch 2</td>
</tr>
<tr>
<td>4</td>
<td>NA/NC relay contact - branch 2</td>
</tr>
<tr>
<td>5</td>
<td>User input 01</td>
</tr>
<tr>
<td>6</td>
<td>User input 02</td>
</tr>
<tr>
<td>7</td>
<td>User input 03</td>
</tr>
<tr>
<td>8</td>
<td>User input 04</td>
</tr>
<tr>
<td>9</td>
<td>Ground</td>
</tr>
</tbody>
</table>

### Tab.18 - MNGT/1 and MNGT/2 100BaseT connector pin-out for 10/100BaseT Ethernet connection (RJ45)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tx+</td>
</tr>
<tr>
<td>2</td>
<td>Tx-</td>
</tr>
<tr>
<td>3</td>
<td>Rx+</td>
</tr>
<tr>
<td>4</td>
<td>--</td>
</tr>
<tr>
<td>5</td>
<td>--</td>
</tr>
<tr>
<td>6</td>
<td>Rx-</td>
</tr>
<tr>
<td>7</td>
<td>--</td>
</tr>
<tr>
<td>8</td>
<td>--</td>
</tr>
</tbody>
</table>

### Tab.19 - CH2 connector pin-out for 64 kbit/s channel - V.11 interface (RJ45)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>D-V11-Tx</td>
</tr>
<tr>
<td>2</td>
<td>D+V11-Tx</td>
</tr>
<tr>
<td>3</td>
<td>C-V11-Tx</td>
</tr>
<tr>
<td>4</td>
<td>C+V11-Tx</td>
</tr>
<tr>
<td>5</td>
<td>D-V11-Rx</td>
</tr>
<tr>
<td>6</td>
<td>D+V11-Rx</td>
</tr>
<tr>
<td>7</td>
<td>C-V11-Rx</td>
</tr>
<tr>
<td>8</td>
<td>C+V11-Rx</td>
</tr>
</tbody>
</table>
## Tab.20 - 2 Mbit/s wayside connector pin-out (RJ45)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tx-C (IN) common</td>
</tr>
<tr>
<td>2</td>
<td>TX-F (IN) 120 Ohm</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
</tr>
<tr>
<td>4</td>
<td>TX-F (IN) 75 Ohm</td>
</tr>
<tr>
<td>5</td>
<td>Rx-C (OUT) common</td>
</tr>
<tr>
<td>6</td>
<td>Rx-F (OUT) 120 Ohm</td>
</tr>
<tr>
<td>7</td>
<td>GND</td>
</tr>
<tr>
<td>8</td>
<td>Rx-F (OUT) 75 Ohm</td>
</tr>
</tbody>
</table>
13 ALCPLUS2 CONNECTORS

13.1 IDU FRONT PANEL

The front panel of the ALCplus2 IDU is made up by various connectors depending on IDU version: in the following type of connectors and relevant pin-out are listed. On the body of each IDU there is the ground connection: 6.3mm male (Faston).

13.2 ALCplus2 1+0/1+1 (GAI0157/GAI0152)

In Fig.8 and Fig.9 are shown the 1+0 and 1+1 version. The following connectors are available:

- MNGT1, 2 management
  Port MNGT 1, 2 set MDI or MDIX status automatically RJ45 (Tab.18)
- LAN port 1, 2, 3, 4 electrical 10/100/1000BaseT
  Electrical port 1, 2, 3, 4 can be configured MDI or MDIX via WEBLCT RJ45 (Tab.13)
- LAN port 3, 4 100/1000BaseX
  SFP-LC
- Trib A, B RJ45 (Tab.21)
- LCT, management USB type B (receptable)
- USER IN/OUT SUB-D male 9 pin (Tab.22)
- Connector for 50 Ohm interconnection to ODU 1 connector 1+0, 2 connectors in 1+1 SMA
- -48 Vdc power supply 1 connector in 1+0, 2 connectors in 1+1
  SUB-D 3W3 (pinout on the panel)

Tab.21 - Trib A, B connector

<table>
<thead>
<tr>
<th>PIN RJ45</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rx-F (OUT) 120 Ohm</td>
</tr>
<tr>
<td>2</td>
<td>Rx-C (OUT) 120/75 Ohm common</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
</tr>
<tr>
<td>4</td>
<td>Tx-F (IN) 120 Ohm</td>
</tr>
<tr>
<td>5</td>
<td>Tx-C (IN) 120/75 Ohm common</td>
</tr>
<tr>
<td>6</td>
<td>Tx-F (IN) 75 Ohm</td>
</tr>
<tr>
<td>7</td>
<td>GND</td>
</tr>
<tr>
<td>8</td>
<td>Rx-F (OUT) 75 Ohm</td>
</tr>
</tbody>
</table>

1 In 1+1 the two power supply connectors are in parallel
13.3 **ALCplus2 16E1 1+0/1+1 (GAI0155/GAI0156)**

In [Fig.10](#) and [Fig.11](#) are shown the 1+0 and 1+1 version. The following connectors are presents:

- MNGT1, 2 management
  Port MNGT 1, 2 set MDI or MDIX status automatically RJ45 ([Tab.18](#))
- LAN port 1, 2, 3, 4 electrical 10/100/1000BaseT
  Electrical port 1, 2, 3, 4 can be configured DI or MDIX via WEBLCT RJ45 ([Tab.13](#))
- LAN port 3, 4 100/1000BaseX SFP-LC RJ45 ([Tab.21](#))
- Trib A, B RJ45 ([Tab.21](#))
- LCT, management USB type B (receptable)
- USER IN/OUT SUB-D male 9 pin ([Tab.22](#))
- Trib 1/8, 9/16 E1, 75 Ohm and 120 Ohm interfaces are present in the same connectors (different pins) 50 pin SCSI female ([Tab.14](#) for 75 Ohm and [Tab.15](#) for 120 Ohm)

- Connector for 50 Ohm interconnection to ODU 1 connector 1+0, 2 connectors in 1+1 SMA
- -48 Vdc power supply 1 connector in 1+0, 2 connectors in 1+1 SUB-D 3W3 (pinout on the panel)

13.4 **ALCplus2 NODAL 1+0/1+1 (GAI0163/GAI0162)**

In [Fig.14](#) and [Fig.15](#) are shown the 1+0 and 1+1 version. The following connectors are present:

- MNGT1, 2 management
  Port MNGT 1, 2 set MDI or MDIX status automatically RJ45 ([Tab.18](#))
- LAN port 1, 2, 3, 4 electrical 10/100/1000BaseT
  Electrical port 1, 2, 3, 4 can be configured MDI or MDIX via WEBLCT RJ45 ([Tab.13](#))

---

<table>
<thead>
<tr>
<th>PIN RJ45</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C relay contact</td>
</tr>
<tr>
<td>2</td>
<td>NO relay contact</td>
</tr>
<tr>
<td>3</td>
<td>User Input 01</td>
</tr>
<tr>
<td>4</td>
<td>User Input 02</td>
</tr>
<tr>
<td>5</td>
<td>Ground</td>
</tr>
<tr>
<td>6</td>
<td>Do not use</td>
</tr>
<tr>
<td>7</td>
<td>NC relay contact</td>
</tr>
<tr>
<td>8</td>
<td>Not connected</td>
</tr>
<tr>
<td>9</td>
<td>Do not use</td>
</tr>
</tbody>
</table>

---

**Tab.22 - SUB-D 9 pin male USER IN/OUT**
- STM-1 1, 2 in/out  
  SFP can be I.1, S1.1, L1.1, L1.2, electrical coaxial 1.0/2.3  
  SFP  
- LAN port 3, 4 100/1000BaseX  
  SFP-LC  
- Trib A, B  
  RJ45 (Tab.21)  
- N-BUS 1, 2 connection among IDUs only through SIAE cable  
  F03471  
- LCT, management  
  USB type B (receptable)  
- USER IN/OUT  
  SUB-D male 9 pin (Tab.22)  
- Trib 1/8, 9/16  
  E1, 75 Ohm and 120 Ohm interfaces are present in the same connectors (different pins)  
  and Tab.15 for 120 Ohm)  
  50 pin SCSI female (Tab.14 for 75 Ohm)  
- Connector for 50 Ohm interconnection to ODU  
  1 connector 1+0, 2 connectors in 1+1  
  SMA  
- -48 Vdc power supply  
  1 connector in 1+0, 2 connectors in 1+1  
  SUB-D 3W3 (pinout on the panel)  

13.5 **ALCplus2 32E1 1+0/1+1 (GAI0169/GAI0168)**

In Fig.12 and Fig.13 are shown the 1+0 and 1+1 version. The following connectors are present:

- MNGT1, 2 management  
  Port MNGT 1, 2 set MDI or MDIX status automatically  
  RJ45 (Tab.18)  
- LAN port 1, 2, 3, 4 electrical 10/100/1000BaseT  
  Electrical port 1, 2, 3, 4 can be configured  
  MDI or MDIX via WEBLCT  
  RJ45 (Tab.13)  
- STM-1 1, 2 in/out  
  SFP can be I.1, S1.1, L1.1, L1.2, electrical coaxial 1.0/2.3  
  SFP  
- LAN port 3, 4 100/1000BaseX  
  SFP-LC  
- Trib A, B  
  RJ45 (Tab.21)  
- N-BUS 1, 2 connection among IDUs only through SIAE cable  
  F03471  
- LCT, management  
  USB type B (receptable)  
- USER IN/OUT  
  SUB-D male 9 pin (Tab.22)  
- Trib 1/8, 25/32  
  E1, 75 Ohm and 120 Ohm interfaces are present in the same connectors (different pins)  
  50 pin SCSI female (Tab.14 for 75 Ohm and Tab.15 for 120 Ohm)  
- Connector for 50 Ohm interconnection to ODU  
  1 connector 1+0, 2 connectors in 1+1  
  SMA  
- -48 Vdc power supply  
  1 connector in 1+0, 2 connectors in 1+1  
  SUB-D 3W3 (pinout on the panel)
14 ALCPLUS2E CONNECTORS

14.1 IDU FRONT PANEL

The front panel of the ALCplus2e IDU is made up by various connectors depending on IDU version: in the following type of connectors and relevant pin-out are listed. On the body of each IDU there is the ground connection: 6.3mm male (Faston).

14.2 ALCplus2e 1+0 (GAI0178), 2+0/1+1 (GAI0175), 2+0/XPIC (GAI0172)

In Fig.8 and Fig.9 are shown the 1+0 and 1+1 version. The following connectors are available:

- MNGT1, 2 management
  Port MNGT 1, 2 set MDI or MDIX status automatically RJ45 (Tab.18)
- LAN port 1, 2, 3, 4 electrical 10/100/1000BaseT
  Electrical port 1, 2, 3, 4 can be configured MDI or MDIX via WEBLCT RJ45 (Tab.13)
- LAN port 3, 4 100/1000BaseX
- Trib A, B RJ45 (Tab.21)
- LCT, management USB type B (receptable)
- USER IN/OUT SUB-D male 9 pin (Tab.22)
- Connector for 50 Ohm interconnection to ODU
  1 connector 1+0, 2 connectors in 1+1/2+0 SUB-D SMA
- -48 Vdc power supply
  1 connector in 1+0, 2 connectors in 1+12 SUB-D 3W3 (pinout on the panel)

<table>
<thead>
<tr>
<th>PIN RJ45</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rx-F (OUT) 120 Ohm</td>
</tr>
<tr>
<td>2</td>
<td>Rx-C (OUT) 120/75 Ohm common</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
</tr>
<tr>
<td>4</td>
<td>Tx-F (IN) 120 Ohm</td>
</tr>
<tr>
<td>5</td>
<td>Tx-C (IN) 120/75 Ohm common</td>
</tr>
<tr>
<td>6</td>
<td>Tx-F (IN) 75 Ohm</td>
</tr>
<tr>
<td>7</td>
<td>GND</td>
</tr>
<tr>
<td>8</td>
<td>Rx-F (OUT) 75 Ohm</td>
</tr>
</tbody>
</table>

Tab.23 - Trib A, B connector

2 In 1+1 the two power supply connectors are in parallel
### Tab.24 - SUB-D 9 pin male USER IN/OUT

<table>
<thead>
<tr>
<th>PIN RJ45</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C relay contact</td>
</tr>
<tr>
<td>2</td>
<td>NO relay contact</td>
</tr>
<tr>
<td>3</td>
<td>User Input 01</td>
</tr>
<tr>
<td>4</td>
<td>User Input 02</td>
</tr>
<tr>
<td>5</td>
<td>Ground</td>
</tr>
<tr>
<td>6</td>
<td>Do not use</td>
</tr>
<tr>
<td>7</td>
<td>NC relay contact</td>
</tr>
<tr>
<td>8</td>
<td>Not connected</td>
</tr>
<tr>
<td>9</td>
<td>Do not use</td>
</tr>
</tbody>
</table>

#### 14.3 ALCplus2e 18E1 2xSTM1 NODAL (GAI0176), 2+0/1+1 (GAI0173), 2+0/XPIC (GAI0170)

In Fig.14 and Fig.15 are shown the 1+0 and 1+1 version. The following connectors are present:

- **MNGT1, 2 management**
  Port MNGT 1, 2 set MDI or MDIX status automatically RJ45 (Tab.18)

- **LAN port 1, 2, 3, 4 electrical 10/100/1000BaseT**
  Electrical port 1, 2, 3, 4 can be configured MDI or MDIX via WEBLCT RJ45 (Tab.13)

- **STM-1 1, 2 in/out**
  SFP can be I.1, S1.1, L1.1, L1.2, electrical coaxial 1.0/2.3 SFP

- **LAN port 3, 4 100/1000BaseX**
  SFP-LC (Tab.21)

- **Trib A, B**
  RJ45 (Tab.21)

- **N-BUS 1, 2 connection among IDUs only through SIAE cable**
  F03471

- **LCT, management**
  USB type B (receptable)

- **USER IN/OUT**
  SUB-D male 9 pin (Tab.22)

- **Trib 1/8, 9/16**
  E1, 75 Ohm and 120 Ohm interfaces are present in the same connectors (different pins) and Tab.15 for 120 Ohm)
  50 pin SCSI female (Tab.14 for 75 Ohm)

- **Connector for 50 Ohm interconnection to ODU**
  1 connector 1+0, 2 connectors in 1+1 SMA

- **-48 Vdc power supply**
  1 connector in 1+0, 2 connectors in 1+1 SMA
  SUB-D 3W3 (pinout on the panel)
14.4  ALCplus2e 34E1 2xSTM1 1+0 (GAI0177), 2+0/1+1 (GAI0174), 2+0/XPIC (GAI0171)

In Fig. 12 and Fig. 13 are shown the 1+0 and 1+1 version. The following connectors are present:

- **MNGT1, 2 management**
  Port MNGT 1, 2 set MDI or MDIX status automatically RJ45 (Tab.18)

- **LAN port 1, 2, 3, 4 electrical 10/100/1000BaseT**
  Electrical port 1, 2, 3, 4 can be configured MDI or MDIX via WEBLCT RJ45 (Tab.13)

- **STM-1 1, 2 in/out**
  SFP can be I.1, S1.1, L1.1, L1.2, electrical coaxial 1.0/2.3 SFP

- **LAN port 3, 4 100/1000BaseX**
  SFP-LC

- **Trib A, B**
  RJ45 (Tab.21)

- **N-BUS 1, 2 connection among IDUs only through SIAE cable**
  F03471

- **LCT, management**
  USB type B (receptable)

- **USER IN/OUT**
  SUB-D male 9 pin (Tab.22)

- **Trib 1/8, 25/32**
  E1, 75 Ohm and 120 Ohm interfaces are present in the same connectors (different pins) 50 pin SCSI female (Tab.14 for 75 Ohm and Tab.15 for 120 Ohm)

- **Connector for 50 Ohm interconnection to ODU**
  1 connector 1+0, 2 connectors in 1+1 SMA

- **-48 Vdc power supply**
  1 connector in 1+0, 2 connectors in 1+1 1 SUB-D 3W3 (pinout on the panel)
15 INSTALLATION NOTE ON FREQUENCY REUSE SYSTEMS (XPIC)

15.1 FREQUENCY REUSE

The ALS with frequency reuse is double carrier systems with one carrier on vertical path and one carrier on horizontal path. One carrier can have a radio frame up to 341 Mbit/s for a total of 682 Mbit/s. For frequency reuse systems to assume the achievement of guaranteed performances of XPIC functionalities some cares shall be taken for IDU-ODU cabling. ALS XPIC systems use IDU ALCplus2e; ODU can be AS version or ASN version in accordance with necessity.

15.2 CHARACTERISTICS

15.2.1 Antennas

Antennas will be double polarization type.

15.2.2 RF channel

RF channel shall be the same for vertical polarization path and horizontal polarization path.

15.2.3 ATPC

Low ATPC level shall be 15 dB higher than BER $10^{-6}$ threshold.

15.2.4 IDU-ODU cable

The IDU-ODU cable length difference shall be:

- cable from RT1A to IDU-ODU SMA connector 1 and cable from RT1B to IDU-ODU SMA connector 2 shall have the same length with the following tolerance:
  - 6 m for 14 MHz bandwidth systems
  - 3 m for 28 MHz bandwidth systems
  - 1.5 m for 56 MHz bandwidth systems
16 INSTALLATION ONTO THE POLE OF THE ODU WITH SEPARATED ANTENNA

16.1 INSTALLATION KIT

Following installation kits are supplied with the equipment depending on different versions:

- 1+0 version
  - antisliding strip (see Fig.52)
  - supporting plate plus 60–114 mm pole fixing bracket and relevant nuts and bolts (see Fig.53)
  - adapting tools and relevant bolts and nuts for 219 mm pole (see Fig.54)
  - Band-it fixing system (see Fig.57)
  - antenna side flange, variable as function of RF frequency (see Fig.55)
  - support with ODU fast locking mechanism (see Fig.53)
  - connection to the antenna with flexible wave guide and possible use of a rigid elbow (optional) (see Fig.55)
  - kit for ground connection making part of ODU

- 1+0 version (6 GHz only)
  Besides the previous items a specific flange adaptor (kit V32409) must be used (see Fig.63). The flange is UDR70.

- 1+1 version
  - antisliding strip (see Fig.52)
  - supporting plate plus pole fixing bracket and relevant nuts and bolts (see Fig.53)
  - adapting tools and relevant bolts and nuts for 219 mm pole (see Fig.54)
  - hybrid with ODU fast locking mechanism (see Fig.56)
  - flexible waveguide trunk for connection to antenna (optional) (see Fig.55)
  - kit for ground connection making part of the two ODUs.

- 1+1 version (6 GHz only)
  Besides the previous items a specific flange adaptor (kit V32415) must be used (see Fig.64). The flange is UDR70.

**Warning:** in order to avoid damages to flexible waveguides, don’t fold or twist them more than values specified as limit in installation instructions of the waveguide supplier.

In case of flexible wave guide use, Tab.27 shows the maximum bending radius.
16.2 REQUIRED TOOLS FOR MOUNTING (NOT SUPPLIED)

- N.2 13mm torque wrench
- N.1 15 mm torque wrench
- N.1 17 mm torque wrench
- N.1 3 mm Allen wrench

Warning: if screwing operation concerns more than one screw or bolt, tighten subsequently everyone and its opposite, step by step.

16.3 INSTALLATION PROCEDURE

Installation procedure proceeds according to the following steps:

- Version 1+0: installation onto the pole of the supporting plate
- Version 1+0: installation onto the pole of the support plate by Band-it
- Version 1+1: installation onto the pole of the supporting plate
- Installation of the ODU (common to both 1+0 and 1+1 version)
- ODU grounding

1+0 version – Installation onto the pole of the supporting plate

Fig.52 – Mount antislide strip around the pole. The position of the plastic blocks depends on the position of the supporting plate (see next step)

Fig.53 – Adhere the supporting plate to the antisiliding strip plastic blocks and then secure it to the pole through the fixing bracket for 60–114 mm pole (see Fig.53). Bolts and nuts are available on the supporting plate. Tightening torque must be 32 Nm.

Warning: As shown in Fig.54 an adapting kit must be used for the 219 mm pole. It consists of an additional plate to enlarge the standard supporting plate dimension and relevant U-bolt for 219 mm pole fixing.

Fig.55 – Fix the flexible waveguide to the antenna side flange. Four fixing screws are available the dimensions of which depend on the waveguide type. Tighten progressively and alternatively the four screws with the following torque:

<table>
<thead>
<tr>
<th>Frequencies</th>
<th>Screw</th>
<th>Tool</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>from 18 to 38 GHz</td>
<td>Allen screw M3</td>
<td>Allen key 2.5 mm</td>
<td>1 Nm</td>
</tr>
<tr>
<td>up to 15 GHz</td>
<td>Allen screw M4</td>
<td>Allen key 3 mm</td>
<td>2 Nm</td>
</tr>
</tbody>
</table>

Fig.55 – Fix the antenna side flange to the support with ODU fast locking mechanism. The flange can be mounted horizontally (as shown in Fig.55) or vertically as function of convenience.

Fig.56 – Fix the support with ODU fast locking mechanism to the supporting plate making use of available bolts and nuts. Fig.56 shows the possible positions. Tightening torque must be 18 Nm.

3 In case of 219 mm pole, an adapting kit is supplied for the purpose.
1+0 version – Installation onto the pole of the supporting plate by Band-it

In case of 1+0 ODU installation, a Band-it pole mounting kit can be used: through slots (see Fig.57) on the supporting plate two metallic bands secure the plate on the pole. Band characteristics are:

- thickness 0.76 mm
- width 19 mm.

It is also possible to use the anti-sliding system (optional).

1+1 version – Installation onto the pole of the supporting plate

Fig.52 – Mount antislide strip around the pole. The position of the plastic blocks depends on the position of the supporting plate (see next step)

Fig.53 – Position the supporting plate to the antisliding strip plastic blocks and then secure it to the pole through the fixing bracket for 60–114 mm pole (see Fig.53). Bolts and nuts are available on the supporting plate kit. Tightening torque must be 32 Nm.

Fig.58 – Secure the hybrid with ODU fast locking mechanism to the supporting plate using bolt and nuts available on the support plate. Tightening torque must be 18 Nm.

Warning: Do not remove the foil from the hybrid flange sides.

Tab.26 - Torques for tightening screws

<table>
<thead>
<tr>
<th>Frequencies</th>
<th>Screw</th>
<th>Tool</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>from 18 to 38 GHz</td>
<td>Allen screw M3</td>
<td>Allen key 2.5 mm</td>
<td>1 Nm</td>
</tr>
<tr>
<td>up to 15 GHz</td>
<td>Allen screw M4</td>
<td>Allen key 3 mm</td>
<td>2 Nm</td>
</tr>
</tbody>
</table>

Warning: It is advisable to shape the waveguide flexible trunk, connecting ODU flange with antenna flange as shown in Fig.61. This avoids possible condensate to be channelled towards the ODU flange.

Installation of the ODU

1. Remove the plastic cover from the ODU flange side. Apply silicon grease e.g. type RHODOSIL PATE 4 to the O–ring of Fig.60.

   Warning: Do not remove the foil from the flange.

2. Bring the ODU with the two hands and position the ODU handle at the bottom side.

3. Position the ODU body close to the support with ODU fast locking mechanism and align ODU side flange (see Fig.60) to antenna side flange (see Fig.55 – 1+0 version) or hybrid side flange (see Fig.58 – 1+1 version).

   Note: For 1+0 version the ODU can assume positions of Fig.59 depending on the polarisation.

4. With respect to the flange alignment, turn the ODU body approx. 30° anti–clockwise and then insert the ODU body into the support and search for alignment between reference tooth on the support (see Fig.55 – 1+0 version or Fig.58 – 1+1 version) and ODU body reference tooth (see detail Fig.60).

5. When alignment is achieved, turn the ODU body clockwise until “clack” is heard and the ODU rotation stops.

6. Secure ODU body on the support by tightening bolts (1) (see Fig.55 – 1+0 version or Fig.58 – 1+1 version). Tightening torque must be 6 Nm.

Final assembly of 1+1 version is shown in Fig.61. A parasol mounting is optionally possible.
16.4 GROUNDING

The ODU must be connected to ground making reference to details of Fig.62.

Tab. 27 - Waveguide bending radius according to frequency

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Bending radius without rebending mm (inch) E-plane (^a)</th>
<th>Bending radius without rebending mm (inch) H-plane (^b)</th>
<th>Bending radius with rebending mm (inch) E-plane (^h)</th>
<th>Bending radius with rebending mm (inch) H-plane (^h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 GHz or 7 GHz low</td>
<td>200 (7,9)</td>
<td>500 (19,8)</td>
<td>300 (11,9)</td>
<td>600 (23,7)</td>
</tr>
<tr>
<td>7 GHz high</td>
<td>200 (7,9)</td>
<td>500 (19,8)</td>
<td>250 (9,9)</td>
<td>600 (23,7)</td>
</tr>
<tr>
<td>11 GHz</td>
<td>130 (5,1)</td>
<td>280 (11,0)</td>
<td>150 (5,9)</td>
<td>300 (11,9)</td>
</tr>
<tr>
<td>13 GHz</td>
<td>130 (5,1)</td>
<td>280 (11,0)</td>
<td>150 (5,9)</td>
<td>300 (11,9)</td>
</tr>
<tr>
<td>15 GHz</td>
<td>130 (5,1)</td>
<td>280 (11,0)</td>
<td>150 (5,9)</td>
<td>300 (11,9)</td>
</tr>
<tr>
<td>18 GHz</td>
<td>130 (5,1)</td>
<td>280 (11,0)</td>
<td>150 (5,9)</td>
<td>300 (11,9)</td>
</tr>
<tr>
<td>23 GHz</td>
<td>110 (4,3)</td>
<td>230 (9,1)</td>
<td>130 (5,1)</td>
<td>250 (9,9)</td>
</tr>
<tr>
<td>38 GHz</td>
<td>80 (3,1)</td>
<td>140 (5,5)</td>
<td>90 (3,6)</td>
<td>150 (5,9)</td>
</tr>
</tbody>
</table>

a. Bending E-plane

\[ \text{R}_{\text{min/E}} \]

Bending E-plane
(short side of the section)

b. Bending H-plane

\[ \text{R}_{\text{min/H}} \]

Bending H-plane
(long side of the section)
Fig. 52 - Antisliding strip

Antisliding strip

Plastic blocks
Fig. 53 - 60–114 mm pole supporting plate fixing

Use 15 mm wrench (32Nm torque)

Use 17 mm wrench (32Nm torque)
Fig. 54 - Adapting kit for 219 mm pole
1 13 mm wrench
6 Nm torque

Fig.55 - Mounting position
Fig. 56 - Possible positions of the support with ODU fast locking mechanism
Fig. 57 - Band-it pole mounting kit
Fig. 58 - Installation onto the pole of the supporting plate

Hybrid with ODU fast locking mechanism

Reference tooth

Reference tooth

Use 13 mm wrench (18 Nm torque)

Optional vawe guide

RT1 RT2
Fig. 59 - Position of the ODU body depending on the polarisation for 1+0. For 1+1 the polarisation is always vertical: handle at the left side.
Fig. 60 - ODU body reference tooth

Reference tooth

ODU side flange

ASN version

AS version

O-ring

"N"

"BNC"

Ground bolt
Fig. 61 - Final ODU assembly of 1+1 version
Fig. 62 - ODU grounding
Fig. 63 - Kit V32409

- Spring
- Washer
- Screw M5x25
- UDR70 antenna flange
- Screw M4x8
Fig. 64 - Kit V32415

UDR70 flange

Screw M4x18

Spring

Washer

O-Ring

Hybrid 6 GHz (balanced or unbalanced)
17 INSTALLATION ONTO THE WALL OF THE ODU WITH SEPARATED ANTENNA

17.1 INSTALLATION KIT

Following installation kits are supplied with the equipment depending on different versions:

- **1+0 version**
  - wall supporting plate with additional contact surface extension plates (see Fig.65)
  - antenna side flange, variable as function of RF frequency (see Fig.66)
  - support with ODU fast locking mechanism (see Fig.66)
  - connection to the antenna with flexible wave guide and possible use of a rigid elbow (optional) (see Fig.66)
  - kit for ground connection making part of ODU

- **1+0 version (6 GHz only)**
  Besides the previous items a specific flange adaptor (kit V32409) must be used (see Fig.73). The flange is UDR70.

- **1+1 version**
  - supporting plate with additional contact surface extension tools (see Fig.65)
  - hybrid with ODU fast locking mechanism (see Fig.68)
  - connection to the antenna with flexible wave guide and possible use of a rigid elbow (optional) (see Fig.66)
  - kit for ground connection making part of the two ODUs.

- **1+1 version (6 GHz only)**
  Besides the previous items a specific flange adaptor (kit V32415) must be used (see Fig.74). The flange is UDR70.

In case of flexible wave guide use, Tab.30 shows the maximum bending radius.

17.2 REQUIRED TOOLS FOR MOUNTING (NOT SUPPLIED)

- N.2 13mm torque wrench
- N.1 15 mm torque wrench
- N.1 17 mm torque wrench
- N.1 3 mm allen wrench.

**Warning:** if screwing operation concerns more than one screw or bolt, tighten subsequently everyone and its opposite, step by step.
17.3 INSTALLATION PROCEDURE

Installation procedure proceeds according to the following steps:

- version 1+0: installation onto the wall of the supporting plate
- version 1+1: installation onto the wall of the supporting plate
- installation of the ODU (common to both 1+0 and 1+1 version)
- ODU grounding.

1+0 version – Installation onto the wall of the supporting plate

Fig.65 – Fix on the supporting plate the two supplied extension plates to increase the wall contact surface.

Fig.65 – Secure the supporting plate on the wall using the more suitable screws.

Fig.66 – Fix the flexible waveguide to the antenna side flange. Four fixing screws are available the dimensions of which depend on the waveguide type. Tighten progressively and alternatively the four screws with the following torque:

<table>
<thead>
<tr>
<th>Frequencies</th>
<th>Screw</th>
<th>Tool</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>from 18 to 38 GHz</td>
<td>Allen screw M3</td>
<td>Allen key 2.5 mm</td>
<td>1 Nm</td>
</tr>
<tr>
<td>up to 15 GHz</td>
<td>Allen screw M4</td>
<td>Allen key 3 mm</td>
<td>2 Nm</td>
</tr>
</tbody>
</table>

Fig.66 – Fix the antenna side flange to the support with ODU fast locking mechanism. The flange can be mounted horizontally (as shown in Fig.66) or vertically as function of convenience.

Fig.67 – Fix the support with ODU fast locking mechanism to the supporting plate making use of available bolts and nuts. Fig.67 shows three possible positions. Tightening torque must be 18 Nm.

1+1 version – Installation onto the wall of the supporting plate

Fig.65 – Fix on the supporting plate the two supplied extension plates to increase the wall contact surface.

Fig.65 – Secure the supporting plate on the wall using the more suitable screws.

Fig.68 – Secure the hybrid with ODU fast locking mechanism to the supporting plate using bolt and nuts available on the support plate. Tightening torque must be 18 Nm. Remove the plastic cover from the hybrid flange sides.

Warning: Do not remove the foil from the hybrid flange sides.

Fig.68 – Fix the flexible waveguide to the antenna side flange. Four fixing screws are available the dimensions of which depend on the waveguide type. Tighten progressively and alternatively the four screws with the following torque:

<table>
<thead>
<tr>
<th>Frequencies</th>
<th>Screw</th>
<th>Tool</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>from 18 to 38 GHz</td>
<td>Allen screw M3</td>
<td>Allen key 2.5 mm</td>
<td>1 Nm</td>
</tr>
<tr>
<td>up to 15 GHz</td>
<td>Allen screw M4</td>
<td>Allen key 3 mm</td>
<td>2 Nm</td>
</tr>
</tbody>
</table>

Warning: It is advisable to shape the waveguide flexible trunk, connecting ODU flange with antenna flange as shown in Fig.71. This avoids possible condensate to be channelled towards the ODU flange.
**Installation of the ODU**

1. Remove the plastic cover from the ODU flange side. Apply silicon grease e.g. type RHODOSIL PATE 4 to the O–ring of Fig.70.
   Warning: Do not remove the foil from the flange.

2. Bring the ODU with the two hands and position the ODU handle at the bottom side.

3. Position the ODU body close to the support with ODU fast locking mechanism and align ODU side flange (see Fig.70) to antenna side flange (see Fig.66 – 1+0 version) or hybrid side flange (see Fig.68 – 1+1 version).

   **Note:** For 1+0 version the ODU can assume positions of Fig.69 depending on the polarisation.

4. With respect to the flange alignment, turn the ODU body approx. 30° anti-clockwise and then insert the ODU body into the support and search for alignment between reference tooth on the support (see Fig.66 – 1+0 version or Fig.68 – 1+1 version) and ODU body reference tooth (see detail Fig.70)

5. When alignment is achieved, turn the ODU body clockwise until "clack" is heard and the ODU rotation stops.

6. Secure ODU body on the support by tightening bolts (1) (see Fig.66 – 1+0 version or Fig.68 – 1+1 version). Tightening torque must be 6 Nm.

Final assembly of 1+1 version is shown in Fig.71. A parasol mounting is optionally possible.
17.4 GROUNDING

The ODU must be connected to ground making reference to details of Fig.72.

Tab.30 - Waveguide bending radius according to frequency

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Bending radius without rebending mm (inch) E-plane</th>
<th>Bending radius without rebending mm (inch) H-plane</th>
<th>Bending radius with rebending mm (inch) E-plane</th>
<th>Bending radius with rebending mm (inch) H-plane</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 GHz or 7 GHz low</td>
<td>200 (7,9)</td>
<td>500 (19,8)</td>
<td>300 (11,9)</td>
<td>600 (23,7)</td>
</tr>
<tr>
<td>7 GHz high</td>
<td>200 (7,9)</td>
<td>500 (19,8)</td>
<td>250 (9,9)</td>
<td>600 (23,7)</td>
</tr>
<tr>
<td>11 GHz</td>
<td>130 (5,1)</td>
<td>280 (11,0)</td>
<td>150 (5,9)</td>
<td>300 (11,9)</td>
</tr>
<tr>
<td>13 GHz</td>
<td>130 (5,1)</td>
<td>280 (11,0)</td>
<td>150 (5,9)</td>
<td>300 (11,9)</td>
</tr>
<tr>
<td>15 GHz</td>
<td>130 (5,1)</td>
<td>280 (11,0)</td>
<td>150 (5,9)</td>
<td>300 (11,9)</td>
</tr>
<tr>
<td>18 GHz</td>
<td>130 (5,1)</td>
<td>280 (11,0)</td>
<td>150 (5,9)</td>
<td>300 (11,9)</td>
</tr>
<tr>
<td>23 GHz</td>
<td>110 (4,3)</td>
<td>230 (9,1)</td>
<td>130 (5,1)</td>
<td>250 (9,9)</td>
</tr>
<tr>
<td>38 GHz</td>
<td>80 (3,1)</td>
<td>140 (5,5)</td>
<td>90 (3,6)</td>
<td>150 (5,9)</td>
</tr>
</tbody>
</table>

a. Bending E-plane

Rmin/E
Bending E-plane
(short side of the section)

b. Bending H-plane

Rmin/H
Bending H-plane
(long side of the section)
Fig. 65 - Wall supporting plate

- Extension plate
- Supporting plate
- M8 bolt and nut
- Another possible fixation
Fig. 66 - Support with ODU fast locking mechanism

- In option
- Antenna side flange
- Support with ODU fast locking mechanism
- Reference tooth
- Position of antenna side flange

13 mm wrench
6 Nm torque
Fig.67 - Mounting possible positions
Fig. 68 - Installation onto the wall of the supporting plate

Use 13 mm wrench (18 Nm torque)

Hybrid with ODU fast locking mechanism

Reference tooth

Optional wave guide

RT1 RT2

Reference tooth
Fig. 69 - Position of the ODU body depending on the polarisation for 1+0. For 1+1 the polarisation is always vertical: handle at the left side.
Fig. 70 - ODU body reference tooth

Reference tooth
O-ring
ODU side flange
Ground bolt

ASN version

"N"
"BNC"

AS version

ALS ALplus2, ALCplus2, ALCplus2e - MN.00224.E - 005
Fig. 71 - Final ODU assembly of 1+1 version
1 Bolt
2 Spring washer
3 Flat washer
4 Earth cable collar
5 Flat washer

**Fig.72 - ODU grounding**
Fig. 73 - Kit V32409

- Spring
- Washer
- Screw M5x25
- UDR70 antenna flange
- Screw M4x8
Fig. 74 - Kit V32415

UDR70 flange

Screw M4x18

Spring

Washer

O-Ring

Hybrid 6 GHz (balanced or unbalanced)
18 INSTALLATION ONTO THE POLE OF THE ODU WITH INTEGRATED ANTENNA

18.1 FOREWORD

The installation onto the pole of the ODU with integrated antenna concerns both 1+0 and 1+1 versions.

18.2 INSTALLATION KIT

Following installation kits are supplied with the equipment depending on different versions:

1+0 version

- 60 to 114 mm pole mounting kit consisting of:
  - centring ring and relevant screws (see Fig.75)
  - antislide strip (see Fig.76)
  - pole support system and pole fixing brackets (see Fig.77)
  - ODU with O–ring and devices for ground connection

1+1 version

- pole mounting kit from 60 to 114 mm for 1+1 consisting of:
  - centring ring and relevant screws (see Fig.75)
  - antislide strip (see Fig.76)
  - pole support system and pole fixing brackets (see Fig.77)
- hybrid mechanical body (see Fig.86)
- polarization twist disk (see Fig.88)
- 2 ODUs with O–rings and devices for ground connection.
18.3 REQUIRED TOOLS FOR MOUNTING (NOT SUPPLIED)

- N.2 13 mm torque wrench
- N.1 15 mm torque wrench
- N.1 17 mm torque wrench
- N.1 3 mm allen wrench.

**Warning:** if screwing operation concerns more than one screw or bolt, tighten subsequently everyone and its opposite, step by step.

18.4 INSTALLATION PROCEDURE

Installation procedure proceeds according with the following steps:

**1+0 version**

1. installation onto the pole of the support system
2. installation of the antenna
3. installation of ODU
4. antenna aiming
5. ODU grounding

**1+1 version**

1. installation onto the pole of the support system
2. installation of the antenna
3. installation of hybrid circuit
4. installation of the two ODUs
5. antenna aiming
6. ODU grounding.

18.4.1 Installation onto the pole of the support system and the antenna

**Fig.75** – Set the antenna in such a position as to be able to operate on its rear side. Locate the five threaded holes around antenna flange. Mount centring ring onto antenna flange and tight it with 3 calibrated bolts. Caution: centring ring should be mounted so that the screws do not stick out.

Define if the antenna will be mounted with vertical or horizontal polarization. Check that free drain holes stay at bottom side. Mount bolt type M10x30, in position A leaving it loose of 2 cm approx. With horizontal polarization mount bolt type M10x30 in position D, leaving it loose of 2 cm approx.

**Fig.76** – Mount antislide strip onto the pole. Place blocks as in **Fig.76** following antenna aiming direction. Tighten the strip with screwdriver.

**Fig.77** – Mount pole supporting system with relevant pole fixing brackets following antenna aiming direction as indicated by arrow. Antislide strip should result at the centre of supporting plate. Supporting system should lean against antislide clamp with the tooth as in **Fig.78**. Position the antenna in such a way that bolt...
in position A or D of Fig.75 cross through hole E of Fig.79. Secure the support system to the pole by means of the pole fixing brackets and relevant fixing bolts.

Fig.80 - Rotate the antenna body until the remainder three antenna holes coincide with the three support holes. Secure the antenna to the support by tightening the relevant passing through bolts.

18.4.2 Installation of ODU

1+0 version

1 Apply silicon grease e.g. RHODOSIL PATE 4" to the O–ring (4) of Fig.83 by protecting finger hands with gloves.
2 Bring the ODU with the two hands and position the ODU handle at the bottom side. The ODU handle can assume position of Fig.81 depending on the polarization.
3 Position the ODU body near the support system and align ODU side flange to antenna side flange (see Fig.82). With respect to the flange alignment, turn the ODU body approx. 30° anti–clockwise and then insert the ODU body into the support and search for alignment between reference tooth on the support (see Fig.82) and ODU body reference tooth (see detail of Fig.83).
4 When alignment is achieved, turn the ODU body clockwise until "clack" is heard and the ODU rotation stops.
Fig.84 and Fig.85 show ODU housing final position for vertical and horizontal polarization respectively.
5 Secure ODU body on the support system by tightening bolts (1) of Fig.82.

1+1 version

Fig.86 - Apply silicon grease, type "RHODOSIL PATE 4" to O–rings (1). Insert O–rings (1) and (6) into twist polarization disk (2).

Vertical polarization
Fix the disk on hybrid flange placing marker (4), on disk, close to V mark.

Horizontal polarization
Fix the disk on hybrid flange placing reference (4), on disk, close to H mark.

In 13 GHz and 15 GHz ODUs the polarization disk is fixed to the hybrid flange by means of 3 screws as shown in Fig.87.

Caution: Twist disk has two planes. Take care of position marker (4) on twist disk. The position of marker (4) plane should be in contact to hybrid like in figure. Tighten progressively and alternatively screws (7) with the same number of spring washers (8) with the following torque:

<table>
<thead>
<tr>
<th>Frequencies</th>
<th>Screw</th>
<th>Tool</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>from 18 to 38 GHz</td>
<td>Allen screw M3</td>
<td>Allen key 2.5 mm</td>
<td>1 Nm</td>
</tr>
<tr>
<td>up to 15 GHz</td>
<td>Allen screw M4</td>
<td>Allen key 3 mm</td>
<td>2 Nm</td>
</tr>
</tbody>
</table>

Fig.88 - Fix hybrid to support system with four bolts (1) taking care of RT1/RT2 position shown by labels of Fig.88. Tighten progressively and alternatively four bolts (1).
18.4.3 ODU installation

The installation procedure of the two ODUs is the same.

1. Apply silicon grease e.g. RHODOSIL PATE 4" to the O-ring (4) of the Fig. 83 by protecting fingers with gloves.

2. Bring the ODU with the two hands and position the ODU handle at the bottom side. For 1+0 the ODU can assume position of Fig. 81 depending on the polarisation. For 1+1 the handle ODU position is always placed at the right side (horizontal polarization).

3. Position the ODU body near the support system and align ODU side flange to antenna side flange (see Fig. 82). With respect to the flange alignment, turn the ODU body approx. 30° anti-clockwise and then insert the ODU body into the support and search for alignment between reference tooth on the support (see Fig. 82) and ODU body reference tooth (see detail of Fig. 83).

4. When alignment is achieved, turn the ODU body clockwise until "clack" is heard and the ODU rotation stops. Fig. 84 and Fig. 85 show ODU housing final position for vertical and horizontal polarization respectively for 1+0 version. Fig. 89 shows ODU housing final position for 1+1 version.

5. Secure ODU body on the support system by tightening bolts (1) of Fig. 82.

18.5 Antenna Aiming

Antenna aiming for 1+0 version and 1+1 version is the same. The antenna aiming devices allow to perform the following adjustments with respect to the starting aiming position:

- Horizontal ± 15° operating on the nut (3) shown in Fig. 90, only after having loosen the nuts (7), (8), (9), (10) of Fig. 91.
- Vertical ± 15° operating on vertical adjustment worm screw (2) shown in Fig. 90 only after having loosen nuts (1), (2), (11) of Fig. 91 and (4) and (5) of Fig. 90.

For adjustment from 0° to +30° extract nut (1) Fig. 91 and position it in hole (4), extract nut (2) Fig. 91 and position it in hole (6). Operate on vertical adjustment worm screw (2) after having loosen nuts (1), (2), (11) of Fig. 91 and (4) of Fig. 90.

For adjustment from 0° to -30° extract nut (1) of Fig. 91 and position it in hole (3), extract nut (2) of Fig. 91 and position it in hole (5). Operate on vertical adjustment worm screw (2) after having loosen nuts (1), (2), (11) of Fig. 91 and (4) of Fig. 90.

For vertical adjustment some markers, every 10°, are available on support. The bigger marker gives 0° starting aiming position. Once the optimum aiming position is obtained, tighten firmly the four nuts (1), (2), (11) of Fig. 91 and (4) and (5) of Fig. 90 for vertical adjustment and the four nuts (7), (8), (9), (10) of Fig. 91 for horizontal adjustment. Tighten with 15 mm wrench and 32 Nm torque.

18.6 Compatibility

The pole installation kit of the ODU unit in 1+0 and 1+1 configuration is compatible with integrated antenna complying with SIAE standard with measures 0.2 m, 0.4 m, 0.6 m, 0.8 m of diameter.
18.7 GROUNDING

See Fig.92.

On ODU grounding can be connected with the available bolt spring washer and flat washers as shown.

![Diagram of grounding connection with labels and descriptions.]

Fig.75 - Centring ring position

- Antenna
- Calibrated Allen screw
- Centring ring

3 mm allen key 2.5 Nm torque

Vertical polarization

Horizontal polarization
1 Steel belt
2 Plastic blocks

Fig. 76 - Antislide strip
1 Pole fixing brackets
2 Tooth
3 Bolt
4 Pole support system

Fig.77 - Support mount on pole
Fig. 78 - Supporting system position

Fig. 79 - Hole E
A, B, C, D Bolt slots

**Fig.80 - Antenna installation on pole support**

![Antenna installation on pole support diagram]

**Fig.81 - Position of the ODU handle depending on the polarisation for 1+0. For 1+1 the polarisation is always horizontal. Handle at the right side.**

![Position of the ODU handle diagram]
H: Reference tooth

**Fig. 82** - Support system for ODU housing and reference tooth in evidence
Fig. 83 - ODU body reference tooth

- Reference tooth
- O-ring
- ODU side flange
- "N"
- "BNC"
- Ground bolt

ASN version

AS version

Fig. 83 - ODU body reference tooth
Fig. 84 - ODU housing final position for vertical polarization

Fig. 85 - ODU housing final position for horizontal polarization
1 O–ring
2 Polarization twist disk
3 Hybrid mechanical body
4 Position marker of twist disk
5 Reference label for twist disk
6 O–ring
7 Allen screws
8 Spring washer

Fig. 86 - Hybrid and polarization disk
Fig. 87 - Polarization disk fixing (only for 13GHz and 15 GHz)
1 Bolts
2 Spring washer

13 mm wrench
18 Nm torque

Fig.88 - Hybrid mount on pole support
Fig. 89 - ODU housing final position for 1+1 version
1 Marker
2 Vertical adjustment
3 Horizontal adjustment
4 Bolt
5 Fixing nut

Fig.90 - Vertical and horizontal adjustments
1., 2., 3., 4. Horizontal aiming block bolts
5., 6., 7. Vertical aiming block bolts
8., 11. Threaded hole for vertical aiming up to –30°
9., 10. Threaded hole for vertical aiming up to +30°

**Fig.91 - Antenna aiming block**
1 Bolt
2 Spring washer
3 Flat washer
4 Earth cable collar
5 Flat washer

Fig.92 - ODU grounding
19 INSTALLATION ONTO THE POLE OF THE ODU WITH INTEGRATED ANTENNA (KIT V32307, V32308, V32309)

19.1 FOREWORD

The description concerns pole mounting of ODU, in 1+0 and 1+1 version, using following installation kits:
- V32307 for ODU with frequency from 10 to 13 GHz
- V32308 for ODU with frequency from 15 to 38 GHz
- V32309 for ODU with frequency from 7 to 8 GHz

Differences regard the dimensions and the presence of the centring ring (see Fig.93):
- V32307 centring ring for antenna flange from 10 to 13 GHz
- V32308 centring ring for antenna flange from 15 to 38 GHz
- V32309 no centring ring (and relevant screws).

19.2 INSTALLATION KIT

Following installation kits are supplied with the equipment depending on different versions.

1+0 version

- 60 to 129 mm pole mounting kit:
  - centring ring and relevant screws
  - pole support system plus antenna (already assembled) and pole fixing brackets
  - 1+0 ODU support and relevant screws
  - ODU with O–ring and devices for ground connection

1+1 version

- 60 to 129 mm pole mounting kit:
  - centring ring and relevant screws
  - pole support system plus antenna (already assembled) and pole fixing brackets
  - 1+0 ODU support
  - hybrid and relevant screws
  - polarization twist disk and relevant screws
  - 2 ODUs with O–rings and devices for ground connection.
19.3 REQUIRED TOOLS FOR MOUNTING (NOT SUPPLIED)

- N.1 2.5 mm Allen wrench
- N.1 3 mm Allen wrench
- N.1 6 mm Allen wrench
- N.1 13 mm spanner
- N.2 17 mm spanner.

**Warning:** if screwing operation concerns more than one screw or bolt, tighten subsequently everyone and its opposite, step by step.

19.4 INSTALLATION PROCEDURE

Installation procedure is listed below:

**1+0 version**

1. antenna polarization
2. installation of the centring ring on the antenna
3. installation of 1+0 ODU support
4. installation onto the pole of the assembled structure
5. installation of ODU
6. antenna aiming
7. ODU grounding

**1+1 version**

1. antenna polarization
2. installation of the centring ring on the antenna
3. installation of 1+0 ODU support
4. installation onto the pole of the assembled structure
5. installation of hybrid
6. installation of ODUs
7. antenna aiming
8. ODU grounding.
19.5 1+0 MOUNTING PROCEDURES

19.5.1 Setting antenna polarization

Fig.93 – Set the antenna in such a position to operate on its rear side. Locate the four M3 Allen screws around the antenna flange. Unscrew them (use 2.5 mm Allen wrench) and position the antenna flange according to: horizontal wave guide -> vertical polarization, vertical wave guide -> horizontal polarization. Screw again the four Allen screws (torque = 1 Nm).

19.5.2 Installation of the centring ring on the antenna

Fig.93 – Set the antenna in such a position to operate on its rear side. Locate the three holes around the antenna flange. Mount the centring ring onto antenna flange and tight it with the 3 Allen screws M4 (use 3mm Allen wrench, torque 2 = Nm).

19.5.3 Installation of 1+0 ODU support

Fig.93 – Mount the support onto assembled structure (pole support system plus antenna) using the four M8 Allen screws (use 6 mm Allen wrench, torque 18 = Nm). Two of the four screws, diagonally opposed, must be mounted with the two bushes around.

19.5.4 Installation onto the pole of the assembled structure

Fig.93 – Mount the assembled structure on the pole using the two pole fixing brackets and the four M10 screws (use 17 mm spanner, torque = 13 Nm); the heads of the screws are inserted on the antenna side, the four nuts and the springs between nut and brackets are inserted on bracket side.

19.5.5 Installation of ODU (on 1+0 support)

Fig.94 – Apply silicon grease (e.g. RHODOSIL PATE 4") on the O–ring by protecting fingers with gloves.

Fig.95 – Bring the ODU with the two hands and position the ODU handle at the bottom side. The handle can assume the positions shown in the figure depending on the polarization. Position the ODU body near the support and align the wave guide of the ODU to the Wave guide of the antenna: respect to the position of wave guide alignment, turn the ODU body approx. 30° counter–clockwise into the support and search for matching between reference tooth on the support (see Fig.95) and reference tooth on the ODU body.

Fig.97 – When alignment of the references teeth is achieved, turn the ODU body clockwise until rotation is stopped. In figure are shown ODU final position for both polarizations.

Fig.96 – When ODU positioning is over, secure ODU body on the support by tightening bolts (use 13mm spanner, torque = 6Nm).
19.5.6 **Antenna aiming**

Antenna aiming procedure for 1+0 version or 1+1 version is the same.

Horizontal aiming: ±5° operating on the 17 mm nut shown in Fig. 98 with a 17 mm spanner, only after having loosen the two 17 mm nut on the pivot.

Vertical aiming: ±20° operating on the 13 mm nut shown in Fig. 98 with a 13 mm spanner, only after having loosen the three 13 mm nut on the pole support.

Once optimum position is obtained, tighten firmly all the nuts previously loosen.

19.5.7 **ODU grounding**

ODU grounding is achieved with:

- M8 screw without washers
- M6 screw with washer

as shown in Fig. 99.

19.6 **1+1 MOUNTING PROCEDURES**

In further page are explained all the mounting step not already discussed in paragraph "19.5 1+0 MOUNTING PROCEDURES".

19.6.1 **Installation of Hybrid**

Fig. 100 – The polarization disk must be always fixed on hybrid flange. Apply silicon grease (e.g. RHODOSIL PATE 4") on the O–rings by protecting fingers with gloves. Bring the polarization twist disk with the position marker down. Insert the O–ring into polarization twist disk.

Vertical polarization: fix the twist disk on hybrid flange placing the marker of the disk towards V mark.

Horizontal polarization: fix the twist disk on hybrid flange placing the marker of the disk towards H mark.

In 13 GHz and 15 GHz ODUs the polarization disk is fixed to the hybrid flange by means of 3 screws as shown in Fig. 101.

Tighten progressively and alternatively the screws and the spring washer with following torque:

<table>
<thead>
<tr>
<th>Frequencies</th>
<th>Screw</th>
<th>Tool</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>from 18 to 38 GHz</td>
<td>Allen screw M3</td>
<td>Allen key 2.5 mm</td>
<td>1 Nm</td>
</tr>
<tr>
<td>up to 15 GHz</td>
<td>Allen screw M4</td>
<td>Allen key 3 mm</td>
<td>2 Nm</td>
</tr>
</tbody>
</table>

Fig. 102 – Fix hybrid body to 1+0 support with four M8 bolts (use 13 mm spanner, torque = 18 Nm), tighten progressively and alternatively the bolts.
19.6.2 Installation of ODUs (on hybrid for 1+1 version)

For both ODUs.

Fig.94 – Apply silicon grease e.g. RHODOSIL PATE 4" to the O–ring by protecting fingers with gloves.

Fig.95 – Bring the ODU with the two hands and position the ODU handle at the bottom side. The handle can assume the positions shown in the figure depending on the polarization. Position the ODU body near the support and align the wave guide of the ODU to the wave guide of the hybrid: respect to the position of wave guide alignment, turn the ODU body approx. 30° counter–clockwise and then insert the ODU body into the support. For 1+1 system the handle of the ODU is always positioned on the right. The polarization twist disk on the hybrid matches the antenna polarization.

Fig.103 – When alignment of the reference teeth is achieved, turn the ODU body clockwise until the rotation stops. In figure are shown ODUs final position.

Fig.96 – When ODU positioning is over, secure ODU body on the support by tightening bolts (use 17 mm spanner, torque = 6 Nm).

WARNING: Internal codes (e.g. installation items, antennas, PCB) are here reported only as example. The Manufacturer reserves the right to change them without any previous advice.
Fig. 94 - ODU body reference tooth

Fig. 95 - Position of the ODU handle depending on the polarisation for 1+0. For 1+1 the polarisation is always horizontal. Handle at the right side.
1 6 mm Allen screw
2 Bush (diagonally placed)
3 17 mm Tightening bolts (max torque = 6 Nm)
4 Reference point for horizontal polarization
5 Reference point for vertical polarization

Fig.96 - 1+0 support
Fig.97 - ODU housing final position for both polarization
Fig.98 - Antenna aiming

- **Horizontal aiming:**
  - Two 17mm block screws

- **Vertical aiming:**
  - 13mm block screws

- **Pole support**

- **17mm nut for horizontal adjustment of antenna**

- **Internal 5mm Allen screw for vertical adjustment of antenna**
1 Bolt
2 Spring washer
3 Flat washer
4 Earth cable collar
5 Flat washer

Fig.99 - ODU grounding
1 O-ring
2 Polarization twist disk
3 Hybrid mechanical body
4 Position marker of twist disk
5 Reference label for twist disk
6 O-ring
7 Allen screws
8 Spring washer

Fig. 100 - Hybrid and twist disk
Fig.101 - Polarization disk fixing (only for 13 GHz and 15 GHz)

Horizontal polarization

Vertical polarization
Fig. 102 - Hybrid installation
Fig. 103 - 1+1 ODUs installation

ASN version

AS version
20 INSTALLATION ONTO THE POLE OF THE ODU WITH RFS INTEGRATED ANTENNA

20.1 FOREWORD

The installation onto the pole of the ODU with integrated antenna concerns both 1+0 and 1+1 version.

20.2 INSTALLATION KIT

Following installation kits are supplied with the equipment depending on different versions.

1+0 version

- 60 to 129 mm pole mounting kit:
  - centring ring and relevant screws
  - pole support system plus antenna (already assembled) and pole fixing brackets
  - 1+0 ODU support and relevant screws
  - ODU with O–ring and devices for ground connection

1+1 version

- 60 to 129 mm pole mounting kit:
  - centring ring and relevant screws
  - pole support system plus antenna (already assembled) and pole fixing brackets
  - 1+0 ODU support
  - hybrid and relevant screws
  - polarization twist disk and relevant screws
  - 2 ODUs with O–rings and devices for ground connection.

20.3 REQUIRED TOOLS FOR MOUNTING (NOT SUPPLIED)

- N.1 2.5 mm Allen wrench
- N.1 3 mm Allen wrench
- N.1 6 mm Allen wrench
• N.1 13 mm spanner
• N.2 17 mm spanner.

Warning: if screwing operation concerns more than one screw or bolt, tighten subsequently everyone and its opposite, step by step.

20.4 INSTALLATION PROCEDURE

Installation procedure is listed below:

1+0 version
1 antenna polarization
2 installation of the centring ring on the antenna
3 installation of 1+0 ODU support
4 installation onto the pole of the assembled structure
5 installation of ODU
6 antenna aiming
7 ODU grounding

1+1 version
1 antenna polarization
2 installation of the centring ring on the antenna
3 installation of 1+0 ODU support
4 installation onto the pole of the assembled structure
5 installation of hybrid
6 installation of ODUs
7 antenna aiming
8 ODU grounding.

20.5 1+0 MOUNTING PROCEDURES

20.5.1 Setting antenna polarization

Fig. 93 – Set the antenna in such a position to operate on its rear side. Locate the four M3 Allen screws around the antenna flange. Unscrew them (use 2.5 mm Allen wrench) and position the antenna flange according on: horizontal wave guide -> \textbf{vertical} polarization, vertical wave guide -> \textbf{horizontal} polarization. Screw again the four Allen screws (torque = 1 Nm).
20.5.2 Installation of the centring ring on the antenna

Fig.93 – Set the antenna in such a position to operate on its rear side. Locate the three holes around the antenna flange. Mount the centring ring onto antenna flange and tighten it with the 3 Allen screws M4 (use 3mm Allen wrench, torque 2 = Nm).

20.5.3 Installation of 1+0 ODU support

Fig.93 – Mount the support onto assembled structure (pole support system plus antenna) using the four M8 Allen screws (use 6mm Allen wrench, torque 18 = Nm). Two of the four screws, diagonally opposed, must be mounted with the two bushes around.

20.5.4 Installation onto the pole of the assembled structure

Fig.93 – Mount the assembled structure on the pole using the two pole fixing brackets and the four M10 screws (use 17mm spanner, torque = 13 Nm); the heads of the screws are inserted on the antenna side, the four nuts and the springs between nut and brackets are inserted on bracket side.

20.5.5 Installation of ODU (on 1+0 support)

Fig.94 – Apply silicon grease (e.g. RHODOSIL PATE 4”) on the O-ring by protecting fingers with gloves.

Fig.95 – Bring the ODU with the two hands and position the ODU handle at the bottom side. The handle can assume the positions shown in the figure depending on the polarization. Position the ODU body near the support and align the wave guide of the ODU to the Wave guide of the antenna: respect to the position of wave guide alignment, turn the ODU body approx. 30° counter-clockwise into the support and search for matching between reference tooth on the support (see Fig.96) and reference tooth on the ODU body.

Fig.97 – When alignment of the reference teeth is achieved, turn the ODU body clockwise until rotation is stopped. In figure are shown ODU final position for both polarizations.

Fig.96 – When ODU positioning is over, secure ODU body on the support by tightening bolts (use 13mm spanner, torque = 6Nm).

20.5.6 Antenna aiming

Antenna aiming procedure for 1+0 version or 1+1 version is the same.

Horizontal aiming: ±5° operating on the 17 mm nut shown in Fig.98 with a 17 mm spanner, only after having loosen the two 17 mm nut on the pivot.

Vertical aiming: ±20° operating on the 13 mm nut shown in Fig.98 with a 13 mm spanner, only after having loosen the three 13 mm nut on the pole support.

Once optimum position is obtained, tighten firmly all the nuts previously loosen.
20.5.7  ODU grounding

ODU grounding is achieved with:

- M8 screw without washers
- M6 screw with washer

as shown in Fig. 99.

20.6  1+1 MOUNTING PROCEDURES

In further page are explained all the mounting step not already discussed in paragraph “19.5 1+0 MOUNTING PROCEDURES”.

20.6.1  Installation of Hybrid

Fig. 100 – The polarization disk must be always fixed on hybrid flange. Apply silicon grease (e.g. RHODOSIL PATE 4") on the O-rings by protecting fingers with gloves. Bring the polarization twist disk with the position marker down. Insert the O-ring into polarization twist disk.

Vertical polarization: fix the twist disk on hybrid flange placing the marker of the disk towards V mark.

Horizontal polarization: fix the twist disk on hybrid flange placing the marker of the disk towards H mark.

In 13 GHz and 15 GHz ODUs the polarization disk is fixed to the hybrid flange by means of 3 screws as shown in Fig. 101.

Tighten progressively and alternatively the screws and the spring washer with following torque:

<table>
<thead>
<tr>
<th>Frequencies</th>
<th>Screw</th>
<th>Tool</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>from 18 to 38 GHz</td>
<td>Allen screw M3</td>
<td>Allen key 2.5 mm</td>
<td>1 Nm</td>
</tr>
<tr>
<td>up to 15 GHz</td>
<td>Allen screw M4</td>
<td>Allen key 3 mm</td>
<td>2 Nm</td>
</tr>
</tbody>
</table>

Fig. 102 – Fix hybrid body to 1+0 support with four M8 bolts (use 13 mm spanner, torque = 18 Nm), tighten progressively and alternatively the bolts.

20.6.2  Installation of ODUs (on hybrid for 1+1 version)

For both ODUs.

Fig. 94 – Apply silicon grease e.g. RHODOSIL PATE 4” to the O-ring by protecting fingers with gloves.

Fig. 95 – Bring the ODU with the two hands and position the ODU handle at the bottom side. The handle can assume the positions shown in the figure depending on the polarization. Position the ODU body near the support and align the wave guide of the ODU to the wave guide of the hybrid: respect to the position of wave guide alignment, turn the ODU body approx. 30° counter-clockwise and then insert the ODU body into the support. For 1+1 system the handle of the ODU is always positioned on the right. The polarization twist disk on the hybrid matches the antenna polarization.

Fig. 103 – When alignment of the reference teeth is achieved, turn the ODU body clockwise until the rotation stops. In figure are shown ODUs final position.
**Fig.96** – When ODU positioning is over, secure ODU body on the support by tightening bolts (use 17 mm spanner, torque = 6 Nm).

**WARNING:** Internal codes (e.g. installation items, antennas, PCB) are here reported only as example. The Manufacturer reserves the right to change them without any previous advice.

**Fig.104 - 1+0 pole mounting**
Fig.105 - ODU body reference tooth

Fig.106 - Position of the ODU handle depending on the polarisation for 1+0. For 1+1 the polarisation is always horizontal. Handle at the right side.
1 6 mm Allen screw M10
2 17 mm Tightening bolts (max torque = 6 Nm)
3 Reference point for horizontal polarization
4 Reference point for vertical polarization

*Fig.107 - 1+0 support*
Fig. 108 - ODU housing final position for both polarization

1+0 ODU with handle on the left: vertical polarization

1+0 ODU with handle on the right: horizontal polarization
Fig. 109 - Antenna aiming

1. Pole support
2. Horizontal aiming
3. Vertical aiming
1 Bolt
2 Spring washer
3 Flat washer
4 Earth cable collar
5 Flat washer

Fig.110 - ODU grounding
Fig.111 - Hybrid and twist disk

1 O-ring
2 Polarization twist disk
3 Hybrid mechanical body
4 Position marker of twist disk
5 Reference label for twist disk
6 O-ring
7 Allen screws
8 Spring washer
Fig. 112 - Polarization disk fixing (only for 13 GHz and 15 GHz)

Horizontal polarization

Vertical polarization
Fig. 113 - Hybrid installation
Fig.114 - 1+1 ODUs installation
21 INSTALLATION ONTO THE POLE OF ODU ASN WITH STANDARD LOCK

21.1 ODU COUPLING KIT

Two versions of ODU can be connected to ALplus2/ALCplus2 IDU: ODU AS and ODU ASN. Both versions need to be completed with a coupling kit to be connected to the mechanical structure for the installation.

21.1.1 ODU AS

ODU AS is factory assembled with a "Fast Lock" coupling kit (see Fig.115); for the installation it needs O-ring and grounding bolt only.

21.1.2 ODU ASN

ODU ASN can mount two different coupling kits in order to obtain a Fast Lock ASN or a Standard ASN. After having mounted the proper coupling kit the ODU needs O-ring and grounding bolt.

21.1.2.1 Fast lock coupling kit

The Fast Lock coupling kit is the same used in ODU AS and so after kit, O-ring and grounding bolt assembly, the ASN Fast Lock can be installed in the same way of ODU AS.

Coupling kit assembly procedure

See Fig.116 - Put the Fast Lock coupling kit on the ODU.
Align the four holes of the coupling kit with the four nut screws on the ODU. Insert and tighten the four screws.

21.1.2.2 Standard coupling kit

The standard coupling kit is mounted on ASN ODU by means of four screws.

Coupling kit assembly procedure

See Fig.117 - Put the standard coupling kit on the ODU.
Align the four holes of the coupling kit with the four nut screws on the ODU. Insert and tighten the four screws.
21.2 INSTALLATION ONTO THE POLE OF THE ODU WITH INTEGRATED ANTENNA

21.2.1 ODU AS and ODU ASN (Fast Lock)

The installation of ODUs with Fast Lock coupling kit is described in previous chapters.

21.2.2 ODU ASN (Standard Lock)

Mounting kit 1+0 version
- Centring ring and relevant screws
- M10 bolts
- ODU with O-ring and devices for ground connection

Mounting kit 1+1 version
- Centring ring and relevant screws
- M10 bolts for hybrid and ODU mounting
- Hybrid mechanical body
- Polarization twist disk (see Fig.120)
- 2 ODUs with O-rings and devices for ground connection.

21.2.2.1 1+0 ODU

Install the antenna using the antenna installation guide (specific for each antenna) inside the antenna box provided by antenna producer. Keep attention to the polarization of the antenna feeder depending on requested polarization.

After the antenna is installed onto the pole, the ODU must be installed, see Fig.118.

- Position the three holes circular flange (1) on the antenna flange and align the three holes on the circular flange with the three relevant holes on the antenna flange
- Insert and tighten the three 3mm M4 Allen screws (2) using a 3mm Allen wrench (torque = 2 Nm)
- Screw partially the four M10 bolts (3) on the antenna back plate: each bolt should be tightened to have the square head out of the hole of about 13-14mm (the thickness of hook (4), use 15mm spanner)
- Apply silicone grease (e.g. RHODOSIL PATE 4°) to the O-ring, protecting fingers with gloves, and insert in the proper track on the ODU flange
- Position the ODU (5) vertically near the four bolts on the antenna flange and align the ODU to match the polarization of the antenna feeder:
  - vertical polarization: the handle (6) of the ODU is at the bottom left corner
  - horizontal polarization: the handle (6) of the ODU is at the bottom right corner
- After the right position has been found, rotate 30° counterclockwise the ODU and approach the ODU to the antenna flange in order to have the four slots of the Standard Lock cross between the four bolts
• Rotate 30° clockwise the ODU to hook each slots on the relevant bolt
• When each slot is firmly hooked on the relevant bolt, tighten each bolt (use 15mm spanner, torque=46mm)
• Optional: sun cover kit - Insert the sun cover and tie one of its bottom holes to the ODU handle by means of the black plastic strip included in the sun cover kit
• The ODU is ready to be connected to the IDU-ODU cable and to the grounding cable.

21.2.2.2 1+1 ODU

Install The antenna using the antenna installation guide (specific for each antenna) inside the antenna box by antenna producer. Keep attention to the polarization of the antenna feeder depending on requested polarization.

After the antenna is installed onto the pole, follow the procedure below, see Fig.119.

Mounting the hybrid (3) on the back of the antenna:
• Position the three holes circular flange (1) on the antenna flange and align the holes on the circular flange with the relevant holes on the antenna flange
• Insert and tighten the three 3mm M4 Allen screws (2) using a 3mm Allen wrench (torque = 2mm)
• Prepare the polarization disk (see Fig.120) with the two O-rings: silicone grease e.g RHODOSIL PATE 4” must be applied to the O-ring, protecting fingers with gloves; each O-ring must be inserted in the proper track on each surface of the disk
• Mount always (with vertical and with horizontal polarization) the polarization disk on the hybrid flange (antenna side) as shown in Fig.120 and tighten the four screws (only three screws in 13 GHz and 15 GHz hybrid). The polarization disk must be oriented depending on requested polarization by antenna feeder (position V or H as shown in Fig.120). Torque values as in Tab.34.

21.3 INSTALLATION ONTO THE POLE OF THE ODU WITH SEPARATED ANTENNA

• Diameter of the pole 60-114 mm

21.3.1 ODU AS and ODU ASN (Fast Lock)

The installation of ODUs with Fast Lock coupling kit is described in previous chapters.

21.3.2 ODU ASN (Standard Lock)

Mounting kit 1+0 version
• Supporting plate, fixing bracket with M10 130mm bolts (with washer, spring and nut)
• 1 antenna side flange, variable as function of RF frequency, with relevant screws
• M10 25mm bolts for ODU mounting
• ODU with O-ring and devices for ground connection
Mounting kit 1+1 version

- Supporting plate, fixing bracket with M10 130mm bolts (with washer, spring and nut)
- M10 25mm bolts for hybrid and ODUs mounting
- Hybrid mechanical body
- Polarization twist disk (see Fig.120)
- 2 ODUs with O-rings and devices for ground connection.

21.3.2.1 1+0 ODU

See Fig.121.

- Position the supporting plate (1) on the pole and fix the rear bracket (2) to it by means of the four 130 mm M10 bolt (3) with relevant washers, springs and nuts (use 15mm spanner, torque = 46Nm).
- Fix the antenna side flange (4) with the proper screws (in Fig.121 the antenna flange is shown in two different positions depending on the polarization), the screw holes side is the side where the waveguide must be installed.
- On the supporting plate, on the opposite side respect to the antenna flange just mounted, insert in holes (5) on the supporting plate the four 25mm M10 bolts (3): screw them partially, each bolt should be tightened to have the square head out of the hole of about 13-14 mm (the thickness of hook (4), use 15mm spanner).
- Apply silicon grease (e.g. RHODOSIL PATE 4") to the O-ring, protecting fingers with gloves, and insert it in the proper track on the ODU flange.
- Position the ODU vertically near the four bolts on the supporting plate and align the ODU to match the polarization of the antenna flange:
  - vertical polarization: the handle of the ODU is at the bottom left corner
  - horizontal polarization: the handle of the ODU is at the bottom right corner
- After the right position has been found, rotate 30° counter clockwise the ODU and approach the ODU to the supporting plate in order to have the four slots of the Standard Lock cross between the four bolts
- Rotate 30° clockwise the ODU to hook each slots on the relevant bolt
- When each slot is firmly hooked on the relevant bolt, tighten each bolt (use 15 mm spanner, torque =46 Nm).

<table>
<thead>
<tr>
<th>Frequencies</th>
<th>Screw</th>
<th>Tool</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>from 18 to 38 GHz</td>
<td>Allen screw M3</td>
<td>Allen key 2.5 mm</td>
<td>1 Nm</td>
</tr>
<tr>
<td>up to 15 GHz</td>
<td>Allen screw M4</td>
<td>Allen key 3 mm</td>
<td>1 Nm</td>
</tr>
</tbody>
</table>

- Mount the hybrid on the back of the antenna by means of four M10 bolts (4) (torque = 46 Nm)

Mounting each ODU on the hybrid:

- Screw partially four M10 bolts (4) on the hybrid flange (ODU side): each bolt should be tightened to have the square head out of the hole of about 13-14 mm, use 15 mm spanner
- Apply silicon grease (e.g. RHODOSIL PATE 4") to the O-ring, protecting fingers with gloves, and insert in the proper track on the ODU flange
- Position the ODU (5) vertically near the four bolts on the antenna flange and align the ODU to match the polarization of the antenna feeder: horizontal polarization must be used, the handle (6) of the ODU is at the bottom right corner
After the right position has been found, rotate 30° counter clockwise the ODU and approach the ODU to the antenna flange in order to have the four slots (7) of the Standard Lock cross between the four bolts on the hybrid.

- Rotate 30° clockwise the ODU to hook each slots on the relevant bolt.
- When each slot is firmly hooked on the relevant bolt, tighten each bolt (use 15 mm spanner, torque = 46Nm).
- Optional: sun cover kit - Insert the sun cover and tie one of its bottom holes to the ODU handle by means of the black plastic strip included in the sun cover kit.
- Now the ODU is ready to be connected to the IDU-ODU cable and to the grounding cable.
- Repeat for the other ODU on the other side.
- Optional: sun cover kit. Insert the sun cover and tie one of its bottom holes to the ODU handle by means of the black plastic strip included in the sun cover kit.
- Now the ODU is ready to be connected to the IDU-ODU cable and to the grounding cable.

### 21.3.2.2 1+1 ODU

See Fig.122.

- Position the supporting plate (1) on the pole and fix the rear bracket (2) to it by means of the four 130 mm M10 bolt (3) with relevant washers, springs and nuts (use 15 mm spanner, torque = 46 Nm).
- Mount the hybrid (4) on the back of the antenna by means of four 25 mm M10 bolts (5) (use 15 mm spanner with torque = 46 Nm) in the holes (6).

Mounting each ODU on the hybrid:

- Screw partially four 25 mm M10 bolts positioning them in the holes (7) on the hybrid flange (ODU side): each bolt should be tightened to have the square head out of the hole of about 13-14 mm, use 15 mm spanner.
- Apply silicon grease e.g. RHODOSIL PATE 4” to the O-ring, protecting fingers with gloves, and insert in the proper track on the ODU flange.
- Position the ODU vertically near the four bolts on the antenna flange and align the ODU to match the polarization of the antenna feeder: horizontal polarization must be used, the handle of the ODU is at the bottom right corner.
- After the right position has been found, rotate 30° counter clockwise the ODU and approach it to the antenna flange in order to have the four slots of the Standard Lock cross between the four bolts on the hybrid.
- Rotate 30° clockwise the ODU to hook each slots on the relevant bolt.
- When each slot is firmly hooked on the relevant bolt, tighten each bolt (use 15 mm spanner, torque = 46Nm).
- Optional: sun cover kit - insert the sun cover and tie one of its bottom holes to the ODU handle by means of the black plastic strip included in the sun cover kit.
- Now the ODU is ready to be connected to the IDU-ODU cable and to the grounding cable.
- Repeat for the other ODU on the other side.

### 21.3.2.3 Waveguide towards the antenna

After having installed the ODU in 1+0 configuration or in 1+1 configuration, the waveguide towards the antenna must be installed.

- 1+0: the waveguide must be fixed to the antenna flange on the supporting plate of the ODU. In case of flexible waveguides, an excessive folding can damage the waveguide, see Tab.35 for details.
- 1+1: the waveguide must be fixed to the hybrid. In case of flexible waveguides, an excessive folding can damage the waveguide, see Tab.35 for details.
Tab. 35 - Waveguide bending radius according to frequency

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Bending radius without rebending mm (inch) E-plane</th>
<th>Bending radius without rebending mm (inch) H-plane</th>
<th>Bending radius with rebending mm (inch) E-plane</th>
<th>Bending radius with rebending mm (inch) H-plane</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 GHz or 7 GHz</td>
<td>200 (7,9)</td>
<td>500 (19,8)</td>
<td>300 (11,9)</td>
<td>600 (23,7)</td>
</tr>
<tr>
<td>low</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 GHz high</td>
<td>200 (7,9)</td>
<td>500 (19,8)</td>
<td>250 (9,9)</td>
<td>600 (23,7)</td>
</tr>
<tr>
<td>11 GHz</td>
<td>130 (5,1)</td>
<td>280 (11,0)</td>
<td>150 (5,9)</td>
<td>300 (11,9)</td>
</tr>
<tr>
<td>13 GHz</td>
<td>130 (5,1)</td>
<td>280 (11,0)</td>
<td>150 (5,9)</td>
<td>300 (11,9)</td>
</tr>
<tr>
<td>15 GHz</td>
<td>130 (5,1)</td>
<td>280 (11,0)</td>
<td>150 (5,9)</td>
<td>300 (11,9)</td>
</tr>
<tr>
<td>18 GHz</td>
<td>130 (5,1)</td>
<td>280 (11,0)</td>
<td>150 (5,9)</td>
<td>300 (11,9)</td>
</tr>
<tr>
<td>23 GHz</td>
<td>110 (4,3)</td>
<td>230 (9,1)</td>
<td>130 (5,1)</td>
<td>250 (9,9)</td>
</tr>
<tr>
<td>38 GHz</td>
<td>80 (3,1)</td>
<td>140 (5,5)</td>
<td>90 (3,6)</td>
<td>150 (5,9)</td>
</tr>
</tbody>
</table>

a. Bending E-plane

Rmin/E
Bending E-plane
(short side of the section)

b. Bending H-plane

Rmin/H
Bending H-plane
(long side of the section)
Fig.115 - AS and ASN ODUs
Fig.116 - ODU ASN with fast lock coupling flange
Fig. 117 - ODU ASN with standard coupling flange
Fig. 118 - 1+0 ODU installation
Fig. 119 - 1+1 ODU installation
Fig.120 - Polarization disk

Fig.121 - 1+0 antenna flange
Fig. 122 - 1+1 antenna flange
Section 4.
LINE-UP

22 LINE-UP OF THE RADIO HOP

22.1 LINE-UP OF THE RADIO HOP

The line-up consists of the following steps:

- on site radio terminal installation (user connections and ODU installation as described in the relevant chapters)
- equipment switch-on
- equipment configuration (through PC software)
- antenna alignment for maximum received RF signal level
- network element configuration
- check measurements.

Equipment installation is described in Section 3, INSTALLATION.

22.1.1 Equipment configuration

In order to have the link working properly, in the local and remote equipment the same parameters have to be set:

- system layout (1+0, 1+1 hot stand-by, 1+1 frequency diversity.....) (Equipment - Configuration)
- ACM Engine (Equipment - Modulation&Capacity): during Line-up “ACM Engine” must be disable
- Bandwidth&Modulation (Equipment - Modulation&Capacity): during Line-up set the reference Mod&Cap
- link ID (Equipment - General)
- RF channel (Equipment-Radio-Radio Branch1A/2A-Tx Frequency Selector)
The software to run is Web LCT Console and Web LCT on Internet Explorer with Flash player. You can download Web Lct Console program and Flash Player from [http://www.siaemic.com](http://www.siaemic.com).

**Traffic (Baseband - Tributary)**

Used tributaries must be enabled on local and on remote equipment.

### 22.1.2 Antenna alignment and received field measurement

Purpose of antenna alignment is to maximize the RF received signal level. Proceed as follows:
- connect a multimeter to BNC connector on the ODU for AGC measurement
- adjust antenna pointing as soon as the maximum AGC voltage value is achieved.

The relationship between AGC voltage and received field is shown by Fig.123. The received field level has a tolerance of ±4 dB in the full temperature range.

### 22.1.3 Network element configuration

A factory default address is assigned to each network element that must normally be reconfigured on site following the network administrator rules.

For this purpose it is required to connect the PC, where the WEB LCT program has been installed, to the network interfaces: this has to be done via USB cable or Ethernet cable.

Warning: the checks that follow require the knowledge of the program use.

Run the program and perform the connection to equipment by choosing from menu “Option” the connection made via USB cable.

Perform the login to the equipment by entering:
- Equipment IP address 4
- User ID (default: SYSTEM)
- Password: (default: siaemicr)

Proceed to program what above mentioned following this path:
- IP Address: select Port Configuration. Enter the required port addresses in the available communication ports.
- Routing Table and Default Gateway: select Routing table: add the routes and default gateway if necessary.
  - **Warning:** the routing policy depends on the routing type: static IP/OSPF/IS-IS. The relevant routing rules must be normally given by network administrator.
- Remote Element Table: select Remote Element Table. Add station name. Add local equipment IP address, add remote equipment IP address selecting Remote Link.
- Agent IP Address: select Equipment Properties. Assign the address in accordance to the address of Ethernet port.

---

4 If the connection is made via USB cable, the IP address is automatically achieved.
22.1.4 Few considerations about addresses

Here are listed few observation to follow during the address/netmask setup:

1. PPP connection (RS232 and LCT ports) - PC address can be selected among:
   a. Ethernet port address +1
   b. broadcast address -1
   c. a given address.

   For a correct management, solutions b) and c) must be different than Ethernet port address.

2. PPP connection (RS232 and LCT ports) - if Unnumbered is used, the netmask relevant RS232 and LCT ports must be equal or wider than the Ethernet port netmask.

3. PPP connection (RS232 and LCT ports) - never assign network addresses to RS232 or LCT ports (check that they are hosts).

22.1.5 Radio checks

It is advisable to perform the following measurements to check the correct operation of the radio hop:

- transmitted power
- received power
- RF frequency
- S/N measurement

All these checks make use of the WLC program.

- Transmitted power, received RF level, RF frequency
  - run WLC program and then perform the connection to the equipment you want to check.
  - on top of the window Tx/Rx power and frequency values are displayed. In case of Tx power and frequency setup proceed to Branch 1/2 and Power/Frequencies submenus.

- S/N measurement
  - Run WLC program and then perform the connection to the equipment you want to check.
  - On the left side select S/N meas. 1 or S/N meas. 2.
  - In alternative it is possible to use the PRBS function if one or 2 Mbit/s line is free.
  - Perform the S/N measurement and check that values comply with the requirements.

22.1.6 ACM setting

In order to enable the ACM features in the radio links, the following parameters must be set on both ends just to have the same configuration.

ACM parameters can be set in WEB LCT in Modulation and Capacity card in the window

- Mod.Cap/LinkID in case of ALplus2 and ALCplus2
- BW&Mod/LinkID in case of ALCplus2e

**ACM engine**

- Enabled - the link uses different ACM profiles
- Disabled - the link uses the reference modulation only
**Tx Power Constant Peak mode (ALplus2 and ALCplus2)**

**Tx Power Ramp Up To (ALCplus2e)**

- **Enabled** - The Tx power is the maximum allowed in each modulation profile (only if “reference modulation” is equal to “lower modulation”)
- **Disabled** - The link uses the same Tx power in each profile (Tx power is the Tx power at “upper modulation”)

**Bandwidth and Modulation**

- Transmitted channel bandwidth
- Reference modulation, with ACM enabled, or used modulation, with ACM disabled

**Upper Modulation**

The higher modulation can be used with ACM enabled.

**Lower Modulation**

The lower modulation can be used with ACM enabled.

**Permanent TDM**

Number of TDM (E1 streams) always transmitted.

**Extra TDM**

Number of TDM (E1 streams) transmitted besides the permanent TDM, in each ACM profile. In case of Extra TDM usage, in the Extra TDM Priority card is present the list of which extra TDMs are transmitted.
**Fig. 123 - Detected voltage versus RF received signal**
23 BACK UP FULL EQUIPMENT CONFIGURATION WITHOUT POSSIBILITY OF MODIFYING THE PARAMETERS

23.1 SCOPE

This chapter describes the procedure to back up the full equipment configuration. This permits to recover the original equipment configuration in case of faulty CONTROLLER module replacement with spare.

23.2 CONFIGURATION UPLOAD AND DOWNLOAD USING SCT

23.2.1 Configuration upload

Foreword: it is advisable to backup the configuration after the first installation. Proceed as follows:

1. Select "Equipment Configuration Wizard" from menu "Tools"; "Equipment Configuration Wizard" window will be displayed.
2. Select "Upload" and then "Backup Full Equipment Configuration"; "Template Selection" window will be displayed.
3. Select the correct equipment template (in case of uncorrected choice the backup will be aborted).
4. Press OK and then select the equipment to be uploaded from "Upload Configuration File" window.
5. Press OK and then edit the file name from "Save backup as" window.
6. Press Save; "Equipment Configuration Wizard: Complete Backup" window will appear. The window shows dynamically the backup procedure. If everything is OK, at the end of the upload will appear the word "done" showing the procedure success.
7. Press OK to finish.

23.2.2 Configuration download

Once the spare controller has been installed, or everytime you need the primitive configuration, proceed as follows:

1. Select "Equipment Configuration Wizard" from menu "Tools". "Equipment Configuration Wizard" window will be displayed.
2. Select "Download" and then "Restore Full Equipment Configuration" from Equipment Configuration Wizard. "Select Backup File" window will be displayed.
3. Select the wanted backup file with extension .bku and then press Open. "Download Configuration File" window will be displayed.
4. Select the equipment to download and then press **OK**; “Equipment Configuration Wizard: Complete restore” window will be displayed. This window shows dynamically the download operation. The word “**done**” indicates that download has been successfully.

5. Press **OK** to finish.

**Warning:** In case of EOC alarm proceed to restart the equipment.

### 23.3 CONFIGURATION UPLOAD AND DOWNLOAD USING WEBLCT

#### 23.3.1 Configuration upload

Foreword: it is advisable to backup the configuration after the first installation. Proceed as follows:

1. Select “Backup/Restore Configuration” in the “Main menu”
2. In the field “Backup File name” write the name of the configuration file you are going to upload in the PC, complete with the full path of its folder
3. Push **Backup**. The status of the backup procedure is shown in the “Operation Status” field.

#### 23.3.2 Configuration download

Once the spare Controller has been installed or every time the saved configuration is necessary, proceed as follow:

1. Select “Backup/Restore Configuration” in the “Main menu”
2. Select “Browse local system” in order to locate the configuration file you need and push **Open** when it has been found
3. Push **Restore**. The status of the backup procedure is shown in the “Operation Status” field. During Restore operation the equipment creates a backup configuration, you can come back to this configuration at the end of the restore pushing **Revert**.

#### 23.3.3 SD Memory card

A SD card slot is available on the ALplus2 Controller module (on the board) or on the front panel of ALCplus2.

Using a SD memory card is possible to perform an auto restore of Configuration and of Equipment Firmware everytime a mismatch between running ones and saved occurs.

1. Select “SD Memory Management” in the “Main menu”
2. In the “Actions” field select the operation you want to perform (...... “Enable automatic restore (all)” for example)
3. Select **Execute**.
24 LINE-UP FOR ETHERNET TRAFFIC

24.1 LAN SETUP

This paragraph deals with line-up of ALplus2 LIM Ethernet and ALCplus2/ALCplus2e IDU with details of WEB LCT program related only to Ethernet application.

Differences among the IDUs are pointed out.

Main difference is the number of LAN ports: three in ALplus2 and four in ALCplus2/ALCplus2e, moreover in ALplus2 the LAN2 port can manage POE functionality besides in ALCplus2/ALCplus2e Sync Signal can be taken from LAN ports also (see relevant paragraph).

Assuming that the radio link is already in service, with correct frequency, output power and correct antenna alignment, the line up procedure for two different kinds of connection set up of a radio link ALplus2, equipped with LIM module with Ethernet ports, is hereafter described:

- Local Lan-1 port to remote Lan-1 port connection Lan per port, see Fig.124
- from 3 ports to 3 ports connections and segregated traffic for Untagged Traffic, see Fig.132
- from 3 ports to 3 ports connections and segregated traffic for Tagged and Untagged Traffic, see Fig.142.

Settings here below are intended to be done both into local and remote radio equipment. The software to be used to configure the equipment is WEB LCT. In the following chapter the figures used as example can differ in the position of main commands depending on WEB LCT release.

24.2 LOCAL LAN-1 PORT TO REMOTE LAN-1 PORT TRANSPARENT CONNECTION LAN PER PORT

Settings for Untagged and Tagged Traffic

![Diagram](image-url)

**Fig.124 - Local Lan-1 port to remote Lan-1 port connection**

The first example is local Lan1 port to remote Lan1 port transparent connection for tagged and untagged traffic please refer to Fig.124.
Select 1+0 or 1+1 configuration according to system requirements. Please refer to Fig. 125. First selection is channel bandwidth and modulation, in this example we selected 28MHz and 16QAM.

ACM Engine, Upper Modulation, Lower Modulation, Permanent Traffic and extra TDM Capacity at any modulation must be the same local and remote.

The throughput at any modulation with 28 MHz bandwidth is shown in Fig. 126 with View Current Config button of Fig. 125.

So with 4QAM strong modulation the Ethernet capacity is 20 Mbit/s and with 256QAM modulation the Ethernet capacity is 140 Mbit/s.
Fig.127 - Switch general settings

See Fig.127 for general settings of the switch. All the used ports must be Enabled, so enable Lan-1 and Internal Port A, see Fig.128.

Please notice the MAC Address Aging Time reduced, only for this test at 15 sec.

The other ports should be disabled. The correct cable crossover arrangement must be selected too (see Fig.128). Enable LLF, if needed, only at the end of link line up.

Select Master or Slave Role for 1000BaseT interface.

Switch connections are done with Lan per port selections. Referring to Fig.129, incoming traffic at Lan-1 exits at internal Port A and as in Fig.130 and in Fig.131 incoming traffic at internal Port A exits at Lan-1 port. This connection are done for all Untagged packets and all Tagged packets with Vlan Id not described into Vlan Configuration Table.

If Vlan Configuration Table is blank all Tagged traffic follows the rules of Lan per port.

Possible selections of Ingress Filtering Check:

- "Disable 802.1Q": no check of Virtual Lan tag is done and all packets follow Lan per port settings
- "Fallback": if Tagged packets have their Vlan Id into Vlan Configuration Table they follow the connection described into the table, otherwise they follow the Lan per port settings as Untagged packets
- "Secure": no Untagged packet transits; only Tagged packets with Vlan Id listed into the table can transit.

For all previous configuration "Disable 802.1" should be selected. With Egress Mode as Unmodified the outgoing packets at Lan-1 port exit Untagged or Tagged exactly as they were Untagged or Tagged at the incoming port.
**Fig. 128 - Lan-1 interface settings**

- **Master/Slave Role**
  - Master
  - Slave

- **M/S Autoneg.**
  - Enable
  - Disable

- **Cable crossover**
  - MDI (NIC)
  - MDIX (switch)

- **Rate control**
  - Full Rate

- **Flow Control Full Dpx**
  - Disable

- **Back Pressure Half Dpx**
  - Disable

- **Speed/Duplex**
  - Auto

- **Speed**
  - 10 M
  - Half-Duplex

- **Duplex**
  - Auto Neg.

- **Port Role**
  - Restart Auto Neg.

- **Buttons**
  - LLF
  - Module Mism.
  - Loc Alarm
  - Sync Alarm
  - Auto Neg.
  - MS Config. Fault

---

**Fig. 129 - Vlan settings for LAN-1**

- **Default Vid (Max 4095)**
  - 1

- **Ingress Filtering Check**
  - Disable 802-1Q

- **Frame Egress Mode**
  - Unmodified

- **Lan per Port**
  - Port A: Enable
  - LAN 2: Disable
  - LAN 3: Disable
Fig.130 - Vlan settings for Port A

Fig.131 - Priority setting for Lan-1 and Port A
24.3 FROM 3 PORT TO 3 PORT CONNECTIONS

Settings for Untagged traffic.

Fig.132 - 3 ports to 3 ports connections with segregated traffic

In this example 3 local port must communicate with corresponding 3 remote ports. All the ports share the same radio channel but traffic originated and directed to Lan1 should be kept separated from traffic from Lan2 and Lan3 and viceversa.

Lan-1 to Lan-1, connection must transfer untagged packets.

Lan-2 and Lan-3 have the same requirements. Please refer to Fig.132.

Select 1+0 or 1+1 configuration according system requirements.

Fig.133 - Modulation and capacity

Please refer to Fig.133. First selection is channel bandwidth and modulation, in this example we selected 28MHz and 16QAM.

ACM Engine, Upper Modulation, Lower Modulation, Permanent Traffic and extra TDM Capacity at any modulation must be the same local and remote.

The throughput at any modulation with 28 MHz bandwidth is shown in Fig.134 with View Current Config button of Fig.133.
So with 4QAMstrong modulation the Ethernet capacity is 20 Mbit/s and with 256QAM modulation the Ethernet capacity is 140 Mbit/s.

See Fig.135 for Switch general settings of the switch. All the used ports must be Enabled, so enable Lan-1, Lan-2, Lan-3 and Internal Port, see Fig.136.

Please notice the MAC Address Aging Time reduced, only for this test, at 15 sec. The correct cable crossover arrangement must be selected too (see Fig.136). Enable LLF if needed only at the end of link line up.

Select Master or Slave Role for 1000BaseT interface.

For Untagged traffic, connections are done with Lan per port selections. Referring to Fig.137 incoming traffic at Lan-1 exits at internal Port A and into Fig.140 incoming traffic at internal Port A exits at Lan-1 port.
This connection are done for all Untagged traffic and all Tagged packets with Vlan Id not described into Vlan Configuration Table.

If Vlan Configuration Table is blank all Tagged traffic follows the rules of Lan per port.

Possible selections of Ingress Filtering Check:

- "Disable 802.1q": no check of Virtual Lan tag is made and all packets follow Lan per port settings
- "Fallback": if Tagged packets have their Vlan Id in Vlan Configuration Table they follow the connection described into the table, otherwise they follow the Lan per port settings as Untagged packets
- "Secure": no Untagged packet transits; only Tagged packets with Vlan Id listed into the table can transit.

![LAN 1 Interface Settings](image)

**Fig.136 - Lan-1 interface settings**

All the used ports must be Enabled.

The correct Cable Crossover arrangement must be selected too.

Untagged traffic transits only if the selection for Ingress Filtering Check is disabled at each input port and a separated Vlan for Untagged traffic is set up for each port.

Each port of the switch must be associated with a different Default VLAN ID, Lan-1 with Default VID 4001, Lan-2 with Default VID 4002, Lan-3 with Default VID 4003, for Lan-1 see Fig.136 and Fig.137.

Untagged packets coming at physical ports are tagged on common radio channel but tagged with different Vlans. At receiving end packets are distributed at their ports and untagged.

Vlan Configuration Table will be defined in order to group traffic from Lan-1, Lan-2, Lan-3 to Port A.

The Vlan Configuration Table must be programmed as in Fig.141.
**Fig.137 - Lan1 Vlan settings**

**Fig.138 - Lan2 Vlan settings**
**Fig. 139 - Lan3 Vlan settings**

**Fig. 140 - Port A Vlan settings**
24.4 FROM 3 PORT TO 3 PORT CONNECTIONS

Settings for Tagged Traffic, QinQ

![Diagram of QinQ setup](image)

In this example 3 local port must communicate with corresponding 3 remote ports. All the ports share the same radio channel but traffic originated and directed to Lan1 should be kept separated from traffic from Lan2 and Lan3 and vice versa.

Lan-1 to Lan-1, connection must transfer tagged and untagged packets. Lan-2 and Lan-3 have the same requirements. Please refer to Fig.142.

Select 1+0 or 1+1 configuration according system requirements.
Please refer to Fig. 143. First selection is channel bandwidth and modulation, in this example we selected 28MHz and 16QAM.

ACM Engine, Upper Modulation, Lower Modulation, Permanent Traffic and extra TDM Capacity at any modulation must be the same local and remote.

The throughput at any modulation with 28 MHz bandwidth is shown in Fig. 144 with View Current Config button of Fig. 143.

**Fig. 144 - View Current Configuration**
So with 4QAMstrong modulation the Ethernet capacity is 20 Mbit/s and with 256QAM modulation the Ethernet capacity is 140 Mbit/s.

![Switch general settings](image1)

**Fig.145 - Switch general settings**

See Fig.145 for Switch general settings of the switch. All the used ports must be Enabled, so enable Lan-1, Lan-2, Lan-3 and internal Port A, see Fig.128.

For already Tagged traffic we need to add a second Vlan Tag to the packets creating the Vlan of Vlan into radio channel, so we need a Max packet size of 2048.

Settings are as reported in Fig.146, Fig.147, Fig.148, Fig.149, Fig.150.

![Lan1 Vlan settings](image2)

**Fig.146 - Lan1 Vlan settings**
Fig. 147 - Lan2 Vlan settings

Fig. 148 - Lan3 Vlan settings
Fig. 149 - Port A Vlan settings

Fig. 150 - Vlan Configuration Table
25 HOW TO CHANGE ADDRESS ON REMOTE EQUIPMENT WITHOUT LOSING THE CONNECTION

25.1 TOOLS

The following procedure can be done with SCT/LCT or with Web LCT and similar windows.

25.2 PROCEDURE

1. Set new addresses on remote equipment
2. Clear the Stored Routing Table on remote equipment and add new lines to it
3. Set the new Agent and restart remote equipment
4. Configure Local equipment
5. Prepare Subnetwork on local equipment, capture the remote equipment and send it the new subnetwork

Select the remote equipment

Select menu Equipment -> Configuration Setup -> Port Configuration
**Fig. 151 - Subnetwork Craft Terminal - Communication setup**

**Configuration**

Configure:

**IP Ethernet** -> IP address and netmask (see **Fig.152**)

**Lct PPP** -> IP address and netmask (see **Fig.153**)

**PPP Radio** -> IP address and netmask (see **Fig.154**)

If you have other port to configure ex. PPP RS232 - 2Mbit/s EOC ecc. configure it with IP and netmask
Fig. 152 - IP Ethernet

Fig. 153 - LCT PPP
At the end select **Set Values** -> **Confirm** and **Store** -> **Confirm**.
Select the equipment

Select menu **Equipment** -> **Configuration Setup** -> **Stored Routing Table**

![Fig.155 - Store Routing Table](image)

In this menu delete all lines and default gateway, push **Apply** and then **Save**.
Add new routine lines (relevant the new addresses configuration) pushing the **Add** button.

When the **Stored Routing Table** is complete, push **Apply** and then **Save**.

**Select the remote equipment**

Select menu **Equipment** -> **Properties**. Set new **Agent** (equal to Ethernet port address).

Push **Restart** and then **Confirm**.

After the restart, the Remote Equipment disappears from SCT display.

**Configure the local equipment**

Configure the local equipment with the same procedure seen before. Then restart the local equipment.

**Subnetwork Configuration Wizard**

To see both local and remote equipment the new subnetwork (station and equipment) must be prepared.

Select menu **Tools** -> **Subnetwork Configuration Wizard**.
Fig. 157 - Subnetwork Configuration Wizard
Push **Add Station**, write its name and push **OK**.
Select this new station and push **Add Element**.

The *Ip Address* to set is the *Agent* (equal to Ethernet port address).
After having set the *Equipment Address*, push **OK**.

The new element is created inside the previously created station.

This step must be done for local and remote equipment.
Fig. 161 - Subnetwork Configuration Wizard

Select the local equipment (the one with System (Local))
Send the configuration to local equipment.

When the remote equipment appears in Actual Configuration, prepare again the network configuration you have set before (or select the local equipment, push Retrieve) and send the configuration to remote equipment.
26  LINE-UP OF THE NODE WITH NODAL IDU

26.1  OVERVIEW

The following paragraph deals with the activation of the Node with Nodal IDU unit with details of the SCT/LCT program relevant to the functionalities offered by the cross-connection matrix and Ethernet switch in relation to the achievable connections.

Supposing that the radio links are already commissioned, the following items are described:

- tributary - radio cross-connection
- tributary - tributary cross-connection
- ethernet switch.

26.2  NODE CONNECTIONS

The connections among the IDUs in the node are the following:

- connections for E1: Nbus cables are used (connectors NBUS1 and NBUS2 are involved)
- connections for Ethernet: Ethernet cables are used (ports LAN1 and LAN2 are involved).

The number of IDUs in the node is between 2 and 8.

In Fig.163 there is an example of connection between one IDU and the adjacent IDUs in the same node.

Remember that in a node for Ethernet Traffic can be used port 3 and port 4 only because port LAN1 and LAN2 are used for nodal connections.
26.3 EQUIPMENT CONFIGURATION

The operations to enable the functionalities offered by the internal cross-connection matrix and Ethernet switch are the following:

- run the software **SCT**, select tools and Subnetwork Configuration Wizard
- insert all the Nodal IDU present into the Node, all these Nodals must be reachable and connected
- select **Network, Nodal ALCplus2 Manager** as in **Fig.164**
- configure the Node with **Station name, Node name**, define if Nodal cables are **Protected** or **Not Protected**
- configure the Node indicating the number of IDU setting the Node for E1 TDM traffic, **Number of TDM Elem**.
- configure the Node indicating the number of IDU setting the Node for E1 TDM traffic, **Number of ETH Elem**.
- insert the IP number of the IDU setting the Node and press **Apply Config** button
- at this point there are Cross-connections and Ethernet LAN details.
26.4 TRIBUTARY CONFIGURATION

The operations to create and configure this cross-connection are:

- to run the software WebLCT, open Equipment Menu, TDM Tributaries, E1 and select the type of used tributary
- to enable the E1 and/or STM-1 tributaries (transport of 63 E1 each) involved by the cross-connection
• to route an E1 stream to remote equipment, a Tributary-Radio cross-connection must be created, the enabling of the stream itself is not sufficient, the cross-connection can be done directly into Nodal ALCplus2 Manager
• in case of STM-1 streams, configure the parameters VC4 (Label - TUG Structure) and any VC12 (Label: Asynchronous) and the synchronization parameters (WebLCT, Equipment Menu, Synchronization).

26.5 CONFIGURATION OF THE CROSS-CONNECTION MATRIX

The operations to configure a cross-connection can be done IDU by IDU into WebLCT or easier into the Nodal ALCplus2 Manager:

- run the software SCT, open Network, Nodal ALCplus2 Manager and press Cross-connection
- select the type of cross-connection:
  - tributary - radio: cross-connection between the tributaries available on the front side of IDUs (E1, STM-1, IDU1 to IDU8) and the tributaries available on the radio link, IDU1 to 8 Radio Extra E1 and Permanent E1
  - tributary - tributary: cross-connection between the tributaries available on the front side of IDUs (E1, STM-1, IDU1 to 8).

26.5.1 Tributary - Radio Cross-connection

The operations to create and configure this cross-connection are:

- select the type of tributary to use on the front side of the IDU: the relevant E1 streams will be displayed in the window together with the number of E1 streams relevant to the radio link
- select which radio link you want to use in cross-connection (up to eight available)
- move the symbol of the E1 stream (the number corresponds to the physical position in the connector of the IDU) by dragging and dropping from a type of tributary to the position to use in the radio frame, see Fig.165.
- the tributaries in the radio frame (link direction A or others) can be involved in a tributary loop towards the corresponding remote radio by means of a double click on the relevant box that points out the position in the frame, see Fig.166.
- the tributaries on radio side can transit directly from a radio link to the other without need to pass from the tributaries on matrix side: by means of drag’n’drop, a box relevant to an E1 on radio side is moved from a link to the other link. The two involved links must be selected in the fields 1st Radio and 2nd Radio. A pass- through (transit) cross-connection is so executed: see Fig.167.
- to delete a cross-connection, move it to the trash
- to activate the configuration, press Apply and Confirm.

26.5.2 Tributary - Tributary Cross-connection

The operations to create and configure this cross-connection are:

- select the two types of tributary (1st tributary and 2nd tributary) on the front side of the IDUs module to use as ends: the relevant E1 streams will be displayed in the top and bottom part of the window
• move the symbol of the E1 stream (the number corresponds to the physical position in the connector on the IDU) by means of the drag’n’drop from a tributary type to another, see Fig.168
• to delete a cross-connection, move to the trash
• to activate the configuration, press Apply and Confirm.

This type of cross-connection includes even those relevant to the transport of E1 streams from a nodal IDU to another one belonging to the same node.

NBUS connections are not displayed.

### 26.6 ETHERNET SWITCH

For Ethernet connections the Nodals are as one big switch with two Lan ports and a radio Ethernet port for any IDU.

Connections between the IDU are not shown into SCT but are programmed automatically by SCT in order to create the big switch.

Setting of the Ethernet switch is performed through Nodal ALCplus2 Manager which then programs any Nodal part of the switch.

All settings of Ethernet switches part of the Node can be done directly into Nodal ALCplus2 Manager.

See from Fig.169 to Fig.180.

---

**Fig.165 - Drag and drop E1 stream**
Fig.166 - VC auto loop
Fig. 167 - Pass-through cross-connection
Fig.168 - Drag and drop E1 stream
Fig.169 - Ethernet switch settings
**Fig. 170 - Ethernet switch settings**
Fig.171 - Ethernet switch settings
Fig.172 - Ethernet switch settings
Fig.173 - Ethernet switch settings
Fig. 174 - Ethernet switch settings
Fig.175 - Ethernet switch settings
Fig. 176 - Ethernet switch settings
Fig. 177 - Ethernet switch settings

Fig. 178 - Ethernet switch settings
Fig. 179 - Ethernet switch settings
Fig.180 - Ethernet switch settings

<table>
<thead>
<tr>
<th>IDU</th>
<th>Lan 3</th>
<th>Lan 4</th>
<th>Port A</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDU 1</td>
<td>Untagged</td>
<td>—</td>
<td>Tagged</td>
</tr>
<tr>
<td>IDU 2</td>
<td>Untagged</td>
<td>—</td>
<td>Tagged</td>
</tr>
</tbody>
</table>

IDU Table:

<table>
<thead>
<tr>
<th>IDU</th>
<th>LAN 3</th>
<th>LAN 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDU 1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>IDU 2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>IDU 3</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>IDU 4</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>IDU 5</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>IDU 6</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>IDU 7</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>IDU 8</td>
<td>/</td>
<td>/</td>
</tr>
</tbody>
</table>

Switch Default VID:

- ID: 444
- Label: VLAN 444
27  EXAMPLE OF ALCPLUS2 NODE EXPANSION

27.1  INTRODUCTION

The goal of this chapter is to define a procedure to add one (or more) ALCplus2 IDU to an existing node of similar IDUs, carrying live traffic. This procedure is applicable to the following IDUs:

- GAI0162
- GAI0163

equipped with system versions 01.01.xx.

In the following paragraphs some screenshots are provided, related to a 3-IDU node expanded to a 4-IDU node, as an example. The example can be easily applied to a N-IDU node (i.e. a node composed by a number of IDUs equal to N) expanded to N+K-IDU node: the 3 to 4 IDU case corresponds to the N=3 K=1 case.

This procedure does not provide specific guidance about the GEthernet traffic: with this respect the node expansion shall be treated as an usual case of interconnection between Ethernet Switches, implementing Rapid Spanning Tree Protocol.

Attention: this procedure covers also the case when you want to withdraw one (or more) IDU from the node.

27.2  PRECONDITIONS

The SCT distribution to be used to perform this task shall be 4.6.8 or greater.

All the IDUs are reachable by the PC running the SCT/Web browser. All the operations performed via SCT/WebLCT shall be done logged as 'System' into the relevant equipment.

The existing node is composed by IDUs configured as "AlcPlus2 (Protected)". See hereafter the screenshots relevant to an example.
Fig. 181 - Node composition
27.3 NBUS AND INTRA-NODE GE CABLING RULES

In a N-IDU node, the NBUS cabling shall be as follows:

- IDU 1 NBUS 1 shall be connected to IDU 2 NBUS 2
- IDU 2 NBUS 1 shall be connected to IDU 3 NBUS 2
- ...
- IDU J NBUS 1 shall be connected to IDU J+1 NBUS 2
- ...
- IDU N NBUS 1 shall be connected to IDU 1 NBUS 2.

In a N-IDU node, the intra-node GEth. cabling shall be as follows:

- IDU 1 LAN1 port shall be connected to IDU 2 LAN2 port
- IDU 2 LAN1 port shall be connected to IDU 3 LAN2 port
- ...
- IDU J LAN1 port shall be connected to IDU J+1 LAN2 port
- ...
- IDU N LAN1 port shall be connected to IDU 1 LAN2 port.
27.4 NODE EXPANSION FROM N TO N+K ELEMENTS

27.4.1 Step 1

Install the K new IDUs in the same rack where the existing node is installed (or in an adjacent rack, provided that the NBUS cables length is compatible with the installation). Do not connect the N-BUS cables to the new IDUs.

Configure the new IDUs as "AlcPlus2 (Protected)", with the following parameters:
- Nodes Id: from N+1 to N+K, depending on the IDU position inside the node
- Number of nodes: N+K

27.4.2 Step 2

Interconnect the new IDUs with the nodal bus, as per rule in 27.2 PRECONDITIONS. Do not connect the new IDUs to the existing IDUs.

27.4.3 Step 3 (traffic affecting)

Disconnect the N-BUS 2 from IDU 1.

Depending on the number and kind of interconnections among the IDUs, there will be errors and/or AIS on some of the E1, due to the traffic protection intervention on the N-BUS. The typical duration of the traffic interruption, measured at E1 level, is around 1s.

Alarms will appear: some possibly related to E1 traffic (depending on the existing interconnections) and at least two one related to the nodal bus interruption. The E1 related alarms will disappear as soon as the protection on the N-BUS will take place. The N-BUS related alarms will remain. See screenshots hereafter as an example.
27.4.4 Step 4

Change configuration of IDU 1 and IDU N, modifying the 'number of nodes' parameter from N to N+K. Change configuration of IDUs from number 2 to number N-1, modifying the 'number of nodes' parameter from N to N+K.

27.4.5 Step 5 (traffic affecting)

Connect the N-BUS from IDU N to IDU N+1 as per rule in paragraph 27.2 PRECONDITIONS. Connect the N-BUS from IDU N+K to IDU 1, as per rule in paragraph 27.2 PRECONDITIONS.

Depending on the number and kind of interconnections among the IDUs, there will be errors and/or AIS on some of the E1, due to the traffic protection intervention on the N-BUS. The typical duration of the traffic interruption, measured at E1 level, is around 1s.

The N-BUS related alarms shall disappear.
27.5 NODE REDUCTION FROM N+K TO N ELEMENTS

Basically this procedure consists in reverting the steps done to expand the node.

27.5.1 Step 1 (traffic affecting)

Disconnect the N-BUS from IDU N to IDU N+1 and from IDU N+K to IDU 1.

Depending on the number and kind of interconnections among the IDUs, there will be errors and/or AIS on some of the E1, due to the traffic protection intervention on the N-BUS. The typical duration of the traffic interruption, measured at E1 level, is around 1s.

The N-BUS related alarms shall appear in IDU 1, IDU N, IDU N+1 and IDU N+K.

27.5.2 Step 2

Change configuration of IDU 1 and IDU N, modifying the 'number of nodes' parameter from N+K to N.

Change configuration of IDUs number 2 to number N-1, modifying the 'number of nodes' parameter from N+K to N.

27.5.3 Step 3 (traffic affecting)

Connect the N-BUS from IDU N to IDU 1, as per rule in paragraph 27.2 PRECONDITIONS.

Depending on the number and kind of interconnections among the IDUs, there will be errors and/or AIS on some of the E1, due to the traffic protection intervention on the N-BUS. The typical duration of the traffic interruption, measured at E1 level, is around 1s.

At the end of a transitional period the N-BUS related alarms shall disappear.

27.5.4 Step 4

Withdraw the IDUs from N+1 to N+K.
28 LINE-UP RADIO TRUNKING (LINK AGGREGATION RADIO SIDE)

28.1 RADIO TRUNKING MODE (INTERNAL PORT - PORT A)

This mode is available only for equipment belonging to an ALCplus2 node and interconnected by nodal Bus Ethernet.

The radio Trunking mode allows aggregating some radio streams of a nodal system.

The functionality manages an aggregation group (Trunk): Enable-Trunk1.

To insert a radio port of a switch in the Trunk, it is necessary to enable the radio Trunking mode for this port (Enable-Trunk1). In this mode, up to 4 radio ports can be aggregated.

The use of the radio Trunking mode is alternative to the use of the Spanning Tree protocol.

28.1.1 To verify the status of the internal port in relation to the trunking mode

Operations available only if the equipment belongs to an ALCplus2 node and is interconnected to the other node elements by the nodal Bus Ethernet.

1. Select the Equipment Menu > Base Band > Port A command. The Port A contextual area opens.
2. Bring in front of page the STP/Trunking tab. The tab points out the status of the port in relation to the Trunking modality or to the Spanning Tree protocol.

Fig. 184 reports an example of the tab when the Trunking modality is active.

Fig. 184 - STP/Trunking tab (Trunk active) (Port A contextual area)
**Trunk Value:**
- Disable. Trunking mode disabled
- Enable-Trunk1. Trunking mode enabled at radio port level.

If the STP protocol is enabled the parameter Trunk is automatically forced to the value Disable. To modify the value, it is first necessary to disable the Spanning Tree protocol. **STP Parameters relevant to the Spanning Tree protocol.**

### 28.1.2 To enable/disable the Trunking mode for the internal port

Operations available only if the equipment belongs to an ALCplus2 node and is interconnected to other elements of the node through nodal Bus Ethernet. The Trunking modality cannot be enabled when the Spanning Tree protocol is enabled.

- Select the **Equipment Menu > Base Band > Port A** command. The Port A contextual area opens.
- Bring in front of page the **STP/Trunking** tab. The **Trunk** parameter points out the enabling status of the Trunking mode for the selected port (see **Fig.184**).
- To change the parameter, select the value:
  - Disable. Trunking mode disabled.
  - Enable-Trunk1. Trunking mode enabled at radio port level.
- Press **Apply** and confirm.
29 LINE-UP LINE TRUNKING (LINK AGGREGATION LINE SIDE)

29.1 LINE TRUNKING MODE

This mode is available for a connection between IDU and ODU and from a node to other node connected via Lan ports.

1. Select the Equipment Menu > Base Band > LAN 1, LAN 2, LAN 3 or LAN 4 command.
   The LAN <port number> contextual area opens.

2. Bring in front of page the STP/ELP/Trunking tab.

   The tab points out the status of the port in relation to the Ethernet Line Protection, to the Spanning Tree protocol or to the Trunking modality. Fig.185 reports an example of the tab when the Trunking modality is active.

   ![](image)

   **Fig.185 - Trunking tab (Trunk active)**

Parameter:

- **Status.** Status of the port as regards the LACP (Link Aggregation Control Protocol):
- **Partner Id.** MAC Address of the remote equipment located at the other end of the Ethernet connection (remote switch).
- **Tx Pck Cnt.** LACP packets transmitted to the remote switch.
- **Rx Pck Cnt.** LACP packets received from the remote switch.

Value:

- **Disable.** Trunking mode disabled.
- **Enable-Trunk1.** Trunking mode enabled. The considered LAN port is aggregated to the equipment LAN ports, whose considered parameter has value Enable-Trunk1.
- **Enable-Trunk2.** Trunking mode enabled. The considered LAN port is aggregated to the equipment LAN ports, whose considered parameter has value *Enable-Trunk2*.

- **Enable-Trunk3.** Trunking mode enabled. The considered LAN port is aggregated to the equipment LAN ports, whose considered parameter has value *Enable-Trunk3*.

- **Enable-Trunk4.** Trunking mode enabled. The considered LAN port is aggregated to the equipment LAN ports, whose considered parameter has value *Enable-Trunk4*.

It is possible to aggregate up to 4 LAN ports for each group *(Trunk)*. Another example is to aggregate two Lans on Trunk1 and other two Lans on Trunk2. Send Trunk1 to one IDU and Trunk2 to a second IDU.

All the Lan port belonging to a group *(Trunk)* must have the same speed.

If the equipment belongs to an ALCplus2 node and it is interconnected to other elements of the node through nodal Bus Ethernet, this operation is available for the external ports LAN3 and LAN4.
30 LINE-UP OAM

Please, first read paragraph "8.8 ETHERNET OAM (Operation Administration and Maintenance)".

To use the OAM facilities it is necessary to:

- assign a Domain with its Level
- bind a Maintenance Association to a VLan (that is sufficient to create MIP)
- bind a MEP to a VLan.

Do the same on remote equipment. Now it is possible to verify the status of connection with Remote MEP (Rmep), or send a Loop back Message (Lbm) or send a Link trace Message (Ltm)

30.1 FM DOMAIN

The OAM-FM Domain command manages the OAM domain of an equipment.

In details it is possible:

- To verify the characteristics of the OAM domain of an equipment
- To define an OAM domain for an equipment
- To remove the OAM domain of an equipment

The name or the level of an OAM domain associated to an equipment cannot be modified. In order to modify one or both the parameters, it is necessary to remove the current domain and to define a new one.

To verify the characteristics of the OAM domain of an equipment

- Select the Equipment Menu > Maintenance > OAM-FM Domain command.

The OAM-FM Domain contextual area opens where the name and level of the OAM domain of the equipment are displayed Fig.186.

![Fig.186 - OAM-FM Domain contextual area](image_url)
If the Domain field is empty and available for the setting, this means that no OAM domain is defined for the equipment. To define an OAM domain for an equipment:

- Select the Equipment Menu > Maintenance > OAM-FM Domain command. The OAM-FM Domain contextual area opens (see Fig.186).
- Into the Domain box, type the OAM domain name of the equipment (alphanumeric string with minimum 1 and maximum 45 characters).
- Move the cursor Level over a number between 0 and 7 according to the priority level you wish to assign to the OAM domain (0: lowest priority, 7: highest priority).
- Press Create.

The equipment is associated to the set OAM domain.

30.2 OAM-FM MA/MEP

This command is available only if an OAM domain has been defined for the equipment (see Fig.186). The OAM-FM MA/MEP command manages the maintenance points of the OAM domain of the equipment.

To verify the status of the VLANs as regards the OAM Ethernet protocol:

- Select the Equipment Menu > Maintenance > OAM-FM MA/MEP command. The OAM-FM MA/MEP contextual area opens, pointing out the status of the VLANs in relation to the OAM Ethernet protocol.

Fig.187 - OAM-FM MA/MEP contextual area

Every VLAN is represented by a rectangle whose characteristics are described here below (see Fig.188).

Fig.188 - Vlan status and commands
30.3 VLAN IDENTIFIER - VLAN NAME - ETHERNET SWITCH PORT

Status of the port as regards the transit of packets with VLAN ID equal to that of the VLAN:

- ----, the port is not enabled to the transit of the packets with VLAN ID equal to that of the virtual Lan, other possible settings are: Untag, Tagged, Unmodif.

Name of the MA (Maintenance Association) associated to the VLAN.

Identifier of the MEP (Maintenance End Point) associated to the VLAN.

Only one VLAN at a time can be selected.

The VLAN must be into the range 2-4094 to be into OAM functionality.

Push-buttons:

- **Bind MA.** Creates a MA and MIP.
- **Bind MEP.** Creates a MEP.
- **Unbind.** Removes the MA and/or the MEP associated to the VLAN.

The availability of the push-buttons depends on the status of the selected VLAN.

If a MA or a MEP is associated to the VLAN, only the **Unbind** push-button will be available.

In Fig.187 the arrow shows direction of messages, in this case the messages are sent into the equipment at Lan 3 port. Further details can be found into Help on-line of WebLct for ALCplus2.
31  LINE-UP ELP

31.1  ETHERNET LINE PROTECTION (ELP)

The Ethernet Line Protection (ELP) is a function which allows implementing a protection at physical level (Level 2) between two or more LAN external ports.

When the user enables the Ethernet line protection, even the management of the ELP switch is enabled. The switch operates in automatic mode: the equipment executes the switch when the LOS alarm is present on the LAN port in service. When the alarm clears, the controller does not execute the switch again.

The Ethernet line protection is implemented by means of proprietary protocol. As consequence, the ELP switch is managed without considering alarms or settings executed on the equipment on the other side of the LAN connection.

In ALCplus2 equipment, the line Ethernet protection can be enabled at equipment level or at node level. This last chance is available and meaningful only for the equipment belonging to an ALCplus2 node and which are interconnected to other node elements through the nodal Bus Ethernet.

Fig.189 - ELP Enabling Protection

There are two groups of protection: Protection1 and Protection2. One group may have Lan1…Lan4 up to 4 ports. Normal situation is two ports on Protection1 and two ports on Protection2. Protection1 can go to one IDU Protection2 to a second IDU. Selection between ports is based on priority and cost.

The port with highest priority (that is lowest number) is selected. The port with lowest cost is selected (ports with same speed, as the protected two, have same cost).
32 LINE-UP ACL

32.1 ACCESS CONTROL LIST (ACL)

Access Control List (ACL) permits to define a list of IP address allowed to control the equipment.

It is possible to define some address or a range of address.

It is possible to create a white list or a black list.

Before activating Enable please create the list of allowed IP address, see Fig.190.

After creating a correct list of allowed IP address it is possible to Enable the ACL, see Fig.191.

**Warning:** with no address into the list and Enable active no computer can access the equipment via Lan. With USB cable it is always possible to access the equipment.

ACL is effective only on local equipment, remote equipment reached by routing are not affected by local ACL.

![Fig.190 - Inserting allowed IP address](image-url)
Fig. 191 - List of allowed IP address

<table>
<thead>
<tr>
<th>Name</th>
<th>IP Address</th>
<th>Mask</th>
<th>Permission</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACL-1</td>
<td>192.168.76.34</td>
<td>255.255.0.0</td>
<td>allow</td>
</tr>
</tbody>
</table>
33 LINE-UP SYNCHRONISATION

33.1 LINE-UP SYNCHRONISATION

With reference to Fig.192 let’s do the examples:

![Diagram of line-up synchronisation](image)

**Fig.192 - Sync transmitted from local to remote radio**

Examples:

1. Synchronisation is coming from Lan3 local (working at 14 Gbit) and it is exiting from Lan3 on remote radio.
2. Synchronisation is coming from E1 tributary 1 and it is exiting from E1 tributary 1 on remote radio.

33.2 Synchronisation from Lan3 at 1Gbit/s

The starting point is that local SETS circuit is synchronised by an external source which may be one of the sources shown in the picture so also Lan3 or Tributary 1. Sources can be one or many with different priority.
Synchronization signal is transmitted from local radio to remote radio via radio frame timing. Remote SETS is synchronised by incoming radio frame generated by local SETS that is with SDH quality. All local signals are generated by SETS and will have the same frequency precision and stability.

Settings at local radio:
See Fig.193.
With WebLct go to Configurator -> Sync Enable -> Enable, press Apply and Confirm. Now into Equipment Menu a new item Synchronization is available.

See Fig.194 into Synchronization the system is synchronised from Internal Source.

See Fig.195, now select TE-Lan3 and select Enabled with priority 1 which is the maximum.

See Fig.196, now if Lan3 is connected to a Lan port working at 1Gbit, the SETS is synchronised by Lan 3. But Lan 3 Interface must be programmed as Slave and external Lan port must be programmed as Master (for Gbit clock).

Now if local radio is receiving a correct signal, the SETS is synchronized by Lan 3 as in Fig.197

Settings at remote radio:
On remote radio enable synchronization as Fig.193.

On remote radio into Synchronization SETS folder select Radio and Enable with Priority 1. See Fig.198.

Now if remote radio is receiving a correct signal the SETS is synchronized by radio as in Fig.199.

33.3 SYNCHRONIZATION FROM E1

See Fig.200.

E1 tributary N is used as a signal transfer and a synchronization source for external equipment into remote site.

Local SETS is synchronised by E1 Trib. 1. Remote radio SETS is synchronised by receiving radio frame.

We must Enable E1 Retiming so the E1 Trib. 1 at remote site can be used by external equipment as an SDH synchronism source as in Fig.201.
Fig. 193

Fig. 194
Fig. 197

Fig. 198
E1Trib1 used as 2Mbit timing source on remote for external equipment, needs E1 retiming = Enabled on remote

Local = SETS synchronised by TRIB1
Remote = SETS synchronised by Radio, TRIB1 distributing synchronisation (and data) to external equipment

Fig. 199

Fig. 200 - E1 retiming
Fig. 201
Section 5. MAINTENANCE

34 ALARMS AND TROUBLESHOOTING

34.1 GENERAL

In these pages a description of alarms is given in order to help operators to perform equipment troubleshooting.

34.2 FAULTY CONDITION

A faulty condition is pointed out by LEDs on front panel (alarm area) or by alarms reported by management software. Power ON LEDs are not considered (equipment are ON).

34.2.1 Front panel LEDs

ALplus2

- FAIL: controller self test failed (red LED)
- PoE: Power Over Ethernet enabled (green LED)
- URG: critical and/or major alarms (red LED)
- NURG: minor and/or warning alarms (red LED)
- SW: firmware mismatch (red LED)
- TEST: local manual operation active (yellow LED).
**34.2.2 SCT/WEBLCT alarm window**

**SCT**

Active and old alarms can be monitored in Event History Log area, with alarm correlation between starting and clearing time. Alarms are from all the equipment reached by SCT.

Active alarms only, can be monitored in Current Alarms window. Alarms are from selected equipment only.

**WEBLCT**

In Event List area of WEBLCT all alarms are listed, local ones on the left, remote ones on the right (.... if Remote List is well configured).

Moving the mouse over an alarm, its starting time, severity and group information are pointed out. There is correlation between starting and clearing time.

**34.2.3 Direction of an alarm**

When an alarm occurs, its origin can be hardware or can be a problem caused by failures or a bad situation (propagation and/or configuration mismatch) in previous parts of the equipment: an alarm can be caused by previous alarms and, not only, the same alarm can produce further alarms.

In this way, it's important to understand the direction of the problem described by alarms.

**Tx direction, from LIM to ODU flange**

A problem in LIM can cause alarms in ODU also: when a situation of more alarms is occurring, the most significant alarm is at the beginning of Tx chain, all the others following are due to this.

**Rx direction, from ODU flange to LIM**

A problem in ODU, or in far end terminal, can cause alarms in LIM also: when a situation of more alarms is occurring, the most significant alarm is at the beginning of Rx chain, all the others following are due to this.

**34.2.4 Alarms group**

Alarms are divided in groups regarding the module that has generated them or the described function.
Common
Alarms related to Controller module and EOC channel.

ETH LAN
Alarms (internal and external) regarding Ethernet traffic and relevant ports.

LIM
Alarms coming from LIM failure or from:
- Tx direction - external failure (tributary LOS)
- Rx direction - alarms in previous module (RIM, ODU) or external failure (bad propagation or remote alarmed or no remote)

Node
Alarm relevant the connections between the IDUs composing the node.

Performance Monitoring
Alarms regarding all measurements performed in Performance Monitoring section.

Plug-in module
Alarms relevant the plug-in modules used for STM-1 lines.

Port service
Alarms relevant the service ports used in the link.

Radio
Alarms not relevant to a specific module but relevant to the link.

RIM
Alarms coming from RIM failure or from:
- Tx direction - alarm in previous module (LIM) or external failure (tributary LOS)
- Rx direction - alarms in previous module (IDU-ODU cable, ODU) or external failure (bad propagation or remote alarmed or no remote)

RT
Alarms coming from RT (ODU) failure or from:
- Tx direction - alarms in previous module (LIM, RIM, IDU-ODU cable) or external failure (tributary LOS)
- Rx direction - external failure (bad propagation or remote alarmed or no remote)
SETS

Alarms (internal and external) relevant to the synchronization sources and their setting.

SNTP

Alarms regarding the SNTP server.

STM1

Alarms (internal and external) relevant to STM1 stream, line side.

34.3 ALARMS

Each alarm is ordered group by group with the following explanations:

- hardware causes of the alarm
- alarms that could have generated the alarm (if any)
- alarms generated by the alarm (if any).

Alarms list is ordered as in the following tables.

34.3.1 Common alarms

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Causes</th>
<th>Alarms that could have generated the alarm</th>
<th>Alarm generated</th>
</tr>
</thead>
<tbody>
<tr>
<td>2Mb/s G704 Line Side AIS</td>
<td>Trib with EOC has AIS</td>
<td>EOC trib LOS</td>
<td></td>
</tr>
<tr>
<td>2Mb/s G704 Line Side Fail</td>
<td>Trib with EOC is missing</td>
<td>EOC trib LOS</td>
<td></td>
</tr>
<tr>
<td>2Mb/s G704 Radio Side AIS</td>
<td>Trib with EOC has AIS from remote</td>
<td>EOC trib LOS</td>
<td></td>
</tr>
<tr>
<td>2Mb/s G704 Radio Side Fail</td>
<td>Trib with EOC is missing from remote</td>
<td>EOC trib LOS</td>
<td></td>
</tr>
<tr>
<td>Comm. 2Mb/s EOC Data Link</td>
<td>Trib with EOC is missing</td>
<td>EOC trib LOS</td>
<td></td>
</tr>
<tr>
<td>Comm. Radio EOC Data Link</td>
<td>Link EOC is missing</td>
<td>Link ID</td>
<td></td>
</tr>
<tr>
<td>Controller waiting for restore</td>
<td>Configuration mismatch (download backup)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equip. Man Op</td>
<td>Manual operation active (check list)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAN Cable Fail</td>
<td>EOC LAN cable missing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RMON (Remote Monitoring)</td>
<td>Statistic Counter Ethernet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan</td>
<td>Rear Fans Failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rescue setup Active</td>
<td>Equipment in Rescue mode</td>
<td>Telemetry Fail</td>
<td></td>
</tr>
<tr>
<td>OAM FM MEP</td>
<td>MEP not receiving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OAM FM MEP config.</td>
<td>MEP not configured properly</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
34.3.2 ETH LAN alarms

Tab.37 - ETH LAN alarms - ALplus2/ALCplus2/ALCplus2e

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link loss</td>
<td>Loss of Ethernet signal</td>
</tr>
<tr>
<td>Sync</td>
<td>Gigabit frame not aligned</td>
</tr>
<tr>
<td>Auto Negotiation</td>
<td>Auto negotiation failed</td>
</tr>
<tr>
<td>Link loss forwarding</td>
<td>Link loss in remote ports</td>
</tr>
<tr>
<td>Master Slave Configuration</td>
<td>Configuration error</td>
</tr>
<tr>
<td>Lag Lacp Protocol Down</td>
<td>Link aggregation not working</td>
</tr>
</tbody>
</table>

34.3.3 LIM alarms

Tab.38 - LIM alarms - ALplus2/ALCplus2/ALCplus2e

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trib Signal Loss</td>
<td>Enabled trib missing or disabled trib present</td>
</tr>
<tr>
<td>Trib AIS</td>
<td>AIS present in input</td>
</tr>
<tr>
<td>Modulator Fail</td>
<td>Modulator fail or without/low quality input</td>
</tr>
<tr>
<td>Demodulator Fail</td>
<td>Demodulator fail or without/low quality input</td>
</tr>
<tr>
<td>ODU-IDU communication fail</td>
<td>Signal from ODU missing</td>
</tr>
<tr>
<td>Synch</td>
<td>Trib. Retiming not working</td>
</tr>
<tr>
<td>Temperature</td>
<td>IDU temperature &gt; 75°C</td>
</tr>
<tr>
<td></td>
<td>Alarm generated</td>
</tr>
<tr>
<td></td>
<td>Fan</td>
</tr>
</tbody>
</table>

34.3.4 Node alarms

Tab.39 - Node alarms - ALCplus2/ALCplus2e

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los</td>
<td>NBUS cable missing</td>
</tr>
<tr>
<td>Lof</td>
<td>FAW not recognized</td>
</tr>
<tr>
<td>MsAis</td>
<td>MsAIS in NBUS frame payload</td>
</tr>
<tr>
<td>Check</td>
<td>Wrong NBUS connection order between IDUs</td>
</tr>
<tr>
<td>Config. Mismatch</td>
<td>Wrong Node configuration</td>
</tr>
<tr>
<td></td>
<td>Alarm generated</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ALS ALplus2, ALCplus2, ALCplus2e - MN.00224.E - 005
34.3.5 Performance Monitoring alarms

The following list of measurements can generate alarms if their thresholds are exceeded for a configurable amount of seconds (regarding periods of 15 minutes or 24 hours):

- G828 radio quality measurements on signal radio received
- G828 LimA E1 line side quality measurements on E1 line side
- G828 LimA E1 radio side quality measurements on E1 radio side
- Rx Pwr radio Rx power measurements
- Tx Pwr radio Tx power measurements
- ACM radio ACM profile monitoring
- G.829 RST B1 quality measurements on RST (STM1)
- G.829 MST B2 M1 quality measurements on MST (STM1)
- G.828 VC12 quality measurements on VC12 (STM1)

34.3.6 Plug-in alarms

The following alarms describe the plug-in status:

- status change
- module mismatch
- module
- los

34.3.7 Radio alarms

Tab. 40 - Radio alarms - ALplus/ALCplus2/ALCplus2e

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Causes</th>
<th>Alarms that could have generated the alarm</th>
<th>Alarm generated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link ID</td>
<td>Wrong ID received</td>
<td>Link Telemetry Fail</td>
<td></td>
</tr>
<tr>
<td>Link Telemetry Fail</td>
<td>Radio link missing</td>
<td>Link ID</td>
<td>Comm, radio EOC data link</td>
</tr>
<tr>
<td>Revertive</td>
<td>Radio link working on reserve branch</td>
<td>Alarms of the preferential branch</td>
<td></td>
</tr>
<tr>
<td>Tx Fail</td>
<td>Tx switch on remote Ber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRBS Fail</td>
<td>PRBS not receiving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced Capacity</td>
<td>Degraded radio link capacity (Actual Tx modulation ≠ Upper modulation)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 34.3.8 RIM alarms

**Tab.41 - Radio alarms - ALplus/ALCplus2/ALCplus2e**

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Causes</th>
<th>Alarms that could have generated the alarm</th>
<th>Alarm generated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply</td>
<td>48 Vdc input missing, dc output not compliant</td>
<td></td>
<td>RF unit not responding</td>
</tr>
<tr>
<td>Cable Open</td>
<td>IDU-ODU cable cut or not connected</td>
<td></td>
<td>RF unit not responding/Comm. fail</td>
</tr>
<tr>
<td>Cable Short</td>
<td>IDU-ODU cable damaged (shortened)</td>
<td></td>
<td>RF unit not responding/Comm. fail</td>
</tr>
<tr>
<td>Cable Open and Short (both active)</td>
<td>Power supply is weak</td>
<td></td>
<td>RF unit not responding/Comm. fail</td>
</tr>
</tbody>
</table>

### 34.3.9 RT alarms

**Tab.42 - RT alarms - ALplus/ALCplus2/ALCplus2e**

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Causes</th>
<th>Alarms that could have generated the alarm</th>
<th>Alarm generated</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDU-ODU communication</td>
<td>RT o relevant RIM damaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rx power low</td>
<td>Rx signal lower than Rx threshold</td>
<td>Remote Tx not working/ Bad propagation</td>
<td>LIM quality alarms</td>
</tr>
<tr>
<td>Tx power low</td>
<td>RT failure if Tx is ON</td>
<td>Man Op (Tx Off), Modulator fail</td>
<td></td>
</tr>
<tr>
<td>IF fail</td>
<td>RT failure if Tx is ON</td>
<td>Man Op (Tx Off), Modulator fail</td>
<td></td>
</tr>
<tr>
<td>RT VCO fail</td>
<td>RT failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rx quality alarm</td>
<td>BER ≈ 10^-6</td>
<td>Bad propagation</td>
<td></td>
</tr>
<tr>
<td>Rx quality warning</td>
<td>BER ≈ 10^-10</td>
<td>Bad propagation</td>
<td></td>
</tr>
<tr>
<td>IF out</td>
<td>Rx IF missing</td>
<td></td>
<td>Demod fail</td>
</tr>
</tbody>
</table>

### 34.3.10 SETS alarms

**Tab.43 - SETS alarms - ALplus/ALCplus2/ALCplus2e**

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0Fail</td>
<td>T0 missing</td>
</tr>
<tr>
<td>FreeRunning</td>
<td>Equipment in FreeRunning status</td>
</tr>
<tr>
<td>Holdover</td>
<td>Equipment in Holdover status</td>
</tr>
<tr>
<td>SynkLos</td>
<td>Selected Synch missing</td>
</tr>
<tr>
<td>SynkDrift</td>
<td>Selected Synch bad quality</td>
</tr>
</tbody>
</table>
34.3.11 SNTP alarms

Tab.44 - SNTP alarms - ALplus2/ALCplus2/ALCplus2e

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unicast Server Lost</td>
<td>Server is missing</td>
</tr>
</tbody>
</table>

34.3.12 STM1 alarms

Tab.45 - STM1 alarms - ALplus2/ALCplus2/ALCplus2e

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Causes</th>
<th>Alarms that could have generated the alarm</th>
<th>Alarm generated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los</td>
<td>Enabled trib missing or disabled trib present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lof</td>
<td>FAW not recognised</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B2ExcessiveBer</td>
<td>Excessive BER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B2SignalDegraded</td>
<td>Signal degraded</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J0TraceIdentifierMismatch</td>
<td>J0 received is not the expected one</td>
<td></td>
<td>EOC alarm</td>
</tr>
<tr>
<td>MsAis</td>
<td>AIS in Multiplexer section</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MsRdi</td>
<td>RDI in Multiplexer section</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Section 6.
PROGRAMMING AND SUPERVISION

35   PROGRAMMING AND SUPERVISION

35.1   GENERAL

The radio equipment was designed to be easily programmed and supervised.
The following tools are implemented to the purpose:

- SCT Subnetwork Craft Terminal + WEB LCT Local Craft Terminal. They are used for remote and local
  control of a subnetwork consisted of a maximum of 100 radio equipment.
- NMS5–UX Network Management. It is used for the remote control of an entire network consisted of
  different SIAE equipment including radio equipment.

For details refer to relevant documentation. SCT/LCT documentation is available as help on-line.

35.2   WEBLCT

Equipment can be locally controlled by an embedded Web Server, the WEB LCT, and an http browser run-
ning on PC.

It is also available a software named SCT that can manage sub networks of SIAE Network Elements.
The hardware platform used by SCT is based on Personal Computer with at least the following character-
istics:

- HD with 100 Mbyte of free space
- Windows XP/Windows Vista
- Flash Player version 8.1 or higher
Fault Management

The operator can check the status the equipment through an "Alarm Display Panel" that is automatically updated by the system.

Alarm records are stored by the equipment in an history log together with all information which could be of interest for the user, among which:

- event occurrence date and time
- equipment type and address
- unit identification information
- alarm description
- event severity level

The operator can access the history log using different filters.

Equipment Configuration

The configuration parameters the operator can update from the WebLCT are:

- System type (protected or not protected)
- Channel bandwidth
- ACM profiles
- RF channel
- ATPC enable/disable
- ATPC Rx thresholds
- RTPC
- Rx power alarm threshold
- Tributary port enable/disable
- STM-1, VC4 and VC12 parameters
- E1 cross connection matrix
- Ethernet switch parameters
- Synchronisation parameters
- Alarm enable
- Alarm severity
- User inputs and relay configuration
- TMN port configuration

Equipment Maintenance

The main maintenance parameters that the operator can update from the WebLCT are:

- transmitter enable/disable
- carrier only
- loops\(^5\) (see Fig.202)
- active state forcing in 1+1 configuration
- PRBS

The following figure shows the loops that can be set from the WEBLCT, for any IDU configuration.

---

5 Line loops can be done for E1, STM-1 and Ethernet interfaces. Internal loops can be done for E1 and STM-1 interfaces.
Software management

A new firmware or a new WEBLCT release can be downloaded from the WEBLCT itself. Actual software release is reported to the operator.

Performance management

G828, Rx Power, Tx Power and ACM counters are calculated both on radio side and line side.

All counters are available on 15 minutes basis and daily, the WEBLCT collects 16 blocks of 15 minutes counters showing in this way the history of 4 hours.

The user can start and stop the Performance Monitoring function.

The user can define a threshold for each counter, when the threshold is crossed an alarm is set by the equipment, the performance alarm severity can be set by the operator.

Fig.203 reports all the Termination points for the performance monitoring supported by ALplus2.
In addition to what shown in the figure above, the following performance monitoring features are available:

- RMON for Ethernet port statistics, both on tributary and radio side
- ACM performance monitoring counters

**Security Management**

The WEBLCT Administrator creates and manages a set of user accounts, the security information (Password and User profile) is used for identification, authentication purpose.

Two operator levels are enabled depending on the profile assigned to the operator:

- **System**: read and write user - full privilege level allows the operator to perform all the available options.
- **RLOM**: read only user - partial privilege level allows the operator to read alarm and configuration parameters and maintenance commands (e.g. force switch over in 1+1 systems).
Section 7.
COMPOSITION

36 COMPOSITION OF ALPLUS2 IDU

36.1 GENERAL

The ALplus2 IDU is available in following versions:
- 1RU 1+0
- 1RU 1+1
- 1RU 2+0

All the units consist of plug-in modules as LIM/RIM/Controller that can individually be replaced.
Module part number, hardware layout and equipment composition are subject to change without notice.

36.2 IDU PART NUMBER

Every version is identified by a specific part number shown on a label (see Fig.206) attached on IDU, top left side. Important power supply informations are also written.
The P/N consists of seven digits with the following meaning:
36.3 COMPOSITION OF THE INDOOR UNIT

1+0/1+1/2+0 Ethernet version

The IDU consists of LIM/RIM/CONTROLLER modules. Each module is identified through internal label indicating the relevant P/N.

The P/Ns are the following:
- LIM
- RIM
- CONTROLLER.

<table>
<thead>
<tr>
<th>Digit</th>
<th>Letter/number</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G</td>
<td>Functional assembly of units completed by a mechanical structure</td>
</tr>
<tr>
<td>2</td>
<td>A</td>
<td>AL equipment</td>
</tr>
<tr>
<td>3</td>
<td>I</td>
<td>Indoor installation</td>
</tr>
<tr>
<td>4 to 7</td>
<td>0165</td>
<td>Modular 1+0 - 1 unit - 16E1 + 2xSTM1 + 3GE</td>
</tr>
<tr>
<td></td>
<td>0166</td>
<td>Modular 1+1 - 1 unit - 16E1 + 2xSTM1 + 3GE</td>
</tr>
</tbody>
</table>

Fig.204 - IDU GAI0165

Fig.205 - IDU GAI0166
Fig.206 - IDU P/N
37 COMPOSITION OF ALCPLUS2 IDU

37.1 GENERAL

The ALCplus2 IDU is available in many versions depending on the kind and the number of user connections and facilities.

The versions are listed in the following chapter and are offered in two different configuration:

- 1RU  1+0
- 1RU  1+1.
- All of them consist of a single unit.
- Unit part number, hardware layout and equipment composition are subject to change without notice.

37.2 IDU PART NUMBER

Every version is identified by a specific part number shown on a label (see Fig.206) attached on IDU, top left side. Important power supply informations are also written.

- ALCplus2  1+0 4GE  2xE1 GAI0157 (see Fig.207)
- ALCplus2  1+1 4GE  2xE1 GAI0152 (see Fig.208)
- ALCplus2  1+0 4GE  18xE1 GAI0155 (see Fig.209)
- ALCplus2  1+1 4GE  18xE1 GAI0156 (see Fig.210)
- ALCplus2  1+0 4GE  34E1  2xSTM1 GAI0169 (see Fig.211)
- ALCplus2  1+1 4GE  34E1  2xSTM1 GAI0168 (see Fig.212)
- ALCplus2  1+0 4GE  18E1  2xSTM1 Nodal GAI0163 (see Fig.213)
- ALCplus2  1+1 4GE  18E1  2xSTM1 Nodal GAI0162 (see Fig.214)
Fig.209 - ALCplus2 1+0 exp 16E1

Fig.210 - ALCplus2 1+1 exp 16E1

Fig.211 - ALCplus2 1+0 32E1

Fig.212 - ALCplus2 1+1 32E1

Fig.213 - ALCplus2 1+0 exp nodal

Fig.214 - ALCplus2 1+1 exp nodal
38 COMPOSITION OF ALCPLUS2E IDU

38.1 GENERAL

The ALCplus2e IDU is available in many versions depending on the kind and the number of user connections and facilities.

The versions are listed in the following chapter and are offered in two different configurations:

- 1RU 1+0
- 1RU 1+1.
- 2RU 2x(1+1).
- Unit part number, hardware layout and equipment composition are subject to change without notice.

38.2 IDU PART NUMBER

Every version is identified by a specific part number shown on a label (see Fig. 206) attached on IDU, top left side. Important power supply informations are also written.

<table>
<thead>
<tr>
<th>1+0</th>
<th>ALCplus2e 1+0 4GE 2xE1</th>
<th>GAI0178</th>
<th>See Fig. 215</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ALCplus2e 1+0 4GE 34xE1 2xSTM1</td>
<td>GAI0177</td>
<td>See Fig. 216</td>
</tr>
<tr>
<td></td>
<td>ALCplus2e 1+0 4GE 18xE1 2xSTM1 NODAL</td>
<td>GAI0176</td>
<td>See Fig. 217</td>
</tr>
<tr>
<td>EPP</td>
<td>ALCplus2e 1+0 4GE 2xE1 EPP</td>
<td>GAI0189</td>
<td>See Fig. 215</td>
</tr>
<tr>
<td></td>
<td>ALCplus2e 1+0 4GE 34xE1 2xSTM1 EPP</td>
<td>GAI0188</td>
<td>See Fig. 216</td>
</tr>
<tr>
<td></td>
<td>ALCplus2e 1+0 4GE 18xE1 2xSTM1 NODAL EPP</td>
<td>GAI0187</td>
<td>See Fig. 217</td>
</tr>
<tr>
<td>2+0/1+1</td>
<td>ALCplus2 2+0/1+1 4GE 2xE1</td>
<td>GAI0175</td>
<td>See Fig. 218</td>
</tr>
<tr>
<td>EPP</td>
<td>ALCplus2e 2+0/1+1 4GE 34xE1 2xSTM1</td>
<td>GAI0174</td>
<td>See Fig. 219</td>
</tr>
<tr>
<td></td>
<td>ALCplus2e 2+0/1+1 4GE 18xE1 2xSTM1 NODAL</td>
<td>GAI0173</td>
<td>See Fig. 220</td>
</tr>
<tr>
<td></td>
<td>ALCplus2e 2+0/1+1 4GE 2xE1 EPP</td>
<td>GAI0186</td>
<td>See Fig. 218</td>
</tr>
<tr>
<td></td>
<td>ALCplus2e 2+0/1+1 4GE 34xE1 2xSTM1 EPP</td>
<td>GAI0185</td>
<td>See Fig. 219</td>
</tr>
<tr>
<td></td>
<td>ALCplus2e 2+0/1+1 4GE 18xE1 2xSTM1 NODAL EPP</td>
<td>GAI0184</td>
<td>See Fig. 220</td>
</tr>
</tbody>
</table>
Fig.219 - ALCplus2e 2+0/1+1 4GE 34xE1 2xSTM1

Fig.220 - ALCplus2e 2+0/1+1 4GE 18E1 2xSTM1 NODAL
39 COMPOSITION OF OUTDOOR UNIT

39.1 GENERAL

The ODU consists of a mechanical structure that houses all the transceiver circuitry. In 1+1 HSB version the connection to the antenna is performed through a passive hybrid.

Both transceiver and hybrid are offered in different versions depending on the operating bands, the antenna configuration etc...

A label (see Fig.221) attached on the ODU structure shows the most significant parameters as go/return frequency value, subband, operating band and part number.

Part number identifies the ODU type. ODU description in the following tables shows frequency, go-return, channel and capacity if specified.

For example:

- ODU AS 11/530 ITU CH9L 2xSTM1 means:
  ODU 11 GHz band frequency, 530 MHz go-return, CH9 Low fixed preset, 2xSTM1 capacity

- ODU AS 23/1008 SB 2H means:
  ODU 23 GHz band frequency, 1008 MHz go-return, 2 high subband.

In Tab.47 and Tab.48 various ODU versions and hybrid part number are listed.

Part number, hardware layout and equipment composition are subject to change without notice.

<table>
<thead>
<tr>
<th>RF band in GHz</th>
<th>ODU description</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ODU AS6L CH=1H</td>
<td>GE9185</td>
</tr>
<tr>
<td></td>
<td>ODU AS6L CH=1H</td>
<td>GE9185-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6L CH=1L</td>
<td>GE9184</td>
</tr>
<tr>
<td></td>
<td>ODU AS6L CH=1L</td>
<td>GE9184-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6L CH=2H</td>
<td>GE9187</td>
</tr>
<tr>
<td></td>
<td>ODU AS6L CH=2H</td>
<td>GE9187-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6L CH=2L</td>
<td>GE9186</td>
</tr>
<tr>
<td></td>
<td>ODU AS6L CH=2L</td>
<td>GE9186-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6L CH=3H</td>
<td>GE9189</td>
</tr>
<tr>
<td></td>
<td>ODU AS6L CH=3H</td>
<td>GE9189-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6L CH=3L</td>
<td>GE9188</td>
</tr>
<tr>
<td></td>
<td>ODU AS6L CH=3L</td>
<td>GE9188-03</td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>ODU AS6L CH=4H</td>
<td>GE9191</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=4H</td>
<td>GE9191-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=4L</td>
<td>GE9190</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=4L</td>
<td>GE9190-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=5H</td>
<td>GE9192</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=5H</td>
<td>GE9193-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=5L</td>
<td>GE9192-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=6H</td>
<td>GE9195</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=6H</td>
<td>GE9195-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=6L</td>
<td>GE9194</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=6L</td>
<td>GE9194-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=7H</td>
<td>GE9197</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=7H</td>
<td>GE9197-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=7L</td>
<td>GE9196</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=7L</td>
<td>GE9196-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=8H</td>
<td>GE9199</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=8H</td>
<td>GE9199-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=8L</td>
<td>GE9198</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L CH=8L</td>
<td>GE9198-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L SB=1H</td>
<td>GE9269</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L SB=1H</td>
<td>GE9269-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L SB=1L</td>
<td>GE9268</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L SB=1L</td>
<td>GE9268-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L SB=2H</td>
<td>GE9271</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L SB=2H</td>
<td>GE9271-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L SB=2L</td>
<td>GE9270</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L SB=2L</td>
<td>GE9270-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L SB=3H</td>
<td>GE9273</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L SB=3H</td>
<td>GE9273-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L SB=3L</td>
<td>GE9272</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L SB=3L</td>
<td>GE9272-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L SB=4H</td>
<td>GE9275</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L SB=4H</td>
<td>GE9275-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L SB=4L</td>
<td>GE9274</td>
<td></td>
</tr>
<tr>
<td>ODU AS6L SB=4L</td>
<td>GE9274-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS6U CH=1H</td>
<td>GE9291</td>
<td></td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=1H</td>
<td>GE9291-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=1L</td>
<td>GE9290</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=1L</td>
<td>GE9290-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=2H</td>
<td>GE9293</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=2H</td>
<td>GE9293-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=2L</td>
<td>GE9292</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=2L</td>
<td>GE9292-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=3H</td>
<td>GE9295</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=3H</td>
<td>GE9295-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=3L</td>
<td>GE9294</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=3L</td>
<td>GE9294-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=4H</td>
<td>GE9297</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=4H</td>
<td>GE9297-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=4L</td>
<td>GE9296</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=4L</td>
<td>GE9296-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=5H</td>
<td>GE9299</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=5H</td>
<td>GE9299-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=5L</td>
<td>GE9298</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=5L</td>
<td>GE9298-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=6H</td>
<td>GE9301</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=6H</td>
<td>GE9301-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=6L</td>
<td>GE9300</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=6L</td>
<td>GE9300-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=7H</td>
<td>GE9302</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=7H</td>
<td>GE9302-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=7L</td>
<td>GE9305</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=7L</td>
<td>GE9305-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=8H</td>
<td>GE9304</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=8H</td>
<td>GE9304-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=8L</td>
<td>GE9285</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U CH=8L</td>
<td>GE9285-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U SB=1L</td>
<td>GE9284</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U SB=1L</td>
<td>GE9284-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U SB=2H</td>
<td>GE9287</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U SB=2H</td>
<td>GE9287-03</td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>6</td>
<td>ODU AS6U SB=2L</td>
<td>GE9286</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U SB=2L</td>
<td>GE9286-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U SB=3H</td>
<td>GE9289</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U SB=3H</td>
<td>GE9289-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U SB=3L</td>
<td>GE9288</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U SB=3L</td>
<td>GE9288-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U SB=4H</td>
<td>GE9331</td>
</tr>
<tr>
<td></td>
<td>ODU AS6U SB=4L</td>
<td>GE9330</td>
</tr>
<tr>
<td></td>
<td>ODU AS7H/245 SB=1H</td>
<td>GE9137</td>
</tr>
<tr>
<td></td>
<td>ODU AS7H/245 SB=1H</td>
<td>GE9137-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7H/245 SB=1L</td>
<td>GE9136</td>
</tr>
<tr>
<td></td>
<td>ODU AS7H/245 SB=1L</td>
<td>GE9136-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7H/245 SB=2H</td>
<td>GE9139</td>
</tr>
<tr>
<td></td>
<td>ODU AS7H/245 SB=2H</td>
<td>GE9139-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7H/245 SB=2L</td>
<td>GE9138</td>
</tr>
<tr>
<td></td>
<td>ODU AS7H/245 SB=2L</td>
<td>GE9138-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7H/245 SB=3H</td>
<td>GE9141</td>
</tr>
<tr>
<td></td>
<td>ODU AS7H/245 SB=3H</td>
<td>GE9141-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7H/245 SB=3L</td>
<td>GE9140</td>
</tr>
<tr>
<td></td>
<td>ODU AS7H/245 SB=3L</td>
<td>GE9140-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/161 SB=1H</td>
<td>GE9253</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/161 SB=1H</td>
<td>GE9253-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/161 SB=1L</td>
<td>GE9252</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/161 SB=1L</td>
<td>GE9252-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/161 SB=2H</td>
<td>GE9255</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/161 SB=2H</td>
<td>GE9255-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/161 SB=2L</td>
<td>GE9254</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/161 SB=2L</td>
<td>GE9254-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/161 SB=3H</td>
<td>GE9257</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/161 SB=3H</td>
<td>GE9257-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/161 SB=3L</td>
<td>GE9256</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/161 SB=3L</td>
<td>GE9256-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/196 SB=1H</td>
<td>GE9009</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/196 SB=1H</td>
<td>GE9009-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/196 SB=1L</td>
<td>GE9008</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/196 SB=1L</td>
<td>GE9008-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7L/196 SB=2H</td>
<td>GE9011</td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>ODU AS7L/196 SB=2H</td>
<td>GE9011-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7L/196 SB=2L</td>
<td>GE9010</td>
<td></td>
</tr>
<tr>
<td>ODU AS7L/196 SB=2L</td>
<td>GE9010-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7L/196 SB=3H</td>
<td>GE9013</td>
<td></td>
</tr>
<tr>
<td>ODU AS7L/196 SB=3H</td>
<td>GE9013-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7L/196 SB=3L</td>
<td>GE9012</td>
<td></td>
</tr>
<tr>
<td>ODU AS7L/196 SB=3L</td>
<td>GE9012-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=10H</td>
<td>GE9329</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=10L</td>
<td>GE9328</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=10L</td>
<td>GE9328-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=1H</td>
<td>GE9173</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=1H</td>
<td>GE9173-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=1L</td>
<td>GE9172</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=1L</td>
<td>GE9172-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=2H</td>
<td>GE9175</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=2H</td>
<td>GE9175-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=2L</td>
<td>GE9174</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=2L</td>
<td>GE9174-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=3H</td>
<td>GE9177</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=3H</td>
<td>GE9177-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=3L</td>
<td>GE9176</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=3L</td>
<td>GE9176-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=4H</td>
<td>GE9179</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=4H</td>
<td>GE9179-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=4L</td>
<td>GE9178</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=4L</td>
<td>GE9178-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=5H</td>
<td>GE9181</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=5H</td>
<td>GE9181-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=5L</td>
<td>GE9180</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=5L</td>
<td>GE9180-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=7H</td>
<td>GE9323</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=7H</td>
<td>GE9323-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=7L</td>
<td>GE9322</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=7L</td>
<td>GE9322-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=8H</td>
<td>GE9325</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=8H</td>
<td>GE9325-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS7M/154 SB=8L</td>
<td>GE9324</td>
<td></td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/154 SB=8L</td>
<td>GE9324-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/154 SB=9H</td>
<td>GE9327</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/154 SB=9H</td>
<td>GE9327-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/154 SB=9L</td>
<td>GE9326</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/154 SB=9L</td>
<td>GE9326-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/161 SB=1H</td>
<td>GE9259</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/161 SB=1H</td>
<td>GE9259-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/161 SB=1L</td>
<td>GE9258</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/161 SB=1L</td>
<td>GE9258-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/161 SB=2H</td>
<td>GE9261</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/161 SB=2H</td>
<td>GE9261-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/161 SB=2L</td>
<td>GE9260</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/161 SB=2L</td>
<td>GE9260-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/161 SB=3H</td>
<td>GE9263</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/161 SB=3H</td>
<td>GE9263-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/161 SB=3L</td>
<td>GE9262</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/161 SB=3L</td>
<td>GE9262-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/168 SB=1H</td>
<td>GE9015</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/168 SB=1H</td>
<td>GE9015-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/168 SB=1L</td>
<td>GE9014</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/168 SB=1L</td>
<td>GE9014-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/168 SB=2H</td>
<td>GE9017</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/168 SB=2H</td>
<td>GE9017-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/168 SB=2L</td>
<td>GE9016</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/168 SB=2L</td>
<td>GE9016-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/168 SB=3H</td>
<td>GE9019</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/168 SB=3H</td>
<td>GE9019-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/168 SB=3L</td>
<td>GE9018</td>
</tr>
<tr>
<td></td>
<td>ODU AS7M/168 SB=3L</td>
<td>GE9018-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/266 SB=1H</td>
<td>GE9279</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/266 SB=1H</td>
<td>GE9279-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/266 SB=1L</td>
<td>GE9278</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/266 SB=1L</td>
<td>GE9278-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/266 SB=2H</td>
<td>GE9281</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/266 SB=2H</td>
<td>GE9281-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/266 SB=2L</td>
<td>GE9280</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/266 SB=2L</td>
<td>GE9280-03</td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/266 SB=3H</td>
<td>GE9283</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/266 SB=3H</td>
<td>GE9283-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/266 SB=3L</td>
<td>GE9282</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/266 SB=3L</td>
<td>GE9282-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/310 SB=1H</td>
<td>GE9145</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/310 SB=1H</td>
<td>GE9145-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/310 SB=1L</td>
<td>GE9144</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/310 SB=1L</td>
<td>GE9144-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/310 SB=2H</td>
<td>GE9147</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/310 SB=2H</td>
<td>GE9147-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/310 SB=2L</td>
<td>GE9146</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/310 SB=2L</td>
<td>GE9146-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/310 SB=3H</td>
<td>GE9149</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/310 SB=3H</td>
<td>GE9149-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/310 SB=3L</td>
<td>GE9148</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/310 SB=3L</td>
<td>GE9148-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=1H</td>
<td>GE9051</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=1H</td>
<td>GE9051-01</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=1H</td>
<td>GE9051-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=1L</td>
<td>GE9050</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=1L</td>
<td>GE9050-01</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=1L</td>
<td>GE9050-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=2H</td>
<td>GE9053</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=2H</td>
<td>GE9053-01</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=2H</td>
<td>GE9053-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=2L</td>
<td>GE9052</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=2L</td>
<td>GE9052-01</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=2L</td>
<td>GE9052-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=3H</td>
<td>GE9265</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=3H</td>
<td>GE9265-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=3L</td>
<td>GE9264</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=3L</td>
<td>GE9264-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=4H</td>
<td>GE9267</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=4H</td>
<td>GE9267-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=4L</td>
<td>GE9266</td>
</tr>
<tr>
<td></td>
<td>ODU AS8/311,32 SB=4L</td>
<td>GE9266-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS11 - G/R490 CH=9H</td>
<td>GE9129-03</td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>ODU AS11 SB=1H</td>
<td>GE9235</td>
</tr>
<tr>
<td></td>
<td>ODU AS11 SB=1H</td>
<td>GE9235-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS11 SB=1L</td>
<td>GE9234</td>
</tr>
<tr>
<td></td>
<td>ODU AS11 SB=1L</td>
<td>GE9234-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS11 SB=2H</td>
<td>GE9237</td>
</tr>
<tr>
<td></td>
<td>ODU AS11 SB=2H</td>
<td>GE9237-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS11 SB=2L</td>
<td>GE9236</td>
</tr>
<tr>
<td></td>
<td>ODU AS11 SB=2L</td>
<td>GE9236-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS11 SB=3H</td>
<td>GE9239</td>
</tr>
<tr>
<td></td>
<td>ODU AS11 SB=3H</td>
<td>GE9239-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS11 SB=3L</td>
<td>GE9238</td>
</tr>
<tr>
<td></td>
<td>ODU AS11 SB=3L</td>
<td>GE9238-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=10H</td>
<td>GE9131</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=10L</td>
<td>GE9130</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=11H</td>
<td>GE9133</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=11H</td>
<td>GE9133-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=11L</td>
<td>GE9132</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=11L</td>
<td>GE9132-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=12H</td>
<td>GE9135</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=12L</td>
<td>GE9134</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=1L</td>
<td>GE9113</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=1L</td>
<td>GE9112</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=2H</td>
<td>GE9115</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=2L</td>
<td>GE9114</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=3H</td>
<td>GE9117</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=3L</td>
<td>GE9116</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=4H</td>
<td>GE9119</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=4H</td>
<td>GE9119-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=4L</td>
<td>GE9118</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=4L</td>
<td>GE9118-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=5H</td>
<td>GE9121</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=5H</td>
<td>GE9121-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=5L</td>
<td>GE9120</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=5L</td>
<td>GE9120-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=6H</td>
<td>GE9123</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=6L</td>
<td>GE9122</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/490 CH=7H</td>
<td>GE9125</td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>ODU AS11/490 CH=7H</td>
<td>GE9125-03</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/490 CH=7L</td>
<td>GE9124</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/490 CH=7L 2XSTM1</td>
<td>GE9322</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/490 CH=8H</td>
<td>GE9127</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/490 CH=8H 2XSTM1</td>
<td>GE9324</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/490 CH=8L</td>
<td>GE9126</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/490 CH=8L 2XSTM1</td>
<td>GE9326</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/490 CH=9H</td>
<td>GE9129</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/490 CH=9L</td>
<td>GE9128</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/490 CH=9L 2XSTM1</td>
<td>GE9328</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=10H</td>
<td>GE9229</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=10L</td>
<td>GE9228</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=11H</td>
<td>GE9231</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=11L</td>
<td>GE9230</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=11L 2XSTM1</td>
<td>GE9330</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=12H</td>
<td>GE9233</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=12L</td>
<td>GE9232</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=12L 2XSTM1</td>
<td>GE9332</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=1H</td>
<td>GE9211</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=1L</td>
<td>GE9210</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=2H</td>
<td>GE9213</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=2L</td>
<td>GE9212</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=3H</td>
<td>GE9215</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=3H 2XSTM1</td>
<td>GE9333</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=3L</td>
<td>GE9214</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=3L 2XSTM1</td>
<td>GE9332</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=4H</td>
<td>GE9217</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=4L</td>
<td>GE9216</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=5H</td>
<td>GE9219</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=5H 2XSTM1</td>
<td>GE9335</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=5L</td>
<td>GE9218</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=5L 2XSTM1</td>
<td>GE9334</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=6H</td>
<td>GE9221</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=6L</td>
<td>GE9220</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=7H</td>
<td>GE9223</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=7H 2XSTM1</td>
<td>GE9337</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=7L</td>
<td>GE9222</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=7L 2XSTM1</td>
<td>GE9336</td>
<td></td>
</tr>
<tr>
<td>ODU AS11/530 ITU CH=8H</td>
<td>GE9225</td>
<td></td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>11</td>
<td>ODU AS11/530 ITU CH=8L</td>
<td>GE9224</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/530 ITU CH=9H</td>
<td>GE9227</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/530 ITU CH=9H 2XSTM1</td>
<td>GE9339</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/530 ITU CH=9L</td>
<td>GE9226</td>
</tr>
<tr>
<td></td>
<td>ODU AS11/530 ITU CH=9L 2XSTM1</td>
<td>GE9338</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=1H</td>
<td>GE9151</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=1H</td>
<td>GE9151-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=1L</td>
<td>GE9150</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=1L</td>
<td>GE9150-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=2H</td>
<td>GE9153</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=2H</td>
<td>GE9153-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=2L</td>
<td>GE9152</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=2L</td>
<td>GE9152-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=3H</td>
<td>GE9155</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=3H</td>
<td>GE9155-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=3L</td>
<td>GE9154</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=3L</td>
<td>GE9154-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=4H</td>
<td>GE9157</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=4H</td>
<td>GE9157-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=4L</td>
<td>GE9156</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=4L</td>
<td>GE9156-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=5H</td>
<td>GE9159</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=5H</td>
<td>GE9159-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=5L</td>
<td>GE9158</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=5L</td>
<td>GE9158-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=6H</td>
<td>GE9161</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=6H</td>
<td>GE9161-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=6L</td>
<td>GE9160</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=6L</td>
<td>GE9160-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=7H</td>
<td>GE9163</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=7H</td>
<td>GE9163-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=7L</td>
<td>GE9162</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=7L</td>
<td>GE9162-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=8H</td>
<td>GE9165</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=8H</td>
<td>GE9165-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=8L</td>
<td>GE9164</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 CH=8L</td>
<td>GE9164-03</td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>13</td>
<td>ODU AS13 SB=1H</td>
<td>GE9021</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 SB=1H</td>
<td>GE9021-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 SB=1L</td>
<td>GE9020</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 SB=1L</td>
<td>GE9020-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 SB=2H</td>
<td>GE9023</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 SB=2H</td>
<td>GE9023-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 SB=2L</td>
<td>GE9022</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 SB=2L</td>
<td>GE9022-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 SB=3H</td>
<td>GE9025</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 SB=3H</td>
<td>GE9025-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 SB=3L</td>
<td>GE9024</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 SB=3L</td>
<td>GE9024-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 SB=4H</td>
<td>GE9277</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 SB=4H</td>
<td>GE9277-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 SB=4L</td>
<td>GE9276</td>
</tr>
<tr>
<td></td>
<td>ODU AS13 SB=4L</td>
<td>GE9276-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15 CH=1H</td>
<td>GE9105</td>
</tr>
<tr>
<td></td>
<td>ODU AS15 CH=1L</td>
<td>GE9104</td>
</tr>
<tr>
<td></td>
<td>ODU AS15 CH=2H</td>
<td>GE9107</td>
</tr>
<tr>
<td></td>
<td>ODU AS15 CH=2L</td>
<td>GE9106</td>
</tr>
<tr>
<td></td>
<td>ODU AS15 CH=3H</td>
<td>GE9109</td>
</tr>
<tr>
<td></td>
<td>ODU AS15 CH=3L</td>
<td>GE9108</td>
</tr>
<tr>
<td></td>
<td>ODU AS15 CH=4H</td>
<td>GE9111</td>
</tr>
<tr>
<td></td>
<td>ODU AS15 CH=4L</td>
<td>GE9110</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=3H</td>
<td>GE9205</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/315/322 SB=1H</td>
<td>GE9201</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=1H</td>
<td>GE9201-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=1L</td>
<td>GE9200</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=1L</td>
<td>GE9200-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=2H</td>
<td>GE9203</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=2H</td>
<td>GE9203-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=2L</td>
<td>GE9202</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=2L</td>
<td>GE9202-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=3H</td>
<td>GE9205-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=3L</td>
<td>GE9204</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=3L</td>
<td>GE9204-03</td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=4H</td>
<td>GE9207</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=4L</td>
<td>GE9206</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=4L</td>
<td>GE9206-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=5H</td>
<td>GE9209</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=5H</td>
<td>GE9209-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=5L</td>
<td>GE9208</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/315/322 SB=5L</td>
<td>GE9208-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/420 SB=1H</td>
<td>GE9027</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/420 SB=1H</td>
<td>GE9027-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/420 SB=1L</td>
<td>GE9026</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/420 SB=1L</td>
<td>GE9026-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/420 SB=2H</td>
<td>GE9028</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/420 SB=2H</td>
<td>GE9029</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/420 SB=2L</td>
<td>GE9028</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/420 SB=2L</td>
<td>GE9028-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/420 SB=3H</td>
<td>GE9031</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/420 SB=3H</td>
<td>GE9031-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/420 SB=3L</td>
<td>GE9030</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/420 SB=3L</td>
<td>GE9030-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/420 SB=4H</td>
<td>GE9033</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/420 SB=4H</td>
<td>GE9033-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/420 SB=4L</td>
<td>GE9032</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/420 SB=4L</td>
<td>GE9032-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/490 SB=1H</td>
<td>GE9035</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/490 SB=1H</td>
<td>GE9035-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/490 SB=1L</td>
<td>GE9034</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/490 SB=1L</td>
<td>GE9034-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/490 SB=2H</td>
<td>GE9037</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/490 SB=2H</td>
<td>GE9037-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/490 SB=2L</td>
<td>GE9036</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/490 SB=2L</td>
<td>GE9036-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/490 SB=3H</td>
<td>GE9039</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/490 SB=3H</td>
<td>GE9039-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/490 SB=3L</td>
<td>GE9038</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/490 SB=3L</td>
<td>GE9038-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/490 SB=4H</td>
<td>GE9041</td>
</tr>
<tr>
<td></td>
<td>ODU AS15/490 SB=4H</td>
<td>GE9041-03</td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/490 SB=4L</td>
<td>GE9040</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/490 SB=4L</td>
<td>GE9040-03</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/644 SB=1H</td>
<td>GE9041</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/644 SB=1H</td>
<td>GE9041-03</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/644 SB=1L</td>
<td>GE9041</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/644 SB=1L</td>
<td>GE9041-03</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/644 SB=2H</td>
<td>GE9041</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/644 SB=2H</td>
<td>GE9041-03</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/644 SB=2L</td>
<td>GE9041</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/644 SB=2L</td>
<td>GE9041-03</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/728 CH=1H</td>
<td>GE9042</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/728 CH=1L</td>
<td>GE9042-03</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/728 CH=2H</td>
<td>GE9042</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/728 CH=2L</td>
<td>GE9042-03</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/728 CH=3H</td>
<td>GE9042</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/728 CH=3L</td>
<td>GE9042-03</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/728 CH=4H</td>
<td>GE9042</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/728 CH=4L</td>
<td>GE9042-03</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/728 SB=1H</td>
<td>GE9043</td>
</tr>
<tr>
<td>15</td>
<td>ODU AS15/728 SB=1L</td>
<td>GE9043-03</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18 CH=10H</td>
<td>GE9073</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18 CH=10L</td>
<td>GE9072</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18 CH=11H</td>
<td>GE9074</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18 CH=11L</td>
<td>GE9074</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18 CH=12H</td>
<td>GE9075</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18 CH=12L</td>
<td>GE9075</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18 CH=13H</td>
<td>GE9076</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18 CH=13L</td>
<td>GE9077</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18 CH=14H</td>
<td>GE9078</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18 CH=14L</td>
<td>GE9078</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18 CH=15H</td>
<td>GE9081</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18 CH=15L</td>
<td>GE9082</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18 CH=16H</td>
<td>GE9083</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18 CH=16L</td>
<td>GE9083</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18 CH=17H</td>
<td>GE9084</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18 CH=17L</td>
<td>GE9084</td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=1L</td>
<td>GE9065</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=1H</td>
<td>GE9055</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=1L</td>
<td>GE9054</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=2H</td>
<td>GE9057</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=2L</td>
<td>GE9056</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=3H</td>
<td>GE9059</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=3L</td>
<td>GE9058</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=4H</td>
<td>GE9061</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=4L</td>
<td>GE9060</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=5H</td>
<td>GE9063</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=5L</td>
<td>GE9062</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=6H</td>
<td>GE9065</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=6L</td>
<td>GE9064</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=7H</td>
<td>GE9067</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=7L</td>
<td>GE9066</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=8H</td>
<td>GE9069</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=8L</td>
<td>GE9068</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=9H</td>
<td>GE9071</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 CH=9L</td>
<td>GE9070</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 SB=1H</td>
<td>GE9001</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 SB=1L</td>
<td>GE9000</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 SB=2H</td>
<td>GE9003</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 SB=2L</td>
<td>GE9002</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 SB=3H</td>
<td>GE9005</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 SB=3L</td>
<td>GE9004</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 SB=4H</td>
<td>GE9007</td>
</tr>
<tr>
<td></td>
<td>ODU AS18 SB=4L</td>
<td>GE9006</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=10H</td>
<td>GE9073-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=10L</td>
<td>GE9072-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=11H</td>
<td>GE9075-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=11L</td>
<td>GE9074-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=12H</td>
<td>GE9077-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=12L</td>
<td>GE9076-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=13H</td>
<td>GE9079-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=13L</td>
<td>GE9078-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=14H</td>
<td>GE9081-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=14L</td>
<td>GE9080-03</td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>18</td>
<td>ODU AS18/1010 CH=15H</td>
<td>GE9083-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=15L</td>
<td>GE9082-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=16H</td>
<td>GE9085-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=16L</td>
<td>GE9084-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=17H</td>
<td>GE9087-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=17L</td>
<td>GE9086-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=1H</td>
<td>GE9055-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=1L</td>
<td>GE9054-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=2H</td>
<td>GE9057-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=2L</td>
<td>GE9056-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=3H</td>
<td>GE9059-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=3L</td>
<td>GE9058-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=4H</td>
<td>GE9061-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=4L</td>
<td>GE9060-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=5H</td>
<td>GE9063-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=5L</td>
<td>GE9062-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=6H</td>
<td>GE9065-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=6L</td>
<td>GE9064-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=7H</td>
<td>GE9067-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=7L</td>
<td>GE9066-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=8H</td>
<td>GE9069-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=8L</td>
<td>GE9068-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=9H</td>
<td>GE9071-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 CH=9L</td>
<td>GE9070-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 SB=1H</td>
<td>GE9001-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 SB=1L</td>
<td>GE9000-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 SB=2H</td>
<td>GE9003-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 SB=2L</td>
<td>GE9002-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 SB=3H</td>
<td>GE9005-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 SB=3L</td>
<td>GE9004-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 SB=4H</td>
<td>GE9007-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1010 SB=4L</td>
<td>GE9006-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1560 SB=1H</td>
<td>GE9183</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1560 SB=1H</td>
<td>GE9183-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1560 SB=1L</td>
<td>GE9182</td>
</tr>
<tr>
<td></td>
<td>ODU AS18/1560 SB=1L</td>
<td>GE9182-03</td>
</tr>
<tr>
<td>23</td>
<td>ODU AS23/1008 SB=1H</td>
<td>GE9171</td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>23</td>
<td>ODU AS23/1008 SB=1H</td>
<td>GE9171-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1008 SB=1L</td>
<td>GE9170</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1008 SB=1L</td>
<td>GE9170-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1008 SB=2H</td>
<td>GE9049</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1008 SB=2H</td>
<td>GE9049-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1008 SB=2L</td>
<td>GE9048</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1008 SB=2L</td>
<td>GE9048-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1200-1232 SB=1H</td>
<td>GE9241</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1200-1232 SB=1H</td>
<td>GE9241-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1200-1232 SB=1L</td>
<td>GE9240</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1200-1232 SB=1L</td>
<td>GE9240-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1200-1232 SB=2H</td>
<td>GE9243</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1200-1232 SB=2H</td>
<td>GE9243-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1200-1232 SB=2L</td>
<td>GE9242</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1200-1232 SB=2L</td>
<td>GE9242-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1200-1232 SB=3H</td>
<td>GE9245</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1200-1232 SB=3H</td>
<td>GE9245-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1200-1232 SB=3L</td>
<td>GE9244</td>
</tr>
<tr>
<td></td>
<td>ODU AS23/1200-1232 SB=3L</td>
<td>GE9244-03</td>
</tr>
<tr>
<td>25</td>
<td>ODU AS25 SB=1H</td>
<td>GE9167</td>
</tr>
<tr>
<td></td>
<td>ODU AS25 SB=1H</td>
<td>GE9167-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS25 SB=1L</td>
<td>GE9166</td>
</tr>
<tr>
<td></td>
<td>ODU AS25 SB=1L</td>
<td>GE9166-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS25 SB=2H</td>
<td>GE9169</td>
</tr>
<tr>
<td></td>
<td>ODU AS25 SB=2H</td>
<td>GE9169-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS25 SB=2L</td>
<td>GE9168</td>
</tr>
<tr>
<td></td>
<td>ODU AS25 SB=2L</td>
<td>GE9168-03</td>
</tr>
<tr>
<td>32</td>
<td>ODU AS32 SB=1H</td>
<td>GE9317</td>
</tr>
<tr>
<td></td>
<td>ODU AS32 SB=1H</td>
<td>GE9317-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS32 SB=1L</td>
<td>GE9316</td>
</tr>
<tr>
<td></td>
<td>ODU AS32 SB=1L</td>
<td>GE9316-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS32 SB=2H</td>
<td>GE9319</td>
</tr>
<tr>
<td></td>
<td>ODU AS32 SB=2H</td>
<td>GE9319-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS32 SB=2L</td>
<td>GE9318</td>
</tr>
<tr>
<td></td>
<td>ODU AS32 SB=2L</td>
<td>GE9318-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS32 SB=3H</td>
<td>GE9321</td>
</tr>
<tr>
<td></td>
<td>ODU AS32 SB=3H</td>
<td>GE9321-03</td>
</tr>
</tbody>
</table>
## Tab. 48 - ODU ASN part number and description

<table>
<thead>
<tr>
<th>RF band in GHz</th>
<th>ODU description</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>ODU AS32 SB=3L</td>
<td>GE9320</td>
</tr>
<tr>
<td></td>
<td>ODU AS32 SB=3L</td>
<td>GE9320-03</td>
</tr>
<tr>
<td>38</td>
<td>ODU AS38 SB=1H</td>
<td>GE9307</td>
</tr>
<tr>
<td></td>
<td>ODU AS38 SB=1H</td>
<td>GE9307-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS38 SB=1L</td>
<td>GE9306</td>
</tr>
<tr>
<td></td>
<td>ODU AS38 SB=1L</td>
<td>GE9306-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS38 SB=2H</td>
<td>GE9309</td>
</tr>
<tr>
<td></td>
<td>ODU AS38 SB=2H</td>
<td>GE9309-03</td>
</tr>
<tr>
<td></td>
<td>ODU AS38 SB=2L</td>
<td>GE9308</td>
</tr>
<tr>
<td></td>
<td>ODU AS38 SB=2L</td>
<td>GE9308-03</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RF band in GHz</th>
<th>ODU description</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>ODU ASN6L SB=1H</td>
<td>GE9501</td>
</tr>
<tr>
<td></td>
<td>ODU ASN6L SB=1L</td>
<td>GE9500</td>
</tr>
<tr>
<td></td>
<td>ODU ASN6L SB=2H</td>
<td>GE9503</td>
</tr>
<tr>
<td></td>
<td>ODU ASN6L SB=2L</td>
<td>GE9502</td>
</tr>
<tr>
<td></td>
<td>ODU ASN6L SB=3H</td>
<td>GE9505</td>
</tr>
<tr>
<td></td>
<td>ODU ASN6L SB=3L</td>
<td>GE9504</td>
</tr>
<tr>
<td></td>
<td>ODU ASN6L SB=4H</td>
<td>GE9507</td>
</tr>
<tr>
<td></td>
<td>ODU ASN6L SB=4L</td>
<td>GE9506</td>
</tr>
<tr>
<td></td>
<td>ODU ASN6U SB=1H</td>
<td>GE9509</td>
</tr>
<tr>
<td></td>
<td>ODU ASN6U SB=1L</td>
<td>GE9508</td>
</tr>
<tr>
<td></td>
<td>ODU ASN6U SB=2H</td>
<td>GE9511</td>
</tr>
<tr>
<td></td>
<td>ODU ASN6U SB=2L</td>
<td>GE9510</td>
</tr>
<tr>
<td></td>
<td>ODU ASN6U SB=3H</td>
<td>GE9513</td>
</tr>
<tr>
<td></td>
<td>ODU ASN6U SB=3L</td>
<td>GE9512</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RF band in GHz</th>
<th>ODU description</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>ODU ASN7L/161 SB=1H</td>
<td>GE9519</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7L/161 SB=1L</td>
<td>GE9518</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7L/161 SB=2H</td>
<td>GE9521</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7L/161 SB=2L</td>
<td>GE9520</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7L/161 SB=3H</td>
<td>GE9523</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7L/161 SB=3L</td>
<td>GE9522</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7L/196 SB=1H</td>
<td>GE9525</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7L/196 SB=1L</td>
<td>GE9524</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7L/196 SB=2H</td>
<td>GE9527</td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>7</td>
<td>ODU ASN7L/196 SB=2L</td>
<td>GE9526</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7L/196 SB=3H</td>
<td>GE9529</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7L/196 SB=3L</td>
<td>GE9528</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7M/154 SB=1H</td>
<td>GE9535</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7M/154 SB=1L</td>
<td>GE9534</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7M/154 SB=2H</td>
<td>GE9537</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7M/154 SB=2L</td>
<td>GE9536</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7M/154 SB=3H</td>
<td>GE9539</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7M/154 SB=3L</td>
<td>GE9538</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7M/154 SB=4H</td>
<td>GE9541</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7M/154 SB=4L</td>
<td>GE9540</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7M/154 SB=5H</td>
<td>GE9543</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7M/154 SB=5L</td>
<td>GE9542</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7M/161 SB=1H</td>
<td>GE9545</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7M/161 SB=1L</td>
<td>GE9544</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7M/161 SB=2H</td>
<td>GE9547</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7M/161 SB=2L</td>
<td>GE9546</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7M/161 SB=3H</td>
<td>GE9549</td>
</tr>
<tr>
<td></td>
<td>ODU ASN7M/161 SB=3L</td>
<td>GE9548</td>
</tr>
<tr>
<td>8</td>
<td>ODU ASN8/311,32 SB=1H</td>
<td>GE9583</td>
</tr>
<tr>
<td></td>
<td>ODU ASN8/311,32 SB=1L</td>
<td>GE9582</td>
</tr>
<tr>
<td></td>
<td>ODU ASN8/311,32 SB=2H</td>
<td>GE9585</td>
</tr>
<tr>
<td></td>
<td>ODU ASN8/311,32 SB=2L</td>
<td>GE9584</td>
</tr>
<tr>
<td></td>
<td>ODU ASN8/311,32 SB=3H</td>
<td>GE9587</td>
</tr>
<tr>
<td></td>
<td>ODU ASN8/311,32 SB=3L</td>
<td>GE9586</td>
</tr>
<tr>
<td></td>
<td>ODU ASN8/311,32 SB=4H</td>
<td>GE9589</td>
</tr>
<tr>
<td></td>
<td>ODU ASN8/311,32 SB=4L</td>
<td>GE9588</td>
</tr>
<tr>
<td>10</td>
<td>ODU ASN10/350 SB=1H</td>
<td>GE9601</td>
</tr>
<tr>
<td></td>
<td>ODU ASN10/350 SB=1L</td>
<td>GE9600</td>
</tr>
<tr>
<td>13</td>
<td>ODU ASN13 SB=1H</td>
<td>GE9613</td>
</tr>
<tr>
<td></td>
<td>ODU ASN13 SB=1L</td>
<td>GE9612</td>
</tr>
<tr>
<td></td>
<td>ODU ASN13 SB=2H</td>
<td>GE9615</td>
</tr>
<tr>
<td></td>
<td>ODU ASN13 SB=2L</td>
<td>GE9614</td>
</tr>
<tr>
<td></td>
<td>ODU ASN13 SB=3H</td>
<td>GE9617</td>
</tr>
<tr>
<td></td>
<td>ODU ASN13 SB=3L</td>
<td>GE9616</td>
</tr>
<tr>
<td></td>
<td>ODU ASN13 SB=4H</td>
<td>GE9619</td>
</tr>
<tr>
<td></td>
<td>ODU ASN13 SB=4L</td>
<td>GE9618</td>
</tr>
<tr>
<td>RF band in GHz</td>
<td>ODU description</td>
<td>Part number</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>15</td>
<td>ODU ASN15 315/322 SB=1H</td>
<td>GE9629</td>
</tr>
<tr>
<td></td>
<td>ODU ASN15 315/322 SB=1L</td>
<td>GE9628</td>
</tr>
<tr>
<td></td>
<td>ODU ASN15/420 SB=1H</td>
<td>GE9647</td>
</tr>
<tr>
<td></td>
<td>ODU ASN15/420 SB=1L</td>
<td>GE9646</td>
</tr>
<tr>
<td></td>
<td>ODU ASN15/420 SB=2H</td>
<td>GE9649</td>
</tr>
<tr>
<td></td>
<td>ODU ASN15/420 SB=2L</td>
<td>GE9648</td>
</tr>
<tr>
<td></td>
<td>ODU ASN15/420 SB=3H</td>
<td>GE9651</td>
</tr>
<tr>
<td></td>
<td>ODU ASN15/420 SB=3L</td>
<td>GE9650</td>
</tr>
<tr>
<td></td>
<td>ODU ASN15/420 SB=4H</td>
<td>GE9653</td>
</tr>
<tr>
<td></td>
<td>ODU ASN15/420 SB=4L</td>
<td>GE9652</td>
</tr>
<tr>
<td></td>
<td>ODU ASN15/728 SB=1H</td>
<td>GE9691</td>
</tr>
<tr>
<td></td>
<td>ODU ASN15/728 SB=1L</td>
<td>GE9690</td>
</tr>
<tr>
<td></td>
<td>ODU ASN18/1010 SB=1H</td>
<td>GE9701</td>
</tr>
<tr>
<td></td>
<td>ODU ASN18/1010 SB=1L</td>
<td>GE9700</td>
</tr>
<tr>
<td></td>
<td>ODU ASN18/1010 SB=2H</td>
<td>GE9703</td>
</tr>
<tr>
<td></td>
<td>ODU ASN18/1010 SB=2L</td>
<td>GE9702</td>
</tr>
<tr>
<td></td>
<td>ODU ASN18/1010 SB=3H</td>
<td>GE9705</td>
</tr>
<tr>
<td></td>
<td>ODU ASN18/1010 SB=3L</td>
<td>GE9704</td>
</tr>
<tr>
<td></td>
<td>ODU ASN18/1010 SB=4H</td>
<td>GE9707</td>
</tr>
<tr>
<td></td>
<td>ODU ASN18/1010 SB=4L</td>
<td>GE9706</td>
</tr>
<tr>
<td></td>
<td>ODU ASN18/1560 SB=1H</td>
<td>GE9717</td>
</tr>
<tr>
<td></td>
<td>ODU ASN18/1560 SB=1L</td>
<td>GE9716</td>
</tr>
<tr>
<td></td>
<td>ODU ASN23/1008 SB=1H</td>
<td>GE9719</td>
</tr>
<tr>
<td></td>
<td>ODU ASN23/1008 SB=1L</td>
<td>GE9718</td>
</tr>
<tr>
<td></td>
<td>ODU ASN23/1008 SB=2H</td>
<td>GE9721</td>
</tr>
<tr>
<td></td>
<td>ODU ASN23/1008 SB=2L</td>
<td>GE9720</td>
</tr>
<tr>
<td></td>
<td>ODU ASN23/1200/1232 SB=1H</td>
<td>GE9727</td>
</tr>
<tr>
<td></td>
<td>ODU ASN23/1200/1232 SB=1L</td>
<td>GE9726</td>
</tr>
<tr>
<td></td>
<td>ODU ASN23/1200/1232 SB=2H</td>
<td>GE9729</td>
</tr>
<tr>
<td></td>
<td>ODU ASN23/1200/1232 SB=2L</td>
<td>GE9728</td>
</tr>
<tr>
<td></td>
<td>ODU ASN23/1200/1232 SB=3H</td>
<td>GE9731</td>
</tr>
<tr>
<td></td>
<td>ODU ASN23/1200/1232 SB=3L</td>
<td>GE9730</td>
</tr>
<tr>
<td></td>
<td>ODU ASN25 SB=1H</td>
<td>GE9737</td>
</tr>
<tr>
<td></td>
<td>ODU ASN25 SB=1L</td>
<td>GE9736</td>
</tr>
<tr>
<td></td>
<td>ODU ASN25 SB=2H</td>
<td>GE9739</td>
</tr>
<tr>
<td></td>
<td>ODU ASN25 SB=2L</td>
<td>GE9738</td>
</tr>
</tbody>
</table>
Fig.221 - Label attached on the ODU mechanical body AL
Section 8.
LISTS AND SERVICES

40 LIST OF FIGURES

Fig.1 - Components electrostatic charge sensitive indication.................................................. 14
Fig.2 - Elasticized band ........................................................................................................ 14
Fig.3 - Coiled cord ............................................................................................................... 14
Fig.4 - Laser indication ....................................................................................................... 14
Fig.5 - WEEE symbol - 2002/96/CE EN50419 ................................................................. 15
Fig.6 - ALplus2 1+0 .......................................................................................................... 26
Fig.7 - ALplus2 1+1 .......................................................................................................... 26
Fig.8 - ALCplus2 1+0 and ALCplus2e 2E1 1+0 ................................................................. 26
Fig.9 - ALCplus2 1+1 and ALCplus2e E1 2+0/1+1 and ALCplus2e 2E1 XPIC 2+0 .......... 26
Fig.10 - ALCplus2 1+0 exp 16E1 .................................................................................... 27
Fig.11 - ALCplus2 1+1 exp 16E1 .................................................................................... 27
Fig.12 - ALCplus2 1+0 32E1 .......................................................................................... 27
Fig.13 - ALCplus2 1+1 32E1 .......................................................................................... 27
Fig.14 - ALCplus2 1+0 exp nodal .................................................................................... 27
Fig.15 - ALCplus2 1+1 exp nodal .................................................................................... 27
Fig.16 - ALCplus2e 1+0 4GE 2xE1 .................................................................................. 27
Fig.17 - ALCplus2e 1+0 4GE 34E1 2xSTM1 .................................................................. 28
Fig.18 - ALCplus2e 1+0 4GE 18E1 2xSTM1 NODAL .................................................. 28
Fig.19 - ALCplus2e 2+0/1+1 4GE 2xE1 .......................................................................... 28
Fig.20 - ALCplus2e 2+0/1+1 4GE 34xE1 2xSTM1 ........................................................ 28
Fig.21 - ALCplus2e 2+0/1+1 4GE 18E1 2xSTM1 NODAL .............................................. 28
Fig.22 - Synchronisation block diagram .......................................................................... 46
Fig.23 - IDU loopback ....................................................................................................... 51
Fig. 24 - ALplus2 with 16E1, 1+0 and 1+1 version, block diagram ........................................ 52
Fig. 25 - ALplus2 with 16E1, 2x(1+0) configuration, block diagram .................................... 53
Fig. 26 - Enabling Line Aggregation, Enable trunk1 .......................................................... 58
Fig. 27 - Line trunking ...................................................................................................... 59
Fig. 28 - Radio trunking .................................................................................................. 60
Fig. 29 - Line protection through distributed ELP .............................................................. 61
Fig. 30 - Hierarchical structure of Maintenance Domains .................................................. 63
Fig. 31 - ALCplus2 with 32E1 expansion, STM-1, 1+0 and 1+1 version, block diagram ....... 66
Fig. 32 - ALCplus2 with 16E1 expansion, STM1, NBUS, 1+0 and 1+1 version, block diagram ... 67
Fig. 33 - ALCplus2 with 2E1, 1+0 and 1+1 version, block diagram .................................... 68
Fig. 34 - ALCplus2 with 16E1, 1+0 and 1+1 version, block diagram .................................. 68
Fig. 35 - Node block diagram in protected configuration ..................................................... 69
Fig. 36 - Synchronization circuit ..................................................................................... 74
Fig. 37 - RED curve ........................................................................................................ 78
Fig. 38 - ALCplus2e block diagram .................................................................................. 80
Fig. 39 - ALCplus2e 2x(1+1) layout ................................................................................ 80
Fig. 40 - ALCplus2e 2+0 layout ...................................................................................... 81
Fig. 41 - Frequency reuse system ................................................................................... 81
Fig. 42 - AS and ASN ODUs ........................................................................................... 85
Fig. 43 - Final 1+1 assembly with AS and ASN ODU ............................................................ 86
Fig. 44 - ODU block diagram ............................................................................................ 87
Fig. 45 - 1+1 hot stand–by 1 antenna ................................................................................ 88
Fig. 46 - 1+1 hot stand–by 2 antennas .............................................................................. 88
Fig. 47 - ATPC operation ............................................................................................... 88
Fig. 48 - Grounding connection ..................................................................................... 95
Fig. 49 - IDU ALplus2 front panel .................................................................................... 97
Fig. 50 - Pin-out Tributary 50 pin SCSI female ................................................................. 98
Fig. 51 - Pin-out Tributary 50 pin SCSI female ................................................................. 100
Fig. 52 - Antisliding strip .............................................................................................. 114
Fig. 53 - 60–114 mm pole supporting plate fixing .............................................................. 115
Fig. 54 - Adapting kit for 219 mm pole .......................................................................... 116
Fig. 55 - Mounting position .......................................................................................... 117
Fig. 56 - Possible positions of the support with ODU fast locking mechanism ................. 118
Fig. 57 - Band-it pole mounting kit ................................................................................ 119
Fig. 58 - Installation onto the pole of the supporting plate .............................................. 120
Fig. 59 - Position of the ODU body depending on the polarisation for 1+0. For 1+1 the polarisation is always vertical: handle at the left side. ..................................................... 121
Fig. 60 - ODU body reference tooth ................................................................................ 122
Fig. 61 - Final ODU assembly of 1+1 version ................................................................. 123
Fig. 62 - ODU grounding ............................................................................................. 124
Fig. 63 - Kit V32409 ..................................................................................................... 125
Fig. 64 - Kit V32415 ..................................................................................................... 126
Fig. 65 - Wall supporting plate .................................................................................... 131
Fig.66 - Support with ODU fast locking mechanism .......................................................... 132
Fig.67 - Mounting possible positions ........................................................................... 133
Fig.68 - Installation onto the wall of the supporting plate ........................................... 134
Fig.69 - Position of the ODU body depending on the polarisation for 1+0. For 1+1 the polarisation is always vertical: handle at the left side. ............................................. 135
Fig.70 - ODU body reference tooth .............................................................................. 136
Fig.71 - Final ODU assembly of 1+1 version ................................................................. 137
Fig.72 - ODU grounding .............................................................................................. 138
Fig.73 - Kit V32409 ..................................................................................................... 139
Fig.74 - Kit V32415 ..................................................................................................... 140
Fig.75 - Centring ring position .................................................................................... 145
Fig.76 - Antislide strip ............................................................................................... 146
Fig.77 - Support mount on pole ................................................................................. 147
Fig.78 - Supporting system position .......................................................................... 148
Fig.79 - Hole E ......................................................................................................... 148
Fig.80 - Antenna installation on pole support ............................................................. 149
Fig.81 - Position of the ODU handle depending on the polarisation for 1+0. For 1+1 the polarisation is always horizontal. Handle at the right side. ................................. 149
Fig.82 - Support system for ODU housing and reference tooth in evidence ................. 150
Fig.83 - ODU body reference tooth .......................................................................... 151
Fig.84 - ODU housing final position for vertical polarization ..................................... 152
Fig.85 - ODU housing final position for horizontal polarization ................................. 152
Fig.86 - Hybrid and polarization disk ....................................................................... 153
Fig.87 - Polarization disk fixing (only for 13GHz and 15 GHz) .................................. 154
Fig.88 - Hybrid mount on pole support ...................................................................... 155
Fig.89 - ODU housing final position for 1+1 version ................................................ 156
Fig.90 - Vertical and horizontal adjustments ............................................................... 157
Fig.91 - Antenna aiming block ................................................................................ 158
Fig.92 - ODU grounding ............................................................................................ 159
Fig.93 - 1+0 pole mounting ....................................................................................... 164
Fig.94 - ODU body reference tooth .......................................................................... 165
Fig.95 - Position of the ODU handle depending on the polarisation for 1+0. For 1+1 the polarisation is always horizontal. Handle at the right side. ................................ 165
Fig.96 - 1+0 support .................................................................................................. 166
Fig.97 - ODU housing final position for both polarization .......................................... 167
Fig.98 - Antenna aiming .......................................................................................... 168
Fig.99 - ODU grounding ............................................................................................ 168
Fig.100 - Hybrid and twist disk ............................................................................... 169
Fig.101 - Polarization disk fixing (only for 13 GHz and 15 GHz) .............................. 171
Fig.102 - Hybrid installation ...................................................................................... 172
Fig.103 - 1+1 ODUs installation ............................................................................... 173
Fig.104 - 1+0 pole mounting ..................................................................................... 178
Fig.105 - ODU body reference tooth ....................................................................... 179
Fig.106 - Position of the ODU handle depending on the polarisation for 1+0. For 1+1 the polarisa-
tion is always horizontal. Handle at the right side. ............................................................ 179

Fig.107 - 1+0 support........................................................................................................ 180
Fig.108 - ODU housing final position for both polarization ................................................. 181
Fig.109 - Antenna aiming .............................................................................................. 182
Fig.110 - ODU grounding.............................................................................................. 183
Fig.111 - Hybrid and twist disk .................................................................................... 184
Fig.112 - Polarization disk fixing (only for 13 GHz and 15 GHz)................................. 185
Fig.113 - Hybrid installation ....................................................................................... 186
Fig.114 - 1+1 ODU installation ..................................................................................... 187
Fig.115 - AS and ASN ODU ......................................................................................... 188
Fig.116 - ODU ASN with fast lock coupling flange.......................................................... 189
Fig.117 - ODU ASN with standard coupling flange ......................................................... 190
Fig.118 - 1+0 ODU installation ..................................................................................... 191
Fig.119 - 1+1 ODU installation ..................................................................................... 192
Fig.120 - Polarization disk ........................................................................................... 193
Fig.121 - 1+0 antenna flange ....................................................................................... 194
Fig.122 - 1+1 antenna flange ....................................................................................... 195
Fig.123 - Detected voltage versus RF received signal .................................................... 200
Fig.124 - Local Lan-1 port to remote Lan-1 port connection ............................................ 201
Fig.125 - Modulation and capacity ............................................................................... 202
Fig.126 - View Current Configuration ........................................................................... 203
Fig.127 - Switch general settings .................................................................................. 204
Fig.128 - Lan-1 interface settings .................................................................................. 205
Fig.129 - Vlan settings for LAN-1 ................................................................................ 206
Fig.130 - Vlan settings for Port A ................................................................................ 207
Fig.131 - Priority setting for Lan-1 and Port A ............................................................... 208
Fig.132 - 3 ports to 3 ports connections with segregated traffic .................................... 209
Fig.133 - Modulation and capacity ............................................................................... 210
Fig.134 - View Current Configuration ........................................................................... 211
Fig.135 - Switch general settings .................................................................................. 212
Fig.136 - Lan-1 interface settings .................................................................................. 213
Fig.137 - Lan1 Vlan settings ......................................................................................... 214
Fig.138 - Lan2 Vlan settings ......................................................................................... 215
Fig.139 - Lan3 Vlan settings ......................................................................................... 216
Fig.140 - Port A Vlan settings ....................................................................................... 217
Fig.141 - Vlan Configuration Table ............................................................................... 218
Fig.142 - 3 ports to 3 ports connections with segregated Tagged and Untagged traffic ... 219
Fig.143 - Modulation and Capacity ............................................................................... 220
Fig.144 - View Current Configuration ........................................................................... 221
Fig.145 - Switch general settings .................................................................................. 222
Fig.146 - Lan1 Vlan settings ......................................................................................... 223
Fig.147 - Lan2 Vlan settings ......................................................................................... 224
Fig.148 - Lan3 Vlan settings ......................................................................................... 225
Fig.149 - Port A Vlan settings

Fig.150 - Vlan Configuration Table

Fig.151 - Subnetwork Craft Terminal - Communication setup

Fig.152 - IP Ethernet

Fig.153 - LCT PPP

Fig.154 - PPP Radio

Fig.155 - Store Routing Table

Fig.156 - Stored Routing Table

Fig.157 - Subnetwork Configuration Wizard

Fig.158 - Subnetwork Configuration Wizard - Actual Configuration

Fig.159 - Add new station

Fig.160 - Add New Network Element

Fig.161 - Subnetwork Configuration Wizard

Fig.162 - Subnetwork Configuration Wizard

Fig.163 - ALCplus2 node connections

Fig.164 - Nodal ALCplus2 Manager

Fig.165 - Drag and drop E1 stream

Fig.166 - VC auto loop

Fig.167 - Pass-through cross-connection

Fig.168 - Drag and drop E1 stream

Fig.169 - Ethernet switch settings

Fig.170 - Ethernet switch settings

Fig.171 - Ethernet switch settings

Fig.172 - Ethernet switch settings

Fig.173 - Ethernet switch settings

Fig.174 - Ethernet switch settings

Fig.175 - Ethernet switch settings

Fig.176 - Ethernet switch settings

Fig.177 - Ethernet switch settings

Fig.178 - Ethernet switch settings

Fig.179 - Ethernet switch settings

Fig.180 - Ethernet switch settings

Fig.181 - Node composition

Fig.182 - Node composition

Fig.183 - Current alarms

Fig.184 - STP/Trunking tab (Trunk active) (Port A contextual area)

Fig.185 - Trunking tab (Trunk active)

Fig.186 - OAM-FM Domain contextual area

Fig.187 - OAM-FM MA/MEP contextual area

Fig.188 - Vlan status and commands

Fig.189 - ELP Enabling Protection

Fig.190 - Inserting allowed IP address

Fig.191 - List of allowed IP address
Fig.192 - Sync transmitted from local to remote radio ...................................................... 270
Fig.193 ...................................................................................................................... 272
Fig.194 ...................................................................................................................... 272
Fig.195 ...................................................................................................................... 273
Fig.196 ...................................................................................................................... 273
Fig.197 ...................................................................................................................... 274
Fig.198 ...................................................................................................................... 274
Fig.199 ...................................................................................................................... 275
Fig.200 - E1 retiming ............................................................................................. 275
Fig.201 ...................................................................................................................... 276
Fig.202 - Loop ......................................................................................................... 287
Fig.203 - Termination points for the Performance Monitoring ...................................... 287
Fig.204 - IDU GAI0165 .......................................................................................... 290
Fig.205 - IDU GAI0166 .......................................................................................... 290
Fig.206 - IDU P/N ................................................................................................. 291
Fig.207 - ALCplus2 1+0 ....................................................................................... 292
Fig.208 - ALCplus2 1+1 ....................................................................................... 292
Fig.209 - ALCplus2 1+0 exp 16E1 ................................................................. 293
Fig.210 - ALCplus2 1+1 exp 16E1 ................................................................. 293
Fig.211 - ALCplus2 1+0 32E1 ........................................................................ 293
Fig.212 - ALCplus2 1+1 32E1 ........................................................................ 293
Fig.213 - ALCplus2 1+0 exp nodal ............................................................... 293
Fig.214 - ALCplus2 1+1 exp nodal ............................................................... 293
Fig.215 - ALCplus2e 1+0 4GE 2xE1 ............................................................. 295
Fig.216 - ALCplus2e 1+1 4GE 34E1 2xSTM1 ............................................... 295
Fig.217 - ALCplus2e 1+0 4GE 18E1 2xSTM1 NODAL .................................. 295
Fig.218 - ALCplus2e 2+0/1+1 4GE 2xE1 ............................................................. 295
Fig.219 - ALCplus2e 2+0/1+1 4GE 34xE1 2xSTM1 ........................................ 296
Fig.220 - ALCplus2e 2+0/1+1 4GE 18E1 2xSTM1 NODAL ............................ 296
Fig.221 - Label attached on the ODU mechanical body AL ................................... 316
41 LIST OF TABLES

Tab.1 - Artificial respiration .................................................................13
Tab.2 - ALCplus2e IDU configurations ..................................................23
Tab.3 - Optical interface characteristics ................................................31
Tab.4 - Guaranteed Ethernet Throughput (Mbit/s) for ALplus2/ALCplus2/ALCplus2e (Ethernet only) ..........................................................31
Tab.5 - Estimated Ethernet throughput ..................................................32
Tab.6 - Guaranteed Ethernet Latency (ms) for ALplus2/ALCplus2/ALCplus2e (Ethernet only) .................................................................33
Tab.7 - Rx Alarm Priority ....................................................................36
Tab.8 - Maximum outage due to the Tx switching .................................36
Tab.9 - Tx Alarm Priority ....................................................................36
Tab.10 - $I_{\text{MAX}}$ and consumption ................................................37
Tab.11 - E1 priority .............................................................................49
Tab.12 - Characteristics of the cables ...................................................93
Tab.13 - 10/100/1000BaseT, RJ45 .......................................................97
Tab.14 - 8xE1, 50 pin SCSI female 75 Ohm ..........................................98
Tab.15 - 8xE1, 50 pin SCSI female 120 Ohm .........................................99
Tab.16 - RS232 SUB-D 9 pin male ........................................................100
Tab.17 - SUB-D 9 pin male USER IN/OUT) ........................................101
Tab.18 - MNGT/1 and MNGT/2 100BaseT connector pin-out for 10/100BaseT Ethernet connection (RJ45) .................................................101
Tab.19 - CH2 connector pin-out for 64 kbit/s channel - V.11 interface (RJ45) .................................................................101
Tab.20 - 2 Mbit/s wayside connector pin-out (RJ45) ............................102
Tab.21 - Trib A, B connector .................................................................103
Tab.22 - SUB-D 9 pin male USER IN/OUT ...........................................104
Tab.23 - Trib A, B connector .................................................................106
Tab.24 - SUB-D 9 pin male USER IN/OUT ...........................................107
Tab.25 - Torques for tightening screws ...............................................111
Tab.26 - Torques for tightening screws ...............................................112
Tab.27 - Waveguide bending radius according to frequency ............113
Tab.28 - Torques for tightening screws ...............................................128
Tab.29 - Torques for tightening screws ...............................................128
Tab.30 - Waveguide bending radius according to frequency ............130
Tab.31 - Torques for tightening screws ...............................................130
Tab.32 - Torques for tightening screws ...............................................143
Tab.33 - Torques for tightening screws ...............................................163
Tab.34 - Torques for tightening screws ...............................................177
Tab.35 - Waveguide bending radius according to frequency ............191
Tab.36 - Waveguide bending radius according to frequency ............193
Tab.37 - Common alarms - ALplus2/ALCplus2/ALCplus2e ...............280
Tab.37 - ETH LAN alarms - ALplus2/ALCplus2/ALCplus2e...............................................................281
Tab.38 - LIM alarms - ALplus2/ALCplus2/ALCplus2e.......................................................................281
Tab.39 - Node alarms - ALCplus2/ALCplus2e..................................................................................281
Tab.40 - Radio alarms - ALplus/ALCplus2/ALCplus2e.....................................................................282
Tab.41 - Radio alarms - ALplus/ALCplus2/ALCplus2e.....................................................................283
Tab.42 - RT alarms - ALplus/ALCplus2/ALCplus2e.........................................................................283
Tab.43 - SETS alarms - ALplus/ALCplus2/ALCplus2e ......................................................................283
Tab.44 - SNTP alarms - ALplus/ALCplus2/ALCplus2e ......................................................................283
Tab.45 - STM1 alarms - ALplus/ALCplus2/ALCplus2e ......................................................................284
Tab.46 - IDU part number .................................................................................................................290
Tab.47 - Part number and description ..............................................................................................297
Tab.48 - ODU ASN part number and description .............................................................................313
42 ASSISTANCE SERVICE

For more information, refer to the section relevant to the technical support on the Internet site of the company manufacturing the product.