

Quick Start Guide

NMEA0183 Sender

SER0069 – NMEA0183 Sender for Beijer PLC systems

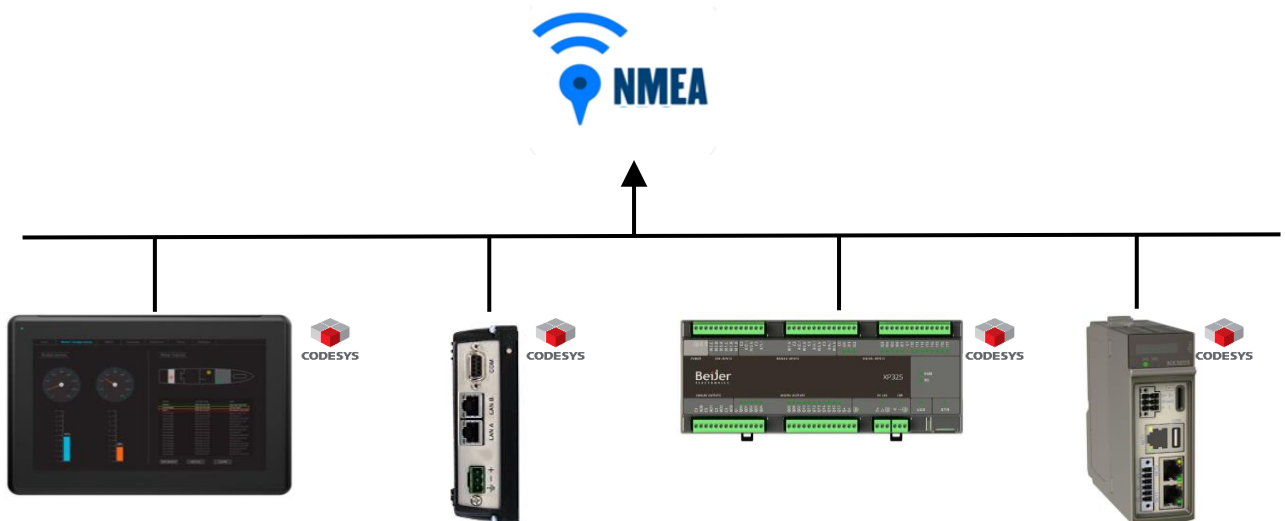


1. Function and area of use

This document explains how to install and setup the NMEA0183Sender smartobject in BCS Tools/Codesys using control systems from Beijer Electronics.

This guide requires the following steps to be completed:

- Set up the actual hardware.
 - X2 marine SC, X2 control, X2 extreme SC or BoX2 SC variants.
 - Nexto Xpress (XP-CPU) or Nexto Modular (NX-CPU)
- Download the smartobject and install into BCS Tools.
- Verify the setup using a testproject.



2. About this startup document

This quick start guide should not be considered as a complete manual. It is an aid to be able to start using our smartobject for the X2 control series and the Nexto plc.

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Use the following hardware, software, drivers and utilities in order to obtain a stable application:

Software

- BCS Tools 3.63 or later <https://smartstore.beijerelectronics.com>

Hardware

- X2 marine SC (X2 control, X2 extreme SC and Box2 SC can also be used).
- Nexto Xpress (XP) or Nexto modular (NX).

For further information refer to

- [Beijer Electronics knowledge database, HelpOnline](#)

This document and other quick start documents can be obtained from our homepage. Please use the address support.europe@beijerelectronics.com for feedback.

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4. The NMEA 0183 standard

NMEA 0183 is a combined electrical and data specification for communication between marine electronics such as echo sounder, sonars, anemometer, gyrocompass, autopilot, GPS receivers and many other types of instruments. It has been defined by, and is controlled by, the National Marine Electronics Association.

The electrical standard that is used is RS422, although most hardware with NMEA-0183 outputs are also able to drive a single RS232 port.

The NMEA 0183 standard uses a simple ASCII, serial communications protocol that defines how data are transmitted in a "sentence" from one "talker" to multiple "listeners" at a time.

4.1 Data link layer

The Serial configuration is 4800, N, 8, 1 with no handshake. The recommended interconnect wiring is a shielded twisted pair, with the shield grounded only at the talker. The standard does not specify the use of a particular connector.



Note: The 0183-HS standard (HS = high speed) uses a 3-wire interface and a baud rate of 38400. This type of interface is not discussed here.

4.2 Message structure

All data is transmitted in the form of sentences. Data are printable ASCII characters (16#20 – 16#7E). Each sentence starts with a "\$" sign and ends with <CR><LF>.

The following characters are reserved:

ASCII	HEX	
<CR>	16#0D	Carrige return
<LF>	16#0A	Line feed, end delimiter
!	16#21	Start of encapsulation sentence delimiter
\$	16#24	Start delimiter
*	16#2A	Checksum delimiter
,	16#2C	Field delimiter
\	16#5C	TAG block delimiter
^	16#5E	Code delimiter for HEX representation
~	16#7E	Reserved

There are three basic kinds of sentences: talker sentences, proprietary sentences and query sentences. It is the talker sentences that are the scope of the NMEA0183Sender smartobject.

An example of a talker sentence is:

GLL Geographic Position - Latitude/Longitude

1	2 3	4 5	6 7

\$--GLL,llll.ll,a,yyyyy.yy,a,hhmmss.ss,A*hh<cr><lf>

- 1 - Latitude
- 2 - N or S (North or South)
- 3 - Longitude
- 4 - E or W (East or West)
- 5 - Time (UTC)
- 6 - Status A - Data Valid, V - Data Invalid
- 7 - Checksum

A sentence may contain up to 80 characters plus "\$" and CR/LF. If data for a field is not available, the field is omitted, but the delimiting commas are still sent, with no space between them. The checksum field consists of a "*" and two hex digits representing the exclusive OR of all characters between, but not including, the "\$" and "*".



Checksum is added by the NMEA0183Sender smartobject.

5. Prepare the hardware

In this section we describe the hardware, connections and necessary configuration for the different systems we can run the solution on.

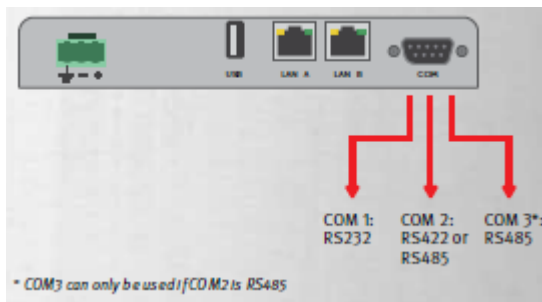
5.1 X2 Marine SC / X2 control / X2 extreme SC / Box2 SC

A X2 panel or Box2 from Beijer Electronics with Codesys PLC runtime included is delivered with the needed serial ports for the smartobject to run. The connections is 24Vdc power and a serial line for the NMEA0183 signal. RS422/RS485 is normally used, but RS232 can also be used in a point-point connection if the NMEA equipment permits. A network connection to one of the LAN ports is necessary for commissioning and program transfer.



5.1.1 Connect serial port

COM1 (RS232) or COM2(RS422/RS485) or COM3 (RS485) can be used to receive the NMEA 0183 signal. The serial parameters are normally 4800, N, 8, 1.



X2 Pro X2 Control X2 Motion X2 Marine

Female DB-9	Pin	COM1 signal	COM2 signal	COM3 signal
9	1	-	RS422 TX+/RS485 TX+/RX+	-
8	2	RS232 RX	-	-
7	3	RS232 TX	-	-
6	4	-	RS422 RX+	RS485 TX+/RX+
5	5	GND	GND	GND
4	6	-	RS422 TX- / RS485 TX-/RX-	-
3	7	RS232 RTS	-	-
2	8	RS232 CTS	-	-
1	9	-	RS422 RX-	RS485 TX-/RX-



Normally the NMEA 0183 signal is RS422, but it is also possible use RS485 since it is the same electrical levels and we use only 1 pair (RX).

5.2 BCS Nexto Compact (XP)

A compact PLC in the BCS XP-series with Codesys PLC runtime included is delivered with one serial RS485 port that can be used for NMEA 0183 purpose. The needed connections is 24Vdc power and a serial line for the NMEA0183 signal. A network connection to the LAN port is also necessary for commissioning and program transfer.



5.2.1 Connect serial port

COM1 (RS485) is used to receive the NMEA 0183 signal. The serial parameters are normally 4800, N, 8, 1.



Normally the NMEA 0183 signal is RS422, but in this case we can use RS485 also since it is the same electrical levels and we use only 1 pair (RX).

5.3 BCS Nexto modular (NX)

A modular PLC in the BCS XP-series with Codesys PLC runtime included is delivered with one, two or three serial ports (depending on the cpu) that can be used for NMEA 0183 purpose. The needed connections is 24Vdc power and a serial line for the NMEA0183 signal. RS422/RS485 is normally used, but RS232 can also be used in a point-point connection if the NMEA equipment permits. A network connection to one of the the LAN ports is also necessary for commissioning and program transfer.



Nexto Series

Type	Code	Communication Ports
CPUs	BCS-NX3003 *	1x Serial (RS-485) 1x Ethernet TCP/IP
	BCS-NX3004	1x Serial (RS-485/RS-422) 1x Ethernet TCP/IP
	BCS-NX3005	1x Serial (RS-485/RS-422) 1x Ethernet TCP/IP
	BCS-NX3010	2x Serial (RS-232 e RS-485/RS-422) 1x Ethernet TCP/IP
	BCS-NX3020	2x Serial (RS-232 e RS-485/RS-422) 2x Ethernet TCP/IP
	BCS-NX3030	2x Serial (RS-232 e RS-485/RS-422) 2x Ethernet TCP/IP

5.3.1 Connect serial port

COM1 or COM2 is used to receive the NMEA 0183 signal depending on the CPU type.

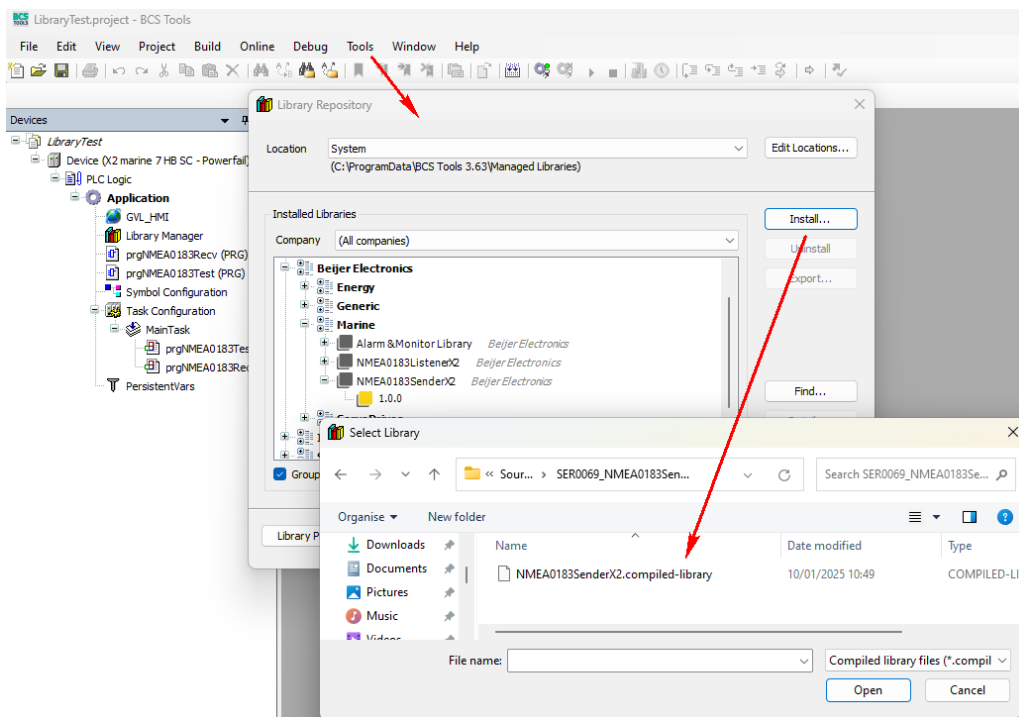


Normally the NMEA 0183 signal is RS422, but it is also possible use RS485 since it is the same electrical levels and we use only 1 pair (RX).

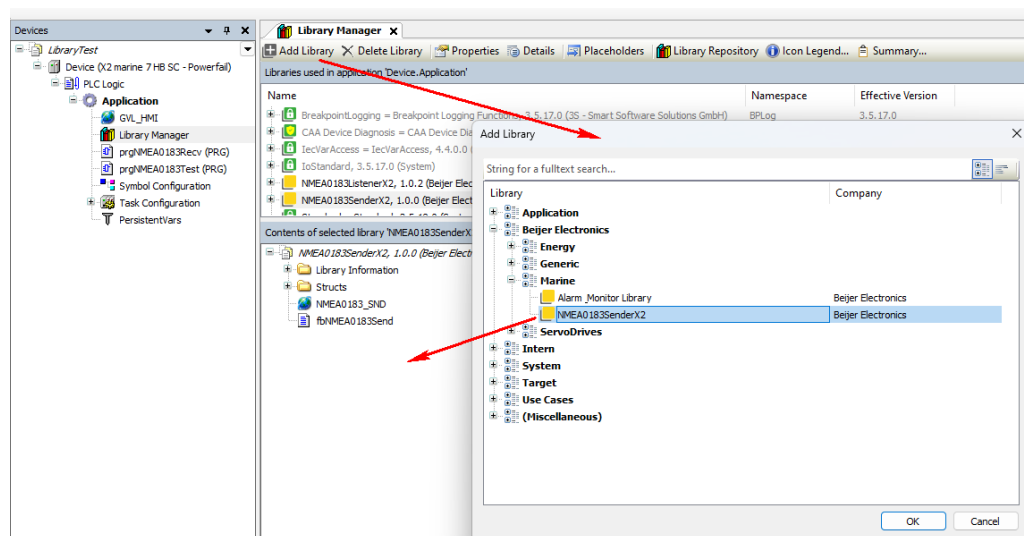
6. Configure the software

6.1 Add NMEA0183Sender.compiled-library to your project

Start BCS Tools and select Library Repository under the Tools menu. Install the compiled library 'SER0069_Vxxx_NMEA0183Sender.compiled-library'. There is one library for the X2-series and one for the Nexto-Series.



Open Library Manager in your project and add 'NMEA0183Sender'.



6.2 Open testproject in BCS Tools

In addition to the library file, two testproject is included to show the functionality. It is called NMEA0183SenderX2.projectarchive for the X2-series and NMEA0183SenderNexto.projectarchive for the Nexto-series. The functionality is the same.

6.2.1 NMEA0183SenderX2

The NMEA0183Send function block is added in the project. In X2 the serial parameters are configured in the function block. It is possible to change the baudrate, but normally it is 4800. Talker ID can be changed, but is default 'BE' for Beijer Electronics.

The screenshot shows the BCS Tools interface with the NMEA0183Send function block configured. The configuration parameters are as follows:

- COM3: 3
- b4800: 4800
- T#1000MS: 1000
- TalkerID: 'BE'
- ComPort: 3
- Baud: 4800
- SendFrq: 1000
- Talker_ID: 'BE'
- IncompatibleHardware: FALSE
- Enable_APB: TRUE
- Enable_DBT: TRUE
- Enable_EBF: TRUE
- Enable_GGA: TRUE
- Enable_GLL: TRUE
- Enable_HDT: TRUE
- Enable_MDA: TRUE
- Enable_MWV: TRUE
- Enable_RMC: TRUE
- Enable_ROT: TRUE
- Enable_RSA: TRUE
- Enable_VHW: TRUE

The Watch 1 table below shows the values of the variables used in the function block:

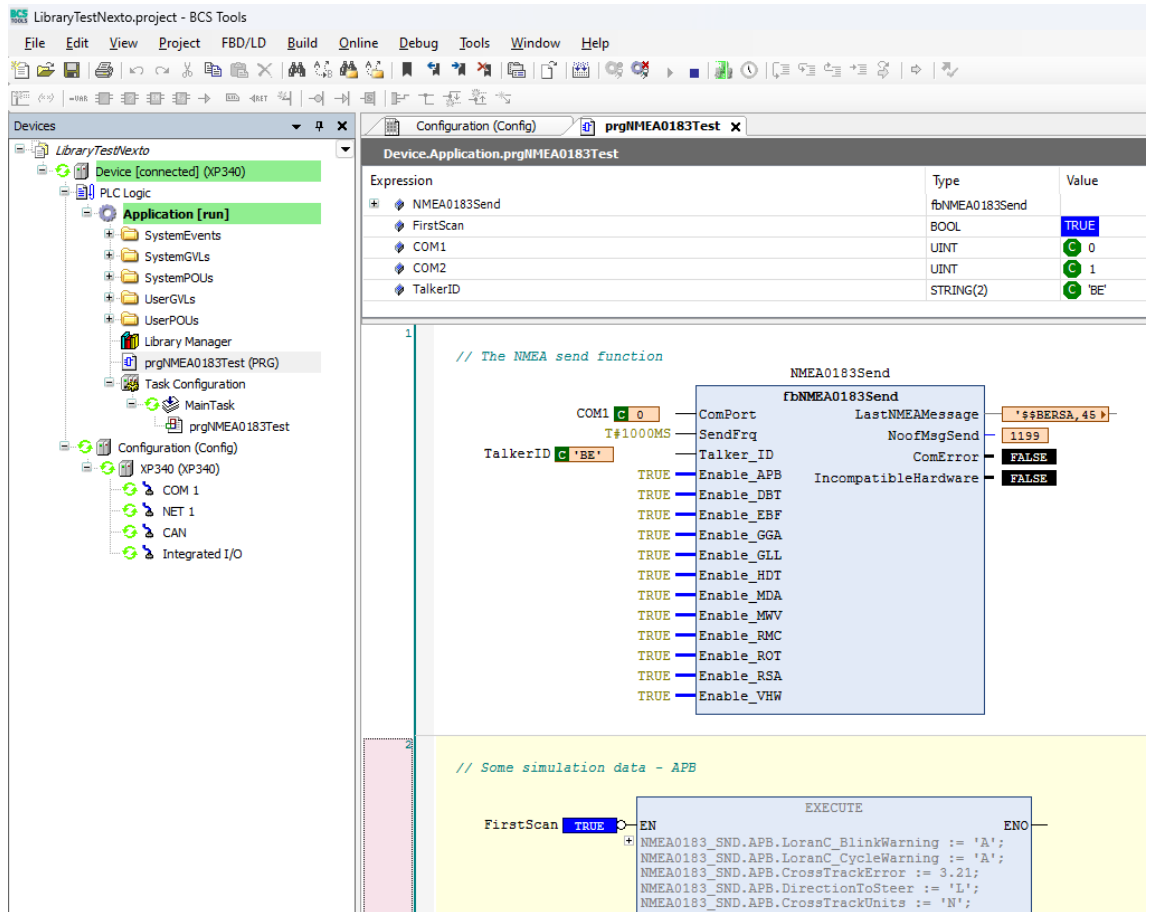
Expression	Type	Value	Comment
NMEA0183SND.NMEA0183_SND	NMEA0183_SND		
DBT	DBT_DUT		DBT - Depth Below Transducer
GGA	GGA_DUT		GGA - Global Positioning System Fixed Data
GLL	GLL_DUT		GLL - Geographic Position - Latitude/Longitude
Latitude_Degree	WORD	17	Latitude DDmm.mmmm
Latitude_Minute	LREAL	49.4088	Latitude ddMM.MMMM
Latitude_NS	STRING(1)	'N'	N=North or S=South
Longitude_Degree	WORD	59	Longitude DDDmm.mmmm
Longitude_Minute	LREAL	17.8728	Longitude dddMM.MMMMM
Longitude_EW	STRING(1)	'E'	E=East or W=West
UTC_Hour	WORD	15	UTCHHmss.sss
UTC_Minute	WORD	19	UTCHmMss.sss
UTC_Second	REAL	34.123	UTC hhmmSS.SSS
Status	STRING(1)	'A'	A - Data Valid, V - Data Invalid
Mode	STRING(1)	'D'	A=Autonomous, D=DGPS, E=DR (Only present in NMEA v3.00)
HDT	HDT_DUT		HDT - Heading - True
Heading_Degrees	LREAL	179.5	HeadingDegrees
Heading_True	STRING(1)	'T'	T=True
MWV	MWV_DUT		MWV - Wind Speed and Angle
RMC	RMC_DUT		RMC - Recommended Minimum Specific GNSS Data



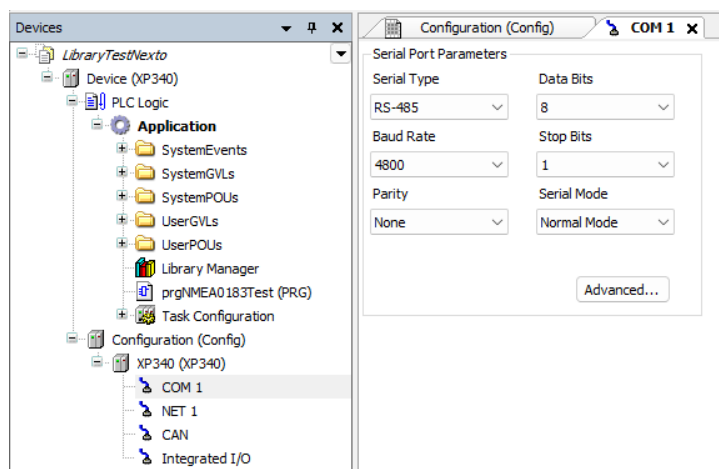
Only enable the NMEA sentences you need. The library will send one sentence on each SendFrq positive flank (adjustable from 100ms to 10s).

6.2.2 NMEA0183SenderNexto

The NMEA0183Send function block is added in the project. Note that the port numbers start with '0' in Nexto.



For the Nexto PLS's, the serial parameters are configured in device list.



7. Description of the library

The library consist of the 'fbNMEA0183Send' function block, a struct for each message type and a global variable list with the messages to send. See chapter 8 for details. The X2 version of the library have an additional setting for the baudrate.

The screenshot shows the 'Library Manager' window with the 'NMEA0183SenderX2, 1.0.0' library selected. The 'Details about selected library element' pane shows the 'FUNCTION_BLOCK fbNMEA0183Send' with the following properties:

Name	Type	Inherited from	Address	Initial	Comment
ComPort	UDINT				Comport to use
Baud	UDINT				Baudrate, normally 4800. Nexto is set in configuration
SendFrq	TIME				Send frequency (i.e T#1S, T#1000ms)
Talker_ID	STRING(2)				Talker ID. Default 'BE' (Beijer)
Enable_APB	BOOL				Enable APB message
Enable_DBT	BOOL				Enable DBT message
Enable_EBF	BOOL				Enable EBF message
Enable_GGA	BOOL				Enable GGA message
Enable_GLL	BOOL				Enable GLL message
Enable_HDT	BOOL				Enable HDT message
Enable_MDA	BOOL				Enable MDA message
Enable_MWV	BOOL				Enable MWV message
Enable_RMC	BOOL				Enable RMC message
Enable_ROT	BOOL				Enable ROT message
Enable_RSA	BOOL				Enable RSA message
Enable_VHW	BOOL				Enable VHW message
LastNMEAmessage	STRING(255)				Output the last NMEA message sent
NoofMsgSend	WORD				Number of messages sendt
ComError	BOOL				Problem accessing comport
IncompatibleHardware	BOOL				Incompatible hardware is found

The screenshot shows the 'Library Manager' window with the 'NMEA0183SenderX2, 1.0.0' library selected. The 'Details about selected library element' pane shows the 'VAR_GLOBAL NMEA0183_SND' with the following properties:

Name	Type	Inherited from	Address	Initial	Comment
DBT	DBT_DUT				DBT - Depth Below Transducer
GGA	GGA_DUT				GGA - Global Positioning System Fixed Data
GLL	GLL_DUT				GLL - Geographic Position - Latitude/Longitude
HDT	HDT_DUT				HDT - Heading - True
MWV	MWV_DUT				MWV - Wind Speed and Angle
RMC	RMC_DUT				RMC - Recommended Minimum Specific GNSS Data
ROT	ROT_DUT				ROT - Rate of Turn
RSA	RSA_DUT				RSA Rudder Sensor Angle
VHW	VHW_DUT				VHW - Water Speed and Heading
MDA	MDA_DUT				MDA - Meteorological Composite
APB	APB_DUT				APB - Autopilot Sentence 'B'
EBF	EBF_DUT				EBF - Alphantron River Pilot mode

8. Supported NMEA messages

The following NMEA messages is supported in this version.

8.1 DBT

DBT - Depth Below Transducer

Expression	Type	Value	Comment
NMEA0183_GVL.DBT	DBT_DUT		DBT - Depth Below Transducer
Depth_Feet	LREAL	564.9600	Depth in feet
Feet_Ind	STRING(1)	'F'	f=feet
Depth_Meters	LREAL	172.2000	Depth in meter
Meter_Ind	STRING(1)	'M'	M=Meter
Depth_Fathoms	LREAL	0.0000	Depth in fathoms
Fathoms_Ind	STRING(1)	'F'	F=Fathoms













8.2 GGA

Global Positioning System Fix Data. Time, Position and fix related data for a GPS receiver.

Expression	Type	Value	Comment
NMEA0183_GVL.GGA	GGA_DUT		GGA - Global Positioning System Fixed Data
UTC_Hour	WORD	11	UTCHHmss.sss
UTC_Minute	WORD	41	UTChhMMss.sss
UTC_Second	REAL	38.0000	UTC hhmmSS.SSS
Latitude_Degree	WORD	0	Latitude DDmm.mmmm
Latitude_Minute	LREAL	1.2559	Latitude ddMM.MMMM
Latitude_NS	STRING(1)	'N'	N=North or S=South
Longitude_Degree	WORD	0	Longitude DDDmm.mmmm
Longitude_Minute	LREAL	0.0177	Longitude dddMM.MMMMM
Longitude_EW	STRING(1)	'E'	E=East or W=West
GPS_Quality	WORD	2	0=Fix not available, 1=G...SPS Mode, 2=Differenti...
SatellitesUsed	WORD	8	Number of satellites used (0-12)
HDOP	REAL	1.4000	Horizontal dilution of precision
MSL_Altitude	REAL	0.0000	Mean Sea Level Altitude
MSL_Units	STRING(1)	'M'	Mean Sea Level Units (Meters 'M')
Geoid_Separation	REAL	0.0000	Geoid Separation
Geoid_Units	STRING(1)	'M'	Geoid Separation Units (Meters 'M')
AgeOfGPSData	REAL	5.0000	Age of differential GPS data, empty if not used
DiffRefStationID	WORD	100	Differential reference station ID, 0000-1023




8.3 GLL

Geographic Position – Latitude/Longitude.

Expression	Type	Value	Comment
 NMEA0183_GVL.GLL	GLL_DUT		GLL - GeographicPosition – Latitude/Longitude
 Latitude_Degree	WORD	0	Latitude DDmm.mmmm
 Latitude_Minute	LREAL	0.1499	Latitude ddMM.MMMM
 Latitude_NS	STRING(1)	'N'	N=North or S=South
 Longitude_Degree	WORD	0	Longitude DDDmm.mmmm
 Longitude_Minute	LREAL	0.0039	Longitude dddMM.MMMMM
 Longitude_EW	STRING(1)	'E'	E=East or W=West
 UTC_Hour	WORD	13	UTCHHmss.sss
 UTC_Minute	WORD	43	UTChhMMss.sss
 UTC_Second	REAL	6.0000	UTC hhmmSS.SSS
 Status	STRING(1)	'A'	A - Data Valid, V - Data Invalid
 Mode	STRING(1)	'D'	A=Autonomous, D=DGP...R (Only present in N...







8.4 HDT

HDT - Heading – True.

Expression	Type	Value	Comment
 NMEA0183_GVL.HDT	HDT_DUT		HDT - Heading – True
 Heading_Degrees	LREAL	137.4000	HeadingDegrees
 Heading_True	STRING(1)	'T'	T=True



















8.5 MWV

MWV - Wind Speed and Angle.

Expression	Type	Value	Comment
 NMEA0183_GVL.MWV	MWV_DUT		MWV - Wind Speed and Angle
 Wind_Angle	LREAL	124.3000	Wind Angle 0-360 degrees
 Angle_Ref	STRING(1)	'T'	Reference R=Relative, T=True
 Wind_Speed	LREAL	17.6000	Wind Speed
 Speed_Units	STRING(1)	'K'	Wind Speed Units K/M/N
 Status	STRING(1)	'A'	Status, 'A' = Data valid, 'V' = Data invalid




8.6 RMC

RMC - Recommended Minimum Specific GNSS Data.

Expression	Type	Value	Comment
 NMEA0183_GVL.RMC	RMC_DUT		RMC - Recommended Minimum Specific GNSS Data
 UTC_Hour	WORD	13	UTCHHmss.sss
 UTC_Minute	WORD	45	UTChhMMss.sss
 UTC_Second	REAL	48.0000	UTC hhmmSS.SSS
 Status	STRING(1)	'A'	Status, A = Active, V = Navigation receiver warning
 Latitude_Degree	WORD	0	Latitude DDmm.mmmm
 Latitude_Minute	LREAL	0.7421	Latitude ddMM.MMMM
 Latitude_NS	STRING(1)	'N'	N=North or S=South
 Longitude_Degree	WORD	0	Longitude DDDmm.mmmm
 Longitude_Minute	LREAL	0.0193	Longitude dddMM.MMMMM
 Longitude_EW	STRING(1)	'E'	E=East or W=West
 SpeedOverGnd	LREAL	13.1000	Speed over ground, knots
 CourseOverGnd	LREAL	1.5000	Course over ground, degrees True
 Date_dd	WORD	29	Date Day
 Date_mm	WORD	11	Date Month
 Date_yy	WORD	21	Date Year
 MagneticVar	LREAL	0.0000	Magnetic Variation, degrees
 MagneticVar_EW	STRING(1)	'E'	E=East or W=West






8.7 ROT

ROT - Rate of Turn.

Expression	Type	Value	Comment
 NMEA0183_GVL.ROT	ROT_DUT		ROT - Rate of Turn
 RateOfTurn	LREAL	29.0000	Rate of Turn, degrees/minutes
 Status	STRING(1)	'A'	A - Data Valid, V - Data Invalid

8.8 RSA

RSA - Rudder Sensor Angle.

Expression	Type	Value	Comment
 NMEA0183_GVL.RSA	RSA_DUT		RSA Rudder Sensor Angle
 RudderAngle_Star	LREAL	-44.0000	Starboard (or single) rud...sensor, "-" means Turn...
 RASStar_Status	STRING(1)	'A'	Status, A means data is valid
 RudderAngle_Port	LREAL	0.0000	Port rudder sensor
 RAPort_Status	STRING(1)	"	Status, A means data is valid

8.9 VHW

VHW – Water speed and Heading.

Expression	Type	Value	Comment
NMEA0183_GVL.VHW	VHW_DUT		VHW - Water Speed and Heading
Degrees_True	LREAL	0.0000	Degrees true
True_Ind	STRING(1)	'T'	T=TRUE
Degrees_Magnetic	LREAL	137.1900	Degrees magnetic
Magnetic_Ind	STRING(1)	'M'	M=Magnetic
WaterSpeed_Kn	LREAL	1.5000	Waterspeed in knots
Kn_Ind	STRING(1)	'N'	N=Knots
WaterSpeed_Kmh	LREAL	2.7800	Waterspeed in km/h
Kmh_Ind	STRING(1)	'K'	K=Km/h
















8.10 MDA

MDA - Meteorological Composite.

Expression	Type	Value	Comment
NMEA0183.NMEA0183_GVL.MDA	MDA_DUT		MDA - Meteorological Composite
Pressure_I	LREAL	30.0000	Barometric pressure, inc...OF mercury, TO the ne...
Pressure_I_Ind	STRING(1)	'I'	I = inches of mercury
Pressure_B	LREAL	1.0149	Barometric pressure, bars, to the nearest .001 bar
Pressure_B_Ind	STRING(1)	'B'	B = bars
AirTemp	LREAL	0.0000	Air temperature, degrees... to the nearest 0.1 deg...
AirTemp_Ind	STRING(1)	'C'	C = degrees C
WaterTemp	LREAL	0.0000	Water temperature, degr... (this field left blank ...
WaterTemp_Ind	STRING(1)	'C'	C = degrees C
RelHumidity	LREAL	0.0000	Relative humidity, percen...o the nearest 0.1 percent
AbsHumidity	WORD	0	Absolute humidity, percent
DewPoint	LREAL	0.0000	Dew point, degrees C, to the nearest 0.1 degree C
DewPoint_Ind	STRING(1)	'C'	C = degrees C
WindDir_T	LREAL	0.0000	Wind direction, degrees ..., to the nearest 0.1 de...
WindDir_T_Ind	STRING(1)	'T'	T = true
WindDir_M	LREAL	38.7000	Wind direction, degrees ...etic, to the nearest 0....
WindDir_M_Ind	STRING(1)	'M'	M = magnetic
WindSpeed_N	LREAL	10.8800	Wind speed, knots, to the nearest 0.1 knot
WindSpeed_N_Ind	STRING(1)	'N'	N = knots
WindSpeed_M	LREAL	5.6000	Wind speed, meters per ...nd, to the nearest 0.1...
WindSpeed_M_Ind	STRING(1)	'M'	M = meters per second



8.11 APB

APB - Autopilot Sentence 'B'.

Expression	Type	Value	Comment
 NMEA0183.NMEA0183_GVL.APB	APB_DUT		APB - Autopilot Sentence 'B'
 LoranC_BlinkWarning	STRING(1)	'A'	V = LORAN-C Blink/SNR ...ing, A = General Warn...
 LoranC_CycleWarning	STRING(1)	'A'	V = Loran-C Cycle Lock ...ing, A = General Warni...
 CrossTrackError	LREAL	1.1230	Cross Track Error Magnitude
 DirectionToSteer	STRING(1)	'L'	Direction to steer, L or R
 CrossTrackUnits	STRING(1)	'N'	Cross Track Units (Nautic miles(N) or kilometres(K))
 ArrivalCircle	STRING(1)	'V'	A = Arrival Circle Entered
 PerpendicularPassed	STRING(1)	'V'	A = Perpendicular passed at waypoint
 BearingOriginToDest	LREAL	2.2340	Bearing originto destination
 BO_TrueOrMagnetic	STRING(1)	'M'	Bearing M = Magnetic, T = True
 DestWaypointID	STRING(5)	'DESTI'	Destination Waypoint ID
 BearingPresentToDest	LREAL	3.3450	Bearing present position to destination
 BP_TrueOrMagnetic	STRING(1)	'M'	Bearing M = Magnetic, T = True
 HeadingToDest	LREAL	4.4560	Heading to steerto destination waypoint
 HTS_TrueOrMagnetic	STRING(1)	'M'	Heading M = Magnetic, T = True

8.12 EBF

EBF – Alpatron River Pilot mode.

Expression	Type	Value	Comment
 NMEA0183_GVL.EBF	EBF_DUT		EBF - Alpatron River Pilot mode
 Mode	WORD	1	Mode (0-4)

9. About Beijer Electronics

Beijer Electronics is a multinational, cross-industry innovator that connects people and technologies to optimize processes for business-critical applications. Our offer includes operator communication, automation solutions, digitalization and support. As experts in user-friendly software, hardware and services for the Industrial Internet of Things, we empower you to meet your challenges through leading-edge solutions.

Beijer Electronics is an Ependion company. Ependion (formerly Beijer Group) is listed on the NASDAQ OMX Nordic Stockholm Mid Cap list under the ticker EPEN.

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