Technical Manual

ALPHA STARS™ M505A
Remote Meter Reading via Wireless Modem Communication and Data Packet Networks

ABB Information Systems

Contents

FCC Compliance

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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Safety Information

Installation, operation, and maintenance of this product can present potentially hazardous conditions (high voltages for example) if safety procedures are not followed. To ensure that this product is used safely, it is important that you:

- Review, understand, and observe all safety notices and recommendations within this manual.
- Do not remove or copy individual pages from this manual, as this manual is intended for use in its entirety. If you were to remove or copy individual pages, cross references and safety notices may be overlooked, possibly resulting in damage to equipment, personal injury, or even death.

- Inform personnel involved in installation, operation, and maintenance of the product about safety notices and recommendations contained in this manual.

Within this manual safety notices appear preceding the text or step to which they apply. Safety notices are divided into the following four classifications:

- Danger
- Warning
- Caution
- Notice

Manual Conventions

Type Style	Significance
`Screen Font`	Words or indicators which will appear on the meter LCD.
Italic Font	Used as a point of emphasis when needing to distinguish one part of a description more than the surrounding text.
⚠ DANGER	Used to alert personnel to the presence of a hazard that will cause severe personal injury, death, equipment damage, or property damage if the notice is ignored.
⚠ WARNING	Used to alert personnel to the presence of a hazard that can cause severe personal injury, death, equipment damage, or property damage if the notice is ignored.
⚠ CAUTION	Used to alert personnel to the presence of a hazard that will or can cause minor personal injury, equipment damage, or property damage if the notice is ignored.
NOTICE	Used to alert personnel to installation, operation, or maintenance information that is important but not hazard related.

1 Introduction

ALPHA STARS permits remote meter reading of ABB ALPHA Power+ meters. This is accomplished through a wireless modem that communicates using data packet networks. The communications system is known as ARDIS, which is a public network using an open protocol standard invented by Motorola.

The ALPHA STARS unit is contained in a weather resistant enclosure which can be easily mounted beside an ALPHA Power+ meter. A weather-resistant, molded cord connects the ALPHA STARS unit to the meter providing the following:

- Power to the ALPHA STARS unit
- Communications between ALPHA STARS and the meter

ALPHA STARS is a microprocessor based transmitter and receiver which:

1. Receives requests for data collection from the system server
2. Initiates the data collection from the meter
3. Reports the data back to the host computer system

1.1 ALPHA Power+ Meter Requirements

The ALPHA Power+ meter must be equipped with the wide area network (WAN) option board. This option board connects to the 20-pin header on the main circuit board of the meter, as shown in Figure 1-1.

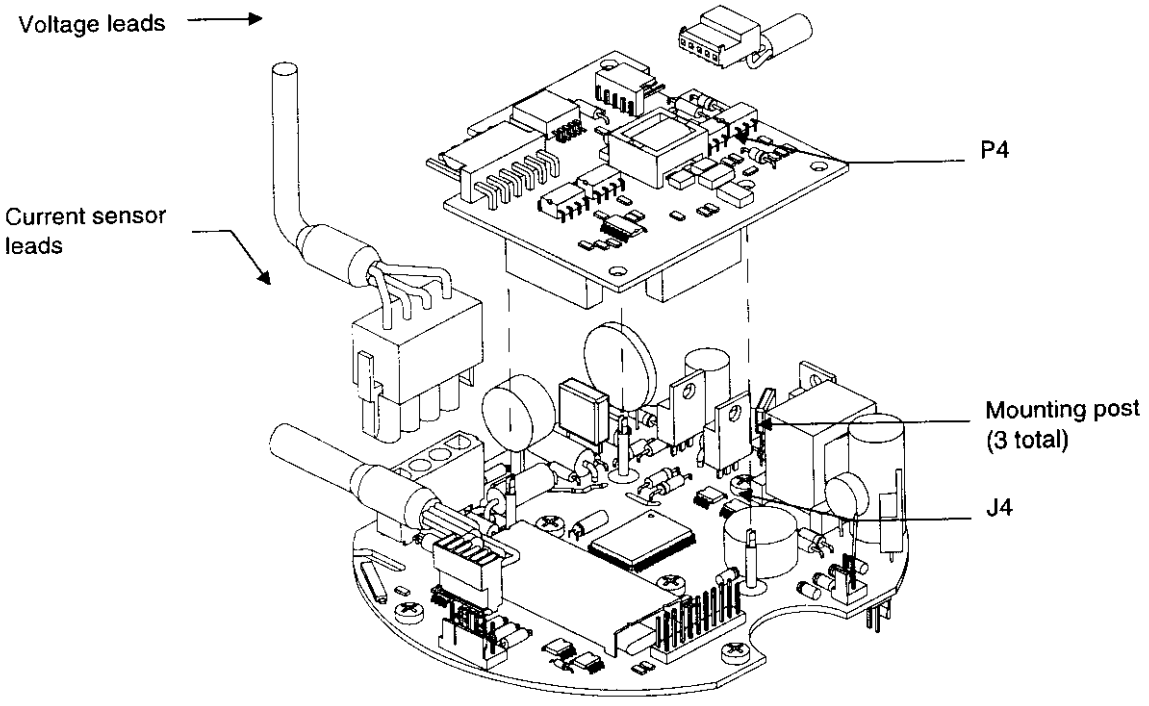


Figure 1-1 ALPHA Power+ Meter Board with WAN Option Board

The WAN option board includes a 24v DC power supply for a modem. A 6 foot cable with 4-pin connector is also provided to connect to the ALPHA STARS unit as shown in Figure 1-2. KYZ relays (2 maximum) may be added to the WAN option board for pulse output.

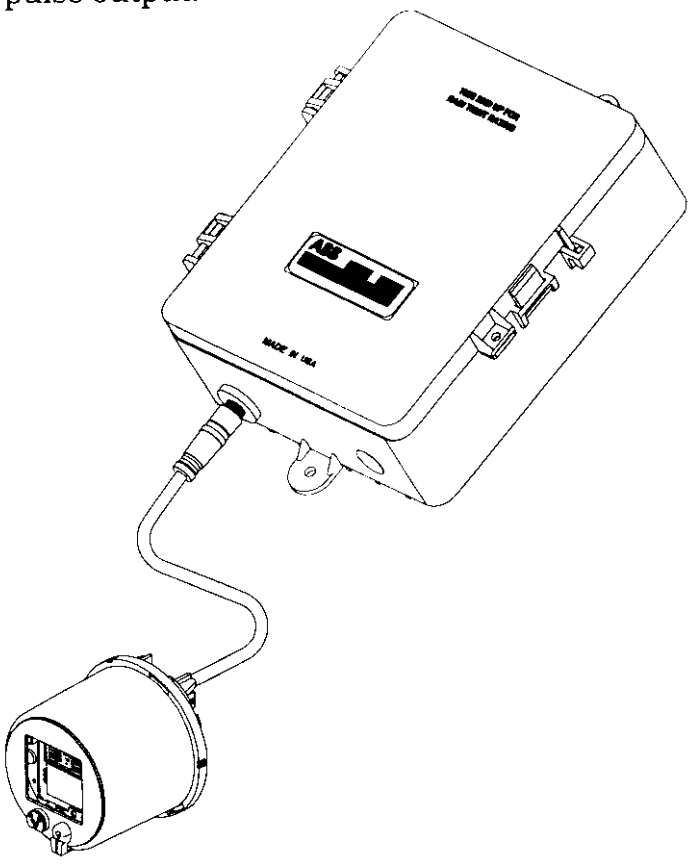


Figure 1-2 ALPHA STARS and ALPHA Power+ Meter Connection

The ALPHA Power+ meter must also have the AMR Data Link feature. This factory set feature facilitates communication with the ALPHA STARS unit and supports packet-based wireless transmission.

1.2 Outage Reporting Features

The ALPHA STARS unit can perform power outage reporting features. In order to conserve battery power, ALPHA STARS will not report power outages and restorations by default. Using ALPHA STARS support software the ALPHA STARS unit can be configured for either or both of the following:

- Outage reporting
- Power restoration reporting

When outage reporting is enabled, an outage message will be transmitted within 1-120 seconds (as programmed or 120s default) following the power failure. When power restoration reporting is enabled, a message will be transmitted to report power restoration following the return of power. There is a programmable random

delay of 1-15 minutes before sending the restoration message. This delay prevents the system from being overloaded with multiple incoming power restoration messages.

1.3 AlphaPlus Software

ABB meter support software is required to program an ALPHA Power+ meter so that it may communicate with the ALPHA STARS unit. AlphaPlus v1.11 or higher should be used to program any meter which is to be used with an ALPHA STARS installation.

2 Installation

The following items are required in order to install the ALPHA STARS unit:

- Computer and ABB meter support software to communicate with the meter
- Installation & Diagnostic Tool
- Optical probe (for communicating with the meter)
- Drill to make holes for mounting the ALPHA STARS unit (and ½" opening, if knock-out not present, for meter cable)
- Drill bits for the mounting holes (and ½" opening, if not present)
- Screws for mounting the unit
- Miscellaneous hand tools such as:
  - Pliers
  - Screwdriver
  - Crescent wrench
  - Channel locks

2.1 Choosing a Location

When selecting a location for installing the ALPHA STARS unit, a zip code analysis is recommended. This analysis will verify that the site is suitable for an ALPHA STARS installation. A signal strength survey tool can also be used to determine actual site coverage. The following procedure should be used in determining where to install an ALPHA STARS unit:

1. If internet access is available, the site **http://ardis.com** has geographical maps which can be used to determine coverage expectations for an area.
2. Obtain the zip code for the desired installation site, and send it to ABB. ABB will then predict in-building and on-street coverage.
3. Use a signal strength survey tool to measure the actual coverage at the desired installation site. This will provide a Receive Signal Strength Indicator (RSSI) value which can be used to determine how ALPHA STARS will function if installed at this location.
4. If both the zip code analysis and the survey tool results are favorable, the ALPHA STARS unit may be installed at this location.

The optimal location for any radio frequency (RF) device is away from any large metal objects. The ALPHA STARS unit should also be installed in a location where there are no large objects (buildings) in the transmission path to the tower. If an optimal location does not exist, a compromise may be achieved which gives

the best overall coverage. See *Appendix B* for further information on radio coverage.

2.2 Installing the ALPHA Meter with Power+ Features

The ALPHA meter with Power+ features should be installed according to the instructions contained within the technical manual accompanying that meter. There are some additional requirements before the ALPHA STARS unit can be installed:

⚠ DANGER

Exercise caution and make sure that power is disconnected from the ALPHA Power+ meter before continuing. Failure to do this will cause severe personal injury, death, equipment damage, or property damage

1. Most meter socket enclosures have knock-outs along the bottom of the socket. A ½" knock-out should be removed in order to accommodate the meter cable which will exit the enclosure.

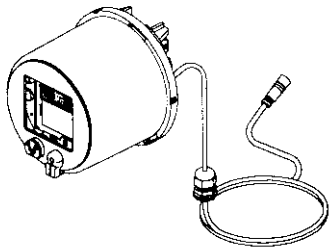


Figure 2-1 ALPHA Power+ Meter and Interface Cable with Lock-nut

2. After removing this knock-out, remove the plastic lock-nut from the strain relief on the meter cable and slip the lock-nut off of the cable. This will allow the strain relief to be freely moved along the cable.
3. Install the strain relief in the ½" space where the knock-out was removed.

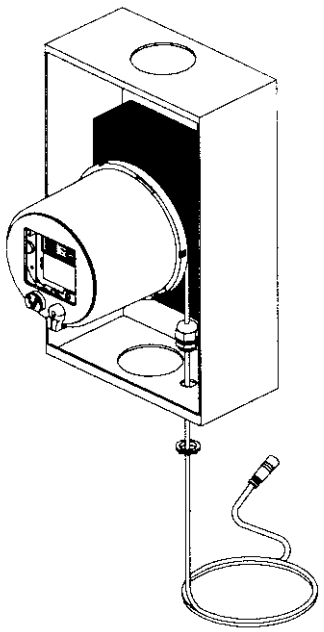


Figure 2-2 Interface Cable Routing and Lock-nut Assembly

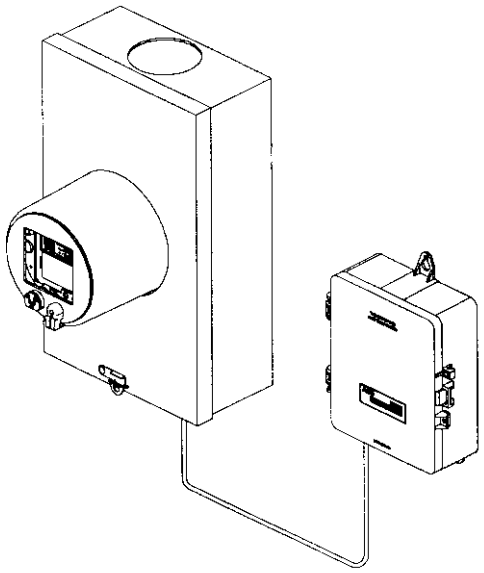


Figure 2-3 ALPHA Power+ Meter and ALPHA STARS Unit Connected by Interface Cable

4. Slide the plastic lock-nut upwards along the cable until it mates with the strain relief and then tighten it.
5. Pull the meter cable down through the strain relief to the desired length and tighten the strain relief nut on the inside of the meter socket to prevent the cable from sliding back through it.
6. Power may now be applied to the meter (if desired).

2.3 Installing the ALPHA STARS Unit

The ALPHA STARS unit is water resistant and can have two connectors located on the bottom of the unit. One connector is standard and accepts the cable from the ALPHA Power+ meter or the Installation & Diagnostic Tool. The other connector is optional and is for an N-type antenna connector for installations which require an external antenna[1]. An internal antenna is provided and mounted within the unit.

[1] An external antenna kit may be ordered from ABB. See *Appendix D* for style numbers.

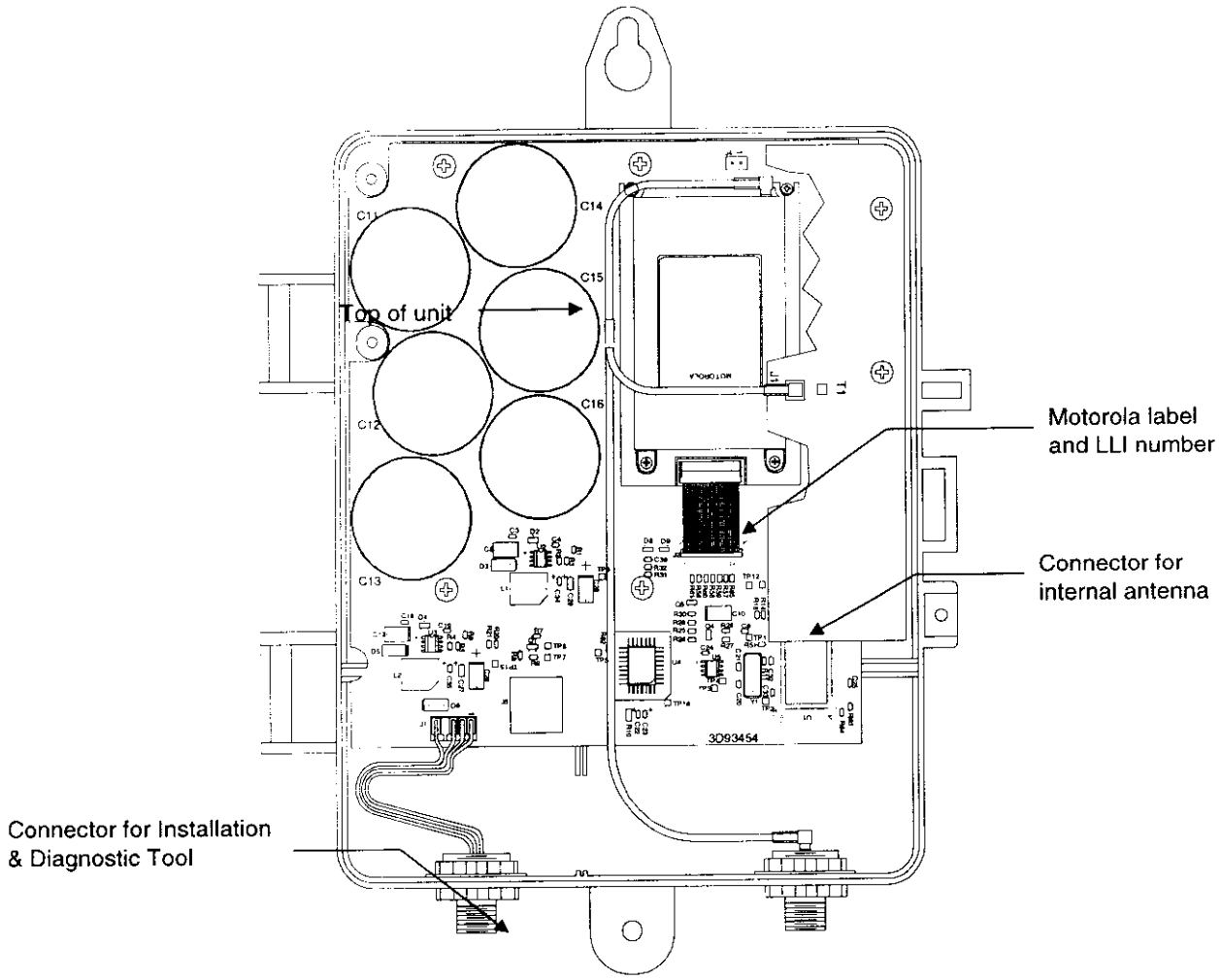


Figure 2-4 ALPHA STARS Unit Shown with Optional External Antenna Connector

The ALPHA STARS unit must be mounted vertically with the top of the unit as indicated in Figure 2-4. Use the following steps to mount the ALPHA STARS unit:

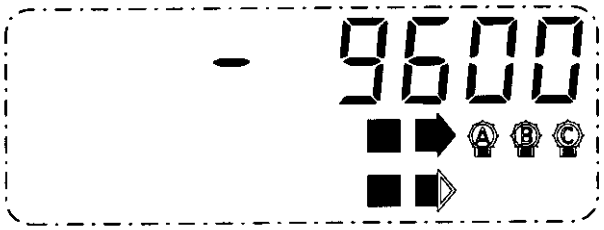
1. Choose the mounting location and mark the holes for mounting.
2. Drill all mounting holes before inserting screws.
3. Partially screw in the top mounting screw so that the unit will hold itself while starting the bottom mounting screw. Tighten both screws securely.
4. Connect the meter cable to the bottom connector on the ALPHA STARS unit and screw on the sleeve until tight.

2.3.1 Ensuring Communications with the Meter

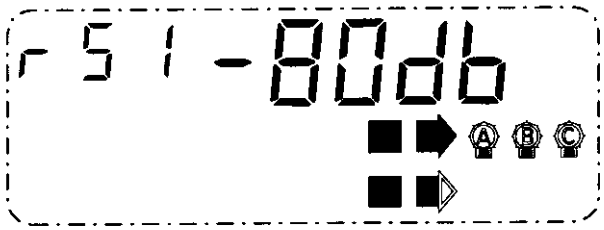
Once the ALPHA STARS unit and ALPHA Power+ meter have been installed, communications between the two must be verified. The following procedure should be used:

1. The meter must have its statuses reset (not a demand reset) through ABB meter support software. (STILL DO NOT KNOW HOW TO DO THIS!!)

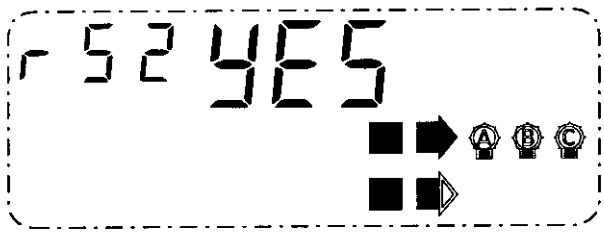
2. The meter liquid crystal display (LCD) will indicate communications status. After approximately 30 seconds "9600" should be shown on the LCD to indicate that the meter is attempting to communicate with ALPHA STARS.



3. If "4800" followed by "2400", "1200", "300", "00" is shown on the LCD, then the two units are not communicating. Verify all connections and start this procedure from the beginning. If the problem persists, the ALPHA STARS unit may need to be returned to the factory for repair or replacement.
4. If communication is established, the meter LCD should then cycle through the normal display sequence. The ALPHA STARS unit will interrupt the display sequence approximately every 30 seconds to display the following values: "rS1 -xxdb", and one of the following "rS2 yes", "rS2 no", or "rS2 no reg".



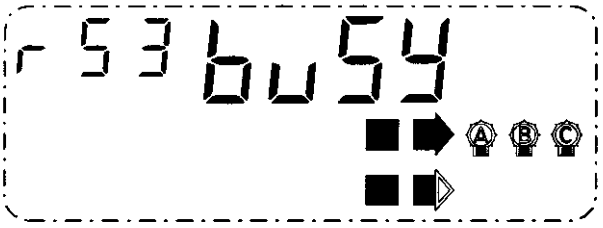
The "rS1" indicator will be followed by a numeric indication of the RSSI value between -110 and -40 in decibels (db).



The "rS2" indicator is described in the following table:

Indicator	Meaning
rS2 yes	The modem is functioning properly and the RSSI value is acceptable.
rS2 no	The modem is functioning properly, but the RSSI value is unacceptable. The ALPHA STARS unit may be moved right or left by the physical width of the unit to see if this helps. If moving the unit does not resolve the problem, an alternate installation site may be necessary
rS2 no reg	The modem has not been registered, and the unit will not function properly until this has been done.

When the ALPHA STARS unit is processing a request from the host system, "rS3 busy" will be shown on the meter LCD. This is not part of the normal display sequence, and will appear as shown below:



After the ALPHA STARS unit has been successfully installed, the operation may be verified by scheduling a communications session using the ARDIS communication network. The network operator will need the serial number of the ALPHA Power+ meter and the logical link identifier (LLI) from the ALPHA STARS unit. The serial number for the meter is located on the nameplate. The LLI number is printed on a label affixed to the metal shield over the modem inside the ALPHA STARS unit as indicated in Figure 2-4. The network operator should be able to confirm a successful communications session by verifying that meter readings were received.

2.4 The ALPHA STARS Installation & Diagnostic Tool

This tool is used to assist with installing an ALPHA STARS unit.The Installation & Diagnostic Tool[2], shown in Figure 2-5, provides status LED indicators and a PC interface which can be connected to a computer to view further information about the ALPHA STARS unit. Connections are provided for interfacing with the following devices:

- ALPHA STARS unit
- ALPHA Power+ meter
- Standard PC compatible computer via a DB-9 RS-232 connector

[2] An Installation & Diagnostic Tool may be ordered from ABB as Style Number 1C11626G01.

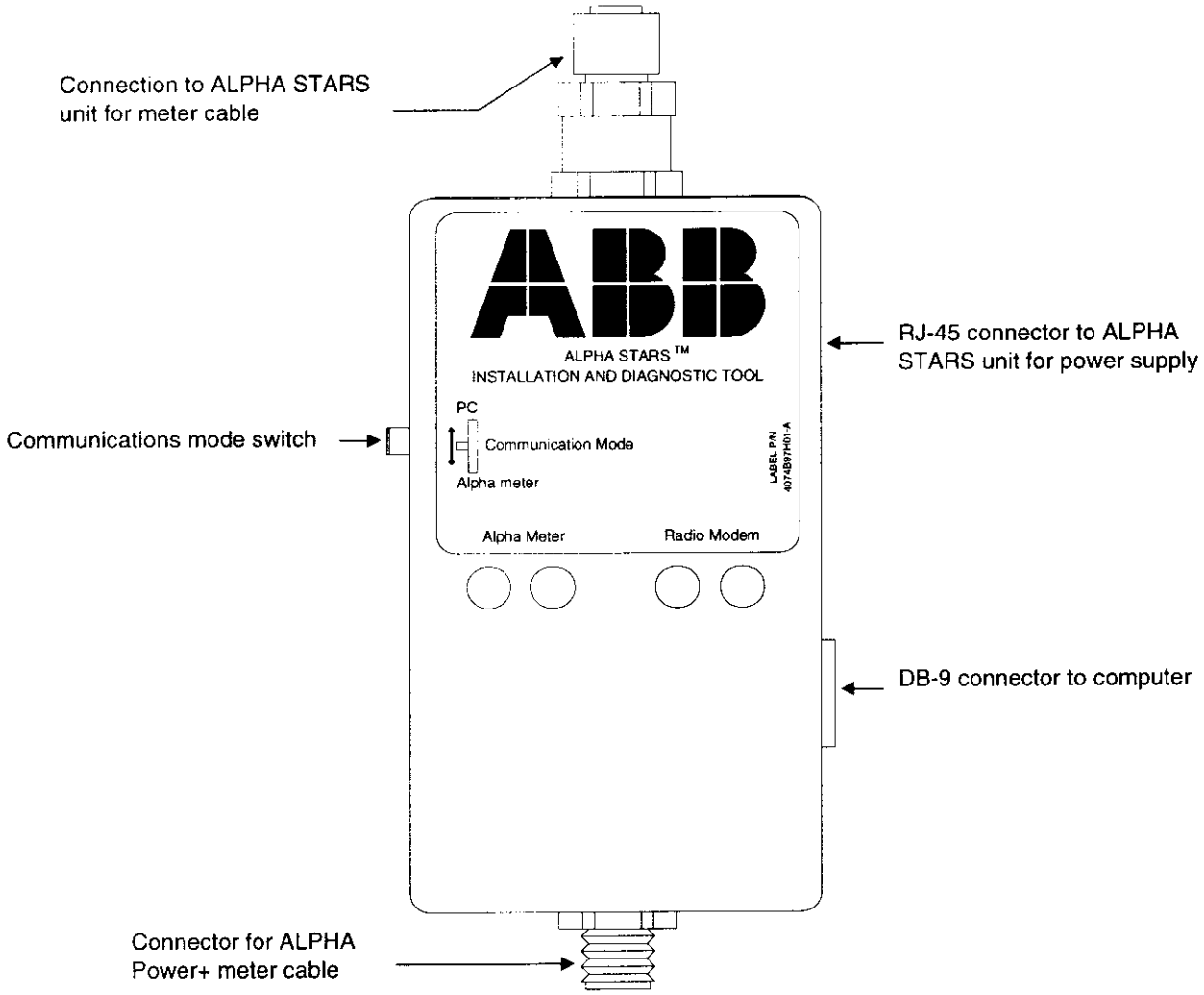


Figure 2-5 ALPHA STARS Installation & Diagnostic Tool

One cable connects to the ALPHA Power+ meter and provides:

- Power to the ALPHA STARS unit
- Communications between ALPHA STARS and the meter

The second cable connects from the ALPHA STARS unit to the Installation & Diagnostic Tool in order to provide power to the tool. The third cable can be used to connect the tool to a local PC compatible computer. See Figure 2-6 for an illustration of one possible configuration.

ALPHA STARS support software can be used when the Installation & Diagnostic Tool is connected between a computer and the ALPHA STARS unit. Below are some of the features which are available through this software:

- In-field upgrade of the ALPHA STARS firmware
- View real-time RSSI values as they are measured
- View statistics and error counters:
  - Out of range

- Failed communications attempts
- Modem and meter status

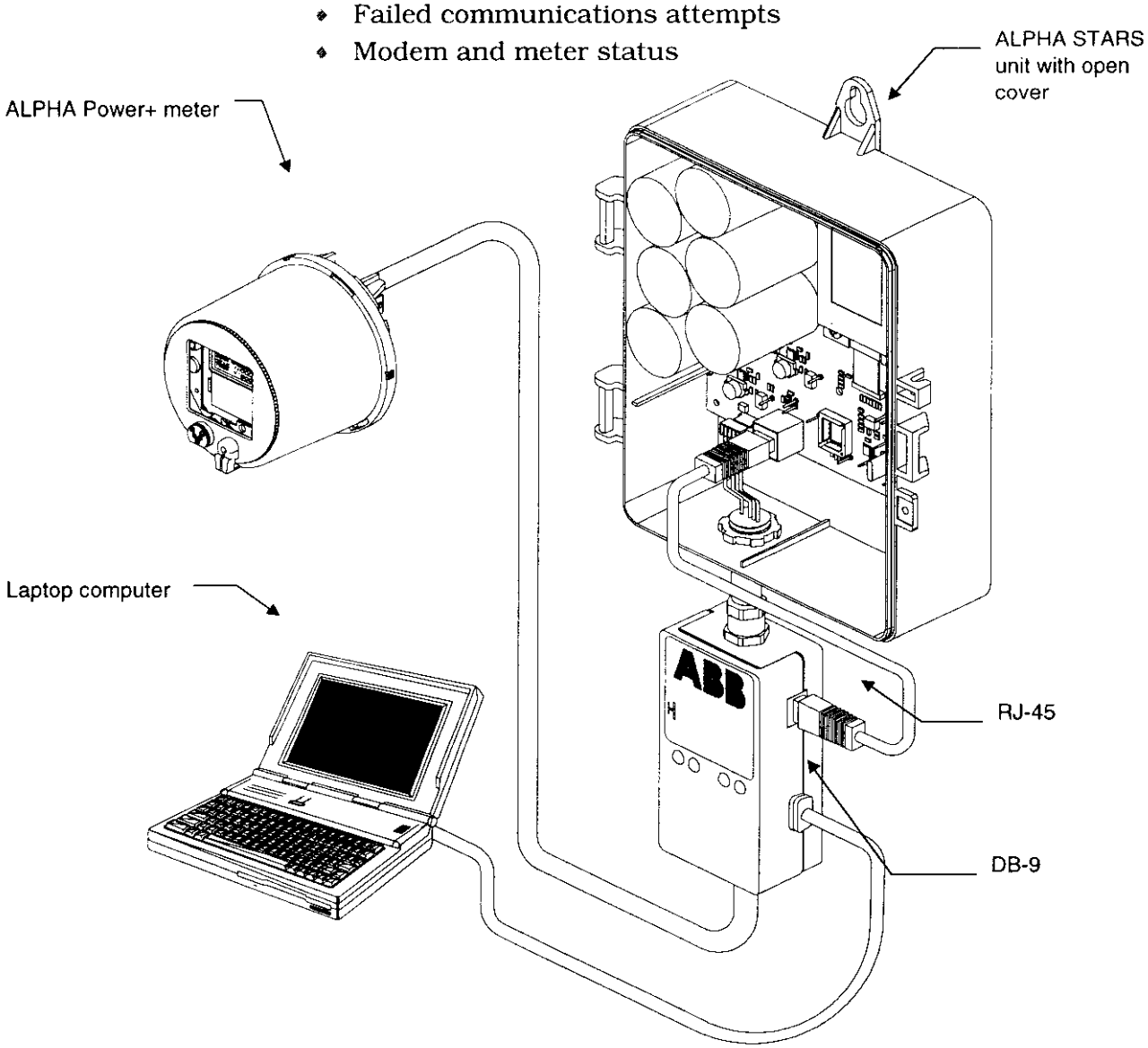


Figure 2-6 ALPHA STARS Interfaced with Computer and Meter

A switch, as illustrated in Figure 2-5, on the Installation & Diagnostic Tool selects the routing of communications through the device in one of the following ways:

- From ALPHA STARS unit to the meter
- From ALPHA STARS unit to PC

Note: When the switch on the Installation & Diagnostic Tool is in the PC position, the ARDIS network will be unable to communicate with the ALPHA STARS unit.

2.4.1 LED Indicators

The Installation & Diagnostic Tool provides two sets of LED indicators. Each set of LED indicators contains one red and one

green LED. See the following table for more details on each set of LED indicators:

LED Set	Status Indicated
Alpha Meter	Communications with the meter; where green indicates a successful communications, and red indicates failure.
Radio Modem	Modem initialization status, and RSSI value; where green indicates successful modem initialization and acceptable values for RSSI and red indicates failure of modem initialization or RSSI values that are unacceptable.

The *Radio Modem* LED indicators provide information similar to that which can be seen on the meter LCD during the normal display sequence. Since the ALPHA STARS unit may be mounted in a location far enough from the meter that the LCD can not be seen, these LED indicators provide similar information.

2.5 External Antennas

In some installations it may be necessary to install the ALPHA STARS unit in a physical location which does not have optimum coverage. In such installations, the internal antenna may not be sufficient to provide communications to the tower. ALPHA STARS provides for an optional connection for an external antenna in these situations. Below are the two most common reasons why an external antenna may be needed:

- **Enclosed Metering Devices —** The ALPHA Power+ meter and ALPHA STARS unit are mounted inside metallic NEMA enclosures which prevent radio communications.
- **Obstructed Installation Sites —** ALPHA STARS installation site is in a fringe (remote) area, surrounded by tall buildings, or other similar obstruction to radio communications.

See *Appendix B* for further information on radio coverage.

2.5.1 Enclosed Metering Devices

Many commercial and industrial metering installations will be mounted within metallic NEMA enclosures. This enclosure will inhibit radio signals from being sent or received by ALPHA STARS. In these installations an external antenna would need to be installed. This antenna could be mounted on the top of the NEMA enclosure. Below are some examples of antennas which may be used in this situation:

- ¼-wave antenna
- ½-wave whip antenna
- Ground plane antenna with 0db gain

After installing the external antenna, the effective radiated power (ERP) should be about the same as the internal antenna provided with ALPHA STARS.

2.5.2 Obstructed Installation Sites

Many industrial factories or sites are in suburban or rural areas. This would place the ALPHA STARS installation on the fringes or sometimes just outside desired coverage. Alternately, locations which are surrounded by obstructions which interfere with communications to the tower can also result in lack of coverage at the installation site. The following are examples of obstructions which would hinder communications:

- High terrain, such as mountains, or man-made constructs (buildings) in the line-of-sight from ALPHA STARS to the tower
- Sub-station fences or walls surrounding the installation site
- Switch-gear
- Transformers
- Reflectors

In these situations, an external antenna may need to be extended beyond the obstructions in order for ALPHA STARS to communicate with the tower. The optional N-type connector on the unit can be connected to various types of low-loss transmission cable. Using ½" or 7/8" heliax cable is generally recommended depending upon the total length of the cable needed. This cable may then be extended and connected to an external antenna which is mounted on any of the following:

- Rooftops
- Masts
- Towers

For most installations any of the following types of antennas may be used:

- Standard ground-plane antenna
- Omni-directional antenna with 0db to 3db gain

⚠ CAUTION

When mounting an external antenna in any of the above locations, proper lightning protection standards should be observed in order to protect equipment and personnel.

Appendix A. Glossary

antenna —

ARDIS —

db — see "decibels"

dead zones — areas which lie inside of a coverage area but communications are not possible due to obstruction or excessive noise levels.

decibels —

demand reset — the act of resetting the present maximum demand to zero.

directional — an antenna which radiates energy concentrated in the specific direction it is pointed, typically towards a tower.

ERP — see "effective radiated power"

effective radiated power —

firmware — instructions (coded language) used by ALPHA STARS to control how it functions and what features it provides; firmware cannot be altered except allowed upgrades through ALPHA STARS support software.

fringe areas — the areas which existsalong the boundary of a radio coverage contour (outlined coverage area) where radio signals tend to degrade.

gain —

heliax — recommended type of transmission cable for radio communications.

host system —

LCD — see "liquid crystal display"

LED — see "light emitting diode"

LLI — see "logical link identifier"

light emitting diode — red and green LED indicators are on the Installation & Diagnostic Tool; each indicator represents the status (green for success, red for failure) of communications between ALPHA STARS and the ALPHA Power+ meter or the ARDIS network.

liquid crystal display — the LCD allows information to be shown on the ALPHA Power+ meter; ALPHA STARS status information will be shown as part of the normal display sequence.

logical link identifier —

NEMA — see "National Electrical Manufacturers Association"

National Electrical Manufacturers Association —

normal mode — the default operating mode of the ALPHA Power+ meter; typically displays billing data on the LCD following a

programmed sequence, but is interrupted approximately every 30 seconds by ALPHA STARS to display status information.

omni-directional — an antenna which radiates energy in all directions rather than pointing specifically at a tower location.

RF — see "radio frequency"

RSSI — see "receive signal strength indicator"

radio frequency —

receive strength signal indicator —

receiver —

signal reflections — the resulting simultaneous reception of multiple signals caused by radio signals being absorbed or reflected to different degrees.

tower —

transmitter —

WAN — see "wide area network"

wide area network —

GENERIC — D

Appendix B. Radio Coverage

It is necessary to take into account many details when determining radio coverage for an area. In addition to signal strength and receiver sensitivity, many other factors can affect radio communications:

- Signal reflections
- Atmospheric bending of radio waves
- Fringe areas
- Dead zones

Signal Reflections

Signal reflections and the resulting simultaneous reception of multiple signals is a significant obstacle to successful radio communications. When a signal is transmitted, an obstacle may either absorb or reflect it. The amount of absorption vs. reflection is dependent upon the type of obstacle and the frequency of the radio signal. Signal reflection occurs in most radio systems.

The signal which arrives at the antenna is made up of many different signals which have traveled different paths. These signals may add up out of phase and in some cases cancel each other out entirely. Since the paths of these signals and their content may change, the resulting composite signal received by the antenna will also be changing. Moving the receiver antenna just a few inches can significantly improve the received signal level.

Atmospheric Bending of Radio Waves

Radio waves would travel in straight lines in a vacuum. Due to the atmosphere on the earth, however, radio waves tend to follow the curvature of the earth. Some of the following can also affect radio signals:

- Atmospheric content
- Elevation within the atmosphere
- Heavy rains or storms
- Temperature fluctuations

Fringe Areas

Fringe areas are considered to be on the edge of radio coverage contours (outlined coverage areas). Radio waves do not abruptly stop at these boundaries, but the strength of the signals does decrease. They are, however, much less likely to reach locations which are outside of the designated coverage area. Fringe areas are right along these boundaries where the radio signal reception begins to degrade.

An installation is in a fringe area does not mean that radio signals cannot be sent or received. The following factors can contribute to the ability to communicate:

- **Foliage —** Leaves absorb radio signals, so areas which have tall trees may provide better coverage in the winter when the limbs are bare than in the summer when the leaves are in full bloom.
- **Subscriber Unit Location —** Location of equipment is more important in fringe areas because the slightest reduction in coverage can significantly impact radio signal reception.
- **Subscriber Unit Orientation —** Many devices require an antenna with directional characteristics, and in fringe areas this is more pronounced since deviation from the desired directional orientation will have a greater impact than higher coverage areas.
- **Terrain Variations —** Sometimes a fringe area is determined by a variation in terrain, such as a mountain range or a river valley where coverage may be impossible at some points on one side of the terrain but will suffice on another.

Increasing Effectiveness in Fringe Areas

Better performance in fringe areas can be obtained in many cases. Below are some suggestions which may assist in gaining adequate coverage in a fringe area:

- Install the unit (or antenna) outside of the building wherever possible
- If the unit or antenna must be installed inside a building, move as close to a window as possible
- Install the unit (or antenna) at the highest point within (or outside) the building as possible
- Rotate the unit (or antenna) in a location, or move slightly to the left or right
- Install the unit (or antenna) on the side of the building facing a coverage area

Dead Zones

Unlike fringe areas, dead zones occur within a coverage area. Dead zones are areas in which communications are not possible. The size of such an area can vary from a few square feet to many city blocks depending upon the environment. Insufficient signal strength or high noise levels within a particular area can cause dead zones to occur. The following can also contribute to a dead zone occurrence:

- **Excessive Signal Loss due to Buildings —** The more surfaces that a radio signal must penetrate within a building, the more likely a dead zone is to occur.

- **Terrain Variations** — Radio waves generally travel in a straight line, so narrow alleys between large buildings for instance can result in a dead zone.
- **Low Signal Areas** — Antennas or units which are mounted on the sides of buildings can sometimes create their own blind spot depending upon the orientation of the installation and in a low signal strength area this can result in a dead zone.
- **High Noise Level Areas** — Areas with electromechanical equipment which generate radio frequency noise can cause interference with radio signals and result in a dead zone.

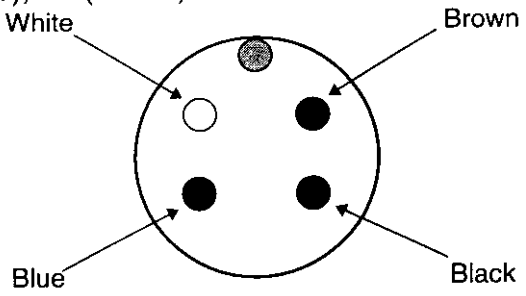
Appendix C. Troubleshooting

Appendix D. ALPHA STARS Specifications

Model	M505A
FCC ID #	I7JM505A
Canada ID #	109 195 263

ALPHA STARS Style Number	3D93476G01
ALPHA STARS with Optional Antenna Connector Style Number	3D93476G02
Installation & Diagnostic Tool Style Number	1C11626G01
External Antenna Unity Gain Kit Style Number	1B12086G01
External Antenna 3db Gain Kit Style Number	1B12086G02

Physical Specifications	
Size	10.86 x 6.88 x 3.13 in. (275.8 x 174.75 x 79.5 mm)
Weight	3 lbs 1360 grams
Mounting	Fastened through holes (M2, 2 positions)
Housing	Polycarbonate
External Connector	4-pin keyed, waterproof connector: 24v DC (Black), GND (White),Tx (Blue), Rx (Brown)



External Antenna Connector	N-type
Modem	Motorola series 505sd
Grounding	Isolated

Electrical Specifications	
Operating Voltage	24v DC
Operating Current	80mA
Operating Temperature	-40°C to 85°C at electronics -20°C to 60°C for radio
Humidity Range	0 to 100% (non-condensing)

Operating Characteristics	
Startup Delay	Less than 2 minutes from power up to ready state
Minimum Recognized Outage	User defined Maximum delay before outage report of 2 minutes Minimum delay before outage report of 2 seconds
Communications Data Rate	9600 bps

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Power T&D Company Inc.
ation Systems Division
outh Rogers Lane
h, NC 27610 USA
: 919-212-4700
19-212-4717

To Do: Week of 09/21/98

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2.0 HF EMI on ANSI Meters

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~~4.0 Get Lotus Notes installed on Home Computer~~

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- NDA

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19.0 EF Johnson
- NDA

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