Rhino II

manual version 1.3

Contents

RHINO II LCD DISPLAY AND KEYS

The 2 line by 16 character backlit LCD is used to display GPS (Line 1) and unit status (Line 2). In addition, the display is used to select setup's using the F1 and F2 keys located on the Front Panel. The Front Panel also has a RESYNC and RESET button. The RESYNC button function is described below. The RESET button should ONLY BE USED in cases where the RHINO is malfunctioning. Pressing the reset button has the

same effect as powering up the unit.

POWER UP SEQUENCE

When the unit is first turned on, Line 1 displays GPS status and the number of satellites being tracked:

GPS UNLOCKED

The GPS receiver requires at least 3 satellites to lock. With good antenna placement, this usually takes about 1 minute. Whenever the unit is moved more than one hundred miles, the GPS will take longer to aquire lock (up to 20 minutes). After it locks in the new location, the next time it is turned on (in the new location), the GPS will again take about 1 minute to lock.

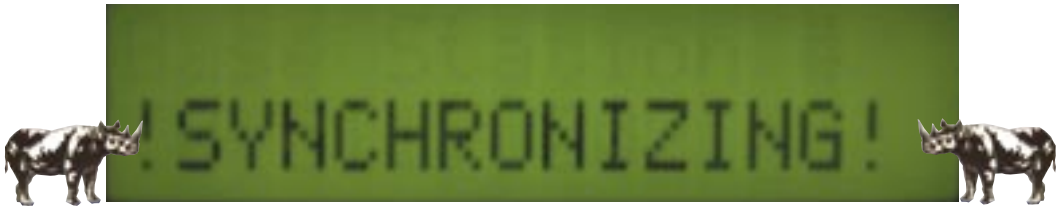
Problems with the GPS (never locking) can be diagnosed using the PC software "View GPS Data" screen.

Once the GPS locks, Line 1 is replaced with the GPS time and date.

After power up, Line 2 displays:

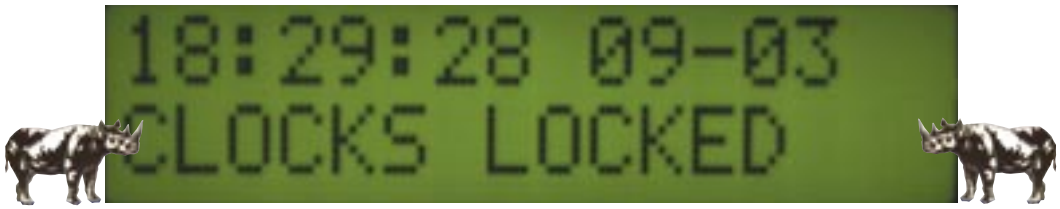
UNIT WARMING UP

When the Rubidium (Rb) Oscillator has been locked (Front Panel Rb LOCK LED on) for 5 minutes, the unit is warmed up and will synchronize its Rb PPS output to the GPS PPS (if the GPS is locked). This is indicated on Line 2 with the message:



!SYNCHRONIZING!

After this synchronization is complete, Line 2 changes to:



CLOCKS LOCKED

LCD LINE 2 MESSAGES

The following is a summary of messages displayed on LINE 2 of the LCD:

BATTERY LOW - Indicates the internal battery is low and should be recharged. The Front Panel BATTERY LOW LED also turns on.

!SYNCHRONIZING! - Displayed whenever the RHINO is locking the Rb oscillator to the GPS PPS.

GPS ALARM - Displayed if GPS unlocked for 24 hours after unit is synchronized.

Rb ALARM - Displayed if Rb oscillator becomes unlocked after unit is synchronized.

Rb UNLOCKED - Displayed if Rb oscillator is not locked.

OFFSET ALARM - Displayed if OFFSET PPS is more than 64 chips away from the user entered setting. This message will be replaced by:

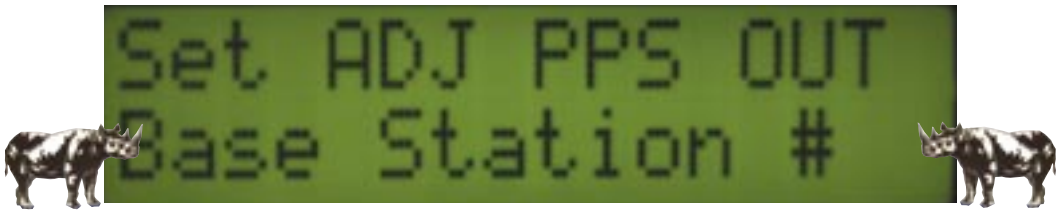
CLOCKS UNLOCKED - Follows an OFFSET ALARM - indicates the RHINO should be re-synchronized. The RHINO can be re-synchronized by pushing the Front Panel RESYNC button or with the PC software.

NOTE: After entering a new PPS OFFSET from the PC, the unit MUST be re-synchronized.

USING THE FRONT PANEL F1 AND F2 BUTTONS TO SELECT OPTIONS

Press the F1 button to display the first setup selection. Continue pressing the F1 button to scroll through the setup options. To select the currently displayed option, press the F2 button.

SETUP OPTIONS (DISPLAYED ON LINE 1 AND 2 OF THE LCD)

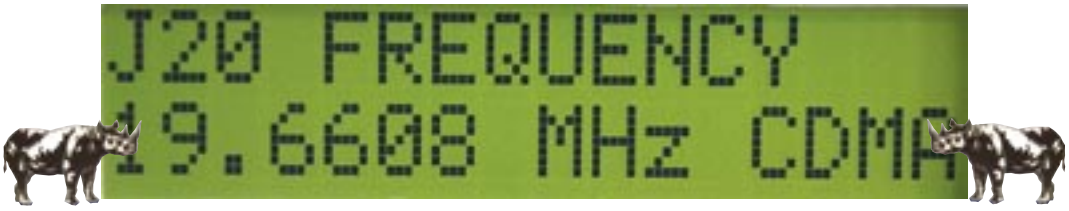


Set ADJ PPS OUT
Base Station #

Press F2 to change the BASE STATION OFFSET. When F2 is pressed, the BASE STATION can be changed as follows:

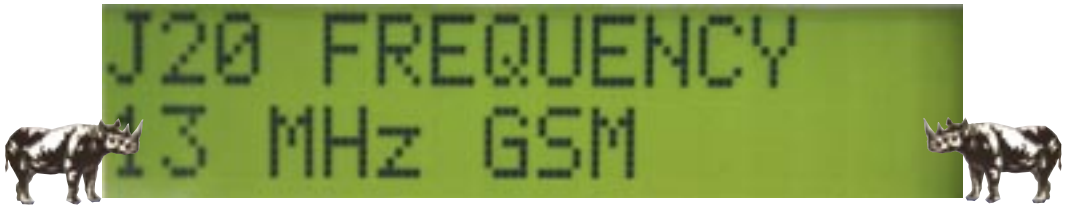
Press F1 to increment the current digit. Press F2 to move one digit to the right. When F2 is pressed on the last digit, the new Base Station offset is entered and the unit automatically re-synchronizes.

The BASE STATION offset entered must be in the range of 0 to 511. Chip Offset is equal to BASE STATION # times 64 (1 chip = 1/19.6608)



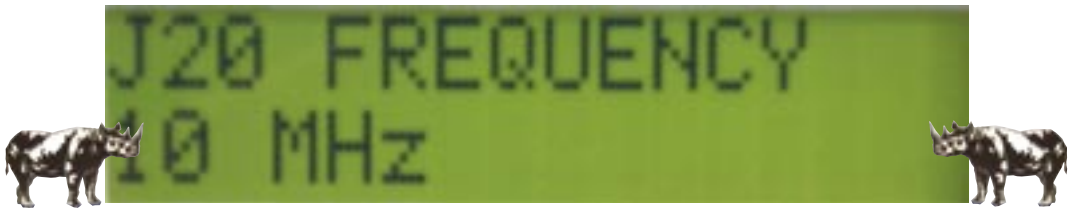
J20 FREQUENCY
19.6608 MHz CDMA

Press F2 to output 19.6608 MHz from Back Panel OUTPUT labled 19.6608



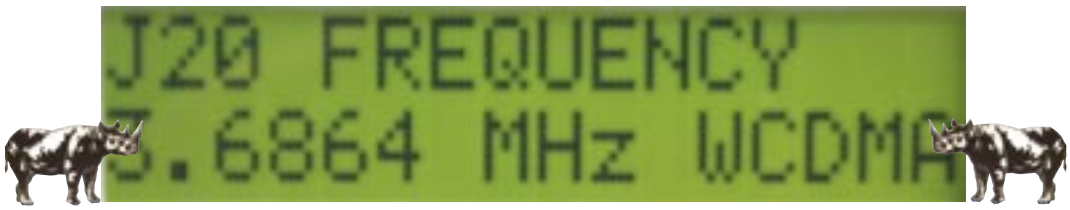
J20 FREQUENCY
13 MHz GSM

Press F2 to output 13.0000 MHz from Back Panel OUTPUT labled 19.6608



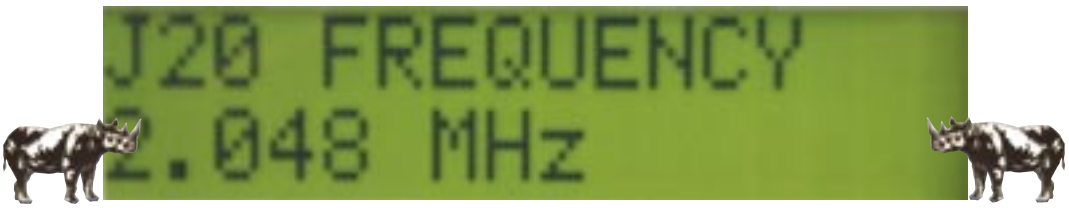
J20 FREQUENCY
10 MHz

Press F2 to output 10.0000 MHz from Back Panel OUTPUT labled 19.6608



J20 FREQUENCY
3.6864 MHz WCDMA

Press F2 to output 3.6864 MHz from Back Panel OUTPUT labled 19.6608

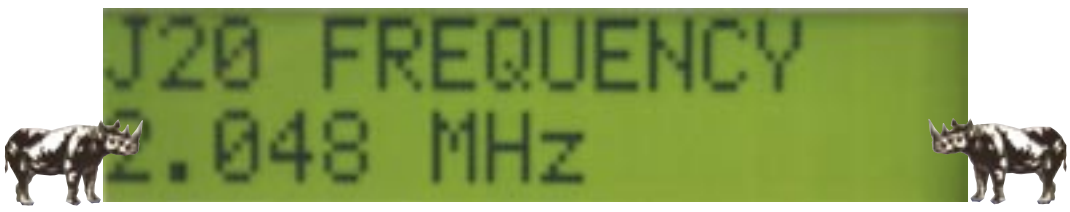


J20 FREQUENCY
2.048 MHz

Press F2 to output 2.048 MHz from Back Panel OUTPUT labled 19.6608

PPS
INTERNAL GPS

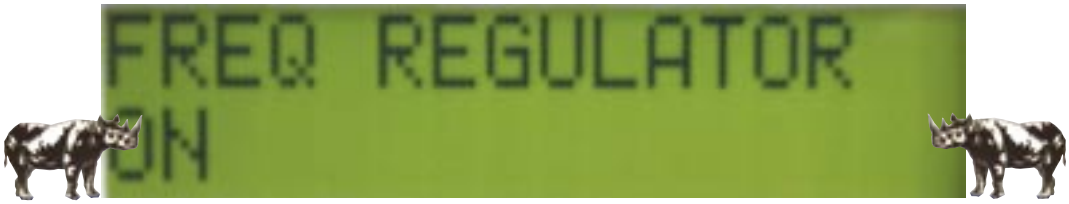
Press F2 to use the internal GPS PPS as reference (NORMAL MODE).



PPS
EXTERNAL J27

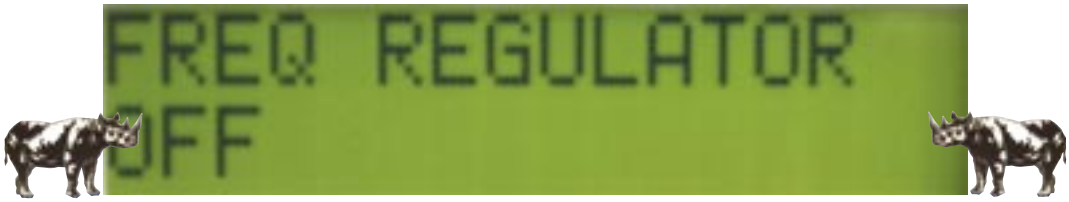
Press F2 to use an external PPS connected to J27 as reference.

NOTE: DO NOT CONNECT the external PPS source to J27 untill PPS has been selected EXTERNAL. J27 is normaly PPS output.



FREQ REGULATOR
ON

Press F2 to turn on the Rb regulator. See the section on the Rb regulator.



FREQ REGULATOR
OFF

Press F2 to turn off the Rb regulator (NORMAL MODE).

All changes to unit setups are saved in non-volatile memory and are restored whenever the unit is re-powered.

CONNECTORS FRONT PANEL

J27 PPS output or EXTERNAL PPS input
J17 1/2 PPS output
J10 10.00 MHz output
J11 10.00 MHz output

FRONT PANEL LED INDICATORS

Rb Lock - Lit when Rb oscillator is LOCKED.

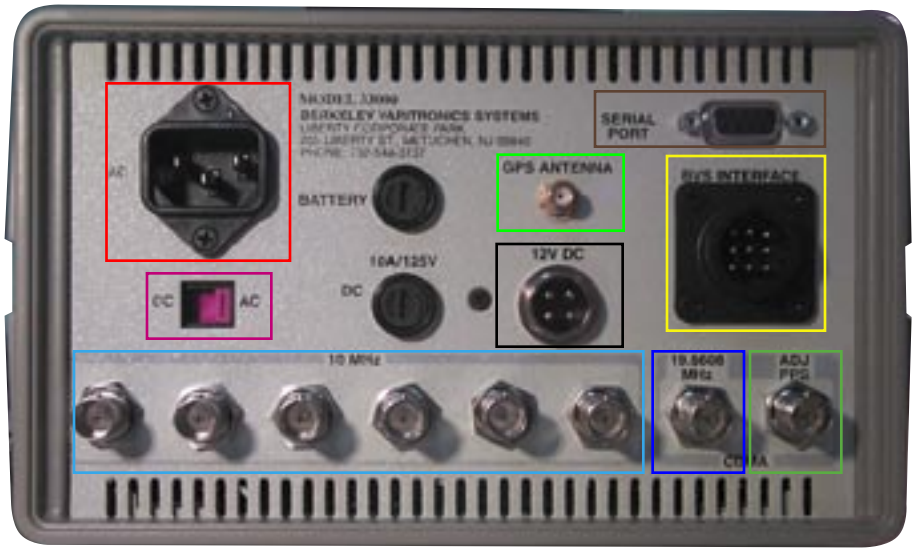
BATTERY
POWER - Lit when the RHINO is running on the internal

battery (approximately 15 minutes with a fully charged battery). This provides enough time to move the unit after it is locked to areas (such as indoors) where GPS is not available.

This LED is OFF when unit is externally powered (AC or DC).

LOW - Internal battery is low and should be charged. Battery is charged when running on external AC power.

NOTE: The unit will shut itself OFF if battery



charge is TOO low.

REAR PANEL

There are 6 connectors with 10.00 MHz output.

19.6608 MHz connector (J20): normally 19.6608 MHz but can be changed via the RHINO setup or PC software.

ADJ PPS: This connector outputs PPS offset by user entering BASE STATION # on front panel LCD or in CDMA chips via the PC software.

AC/DC power select switch: Set to AC if using 117V AC, set to DC if using 12V DC to externally power the RHINO.

AC runs the Rhino2 and/or to charge the internal battery. The AC voltage is in range of 85 VAC to 264 VAC with frequency 47-440 Hz.

GPS ANTENNA to connect GPS antenna here.

BVS INTERFACE to connect Rhino to BVS instruments requiring precision timing such as a Gecko™ or Crocodile™

12V DC input for mobile power from a cigarette lighter adaptor

SERIAL PORT for connection to a PC

Rb REGULATOR

Rb Regulator is used to keep the Rb oscillator to within 1e-12 of 10.0 MHz. To use the regulator, the unit MUST have the GPS locked at ALL times. When first turned on, the regulator can take up to 3 days to settle to final accuracy. Once final accuracy is achieved, the regulator will return to its last state if re-powered.

NOTE: When using PPS offsets to simulate base stations, the

Some custom models have unique settings (output frequencies and/or signals) that are different from the standard Rhino 2.

For example, standard 1/2 PPS output on soem models has been used to output 1 pulse every 16 seconds.

BVS Rhino II Controller
Application Software

INTRODUCTION

The Rhino Controller application software is the PC interface that enables a user of the Rhino Frequency Source to control the unit for desired performance.

The chip offset may be selected using this software. In addition, GPS and Unit information is retrieved from the Rhino for display purposes. The following sections outline the operation of the Rhino Controller in greater detail.

APPLICATION OVERVIEW

The Rhino interface application displays pertinent information as it regards to the Rhino. The information is updated on the PC display as it comes in through the RS-232 port.

The chip offset may be set from 0-32767 in this application. The J20 frequency may also be set.

The individual features of the application software are discussed in the following sections.

Installing the Application

Insert the supplied CD-ROM. Run the SETUP.EXE application and InstallShield will prompt for further installation questions. After the installation is completed, an icon will be created in the folder specified during the installation process.

Starting the Application

Make sure that the Rhino is running and connected to a serial port on a PC using the cable packed with the unit. Clicking on the Rhino Controller icon starts the Rhino Controller application.

When the PORT screen appears, choose the port to which the Rhino is connected. When the main screen appears, check the status bar for verification that the connection was made to the Rhino.

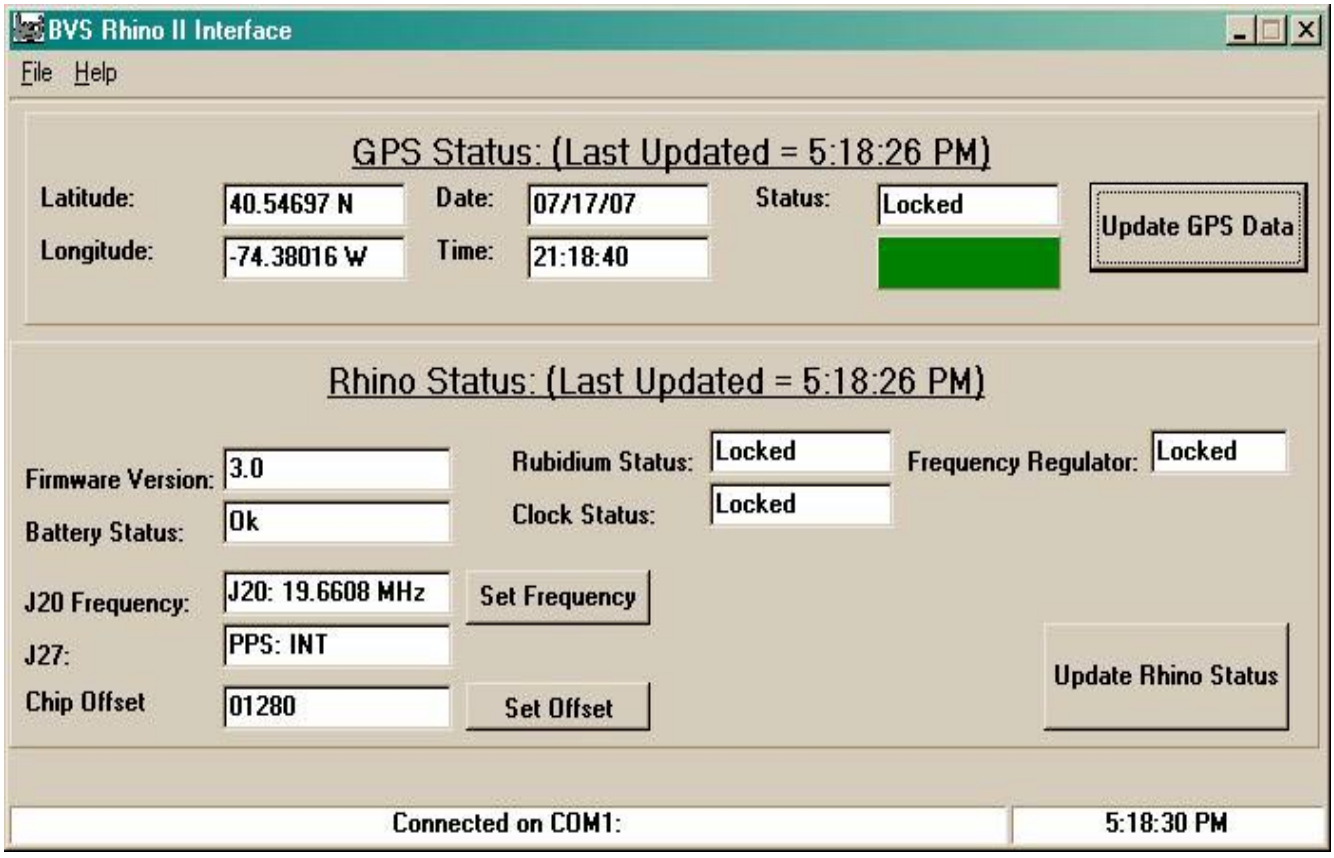


Figure 1 – Rhino Interface

MAIN SCREEN

The main display is broken up into two different sections. The top section includes GPS information. All of the fields will be initially updated at startup. Press the update button to retrieve current information. The time of the last update is displayed next to the “GPS Status” header. The status color box will be green if the GPS receiver is locked and red if it is not locked.

The bottom section is for Rhino-specific information. All of the fields will be initially updated at startup. Press the update button to retrieve current information.

SET FREQUENCY DIALOG

To set the J20 frequency, press the “Set Frequency” button. A pop-up window will allow the user to choose a new frequency. After choosing and pressing “OK”, the frequency on the Rhino will change and be reflected in the field on the software.

SET OFFSET DIALOG

To set the chip offset, press the “Set Offset” button. A pop-up window will allow the user to choose a new offset. After choosing and pressing “OK”, the chip offset on the Rhino will change and be reflected in the field on the software.

FREQUENCY/OFFSET SCREEN

In order to set the chip offset of the Rhino, enter a number between 0 and 32767. If a number is entered which is outside this range, the value will be adjusted to either 0 or 32767.

BVS Rhino II Serial Port Interface

Communications Port Settings

Baud Rate	1200
Parity	None
Data Bits	8
Stop Bits	1

NOTE: Do not strip NULL's!!!

Command/Response Structure

The structure of records to and from the Rhino are as follows:

Sync Byte	0xAA	1 byte
Record Length	< Length of record including this byte but not the sync byte>	1 byte
Record Type	< Command/Response number >	1 byte
Parameters	< Parameters for command/response>	Variable

An example command would be:

Get GPS (Command 0x03)

To Rhino II:	0xAA	0x01	0x03	
From Rhino II:	0xAA	<Length>	0x03	<GPS Data>

COMMANDS

Description	Command Number	Parameters	
Get Status	0x02		
Get GPS	0x03		
ReSync	0x04		
Set Offset	0x05	Chip Offset (1-32767)	(2 bytes)
Set Frequency	0x09	Frequency Package (see below)	
Get Frequency	0x0A		
Turn Measurement On	0x0E		
Turn Measurement Off	0x0F		

RESPONSES

Get Status	0x02	Status Package (see below)
Get GPS	0x03	GPS Data (see below)
Get Frequency	0x0A	Frequency Package (see below)

Status Package

BYTE Status; GPS Sync Status
0x40 – GPS Locked (if Rubidium is locked)
BYTE VisSat; Num Visible Satellites
WORD ChipOffset; Chip Offset (1-32767)
BYTE Alarm; Alarm Status
short Offset; Offset
BYTE GPS_Hour; GPS Hour
BYTE GPS_Minute; GPS Minute
BYTE GPS_Second; GPS Second
BYTE MiscStatus; Rubidium,battery, etc.
0x01 – Rubidium Warming Up
0x20 – Clocks Locked
0x40 – Battery Low
0x80 – Rubidium Lock
BYTE VersionMajor; Firmware Version
BYTE VersionMinor;
BYTE RegFlag; Regulator Flag (Firmware Version Major>=2, Minor>=1)
0xA0 – Regulator Locked
0x80 – Regulator On
WORD RegGain; Regulator Gain
WORD RegDAC; Regulator DAC Value

Frequency Package

BYTE PP;
0 = PPS is internal
BYTE J10J11;
BYTE J20;
0 = 19.6608 MHz
1 = 10.0 MHz
2 = 2.048 MHz
3 = 3.6864 MHz
4 = 13.0 MHz
5 = 9.6 MHz

GPS Data

You will receive one packet of GPS data as follows:

<23 bytes of fill> and…

m	month	1..12
d	day	1..31
yy	year	1980..2079
h	hours	0..23
m	minutes	0..59
s	seconds	0..60
ffff	fractional second	0 .. 999,999,999 (0.0 0.999999999)

aaaa latitude in mas -324,000,000..324,000,000 (-90..90 degrees)
oooo longitude in mas -648,000,000..648,000,000 (-180..180 degrees)
hhhh ellipsoid height in cm -100,000..1,800,000 (-1000.00..18,000.00 m)
mmmm not used

vv velocity in cm/s 0..51,400
hh Heading 0..3,599 (0.0 .. 359.9 degrees) (from North)

dd current DOP (0.1 res) 0..999 (0.0 to 99.9 DOP)
(0 = not computable, position-hold, or position prop)

t DOP Type
0 PDOP(3D)/antenna ok
1 HDOP(2D)/antenna ok
64 PDOPODYantenna shorted
65 HDOP(2D)/antenna shorted
128 PDOPOD)/antenna open
129 HDOPUDYantenna open
192 PDOPOW/antenna shorted
193 HDOP(2D)/antenna shorted

n num of visible sats 0..12
t num of satellites tracked 0..8

For each of eight receiver channels

i sat ID 0..37
m channel tracking mode 0..8

0 = code search 5 = message sync detect
1 = code acquire 6 = satellite time avail
2 = AGC set 7 = ephemeris acquire
3 = preq acquire 8 = avail for position
4 = bit sync detect

s signal value 0..255
d channel status flag
Each bit represents one of the following:
(msb) Bit 7: using for position fix
Bit 6: satellite momentum alert flag
Bit 5: satellite anti-spoof flag set
Bit 4: satellite reported unhealthy
Bit 3: satellite reported inaccurate (>16 m)
Bit 2: spare
Bit 1: spare
(lsb) Bit 0: parity error
End of channel dependent data

s Receiver status flag
Each bit represents one of the following:

(msb) Bit 7: position propagate mode
Bit 6: poor geometry (DOP > 12)
Bit 5: 3D fix
Bit 4: 2D fix
Bit 3: acquiring satellites/position hold
Bit 2: spare
Bit 1: insufficient visible satellites (<3)
(lsb) Bit 0: bad almanac

Information on these fields are based on the Motorola Oncore receiver user manual.

Glossary of Acronyms

AC	Alternating Current
A/D	Analog to Digital converter
AGC	Automatic Gain Control
Applet	a small application
BER	Bit Error Rate
BPSK	Binary Phase Shift Keying
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
FIR	Finite Impulse Response
GHz	GigaHertz
GPS	Global Positioning System (satellite based)
GPS diff.	GPS error correction signal which enhances GPS accuracy
IF	intermediate frequency
I and Q	In phase and Quadrature
kHz	kiloHertz
LCD	Liquid Crystal Display
LO	Local Oscillator
Mbits	Megabits
MHz	MegaHertz
modem	modulator/demodulator
PC	Personal Computer
PCS	Personal Communications Service (1.8 to 2.1 GHz frequency band)
PN	Pseudo Noise
QPSK	Quaternary Phase Shift Keying, 4-level PSK
RF	Radio Frequency
RSSI	Receiver Signal Strength Indicator
UCT	Universal Coordinated Time
VAC	Volts Alternating Current
VGA	Video graphic

GPS-MM Active Mobile (Magnetic Mount) GPS Antenna

General Description:

The GPS-MM is a high performance GPS patch antenna combing a state-of-the-art low noise amplifier with a low profile, compact, fully waterproof enclosure. When connected to a GPS receiver with 3-5 VDC antenna power, the GPS-MM provides excellent signal amplification in addition to out-of-band filtering & rejection.

This data sheet specifies the basic operational characteristics of the active GPS antenna module GPS-MM under a standard test condition of 3V DC at 25°C and 50% relative humidity.

Specifications:

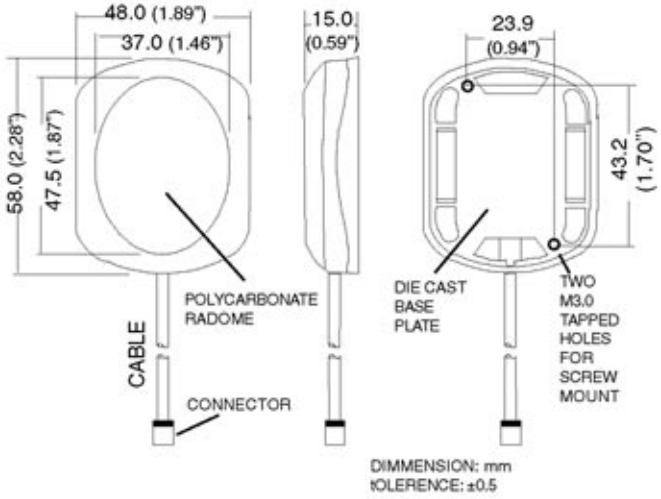
PHYSICAL	
Construction:	Dark gray Polycarbonate-radome at top, die-cast shell at bottom/ rubber gasket for water seal in between
Dimension:	58mm (L) x 48mm (W) x 14mm (H)
Weight:	65 grams (excluding cable & connector)
Standard Mounting:	Magnet mount with two magnets
ANTENNA ELEMENT	
Center Frequency:	1575.42 MHz +/- 1.023 MHz
Polarization:	R.H.C.P. (Right Hand Circular Polarization)
Absolute Gain at Zenith:	+5 dBi typically
Gain at 10o Elevation:	-1 dBi typically
Axial Ratio:	3 dB max.
Output VSWR:	1.5 max.
Output Impedance:	50 ohm
OVERALL PERFORMANCE (Antenna Element, LNA & Cable)	
Center Frequency:	1575.42 MHz
Gain:	25 dB min.
Noise Figure:	2.6 max.
Band Width:	2 MHz
Axial Ratio:	3 dB max.
VSWR:	2.0 max
Output Impedance:	50 ohm

Specifications (Continued):

LOW NOISE AMPLIFIER	
Center Frequency:	1575.42 MHz ±1.023 MHz
Gain:	25 dB typically
Band Width:	2 MHz min.
Noise Figure:	2.6 max.
Out Band Attenuation:	12dB min. @F0 ±140MHz
Supply Voltage:	3.0~5.0V DC
Current Consumption:	12 mA +/- 2 mA
VSWR:	2.0 max.
Output Impedance:	50 ohm

ENVIRONMENTAL	
Operating Temperature	-30oC~+85oC
Storage Temperature:	-40oC~+90oC
Relative Humidity:	95% non-condensing
Waterproof:	100% waterproof

Dimensional Drawing:



Ordering Information:

Model Number	Part Number
BVS-MM	10001268 with 5 m cable & R/A MMCX Plug
BVS-MMB	10001273 with 5 m cable & ST BNC Plug

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.