



ACE6490

Industrial 900MHz ACE

User's Manual
Version 1.4



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For a period of one (1) year from the date of purchase, AEROCOMM warrants the transceiver against defects in materials and workmanship. AEROCOMM will not honor this warranty (and this warranty will be automatically void) if there has been any:

- (1) Tampering, signs of tampering, or opening the transceiver's case.
- (2) Use of AC power adapters and cables other than those originally supplied with the transceivers.
- (3) Repair or attempt to repair by anyone other than an AEROCOMM authorized technician.

This warranty does not cover and AEROCOMM will not be liable for, any damage or failure caused by misuse, abuse, acts of God, accidents, electrical irregularity, or other causes beyond AEROCOMM control, or claim by other than the original purchaser.

FCC Notice



WARNING: This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference and (2) This device must accept any interference received, including interference that may cause undesired operation.

RF Exposure/Installation Instructions



WARNING: To satisfy FCC RF exposure requirements for mobile transmitting devices, this equipment must be professionally installed such that the end user is prevented from replacing the antenna with a non-approved antenna. The end user should also be prevented from being within 20cm of the antenna during normal use with the exception of hands, feet, wrists and ankles.

The preceding statement must be included as a CAUTION statement in manuals for OEM products to alert users on FCC RF Exposure compliance.

Caution: Any change or modification not expressly approved by AeroComm could void the user's authority to operate the equipment.

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1. ACE6490 RF Transceiver

ACE RF devices combine high performance and reliability with heavy-duty packaging designed to withstand hard environmental conditions—splashing water, corrosive agents, dirt, ice and snow. ACEs suit rugged industrial applications where outdoor communications and NEMA-4x ratings are essential.

- ✓ NEMA-4X rated package
- ✓ Durable Industrial grade enclosure
- ✓ One full watt of RF output power
- ✓ Up to 20-miles line-of-sight range
- ✓ Industrial temp -40° to +80° C
- ✓ RS232 & RS485 interfaces

1.1 *Overview*

The ACE6490 uses Frequency Hopping Spread Spectrum modulation, where the units “hop” from frequency to frequency many times per second using a specific hop pattern applied to all the transceivers in the same network. A distinct hopping pattern is provided for each Channel Number, thereby allowing multiple networks to co-exist in the same area without interference.

ACE6490 transceivers operate in a Point-to-Point or Point-to-Multipoint, Server-Client architecture. One transceiver is configured as a Server communicating to one or many Clients. To establish synchronization between transceivers, the Server emits a beacon. Upon detecting a beacon, a Client transceiver informs its Host and a RF link is established.

ACE6490s implement a proprietary communication protocol providing secure data transmissions. Utilizing FHSS technology, the data remains reliable over long distances. Use of license free frequency bands ensure that the units are ready to use with no further certification requirements.

Each unit is small and easily portable for use in mobile and temporary settings as well as for fixed installations. The ACE configuration software enables custom configurations based on unique application requirements.

1.2 ACE6490 Specification

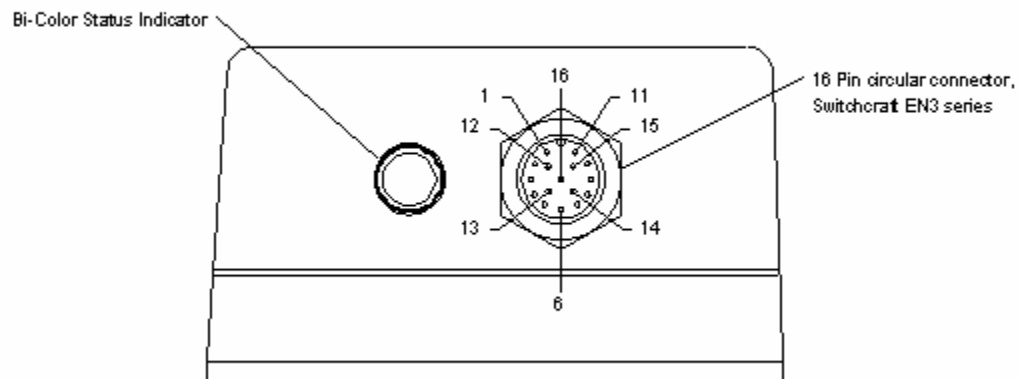
Specifications	ACE6490 - 1000
TRANSCEIVER PERFORMANCE	
Output power	1000mW
Transmission range	Up to 1500 feet (450m) indoors; Up to 20 miles (32 km) line-of-sight
Data rate	Up to 115.2 Kbps
RF Data Rate	76.8kbps fixed
Receiver Sensitivity	-100dBm typical @ 76.8kbps RF Data Rate
Power Consumption (@ 12 Vdc)	400mA
Configuration software	Easy-to-use Windows based software
NETWORKING AND SECURITY	
Frequency band, RF Technology	902 – 928, FHSS (USA); 915-928, FHSS (Australia)
Supported Network Topologies	Point-to-Point, Point-to-Multipoint
Channels	32
Security	One byte System ID. 56-bit DES encryption key.
ANTENNA	
RF Connector	RPSMA Jack
Type	1/2 Wave Dipole
ELECTRICAL	
Electrical requirements	Line voltage 100 – 120V (240V outside US);
Power supply	6-foot cable, AC power connector
ENVIRONMENTAL	
Environmental conditions	Operating temperature -40° to +80°C; 10% to 90% humidity (non-condensing)
PHYSICAL	
Dimensions	6.87 x 3.57 x 2.05 inches
Weight	6 oz (170 g)
Serial Connector	16-pin circular
Serial Cord length	6 feet (183 cm)

1.3 ACE6490 Interface

The ACE6490 unit supports RS-232/RS-485 (2-wire Half Duplex) protocols. By definition, RS-485 protocol can tolerate high noise and push signals over long cable lengths. When using cables, RS-485 will communicate as far as 4000 feet (1200m) and offer multi-drop capability where up to 32 nodes may be connected. RS-232 cables are suitable for distances less than 100 feet (30.5m). AeroComm wireless solutions are not subject to the cabling restrictions for distance, but either interface (RS-232 or RS-485) is available when ordering the ACE6490s.

Note: The ACE6490 units are shipped with a cable that has a Switchcraft connector on one end and a DB-9 connector and a power jack on the other. Caution must be exercised, as only the Switchcraft connector on the cable is waterproof.

Figure 1- ACE6490 Front View



ACE6490 Status LED		
LED	Color	Description
Pwr	Half Bright Green	On indicates that the unit is powered up.
Link	Full Bright Green	On indicates the Client unit(s) and Server unit are in range of one another. Link LED remains activated on Server units. Client units activate the Link LED when in range of the Server unit.
Rx	Orange	When flashing, LED indicates ACE6490 unit is receiving data.
Tx	Orange	When flashing, LED indicates ACE6490 unit is sending data.

Figure 2- ACE6490 Back View

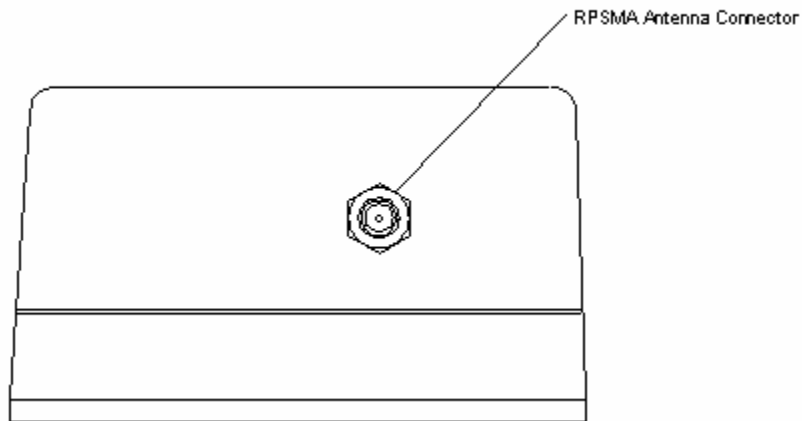


Figure 3- ACE6490 Mechanical Diagram

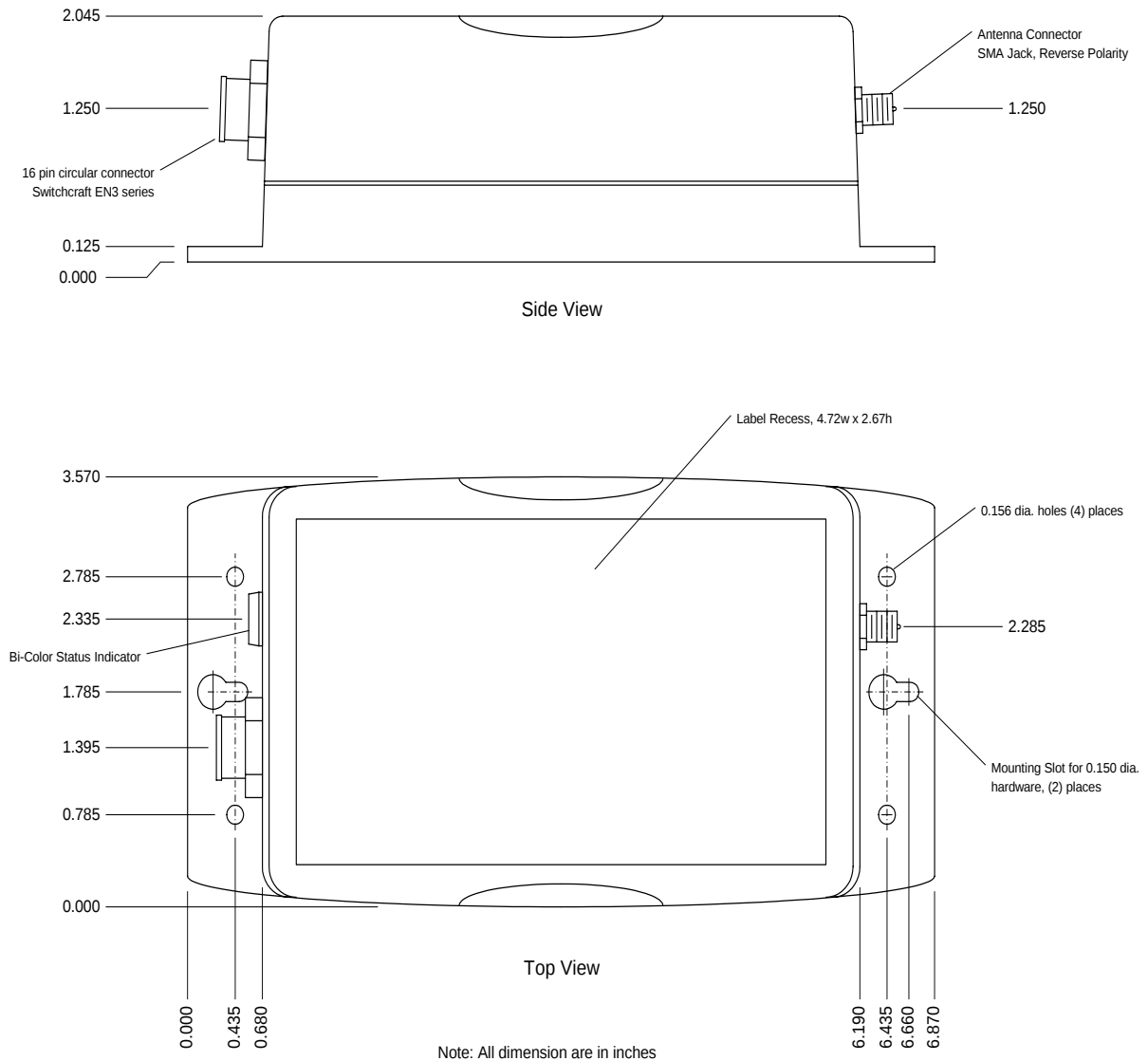
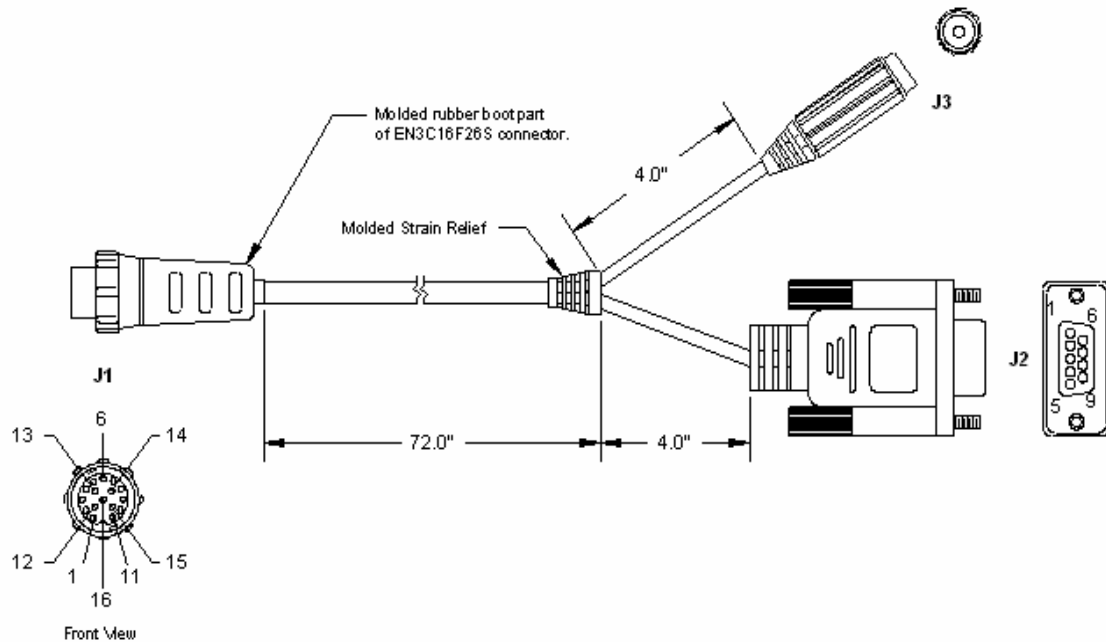


Figure 4- Cable shipped with ACE6490 Starter Packs



DB-9 Pinout		
Pin	RS-485	RS-232
1	DCD	DCD
2	- TX	RxD
3	+TX	TxD
4	N/C	DTR
5	GND	GND
6	N/C	DSR
7	N/C	RTS
8	N/C	CTS
9	N/C	RI

Note: The 6 foot cable shipped along with the ACE unit is only for development purpose. Refer to Appendix A for more details on making a custom cable.

2. Interfacing Protocol

The ACE6490 is a DCE (Data Communications Equipment). A DCE can be interfaced to a DTE using a straight through serial cable (the serial cable provided with the ACE6490 is a straight through cable). Typically, PC's are defined as a DTE and peripherals are defined as DCE. To interface a DCE with another DCE, or a DTE with another DTE, a null modem (or a Crossover) cable is required. The null modem simply swaps pins to convert a DCE to a DTE and vice-versa. A null modem cable can be provided with the ACE6490 on request.

The ACE6490 transceivers support the following interface protocols

- RS-232
- RS-485 (2-wire) Half Duplex

Table 1 – DTE, DCE and Null Modem Signal Definitions

DCE Pin Number	DCE Signal Name	DCE Direction	DTE Pin Number	DTE Signal Name	DTE Direction	Null Modem Female DB9	Null Modem Male DB9
1	DCD	O	1	DCD	I	1	NC
2	TXD	O	2	RXD	I	2	3
3	RXD	I	3	TXD	O	3	2
4	DTR	I	4	DTR	O	4	6
5	GND		5	GND		5	5
6	DSR	O	6	DSR	I	6	4
7	RTS	I	7	RTS	O	7	8
8	CTS	O	8	CTS	I	8	7
9	RI	O	9	RI	I	9	NC

1.4 RS-232

RS-232 is a single ended data transmission protocol. The RS-232 signals are represented by voltage levels with respect to a system common (power / logic ground). The "idle" state (MARK) has the signal level negative with respect to common, and the "active" state (SPACE) has the signal level positive with respect to common. RS-232 has numerous handshaking lines (primarily used with modems), and also specifies a communications protocol.

Figure 5- RS-232 Male/Female Connector Pin out

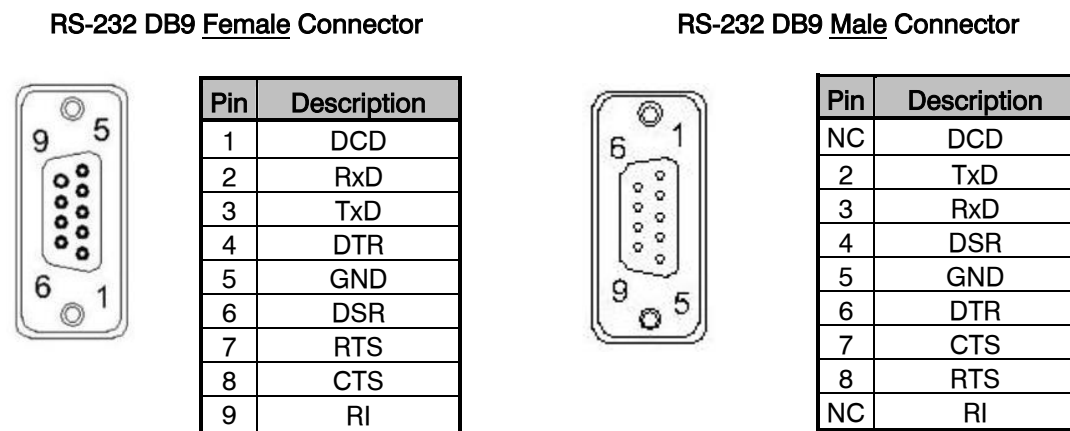


Figure 6- DCE to DTE Interface

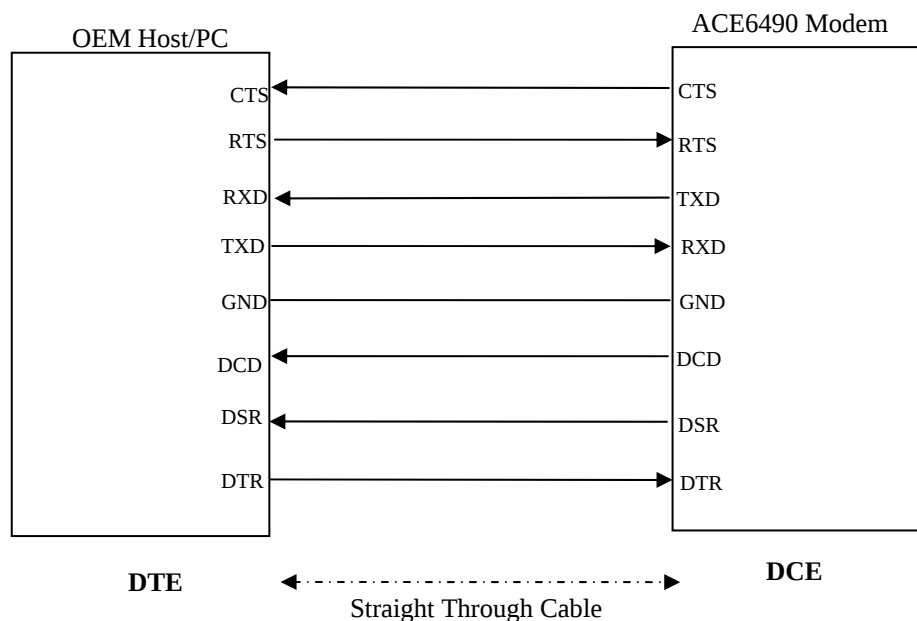
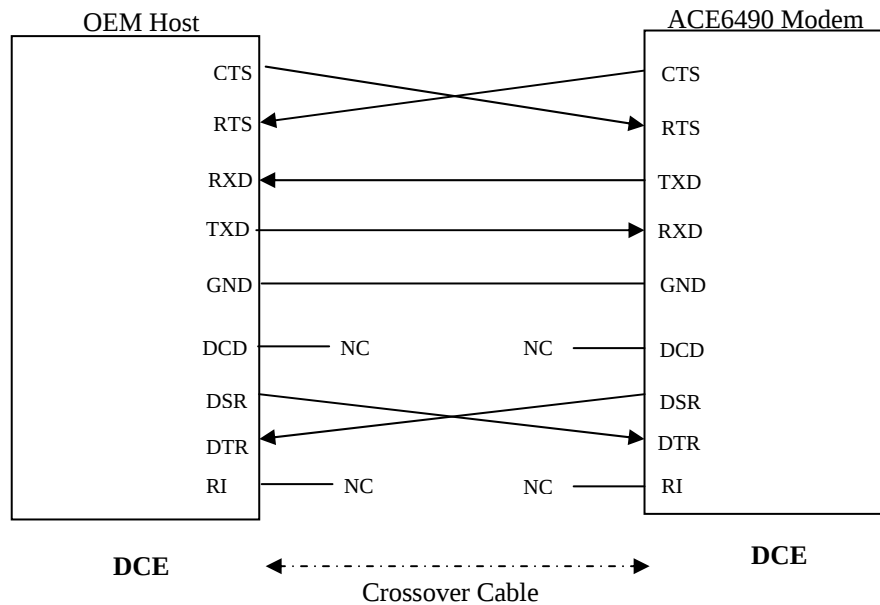


Figure 7- DCE to DCE Interface



Note: The Straight Through Cable provided with the ACE6490 has female connectors on both ends and the Crossover cable has a male connector at one end and a female connector at the other end. Please use a male-to-male adapter or female-to-female adapter wherever required. Using a null modem adapter with a Crossover cable is equivalent to using a Straight Through cable.

1.5 RS-485 (2-wire Half Duplex)

The RS-485 interface uses a Differential Data Transmission that can help nullify the effects of ground shifts and induced noise signals that can appear as common mode voltages on a network.

The ACE6490 implements a RS-485 (2-wire Half Duplex) multi-drop interface. Typically, a RS-485 bus will consist of a master and several slaves. The nodes will have unique addresses and can send addressed packets to specific nodes. Because the bus is half duplex, no two nodes should try to talk at the same time. The ACE6490 does not have a RS-485 address; therefore, it will transmit all RS-485 traffic over the RF. Conversely, as soon as an ACE6490 receives a packet over the RF, it will transmit the packet over the RS-485 bus.

1.6 *Hardware Flow Control*

Flow control refers to the control of data flow between the host and the ACE6490. It is the method used to handle data in the transmit/receive buffer of the ACE6490 interface, and determines how data flow between the host and the ACE6490 is throttled. Often in serial communication, one device is capable of sending data much faster than the other can receive. Flow control allows the slower device to tell the faster device to pause and resume data transmission. (Flow control CTS and RTS are used by the ACE6490 and its Host, locally – NOT over the air. Therefore, one ACE6490 cannot tell the other to slow down or speed up as is mentioned above in the paragraph.)

When the RTS Enable option is selected on the Configuration Utility, the transceivers use hardware flow control to regulate data flow. While using hardware flow control, the transceiver that is ready to receive data sends a **Clear To Send** signal to its host (or the device it is connected to). On the other hand, when a transceiver has something it wants to send to its host, it checks the state of **Ready To Send** and if it is logic low, will send data to its host. If RTS is logic high, it will not send data to its host. These signals are sent apart from the data itself on separate wires. **Note: CTS is always enabled by default. RS-485 Interface does not support Hardware flow control.**

3. Network Topologies

Topology refers to the shape of a network, or the network's layout. How different nodes in a network are connected to each other and how they communicate, is determined by the network's topology. The ACE6490s support a Point-to-Point and a Point-to-Multipoint network topology.

3.1 Point-to-Point

A point-to-point system is a simple arrangement consisting of just two ACE6490s - a Server and a Client. Sometimes referred to as a wireless bridge, a point-to-point link replaces a single communications cable. A point-to-point link might be used to connect a PLC to a remote monitoring station.

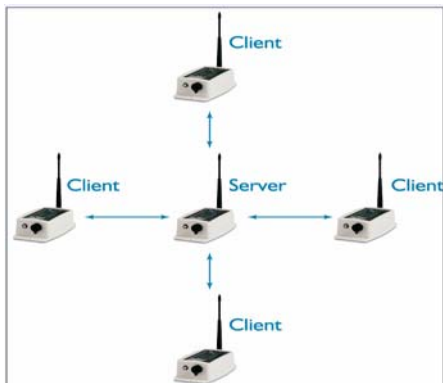
Figure 8- Point-to-Point Network



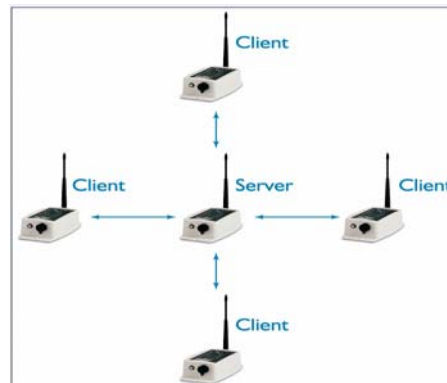
3.2 Point-to-Multipoint

Point-to-Multipoint systems have one base station, or access point, that controls communications with all of the other wireless nodes in the network. This allows for the creation of a wireless network consisting of multiple nodes. By programming each ACE6490 with a network specific Channel Number and System ID multiple networks can be created see (Fig 9).

Figure 9- Multiple Networks of Point-to-Multipoint ACE6490s



Example: Channel Number = 13
System ID = 123



Example: Channel Number = 25
System ID = 256

4. ACE6490 Configuration Utility Software

AeroComm provides the easy to use ACE6490 Utility Software for programming the ACE6490. The GUI based software does not require any hardware configuration and works by itself. The software is compatible with Microsoft® Windows 95, 98, 2000, Me, NT and XP. ACE6490s are plug-and-play devices that work with minimal or no configuration.

However, users may refer to the AC4490 manual for details about the radio's operation and advanced configuration commands. The SDK Software can be used to evaluate the advanced configuration commands. The SDK Software and AC4490 manual can be found on the Connex Tools and Literature CD or on our website at <http://www.aerocomm.com/>.

4.1 Installation

1. Locate the **ACE6490 Configuration Utility, 900 MHz** link in the Software section on the Connex Tools & Literature CD. This software is also available at <http://www.aerocomm.com/Software/Driver ACE6490 900Mhz v.1.zip>.
2. When prompted, accept the default directory or change to the desired directory where the program files will be installed.
3. When finished, a window will be displayed indicating a successful installation. Select **OK**.

4.2 ACE6490Settings

The ACE6490 **Settings** Page is shown below, as it will appear the first time the program is run.

The screenshot shows the 'CL4490 Configuration Utility' window. It has a blue title bar with standard Windows window controls. The main area is divided into two sections: 'ConnexLink Settings' and 'PC Settings'.

ConnexLink Settings:

- Options:** A group box containing five checkboxes: 'RTS Enable' (checked), 'Modem Mode', 'Parity', 'Full Duplex', and 'Data Encryption'.
- Show Defaults:** A button.
- RF Delivery:** A text label.
- Firmware Version:** A text label.
- MAC Address:** A text label.
- Interface Baud Rate:** A dropdown menu.
- Client/Server:** A dropdown menu.
- Channel Number:** A text field with 'Range: 16 - 47'.
- Max Transmit Retries:** A text field with 'Range: 0 - 255'.
- Broadcast Attempts:** A text field with 'Range: 0 - 255'.
- System Identification:** A text field with 'Range: 0 - 255'.
- Destination Address(hex):** A series of six text boxes.
- Data Encryption Key:** A series of six text boxes.

PC Settings:

- ConnexLink / ConnexNet:** Two radio buttons, with 'ConnexLink' selected.
- Port:** A dropdown menu showing 'Communications Port (COM1)'.
- Baud Rate:** A dropdown menu showing '57600'.
- System Config:** A dropdown menu showing 'Point-to-Multipoint'.

Buttons: 'About', 'Help', 'Load File', 'Save to File', 'Write Radio', and 'Read Radio' are located at the bottom right.

4.2.1 ConnexLink Settings

Client/Server: Designates ACE6490 type. In each network, there must be only one Server. All other ACE6490 units must be programmed as Clients. The number of Clients in the network is not limited; however, if performance diminishes, consider additional RF Networks.

Interface Baud Rate: This defines the baud rate used for communicating with the ACE6490 over the serial interface. The RF baud rate is fixed at 76.8 Kbps and is independent of the Interface Baud Rate. The default baud rate setting is 57600 bps unless the units have been pre-configured by AeroComm. **The Interface Baud Rate setting of the ACE6490 must match the Baud Rate setting of its host device.**

Channel Number: A number that designates an independent network of ACE6490 units. Up to 32 independent networks can be created. The valid range of values for this field is 16 to 47.

Max Transmit Retries (For Clients and Servers in Point-to-Point networks only): This value represents the maximum number of times a particular data packet will be transmitted unsuccessfully, or without an acknowledgement, before the ACE6490 discards the packet. The default value is 16 attempts. If communication is lost and the Client's Link LED is on, try increasing this value in small increments until communication is reestablished.

Note: This value is always associated to Client radios and Server radios in Point to Point Mode. The valid range of values for this field is 2 to 255.

Broadcast Attempts (For Servers in Point-to-Multipoint networks only): This value represents the number of times a data packet will be transmitted by the Server ACE6490. The default value is 4 attempts. If communication is lost and the Clients' Link LED is on, try increasing this value in small increments until communication is reestablished. The valid range of values for this field is 2 to 255

System Identification: A number from 0 to 256 that provides added security to each independent network of ACE6490 units. The System ID is used in conjunction with the Channel Number and serves as an RF password to maintain secure transfers of data. The combination of the Channel Number and System ID must be unique to each network of ACE6490s to establish communication. Multiple Servers in the same coverage area must be programmed with different Channel Numbers to prevent inoperability of the networks. The System ID will not prevent inoperability that occurs from locating multiple Servers with the same Channel Number in the same coverage area.

Important Note: **Separate Collocated ACE6490 networks must operate on different Channel Numbers. All units in a given ACE6490 network must have identical Channel Numbers and System IDs.**

Data Encryption Key: Encryption is the process of encoding an information bit stream to secure the data content. The DES algorithm is a common, simple and well-established encryption routine. An encryption key of 56 bits is used to encrypt the packet. The receiver must use the exact same key to decrypt the packet; otherwise garbled data will be produced.

Destination Address: The MAC Address of the remote ACE6490 in a Point-to-Point network. Used to optimize Point-to-Point communications by utilizing RF Acknowledgement.

Firmware Version: Displays the ACE6490's firmware version.

MAC Address: A unique 6 Byte, IEEE 802.3 Ethernet address assigned by AeroComm to each ACE6490.

4.1.2 Optional Settings

Data Encryption: Enables the Data Encryption Key. All ACE6490s in the same network must have the same encryption setting.

RTS Enable: Enables the Request To Send control line. When enabled, enables Hardware Flow Control. Refer to **Section 2.3 Hardware Flow Control**.

Parity: Needs to be enabled if host requires even or odd parity and 8 data bits. This is considered as 9-bit mode. **Note: Enabling Parity cuts the overall throughput into half.**

Full Duplex: This mode restricts Client radios to transmitting on odd numbered frequency hop bins and the Server to even numbered frequency hop bins. Though the RF hardware is still technically half duplex, it makes the transceiver seem full duplex. This can cause overall throughputs to be cut in half. **Note: All transceivers on the same network must have the same setting for Full Duplex.**

Modem Mode: Full modem handshaking is supported by the transceivers when Modem Mode is enabled. Modem Mode is incompatible with RS-485Interface. Enables DCD, DTR, DSR and Ring Indicator control lines.

4.1.3 PC Settings

Port: Serial communications port of the PC connected to the ACE6490 unit.

Baud Rate: Must equal the Interface Baud Rate setting of the ACE6490 unit that is about to be programmed.

System Config: Type of ACE6490 network to be configured. Valid choices are **Point-to-Point** (one Server and one Client) or **Point-to-Multipoint** (one Server and multiple Clients).

Attention: When setting up a Point-to-Point network the Server's Destination address must be set to the Client's MAC Address.

4.1.4 Programming the ACE6490 units

1. Connect an ACE6490 unit to the serial communications port on the PC.
2. Connect the power supply to the ACE6490 unit. Make sure the **Pwr** LED is on.
3. Start the ACE6490 Configuration Utility.
4. Select the COM Port that is connected to the ACE6490 unit on the PC Settings section.
5. Select the Interface Baud Rate of the ACE6490 unit. All ACE6490 units are shipped with a default rate of 57600 (unless units have been pre-configured to match specific serial settings). If the Interface Baud Rate of the ACE6490 unit is changed as described in **Section 4.2 Changing ACE6490 Settings**, then PC Setting Baud Rate must be set to the same Baud Rate to allow proper programming of the units.
6. Select the System Configuration for the ACE6490 network, **Point-to-Point** (one Server and one Client) or **Point-to-Multipoint** (one Server and multiple Clients).
7. Select **Read Radio** to display the current settings of the ACE6490 unit.
8. Change desired settings.
9. After all changes have been made, select **Write Radio** to save the changes.
10. Cycle Power to the unit after all changes has been saved. This will set the ACE6490 unit to its normal mode of operation.

Note: The **Show Defaults** button can be used to display the default Radio settings.

5. Troubleshooting

Problem	ACE6490
Read Radio displays error message: "Radio not responding."	1. Make sure the PC Settings are right. See Section 4.2.3 PC Settings. 2. Make sure the ACE6490 unit uses the right serial cable. Refer to Section 2.1 RS-232. 3. If any other program that is using the same COM port as ACE6490 is open, close that program and try to read the radio again. 4. Reset the radio by cycling power after each unsuccessful Read.
Write Radio displays error message: "Radio not responding."	1. Cycle power to the radio. 2. Read the radio and make desired changes and then Write the radio.
Garbled Data received.	Check Data Encryption Standard settings.
Client's Link LED does not come on.	1. Make sure the unit is connected to power. 2. Cycle power to the radio.
Link LED is on, but data does not get transmitted or received.	1. Make sure the ACE6490 unit(s) is connected to the correct COM Port. 2. Check the COM port settings for correct Baud Rate, Parity and either Hardware or No Flow Control. Units can have transmission errors with Flow Control set to Xon/Xoff. 3. Try increasing the Maximum Transmit Attempts (for Clients) and/or Broadcast Attempts (for Servers) values in small increments until communication is established. 4. Connect a Null Modem adapter between the Client and its host device. 5. Check the Destination Address setting.

If these troubleshooting tips do not resolve the problem, please call our toll free number at (800) 492-2320, extension 207. Technical support hours are Monday through Friday, 8:00 am to 5:00 pm Central Standard Time.

6. APPENDIX A

Making custom cables

PIN OUT	
J1	color signal
1	yellow DCD
2	orange RxD
3	green TxD
4	blue DTR
5	black GND
6	brown DSR
7	white RTS
8	pink CTS
9	violet RI
10	red PWR
11	red/white PWR
13	blk/white GND
12, 14, 15, 16	No Connect

Notes:
1.) J1 Circular connector to be Switchcraft EN3C16F26S or equivalent.
2.) Cable to be black PVC jacket 0.195 to 0.250 dia., wire to be 26 AWG.
3.) Apply heatshrink 1/2" to 3/4" long for strain relief at wire breakout.
4.) All dimensions are inches unless noted.

12 feet

Strip insulation back 1/4", tin wires

Strip jacket back 2.0" to here

Molded rubber boot part of EN3C16F26S connector.

J1

Front View

DEVICE USED ON	REQ D	MATERIAL	SIZE	SCALE	TOLERANCES	OTHERWISE
			A	1=1	SPECIFIED	
DRAWN BY	THE	DATE	REV	SHEET	TOLERANCES:	
		02-22-05	0	1/1	.XX ±0.01	
CHECKED BY		DATE			ANGLES ±1°	
APPROVED BY		DATE				

DWG. NO. 1300-00041

TITLE Cable Assembly
16 pin circular to Flying Leads

Part No. 000-000000
Rev. 002 1.0.0
© 2005
www.switchcraft.com

