EchoRange™ / EchoRange+™
And 200m Mini Altimeter Kit
User Technical Manual

Revision 1.004
2/6/2019

AIRMAR Technology Corporation
35 Meadowbrook Drive
Milford, NH 03055-4613
(603) 673-9570

Table of Contents

1.   Introduction

This document provides a detailed description of the communications protocol for the following Airmar products:

- EchoRange™ Single Frequency Smart Transducer (A version without sea water temperature may also be available). The first single frequency product will operate at 200 kHz.
- EchoRange™ Dual Frequency Smart Transducer (has an internal I2C interface to a second (lower frequency) Smart Transducer). The first dual frequency product will operate at 200 kHz and 30 kHz. The 200 kHz Smart Transducer will be referred to as the Master, the 30kHz as the Slave.
- 200m Mini Altimeter Kit Single Frequency Smart Transducer - A board level product available in two frequencies, 200 kHz and 170 kHz.

The single frequency product has two separate communication interfaces: one a bidirectional interface compliant with the NMEA 0183 protocol using RS422, the other is a transmit-only interface with a proprietary protocol using RS485. The first interface is required, the latter interface is an optional adjunct used for obtaining detailed echo envelope data.

The dual frequency product has three separate external communication interfaces: one a bidirectional interface compliant with the NMEA 0183 protocol using RS422, the other two are transmit-only interfaces with a proprietary protocol using RS485. The first interface is required, the latter two interfaces (one for each frequency) are optional adjuncts used for obtaining detailed echo envelope data.

The 200m Mini Altimeter Kit products never have the transmit-only interface with a proprietary protocol using RS485 used for obtaining detailed echo envelope data.

Products with the echo envelope option are designated EchoRange+™.

For further information about the NMEA 0183 protocol, refer to the document, *NMEA 0183 Standard for Interfacing Marine Electronic Devices, v4.00*. This document is available from the National Marine Electronics Association (www.nmea.org).

ECHO-OUT HIGH FREQUENCY

ECHO-OUT LOW FREQUENCY

NMEA-IN

NMEA-OUT

Airmar Dual Frequency Smart Transducer w/ Echo Envelope

9 – 40 Volt Power

RS485 Converter

RS485 Converter

RS422 Converter

High Frequency Transducer

Low Frequency Transducer

ECHO ENVELOPE @ 921600 BAUD

NMEA-0183 DATA @ 4800 BAUD

ECHO-OUT

NMEA-IN

NMEA-OUT

Airmar Single Frequency Smart Transducer w/ Echo Envelope

9 – 40 Volt Power

RS485 Converter

RS422 Converter

High Frequency Transducer

ECHO ENVELOPE @ 921600 BAUD

NMEA-0183 DATA @ 4800 BAUD

NMEA-IN

NMEA-OUT

Airmar Single Frequency Smart Transducer w/o Echo Envelope Includes 200m Mini Altimeter Kit

9 – 40 Volt Power

RS422 Converter

High Frequency Transducer

NMEA-0183 DATA @ 4800 BAUD
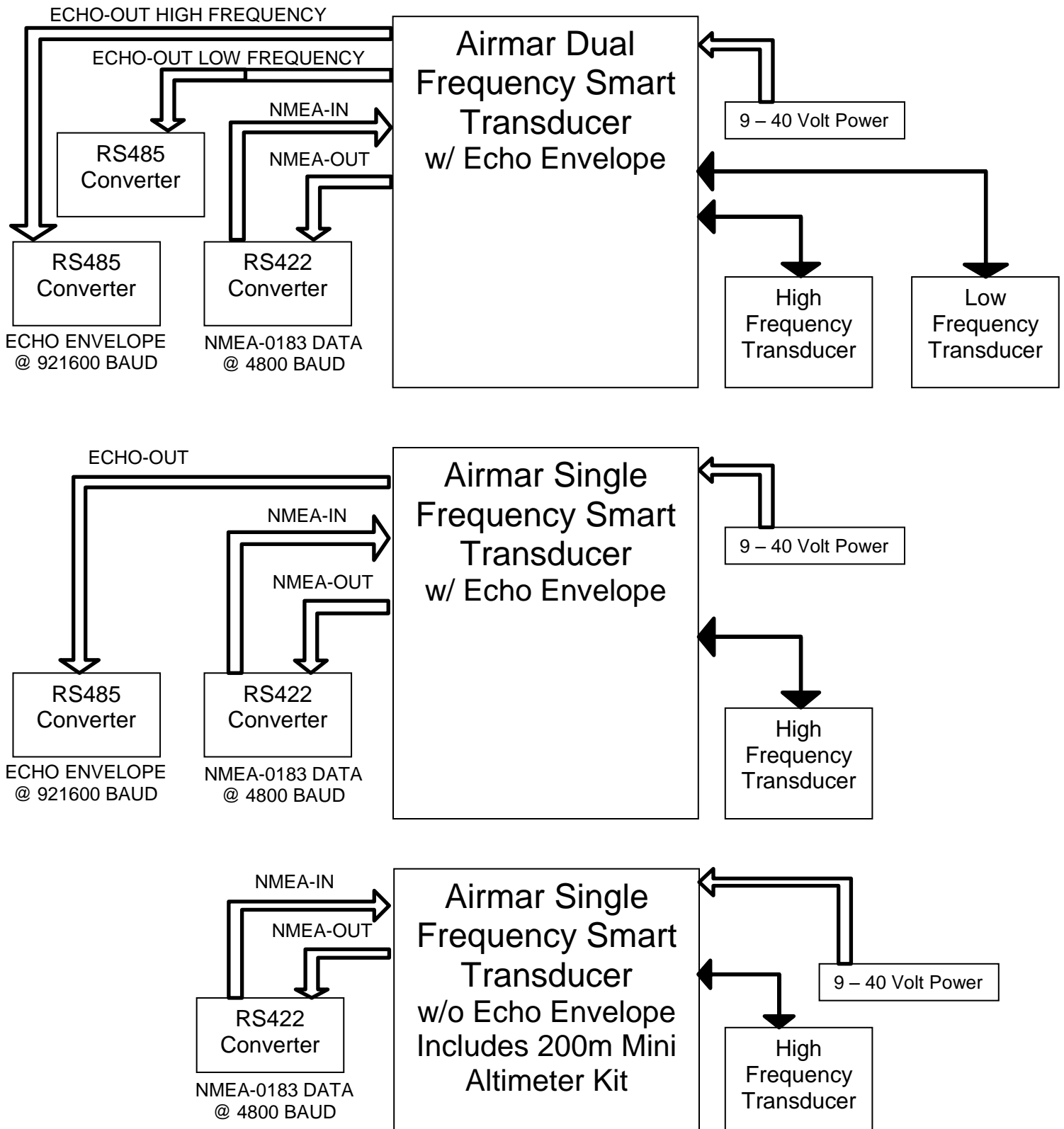
Figure 1.1 Transducer Configurations

2.   NMEA 0183 Interfaces

An Airmar EchoRange™ Sensor has a single standard NMEA 0183-compliant output channel, and a single standard NMEA 0183-compliant input channel. The unit transmits standard NMEA 0183 sentences on its output channel. It also recognizes standard and proprietary NMEA 0183 sentences received on its input channel. The standard baud rate for both input and output channels is 4800 baud, though if desired this may be increased to 38400 baud via a proprietary command.[1]

The transmitted NMEA 0183 sentences are described in section 2.1. Received NMEA 0183 sentences and proprietary commands are described in section 2.2

2.1.   Transmitted NMEA 0183 Sentences

By default, only certain NMEA sentences are enabled for transmission. Other sentences may be enabled individually for transmission via commands sent to the input channel.[2]

The standard transmission interval for most of the transmitted sentences is once per second. However, if every sentence were enabled for transmission at rates higher than once per second, there would not be enough bandwidth in the output channel at 4800 baud to output all sentences within a one second timeframe. Therefore, one or more of the following remedies should be employed:

- To conserve bandwidth, only enable for transmission those sentences required for the given application, and disable all others.

- Reduce the frequency of transmission for less critical sentences.

- Increase the overall bandwidth eightfold by increasing the baud rate from the standard 4800 baud to 38400 baud (though keep in mind that most NMEA 0183 instruments are not capable of operating at 38400 baud)

All NMEA sentences transmitted by the device include a checksum at the end of the sentence, consisting of an asterisk (*) followed by two ASCII hexadecimal characters. In the detailed specifications to follow, these hexadecimal characters are designated by "hh".

The standard NMEA 0183 sentences provided by the EchoRange™ Sensor are summarized in Table 1. Each of the transmitted sentences in Table 1 is described in detail on the subsequent pages.

The Maximum Length (chars) column in the table indicates an expected worst-case scenario that can be used for bandwidth budgeting. The total time in seconds required to transmit all enabled sentences in a single interval is

---

[1] See the $PAMTC,BAUD command.
[2] See the $PAMTC,EN command.

$$Total\_transmission\_time = \frac{Total\_number\_of\_characters \times 10}{baud\_rate}$$

Table 1: NMEA 0183 Transmitted Sentences

Sentence	Description	On by Default single frequency	On by Default dual frequency	On by Default 200m Mini Altimeter Kit	Maximum Length (chars)
$SD**DBT**	Depth Below Transducer	☐	☐	☐	40
$SD**DPT**	Depth	☑	☐	☑	35
$SD**MTW**	Sea Water Temperature	☑	☑	☑	20
$SD**XDR**	Depth in meters and sea water temperature from Master/Slave transducers	x	☑	x	43
$YX**XDR**	Transducer Measurements: Board Temperature and Voltage from Master/Slave transducers	☐	☐	☐	43

☑ = supported and enabled by default
☐ = supported but not enabled by default
✕ = not supported

$SD**DBT**

Summary

NMEA 0183 standard Depth Below Transducer sentence.

Syntax

```
$SDDBT,<1>,<2>,<3>,<4>,<5>,<6>*hh<CR><LF>
```

Fields

<1>   Water Depth referenced to the transducer, in feet

<2>   f (feet)

<3>   Water Depth referenced to the transducer, in meters

<4>   M (Meters)

<5>   Water Depth referenced to the transducer, in fathoms

<6>   F (Fathoms)

Default State

Disabled. Once per second when enabled.

Notes

This sentence may be enabled or disabled via the $PAMTC,EN,DBT command.

$SD**DPT**

Summary

NMEA 0183 standard Depth sentence

Syntax

$SDDPT,<1>,<2>,<3>*hh<CR><LF>

Fields

<1>   Water Depth relative to the transducer, in meters

<2>   Offset from transducer, in meters (to point of interest, water line or keel, positive is distance from transducer to water line, negative is from transducer to keel)

<3>   Maximum range scale in use, in meters (that is, Maximum depth in current sounding mode of operation)

Default State

Enabled.   Transmitted once per second for single frequency EchoRange™ Sensor.

Disabled.   For dual frequency EchoRange™ Sensor, transmitted once per second, when enabled.

Notes

This sentence may be enabled or disabled via the $PAMTC,EN,DPT command.

$SD**MTW**

Summary

NMEA 0183 standard Sea Water Temperature sentence.

Syntax

```
$SDMTW,<1>,<2>*hh<CR><LF>
```

Fields

<1>   Sea Water Temperature, in degrees C

<2>   C

Default State

Enabled. Transmitted once per second.

Notes

This sentence may be enabled or disabled via the $PAMTC,EN,MTW command.

$YX**XDR(T)**

Summary

NMEA 0183 Transducer Measurements, used to report Board Temperature and Voltage from Master/Slave transducers.

Syntax

```
$YXXDR,<1>, <2>, <3>, <4>,
       <5>, <6>, <7>, <8>,
       <9>, <10>, <11>, <12>,
       <13>, <14>, <15>, <16>
       *hh<CR><LF>
```

Fields

There is only one version of the XDR sentence for the single frequency EchoRange™ Sensor, but two versions for the dual frequency version. For compatibility, this version of the XDR sentence will be implemented as a "T" version in both. The output does not change, only its identifier for enable/disable purposes is different.

<1>	C = Temperature
<2>	Board Temperature, reported to 0.1 degrees
<3>	C = Degrees C
<4>	BRDT (ID indicating Board Temperature)
<5>	U = Voltage
<6>	Board Voltage, reported to 0.01 volts
<7>	V = Volts
<8>	BRDV (ID indicating Board Voltage)

The following for Dual Frequency only

<9>	C = Temperature
<10>	Slave Board Temperature, reported to 0.1 degrees
<11>	C = Degrees C
<12>	SLVT (ID indicating Slave Board Temperature)
<13>	U = Voltage
<14>	Slave Board Voltage, reported to 0.01 volts
<15>	V = Volts
<16>	SLVV (ID indicating Board Voltage)

Default State

$YXXDR(T): Disabled. Once per second when enabled.

Notes

The fields in an XDR sentence are grouped in sets of four. There may be up to four sets, with four fields per set, in a single transmitted XDR sentence. Each set contains, in order, the four fields <Type>, <Data>, <Units>, and <ID>. If for some reason the contents of a given set are not available, then the entire set (including commas) may be omitted. Future versions of firmware may provide multiple XDR sentences, containing different types of data in each sentence. Therefore, it is necessary when parsing any XDR sentence to examine the <ID> field in each set of four fields in order to identify the meaning of the data in that set.

Fields 8-16 are only present in the Dual Frequency EchoRange™ Sensor, and even then may not be present in single board implementations.

The XDR(T) sentence may be enabled via the $PAMTC,EN,XDRT command.

$SD**XDR(X)**

Summary

NMEA 0183 Transducer Measurements, used to report Depth in meters and Sea Water Temperature from Master/Slave transducers.

Syntax

```
$SDXDR,<1>, <2>, <3>, <4>,
        <5>, <6>, <7>, <8>,
        <9>, <10>, <11>, <12>,
        <13>, <14>, <15>, <16>
        *hh<CR><LF>
```

Fields

This version of the XDR sentence is only implemented for the dual frequency EchoRange™ Sensor. Because there are two versions of the XDR sentence, this one will be implemented as the "X" version. The output does not change, only its identifier for enable/disable purposes is different.

<1>	D = Linear Displacement
<2>	Depth, reported to 0.01 meters
<3>	M = Meters
<4>	XDHI (ID indicating Transducer Depth, High Frequency)
<5>	D = Linear Displacement
<6>	Depth, reported to 0.01 meters
<7>	M = Meters
<8>	XDLO (ID indicating Transducer Depth, Low Frequency)
<9>	C = Temperature
<10>	Water Temperature, reported to 0.1 degrees
<11>	C = Degrees C
<12>	WTHI (ID indicating Water Temperature, High Frequency)
<13>	C = Temperature
<14>	Water Temperature, reported to 0.1 degrees
<15>	C = Degrees C
<16>	WTLO (ID indicating Water Temperature, Low Frequency)

Default State

$SDXDR(X): Enabled. Transmitted once per second.

Notes

The fields in an XDR sentence are grouped in sets of four. There may be up to four sets, with four fields per set, in a single transmitted XDR sentence. Each set contains, in order, the four fields <Type>, <Data>, <Units>, and <ID>. If for some reason the contents of a given set are not available, then the entire set (including commas) may be omitted. Future versions of firmware may provide multiple XDR sentences, containing different types of data in each sentence. Therefore, it is necessary when parsing any XDR sentence to examine the <ID> field in each set of four fields in order to identify the meaning of the data in that set.

Fields 8-16 are only present in the Dual Frequency EchoRange™ Sensor, and even then the WTLO field may not be present in all configurations.

The XDR(X) sentence may be enabled via the $PAMTC,EN,XDRX command.

2.2.   Received NMEA 0183 Sentences and Commands

The EchoRange™ Sensor has an NMEA 0183-compliant input channel that is capable of receiving standard NMEA sentences as well as proprietary commands for initialization, calibration, or to modify the behavior of the unit.

All received sentences and commands can include or omit the NMEA checksum. If a checksum is included, the sentence will be checked against its checksum, and the sentence will be accepted only if there is a checksum match. If the NMEA checksum is excluded, it is required that the preceding asterisk (*) also be excluded. If no checksum is provided, the device will accept the sentence without error checking. It is recommended that all sentences and commands provided to the device include a checksum to help ensure integrity of the transmitted data.

There are currently no standard NMEA sentences recognized by the EchoRange™ Sensor on the serial input channel. The proprietary sentences recognized by the EchoRange™ Sensor on the serial input channel are summarized in Table 2 on the next page.

Each of the sentences in Table 2 is described in detail on the subsequent pages.

Table 2: NMEA 0183 Received Sentences and Commands

Sentence or Command	Description	Supported in EchoRange	Supported in 200m Mini Altimeter Kit
$PAMTC,BAUD	Change the baud rate from the nominal 4800 baud to 38400 baud	✓	✓
$PAMTC,EEC	Control the Echo Envelope channel.	✓	x
$PAMTC,EN	Enable/disable transmission of specific sentences, and change their rate of transmission	✓	✓
$PAMTC,ERST	Reset the user portion of nonvolatile EEPROM to factory defaults	✓	✓
$PAMTC,OPTION	Enable/disable certain product features.	✓	✓
$PAMTC,POST	Perform the Power On Self Test function.	✓	✓
$PAMTC,QPS	Query device part number and serial number	✓	✓
$PAMTC,QV	Query device hardware and firmware versions	✓	✓
$PAMTC,RESET	Reset the device	✓	✓
$PAMTX	Pause or resume all automatic transmission of messages	✓	✓

✓ = supported
✕ = not supported

$PAMTC

Summary

Prefix for recognized proprietary commands.

Syntax

`$PAMTC,<1>…*hh<CR><LF>`

Fields

    `<1>`   Command mnemonic. This may be any of the following:

                    `BAUD`
                    `EEC`
                    `EN`
                    `ERST`
                    `OPTION`
                    `POST`
                    `QPS`
                    `QV`
                    `RESET`

The number and meaning of any subsequent fields is dependent on the command mnemonic. Each of the command mnemonics defines a separate proprietary command (or set of commands) recognized by the unit. These commands are each described in their own section on the following pages.

$PAMTC,**BAUD**

Summary

Change the baud rate for both the transmitting and receiving NMEA 0183 channels.

Syntax

One of the following forms:

```
$PAMTC,BAUD,4800*hh<CR><LF>

$PAMTC,BAUD,9600*hh<CR><LF>

$PAMTC,BAUD,19200*hh<CR><LF>

$PAMTC,BAUD,38400*hh<CR><LF>

$PAMTC,BAUD,57600*hh<CR><LF>

$PAMTC,BAUD,115200*hh<CR><LF>

        Set active Baud Rate.

$PAMTC,BAUD,Q*hh<CR><LF>

        Query active Baud Rate.

        Reply is:

        $PAMTR,BAUD,4800*hh<CR><LF>

$PAMTC,BAUD,XXXXX,CFG*hh<CR><LF>

        Set the Baud to be saved in Non-Volatile memory and
        used as the default after the next Power On /
        Reset. Where XXXXX is: 4800, 9600, 19200, 38400,
        57600, or 115200.

$PAMTC,BAUD,Q,CFG*hh<CR><LF>

        Query the Baud Rate saved in Non-Volatile memory,
        and used as the default after the next Power On /
        Reset. Reply is:

        $PAMTR,BAUD,4800,CFG*hh<CR><LF>
```

Notes

The $PAMTC,BAUD command may be used to increase the baud rate from the standard 4800 baud up to 115200 baud. This will provide up 24 X increase in the bandwidth of the NMEA 0183 interface, allowing more data to be transmitted in a given period of time.

On power up, the NMEA input and output interfaces default to 4800 baud, unless the default Baud Rate has been changed with the ",CFG" modifier.

It is recommended to employ the following sequence when changing the baud rate from 4800 baud to 38400 baud. The following example assumes there is a single host device communicating with the Echo Range unit:

1. Send the $PAMTX command to the Echo Range unit (at 4800 baud) to temporarily disable transmission of periodic sentences.

2. Send the $PAMTC,BAUD,38400 command (at 4800 baud) to instruct the unit to change its baud rate to 38400. The unit will finish transmitting any periodic sentences in progress at 4800 baud, and will then change its interface to use 38400 baud.

3. Delay a short interval within the host to allow reception of any remaining queued sentences from the device at 4800 baud.

4. Change the baud rate on the host's serial port to 38400 baud.

5. Send the $PAMTX,1 command to the device (at 38400 baud) to resume transmission of periodic sentences.

6. All subsequent communication with the device will be at 38400 baud, until it is powered down or reset, or the $PAMTC,BAUD,4800 command is sent to the unit.

Note that a baud rate other than 4800 does not comply with the NMEA 0183 standard.

Note that the Baud Rate set with the ".CFG" modifier, does not change the current Baud Rate. It will take effect when the system is Reset.

$PAMTC,**EEC**

Summary

Echo Envelope Control command for the RS485 transmit channel.
Baud rate is fixed at 921600.

Syntax

One of the following forms:

`$PAMTC,EEC,H*hh<CR><LF>`

`$PAMTC,EEC,Q*hh<CR><LF>`

`$PAMTC,EEC,OFF*hh<CR><LF>`

`$PAMTC,EEC,ON*hh<CR><LF>`

`$PAMTC,EEC,FULL*hh<CR><LF>`

`$PAMTC,EEC,SUBSET,<1>,<2>*hh<CR><LF>`

EEC,H – Help, display sentence formats
    $PAMTR,EEC,Q
    $PAMTR,EEC,ON
    $PAMTR,EEC,OFF
    $PAMTR,EEC,FULL
    $PAMTR,EEC,SUBSET,start(00),end(99)
EEC,Q – Query, display current settings
    Sample Output:
    $PAMTR,EEC,ON,0,899, S
    $PAMTR,EEC,OFF,0,399,M
    $PAMTR,EEC,DISABLED
EEC,OFF – Stop transmitting on RS485 echo envelope channel
EEC,ON – Start transmitting on RS485 echo envelope channel
EEC,FULL – Set range to default (0-899) and start transmitting
EEC,SUBSET – Set range as specified (Start-End) and start transmitting
    <1> = Starting Sample (0, 100, 200, 300, … 800)
    <2> = Ending Sample (99, 199, 299, … 899)
        Starts on multiples of 100 and is multiple of 100 long (ends in 99)

For dual frequency models, an optional ",S" or ",M" may be added before the "*" in
any of the above commands indicating this command is only for the Master (M) or
only for the Slave (S), default – command is for both. (For example,
`$PAMTC,EEC,SUBSET,100,499,S*hh<CR><LF>`)

Notes

The $PAMTC,EEC command may be used to control the Echo Envelope output channel. ON and OFF do not change the range, FULL and SUBSET change the range and start transmitting.

These values are stored in eeprom in master for both master and slave. The slave's values are uploaded on power up.

Not available in 200m Mini Altimeter Kit.

Output Format of the envelope data:

Each record begins with "TS" followed by a Time Stamp (32 bit elapsed time in msec). The same Time Stamp appears at the end of the record to make sure we haven't missed any data. This may be replaced with a CRC or Checksum.
The status data is as follows:

```
Start of new Record
 |      Timestamp (msec)
 |      |       Depth (100ths of meters - decimal)
 |      |       |   Target used for Depth reporting (0-5)
 |      |       |   | Target Integrity (hex 0-14, 0 - 20)
 |      |       |   | | Noise Floor (hex 0-ff, 0-255)
 |      |       |   | | | Machine State (includes current range, pulses, lock state)
 |      |       |   | | | | Target 0 Amplitude  (hex 0-ff, 0-255)
 |      |       |   | | | | | Target 0 Range Index  (hex 0-383, 0-899)
 |      |       |   | | | | | | Target 1 Amplitude
 |      |       |   | | | | | | | Target 1 Range Index
 |      |       |   | | | | | | | | Target 2 Amplitude
 |      |       |   | | | | | | | | | Target 2 Range Index
 |      |       |   | | | | | | | | | | Target 3 Amplitude
 |      |       |   | | | | | | | | | | | Target 3 Range Index
 |      |       |   | | | | | | | | | | | | Target 4 Amplitude
 |      |       |   | | | | | | | | | | | | | Target 4 Range Index
 |      |       |   | | | | | | | | | | | | | | Target 5 Amplitude
 |      |       |   | | | | | | | | | | | | | | | Target 5 Range Index
 |      |       |   | | | | | | | | | | | | | | | | Sample Offset
 |      |       |   | | | | | | | | | | | | | | | | | Sample Data …
 |      |       |   | | | | | | | | | | | | | | | | | | | | | End Stamp
 |      |       |   | | | | | | | | | | | | | | | | | | | | | Time
 |      |       |   | | | | | | | | | | | | | | | | | | | | | |
TS, 648108, 1143,0,14,0c,073,7e,4c,5d,58,00,00,00,00,00,00,00,00,0FF0, 72,c1,86,…,ES, 648108
```

Depth = (Sound Speed in m/s) * (Sample Interval in seconds) * (Range Index) / 2;

Depth per sample (index number) changes with range setting:

Range	Sampling Rate	Depth/Sample
Short	25 uSecs	1.875 cm
Medium	100 uSecs	7.500 cm
Long	200 uSecs	15.00 cm
Very Long	300 uSecs	22.50 cm

Default Speed of Sound 1500 m/s.

The 12 bit Machine State is deciphered as follows:

```
High 6 bits of pulses per ping
 |        Locked: 1 bit 0-No, 1-Yes
 |        |   Range: 2 bits 0-Short, 1-Medium, 2-long, 3-very long
 |        |   |   Low 3 bits of pulses per ping
 |        |   |   |
hhhhhh L  rr  ppp

000001 1 10 011
```

Target Amplitude is the digitized output of a log amplifier. Each count represents approximately 0.35 dB of return signal level.

The Sample Offset is the offset into the 900 samples that the following (100-900) samples represent, For example, OFF200, OFF500, etc.

The Firmware tracks up to six potential targets on each ping, then selects which one it believes is the real depth.

The example is reporting a timestamp of 648108 milliseconds , depth of 11.43 meters, target 0 (of six reported targets) is being tracked, integrity is 20, noise floor is 12, depth is locked, range is long, there are 11 pulses per ping, target 0 Amplitude is 126, target 0 index is 76, the first 3 amplitude samples are 114, 193, 134.

$PAMTC,**EN**

Summary

Enable or disable the periodic transmission of individual standard NMEA 0183 sentences, and specify their rate of transmission.

Syntax

One of the following forms:

`$PAMTC,EN,<2>,<3>,<4>*hh<CR><LF>`

`$PAMTC,EN,S*hh<CR><LF>`

`$PAMTC,EN,L*hh<CR><LF>`

`$PAMTC,EN,LD*hh<CR><LF>`

`$PAMTC,EN,Q*hh<CR><LF>`

Fields

`<2>`   The identifier `ALL`, or one of the following sentence ID's:

Model EchoRange™ Sensor: `DBT, DPT, MTW, XDRT, XDRX`

`<3>`   If field <2> is the `ALL` identifier, then

0 = disable transmission of all sentences
1 = enable transmission of all sentences.

Otherwise,

0 = disable transmission of the specified sentence
1 = enable transmission of the specified sentence

`<4>`   The amount of time between successive transmissions of the specified sentence, in tenths of a second. For example, if field <4> contains the value 5, this specifies an interval of 0.5 seconds between successive transmissions of the specified sentence.

If field <2> is the `ALL` identifier, then field <4> specifies the transmission interval for all sentences.

Notes

The transmission interval set by this command is dependent on the setting of the OPTIONS,OUTPUTMC command. If that command is set to INTERVAL, then the transmission intervals set here are used for those depth sentences (DBT, DPT, XDRX) that are enabled. If set to PING, the enabled depth sentences are output after each ping (see OPTIONS command for more details)

The factory default settings are as follows:

MODEL: Single Frequency EchoRange™ Sensor:

Sentence ID	Enabled by default?	Default Transmission Interval (in tenths of seconds)
DBT	–	10
DPT	✓	10
MTW	✓	10
XDR(T)	–	10
XDR(X)	–	10

MODEL: Dual Frequency EchoRange™ Sensor:

Sentence ID	Enabled by default?	Default Transmission Interval (in tenths of seconds)
DBT	–	10
DPT	–	10
MTW	✓	10
XDR(T)	–	10
XDR(X)	✓	10

If either of fields <3> or <4> is a null field, then that field will remain unchanged from its previous value.

The selections as to which sentences are enabled for transmission, and the rate at which each sentence is transmitted, are stored in nonvolatile EEPROM memory within the unit. On power up, these settings are copied from EEPROM into a working copy in RAM memory. It is the working copy in RAM that determines the behavior of the unit, with regard to the transmission of sentences.

Any changes to these settings using the $PAMTC,EN,<2>,<3>,<4> command only affect the working copy in RAM. When power is lost, the changes to the working copy in RAM will be lost.
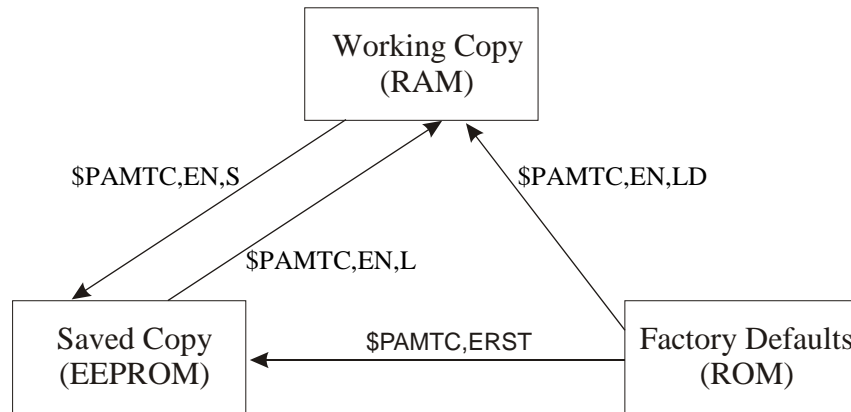
The **$PAMTC,EN,S** command causes the contents of the current working copy in RAM to be saved to EEPROM. The saved settings will then be restored to RAM each time power is applied to the unit.

The **$PAMTC,EN,L** command allows the settings to be reloaded from EEPROM to RAM without cycling power to the unit. This can be used to discard any changes made to the working copy in RAM, and restore the saved settings as though the unit had been turned off and then back on again.

The **$PAMTC,EN,LD** command loads the factory default settings from ROM memory into RAM memory.

Note that the $PAMTC,ERST command (see separate description) differs from the $PAMTC,EN,LD command in that $PAMTC,ERST will initialize *all* of user EEPROM memory to its factory default settings. This includes settings unrelated to the selection of transmitted sentences.

The above paragraphs are summarized in the below figure.

```
                    ┌─────────────────┐
                    │  Working Copy   │
                    │     (RAM)       │
                    └─────────────────┘
          $PAMTC,EN,S              $PAMTC,EN,LD

              $PAMTC,EN,L

  ┌─────────────────┐                    ┌─────────────────┐
  │  Saved Copy     │   $PAMTC,ERST      │ Factory Defaults│
  │  (EEPROM)       │ ◄──────────────────│     (ROM)       │
  └─────────────────┘                    └─────────────────┘
```

The **$PAMTC,EN,Q** command provides a query function to allow reading the current settings from the working copy in RAM. The reply to the $PAMTC,EN,Q command is a series of sentences with the following format:

```
$PAMTR,EN,<1>,<2>,<3>,<4>,<5>*hh<CR><LF>
```

where

    <1> = Total number of $PAMTR,EN sentences in the reply
    <2> = Sentence number
    <3> = Sentence ID (DBT, DPT, MTW, or XDRT)

    <4> = 0 or 1 (0=disabled, 1=enabled)

    <5> = Transmission interval (tenths of a second)

For example, a single frequency model EchoRange™ Sensor programmed with only the factory default settings would provide the following as a reply to the $PAMTC,EN,Q command:

```
$PAMTR,EN,5,1,DBT,0,10*35
$PAMTR,EN,5,2,DPT,1,10*2A
```

```
$PAMTR,EN,5,3,MTW,1,10*2D
$PAMTR,EN,5,4,XDRT,0,10*39
$PAMTR,EN,5,5,XDRX,0,10*39
```

Keep in mind when enabling sentences that the overall bandwidth of the interface should not be exceeded. At 4800 baud, only 480 characters can be transmitted in a one second period of time. It is possible to use the $PAMTC,EN command to overspecify the amount of data transmitted, beyond the bandwidth capacity of the NMEA output channel. See section 2.1. for further information regarding bus bandwidth.

Examples

Example 1:

To disable all sentences for transmission, except transmit the SeaWater Temperature (MTW) sentence 5 times per second, and save the settings in EEPROM, send the following sequence of commands to the unit:

    $PAMTC,EN,ALL,0
    $PAMTC,EN,MTW,1,2
    $PAMTC,EN,S

Example 2:

To reload the factory defaults for the $PAMTC,EN settings into EEPROM without affecting other EEPROM settings, send the following sequence of commands to the unit:

    $PAMTC,EN,LD
    $PAMTC,EN,S

Example 3:

To enable transmission of the XDR(T) sentence and set it to transmit at the slow rate of once every 10 seconds *for the current session only*, send the following command to the unit:

    $PAMTC,EN,XDRT,1,100

Example 4:

To disable transmission of the DBT sentence permanently:

    $PAMTC,EN,DBT,0
    $PAMTC,EN,S

$PAMTC,**ERST**

Summary

Reset the user portion of nonvolatile EEPROM to its factory default state.

Syntax

$PAMTC,ERST*hh<CR><LF>

Notes

$PAMTC,**OPTION**

Some commands are only available with the dual frequency models. These commands are marked with an "******".

Summary

Enable or disable certain features, or query their state.

Syntax

One of the following forms:

```
$PAMTC,OPTION,SET,<3>,<4>*hh<CR><LF>

$PAMTC,OPTION,SET,<3>,<4>,<5>*hh<CR><LF>

$PAMTC,OPTION,SET,<3>,<4>,<5>,<6>,<7>*hh<CR><LF>

$PAMTC,OPTION,SET,<3>,<4>,<5>,<6>,<7>,<8>*hh<CR><LF>

$PAMTC,OPTION,Q,<3>,<4>*hh<CR><LF>
```

For Q:
Field <3>

One of the Field <3> parameters listed below for SET

<4>   M, S. Optional parameter indicating this command is for the Master (M) or for the Slave (S), if omitted, the default is – command is for the Master.

For SET:
Field <3>

SOSTW: Speed of sound through water
<4>   13500 to 16500, tenths of meters per second, default is 15000, representing 1500 meters per second.

<5>   M, S. Optional parameter indicating this command is only for the Master (M) or only for the Slave (S), default – command is for both.

DOFFSET: Depth Offset
<4>   -32764 to 32764, 1/1000ths of meters, reported in DPT sentence

<5>   M, S. Optional parameter indicating this command is only for the Master (M) or only for the Slave (S), default – command is for both.

TOFFSET: Temperature Offset
<4>   -9999 to 9999, 1/1000ths of degrees C, added to calculated temperature before reporting it in MTW sentence.

<5>   M, S. Optional parameter indicating this command is only for the Master (M) or only for the Slave (S), default – command is for both.

RANGEDEFAULT: Default Depth Range (Only used on power up / reset)

<4>   0= Short, 1=Medium, 2=Long, 3=Very Long, 4=Auto Ranging for Master, Auto tracking of Master for Slave. Maximum depths are approximately 56 ft, 225 ft, 450ft, and 675 ft, respectively.

<5>   M, S. Optional parameter indicating this command is only for the Master (M) or only for the Slave (S), default – command is for both.

RANGE: Operational Depth Range

<4>   0= Short, 1=Medium, 2=Long, 3=Very Long, 4=Auto Ranging for Master, Auto tracking of Master for Slave. Maximum depths are approximately 56 ft, 225 ft, 450ft, and 675 ft, respectively.

<5>   M, S. Optional parameter indicating this command is only for the Master (M) or only for the Slave (S), default – command is for both.

OUTPUTMC: Sentence Output Mode Control Command

<4>   INTERVAL,PING.

        INTERVAL – output of enabled sentences is at the rate specified by the sentence enable command.
        PING – enabled depth sentences are output after each synchronized master/slave ping or if not synchronized they are output after each master ping.

SYNCMODE: Master Slave Synchronization Mode **

<4>   NONE, MANUAL, OVERLAP, INTERLEAVE.

        NONE– Master and slave are under control of PING commands.
        MANUAL - Master and Slave are under control of SYNC commands.
        OVERLAP – Master and Slave are under control of Master which synchronizes pings so that they overlap.
        INTERLEAVE – Master and Slave are under control of Master which synchronizes slave operations so that its pinging, data collection, data processing, and envelope output do not overlap master operations.

        Note: When running in any SYNCMODE other than NONE, it is necessary to configure the slave as "PING,OFF,S". See PING command below

SYNC: Synchronization Commands **

<4>   TS, NOW,B2B.

        TS – synchronizes Master and Slave timestamps.

        NOW – Used in SYNCMODE/MANUAL to cause a single overlapped ping operation.

        B2B – Used in SYNCMODE/MANUAL to cause a single interleaved (back to back) ping operation.

SLAVE: Slave Activation Commands **

\<4\>   OFF, ON.

       OFF – Slave communication is deactivated.
       ON – Slave communication is activated.

PING: Ping Commands

\<4\>   OFF, ON, ONCE, LOSELOCK.

       OFF – Do not ping unless PING ONCE or SYNC NOW command is
       issued.
       ON – Ping at rate set in PINGSPS command.
       ONCE – issue a single ping.

       LOSELOCK – restart depth search mode, i.e. lose current lock
       information (not needed in normal operation).

\<5\>   M, S. Optional parameter indicating this command is only for the
       Master (M) or only for the Slave (S), default – command is for both.

PINGSPS: Pings Per Second Command

\<4\>   1-8. Set ping rate for Short Range

\<5\>   1-8. Set ping rate for Medium Range

\<6\>   1-4. Set ping rate for Long Range

\<7\>   1-3. Set ping rate for Very Long Range

\<8\>   M, S. Optional parameter indicating this command is only for the
       Master (M) or only for the Slave (S), default – command is for both.

PINGSPS: Pings Per Second Command (Auto)

\<4\>   AUTO. Set ping rates to defaults (5,5,4,3).

\<5\>   M, S. Optional parameter indicating this command is only for the
       Master (M) or only for the Slave (S), default – command is for both.

PULSESPP: Pulses Per Ping Commands

\<4\>   1-180 (M) or 1-25 (S). Set number of transmit cycles per ping for Short
       Range
\<5\>   1-180 (M) or 1-25 (S). Set number of transmit cycles per ping for
       Medium Range
\<6\>   1-180 (M) or 1-25 (S). Set number of transmit cycles per ping for Long
       Range
\<7\>   1-180 (M) or 1-25 (S). Set number of transmit cycles per ping for Very
       Long Range
\<8\>   M, S. Optional parameter indicating this command is only for the
       Master (M) or only for the Slave (S), default – command is ONLY for
       the Master.

PULSESPP: Pulses Per Ping Command (Auto)

\<4\>   AUTO. Set pulses to defaults (Master:5,20,40,60; SLAVE:6,12,18,24).

`<5>` M, S. Optional parameter indicating this command is only for the Master (M) or only for the Slave (S), default – command is ONLY for the Master.

DFILTER: Depth Filter Command

`<4>` 0,2,4.

> 0 = OFF – No averaging, report last calculated depth.
> 2 - report average of last two calculated depths.
> 4 - report average of last 4 calculated depths.

`<5>` M, S. Optional parameter indicating this command is only for the Master (M) or only for the Slave (S), default – command is for both.

SFILTER: Transducer Sample Filter Command

`<4>` 0,2,4,8.

> 0 = OFF – No IIR filtering of successive (ping to ping) samples.
> 2 - IIR filtering of successive (ping to ping) samples (1/2 of last plus 1/2 of new sample).
> 4 - IIR filtering of successive (ping to ping) samples (3/4 of last plus 1/4 of new sample).
> 8 - IIR filtering of successive (ping to ping) samples (7/8 of last plus 1/8 of new sample).

`<5>` M, S. Optional parameter indicating this command is only for the Master (M) or only for the Slave (S), default – command is for both.

DBLANK: Depth Blank

`<4>` 0 to 150, tenths of meters to blank (minimum acceptable depth)

`<5>` M, S. Optional parameter indicating this command is only for the Master (M) or only for the Slave (S), default – command is for both.

Notes:

Commands marked with an ** are only available for dual frequency models.
M, S. Optional parameter indicating a command is only for the Master (M) or only for the Slave (S), is only required for dual frequency models, but (M) is accepted for single frequency models.
These values are stored in eeprom in master for both master and slave, slave's values are uploaded on power up:

> Speed of sound through water
> Depth Offset
> Temperature Offset
> Pings Per Second
> Pulses Per Ping
> Depth Filter
> Transducer Sample Filter
> Default Depth Range

These values are stored in eeprom for master only:
> Slave Activation
> Output Mode Control
> Master Slave Synchronization Mode

$PAMTC,**POST**

Summary

Perform the Power-On Self Test.

Syntax

```
$PAMTC,POST,H*hh<CR><LF>
```

The device will reply with this string that describes POST sentence fields:

```
$PAMTR,POST,FMT,FEE,UEE,WT,XD(M),SP,BT,BV,SLV,,,,,XD,BT,BV,ER0183*hh<CR><LF
>
```

```
$PAMTC,POST*hh<CR><LF>
```

```
$PAMTC,POST,Q*hh<CR><LF>
```

The device will reply with a sentence in the following form:
```
$PAMTR,POST,<1>,<2>,<3>,<4>,<5>,<6>,<7>>,<8>,<9>,<10>,<11>,<12>,<13>,<14>*hh<CR><LF>
```

Each of the fields <1> through <13> contains an integer value that represents the status of a simple test performed on a given submodule within the unit. For each field, a value of 0 (zero) indicates the unit passed the respective test; a nonzero value indicates a possible problem was discovered with the given submodule. A null field (i.e. two adjacent commas) indicates this model does not include the specified submodule.

The fields and their corresponding submodules are listed below.

where

   `<1>` = Format Code
   `<2>` = Factory EEPROM
   `<3>` = User EEPROM
   `<4>` = Sea Water Thermistor
   `<5>` = Master SONAR Transceiver
   `<6>` = Speed Sensor
   `<7>` = Master internal temperature Sensor
   `<8>` = Master battery voltage Sensor
   `<9>` = Slave Communication/Sync
   `<10>` = Reserved
   `<11>` = Slave SONAR Transceiver
   `<12>` = Slave internal temperature Sensor
   `<13>` = Slave battery voltage Sensor
   `<14>` = "ER0183" string that indicates POST results are for the class of
      products described in this specification.

Notes

The Power-On Self Test is performed automatically a few seconds after applying power to the unit.

A properly operating single frequency EchoRange™ Sensor will reply with $PAMTR,POST,0,0,0,0,0,0,0,0,,,,,,ER0183.

A properly operating dual frequency EchoRange™ Sensor will reply with $PAMTR,POST,0,0,0,0,0,0,0,0,0,,0,0,0, ER0183.

$PAMTC,**QPS**

Summary

Query part number and serial number information.

Syntax

```
$PAMTC,QPS*hh<CR><LF>
```

The device will reply with a sentence in the following form:

```
$PAMTR,QPS,<1>,<2>,<3>*hh<CR><LF>
```

where

        `<1>` = Part number string (up to 32 ASCII characters)
        `<2>` = Serial number string (up to 32 ASCII characters)
        `<3>` = Model Number
                0 = 200kHz
                1 = 30kHz
                2 = 200/30kHz
                3 = 200m Mini Altimeter Kit 200kHz
                4 = 200m Mini Altimeter Kit 170kHz

Notes

The part number and serial number strings may not contain the following characters:
"$"   (dollar sign)
","   (comma)
"*"   (asterisk)
" "   (space)

$PAMTC,**QV**

Summary

Query version information.

Syntax

```
$PAMTC,QV*hh<CR><LF>
```

The device will reply with a sentence in the following form:

```
$PAMTR,QV,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>*hh<CR><LF>
```

where
- `<1>` = Null field
- `<2>` = Hardware version
- `<3>` = OEM option
- `<4>` = Null field
- `<5>` = Bootloader firmware version
- `<6>` = Application firmware version
- `<7>` = Slave Bootloader firmware version
- `<8>` = Slave Application firmware version

$PAMTC,**RESET**

Summary

      Reset the unit.

Syntax

      `$PAMTC,RESET*hh<CR><LF>`

The device will reset as though power had been removed and reapplied. All settings will revert to their power-on defaults.

$PAMTX

Summary

Suspend and resume transmission of NMEA sentences.

Syntax

`$PAMTX,<1>*hh<CR><LF>`

Fields

`<1>`   0 = temporarily suspend transmission of all NMEA sentences. (default)

1 = resume transmission

Notes

Upon receiving this sentence, the device will suspend transmission of all future NMEA sentences after the currently transmitting sentence has completed.

If the $PAMTX command is received with no fields present (i.e. $PAMTX*50<CR><LF> or $PAMTX<CR><LF>, the default case shall prevail, i.e. transmission of sentences will be suspended.

Transmission of NMEA sentences will resume when one of the following has occurred:

- A `$PAMTX,1` command has been received.

- The power to the unit has been cycled.

- A `$PAMTC,RESET` command has been received.

2.3.   Using Option Commands

This section gives examples of how the echo envelope and option commands can be used in different scenarios.

2.3.1 Single Frequency, Master Only – this sequence could be used to set the pings per second, pulses per ping (increased to 30 for Medium Range), and echo envelope range parameters (for 700 samples starting at sample 200). The sentence output rate is controlled by the sentence enable command and the starting depth range is set to 1 (Medium).

    $PAMTC,OPTION,SET,PING,OFF
    $PAMTC,OPTION,SET,OUTPUTMC,INTERVAL
    $PAMTC,OPTION,SET,SLAVE,OFF   (Not needed unless dual frequency sensor)
    $PAMTC,OPTION,SET,PINGSPS,8,8,4,3
    $PAMTC,OPTION,SET,PULSESPP,5,30,40,60
    $PAMTC,OPTION,SET,RANGE,1   (Medium)
    $PAMTC,EEC,SUBSET,200,899
    $PAMTC,OPTION,SET,PING,ON,M (,M not needed unless dual frequency sensor)

2.3.2 Dual Frequency, Synchronized Mode – this sequence could be used to set the pings per second, the pulses per ping (decreased for short range), and echo envelope range parameters (for first 300 samples). The sentence output rate is controlled by the ping rate (output after each synchronized, overlapped, master/slave ping) and the starting depth range is set to 0 (Short).

    $PAMTC,OPTION,SET,PING,OFF (Set PING,OFF for master and slave)
    $PAMTC,OPTION,SET,OUTPUTMC,PING
    $PAMTC,OPTION,SET,SLAVE,ON
    $PAMTC,OPTION,SET,SYNCMODE,OVERLAP
    $PAMTC,OPTION,SET,PINGSPS,8,8,4,3
    $PAMTC,OPTION,SET,PULSESPP,2,12,18,24,S
    $PAMTC,OPTION,SET,PULSESPP,2,20,40,60,M
    $PAMTC,OPTION,SET,RANGE,0   (Short – for both Master and Slave)
    $PAMTC,EEC,SUBSET,0,299
    $PAMTC,OPTION,SET,PING,ON M (Only turn pinging back on for Master)
    $PAMTC,OPTION,SET,PING,OFF,S (Only needed if PING,OFF omitted above)

2.3.3 Dual Frequency, Synchronized Manual Mode – this sequence could be used to set the pulses per ping (decreased for short and medium range) and echo envelope range parameters (for all 900 samples). The sentence output rate is controlled by the ping rate (output after each synchronized, overlapped, master/slave ping) and the starting depth range is set to 0 (Short). The ping rate is controlled manually using the SYNC,NOW command.

    $PAMTC,OPTION,SET,PING,OFF
    $PAMTC,OPTION,SET,OUTPUTMC,PING
    $PAMTC,OPTION,SET,SLAVE,ON (Set PING,OFF for master and slave)
    $PAMTC,OPTION,SET,SYNCMODE,MANUAL

$PAMTC,OPTION,SET,PULSESPP,2,6,21,24,S
$PAMTC,OPTION,SET,PULSESPP,2,10,50,60,M
$PAMTC,OPTION,SET,RANGE,4,S   (Auto tracking of Master for Slave)
$PAMTC,OPTION,SET,RANGE,0,M   (Short)
$PAMTC,EEC,SUBSET,FULL

Repeat this sequence:
    $PAMTC,OPTION,SET,SYNC,NOW wait for completion
    If depth > 20 feet, set Master range to 1 (Medium):
        $PAMTC,OPTION,SET,RANGE,1,M

3. Revision History

Revision 1.003
Date: 11/02/17
Description: Initial Release Version.

Revision 1.004
Date: 2/6/19
Description: Made 200m Mini Altimeter Kit changes. Most significantly, two new model numbers (See
                 QPS).