Bad Elf
Flex™

BE-GPS-5500

User Manual

V 1.2
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Bluetooth®

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Introduction

Thank you for your purchase of a Bad Elf Flex GNSS receiver. This manual describes the basic operation and usage of your Bad Elf Flex. Additional information provided includes operating specifications, product specifications, and warranty information. For the most recent information, visit bad-elf.com/flex.

What's in the box

The following items are included in the standard Bad Elf Flex configuration:

- Bad Elf Flex
- Rugged carrying case
- Accessory case
- AC Wall charger
- Vehicle charger
- 1m USB charging cable
- USB OTG adapter cable
- 5/8" x 11 to 1/4" x 20 pole mount adapter
- Quick start guide

Product Overview - Front

Antenna cap

Helical GNSS antenna & SMA connector (inside cap)

LCD screen

Status LED's

Enter key

Directional keys

Power key

Back/Cancel key

5/8 x 11 UNC female pole mount

Product Overview - Back

Top lanyard
mount

1/4" x 20
accessory

USB charging
and data

Bottom lanyard
mount
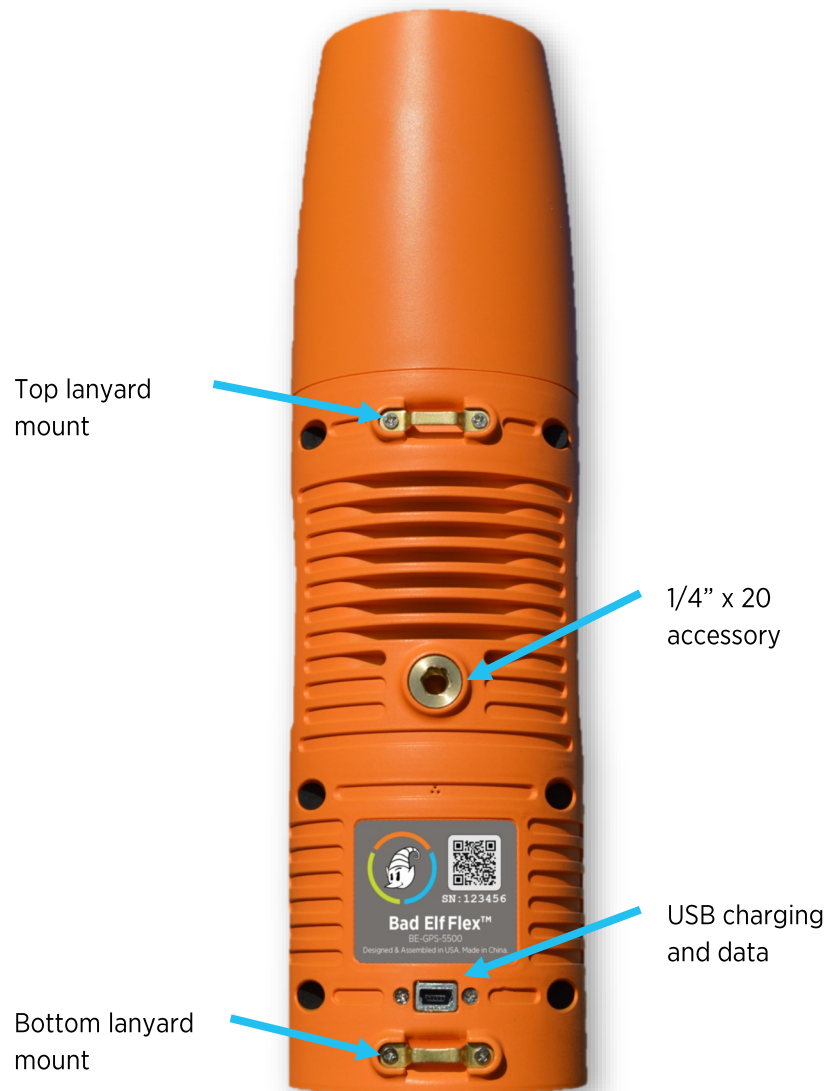
Supported Devices

You can connect a Bad Elf Flex receiver to a handheld phone, tablet or PC powered by the following operating systems:

- iOS version 11 or newer
- Android versions 4.1x or newer
- Windows 10.x or newer
- Mac OS X 10.4 or newer

Charging and Charge Management

Charging your Bad Elf Flex

Charge your Bad Elf Flex fully before first use. The following process describes how to properly charge your Bad Elf Flex.

- Using the supplied USB charging cable, insert the Mini-USB connector into your Bad Elf Flex USB connector.
- Insert the other end of the charging cable into the supplied AC wall adapter or the supplied car adapter.
- Charge your Bad Elf Flex until the LED on the left turns green.

Operation while charging

Bad Elf Flex can be operated while charging. A charge current of 1500 maH or greater can sustain unlimited operation regardless of charge state.

Compatible chargers

The standard configuration for the Bad Elf Flex includes an AC adapter and a car adapter. Any standard USB compatible charger may be used as an alternative. Bad Elf Flex can support quick-charger adapters as well as standard USB charging from a PC or laptop. Charge rates are dependent upon the USB charger current.

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Temperature – charge limitations

Charging only occurs inside the valid temperature range defined in the specifications of this manual. Battery temperatures outside the range of the listed charge temperature prevent the Bad Elf Flex from charging to protect the battery.

Note: The battery temperature may differ from the ambient air temperature as internal temperatures vary during usage.

Low battery – device behavior

The Bad Elf Flex monitors charge state of the battery actively. As the charge state approaches a low point, an indicator provides information of a low battery state. Continued operation causes the receiver to automatically shut down, preventing over-discharge of the battery. Should this occur, you must charge the battery sufficiently to restore operation. Normal operation will occur once the receiver detects either sufficient USB charging for operation or a battery level above internal low voltage thresholds.

Battery Safety

Charge and use the rechargeable Lithium-ion battery only in strict accordance with the instructions. Charging or using the battery in unauthorized equipment can cause an explosion or fire, and can result in personal injury and/or equipment damage. To prevent injury or damage:

- Do not charge or use the product if it appears to be damaged or leaking.
- Charge the product only with an approved USB power source that can provide at least 1500 maH of charging current at 5VDC.
- Discontinue charging a battery that gives of extreme heat or a burning odor.
- Use the product only for its intended use and according to the instructions found in this document.

Powering On and Off Bad Elf Flex

To turn the receiver on, press and hold the power button for 3 seconds. The Flex will take approximately 20 seconds to start up and begin looking for satellites.
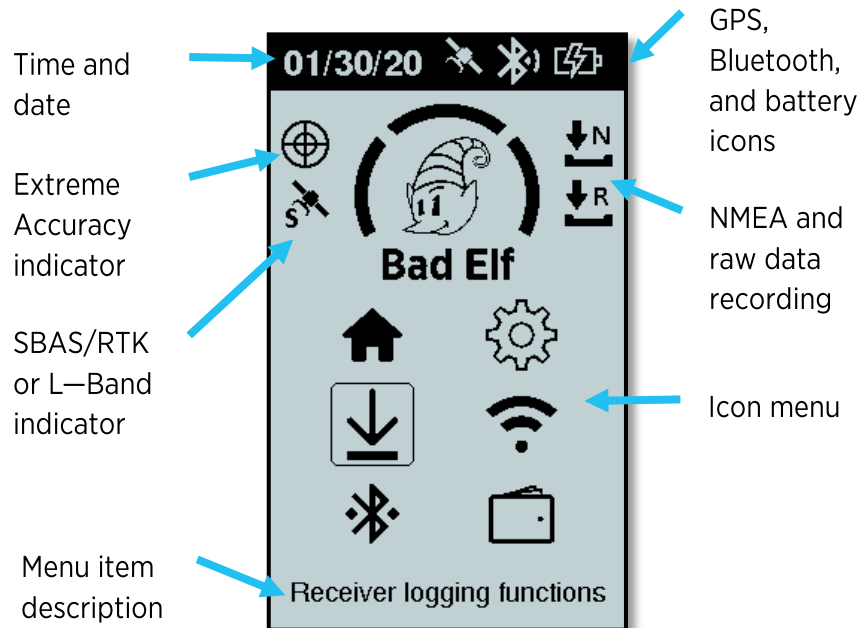
To turn the receiver off, press and hold the power button until the display turns off.

Using Bad Elf Flex

We've designed the Flex to be as simple and intuitive as possible. See the pictures and illustrations below for a description of the primary components of the user interface.

Status information – LCD & LEDs

The LCD display is the primary user interface of the Bad Elf Flex.

Time and date

GPS, Bluetooth, and battery icons

Extreme Accuracy indicator

NMEA and raw data recording

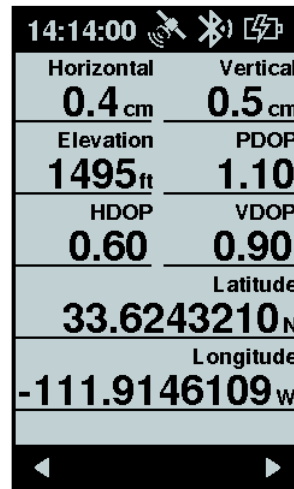SBAS/RTK or L—Band indicator

Icon menu

Menu item description
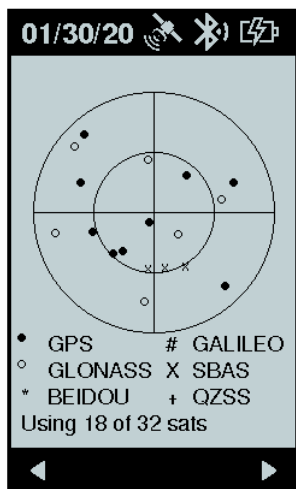
GNSS Status Screens

The GNSS status screens provide detailed information for the operation of the internal GNSS engine of the Bad Elf Flex. Using the left and right directional keys, you may cycle through each of the displays. Pressing the back key returns you to the main menu.
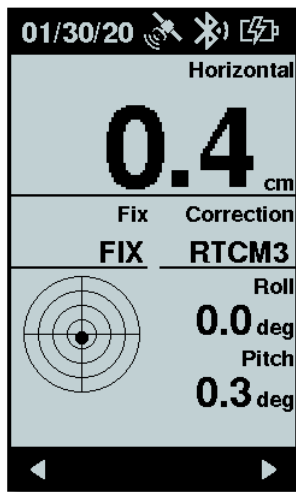
Primary GNSS display

Detailed GNSS display

Satellite location display

This Bad Elf Flex has Extreme mode activated and has an RTCM3 correction source. The fix type is RTK Fixed with accuracy, elevation, and position shown using the primary and detailed screens.

The satellite display provides visibility into the currently used satellites and the current sky portrait.

Status Icons

The menu bar at the top of the screen provides status of the GNSS engine, Bluetooth, and battery. Each of the icons represents the current state of a particular function of the Bad Elf Flex. The table below contains descriptions of each icon.

GNSS Icons

GNSS lock	GNSS not locked

Bluetooth Icons

On	Disabled	Connected

Battery Icons

Battery below 10%	Battery 10%-25%	Battery 25%-50%	Battery 50%-75%	Battery above 75%

Battery charged	Battery charging	Battery temperature	USB on the go

Icon Menu Status Icons

Extreme mode enabled

GNSS is using SBAS or RTK

GNSS is using L-Band satellite corrections

Recording NMEA

Recording raw data

Bluetooth LED (right)

Color	Meaning
Solid Blue	Bluetooth connection established
None	No Bluetooth connection found

Connecting Phones or Tablets via Bluetooth

The following steps will help you connect your mobile phone or tablet to the Bad Elf Flex receiver via Bluetooth.

Start by making sure you Bad Elf Flex is turned on, and within range of your phone or tablet. Follow the instructions below to complete the pairing process:

For iPhone and iPad devices running iOS

1. On your iOS Device, open the Settings app and navigate to the Bluetooth screen.
2. If needed, turn Bluetooth on.
3. If you have not previously paired with this Bad Elf Flex, it will appear in the "Other Devices" section. Tap Bad Elf Flex in the list to start the pairing process. If requested, confirm the pairing on your phone or tablet and the Bad Elf Flex.
4. Once you are paired, the Bad Elf Flex will appear in the My Devices section. If the status shows as Disconnected, you can tap the Flex name to initiate a connection.
5. Once the pairing succeeds, you should see it listed as Connected in the list of devices on your iOS device.

For Android phones and tablets

To pair the Flex with your Android device:
1. On your Android device, go to Settings > Wireless & Networks. Make sure Bluetooth is turned on.

For Android phones and tablets

To pair the Flex with your Android device:
1. On your Android device, go to Settings > Wireless & Networks. Make sure Bluetooth is turned on.
2. Go to Settings > Wireless & Networks > Bluetooth Settings and tap Scan for devices.
3. After a few seconds, the Bad Elf Flex should appear in the list of available Bluetooth devices.
4. Tap the name in the list and to start the pairing process. If requested, confirm the pairing on your phone or tablet and the Bad Elf Flex.
5. Once paired, you will see the Bad Elf Flex appear in the list as Connected for a few seconds then return to Disconnected. This is normal. The Bluetooth connection will be established whenever an app requests it.

For Windows

To pair the Bad Elf Flex with your Windows computer please follow the instructions below. This process will only have to be done once and does not need to be repeated in the future.

1. Select Bluetooth Devices from the icon list in the lower right hand portion of your desktop.
2. Note, the Bluetooth option may not be displayed. If not click the up arrow.
3. If your Bad Elf accessory is turned on, you should see something like BE5500-123456 (with your unit's serial number) in the list.
4. Select your Bad Elf receiver from the list, and tap the Pair button.
5. Within 5-10 seconds, you should see a prompt from windows showing pairing is complete. Once this action is completed, the message "Ready to pair" will change to "Paired".

At this point you have successfully paired your Bad Elf Flex receiver with your Windows computer. Next, you will need to determine the COM port assigned by the operating system. To accomplish this:

1. Click on the icon to the left of BE5500-XXXXXX
2. Click on "More Bluetooth Options"
3. A Bluetooth settings dialog will open
4. Click on the "COM Ports" tab
5. The COM port with your device serial number labeled as "Outgoing" is the COM port you should use for your application.

Installing the Bad Elf Flex app

From your phone or tablet, visit http://bad-elf.com/flex/app to download the correct Bad Elf Flex companion app for your operating system. This app is used to check the health of your hardware, perform firmware upgrades, change settings, and stream correction data to your Bad Elf Flex.

Using 3rd party apps

Any location-based app on iOS or Android can be used with the Bad Elf Flex. You can visit http://bad-elf.com/apps for a list of compatible apps that we've either tested or have been recommended by other customers.

Connecting an external GNSS antenna

Only use an external antenna that is designed to be used with the Bad Elf Flex. Ensure the antenna being connected does not exceed the voltage and current limits defined in the Bad Elf Flex product specifications.

Bad Elf Flex Tokens

Each Bad Elf Flex Token is good for 24-hours. With one Bad Elf Flex Token you can do any of the following:

- Unlock multi-constellation and multi-frequency for higher accuracy SBAS (30-60cm accuracy).*
- Use RTK with your local CORS or VRS network for survey-grade accuracy (1cm).*
- Use L-Band satellite corrections for places without SBAS or Internet connectivity (5-10cm worldwide).

If your Bad Elf Flex is permanently unlocked these features do not require Bad Elf Flex Tokens.

Use the Bad Elf Flex app to load tokens.

- Scan the QR code on the back of the Bad Elf Flex Token card.
- Or, type in the code on the back of the Bad Elf Flex Token card.
- Transfer some or all of your tokens to the Bluetooth connected Bad Elf Flex.
- When you require higher accuracy, activate Extreme mode using the app or the Bad Elf Flex user interface.

Using a Bad Elf Flex Token does not require wireless data connectivity. Bad Elf Flex Tokens don't expire, and you can load more tokens onto your Bad Elf Flex using the Bad Elf Flex app.

Loading tokens directly on the Bad Elf Flex

- Select the Tokens menu option from the Bad Elf Flex main Menu
- If there is 1 or more tokens available, press the enter key to enable Extreme Accuracy
- From the Tokens screen, press enter to enable Extreme Accuracy
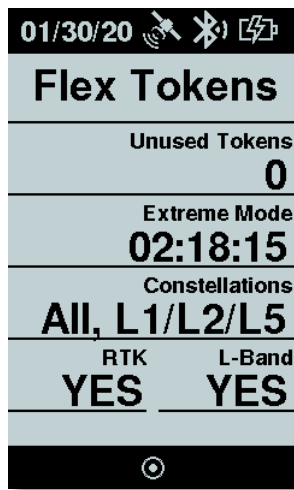
Press the enter key to enable use of a Bad Elf Flex Token
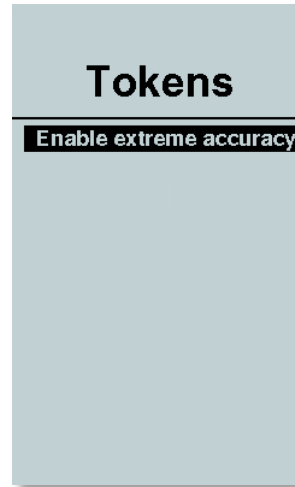
Token confirmation screen

Using an External Antenna

To connect an external antenna, remove the top cover by leaning it towards the back of the unit. With the top cap removed, unscrew the helical antenna by rotating it counterclockwise as seen from the top of the Bad Elf Flex.

The top connector utilizes a standard SMA connector. Attach your antenna using a 50 ohm cable.

- Remove top cap
- Remove antenna by rotating counter-clockwise.
- Attach external antenna to SMA connector

Height Reference

For measurements along the Z-axis, height reference, use the diagram below to assist in determining your height offset.

GNSS height offset is measured from the base of the Bad Elf Flex to 58mm above the top of the case.

Vertical reference offset is 230mm.
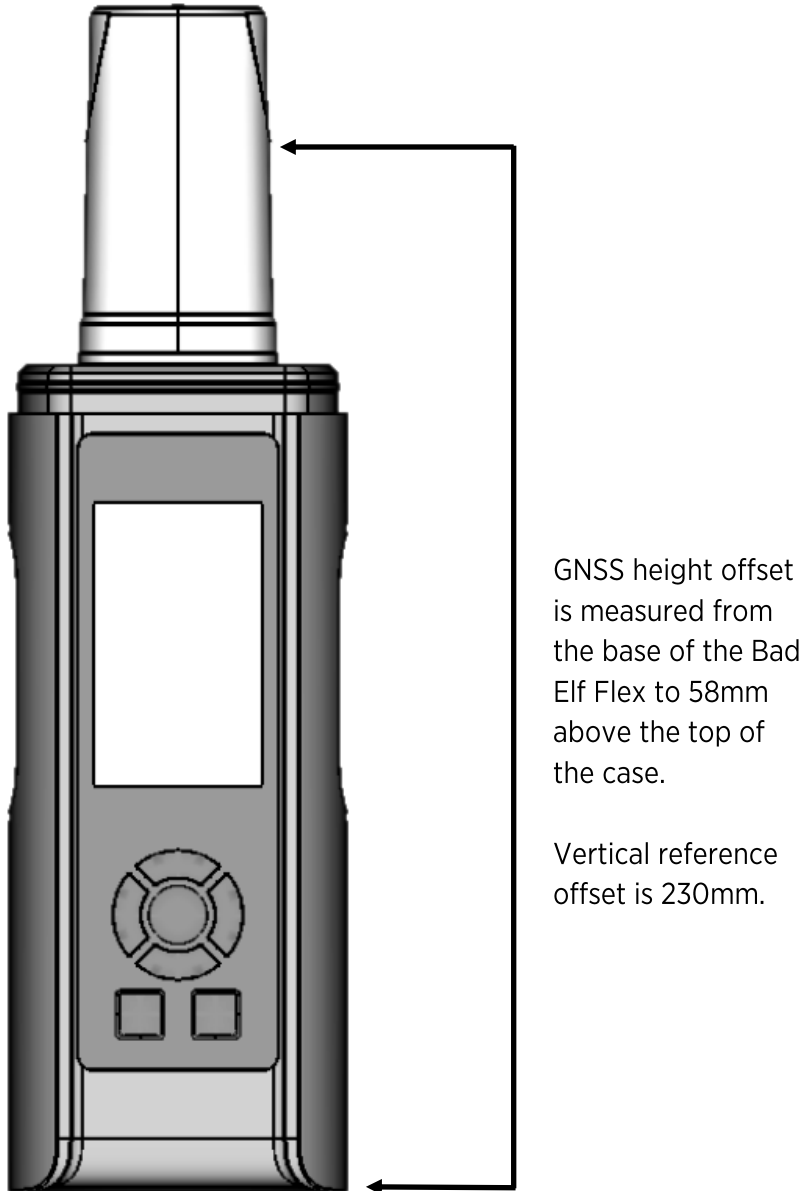
Specifications

COMMUNICATIONS

USB	USB 2.0 device via Mini-USB receptacle USB 2.0 host OTG via supplied adapter
Bluetooth	Bluetooth V4.0 (HS) with integrated Class 1.5 PA, Supports 3 simultaneous connections
Wi-Fi	Client and access point (AP) modes 802.11b/g/n

POSITIONING ENGINE

GPS	L1CA/L1P/L1C/L2P/L2C/L5
GLONASS	G1/G2/P code (P1/P2)
BeiDou	B1/B2/B3 (separate variant without L5)
Galileo	E1BC/E5a/E5b
QZSS	L1CA/L1C/L2C/L5

Note: constellations and frequencies are dependent on receiver configuration and subscriptions.

POSITIONING PERFORMANCE

Horizontal accuracy		RMS (67%)	2DMRS
	RTK	8 mm + 1	15 mm + 2
	SBAS	0.3 m	0.6 m
	Autonomous	1.2 m	2.4 m
	L-Band Atlas	4cm	8cm
Timing (1PPS)	20 ns		
Cold start time	< 60 s typical (no almanac or RTC)		
Warm start time	< 30 s typical (almanac and RTC)		
Hot start time	< 10 s (almanac, RTC, and position)		
Maximum speed	1,850 kph (999 kts)		
Maximum altitude	18,288 m (60,000 ft)		
Differential	SBAS, Autonomous, External RTCM v2.3,		
Correction I/O	Hemisphere GNSS' ROX, RTCM v2.3		
Antenna input	50Ω		
Antenna gain	10 to 40 dB		
Antenna Voltage	5VDC		
Antenna Current	Up to 500mA, with short circuit		

BATTERY AND POWER

Internal Battery	Non-replaceable 3.7VDC, 12000mAh, Lithium ion
Battery Life	11 hours in RTK, SBAS, or autonomous modes 7hrs with L-Band corrections enabled
External Power	Mini-USB power input from 10W or greater USB power source

MECHANICAL

User interface	Transflective LCD Membrane Keypad 3 multicolor LEDs Audible tones
Dimensions	10.0" x 2.75" / 254mm x 70mm
Weight	29oz / 854g
Helical Antenna Phase Center	177 mm above base of Flex unit without adapter installed

ENVIRONMENTAL

Temperature	Operating: –20°C to +55°C (–4°F to +131°F) Storage: –40°C to +75°C (–40°F to +167°F)
Humidity	100% condensing
Waterproof	IP65

BLUETOOTH RF CHARACTERISTICS

Frequency band	2402MHz ~ 2480MHz
Number of channels	79 channels
Modulation	FHSS, GFSK, DPSK, DQPSK
Output Power (Class 1.5)	9 dBm (typical)
Sensitivity @ BER=0.1% for GFSK (1Mbps)	-86 dBm (typical)
Sensitivity @ BER=0.01% for Ω/4-DQPSK (2Mbps)	-86 dBm (typical)
Sensitivity @ BER=0.01% for 8DPSK (3Mbps)	-80 dBm (typical)
Maximum Input Level	GFSK (1Mbps):-20dBm Ω/4-DQPSK (2Mbps) :-20dBm 8DPSK (3Mbps) :-20dBm
Antenna	Internal whip antenna (shared with Wi-Fi)

WI-FI RF CHARACTERISTICS

WLAN Standard	IEEE 802.11b/g/n, Wi-Fi compliant
Frequency range	2.400 GHz ~ 2.497 GHz (2.4 GHz ISM
Number of channels	2.4GHz:Ch1 ~ Ch14
Modulation	802.11b : DQPSK, DBPSK, CCK
Output power	802.11b /11Mbps : 16 dBm ± 1.5 dB @ EVM -9dB 802.11g /54Mbps : 15 dBm ± 1.5 dB @ EVM -25dB 802.11n /65Mbps : 14 dBm ± 1.5 dB @ EVM -28dB
Receive Sensitivity (11n) @10% PER	MCS=0 PER @ -85 dBm, typical MCS=1 PER @ -84 dBm, typical MCS=2 PER @ -82 dBm, typical MCS=3 PER @ -80 dBm, typical MCS=4 PER @ -77 dBm, typical MCS=5 PER @ -73 dBm, typical MCS=6 PER @ -71 dBm, typical
Receive Sensitivity (11g) @10% PER	6Mbps PER @ -86 dBm, typical 9Mbps PER @ -85 dBm, typical 12Mbps PER @ -85 dBm, typical 18Mbps PER @ -83 dBm, typical 24Mbps PER @ -81 dBm, typical 36Mbps PER @ -78 dBm, typical 48Mbps PER @ -73 dBm, typical
Receive Sensitivity (11b) @8% PER	1Mbps PER @ -90 dBm, typical 2Mbps PER @ -88 dBm, typical 5.5Mbps PER @ -87 dBm, typical 11Mbps PER @ -84 dBm, typical

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WI-FI RF CHARACTERISTICS (cont.)

Data rate	802.11b : 1, 2, 5.5, 11Mbps 802.11g : 6, 9, 12, 18, 24, 36, 48, 54Mbps 802.11n (20MHz, long GI, 800ns): 6.5, 13, 19.5, 26, 39, 52, 58.5, 65Mbps 802.11n (20MHz, short GI, 400ns) : 7.2, 14.4, 21.7, 28.9, 43.3, 57.8, 65,72.2Mbps
Maximum input	802.11b : -10 dBm
Antenna	Internal whip antenna (shared with Bluetooth)

Limited Warranty Terms and Conditions

Warranty

Bad Elf products are warranted to be free from defects in materials or workmanship for one year from the date of purchase. Within this period, Bad Elf will, at its sole option, repair or replace any components that fail in normal use. Such repairs or replacement will be made at no charge to the customer for parts or labor.

This warranty does not apply to: (i) cosmetic damage, such as scratches, nicks and dents; (ii) consumable parts, such as batteries, unless product damage has occurred due to a defect in materials or workmanship; (iii) damage caused by accident, abuse, misuse, water, flood, fire, or other acts of nature or external causes; (iv) damage caused by service performed by anyone who is not an authorized service provider of Bad Elf; or (v) damage to a product that has been modified or altered without the written permission of Bad Elf. In addition, Bad Elf reserves the right to refuse warranty claims against products or services that are obtained and/or used in contravention of the laws of any country.

Bad Elf's products are intended to be used only as a travel aid and must not be used for any purpose requiring precise measurement of direction, distance, location or topography. Bad Elf makes no warranty as to the accuracy or completeness of applications that use Bad Elf position data.

Repairs have a 90 day warranty. If the unit sent in is still under its original warranty, then the new warranty is 90 days or to the end of the original one year warranty, depending upon which is longer.

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How to Obtain Warranty Service

To obtain warranty service, contact Bad Elf Product Support for shipping instructions and an RMA tracking number. Securely pack the device and a copy of the original sales receipt, which is required as the proof of purchase for warranty repairs. Write the tracking number clearly on the outside of the package. Send the device to the Bad Elf warranty service station.

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Document Version

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