XG1 Radio
Installation Manual

A4-00103-011-02, Rev. 1.11
May, 2007

Operational and Safety Warnings

Antenna Connection and Lightning Arrestor

The warranty requires that the radio must not be powered-up without an antenna connected. The warranty also requires that a lightning arrestor be installed.

RF Exposure

The equipment described herein emits radio frequency (RF) energy and requires professional installation. Although the power emitted is two watts or less, care should be taken to use the radio equipment properly to avoid the concentrated radio frequency energy near an antenna, especially a directional antenna (for example, a *yagi* antenna). No person should be within 81 centimeters (32 inches) of the antenna when the radio is transmitting. This includes indoor, outdoor and mobile use of the radio equipment.

High Surface Temperature

There may be a high surface temperature when the unit is operating at the maximum rated ambient temperature

FCC Part 15 Compliance

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE CONDITION THAT THIS DEVICE DOES NOT CAUSE HARMFUL INTERFERENCE.

NOTE: the manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.

NOTICE

Adapt4, Inc. assumes no responsibility for any errors that may appear in this document, nor does it make any commitment to update the information contained herein. However, questions regarding the information contained in this document are welcomed.

Adapt4, Inc. also reserves the right to make changes to the specifications of the XG1 Series and to the information contained in this document at any time without notice.

This manual is not all inclusive of our products and services. The software and procedures discussed herein are continuously evolving just as are the requirements of our customers. Its format is informal, and hopefully will stimulate as many questions as it answers. Copies of cut sheets, engineering data, customer lists, installation guides, and test procedures are all available for further information.

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1.0 Overview

1.0.1 Brief System Description

The XG1 Installation Software provides a tool that enables a field installer to configure an Adapt4 *XG1* radio as part of its installation in the field. The field installer “installs” the radio to make it capable of communicating on the correct network. Subsequently, the Network Operator will “commission” the site, possibly after the field installer has left the site. The commissioning process includes further configuring of the site over-the-air and coordinating the start of service with the end-user. When the site is commissioned, it may begin carrying end-user traffic.

The Installation Software normally runs on a laptop computer and has the following capabilities:

- Network configuration – Set the *XG1* radio configuration so that it can join the correct network. The network's Element Management System (EMS) will further configure the radio after it has joined the network.
- Software updates – Download new software distributions from the laptop to the radio.
- Antenna Pointing – Point the station's antenna using the laptop software's visual and audible indications of the signal strength received from the Base Station.
- Interface configuration – If applicable, configure the RS-232 serial ports.

The above list of capabilities is also a brief outline of the tasks of installing the radio. More details will be given below.

Table 1.0-1 provides an equipment list needed to support use of the XG1 Installation Software.

Table 1.0-1: Items Needed to Connect Radio to Computer

1. Laptop with:
   - Windows 98 or later
   - Ethernet port
   - 128 MB RAM
   - Correct time/date set
   - SVGA display or better
2. Ethernet cable
   - Cross-over (if directly connected)
   - Straight-through (if connected via hub)
3. RS-232 cable (for testing user ports)
   - DB-9F, null cable or null adapter
   - XG1 Installation software

Figure 1.0-1 illustrates an *XG1* radio network, which is comprised of three XG1 radio Remote Sites and a Base Station (Hub). The Remote Sites are further comprised of an antenna, the *XG1* radio and end-user equipment. The end-user equipment is attached to the radio via Ethernet and/or RS-232 serial cables.

The Base Station comprises an antenna (typically omnidirectional), an *XG1* Base Station Radio, Ethernet and optional RS-232 serial cabling from the radio into a shelter or building. These cables connect to user host equipment. In addition, the Ethernet cable connects to the Element Management System (EMS) computer that manages the *XG1* radio network and provides a graphical user interface (GUI) to Network Operators.

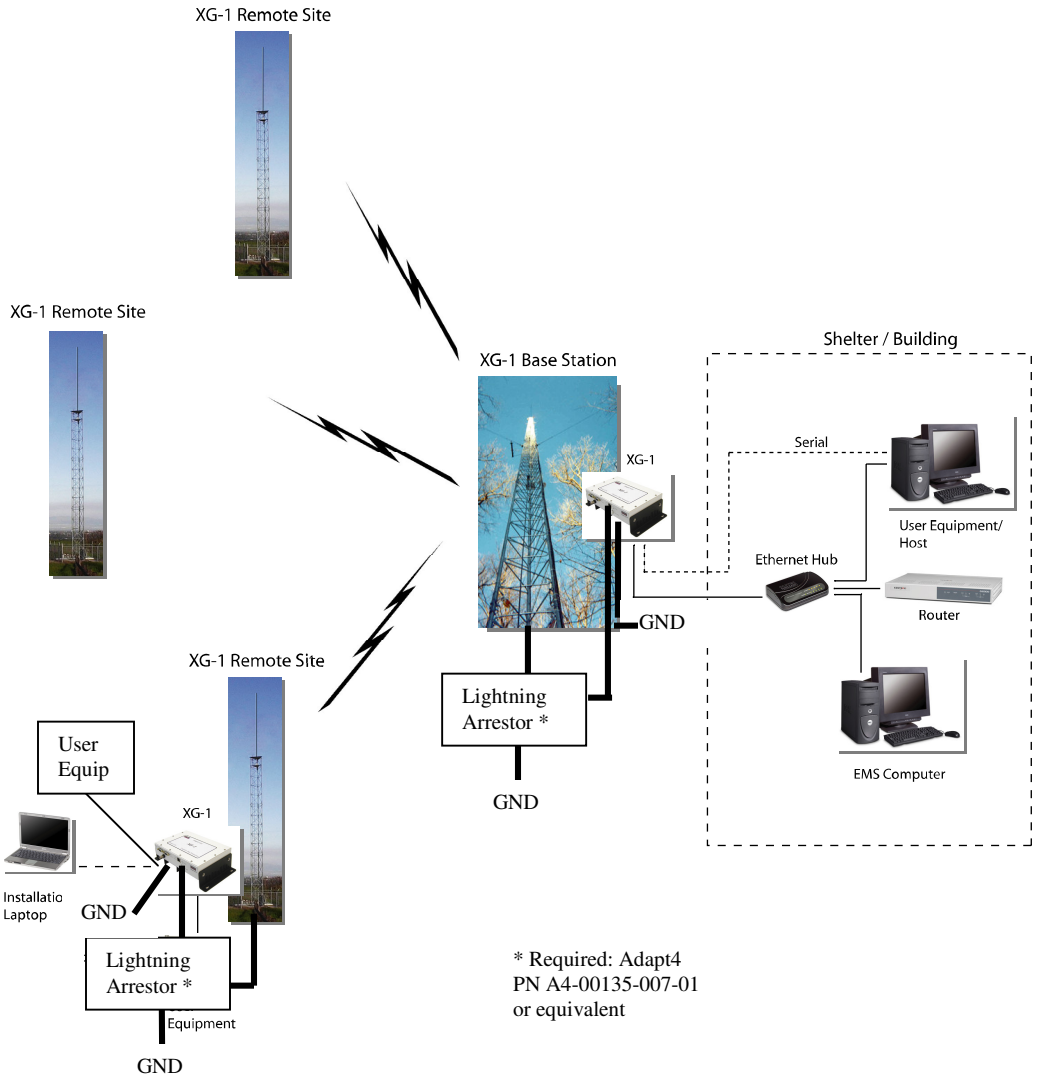


Figure 1.0-1: XG1 Radio Network

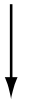
The XG1 radio must be installed vertically, typically on a wall, as illustrated in Figure 1.0-3.

Warning: the radio was designed for vertical mounting for heat dissipation; if it is mounted any other way without approval from Adapt4, this will void the warranty.

After installation, the Field Engineer performs the following basic steps to configure a Remote Site XG1 radio:

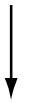
1. Connect laptop to radio

The laptop communicates with the *XG-1* radio via an Ethernet cable, as shown in Figure 1.0-2. To connect the laptop directly to the XG-1 radio, use a crossover Ethernet cable. To connect to the XG-1 via an Ethernet hub, use a straight-through Ethernet cable. **Note**: Some Ethernet hubs can automatically detect and compensate for the type of Ethernet cable being used.



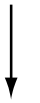
2. Start the XG-1 installation application

Use the shortcut icon provided during installation of the software. The application divides the functions into seven tabs organized across the window frame from left to right. The tabs are generally used in the order presented: Admin, Download, Startup, Advanced, Channels, Spectrum Analysis, and Help.



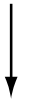
3. Log in and test communications (Admin Tab)

The operator must click the Admin Tab and log into the XG-1 Installation program using the Network Operator-provided User Name/Password. The Network Operator might also require an Operator ID. After logging in, test Ethernet communications with the radio.



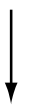
4. Install software onto radio (Download Tab)

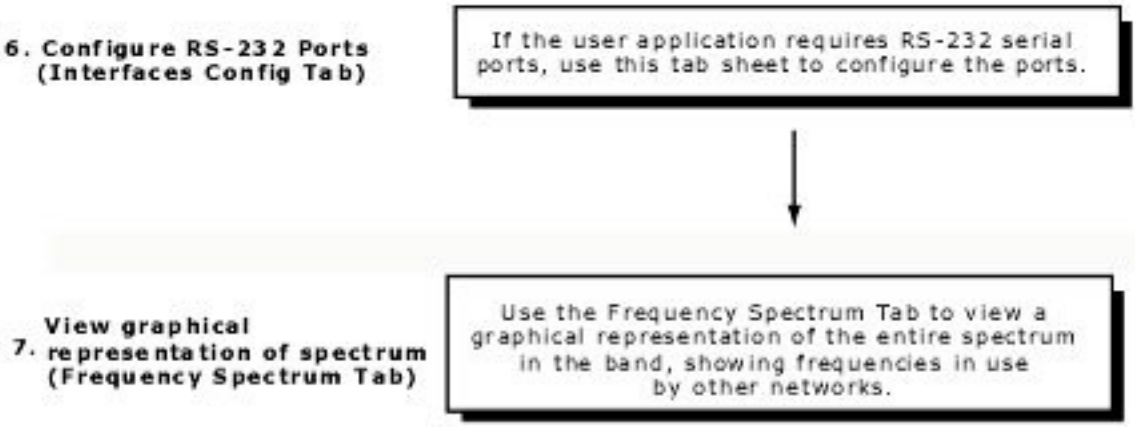
If the Network Operator provided a new version of software for the radio, then install the software onto the radio via the Ethernet connection.

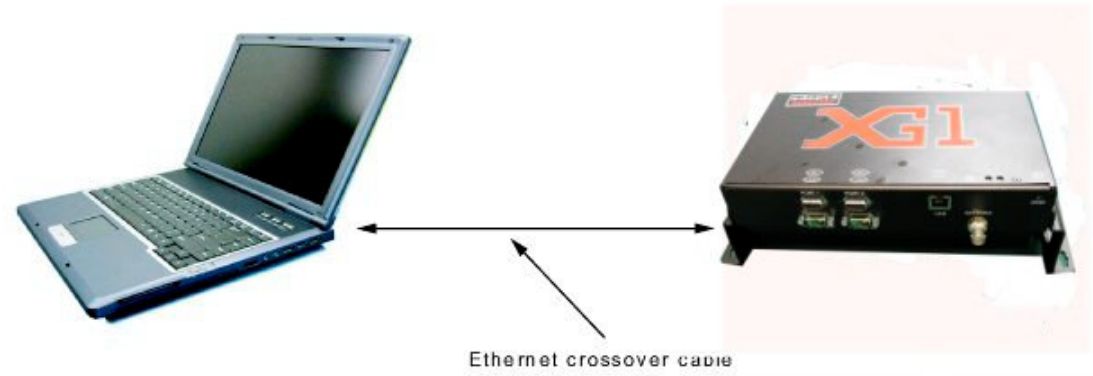


5. Configure the XG-1 radio and point the antenna (Startup Config Tab)

Since the EMS provides most of the configuration over-the-air after ther remote site has been installed, field installation requires only a few configuration parameters. If a directional antenna has been used at the site, the Antenna Pointing Tool can be used to point the antenna towards the hub.The tool gives visual and audible indications of the signal strength of the Base Station radio's signal.




6. Configure RS-232 Ports
(Interfaces Config Tab)
If the user application requires RS-232 serial ports, use this tab sheet to configure the ports.
7. View graphical representation of spectrum (Frequency Spectrum Tab)
Use the Frequency Spectrum Tab to view a graphical representation of the entire spectrum in the band, showing frequencies in use by other networks.



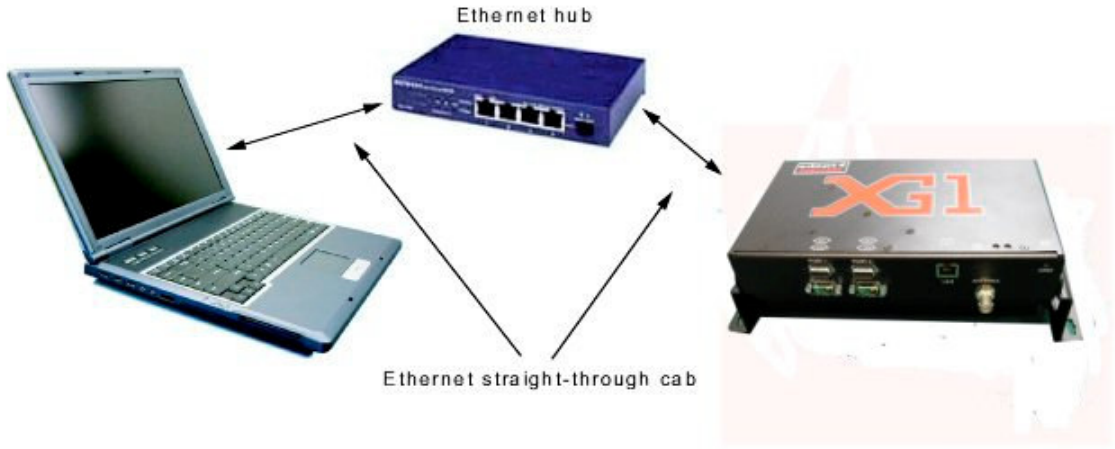


Figure 1.0-2: Connecting XG1 Radio to a Laptop

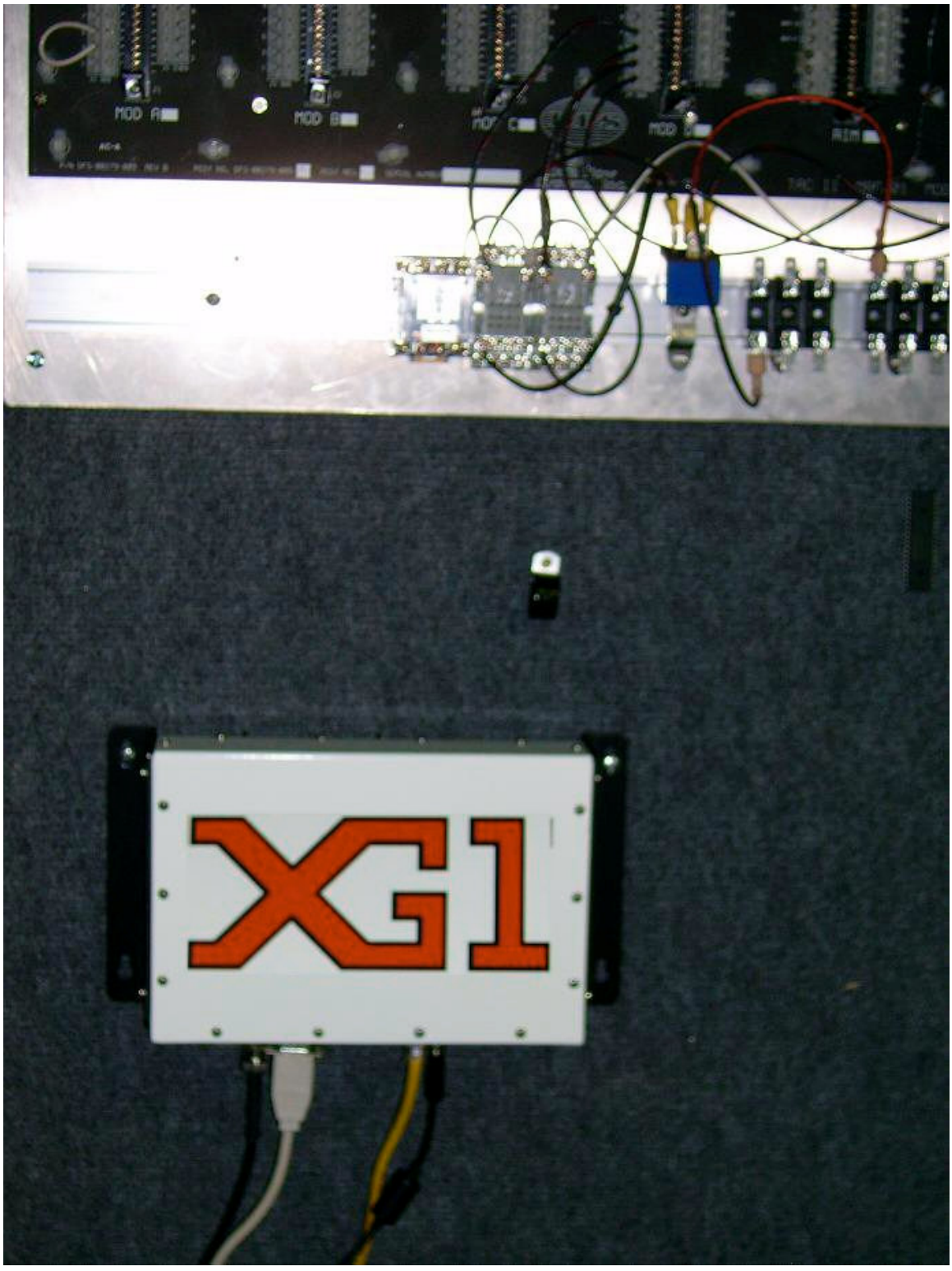


Figure 1.0-3. Typical Wall-Mounted Remote Site

1.0.2 Front Panel Indicators

Table 1.0 -2 describes the front panel indicators of the XG-1.

Table 1.0-2: Front Panel Indicators

Base Station Radio		
Indicator	State	Meaning
LED A	Green/Solid	The radio is operational
LED B	Green/Flashing	Packet received over-the-air
	Amber/Flashing	Packet transmitted over-the-air
RJ-45 Ethernet		
--Green LED	Dim solid	Radio powering up
	Flashing	Transmitting on Ethernet port (from radio to user device)
--Amber LED	Solid	Ethernet link indicator
	Flashing	Receiving on Ethernet port (from user device to radio
Remote Radio		
Indicator	State	Meaning
LED A	Green/Solid	The radio is operational/joined
	Green/Flashing	Contacting prospective Base Station to join network
	Amber	Unjoined—looking for Base Station
LED B	Green/Flashing	Packet received over-the-air
	Amber/Flashing	Packet transmitted over-the-air
RJ-45 Ethernet		
--Green LED	Dim solid	Radio powering up
	Flashing	Transmitting on Ethernet port (from radio to user device)
--Amber LED	Solid	Ethernet link indicator
	Flashing	Receiving on Ethernet port (from user device to radio

1.1 Admin Tab

General: Use the Admin tab (Figure 1.1-1) to log onto the XG1 radio Installation Software for operator authentication and to test communications with the radio connected to the laptop via the Ethernet port. In addition, the operator may save some default configuration parameters (such as the default radio IP address) for convenience during subsequent installations.

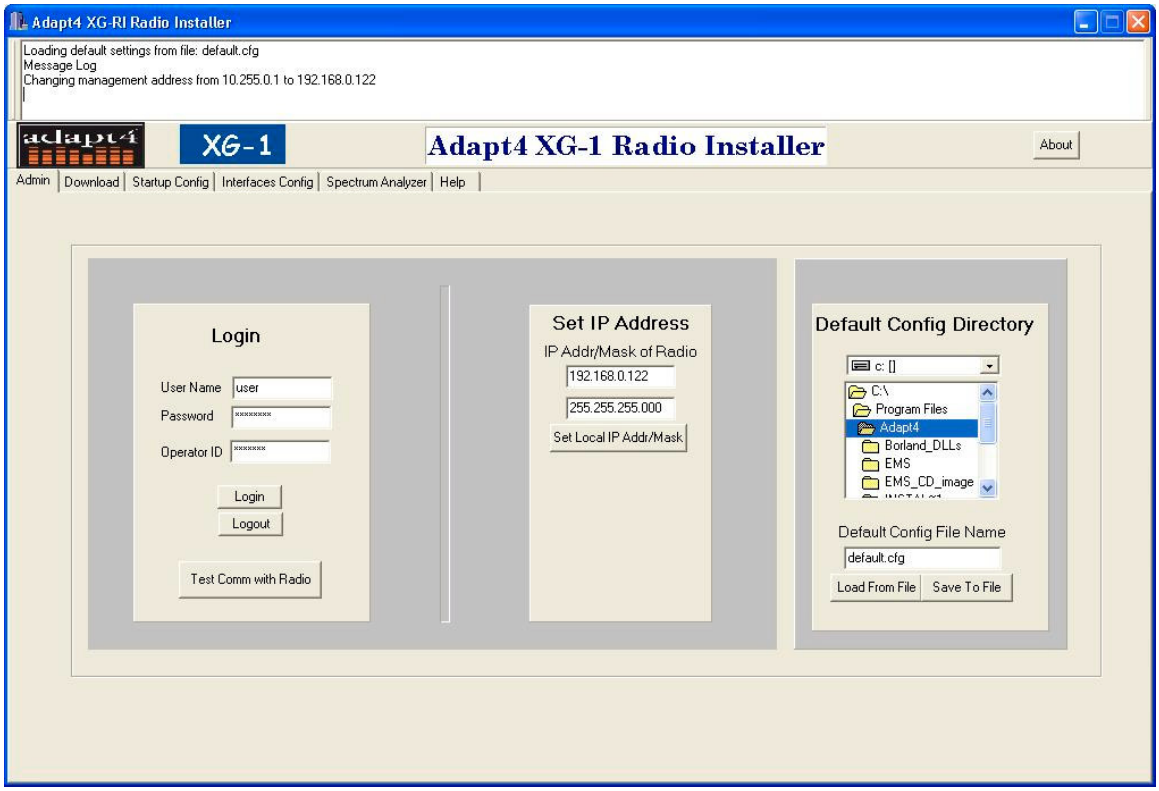


Figure 1.1-1: Admin Tab

Login – Enter your User Name and Password (provided by Network Operator). Optionally, enter your Operator ID, also provided by the Network Operator. Click the **Login** button. (Later, click **Logout** to cancel your session.) A message will be sent to the EMS that an operator has logged in. A message will appear in the Message Log area of your screen. (The User is the user login name for all users of the software. The Operator ID is unique for the individual user; this identifies the operator in log entries.)

Test Communications with Radio – Enter the IP address and IP mask of the radio. The default values for an unconfigured radio are IP address (10.255.0.1) and mask (255.255.255.0). This address is permanent and may be used only for configuring the radio. Your laptop must be configured on this IP subnet as well. Alternatively, you may set an alternate address in the radio that is compatible with your laptop's present IP configuration by putting an IP address and mask in the Set IP Address panel and pressing the **Set Local IP Addr/Mask**. (The Network Operator

may later change the IP address over-the-air.) To change your laptop's IP address, use the Network Connect tool on the Windows Control Panel to set the static IP address (instructions vary with Windows version). Note: make certain your firewall is not interfering with communications with the radio.

Click the **Test Comm with Radio** button to verify that you have communications with the radio via the Ethernet port. A message will be displayed in the Message Log area when the test message is sent to the radio. If the radio replies successfully, a "From Radio: test reply" message will be displayed.

Save Default Configuration – To save your configuration (at any time) come to this tab, select a directory in the directory box, and click the **Save To File** button. At some time later, restore this configuration by clicking the **Load From File** button. This stores the laptop installation application configuration, not the radio configuration. The configuration items stored are default IP address and mask of radio.

1.2 Download Tab

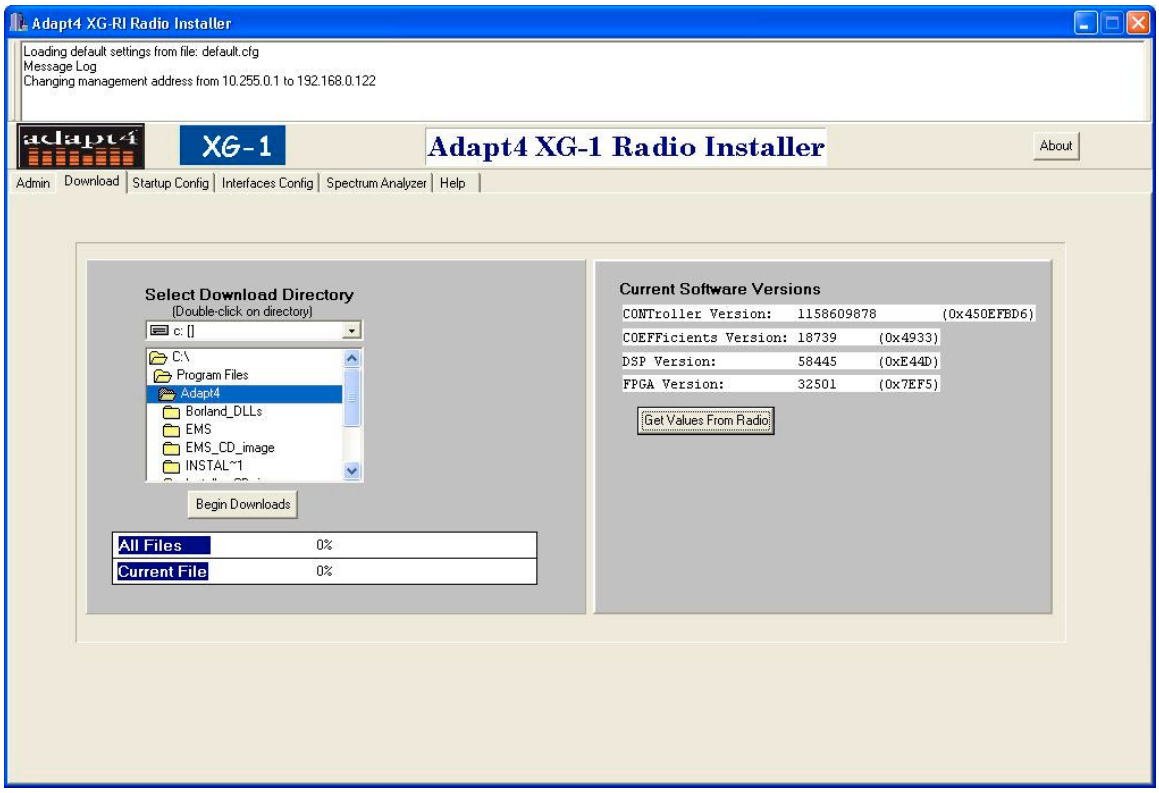


Figure 1.2-1: Download Tab

General: Use this tab to install (download) new software onto the *XG1* radio, if the Network Operator provided a new version of software. The laptop sends this software to the radio via the Ethernet connection.

Procedure

1. Copy the software directory to be downloaded to the radio into a folder on your laptop or desktop computer. Only one revision of software should be placed in a directory. Typically, these files will be in a directory for the revision under the c:/program files/adapt4/revXXXX directory, where *XXXX* is a revision number.

   IMPORTANT: Adapt4 distributes the files in a single directory, which will have a name that indicates the software release. The directory *must* be kept intact; the Downloader will reject the directory if it is not kept intact.

2. From the **Select Download Directory** box, select the drive and folder containing the software release to be installed in the *XG1*.

3. Click **Begin Downloads**. The progress of the downloads will be shown via the **All Files** and **Current File** progress indicators. The file names will be listed in the Message Log area.

To determine the current software version of every software file in the radio, click **Get Value From Radio** from the Current Versions panel. Table 1.2-1 describes the download files.

Table 1.2-1: Description of Download Files

Download Tab	Description	Type
ControllerVersion	Version of Dig Microprocessor Firmware	Read-only text
CoefficientsVersion	Version of Coefficients File	Read-only text
DSPVersion	Version of DSP Firmware	Read-only text
FPGAVersion	Version of FPGA code	Read-only text

1.3 Startup Config Tab

General: Use this tab to give the *XG1* radio the minimum network configuration that it needs to join (become part of) the network. After the radio has this information, it will receive further configuration over-the-air from the EMS. The radio needs the proper Network ID to join the network and needs the Radio Function to perform the correct role: Base Station or Remote Station. These configuration values will be provided by the Network Operator. The radio joins the network by looking for special transmissions (preambles) containing the Network ID.

The installer may also use the Antenna Pointing Tool on this tab to point the Remote Site's directional antenna towards the Base Station.

Note: The Channel Set must be set before the radio can become operational; this is described in the Channels Tab section

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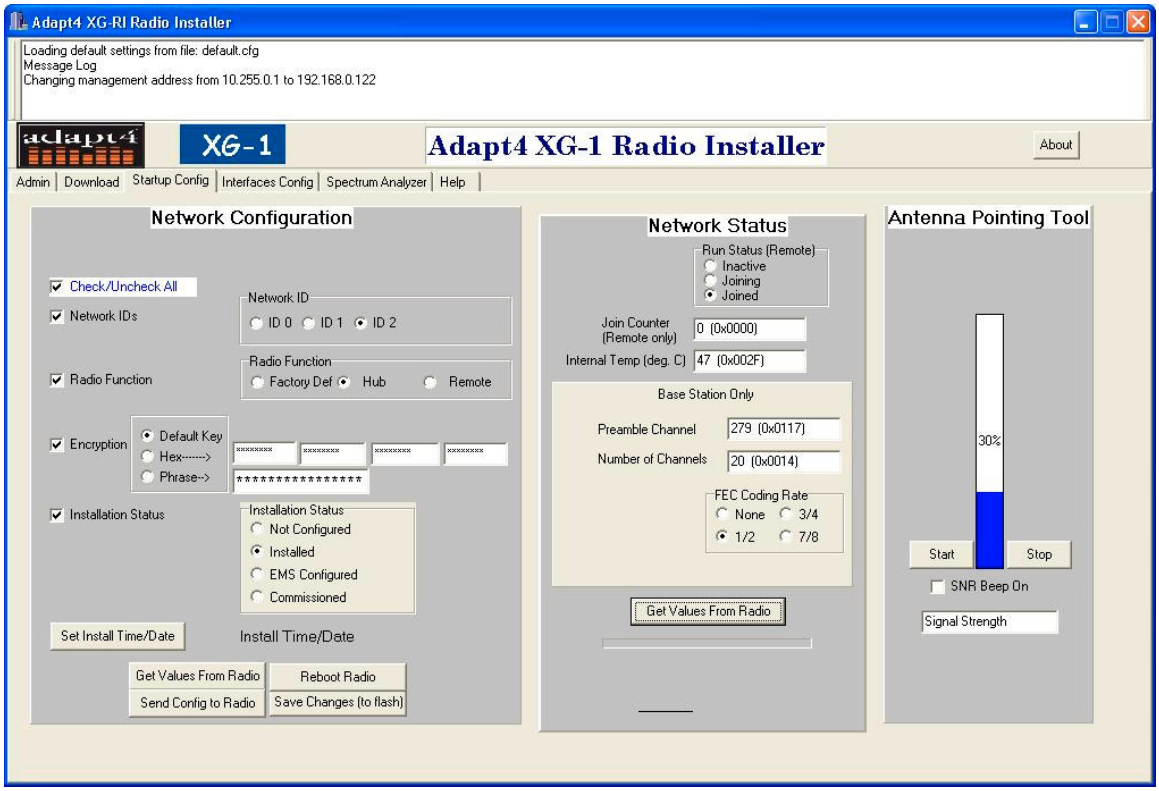

Figure 1.3-1: Startup Config Tab

1.3.1 Network Configuration Panel

1. Set the **Network ID** and **Radio Function** fields:
    - Enter the **Network ID** in decimal or hexadecimal (beginning with "0x"). For example: 25238 (decimal) or 0x6296 (hexadecimal). These two example values are equivalent (refer to the same network). The **Network ID** is comprised of two values that must be accurately entered: the Multi Tx/Rx field and Single Tx/Rx field.
    - Click the **Network ID** checkbox (if it is not already checked).
    - Select a radio type by clicking the appropriate option (**Factory Default**, **Hub (Base Station) or Remote**) in the Radio Function area.
    - Click the **Radio Function** checkbox (if it is not already checked).
    - Click the **Send Config to Radio** button.

2. Set the Encryption Key

   All stations in the network must have the same encryption key. The Network Operator provides this key. The key may be entered in one of three ways:

   - Default Key: a default encryption key is used
   - Hex: a 32-character hexadecimal key must be entered. For ease of entry, four 8-character fields are provided. The valid characters for a hexadecimal key are: 0-9 and A-E (or a-e). Note that a "0x" prefix should not be included in the fields.
   - Phrase: a sixteen-character "pass phrase" may be used instead of a hexadecimal key. **NOTE**: This key type is provided for convenience, but it produces less-secure keys.

3. Set the Installation Status

   When the Field Installer has completed all steps and the field installation is complete, return to this tab and set the installation status of the radio via the **Installation Status** field. The Field Installer indicates that the radio is installed and ready for further configuration from the EMS (which might not happen until after the Field Installer has left the site) by setting the **Installation Status** field to the **Installed** value.

   - Deselect the **Network ID** and **Radio Function** checkboxes by clicking them.
   - Click the **Installed** radio button in the Installation Status area.
   - Click the **Send Config to Radio** button to send the Encryption Key and Install Status to the radio

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   Note: The EMS operator will set the **Installation Status** field to **Commissioned** (over-the-air) after the EMS has further configured the radio - possibly after the Installer has left the location.

   The present values stored in the radio can be retrieved by selecting all the checkboxes (or clicking the **Check/Uncheck All** checkbox) and clicking the **Get Values from Radio** button. However, for security, encryption keys will not be displayed.

4. Set the Install Time/Date

   The Install Time/Date is stored in the radio's internal database for record-keeping. This time will also set the initial time/date included in log entries made by the radio. (The EMS will update the logging time/date periodically.

5. Save To Flash and Reboot Radio

   After completing the above steps, the radio is ready to join the network. Save the configuration changes in the radio by pressing the **Save Changes (to flash)** button. Then reboot the radio by pressing the **Reboot Radio** button.

1.3.2 Network Status Panel

At remote stations, use this panel to determine if the radio has joined the network. (This can happen before being configured by the EMS; however, user traffic will not pass over the network

until the EMS configures the site.) Click the **Get Values from Radio** button in this panel The network status will be displayed, including:

- **Run Status**: If Run Status is in the joined state, the radio has connected with the network
- **Join Counter**: the number of times the radio has joined the network. (For example, the radio will have to re-join if the installer mispoints the antenna or removes power from the radio for a while).
- **Internal Temp**—this field gives the temperature measured by a sensor **inside** the radio in degrees-centigrade. This temperature will typically be higher than the external ambient temperature.

Hub (Base Station) Radio: A second panel gives status of hub (base station) radios:

- **Preamble Channel** (changes frequently)
- **Number of Channels** (1-45)
- **FEC Coding Rate** (none, 1/2, 3/4 or 7/8)
- **Tx Power Level** (changes frequently)
- **Last SNR** (signal/noise ratio, which changes frequently)
- **System Time**: the network time-of-day (which will be set by the Base Station after the Remote Station joins the network)

1.3.3 Antenna Pointing Tool Panel

Click the **Start** button to start the tool. The tool will begin periodically polling the attached remote radio for its signal strength from the Base Station. The tool will show the relative strength in a vertical bar graph and in a numeric text box. If **SNR Beep On** is selected (and if laptop sound is supported and enabled), a beep will sound at a rate proportional to the signal strength. This enables the Installer to adjust the antenna without viewing the laptop screen. **Note**: not all laptops support sound; use the visual display in this case.

Table 1.3-1: Description of Startup Config Tab Fields

Startup Config Tab	Description	Type
Network ID	Select the Network ID for your network from the radio buttons. Some installations may have more selections than others.. The Network ID uniquely identifies the network within your area.	Read-write integer
Encryption Key	A 128-bit key used to encrypt radio transmissions (user and management messages)	
FEC Rate	Forward error-correction rate (none, 1/2, 3/4, 7/8); used to correct transmission errors on the receiving side.	Read-write pick list
Number of Channels	The number of 6.25 Khz channels that all radios in the network will use at any given time out of the available channels (numbered from 0 to 479).	Read-write Integer (0-479)
Signal Strength (Antenna pointing tool)	Displays a vertical bar (and “beep” tone rate) that is proportional to the signal strength of the hub's preamble channel.	Read-only visual, aural and textual indicator
Run Status	Indicates whether or not a remote site is inactive, is trying to join the network, or has joined the network.	Radio button indicator

1.4 Interfaces Config Tab

General: Use the Interfaces tab shown in Figure 1.4-1 to configure the RS-232 serial port(s), if these are used in the end-user's application.

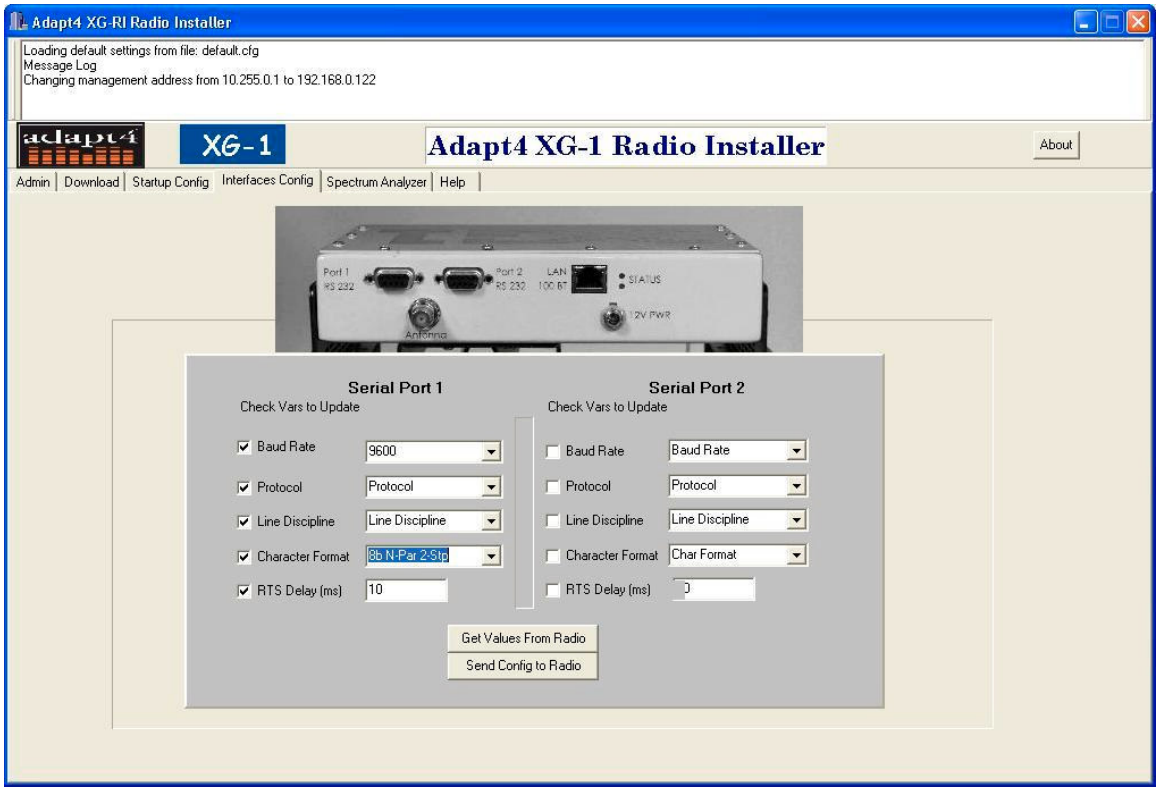


Figure 1.4-1: Interfaces Config Tab

Procedure for Serial Port Configuration

1. For each serial port being used, enter values for baud rate, protocol, line discipline, duplex, and RTS/CTS delay. See Table 1.4-1 for more information on these variables. **Note**: not all variables are presently supported.
2. Click **Send Config to Radio** when all the variables have been defined to configure serial port.
3. Click **Get Values from Radio** to get the current values stored in the radio.

Table 1.4-1: Serial Port Configuration

Option	Description
Baud rate	Serial port baud rate; standard rates are 1200, 2400, 9600, 19200 and 38400 baud.
Protocol	Port protocol: Transparent, Data Flow Systems, Modbus, Modbus ASCII, or DNP.3
Line Discipline	2-wire, RTS/CTS Signaling, or Full RS 232 Signaling
Character Format	Select the character length (8 or 7 bits), parity (none, even or odd), and number or stop bits (1 or 2). For ex: "8b E-Par 1-Stp" is 8-bits, even parity and 1 stop bit
RTS/CTS delay	A delay between receipt of RTS and the subsequent issue of CTS – used in some protocols

1.5 Spectrum Analyzer Tab

General: A unique feature of the *XG1* radio is that it does a continuous, distributed/network-wide spectral analysis of each band. Each Remote Site contributes its local view of the spectrum and the Base Station creates a composite view. This screen plots 480 channels of the band and shows a graphic representation of the detected radio signals.

Note that the radio gathers this information only while no radios in the network are transmitting. Therefore, the plot shows potential interference and may be useful in troubleshooting radio network issues in cooperation with the Network Operator.

Typically, this tab will not be needed.

Usage

- Click **Get Spectral Data**. The most recent spectral information from the radio is plotted.
- Click **Clear Data** to clear the screen.
- **Max Hold** behaves much like a similar control on a Spectrum Analyzer instrument. It keeps the highest value for each plot point over time until either **Clear Data** is clicked or **Max Hold** is set to **Off**.
- You can zoom in on the plot, as shown in Figure 1.6-2, by dragging the mouse from upper left to lower right. Do the reverse to zoom back out.

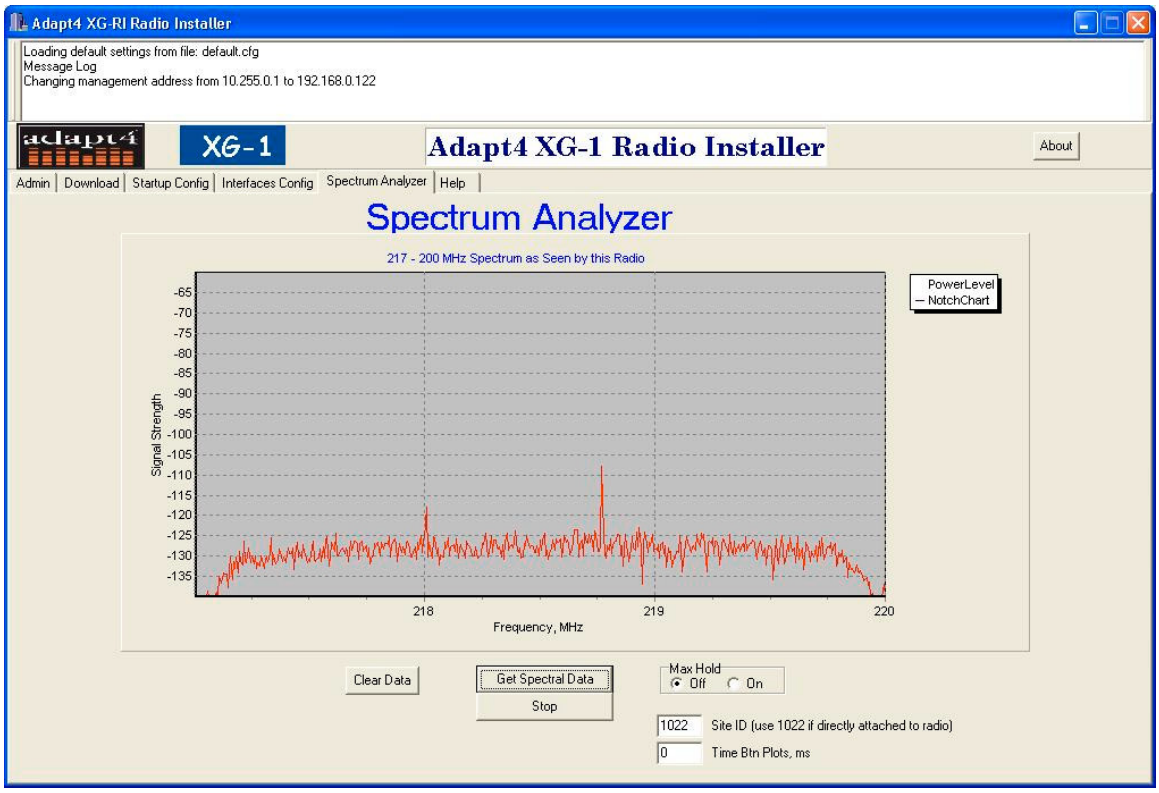


Figure 1.6-1: Spectrum Analyzer Tab

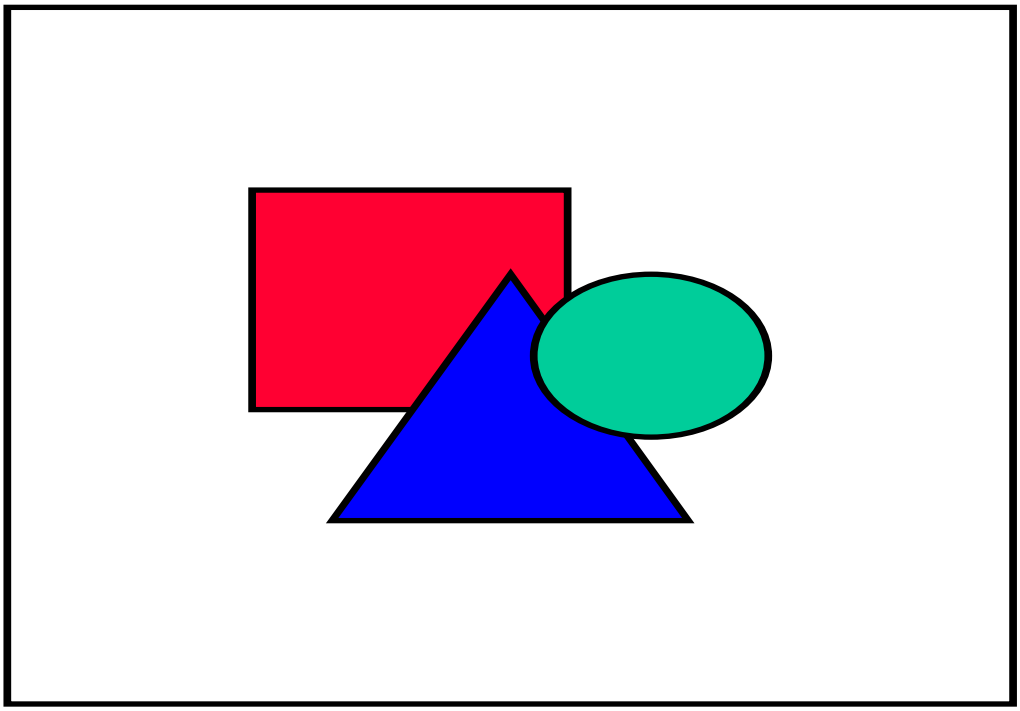
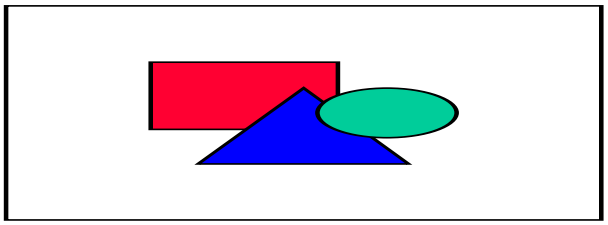


Figure 1.6-2: Zoomed In Plot



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