Intelligent Gyro Compass (iGC)

Product Manual

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Tritech

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Table of Contents

Help & Support 5
Warning Symbols 6
1. Safety Notices 7
    1.1. General 7
    1.2. Pressure 7
    1.3. Electrics 8
2. Introduction 9
    2.1. Intelligent Gyro Compass (iGC) 9
    2.2. Intelligent Fibre-optic Gyro (iFG) 10
    2.3. Intelligent Interface PCB (iIF) 10
3. Typical Applications 11
4. Installation 14
    4.1. Safety Note 14
    4.2. iGC Mechanical Installation 14
        4.2.1. Introduction 14
        4.2.2. Magnetic Disturbance 14
        4.2.3. Alignment 14
        4.2.4. Stiffness 15
        4.2.5. Collision Protection 15
    4.3. Installation Drawing 15
    4.4. iGC Electrical Installation 15
        4.4.1. Preparation 15
        4.4.2. Adjusting iGC Mode or Jumpers 17
    4.5. Electrical Installation 18
5. Commissioning 20
    5.1. General 20
    5.2. Overview 20
    5.3. Powering up for the first time 20
    5.4. Checking iGC output using a terminal programme 21
    5.5. Checking iGC output on an RS485 interface 22
    5.6. iGC data Check procedures 22
        5.6.1. Heading Checks 23
        5.6.2. Pitch & Roll Checks 23
        5.6.3. Heave Acceleration Data Checks 23
        5.6.4. Water Ingress Alarm Checks 23
        5.6.5. Other Data Checks 24
6. Calibration 25
    6.1. Introduction 25
    6.2. Physical Offsets 25
    6.3. Magnetic Offsets 25
7. Operation 27
    7.1. Introduction 27
    7.2. Data Output Formats 27
        7.2.1. Proprietary Outputs 27
        7.2.2. Industry Standard Outputs 27
        7.2.3. Special Modes 27
    7.3. Operational Issues 28
    7.4. Using iGC Navigation Software 28
8. Maintenance 31
    8.1. Safety 31
    8.2. General 31
    8.3. Seals 31
    8.4. Basic Maintenance Procedure 31
        8.4.1. Pre and Post Dive Checks 31
        8.4.2. Storage 32

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8.5. Procedure For Repair of Anodised Surfaces 32
8.6. Flooding 32
8.7. Dismantling and Re-assembly 33
8.7.1. Removal of Pressure Dome 33
8.7.2. Removal Of Sensor Assembly, Interface PCB and Processor Module 33
8.7.3. Removal Of the Underwater Connector 34
8.7.4. Replacement Of the Underwater Connector 34
8.7.5. Replacement Of Sensor Assembly, I/F PCB and Processor Module 34
9. Basic Fault Finding 36
9.1. General 36
9.2. Fault Symptoms 36
9.3. Firmware Reprogramming 37
A. iGC Technical Specifications 38
B. General Assembly Drawing 39
C. iGC Bill of Materials 40
D. iGC Mode Listing - Proprietary iGC Outputs 41
E. iGC Mode Listing - Special Modes 43
F. iGC Mode Listing - Industry Standard Modes 46
G. iGC & iFG Electrical Interconnection Schematic 51
H. iGC Recommended Spares 52

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Help & Support

First please read this manual thoroughly (particularly the Troubleshooting section, if present). If a warranty is applicable, further details can be found in the Warranty Statement, 0080-STF-00139, available upon request.

Tritech International Ltd can be contacted as follows:

	Mail	*Tritech International Ltd* Peregrine Road Westhill Business Park Westhill, Aberdeenshire AB32 6JL, UK
	Telephone	+44 (0)1224 744111
	Email	support@tritech.co.uk
	Website	www.tritech.co.uk

Prior to contacting *Tritech International Ltd* please ensure that the following is available:

1. The Serial Numbers of the product and any *Tritech International Ltd* equipment connected directly or indirectly to it
2. Software or firmware revision numbers
3. A clear fault description
4. Details of any remedial action implemented

Contamination

If the product has been used in a contaminated or hazardous environment you *must* de-contaminate the product and report any hazards *prior* to returning the unit for repair. *Under no circumstances should a product be returned that is contaminated with radioactive material.*

The name of the organisation which purchased the system is held on record at *Tritech International Ltd* and details of new software or hardware packages will be announced at regular intervals. This manual may not detail every aspect of operation and for the latest revision of the manual please refer to www.tritech.co.uk

Tritech International Ltd can only undertake to provide software support of systems loaded with the software in accordance with the instructions given in this manual. It is the customer's responsibility to ensure the compatibility of any other package they choose to use.

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Warning Symbols

Throughout this manual the following symbols may be used where applicable to denote any particular hazards or areas which should be given special attention:

Note

This symbol highlights anything which would be of particular interest to the reader or provides extra information outside of the current topic.

Important

When this is shown there is potential to cause harm to the device due to static discharge. The components should not be handled without appropriate protection to prevent such a discharge occurring.

Caution

This highlights areas where extra care is needed to ensure that certain delicate components are not damaged.

Warning

DANGER OF INJURY TO SELF OR OTHERS

Where this symbol is present there is a serious risk of injury or loss of life. Care should be taken to follow the instructions correctly and also conduct a separate Risk Assessment prior to commencing work.

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1. Safety Notices

1.1. General

Warning

The iGC may contain fluid or gas under pressure and electrical systems at potentially hazardous voltages.

All installation, operation, maintenance and repair works must be carried out by competent personnel.

The installation of the iGC and associated components is fully the responsibility of the user.

The iGC shall be installed, commissioned, operated and maintained in accordance with this instruction manual, including staying within the maximum operating conditions given in Appendix A, *iGC Technical Specifications*Appendix A - iGC Supply Specification. Failure to do so may lead to safety hazards or equipment failure.

Before starting installation, commissioning, operation or maintenance of the iGC, personnel should read and understand all relevant sections of this manual.

Any queries, comments or suggestions regarding the content of this manual or the safe installation, operation or maintenance of the iGC should be referred to Tritech.

1.2. Pressure

Caution

If a seal has failed AND then acts as a one-way check during flooding, it is possible that pressurised fluid and gas has been trapped inside the iGC pressure vessel. This may be indicated by one or more of the following:

1. The iGC has ceased to function after flooding
2. A water-ingress alarm has been generated
3. If the iGC is shaken fluid can be heard or felt moving around inside the housing
4. During removal, the pressure dome is very tight on its threads
5. During removal of the pressure dome there is fluid leakage at the joint

The pressure housing has been designed so that the main seal will cease to function whilst there is still sufficient thread engagement to prevent the components from flying apart. The correct procedure for disassembly is given in Chapter 8, *Maintenance*.

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1.3. Electrics

Caution

Any electrical supply or connection should be regarded as dangerous until proven otherwise by disconnection and isolation or by measurement. This applies as much to supply circuitry as to the equipment described in this manual.

Before doing any work inside the iGC the electrical power supply to the iGC should isolated and the power connector unplugged. This includes electrical faultfinding so as to avoid inadvertent contact between the pressure housing and exposed connections on any of the electrical components or circuit boards during removal or installation of the dome.

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2. Introduction

2.1. Intelligent Gyro Compass (iGC)

The Tritech intelligent gyrocompass is the core component within an integrated and flexible family of products that provide the user with heading direction, attitude and motion data. This device finds numerous applications as a component in underwater navigation and positioning systems, ranging from ROV heading sensors, tooling skid positioning, heave compensation systems, construction projects, vessel navigation etc.

As standard the iGC is supplied in a 1-atmosphere pressure housing suitable for use down to 4000 metres depth, but is available in a 6000 metre version or in a 'surface' housing (i.e. suitable for use inside an existing pressure vessel or at the surface) as an option.

The iGC is based around a sophisticated set of sensors measuring acceleration, magnetic field and rate of turn on three orthogonal axes. Data from these sensors is processed internally using state of the art digital signal processing and advanced adaptive filtering techniques to give outputs of heading, pitch, roll and heave acceleration. Optionally, the unit can also provide surge and sway accelerations.

In order to find applications in a wide range of areas, the output data from the iGC is selectable by the user to match numerous industry standard formats. This allows the iGC to 'emulate' more expensive or existing heading sensors and therefore provide an easy upgrade or replacement path for customers looking for a more reliable or compact solution.

As standard, the iGC is supplied with a PC software application that gives a clear animated display of heading, pitch, roll, turns counter, heave acceleration and iGC status. This PC programme is normally used when the user does not have an effective heading display, for diagnostics / additional data control or in applications where an additional display is useful to complement the existing heading display system.

The iGC communicates with the 'host' system via a digital communication link, either using RS232 or RS485. The data rate and output telegram format are user selectable depending on the application.

Power to the iGC is nominally 24V dc at 250mA, but supply voltages in the range 12V to 26V are acceptable.

Since the iGC is based around magnetic North detecting sensors, it is sensitive to external magnetic fields that are not produced by the earth's magnetic field. Such fields may vary in intensity and direction, and will affect the performance and accuracy of the iGC outputs to a greater or lesser extent, depending on their severity.

By careful positioning of the iGC on the host system, local 'soft iron' magnetic errors can normally be avoided, but external effects may produce undesirable results under certain circumstances.

There are several other members of the iGC product family that increase the functionality and application areas of the iGC.

These are described in more detail later in this manual and comprehensively in their own Operators Manuals, but comprise:

1. Intelligent Fibre-optic Gyro (iFG)

2. Intelligent Interface PCB (iIF)

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2.2. Intelligent Fibre-optic Gyro (iFG)

This is a solid-state single-axis fibre-optic gyro (FOG) sensor system that measures rate of turn to a high degree of accuracy, and with very low drift-rate. This sensor when coupled with an iGC provides a magnetic-north referenced fibre-optic stabilised gyro system with a drift rate of ~1° heading per hour. The combination of an iGC and iFG can be used to replace traditional spinning mass gyro compasses with a more reliable solid-state solution with significantly better drift-rate performance. The effects of extraneous magnetic fields is also much reduced with the iGC / iFG combination.

2.3. Intelligent Interface PCB (iIF)

For systems where an RS232 or RS485 sensor output is not compatible with the existing heading sensor interface, Tritech have developed a number of interface PCBs that can be used to convert the digital telemetry signals from the iGC and iFG into a compatible format. These PCBs are installed in the host system in place of the existing heading sensor interface PCB, and emulate the original sensor outputs (e.g. synchro, analogue, digital etc.) but use the iGC / iFG as the data source.

These PCBs offer a simple ‘hardware’ upgrade to existing systems, without the requirement to rewrite control system software or redesign hardware. They also offer additional capabilities over existing systems, such as the ability to receive data from a North-seeking gyro and convert to the host format, output of pitch and roll signals in the host system’s correct format, automatic selection of the ‘best’ heading source and improved autoheading / turns counter interfaces.

At the time of writing this manual, the following iIF PCBs are available:

1. Ametek Straza / Perry Tritech Scorpio ROV
2. Perry Tritech Super Scorpio ROV
3. Subsea 7 (Subsea Offshore) Pioneer ROV

Tritech are continually expanding the range of supported systems, so please contact Tritech if you have requirements that are not covered by the list above.

Please refer to the Chapter 3, *Typical Applications* section for details of the common configurations that the iGC product family can be used in.

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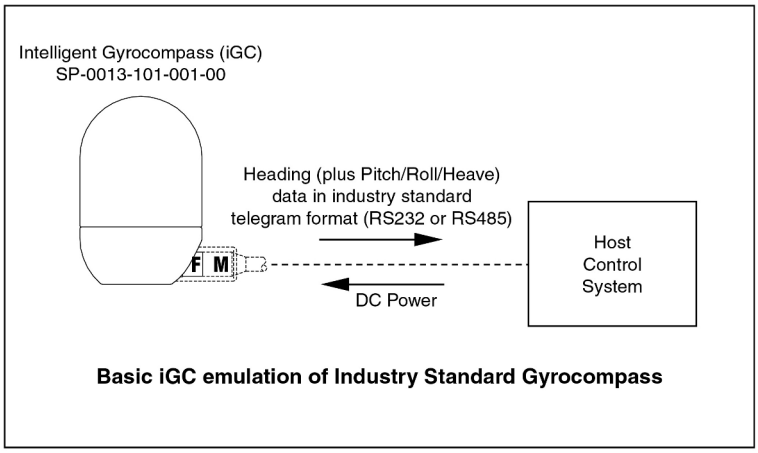
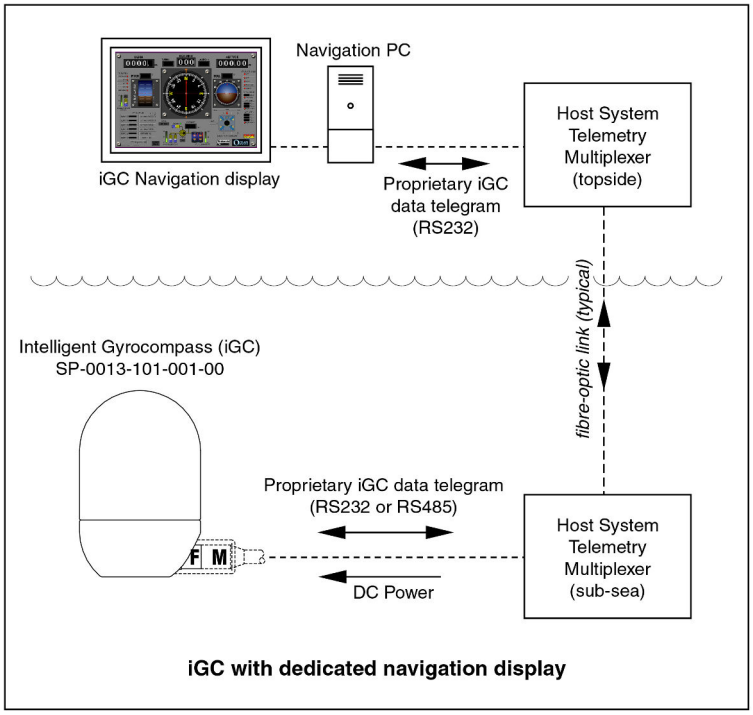
3. Typical Applications

There are various method of integrating the iGC with existing control systems, the following drawings illustrate typical applications.



Basic iGC emulation of Industry Standard Gyrocompass



iGC with dedicated navigation display

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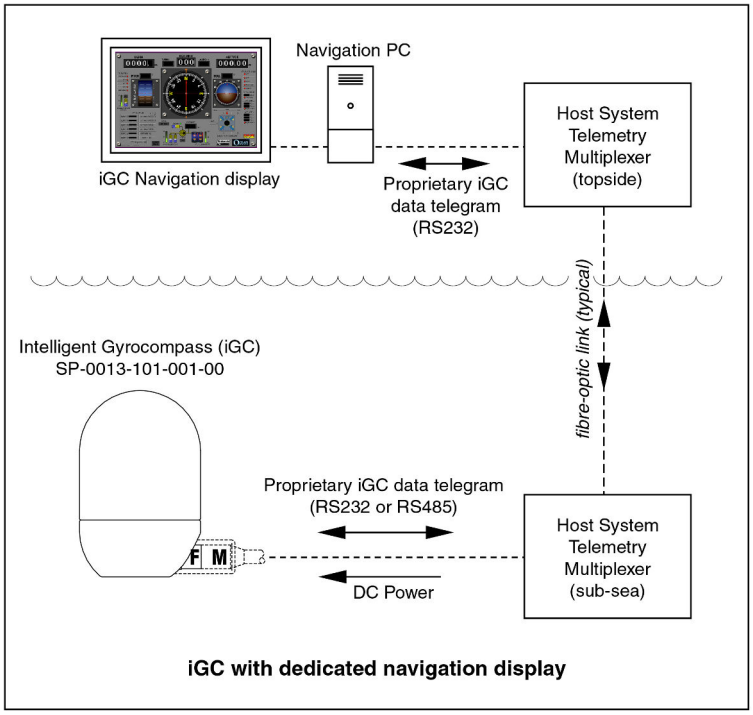
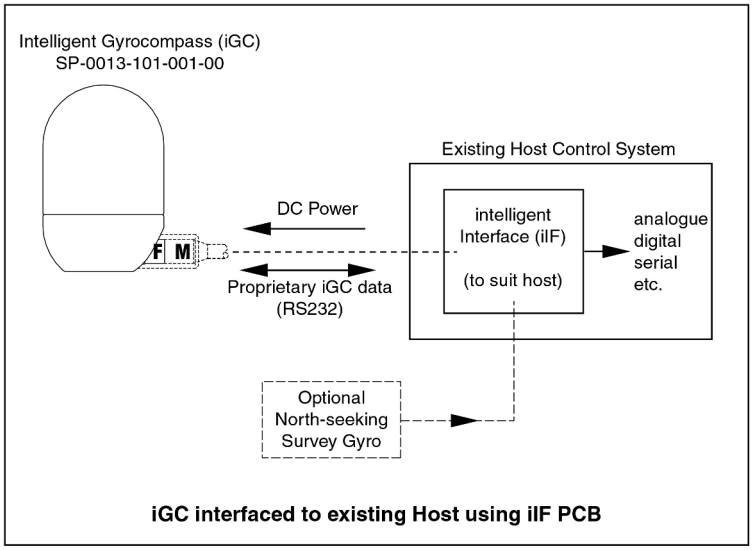
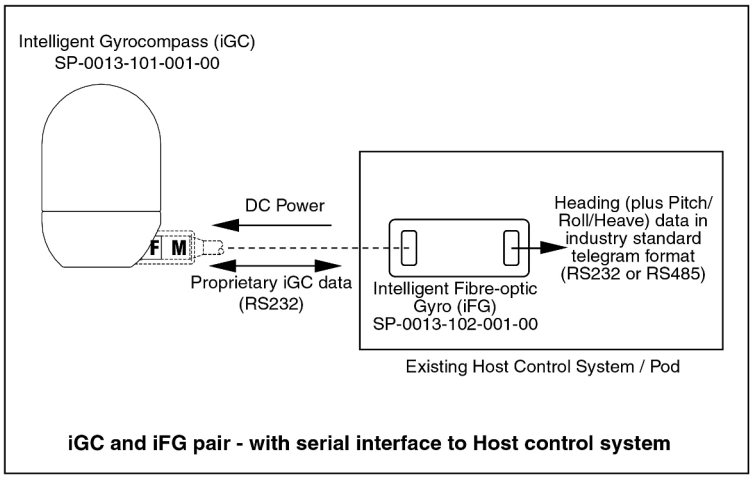


iGC with dedicated navigation display



iGC interfaced to existing Host using iIF PCB



iGC and iFG pair - with serial interface to Host control system

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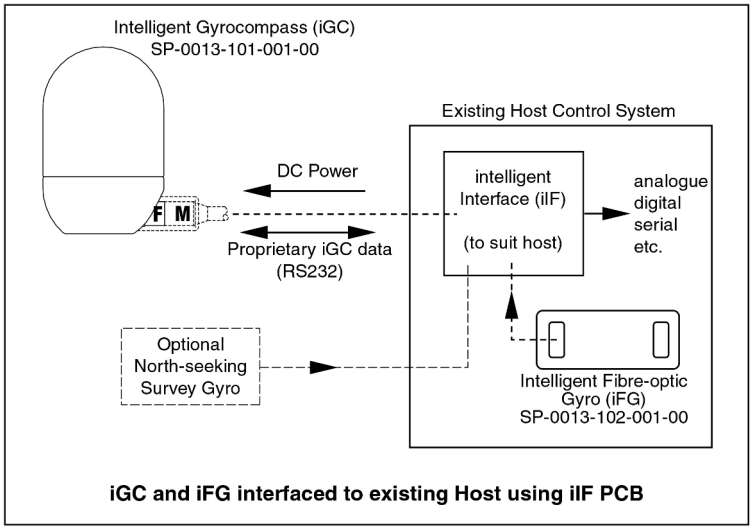

iGC and iFG interfaced to existing Host using iIF PCB

In addition to the sketches shown, there are numerous alternative options for interconnection of the iGC product family to existing or bespoke control systems.

If your desired application is not shown, please contact Tritech for advice on the best method of achieving the interface that you require.

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4. Installation

4.1. Safety Note

Before commencing installation of the iGC:

1. Refer to Chapter 1, *Safety Notices*
2. All relevant parts of this section of the manual should be read and understood

4.2. iGC Mechanical Installation

4.2.1. Introduction

When deciding where to mount the iGC, consideration should be given to:

1. Its location relative to magnetically active materials on the host system
2. Alignment with the axes of the host system
3. Stiffness of the mounting arrangement
4. Collision protection

4.2.2. Magnetic Disturbance

To reduce the effects of fixed magnetic disturbances on the iGC output, it should be mounted as far as is practically possible from the following:

1. Ferrous or other magnetically active materials (including fasteners or brackets used to mount the iGC)
2. Sources of electrically induced magnetic fields such as motors and transformers
3. Moving equipment (e.g. manipulator arms, pan & tilt units etc.)

The iGC is more susceptible to ferrous materials underneath the assembly than from the side or above.

4.2.3. Alignment

The electrical connector is mounted at the “rear” of the iGC. In addition, three meridian lines have been engraved into the body of the iGC. These show the forward, port and starboard directions of the iGC axes. (Refer to Section 4.3, “ Installation Drawing ” for details).

To maximise the accuracy of the iGC outputs, its pitch, roll and yaw axes should be aligned, as accurately as possible, with the pitch, roll and yaw axes of the host system / vehicle.

If necessary, small corrections can be made in accordance with the commissioning and calibration sections of this manual, provided that the existing host control system can provide this function, or the iGC is being used with the iGC PC software, iFG or iIF.

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4.2.4. Stiffness

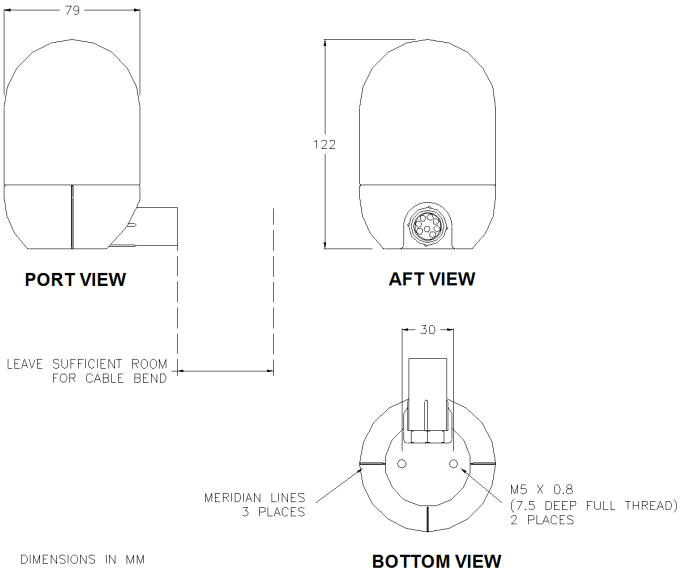
The iGC should be rigidly mounted so that flexibility and / or system vibration does not affect the outputs.

4.2.5. Collision Protection

To protect against accidental damage, the iGC should be mounted in a protected location. The protection around the iGC should not be manufactured form a ferrous material.

4.3. Installation Drawing

The following drawing shows installation dimensions and fastener details for the installation of the iGC:



NB: As stated previously non-magnetic fasteners and mounting bracket should be used for mounting the iGC.

4.4. iGC Electrical Installation

4.4.1. Preparation

All electrical connections to the iGC are via a single Subconn 8-pin micro series connector. This connector is a Male on the iGC (MCBH8MSS) and therefore a female is required on the interface cable (MCIL8F or equivalent).

The connector should be made up in accordance with Subconn guidelines, as detailed below (taken from MacArtney Subconn standard literature):

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1. The connector should not be exposed to long-term heat or sunshine. If this occurs, and the connectors are very dry, soak in fresh water before use

2. Ensure the connectors are lubricated - the recommended lubricant is Molykote 44 Medium -but use sparingly. Half a match head dose per contact is adequate.

3. Any accumulation of sand or mud in the female contact should be removed with fresh water. Failure to do so could result in the splaying of the female contact and damage to the O-ring seals.

4. Do not overtighten the bulkhead nuts

5. Do not disconnect by pulling on the cable and avoid sharp bends at cable entry

6. When using bulkhead connectors see that there are no angular loads as this destroys the connector

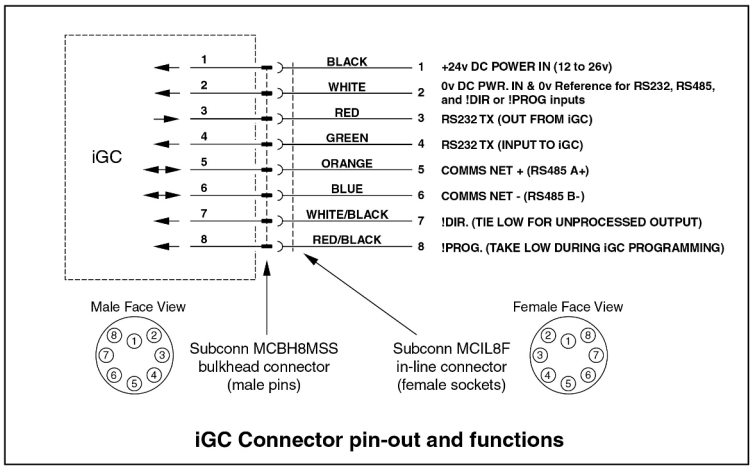
7. When disconnecting, pull straight, not at an angle. Ensure the above points are fulfilled to get the best out of your connectors. If in doubt, please contact your local distributor or MacArtney A/S for advice.

The mated connector should be retained using the Delrin locking sleeve supplied with the iGC. This ensures that the connector does not become inadvertently partially or fully disconnected.

The iGC requires electric power at 24v DC nominal supply, operating current typically between 220mA and 250mA. The iGC will however function correctly at any voltage in the range 12v DC to 26v DC.

The power supply should be from a regulated and smooth (low ripple) power supply for best results. An unregulated or un-smoothed supply should not be used.

The following drawing details the pin-outs of the iGC:



iGC Connector pin-out and functions

If the operating mode that the iGC is to be used in differs from the mode settings as the unit was supplied, the iGC will need to be opened and the Mode Switch settings adjusted. This is covered in section 7.4.2 below.

If RS485 telemetry is going to be used, check that the selector jumpers JP1, JP2 and JP3 are in their correct positions as the unit was supplied. If not, the iGC will need to be opened and the Jumper settings adjusted as described below. The correct settings are given in the following table:

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Mode	Jumper JP1	Jumper JP2	Jumper JP3
RS232 only	(don't care)	(don't care)	(don't care)
RS485 (end terminated)	Position 2-3	Position 2-3	IN
RS485 (unterminated)	Position 2-3	Position 2-3	OUT

Note

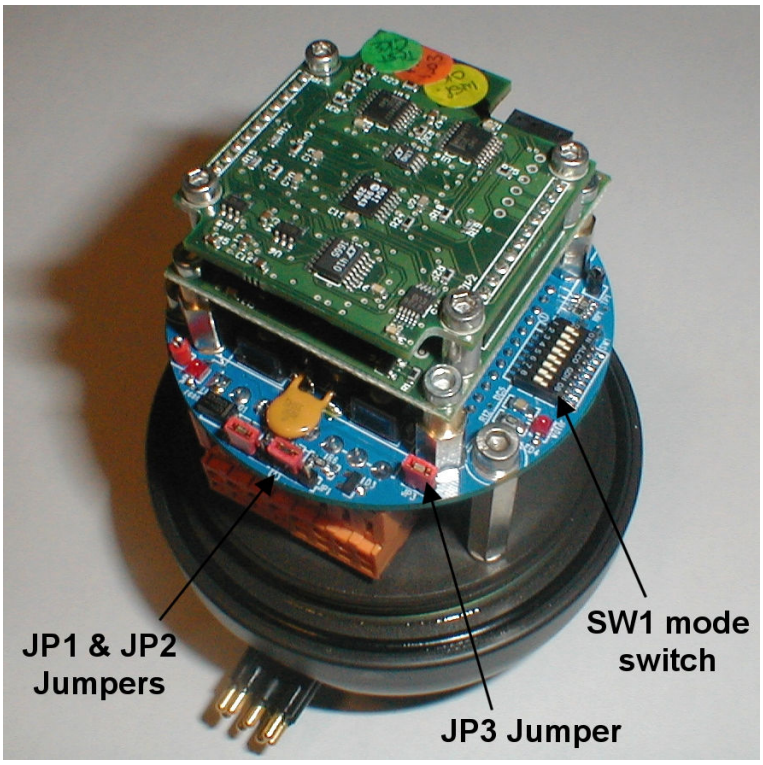
Depending on the manufacturing date of the iGC, the unit may not have a tri-jumper assembly. In this instance the presence of the jumpers JP1 and JP2 is only required when using RS485 communications.

4.4.2. Adjusting iGC Mode or Jumpers

In order to adjust the Mode switch settings the iGC must be opened. Firstly isolate the iGC supply and disconnect the iGC from its interconnecting cable (if already connected).

Follow the procedure for iGC Disassembly (see Section 8.7, “ Dismantling and Re-assembly ”). This procedure exposes the internal iGC components.

Identify the Mode Selector switch (SW1) on the Interface PCB (Item 4 on the G.A.). Refer to the photograph below, and to the General Assembly drawing in Appendix B, *General Assembly Drawing*.



Set the DIL mode switch (SW1) to the desired setting (as determined above – and according to the switch settings from Appendices C and D). Operate the switches carefully with a sliding motion using a small jeweller’s screwdriver or similar, ensuring that the switches are moved fully into the desired position.

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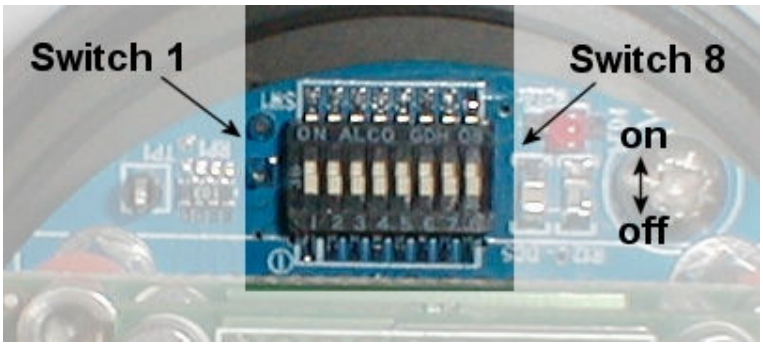
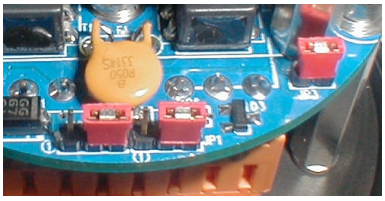


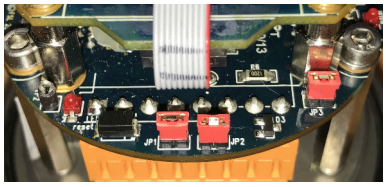
Once the DIL switch has been set, the RS485 jumpers should be checked and set accordingly.

The Jumpers are identified as the shorting links (see photograph). The position to set the Jumpers can be seen from the photographs below:

Settings for RS485 Mode	
Terminated with 120R	**Unterminated**
	

Note

For newer iGC units, JP1 and JP2 are no longer tri-state jumpers.



4.5. Electrical Installation

The following procedure should be followed to complete the Electrical Installation of the iGC:

1. Make any necessary wiring and modifications to the Host control system to provide the appropriate power supply and telemetry circuits
2. With the power to the Host control system isolated, attach the interconnecting cable to the appropriate underwater connector at the Host end
3. Using a digital multimeter, insert probes into sockets 1 and 2 of the interconnecting cable (prior to connecting to the iGC)
4. Carefully power-up the Host supply (or the iGC supply circuit if switchable). Confirm that the output voltage is the correct value and polarity

Caution

Do not connect the cable to the iGC until provision of correct voltage to the correct pins on the iGC connector has been checked (see Section 5 - Commissioning).

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Note: The iGC input power connection is protected against reverse polarity supply connections. If power is inadvertently connected in reverse polarity, the iGC will not power up, but will not be damaged.

Care should be taken when providing power to an iGC and iFG combined system. The iGC has a lower voltage range than the iFG. Over voltaging the iGC will result in damage.

Caution

1. When the correct iGC supply voltage has been confirmed, isolate the iGC supply and check that there is no power present on the connector sockets (pins 1 & 2)
2. Connect the female Subconn connector to the iGC
3. Carefully power-up the Host supply (or the iGC circuit if switchable)
4. Check correct operation of the iGC according to Chapter 7, *Operation*.

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5. Commissioning

5.1. General

Before starting commissioning of the iGC :

1. Refer to Chapter 1, *Safety Notices*
2. All relevant parts of this section of the manual should be read and understood
3. All electrical power and data connections must be complete and tested

5.2. Overview

If the Electrical Installation procedures in Section 4.4, “iGC Electrical Installation” have been followed correctly, the iGC should function correctly when it is powered-up for the first time.

On application of DC power, the iGC reads the Mode selector switch and calculates the required internal settings to match the required output format. Prior to entering the operational mode, the iGC transmits a configuration data packet from the RS232 port. This packet is sent at a data rate of 19,200 baud, N,8,1 and comprises a number of ASCII text messages about the iGC mode switch settings and its interpretation of these.

After 5 seconds, the iGC enters the actual output mode selected and begins to function according to the rules of the mode settings.

The reason for transmitting the configuration packet is that it allows users to check the correct operating mode and settings using a simple terminal programme (e.g. HyperTerminal) for faultfinding. Under most circumstances, the Host data interface should ignore or discard this data and begin responding to or processing the normal output telegram packets once they start.

5.3. Powering up for the first time

With the host control system powered up and ready, apply power to the iGC. Check that the correct data appears 5 seconds or so after application of power. If the data is detected and appears to be correct, the iGC data check procedures in Section 8.7 below should be followed.

If no data appears, check that the iGC connections and interfaces are all correct. A very common commissioning problem that can occur with RS232 and RS485 interfaces is that the TX and RX lines (for RS232), A+ and B- lines (for RS485) are accidentally swapped the wrong-way around.

With these lines swapped, no damage should occur but the system will not function – it is therefore safe to try swapping the telemetry connections.

If problems persist, it may be necessary to examine the data signals with an oscilloscope or a breakout box with LED indicators.

If the iGC data is still not received correctly, the output and mode settings of the iGC should be checked with a terminal programme

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5.4. Checking iGC output using a terminal programme

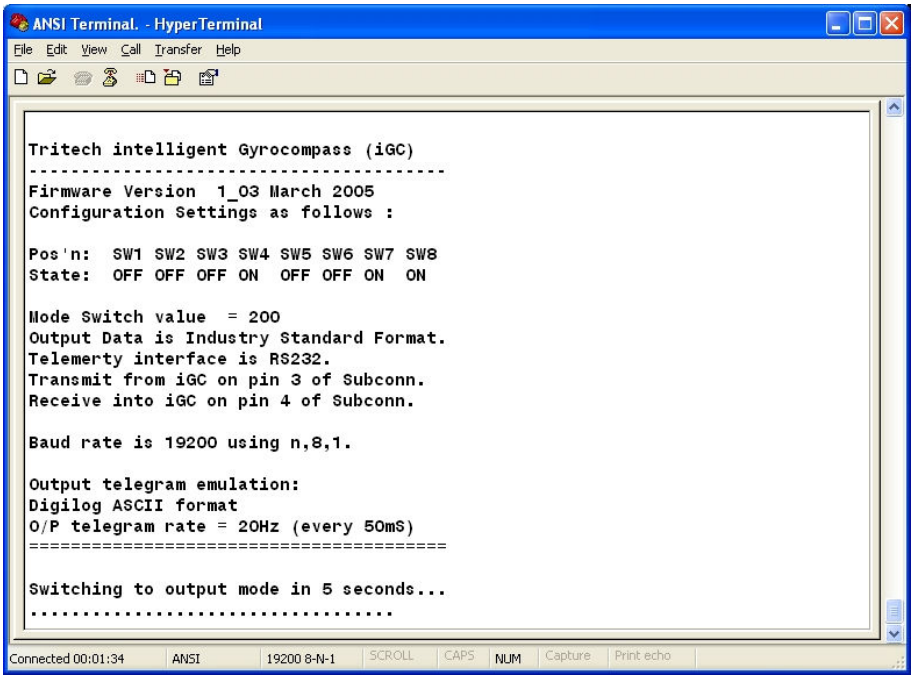
The output data from the iGC RS232 port should be connected to a PC or Laptop with an RS232 serial port using a suitable test cable.

Details of a suitable cable are found in Appendix K – the programming switch connections are not required however for this test.

Boot the PC and run up a terminal emulator programme (e.g. HyperTerminal, Procomm, Telix etc.). Select the correct COM port that the iGC is attached to in the terminal software. Note that PCs that are using a USB to Serial converter often assign a COM port above COM3. Check under Device Manager (or equivalent) to check if in doubt.

Set the terminal programme's port settings to 19,200 baud No parity, 8 data bits and 1 stop bit. Enable the terminal programme into 'connected state' if applicable.

Power up the iGC and observe the terminal output window. The configuration data message should be seen on the terminal screen – a typical output is shown below:



If the configuration screen is not seen, check the cabling and power supply to the iGC, check the terminal programme with a known good data source (or looped back from itself by connecting pins 2 & 3 of the PC com port and typing on the keyboard). Check that if using a programming cable that the programming switch is NOT in programming position.

Investigate the problem until a satisfactory configuration message is received.

In exceptional circumstances, it may be necessary to re-open the iGC and check status LEDs. Refer to Chapter 9, *Basic Fault Finding* for more details.

Once the configuration message is correctly received, it is likely that the 'live' iGC data will be received also (particularly if the output data is via the RS232 port on the iGC). For RS485 there may be additional work required to commission the interface.

For RS232 output data from the iGC, check the output telegram from the iGC using the terminal programme. For ASCII protocols this is very easy – just select the correct baud-rate on the terminal software and power up the iGC. After 5 seconds, the data should appear on the terminal display.

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Binary protocols (e.g. Proprietary iGC data or SKR80 data) are more difficult to confirm. There should however be some data received if the terminal is set at the correct baud-rate – although this data will not be easily decipherable. Note that SKR80 data only generates printable ASCII characters at certain heading angles – so rotating the iGC is sometimes required to see data on the terminal screen in this mode.

5.5. Checking iGC output on an RS485 interface

Checking the data from the iGC when connecting via the RS485 interface may require additional investigation. One method of checking the output is to use an RS485 to RS232 converter and read the data with the PC terminal. Alternatively, an oscilloscope may be required to check the state of the interface lines.

Some common RS485 problems and remedies are noted below:

1. Data lines A+ and B- crossed – this generates inverted output data that the receiving UART interprets as multiple 'Break' signals. Swap the RS485 wires and check operation – alternatively use an oscilloscope to check signal voltages

2. RS485 bus not correctly terminated – there should be a 120 ohm resistor at each end of the RS485 bus, but no more than 2 on the bus at any one time. There is a jumper (JP3) o the iGC PCB that enables this terminator

3. Signal ground not connected correctly – The RS485 interface requires that the common-mode voltage between devices is in the range –7V to +12V typically. The 0V signal ground connection between the iGC and the Host MUST be connected for reliable performance

4. Additional 'alien' devices on the RS485 bus – if the iGC RS485 bus is connected other than 'point-to-point' from iGC to Host, the other devices on the bus should be approved Tritech devices, and configured to Tritech specifications. Do not connect non-Tritech devices to the iGC RS485 bus

5. Transmitter enabled on the receiving port – The iGC only enables its transmitter for just enough time to transmit the complete telegram. At other times the transmitter is disabled and the iGC is listening for received data. If the Host interface attempts to transmit during the iGC transmissions data will be lost. If the Host enables its transmitter continually (as is done with RS422 interfaces), no data will be seen from the iGC

6. Receiver not a 'failsafe' type and receives 'Breaks' when iGC is in Receive mode – this can occur particularly with older RS485 interface circuits. The receiver does not see an idle (i.e. nobody transmitting) RS485 pair as idle data – rather it interprets this as inverse polarity (serial 'Break' characters). This can be remedied by fitting two resistors to the RS485 signal lines – a 330ohm resistor between A+ and +5V, and a 180 Ohm resistor between B- and ground. This should be done at the Host end, as the iGC is a 'failsafe' receiver device and does not suffer from this problem.

If the RS485 interface still proves difficult to diagnose, please contact Tritech for assistance.

5.6. iGC data Check procedures

Once the 'live' iGC data is received correctly via the telemetry interface with the Host, the validity of this data should be checked.

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5.6.1. Heading Checks

Heading data should be checked against a known good heading reference (e.g. surveyed Magnetic North reference line or a calibrated gyrocompass). If comparing the iGC heading against a True North seeking gyro (NSG), the appropriate corrections should be made to the NSG heading to convert it to a Magnetic North reference prior to checking the iGC.

When the North reference is confirmed, rotate the Host platform that the iGC is mounted to through 360° heading and check the correlation with the reference gyrocompass or against cardinal compass points.

If the data from the iGC is not satisfactory, following steps in Chapter 6, *Calibration* , may make improvements.

It should be noted that attempting to check magnetic heading performance on a Steel hulled / decked vessels or in close proximity to steel structures (e.g. bulwarks, handling system components etc.) may produce results that are not ideal.

5.6.2. Pitch & Roll Checks

The output of Pitch and Roll should be checked either with the Host system on a known horizontal flat surface or alternatively against a calibrated vertical reference unit. The iGC gives accurate Pitch and Roll data over the range ±50° and beyond. Pitch angles that approach 90° however cause instability with the heading output of the device. This is not a limitation with the iGC sensors, but with the mathematical angle conversions used in generating the output data. If users require pitch angles to be measured beyond ±60°, please contact Tritech for an alternative firmware implementation that does not suffer from this problem.

Note that only certain Industry Standard telegram formats include the Pitch and Roll data, so if this data is not requested it cannot be checked.

5.6.3. Heave Acceleration Data Checks

In certain modes, the iGC transmits the raw heave acceleration from its ‘z-axis’ accelerometer sensor. This can be used for heave compensation systems or for other navigation / survey purposes.

If the selected operating mode supports this output, check that with the system at rest the output is nominally 1.00g acceleration or -9.81 ms^{-2} depending on the selected telegram format. By moving the iGC up and down, a change to the heave acceleration should be seen. Note that certain telegram formats show the acceleration due to gravity, and others remove this offset prior to transmission.

Note that this output is referenced to the vertical iGC axis, not to ‘earth’ frame. It follows that the output at pitch and roll angles other than 0° will give a heave acceleration figure approximately equal to the measured Heave multiplied by the combined cosine of the pitch and roll angles.

5.6.4. Water Ingress Alarm Checks

Inside the iGC there is a water ingress detector, comprising two gold pins that extend from the interface PCB down to the lowest point inside the iGC housing. See photograph below for details:

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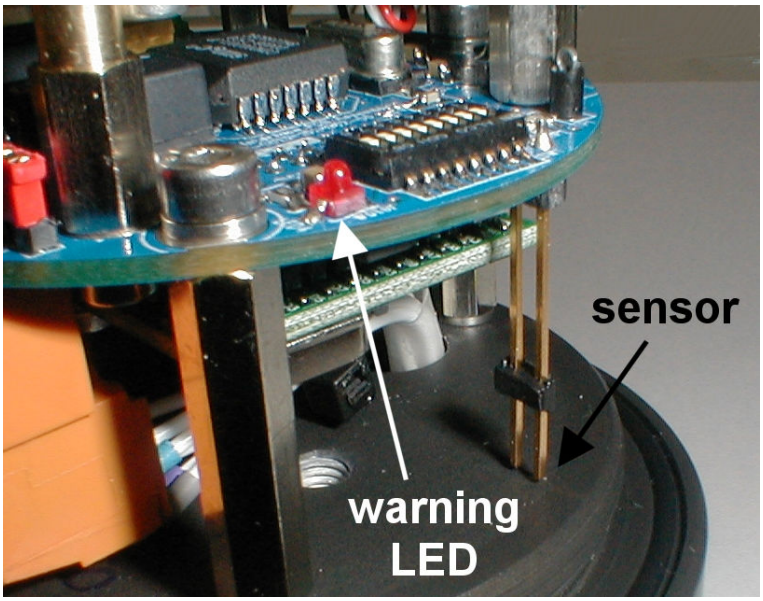

Certain output formats support the transmission of a Water ingress alarm. If used in one of these modes, during checks the water ingress signal should be ‘Dry’. If not, the reasons for this should be investigated before operating the system underwater.

When the interface PCB detects a water ingress condition, the Red LED (shown in the photograph) illuminates. The water ingress sensor function can be checked by placing a wet finger (or a resistance less than 300kohm) across the sensor pins.

5.6.5. Other Data Checks

In iGC Proprietary data formats, additional data such as iGC temperature, serial number etc. are available. These can be checked using the iGC Navigation Software.

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6. Calibration

6.1. Introduction

If the iGC has been mounted to align closely with the host system's axes and away from the magnetic influence of other equipment, it is expected that, in the majority of cases, no further calibration will be required.

If the full accuracy of the iGC is needed then the system can be calibrated and the necessary offsets applied.

Note

For this to be achieved, additional measuring equipment for heading, pitch and roll will be required. This equipment should have greater accuracy and resolution than the values that are to be calibrated.

6.2. Physical Offsets

If the iGC has been mounted with reasonable care and with normal manufacturing tolerances, it is expected that in the majority of cases no further calibration will be required.

If the full accuracy of the iGC is needed then the system can be calibrated and offsets applied either mechanically or by using the Host system's control software or the iGC Navigation software (whichever is being used).

To calibrate the iGC mechanically its mounting bracket should be designed to incorporate vernier adjustment on the axes to be calibrated.

With the vehicle's pitch, roll and heading measured or set to known values (e.g. 0° pitch and roll and known magnetic heading), the mounting bracket is adjusted until the iGC outputs match the measured reference values.

Where the Host system's own software is used to process and display the iGC data, fixed offsets to heading, pitch and roll data can be applied within this software (if this facility is catered for in the software application).

Where the supplied iGC Navigation software is used, heading, pitch and roll offsets can be easily applied from the system set-up screen. These offsets are added in the PC software only, and will adjust the live data as it is displayed. They do not adjust the actual output data from the iGC.

6.3. Magnetic Offsets

Magnetically generated offsets that remain after mounting the iGC as far away from magnetic influences as possible can in certain cases be calibrated out by conducting a compass swing calibration procedure.

This procedure typically involves connecting a calibration PC directly to the iGC (with the iGC in Raw data interface mode as selected by tying pin 7 of the Subconn connector to ground) and rotating the Host system to a known heading and inputting this value to the

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calibration software on the PC. The iGC then compares this with its measured heading and stores the difference. This procedure is repeated for various points around the compass. Upon completion of the swing routine, the iGC constructs an offset curve by extrapolating between the measured points and stores this in memory.

The more points visited during the swing, the more accurate the final offset curve will be. The minimum number of points is four approximately equally spaced close to the cardinal points of the compass. If this procedure is required, please contact Tritech for full details / procedures and the appropriate calibration software.

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7. Operation

7.1. Introduction

Operation of the iGC depends mainly on its application, but in general the iGC transmits the requested output data in the desired format, commencing this transmission immediately after power-up and continually until the unit is switched off.

Making the best use of the output data is the user's responsibility, but Tritech can offer valuable assistance to ensure that the performance of the sensor is maximised.

7.2. Data Output Formats

7.2.1. Proprietary Outputs

Proprietary operating modes are selected by setting the mode switch position SW8 to the OFF position.

The proprietary modes are mainly used in applications where the iGC is interfaced with other Tritech iGC product family devices or directly to the iGC Navigation software.

There is also a fixed-length ASCII output proprietary mode that provides additional iGC data to 'Industry Standard' ASCII formats. This mode is useful where specific telegram decoding / parsing can be implemented by the Host system.

Full details of the output data formats in Proprietary modes can be found in Appendix D, *iGC Mode Listing - Proprietary iGC Outputs*.

Note

Modes 0 to 47 are not user interpretable and are only usable via the iGC Navigation Software - see Section 7.4, " Using iGC Navigation Software " for more details.

7.2.2. Industry Standard Outputs

The iGC emulates a large number of commonly used heading sensors. In the Industry Standard emulation modes, data telegrams are transmitted at data rates and in formats that match the original heading sensors they are emulating.

Emulated modes are selected by setting the mode switch position SW8 into the ON position.

Full details of the output data formats in Proprietary modes can be found in Appendix D, *iGC Mode Listing - Proprietary iGC Outputs*.

7.2.3. Special Modes

For special applications, a non-standard data telegram may be required to interface with existing equipment or software. Normally data in a non-standard format can be implemented

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for no additional cost – if requested at the time of purchase of the iGC. If requested after delivery, a nominal charge may be made for providing updated firmware to support the required output.

7.3. Operational Issues

During operations, the iGC may be used in areas where external magnetic influences cause a deviation to the heading output data. Under these conditions, the data should be used with caution.

If problems from magnetic influences are regularly encountered, the addition of an iFG to the heading sensor system will provide significant improvements.

If the iGC is used in applications where the pitch angle goes beyond around 70° from vertical, the standard mathematical data processing methods will cause anomalies with the heading data until 90° is reached, at which point the heading data will be unstable. If this type of use is expected, please contact Tritech and the firmware conversion routines can be changed to support correct operation over the full 360° pitch range.

7.4. Using iGC Navigation Software

The iGC PC software is a stand-alone application that provides the user with a real-time display of Heading, Pitch, Roll, turns counter, heave and iGC status. Normally this software is used where the iGC is not integrated to a complete host control system, but it can be used in parallel with an existing host control system, providing certain interface criteria are met.

The software operates under the Windows® operating system, and provides a clear graphical display of iGC data. There are various options selectable by the User in the software that allows integration with different iGC configurations. It is also a useful tool for faultfinding, commissioning and setting up iGC applications.

The minimum requirements of the host PC are as follows:

1. 1GHz Pentium 3 or 4 (or AMD equivalent)
2. Windows OS
3. 256MB RAM
4. 200MB Free disk space
5. 1 x RS232 serial port (or USB port for USB to RS232 converter)
6. 1024 x 768 display
7. CD ROM drive

The Navigation Display presents the following information:

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Display Item	Description
Analogue Heading	Animated rotating compass card – this shows instantaneous output of the active heading sensor output.
Digital Heading	Numeric display of the active heading sensor output to 1 decimal place.
Digital Reciprocal	Numeric display of the active heading sensor reciprocal heading output to 1 decimal place.
Analogue Pitch	Animated artificial horizon display of iGC pitch sensor. ±30° range.
Digital Pitch	Numeric display of the iGC pitch sensor output to 1 decimal place. ±90° range.
Analogue Roll	Animated artificial horizon display of iGC pitch sensor. ±90° range.
Digital Roll	Numeric display of the iGC roll sensor output to 1 decimal place. ±90;deg; range.
Analogue Heave	Animated heave acceleration sensor display. +30 to –40 ms^{-2} range.
Digital Heave	Digital heave acceleration sensor display to 1 decimal place. ±99ms^{-2} range.
Turns Counter	Digital display of number of turns made by iGC system since power-up or last reset. Range ±9.9 turns to 1 decimal place.
iGC Temperature	Digital display of iGC internal temperature. –9.9°C to +70°C range to 1 decimal place.
System Time	Digital display of PC system time in format hh:mm:ss
Telemetry Status	LED indicator showing telemetry status of iGC, iFG, iIF, North-Seeking Gyro (survey gyro / NSG) and Seanet SCU. LED colours as follows: Red – Comms failed or absent Green – Comms good Grey – No comms expected (not enabled) Yellow – Comms failed or absent
Sensor Status Box	Text description of each sensor's status.
Heading Source	Indicators to show the source of the current displayed heading. This can be one of the following: *iGC* – This is the iGC heading output alone. *iFG Relative* – This is the iFG relative heading output prior to a valid iGC heading having been received. *iFG Unslaved* – This is the iFG heading after having been slaved to the iGC, but the iGC data stream has been lost (or the slaving function has been switched off). *iFG / iGC Slaved* – This is the ideal output mode where the iFG is providing stabilised heading output with magnetic slaved corrections from the iGC. *Survey Gyro* – Where a survey gyro or North-seeking Gyro is used with the system, this shows when the NSG is providing the active displayed heading data.
System Alarm	Illuminates Red when any system alarm is detected (e.g. telemetry failure, water ingress etc.).
Turns Counter "Reset Button"	Resets the turns counter to 0.0 turns.
Setup Button	Accesses the set-up and configuration screen(s).
Exit Button	Quits the application.

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Typical screenshot:

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8. Maintenance

8.1. Safety

Before commencing installation of the iGC:

1. Refer to Chapter 1, *Safety Notices*
2. All relevant parts of this section of the manual should be read and understood

8.2. General

The iGC is designed for low maintenance operation using corrosion resistant materials, and generally speaking does not require any preventative maintenance.

In addition there are no user serviceable parts inside the iGC.

8.3. Seals

Seal integrity is vital for the continued reliability of the iGC. There are two ‘O’-ring seals in the assembly – one between the dome and end-cap and the other between the Subconn connector and end-cap. The following should be noted:

1. Any time that a seal is disturbed, before replacement in the iGC it should be thoroughly cleaned and inspected for damage
2. The seal housing should be thoroughly cleaned and inspected for damage
3. Any damaged seals or components with damaged sealing faces should be replaced with new components
4. All replacement seals should be correctly specified as per the iGC parts lists
5. Never use ‘O’-rings made up by gluing cord to the correct length
6. When replacing an ‘O’-ring, use an approved ‘O’-ring grease (such as Dow Corning 111 silicone compound) sparingly and make sure that all surfaces are kept clean during the process of replacement
7. The ‘O’-rings fitted to the iGC have a recommended service life of seven years
8. Spare ‘O’-rings should be stored in suitable UV light proof bags or containers

8.4. Basic Maintenance Procedure

8.4.1. Pre and Post Dive Checks

1. Check that the interconnecting cable is secure and undamaged

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2. Check that the mountings are secure
3. Visually check the iGC for external damage to the anodised surfaces
4. Function check the system as appropriate

8.4.2. Storage

If the iGC is taken out of service, the connector should be cleaned and blanked off and the unit thoroughly washed with fresh water.

Repair any damage to the anodised surfaces of the iGC as per the procedure in Section 8.5, “ Procedure For Repair of Anodised Surfaces ”.

8.5. Procedure For Repair of Anodised Surfaces

Every effort should be made to preserve the integrity of the anodised surface on the iGC. If the anodised layer is broken, the following procedure should be followed in order to minimise damage to the affected component:

1. Mechanically remove all visible corrosion products to get a clean metal surface
2. Clean the affected area
3. Apply an etch primer to the affected area, following the manufacturer’s instructions
4. Apply a suitable paint coating(s) to the etch primer, following the manufacturer’s instructions

Note: If the damaged area extends to and over a sealing surface the component should be replaced.

8.6. Flooding

If the iGC is flooded for any reason, then speed is of the essence. If the system software / interface supports the water ingress sensor signal, the iGC should be powered down immediately that the sensor detects water ingress.

After ensuring that pressure is not trapped inside the pressure vessel (see disassembly procedure), the iGC should be opened and inspected. If the unit has suffered a significant leak and the PCBs have become contaminated with seawater, the entire assembly should be washed in clean fresh water, preferably by immersion. After washing, excess water should be removed carefully by blowing clean with an airline, and the assembly should be sprayed with a water displacing fluid (e.g. WD40) and excess blown off again.

After serious flooding it is recommended that the iGC returned to Tritech for repair.

If however the leakage into the iGC is only very minor and the PCBs have not become contaminated, it may be possible to clean the internals without immersing in fresh-water. Under these circumstances, the seawater should be dried off and a de-watering fluid (e.g. WD40) used to displace any traces of water. It is recommended that the Subconn connector be removed and the ‘O’-ring replaced after flooding, and at this time any traces of seawater that bay have entered the connector wire gallery should be removed.

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In all cases it is recommended that the unit be returned to Tritech for repair / test and pressure testing prior to returning to service.

8.7. Dismantling and Re-assembly

Before starting to dismantle the iGC:

1. Refer to Section 4.2 - Safety Notes at the beginning of this manual.
2. All relevant parts of this section of the manual should be read and understood
3. Refer to the Appendices for details of exploded views and identification of components
4. Ensure that power to the iGC has been turned off, the connector disconnected and the iGC removed to a suitable workshop environment

The main components inside the iGC include:

1. Sensor Assembly (Item 3), which consists of the top two boards
2. Interface PCB Assembly (Item 4) – the blue circular PCB
3. Processor module (Item 24) – the small PCB underneath the interface PCB
4. Underwater connector tails and orange interface connector (Item 11)

The Sensor Assembly, Interface PCB and Processor module should be regarded as a single replaceable unit.

8.7.1. Removal of Pressure Dome

The procedure for removal of the dome is as follows:

1. Thoroughly clean and de-grease the outside of the iGC
2. Unscrew the dome (Item 1) from the end cap (Item 2). Normally this can be done by hand with the assistance of clean rubber gloves (or rubber sheet) to improve grip on the smooth anodised surface. If additional torque is required a pair of strap wrenches can be used, or fasteners can be inserted into the end cap to allow it to be held in a vice and a strap wrench then used to unscrew the dome.

In all cases care must be taken to avoid damaging the anodising.

8.7.2. Removal Of Sensor Assembly, Interface PCB and Processor Module

The procedure for removal of the Sensor Assembly, Interface PCB and Processor Module (as a single unit) is as follows:

1. Remove the dome (Item 1)
2. Unscrew the two cross head screws (Item 16) that attach the two regulators to the heatsink block projecting from the end cap base. Remove the washers (Item 13), small plastic insulating bushes (Item17) and the flat insulating washer (Item18) and store carefully
3. Unscrew the three M3 socket head cap screws (Item 12) that attach the Interface PCB (Item 4) to the three hexagonal spacers (Item 10)

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4. Raise the stack of PCBs together and remove the cable end plug (Item 11) from the orange connector on the Interface PCB.

8.7.3. Removal Of the Underwater Connector

The procedure for removal of the underwater Subconn connector is as follows:

1. Remove the Sensor Assembly, Interface PCB and Processor Module
2. Using a 2.5mm flat-blade screwdriver, remove the connector wires from the plug (Item 11)
3. Using a box spanner or a deep socket (19mm A/F), slacken the connector. Holding the iGC end-cap (Item 2) in a vice by means of two M5 screws in the mounting holes is the easiest way to react the torque required to slacken the connector
4. Remove the cable tie from the connector tails. Carefully unscrew the connector and at the same time, turn the connector wire tails inside the wire gallery. When fully slackened, carefully feed the wires through the gallery and pull the connector clear. It may be necessary to remove the bootlace ferrules, or alternatively pull the wires through in stages.

8.7.4. Replacement Of the Underwater Connector

The procedure for replacing the underwater Subconn connector is as follows:

1. If a new connector is to be used, attach heat-shrinkable wire numbers (1-8) to the wire tails and cut tails to the same length as the removed connector
2. Fit a 30mm length of 4.8mm diameter heatshrink over the connector wire tails. This is used to protect the wire tails from abrasion when the connector is screwed into the endcap
3. Remove, clean, re-grease and re-fit the connector sealing ‘O’-ring. Ensure that the ‘O’-ring groove is clean
4. Insert the wires into the connector hole and carefully screw the connector into the endcap while turning the wires to avoid twisting them
5. When fully home, re-torque the connector with a 19mm A/F box-spanner or deep socket
6. If previously removed or a new connector is being installed, strip wires and fit new bootlace ferrules to the connector tails. Crimp in place
7. Insert the wires into the 8-way orange connector (Item 11) and tighten with a 2.5mm flatblade screwdriver. Wires are connected in sequence from pin 1 to 8 of the PCB connector attached to pins 1-8 of the Subconn. Pin 1 of the PCB connector is identified by the square pad on the topside of the PCB (it is at the end closest to the regulators).

8.7.5. Replacement Of Sensor Assembly, I/F PCB and Processor Module

The procedure for replacement of the Sensor Assembly, Interface PCB and Processor Module (as a single unit) is as follows:

1. Insert the PCB stack between the pillars and secure with the 3 x M3 cap screws to the pillars. Engage the 8-way orange connector when lowering the PCBs into position
2. Slide the insulating washer (Item 18) between the mounting block on the end-cap and the two regulators. Position this washer so that the holes align with the regulator holes and tapped holes in the end-cap

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3. Fit the small black plastic insulating bushes (Item 17) into the regulator tabs. Screw in the 2 x M3 screws and washers (Items 16 & 13). Do not overtighten

4. Check tightness of the 3 x M3 Interface PCB retaining screws

5. Using a multimeter, check that there is no electrical continuity between the tab of both regulators and the iGC end-cap. There is a threaded hole on the inside surface of the end-cap that facilitates electrical continuity for checking. This is important, as a short circuit between the regulator tabs and the iGC housing may cause rapid corrosion of the iGC housing. If continuity is measured, check the positioning of the insulating washer and bushes

6. Refit dome and function-check

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9. Basic Fault Finding

9.1. General

This section is intended to help with fault finding down to easily replaceable components (i.e. to PCB assembly level).

The following are guidelines on how to approach the diagnosis of a fault in the system:

1. Assemble all relevant information on the iGC and any other systems that interface with the iGC. This might include:
   a. Manuals
   b. System drawings (particularly electrical diagrams)
2. Have a good set of diagnostic tools
3. Start at the general & work towards the particular
4. Use all the information available. For example:
   a. Are any other systems malfunctioning?
   b. Are all functions malfunctioning or just one or a few?
   c. Are there connections between these faults?

9.2. Fault Symptoms

The following table gives a list of fault symptoms with components to check in order to narrow down the cause of the likely fault. This should act as a pointer towards which items should be replaced.

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Symptom	Suggested Action
No output data from iGC.	Check that power is applied. Under normal conditions, the iGC feels warm to the touch when switched ON – this can be used as a quick check that power is present.
No power present on pins 1 & 2 of the interconnecting cable.	Check that the supply is switched on. Check status of fuses, or output from power supply. Check continuity of interconnecting cable.
No output data from iGC, but power is present at the interface connector.	Check interconnecting cable. Remove cable and check continuity of wiring and insulation value. More than 50% of underwater system faults are attributable to cables and connectors.
No output data from iGC received by host, but cable checks OK.	Attach a test-cable, Laptop and power supply to the iGC and check correct operation. If data is OK from iGC, investigate the host system telemetry interfaces.
No output data from iGC when tested with test cable and laptop.	Use a terminal programme set to 19,200 n, 8, 1 and check for configuration output message when the iGC is powered up. Refer to Chapter 5, *Commissioning* for details of what to expect. If configuration data looks OK, check host interface for correct operation / function.
No configuration output data from iGC ant 19k2 on start-up.	Check that Laptop is set to the correct COM port and that the terminal emulator is working OK (do a loopback test by shorting pins 2 & 3 of COM port connector on laptop).
No configuration output data from iGC, Laptop checked OK	Open up iGC and check for damage / water ingress and status LED function. When switched on, the green power LED should be illuminated. The green status LED should flicker as data is transmitted, the red Reset LED should flash once when power is first applied, then go dark.

9.3. Firmware Reprogramming

If required, the unit should be returned to *Tritech International Ltd* in order to reprogram the unit with firmware.

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Appendix A. iGC Technical Specifications

Note
Values given are for iGC without iFG Stabilisation.

Orientation range	360° heading axis 360° roll axis ±90° pitch axis with standard firmware (360° optional)
Angular velocity range	±300° per second (max)
Sensor types	3 sensors on each axis (9 in total) 3 x magnetometers 3 x rate gyros 3 x accelerometers
Sensor resolution	16 bit
Dynamic compensation	Closed loop digital control (0-50Hz)
Orientation angle resolution	<0.1°
Typical accuracy	Better than 1°
Temperature drift	± 0.025% °C
Nonlinearity	0.23% full-scale (tested in static conditions)
Repeatability	0.2°
Output modes	Full range of industry standard outputs, proprietary iGC formats and special formats.
Sesnor range	Rate gyros: ±300° per second full-scale Accelerometers: ±5g full-scale Magnetometers: ± 1 Gauss full-scale
Output hardware interfaces	RS232 and RS485
Output data rate	20Hz (typical) Other output rates dependent on output format
Serial data rate	2400, 4800, 9600, 19200, 38400 as standard Output rate dependent on output format
Power requirements	12-26VDC at 250mA (typical)
Operating temperature	-20°C to +50°C operating
Weight in air	0.95kg
Weight in water	0.45kg
Diameter	79mm
Height	121.5mm

Notes:

1. Specifications are correct at time of issue, but are subject to change in line with Tritech's policy of continual product development.
2. Quoted accuracies are based on typical performance tests.

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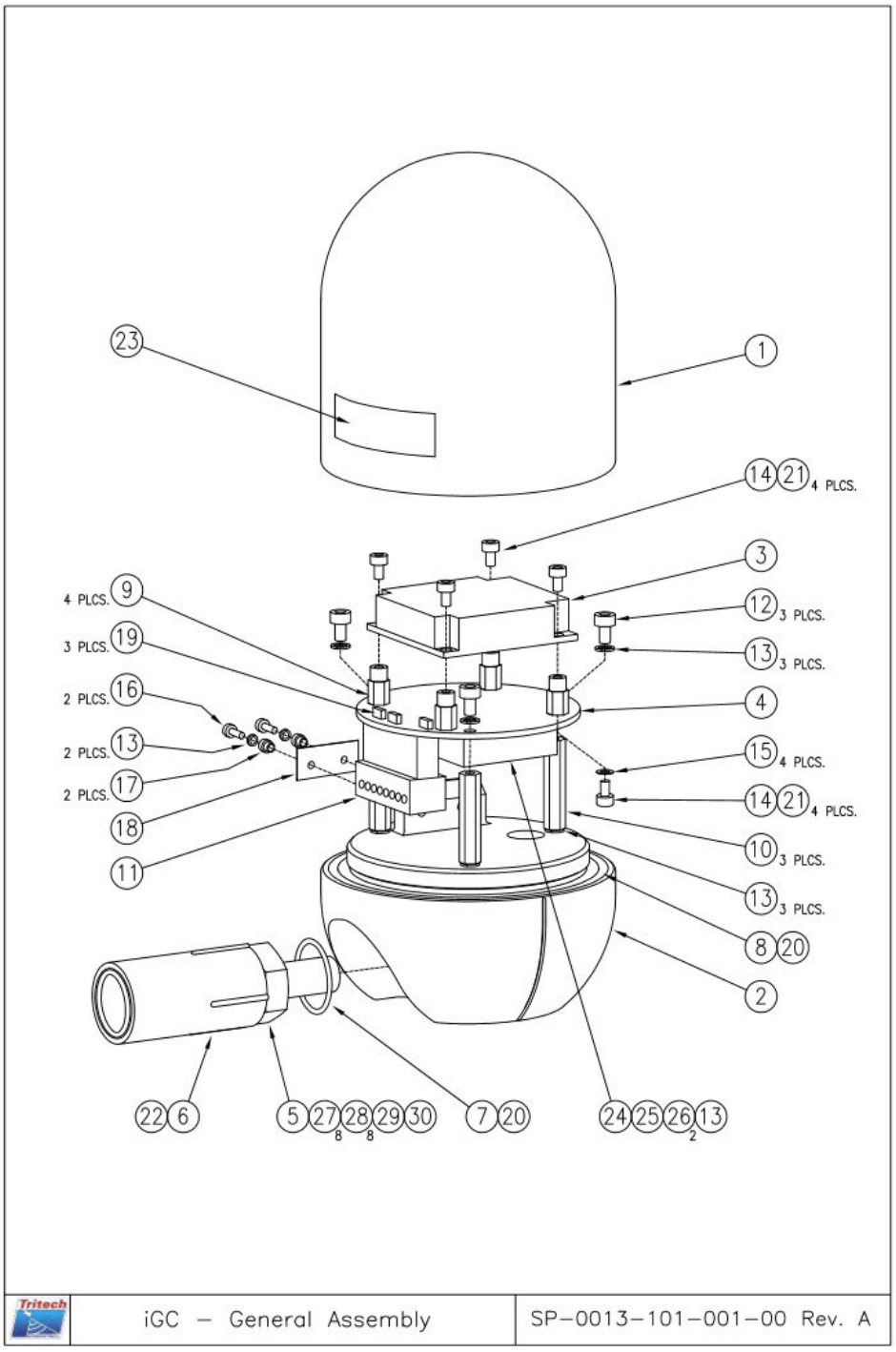
Appendix B. General Assembly Drawing



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Appendix C. iGC Bill of Materials

Item	Qty	Description	Part No.
1	1	Dome	SP-0013-101-001-01
2	1	End Cap	SP-0013-101-001-02
3	1	Sensor Assembly	SP-0013-101-003-00
4	1	iGC Interface PCB Assembly	SP-0013-101-002-00
5	1	Subconn 8-way micro bulkhead male connector (SS)	MCBH8MSS
6	1	Subconn Locking sleeve	MCDLSF
7	1	Subconn connector 'O'-ring	SP-0013-101-001-00-7
8	1	'O'-ring	200-039
9	4	M2.5 mounting pillar	SP-0013-101-002-01
10	3	M3 mounting pillar	SP-0013-101-002-02
11	1	8 -way screw terminal connector	SP-0013-101-001-00-11
12	3	M3 x 6mm lg. Skt. head cap screw - st. stl.	SP-0013-101-001-00-12
13	9	M3 spring washer - st. stl.	SP-0013-101-001-00-13
14	8	M2.5 x 6mm lg. Skt. head cap screw	SP-0013-101-001-00-14
15	4	M2.5 plain washer	SP-0013-101-001-00-15
16	2	M3 x 10mm lg. Pan head pozi m/v screw - st. stl.	SP-0013-101-001-00-16
17	2	TO-220 insilating bush	SP-0013-101-001-03
18	1	Insulating washer	SP-0013-101-001-04
19	3	2mm Jumper link (typ. red)	SP-0013-101-001-00-19
20	-	Silicone grease	111
21	-	Thread locking compound	222
22	1	Subconn Locking sleeve circlip	SP-0013-101-001-00-22
23	1	Identification / Serial No. Label	SP-0013-101-001-05
24	1	Processor module	SP-0013-101-001-06
25	1	M3 x 6mm lg. Pan head pozi m/c screw - st. stl.	SP-0013-101-001-00-25
26	2	M3 red fibre washer	SP-0013-101-001-00-26
27	8	Heat-shrinkable wire ident markers	SP-0013-101-001-00-27
28	8	Bootlace ferrule 0.34mmsq	SP-0013-101-001-00-28
29	1	30mm length 4.8mm clear heatshrink	SP-0013-101-001-00-29
30	1	100mm lg. Cable tie	SP-0013-101-001-00-30

Notes:

1. Spares are available from Tritech by quoting BOM and item number
2. Refer to Recommended Spares List for cross-reference
3. To maintain warranty and get the best performance from the iGC, only use genuine spare parts

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Appendix D. iGC Mode Listing - Proprietary iGC Outputs

		Baud rate selection [off][off]=19200, [on][off]=9600, [off][on]=4800, [on][on]=38400														
		Hardware Protocol [off][off]=RS232, [on][off]=RS485, [off][on]=N/A, [on][on]=N/A														
		Proprietary Mode (8 possible selections)														
		Protocol type - [off] = iGC Proprietary, [on] = Industry Standard														
Telegram Code	**Mode Code**	**SW 1**	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**SW 6**	**SW 7**	**SW 8**	**Telegram Description**	**Protocol**	**Baud Rate**	**Params**	**Rate (Hz)**	**Notes**	**Applicable Firmware**
0	0	off	off	off	off	off	off	off	off	Standard iGC Packet output - Streaming @ 20Hz	RS232	19200	n,8,1	20	Standard binary output packet in iGC Proprietary format - streamed ouput Contents: Heading, Pitch, Roll, Heave acceleration, CRC. Will accept command requests and poll commands for extended packets	1.03
	1	ON	off	off	off	off	off	off	off	Standard iGC Packet output - Streaming @ 20Hz	RS232	9600	n,8,1	20		
	2	off	ON	off	off	off	off	off	off	Standard iGC Packet output - Streaming @ 20Hz	RS232	4800	n,8,1	20		
	3	ON	ON	off	off	off	off	off	off	Standard iGC Packet output - Streaming @ 20Hz	RS232	38400	n,8,1	20		
	4	off	off	ON	off	off	off	off	off	Standard iGC Packet output - Streaming @ 20Hz	RS485	19200	n,8,1	20		
	5	ON	off	ON	off	off	off	off	off	Standard iGC Packet output - Streaming @ 20Hz	RS485	9600	n,8,1	20		
	6	off	ON	ON	off	off	off	off	off	Standard iGC Packet output - Streaming @ 20Hz	RS485	4800	n,8,1	20		
	7	ON	ON	ON	off	off	off	off	off	Standard iGC Packet output - Streaming @ 20Hz	RS485	38400	n,8,1	20		
	8	off	off	off	ON	off	off	off	off							
	9	ON	off	off	ON	off	off	off	off							
	10	off	ON	off	ON	off	off	off	off							
	11	ON	ON	off	ON	off	off	off	off							
	12	off	off	ON	ON	off	off	off	off	Mode not available						
	13	ON	off	ON	ON	off	off	off	off							
	14	off	ON	ON	ON	off	off	off	off							
	15	ON	ON	ON	ON	off	off	off	off							
1	16	off	off	off	off	ON	off	off	off	Extended iGC Packet output - Streaming @ 20Hz	RS232	19200	n,8,1	20	Extended binary output packet in iGC Proprietary format - streamed output Contents: Heading, Pitch, Roll, Heave acceleration, Serial No., Temperature, status, CRC. Will accept command requests and poll commands for extended packets	1.03
	17	ON	off	off	off	ON	off	off	off	Extended iGC Packet output - Streaming @ 20Hz	RS232	9600	n,8,1	20		
	18	off	ON	off	off	ON	off	off	off	Extended iGC Packet output - Streaming @ 10Hz	RS232	4800	n,8,1	10		
	19	ON	ON	off	off	ON	off	off	off	Extended iGC Packet output - Streaming @ 20Hz	RS232	38400	n,8,1	20		
	20	off	off	ON	off	ON	off	off	off	Extended iGC Packet output - Streaming @ 20Hz	RS485	19200	n,8,1	20		
	21	ON	off	ON	off	ON	off	off	off	Extended iGC Packet output - Streaming @ 20Hz	RS485	9600	n,8,1	20		
	22	off	ON	ON	off	ON	off	off	off	Extended iGC Packet output - Streaming @ 10Hz	RS485	4800	n,8,1	10		
	23	ON	ON	ON	off	ON	off	off	off	Extended iGC Packet output - Streaming @ 20Hz	RS485	38400	n,8,1	20		
	24	off	off	off	ON	ON	off	off	off							
	25	ON	off	off	ON	ON	off	off	off							
	26	off	ON	off	ON	ON	off	off	off							
	27	ON	ON	off	ON	ON	off	off	off	Mode not available						
	28	off	off	ON	ON	ON	off	off	off							
	29	ON	off	ON	ON	ON	off	off	off							
	30	off	ON	ON	ON	ON	off	off	off							

		Baud rate selection [off][off]=19200, [on][off]=9600, [off][on]=4800, [on][on]=38400													
		Hardware Protocol [off][off]=RS232, [on][off]=RS485, [off][on]=N/A, [on][on]=N/A													
		Proprietary Mode (8 possible selections)													
		Protocol type - [off] = iGC Proprietary, [on] = Industry Standard													
Telegram Code	**Mode Code**	**SW 1**	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**SW 6**	**SW 7**	**SW 8**	**Telegram Description**	**Protocol**	**Baud Rate**	**Params**	**Rate (Hz)**	**Notes**	**Applicable Firmware**
	31	ON	ON	ON	ON	ON	off	off	off							
2	32	off	off	off	off	off	ON	off	off	Polled iGC Packet Output	RS232	19200	n,8,1	20	Standard binary output packet in iGC Proprietary format - polled outputs only. Contents: Standard or Extended packets, Special packets and industry standard packets depending on poll command. Will accept ad-hoc command requests and all poll commands.	1.03
	33	ON	off	off	off	off	ON	off	off	Polled iGC Packet Output	RS232	9600	n,8,1	20		
	34	off	ON	off	off	off	ON	off	off	Polled iGC Packet Output	RS232	4800	n,8,1	10		
	35	ON	ON	off	off	off	ON	off	off	Polled iGC Packet Output	RS232	38400	n,8,1	20		
	36	off	off	ON	off	off	ON	off	off	Polled iGC Packet Output	RS485	19200	n,8,1	20		
	37	ON	off	ON	off	off	ON	off	off	Polled iGC Packet Output	RS485	9600	n,8,1	20		
	38	off	ON	ON	off	off	ON	off	off	Polled iGC Packet Output	RS485	4800	n,8,1	10		
	39	ON	ON	ON	off	off	ON	off	off	Polled iGC Packet Output	RS485	38400	n,8,1	20		
	40	off	off	off	ON	off	ON	off	off	Mode not available						
	41	ON	off	off	ON	off	ON	off	off							
	42	off	ON	off	ON	off	ON	off	off							
	43	ON	ON	off	ON	off	ON	off	off							
	44	off	off	ON	ON	off	ON	off	off							
	45	ON	off	ON	ON	off	ON	off	off							
	46	off	ON	ON	ON	off	ON	off	off							
	47	ON	ON	ON	ON	off	ON	off	off							
3	48	off	off	off	off	ON	ON	off	off	Standard iGC ASCII output - Streaming @ 20Hz	RS232	19200	n,8,1	20	Standard ASCII output packet in iGC ASCII format - streamed ouput. Contents: Fixed length (27 chars) ASCII telegram in format: HhhhhPspppRsrrrrZsaaaafw<CR><LF> where: H is a 'H' character hhhh is ASCII heading in degrees * 10, packed with leading zero(es) P is a 'P' character, s is + or - sign, pppp is pitch angle in degrees * 10 R is an 'R' character, s is + or - sign, rrrr is roll angle in degrees * 10 Z is an 'Z' character, s is + or - sign, aaaa is heave accel. in ms^{-2} * 100 (-0981 at rest) f is flag 'E' is OK, 'N' is invalid data; w is WIA status 'D' for dry, 'W' for wet.	1.03
	49	ON	off	off	off	ON	ON	off	off	Standard iGC ASCII output - Streaming @ 20Hz	RS232	9600	n,8,1	20		
	50	off	ON	off	off	ON	ON	off	off	Standard iGC ASCII output - Streaming @ 20Hz	RS232	4800	n,8,1	20		
	51	ON	ON	off	off	ON	ON	off	off	Standard iGC ASCII output - Streaming @ 20Hz	RS232	38400	n,8,1	20		
	52	off	off	ON	off	ON	ON	off	off	Standard iGC ASCII output - Streaming @ 20Hz	RS485	19200	n,8,1	20		
	53	ON	off	ON	off	ON	ON	off	off	Standard iGC ASCII output - Streaming @ 20Hz	RS485	9600	n,8,1	20		
	54	off	ON	ON	off	ON	ON	off	off	Standard iGC ASCII output - Streaming @ 20Hz	RS485	4800	n,8,1	20		
	55	ON	ON	ON	off	ON	ON	off	off	Standard iGC ASCII output - Streaming @ 20Hz	RS485	38400	n,8,1	20		
	56	off	off	off	ON	ON	ON	off	off							
	57	ON	off	off	ON	ON	ON	off	off							
	58	off	ON	off	ON	ON	ON	off	off							
	59	ON	ON	off	ON	ON	ON	off	off							
	60	off	off	ON	ON	ON	ON	off	off							
	61	ON	off	ON	ON	ON	ON	off	off							
	62	off	ON	ON	ON	ON	ON	off	off							
	63	ON	ON	ON	ON	ON	ON	off	off							

Appendix E. iGC Mode Listing - Special Modes

										Protocol type - [off] = iGC Proprietary, [on] = Industry Standard						
Telegram Code	Mode Code	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	Telegram Description	Protocol	Baud Rate	Params	Rate (Hz)	Notes	Applicable Firmware
4	64	off	off	off	off	off	off	ON	off	Mode not available						
5	65	ON	off	off	off	off	off	ON	off	TSS1 on RS485, HEHDT on RS232	232 & 485	19200	n,8,1 both	20	TSS1 heave, pitch & roll (modified) on RS485 port. NMEA HEHDT on RS232 port	1.03
6	66	off	ON	off	off	off	off	ON	off	Watson ASCII AHRS-E304 for Perry - Type 1	RS232	9600	n,8,1	10	I HHH.H +rr.r +pp.p +hh.h +RR.R +PP.P +TT<cr> 42 chars pitch + is bow UP	>= 1.06
7	67	ON	ON	off	off	off	off	ON	off	Watson ASCII AHRS-E304 for Perry - Type 2	RS232	9600	n,8,1	10	I HHH.H +rr.r +pp.p +hh.h +RR.R +PP.P +TT<cr> 42 chars pitch + is bow DOWN	>= 1.06
8	68	off	off	ON	off	off	off	ON	off	TCM2 Data String	RS232	9600	n,8,1	10	$Cxxx.xPxx.xRxx.x*6C<CR><LF>	>= 2.02
9	69	ON	off	ON	off	off	off	ON	off	iGC Expanded OEM Data	RS485	115200	n,8,1	40	Hnnn.nnnr+n.nnnnP-nnn.nq-n.nnnnR-nnn.np+n.nnnnX-nn.nnnY +nn.nnnZnnnZnn.nnnfw<CR><LF> H is a 'H' character, nnn.nnn is ASCII heading in degrees * 1000, packed with leading zero(es) r is a 'r' character, + or - sign, n.nnnn is heading rate in rad/s * 10000 P is a 'P' character, + or - sign, nnnn is pitch angle in degrees * 10 q is a 'q' character, + or - sign, nnnnn is pitch rate in rad/s * 10000 R is a 'R' character, + or - sign, nnnn is roll angle in degrees * 10 p is a 'p' character, + or - sign, nnnnn is roll rate in rad/s * 10000 X is an 'X' character, + or - sign, nnnnn is X accel. in ms-2 * 1000 (0 at rest) Y is an 'Y' character, + or - sign, nnnnn is Y accel. in ms-2 * 1000 (0 at rest) Z is an 'Z' character, + or - sign, nnnnn is heave accel. in ms-2 * 1000 (-0981 at rest) f is flag 'E' is OK, 'N' is invalid data; w is WIA status 'D' for dry, 'W' for wet.	>= 2.05
	70	off	ON	ON	off	off	off	ON	off	All others undefined - for future expansion						
	71	ON	ON	ON	off	off	off	ON	off							
	72	off	off	off	ON	off	off	ON	off							
	73	ON	off	off	ON	off	off	ON	off							
	74	off	ON	off	ON	off	off	ON	off							
	75	ON	ON	off	ON	off	off	ON	off							
	76	off	off	ON	ON	off	off	ON	off							
	77	ON	off	ON	ON	off	off	ON	off							
	78	off	ON	ON	ON	off	off	ON	off							
	79	ON	ON	ON	ON	off	off	ON	off							
	80	off	off	off	off	ON	off	ON	off							
	81	ON	off	off	off	ON	off	ON	off							
	82	off	ON	off	off	ON	off	ON	off							
	83	ON	ON	off	off	ON	off	ON	off							
	84	off	off	ON	off	ON	off	ON	off							
	85	ON	off	ON	off	ON	off	ON	off							
	86	off	ON	ON	off	ON	off	ON	off							
	87	ON	ON	ON	off	ON	off	ON	off							
	88	off	off	off	ON	ON	off	ON	off							

										Protocol type - [off] = iGC Proprietary, [on] = Industry Standard						
Telegram Code	Mode Code	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	Telegram Description	Protocol	Baud Rate	Params	Rate (Hz)	Notes	Applicable Firmware
	89	ON	off	off	ON	ON	off	ON	off							
	90	off	ON	off	ON	ON	off	ON	off							
	91	ON	ON	off	ON	ON	off	ON	off							
	92	off	off	ON	ON	ON	off	ON	off							
	93	ON	off	ON	ON	ON	off	ON	off							
	94	off	ON	ON	ON	ON	off	ON	off							
	95	ON	ON	ON	ON	ON	off	ON	off							
	96	off	off	off	off	off	ON	ON	off							
	97	ON	off	off	off	off	ON	ON	off							
	98	off	ON	off	off	off	ON	ON	off							
	99	ON	ON	off	off	off	ON	ON	off							
	100	off	off	ON	off	off	ON	ON	off							
	101	ON	off	ON	off	off	ON	ON	off							
	102	off	ON	ON	off	off	ON	ON	off							
	103	ON	ON	ON	off	off	ON	ON	off							
	104	off	off	off	ON	off	ON	ON	off							
	105	ON	off	off	ON	off	ON	ON	off							
	106	off	ON	off	ON	off	ON	ON	off							
	107	ON	ON	off	ON	off	ON	ON	off							
	108	off	off	ON	ON	off	ON	ON	off							
	109	ON	off	ON	ON	off	ON	ON	off							
	110	off	ON	ON	ON	off	ON	ON	off							
	111	ON	ON	ON	ON	off	ON	ON	off							
	112	off	off	off	off	ON	ON	ON	off							
	113	ON	off	off	off	ON	ON	ON	off							
	114	off	ON	off	off	ON	ON	ON	off							
	115	ON	ON	off	off	ON	ON	ON	off							
	116	off	off	ON	off	ON	ON	ON	off							
	117	ON	off	ON	off	ON	ON	ON	off							
	118	off	ON	ON	off	ON	ON	ON	off							
	119	ON	ON	ON	off	ON	ON	ON	off							
	120	off	off	off	ON	ON	ON	ON	off							
	121	ON	off	off	ON	ON	ON	ON	off							
	122	off	ON	off	ON	ON	ON	ON	off							
	123	ON	ON	off	ON	ON	ON	ON	off							

									Protocol type - [off] = iGC Proprietary, [on] = Industry Standard							
Telegram Code	Mode Code	SW 1	SW 2	SW 3	SW 4	SW 5	SW 6	SW 7	SW 8	Telegram Description	Protocol	Baud Rate	Params	Rate (Hz)	Notes	Applicable Firmware
	124	off	off	ON	ON	ON	ON	ON	off							
	125	ON	off	ON	ON	ON	ON	ON	off							
	126	off	ON	ON	ON	ON	ON	ON	off							
	127	ON	ON	ON	ON	ON	ON	ON	off							

Appendix F. iGC Mode Listing - Industry Standard Modes

		Baudrate selection [off][off]=19200, [on][off]=9600, [off][on]=4800, [on][on]=2400													
		Hardware Protocol [off]=RS232, [on]=RS485 half-duplex													
		Emulated telegram type (16 possible selections) from Industry standard formats													
		Protocol type - [off] = iGC Proprietary, [on] = Industry Standard													
Telegram Code	**Mode Code**	**SW 1**	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**SW 6**	**SW 7**	**SW 8**	**Telegram Description**	**Protocol**	**Baud Rate**	**Params**	**Rate (Hz)**	**Notes**	**Applicable Firmware**
0	128	off	off	off	off	off	off	off	ON	Roberston SKR80/SKR82	RS232	19200	n,8,1	20	Streaming output - see 'rate' column for output telegram frequency 4 bytes sent in sequence (no delimiter) hundreds pattern (0)(0)00hhhh tens pattern (0)(0)01tttt units pattern (0)(0)10uuuu decimals pattern (0)(0)11uuuu	1.03
	129	ON	off	off	off	off	off	off	ON		RS232	9600				
	130	off	ON	off	off	off	off	off	ON		RS232	4800				
	131	ON	ON	off	off	off	off	off	ON		RS232	2400				
	132	off	off	ON	off	off	off	off	ON		RS485	19200				
	133	ON	off	ON	off	off	off	off	ON		RS485	9600				
	134	off	ON	ON	off	off	off	off	ON		RS485	4800				
	135	ON	ON	ON	off	off	off	off	ON		RS485	2400				
1	136	off	off	off	ON	off	off	off	ON	Roberston SKR80/SKR82	RS232	19200	0,8,2	20	Streaming output - see 'rate' column for output telegram frequency 4 bytes sent in sequence (no delimiter) hundreds pattern (0)(0)00hhhh tens pattern (0)(0)01tttt units pattern (0)(0)10uuuu decimals pattern (0)(0)11uuuu	1.03
	137	ON	off	off	ON	off	off	off	ON		RS232	9600				
	138	off	ON	off	ON	off	off	off	ON		RS232	4800				
	139	ON	ON	off	ON	off	off	off	ON		RS232	2400				
	140	off	off	ON	ON	off	off	off	ON		RS485	19200				
	141	ON	off	ON	ON	off	off	off	ON		RS485	9600				
	142	off	ON	ON	ON	off	off	off	ON		RS485	4800				
	143	ON	ON	ON	ON	off	off	off	ON		RS485	2400				
2	144	off	off	off	off	ON	off	off	ON	Robertson ASCII short (no leading zeroes)	RS232	19200	n,8,1	20	Streaming output - see 'rate' column for output telegram frequency Variable length (11, 12 or 13 characters) ASCII telegram in format: $HHH.H,N,SS<CR><LF> where: $ is a '$' character HHH.H is ASCII heading, no leading zero(es), decimal place always sent N is Normal - always sent as 'N' SS is Status, ASCII '00' (two zero characters) is OK 80 is 'Not Ready', '10' is Water Ingress	1.03
	145	ON	off	off	off	ON	off	off	ON		RS232	9600		20		
	146	off	ON	off	off	ON	off	off	ON		RS232	4800		20		
	147	ON	ON	off	off	ON	off	off	ON		RS232	2400		10		
	148	off	off	ON	off	ON	off	off	ON		RS485	19200		20		
	149	ON	off	ON	off	ON	off	off	ON		RS485	9600		20		
	150	off	ON	ON	off	ON	off	off	ON		RS485	4800		20		
	151	ON	ON	ON	off	ON	off	off	ON		RS485	2400		10		
3	152	off	off	off	ON	ON	off	off	ON	Robertson ASCII short (with leading zeroes)	RS232	19200	n,8,1	20	Streaming output - see 'rate' column for output telegram frequency Fixed length (13 characters) ASCII telegram in format: $HHH.H,N,SS<CR><LF> where: $ is a '$' character HHH.H is ASCII heading, no leading zero(es), decimal place always sent N is Normal - always sent as 'N' SS is Status, ASCII '00' (two zero characters) is OK 80 is 'Not Ready', '10' is Water Ingress	1.03
	153	ON	off	off	ON	ON	off	off	ON		RS232	9600		20		
	154	off	ON	off	ON	ON	off	off	ON		RS232	4800		20		
	155	ON	ON	off	ON	ON	off	off	ON		RS232	2400		10		
	156	off	off	ON	ON	ON	off	off	ON		RS485	19200		20		
	157	ON	off	ON	ON	ON	off	off	ON		RS485	9600		20		
	158	off	ON	ON	ON	ON	off	off	ON		RS232	4800		20		

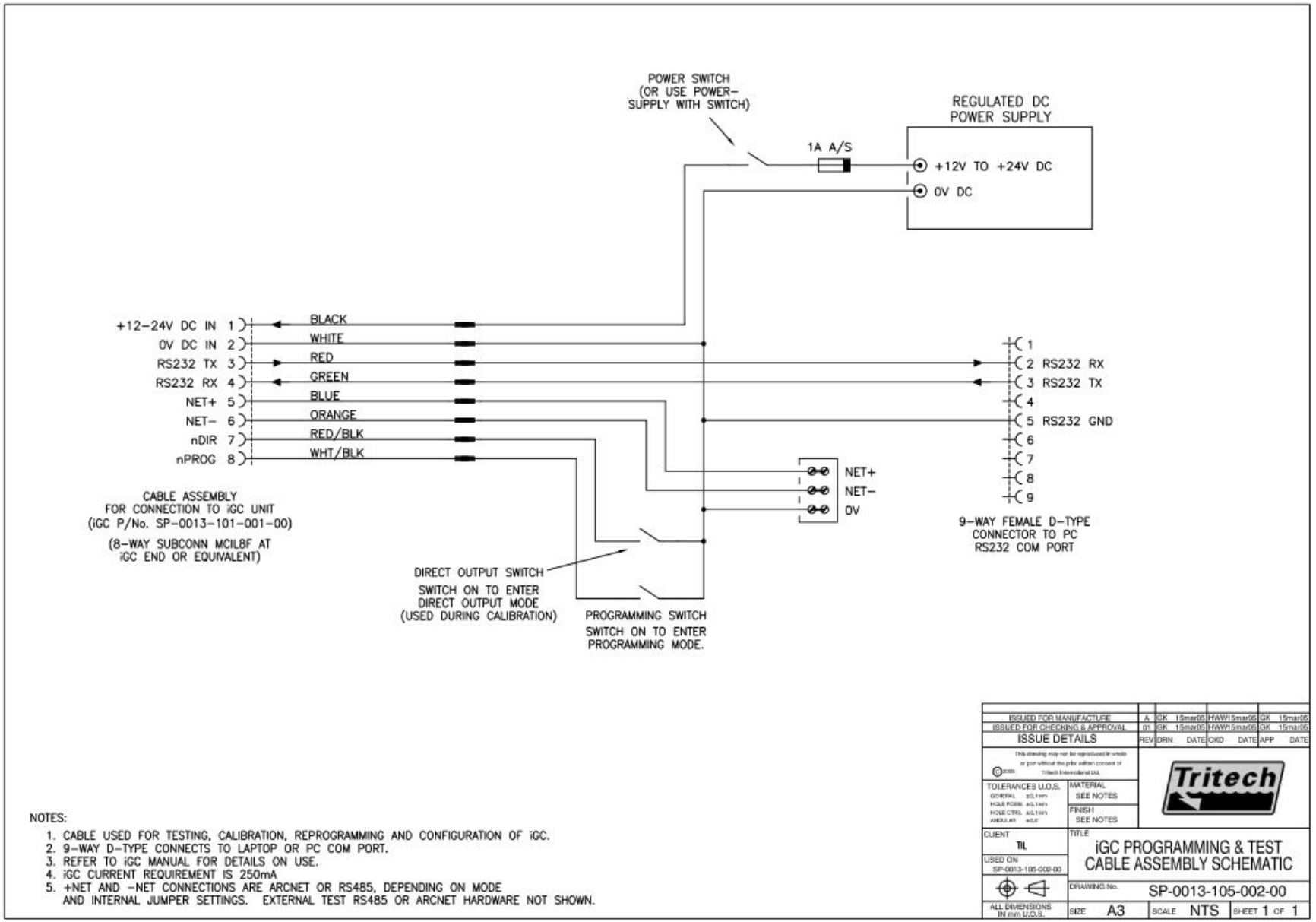
		Baudrate selection [off][off]=19200, [on][off]=9600, [off][on]=4800, [on][on]=2400														
				Hardware Protocol [off]=RS232, [on]=RS485 half-duplex												
					Emulated telegram type (16 possible selections) from Industry standard formats											
									Protocol type - [off] = iGC Proprietary, [on] = Industry Standard							
Telegram Code	**Mode Code**	**SW 1**	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**SW 6**	**SW 7**	**SW 8**	**Telegram Description**	**Protocol**	**Baud Rate**	**Params**	**Rate (Hz)**	**Notes**	**Applicable Firmware**
	159	ON	ON	ON	ON	ON	off	off	ON		RS485	24000		10		
4	160	off	off	off	off	off	ON	off	ON	Robertson ASCII long (no leading zeroes)	RS232	19200	n,8,1	20	Streaming output - see 'rate' column for output telegram frequency Variable length (26 to 30 characters) ASCII telegram in format: $HHH.H,N,SS,+LL,QQ,+RR.R,+PP.P<CR><LF> where: $ is a '$' character, HHH.H is ASCII heading, no leading zero(es) N is Normal - always sent as 'N', SS is Status as per Roberston ASCII Short +LL is latitude, always sent as '+0' QQ is speed, always sent as '0' +RR.R is roll degrees in -30 to +30 range, decimal always sent +PP.P is pitch degrees in -30 to +30 range, decimal always sent.	1.03
	161	ON	off	off	off	off	ON	off	ON		RS232	9600		10		
	162	off	ON	off	off	off	ON	off	ON		RS232	4800		10		
	163	ON	ON	off	off	off	ON	off	ON		RS232	2400		5		
	164	off	off	ON	off	off	ON	off	ON		RS485	19200		20		
	165	ON	off	ON	off	off	ON	off	ON		RS485	9600		10		
	166	off	ON	ON	off	off	ON	off	ON		RS485	4800		10		
	167	ON	ON	ON	off	off	ON	off	ON		RS485	2400		5		
5	168	off	off	off	ON	off	ON	off	ON	Robertson ASCII long (with leading zeroes)	RS232	19200	n,8,1	20	Streaming output - see 'rate' column for output telegram frequency Fixed length (30 characters) ASCII telegram in format: $HHH.H,N,SS,+LL,QQ,+RR.R,+PP.P<CR><LF> where: $ is a '$' character, HHH.H is ASCII heading, no leading zero(es) N is Normal - always sent as 'N', SS is Status as per Roberston ASCII Short +LL is latitude, always sent as '+0' QQ is speed, always sent as '0' +RR.R is roll degrees in -30 to +30 range, decimal always sent +PP.P is pitch degrees in -30 to +30 range, decimal always sent	1.03
	169	ON	off	off	ON	off	ON	off	ON		RS232	9600		10		
	170	off	ON	off	ON	off	ON	off	ON		RS232	4800		10		
	171	ON	ON	off	ON	off	ON	off	ON		RS232	4800		5		
	172	off	off	ON	ON	off	ON	off	ON		RS485	19200		20		
	173	ON	off	ON	ON	off	ON	off	ON		RS485	9600		10		
	174	off	ON	ON	ON	off	ON	off	ON		RS485	4800		10		
	175	ON	ON	ON	ON	off	ON	off	ON		RS485	2400		5		
6	176	off	off	off	off	ON	ON	off	ON	SG Brown ASCII (fixed length)	RS232	19200	n,8,2	20	Streaming output - see 'rate' column for output telegram frequency Fixed length (6 chars) ASCII telegram in format: HHHH<CR><LF> where: HHHH is ASCII heading in degrees x 10 leading zeroes always sent e.g. 0461 is heading 46.1 degrees	1.03
	177	ON	off	off	off	ON	ON	off	ON		RS232	9600				
	178	off	ON	off	off	ON	ON	off	ON		RS232	4800				
	179	ON	ON	off	off	ON	ON	off	ON		RS232	2400				
	180	off	off	ON	off	ON	ON	off	ON		RS485	19200				
	181	ON	off	ON	off	ON	ON	off	ON		RS485	9600				
	182	off	ON	ON	off	ON	ON	off	ON		RS485	4800				
	183	ON	ON	ON	off	ON	ON	off	ON		RS485	2400				
7	184	off	off	off	ON	ON	ON	off	ON	NMEA 0183 $HEHDT (north seekng gyro) ASCII	RS232	19200	n,8,1	20	Streaming output - see 'rate' column for output telegram frequency Variable length (17-19 chars) ASCII telegram (no leading zeroes) in format: $HEHDT,hhh.h,T*kk<CR><LF> where: $HEHDT signifies north seeking gyro, true heading hhh.h is heading without leading zeroes T signifies relative to True North	1.03
	185	ON	off	off	ON	ON	ON	off	ON		RS232	9600		20		
	186	off	ON	off	ON	ON	ON	off	ON		RS232	4800		10		
	187	ON	ON	off	ON	ON	ON	off	ON		RS232	2400		5		
	188	off	off	ON	ON	ON	ON	off	ON		RS485	19200		20		

		Baudrate selection [off][off]=19200, [on][off]=9600, [off][on]=4800, [on][on]=2400													
				Hardware Protocol [off]=RS232, [on]=RS485 half-duplex											
					Emulated telegram type (16 possible selections) from Industry standard formats										
									Protocol type - [off] = iGC Proprietary, [on] = Industry Standard						
Telegram Code	**Mode Code**	**SW 1**	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**SW 6**	**SW 7**	**SW 8**	**Telegram Description**	**Protocol**	**Baud Rate**	**Params**	**Rate (Hz)**	**Notes**	**Applicable Firmware**
	189	ON	off	ON	ON	ON	ON	off	ON		RS485	9600		20	* is a '*' character kk is XOR checksum of all chars between $ and * exclusive	
	190	off	ON	ON	ON	ON	ON	off	ON		RS485	4800		10		
	191	ON	ON	ON	ON	ON	ON	off	ON		RS485	2400		5		
8	192	off	off	off	off	off	off	ON	ON	NMEA 0183 $HCHDM (mag. compass) ASCII	RS232	19200	n,8,1	20	Streaming output - see 'rate' column for output telegram frequency Variable length (17-19 chars) ASCII telegram (no leading zeroes) in format: $HCHDM,hhh.h,M*kk<CR><LF> where: $HCHDM signifies magnetic compass, magnetic heading hhh.h is heading without leading zeroes M signifies relative to Magnetic North * is a '*' character kk is XOR checksum of all chars between $ and * exclusive.	1.03
	193	ON	off	off	off	off	off	ON	ON		RS232	9600		20		
	194	off	ON	off	off	off	off	ON	ON		RS232	4800		10		
	195	ON	ON	off	off	off	off	ON	ON		RS232	2400		5		
	196	off	off	ON	off	off	off	ON	ON		RS485	19200		20		
	197	ON	off	ON	off	off	off	ON	ON		RS485	9600		20		
	198	off	ON	ON	off	off	off	ON	ON		RS485	4800		10		
	199	ON	ON	ON	off	off	off	ON	ON		RS485	2400		5		
9	200	off	off	off	ON	off	off	ON	ON	Digilog ASCII (fixed length with leading zeroes)	RS232	19200	n,8,1	20	Streaming output - see 'rate' column for output telegram frequency Fixed length (20 chars) ASCII telegram in format: HhhhhPsppppRsrrrrf<CR><LF> where: H is a 'H' character hhhh is ASCII heading in degrees * 10, packed with leading zero(es) P is a 'P' character, s is + or - sign, pppp is pitch angle in degrees * 10 R is an 'R' character, s is + or - sign, rrrr is roll angle in degrees * 10 f is flag where 'E' is OK, 'N' is invalid heading, 'S' is settling, 'W' is water ingress *	1.03
	201	ON	off	off	ON	off	off	ON	ON		RS232	9600		20		
	202	off	ON	off	ON	off	off	ON	ON		RS232	4800		10		
	203	ON	ON	off	ON	off	off	ON	ON		RS232	2400		5		
	204	off	off	ON	ON	off	off	ON	ON		RS485	19200		20		
	205	ON	off	ON	ON	off	off	ON	ON		RS485	9600		20		
	206	off	ON	ON	ON	off	off	ON	ON		RS485	4800		10		
	207	ON	ON	ON	ON	off	off	ON	ON		RS485	2400		5		
10	208	off	off	off	off	ON	off	ON	ON	OceanTools ASCII (fixed length, leading zeroes)	RS232	19200	n,8,1	20	Streaming output - see 'rate' column for output telegram frequency Fixed length (20 characters) ASCII telegram in format: HhhhhPsppppRsrrrrf<CR><LF> where: H is a 'H' character hhhh is ASCII heading in degrees * 10, packed with leading zero(es) P is a 'P' character, s is + or - sign, pppp is pitch angle in degrees * 10 R is an 'R' character, s is + or - sign, rrrr is roll angle in degrees * 10 f is flag : 'E' is OK, 'N' is invalid heading, 'M' is settling (aligning), 'W' is water ingress *	1.03
	209	ON	off	off	off	ON	off	ON	ON		RS232	9600		20		
	210	off	ON	off	off	ON	off	ON	ON		RS232	4800		10		
	211	ON	ON	off	off	ON	off	ON	ON		RS232	2400		5		
	212	off	off	ON	off	ON	off	ON	ON		RS485	19200		20		
	213	ON	off	ON	off	ON	off	ON	ON		RS485	9600		20		
	214	off	ON	ON	off	ON	off	ON	ON		RS485	4800		10		
	215	ON	ON	ON	off	ON	off	ON	ON		RS485	2400		5		
11	216	off	off	off	ON	ON	off	ON	ON	Anschutz Binary (modified to add Pitch & Roll)	RS232	19200	n,8,1	20	Streaming output - see 'rate' column for output telegram frequency Fixed length (18 chars) binary telegram in format: <stx> b1… b16 <etx> where: <stx> is binary 0x02, <etx> is binary 0x03 b1 & b2 is 12-bit heading, b3 is incremental heading, b4 & b5 is pitch b6 & b7 is roll, b8 to b10 is rate of turn, b11 & b12 is status	1.03
	217	ON	off	off	ON	ON	off	ON	ON		RS232	9600		20		
	218	off	ON	off	ON	ON	off	ON	ON		RS232	4800		10		
	219	ON	ON	off	ON	ON	off	ON	ON		RS232	2400		5		
	220	off	off	ON	ON	ON	off	ON	ON		RS485	19200		20		

		Baudrate selection [off][off]=19200, [on][off]=9600, [off][on]=4800, [on][on]=2400													
				Hardware Protocol [off]=RS232, [on]=RS485 half-duplex											
					Emulated telegram type (16 possible selections) from Industry standard formats										
									Protocol type - [off] = iGC Proprietary, [on] = Industry Standard						
Telegram Code	**Mode Code**	**SW 1**	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**SW 6**	**SW 7**	**SW 8**	**Telegram Description**	**Protocol**	**Baud Rate**	**Params**	**Rate (Hz)**	**Notes**	**Applicable Firmware**
	221	ON	off	ON	ON	ON	off	ON	ON		RS485	9600		20	b13 to b15 is compass data b16 is checksum see manual for full details of bit positions / functions	
	222	off	ON	ON	ON	ON	off	ON	ON		RS232	4800		10		
	223	ON	ON	ON	ON	ON	off	ON	ON		RS485	24000		5		
12	224	off	off	off	off	off	ON	ON	ON	Octans 'Gyrocompass 1' format (NMEA)	RS232	19200	n,8,1	20	Streaming output - see 'rate' column for output telegram frequency Three Alternate NMEA 0183 var. length messages Heading / Pitch Roll / Status $HEHDT,hhh.h,T*kk<CR><LF> (as NMEA format above - 17-19 chars) $PHTRO,x.xx,a,y.yy,b*kk<CR><LF> where x.xx is pitch in degrees, a is 'M' for bow up, 'P' for bow down, y.yy is roll in degres b is 'B' for port down, 'T' for port up checksum etc as standard NMEA. (25 - 29 chars variable). $PHINF,hhhhhhhh*kk<CR><LF> where hhhhhhhh is status hex chars 00000000 for healthy good data, 00000007 for invalid data. (20 chars)	1.03
	225	ON	off	off	off	off	ON	ON	ON		RS232	9600		20		
	226	off	ON	off	off	off	ON	ON	ON		RS232	4800		10		
	227	ON	ON	off	off	off	ON	ON	ON		RS232	2400		5		
	228	off	off	ON	off	off	ON	ON	ON		RS485	19200		20		
	229	ON	off	ON	off	off	ON	ON	ON		RS485	9600		10		
	230	off	ON	ON	off	off	ON	ON	ON		RS485	4800		10		
	231	ON	ON	ON	off	off	ON	ON	ON		RS485	2400		5		
13	232	off	off	off	ON	off	ON	ON	ON	Octans 'Gyrocompass 2' format (NMEA)	RS232	19200	n,8,1	20	Streaming output - see 'rate' column for output telegram frequency Three Alternate NMEA 0183 messages Heading / Pitch Roll Heave / Status $HEHDT,hhh.h,T*kk<CR><LF> (as NMEA format above - 17-19 chars) $PHTRH,x.xx,a,y.yy,b,z.zz,c*kk<CR><LF> where x.xx is pitch in degrees, a is 'M' for bow up, 'P' for bow down, y.yy is roll in degress b is 'B' for port down, 'T' for port up, z.zz is heave acceleration in ms^{-2}, c is 'U' going up, 'O' going down $PHINF,hhhhhhhh*kk<CR><LF> where hhhhhhhh is status hex chars 00000000 for healthy good data, 00000007 for invalid data. (20 chars)	1.03
	233	ON	off	off	ON	off	ON	ON	ON		RS232	9600		20		
	234	off	ON	off	ON	off	ON	ON	ON		RS232	4800		10		
	235	ON	ON	off	ON	off	ON	ON	ON		RS232	4800		5		
	236	off	off	ON	ON	off	ON	ON	ON		RS485	19200		20		
	237	ON	off	ON	ON	off	ON	ON	ON		RS485	9600		20		
	238	off	ON	ON	ON	off	ON	ON	ON		RS485	4800		10		
	239	ON	ON	ON	ON	off	ON	ON	ON		RS485	2400		5		
14	240	off	off	off	off	ON	ON	ON	ON	Tokimec PTVG Format (NMEA)	RS232	19200	n,8,1	20	Streaming output - see 'rate' column for output telegram frequency NMEA 0183 message containing Pitch, Roll and Heading (30 chars): $PTVG,abbbbPaccccR,ddd.dT*kk<CR><LF> where: abbbb is pitch bb(degrees)bb(minutes) a is '-' for bow down, space for bow up. acccc is roll cc(degrees)cc(minutes) a is '-' for port up, space for port down. ddd.d is heading in degrees checksum etc as standard NMEA.	1.03
	241	ON	off	off	off	ON	ON	ON	ON		RS232	9600		20		
	242	off	ON	off	off	ON	ON	ON	ON		RS232	4800		10		
	243	ON	ON	off	off	ON	ON	ON	ON		RS232	2400		5		
	244	off	off	ON	off	ON	ON	ON	ON		RS485	19200		20		
	245	ON	off	ON	off	ON	ON	ON	ON		RS485	9600		20		
	246	off	ON	ON	off	ON	ON	ON	ON		RS485	4800		10		
	247	ON	ON	ON	off	ON	ON	ON	ON		RS485	2400		5		
15	248	off	off	off	ON	ON	ON	ON	ON	Honeywell HMR3000 $PTNTHPR (NMEA)	RS232	19200	n,8,1	5	Streaming output - see 'rate' column for output telegram frequency	1.05a
	249	ON	off	off	ON	ON	ON	ON	ON		RS232	9600				

		Baudrate selection [off][off]=19200, [on][off]=9600, [off][on]=4800, [on][on]=2400													
		Hardware Protocol [off]=RS232, [on]=RS485 half-duplex													
		Emulated telegram type (16 possible selections) from Industry standard formats													
		Protocol type - [off] = iGC Proprietary, [on] = Industry Standard													
Telegram Code	**Mode Code**	**SW 1**	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**SW 6**	**SW 7**	**SW 8**	**Telegram Description**	**Protocol**	**Baud Rate**	**Params**	**Rate (Hz)**	**Notes**	**Applicable Firmware**
	250	off	ON	off	ON	ON	ON	ON	ON		RS232	4800			NMEA 0183 message containing Pitch, Roll and Heading (30 chars): $PTNTHPR,ddd.d,N,abbbb,N,acccc,N,kk<CR><LF> where: abbbb is pitch bb(degrees)bb(minutes) a is '-' for bow down, nothing for bow up. acccc is roll cc(degrees)cc(minutes) a is '-' for port up, nothing for port down. ddd.d is heading in degrees checksum etc as standard NMEA.	
	251	ON	ON	off	ON	ON	ON	ON	ON		RS232	2400				
	252	off	off	ON	ON	ON	ON	ON	ON		RS485	15200				
	253	ON	off	ON	ON	ON	ON	ON	ON		RS485	9600				
	254	off	ON	ON	ON	ON	ON	ON	ON		RS485	4800				
	255	ON	ON	ON	ON	ON	ON	ON	ON		RS485	2400				

Appendix G. iGC & iFG Electrical Interconnection Schematic



Appendix H. iGC Recommended Spares

Item	Qty	Description	Part No.
1	0	Dome	SP-0013-101-001-01
2	0	End Cap	SP-0013-101-001-02
3	0	Sensor Assembly	SP-0013-101-003-00
4	0	iGC Interface PCB Assembly	SP-0013-101-002-00
5	1	Subconn 8-way micro bulkhead male connector (SS)	MCBH8MSS
6	0	Subconn Locking sleeve	MCDLSF
7	0	Subconn connector 'O'-ring	SP-0013-101-001-00-7
8	2	'O'-ring	200-039
9	0	M2.5 mounting pillar	SP-0013-101-002-01
10	0	M3 mounting pillar	SP-0013-101-002-02
11	0	8 -way screw terminal connector	SP-0013-101-001-00-11
12	0	M3 x 6mm lg. Skt. head cap screw - st. stl.	SP-0013-101-001-00-12
13	0	M3 spring washer - st. stl.	SP-0013-101-001-00-13
14	0	M2.5 x 6mm lg. Skt. head cap screw	SP-0013-101-001-00-14
15	0	M2.5 plain washer	SP-0013-101-001-00-15
16	0	M3 x 10mm lg. Pan head pozi m/v screw - st. stl.	SP-0013-101-001-00-16
17	2	TO-220 insilating bush	SP-0013-101-001-03
18	1	Insulating washer	SP-0013-101-001-04
19	2	2mm Jumper link (typ. red)	SP-0013-101-001-00-19
20	1	Silicone grease	111
21	0	Thread locking compound	222
22	0	Subconn Locking sleeve circlip	SP-0013-101-001-00-22
23	0	Identification / Serial No. Label	SP-0013-101-001-05
24	0	Processor module	SP-0013-101-001-06
25	0	M3 x 6mm lg. Pan head pozi m/c screw - st. stl.	SP-0013-101-001-00-25
26	0	M3 red fibre washer	SP-0013-101-001-00-26
27	8	Heat-shrinkable wire ident markers	SP-0013-101-001-00-27
28	8	Bootlace ferrule 0.34mmsq	SP-0013-101-001-00-28
29	1	30mm length 4.8mm clear heatshrink	SP-0013-101-001-00-29
30	1	100mm lg. Cable tie	SP-0013-101-001-00-30

Notes:

1. Spares are available from Tritech by quoting BOM and item number
2. Refer to Recommended Spares List for cross-reference
3. To maintain warranty and get the best performance from the iGC, only use genuine spare parts

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