Industrial Automation with PCs

ADVANTECH®

ADAM-4550

Radio Modem Module
(RS-232/485 Interface)

User's Manual

Contents

FCC Identification

MKZAZY4550MDM

FCC Warning

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in an industrial / commercial installation. 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. However, there is not a guarantee that interference will not occur in a particular installation.

ADAM-4550 is an economical, wireless RS-232/485 converter designed to interface any bidirectional RS-485 device with a control center host computer. The ADAM-4550 can be used in data acquisition where data sensors are inaccessible to the host computer due to wiring difficulties or long distances that make wiring impractical or impossible.

1.1 Built-in Intelligence

The ADAM-4550 is equipped with an on-board microprocessor and a radio-frequency (RF) module that can be used to interface one host computer with multiple RS-485 networks. Each RS-485 network can be used to support numerous data acquisition devices.

1.2 Features

- Built-in microprocessor
- Data transmission speeds up to 115.2 Kbps
- Built-in RS-485 line surge protection
- Software configurable address and baud rate
- Easily mounted on DIN rails, panels or as a piggyback unit.
- All communication setup information stored on system EEPROM
- Automatically sets RS-232 port to DTE/DCE and automatic RS-485 data flow control
- Can be used as point to point or point to points communication
- Can be operated with address or without address

1.3 Specifications

- **Transmission speed (bps):** 300, 600, 1200, 2400, 4800, 9600, 19.2K, 38.4K, 57.6K, 115.2K (transmission speeds are software configurable)

- **Radio frequency :** 2.442 GHz, Direct Sequence Spread Spectrum (DSSS)

- **Radio bandwidth :** 22 MHz

- **Radio transmission power:** 100 mW nominal

- **Radio transmission rate:** 1 Mbps

- **Power requirement:** Unregulated ($+10V_{DC}$ to $+30V_{DC}$) with protection from power reversals

- **Case:** ABS with captive mounting hardware

- **Standard accessories:** Nylon DIN-rail mounting adapter, SECC panel mounting bracket

- **RS-232 interface connector:** DB-9 (female)

- **RS-485 interface connector:** Plug-in screw type terminal [accepts AWG 1-#12 or 2-#14~#22 (0.5 to 2.5 mm^2) wires]

- **Operating temperature:** -10º to 70º C

- **Power consumption :** 4 W

- **Communication distance:** 550 ft. effective range (under open site test with 2 dBi omni antenna). Actual distance depends on environmental conditions, antenna type and positioning.

2.1 Basic Configuration

Before installing the ADAM-4550 in an existing network, the ADAM-4550 unit should be pre-configured. Though all modules are initially pre-configured at the factory, it is recommended that you check the baud rate settings.

Factory Default Settings:

Baud Rate: 9600 bps (both RS-232 and RS-485)

Delimiter: {

Address: 00

2.2 Power Supply

For ease of use in industrial environments, ADAM modules are designed to accept industry standard +24 V_{DC} unregulated power. Modules are certified for operation with any power supply source between +10 and +30 V_{DC}. Power

ripples must be limited to 5 V peak to peak, while voltage must in all cases remain between +10 and +30 V_{DC}. All power supply specifications are referenced at the module connector.

Power cables should be selected according to the number of modules connected and the length of the power lines. When using a network with long cables, we advise the use of thicker wire to limit the line voltage drop. In addition to serious voltage drops, long voltage lines can also cause interference with communication wires.

We advise that the following standard colors (as indicated on the modules) be used for power lines:

+Vs   ⇨ (R) Red

GND   ⇨ (B) Black

2.3 RS-485 Communication Wiring

We recommend using shielded-pair cables which comply with the EIA RS-485 standard to reduce interference in an ADAM network. Only one set of twisted-pair cables is required to transmit both DATA and RTS signals. We advise that the following standard colors (as indicated on the modules) be used for the communication lines:

DATA+ $\Rightarrow$ (Y) Yellow

DATA- $\Rightarrow$ (G) Green

2.4 Software Configuration

The ADAM-4550 comes with a setup disk that contains software for the following:

- Baud rate configuration
- Address configuration
- Statistical RF error rate retrieval
- Firmware upload tool for firmware upgrades

Note: 1. Before turning on the power and configuring the ADAM-4550, make sure it is connected to your host computer through an RS-232 cable and that the host computer is on. The ADAM-4550 will automatically detect the cable and set itself as a DTE/DCE according to the RS-232 port of the connected host computer. If there is no RS-232 cable connected to the host computer, the ADAM-4550 will set itself as a DCE when you turn on the power.
For RS-485 wireless transceiver applications, the user can leave the RS-232 port opened. The ADAM-4550 should set RS-232 as a DCE after power is turned on.
2. The pin INIT (pin 6) should be grounded while you turn on the power of ADAM-4550 for configuration. For normal operation, just leave INIT (pin 6) open while you turn the power on.

2.5 Configuring ADAM-4550

1. Insert the ADAM-4550 disk in drive A. Start Microsoft Windows. From the **Program Manager**, select the **File** menu and choose **Run**. Type **a:\ADAM4550** and press **ENTER**. The ADAM Configuration and Diagnostics window should now open.

2. You must now set the host computer's port configuration before configuring your ADAM-4550. To configure your host communication port, select the **Setting...** menu and choose **Local**. A dialog box will open. Select the proper COM port that is connected to the ADAM-4550 and set the baud rate to 9600. Click the **OK** button.

3. Connect your PC's RS-232 serial port to ADAM-4550's RS-232 port. Connect the INIT pin with the ADAM-4550's ground pin. Turn on the power. The unit is now in configuration mode. The green LED light should blink slowly.

4. You must now search your unit for its current settings. To do this, select the **Setting...** menu and choose **Get**. Enter a starting address into the dialog box or use the default start address 0. Click the **OK** button. The configuration software will scan the unit for the address by matching the unit's address with each address number between the starting address and 255. If the unit's address is found, its ID address, baud rate and delimiter settings will be displayed.

5. You may now change the settings. To change the configuration, select the **Setting...** menu and choose **Set**. A dialog box will open. Enter the new configuration settings (new address, identification, new baud rate, master/slave) and click the **OK** button. Follow the procedure in the **Search** section to get the new desired configurations.
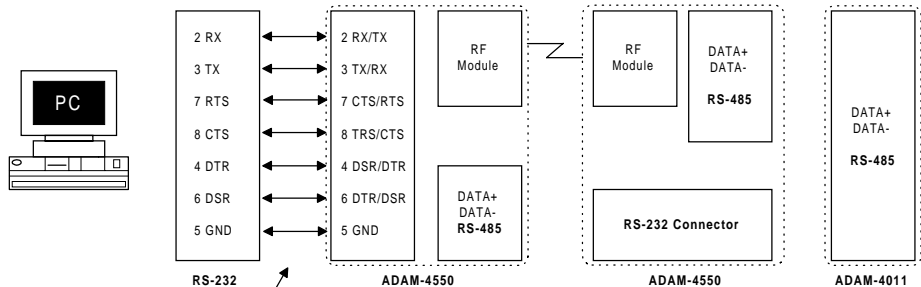
Note: The RS-232 cable does not have to be
a null-modem cable. The ADAM-4550
will automatically detect and set itself
as a DCE.
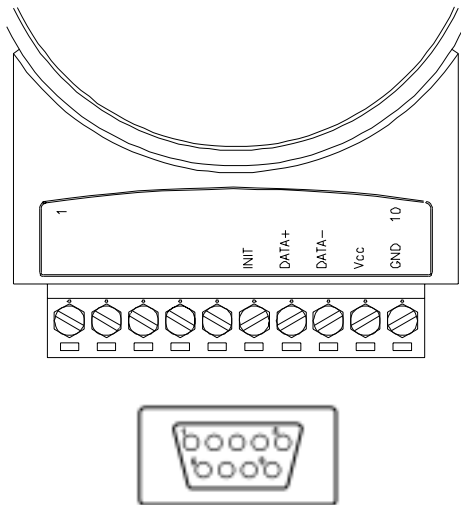
Figure 1: Basic Connection Diagram

Figure 2: Pin Assignment

Note: 1. The address between F8h and FFh are used for non-addressable modules. The addresses for addressable modules are between 00h and F7h.

2. The ADAM-4550 can be configured as either a MASTER type module or a SLAVE type module. The MASTER ADAM-4550 is the module connected to the host PC. The SLAVE ADAM-4550s are those connected to remote RS-485 devices or other ADAM series products. Run your configuration program ADAM4550.EXE to set the unit to the correct type.

6. Disconnect INIT pin from the ground pin after configuration is complete.

Note: During the Get or Set configuration process, the configuration software will automatically search the unit for current settings using a certain default ID address. If the unit does not respond, a scanning address dialog box will appear. Click OK in the box to start the scanning process. Now the configuration software will scan for ID addresses between 0 and 255. The current settings of the unit will be displayed when the units address is found. Users can also change the time-out value in the scanning dialog box to allow more scanning time for the configuration software.

2.6 Uploading a New Version of Firmware

1. Follow the procedures in sections A.1 and A.2 and start the Adam Configuration and Diagnostic Program.

2. Select the **Setting...** menu and choose **Local**. A dialog box will open. Select the proper COM port connected to the ADAM-4550 and set the baud rate to 9600. Click the **OK** button.

3. Select the **Upload** menu. A dialog box will open. Enter the file name where the firmware to be uploaded is located. Click the **OK** button to begin uploading. The green LED light on ADAM-4550 now changes to a steady glow. When uploading is completed, the green LED will turn off. Turn off your ADAM-4550's power and then turn the power on again to complete the uploading process. The ADAM-4550 unit is now ready to be configured. Follow procedures in section A to re-configure the unit.

2.7 Using the Diagnostics Functions

Start the ADAM Configuration and Diagnostic Program. Select the **Diagnostics** menu. A dialog box will open. Enter the selected ADAM-4550 unit ID address and the communication port baud rate. Click the **OK** button. The RF link quality indicator will be displayed:

Total Received Packets indicates the total number of packets received by the selected ADAM-4550 unit.

CRC Error indicates the number of received packets with the CRC checking error.

Check Sum indicates the number of received packets with the Check Sum error.

Transmit acknowledged indicates the total number of acknowledged packets received by the selected ADAM-4550 unit from the remote ADAM-4550 unit.

Transmit retransmitted indicates the total number of retransmitted packets sent out from the selected ADAM-4550 unit due to poor link quality (i.e. no acknowledgment received).

2.8 Antenna Installation

Indoor communication distance is about 300 to 550 ft. using a standard 2 dB antenna. However, actual distance depends on environmental conditions as well as antenna type and positioning.

Longer communication distances can be achieved by using an antenna with a higher gain. A table of communication ranges as a function of differing combinations of antennas (at the source and receiving ends) is displayed below.

Antenna Gain at either end	24 dB directional	18 dB directional	11 dB omni-directional
24 dB directional	10 Km	5 Km	2 Km
18 dB directional	5 Km	2.5 Km	1 Km
11 dB omni-directional	2 Km	1 Km	0.5 Km

Note : 1. While using directional antennas, care should be taken to install and adjust the antenna s direction according to the instructions of the antenna's manufacturer.   Please see the example specification for an external 24 dBi antenna at appendix A.

2. A user's license may be required to use a directional antenna. Please consult your local authority for local regulations.

3. We strongly recommend that you install ADAM-4550 as near as possible to its antenna. Where the antenna has to be located at a distance from the ADAM, special RF cable is required. Please see the example cable connection arrangement in appendix B.

4. Omnidirectional antennas should be used when the ADAM-4550 communicates with more than one other ADAM-4550 unit located in different directions.

3. Using ADAM-4550

Connect one ADAM-4550 to the controlling PC's serial port with the RS-232 cable. Connect remote ADAM-4550 units to remote data units through the RS-485 bus.

Configure each ADAM-4550 unit by following the procedures in section A.

Start the ADAM Configuration and Diagnostic Program on the controller PC. Select the **Setting...** menu and choose **Local**. In the dialog box, select the proper COM port and set the baud rate to the one configured for the ADAM-4550.

Make sure all ADAM-4550 units are powered off. From the ADAM Configuration and Diagnostic Program, select the **Connections** menu and choose **Connect**. Turn on power to the ADAM-4550 connected to the controlling PC and the green LED should blink slowly. Turn on the power to the remote ADAM-4550 units one by one. The green LED on the ADAM-4550 that is

connected to the controlling PC, as well as the green LEDs on the remote ADAM-4550 units should now be in a rapid blinking mode. This indicates that the RF links between the controlling unit and all the remote units have been established.

Note: *It is important that during the initial setup, the ADAM-4550 unit connected to the controlling PC must be powered up before the other remote ADAM-4550 units are powered up. Moreover, any devices connected to an ADAM-4550 through RS-232 must be powered on before the ADAM-4550 is powered on. This will allow the ADAM-4550 to automatically detect the connected device and set itself into proper DCE or DTE modes.*
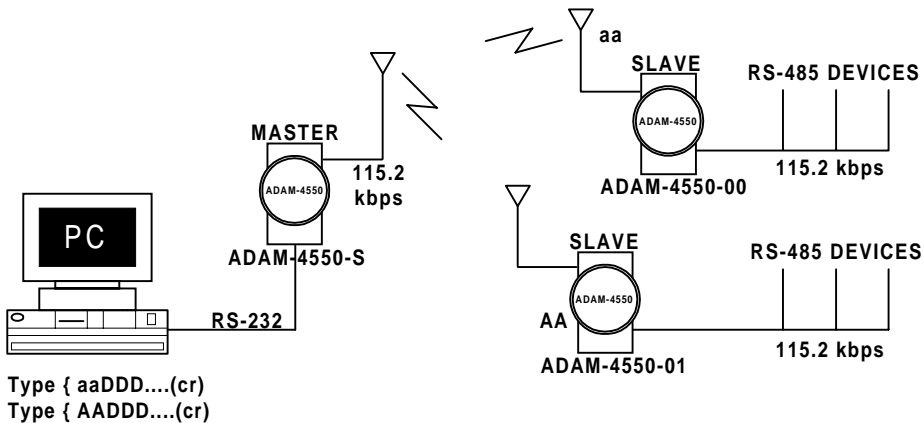
Figure 3: Test Sample

3.1 A Test Sample

1. Follow procedures in section C to install one ADAM-4550 unit as the MASTER module for a controlling PC and two ADAM-4550s as SLAVEs for the remote devices (see Fig. 3).

2. Start the ADAM Configuration and Diagnostic Program on the controlling PC. Select **Generate-Traffic** menu and choose **Send One Packet.** In the window area type in **{AADDD...... (cr)}** where **{** is the delimiter selected when configuring the ADAM-4550 units, **AA** is the hexadecimal unit ID address and **DDD......** is the data. The transmitted data **DDD......** should be displayed on the PC monitor connected to the remote ADAM-4550.

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4. ADAM-4550 Command Set

In order to avoid communication conflicts, all actions are instigated by the host computer when several devices attempt to send data at the same time . The basic form is a command/response protocol with the host initiating the sequence.

The host issues a command to a module with a specified address and waits a specific amount of time for the module to respond. If no response is received, a time-out command aborts the sequence and returns control to the host.

Syntax

[delimiter character] [address] [command] [data] [carriage return]

Every command begins with a delimiter character. Most of the commands can use a **$** (dollar sign) or a **%** (percentage sign), but the Data Pass mode command uses one of eight special characters. The delimiter character is followed by a

two-character address (hexadecimal) that specifies the target module. Depending on the command, an optional data string follows the command string. Every command is terminated by a (cr) carriage return. Command sets are divided into two categories: **configuration mode commands** and **data pass mode commands**:

Configuration Mode Commands

Command Syntax	Command Name	Description
%AANNTTCCFFPP(cr)	Sets new configuration	Requests to set new address, baud rate at module AA
$AA2(cr)	Reads configuration	Requests to get current configuration from module address AA
$AA6(ID string)(cr)	Writes identification	Sets the identification data (0 to 16 bytes) to module at address AA
$AA7(cr)	Reads identification	Reads the identification data from the module at address AA
$AACD(cr)	Sets the delimiter	Sets the delimiter character (":", "[", "]", "^", "{", "}", "~", "|") for Data Pass mode commands
$AAD(cr)	Reads the delimiter	Reads delimiter character from the module at address AA
$AAF(cr)	Reads firmware version	Reads the firmware version number
$AAM(cr)	Reads module name	Reads the model name of the module
$AAL(cr)	Starts uploading	Starts uploading of new firmware to the module at address AA
&AAAD1D2(cr)	Sets Data Gate command	Requests the module at address AA to set Data Gate to Open(1) or Close(0)
&AAB(cr)	Reads Data Gate Status	Requests the module at address AA to return Data Gate status

Data Pass Mode Commands

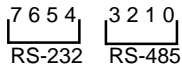| Command Syntax	Command Name	Description
{AADD(cr)	Sends data to remote	Sends data string DD through the remote module at address AA
&AAQ(cr)	Gets error rate statistics	Gets RF error rate statistics from the module at address AA
&AAAD1D2(cr)	Sets Data Gate command	Requests the module at address AA to set Data Gate to Open(1) or Close(0)
&AAB(cr)	Reads Data Gate Status	Requests the module at address AA to return Data Gate status

Note: All commands should be issued in upper case letters.

Command Descriptions

4.1 Set New Configuration

Description Requests to set new baud rate, new address… for module.

Syntax %AANNTTCCFFPP(cr)

AA: module address (2 characters hexadecimal)

NN: new module address

TT: set to 0x40(H)

CC: High 4 bits represents RS-232 baud rate code for module. Low 4 bits represents RS-485 baud rate code for module.

Currently, RS-232 and RS-485 ports have the same baud rate.

Baud rate code are listed below:

$$\underbrace{7\ 6\ 5\ 4}_{RS\text{-}232}\quad \underbrace{3\ 2\ 1\ 0}_{RS\text{-}485}$$

Code	Baud rate
01	300 bps
02	600 bps
03	1200 bps
04	2400 bps
05	4800 bps
06	9600 bps
07	19200 bps
08	38400 bps
09	57600 bps
0A	115200 bps

FF : ADAM-4550 mode configuration

bit 7 6 5 4 3 2 1 0

Reserved for addressable/non-addressable

Master (1) / Slave (0)
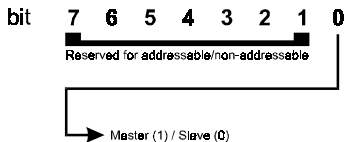
PP: RS-232/RS-485 data format. It is currently a fixed number.
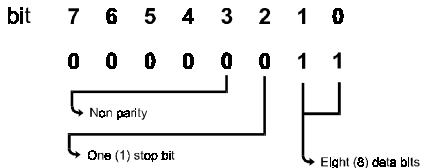
bit 7 6 5 4 3 2 1 0

     0 0 0 0 0 0 1 1

Non parity

One (1) stop bit

Eight (8) data bits

Response   !AA(cr) if the command is valid

?AA(cr) if an invalid command is entered

Example   Command:
%0A1B40AA2103(cr)

Response: !0A(cr)

The ADAM-4550 module with address 0Ah is configured to a new address 1Bh and the baud rate is set to 115.2 Kbps. RS-232 data format is fixed to N, 8, 1.

4.2 Read Configuration

Description Requests to read the current baud rate and address from the module.

Syntax $AA2(cr)

AA: module address (2 hexa-decimal characters)

Response !AATTCCFFPP(cr) if the command is valid (refer to "Set New Configuration" in Command Set)

?AA(cr) if an invalid command is entered

Example Command : $0A2(cr)

Response: !0A40AA2103(cr)

4.3 Write Identification

Description Requests to assign identification data to the module at address AA. The identification character lengths can range from 0 to 16 bytes including carriage-return.

Syntax $AA6(identification characters)(cr)

Response !AA(cr) if the command is valid

?AA(cr) if an invalid command is entered

Example Command: $0A6ADAM4550 Unit#1(cr)

Response: !0A(cr)

4.4 Read Identification

Description	Requests to read identification data from the module at address AA.
Syntax	$AA7(cr)
Response	!AA(identification characters)(cr) if the command is valid
	?AA(cr) if an invalid command is entered
Example	Command: $0A7(cr)
	Response: !0AADAM4550 Unit#1(cr)

4.5. Set Delimiter Character

Description	Requests to assign a new delimiter character to the module at address AA.
Syntax	$AACD(cr)
	D: delimiter character selected from ':','[', ']','^', '{', '}', '|', '~'
Response	!AA(cr) if the command is valid
	?AA(cr) if an invalid command is entered
Example	Command: $0AC[(cr)
	Response: !0A(cr)

4.6. Read Delimiter Character

Description	Requests to read the delimiter character data from the module at address AA.
Syntax	$AAD(cr)
Response	!AA(delimiter character)(cr) if the command is valid
	?AA(cr) if an invalid command is entered
Example	Command: $0AD(cr)
	Response: !0A[(cr)

4.7. Set Data Gate

Description	Requests the module at address AA to set data gate to open(1) or close (0).
Syntax	&AAAD1D2(cr)
	where AA is the module address
	D1 = 1 Open data gate
	D1 = 0 Close data gate
	D2 = 1 Write to Flash memory
	D2 = 0 Do not write to Flash memory
Response	!AA(cr) if the command is valid
	?AA(cr) if an invalid command is entered
Example	Command: &0AA00(cr)

Response: !0A(cr)

The command asks the module at address 0Ah to close the data gate and not to write to FLASH memory.

Command: &0AA11(cr)

Response: !0A(cr)

The command requests the module at address 0Ah to open the data gate and write to Flash memory.

Note: 1. If the command asks the module to write to FLASH memory, the status will remain at <u>Open Gate/Write to FLASH</u> when the power is turned off and then on again.

2. If the command asks the addressable module to open the data gate, the module will automatically assume non-addressable mode. This enables the module to issue commands without adding {AA until the user issues another command to close the data gate.}

4.8. Read Data Gate Status

Description	Requests the module at address AA to return data gate status.
Syntax	&AAB(cr)
Response	!AAS(cr) if the command is valid where S = 1 open data gate S = 0 close data gate ?AA(cr) if an invalid command is entered
Example	Command: &0AB(cr) Response: !0A0(cr) The module returns that current data gate status is close.

4.9. Read Firmware Version

Description	Requests to read the ADAM-4550 firmware version number from the module at address AA.
Syntax	$AAF(cr)
Response	!AA(version number)(cr) if the command is valid ?AA(cr) if an invalid command is entered
Example	Command: $0AF(cr) Response: !0AA1.0(cr)

4.10. Read Module Name

Description	Requests to read the module name from the module at address AA.
Syntax	$AAM(cr)
Response	!AA(module name)(cr) if the command is valid
	?AA(cr) if an invalid command is entered
Example	Command: $0AM(cr)
	Response: !0A4550(cr)

4.11. Uploading

Description	Requests to upload new firmware to the module at address AA.
Syntax	$AAL(cr)
Response	!AA(cr) if the command is valid
	?AA(cr) if an invalid command is entered
	After having received '!AA(cr)' response, the host computer starts to send 2 bytes Hi-Lo data length followed by the firmware binary data. If the host receives response '?AA(cr)' or no response, it will stop sending the binary data.

Example   Command : $0AL(cr)

Response : !0A(cr)

command : 0A 80   12 34 56
.... length 2688
bytes followed by data 12h 34h

4.12. Send Data to Remote

Description   Send the DATA to RS-485 device through the remote module at address AA

This command only works in *Data Pass* mode. The user can use the "Set Data Gate" command to open the data gate of the module at AA so that you can send the data to module AA without {AA.

Syntax   {AA(Data string)(cr)

{ — one of the eight optional delimiters which is configured into the module

Example   Command :
{0C123456abcdABCD(cr)

The command sends data '123456abcdABCD(cr)' through the local ADAM4550 and the remote ADAM-4550 module at address 0Ch to a connected RS-485 device.

4.13. Get Error Rate Statistics

Description Requests to get the current RF error rate statistics from the module at address AA.

This command only works in *Data Pass* mode.

Syntax &AAQ(cr)

Response !AAQ(statistic data)(cr) if the command is valid

?AA(cr) if an invalid command is entered

The statistic data format is in the following order:

Total number of packets: 4 bytes

Total number of CRC error packets received: 2 bytes

Total number of checksum error packets received : 2 bytes

Total number of good packets received: 4 bytes

Total number of transmit acknowledged packets: 4 bytes

Total number of transmit retransmitted packets: 4 bytes

Note: All data in Hi-Lo format

Example Command : &0AQ(cr)

Response : !0AQ0A 00 00 00 01 00   00 00   09 00 00 00 1A 00 00 00   05 00 00 00(cr)

The underlined portion of the above response is used to show binary data. In this example: there are 10 packets received, 1 of them is the CRC error, no

checksum error and 9 good packets. There are 26 packets that were transmitted from this module that received acknowledgment. There are 5 retransmitted packets due since no acknowledgment was received.

8 dBi Omni-Directional Antenna

Electrical Specifications:

Frequency:	2.4 to 2.483 GHz
Gain:	8 dBi
3 dB beamwidth:	15° in elevation plane, uniform in azimuth plane.
VSWR:	1.5:1 max @ 50 ohm
Polarization:	Vertical

Mechanical Specifications:

Antenna Type:	Colinear
Size:	750 mm
Weight:	1.5 kg
Connector:	Type N Female

Environmental Specifications:

Windload:	240 km/hr.
Humidity:	100%

11 dBi Omni-Directional Antenna

Electrical Specifications:

Frequency:	2.4 to 2.483 GHz
Gain:	11 dBi
3 dB beamwidth:	9° in elevation plane, uniform in azimuth plane.
VSWR:	1.5:1 max @ 50 ohm
Polarization:	RHCP

Mechanical Specifications:

Antenna Type:	Colinear
Size:	1500 mm
Weight:	0.9 kg
Connector:	Type N Female

Environmental Specifications:

Windload:	200 km/hr.
Humidity:	100%

24 dBi Grid Parabolic Reflector Directional Antenna

Electrical Specifications:

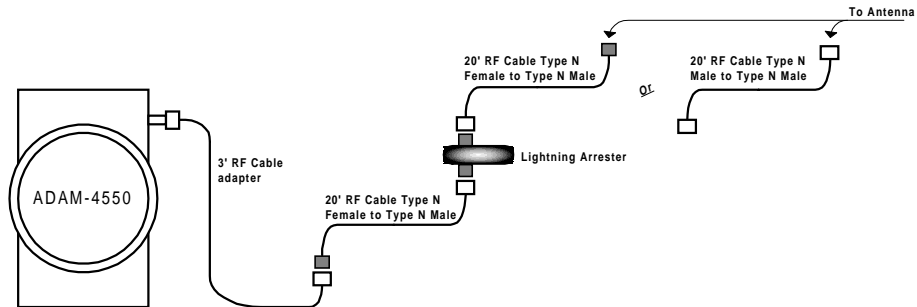|	
Frequency:	2.4 to 2.483 GHz
Gain:	24 dBi
3 dB beamwidth:	10°
Sidelobe level:	-20 dB
Front-to-back ratio:	28 dB minimum
VSWR:	1.5:1 max @ 50 ohm
Polarization:	Vertical/Horizontal Linear
Cross Polarization:	28 dB minimum

Mechanical Specifications:

Antenna Type:	Wire Grid Parabola Reflector
Size:	686 x 813 mm
Weight:	2.4 kg
Connector:	Type N Male

Environmental Specifications:

Temperature:	-40 to +80° C
Humidity:	100%

To Antenna

**20' RF Cable Type N
Female to Type N Male**

**20' RF Cable Type N
Male to Type N Male**

Or

**3' RF Cable
adapter**

ADAM-4550

Lightning Arrester

**20' RF Cable Type N
Female to Type N Male**

* Not for applications in the U.S. or EC countries.