Sonardyne

IM-8262-V2

Integration Manual for Type 8262 Nano Transponders and Transceivers

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Note

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Amendment History

The amendment history records all amendments and additions made to this manual.

Issue	Revision	Date	Comments	Section	Page
A	1	10/03/2021	First Issue	All	All

Section 1 – Introduction

1.1 Scope of this Manual

This integration manual describes how to integrate the Type 8262 6G® family of Nano transponders into a vehicle or platform.

1.2 Purpose of this Manual

This integration manual is intended for qualified personnel involved with installing, configuring and operating Nano form factor transponders as below.

Product family	Product name	Type
Nano	Nano	8262-000-23
	Nano with Connector	8262-000-28
	Nano OEM	8262-000-27
AvTrak 6	AvTrak 6 Nano	8262-000-29
	AvTrak 6 OEM Nano	8262-000-24
Modem 6	Modem 6 OEM Nano	8262-000-22

1.3 Related Publications

Related publications for integrating the Nano, AvTrak6 Nano and Modem 6 Nano are supplied on the media with this integration manual; see *Table 1-1*.

Table 1-1 Related Publications

Publication	Title
Sonardyne Safety Manual	*Operational and Safety Precautions*
Application Note	*Using SMS Telemetry Position Updates*
UM-8300-099	*User Manual for 6G Terminal Lite (included in the media)*
UM-8251	*Ranger 2 User Manual*
UM-8262	*User Manual for Type 8262 Nano Transponders and Transceivers*
IM-Modem 6	*Integration Manual for Modem 6 products*

1.4 Conventions

Table 1-2 Conventions used in this Manual

Format	Convention
Boldface Type	User Input, Menu Options, Keys, e.g. Click **OK**
Numbers preceded by **0x**	Are in hexadecimal notation
Examples of command syntax	Are shown fixed width font and for clarity will not show the required <CR> and <LF> characters, i.e. <FS should be interpreted as <FS<CR><LF>. This also applies to command replies, i.e. >CKHW:PASS should be interpreted as >CKHW:PASS<CR><LF>
Italic Type	References to Figures, Tables, Sections and internal/external source

Section 2 – Safety

2.1 Introduction

Before any activity is carried out on the equipment, it is recommended that the included *Sonardyne Safety Manual* and all warnings and cautions in the user manual UM-8262 are read and fully understood.

2.2 Safety Procedures

2.2.1 Warnings

OEM PCB sets must not be active while being installed into a vehicle. Refer to *UM-8262, Section "Connecting/Disconnecting the Nano Battery"* for instructions on disconnecting the battery by serial command, or if in any doubt remove jumper JP2 from the Nano motherboard (note this may cause loss of stored battery % data until the unit is next fully charged). External power must not be applied .

Section 3 – Configuration

3.1 Initial Powering and Testing

See UM-8262 for information on testing and commissioning the hardware elements of Nano based products.

3.2 Reading Fixed Parameters

3.2.1 Unit ID

The unit id (UID) is reported as part of a Fixed Status (FS) reply and is denoted by the U parameter. The UID is reported as a 6-digit hexadecimal value:

```
<FS
>FS:2709,U0054D6,FL0015,FV3.07.00.06,TDR;MF;OMNI;184;175;169,INC-90.00;+90.00;AC1.00
```

3.2.2 Firmware Version

The firmware version is reported as part of a Fixed Status (FS) reply and is denoted by the FV parameter. The firmware version is denoted by a version, development, revision and build, the values of which are separated by '**.**'.

```
<FS
>FS:2209,U0054D6,FL0015,FV3.07.00.06,PV1.13,TDR;MF;OMNI;184;175;169,INC-
90.00;+90.00;AC1.00
```

3.2.3 Transducer Information

The acoustic frequency band and transducer type that a Nano is built to support is reported after the TDR parameter in a FS command response. The acoustic band will be denoted by MF (Medium Frequency); the transducer type will be denoted by OMNI (omni-directional). In addition, three numerical values follow which give the three available acoustic power level settings that the Nano supports:

```
<FS
>FS:2209,U0054D6,FL0015,FV3.07.00.06,PV1.13,TDR;MF;OMNI;184;175;169,INC-
90.00;+90.00;AC1.00
```

3.2.4 Battery Status

A VS command (Volatile Status) is used to measure electrical power and charge parameters in 6G devices.

```
<VS
>VS:2209,HPR45,EXT,TILT,BT1;LI_ION;VLT3.6;IDC366.0;CAP3.4/32;T24.2;CHG
```

The VS command will report if external power is detected (**EXT** flag) and whether the battery is charging (**CHG** flag).

The **IDC** parameter reports the charge current in mA (positive if charging, negative if discharging). The amount of charge current will be dependent on the voltage of the battery, reported in the **VLT** parameter (the example above shows a typical charge current of >300 mA with a battery voltage of 3.6 V).

If the VS command reply does not report that the battery is charging when it is expected to, check the charge status in the SC settings as described in *Section 4 – "Operational Guidance"*.

The VS command reports whether the unit is tilted (**TILT** flag) – from the point of view of the Nano Transceiver; "upright" is when the transducer connector PL1 is pointed upwards.

The remaining battery % is reported in the VS reply (underlined).

Note

When a Type 8262 nano transponder is enabled from a disconnected state, charging will always be enabled (this helps prevent the battery from becoming deeply discharged).

3.3 Basic Acoustic Configuration

All Nano variants have configurable power settings but are gainless so optimise their own receive. In order to optimise an acoustic link, the power settings at each end of the acoustic link need to be configured appropriately.

3.3.1 Setting the Power Levels

There are three different power level settings available. The three available power levels are reported in the FS command reply as previously described. Separate power levels can be set for Navigation and Telemetry.

3.3.1.1 Navigation Power Level (NPL)

The Navigation Power Level is used to control the power level for all short navigation interrogations and replies.

3.3.1.2 Telemetry Power Level (TPL)

The Telemetry Power Level is used to control the power level for telemetry acoustics.

Notes

When deploying it is recommended to set the NPL to 184 and the TPL to 175. Lower power levels should only be used at very low ranges e.g. tank testing/commissioning.

3.3.2 Setting the Receive Wait Time (RXW)

The Receive Wait Time (RXW) parameter is used to determine how long to wait for an acoustic reply for navigation and telemetry. It should be set based on the maximum slant range in the operating scenario, the maximum turn-around time (640 ms) and the sound speed.

Table 3-1 Suggested RXW Values

Maximum Slant Range	Suggested RXW
< 250 m	1200 ms
< 500 m	1600 ms
< 1000 m	2400 ms
< 2000 m	3600 ms
< 3000 m	5200 ms
< 4000 m	6400 ms
< 5000 m	7600 ms

3.3.3 Setting the Activity Time

The Activity Time setting controls the amount of time the Nano waits after any acoustic or serial activity before entering a "sleep mode".

In sleep mode, the Nano will consume a much lower amount of power (<5mW), but it will still respond and be woken up upon detecting an acoustic signal matching any of its active detectors, or any serial communications received.

The Activity Time is set by the AT parameter of the CS command. Table 2-1 shows the length of time each AT value equates to.

Table 2-1 Activity Time Options

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

The lower the AT value, the longer the battery will last, because the Nano will enter sleep mode more quickly. However, a Nano will not decode telemetry if in sleep mode – it must be woken by a navigation interrogation first.

Therefore, the AT value must be set based on the application the Nano is being used for and it is for the user to decide the most suitable value prior to a deployment.

For general purpose use, an AT value of 5 (16 minutes) is recommended.

3.4 Storing the Configuration

The Nano has non-volatile storage to store a copy of the configuration. The configuration is loaded on a cold start. To transfer the current configuration to non-volatile storage it is necessary to send an STR command:

```
<STR
>STR:OK
```

Note

Some configuration parameters are automatically written to non-volatile storage whenever they are changed. These include all configurable parameters in the PORT and SC command.

Section 4 – Operational Guidance

4.1 Disabling the Battery Charger

The built-in li-ion battery charger produces a small amount of electrical noise. To achieve optimum noise performance of the acoustic receiver during operation it may be necessary to turn the battery charger off.

With the charger turned off the electronics still consume battery power, even when using external power. Therefore, the battery should be fully charged prior to deployment. The battery charge time can be up to eight hours and a fully charged battery will last up to 90 days on a full charge if using external power, depending on sleep mode settings.

The charger can be enabled/disabled using the CHG parameter of the SC (Secure Configuration) command as shown below.

Send an SC command to get the UID (**U** parameter) of the Nano and the current configuration:

```
<SC
>SC:2209,U0054D6,HPR45,BT1;DIS0;CHG0,OV0,CAS0,LKD0
```

Set the CHG parameter to 1 to enable (or 0 to disable) the charger. The UID must be provided in the command to allow setting of parameters.

```
<SC:U54D6,CHG1
>SC:2209,U0054D6,HPR45,BT1;DIS0;CHG1,OV0,CAS0,LKD0
<SC:U54D6,CHG0
>SC:2209,U0054D6,HPR45,BT1;DIS0;CHG0,OV0,CAS0,LKD0
```

4.2 Disconnecting the Battery

The battery is connected each time the Nano is power cycled. The battery should be disconnected to conserve the battery between deployments.

The battery can be disconnected using the SC (Secure) command as shown below (DIS parameter):

```
<SC:U54D6,DIS1
>SC:2209,U00552A,HPR45,BT1;DIS1;CHG0,OV0,CAS0,LKD0
```

Notes

The unit will stay powered if the battery is disconnected while external power is still applied.

When the battery is disconnected and external power is removed, all nano variants can take up to 40 seconds to shutdown completey. Wait at least 40 seconds before attempting to power it up again.

It is always recommended to disconnect the battery prior to storage. To prevent a deep discharge, the battery automatically disconnects when it reaches approximately 3.1 V. It will however continue to slowly discharge over the course of several months. At 2.3V it will enter a micro-power state to delay deep discharge as long as possible. The battery being at this low level will mean a slow charge rate when power is next applied, until the battery voltage is sufficient to allow fast charging. It may also prevent booting until the batteries have charged enough to be electronically connected.

4.3 Connecting the Battery

When the Nano battery is disconnected, i.e. the Nano is disabled, connection of the battery is achieved by applying external power. Once the Nano has booted, external power can be turned off and the Nano will remain enabled.

4.4 Initial Configuration

As a minimum the power levels should be configured; see *Section 3.3.1 "Setting the Power Levels"*.

4.4.1 Hardware Self-Test

Prior to the start of any vehicle operation, it is advised to run a hardware self-test. The self-test will attempt to electronically validate as many subsystems as possible and report any problems.

To perform a self-test a CKHW command is sent, which reports PASS as part of the serial response if all subsystems are verified as working:

```
<CKHW

>CKHW:PASS
```

If the Nano fails to verify any of the subsystems, the CKHW will reply with a FAIL and a description of the component which failed. The example below shows a failed self-test because the Nano could not communicate with the battery monitor IC:

```
<CKHW

>CKHW:FAIL;BATT
```

In the event of a recurrent FAIL reply, reset the unit by sending a serial break or a UNLK command (see *Appendix A.6.2*) and then resend the CKHW command to confirm the error persists through a code restart. If the error persists, contact Sonardyne support.

4.4.2 Checking the Battery

Prior to the start of any vehicle operation, it is advised to fully charge the li-ion battery. The battery status should report 100% charge and a voltage of >4 V; see *UM-8262*, *Section "Battery Status".*

4.5 Noise Measurements

Once a Nano transponder has been mounted in a vehicle, it is highly recommended to run a noise measurement test using 6G Terminal Lite software. For instructions refer to *UM-8300-099 User Manual for 6G Terminal Lite, Section 6.2*.

The noise measurement will show the noise level present at the receiver at all frequencies from 0 to 62.5 kHz. Ensure there are no large spikes present between 17 kHz and 35 kHz.

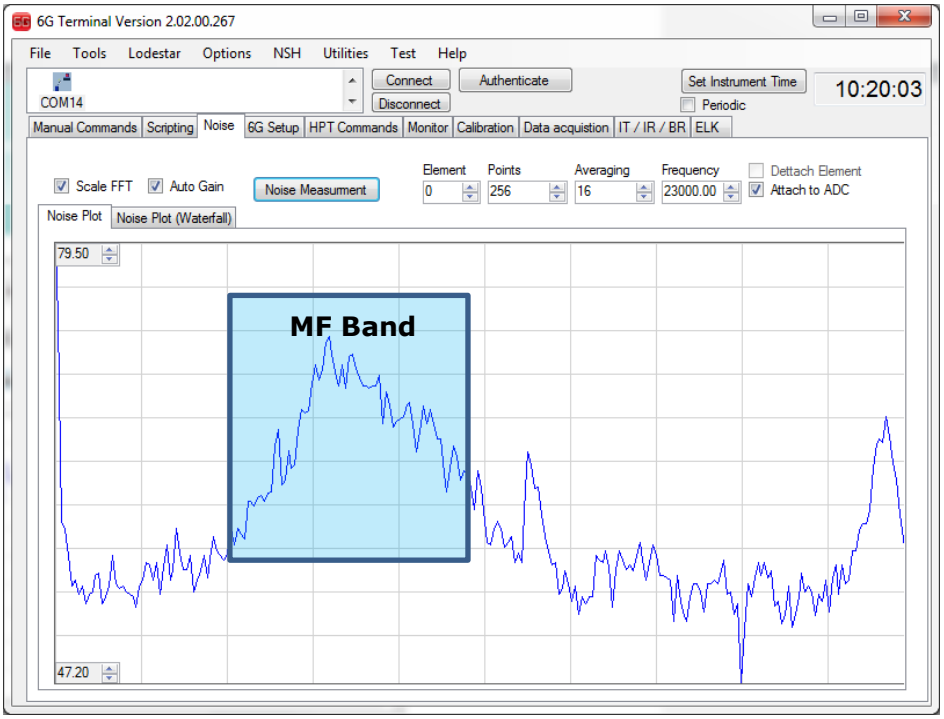
Noise measurements should be taken while all other electronic subsystems in the vehicle are active.

Figure 4-1 shows an example of an electrically quiet environment.

Note

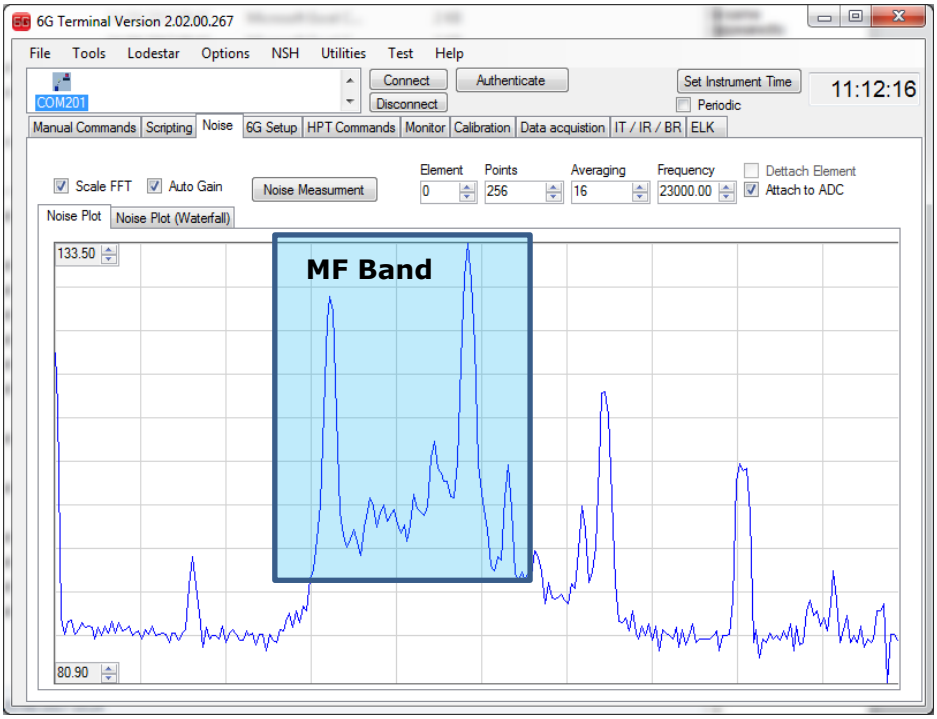
OEM variants are particularly susceptible to noise and as such particular attention should be paid to avoiding routing cabling via sources of electrical noise.

Figure 4-1 Noise Measurement Indicating an Electrically Quiet Environment



Any electrical interference picked up by an OEM board set or the transducer from other electronic sub-systems will be apparent from the noise plot, as shown in *Figure 4-2* (note that the scale of the graph has increased due to the size of the noise spikes). Any large noise sources within the MF band can severely degrade acoustic performance. Typical sources of noise in a subsea vehicle are thruster motors, switch mode power supplies, DC-to-DC converters and microcontrollers.

Figure 4-2 Noise Measurement Indicating an Electrically Noisy Environment



The following actions can be taken for OEM variants if large amounts of noise are present:

- Enclose OEM PCBs in a shielding box
- Shield the transducer wires
- Shield the noise sources
- Position the Nano OEM PCBs further away from the noise sources
- Electrically filter the power supply to the OEM PCB, for example, use magnetic chokes to attenuate the noise at the relevant frequencies

Note

Enabling/disabling the charger (see *Section 4.1*) may have an effect on the overall noise level.

Section 5 – AvTrak 6 Nano Command and Control (Applicable to AvTrak6 variants only)

The AvTrak 6 Nano can be used in many combinations of operating scenarios, enabling functionality above the level available to a standard Nano transponder. This section provides an example of the steps required for integration into a vehicle. It may be the case that a particular integration only requires a subset of the functionality described or that an integration will have to deviate substantially from the steps below; in either case it is recommended to read the whole section as it contains a number of hints for debugging an integration that are applicable in multiple areas.

AvTrak 6 Nano also benefits from full modem functionality which is covered in a dedicated integration guide and in *Section 7 – Modem*.

5.1 Integration Assumptions

There is one serial port available for connection.

For the purposes of the following examples the following scenario will be true:

- The instrument in question is an AvTrak 6 Nano or Nano.
- The serial port, P0, is connected to the subsea vehicle control computer.
- The AvTrak 6 Nano is communicated to acoustically via a 6G transceiver, for example an HPT 5000.

Notes

A 6G transceiver such as an HPT 5000 can be commanded directly via serial command using a terminal program such as 6G Terminal.

Acoustic commands intended for the AvTrak 6 Nano can be routed through Ranger 2 software using a PAN port or the remote control interface, allowing acoustic navigation to continue; see UM-8251 "Ranger 2 User Manual".

5.2 SMS (Sonardyne Messaging Service)

5.2.1 Command Description

The SMS protocol offers a low overhead method for communicating user data between 6G instruments. The table below shows the SMS command parameters to change the behaviour of the data exchange.

Command	**SMS:aaaa; P#,R#|*<ASCII-Message>***	
Reply	SMS:aaaa,ACK SMS:aaaa|AUV Status SMS:aaaa,NO_REPLY	*Message acknowledged successfully* *Message received from AUV* *Message acknowledgement not received*
aaaa	Acoustic Address of beacon	
B#	Fill Buffer	0 (=Send Immediately) 1 (=Load into long data exchange buffer) 2 (=Load into short data exchange buffer)
A#	Exchange type	0 (=Standard Exchange) 1 (=Ack Only), 3, (=Do not respond)
R#	Ranging enabled	R1 = Ranging enabled

5.2.2 Simple SMS Exchange

In a typical scenario, a surface vessel will send information to a subsea vehicle (via SMS command) and the subsea vehicle will have previously loaded status information into the SMS buffer of the AvTrak 6 Nano so that a transceiver on the surface vessel can retrieve this information during the SMS exchange.

5.2.2.1 Fill SMS buffer

The example below shows a command sent by the subsea vehicle to the AvTrak 6 Nano to load information into its buffer. Note that writing to the buffer clears any previous data stored in the buffer. The response to the command is also shown:

```
<SMS:B1|AUV STATUS GOOD
>SMS:OK
```

The maximum size of the message transmitted by SMS depends on the message format and the telemetry data rate.

At the default data rate of 200 bits per second, the message length should not exceed 94 characters (or 125 characters in upper case) to ensure the full message is sent.

It is possible to transmit longer messages by increasing the telemetry data rate (this is outside the scope of this document). For further information contact Sonardyne Support who can make available a Marine Robotics application note via the applications team.

5.2.2.2 Send an SMS Message to an AvTrak 6 Nano

The surface transceiver can send SMS messages to convey information to the subsea vehicle.

The example below shows a command for the vessel transceiver to send a message to a subsea vehicle via the AvTrak 6 Nano.

The P0 parameter specifies that the AvTrak 6 Nano is to output the message on port 0 (the only port).

The A1 parameter instructs the AvTrak 6 Nano to transmit an Acknowledgement pulse (ACK) to inform the user that the message was received successfully.

```
<SMS:2209,P0,A1|User Message to Vehicle
>SMS:2209,ACK
```

5.2.2.3 Send an SMS Message to an AvTrak 6 Nano (Standard Exchange)

The SMS command can be configured so that the reply from the AvTrak 6 Nano contains the information loaded into its buffer as described in *Section 5.2.2.1 "Fill SMS buffer"*.

The example below shows a command for the vessel transceiver to send a message to an AvTrak 6 Nano on a subsea vehicle.

The A0 parameter instructs the AvTrak 6 Nano to respond with the information loaded into its buffer.

```
<SMS:2209,P0,A0|User Message to Vehicle
>SMS:2209|AUV STATUS GOOD
```

The AvTrak 6 Nano will output the message shown below to the subsea vehicle upon receipt of the SMS command. The address displayed is the address of the surface transceiver which transmitted the SMS command.

```
>SMS:3014|User Message to Vehicle
```

5.2.2.4 Append range to SMS reply

The SMS command can be configured to include range information in the reply. The example below is the same as is shown in *Section 5.2.2.3"Send an SMS Message to an AvTrak 6 Nano (Standard Exchange)"* but includes range information.

The R1 parameter specifies a range value be added to the command response:

```
<SMS:2209,P0,A0,R1|User Message to Vehicle
>SMS:2209,R319957|AUV STATUS GOOD
```

5.2.3 SMS Telemetry Position Updates with Ranger 2 software

The Sonardyne Messaging Service (SMS) provides an integrated positioning and data telemetry capability that has low impact on the navigation update rate. If position telemetry updates are selected in the Ranger 2 software, the position when the Nano was last interrogated will be telemetered to the AvTrak 6 Nano on the next update. In addition, user data can be loaded into the SMS buffer in the AvTrak 6 Nano, which will be telemetered back to the surface as part of the next ranging cycle. In Ranger 2 software, select telemetry ranging on the AvTrak 6 Nano instrument.

On each navigation cycle the Nano will receive its previous position and output it on the RS232 serial port.

If the AUV system needs to send a message back to the topside system, it can buffer a message in the SMS Buffer as described in *Section 5.2.2.1 "Fill SMS buffer"*.

```
<SMS:B1|AUV_STATUS_GOOD
>SMS:OK
```

For more information on the SMS capability, see the "*Using SMS Telemetry Position Updates*" application note.

5.3 Using an AvTrak 6 Nano as a Modem

See *Section 7 – Modem*.

5.4 Using an AvTrak 6 Nano as a Transceiver

5.4.1 Ranging to a Remote Beacon

The Measure Range (MR) command is used to perform an individual interrogation to a single beacon. This command initiates the acoustic transmission of an Individual Interrogation Signal (IIS) from the AvTrak 6 Nano and a receiver for a Common Reply Signal (CRS). The timeout for the receiver is governed by the receive wait (RXW) parameter of the AvTrak 6 Nano. The command response will report a time of flight in microseconds which is equal to the two-way travel time added to a fixed turn-around time of 320 ms. A reported time of 0 denotes that no acoustic reply was received.

```
<MR:aaaa
>MR:aaaa;Rx
```

aaaa denotes the acoustic address of the beacon to range to.

x denotes the time of flight (and includes the fixed TAT of 320000).

Notes

If the RXW parameter is set much longer than required it will result in longer than necessary response times if the acoustics have failed, which may hinder the update rate of the system.

Multiple transponders can also be ranged to and data can be encoded into these range measurements. Contact Sonardyne for more information.

Section 6 – Diagnostics

Diagnostics are available for operations performed via serial command on a 6G instrument. The diagnostics can assist with optimising the performance within the specific acoustic environment.

For any acoustic operations carried out via serial command on a 6G instrument, diagnostics can be made available to assist with optimising the performance within the specific acoustic environment.

The following sections describe the core diagnostics available.

6.1 DIAG – Diagnostic Information

The Diagnostic Information (DIAG) command can be used to turn on or off the reporting of diagnostic information from the local instrument.

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

Command:	<**DIAG**: [XC,][SNR,][DBV,][SL,][DOP,][TEL,][FEC,][IFL,] [MCHAN,] <**DIAG**:NONE (*turn OFF all diagnostic settings*)	
Reply:	>**DIAG**:[XC,][SNR,][DBV,][SL,][DOP,][TEL,][FEC,][IFL,] [MCHAN,] (*reply showing diagnostic flags currently ON*) >**DIAG**:NONE	
Parameters:	aaaa	Local Address
	XC	Correlation score, e.g. [XC67]
	SNR	Signal to Noise level e.g. [SNR21]
	DBV	Signal level relative to full scale voltage in dB's e.g. [DBV-12]
	SL	Signal level at the receiver (takes into account transducer sensitivity and gain of system, not calibrated on most instruments)
	DOP	Estimated Doppler for the return path in m/s
	TEL	Returns the type of telemetry received e.g. [TEL;RPSKv600]
	FEC	Returns errors in telemetry reception [FEC2;3;1 etc] per block, -1 indicates un-correctable
	E	Detection element in multi-element systems
	IFL	InterFerence Level, maximum cross-correlation prior to detection.
	MCHAN	Turns on multichannel diagnostics capability, this turns element specific data into multi-element diagnostics, 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 is wrapped in square brackets.

Examples	Command	Description
Example 1	<DIAG:XC,DBV	This command enables cross-correlation (XC) and signal level information (DBV) to be appended to all received acoustic replies detected by the local unit.
	>DIAG:2209,DBV,SNR,XC,P0,DEV0,SYS0,MOD0,RX0,TX0,ERR0	Response, indicating enabled diagnostics
Example 2	<FS:2011 >FS:2011,U00154D,FL007F,FV2.00.01.08,PV1.03,TDR;MF;OMNI,R421006[XC88,DBV-21,FEC0]	Command telegram and reply from a transceiver which has had its XC, DBV and FEC diagnostics enabled

Note

In this version of the protocol some parameters are grouped together; if one is turned on then all parameters in that group are also turned on. The following text identifies the various groups and the parameters that comprise each group:

XC, DBV, SNR

TEL, FEC

SL, SINR

Section 6.3 "Interpreting Diagnostics Information" describes the interpretation of the values reported.

6.2 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 received signal (dBV), signal-to-noise at the receiver (SNR), telemetry synchronisation signal (CRP), maximum interference level (IFL) and forward error correction (FEC) status.

Command:	**<ALS**:aaaa,[**ID**x],[**CIS**], [**IIS**],[**HPR**]	
Reply:	**>ALS**:aaaa,**ID**x,[**CIS**],[**IIS**],[**HPR**],**EL**x,**XC**x,**SNR**x,**DBV**x,**CRP**x;x,**IFL**x,[**FEC**x],**R**x	
Parameters:	aaaa	Acoustic Address
	IDx	Used to determine which detector the ALS reports diagnostics for:- 0 – The header pulse for the ALS command telemetry 1 – The last CIS detection 2 - The last IIS detection that wasn't followed by a telemetry packet 3 – The last HPR detection (first pulse)
	CIS	A more convenient method of specifying ID1
	IIS	A more convenient method of specifying ID2
	HPR	A more convenient method of specifying ID3

Examples	Command	Description
Example 1	<ALS:2013 >ALS:2013,IIS;EL0;XC91;SNR23;DBV-15;CRP80;14;IFL22;FEC0,R321528	Used to get a remote instrument's diagnostic data, locally use DIAG options

Examples	Command	Description
Example 2	<ALS:2013,CIS >ALS:2013,ID1,CIS;EL0;XC91;SNR23;DBV-15;CRP40;10,IFL18,R321532	Used to get a remote instrument's diagnostics for the last CIS detection

Section 6.3 "Interpreting Diagnostics Information" describes the interpretation of the values reported.

6.3 Interpreting Diagnostics Information

The diagnostic information from the instrument provides information that can be useful in determining the status of the acoustic channel. The following description provides a simplified interpretation of this data and attempt 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. Several of the parameters are linked together.

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.

Table 6-1 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 the parameters within the good or okay bounds. Generally, this can be achieved by adjusting the gain of the instrument in test conditions.

Table 6-1 Diagnostic Interpretation

Parameter	Good	Okay	Difficult	Description
XC WBv1 WBv2 WBv2+	>70 >60 >50	>55 >50 >40	<55 <50 <40	The threshold for detection depends on Signal type WBv1 50%, WBv2 45%, WBv2+ 35% default levels.
DBV	-3 to -26	>-36 & <-3	<-36 or >-3	If the signal is either too large (>-3dB) or too small (<-36) then the system is not optimal.
SNR	>12	>6	<6	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.
FEC (number depends on telemetry scheme used)	<1	<4	<6	Number of telemetry code symbol errors corrected by the forward error correction algorithm. -1 indicates that the correction power has been exceeded, un-correctable. The number of correctable errors is dependent on the telemetry type.
Diagnostics traffic light interpretation				

Section 7 – Modem

7.1 Introduction

AvTrak 6 Nano and Modem 6 Nano variants contain the ability to do full modem, which can be used for large volume data offload/upload where using the Sonardyne SMS protocol is not optimal or practical; see *IM-Modem 6 "Modem 6 Integration Manual"* for more information

7.2 Nano Modem Specifics

For modem operations the telemetry power of the Nano is capped, because modem data, by its nature, could continue for long stretches of time. Given the small form factor of the Nano, left unchecked the PCBs would overheat at the maximum telemetry power level the Nano is capable of.

Because of this, modem data transfers have a lower maximum range than navigation and standard telemetry. User data can be transferred via SMS at the maximum telemetry power.

7.3 Single Port Modem Functionality

As Nano variants have one serial port care should be taken when configuring the modem so that it is either:

- Pre-configured before deployment
- CF2 parameter is used to auto detect between binary data and 6G command language; see *IM-Modem 6, Section 4.5* of the Modem 6 Integration Manual.
- If the serial port is in binary mode (CF1) the escape sequence "+++" will break the modem into command mode.

Appendix A – Concepts and Definitions

A.1 UID

The UID is a unit id that is unique and cannot be reconfigured. It is represented as a 6 digit hexadecimal number, e.g. 0x00411A.

A.2 Acoustic Frequency Band

The Nano is designed to operate in the MF band (medium frequency), which covers a frequency range from 19–34 kHz.

A.3 Wideband Signaling

Wideband is a proprietary signaling method that utilises spread spectrum phase shift keying. There are three variants of Wideband signaling; Wideband1 which is for legacy 5G beacons, Wideband 2 which is the standard signaling for 6G beacons and Wideband 2+ which are longer duration signals designed to be used for shallow water or highly reverberant environments. It is recommended that Wideband 2 signaling should be used unless advised by Sonardyne.

Note

Wideband 2+ signals have twice the duration of Wideband 2 signals. This can have a significant adverse effect on battery life which should be considered when choosing the set of navigation signals being used.

A.4 Acoustic Addresses

Every Sonardyne Wideband instrument, including the Nano, has a configurable acoustic address. This address is used in many serial commands in order to request a transceiver to navigate or send acoustic command to. The acoustic address, along with the frequency band of operation, determines the acoustic signaling used for navigation.

Addresses are divided into families. Families are then grouped where different groups change the type of Wideband signaling used. The address is a 4-digit number where the first two digits denote the family and the last two digits represent the channel within that family.

Table 7-1 Address Families

Family Range	Signalling
01-15	Wideband 1
17-31	Wideband 2
50-63	Wideband 2+

Within each address family there are 14 different channels (01 through 14). This allows for over 200 unique acoustic addresses per group per acoustic frequency band.

Notes

Acoustic addresses in the range 101 through 1514 are legacy addresses that use Wideband 1 signaling. Wideband 2 has increased detection performance over Wideband 1 and is preferred over Wideband 1 in all scenarios.

Refer to the frequency chart in UM-8262 for information on restricted/not recommended addresses.

A.5 Navigation

A.5.1 Individual Interrogation

An individual interrogation denotes a unique interrogation pulse that will only be received by a beacon with a specific acoustic address. On receipt of an individual interrogation the beacon will reply with a common reply signal. There is no ambiguity here though as only one beacon will reply.

A.5.2 Common Interrogation

A common interrogation denotes an acoustic signal that may interrogate a number of beacons simultaneously (only those beacons that have been configured to listen for the particular common interrogation). When a beacon receives a common interrogation, it replies with a unique (to the acoustic address) individual reply signal. The advantage of a common interrogation is that multiple travel times can be attained in a single interrogation cycle. When using common interrogations for navigation, it is advisable to configure the beacon turn-around times to minimise pulse overlap. There are 14 different common interrogation signals per signaling type per acoustic frequency band.

A.5.3 Pulse Overlap

Pulse overlap refers to a situation where multiple acoustic signal arrivals overlap (either partially or fully) at a beacon or transceiver. The most common scenario where this may occur is during common interrogation tracking as many individual replies are present in the water following a common interrogation signal.

A.5.4 Travel Time

All ranging serial commands return a travel time, reported in microseconds, which is the two-way time of flight including the turn-around time at the beacon.

A.5.5 Turn-around Time (TAT)

The turn-around time is the length of time that a beacon takes on receipt of an acoustic interrogation until it begins transmission of its acoustic reply. This time is measured from the leading edge of the interrogation to the leading edge of the reply.

A.5.6 Navigation Summary

A summary of the two distinct navigation methods is detailed in *Table 7-2*.

Table 7-2 Navigation Summary

Method	Interrogation	Reply	Turn-around time
Individual	Individual Interrogation Signal	Common Reply Signal	Fixed (320 ms)
Common	Common Interrogation Signal	Individual Reply Signal	Configurable (80–640 ms)

A.6 Internal Watchdog

A mechanism exists within the Nano (independent to the main processor) that will carry out a controlled reset of the unit every 15 minutes. The Watchdog controller will also force a reset of the main processor after 15 seconds if it stops receiving a "tick" send by the main processor. These are referred to as hardware watchdogs and are designed to guarantee that the main processor will be recovered from any lock up condition. The hardware watchdog can be deferred by the main processor if it is busy with a task. The watchdog strategy in the Nano is to defer the watchdog when it occurs and then perform a controlled reset of the electronics at the next opportune moment (when no acoustics or serial traffic is present). The idea is to make the watchdog process as transparent as possible while minimising interruptions to serial or acoustic transactions.

Note

During the reset period of the Nano, it will not receive serial or acoustic communication for approximately two seconds.

After the watchdog period has expired, the Nano will look at one second intervals for an opportune moment to reset. If there is no such opportunity after a further 15 minutes then the reset will not be controlled and a hard reset will occur. The hard reset will interrupt serial or acoustic transactions and may revert power and gain settings to the last values stored, if these have been changed during deployment.

A.6.1 Hardware Reset and Start-Up

The Nano distinguishes between two types of reset mechanism. A cold start describes either a power on reset, a forced watchdog or a full reset triggered by the external host. A warm start is used to describe a reset that was triggered by the internal watchdog.

A.6.2 External Reset

A full reset can be triggered by an external host system by either sending a serial break to the serial port or by sending `UNLK<CR>` at 9600 baud. Both reset mechanisms are detected and actioned by a processor independent of the main acoustic / serial processor.

Note

The Nano requires the serial receive line to be asserted for a period of at least 50 ms in order to register a serial break event and subsequently trigger a full reset.

A.6.3 Cold Start

On a cold start, the configuration for the Nano is loaded from non-volatile memory. In addition, a PORT command response is output (at 9600 baud).

An example of a PORT response is as follows:

```
>PORT:2010,P0;BR9600;CF0;RS232
```

Note

The PORT response sent on a cold start is always serially transmitted at 9600 baud regardless of the configured baud rate of the serial port. This allows a method of determining the baud rate when it is unknown.

Definitions

Term	Definition
6G®	Sonardyne's sixth generation technology hardware platform.
AvTrak	Acoustic navigation and communications instrument designed to form part of an integrated AUV tracking and navigation system.
DNV	International accredited registrar and classification society.
FS	Fixed Status
LED	Light Emitting Diode
NPL	Navigation Power Level
OEM	Original Equipment Manufacturer
Sonardyne	Sonardyne International Limited and its affiliates.
Sonardyne Wideband®2	6G transponders and transceivers use Sonardyne Wideband 2 ultra-wide bandwidth signals giving a faster and robust transmission of data, more precise ranging and mitigation from multipath in shallow water and amongst steel structures in deep-water.
TPL	Telemetry Power Level
UART	Universal Asynchronous Receiver/Transmitter
UID	Unit ID

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