UM-8008

USER MANUAL

FOR THE

TYPE 8008 REMOTE INCLINOMETER FOR COMPATT 5

ISSUE A

REVISION 0

IMPORTANT SAFETY INFORMATION OVERLEAF

Prepared by : D. J. Mould.

Authorised by : N D Street

Date of Issue : 27 June 2005

SONARDYNE INTERNATIONAL LIMITED
Blackbushe Business Park, Yateley, Hampshire, GU46 6GD, United Kingdom
Tel: (0) 1252 872288 Fax : (0) 1252 876100 www.sonardyne.co.uk

Sonardyne
SOUND IN DEPTH

SAFETY

It is essential that all personnel involved in the operation and servicing of this product are familiar with the details below.

This product contains hazardous voltages and must only be opened by qualified service personnel. There are no operator adjustable components inside.

SUBSEA EQUIPMENT GENERAL OPERATIONAL & SAFETY PRECAUTIONS

Operators and Service personnel must be familiar with the information below.

Not all sections will apply to all instruments.

Additional information, if applicable, is included in the relevant sections of the product operating and maintenance manuals

CONTENTS

1. HAZARD APPRECIATION

Subsea equipment remains safe in use when operated and handled within standard operating procedures and written guidelines, therefore in normal operation little threat is posed to the safety of individuals or instruments. However all subsea units are capable of posing a threat to personnel safety, particularly when pressure housings become internally pressurised. Great care must be taken when this happens, or is even suspected to have happened, since the pressures present within the instrument are likely to be **extremely** high. Internal pressure problems may also be aggravated by unknown chemical hazards if battery breakdown has also occurred.

The following non-exhaustive list gives examples of typical hazardous situations:

- a pressure housing becomes internally pressurised by water pressure, following a leak
- a pressure housing becomes internally pressurised due to battery malfunction
- attempts are made to charge non-rechargeable battery packs/cells
- using an instrument outside its design parameters
- using an instrument beyond its load bearing limits
- failing to maintain the equipment can reduce its load bearing capability
- using unauthorised components or inferior parts in critical assemblies, e.g. release systems

2. GENERAL HANDLING OF EQUIPMENT

Do not allow instruments to be dropped or exposed to shock damage which can cause sensitive internal components to fail. Note that minor damage to metal finishes often creates burrs which can present a hazard to unprotected hands or other parts of the body. Control the local environment by preventing personnel stepping into the bight of haphazardly laid ropes or cables which are attached to a unit. Do not allow an instrument to block an access or impede normal traffic flows in a gangway or on a stairway.

Water tightness of instruments depends on fine surface finishes, accurate dimensional tolerances and cleanliness of components. Generally when dismantling equipment care should always be taken, the disassembly process should be carried out in a well-ventilated area with as few personnel in the vicinity as possible. Servicing must always be carried out by competent personnel with appropriate training.

3. DISMANTLING SUB-SEA EQUIPMENT

3.1 INTRODUCTION

All sub-sea equipment fitted with pressure housings are subject to a vast range of externally applied pressures and are susceptible to internal pressure rise if, for example, a leak occurs or the unit's battery destructs. Internal pressure presents a **potentially dangerous situation** and all appropriate **safety measures must be enforced**. Note that fumes given off by deteriorated batteries, particularly lithium based types, pose a health hazard. Apply precautions as appropriate to the circumstances prevailing at the time.

Note (1) that there is likely to be *no prior indication of the presence of internal pressure*, first indications being that the endcap(s) of the unit are being forced out of the housing under pressure during the dismantling process. Symptoms that indicate a higher risk of internal pressure include:

- Equipment that failed when deployed, in transit or storage
- Equipment stored for a long time with batteries connected
- Equipment having suffered physical damage.

Note (2) that when a unit has leaked it often behaves like a valve, i.e. water pressure causes a rise in internal pressure which cannot then escape because the point of leakage becomes sealed. Complete removal of an endcap's retaining mechanism means that it becomes unconstrained and therefore free to be discharged from its housing under high internal pressure - **an uncontrolled and potentially dangerous situation**.

DO NOT TRANSPORT EQUIPMENT WHICH IS INTERNALLY PRESSURED

The following precautions & procedures are recommended.

3.2 INSTRUMENTS FITTED WITH SPRUNG VENT PLUGS

Pressure Vent Plugs are fitted into all subsea equipment housings containing batteries and incorporate a red or green bung with dual O rings and a vent hole behind the second O ring. The vent plug is designed so that it can be partially withdrawn using a M4 screw to the point where its relief hole, positioned inboard of the second O ring, becomes open to atmosphere and thus allows internal pressure to dissipate. The vent plug cannot be totally removed (and forgotten) because of a retaining spring holding the red or green bung in place.

A normal unit may emit an audible rush of air when the vent plug is retracted, but it will typically only last for 1 second maximum. A longer rush of air/gas indicates a pressurised unit, in which case ventilate the area, and let the remaining pressure out of the unit. Internal pressure dissipates to atmosphere in a very short time and may be accompanied by water, debris, noise etc. Do not allow unnecessary personnel to enter the vicinity of the work or to be anywhere near dissipating gases and debris.

3.3 PRECAUTIONS (INSTRUMENT FULLY FUNCTIONING)

The techniques for retaining endcaps in the pressure housings differ from product to product, and detailed instructions on opening the pressure housing are given in the servicing section of the individual product manuals.

To ease dismantling and release any slight internal pressure that may have built up during normal operation, the vent plug should be operated as described in 3.2.

When removing the endcap it is recommended to stand to one side, and not inline. This will avoid potential injury if the endcap is ejected by any remaining internal pressure.

3.4 PRECAUTIONS (INSTRUMENT KNOWN OR SUSPECTED TO BE PRESSURISED)

If an instrument is known, or suspected to be internally pressurised through water ingress or battery venting additional precautions must be taken.

Remove the instrument to a well - ventilated location away from other working personnel.

If the housing is hot, indicating recent or current active internal chemical action, do not attempt to open. Lower overboard into water for several hours minimum or into a secure area away from all personnel. Do not attempt to dismantle until it has cooled.

Wear protective clothing, safety glasses and gloves, and refer to battery manufacturer's material safety data sheet (MSDS).

Release the safety vent as described in section 3.2. If there is no significant pressure dissipation and no fumes indicating a battery malfunction, the unit can be dismantled using the precautions described in section 3.3 and the relevant product servicing manual.

If there are any chemical fumes when the vent plug is released, or signs of deposit around the vent exterior, these are signs that the battery has vented due to water ingress or electronic/battery malfunction. In these circumstances the battery pack and internal electronics may have been severely damaged.

Take extreme care when removing the end cap, using any additional precautions detailed in the individual product manuals. There may be a possibility of some residual pressure remaining, within the housing, if during operation of the vent valve, it becomes blocked with the products of the internal chemical reaction.

When the battery is removed it should be covered with dry sand, or preferably sodium carbonate, or a mixture of 1:1 soda ash and slaked lime. It should be placed in an approved container (after cooling if necessary) and disposed in accordance with local regulations.

The electronics, end caps and pressure housings should be thoroughly hosed down

4. ELECTRONIC HAZARDS

4.1 HIGH VOLTAGES

WARNING

High Voltages

Operation of this equipment does not present any danger to users in normal use. If the internal electronics chassis is removed from it's housing for maintenance, the user should be aware that high voltages are present, particularly on the transmitter PCB and transducer.

Storage Capacitors

Note that subsea equipment incorporates capacitors which are capable of storing large quantities of electrical energy. Avoid inadvertent discharge during dismantling.

4.2 HANDLING OF ELECTRONIC COMPONENTS

Most of the circuits in subsea equipment use CMOS logic, which is easily damaged by static discharge or excessive supply voltage. The best handling for electronics is NO HANDLING. Field servicing cannot compare in efficiency and accuracy with the original factory calibration and therefore field servicing should be limited to checking correct calibration/operation (within the limits of the test gear available) and repair by exchange of PCB's or modules.

4.3 SAFETY PRECAUTIONS FOR LITHIUM BATTERIES

WARNING

Lithium based batteries become hazardous (fire and corrosion) if exposed to air and water. If damaged they may also emit **thionyl chloride**. Consult battery manufacturer's Material Safety Data Sheets (MSDS) prior to operating lithium based battery products.

Additional information applicable to lithium cells (model LSH20) is available from:

SAFT Ltd
River Drive
South Shields
TYNE AND WEAR
NE33 2TR
UK

Tel: +44 (0) 191 456 1451
Web Site: www.saftbatteries.com

4.4 LITHIUM BASED BATTERIES, GENERAL

Special precautions and regulations apply to transport, handling and disposal of lithium based products.

Lithium batteries are powerful sources of electrical energy and should be handled with care to avoid short-circuiting.

Where a battery powered underwater instrument is suspected of flooding, extreme caution must be exercised in opening the instrument in case an internal pressure has developed, which might cause the components to fly apart, causing damage or injury. Release of cell contents within the pressure vessel is very unlikely to cause hazard but the following safety procedures should be followed.

4.5 LITHIUM BASED BATTERIES, STORAGE TEMPERATURE

Cells and batteries, and hence the whole Sonardyne instrument, should not be exposed to temperatures in excess of 70°C. Instruments should not be left on deck in strong sunlight such that they become hot to the touch.

Lithium battery packs should be stored at +20°C, and in a humidity-controlled atmosphere to prevent passivation developing, which can reduce actual operating life, and in extreme cases may cause the unit to malfunction once deployed.

Instruments should be cooled to normal room temperature or lower before being opened.

4.6 OPENING A LITHIUM POWERED INSTRUMENT

The normal procedure before opening any underwater instrument is to wash in fresh water, remove salt deposits and dry it. The instrument should only be opened in clean, well-ventilated, dry surroundings.

All **precautions outlined in paragraph 3.4 above** should be applied during dismantling processes if it is suspected that internal pressure is present.

4.7 FAULT PROCEDURES

If a cell or battery is shorted or starts to heat up, it should be disconnected from the transponder immediately and removed to the outdoors or to a well-ventilated area to cool down. Tongs, or a shovel, are recommended for this purpose. Once the temperature has dropped and it is deemed safe to do so, the cell or battery can be disposed of as below. Suitable protection clothing should be worn when handling suspect cells/batteries and if the skin has come into contact with the electrolyte, it should be washed thoroughly with water.

If a cell is ruptured, potentially flammable materials may be exposed.

WARNING

For Lithium battery packs, Class D fire extinguishers should be used. Water, CO2, Halon, dry chemical or foam extinguishers are not suitable.

4.8 DISPOSAL OF LITHIUM BASED BATTERIES

Cells and batteries in small quantities can be disposed of in a secured landfill. If a secured landfill is not immediately available then appropriate safety precautions should be taken to temporarily secure the items. Packaging suitable for the storage and transport of lithium cells/batteries must be used at all times when not installed in an instrument.

DO NOT DISPOSE OF LITHIUM BATTERIES IN A FIRE.

4.9 TRANSPORTING LITHIUM BASED PRODUCTS

The current regulations and information below is provided for guidance only. Note that data sheets concerning quantities of lithium per cell are available from cell manufactures and these may change without prior notice, therefore the quantities of lithium per battery pack cannot be verified by Sonardyne Ltd. When transporting lithium based products it is the operators responsibility to comply with local, national and international regulations in force at the time of transport.

By Road: ADR European Agreement concerning the International Carriage of Dangerous Good by Road Regulations.

By Sea: International Maritime Dangerous Goods Code

By Air: IATA Regulations UN 3090 and UN 3091

5. BATTERIES GENERAL

5.1 USE OF APPROPRIATE BATTERY TYPES

Sonardyne equipment uses a variety of battery types. In some instrument designs only one type of battery pack is authorised for use but others will accommodate NiCad rechargeable, alkaline or lithium based packs. Instruments must **NOT** be fitted with alternative battery pack types unless they are specifically designed to use them.

DO NOT FIT UNAUTHORISED BATTERY PACK TYPES INTO AN INSTRUMENT

NOTE THAT DAMAGE CAUSED BY USING BATTERY PACKS WHICH ARE NOT AUTHORISED OR ARE NOT CONSTRUCTED TO SONARDYNE'S BUILD STANDARDS INVALIDATES ANY WARRANTY

5.2 CHARGING OF BATTERIES IN SEALED CONTAINERS

Batteries/Cells may give off gases when recharged. As a general rule, sealed containers MUST be allowed to vent to atmosphere during the charging process.

Some instruments may be fitted with safety features which prevent the possibility of problems caused by gasses vented by batteries. Detailed charging procedures for the particular instrument should be carefully followed.

5.3 ATTEMPTING TO CHARGE NON-RECHARGEABLE BATTERY PACKS

DO NOT ATTEMPT TO CHARGE NON-RECHARGEABLE BATTERIES PACKS OR CELLS

All **PRIMARY BATTERIES**, i.e. alkaline-manganese dioxide, lithium-manganese dioxide, silver oxide, zinc air, zinc carbon and zinc chloride batteries are NOT designed to be charged.

Non-rechargeable cells exhibit a range of unpredictable characteristics if any attempt is made to charge them, **Very high pressures and temperatures** can occur in an instrument often some time after the attempt to charge them has terminated.

Attempts to charge a primary battery may lead to an imbalance within the cell potentially leading to gas generation and in extreme cases explosion.

Battery packs **MUST NOT** be reconfigured from one type to another, e.g. NiCad to alkaline or lithium. Alkaline or lithium cells may be inadvertently charged.

5.4 HANDLING OF USED BATTERIES

Batteries should not be discharged below their end point voltage. To do so can lead to internal corrosion and leakage of electrolyte in certain types of sulphur dioxide cells. Although there is very little gas to cause a pressure rise under these conditions, the electrolyte leakage will cause severe corrosion.

After recovering an instrument from the sea it should be opened, and the battery voltage(s) checked while still connected to see if above the end point voltage for that type of cell. Disconnect and mark as usable or not with date of disconnection noted both on the pack and in written records. Check the instrument for signs of corrosion, such as at solder joints, as a sign of any slight leakage.

The remaining life of a battery depends on both time and, for a transponder, the number of times it has been interrogated. Normally transponders keep their own record of battery usage, but users must maintain a separate record of time elapsed whilst battery is installed and connected, plus estimates of the number of interrogations.

5.5 RE-CONNECTING A PARTIALLY USED BATTERY

Calculate if the remaining battery life will allow your next mission to be safely accomplished. If so, note the date of re-connection, both on the battery label and in written records, against the serial number of the instrument.

5.6 FITTING A NEW BATTERY

Note the date it is connected and therefore starts to supply current. Write this date on the battery label and also in your written records.

5.7 BATTERY PACK FUSES

A number of Sonardyne battery packs have carefully selected, high-reliability fuses soldered onto the diode-board of the pack. These are "Littlefuse" devices. If you have blown a fuse due to mishandling, it may be replaced by an identical type, but the rating must not on any account be increased.

6. EQUIPMENT ENVIRONMENTAL LIMITATIONS

6.1 STORAGE TEMPERATURE LIMITS

Equipment may be stored at temperatures in the range -20 to + 60°C. It should be noted however that lines connecting pressure transducers to a transponder may become partly filled with seawater during service. This cannot easily be expelled and may therefore freeze if transponders are stored at sub-zero temperatures after recovery from the sea.

Spare battery packs should be stored at room temperature, in an environment with a controlled humidity level.

7. INSTRUMENT LOAD BEARING CAPABILITY

Navigational Transponders are NOT normally designed to take in-line loads greater than the maximum upthrust applied by the floatation equipment. The carrying straps, if fitted, are for ease of manual handling and the range of transducer guards selected for their acoustic properties.

The Safe Working Load (SWL) capability of the release mechanism, built into most instruments, can only be used for in-line lifting operations if a suitably - rated, approved, lifting strap, transducer guard, buoyancy collar eyes or other safe method is selected.

It is the operators responsibility to ensure the condition of the equipment and that a safe lifting method has been devised for any particular operation.

Sonardyne's range of Oceanographic Release Transponders have been designed specifically for in-line lifting operations.

Appropriate shackles must be used in release systems to ensure freedom from corrosion. It is important to note that instruments, their release mechanisms and shackles form part of an integrated and complete system.

8. FLOATATION EQUIPMENT

8.1 INTRODUCTION

Floatation equipment is fitted to subsea transponders in order to aid their recovery once a deployment is complete. A nett upthrust requirement is given in manuals and technical data for any particular instrument. The following guidelines are given to assist operators in their understanding of the general requirements.

8.2 MINIMUM NETT BUOYANCY OF FLOATS

Floats are described as having a minimum nett buoyancy in seawater and this is the figure quoted in Sonardyne Float Technical Data and by the float manufacturer. Total upthrust can be calculated by knowing this figure, e.g., a float with 30kgs nett buoyancy in sea water supporting a load with weight in sea water of 30kgs would result in neutral buoyancy, i.e. no nett upthrust.

8.3 FLOAT INSERTS

Float collar Inserts are used to allow floats of larger internal bore to be used with housings of nominal 6" diameter. The weight *in water* of an insert is usually slightly positive and this will be additional to the weight of the instrument being supported by the float. Two inserts will result in approximately 0.5kg reduction in nett upthrust.

8.4 NETT UPTHRUST

The difference between the nett buoyancy of the float and the total weight of an object, or objects, in water that it is supporting, e.g.

Nett Upthrust =

(Minimum nett buoyancy of the Float) - (the weight of the instrument + inserts in water)

e.g. 30 kgs - (11.2+ 0.5) kgs = 17.3 kgs nett upthrust

8.5 FLOAT STORAGE CONDITIONS

Special storage conditions are not called for if due care and attention is applied to a float. Floats are not hygroscopic and should not therefore be affected by moisture in air.

8.6 FLOAT OVER-PRESSURE

The maximum water depth quoted for a float must not be exceeded. Over-pressured floats are forced to absorb water and their weight in air thus increases. All floats should be weighed prior to use to check that they are maintaining their original manufactured weight.

9. DEFINITIONS OF VARIOUS LOADS AND LOADING TERMS

9.1 A STATIC LOAD

An unvarying long term load.

9.2 A DYNAMIC LOAD

A time varying load resulting from the motion and inertia of connected masses and forcing functions such as wave action on the vessel. This may include transient and steady state harmonically alternating loads.

9.3 MAXIMUM ULTIMATE STATIC LOAD OR BREAKING LOAD OR PARTING LOAD

The load that induces structural failure in one or more parts of the instrument causing the load to part with the release.

9.4 MAXIMUM PROOF STATIC LOAD OR MAXIMUM RATED STATIC LOAD

The maximum in-line static load the instrument can bear without suffering an unacceptable degree of permanent deformation. Ideally this should correspond with the load at which the maximum stress at any point in any component is the 0.2% proof stress for the material used in that component (in the condition that it is used).

9.5 SHOCK LOAD OR SNATCH LOAD

A time transient load generally caused by the sudden acceleration (positive or negative) of the load. Examples are the sudden snatch of a load off the deck or a sudden arrest of a load falling under gravity.

9.6 SAFE WORKING LOAD

A load set as a proportion of the Ultimate Static Load to allow for factors such as corrosion, fatigue, shock loads, harmonic loads, manufacturing defects, material defects etc. Various figures may be adopted according to the practise of the industry, risk to health and applicable legislation. Typical factors are $^1/_6$ to $^1/_3$ of the Ultimate Load.

9.7 PROOF LOAD

Normally a Load that is periodically applied to the load bearing device to demonstrate that it is still safe. Generally this is 2 times the Safe Working Load.

9.8 RELEASE LOAD

The maximum in-line load the instrument can withstand and successfully release without overloading any part of the release mechanism or demanding an unsupportable quantity of energy from the battery supply (at its specified end point).

10. IF IN DOUBT

Contact Sonardyne for advice.

Our telephone number is (UK) +44 (0) 1252 872288

Our facsimile number is (UK) +44 (0) 1252 876100

Our email address is **support@sonardyne.co.uk**

Sonardyne International Limited
Ocean House
Blackbushe Business Park
Yateley
Hampshire
GU46 6GD, England

AMENDMENT RECORD

All amendments and additions will be issued with a copy of this sheet, recording the history of amendments.

Revision	Date	Comments
1	26.10.96	Initial Issue
2	21.03.02	
3	19.04.02	CN 7167 Modified to allow transponders to be charged in a closed environment provided safety features are provided
4	14.03.03	CN 7699 Updated to ensure safety precautions cover more general equipment
5	24.02.04	CN 8104. Transportation regulations updated. Dismantling method removed and refers to unit manual. Carrying strap not to be used for mechanical lifting.

Authorised :

Date of Issue : 24 Feb. 2004

CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

AMENDMENT RECORD

All amendments and additions will be issued with a new copy of this sheet, recording the history of amendments.

Issue	Revision	Date	Comments	Section	Page
A	0	27/06/05	New	All	All

SECTION 1

1. INTRODUCTION

The type 8008 Remote Inclinometer is primarily intended for use with Sonardyne's family of Compatt 5 (Computing and Telemetering Transponders), taking power from the Compatt 5 and communicating with the Compatt 5 over a RS232 link.

The standard (8008-00-01) unit is in a hard anodized aluminium housing uses RS232 communications and only contains a dual axis 90° inclinometer. There are additional options for a range of high precision strain gauge pressure sensors, RS485 communications and housing material that allow partial customization for a customer's particular application.

1.1 PHYSICAL DESCRIPTION AND IDENTIFICATION

1.1.1 Standard Unit: Type 8008-000-01

The remote inclinometer only unit is a one-piece instrument, packed in a wooden case with cables and accessories. It is approximately 0.25 metre overall length and comprises a dark blue, hard-anodised pressure housing, protected by a yellow sleeve with a overall diameter of 135±2mm, and the base is a square of 140mm. The upper end is fitted with an orientation label which should be checked for alignment with the forward mark on the end cap. The lower end is a square end cap with faces at 90° to one another, in X Y and Z to allow easy alignment with a structure. The forward face (Plant North), is marked with a indentation. The pressure housing is secured to the end cap by a pair clamp rings held together by two bolts.

1.1.2 Inclinometer unit with pressure sensor: Type 8008-000-02

As for type 8008-000-01 but with a High Precision 3000m pressure sensor.

1.1.3 Housing Labelling

There a waterproof label on the housing, which uniquely identify the instrument by "Type Number", "Serial Number".

The housing label shows the following permanent information. For example:

TYPE No : 8008-000-01
SERIAL No : 212345-006
Configuration : I2 HP RS232
Depth Limit : 3000m

The **Type Number** is a four digit number beginning with an 8, (e.g. 8008).

The **Serial Number** uniquely identifies the unit and should be quoted in all communications with Sonardyne or agents to allow quick cross-referencing with production documentation.

The **Configuration** lists the sensors and features fitted to the end cap, selected from the following list:

I2 = dual-axis Inclinometer
HP = Hi-precision strain gauge Pressure sensor
232 = RS232 Comms
485 = RS485 Comms

The **Depth Limit** of the unit housing is marked on the housing label (default is 3000m). However, if a pressure sensor is fitted which has a depth limit less than the housing, then the limit shown will be that of the pressure sensor.

Sensor ranges: -

Depth Limit: This is the full-scale rating of the pressure sensor fitted. **Note:** Strain gauges can be over-pressured by 100% without damaging the sensor.

Inclinometer: The sensor fitted have a range of ±90°, however the AN7 command emulates a range of ±14.5°, ±90° or ±5° depending on the configuration of the Compatt 5 DAS card – ref. Appendix B and G.

Remote Inclinometer accessories: -

• Compatt 5 to remote Inclinometer Interlink cable assembly	8008-040	1 per system
• Serial Power cable assembly for Remote Inclinometer	8008-050	1 per system

1.2 FUNCTIONAL DESCRIPTION

1.2.1 Remote Inclinometer

The Remote Inclinometer unit is fitted with a pair or ±90° Inclinometers that are orthogonally mounted so as to indicate Pitch and Roll in the Sonardyne Bow Up Port Up convention.

The unit is powered from a Compatt 5 when used with a Compatt 5 and communicates with the Compatt 5 over a RS232 serial link.

Note:- The Remote Inclinometer may not be used with a Compatt 5 fitted with a Sound Speed sensor end cap as that sensor is connected to external sensor communications wires internally.

There is the option to have a High Precision pressure sensor fitted to the unit. As standard this would be a 300bar rated sensor so as to match the housing depth rating, however shallower options may be specified. To be able to use the Pressure sensor the Compatt 5 needs to be controlled from a 'Fusion transceiver' that is capable of sending the CSD command.

Alternatively the unit may be used as a stand alone unit powered by a 10V to 18V supply and using either RS232 or RS485 serial communications to a PC.

A 24V supply version can be supplied as an option.

1.3 MINIMUM SYSTEM REQUIREMENTS

1.3.1 8008-000-01 Remote Inclinometer Only

Not usable with Compatt 5's that are fitted with a Sound Speed sensor unless it is disconnected.

The Compatt 5 DAS Board must be fitted with firmware V3.04f or greater. To update the firmware requires C5Test Terminal, DAS Cal V2_00_006 or greater, and the new DAS firmware as supplied on a CD with this Manual, and test lead 8000-157 to install firmware.

Any Sonardyne transceiver capable of sending the AN7 command.

Any software that supports the AN7 command.

1.3.2 8008-000-02 Remote Inclinometer with Pressure Sensor

Not usable with Compatt 5's that are fitted with a Sound Speed sensor unless it is disconnected.

The Compatt 5 DAS Board must be fitted with firmware V3.04f or greater. To update the firmware requires C5Test Terminal, DAS Cal V2_00_006 or greater, and the new DAS firmware as supplied on a CD with this Manual, and test lead 8000-157 to install firmware.

The Compatt 5 main firmware must be V1.06a or greater, this requires a Sonardyne engineer to install by flash link.

A MF Sonardyne Fusion transceiver fitted with V8.01.00.00 that supports the Compatt Serial Data command in RPSK telemetry. RPSK telemetry is NOT supported by EHF Compatt 5, PAN, RovNav 4, ANT and LCU.

Software that supports MF Fusion transceivers fitted with V8.01.00.00.

1.4 BASIC DEPLOYMENT

Prior to deployment, a functional checkout should be made, as in Section 2.2.

SECTION 2

2. ROUTINE MAINTENANCE

To prolong the life of the unit, regular maintenance must be carried out, and a logbook kept covering deployments and running repairs which helps to identify potential problems.

2.1 INSPECTION AND EXTERNAL MAINTENANCE

Immediately after recovery from the sea, the unit should be washed in fresh water, paying particular attention to the clamp rings and connector. The items to be inspected include:

Housing : Check for damage to the anodising showing areas of exposed metal. If damaged, clean with a degreaser and treat with Alocrom for 2 minutes or until the aluminium goes golden brown, then wash off with water. Dry and cover the exposed metal with 2-part epoxy.

Vent Plug Check it is fully home and sits flush on the sensor end-cap.

Connector Check the contacts for signs of corrosion. Always fit the blanking plug supplied before deployment. Ensure the connectors are lubricated - the recommended lubricant is Molykote 44 Medium -but use sparingly. Half a match head dose per contact is adequate.

Anodes : Check there is sufficient zinc remaining. Clean with a nylon brush. Do not brush with a metal-wire brush as iron contamination of the zinc will impair cathodic protection.

2.2 FUNCTIONAL CHECK-OUT

2.2.1 Using RS232 Interface

These tests are carried out using the RS232 test cable 8008-050 shown in figure 6, connected to a PC or Laptop. There are functions available for reading back the sensors fitted to the Remote End Cap using the Remote Inclinometer Test Terminal (refer to Appendix B.3). The test software is also used to re-calibrate and test the sensors, and it automatically produces a test report for the sensors (refer to Appendix B.3). The results are stored in a text file in C:\Sonardyne\C5Status\ RemoteInclinometerLog.txt. Each time the software is run the set up is saved the log file is added to. In this way a history of the changes made is recorded in one file. Note that the Remote Inclinometer Calibration status is not changed by this method.

2.2.2 Acoustically

The unit can be tested acoustically on deck by using a suitable transceiver. If the unit has been checked out via RS232 to a PC (see above) then only a minimal amount of in-air acoustic testing is required.

Link the remote Inclinometer to the Compatt 5 using the link cable 8008-040.

ANT: place the ANT test loop around the middle of the transducer.

PAN: wrap the Test Loop 3-4 times around the middle of the transducer. A PAN Test Transducer can also be used (7145-251 PAN Test Transducer Interface Box + 7935-000 Test Transducer).

RovNav 5: Place the remote transducer close to the Compatt 5's transducer. In air select High power and High gain.

LCU: place the LCU transducer at an angle of about 45° to the Compatt 5 transducer, and get them as close as possible.

The following sequence of commands and interrogations will check the basic functions of a the Remote Inclinometer interfaced to a Compatt 5, and should be carried out before deployment, and after recovery but before storage.

RD nnn : Reset Default nnn = Compatt address. Sets IRF = channel number. Clears the override flag. . A letter 'J' in the reply indicates the tilt switch has closed, i.e. Compatt is tilted >45°. Enables interrogation mode to CIF.

EN : Enable interrogation replies and set the normal telemetry baud rate.

TW12 : Telemetry wait. Set the wait time for the telemetry reply to 12 seconds.

PL3 : PAN Power level. Select high power

PG3 : PAN Gain. Select High gain.

AN7 : Compatt external sensor pair measurement Command. Use to collect the Roll and Pitch voltage measurements, Roll first, Pitch second. Repeat with the unit vertical several times to check for stability problems, and tip in positive and negative direction in both axis to check function.

(DS) : Disable interrogation replies. This will not be necessary if this is a pre-deployment check. It is necessary if the unit is to be put in storage until the next job, to ensure it cannot be interrogated by background noise, and hence drain the battery too quickly, and also leave it in its lowest power state.

(CPA2) : Set high power transmission level, prior to deployment, to ensure maximum command reply range.

2.3 SENSOR RECALIBRATION

The remote Inclinometer is fitted with a dual axis 90° as standard and can optionally be fitted with a high precision strain gauge depth sensor. Due to ageing effects, the sensor and/or the signal conditioning circuitry will need a regular service to maintain the calibration of the measurements, see Section 4.12 and 4.13 for details.

Sensor Type	**Recalibration Interval**
Depth (strain gauge)	1 year
Inclinometer	2 years

SECTION 3

3. DEPLOYMENT

Remote Inclinometers should be mounted in a position where easy access is available for connection of the Compatt 5 link cable 8008-040 or the Serial Power cable 8008-050 for use with a PC and a bench supply or 12V battery. The mounting location should also provide protection of the Remote inclinometer and Compatt 5 from impact from heavy items and welding splatter (especially for the link cable). See also recovery.

When installing the Remote Inclinometer it is essential that the orientation mark on the end cap is correctly aligned with Plant North. DO NOT rely upon the label on the housing as a absolute indication of forward as is it possible to fit the housing in any rotational orientation relative to the forward mark on the end cap.

The Mounted Roll and Pitch voltages should be recorded and converted to angles for use as offsets in the operation control software such as Pharos, with the structure at a known inclination. This may not be possible if the structure is laying on it's side especially if the Compatt 5 is set to use either the 14.5° or 5° telemetry scaling. To facilitate collecting the mounting offsets with out a Compatt 5 a Laptop PC running the Remote Inclinometer Test Terminal may be used, with the unit powered from a 12V supply and connected via the cable 8008-050.

3.1 LONG TERM DEPLOYMENTS

Do not paint the zinc anodes.

3.2 RECOVERY PLANNING

Before deployment, consider the likely recovery procedure. Recovery using ROV manipulators or grappling with boat hooks can easily result in damage to the Compatt 5 transducer and the Link cable. For ROV handling the unit may need to secured to the structure using ROV friendly clamps, and the link cable installed such a way that it does not need to be cut by the ROV to allow removal of the Compatt 5 and Remote inclinometer as a complete assembly.

3.3 RECOVERY FROM THE SEA

The Compatt 5 and remote inclinometer should be immediately washed with fresh water and inspected, as described in section 2.1, before storage or re-deployment.

SECTION 4

4. SERVICING

4.1 RECOMMENDED TOOL KIT

- Compatt 5 opening tool (order code 641-3332)
- Vaseline petroleum jelly
- Molykote 44 (order code 120-101B)
- Metric Allen keys (hex keys)
- Earthing wrist strap

4.2 DISMANTLING

WARNINGS:

There are no operator adjustable components inside.

Service personnel must be familiar with the Safety Information at the beginning of this manual.

If the unit fails to respond, it may indicate a hazardous condition such as a pressurised housing due to water ingress and/or battery failure. Proceed with caution and refer to the Safety Precautions contained within this document

Before working on the unit ensure the handling precautions for CMOS and circuit boards listed in Appendix F have been observed.

IMPORTANT: Using a M4 screw, pull the green vent plug out 1cm from its seat on the sensor end cap, until the second O ring is visible. This will allow the internal pressure to equalise with atmospheric pressure. If the pressure takes longer than 1 second to equalise, the housing may have been pressurised due to a faulty battery pack, in which case let the pressure escape fully, then proceed with extreme caution. Refer to the Safety Notes at the front of this manual.

4.2.1 End-cap Removal if Remote Inclinometer is suspected of being internally pressurised

Place the unit in a ***safe working area***, preferably in the open air, do not leave unattended until all is safe.

Make the unit as safe as possible by restricting lower endcap travel as follows:

Using a rope tie the end cap and the housing of the instrument together, thus constraining endcap travel in the event of pressure discharge.

Stand alongside not in-line with the unit.

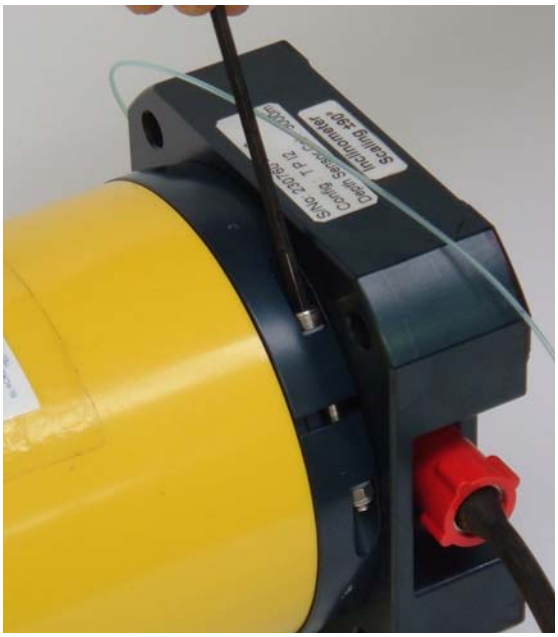
Using an Allen Key (hex key), slowly remove the two M5 hexagon socket head cap screws holding the clamp halves together on the end cap. The clamp ring will probably be difficult to remove, as internal pressure will be forcing the end-cap outwards, or grit inside the groove may be jamming the ring.

With one clamp ring removed, any internal pressure will probably cock the end-cap but it will be held in place by the second clamp ring. Full pressure relief may not have been achieved.

Removing the second clamp ring may result in a gas and/or liquid discharge. Refer to the **Safety Precautions** section.

4.3 END CAP REMOVAL

Using an Allen Key (hex key), remove the two M5 hexagon socket head cap screws holding the clamp halves together on the sensor end cap.



Remove the two clamp halves and clean around the grooves to remove any dirt or water from the grooves in the pressure housing and end cap.

Hold the end cap flange between the wrists and push against the clamp ring groove in the pressure housing to remove the sensor end cap. To overcome stiction, some form of blunt levers may be necessary. The Compatt 5 Opening Tool is available from Sonardyne.

Note 1: Do not use metal objects to prise the clamps apart as the hard anodised is easily damaged.

When the end cap has withdrawn about 1 cm, wipe around the exposed faces and also the 'O' ring bore seals to remove any water or dirt before exposing any of the electronic circuitry.

Note 2: A drop of water falling onto the live electronics can cause considerable damage.

Withdraw the end cap further until both 'O' rings are visible and wipe around the seals again. Once the second bore 'O' ring is visible, the pivoted sensor end cap must be supported from below, to avoid it falling and straining the ribbon connector.

Continue withdrawing the end cap from the pressure housing. As the assembly slides out, support the chassis but do not touch the printed circuit board.

Ensure that the earthing spring gaskets located in the grooves on the sensor end is not damaged during withdrawal.

Lay the complete end cap assembly on a clean dry surface.

4.4 DAS CIRCUIT BOARD REMOVAL

Cut the cable tie securing the cable to the white anchor pad on the PCB.

Disconnect the connector on the component side of the PCB.

Disconnect the connectors on the underside of the PCB.

Locate the four M3 anchor screws securing the PCB to the chassis.

Remove the anchor screws using a 2.5mm Allen key (hex key), and the four crinkle washers.

Remove the DAS PCB and place on a clean dry anti-static surface.

The DAS PCB contains all the sensor calibration information. Replacing the PCB will entail a full recalibration of the unit.

4.5 RE-ASSEMBLY

Prior to re-assembly, all the 'O' rings should be removed, cleaned and inspected for damage e.g. cuts or flats. Refer to Figure 5 for the 'O' ring removal technique. The 'O' ring grooves and tube bore should also be cleaned. The 'O' rings and tube bore should be re-greased with 'Vaseline' petroleum jelly or a specialist silicone grease (Molykote 44), to give a light, even spread. Ordinary grades of silicone grease tend to crystallise and are not recommended. Refit both bore 'O' rings to the end caps.

When fitting the housing to the end cap, ensure that the orientation of the housing is such that the forward indicating label on the housing has Forward aligned with the Forward mark on the end cap.

4.6 DAS CIRCUIT BOARD REPLACEMENT

Working on a clean dry surface.

Place the DAS PCB on the chassis.

Secure to the chassis using four M3 anchor screws and crinkle washers.

Note: The crinkle washers are required as they provide earthing for the board.

Tighten all the anchor screws evenly using a 2.5mm Allen key (hex key). Ensure the PCB is not distorted during tightening.

Connect the connectors on the underside of the PCB.

Connect the connector on the top of the PCB.

Secure the cable to the white anchor pad on the PCB using a cable tie.

4.7 END CAP ASSEMBLY REPLACEMENT IN PRESSURE HOUSING

Ensure the “O" rings have been fitted and are not damaged.

Check that the earthing spring gasket located in the groove on the sensor end cap is fitted and is not damaged.

Check the ‘O’ rings on the vent plug on the sensor end cap are clean, and the vent plug is fully home. Check also that no screw has been left fitted in the tapped hole.

On units with a pressure sensor check that the pin hole in the red pressure port plug is clear.

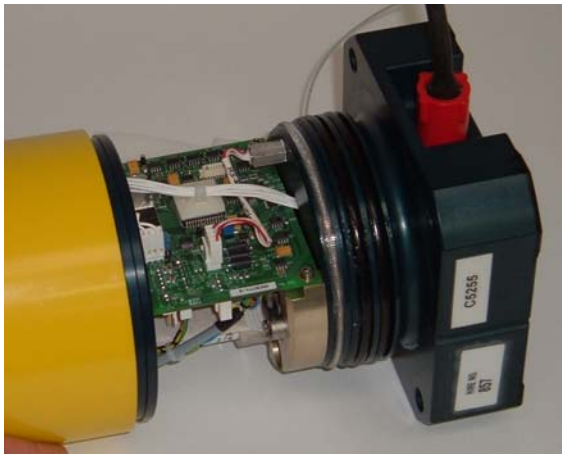
Place two dry silica gel bags over the DAS PCB.

Note: It is possible to measure the state of a silica gel bag by using a 500V Megger test, if the resistance is >50MΩ it is still dry.

During 2004 Sonardyne switched to fitting self-indicating silica gel bags. These start off orange when dry, and will change to green. REPLACE IF GREEN.

Ensure the clamp grooves on the pressure housing and sensor end cap are clean.

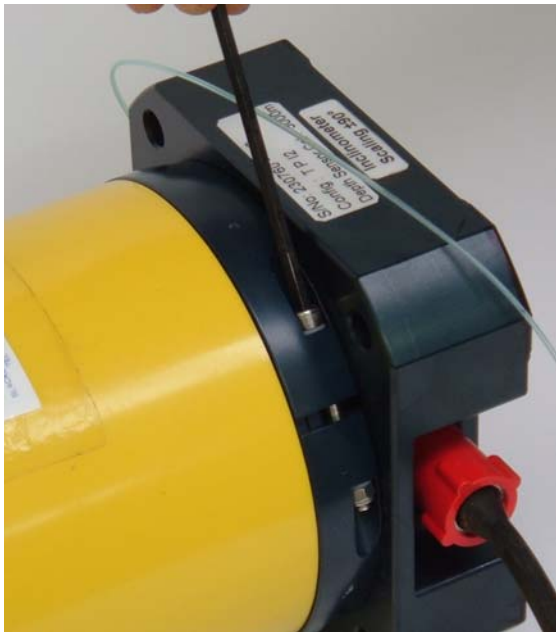
Offer the end cap assembly up to the pressure tube and slide into the tube. Take care not to knock the electronics against the housing. Check that any flying leads do not get trapped and the earthing spring gaskets are not damaged.



Fit the two clamp halves to the grooves ensuring they are evenly spaced.

Fit the two M5 hexagon socket head cap screws and Nyloc nuts that secure the clamp halves.

Using a 5mm Allen Key (hex key), tighten the clamp halves evenly.



4.8 EXTERNAL CONNECTORS

Lightly grease the external bulkhead connector, blanking plug and cable connectors with Molykote 44, prior to mating.

4.9 TESTING OF ASSEMBLED UNIT

The unit may be tested using the Remote Inclinometer test terminal or connected to a Compatt 5 and the functional check-list in Section 2.2 used to exercise the unit.

4.10 ELECTRONIC FAULT FINDING - POWER CHECKS AND ACOUSTIC SIGNAL TRACING

The following procedure will allow major faults to be located to board level. Board replacement is the recommended repair policy. The following checks and the waveform and timing diagrams give sufficient information to trace a fault to board level.

The test equipment assumed to be available comprises a voltmeter, an oscilloscope, an ANT, and a PC.

The unit should be out of its housing for these tests, refer to Section 4.3.

4.10.1 DAS DC Checks

Test points on 8000-059

TP98 and 99 are 0V points

TP16 is the incoming supply (after blocking diode)

TP3 is the 3V3 supply for the CPU

TP12 is the +12V supply to the inclinometers

TP13 is the -12V supply to the inclinometers

4.10.2 DAS Comms Check

The following checks cover the operations controlled from the DAS PCB.

TP4 and 5 are the comms lines

For RS232 TP5 is Tx and TP4 is Rx

For RS485 TP5 is the Y and TP4 the Z signal

On power up the comms can be monitored using a terminal at 9600,n,8,1 in ASCII format. The unit will output its basic information before going into its normal MODBUS commanded interface format.

Typical output:- 09:000003BC7B5D 8000-59-1-B2 235492-05 E00789-01 V3.00C<CR><LF>

4.11 STRAIN GAUGE PRESSURE SENSOR RECALIBRATION

End caps with the HP option are fitted with a High Precision Strain gauge pressure sensor.

Strain gauge sensors can alter their characteristics with time and usage, so recalibration is necessary. The frequency of recalibration depends on usage, but should be carried out at least annually. The largest error will be an offset rather than a span or scaling error.

To recalibrate the pressure sensor a calibrated Barometer and calibrated dead weight tester with an appropriate operating range are required.

During the calibration, it is possible to calibrate the sensor for best accuracy at a known working depth, by taking the span reading at a different pressure to the suggested pressure. This removes any non-linearity errors in the sensor, at the defined pressure.

The span calibration procedure requires use of the RemoteIclinometer.exe program to control the Compatt. Refer to Appendix B.3

4.12 INCLINOMETER SENSOR CHECK

The Inclinometers are fitted as a pair of inclinometers orthogonally mounted and are replaced as a pair should replacement be needed.

A bipolar supply is generated, nominally ±12V, and the sensors output a voltage of ±5V. The sensors are allowed about 7 seconds to settle after power-up before the readings are made. Further scaling is carried out in firmware, to generate the ±4.000V range returned by an AN7 command.

Calibration of the sensors requires specialist test equipment, and is recommended to be carried out every 24 months. Contact Sonardyne International Ltd for details.

SECTION 5

5. OPERATIONAL TROUBLE-SHOOTING

This section deals with various possible fault symptoms that may occur following a Remote Inclinometer deployment.

5.1 COMPATT DOES NOT REPLY TO AN7 COMMAND

Check all connectors between the Remote Inclinometer and the Compatt 5.

Is the Compatt set to work with a Remote Inclinometer?

Is the battery state good?

5.2 COMPATT DOES NOT REPLY TO ANY COMMAND

Is the correct Compatt address set in the surface transceiver?

If operating at long range, is the surface transceiver in high power?

Are ray-bending effects stopping the Compatt from receiving? The acoustic propagation of pulses travelling through a known velocity profile can be predicted using the PC based application software package "RAY_TRACE" available from Sonardyne.

A surface thermocline may be refracting the Compatt reply signals away from the surface transducer. Lower the transducer below the thermocline.

Is the noise level at the surface transducer too high? Lower the dunking transducer or towfish and/or reduce the PAN gain setting. Do a noise check by using the appropriate Transceiver Noise Check command (e.g. PAN command XRX, Rovnav RX) to see if any channels are validating on noise.

The Compatt may have a low battery voltage that reduces acoustic output power. Check the log for the battery voltage prior to deployment.

Surface currents may be streaming the surface transducer, such that it is directed away from the Compatt location. Adding 20kg ballast on a 1m strop from the transducer guard may reduce this.

If a low gain setting has been commanded, the unit may be unable to receiver further commands or interrogations. Wait for 3 minutes with no interrogations being made, then send the command CG4 to program high gain.

Other acoustic systems, e.g. free-running pingers, may be operating in the same frequency band. Check for signals validating by using the Noise Check command on the surface transceiver.

If operating in air, VDU emissions can cause interference

5.3 COMPATT REPLIES TO COMMANDS, BUT TELEMETRY ERRORS ARE DETECTED

Re-establish the telemetry baud rate by sending one of the baud rate setting commands.

The noise level at the surface transducer may be too high, see Section 5.1. Set the Compatt to high power telemetry transmission using the CPA2 command.

Other acoustic systems may be operating on the telemetry frequencies e.g. certain echo sounders on 33kHz.

The depth of the transceiver (especially PAN/Dunker or Towfish) may be such that a surface bounce of a previous pulse arrives in sync with a new incoming pulse. The interference causes poor telemetry reception and hence errors. The optimum depth for the Dunker is 27.0m, 29.5m, 34.5m or 37.0m.

5.4 COMPATT DOES NOT CHANGE STATUS

If commands are replied to but the status does not change, for example sending a Reset Default command is acknowledged but the reply shows the various parameters have not been changed. The Compatt may have had its STATUS LOCKED. The unit must first be commanded to the UNLOCKED state using the system software to drive the transceiver.

5.5 SONARDYNE EMERGENCY HELP-LINE TEL. + 44 (0) 1252 877600

Sonardyne run a 24-hour emergency help-line, where a call during office hours (08:30 - 17:00 UK time) will be answered on a priority basis. Outside of office hours, an agency will take your message and alert the appropriate Sonardyne person. The aim is to ensure that emergency requests are dealt with immediately during office hours, and responded to within 30 minutes at all other times. Alternatively, email us at **support@sonardyne.co.uk**.

SECTION 6

6. TECHNICAL SPECIFICATION: TYPE 8000 COMPATT 5

6.1 APPROVALS

CE LVD: EN 61010-1 : 2001

CE EMC: EN 60945 : 1997

This product complies with the requirements of the Low voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carries the CE marking accordingly.

6.2 SENSORS

6.2.1 Depth Measurement (Strain Gauge)

Span (options)	3000 m	1000m	500m
Resolution	0.75m	0.25m	0.12m
Accuracy	±0.3m	±0.1m	±0.05m

6.2.2 Inclinometer Measurement

Option 2 – Dual Axis High Accuracy Inclinometer

Resolution:	0.01°	(over the range ± 14.5°)	0.05°	(over the range ± 45°)
Accuracy:	±0.05°	(over the range ± 14.5°)	±0.2°	(over the range ± 45°)
Range:	± 90°	(refer to Appendix G)		

6.3 EXTERNAL POWER

The Remote inclinometer may be powered from a dc source in the range 10 to 18V.

An optional 24V input unit is available.

When used with a Compatt 5 the power is supplied by the Compatt 5 and will be in the range 10 to 15V depending upon the state of the battery pack in the Compatt 5.

At 15 V the unit typically draws 65mA

6.4 COMMUNICATIONS

Type RS-232 or RS-485
Baud Rate 9600, 8 data bits, 1 stop bit, no flow control, no parity.
Modbus format

6.5 ENVIRONMENTAL

Temperature:	Operation:	–5°C to +30°C
	Storage:	–20°C to +70°C

For storage of batteries, room temperature is recommended, and a controlled-humidity environment.

6.6 MECHANICAL

6.6.1 Standard Unit

Length:	243 mm	(9.57 ins)	
Diameter:	135 ± 2 mm	(5.3 ± 0.1 ins)	over plastic sleeve
Base:	140x140 mm	(5.51x5.51 ins)	
Weight in air:	6.4 kg	(14.1 lbs.)	
Weight in water:	3 kg	(6.6 lbs.)	

Max Operating Depth, 3000m - but may be limited by depth sensor (see Sensor End Cap label)

Inclinometer Endcap, refer to Fig 1 for dimensions.

6.7 CONNECTORS

Sensor Endcap connector Micro-Subconn MCBH8FAL

Mating Connector Micro-Subconn MCIL8M with locking sleeve MCDLS.

Connector Pin Allocations: See Figures 5 and 6.

FIGURES

FIG 1 OUTLINE DRAWING

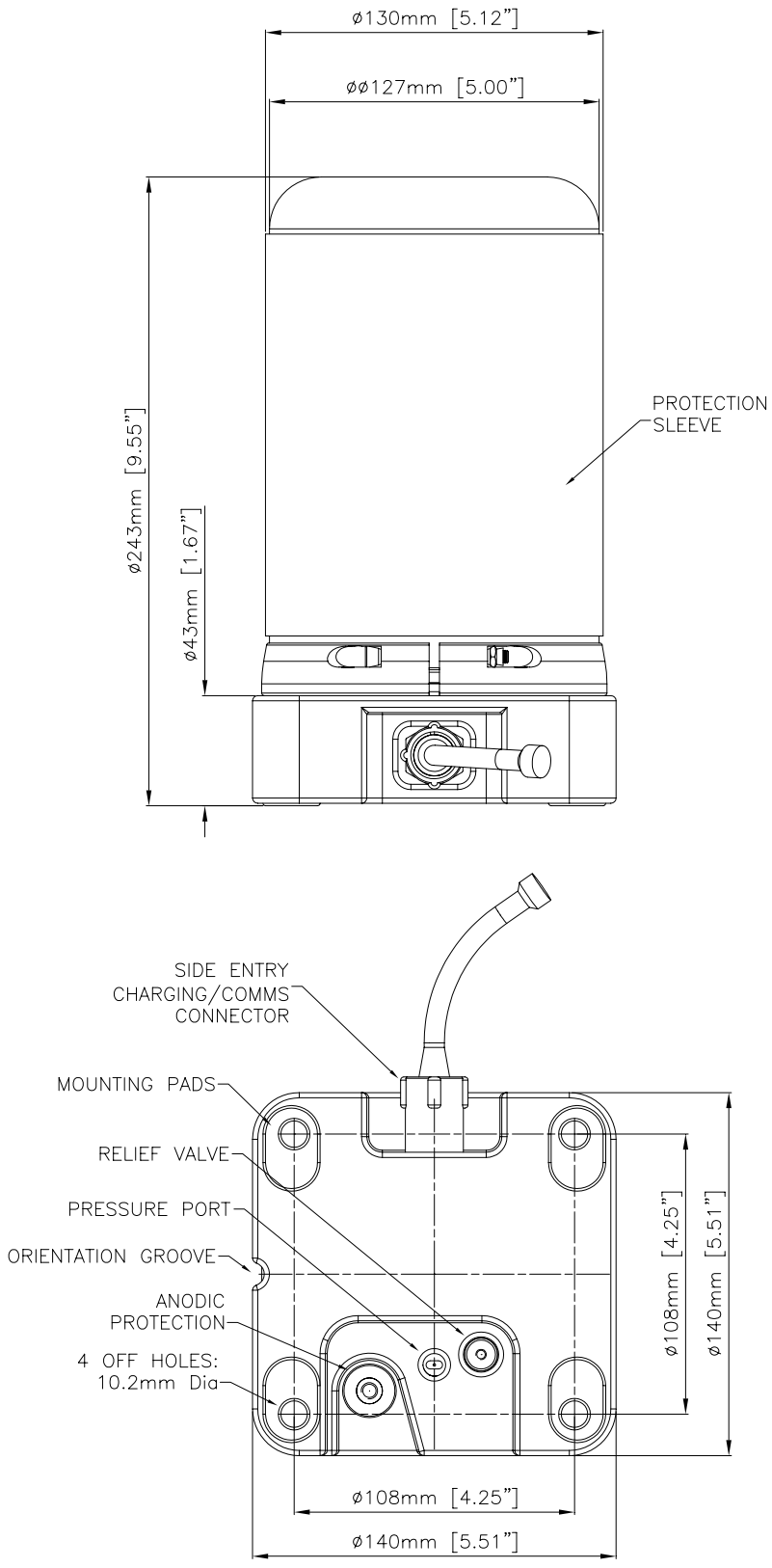
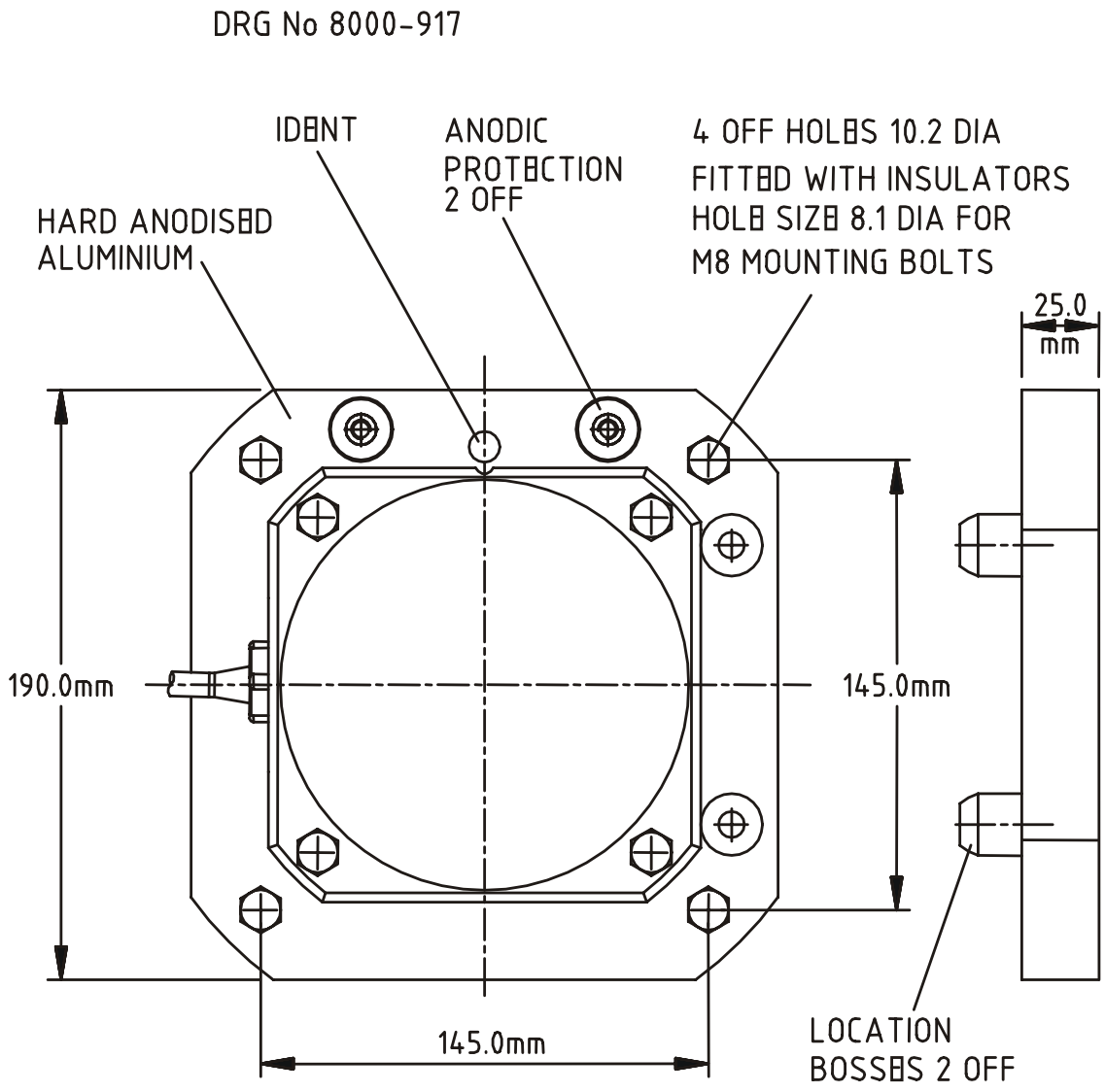


FIG 2 RECOMMENDED INCLINOMETER ENDCAP MOUNTING PLATE



Refer to Appendix G.

FIG 3 8000-059 REMOTE INCLINOMETER DAS BOARD – ISSUE B

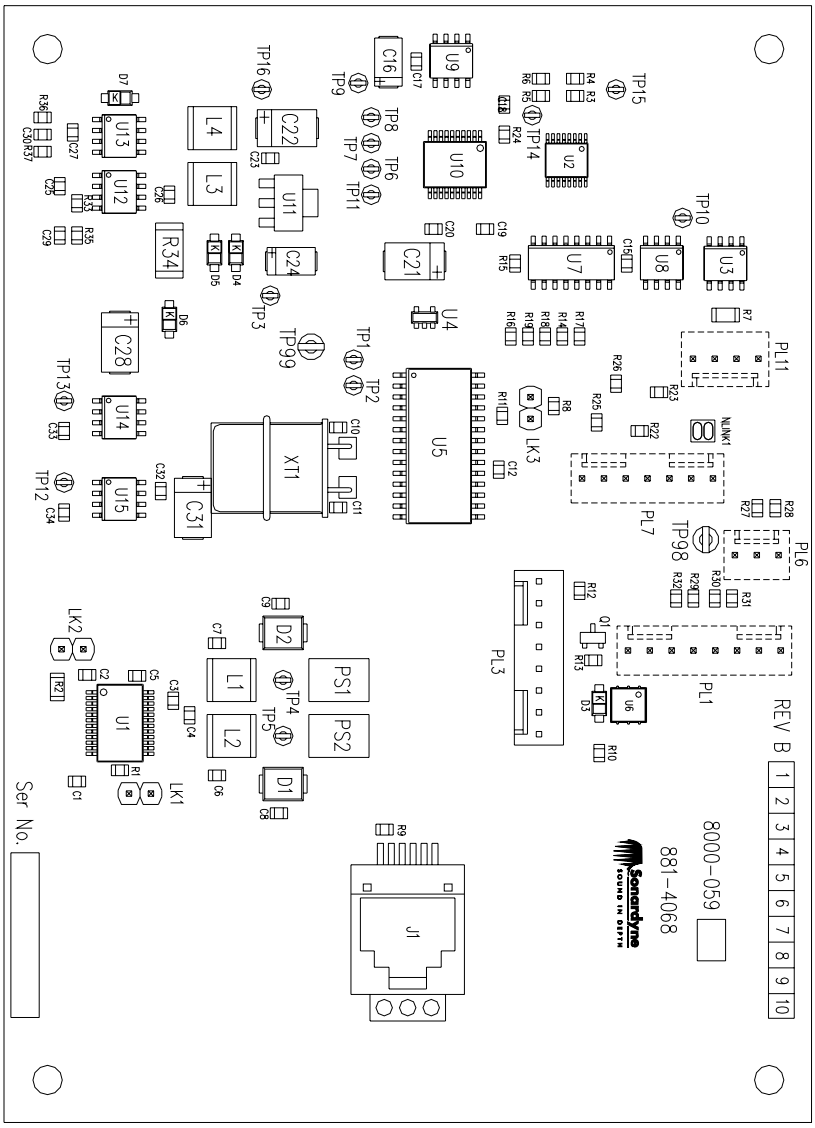


FIG 4 'O' RING REMOVAL

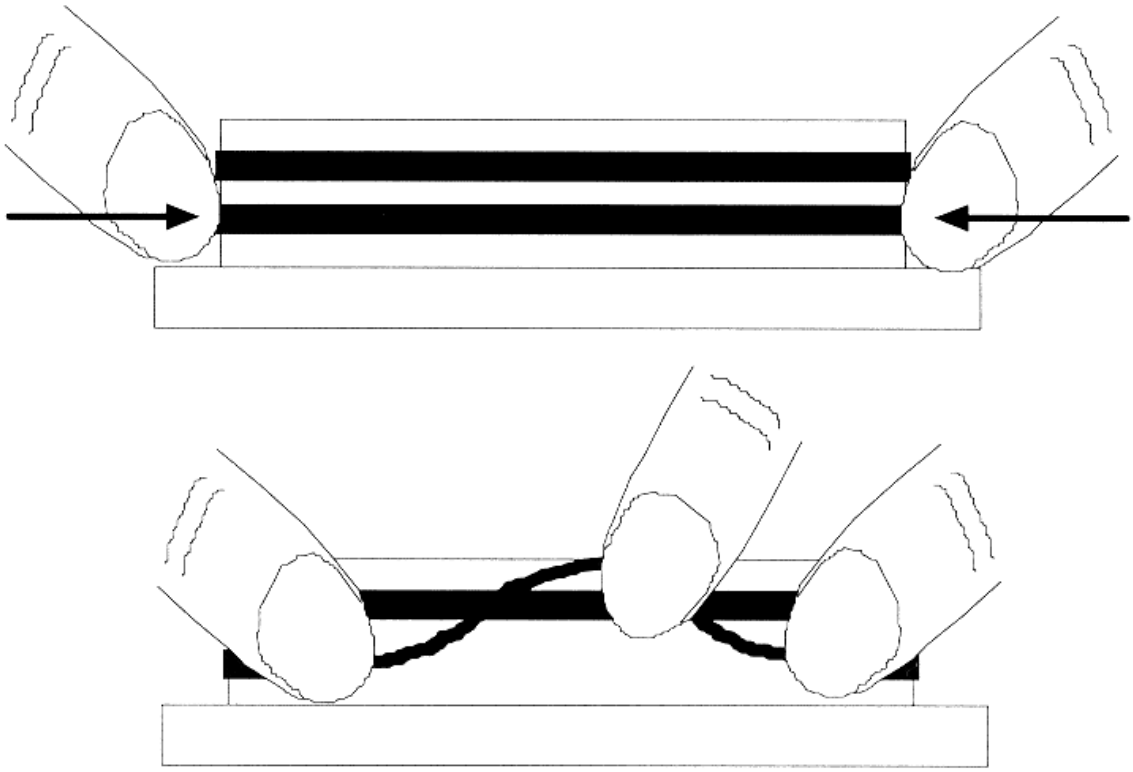
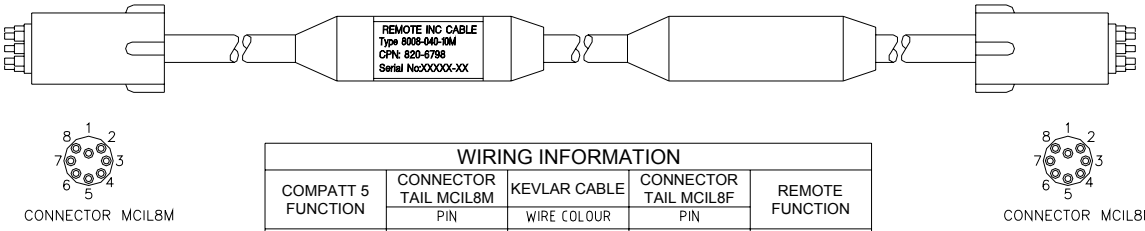


FIG 5 COMPATT 5 TO REMOTE INCLINOMETER INTERLINK CABLE: 8008-040

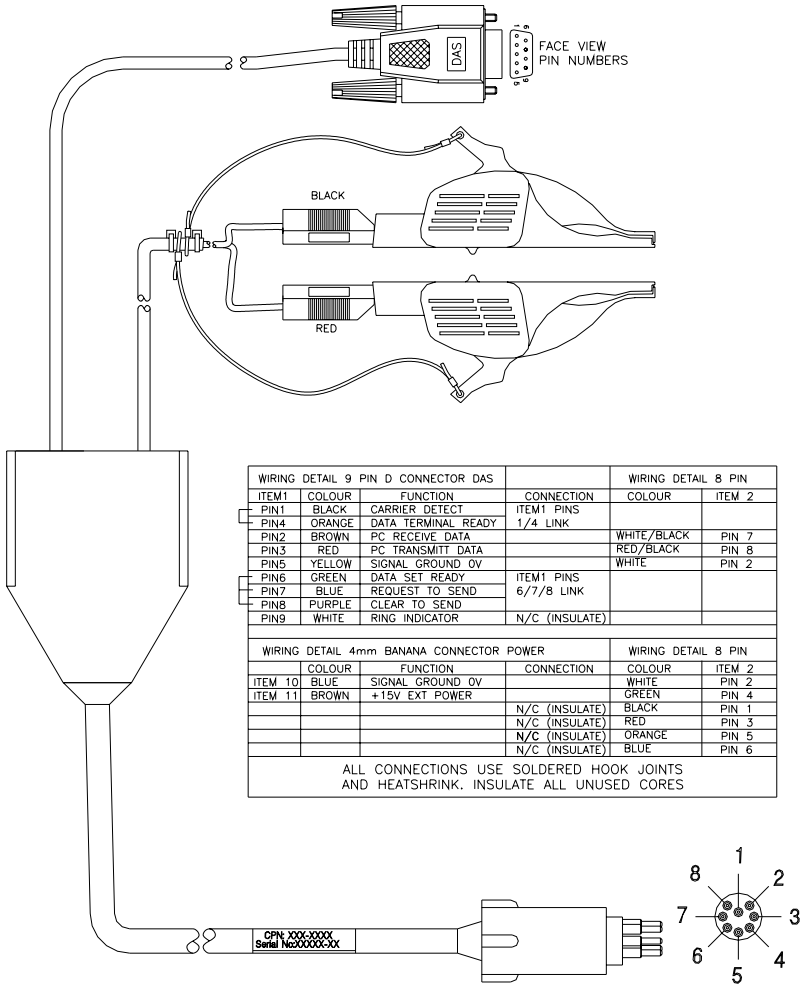


CONNECTOR MCIL8M

CONNECTOR MCIL8M

WIRING INFORMATION				
COMPATT 5 FUNCTION	CONNECTOR TAIL MCIL8M	KEVLAR CABLE	CONNECTOR TAIL MCIL8F	REMOTE FUNCTION
	PIN	WIRE COLOUR	PIN	
-	1	-N/C-	1	-
0v	2	BLACK	2	0v
-	3	-N/C-	3	-
DAS POWER IN	4	GREEN	4	REMOTE POWER IN
-	5	-N/C-	5	-
-	6	-N/C-	6	-
DAS RS232 IN	7	YELLOW	8	REMOTE RS232 IN
DAS RS232 OUT	8	WHITE	7	REMOTE RS232 OUT
CUT BACK AND INSULATE ALL UNUSED CORES.				

FIG 6 SERIAL POWER CABLE: 8008-050

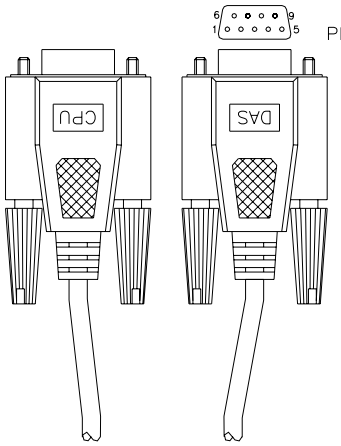


WIRING DETAIL 9 PIN D CONNECTOR DAS				WIRING DETAIL 8 PIN	
ITEM1	COLOUR	FUNCTION	CONNECTION	COLOUR	ITEM 2
PIN1	BLACK	CARRIER DETECT	ITEM1 PINS 1/4 LINK		
PIN4	ORANGE	DATA TERMINAL READY			
PIN2	BROWN	PC RECEIVE DATA		WHITE/BLACK	PIN 7
PIN3	RED	PC TRANSMITT DATA		RED/BLACK	PIN 8
PIN5	YELLOW	SIGNAL GROUND 0V		WHITE	PIN 2
PIN6	GREEN	DATA SET READY	ITEM1 PINS 6/7/8 LINK		
PIN7	BLUE	REQUEST TO SEND			
PIN8	PURPLE	CLEAR TO SEND			
PIN9	WHITE	RING INDICATOR	N/C (INSULATE)		

WIRING DETAIL 4mm BANANA CONNECTOR POWER				WIRING DETAIL 8 PIN	
	COLOUR	FUNCTION	CONNECTION	COLOUR	ITEM 2
ITEM 10	BLUE	SIGNAL GROUND 0V		WHITE	PIN 2
ITEM 11	BROWN	+15V EXT POWER		GREEN	PIN 4
			N/C (INSULATE)	BLACK	PIN 1
			N/C (INSULATE)	RED	PIN 3
			N/C (INSULATE)	ORANGE	PIN 5
			N/C (INSULATE)	BLUE	PIN 6

ALL CONNECTIONS USE SOLDERED HOOK JOINTS
AND HEATSHRINK. INSULATE ALL UNUSED CORES

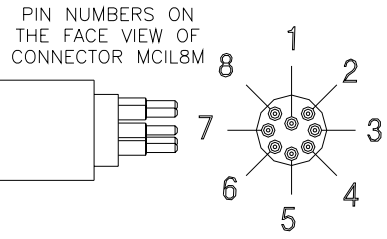
FIG 7 COMPATT 5 TO PC DUAL SERIAL CABLE: 8000-157



WIRING DETAIL 9 PIN D CONNECTOR DAS				WIRING DETAIL 8 PIN	
ITEM1	COLOUR	FUNCTION	CONNECTION	COLOUR	ITEM 2
PIN1	BLACK	CARRIER DETECT	ITEM1 PINS 1/4 LINK		
PIN4	ORANGE	DATA TERMINAL READY			
PIN2	BROWN	PC RECEIVE DATA		WHITE/BLACK	PIN 7
PIN3	RED	PC TRANSMITT DATA		RED/BLACK	PIN 8
PIN5	YELLOW	SIGNAL GROUND		WHITE	PIN 2
PIN6	GREEN	DATA SET READY	ITEM1 PINS 6/7/8 LINK		
PIN7	BLUE	REQUEST TO SEND			
PIN8	PURPLE	CLEAR TO SEND			
PIN9	WHITE	RING INDICATOR	N/C (INSULATE)		

WIRING DETAIL 9 PIN D CONNECTOR CPU				WIRING DETAIL 8 PIN	
ITEM1	COLOUR	FUNCTION	CONNECTION	COLOUR	ITEM 2
PIN1	BLACK	CARRIER DETECT	ITEM1 PINS 1/4 LINK		
PIN4	ORANGE	DATA TERMINAL READY			
PIN2	BROWN	PC RECEIVE DATA		RED	PIN 3
PIN3	RED	PC TRANSMITT DATA		BLACK	PIN 1
PIN5	YELLOW	SIGNAL GROUND		WHITE	PIN 2
PIN6	GREEN	DATA SET READY	ITEM1 PINS 6/7/8 LINK		
PIN7	BLUE	REQUEST TO SEND			
PIN8	PURPLE	CLEAR TO SEND			
PIN9	WHITE	RING INDICATOR	N/C (INSULATE)		
			N/C (INSULATE)	GREEN	PIN 4
			N/C (INSULATE)	ORANGE	PIN 5
			N/C (INSULATE)	BLUE	PIN 6

ALL CONNECTIONS USE SOLDERED HOOK JOINTS AND HEAT SHRINK
INSULATE ALL UNUSED CORES



EXTERNAL CONNECTOR PIN-OUT:

Pin Number	Function	Description
1	RS232 in	To Compatt 5 from PC
2	Ground	
3	RS232 out	From Compatt 5 to PC
4	External D.C. Power	External power will bypass the battery.
5	Analogue sensor input	Option: 0-5V or 4-20mA.
6	Sync	Trigger line
7	DAS RS232 out	From DAS to PC or Gyro
8	DAS RS232 in	To DAS from PC or Gyro

APPENDIX A

A. SPARE PARTS AND OPTIONS LIST

Order Code	Dwg No	Description	Qty per unit
PCBs			
631-7467	8000-059-01*	DAS PCB (* or similar depending on option required)	1
MISCELLANEOUS PARTS			
641-3332	-	Compatt 5 Opening Tool	1
860-2087	8000-116	Sacrificial Anode	1
650-2318	8000-008	Clamp ring pair kit (incl. nuts, screws, insulators)	1
810-1136	8000-111	Housing Sleeve Yellow	1
200-3455		Tube 'O' Rings, 100-345-5570	2
201-5140		Spring Gasket, 106LB-[MW]-4.005-2	1
925-0012		Silica Gel Bag – self-indicating	2
CABLES			
820-6795	8000-075	SubConn 8w mating connector 5m tail kit including locking sleeve	1
820-6798	8008-040	Compatt 5 to Remote Inclinometer Link cable	1
820-6804	8000-050	Serial Power cable assembly	1

APPENDIX B

B. USE OF UTILITIES SOFTWARE PROGRAMS

B.1 SOFTWARE INSTALLATION

The Compatt 5 Test Terminal, DASCAL and Remote Inclinometer programs described in this appendix are located on the CD supplied with this Manual, along with the latest version of the Compatt 5 DAS firmware.

To install the programs on a PC, first place the CD in the CD-ROM Drive, then view the contents of the CD. Copy and Paste all the files into a new directory on the C: drive.

For ease of operation, create shortcuts on the Desktop for the programs contained in the directory.

Note:- the CD may contain files that are not need for the Remote Inclinometer.

B.2 CONFIGURING COMPATT 5 FOR REMOTE INCLINOMETER

Compatt 5 Test Terminal is a general package that allows a Compatt to be configured and checked out.

DASCAL is specifically for configuring and recalibrating the sensor end-cap.

Remote Inclinometer Terminal is specifically for configuring and recalibrating the Remote Inclinometer sensor end-cap.

B.2.1 Test Equipment Required

Description	Sonardyne Drawing No	Sonardyne CPN
PC with 1 or 2 spare Comm Ports	-	-
8008 Utilities CD-ROM	-	-
Compatt 5 Dual Serial Cable	8000-157	820-6713
Serial Power cable Assembly	8008-050	820-6804

B.2.2 Test Equipment Set-Up

Connect the Test Equipment as shown in Fig B.1.

B.2.3 Compatt 5 Test Terminal Program Operation

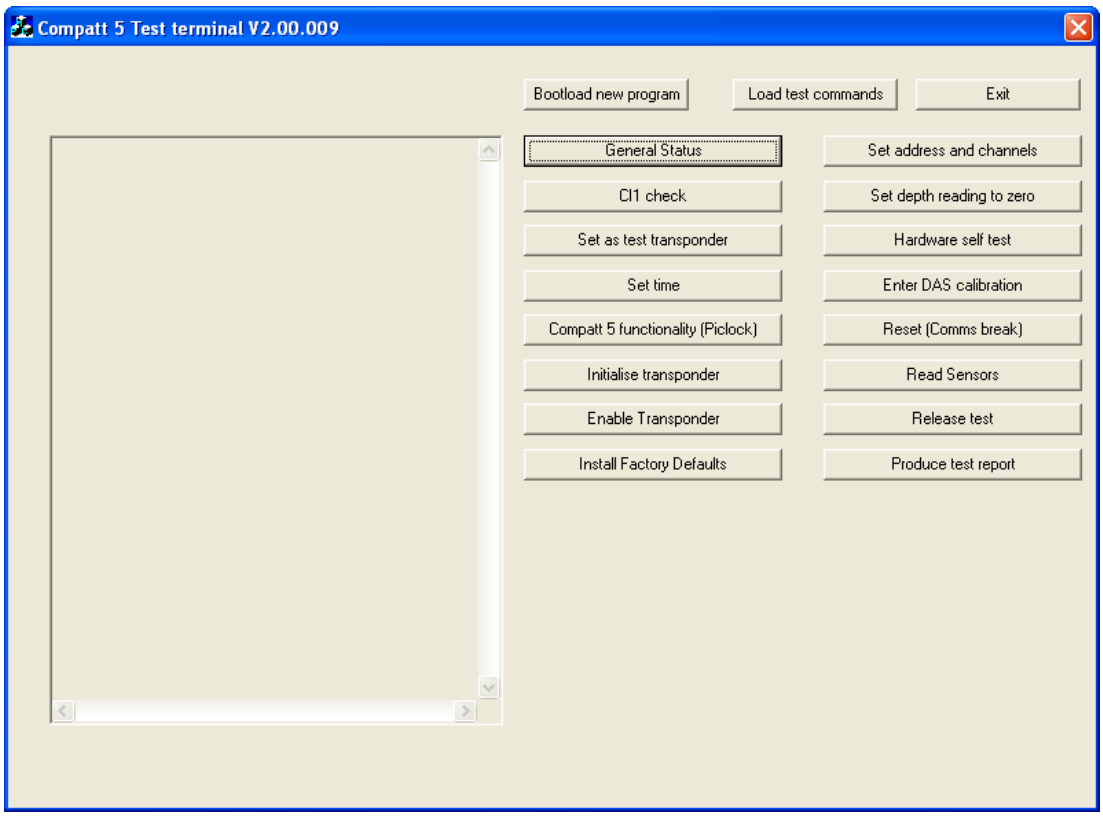
Run the Compatt 5 Test Terminal program from the **'Terminal'** icon placed on the **'Desktop'** of the PC.

The Test Terminal program is for basic tests and changes to the Compatt 5 address, channel and functionality.

This description applies to program version V2.00.009.

B.2.3.1 **Main Window**

On starting the Compatt 5 Test Terminal program, you will first be prompted to select a PC COMM port, then the Main Window is displayed as shown below. This COMM port will then be used until the program is shut down.



The functions on the '**Main Window'** are listed below with instructions for use.

The first time this program is run, a new directory will be created:-

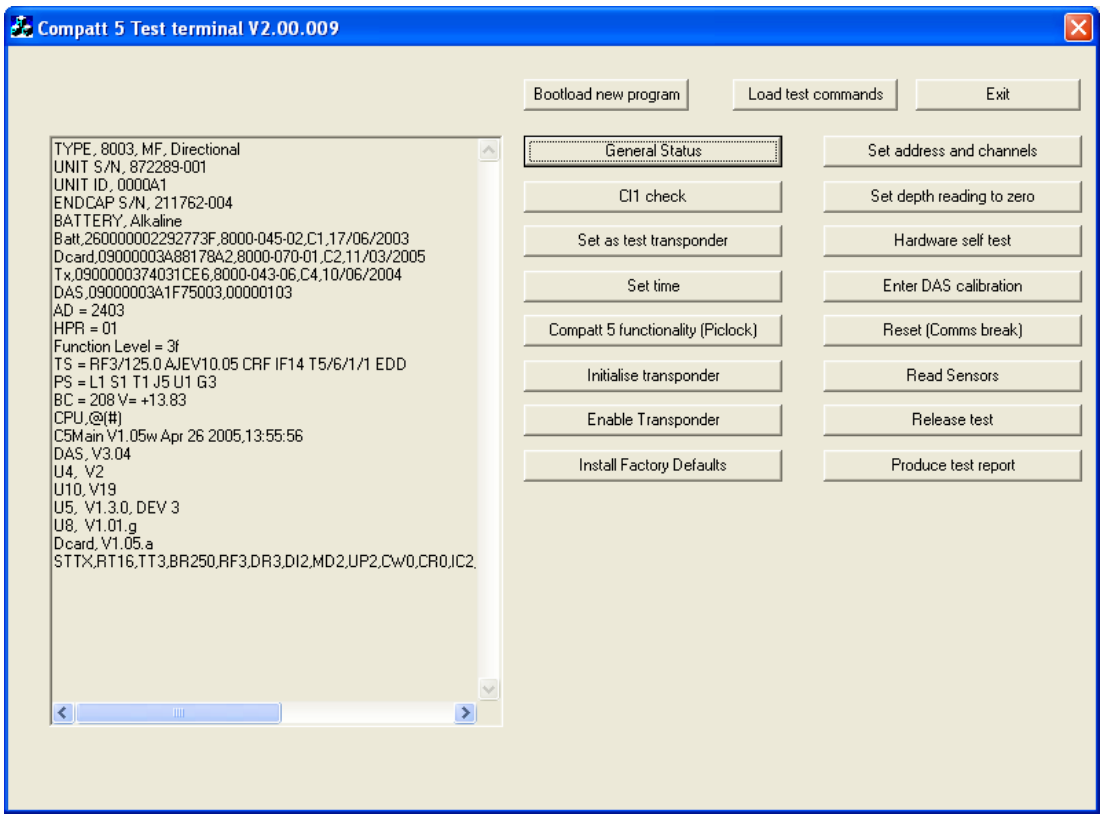
C:\Sonardyne\

Files containing status information for all Compatts will be stored in this directory.

B.2.3.2 General Status

This gets the general status information for the Compatt 5 and the display will be similar to that below

It is very useful if the contents of this window can be copied and pasted into any email correspondence with Sonardyne, as it contains a complete picture of the unit's current state.



The first time this program is run, a new file will be created:-

C:\Sonardyne\ Current-Status.xml

This file contains the status information for all Compatts, and will be updated every time the program is used to talk to a Compatt.

B.2.3.3 Enter DAS Calibration

This is used in conjunction with the DAS calibration software DASCAL and is described in Section B.2.4 of the manual.

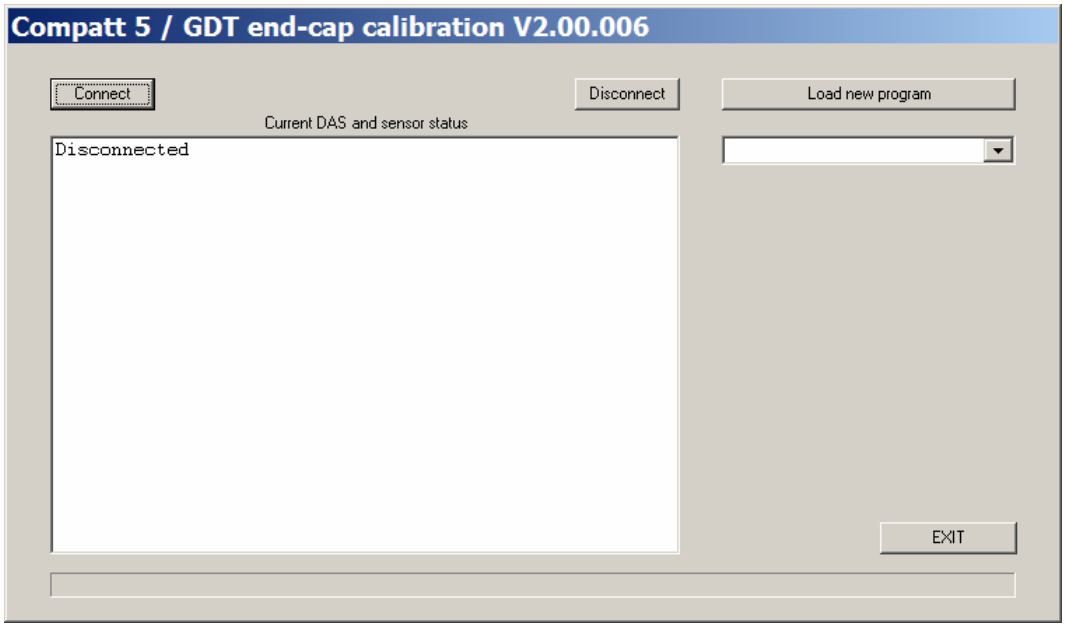
Click on the <**Enter DAS Calibration**> button. This will force the Compatt 5 to switch on power to the DAS. The message window should show the reply "DAS calibration mode entry".

Note: the watchdog will reset the whole unit after 10 minutes and abort any DAS measurement in progress at the time. Therefore, this calibration procedure must be completed in under 10 minutes, otherwise there will be an error message "Comms connection fault".

If the PC in use has multiple Com Ports leave the program running otherwise select **<Exit>.**

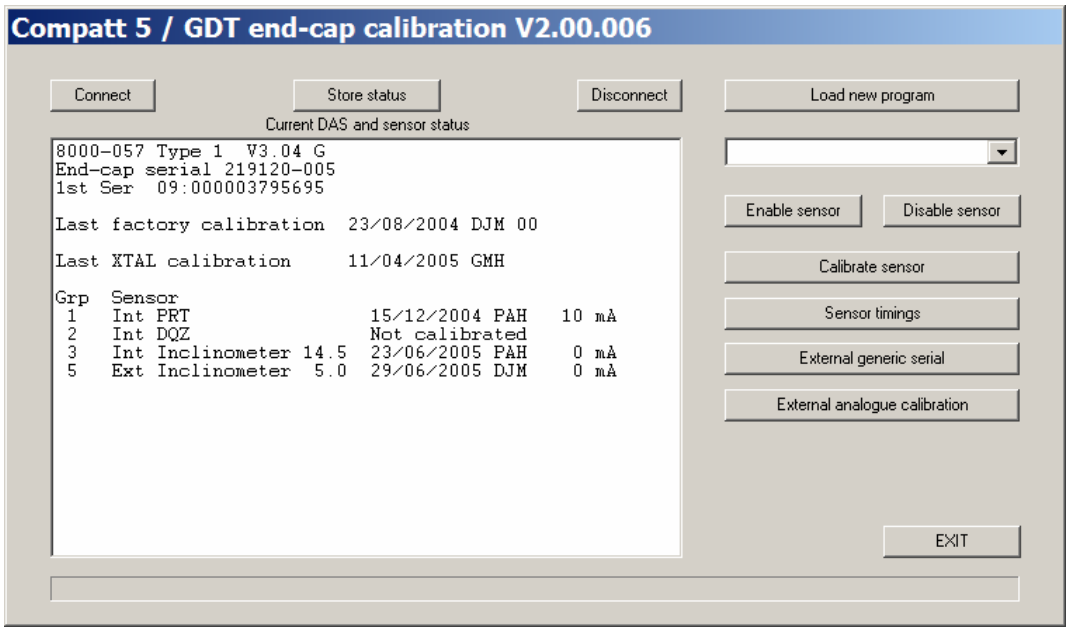
B.2.4 DASCAL Terminal Operation

Run the Dascal program from the **'Dascal'** icon placed on the **'Desktop'** of the PC. This description applies to program version 2.00.006**.**



Click on <**Connect**>. Select the comm port used by the PC, then click on **'Select'.**

After a short period of time, the Endcap Status will appear in the window as shown below:-



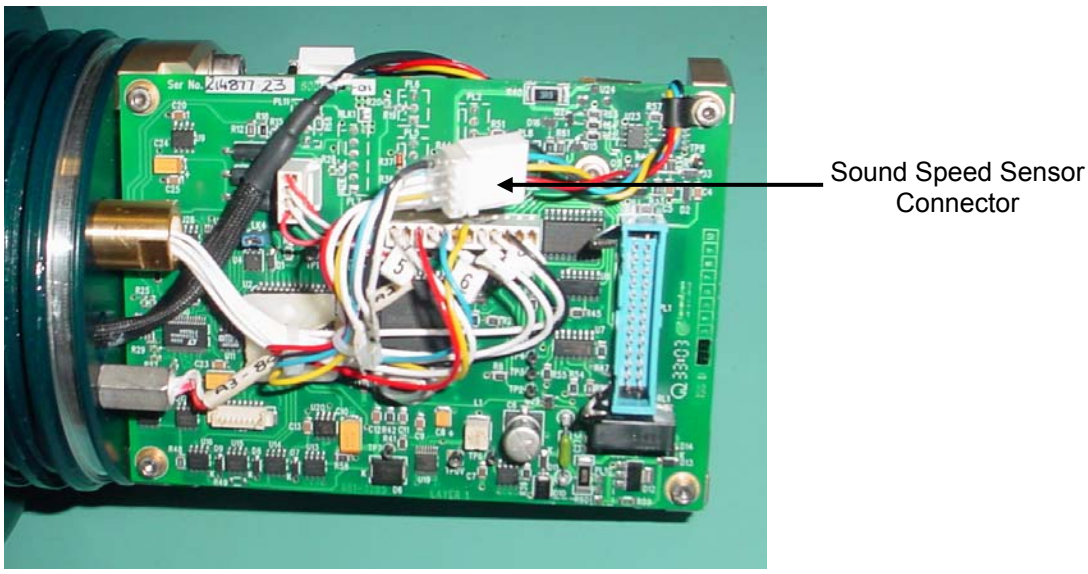
The display shows the DAS board type and the firmware version.

To be able to use a Remote Inclinometer the Compatt 5 DAS firmware must be V3.04f or greater.

Additionally the window also shows which sensors are enabled and calibrated. Sensors which are not calibrated show 'Not calibrated'. Sensors are selectable in groups and only one sensor from a group may be enabled at a time.

As the Remote Inclinometer is a device that uses the external serial comms connection it is a group 5 device and therefore would not be usable without first disabling the current group 5 sensor in the above example.

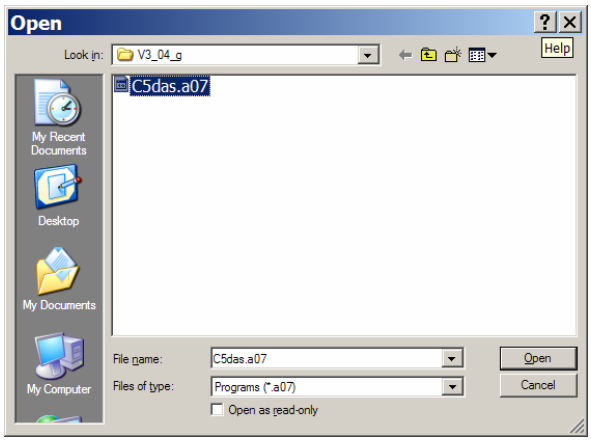
NOTE:- In the case of a Sound Speed sensor equipped Compatt 5 the Compatt 5 must be opened and the sensor disconnected, this is also needs to be done to be able to use Dascal reliably.



B.2.4.1 Boot loading Firmware

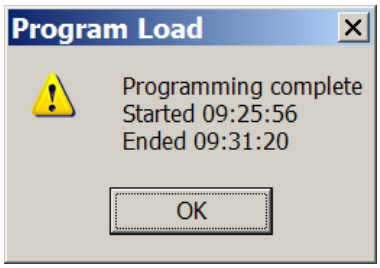
This operation takes approximately 6 minutes MUST NOT be interrupted in any way such as selecting a different program or a pop-up announcing the arrival of an e-mail.

Operate the ‘Load new program’ button and use the Open dialog to select the C5das.a07 file to be installed.

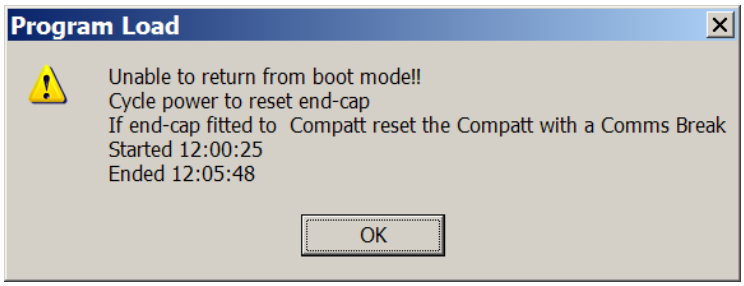


Pressing Open commences the programming.

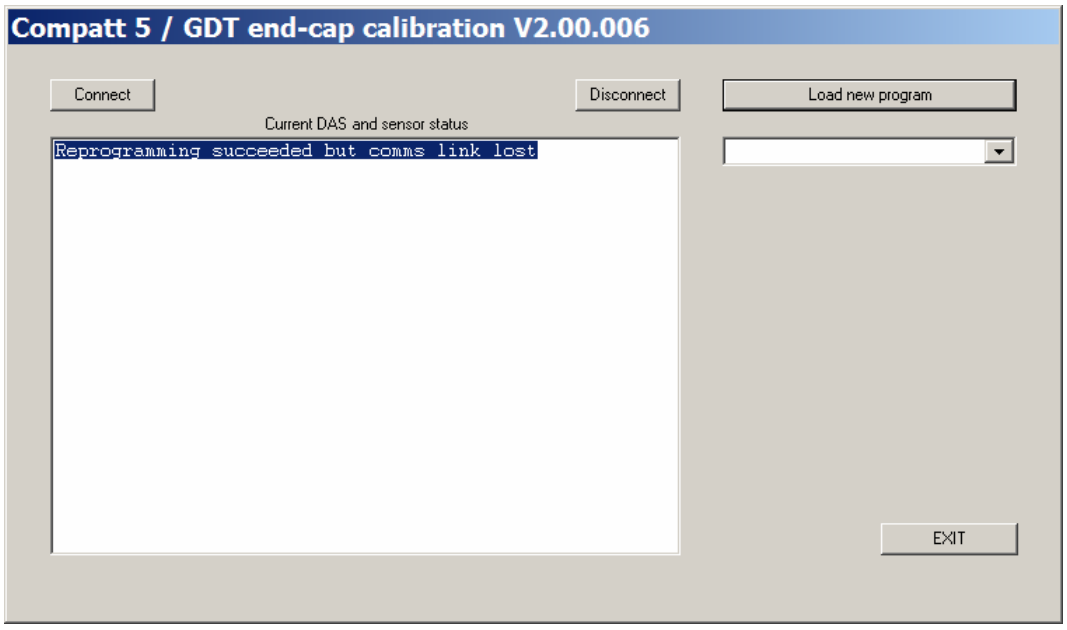
At the completion of programming the following is displayed:-



Pressing Ok results in:-

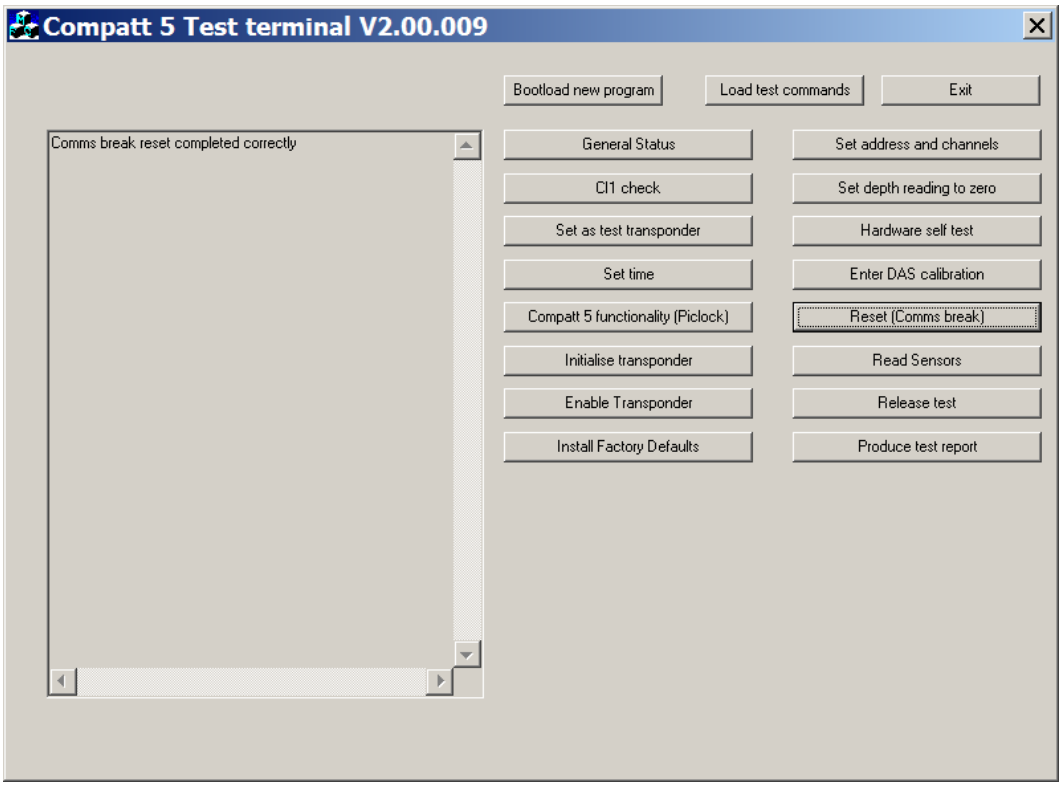


Pressing Ok results in:-



Use the <Exit> button to Close DasCal.

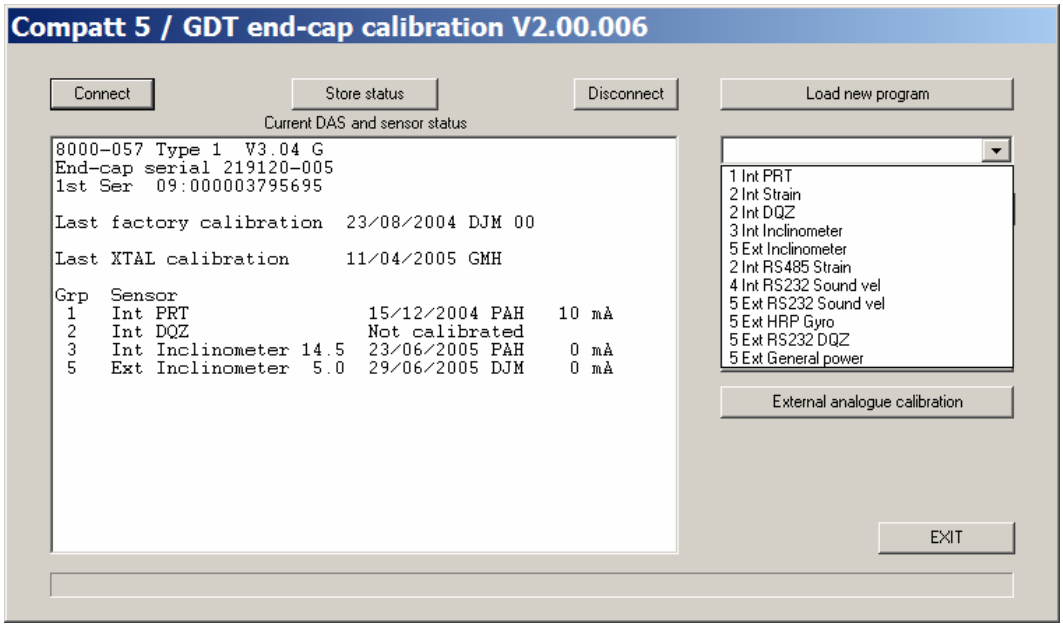
Return to Compatt 5 Test Terminal and use the <Reset (Comms break)> button the display should change to:-



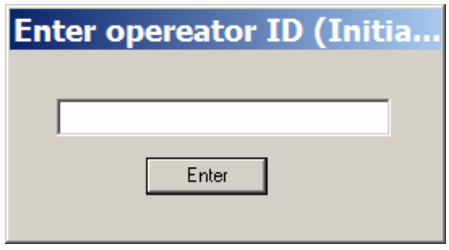
after approximately 30 seconds. If the Display appears after only a few seconds it is likely to show the message O2Boot, if this is the case repeat the use of the <Reset (Comms break)> Button until the above is displayed.

B.2.4.2 **Configuring DAS for Remote Inclinometer use.**

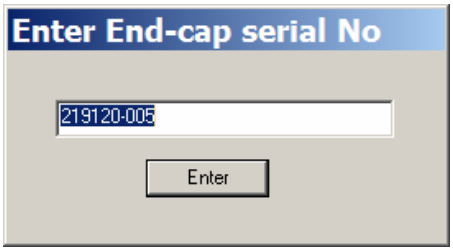
Select the sensor to be Enabled, Disabled or Calibrated from the drop down menu.



On operating any one of the <Enable sensor>, <Disable sensor> or <Calibrate sensor> buttons the following is displayed :-



Input your initials and press the <Enter> button. The next display requests the end cap serial number which should be correct as long as no board swapping has taken place.

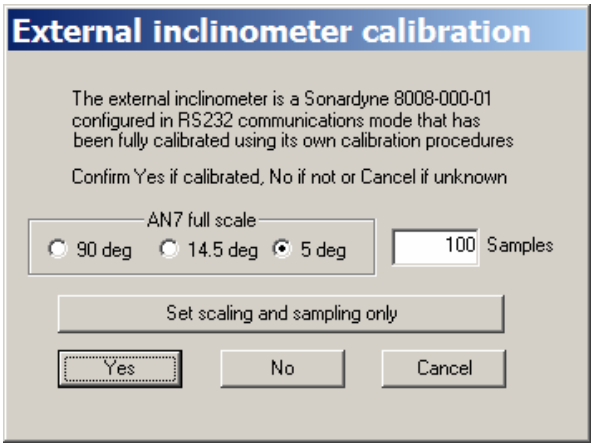


Change the serial number if necessary and the press the <Enter> button. This is the end of the process for the Enable sensor and Disable sensor options, the main display returns showing the new sensor selection.

NOTE:- In the case of external serial data sensors if a sensor of that type has previously been used with the end cap it will be shown as calibrated. Recalibration is recommended as the main display does not show all of the settable parameters.

Provided the terminal is not closed down the above two dialog will not be displayed again unless a different end cap is in use when the serial number will be recognised as being different.

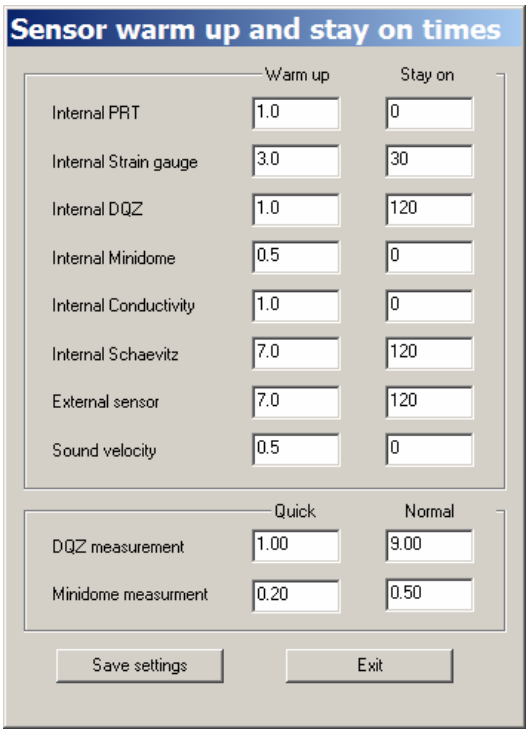
In the Case of choosing Ext Inclinometer from the drop down menu the following is displayed:-



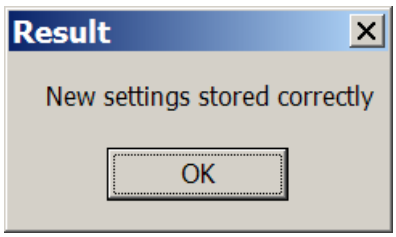
Set the telemetry scaling to be used by the Compatt and the number of samples the measurement is to be taken over. 100 samples represent a 1 second measurement. Where the object on which the remote inclinometer is installed is free from vibration then 100 samples is adequate, however if the object suffers from vibration such as a drill string then 400 samples are recommended. The value set will override the default value set in the Remote Inclinometer. Once the desired settings are ready to be applied press the <Yes> button. The main display returns and the Ext inclinometer will show the telemetry scaling, current date and the initials used above.

The Sensor timings also need to be set.

Operate the <Sensor timings> button if the terminal has been shut down the two dialog above will appear other wise the following will be displayed:-



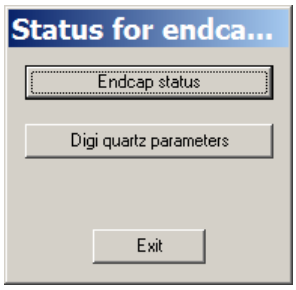
Set the External sensor values to match and use the <Save settings> button. Once the save is complete the following is displayed:-



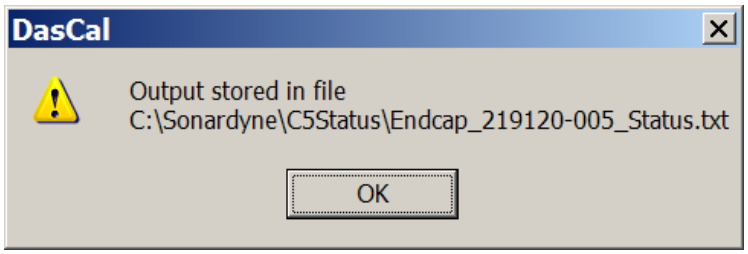
Operate the <OK> button and then the <Exit> button to return to the main display.

A results text file named **DasCalibration.txt** will have been generated and saved to C:\Sonardyne\C5Status. Each time a end cap is calibrated the file is added to.

If the <**Store Status**> button is selected the following is displayed:-



using the <Endcap status> button stores the contents of the 'Current DAS and sensor settings' window to an end cap specific file with a timestamp in the same directory.



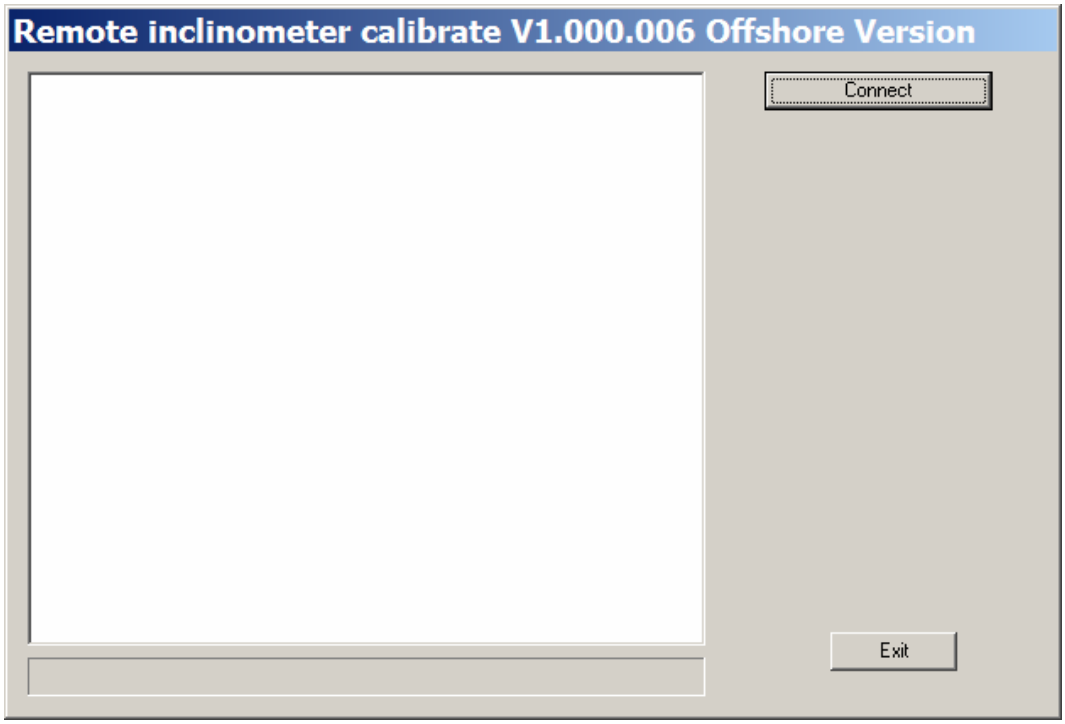
Select <**Disconnect**> and then <**Exit**>.

If the Compatt 5 Test Terminal is still connected it may also be exited from.

B.3 REMOTE INCLINOMETER TERMINAL

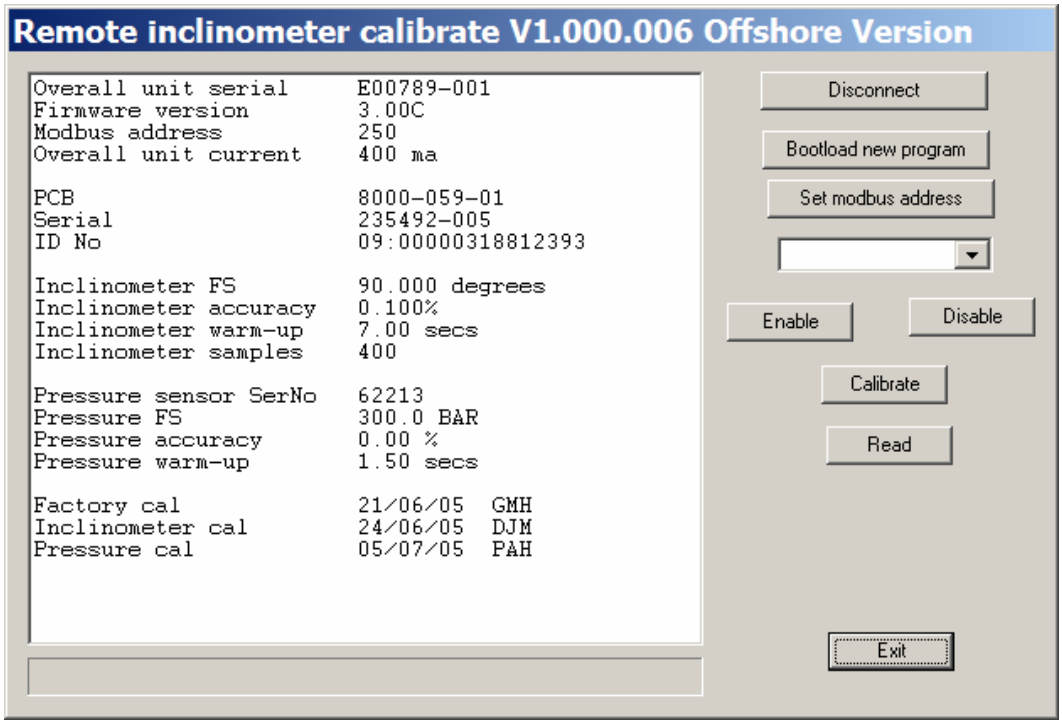
B.3.1 Connecting to the unit

Launch the Remote Inclinometer terminal from RemoteInclinometer.exe.



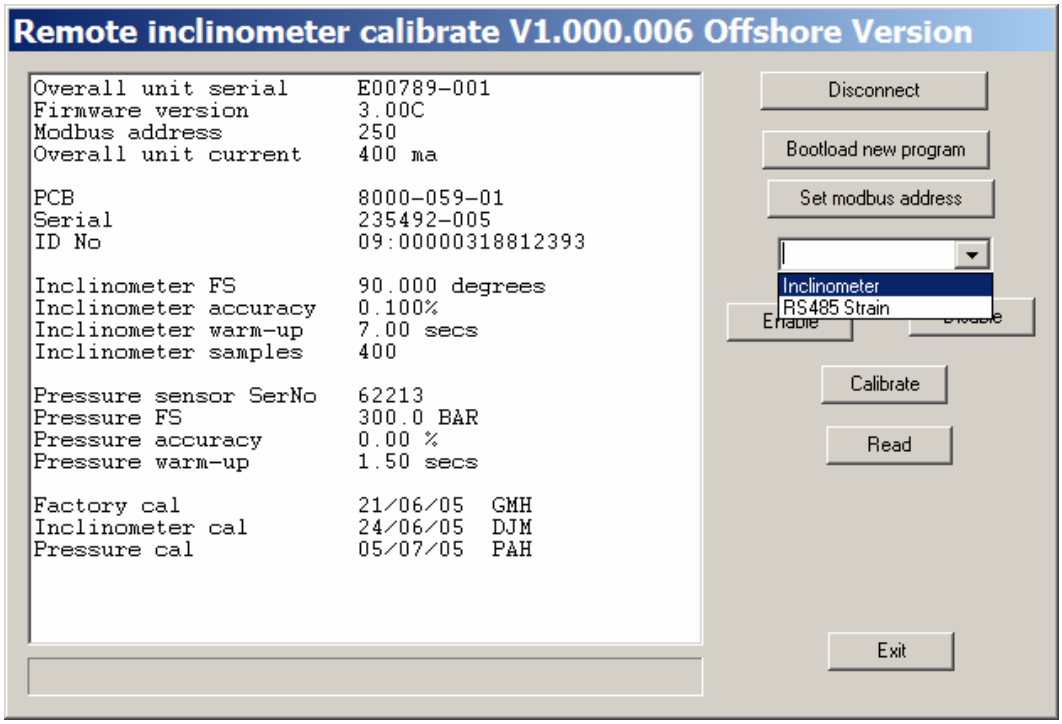
Operate <Connect> and set the Comm port to use

Once connected the current status of the unit is displayed.

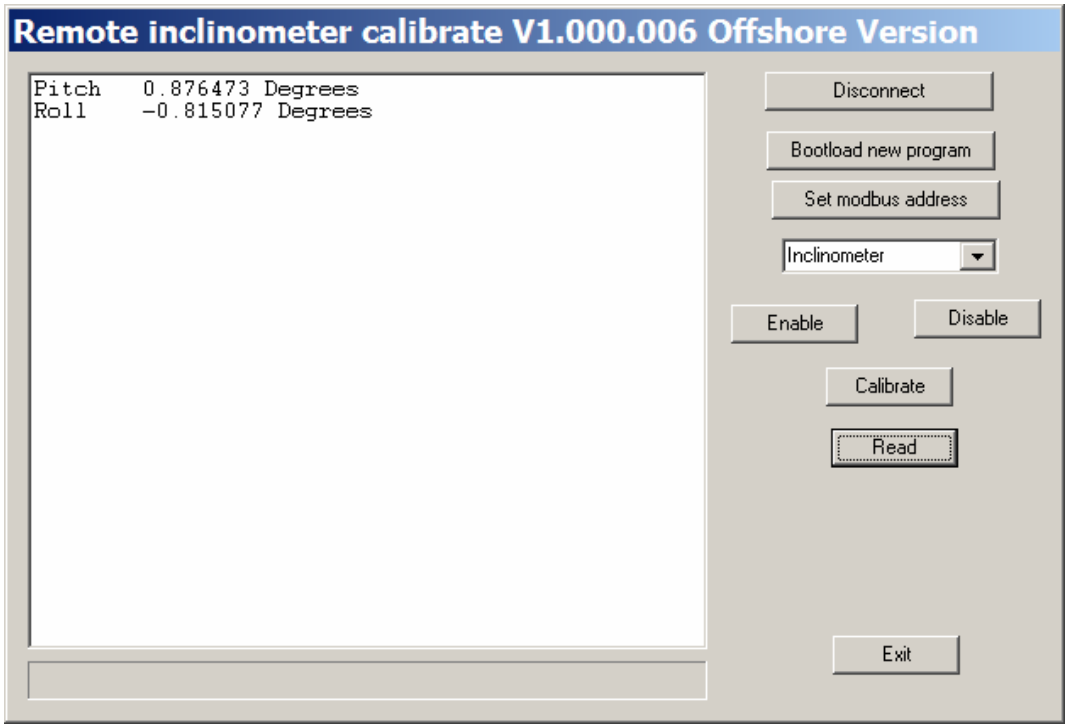


B.3.2 Reading the sensors

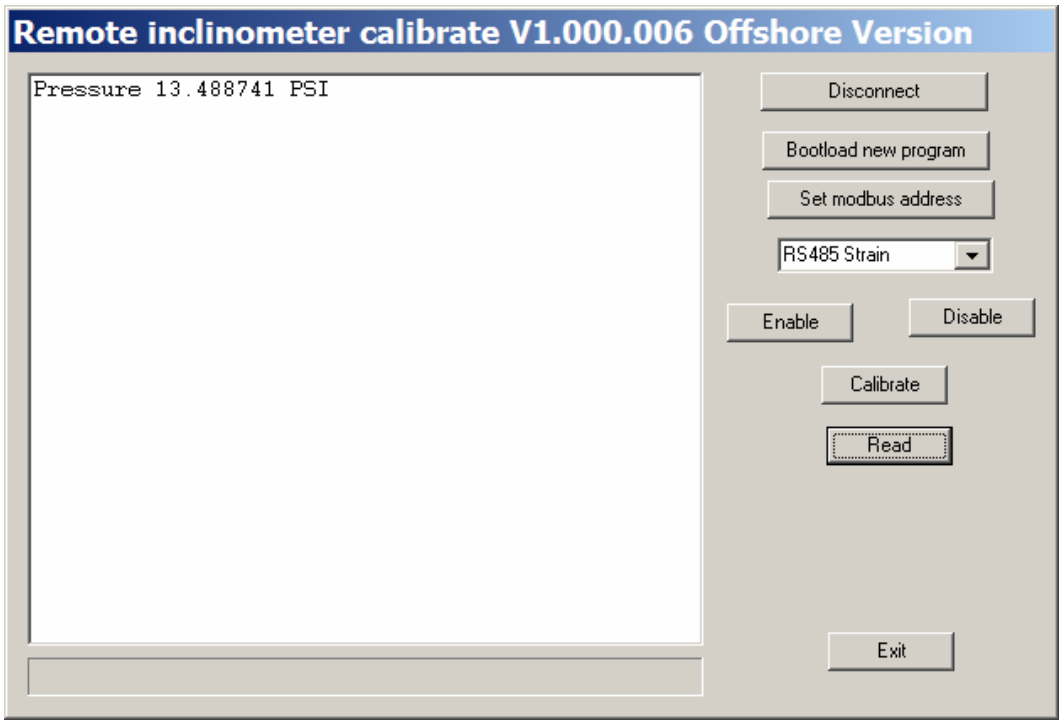
From the drop down menu select the sensor to be read.



Operate the <Read> button



The current pitch and roll values are returned or



The current pressure is reported in psi absolute.

B.3.3 Calibrating the sensors

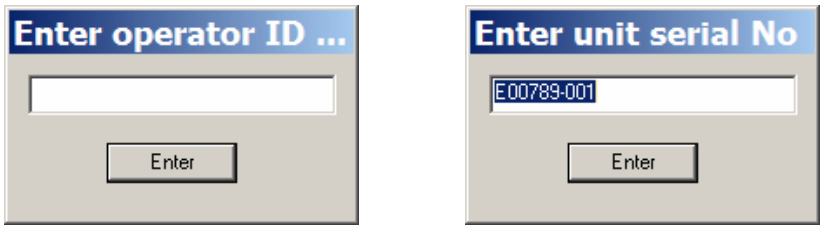
B.3.3.1 **Inclinometers**

Specialist equipment is required to carry out a calibration of the inclinometers and it is recommended that the unit should be returned to Sonardyne for calibration of the inclinometers.

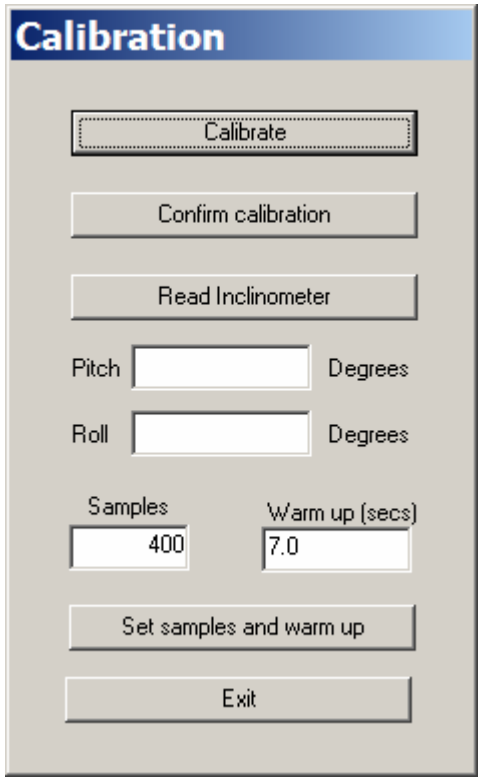
However the user may set the number of samples that the measurement is taken over.

Select the Inclinometer as the current sensor from the drop down menu and operate the <Calibrate> button.

At the Prompt enter your initials, and at the second prompt enter the serial number of the end cap, this should already be present in the display.



Set the number of samples to the desired setting and operate the <Set samples and warm up> button. The default number of samples is 400 and this equates to a 4 second measurement period suitable for use on a structure where vibrations occur, the value may be reduced to 100 when fitted to a vibration-free structure. The value defaults to 400 as it can be over written by the Compatt using the value set in the DAS card.



Press <Exit> to return to the main display

B.3.3.2 **Pressure sensor**

Equipment required

Description	Sonardyne Drawing No	Sonardyne CPN
PC with1 or 2 spare Comm Ports		
Compatt 5 Utilities CD-ROM		
Serial power cable serial cable	8008-050	820-6804
Pressure Adaptor	7431-027	860-0879
Or Extended Adaptor	8000-255	760-1242
Dowty Washer		201-0216
Calibrated Aneroid Barometer		
Calibrated Class A Dead Weight Tester		
Calibrated Thermometer		

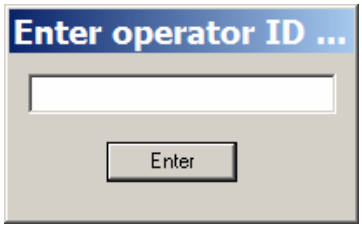
Connect the Test Equipment as shown in Fig B.2.

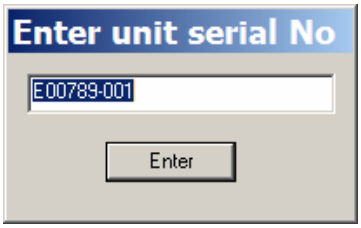
Remove the red pressure port screw and fit the Dowty washer and adapter.

Connect the End Cap to the calibrated Dead Weight tester. Clear any air bubbles from the piping

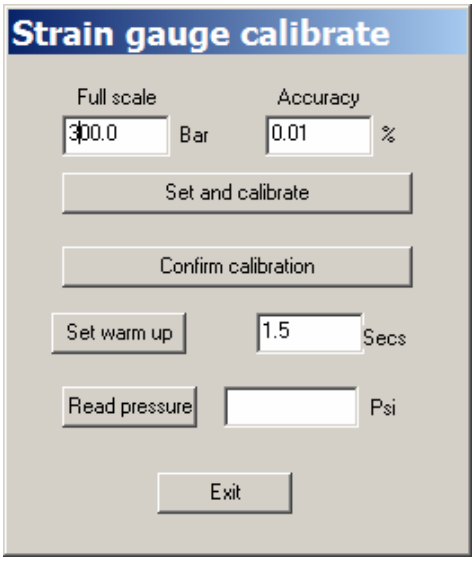
Select the RS485 Strain as the current sensor from the drop down menu and operate the <Calibrate> button.

At the Prompt enter your initials and at the second prompt enter the serial number of the end cap, this should already be present in the display.





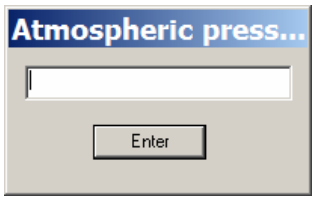
Once the prompt dialogs have been filled in the Strain gauge calibrate dialog is displayed.

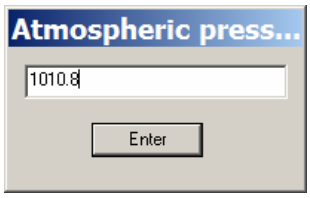


In the upper windows set the Bar rating of the fitted sensor and it's accuracy, the default sensor values are shown above.

The following two dialogs request information that affect the calibration.

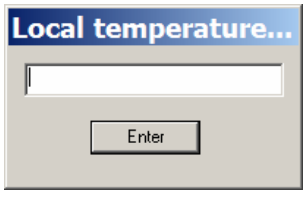
Operate the <Set and calibrate> button, the pressure sensor full scale prompt is displayed, choosing <No > returns to the previous display. Pressing <Yes> presents;-

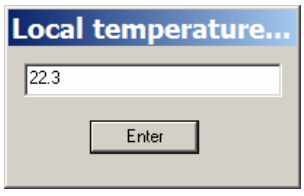




Input the atmospheric pressure in millibar to 1 decimal place.

The local temperature is then requested

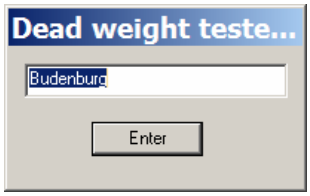


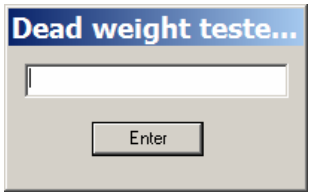


In put the temperature in degrees C to one decimal place.

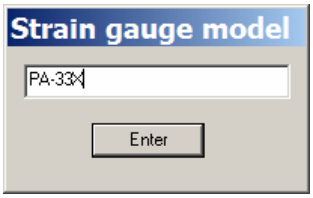
The following four dialogs are for record keeping.

The Deadweight tester type in use is then prompted for followed by the serial number prompt. Note:- on high resolution screens the title of the dialog is not fully displayed.

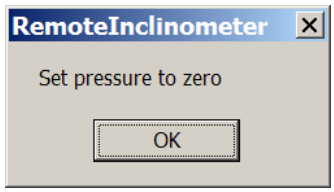




The strain gauge manufacturer and model number are then prompted for.

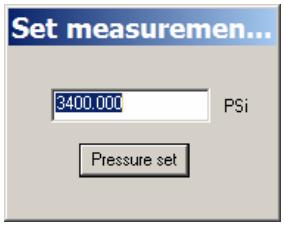


The atmospheric pressure reading is then prompted for.



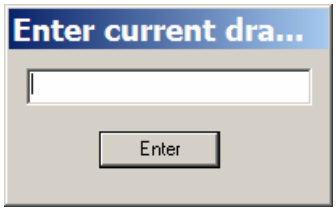
Leave the pipe work connected but vented to atmosphere. When ready press <OK>.

The suggested near full scale calibration pressure is then displayed. If a different value is to be used so as to produce the best possible calibration at a given pressure, replace the suggested value in the window with the actual value to be used.



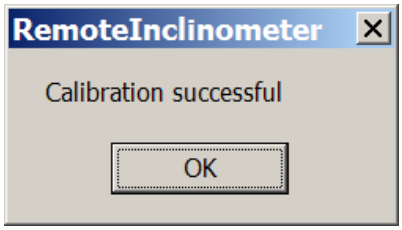
Set the Deadweight tester to apply the suggested pressure or your alternative and once the pressure is stable, press the <OK> button.

The next step is only possible if a voltage source that displays current is in use or an Ammeter is in the line. The current is typically 65mA.



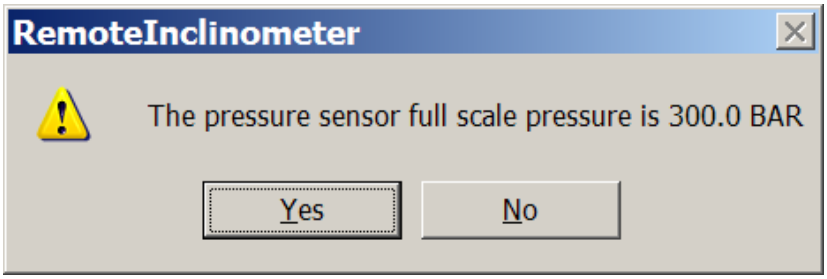
Enter the value and press <Enter>.

The Calibration successful message is now displayed.

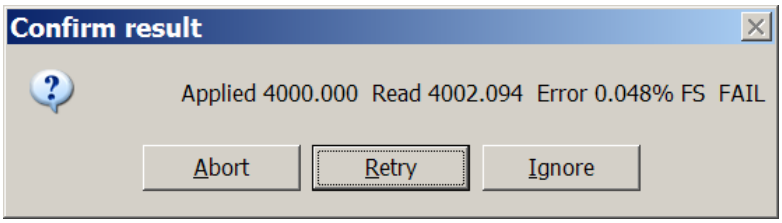


If desired the calibration may be checked at 5 additional readings and 0 applied pressure.

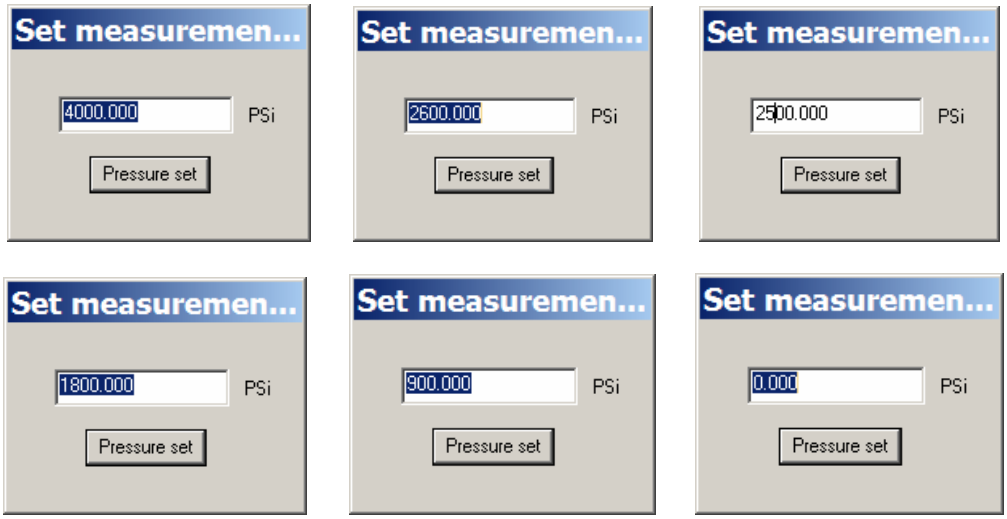
Select the <Confirm calibration> button, the full scale message needs to be answered with <Yes>.

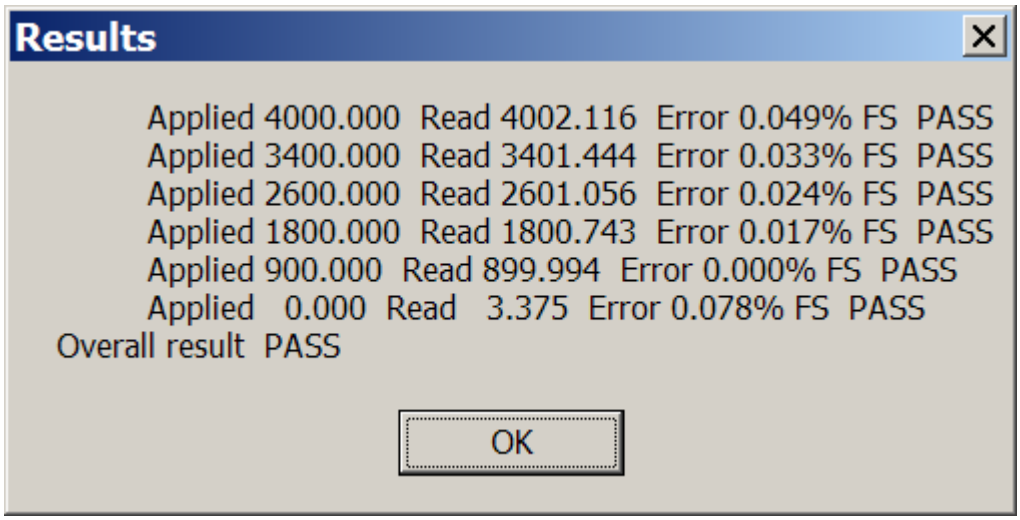


If at any point a Confirm result message is displayed it is suggested that <Retry> is used at least once and then <Ignore>. Using Ignore will result in a fail in the final display for the specific failure and an overall fail. This is more likely to happen if a high pressure sensor is deliberately calibrated at a low pressure and a check reading is done at a high pressure.

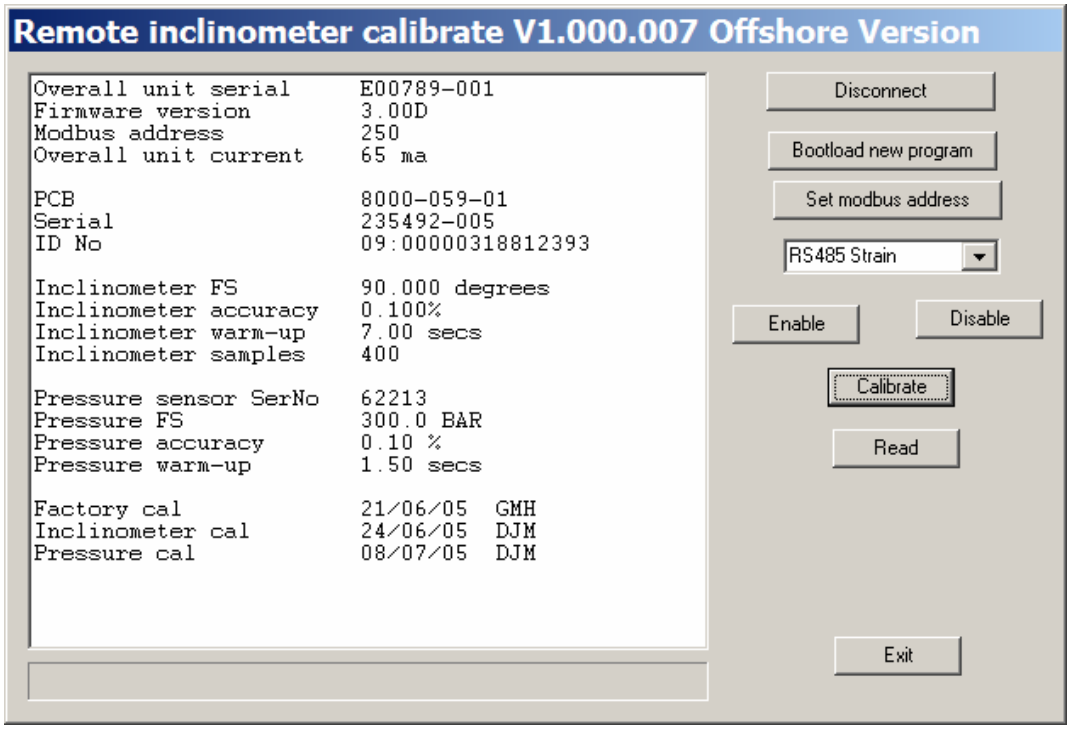


The suggested pressures to be used for a 300bar sensor are shown below:-





Operate the <OK> key to return to the calibrate dialog and then the <Exit> key to return to the main display.

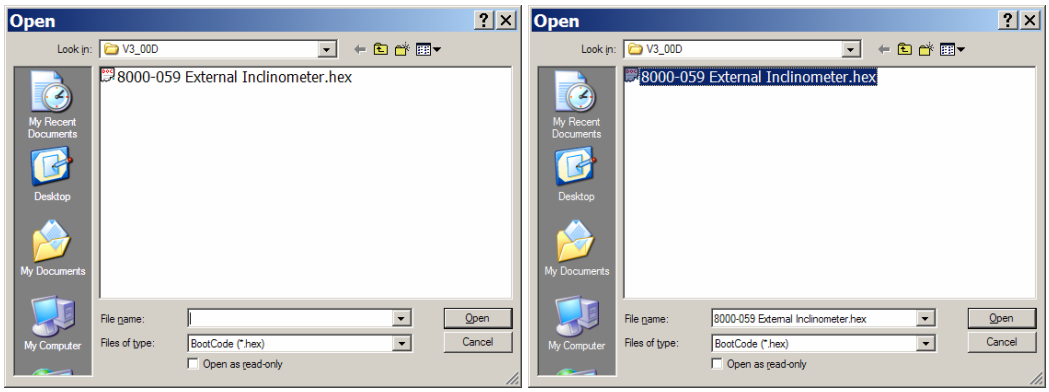


Any items that have changed during the calibration will have been updated in the display window.

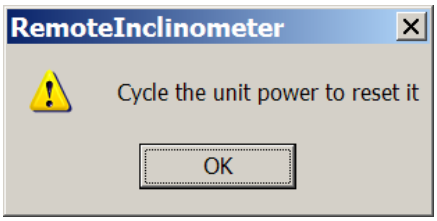
B.3.4 Re-programming

This operation takes approximately 6 minutes MUST NOT be interrupted in any way such as selecting a different program or a pop-up announcing the arrival of an e-mail.

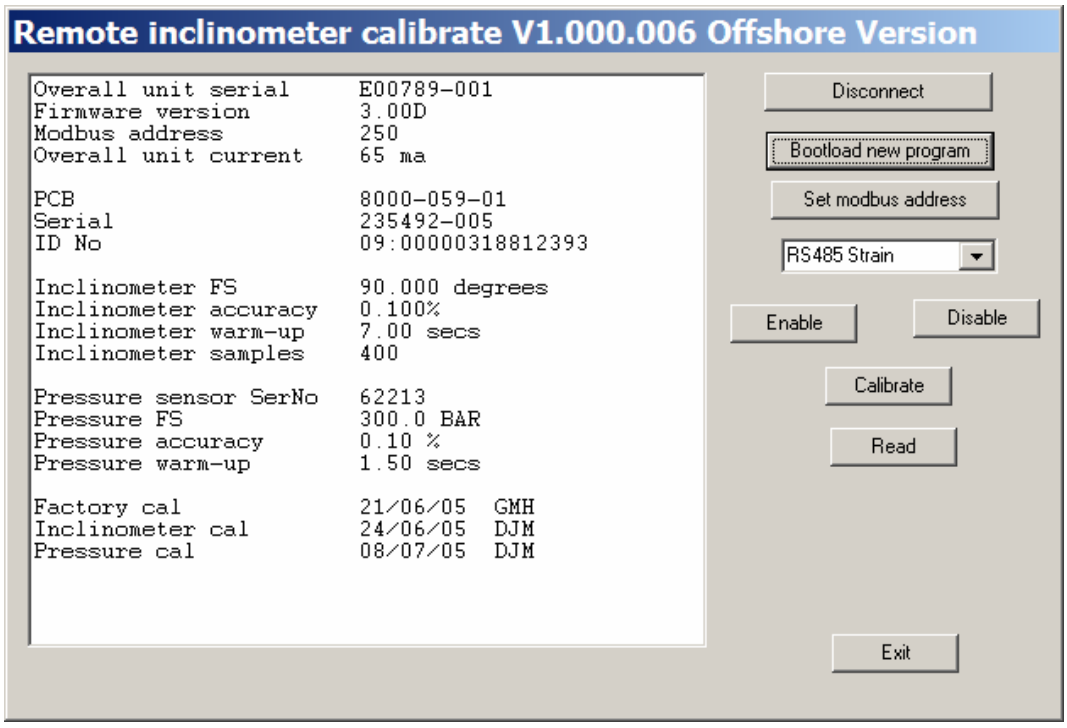
Operate the <Bootload new program> which presents the open dialog, browse to where you have the new file to be installed and select it into the File name window and operate the <Open> button, programming will commence.



Once programming is complete the following is displayed. Leave the Remote Inclinometer terminal running and disconnect and reconnect to the remote inclinometer, then operate the <OK> button.



The main display will return and the new Firmware version will be shown.



B.3.5 Exiting Remote Inclinometer terminal

Operate the <Disconnect> button and then the <Exit> button to close the terminal. If a different unit is to be worked on the terminal may be left open by using just the <Disconnect> button.

FIG B.1 COMPATT 5 TEST EQUIPMENT CONNECTION

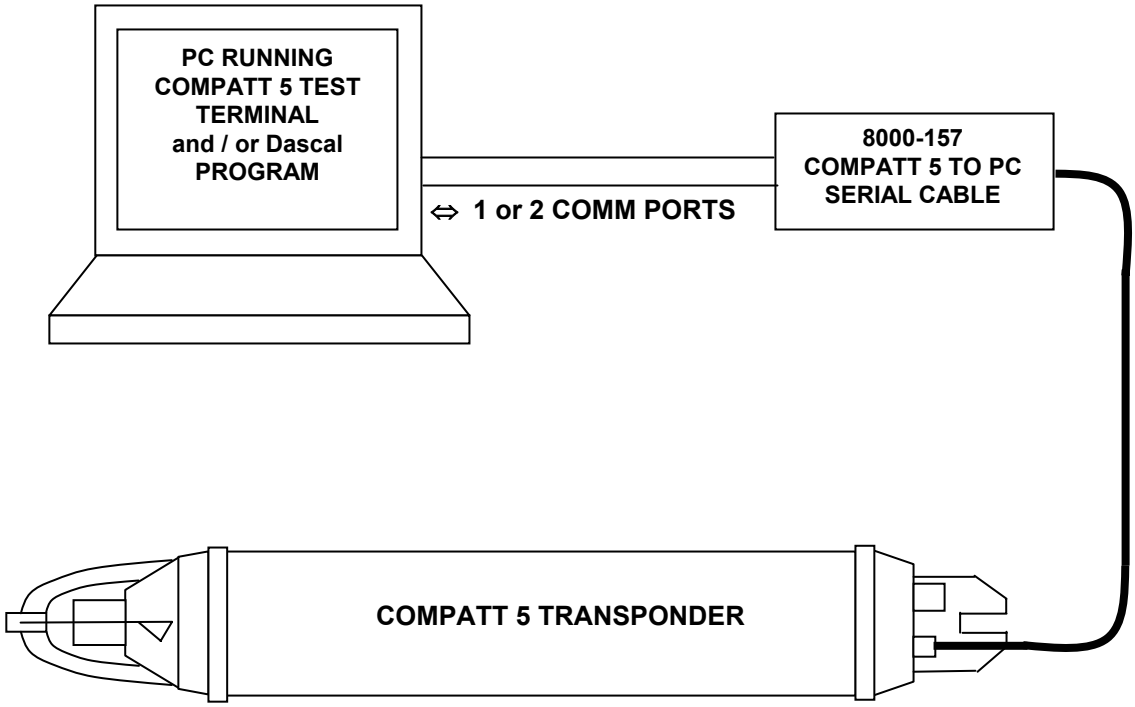
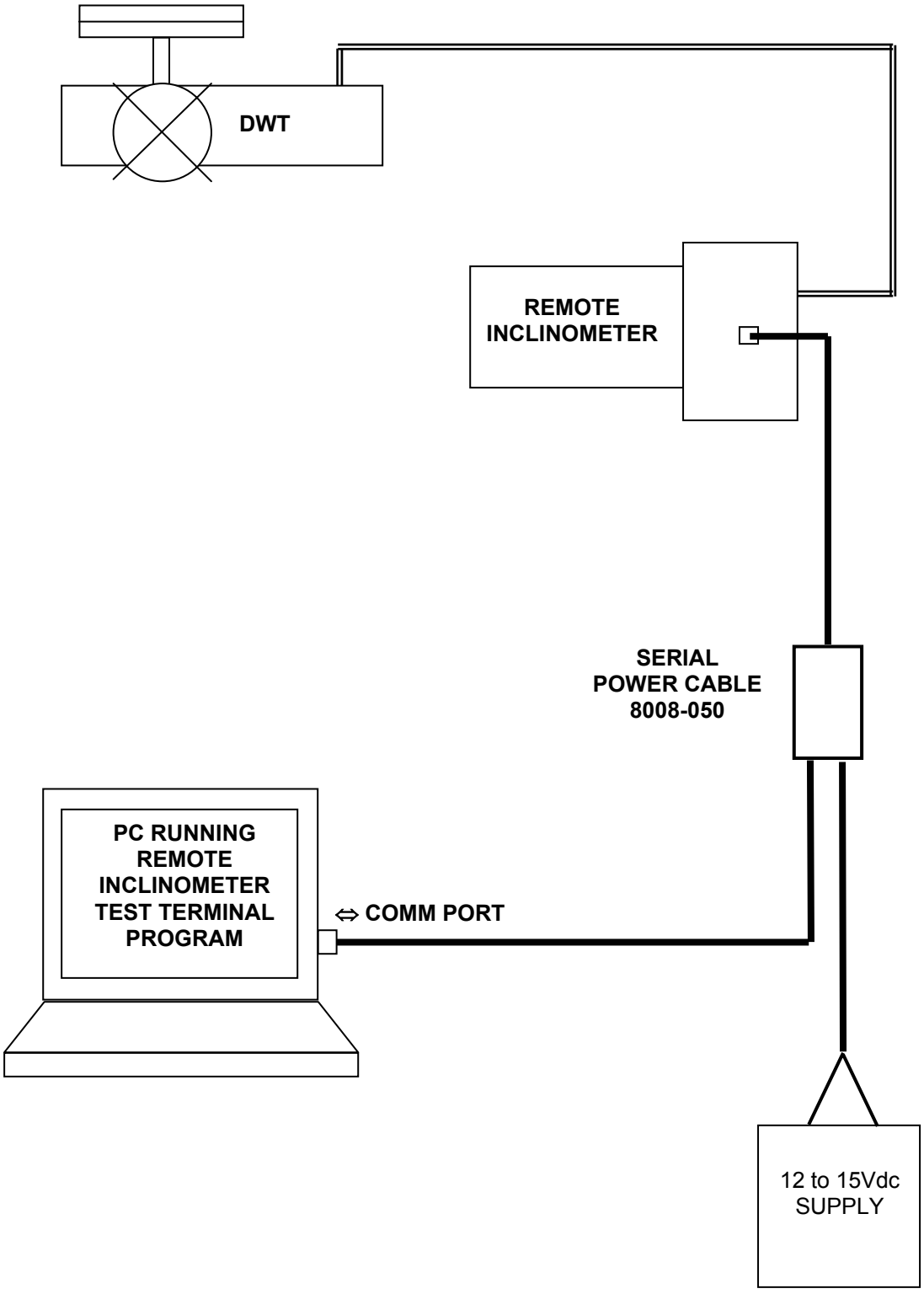


FIG B.2 IN-SITU DEPTH SENSOR RE-CALIBRATION



APPENDIX C

C. REMOTE INCLINOMETER FIRMWARE HISTORY

Build	Date	Comments
V3.00D	7-7-2005	First release

APPENDIX D

D. MODBUS COMMANDS

These command strings can be used to read the sensors once the warm up delay has elapsed from power up.

D.1 PITCH AND ROLL

To recover the pitch and roll in Radians, the following Hex string needs to be sent to the unit:-

FA 04 01 2C 00 05 E5 B7

The response when there is no valid data ready contains Hex 00 00 in the status Byte:-

			Pitch				Roll				Status		Check sum	
FA	04	0A	40	00	00	00	3E	32	94	2F	00	00	A9	30

The response when the data is valid contains Hex 00 01 in the status byte:-

			Pitch				Roll				Status		Check sum	
FA	04	0A	BA	0E	2F	41	3E	32	94	2F	00	01	12	2F

In the example the pitch is -0.00054 Radians and the Roll is +0.174393 radians.

The data in the Pitch and Roll fields is a floating point number, of single precision 32 bit, see:-

http://www.math.byu.edu/~schow/work/IEEEFloatingPoint.htm

An Excel spread sheet ‘Hex2float to pitch and roll.xls’ is contained on the CD 8008 utilities.

D.2 PRESSURE

To recover the absolute pressure in kPa, the following Hex string needs to be sent to the unit:-

FA 04 01 33 00 02 95 B3

The response when there is no valid data ready produces a large negative value <-1:-

FA 04 04 C4 7A 00 00 AD A2

C4 7A 00 00 = Pressure; AD A2 = Check sum

The response when there is valid data ready produces a positive value:-

FA 04 04 41 4E 70 26 61 7A

41 4E 70 26 = Pressure; 61 7A = Check sum

In the example the pressure is 12.902kPa or 1.871 psia.

The data in the Pressure field is a floating point number, of single precision 32 bit.

An Excel spread sheet ‘Hex2float to pressure convertor.xls’ and utility ‘Floatconv.exe’ are contained on the CD 8008 utilities.

D.3 CHECK SUM

The check sum conforms to modbus standard see:-

http://www.modbus.org/default.htm

APPENDIX E
INTENTIONALLY BLANK

APPENDIX F

F. HANDLING PROCEDURES FOR CMOS DEVICES AND CIRCUIT BOARDS

CMOS devices have diode input protection against adverse electrical environments such as electrostatic discharge.

Unfortunately, severe electrical transient voltages can be generated during handling. For example, static voltages generated by a person walking across a common waxed floor have been measured in the 4 to 15kV range (depending on humidity, surface conditions, etc). These static voltages are potentially dangerous when discharged into a CMOS input, considering the energy stored in the capacity (~ 300 pF) of the human body at these voltage levels.

Present CMOS gate protection structures can generally protect against over-voltages. This is usually sufficient except in the severe cases.

All CMOS devices should be stored and transported in materials that are anti-static. CMOS devices must not be inserted into conventional plastic "snow", Styrofoam or plastic trays, but should be left in their original container until ready for use.

Workbenches should have conductive tops that are grounded to an earth ground.

Operators must comply with precautions previously explained.

Completed assemblies should be placed in anti-static containers prior to being moved to subsequent stations.

All low impedance equipment (pulse generators, etc) should be connected to CMOS inputs only after the CMOS is powered up. Similarly, this type of equipment should be disconnected before power is turned off.

A circuit board containing CMOS devices is merely an extension of the device and the same handling precautions apply. Unprotected handling of any board containing edge connectors wired directly to CMOS device inputs can cause damage. Plastic wrapping should be avoided.

Do not insert or remove CMOS devices from their original or test sockets with power applied. Check all power supplies to be used for testing CMOS devices to be certain there are no voltage transients present.

All CMOS devices should be placed on a grounded bench surface and operators should ground themselves prior to handling devices, since a person can be statically charged with respect to the bench surface. Wrist straps in contact with skin are strongly recommended.

Nylon or other static generating materials should not come in contact with CMOS circuits.

When lead straightening or hand soldering is necessary, provide ground straps for the apparatus used and be sure that soldering irons are grounded.

APPENDIX G

G. OPERATING NOTES FOR REMOTE INCLINOMETER OPTION FOR COMPATT 5

Any Compatt 5's can be configured for use with a remote unit containing dual axis inclinometers. The range of the sensors fitted is ±90°, although when used with the Compatt command AN7 they will reply with a full-scale range of either ±14.5°, ±90° or ±5° depending on how the DAS card is configured, see G.3 below. A label on the end-cap will indicate the scaling range (the default is ±14.5°).

Upon receipt of the PAN command AN7 the sensors are powered up and given an 7 second warm-up delay. The 2 sensors are then repeatedly sampled and averaged, with a telemetered reply being sent back after approximately 12-18. The telemetry wait time in PAN must be extended to allow the PAN to receive the delayed reply, by entering the TW 12 command.

The AN7 command gives a displayed reply in the form:

AN7, 8 = +1.234, =2.345 E : ∅

Roll Pitch

The numerical data is displayed in volts and converted to an angle in degrees using the formula:

Angle, ∅ = arc sin (V / S.F.)

where V is the data displayed in volts, and S.F. is a scale factor which depends on the range of the inclinometer sensors fitted.

Compatt Mk4 Emulated Sensor Range	S.F.
± 14.5 °	16.000
± 5 °	45.895
± 90 °	4.000

The inclinometers orientation is marked on the bottom end-cap by a groove running up the edge of the end-cap, indicating the bow or for'ard face. The polarity follows a standard Cartesian format:

Bow Up = Pitch +ve

Port Up = Roll +ve

G.1 MOUNTING DETAILS

An example of a mounting plate is shown in Figure 2. Four mounting holes to take M8 bolts are needed and 2 bosses to give a datum line to which the end-cap can be abutted. To offer corrosion protection, provision of zinc anodes on the plate is recommended. Note that the locking sleeve on the Compatt connector protrudes from the Port side face of the end-cap.

G.2 ON-SITE CALIBRATION METHOD

Roll and pitch corrections, to be applied when tracking a Compatt on a structure, can be measured when the Compatt is installed on the structure on land. Take 3 roll and pitch measurements and use the average as the correction values. These are subtracted from real-time measurements in the navigation software.

This may be done using the Remote Inclinometer terminal using the Serial power cable 8008-050 from a laptop PC with a 12V battery used to power the Remote Inclinometer.

G.3 CHANGING THE SCALING RANGE

On the PC run the **Compatt 5 Test Terminal** program, as described in section B.2.3.

Click on the "**Enter DAS Calibration**" button. This will force the Compatt 5 to switch on power to the DAS. The message window should show the reply "DAS calibration mode entry".

Close the Compatt 5 Test Terminal.

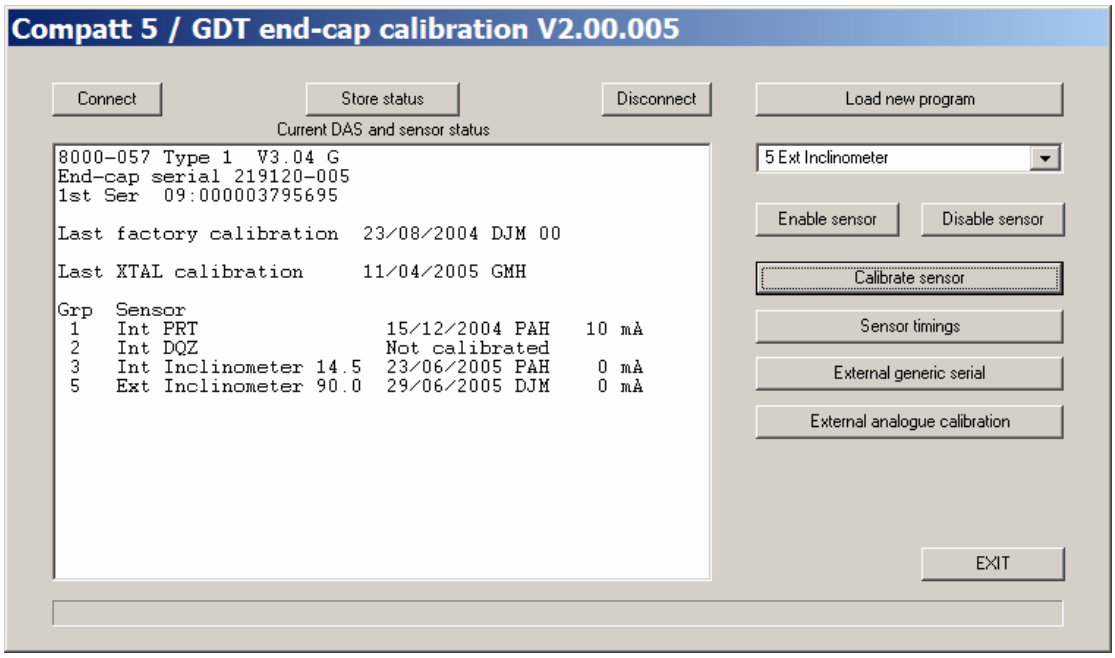
Disconnect the PC comm port from the Compatt CPU connector on the Dual serial cable 8000-157, and connect to the DAS connector.

Note: the watchdog will reset the whole unit after 10 minutes and abort any DAS measurement in progress at the time. Therefore, this procedure must be completed in under 10 minutes, otherwise there will be an error message "Comms connection fault".

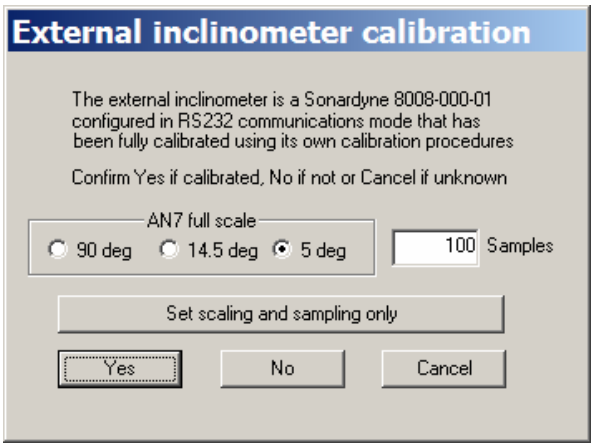
Run the Dascal program from the **'Dascal'** icon placed on the **'Desktop'** of the PC as detailed in section B.2.4.

Click on **'Connect'**. Select the comm port used by the PC, then click on **'OK'.**

After a short period of time, the Endcap Status will appear in the window as shown below:-



From the pull down menu, select '**5. Ext Inclinometer'** and then select '**Calibrate sensor'**. The window below will appear.



Select the Compatt 4 (C4) scaling and number of samples required, then click on **<Yes>**. Note that changing the scaling does not affect the sensor calibration.

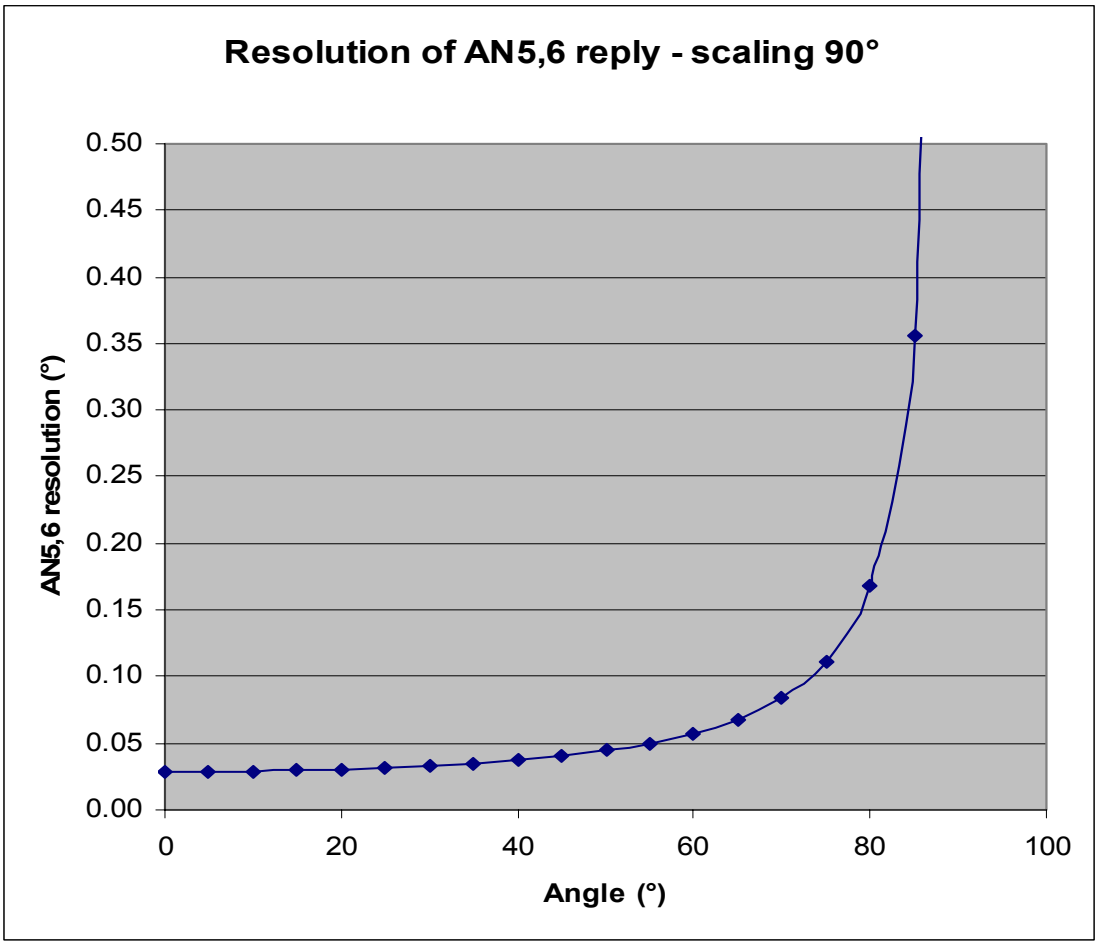
From the main DASCAL window click on **'Disconnect'** then **'Exit'**.

The end-cap labelling must reflect the new scaling range.

G.4 RESOLUTION

The resolution of the telemetered AN7 readings will be greatly affected by the angle when the 90° scaling range is being used, see the graph below. This is because the reported voltage is a sine function of the angle.

By comparison, the resolution when using the 14.5° scaling range is a constant 0.007° over the range.



G.5 READING THE SENSORS VIA RS232

Using the RS232 link, and running Remote Inclinometer Terminal, selecting inclinometer from the drop down menu, and using the <Read> button returns the current Pitch and Roll values in degrees to full accuracy for any angle. If the pressure sensor is selected then psi absolute is reported when the <Read> button is used.