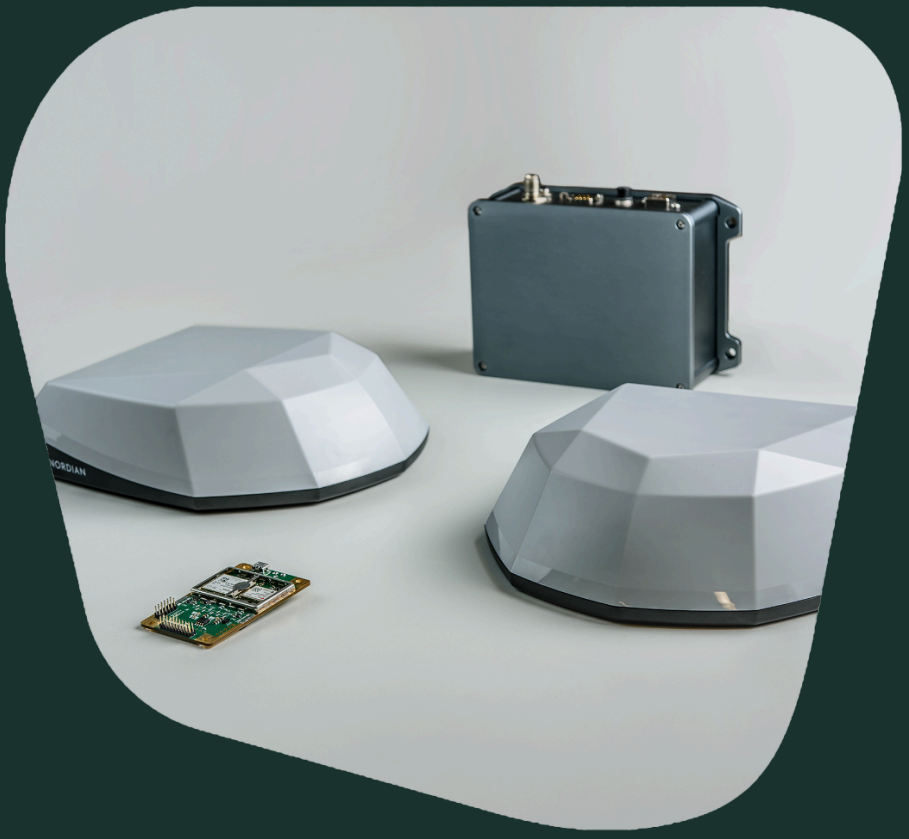
Nordian

Interface Manual

Firmware Version 2.9.9



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Interface Manual FW 2.9.9

Nordian

Contents

1. Communication Interfaces

This manual describes how to configure Nordian Products using both Serial and CAN communication interfaces. Commands are organized by functional groups and may apply to one or both interfaces. While many commands are available via both Serial and CAN, some commands are exclusive to Serial and are not available through the CAN interface.

1.1. Serial Communication

1.1.1. Serial Message Layout

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	<group>	<subgroup>	<command>	<value1>	<value2>	<CR><LF>

1.1.2. Serial Message Groups

Group Name	Description
COM	Communication ports group
GNSS	GNSS Receiver configuration
NMEA0183	NMEA 0183 Serial protocol
NMEA2000	NMEA 2000 CAN protocol
J1939	J1939 CAN protocol
CAN_CONFIG_PROTOCOL	CAN Configuration protocol
RADIO	Radio configuration
LBAND	L-Band configuration
SOFT_INTELLIGENCE	Soft Intelligence configuration
TERRAIN_COMP	Terrain Compensation configuration
TILT_COMP	Tilt Compensation configuration
SPEED_FILTER	Speed Filter configuration

Group Name	Description
COG_FILTER	Course over Ground filter configuration
TRUE_HEADING	True Heading configuration
IMU	IMU axis customization
SMOOTHTRACK	Smoothtrack configuration
SCINTILLATION	Scintillation group configuration
IO	GSO and PPS Input and Output ports configuration
CELLULAR	Internet Connectivity configuration and diagnostics
CORRECTION	Correction Services general configuration
REFERENCE_CONV	Correction for shifts, rotation, scale and tectonic movements
SPECTRUM	Configuration of operation mode of SX variants
BASE_STATION	Configuration of base station parameters
PointPerfect	PointPerfect Correction Service configuration
INFO	General information about the product
ALL	Configuration for all groups

NOTES

- When issuing a command, there must be a space between each field.
- Commands should be written using upper case letters.
- If a field is not used, it might be left blank.
- “$” character should be included in the beginning of all messages.
- Each command issued to the product must be finished using CR and LF characters.

1.1.3. Serial Command Status

Receivers will display a status message according to the protocol command sent by the user.

Status	Description
<<INVALID GROUP>>	Invalid group according to section 1.2 table.
<<INVALID SUBGROUP>>	Invalid subgroup according to group options.
<<INVALID COMMAND>>	Invalid command according to group options.
<<INVALID COMBINATION OF SUBGROUP AND COMMAND>>	Invalid subgroup and command according to corresponding group options.
<<INVALID VALUE 1>>	Invalid Value 1 according to command options.
<<INVALID VALUE 2>>	Invalid Value 2 according to command options.
<<COMMAND INCOMPLETE>>	Missing field according to section 1.1 table. (Beware of the *End Sequence* characters.)
<<COMMAND ACCEPTED>>	The command has been acknowledged by the receiver.
<<DEMO EXPIRED>>	The demo period has ended.
<<DEMO ALREADY STARTED>>	The demo has already been activated.
<<DEMO NOT AVAILABLE, SERVICE ALREADY ACTIVE>>	Demo unavailable because the service is already active.
<<INACTIVE PRODUCT, ENABLE SOFT INTELLIGENCE>>	Product is inactive; Soft Intelligence must be enabled.
<<BLOCKED PRODUCT, CONTACT SUPPORT>>	Product is blocked; please contact support.
<<SERVICE DOWNGRADE REJECTED>>	The downgrade request was denied.
<<COMMAND REJECTED, SERVICE ALREADY ACTIVE>>	Command rejected; the service is already active.

NOTE

If the receiver is not responsive, check wiring and beware of the “$” character at the start of messages.

1.2. CAN Communication

By default, the messages are set to 0x06 for priority and 0x1C for the source address. In this manual, you will learn how to send commands to configure the receiver.

1.2.1. CAN Protocol Layout: Message ID and Format

The message ID is composed of 3 parts: Priority, PGN and Source Address. The Priority is bit shifted 3 bits, so 0x06 will be represented by 0x18, the PGN list is shown above and the Source Address is the last byte.

PGN List	
Command Type	**Group ID**
Write	FF14
Write and Save	FF15
Read	FF16
Reply	FF17
Save	FF18
Log Transmit	FF19

Message ID		
<Priority>	<PGN>	<Source Address>

The message is composed of 1 byte for the command group, which describes which group the message belongs to, 1 byte for the command size and address, which describes the size and start of the command, 1 byte for the SPN, which describes which function of the group the message refers to, 1 byte for the SPN size, which describes the message size, and 4 bytes of payload, which contain the information to be sent.

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
<Command Group>	<Command size>	<Command Index>	<SPN>	<SPN Size>	<Payload byte 01>	<Payload byte 02>	<Payload byte 03>	<Payload byte 04>

1.2.2. CAN Command Groups

The available group messages are listed in the table below.

Group Name	Command Group	Description
COM	00	Configurations related to the serial and CAN ports.
NMEA0183	01	Configurations related to the NMEA 0183 messages.
NMEA2000	02	Configurations related to the NMEA 2000 messages.
TRUE_HEADING	03	Configurations related to true heading functionality using another device as a moving base.
RESERVED	04	Reserved
CAN_CONFIG	05	Configurations related to the CAN Config Protocol
INFO	06	Configurations related to information of each product like serial number, model and firmware version.
CORRECTION	07	Configurations related to GNSS positioning correction.
TERRAIN_COMP	08	Configurations related to terrain compensation.
TILT_COMP	09	Configurations related to tilt compensation.

2. Communication Port Configuration

This section presents Serial and CAN ports configuration commands.

2.1. Serial Ports

The configuration commands related to Serial Ports are described below. By default, the products are configured with 115200 bps, 8 data bits, without parity control and 1 stop bit.

2.2. Baud Rate Configuration Command

Receivers can operate at 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps, 230400 bps and 460800 bps. The following table describes the configuration commands.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	COM	SERIAL1	BAUDRATE	9600	<CR><LF>
				19200	
		SERIAL2		38400	
				57600	
		SERIAL3		115200	
				230400	
				460800	

(Interface: CAN)

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
00	1	0	00 (Serial 1)	03	<Baud Rate value (hexadecimal little endian)>			<Reserved>
			01 (Serial 2)					
			02 (Serial 3)					

2.3. Word Length Configuration Command

Receivers can operate with 7, 8 or 9 data bits. The following table describes the configuration commands. A message with 9 data bits is only available without parity control.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	COM	SERIAL1	LENGTH	7	<CR><LF>
		SERIAL2		8	
		SERIAL3		9	

1.1.1. Parity Control Configuration Command

Receivers can operate without parity control or with odd or even parity. The following table describes the configuration commands.

(Interface: CAN)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	COM	SERIAL1	PARITY	NONE	<CR><LF>
		SERIAL2		ODD	
		SERIAL3		EVEN	

1.1.2. Stop Bits Configuration Command

Receivers can operate without parity control or with odd or even parity. The following table describes the configuration commands.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	COM	SERIAL1	STOPBITS	0.5	<CR><LF>
		SERIAL2		1.0	
		SERIAL3		1.5	
				2.0	

After all configurations, this will be the message frame format.

Start bit	7 to 9 data bits	Parity bit	Stop bits

Command Examples via Serial

➢ Configuring the Serial 1 port baud rate to 115200 bps:

$COM SERIAL1 BAUDRATE 115200<CR><LF>

➢ Configuring the Serial 1 port word length to 7 data bits:

$COM SERIAL1 LENGTH 7<CR><LF>

➢ Configuring the Serial 2 port parity control to odd parity:

$COM SERIAL2 PARITY ODD<CR><LF>

➢ Configuring the Serial 1 port stopbits to 2 stop bits:

$COM SERIAL1 STOPBITS 2.0<CR><LF>

Command Examples via CAN

➢ Configuring the Serial 2 port baud rate to 115200 bps and saving:

ID: 0x18FF151C Message: 0x0001010300C20100

2.4. CAN Port

The configuration commands related to CAN Port are described below.

2.4.1. Bitrate Configuration Command

Receivers can operate at 125 kbps, 250 kbps, 500 kbps, 1 Mbps and 2 Mbps. The following table describes the configuration commands.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	COM	FDCAN1	BITRATE	125000 250000 500000 1000000 2000000	<CR><LF>

2.4.2. ID Priority Configuration Command

This feature allows you to configure the J1939 message ID. By default, the product is set to 6 and can go from 0 (most priority) to 7.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	CAN_CONFIG_PROTOCOL	J1939_PRIORITY	SET	<Priority>	<CR><LF>

(Interface: CAN)

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
05	1	0	00	01	<Priority>	<Reserved>	<Reserved>	<Reserved>

2.4.3. Source Address Configuration Command

The command below configures the J1939 Source Address in the J1939 ID field, requiring a two-digit hexadecimal value between 01 and FE.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	CAN_CONFIG_PROTOCOL	J1939_SA	SET	<SA>	<CR><LF>

(Interface: CAN)

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
05	1	0	01	01	<Source Address>	<Reserved>	<Reserved>	<Reserved>

Command Examples via Serial

➢ Configuring the FDCAN 1 port bitrate to 500 kbps:

$COM FDCAN1 BITRATE 500000<CR><LF>

Command Examples via CAN

➢ Reading the FDCan Bit Rate:

ID: 0x18FF161C
Message: 0x0001030300000000

➢ Setting ID priority to 0x05 and saving:

ID: 0x18FF151C
Message: 0x0501000105000000

➢ Setting Source Address to 0x10 and saving:

ID: 0x18FF151C
Message: 0x0501010110000000

2.5. Echo Command

The configuration command controls whether the commands sent through the serial interface are echoed back to the sender. By default, the echo feature is turned off.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	COM	ECHO	ENABLE	<CR><LF>
			DISABLE	

Command Examples via Serial

➢ Enabling echo feature:

```
$COM ECHO ENABLE<CR><LF>
```

3. GNSS Receiver

This section presents GNSS configurations. The device supports constellation selection, minimum satellite elevation and GNSS Talker ID configuration.

3.1. Constellations Enable Command

Constellations are configured through the CONSTELLATIONS subgroup of the GNSS group. The ENABLE command makes Smart Antennas receive signals from each constellation.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	GNSS	CONSTELLATIONS	ENABLE	GPS	<CR><LF>
				GALILEO	
				BEIDOU	
				GLONASS	
				ALL	

3.2. Constellations Disable Command

The DISABLE command disables the reception of signals from the constellation passed in Value 1.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	GNSS	CONSTELLATIONS	DISABLE	GPS	<CR><LF>
				GALILEO	
				BEIDOU	
				GLONASS	
				ALL	

3.3. GNSS Constellations Set Command

The minimum satellite elevation can be configured as follows: the Elevation [deg] value is a number between zero and 90 degrees, it represents the minimum vertical angle with the horizon that receives satellite signals.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	GNSS	ELEVATION	SET	0 - 90 deg	<CR><LF>

3.4. GNSS Elevation Default Command

The DEFAULT Command sets the minimum elevation to the Default Value of 10 degrees.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	GNSS	ELEVATION	DEFAULT	<CR><LF>

3.5. GNSS Talker ID Set Command

The Talker ID value represents the first two letters used in NMEA0183 protocol messages, it is either GN or GP. The default Talker ID is GN. The SET Command of the TALKER_ID subgroup can change its value.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	GNSS	TALKER_ID	SET	GN	<CR><LF>
				GP	

3.6. GNSS Talker ID Default Command

Default Talker ID is GN, it can be reset with the DEFAULT Command of the TALKER_ID subgroup.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	GNSS	TALKER_ID	DEFAULT	<CR><LF>

3.7. CNO Configuration Command

The command below sets the minimum CNO for GNSS satellites in dBHz.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	GNSS	CNO	SET	0 to 65535	<CR><LF>

3.8. CNO Default Command

The command below sets the minimum CNO to 20.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	GNSS	CNO	DEFAULT	<CR><LF>

Command Examples via Serial

- Enabling GNSS constellation:

```
$GNSS CONSTELLATIONS ENABLE GPS<CR><LF>
```

- Setting minimum elevation to 30 degrees:

```
$GNSS ELEVATION SET 30<CR><LF>
```

- Setting Talker ID to GP:

```
$GNSS TALKER_ID SET GP<CR><LF>
```

- Resetting Talker ID to Default (GN):

```
$GNSS TALKER_ID DEFAULT<CR><LF>
```

- Setting the minimum CNO to 30 dBHz:

```
$GNSS CNO SET 30<CR><LF>
```

- Setting the minimum CNO to 20 dBHz (default value):

```
$GNSS CNO DEFAULT<CR><LF>
```

4. Communication Protocols

Receivers offer both industry-standard and proprietary communication protocols to facilitate the integration into various systems. The available protocols include the Serial NMEA 0183 standard protocol, CAN Network NMEA 2000 messages, and a Nordian proprietary protocol.

4.1. NMEA 0183 Protocol Messages

Receivers support the following NMEA 0183 messages:

Protocol	Available Messages	Description (click to see more)
NMEA 0183	DTM	Datum reference information
	GGA	Time, position, and fix related data
	GLL	Position data: position fix, time of position fix, and status
	GRS	GPS range residuals for each satellite
	GSA	GPS DOP and active satellites
	GST	Position error statistics
	GSV	Number of SVs in view, PRN, elevation, azimuth, and SNR
	HDT	Heading from true north
	RMC	Position, Velocity, and Time
	VTG	Actual track made good and speed over ground
	ZDA	UTC day, month, and year, and local time zone offset
	ALL	

CAN SPN list				
NMEA0183 Message	State SPN	Serial 1 Period SPN	Serial 2 Period SPN	Serial 3 Period SPN
DTM	00	01	02	03
GGA	04	05	06	07
GLL	08	09	0A	0B
GSA	0C	0D	0E	0F
GST	10	11	12	13
GSV	14	15	16	17
HDT	18	19	1A	1B
RMC	1C	1D	1E	1F
VTG	20	21	22	23
ZDA	24	25	26	27

4.1.1. NMEA 0183 Enable Messages Command

The NMEA 0183 messages can be enabled independently or altogether in each serial port with individual periods. The table below summarizes the field values for the enable command, where Value 2 is the period in milliseconds (must be a multiple of 10).

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	NMEA0183	SERIAL1	ENABLE	DTM	10 - 60000	<CR><LF>
				GGA		
				GLL		
				GRS		
				GSA		
		SERIAL2		GST		
				GSV		
				HDT		
				RMC		
				VTG		
		SERIAL3		ZDA		

				ALL		

(Interface: CAN)

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
01	1	0	<SPN>	02	0x0100		<Reserved>	<Reserved>

4.1.2. NMEA 0183 Period Message Command

The NMEA 0183 messages period can be personalized by sending the command below. Note that in serial communication, there is only one command to enable and to configure the period of the message.

(Interface: CAN)

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
01	1	0	<SPN>	02	<Period in ms (must be multiple of 10)>		<Reserved>	<Reserved>

4.1.3. NMEA 0183 Disable Messages Command

The NMEA 0183 messages can be disabled independently or altogether in each serial port. The table in the next page summarizes the field values for the disable command.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	NMEA0183	SERIAL1	DISABLE	DTM	<CR><LF>
				GGA	
				GLL	
				GRS	
				GSA	
		SERIAL2		GST	
				GSV	
				HDT	
				RMC	
				VTG	
		SERIAL3		ZDA	
				ALL	

(Interface: CAN)

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
01	1	0	<SPN>	02	0x0100		<Reserved>	<Reserved>

Command Examples via Serial

- Enabling NMEA 0183 GGA message, in serial port 3, with period of 250 *milliseconds*:

```
$NMEA0183 SERIAL3 ENABLE GGA 250<CR><LF>
```

- Enabling NMEA 0183 GSV message, in serial port 1, with period of 2000 *milliseconds*:

```
$NMEA0183 SERIAL1 ENABLE GSV 2000<CR><LF>
```

- Disabling NMEA 0183 GGA message, in serial port 3:

```
$NMEA0183 SERIAL3 DISABLE GGA<CR><LF>
```

- Disabling NMEA 0183 GSV message, in serial port 1:

$NMEA0183 SERIAL1 DISABLE GSV<CR><LF>

Command Examples via CAN

➢ Enabling GGA message and saving:

ID: 0x18FF151C Message: 0x0101040200010000

➢ Setting GGA message period to 500ms and saving:

ID: 0x18FF161C Message: 0x01010502F4010000

4.2. NMEA 2000 Protocol Messages

Receivers support the following NMEA 2000 messages:

Protocol	Available Messages	SPN list	CAN ID
NMEA 2000	PGN 126992	00	0x0DF0101C
	PGN 127250	01	0x09F1121C
	PGN 127251	02	0x09F1131C
	PGN 127257	03	0x09F1191C
	PGN 128001	04	0x0DF4011C
	PGN 129025	05	0x09F8011C
	PGN 129026	06	0x09F8021C
	PGN 129027	07	0x09F8031C
	PGN 129028	08	0x09F8041C
	PGN 129029	09	0x0DF8051C
	PGN 129539	0A	0x0DFA031C
	PGN 129540	0B	0x0DFA041C
	PGN 129542	0C	0x0DFA061C
	PGN 130312	0D	0x0DFD081C
	PGN 130578	0E	0x0DFE121C

NOTE

To use PGN 129027 and PGN 129028 messages the PGN 129029 message must be enabled.

Message PGN 127257 is only available in PXULT, PXRTK and PXOEM.

The messages PGN 127251 and PGN 128001 require measurements from the IMU sensor to work.

4.2.1. NMEA 2000 Enable Messages Command

The NMEA 2000 messages can be enabled independently, with individual periods, or altogether. The table below summarizes the field values for the enable command, where the Value 2 is the period in milliseconds (must be a multiple of 10).

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	NMEA2000	FDCAN1	ENABLE	PGN126992	10 - 60000	<CR><LF>
				PGN127250		
				PGN127251		
				PGN127257		
				PGN128001		
				PGN129025		
				PGN129026		
				PGN129027		
				PGN129028		
				PGN129029		
				PGN129539		
				PGN12950		
				PGN129542		
				PGN130312		
				PGN130578		
				ALL		

(Interface: CAN)

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
02	1	0	<SPN>	04	<Enable: 0x0100>	<Priority from 1 to 7>	<Period in ms (must be multiple of 10)>	

4.2.2. NMEA 2000 Disable Messages Command

The NMEA 2000 messages can be disabled independently or altogether. The table below summarizes the field values for the disable command.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	NMEA2000	FDCAN1	DISABLE	PGN126992	10 - 60000	<CR><LF>
				PGN127250		
				PGN127251		
				PGN127257		
				PGN128001		
				PGN129025		
				PGN129026		
				PGN129027		
				PGN129028		
				PGN129029		
				PGN129539		
				PGN12950		
				PGN129542		
				PGN130312		
				PGN130578		
				ALL		

(Interface: CAN)

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
02	1	0	<SPN>	04	<Disable: 0x0000>	<Priority from 1 to 7>	<Period in ms (must be multiple of 10)>	

4.2.3. NMEA 2000 Set Priority Command

The priority of each NMEA 2000 message can be set from 01 to 07, with 01 being the highest priority and 07 the lowest. This value must be in decimal format. Note that the enable command also configures the priority on CAN protocol.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	NMEA2000	FDCAN1	SET_PRIORITY	PGN126992	01 - 07	<CR><LF>
				PGN127250		
				PGN127251		
				PGN127257		
				PGN128001		
				PGN129025		
				PGN129026		
				PGN129027		
				PGN129028		
				PGN129029		
				PGN129539		
				PGN12950		
				PGN129542		
				PGN130312		
				PGN130578		
				ALL		

4.2.4. NMEA 2000 Set Source Address

The source address for NMEA 2000 messages from FDCAN1 can be set from 0x01 to 0xFE using the command below. This value must be in hexadecimal.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	NMEA2000	FDCAN1	SET_SOURCE_ADDRESS	0x01 - 0xFE	<CR><LF>

(Interface: CAN)

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
02	1	0	0F	01	<Source Address>	-	-	-

Command Examples via Serial

- Enabling NMEA 2000 PGN 129025 message with period of 250 *milliseconds*:

```
$NMEA2000 FDCAN1 ENABLE PGN129025 250<CR><LF>
```

- Enabling NMEA 2000 PGN 129029 message with period of 2000 *milliseconds*:

```
$NMEA2000 FDCAN1 ENABLE PGN129029 2000<CR><LF>
```

- Disabling NMEA 2000 PGN 129025 message:

```
$NMEA2000 FDCAN1 DISABLE PGN12902<CR><LF>
```

- Disabling NMEA 2000 PGN 129029 message:

```
$NMEA2000 FDCAN1 DISABLE PGN12902<CR><LF>
```

➢ Setting source address of NMEA2000 messages to 1C:

$NMEA2000 FDCAN1 SET_SOUCE_ADDRESS 1C<CR><LF>

➢ Setting priority of NMEA2000 PGN129029 message to 1:

$NMEA2000 FDCAN1 SET_PRIORITY PGN129029 1<CR><LF>

Command Examples via CAN

➢ Enabling PGN 126992 message with 500 ms period, 1 of priority and saving:

ID: 0x18FF151C Message: 0x020102040101F401

➢ Setting the source address of NMEA 2000 messages to 1C and save:

ID: 0x18FF151C Message: 0x02010F011C

4.3. J1939 CAN Protocol

Receivers support the following J1939 messages:

Protocol	Available Messages
J1939	PGN 65254
	PGN 65256
	PGN 65267
	ALL

4.3.1. J1939 Enable Messages Command

The J1939 messages can be enabled independently, with individual periods or altogether. The table below summarizes the field values for the enable command, where Value 2 is the period in milliseconds (must be a multiple of 10).

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	J1939	FDCAN1	ENABLE	PGN65254	10 - 60000	<CR><LF>
				PGN65256		
				PGN65267		
				ALL		

4.3.2. J1939 Disable Messages Command

The J1939 messages can be disabled independently or altogether. The table below summarizes the field values for the disable command.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	J1939	FDCAN1	DISABLE	PGN65254	<CR><LF>
				PGN65256	
				PGN65267	
				ALL	

Command Examples via Serial

➢ Enabling J1939 PGN 65256 message with period of 600 *milliseconds*:

$J1939 FDCAN1 ENABLE PGN65256 600<CR><LF>

➢ Disabling J1939 PGN 65267 message:

$J1939 FDCAN1 DISABLE PGN65267<CR><LF>

5. Radio Configuration

RTK devices integrate a radio interface that can be configured using the commands below:

5.1. Harxon Command

Sets Radio to interface with Harxon Devices. Presets: 1 to 6.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	RADIO	PROTOCOL	HARXON	1 - 6	<CR><LF>

5.2. Pacific Crest Command

Sets Radio to interface with Pacific Crest Devices. Presets: 1 to 24.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	RADIO	PROTOCOL	PACIFIC_CREST	1 - 24	<CR><LF>

5.3. Satel Command

Sets Radio to interface with Satel Devices. Presets: 1 to 22.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	RADIO	PROTOCOL	SATEL	1 - 22	<CR><LF>

5.4. Trimble Command

Sets Radio to interface with Trimble Devices. Presets: 1 to 14.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	RADIO	PROTOCOL	TRIMBLE	1 - 14	<CR><LF>

5.5. Channel Frequency Command

The Channel Frequency can be altered with the CH_FREQ Command of the PARAM Subgroup. Note that the frequency in Value 1 must be in Hz.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	RADIO	PARAM	CH_FREQ	390000000 - 480000000	<CR><LF>

Command Examples via Serial

➢ Setting Protocol to Harxon Preset 6:

```
$RADIO PROTOCOL HARXON 6<CR><LF>
```

➢ Setting Channel Frequency to 400 MHz:

```
$RADIO PARAM CH_FREQ 400000000<CR><LF>
```

6. L-Band Configuration

Ultra and *RTK* devices can obtain GNSS correction data from L-Band satellites. Parameters for the L-Band interface are configured using the commands below.

6.1. Center Frequency Set Command

Sets the center frequency of the L-Band signal. The unit is *Hz*, and the value must be between 1525000000 (1.525 GHz) and 1559000000 (1.559 GHz).

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	LBAND	CENTER_FREQ	SET	<Frequency>	<CR><LF>

6.2. Center Frequency Default Command

Resets the center frequency to default (1545830000 Hz).

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	LBAND	CENTER_FREQ	DEFAULT	<CR><LF>

6.3. Search Window Set Command

Sets the search window, in *Hz*, for the L-Band device.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	LBAND	SEARCH_WINDOW	SET	0-65535	<CR><LF>

6.4. Search Window Default Command

Resets the search window to default (2200 Hz).

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	LBAND	SEARCH_WINDOW	DEFAULT	<CR><LF>

6.5. Enable Service ID Command

Enables check to confirm the correct Satellite Service ID is received (enabled by default).

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	LBAND	USE_SERVICE_ID	ENABLE	<CR><LF>

6.6. Disable Service ID Command

Disables Service ID check.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	LBAND	USE_SERVICE_ID	DISABLE	<CR><LF>

6.7. Service ID Set Command

Sets the L-Band Satellite Service ID to expect.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	LBAND	SERVICE_ID	SET	0-65535	<CR><LF>

6.8. Service ID Default Command

Resets the L-Band Satellite Service ID to default (21845).

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	LBAND	SERVICE_ID	DEFAULT	<CR><LF>

6.9. Data Rate Set Command

Sets the L-Band Satellite data rate, in *bps*.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	LBAND	DATA_RATE	SET	600	<CR><LF>
				1200	
				2400	
				4800	

6.10. Data Rate Default Command

Resets the L-Band Satellite data rate to default (2400 bps).

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	LBAND	DATA_RATE	DEFAULT	<CR><LF>

6.11. L-Band Diagnostic Command

Obtain diagnostics of L-Band. This diagnostic report will indicate whether the correction and hardware are functioning properly and provide the expiration date of the credential key.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	LBAND	DIAGNOSTIC	CORRECTION	<CR><LF>

Command Examples via Serial

➢ Setting L-Band Center Frequency to 1.525 GHz:

```
$LBAND CENTER_FREQ SET 1525000000<CR><LF>
```

➢ Setting L-Band Search Window to 10 kHz:

```
$LBAND SEARCH_WINDOW SET 10000<CR><LF>
```

➢ Enabling Service ID check:

```
$LBAND USE_SERVICE_ID ENABLE<CR><LF>
```

7. Soft Intelligence

This group provides options to configure the Smart Antenna's correction type, display its current status and enable the demo feature.

7.1. Enable Soft Intelligence

With this subgroup, it is possible to select the desired correction type for use or to activate the demo.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	SOFT_INTELLIGENCE	ENABLE	P1	First 16 Bytes of Soft Intelligence Key	First 16 Bytes of Soft Intelligence Key	<CR><LF>
			P2			
			DEMO	1-5	-	

The demo feature provides P2-level correction and can be used for a period of one (1) to five (5) days. The selected correction type must correspond to the provided activation key.

7.2. Soft Intelligence Diagnostic

The status of the correction being used on the Smart Antenna can be displayed by sending the command below:

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	SOFT_INTELLIGENCE	DIAGNOSTIC	STATE	<CR><LF>

7.3. Soft Intelligence Demo Status

The status of the demo can be displayed by sending the command below:

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	SOFT_INTELLIGENCE	DEMO	STATUS	<CR><LF>

Command Examples via Serial

➢ Enabling P2 Correction:

$SOFT_INTELLIGENCE ENABLE P2 <High part of the key> <Lower part of the key><CR><LF>

➢ Start P2 Demo for six (5) days :

$SOFT_INTELLIGENCE ENABLE DEMO 5<CR><LF>

➢ Check current demo status:

$SOFT_INTELLIGENCE DEMO STATUS<CR><LF>

8. Terrain Compensation

In order to compensate for the position deviations originated from terrain inclination, receivers are equipped with a Terrain Compensation algorithm.

8.1. Terrain Compensation Enable Command

It is possible to turn the feature ON using the ENABLE Command.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	TERRAIN_COMP	STATE	ENABLE	<CR><LF>

(Interface: CAN)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
08	01	00	02	0x0100 : Enable		<Reserved>	<Reserved>

8.2. Terrain Compensation Disable Command

It is possible to turn the feature OFF using the DISABLE Command.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	TERRAIN_COMP	STATE	DISABLE	<CR><LF>

(Interface: CAN)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
08	01	00	02	0x0000 : Disable		<Reserved>	<Reserved>

8.3. Terrain Compensation Height Set Command

You must set the height of the device using the SET command with the HEIGHT subgroup, followed by the height value (in centimeters).

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	TERRAIN_COMP	HEIGHT	SET	0 - 1000	<CR><LF>

(Interface: CAN)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
08	01	01	02	<Height>		<Reserved>	<Reserved>

8.4. Terrain Compensation Height Default Command

The default height value (350 cm) can be restored using the Default command.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	TERRAIN_COMP	HEIGHT	DEFAULT	<CR><LF>

8.5. Terrain Compensation Preset Set Command

The compensation sensitivity can be adjusted depending on the terrain where the device will operate. Use the SET command with the PRESET subgroup, followed by the preset number (1 to 3) to set different sensitivities. 1 is the lowest sensitivity, meaning the compensation is smoother but may take more time to stabilize, while 3 is the highest, meaning the compensation is faster, but oscillations may appear depending on the terrain.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	TERRAIN_COMP	PRESET	SET	1 - 3	<CR><LF>

(Interface: CAN)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
08	01	02	01	<Preset>	<Reserved>	<Reserved>	<Reserved>

8.6. Terrain Compensation Preset Default Command

The default preset value is 2, and can be restored using the Default command.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	TERRAIN_COMP	PRESET	DEFAULT	<CR><LF>

Command Examples via Serial

➢ Enabling Terrain Compensation:

$TERRAIN_COMP STATE ENABLE<CR><LF>

➢ Setting Device Height to 200 cm:

$TERRAIN_COMP HEIGHT SET 200<CR><LF>

➢ Setting Preset to 1:

$TERRAIN_COMP PRESET SET 1<CR><LF>

Command Examples via CAN

➢ Enable Terrain Compensation and save:

ID: 0x18FF151C
Message: 0x0801000201000000

➢ Setting Terrain Compensation Height to 100 cm and saving:

ID: 0x18FF151C
Message: 0x0801010264000000

➢ Setting Terrain Compensation Preset to 2 and saving:

ID: 0x18FF151C
Message: 0x0801020102000000

9. Tilt Compensation

When mounting the device on a vehicle, the receiver may not be completely flat. In order to compensate for the device mounting angle, receivers are equipped with a Tilt Compensation algorithm. The feature is enabled automatically upon sending the calibration command.

9.1. Tilt Compensation Enable Command

It is possible to turn the feature ON using the ENABLE Command.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	TILT_COMP	STATE	ENABLE	<CR><LF>

(Interface: CAN)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
09	01	00	01	0x01 : Enable	<Reserved>	<Reserved>	<Reserved>

9.2. Tilt Compensation Disable Command

It is possible to turn the feature OFF using the DISABLE Command.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	TILT_COMP	STATE	DISABLE	<CR><LF>

(Interface: CAN)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
09	01	00	01	0x00 : Disable	<Reserved>	<Reserved>	<Reserved>

9.3. Tilt Compensation One-Stage Set Command

To use the Tilt Compensation feature, the device must be calibrated using one of the available methods. For One-Stage Calibration, first mount the device on the vehicle, then send a SET command. The vehicle must be on a flat surface.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	TILT_COMP	ONESTAGE	SET	<CR><LF>

(Interface: CAN)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
09	01	01	01	Set Point: 0x01	<Reserved>	<Reserved>	<Reserved>

9.4. Tilt Compensation One-Stage Default Command

One-stage calibration can be restored to factory default using the DEFAULT command.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	TILT_COMP	ONESTAGE	DEFAULT	<CR><LF>

(Interface: CAN)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
09	01	01	01	Reset: 0x0A	<Reserved>	<Reserved>	<Reserved>

9.5. Tilt Compensation Two-Stage Set Command

If the vehicle is not on a flat surface, Tilt Compensation can also be calibrated using the Two-Stage Calibration method, which requires two calibration points. For the first point, mount the device on the vehicle, then send a SET 1 command. Then, for the second point, move the vehicle to the same position as before, but facing the opposite direction, and send a SET 2 command.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	TILT_COMP	TWOSTAGE	SET	1	<CR><LF>
				2	

(Interface: CAN)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
09	01	02	01	Set First Point: 01 Set Second Point: 02	<Reserved>	<Reserved>	<Reserved>

9.6. Tilt Compensation Two-Stage Default Command

Two-stage calibration can be restored to factory default using the DEFAULT command.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	TILT_COMP	TWOSTAGE	DEFAULT	<CR><LF>

(Interface: CAN)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
09	01	02	01	Reset: 0x0A	<Reserved>	<Reserved>	<Reserved>

Command Examples via Serial

➢ Enabling Tilt Compensation:

$TILT_COMP STATE ENABLE<CR><LF>

➢ Calibrating using One-Stage Calibration (when vehicle is on a flat surface):

$TILT_COMP ONESTAGE SET<CR><LF>

➢ Calibrating the first point in Two-Stage Calibration:

$TILT_COMP TWOSTAGE SET 1<CR><LF>

➢ Calibrating the second point in Two-Stage Calibration (when vehicle is rotated 180°):

$TILT_COMP ONESTAGE SET<CR><LF>

Command Examples via CAN

➢ Enable Tilt Compensation and save:

ID: 0x18FF151C Message: 0x0901000101000000

➢ Configuring One Stage Calibration of Tilt Calibration:

ID: 0x18FF151C Message: 0x0901010101000000

10. Speed Filter

Receivers are equipped with Speed Filtering for increased responsiveness of the speed value.

10.1. Speed Filter Enable Command

This functionality can be enabled with the STATE subgroup of the SPEED_FILTER group and the ENABLE Command.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	SPEED_FILTER	STATE	ENABLE	<CR><LF>

10.2. Speed Filter Disable Command

This functionality can be disabled with the STATE subgroup of the SPEED_FILTER group and the DISABLE Command.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	SPEED_FILTER	STATE	DISABLE	<CR><LF>

10.3. Speed Filter Preset Set Command

The sensitivity of the filter can be adjusted. The SET command with the PRESET subgroup, followed by the preset number (1 to 3), sets different sensitivities. 1 is the lowest sensitivity, and 3 is the highest sensitivity.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	SPEED_FILTER	PRESET	SET	1 - 3	<CR><LF>

10.4. Speed Filter Preset Default Command

The preset value can be reset to the default value (2) with the DEFAULT command.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	SPEED_FILTER	PRESET	DEFAULT	<CR><LF>

Command Examples via Serial

- Disabling Speed Filtering:

```
$SPEED_FILTER STATE DISABLE<CR><LF>
```

- Setting Preset to 3:

```
$SPEED_FILTER PRESET SET 3<CR><LF>
```

- Setting Preset to Default:

```
$SPEED_FILTER PRESET DEFAULT<CR><LF>
```

11. Course over Ground (CoG) Filter

Receivers are equipped with Course over Ground (CoG) Filtering for better orientation responsiveness.

11.1. CoG Filter Enable Command

This functionality can be enabled with the STATE subgroup of the COG_FILTER group and the ENABLE Command.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	COG_FILTER	STATE	ENABLE	<CR><LF>

11.2. CoG Filter Disable Command

This functionality can be disabled with the STATE subgroup of the COG_FILTER group and the DISABLE Command.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	COG_FILTER	STATE	DISABLE	<CR><LF>

11.3. CoG Filter Preset Set Command

The sensitivity of the filter can be adjusted. The SET command with the PRESET subgroup, followed by the preset number (1 to 3), sets different sensitivities. 1 is the lowest sensitivity (lowest filtering level), and 3 is the highest sensitivity (highest filtering level). Setting the filter sensitivity to 3 means that the heading will be less responsive, recommended for rough terrain.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	COG_FILTER	PRESET	SET	1 - 3	<CR><LF>

11.4. CoG Filter Preset Default Command

The preset value can be reset to a Default value with the DEFAULT command. The Default preset is 1.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	COG_FILTER	PRESET	DEFAULT	<CR><LF>

Command Examples via Serial

- Setting State to ENABLE:

```
$COG_FILTER STATE ENABLE<CR><LF>
```

- Setting State to DISABLE:

```
$COG_FILTER STATE DISABLE<CR><LF>
```

- Setting Preset to 3:

```
$COG_FILTER PRESET SET 3<CR><LF>
```

- Setting Compensating Rear Distance to 500 mm:

```
$COG_FILTER COMPENSATION SET REAR_DISTANCE 500<CR><LF>
```

12. IMU Axes Customization

IMU Axes Customization is an exclusive feature for OEM variants, designed to adjust the IMU axes to compensate the installation orientation. It lets you set the forward and upward axes separately (in that order), ensuring the same axis isn't used for both. By default, the forward axis is set to -x and the upward axis to -z.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	IMU	AXES	SET	+X	+X	<CR><LF>
				-X	-X	
				+Y	+Y	
				-Y	-Y	
				+Z	+Z	
				-Z	-Z	

Command Examples via Serial

➢ Customizing IMU axes for upside-down OEM installation:

$IMU AXES SET -X +Z<CR><LF>

➢ Customizing IMU axes for 180-degree OEM rotation:

$IMU AXES SET +X -Z<CR><LF>

NOTE

General group commands like SAVE and RESTORE are not supported; only the STATUS command is available. However, the IMU command is saved automatically.

13. True Heading

The True Heading feature utilizes two devices, with one acting as the base and the other as the rover. This feature calculates the heading, defined as the angle from True North to the vector formed between the base and rover antennas, measured in a clockwise direction. It may take up to 5 minutes after the setup for the base to acquire accurate data. The device, enable/disable and mounting commands are configurable with separate commands via serial, while via CAN its done with flags.

13.1. True Heading Device Command

The command configures each device as either a base or a rover. Remember to set this configuration on both products.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	TRUE_HEADING	CONFIGURATION	SET	BASE	<CR><LF>
				ROVER	

(Interface: CAN): Check section: Configuring True Heading Flags over CAN.

13.2. True Heading Serial Port Command

This command sets up which serial port is used on the rover and on the base for their communication. Make sure to apply this configuration to both devices.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	TRUE_HEADING	PORT	SET	SERIAL1	<CR><LF>
				SERIAL2	
				SERIAL3	

(Interface: CAN)

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
03	1	0	00	02	Serial 1: 0x0000 Serial 2: 0x0100 Serial 3: 0x1000		<Reserved>	<Reserved>

13.3. True Heading Mounting Command

Devices can be mounted in two configurations:

- Longitudinal setup, where the base and rover are aligned along the vehicle's centerline with one device at the front and the other at the rear;
- Lateral setup, where the base and rover are positioned side by side when viewed from the pilot's perspective.

With this command, you must specify the mounting configuration chosen and indicate the base position relative to the pilot reference point. This configuration needs to be applied only to the base.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	TRUE_HEADING	BASE	MOUNTING	LONGITUDINAL	BACK	<CR><LF>
					FRONT	
				LATERAL	LEFT	
					RIGHT	

(Interface: CAN): Check section: Configuring True Heading Flags over CAN.

13.4. True Heading Rover Distance Command

This command sets the distance between the rover and the base in centimeters and is an optional configuration that enhances heading accuracy. It only needs to be applied to the rover.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	TRUE_HEADING	ROVER	DISTANCE	0 - 65535	<CR><LF>

(Interface: CAN)

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
03	1	0	01	02	<Distance>		<Reserved>	<Reserved>

13.5. True Heading State Command

This command enables and disables the feature. True Heading, which is disabled by default, must be enabled on both the rover and the base to work correctly.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	TRUE_HEADING	STATE	ENABLE	<CR><LF>
			DISABLE	

(Interface: CAN): Check section: Configuring True Heading Flags over CAN.

13.6. Configuring True Heading Flags over CAN

The flag is a 4 bits message composed of 3 items. The first item is the device state, enabled or disabled, the second item is the device configuration and the last is the mounting configuration, with 2 bits. The following table describes each item and their values.

Item	Subitem	Value
State (bit 0)	Disable	0
	Enable	1
Device configuration (bit 1)	Base	0
	Rover	1
Mounting configuration (bits 2 and 3)	Back	0x00
	Front	0x01
	Left	0x10
	Right	0x11

The following table describes the True Heading Flags Command.

(Interface: CAN)

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
03	1	0	02	02	<Flags (hexadecimal)>		<Reserved>	<Reserved>

Command Examples via Serial

➢ Setting mounting configuration to lateral with the base on the left side:

$TRUE_HEADING BASE MOUNTING LATERAL LEFT<CR><LF>

➢ Setting the distance from rover to base to 30cm:

$TRUE_HEADING ROVER DISTANCE 30<CR><LF>

➢ Enabling True Heading:

$TRUE_HEADING STATE ENABLE<CR><LF>

Command Examples via CAN

➢ Setting up serial 2 without saving:

ID: 0x18FF141C
Message: 0x0301000200010000

➢ Setting the distance to 100cm without saving:

ID: 0x18FF141C
Message: 0x0301010264000000

➢ Setting the flags with state as enable, device configuration as rover and mounting configuration as back without saving:

ID: 0x18FF141C
Message: 0x03010202000C0000

14. Smoothtrack

Smoothtrack is a feature designed to ensure seamless operation during the complete loss of correction signals. When a correction signal is no longer available, Smoothtrack activates to maintain stability and consistent tracking, minimizing jumps when switching from corrected to non-corrected operation. Comes disabled by default.

14.1. Smoothtrack Enable Command

The command below enables the Smoothtrack feature.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	SMOOTHTRACK	STATE	ENABLE	<CR><LF>

14.2. Smoothtrack Disable Command

The command below disables the Smoothtrack feature.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	SMOOTHTRACK	STATE	DISABLE	<CR><LF>

14.3. Smoothtrack Transition Command

The command below defines how quickly the route transition will occur. The default transition time is 60 seconds, but it can be adjusted between 0 and 600 seconds.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	SMOOTHTRACK	TRANSITION	SET	0 - 600	<CR><LF>
			DEFAULT	-	

Command Examples via Serial

➢ Enabling Smoothtrack:

```
$SMOOTHTRACK STATE ENABLE<CR><LF>
```

➢ Setting transition time to 30 seconds:

```
$SMOOTHTRACK TRANSITION SET 30<CR><LF>
```

➢ Setting transition time to default (60 seconds):

```
$SMOOTHTRACK TRANSITION DEFAULT<CR><LF>
```

15. Scintillation

Scintillation is an algorithm designed to detect and mitigate ionospheric scintillation, a phenomenon that disrupts signal integrity in satellite-based navigation systems. By addressing these disturbances, Scintillation enhances the reliability of positioning accuracy. This effect is most pronounced in polar regions and along the equatorial belt, where ionospheric activity is intensified due to geomagnetic and solar influences, and is not so relevant in mid-latitude regions, such as the European and North American continents. Scintillation occurs more precisely 2 to 6 hours after the sun is down, when ionospheric irregularities reach their peak activity, further impacting signal transmission.

15.1. Scintillation Enable Command

The command below enables the Scintillation feature.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	SCINTILLATION	STATE	ENABLE	<CR><LF>

15.2. Scintillation Disable Command

The command below disables the Scintillation feature.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	SCINTILLATION	STATE	DISABLE	<CR><LF>

Command Examples via Serial

➢ Enabling Scintillation:

```
$SCINTILLATION STATE ENABLE<CR><LF>
```

16. Antenna Position Compensation

Antenna Compensation is an algorithm that compensates the position and course over ground based on the longitudinal distance to the vehicle's rear axis and the transversal distance to the vehicle's longitudinal central axis. It comes disabled by default. The position and course over ground compensation can be enabled separately.

16.1. Antenna Position Enable Command

The command below enables the Antenna Position compensations. “COORDINATES” in value 1 enables the position compensation based on the distances configured and “COURSE_GND” enables the course over ground compensation. Coordinates compensation can be separately enabled for rear or center coordinates. Leave <Value 2> empty to enable rear and center at once.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	ANTENNA_POSITION	STATE	ENABLE	COORDINATES or COURSE_GND	REAR or CENTER	<CR><LF>

16.2. Antenna Position Disable Command

The command below disables the Antenna Position feature. “COORDINATES” in value 1 disables the position compensation based on the distances configured and “COURSE_GND” disables the course over ground compensation. Coordinates compensation can be separately disabled for rear or center coordinates. Leave <Value 2> empty to disable rear and center at once.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	ANTENNA_POSITION	STATE	DISABLE	COORDINATES or COURSE_GND	REAR or CENTER	<CR><LF>

16.3. Antenna Position Rear Distance Command

The command below sets the distance to the vehicle's rear axis in centimeters. A negative value means the antenna is behind the rear axis, while a positive value indicates the antenna is ahead of the axis.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	ANTENNA_POSITION	SET	REAR_DISTANCE	[-32767 | +32767]	<CR><LF>

16.4. Antenna Position Center Distance Command

The command below sets the distance to the vehicle's longitudinal axis in centimeters. A negative value means the antenna is on the left of the longitudinal axis, while a positive value indicates the antenna is on the right of the axis.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	ANTENNA_POSITION	SET	CENTER_DISTANCE	[-32767 | +32767]	<CR><LF>

Command Examples via Serial

➢ Enabling Antenna Position Compensation respective to the rear axis:

$ANTENNA_POSITION STATE ENABLE COORDINATES REAR<CR><LF>

$ANTENNA_POSITION STATE ENABLE COURSE_GND<CR><LF>

➢ Setting Antenna Rear Distance to 100mm:

$ANTENNA_POSITION SET REAR_DISTANCE 100<CR><LF>

➢ Setting Antenna Center Distance to -100mm:

$ANTENNA_POSITION SET CENTER_DISTANCE -100<CR><LF>

17. Ground Speed Output (GSO) Radar

Receivers have an output that generates a variable frequency digital pulse proportional to the vehicle's ground speed. Output signal parameters are configurable by the user.

17.1. GSO Pulse Per Meter Command

The Pulse Per Meter (PPM) command configures the number of transitions that will be performed at GSO Output per meter traveled by the receiver.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	IO	GSO	PPM	1 - 1000	<CR><LF>

17.2. GSO Update Rate Command

The Update Rate command sets how fast the GSO output will be updated with the new speed value. The table below shows the command's message fields, where Value 1 represents the possible update rate values in Hertz (Hz).

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	IO	GSO	UPDATE_RATE	1	<CR><LF>
				2	
				5	
				10	
				20	
				50	
				100	

17.3. GSO Minimal Velocity Command

The Minimal Velocity command sets the minimal velocity at which the receiver must be moving to enable GSO output. This is useful to avoid noise when the receiver is not moving/idle. Value 1 sets the threshold velocity in millimeters per second (mm/s).

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	IO	GSO	MIN_VEL	0 - 65536	<CR><LF>

17.4. GSO Enable Command

The Enable command sets Ground Speed Output to start operation, considering the configured values for PPM, Minimal Velocity and Update Rate.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	IO	GSO	ENABLE	<CR><LF>

17.5. GSO Disable Command

The Disable command stops the Ground Speed Output's from operating.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	IO	GSO	DISABLE	<CR><LF>

Command Example via Serial

- Setting GSO output to operate at 30 PPM:

```
$IO GSO PPM 30<CR><LF>
```

- Setting GSO Output Rate to 100 Hz:

```
$IO GSO UPDATE_RATE 100<CR><LF>
```

- Setting GSO Minimal Velocity to 1 km/h (277 mm/s):

```
$IO GSO MIN_VEL 277<CR><LF>
```

- Enabling GSO operation:

```
$IO GSO ENABLE<CR><LF>
```

- Disabling GSO operation:

```
$IO GSO DISABLE<CR><LF>
```

18. Pulse Per Second (PPS)

Receivers have an output that generates a pulsed signal having its edge synchronized with the seconds counter from the satellites. This is particularly useful for accurate time measurement on a seconds level.

18.1. PPS Polarity Command

This command selects if the rising or falling edge of the pulse will be synchronized with the second clock.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	IO	PPS	POLARITY	RISING	<CR><LF>
				FALLING	

18.2. PPS Duty Cycle Command

The Duty Cycle commands selects what percentage (%) of the period the pulse will be in high state.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	IO	PPS	DUTY_CYCLE	0 - 100	<CR><LF>

18.3. PPS Period Command

The Period command sets the period of the pulse output, in milliseconds (ms).

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	IO	PPS	PERIOD_MS	10-65000	<CR><LF>

18.4. PPS Enable Command

The Enable command sets the Pulse per Second to start operation, considering the previous values configured to Period, Duty Cycle and Polarity.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	IO	PPS	ENABLE	<CR><LF>

18.5. PPS Disable Command

The Disable command stops the Pulse Per Second operation.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	IO	PPS	DISABLE	<CR><LF>

Command Example via Serial

- Setting PPS output to operate at rising polarity:

```
$IO PPS POLARITY RISING<CR><LF>
```

- Setting PPS output to operate at 20% duty cycle:

```
$IO PPS DUTY_CYCLE 20<CR><LF>
```

- Setting PPS period to 100 ms:

```
$IO PPS PERIOD_MS 100<CR><LF>
```

- Enabling PPS start of operation:

```
$IO PPS ENABLE<CR><LF>
```

- Disabling PPS operation:

```
$IO PPS DISABLE<CR><LF>
```

19. Cellular Network Configuration and Diagnostics

Ultra and *RTK* devices are capable of connecting to the Internet via a cellular network (2G/3G/4G). The Cellular message group can be used to configure the APN for the SIM card's mobile provider, and to verify Internet connection to the correction servers.

NOTE

When *Ultra* (or *RTK)* powers on, Internet connectivity may take some minutes to establish. Status can be checked with the *Cellular Diagnostic Internet* command.

19.1. Cellular APN Name Command

The APN Name command sets the APN (Access Point Name) name. The device can store up to 4 APN configurations, specified with an Index (0-3).

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	CELLULAR	APN	NAME	<Index> (0-3)	<Name>	<CR><LF>

19.2. Cellular APN User Command

The APN User command sets the APN (Access Point Name) username. The device can store up to 4 APN configurations, specified with an Index (0-3).

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	CELLULAR	APN	USER	<Index> (0-3)	<User>	<CR><LF>

19.3. Cellular APN Password Command

The APN Password command sets the APN (Access Point Name) password. The device can store up to 4 APN configurations, specified with an Index (0-3).

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	CELLULAR	APN	PASSWORD	<Index> (0-3)	<Password>	<CR><LF>

19.4. Cellular APN Context Type Command

The APN Context Type command sets the APN (Access Point Name) protocol type. The device can store up to 4 APN configurations, specified with an Index (0-3).

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	CELLULAR	APN	CONTEXT_TYPE	<Index> (0-3)	IPv4	<CR><LF>
					IPv6	
					IPv4v6	

19.5. Cellular APN Auth Method Command

The APN Auth Method command sets the APN (Access Point Name) authentication method. The device can store up to 4 APN configurations, specified with an Index (0-3).

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	CELLULAR	APN	AUTH_METHOD	<Index> (0-3)	NONE	<CR><LF>
					PAP	
					CHAP	
					PAP_CHAP	

19.6. Cellular APN Select Command

The APN Select command selects which saved APN (Access Point Name) to use by specifying its Index (0-3).

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	CELLULAR	APN	SELECT	<Index> (0-3)	<CR><LF>

19.7. Cellular Diagnostic Internet Command

The Diagnostic Internet command displays current Internet connection status and data rate.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	CELLULAR	DIAGNOSTIC	INTERNET	<CR><LF>

Command Examples via Serial

- Set APN #0 name to Verizon:

```
$CELLULAR APN NAME 0 vzwinternet<CR><LF>
```

- Set APN #0 protocol to IPv4/IPv6:

```
$CELLULAR APN CONTEXT_TYPE 0 IPv4v6<CR><LF>
```

- Select APN #0 for usage when connecting to Internet:

```
$CELLULAR APN SELECT 0<CR><LF>
```

- Display current Internet connection status:

```
$CELLULAR DIAGNOSTIC INTERNET<CR><LF>
```

20. Position Correction Services

Ultra and *RTK* devices support several services for GNSS positioning correction. The Correction message group configures which correction service to use, if any. The device supports correction via internet and satellite.

NOTE

PPP-RTK correction services (LBAND, MQTT) are available in Nordian's PointPerfect.

20.1. Correction State Enable Command

The State Enable command enables GNSS positioning correction.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	CORRECTION	STATE	ENABLE	<CR><LF>

(Interface: CAN)

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
07	1	0	00	01	Enable: 01	<Reserved>	<Reserved>	<Reserved>

20.2. Correction State Disable Command

The State Enable command disables GNSS positioning correction.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	CORRECTION	STATE	DISABLE	<CR><LF>

(Interface: CAN)

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
07	1	0	00	01	Disable: 00	<Reserved>	<Reserved>	<Reserved>

20.3. Correction Source Set Command

The Source Set command sets the correction data source among available services. Position

correction via RADIO is only available in *RTK* devices.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	CORRECTION	SOURCE	SET	RADIO	<CR><LF>
				LBAND	
				MQTT	

(Interface: CAN)

Byte 0	Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
07	1	0	01	01	Radio: 01 LBand: 03 MQTT: 04	<Reserved>	<Reserved>	<Reserved>

20.4. Correction Reference Station ID Set Command

The command sets the reference station ID field of the NMEA0183 (GGA) and NMEA2000 (PGN129029) messages. The value must be from 0 to 1023.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	CORRECTION	REF_STATION_ID	SET	0 - 1023	<CR><LF>

Command Examples via Serial

➢ Enable GNSS correction:

$CORRECTION STATE ENABLE<CR> <LF>

➢ Setting source correction to LBAND PointPerfect:

$CORRECTION SOURCE SET LBAND<CR><LF>

➢ Setting reference station ID to 555 :

$CORRECTION REF_STATION_ID SET 555<CR><LF>

Command Examples via CAN

➢ Enable GNSS correction and save:

ID: 0x18FF151C Message: 0x0701000101000

➢ Setting source correction to LBAND PointPerfect and saving:

ID: 0x18FF151C Message: 0x0701010103000000

21. Reference Frame Conversion

The Reference Frame Conversion ensures that GNSS data is accurately aligned with the global reference frame by correcting for shifts, rotation, scale, and tectonic movements. This guarantees precise, consistent positioning for applications such as surveying and mapping. Nordian positioning is aligned with ITRF2020 current epoch, so if there's a need to align the position to other reference frames, this function can be used.

21.1. Reference Frame Conversion Enable Command

This functionality can be enabled with the STATE subgroup of the REFERENCE_CONV group and the ENABLE Command.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	REFERENCE_CONV	STATE	ENABLE	<CR><LF>

21.2. Reference Frame Conversion Disable Command

This functionality can be disabled with the STATE subgroup of the REFERENCE_CONV group and the DISABLE Command.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	REFERENCE_CONV	STATE	DISABLE	<CR><LF>

21.3. ITRF Command

This functionality sets the ITRF_NUM reference frame to convert to.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	REFERENCE_CONV	ITRF	SET	ITRF2020	<CR><LF>
				ITRF2014	
				ITRF2008	
				ITRF2005	
				ITRF2000	

21.4. ITRF Default Command

This functionality resets ITRF to default value ITRF2020.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	REFERENCE_CONV	ITRF	DEFAULT	<CR><LF>

21.5. EPOCH Command

This functionality sets the desired epoch, in years and the decimal case. For example: Jun/2024 can be represented as 20245 (2024.5).

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	REFERENCE_CONV	EPOCH	SET	<Epoch> <20245>	<CR><LF>

21.6. EPOCH Default Command

This functionality resets offset to default value (actual epoch).

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	REFERENCE_CONV	EPOCH	DEFAULT	<CR><LF>

Command Examples via Serial

➢ Enable Reference Frame Conversion:

```
$REFERENCE_CONV STATE ENABLE<CR><LF>
```

22. Spectrum Operation Mode

This functionality is available exclusively for SX variants. It allows you to configure the Spectrum antenna's operation mode as either a reference station (base) or a smart antenna (rover). By default, the Spectrum antenna is set to operate as a rover.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	SPECTRUM	OPERATION	SET	BASE	<CR><LF>
				ROVER	

Command Examples via Serial

➢ Set Spectrum operation mode to operate as a base:

```
$SPECTRUM OPERATION SET BASE<CR><LF>
```

23. Base Station Configuration

This group enables the configuration of various parameters for the Spectrum antenna variants when operating in base mode.

23.1. Base Calibration

Select the algorithm for determining the base station absolute position.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	BASE_STATION	CALIBRATION	SET	POSITION	<CR><LF>
				CURR_POSITION	
				SURVEY_IN	
				STANDALONE	

When the POSITION algorithm is enabled, you must specify the latitude, longitude, and height, which includes setting the reference station position latitude (up to 9 decimal places), longitude (up to 9 decimal places), and antenna height (up to 4 decimal places) in Fixed Position calibration mode

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	BASE_STATION	CALIBRATION	POSITION	LAT	<Latitude (deg)>	<CR><LF>
				LON	<Longitude (deg>	
				HEIGHT	<Height (m)>	

When CURR_POSITION is set, a minimum horizontal accuracy must be specified. The maximum allowable value for this accuracy is 65535.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	BASE_STATION	CALIBRATION	CURR_POSITION	ACC	<Accuracy (mm)>	<CR><LF>

When SURVEY_IN is set, a minimum time to acquire position and accuracy must be specified. The maximum allowable value for minimal time is 4294967295 seconds, and for accuracy, it is 429496729.5 mm. Additionally, the required accuracy (i.e., maximum standard deviation, up to 1 decimal place) can be set to end Survey-In calibration mode.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	BASE_STATION	CALIBRATION	SURVEY_IN	MIN_TIME	<Time (s)>	<CR><LF>
				ACC	<Accuracy (mm)>	
				RESET	-	

- The RESET command deletes the Survey-In position stored in memory, allowing for recalibration
- The STANDALONE mode does not require any parameter configuration for setup or operation
- The POSITION calibration mode is selected by default

23.2. Base RTCM Message

Configures the type and RTCM messages to be transmitted through a designated serial port.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	BASE_STATION	RTCM_MSG	TYPE	MSM4	-	<CR><LF>
				MSM7		
			ENABLE	SERIAL1	<Message Number>	
				SERIAL2		
				SERIAL3		
			DISABLE	SERIAL1	<Message Number>	
				SERIAL2		
				SERIAL3		
			PERIOD	MSM	<Period>	
				<Message Number>	<Period>	

When the type is set to MSM4, the following message numbers are enabled: 1074, 1084, 1094, and 1124. Selecting MSM7 enables these message numbers: 1077, 1087, 1097, and 1127. Additional messages are enabled for both types. The type MSM4 is activated by default. The RTCM message period must be selected within the range of 200 ms to 65535 ms.

23.3. Base RTCM Output

Enable or disable RTCM as the serial output for the desired serial port.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	BASE_STATION	RTCM_OUT	ENABLE	SERIAL1	<CR><LF>
				SERIAL2	
				SERIAL3	
			DISABLE	SERIAL1	
				SERIAL2	
				SERIAL3	

Serial port 3 works only if the radio is not configured on the same port.

23.4. Base ID

Sets the Reference Station ID (0-4095) for the RTCM output messages..

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	BASE_STATION	STATION_ID	SET	<Station ID>	<CR><LF>

23.5. Antenna ID

Sets the antenna ID for the RTCM output messages.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	BASE_STATION	SETUP_ID	SET	<Antenna ID>	<CR><LF>

23.6. Antenna Type

Sets the Antenna description according to IGS conventions for the RTCM output messages.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	BASE_STATION	ANTENNA_TYPE	SET	<Antenna Code>	<Radome Code>	<CR><LF>
			CLEAR			

The antenna code can be up to 15 characters, and the radome code up to 4 characters.

Selecting "Clear" resets the Antenna Descriptor to "ADVNULLANTENNA" for RTCM output messages.

23.7. Antenna Serial Number

Sets the Serial Number of the used antenna for the RTCM output messages.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	BASE_STATION	ANTENNA_SERIAL	SET	<Antenna Serial Num>	<CR><LF>

Command Examples via Serial

➢ Set STANDALONE as algorithm for determining the base station absolute position:

```
$BASE_STATION CALIBRATION SET STANDALONE<CR><LF>
```

24. PointPerfect Service

Ultra and *RTK* receivers integrate Nordian's proprietary PointPerfect position correction service. PointPerfect fetches correction data from local base stations, which increases the GNSS antenna accuracy up to a few centimeters.

NOTE

PointPerfect is factory enabled on all *Ultra* devices with an active plan. If no connection can be established with the PointPerfect server, position correction turns off.

Receivers obtain correction data from PointPerfect from satellites in supported regions with the L-Band option, or over the Internet with the MQTT.

24.1. PointPerfect MQTT Option

PointPerfect can get correction data using an Internet connection via the MQTT protocol. MQTT is a standard messaging protocol optimized for avoiding losses in unreliable networks.

24.1.1. PointPerfect MQTT Distribution Type Command

Correction data in PointPerfect via MQTT has two distribution types, selected with the Distribution Type command. Continental distribution receives encrypted correction for your region, regardless of your specific coordinates. Localized distribution gets unencrypted correction for a known base station near your coordinates.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	POINTPERFECT	MQTT_TOPICS	DISTRIBUTION	CONTINENTAL	<CR><LF>
				LOCALIZED	

24.1.2. PointPerfect MQTT Continental Topic Command

Use the Continental Topic command to set the MQTT Topic for encrypted Continental correction.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	POINTPERFECT	MQTT_TOPICS	CONTINENTAL	<Topic>	<CR><LF>

24.1.3. PointPerfect MQTT Localized Topic Command

Use the Localized Topic command to set the MQTT Topic for unencrypted Localized correction.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	POINTPERFECT	MQTT_TOPICS	LOCALIZED	<Topic>	<CR><LF>

24.1.4. PointPerfect MQTT Automatic Localized Topic

Use the Automatic Localized Topic command to enable automatic detection of Localized Topic depending on your location.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	End Sequence
$	POINTPERFECT	MQTT_TOPICS	AUTO_LOCALIZED	ON	<CR><LF>
				OFF	

Command Examples via Serial

➢ Set MQTT Distribution Type to Continental:

```
$POINTPERFECT MQTT_TOPICS DISTRIBUTION CONTINENTAL<CR><LF>
```

➢ Set MQTT Continental Topic:

```
$POINTPERFECT MQTT_TOPICS CONTINENTAL /a/b/myTopic<CR><LF>
```

➢ Enable MQTT Automatic Localized Topic:

```
$POINTPERFECT MQTT_TOPICS AUTO_LOCALIZED ON<CR><LF>
```

24.2. PointPerfect L-Band Option

PointPerfect can get correction data from satellite signals in supported regions using L-Band signals. L-Band data is encrypted and if Internet connection is available, the device automatically gets decryption keys from the PointPerfect servers.

24.2.1. PointPerfect L-Band Credentials Command

The L-Band Credentials Command sends all encrypted data information needed for the PointPerfect connection when there's no connection to the internet. The credential key is 48 bytes in length. Divide it in half, sending the first part to <Value 1> and the second part to <Value 2>.

(Interface: Serial)

First Character	Group	Subgroup	Command	Value 1	Value 2	End Sequence
$	POINTPERFECT	LBAND_KEYS	CREDENTIALS	<First 24 bytes >	<Last 24 bytes>	<CR><LF>

Command Examples via Serial

➢ Set credential key for PointPerfect connection via L-Band Note:
(Example key shown — not a real or active key)

$POINTPERFECT LBAND_KEYS CREDENTIALS
aa959c43485ed26bbe0f5b2bbd328aa886eba1d815690a82eb2e383c65605a8279da475fda6d5ee765117ba556420ea0
4d62a4655f5ed958523d257d2f5110b4b9c5f270c541c57ba1b79508658ab024eb3194f19b8fdf70cedad9fe622d1e3f <CR><LF>

25. Group Configurations

When configurations are altered via Serial commands, they're only active while the device is powered on. Configuration settings can be saved in/restored from internal memory between power cycles (ON/OFF) using the CONFIGS subgroup.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	<Group>	CONFIGS	RESTORE	<CR><LF>
			SAVE	
			STATUS	

NOTE

General Configurations commands can be used with all message groups.

Command Examples via Serial

➢ Save current configurations of the COM group in the device's non-volatile memory:

$COM CONFIGS SAVE<CR><LF>

➢ Restore the NMEA 0183 group from configurations saved in memory:

$NMEA0183 CONFIGS RESTORE<CR><LF>

➢ Display current configurations of the NMEA 2000 group:

$NMEA2000 CONFIGS STATUS<CR><LF>

➢ Save current configuration source of PointPerfect to MQTT

$POINTPERFECT CONFIGS SAVE MQTT_TOPICS<CR><LF>

26. All Configurations

All configuration settings can be saved/restored at once from Smart Antenna internal memory using the ALL command list. ALL can be also used to restore the device to factory settings.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	ALL	CONFIGS	DEFAULT	<CR><LF>
			SAVE	
			RESTORE	

Command Examples via Serial

➢ Restore receiver to factory settings:

```
$ALL CONFIGS DEFAULT<CR><LF>
```

➢ Save *all* current configurations into Smart Antenna non-volatile memory:

```
$ALL CONFIGS SAVE<CR><LF>
```

➢ Restore *all* groups to saved configurations:

```
$ALL CONFIGS RESTORE<CR><LF>
```

27. General Information

Displays product information.

27.1. Product Information Commands

Displays the product's serial number, model and correction status.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	INFO	PRODUCT	SERIAL_NUM	<CR><LF>
			MODEL	
			STATUS	
		CPU	USAGE	

(Interface: CAN)

Serial Number Information							
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
06	51	00	0D	<Reserved>	<Reserved>	<Reserved>	<Reserved>

(Interface: CAN)

Model Version Information							
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
06	21	01	05	<Reserved>	<Reserved>	<Reserved>	<Reserved>

27.2. Software Information Commands

Displays the product firmware version.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	INFO	SOFTWARE	FIRMWARE	<CR><LF>

(Interface: CAN)

Firmware Version Information							
Byte 0	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**
06	21	02	06	<Reserved>	<Reserved>	<Reserved>	<Reserved>

27.3. Hardware Information Commands

Displays the product board version.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	INFO	HARDWARE	BOARD	<CR><LF>

(Interface: CAN)

Hardware Version Information							
Byte 0	**Byte 1**	**Byte 2**	**Byte 3**	**Byte 4**	**Byte 5**	**Byte 6**	**Byte 7**
06	21	03	08	<Reserved>	<Reserved>	<Reserved>	<Reserved>

27.4. Hardware Fault Command

Displays the hardware fault status of the product.

(Interface: Serial)

First Character	Group	Subgroup	Command	End Sequence
$	INFO	FAULT	STATUS	<CR><LF>

Command Examples via Serial

➢ Displays the product's serial number:

$INFO PRODUCT SERIAL_NUM<CR><LF>

➢ Displays the product model:

$INFO PRODUCT MODEL<CR><LF>

➢ Displays the product correction status:

$INFO PRODUCT STATUS<CR><LF>

➢ Displays the CPU usage:

$INFO CPU USAGE<CR><LF>

➢ Displays the product's firmware version:

$INFO SOFTWARE FIRMWARE<CR><LF>

➢ Displays the product's board version:

$INFO HARDWARE BOARD<CR><LF>

➢ Displays the product fault status:

$INFO FAULT STATUS<CR><LF>

Command Examples via CAN

➢ Displays the product model:

ID: 0x18FF161C Message: 0x060B01050000000

28. Appendix

NMEA 0183 DTM Description

The DTM message identifies the local geodetic datum and datum offsets from a reference datum.

Structure

```
$xxDTM,datum,subDatum,lat,NS,lon,EW,alt,refDatum*cs\r\n
```

Example

```
$GPDTM,999,,0.08,N,0.07,E,-47.7,W84*1C\r\n
```

DTM Message Data

Field	Name	Description
1		DTM Field
2	Datum	Local datum code: W84 = WGS84
3	Sub Datum	null
4	Latitude	Offset in Latitude
5	North or South	North/South indicator
6	Longitude	Offset in Longitude
7	East or West	East/West indicator
8	Altitude	Offset in altitude
9	Reference Datum	Reference datum code: W84 (WGS 84, fixed field)
10	CS	Checksum
11	CRLF	Carriage return and line feed

NMEA 0183 GGA Description

The GGA message includes positioning, time and receiver fix information.

Structure

```
$xxGGA,hhmmss.ss,ddmm.mmmmm,a,dddmm.mmmmm,a,d,ss,h.hh,aaaa.a,M,gg.g,M,ss,iiii*cs\n\r
```

Example

```
$GNGGA,142357.00,3027.11489,S,52473.51290,W,1,08,1.21,679.6,M,12.0,M,,*8E\r\n
```

GGA Message Data

Field	Name	Description
1		GGA Field
2	UTC Time	UTC time
3	Latitude	Latitude (degrees and minutes)
4	N or S	North / South indicator
5	Longitude	Longitude (degrees and minutes)
6	E or W	East/West indicator
7	Quality Indicator	Quality indicator for position fix
8	Number of Satellites	Number of satellites into positioning solution
9	HDOP	Horizontal Dilution of Precision (HDOP)
10	Altitude	Altitude above mean sea level
11	Altitude Unit	Altitude units: M (meters)
12	Geoid Separation	Difference between ellipsoid and mean sea level
13	Geoid Separation Unit	Geoid Separation units: M (meters)
14	DGPS Age	Age of differential corrections
15	DGPS Station ID	Station ID that provides differential corrections
16	CS	Checksum
17	CRLF	Carriage Return and Line Feed

NMEA 0183 GLL Description

The GLL message includes latitude and longitude, with time of position fix and status.

Structure

```
$xxGLL,lat,NS,lon,EW,time,status,posMode*cs\r\n
```

Example

```
$GPGLL,4717.11364,N,00833.91565,E,092321.00,A,A*60\r\n
```

GLL Message Data

Field	Name	Description
1		GLL Field
2	Latitude	Latitude (degrees and minutes)
3	N or S	North / South indicator
4	Longitude	Longitude (degrees and minutes)
5	E or W	East/West indicator
6	Time	UTC time.
7	Status	Data validity status
8	Position Mode	Positioning mode
9	CS	Checksum
10	CRLF	Carriage Return and Line Feed

NMEA 0183 GRS Description

The GRS message provides residuals from the GNSS navigation solution, which indicate how well the receiver's position estimate aligns with the received satellite signals. These residuals help in assessing GNSS accuracy and detecting potential errors.

Structure

```
$xxGRS,hhmmss.ss,<mode>,<residual1>,<residual2>,...,<residual12>,<systemID>*cs\r\n
```

Example

```
$GPRS,123519.00,2,0.5,1.2,-0.8,,,0.7,,,,,,1*47
```

GRS Message Data

Field	Name	Description
1		GRS Field
2	Time	UTC time at which the range residuals were calculated (hhmmss.ss)
3	Mode	Mode indicator (0 = No fix, 1 = Fix with no residuals, 2 = Fix with residuals)
4 - 15	Residuals	Range residuals for up to 12 satellites (in meters)
16	System ID	Satellite information related to System ID constellation
17	CS	Checksum
18	CRLF	Carriage Return and Line Feed

NMEA 0183 GSA Description

The GSA message includes the GPS DOP and active satellites information.

Structure

```
$GPGSA,n,n,nn,nn,nn,nn,nn,nn,nn,nn,,,,,n.nn,n.nn,n.nn,l*cs\r\n
```

Example

```
$GPGSA,A,3,23,29,07,08,09,18,26,28,,,,,1.94,1.18,1.54,1*0D\r\n
```

GSA Message Data

Field	Name	Description
1		GSA Field
2	Mode	Mode indicator
3	Fix Type	Positioning fix type
4	PRN number	Satellite PRN number
5	PDOP	Position dilution of precision (DOP)
6	HDOP	Horizontal dilution of precision (DOP)
7	VDOP	Vertical dilution of precision (DOP)
8	CS	Checksum
9	CRLF	Carriage Return and Line feed

NMEA 0183 GST Description

The GST message includes error statistics for the position measurements.

Structure

```
$GNGST,hhmmss.ss,n.nnn,n.nnn,n.nnn,n.nn,n.nnn,n.nnn,n.nnn*cs\r\n
```

Example

```
$GNGST,163023.94,8.141,3.187,3.187,0.00,3.187,3.187,6.780*74\r\n
```

GST Message Data

Field	Name	Description
1		GST Field
2	UTC Time	UTC Time
3	Range Inputs Std Dev	RMS value of the standard deviation of range inputs to the navigation process
4	Error Ellipse Semi-Major Std Dev	Standard deviation of semi-major axis of error ellipse (meters)
5	Error Ellipse Semi-Minor Std Dev	Standard deviation of semi-minor axis of error ellipse (meters)
6	Error Ellipse Semi-Major Orientation	Orientation of semi-major axis of error ellipse (degrees)
7	Latitude Error Std Dev	Standard deviation of latitude error (meters)
8	Longitude Error Std Dev	Standard deviation of longitude error (meters)
9	Altitude Error Std Dev	Standard deviation of altitude error (meters)

NMEA 0183 GSV Description

The GSV message includes information of the GNSS satellites in view.

Structure

```
$xxGSV,s,s,ss,ss,ss,sss,ss,s*cs\r\n
```

Example

```
$GNGSV,3,1,09,09,,,17,10,,,40,12,,,49,13,,,35,1*6F\r\n
```

GSV Message Data

Field	Name	Description
1		GSV Field
2	Number of Messages	Number of messages, total number of GSV messages being output (range: 1-9)
3	Message No	Number of this message
4	No of Satellites	Number of satellites
Start of repeating group (1 ... 4 times)		
5	Sat Number & ID	Satellite number & ID
6	Elevation	Elevation (range: +/-90)
7	Azimuth	Azimuth (range 0-360)
8	Carrier to Noise	Carrier to noise ratio (signal strength)
End of repeating group (1 ... 4 times)		
9	NMEA GNSS ID	NMEA-defined GNSS system ID
10	CS	Checksum
11	CRLF	Carriage Return and Line feed

NMEA 0183 HDT Description

The HDT message provides the heading relative to true north.

Structure

```
$GNHDT,hhh.hhh,T*cc\r\n
```

Example

```
$GNHD,123.456,T*1A
```

HDT Message Data

Field	Name	Description
1		HDT Field
2	Heading	The heading in degrees relative to true north
3		T Field
4	Checksum	Checksum data for error checking

NMEA 0183 RMC Description

The RMC message includes the recommended minimum sentence defined by NMEA for GNSS system data.

Structure

```
$xxRMC,hhmmss.ss,a,ddmm.mmmmm,a,ddmm.mmmmm,a,vv.vv,dd.dd,ddmmyy,dd,dd,a,a,*cs\r\n
```

Example

```
$GNRMC,083559.00,A,4717.11437,N,00833.91522,E,0.004,77.52,091202,,,A,V*57\r\n
```

RMC Message Data

Field	Name	Description
1		RMC Field
2	UTC Time	UTC time
3	Data Validity	Data validity indicator
4	Latitude	Latitude (degrees and minutes)
5	N or S	North / South indicator
6	Longitude	Longitude (degrees and minutes)
7	E or W	East/West indicator
8	Speed Over Ground	Speed over ground in knots
9	Course Over Ground	Course over ground in degrees
10	Date	Date in day, month and year format
11	Magnetic Variation	Magnetic variation value
12	Magnetic Variation Indicator	Magnetic variation E/W indicator
13	Position Mode	Position mode indicator
14	Navigation Status	Navigation status indicator
15	CS	Checksum
16	CRLF	Carriage Return and Line Feed

NMEA 0183 VTG Description

The VTG message includes course over ground and speed over ground information.

Structure

```
$xxVTG,dd.dd,a,dd.dd,a,vv.vvv,a,vv.vvv,a,a*cs\r\n
```

Example

```
$GNVTG,77.52,T,,M,0.004,N,0.008,K,A*06\r\n
```

VTG Message Data

Field	Name	Description
1		VTG Field
2	Course Over Ground	Course over ground in degrees
3	Course Over Ground Unit	Course over ground unit: T
4	Course Over Ground Magnetic	Course over ground magnetic in degrees
5	Course Over Ground Magnetic Unit	Course over ground unit: M
6	Speed Over Ground	Speed over ground in knots
7	Speed Over Ground Unit	Speed over ground unit: N
8	Speed Over Ground	Speed over ground in kilometers per hour
9	Speed Over Ground Unit	Speed over ground unit: K
10	Position Mode	Position mode indicator
11	CS	Checksum
12	CRLF	Carriage Return and Line feed

NMEA 0183 ZDA Description

The ZDA message includes UTC Time information.

Structure

```
$xxZDA,hhmmss.ss,dd,mm,yyyy,xx,zz*c*cs\r\n
```

Example

```
$GNZDA,082710.00,16,09,2002,00,00*64\r\n
```

ZDA Message Data

Field	Name	Description
1		ZDA Field
2	Time	UTC Time
3	Day	UTC day
4	Month	UTC month
5	Year	UTC year
6	Local Zone Hours	Local zone hours (fixed field, always 00)
7	Local Zone Minutes	Local zone minutes (fixed field, always 00)
8	CS	Checksum
9	CRLF	Carriage Return and Line feed

Radio Presets

CONFIG PROTOCOL		RADIO SPECS				
Sub Group	Value 1	Brand	Model	Protocol	BW (kHz)	Rate (kbps)
HARXON	1	HARXON	-	Satel 9600 air baud rate	12.5	9.6
	2			Satel 19200 air baud rate	25	19.2
	3			TRIMTALK 4800 air baud rate	12.5	4.8
	4			TRIMTALK 9600 air baud rate	25	9.6
	5			TRANSEOT 4800 air baud rate	12.5	4.8
	6			TRANSEOT 9600 air baud rate	25	9.6
PACIFIC_CREST	1	PACIFIC CREST	PDL High Power Base, PDL Low Power Base	Transparent with EOT Timeout (PC), 2FSK	12.5	4.8
	2				25	9.6
	3			Trimtalk 450S, 2FSK	12.5	4.8
	4				25	9.6
	5		ADL Sentry, Vantage	Pacific Crest Trans-parent with EOT Timeout, GMSK	12.5	4.8
	6				25	9.6
	7			Pacific Crest Trans-parent with EOT Timeout, 4FSK, Scrambler control On	12.5	9.6
	8				25	19.2
	9			Pacific Crest Trans-parent FST	12.5	9.6
	10				25	19.2
	11			Trimtalk 450S, GMSK	12.5	4.8
	12				25	9.6
	13			Satel 3AS	12.5	9.6
	14				25	19.2
	15		ADL Foundation	Pacific Crest Trans-parent with EOT Timeout GMSK	12.5	4.8
	16				25	9.6
	17			Pacific Crest Trans-parent with EOT Timeout, 4FSK, Scrambler control On	12.5	9.6
	18				25	19.2
	19			Pacific Crest Trans-parent FST	12.5	9.6
	20				25	19.2
	21			Trimtalk 450S, GMSK	12.5	4.8
	22				25	9.6
	23			Satel 3AS	12.5	9.6
	24				25	19.2
SATEL	1	SATEL	Satelline-M3-TR1	Pacific Crest Transparent with EOT Timeout GMSK (Option 2), 3AS's FEC off	12.5	4.8
	2				25	9.6
	3			Pacific Crest Transparent with EOT Timeout 4FSK	12.5	9.6

	4			(Option 1), 3AS's FEC off	25	19.2
	5			Trimtalk 450S GMSK (Option 3), 3AS's FEC off	12.5	4.8
	6				25	9.6
	7			Satel 3AS, 3AS's FEC on	12.5	9.6
	8				25	19.2
	9		Satelline-M3-TR3	Pacific Crest Transparent with EOT Timeout GMSK (Option 2), 3AS's FEC off	12.5	4.8
	10				25	9.6
	11			Pacific Crest Transparent with EOT Timeout 4FSK (Option 1), 3AS's FEC off	12.5	9.6
	12				25	19.2
	13			Pacific Crest Transparent FST (Option 5), 3AS's FEC off	12.5	9.6
	14				25	19.2
	15			Trimtalk 450S GMSK (Options 3,4), 3AS's FEC off	12.5	4.8
	16				25	9.6
	17			Satel 3AS, 3AS's FEC on	12.5	9.6
	18				25	19.2
	19		M3-TR1	Trimtalk 450S	12.5	-
	20				25	-
	21		M3-TR3	Trimtalk 450S (T & P)	12.5	-
	22				25	-
TRIMBLE	1	TRIMBLE	TDL 450L(H)	Transparent with EOT Timeout Pacific Crest, GMSK, Scrambler control On	12.5	4.8
	2				25	9.6
	3			Transparent with EOT Timeout Pacific Crest, 4FSK, Scrambler control On	12.5	9.6
	4				25	19.2
	5			Trimtalk 450S, GMSK	12.5	4.8
	6				25	9.6
	7			3AS, Satel	12.5	9.6
	8				25	19.2
	9			Pacific Crest Transparent FST	12.5	9.6
	10				25	19.2
	11		PDL 450 HPB 450	Pacific Crest Transparent with EOT Timeout, GMSK	12.5	4.8
	12				25	9.6
	13			Trimtalk 450S, GMSK	12.5	4.8
	14				25	9.6


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