Optical Access

***Optical Access Inc.***

Wireless Optical Communications

| **TS3101** | **TS3103,** | **TS3303** |
|---|---|---|
| (TS155/B/DCS/VS) | (TS155/C/DCS/VS) | (TS155/D/DCS/VS) |

# Installation Manual

WIRELESS OPTICAL COMMUNICATIONS

# Installation Manual

Document Number 4704000, Rev. 3.1

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**CAUTION!**
Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure

**CAUTION!**

This is a Class 1M FSOCS transmitter and receiver and shall be installed in a restricted location as defined in this manual. A restricted location is a location where access to the transmission equipment and open beam is restricted and not open to the general public or casual passerby. Examples include above a certain height on the sides of buildings, restricted rooftops, and telephone poles. This definition of a restricted location is in accordance with the proposed IEC 60825-I Part 12 requirements.

**CAUTION!**
It is the responsibility of the installer that this system be installed in accordance with applicable building and installations codes

**CAUTION!**
It is the responsibility of the installer that this system be installed in accordance with ANSI Z136.1 control measures (engineering, administrative and procedural controls)

**CAUTION!**
AVOID EXPOSURE – INVISIBLE LASER RADIATION IS EMITTED FROM THIS APERTURE

**For TS3101 & TS3103:**

**CAUTION!**
INVISIBLE LED RADIATION. DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS. CLASS 1M LED PRODUCT

5 Mw peak power per beam. 830-860nm wavelength.

IEC 60825-1:1993-A1 1997 A2 2001 AND PROPOSED IEC 60825-12

**For TS3303:**

**CAUTION!**
INVISIBLE LASER RADIATION. DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS. CLASS 1M LASER PRODUCT

Complies with FDA performance standards for laser products except for deviations pursuant to laser Notice No. 50, dated JULY 26, 2001.

10 Mw peak power per beam. 830-860nm wavelength.

IEC 60825-1:1993-A1 1997 A2 2001 AND PROPOSED IEC 60825-12

# Standards & Procedures:

EN50081-1: 1991; EN50082-1: 1998; EN55022: 1997;

EN61000-4-2: 1995; EN61000-4-3: 1995; EN61000-4-4: 1995;
EN61000-4-5: 1995/ENV50142; EN61000-4-6: 1996/ENV50141;
EN61000-408: 1993; EN61000-4-11:1994; EN61000-3-2: 1995

CISPR 22: 1993
AS/NZS 3548: 1995, Class A,
Joint Amendment No. 1: 1997, Joint Amendment No. 2: 1997

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) This device must accept interference received, including interference that may cause undesired operations.

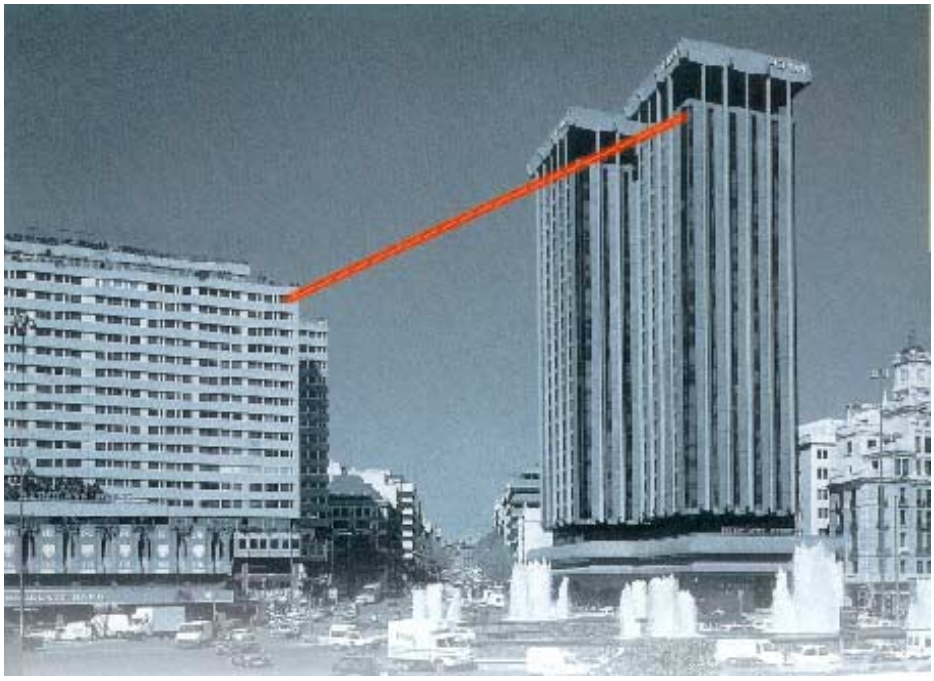
EN 60950+A1+A2+A3+A4+A11
ACA TS001-1997
AS/NZS 3260: 1993 A4: 1997

# TABLE OF CONTENTS

# Introduction

## Read attentively the entire Manual before installation.

An InfraRed (IR) link allows connection without any cable between two distant sites. For that, two identical transceivers, each installed on one site and aligned one facing each other, provide a point-to-point connectivity. This configuration makes possible the data transfer from one terminal to the other through the air over an optical wavelength carrier, the IR.



The installation of such a link can be summed up in 4 stages:

- Site survey
- Installation of the infrastructure
- Mounting of the equipment
- Aiming procedure

**Always use appropriate safety equipment and procedures when working with electrical equipment and when working on roofs.**

Chapter

1

# The Product

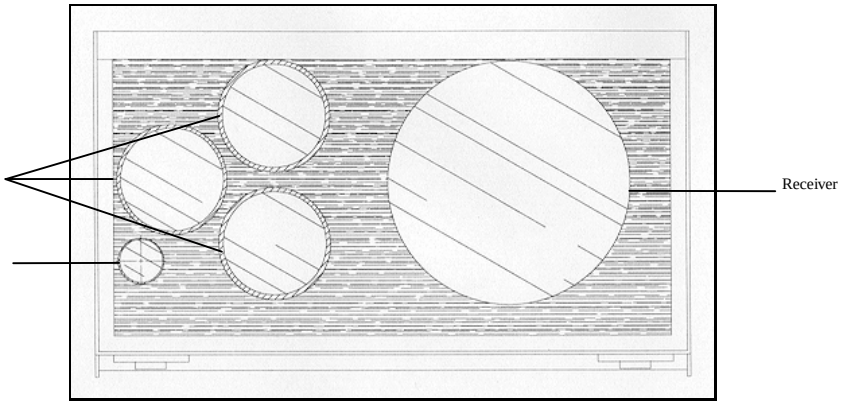
**Handle the transceiver with caution. Take particular care not to damage the front Plexiglas window.**

## General Description

Each unit comprises a receiver, a transmitting block and an interface on the rear panel for the connection to the peripheral equipment.

Front view
The receiver side, including the transmitting block and the telescope

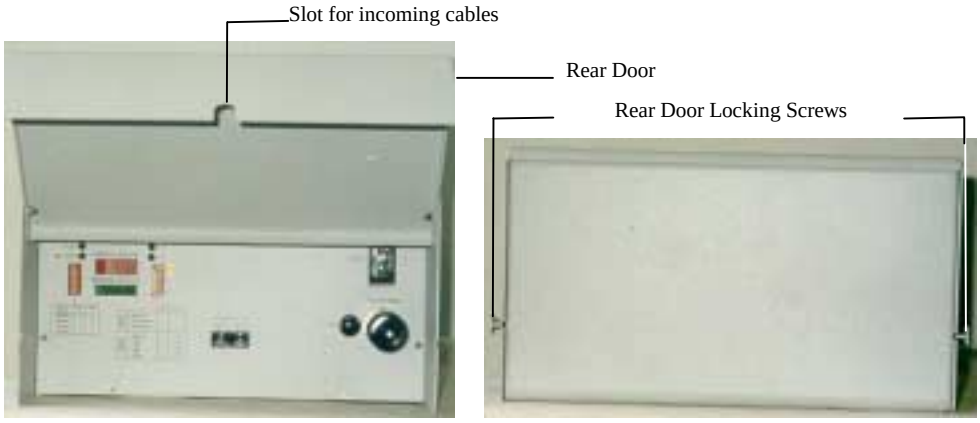
**CAUTION!**
AVOID EXPOSURE – INVISIBLE LASER RADIATION IS EMITTED FROM THIS APERTURE




Note

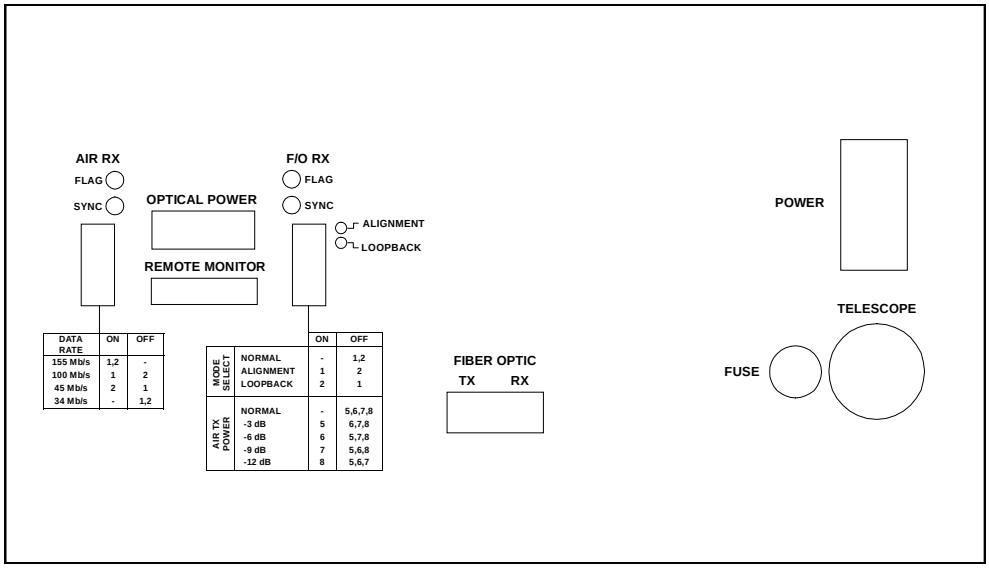
In the TS3101 only the upper transmitter is in use.

Rear view




a. Rear Door opened, showing the Back Panel  b. Rear Door closed, shielding the Back Panel

Back Panel Sketch




## Back Panel Description

| | | |
|---|---|---|
| Connectors | Power | Power source inlet (Main or UPS) |
| | Fiber optic | Fiber Optic interface for connection to peripheral equipment |
| | Remote Monitor | Connection to an optional Remote Status Monitor (not included in the standard transceiver kit) |
| Selectors | Data Rate | Set the transmission rate of the transceiver (internal clock) |
| | Mode Select | Set the Operating Mode<br>ALIGNMENT = Idle transmitted automatically<br>NORMAL = Signal received through the F/O port is transmitted through the Airlink TX. Signal received through the Airlink RX is transmitted through the F/O TX<br>LOOPBACK=The Data received by the F/O RX is directly returned through the F/O TX |
| | Air TX Power | Used for attenuating the optical power radiated by the Airlink TX (Normal = no attenuation, -3dB=3dB attenuation, and so on) |

| | | |
|---|---|---|
| DISPLAY | Air RX Flag | Green LED indicates data is received by the Airlink receiver. Switches ON at the threshold level. |
| | Air TX Sync | Yellow LED. Switches ON if the rate of the received Data matches the Data Rate set on the Data Rate Dip-switch |
| | F/O RX Flag | Green LED indicates Data is received by the Fiber Optic receiver. Switches ON at the threshold level. |
| | F/O RX Sync | Yellow LED. Switches ON if the rate of the received Data matches the Data Rate set on the Data Rate Dip-switch |
| | Optical Power | Digital readout indicates in mV the Optical Power level received by the Airlink receiver |
| | Alignment | Yellow LED. Switches ON as the ALIGNMENT Operating Mode is selected |
| | Loopback | Yellow LED. Switches ON as the LOOPBACK Operating Mode is selected |

Side view

# Technical Specifications

| | | | | | |
|---|---|---|---|---|---|
| Application | E3, T3, Fast-Ethernet, FDDI, ATM, OC-3/STM-1. | | | | |
| | (Other speeds can be obtained by factory set only.) | | | | |
| Performances | Rate | | 34, 45, 100, 125, 155 Mbps adjustable with a dip switch | | |
| | | | **TS3101** | **TS3103** | **TS3303** |
| | Range | @10dB/km[1] | 380m | 600m | 1100m |
| | | @17dB/km[2] | 320m | 460m | 8400m |
| | | @30dB/km[3] | 250m | 350m | 590m |
| | | Minimum[4] | 20m | 30m | 120m |
| | Bit Error Rate | | less than 1E-12 (unfaded) | | |
| | MTBF | | 8 years | | |
| Transmitter | Light source | | LED for the models 3101/3103 - VCSEL for the 3303 | | |
| | Wavelength | | 850nm | | |
| | Output Power | | 1.1mW for the TS3101<br>3.3mW for the TS3103<br>16.5mW for the TS3303 | | |
| | Beam Divergence | | 2.8mrad for the TS3101 and TS3103<br>1.8mrad for the TS3103 | | |
| Receiver | Detector | | Si PIN photodiode | | |
| | Field Of View | | 14mrad | | |
| | Sensitivity | | -34dBm | | |
| Interface | Type | | Fiber Optic - Multimode (Singlemode upon request) | | |
| | Connectors | | SC | | |
| | Wavelength | | 1300nm | | |
| | Output Power | | -17 ± 3dBm (measured with a 62.5µm fiber) | | |
| | Rx Operating Range | | -14 to -30dBm | | |
| Power Supply | 230VAC @ 50Hz / 110VAC @ 60 Hz - 22W Factory set or 24VDC - 20W | | | | |
| Environmental Information | Operating Temp. | | -50°C to +50°C | | |
| | Storage Temp. | | -50°C to +70°C | | |
| | Humidity | | less than 90% non-condensing | | |
| | Housing | | Weatherproof | | |
| Mechanical Design | Dimensions | | 412mm X 268mm X 155mm | | |
| | Weight | | 4.5kg for the unit only<br>3kg for the accessories | | |

Notes

(1) Medium to Heavy rain (45mm/hr)-Light snow-Thin fog
(2) Cloudburst (100mm/hr)-Medium snow-Light snow
(3) Rain (up to 180mm/hr)-Blizzard-Moderate fog
(4) Below this range the receiver could saturate. You should use the Air TX Power Dip-switch to reduce the power radiated by the transmitter for reaching shorter ranges.

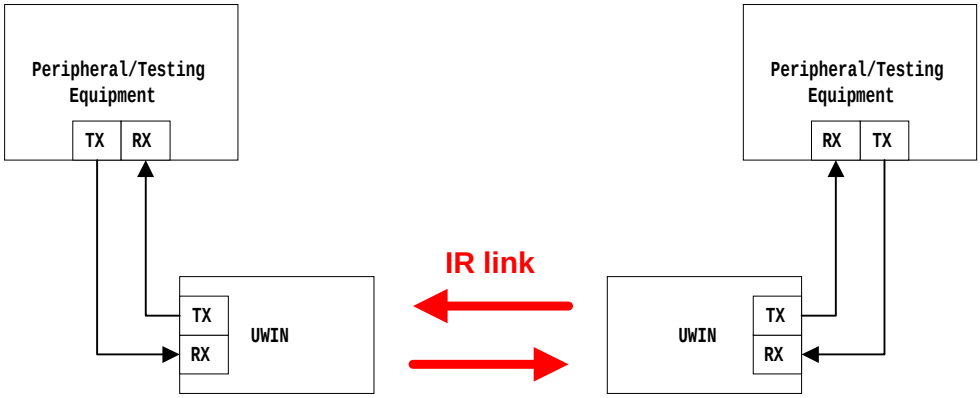
## Typical Connection

In order to implement a connection, each transceiver must be connected to the peripheral/testing equipment through fiber optic cables. A correct connection is notified by the display on the back panel of the transceiver (see the section Display and Results page 12).

*It is a cross connection:*

*TX ➔RX and RX ➔ TX*

Scheme of the Connection to peripheral equipment



Chapter

2

# Site Survey

**The first step before every installation is to physically inspect the sites to be linked. This in order to make sure that the connection is feasible, to detect potential obstacles or difficulties and to decide on the exact location and mounting points of the transceivers**

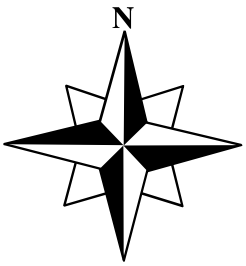
## Line of Sight

It is imperative that the two mounting sites must be within a clear sight of each other when linking two distant buildings.

Pay attention to :

- Growing vegetation and increasing foliage during spring
- Building sites (cranes movements, ...)
- Chimneys (drained away smokes could block the beam from time to time).

## Orientation




Direct sunlight could overload the airlink receiver and generate its saturation. Avoid as far as possible the East to West path link.

Note

In case this is not possible the surrounding buildings can shield the transceiver from the direct sunlight. Otherwise, outages lasting several minutes (depending on the time of the year and the angle of the sun) can occur. The system will fully recover once the sun is out of the receiver field of view.

## Location

The transceiver must be mounted extremely rigidly (preventing the installation from twists of 1 mrad). To obtain the required rigidity the mounting accessories must be attached on strong mounting points such as:

- Stiff building structures
- Concrete or reinforced concrete surfaces

| Prefer | Avoid | Avoid if possible |
|---|---|---|
| Concrete<br>Parapet<br>Structural wall or column | Old constructions<br>Soft material (asphalt, etc.)<br>Non-uniform surfaces<br>Wooden and metal structures | Coloured windows<br>Double glazing<br>The proximity of powerful radio antennas |

(1) In case such situations could not be bypassed, special mounting accessories and techniques must be designed and considered (see section Special Installation Techniques)



**For reasons of convenience, it is always preferable to install the units indoors in so much as all the required conditions previously described are satisfied and the customer/building owner allows it. However, when windows intervene to the beam path, the attenuating factor of the glass must be considered regarding the distance and the required fade margin.**

**CONSULT FACTORY IN CASE OF DOUBT !**

**CAUTION!**

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Chapter

3

# Infrastructure

**The only infrastructure required for operating the transceiver and linking the sites is Power and Data/Signal connection to the peripheral networking equipment. This must be ready prior to the airlink installation.**



**AT OUTDOORS INSTALLATIONS TAKE CARE TO USE SHIELDED AND WEATHERPROOF MATERIALS (CABLES, INLETS, CONNECTORS) COMPLIANT TO THE SAFETY STANDARDS IN FORCE.**

## Power

### Source


The power requirement for standard units is 230VAC @ 50Hz - 22W. An appropriate power supply inlet must be set on each site 1m nearby the mounting point (selected during the site survey).

| Note |
| --- |
| Units requiring 110VAC @ 60Hz - 22W or 24VDC - 20W can be factory set upon request |

### Cabling

Standard 3 conductors power cord is required.

All units are to be installed with a Listed overcurrent protection device and suitably rated disconnect device. These products are to be wired with solid conductors min. 22 AWG copper conductor and suitable conduit in accordance with the NEC.

## Data/Signal Cabling

### Type

For connecting the transceiver to the peripheral equipment two optical fiber cables are required (one for the transmission and one for the reception). The standard recommended cable is a 62.5/125µm fiber.

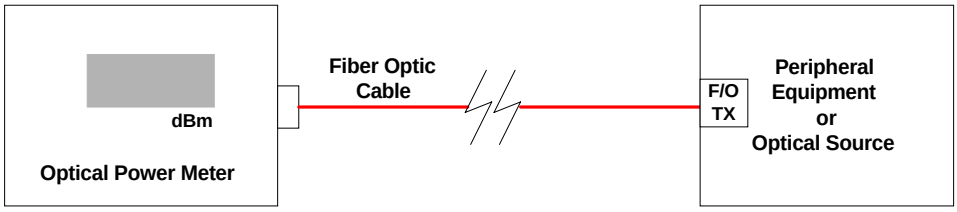
## Connectors

Each fiber should be terminated with an SC connector on the transceiver end.

## Optical Fiber Testing

The cabling installer must specify the attenuation of each fiber installed.

A simple power loss test can inform us about the condition of the fibers. This test consists of measuring with an optical power meter the output power at one end of the tested fiber while a fiber source is connected at the other end. If the values are in dBm, the difference between the input power and the output power gives the power attenuation of the fiber (in dB).




**In case the above equipment is not available, a simple visual test may be performed to locate and reject badly damaged fibers. Place near one end of the fiber a light source and block alternatively the termination, you must observe the light coming out of the other end. (This procedure does not guarantee that a fiber is acceptable)**

A standard 62.5µm fiber optic cable has an attenuation factor of around 3 to 5dB/km. Then a loss value of more than 3dB for runs up to 200m can indicate a suspect fiber.

Note

The fiber optic cables must be installed by a specialist.

***HANDLE THE FIBERS VERY CAREFULLY.***

Chapter

4

# Bench Test

**It is always easier and more convenient to locate a failure and solve a problem in a lab on a bench than on a roof under bad conditions. It is then strongly recommended to bench-test with all the modules prior to the installation in order to check the equipment compatibility and to validate the configuration.**

## Compatibility

### Peripheral Equipment

Check the operation of the peripheral equipment at both sites (see Configuration 1 below).

### Interfaces

Check the specifications compatibility (type, wavelength, receiver range, output power, data rate, etc.) between the TS155 and the peripheral equipment interfaces.

## Testing equipment

Chose an appropriate BER (Bit Error Rate) tester for checking the physical link quality. A portable one is preferred for convenient use in the field.
For example: the OC3port plus SONET and ATM analyzer manufactured by Desknet Systems or Fluke.

A ping test or a file transfer between two workstations - connected to the networking equipment - is useful and easy to implement for testing the performance of the whole configuration.

## Setup

### Data Rate Dip-switch

According to the application in use set the switches as indicated in the following table:

Legend:
☑ = ON
☐ = OFF

| Switch number | 1 | 2 |
|---|---|---|
| ATM (155Mbps) | ✓ | ✓ |
| Fast-Ethernet, FDDI (100Mbps) | ✓ | |
| 4E1 | | ✓ |

| | | |
|---|---|---|
| E3 (34Mbps) | | |

**Mode Select Dip-switch**

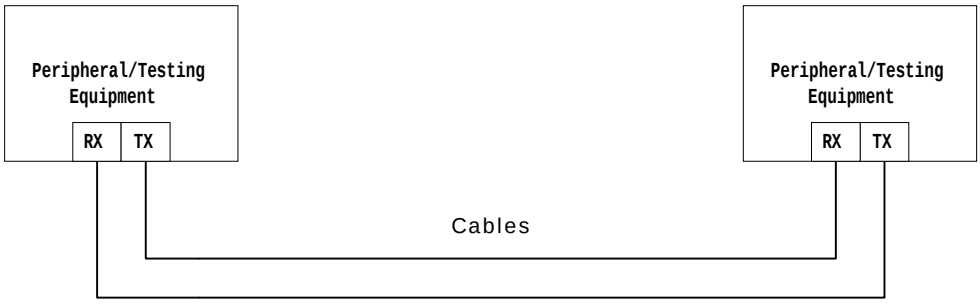
Set all the switches on the position OFF for normal operation.

## Test configurations

**IN ALL THE FOLLOWING CONFIGURATIONS TAKE CARE TO ADJUST THE TRANSCEIVERS OUT OF SATURATION. ALIGN THEM SLIGHTLY AT AN ANGLE SO THAT THE DIGITAL READOUT SHOWS A READING LOWER THAN 1100 BUT HIGHER THAN 20.**

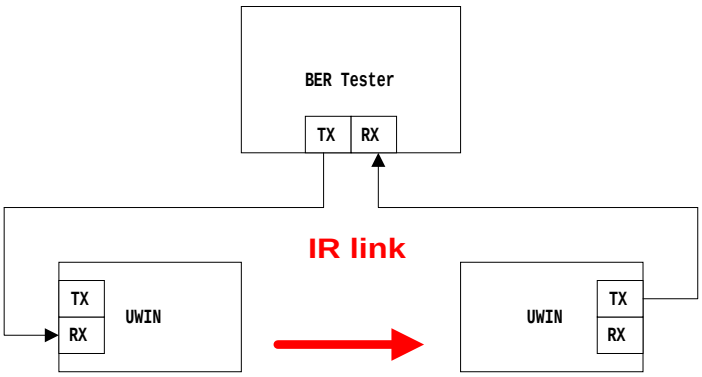
**Configuration 1**

Peripheral equipment operating test



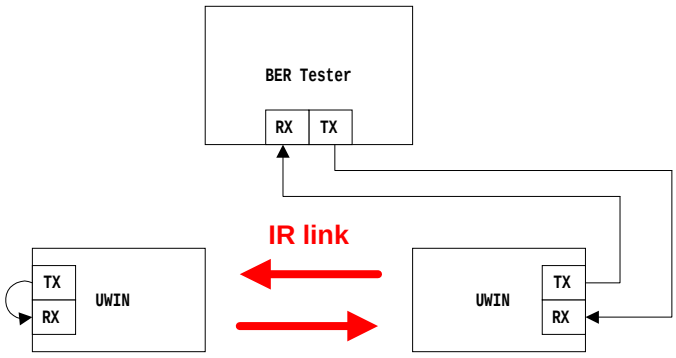

**Configuration 2**

One way Airlink BER test



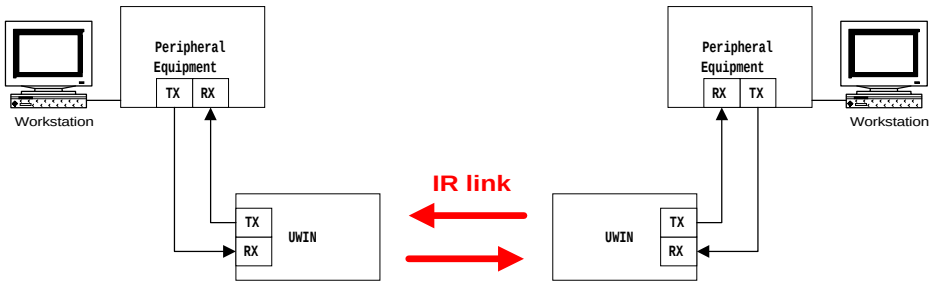
**Configuration 3**

Loop-back Airlink BER test




**Configuration 4**

Whole configuration operating test (Ping test or File transfer)




# Display and Results

## Proper Display

1. **Indicators**

| Indicator / Position | AIR RX | | F/O RX | | Alignment | Loopback |
|---|---|---|---|---|---|---|
| | Flag | Sync. | Flag | Sync. | | |
| ON | X | X | X | X | | |
| OFF | | | | | X | X |

2. **Received power**

**20 < OPTICAL POWER < 1100**

**Expected Results**

The BER must be less than 1E-12 for lasting tests and display *NO ERRORS* for brief ones.

The PING test and file transfer procedure should not notify any *TIME OUT alarm* or last too long compared to cabling connection.

Chapter

5

# Installation

**This chapter deals with the mounting of the hardware and the unit on the site (see Appendix B for the required material).**

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**All units are to be installed with a Listed overcurrent protection device and suitably rated disconnect device. These products are to be wired with solid conductors min. 22 AWG copper conductor and suitable conduit in accordance with the NEC.**

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## Accessories

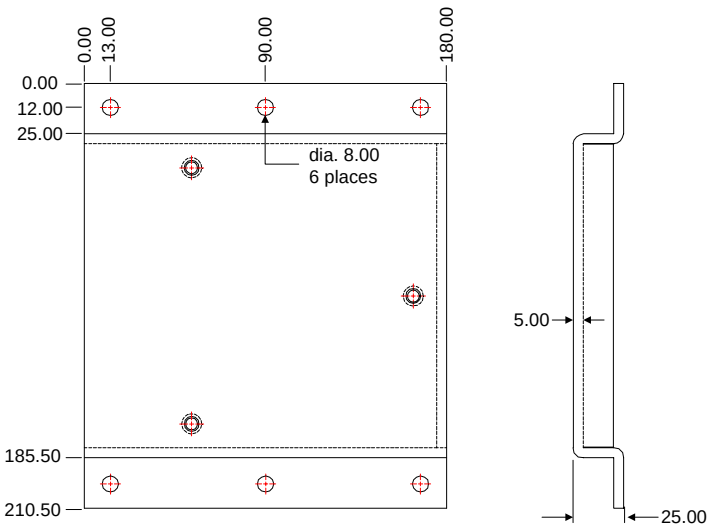
The standard mounting accessories are supplied with the transceiver in a kit. They are designed for typical mounting on horizontal and vertical surfaces.

**Description**

The accessories kit consists of : -The Jolt Mounting Kit (JMK)
-The Jolt Aiming Head (JAH)

The JMK (comprised of the Jolt Mounting Plate (JMP) and the Jolt Mounting Bracket (JMB) is used for mounting the transceiver on the support surface. The JAH allows the aiming of the two units making the link (see chapter 6).

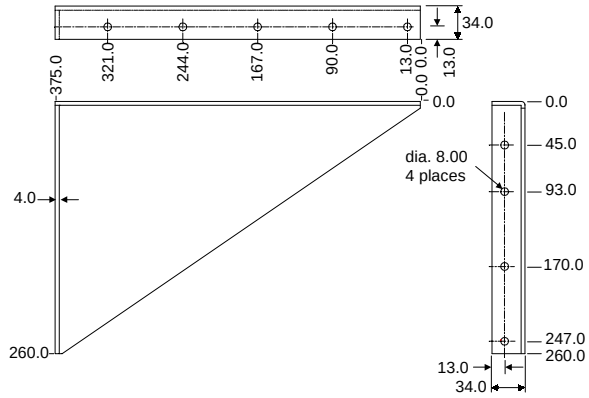
JMP
Jolt Mounting Plate
(dimensions in mm)



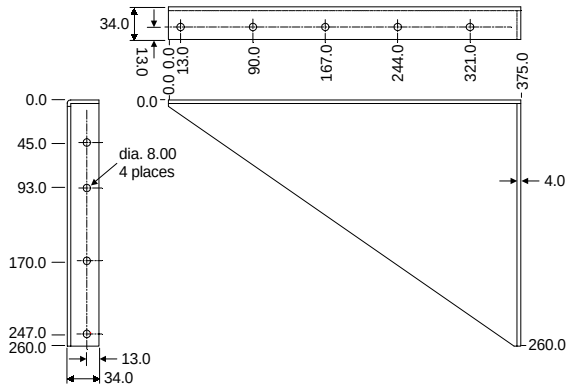

a. Top view

b. Side view

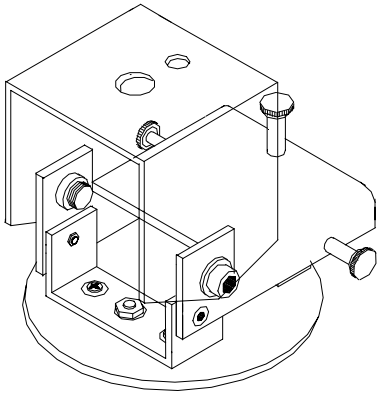
JMB
Jolt Mounting Bracket
(dimensions in mm)



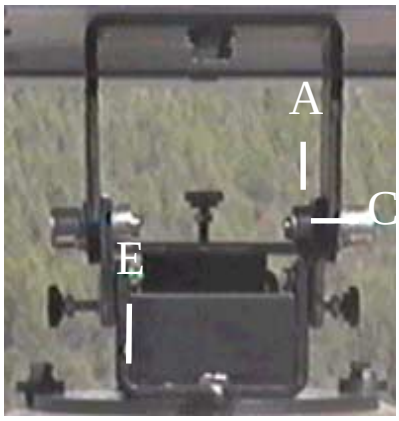

a. JMB Left



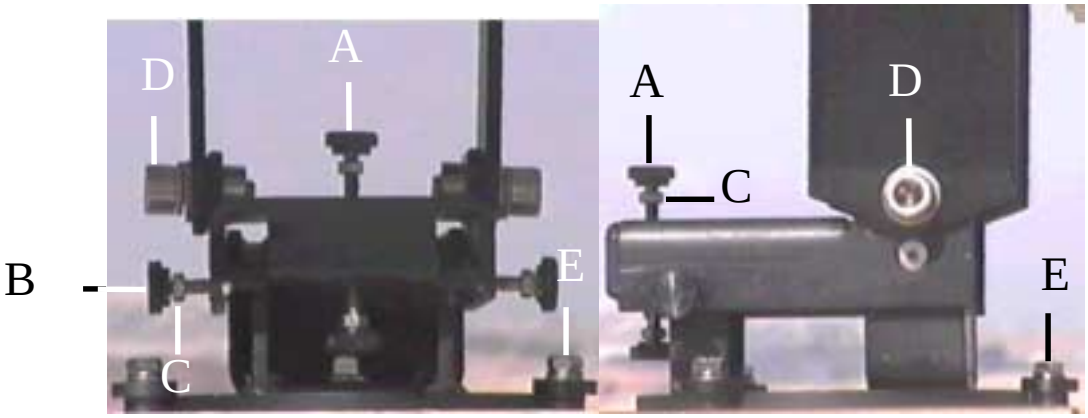

b. JMB Right



a. Perspective view




b. Front view




. c.Back view

d. Side View

AIMING HEAD ADJUSTMENT AND LOCKS:

A: Vertical Fine Aiming Screws (2)

B: Horizontal Fine Aiming Screws (2)

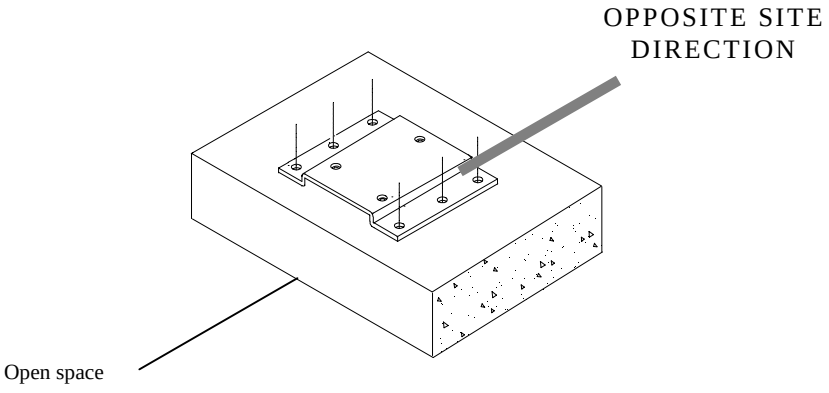
C: Fine Locking Nuts(4)

D: Gross Elevation Locking Screws (2)

E: Lug Bolts (3)

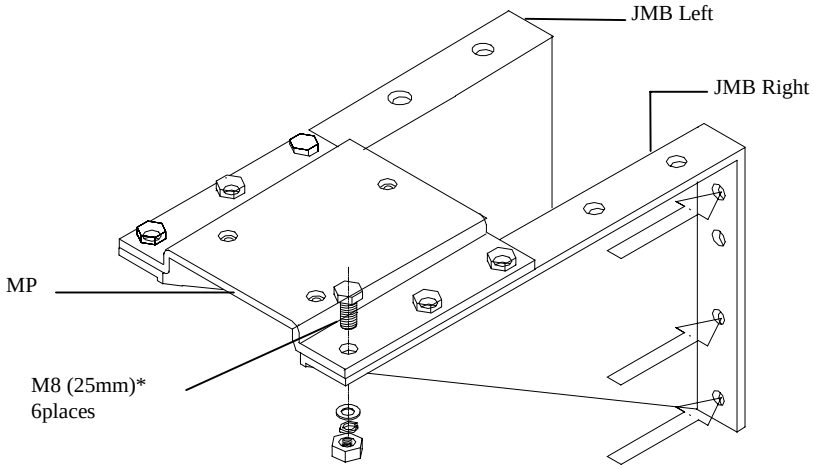
## Mounting

- Horizontal surfaces (parapet, ...):



**THE JMP SHOULD BE ORIENTED IN SUCH A WAY THAT THE "OPEN SPACE" UNDER THE ACCESSORY IS LOCATED ON THE BACK (CLOSE TO THE INSTALLER).**

- Vertical surfaces (wall, rectangular column, ...):




*These bolts and nuts are included in the kit

Note

For more convenience it is suggested to assemble the 3 parts of the MB before mounting it on the surface.

## Special Installation Techniques

This section describes two frequently encountered installation types.

**1. Mounting on the floor**

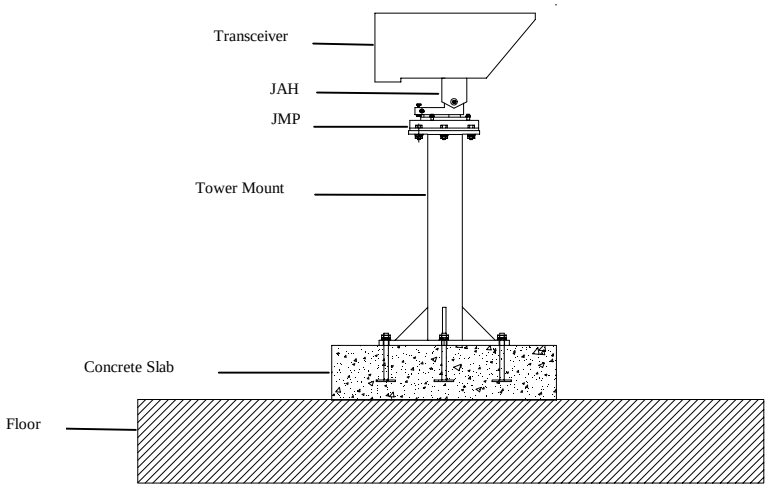
In some cases the only place where the installation is acceptable, possible or authorized is on the floor (for example on a roof without any parapet or if the parapet is metallic, ...). In such situations drilling holes on the floor is out of the question.

The principle consists in fixing in a very stable way a tower standing on the floor. The transceiver will be attached on the top of the tower.

Two techniques using a small concrete block are suggested for stabilizing the tower on the floor.

- The concrete slab is directly poured on the basis of the tower

- Four bolts are inserted in the concrete slab placed on the floor. The tower mount is fixed on the slab with the inserted bolts using nuts.

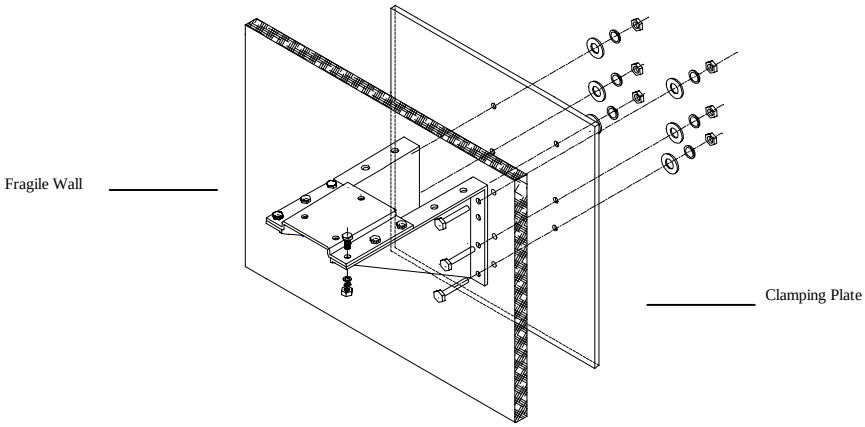



**REMOVE ANY INTERVENING SOFT MATERIAL, SUCH AS ASPHALT, FROM BETWEEN THE SLAB/TOWER BASIS AND THE FLOOR. AFTER THE INSTALLATION IS COMPLETED, RESTORE THE ROOF WATER-PROOFING AROUND THE SLAB WITH A SEALING MATERIAL.**

**2. Mounting on a fragile/crumbly wall**

At sites where the installation on fragile (pre-fab) or crumbly (old building) walls is unavoidable, the best way to securely fix the MB is to use a metallic clamping plate on the other side of the wall as sketched below.

In this technique, a large section of the wall is clasped providing higher rigidity and stability.

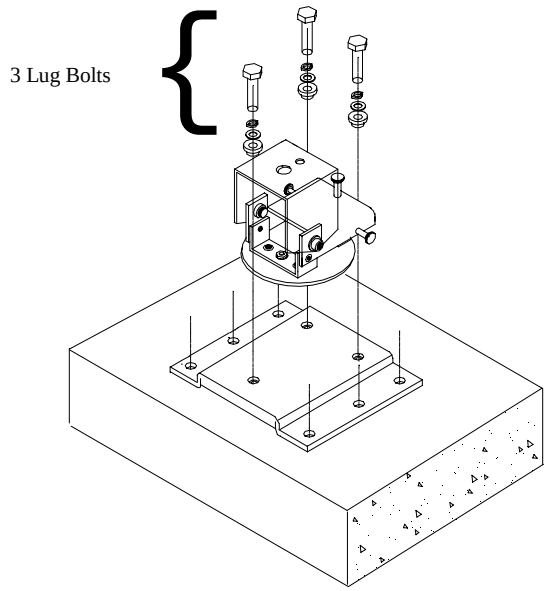


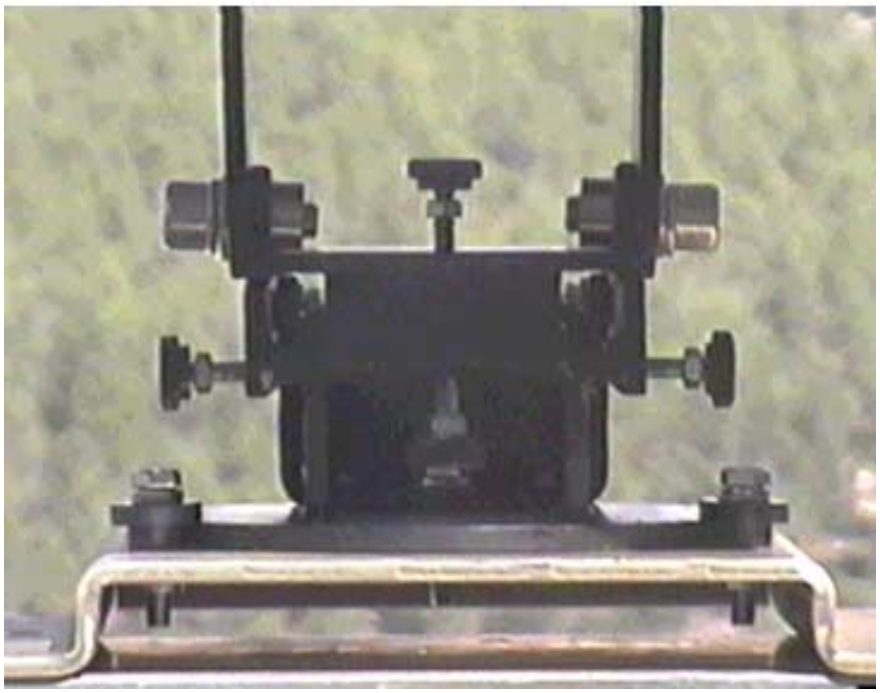

Note

The Tower Mount and the Clamping Plate are not provided with the equipment and should be supplied by the installer.

## Attachment of the Transceiver

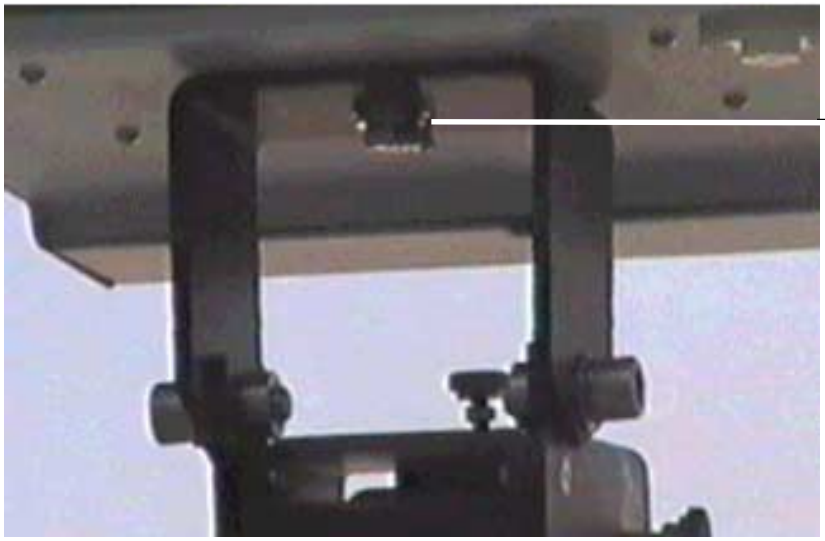
Install the JAH on the accessory (JMP or JMB) already mounted, taking care to place the Fine Tuning Device on the back, and tighten slightly the three Lug bolts.



Aiming Head mounted on a JMP - Back view

Mount the Transceiver - front face oriented towards the opposite site - onto the JAH, using the two bolts and washers provided. Tighten firmly these bolts.



Bolts for the attachment of the Transceiver to the Aiming Head

Final appearance of the whole assembly

Chapter

6

# Aiming Procedure

**Point to point connections require the orientation face to face of both "transceiving" ends of the link. With wireless optical links symmetrically positioning the beam all around the remote receiver should be done as accurately as possible.**

**CONNECT THE TRANSCEIVERS TO THE ELECTRICAL POWER AND SET THE MODE SELECT DIP-SWITCH ON THE ALIGNMENT POSITION ON BOTH SITES (THE ALIGNMENT INDICATOR SHOULD BE ON).**

This procedure is implemented in two stages:

## Rough Alignment

At this stage, the transceiver at the opposite site is caught in the telescope crosshairs, and we get a first readout on the digital display.

**Horizontal orientation**

Rotate the Transceiver-AH assembly slightly from side to side, so as to place the horizontal axis of the telescope crosshairs on the same horizontal level as the opposite site. Tighten the three Lug Bolts to fix this position.

**Vertical orientation**

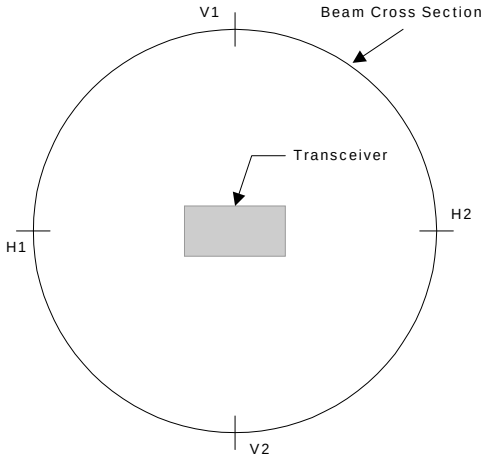
Similarly, slightly loosen the Gross Elevation Locking Screws (on the side of the Yoke) and slightly tilt the Transceiver-AH assembly up or down, so as to place the vertical axis of the telescope crosshairs on the same vertical level as the opposite.

## Fine Positioning

- **THIS STAGE REQUIRES TWO PERSONS, ONE AT EACH SITE.**
- **EACH OF THEM MUST HAVE A COMMUNICATION DEVICE (I.E., A WALKIE TALKIE, A CELLULAR PHONE)**

The target at this stage is to aim **only the local transmitter**, using the Fine Tuning Device (the 4 Fine Aiming Screws), so that the **remote receiver** will be situated in the middle of the beam cross section at short distance.

Front view
Transceiver at the middle of the beam cross section




In transmitting technology, the fine positioning procedure is different:

**For LED based systems - TS3101 and TS3103**

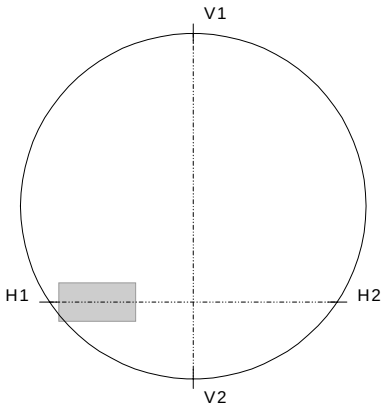
Scan horizontally and vertically the field at the opposite site using alternately the Horizontal Fine Aiming Screws and the Vertical Fine Aiming Screws. The choice of the displacement direction will be dictated by the digital readout level continuously reported by the opposite installer. Set the position with the maximum reading and tighten firmly the 4 Fine Locking Nuts.

**For LASER based systems - TS3303**

Procedure:

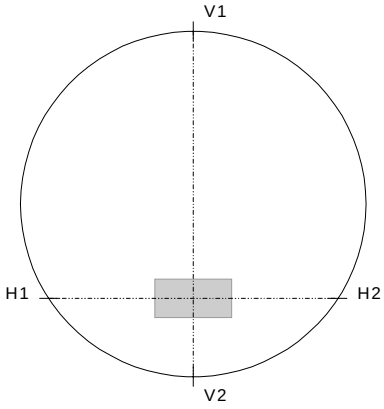
1. Find the horizontal and vertical Beam edges (H1, H2, V1, V2)
2. Set successively the remote transceiver in the middle of the two segments [H1,H2] and [V1,V2].

Position at the beginning
(after the rough alignment)



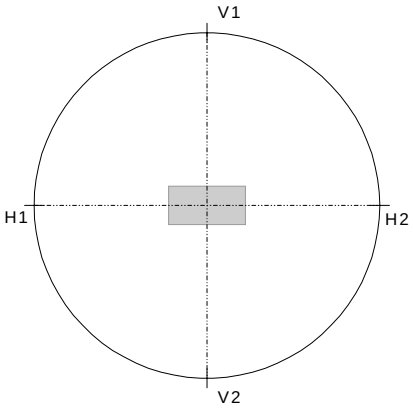

?To determine the horizontal beam edges H1 and H2, tilt the local transceiver from side to side slowly until the digital readout on the remote unit becomes 20. Locate these two points relating to reference points on the opposite site looking through the telescope. Set the remote transceiver - moving the local transceiver - at the middle of these two reference points.?

Position after the horizontal
aiming




Repeat this process for the vertical positioning (middle of segment [V1,V2]).

Final position after the
vertical aiming




Once the position is reached, tighten firmly the 4 Fine Locking Nuts.

**For both methods, repeat this procedure changing places with the second installer (i.e. he will move the remote transceiver and you will report to him the digital readout on the local one).**

*At the end of the process the digital readout should be approximately the same on both units (see Appendix A for expected readings).*

**For short distances below or close to the minimum distance specified for each model (see section Technical Specifications), make sure that the digital readout does not exceed 1100. Otherwise use the Air TX Power Dip-switch (-3dB, -6dB, -9dB, -12dB) on *THE REMOTE TRANSCEIVER* to bring the reading down and get the highest value below 1100.**

Chapter

7

# Installation Completion

## Link Operating Test

Set the Mode Select Dip-Switch back to the Normal position (the Alignment indicator should switch OFF).

At both sites, connect the optical fiber cables leading from the peripheral equipment to the fiber optic port of the transceiver.

*It is a cross connection:*

*TX ➔RX and RX ➔ TX*

The F/O RX Flag and Sync. indicators should switch ON as soon as the peripheral equipment is powered ON.

A BER test is recommended. In case this is not possible it is advisable to check system performance with the customer/user (see the chapter Bench Test).

## Installation Log

Record all the information about the installation (including digital readout and the setup of the transceivers) in the Installation Log. This information will be a valuable reference for future maintenance or troubleshooting visits.

***An installation form is proposed as an example in Appendix C***

## Sealing of the units

1. Check that the cables are well engaged in the connectors, and the Fine Locking nuts well tightened.
2. Close the rear door passing the cables through the slot designed for this purpose on the bottom edge of the door.
3. Lock the door with the Door Locking Screws located on the sides of the transceiver.

Chapter

8

# Maintenance

## Periodic Visits

Every three months carry out visits to:

- Check the display
- Check the mounting
- Clean the optical aperture of the transceivers
- Clean the building windows for indoors installations.



**At cleaning time, the digital readout should be marked down in a service log book. After the optical aperture is cleaned, if the reading is substantially lower than the reading noted at installation time, the aiming accuracy should be examined and restored if necessary.**

Note

Check aiming accuracy through the telescope and compare the present scene sighting to the one sketched in the Installation Log at installation time.

# APPENDIX A

## Digital Readout vs. Distance

These tables are only intended to give you an idea of what digital readout you could expect according to the distance to link. Variations of ±20% can be expected

D= Distance [m]

R= Reading (Digital readout)

TS3101

| **D** | 100 | 200 | 300 | 400 | 500 | 600 |
|---|---|---|---|---|---|---|
| **R** | 800 | 300 | 120 | 80 | 40 | 20 |

TS3103

| **D** | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 |
|---|---|---|---|---|---|---|---|---|---|
| **R** | 1000 | 560 | 260 | 160 | 100 | 60 | 50 | 30 | 20 |

TS3303

| **D** | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1500 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **R** | 1150 | 1060 | 960 | 880 | 800 | 660 | 580 | 380 | 340 | 140 | 80 |

# APPENDIX B

## Tool Kit, Equipment and Materials

TOOLS

1. Electric drill (impact for masonry), reversible, with speed control and 0-13mm chuck
2. Drills set High Speed Steel (HSS) 3-12mm.
3. Concrete carbide .bit drills 6,8,9 and 10mm (regular and long shank).
4. Adjustable (crescent) wrench 6", 10".
5. Open-ring wrenches (spanners), standard and metric.
6. Vise grip plier 10-12"
7. Cutter, long nose plier, electrician's plier (insulated).
8. Pen, Pencil, Permanent markers.
9. Lens cleaning clothes.
10. Screwdrivers (flat and Philips), sizes 1, 2, 3 + power screwdriver bits.
11. 50m extension cable + 3 outlet multiple electrical tap
12. 200g hammer.
13. Blade knife.
14. Ratchet handle driver.
15. Socket wrenches 8mm, 10mm, 11mm, 13mm, 14mm, ½" .
16. Allen 8mm.

MATERIALS

1. Anchors (wall plugs) "UPAT" 10mm diameter
2. Hex-head screws to fit wall plugs 40, 60, 75mm length.
3. Assortment of screws, nuts, washers, spring washers.
4. Electric insulation tape.
5. Super glue, tie wraps (Panduit™).
6. 20 mm fuse SB, 125mA, 160mA, 250mA, 500mA, 1A.

ELECTRONIC & GENERAL EQUIPMENT

1. Digital voltmeter (DVM)
2. 2 Walkie Talkies or cellular phones.

OPTICAL EQUIPMENT

1. Optical Power Meter (Fotec, Noyes) with fiber sockets.
2. 2 sets of multimode (62.5µm) optical fibers with SC terminations.
3. Binoculars.

LAB EQUIPMENT

Testing equipment for Fast-Ethernet and ATM (preferably portable).

# APPENDIX C

## Installation Log

### C.1. Client / Dealer details

| | Customer | Dealer |
|---|---|---|
| Company Name | | |
| Address<br>City<br>Country | | |
| Contact Person | | |
| Tel | | |
| Fax | | |
| e-mail | | |

### C.2. Application details

| | |
|---|---|
| Type of network | ☐ T1 , ☐ E1 , ☐ Ethernet , ☐ Token Ring , ☐ Fast Ethernet ,☐ FDDI , ☐ ATM , ☐ Other (Specify) |
| Product | |
| Evaluated distance by customer | |
| Address of installation (site A) | |
| Address of installation (site B) | |

### C.3. Sketch of the area

## C.4. Site survey

| | |
|---|---|
| Done by | |
| Customer representative | |
| Distance | |
| Date | |

| | Site A | Site B |
|---|---|---|
| Location | | |
| Floor | | |
| Orientation (NSEW) | | |
| Installation site scheme | | |
| Indoor / Outdoor | | |
| Plate JMP / Bracket JMB | | |
| Window attenuation | | |
| On-line UPS | | |
| Voltage required (110V / 230V) | | |
| Ground earthing | | |
| Radio antenna field | | |

| Associated interface equipment | Site A | Site B |
|---|---|---|
| Manufacturer | | |
| Type | | |
| Model number | | |
| Interface type | | |

## C.5. Installation

| | |
|---|---|
| Done by | |
| Customer representative | |
| Date | |

| | Site A | Site B |
|---|---|---|
| System model | | |
| Serial number | | |
| Location : Same as site survey, if not, provide details | | |
| Accessories : Same as site survey, if not provide details | | |
| Digital readout | | |
| Telescope calibration : if cannot , sketch the telescope view | | |

| | |
|---|---|
| BER test | |
| BER equipment type | |
| Loopback location | |
| Error type (random, burst) | |
| Brief interruption test | |

## C.6. System failure

| | |
|---|---|
| Visit made by | |
| Customer representative | |
| Date | |

| | Site A | Site B |
|---|---|---|
| Sketch of telescope view | | |
| Digital readout | | |
| Failure detail | | |
| Action items | | |

| | |
|---|---|
| Visit made by | |
| Customer representative | |
| Date | |

| | Site A | Site B |
|---|---|---|
| Sketch of telescope view | | |
| Digital readout | | |
| Failure detail | | |
| Action items | | |