Jupiter™
SUBSEA DISPLAY SYSTEMS
SDS

SUBSEA DISPLAY SYSTEM MANUAL

INSTALLATION, OPERATION & MAINTENANCE

Jupiter™
SUBSEA CONTROL SYSTEMS

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Specification

Operational Environment:	Fresh water or seawater to a depth of 3000m -10 to +50°C Operational. -20 to +65°C Storage
Electrical:	2 Connectors Connector 1 – (5 way) – Power and data (RS232) Connector 2 – (8 way) – Sensors
Material:	Main Housing – 316 stainless steel pressure housing with removable end cap Display – Acetal or 316 stainless steel, solid potted
Size:	2 Digit:- Ø50 x 199.5mm 4 Digit:- Ø50 x 230mm, Display 80 x 40mm Dual 4 Digit:- Ø50 x 230mm Display 80 x 72mm
Weight:	2 Digit:-1.4kg (in air), 1.0kg (in water)4 4 Digit:-1.5kg (in air), 1.1kg (in water) Dual 4 Digit:-1.6 kg (in air), 1.2kg (in water)
Display Type and Range:	Blue 7 segment LEDs – digits 14.2mm High 2 digit: -99 to 99 up to 1 decimal place 4 digit: -9999 to +9999 up to 3 decimal places Leading zero suppression except immediately before decimal point
Strain Gauge Transducer Interface: Suitable for 4 wire bridge transducers such as pressure, torque, load cell or other strain gauge applications	**Strain Gauge Measurement Accuracy:** ± 1.0% of full scale (From 10% to 100% of full scale) **Offset Variation:** ± 1.0% of full scale **Transducer Sensitivity Range:** 2, 5 or 10 mV/V **Bridge Resistance:** >100 ohms **System Calibration Frequency:** Minimum bi-annually recommended
Counter Sensor Interface: Suitable for reed switch contact closures and 2 or 3 wire proximity sensors, including NAMUR type	**Counter Sensor Supply up to 10mA:** +5V Nominal or +10V Nominal **Maximum Input frequency on each input:** 2kHz **Minimum dwell time in any input state:** 250µ seconds
Power Supply:	Battery – 1 D Cell Normally NiMH Rechargable Capacity >7000mAH. May be fitted with Primary cell – Duracell or equivalent for higher Capacity and / or longer shelf / standby life.
Power Supply/Battery Life:	5 Days Average with continuous display, 5 Months Standby.

Mounting the System

The system should be attached to a secure and stable structure with good visibility of the display. Securing cylindrical body with a Jubilee® clip is an effective method.

The 4 Digit Subsea Display (not dual), may also be mounted within a Remote Actuator Assembly, that provides a facility for switching the zero display, scaling and units functions. Zetechtics Part No: 023-14-16-002.

Electrical Connections

Conn 1 – Subconn MCBH5F – Power & Data, use RS232 Interface Cable or Power Enable Connector.

Pin	Signal
1	RS232 Tx.
2	RS232 Rx.
3	0V / Battery.
4	0V / Circuitry.
5	Battery +ve / fused at 1A.

Note: A) Power Enable Connector links pins 3 and 4 to enable system.
B) Charger Connects to pins 3 and 5.

Conn 2 – Subconn MCBH8F – Sensors / Transducers, see Sensor Connection diagram: 023-14-52-011 in Hardware Options section of this manual.

Pin	Signal
1	+ve Excitation (to Strain Gauge)
2	-ve Excitation (to Strain Gauge), (Also digital sensor 0V if required)
3	+ve Sense (to Strain Gauge)
4	-ve Sense (to Strain Gauge)
5	Sensor 1 Supply +5V or +10V
6	Sensor 1 Input
7	Sensor 2 Supply +5V or +10V
8	Sensor 2 Input

Replacing Fuses

Both fuses are to be found on the Rear Interface PCB (nearest the connectors).

Fuse	Nanofuse Type	Farnell Part No.	Function
F1	3A Quick Blow	992-2180	Battery +ve Line
F2	3A Quick Blow	992-2180	Battery –ve Line

NOTE: Earlier systems were fitted with 1A fuses. These may be replaced with 3A fuses to permit the use of international charger unit, Zetechtics part number: 023-14-02-005.

RS232 Serial Interface / Command Console Interface

The Subsea Display has an RS232 serial interface to allow configuration of various aspects of the system functionality using the "Command Console Interface". The system options defined elsewhere within the system manual may be configured as required via the Command Console Interface using a PC with an RS232 port and a communications program such as "Windows Hyper Terminal".

Normally the Jupiter Subsea Display system outputs the display reading over the RS232 serial interface whilst it is active.

The operational mode must be set for the system application, – see **"System Modes"**.

The system scale factors must be set to give the correct display for a given input, – see **"Calibration"**.

Note: A Serial Interface Cable to connect to a standard PC 9 pin RS232 connector is supplied with the Subsea Display System (Part No. 023-14-11-020). Connection to a USB port is possible via a suitable USB to RS232 convertor. Contact Zetechtics, for further information.

RS232 Communication Parameters

Default	Data	Start	Stop	Parity	Handshaking
19200	8	1	1	None	None

Note: Available baud rates 2400 to 115200 (see RS232 Console User Commands).

Option Links – (It is only necessary to open the system to configure display brightness or strain gauge sensitivity!!!)

Links on Front Interface PCB 023-14-14-003 / 023-14-19-003 (nearest PCB to display).		
LK	**Option**	**Function**
A	Light Sensor.	Swap Light Sensor Enabled / Disabled State
B	Tare (Zero) switch.	Swap Zero Switch Enabled / Disabled State
C	Scale switch, (no effect for strain gauge).	Swap Scale Switch
D	Not fitted to 2 Digit Quadrature Counter.	Display Brightness 1.
E	See Separate Table (below).	Display Brightness 2

Factory default link setting is A, B, C & E fitted / enabled.

Display Brightness / Typical Battery Life All Digits Continuously Illuminated With Average Number of segments lit				
Link D	**Link E**	**Brightness**	**4 digit / Days**	**Dual 4 digit / Days**
Off	Off	Low	9	4.5
On	Off	Medium Low	6	3
Off	On	Medium High (Default)	4	2
On	On	High	3	1.5

Strain Gauge Input Gain Setting – Links

The system has three gain settings, which should be selected based on the maximum output (sensitivity) from the transducer.

Links on Strain gauge Interface PCB023-14-07-003 (2nd from Cylindrical Housing End Cap)		
Links		**Transducer Sensitivity (mV/V)**
A	(Default)	2
B		5
C		10

System Power Up / Operation

Ensure that the display face is exposed to daylight or artificial light.

Activate the Jupiter Subsea Display by fitting the RS232 Interface Cable or 5 way Power Enable connector to Conn 1.

The Power – up Information Sequence is displayed.

The normal system display is shown with the display reset to zero.

The Subsea Display System is doing this, what does it mean?

Description	Cause
The display is illuminated constantly	The light sensor is disabled. (Software or Link A)
The display is only illuminated when light is shone on the unit	The light sensor is enabled. (Software or Link A)
The display is not illuminated at all	No connector in CONN 1 **OR** There is insufficient light shining on the unit and the light sensor is enabled **OR** The battery is completely flat **OR** A fuse has blown
The display shows ErHi (Strain Gauge input)	The input value is above that set as maximum or there is a sensor cabling / connector fault.
The display shows ErLo (Strain Gauge input)	The input value is below that set as minimum or there is a sensor cabling / connector fault.
The display is on continually except for a brief flicker every six seconds	The light sensor is enabled (the unit turns off the display briefly to test the ambient light level).
The display is on continually except for two brief periods every six seconds	Low Battery

Issue Information

Issue	Changes	Date
1	Original Issue	25 Jan 2011
2	Calibration example correction. Technical support details updated	28 March 2011
3	Correction to Battery Life	17 October 2014
4	Updating for new Control Comands	13 June 2018

Warning & Disclaimer

Jupiter is a registered trademark of Zetechtics Ltd.

The Jupiter System is highly complex and should only be operated & maintained by suitable qualified & experienced personnel. In particular it is recommended that personnel undergo training by Zetechtics on all aspects of this system. Failure to do so may jeopardise warranty and other service agreements.

As part of our continuous improvement program Zetechtics reserves the right to change any of the specifications contained within this document without prior notice. The information provided is believed to be reliable however Zetechtics assumes no responsibility for inaccuracies & omissions.

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INTRODUCTION

BRIEF DESCRIPTION

All Jupiter Subsea Display Systems are rated to 3,000m depth in sea water, and can be interfaced to a Jupiter Subsea Control System or data-link. They are stand-alone, battery powered, ultra low power consumption with selectable dormant state. Designed for Strain Gauge input and/or Digital Sensor input and display either individually or simultaneously.

The Jupiter **Strain Gauge Subsea Display System** is a simple means of measuring a strain based variable (such as pressure, torque, etc.) when an electronic control system is not fitted. The Subsea Strain Gauge Display System can be calibrated to display any variable with a scale and offset applied to ensure that the user sees a real world value directly related to the measurement in question.

The Jupiter **Subsea Quadrature Counter System** is a means of monitoring how a Quadrature Sensor, changes state, when an electronic control system is not fitted. Sensor types, including contact closure such as a Reed Switch and Inductive Proximity (including NAMUR) types are supported.

For example if a rotating tool, is fitted with a Quadrature Sensor, which has a known number of changes of state per revolution, then the 2 or 4 digit display will show the number of full revolutions, together with an indication of whether a partial revolution has occurred.

2 Digit Display: Can be used as a 2 digit counter only.

4 Digit Display: Can be used as either a 4 digit counter display or a 4 digit strain gauge input display. An externally applied magnet can quickly and easily zero the display as well as changing the unit between scaled and un-scaled modes or units, ie. Nm / lb.ft.

Dual 4 Digit Display: Can display count and strain gauge input simultaneously. An externally applied magnet can quickly and easily zero the display as well as changing the unit between scaled and un-scaled modes or units, ie. Nm/lb.ft.

Both 2 and 4 Digit Counters have a user set 5V or 10V power supply provided for the input sensor(s).

All Jupiter Subsea Display Systems have a visible low battery indication and power saving options, which can user configured.

EQUIPMENT SUPPLIED

The standard Subsea Display System is supplied with the following components:

1 x Subsea display system

1 x Battery Charger

1 x Power enable connector

1 x RS232 interface cable

1 x Manual

1 x Test Certificate

System Types

Part Number	Description
023-14-52-121	2 Digit Jupiter Subsea Display (Counter Only)
023-14-52-122	2 Digit Jupiter Subsea Display – NAMUR (Counter Only)
023-14-52-131	4 Digit Jupiter Subsea Display
023-14-52-132	4 Digit Jupiter Subsea Display – NAMUR
023-14-52-141	Dual 4 Digit Jupiter Subsea Display [TorqueNm/Ft.lb & Turns]
023-14-52-142	Dual 4 Digit Jupiter Subsea Display – NAMUR [TorqueNm/Ft.lb & Turns]
023-14-52-151	2x4 Digit Jupiter Subsea Display System [Flow Rate & Volume]
023-14-52-161	2x4 Digit Jupiter Subsea Display System [Flow Rate USG/Min & Pressure/bar]

Note: The 2 Digit Jupiter Subsea Display can function as a counter only.

MOUNTING THE SYSTEM

The system should be attached to a secure and stable structure so that there is good visibility of the output display. The means of mounting will be dependent on the specific application, however using a worm drive hose clip (such as a Jubilee® clip) to secure the cylindrical body of the system to channel section proves an effective method.

The 4 Digit Subsea Display (**not dual**) may also be mounted within a Remote Actuator Assembly, Part No: 023-14-16-002, that provides a facility for switching the zero display, scaling and units functions. If this is the case the system will be mounted directly to the Remote Actuator as detailed in the General Assembly Drawing, Doc. No: 023-14-16-001, which in turn should be mounted using the 2 off mounting holes on the front flange. The position and size of these mounting holes are detailed in the General Assembly Drawing. Consideration should be made to the mounting position to allow the actuator levers to be operated.

If a Remote Actuator Assembly is required for a Dual 4 Digit Subsea Display, then please contact Zetechtics.

Note: Adapter holes are provided on the Remote Actuator to allow for mounting of adapter levers (not supplied by Zetechtics).

If the front glass of the 2 digit display is scratched or otherwise damaged, the Unit should be returned to Zetechtics for replacement/pressure testing.

GETTING STARTED

CONNECTIONS

Conn 1 – Power & Data, use RS232 Interface Cable or Power Enable Connector supplied.

Pin	Signal
1	RS232 Tx.
2	RS232 Rx.
3	0V / Battery.
4	0V / Circuitry.
5	Battery +ve / fused at 1A.

Note: A) Power Enable Connector links pins 3 and 4 to enable system.
B) Charger Connects to pins 3 and 5.

Conn 2 – Sensors / Transducers, see Sensor Connection diagram: 023-14-52-011 in Hardware Options section of this manual.

Pin	Signal
1	+ve Excitation (to Strain Gauge)
2	-ve Excitation (to Strain Gauge), (Also digital sensor 0V if required)
3	+ve Sense (to Strain Gauge)
4	-ve Sense (to Strain Gauge)
5	Sensor 1 Supply +5V or +10V
6	Sensor 1 Input
7	Sensor 2 Supply +5V or +10V
8	Sensor 2 Input

Note: Older type systems (023-14-40-XXX) provided +5V on pin 1 of CONN 2. These systems do not. Contact Zetechtics for compatibility information.

SYSTEM CONFIGURATION

There is no need to open the subsea display unit to configure any system options, except adjusting the display brightness for the single / dual 4 digit display unit, or the strain gauge sensitivity!!!

RS232 Serial Interface / "Command Console Interface"

The Subsea Display has an RS232 serial interface to allow configuration of various aspects of the system functionality using the Command Console Interface, and to provide an output of the Subsea Display Reading to third party equipment, such as a data multiplexer, or data logger.

The system options defined elsewhere within this manual may be configured as required via the Command Console Interface using a PC with an RS232 port and a communications program such as "Windows Hyper Terminal".

Normally the Jupiter Subsea Display system outputs the display reading whilst it is active.

The operational mode must be set for the system application, – see **"System Modes"**.

The system must be scaled to give the correct display for a given input, – see **"Calibration"**.

Note: A Serial Interface Cable to connect to a standard PC 9 pin RS232 connector is supplied with the Subsea Display System (Part No. 023-14-11-020). Connection to a USB port is possible via a suitable USB to RS232 converter, contact Zetechtics for further information.

See the Command Console Interface section for full details of how to use the Command Console.

SYSTEM POWER UP / OPERATION

The battery should be charged according to the instructions, see the **"Power"** section of this manual.

The unit should be connected to the sensor(s) via Conn 2, as shown in the table above.

Ensure that the display face is exposed to daylight or artificial light.

Activate the Jupiter Subsea Display by fitting the RS232 Interface Cable or 5 way Power Enable connector to Conn 1.

The Power – up Information Sequence is displayed.

The normal system display is shown with the display reset to zero.

Low Battery Indication

The battery potential is internally monitored and if it falls below 1.1 Volts, the display will indicate a low battery by switching off twice, briefly, every 6 seconds. This battery low state will not be cleared until the battery voltage is raised above 1.2 Volts by recharging or replacement.

Power Up Information Sequence

Ensure that the display face is exposed to daylight or artificial light.

Activate the Jupiter Subsea Display by fitting the RS232 Interface Cable or 5 way Power Enable connector supplied to Conn 1.

On power up the display will:-

Power Up Information Sequence

	Description	2 Digit Display Shows	4 Digit Display Shows
1	**Lamp test:** All the segments of the display are illuminated to assure the user that the display is fully operational and therefore any information shown cannot be misinterpreted by misrepresentation of the characters due to a faulty segment.		
2	**Display serial number:** The serial number of the unit is a simple 8-digit index with no decimal places, and is displayed with the prefixes 'J.' and 'I.' as shown. eg. J.2845 and I.1234, = 28451234	No Equivalent	 Followed by:- 
3	**Display software version:** The version of the software the unit is programmed with, is a simple 4-digit index with no decimal places, and is displayed with the prefix 'V.' as shown.	No Equivalent	
4	**Display battery voltage:** Full – 1.4V, ½ - 1.2V, Low – 1.0V. The present potential on the battery is displayed in Volts with 3 decimal places, and is displayed with the prefix 'b.' as shown.	No Equivalent	
5	**Display RS232 baud rate**: The present setting of the baud rate is shown together with the prefix 'R.' as shown.	No Equivalent	
6	**Display Function:** **Normal Display:** After the power sequence, the display is shown. Note that the display has been reset to zero, however the system configuration is exactly as previously configured.		

To deactivate the system remove the RS232 Interface Cable or Power Enable connector from Conn 1.

Factory Default Conditions

All parameters and options as described in the Command Summary, (see RS232 Console User Commands), will be in the state as if the command 'reset' has been executed.

The Baud rate will be set to 19200 bits per second.

Display Operation

Light Sensing

In order to conserve battery charge and therefore maximize operational time before a recharge is required, the system has a light sensor which if enabled is used to detect the presence of light. If there is little or no ambient illumination the system enters a very low power mode where the display is switched off. However, the unit will still register any changes on the counter inputs at full specified speed.

The time lapse between loss of illumination and the display switching off, can be set by the user at the command Console interface, with the 'dwelltime' command. Type 'dwelltime 0500', for example, this will give a time lapse of 500 seconds between loss of illumination and the display switching off. The value is always entered as a 4 figure number in seconds. The maximum value that can be entered is 1000.

Operational Option Links A, B, C, D & E

Important: The functions set by links A, B and C can all be configured via a PC communications link (RS232) using the Command Console Interface. It is strongly advised that this method is used rather than physically changing links as damage may occur during disassembly and subsequent reassembly.

Inside the cylindrical pressure housing there are 3 (on the 2 digit counter) or 5 (on the 4 digit counter) links on the front interface PCB nearest to the display (which can be seen through the window of the 2 digit counter).

These links allow the user to change the operation of the display controls (A, B, C) if it is not possible to connect the system to a PC RS232 port, and to adjust the display brightness of the 4 digit or dual 4 digit counter (D, E).

Note: The link positions can be overridden through the console interface, and vice versa. i.e. fitting or removing links A, B or C will swap the current enabled or disabled state of the control, to the alternate state.

Links on Front Interface PCB 023-14-14-003 / 023-14-19-003 (nearest PCB to display).		
	Option	Function
A	Light Sensor	Swap Light Sensor Enabled / Disabled State
B	Zero switch	Swap Zero Switch Enabled / Disabled State
C	Scale switch (Counter or Torque modes only)	Swap Scale Switch Enabled / Disabled State
D	Not fitted to 2 Digit Quadrature Counter. See Separate Table (below).	Display Brightness 1.
E		Display Brightness 2

Factory default link setting is A, B, C & E fitted.

Display Brightness / Typical Battery Life All Digits Continuously Illuminated With Average Number of segments lit				
Link D	**Link E**	**Brightness**	**4 digit / Days**	**Dual 4 digit / Days**
Off	Off	Low	9	4.5
On	Off	Medium Low	6	3
Off	On	Medium High (Default)	4	2
On	On	High	3	1.5

Note: At lower brightness level settings, inconsistencies in display segment brightness may become apparent due to tolerances in their design and manufacture. If your application requires the increased battery life offered by lower display brightness, please contact Zetechtics for a specially selected display assembly to your requirements.

To change the links:

Open the Subsea Display System by removing the end cap from the cylindrical housing and sliding out the internal support tube (see Opening the Subsea Display).

The links are located on the Front Interface PCB (nearest the display) and can be fitted or removed using fine nose pliers.

Re-assemble the Subsea Display System (see Reassembling / Sealing the Subsea Display).

2 AND 4 DIGIT QUADRATURE COUNTER OPERATIONAL MODES

The modes of operation describe the behaviour of the display when the count is below zero or above the maximum number the 2 or 4 digit display is able to convey i.e. 99 and 9999 respectively. Counts below zero are only applicable to a system using Quadrature inputs which has the ability to turn in both directions, however the behaviour of the counter after the full scale of the display has been exceeded will still be important.

QUADRATURE OR SINGLE INPUT

It is possible to use both sensor inputs if a quadrature input is required. Alternatively either one of the inputs may be used if a quadrature input is not required.

WHAT IS QUADRATURE?

A quadrature sensor input arrangement allows the system to monitor 2 inputs and determine the direction of travel whenever a sensor changes state. This can relate to rotation or linear movement depending on the mechanical system and sensor arrangement.

The sensors and sensor triggers are arranged such that after a sensor changes state, the other sensor must change state next if movement continues in the same direction. If the direction of movement changes and movement continues, the last sensor to change state will revert to its state prior to the previous change of state next time it is triggered.

For a graphical representation of this see the section on Quadrature Input Decoding.

This can be achieved in a number of ways such as:

- A wheel or rail with a number of magnetic targets at regular intervals
- A wheel or rail with a number of teeth at regular intervals
- A helical / threaded drive shaft with a wheel as described above

It is very important to get the arrangement of sensors and targets correct. If a single sensor changes state twice before the other sensor changes state, or is intermittent, then the count will be unreliable.

Correctly implemented Quadrature schemes are inherently immune to noise / contact chatter.

UNIPOLAR

In Unipolar mode the display is always positive as indicated by the sign indicator on the display.

As the count is decremented, one less count than zero be comes '+9999' and '99' on the 4 and 2 digit displays respectively. Similarly as the count is incremented one more count than the +9999 or 99 becomes +0 or 0.

BIPOLAR

In Bipolar mode, the display with one count less than zero is –1, and with one more count than +9999 is 'o000' which represents an overflowed zero equivalent to 10,000 which cannot be displayed on a 4 digit display. More counts in the positive direction will yield –9999 on the display followed by –9998, -9997 etc through –1, 0, +1, +2 and up to +9999 again. Decrementing the count through zero from say +5 will yield +4, +3, +2, +1, 0, -1, -2, -3, -4 etc.

UN-SCALED DISPLAY

It is possible to configure the display to display an un-scaled count (actual number of counts before the scale factor is applied). It is possible to monitor both the scaled and un-scaled counts simultaneously via the RS232 diagnostic display, and in the case of the 4 digit display it is possible to swap the display between the scaled and un-scaled values with the display switches. This enables the user to precisely monitor the detection of the change of state of each input.

The un-scaled count is reset to zero when the scaled count is reset to zero. The mode of operation of the un-scaled count is the same as either the "Single Input Continuous" or "Dual Input Quadrature Continuous" modes of counting, depending on whether a single input or quadrature input mode is being used. That is, the unscaled count value is not signed.

The un-scaled count may rollover from 9999 to 0 (or 99 to 0 for the 2 digit counter), (or vice versa in quadrature mode) before the scaled value, and may do so many times, depending on the scale factor determined by the numerator and denominator. This means the user must keep track of the number of rollovers if they wish to compare the scaled value to the un-scaled count. However, the display of the un-scaled value always changes by 1 in the correct direction for each edge transition (except when rolling over). Also, a given number of counts in either direction will always display the same un-scaled value.

SCALED DISPLAY

Scaled operation modes may be selected as either Rounded or Truncated. This determines how the displayed value is determined after scaling.

The rounding mode, overflow mode and absolute zero mode configuration all affect the system's operation and display.

STANDARD MODES

Counting Modes

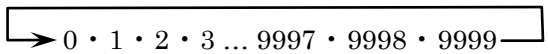
The following modes configure standard operational configurations which should suit most user's needs, but can each be modified once set by adjusting any individual option.

Single Input Continuous Display

Available with 2 or 4 digit display.

seti1c: This command sets the Counter to Input 1, Unipolar mode, continuous display, with overflow indication disabled.

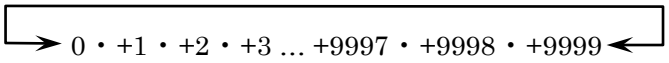
seti2c: This command sets the Counter to Input 2, Unipolar mode, continuous display, with overflow indication disabled.



Dual Input Quadrature Continuous Display

Available with 2 or 4 digit display.

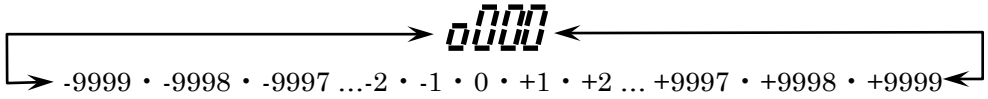
Setiqc: This command sets the Counter to Quadrature using Inputs 1 and 2, Unipolar mode, continuous display, with overflow indication disabled.



Dual Input Quadrature Bipolar Continuous Display

Available with 2 or 4 digit display.

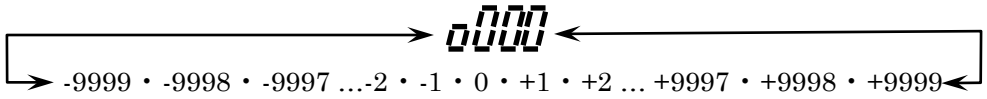
Setiqbc: This command sets the counter to Quadrature using Inputs 1 and 2, Bipolar mode, continuous display, with overflow indication disabled.



Dual Input Quadrature Bipolar Overflow Display

Available with 4 digit display only.

Setiqbo: This command sets the Counter to Quadrature using Inputs 1 and 2, Bipolar mode, continuous display, with overflow indication enabled.



In this mode once an overflow has occurred an indication is displayed until the counter is reset, or the unit is powered off. The indication is displayed once a second at a duty cycle of 25%, overlaying the sign indication, i.e.

"+" 25% 75%

or

"-" 25% 75%

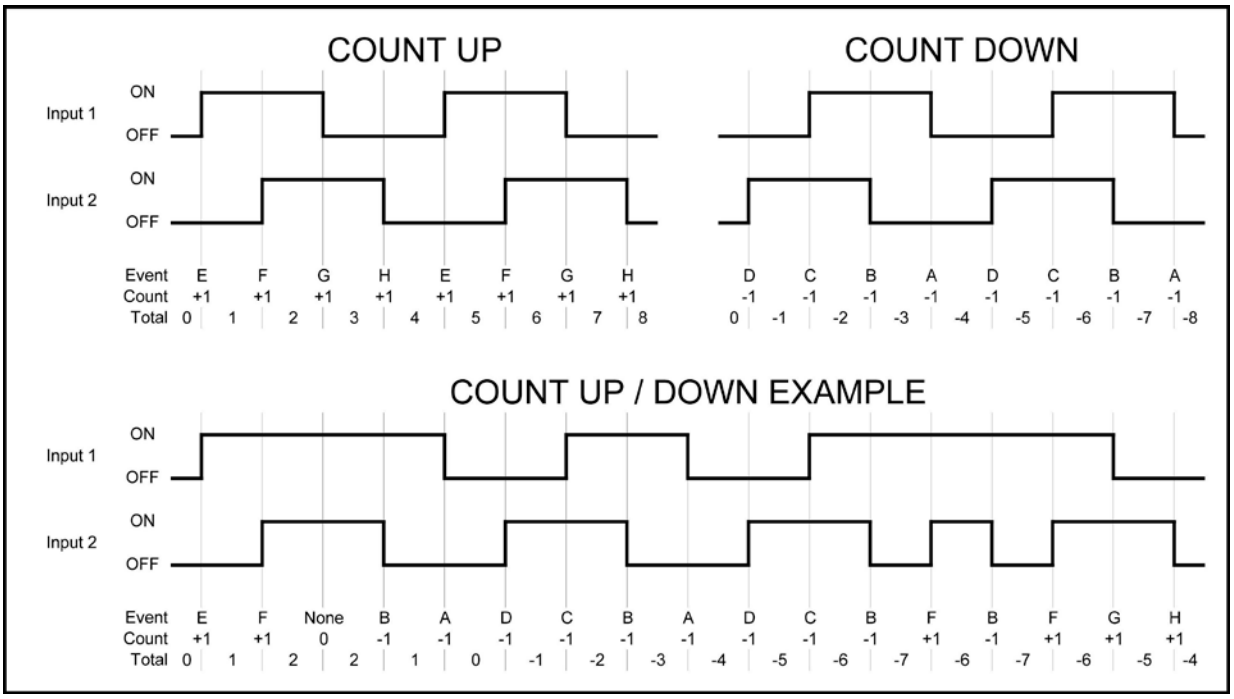
QUADRATURE INPUT DECODING

Examples of the change in inputs versus the change in the count are shown in the table and timing diagram below.

Quadrature Input Decoding Table

Event	Input 1	Input 2	Count	Event Description
A	↓ Off	Off	-1	Input 1 has gone to the off state
B	On	↓ Off	-1	Input 2 has gone to the off state
C	↑ On	On	-1	Input 1 has gone to the on state
D	Off	↑ On	-1	Input 2 has gone to the on state
E	↑ On	Off	+1	Input 1 has gone to the on state
F	On	↑ On	+1	Input 2 has gone to the on state
G	↓ Off	On	+1	Input 1 has gone to the off state
H	Off	↓ Off	+1	Input 2 has gone to the off state

Quadrature Input Timing Diagram



From any stable state in the table above, e.g. in rows C & G where input 2 is on and stable, a change in Input 1 in row C where Input 1 goes from off to on, the count becomes one less than before as is described in the "count" column of the table, and similarly in row G where input 1 goes from off to on, the "count" column describes that the count is incremented.

Note that when the input count is 'zeroed' the present input state is stored as the starting point and as such is taken as the datum i.e. absolute zero.

CALIBRATION PROCEDURE

In order to get the correct display for the intended application it is necessary to calibrate the system.

Prior to calibration the system must be configured to the required counting mode. See the sections on **System Configuration** on page 3 and **Standard Modes** on page 8.

The system provides both numerator and denominator scale factors which allow a fractional scale factor such as 2/3 to be derived rather than losing accuracy from the truncated recurring decimal 0.6666. Also this makes calibrating by experiment simple.

Numerator: The numerator must include a sign and a decimal point. The sign is used to control whether a particular direction of travel is positive or negative. The position of the decimal point determines the displayed precision. E.g. a numerator of +01.00 will give a displayed precision of 2 decimal places. The numerator must include 4 digits, with leading zeros added if necessary.

Denominator: The denominator must be an integer value. It will be necessary to multiply both the numerator and denominator by a multiple of 10 if the denominator would otherwise have a decimal. The denominator must include 4 digits, with leading zeros added if necessary.

Example:

If a numerator and denominator of 7/85.7 were required with 2 decimal places to be displayed then multiply top and bottom by 10 to get:

Numerator: 70 Use +70.00

Denominator: 857 Use 0857

Methods

There are 2 methods of calibrating the system, depending whether the number of sensor targets and any gearbox ratio is precisely known or not:

Method 1 – Calculating calibration scale factors

Calibrating a system with a known number of sensor targets and gearbox ratio:

1. Determine if 1 (Single input) or 2 (Quadrature) sensors will be used.
2. Determine the display precision required (number of decimal places).
3. Determine the number of sensor targets per rotation / unit length **[A]**.
4. Determine the gearbox ratio (eg 5 to 1 for 5 revolutions in to get 1 revolution out, or 1 to 1 for no gearbox **[B to C]**.
5. Calculate the numerator and denominator as follows

   If single input **D** = 1

   If quadrature input **D** = 4 because there are 4 changes of state from the 2 sensors for each target

   Numerator = **C**

   Denominator = **A x D x B**
6. Correct for any decimal in denominator (multiply top and bottom by the same multiple of 10)
7. Format Numerator (add sign, decimal point and leading zeros as required) and Denominator (add leading zeros as required).
8. Connect the system to a PC as described in the section on the **Command Console Interface** on page 27. Enter the numerator and denominator using the commands:

   PNUM??????

   PDEN????
9. Check the calibration using the **Calibration Check Procedure** on page 15.

e.g.[1] The following is a simple example

1. QUADRATURE input
2. 2 decimal place
3. **A = 16** targets per rotation
4. Gearbox None

   B = 1

   C = 1
5. **D = 4**

   Numerator = 1

   Denominator = 16 x 4 x 1 = 64
6. There is no need to multiply both by a multiple of 10 to eliminate decimal in denominator
7. Format

   Numerator = +01.00

   Denominator = 0064
8. Program scale factors

   PNUM+01.00

   PDEN0064
9. Check the calibration using the **Calibration Check Procedure** on page 15.

e.g. [2] The following example is chosen to illustrate all aspects of this procedure.

1. QUADRATURE input
2. 1 decimal place
3. **A = 3** targets per rotation
4. Gearbox ratio 4.7 to 2

   B = 4.7

   C = 2
5. **D = 4**

   Numerator = 2

   Denominator = 3 x 4 x 4.7 = 56.4
6. Multiply both by 10 to eliminate decimal in denominator

   Numerator = 2 x 10 = 20

   Denominator = 56.4 x 10 = 564
7. Format

   Numerator = +020.0

   Denominator = 0564
8. Program scale factors

   PNUM+020.0

   PDEN0564
9. Check the calibration using the **Calibration Check Procedure** on page 15.

Note: 20/564 = 0.0354609929078014 to 16 decimal places. The ratio ensures no precision is lost.

Method 2 – Determining calibration scale factors by experiment

Calibrating a system with an unknown number of sensor targets or gearbox ratio:

1. Verify that the mechanism and sensors (or sensor if only 1 input is being used, and it is not necessary to use quadrature) are operating correctly.
2. Determine if 1 (Single input) or 2 (Quadrature) sensors will be used.
3. Determine the display precision required (number of decimal places).
4. Connect the system to a PC as described in the section on the **Command Console Interface** on page 27. Set both the numerator and denominator to 1 using the Console interface commands:

   PNUM+0001.

   PDEN0001

   This makes the overall scale factor 1.
5. Check the display is reading 0. Zero the display if not.
6. Operate the system over a set number of complete turns or known number of unit lengths for distance, whichever is appropriate to the application.

   Ensure the direction of travel is that intended to be used for a positive count when using a quadrature system.

   Ensure the start and finish points are precisely marked and aligned both before and after to ensure the calibration procedure is accurate.

   For example, with a torque tool, mark both the outer body and the drive socket as aligned with the display reading 0 and ensure the tool is stopped at precisely the same point.

   10 is a reasonable number of turns for a torque tool, but more turns will give a more accurate calibration, particularly if the tool is intended to be used over many hundreds of turns.
7. Record the displayed value (the unscaled count). (This may also be read from the console interface if still connected).
8. The numerator is the number of turns executed or the number of unit lengths. The denominator is the unscaled count.

   Numerator = Number of turns / units lengths

   Denominator = unscaled count
9. Format Numerator (add sign, decimal point and leading zeros as required) and Denominator (add leading zeros as required).
10. Connect the system to a PC as described in the section on the Command Console Interface on page 27. Enter the numerator and denominator using the commands:

    PNUM??????

    PDEN????
11. Check the calibration using the **Calibration Check Procedure** on page 15.

See the next page for an example.

e.g.[3] The following is an example of calibrating a torque tool by experiment

1. Check the mechanism operates
2. QUADRATURE input
3. 1 decimal place
4. Set scale factor to 1
5. Zero the display
6. Operate the tool for exactly 10 turns
7. Record a displayed value of 456
8. Write down numerator and denominator

   Numerator = 10

   Denominator = 456
9. Format values

   Numerator = +010.0

   Denominator = 0456
10. Program scale factors

    PNUM+010.0

    PDEN0456
11. Check the calibration using the **Calibration Check Procedure** on page 15.

Calibration Check Procedure

Checking the calibration is correct:

1. Verify that the mechanism and sensors (or sensor if only 1 input is being used, and it is not necessary to use quadrature) are operating correctly.
2. Check the display is reading 0. Zero the display if not.
3. Check the display is not displaying an unscaled value. In the unscaled operating mode the count is preceded by 'u' in the left hand digit and no sign is displayed.
4. Operate the system over a set number of complete turns or known number of unit lengths for distance, whichever is appropriate to the application.

   Ensure the direction of travel is that intended to be used for a positive count when using a quadrature system.

   Ensure the start and finish points are precisely marked and aligned both before and after to ensure the calibration check procedure is accurate.

   For example, with a torque tool, mark both the outer body and the drive socket as aligned with the display reading 0 and ensure the tool is stopped at precisely the same point.

   10 is a reasonable number of turns for a torque tool, but more turns will give a more accurate calibration, particularly if the tool is intended to be used over many hundreds of turns.
5. Record the displayed value (**the scaled count**). (This may also be read from the console interface if still connected).

   The scaled count should precisely agree with the operation carried out to the displayed precision.
6. Now repeat step 4 in the reverse direction to check the counting mechanism / sensor alignment is operating correctly in both directions. Do not zero the display if using a quadrature system.
7. The display should return to exactly 0 which is indicated by no sign display on 4 digit units, or a flashing ☷ on 2 digit units. See Zero Display modes on page 17.

e.g. [4] The following is an example of checking the calibration of a torque tool turns counter displaying to 2 decimal places

1. Verify mechanism operation
2. Check display is zero
3. Check the display is scaled
4. Operate the tool over precisely 10 turns clockwise (intended positive)
5. Record a displayed value of +10.00
6. Operate the tool over precisely 10 turns counter clockwise (intended negative)
7. Record a displayed value of 0.00

Both recorded values were exactly right.

The calibration is good.

Scaling Options

In normal operation the Numerator and the Denominator dictate the ratio of the displayed count for a given number of inputs transitions of the inputs, however a 'raw' un-scaled count equivalent to a numerator of +0001 and a denominator of 0001 can be displayed instead, by operating the scale reed switch as described previously.

While the un-scaled value, which is unsigned, is being displayed, the display is prefixed by a 'u'.

The un-scaled value is only available on the 4 digit counter system as the 2 digit system does not have reed switches.

Count Scaling

Scaled by both multiplication and division factors, (Numerator and Denominator).

Numerator

Must lie in the range -9999 to +9999, smallest decimal values +/- 0.001 Signed (+ or -), may include 0, 1, 2 or 3 decimal places, though a decimal point must always be specified.

Always entered in the following format, 6 characters including: sign, 4 digits, left side padded with zeros and a decimal point.

Note: The position of the Decimal point when the four digit numerator is entered into the system, defines where the decimal point will appear on subsequent count displays. If the numerator of 75 say is entered as 075.0, then subsequent count displays will have the decimal point in the position 000.0 for example.

Examples below:

[optional]:[+/-]0[.]0[.]0[.]0[.]
+0.123
-01.23
+456.7
-0234.

Denominator

Unsigned (no + or -), integer must lie in the range 1 to 9999.

Always entered in the following format as 4 digits, left side padded with zeros.

Examples below:

0000
9999
0543
0021
0001

The numerator/denominator system is provided so that ratios may be accurately evaluated, with no loss of accuracy due to mathematical approximation.

Displaying more decimal places reduces the maximum display range, but increases the fractional precision of the displayed value.

Changing the numerator or denominator resets the current count to zero.

DISPLAY MODES

Operational Display Examples

Normal Counter Display with Input Activity

When the denominator is greater than the numerator, or a Quadrature input is deployed, the display count may not always change with every state change on the inputs. In order to provide the user with an indication of 'activity' on the inputs the centre decimal point of the 2 digit display and the right hand decimal point of the 4 digit display will flash for 250mS each second as is shown below.

2 Digit Display

4 Digit Display

Zero Display modes

In order to allow the user to precisely determine that the scaled count is exactly zero, rather than a fractional value which displays as zero in the current display mode (Rounded or Truncated), both the 4 and 2 digit display versions of the counter systems have particular means to indicate the count is exactly zero. This explicit zero display mode may be enabled or disabled by the user when using a 2 digit display.

In addition there are the overflow display modes, which look similar to zero, but are not, as described above.

2 Digit Display

Scaled Value	Display
0	1 second 20% 80% [0.]0
Value which logically displays as zero	[-] [0.] 0
Overflow	o[.]0

4 Digit Display

Scaled Value	Display
0	No Sign displayed
Value which logically displays as zero	Logical display with sign
Overflow	o[.]0[.]0[.]0

Normal Counter Display showing Absolute Zero

In order to allow the user to precisely determine that the scaled count is exactly zero, rather than a fractional value which displays as a zero in the current counting mode (Rounded or Truncated), both the 4 and 2 digit versions have means to indicate that the count is exactly zero. The Absolute Zero for the 2 digit display may be enabled or disabled by the user.

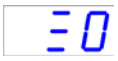
Before Zero (Slightly Negative)

2 Digit Display

4 Digit Display

Absolute Zero or Top Dead Centre (TDC)

2 Digit Display



4 Digit Display

After Zero (Slightly Positive)

2 Digit Display

4 Digit Display

One example of the utilization of absolute zero

A rotating tool is fitted with a Quadrature sensor which has 4 changes of state per revolution. In order to show complete revolutions on the display, a denominator of 4 is chosen, and the rounding mode is chosen as 'Truncated'.

360 degrees Anticlockwise…	Count = -4	display shows –1
270 degrees Anticlockwise…	Count = -3	display shows –0
180 degrees Anticlockwise…	Count = -2	display shows –0
90 degrees Anticlockwise…	Count = -1	display shows –0
0 degrees Top Dead Centre...	Count = 0	display shows 0 or ≡0 on the 2 digit version
90 degrees Clockwise…	Count = +1	display shows +0
180 degrees Clockwise…	Count = +2	display shows +0
270 degrees Clockwise…	Count = +3	display shows +0
360 degrees Clockwise…	Count = +4	display shows +1

4 Digit Counter Display with Overflowed Indication

If the overflow indicator is enabled and the count on the display has gone beyond the +/- 9999 full-scale range, and rolled over, the display will notify the user by flashing 'X' superimposed over the sign on the left hand digit, and will continue to do so until either the count is zeroed or, the power is removed from the unit.

Note that this rollover at +/-9999 will occur regardless of the position of the decimal point for example at +999.9 +1 LS digit counts, or 99.99 +1 LS digit counts, or 9.999 + LS digit counts.

Note, for clarity the sign has been omitted from the left hand digit.

4 Digit Counter Bipolar Overflow Display

In bipolar modes, the displayed count is able to reach a count of 1 more than +9999 or 1 less than -9999. At first sight the result may seem obvious. Clearly it is 10,000, but what is the sign? 1 count more than 10,000 is actually –9999, and 1 count less than 10,000 is actually +9999! This 'special number' is shown as follows on the display.

Note, that the overflow indicator (if enabled) will be activated on this count value.

Rounding Options

Rounding Mode

In Rounding mode any non displayable portion of the scaled value is rounded up to the nearest displayable value.

Set to rounding, the display is rounded up if the answer after the division of the actual input counts by the denominator results in digits to the right of the least significant digit being greater or equal to one half.

Example 1:

If the input count is 1 and the denominator is 3 then the result of the division is 0.33' and the display will show 0. If however the count is 2 the result of the division will be 0.66' and the display will show 1.

Note: the magnitude of the count is rounded up, and as such –0.66 is also rounded up to –1.

Example 2:

4 digit display, configured to display 2 decimal places.

Scaled Value: +0.2568.

Displayed Value: +_0.26, (_ indicates blank display position due to leading zero suppression).

Truncated Mode

In Truncated mode (Rounding off), any non displayable portion of the scaled value is truncated.

Example 1:

If the inputs count is 2 and the denominator is 3 then the result of the division is 0.66' and the display will show 0. If however the count is 3 the result of the division will be 1.0 and the display will show 1.

Example 2:

4 digit display, configured to show 2 decimal places.

Scaled Value: +0.2568

Displayed Value: +_0.25 (_ indicates blank display position due to leading zero suppression).

Truncated mode is particularly useful when implementing a turns counter, for example, where it is only desirable to increment or decrement the display when the count corresponds to complete revolutions (or tenths / hundredths / thousandths there of).

The examples below are all based on a 4 digit display. A 2 digit display operates in the same way, but with 2 digits displayed.

Overflows: In some counting modes an "Overflow" display value is used. This represents an imaginary number that is 1 less than the minimum displayable value, and 1 more than the maximum displayed value, and is governed by the same scaling factor as normal counting mode. That is to say: If the scale factor has a numerator of 1 and a denominator of 5, then the count follows the sequence in the following table, with the given count inputs:

Index	Count	Display
1	-	-9998
2	-5	-9999
3	-5	
4	-5	+9999
5	-5	+9998
6	+5	+9999
7	+2	+9999
8	+2	+9999
9	+1	
10	+3	
11	+1	
12	+1	-9999
13	+5	-9998

Examples of the display with various options

The following examples assume the following:

The numerator has been set to +000.1 through the ‘pnum’ command.
The denominator has been set to 0003 though the ‘pden’ command.
The Quadrature input has been deployed.
The system has a 4 digit display.

	Bipolar		Unipolar	
Count	Truncated	Rounded	Truncated	Rounded
-6	-0.2	-0.2	+999.8	+999.8
-5	-0.1	-0.2	+999.8	+999.8
-4	-0.1	-0.1	+999.8	+999.9
-3	-0.1	-0.1	+999.9	+999.9
-2	-0.0	-0.1	+999.9	+999.9
-1	-0.0	-0.0	+999.9	+0.0
0	0.0	0.0	0.0	0.0
+1	+0.0	+0.0	+0.0	+0.0
+2	+0.0	+0.1	+0.0	+0.1
+3	+0.1	+0.1	+0.1	+0.1
+4	+0.1	+0.1	+0.1	+0.1
+5	+0.1	+0.2	+0.1	+0.2
+6	+0.2	+0.2	+0.2	+0.2

	Bipolar		Unipolar	
Count	Truncated	Rounded	Truncated	Rounded
29994	+999.8	+999.8	+999.8	+999.8
29995	+999.8	+999.8	+999.8	+999.8
29996	+999.8	+999.9	+999.8	+999.9
29997	+999.9	+999.9	+999.9	+999.9
29998	+999.9	+999.9	+999.9	+999.9
29999	+999.9	o000	+999.9	+0.0
30000	o000	o000	0.0	0.0
30001	-999.9	o000	+0.0	+0.0
30002	-999.9	-999.9	+0.0	+0.1
30003	-999.9	-999.9	+0.1	+0.1
30004	-999.8	-999.9	+0.1	+0.1
30005	-999.8	-999.8	+0.1	+0.2
30006	-999.8	-999.8	+0.2	+0.2

DISPLAY CONTROLS

Each of these controls can be enabled or disabled using the console interface or the option links as described later.

Zero Display Reed Switches (4 Digit Display only)

The Display may be zeroed by using the Reed Switch built in to the 4 Digit Display, or by using the Remote Reed Switch and Cable, supplied separately as an option.

Placing a magnet near the right hand side of the display assembly will operate the 'Zero' reed switch. For the first 4 seconds after connecting the switch, 'Zero?' will be shown (as seen below) to allow the user the chance to abort the operation. Removing the magnet from the vicinity of the switch before the 4 second time elapses will immediately return the system to normal operation without affecting the count.

After that and while the switch is operated, the display will flash the message Z0000 as shown below to confirm that the current count is being held at zero.

After the switch is deactivated, the 'Z0000' message persists in a steady state for 3 seconds to confirm the new state.

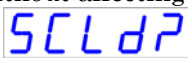
Remote Reed Switch: Operated as above by placing a magnet close to the Reed Switch (999-11-07-001) at the end of the Cable (999-11-07-003) and observing the Display changes.

Note that it may be necessary to enable the Remote Reed Switch prior to use. This is done within the RS232 Console Interface using the command, "enable232zero".

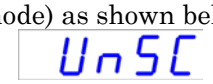
This command enables the "RS232 DATA LOOP BACK ZERO" function. The RS232 data output from pin 1 (5 way connector) is fed back into the data input pin 2 and a comparison carried out. If there is no difference between them (which is to be expected), then the Zeroing of the Display commences.

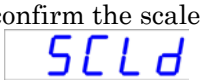
Scale Swap Reed Switch (4 Digit Display only)

Placing a magnet near the left hand side of the display assembly will operate the 'Scale' reed switch. For the first 4 seconds after connecting the switch, 'Unsc?' (or 'Scld?' if the system is unscaled mode) will be shown (as seen below) to allow the user the chance to abort the operation. Removing the magnet from the vicinity of the switch before the 4 second time elapses will immediately return the system to normal operation without affecting the count.



After that and while the switch is operated, the display will flash the message 'Unsc' (or 'Scld' if the system was in unscaled mode) as shown below to confirm the scale mode will be changed.





After the switch is deactivated, the 'Unsc' (or 'Scld' if the system was in unscaled mode) message persists in a steady state for 3 seconds to confirm the new state. In the unscaled operating mode the count is preceded by 'u' in the left hand digit and no sign is displayed.

4 Digit Strain Gauge Input Operational Modes

Gain Settings

The system has three possible gain settings. The setting should be selected based on the maximum expected output (sensitivity) from the transducer.

Links on Strain gauge Interface Board 023-14-07-003 (2nd from Cylindrical Housing End Cap)

Transducer Sensitivity (mV/V)	**Link**
2	A
5	B
10	C

Fit the link on the strain gauge conditioning PCB according to the above table. The selected sensitivity setting should be just greater than that of the transducer. The table below illustrates some examples.

Transducer Sensitivity (mV/V)	**Display System Sensitivity** (mV/V)
1.852	2
2.050	5
3.580	5
4.815	5
6.326	10

Calibration

In order to calibrate the system a reference calibrated measuring system and the Subsea Display System, Command Console Interface are required (see Command Console Interface section).

To calibrate the system:

1. Reset calibration to default factory set condition.
   METHOD:
   COMMAND: 'reset'
2. With the transducer connected to the Subsea Display System and no load applied on the transducer, zero the displayed value.
   METHOD:
   Make a note of the unscaled ADC reading. Use this as the zero value.
   COMMAND: 'pzeroXYYYY', where X = sign and YYYY = value (e.g. 'pzero+1234')
3. Put full scale or maximum load on transducer. Record reading from measuring system and reading from the Subsea Display System. **Note:** Subsea Display must be set to show Nm.

CALCULATE:			EXAMPLE CALCULATION:	
$\frac{\text{Measured Load (Nm)}}{\text{Subsea Display System Reading (set to Nm)}}$	X	+8192 = Subsea Display System Full Scale	Measured Load = 400.0 Nm Subsea Display System Reading = 6864 (set to Nm)	(400.0/6864) x 8192 = 477.4 477.4 = Subsea Display System Full Scale

4. Program Subsea Display System full scale.
   METHOD:
   COMMAND: 'pfsXYYYYY', where X = sign and YYYYY = value (e.g. 'pfs+477.4')
   Note: The value must be the 4 most significant digits and include a decimal point for example:
   pfs+1.234
   pfs+00.12
   pfs-357.2
   pfs-4562.
5. Check reading against measuring system.

Dead Band Trim Function

This function enables the system to be adjusted so that the display reads zero, during operations to either side of zero, where for instance an applied torque has no effect.

Note: **Setting the "dead band" must be carried out when the Subsea Display System "User FSD" is set to +8192.**

If the Subsea Display System has been calibrated and a new User FSD has been set, then a record of the new User FSD can be taken, before setting the User FSD to +8192. Use the 'pfs' command at the Command Console interface (type: 'pfs+8192').

The value to enter for the dead band function may be obtained by operating the system that applies Torque, for example and noting the Subsea Display reading above and below zero, where the applied torque has no effect.

The dead band value is entered as a single number and has equal effect above and below zero. For example if the value is 235, then type: 'setdeadband 0235' at the Command Console Interface. The value is always entered as a 4 digit number.

After the dead band has been set, then if necessary the User FSD can be reset to the value previously recorded for the calibrated Subsea Display System, by using the 'pfs' command at the Command Console interface.

DISPLAY CONTROLS

Zero Display Reed Switches

It is possible to zero the display reading of the Subsea Display System (this function may be disabled at the RS232 Command Console Interface).

Positioning a magnet in close proximity to the right-hand side of the display (or by actuating the right-hand lever on the Remote Actuator Assembly):

Switch Actuator	Description	Display Shows
The following will confirm that the switch function is enabled (the display will NOT zero):		
	Displays reading	26
Press & release	Do you want to zero display? (release if not)	TARE?
	Returns to reading (display NOT zeroed)	26

	Displays reading	26
Press & hold for 3 seconds	Do you want to zero display? (hold to zero)	TARE?
	Zeroing display (flashing)	T0000
Release	Display zeroed	TARED
	Returns to reading (display zeroed)	0

Units (Nm / lb.ft) Reed Switches (Torque display modes only)

Note: The "units" reed switch only operates when the Strain Gauge input Subsea Display System is in 'TVS' mode. The mode is shown under "Analogue Operation", in the Command Console interface.

The unit of measurement for the variable being measured may be set to Nm or lb.ft by activating the reed switch at the left side of the display.

Positioning a magnet in close proximity to the left side of the Subsea Display (or by actuating the left-hand lever on the Remote Actuator Assembly).

Switch Actuator	Description	Display Shows
The following will confirm that the switch function is enabled (the display will NOT zero):		
	Displays Reading / Nm (Bar at top on left side)	2526
Press & release	Change units to lb.ft? (release if not)	U lb.Ft
	Returns to reading (units NOT changed)	2526

	Displays reading	2526
Press & hold for 3 seconds	Change units to lb.ft? (hold to change)	U lb.Ft
	New units displayed (flashing)	lb.Ft
Release	New units displayed	lb.Ft
	Returns to reading (new units now in use, bar at bottom on left side))	1863

Note: The left side of the display has an illuminated horizontal bar. If the bar is at the top of the display then Nm is selected. If the bar is at the bottom then lb.ft is selected.

Dual 4 Digit Display Operational Modes

Description

The Dual 4 Digit Subsea Display System is capable of operating as both a quadrature counter display and a display for a strain gauge derived input such as torque,. The system displays turns and torque simultaneously without the need for any re-configuration or switching of displays.

The default factory set condition is that the strain gauge input (torque) is displayed at the top and the count display is at the bottom 4 digit display.

The operational modes described in the previous sections for the Strain Gauge and Quadrature Counter systems are all applicable to the Dual 4 Digit subsea Display.

The unit is therefore particularly suitable for use with a Torque Tool, where readings of "Number of Turns" and "Applied Torque" are required.

Dual 4 Digit Display Controls

The display consists of two 4 digit displays enclosed within one display housing. Each display has two magnet operated reed switches, one at the left of the front and one at the front right side. Therefore the dual display has two switches to the left side and two to the right.

Left Reed Switches: Either switch will change the units of the top display showing strain gauge input (Torque) between Nm and lb.ft.

Right Reed Switches: Either switch will simultaneously "Tare" the top display (Torque) and zero the count of the bottom 4 digit display.

The Subsea Display System is doing this, what does it mean?

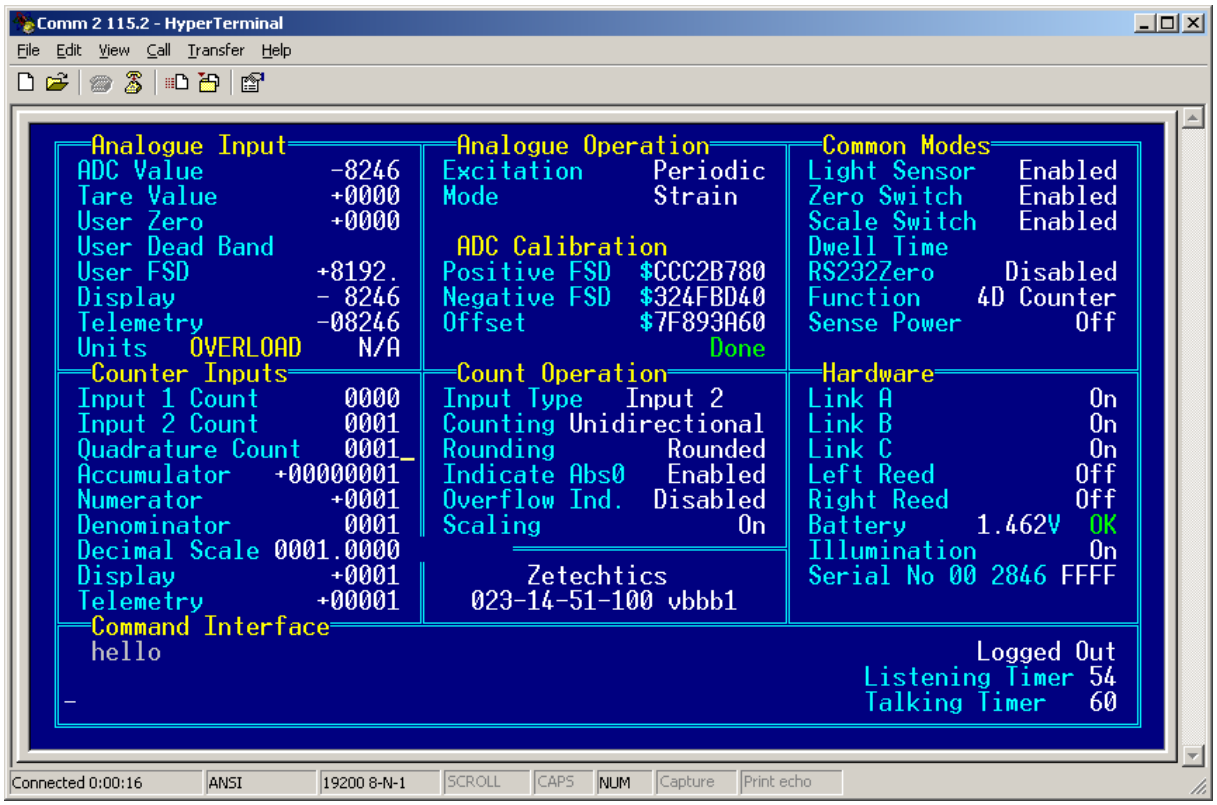
Description	Cause
The display is illuminated constantly	No option links are fitted or light sensor disabled.
The display is only illuminated when a light is shone on the unit	The Subsea Display System is set to only operate when illuminated, option link A is fitted or light sensor enabled.
The display is not illuminated at all	There is insufficient light shining on the unit when option link A fitted / light sensor enabled. **OR** The battery is completely flat.
The display shows ErHi	The input value is above that set as maximum or there is a sensor cabling / connector fault.
The display shows ErLo	The input value is below that set as minimum or there is a sensor cabling / connector fault.
The display is on continually except for a brief flicker every six seconds	Option link A is fitted / light sensor is enabled (the unit turns off the display to test the ambient light level).
The display is on continually except for two brief periods every six seconds	The battery is nearly discharged

COMMAND CONSOLE INTERFACE

The Command Console interface provides a means to set all system configuration options, including modes of operation and counter scaling. It is also possible to diagnose some system operation issues.

RS232 Console Display

An example of the console display is shown below:



Console Operation Procedure

In normal operation the Diagnostics & Command Console is disabled to save power, and to make the RS232 Serial Data Output simple to decode.

1. Connect the Subsea Display System to a PC serial port using the cable provided (5w micro to 9 way D, part number: 023-14-11-020).
2. Run Windows Hyper Terminal and configure the serial port. The default RS232 baud rate is 19200, but if this does not work, test the other available baud rates. The 4 digit display shows the baud rate setting during power up. The other serial port settings should be as follows:

RS232 Parameters

Default	Data bits	Start bits	Stop bits	Parity	Handshaking
19200	8	1	1	None	None

Note: Available baud rates 2400 to 115200 (see **RS232 Console User Commands**).

3. When the connection is configured, Hyper Terminal should open the RS232 serial communications port automatically. The current display value will be shown on the Command Console terminal, eg 000000. The display must be active, i.e. there is enough light falling on the display if the light sensor is enabled.
4. Hit return, type "hello" and hit return again, this should start the Command Console display. Diagnostic data is displayed, together with all programmed parameters. If not try again.
5. The user can monitor the system from the continuously updated display. Hitting return every minute or so will prevent the console display "Listening Timer" from timing out.
6. To change any system operating options, first type the user password 'letmein' followed by return.
7. Any required configuration changes can now be made using the commands described below.

NOTE:
The console display "listening timer" will time out after 2 minutes of keyboard inactivity.

To re activate the console, press 'return' a couple of times and the console display will refresh. Type the user password 'letmein' and press 'return'.

The password is valid for another 2 minutes after the last keyboard activity once entered.

The console is 'case sensitive' and all inputs should to be entered in lower case.

RS232 Data Output

After the console display has timed out, the RS232 output reverts to broadcasting the displayed value.

Note that if the light sensor is enabled, the RS232 string will not transmit whilst the display is turned off due to lack of ambient light.

RS232 Serial Data Format

The bit rate is determined by the baud rate setting, which can be changed using the commands at the console. The default speed is 19200. Each byte is ASCII coded Decimal with 8 bits, no parity and 1 stop bit. Each data frame is terminated by the carriage return character 13d (0x0D). No handshaking is available.

The frame has a fixed data length (n characters). Specifying the numerator through the 'pnum' command determines the position of the decimal point. If no decimal point is the required option, then the data frame is padded with an extra '0' in the position of the most significant digit.

One exception to the numeric display, is the case when the count becomes overloaded, i.e. the displayed count is 1 more than +/-9999. In this case the data frame will be "_ERROR".

Examples of the output string where '¶' represents the CR character:
+09999¶
+99.99¶
000000¶
-9.999¶
_ERROR¶

Dual Display RS232 Serial Data Format

If the unit is a dual 4 digit display type, then both readings are output separated by a comma, count value followed by strain gauge value.

Examples of the output string where '¶' represents the CR character:
000.0, +0000¶
-0.000, +00.00¶

RS232 Console User Commands

Command Summary – General Use

Command	Description	Password
hello	Starts the RS232 Diagnostics & Command Console	N/A
letmein	User password	N/A
setrs232	Sets the Serial Interface to RS232 {3}	Requires User Password
setrs485	Sets the Serial Interface to RS485	Requires User Password
baud2400	Set the Baud Rate to 2400 {3}	Requires User Password
baud4800	Set the Baud Rate to 4800 {3}	Requires User Password
baud9600	Set the Baud Rate to 9600 {3}	Requires User Password
baud19200	Set the Baud Rate to 19200 {3}	Requires User Password
baud38400	Set the Baud Rate to 38400 {3}	Requires User Password
baud57600	Set the Baud Rate to 57600 {3}	Requires User Password
baud115200	Set the Baud Rate to 115200 {3}	Requires User Password
deepsleepdisable	Disable Deep Sleep mode	Requires User Password
deepsleepenable	Enable Deep Sleep mode	Requires User Password
disablelightsensor	Disable the Light Sensor {2}	Requires User Password
dwelltime	Input a dwell time	Requires User Password
enablelightsensor	Enable the Light Sensor {2}	Requires User Password
normal	Normal Display i.e. No Tests	N/A
powercycle	Emulates a complete restart of the system	Requires User Password
reset	Resets calibration values and configuration options to factory default	Requires User Password
setcount	Set 4 digit counter display on display 1 {4}	Requires User Password
set8rate	Set 8 Digit Volume and Flow Meter {2}	Requires User Password
setsas	Set 4 digit strain gauge system on display 1 {4}	Requires User Password

Notes: {1} Applies to 2 digit display variant only.
{2} Applies to 4 digit and dual 4 digit display variants only.
{3} Requires a power cycle, physical or by command after command use
{4} Applies to 4 digit display variants only.

Command Summary – Counter

Command	Description	Password
bipolar	Count +/- Around Zero (Bipolar Mode)	Requires User Password
deepsleepdisable	Disable Deep Sleep mode	Requires User Password
deepsleepenable	Enable Deep Sleep mode	Requires User Password
disable232zero	Disables RS232 Data Loopback Zero	Requires User Password
disableabs0	Disable the Display of Absolute Zero (TDC) {1}	Requires User Password
disableoverflow	Disable the overflow indication	Requires User Password
disableunscaled	Disable the Scale Swap Switch {2}	Requires User Password
disablezero	Disable the Zero Switch {2}	Requires User Password
display1	Display the Count on Input 1	Requires User Password
display2	Display the Count on Input 2	Requires User Password
displayq	Display the Quadrature Count	Requires User Password
enable232zero	Enables RS232 Data Loopback Zero	Requires User Password
enablezero	Enable the zero switch	Requires User Password
enableabs0	Enable the Display of Absolute Zero (TDC) {1}	Requires User Password
enableoverflow	Enable the overflow indication	Requires User Password
enableunscaled	Enable the Scale Swap Switch {2}	Requires User Password
loaddisp	Load accumulator	Requires User Password
pden	Program the Denominator	Requires User Password
pfnumph xxxx	Program the Flow Numerator to 1 Per Hour	Requires User Password
pfnumphxxxx	Program the Flow Numerator to 1 Per Hour	Requires User Password
pfnumpm xxxx	Program the Flow Numerator to 1 Per Minute	Requires User Password
pfnumpmxxxx	Program the Flow Numerator to 1 Per Minute	Requires User Password
pfnumps xxxx	Program the Flow Numerator to 1 Per Second	Requires User Password
pfnumpsxxxx	Program the Flow Numerator to 1 Per Second	Requires User Password
pfnumph xxx.x	Program the Flow Numerator to 1.0 Per Hour	Requires User Password
pfnumphxxx.x	Program the Flow Numerator to 1.0 Per Hour	Requires User Password
pfnumpm xxx.x	Program the Flow Numerator to 1.0 Per Minute	Requires User Password
pfnumpmxxx.x	Program the Flow Numerator to 1.0 Per Minute	Requires User Password
pfnumps xxx.x	Program the Flow Numerator to 1.0 Per Second	Requires User Password
pfnumpsxxx.x	Program the Flow Numerator to 1.0 Per Second	Requires User Password
pnum	Program the Numerator	Requires User Password
rounddown	No rounding (same as “setrunc”)	Requires User Password
roundup	Round up (same as “setround”)	Requires User Password
sensepower5v	Set the sensor power to 5v; sleep when there is no light	Requires User Password
sensepower10v	Set the sensor power to 10v ; sleep when there is no light	Requires User Password
sensepowerconst	Set the sensor power to constant – always on	Requires User Password
sensepoweroff	Switch off the sensor power	Requires User Password
setcount	Set 4 digit counter display on display 1	Requires User or Supervisor Password
set2dcount	Set 2 digit counter display on display 1	Requires Supervisor Password
set4dcount	Set 4 digit counter display on display 1	Requires Supervisor Password
set2dd	Set 2 digit counter displayon display 1	Requires Supervisor Password
set4dd	Set 4 digit counter display on display 1	Requires Supervisor Password
set8dd	Set 8 digit display with strain gauge and counter – counter is on display 1	Requires Supervisor Password
set8rate	Set 8 Digit Volume and Flow Meter	Requires User Password
seti1c	Input 1 Continuous (Unipolar)	Requires User Password
seti2c	Input 2 Continuous (Unipolar)	Requires User Password

setiqbc	Quadrature Bipolar Continuous	Requires User Password
setiqbo	Quadrature Bipolar Overflow	Requires User Password
setiqc	Quadrature Input Continuous (Unipolar)	Requires User Password
setround	Rounding On	Requires User Password
setsas	Set 4 digit analogue system on display 1 {4}	Requires User or Supervisor Password
settrunc	Rounding Off (Truncated)	Requires User Password
unipolar	Count Linearly (Unipolar Mode)	Requires User Password
zero	Zero the Input Counters	Requires User Password

Notes: {1} Applies to 2 digit display variant only.
{2} Applies to 4 digit and dual 4 digit display variants only.
{3} Requires a power cycle, physical or by command after command use
{4} Applies to 4 digit display variants only.

Command Summary – Strain Gauge Input

Command	Description	Password
excite	Keep the bridge on	Requires User Password
pfs	Program full scale	Requires User Password
ptare	Manual tare value input, eg. ptare+3456 or ptare-3456	Requires User Password
pzero	Program the user zero set point	Requires User Password
setlbft	Set the scaling factor to 1bs.Ft	Requires User Password
setcount	Set 4 digit counter display on display 1 {4}	Requires User Password
set8dd	Set 8 digit display with strain gauge and counter – counter is on display 1	Requires User Password
setdeadband	Set the dead band	Requires User Password
setnm	Set the scaling factor to 1 for Nm	Requires User Password
setsas	Set 4 digit strain gauge system on display 1 {4}	Requires User Password
setsasbot	Set 4 Digit Analogue System on Display 2 {2}	Requires User Password
setsastop	Set 4 Digit Analogue System on Display 1 {2}	Requires User Password
setstrain	Set non TVS mode	Requires User Password
settvs	Set TVS mode	Requires User Password
tare	Tare the current value	Requires User Password

Notes: {1} Applies to 2 digit display variant only.
{2} Applies to 4 digit and dual 4 digit display variants only.
{3} Requires a power cycle, physical or by command after command use
{4} Applies to 4 digit display variants only.

Command Summary – System Availability

Command	2 Digit Counter	4 Digit Strain Gauge	4 Digit Counter	4 Digit Torque Verification System	Dual Display	Dual Display Torque Tool
hello	Unrestricted	Unrestricted	Unrestricted	Unrestricted	Unrestricted	Unrestricted
letmein	Unrestricted	Unrestricted	Unrestricted	Unrestricted	Unrestricted	Unrestricted
reset	Factory Only	User Password	User Password	Factory Only	User Password	Factory Only
enablezero	Not applicable	User Password	User Password	User Password	User Password	User Password
deepsleepdisable	User Password	User Password	User Password	User Password	User Password	User Password
deepsleepenable	User Password	User Password	User Password	User Password	User Password	User Password
disablezero	Not applicable	User Password	User Password	User Password	User Password	User Password
enableunscaled	Not applicable	User Password	User Password	User Password	User Password	User Password
disableunscale	Not applicable	User Password	User Password	User Password	User Password	User Password
enableroverflow	Not applicable	User Password	User Password	User Password	User Password	User Password
disableoverflo	Not applicable	User Password	User Password	User Password	User Password	User Password
pfs	N/A	User Password	N/A	Factory Only	User Password	User Password
pzero	N/A	User Password	N/A	Factory Only	User Password	User Password
setnm	User Password	Not applicable	Not applicable	User Password	Not applicable	User Password
setlbft	User Password	Not applicable	Not applicable	User Password	Not applicable	User Password
setdeadband	User Password	User Password	User Password	Not applicable	User Password	Not applicable
set4dcount	Not applicable	User Password	Not applicable	Factory Only	Not applicable	Not applicable
setcount	Factory Only	User Password	Not applicable	Factory Only	Not applicable	Not applicable
setcountbot	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
setcounttop	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
setratebot	Not applicable	Not applicable	Not applicable	Not applicable	User Password	Factory Only
setratetop	Not applicable	Not applicable	Not applicable	Not applicable	User Password	Factory Only
set8rate	Not applicable	Not applicable	Not applicable	Not applicable	User Password	Not applicable
setsas	Not applicable	User Password	Not applicable	Factory Only	Not applicable	Not applicable
setsasbot	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
setsastop	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Note: To set the 4 digit Subsea Display System so that it operates with a Strain Gauge input, use the 'setsas' command.

To set the 4 digit Subsea Display System so that it operates with a Counter input, use the 'setcount' command.

Command Description

All the following commands should be followed by carriage return on the keyboard.

hello

Starts the RS232 Diagnostics & Command Console:

letmein

User password.

baud2400

Changes the baud rate of the serial port to 2400 bits per second. No change occurs until there is a power cycle on the system, or the “powercycle” command is issued.

baud4800

Changes the baud rate of the serial port to 4800 bits per second. No change occurs until there is a power cycle on the system, or the “powercycle” command is issued.

baud9600

Changes the baud rate of the serial port to 9600 bits per second. No change occurs until there is a power cycle on the system, or the “powercycle” command is issued.

baud19200

Changes the baud rate of the serial port to 19,200 bits per second. No change occurs until there is a power cycle on the system, or the “powercycle” command is issued.

baud38400

Changes the baud rate of the serial port to 38,400 bits per second. No change occurs until there is a power cycle on the system, or the “powercycle” command is issued.

baud57600

Changes the baud rate of the serial port to 57,600 bits per second. No change occurs until there is a power cycle on the system, or the ‘powercycle’ command is issued.

baud115200

Changes the baud rate of the serial port to 115,200 bits per second. No change occurs until there is a power cycle on the system, or the ‘powercycle’ command is issued.

bipolar

Sets the display value to bipolar mode where decreasing the count through zero results in a small negative value which increases in magnitude.

deepsleepdisable

Disables the Deep Sleep mode.

deepsleepenable

Enables the Deep Sleep mode.

disable232zero

This command enables the “RS232 DATA LOOP BACK ZERO” function. The RS232 data output from pin 1 (5 way connector) is fed back into the data input pin 2 and a comparison carried out. If there is no difference between them (which is to be expected), then the Zeroing of the Display commences.

disableabs0

This command disables the display of absolute zero or ‘TDC’.

disablelightsensor

If the Light Sensor is enabled by the hardware link ‘link A’, issuing this command will disable the Light Sensor which will ensure that the unit never enters the very low power mode when the presence of light is not detected, and the display will remain on until the battery is exhausted.

disableoverflow

Disables the overflow indication.

disableunscaled

If the 'Scale' reed switch is enabled by the hardware link 'link C' or by software, issuing this command will prevent Scale Swapping function from affecting the count.

disablezero

If the 'Zero' reed switch is enabled by the hardware link 'link B' or by software, issuing this command will prevent the zero function from affecting the count.

display1

Directs the system to display the value derived from the number of counts registered from (non-quadrature) input 1

display2

Directs the system to display the value derived from the number of counts registered from (non-quadrature) input 2.

displayq

Directs the system to display the value derived from the number of counts registered from the quadrature input comprising of both inputs 1 & 2.

dwelltime

Input a dwell time – adjusts the time that the display remains illuminated after light is extinguished, in seconds – 1255 seconds maximum.

enable232zero

This command disables the "RS232 DATA LOOP BACK ZERO" function. The RS232 data output from pin 1 (5 way connector) is fed back into the data input pin 2 and a comparison carried out. If there is no difference between them (which is to be expected), then the Zeroing of the Display commences.

enableabs0

This command enables the display of absolute zero or 'TDC' (Top Dead Centre).

enablelightsensor

If the Light Sensor is not enabled by the hardware link 'link A', issuing this command will enable the Light Sensor which will allow the unit to enter a very low power mode when the presence of light is not detected.

enableoverflow

Enables indication of an overflow.

enableunscaled

If the 'Scale' reed switch is not enabled by the hardware link 'link C', issuing this command will enable the Scale Swapping function for when the reed is in close proximity of a magnetic field.

enablezero

If the 'Zero' reed switch is not enabled by the hardware link 'link B', issuing this command will enable the zero function when the reed is in close proximity of a magnetic field.

excite

Keep the bridge on

loaddisp

Load accumulator

normal

'normal' defeats any or all tests in progress and returns the system to 'normal' operation.

pden (Program the DENominator)

The denominator is entered as a four digit unsigned integer with leading zeroes between 0001 & 9999.

Note that when the denominator is changed, the accumulators are zeroed unless the supervisor password has been issued.

pfnumph xxxx

Program the Flow Numerator to 1 per Hour.

pfnumphxxxx

Program the Flow Numerator to 1 per Hour.

pfnumpm xxxx

Program the Flow Numerator to 1 per Minute.

pfnumpmxxxx

Program the Flow Numerator to 1 per Minute.

pfnumps xxxx

Program the Flow Numerator to 1 per Second.

pfnumpsxxxx

Program the Flow Numerator to 1 per Second.

pfnumph xxx.x

Program the Flow Numerator to 1.0 per Hour.

pfnumphxxx.x

Program the Flow Numerator to 1.0 per Hour.

pfnumpm xxx.x

Program the Flow Numerator to 1.0 per Minute.

pfnumpmxxx.x

Program the Flow Numerator to 1.0 per Minute.

pfnumps xxx.x

Program the Flow Numerator to 1.0 per Second.

pfnumpsxxx.x

Program the Flow Numerator to 1.0 per Second.

pfs

Program full scale

pnum (Program the NUMerator)

The numerator is entered as a four digit signed integer with leading zeros and optional decimal point in the ranges +0.001 & +9999 and -0.001 & –9999.

The position of the Decimal point when the four digit numerator is entered into the system, defines where the decimal point will appear on subsequent count displays. If the numerator of 75 say is entered as 075.0, then subsequent count displays will have the decimal point in the position 000.0 for example.

If the negative or positive sign is not supplied then the input is assumed to be positive.

Note that when the numerator is changed, the accumulators are zeroed unless the supervisor password has been issued.

powercycle

Issuing this command forces the processor to reset as if it had been powered down and up again

Note that while the system is executing a power cycle the accumulators will be reset to zero and changes to the inputs will not be recognized and counts will be lost.

ptare

Manual tare value input

pzero

Program the user zero set point

reset

Resets calibration values and configuration options to factory default

rounddown

Same as “settrunc”

roundup

Same as “setround”.

sensepower5v

Sets the sensor power to 5V while light is detected or the light sensor is disabled.

sensepower10v

Sets the sensor power to 10V while light is detected or the light sensor is disabled.

sensepowerconst

Sets the sensor power for a constant output regardless of the state of the light sensor.

sensepoweroff

Switches the sensor power off.

set4dcount

Set 4 digit Counter Display on Display 1

setcount

Set 4 digit counter display on display 1

setcountbot

Set 4 Digit Counter Display on Display 2.

setcounttop

Set 4 Digit Counter Display on Display 1.

setdeadband

Set the dead band

seti1c (SET Input to 1 Continuous)

This command is essentially a short cut to 1 of 5 of the most obvious configurations for the deployment of the system.

The seti1c command:

Sets the input to Input 1 (non quadrature).
Sets Unipolar Mode.
Disables Overflow Indication.

seti2c (SET Input to 2 Continuous)

This command is essentially a short cut to 1 of 5 of the most obvious configurations for the deployment of the system.

The seti2c command:

Sets the input to Input 2 (non quadrature).
Sets Unipolar Mode.
Disables Overflow Indication.

setiqbc (SET Input to Quadrature Bipolar Continuous)

This command is essentially a short cut to 1 of 5 of the most obvious configurations for the deployment of the system.

Sets the input quadrature using inputs 1 & 2 (Input 1 Leads).
Sets Bipolar Mode.
Disables Overflow Indication.

setiqbo (SET Input to Quadrature Bipolar Overflow Continuous)

This command is essentially a short cut to 1 of 5 of the most obvious configurations for the deployment of the system.

setiqc (SET Input to Quadrature Continuous)

This command is essentially a short cut to 1 of 5 of the most obvious configurations for the deployment of the system.

setlbft

Set the display to show readings in lbft. (The scale factor must still be determined in Nm. A conversion factor of 0.737562121 is applied to the Nm reading.)

setnm

Set the display to show readings in Nm. (No conversion factor is applied.)

set8rate

Set 8 digit Volume and Flow Meter

setratebot

Set 4 Digit Rate Display on Display 2.

setratetop

Set 4 Digit Rate Display on Display 1.

setround

Sets the display rounding on, and thereby defeats the truncation of the displayed value.

setsas

Set 4 digit analogue system on display 1

setsasbot

Set 4 Digit Analogue System on Display 2.

setsastop

Set 4 Digit Analogue System on Display 1.

setsasbot

Set 4 Digit Analogue System on Display 2.

setstrain

Set non TVS mode (strain gauge mode).

settrunc

Sets the display truncation on, and thereby defeats the rounding of the displayed value.

settvs

Set TVS mode

tare

Tare the current value

unipolar

Sets the display value to Unipolar mode where decreasing the count though zero results in a large (full scale (+9999 on the four digit display or 99 on the two digit display) value that decreases in magnitude.

zero

Clears all the internal counter registers to zero.

POWER

BATTERY

The battery installed is a high capacity Ni-MH 'D-Cell'. If this fails it can be replaced with a spare from Zetechtics Ltd, or in an emergency, an alkaline primary D-Cell such as a Duracell® or similar, see Replacing the Battery.

SYSTEM CHARGING

Note: The display will flash twice every 6 seconds when the battery is low.

WARNING: Do not attempt to charge if Primary Cells are fitted

The system may be supplied with 2 types of charger:

WARNING: Only use the New type of charger with systems labelled as compatible – contact Zetechtics for details regarding compatibility.

New type International 100 to 240VAC charger: 023-14-02-005

1. Disconnect the 5way Power Enable connector from the back of the system.
2. Fit the correct international mains adapter supplied with the charger for the mains supply. Attach the Charger (Part No. 023-14-02-005).
3. The charger will charge until the battery is fully charged or for up to 10 hours and then switch to trickle charging. If the battery is fully discharged a second charge cycle is required. If the charge has run for around 10 hours before terminating, initiate a second charge cycle by switching the charger off and back on again.
4. To charge a fully discharged system takes approximately 16 hours.
5. The discharge function may be used to fully discharge the system, but this should not be required as the system uses NiMH batteries, that do not need a regular full discharge, like NiCad batteries.

Older type UK 230VAC charger: 023-14-02-001

1. Disconnect the 5way Power Enable connector from the back of the system.
2. Attach the Charger (Part No. 023-14-02-001).
3. Ensure that the charger is set to 600mA and 8 hours.
4. To fully charge the system takes two 8-hour cycles. However if the battery still retains over half its original charge, then it is reasonable to only execute one 8-hour cycle.

Checking the System Operation

1. The batteries should be charged according to the instructions.
2. The unit should be connected to a strain gauge sensor or counter input. The Power Enable connector should be fitted.
3. The current value is shown on the display.

Note: If link A is fitted the display will only light up when there is some ambient light.

Remote - Display Zero Control

Items required for Remote - Display Zero, Reed Switch option.

1. Cable: 999-11-07-003, 1 off.
2. Reed Switch: 999-11-07-001, 1 off.

MAINTENANCE

OPENING THE SUBSEA DISPLAY

1. Using fine nose pliers pull out the nylon cord from within the groove inside the rear end of the cylindrical housing of the unit. If undamaged put to one side for re-use.
2. Pull the end cap away from the cylindrical housing using a rocking motion. Do not attempt to twist the end cap off as it is prevented from doing so by a metal pin between itself and the cylindrical housing. Take care not to damage the O-ring in the process.
3. When the end cap is free, pull the internal support tube from the cylindrical housing. **Warning**: Do not pull on the wires between the internal support tube and the subsea connectors on the end cap.

   Note: The 2 digit display is removed with the internal support tube leaving only the clear lens which should not normally require removal from the cylindrical housing.
4. It is not usually necessary to remove the 4 digit or dual 4 digit display from the cylindrical housing at all and this is discouraged by Zetechtics, as unnecessary damage may result. The 4 digit and dual 4 digit display disconnects via sprung contact pins as the internal support tube is removed from within the cylindrical housing.

   Earlier types of 4 digit display have a wired connector, which disconnects as the internal support tube is removed from the cylindrical housing. The display needs to be removed from the cylindrical housing to enable the wired connector to be re-connected to the front interface PCB upon re-assembly. This may be checked by looking at the rear of the display inside the cylindrical housing. For removal of 4 digit or dual 4 digit displays follow steps 5 to 6.
5. Using circlip pliers remove the circlip which retains the display assembly into the housing.
6. Pull the display assembly directly out of the tube, avoiding any rocking or twisting motions that may cause damage to the sealing face and O-ring on the display. Be especially careful not to damage the sprung contact pins.
7. If the display is an earlier version with a wired connector, it must be disconnected from the front interface PCB. **Warning**: Do not pull on the interconnect cable, as damage may be caused to the connections within the display.
8. Place the display to one side, where it won't get damaged, being especially careful with the sprung contact pins.

REPLACING FUSES

The Subsea Display has two fuses, these are to protect the unit wiring or users, if an over-current event occurs. The battery contains a considerable amount of energy and in no circumstance should any fuse be replaced with a higher rating or shorted out entirely.

To replace a fuse:

1. Open the Subsea Display (see: Opening the Subsea Display).
2. Both fuses are to be found on the Rear Interface PCB (nearest the connectors). The faulty fuse can be extracted & replaced using a pair of fine nose pliers.
3. Re-assemble the Subsea Display (see: Reassembling / Sealing the Subsea Display).

Fuse	Nanofuse Type	Farnell Part No.	Function
F1	3A Quick Blow	992-2180	Battery +ve Line
F2	3A Quick Blow	992-2180	Battery –ve Line

NOTE: Earlier systems were fitted with 1A fuses. These have been changed to permit the use of an international charger unit. 1A fuses may be replaced with 3A fuses in earlier systems. If both fuses are 3A fuses then the system may be charged using the international charger part number 023-14-02-005.

Replacing the Battery

The battery installed is a high capacity Ni-MH 'D-Cell'. If this fails it can be replaced with a spare from Zetechtics Ltd, or in an emergency, an alkaline primary D-Cell such as a Duracell® or similar.

1. Open the Subsea Display System (see Opening the Subsea Display).
2. Unplug 10way sub-miniature connector from rear PCB.
3. Carefully lift the access strip of the Internal Support Tube.
4. Carefully lift out old battery and replace with the new item (+ve to end of assembly with Display).
5. Replace access strip of Internal Support Tube taking care to align slots.
6. Refit 10 way sub-miniature connector to rear PCB.
7. Charge new battery if required (see System Charging) and retest before assembly.
8. Re-assemble the Subsea Display System (see: Reassembling / Sealing the Subsea Display).

Reassembling / Sealing the Subsea Display

1. Clean and inspect all O-rings for damage and then lubricate with O-ring grease before replacing.
2. The 2 digit display is replaced with the internal support tube at step 5.
3. Early versions of 4 digit displays have a wired connector that must be connected to the front interface PCB before sliding the display into the cylindrical housing. This display must therefore be fitted after the internal support tube and end cap has been fitted at steps 5 to 9 of this section.

   If re-fitting a wired 4 digit display, fit the wired connector to the front interface PCB and carefully slide the internal support tube to take up any slack in the cables, so that they do not become trapped between the display and the housing. Slide the display into the cylindrical housing as above.

   The 4 digit and dual 4 digit displays are re-fitted by sliding into the cylindrical housing, avoiding any rocking or twisting motions that may cause damage to the sealing face or O-ring on the display. Take special care not to damage the sprung contact pins in the process.
4. Replace the circlip to retain the display into the housing.
5. Slide the Internal Support Tube back into the Housing.
6. Coil the wires between the end cap and the body neatly into the rear of the unit and replace or renew the silica gel bag.
7. Gently push in the end cap checking to make sure that it is correctly aligned with the housing and the alignment pin enters the hole in the end cap correctly.
   Note: If there is any doubt regarding the correct alignment of the two parts or the possibility of a trapped wire, then do not proceed, open up the unit and recheck.
8. Push the end cap & housing firmly together so that there is no gap between them.
9. Insert the Nylon Cord into the groove inside the rear end of the cylindrical housing of the unit using fine nose pliers. If this item is damaged, the replacement part is 2mm nylon monofilament, Zetechtics part number: 023-14-00-005.
10. Check the unit for correct operation.

MAINTENANCE/STORAGE

The Subsea Display System should be rinsed with clean fresh water after use and dried thoroughly before being stored in a suitable box and secured.

Subconn® Connectors

Maintaining the quality and performance of the connectors in the Subsea Display is integral to the overall system operation. The manufacturer of the connectors supplied with the system recommends the following procedures be adopted to maintain their quality. Good connector maintenance will help to ensure that the system operates properly and accurately.

- Connectors and cable assemblies should not be exposed to long-term heat or sunshine.
- If this occurs, and the connector/cable assembly is very dry, soak in fresh water before use.
- Ensure that the connectors are lubricated – the recommended lubricant is Molykote® 55 (or approved alternative such as Molykote 111) O-Ring grease prior to re-assembly. Please use grease sparingly since too much grease can causealeak path.Only apply a thin film to the connector so that the rubber turns from matt to a shiny wet appearance. Any excess O-Ring grease should be removed.
- 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.
- Do not disconnect by pulling on the cable and avoid sharp bends at cable entry.
- When disconnecting, pull straight, not at an angle.
- In order to prolong the life of the connectors, leave the cable assemblies connected and do not disconnect unnecessarily.

O-Rings

During disassembly and reassembly of the unit, O-Rings should be clean and dry, then lubricated with a thin film of Molykote® 55 (or approved alternative such as Molykote 111) O-Ring grease prior to re-assembly.

Important Note!

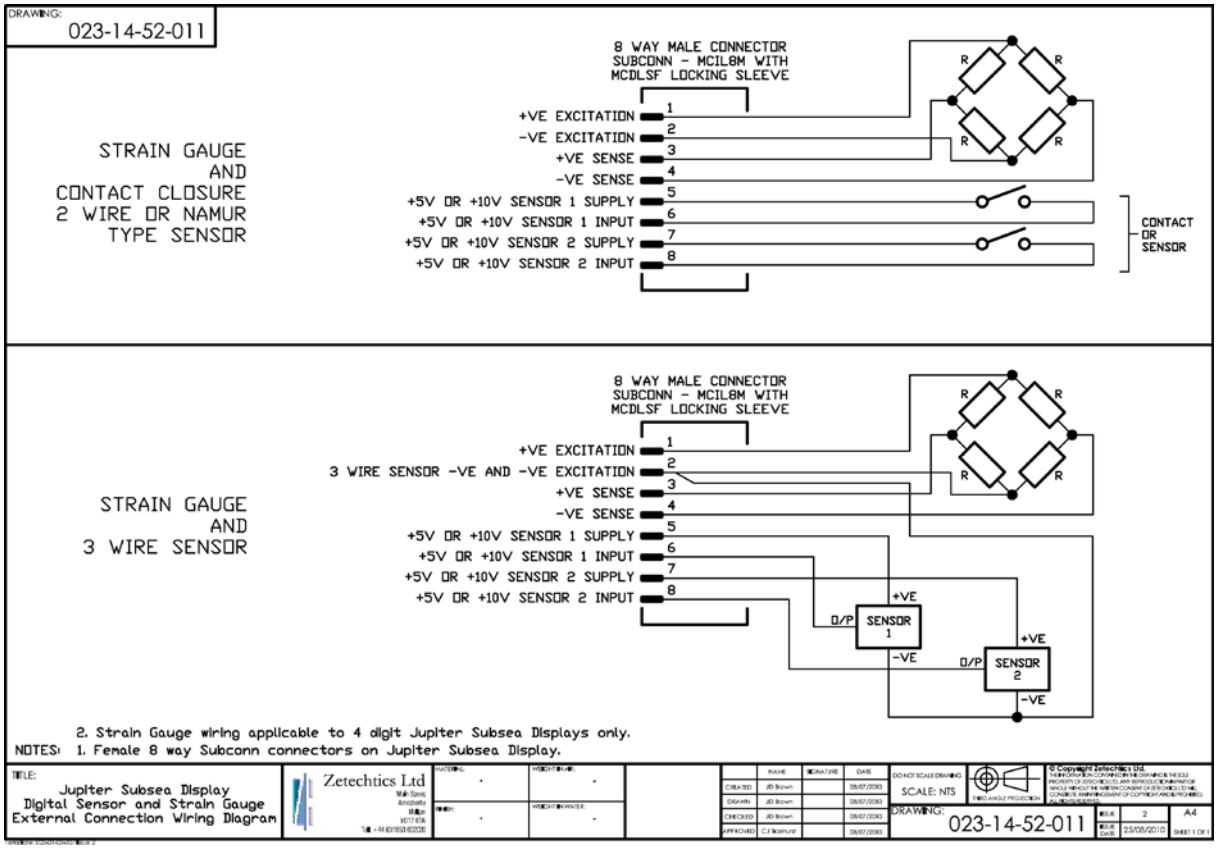
Please do not allow WD40 to come into contact with these Display units and especially the connectors since permanent damage could occur.

HARDWARE OPTIONS

SYSTEM OPTIONS

System Types	
Part Number	Description
023-14-52-121	2 Digit Jupiter Subsea Display
023-14-52-122	2 Digit Jupiter Subsea Display - NAMUR
023-14-52-131	4 Digit Jupiter Subsea Display
023-14-52-132	4 Digit Jupiter Subsea Display - NAMUR
023-14-52-141	Dual 4 Digit Jupiter Subsea Display
023-14-52-142	Dual 4 Digit Jupiter Subsea Display - NAMUR

Sensor Connection



Note:

In order to use NAMUR type sensors, the system must be ordered correctly wired for this sensor type. See system types in the table above.

SYSTEM SPECIFICATION

Operational Environment:	Fresh water or seawater to a depth of 3000m. -10 to +50°C Operational. -20 to +65°C Storage.	
Electrical:	2 Connectors. Connector 1 – Power and data (RS232). Connector 2 – Sensors	
Mechanical:	Main Housing – 316 stainless steel pressure housing with removable end cap. Display – acetal or 316 stainless steel, solid potted.	
Material:	316 Stainless Steel & Acetal	
Size:	Ø50 x 199.5mm - 2 Digit. Ø50 x 230mm - 4 Digit Display: 80 x 40mm, Dual 4 Digit Display: 80 x 72mm.	
Weight:	4 Digit 1.5kg (in air), 1.1kg (in water).	
Display Type and Range:	Blue 7 segment LEDs – digits 14.2mm High 2 digit: -99 to 99 up to 1 decimal place. 4 digit: -9999 to +9999 up to 3 decimal places Leading zero suppression except immediately before decimal point.	
Counter Sensor Interface:	Suitable for reed switch contact closures and 2 or 3 wire proximity sensors, including NAMUR type.	
Strain Gauge Sensor Interface	**Strain Gauge Measurement Accuracy:**	± 1.0% of full scale (From 10% to 100% of full scale)
	Offset Variation:	± 1.0% of full scale
	Transducer Sensitivity Range:	2, 5 and 10 mV/V
	System Calibration Frequency:	Annually.
Sensor Supply:	+5V Nominal (+5.5V unloaded) up to 10mA. +10V Nominal (+11.5V unloaded) up to 10mA	
Maximum Input frequency on any: single input	2kHz.	
Minimum dwell time on any input:	250µ seconds.	
Power Supply:	Battery - D Cell Normally NiMH Rechargable Capacity >7000mAH. May be fitted with Primary cell – Duracell or equivalent for higher Capacity and / or longer shelf / standby life. 1 x D Cell Type 5 Days Average Display on Continuously, 5 Months Standby.	
Power Supply/Battery Life:	This depends on the sensor type in use. Please check with Zetechtics for a specific application. Active sensors running off the +5V or +10V sensor supply will significantly affect the battery life.	

ZETECHTICS CONTACT INFORMATION

TECHNICAL SUPPORT

Mail Address: Zetechtics Ltd

Main Street
Amotherby
Malton
North Yorkshire
YO17 6TA
England

POTS (Plain Old Telephone System)

Telephone: +44 (0)1653 602023 (Technical Support Line).

Zetechtics Telephone Technical Support is available 24 hours a day 7 days a week. Outside normal UK working hours, between 8.30am and 5.30pm UK time, you may be diverted to a mobile phone or voicemail service. These are closely monitored and voicemail messages with a telephone number will be called back typically within 30 minutes.

Facsimile: +44 (0)1653 691712

Zetechtics Facsimile Technical Support is available every working day between 8.30am and 5.30pm. Any fax message will be responded to within a working day either by fax, phone or email.

e-mail Address:

mailto:support@zetechtics.com

Zetechtics email Technical Support is available 24 hours a day 7 days a week. Between midnight and 6am urgent support requests should be made to the technical support telephone number given above. Responses to simple email questions, or email acknowledgement / telephone call back for more complex support requests is typically within 30 minutes.

Internet: http://www.zetechtics.com/

A web page is available on www.zetechtics.com and shows the latest range of options available for Jupiter systems together with assembly drawings for use by engineers wishing to design a Jupiter System into their tooling.

The site is under continual development, the user is able to download the latest versions of User Manuals and other documentation.

AGENTS

Zetechtics have appointed agents who are able to supply certain spares and information relating to Jupiter Systems. The contact details for all Zetechtics agents are given on the website. www.zetechtics.com