Sonardyne
Command Language
PV1.04.05

Table of Contents

1. Introduction 4
1.1. Command Rules 4
1.2. General Terms 4
1.3. Accessing Local and Remote Instruments 5
1.4. Command Protocol Definition 5
1.5. Delimiters 5
1.6. ASCII Telegrams and CRC 6
1.7. Response Time for Individual Commands 6
1.11. No Response Received (NO_REPLY) 6
1.12. No Data or Data Codeword Error (NO_DATA) 6
1.13. Received Telemetry Decode Failure (Range) 7
1.14. Wake-up Control (W#) 7
1.15. Telemetry Schemes (TS and RTS) 7
1.16. Flags 8
1.17. Command Errors 8
1.18. USBL or SBL Appended Response 8
1.19. Function Level Control 11

2. Transceiver Local Commands 13
2.1. FV - *F*irmware and Protocol *V*ersion 13
2.2. BV - Bootloader Version 13
2.3. MR – Measure Range [TCVR + NAV] 13
2.4. MSR – Measure Slant Range [TCVR + NAV] 14

3. Generation 6 Commands 15
3.1. FS - Fixed Status (Read only) 15
3.2. VS - Volatile Status (Read only) 16
3.3. CS - Configuration Status 17
3.4. SC – Secure Configuration 20
3.5. REL – Release Command 21
3.6. PORT - Interface 22
3.7. SENS - Sensor Measurement 23
3.8. TIME – Set or Get the RTC 24
3.9. MI – Measure Individual range [FL NAV + GEN6] 24
3.10. SI - Simultaneous Interrogation [FL NAV + GEN6] 26
3.12. ALS - Acoustic Link Status 28

4. Sonardyne Messaging Service (SMS) [FL SMS] 29
4.1. Data Transfer Use Cases 29
4.2. Unsolicited Messages 30
4.3. ASCII Printable Character Set 30
4.4. SMS Command String 32
4.5. Displaying SMS Messages 32
4.6. SMS Reply Strings and Examples 33

5. Modem Command Set 35
5.1. MS - Modem Status 35
5.2. MDFT – Modem Data Frame Transfer [FL MOD] 39

7. Specific Commands for Retrieving Diagnostic Information 40
7.1. FFT – Fast Fourier Transform (noise measurement) 40
7.2. CALL: Calibration Loopback Test 40

8. Diagnostics Information 42

8.4. Interpreting Diagnostic Information 42

1. Introduction

This document provides a comprehensive usage guide to the serial commands available within the latest generation of acoustic positioning and communications instruments from Sonardyne.

It should be noted that this document relates to a particular command Protocol Version (PV) with format *PVX.XX.YY* where *X_XX* relates to the version and issue number and *YY* relates to the revision (e.g. PV1.04.02 represents protocol version 1, issue 4, revision 2).

Both the PV and this document are subject to change according to the following policy:

- Minor corrections that do not change the function of the commands will result in the revision being updated.
- The introduction of, or changes to, individual commands normally result in an issue number increment.
- Changes to command reply formats normally result in a version number increment.

For information, the Transceiver PV supported by the firmware can be retrieved from an instrument using either the FS or FV command.

Note: Some sections that are in development have been removed, hence jumps in the section numbering.

1.1. Command Rules

Sonardyne instruments typically operate in one of two modes:

- Transceiver mode, wherein the instrument instigates an acoustic command to a remote instrument;
- Transponder mode, wherein the instrument responds to an acoustic command instigated by a remote instrument.

The difference between a transceiver and transponder instruments is minimal. A transceiver is controlled via a serial cable and a transponder is controlled via an acoustic communications link. The new Generation 6 commands detailed in this document do not discriminate between these two methods of control.

1.2. General Terms

There are a number of general terms used repeatedly within this document:

- Local – Commands relating to a local instrument that are communicated via a serial cable
- Remote – Commands relating to a remote instrument that are communicated via an acoustic transmission
- Addr – the address of a local or remote instrument
- TCVR – Transceiver (Wired or local device)
- FTAT – Fixed Turn-Around-Time (320ms)
- FEC – Forward Error Correction
- NTAT – Navigation Turn-Around-Time (programmable 80 to 640ms)
- TPDR – Transponder (Acoustic or remote device)
- IIS – Individual Interrogation Signal
- CIS – Common Interrogation Signal
- IRS – Individual Reply Signal
- CRS – Common Reply Signal
- RPSK – Robust Phase Shift Keying
- SMS – Sonardyne Messaging Service

- Telegram – serial message sent to an instrument
- GEN6 – Generation 6 command set

1.3. Accessing Local and Remote Instruments

All instruments have a Unique IDentification (UID) number of the format U*hhhhhh* and a working acoustic address of the format *aaaa*.

To command a specific remote instrument, its acoustic address must be specified within the command. If this address is omitted then the command is pertinent to the local instrument.

1.4. Command Protocol Definition

The command protocol is defined using the following syntax convention:

Syntax	Interpretation
P	Parameter '**P**', as given in a real telegram
X	Integer value (any width)
x.xx	Floating-point value, showing the maximum decimal point precision
XX	Fixed width integer value (with leading zeros)
Aaaa	Address field
Hhhh	Hexadecimal (fixed width) data, in ASCII (0-9,A-F)
Data	Syntax detailed elsewhere (or undefined)
[…]	Reported diagnostic data, or optional parameters
{…}	CRC is optional and is not shown throughout this document for clarity
|	Acoustic telemetry data delimiter (e.g. SMS and MDFT)

All characters that appear as they are in a telegram are shown in bold. All parameter values and syntax details are given in normal type. All other syntaxes are given in italic type.

1.5. Delimiters

Syntax	Interpretation
:	Colon – Command Address separator
;	Semi-Colon – Grouped, repeated information separator
,	Comma – parameter separator
&	Multiple Command separator
{}	CRC and sequence number (Once sent is always required)
<	Command
>	Response
[]	Diagnostics, XC, DBV, FEC, Doppler etc
| pipe	Command data delimiter (SMS, MDFT)
<cr>	Carriage return terminated commands and replies

It should be noted that not all parameters need to be specified and only specified parameters will be changed. The response will report all the valid parameter values.

1.6. ASCII Telegrams and CRC

All ASCII telegrams have a **Telegram Type** character of '<'. The telegram text then ends with a terminator character of '<cr>' or <cr><lf>. An optional cyclic redundancy check (**CRC)** can be appended to the command**.** It is expressed as a 4 character hexadecimal string enclosed in curly brackets of the format *{hhhh}*.

ASCII telegrams therefore take the following form:

<Mnemonic:aaaa,Parameters{hhhh}<cr>

The 16-bit **CRC** is generated using the standard CRC16 – IBM generator polynomial ($x^{16} + x^{15} + x^2 + 1$) and is calculated on all ASCII characters excluding the {} brackets and CRC characters within them, i.e. the **Telegram Type** character '<', the *TelegramText*. Once a telegram with a CRC has been sent to an instrument, that instrument will continue to require a valid CRC, otherwise the following errors will be reported.

>CRC_ERROR{EF4E}<cr><lf>

1.7. Response Time for Individual Commands

The instrument responses to Gen6 commands precisely after the FTAT + n*packet delay, where n is the number of packets, which is compensated for by the transceiver. The propagation delay between instruments is proportional to range and has not been accounted for in this calculation.

When using acoustic telemetry (e.g. RPSK600) the FTAT is always 320ms and the packet delay is 120ms. Individual commands are transmitted using the IIS of the remote instrument and its response is transmitted using an IRS header signal. If the command or telemetry is not decoded by the remote instrument then the response to an IIS is a CRS, again using the FTAT.

Therefore, to calculate the distance between instruments from the range time (R) reported by the local instrument, the following equation is used:

$$d = \frac{R - FTAT}{2} \times \frac{c}{1 \times 10^6}$$

where d = distance in metres (m)

c = speed of sound in metres/second (m/s)

R = report time in microseconds (µs)

FTAT = 320000µs

It should be noted that the use of all remote Gen6 commands will result in the generation of a range (R) value unless otherwise stated in this document.

1.11. No Response Received (NO_REPLY)

If an acoustic response is not received from the remote instrument within the receiver wait time (RXW), the instrument will output a serial NO_REPLY string as shown below:

>CS:0114,NO_REPLY *No reply from instrument Addr 0114*

1.12. No Data or Data Codeword Error (NO_DATA)

If a multiple telemetry packet reply is partially received due to un-correctable errors (FEC failure) or a telemetry sync signal is not received a NO_DATA message will be inserted for the packet that has been received in error.

An example is shown below:

<FS:0114 *Request the Fixed Status from instrument Addr 0114*

>FS:0114,U000C8A,FL007F,FV1.05.03.08,PV1.03,NO_DATA,T-4;40;AC0.1,PR6000;AC0.01,R324455

The example shows correctly received data in the first and third packets but the second packet contained errors and has been replaced by NO_DATA. The Diagnostics command (DIAG) can be used to determine the exact reason for the packet failure. This is discussed in Section 8.

1.13. Received Telemetry Decode Failure (Range)

If a telemetry response cannot be decoded without errors only the range time (Rxxxxx) in microseconds is displayed. This confirms that the command was received and executed by the remote instrument but the status of the parameters received by the local instrument is unconfirmed.

<CS:114 *Request a CS from instrument Addr 0114*

>CS:0114,NO_DATA,R321286

1.14. Wake-up Control (W#)

If a remote instrument is in sleep mode then a wake-up tone must be transmitted to it before it will receive commands. This wake-up can be transmitted prior to each command or navigation signal as part of the transmission.

To instruct the local instrument to transmit a wake-up signal the W# parameter must be appended to the address field using the semi-colon as shown below:

<CS:114;W1,LG26,DT14,NPL180,TPL180,SPL180,CIS1 *Transmit a CS command with wake-up to Addr 0114*

>CS:0114,TAT200,BLK120,RXW4800,TXW120,NPL166,SPL166,TPL166,LG26,DT14.0,CIS1,AT9,R321296

It should be noted that command parameters other than W# can be in any order

The wake-up signal of the instrument is a short 4ms tone burst with a frequency specified as either 26.4kHz (W1) or 32.25kHz (W2).

If the pre-programmed wake-up signal is not known or may have been altered, it may be necessary to transmit both W1 and W2 to ensure the instrument wakes up correctly.

<CS:0114;W1;W2,NPL187

The wake-up signal can be retrieved from a remote instrument using the VS command. It is set using the SC command.

1.15. Telemetry Schemes (TS and RTS)

The telemetry scheme (TS#) and reply telemetry scheme (RTS#) fields can be used within a command to specify the modulation scheme used for acoustic telemetry transmissions to and from a remote instrument.

The ability to use different telemetry schemes for commands and replies can be of value when prevailing environmental conditions (e.g. ambient noise and reverberation levels etc) are different for the local and remote instruments and it is necessary to maximise the data rate in each direction.

The telemetry scheme can be selected according to the following table:

TS\RTS Parameter	Command\Reply telemetry
0	100bps
1	200bps (default)
2	400bps
3	900bps
4	Reserved
5	HDR 6000bps*
6	Reserved
7	Reserved
8	RPSKv1 600bps

*Only certain schemes are available and depends on the equipment

If no TS# is specified then the default is TS1/RTS1 (RPSKv2 200bps) and is used for all addresses. Therefore to communicate with older equipment TS8 must be defined in all commands to the transceiver to force RPSKv1 to be used.

If no Reply Telemetry Scheme (RTS) is specified then the remote instrument will reply with the same telemetry scheme as was used to command it, hence the RTS# parameter is internally set to the TS parameter. If TS# and RTS# are required to be different then they must be specified in the command string as follows:

<CS:114;TS2;RTS5,LG26,DT14,NPL180,TPL180,SPL180,CIS1

In this example, the local instrument will transmit using TS2 (RPSKv2_400) telemetry and the remote instrument will respond with RTS5, high data rate (HDR 6000bps).

Note: If using RPSKv1 telemetry the RTS parameter is invalid, hence the response will be RPSKv1.

1.16. Flags

All flags are positive logic, e.g. EC1 = Common Interrogation mode ON and EU0 = HPR support OFF. If the flag parameter 'ECx' is not displayed then this functionality is not supported by the instrument.

1.17. Command Errors

If a command string contains any invalid parameters then the instrument will reply with a question mark next to the parameter detected in error. For example:

<CS:TRX100, RXW4800	*Configure the local instruments transmit and receive wait times*
>CS:TRX100?	*TRX100 not understood*

In this case TRX100 is not a valid command parameter (it should have been TXW) and is flagged with '?'. It should be noted that although the RXW parameter is correct the command will not have been executed.

1.18. USBL or SBL Appended Response

If a USBL or SBL instrument is a used, it will generate various extra fields that can be used to determine the position of a remote instrument. For this to occur, the multi-element support (ME) parameter in the CS command must be set to 1.

When in multi-element support mode then the following parameters are appended to the Range time (R): direction cosines Jx, Jy, the resolver technique RT and the quality of fit QJ are reported for a USBL system or Time-Of-Arrival (TOA) for an SBL system.

1.18.1. USBL system

Example of command & response for a USBL system with and without multi-element support enabled:

<CS:ME0	*Disable multi-element support, response not shown*
<SI:INT1,CIS0,IR201,IR202	*Perform simultaneous interrogation.*
>SI:101,INT1,IR201;R345123,IR202;R345123	*No USBL information provided*
<CS:ME1	*Enable multi-element support, response not shown*
<SI:INT1,CIS0,IR201,IR202	*Simultaneous interrogate...*
>SI:101,INT1,IR201;R345123;JX2.232308e-4;JY1.120101e-5;RT10;QJ1.21e-9,IR202;R345123;JX2.232308e-4;JY1.120101e-5;RT6;QJ1.21e-9	*USBL information provided*

The RT value indicates the resolver technique algorithm used to derive the positional solution (0 to 10), the higher the better, a value of 0 indicates the algorithm could not resolve the acoustic data to provide a position fix.

The QJ value indicates the quality of the direction fit and the lower the value the better. The Quality of fix parameter, QJ, can be used to calculate the standard deviation on the fix as shown in the following equations.

The USBL Jx and Jy data can be converted into component X and Y ranges along the appropriate axis of the defined coordinate frame of reference as shown in the figure below by apply the following formula:

The direction cosines '***l***' and '***m***' can be calculated as follows

$$l = Jx \times c$$

$$m = Jy \times c$$

And the direction cosine Standard deviation:- $SD = c \times \sqrt{Qj}$

Where c = speed of sound in metres/second (~1490m/s).

These direction cosines can then be converted to actual component ranges as follows:

$$X_{(m)} = R_d \times l$$

$$Y_{(m)} = R_d \times m$$

$$Z_{(m)} = R_d \times \sqrt{1 - l^2 - m^2}$$

And the Standard deviation in the X and Y values is given as:- $SD = R_d \times c \times \sqrt{Qj}$

Where R_d = One way range in metres calculated as follows:

$$R_d = \frac{R - TAT}{2} \times \frac{1}{1 \times 10^6} \times c$$

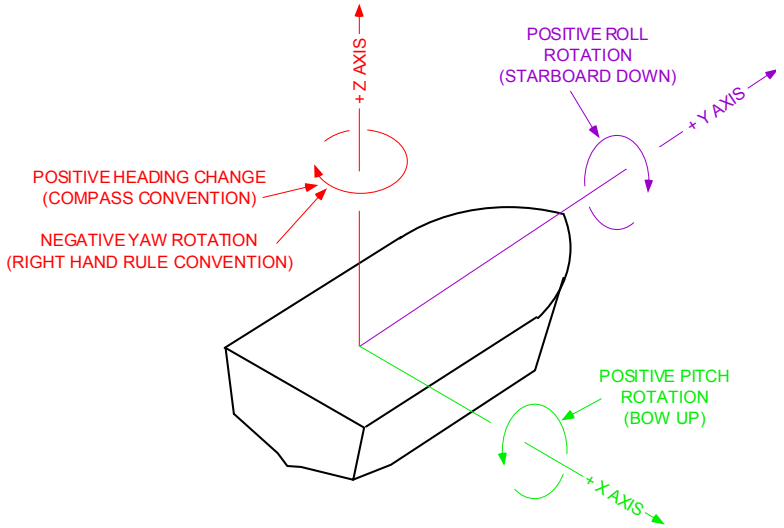
where R = Reported Range time returned in reply.in microseconds (µs)

TAT = TAT of the remote instrument in microseconds (µs)

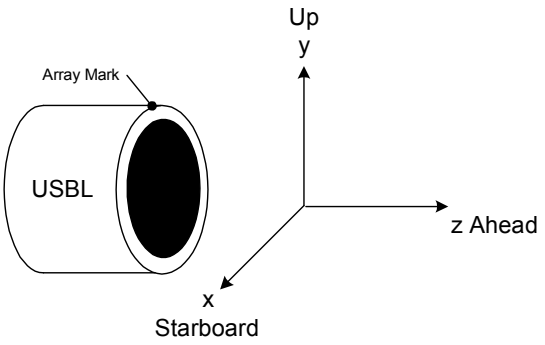
Note in earlier protocol versions the parameters Kx and Ky were used. The new parameters Jx and Jy take out the need to know about the frequency of the signal used. Therefore to relate Jx and Jy to the legacy values Kx and Ky: -

$$Jx = Kx / fc \qquad Jy = Ky / fc$$

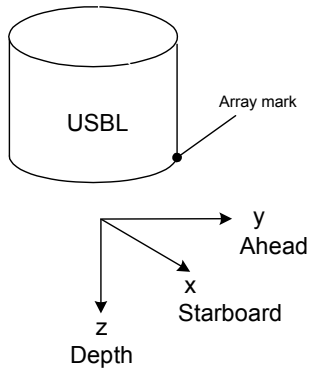
where *fc* is the carrier frequency in Hz



Traditional USBL Coordinate reference frame (note –z = depth, unlike below and formula above)



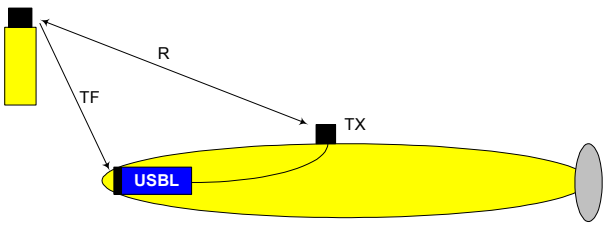
Coordinate frame of reference for USBL Homing application.



Coordinate frame of reference for Standard USBL applications

1.18.2. USBL System with Remote Transmit Transducer

The following diagram shows the case of a USBL instrument with a remote TX transducer (such as the AvTrak Navigator) which is not co-located with the USBL array.



Remote transmit and receiver

In this instance the range time (R) measurement is based upon the two-way travel time to the transmit transducer. Time of Flight (TF) is reported for the receive time at the USBL array. This data is displayed in the following manner:-

<MI:101,INT1,II102

>MI:101,INT1,II102;R550922;TF322034;JX2.223211e-5;JY12.038312e-4;RT10;QJ2.1e-9

If the transmit transducer is transmit only, i.e. no receive capability then the range (R) parameter is omitted as shown below:-

<MI:101,INT1,II102

>MI:101,INT1,II102;TF322034; JX2.223211e-5;JY12.038312e-4;RT10;QJ2.1e-9

1.19. Function Level Control

The capability of the instrument is controlled by a security dongle that can be upgraded if the instrument has the capability by contacting Sonardyne customer support. The programmed Function Level (FL) can be retrieved using the FS command. The FL control uses a bit mask and the following explains each of the available options.

1.19.1. Transceiver Functionality – Bit 0

Setting this functionality level alone allows the basic subset of Gen6 commands to be sent to remote devices. Further functionality is granted when this functionality level is combined with the navigation, modem or Gen6. See the description of these functionality levels for more details.

1.19.2. HPR400 Functionality – Bit 1

Setting this level of functionality allows the instrument to reply to HPR400 interrogations regardless of the state of the navigation bit 4.

1.19.3. SMS Functionality – Bit 2

Setting this bit allows the instrument to send and receive SMS messages.

1.19.4. Modem Functionality – Bit 3

Setting this level of functionality allows the instrument to perform modem operations. However, not all instruments support high-speed telemetry reception as this requires increase processing and multi-element receiver technology. In addition, the ability to be a modem master is controlled by the presence of the transceiver functionality bit0.

1.19.5. Navigation – Bit 4

Setting this bit allows the instrument to reply to Sonardyne ranging Wideband™ interrogation signals, e.g. CIS and IIS. If the transceiver functionality level (bit 0) is also set then the instrument can be serially commanded to instigate ranging operations - MR, MSR serial commands.

1.19.6. Generation 5 Commands – Bit 5

Setting this bit allows the instrument to send a limited set of legacy Compatt 5 commands using RPSKv600, Compatt 5 wakeup signals and to decode all RPSK Compatt replies as hex output.

1.19.7. Generation 6 Commands – Bit 6

Setting this bit allows the instrument to receive a larger subset of the Gen6 commands; if the navigation functionality level is set then these will include commands such as MI and SI, hence remote ranging cycles. If the transceiver functionality level is also set then the instrument can send the larger subset of Gen6 commands which will include navigation/sensor commands provided the navigation functionality level is set.

Bit #	Functionality
0	Transceiver
1	HPR400
2	SMS
3	Modem
4	Navigation

5	Generation 5 Commands
6	Generation 6 commands

The Function Level (FL) is reported in the FS command shown below and highlights the capability of the instrument being used. e.g. a FL0016 will have the following functionality according to the binary bit map, hence it has Navigation, SMS and HPR400 capability.

*>FS:0105,U000C8A,**FL0016**,FV1.05.03.08,PV1.03,TDR;MF;OMNI;190;187;166,T0;40;AC0.1*

BIT7 NU	GEN6	GEN5	NAV	MOD	SMS	HPR	TCVR
X	0	0	1	0	1	1	0
1				6			

2. Transceiver Local Commands

2.1. FV - *F*irmware and Protocol *V*ersion

The **FV** command is used to determine the **Firmware Version** of the instrument and the **Protocol Version** that it supports.

Command:	**<FV** Requests the Firmware Version	
Replies:	**>FV:FV**x.xx,**PV**x.xx	
Parameters:	**FV**x.xx.xx.xx	Firmware Version
	PVx.xx	Protocol Version (x_xx format)

<FV *Request instrument firmware version*

>FV:FV2.01.00.02,PV1.04 *Firmware version 2.01, protocol Version 1.04*

The FS command can be used remotely to retrieve this information see section 3.1.

2.2. BV - Bootloader Version

The **BV** command is used to determine the **Bootloader Version** of the instrument.

Command:	**<BV** Requests the Bootloader Version	
Replies:	**>BV**:*VERSION*	
Parameters:	*VERSION*	Bootloader Version String (this may vary in format from product to product).

Example command and reply:-

<BV *Request instrument bootloader version.*

>BV: CPU5510-8MHz-BL, V4.01a, Dec 11 2008, 15:20:26

2.3. MR – Measure Range [TCVR + NAV]

The **MR** command is used to measure an individual range to a remote instrument with an address *aaaa*.

This method of range measurement uses the Individual Interrogate Signal (IIS) of the remote instrument, which responds with its corresponding Common Reply Signal (CRS). Compatt 5 instruments must be enabled in the correct mode and respond after the NTAT, which is different to the new generation 6 instruments that always have the IIS receiver enabled and respond after the FTAT.

Command:	**<MR:**aaaa	
Replies:	>MR:aaaa;Rx **>MR:**aaaa**;R**x;**JX**x;**JY**x;**RT**x;**QJ**x.x Co-located Transmitter – CS:ME1 **>MR:**aaaa**,R**x;**TF**x;**JX**x;**JY**x;**RT**x;**QJ**x.x Separate Transmitter – CS:ME1	
Parameters:	**R**x	Range time in microseconds includes TAT
	TFx	Time of Flight in microseconds includes TAT
	JXx	Scaled Direction cosine
	JYx	Scaled Direction cosine
	RTx	Resolver Technique, zero shows fit is not possible
	QJx.x	Quality of fit.

<MR:1010 *Measure range to remote instrument Addr 1010*

>MR:1010;R450234 *Range provided*

Multi-element enabled and separate Transmit transducer – CS:ME1

>MR:1010;R450234;TF450345; JX2.232308e-4;JY1.120101e-5;RT10;QJ1.21e-9

2.4. MSR – Measure Slant Range [TCVR + NAV]

The **MSR** command is used to measure several slant ranges to up to four remote instruments. This method of range measurement uses the Common Interrogate Signal (CIS) of the remote instruments, which responds with its corresponding Individual Reply Signal (IRS). All instruments must be enabled in the correct mode (EC1) and will respond after the NTAT.

Command:	<MSR:TXx;*Wx,*CHx,CHx,CHx,CHx	
Replies:	>MSR:CHx;Rx,CHx;Rx,CHx;Rx,CHx;Rx >**MSR:CH**x;**R**x;**JX**x;**JY**x;**RT**x;**QJ**x.x Co-located Transmitter – CS:ME1 >**MSR:CH**x;**R**x;**TF**x;**JX**x;**JY**x;**RT**x;**QJ**x.x Separate Transmitter – CS:ME1	
Parameters:	**R**x	Range time in microseconds includes TAT
	TFx	Time of Flight in microseconds includes TAT
	CHx	Receive channel descriptor – CH = IRx, CRx, Fx, Bx The band of the instrument is used, i.e. LMF, MF, HMF
	TXx	Interrogation Signal, typically CI0 to CI14 or F0 to F14
	Wx	Optional Wake-up Tone, e.g. W1
	JXx	Scaled Direction cosine
	JYx	Scaled Direction cosine
	RTx	Resolver Technique, zero shows fit is not possible
	QJx.x	Quality of fit

<MSR:CI0,IR201,IR202 *Measure range to remote instruments 201 & 202*

>MSR:IR201;R450234,IR202;R323400 *Ranges provided*

Multi-element enabled and Co-located transmit transducer – CS:ME1

>MSR:IR201;R450234;JX2.232308e-4;JY1.120101e-5;RT10;QJ1.21e-0,IR202;R450234;JX2.232308e-4;JY1.120101e-5;RT8;QJ1.21e-0

Multi-element, non co-located transmitter and transponder in sleep mode:-

<MSR:CI0;W1,IR201

>MSR:IR201;R450234;TF453723;JX2.232308e-4;JY1.120101e-5;RT10;QJ1.21e-9

3. Generation 6 Commands

The following commands enable local and remote (acoustically commanded) instruments to be configured. The command and reply formats are identical with the exception that the address field is added for remote commands. The response from the local unit will be almost immediate whereas the remote response will be dependent on range or receive wait time. All remote Gen6 commands will report the acoustic travel time as discussed in section 1.7.

3.1. FS - Fixed Status (Read only)

The FS command is used to report the fixed status of the instrument and includes details of all the attached sensors.

Command:	**<FS**:*aaaa* Request Fixed Status Information		
Reply:	**>FS:***aaaa*,**U***hhhhhh*,**FL***hhhh*, **FV***XX.XX.XX.XX*,**PV***XX.XX*,**TDR***;BD;TYPE;PWR* ,***T****-4;+40;AC0.1,****PR****4000;****SG****;****AC****0.1,****INC****-90+90;****AC****0.1*,**SV***1400;1600;****AC****0.3,****R****x*		
Parameters:	*aaaa*	Address	
	U	Unique IDentification number	
	FL	Functionality Level (Dongle 0xFFFF, see section 1.18)	
	FV	Firmware Version (Vxx.xx.xx.xx)	
	PV	Protocol Version (PVxx.xx) restricted to 15.15	
Transducer	TDR	TDR;MF;OMNI or TDR;LMF;DIR BD - Bands: LF,LMF,MF,HMF,HF,EHF TYPE - Transducers\Arrays: OMNI, DIR, DIR_TI, DIR_H, PA5, PA7, PA10, VLA5 *PWR* - If the transmitter element then the supported power levels can be displayed.	
Sensors	T, PR;SG; DQZ, INC, SV, HDA	Pressure (PR) = kPa SG = Strain Gauge DQZ = DigiQuartz Temperature (T) = degree C Inclinometer (INC) = degree Sound Velocity (SV) = m\s Heading (HDA) = degree	Sensor information header, if type is known it will be expanded e.g. *Pressure = PR4000;AC0.1,* *Temp = T-4;+40;AC0.1* *Inclinometer = INC-90+90;AC0.1,* *Sound Velocity = SV1400;1600;AC0.3*
	AC	Accuracy of the sensor	

Example command and reply:-

Local Transceiver command:-

<FS *Request local instrument fixed status*

>FS:0105,U000C8A,FL007F,FV1.05.03.08,PV1.03,TDR;MF;OMNI;190;187;166,T0;40;AC0.1

Remote command:-

<FS:0105 *Request remote instrument Addr 0105 fixed status*

>FS:0105,U000C8A,FL007F,FV1.05.03.08,PV1.03,TDR;MF;OMNI;193;190;187;166,TDR;MF;PA5,T0;40;AC0.1,PR

6000;DQZ;AC0.01,R324455

3.2. VS - Volatile Status (Read only)

The VS command is used to report the volatile status of the instrument and includes fields that are variable such as battery condition/capacity and tilt etc. Note some of these parameters may be modified through the SC (secure Command) described later in this document.

Command:	**<VS**:*aaaa* Request Volatile Status Information	
Reply:	**>VS:***aaaa*,**WKT**x,**HPR**xx,**EXT**,**TILT**,**OV**,**CAS**,**BT**x;*type*;**VLT***x.x*;**IDC***x.x*;**CAP***x.x/x.x*;**T**x.x;**DIS**;**CHG**;**R***x*	
Parameters:	*aaaa*	Address
	WKT	Wake Up Tone
	HPR	HiPAP Channel
*Flag	EXT	External power connected (and being used)
*Flag	TILT	The unit is tilted at greater than 45deg from the vertical.
*Flag	OV	Override flag – Battery Low or Tilted
*Flag	CAS	Casius – Sonardyne calibration mode
Battery	BTx	Battery number, can have multiple batteries
	type	LI_ION, LI, ALK
	VLT	Battery or External Voltage
	IDC	Current Drain/Charge, (positive value battery is charging, negative value battery is delivering current).
	CAP	Battery Capacity Total (Ahr) and Remaining (%)
	T	Battery Temperature
*Flag	DIS	Battery DISconnected flag – if Disconnect capability
*Flag	CHG	Battery Charger enabled – if rechargeable

*Omitted if not set or supported

Example command and reply:-

<VS:1001 *Request remote instrument Addr 1001 volatile status*

>VS:1001,WKT1,HPR45,EXT,TILT,BT1;LI_ION;VLT14.9;IDC-12.6;CAP2.4/93;T20.4;CHG,R345422

Multiple battery systems:-

>VS:1011,WKT1,HPR45,EXT,TILT,BT1;LI_ION;VLT14.9;IDC-12.6;CAP2.4/93;T20.4;CHG,BT2;LI;VLT14.9;IDC-0.1.6;CAP60/93;T20.4,R345422

No battery and on external supply – Nano Responder

>VS:1011,EXT,VLT22.9

3.3. CS - Configuration Status

This command is read/write and contains the regularly changed parameters of the instrument. Parameters can be set individually or collectively without affecting other parameters. These parameters will remain set and are protected by a CRC in memory; however they are not stored to non-volatile memory.

Therefore if the instrument is reset or power-cycled the configuration will return to the last stored user or factory defaults. The SC command STR;CS option can be used to store the configured data to EEPROM as user defaults:

Command:	**<CS**:*aaaa*	Request Configuration Status Information	
Reply:	**>CS:***aaaa*,**TAT**x,**BLK**x,**RXW**x,**TXW**x,**NPL**x,**SPL**x,**TPL**x,**LG**x,**DET**x,**CIS**x,**EU**x,**EC**x,**ME**x,***FS*** x,**RSP**x,**PPR**x,**TRP**x,**AT**x,**R**x		
Para:	*aaaa*	Address	Default
	TAT	Turn-Around-Time (40ms steps, 80 to 640)	200ms
	BLK	Blocking Delay (80ms steps, 20 to 1140)	100ms
	RXW	Receiver Wait (400ms steps, 400 to 25200)	4800ms
	TXW	Transmitter Wait (80ms steps, 20 to 1140)	100ms
	NPL	Navigation Power Level (3dB steps, min 166 max 208dB)	
	SPL	Telemetry Start Power Level (3dB steps, min 166 max 208dB)	
	TPL	Telemetry Data Power Level (3dB steps, min 166 max 208dB)	
	LG	Linear Gain (1dB steps, AGC) default: 26dB†	26dB
	DET	Detection Threshold (%) (25 – 90 valid)†	45%
	CIS	CIS channel (0 – 14)	CIS0
*	EU	Enable HPR 400 ranging	
*	EC	Enable Common interrogate ranging	
*	ME	Multi-Element support	
*	*RSP*	*Responder mode*	
*	*PPR*	*Pulse Position Replies*	
Δ	OFF	Disable device – puts unit in sleep mode and will therefore require W1 or W2 appended to the address field	Write only
*	AT	Activity time (index)	AT9

* Omitted if not supported

† If either of these parameters are changed using an acoustic command, an interrogation or command must be received within 60 seconds of the change command otherwise the values will revert to their previous settings. This is for security purposes to prevent an invalid change that will prevent all future communications with the subsea instrument.

Δ Only displayed in the reply when the OFF parameter was sent.

The following shows an example of two parameters being set using the CS command:

<CS:1011,DET50,LG14 *note the parameters can be in any order*

Reply

>CS:1011,TAT240,BLK400,RXW1200,TXW400,NPL188,SPL182,TPL182,LG14,DET50,CIS1,EC0,AT4,R452300

All parameters will snap to the nearest valid setting as long as the specified parameter is between the minimum and maximum values. If a parameter is specified outside of the valid range the instrument will echo the command with '?' indicating the parameter that is in error.

3.3.1. TAT : Turn Around Time

The programmable Navigation Turn Around Time (NTAT) is the time in milliseconds that the remote instrument waits to respond to a CIS. This period can be set from 80ms to 640ms in steps of 40ms.

3.3.2. BLK : BLocKing period

The blocking period is the time that the instrument waits before re-enabling its receivers following an acoustic transmission. This period can be set from 20 to 1140ms is steps of 80ms.

3.3.3. RXW : Receiver Wait

This is the time that the instrument will wait for a response to an acoustic command or navigation cycle. This period can be optimised to the depth or acoustic range. The RXW can be set from 400ms to 25.2s in 400ms steps.

3.3.4. TXW : Transmitter Wait

This is the time that the instrument will wait following receipt of a command, before transmitting an interrogation signal. This period is sometimes adjusted if acoustic reverberation of the transmission causes interference to subsequent range measurements. The TXW can be set from 20ms to 1140ms in 80ms steps.

3.3.5. NPL : Navigation Power Level

The NPL parameter represents the approximate source level (SL) settings that the instrument can support and is therefore hardware dependent. Typical instruments have three or four discrete power levels for navigation, which will be specified in the FS command reply or user manual. For example, the 8065 MF Omni-directional TCVR supports the following power levels:-

Parameter	NPL and SPL	TPL (dB re 1uPa @ 1m)
Maximum	187	Not Supported
Normal	181	181
Ultra-low	167	167

3.3.6. SPL : Start Power Level

The SPL is the telemetry start power level and typically has the same power levels as the NPL.

3.3.7. TPL : Telemetry Power Level

The TPL is the telemetry power level that an instrument can support. Often only the lower power levels are supported due to the extended duration of telemetry transmissions. Currently MF systems support telemetry up to 190dB and 196dB for omni-directional and directional transducers respectively

3.3.8. LG : Linear Gain

The LG parameter sets the variable linear gain of the instruments receive amplifier from 0dB to 80dB depending on the hardware configuration. For example the 8065 TCVR has the following variable gain range and quantisation:-

LG (dB)
0
6
14
20
26 (default)
34
40

3.3.9. DET : Detection Level

The DET field relates to the correlation threshold that must be achieved for the instrument to validate a received interrogation signal as successfully detected. This is specified as a percentage,

For example, DET50 indicates the received signal correlation must be greater than 50% for successful detection. This field should only be adjusted by advanced users who understand the acoustic environment and the impact of changing the detection level. Incorrect setting of the DET can lead to unpredictable behaviour. Setting of the detection threshold below 25% and above 90% is not permitted.

3.3.10. CIS : Common Interrogation Signal

There are 15 primary common interrogation signals that can be set using the CIS parameter. The default is CIS0 (global), however this can be changed to a user specific CIS to avoid interference or to allow separate array interrogations.

3.3.11. EU : Enable HPR400 USBL Interrogation

The presence of the EU flag parameter in the CS response indicates that support for HPR400 tone based navigation signals is enabled. EU0 denotes that this support is disabled and/or unavailable.

3.3.12. EC : Enable Common Interrogation

The presence of the EC1 flag parameter in the CS response indicates that common interrogation support (CIS) is enabled, EC0 denotes that this support is disabled and/or unavailable

3.3.13. ME : Multi-Element support

The presence of the ME1 flag parameter in the CS response indicates that Multi-Element support is enabled. ME0 denotes that this support is disabled and/or unavailable.

3.3.14. FI : Fast Interrogation (In Dev.)

The presence of the FI flag indicates that the system can support fast interrogation navigation. When FI;SI, the instrument will perform a Remote SI command each time the it is interrogated using the IIS channel of the instrument. The SI command can be used to set or change the SI interrogation and receiver channels. The default is CIS0 interrogation and the instruments own address family replies.

When FI;MI the instrument is enabled in Fast MI mode and will perform the configured MI measurements.

3.3.15. RSP : Responder

The RSP flag indicates that the instrument can act as a responder and if the RSP flag is set to 1 it will transmit by default the IRS signal relating to the its address.

3.3.16. TRP : Trans Pinger (In Dev.)

3.3.17. PPR : Pulse Position Replies

Pulse position replies (PPR) allow efficient reporting of depth (PPR1), inclinometer (PPR2) or heading (PPR4) data from a remote instrument. The position of the pulses following the navigation reply communicates the relevant data.

3.3.18. AT : Activity Time

The activity time is the period that the instrument will remain active for after its last serial or acoustic activity is detected. For example, if the instrument has an AT1 it will remain active for 30s following the last

interrogation. Therefore, if the instrument is interrogated every 29s it will continue to remain active. The relationship of AT index and time is shown in the table below, D = Days, H = Hours and M = Minutes:-

AT (Index)	Days/Hours/Mins
0	2s
1	30s
2	M1
3	M4
4	M8
5	M16
6	H1
7	H4
8	H16 (default)
9	D2
10	D4
11	D8
12	D16
13	D32
14	Permanently on

3.4. SC – Secure Configuration

This command is used to change important transceiver or transponder parameters, such as the wake-up tone (WKT) or the instrument address, etc. To ensure changes are only made to one instrument at a time the Unique device ID must be entered as part of the command. All SC parameters will be stored to non-volatile memory on successful execution of the command.

Command:	**<SC**:*aaaa* Request secure configuration acoustic address known **<SC**:*aaaa*,**U**hhhhhh,**AD***aaaa,***WKT**x,**HPR**xx,**DIS**x,**CHG**x,**OV**x,**CAS**x,**STR**;CS;MS	
Reply:	**>SC**:*aaaa*,**U**hhhhhh,**WKT**x,**HPR**xx,**BT**x;**DIS**x;**CHG**x,**OV**x,**CAS**x,**R**x	
Parameters:	*aaaa*	Address
	U	Unique IDentity (UID)
Write only	AD	New acoustic address, not in reply as *aaaa* is the address
	WKT	Wake Up Tone
	HPR	HiPAP Channel
*	BT	Battery number – allows individual control of multiple batteries – if omitted the DIS and CHG will be applied to all batteries.
*	DIS	Battery DISconnected flag, only display in reply string if disconnect feature is supported
*	CHG	Battery Charging 1 = enabled, 0 = disabled. If not displayed in the reply this feature is not supported, i.e. primary cells
*	OV	Set Override flag, override low battery/tilt flag
*	CAS	Set CASIUS mode – special reply mode used for USBL calibration

Write only	STR	Write only. Stores CS and/or MS parameters to EEPROM.

* Omitted if not supported

Example command and reply:-

<SC:U1BC,AD103,WKT2 *Set local instrument Addr and wake-up signal using secure command*

>SC:103,U0001BC,WKT2,HPR43,BT1;DIS0;CHG1 *New Address displayed in standard address field*

Remote Address set with known acoustic address

<SC:104,U1BC,AD103,WKT3 *Standard Gen6 Command*

>SC:103,U0001BC,WKT3, HPR43,BT1;CHG1

Remote Get with acoustic address known

<SC:104

>SC:104,U0001BC,WKT3,HPR43,BT1;CHG1,R324222

Remote Address Get (Address unknown)

<SC:0;CI#,U123 *See notes on global commands*

>SC:0,AD908,U000123,WKT1, HPR45,BT1;CHG0 *Note: Response comes back on the special CRS0000*

Configuring multiple battery systems

<SC:0114,U1BC,BT2;CHG1;DIS1 *Remote SC setting Battery 2 to Chg and Disabled*

>SC:0114,U0001BC,WKT1,HPR45,BT2;CHG1;DIS1,R323222

<SC:0114 *Standard Remote SC command*

>SC:0114,U0001BC,WKT1,HPR45,BT1;CHG1;DIS0 *Default BT1 reply*

Enable battery charging on all connected batteries

<SC:0114,U1BC,CHG1 *Remote SC setting Charging enabled on all batteries*

>SC:0114,U0001BC,WKT1,HPR45,BT1;CHG1;DIS0 *Default BT1 reply*

3.5. REL – Release Command

This command is used to activate an acoustic release mechanism. To activate a release it must first be armed. This is done using the ARM parameter within the REL command and requires the acoustic address *aaaa* and the UID *Uhhhhhh* to be correct. Once armed the release can be activated using the actuate parameter, !OPEN for standard releases or OPEN for a screw release. The release mechanism will remain armed for 60 seconds. Once a release is activated, the beacon will ping for the duration of the release time before sending a status reply at the end of the release operation. The transceiver will automatically listen for beacon activity during the releasing period and will report accordingly.

Command:	**<REL**:*aaaa* Request Release status **<REL**:*aaaa*,**U**hhhhhh,[**RL**x],[*action*]	
Reply:	**>REL**:*aaaa*,**U**hhhhhh,[**NONE**],[**RL**x],[*type]*,[*status*]	
Parameters:	*aaaa*	Address
	U	Unique IDentity (UID)
	RL	Release number, some beacons can have multiple releases
Input only	action	ARM - Arms the release mechanism. !OPEN - opens a standard spring release.

		!CLOSE - closes a standard spring release. OPEN - opens a screw release drive. CLOSE - closes a screw release drive. ABORT- aborts any current release operation. JIG - Jiggles a screw release drive.
Input only		Actuate Release, cannot ARM and ACT in the same command
Input only		
Reply only	NONE	Indicates that no release is fitted to the beacon.
Reply only	UID_ERR	Indicates that the UID received was in error.
Reply only	CMD_ERR	Indicates that the action specified was not valid.
Reply only	*type*	Release Type: STD, SCR, NONE
Reply only	*status*	Current status of the release, ARM, OPEN, CLOSED, ACTIVE. Multiple status flags may be reported.

Example command and reply:-

<REL:901,U1BC,!OPEN *Open the primary release on beacon 901*

<REL:901,U1BC,CMD_ERR,RL1,STD,CLOSED *Reports a command error because the release was not armed.*

Arm the Release

<REL:901,U1BC,ARM *Arm the primary release on beacon 901*

>REL:901,U0001BC,ARM,RL1,STD,CLOSED *The primary release is armed.*

Actuate the release

<REL:901,U1BC,!OPEN *Open the primary release on beacon 901*

>REL:901,U0001BC,RL1,STD,ACTIVE *The primary release is now active.*

>REL:901,RELEASING,R# *The primary release is releasing*

>REL:901,RELEASING,R# *The primary release is releasing*

……

>REL:901,U0001BC,,RL1,STD,OPEN *The primary release is now open, the beacon is released.*

3.6. PORT - Interface

The PORT command is used to set the baud rate and multi-drop control of an instrument:

Command:	<**PORT**:aaaa,**P**x;**BR**dddddd;**CF**x	Sets the Baud Rate of transceiver
	<**PORT**:aaaa	Requests Baud Rate information
Reply:	>**PORT**:aaaa,**P**x;**BR**dddddd;**CF**x,**R**x	

Parameters:	aaaa	Address (individual 101, or omit if local)	Baud
	Px	Port number: 0 default	2400
	BRx		4800
		Baud Rate	9600
		(see table for series)	14400
		9600 default	19200
	CFx	Configuration: 0 – Command Port, 1 = Modem Data (Raw binary)	28800
			38400
	TDMx/x	Time Division Multiplexing: default not active/displayed	57600
			115200

Port command example:-

<PORT:0908,P0;BR57600;CF0 *Set Port 0 to 57600 and as a command port*

>PORT:0908,P0;BR57600;CF0,P1;BR19200;CF1,R324000 Port 1 unchanged, configured as a modem data port.

The Baud rate must be specified exactly as per the above table otherwise no change will be made to this field.

Note: The PORT command response is send out of the primary port at 9600 Baud following a hard reset.

3.7. SENS - Sensor Measurement

Each sensor that is connected to an instrument is reported in the FS (Fixed Status) reply which indicates the type, range and precision of the sensor. The SENS command can be used to request sensor data from any of the attached sensors.

Command:	**<SENS**:aaaa,T,PR,INC,SV,SWTx	
Reply:	**>SENS**:*aaaa,***T***x.x;***AG***x;***ER***x,***PR***x.x;***AG***x;***ER***x,***INC**+*x.xx+x.xx;***AG***x;***ER***x,***SV***x.xxx;***AG***x;***ER***x* , **HDA**+*x.xx+x.xx+ x.xx+ x.xx;***AG***x;***ER***x*	
Parameters:	*aaaa*	Address
In dev.	SWT	
	T	Temperature reading in degrees Celsius
	PR	Pressure reading in kPa
	INC	Inclinometer reading which is in the form roll then pitch both reported in degrees
	SV	Sound Velocity reading in m/s. Add 1000 to returned value for actual SV.
	HDA	Heading and Attitude reading in the form heading, heave, roll then pitch with heading, roll and pitch reported in degrees and heave reported in meters
	AG	Age of reading in seconds, this parameter will be omitted from the reply if no age data is available. The maximum age of the sensor data is 240s, however for some systems this maybe shorter.
	ER	Reports any error codes associated in the measurement, this parameter will be omitted if the reading is considered valid Bit fields ER1 = Age older than 60s, ER2 = Out of range, ER3 = no age and out of range

NB: The '+' sign in the reply string denotes that the measurement is explicitly signed (i.e. will always be proceeded by a '+' or '-' character.

Example:

Command to retrieve temperature and pressure data from a beacon with an acoustic address 1013.

<SENS:1013,PR,T,SV

Reply generated with the sensor readings requested.

>SENS:1013,T23.41;AG1,PR103.1;AG1,SV1000;ER3,R345530

If no sensors are connected the unit will report NONE as shown below:-

>SENS:1013,NONE,R345432

3.8. TIME – Set or Get the RTC

The Time command is used to set or get the Real Time Clock (RTC) date and time from within the instrument. The date and time will be set or retrieved within 200ms of receiving the command, either via the serial interface (local) or acoustically (remote).

Command:	<**TIME**:aaaa,**TD**hh.mm.ss;dd/mm/yy Sets the time and date	
	<**TIME**:aaaa	Requests the RTC Time and Date
Reply:	>**TIME**:aaaa,**TD**09.06.56;04/12/08	
Parameters:	aaaa	Address (individual 101, or omit if local)
	TDx	Time and Date

Time command example:-

<TIME:0908,TD09.06.56;04/06/09	*Set time and date*
>TIME:0908,TD09.06.56;04/06/09	*Time and date set*
<TIME:0908	*Get time and date*
>TIME:0908,TD09.07.10;04/06/09	*Time and date set*

3.9. MI – Measure Individual range [FL NAV + GEN6]

This is used to command an instrument to transmit one or more IIS and receive the corresponding CRS of the remote instrument(s), along with any requested sensor information. This command is similar to the legacy baseline measurement command (WCI). Additional parameters can be sent to request multiple range measurements and averaging etc.

Command:	**<MI**:*aaaa,**SENS**,***DIAGx,**WKTx,**INTx,**AVG**x,**TXW**x,**RXW**x,**II**XXXX,**II**XXXX,**II**XXXX,**II**XXXX	
Reply:	**>MI**:*aaaa,**INT**xx,**AVG**x,**II**XXXX;**R**x,**II**XXXX;**R**x,**II**XXXX;**R**x,…,**II**XXXX;**R**x	
Parameters:	*aaaa*	Address
	INT	Number of Interrogation cycles, send data back each time if no AVG (Max. 14)
	DIAG	Diagnostics reporting
	WKT	Wake-up tone sent on the front of the interrogation sequence – this is different to W# as it instructs the remote unit to send a wake-up tone prior to the interrogation II signal.
	AVG	Averaging – Send range and information upon completion of INTs
	SENS	Sensor data (PR,T,SV,INC etc)
	TXW	Transmit wait to be used for SI cycle – see CS command, if not specified in the

		command the CS TXWx is used.
	RXW	Receive wait to be used for SI cycle – see CS command, if not specified in the command the CS RXWx is used.
	II	Transmit signal – Individual Interrogation Signal(s) Up to 14 IIS can be specified. Therefore 14 remote instruments can be interrogated sequentially. *Limitation:- All IIS must be of the same group, e.g. 101 – 1514 or 1701 – 3114, it is not possible to span multiple address range groups, i.e. WBv1 and WBv2*
*	AG	Age of reading in seconds, this parameter will be omitted from the reply if no age data is available
*	ER	Reports any error codes associated in the measurement, this parameter will be omitted if the reading is considered valid

* Reply parameter only.

Example:

If the INT parameter is not part of the command then the current MI settings will be returned.

<MI:II101,II102,II103

>MI:102,DIAG0,WKT0,AVG0,TXW100,RXW4800,II1011,II1012

If the INT parameter is part of the command then a MI interrogation cycle will be completed

<MI:INT1,T,RXW2400,II101,II102,II103

>MI:1010,INT1,T23.5;AG2,II101;R550922,II102;R676509,II103;R445509

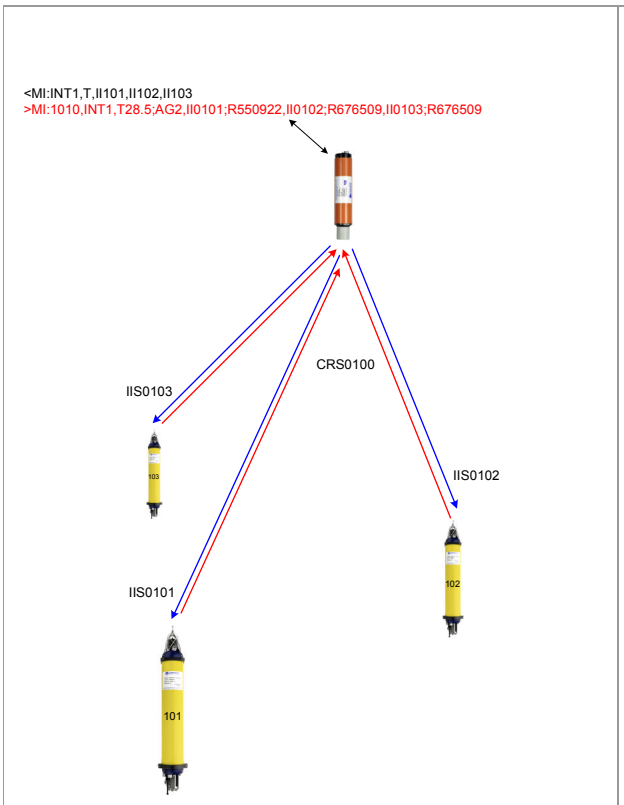
The MI command used remotely allows a seabed baseline to be measured as shown in the diagram below, e.g.

<MI:102,INT1,T,PR,RXW2400,II101,II103

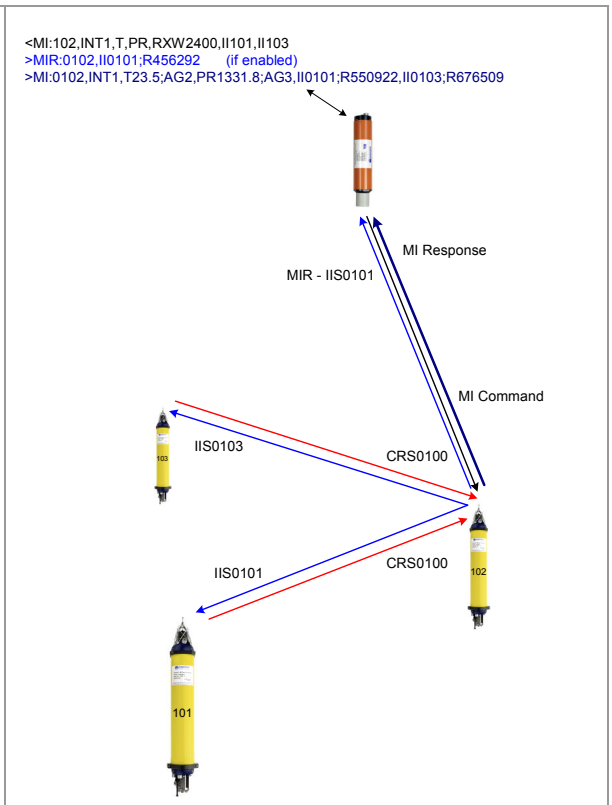
>MI:0102,INT1,T23.5;AG2,PR1212.34;AG3,II101;R550922,II103;R676509

It should be noted that complete MI cycle is performed before a response is transmitted to the requesting instrument. For example if IIS101 and IIS103 have been specified in the command then a range measurement to both instruments will be performed sequentially before a response is sent back to requesting instrument.

If no response is received then the RXW will lapse for each measurement, e.g. if the RXW is set to 4800ms, the transponder will respond after waiting this period for the first interrogation response (IIS101) and for the subsequent response (IIS102). This can amount to a considerable period with multiple interrogations specified.



Local MI- Sequential Individual measurements



Remote MI – Sequential baseline measurements

A MIR response can be received from the transceiver confirming that the command has been received. This can also provide range information to the MI commanded instrument as long as the TXW is known and subtracted.

3.10. SI - Simultaneous Interrogation [FL NAV + GEN6]

This is used to command an instrument to transmit a CIS and receive multiple IRS of the prescribed remote instruments, along with reporting requested sensor information. Additional parameters can be sent to request multiple range measurement and averaging etc.

Command:	**<SI**:*aaaa*,***SENS***,**DIAG***x*,**WKT***x*,**INT***x*,**AVG**x,**TXW**x,**RXW**x,**CI**x,**IR**XXXX,**IR**XXXX,**IR**XXXX	
Reply:	**>SI**:*aaaa*,**INT**xx,**AVG**x,**IR**XXXX;**R**x,**IR**XXXX;**R**x,**IR**XXXX;**R**x,…,**IR**XXXX;**R**x	
Parameters :	*aaaa*	Address
	INT	Number of Interrogation cycles, send data back each time if no AVG
	DIAG	Diagnostics reporting
	WKT	Wake-up tone sent on the front of the interrogation sequence – this is different to W# as it instructs the remote instrument to send a wake-up tone prior to the interrogation CI signal.
	AVG	Averaging – Send range and information upon completion of INTs
	SENS	Sensor data (PR, T, SV, INC etc)
	TXW	Transmit wait to be used for SI cycle – see CS command, if not specified in the command the CS TXWx is used.

	RXW	Receive wait to be used for SI cycle – see CS command, if not specified in the command the CS RXWx is used.
	CI	Transmit signal - Common interrogation signal (0 – 14)
	IR	Receive signals – can specify exact signals or up to two families NB Some instruments may be limited to less receive signals.
*	AG	Age of reading in seconds, this parameter will be omitted from the reply if no age data is available
*	ER	Reports any error codes associated in the measurement, this parameter will be omitted if the reading is considered valid

* Reply parameter only

Example:

If the INT parameter is not part of the command then the current SI settings will be returned.

Command *<SI:IR1011,IR1012*

Reply *>SI:1001,DIAG0,WKT0,AVG0,TXW100,RXW4800,CI4,IR1011;IR1012*

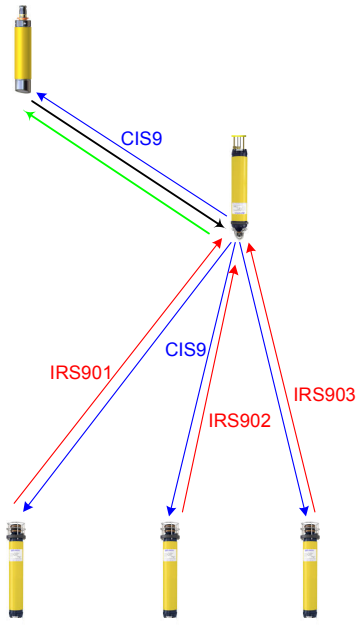
If the INT parameter is part of the command then a simultaneous interrogation cycle will be completed

Command *<SI:0101,INT1,T,PR,CI0,RXW2400,IR1003,IR1004*

Reply *>SI:0101,INT1,T23.5;AG2,PR1331.8;AG3,IR1003;R550922,IR1004;R676509*

The example below shows a typical mobile positioning task and the SIR (Simultaneous Interrogation Reply in development) additional range information. This provides the range to the remote SI commanded unit, but instead of the FTAT, the TXW of the instrument is used. Therefore the range time must compensate for the TXW of the instrument.

<SI:912,T,PR,INC,SV,INT1,CI9,IR901,IR902,IR903
>SIR:0912,CI9;R444340
>SI:912,INT1,T23.6;AG4,PR1203.2;AG3,INC+2.98-1.23;AG5,SV1486.87;AG3,IR901;R231876,IR902;R432981,IR903;R342876



Remote SI with SIR and remote SI reply

3.12. ALS - Acoustic Link Status

The acoustic link status command reports key information about the performance of the acoustic link at the remote instrument. This information includes the cross-correlation level of the signal, amplitude of the signal (dBV), signal-to-noise at the receiver (SNR), telemetry synchronisation signal (CRP), maximum interference level (IFL) and forward error correction (FEC) status.

<ALS:1013 Used to get a remote instrument's diagnostic data, locally use DIAG options

>ALS:1013,EL0,XC91,SNR23,DBV-15,CRP97;15,IFL22,FEC0,R321528

Parameter	Typical	Min	Max	Description
Detection Element	EL	0	x	If multi-element, element that detected first
Cross-correlation	XC	32	99	Detection Level (DET threshold, in CS Command), higher the level the better the correlation
Signal to Noise	SNR	6	50	Normal working range, higher the better, hence more signal to noise.
Amplitude dBV re FSp-p	DBV	-40	0	Amplitude of the signal at the ADC
Telemetry Sync Status	CRP	40/10	9/99	Telemetry sync properties
Interference Level	IFL	0	DET	Maximum XC prior to detection, interference level. Helps when setting the DET level in the CS.
Forward Error Correction	FEC	0	1 or 5	Number of code symbol errors corrected

Acoustic Link Status - ALS

4. Sonardyne Messaging Service (SMS) [FL SMS]

The Sonardyne Message Service communication protocol facilitates the transfer of ASCII printable data between instruments with minimal protocol overhead. This protocol satisfies most telemetry requirements where maximised tempo is important and the data to be transmitted has only a short validity period or is non-critical, e.g. Gyro data, position updates, spooling of sensor data etc. Figure 4.1 shows some usage examples for the SMS protocol and possible extensions.

The main requirements are shown; AUV to AUV communication, baseline signal information, spooling of data and broadcasting of data.

The key points for the SMS protocol are as follows:

- All SMS enabled instruments must have an acoustic address
- Range information is collected as a by product of the SMS. Therefore the SMS response is time critical.
- Only ASCII printable characters can be sent
- The protocol does not handle lost packets (use MDFT instead)
- The maximum message length is 128 characters
- Only wideband telemetry schemes supported

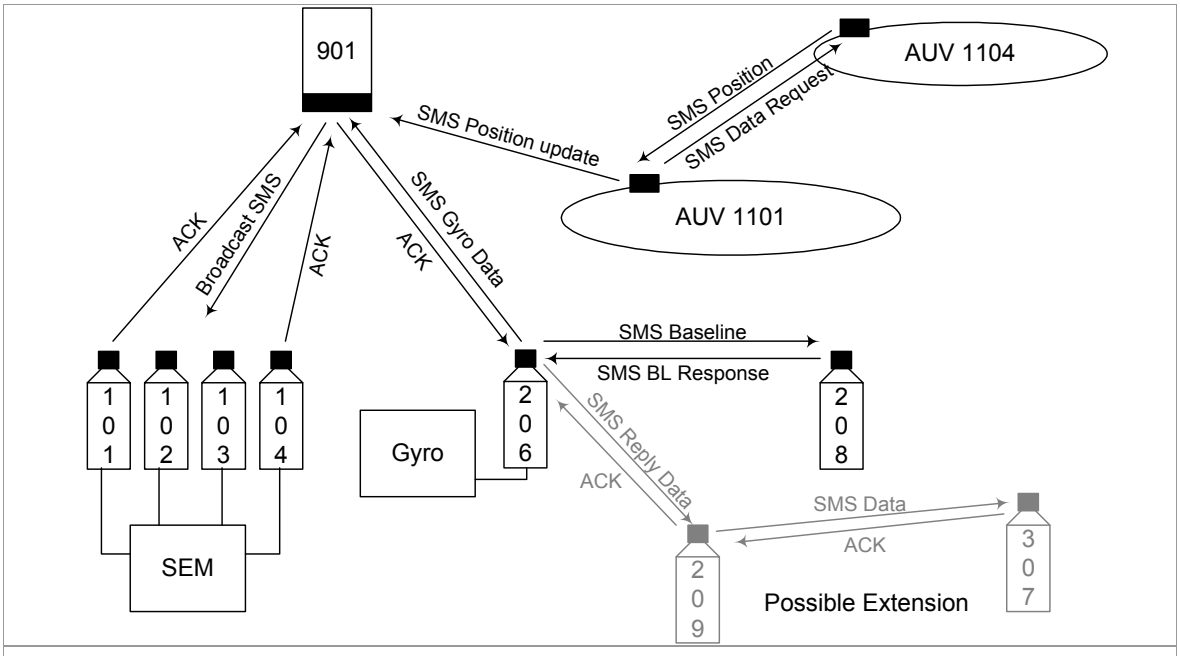


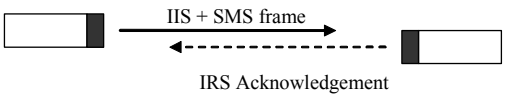
Figure 4.1 Use Cases for the SMS protocol

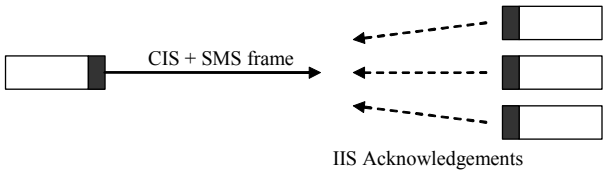
4.1. Data Transfer Use Cases

This section describes the use cases that have been considered for the SMS protocol design and possible extensions to the protocol.

4.1.1. Single SMS Message

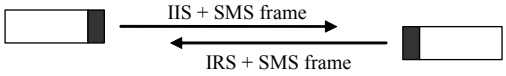
An SMS message can be sent from one instrument to one or more other instruments. It is also possible to specify whether or not the receiving instrument(s) should acknowledge receipt of a successfully received, error free SMS message.





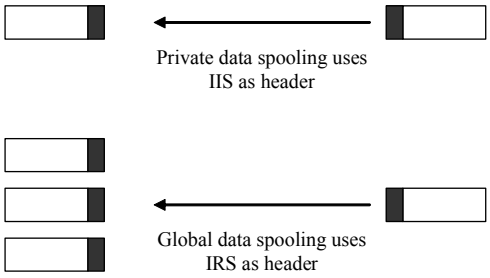
4.1.2. Standard Data Exchange

The standard data transfer sends data to an acoustically addressable device and receives a reply SMS frame[1], in both cases it confirms that the data arrived successfully.



4.1.3. Data Spooling

Data spooling allows a device to periodically send a small amount of data to a particular recipient or global to any system that maybe listening. If the data is sent to a particular recipient then a standard SMS Data (IIS) frame is sent, (possibly with the don't ACK flag set).



4.2. Unsolicited Messages

An unsolicited message is defined as the first or out-going message. Some older instruments, such as GDT USBL, cannot receive unsolicited messages. Therefore, there is a means of commanding instruments not to send unsolicited SMS messages (i.e. SMS data must be transferred using the standard data exchange method).

4.3. ASCII Printable Character Set

There are 95 printable ASCII characters, numbered 32 to 126 as shown below. These are the only valid characters that can be transferred using the standard SMS protocol.

[1] A frame is defined as a complete acoustic transmission – in the case of SMS it is up to a maximum of 128 bytes

Dec	Hex	Character		Dec	Hex	Character		Dec	Hex	Character
32	20	SP		64	40	@		96	60	`
33	21	!		65	41	A		97	61	a
34	22	"		66	42	B		98	62	b
35	23	#		67	43	C		99	63	c
36	24	$		68	44	D		100	64	d
37	25	%		69	45	E		101	65	e
38	26	&		70	46	F		102	66	f
39	27	'		71	47	G		103	67	g
40	28	(		72	48	H		104	68	h
41	29	)		73	49	I		105	69	i
42	2A	*		74	4A	J		106	6A	j
43	2B	+		75	4B	K		107	6B	k
44	2C	,		76	4C	L		108	6C	l
45	2D	-		77	4D	M		109	6D	m
46	2E	.		78	4E	N		110	6E	n
47	2F	/		79	4F	O		111	6F	o
48	30	0		80	50	P		112	70	p
49	31	1		81	51	Q		113	71	q
50	32	2		82	52	R		114	72	r
51	33	3		83	53	S		115	73	s
52	34	4		84	54	T		116	74	t
53	35	5		85	55	U		117	75	u
54	36	6		86	56	V		118	76	v
55	37	7		87	57	W		119	77	w
56	38	8		88	58	X		120	78	x
57	39	9		89	59	Y		121	79	y
58	3A	:		90	5A	Z		122	7A	z
59	3B	;		91	5B	[		123	7B	{
60	3C	<		92	5C	\		124	7C	|
61	3D	=		93	5D	]		125	7D	}
62	3E	>		94	5E	^		126	7E	~
63	3F	?		95	5F	_				

!"#$%&'()*+,-./0123456789:;<=>?@

ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_'

abcdefghijklmnopqrstuvwxyz{|}~

Table 4.1 ASCII Printable Characters 32-126

4.3.1. Compression Flag

Compression is used automatically to reduce the acoustic payload if the message contains all ASCII characters with a value less than 96.

!"#$%&'()*+,-./0123456789:;<=>?@

ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_

Table 4.2 Compressed ASCII printable Character set

4.3.2. Port Number

The port number determines which port the SMS message is routed to. It should be noted that port configurations vary for different instrument types. Port 0 is always defined as the default port. Port definitions are platform dependent, see Appendix A: Platform Port Definitions for further details.

4.3.3. Load Buffer

The load buffer (B1) command option allows the SMS buffer to be loaded with data without sending an unsolicited SMS. This enables the SMS data buffer to be loaded with data at any time and will only be sent when an SMS standard data exchange message is received for the destination address specified in the loaded message. The destination address can be a group address, 0100 or the global address 0000. Once the message has been sent the buffer is flushed “fire and forget”. Multiple writes to the buffer will over-write previous buffer data.

4.4. SMS Command String

The full command string takes the following form:-

<SMS:aaaa;W#,P#,C#,WKT#,A#,R#,B#|Message<CR>

The command line parameters between the address and the pipe '|' character can appear in any order. The exception is the wake up W# parameter which if not to persist, must be appended to the address using the semi-colon ';'.Unused command parameters can be omitted as necessary. For example:

<SMS:1001;W1,P1|Test Message<CR> *Send SMS message 'Test Message' to Addr 1001*

Parameter	Explanation
aaaa	Standard four digit acoustic address
W#	Specifies whether to precede the message with a wakeup signal, this parameter is associated with the address and take precedence over the WKT parameter. The W# is not persistent and conforms to the Gen6 Command specification.
WKT#	Specifies whether to precede the message with a wakeup signal, this parameter is persistent.
P#	Sets the port number 0-7 – this setting is stored and will be used on subsequent SMS messages until changed. Port 7 is a special port number that delivers messages to all available ports. NB: Port 6 is reserved
C#	Specifies the command number – this setting is stored and will be used on subsequent SMS messages until changed.
A#	Specifies the sub code to use (0=SMS_STD_EXCHANGE, 1=SMS_ACK_ONLY, 3=SMS_NO_RESPONSE – this setting is stored and will be used on subsequent SMS messages until changed. NB: A2 is reserved.
R#	Specifies whether range data should be displayed (0=No range data, 1 = Range data displayed) – this setting is stored and will be used on subsequent SMS messages until changed. Range time information is displayed in micro seconds.
B#	Specifies whether the message is to be loaded into the SMS exchange data buffer or whether it is sent immediately. This is persistent through a Watch Dog Timer (WDT instrument specific) so that the short form can be used to load the buffer. If loaded, the previous buffer contents are overwritten.
Message	The characters after the pipe,'|' define the SMS message to be sent.

NB: The default (power on reset) settings are P0,C0,W0,A0,R0 & B0.

4.5. Displaying SMS Messages

The SMS command interface is similar to the legacy PAN command interface. The Command and Response ports can be used for both command and data as only ASCII data is allowed. However, the data can be directed to another port, for example Port 0 is the main command port and Port 1 is the data port. If a message is sent to Port 1 then the SMS command information appears on Port 0 and the data appears on Port 1.

SMS message information always appears on the default port (port 0). If the message is being output to port 0 then the message is displayed with the information, else the message is directed to the specified port.

The SMS message received information comprises the following string:-

SMS:aaaa,P#,C#,N#<CR><LF>

aaaa is the source address

P# is the port number to which the message has been dispatched

C# is the command number associated with the SMS message

N# is the number of characters in the message (0 to 128).

If the port is 0 then the number of characters, N#, field is omitted from the message information string. The message is appended on to the message information after a pipe,'|', character:-

SMS:aaaa,P#,C#|This message was sent with the port field set to zero<CR>

If the port is 0 and the command is 0 then the command field of the message information string is not displayed.

4.6. SMS Reply Strings and Examples

If enabled, range information of the format R*xxxxxx* is provided in the SMS reply string. The number displayed is in microseconds and includes any fixed TAT but automatically subtracts the variable telemetry duration, which is proportional to the number of characters sent.

4.6.1. SMS Simple Message using Last Configured Settings

The following command sends "This is a test message" to an instrument with an acoustic address of 0101 and highlights the possible responses and reasons.

<SMS:0101|This is a test message

Possible Reply Strings, for the SMS sent with ACK ONLY or STD_EXCHANGE.

>SMS:0101,ACK	*Data received okay and device had no available SMS data.*
>SMS:0101,NO_REPLY	*No response received yet one was expected.*
>SMS:0101|Message received!	*Standard Exchange completed successfully.*
>SMS:0101,OK	*SMS sent with No Response (A3) so TCVR doesn't listen for response*
>SMS:0101,NO_DATA	*Data received back but wasn't decoded correctly (i.e. FEC errors).*
>SMS:FAILED	*TCVR not ready or incorrect parameter*

4.6.2. SMS Transfer with Range Data Reply

Enabling the Range time information

*<SMS:0101,**R1**|This is a test message*

Possible Responses

*>SMS:0101,**R5423287***	*Range R field replaces the ACK*
>SMS:0101,NO_REPLY	*No response received*
*>SMS:0101,**R5423287**|Message received!*	*Standard Exchange*
*>SMS:0101,NO_DATA,**R254287***	*Data received back but wasn't decoded correctly (i.e. FEC errors).*
>SMS:FAILED	*TCVR not ready or incorrect parameter*

4.6.3. SMS Transfer Specifying no Response from Receiving Device

*<SMS:0101,**A3**|Test message*	*Set to SMS_NO_RESPONSE*

Possible Responses

*>SMS:0101,**OK***	*Message sent successfully*
>SMS:FAILED	*TCVR not ready or incorrect parameter*

4.6.4. Buffered SMS Transfer

*<SMS:0101,**B1**|Test message*

Buffer the Data, this data will be transfer if a Standard Exchange message is received from 0101

Possible Responses

>SMS:0101,OK	*Message buffered successfully*
>SMS:FAILED	*TCVR not ready or incorrect parameter*

5. Modem Command Set

The Modem Command Set is part of Sonardyne's integrated positioning and communication system. This section describes how the integrated modem can be configured and used for data transfer within Sonardyne's navigation architecture.

5.1. MS - Modem Status

The Modem Status (MS) command can be used to read and configure modem status parameters of the instrument. Individual parameters can be set without affecting or knowing the other parameters. These parameters will remain set and are stored in memory; however they are not stored in non-volatile memory. Therefore if the instrument is reset or its power cycled, the configuration will return to the last stored user defaults or factory defaults. The SC command STR;MS option can be used to store the user configured data to EEPROM as user defaults.

Command:	<MS:DD*x*,MD*x*,UD*x*,TS*x*,P*x*,MR*x*,SM*x*,THR*x*,ICT*x*,FQ*x*,MSTx,Bx <MS:*aaaa*,DD*x*,MD*x*,UD*x*,TS*x*,P*x*,MR*x*,SM*x*,THR*x*,ICT*x*,FQ*x*,MSTx,Bx		
Reply:	>MS:*aaaa*,MV*x*,DD*x*,MD*x*,UD*x*,TS*x*,P*x*,MR*x*,SM*x*,ICT*x*,FQ*x*,*MST*x,B*x*/*x.x*,R*x*		
Parameters:		**Valid Input:**	**Default Value:**
MV#	**M**odem **V**ersion	Read Only	
DDx	**D**ata **D**elay	32ms to 4096ms	256ms
MDx	**M**odem **D**elay	32ms to 32768ms	512ms
UDx	**U**plink **D**elay	32ms to 4096ms	512ms
TSx	**T**elemetry **S**cheme	0 to 7	4 : RPSK600
Px	**P**ort	0 to 7	1 : Serial Data Port
MRx	**M**aster **R**etries	0 to 7	1 (Advanced user)
SMx	**S**ubframes **M**issed	0 to 7	1 (Advanced user)
THRx	**THR**eshold	0 to 14 subframes	0
ICTx	**I**nter **C**haracter **T**ime	32ms to 32768ms	32ms
FQx	**F**orward **Q**ueue	0 or 1	0
MSTx	**MaST**er mode	0 or 1	0
Bx/x.x	**B**uffer Size and % used	4KB to 512KB	512KB
R	**R**ange	Microseconds	

<MS Local Command

>MS:1001,MV1,DD128,MD512,UD512,TS3,P1,MR1,SM1,THR0,ICT32,FQ0,MST0,B512/0.0,R345322

<MS:112 Remote Command

>MS:112,MV1,DD256,MD256,UD512,TS3,P1,MR1,SM1,THR0,ICT32,FQ0,MST0,B512/10.6,R345322

The following provides a detailed description of each parameter:

5.1.1. MV : Modem Version

The modem protocol version is read only and specifies the valid parameters and acoustic behaviour of the instrument. The system must check that the modem version is compatible and supported by the master instrument on connection.

5.1.2. DD : Data Delay

This defines the time delay in the transmission between the end of one telemetry packet and the start of the next. The Data Delay is specified in milliseconds and has the following quantisation:

Data Delay (ms)
32
64
128
256 (default)
512
1024
2048
4096

The instrument will round upwards the input data delay value to the next permitted value in the list above, e.g. If DD250 was input, it would be rounded up to DD256. If a parameter is specified above the maximum or below the minimum an error message will be returned by the instrument (i.e. 'DD?')

5.1.3. MD : Modem Delay

The Modem Delay (MD) parameter sets the maximum time delay between the end of transmission of the first packet (Command/Ack) and the start of transmission of the first Data packet in a Modem uplink Frame transfer sequence.

This delay allows the remote instrument to wait for the attached serial device to communicate data into its modem data buffer if it is currently empty. This time delay is activated once the Acknowledge Packet has been transmitted in response to the End Packet of the previous Downlink transmission. However, if data is already available in the remote instruments modem buffer then the minimum delay time for the transmission of the first Data packet in the uplink is referenced to the Acknowledge Packet and is defined by the UD parameter setting.

The quantisation of the MD parameter value is shown below:

Modem Delay (ms)
32
64
128
256
512 (default)
1024
2048
4096
8192
16384
32768

5.1.4. UD : Uplink Delay

The Uplink Delay (UD) parameter defines the time delay in the Uplink transmission between the end of one telemetry packet and the start of the next. The instrument will always wait for a minimum of either UD or MD before it responds. The quantisation of the UD parameter value is given below:

Uplink Delay (ms)
32
64
128
256
512 (default)
1024
2048
4096

5.1.5. TS : Telemetry Scheme

The Telemetry Scheme (TS) parameter defines the telemetry scheme that the instrument will use for modem transfers.

The relationship between parameter value and telemetry scheme used is provided below:

TS Parameter	Telemetry Type
0	100bps
1	200bps
2	400bps
3	900bps
4	Reserved
5	HDR 6000bps
6	Reserved
7	Reserved
8	RPSKv1 600bps

The available telemetry schemes depend on firmware version, security dongle setting and hardware platform capabilities. Attempts to select a telemetry scheme that is unavailable will be ignored by the instrument.

5.1.6. P : Port

The Port (P) parameter defines the serial port that the user data will be sent to. The number of available serial ports is hardware dependant. If an invalid port is specified the P parameter will remain unchanged.

P Parameter	Port
0	Command Port
1	Data Port
2	Serial Port2
3	Serial Port 3
4	Serial Port 4
5	Serial Port 5
6	Reserved
7	Global – all ports

Most instruments have one or two ports. Therefore, high number port options are not normally available.

5.1.7. MR : Master Retries

The Master Retries (MR) parameter defines the number of times the master modem instrument will attempt to retrieve data that has been received in error. Only the data packets that were received in error are re-requested. Data packets will be pieced together automatically once they have all been received without errors. In a difficult acoustic environment this automatic re-request feature can be very powerful. However, it can result in latency in the data being delivered to the communications port.

Master Retries
0 none
1 (default)
2- 7

5.1.8. SM : Sub-frames Missed

The Sub-frames Missed (SM) parameter sets the permitted number of sub-frames that can be missed (i.e. not detected or decoded) before the receiving unit terminates the data reception.

Missed Sub-frames
0 none
1 (default)
2- 7

A large number of missed sub-frames can introduce a delay in the remote modem responding, and ultimately result in a reduction to the user data rate. The SM parameter can be used to control this delay.

5.1.9. THR : Threshold

The Threshold (THR) parameter contains the number of sub-frames that are required to be queued before automatic modem transfer is initiated. For automatic modem transfer to take place the MST parameter must be set to 1. In addition to the MST, the Inter-Character-Time ICT must have expired and the amount of data queued in the modem buffer must have exceeded the threshold THR parameter.

5.1.10. ICT : Inter Character Time

The Inter Character Time (ICT) parameter controls the timeout (in milliseconds) after receiving a serial modem input until automatic modem transfer takes place. The MST, THR parameters must also be configured correctly for the modem to initiate a frame transfer.

5.1.11. FQ : Forward Queue

The Forward Queue (FQ) parameter controls whether the contents from the last modem frame transfer will be automatically cleared even if the transfer is unsuccessful. When set to 1, the buffer is always cleared. When set to 0, the contents will remain if the modem frame transfer was unsuccessful.

5.1.12. MST : Master mode

The Master Mode (MST) parameter controls whether the instrument is operating in autonomous master mode. For automatic modem transfer to take place the MST parameter must be set to 1 and the ICT and THR parameters configured correctly. When set to 0 this mode is disabled and the ICT and THR parameters are unused.

5.2. MDFT – Modem Data Frame Transfer [FL MOD]

The Modem Data Frame Transfer (MDFT) command initiates a modem data frame transfer comprising two parts: The first involves the transfer of Modem data on the Downlink (if present) and this is followed by the second part which involves the transfer of modem data on the uplink (if present).

A frame transfer starts with the transmission of up to 16 'packets' from the local Modem. A packet is defined as a single modem acoustic entity. Encoded in these downlink packets is the modem data for transfer to the remote Modem. The last packet in the downlink sequence automatically initiates the uplink part of the frame transfer sequence. This involves the transmission of up to 16 'packets' from the remote Modem in which is encoded the remote modem data for transfer to the local Modem.

Command:	<**MDFT**:aaaa;**W#**,**RS#**,**SPR#** **<MDFT:**aaaa**|**ccccccccccccccc…	
Reply:	>**MDFT**:*aaaa*,LDAx,RDAx,DCx >**MDFT**:0101,NO_REPLY **>MDFT:**0101,LDA0,RDA0,DC23|cc…ccc (if command and data port are the same)	
Parameters:		
aaaa	Address of Remote Modem Compatt	
|cccc…	The '|' identifies the following characters, 'ccc..' to be free form text and is to be interpreted as modem data for transfer on the Downlink.	
LDAx	Local Modem Data Available in buffer for download	'**x**' = 1: TRUE '**x**' = 0: FALSE
RDAx	Remote Modem Data Available in buffer for download	'**x**' = 1: TRUE '**x**' = 0: FALSE
RSx	Allows the resetting of the local or remote instrument?? prior to the modem frame transfer	'**x**' = 1: Reset local modem '**x**' = 2 Reset remote modem '**x**' = 3 Reset both modems
SPRx	Allows suppression of either the downlink or the uplink portion of the modem frame transfer	'**x**' = 1: Suppress the downlink '**x**' = 2: Suppress the uplink
DCx	Data Count, number of data byte received	
Examples:	MDFT:0102 MDFT:0102,LDA0,RDA1,DC234	Perform a transfer with unit address 0102 Successfully completed transfer, FEC ok and there's more data available in the Remote modem's buffer. 234 data bytes have been received and sent out of the data port.

7. Specific Commands for Retrieving Diagnostic Information

7.1. FFT – Fast Fourier Transform (noise measurement)

The FFT command computes the fast Fourier transform on acoustic data received by the unit. It is possible to perform transforms on the pass band or baseband data, either way the data is returned in the same format, and is as follows:

Command:	**<FFT**: E0,N1024, A16,F0	
Reply:	<FFT:E0,N1024,F0,A16,-87.2,-85,2 ….. …… ….. …. …. … <CR>	
Parameters	Ex	Element number , where applicable
Write only	Nx	Number of points in FFT, valid ones are: 128 256 512 1024
	Ax	Averaging for FFT, this the number of times the FFT is performed, then averaged
	Fx	This parameter defines which frequency the FFT should be ran at, this should be set to zero for most cases, as this will specify the FFT to be performed at the passband sample rate.

It should be noted that this command has local scope only at present, and cannot be used via the address parameter *aaaa* to remote instruments.

After all parameters have been returned the data is appended (to what??) as floats, the number of data points will depend on the number requested in the command (using the “N” parameter). The data is output in dB’s referenced to full scale (which is what), and on certain instruments this is quantised in 3dB steps.

7.2. CALL: Calibration Loopback Test

This command is used to perform a calibration loopback test on the instrument by performing a loopback test at each frequency within the addressable range of NAV signals. On current instruments this ranges from 19250Hz up to 33500, in 500Hz steps.

Cmd:	<CALL		(Get current Cal. values)
	<CALL:Ax,SFx,Nx,Sx		(Perform Cal.)
	<CALL:Ax		(Perform default Cal.)
Reply: (a)	>CALL:Ax,Fy;Txx;XCxx;SNRxx;DBVxx;Ax;Bx;Cx;Dx;Ex,		
Parameters:	Ax	Averaging, A1 to A32 is the valid range If omitted then no CAL is performed and current values are read from EEPROM and returned.	
	SFx	Start frequency	(default: 19000Hz)
	Nx	Number of steps	(default: 30)

	Sx	Step size in Hz (default: 500Hz)
	Fy	Frequency of measurement
	Tx	Time offset of detection
	XCxx	Correlation score
	SNRxx	Signal to Noise Ratio (dB)
	DBVxx	Signal Level (dB reference to full scale)
	Ax	Phase offset in element A
	Bx;Cx e.t.c	Phase offsets... repeated for all elements in system

<CALL:A4,SF26000,N10,S500

Start frequency 26kHz and measures 10 frequencies from 26kHz to 30.5kHz in 500Hz steps.

8. Diagnostics Information

The Diagnostic Information (DIAG) command can be used locally or remotely (via Addr *aaaa*) to provide diagnostic information.

The following table describes the use of the command on a local instrument.

XC	Correlation score [XC67]
SNR	Signal to Noise level [SNR21]
DBV	Signal level relative to full scale voltage in dB's [DBV-12]
DOP	Estimated Doppler of the remote unit
CHAN	Channel plot, returns the channel estimate upon detection [CHAN0;32;1;54;3 .. etc]
TEL	Returns the type of telemetry received [TEL;RPSKv600]
FEC	Returns errors in telemetry reception [FEC2;3;1 .. etc] per block, -1 indicates un-correctable
CRP	Chirp detection diagnostics [CRP99;12] indicates the ratio of the energy between the Nav pulse and the chirp.
E	Detection element in multi-element systems
SXC	Spatial Correlation Results [SXC231;231;21;1 etc] see below
IFL	InterFerence Level, maximum cross-correlation prior to detection.
MCHAN	Turns on multichannel diagnostics capability, this turns element specific data into multi-element diagnositics, i.e. [XC78;68;69;56;56] for a 5 element array

The command has several parameters that can be turned on or off, and when enabled, the diagnostic information is appended to all acoustic commands output from the command port of the transceiver and wrapped in square brackets. Information such as correlation level, background noise level and other parameters can be output.

<DIAG:XC,DBV This command enables cross-correlation (XC) and signal level information (DBV) to be appended to all received acoustic replies

>DIAG:1013,DBV,XC Response, indicating enabled diagnostics

Example command telegram and reply from a transceiver with XC, DBV and FEC diagnostics enabled:-

<FS:1001

>FS:1001,U00154D,FL007F,FV2.00.01.08,PV1.03,TDR;MF;OMNI,R421006[XC88,DBV-21,FEC0]

8.4. Interpreting Diagnostic Information

The diagnostic information from the instrument provides information that can be useful in determining the status of the acoustic channel. These notes provide a simplified interpretation of the values and have tried to categorise them into the following three conditions; good, okay and difficult. The cross-correlation (XC) value is very important and can be used simply to categorise the channel. This must be greater than the DET level set in the CS command for the system to detect the signal. Several of these parameters are linked together. For example changing the receiver gain (LG) may improve the XC and SNR in the case where the acoustic signal is saturating the receiver.

If possible, it is important to ensure that the system is not saturating by adjusting the LG parameter in the CS command to bring the DBV level to within the 'good' range indicated in the table below. The IFL can be used to determine whether the system DET level is set correctly. Normally the DET level should not need

to be changed from its default value, however if there is significant interference being reported by the IFL then this maybe a reason to increase the DET level.

The table below shows a traffic light interpretation and bounds for each of the parameters that are available from the DIAG command (local) and the ALS command (remote). The aim is to have all of the parameters within the good or okay bounds. Generally this can be achieved by adjusting the gain of the instrument in test conditions.

Parameter	Good	Okay	Difficult	Description
XC	>60	>45	<45	Setting the DET <45 will increase the probability of false detection.
DBV	-3 to -26	>-36	<-36 or >-3	If the signal is either too large (>-3dB) or too small (<-36) then the system is not optimal.
SNR	>20	>12	<12	Signal to noise, higher the better, ensure that the system is not saturating (DBV) as this will degrade the SNR
IFL	<20	<40	>40	Interference level, maximum correlation level prior to detection. Depends on the DET setting in the CS.
FEC (number depends on telemetry scheme used)	<2	<4	<5	Number of telemetry code symbol errors corrected by the forward error correction algorithm. Minus 1 indicates that the correction power has been exceeded, un-correctable.

Diagnostics traffic light interpretation