NMEA-0183 Input data format Ver. 1.5/2.0

Input sentences

The following input data formats are available for displaying own boat's position readings or presenting north-up or course-up mode.

Priority of data

Latitude/longitude:	GGA > GLL
Waypoint data:	BWC > WPL > BOD & WDC
Bearing:	HDT = VHW (T) > HDM = VHW (M) > HCC > VTG (T) > VTG (M) > HSC
Speed:	VTG > VHW

Descriptions	Contents of data field
BOD (Ver. 2.0)	**Bearing - Origin to Distance**
BWC (Ver. 2.0)	**Bearing & Distance to Waypoint**
GGA (Ver. 2.0)	**Global Positioning System Fix Data**
GLL (Ver. 2.0)	**Geographic Position, Latitude/Longitude**
GTD (Ver. 1.5)	**Geographical Position, Loran C TDs**
HCC (Ver. 1.5)	**Compass Heading**

BOD

```
$ - - BOD, , xxx.x, T, xxx.x, M, xxx, xxx  *hh <CR> <LF>
```

- Checksum
- Origin number
- Waypoint number
- Magnetic bearing from origin to waypoint
- Sentence format
- Talker device
- Start of sentence
- True bearing from origin to waypoint

BWC

```
$ - - BWC, , xxxx.xxx, N/S, xxxxx.xxx, E/W, xxx.x, T, xxx.x, M, xxx.x, N,
```

- Waypoint latitude
- Waypoint longitude
- Waypoint bearing (magnetic)
- Sentence format
- N: North / S: South
- E: East / W: West
- Waypoint bearing (true)
- Talker device
- Distance to go (nm)
  xx.xx: 00.00 to 09.99 nm
  xxx.x: 010.0 to 999.9 nm
- Start of sentence

```
xxx *hh <CR> <LF>
```

- Checksum
- Waypoint number

GGA

```
$ - - GGA, , xxxx.xxx, N/S, xxxxx.xxx, E/W, x, , , , , , , , *hh <CR> <LF>
```

- Checksum
- Latitude
- Longitude
- Sentence format
- N: North / S: South
- E: East / W: West
- Talker device
- GPS quality indicator
  0: fix not available
  1: GPS fix
  2: DGPS fix
- Start of sentence

GLL

```
$ - - GLL, xxxx.xxx, N/S, xxxxx.xxx, E/W, , A *hh <CR> <LF>
```

- Checksum
- Sentence format
- Latitude
- Longitude
- A: Valid
- N: North / S: South
- E: East / W: West
- Talker device
- Start of sentence

GTD

```
$ - - GTD, xxxxx.x, xxxxx.x, , , *hh <CR> <LF>
```

- Checksum
- Sentence format
- LOPs value (in µsec) of secondary station 2
- LOPs value (in µsec) of secondary station 1
- Talker device
- Start of sentence

HCC

```
$ - - HCC, xxx.x *hh <CR> <LF>
```

- Checksum
- Sentence format
- Compass heading
- Talker device
- Start of sentence

HDM (Ver. 1.5)

Heading, Magnetic

$ - - HDM, xxx.x, M *hh <CR> <LF>

- Start of sentence
- Talker device
- Sentence format
- Heading (Magnetic)
- Checksum

HDT (Ver. 2.0)

Heading, True

$ - - HDT, xxx.x, T *hh <CR> <LF>

- Start of sentence
- Talker device
- Sentence format
- Heading (True)
- Checksum

HSC (Ver. 2.0)

Heading Steering Command

$ - - HSC, xxx.x, T, xxx.x, M *hh <CR> <LF>

- Start of sentence
- Talker device
- Sentence format
- Commanded heading (True)
- Commanded heading (Magnetic)
- Checksum

VHW (Ver. 2.0)

Water Speed and Heading

$ - - VHW, xxx.x, T, xxx.x, M, xx.x, N, xx.xx, K *hh <CR> <LF>

- Start of sentence
- Talker device
- Sentence format
- Heading (True bearing)
- Heading (Magnetic)
- Speed (knots)
- Speed (km per hour)
- Checksum

VTG (Ver. 2.0)

Course and Ground Speed

$ - - VTG, xxx, T, xxx, M, xx.x, N, xx.x, K *hh <CR> <LF>

- Start of sentence
- Talker device
- Sentence format
- Course (True bearing)
- Course (Magnetic bearing)
- Speed over ground (knots)
- Speed over ground (km/h)
- Checksum

WDC (Ver. 2.0)

Distance to Waypoint

$ - - WDC, xxx.x, N, xxx *hh <CR> <LF>

- Start of sentence
- Talker device
- Sentence format
- Distance to go (nm)
  xx.xx: 00.00 to 09.99 nm
  xxx.x: 010.0 to 999.9 nm
- Waypoint number
- Checksum

WPL (Ver. 2.0)

Waypoint Location

$ - - WPL, xxxx.xxx, N/S, xxxxx.xxx, E/W, xxx *hh <CR> <LF>

- Start of sentence
- Talker device
- Sentence format
- Waypoint latitude
- N: North
  S: South
- Waypoint longitude
- E: East
  W: West
- Waypoint number
- Checksum

APPENDIX 6

TRANSMITTER TUNE-UP PROCEDURE

TWO (2) PAGE ALIGNMENT PROCEDURE
FOLLOWS THIS SHEET

ALIGNMENT PROCEDURE OF MD-3420Mk2/3441 TRANSMITTER

1. Preparation

   1) The modulator unit under alignment and following instruments should be arranged according to the Fig. 1.

      Instruments required:

      a. Digital multimeter
      b. Universal counter
      c. Peak power meter — Ex.: GMC type 478A
      d. Microwave frequency meter — Ex.: EIP type 585
      e. Directional coupler for wave guide
      f. Wave guide attenuator (20 dB)
      g. Coax attenuator (20 dB) 2 pcs — Ex.: Wavetec: Model 1
      h. Wave guide attenuator (20 dB)
      i. No reflection terminator
      j. Display unit connected to the antenna unit

   2) Remove the scanner unit consisting with the antenna, circulator and rotary joint referring to the exploded view drawing.

2. Turn on the unit to get initial stand by screen without transmission. Never make the transmitter on during this measurement. It is very dangerous.

   a. Confirmation of the magnetron heater voltage.

      Measure the magnetron heater voltage by the digital multimeter between J6-1 pin (+) and J6-3 pin (-) on the modulator board (E36-100A). The voltage should be 5.0 +/- 0.1 Vdc. Adjust to get the voltage within specification if required.

   b. Confirmation of the transmitter high voltage.

      Measure the voltage between TP and the ground by the multimeter. The voltage should be 285 +/- Vdc. Adjust to get the voltage within the specification if required.

3. Transmitter alignment:

   Turn on the unit with both FUNC 1 and FUNC 2 keys depressed to get maintenance MENU screen. After standby time of 120 sec., select "1. MAINTENANCE TX." By moving cursor by the pointing device and press SET key to initiate transmission without rotation of the antenna.

ALIGNMENT PROCEDURE (continued)

1) S (short) pulse measurement.

Select the 1/8 mile range by pressing the RANGE keys.

a. Confirmation of the pulse length.

Measure the pulse length at the 50% of the peak power meter screen. It should be between 0.09 and 0.11 micro sec. Adjust the R58 if required.

b. Peak power measurement.

Read peak the power from the peak power meter screen. It should be between 1.4 and 1.6 kW.

c. Frequency measurement.

Take the reading of the microwave frequency meter. It should be 9410 +/- 30 MHz.

d. Measurement of the PRF (pulse repetition frequency).

Measure PRF by the reading of the universal counter. It should be 2200 +/- 100 Hz.

2) M and L pulse measurement

a. Measure pulse length, peak power, transmitter frequency and PRF in the same procedure as S pulse measurement according to the following table:

Pulse length	Range	Adjuster
M 0.2 to 0.3 micro sec.	1.5 NM	R57
L: 0.8 to 1.2	24 NM	R66

Peak power:

M and L pulse: 1.7 to 2.2 kW

Transmitter frequency:

9410 +/- 30 MHz

APPENDIX 7

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

Operating frequency is established by characteristics of the magnetron.

Pulse width and pulse repetition rate is established by conventional digital circuitry.

APPENDIX 8

CIRCUITS TO SUPPRESS SPURIOUS RADIATION LIMIT MODULATION AND CONTROL POWER

a. Spurious emission suppression is accomplished by waveguide characteristics which attenuate lower frequencies. Spurious radiation suppression is accomplished by shielding and by-passing.

b. Modulation limiting is provided by characteristics of the PRF generator circuitry, trigger SCR, and magnetron.

c. Power output is maintained by power supply regulation, trigger SCR and magnetron.

APPENDIX A

POWER-BANDWIDTH DETERMINATION

The bandwidth within which 99% of the emission power density occurs was determined by area integration.

The Tektronix 494P spectrum analyzer digitizes the screen into 1000 x 250 data points as Y-axis (frequency) and X-axis (log amplitude) respectively.

To determine the 99% power density, the digitized spectrum plot, Figure 2a, was normalized to the noise baseline and the anti-log taken of each resulting X-axis value. This value, now a linear function, was multiplied by the corresponding Y-axis increment and the successive results summed over the 1000 increment total, resulting in an area value.

Additional summations were made in which successive approximations of less than the full 1000 increment Y-axis (frequency) width were included in the integrated area and the result compared to the original area computation.

When a ratio of 0.99 was detected, the successive approximations were halted and the resulting Y-axis value noted. This value was then scaled back into frequency by using the frequency/division calibration of the plot.

Results of this process, when applied to the Sitex MRT-152 (Figure 2a), resulted in a value of 85.2 MHz.