NorthStar User Manual

RTK RADIO REPEATER, DATA COLLECTION HUB

A division of Xeos Technologies Inc.

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Shipped From

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Version History

Version No.	Firmware Version	Date	Description
1.0	1.1.4146	November 2017	Initial document
1.1	1.1.4780	February 2019	Reformatting, command and link corrections, PVT message format update

Regular checks for the latest manual are suggested. Be sure to check Alert Geomatics' manuals page to compare versions and download the latest version.

Table of Contents

Overview

General Description

The NorthStar is a GNSS RTK correction repeater and communications unit, and has two primary functionalities relating to RTK receivers. Firstly, it can be a **correction relay** unit to overcome geographical issues such as distance and topography between the RTK Base and RTK Rover. Additionally, it can be utilized as a **collection point** for RTK Rover data. In this second functionality the NorthStar can be attached to a server or doghouse computer and collate 30 second averaged positions from any RTK Rovers in its downstream radio network.

Device Preparation

Before heading into the field with the NorthStar it is advisable to ensure that you can connect and communicate with the unit. Pre-configuring the unit in the office will result in a smoother and well-planned installation.

Making the Connection
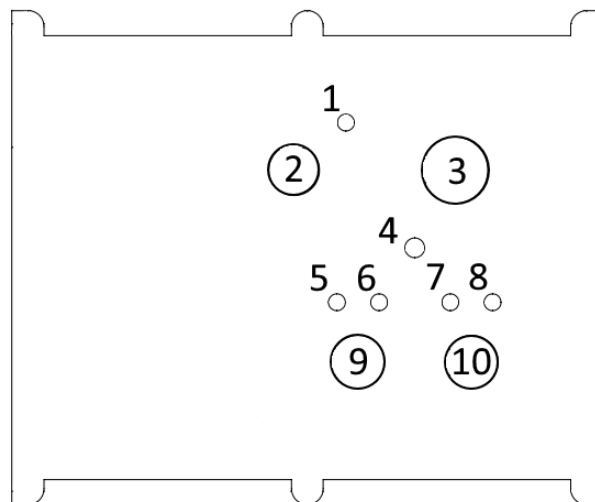
NorthStar Front Panel Diagram

No.	Name	Function
1	Power LED	Indicates presence of power (On indicator)
2	USB-Mini	Access for configuration of device for deployment via PC
3	Power/Serial	Connection to power supply, serial PVT
4	2 BA Ground Stud	Grounding connection for lightning and surge protection
5	Radio A LED	Indicates Operation Mode of Radio A
6	Radio A LED	Indicates Radio A is currently powered
7	Radio B LED	Indicates Operation Mode of Radio B
8	Radio B LED	Indicates Radio B is currently powered
9	Radio A connector	Used to affix a 900MHz radio antenna
10	Radio B connector	Used to affix a 900MHz radio antenna

The USB port (USB Mini) is used as a diagnostic I/O port for the device. The user can set various settings on the device through this port, as well as receive diagnostic output. It is also where the device will accept firmware upgrades. Conventional USB Mini's will not mechanically fit in the connector without trimming back the housing of the cable. A USB Mini specifically for the connector is supplied with the NorthStar.

The serial port is on the 8-pin yellow circular connector and can be used to receive PVT averaged data. Power is also supplied over this connector.

The two TNC connectors are intended to attach to 900 MHz radio antennas. Below are the pinouts for the yellow 8 pin connector:

| Pin	Function
1	V+
2	TXD1_RS-232
3	RXD1_RS-232
4	RTS1_RS-232
5	CTS1_RS-232
6	NC
7	GND
8	CHASSIS GND
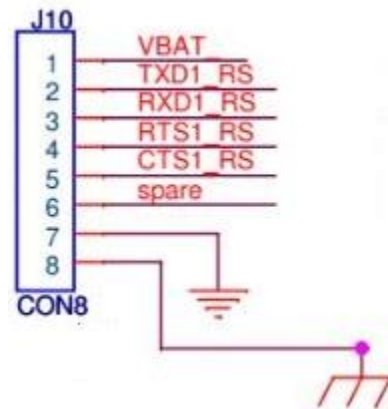
The power leads () are connected to an AC power adapter on the supplied cable. The unit requires a DC power supply of **11 V to 28V** capable of supplying **1 A** if powering independently.

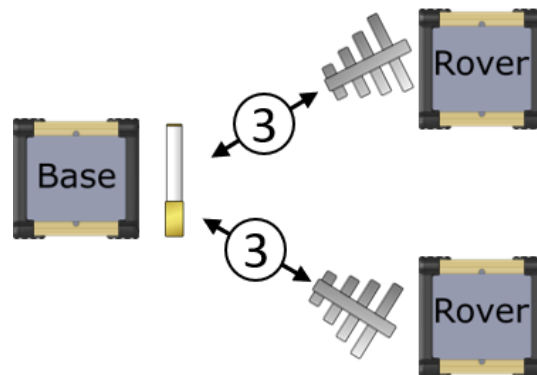# Device Configuration

RTK Radio Network Design

The Resolute RTK units contain an embedded radio peripheral for sending and receiving RTK corrections. The radio peripherals included with RTK and NorthStar units operate on a channel basis, with 8 possible channels (0-7).

For a simple single Base-single Rover network all the radios should operate on the same channel to receive the corrections. The default channel from the factory for this is channel 3. The Base broadcasts corrections to the Rover, and the Rover receives the corrections. For this configuration the use of Yagi antennas is recommended.
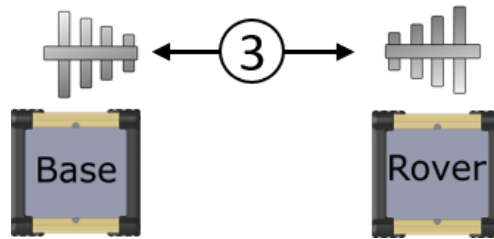
An example of a single Base-single Rover network.

A step up from this network is the single Base-multiple Rover network. For this to work the Base needs to be equipped with an Omni antenna to allow strong radio signal in all directions. Because the base broadcasts, this is the only change required. All Rovers should be configured on the same channel as the Base.
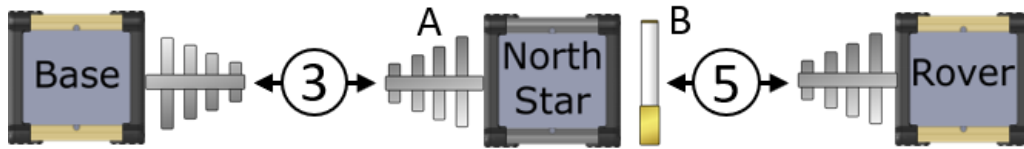

An example of a single Base-multiple Rover configuration.

If the Base radio does not have line of sight to all the Rovers required for your application you may add NorthStar Repeater(s) into the Network. The NorthStar Repeater is equipped with two radios which are identified as Radio A and Radio B. Radio A receives corrections broadcast from the Base, in this way it operates as a Rover and should be configured to the same channel as the Base, in this case the default (3).

Radio B rebroadcasts the corrections like a Base. Because this radio is a second broadcasting radio on the same network it must be on a different channel to the Base it is receiving corrections from. The factory default for Radio B is channel 5. Any Rovers that require the NorthStar for line of sight to receive corrections should be on the same channel as the NorthStar Radio B.

In the configuration where a base is only broadcasting to a single Northstar, the Base would need to be equipped with a Yagi antenna pointed at the NorthStar. NorthStar Radio A would be equipped with a Yagi Antenna pointed at the Base, while, NorthStar Radio B would be equipped with an Omni Antenna to broadcast to multiple Rovers.
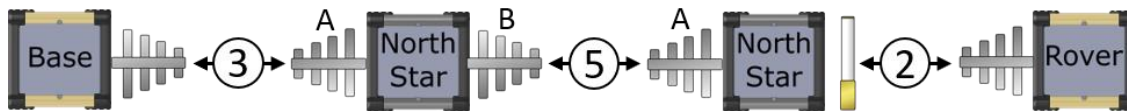
An example of a single NorthStar network (only one Rover shown).

It is possible to add multiple NorthStars in sequence for a long baseline connection to an RTK Rover.

To add an additional NorthStar to the network mentioned above. Radio A would be configured to channel 5. Radio B could be configured to channel 2 (There are many options here if the channel is free). Rovers attached to this NorthStar would be configured to channel 2. For the best performance from the system, it is ideal to have Rovers connected to the Base as directly as possible.

Each NorthStar added in series adds roughly ½ second of delay in the corrections. In addition, baseline length can also degrade the RTK results, resulting in an additional +/- 1mm error per kilometer of baseline. To reach multiple NorthStars, the Base would need to be equipped with an Omni Antenna.

An example of a chained NorthStar network.

Multiple Base-Multiple Rover setups are the best way to collect the most accurate results possible.

Note: Bases cannot be configured on the same network; separate channels are required.

Multiple Bases reduce baselines and transmission delays. Bases or NorthStar Radio Bs cannot transmit on the same channel, when they are within communication distance of one another. **This means up to seven kilometers (4.3 miles) line of sight.**

Rovers should be configured to receive from the Base closest to them, within line of sight. The maximum number of units linked to one Base or NorthStar is 28.
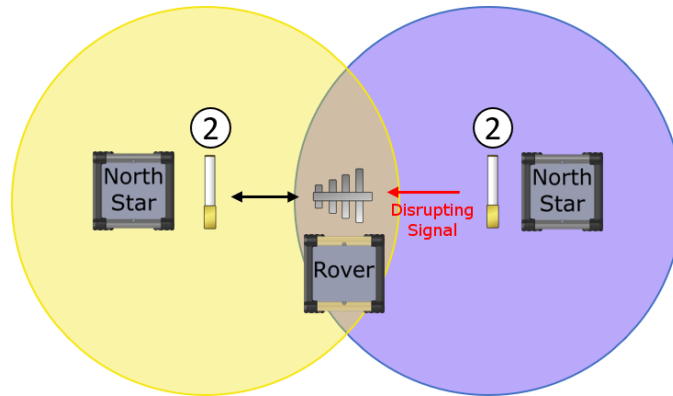
Avoid overlapping base coverage boundaries.

Best practice when setting up a large RTK network is to draw a radio network map. Examples of such a map can be found in the Appendix D. The map in Appendix E is also a good example of possible configurations.

Results Configuration

The NorthStar also needs to be configured to either pass on the position results it receives from Rovers, or pass them out the serial port. This can be configured through the following command:

$PvtSetResultInterface [interface]

Where interface is a number corresponding to an index.

A value of 0 corresponds to sending the results over radio, while 1 outputs the results over the serial port.

The message format can be found in Appendix B.

To configure the NorthStar to output results over the serial port the following command would be sent:

$PVTSetResultInterface 1

Radio Configuration

The NorthStar radios as configured from the factory are will receive on the factory default base channel 3, while repeating on Channel 5. Multiple NorthStar Repeaters in series will require reconfiguration of the Rovers and NorthStars in the RTK Network.

To configure the radio channel on a NorthStar use the **$RadioSetChannelid [identifier] [channel]** command. Where the identifier for a NorthStar is an "**A**" or "**B**". Channel is a value between and inclusive of **0** and **7**.

$RadioSetChannelid [identifier] [channel]

To configure the radio to broadcast on channel 0 the following command would be sent.

$RadioSetChannelid B 0

The radios can be configured to be diable or enabled through the **$RadioSetEnabled [option]** command. Where option is either T for true or F for false. To enable the radio the following command would be sent:

$RadioSetEnabled t

USB Diagnostic Port

All the settings on the NorthStar can be configured by connecting the USB diagnostic port to a USB port on your computer.

To connect to the USB diagnostic port, if on windows you may need to download a driver for the STM32 USB chip contained in the unit. The driver can be found here:

http://www.st.com/en/development-tools/stsw-stm32102.html

Modern Linux and Mac operating systems already support the driver.

NOTE: For PCs running Windows 10, you will need to go to the installation folder of the drivers and manually install the Windows 7 driver. The installation folder is typically found under *C:\Program Files (x86)\STMicroelectronics\Software\Virtual comport driver\Win7* . Run the following program: *dpinst_amd64.exe* and attempt connecting to the NorthStar with the driver properly installed.

After downloading and installing the driver, connect the supplied USB mini cable between the NorthStar and your computer. Your computer should assign the NorthStar a COM port number (Windows only), that will show up under ports in the Windows Device Manager.

To communicate with the NorthStar, you will need a serial port terminal program. **Alert Geomatics recommends STerm a Windows only product**. A free alternative for Linux and Mac is CoolTerm. STerm and related configuration files can be downloaded here:

https://manuals.alertgeo.com/STerm

The port settings for the NorthStar USB are:

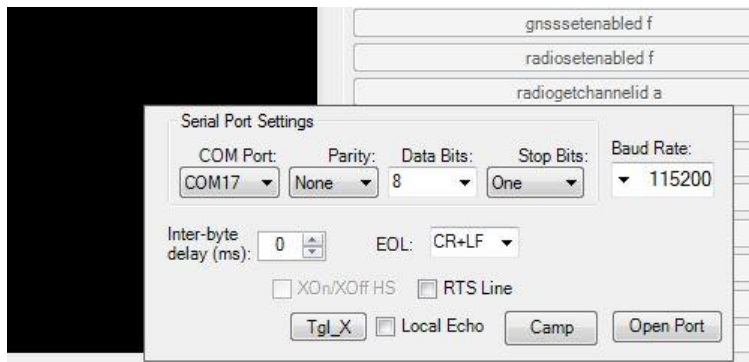| Port Settings - USB	
Baud Rate	Any
Data Bits	8
Parity	None
Stop Bits	1
Flow Control	Disabled

Using STerm and Sending Commands

An STerm Window

STerm is the officially supported serial port terminal program of Alert Geomatics. STerm can load configuration files to allow the commands for Alert Geomatics products to appear as buttons on the right side of the window. This can be done through the FILE>OPEN menu and opening the NorthStar Config File.stm file. This is available to download here:

https://manuals.alertgeo.com/STerm

To open up a connection power on your unit and wait for the computer to recognize your device. Select the COM port of your device on the Serial Port Settings menu in the bottom right of the screen. Click the open port button. You should now be connected to the unit. The buttons that appear on the right side of the window can be clicked and will send commands to your unit.

STerm Serial Port Settings Menu

The buttons on the right side of the window can be edited to change the input variable you are sending to the device. This is done by hovering over the right side of the button then clicking the green edit button. Type your changes into the button then move your mouse away to end the edit.
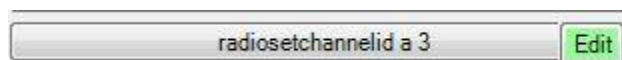
The Edit icon of the command buttons

When connecting to a device, the diagnostics can flow too quickly to read, especially when not familiar with the output. To confirm commands are correctly received by the unit it is

recommended to disable the Radios, which are the primary diagnostic generating peripherals in the unit. This can be done through the top button on the right of the NorthStar Sterm config file **$RadioSetEnabled f.**

If the radios do not disable within 30 seconds (the diagnostics should almost completely stop), reset the unit. Resetting the unit may cause you to have to reconnect in the USB connector, depending on your version of Windows. You will also have to reopen the COM port.

After disabling the peripherals send the commands desired and be aware of the units' reply. Re-enable the radios with **$RadioSetEnabled t** and reset the unit with the **$resetnow** command. Your unit is ready for operation.

LED Behavior

The NorthStar LED behavior is very simple. The LEDs are always on and tell you the power state of the Radio modems and overall unit.

Power LED	
Behaviour	Meaning
Green	Unit is Powered
No LED	Unit is not Powered
Radio LEDs	
Behaviour	Meaning
Green & Flashing Yellow	Radio is powered
No LEDS	Radio is not Powered

The radios only have the one powered state, so the opposite state is indicated by the absence of LEDs.

Installing a NorthStar

When installing a NorthStar, radio line of sight to a source of corrections and an end for corrections is the most important consideration.

Radio Network Design

Before leaving the office, if your unit includes a radio for broadcasting or receiving corrections best practice is to determine the radio network for your device. Consider any already installed units that you want to avoid disturbing or include in your network. See the example radio network drawings in the Appendix D in addition to the RTK Radio Network Design section for more information. It is easiest to configure the radios in the office before leaving, but is possible to do in the field.

Record the channel numbers of various units for future reference. The easiest installation order is generally from Base to NorthStars (if utilized) to Rovers as this allows the installer to confirm corrections are being received at the Rovers before concluding install.

Installing the Radio Antennas

Radio antennas come in two flavors, Yagi and Omni antennas. Yagi antennas are directional antennas and are best used when communicating with only one other radio. Omni antennas are omni(all)-directional antennas and are best used when a radio must communicate with multiple devices.

Both Yagi and Omni radio antennas work on a line of sight basis, with a range up to seven kilometers (4.3 miles) in ideal conditions. Mounting a radio antenna higher in general will allow the radio antenna to transmit over more obstacles in the path between radios. If line of sight is not possible between radios. Additional NorthStars are perfect for relaying corrections over or around obstacles, and are not inhibited by the GNSS antenna mounting requirements.

Radio A needs to be equipped with a Yagi antenna. Install the Yagi on a pole, or other high point in a horizontal orientation, and point the Yagi to the nearest source of corrections. Poles are advantageous for mounting as they allow 360 degrees of orientation options. The smallest element of the antenna is the "front" of the antenna when orientating. The antenna comes equipped with mounting hardware.

Radio B can be equipped with a Yagi or an Omni antenna depending if the intent is to broadcast to a single end, or multiple end points. If multiple end points for the corrections are needed, an Omni antenna must be used. If installing a Yagi, point the Yagi to the desired end of the corrections. If installing an Omni, mount in a vertical orientation, on a mast or other high point. The antenna comes equipped with mounting hardware.

Installing RF Cables

Connecting the RF cables to the antennas involves transitioning the cables through a weather protective enclosure or building for the NorthStar. This can be done, depending on the environment, through a downspout on the enclosure, or through polyphasers in the wall of the enclosure (not supplied).

RF cables supplied by Alert Geomatics are marked with a part number and color code. The color code matches the ring around the connector on the panel. This allows for easy tracing of cables. For an assembly diagram of the various RF cable configurations see Appendix C.

Installing Power to the Unit

The NorthStar requires an **11-28 V** power supply capable of sourcing **1 A** surge currents. The power cable supplied has a yellow ring that matches the yellow ring of the power connector on the box along with a wall wart capable of powering the unit.

It is also important to ground the NorthStar for lightning and surge protection. The nickel-plated ground stud is located in the center of the four circular connectors. The thread of the grounding stud is 2 BA.

Confirming NorthStar Operation

Plugging in the power connector to the unit, the power LED will come on. Within one minute the Radio LEDs will illuminate.

Confirm the radio LEDs are green and flashing yellow. If the radio A is pointing at a functional correction source, the diagnostics should exhibit the corrections coming multiple times every second. This message would appear as **XBeeRXRTCM ….** on the diagnostics. This indicates the radio is receiving corrections.

Confirm the Rovers that are attached to the NorthStar network are receiving corrections at the Rovers. After the Rovers are connected to the system, results will begin to be distributed out the serial port (default configuration), or passed on over radio.
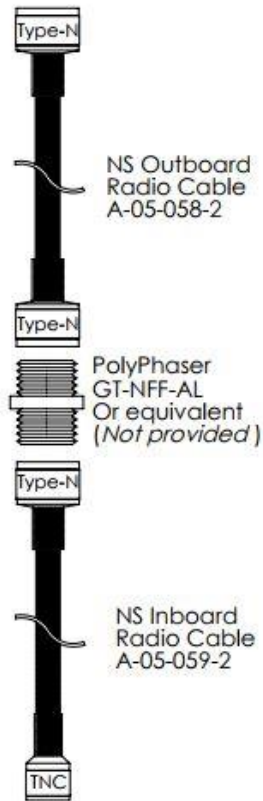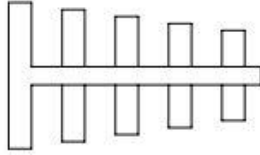
Appendix A: Command Index

Command	Variables	Description	Sample
$radiosetenabled	t,f	t (true) enables the radio, f (false) disables the radio	$radiosetenabled t
$radiogetenabled	N/A	Returns the enabled state of the radio	$radiogetenabled
$radiosetchannelid a	0,1,2,3,4,5,6,7	Sets the A radio channel	$radiosetchannelid a 1
$radiogetchannelid a	N/A	Returns the A radio channel	$radiogetchannelid a
$radiosetchannelid b	0,1,2,3,4,5,6,7	Sets the B radio channel	$radiosetchannelid b 1
$radiogetchannelid b	N/A	Returns the B radio channel	$radiogetchannelid b
$pvtsetresultinterface	0,1	Set the results to transmit over radio or serial	$pvtsetresultinterface 0
$pvtgetresultinterface	N/A	Return the result interface	$pvtgetresultinterface

Appendix B: Result Message Format

Parameter	Bytes	Data Format
Start Byte	1	0xEF
Message Version	1	0x03
Message Length	2	Length of full message (DEC 92)
Station ID	2	unsigned short integer
GPS time of week	4	unsigned integer
GPS week number (continuous)	2	unsigned short integer
Sample period (seconds)	4	unsigned integer
Sample count	4	unsigned integer
Reference Latitude	8	IEEE 754 double
Reference Long	8	IEEE 754 double
Reference Height	8	IEEE 754 double
Rover Latitude	8	IEEE 754 double
Rover Longitude	8	IEEE 754 double
Rover Height	8	IEEE 754 double
Quality	4	unsigned integer
Latitude Variance Average	4	IEE 754 single
Longitude Variance Average	4	IEE 754 single
Height Variance Average	4	IEE 754 single
Latitude Variance Cutoff	4	IEE 754 single
Longitude Variance Cutoff	4	IEE 754 single
Height Variance Cutoff	4	IEE 754 single
Battery Voltage	4	IEE 754 single
Checksum	2	unsigned short integer
Total:	**102**	

Appendix C: RF Cable Installation Diagrams

Directional Radio Antenna
E-09-024

Omni Radio Antenna
E-09-025

Directional Radio Antenna
E-09-024

OR

Type-N

NS Outboard
Radio Cable
A-05-058-2

Type-N

PolyPhaser
GT-NFF-AL
Or equivalent
(*Not provided*)

Type-N

NS Inboard
Radio Cable
A-05-059-2

TNC

To NorthStar
Radio A Connector

Type-N

NS Outboard
Radio Cable
A-05-058-1

Type-N

PolyPhaser
GT-NFF-AL
Or equivalent
(*Not provided*)
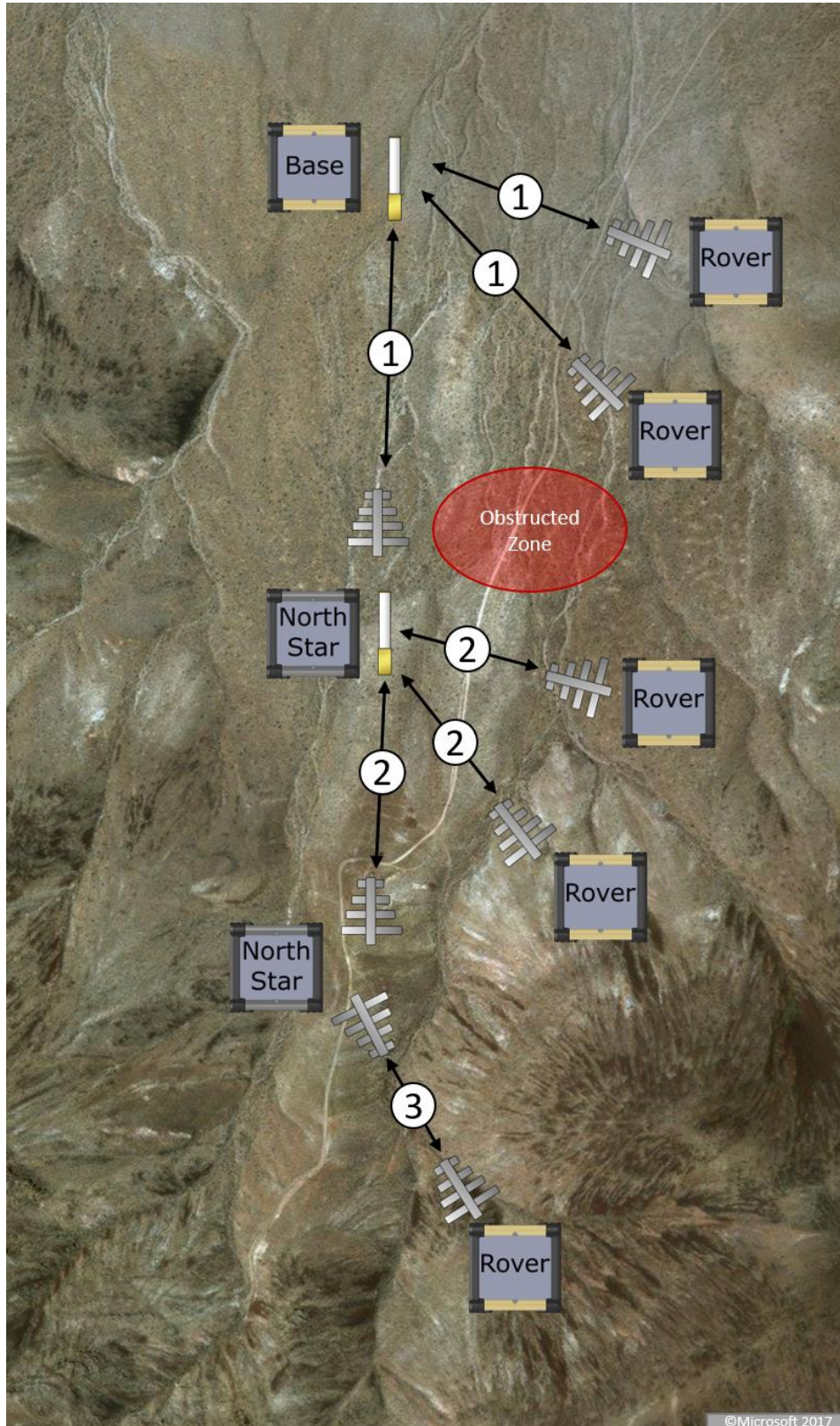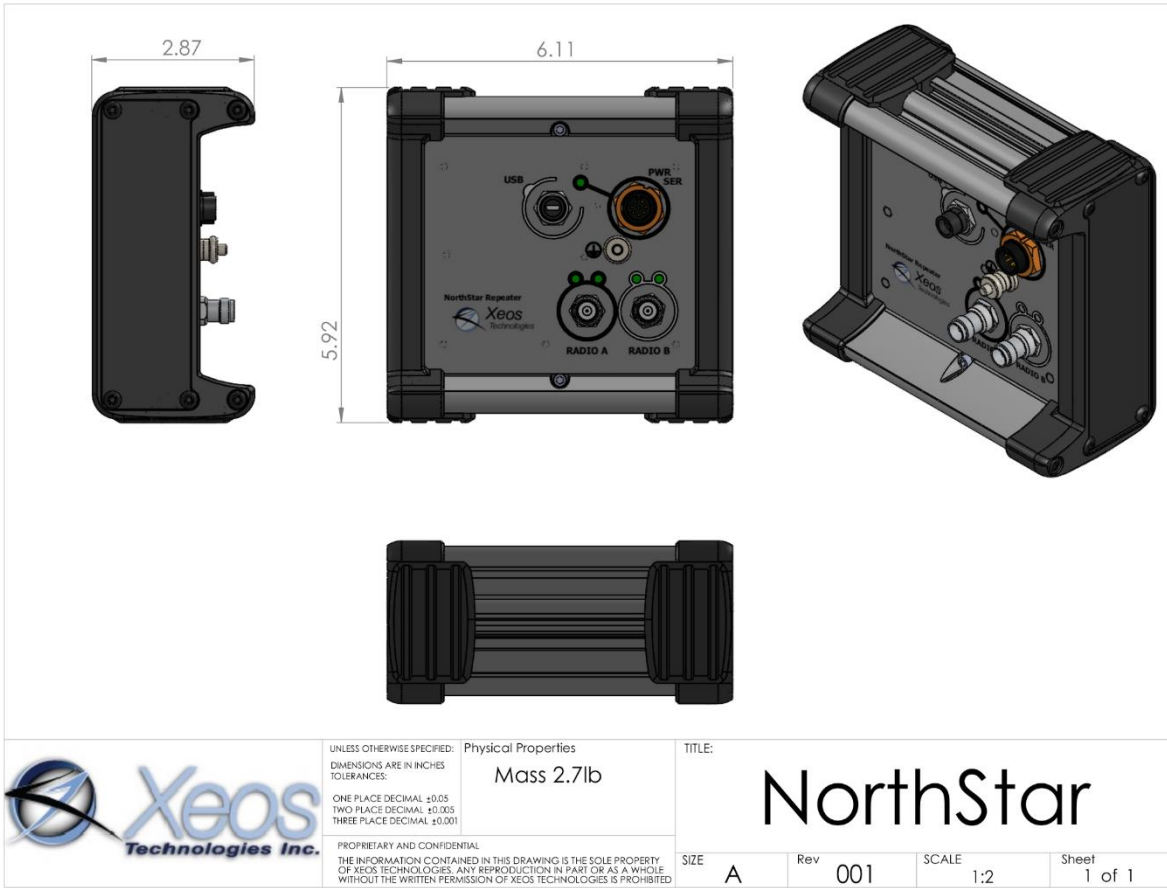
Type-N

NS Inboard
Radio Cable
A-05-059-1

TNC
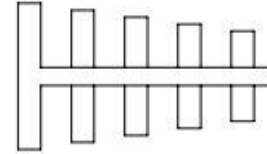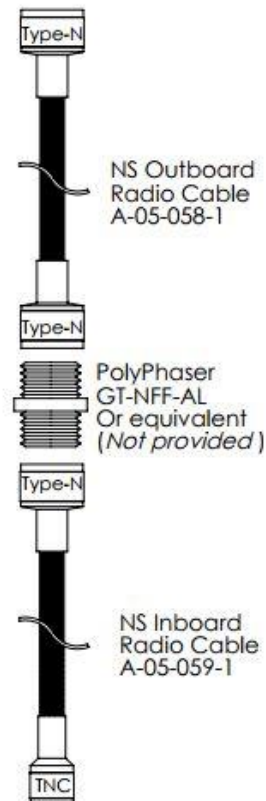
To NorthStar
Radio B Connector

Appendix D: Radio RTK Network Examples

Appendix E: Mechanical Drawing

Warranty, Support and Limited Liability

Alert Geomatics warranties the NorthStar to be free of defects in material or manufacturing for a period of one year following delivery. Liability is limited to repair or replacement of the defective part and will be done free of charge.

LIMITED WARRANTY: Alert Geomatics warrants that the product will perform substantially in accordance with the accompanying written materials for a period of one year from the date of receipt.

CUSTOMER REMEDIES: Alert Geomatics entire liability and your exclusive remedy shall be at Alert Geomatics option, either (a) return of the price paid or (b) repair or replacement of the product that does not meet Alert Geomatics Limited Warranty and that is returned to Alert Geomatics with a copy of your receipt. This Limited Warranty is void if failure of the product has resulted from accident, abuse, or misapplication. Any replacement product will be warranted for the remainder of the original warranty period or ninety (90) days, whichever is longer.

NO OTHER WARRANTIES: Alert Geomatics disclaims all other warranties, either express or implied, including but not limited to implied warranties of merchantability and fitness for a purpose, with respect to the product or the accompanying written materials. This limited warranty gives you specific legal rights. You may have others, which vary from state to state.

NO LIABILITY FOR CONSEQUENTIAL DAMAGES: In no event shall Alert Geomatics or its suppliers be liable for any damages whatsoever (including, without limitation, damages for loss of equipment, for loss of business profits, business interruption, loss of business information, or other pecuniary loss) arising out of the use of or inability to use this Alert Geomatics product, even if Alert Geomatics has been advised of the possibility of such damages.