Lars Thrane A/S

LT-1000 NRU - Technical Presentation Rev. 1.00

January 2017

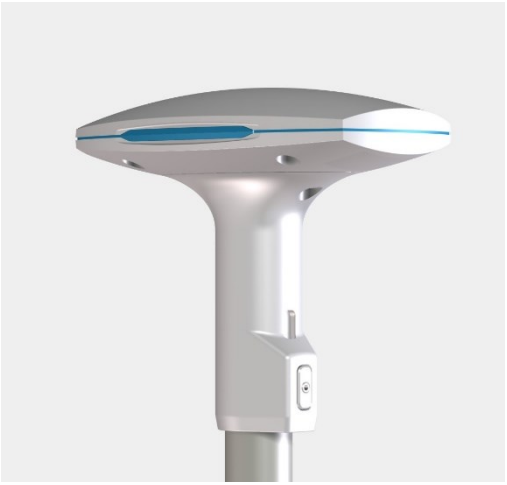
LT-1000 NRU

Market:

- Yachting, fishery, and workboats

Product technology and key features:

- Electronic compass with built-in GNSS receiver
- 72 channel GNSS receiver with SBAS correction (GPS, WAAS, EGNOS, MSAS, GLONASS, and BeiDou)
- The LT-1000 NRU has performance and functionality matching more expensive products, which could be satellite compasses
- Providing heading and position input to chart plotters, autopilots, and radars
- Providing heading and position input to AIS transponders
- Providing position input to VHF radios
- Ideal as back-up heading and position sensor to satellite compasses and gyros on any vessel
- *Note*: Deviation calibration required to output true heading (in full resolution)
- *Note*: The LT-1000 NRU is not IMO approved



LT-1000 NRU - In-The-Box

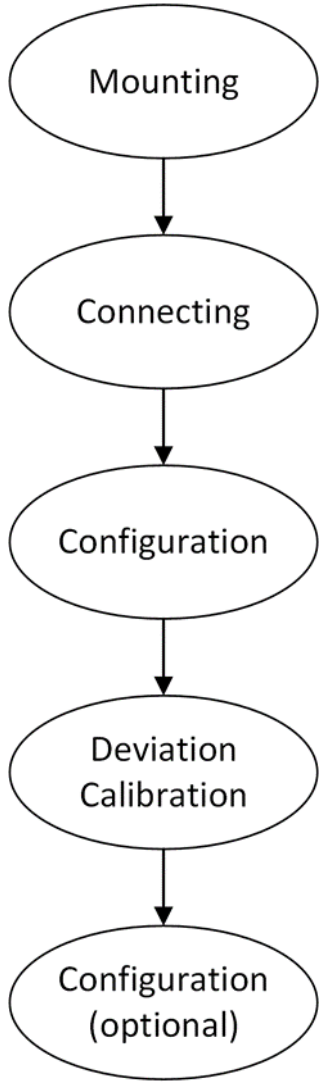
In-The-Box:

- LT-1000 NRU
- Pole mount
- Roof mount (incl. screws)
- 10m cable 8-pin multi-cut
- Screw-in connector (NMEA 2000)
- Cable plug
- Quick installation guide
- Safety instructions sheet
- Unit test sheet

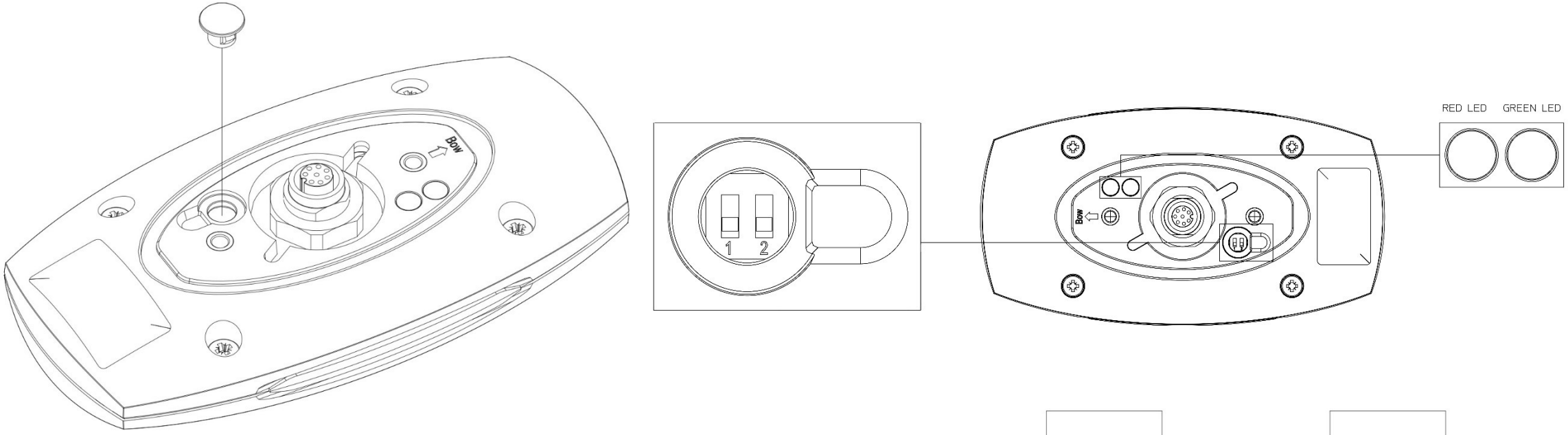
Box dimensions (LxWxH): 25 x 24 x 10 cm
Box weight: 1.2 kg

LT-1000 NRU – Installation Procedure

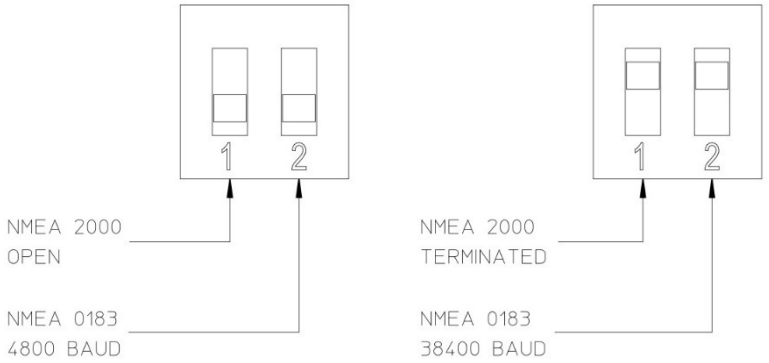
- **Mounting**
  Choose Pole or Roof mount
- **Connecting**
  NMEA 0183, NMEA 2000, and power
- **Configuration (optional)**
  LT-Service Tool (e.g. enable/disable NMEA 0183 sentences, etc.)
- **Deviation calibration**
  Perform Standard (figure 8-pattern) or Adaptive deviation calibration
- **Configuration - Heading offset (optional)**
  LT-Service Tool



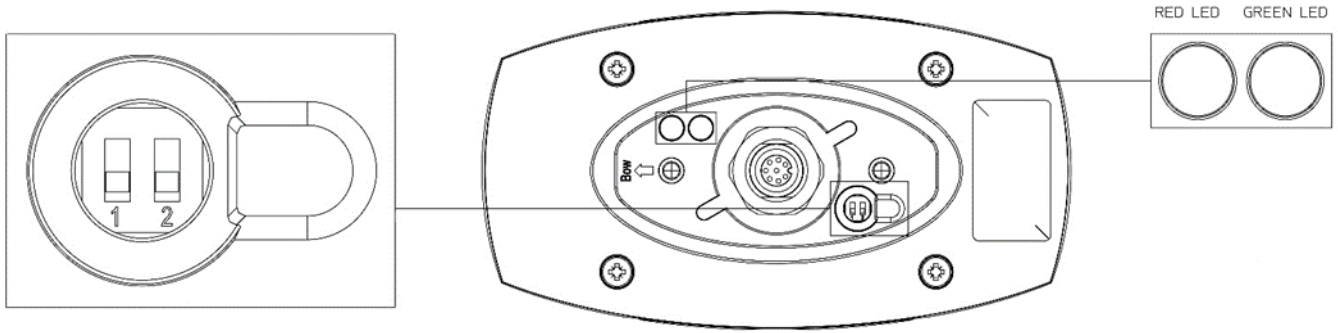
LT-1000 NRU - Dip-switch



- To access the DIP-switch, the cap plug has to be removed
- The DIP-switch is configured to 4800 baud (NMEA 0183) and ‘Open’ (NMEA 2000) when leaving the factory



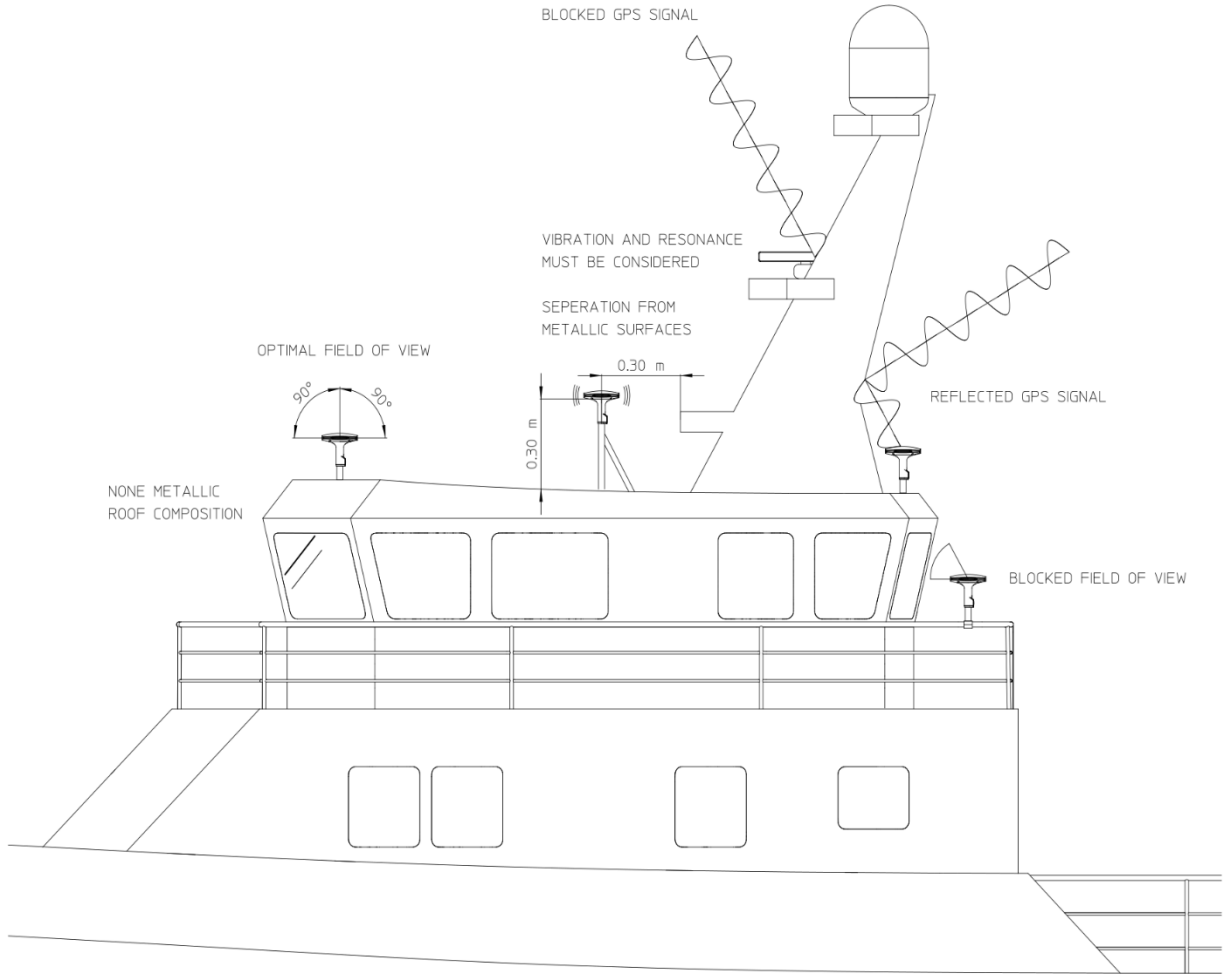
LT-1000 NRU - LEDs



LT-1000 NRU LEDs Color Description		
Power LED (Green)	**Status LED (Red)**	**Description**
On	Off	Power on unit. Unit is ready for navigation.
On	On	Power on unit. Error or warnings present. Check installation setup and Troubleshooting to resolve the problem. Connect the LT-Service Tool to retrieve details from the LT-1000 NRU.
Off	NA	No power on unit.

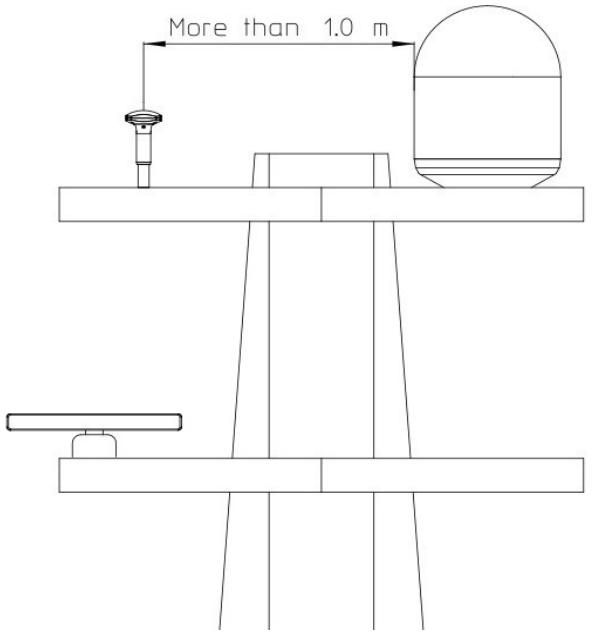
LT-1000 NRU – Installation Considerations

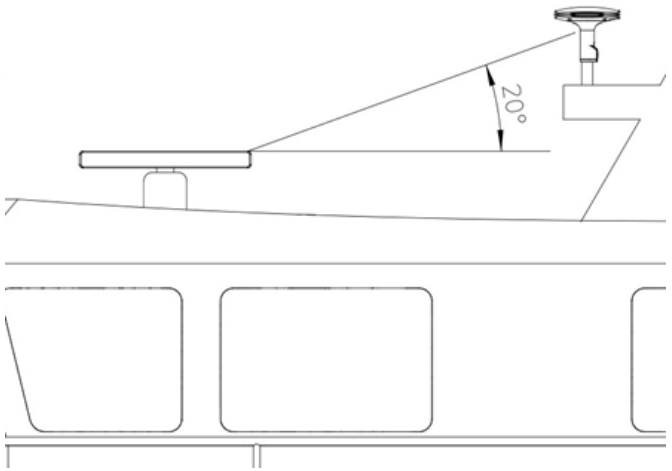
- Mount the unit horizontally
- Mount the unit with free line of sight to GNSS satellites.
- If the Roof Mount is used for below deck installation, make sure that the unit is capable of receiving signals from the GNSS satellites
- Mount the unit on a rigid structure with a minimum of exposure to vibration and shock
- Mount the unit so that direct spray from seawater is avoided
- Mount the unit so that ventilation through the pole mount is possible (pressure sensor)
- Mount the unit in an area with an ambient temperature between -40°C and +55°C (-40°F to +131°F)
- Mount the unit away from possible magnetic disturbances (e.g. loudspeakers) and power cables



LT-1000 NRU – Installation Considerations

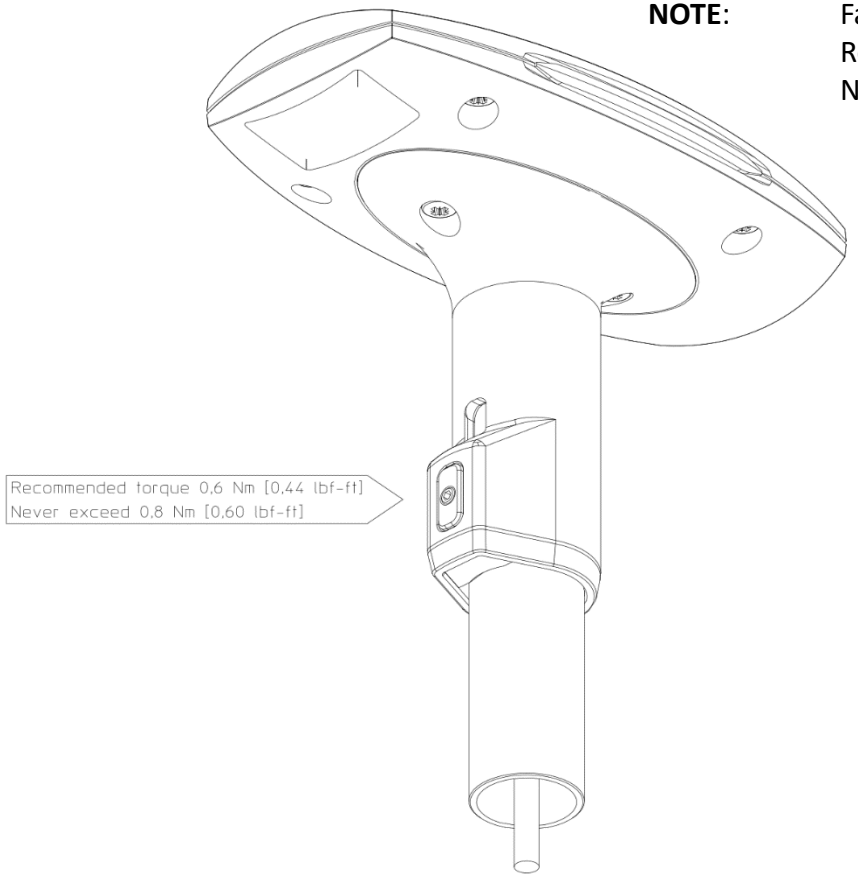
- Mount the unit at least 1 m. (3 ft.) away from radio transmitting antennas (VHF, UHF, MF-HF, Inmarsat, Iridium, Transmitting VSAT, etc.)
- Mount the unit with a minimum angle of 20 degrees towards a radar antenna (above or below).
- Mount the unit at least 50 cm. (20”) away from the following: Engines, generators, steel fuel and water tanks, bilge pump, anchor, anchor chain, iron mast support, electrically powered products (search lights, IR cameras, etc.)
- Mount the unit as close as possible to the ship’s center of gravity and center line

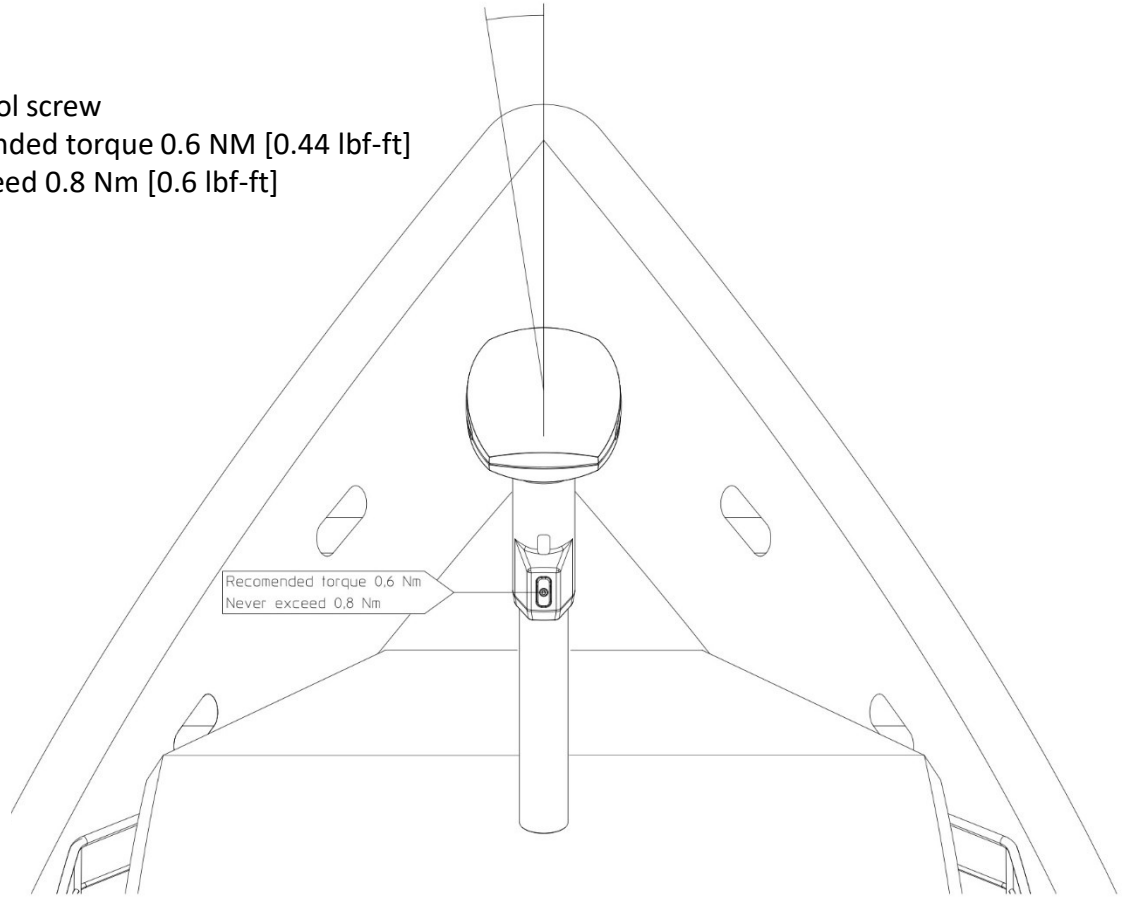




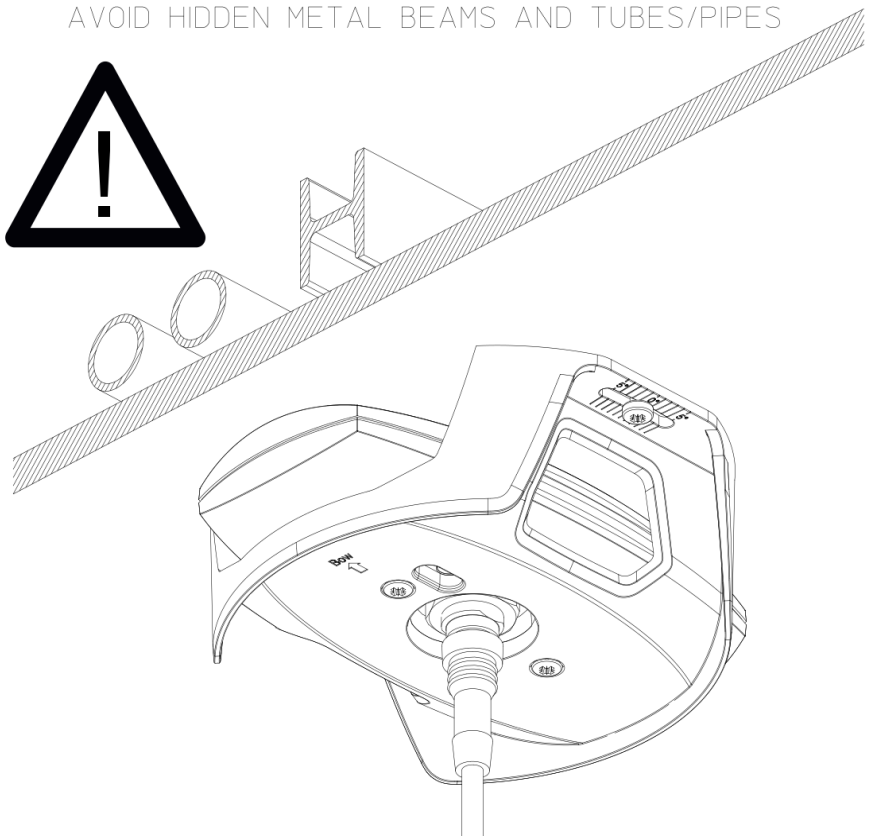
LT-1000 NRU – Pole Mount

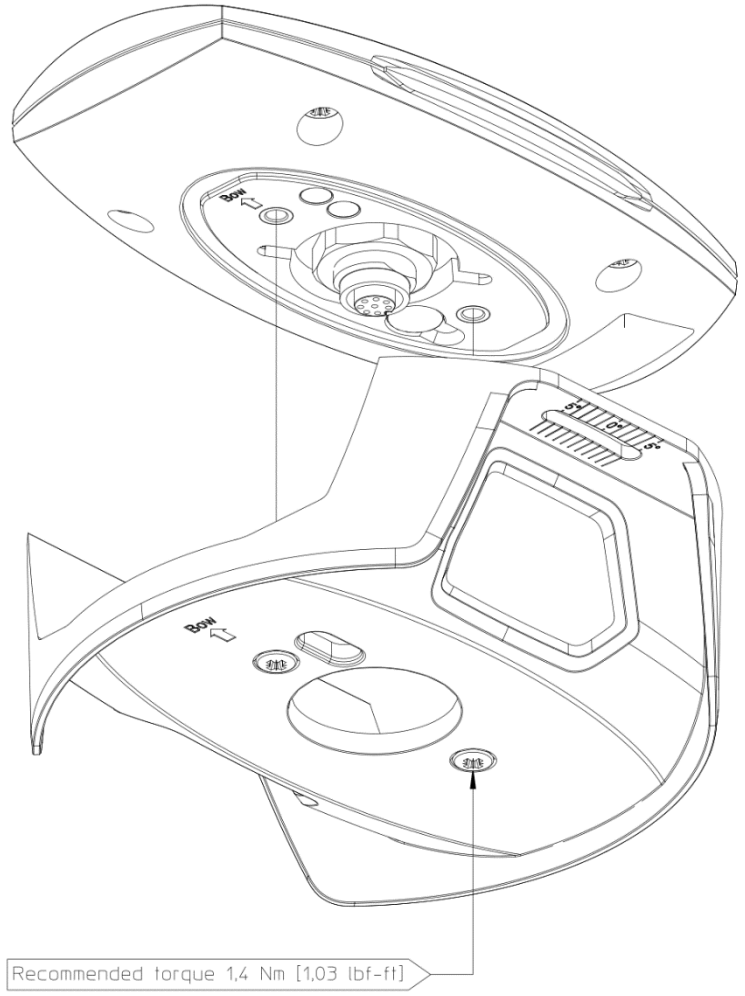
NOTE: Fasten pinol screw
Recommended torque 0.6 NM [0.44 lbf-ft]
Never exceed 0.8 Nm [0.6 lbf-ft]





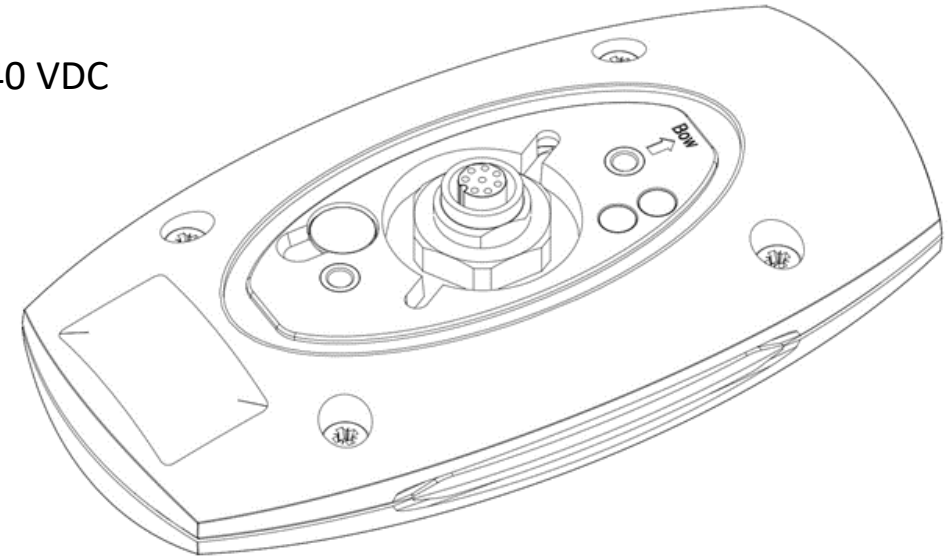
LT-1000 NRU – Roof Mount



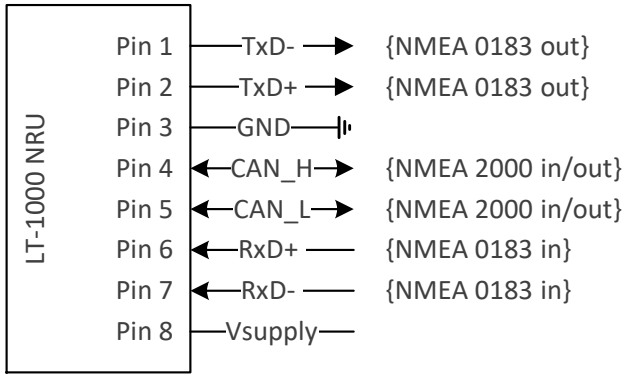


LT-1000 NRU - Connecting

- 10m cable 8-pin multi-cut is always in-the-box
- 30m cable 8-pin multi-cut is available as sales option
- NMEA 0183, NMEA 2000, and power
- Power: 9-40 VDC

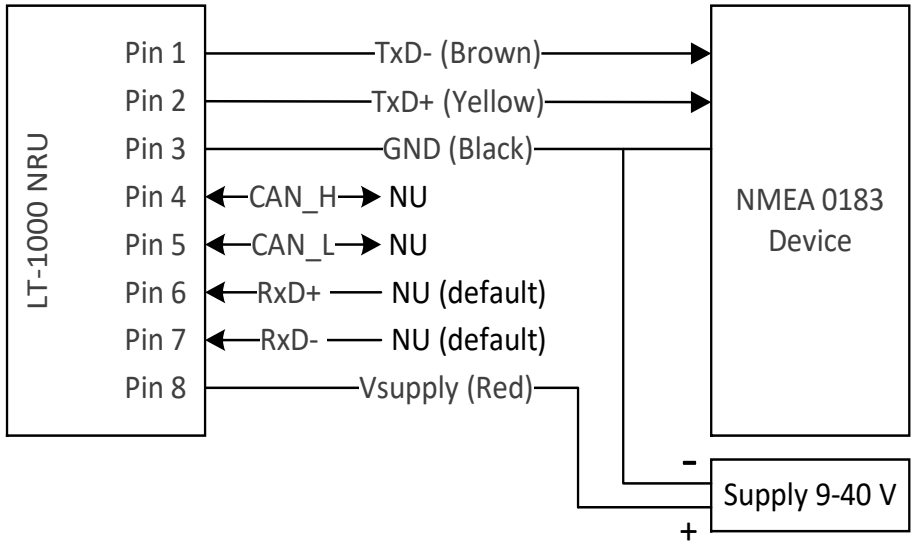


LT-1000 NRU Interconnect Details		
Pin No.	**Wire Color**	**Wire Designation**
1	Brown	TxD-
2	Yellow	TxD+
3	Black	GND
4	White	CAN_H
5	Blue	CAN_L
6	Orange	RxD+
7	Green	RxD-
8	Red	Vsupply

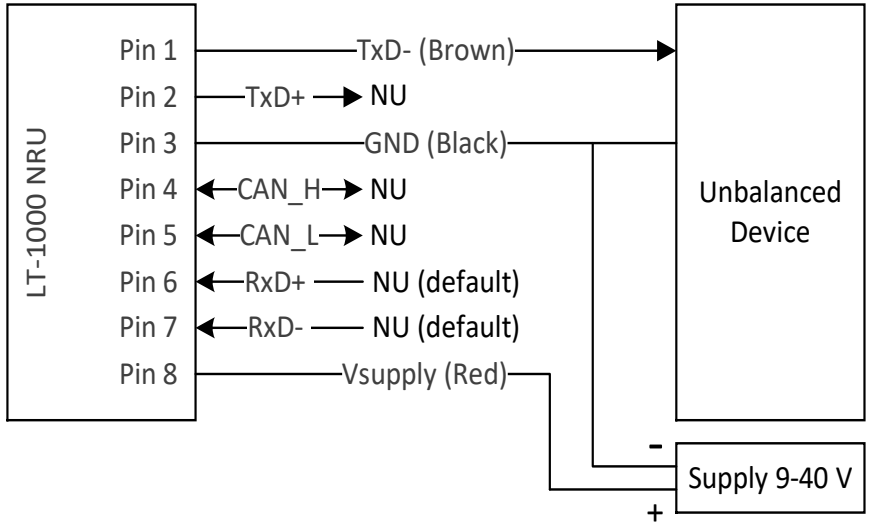


LT-1000 NRU – Connecting to NMEA 0183

Connecting the LT-1000 NRU to a balanced NMEA 0183 device:

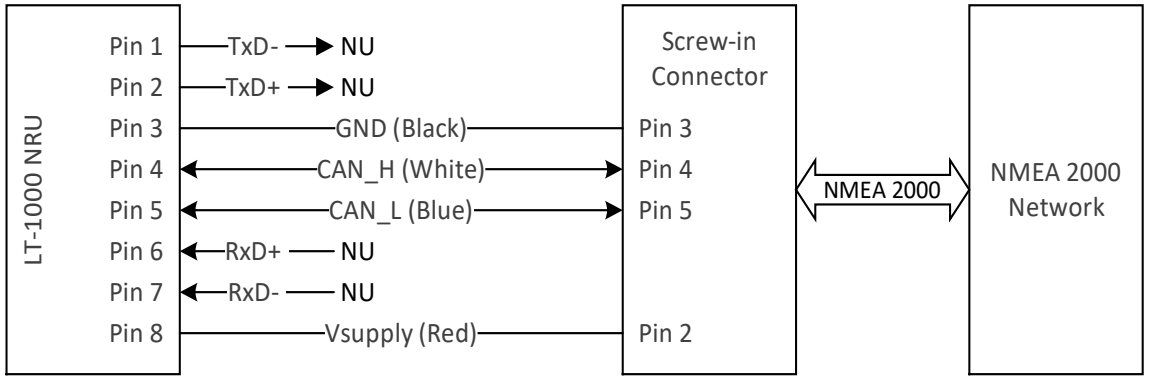


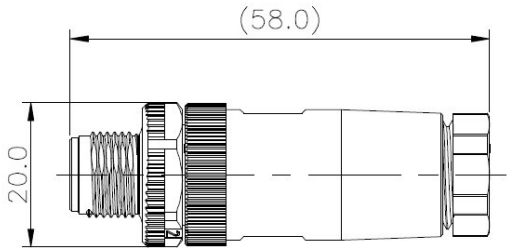
Connecting the LT-1000 NRU to an unbalanced device:

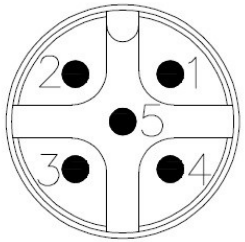


IMPORTANT: It is recommended to connect the LT-1000 NRU with a balanced NMEA 0183 connection (RS-422). An unbalanced connection (RS-232) is less robust and should only be considered, when using a short communication cable.

LT-1000 NRU – Connecting to NMEA 2000







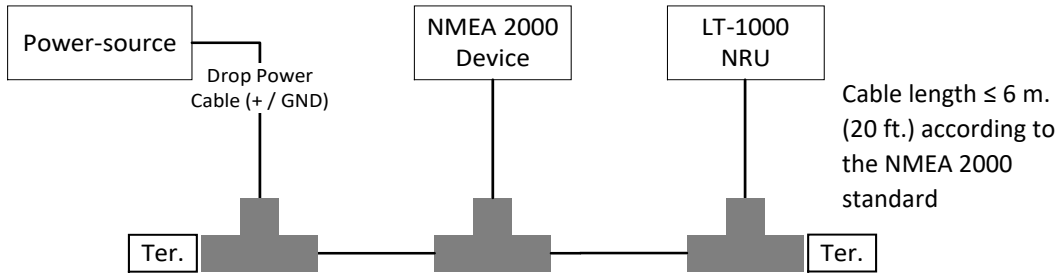
NOTE: The LT-1000 does not require a connection on Pin No. 1: drain/shield. The unit is designed to work with open cable shield.

- It is required to use a screw-in connector if connecting the LT-1000 NRU to a NMEA 2000 network. The screw-in connector is in-the-box
- The screw-in connector outline and pin-out is illustrated in the figures above

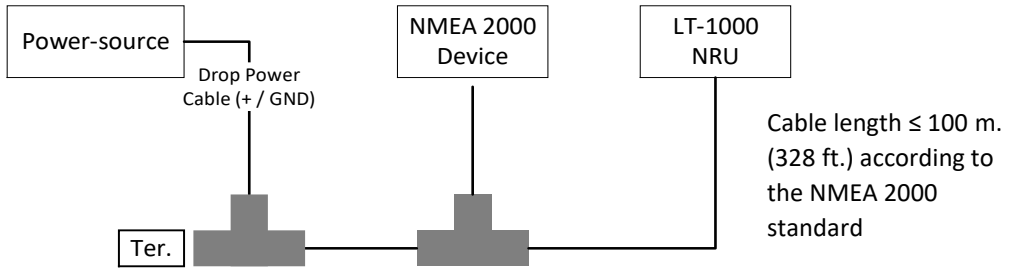
NMEA 2000 Screw-in Conn. Wiring		
Cable Wire Color	**Cable Wire Designation**	**Screw-in Conn. Pin No.**
-	-	1
Red	Vsupply	2
Black	GND	3
White	CAN_H	4
Blue	CAN_L	5

LT-1000 NRU – Connecting to NMEA 2000

NMEA 2000 (‘Open’)



NMEA 2000 (‘Terminated’)

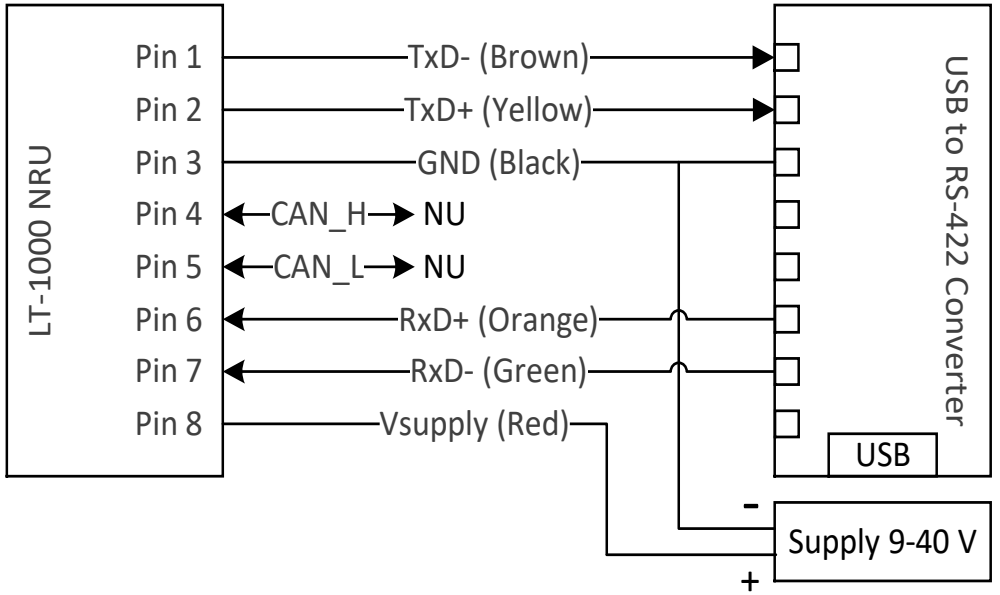


NOTE: The LT-1000 NRU DIP-switch can be configured to either ‘Open’ or ‘Terminated. The two figures above illustrates two options for connecting the LT-1000 NRU to a NMEA 2000 network (backbone).

LT-1000 NRU – Connecting to LT-Service Tool

- The LT-Service Tool is a PC program, which may run on any Windows PC.
- The LT-Service Tool is a PC program made for configuration, maintenance, and service of the LT-1000 NRU
- The LT-Service Tool is using the NMEA 0183 interface for communicating with the LT-1000 NRU (both Tx and Rx directions)
- Connection to the LT-Service Tool on a PC may be obtained using either:
  - USB to RS-422 Converter
  - Serial Port (RS-422)
  - Serial Port (RS-232)

USB to RS-422 converter providing the communication link between the PC (LT-Service Tool) and the LT-1000 NRU:



LT-1000 NRU – Configuration Options

Dip-switch configurations:

- Baud rate: 4800 or 38400 baud
- NMEA 2000 Term.: Open or Terminated

LT-Service Tool:

- Deviation calibration & options
- Auto level
- Heading offset
- Roll offset
- Pitch offset
- Vertical offset
- Attitude filter
- GNSS receiver
- NMEA 0183 sentences
- Factory default

NOTE: The details of these configurations are explained and listed in the User & Installation Manual.

LT-1000 NRU - Deviation Calibration

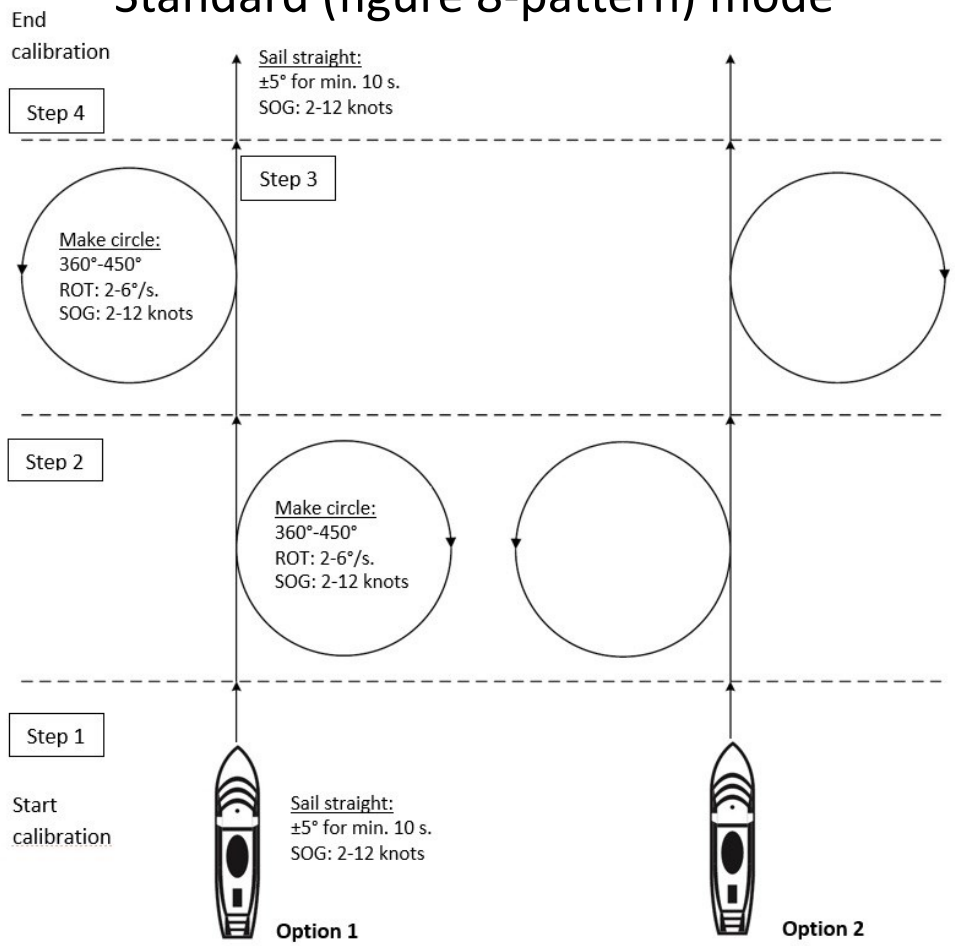
The user can choose between two methods for performing a deviation calibration:

- Standard (figure 8-pattern) *default*
- Adaptive

Step 1:	Keep a steady course (± 5 degrees) for minimum 10 seconds SOG: 2–12 knots
Step 2:	Make a full circle (360-450°) clockwise or counterclockwise ROT: 2-6 degrees/second (1-3 minutes pr. circle) SOG: 2-12 knots
Step 3:	Make a full circle (360-450°) in opposite direction ROT: 2-6 degrees/second (1-3 minutes pr. circle) SOG: 2-12 knots
Step 4:	Keep a steady course (± 5 degrees) for minimum 10 seconds SOG: 2–12 knots

NOTE: Default, the LT-1000 NRU will indicate absence of a valid calibration by outputting heading (true and magnetic) with a 5 degrees resolution. This indication can be disabled. When a calibration has been successful, the heading will be output with full resolution (0.1° degrees).

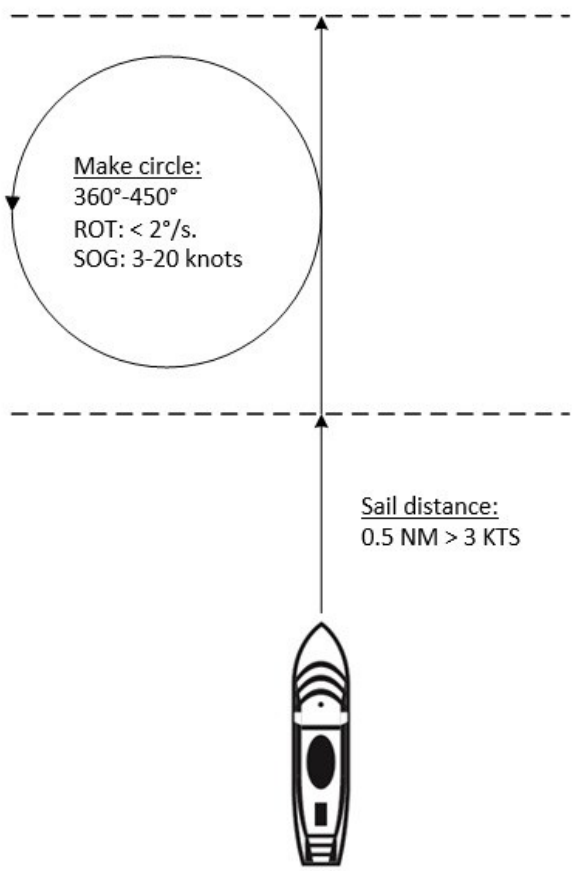
Standard (figure 8-pattern) mode



LT-1000 NRU - Deviation Calibration

- The adaptive deviation calibration algorithm will improve performance over time as the vessel navigates on different courses.
- An initial adaptive deviation calibration can be forced by keeping a minimum speed of 3 KTS for at least 0.5 NM and then completing a 360° circle at low speed (3 to 20 KTS) and low rate-of-turn (< 2°/s)

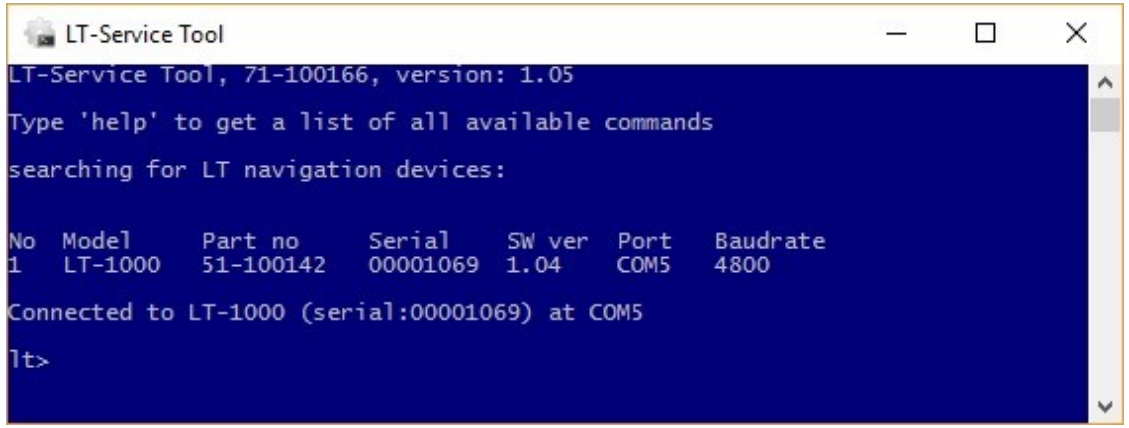
Adaptive mode



NOTE: If continuous improvement is not wanted, the adaptive deviation calibration can be disabled by setting deviation calibration to 'Off'.

LT-1000 NRU – LT-Service Tool

- The LT-Service Tool is a PC program interfacing and communicating with LT-Navigation devices
- The LT-Service Tool is communicating via the NMEA 0183 serial interface
- The LT-Service Tool will automatically search all COM ports on the PC to identify potential LT-Navigation devices connected to the PC. Devices found, will be shown in a list
- It is recommended to use a 'USB to RS-422 converter' for easy interfacing in-between the PC (LT-Service Tool) and the LT-1000 NRU

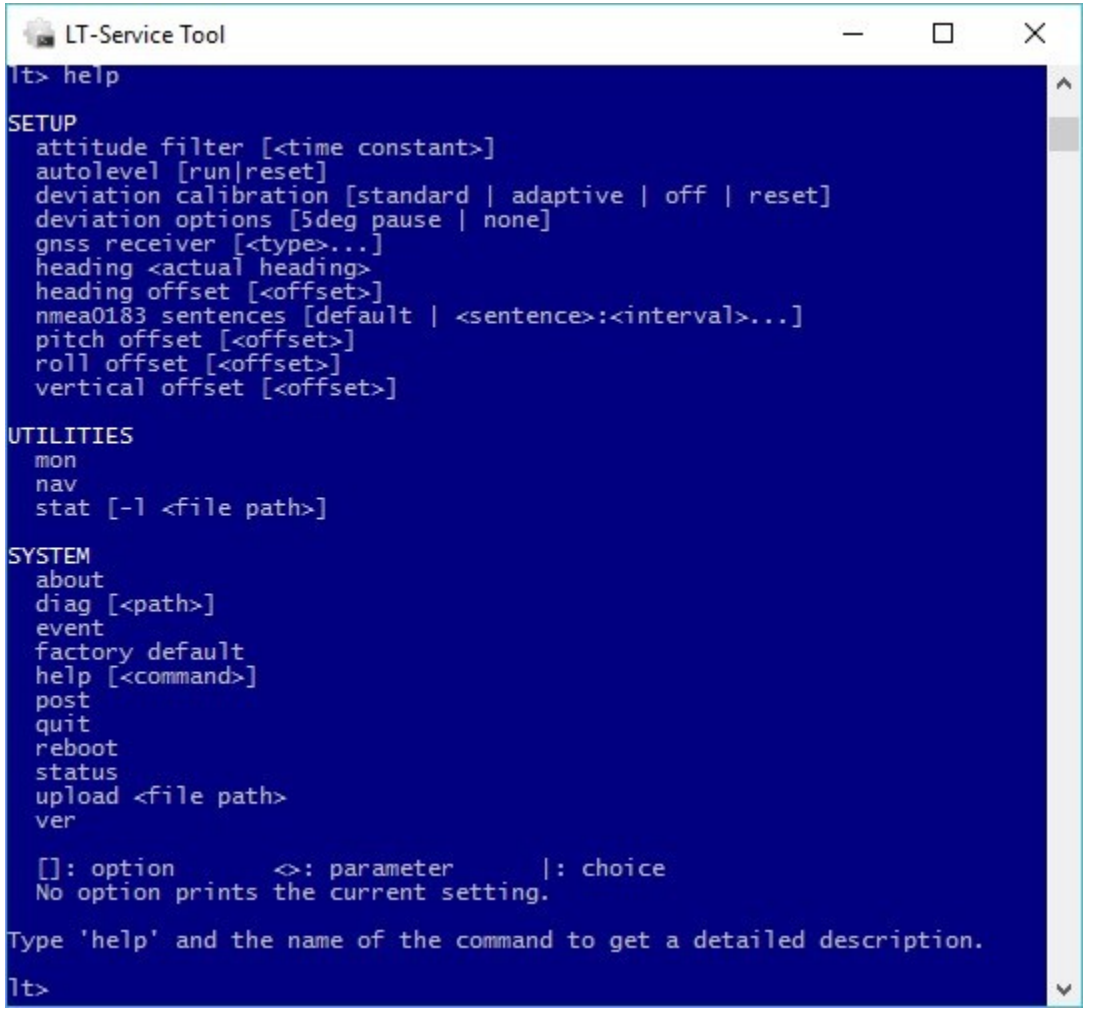


LT-1000 NRU – LT-Service Tool

The LT-Service Tool functions and commands are divided into three main groups:

- SETUP — The setup commands can be used for configuration of installation parameters
- UTILITIES — The utilities commands are related to the navigation status of the unit
- SYSTEM — The system commands are supporting general support related issues

List of commands
All available commands in the LT-Service Tool are listed when using the “help” command



LT-1000 NRU – NMEA 0183 Sentences

- The dip-switch is by default configured to 4800 baud
- From factory, the LT-1000 NRU has a default NMEA 0183 sentence configuration that determines which sentences are output at a given baud rate (4800 and 38400), their rate, and talker ID.
- Using the LT-Service Tool, sentences can be enabled/disabled, and their rate and talker ID configured
- GNSS sentences can only be enabled/disabled. Configuration of output rate is currently not supported. All enabled GNSS sentences are output with 1 Hz.
- If changing the NMEA 0183 baud rate, the NMEA 0183 sentences configuration will be reset to factory default
- The LT-1000 NRU is compliant with version 4.00 of the NMEA 0183 standard

NMEA 0183 Sentences		
Sentence	**Description**	**Rate**
4800 baud		
GNRMC	Recommended Minimum Specific GNSS Data	1 Hz
HCHDG	Heading and Magnetic Heading Variation	1 Hz
HCHDM	Magnetic Heading	1 Hz
HCHDT	True Heading	10 Hz
HCROT	Rate of Turn	1 Hz
PFEC,GPatt	Attitude	1 Hz
WIMDA[1]	Meteorological Composite	0.5 Hz
38400 baud		
GNDTM	Datum Reference	1 Hz
GNGGA	GPS Fix Data	1 Hz
GNGLL	Position Latitude/Longitude WGS84	1 Hz
GNGSA	GNSS DOP and Active Satellite	1 Hz
GNRMC	Recommended Minimum Specific GNSS Data	1 Hz
GNVTG	Course Over Ground and Ground Speed	1 Hz
GNZDA	Time and Date	1 Hz
GPGSV[2]	GNSS Satellites in View	1 Hz
HCHDG	Heading and Magnetic Heading Variation	10 Hz
HCHDM	Magnetic Heading	10 Hz
HCHDT	True Heading	10 Hz
HCROT	Rate of Turn	10 Hz
HCTHS	True Heading and Status	10 Hz
PFEC,GPatt	Attitude	10 Hz
WIMDA[1]	Meteorological Composite	2 Hz
WIXDR[3]	Transducer Measurements	2 Hz

LT-1000 NRU – NMEA 2000 PGN's

- The LT-1000 NRU is compliant with version 2.000 of the NMEA 2000 standard and version 2.000 of the NMEA Network Database
- The NMEA 2000 PGN's can not be configured

NMEA 2000 PGNs		
PGN	**Description**	**Rate**
Periodic PGNs		
126992	System Time	1 Hz
126993	Heartbeat	< 0.1 Hz
127250	Vessel Heading	10 Hz
127251	Rate of Turn	10 Hz
127257	Attitude	10 Hz
127258	Magnetic Variation	1 Hz
129025	Position, Rapid Update	10 Hz
129026	COG & SOG, Rapid Update	4 Hz
129029	GNSS Position Data	1 Hz
129044	Datum	0.1 Hz
129539	GNSS DOPs	1 Hz
129540	GNSS Sats in View	1 Hz
130311	Environmental Parameters	2 Hz
130312	Temperature	0.5 Hz
130314	Actual Pressure	0.5 Hz
130316	Temperature, Extended range	0.5 Hz
Requestable PGNs		
126464	PGN List (Transmit and Receive)	-
126996	Product Information	-
129538	GNSS Control Status	-
Oher PGNs		
059392	ISO Acknowledgement	-
059904	ISO Request	-
060928	ISO Address Claim	-
126208	NMEA Request/Command/Acknowledge	-

LT-1000 NRU - Performance

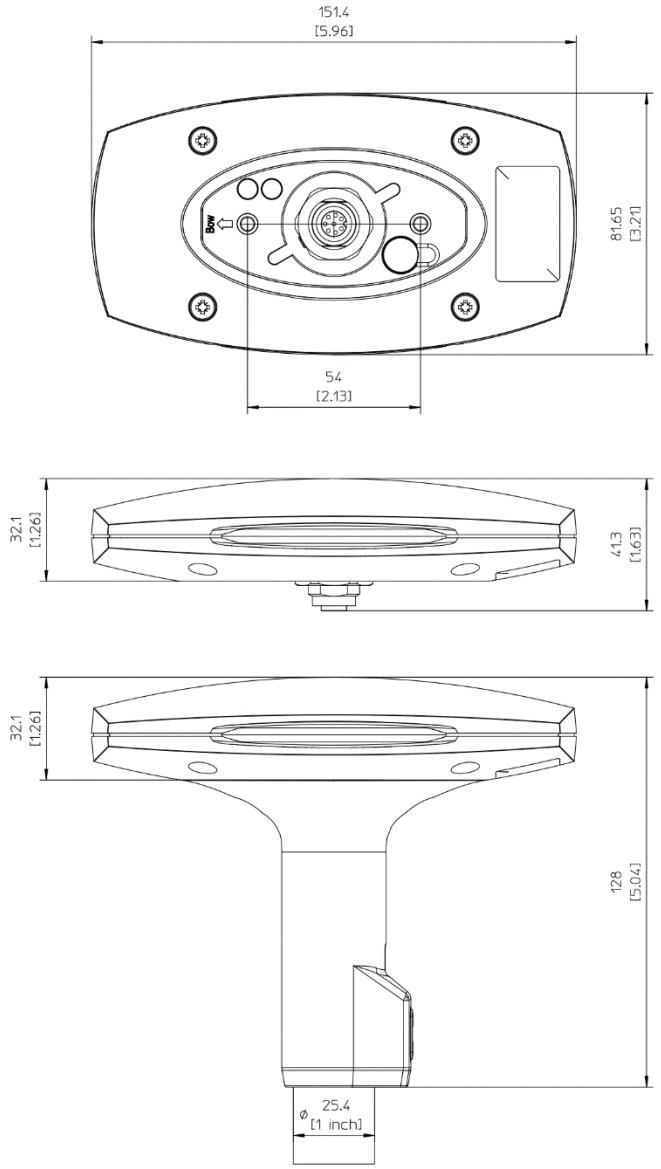
- The LT-1000 NRU is a small, compact, and very advanced unit with 12 precision sensors (magnetometers, gyros, accelerometers, GNSS, barometer, and thermometer)
- With the use of sensor fusion and Kalman filtering, the LT-1000 NRU outputs:
  - true heading, magnetic heading, deviation, variation, roll, pitch, position, satellite information, ground speed, course over ground, time and date, air pressure, and temperature
- The LT-1000 NRU includes advanced technologies such as:
  - Kalman filtering & sensor fusion
  - Calculation of magnetic variation based on the World Magnetic Model (WMM)
  - Compensation for soft and hard iron (deviation)
  - Built-in magnetometer calibration algorithm
  - Receive and track multiple satellite systems (GPS, SBAS, GLONASS, and BeiDou)
  - Support for Satellite-Based Augmentation System (SBAS): EGNOS, WAAS and MSAS
- The LT-1000 NRU makes use of the latest technology within GNSS receivers, with market leading acquisition and tracking performance

LT-1000 NRU Performance[1]			
Data	Accuracy	Resolution	Range/Comments
Heading[2]	Static: < 0.5° (rms) Dynamic: < 1.5° (rms)	0.1°	Heading is calculated with input from Sensor-fusion technology and Kalman filtering
Position[3]	GNSS: < 2.5 m SBAS: < 2 m	0.1 m	CEP, 50%, 24 hours static, -130 dBm, > 6 SVs By default the GNSS receiver is configured for GPS/GLONASS & SBAS reception Time-To-First-Fix (cold acquisition): 26 s.
Speed	0.1 knot	0.1 knot	0 to 195 knots
Roll	Static: < 0.5° (rms)	0.1°	± 180°
Pitch	Static: < 0.5° (rms)	0.1°	± 90°
Rate of turn	< 1°/s	0.1°/s	0 to 45°/s
Air Pressure	1 hPa	0.1 hPa	800 to 1100 hPa
Air Temperature[4]	1°C (1.8°F) 2°C (3.6°F)	0.1°C (0.1°F)	0°C to +55°C (32°F to +131°F) -40°C to 0°C (-40°F to +32°F)

1: The LT-1000 NRU performance may be subject to degradation caused by an improper installation.
2: The dynamic heading accuracy is specified with roll/pitch less than ± 45° and ROT ≤ 45°/s.
3: The LT-1000 NRU has an immunity filter against Iridium and Inmarsat transceivers
4: Solar radiation and environmental conditions will affect the measured air temperature (accuracy is specified as on-board sensor performance)

LT-1000 NRU – Specifications

LT-1000 NRU Specifications	
Certification and standards	CE, IEC 60945, IEC 60950-1/-22, EN 300 440, EN 301 389, FCC, IC, RCM (C-Tick), RoHS NMEA 0183, NMEA 2000
Equipment class	Protected, according to IEC 60945
Weight, with pole mount	240 g (0.53 lbs)
Weight, with roof mount	281 g (0.62 lbs)
Dimensions, with pole mount	151.4 x 81.6 x 128.0 mm (5.96 x 3.21 x 5.04 in)
Dimensions, with roof mount	151.4 x 136.0 x 46.0 mm (5.96 x 5.35 x 1.81 in)
Temperature, operational (ambient)	-40°C to +55°C (-40°F to +131°F)
Temperature, storage (ambient)	-40°C to +85°C (-40°F to +185°F)
Vibration, operational	IEC 60945 (sine) & Proprietary Maritime Random profile (240 h)
Vibration, survival	Proprietary Maritime Random profile (100 h)
Vibration, shock	Proprietary Maritime profile (60 g pk, 11 ms)
Waterproof rating	IP46
Humidity	95% non-condensing @ 40°C
Wind, operational	80 knots (93 MPH)
Wind, survival	110 knots (127 MPH)
Ice, survival	25 mm (1 in)
Solar radiation	1120 W/m2
Communication interface	8-pin female connector for NMEA 0183, NMEA 2000, and power
Input voltage	9-40 VDC
Power consumption	< 1 W (@ 12 VDC)
Load Equivalent Number (LEN)	2
Compass safe distance standard	0.3 m (1 ft)
Compass safe distance steering	0.3 m (1 ft)
Mounting, pole mount	25.4 mm (1 in)
Warranty	2 year
Maintenance	None



LT-1000 NRU - Test Boat

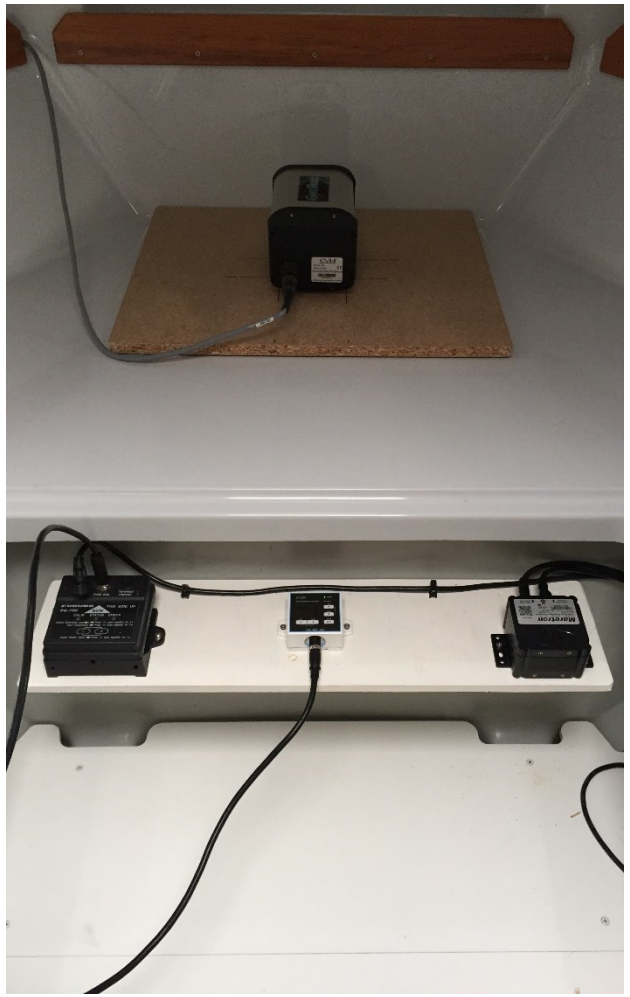
- Sargo 36
  - Ship yacht: SARGO - Sarins Båtar Oy
  - Length Overall: 11.8 m/ 38.7 ft
  - Beam: 3.6 m / 11.8 ft
  - Draft: 1.1 m / 3.6 ft
  - Dry weight: 8800 kg / 19400 lb
  - Top speed: 40 knots

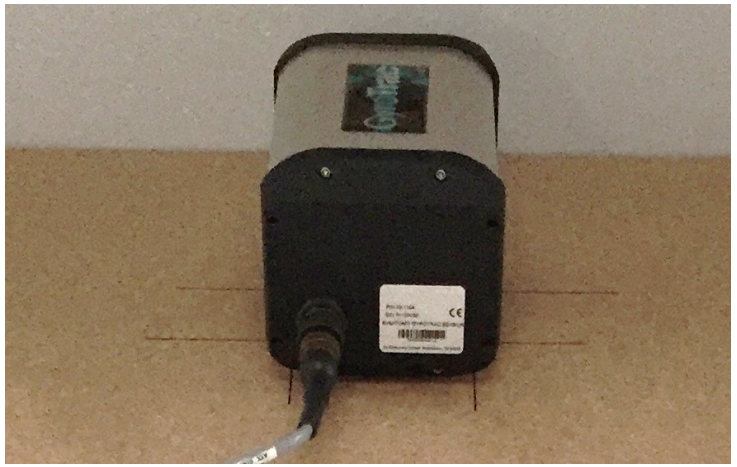
LT-1000 NRU – Test Boat Installation (deck)

- Products:
  - LT-1000 NRU
  - Furuno SC-30

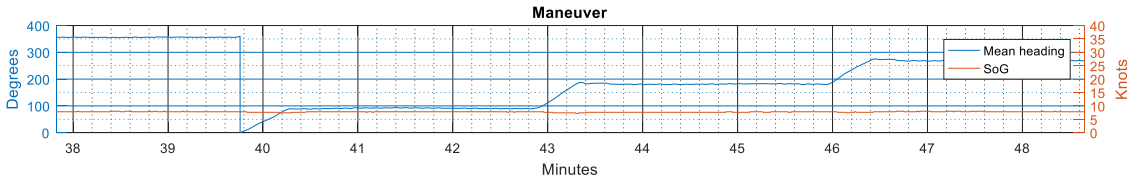
LT-1000 NRU – Test Boat (below deck)

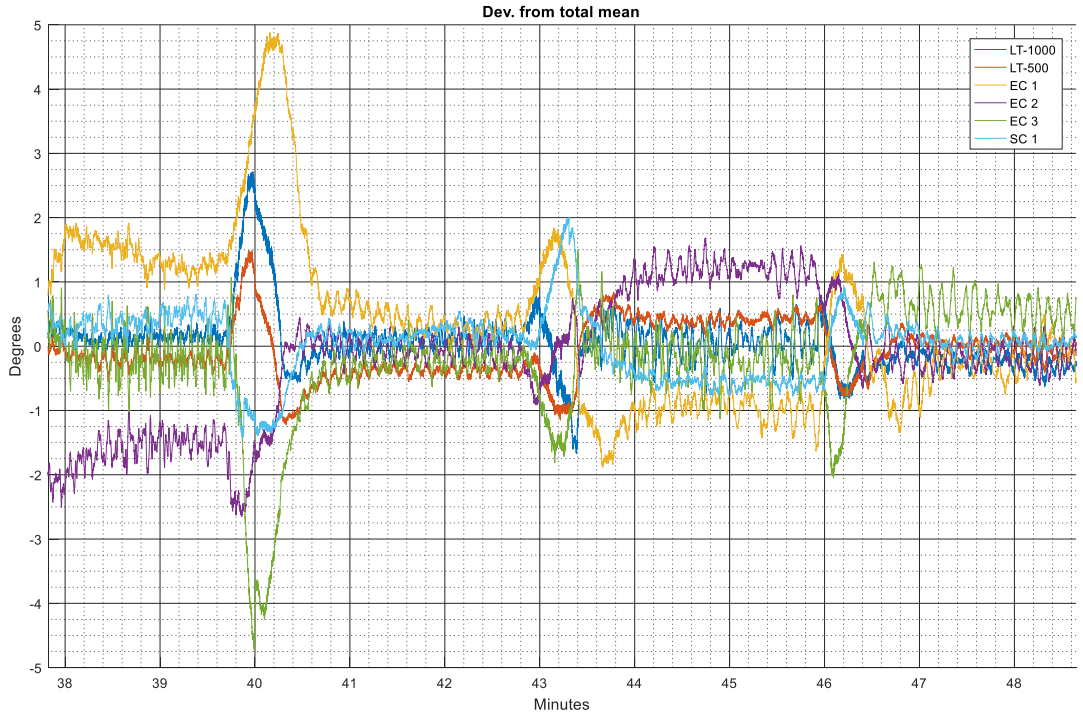
- Products:
  - LT-500 AHRS
  - Furuno PG-700 (EC1)
  - Maretron SSC300 (EC2)
  - KVH GyroTrac (EC3)





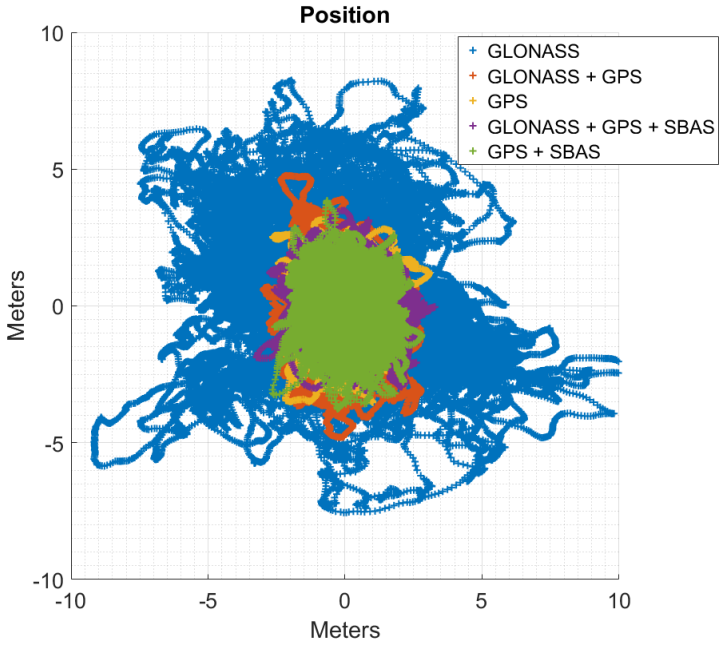
LT-1000 NRU – Heading Accuracy (example)



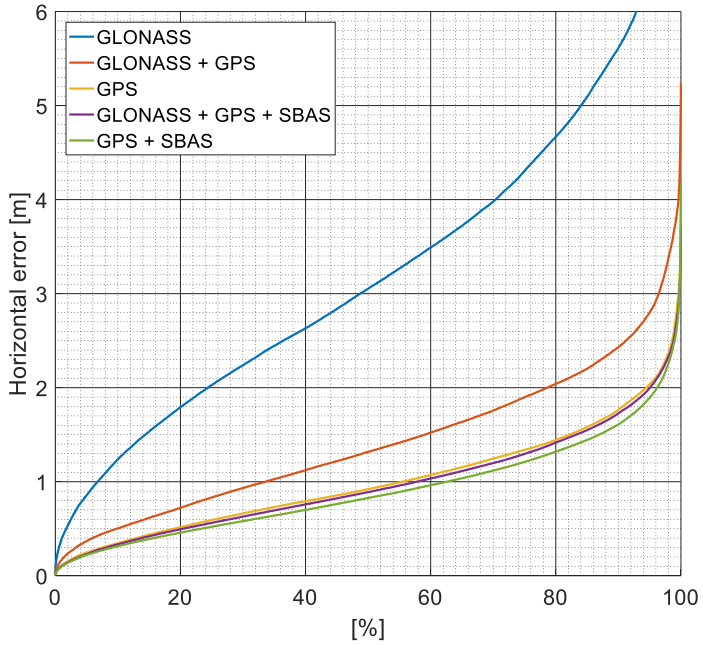


Device	RMS	Peak to Peak
Static		
LT-1000	0.22	1.39
LT-500	0.35	1.94
GyroTrac (EC 1)	0.96	5.04
PG-700 (EC 2)	0.99	4.19
SSC300 (EC 3)	0.44	2.59
SC-30 (SC 1)	0.36	1.58
Dynamic		
LT-1000	0.48	4.39
LT-500	0.44	2.71
GyroTrac (EC 1)	1.33	6.76
PG-700 (EC 2)	1.00	4.34
SSC300 (EC 3)	0.91	6.22
SC-30 (SC 1)	0.51	3.44

LT-1000 NRU - Position Accuracy



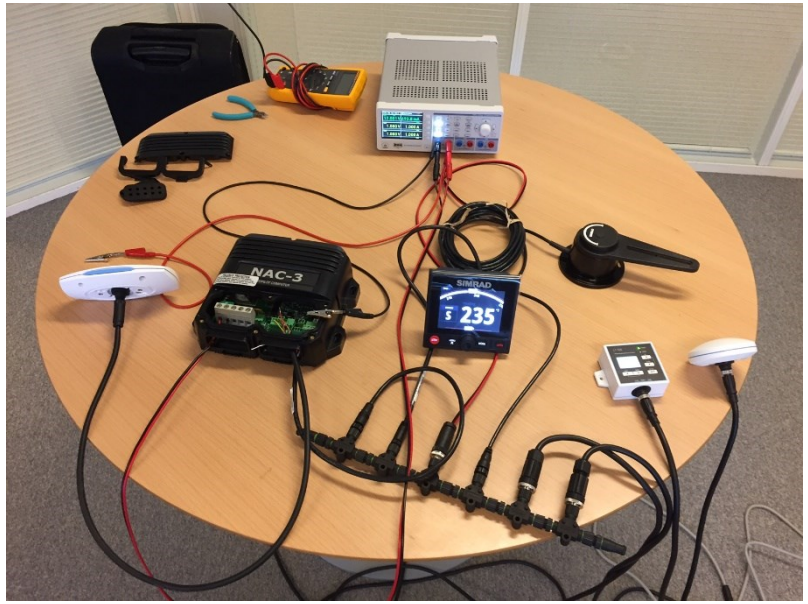
Horizontal Position Accuracy			
Configuration	**< 1 m.**	**< 1.5 m.**	**< 2 m.**
GPS, SBAS	63 %	87 %	96 %
GPS, SBAS, GLONASS (default)	58 %	83 %	95 %
GPS	55 %	82 %	94 %
GPS, GLONASS	34 %	59 %	79 %
GLONASS	7 %	14 %	24 %

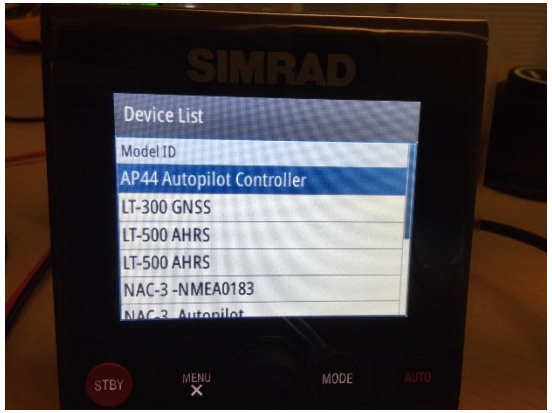


- The table above shows the measured horizontal position accuracy for the LT-1000 NRU GNSS receiver
- The LT-1000 GNSS receiver has a horizontal position accuracy better than 2 meters in 95 % of the time (default configuration)

LT-1000 NRU – Test Installation (example)

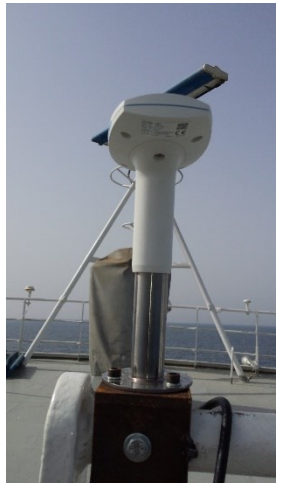
- SIMRAD equipment
  - AP44 autopilot display
  - NAC-3 autopilot computer
- LT-1000 NRU
  - Verified on NAC-3 NMEA 0183 interface
  - Verified on NMEA 2000 back-bone (drop cable)

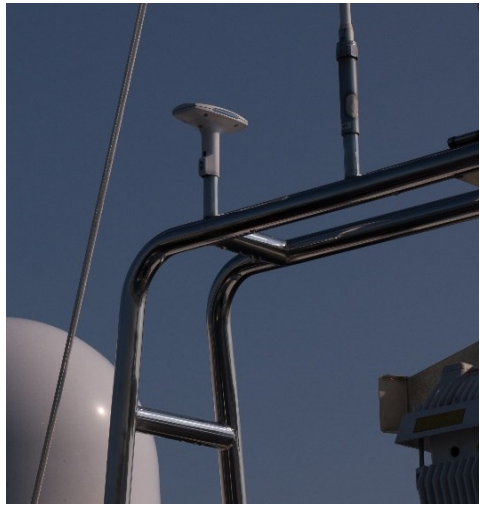
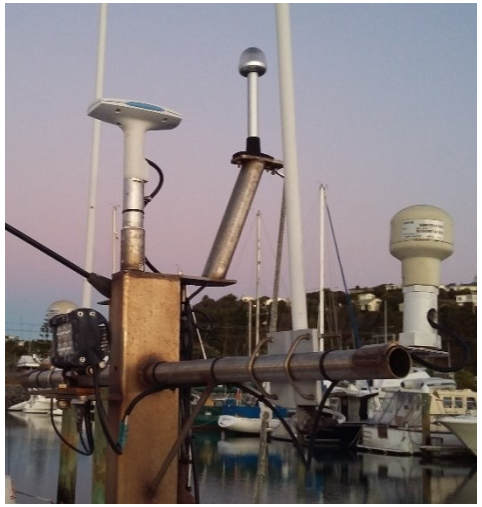




LT-1000 NRU – Installation Pictures

- Leisure
- Fishing
- Work
- *Deep sea*

LT-1000 NRU Documentation

- LT-1000 NRU documentation and software can be downloaded from the website (free):
  http://thrane.eu/wdpress/index.php/lt-1000-nru/

- Website (download):
  - Product Sheet
  - Quick Installation Guide
  - User & Installation Manual
  - Outline Drawings
  - Declaration of Conformity (DoC)
  - LT-1000 Application SW
  - LT-Service Tool SW
  - Release Notes

- Access Partner Area or request additional information

END