Grasshopper

manual version 2.0

Contents

Grasshopper™ is a **handheld, wireless receiver designed specifically for sweeping and optimizing Local Area Networks. The instrument measures coverage of direct sequence CDMA networks which operate on the IEEE 802.11b standard allowing the user to measure and determine the AP (Access Point), PER (Packet Error Rate), and RSSI signal levels aiding in locating the hub and access points throughout a building. Grasshopper detects and differentiates from narrow-band multipath interferences such as microwave ovens and frequency hopping systems and features a built-in display, keypad and removable battery pack for true portability.**

Grasshopper uses common AA battery cells found in any conveinence store. Ni-Cad, Alkalines, Ni-MH and Li-Ion cells may all be used. Grasshopper does require 5 AA cells with at least 1500 mAh per cell. BVS supplies 2 battery packs complete with 10 Ni-MH battery cells to get users working right out of the box. Ni-MH cells are recommended for best performance from your Grasshopper.

Grasshopper also includes a simple 2.4 GHz threaded antenna that screws right into the top of the unit. Additional antennas may be ordered from BVS through BVS.

At the top of the Grasshopper rest the power switch, antenna connector and upload port. The power switch (left) is a simple two way toggle switch. The antenna connector (middle) is an SMA Female 50 ohm. The provided antenna easily screws and unscrews from this connector. Be sure to unscrew antenna when transporting the Grasshopper. The upload port (right) is used as a one way communications port for uploading new firmware to the Grasshopper. The port uses the provided cable which employs a standard RJ-11 phone jack on one end and DB-9 PC serial cable on the other end.

See UPDATING GRASSHOPPER FIRMWARE in this manual for firmware updating procedures.

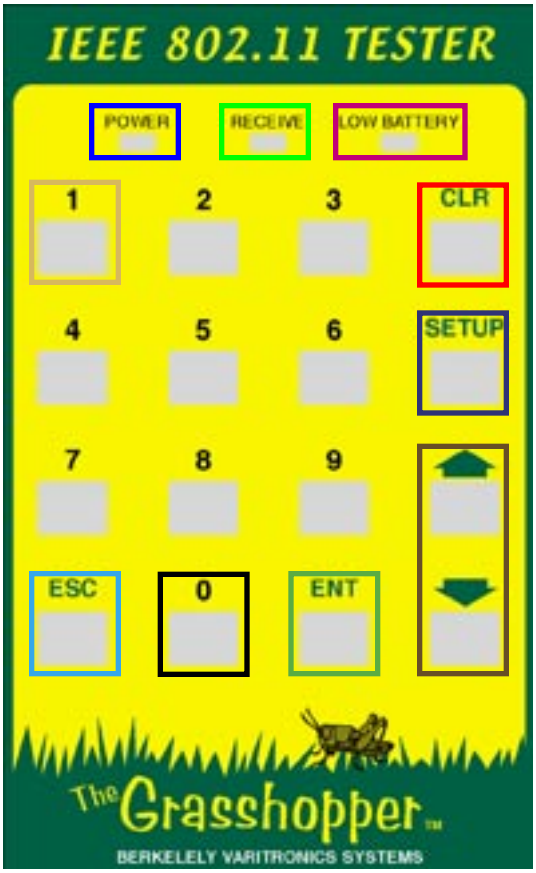
GRASSHOPPER ACCESSORIES

Your **Grasshopper** includes all basic operational accessories including the following: antenna, battery pack charger (Ni-MH), spare battery pack (Ni-MH), AC/DC power cable, carrying case and upload cable. Simply insert depleted battery pack into charger and plug charger into AC outlet. See rear of charger for LED status indicator lights. Approximate charging time for included Ni-MH battery pack is just over one hour. Run time using these same batteries is just over two hours.

NOTE: The included charger may only be used to charge the included Ni-MH batteries or other AA Ni-MH batteries. <u>NOT</u> Ni-CAD batteries.

Batteries that are warm or hot to the touch (from constant usage or warm ambient temperatures) will take longer to charge than batteries of a normal temperature. Contact BVS for new Ni-MH battery packs. Expect over 500 cycles from each Ni-MH pack.

GRASSHOPPER KEYPAD

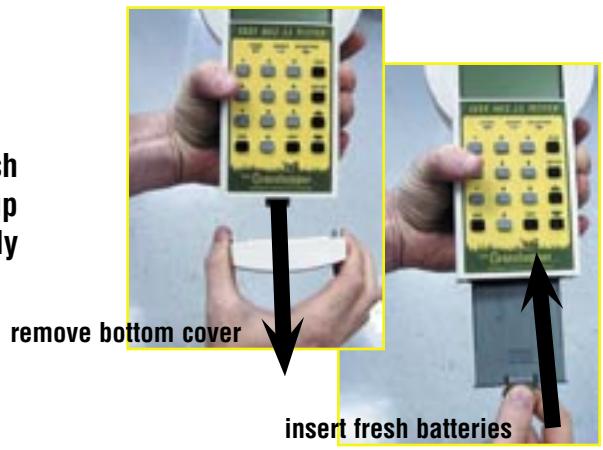


Grasshopper uses a raised plastic keypad as its only interface. Below are simple descriptions of the buttons and their features.

POWER - indicates if unit is On or OFF
RECEIVE - indicates if any signals are being received
LOW BATTERY - indicates low battery power warning
ESC - exits current menu screen
0 - adjust contrast screen
1 - activates Peak Hold mode (only in Spectrum Screen)
ENT - executes currently selected option
UP/DOWN ARROWS - scroll through selections
SETUP - enters the channel setup screen
CLR - clears current selection

GETTING STARTED

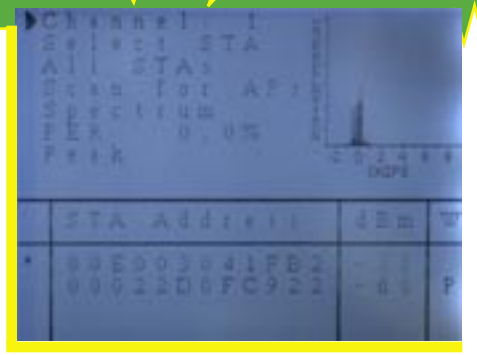
Operation of the **Grasshopper** is straightforward. Insert 5 fresh battery cells into removable pack. Close the bottom back up and power on the Grasshopper. The Grasshopper will instantly display the screen to the right.



remove bottom cover

insert fresh batteries

MAIN SCREEN



This is the main measurement screen used for monitoring and selecting APs or Access Points. The window to the upper right displays the received signal multipath in realtime of the currently selected AP. Any AP listed under the AP Address window is recognized as an IEEE 802.11b address. Multiple addresses may be listed and monitored simultaneously here. Use the UP/ DOWN ARROW keys to toggle between all of these selections and ENT to choose one.

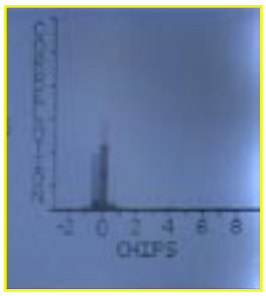
Channel - indicates current channel selection for measure
Select AP - toggles between listed APs at bottom
Clear APs - clears list of APs shown at bottom
Scan for APs - scans all channels for authentic APs
Spectrum - enters spectrum analyzer mode

PER - indicates Packet Error Rate of current AP

The AP address window at the bottom indicates all IEEE addresses indentified. The asterisk to the left indicates the address that is currently selected.

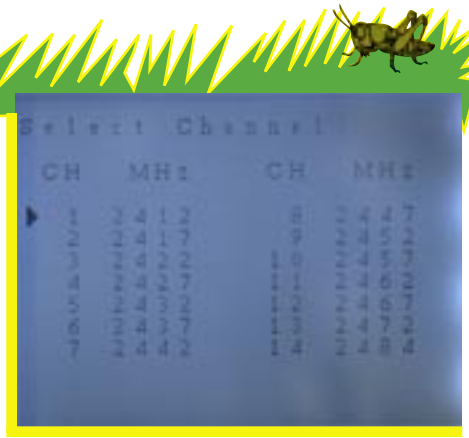
dBm - indicates the signal strength of the last packet measured.

W - indicates WEP (Wireless Equivalent Privacy). “P” indicates encryption is detected.



multipath window

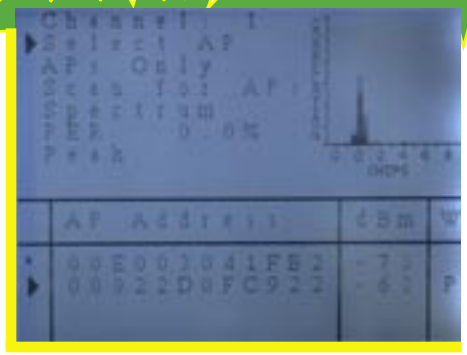
CHANNEL SCREEN



This selection opens the channel screen indicating all available channels and their corresponding frequencies. Refer to channel chart towards the end of this manual. Use the UP/ DOWN ARROW keys to toggle bewteen the desired channels and the press ENT to choose the channel. The user may also press SETUP on the keypad at anytime to access this screen. Press ESC to exit screen.

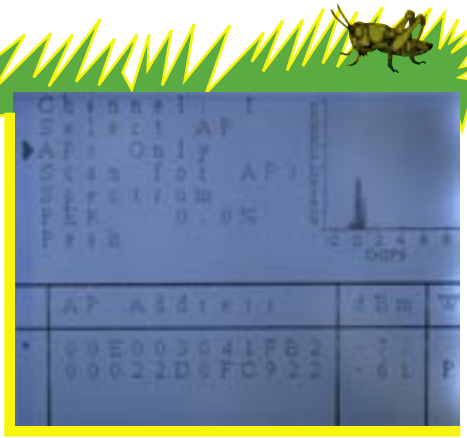
SELECT AP

This selection places a cursor at the bottom of the screen to the left of the AP addresses. By pushing ENT, the user selects (indicated by an asterisk) a specific AP address to monitor. Use Select AP to toggle through all received addresses. This selection will change from Select AP to Select STA if the user chooses to view all STA's. See next menu option.



APs ONLY

This selection toggles between APs Only (valid Access Points only) and all STAs Only (STAtions only or all DSSS channels detected including valid APs). When the cursor is next to this option, press ENT to toggle from one selection to the other.

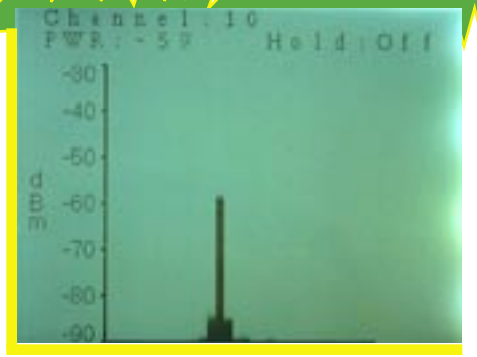


SCAN FOR APs

This selection scans all 14 channels searching for authentic access points. Up to 8 APs are listed. Pressing ENT will scan again. Press ESC to exit to main screen. Note that only valid APs can be scanned using this selection. STAs will not be listed or scanned.

SPECTRUM SCREEN

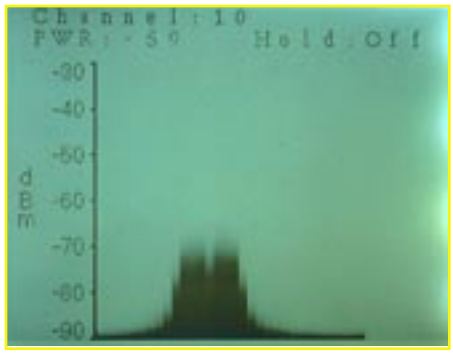
This RSSI screen indicates all received signals in a 22 MHz bandwidth that Grasshopper continuously scans. Any peaks indicate a signals although it could represent some spurious noise so the user must check that their channel corresponds with an appropriate AP address. The peak power is indicated graphically and numerically on this screen as well as the channel being scanned. Here, the signal peak indicates a narrowband jammer source. Press ESC to exit this screen.



narrowband jammer

RSSI SCREENS

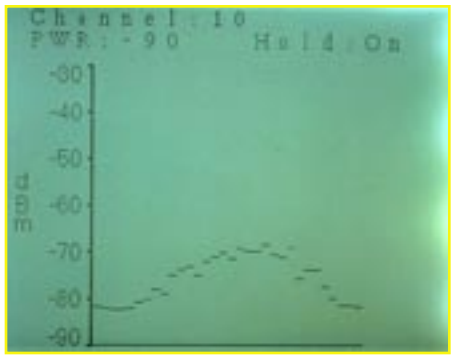
The following screens illustrate various forms of interference that Grasshopper's Spectrum screen displays. The first screen is a wideband 5 MHz jammer. Notice that the Peak Hold is Off in the upper right corner.



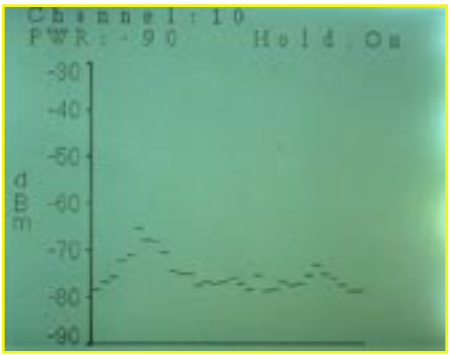
wideband 5 MHz jammer

PEAK HOLD

Peak Hold is only activated and deactivated in the Spectrum Screen. Use Peak Hold when looking for interference sources with low duty cycles. Push the 1 key on the keypad to turn ON the Peak Hold. Push the 1 key again to turn the Peak Hold back OFF. Remember the last signal displayed will reset when Peak Hold is toggled ON.

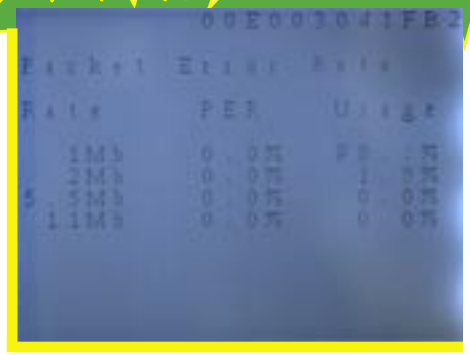


802.11 Access Point



Microwave Oven

PER



This selection will display the Packet Error Rate screen for the currently selected AP. The Rate column to the left indicates the speed rate that is being used in Megabits per second. The PER is based on actual packets coming in at different data rates. PER indicates the Packet Error Rate using each of these speeds in the selected AP. Usage displays the respective percentage breakdowns between the 4 different transfer rates all in the selected AP. PER is calculated by the percentage of bad packets out of the packets coming in at that data rate.

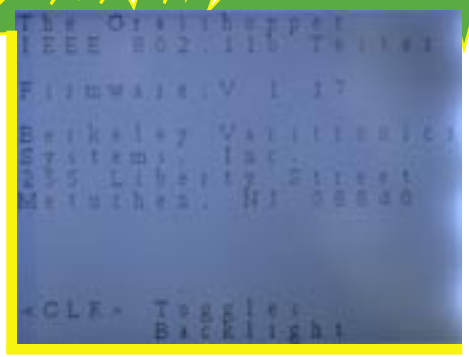
PEAK

This screen provides various information and measurements on the currently selected AP. Be sure to first select an Access Point in the main screen and then select PEAK. The top line displays the MAC address of the selected AP. Below that is the current signal strength in dBm of the selected AP. Below that is the PER of that AP. The bottom line displays the SSID (Service Set IDentification). The small speaker icon to the right of the screen indicates that the "geiger counter" mode is enabled. This mode will sound a series of audible beeps that indicate signal strength of the currently selected AP. Press the number 8 key at anytime in this screen to toggle this mode ON or OFF.

CONTRAST ADJUSTMENT

At anytime, press 0 on the key pad to access the Contrast Adjustment screen. Use the UP/DOWN ARROW keys to increase or decrease LCD contrast. When finished, press ESC to exit this screen.

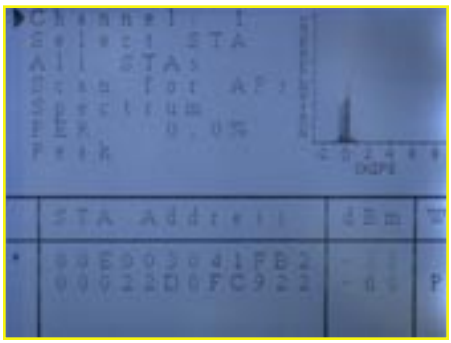
BACKLIGHT ADJUSTMENT



At anytime, press CLR key to display the Grasshopper info screen. Here, the current firmware version is displayed. Press CLR again to toggle the backlght off and on. When finished, press ESC to exit this screen. Remember that using the Grasshopper without the backlight on will increase overall battery life.

WEP ENCRYPTION DETECTION

A “P” next to its associated AP address and signal strength indicates that WEP (Wireless Equivalent Privacy) encryption is enabled and detected for that particular AP. An empty space indicates no WEP.



WEP Encryption

UPDATING GRASSHOPPER FIRMWARE

1. Install the Grasshopper loader program on a PC. Insert Disk 1 of the Grasshopper loader and run Setup.exe. Install Shield will guide you through the installation. Please make note of the install directory. You will need this information later.

2. Connect the download cable to the Grasshopper and to the PC. Turn the unit on and press the Setup key. This places the unit in the channel selection screen.

3. Run the Grasshopper firmware loader installed in step 1. Select the Comm port that the Grasshopper is connected to. Hit the browse button and select the file that is located in the installation directory for the Grasshopper firmware loader. Press the load button and wait for the download to complete.

4. Turn the unit off. In order to reset the unit and run the new firmware, turn the unit off, remove the download cable and turn the unit back on.

The Grasshopper firmware loader can be uninstalled from your computer at this point.

Networking Basics

Packets and traffic

Information travels across a network in chunks called "packets." Each packet has a header that tells where the packet is from and where it's going, similar to what you write on the envelope when you send a letter. The flow of all these packets on the network is called "traffic."

Hardware addresses

Your PC "listens" to all of the traffic on its local network and selects the packets that belong to it by checking for its hardware address in the packet header or MAC (Media Access Control). Every hardware product used for networking is required to have a unique hardware address permanently embedded in it.

IP addresses

Since the Internet is a network of networks (connecting millions of computers), hardware addresses alone are not enough to deliver information on the Internet. It would be impossible for your computer to find its packets in all the world's network traffic, and impossible for the Internet to move all traffic to every network, your PC also has an IP (Internet Protocol) address that defines exactly where and in what network it's located. IP addresses ensure that your local Ethernet network only
receives the traffic intended for it. Like the hierarchical system used to define zip codes, street names, and street numbers, IP addresses are created according to a set of rules, and their assignment is carefully administered.

Put another way, the hardware address is like your name; it uniquely and permanently identifies you. But it doesn't offer any clues about your location, so it's only helpful in a local setting. An IP address is like your street address, which contains the information that helps letters and packages find your house.

Rules for Sending Information (Protocols)

A protocol is a set of rules that define how communication takes place. For instance, a networking protocol may define how information is formatted and addressed, just as there's a standard way to address an envelope when you send a letter.

Networking Devices:

Bridges

A bridge joins two networks at the hardware level. This means that as far as other protocols are concerned, the two networks are the same.

Routers

A router connects two IP networks. In contrast to a bridge, which joins networks at the hardware level, a router directs network IP traffic based on information stored in its routing tables. A routing table matches IP addresses with hardware addresses. The router stamps each incoming IP packet with the hardware address that corresponds to that IP address. As a result, the packet can be picked up by the right computer on the hardware network.

DNS (Domain Name Server)

Networks (domains) on the Internet have names that correspond to their IP addresses. A Domain Name Server maintains a list of domain names and their corresponding addresses. This is why you can go to Berkeley's Web site by entering www.bvsystems.com, instead of the IP address.

Networking Terms:

TCP/IP (Transport Control Protocol/Internet Protocol)

TCP/IP is a collection of protocols that underlies almost every form of communication on the Internet.

DHCP (Dynamic Host Control Protocol)

DHCP is a method of automatically assigning IP addresses. Instead of assigning addresses to individual users, addresses are assigned by the DHCP server when clients need them. This means that instead of entering several fields of long addresses, users need only to select DHCP as their configuration method for IP networking.

PPP (Point-to-Point Protocol)

PPP is the most common protocol for providing IP services over a modem.

NAT (Network Address Translation)

NAT is used to share one IP address among several computers. A device set up as a NAT router uses a collection of "private" IP addresses (in the range 10.0.1.2 to 10.0.1.254 for example) to allow several computers to access the Internet using one "public" IP address. When a computer using a private IP address requests information from the Internet, the NAT router keeps a record of the computer making the request, and sends the information to the Internet using its own IP address. When the response comes back from the Internet, the NAT router forwards the packet to the appropriate computer.

Channel Number	Frequency GHz	North America	Europe	Spain	France	Japan MKK
1	2.412	X	X			
2	2.417	X	X			
3	2.422	X	X			
4	2.427	X	X			
5	2.432	X	X			
6	2.437	X	X			
7	2.442	X	X			
8	2.447	X	X			
9	2.452	X	X			
10	2.457	X	X	X	X	
11	2.462	X	X	X	X	
12	2.467		X		X	
13	2.472		X		X	
14	2.483					X

DSSS INTERNATIONAL CHANNEL CHART

Glossary of Acronyms

AC	Alternating Current
A/D	Analog to Digital converter
AGC	Automatic Gain Control
AP	Access Point
Applet	a small Application
BER	Bit Error Rate
BPSK	Binary Phase Shift Keying
BSS	Basic Service Set
BW	Band Width
CDMA	Code Division Multiple Access (spread spectrum modulation)
DC	Direct Current
D/A	Digital to Analog
dB	decibel
dBm	decibels referenced to 1 milliwatt
DOS	Digital Operating System
DSP	Digital Signal Processing
DSSS	Direct Sequence Spread Spectrum
ESS	Extended Service Set
FIR	Finite Impulse Response
GHz	GigaHertz
IF	Intermediate Frequency
I and Q	In phase and Quadrature
IBBS	Independent Basic Service Set
kHz	kiloHertz
LCD	Liquid Crystal Display
LO	Local Oscillator
MAC	Medium Access Control
Mbits	Megabits
MHz	MegaHertz
NIC	Network Interface Card
OFDM	Orthogonal Frequency Domain Multiplexing (802.11a)
PC	Personal Computer
PCS	Personal Communications Service (1.8 to 2.1 GHz frequency band)
PER	Packet Error Rate
PN	Pseudo Noise
QPSK	Quaternary Phase Shift Keying, 4-level PSK
RF	Radio Frequency
RSSI	Receiver Signal Strength Indicator
SSID	Service Set IDentification
UCT	Universal Coordinated Time
VAC	Volts Alternating Current
VGA	Video graphic
WEP	Wired Equivalent Protocol
WLAN	Wireless Local Area Network

IMPORTANT SAFETY INSTRUCTIONS

When using your telephone equipment, basic safety precautions should always be followed to reduce the risk of fire, electric shock and injury to persons, including the following:

1)Read and understand all instructions.

2)Follow all warnings and instructions marked on the product.

3)Unplug this product from the wall outlet before cleaning. Do not use liquid cleaners or aerosol cleaners. Use a damp cloth for cleaning.

4)Do not use this product near water, for example, near a bath tub, wash bowl, kitchen sink, or laundry tub, in a wet basement, or near a swimming pool.

5)Do not place this product on an unstable cart, stand, or table. The product may fall, causing serious damage to the product.

6)Slots and openings in the cabinet and the back or bottom are provided for ventilation, to protect it from overheating these openings must not be blocked or covered The openings should never be blocked by placing the product on the bed, sofa, rug or other similar surface. This product should never be placed near or over a radiator or heat register. This product should not be placed in a built-in installation unless proper ventilation is provided.

7) This product should be operated only from the type of power source indicated on the appliance. If you are not sure of the type of power supply to your home, consult your dealer or local power company.

8)Do not allow anything to rest on the power cord. Do not locate this product where the cord will be abused by persons walking on it.

9)Do not overload wall outlets and extension cords as this can result in the risk of fire or electric shock.

10)Never push objects of any kind into this product through cabinet slots as they may touch dangerous voltage points or short out parts that could result in a risk of fire or electric shock. Never spill liquid of any kind on the product.

11) To reduce the risk of electric shock, do not disassemble this product, but take it to a qualified service facil4 when some service or repair work is required. Opening or removing covers may expose you to dangerous voltages or other risks. Incorrect reassembly can cause electric shock when the appliance is subsequently used.

12)Unplug this product from the wall outlet and refer servicing to qualified service personnel under the following conditions:

A) When the power supply cord or plug is damaged or frayed. B) If liquid has been spilled into the product.

C)If the product has been exposed to rain or water.

D) If the product does not operate normally by following the operating instructions. Adjust only those controls, that are covered by the operating instructions because improper adjustment of other controls may result in damage and will often require extensive work by a qualified technician to restore the product to normal operation.

E) If the product has been dropped or the cabinet has been damaged. F) If the product exhibits a distinct change in performance.

13)Avoid using the product during an electrical storm. There may be a remote risk of electric shock from lightning.

14)Do not use the telephone to report a gas leak in the vicinity of the leak.

INSTALLATION INSTRUCTIONS

1. Never install telephone wiring during a lightning storm.

2. Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.

3. Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.

4. Use caution when installing or modifying telephone lines.

INSTRUCTION FOR BATTERIES

CAUTION: To Reduce the Risk of Fire or Injury to Persons, Read and Follow these Instructions:

1. Use only the type and size of batteries mentioned in owner's manual.

2. Do not dispose of the batteries in a fire. The cells may explode. Check with local codes for possible special disposal instructions.

3. Do not open or mutilate the batteries. Released electrolyte is corrosive and may cause damage to the eyes or skin. It may be toxic if swallowed.

4. Exercise care in handling batteries in order not to short the battery with conducting materials such as rings, bracelets, and keys. The battery or conductor may overheat and cause burns.

5. Do not attempt to recharge the batteries provided with or identified for use with this product. The batteries may leak corrosive electrolyte or explode.

6. Do not attempt to rejuvenate the batteries provided with or identified for use with this product by heating them. Sudden release of the battery electrolyte may occur causing burns or irritation to eyes or skin.

7. When replacing batteries, all batteries should be replaced at the same time. Mixing fresh and discharged batteries could increase internal cell pressure and rupture the discharged batteries. (Applies to products employing more than one separately replaceable primary battery.)

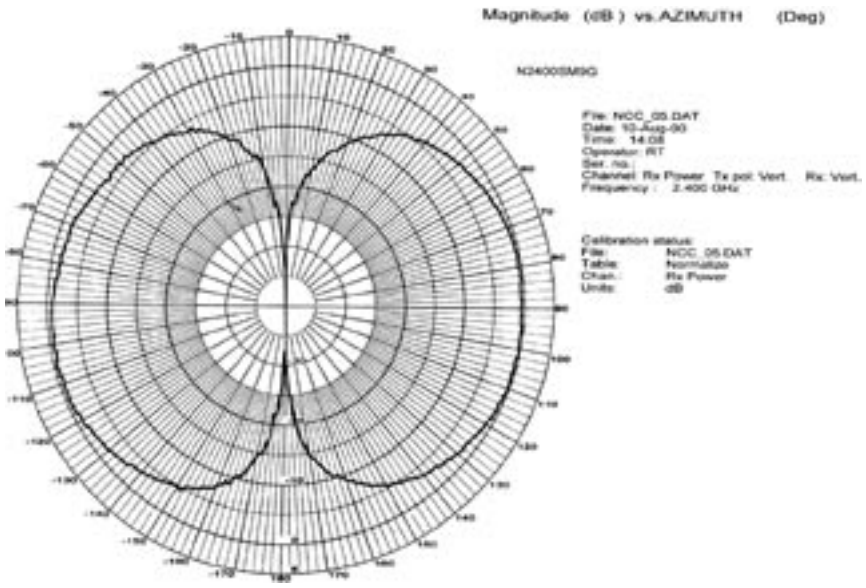
8. When inserting batteries into this product, the proper polarity or direction must be observed. Reverse insertion of batteries can cause charging, and that may result in leakage or explosion. (Applies to product employing more than one separately replaceable primary battery.)

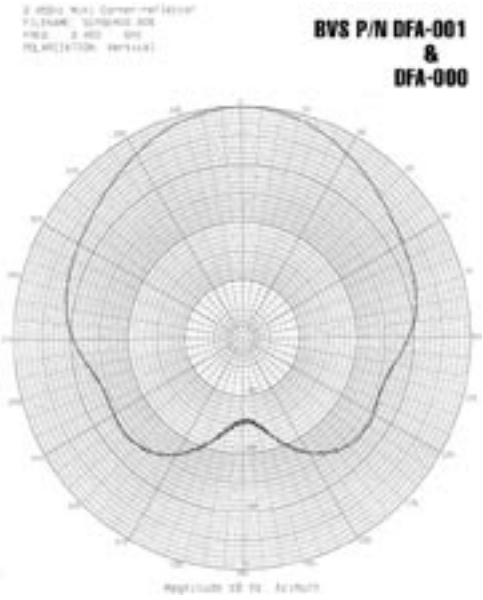
9. Remove the batteries from this product if the product will not be used for a long period of time (several months or more) since during this time the battery could leak in the product.

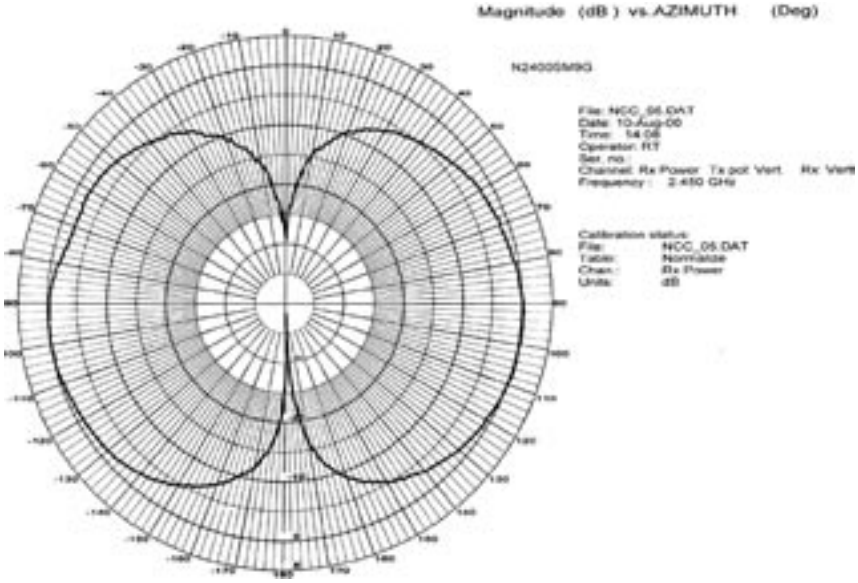
10. Discard "dead" batteries as soon as possible since "dead" batteries are more likely to leak in a product.

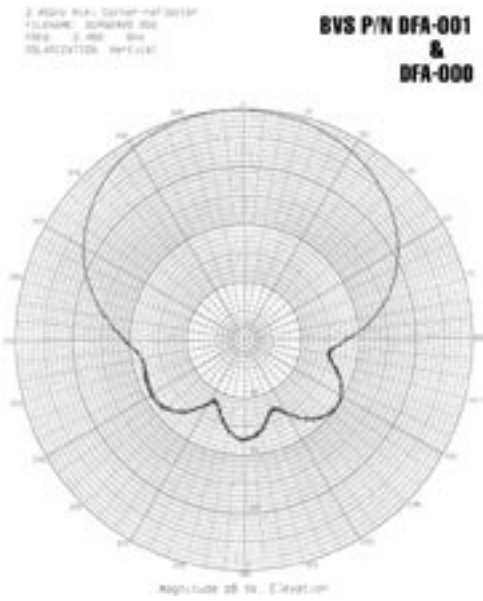
11. Do not store this product, or the batteries provided with or identified for use with this product, in high-temperature areas. Batteries that are stored in a freezer or refrigerator for the purpose of extending shelf life should be protected from condensation during storage and defrosting. Batteries should be stabilized at room temperature prior to use after cold storage.

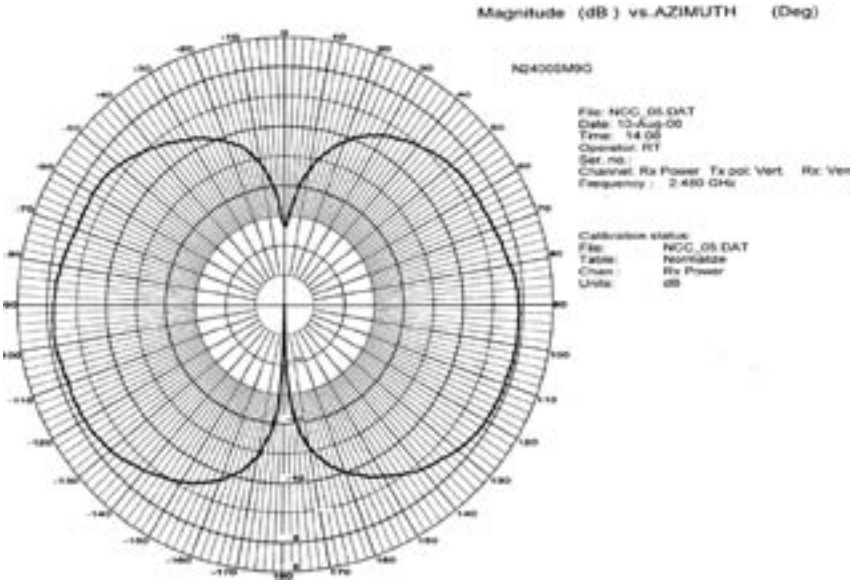
Below are Radiation Patterns for the included N2400SMA1G Antenna (left) and BVS' optional DF corner reflector (right). The Antenna Under Test was measured against a 1/2 Wave Dipole, therefore; The Gain is measured in dBd (0 dBd = 2.14 dBi).











Grasshopper™ WLAN 2.4 GHz SCANNER

IEEE 802.11 TESTER

Grasshopper™ is a handheld, wireless receiver designed specifically for sweeping and optimizing Local Area Networks. The instrument measures coverage of direct sequence CDMA networks which operate on the ***IEEE 802.11b*** standard allowing the user to measure and determine the AP (Access Point), PER (Packet Error Rate), and RSSI signal levels aiding in locating the hub and access points throughout a building. ***Grasshopper***™ detects and differentiates from narrowband multipath interferences such as microwave ovens and frequency hopping systems and features a built-in display, keypad and removable battery pack for true portability.

FEATURES:

- Measure coverage for direct sequence (DSSS) wireless networks (wideband IF 22 MHz)
- Tests 2.4 GHz DSSS networks operating within the **IEEE 802.11b** standard
- Measures Packet Error Rate
- Measures and displays channel time dispersion for multipath analysis
- Measures and displays RF power measurements: narrow band received signal strength (RSSI), total channel power
- Light-weight, portable and rugged design ideal for realtime network analysis
- Removable battery pack (5 AA Ni-MH cells)
- Built-in numeric keypad, backlit display with simple menu interface

The Grasshopper is just one of many exceptional design solutions from Berkeley Varitronics. Call us today for more information:
(732) 548-3737 / Fax: (732) 548-3404
Internet: www.bvsystems.com
E-mail: info@bvsystems.com

wireless products
BERKELEY VARITRONICS SYSTEMS

Grasshopper™ WLAN 2.4 GHz SCANNER

IEEE 802.11 TESTER

BANDS SUPPORTED	ISM:	2.400-2.485 GHz
RF SENSITIVITY (Wide Band)		-20 to -90 dBm
RSSI MEASUREMENT (Narrow Band)		-30 to -90 dBm @ 100 kHz resolution bandwidth
TUNING INCREMENTS		50 kHz steps

PACKET PREAMBLE DEMODULATOR and ANALYZER:
Multipath Measurement and Graphical Display

CORRELATED POWER MEASUREMENTS:	**RATIO**
Correlated Power (dBm)	-30 dBm : -100 dBm
Correlated Power to Total Power Ec/Io (dB)	0 dB : -10 dB
Total Channel Power Measurement	-20 dBm : -90 dBm

GENERAL SPECIFICATIONS

IF Bandwidth:	Wideband 22 MHz
Stability:	± 2.5 PPM Temp range 32° to 120 F°
Antenna:	SMA Female 50 ohm
Controls:	20 button keypad
Warm Up Time:	< 3 minutes
Power:	Internal battery pack (5 AA Ni-MH batteries)
Weight:	3 lbs.
Dimensions:	2” H x 4” W x 9” L (water resistant, high impact ABS plastic case)

*Multipath and signal quality assessment via comparison of correlated power to total channel power ratio and correlated power.

*Features graphical display of multipaths.

*Interference detection via RSSI scan and active DSSS 802.11 channel scan.

Grasshopper includes a straight 3dBi 2.4 GHz antenna (SMA Female 50 ohm), two removable battery packs (5 AA Ni-MH cells each) charger, RS-232 cable all in a rugged carrying case.

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