Nordian

Spectrum Rugged Receiver

Hardware Version 5.0.0

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NOTICE

This document contains the technical specifications and operating instructions for the Spectrum Rugged Receiver. Please review it carefully before using the device.

Nordian is committed to providing state-of-the-art products to our customers.

DISCLAIMER

As this document is continuously updated, its contents may change without prior notice. Please ensure that you are always referring to the latest version.

This manual is intended to present the general installation and application guide for Spectrum usage. For detailed information on the device configuration, please refer to the Interface Manual.

Visit www.nordian.com for more information.

CONTACT INFORMATION

Website: www.nordian.com
Customer Support: support@nordian.com

Version Log

Date	Version	Changes
06/2024	HW 4.0.0	Version 4.0 First Release
01/2025	HW 4.0.1	Additional electrical specifications
04/2025	HW 4.0.2	OEM New Auxiliary Dimensions
06/2025	HW 5.0.0	New Hardware Core Version

Contents

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1. Introduction

1.1. Spectrum

Spectrum is a high-precision rugged receiver. Designed for reliable geopositioning in daily applications, it offers fast setup, user-friendly configuration and compatibility across platforms. Spectrum combines broad satellite signal support with an integrated IMU-based correction system to deliver accurate position, speed, altitude and timing for industrial applications.

1.2. Features Overview

- Full GNSS compatibility: GPS, GLONASS, BeiDou, Galileo, NavIC, QZSS, SBAS (including WAAS, EGNOS, GAGAN, MSAS, BDSBAS) and all-band L1, L2, L5 and L6.

- GNSS Signal Compatibility:
  - GPS: L1C/A, L2C, L5
  - GLONASS: L1OF, L2OF
  - Galileo: E1B/C, E5b, E6
  - BeiDou: B1I, B1C, B2a, B3I
  - QZSS: L1C/A, L1C/B, L2C, L5, L6
  - SBAS: WAAS, EGNOS, GAGAN, MSAS, BDSBAS

- Maximum Update Rate:
  - GNSS: 25 Hz
  - GNSS + IMU Sensor Fusion: 50 Hz

- Fast convergence time:
  - Cold start: 24s; Aided start: 2s; Reacquisition: 2s;

- Embedded high-grade IMU:
  - 6-axis;
  - Accelerometer range: 16 g;
  - Gyroscope full-range 2kdps;

- GNSS+IMU sensor fusion;
- Reduced start-stop delays;

- Anti-interference and scintillation algorithms;
- Terrain compensation;
- User Interfaces
    - Three (3) Serial UART COM ports;
    - One (1) CAN port;
    - Pulse Per Second (PPS) output;
    - Ground Speed Output (GSO/Radar) output;
    - Two (2) status LED indicators;

- Base and Rover features with RTK corrections generation
- Connectivity:
    - Cellular 5G/4G fallback;
    - Ethernet

2. Technical Specifications

2.1. Electrical

Please see below the specified working voltage range. Applying voltage outside the specified range may result in permanent device damage.

Table 1: Electrical Requirements

Specification	Value
Voltage	+7 to +32 VDC
Average Current	425 mA
Average Power	1.5 W

2.2. Accuracy

Accuracy	Standalone	P1 Soft-Intelligence	P2 Soft-Intelligence
Horizontal Accuracy (RMS)*	1.2 m	0.40 m	0.03 m

Pass-to-Pass Accuracy	0.20 m	0.10 m	0.02 m

**Horizontal accuracy may vary based on satellites in view, clear sky and multipath.*

2.3. GNSS Specifications

Table 3: Spectrum Supported GNSS signals

Supported GNSS signals	
GPS	L1C/A, L2C, L5
GLO	L1OF, L2OF
GAL	E1B/C,E5a, E5b, E6
BDS	B1I, B1C, B2, B2a, B3I
QZSS	L1C/A, L1C/B, L2C, L5
SBAS	WAAS, EGNOS, GAGAN, MSAS, BDSBAS

Table 4: Time and Acquisition

Time and Acquisition	
Convergence Time	< 30 s
Acquisition: Cold start	24 s
Acquisition: Aided start	2 s

2.4. IMU Sensors

A high-end embedded Inertial Measurement Unit (IMU) is an integral part of the product's positioning calibration. The IMU operates continuously alongside the GNSS system.

The IMU has the following features:

- 6-axes
- Accelerometer full range: ±16g
- Gyroscope full range: ±2000 degrees per second

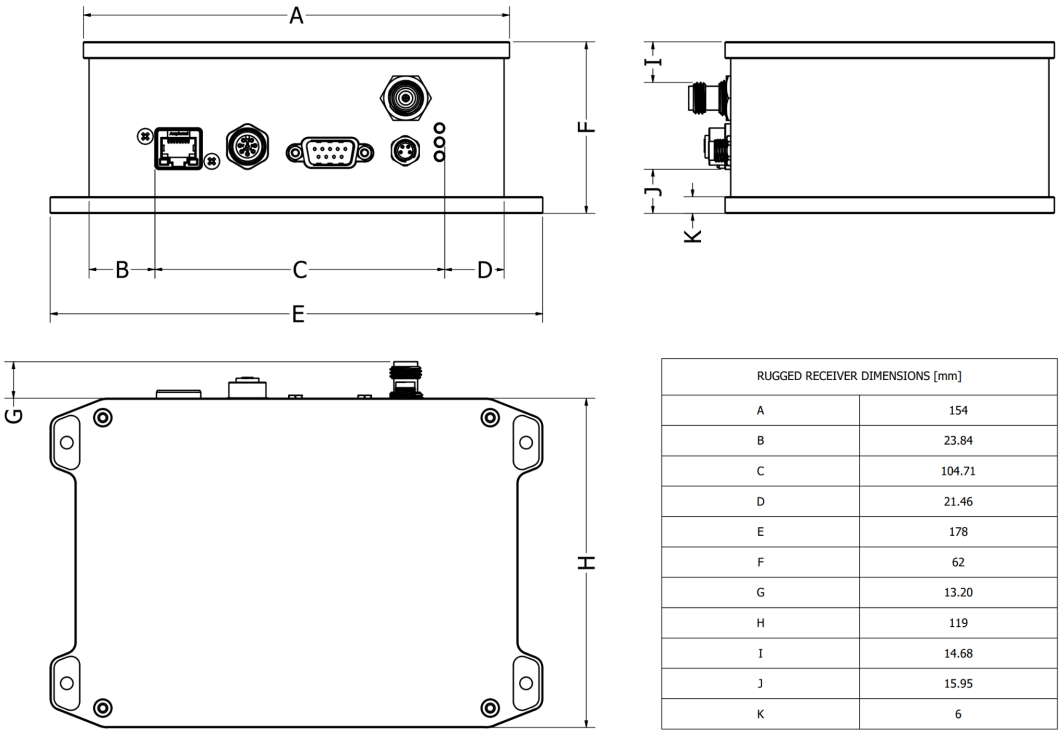
2.5. Mechanical

This section presents the general mechanical characteristics and specifications.

Table 1: Spectrum Mechanical Specs

Mechanical Specifications	
Size	178 x 119 x 59 mm (7.01 x 4.69 x 2.32 in)
Weight	1,300 g (2.87 lb)
Operating Temperature	-40°C to 85°C (-40°F to 185°F)
IP Rating	IP67

Figure 1: Spectrum Dimensions (mm)



RUGGED RECEIVER DIMENSIONS [mm]	
A	154
B	23.84
C	104.71
D	21.46
E	178
F	62
G	13.20
H	119
I	14.68
J	15.95
K	6

The Rugged Receiver features five (5) connectors, detailed in the tables below.

Table 2: Spectrum Connectors Description

Connectors	
Connector 1	GNSS Antenna TNC Part Number: **CBA-TNCF-MCXM**
Connector 2	Serial DB9 9 Position D-Sub, Male Pins Part Number: **629-W09-240-015**
Connector 3	Power Connector 4 Position Circular Connector, Male Pins Part Number: **839-54-00272-ND**
Connector 4	I/Os M12 Female-8 Pins Part Number: **MSAS-08PFFR-SF7003**
Connector 5	RJ45 Ethernet

Table 3: Spectrum Pinout*

Pin Number	Connector 1 (GNSS Antenna)	Connector 2 (Serial)	Connector 3 (Power)	Connector 4 (Communication)	Connector 5 (Ethernet)
1	-	-	+VCC	CAN High	-
2	-	Serial 1 RX	GND	CAN Low	-
3	-	Serial 1 TX	Serial 2 TX	GSO	-
4	-	-	Serial 2 RX	PPS	-
5	-	GND	-	Serial 3 TX	-
6	-	-	-	Serial 3 RX	-
7	-	-	-	-	-
8	-	-	-	GND	-
9	-	-	-	-	-

2.6 Communication

Spectrum Rugged Receiver has three (3) serial communication ports, as well as one CAN FD port.

RS-232 Serial Port

1. Spectrum configuration is possible through serial communication on COM1, COM2, or COM3, with each port configurable independently.

2. Available baud rates (kbps) are: 9600, 19200, 38400, 57600, 115200, 230400, and 460800. The default settings are: no parity bit, 1 stop bit, 8 data bits, no handshaking, and 115200 kbps.

3. For message configuration details, please refer to the Nordian Interface Manual: https://www.nordian.com/docs/rugged-receiver

CAN FD Port

1. The device provides one (1) Controller Area Network (CAN FD) bus

2. Available bitrates (kbps) are: 125, 250, 500, 1000, and 2000.
   2.1. CAN bus version: CAN 2.0B (extended).
   2.2. Maximum CAN FD port speed: 8 Mbps.
   2.3. J1939 protocol messages are transmitted exclusively over the CAN bus.

3. For message configuration details, please refer to the Nordian Interface Manual: https://www.nordian.com/docs/rugged-receiver

PPS (Pulse per Second)

Pulse Per Second (PPS), is an output signal that generates pulses synchronized with the satellites internal precision clock. It's a useful tool for precision timing.

PPS varies digitally from GND to 3V3. The pulse edge is synchronized with the satellites clock, it can be configured for rising or falling edge synchronization. Other than that, the pulse duty cycle and period can be configured.

- NOTE: All configurations regarding PPS must be done through serial communication.

GSO (Ground Speed Output)

Ground Speed Output (GSO), also known as Radar, is an output signal whose frequency varies according to product speed with respect to the ground.

When idle the GSO output is stable at GND level. Once the speed has passed the configurable speed threshold GSO output will vary digitally from GND to +VBAT level with frequency proportional to PRECISIO's speed. The number of transitions per meter (from the GND to the +VBAT values) can be configured.

- NOTE: Configurations regarding Ground Speed Output (GSO) must be done through serial communication;

Ethernet

Ethernet Port with NTRIP Capability provides a high-speed network interface for real-time correction data streaming.

When connected, the Ethernet port enables seamless communication with NTRIP casters to receive RTCM correction messages, improving positioning accuracy.

The Ethernet interface supports standard network configurations and protocols to ensure reliable data transmission.

NOTE: Configuration of the Ethernet port and NTRIP settings must be performed via the serial communication interface.

2.7 Communication Protocols

NMEA 0183 (Serial Port)

Protocol compatible with serial communication. NMEA0183 available output messages are shown in the table below:

Table 8: NMEA 0183 Available Messages

Message	Description

DTM	Datum reference information
GGA	Time, position and fix related data
GLL	Latitude, longitude, time of position fix and status
GRS	Manages GNSS signal data, transmission timing, and system/signal IDs.
GSA	GPS DOP and active satellites
GST	UTC time, RMS value of pseudorange residuals and error ellipse
GSV	Satellites in view related data
HDT	Vessel Heading
RMC	Position, velocity and time
VTG	Course over ground and speed over ground related data
ZDA	UTC time related data

NMEA 2000 (CAN FD Port)

Protocol compatible with CAN bus communication. NMEA2000 available output messages are shown below:

Table 9: NMEA 2000 Available Messages

Message	Description
PGN126992	System Time
PGN127250	Vessel Heading
PGN127251	Rate of Turn
PGN127257	Attitude (pitch, roll, yaw)
PGN128001	Speed (through water)
PGN129025	GNSS position, rapid update
PGN129026	Course over ground and speed over ground, rapid upgrade
PGN129027	Position delta high precision rapid update
PGN129028	Altitude delta, rapid Update
PGN129029	GNSS position data
PGN129539	GNSS dilution of precision
PGN129540	GNSS satellites in view

Message	Description
PGN129542	GNSS Pseudorange Noise Statistics
PGN130312	Temperature
PGN130578	Longitudinal, transverse and stern speed

J1939 Protocol (CAN FD Port)

Table 10: J1939 Available Messages

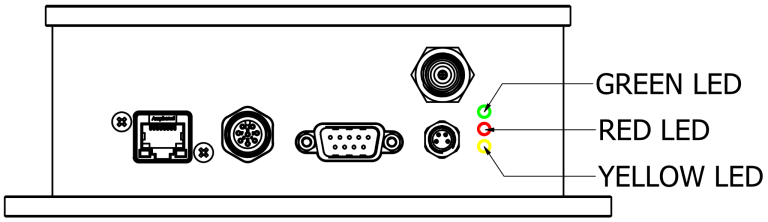
Message	Description
PGN65254	Time and Date
PGN65256	Vehicle speed and direction
PGN65267	Vehicle position

2.8 Diagnostics

Spectrum features three (3) LEDs for status indication. Each blinking pattern corresponds to a specific status, as shown in the table below:

- LED 01: green, LED 02: yellow, LED 03: red.

Figure 3: Rugged Receiver Status LEDs Indication



Group	GREEN		YELLOW		Code	Meaning
	ON	OFF	ON	OFF		
Update	1 blink	1s	Always	-	01	Update active
	2 blinks	1s	Always	-	02	Update error
	3 blinks	1s	Always	-	03	Previous update error
Firmware	4 blinks	1s	Always	-	04	Firmware fault
	5 blinks	1s	Always	-	05	Firmware rollback
Hardware	0.5s	0.5s	0.5 s	0.5 s	06	Power Fault
	0.25s	0.25s	0.25 s	0.25 s	07	Hardware Fault
Operation as Rover	Always	-	Always	-	08	Tracking Satellites
	Always	-	1 s	1 s	09	Position fixed
	Always	-	0.5 s	0.5 s	10	RTK fixed
Operation as Base	Always	-	Always	-	11	Tracking Satellites
	Always	-	1 s	1 s	12	Position fixed and Calibrating
	Always	-	0.5 s	0.5 s	13	Position fixed and Sending RTCM

Table 12: RED LED Behavior

Group	LED 03		Meaning
	ON	OFF	
Serial	Blinking	-	Serial Communication Working via COM1, exclusively

Table 13: Status LEDs Description

Code	Description	Action
01	Firmware is being updated	Stand by
02	An error has occurred during update	Retry update
03	Non solved error occurred during last update	Retry update
04	Non valid firmware detected	Update firmware

Code	Description	Action
05	Spectrum is running on last functional firmware	Update firmware
06	Power is not within acceptable margin	Check power source, if error persists contact support
07	Hardware is defective	Contact support
08	Rover is working correctly and tracking satellites in view	Stand by, fixed position should soon be achieved
09	Rover is working correctly and has converged to a fixed position	Rover is ready to use
10	Rover is successfully receiving correction data	RTK correction is active
11	Base is working correctly and tracking satellites in view	Stand by, fixed position should soon be achieved
12	Base is working correctly and has converged to a fixed position but is calibrating	Stand by and wait for the end of the calibration
13	Base is working correctly and has converged to a fixed position and it is ready to send RTCM	Base is ready to use

2.9 Default Configurations

Table 14: Communications Default Configurations

Configuration	Default	Unit
$COM SERIAL1 BAUDRATE _	115200	bps
$COM SERIAL2 BAUDRATE _	115200	bps
$COM SERIAL3 BAUDRATE _	115200	bps
$COM FDCAN1 BITRATE _	500	kbps

Table 15: GNSS Receiver Default Configurations

Configuration	Default (command)	Default (value 1)	Unit
$GNSS CONSTELLATIONS _ GPS	**ENABLED**	-	-
$GNSS CONSTELLATIONS _ GALILEO	**ENABLED**	-	-

$GNSS CONSTELLATIONS _ BEIDOU	**ENABLED**	-	-
$GNSS CONSTELLATIONS _ GLONASS	**ENABLED**	-	-
$GNSS ELEVATION SET _	-	20	deg.
$GNSS TALKER_ID SET _	-	GN	-

Table 16: NMEA 0183 Default Configurations

Configuration		Default Status (command)	Default Period (value 2)	Unit
COM1	$NMEA0183 SERIAL1 _ DTM _	DISABLED	50	ms
	$NMEA0183 SERIAL1 _ GGA _	**ENABLED**	50	ms
	$NMEA0183 SERIAL1 _ GLL _	DISABLED	50	ms
	$NMEA0183 SERIAL1 _ GRS _	DISABLED	50	ms
	$NMEA0183 SERIAL1 _ GSA _	DISABLED	50	ms
	$NMEA0183 SERIAL1 _ GST _	DISABLED	50	ms
	$NMEA0183 SERIAL1 _ GSV _	DISABLED	50	ms
	$NMEA0183 SERIAL1 _ HDT _	DISABLED	50	ms
	$NMEA0183 SERIAL1 _ RMC _	DISABLED	50	ms
	$NMEA0183 SERIAL1 _ VTG _	**ENABLED**	50	ms
	$NMEA0183 SERIAL1 _ ZDA _	DISABLED	50	ms
COM2	$NMEA0183 SERIAL2 _ DTM _	DISABLED	50	ms
	$NMEA0183 SERIAL2 _ GGA _	DISABLED	50	ms
	$NMEA0183 SERIAL2 _ GLL _	DISABLED	50	ms
	$NMEA0183 SERIAL2 _ GRS _	DISABLED	50	ms
	$NMEA0183 SERIAL2 _ GSA _	DISABLED	50	ms
	$NMEA0183 SERIAL2 _ GST_	DISABLED	50	ms
	$NMEA0183 SERIAL2 _ GSV _	DISABLED	50	ms
	$NMEA0183 SERIAL2_ HDT _	DISABLED	50	ms
	$NMEA0183 SERIAL2 _ RMC _	DISABLED	50	ms
	$NMEA0183 SERIAL2 _ VTG _	DISABLED	50	ms
	$NMEA0183 SERIAL2 _ ZDA _	DISABLED	50	ms
COM3	$NMEA0183 SERIAL3 _ DTM _	DISABLED	50	ms
	$NMEA0183 SERIAL3 _ GGA _	DISABLED	50	ms
	$NMEA0183 SERIAL3 _ GLL _	DISABLED	50	ms
	$NMEA0183 SERIAL3 _ GRS _	DISABLED	50	ms
	$NMEA0183 SERIAL3 _ GSA _	DISABLED	50	ms
	$NMEA0183 SERIAL3 _ GST _	DISABLED	50	ms

	$NMEA0183 SERIAL3 _ GSV _	DISABLED	50	ms
	$NMEA0183 SERIAL3_ HDT _	DISABLED	50	ms
	$NMEA0183 SERIAL3 _ RMC _	DISABLED	50	ms
	$NMEA0183 SERIAL3 _ VTG _	DISABLED	50	ms
	$NMEA0183 SERIAL3 _ ZDA _	DISABLED	50	ms

Table 17: NMEA 2000 Default Configurations

Configuration	Default Status (command)	Default Period (value 2)	Unit
$NMEA2000 FDCAN1 _ PGN126992 _	DISABLED	50	ms
$NMEA2000 FDCAN1 _ PGN127250 _	DISABLED	50	ms
$NMEA2000 FDCAN1 _ PGN127251 _	DISABLED	100	ms
$NMEA2000 FDCAN1 _ PGN127257 _	DISABLED	50	ms
$NMEA2000 FDCAN1 _ PGN128001 _	DISABLED	100	ms
$NMEA2000 FDCAN1 _ PGN129025 _	DISABLED	50	ms
$NMEA2000 FDCAN1 _ PGN129026 _	**ENABLED**	50	ms
$NMEA2000 FDCAN1 _ PGN129027 _	DISABLED	50	ms
$NMEA2000 FDCAN1 _ PGN129028 _	DISABLED	50	ms
$NMEA2000 FDCAN1 _ PGN129029 _	**ENABLED**	50	ms
$NMEA2000 FDCAN1 _ PGN129539 _	DISABLED	50	ms
$NMEA2000 FDCAN1 _ PGN129540 _	DISABLED	1000	ms
$NMEA2000 FDCAN1 _ PGN129542 _	DISABLED	50	ms
$NMEA2000 FDCAN1 _ PGN130312 _	DISABLED	2000	ms
$NMEA2000 FDCAN1 _ PGN130578 _	DISABLED	250	ms

Table 18: J1939 Default Configurations

Configuration	Default Status (command)	Default Period (value 2)	Unit
$J1939 FDCAN1 _ PGN65254 _	DISABLED	50	ms
$J1939 FDCAN1 _ PGN65256 _	DISABLED	50	ms
$J1939 FDCAN1 _ PGN65267 _	DISABLED	50	ms

Table 19: IO Default Configurations

Configuration		Default Status (command)	Default (value 1)	Unit
GSO	$IO GSO _	**ENABLED**	-	-
	$IO GSO UPDATE_RATE _	-	20	Hz
	$IO GSO PPM _	-	60	-
	$IO GSO MIN_VEL _	-	140	mm/s
PPS	$IO PPS _	**ENABLED**	-	-
	$IO PPS POLARITY _	-	RISING	-
	$IO PPS DUTY_CYCLE _	-	10	%
	$IO PPS _ PERIOD_MS	-	1000	ms

Table 20: Speed Filter Default Configurations

Configuration	Default (command)	Default (value 1)
$SPEED FILTER STATE _	**ENABLED**	-
$SPEED_FILTER PRESET SET _	-	2

Table 21: Course Over Ground (Heading) Default Configurations

Configuration	Default (command)	Default (value 1)
$COG_FILTER STATE _	**ENABLED**	-
$COG_FILTER PRESET SET _	-	2

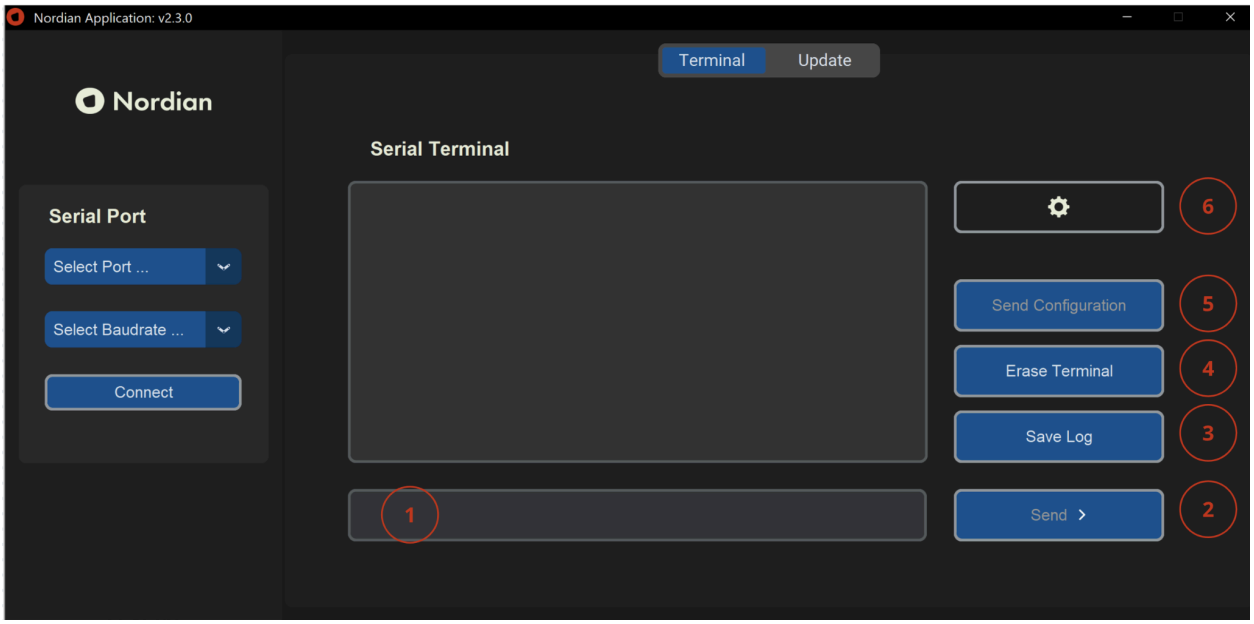
3.0 Firmware Update

Nordian Application Software

Nordian Inc. disposes of a proprietary software aimed for serial communication with all Nordian products, as well as for its firmware update. To proceed with the firmware update, please refer to the Nordian Inc. website www.nordian.com/support and download the software.

The software has a serial terminal interface that can be used to communicate with the Spectrum Rugged Receiver. The figure below shows the software interface and its main communication functionalities.

Figure 4: Nordian Software Interface



Legend:

1) Serial terminal command line: write here the commands according to the *Interface Manual.*

2) Send Command: after writing the command, click on this button to send it to Rugged Receiver.

3) Save Log: If the user selects a file, the terminal data will be saved to that file until the user clicks at "Stop Logging".

4) Erase Terminal: click here to erase the Serial terminal for better visualization.

5) Send Configuration: after loading a command script click here to send it to Rugged Receiver.

6) Load Command Script: a series of commands can be written in a text document and loaded using this button. This is useful if a series of Precisio devices shall be configured in the same way, thus the process can be done in a semi-automated way.

NOTE: remember to always connect Rugged Receiver to the correct port and select the correct serial baudrate (default 115200).

Firmware Update Process

Spectrum Rugged Receiver comes with a fully functional firmware already installed. Yet, due to Nordian's continuous improvement policy, new firmware versions may be made available online at www.nordian.com/support, without notification.

If Spectrum Rugged Receiver presents an unexpected behavior indicating a possible firmware issue, follow the instructions to update the firmware. Furthermore, if a new firmware version is available it is always recommended to update the firmware.

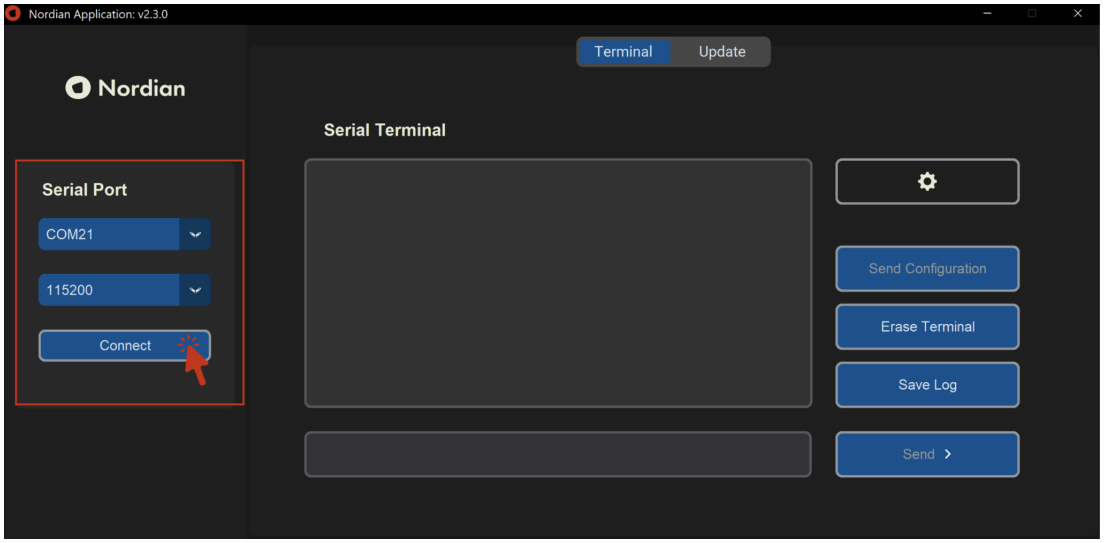
Follow the instructions below in order to update the firmware.

1) Connect Spectrum: connect Spectrum to the correct serial port with the correct baudrate. If the chosen baudrate doesn't match the device baudrate the software will remain idle, without properly communicating, thus updating won't be possible.

   In the figure below Rugged Receiver is being connected to the software via COM21 and with 115200 (default) baurate. The software will automatically identify the available ports. Note that all peripheral devices will be identified as a possible connection port, it's up to the user to identify the correct one.

   Once the port and baurdate are selected press "Connect", if the connection is successful the button will update to "Disconnect", which means that when pressed it will disconnect Rugged Receiver.

Figure 5: Rugged Receiver Connection

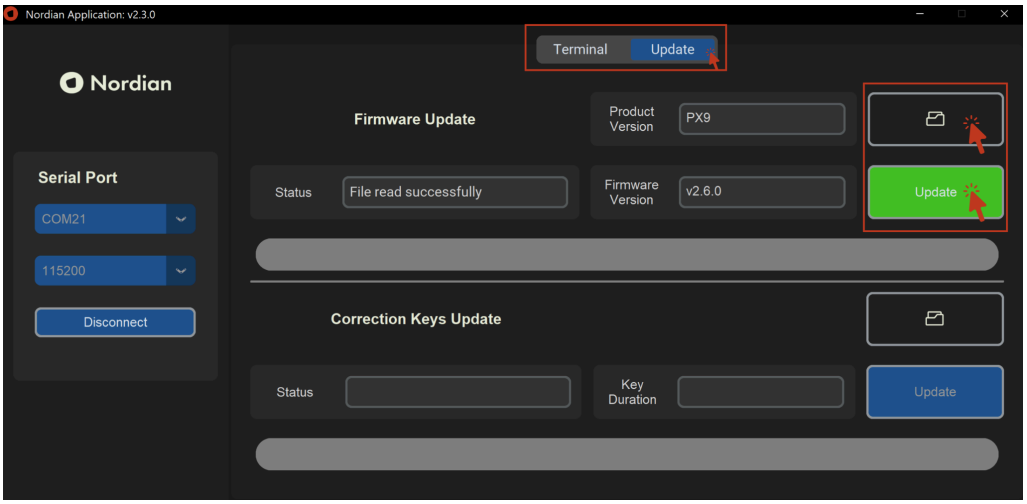


2) Load Firmware File: access www.nordian.com/support and download the firmware file (.ndn). Click on the folder icon and select the .ndn file. Once selected, the software will indicate that

the firmware file corresponds to a valid firmware. It will show the version of the firmware and the corresponding product.

Once the firmware file has been read by the software the folder icon will turn green. If the Rugged Receiver is correctly connected to the software the “Update” button will be enabled. Press the button to begin the firmware update, as shown below:

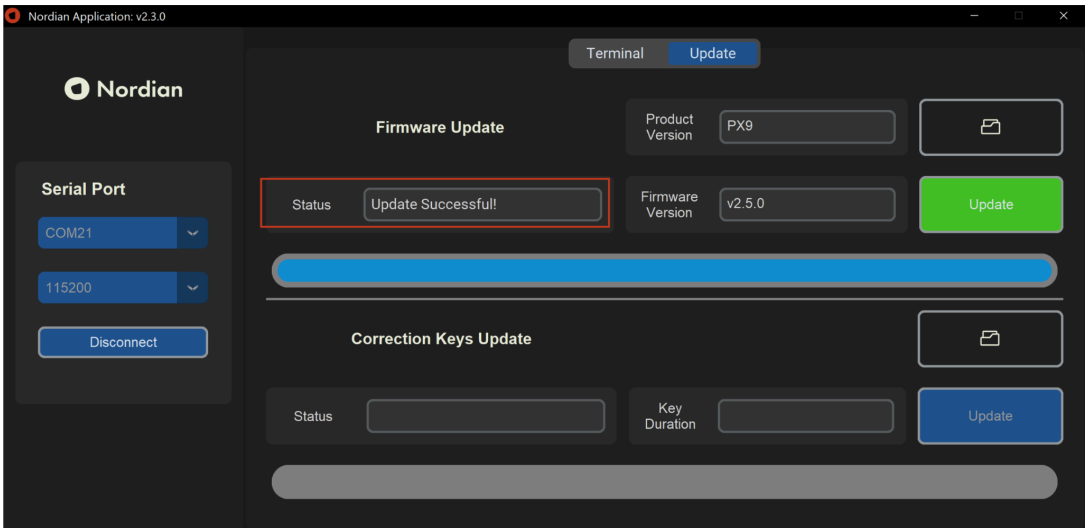
Figure 6: Rugged Receiver Firmware Update Screen



3) Update Successful: if the update process is successful the “Update Successful!” message shall be displayed on the Update Status field. If any communication or power failure occurs during the firmware update process the software must be closed and the process must be restarted.

   Once the process is finished disconnect Rugged Receiver and close the software. Rugged Receiver is ready to use.

Figure 7: Rugged Receiver Firmware Update Successful



3.0 Warranty

Spectrum Rugged Receiver comes with a 12-month warranty starting from the shipment date. Nordian Inc. will repair or replace — at no cost — any device proven to be defective within this warranty period.

The warranty does not apply if the Spectrum Rugged Receiver has been subjected to negligence, misuse, improper storage, operation outside specified physical limits, improper application, physical damage, or unauthorized modifications or repairs by personnel other than Nordian Inc.

Please note that occasional, non-recurring errors or malfunctions that do not affect the device's continuous operation are not covered under this warranty.

Support

For specific support, doubts and warranty claim, contact Nordian Inc at:

Website: www.nordian.com
Customer Service: support@nordian.com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