

# **TereScope700 and TereScope800**

## **Wireless Optical Communication Links**

Models TS700/100, TS700/155, TS700/G, TS800/155



# **User Manual**



WIRELESS OPTICAL COMMUNICATIONS

# User Manual

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## Standards

### Standards Compliance

UL 1950; CSA 22.2 No 950; FCC Part 15 Class B; CE-89/336/EEC, 73/23/EEC

### FCC Notice

**WARNING:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions in the manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct for the interference at the user's own expense. The user is cautioned that changes and modifications made to the equipment without approval of the manufacturer could void the user's authority to operate this equipment.

It is suggested that the user use only shielded and grounded cables when appropriate to ensure compliance with FCC Rules.

### CE Mark

The CE mark symbolizes compliance with the EMC directive of the European Community. Such marking is indicative that the specified equipment meets or exceeds the following technical standards:

- EN 55022 - Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment
- EN 50081-1- Electromagnetic compatibility - of Radio Interference Characteristics of Information Technology Equipment Generic Emission standard Part 1 – Residential commercial and light industry environment
- EN 50082-1 - Electromagnetic compatibility -- Generic immunity standard Part 1: Residential, commercial and light industry environment
- EN61000-4-2 (previously IEC 1000-4-2) - Electromagnetic compatibility for industrial-process measurement and control equipment Part 4: Section 2 - Electrostatic discharge requirements
- EN61000-4-3 (previously IEC 1000-4-3) - Electromagnetic compatibility for industrial-process measurement and control equipment Part 4: Section 3 - Radiated electromagnetic field requirements
- EN61000-4-4 (previously IEC 1000-4-4) - Electromagnetic compatibility for industrial-process measurement and control equipment Part 4: Section 4 - Electrical fast transient/burst requirements
- EN61000-4-5 - Electromagnetic compatibility for industrial-process measurement and control equipment Part 4: Section 5 – Surge Immunity requirements
- EN61000-4-6 - Electromagnetic compatibility for industrial-process measurement and control equipment Part 4: Section 6 – Immunity to conducted disturbances induces by radio frequency fields
- EN61000-4-8- Electromagnetic compatibility for industrial-process measurement and control equipment Part 4: Section 8– Power frequency magnetic field immunity requirements
- EN61000-4-11 – Electromagnetic compatibility for industrial-process measurement and control equipment Part 4: Section 11 – Voltage dips short interruptions and voltage variations immunity requirements
- EN61000-3-2 – Harmonic standard
- EN61000-3-3 – Voltage Fluctuation and Flicker standard
- CISPR 22 - Radiated and Line-conducted Class B
- EN 60950 - ITE Safety

## Other Standards

1. CISPR 22: 1993  
AS/NZS 3548: 1995, Class B  
Joint Amendment No. 1: 1997, Joint Amendment No. 2: 1997
2. EN 60950+A1+A2+A3+A4+A11  
ACA TS001-1997  
AS/NZS 3260: 1993 A4: 1997
3. ITU G.703, G.704, G.706, G.736, G.737, G.738, G.739, G.740, G.775, G.823.

## MRV™ Laser Safety Certification

The TereScope is designed, built, and tested to be eyesafe, even if the output beams are viewed directly, provided that no magnifying optics are used.

This product is Class 1M according to the American National Standard for Safe Use of Lasers, ANSI Z136.1-1993, provided that there is not a reasonable probability of accidental viewing with optics in the direct path of the beam where the TereScope is installed.

This product is Class 1M according to the International Standard of the International Electrotechnical Commission IEC 60825-1, Amendment 2, January 2001 entitled "Safety of laser products." The following explanatory label is applicable to these products:

**LASER RADIATION  
DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS  
(BINOCULARS OR TELESCOPES)  
CLASS 1M LASER PRODUCT**

This product complies with United States FDA performance standards for laser products except for deviations pursuant to Laser Notice No. 50 as published in June, 2001, which allows for the use of the IEC 60825-1 classification standard. Under this standard, these products are Class 1M. A 'Declaration of Conformity', in accordance with the above standards, has been made and is on file at MRV.

## Disclaimer

MRV reserves the right to modify the equipment at any time and in any way it sees fit in order to improve it.

MRV provides this document without any warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of merchantability or fitness for a particular purpose.

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## About this User Manual

### Audience

This manual is intended for the user who wishes to install, operate, manage and troubleshoot the TereScope700 and TereScope800.

### Qualifications

Users of this guide are expected to have:

- Working knowledge of Electro-optical equipment
- Working knowledge of LAN equipment (Layer 2 and 3)
- A License to install equipment on buildings/elevated structures
- A License to work with power line (mains) voltages 110/230 Vac

### Training

Installers are required to do a training course on MRV TereScopes that includes:

- IR links (site survey, installation equipment, alignment, etc.)
- Indoors and outdoors installation
- On-the-job-training
- Proficiency tests

### Experience


Installers are required to have experience in coax cable TV home pass installation, PTT home pass installation, LAN installation, IR equipment installation, and home electrical wiring.

### Authorization

After all the requirements specified above (namely, Qualifications, Training, and Experience) have been met, the installer must receive authorization from MRV certifying eligibility.

## Safety Requirements

All requirements stipulated in the safety laws of the country of installation must be abided by when installing the TereScopes.

	<p><b>Caution!</b></p> <p>In addition, ensure that the requirements noted in this chapter are met in order to reduce risk of electrical shock and fire and to maintain proper operation.</p>
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### Before Installing

**Power:** Ensure that *all* power to the TereScope is cut off. Specifically, disconnect all TereScope power cords from the power line (mains).

**Inspection:** Ensure by inspection that no part is damaged.

### Before Powering On

**Line Power:** Ensure that the power from the line (mains) is as specified on the TereScope.

**Power Cord:** The power cord of The TereScope must have the following specifications:

Flexible 3-conductor power cord approved by the cognizant safety organization of the country. The power cord must be Type HAR (harmonized), with individual conductor wire having cross-sectional area 0.75 sq. mm. min. The power cord terminations should be a suitably rated earthing-type plug at one end and 3 terminal cord forks for M3 screws (1 for each wire) at the other end. Both of the power cord terminations must carry the certification label of the cognizant safety organization of the country.



Figure A: 3 terminal cord forks

### When Installing

- Ensure, by visual inspection, that no part of the TereScope is damaged.
- Avoid eye contact with the laser beam at all times.
- Ensure that the system is installed in accordance with ANSI Z136.1 control measures (engineering, administrative, and procedural controls).
- Ensure that the system is installed in accordance with applicable building and installations codes.
- Install the TereScope in a restricted location as defined in this manual since it is a Class 1M FSOCS transmitter and receiver. A restricted location is a location where access to the transmission equipment and exposed beam is restricted and not accessible to the general public or



casual passersby. Examples of restricted locations are: sides of buildings at sufficient heights, restricted rooftops, and telephone poles. This definition of a restricted location is in accordance with the proposed IEC 60825-I Part 12 requirements.

- Avoid using controls, adjustments, or procedures other than those specified herein as they may result in hazardous radiation exposure.
- Avoid prolonged eye contact with the laser beam (maximum 10 sec.).

### **Servicing**

All servicing must be carried out only by qualified service personnel. Before servicing, ensure that all power to the TereScope is cut off!

## Introduction

### ***CAREFULLY READ THE ENTIRE MANUAL BEFORE INSTALLING***

**A**n InfraRed (IR) link allows connection without any cable between two distant sites. For that, two identical transceivers, each installed on one site and aligned to face each other, provide point-to-point connectivity. This configuration makes possible data transfer from one terminal to the other through the air over an optical wavelength carrier, the IR link – see picture in Figure B, below.



**Figure B: IR Link**


The installation of such a link can be summarized as 4 stages:

- ◆ Site survey
- ◆ Installation of the infrastructure
- ◆ Mounting of the equipment
- ◆ Aiming (alignment) procedure



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

## The Product

	<p><b>Caution!</b></p> <p>When handling the TereScope, take special care not to damage the polycarbonate window!</p>
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### Models

**Table 1: Models of the TereScope<sup>1</sup>**

Models	Part Number	Description
TS700/100	TS100/A/FET/VS	TereScope700 for Fast Ethernet 100Base-TX connectivity up to a distance of 360 m + Power-over-Ethernet option.
TS700/155	TS155/A/YUW/VS	TereScope700 for 1-155 Mbps connectivity up to a distance of 360 m.
TS700/G	TS1000/A/YUW/VS	TereScope700 for Gigabit Ethernet and FiberChannel (1.0625) connectivity up to a distance of 400 m
TS800/155	TS155/C2/YUW/VS	TereScope800 for 1-155 Mbps connectivity up to a distance of 550 m + Fusion option.

### Using the Part Number for Ordering

To place an order for a TereScope model having a specific configuration, use the Part Number format shown in *Table 1*, noting the following:

‘155’ represents link operation speed in the range 1 to 155 Mbps.

‘A’ represents TereScope700.

‘C2’ represents TereScope800.

‘Y’ represents Optical Fiber Mode.

Instead of Y use one of the following:

M (for MultiMode)

<sup>1</sup> TereScope700 or TereScope800.

S (for SingleMode)

'U' represents operating wavelength.

Instead of U use one of the following:

8 (for 850 nm)

3 (for 1310 nm)

5 (for 1550 nm)

'W' represents connector type.

Instead of W use one of the following:

C (for SC)

T (for ST)

'FET' (Fast ethernet) represents 100Base-TX with RJ45 connector

'V' represents existence/absence of Fusion.

Instead of V use one of the following:

V designates no built-in Fusion option.

F designates built-in Fusion option (only in TS800).

'S' represents power supply type.

Instead of S use one of the following:

S (for input to the power supply in the range 100-240 VAC)

3 (for input to the power supply in the range 24-60 VDC)

### Examples

1 - TS155/A/M3C/VS means TS700/155 :1-155Mbps link, Multimode, 1310 nm, SC interface, 100-240 VAC power supply.

2 - TS155/C2/S3T/F3 : TS800/155 :1-155Mbps link, Singlemode, 1310 nm, ST interface, built-in Fusion option, 24-60 VDC power supply.

## General Description and explanations

### 1. Front

Each TereScope head comprises a receiver, 1 transmitter and an interface on the rear panel for connection to the peripheral equipment see Figure 1.1.

Front view  
Showing the receiver  
side, the transmitters and  
the telescope

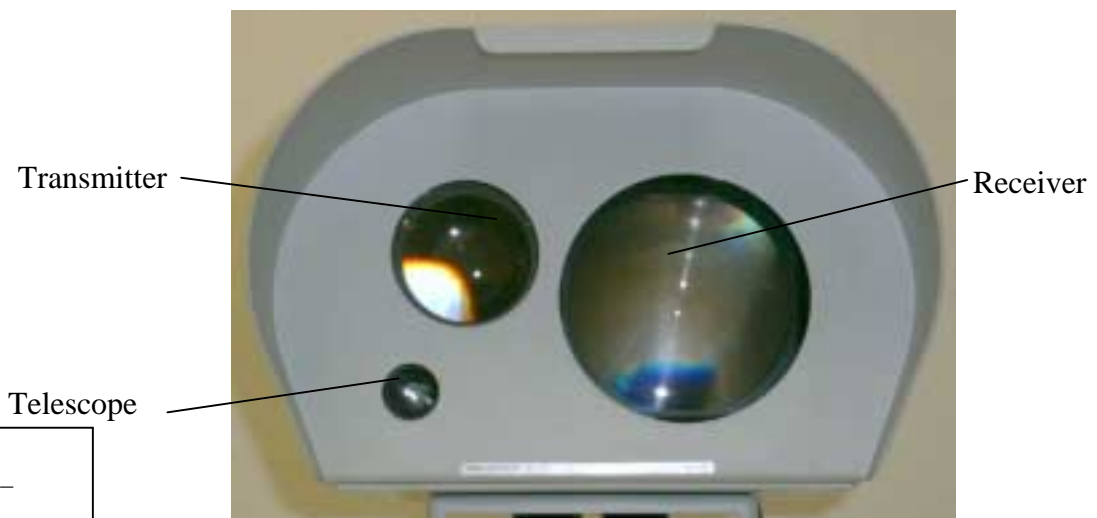


Figure 1.1: Front View

#### CAUTION!

AVOID EXPOSURE –  
INVISIBLE LASER  
RADIATION IS EMITTED  
FROM THIS APERTURE

## 2. Back

All models of the TereScope are SNMP manageable. SNMP monitoring can be performed using MRV's MegaVision SNMP management application.

### A. TS700/155 (Standard Model)

The TS700 supports Fast Ethernet, OC3, STM1, E3, and T3 protocols in the 34-155 Mbps range. A special type of TS700 can be ordered that **can be used for Open Protocol applications** which ensures complete transparency (**including all data in the range of 1-155 Mbps.**) In this type, less than 2 dB of the budget is lost.

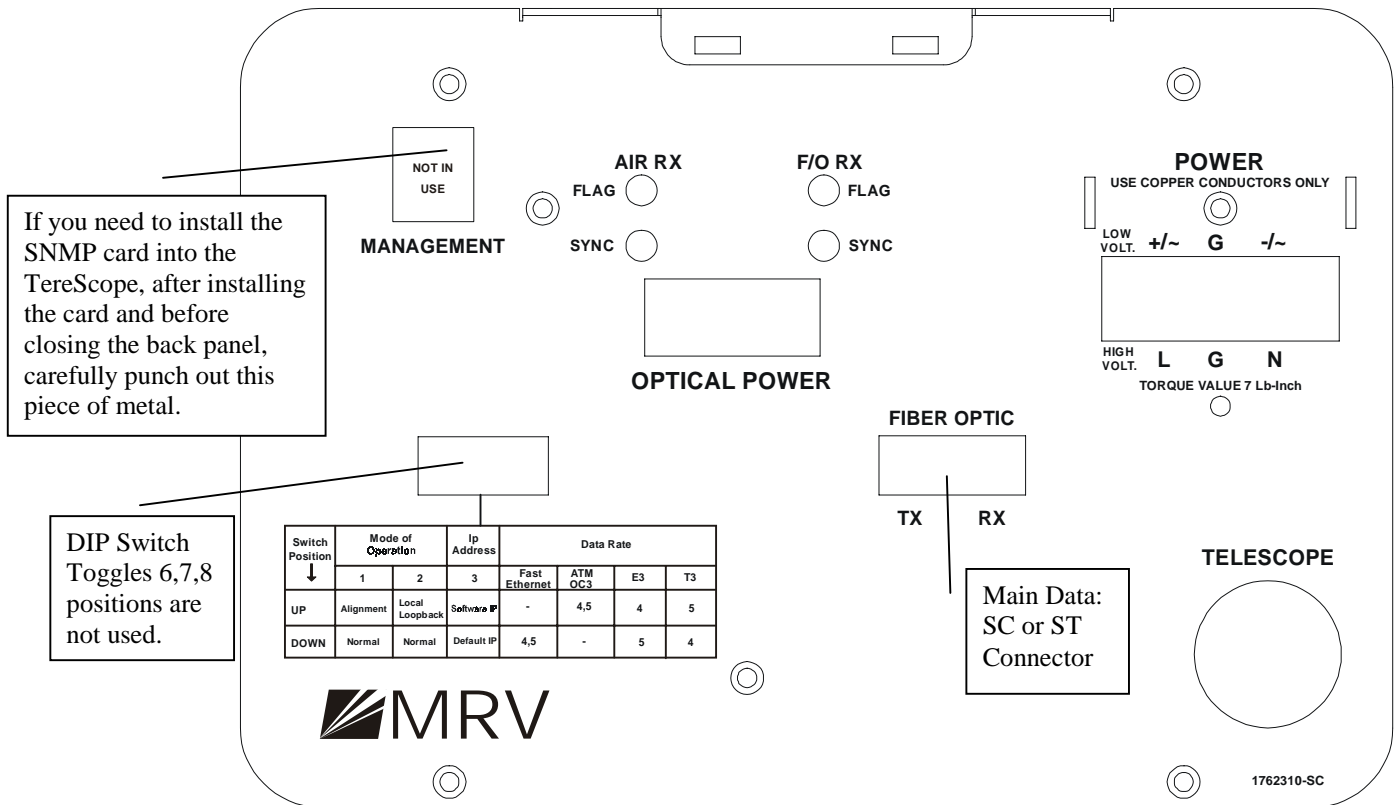


Figure 1.2a: TS700/155 Standard Model Panel Schematic



Figure 1.2b: Rear View of TS700/155

## Back Panel Description

**Table 2: TS700/155 Standard Model Back Panel Controls, Interfaces, and Indicators**

<b><u>Connectors</u></b>	<b><u>Power</u></b>	Power source Terminal Block (Main or UPS) AC power supply (100 to 240 Vac) or DC power supply (24 to 60 Vdc)
	<b><u>Fiber optic</u></b>	Fiber Optic interface for connection to the peripheral equipment. The standard interface is MM 1310nm SC connector; other interfaces are available upon request.
<b><u>Selectors (DIP Switch Toggles)</u></b> -- shown in Figure 1.3	<b><u>Management (Optional)</u></b>	Connection to 10base-T SNMP management interface. (To be ordered separately)
	<b><u>Mode of Operation (Toggles 1 and 2)</u></b>	Set the Operating Mode ALIGNMENT = Idle transmitted automatically 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. LOOPBACK=The Data received by the F/O RX is directly returned through the F/O TX.
	<b><u>IP address set up (for Mgt. option) (Toggle 3)</u></b>	Used only with the management option. When the Switch toggle is on OFF position, the TereScope's IP address is the default one (shown on the back panel label: 10.0.0.101). To set a new IP address please refer to the "IP address setting procedure for TereScope management card" file in the Manuals CD. The new IP address is valid only after the TereScope is powered off and on.
	<b><u>Data Rate (Toggles 4 and 5)</u></b>	Set the transmission rate of the transceiver (internal clock). - Fast Ethernet: 4,5 OFF - ATM/OC3/STM1:155 Mbps: 4,5 ON - E3: 34.368 Mbps: 5 OFF, 4 ON - T3: 44.736 Mbps: 4 OFF, 5 ON

<b><u>Indicators (7-segment display LEDs)</u></b>	<b><u>Air RX Flag LED</u></b>	Green LED indicates data received by the Airlink receiver. Turns ON at the threshold level.
	<b><u>Air RX Sync LED</u></b>	Yellow LED. Turns ON if the rate of the received Data matches the Data Rate set on the Data Rate DIP switch.
	<b><u>F/O RX Flag LED</u></b>	Green LED indicates Data received by the Fiber Optic receiver. Turns ON at the threshold level.
	<b><u>F/O RX Sync LED</u></b>	Yellow LED. Turns ON if the rate of the received Data matches the Data Rate set on the Data Rate DIP switch.
	<b><u>Optical Power 7-segment display</u></b>	Digital readout indicates the Optical Power level received by the Airlink receiver.

<b><u>Alignment</u></b>	<b><u>Telescope</u></b>	For fine alignment.
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### B. TS800/155 Standard Model

The TS800/155 supports most of the prevalent protocols in the 34-155 Mbps range. Support for a special protocol, which is not on the list, can be ordered after coordination with the factory. **This model can be used for Open Protocol applications** which ensures complete transparency (**including all data in the range of 1-155 Mbps.**) In this case, a maximum 2 dB of the power budget is lost.

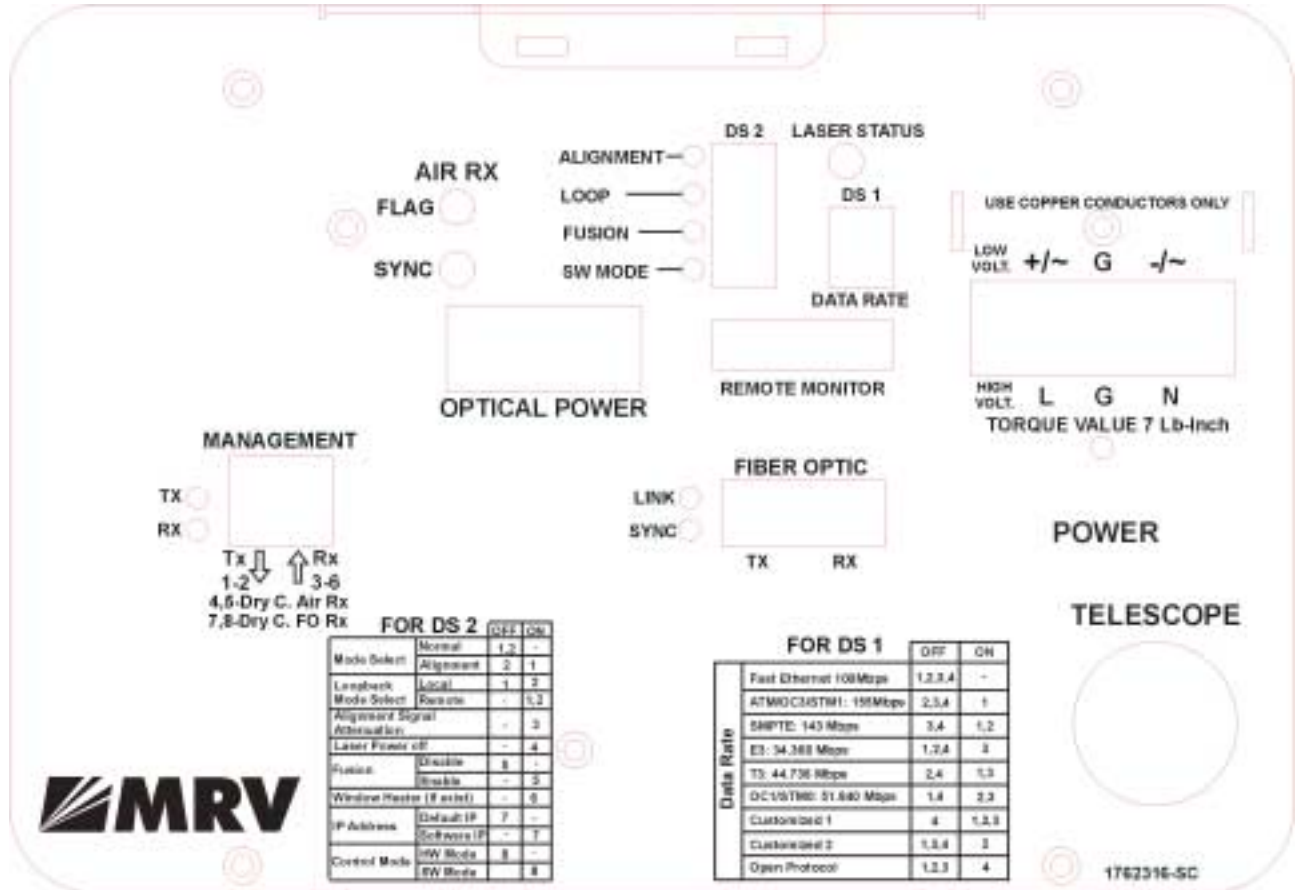


Figure 1.3: TS800/155 Standard Model Panel Schematic

### Back Panel Description

Table 3: TS800/155 Standard Model Back Panel Controls, Interfaces, and Indicators

<b>Connectors</b>	<b>Power</b>	Power source Terminal Block (Main or UPS). AC power supply (100 to 240 Vac) or DC power supply (24 to 60 Vdc)
	<b>Fiber optic</b>	Fiber Optic interface for connection to the peripheral equipment. The standard interface is MM 1310nm SC connector; other interfaces are available upon request. In model TS800/155-F with the fusion option, there are two fiberoptic interface ports for connection to the Fusion system; one primary and the other redundant.
	<b>Remote monitor</b>	Connection to the RSM. (The RSM has to be ordered separately)
	<b>Management</b>	Connection to 10Base-T SNMP management interface. Pins 1,2: TX and 3,6 RX. Pins (4,5) and (7,8) of this connector can be used for dry contact purposes, for Airlink flag and F/O flag alarms respectively

<p><b>Selectors</b> <b>(DIP Switch</b> <b>DS1 Toggles)</b> -- shown in Figure 1.3 and 1.4</p>	<p><u>Data Rate</u> (Toggles 1,2,3,4)</p>	<p>Set the transmission rate of the transceiver (internal clock).</p> <ul style="list-style-type: none"> <li>- Fast Ethernet: 1,2,3,4 OFF</li> <li>- ATM/OC3/STM1:155 Mbps: 2,3,4 OFF, 1 ON</li> <li>- SMPTE 143 Mbps: 3,4 OFF, 1,2 ON</li> <li>- E3: 34.368 Mbps: 1,2,4 OFF, 3 ON</li> <li>- T3: 44.736 Mbps: 2,4 OFF, 1,3 ON</li> <li>- OC1/STM0: 51.840 Mbps: 1,4 OFF, 2,3 ON</li> <li>- Customized 1 : 4 OFF, 1,2,3 ON</li> <li>- Customized 2 : 1,3,4 OFF, 2 ON</li> <li>- Open Protocol: 1,2,3 OFF, 4 ON.</li> </ul>
<p><b>Selectors</b> <b>(DIP Switch</b> <b>DS2 Toggles)</b> -- shown in Figure 1.3 and 1.4</p>	<p><u>Mode Select</u> (Toggles 1, 2, 3)</p>	<p>Set the Operating Mode</p> <p>ALIGNMENT = Idle transmitted automatically</p> <p>NORMAL = Signal received via the F/O port is transmitted through the Airlink TX. Signal received via the Airlink RX is transmitted through the F/O TX.</p> <p>LOOPBACK= Data received by the F/O RX is directly returned through the F/O TX.</p> <p>REMOTE LOOP = Loops the electrical RX to the electrical TX and optical RX to the optical TX of the remote unit.</p> <p>ATTENUATION: The alignment signal is attenuated (~20db) when the DIP switch toggle #3 is moved to ON position.(to use when the installation distance is less than 200m only for alignment mode). Switch back to OFF position for normal mode.</p>
	<p><u>Laser Power Off</u> (Toggle 4)</p>	<p>Turning off laser TX when the DIP switch toggle is moved to ON</p>
	<p><u>Fusion</u> (Toggle 5)</p>	<p>This switch toggle enables working with MRV's Fusion system (Built-in fusion option or switch option). For additional information, see page 7.</p> <p>Switch toggle 5 OFF: Fusion not Active (Disabled)</p> <p>Switch toggle 5 ON: Fusion active (Enabled).</p>
	<p><u>Window Heater</u> <u>(Optional)</u> (Toggle 6)</p>	<p>Used only with the heating option (To be specified in the PO).</p> <p>Switch toggle 6 OFF: The heater is disabled</p> <p>Switch toggle 6 ON: The heater is enabled.</p>
	<p><u>IP address set up</u> (Toggle 7)</p>	<p>When the Switch toggle is on OFF position, the TereScope's IP address is the default one (shown on the back panel label: 10.0.0.101). To set a new IP address please refer to the "IP address setting procedure for TereScope management card" file in the Manuals CD. The new IP address is valid only after the TereScope is powered off and on.</p>
	<p><u>Control Mode</u> (Toggle 8)</p>	<p>When the Dip Switch toggle #8 is on OFF position, the TereScope is in the HARDWARE mode, i.e. the TereScope is controlled only by the TereScope itself by means of the switches on its back panel.</p> <p>When the Dip Switch toggle is on ON position, the TereScope is in the SOFTWARE mode i.e. the TereScope is controlled by the management Software and various functions can be activated by means of this management Software.</p>

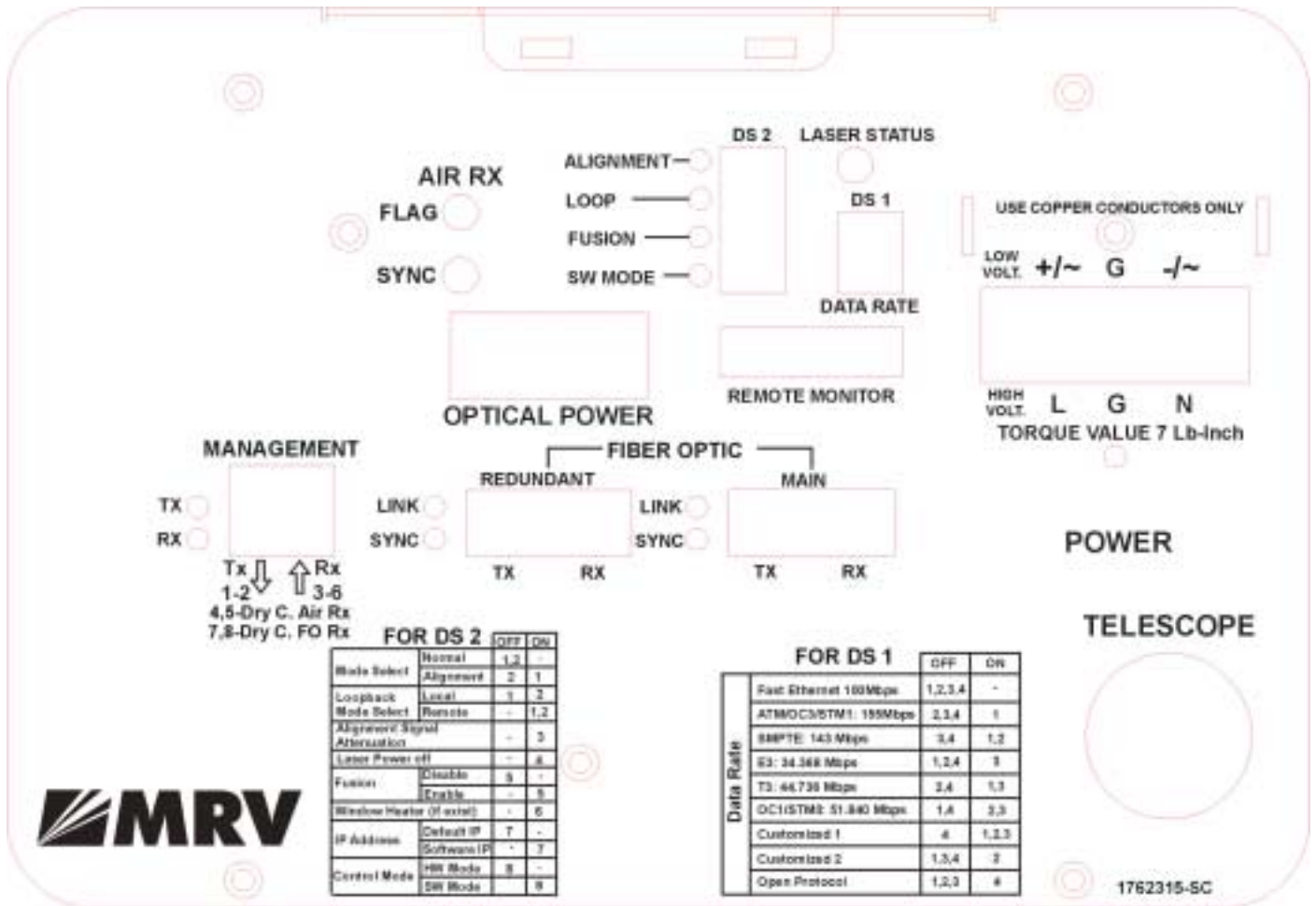
**Note:** Pins (4,5) and (7,8) of the management RJ45 connector can be used for dry contact purposes, for Airlink flag and F/O flag alarms respectively.



<b><u>Indicators (7-segment display and LEDs)</u></b>	<b><u>Air RX Flag LED</u></b>	Green LED indicates data received by the Airlink receiver. Turns ON at the threshold level.
	<b><u>Air RX Sync LED</u></b>	Yellow LED. Turns ON if the rate of the received Data matches the Data Rate set on the Data Rate DIP switch.
	<b><u>F/O Main, RX Flag LED</u></b>	Upper green LED indicates Data received by the Fiber Optic receiver. Turns ON at the threshold level.
	<b><u>F/O Main, RX Sync LED</u></b>	Lower green LED. Turns ON if the rate of the received Data matches the Data Rate set on the Data Rate DIP switch.
	<b><u>F/O Redundant, RX Flag LED (Optional)</u></b>	Upper green LED indicates Data received by the Fiber Optic receiver. Turns ON at the threshold level.
	<b><u>F/O Redundant, RX Sync LED (Optional)</u></b>	Lower green LED. Turns ON if the Fusion is active and there is synchronisation with the received Data.
	<b><u>Optical Power 7-segment display</u></b>	Digital readout indicates the Optical Power level received by the Airlink receiver.
	<b><u>Alignment LED</u></b>	Yellow LED. Turns ON if the Alignment Operating Mode is selected.
	<b><u>Loopback LED</u></b>	Yellow LED. Turns ON in LOOPBACK mode. Flashing in Remote Loop mode.
	<b><u>Fusion LED</u></b>	Yellow LED. Turns ON if the Fusion mode is enabled. Flashing when the Fusion (radio back-up system) is active.
	<b><u>SW Mode LED</u></b>	Red LED. Turns ON if the SW Mode (SOFTWARE) Operating Mode is selected.
	<b><u>Laser Status</u></b>	Shining Red LED: Turns ON when the Laser is ON and turns OFF when the laser is powered off by pushing the DS toggle #4 ON.
	<b><u>Management TX</u></b>	Flashing when the RSM-SNMP is connected and the TereScope is transmitting management Data. (There is no Link indication)
<b><u>Management RX</u></b>	Flashing when the RSM-SNMP is connected and the TereScope is receiving management Data. (There is no Link indication)	

<b><u>Alignment</u></b>	<b><u>Telescope</u></b>	For fine alignment.
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**C. TS800/155-F (Standard Model including Fusion option)**



**Figure 1.4: TS800/155-F Standard Model Panel Schematic**

This special TS800/155-F model can be connected to the back-up radio system without a special MRV switch and card supporting Fusion. This TereScope can be connected to any switch (supporting 10/100 Mbps data rate) via a standard converter that should be connected to the optical port of the TereScope labeled “Redundant”, while the back-up radio system is connected to the same Switch.

As an alternative, the TereScope can be directly connected to a Media Converter of type 10/100 TX-100 FX (for example, MRV’s media converter MC102F). When the TereScope stops operating, the connectivity from the main optical module to the air channel stops and starts flowing into the second optical module designated for radio.

That's what happens when the air channel is interrupted.

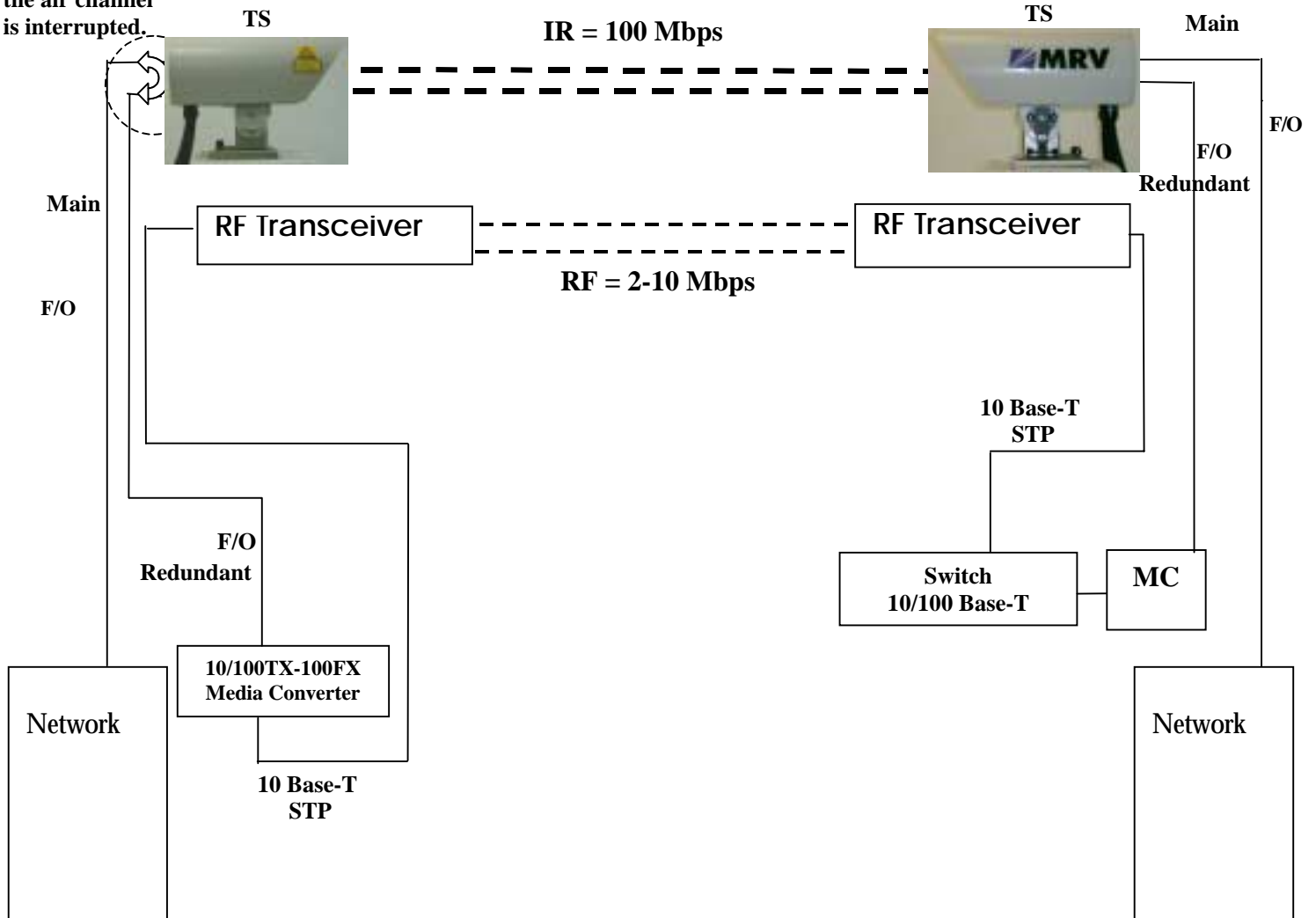


Figure 1.5a: TereScope800/155 F - & Fusion System Connection

For a description of the Back Panel and all the functions, see Paragraph B table 3, and Paragraph C Figure 1.4 – TS800 with Fusion model, page 8.

### Fusion Operation Mode

When at least one of the air channels (IR) is cut for more than one second or drops to approximately 60 mV at the display readout:

1. TereScope switches to Fusion mode
2. Data is transmitted from Main module to Redundant module without passing through the air channel
3. The signal is converted to 10Base-T by the Switch and the data Rate decreases to 2-10 Mbps

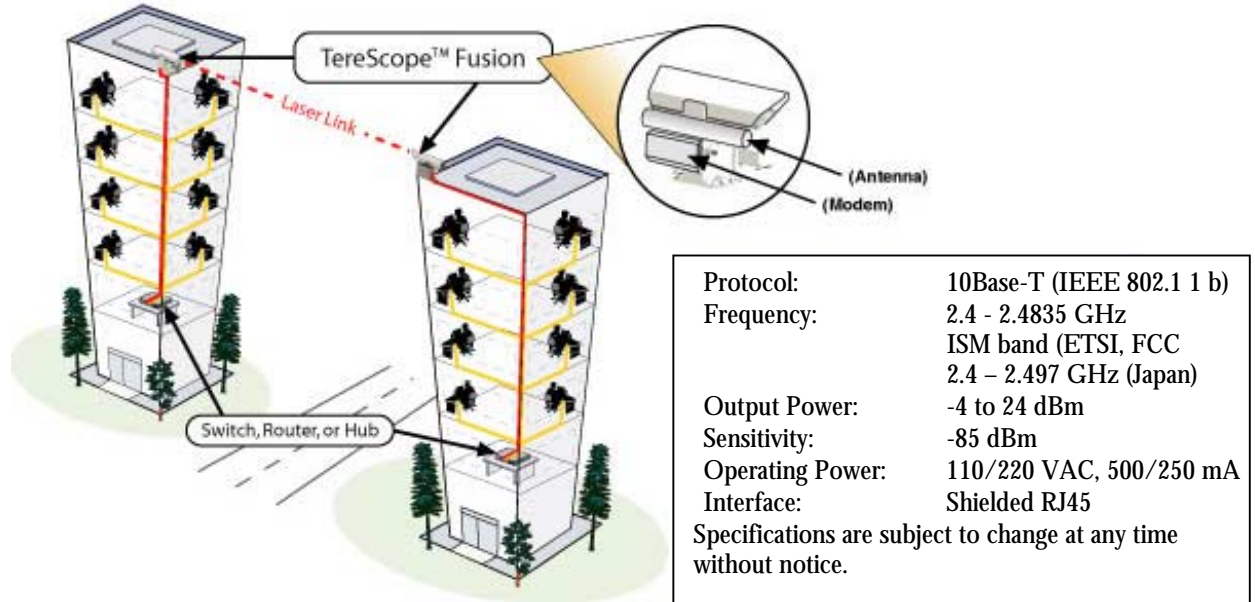
The system switches back to IR channel (TereScope) only when the display readout on both sides increases to approximately 150 mV.

**Note:** To activate the Fusion option, set DIP Switch toggle 5 to the ON position.

## Fusion

### Maximizing Link Availability in All Weather Conditions.

The TereScope Fusion was designed to combine the best features of two transport mediums, laser light and radio waves, to form a single, seamless, wireless communication link between network devices. By leveraging both technologies, we can provide the 99.999% availability that your network requires.



**Figure 1.5b: TS & Fusion**

The TereScope Fusion has been specifically constructed to maximize link availability between network nodes. These systems use the internationally unlicensed, 2.4 GHz ISM band and are used as a backup for a number of TereScope systems.

TereScope Fusion systems have an optical wireless link that provides Fast Ethernet connectivity as the primary link and Ethernet RF as the backup link. These systems operate in most weather conditions, including heavy rain, snow, and fog with nearly 100% link availability. Ease of installation and freedom from licensing make these systems very simple to deploy.

### D. TS700/100 - Fast-Ethernet System

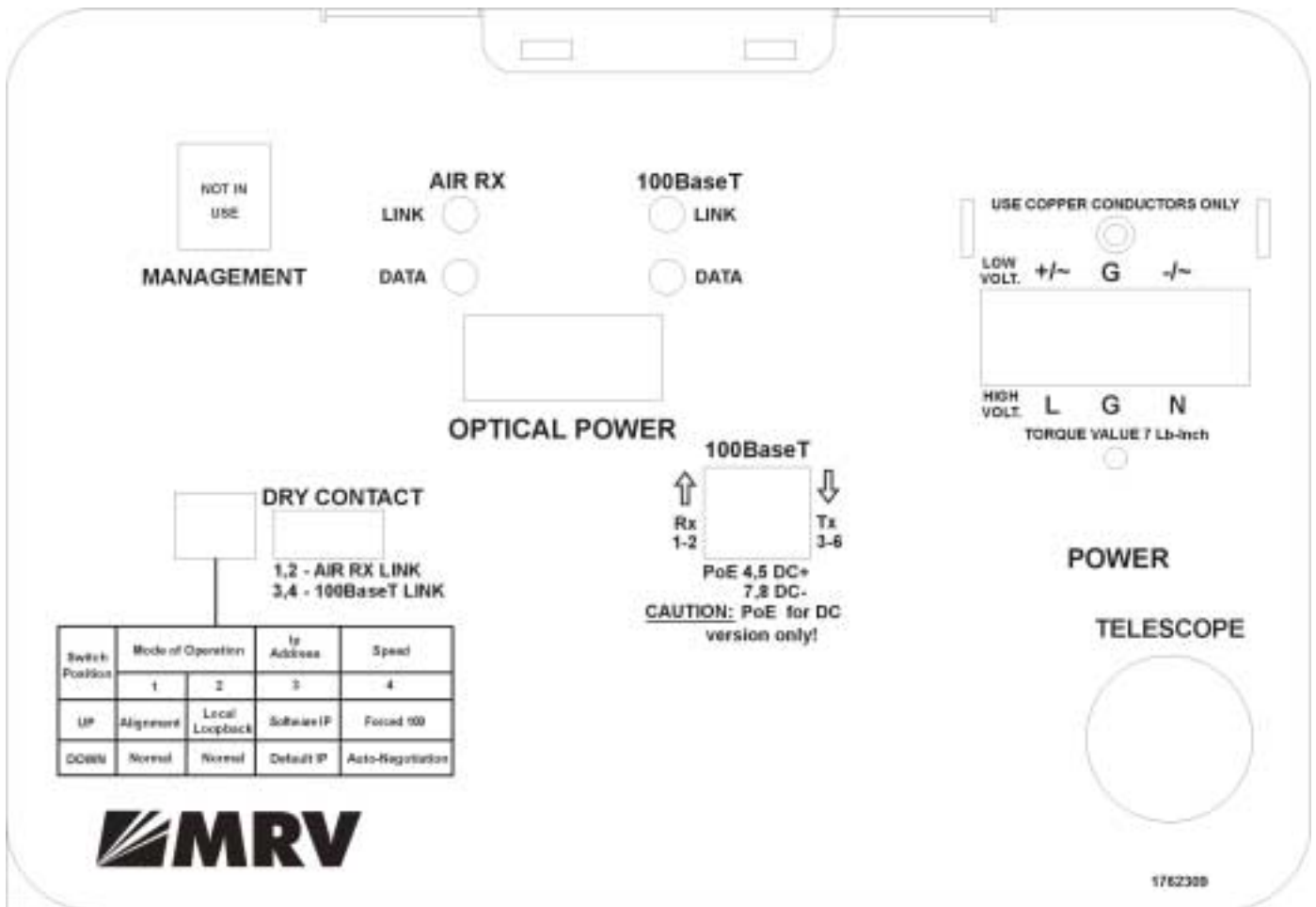


Figure 1.6: TS700/100 Model Back Panel

### Back Panel Description

Table 4: TS700/100 Back Panel Controls, Interfaces, and Indicators

<b>Connectors</b>	<u>Power</u>	Power source Terminal Block (Main or UPS) AC power supply (100 to 240 Vac) or DC power supply (24 to 60 Vdc).
	<u>100Base-TX</u>	Copper interface (RJ45) for STP cables. MDI-X connection (TX: pins 3,6 and RX: pins 1,2). Connection to the peripheral equipment. This connector can be used for Power-over-Ethernet (PoE) but only with the Low Voltage TereScope version (TS100/A/FET/V3). The standard power for PoE is 36-57 Vdc. However, the TS700/100 can operate with 20-60 Vdc. See appendix I.
	<u>Management (Optional)</u>	Connection to 10Base-T SNMP management interface. (To be ordered separately)
	<u>Dry Contacts</u>	There are 2 pairs of dry contact indicators available, one for Air RX Link LED (Pins 1 and 2), and the other for 100BaseT LED (Pins 3 and for). Dry contacts are normally closed (25 ohms), and open in an alarm condition

<b>Selectors</b> <b>(DIP Switch</b> <b>Toggles)</b> -- <i>shown in Figure</i> <i>1.6</i>	<u>Mode of Operation</u> (Toggles 1, 2)	Set the Operating Mode ALIGNMENT = Idle transmitted automatically NORMAL = Signal received through the TP port is transmitted through the Airlink TX. Signal received through the Airlink RX is transmitted through the TP TX. LOOPBACK=The Data received by the TP RX is directly returned through the TP TX
	<u>IP address set up</u> (for Mgt. option) (Toggle 3)	Used only with the management option. When the Switch toggle is on OFF position, the TereScope's IP address is the default one (shown on the back panel label: 10.0.0.101). To set a new IP address please refer to the "IP address setting procedure for TereScope management card" file in the Manuals CD. The new IP address is valid only after the TereScope is powered off and on.
	<u>Speed</u> (Toggle 4)	Sets the TereScope to Auto-negotiation mode or to forced 100 mode: OFF : Auto-negotiation, ON: Forced 100

<b>Indicators</b> <b>(7-segment</b> <b>display,</b> <b>LEDs)</b>	<u>Air RX Link LED</u>	Green LED indicates signal received by the Airlink receiver. Turns ON at the threshold level.
	<u>Air RX Data LED</u>	Yellow LED blinking indicates Data transfer via the Airlink receiver to the interface.
	<u>TP RX Link LED</u>	Green LED indicates Link established at the 100Base-T receiver. Turns ON when connected to peripheral equipment.
	<u>TP RX Data LED</u>	Yellow LED blinking indicates Data transferred via the 100Base-TX interface.
	<u>Optical Power 7-segment display</u>	Digital readout indicates the Optical Power level received by the Airlink receiver.

<b><u>Alignment</u></b>	<b><u>Telescope</u></b>	For fine alignment.
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### E. TS700/G - Gigabit-Ethernet System

The TereScope 700/G supports Gigabit Ethernet and FiberChannel protocols. The physical design and configuration of the TS700/G is similar to the other members of the series, and its operational principles are essentially the same. However, The TS700/G only offers a duplex fiber interface. The standard is 850nm SC multimode. (850nm ST multimode, 1310nm and 1550nm SC singlemode are available on request).

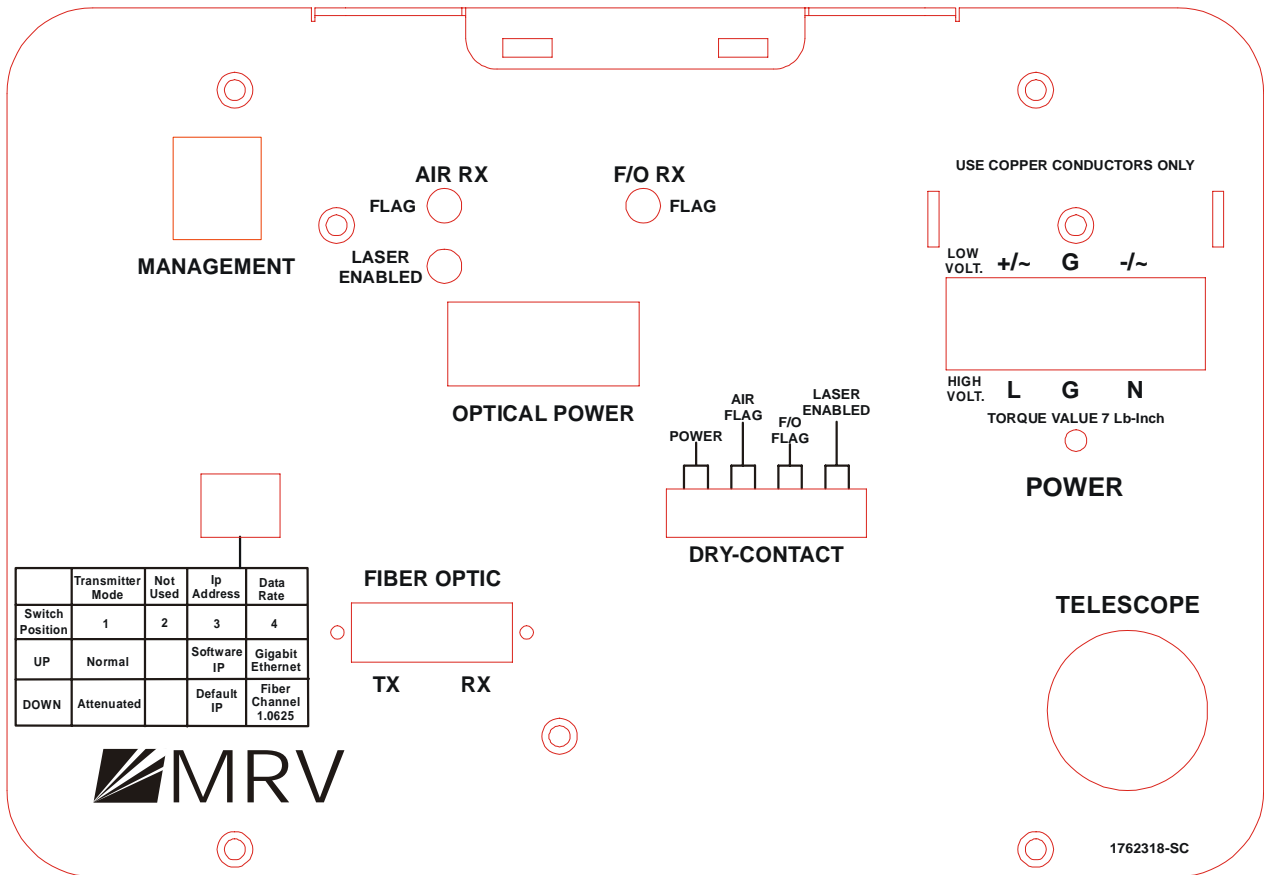


Figure 1.7: TS700/G Model Back Panel

Table 5: TS700/155 Standard Model Back Panel Controls, Interfaces, and Indicators

<b>Connectors</b>	<b>Power</b>	Power source Terminal Block (Main or UPS) AC power supply (100 to 240 Vac) or DC power supply (24 to 60 Vdc)
	<b>Fiber optic</b>	Fiber Optic interface for connection to the peripheral equipment. The standard interface is MM 850nm SC connector; other interfaces are available upon request.
	<b>Management (Standard)</b>	Connection to 10base-T SNMP management interface.
	<b>Dry Contact</b>	There are 4 pairs of dry contact indicators available: <ul style="list-style-type: none"> <li>▪ Power</li> <li>▪ Air RX Link LED</li> <li>▪ F/O Flag LED</li> <li>▪ Laser Enabled</li> </ul> Dry contacts are normally closed (25 ohms), and open in an alarm condition

<b><u>Selectors</u></b> <b><u>(DIP Switch</u></b> <b><u>Toggles)</u></b> -- <i>shown in Figure</i> <i>1.7</i>	<u>Transmitter Mode</u> (Toggle 1)	ON position (up) for links above 150m distance. OFF position (down) is for under 170m distance
	<u>Not Used</u> (Toggle 2)	Not used. (No internal loopback function. For a complete loop test, far-end loopback of airlink data can be performed externally with fiber from Tx to Rx)
	<u>IP Address</u> (Toggle 3)	When the Switch toggle is on OFF position, the TereScope's IP address is the default one (shown on the back panel label: 10.0.0.101). To set a new IP address please refer to the "IP address setting procedure for TereScope management card" file in the Manuals CD. The new IP address is valid only after the TereScope is powered off and on.
	<u>Data rate</u> (Toggle 4)	ON position (up) for Gigabit Ethernet, OFF position (down) for 1.0625Gb/s FiberChannel

<b><u>Indicators</u></b> <b><u>(7-segment</u></b> <b><u>display</u></b> <b><u>LEDs).Dry</u></b> <b><u>Contact</u></b> <b><u>Alarms</u></b>	<u>Air RX Flag LED</u>	Green LED indicates signal received by the Airlink receiver. Turns ON at the threshold level.
	<u>Laser Enabled LED</u>	Red LED. Turns ON to indicate that laser is enabled to transmit light.
	<u>F/O RX Flag LED</u>	Green LED indicates Data received by the Fiber Optic receiver. Turns ON at the threshold level.
	<u>Pins 1,2</u>	Closed (25 ohm) = Internal DC power functional Open = internal DC voltage not present in circuit
	<u>Pins 3,4</u>	Air Rx alarm Closed (25 ohm) = airlink optical power received above threshold Open = received optical signal below threshold
	<u>Pins 5,6</u>	F/O Rx alarm Closed (25 ohm) = received signal at fiber interface above threshold open = signal received at fiber receiver below threshold
	<u>Pins 7,8</u>	Laser Enabled Alarm Closed (25 ohm) laser is enabled Open = laser is disabled due to malfunction
	<u>Optical Power 7-segment display</u>	Digital readout indicates the Optical Power level received by the Airlink receiver.

<b><u>Alignment</u></b>	<b><u>Telescope</u></b>	For fine alignment.
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## Monitoring and Management options

### 1 – Management

RJ45  
Connection for  
SNMP  
Interface



Figure 1.8: SNMP + TS

The TS is manageable by using SNMP option. SNMP monitoring can be performed via MegaVision, MRV's SNMP software.

### 2 - Dry contact (Only TS800)

RSM-DC



Figure 1.9: RSM-DC + TS

The TS can be connected to dry contact box (RSM-DC). The RSM-DC is directly attached to TS at "Remote Monitor" connector.

### 3 – RSM\_(Only TS800)

RSM connection

RSM



Figure 1.10: RSM + TS

The TS can be connected to monitoring unit: RSM. The connection between the TS and the RSM is made with 7 wires twisted cable.

## Typical Connection

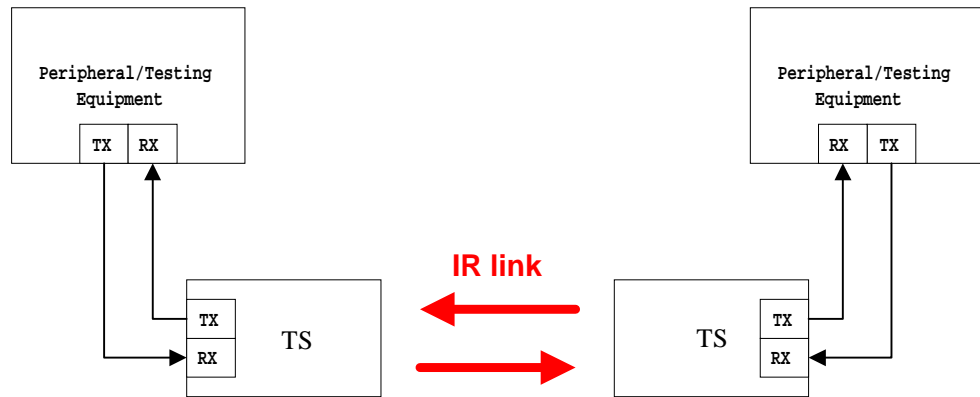
### 1 - Fiber Connection

In order to implement a connection, each transceiver must be connected to the peripheral/testing equipment through fiber optic cables. A correct connection is indicated by the display on the back panel of the transceiver (see the section Display and Results pages 29 and 30).

**IT IS A CROSS CONNECTION:**

**TX → RX AND RX → TX**

Scheme of the Connection to peripheral equipment

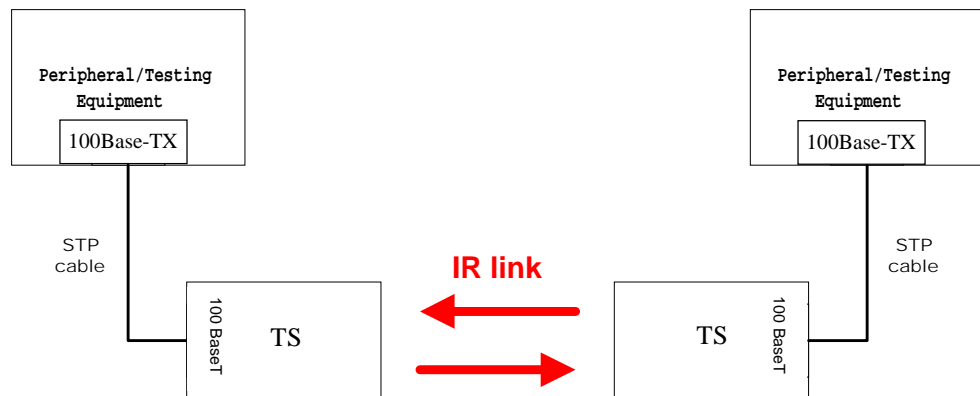


**Figure 1.11: Typical Connection for Models 155 and 155-F**

### 2 - Copper Connection

In order to implement a connection, each transceiver must be connected to the peripheral/testing equipment with an STP cable. A correct connection is indicated by the display on the back panel of the transceiver (see the section Display and Results pages 29).

Scheme of the Connection to the peripheral equipment



**Figure 1.12: Typical Connection for Model TS700/100**

## Site Survey

**The first step before every installation is to visit the sites to be linked. In order to make sure that the connection is feasible, to find out potential obstacles or difficulties and to decide on the location and mounting points of the transceivers.**

### Line of Sight

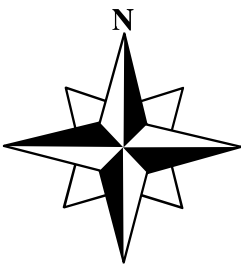


A necessary condition for linking two distant buildings is that the two mounting sites must be within clear sight of each other.

- Pay attention to:
- Growing vegetation and increasing foliage during spring
  - Building sites (cranes movements, etc.)
  - Chimneys (intervening smoke can interrupt the beam from time to time).

### Orientation

Direct sunlight can overload the aerialink receiver to saturation level. Avoid, as far as possible, the East-West direction for the link.



#### Note

In case this is not possible, the surrounding buildings could 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) could occur. The system will fully recover once the sun is out of the receiver field-of-view.

### Location & Range

1. The mounting of the transceiver must be very rigid (preventing the installation from twists of even as little as 1 mrad). The key to the required rigidity is to attach the mounting accessories on strong mounting points such as:
  - Stiff building structures
  - Concrete or reinforced concrete surfaces

<sup>(1)</sup> In case such situations cannot be avoided, special mounting accessories and techniques must be designed and considered (see section Particular Figure Cases\Techniques page 37)



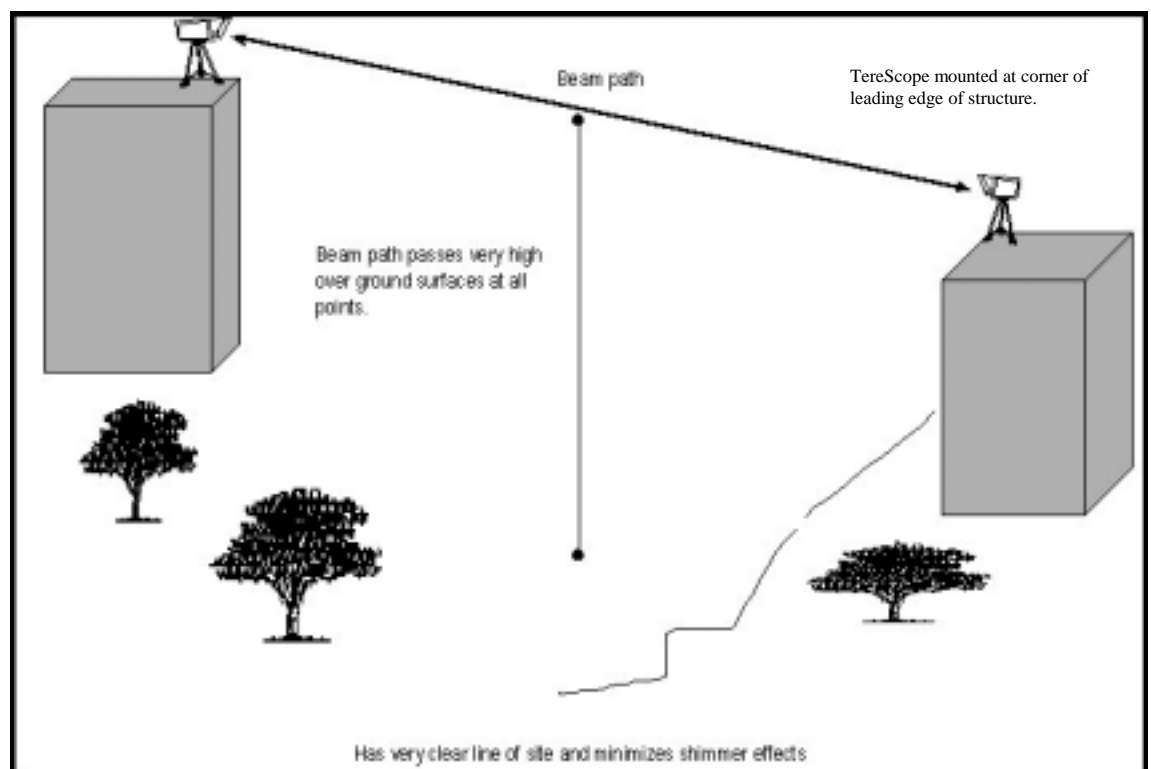
Prefer	Avoid	Pay attention to
Concrete Parapet Structural wall or column	Old constructions Soft material (asphalt, etc.) Non-uniform surfaces Wooden and metal structures	Colored windows Double glazing The proximity of power radio antennas

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

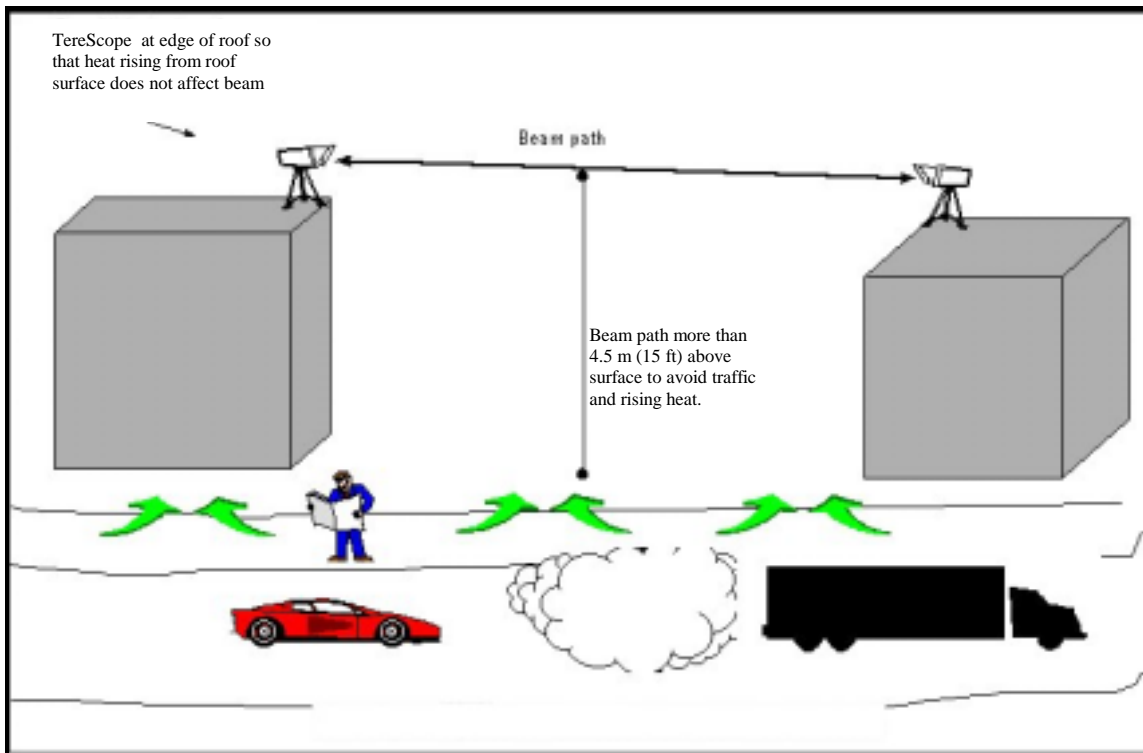
- Referring to the data in Appendix A: Product Specifications, set and record the distance between the two TereScopes of the link. (You can use any of the following equipment to determine the distance: rangefinder laser binoculars, GPS receiver, maps, etc.)
- Noting that two TereScope units are required per link, record the quantity of each model of the TereScope required.
- Record the bearing to the opposite site by compass.
- Record the number of links to be installed at the site.
- Note whether additional sheltering is needed for the TereScope, for e.g., against strong winds (120km/h or more)

### CONSULT FACTORY IN CASE OF DOUBT !

Figure 2.1 and Figure 2.2 show optimal and acceptable locations for the TereScope links. Notice that in both figures the TereScopes are mounted on rooftop edges and high enough above the ground.

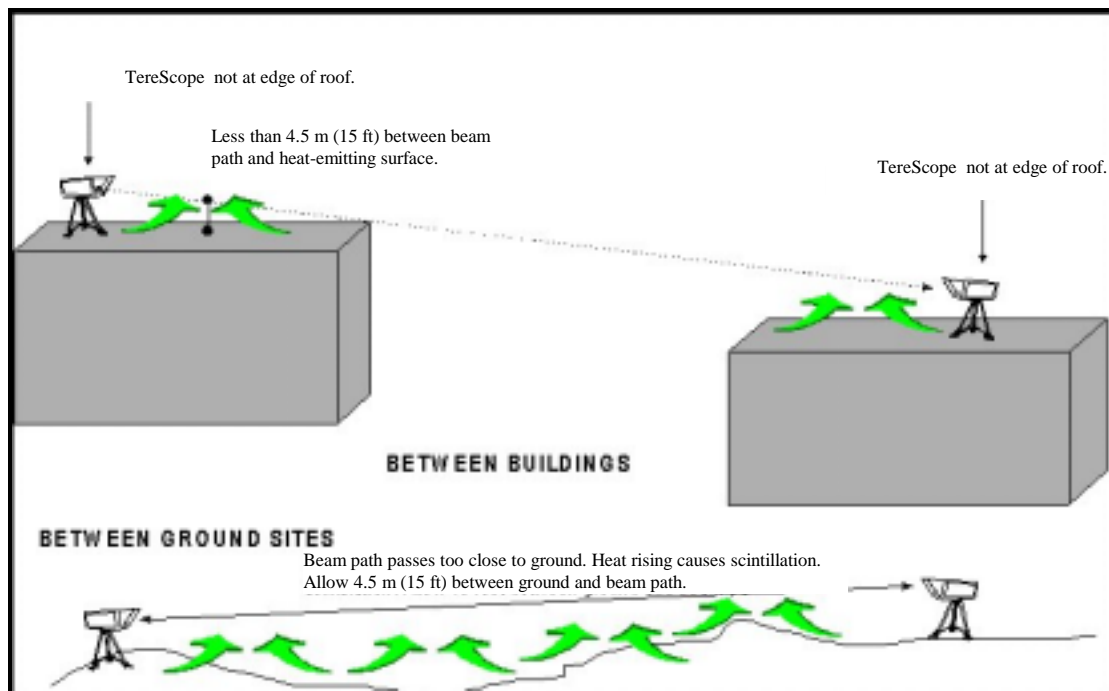


**Figure 2.1: Optimal Mounting**



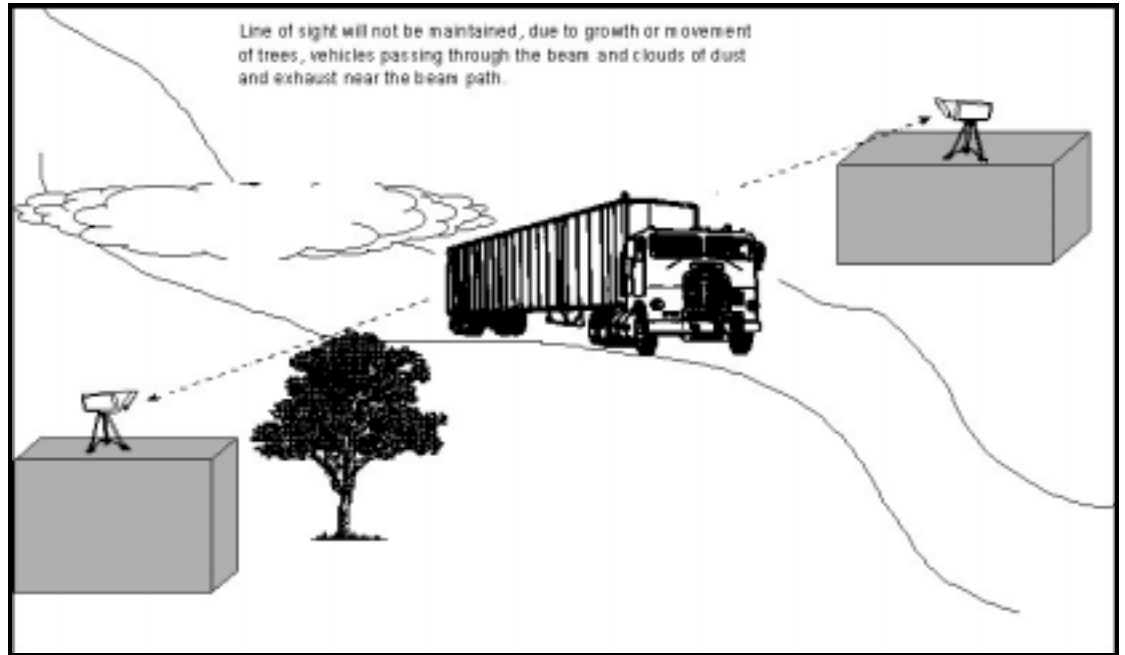
**Figure 2.2: Acceptable Mounting**

Figure 2.3 shows an unrecommended TereScope link location because of interference by IR. Notice that the TereScopes are mounted far from the rooftop edges or are too close to the ground.



**Figure 2.3: Unrecommended Mounting**

Figure 2.4 shows an *unacceptable* TereScope link location because of interference by passing vehicles. Notice that the TereScopes are mounted far from the rooftop edges and not high enough above the ground.

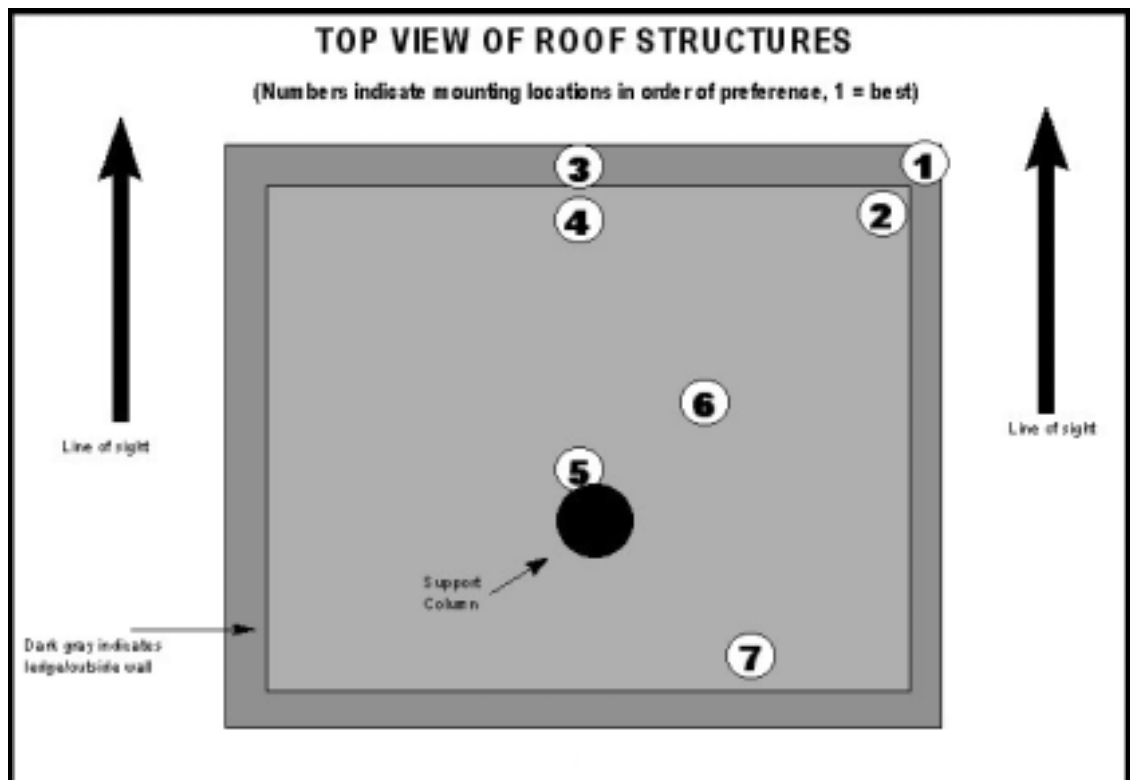


**Figure 2.4: Unacceptable Mounting**

### Mounting Environment & Stability

1. When deciding the mounting location, you should look on the rooftop for vibration sources such as compressors, elevators, motors, and try to avoid them.
2. Photograph the mounting location so as to select the best mounting option.

Figure 2.5 shows mounting locations on a rooftop in descending order of preference. Location **1** is the best; location **7** is the worst.



**Figure 2.5: Mounting Locations in Order of Preference**

**Note:** If the only option to mount the TereScope is at points 5, 6 or 7, it has to be mounted at least 2 m above the rooftop to avoid roof scintillations and people crossing the link beam (If possible, avoid placing the TereScope on a mast).

3. Avoid surfaces with high reflectivity (e.g., white walls) behind the TereScope so as to reduce interference with the optical signal.
4. Get customer approval for the *exact* positions where the TereScopes will be mounted. Using paint, mark these positions.
5. Note the height that each TereScope will be above or aside the rooftop.
6. Identify the floor or wall type and dimensions of the location at which it is planned to mount the TereScope.
7. For each TereScope head, select one of the following mounting options<sup>2</sup> and record it.
  - a. **Parapet/Ledge Mounting** (Figure 2.6) – This is a standard mounting option that uses only the Plate (JMP).
  - b. **Wall Mounting** (Fig. 2.8) – This is a standard mounting option that uses the Plate (JMP) as well as the two Brackets (JMB).
  - c. **Floor Pedestal Mounting** (Figure 2.7) – This is a non-standard mounting option that uses the Plate (JMP) as well as a Floor Pedestal (e.g., M015C).
  - d. **Wall Pedestal Mounting** (Figure 2.9) – This is a non-standard mounting option that uses the Plate (JMP) as well as a Wall Pedestal (e.g., M054C).
  - e. **Extended Wall Mounting** (Figure 2.10) – This is a non-standard mounting option that uses the Plate (JMP) as well as an Extended Wall (e.g., M062C).
  - f. **Angle Bracket Mounting** (Figure 2.11) – This is a non-standard mounting option that uses the Plate (JMP) as well as an Angle Bracket (e.g., M001).



**Figure 2.6: Parapet/Ledge Mounting (using JMP only)**



**Figure 2.7: Floor Pedestal Mounting (using JMP and M015C)**

<sup>2</sup> For more information on these mounting options, refer to *TereScope Installation Guide* (Publication No. 46366).



**Figure 2.8: Wall Mounting (using JMP and JMB)**



**Figure 2.9: Wall Pedestal Mounting (using JMP and MO54C)**



**Figure 2.10: Extended Wall Mounting (using JMP and MO62C)**



**Figure 2.11: Angle Bracket Mounting (using JMP and M001)**

### Transmitting through a Window

1. Determine the number of surfaces the beam transits or is reflected from, the reflectivity of each surface, and condensation/precipitation collection areas.
2. Use the data below to determine whether the light beam attenuation is acceptable.
  - 4% attenuation for each surface of light reflection.
  - 15% attenuation for a double pane window.
  - Attenuation due to tint in windowpane must be taken into consideration in choosing the right TereScope model. (The % attenuation depends on the tint and must be measured.)
3. Ensure that the angle of incidence<sup>3</sup> of the beam striking the windowpane is between 1° and 45°.

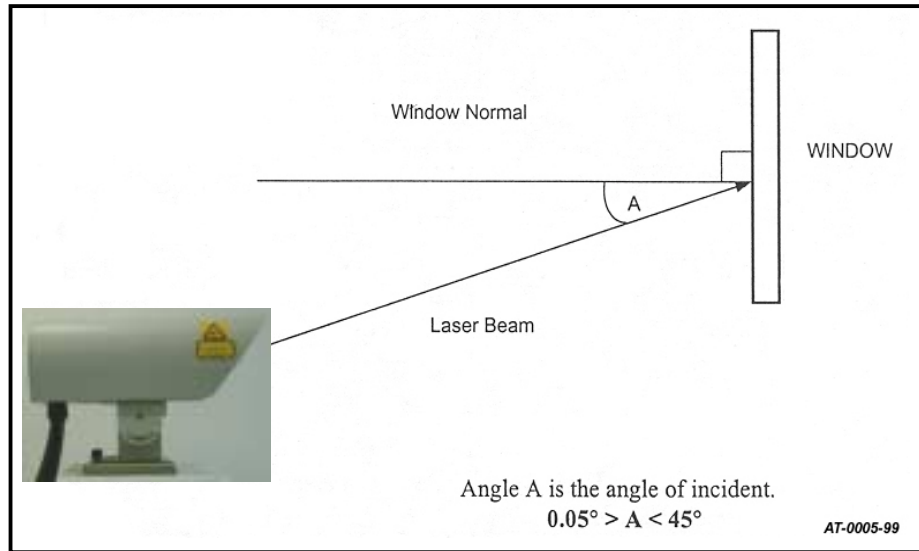


**Note**

On high buildings, for indoor window installation, the user should consider that occasionally the window-cleaning elevator might block the link beam.

<sup>2</sup>Angle which the light beam makes with the perpendicular to the windowpane





**Figure 2.12: Arrangement for transmitting through a window.**

## 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.



**IN OUTDOOR INSTALLATIONS, USE SHIELDED AND WEATHERPROOF MATERIALS (CABLES, INLETS, AND CONNECTORS) COMPLIANT TO THE SAFETY STANDARD IN FORCE.**

### Power

#### Source

The power requirement for standard units is 100-240VAC @ 50/60Hz - 10W.

**230 VOLTS**

Note: Units requiring low Voltage: 24-60 VDC - 10W can be factory set upon request.

**It is recommended to use a Surge Suppression System to avoid damage to the equipment when power supply is unstable. Protection should be at least 25,000A.**

### Cabling

Standard 3-conductor power cords are required. (See Safety requirements, Page iv)

### Data/Signal Cabling

1. For TS700/155, TS700/G, TS800/155, TS800/155-F

#### Type

For connecting the Transceiver to the peripheral equipment, a dual-fiber cable is required (one fiber for transmission, the other for reception). The standard recommended cable is MM 62.5/125  $\mu\text{m}$  fiber or SM 9/125  $\mu\text{m}$  for fiber.

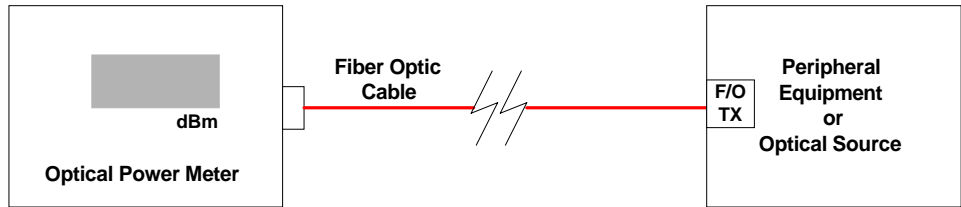
#### Connectors

Each fiber should be terminated with the ordered type of connector on the transceiver end (SC, ST).

#### 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 in measuring (with an optical power meter) the output power at one end of the tested fiber when 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).



**Figure 3.1: F/O cable test.**

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

**A standard 62.5 $\mu$ m fiber optic cable is characterized by an attenuation factor of about 3 to 5 dB/km. A loss value of more than 3 dB for runs up to 200m indicates that the fiber may be faulty.**

Note

The fiberoptic cables must be installed by a qualified person.

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

## 2. For TS700/100

### Type

For connecting the Transceiver to the peripheral equipment, 2-pair STP Category 5 cable is required (one pair for transmission, the other for reception). This cable must be a **straight** one when the peripheral has an MDI-X 100Base-TX interface and a **cross** one otherwise.

For PoE (Power over Ethernet), 2 more pairs STP Category 5 cable are required. **(Use only for the Low Voltage version: TS100/A/FET/V3)**

### Connectors

The cable should be terminated with an RJ-45 connector at the Transceiver end.

## 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. Accordingly, it is strongly recommended to perform a bench test with all the modules prior to installation in order to check the equipment compatibility and to validate the configuration.**

See Unpacking Instructions in Appendix C.

1–TS700/155, TS800/155, and TS800/155-F

### Compatibility

#### Peripheral equipment

Check the operation of the peripheral equipment connected with cables (see Configuration 1 below).

#### Interfaces

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

#### Test equipment

Chose an appropriate Bit Error Rate (BER) tester for checking the physical link quality. A portable one is preferable since it is more convenient for use in the field.

For example: the OC3 port plus SONET and ATM analyser manufactured by Fluke.

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

### Setup

#### Data Rate DIP Switch Toggle

According to the application in use, set the switch toggles as indicated in the following table: (In TS800/155 and TS800/155-F set the DS1 toggles)

**Table 6: DIP Switch Setting for TereScope**

Function	TS700/155		TS800/155	
	<i>OFF</i>	<i>ON</i>	<i>OFF</i>	<i>ON</i>
Fast Ethernet	4,5	–	1,2,3,4	–
ATM/OC3/STM1: 155 Mbps	–	4,5	2,3,4	1
SMPTE 143 Mbps	–		3,4	1,2
E3:34.368 Mbps	5	4	1,2,4	3
T3:44.736	4	5	2,4	1,3
OC1/STMO:51.840 Mbps	–		1,4	2,3
Customized 1	–		4	1,2,3
Customized 2	–		1,3,4	2
Open Protocol	–		1,2,3	4

### Mode Select DIP switch toggle

Set DIP switch toggles 1 and 2 to the OFF position for normal operation. (In TS800/155 and TS800/155-F set the DS2 1, 2, 3 and 4 toggles to OFF position)

## 2– TS700/100 (Fast ethernet)

### Compatibility

#### Peripheral equipment

Check the operation of the peripheral equipment connected with cables (see Configuration 1 below).

#### Interfaces

Check the specifications compatibility (type, data rate) between the TereScope and the peripheral equipment interfaces.

### Test equipment

Chose an appropriate Bit Error Rate (BER) tester for checking the physical link quality. A portable one is preferable since it is more convenient for use in the field.

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

#### DIP Switch

Set DIP switch toggles 1 and 2 to the OFF position for normal operation.

Set DIP switch toggle 4 for the speed. Usually with Cisco Switches set the TS to Auto-negotiation mode.

## 3-TS700/G

## Compatibility

### Peripheral equipment

Check the operation of the peripheral equipment connected with cables (see Configuration 1 below).

### Interfaces

Check the specifications compatibility (type, data rate) between the TereScope and the peripheral equipment interfaces.

### Test equipment

Chose an appropriate Bit Error Rate (BER) tester for checking the physical link quality. A portable one is preferable since it is more convenient for use in the field.

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.

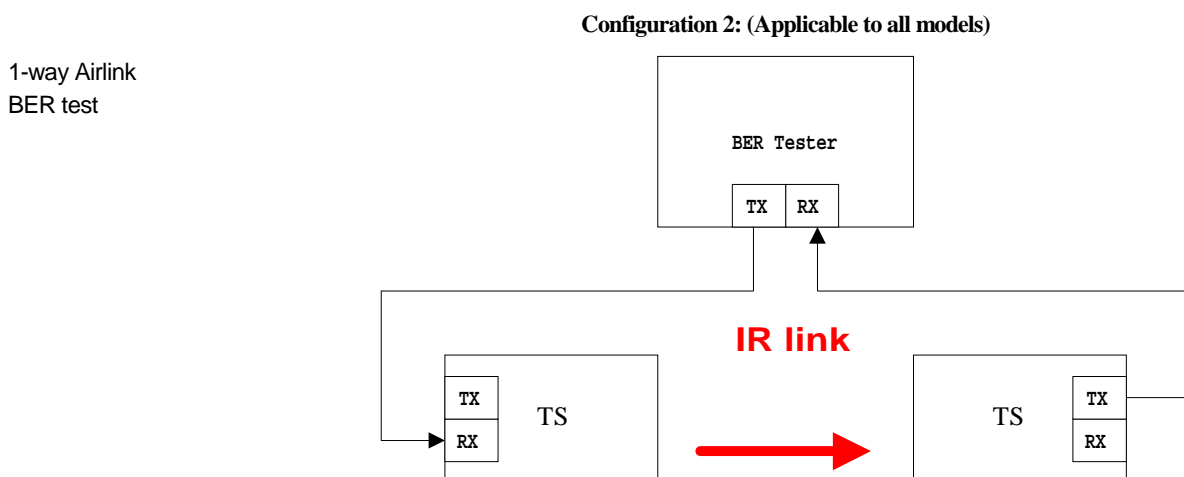
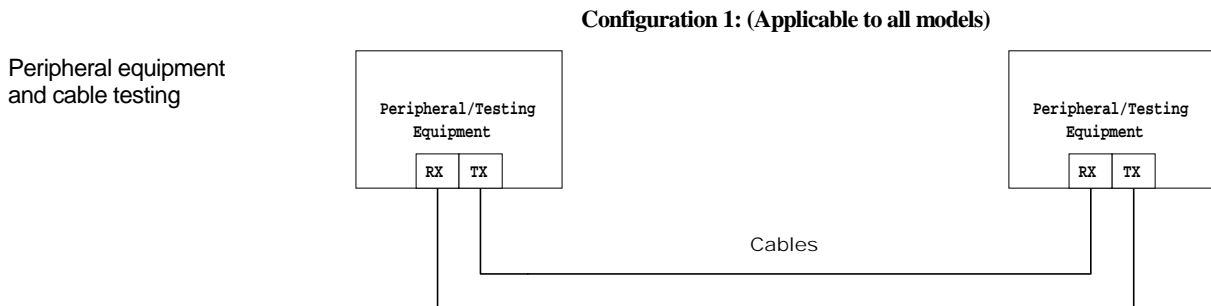
### Setup

#### DIP Switch

Set DIP switch 1 to OFF (attenuated transmitter) in order to enable short range operation with minimal extra attenuation. Set DIP switch 4 to appropriate protocol – ON for Gigabit Ethernet, OFF for FiberChannel.

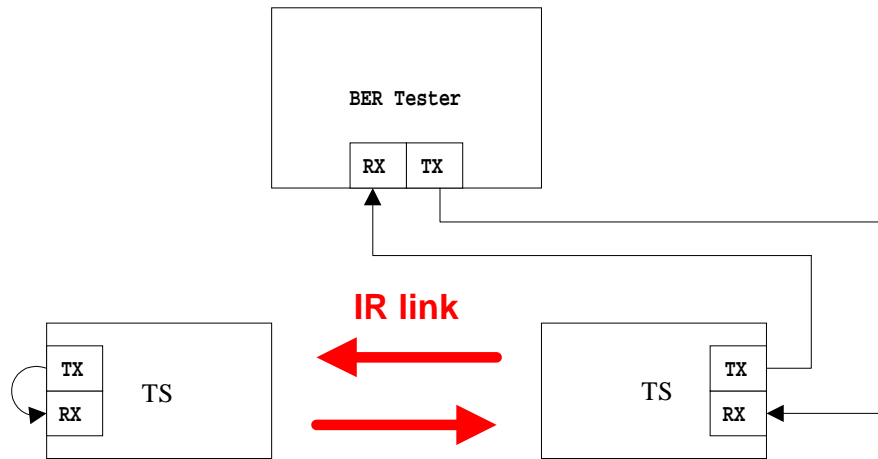
### Bench test

To learn more about TereScope Bench Test, please refer to Appendix E.



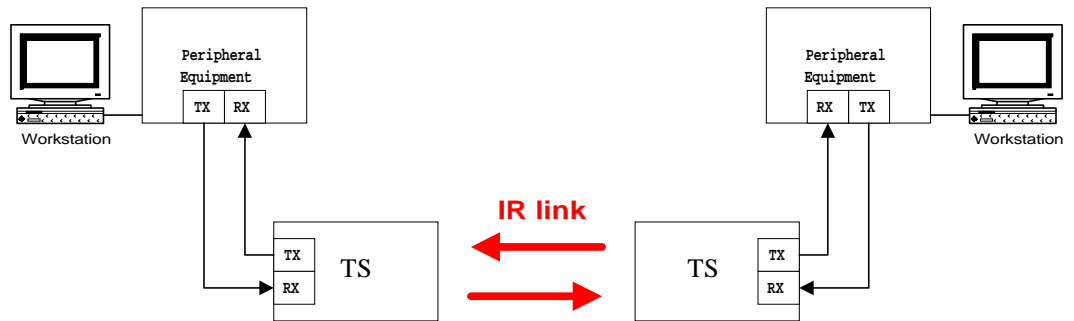
Loop-back Airlink  
BER test

**Configuration 3: (Applicable to all models)**



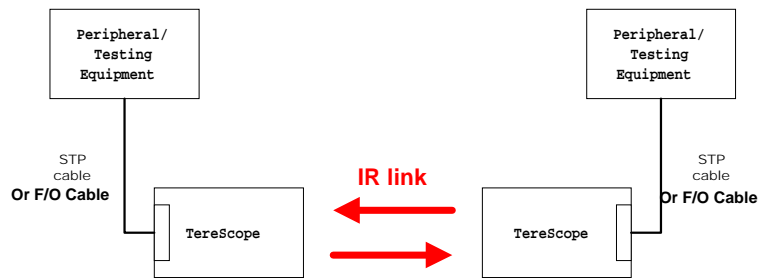
Whole configuration  
operating test (Ping test  
or File transfer) for  
Ethernet or Fast  
Ethernet systems

**Configuration 4: (Applicable to all models)**



Whole configuration  
operating test for all  
models

**Configuration 5: (Applicable to all models)**



## Display and Results

### 1. TS700/155, TS800/155 & TS800/155-F

#### 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

**Table 7: Indicators**

2. **Received power**



100 < OPTICAL POWER < 1000

**Expected Results**

The BER must be less than 10E-12 (10<sup>-12</sup>) for on-going tests and error-free for short tests.

2. TS700/100

Proper Display

2. **Indicators**

Indicator → Position ↓	AIR RX		100baseT		Alignment	Loopback
	Flag	TX	Flag	TX		
ON	x	x	x	x		
OFF					x	x

**Table 8: Indicators**

3. **Received power**



100 < OPTICAL POWER < 1000

**Expected Results**

The BER must be less than 10E-12 (10<sup>-12</sup>) for on-going tests and error-free for short tests.

The PING test and file transfer procedure should not post any *TIME OUT alarm* or last too long time so long as the cabling connection is OK.

3. TS700/G

Proper Display

3. **Indicators**

Indicator → Position ↓	AIR RX		Electrical
	Flag	Laser Enabled	Flag
ON	x	x	x
OFF			

**Table 8: Indicators**

4. **Received power**



100 < OPTICAL POWER < 1000

**Expected Results**

The BER must be less than 10E-12 (10<sup>-12</sup>) for on-going tests and error-free for short tests.

The PING test and file transfer procedure should not post any *TIME OUT alarm* or last too long time so long as the cabling connection is OK.



## Installation

This chapter shows how to mount the TereScope and accessories at the site (see Appendix D for the required material).

See Unpacking Instructions in Appendix C.

**CAUTION:** TereScope must be mounted in the horizontal position only; max angle 45°

### Accessories

The standard mounting accessories are supplied with the transceivers (TereScope heads) in the kit. They are designed for typical mounting on horizontal and vertical surfaces.

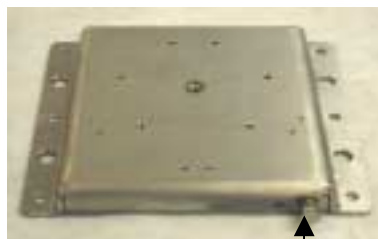
### Description

The accessories kit (supplied by MRV) consists of:

- The Mounting Plate for TS700 and TS800 series (JMP-L)
- The Aiming Head
- The Installer Tool Kit (JITK-L)

The JMP-L is used for mounting the transceiver on the support surface, i.e., a horizontal concrete surface/plate only.

JMP-L  
Mounting Plate  
(Dimensions in  
mm)



Screw for  
grounding

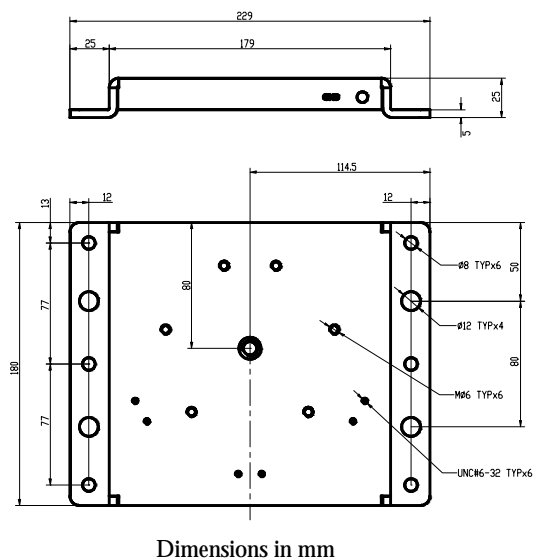


Figure 5.1a: JMP-L

Figure 5.1b: JMP-L scheme

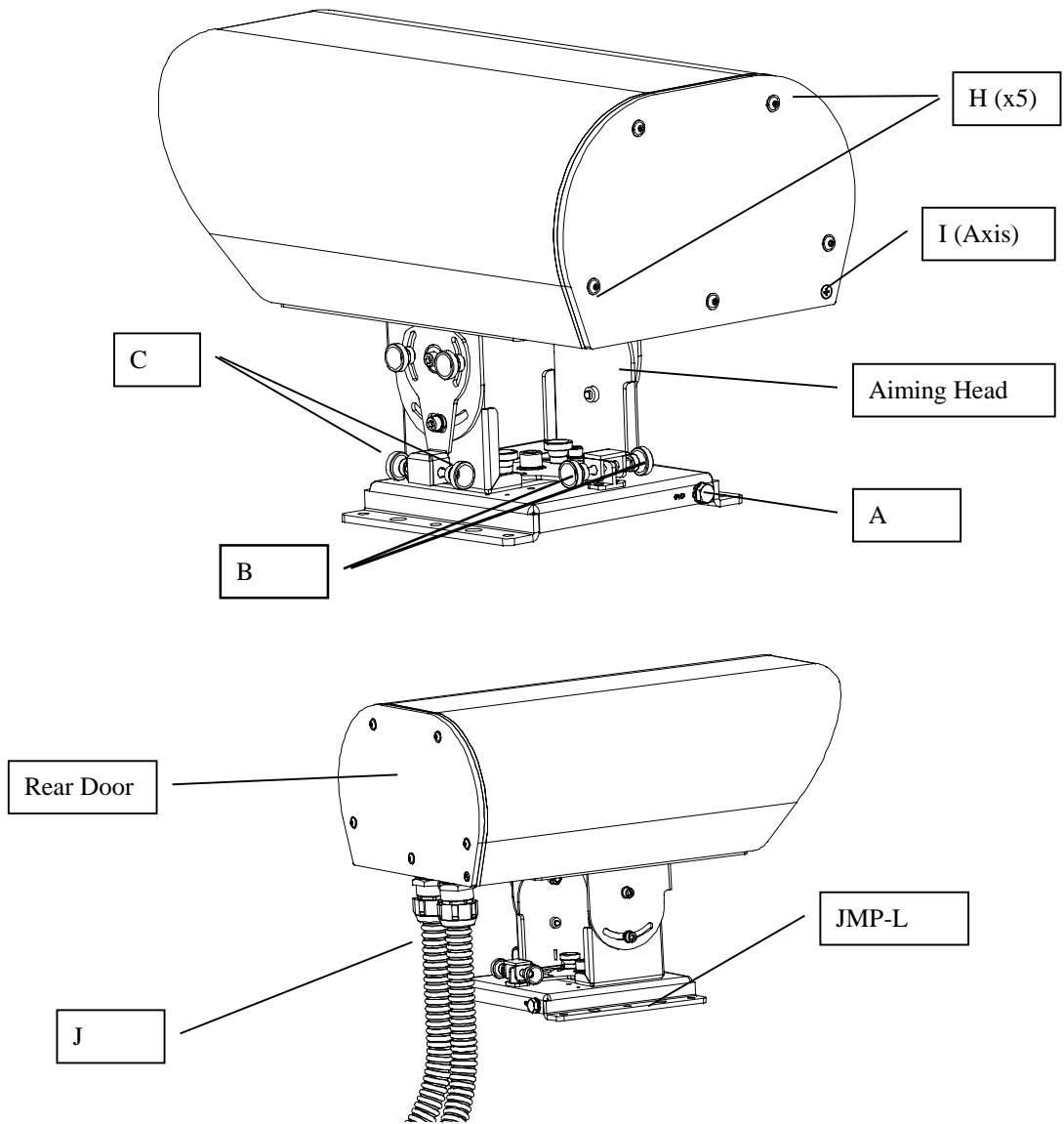


Figure 5.2: TereScope Parts – External view

Table 9: TereScope Parts

Part	Description	Part	Description
A	Screw for Grounding	H(x5)	Door lock Captive Screws
B	Right-Left Fine Alignment Screws	I	Door Axis
C	Up-Down Fine Alignment Screws	J	Cable Duct



Fig. 5.3a: Rear door fixation

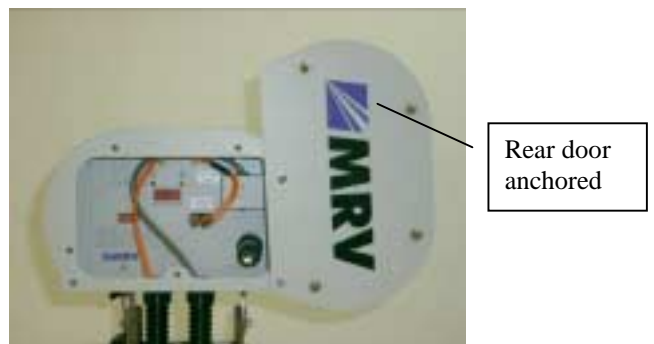


Fig. 5.3b: Rear door fixed

Alignment Kit

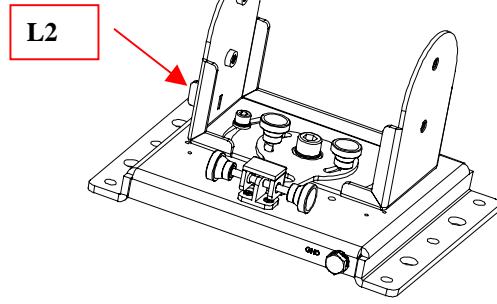


Fig. 5.4: Mounting kit

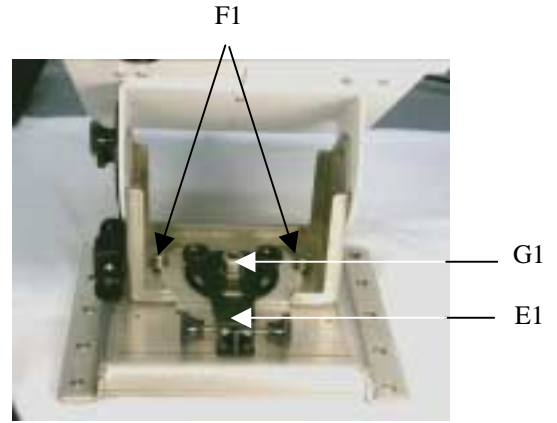


Fig. 5.5: Mounting kit – Top view

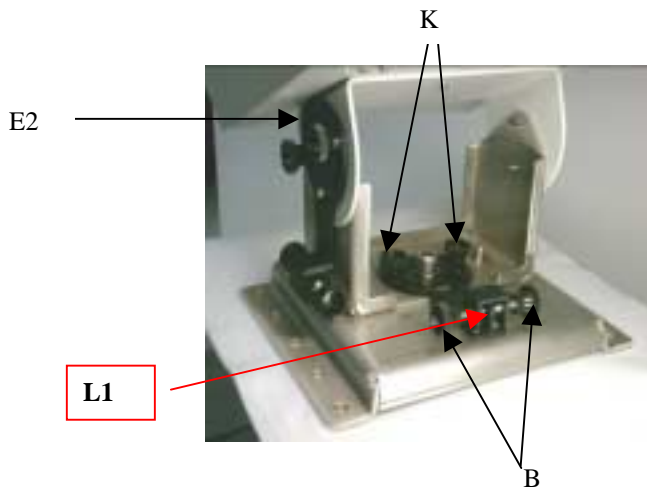


Fig. 5.6: Mounting kit – Back view

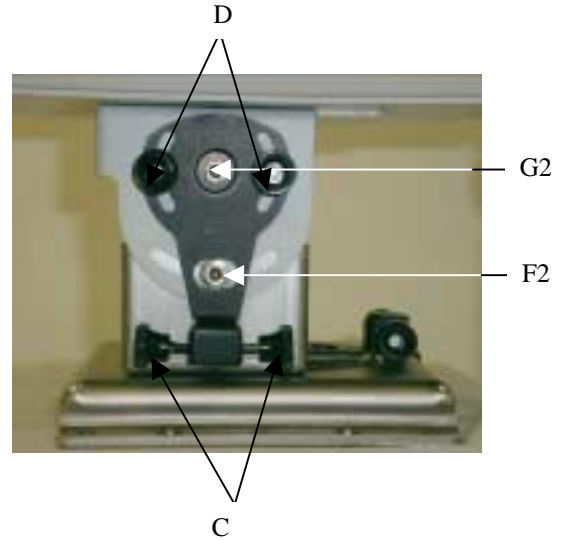


Fig. 5.7: mounting kit – Side view



Fig. 5.8a



Fig. 5.8b



Fig. 5.8c

Figures 5.7a – 5.7b: Mounting kit – detailed views

AIMING HEAD ADJUSTMENT AND LOCKS:

- B: Right-Left (Horizontal) Fine Alignment Screws (2)
- C: Up-Down (Vertical) Fine Alignment Screws (2)
- D: Fine Vertical Aiming Locking Bolts (2)
- E1/E2: Aiming Lug (2)
- F1: Horizontal Aiming Locking Bolts (after aiming is completed)
- F2: Vertical Aiming Locking Bolt (after aiming is completed) (one on the right side and one on the left side).
- G1: Horizontal Aiming Axis
- G2: Vertical Aiming Axis (two screws – one on each side)
- K: Fine Horizontal Aiming Locking Bolts (2)
- L1/L2: Aiming anchor (L1 for Horizontal aiming , L2 for Vertical aiming)

## The Installer Tool Kit (JITK-L)

JITK: Installer Tool Kit

The JITK-L tool kit includes the work tools required for opening and closing nuts and screws of the TereScope for optimal installation. It is recommended that these tools be used. MRV supplies this tool kit with each TereScope head. In addition to the tool kit, screws are supplied for mounting the JMP-L on a pedestal that is supplied by MRV as an option.



Fig. 5.9: JITK: Installer Tool Kit

## Mounting

### 1- Detachment of the TS from the JMP-L

The TereScope Head, Aiming Head, and JMP-L are shipped connected to one another. Before mounting, in order to make installation on the mounting surface easier, the JMP-L must first be detached and connected to the fixation surface. Next, the TereScope Head and Aiming Head can be mounted. To detach the JMP-L, screws 'B' should be loosened and screws 'F1' and 'G1' only should be removed. **Do not remove the 'G2' screws !**

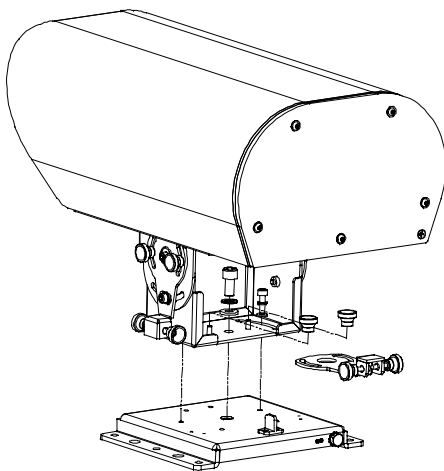


Figure 5.10a: Mounting TS on JMP

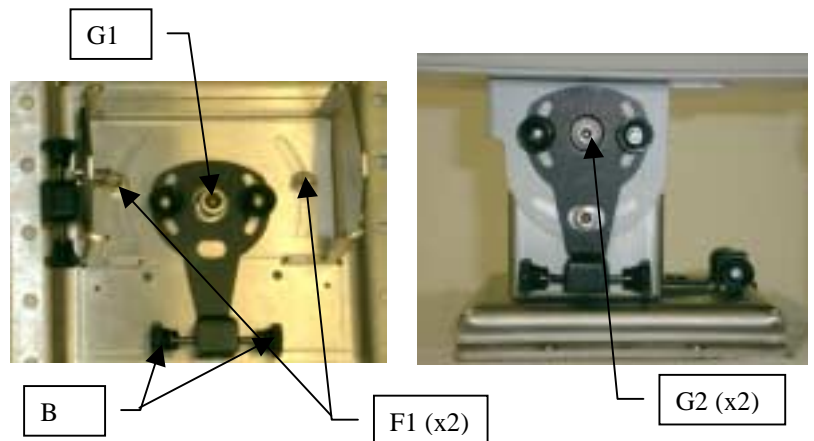


Figure 5.10b and 5.10c: Screws to be removed G1 and F1

If the TereScope head is to be detached (e.g., for servicing, but we recommend to send the entire unit TS + Aiming head to the manufactory), remove the four 'G2' and 'F2' screws (Fig 5.11).

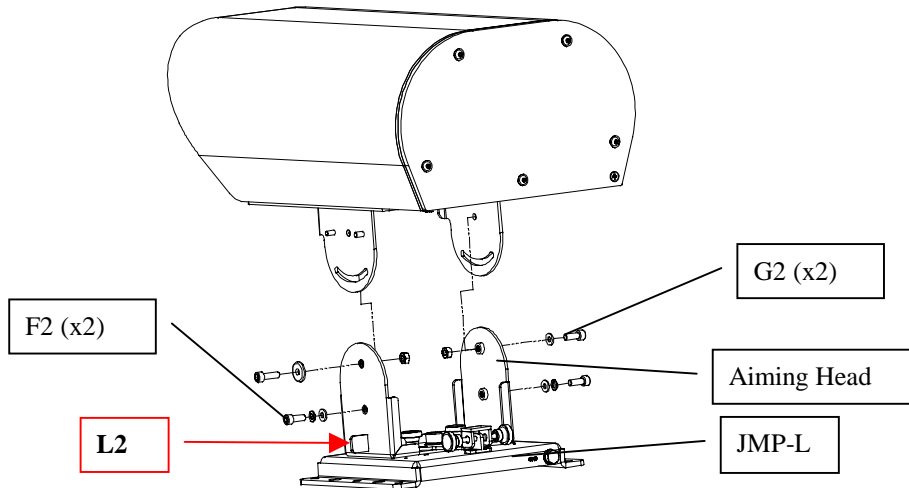


Figure 5.11: TereScope Detached from the Aiming Head

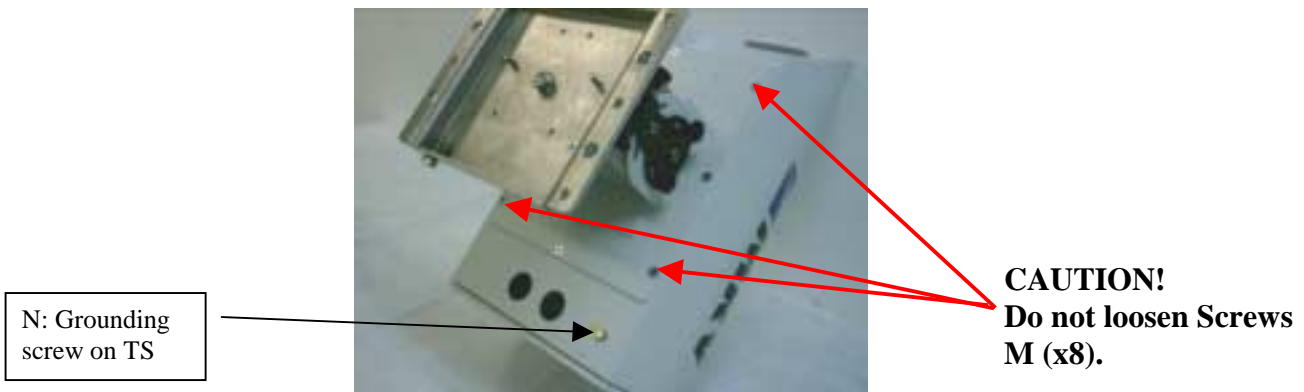


Figure 5.12: Aiming Head Cradle for TereScope Head

## 2- Mounting the accessories

### ■ Horizontal surfaces (parapet, ...):

There are three directional positions for the TereScope mounting on the JMP-L plate:  
It is possible to mount the TereScope at -60 or +60 degrees from the standard position

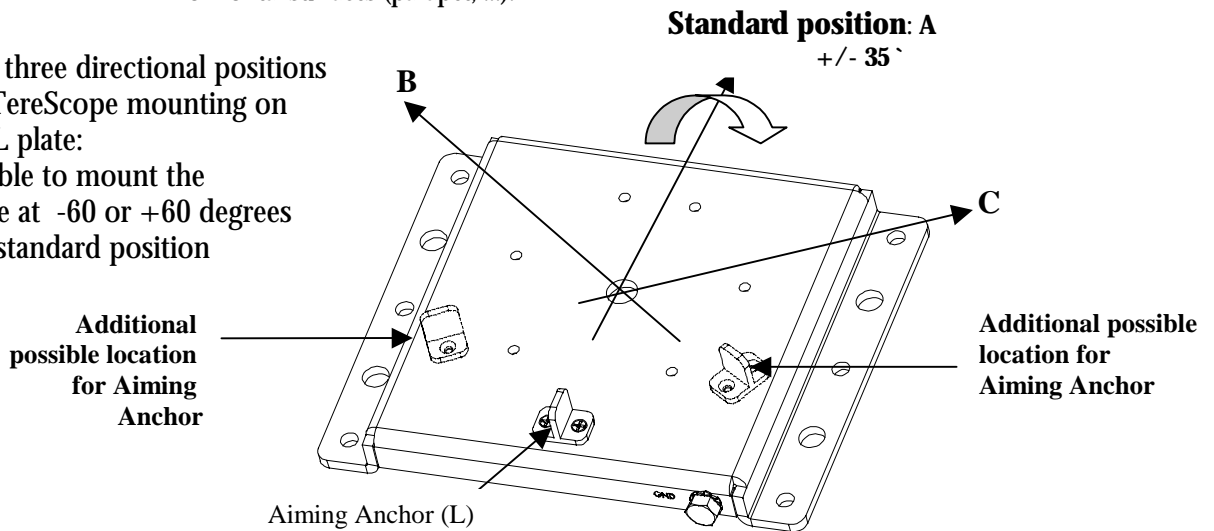
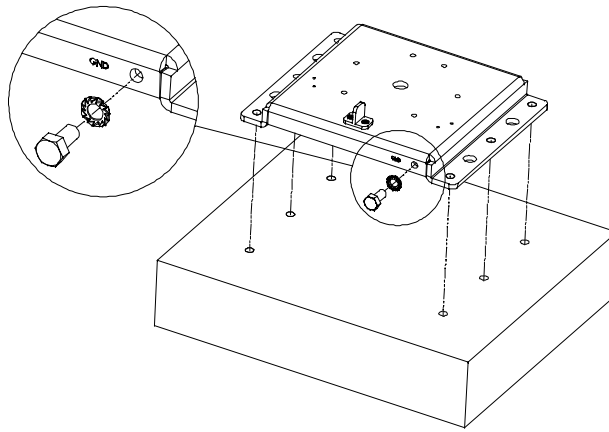


Figure 5.13a: JMP-L mounting positions



**Figure 5.13b: JMP-L on the fixation surface**

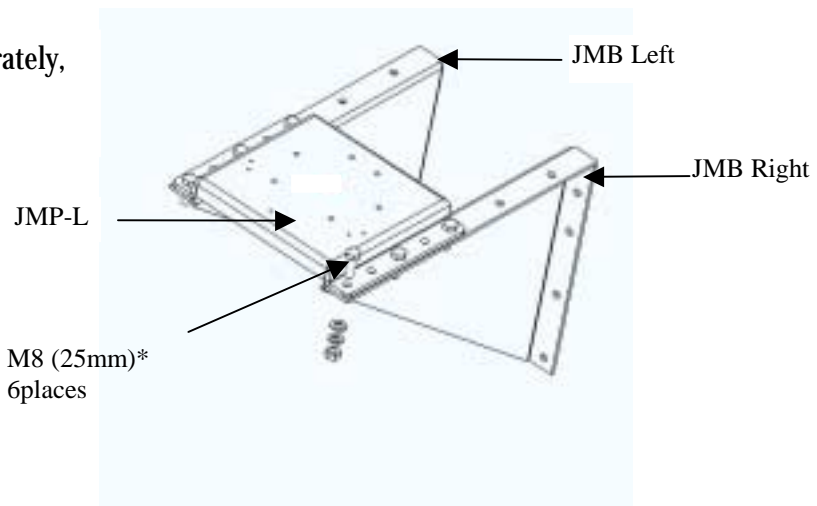
THE JMP-L SHOULD BE ORIENTED IN SUCH A WAY THAT THE GROUNDING SCREW IS LOCATED ON THE BACK (CLOSE TO THE INSTALLER) AND THE FRONT FACING THE OPPOSITE SITE.

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

Use a JMB (To be ordered separately, not included in the standard kit)



\*These bolts and nuts are included in the kit



**Figure 5.14: JMP-L on JMB**

Note

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

## Special Mounting

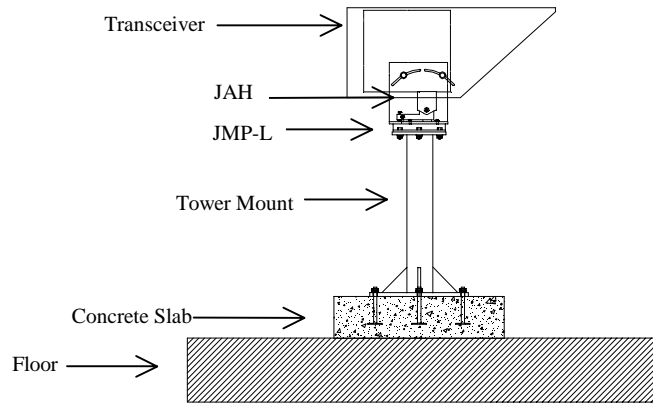
### 1- Mounting on the floor

In some cases the only place where the installation is acceptable, possible, or authorized is on the floor. **Avoid** installation on roofs with a metallic parapet or without a parapet by drilling holes in the roof floor.

To use the floor, a very stable tower standing on the floor is required. The transceiver will be fixed 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 material is poured directly on the base 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.



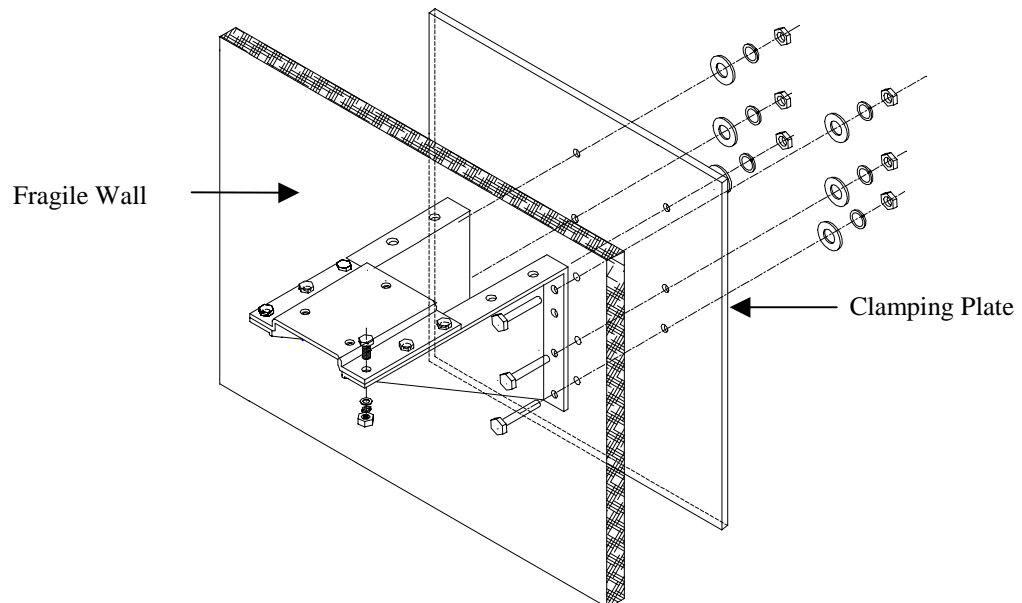
**Figure 5.15: Mounting on a concrete slab**

TAKE CARE TO REMOVE ANY INTERVENING SOFT MATERIAL, SUCH AS ASPHALT, BETWEEN THE SLAB/TOWER BASE AND THE FLOOR. ONCE THE INSTALLATION IS COMPLETED, RESTORE THE ROOF WATER-TIGHTNESS WITH SEALING MATERIAL AROUND THE SLAB.



## 2- Mounting on a fragile/crumblly wall

On sites on which the installation on fragile (pre-fab) or crumbly (old building) walls is unavoidable, the best way to strongly fix the JMB 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.



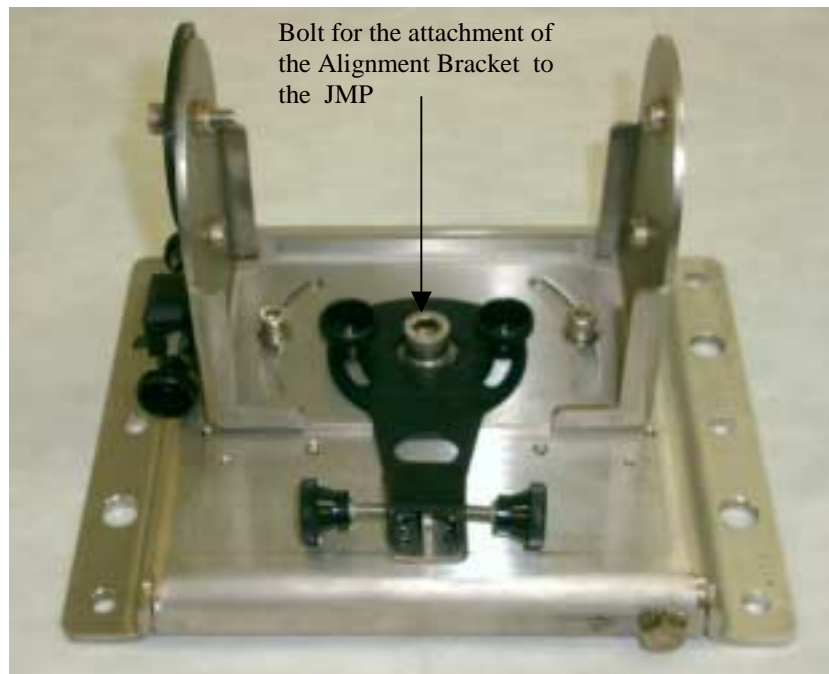
**Figure 5.16: Mounting on a Fragile wall**

**Note**

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

**3- Attachment of the Transceiver (TereScope Head)**

After securely attaching JMP-L to the mounting surface choose one of the three possible directions for installation of the Alignment Kit (Standard A, B or C) depending on the location of the transceiver at the opposite side. Mount the aiming anchor (I) in accordance with the chosen direction.



**Figure 5.17: Alignment kit mounted on JMP-L – Back view**

Mount the Transceiver attached to the mounting bracket front face oriented towards the opposite site using the provided screws (F1, G1). Tighten firmly these screws.



Chapter  
6

## Aiming Procedure

**Point to point connections require the orientation face to face of both “transceiving” ends of the link. Concerning wireless optical links, this should be done as accurately as possible in order to position the beam symmetrically all around the remote receiver.**

### Powering on the TereScope

- 1 – Make sure that the power cable is disconnected from the electrical power source.
- 2 – Undo the five screws H -- see Figure 6.1. Holding the Rear Door, Pull the door, turn it clockwise ¼ of a turn around the axis (I), so that a screw will be opposite hole "O". Fixe the door on the hole "O" with the screw.

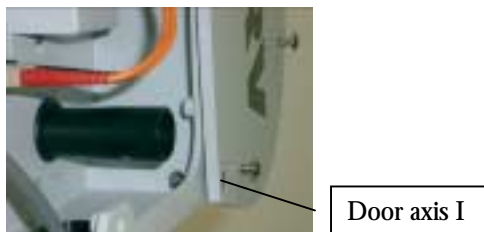
- 4 – After connecting the power cables to corresponding sockets, tightly close the screws of the Terminal block – see Figure 6.5. Gently jerk the cable to check that it stays connected. Cover the Terminal Block with a plastic cover (if available).



**Fig. 6.1: Screws H and door axis**



**Fig. 6.2: Back Door Rotated ¼ of a turn**



**Fig. 6.3: View on Door axis**

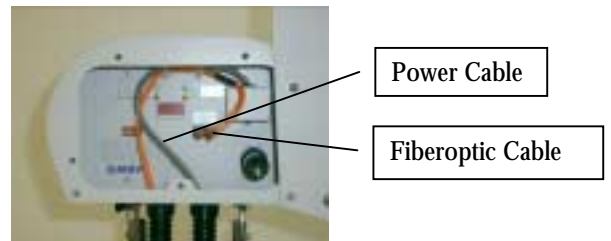
- 3 – Connect the wires of the power cable (see Figure 6.4) to the Terminal Block (see Figure 6.5) paying attention to L=Line, G=Ground & N=Neutral.



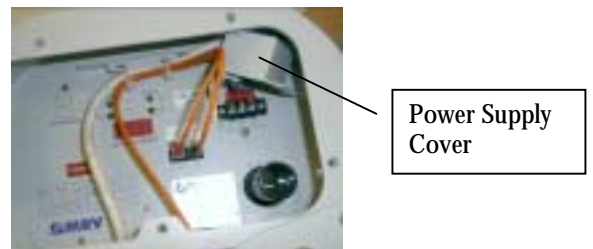
**Fig. 6.4: Power cable & Terminal block**



**Fig. 6.5: Power Terminal Block Locked**



**Fig. 6.6: Power Cable and Fiberoptic Cable**



**Fig. 6.7: Power Supply Cover**

- 5 – Cover the Terminal Block with the power supply cover.
- 6 – Rotate and push the Back Door up, and tighten the five H screws.
- 7 – Connect the power cable to the electrical power source to power on the TereScope.


## Transceiver Alignment

### General

Point-to-point connections require face-to-face orientation of both transceiving ends of the link. With wireless optical links, the beam spot should be positioned symmetrically on the remote receiver, as accurately as possible.

Successful installation of the TereScope depends primarily on precise and accurate optical alignment. Carefully follow the instructions below!!!

### Tools and Equipment

	<p><b>Note</b></p> <p>The customer can order patch cables and high-output portable source from <i>MRV</i>.</p>
---	--

The following tools and equipment are required at each link end:

- A communication device (mobile phone or walkie-talkie)
- Optical-power meter, giving readings in milliwatts/microwatts or dBm. (The Optical power meter is convenient though not necessary.)
- JITK-L.

### Procedure

Turn on the power to the TereScope heads from the power source.

Models TS700/155 ,TS700/100 and TS800/155: Set DIP switch toggles 1, 2 to the “Alignment” position (indicated on the back panel). In TS800 models set the SD2 DIP switch. In TS700/100 only DIP switch toggle 1.

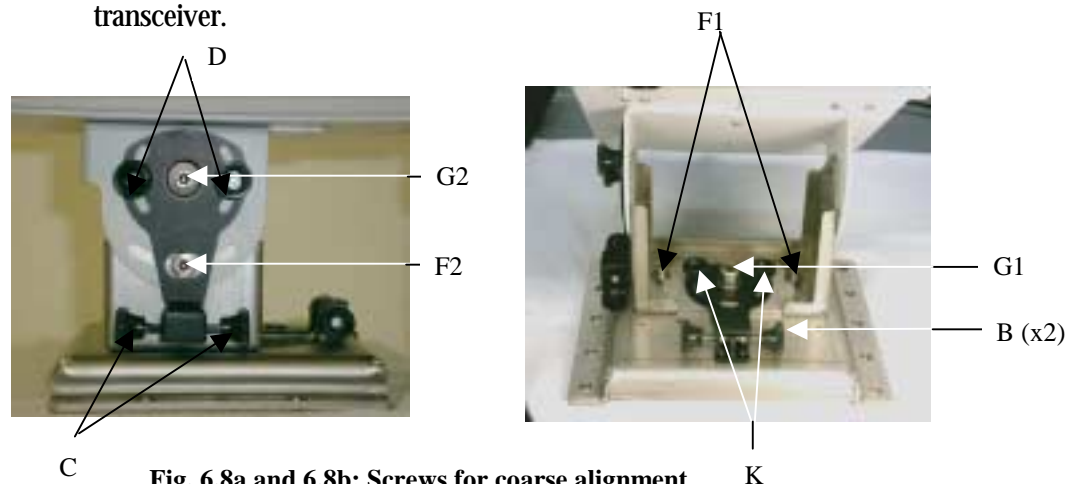
Model TS700G: Even if the data port is left unconnected, the TereScope transmits an Idle Signal which can be used to perform alignment.

The transceiver alignment procedure is implemented in two stages:

- Coarse Alignment
- Fine Alignment

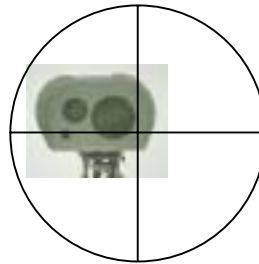
#### Coarse Alignment

1. Make sure that both axes (horizontal ‘G1’ and vertical ‘G2’) can turn freely (**but you shouldn’t loosen or open the ‘G2’ screws**). Loosen bolts F1 and K at least two turns and G1 aiming axis loosen slightly. Loosen bolts D and bolts F2 on both sides of the transceiver.



**Fig. 6.8a and 6.8b: Screws for coarse alignment**

2. While looking (see fig 6.9 below) through the telescope, rotate and tilt the TereScope to bring the telescope crosshairs on the left side (your right side) of the opposite TereScope.

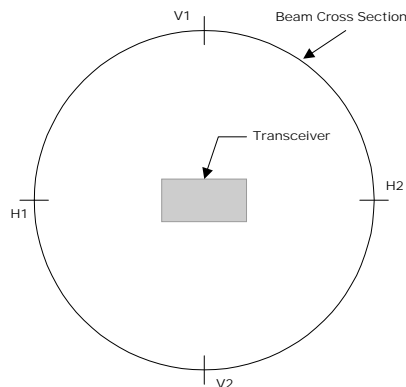


**Fig. 6.9: Telescope crosshair on the opposite TereScope**

3. Tighten firmly 4 Bolts K and D in such a way that the aiming anchors (L1&L2) will be between the screws C and B.

***Fine Alignment***

The purpose of fine alignment is to position the center of the transmitted beam spot on the center of the TereScope receiver – in both directions (Fig 6.10). This is achieved by adjusting the horizontal and vertical motion screws (shown in Figure 6.11) until maximum power is received at the opposite TereScope.




**Figure 6.10: Front view – Transceiver at the middle of the beam cross section**



**Figure 6.11: Fine Alignment Motion Screws**

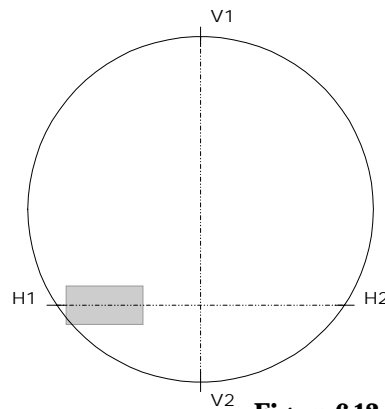
**Fine Alignment Vertical Motion Screws** – Two screws ('C'). Used for fine rotation of the TereScope in the vertical plane.

**Fine Alignment Horizontal Motion Screws** – Two screws ('B'). Used for fine rotation of the TereScope in the horizontal plane..

	<p><b>Note</b></p> <ul style="list-style-type: none"> <li>▪ Two installers are required for <i>fine alignment</i>, one at each TereScope site.</li> <li>▪ The installers should each have a walkie-talkie, a mobile phone or any other equipment to enable each to talk to the other working at the opposite site.</li> </ul>
---	---

The fine alignment procedure is as follows:

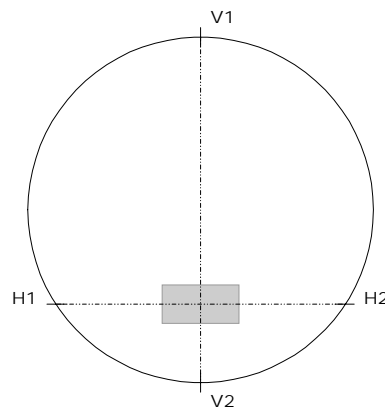
1. Find the horizontal and vertical Beam edges (H1, H2, V1, V2) by obtaining a reading between 50 and 80 on the 7-segment display. (between 250 and 300 for the TS700/G)
2. Set successively the remote transceiver in the middle of the two segments [H1,H2] and [V1,V2].



**Figure 6.12:** Position at the beginning (after the coarse alignment)

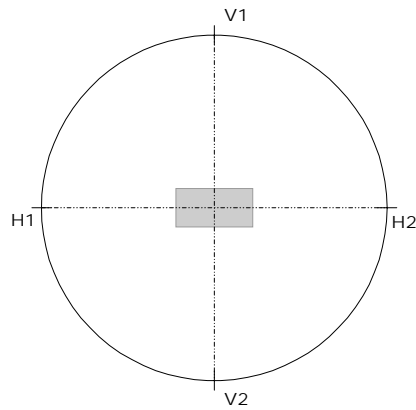
**Important:** Do **not** in any case select the head position for which the DVM reading is maximum! The best position of alignment is the beam center.

To determine the horizontal beam edges H1 and H2, move the local transceiver slowly left and right until the digital readout on the remote transceiver becomes 50. (250 for the TS700/G) Identify these two points relative to reference points on the opposite site by looking through the telescope. By moving the local transceiver, set the remote transceiver at the middle of these two reference points.



**Figure 6.13:** Position after the horizontal aiming

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



**Figure 6.14:** Final position after the vertical aiming

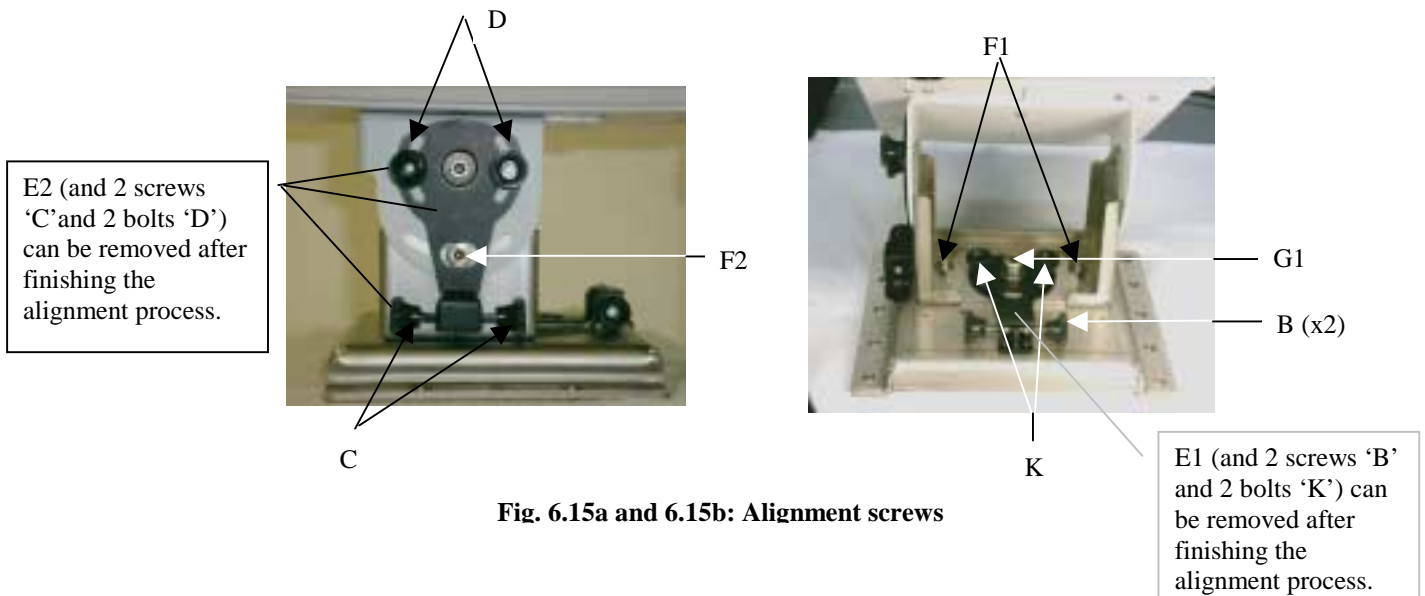
Once the position is reached, **tighten firmly** the 4 Fine Locking Screws (2xF2, 2xF1 and G1).



**Repeat this procedure interchanging roles with the second installer at the opposite site, i.e., the second installer will move the remote transceiver while the first installer will report the digital readout at his end.**

After finishing the alignment process it's possible to remove the alignment kit (2 Aiming Lugs E1, E2 and Bolts K and D and screws B and C).

*At the end of the procedure, the digital readout should be approximately the same on both transceivers (see Appendix B page 44 for expected readings).*



**Fig. 6.15a and 6.15b:** Alignment screws

## Link Operating Test

Set back the Mode Select Dip-Switch on the Normal position (the Alignment indicator should switch OFF (if exists depending on the model)).

At both sites, connect with fiberoptic or STP cables coming from the peripheral equipment to the fiberoptic or copper port of the transceiver.

## IT IS A CROSS CONNECTION:

### TX → RX AND RX → TX

The F/O RX Flag and Sync. (Electrical flag and Rx on TS700/100) indicators should turn ON as soon as the peripheral equipment is powered ON.

A BER test is recommended. In case this is not possible at least check with the customer/user the performance of the whole link (see the chapter Bench Test).

## Installation Log

Write down all the information about the installation (including digital readout and the setup of the transceivers) in an installation log. This information is a valuable reference for future maintenance or troubleshooting visits.

An example of an installation form is shown in Appendix H.

## Before Closing the Rear Door

1. Ensure that the Power Supply Cover is fastened in place.
2. All cables are properly held in position.

## Visual Inspection

Visually check that all parts and cables are connected.

## Closing the rear door

Rotate the Rear Door around the axis (I) and push it. Close the five screws H - - see Figure 6.16.,



**Fig. 6.16: Screws H and door axis**

## Installation Completion

Check that the heads appear as shown in the photographs below.



**Fig. 6.17: Mounted TereScope – Left View**



**Fig. 6.18: Mounted TereScope – Back View**




**Fig. 6.19: Mounted TereScope – Front View**

## Maintenance

### Periodic Visits

Periodic visits (every three/six months, depending on the installation environment) should be planned for:

- Checking the display
- Checking the mounting
- Cleaning the optical aperture of the transceivers
- Cleaning the building windows for indoors installations.



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

#### Note

Aiming accuracy should be checked looking through the telescope and comparing the present scene sighting to the one sketched in the Installation Log at installation time.



## APPENDIX A

## Product Specifications

**TS700/155 (high speed Light)**

<b>Part Number Model</b>		TS155/A/YUW/VS TS700/155
<b>Application / Data Protocol</b>		T3, E3, Fast Ethernet and ATM
<b>Performance</b>	Rate	1-155 Mbps
	Range <sup>(1)</sup> @ 3dB/km	880 m
	@ 5dB/km	770 m
	@ 10dB/km	600 m
	@ 17dB/km	480 m
	@ 30dB/km	360 m
	Minimum Range	10 m
	Bit Error Rate	Less than 1E-12 (unfaded)
MTBF	10 years	
<b>Transmitter</b>	Light source	1 VCSEL
	Wavelength	830-860 nm
	Total Output power	5 mW
	Beam divergence	3-4 mrad
<b>Receiver</b>	Detector	Silicon Photodiode
	Field of view	14 mrad
	Sensitivity	-34 dBm
<b>Interface</b>	Type	Fiber Optic Transceiver - Multimode (Singlemode available upon request)
	Connectors	SC (other connectors available)
	Wavelength	1300 nm (other wavelength available)
	Output power	-17 ± 3 dBm
	Receiver Operating range	-14 to -30 dBm
<b>Power Supply</b>		Factory set: 100-240 VAC @ 50/60 Hz or 24-60 VDC (10 W)
<b>Environmental Information</b>	Operating Temp.	-50 °C to +60 °C
	Storage Temp.	-50 °C to +70 °C
	Humidity	95% non-condensing
	Housing	Weatherproof – IP 66
	Eye safety Class	1M
<b>Mechanical Design</b>	Dimensions [mm]	470 X 282 X 390
	Weight	5 kg
	Accessories	3.5 kg
<b>Diagnostics Indicators / Selectors</b>	Indicators	Airlink: Flag, Sync. Fiber Optic: Flag, Sync. Receive Signal Strength (Digital Display)
	Selector:	Data Rate, Alignment, Loopback (local)
	Management	SNMP Protocol – Optional

Notes:

- <sup>(1)</sup> 3dB/Km: Light rain (5 - 10mm/hr) - Light Haze  
5dB/Km: Light to medium rain (15 - 20mm/hr) - Haze  
10dB/Km: Medium to Heavy rain (45mm/hr)-Light snow-Thick fog  
17dB/Km: Cloudburst (100mm/hr)-Medium snow-Light snow  
30dB/Km: Rain (up to 180mm/hr)-Blizzard-Moderate fog

## **TS700/100 (Fast-Ethernet Light)**

<b>Part Number Model</b>		TS100/A/FET/VS TS700/100
<b>Application / Data Protocol</b>		Fast Ethernet
<b>Performance</b>	Rate	100 Mbps
	Range <sup>(1)</sup> @ 3dB/km	880 m
	@ 5dB/km	770 m
	@ 10dB/km	600 m
	@ 17dB/km	480 m
	@ 30dB/km	360 m
	Minimum Range	10 m
Bit Error Rate	Less than 1E-12 (unfaded)	
MTBF	10 years	
<b>Transmitter</b>	Light source	1 VCSEL
	Wavelength	830-860 nm
	Total Output power	5 mW
	Beam divergence	3-4 mrad
<b>Receiver</b>	Detector	Silicon Photodiode
	Field of view	14 mrad
	Sensitivity	-32 dBm
<b>Interface</b>	Type	Electrical – 100Base Tx
	Connectors	RJ45
	Cable	STP
<b>Power Supply</b>		Factory set: 100-240 VAC @ 50/60 Hz or 24-60 VDC (10 W) PoE (Power over Ethernet) in DC (low Voltage) models (V3)
<b>Environmental Information</b>	Operating Temp	-50 °C to +60 °C
	Storage Temp	-50 °C to +70 °C
	Humidity	95% non-condensing
	Housing	Weatherproof – IP 66
	Eye safety Class	1M
<b>Mechanical Design</b>	Dimensions [mm]	470 X 282 X 390
	Weight	5 kg
	Accessories	3.5 kg
<b>Diagnostics Indicators / Selectors</b>	Indicators	Airlink: Link Flag, Data, 100Base-T: Link Flag, Data Receive Signal Strength (Digital Display)
	Selector:	Loopback (local), Ip address
	Management	SNMP Protocol – Optional

Notes:

- (1) 3dB/Km: Light rain (5 - 10mm/hr) - Light Haze  
5dB/Km: Light to medium rain (15 - 20mm/hr) - Haze  
10dB/Km: Medium to Heavy rain (45mm/hr)-Light snow-Thick fog  
17dB/Km: Cloudburst (100mm/hr)-Medium snow-Light snow  
30dB/Km: Rain (up to 180mm/hr)-Blizzard-Moderate fog

**TS800/155 (high speed Light)**

<b>Part Number Model</b>		TS155/C2/YUW/VS or TS155/C2/YUW/FS TS800/155 or TS800/155-F	
<b>Application / Data Protocol</b>		Fast Ethernet, ATM, OC3,STM1, SMPTE, E3, T3, OC1/STM0 & Open Protocol	
<b>Performance</b>	Rate	1-155 Mbps	
	Range <sup>(1)</sup> @ 3dB/km	1900 m	
	@ 5dB/km	1600 m	
	@ 10dB/km	1150 m	
	@ 17dB/km	850 m	
	@ 30dB/km	600 m	
	Minimum Range	10 m	
	Bit Error Rate	Less than 1E-12 (unfaded)	
	MTBF	10 years	
<b>Transmitter</b>	Light source	1 Laser	
	Wavelength	830-860 nm	
	Total Output power	28 mW	
	Beam divergence	3 mrad	
<b>Receiver</b>	Detector	Silicon Photodiode	
	Field of view	14 mrad	
	Sensitivity	-37 dBm	
<b>Interface</b>	Type	Fiber Optic Transceiver - Multimode (Singlemode available upon request)	
	Connectors	SC (other connectors available)	
	Wavelength	1300 nm (other wavelength available)	
	Output power	-17 ± 3 dBm	
	Receiver Operating range	-14 to -30 dBm	
<b>Power Supply</b>		Factory set: 100-240 VAC @ 50/60 Hz or 24-60 VDC - (10 W)	
<b>Environmental Information</b>	Operating Temp.	-50 °C to +60 °C	
	Storage Temp.	-50 °C to +70 °C	
	Humidity	95% non-condensing	
	Housing	Weatherproof – IP 66	
	Eye safety Class	1M	
<b>Mechanical Design</b>	Dimensions [mm]	470 X 282 X 390	
	Weight	Unit	5 kg
		Accessories	3.5 kg
<b>Diagnostics</b>	Indicators	Airlink: Flag, Sync. Fiber Optic: Flag, Sync., Alignment mode, Loopback mode, Remote LoopBack mode, Fusion mode and activity, Software mode, Laser status, Management Tx and RX, F/O Redundant Link and Sync., Receive Signal Strength (Digital Display)	
	Selectors	Data Rate, Alignment, Loopback (local), Remote LoopBack, Alignment Signal Attenuation, Laser power off, Fusion, Window Heater (if exists), Ip address , Control Mode.	
	Managemen	2 Dry Contacts (AirLink and FO Link) SNMP Protocol Built in	

Notes:

- <sup>(1)</sup> 3dB/Km: Light rain (5 - 10mm/hr) - Light Haze  
5dB/Km: Light to medium rain (15 - 20mm/hr) - Haze  
10dB/Km: Medium to Heavy rain (45mm/hr)-Light snow-Thick fog  
17dB/Km: Cloudburst (100mm/hr)-Medium snow-Light snow  
30dB/Km: Rain (up to 180mm/hr)-Blizzard-Moderate fog

**TS700/G (Giga-Light)**

<b>Part Number Model</b>		TS1000/A/YUW/VS TS700/G	
<b>Application / Data Protocol</b>		Gigabit-Ethernet, Fiber Channel	
<b>Performance</b>	Rate	1.0625Gbps & 1.25 Gbps	
	Range <sup>(1)</sup> @ 3dB/km	1000 m	
	@ 5dB/km	900 m	
	@ 10dB/km	690 m	
	@ 17dB/km	540 m	
	@ 30dB/km	400 m	
	Minimum Range	40 m	
	Bit Error Rate	Less than 1E-12 (unfaded)	
	MTBF	10 years	
<b>Transmitter</b>	Light source	1 VCSEL	
	Wavelength	830-860 nm	
	Total Output power	15 mW	
	Beam divergence	3.5 mrad	
<b>Receiver</b>	Detector	APD	
	Field of view	8 mrad	
	Sensitivity	-33 dBm	
<b>Interface</b>	Type	Fiber Optic Transceiver - Multimode (Singlemode available upon request)	
	Connectors	SC (other connectors available)	
	Wavelength	850 nm (other wavelength available)	
	Cable	Up to 220m length @ 62.5um & Up to 500m length @ 50um	
	Output power	-4 to -9.5 dBm	
	Receiver operating range	0 to -17 dBm	
<b>Power Supply</b>		Factory set: 100-240 VAC @ 50/60 Hz or 24-60 VDC - (10 W)	
<b>Environmental Information</b>	Operating Temp.	-30 °C to +50 °C	
	Storage Temp.	-50 °C to +70 °C	
	Humidity	95% non-condensing	
	Housing	Weatherproof – IP 66	
	Eye safety Class	1M	
<b>Mechanical Design</b>	Dimensions [mm]	470 X 282 X 390	
	Weight	Unit	5 kg
		Accessories	3.5 kg
<b>Diagnostics Indicators / Selectors</b>	Indicators	Airlink: Flag, Fiber Optic: Flag, Laser enabled. Receive Signal Strength (Digital Display)	
	Selector:	Data Rate, Power attenuator (for short distance), IP address setting	
	Diagnostic	4 dry contacts for: Airlink Flag, Fiber Optic Flag, Laser enabled and Power	
	Managemen	SNMP Protocol – Built-in	

Notes:

- <sup>(1)</sup> 3dB/Km: Light rain (5 - 10mm/hr) - Light Haze  
5dB/Km: Light to medium rain (15 - 20mm/hr) - Haze  
10dB/Km: Medium to Heavy rain (45mm/hr)-Light snow-Thick fog  
17dB/Km: Cloudburst (100mm/hr)-Medium snow-Light snow  
30dB/Km: Rain (up to 180mm/hr)-Blizzard-Moderate fog

## APPENDIX B

**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.

D= Distance [m]

R= Reading (Digital readout)

TS700/155  
TS700/100

<b>D</b>	50	100	150	200	250	300	350	400	450	500	550	600	650	700
<b>R</b>	560	520	420	360	300	240	180	140	120	100	80	60	40	30

TS800/155

<b>D</b>	50	100	200	400	500	600	800	900	1000	1100	1300	1500	1700	1900
<b>R</b>	960	760	520	410	380	330	210	170	130	100	70	40	35	25

Actual reading may be greater or up to 15% lower.

TS700/G

<b>D</b>	50	100	150	200	250	300	350	400	450	500	550	600	680	1000
<b>R</b>	1150	1150	1110	1020	940	880	800	730	640	580	520	470	400	250

Actual reading may be greater or up to 15% lower.

**NOTE:** with the Transmitter in “Attenuated” mode for distances under 150m (DIP switch toggle 1 OFF), the DVM should show readings varying from 800 to 1150.

**A note on the Digital Readout Characteristics of the TS700/G**

The digital readout of the TS700G works under a different principle from previous TereScopes in the series. The readout level is derived from the actual light level at the photodetector, much like a standard optical power meter. For this reason, background light entering the lens will also contribute to the reading. A typical reading with no signal on a sunny day would be 030 to 080. This will sum with the signal strength, so outside the reading at the minimum threshold would be higher than the reading for the corresponding signal in a bench test. Due to the AGC function, for higher signals the offset in the reading gradually becomes negligible. All this has no effect on the actual link performance.

Please note, however, that the Air Rx LED is not affected by background light, and is purely a function of the received data level. So even with high background light reading, the Air Rx LED will not light in the absence of signal.

## APPENDIX C

## Unpacking Instructions for TereScope

The TereScope is shipped pre-assembled. See fig.C2

**The packing box contains:**

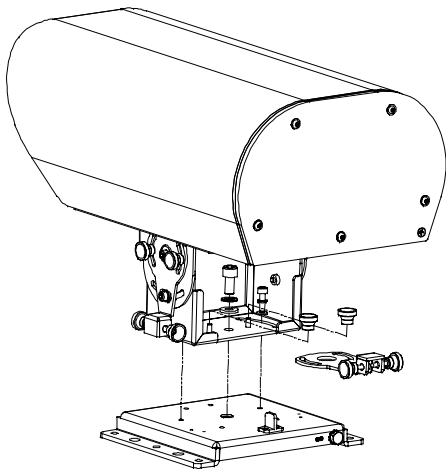
- 2 x TereScope Transceivers mounted
- JITK-L : Installer tools kit and screws
- CD manuals
- Flexible ducts x 2
- Flange x 2



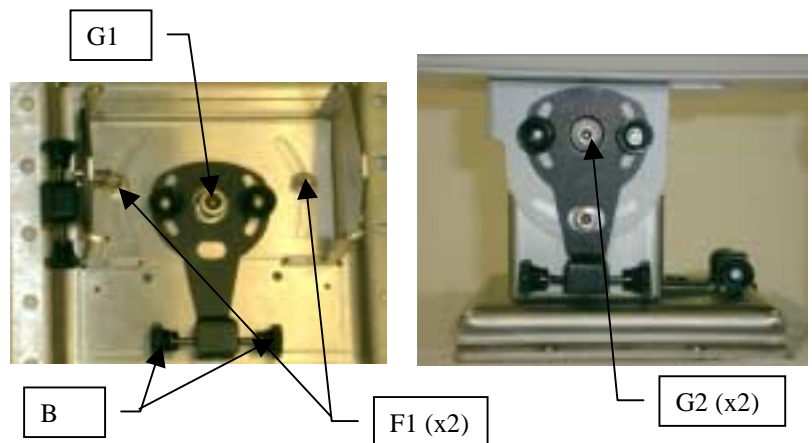
**Fig C.1: TereScope as is packed**

1. Unpack all the accessories.
2. Before mounting, in order to make installation on the mounting surface easier, the JMP-L must first be detached and connected to the fixation surface.

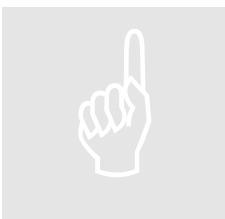
To detach the JMP-L, screws 'B' should be loosened and screws 'F1' and 'G1' only should be removed, shown in Fig: C2, C3a and C3b. **Do not remove the 'G2' screws !**



**Figure C2: Detach JMP-L from TS**



**Figure C3ab and C3b: Screws to be removed G1 and F1**



**KEEP IN SECURE PLACE ALL THE BOLTS AND SCREWS. YOU WILL NEED THEM FOR THE INSTALLATION.**

## APPENDIX D

**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) 3-13mm.
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. Vice grip pliers 10-12"
7. Cutter, long nose pliers, electrician's pliers (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, 1/2".
16. Allen 8mm and Allen 2.5mm.

## MATERIALS

1. Anchors (wall plugs) "UPAT" 13mm 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.
3. Binoculars
4. Four STP cables (two cross and two straight) terminated with RJ-45 connectors each end.

OPTICAL  
EQUIPMENT

(if relevant)

1. Optical Power Meter (Fotec, Noyes, Acterna...)  
with fiber sockets.
2. 2 sets of multimode (62.5 μm) and Singlemode  
(15μm) optical fibers with SC terminations.

## LAB EQUIPMENT

E1/ETH/ATM/Fast Ethernet BER Test equipment- depending on TS model.

**A LIST OF THE TOOLS SUPPLIED BY MRV COMMUNICATIONS  
WITH EVERY TereScope HEAD**

	<b>Description</b>	<b>Qty</b>	<b>Where to use</b>
<u>a</u>	WRENCH #8 for Aiming Head, (M5 nut)	1	<b>N:</b> Grounding screw on TereScope (see page 29)  (Also for rear door axle : I)
<u>b</u>	BALLDRIVER L, WRENCH 5mm for Allen Screw M6	1	<b>F1 and F2:</b> Screws for Vertical and Horizontal coarse Aiming
<u>c</u>	BALLDRIVER L, WRENCH 3mm for Allen Screw M5	1	<b>H:</b> Rear Door lock captive screws
<u>d</u>	WRENCH #13 (M8 Hexa. Screws)	1	<b>A:</b> JMP-L - Grounding screw  Screws between JMP-L and JMB (if needed)  Screws between JMP-L and pedestals (if needed)
<u>e</u>	BALLDRIVER L, WRENCH 8mm for Allen Screw M10	1	<b>G1:</b> Horizontal axis and locking screw for horizontal aiming
<u>f</u>	M8 SCREWS, WASHERS, SPRINGS, NUTS	4 of each	Optional. To mount JMP-L on standard pedestal
<u>g</u>	INSTALLATION TOOL CASE	1	Tool case

Wrenches Kit for TS Installation



# APPENDIX E

## TereScopes Bench Test Procedure

### Introduction

All TS Products are bench tested indoors prior to outdoor installation to ensure that the system is fully functional.

The bench test is a simple procedure whereby a link pair is aligned on the table and activated to simulate a channel of communication (see fig.1).

### 2 Points to Remember

1. Since the link distance during the bench test is very short (i.e. the devices activated are very close), the receivers will go into saturation unless the signal is attenuated. (NOTE: In the 700/G, deep into saturation the DVM reading may actually drop back down, giving the false impression that the link is misaligned. It is therefore vital to place the attenuator in the link path before optimizing alignment.)

To avert entering saturation, the transmit signal must be physically attenuated.

We recommend the simple procedure of inserting a piece of paper or the like into the beam path, or concealing a portion of the beam with an opaque (non-transparent) material. This will reduce the signal power entering the receiver.

Make sure to attenuate the signal enough so that the receiver's optical power meter value falls below the saturation estimate of the device. See table below for saturation estimate.

2. An additional derivative of the short link distance is the presence of reflections.

The signal will reflect off the front window of the receiver back at the transmitting device and may be mistaken as part of the opposite transmission.

This interference is commonly called "cross talk".

To avoid cross talk during the bench test, it is advisable to check whether interfering reflections exist by shutting off power to one device and verifying that the optical power meter reading in the other (active) device is zero.

This should be repeated for the opposite device.

Alternatively, a practical setup for bench testing the 4" series (models B, C and D) and Light series (models A and C2) is presented in Figure 1; the bench test setup for the 10" series (models E and F) is presented in Figures 2a,2b.

In the 4"/Light setup, a thin physical barrier, such as a piece of cardboard, is used as a wall to divide between the beam paths, thus ensuring that no cross talk occurs.

In the 10" setup, the two devices are not centrally aligned; instead, only one corner of each device faces the opposite device. This

allows for testing each transmitter separately. By rotating the devices 45 degrees, the next pair of transmitters is tested. Hence, testing all 8 transmitters in the link pair requires only 4 rotations.

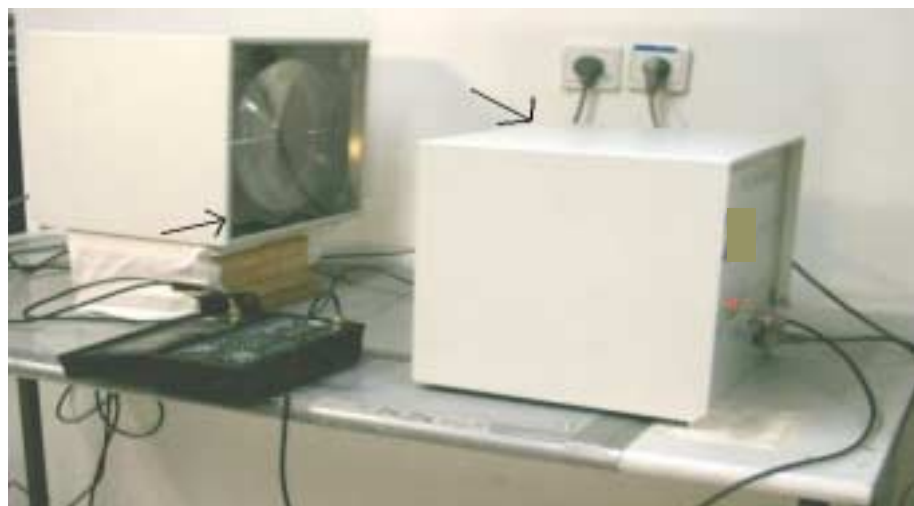
In the 8” setup, the two devices are not centrally aligned; instead, only one corner of each device faces the opposite device. This allows for testing each transmitter separately. By rotating the devices 45 degrees, the next pair of transmitters is tested. Hence, testing all 6 transmitters in the link pair requires only 3 rotations. With opaque masking tape, cover all transmitters that are not under test.

**Table 1:** Bench Test Information for TS Products

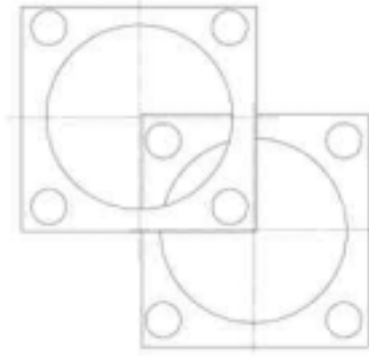
Product name	Opt. Power M. “Sub-Saturation” value	Potential for Interference
TSxxxx	1100	Low
TSxxx/ETH	1200	Med
TSxxx/E1	1200	High
TSxxxx/ST	1200	Med
TS2000/XXX	1100	High
TS4000/XXX	1200	High
TSx00/XXX	1000	High



**Figure E.1:** Bench Test setup for 4”/Light TS models.

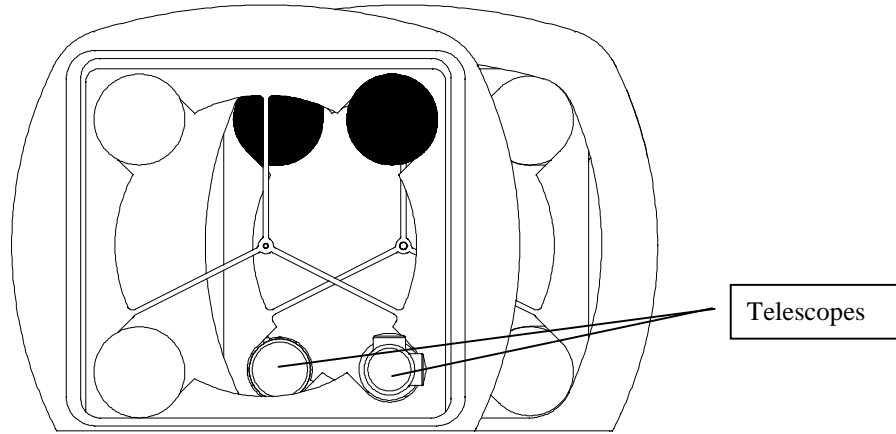


**Figure E.2a:** Bench Test setup for 10” TS model; transmitter aligned opposite receiver marked with arrows.



**Figure E.2b: Bench Test setup drawing for 10” TS model.**

Note that one device is higher than the other and shifted over to the side so that only one transmitter from each device is facing opposite the other device's receiver.



**Figure E.3: Active Transmitters (Shown Darkened).**



## APPENDIX F Effect of Wind on Terescopes

### Introduction

The outdoor environment in which our devices are normally placed exposes the link to wind pressures that may affect the accuracy of the link's alignment.

Several factors play a role in the determination of the extent to which the directionality of a TS device may be affected by the wind:

Wind speed

Wind direction

Surface area of device perpendicular to wind

Mechanical stability of aiming head – device system.

For example, the mechanical stability is greatest along the side-side axis of the device.

Although the surface area along the side of the device is greatest, the resultant wind force – even at very high wind speeds – will barely have an impact on the beam's direction, due to the rigid mechanics along the side-side axis.

### Wind Limits for TS Devices

All TS devices have been tested in “worst-case” scenario of the above four factors.

The force necessary to deviate beam was measured from different direction.

From here<sup>1</sup>, the minimum wind speed with maximum effect on beam deviation was determined.

The following table lists the minimum wind speeds for different TS products that may cause:

A momentary lapse in the communication.

An extended lapse requiring mechanical repair.

TS Device	Momentary	Extended
• 10” (E&F models)	110 km/hr	200 km/hr
• 10” with Windproof-L Accessory	Over 180 km/hr	Over 250 km/hr
• 4” (B,C, D models)	150 km/hr	Over 250 km/hr
• 4” with Windproof-S	220 km/hr	Over 300 km/hr
• Light (A&C2 models)	150 km/hr	Over 250 km/hr
• PAL (TS1)	180 km/hr	Over 250 km/hr
• 8” (Models D2, E2, G)	150 km/hr	

<sup>1</sup> We include here the formula for calculating the effective wind force on a flat surface, given a known wind speed:

$$\text{Wind Force} = 0.79 \times (\text{Wind Speed})^2 \times (\text{Area of Surface})$$

For instance, assuming a wind speed of 27.78 m/s (equal to 100Km/hr) on a surface area of 0.04m<sup>2</sup> (400cm<sup>2</sup>), the force is equal to 24.4 Newtons.

## Appendix G FSO Chaining

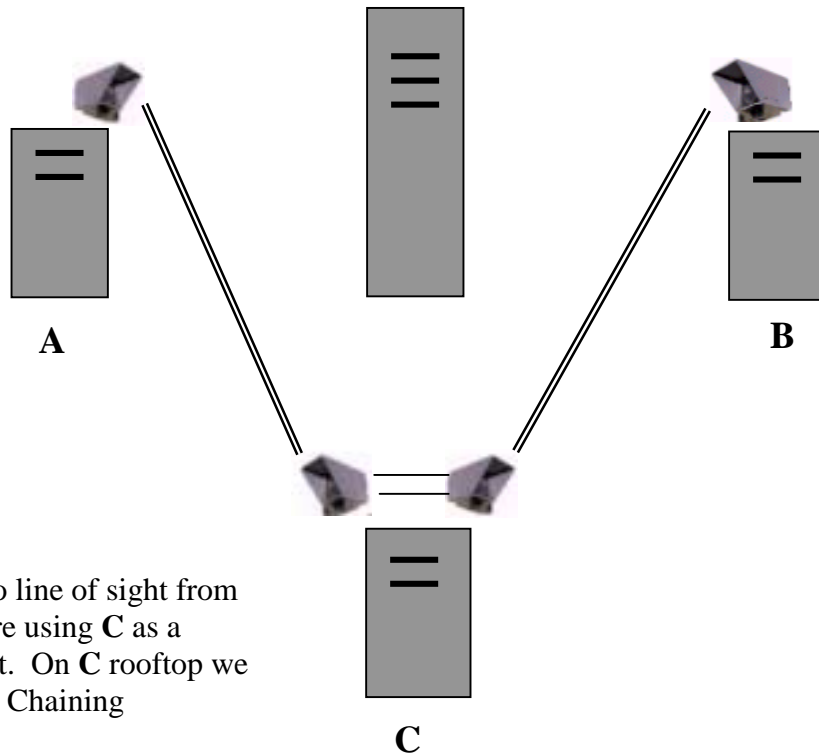
### *What is Chaining?*

The Chaining of FSO is required when the two sites are connected by more than one link using at least one additional building as a mid-point.

### *When is the Chaining required?*

The Chaining of FSO links is required in the following cases:

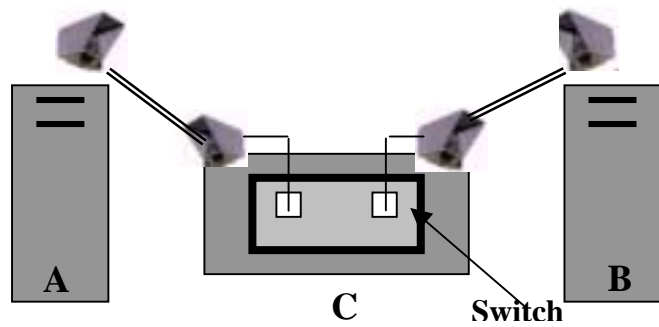
- When there is no direct line of sight between the sites;
- When the distance between the sites is too long;
- When the distance between the sites is reachable with one link but the customer wants much more Power Budget for higher reliability.



**Fig G.1:**  
As there is no line of sight from **A** to **B**, we are using **C** as a repeater point. On **C** rooftop we used “Direct Chaining connectivity”

### Indirect Chaining

**Indirect Chaining is required for connecting FSO units not including clock recovery circuits. In cases of indirect connectivity, the connection between the two FSO units on the same roof must be done through the Switch or Router or another means of connection that is located inside the building. For example, in Fig. 2, we use the indoor switch in building C for the chaining.**

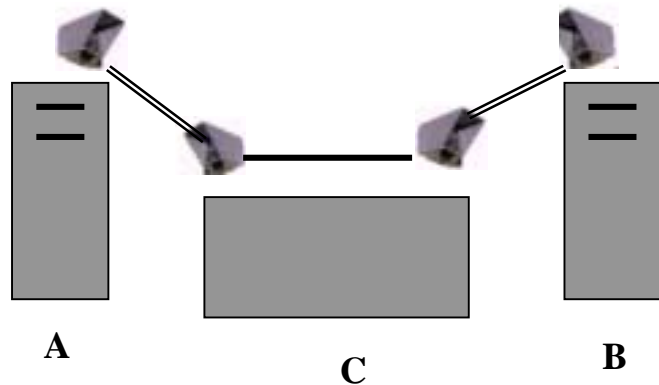


**Fig. G.2**  
Indirect chaining

### Direct Chaining

Direct Chaining is the capability to directly connect two FSO units on the same roof (used as repeaters) i.e.. direct crossing between Rx and TX of the two units. For example, in Fig. 3 connection is achieved on rooftop of building C without the need to enter the building.

Direct connection is possible for FSO that include clock recovery circuits. The clock recovery regenerates the signal and enables smooth direct chaining.



**Fig. G.3**  
Direct chaining

### Chaining Limits

The number of links that can be chained is limited due to the Jitter parameter. Sensitivity to jitter is different for every protocol and can vary with different manufacturers. The typical number is 3-4 chained links. If more chains are required, please consult your MRV representative.

**FSO products & Chaining**

<b>Product series</b>	<b>Chaining</b>	<b>No of chained links</b>
TS155-PS (34-155 Mbps)	Direct	3-4
TS 34 (Open Protocol, 1-34 Mbps)	Indirect	3-4
TS 10 (Ethernet)	Direct	3-4
TS Mux (Mux 4E1, 4T1)	Direct	No Limits*
TS 2 (E1, T1)	Direct	No Limits*

*\*No Limits – it refers to Networking extensions. If the extensions are of TDM type (E1,E3,STM-1, STM-3), after some chains we might face some “jitter” problems. Therefore, in such cases, chaining should be considered on a case by case basis.*



# APPENDIX H

## Installation Log

### D.1. Client / Dealer details

	Customer	Dealer
Company Name		
Address City Country		
Contact Person		
Tel		
Fax		
e-mail		

### D.2. Application details

Type of network	<input type="checkbox"/> E1 , <input type="checkbox"/> Ethernet , <input type="checkbox"/> Token Ring , <input type="checkbox"/> Fast Ethernet , <input type="checkbox"/> FDDI , <input type="checkbox"/> ATM , <input type="checkbox"/> Other (Specify)
Product	
Evaluated distance by customer	
Address of installation (site A)	
Address of installation (site B)	

### D.3. Sketch of the area

**D.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		

**D.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	

**D.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		

## APPENDIX I

## Power over Ethernet

The Power-over-Ethernet (PoE) option is available only for Low Voltage TereScope model 700/100. PoE eliminates a separate DC power supply cable at each Access Point (AP) location, i.e., it allows for a single Ethernet cable providing both data and power to be run to each AP instead of two separate cables, one for power and the other for data. There are two types of PoE connections. One type utilizes all 8 wires of the Ethernet cable. The wires that are connected to pins 1, 2, 3, and 6 carry both power as well as data. The other type utilizes the four wires that are connected to pins 1, 2, 3, and 6 for carrying data, and the four other wires that connect to pins 4, 5, 7, and 8 for carrying power. Pin 4 is shorted to pin 5 and these are connected to the (+) terminal of the power supply. Pin 7 is shorted to pin 8 and these are connected to the (-) terminal of the power supply. Both are floating isolated voltage as is usual for a -48V Telecom supply. TereScope model 700/100 with PoE option supports this second option only (as required per IEEE 802.3af standard) so proper connection to this pins should be provided.

The TereScope model 700/100 can be connected by any of the following three methods:

1. TereScope model 700/100 with PoE option is connected directly to *PoE-enabled* equipment –The only needed part is a straight (non-cross) Category 5 jr 5e cable, which will also supply power to the AP.
2. TereScope model 700/100 with PoE option connected to *non-PoE-enabled* equipment through an external PoE adapter. The PoE adapter couples an Ethernet Line and DC Power (usually -48 VDC – see low voltage power requirement in Appendix A: specifications) onto an 8-wire straight (non-cross) Category 5 or 5e cable, as shown in Figure I.1. The other end of the PoE cable is connected directly to the TereScope model 700/100 with the PoE option. Adapters to be used with the TereScope are required to meet the IEEE 802.3af standard. Examples of brands of such adapters are: *HyperLink Technologies BT-CAT5-P1*, *PowerDsine 6001*. These two types of adapters are commercially available. This connection is illustrated on Figure I.1.

TereScope model 700/100 with PoE option connected to *non-PoE-enabled* equipment. In this case 8-wire straight (non-cross) Category 5 or 5e cable at the equipment side should be split on two wires groups. One group with standard pins 1, 2, 3, and 6 and carrying data to non-PoE enabled equipment. The other should be with four wires that connect to pins 4, 5, 7, and 8 for carrying power using external 48V power supply. Pin 4 is shorted to pin 5 and these are connected to the (+) terminal of the power supply. Pin 7 is shorted to pin 8 and these are connected to the (-) terminal of the power supply.

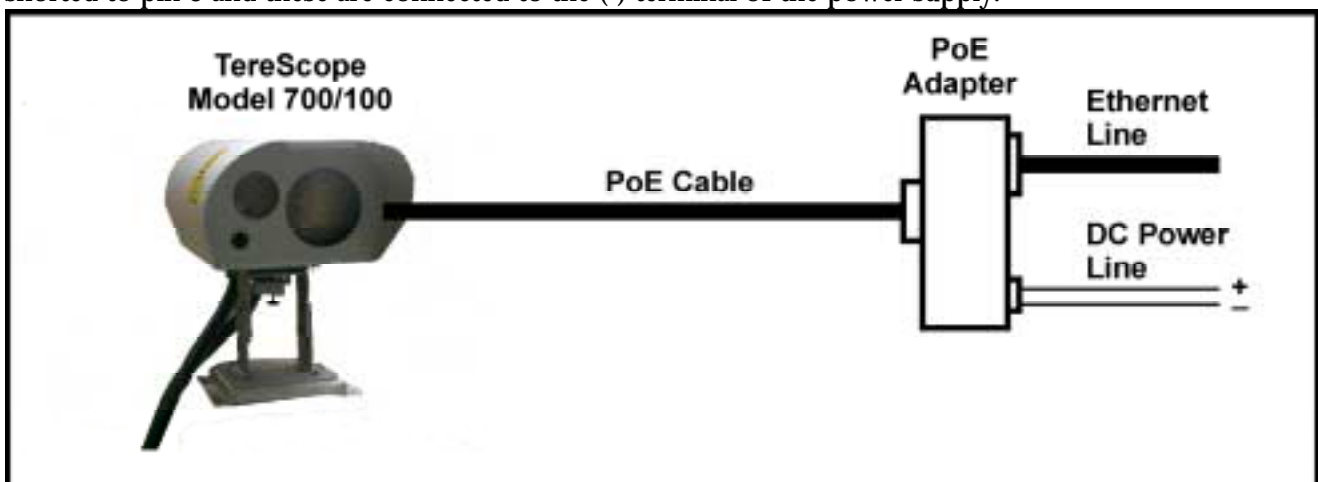


Figure I.1: Power-over-Ethernet Interconnection with external PoE adapter

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