

## Model 8400-eMOR-001

### Transmissometer

PRODUCT MANUAL  
8400-eMOR /Rev A

  
**ADB  
SAFEGATE**

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### Revision History

Revision	Date	Summary of Changes
A	2023 May 1	Initial release in new format

**Communications Settings Quick Reference**

Port	Type	Setting
Receiver Maintenance Port	RS-232	9600,8,N,1,N
Transmitter Maintenance Port	RS-232	9600,8,N,1,N
Control Board Serial Port	RS-232/RS-485	9600,8,N,1,N
Main Controller Data Port	RS-232	9600,8,N,1,N
Receiver Data Bus	RS-485	4800,8,N,1,N
Transmitter Data Bus	RS-485	4800,8,N,1,N
M482306-00 Communications Port	RS-232	9600,8,N,1,N
Model 5000 Background Luminance Sensor Port	RS-232	9600,8,N,1,N

**Command Quick Reference**

<b>Command</b>	<b>Alias</b>
OPEN, CLOSE, RESET	
GET STATUS	GS
CLEAN	CL
ESCAPE	ESC
DO ALIGN	DA
SET VIS MONITOR ON	SVMN
SET VIS MONITOR OFF	SVMO
SET FACTORY	SF
GET PARAMETERS	GP
MESSAGE LIST	ML
SET MESSAGE TYPE	SMT
SET DEBUG	SD
SET AUTOCAL INTERVAL	SAI
SET MAX RVR	SMR
SET MAX VIS	SMV
SET RS485 ON	SRN
SET RS485 OFF	SRO
SET ATP	SA
SET SITE	SS
SET VRP	SV
SET CALC ON	SCN
SET CALC OFF	SCO
SET BASELINE	SB
GET VERSION	GV
DO CAL	DC
SET TEST MOR	STM
SET TEST LUM	STL
DO BITE	DB
DECODE STATUS	DS
GET ERRORS	GE
CLEAR ERRORS	CE

Command	Alias
SET REPORT RATE	SRR
GET REPORT RATE	GRR
POLL	?
SET POLLING ON	SPN
SET POLLING OFF	SPO

# 1. Overview

Visibility and Runway Visual Range are some of the most important meteorological quantities in aviation safety. At times of reduced visibility, the accurate and reliable determination of Runway Visual Range (RVR) from visibility is crucial to maximize air traffic capacity without compromising safety. Transmissometers provide accurate and reliable solutions for measuring MOR and calculating RVR automatically. As the sampled air volume is rather large — typically over a 30 m baseline — thus accuracy of the measurement is high and stable.

The Model 8400-eMOR Transmissometer represents a new generation of transmissometers. It is extremely accurate, and coupled with a forward-scatter Visibility sensor extends the MOR measuring range to 10 to 80,000 m.

The Model 8400-eMOR Transmissometer measures the meteorological optical range (MOR), a critical factor in determining how far humans can see through the atmosphere.

A Model 8400-eMOR Transmissometer consists of a transmitter and a receiver. The transmitter generates a flash of light that is measured at the receiver, which is located a known distance from the transmitter. This distance is referred to as the baseline.

The receiver measures the intensity of the light received from the transmitter, and this intensity measurement is used to calculate the transmittance of the air between the transmitter and receiver, and thereby the current MOR.

Luminance values from an optional Background Luminance Sensor are used together with the integrated runway light intensity value to calculate RVR using official WMO/ICAO algorithms. The accuracy requirements meet or exceed the recommendations of ICAO Annex 3 for the entire range of RVR in airport operations, ranging from CAT I to CAT III.

## 1.1 Models

Model	Description
8400-eMOR-120	120 VAC
8400-eMOR-240	240 VAC

## 1.2 Accessories

The following accessories and replacement parts are available for the 8400-eMOR.

Part Number	Description
M482306-00	Present Weather/Visibility Sensor (required)
5000	Background Luminance Sensor (optional, allows RVR measurements)
M469126-00	Flash drive with Head Control Utility, Firmware, and other files
M488503-00	Verification Kit
M488504-00	Anchor Bolt Installation Kit
M482254-00	Calibration Kit for M482306-00
M493205-00	Technician Head Data Adapter

### 1.3 Positioning And Numbers Of MOR/RVR Sensors

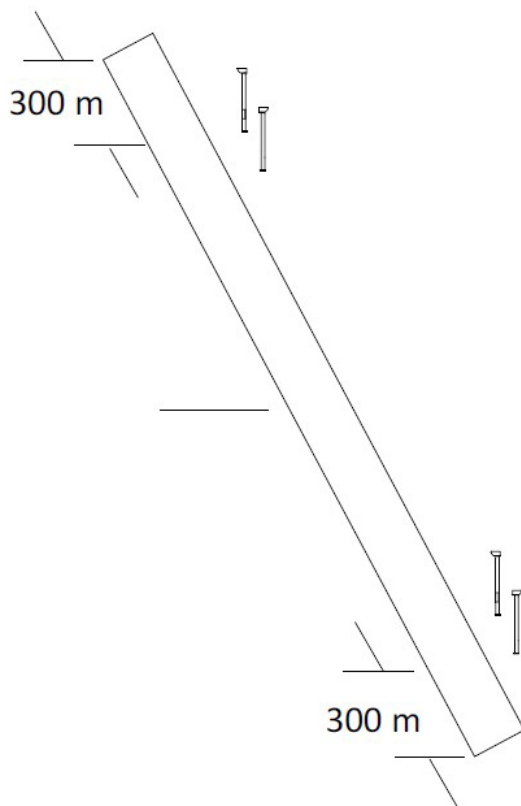
The number and positioning of MOR/RVR sensors depend on the airport's Instrument Landing System (ILS) based on visibility and decision height requirements.

Category of Operations	Sensor Recommendation
Category I	One 8400-eMOR sensor near each touchdown zone
Category II	Shorter than 2400 m: Two 8400-eMOR sensors Longer than 2400 m: Three 8400-eMOR sensors
Category III	Three to five 8400-eMOR sensors. [combined MOR sensor and forward-scatter Visibility sensor] Measuring Range 10–16,000 m

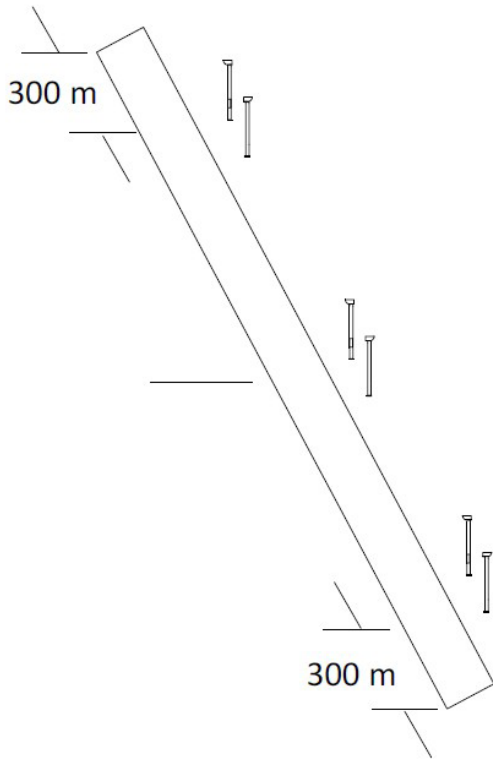
According to ICAO Doc 8896, Appendix 2, and ICAO Annex 3,

- the first MOR sensor should be located about 300 m along the runway from the threshold towards the middle of the runway to be representative of the touchdown zone
- the middle MOR sensor should be located midway along the runway
- the MOR sensor at the other runway end should be located about 300 m from the other runway end, and
- runways exceeding 3600 m in length will require an additional MOR sensor between the runway middle and the runway ends.

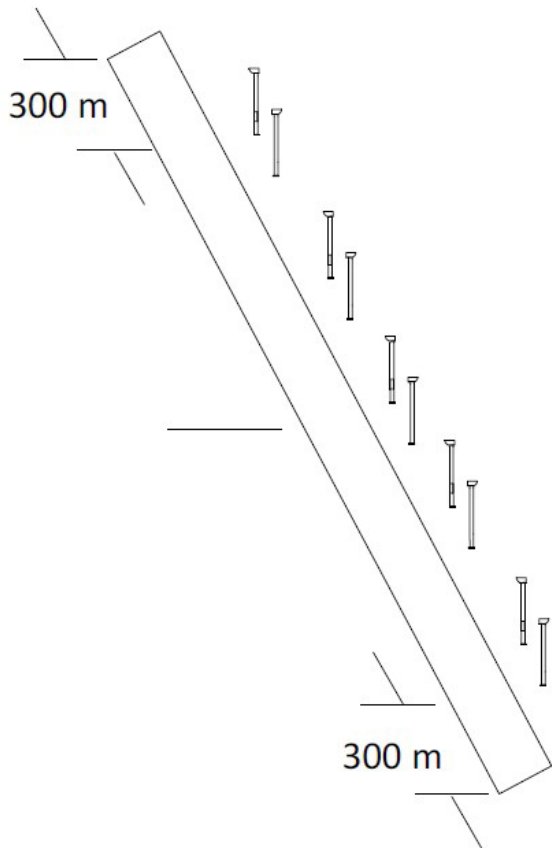
Figure 1 shows the approximate locations of the 8400-eMOR Transmissometers for the various ILS approach categories. They are positioned parallel to the runway no more than 120 m from the runway centerline.



(a) CAT I and CAT II (<2400 m) — 2 Transmissometers



(b) CAT II (>2400 m) — 3 Transmissometers



(c) Cat III — 5 Transmissometers

**Figure 1. Transmissometer Locations**

## 2. General Information

This manual provides all the information needed to enable the end user to install, operate, maintain and troubleshoot the Model 8400-eMOR Transmissometer.

### 2.1 Precautions

Lethal voltages are present during normal operation of this equipment. This device also emits bright light, and in the event of malfunction there may be an eye hazard.

### 2.2 General Safety

Within this manual there are specific pieces of information highlighted in the following ways and with these respective purposes:



#### **NOTE**

Lists important information in this section, important related information from other sections of the manual or advice on best practice in the usage of the instrument or its accessories.

---



#### **CAUTION**

This highlighted information cautions the reader of a potential hazard. Failure to read, understand and employ information contained in this instruction could result in the damage of the instrument or the loss of data.

---



#### **WARNING**

Non-compliance with the precaution described in these specific warning messages violates the manufacturers approved method of use of the instrument. ADB SAFEGATE assumes no liability for the user's failure to comply with these specific warning messages.

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## 2.3 Device-Related Safety Precautions

The 8400-eMOR device is tested for safety compliance prior to being sent from the factory. The following precautions relating to the safe operation of the device must be followed at all times when transporting, installing, using, maintaining or troubleshooting the device.



### **CAUTION**

Do not modify the device without specific instruction from the manufacturer. Non-approved modifications can result in sensor malfunction, product damage or increased safety risk to personnel.

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### **WARNING**

Ensure that the device is well grounded prior to initial operation and prior to each requirement for touching the device.

---



### **WARNING**

Operation of electrical devices in areas where flammable gases, fumes or explosive atmospheres poses a safety hazard. As the 8400-eMOR is an electrical device it should not be operated in such an area.

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### **WARNING**

Do not attempt service of the internal parts of the device unless there are suitably trained personnel on hand to render first aid should it be required.

---



### **WARNING**

All power cables to the sensor should be removed and the residual power allowed to dissipate for a period of not less than 5 minutes prior to internal maintenance of the device.

---



### **WARNING**

The device should not be maintained by personnel other than suitably qualified and trained maintenance personnel.

---

## 2.4 Eye Safety

Under normal operation the 8400-eMOR emits an intense bright white light from its transmitter. Whilst the device is inherently eye safe and there is no danger of injury from this beam of light, certain precautions should be taken when servicing the device to eliminate any temporary negative effects on service personnel's vision resulting from looking into the bright light.



### WARNING

Never look directly into the Transmitter with magnifying optics (glasses, binoculars, telescopes, etc.).

---



### WARNING

When operating, avoid looking at the Transmissometer from the beam direction. Make sure that it is not being viewed from the beam direction with magnifying optics.

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### WARNING

The device should not be maintained by personnel other than suitably qualified and trained maintenance personnel. Untrained personnel should not be present in the work area when maintaining the device.

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## 2.5 Safety Grounding

The AC cable has three wires.



### WARNING

The power cable must be installed with a safety ground connection.

---

## 2.6 Surge Protection

The 8400-eMOR is manufactured with built in surge protection for AC and communications lines. The AC cable consists of Line, Neutral and Ground conductors. The cable must be installed with a safety ground connection.



### CAUTION

Ensure the sensor's ground connection is made to a low impedance earth ground to maximize surge protection effectiveness.

---

## 2.7 Electrical Shock Hazard

Only qualified maintenance personnel should remove instrument covers or perform internal adjustments and component replacements. Never attempt to replace components while the power cable is connected.

When the covers of the transmitter, receiver, or power supply are removed and the 8400-eMOR is connected to AC power, high voltages are exposed and present a serious risk of electrical shock.



### WARNING

High voltages are present inside the device whenever it is energized. All hazardous areas are clearly marked with warning stickers. Always observe these warnings and follow proper safety procedures.

## 2.8 Electrostatic Discharge Precautions

Circuitry inside the 8400-eMOR is susceptible to damage from electrostatic discharges (ESD).



### CAUTION

When handling electronic components ensure that an ESD protected workbench or ESD strap are used to ensure protection of the equipment.

## 2.9 Recycling

The 8400-eMOR has been designed to be highly recyclable.



### NOTE

Recycling of electronic devices should be in conformance with your organizations e-waste policy and also in conformance with the applicable laws in your state, territory or country.



### CAUTION

The optionally supplied backup batteries contain toxic substances. Dispose of batteries in accordance with your local regulations.

To separate waste for the 8400-eMOR sensor, do the following:

1. Remove the optional attached sensors such as the Model 5000 Background Luminance Sensor and the co-located PW/Visibility Sensor, if installed. They will need to be disposed of separately as electronics waste material.
2. Remove the head/shroud covers.
3. Remove all the cables from the structure. They have to be disposed of separately as electronics waste material.
4. Remove the blower fans and junction boxes. They have to be disposed of separately as electronics waste material.
5. Remove the optics head units. They have to be disposed of separately as electronics waste material. Note that the glass elements are completely recyclable.
6. Remove the complete mounting plate and dismantle the mounting poles. They are made of stainless steel and aluminum and may be recycled.
7. If any additional external termination boxes are used remove the complete mounting plate including all electrical components from the boxes. They have to be disposed of separately as electronics waste material.
8. After this strip down work was carried out, the sensor is prepared for material recycling:
  - The shroud, fan cover, and fan filter are all aluminum and may be recycled.
  - The enclosures are fiberglass and polycarbonate, which required specialized recycling.
  - The collar and head connector mount are made of ABS plastic and may be recycled.
  - The sensor poles, mounting hardware and frangible bolts are all stainless-steel parts and fully recyclable.

### 3. Product Description

This section introduces the advantages, features, technology and product nomenclature related to the 8400-eMOR Transmissometer.

#### 3.1 Device Purpose

The 8400-eMOR Transmissometer is a dual-technology visibility sensor designed primarily for use in calculating Runway Visual Range (RVR) at airports. It measures visibility using both atmospheric extinction (light attenuation) and forward scattering principles, providing accurate and reliable data in a variety of weather conditions.

The sensor is available for operation with either 110 VAC or 240 VAC, 50/60 Hz. The required voltage configuration must be specified when ordering, as the device cannot be switched between voltages in the field. Communication is provided via RS-232 or RS-485 serial lines, which support both data transmission and maintenance functions. Visibility and status messages are sent to remote display units or data processing systems.

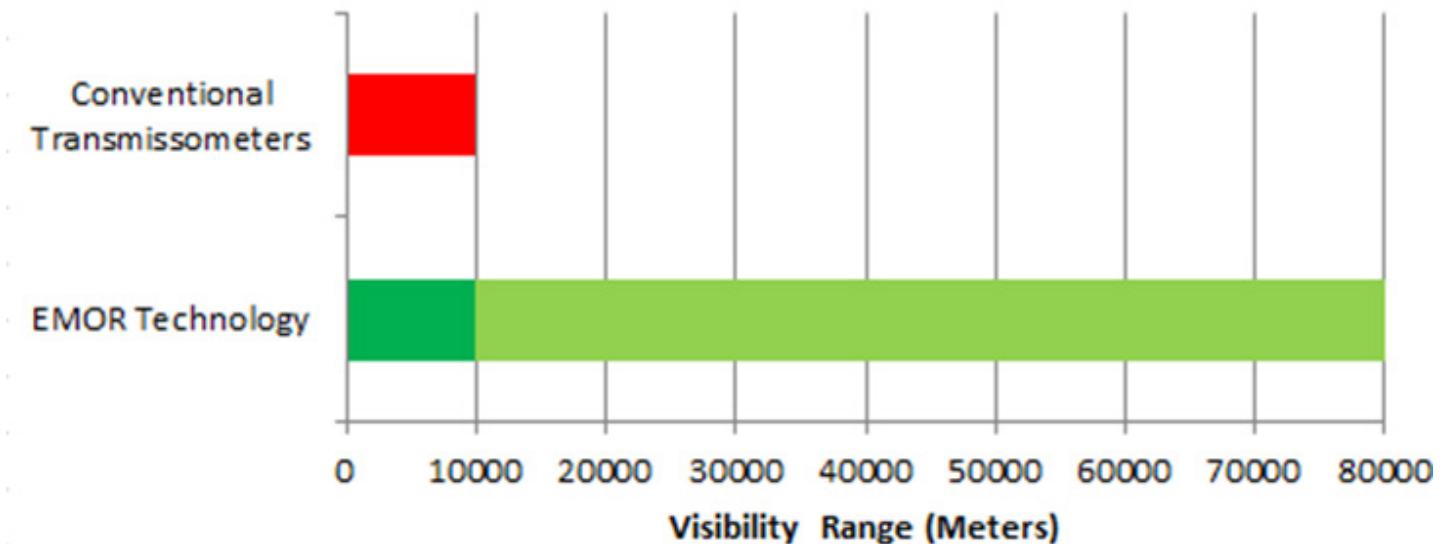
Built-In Test Equipment (BITE) enables remote or local configuration, monitoring, and diagnostics through a terminal emulation program. Calibration, compensation, and alignment can be performed automatically or manually, ensuring optimal performance and ease of maintenance.

#### 3.2 Key Features

The key features of the device are described in the following sections.

##### 3.2.1 Extended Range

Through the usage of both atmospheric extinction (light attenuation) and forward scatter visibility detection we can extend the MOR capability of the sensor out to 80km.



**Figure 2. Improvements in Visibility Range by 8400-eMOR vs Older Transmissometers**

The Transmissometer is most accurate in low visibilities and the forward scatter is most accurate at higher visibilities. As such, the Transmissometer operates in the 30 m – 10 km range and the forward scatter sensor operates from 10 km to 80 km.

### **3.2.2 Automatic Calibration**

The 8400-EMOR performs an auto-calibration during periods of high visibility. The output of the co-located forward-scatter sensor is compared with the output of the Transmissometer and the appropriate compensation factors are saved to ensure continuing accurate operation even in the presence of external factors such as window contamination.

### **3.2.3 Auto-Alignment**

A mechanism inside the receiver head fine tunes the alignment upon request.

### **3.2.4 Window Contamination Detection**

The transparency of the Transmissometer's transmit and receive windows is measured and any detected contamination is compensated for.

### **3.2.5 Contamination Prevention System**

Filtered air is pushed over the transmit and receive windows to prevent the build-up of contamination such as dust on the optical surfaces.

### **3.2.6 Frangible Dual-Mast Construction**

The sensor mast uses a dual support structure to maximize stability and measurement precision. Frangible bolts at the base ensure the mast will safely break away if struck, in accordance with airport safety standards.

### **3.2.7 LED Light Source**

The device uses a high-reliability white LED as its light source. The LED emits in the visible spectrum, closely matching the sensitivity of the human eye, which ensures accurate visibility measurements. The component is designed for a long operational life (high MTBF) and meets all relevant international standards for aviation visibility sensors.

### **3.2.8 Self-Diagnostics (BITE)**

The device features extensive self-diagnostics (BITE), enabling continuous monitoring of all relevant parameters. Diagnostic status can be accessed via a maintenance terminal and is also available through configurable output messages, including the legacy MITRAS sentence.

### **3.2.9 Compatibility**

The 8400-eMOR uses the industry-standard MITRAS message protocol, ensuring seamless integration with systems designed for LT-31, MITRAS, and SKOPOGRAPH transmissometers. The anchor bolt hole pattern is also identical to these models, allowing the 8400-eMOR to serve as a direct, form-fit mechanical replacement.

### 3.3 Transmissometer Description



**Figure 3. 8400-eMOR Transmitter**

The transmissometer has two main components: a Transmitter unit and a Receiver unit. Most of the electronics—including the power supply, intra-sensor communication (RS-485), and external communication interfaces (RS-232/RS-485)—are housed within the transmitter control box.

### 3.4 What Is A Transmissometer?

A transmissometer is an instrument for measuring the extinction coefficient of the atmosphere, and for the determination of visual range. It operates by sending a narrow, collimated beam of light through the propagation medium. A narrow field of view receiver at the designated measurement distance determines how much energy is arriving at the detector and determines the path transmission and/or extinction coefficient. Atmospheric extinction is wavelength dependent phenomenon, but the most common wavelength in use for transmissometers is 550 nm, which is right in the middle of the visible waveband and allows a good approximation of visual range.

Transmissometers are sometimes referred to as tele photometers, transmittance meters, or haze meters.

A transmissometer measures atmospheric transmittance between the light transmitter and the light receiver. It makes measurement of the mean atmospheric transmittance including both scattering and absorption contributions to the extinction coefficient according to the Beer Lambert Law. Given a variable value of T in the range 0.000 to 0.9990, visibility is calculated according to Koschmeiders Law according to the following relationship. This is based on the reduction of apparent contrast of a white and black object to a given ratio,

$$MOR = \frac{B \log(C)}{\log(T)}$$

where

MOR = the optical range in meters

B = baseline length in meters which is set at 30 m

T is the transmittance 0.0 to 0.999

C is the contrast ratio: 0.05

and log() is the logarithm

The 8400-eMOR uses a 24-bit analog to digital converter and with this very high resolution has standardized on a 30 m baseline. Although other baselines are available based on local requirements.

Transmission	MOR (m)
0.995	17929
0.99	8942
0.98	4449
0.97	2951
0.96	2202
0.95	1752
0.94	1452
0.93	1238
0.92	1078
0.91	953
0.9	853
0.89	771
0.88	703
0.87	645
0.86	596

0.85	553
0.84	515
0.83	482
0.82	453
0.5	130

**Table 1. Transmissometer MOR Calculated for a 30 m Baseline**

The target visibility (usually >10000 m) is used to calculate the reference value of the transmission when calibrating the Transmissometer. The calibration constants of the sensor are set based on this reference value.

### 3.5 What Is A Forward-Scatter Visibility Sensor?

A forward-scatter Visibility sensor measures atmospheric scattering coefficient using a light transmitter and the light receiver aligned so that the mean scattering angle is 42 degrees. It uses the scattering coefficient to estimate the extinction coefficient, and from the extinction coefficient the visibility can easily be calculated using the following expression.

$$v = 3/\sigma$$

where V is the visibility and  $\sigma$  is the extinction coefficient.

This is based on a contrast ratio of 5%. The MOR calculated from the above expression is as per the following table:



**Figure 4.** M482306-00 PW/Visibility Sensor

$\sigma$	MOR (m)
0.000167	17929
0.000335	8942
0.000674	4449
0.001017	2951
0.001362	2202
0.001712	1752
0.002066	1452

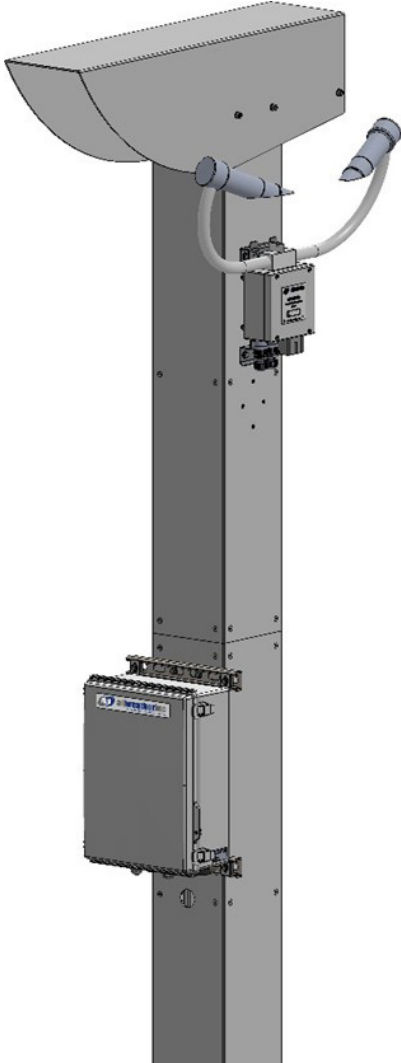
$\sigma$	MOR (m)
0.002423	1238
0.002783	1078
0.003148	953
0.003517	853
0.003891	771
0.004267	703
0.004651	645
0.005034	596
0.005425	553
0.005825	515
0.006224	482
0.006623	453
0.007042	426

**Table 2. Forward-Scatter MOR**

When calibrating the forward-scatter sensor, a standard calibrator is used to provide the reference value of scattering coefficient. The calibration constants of the sensor are set according to this.

### 3.6 What Is EMOR Technology?

The latest generation of Transmissometer technology uses a co-located forward-scatter visibility sensor on the transmitter unit to allow for higher accuracies over an Extended Meteorological Optical Range or eMOR. The accuracy of Transmissometer technology drops off for visibilities above 10,000 meters, and forward-scatter visibility sensor technology is more accurate at these higher visibilities. The co-location of the two sensors allows for the most accurate technology to be used when reporting on current visibility. The forward-scatter sensor enables auto-calibration of the Transmissometer.



**Figure 5.** 8400-eMOR Showing Both Methods of Visibility Measurement

### 3.7 Sensor Physical Description

The following information describes the various physical parts of the Transmissometer.

#### 3.7.1 Site Design

Figure 6 shows the typical site layout. The surface must be level between the Transmitter and Receiver poles.

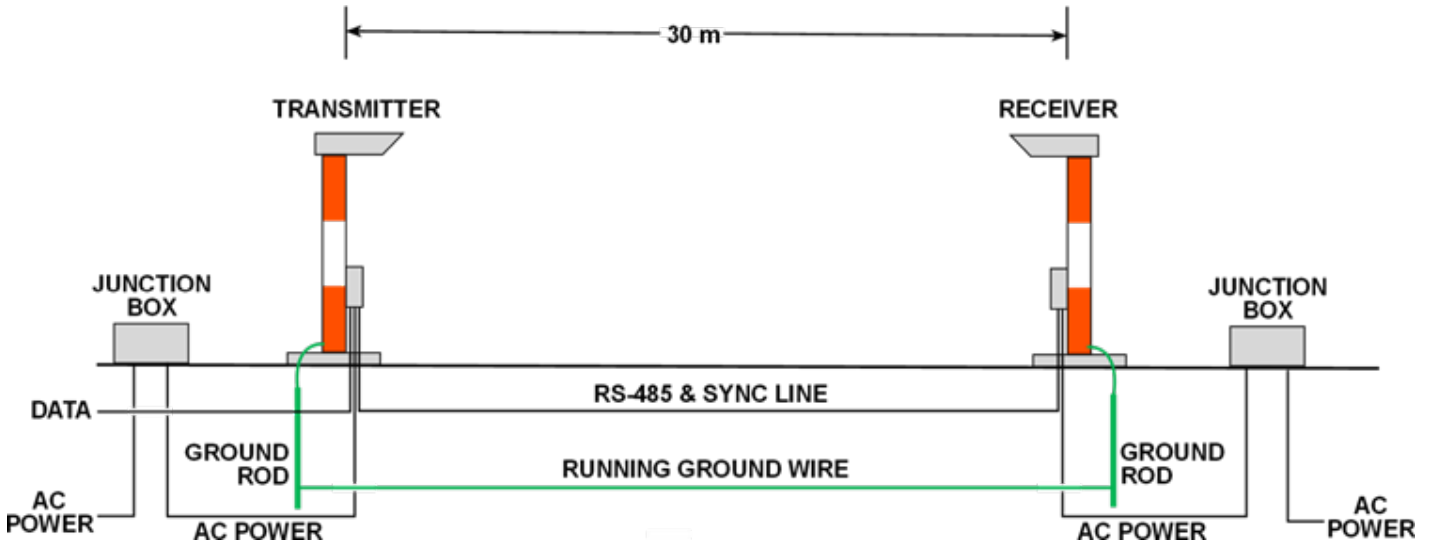


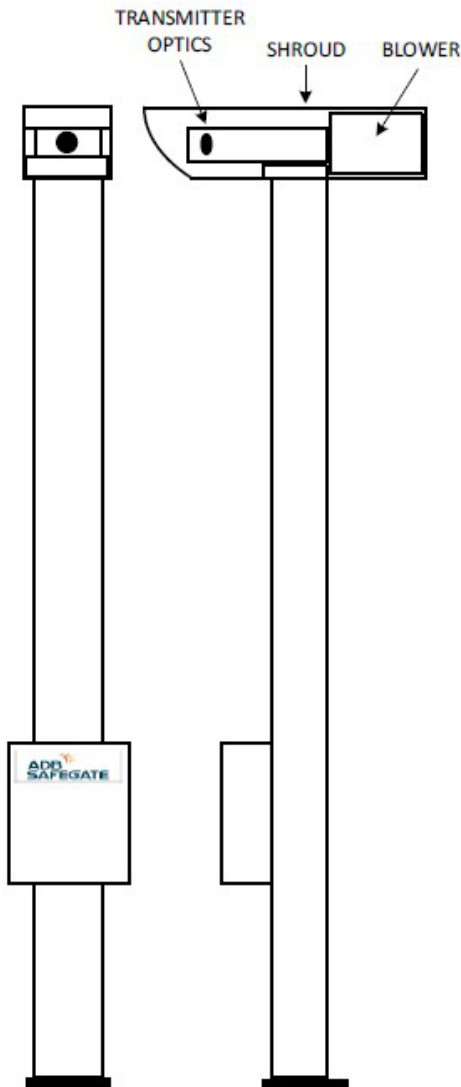
Figure 6. Typical Site Layout

The 8400-eMOR is designed to accept AC power at both the Transmitter and Receiver units. Depending on site requirements, the installer can supply AC power to either unit, to both units independently, or to one unit with an internal AC power line running between the transmitter and receiver to supply the other side. This flexible design allows for convenient installation in a variety of field configurations.

### 3.7.2 Transmitter Unit

The Transmitter incorporates an RVR system controller in the Control box and the Transmitter Optics head. The light source is an ultra high-intensity white LED array coupled via a condenser lens and projection lens into a tight beam with a divergence of approximately a half angle of 1 degree, this increases the signal level at the Receiver end, but also reduces scattering within the beam as required by ICAO Doc 9328.

The light level is measured using a photopic corrected silicon sensor, an ambient light compensation circuit and microprocessor controlled 24-bit analog to digital converter. The beam focuses an image of the LED die very close to the source so the incident light at the plane of the receiving lens is very diffuse. The diameter of the light beam at the Receiver is approximately 1200 mm.



**Figure 7. Transmitter Pole**

#### 3.7.2.1 Transmitter Support Structure

The transmitter mounting pole features a dual support structure for enhanced stability and precision. The inner structure securely holds the transmitter optics assembly, while the outer structure supports the blower/heater unit and helps shield the inner structure from wind-induced vibrations and thermal effects.

The entire assembly is mounted to the foundation using frangible anchor bolts, ensuring the structure will safely break away if struck, in compliance with airport safety standards. Cables are routed internally through the support structure, entering below the enclosure for protection and a clean installation.

### 3.7.2.2 Transmitter Control Box

All power and communications come into the Transmitter control box. Seven cables enter the Transmitter control box.

1. Main power supply, routed from the main circuit breaker panel via a junction box.
2. Jumper-selected RS-232/RS-485 interface to data collection and display.
3. RS-485 data lines to Transmitter head and to Receiver head.
4. Differential twisted pair synchronization lines to Transmitter head and to Receiver head.
5. RS-232 connection to Transmitter head via RJ-45 jack in Transmitter control box for technician access to Transmitter head, Visibility sensor, or Background Luminance Sensor.

Figure 6 Shows a typical site layout for these cables.

A ground wire connection to a ground rod protects against transient events. The Transmitter and Receiver ground rods are tied together so that the potentials of the support structures are kept close during transient events.

The RS-485 interface card has surge protection on the lines and the bus is monitored. LEDs on the PCB show power, RS-485 data, and synchronization status.

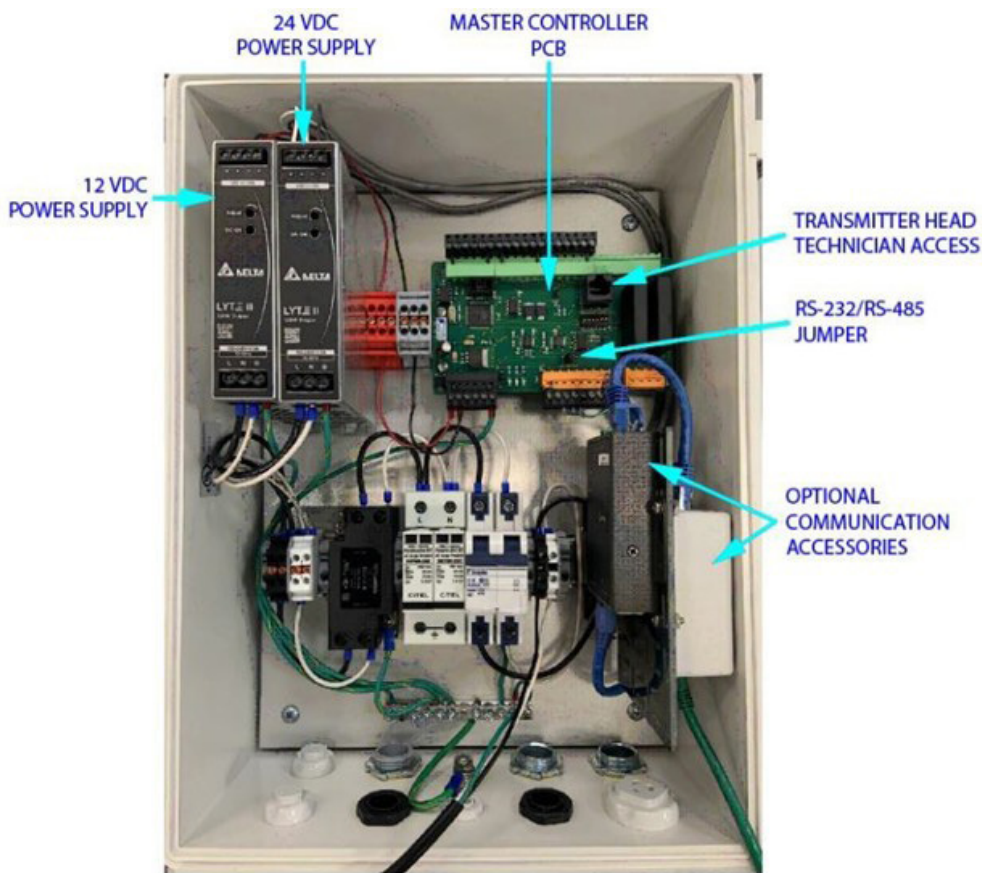
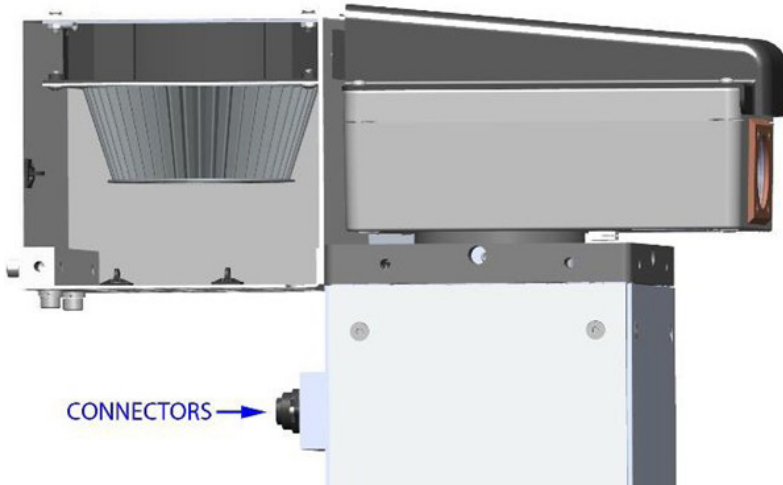


Figure 8. Transmitter Master Control Box

### 3.7.2.3 Blower Assembly

Power to the blower provided by a cable that is routed from the bottom of the blower assembly to a power connector near the top of the pole. Power and signal cables run from the control box to these connectors.

Air from the blower is directed through a hood over the optics assembly shown in Figure 9.

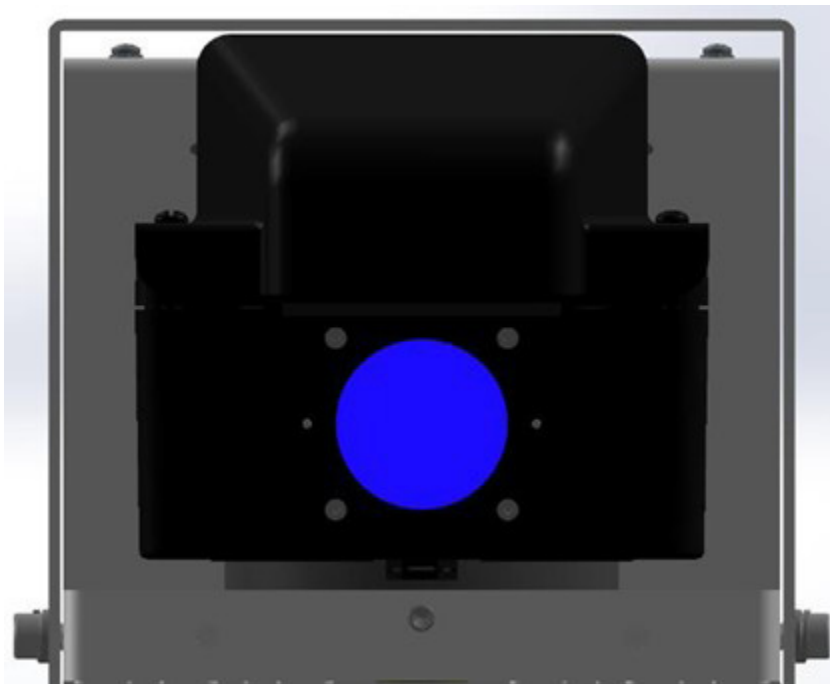


**Figure 9. Blower Assembly**

120 VAC and 240 VAC versions of the blower are available for the respective 8400-eMOR transmissometer models.

### 3.7.2.4 Optics Head

The optics head is connected to the control box by a cable that runs up the middle of the support structure. The connectors for the Transmitter and Receiver are different so they cannot be interchanged.



**Figure 10. Optics Enclosure Inside Hood, Front view**

The windows on both optics heads have continuous blowers to prevent window contamination under any combination of temperature and dew point.

Both optics have internal heating to keep the bottom plate and window at 50°C. This prevents any condensation on the lenses under any combination of temperature and dew point.

### 3.7.2.5 Co-Located Forward Scatter Visibility Sensor

The M482306-00 Visibility sensor is mounted on one of the sides or the back of the Transmitter pole. Power and RS-232 data connections are made into the Transmitter Control via Power and Data connectors on the back of the pole below the hood. The visibility output is averaged over 60 seconds and extends the visibility measurements over a range of 10 to 80 km to complement the ranges below 10 km that are best reported by the Transmissometer.



**Figure 11.** M482306-00 Visibility Sensor

### 3.7.3 Receiver Unit

The Receiver has a receiver Optics head. The light level is measured using a photopic corrected silicon sensor, an ambient light compensation circuit, and microprocessor controlled 24-bit analog to digital converter.

#### 3.7.3.1 Receiver Support Structure

The receiver support structure features a dual design for optimal stability and performance. The inner structure securely holds the receiver optics assembly, while the outer structure supports the blower/heater unit and shields the inner structure from wind-induced vibrations and thermal effects.

The assembly is mounted to a robust baseplate using stainless steel bolts. Frangibility is provided by the design and mounting method, ensuring the structure will safely break away if impacted.

All cables are routed internally through the support structure, entering below the enclosure for protection and a clean installation.

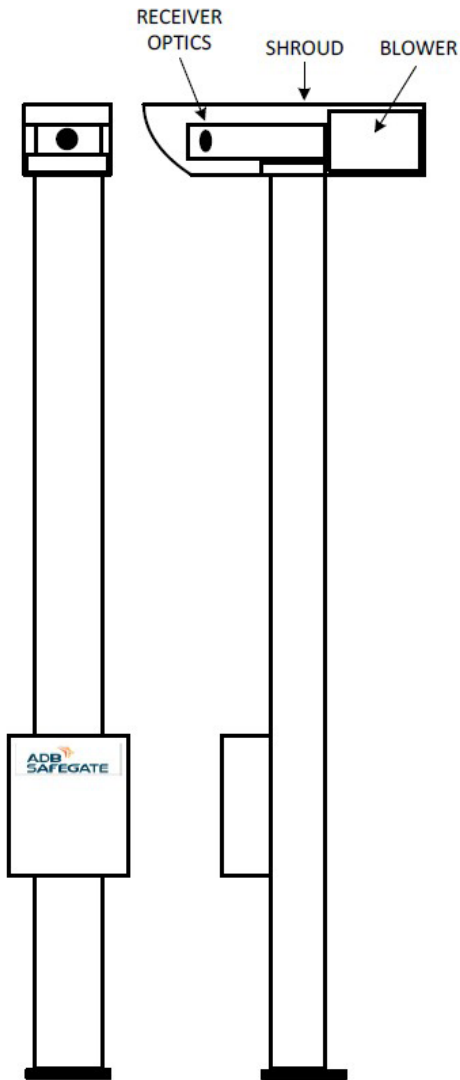


Figure 12. Receiver Pole

### 3.7.3.2 Receiver Control Box

Four cables enter or pass through the Receiver control box.

1. Power supply, routed from the main circuit breaker panel via a junction box.
2. RS-485 data lines to Transmitter head and to Receiver head.
3. Differential twisted pair synchronization lines to Transmitter head and to Receiver head.
4. RS-232 connection to Receiver head via RJ-45 jack in Receiver control box for technician access to Receiver head.

Figure 6 Shows a typical site layout for these cables.

A ground wire connection to a ground rod protects against transient events. The Transmitter and Receiver ground rods are tied together so that the potentials of the support structures are kept close during transient events.

The RS-485 interface card has surge protection on the lines and the bus is monitored. LEDs on the PCB show power, RS-485 data, and synchronization status.

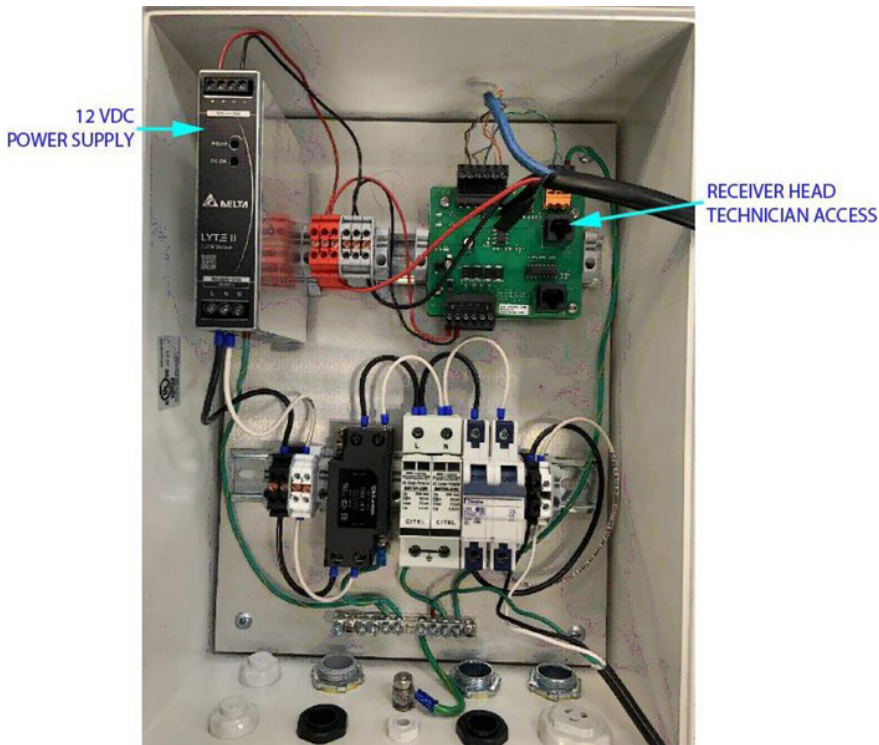


Figure 13. Receiver Control Box

## 3.8 Principle Of Operation

This section describes the internal workings and the theory behind the operation of the Transmissometer.

### 3.8.1 Meteorological Optical Range (MOR) Calculation Principle

The Transmitter head sends out and measures white light pulses, the Receiver head receives and measures the same pulses. The measurements are analyzed on the Main Control Board, which calculates the ratio of received light to transmitted light and normalizes this ratio according to compensation and calibration constants stored in non-volatile memory.

MOR is calculated according to Koschmieder's Law using a contrast ratio of 5%. The MOR is reported every 10 seconds.

### 3.8.2 Visibility Source Averaging

According to ICAO Annex 3, Appendix 3, 4.3.4, RVR and other sensor measurements are updated at least every 60 seconds, the 1-minute averaging period for transmissometers is in line with this requirement. Since the data are measured every 10 seconds, a FIFO stack of six values is averaged to provide the reported value. This averaging minimizes any sudden discontinuity caused by differences in readings between the Visibility sensor and the Transmissometer at the changeover point.

### 3.8.3 Calibration

The Transmissometer calibration is done using the co-located Visibility sensor.

Given an estimate of RVR, say 8000 m, the user issues the command DO CAL 8000 to the Main Control Board. The sensor then calculates and stores the required constants and reports the data in a message stream to the user.

#### 3.8.3.1 Auto-Calibration Control

There is an auto-calibration whereby the system will calibrate the light source when a homogeneous high-visibility condition is identified. The routine takes the MOR measurement from the Visibility sensor and applies this to the current light level of the Transmissometer as its basis for high visibility.

#### 3.8.3.2 Limit Auto-Calibration

Auto-calibration is an automatic adjustment used inside the system to ensure that the transmission value cannot exceed 0.998. The auto-calibration function adjusts the transmission value down until it is less than 0.999 if a high value persists for more than 10 seconds. This is achieved by decrementing the calibration constant.

### 3.8.4 Operating Point Stabilization

The ambient light compensation circuit is enabled whenever the light pulse is off. This stores a compensation signal to oppose the DC component of the sensor current. In this way the sensors can operate over a wide range of ambient light conditions from total darkness to bright sunlight within the field of view of the sensors. The sensors linearity is specified to be better than 1% over 9 orders of magnitude, but the controller also regulates a bias light source to keep the operating point of the sensor the same in both day and night conditions.

### 3.8.5 Transmission Measurement Cycle

The source unit controls the measurement cycle. The source transmits the character @ on the RS-485 bus 50 ms before the beginning of each measurement cycle to signal the receivers to scan for light pulses. Then the source transmits a series of light pulses, with periods of no light between each light pulse. The pulse train takes approximately 600 ms to complete. Both the source and the receiver measure intensity of the light pulses and zero signal levels, then subtract the light from the dark level. The values are averaged at the end of the scan.

At the completion of the scan, the source microprocessor reports the Transmit light level to the sensor controller and polls all the devices on the RS-485 bus in turn over the next 400 ms.

The system controller responds to the @ signal by resetting all 1 second values to the over-scale value and listens for the data from the source and receiver.

Neither the sensor controller nor the source controller sends any polls out during the measurement cycle; there are no serial interrupts to disturb the timing of the measurement cycle.

### 3.8.6 BITE Tests

Each of the microprocessors checks its operation at start up. These checks are done.

- RAM test
- EEPROM checksum
- Identity check

The outcome of each BITE check is reported on the RS-485 bus like this.

**RVR TX V2.1 OK**

or

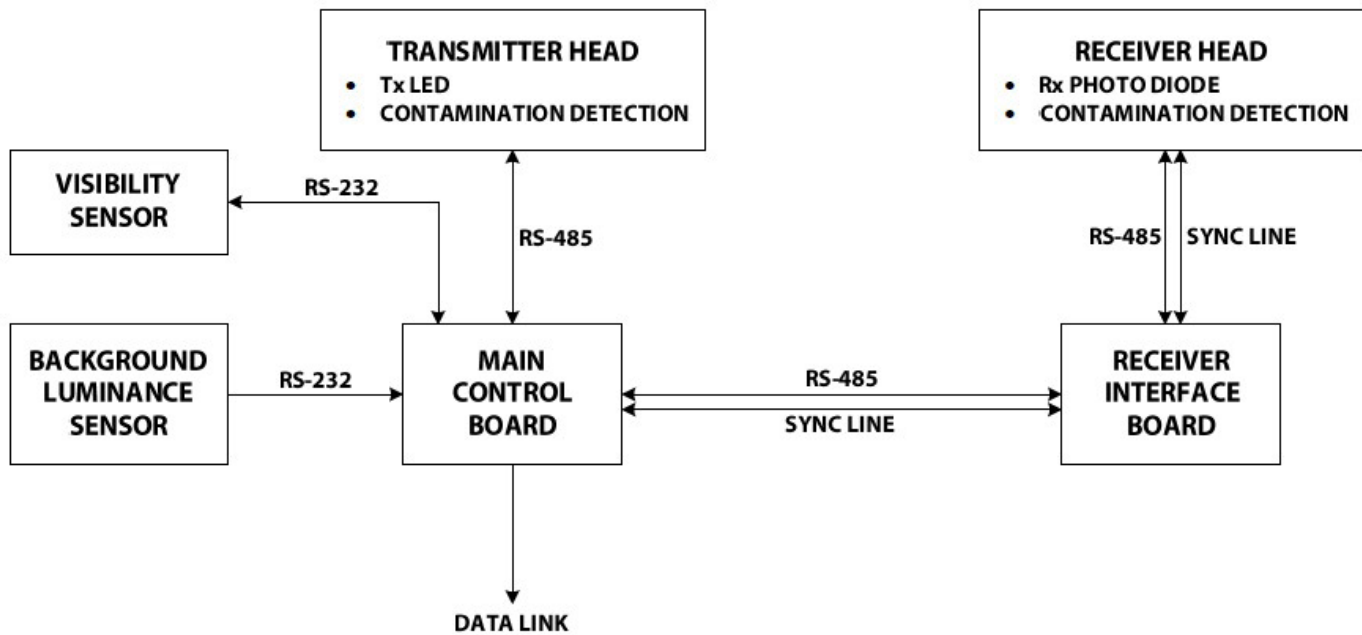
**RVR TX V2.1 NOK**

During operation, each microprocessors BITE checks to ensure operation is normal. The failure of a test will invalidate the data output by transmission of an overscale value and or the indication of the fault in the status message.

### 3.8.7 RS-485 Data and Synchronization Buses

The Transmitter, Main Control Board, and the Receiver are connected by an RS-485 bus. Data messages are transmitted at a baud rate of 4800 bps.

The Transmitter polls devices connected to the bus. The controller listens to the responses, processes them, and sends the result on the data link.



**Figure 14. RS-485 Data Bus and Twisted-Pair Sync Line**

The Transmitter, Main Control Board, and the Receiver are also connected by a twisted pair synchronization line. This synchronization signal ensures the receiver measures the light pulse level and the “dark” levels exactly at the time the light pulses are sent by the Transmitter. The receiver will not respond to polls unless the synchronization pulses are received. The synchronization receiver is opto-isolated.

#### 3.8.7.1 RS-485 Data Bus Messages

The Transmissometer operation is simple in principle but requires faultless operation of the synchronization line and the RS-485 data bus, which acts as a simple Controller Area Network. The microprocessor on the Control Board is synchronized at first by the @ message and the Receiver scans for the synchronization pulses from the Transmitter head microprocessor. After the scan of light pulses during the first 600 ms of the cycle, the sequence of polls and responses allows the Control Board to gather data from all devices in the system. The data flows on the RS- 485 data bus can be viewed using the **\$RS485** command during setup or troubleshooting.

Table 3 provides the key to the messages on the RS-485 bus.

Message	From	To	Purpose
@	Source Optical Unit	Controller and Receivers	Marks the start of a measurement cycle
#T:xxxxx	Source Optical Unit	Controller	Source Signal Level
?R	Source Optical Unit	Receiver 1	Received Signal Level Request
#R:xxxxx	Receiver 1	Controller	Received Signal Level Value
*T:xxxxx	Source Optical Unit	Controller	Source Status Message
*R:xxxxx	Receiver Optical Unit	Controller	Receiver Status Message
#R	Controller	All	Reset, issued in response to the \$RESET command.

? is the message prefix for a poll of a device

# is the prefix for a response

@ is the cycle start prefix

### Table 3. RS-485 Bus Messages

#### 3.8.8 Measurement Technique

The LED light pulse is measured 36 times a second and the no pulse condition is measured and subtracted from the light signal. The measurement cycle takes 10 seconds. The measurement consists of the average of 360 measurements of the light intensity which results in an increase in signal to noise ratio compared with a single pulse by a factor of about 20. Standard deviation of the measurement of as low as 0.1% of reading has been measured.

The light source of the 8400-eMOR Transmissometer is a high intensity LED. The LED produces pulses of light with a spectrum covering the wavelengths of both natural sunlight and runway lights.

##### 3.8.8.1 LED Spectral Characteristics

The 8400-eMOR LED fires 36 pulses of light each second and a sample of each pulse is measured by a photodiode in the Transmitter unit. The actual intensity of each pulse of light is measured digitally and averaged. The transmitted light is split, and part is reflected onto a silicon photodiode for intensity measurement. The response of the photodiode is corrected to the photopic response curve to match the sensitivity characteristics of the human eye.

The light is focused into a narrow beam, which is directed towards the Receiver unit. The received light is focused on a silicon photodiode for intensity measurement. The response of the photodiode is corrected to the photopic response curve to match the sensitivity characteristics of the human eye.

Figure 15 shows the typical LED spectral characteristics.

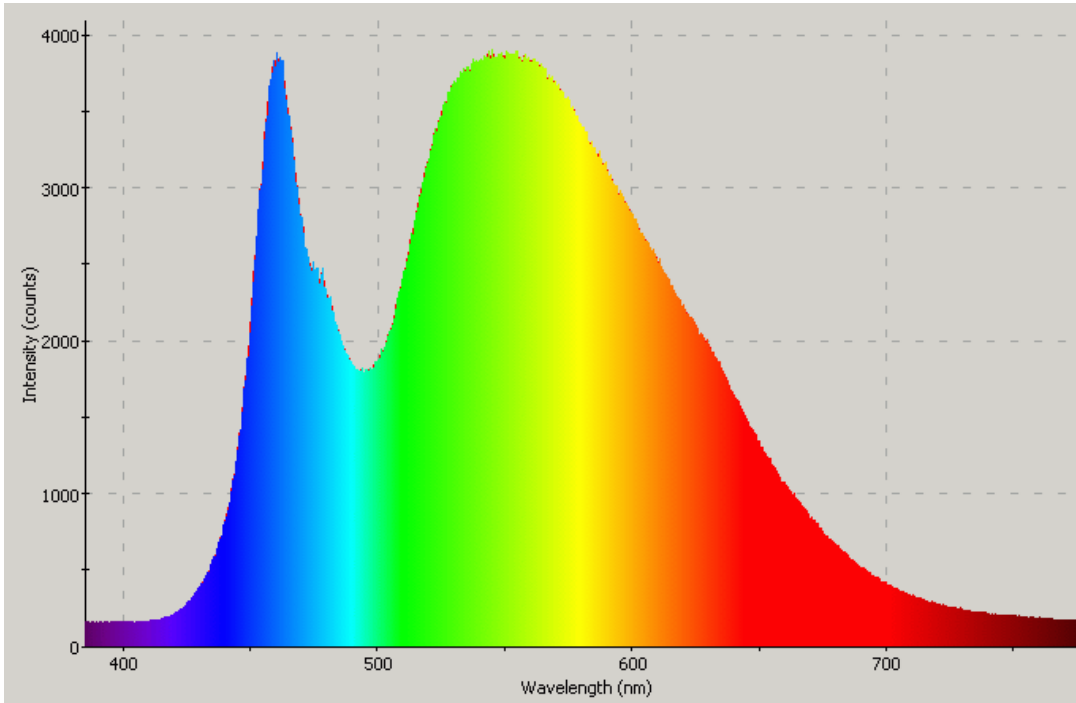


Figure 15. Typical Spectral Characteristics for LED Light Source

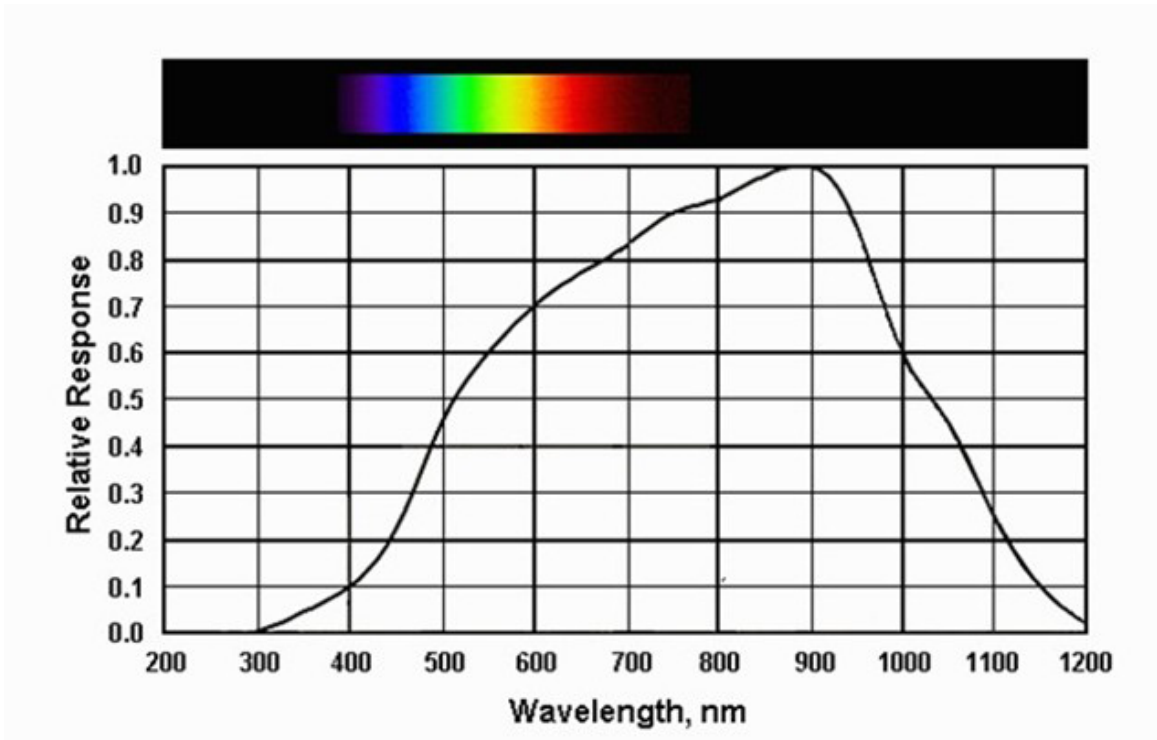


Figure 16. Spectral Response Graph for Silicon Photodiode

Figure 17 shows a typical photopic filter spectral response.

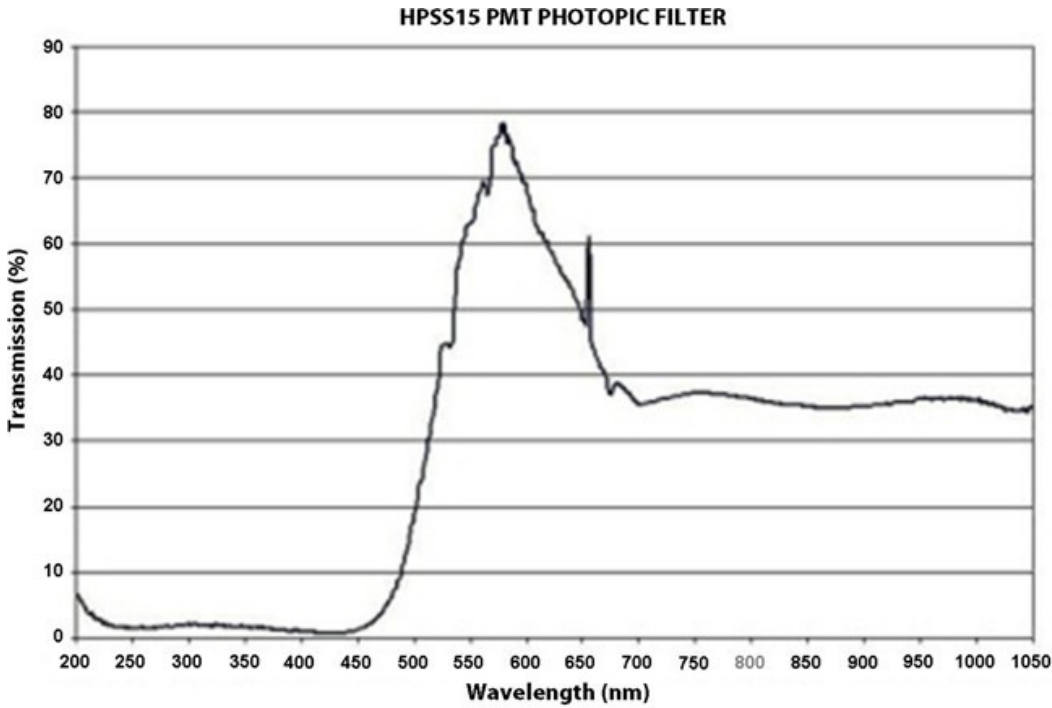


Figure 17. Typical Photopic Filter Spectral Response

Figure 18 shows the typical photopic response of a human eye.

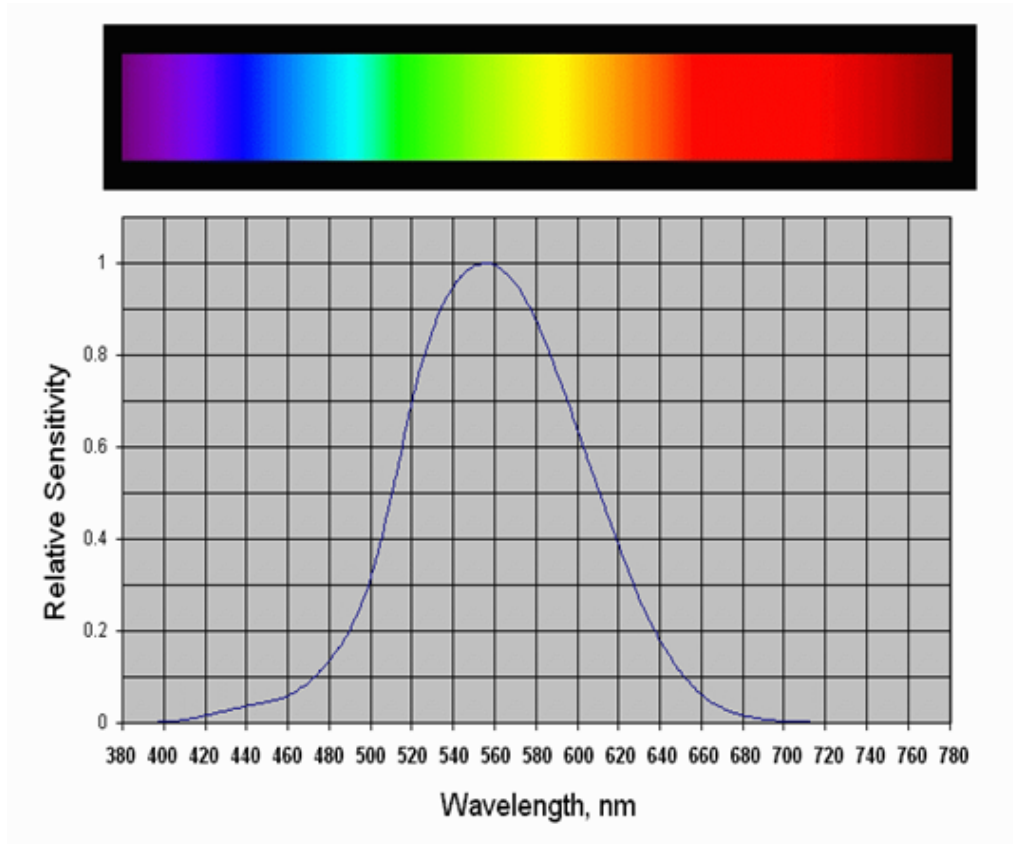


Figure 18. Typical Photopic Response of Human Eye

### 3.8.8.2 Photodiode Lambda Correction Characteristics

The measured intensity is digitized in a 24-bit analog to digital converter, and the result is sent to the Main Control Board for further processing. The LED and sensors at the transmitter and receiver are maintained at the same constant temperature to ensure accurate readings. The LED is driven by a constant-current pulse circuit and the level of current is controlled by the microprocessor.

The 8400-eMOR calculates transmittance as the ratio of received intensity to the transmitted intensity. The aging of the LED is thus compensated automatically.

The intensity of the LED source is monitored, and the current is adjusted to maintain a constant intensity.

If the current required from the LED exceeds the preset limit, there is a flag set to signal end of LED life, however the Transmissometer will continue to operate for some weeks or months under these circumstances.

### 3.8.9 Automatic Measurement Source Selection Methodology

The 8400-eMOR has been designed to use both the accuracy of the measurement of the Transmissometer at low visibilities and the accuracy of the measurement of the co-located Visibility sensor at higher visibilities. Other advantages of this system are that each sensor provides an automatic backup should either be under maintenance or have a failure. The co-located Visibility sensor provides a reference measurement of visibility for the automatic calibration of the Transmissometer during times of high visibility. Figure 19 shows the relationship of the two functionally separate but overlying measurement systems. VRP, the Visibility Reporting Threshold, can be set as described below to be only the Visibility sensor, only the Transmissometer, or a combination with the switch between them occurring at a selected MOR.

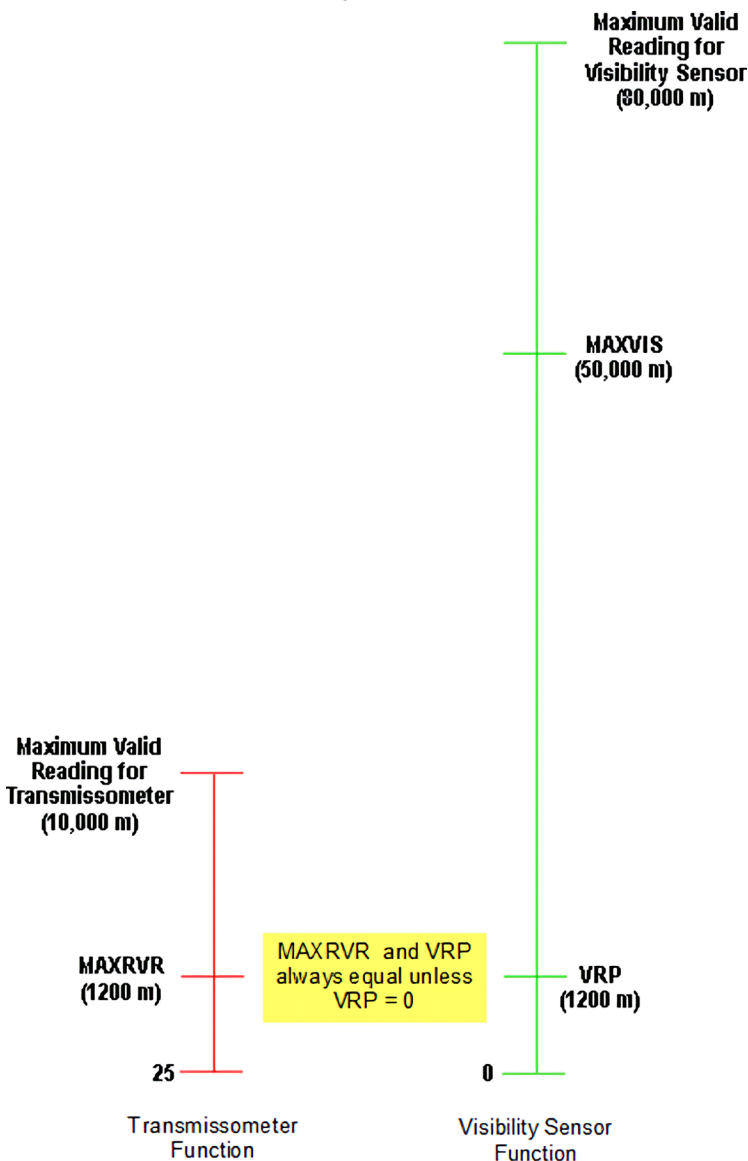


Figure 19. Relationship Between Transmissometer and Visibility Sensor

### 3.8.9.1 Set VRP Visibility Report Parameter and Maximum/Minimum MOR Limits

The MOR reported is chosen with reference to VRP, the Visibility Report Parameter, in meters. VRP can be set to any value in the range 0–10000 m using the **SET VRP** command.

For example,

**SET VRP 1000**

will result in the reporting of MOR from the Visibility sensor when the MOR is above 1000 m and from the Transmissometer when the MOR is less than 1000 m.

If VRP is set to 0, only the MOR from the forward scatter Visibility sensor is reported. If VRP is set to 10000, only the MOR from the Transmissometer is reported.

The default setting for VRP is 3000 m.

To change VRP, access the serial port on the Main Control Board as described in Chapter 5.5, then enter a command such as:

**SET VRP 2000**

To enable MOR from only the Visibility sensor, enter the command:

**SET VRP 0**

Two other MOR parameters are set.

- **MAXVIS** is the maximum MOR reported from the Visibility sensor operating on its own, 10000–80000 m. For example, to set the default of 50,000 m, use the command **SET MAXVIS**.
- **SET MAXVIS 50000**
- **MAXRVR** is the maximum MOR reported from the Transmissometer operating on its own, 2000–10000 m. For example, to set the default of 3000 m, use the command **SET MAXRVR**.
- **SET MAXRVR 3000**

These parameters are stored in nonvolatile memory at the Main Control Board.

The set value can be displayed using the **\$PARAM** command.

### 3.8.9.2 Working With Automatic Measurement Source Selection

The **MAXRVR** value for MOR will always be equal to the Visibility Reporting Threshold (**VRP**) value (unless **VRP** is set to 0). This is because the **VRP** value is required to allow the continuation of the measurement into the range of the Visibility sensor after **MAXRVR** is reached. The requirement of the equality of these two settings is enforced in the firmware. When either **MAXRVR** or **VRP** is changed, the firmware will check that the requested values are in line with each other and adjust automatically to conform with the rule.

In the case that **VRP** is set to 0, then the co-located Visibility sensor will be used over its full range (0–**MAXVIS**) and the Transmissometer reading will be ignored. This can be useful during unserviceability of the Transmissometer or during maintenance operations. Additionally, the co-located Visibility sensor can be removed from the MOR message report by setting **MAXVIS** equal to **MAXRVR**.

VRP	MOR Report
0	Visibility Sensor only
0–10000	Visibility Sensor if MOR > VRP Transmissometer if MOR < VRP
10000	Transmissometer only

**Table 4. MOR Source Based on VRP**

### 3.8.9.3 Modalities for Failover and Redundancy

The 8400-eMOR has been designed to react and recover from failure gracefully and automatically. The sensor will conform to a set of rules to ensure that the Control Board will always use the most appropriate of the two sensor technologies for a given automatic or degraded operational scenario. Table 5 outlines the relationships between the serviceability of the two MOR sensing technologies and resultant visibility data output by the Main Control Board.

Transmissometer	MOR Reported	MOR Reading	Forward Scatter Visibility Sensor	MOR Reported	MOR Reading
Serviceable	Yes	0-MAXRVR	Serviceable	Yes	VRP – MAXVIS
Serviceable	Yes	0-MAXRVR	Unserviceable	No	80001
Unserviceable	No	00000	Serviceable	Yes	0-MAXVIS
Unserviceable	Yes	00000	Unserviceable	No	80001

**Table 5. Service ability Relationships Between MOR Technologies**

The system ensures that any erroneous data will not be used in the message outputs in the event of failure of either technology. In the event of both technologies failing, the sensor will report “00000” reading for MOR, which is a failsafe. The sensor will not report a high MOR reading in any failure state.

The reported error condition for the Transmissometer (00000) and for the Forward Scatter Visibility Sensor (80001) represent the extremes of the full range of the device.

## 4. Installation

### 4.1 Planning The Installation

The installation of MOR/RVR systems requires careful planning and attention to detail. Some degree of customization is necessary for every site, as site conditions do vary widely and different combinations of ground conditions, power, communications option selected and local electrical standards make it difficult to design a standard installation. The installation procedure outlined covers most encountered scenarios during the installation of the standard sensor.

Select the number of MOR/RVR sensors need based on the airport category (Section 1.3).



---

**CAUTION**

The 8400-eMOR must have clear line of sight between the Transmitter and the Receiver.

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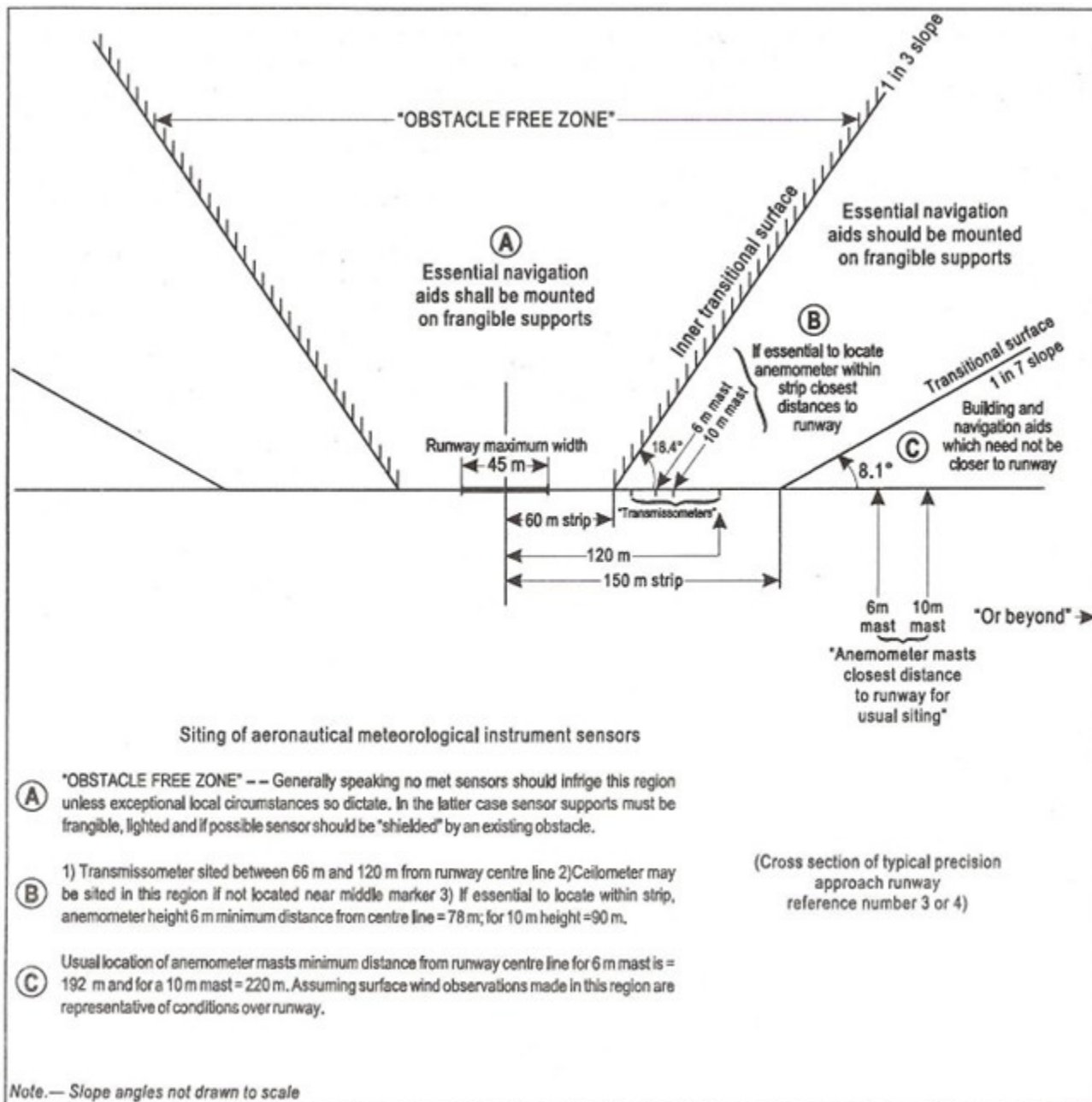
### 4.2 Frangibility

The sensor mast features a dual support structure for enhanced stability and precision. The inner structure securely holds the sensor assembly, while the outer structure supports auxiliary equipment and shields the inner structure from wind-induced vibrations and thermal effects.

Frangible bolts at the base ensure the mast will safely break away if struck, in compliance with airport safety standards.

### 4.3 Obstacle-Free Zones

According to ICAO Annex 14 and ICAO Doc 9328 the siting of devices relative to the obstacle-free zone and between transitional surfaces and the frangibility requirements are summarized in Figure 20.



**Figure 20. Siting Requirements**

The recommended distance range for the MOR sensor from the runway center-line is from 66 to 120 m. MOR sensors are typically 2.5 m above the ground and require special foundations.

Sometimes it is possible to place the MOR sensor close to an ILS glide path shelter or ILS Localizer shelter to save on power supply and communications cabling costs.

## 4.4 Interference Sources

The 8400-eMOR sensors must be installed with their baseline parallel to the runway. To avoid interference, the transmitter and receiver should not be aligned toward runway lights or the sun at any time of year. If direct sunlight is unavoidable at the receiver, the transmitter and receiver positions may be swapped, or the receiver can be tilted slightly downward to minimize solar interference.

The optional Background Luminance Sensor should be mounted on the MOR sensor support structure, oriented toward the north sky in the northern hemisphere or the south sky in the southern hemisphere, and inclined upward at an angle of approximately 10–15 degrees.

Additionally, sensors should not be installed near radar equipment or on the active side of ILS glide path antennas to prevent electromagnetic or radio frequency interference.

## 4.5 Power Supplies

The 8400-eMOR sensors operate from either 240 VAC or 120 VAC supplies, depending on the model selected. The power supply is cabled to a junction box located beside each Transmitter and Receiver pole. The wiring to this point and within the junction box should comply with local regulations.

The size of the junction boxes depends on the space needed to handle the size of cable used. The junction boxes need to be within 5 m of the sensor and elevated so as to avoid moisture ingress. A 10 A general-purpose outlet should be fitted in the junction boxes to allow power tools to be used during construction and servicing.



### **WARNING**

Ensure that the device is well grounded prior to initial operation and prior to each requirement for touching the device.

---



### **WARNING**

Operation of electrical devices in areas where flammable gases, fumes or explosive atmospheres poses a safety hazard. As the 8400-eMOR is an electrical device, it should not be operated in such an area.

---



### **WARNING**

Do not attempt service of the internal parts of the device unless there are suitably trained personnel on hand to render first aid should it be required.

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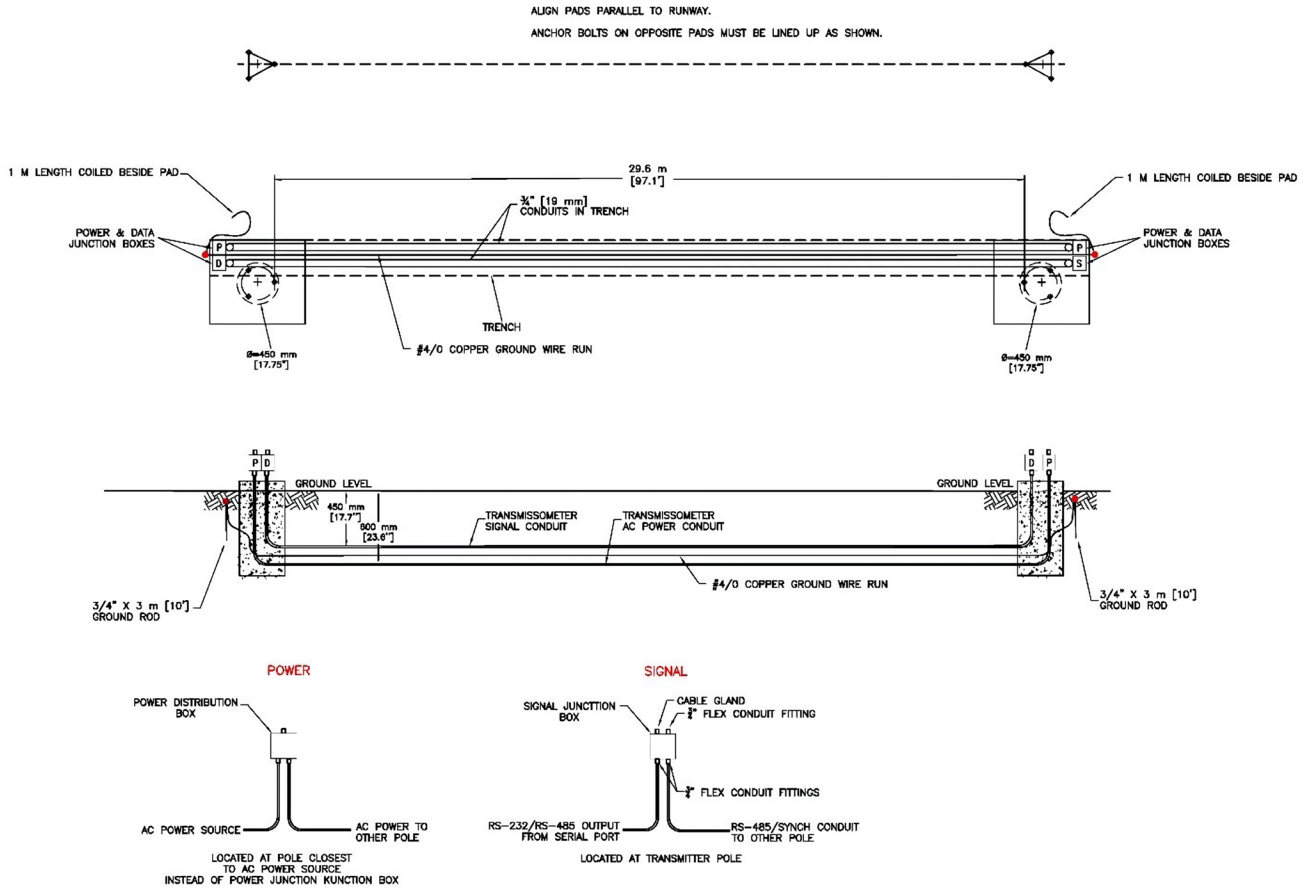
### **WARNING**

All power cables to the sensor should be disconnected and the residual power allowed to dissipate for a period of not less than 5 minutes prior to internal maintenance of the device.

---

## 4.6 Site Layout

The 8400-eMOR sensor site is laid out according to Figure 21.



**Figure 21. 8400-eMOR Site Layout, Trenching, and Grounding**

The performance of the measurement system depends on the alignment stability of the 8400-eMOR Transmitter and Receiver. The 8400-eMOR uses a standard 30 m baseline and requires two mounting pads. Other baselines are supported, but 30 m is the standard baseline.



**NOTE**

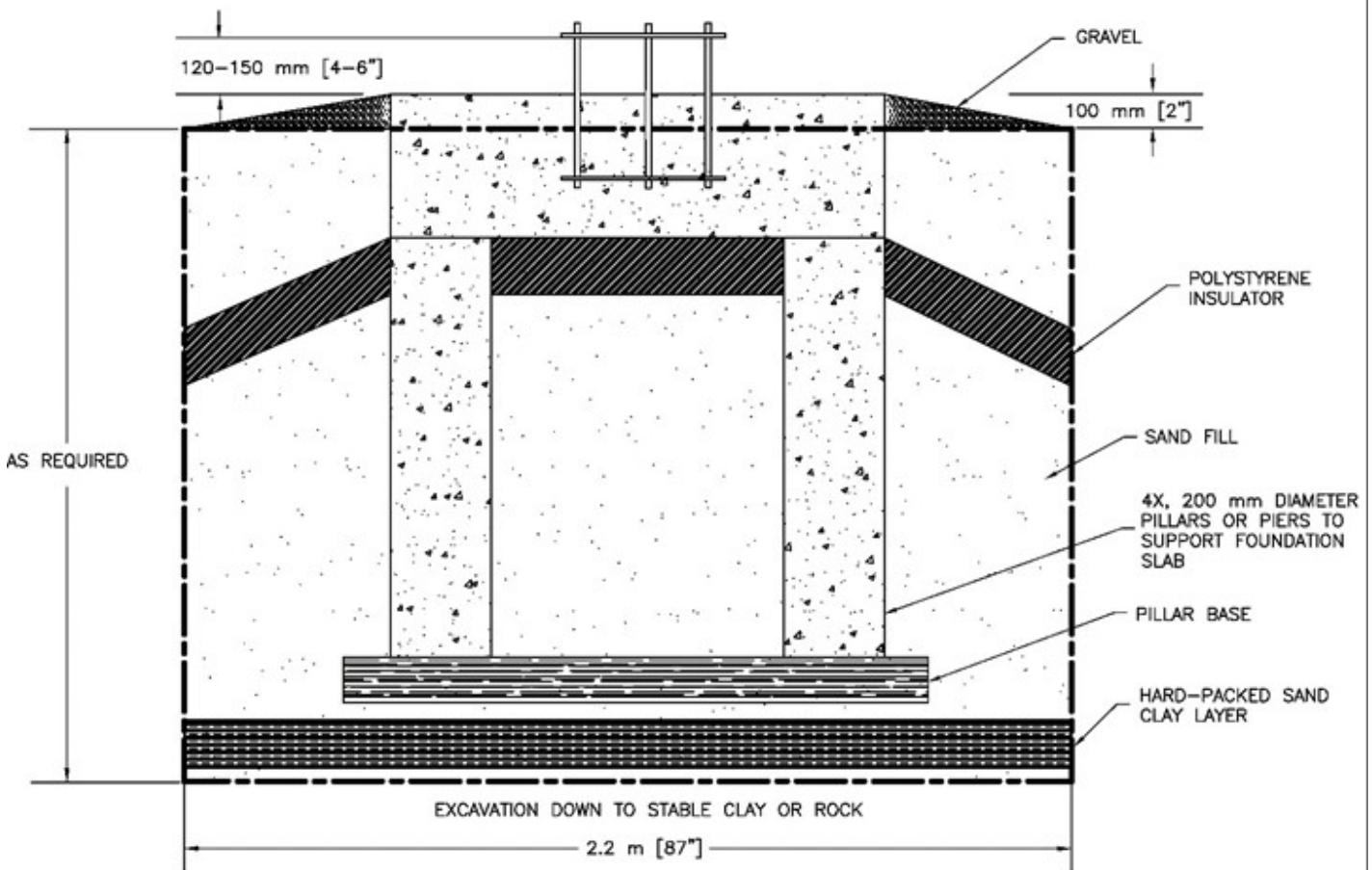
While the sensor can compensate for some movement in the position of the sensor, a large amount of movement is not possible to be compensated for and should be avoided.

## 4.7 Foundation

The choice of foundation design depends on the likelihood of frost and the need for a stable base. Stable soil may be well below the current soil level at locations with fill or reclaimed sites.

The foundation supports the reinforced concrete mounting pad. The mounting pad is on solid pillars that reach to a stable soil or rock layer. The pillars can be poured columns or concrete blocks laid on the stable base layer.

Figure 22 shows the foundation trench for the mounting pad and pillars at each pad. It includes a polystyrene insulator for locations subject to frost.



**Figure 22. Foundation Trench**

The base of the pillars should be on rock, or on a 300 mm layer of hard packed sand on the rock. The area surrounding the pillars should be filled with coarse sand up to the level of the concrete block. On no account should clays or dimensionally unstable material be in contact with the columns. Reinforcing rods cast into the foundation pillars are in turn cast into the mounting pad.

Frost-prone sites need a layer of polystyrene insulating material just below the natural soil surface level to prevent the stable base from being subject to freezing.



### CAUTION

Ensure that the foundation design is suitable for your location. Readings may drift over time as an improperly laid concrete block moves in unstable ground.

The complete foundation is then surrounded by sand, up to the level of the insulating layer. The insulating layer is then placed, with more sand placed on top. Finally, a layer of crushed rock is added to retard grass growth.

### 4.7.1 Soil Test

When designing a foundation, a qualified civil engineer needs to be consulted; soil tests performed, and foundation designs appropriate to different soil type requirements must be used. These considerations must be taken into account to maintain the accuracy of the 8400-eMOR data despite small movements of the foundation during initial settling of the fill and over the long term.

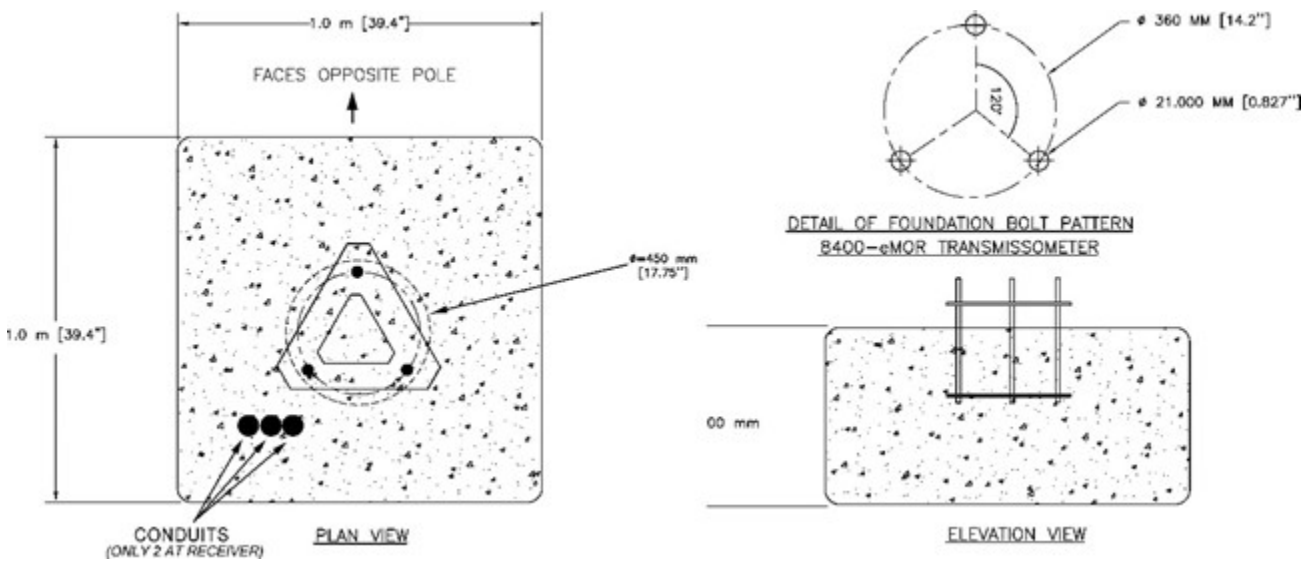


**NOTE**

Take into account year-round weather conditions at the site to ensure a proper site and foundation design.

### 4.7.2 Mounting Pads

Each concrete mounting pad is nominally 1 × 1 × 0.45 m and requires reinforcing and 0.5 m<sup>3</sup> of concrete. Anchor bolts are embedded in the concrete using the bolt cage in the M488504-00 Anchor bolt Installation Kit.



**Figure 23. Pad Foundations**



**NOTE**

A third conduit is only needed at the foundation pad that has the connection to the main power distribution at the site.

This mounting pad needs to be cast in place on a suitable foundation, which is designed based on the site soil conditions so that the block does not move from the dry season to the wet season and from winter to summer. Because of this, the foundation needs to be based on a stable base layer.

### 4.7.3 Aligning the Anchor Bolts

The 8400-eMOR poles are mounted on triangular base plates secured to the anchor bolts. The bolt pattern of the Transmitter and Receiver must be aligned according as shown in Figure 21. A string line should be used in conjunction with the M488504-00 cage kit for the anchor bolts to ensure precise alignment of both ends before pouring concrete.



#### NOTE

The alignment of the anchor bolts is crucial to correct installation of the sensor.

### 4.7.4 Concrete Placement

During concrete placement ensure the following:

- Plug conduits to prevent filling with concrete.
- Anchor bolts protrude 15 cm above the concrete
- Anchor bolt thread is not damaged, exposed threads are taped, or wet cement is brushed / washed out of the exposed threads.
- The concrete surface is 120–150 mm (4"–6") above the natural ground level and sloped away from the bolts to allow water to drain away.
- The concrete is allowed to cure after pouring in accordance with best practice.

### 4.7.5 Mounting Cage for Anchor Bolts

The mounting cage based on the anchor bolts and templates in the M488504-00 Anchor Bolt Installation Kit ensures that the anchor bolts are located correctly during or after the concrete placement. The mounting cage should be placed in position before the concrete is poured.

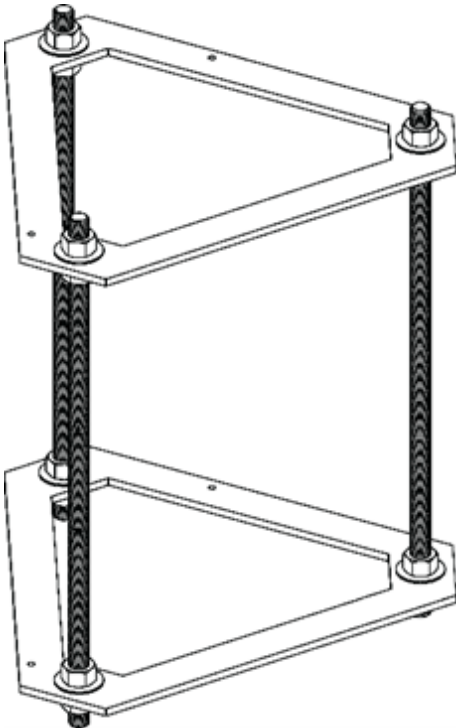


Figure 24. Anchor Bolt Mounting Cage

1. Assemble the anchor bolts and templates as shown.
2. Insert the mounting cage into the concrete as the concrete is poured,.



**NOTE**

Cover the anchor bolts that will extend above the concrete with plastic or plastic cling wrap to keep wet concrete from sticking in that area until the concrete sets.

3. Line up the bolt pattern on opposite pads as explained in Section 4.7.3 and shown in Figure 21.
4. Level the top template, which extends above the concrete base, with the tops of the anchor bolts 15 cm (6") above the concrete.
5. Remove the top template once the concrete sets. Set it aside for future use.
6. Use the leftover nuts and washers to mount the poles.

The top template may be used to check the alignment of anchor bolts that are already in the concrete pad.

#### **4.7.5.1 Concrete Poured Without Anchor Bolts in Place**

If the concrete pad has been poured without the mounting cage, or if there is an issue with the alignment, the template can be used to install new anchor bolts.

1. Cut off any existing misaligned anchor bolts.
2. Assemble the anchor bolts and templates as shown in Figure 24 without the bottom template.
3. Line up the bolt pattern on opposite pads as explained in Section 4.7.3 and shown in Figure 21.
4. Use the bottom template to mark where holes will be drilled for the anchor bolts.
5. The diameter of the holes to be drilled depends on the epoxy being used and is specified in the epoxy instructions based on the diameter of the anchor bolts. Make sure the holes are as vertical as possible while drilling them.
6. Inject epoxy into the holes.
7. Place the mounting cage into the holes without the bottom template.
8. Level the top template, which extends above the concrete base, with the tops of the anchor bolts 15 cm (6") above the concrete.
9. Remove the top template once the epoxy has cured. Set is aside for future use.
10. Use the leftover nuts and washers to mount the poles.

#### **4.7.6 Cable Conduits**

The following 21 mm (¾") cable conduits are required. They should be embedded in the concrete mounting pad at least 20 cm (8") outside the anchor bolt circle. The tops of the conduits should be about 25 cm (10") above the concrete.

- AC Power line to either the Transmitter or the Receiver mounting pad.
- AC Power supply between the Transmitter and Receiver mounting pads.
- Data signal line between the Transmitter and Receiver mounting pads.
- External data line to the Transmitter mounting pad.

## 4.8 Unloading And Unpacking

The 8400-eMOR is shipped in a single wooden container that contains the two poles, two electronic enclosures, hoods, head units, installation kit, accessories, calibration certificate and documentation.

Unpack the case at the installation site to minimize any damage to the support structures and equipment.

Check the crate for damage before opening it. If there is any damage, take photographs prior to opening to substantiate any claims.



**NOTE**

If possible store the original head packaging to allow the safe future shipment or storage of the devices.

---



**WARNING**

The side of the packing crate should not be penetrated with tools.

---



**WARNING**

Materials handling equipment should be used by properly trained personnel.

---



**WARNING**

Do not drop the measurement head units. Exercise caution when removing the device from packaging.

---



**CAUTION**

Avoid touching the windows on the front of the measurement unit.

---



**NOTE**

Retain all protective covers, foam inserts, protective caps, covers and place holders for future use.

---



**NOTE**

If obvious mishandling has occurred then immediately contact ADB Safegate.

---

### 4.8.1 Unpacking

Examine the crate for damage before unpacking it.



#### CAUTION

Note any intrusion into the case by forklifts or crushing of the outside of the wooden crate prior to opening. If there is noticeable damage take photos of the packaging in-situ and prior to opening the box.

1. Carefully remove the lid from the crate.
2. Remove the container that houses the optical assemblies.
3. Remove the hoods and place them in a safe place for later fitting.
4. Remove the wooden packing yoke from the poles.

### 4.8.2 Base Plate

The base plate used to attach the pole with the sensor is slotted to enable coarse alignment and tolerance for slight anchor bolt misalignment. Note the hole on one side where the ground lug will be attached during assembly.

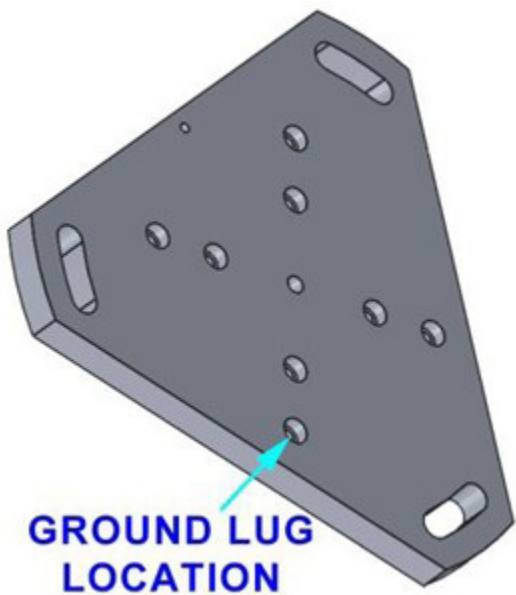


Figure 25. Base Plate

### 4.8.3 Mounting Poles

It is recommended that the poles be removed from the shipping crate using lifting gear, such as a forklift or a crane. Otherwise, at least two able-bodied persons are needed, subject to your local policies or health and safety regulations.

Ensure that all proper safety precautions are taken during the erection of the poles.



#### WARNING

Do not lean heavily on the support structure after fitting.



#### WARNING

The poles and the base plates are heavy. It is recommended that two persons share the weight during the installation process.



**WARNING**

Proper protective clothing such as steel-toes footwear should be worn during the installation.



**CAUTION**

Refer to your organization's occupational Health and Safety guidelines for the appropriate guidance on how to deal with the warning issues such as materials handling, lifting and protective equipment for personnel.

**4.8.4 Secure Poles to Anchor Bolts**

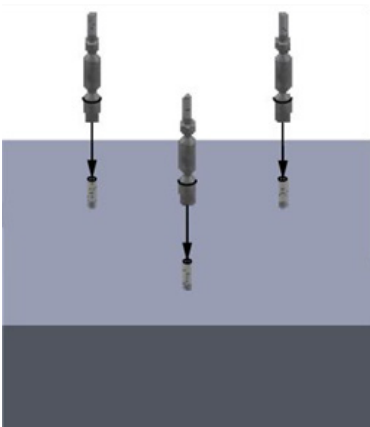
The poles are shipped from the factory with the base plate already attached to each pole.



**CAUTION**

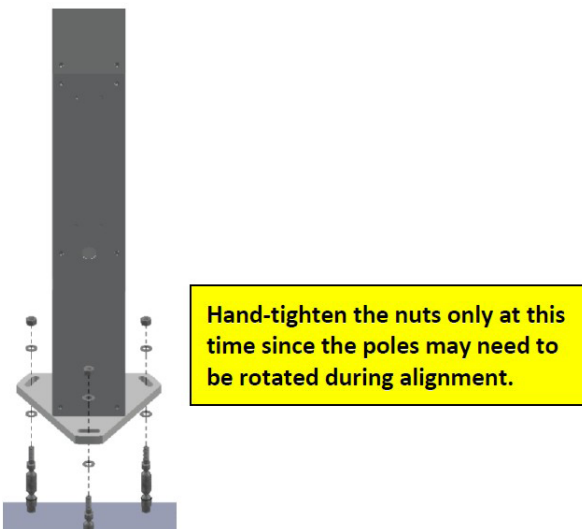
At least 2 people are required to lift the poles into place.

1. Install three frangible bolts from the M488512-00 Frangible Bolt Kit in each mounting pad.



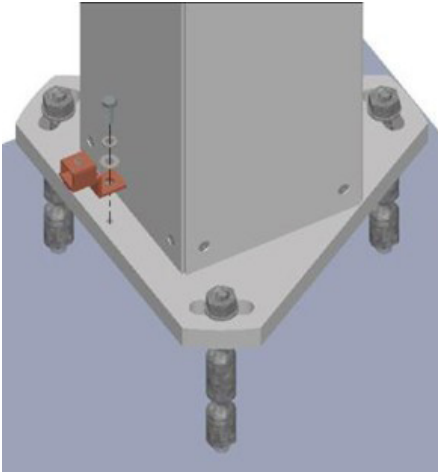
**Figure 26. Install Frangible Bolts (M488512-00 Frangible Bolt Kit)**

2. Use the nuts and washers from the M488512-00 Frangible Bolt Kit to secure the base plate with the pole to the frangible bolts (Figure 27). For reference, note that the connector panel on the Transmitter pole will be parallel with two of the frangible bolts.



**Figure 27. Secure Base Plate with Pole to Frangible Bolts**

3. Install a ground lug on each base plate using the 5/16-18 bolt (M012159-00), split washer (M009065) and flat washer (M009082) as shown in Figure 28.



**Figure 28.** Install Ground Lug on Base Plates

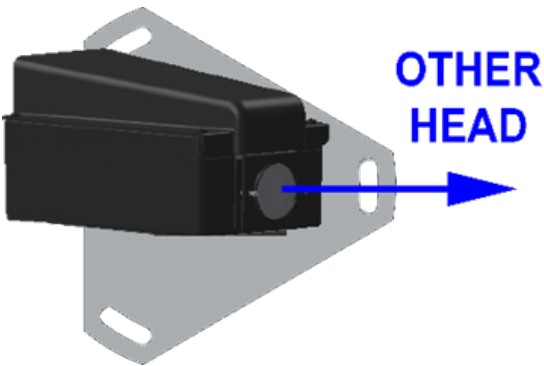
#### 4.8.5 Transmitter and Receiver Optical Head Sub assemblies



#### CAUTION

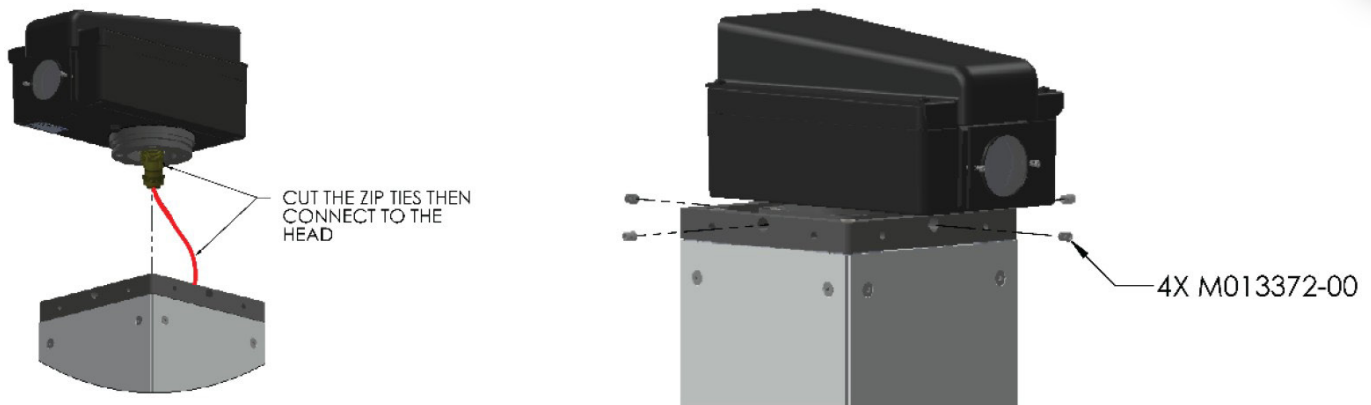
The Optical Heads should be treated as being very fragile. They should not be dropped or treated roughly throughout the process. The Optical Heads should be left in their protective packaging until they are ready to be installed.

1. Position the Optical Head subassembly so that it is facing the one on the opposite pole. Note that the Transmitter and Receiver Optical Head sub assemblies are different — the Transmitter one goes on the Transmitter pole, and the Receiver one goes on the Receiver pole.
  - M403627-00 — Transmitter Optical Head
  - M403625-00 — Receiver Optical Head



**Figure 29.** Optical Head Assemblies Face Each Other

2. Cut the zip tie holding the Optical Head cable at the top of the pole and plug the cable into the connector at the base of the Optical Head.
  - M493203-00 — Cable from Transmitter Control Box to Transmitter Optical Head
  - M493204-00 — Cable from Receiver Control Box to Receiver Optical Head

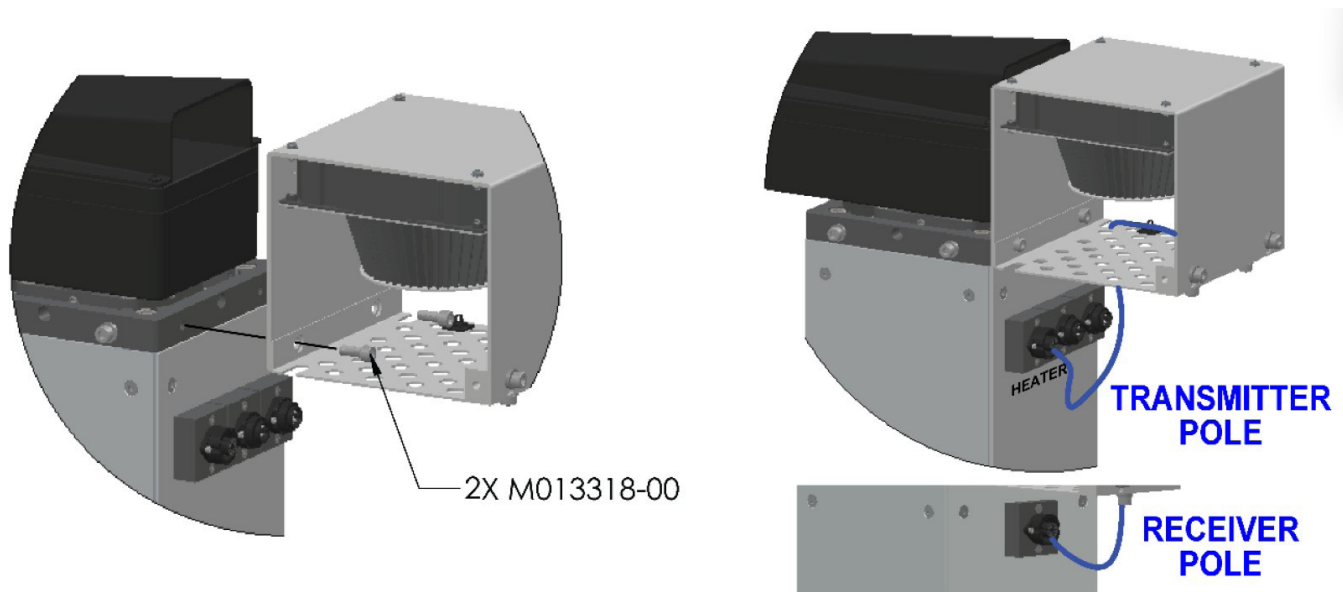


**Figure 30. Install Optical Heads**

3. Position each Optical Head so that it faces the Optical Head on the opposite pole.
4. Orient and visually align the Optical Heads, then secure each Optical Head subassembly to its pole using M8 (M013372-00) set screws.

#### 4.8.6 Blower

1. Position the Blower subassembly behind the Optical Head and secure it to the pole using two M8 (M013318-00) socket screws. Note that the Blower subassembly is voltage- specific.
  - M403636-00 — 120 VAC
  - M403636-01 — 240 VAC



**Figure 31. Install Blower Sub assemblies**

2. Plug the cable from the heater into the HEATER connector at the back of the pole near the top.

## 4.8.7 Mechanical Alignment

### 4.8.7.1 Initial Alignment of Mounting Poles

1. Loosen the upper nuts on the base plate if they are too tight.
2. Place a level on the side of each pole, adjust the three lower nuts to level the support structure in both axes.

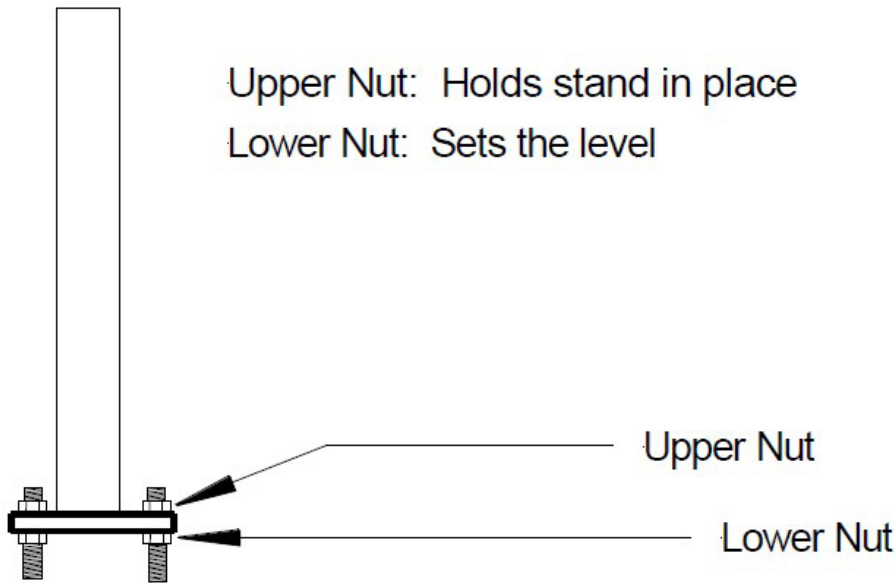


Figure 32. Nuts Supporting Base Plate and Pole



#### NOTE

Further optical alignment will be done after electrical connections are made.

### 4.8.7.2 Azimuth Alignment

The base plates are slotted to allow the poles to be rotated to adjust the azimuthal alignment.

If necessary, loosen the upper nuts of both poles and align the poles by eye from each end so the Optical Heads are more or less pointing at each other.



Figure 33. Visual Alignment

### 4.8.7.3 Check Initial Mechanical Alignment

Figure 34 shows the typical view from Receiver when the Transmitter illuminates the Receiver window. The LED can be seen for half a second at 1 second intervals. Check to see that the beam is centered on the Receiver lens, by checking the extent of the source in the x and y axes. When aligned, tighten the bolts at the source.



#### NOTE

Shroud will not be installed when this check is first performed.

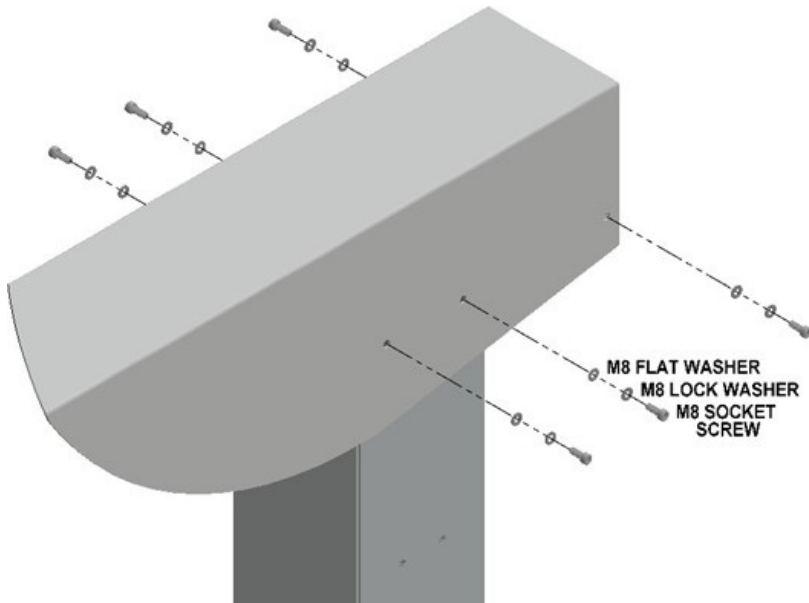


**Figure 34. Mechanical Alignment Check**

Tighten the upper nuts. This completes mechanical installation.

#### 4.8.8 Shroud

1. Position a shroud over each Optical Head/Blower and secure it using M8 (M013318-00) socket screws, M8 (M013362-00) lock washers, and M8 (M013259-00) flat washers as shown in Figure 35. Note that the curved sides of the shroud face each other on the opposite poles.

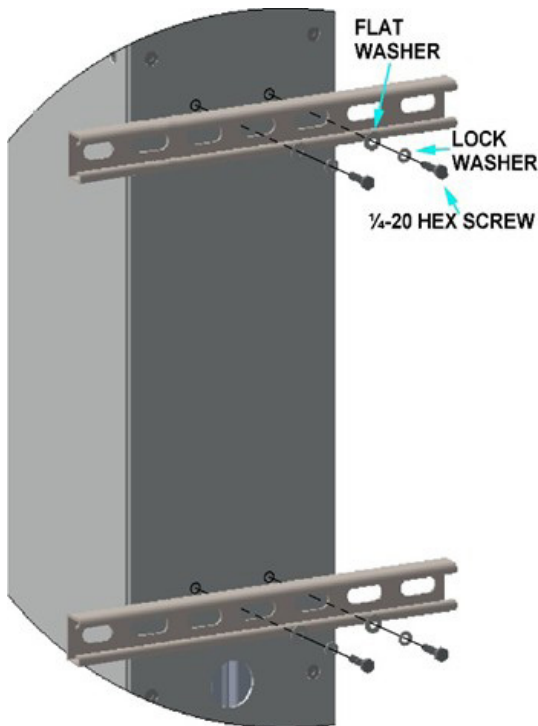


**Figure 35.** Install Shroud Over Each Optical Head/Blower

#### 4.8.9 Control Box

The M488501-00 Control Box Mounting Kit provides the mounting hardware to mount a control box in either pole.

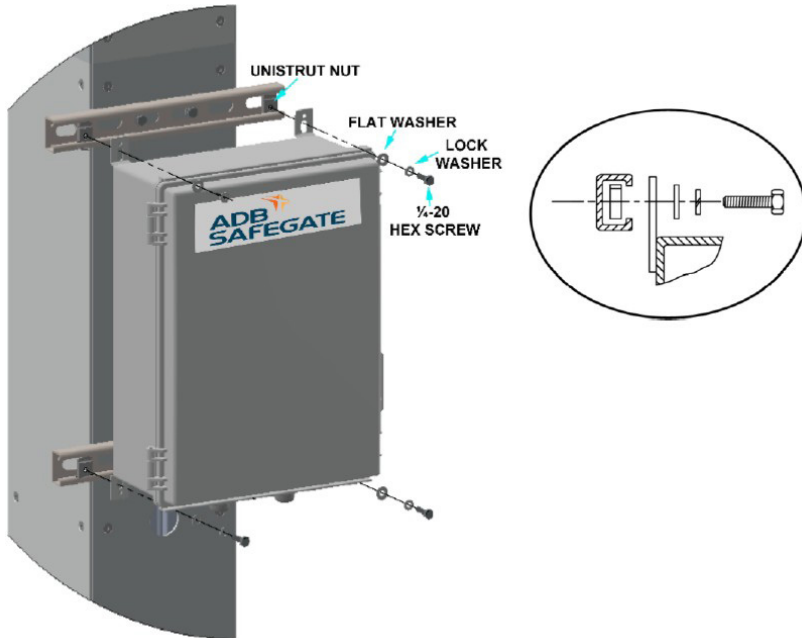
1. Secure two Unistrut mounting rails on each pole as shown in Figure 36 using 1/4-20 hex screws (M0012004-00), lock washers (M009032-000), and flat washers (M009041-00). The Control boxes will face each other on the opposite poles.



**Figure 36.** Attach Unistrut Mounting Rails

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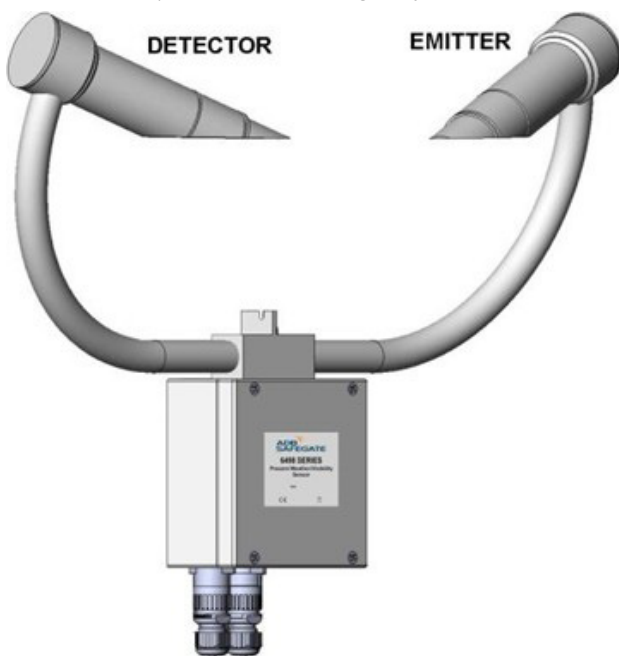
2. Mount the Control boxes to the Unistrut mounting rails on each pole. Note that there are separate Transmitter and Receiver control boxes.
  - M403634-00 — Transmitter Control Box
  - M403633-00 — Receiver Control Box
3. Use the Unistrut nuts, 1/4-20 hex screws (M0012004-00), lock washers (M009032-000), and flat washers (M009041-00) as shown in Figure 37.



**Figure 37.** Mount Control Box

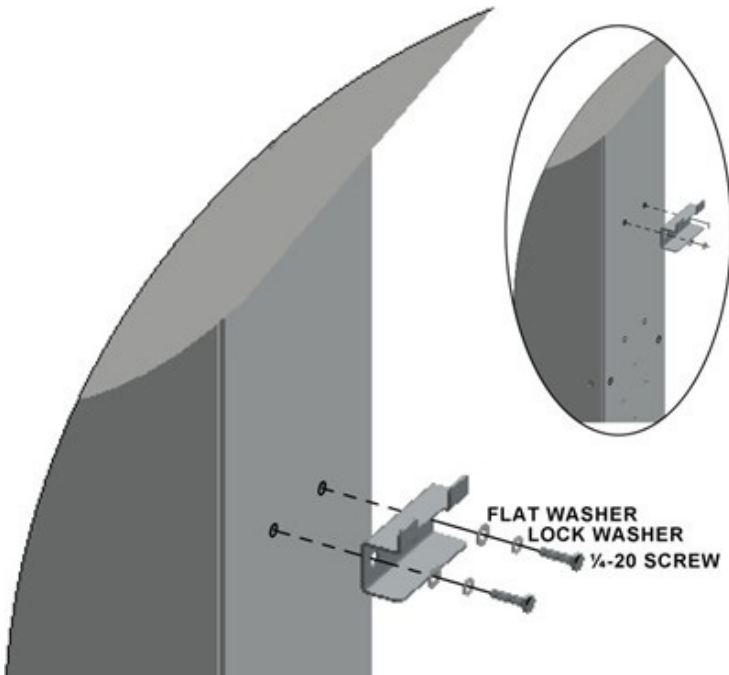
### 4.8.10 Visibility Sensor

The M482306-00 Visibility Sensor may be installed on any of three sides of the Transmitter pole near the top, only the side the Transmitter Optics Head is facing may not be used. Select also the detector optics face away from the equator.



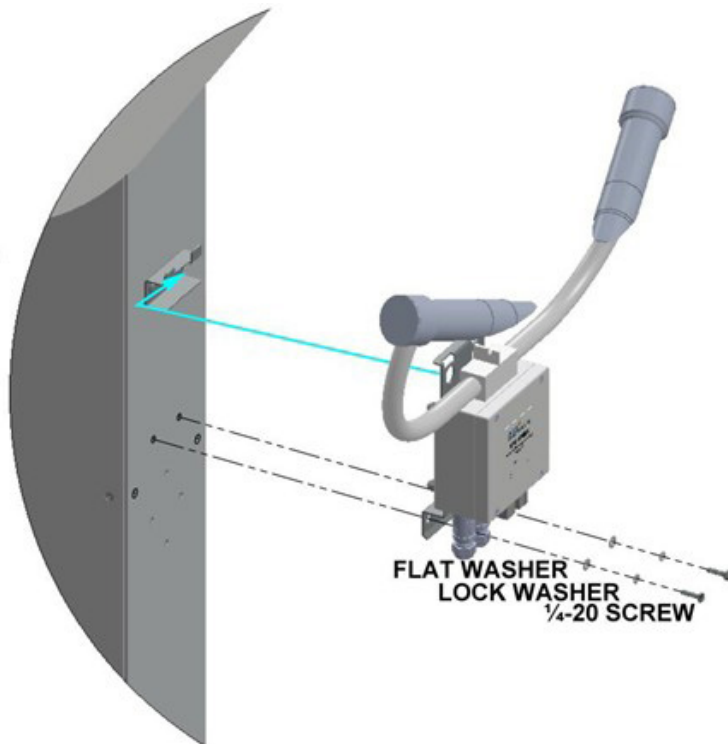
**Figure 38.** Detector Head Faces Away from Equator

1. Position and install the top clamp included with the M482306-00 Visibility Sensor as shown in Figure 39 on the select side of the Transmitter pole. Use 1/4-20 screws (M012004-00), lock washers (M009032-00), and flat washers (M009041-00).



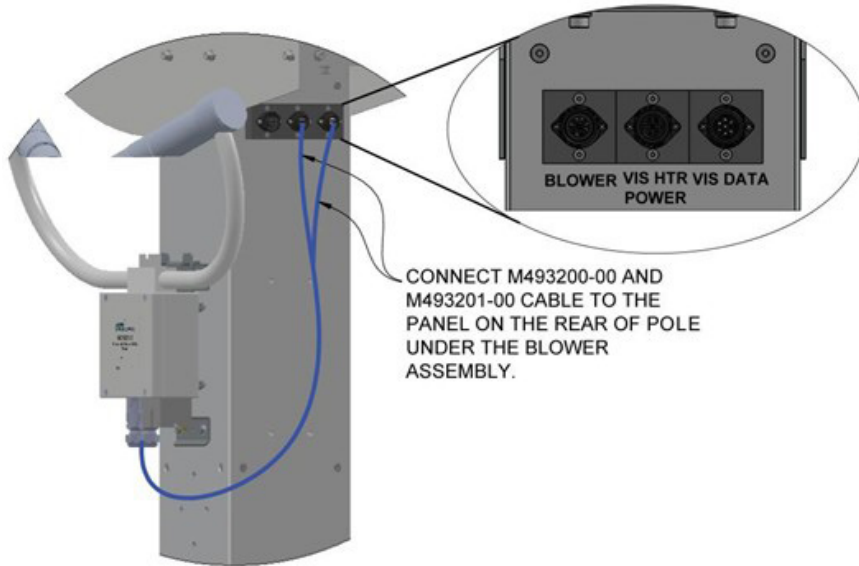
**Figure 39. Install Top Clamp**

2. Slide the top bracket of the M482306-00 Visibility Sensor into clamp just installed and secure the bottom clamp already attached to the sensor to the Transmitter pole using 1/4-20 screws (M012004-00), lock washers (M009032-00), and flat washers (M009041-00).



**Figure 40. Install M482306-00 Visibility Sensor**

3. Connect the **VIS HTR POWER** (M493200-00) and **VIS DATA** (M493201-00) cables to the connectors at the back of the Transmitter pole.

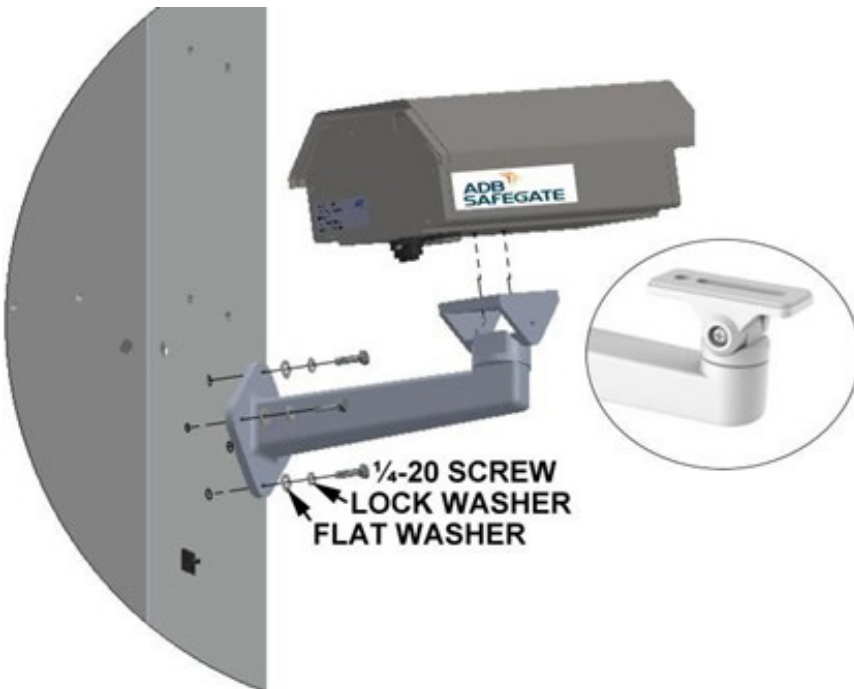


**Figure 41. Visibility Sensor Heater Power and Data Connections**

#### 4.8.11 Background Luminance Sensor (optional)

The Model 5000 Background Luminance Sensor may be installed on either side of the Transmitter pole — the connector panel side and the front side do not have mounting locations for the Model 5000 Background Luminance Sensor. The sensor is mounted on a mounting arm that may be rotated on its vertical and horizontal axes to point the sensor at the sky in the opposite direction from where the sun crosses the zenith. The sensor is normally pointed between 15 and 20 degrees above the horizon.

1. Select the mounting location and secure the mounting arm using 1/4-20 screws (M012004-00), lock washers (M009032-00), and flat washers (M009041-00). Note that the location for this mounting arm is below the location where the M482306-00 Visibility Sensor could be installed.

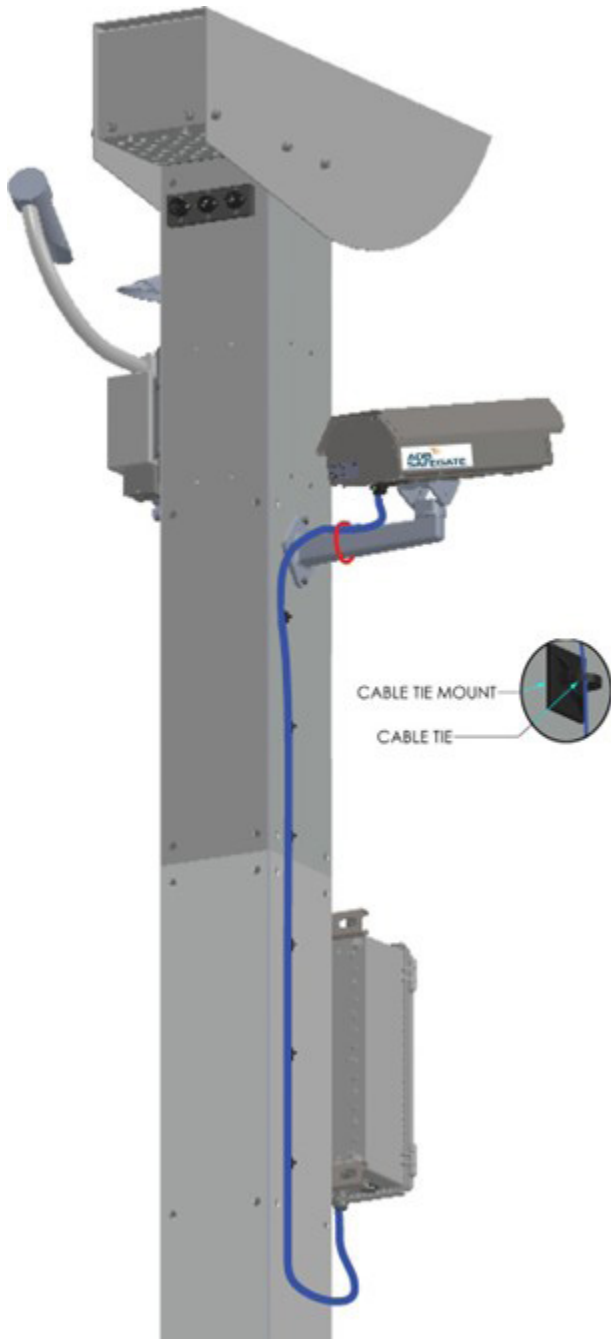


**Figure 42. Install Model 5000 Background Luminance Sensor**

2. Slide the Model 5000 Background Luminance Sensor onto the slot in the mounting arm and secure it with the bolt provided with the mounting arm.

Model 8400-eMOR

3. Plug the M493202-00 cable into the connector of the Model 5000 Background Luminance Sensor and route the cable down the Transmitter pole to the Control Box using cable tie mounts and cable ties every 18 cm (7 "). Secure the cable to the mounting arm with a 25 cm (10") cable tie.

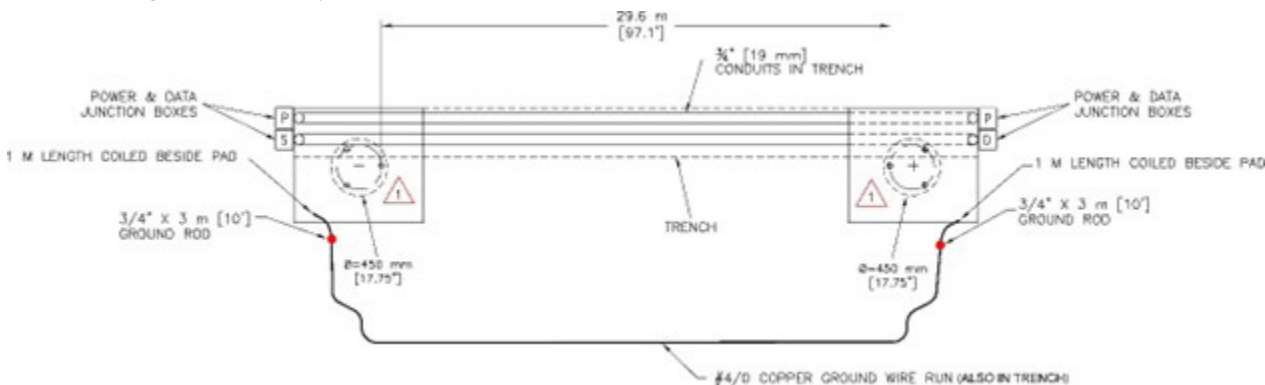


**Figure 43.** Connect M493202-00 Cable and Secure to Pole

## 4.9 Power And Signal Wiring

Figure 44 shows the layout of the site power, signals, and grounding.

- Main AC power is supplied from a power distribution box at either the Transmitter pole or the Receiver pole, depending on which one is more convenient, via a 19 mm (¾") conduit.
  - AC power then connects the Transmitter Control Box and the Receiver Control Box through a junction box via a 19 mm (¾") conduit.
- A signal line is routed to the Transmitter Main Control Box through a data junction box via a 19 mm (¾") conduit. This line is configurable for RS-232 or half duplex RS-485 via a jumper on the Main Control Board.
  - A 19 mm (¾") conduit carries a 4-conductor RS-485 and a synchronization cable through the data junction boxes from the Main Control Board to the Receiver Interface Board.
- A ground wire connects ground rods at the Transmitter and Receiver poles. Coils of ground wire connected to the ground rods left from the site preparation activities are then used to ground the control box ground lugs via ground lugs on the base plates.



**Figure 44. Power, Signal, and Grounding Layout**

- 
- !

**WARNING**

Ensure that the device is well grounded prior to initial operation and prior to each requirement for touching the device.
- 
- !

**WARNING**

Operation of electrical devices in areas where flammable gases, fumes or explosive hazard. As the 8400-eMOR is an electrical device it should not be operated in such an area.
- 
- !

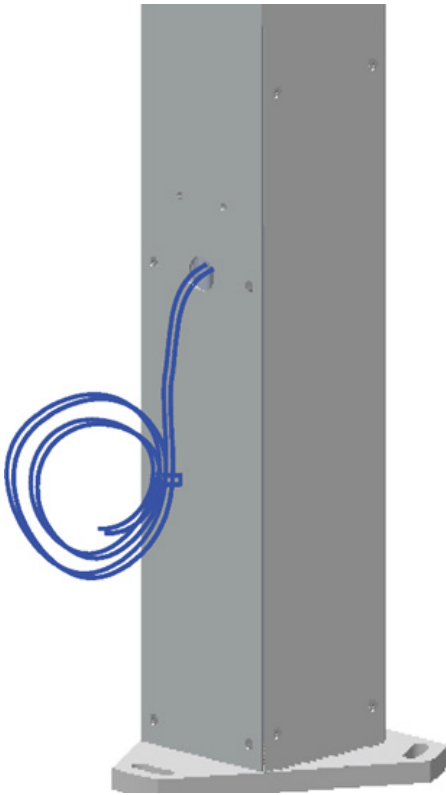
**WARNING**

Do not attempt service of the internal parts of the device unless there are suitably trained personnel on hand to render first aid should it be required.
- 
- !

**WARNING**

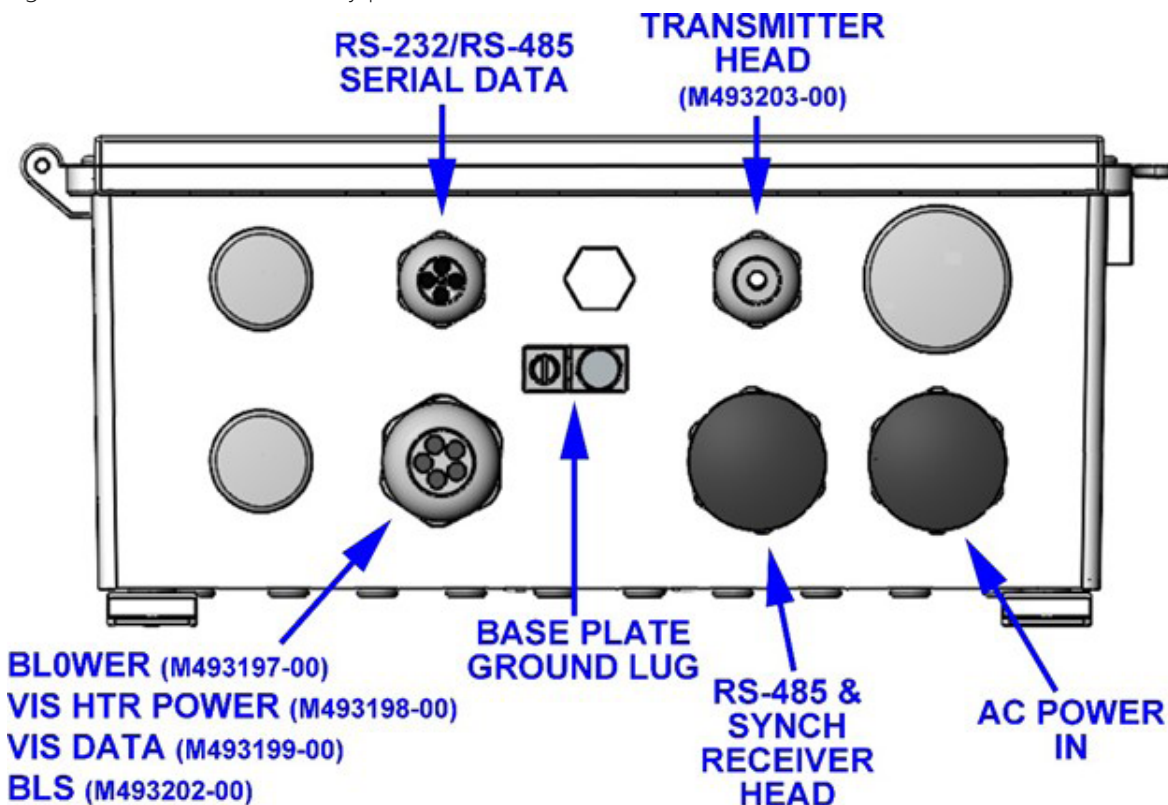
All power cables to the sensor should be removed and the residual power allowed to dissipate for a period of not less than 5 minutes prior to internal maintenance.
-

Cables from the Transmitter and Receiver heads, their blowers, and the sensors emerge from the poles from a hole just below the Control Box so they can be installed easily inside the Control Box through the bottom of the enclosure.



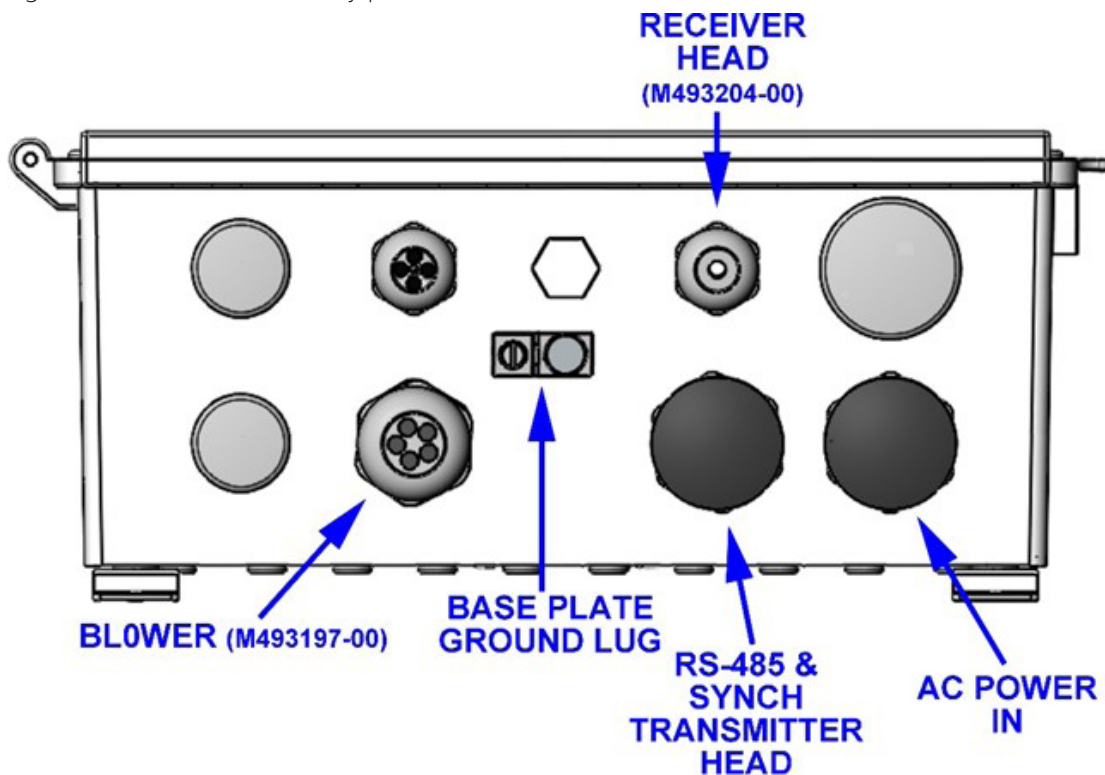
**Figure 45.** Cables from Pole Mounted Equipment

Figure 46 shows the cable entry points at the bottom of the Transmitter Control box enclosure.



**Figure 46.** Transmitter Control Box Cable Entry Points

Figure 47 shows the cable entry points at the bottom of the Receiver Control box enclosure.



**Figure 47.** Receiver Control Box Cable Entry Points

#### 4.9.1 AC Power Supply

A 120/240 V 50/60 Hz supply is required with a capacity of 1000 V•A.

This supply can be routed from an ILS Glide path or Localizer shelter if capacity is available. Otherwise, the AC power cable must be rated to carry the required power for the distance to a Power Distribution Box at the sensor site.

A Power Distribution Unit (PDU) with a circuit breaker is located at either the Transmitter or the Receiver pole, depending on which location is more convenient.

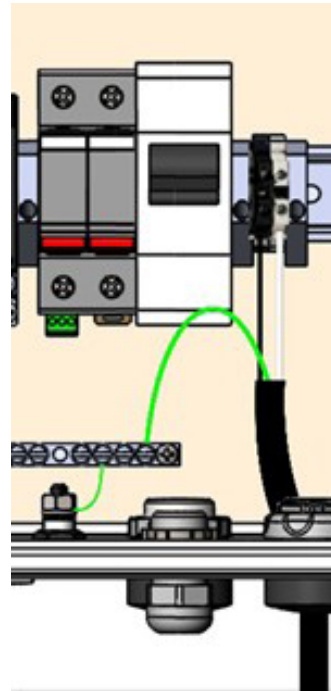


#### **WARNING**

Turn off electrical power at the source before making the electrical connections.

1. Route a conduit from the PDU to the enclosure bottom shown in Figure 46 or Figure 47. Feed the power cable through the conduit fitting. 16 to 18 AWG wires are recommended.
2. Connect the three power cable wires from the PDU to the DIN rail terminal blocks to the side of the circuit breaker and surge suppressor (Figure 48).
  - LINE to BLACK or BROWN
  - NEUTRAL to WHITE or BLUE
  - GROUND/EARTH to GREEN or GREEN/YELLOW

*Connect the green wire to the ground bar below the circuit breaker.*



**Figure 48. AC Wiring to Terminal Blocks**

#### 4.9.1.1 Power Supply Between Poles

If required by site conditions, AC power can be supplied between the Transmitter Control Box and the Receiver Control Box through a 3-conductor cable in an underground 19 mm ( $\frac{3}{4}$ " ) conduit from the Power Distribution Unit to a junction box at the other pole installed during site preparation activities.



#### **WARNING**

There are circuit breakers in the Transmitter and Receiver enclosures to isolate the power and blower supplies. Turn AC power off before working on the AC part of the system.

Connect AC power to the other control box from the junction box as described above for the Control Box near the Power Distribution Unit.

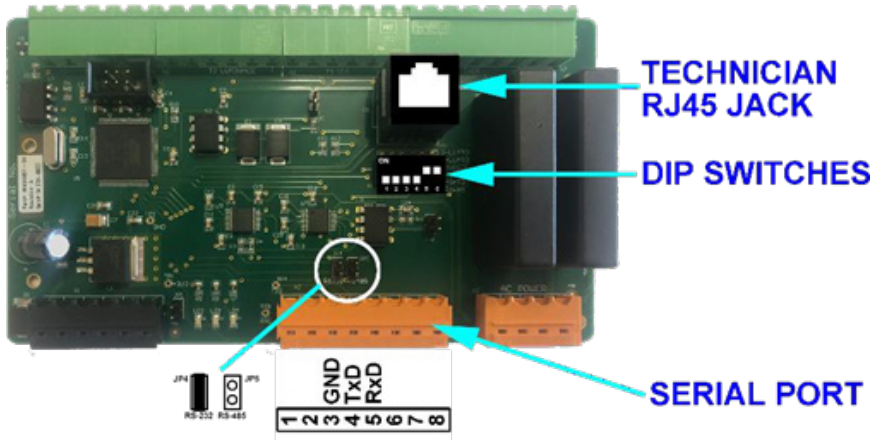
### 4.9.2 Signal Cables

#### 4.9.2.1 Transmitter Pole

Figure 46 shows the cable entry points on the bottom of the Transmitter enclosure.

#### Serial Data Cable

1. Select whether RS-232 or RS-485 serial communication will be used with the Model 1192 Data Collection Platform or other destination.



2. Set the jumper for RS-232 (JP4) or RS-485 (JP5).
3. Run a signal data cable from the Serial Port through the Serial Data gland to the signal junction box.
4. Connect the cable according to whether RS-232 or RS-485 was selected (Figure 49).

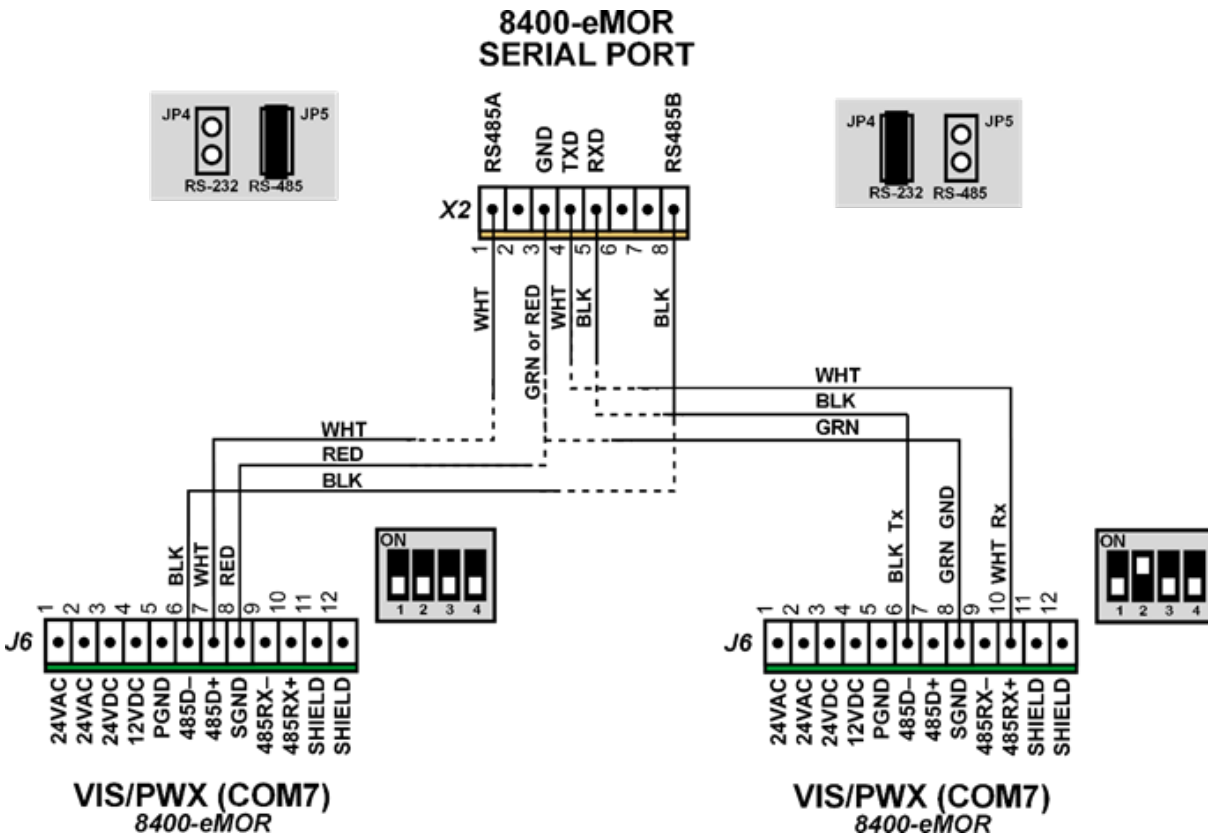
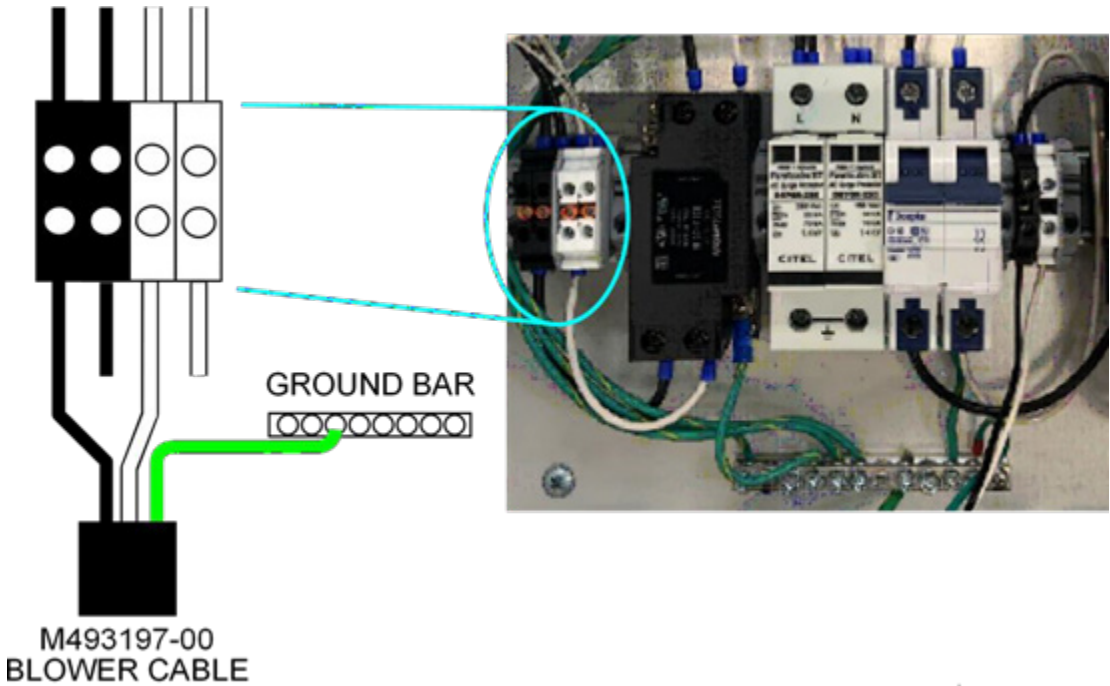


Figure 49. Serial Port Connection Options

**Blower Cable**

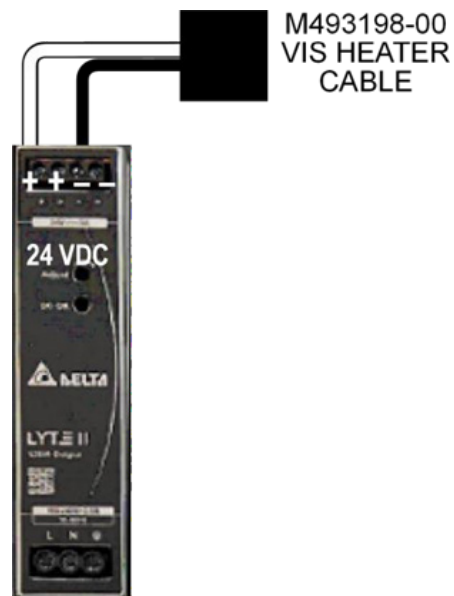
1. Select the M493197-00 blower cable coming out of the pole below the control box and route it through the large gland to the blower terminal blocks.
2. Connect the cable to the DIN rail terminal blocks next to the EMC filter module as shown in Figure 50.



**Figure 50. Transmitter Control Box Blower Cable Connections**

**M482306-00 Visibility Sensor Heater Cable**

1. Select the M493198-00 Visibility Sensor heater cable coming out of the pole below the control box and route it through the large gland to the 24 VDC power supply.
2. Connect the cable to the 24 VDC power supply as shown in Figure 51.
  - WHT to +
  - BLK to -



**Figure 51. Visibility Sensor Heater Cable Connections**

**M482306-00 Visibility Sensor Data Cable**

1. Select the M493199-00 Visibility Sensor data cable coming out of the pole below the control box and route it through the large gland to the VIS DATA screw terminal blocks on the Main Control Board.
2. Connect the cable as shown in Figure 52.
  - » GRN to GND
  - » YEL to VRD (Rx)
  - » BLU to VTD (Tx)



Figure 52. Visibility Sensor Data Cable Connections

**Model 5000 Background Luminance Sensor Cable**

1. Select the M493202-00 Background Luminance Sensor cable coming out of the pole below the control box and route it through the large gland to the BLS screw terminal blocks on the Transmitter Control Board.
2. Connect the cable as shown in Figure 52.
  - » YEL or WHT to LRD (Rx)
  - » RED to +VE
  - » BLK to GND

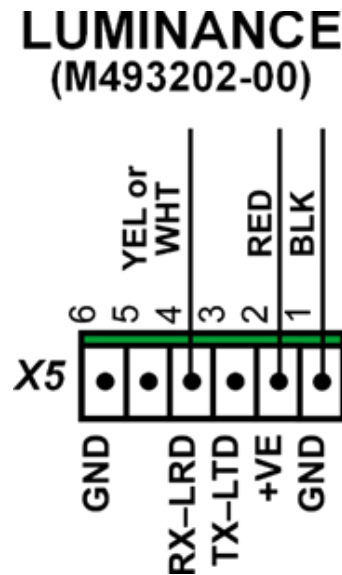
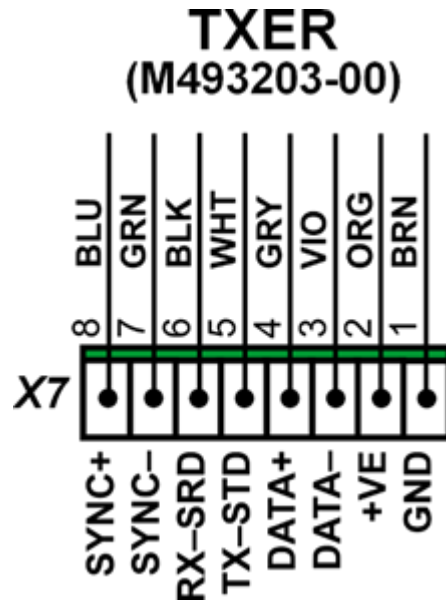


Figure 53. Background Luminance Sensor Cable Connections

**Transmitter Head Cable**

1. Select the M493203-00 Transmitter Head cable coming out of the pole below the control box and route it through the remaining gland to the TXER screw terminal blocks on the Transmitter Control Board.
2. Connect the cable as shown in Figure 54.
  - » BLU to **SYNC+**
  - » GRN to **SYNC-**
  - » BLK to **SRD (Rx)**
  - » WHT to **STD (Tx)**
  - » GRY to **DATA+**
  - » VIO to **DATA-**
  - » ORG to **+VE**
  - » BRN to **GND**



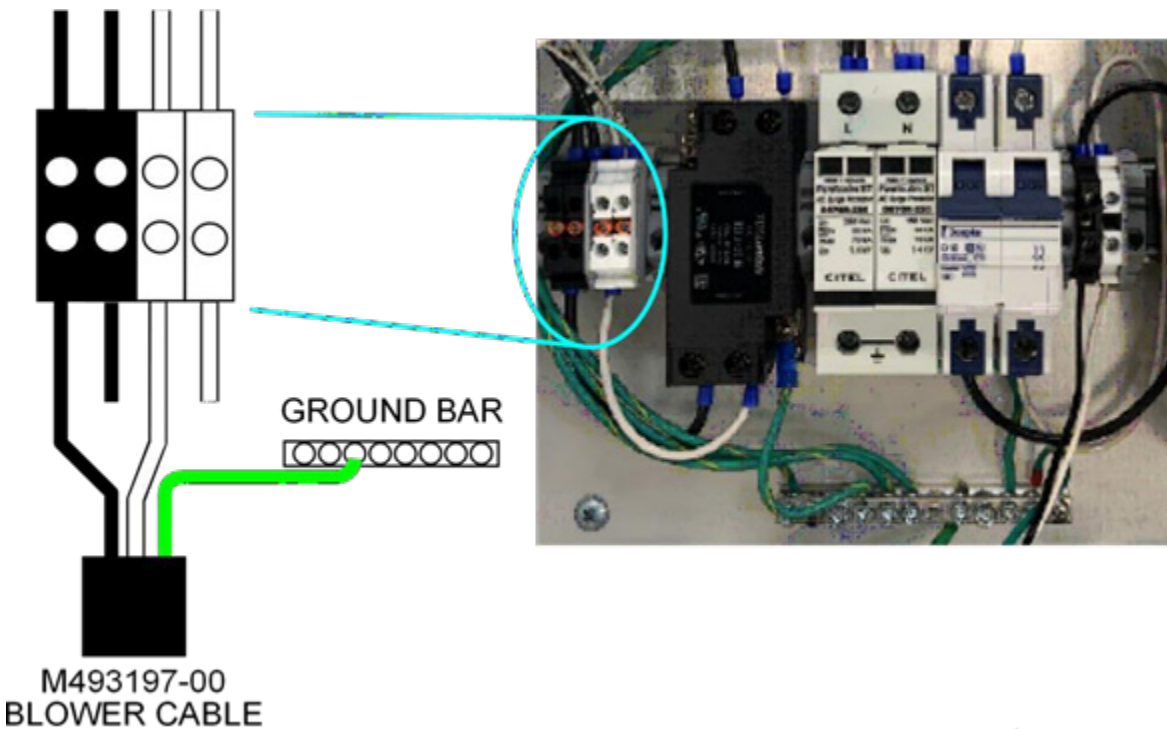
**Figure 54.** Transmitter Head Cable Connections

**4.9.2.2 Receiver Pole**

Figure 47 shows the cable entry points on the bottom of the Receiver enclosure.

**Blower Cable**

1. Select the M493197-00 blower cable coming out of the pole below the control box and route it through the large gland to the blower screw terminal blocks.
2. Connect the cable to the DIN rail screw terminal blocks next to the EMC filter module as shown in Figure 55.



**Figure 55.** Transmitter Control Box Blower Cable Connections

*Receiver Head Cable*

1. Select the M493204-00 Receiver Head cable coming out of the pole below the control box and route it through the remaining gland to the LOCAL and RS232 screw terminal blocks on the Receiver Interface Board.

2. Connect the cable as shown in Figure 56.

**LOCAL**

- GRY to **DATA-**
- VIO to **DATA+**
- BLU to **SYNC-**
- GRN to **SYNC+**
- BRN to **GND**
- ORG to **+VE**

**RS232**

- WHT to **RXD** (Rx)
- BLK to **TXD** (Tx)

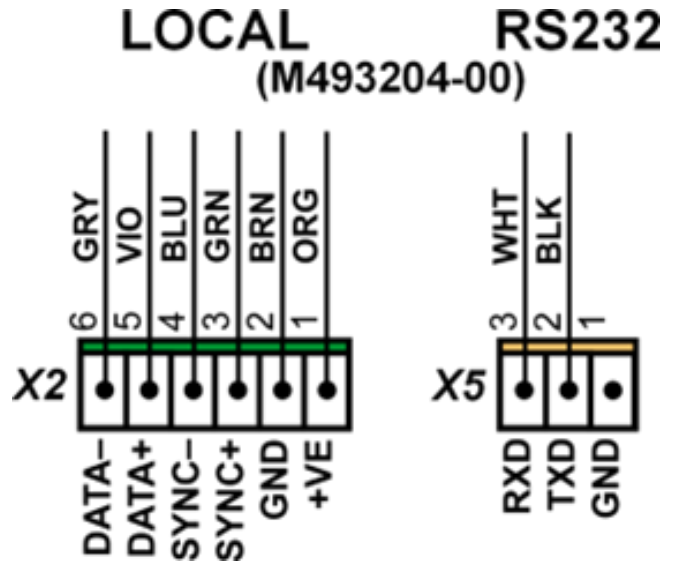


Figure 56. Receiver Head Cable Connections

**4.9.2.3 Communications Between Transmitter and Receiver Heads**

One 4-conductor underground cable carries data and synchronization signals between the Transmitter and Receiver heads. The cable is routed through conduit, signal junction boxes, and a conduit section to each control box.



**CAUTION**

Ensure the DC power supply common at the Receiver end is NOT grounded at the receiver end.

*Transmitter Control Box*

Connect the Transmitter end of the cable to the **RXER** screw terminal blocks on the Transmitter Control Board as shown in Figure 57.

- » GRN to **SYNC+**
- » RED to **SYNC-**
- » WHT to **DATA+**
- » BLK to **DATA-**

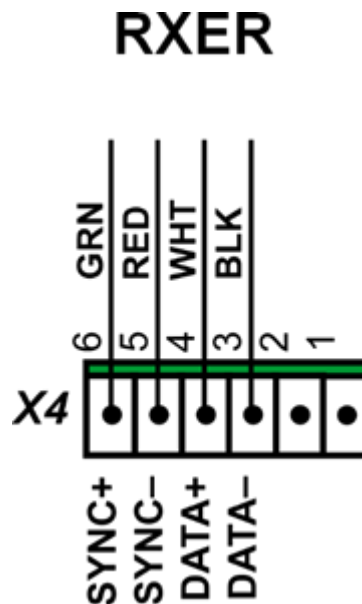


Figure 57. Receiver Cable Connections in Transmitter Control Box

### Receiver Control Box

Connect the **Receiver** end of the cable to the **REMOTE** screw terminal blocks on the Receiver Interface Board as shown in Figure 57.

- » RED to **SYNC+**
- » GRN to **SYNC-**
- » BLK to **DATA+**
- » WHT to **DATA-**

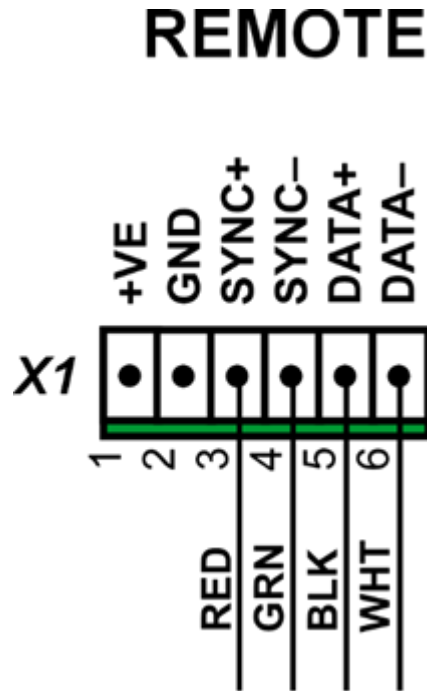


Figure 58. Transmitter Cable Connections in Receiver Control Box

### 4.9.3 Grounding

There is a ground rod at each pad. The ground rods are connected with a 4/0 ground wire between them buried approximately 60 cm below the ground surface as part of the site preparation activities. A ground wire is bonded to each ground rod and is connected to the ground lug at each base plate. A separate ground wire connects the ground lug on the bottom of each control box to the ground lug on the base plate below it.

## 4.10 Start Up Procedure

1. Verify that all the connections are correct.
2. Connect the laptop to the serial port using a USB cable as described in Chapter 5.5.
3. Turn on the power and monitor the startup of the Control Board.
  - Pulsed light should be coming from the Transmitter head.
  - 3 LEDs on the Control Board should light up.
  - Data should be displayed on the laptop as follows.

Normal Startup message.

```
*****  
* ADBSG BOOTLOADER *  
  
* Waiting for firmware image... *  
  
* Waiting for firmware image... *  
* Waiting for firmware image... *  
Running main application...  
8400-EMOR Transmissometer Controller V4.0.0  
An ADBSG Product  
  
Wait 5s for init...
```

If this message is not showing, check the connections and voltages.

- 12 VDC across pins 1 (+VE) and 2 (GND) on connector X1, this is the connection to the +12 VDC power supply
- Voltages on pins 4 (TXD) and 5 (RXD) on connector X2, the serial port, relative to pin 3 (GND) should be negative, around -5 VDC
- Check that there is a jumper across J4 to have the RS-232 pins selected

The following BITE message appears after 5–10 seconds,

Normal BITE message.

```
B.I.T.E  
  
RS485 Port... OK  
VISMeter... OK  
Tx Head... OK  
Rx Head... OK  
Luminance Meter... NOT ENABLED  
Tx Head Temperature... OK  
Rx Head Temperature... OK  
Tx Power Supply... OK  
Rx Head Power Supply..... OK  
Receiver Saturation... OK  
Cal Settings... OK
```

Model 8400-eMOR

followed by the controller parameters,

Normal System Parameters.

**CONTROLLER PARAMETERS**

**SITE..... A**  
**Baseline Length Setting [m]..... 30**  
**Luminance Sensor..... Not Fitted**  
**Calibration Value..... 3840**  
**Autocalibration..... On**  
**Autocal Threshold [m]..... 8000**  
**Autocal Interval [min]..... 2**  
**AutoCal Adjust Threshold .....20**  
**Visibility Report Threshold [m].. 3000**  
**Max Reported Visibility [m]..... 80000**  
**Max Reported RVR [m]..... 3000**  
**Fan Mode..... Auto**  
**Fan Hold Time [min]..... 10**  
**Message Type..... 31**  
**Message Report Rate [sec]..... 15**  
**Auto Status Message 60[sec].....1**  
**Polling Mode..... Off**

followed by the startup message.

Startup. Message

**Starting Output...**

#### 4.10.1 Interpreting the BITE Test

Note the BITE test can also be requested using the DO BITE command when the controller is open in the command mode.

Normal BITE message.

**B.I.T.E**

**RS485 Port... OK**  
**VISMeter... OK**  
**Tx Head... OK**  
**Rx Head... OK**  
**Luminance Meter... NOT ENABLED**  
**Tx Head Temperature... OK**  
**Rx Head Temperature... OK**  
**Tx Power Supply... OK**  
**Rx Head Power Supply..... OK**  
**Receiver Saturation... OK**  
**Cal Settings... OK**

Model 8400-eMOR

**RS485 Port** — This verifies that the controller is connected to the data link between the heads. If this has failed, check the wiring continuity and correct wire order.

**VISMeter** — This verifies that data is coming from the Visibility sensor. If an error is reported, check the wiring and verify data is coming from the sensor.

**Tx Head** — This verifies that messages are being received from the TX head. The system will not work unless the TX head is operating.

**Rx Head** — If the TX head is OK, then check for data from the RX head, and verify the wiring is correct.

**Luminance Meter** — This checks the data from the Background Luminance Sensor, or returns the code **NOT ENABLED** if this sensor is not fitted.

**Tx Head Internal Temperature** — If there is data, the head temperature is checked to ensure it is within 10–60°C (**OK**), below 10°C (**LOW**), or above 60°C (**HIGH**)

**Rx Head Internal Temperature** — If there is data, the head temperature is checked (see above)

**Tx Head Power Supply** — This check that the voltage in the head is between 12.0 and 14.0 V (**OK**), below 12 V (**LOW**), or above 14V (**HIGH**)

**Rx Head Power Supply** — This check the voltage in the head is between 12.0 and 14.0V (**OK**), below 12V (**LOW**), or above 14 V (**HIGH**).

**Receiver Saturation** — This checks the signal level of the RX head and reports **ERROR. SATURATED** if the signal is too high.

**Calibration Settings** — Verifies whether the system has been calibrated.

#### 4.10.2 Interpreting the Controller Parameters:

Normal System Parameters.

##### CONTROLLER PARAMETERS

**SITE..... 0**  
**Baseline Length Setting [m]..... 30**  
**Luminance Sensor..... Not Fitted**  
**Calibration Value..... 3840**  
**Autocalibration..... On**  
**Autocal Threshold [m]..... 8000**  
**Autocal Interval [min]..... 2**  
**AutoCal Adjust Threshold .....20**  
**Visibility Report Threshold [m].. 3000**  
**Max Reported Visibility [m]..... 80000**  
**Max Reported RVR [m]..... 3000**  
**Fan Mode..... Auto**  
**Fan Hold Time [min]..... 10**  
**Message Type..... 31**  
**Message Report Rate [sec]..... 15**  
**Auto Status Message 60[sec].....1**  
**Polling Mode..... Off**

Sample commands are shown in parentheses.

**SITE** — set to 0, 1, 2 ... according to the address of the RS-485 bus. ( **SS 0** ).

**Baseline Length Setting [m]** — this should be 30.

**Luminance Sensor** — Normally fitted on 8400-eMOR at TDZ

**Calibration Value** — a number in the permitted range. ( **DO CAL 4000** ) The calibration value or constant is used to calculate transmittance. It is not the value used to convert to visibility.

**Autocalibration** — If **On**, the unit will calibrate when the visibility exceeds the Autocal threshold. When using Autocalibration, the visibility has to be stable for at least an hour.

**Autocal Threshold Parameter [m]** — This is the threshold at which autocalibration occurs, set to 8000 by default. ( **SET ATP 8000** )

**Autocal Interval [min]** — Normally set to 60 minutes. ( **SAI 60** )

**Visibility Report Threshold [m].** — Above this value the Visibility sensor setting is optimal and will be reported as 2000. ( **SET VRP 2000** )

**Max Reported Visibility [m]** — normally set to 10000.

**Max Reported RVR [m]** — 2000.

**Fan Mode** — **Auto**.

**Fan Hold Time [min]** — 10,

**Message Type** — 31

**Message Report Rate [sec]** — 15 ( **SRR 15** )

**Polling Mode** — Off

### 4.10.3 Optical Alignment

Overall, it is easiest to carry out alignment in comfortable conditions during the day. Since the cone of light sent out by the Transmitter head is hard to see during daylight hours, it may be easier to do the coarse alignment during twilight or cloudy conditions, especially if there is only one person. Two persons are needed to do this during normal daylight hours.

#### *Time to complete*

1–2 hours., 2 persons.

#### *Required Tools*

- Hi-Vis garments as required by site regulations
- Adequate clothing for weather conditions.
- Vehicle with operative heating/cooling for extreme weather.
- Step ladder with 8 steps, do not use an extension ladder or a ladder that would lean on the pole.
- Service laptop and test cable set.
- Mustimeter
- Optics Cleaning Kit
- Installation Tool Set ( large wrench 30 mm jaw, including set of extended Allen wrenches with handles)

#### *Overview of Procedure*

1. Adjust the Transmitter pole to project the beam directly at the Receiver head centered on the receiver window. If done during daylight, have your partner located on a step ladder behind the Receiver head to guide you in orienting the Transmitter pole so the light is more or less centered.



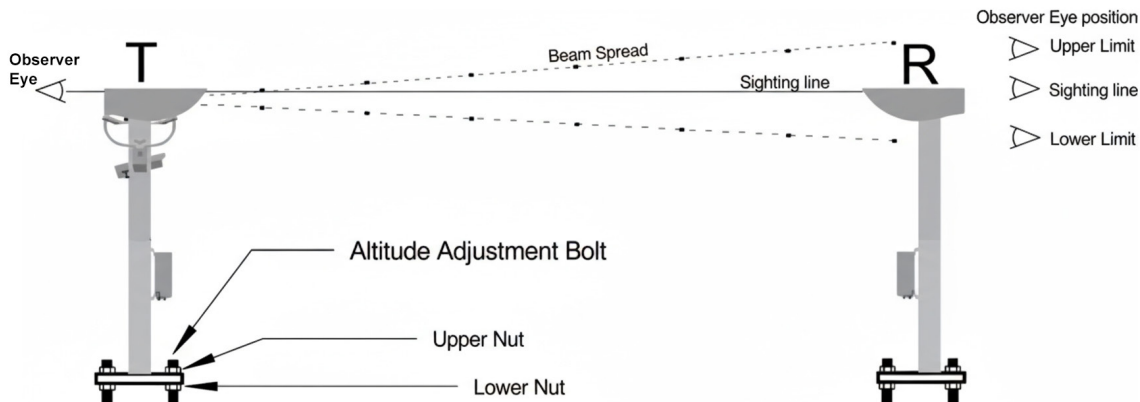
**Figure 59. Center Light Beam from Transmitter on Receiver Head**

2. Align the Receiver head to maximize signal level. This is done in two stages, coarse alignment of the pole and automatic fine alignment of the Receiver head.

#### 4.10.4 Transmitter Vertical Alignment

Align the vertical beam by tilting the base plate holding the Transmitter pole.

Loosen the Upper Nut on the Altitude Adjustment Bolt.

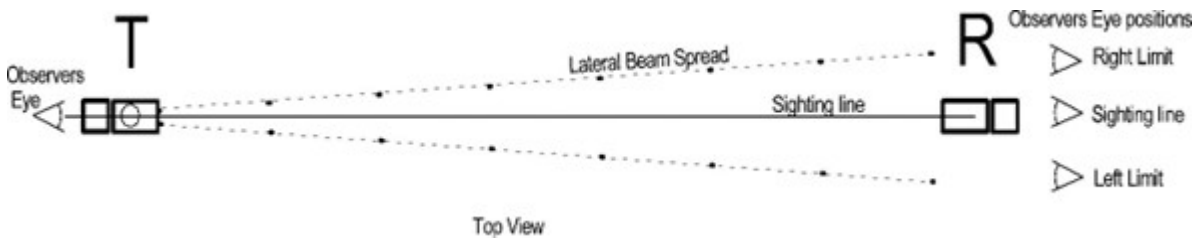


**Figure 60. Tilt Transmitter Base Plate as Needed to Center Beam Vertically**

Use a wrench on the Lower Nut to raise or lower the base plate to tilt it so that an observer on a step ladder at the Receiver end guides the technician at the Transmitter end in centering the projected beam vertically on the Receiver head. Tighten the Upper Nut to keep the pole firm after each adjustment of the Lower Nut. Do a final tightening on all the nuts on the Transmitter base plate.

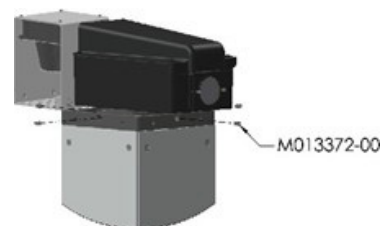
#### 4.10.5 Transmitter Horizontal Alignment

Align the Transmitter head horizontally by rotating the Transmitter Optical Head in its socket — center the beam on the Receiver Optical Head.



**Figure 61. Rotate Transmitter Head/Blower to Center Beam Horizontally**

1. Remove the shroud covering the Transmitter blower and Optical Head (Section 4.8.8).
2. Use an M8 Allen wrench to loosen the set screws holding the Transmitter Optical Head in place on the pole.
3. Rotate the head as guided by an observer on a step ladder at the Receiver end to center the projected beam horizontally on the Receiver head.



**Figure 62. M8 Set Screws**

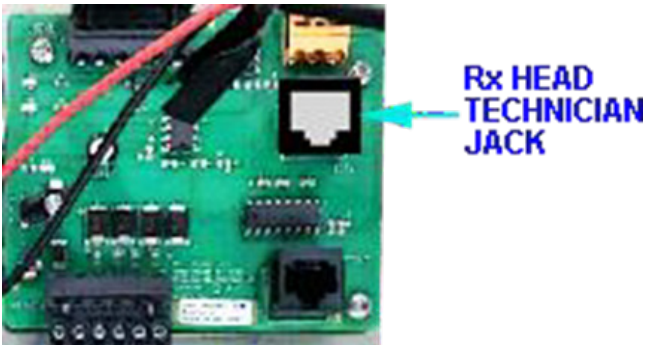
4. If the head cannot be rotated enough for alignment, loosen the base nuts and rotate the entire pole on the base plate as needed.
5. Tighten the set screws slowly, checking the horizontal alignment while tightening the set screws. Tightening the set screws tends to rotate the Optical Head and blower, so a combination of holding them on place, tightening slowly and on opposite sides, and having the observer watching the alignment should produce optimum results.
6. Replace the shroud covering the Transmitter blower and Optical Head.

#### 4.10.6 Receiver Head Coarse Alignment

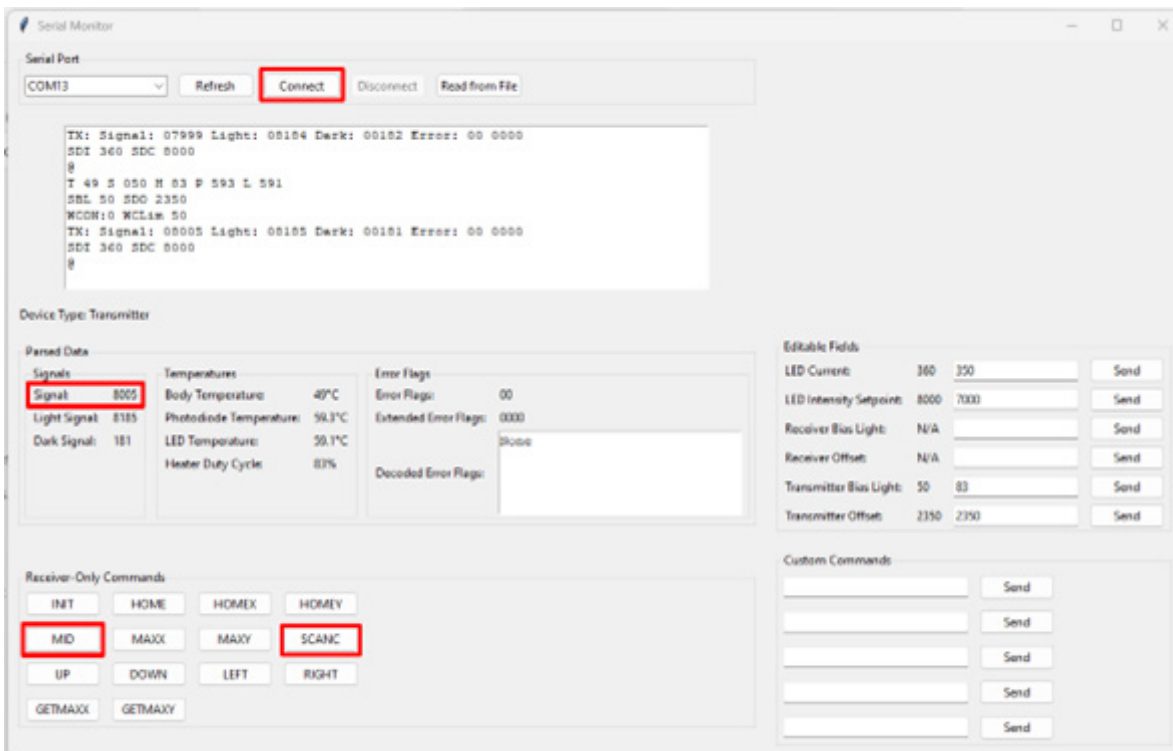
Use the Head Control Utility on the M469126-00 flash drive to perform the coarse and fine alignment of the Receiver head.

1. Connect a laptop to the Receiver Interface Board Technician jack using the M493205-00 Technician Head Adapter

cable with an RS-232 to USB converter.



2. Open the Head Control Utility.
3. Connect to the USB serial port on your laptop and click **Connect**. Only the serialports available on your laptop will be shown in the dropdown menu.
4. Click **Mid**.
5. Loosen the Upper Nut on the Altitude Adjustment Bolt at the Receiver baseplate.
6. Use a wrench on the Lower Nut to raise or lower the base plate to tilt it vertically so that the **Signal** displayed in the Head Control Utility is maximized (the level will likely be several hundred to several thousand). Tighten the Upper Nut to keep the pole firm after each adjustment of the Lower Nut. Do a final tightening on all the nuts on the Receiver base plate.
7. Remove the shroud covering the Receiver blower and Optical Head (Section 4.8.8).
8. Use an M8 Allen wrench to loosen the set screws holding the Receiver Optical Head in place on the pole.
9. Rotate the head horizontally so that the **Signal** displayed in the Head Control Utility is maximized (the level will likely be several thousand).
10. Tighten the set screws slowly, checking the **Signal** displayed in the Head Control Utility while tightening the set screws. Tightening the set screws tends to rotate the Optical Head and blower, so a combination of holding them on place, tightening slowly and on opposite sides, and watching the **Signal** displayed in the Head Control Utility should produce optimum results.
11. Replace the shroud covering the Transmitter blower and Optical Head.



## Figure 63. Head Control Utility Dialog Box for Alignment

### 4.10.7 Receiver Head Fine Alignment

The fine alignment of the Receiver head is carried out by the Head Control Utility using the microprocessor-controlled digital X-Y positioner at the back of the Receiver Optical Head.

1. Keep the Head Control Utility open on your laptop.
2. Click **SCANC**.
3. Watch the fine alignment steps scroll in the dialog window. The alignment will take about 5 minutes, and the dialog window will return to showing the regular data once the fine alignment is complete.
4. The **Signal** displayed in the Head Control Utility will be approximately 14000 once the fine alignment is complete.
5. Close the Head Control Utility and disconnect the RS-232 to USB converter and the M493205-00 Technician Head Adapter cable from the Technician jack on the Receiver Interface Board.

### 4.10.8 MOR Reporting Parameters

Section 3.8.9 explains three MOR reporting parameters that determine whether the Visibility sensor, the Transmissometer, or a combination of their MOR readings is used for MOR reports.

- **VRP** Visibility Report Parameter, the value at which MOR reports switch between the Visibility sensor and the Transmissometer
- **MAXVIS**, the maximum MOR reported from the Visibility sensor operating on its own
- **MAXRVR**, the maximum MOR reported from the Transmissometer operating on its own

Refer to Section 3.8.9 for details on how to change the default settings.

## 5. Setup And Maintenance

### 5.1 Pre-Maintenance safety

Ensure that all appropriate safety equipment is available when performing any work on the device.

Do not touch capacitors and power cables or wires until residual power has been allowed to dissipate. Lethal voltages are present protected within the enclosure of the device the during normal operation of this equipment. This device also emits bright light and close inspection of optical areas of the device should only be undertaken when the device is switched off.

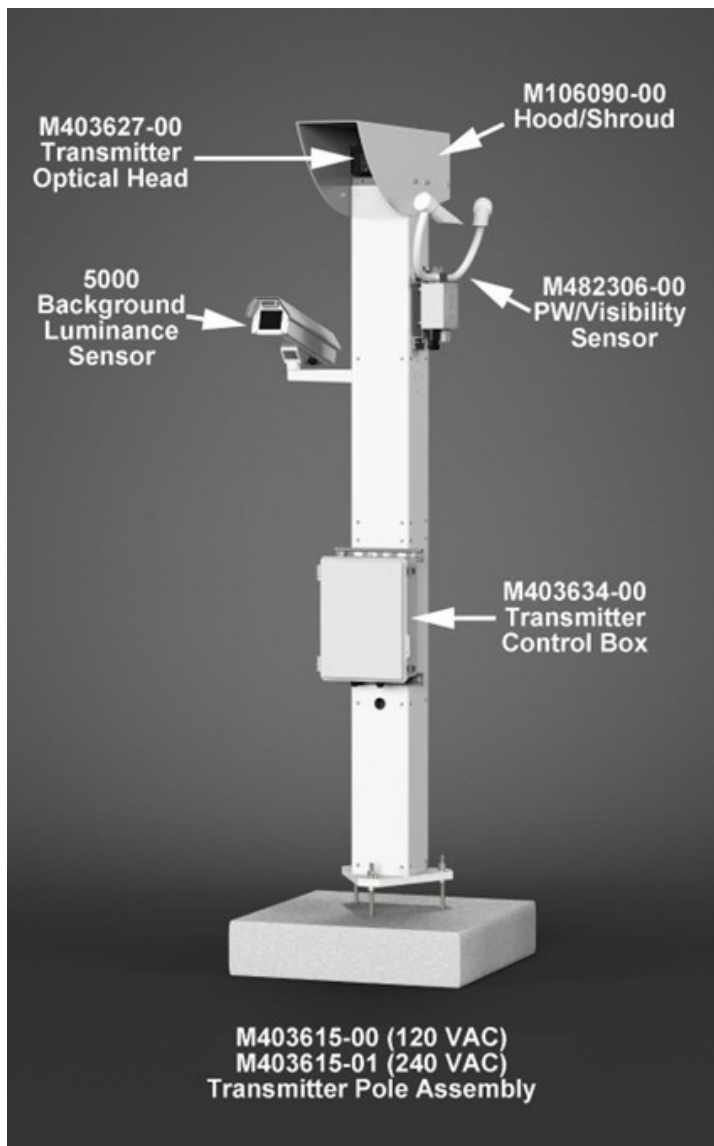
When operating, avoid looking at the device into the beam direction. Make sure that it is not being viewed from the beam direction with magnifying optics. Only trained personnel should perform maintenance functions. The AC version of the sensor is equipped with a three-conductor AC power connector. The power cable must be installed with a safety ground connection.

### 5.2 LRU Parts

Part Number	Description	LRU/FRU
M482306-00	Visibility Sensor	Yes
5000	Background Luminance Sensor	Yes
M028187-00	Enclosure Vent	Yes
M403615-00	ASSY Transmitter Pole 120 VAC 8400-eMOR	No
M403615-01	ASSY Transmitter Pole 240 VAC 8400-eMOR	No
M403627-00	Transmitter Optical Head	Yes
M403615-00	ASSY Transmitter Pole 120 VAC 8400-eMOR	No
M403615-01	ASSY Transmitter Pole 240 VAC 8400-eMOR	No
M403616-00	ASSY Receiver Pole 120 VAC 8400-eMOR	No
M403616-00	ASSY Receiver Pole 120 VAC 8400-eMOR	No
M403616-01	ASSY Receiver Pole 240 VAC 8400-eMOR	No
M403625-00	Receiver Optical Head	Yes
M106090-00	Hood/Shroud	Yes
M444048-00	Fan 115 VAC	Yes
M444049-00	Fan 230 VAC	Yes
M443029-00	Blower Filter	Yes
M438311-00	Power Supply 12 V DC	Yes
M438314-00	Power Supply 24 VDC	Yes
M404972-00	Main Control Board	Yes
M404973-00	RS-485 Interface Board	Yes
M493197-00	Control Box to Blower Panel Cable	Yes
M493198-00	Control Box to 6498 Heater Panel Cable	Yes
M493199-00	Control Box to 6498 Data Cable	Yes
M493200-00	Panel to 6498 Heater Cable	Yes
M493201-00	Panel to 6498 Data Cable	Yes
M493202-00	5000 to 8400-eMOR Cable	Yes

Part Number	Description	LRU/FRU
M493203-00	Control Box to Tx Head Cable	Yes
M493204-00	Control Box to Rx Head Cable	Yes

Part Number	Description	Quantity
M106090-00	Hood/Shroud	2
M403627-00	Transmitter Optical Head	1
M482306-00	PW/Visibility Sensor	1
5000	Background Luminance Sensor	1



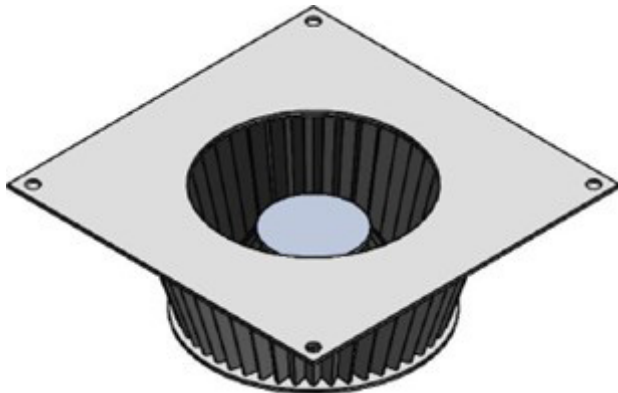
**NOTE**

M403634-00 and M403615-00/M403615-01 are not LRU parts but contain LRU parts.

Part Number	Description	Quantity
M403625-00	Receiver Optical Head	1
M443029-00	Blower Filter	1 per pole
M444048-00	Fan 115 VAC	1 per pole
M444049-00	Fan 230 VAV	



**Receiver Optical Head (M403625-00)**

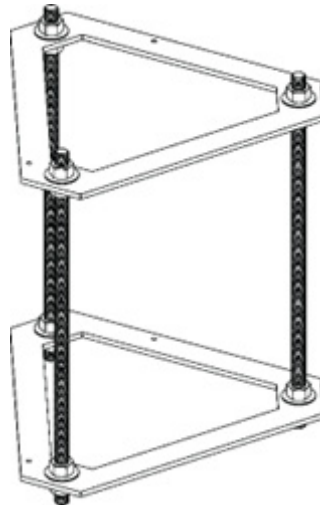


**Blower Filter (M443029-00)**

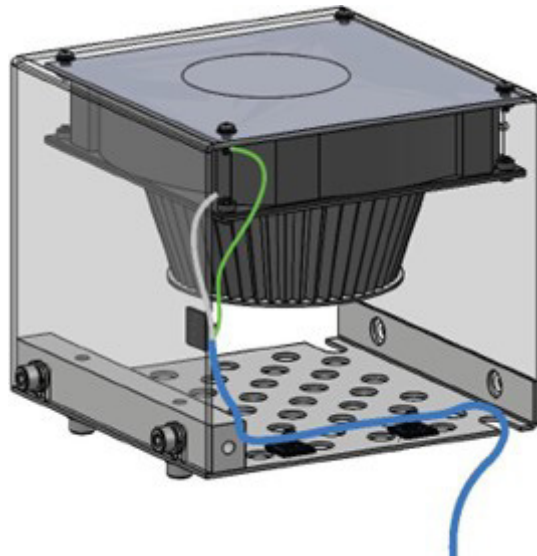


**Fan (M444048-00/M444049-00)**

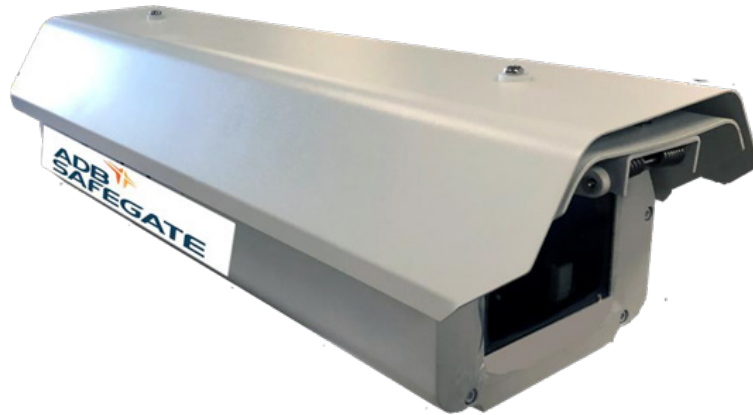
Part Number	Description	Quantity
M488504-00	Anchor Bolt Installation Kit	1



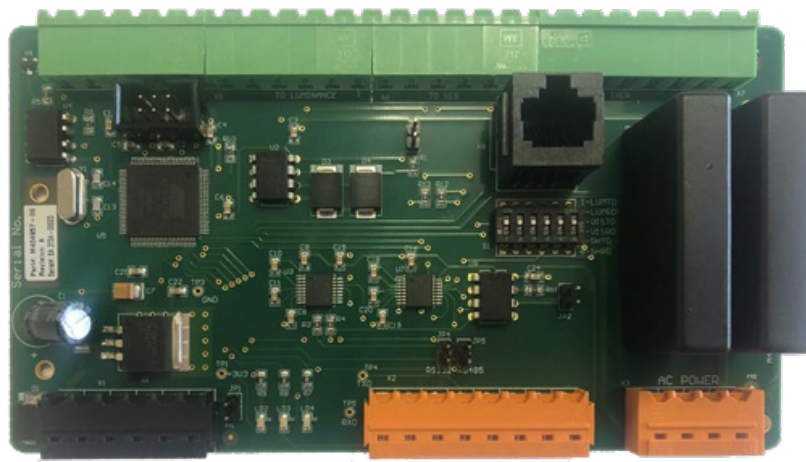
Part Number	Description	Quantity
M403636-00	Blower Subassembly 120 VAC 8400-eMOR	1 per pole
M403636-01	Blower Subassembly 240 VAC 8400-eMOR	



Part Number	Description	Quantity
5000	Background Luminance Sensor	1 (option)



Part Number	Description	Quantity
M404972-00	Main Control Board	1



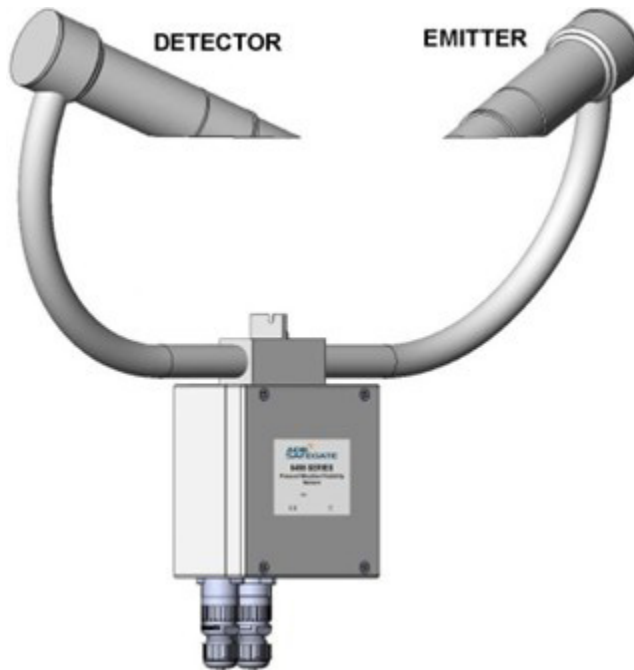
Part Number	Description	Quantity
M438311-00	Power Supply 12 V DC	1



Part Number	Description	Quantity
M438314-00	Power Supply 24 VDC	1 per pole



Part Number	Description	Quantity
M482306-00	PW/Visibility Sensor	1



Part Number	Description	Quantity
M482254-00	Calibration Kit for M482306-00	1 per airport



Part Number	Description	Quantity
M488503-00	Verification Kit	1 per airport



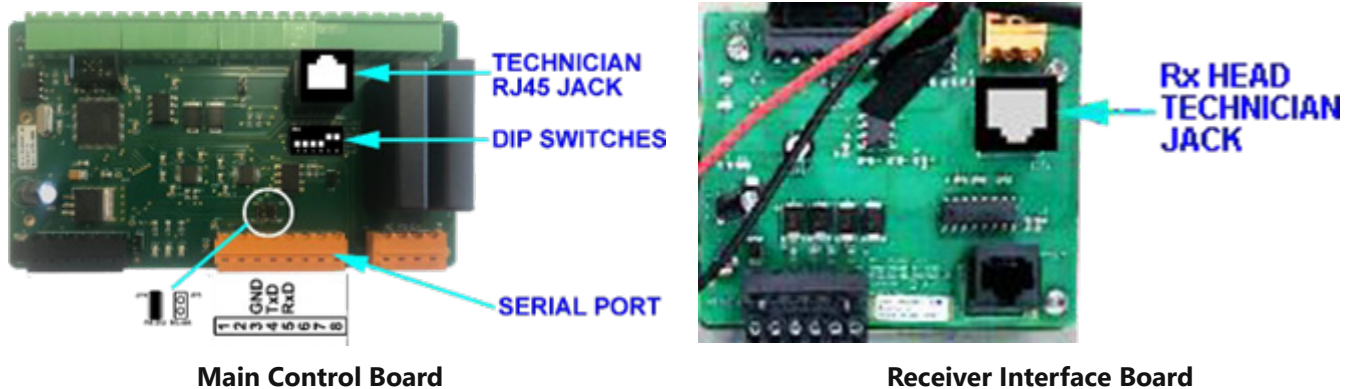
## 5.3 Maintenance tools

The following tools are standard tools that are not specific to the sensors operation or maintenance however are recommended for support of maintenance activities.

1. Digital Temperature sensor / Thermometer / IR Temperature sensor
2. Digital Multimeter
3. Service Laptop
4. Service cables
5. General Tool Kit

### 5.3.1 Laptop Access

Both the 8400-eMOR Main Control Board and Receiver Interface Board have a technician jack accessed via an RJ-45 jack to communicate directly with the heads via RS-232 for maintenance. The RJ45 jack is in a similar location on the Receiver Board, and there are no DIP switches.



**Figure 64.** RJ45 Jacks, DIP Switches, and Jumper Settings

Set the DIP switches at positions 5 and 6 to ON when interacting with either the Transmitter head or the Receiver head of the 8400-eMOR Transmissometer. The remaining DIP switches are set to access the Model 5000 Background Luminance Sensor and the M482306-00 Visibility Sensor.

Use a terminal emulator such as PuTTY when connecting to one of these ports.

1. Using the M493205-00 technician adapter cable and a serial to USB converter to connect one of the computer's USB ports to the RJ45 jack on either the Transmitter Control Board or the Receiver Interface Board.
2. Select the serial COM port related to the USB cable in Putty.

- Identify the serial port associated with the USB port and set up the serial port as follows.

Baud Rate: 9600

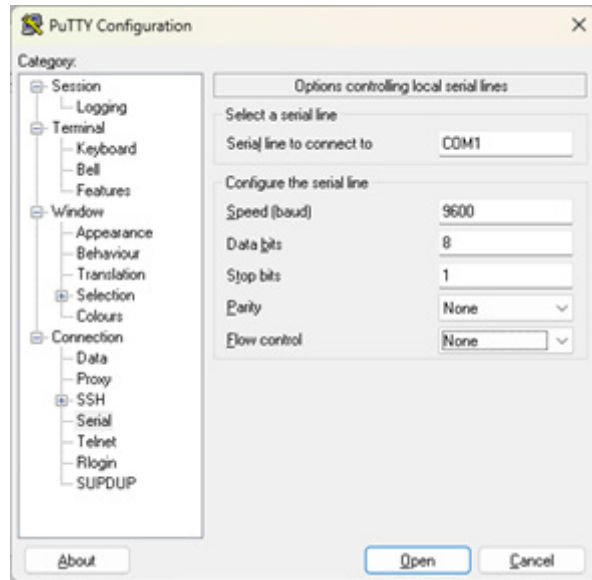
Data Bits: 8 Parity:

None Stop Bits: 1

Flow Control: None

- Click Open.

A communication session with the selected 8400- eMOR head has now been established.



## 5.4 Routine Maintenance procedures

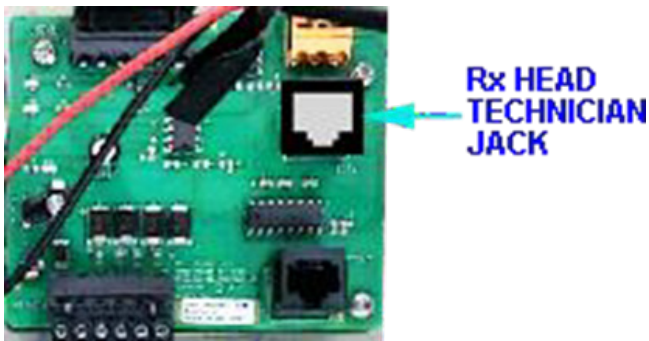
The maintenance procedures in this chapter are the basis for routine maintenance and for fault- finding/troubleshooting as cross referenced to the Troubleshooting Guide in Chapter 7.

### 5.4.1 Receiver Head Fine Alignment

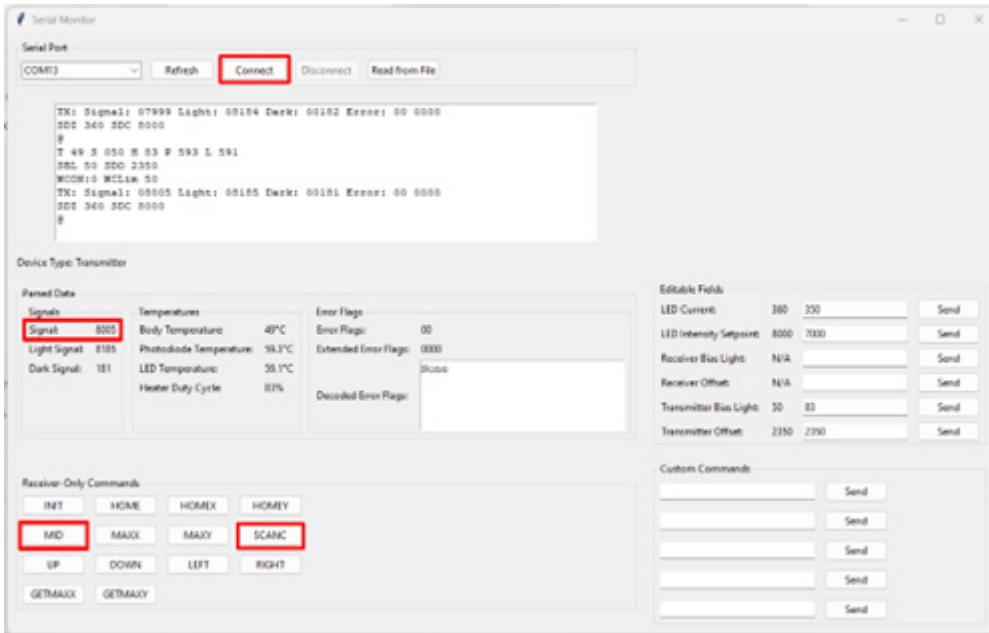
Item	Description
Task Description	Run the fine alignment of the sensor.
Purpose of Task	To ensure that the sensor is correctly aligned.
Tools Required	Data terminal.
Time to complete	25 minute

The fine alignment of the Receiver head is carried out by the Head Control Utility on the M469126-00 flash drive using the microprocessor-controlled digital X-Y positioner at the back of the Receiver Optical Head.

- Connect a laptop to the Receiver Interface Board Technician jack using the M493205-00 Technician Head Adapter cable with an RS-232 to USB converter.



- Open the Head Control Utility.
- Connect to the USB serial port on your laptop and click **Connect**. Only the serial ports available on your laptop will be shown in the dropdown menu.



4. Click **SCANC**.
5. Watch the fine alignment steps scroll in the dialog window. The alignment will take about 5 minutes, and the dialog window will return to showing the regular data once the fine alignment is complete.
6. The **Signal** displayed in the Head Control Utility will be approximately 14000 once the fine alignment is complete.
7. Close the Head Control Utility and disconnect the RS-232 to USB converter and the M493205-00 Technician Head Adapter cable from the Technician jack on the Receiver Interface Board.

### 5.4.2 Power Supply Check

Item	Description
Task Description	Removal and replacement of cover seal
Purpose of Task	Ensure proper supply of power to the sensor.
Tools Required	Multimeter.
Time to complete	15 minutes



#### WARNING

Ensure that extreme caution is used around 110/240 VAC. Ensure rubber detritus is removed from the inside of the measurement unit.



#### WARNING

This module has AC mains supply connected to it. Exercise due care when working on this part of the unit.

1. Open the Transmitter pole enclosure cover.
2. Check the AC voltage on the filtered side of the EMC filter (110 or 240 VAC) inside the Transmitter enclosure going to the DIN rail terminals, BLK is line voltage, WHT is neutral.
3. Check the +12 VDC supply voltage on the DC side of the +12 VDC power supply inside the Transmitter enclosure, RED is +13.2 VDC and BLK is GND.
4. Check the +24 VDC supply voltage on the DC side of the +24 VDC power supply inside the transmitter enclosure, WHT and RED are +24 VDC and both BLK are GND.
5. Check the AC voltage on the filtered side of the EMC filter (110 or 240 VAC) inside the Receiver enclosure going to the DIN rail terminals, BLK is line voltage, WHT is neutral.
6. Check the +12 VDC supply voltage on the DC side of the +12 VDC power supply inside the Receiver enclosure, RED is +13 VDC and BLK is GND.
7. Check the blowers are operational by verifying air movement from the blowers inside the shrouds.
8. Return device to its original operational state.
9. Procedure ends.

### 5.4.3 Communications Check between Sensor Heads

Item	Description
Task Description	Check RS-485 bus
Purpose of Task	Ensure correct operating of the sensor internal RS-485 Bus
Tools Required	Laptop
Time to complete	5 minute

The internal communications system of the sensor uses an RS-485 bus. This bus can be tapped into by connecting a RS-485 capable terminal or device, however, the simplest way to view the operation of the RS-485 is to turn the bus on and off and monitor the communications LEDs on the Main Control Board.

1. Connect the laptop to the RS-232 serial port on the Main Control Board.
2. View the communications LED on Main Control Board, it should be flashing.
3. Turn the RS-485 telemetry bus off by issuing the following command.  
**SET RS485 OFF**
4. View the communications LED on Main Control Board, it should not be flashing.
5. Turn the RS-485 telemetry bus on by issuing the following command.  
**SET RS485 ON**
6. Procedure complete.

### 5.4.4 External Communication Check

Item	Description
Task Description	Check the communications out of the sensor
Purpose of Task	Ensure that the communications are performing satisfactorily.
Tools Required	Laptop
Time to complete	10 minutes

1. Connect the laptop to the RS-232 serial port on the Control Board.
2. Run the **Get Parameters** or **GP** command and the output should be received in less than one second.
3. If the response to the **GP** command is slow, there may be an issue with the communications devices or media.

4. Correct the communications issue and repeat checking parameter output until satisfactory performance is achieved.
5. Procedure complete.

### 5.4.5 Manual Calibration

Item	Description
Task Description	Perform a manual calibration of the sensor
Purpose of Task	Calibrate the sensor
Tools Required	Laptop
Time to complete	25 minutes

The 8400-eMOR is set to auto-calibrate by default, so the unit will calibrate itself automatically and commence operation after the unit is optically aligned as long as the M482306-00 Present Weather/Visibility sensor reads above the Auto cal Threshold Parameter (ATP). In normal operation, the 8400-eMOR calibrates itself automatically to full scale when visibility is above the ATP and the M482306-00 Present Weather/Visibility sensor is operating without any errors being reported.

At start up, for testing or when the ATP is set to zero, the 8400-eMOR can be calibrated as follows.

#### Example

The estimated visibility is 12000 m, and the transmission value is 99%. Enter the command

**DO CAL12000**

A dialog follows, showing the progress of the calibration process.

Check the MOR value against the target in the moments after calibration. If the desired result is not achieved, repeat the calibration command or use the troubleshooting guide to identify other possible issues.

### 5.4.6 Auto Calibration Setup

Item	Description
Task Description	Perform a calibration of the sensor
Purpose of Task	Calibrate the sensor
Tools Required	Laptop
Time to complete	25 minutes

The 8400-eMOR is set to auto-calibrate by default, so the unit will calibrate itself automatically and commence operation after the unit is optically aligned as long as the forward-scatter sensor reads above the Auto cal Threshold Parameter [ATP]. In normal operation, the 8400-eMOR calibrates itself automatically to full scale when visibility is above the ATP and the forward- scatter sensor is operating without any errors being reported.

The automatic calibration is enabled by setting the Auto cal Threshold Parameter to a non-zero value in the range 2000–20000 using the **SET ATP** command, for example,

**SET ATP 10000**

For test purposes, the 8400-eMOR can be calibrated without reference to the forward-scatter sensor by using the **DO CAL vvvv** command.

Open a laptop session. To turn on automatic calibration with a threshold of 8000 m, enter the command

**SET ATP 8000**

To turn automatic calibration off, enter the command

**SET ATP 0**

### 5.4.7 Visibility Sensor Calibration Check

Item	Description
Task Description	Calibrate Visibility Sensor
Purpose of Task	Ensure high end visibility readings are accurate
Frequency	Normally once a year: as recommended in handbook
Tools Required	Laptop, M482254-00 Calibration Kit for M482306-00
Time to complete	30 minutes

The calibration of the M482306-00 sensor can be checked by using the calibrator from the M482254-00 Calibration Kit that attaches to the sensor. The user must be able to physically access the sensor in order to attach the calibrator to the sensor during the procedure.

Only do the calibration check when the following environmental conditions are met.

- Visibility > 10 km or 6.2 SM (as reported by the Visibility Sensor)
- No precipitation
- Ambient air temperature range of 0 to 50°C

#### Calibration Check

1. Set the DIP switches at positions 3 and 4 to ON when interacting with the M482306-00 Present Weather/Visibility Sensor. (See Section 5.3.1.)



**Figure 65. Control Board DIP Switch Settings for the M482306-00 Present Weather/Visibility Sensor**

2. Connect the laptop to the technician jack on the Control Board and start a session with a terminal emulator such as PuTTY as described in Section 5.3.1.
3. Type the following command in the terminal emulation utility and click **Enter** to access the menus.

open 0

Note: The "0" corresponds to the Sensor ID number. The sensor ID is always 0 for the M482306-00 sensor.

4. The setup menu should now be displayed. If the menu does not appear, check the terminal emulation utility settings, then type the command again.

Note: If the sensor does not answer to "open 0", poll all of the other sensor IDs. To poll the other IDs type "open 1" press enter, then type "open 2" and repeat until you reach "open 9". If the sensor answers to a sensor ID other than 0 the sensor ID should be changed to 0. If the sensor ID is set to the wrong ID it will not answer to *open 0*.

```
WELCOME TO THE ADB SAFEGATE 6498 SETUP MENU
ID 0
S/N 1003
(1) Message output menu
(2) User alarm menu
(3) Calibrate ADB SAFEGATE 6498
(4) System information
(5) Communications setup
(6) System configuration

(9) Exit and save
(0) Exit and don't save
->
```

5. Type **4** to access the system information menu. The latest visibility reading is shown in this menu.

ADB SAFEGATE 6498 INFORMATION - MENU 4

ID 0

S/N 1003

OS version: 007646v1

	Value	Alarm
- Last visibility reading:	-	3258M
- Overall system status:	0	No faults
- Emitter dirty window alarm:	0	0%
- Emitter internal temperature:	0	38.4
- Detector dirty window alarm:	0	0%
- Detector internal temperature:	0	31.0
- Detector DC light saturation:	0	-
- Hood heater temperature:	0	25.6
- CS125 Calibrator Serial No:	-	1000
- CS125 Calibrator Exco:	-	30.5
- Calibration value factory offset:	-	-0.026
- Calibration value factory scale:	-	0.02682
- Calibration value cal offset:	-	-0.026
- Calibration value cal scale:	-	0.02682
- Signature fault:	0	-
- Flash write errors:	0	0
- Flash read errors:	0	0
- Supply voltage:	<7.0V	11.3V
- Aux supply voltages:+5V=5.0	-5V=-5.1	+6V=5.9
- External temperature:	0	26.4
- Present weather mode enabled		

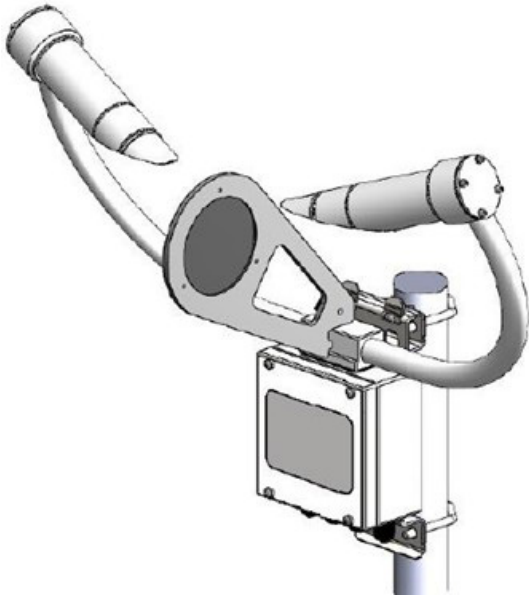
(8) Get debug

(9) Refresh

(0) Return to main menu

->

6. Insert the calibrator into the central mounting point so that it is secure.



**Figure 66.** M482306-00 Calibration Setup

7. Place the foam bungs into the sensor hoods so that they cover the optical lenses completely. The foam bungs block light from reaching the inside of each optical assembly.
8. Wait for 5 minutes.
9. Check the visibility value in the system information menu. For a new sensor, this should be the maximum visibility of at least 75 km. The value will decrease slightly over time.
10. Remove the foam bungs from both optical hoods and wait for 5 minutes.
11. Check the visibility value. This should be within 3% of the MOR value on the calibrator label.
12. Remove the calibrator.
13. Type **0** in the system information menu to return to the main menu.
14. Type **0** in the setup menu to exit without saving. Disconnect the laptop.

Perform the calibration procedure and analysis described in the **Model 6498 Present Weather and Visibility User's Manual** if the calibration check fails.

**5.4.8 Luminance Sensor Check**

Item	Description
Task Description	Check the Luminance sensor operation
Purpose of Task	Ensure proper reading of Luminance
Tools Required	Mild soap, water, and cloth, Data Terminal
Time to complete	10 minutes

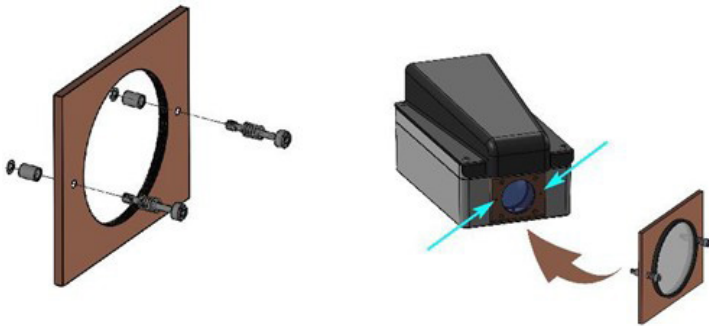
1. Inspect the device for damage.
2. Inspect the device for dust, insect activity, etc.
3. Clean window with soapy water and soft cloth.
4. Check the sensor is pointing at the sky in the opposite direction from where the sun crosses the zenith, between 15 and 20 degrees above the horizon.
5. Check the device is free from obscuration.
6. Obscure the optical path and note the reduction in BL:XXXXX to around 00003 cd/m<sup>2</sup>.
7. Remove obscuration.
8. Check sensor reading. Typical readings are 100–1000 on a dull day, 1000–3000 on a bright sunny day, and 3000–12000 with a bright sunlit cloud in the field of view.
9. Procedure complete.

### 5.4.9 Transmissometer Verification Check

Item	Description
Task Description	Checking Accuracy of Sensor
Purpose of Task	Ensure correct operation of device.
Tools Required	M488503-00 8400-eMOR Verification Kit
Time to complete	20 minutes

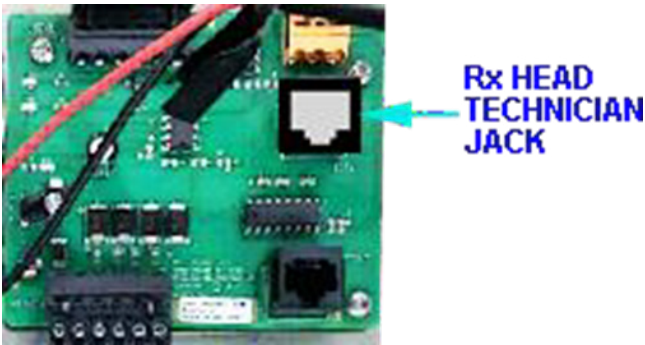
Use the Head Control Utility on the M469126-00 flash drive to perform the coarse and fine alignment of the Receiver head.

1. Assemble the calibration filter holder using the panel screws, springs, spacers, and panel screw retainers as shown in Figure 67.



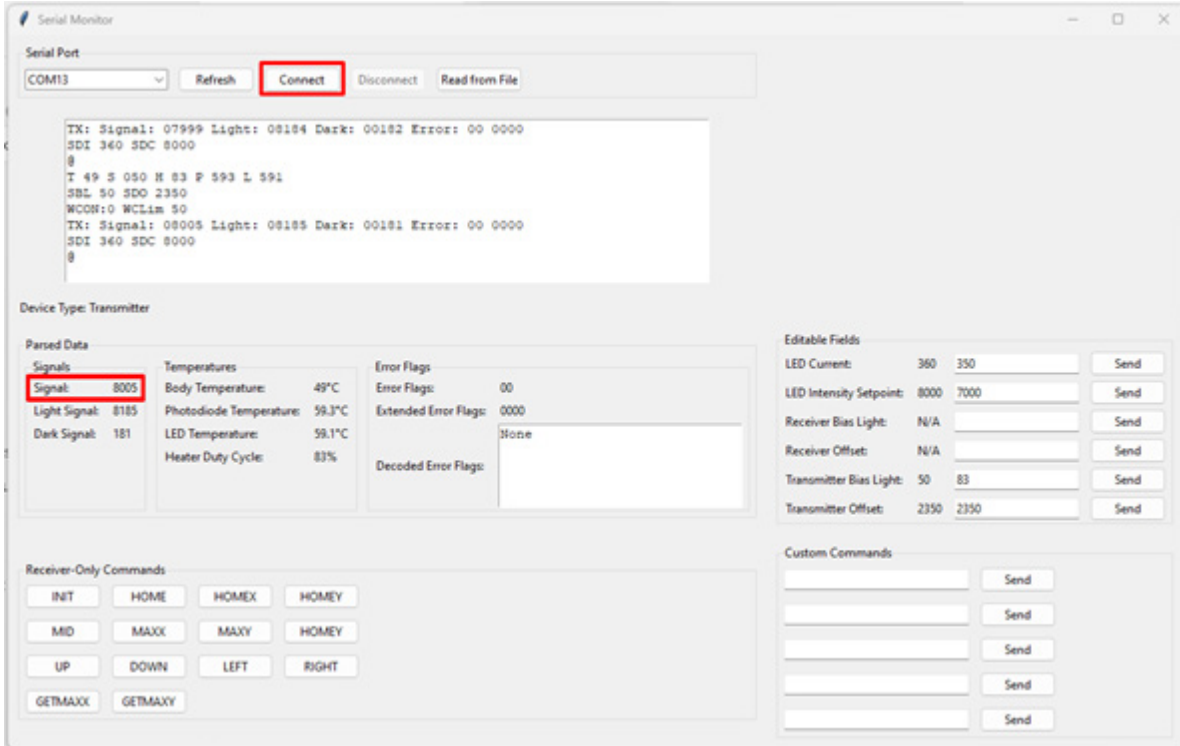
**Figure 67. Calibration Filter Holder**

2. Secure the calibration filter holder in front of the Receiver optical head with the panel screws.
3. Connect a laptop to the Receiver Interface Board Technician jack using the M493205-00 Technician Head Adapter cable with an RS-232 to USB converter.



4. Connect to the USB serial port on your laptop and click **Connect**. Only the serial ports available on your laptop will be shown in the dropdown menu.

- Open the Head Control Utility. Note the **Signal** level reported.



**Figure 68.** Head Control Utility Dialog Box for Optical Performance Check

- Screw the 50% neutral density filter into the filter holder. Wait 5 minutes. The **Signal** level reported should be reduced to 50% of what was noted in Step 5.
- Replace the 50% neutral density filter in the filter holder with a 90% neutral density filter. Wait 5 minutes. The **Signal** level reported should be reduced to 12% of what was noted in Step 5.
- Procedure complete.

### 5.4.10 Visual Inspection and Cleaning

Item	Description
Task Description	Visual inspection and cleaning
Purpose of Task	To ensure the device is in good working order and free of obstructions.
Tools Required	Mild soap, cleaning cloth, duster
Time to complete	20 minutes

#### WARNING



The warm, dry environment of the sensor makes it attractive for insects and small animals to take shelter. While every precaution has been taken to prevent the ingress of this kind of pest, there are some areas where it is not possible to completely prevent these creatures from disturbing the operation. Exercise caution when removing insects such as spiders as these can be poisonous. When using fluids such as soapy water ensure the device is switched off to ensure complete protection against electrical hazard.

1. Disconnect of the power, optional, but highly recommended.
2. Remove the shroud from the Transmitter head.
3. Inspect and clean away any foreign matter in these areas.
4. Inspect window and clean with soft cleaning cloth.
5. Replace blower filter if necessary.
6. Clean the shroud with mild soapy water, allow to dry, and replace the shroud.
7. Inspect cables, seals, glands and ducts for signs of damage and replace or repair as necessary.
8. Use duster or cloth to clean within support structure cavity.
9. Repeat process for the Receiver head.
10. Reconnect power supply
11. Check operation of sensor through data terminal.

### 5.4.11 Optical Head Setup

Item	Description
Task Description	Set head parameters
Purpose of Task	Reinitializing settings for correct operation.
Tools Required	Data Terminal
Time to complete	20 minutes



#### WARNING

This procedure should be conducted when status messages indicate the sensor is out of range or after replacement of a head unit.

The optical heads are set up and tested with a set of commands, some of which can be issued at the technician input jacks. Connect the laptop to the technician jack on the board and start a session with a terminal emulator such as PuTTY as described in Section 5.3.1.

#### 5.4.11.1 Overview

The structure of the commands is as follows:

Command Structure	Description
<b>\$Xyz= ccccc</b>	Set parameter to specified value, in some cases this is set into non-volatile memory
<b>\$ABC</b>	Perform action as defined

**yz** is the command identifier and **ccc** is the required value.

**ABC** is the command.

The table of commands is as follows:

#### Source Maintenance Commands

Command	Description	Min	Max
\$SBL=	Bias LED initial value	2	100
\$SDO=	Photodiode offset current	1000	2200
\$SDC=	Source LED set-point	2000	15000
\$SDI=	Source LED initial value	100	2000
\$SCL=	Source Window contamination limit	0	500
\$SGP	Lists the receiver parameters		

### 5.4.11.2 Transmitter Head Setup and Test

#### Sensor Temperature Control

The photodiode is kept at a fixed constant temperature by an automatic temperature control system. The verification of this is that the thermistor divider voltage is 2.5 V when running at 50°C. The temperature can be measured using an infrared thermometer or measuring the bridge voltage.

#### Sensor Background Level Compensation

The sensor is maintained at a constant level of background light by an LED light source, the bias LED source. It is a single LED in the Transmitter.

The DC level of the Photodiode current is maintained under software control, within close limits irrespective of the outside background brightness. This ensures that the sensor works in the same region as its transfer characteristic and produces a constant linearity in both day and night.

The set-point for the photo current is controlled by the microprocessor and is adjustable.

#### Default Actuator Levels

All controller actuator levels need to be set at some value on start-up. Otherwise, the internal controller will suffer some disturbance and take longer to stabilize. Settings **SBL**, and **SDI** exist to store the default values to minimize startup time.

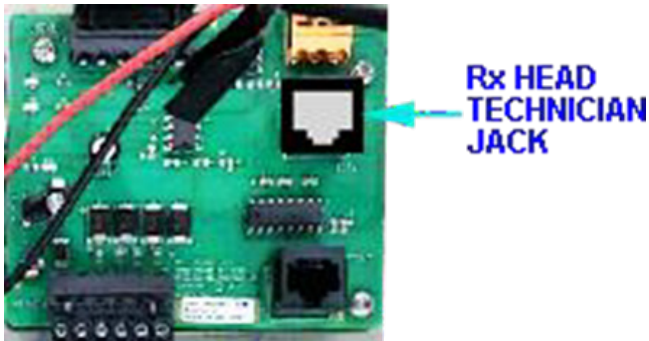
#### Receiver Maintenance Commands

Command	Description	Min	Max
\$RBL=	Bias LED initial value	2	100
\$RDO=	Photodiode offset current	1000	2200
\$RCL=	Receiver Window contamination limit	0	1500
\$RGP	Lists the receiver parameters		

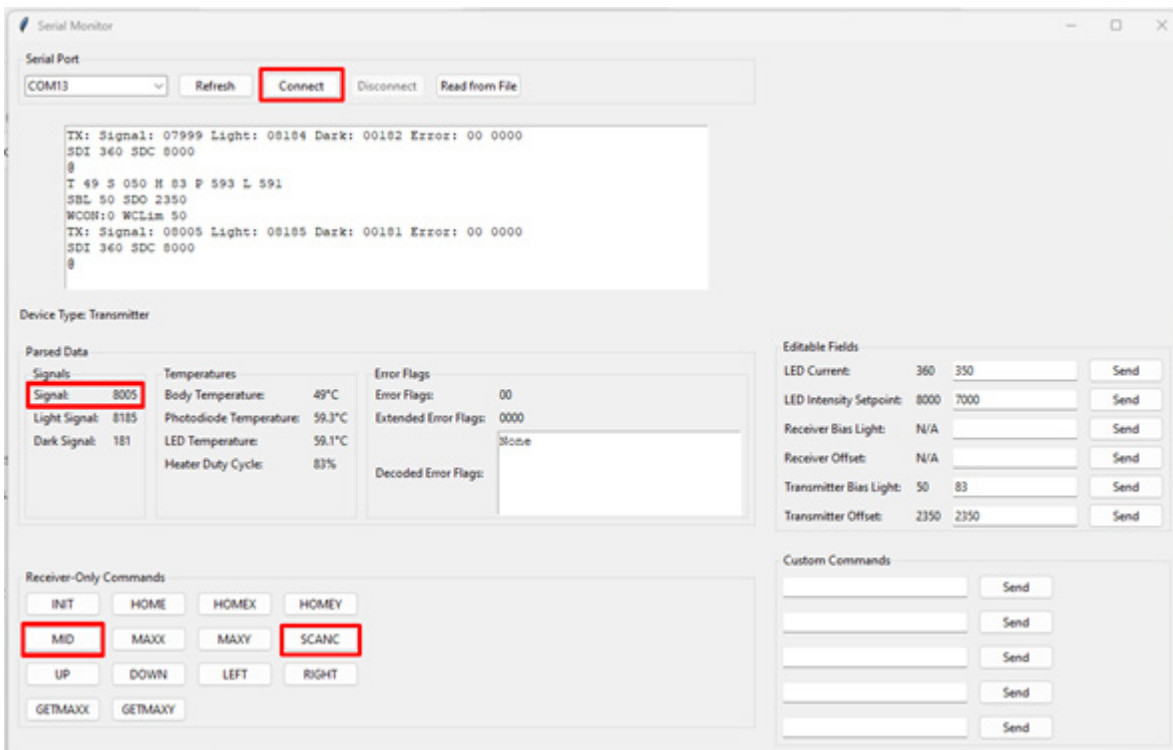
### 5.4.11.3 Alignment Maintenance

Check the fine alignment of the Receiver head with the Head Control Utility interacting with the microprocessor-controlled digital X-Y positioner at the back of the Receiver Optical Head.

1. Connect a laptop to the Receiver Interface Board Technician jack using the M493205-00 Technician Head Adapter cable with an RS-232 to USB converter.



2. Connect to the USB serial port on your laptop and click **Connect**. Only the serial ports available on your laptop will be shown in the dropdown menu.
3. Open the Head Control Utility.



**Figure 69. Head Control Utility Dialog Box for Optical Performance Check**

4. Click **SCANC**.
5. Watch the fine alignment steps scroll in the dialog window. The alignment will take about 5 minutes, and the dialog window will return to showing the regular data once the fine alignment is complete.
6. The Signal displayed in the Head Control Utility will be approximately 14000 once the fine alignment is complete.
7. Close the Head Control Utility and disconnect the RS-232 to USB converter and the M493205-00 Technician Head Adapter cable from the Technician jack on the Receiver Interface Board.

#### 5.4.11.4 Transmitter Head Configuration

The following message is displayed when the laptop is connected to the Transmitter head.

**T 48 S 050 H 00 P 595 L 591**  
**SBL 72 SDO 2100**  
**WCON:0 WCLim 50**  
**TX: Signal: 05694 Light: 03436**  
**Dark: -02261 Error: 00 0000**

This message is sent out every second.

The last line showing the light output measurement can be decoded as shown below.

Item	Description
T	Temperature (0.1°C)
S	Temperature setpoint (0.1°C)
H	Heater duty cycle (%)
P	Photodiode temperature (0.1°C)
L	LED temperature (0.1°C)
SBL	Setting for the bias LED current, and should be in the range 20–60.
SDO	DC current level of the Photodiode



#### NOTE

SBL is set to an operating point within range by setting the Photodiode bias current.

#### 5.4.11.5 Photodiode Current Setpoint

The DC current level of the Photodiode is set by the command :

`$SDO=fff`

(1800 < SDO < 2200. )

The internal control system changes the current in the bias LED so that the output of the Photodiode amplifier is close to zero when there is no light pulse.

The value of SDO should be set so that the value of **SDI** >20 and Z is less than ±1000

#### 5.4.11.6 Light Source Output

The value of SDC must be set to less than 24000.



#### CAUTION

A value above this will cause possible saturation of the amplifiers in the control system and lead to drift of output level.

SDC is normally set to a value (YYYY) that produces a receiver counts level of 20000 or less. This ensures that the receiver amplifiers also operate in the linear region.

The command is:

**`$SDC=YYYY(YYYY<20000)`**

Once LEDC is set and the value is stabilized, the value of SDI (XXX) is noted, and the default value is set by using the command

**`$SDI= XXX`**

### 5.4.11.7 Bias LED Initial Setpoint

The bias LED intensity is controlled internally to maintain a constant operating point for the photodiode. The initial value of this operating point should be set to ensure the system stabilize quickly after start-up.

The command is :

**\$SBL xxx**

where  $2 < xxx < 300$

### 5.4.11.8 Setting the Window Contamination Limit

Window contamination is detected as scatter from the window from the source LED to a sensor angled at 45 degrees to the window. The limit is set at a value between 0 and 1500. It is set by the command:

**\$SCL=ccc**

If the average value of the scattered signal exceeds the limit, a window contamination alert is reported. Window contamination is compensated for by auto-calibration against the M482306-00 sensor.

### 5.4.11.9 Transmitter Error Codes

Each error bit is added to give a single hexadecimal number representing all errors. There are 4 error bits.

Code	Error Type	Limit
0000	No Errors	0
0001	Source Sensor Saturated with high signal.	signal >25000
0002	Source Sensor Ambient Light control out of range	<100
0004	Excessive invalid readings	>20 per second
0008	Source Signal Level low	<100
0010	Low Head Temperature	< 5C
0020	Head Over-temperature Alert	Temp>55
0040	Head Over-temperature Alarm	Temp>65
0080	Under or Over voltage power supply	10<V<14
0100	No Synch Pulse Detected	<100
0200	Control outside Limits	abs(zero)>5000
0400	-	
0800	Window Contamination Alert	0-1500



#### NOTE

The codes are additive: the error codes 1,2 [3] usually occur just after start-up. For example: E=A is excessive invalid readings and ambient light control out of range.

### Multiple Errors Hexadecimal Codes

8+2=A

8+2+1=B

8+4=C

8+4+1=D

8+4+2=E

8+4+2+1=F

### 5.4.11.10 Receiver Head Setup

The photodiode is mounted on an XY positioner to enable automatic fine alignment. It is kept at constant temperature by an automatic temperature control system. The sensor is maintained at a constant level of background light, by two LEDs. The DC level of the photodiode current is maintained within close limits irrespective of the outside background brightness. This ensures that the sensor works in the same region on its transfer characteristic and produces a constant linearity.

The following message is displayed when the laptop is connected to the Receiver head.

```
RX: Signal: 00633 Light: 08211
Dark: 07578 Error: 200 0200
T 47 S 050 H 01 P 596 L 118
RBL 92 RDO 1000
```

Item	Description
T	Temperature (0.1°C)
S	Temperature setpoint (0.1°C)
H	Heater duty cycle (%)
P	Photodiode temperature (0.1°C)
L	LED temperature (0.1°C)
RBL	Setting for the Receiver bias LED current, and Zero is the value of the offset.
RDO	DC bias current level of the photodiode

RBL should be in the range 2–300 and Zero should be ±1000 counts. RBL is set to an operating point within range by setting the photodiode bias current.



**NOTE**

If R is above 20000, the value of SDC in the source should be decreased.

### 5.4.11.11 Photodiode Current Setpoint

The DC Bias current level of the photodiode is set by the command:

**\$RDO=ffff**

(1800 < RDO < 2200.)

The internal control system changes the current in the bias LED so that the output of the photodiode amplifier is close to zero when there is no light pulse.

The value of RDO should be set so that the value of 50 > SBL > 20 and ZERO is less than +-1000 Table of RDO and RBL (typical values )

RDO	RBL
1100	65
1300	57
1500	48
1700	41
1900	32
2100	24

### 5.4.11.12 Receiver Bias LED Initial Setpoint

The bias LED intensity is controlled internally to maintain a constant operating point for the photodiode. The correct value is the value of SBL which results under normal operation. The initial value of this operating point should be set to ensure the system stabilizes quickly after startup.

The command is :

**\$RBL= xxx**

where  $2 < xxx < 300$

### 5.4.12 Receiver Error Codes

Each error bit is added to give a single hexadecimal number representing all errors.. There are 4 error bits.

Code	Error Type	Limit
0000	No Errors	0
0001	Receiver Sensor Saturated with high signal.	signal >25000
0002	Receiver Sensor Ambient Light control out of range	<100
0004	Excessive invalid readings	>20 per second
0008	Receiver Signal Level low	<100
0010	Low Head Temperature	< 5C
0020	Head Over-temperature Alert	Temp>55
0040	Head Over-temperature Alarm	Temp>65
0080	Under or Over voltage power supply	11<V<14
0100	No Synch Pulse Detected	<100
0200	Control outside Limits	abs(zero)>5000
0400	Photodiode Setpoint out of range	1800<SDO<2400
0800	Window Contamination Alert	0-1500

Note, the error codes 1,2 usually occur just after start-up.

For example: E=A is excessive invalid readings and ambient light control out of range.

### 5.4.13 Receiver Test Messages

The test messages can be set so that the technical user can verify correct operation of the optical head.

Message Type	Message	Description
0	Rxxxx Lyyyy Dzzzz E XXX RBL aa Z bb	The standard Message this cannot be turned off.
1	T ttt Stttt Heat pp	Head Temperature Control, Temperature, Set-point and Heater Power in %
2	PS vv.v	Power Supply Voltage
3	RCON= RCLim=	Window Contamination Level and Limit level.

### 5.4.14 Diagnostic Messages

Each head has the capability of transmitting diagnostic messages for fault finding purposes. A maintenance communications lead is plugged into the card at the RJ45 connector. The messages are transmitted at 9600 baud 8 data bits, No Parity.

### 5.4.15 Source Card Diagnostics

Message	Function
T 8008 L 8983 D 976 E 0	Transmitted level 8008 , the Light value 8983 dark value 976 and Error Flags 0 . The error flags are described below
SBL 61 SDO 2200	The Source Bias LED level is 61 , SDO is the setpoint
SDI 806 SDC 8000	The SDC Source LED set-point is 8000 [note the measured level is 8008] and the SDI level of current in the LED is 8-6 in order to develop that level.

### 5.4.16 Receiver Card Diagnostics

Message	Function
R15904 L16811 D00907 E 0	Transmitted level 8008 , the Light value 8983 dark value 976 and Error Flags 0 . The error flags are described below
RBL 36 RDO=2200	The Receiver Bias LED level is 61 , with a zero level of 977

### 5.4.17 Control Board Diagnostics

Message	Function
RVR CON V3.94 OK	This indicates that the controller has performed a restart
ID 1 V 04140 B 32180 S010101	This is the default output message, V prefixing the measured MOR, B prefixing the Background Luminance and S the status flags.
T:25185 R:02934 V:20000 L: 59999	This is the MSG1 diagnostic, which shows the values reported from the Source Receiver sensor on the RS485 bus.

## 5.4.18 Transmissometer and Visibility Sensor Window Cleaning

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### NOTE

Different sites differ in requirement for cleaning frequency

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Both the Transmissometer and Visibility Sensor windows should always be clean of any dirt or particles during operation. The window and should not have any condensate or dust on it.

The MITRAS data message with status includes a warning if the window is contaminated. The blower is running continuously and with active airflow will help keep the lens clear.

If the window contamination warning does not disappear after a while, the window has to be cleaned.

### Effect of Contamination

**Transmissometer** A reduction in visibility occurs when the window is contaminated, but its compensation features adjust for this.

**Visibility Sensor** There are two effects: if the window is contaminated, an increase in visibility is reported. If there are filaments of spider web in the scatter zone or dust on the hood surface, a reduction in visibility is reported.

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### NOTE

It is vital that spider webs, spiders and insects be removed from the sight path. Regular inspection is mandated based on site conditions.

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### When to do it

Different locations experience different sources of window contamination.

For example:

1. Salt at coastal locations
2. If birds roost or perch on the device there may be guano. Fit a bird spike kit.
3. In desert environments dust and sand may accumulate on the window.
4. Dust may accrete on a wet window after rain.

### 5.4.18.2 Window Heating and Condensation

A combination of tight seal, heating and enclosure vents should eliminate the situation of moisture condensing on the optics. If, however, condensate does appear on the inside of the window check the heaters, seals, enclosure integrity and the enclosure vent. In some cases, there may be component out gassing condensate on the inside of the window. This needs to be removed if found.

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What is "component out gassing" ?

Some electronic components decompose when under high temperature stress. The vapor may condense on optical surfaces in the head.

While every effort has been made to select components that do not "out gas" this can occur in the event of over current, short circuit and overheating.

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### 5.4.18.2 Window Cleaning Procedure

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#### **WARNING**

The window should not be cleaned with harsh abrasives, chemicals or high-pressure cleaning systems.

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1. Use the cleaning rag to remove dust and spider webs from within the shroud/hood.
2. Use the blower and brush to remove dust from the window surface.
3. Check the window to see if there is any hardened deposit.
4. If there is a hardened deposit, use a cotton swab dipped in the cleaning solution to soften and remove the material.
5. If required use the cotton swabs to remove accumulated material at the edges.
6. Flush the window with water to remove any remaining material.
7. Clean the window with the soft lint-free cloth moistened with the lens cleaning solution.
8. Dry the window and check that it is optically clean. Repeat step 5 if necessary.

### 5.4.19 Check Enclosure Vent

Item	Description
Task Description	Check enclosure vent
Purpose of Task	Ensure enclosure vent is operating correctly.
Tools Required	Small adjustable wrench
Time to complete	10 minutes



**WARNING**

Ensure the head unit is well supported on a stable base.

The enclosure vent is located on the base of the head units. It is a waterproof membrane to equalize the water vapor pressure inside and outside the unit. This prevents cyclic thermal water pumping into the enclosure. The usage of an enclosure vent removes any need for messy desiccant packs.



**NOTE**

Desiccant packs are not needed.

The enclosure vent should be checked for build-up of mud or dust and cleaned or replaced if required. The port is located on the bottom of the head of each head and has the appearance matching the picture below. The port can be unscrewed by hand to remove and inspect or replace the vent.



**NOTE**

The enclosure vent is expected to last for the life of the sensor unless subjected to unusual force, mechanical action or solvents. Under normal use the vent should not need servicing.



### 5.4.20 Seal Replacement

Item	Description
Task Description	Removal and replacement of head seals
Purpose of Task	Reinstate IP rating of head
Tools Required	Flat blade screwdriver.
Time to complete	10 minutes



#### WARNING

Ensure the head unit is well supported on a stable base.

1. Disconnect head unit.
2. Remove the aluminum head cover
3. Using the screw driver remove the old rubber gasket.
4. Clean up any remaining sealant or rubber with an alcohol solvent.
5. Remove all traces of old gasket material.
6. Fit new gasket.
7. Carefully press each corner into position without stretching it.
8. Ensuring the gasket does not kink.
9. Replace head cover.
10. Connect power and communications.
11. Check operation of device.

### 5.4.21 Periodic Maintenance Activities

#### 5.4.21.1 Check Data Messages for Alarms

Most message types have fields for alarm reporting. The software used for the recording of data should also record alarms and alert the user.

#### 5.4.21.2 Support Personnel Investigation of Alarms

When an alarm is detected the technical support personnel should check the alarm type and investigate the possible causes with reference to this handbook troubleshooting section.

#### 5.4.21.3 Inspection and Cleaning of Sensor

After the sensor is first setup inspection and cleaning should be undertaken at regular intervals so that a baseline can be established for the sensor's installation location. Some locations are cleaner than others and will require less cleaning. Increase the cleaning interval over time until the maximum cleaning interval has been established.

#### 5.4.21.4 Calibration Check

The calibration check can be performed as often as required by your local authority to ensure compliance. Where no requirement for calibration check interval exists, it is recommended that the check be run triannually.

**5.4.22 LRU Procedures**

These procedures describe the methods required to replace the commonly serviced Line Replaceable Units (LRUs). It includes the description of the removal or adjustment of components of the device which are obstructions to the maintenance activity.

The following are reference part numbers for the LRUs and standard inbuilt elements that are involved in the maintenance of the sensor.

<b>Part Number</b>	<b>Description</b>	<b>Procedure Required</b>
M106090-00	Hood/Shroud	No
M028187-00	Enclosure Vent	No
M403627-00	Tx Head Light Source Subassembly	Yes
M403625-00	Rx Head Subassembly	Yes
M444048-00	120 V Blower Fan	Yes
M444049-00	240 V Blower Fan	Yes
M443029-00	Blower filter	Yes
M403972-00	Main Control Board	Yes
M403973-00	RS-485 Interface Board	Yes
M438311-00	12 VDC Power Supply	Yes
M438314-00	24 VDC Power Supply	Yes
M482306-00	PW/Visibility Sensor	No
5000	Background Luminance Sensor	No

### 5.4.22.1 DC Power Supply/Circuit Breaker Removal and Replacement

If 12 VDC or 24 VDC is missing and the Control Board LED is out, check the circuit breaker and the AC power supply. Both are mounted on DIN rails.

First check whether the circuit breaker remains open when turned on. If it does, replace the circuit breaker per the procedure below.

The Transmitter Control Board has both 12 VDC and 24 VDC power supplies, the Receiver Interface Board has just 12 VDC. Check the power supply output voltage, if it is not the voltage specified, replace the power supply per the procedure below.

Item	Description
Task Description	Replace AC power supply
Purpose of Task	Remove defective unit
Tools Required	3 mm Flat screw driver
Time to complete	2 minutes



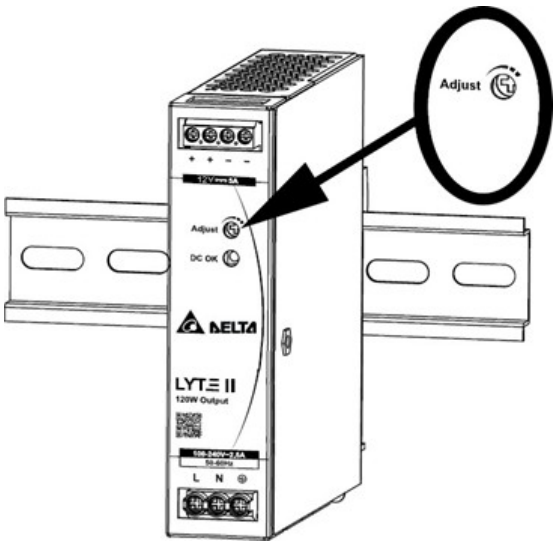
#### WARNING

Disconnect AC power to the sensor and allow residual power to dissipate for a period of not less than 1 minute prior to internal maintenance of the device.



1. Disconnect the wires.
2. Using the screw driver open the latch at the base to release the module from the DIN rail.
3. Remove the circuit breaker or the power supply from the DIN rail.
4. Install the new module on the DIN rail.
5. Push the latch closed with a finger or the screw driver.
6. Connect the wires.

7. Measure the DC voltage across both + and - terminals of the 12 VDC power supply. It should be  $13.2 \text{ VDC} \pm 0.1 \text{ VDC}$ . Adjust the potentiometer on the power supply as necessary to obtain  $13.2 \text{ VDC} \pm 0.1 \text{ VDC}$ . If the 24 VDC power was replaced, measure across both sets of both + and - terminals WHT and RED are +24 VDC with respect to both BLK wires (GND).



**Figure 70.** Adjust +12 VDC Power Supply to  $+13. \pm 0.1 \text{ VDC}$

### 5.4.22.2 Surge Protection Removal and Replacement

This module will usually cause a blown supply fuse if it is defective.

Item	Description
Task Description	Remove and replace EMC / Surge protection Modules
Purpose of Task	Remove defective unit
Tools Required	Heat shrink sleeving , Heat shrink gun.
Time to complete	30 minutes



#### WARNING

- Ensure power is disconnected before starting work on this unit.
- Ensure the earth connection is reconnected to this unit or it will not function correctly.



1. Remove outer cover.
2. Remove enclosure cover.
3. Locate the failed surge protection module.
4. Disconnect input and output power lines.
5. Remove from din rail.
6. Repair wire terminals as required by failure.
7. Check wiring is correct.
8. Close and repower unit.
9. Check device operation.
10. This completes the procedure.

### 5.4.22.3 Air Filter Condition Check & Replacement

Item	Description
Task Description	Check air filter is not clogged up.
Purpose of Task	To ensure proper air flow across the transmission windows.
Tools Required	Allen keys
Time to complete	5 minute



**WARNING**

There are lethal voltages around this area when the fans and / or heaters are operating. All areas of concern are covered and insulated however care should be taken not to pull on nor sever any of the wires in this area.

1. Remove the instrument hood.
2. Visually inspect the filter. IT should not be clogged with dirt and dust or any other obstruction such as insects or webs,etc.
3. If the filter is clogged it will need to be replaced.
4. Disconnect the power to the sensor
5. Undo the four screws and remove the old filter.
6. Replace with new filter unit.
7. Fasten four screws. Ensure that they are not over-tightened as they are screwed in ABS plastic.
8. Replace Filter cover.
9. Replace hood.
10. Reinstate power to sensor.
11. Connect to data terminal.
12. Check airflow is present and correct.
13. Dispose of old filter.
14. Procedure complete.

### 5.4.22.4 Transmitter Head Removal and Replacement

The whole Transmitter head is considered to be an LRU. There are no field replaceable components inside the head.

Item	Description
Task Description	Removal and Replacement of the Transmitter head
Purpose of Task	Replace defective or aged Transmitter head.
Tools Required	Installation Toolkit
Time to complete	15 minutes



#### WARNING

- Ensure Power has been off for at least 5 minutes to allow High Voltage to discharge.
- Ensure that heat has been allowed to dissipate if boost heaters are installed in the heads.

1. Disconnect power to the sensor.
2. Remove the sensor hood.
3. Screw out the 2 grub screws holding the head in position.
4. Carefully and slowly pull the head upwards. Turn it slightly backward and forwards to release resistance fit if necessary. Do not force. Check the grub screws again if you are finding it difficult.
5. Disconnect MIL-Spec connector.
6. Place defective carefully down.
7. Attached new head to the MIL-SPEC connector.
8. Screw out the grub screws until head is firmly in position.
9. Reconnect power to the sensor.
10. Re-alignment is required.
11. Perform are-calibration.
12. This completes the procedure.

### 5.4.22.5 Fan Removal Procedure

Being a moving part it is possible for the fan to fail over time.

Item	Description
Task Description	Removal and Replacement of the fan sub-assembly
Purpose of Task	Ensure sufficient air flow over window
Tools Required	Installation Toolkit
Time to complete	15 minutes



#### WARNING

- Ensure Power has been off for at least 5 minutes to allow High Voltage to discharge.
- Ensure that heat has been allowed to dissipate if boost heaters are installed in the heads.

1. Disconnect power to the sensor.
2. Remove the sensor hood.
3. Remove the fan cover plate and filter.
4. Disconnect the fan connection in the termination box within the filter area.
5. Remove fan screws.
6. Replace fan with new fan unit.
7. Terminate fan power cable in termination box.
8. Reinststate power to sensor.
9. Connect to data terminal.
10. Check airflow is present and correct.
11. Replace all covers, filters, etc.
12. Dispose of old fan unit.
13. Procedure Completed.

### 5.4.22.6 Control Board Removal and Replacement

The M404972-00 Control Board contains settings that control the operation of the unit and also the user's particular specified configuration. The settings need to be recorded, so that they can be exactly reset if the Control Board needs to be replaced. If these settings are not available either the factory defaults can be used.

Item	Description
Task Description	Removal and replacement of the Main Board
Purpose of Task	In the event of failure of the Main Board, or upgrade.
Time to complete	2 minutes



#### WARNING

- Ensure Power has been off for at least 5 minutes to allow High Voltage to discharge.
- Do not attempt to connect the APD Signal Coaxial cable to the Laser HV supply connector.

1. Record all User settings if possible or obtain test sheet showing settings.
2. Remove enclosure cover.
3. Disconnect all cables.
4. Remove the card from the DIN rail.
5. Install replacement card
6. Re-attach cables.
7. Re-establish contact with the sensor via data terminal and change the user settings to match the recorded settings.
8. IF desired operation is not achieved run the installation procedure elements relating to device setup and change settings where appropriate.



#### NOTE

The factory settings on spare Control boards are set to the default settings. These settings may need to be updated for optimum operation on your particular device.

## 5.5 Boot Loader

The 8400-eMOR boot loader runs each time the processor starts up to load the operating system into the main memory. It will wait for input from the boot loader application in three different cycles. The boot loader can only be run with the boot loader application provided by ADB.

If a firmware image is present in flash memory, the application will continue to load the operating system. Otherwise, the boot loader will start over.

```
*****
* ADBSG BOOTLOADER *
* Waiting for firmware image... *
* Waiting for firmware image... *
* Waiting for firmware image... *
Running main application...
8400-EMOR Transmisometer Controller V4.0.0
An ADBSG Product

Please wait 5 seconds for initialization...

B.i.T.E TEST

RS485 Port          OK
```

## 5.6 Firmware Updates

### 5.6.1 Access the Serial Port

The serial port on the Transmitter Control Board must be used to access the microprocessor for firmware updates. Connect the jumper across JP4 to select RS-232 and use the RS-232 pins as shown in Figure 71.

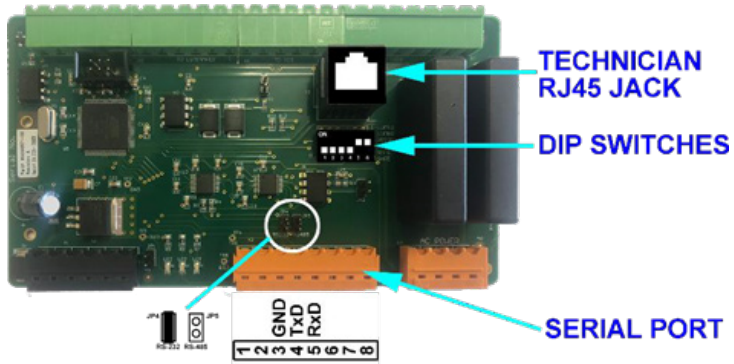


Figure 71. Firmware Update Connections to Serial Port

## 5.6.2 Firmware Update Instructions

1. Extract files from **eMOR\_Firmware\_Update.zip** from the M469126-00 flash drive to an **8400 Firmware Update** folder on your laptop.
2. Place the updated **controller.load** firmware file in the same **8400 Firmware Update** folder on your laptop.
3. Use a serial to USB converter to connect one of the computer's USB ports to pins 3, 4, and 5 of the serial port on the Transmitter Control Board.
4. Double-click **eMOR\_controller\_firmware\_update.bat** to install the firmware update.
5. Power-cycle the Transmitter control box to begin the updates. Here is how the run will look to start,

```
Firmware Upload Tool
*****
Firmware file 'controller.load' read successfully. Total size: 53006 bytes.
Header size: 94 bytes
Firmware content size: 52908 bytes
Total pages to send: 207
CRC: db444068
Attempting to open serial port COM1 at 9600 baud...
Serial port opened successfully.
Waiting for bootloader ready message...
ID A V 01200 B 00000 P // // // // // S33B390/

*****
* ADBSG BOOTLOADER *

* Waiting for firmware image... *

Bootloader ready message received.
Starting firmware upload...
Sending header: 94 bytes
Waiting for 'Flashing firmware image...' message...

Header: AWI_FIRMWARE
```

...while loading,

```
Received 30720 bytes...
Acknowledgment received for 30720 bytes.
Sending page 121/207, size: 256 bytes

Waiting for acknowledgment of 30976 bytes...

Received 30976 bytes...
Acknowledgment received for 30976 bytes.
Sending page 122/207, size: 256 bytes

Waiting for acknowledgment of 31232 bytes...

Received 31232 bytes...
Acknowledgment received for 31232 bytes.
Sending page 123/207, size: 256 bytes

Waiting for acknowledgment of 31488 bytes...

Received 31488 bytes...
Acknowledgment received for 31488 bytes.
Sending page 124/207, size: 256 bytes

Waiting for acknowledgment of 31744 bytes...

Received 31744 bytes...
Acknowledgment received for 31744 bytes.
Sending page 125/207, size: 256 bytes
```

...when complete.

```
Found firmware image, analyzing...
CRC OK
Received valid firmware image...

*****
* ADBSG BOOTLOADER *

* Waiting for firmware image... *

* Waiting for firmware image... *
Firmware and CRC uploaded successfully via serial port COM1
Press any key to continue . . . |
```

6. Disconnect the laptop.
7. Restore the RS-232 or RS-485 data interface, including the jumper setting for an Rs-485 interface.

## 6. Command Interface

### 6.1 Factory Settings

In all subsequent restarts, the user parameter set will be used, unless the 8400-eMOR is returned to the FACTORY settings by issuing of the command in the command interpreter.

#### **SET FACTORY [Enter]**

To display the current set of parameters, from Advanced Level enter the command:

#### **GET PARAMS [Enter]**

A message similar to the following is displayed:



#### **NOTE**

The prompts have been removed from the following output for clarity.

---

#### **CONTROLLER PARAMETERS**

##### **SITE A**

**K 4987**

**Autocal Threshold = 8000**

**Autocal Interval [min] = 720**

**Visibility Report Threshold = 12000**

**Message Type = 9**

**Max Reported Visibility 25000**

**Max Reported RVR 2000**

**Fan Mode Auto**

**Fan Hold Time 10 mins**

## 6.2 Command Listing



### CAUTION

It is possible to change settings on the device so that it no longer complies with your local authority's requirements and possibly also compliance with ICAO/WMO. The factory defaults are set for full compliance. Ensure when changing settings that impact the range of the device or the reporting thresholds that your settings are in line with your organizations policies.



### NOTE

It is recommended that the user of the device record the as installed values for any setting they wish to modify so that it may be reverted should the desired outcome not be achieved.

### 6.2.1 General Controller Commands

Command	Alias	Unit	Function	Min	Max	Default
<b>RESET</b>			Resets the controller.			
<b>OPEN</b>			Opens the unit for commands.			
<b>CLOSE</b>			Puts the unit into RUN mode.			
<b>GET STATUS</b>	<b>GS</b>		List status information of device.			
<b>SET SITE</b>	<b>SS</b>		Sets the site identifier.			A
<b>DECODE STATUS</b>	<b>DS</b>		Decodes the MITRAS status message into readable text.			
<b>GET PARAMETERS</b>	<b>GP</b>		Request readout of parameters via RS232 at the controller source or receiver, depending on where connected.			
<b>CLEAN</b>	<b>CL</b>		Initializes the base level for contamination level Measurement.			
<b>ESCAPE</b>	<b>ESC</b>		Aborts the alignment procedure.			
<b>GET ERRORS</b>	<b>GE</b>		List the error log.			
<b>GET VERSION</b>	<b>GV</b>		Display the controller version number.			
<b>CLEAR ERRORS</b>	<b>CE</b>		Clear the error log.			
<b>SET FACTORY</b>	<b>SF</b>		Sets to Factory Defaults			

**6.2.2 Controller Measurement Commands**

Command	Alias	Unit	Function	Min	Max	Default
<b>DO ALIGN</b>	<b>DA</b>		Send the alignment command to the receiver head. This command passes through into the head and becomes the \$ALIGN command as if entered directly into the head via the local maintenance port.			
<b>DO CAL XXXXX</b>	<b>DC</b>	meters	Do a calibration now. Input the observed MOR from either another device or a human observer. See caution below.	10000	20000	15000
<b>SET MAXVIS XXXXX</b>	<b>SMV</b>	meters	Maximum reading from the Visibility sensor .	10000	80000	50000
<b>SET MAXRVR XXXXX</b>	<b>SMR</b>	meters	Set to the limit of the Transmissometer operating on its own.	2000	10000	3000
<b>SET ATP XXXXX</b>	<b>SA</b>	meters	Auto-calibration Threshold. A zero value disables automatic calibration.	1500	20000	8000
<b>SET VRP XXXX</b>	<b>SV</b>	meters	Reporting threshold. Usually set in the range 500-2000 m, this selects the value, above which the Visibility sensor value is reported in place of the Transmissometer reading.	0	10000	1200
<b>SET BASELINE</b>	<b>SB</b>	meters	Sets the device baseline to either 30, 50 or 75 m	30	75	30
<b>SET AUTOCAL INTERVAL</b>	<b>SAI</b>	min	Sets the minimum time between auto-calibration runs.	10	1000	720
<b>SET VIS MONITOR ON</b>	<b>SVM N</b>		Turns on debugging for the Visibility sensor			
<b>SET VIS MONITOR OFF</b>	<b>SVM O</b>		Turns off debugging for the Visibility sensor			Yes

**CAUTION**

The "DO CAL XXXXX" command should only be performed in conditions where the observed MOR is between 10,000 and 20,000 meters.

### 6.2.3 Controller Message Commands

Command	Alias	Unit	Function	Min	Max	Default
<b>SET CALC ON</b>	<b>SCN</b>		Message Output with Diagnostic data.			
<b>SET CALC OFF</b>	<b>SCF</b>		Turn off Message Output with Diagnostic data.			Yes
<b>MESSAGE LIST</b>	<b>ML</b>		Lists the message numbers and their corresponding descriptions			
<b>SET MESSAGE 0</b>	<b>SMT 0</b>		Industry Standard MITRAS Message with status.			Yes
<b>SET MESSAGE 1</b>	<b>SMT 1</b>		TX,RX, Vis and Luminance output each second			
<b>SET MESSAGE 2</b>	<b>SMT 2</b>		Industry Standard MITRAS Message, with values set by \$TESTMOR and \$TESTLUM			
<b>SET MESSAGE 3</b>	<b>SMT 3</b>		Forward Scatter Visibility Meter message output each second.			
<b>SET MESSAGE 4</b>	<b>SMT 4</b>		Luminance cd/m <sup>2</sup> output each second.			
<b>SET MESSAGE 5</b>	<b>SMT 5</b>		Rx, TX in CSV format.			
<b>SET MESSAGE 6</b>	<b>SMT 6</b>		Tx signal internal units each second.			
<b>SET MESSAGE 7</b>	<b>SMT 7</b>		Rx signal internal units each second.			
<b>SET MESSAGE 8</b>	<b>SMT 8</b>		Bite message.			
<b>SET MESSAGE 9</b>	<b>SMT 9</b>		Tx Status Message			
<b>SET MESSAGE 10</b>	<b>SMT 10</b>		Rx Status Message			
<b>SET RS485 ON</b>	<b>SRN</b>		Turns the RS-485 Bus on			Yes
<b>SET RS485 OFF</b>	<b>SRO</b>		Turns the RS-485 Bus off			
<b>SET TESTMOR XXXX</b>	<b>STM</b>	MOR	Value of MOR inserted into MSG2.	1	10000	2000
<b>SET TESTLUM XXXX</b>	<b>STL</b>	LUM	Value of Background Luminance inserted into MSG2.	1	60000	5000
<b>SET REPORT RATE</b>	<b>SRR</b>	SEC	Sets the reporting rate for the messages in seconds.	1	3600	10
<b>GET REPORT RATE</b>	<b>GRR</b>					
<b>SET POLLING ON</b>	<b>SPN</b>		Sets polling mode on.			
<b>SET POLLING OFF</b>	<b>SPO</b>		Sets Polling Mode off.			Yes
<b>POLL</b>	<b>?</b>		Poll the sensor for output.			

#### CAUTION



The SET CALC ON command should only be used by suitably factory trained personnel or under the guidance of the manufacturer.

### 6.2.4 Transmitter Maintenance Commands

These commands are input into the maintenance port of the Transmitter head.

Command	Command Alias	Unit	Function	Min	Max	Default
<b>\$SBL=</b>		Counts	Bias LED initial value	2	100	30
<b>\$SDO=</b>		Counts	Photodiode offset current	1000	2200	2100
<b>\$SDC=</b>		Counts	Source LED set-point	2000	15000	12000
<b>\$SDI=</b>		Counts	Source LED initial value	100	2000	800
<b>\$SCL=</b>		Counts	Source Window contamination limit	0	1500	100
<b>\$SGP</b>			Lists the source parameters.			



**NOTE**

These values are set on test at the factory and are unique to each device. The default values are approximate only.

### 6.2.5 Receiver Maintenance Commands

These commands are input into the maintenance port of the Receiver head.

Command	Command Alias	Unit	Function	Min	Max	Default
<b>\$RBL=</b>		Counts	Bias LED initial value	2	100	30
<b>\$RDO=</b>		Counts	Photodiode offset current	1000	2200	2100
<b>\$RCL=</b>		Counts	Receiver Window contamination limit	0	1500	100
<b>\$RGP</b>			Lists receiver parameters.			



**NOTE**

These values are set on test at the factory and are unique to each device. The default values are approximate only.

### 6.2.6 Factory Transmitter Configuration Commands

These commands are input at the Transmitter via RS-232.

Command	Command Alias	Unit	Function	Min	Max	Default
<b>SET LEDC=XXXX</b>		Intensity	Setpoint for the LED intensity, when intensity control is used. If current control is used, set LEDC to 0. Normal setting is in the range 10,000 to 20000 intensity units.	8000	20000	
<b>SET LEDI=XXXX</b>		Intensity	Setpoint for LED current	200	1600	

#### CAUTION



The above commands are set by the factory whilst the device is undergoing its initial test, calibration and certification. The above commands should only be changed under the guidance of the manufacturer.

#### NOTE



It is recommended that the user of the device record the as installed values for any setting they wish to modify so that it may be reverted should the desired outcome not be achieved.

## 6.3 Data Message

The data format from COM1 complies with the industry standard MITRAS message type 8.

The message frame consists of a wrapper for the ASCII Text Message

**<STX>TEXT<CR>< LF> <ETX>**

where :

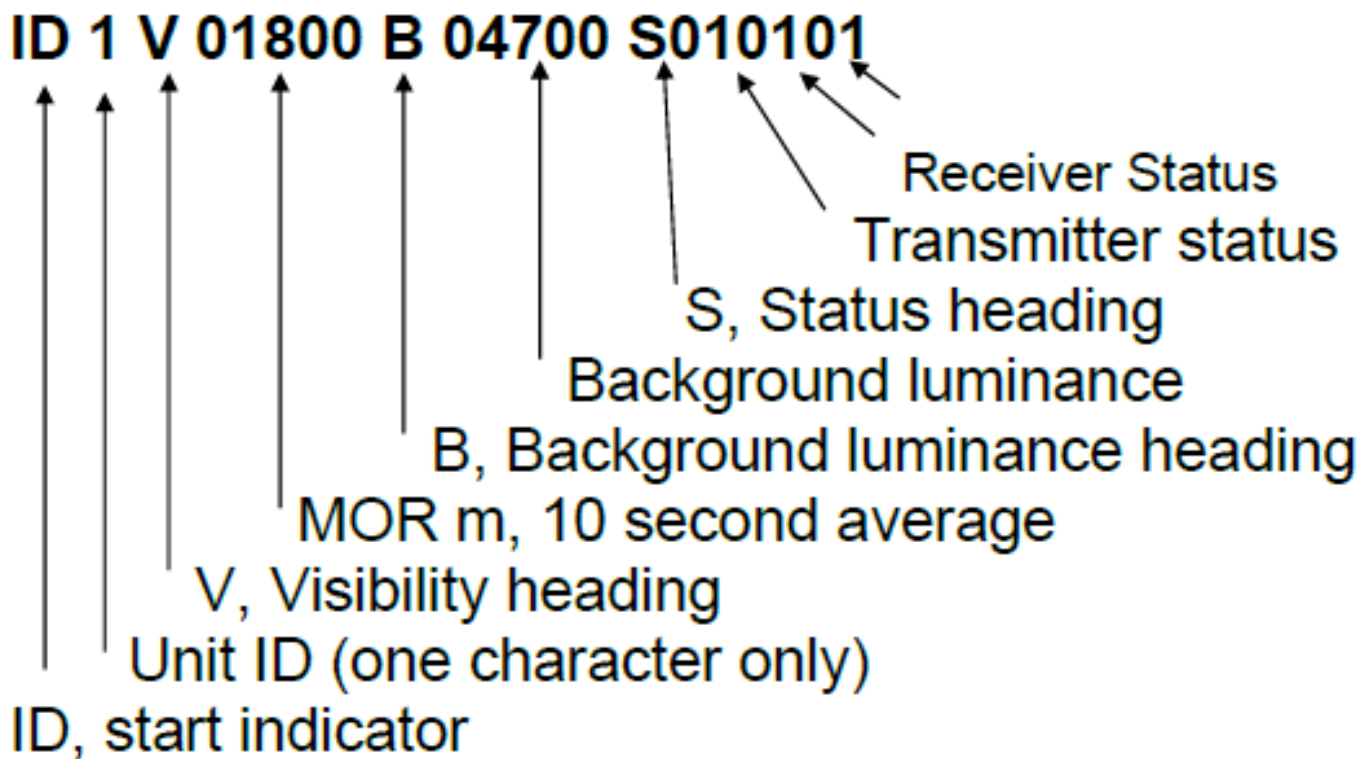
**STX = ASCII 0x2**

**ETX = ASCII 0x3**

**CR = ASCII 0xd**

**LF= ASCII0xa**

and **TEXT** is :



### NOTE

The last two digits are not used and are fixed at 01 for compliance with the message format This is also done on the later generation LT-31 MITRAS emulation.

**6.3.1 Data Message Status Fields**

The bits are encoded as hexadecimal nibbles abcdef in the format **Sabcdef**.

Code	MITRAS Status Items	eMOR Status Items	Coding
	TRANSMITTER (A)		
a0=1	HEATING ON	HEATING ON	1=ON
a1=2	CONT/OTHER	ANY OTHER TX ALARM	1=ALARM
a2=4	OPTICAL SURFACE	OPTICAL SURFACE	1=CONTAMINATED
a3=8	POWER SUPPLY	POWER SUPPLY	1=FAIL
	TRANSMITTER (B)		
b0=1	MEASUREMENT MODE	MEASUREMENT MODE	1=ON
b1=2	FLASH LAMP	LED FAIL	1=FAIL
b2=4	BL METER	BL METER	1=CONNECTED
b3=8	MEASUREMENT LOOP	LIGHT OVER-RANGE	1=FAIL
	RECEIVER (C)		
c0=1	HEATING ON	HEATING ON	1=ON
c1=2	CONT/OTHER	ANY OTHER RX ALARM	1=ALARM
c2=4	OPTICAL SURFACE	OPTICAL SURFACE	1=CONTAMINATED
c3=8	POWER SUPPLY	POWER SUPPLY	1=FAIL
	RECEIVER (D)		
d0=1	MEASUREMENT MODE	MEASUREMENT MODE	1=ON
d1=2	CALIBRATION	BACKGROUND LEVEL	1=FAIL
d2=4	TEST	SIGNAL LEVEL	1=FAIL
d3=8	CONSISTENCY	VIS METER	1=FAIL
	UNUSED (E)		
e0=1	RESERVED	FIXED	0=FIXED
e1=2	RESERVED	FIXED	0=FIXED
e2=4	RESERVED	FIXED	0=FIXED
e3=8	RESERVED	FIXED	0=FIXED
	UNUSED (F)		
f0=1	RESERVED	FIXED	1=FIXED
f1=2	RESERVED	FIXED	0=FIXED
f2=4	RESERVED	FIXED	0=FIXED
f3=8	RESERVED	FIXED	0=FIXED



**NOTE**

The last two digits are not used and are fixed at "01" for compliance with the message format

---



**NOTE**

Use the "DECODE STATUS" command in the controller interface so the six digit status message can be decoded to identify and resolve the issue in the field without having to refer to the manual.

---

**6.3.2 BITE**

This message is generated by the controller as an alternative to the MITRAS message and is designated message type 8. It is available in continuous output mode only.

Data Fields	Index	Width	Description	Range
			Comma separated data fields as per below	
0x1	0	1	Control Prefix.	0x1
S	1	1	Status Prefix	S
c	2	1	site	A-Z
,	3			,
VVVVV	4	5	MOR in meters from Transmissometer	0-59999
,	9			,
www	10	5	MOR in meters from Visibility sensor	0-59999
,	15			,
T or F	16	1	Source of reported MOR	T or F
,	17			,
LLLLL	18	5	Background Luminance CD / Sqrm	0-59999
,	19			,
CCCCCCC	24	7	Calibration Constant	0-9999999
,	31			,
zzzz	32	4	Calibration Offset	0-999
,	36			,
EE.E	37	4	Source PS Voltage	0-200
,	41			,
+TT	42	3	Source Internal Temperature	-99 to +99
,	45			,
www	46	3	Window Transmission Pct	0-999
,	49			,
SSSSS	50	5	Source Light Level	0-32767
,	55			,
HTH	56	3	Heat Percentage	0-999
,	59			,
PPPPP	60	5	Light Level Setpoint	0-32767
,	65			,
LSLS	72	4	Light Current Value	0-9999
,	76			,
EE.E	77	4	Receiver PS Voltage	0-200
,	81			,

Data Fields	Index	Width	Description	Range
+TR	82	3	Receiver Internal Temperature	-99 to +99
,	85			,
www	86	3	Window Transmission Pct	0-999
,	89			,
RRRRR	90	5	Receiver Light level	0-32767
,	95			,
XPOS	96	4	Alignment X value	0-999
,	100			,
YPOS	101	4	Alignment Y value	0-999
,	105			,
bbbb		4	background level	0-4095
S1S1	106	4	Source Status	
,	110			,
R1R1	111	4	Receiver Status	
,	115			,
L1L1	116	4	Luminance Sens or status	
,	120			,
v1v1	121	4	Visibility Sensor status	
,	125			,
CSCS	126	4	Checksum	0-9999
0x03	130			0X03
CR	131	0	carriage Return	



**NOTE**

Change to this message type by typing "SET MESSAGE TYPE 8" or "SMT 8" into the controller interface.

### 6.3.3 Transmitter Status Message

This message can be viewed on the RS-485 bus. It can also be viewed as Message Type 9.

Data Fields	Description	Index
	Comma separated data fields	
*T	Status Prefix	0
,		2
EE.E	Source PS Voltage	3
,		7
+TT	Source Internal Temperature	8
,		11
www	Window Transmission Pct	12
,		15
SSSSS	Source Light Level	16
,		21
HTH	Heat Percentage	22
,		25
PPPPP	Light Level Setpoint	26
,		31
bbbb	background	32
,		37
iiii	Lamp Current	38
,		42
c	Checksum	43

### 6.3.4 Encoded Transmitter Status Description

BIT	Description	Value
0	Ambient Light Suppression out of range	1
1	Signal Over scale	2
2	Lamp Low	4
3	Lamp Fail	8
4	Window contamination	16
5	Over temp Alarm	32
6	Under temp Alarm	64
7	Low Power Supply	128
8	High Power Supply	256
9	Lamp Control Out of Range	512
10	Receiver No reply	1024
11	Temperature Below Zero	2048

### 6.3.5 Receiver Status Message

This message can be viewed on the RS485 bus. It can also be viewed as Message Type 10.

Data Fields	Description	Index
	Comma separated data fields	
*R	ID	0
,		2
EE.E	Receiver PS Voltage	3
,		7
+TR	Receiver Internal Temperature	8
,		11
www	Window Transmission Pct	12
,		15
RRRRR	Receiver Light level	16
,		21
XPOS	Alignment X value	22
,		26
YPOS	Alignment Y value	27
,		31
BBBB	Background signal	32
,		36
c	Checksum	37
CR	carriage Return	38

### 6.3.6 Encoded Receiver Status Description

BIT	Description	Value
0	Ambient Light Suppression out of range	1
1	Signal Over scale	2
2	Lamp Low	4
3	Lamp Fail	8
4	Window contamination	16
5	Over temp Alarm	32
6	Under temp Alarm	64
7	Low Power Supply	128
8	High Power Supply	256
9	Lamp Control Out of Range	512
10	Receiver No replay	1024
11	Temperature Below Zero	2048

## 7. Troubleshooting Guide

### 7.1 Troubleshooting Procedures

This section describes the best practice when troubleshooting issues with the 8400-eMOR Transmissometer.

The goal of the troubleshooting procedure is to find the root cause of issues relating to the operation of the device. By systematically checking elements of the Transmissometer operation, we can quickly identify which hardware component or firmware setting is causing the issue.

Failure situations are usually caused by dirty optics or obstructions in the optical path. The devices status message includes information on suspect modules in its output.

If damage is discovered or suspected on a sub-assembly then please remove and replace the suspect component and return to ADB Safegate for testing or replacement.

In each case the procedure to change the LRU is described in the Maintenance Manual.



#### **CAUTION**

Replacement of LRU components should only be undertaken by suitably qualified maintenance staff. Field maintenance should be limited to only the replacement of LRU components. Please refer to the Maintenance Manual for information on the removal and replacement of LRU components.

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What follows is a series of test procedures designed to systematically determine the cause of the fault and describe a remedy for correcting the fault.

Fault	Areas to check	Corrective Procedures
Unit will not communicate	<ul style="list-style-type: none"> <li>• Check power to device.</li> <li>• Check power to communications device.</li> <li>• Check power to controller.</li> <li>• Check power supply operation. Observe physical appearance for signs of damage or wear. The middle green led flashes once a second as indicative heartbeat.</li> <li>• Check voltages with multi-meter to ensure they are to specification.</li> <li>• Check connection to controller.</li> <li>• Perform loop back test on communications link.</li> <li>• Check Communications device configuration.</li> <li>• Check controller green LED which should flash on incoming data.</li> <li>• Check antenna orientation</li> <li>• Check for cable damage (feeder, xTP, fiber)</li> <li>• ICMP Ping the device.</li> <li>• Check internal cable connections in enclosure.</li> <li>• Check serial communications settings</li> </ul>	<ol style="list-style-type: none"> <li>1. Reload Firmware.</li> <li>2. Replace Control Board.</li> <li>3. Replace Power Supply</li> </ol>

Fault	Areas to check	Corrective Procedures
Unit communicates but will not open configuration mode	<ul style="list-style-type: none"> <li>• Check serial communications settings and jumpers RS-232 vs RS-485.</li> <li>• Check communications cables</li> <li>• Check for faulty controller.</li> </ul>	<ol style="list-style-type: none"> <li>1. Reload Firmware.</li> <li>2. Replace Control Board.</li> </ol>

Fault	Areas to check	Corrective Procedures
Configuration settings not retained	<ul style="list-style-type: none"> <li>• Check for physical damage to the Controller Board.</li> </ul>	<ol style="list-style-type: none"> <li>1. Record User Settings.</li> <li>2. Reload Firmware.</li> <li>3. Replace Control Board.</li> </ol>

Fault	Areas to check	Corrective Procedures
No light from source	<ul style="list-style-type: none"> <li>• Power supply</li> <li>• Head Cable</li> <li>• Terminations</li> </ul>	<ol style="list-style-type: none"> <li>1. Replace head.</li> <li>2. Recalibrate</li> </ol>

<b>Fault</b>	<b>Areas to check</b>	<b>Corrective Procedures</b>
Low Output from LED	<ul style="list-style-type: none"> <li>• Power supply (Low DC Voltage)</li> <li>• Power supply (Low AC Voltage)</li> <li>• Head Cable</li> <li>• Terminations</li> <li>• Obstructions</li> </ul>	<ol style="list-style-type: none"> <li>1. Replace head</li> <li>2. Recalibrate</li> </ol>
LED flashes intermittently	<ul style="list-style-type: none"> <li>• Power supply (Low DC Voltage)</li> <li>• Power supply (Low AC Voltage)</li> <li>• Head Cable</li> <li>• Terminations</li> <li>• Obstructions</li> </ul>	<ol style="list-style-type: none"> <li>1. Replace head</li> <li>2. Recalibrate</li> </ol>
Loss of data from Transmitter head	<ul style="list-style-type: none"> <li>• Check RS-485 Bus</li> <li>• Check cabling</li> <li>• Check connections</li> <li>• Disconnected Receiver head cable?</li> </ul>	<ol style="list-style-type: none"> <li>1. Replace Control Board.</li> </ol>
Loss of data from receiver	<ul style="list-style-type: none"> <li>• Check RS-485 Bus</li> <li>• Check cabling</li> <li>• Check connections</li> <li>• Disconnected Receiver head cable?</li> </ul>	<ol style="list-style-type: none"> <li>1. Replace Control Board.</li> <li>2. Replace RS-485 Interface Board in Receiver enclosure.</li> </ol>
Fail to calibrate	<ul style="list-style-type: none"> <li>• Light signal levels</li> <li>• T counts should be &gt; 2000</li> <li>• R Count should be &gt; 2000</li> <li>• Mechanical alignment</li> <li>• Fine alignment</li> </ul>	<ol style="list-style-type: none"> <li>1. Perform alignment.</li> <li>2. Replace head(s)</li> </ol>
Failure to fine align	<ul style="list-style-type: none"> <li>• Receiver head connection</li> </ul>	<ol style="list-style-type: none"> <li>1. Replace cable to Receiver head.</li> </ol>

Fault	Areas to check	Corrective Procedures
High levels of window contamination	<ul style="list-style-type: none"> <li>• Filter</li> <li>• Fan</li> <li>• Fan power</li> <li>• Local conditions</li> </ul>	<ol style="list-style-type: none"> <li>1. Replace LRUs as required.</li> </ol>
Fogging on window	<ul style="list-style-type: none"> <li>• Enclosure vent</li> <li>• Head seal integrity</li> <li>• Blower failure</li> </ul>	<ol style="list-style-type: none"> <li>1. Replace LRUs as required.</li> </ol>
Blowers not operating	<ul style="list-style-type: none"> <li>• Ambient temperature</li> <li>• Blower cable</li> <li>• Power supply voltage</li> </ul>	<ol style="list-style-type: none"> <li>1. Replace blower.</li> <li>2. Replace head(s).</li> </ol>
Luminance data missing	<ul style="list-style-type: none"> <li>• Model 5000 Luminance sensor operation</li> <li>• Luminance sensor cable</li> <li>• DC power supply voltage</li> </ul>	<ol style="list-style-type: none"> <li>1. Replace LRUs as required.</li> </ol>
Luminance low	<ul style="list-style-type: none"> <li>• Local conditions</li> <li>• Sensor operation</li> <li>• Obscuration check</li> <li>• Cleaning of device</li> <li>• Physical orientation of devices</li> </ul>	<ol style="list-style-type: none"> <li>1. Replace LRUs as required.</li> </ol>
Luminance high	<ul style="list-style-type: none"> <li>• Local conditions</li> <li>• Sensor operation</li> <li>• Obscuration check</li> <li>• Cleaning of device</li> <li>• Physical orientation of devices</li> </ul>	<ol style="list-style-type: none"> <li>1. Replace LRUs as required.</li> </ol>

Fault	Areas to check	Corrective Procedures
Co-located Visibility sensor data missing	<ul style="list-style-type: none"> <li>• Sensor operation</li> <li>• Communications cables</li> <li>• Power Supply voltage</li> <li>• Controller settings</li> </ul>	<ol style="list-style-type: none"> <li>1. Replace LRUs as required.</li> </ol>
Co-located visibility sensor reading is low	<ul style="list-style-type: none"> <li>• Local conditions</li> <li>• Sensor operation</li> <li>• Obscuration check</li> <li>• Cleaning of device</li> <li>• Physical orientation of devices</li> </ul>	<ol style="list-style-type: none"> <li>1. Replace LRUs as required.</li> </ol>
Visibility sensor reading high	<ul style="list-style-type: none"> <li>• Obscurations</li> </ul>	<ol style="list-style-type: none"> <li>1. Clean sensor</li> <li>2. Calibration check.</li> </ol>
Co-located visibility sensor error flag	<ul style="list-style-type: none"> <li>• Set message to "3" to verify data input</li> </ul>	<ol style="list-style-type: none"> <li>1. Run Visibility Sensor setup and calibration check.</li> <li>2. Replace LRUs as required.</li> </ol>
Sudden drop in low-visibility	<ul style="list-style-type: none"> <li>• Inspect Transmissometer cleanliness</li> <li>• Light Output levels</li> <li>• Power supply voltages (DC)</li> <li>• Power Supply Voltages (AC)</li> <li>• Local Weather Conditions</li> <li>• Window integrity</li> </ul>	<ol style="list-style-type: none"> <li>1. Inspect, clean device.</li> <li>2. Replace Transmitter head.</li> <li>3. Replace Receiver Head.</li> </ol>
Sudden increase in high visibility	<ul style="list-style-type: none"> <li>• M482306-00 PW/Visibility sensor obscuration.</li> </ul>	<ol style="list-style-type: none"> <li>1. Clear optical path below measurement area.</li> </ol>

Fault	Areas to check	Corrective Procedures
Failure to detect high visibility	<ul style="list-style-type: none"> <li>• Check M482306-00 PW/Visibility sensor is present.</li> <li>• Check M482306-00 PW/Visibility sensor is connected.</li> <li>• Check M482306-00 PW/Visibility sensor output.</li> <li>• Check M482306-00 PW/Visibility sensor cable for damage.</li> <li>• Check M482306-00 PW/Visibility sensor for physical damage.</li> </ul>	<ol style="list-style-type: none"> <li>1. Calibrate M482306-00 PW/ Visibility sensor.</li> <li>2. Replace M482306-00 PW/Visibility sensor.</li> </ol>

Fault	Areas to check	Corrective Procedures
Sudden significant drop in visibility	<ul style="list-style-type: none"> <li>• Check actual conditions.</li> <li>• Check for spider webs.</li> <li>• Check for nesting birds.</li> <li>• Check for loose rubbish.</li> <li>• Check for lens damage.</li> <li>• Check heads for damage.</li> <li>• Check status messages.</li> <li>• Check LED strength.</li> </ul>	<ol style="list-style-type: none"> <li>1. Remove blockage.</li> <li>2. Clean sensor.</li> <li>3. Replace lens.</li> </ol>

## 7.2 Serial Communication Protocols

### 7.2.1 RS-422 AND RS-485

#### 1. What is RS-232 ?

RS-232 is one of the earliest signaling standards for computers. It defines nominal signaling levels -10 Vand +10 V, and pin connections for 25-pin and 9-pin connectors. Because of the unbalanced signaling standard, there is a limit of about 10 m of normal (untwisted pair) cable for RS-232.

#### 2. What is RS-422?

RS-422 is a technical standard that specifies electrical characteristics of a digital signaling circuit on copper twisted pair cables. It does not define connector pins, as RS-232 does. The differential signaling in RS-422 can transmit data at rates as high as 10 million bits per second on cables as long as 1500 m. Some systems interconnect directly using RS-422 signals, or RS-422 converters may be used to extend the range of RS-232 connections. The standard only defines signal levels; other properties of a serial interface are set by other standards.

In the case of RS-422 4 wire, the data flow is full duplex, and no protocol is required for interfacing via RS-422. It is very often used in place of RS-232 when the length of the cable is beyond a reliable RS-232 length.

RS-422 can also be used for one-way transmission, and because of its drive capabilities it can be used to drive multiple receivers.

RS-422 can be used for purposes other than data transmission, for example firing, or synchronization pulses, timing signals, frequency references, etc.

#### 3. What is RS-485?

RS-485 is a technical standard that specifies electrical characteristics of a digital signaling circuit on copper twisted pair cables. EIA-485 only specifies the electrical characteristics of the driver and the receiver. It does not specify or recommend any communications protocol.

The physical link is a single twisted pair cable. This means the channel is half-duplex and a medium access control protocol is required. The topology allows for multiple devices to share the medium, and to enable this, all the drivers have to be able to disconnect from the channel. Protocols vary, and include Modbus, Profibus, CAN, VAN, etc. Some protocols allow a master-multiple slave configuration, others allow multiple masters.

#### 4. What is the maximum Range of RS-422 and RS-485?

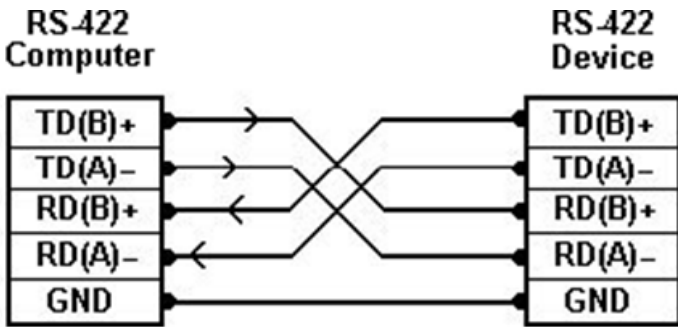
A rule of thumb is that the speed in bits/s multiplied by the length in meters should not exceed  $10^8$ . Thus a 50 m cable should not signal faster than 2 Mbit/s.

#### 7.2.2 Connecting RS-422 Devices

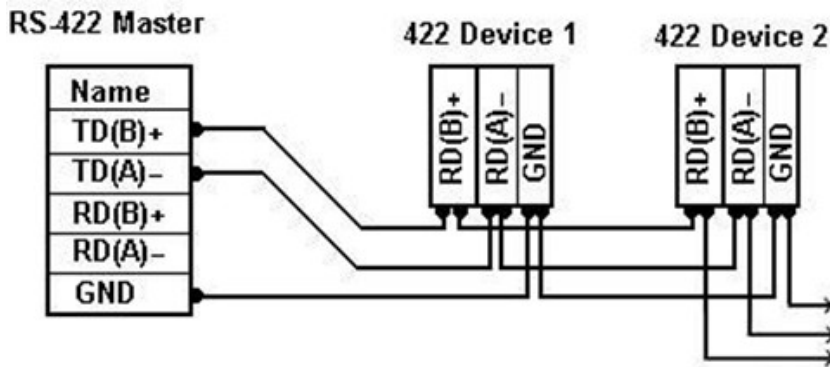
RS-422 is typically used for data transmission from a wind sensor to an Ethernet Interface or a logger.

It is good practice to ensure that the power supply common (GND) for each end is tied together, to ensure that the Common mode range of the two RS-422 devices is not exceeded.

A typical RS-422 full-duplex connection is shown below. Note that, like RS-232, TD is always connected to RD at each end, but the "A" terminal is always connected to the "A" terminal at the other end.



RS-422 can also be used for one-way transmission. Because of its drive capabilities, it can be used to drive multiple receivers.

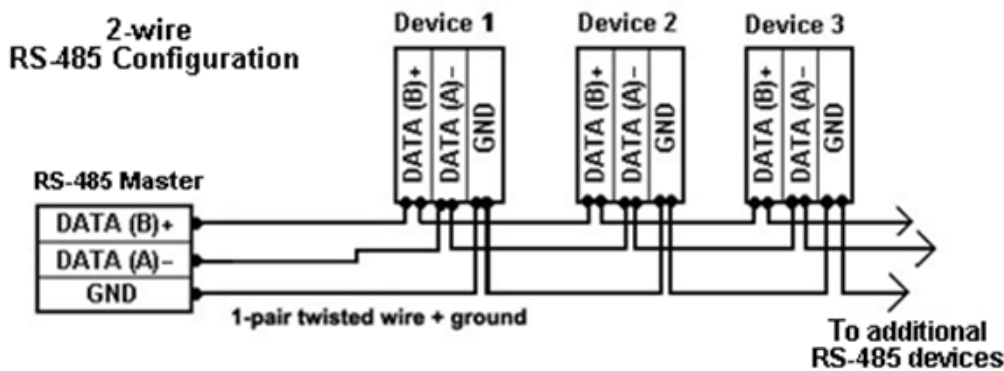


In this case, RS-422 Device 2 may be another permanent device on the network, or it may be a monitoring interface to enable technicians to see what data is flowing on the link.

### 7.2.3 Connecting RS-485 Devices

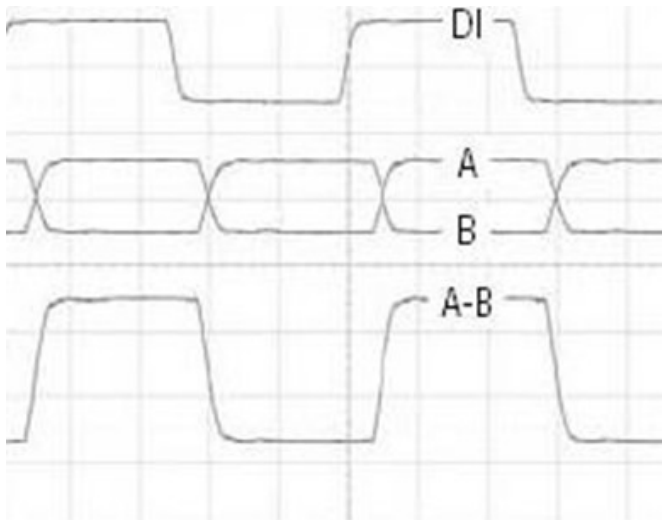
This is simple — the twisted pairs are simply connected with DATA (A) connected to DATA (A) and DATA (B) connected to DATA (B) on each device.

No termination is required for lengths less than 100 m and baud rates less than 19200 bps.



### 7.2.4 RS-422 and RS-485 Waveforms

The oscilloscope trace shown below is typical of RS-422 and RS-485 signal levels.



DI is the data from the micro controller.

A is the A output , which is the inverse of B at any time, except when the RS-485 bus is idle (high impedance)

A-B is the differential signal, which is 2x the signal level on either of the lines alone.

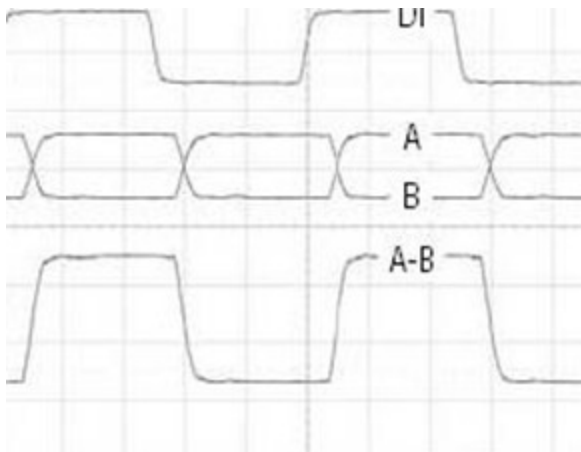
### 7.2.5 Troubleshooting RS-422 (and RS-485) Data Links

The best tool for assessing RS-485 is a scope meter. The scope meter does not have to be the top of the range, it may be any type, say, a 10 MHz bandwidth is fine. Two channels make it easier to visualize each wire in the RS-422 channel.



#### *SYMPTOM: Data are not being received at all.*

- Connect one channel to each wires and the common to GND.



- Ensure the levels of each wire are opposite in phase.
- If they are below 2 V and opposite in phase, suspect excessive loading.
- If the levels are very similar and not out of phase, suspect a broken wire.

#### *SYMPTOM: Data "garbled".*

- Check the baud rate of each end.

#### *SYMPTOM: Data has errors.*

- Check to see whether data looks noisy or has slow rise times.
- Check for possible high-power cables in nearby conduits.
- In very noisy environments, check that the cable is shielded.

## 8. Specifications

Parameter	Specification
MOR Range	10 – 80,000 m (30 m baseline)
Accuracy:	±1% of reading
Receiver Field of View	4°
Averaging Period	10 seconds
Transmitter Light Source	High-Intensity White LED
Flash Pulse Duration:	10 ms
LED Lamp Life :	>10 <sup>8</sup> flashes (typically 6 years)
Spectral Response:	Center Wavelength 555 nm, Bandpass ±100 nm
Calibration	Automatic or Manual
Window Contamination Compensation	Automatic or Manual
Fine Alignment:	Automatic or Manual
Blower	Included
MTBF	33,000 h
<b>Serial Communication</b>	
RS-232, RS-485	9600, 8N1
<b>Electrical</b>	
Power Supply	120 / 240 VAC 50 – 60 Hz
Power consumption	800 W with blowers, PW/Visibility sensor, and Background Luminance Sensor
<b>Mechanical</b>	
Baseline	30, 50 or 75 m
Measurement Height	2.5 m (ICAO Compliant)
Mounting	Bolts to concrete foundation block (Mounting cage kit available)
Frangibility	ICAO compliant frangible bolts
Pole Color	White, Aviation Orange/White or custom
Weight of Assembled Transmitter	82 kg
Weight of Assembled Receiver	80 kg
Shipping Weight	230 kg

Parameter	Specification
<b>Environmental</b>	
Temperature Range	-40 to +60°C
Humidity	0 to 100 % RH
Max. Wind Speed	120 kts (60 m/s)
EMC	IEC/EN 61326
Electrical Safety	IEC/EN 61010

## Appendix Table Of Transmission Vs. Reported RVR Readings (30 M Baseline)

98.6	6374	94.7	1650	55	150	47.2	120	30	75
98.5	5946	94.6	1619	54.8	149	47	119	29.8	74
98.4	5572	94.5	1589	54.6	149	46.8	118	29.6	74
98.3	5242	94.4	1559	54.4	148	46.6	118	29.4	73
98.2	4948	94.3	1531	54.2	147	46.4	117	29.2	73
98.1	4685	94.2	1504	54	146	46.2	116	29	73
98	4449	94.1	1478	53.8	145	46	116	28.8	72
97.9	4235	94	1452	53.6	144	45.8	115	28.6	72
97.8	4040	93.9	1428	53.4	143	45.6	114	28.4	71
97.7	3862	93.8	1404	53.2	142	45.4	114	28.2	71
97.6	3700	93.7	1381	53	142	45.2	113	28	71
97.5	3550	93.6	1359	52.8	141	45	113	27.8	70
97.4	3411	93.5	1337	52.6	140	44.8	112	27.6	70
97.3	3283	93.4	1316	52.4	139	44.6	111	27.4	69
97.2	3165	93.3	1296	52.2	138	44.4	111	27.2	69
97.1	3054	93.2	1276	52	137	44.2	110	27	69
97	2951	93.1	1257	51.8	137	44	109	26.8	68
96.9	2854	93	1238	51.6	136	43.8	109	26.6	68
96.8	2763	92.9	1220	51.4	135	43.6	108	26.4	67
96.7	2678	92.8	1203	51.2	134	43.4	108	26.2	67
96.6	2598	92.7	1186	51	133	43.2	107	26	67
96.5	2523	92.6	1169	50.8	133	43	106	25.8	66

Model 8400-eMOR

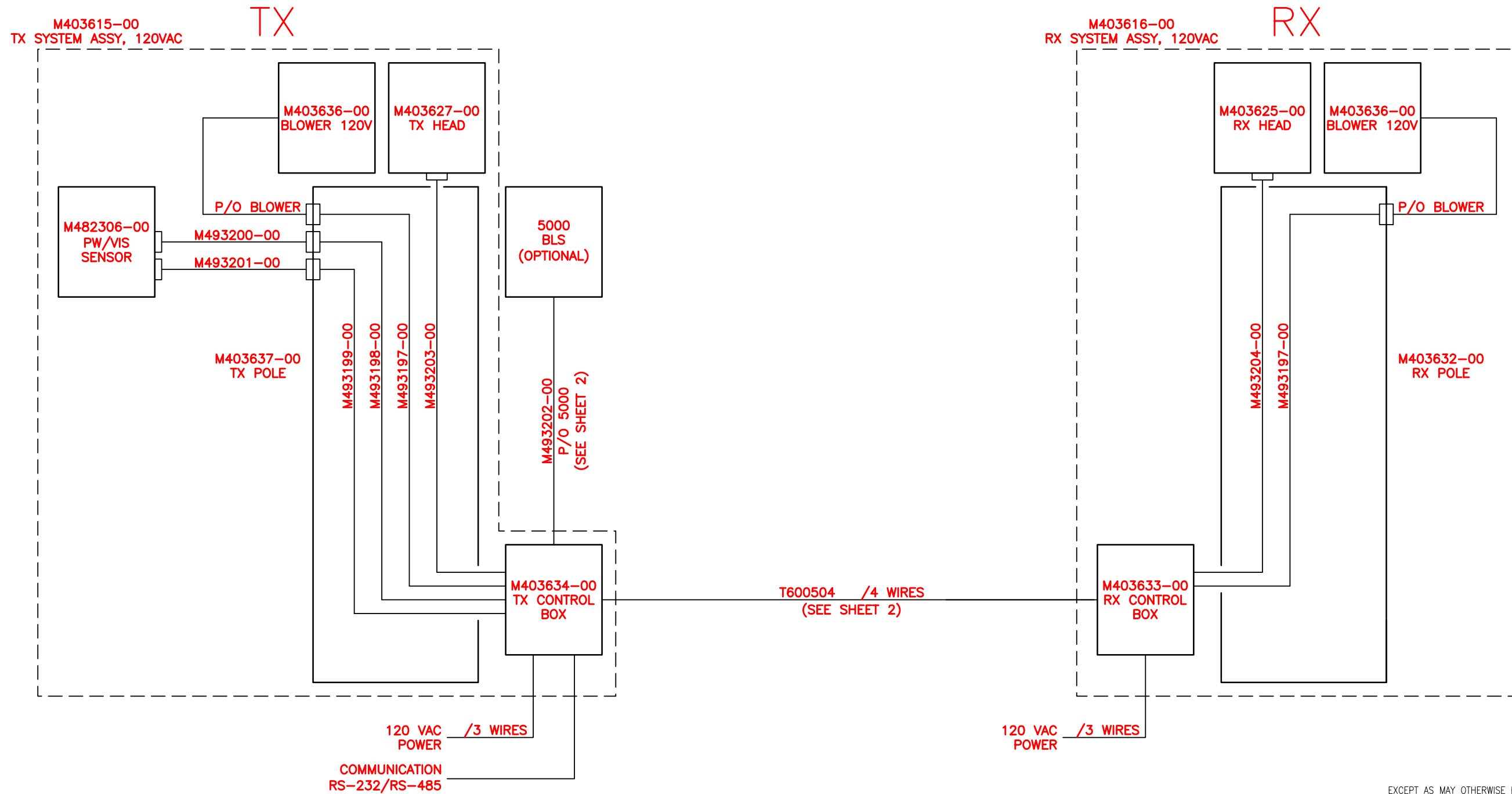
96.4	2451	92.5	1153	50.6	132	42.8	106	25.6	66
96.3	2384	92.4	1137	50.4	131	42.6	105	25.4	66
96.2	2320	92.3	1122	50.2	130	42.4	105	25.2	65
96.1	2259	92.2	1107	50	130	42.2	104	25	65
96	2202	92.1	1092	49.8	129	42	104	24.8	64
95.9	2147	92	1078	49.6	128	41.8	103	24.6	64
95.8	2095	91.9	1064	49.4	127	41.6	102	24.4	64
95.7	2045	91.8	1050	49.2	127	41.4	102	24.2	63
95.6	1997	91.7	1037	49	126	41.2	101	24	63
95.5	1952	91.6	1024	48.8	125	41	101	23.8	63
95.4	1908	91.5	1012	48.6	125	40.8	100	23.6	62
95.3	1867	91.4	999	48.4	124	40.6	100	23.4	62
95.2	1827	91.3	987	48.2	123	40.4	99	23.2	62
95.1	1789	91.2	976	48	122	40.2	99	23	61
95	1752	91.1	964	47.8	122	40	98	22.8	61
94.9	1717	91	953	47.6	121	39.8	98	22.6	60

## 9. Wiring Diagrams

8400-eMOR-240-019	Wiring Diagram, Model 8400-eMOR 240 VAC Transmissometer
M403627-00-019	Wiring Diagram, TX Head 8400-eMOR Transmissometer
M403625-00-019	Wiring Diagram, RX Head 8400-eMOR Transmissometer
M403627-00-019	Wiring Diagram, TX Head 8400-eMOR Transmissometer

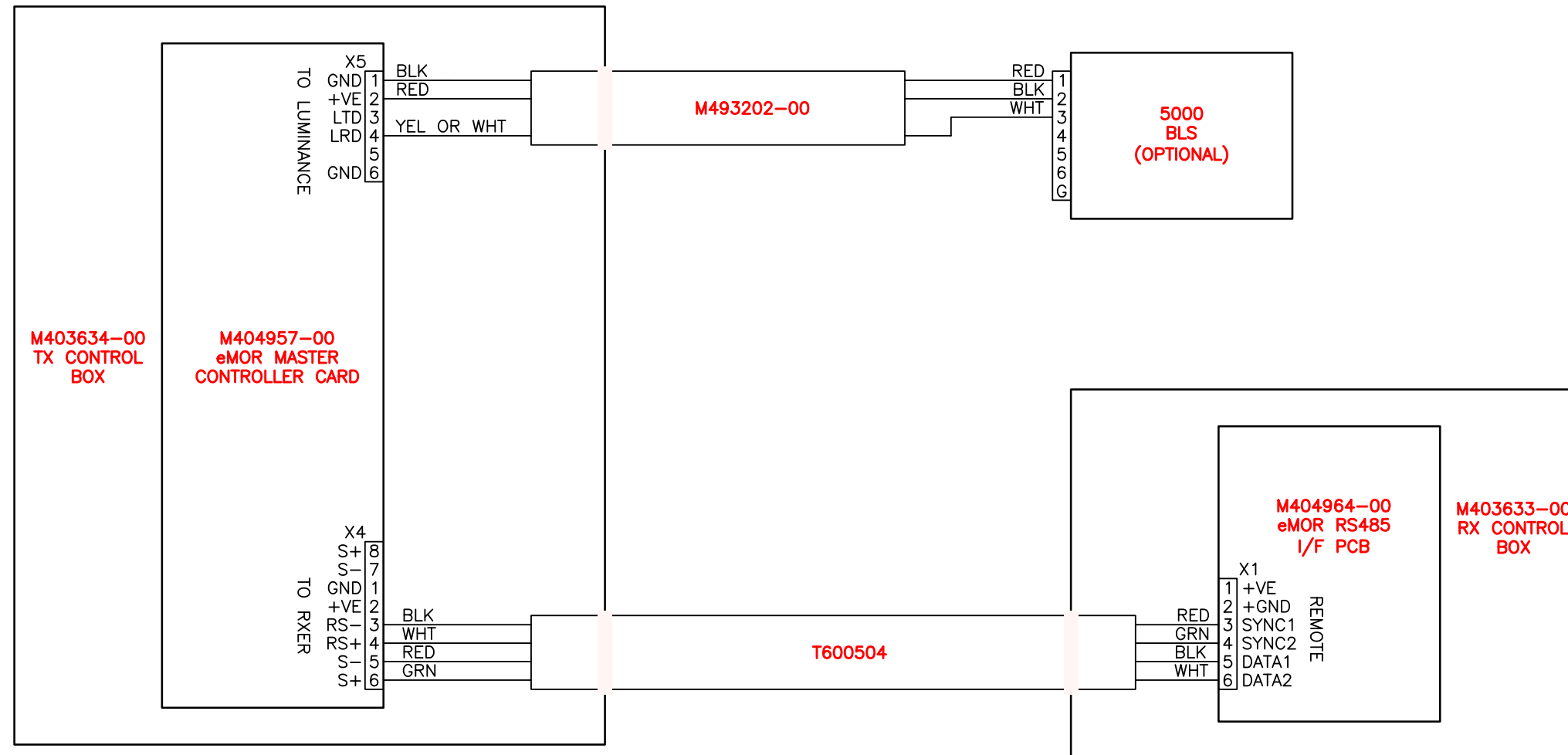
REVISIONS			DWG NO. 8400-eMOR-120-019	
REV	ECO	DESCRIPTION	DATE	APPROVED
A	5711	INITIAL RELEASE	8-19-2024	BRG

# 8400-eMOR



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UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES XX=±.010 ANGLES ±1/2" XXX=±.005 FRACTIONS=±.02 DO NOT SCALE DRAWING	DRAWN BY: B. GALARPE	8-19-2024	TITLE WIRING DIAGRAM, 8400-eMOR, 120VAC TRANSMISSOMETER	ADB SAFEGATE
	REVISIED BY:			
MATL SEE BILL OF MATERIALS	CHECKED BY:		SIZE D	DWG NO. 8400-eMOR-120-019
FINISH N/A	DESIGN ENGINEER: A. HUSTEAD	8-19-2024		
TREATMENT	PROJECT MANAGER:		SCALE NONE	RELEASE DATE 8-19-2024
APPROVALS		DATE	SHEET 1 OF 2	

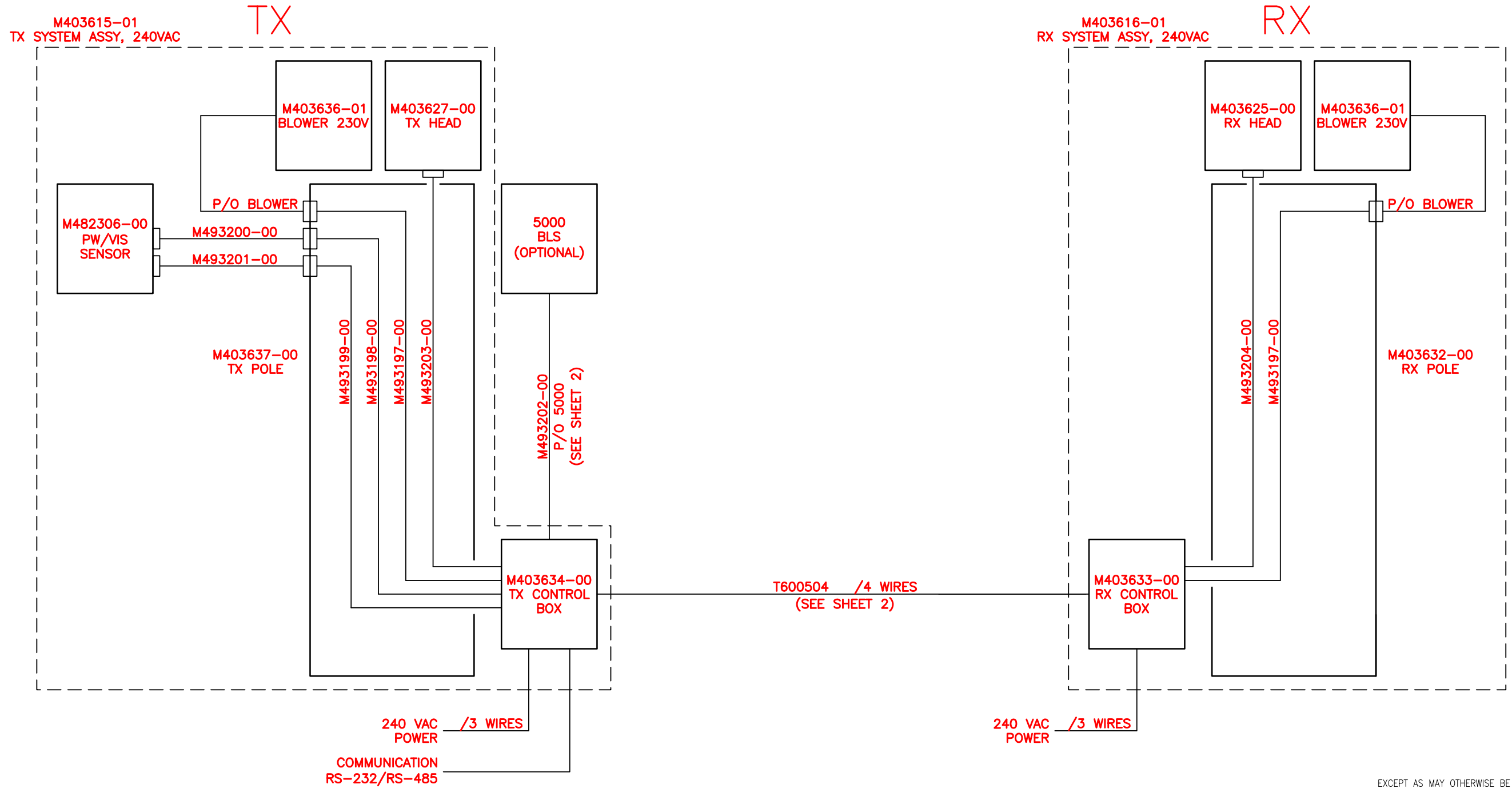


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REV		ECO		DESCRIPTION		DATE		APPROVED	
A	5711			INITIAL RELEASE		8-19-2024		BRG	

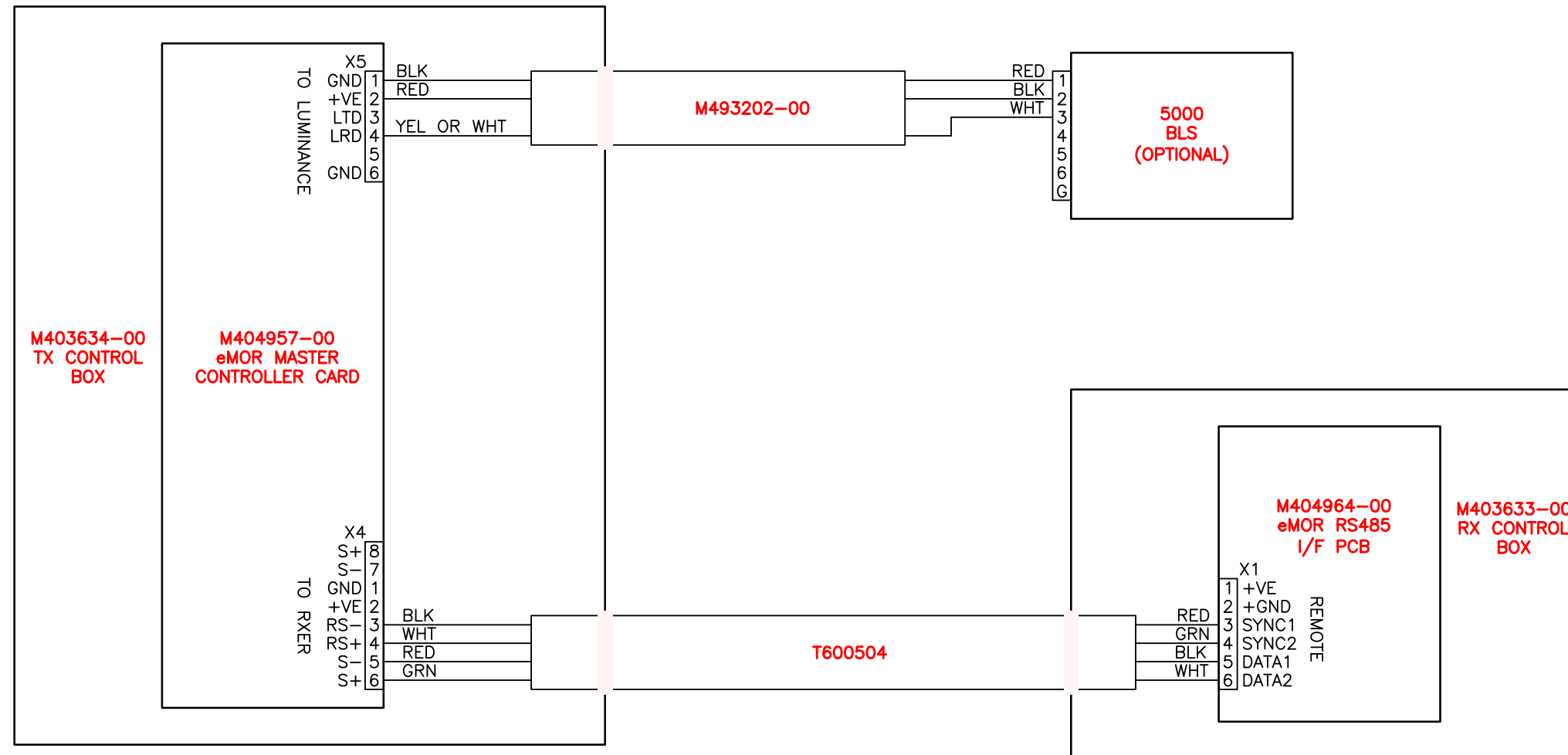
DWG NO: 8400-eMOR-240-019

# 8400-eMOR



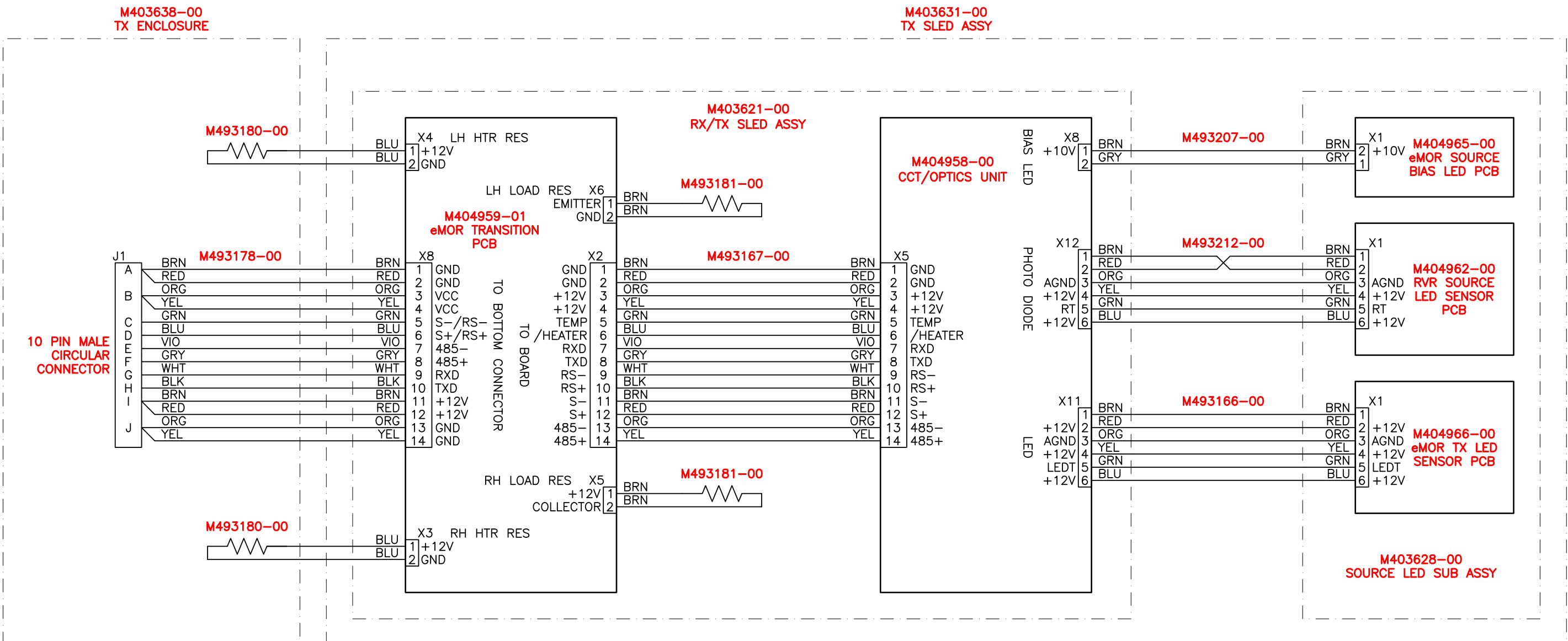
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UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES XX=±.010 XXX=±.005 DO NOT SCALE DRAWING	DRAWN BY: B. GALARPE	8-19-2024	TITLE WIRING DIAGRAM, 8400-eMOR, 240VAC TRANSMISSOMETER	ADB SAFEGATE
	REVISOR BY:			
MATL SEE BILL OF MATERIALS	CHECKED BY:		DESIGN ENGINEER: A. HUSTEAD	8-19-2024
FINISH N/A	PROJECT MANAGER:			
TREATMENT	APPROVALS	DATE	SCALE NONE	RELEASE DATE 8-19-2024
			SIZE D	DWG NO. 8400-eMOR-240-019
			SHEET 1 OF 2	



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REVISIONS			DWG NO. M403627-00-019	
REV	ECO	DESCRIPTION	DATE	APPROVED
A	5836	INITIAL RELEASE	4-24-2024	BRG



NOTES: UNLESS OTHERWISE SPECIFIED;

1 N/A

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<small>UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES XX=±.010 ANGLS ±1/2° XXX=±.005 FRACTIONS=±.02 DO NOT SCALE DRAWING</small>	DRAWN BY: K. YOUNG	3-22-2021	<b>TITLE</b> WIRING DIAGRAM, TX HEAD, TRANSMISSOMETER, AWOS	
	REVISED BY: B. GALARPE	4-24-2024		
	CHECKED BY:			
	DESIGN ENGINEER: A. HUSTEAD	4-24-2024		
MATL SEE BILL OF MATERIALS	PROJECT MANAGER:		<b>SIZE</b> D	<b>DWG NO.</b> M403627-00-019
FINISH N/A	APPROVALS	DATE	SCALE NONE	RELEASE DATE 4-24-2024
TREATMENT			SHEET 1 OF 1	

# Optimizing Airside Operations From approach to take-off

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