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Technology Training for tomorrow's world

AntennaLab

Operator's Manual

57-200-USB

**Also for use with 57-202 *AntennaLab* Upgrade Pack
(57-200 to 57-200-USB)**



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Notes



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Preface

THE HEALTH AND SAFETY AT WORK ACT 1974

We are required under the Health and Safety at Work Act 1974, to make available to users of this equipment certain information regarding its safe use.+

The equipment, when used in normal or prescribed applications within the parameters set for its mechanical and electrical performance, should not cause any danger or hazard to health or safety if normal engineering practices are observed and they are used in accordance with the instructions supplied.

If, in specific cases, circumstances exist in which a potential hazard may be brought about by careless or improper use, these will be pointed out and the necessary precautions emphasised.

While we provide the fullest possible user information relating to the proper use of this equipment, if there is any doubt whatsoever about any aspect, the user should contact the Product Safety Officer at Feedback Instruments Limited, Crowborough.

This equipment should not be used by inexperienced users unless they are under supervision.

We are required by European Directives to indicate on our equipment panels certain areas and warnings that require attention by the user. These have been indicated in the specified way by yellow labels with black printing, the meaning of any labels that may be fixed to the instrument are shown below:



CAUTION -
RISK OF
DANGER



CAUTION -
RISK OF
ELECTRIC SHOCK



CAUTION -
ELECTROSTATIC
SENSITIVE DEVICE

Refer to accompanying documents

PRODUCT IMPROVEMENTS

We maintain a policy of continuous product improvement by incorporating the latest developments and components into our equipment, even up to the time of dispatch.

All major changes are incorporated into up-dated editions of our manuals and this manual was believed to be correct at the time of printing. However, some product changes which do not affect the instructional capability of the equipment, may not be included until it is necessary to incorporate other significant changes.

COMPONENT REPLACEMENT

Where components are of a 'Safety Critical' nature, i.e. all components involved with the supply or carrying of voltages at supply potential or higher, these must be replaced with components of equal international safety approval in order to maintain full equipment safety.

In order to maintain compliance with international directives, all replacement components should be identical to those originally supplied.

Any component may be ordered direct from Feedback or its agents by quoting the following information:

- | | |
|------------------------|----------------------------|
| 1. Equipment type | 2. Component value |
| 3. Component reference | 4. Equipment serial number |

Components can often be replaced by alternatives available locally, however we cannot therefore guarantee continued performance either to published specification or compliance with international standards.



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OPERATING CONDITIONS

WARNING:

This equipment must not be used in conditions of condensing humidity.

This equipment is designed to operate under the following conditions:

Operating Temperature	10°C to 40°C (50°F to 104°F)
Humidity	10% to 90% (non-condensing)

CE DECLARATION CONCERNING ELECTROMAGNETIC COMPATIBILITY

Should this equipment be used outside the classroom, laboratory study area or similar such place for which it is designed and sold then Feedback Instruments Ltd hereby states that conformity with the protection requirements of the European Community Electromagnetic Compatibility Directive (89/336/EEC) may be invalidated and could lead to prosecution.

This equipment, when operated in accordance with the supplied documentation, does not cause electromagnetic disturbance outside its immediate electromagnetic environment.

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AntennaLab

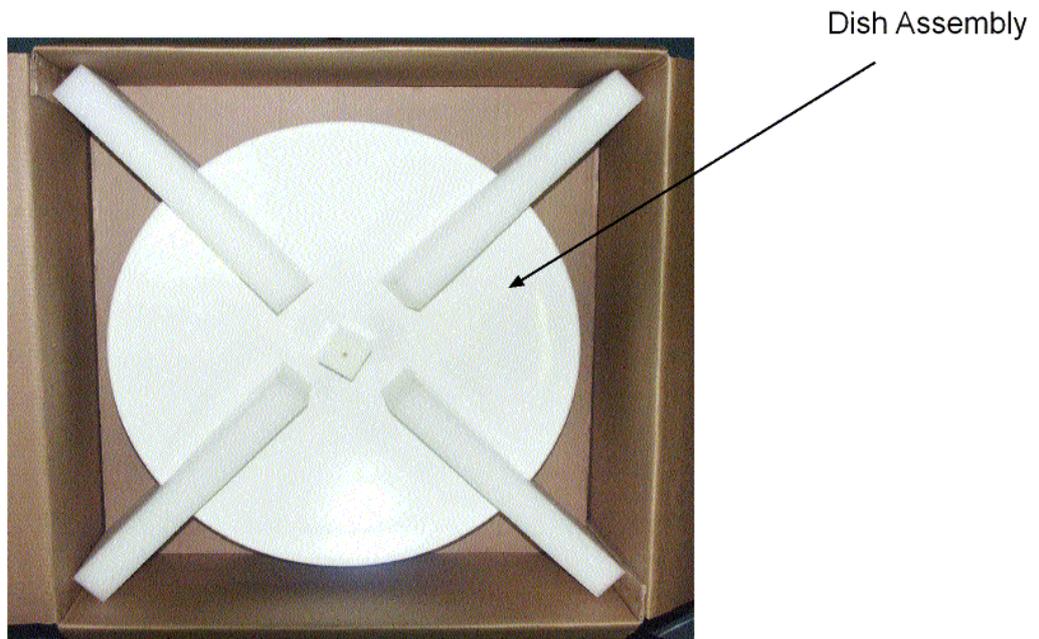
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The equipment is supplied in a single package which is divided into three layers. The contents of each layer are shown in Figures 1 to 3.



Packing Case Top Layer

Additionally, the following items are supplied:

- 1 57-903 Discovery II AntennaLab Software (USB)
- 1 57-200-USB AntennaLab Operator's Manual
- 1 57-200-USB-0T AntennaLab Tutor's Workbook
- 1 57-200-USB-0S AntennaLab Student's Workbook

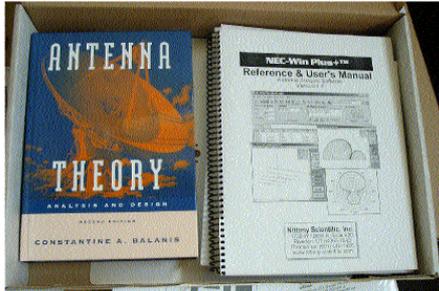
Figure 1: Packing Case Top Layer Contents



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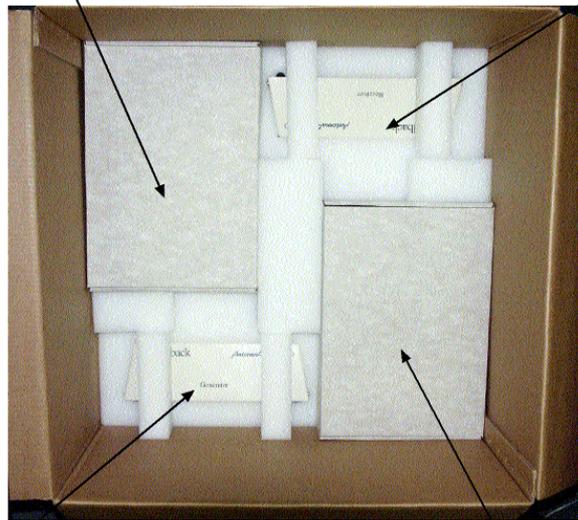
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Box 1

Box 1 Contents

- 1 Antenna Theory Book
- 1 ARRL Antenna Book
- 1 NEC-Win Plus+ Software & Manual
- 1 Ground Plane



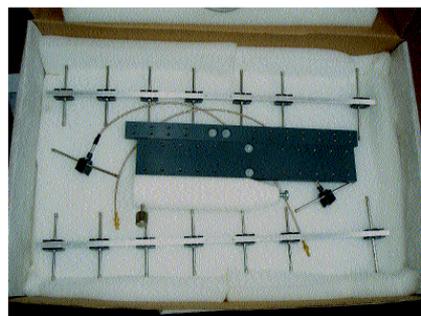
Receiver Tower
(see Bottom Layer)

Generator Tower
(see Bottom Layer)

Packing Case Second Layer

Box 2 Contents

- 1 15/15-way connector cable
- 1 Yagi Bay base assembly
- 1 Yagi Stack base assembly
- 2 Yagi boom assemblies each comprising:
 - 1 Dipole, balun and feeder cable
 - 1 Reflector element
 - 6 Director element
- 1 Receiving Antenna mounting pillar with knurled knob screw and fixing screw



Box 2

Figure 2: Packing Case Second Layer Contents

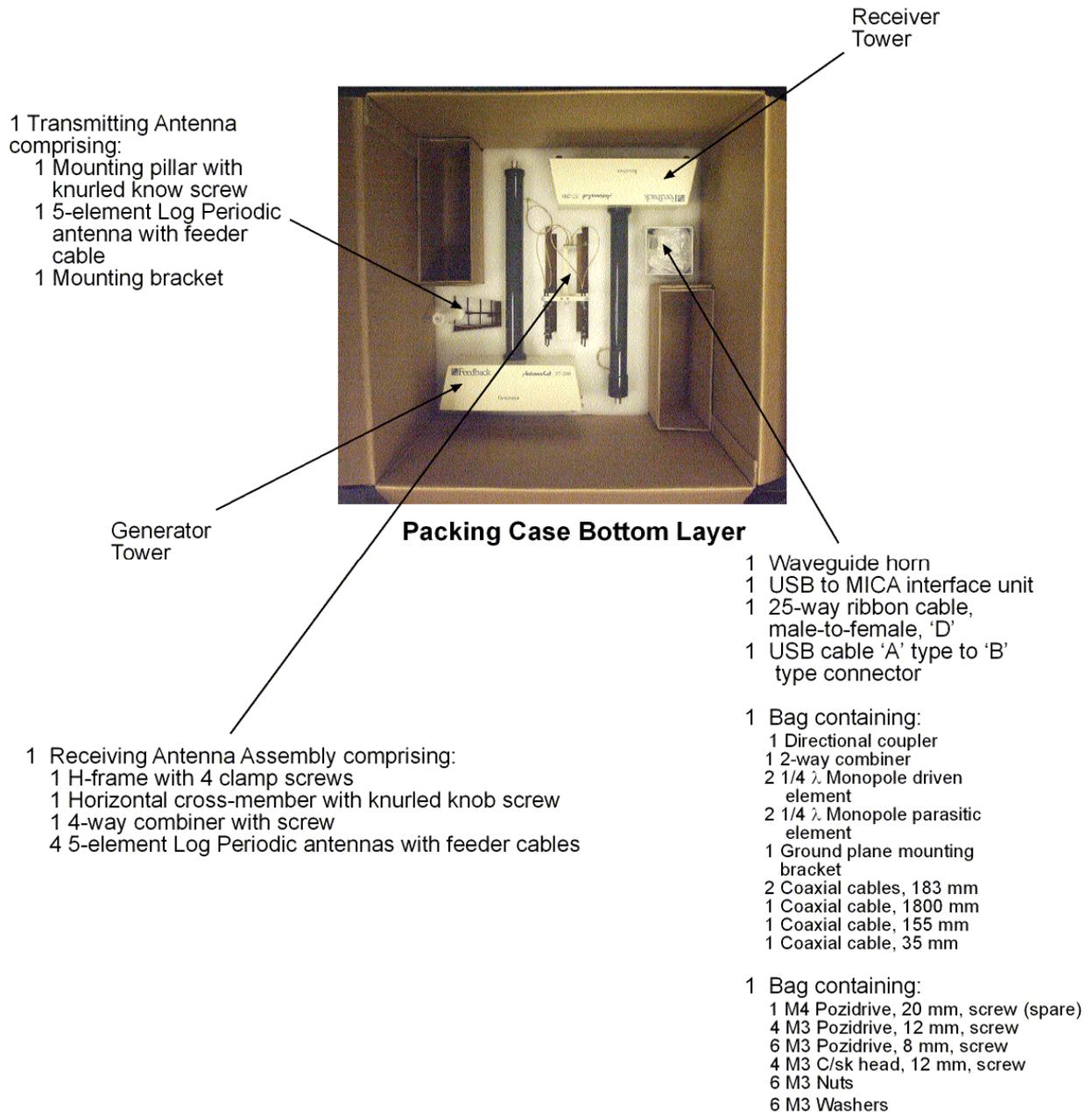


Figure 3: Packing Case Bottom Layer Contents



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1 Introduction to *AntennaLab*

Understanding antennas is often thought of as a 'black art'. The theoretical study of antennas can be mathematically demanding, requiring knowledge of electric field theory, spherical geometry, calculus and other advanced mathematical concepts.

However, even armed with these mathematical tools, analysing the performance of antennas in real, practical situations relies heavily on experience, as it is very difficult to include all of the vagaries of an antenna's electrical and physical surroundings in theoretical calculations.

Don't worry! The work done with *AntennaLab* is essentially non-mathematical in its approach to the subject. The practical aspects and effects associated with antennas are stressed and the software that is supplied along with *AntennaLab* takes care of the high-level mathematics. The unique blend of hardware and software experimentation leads to a practical understanding of antenna performance that would be difficult to achieve with either hardware or software alone.

The 57-200 *AntennaLab* System comprises hardware, software and courseware, which together form an integrated learning environment for the study of antenna principles.

AntennaLab is designed to explore antenna parameters, and operates between 1.2 and 1.8 GHz. Some background knowledge is necessary in order to make proper use of the system. The system is complementary to another Feedback product, the ASD512 Antenna Systems Demonstrator, which deals with the basic concepts of voltage and current in radiating elements. The 57-200 takes these ideas and puts them into practice, introducing the user to the concept of computer-based antenna measurements. The 57-200 is designed to be used at almost any teaching level and, when operated in a low-reflection environment, is capable of producing data suitable for research and development.

The following parameters can be measured:

- Directivity and gain, displayed as polar diagrams.
- Bandwidth, displayed as graphs of amplitude against frequency.
- Matching, displayed as graphs of return loss against frequency.

A directional coupler is provided for the return loss measurements.

Data may be recorded for archive or for playback on another computer not connected to the 57-200 hardware.



Notes



2 Installing *AntennaLab*

2.1 Customers Upgrading from 57-200 to 57-200-USB

If you are upgrading from the earlier 57-200 to 57-200-USB, using the 57-202 *AntennaLab* Upgrade Pack, proceed as follows:

1. You may uninstall the DOS based 57-200 *AntennaLab* software (although this is not necessary). However, please note that the plot files generated using 57-200 may not be used in 57-200-USB nor vice versa.
2. If you have uninstalled the 57-200 software and, if no other software installed on the PC uses the MICA926 interface card, this can be uninstalled and removed.
3. Install the new software, following the instructions given on the software distribution CD 57-903 and Feedback Manual – IMS Compatible Content, Installation and User Guide 93-IMS.. It is important to do this before connecting hardware.

When prompted for hardware calibration values, these may be obtained by examining the sysinfo.ini file that accompanied the 57-200 software. Earlier versions of the hardware do not have the calibration values on the rear of the generator.

Once the software installation is complete, please refer to the section on installing the hardware.

2.2 Installing the Software

Instructions describing how to install the software can be found on the software distribution CD (57-903). For general information on how to install the software, refer to Feedback Manual – IMS Compatible Content, Installation and User Guide 93-IMS.



2.2.1 Installing the NEC-WIN Software

Installation instructions for this software are given in the accompanying supplied manual.

2.3 Installing the Hardware

IMPORTANT NOTE:

It is important that all software packages and components are installed **BEFORE** any USB hardware is connected and switched on.

Connecting the USB hardware before installing the software causes 'unknown device' messages to be displayed, since the computer will not know of the USB devices.

If the hardware has been connected by accident, it should be uninstalled as follows:

1. From the 'Start' menu select 'Settings' → 'Control Panel' → 'System'.
2. Access the 'Device Manager' utility.
3. Select 'View' → 'Devices by type'.
4. In the Device Manager tree expand the 'Other devices' entry and select the 'USB Device' entry that has a question mark icon.
5. Right click on the entry and select 'Uninstall' (or 'Remove') and click OK.

Disconnect the USB hardware.

Reboot the computer.

Install appropriate software.

Reconnect the USB hardware to a different USB port.

When the computer is switched on, a normal 'connection process' will occur.

6. *This procedure is appropriate to the Windows XP operating system; however, it may differ for other operating systems*

AntennaLab requires the use of a single USB port. You can identify a USB port on the back of your computer as a narrow rectangular socket that is usually located close to an existing keyboard connector.



2.3.1 Customers Upgrading from 57-200 to 57-200-USB

If you are upgrading from the earlier 57-200 to 57-200-USB, using the 57-202 *AntennaLab* Upgrade Pack, proceed as follows:

1. The cable from the MICA8 card to the generator is not required when using 57-200-USB and should be removed from the system. (Though this cable should be retained if you think you may use the 57-200 software again.)
2. Proceed as directed in the following sections.

2.3.2 Installing Feedback USB Devices

1. Before connecting hardware, install the driver software.
2. Ensure that the USB interface unit is not connected to any other device.
3. Connect the interface unit directly to a USB port on your computer using a USB cable.

The operating system should detect that a USB device has been connected to the computer and the installation should proceed automatically as shown in Figure 2-1.



Figure 2-1

During the installation, you may be prompted one or more times for the path where a 'sys' file is located, as in the following example (see Figure 2-2).

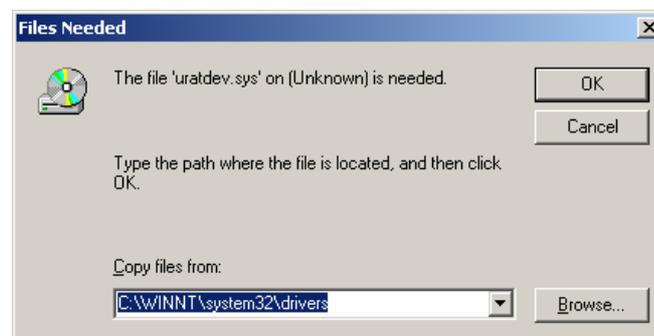


Figure 2-2



If this is the case, specify one of the following (depending on your operating system):

Operating system	Sys file path
Windows 98, ME	C:\windows\system32\drivers
Windows 2000, XP	C:\winnt\system32\drivers

(Where 'C:' is the drive where your operating system is installed.)

Once your computer has completed the installation, your USB device is ready for use. It is not necessary to remove the case of your computer or adjust any switches.

Once the USB interface units are installed, you may then connect the workboards.

2.4 Hardware Setup

The measurement accuracy of the 57-200, as of all antenna testing systems, is affected by reflections from its surroundings. In order to obtain the highest performance, an open field site or anechoic chamber would be necessary; however, excellent results for teaching can be obtained in a typical laboratory. The design separation between the two antennas is 3 metres. If very high gain antenna systems were being tested, then a greater distance would be needed to obtain the plane wavefront necessary to give accurate results. Conversely in a difficult situation with low gain antennas and high levels of room reflection, closer separation can be tolerated. Situations where good reflectors, such as metal, are in close proximity should be avoided.

Place the generator tower, 57-200 Generator on a table or bench where it is about one or two metres from the computer. The receiver tower, 57-200 Receiver, should be located about three metres from the generator tower. It is not advisable to have the computer between the two, as there should be as much space as possible around the two towers in order to reduce reflections.

2.4.1 Connecting the Computer

It is important that you install the 57-903 *AntennaLab* USB driver software before you connect the hardware to the computer.

Once the driver software is installed and the USB interface unit connected to the computer, connect the interface unit to the computer socket on the generator tower using the 25-way ribbon cable. You can fit it only one way round and into only one of the sockets on the tower base.



2.4.2 RF Connections

Connect the RF coaxial cable emerging from the base of the generator tower to the adjacent RF out socket.

Connect the RF coaxial cable emerging from the base of the receiver to the adjacent RF in socket.

2.4.3 Connecting the two Towers Together

The 15-way sockets on the two towers should be inter-connected using the cable assembly provided. It does not matter which way round the cable is fitted.

2.4.4 Connection to the Mains Supply

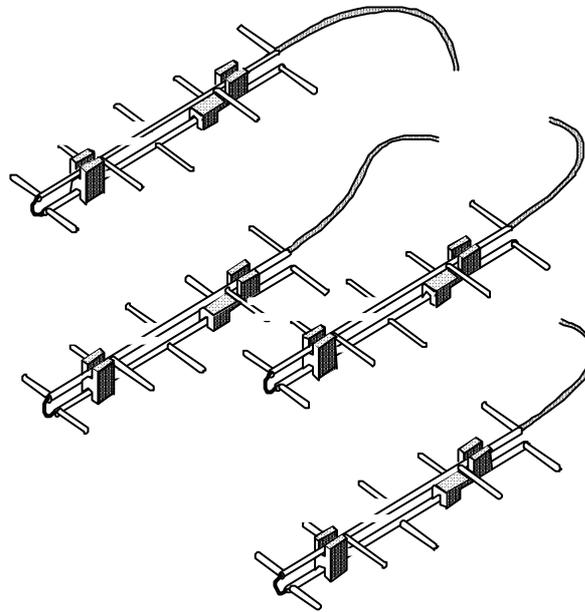
Check that the line voltage selector, mounted on the back of the 57-200 Generator unit, is set to the correct value for your supply. Set the Power and Motor Enable switches off. Connect the Line socket to the mains using the lead provided **making sure the mains earth is properly connected.**

2.4.5 Receiver Antenna

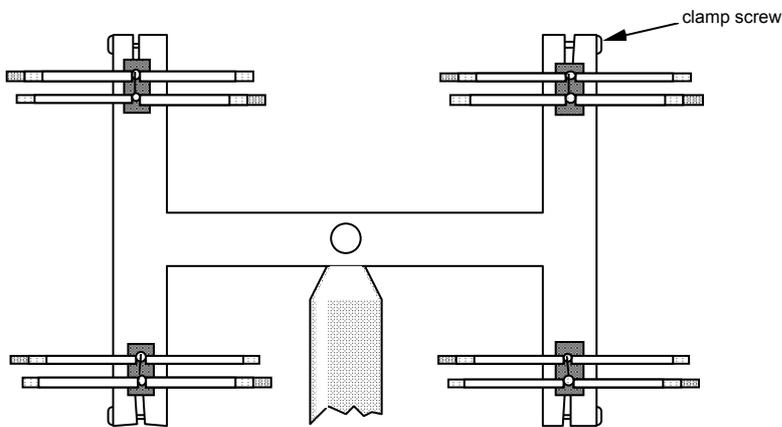
This is an array of four 5-element log periodics fed to a four-way microstrip combiner. It is illustrated in Figure 2-3.

This antenna is used in all the measurements and tests described in the software and is a suitable receiving antenna for most Antenna Tests.

The Receiver Antenna is supplied assembled and should not normally need to be dismantled. However, should you wish to alter the assembly to provide a different antenna, instructions for its re-assembly are given in the following paragraphs.



a) View from above



b) View from Front

Figure 2-3: Receiving Antenna



2.4.6 Assembly

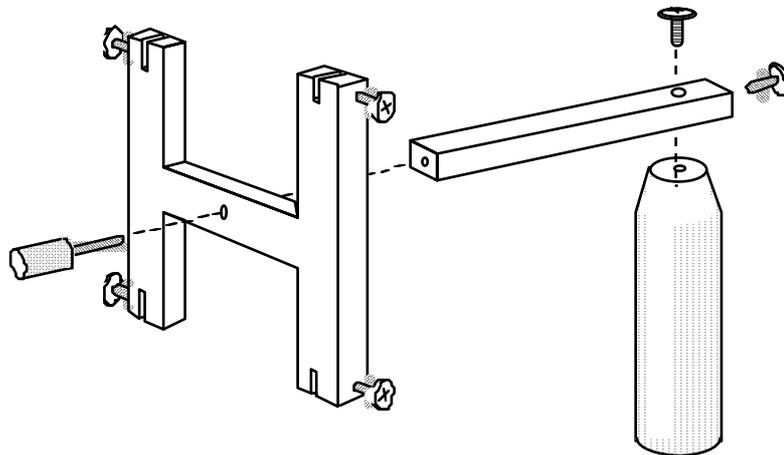


Figure 2-4: Assembling the H-frame

The first stage in assembly is to attach the H-frame to the horizontal bar which is in turn attached to the mounting pillar, as shown in Figure 2-4. The combiner, Figure 2-5, is then attached to the free end of the horizontal bar (see also Figure 2-6).

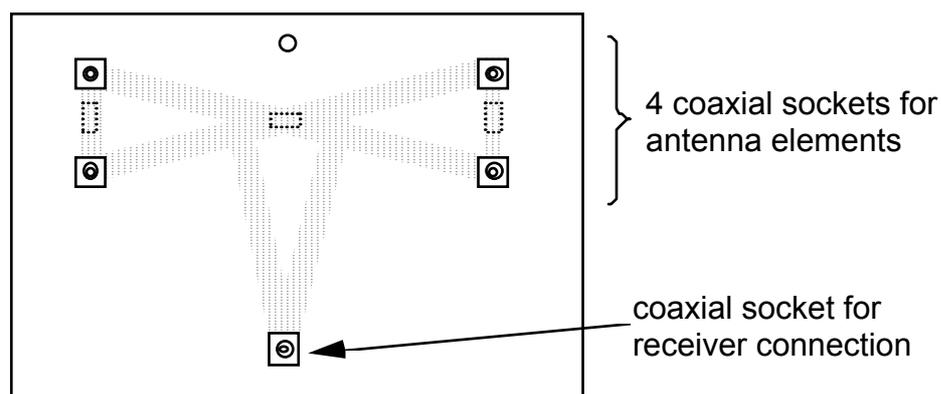


Figure 2-5: The Combiner

Assemble the log-periodic assemblies to the H-frame as indicated in Figure 2-3, making sure that the four antennas are correctly phased; ie, that the individual log-periodics all have the cables emerging at the top (or all at the bottom) and that each element points the same way as the corresponding ones in the other log-periodics.

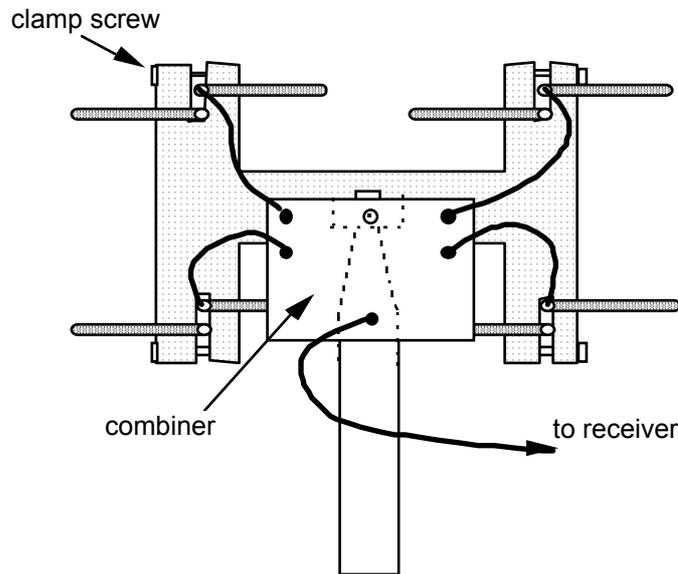


Figure 2-6: Connections to the four Log-Periodic Assemblies

The four log-periodics are connected as shown in Figure 2-6. Once assembled this array is not changed, apart from its polarisation.

2.4.7 Mounting

The completed antenna array should be mounted on top of the receiver tower and set for horizontal polarisation (as is shown in Figure 2-3 and Figure 2-6).

As long as the output is connected to the RF coaxial cable emerging from the plastic tower on the tower, it does not matter which antenna is connected to which input, but the arrangement shown will avoid mechanical problems when the polarisation is changed.

2.4.8 Polarisation

The assembly so far described is for horizontal polarisation. To alter the polarisation, all that is needed is to slacken the knurled screw at the centre of the H-frame and rotate the H through 90°.



3 Using *AntennaLab*

The *AntennaLab* software is presented as a suite of application windows that allow you explore and record the properties of antennas.

3.1 Starting the Software

When both the hardware and the software installation has been completed, you can then start the Stand-Alone Environment (SAE) by double-clicking on the *Discovery IMS* icon the environment installation program created on your computer's desktop. When it has started, you should be able to access the *AntennaLab* entry under the Antennas & Microwaves section of the *Discovery* tree. Use of the SAE is fully described in manual 93-IMS.

3.2 Application Content

AntennaLab content is divided into:

Introduction	Contains general information about <i>AntennaLab</i>
Application	Holds pages relating to the different types of analysis that can be performed using <i>AntennaLab</i>
Help	Provides help on installing and using <i>AntennaLab</i>

The Application section is composed of:

Monitor	The signal strength monitor continuously measures the strength (in dBs) of the signal arriving at the receiver. This signal strength value is displayed using a vertical bar. This function is useful for checking whether the signal is arriving at the receiver. It may also be used when optimising the position and length of antenna elements.
Signal Strength vs. Angle	The signal strength vs. angle graph windows allow you to examine the behaviour of your antenna, with respect to it's orientation in space.
Signal Strength vs. Frequency	The signal strength vs. frequency graph window allows you to examine the behaviour of your antenna, with respect to the frequency of the signal.
Return Loss vs. Frequency	The return loss graph window allows you measure the ratio of forward to reverse power, over the frequency range of 1200 to 1800 MHz. This provides an indication of how good the matching is, between the transmission line and the antenna feed point.



3.3 Application Windows

The following application windows are available:



Signal strength monitor



Signal strength vs. angle, 2D polar graph



Signal strength vs. angle, 2D Cartesian graph



Signal strength vs. angle, 3D polar graph



Signal strength vs. frequency graph



Return loss vs. frequency graph

To launch an application window, select the appropriate button from the toolbar on the application pages.

You may have more than one window open at the same time, navigating freely through the browser pages, while continuing to work with your antenna.

3.4 Further Usage Information

To gain an understanding of how to use the many features provided by *AntennaLab*, please refer to the 'Using *AntennaLab*' page in the help section.



4 System Test

Mount a Test Antenna on the generator tower. A good test antenna is the single log periodic which may be mounted on the white plastic mounting pillar (see Figure 4-1). Fit the pillar to the top of the generator tower and tighten the screw at the base of the pillar.

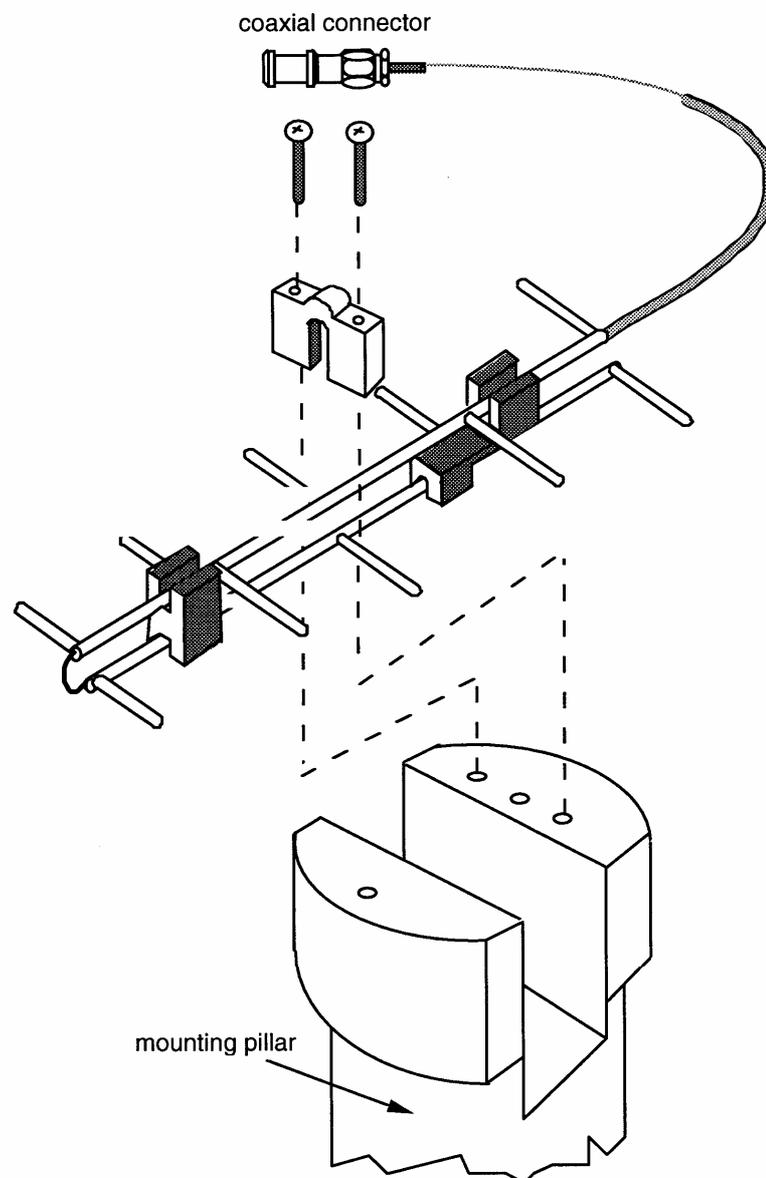


Figure 4-1: Mounting of Log-Periodic Antenna



4.1 The Test

The RF coaxial cable between the test antenna and the generator unit should NOT be connected.

The control switches on the back of the generator unit should be set as follows:

Power Switch – On.

Motor Enable Switch – On

Start the software and navigate to the Signal Strength vs. Angle application page. Select the 2D polar graph window.

When the window appears, the software will then set the motor to its index position, which involves rotating the test antenna through up to 180 degrees from its initial position.

The test antenna may not be pointing at the receiver after the index has been found. The test antenna should be aligned with the receiver by loosening the screw at the base of the test antenna pillar and rotating the pillar by hand. Tighten the screw up when completed.

The RF coaxial cable can now be connected between the test antenna and the generator tower. The cable is not connected until this point because the rotation may cause damage to the connectors.

Select 'File' then 'New Plot' and accept the default frequency by clicking on 'OK'.

At this point, you will be asked for hardware calibration values if they are not already present. If this is the case, see 'Setting Up the Hardware' in Section 4.2.

The Test Antenna should rotate through 360°, then return and a polar diagram should be plotted on the screen.

WARNING

If the system is left switched on but unattended, the **Motor Enable** switch must be switched **OFF**. This is because power line fluctuations may cause the motor to rotate the antenna continuously and damage the coaxial cable. Also, do not leave the hardware switched on with the computer off as this also may cause the antenna to rotate continuously.



4.2 Setting Up the Hardware

To make sure that the values derived from the hardware data are accurate, it is vital that the correct hardware calibration values are present on your system. Calibration values are derived during testing that are specific to each set of hardware. These values must be present before data is acquired.

Also, in order to ensure optimum operation of the motor, a motor stiction value is required. This is a measure of how much friction must be overcome to get the motor rotating. It is strongly recommended that the value is derived using the stiction test. See below for detailed instructions for determining the motor stiction value.

You will most likely want to set these calibration values when the software is first installed. However, if the calibration values are not present when they are needed by the software, you will be asked to enter them when required.

To set the values as part of the installation, simply run the *AntennaLab* software and open any of the application windows. You will then be asked if you want to enter them.

These values can be found on a label at the back of the receiver unit. Alternatively, if you are upgrading from 57-200 to 57-200-USB you will find the required values in your sysinfo.ini file. This can be found in the directory to which you installed the original software or on the original disk.

To view or change these values select 'Tools' then 'Calibration Values...'.

4.2.1 Instructions for Determining the Motor Stiction Value

1. Launch a Signal Strength vs. Angle 2D Graph as normal. You may be presented with a message saying "There is a problem with the motor". If this is the case, click 'Cancel'.
2. From the menu select 'Tools' -> 'Calibration Values...'.
3. To obtain the motor stiction value, click 'Get value from test' and follow the instructions provided.
4. Once the test has finished you will be presented with a message displaying the results of the test. Click 'OK'.



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Chapter 4

System Test

4.3 Using the System Without Hardware

It is not possible to perform some operations unless the hardware is connected and switched on (eg, acquiring a new plot).

However, you may view and analyse existing plots without hardware. If you select an operation that requires the hardware but none is available you will be notified. Simply select 'Cancel' and continue without the hardware.



5 General FAQ's

Q: What is *Discovery*?

A: The *Discovery* philosophy is to combine hardware and software to form an integrated learning environment, combining educational content with interactive practicals that illustrate concepts that are described, allowing students to explore principles and properties. *Discovery* is the latest version of the software that is designed to make use of the latest Internet technologies. It combines the latest development in software technology to guide students.

Q: A dialog box appears when a practical is started - why does this happen? What should I answer?

A: *Discovery* uses software called *applets* which are 'small applications'. Applets run within a web-browser and require access to the resources of your computer. For it to access parts on your computer, it asks your permission whether it is okay. You should always 'trust' applets from Feedback.

Q: When I start a practical, a dialog box is displayed where an error appears, indicating that the 'certificate has expired'. Why does it do this?

A: For your protection, **digital certificates**, codes that allow programs access to the resources of your computer, have a finite life. Software that runs on a browser, such as Microsoft's Internet Explorer has to be digitally signed – a security feature to prevent rogue programs downloaded from the internet causing problems on your computer. If is running from a standalone machine, the older the version of your software, the older the certificate is. This is not a problem – it is merely a reminder. If you get this reminder, contact your Feedback representative.

Q: I'm having trouble installing *Discovery* and its related drivers to my Windows NT and Windows 2000 machine. What should I do?

A: To install *Discovery*, you must have administrative privileges. If you do not have this, *Discovery* cannot be installed. Contact your institutions network administrators for advice.



Notes



6 Troubleshooting

I have checked the switches and cable connections but there is still a problem with the hardware...

Possible cause: Back powering from the generator.

Due to residual voltages on logic lines, it is sometimes necessary to reset the USB to MICA8 interface unit, whilst ensuring it is not powered indirectly by the generator.

1. Close all browser and application windows.
2. Switch off the power to the generator and wait 10 seconds.
3. Disconnect the USB cable from the USB to MICA8 interface unit.
4. Reconnect the USB cable to the USB to MICA8 interface unit.
5. Switch on the power to the generator.
6. Run the application again.

If you are still having problems, restart your computer and try again.

If you continue to experience problems, make sure that the driver has been installed properly. You may wish to reinstall the driver software (refer to the 'Hardware Installation' page in the help section).



Notes