

Real Time Electronic Acquisition & Monitoring & Human Machine Interface

REAM HMI



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Courtenay House, Monument Way East
Woking, Surrey GU21 5LY, United Kingdom
Tel: +44 (0) 1483 750600 Fax: +44 (0) 1483 762233
Website: <http://www.medcotas.com>

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MEDCO

Modelling Engineering & Development Company Limited

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System Overview

The REAM HMI is a user-friendly data acquisition system that reads and displays data from electronic sensors. Data is recorded on solid-state Compact Flash memory and remote monitoring of the data is enabled.

The system is made of two main parts, REAM is a microprocessor based data acquisition board, which collects data from electronic sensors, digitise the readings, and supply the appropriate excitation voltage to the sensors. The HMI communicates with the REAM board to retrieve, display, and store the data.

There are four versions of the REAM board, with some variations between them. The table below shows the main differences between the different versions of the REAM boards.

REAM Version	Number of Channels	Other Features
1	4 x 11-bits analogue 2 x frequency 1 x quadrature	Stored configuration on RAM, battery dependent. Now discontinued.
2	4 x 11-bits analogue 2 x frequency 1 x quadrature	Stored configuration on flash memory, no battery.
MiniREAM-A MiniREAM-B	8 x 16-bits analogue 4 x 16-bits analogue	Used with REAM v 2 to increase analogue channels capacity. Also used as the main board in cases where no frequency channels required.
3	8 x 16-bits analogue 6 x frequency Up to 4 quadrature	4 of the frequency channels can be used as quadrature channels.
4.86	8 x 16-bits analogue 6 x frequency Up to 4 quadrature	• 4 of the frequency channels can be used as quadrature channels. • 16 Gbyte SD card for storing backup data. Up to 3.5 years of data recording at once per second non-stop. • Relay for use with alarms
4.43	4 x 16-bits analogue 3 x frequency Up to 2 quadrature	• 2 of the frequency channels can be used as quadrature channels.

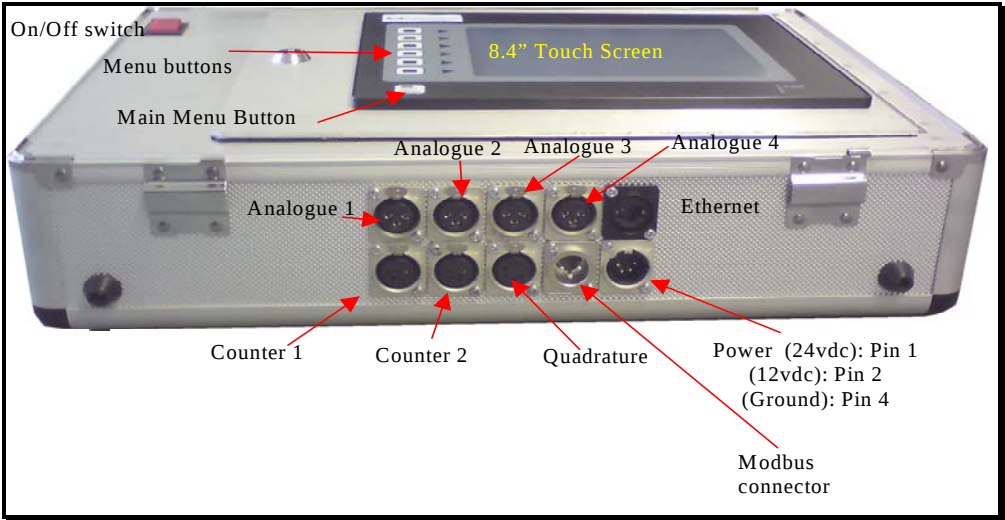
The HMI can communicate with up to 4 REAM boards simultaneously and many other controllers or data acquisition modules. In addition to the signals that can be acquired by the REAM board, the HMI can also communicate with up to 256 MODBUS devices.

The outputs are available on Web Pages, which means that they can be viewed remotely on a Local Area Network (LAN) or even a Wide Area Network (WAN), provided that proper Internet connections are made. This feature means that the data can be viewed simultaneously from several terminals. There are many other features in the HMI and these can be tailored to client's request.

Hardware Description

As a first step to using this manual, the user is advised to identify the system from the different configurations listed below.

The picture below describes the various components of a portable flight-case REAM HMI.



Other arrangements of the REAM HMI:

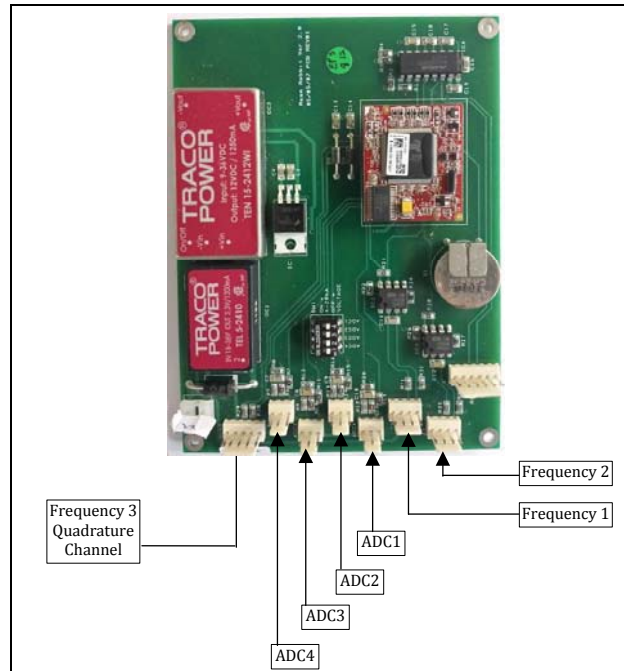
Fixed Enclosure with XLR connectors	
Stainless Steel Enclosure with Military Bayonet connectors. HMI is fitted separately on control panel of CT unit.	
Ex Certified in Stainless Steel Enclosure with Cable Glands. HMI is fitted separately on control panel or in another IP54 enclosure.	

In all the systems shown above, the main design concept is the same with some variations depending on the requirements.

Channel Assignment

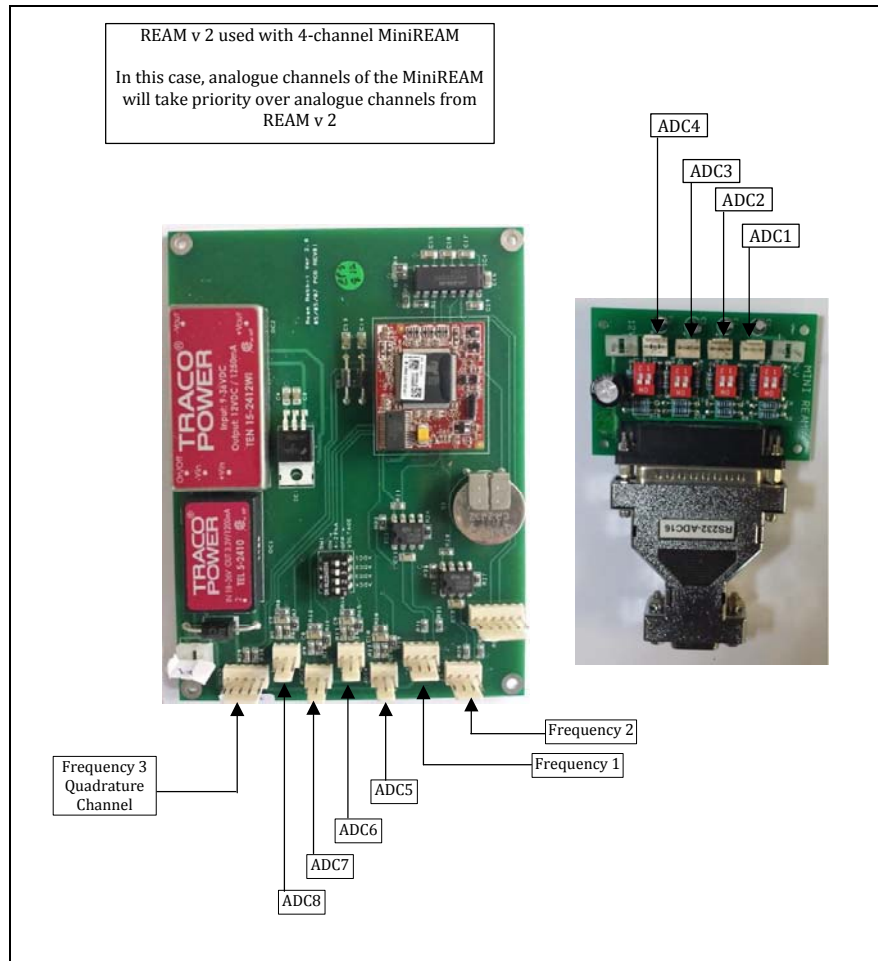
This section will describe the channel assignments per REAM board version. Note though, the HMI will produce different outputs not necessarily in the same order as per the REAM board.

REAM v 2



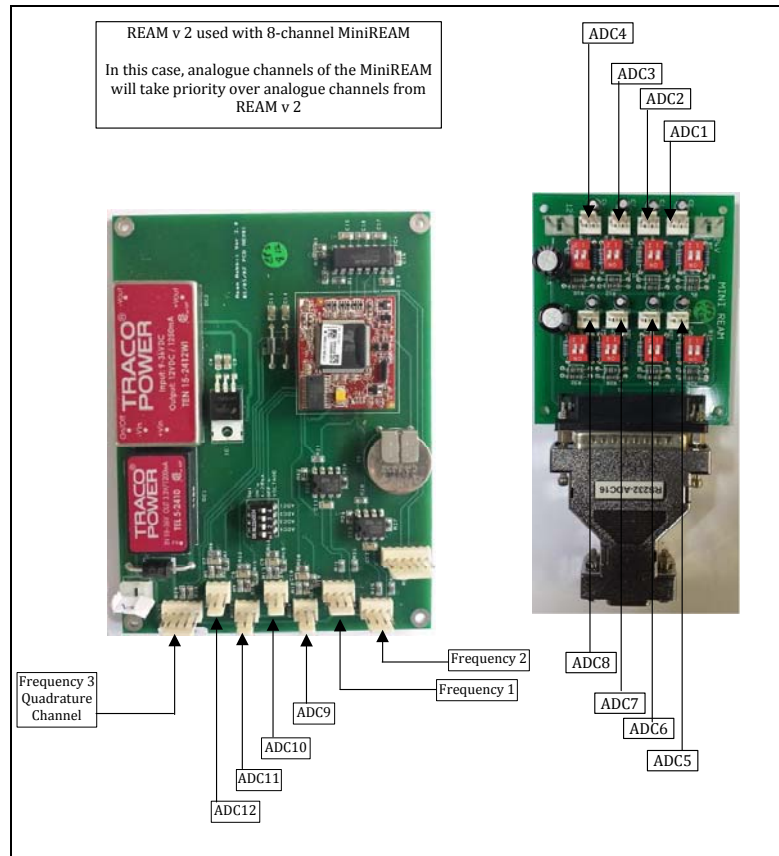
Measured Parameter	Channel No.	Type
Weight Indicator	1	ADC1: Analogue 11 bits resolution
Spare Analogue Channel Commonly used as Light Weight or Casing Pressure	2	ADC2: Analogue 11 bits resolution
Wellhead Pressure	3	ADC3: Analogue 11 bits resolution
Circulation Pressure	4	ADC4: Analogue 11 bits resolution
Fluid Total	5	Frequency 1 - Total
Nitrogen Total	6	Frequency 2 - Total
Depth	7	Frequency 3 - Total: Quadrature only
Fluid Flow	8	Frequency 1 - Rate
N2 Flow	9	Frequency 2 - Rate
Tubing Speed	10	Frequency 3 - Rate: Quadrature only

REAM v 2 and 4-Channel MiniREAM



Measured Parameter	Channel No.	Type
Weight Indicator	1	ADC1 Analogue 16 bits resolution
Spare Analogue Channel Commonly used as Light Weight or Casing Pressure	2	ADC2 Analogue 16 bits resolution
Wellhead Pressure	3	ADC3 Analogue 16 bits resolution
Circulation Pressure	4	ADC4 Analogue 16 bits resolution
Fluid Total	5	Frequency 1 - Total
Nitrogen Total	6	Frequency 2 - Total
Depth	7	Frequency 3 - Total: Quadrature only
Fluid Flow	8	Frequency 1 - Rate
N2 Flow	9	Frequency 2 - Rate
Tubing Speed	10	Frequency 3 - Rate: Quadrature only
Spare Analogue Channel	11	ADC5 Analogue 11 bits resolution
Spare Analogue Channel	12	ADC6 Analogue 11 bits resolution
Spare Analogue Channel	13	ADC7 Analogue 11 bits resolution
Spare Analogue Channel	14	ADC8 Analogue 11 bits resolution

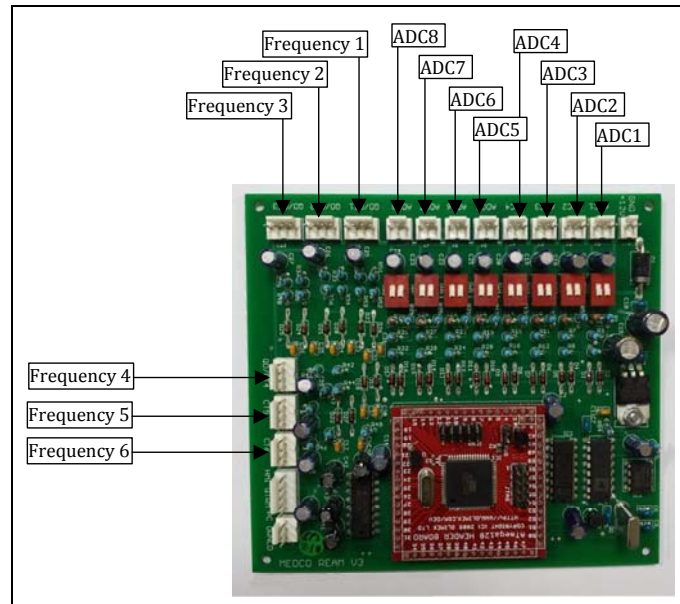
REAM v 2 and 8-Channel MiniREAM



Measured Parameter	Channel No.	Type
Weight Indicator	1	ADC1 Analogue 16 bits resolution
Spare Analogue Channel Commonly used as Light Weight or Casing Pressure	2	ADC2 Analogue 16 bits resolution
Wellhead Pressure	3	ADC3 Analogue 16 bits resolution
Circulation Pressure	4	ADC4 Analogue 16 bits resolution
Spare Analogue Channel	Not Assigned	ADC5 Analogue 16 bits resolution
Spare Analogue Channel	Not Assigned	ADC6 Analogue 16 bits resolution
Spare Analogue Channel	Not Assigned	ADC7 Analogue 16 bits resolution
Spare Analogue Channel	Not Assigned	ADC8 Analogue 16 bits resolution
Fluid Total	9	Frequency 1 - Total
Nitrogen Total	10	Frequency 2 - Total
Depth	11	Frequency 3 - Total: Quadrature only
Fluid Flow	8	Frequency 1 - Total
N2 Flow	9	Frequency 2 - Total
Tubing Speed	10	Frequency 3 - Total: Quadrature only
Spare Analogue Channel	11	ADC9 Analogue 11 bits resolution
Spare Analogue Channel	12	ADC10 Analogue 11 bits resolution
Spare Analogue Channel	13	ADC11 Analogue 11 bits resolution
Spare Analogue Channel	14	ADC12 Analogue 11 bits resolution

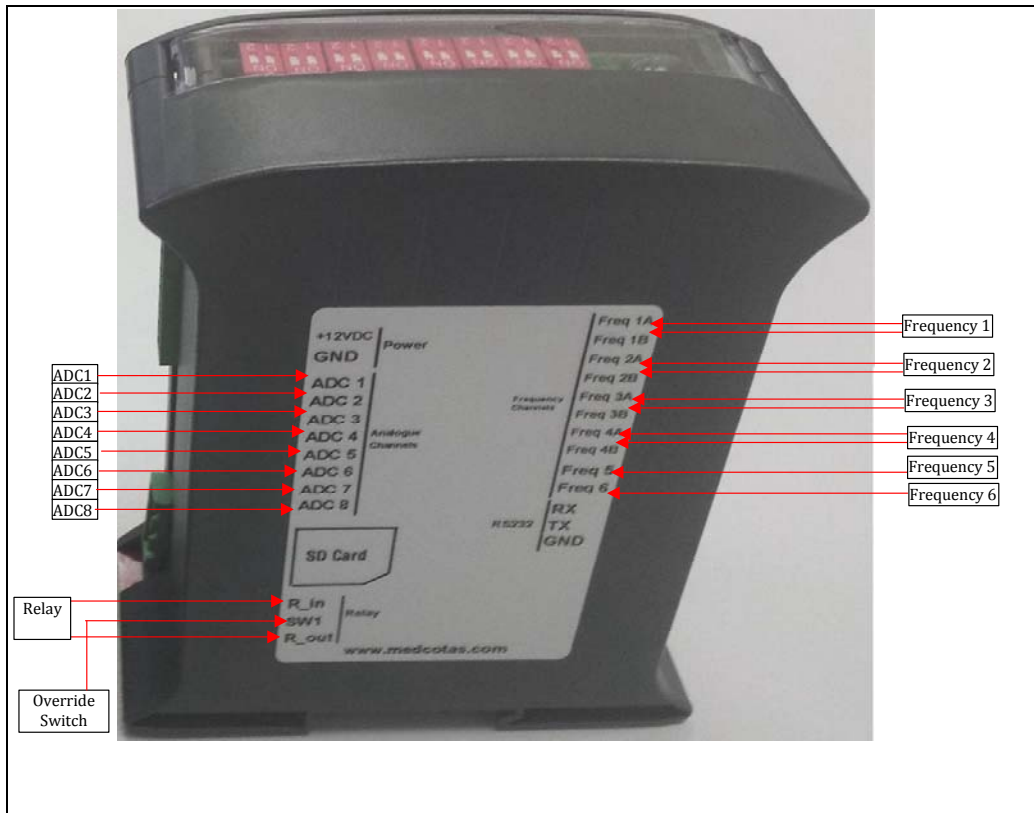
NOTE: Although there 4 additional analogue channels on the MiniREAM board, these are not normally programmed in the HMI. They are spare channels and have only been used in special cases. Contact MEDCO to find out more about using these additional channels.

REAM v 3



Measured Parameter	Channel No.	Type
Weight Indicator	1	ADC1 Analogue 16 bits resolution
Spare Analogue Channel Commonly used as Light Weight or Casing Pressure	2	ADC2 Analogue 16 bits resolution
Wellhead Pressure	3	ADC3 Analogue 16 bits resolution
Circulation Pressure	4	ADC4 Analogue 16 bits resolution
Spare Analogue Channel	5	ADC5 Analogue 16 bits resolution
Spare Analogue Channel	6	ADC6 Analogue 16 bits resolution
Spare Analogue Channel	7	ADC7 Analogue 16 bits resolution
Spare Analogue Channel	8	ADC8 Analogue 16 bits resolution
Depth	9	Frequency 1 - Total
Fluid Total	10	Frequency 2 - Total
N2 Total	11	Frequency 3 - Total
Spare Frequency Total	12	Frequency 4 - Total
Spare Frequency Total	13	Frequency 5 - Total
Spare Frequency Total	14	Frequency 6 - Total
Tubing Speed	15	Frequency 1 - Rate
Fluid Flow	16	Frequency 2 - Rate
N2 Flow	17	Frequency 3 - Rate
Spare Frequency Rate	18	Frequency 4 - Rate
Spare Frequency Rate	19	Frequency 5 - Rate
Spare Frequency Rate	20	Frequency 6 - Rate

REAM v 4



Measured Parameter	Channel No.	Type
Weight Indicator	1	ADC1 Analogue 16 bits resolution
Spare Analogue Channel Commonly used as Light Weight or Casing Pressure	2	ADC2 Analogue 16 bits resolution
Wellhead Pressure	3	ADC3 Analogue 16 bits resolution
Circulation Pressure	4	ADC4 Analogue 16 bits resolution
Spare Analogue Channel	5	ADC5 Analogue 16 bits resolution
Spare Analogue Channel	6	ADC6 Analogue 16 bits resolution
Spare Analogue Channel	7	ADC7 Analogue 16 bits resolution
Spare Analogue Channel	8	ADC8 Analogue 16 bits resolution
Depth	9	Frequency 1 - Total
Fluid Total	10	Frequency 2 - Total
N2 Total	11	Frequency 3 - Total
Spare Frequency Total	12	Frequency 4 - Total
Spare Frequency Total	13	Frequency 5 - Total
Spare Frequency Total	14	Frequency 6 - Total
Tubing Speed	15	Frequency 1 - Rate
Fluid Flow	16	Frequency 2 - Rate
N2 Flow	17	Frequency 3 - Rate
Spare Frequency Rate	18	Frequency 4 - Rate
Spare Frequency Rate	19	Frequency 5 - Rate
Spare Frequency Rate	20	Frequency 6 - Rate

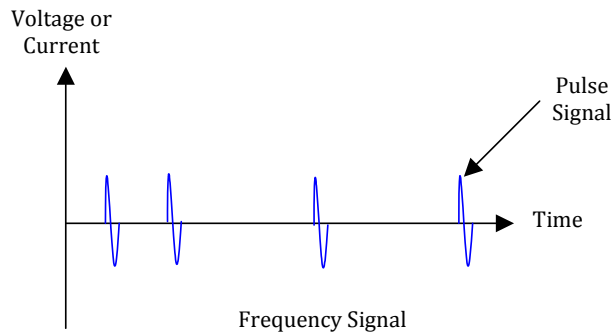
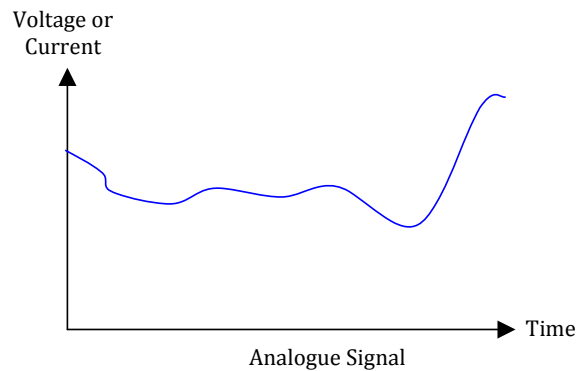
NOTE: Frequency 1 to 4 can take two inputs signals which makes them suitable for use with quadrature encoders signals.

Analogue and Frequency (Counter) Channels

There will be several analogue channels and several frequency channels per system. The number of these channels will depend on the REAM board version. Details of each version channel assignments are listed in the next section.

Analogue channels are used for measuring analogue signals and will accept output signals from sensors with 0-5 vdc, 0-10 vdc, or 0/4-20 mA. An analogue signal is defined as a continuous electrical signal versus time. The electrical signal may vary in magnitude, but will always be present.

The counters (or frequency channels) accept pulse signals produced from proximity switches or magnetic pickups (with amplifier). The quadrature channel accepts quadrature signals (up/down counter such as depth) and is also considered a frequency channel. Frequency channels (or counters) measure number of pulses generated by sensors when an event occurs. When there are no events, there will be no electrical signal. The diagrams below explain the concept.



Analogue sensors are typically used for measuring such parameters as weight, pressure, temperature, density, and several others. The resolution will generally be 16-bits (except in REAM v 2, 11-bits). With 11-bit resolution, the signal can be subdivided to a maximum of $2^{11} = 2048$ divisions, while with 16-bit it is $2^{16} = 65,536$ divisions. For example, if using a 11-bit channel to measure fluid density ranging from 0 to 20 ppg, then the minimum change in density that can be detected will be $20.00 \text{ ppg} / 2048$ which is approximately 0.01 ppg. If using a 16-bit channel to measure weight in the range of -20,000 lbs to +60,000 lbs, then the minimum change in weight that can be detected will be $(60,000 - (-20,000)) = 80,000 \text{ lbs} / 65,536$, approximately 1.22 lbs.

For analogue channels, the sensor electrical response is expected to be linear within the specified range for the sensor. This implies that the relationship between the actual value and the electrical

output will be a straight line. A straight line will have a slope and an intercept, these are referred to as GAIN and OFFSET respectively.

Pulse generating sensors (frequency) are typically used for measuring pump strokes or flow turbine blade movement or rotation of a wheel (using quadrature encoder). The frequency channels will count the number of pulses, therefore the total is the sum of the number of pulses and will always be increasing, except in the case of a quadrature encoder where the count can be up or down (hence used for measuring depth). The rates (fluid flow rate, N2 rate, and speed) are computed by the system automatically. There are no special channels for the rates; they use the same channels as for the Fluid Total, N2 Total, and Depth (i.e. frequency total and frequency rate are measured by a frequency channel).

For counter (frequency) channels, pulses are generated by events. For example, a proximity switch on a pump drive-shaft could generate n number of pulses per revolution, and each revolution corresponds to a quantity Q of fluid pumped. The number of pulses per unit of quantity is known as the *K-Factor*, in this case $= n/Q$. This implies that counter/frequency channels have no GAIN or OFFSET (mathematically, K-Factor is the inverse of the GAIN).

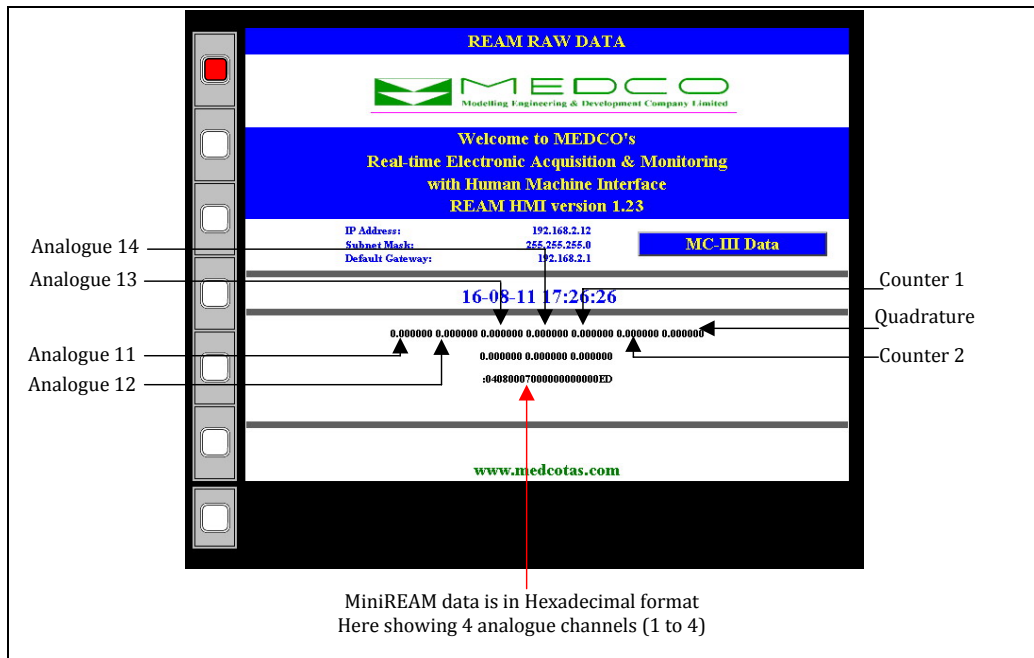
On shipping, the default values are:

- Date and Time: As per the UK date and time.
- ADC channels (Analogue to Digital Convertors):
 - o Gain: Unity.
 - o Offset: Zero.
- Pulse counters (frequency channels) and quadrature: K-factor = 1.

Software Description

REAM HMI starts by displaying the default web page, REAM RAW DATA. To access the other pages in the REAM HMI use the buttons on the left hand side of the touch screen. The REAM RAW DATA can always be accessed by pressing the top button.

The default page shows MEDCO's logo and a Welcome message, including the HMI software version. In addition, the system IP Address, Subnet Mask, Gateway, date and time are shown as well as the data stream from REAM and Mini REAM. There is an option button to display MCIII data, if applicable.

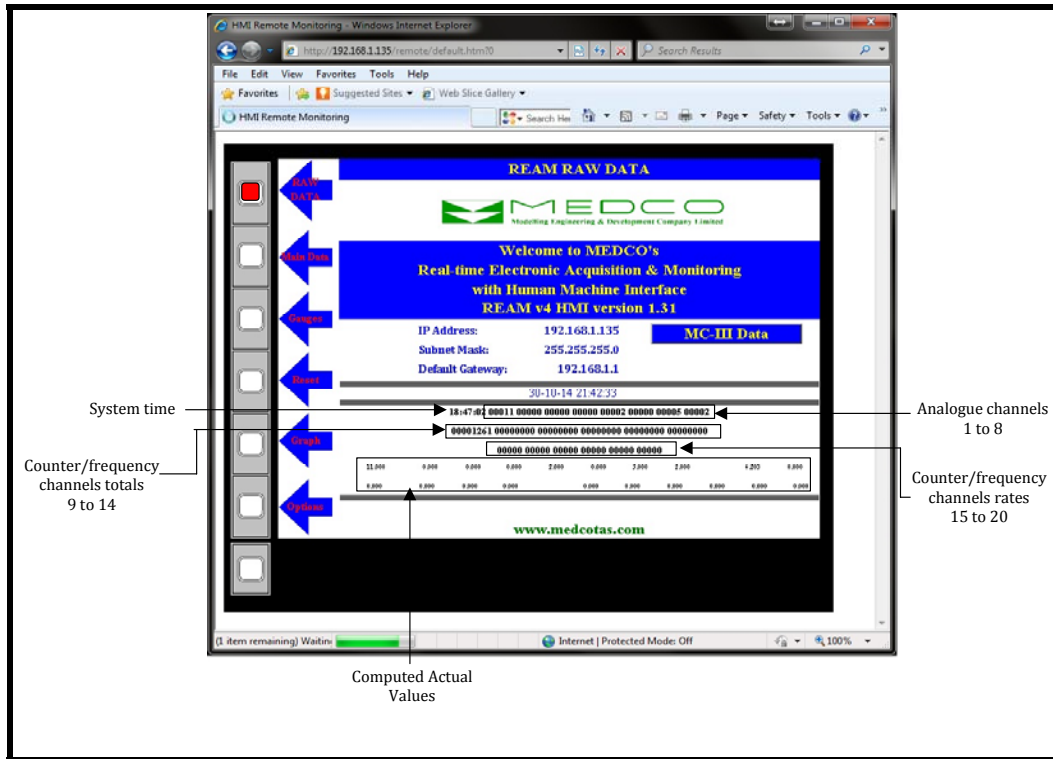


Raw Data Page: REAM v 2 and 4-Channel Mini-REAM

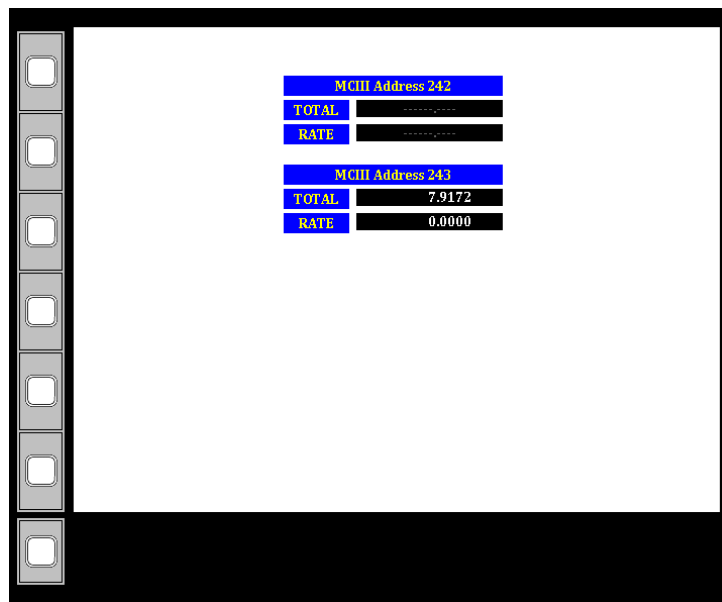
This page displays some important information. The information shown is as follows:

- Software version: In the picture above, the current version is 1.31.
- Ethernet settings: These are the current Ethernet settings, including the *IP Address*, *Mask*, and *Gateway*. To change the Ethernet settings, refer to the MAIN MENU > Set Ethernet Port.
- To display MCIII data from MODBUS devices
MODBUS is a protocol used to communicate with several devices via their address. Different devices can be connected through the MODBUS such as MCIII. Some of the counter channels can be assigned to display the data from the MODBUS.
- The system current Date and Time.
- Raw Data: The raw data is that received by the HMI from the REAM/MiniREAM attached.
 - o REAM v 2: The displayed data represent the 4 analogue channels, followed by the counters and quadrature totals (divided by 100) on the first line, and on the second line the rates of the counters and quadrature per second.
 - o MiniREAM: The displayed data on the third line represents the analogue channels 1 to 4 from the Mini Ream. Note that the data here is not calibrated. If 8-channel MiniREAM is used, then the length of the line will be longer and the first 4 characters will be :040F...
 - o REAM v 3 or REAM v 4: The displayed data is in 3 lines, 1st line showing the system time, followed by 8 analogue channels raw values, 2nd line showing counter (frequency) channels totals, and 3rd line showing counter (frequency) channels rates.

Also, if an ovality monitor is included then the data from the Laser Head will be displayed below the solid line at the bottom of the screen.



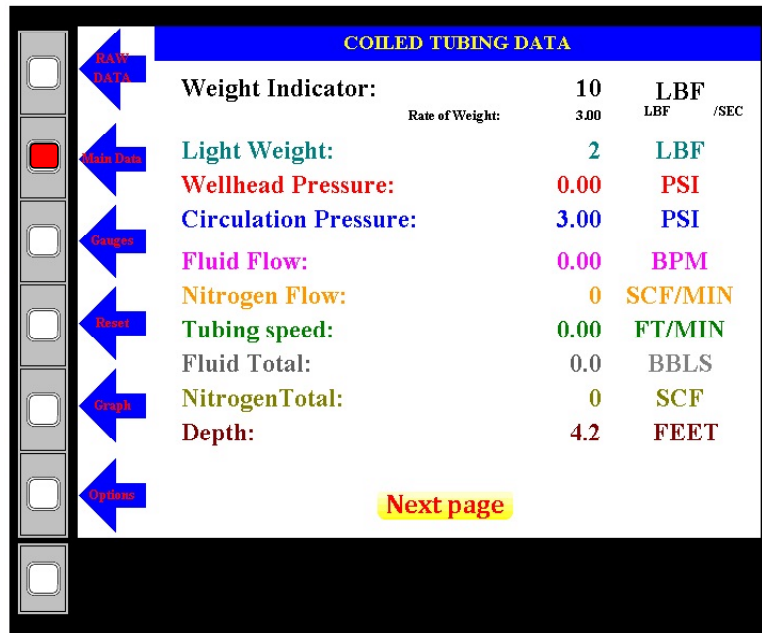
Raw Data Page: REAM v 3 or REAM v 4



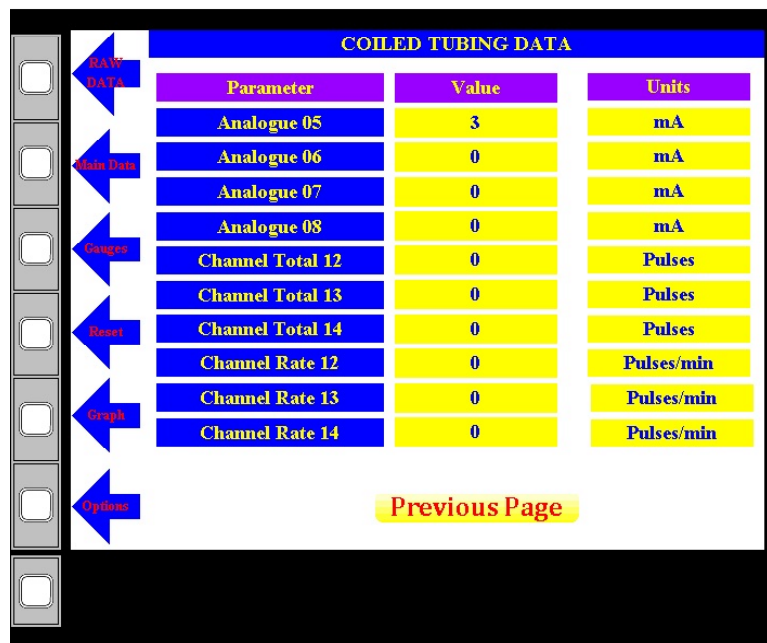
MCIII Data Display

Displaying the Data

The second button is used to display the data page. This page will display the parameter names, current values (adjusted according to calibration data), and units.

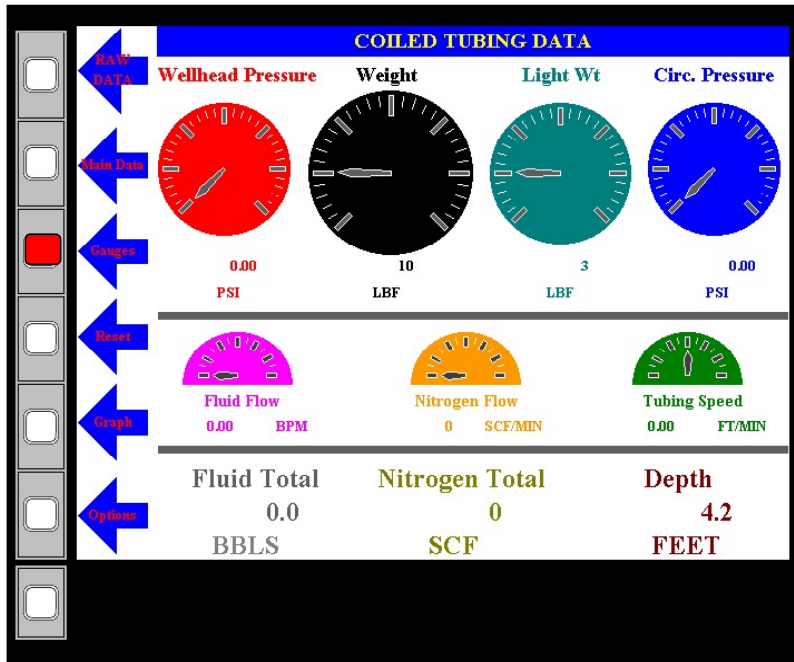


The "Next Page" button will only be available if the REAM/MiniREAM combination has more than 10 parameters. Clicking the "Next Page" button will display the remaining parameters, which are programmable by the user.



Display Schematic

A gauge schematic can be displayed by selecting the third button, or in the case where the Ovality is turned on, this page can be accessed using the “Switch to Schematic View” button. This will show the same data as the Coiled Tubing Data page but in a schematic rather than tabular format. The gauges scales are determined in the MAIN MENU – Change Units section.



Resetting Counters/Quadrature (depth) And Analogue Channels

The fourth button will display a page dedicated to resetting counters and/or quadrature (depth). The actual value will be shown on the left-hand-side column (Current Value) while the user can enter the new value on the right-hand-side column (Reset To).

When resetting is used in conjunction with an analogue channel, such as Weight, it has the effect of changing the Offset of the particular channel.

RESET CHANNELS VALUE		
	Current Value	Reset to:
Fluid Total:	0.0	0.0
NitrogenTotal:	0	0
Depth:	4.2	0.0
Weight Indicator:	9	0.000 1
Light Weight:	0	0.000 1
Wellhead Pressure:	1.00	0.000 1
Circulation Pressure:	0.00	0.000 1

NEXT

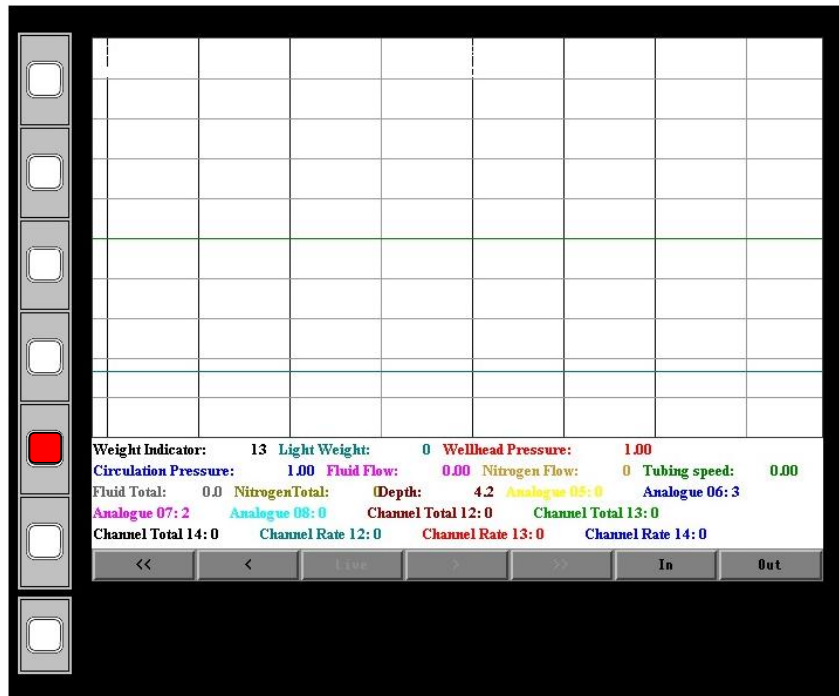
To reset values of the programmable channels, click the NEXT button.

RESET CHANNELS VALUES		
	Current Value	Reset to:
Analogue 05	2.00	0.000
Analogue 06	0.00	0.000
Analogue 07	2.00	0.000
Analogue 08	2.00	0.000
Channel Total 12	0.00	0.000
Channel Total 13	0.00	0.000
Channel Total 14	0.00	0.000

PREVIOUS

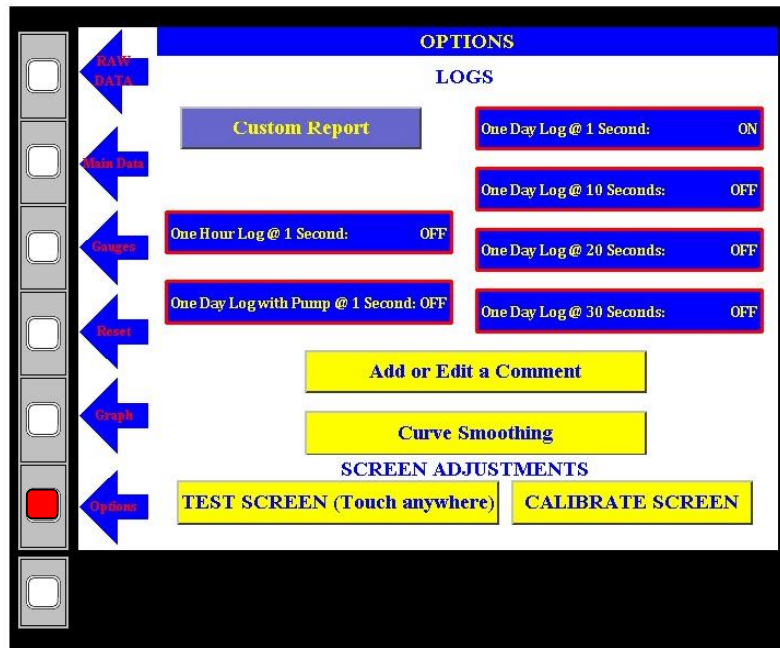
Real Time Graphs

The fifth button will display a real time graph the width of which is, by default, set to 4 minutes. The Y-axis scales are determined in the MAIN MENU – Change Units section. To scroll back use the < button, to scroll back faster use the << button. To zoom-in (smaller time interval), use the IN button and to zoom-out use the OUT button.



Options

The sixth button will display the options page.



Options – Data Logs

There are several data logs that can be created by the REAM HMI. A One-Hour log will have files of a maximum length of 3600 records, thus will record data every one second for one hour. The naming convention of the files is “yymmddhh.csv”, where *yy* represents the year, *mm* the month, *dd* the day, and *hh* the hour. The One-Day log @ 1 second will have a maximum length of 86400 records, which is the number of seconds per day. Again, the naming convention is similar to that of the One-Hour log. In addition, the user may also opt to record One Day Log @ 10 seconds, 20 seconds, or 30 seconds. Though, **for coiled tubing applications, it is strongly recommended to use the One Day Log @ 1 second.**

The data logs are stored in ASCII formatted files (text files) with comma separators; hence the file extension will be “csv” (Comma Separated Values).

Note that the data logs are stored on the CompactFlash. There is a limit of 200 files of the One-Hour log, which corresponds to more than one week, and 20 files of the One-Day log, clearly corresponding to 20 days. If the CompactFlash is full, then the older files will be automatically removed to make room for new ones. However, it is probably a good practice to copy the files to a computer for safe storage and make room on the CompactFlash. This does not need to be done too frequently, but once a week or every two weeks will be sufficient and depending on how often the system is used.

IMPORTANT

The data is captured once per second and stored in the system memory (in a buffer), then written to the CompactFlash card once every two minutes. When the system is writing to the CompactFlash, the amber LED will flicker, indicating that the writing is taking place. It is important to know this because at the end of usage it will be necessary to wait until the amber LED stops flickering indicating the end of the writing, otherwise data since the last *Write* will be lost.

Options - Comments

If the "Add or Edit a Comment" is clicked, then a COMMENTS page will be displayed. The comments can be used to generate a "summary report" while logging data. To speed up the comment's entries, a template of up to 20 user defined comments are stored in the system, thus enabling the user to enter the comment by simply clicking a button.

Thus, this page has two uses; the first is to add comments to the logs (any log that is On will have the comments). To add a comment, for example "PRESSURE TEST" the user will need to click blue button (3) until the comment appears in the "Current Comment" field, then click the BLANK button (otherwise the comment will keep repeating throughout the log).

The second purpose is to Edit the existing pre-defined comments. To edit an existing comment, click the yellow field that has the comment or use a blank yellow field to add a new comment, a pop-up window will appear for writing the comment.

ADD/EDIT COMMENTS

To add a comment to the report, click the comment number button, then click a BLANK
To edit a comment, click the comment box

Current Comment **BLANK**

1 RIH Click to Add Comment 11
2 POOR 12
3 PRESSURE TEST 13 Then click BLANK
4 Comment will appear here 14
5 15
6 16
7 Click to Edit Comment 17
8 18
9 19
10 20

Options - Curve Smoothing

If a parameter value is changing too frequently, then it is possible to smooth the curve by averaging the parameter values over several readings. To do this, click the CURVE SMOOTHING button. The Curve Smoothing/Averaging page will appear. Note that only analogue and counter rates are possible to average, while counter totals are not available for averaging.

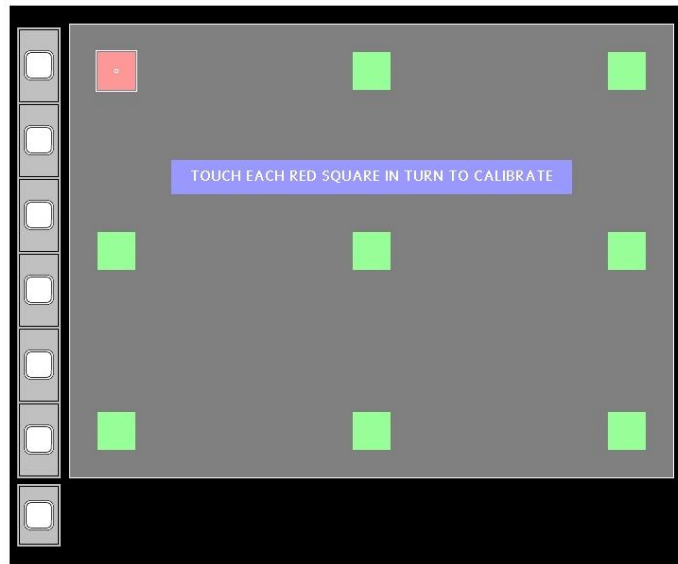
PARAMETER	n
Weight Indicator	1
Light Weight	1
Wellhead Pressure	1
Circulation Pressure	1
Fluid Flow	1
N2 Flow	1
Tubing Speed	1

IMPORTANT

It is strongly recommended that you do not use the averaging, particularly for analogue channels, as this will mean the system may not record the true value of a peak or trough that has lasted less than the number of seconds required for averaging.

Options – Calibrate Screen

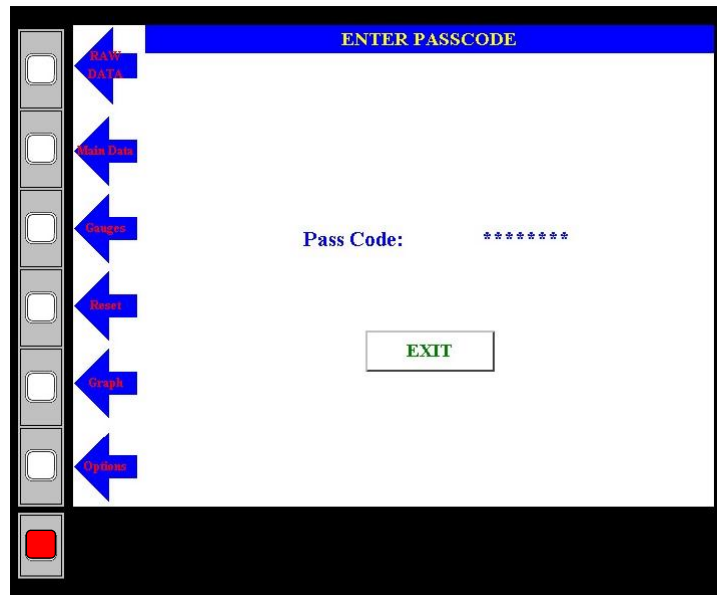
If the touch screen of the HMI is felt not responsive to touching at some parts of the screen, then it is a good idea to calibrate the touch screen. Simply click the CALIBRATE SCREEN button and go through the nine points as required by the HMI.



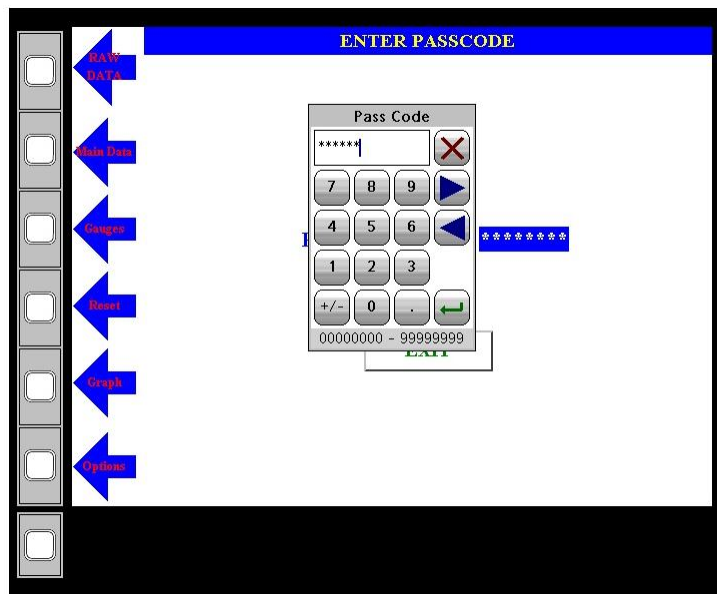
After the Touch Screen has been calibrated, it is a good idea to test the response. Click the TEST SCREEN button and check to ensure that the touch screen is responding to the touches in the right place.

Main MENU Button

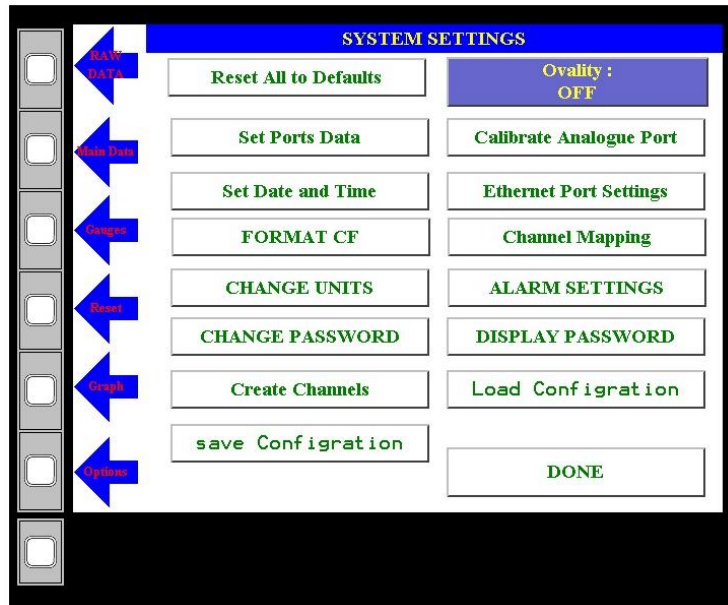
When this button is selected, the user will be prompted to enter the password. The password is "290992" which can be easily remembered as the date MEDCO was founded.



By pressing on the password a popup numeric keyboard will appear which can be used to enter the password.

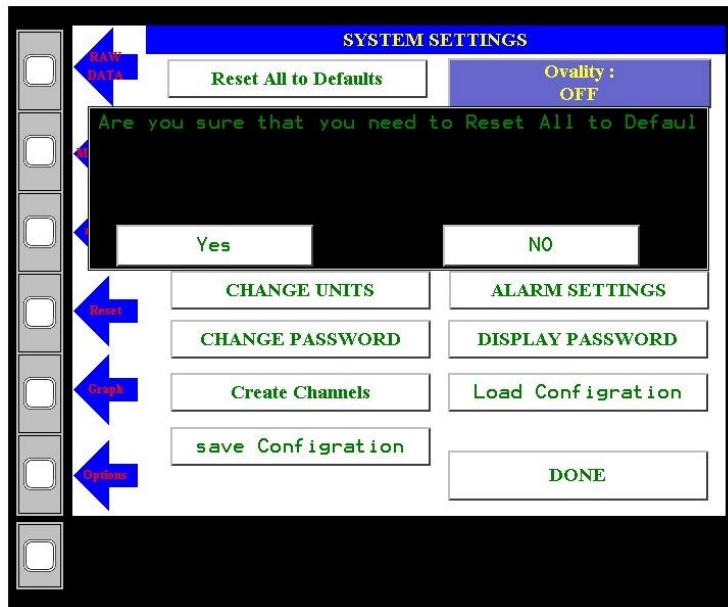


Once the correct password has been entered, another screen will appear with some more options.



MENU Option - Reset All to Defaults

This will reset all the ports (channels) to have Gain or K-Factor of unity (1) and Offset of zero (0). As this function will remove all the calibration data already stored in the system, the user will be prompted to confirm this action.



MENU Option - OVALITY

This button is a flag that either turns the OVALITY on or turns it off. Clearly, without MEDCO's Tubing Ovality Monitor (TOM), this must be OFF. On the other hand, if TOM is available and it is desired to record the Ovality data, then this flag must be turned ON.

MENU Option - Set Ports Data

The page will display the settings of the analogue, counters, and quadrature channels. The user can make the necessary changes here. Note that, if calibrations of analogue channels are done using the Calibrate Analogue Channel, then the gain and offset of analogue channel will display the values obtained from the calibration process.

REAM PORT SETTINGS		
ADVANCED		
Analogue Channels	Offset	Gain
Weight Indicator	0.00000	1.0000
Light Weight	0.00000	1.0000
Wellhead Pressure	0.00000	1.0000
Circulation Pressure	0.00000	1.0000
Counter/Frequency Channels	K-Factor	
Fluid Total	1.0000	
Nitrogen Total	1.0000	
Depth	300.0000	

DONE NEXT

For the counters and the quadrature channels, you only need to change the K-factor. If you already know the K-factor, for example from the manufacturer of the sensor, then you can enter the value directly. There is no need for a K-Factor for “rates”, as these are the same as the K-Factors for the total, the HMI software will compute the rates per minute, for example if depth is in “feet” then speed will be “feet/min”.

For example, if your quadrature encoder (for measuring depth) produces 600 pulses per revolution and each revolution represents 2 ft of depth, then the K-factor for depth would be $600 \div 2 = 300$.

If, on the other hand, you do not know the K-factor for your sensor, then you will need to calculate the K-factor using the following procedure:

1. Ensure that the counter/depth channel has a K-factor of unity.
2. Ensure that the channel reading is zero. If necessary, reset the value to zero.
3. Physically, apply a known total. Example: If this a depth channel, then turn the sensor for a known number of revolutions (has to be exact) then calculate the equivalent depth in ft or meters. If this is a flow total channel, then pump a known quantity of the fluid/gas.
4. Take note of the channel final reading. This is the number of pulses that your sensor will produce for the physical quantity. The K-factor is thus calculated as (Number of Pulses, i.e. final reading) $\div$ (Physical quantity). Example: If you pumped 2 barrels of water and your channel reading is 4600, then your K-factor is $4600 \div 2 = 2300$ (pulses per barrel).

It is recommended that the values saved in this screen are recorded elsewhere in case the system is reset accidentally or deliberately.

The NEXT button on this page will display the settings for the programmable channels.

REAM PORT SETTINGS		
ADVANCED		
Analogue Channels	Offset	Gain
Analogue 05	0.00000	1.0000
Analogue 06	0.00000	1.0000
Analogue 07	0.00000	1.0000
Analogue 08	0.00000	1.0000
Counter/Frequency Channels	K-Factor	
Channel Total 12	1.0000	
Channel Total 13	1.0000	
Channel Total 14	1.0000	

Buttons: Done, PREVIOUS

When entering values of Gain, Offset or K-Factor, the number of decimal points than can be used is restricted to 4 while the number of digits before the decimal point is 5. If these are insufficient, then the ADVANCED button can be used to enter any value using scientific number format.

REAM PORT SETTINGS		
ADVANCED		
Analogue Channels	Offset	Gain
Weight Indicator	0.00000E+0	1.00000E+0
Light Weight	0.00000E+0	1.00000E+0
Wellhead Pressure	0.00000E+0	1.00000E+0
Circulation Pressure	0.00000E+0	1.00000E+0
Counter/Frequency Channels	K-Factor	
Fluid Total	1.00000E+0	
Nitrogen Total	1.00000E+0	
Depth	3.00000E+2	

Buttons: DONE, PREVIOUS

For those not familiar with Scientific Format, here are some examples that explain how to use them:

Value 0.0004451 can be written as 4.4510E-04, i.e. it is $4.451 \div 10,000 = 0.0004451$

Value 1,235,000 can be written as 1.2350E+06, i.e. it is $1.235 * 1,000,000 = 1,235,000$

So basically, E-XX (where XX are numbers) means divide by 10^{XX} (10 to the power XX), or 1 followed by XX zeros. Example, if E-03 then divide by 1000. If the sign for the number XX is positive, then multiply by the resultant number, example E+04 means multiply by 10000.

MENU OPTION - Calibrate Analogue Channel

Analogue sensors produce an electrical signal proportional to the physical input. This sensor response is valid only within the range specified for the sensor. For example, a pressure sensor could have a range of up to 400 bars (5,800 psi), this implies that the sensor will have a linear response between 0 to 5,800 psi, outside this range the sensor may produce an output but there are no guarantees that this response is accurate. Further, the sensor will generally have a maximum pressure beyond which physical damage will occur.

To interpret the sensor signal, a calibration procedure is required. In essence, the procedure is required to determine a mathematical relationship between the sensor output and the physical quantity being measured. Most commonly, the response is linear, thus the mathematical relationship will be a straight line. This procedure only need to be carried out once in a while, which, generally speaking is due to change in component characteristics.

The figure below shows an example of an output response from a 4 - 20 mA pressure sensor. The sensor has a range of 0 to 5,800 psi, and the output signals reported by the REAM board are as follows:

At	0	psi,	REAM reading	13,107
At	5,800	psi	REAM reading	65,535

We construct two equations in the form;

$$Y = Gain * X + Offset$$

Where Y is the actual value (i.e. measured pressure), and X is the REAM raw value:

$$5,800 = Gain * 65,535 + Offset \quad \dots(1)$$

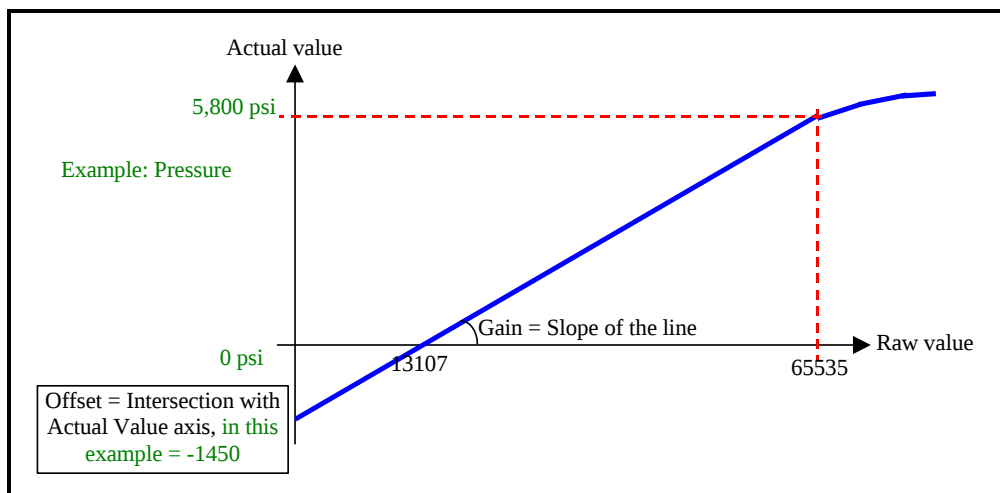
$$0 = Gain * 13,107 + Offset \quad \dots(2)$$

Subtracting (1) - (2) gives;

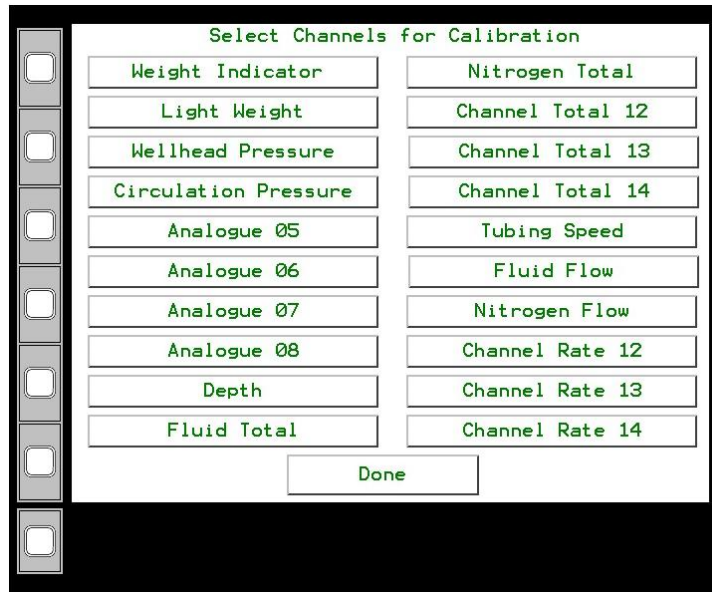
$$5,800 = Gain * 52,428$$

Therefore,

$$Gain = \frac{5,800}{52,428} = 0.1106$$

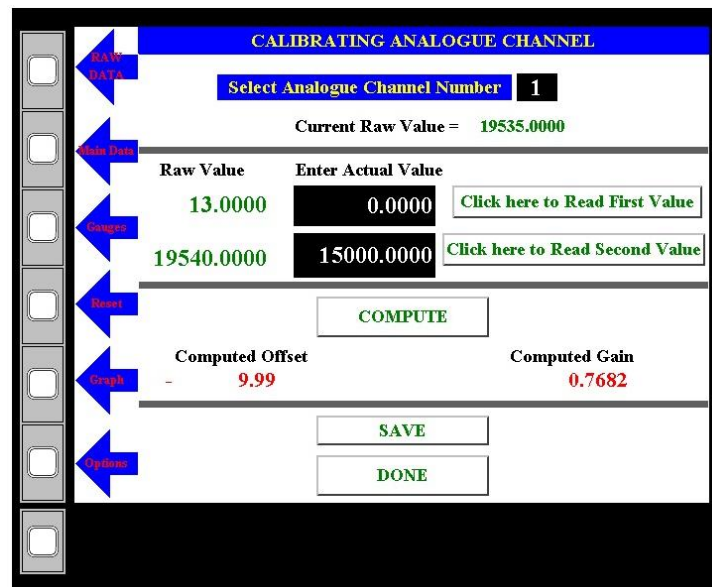


To perform a calibration in the REAM HMI, the user must select the channel to be calibrated and be able to apply two actual (reference) values. The system will provide the raw values then compute the gain and offset and if acceptable, then the user can SAVE these values to be stored. (For counters, see MENU OPTION - Set Ports Data).



A typical calibration procedure will utilize two physical readings that are easy to apply, easily verified, and as far away as practically possible (within the specified sensor range). For example, for a pressure sensor;

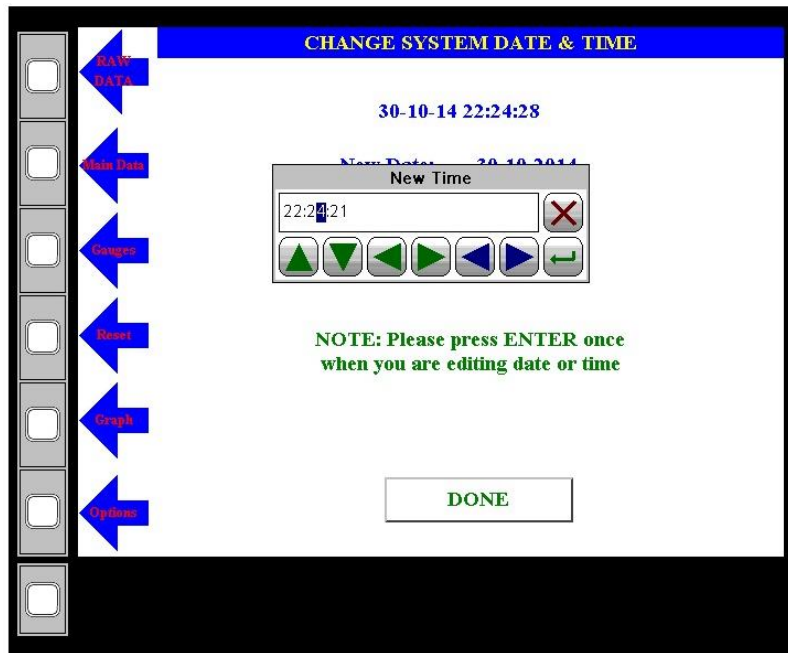
1. Apply the first reading of say 0 psi, wait until the "Current Raw Value" becomes steady, enter the Actual Value, then click the button "Click here to Read First Value".
2. Then, apply the second reading, say 3,000 psi. Again, wait until the "Current Raw Value" becomes steady, enter the Actual Value, then click the button "Click here to Read Second Value".
3. Note that the Raw Values will be automatically shown in the Raw Value column.
4. Click the COMPUTE button and the REAM HMI will compute the GAIN and OFFSET and will display the computed values.
5. If satisfied, click the SAVE button to save the data in the system settings. Remember not to switch off the HMI until the Amber LED has completed blinking indicating saving data to the Compact Flash.



MENU OPTION – Set Date and Time

If the HMI date and time need to be changed, then use this option. A popup window will appear showing the system current date and time. To alter the date, click on the date and then enter the new date, and similarly for the time.

Another popup window will appear, to start making changes, click the ENTER button first then use the up/down arrows to increment or decrement the values, and use the left/right arrows to move to next/previous field.



MENU OPTION - Set Ethernet Port

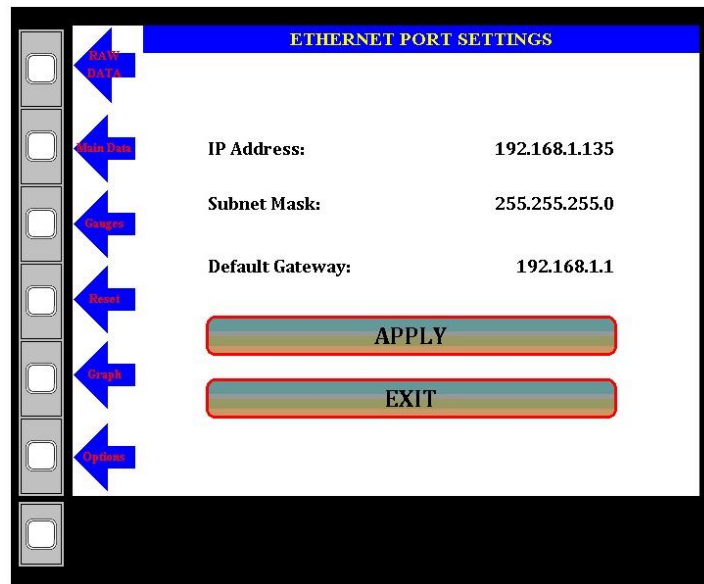
This button will display a page with the Ethernet settings. Should only be used if it is necessary to change these settings. The reason for this is that the system will restart itself automatically. Users should avoid changing the Ethernet settings frequently.

The REAM HMI is shipped with a default IP Address of 192.168.1.xxx (where xxx can be any number between 2 and 254, most likely 135) , Subnet Mask 255.255.255.0 and Default Gateway 192.168.1.1. These addresses will be valid in the case of using a router, as most routers will have a default IP address of 192.168.1.1. Note that all the numbers will range from 0 to 255.

If using the REAM HMI with a direct connection to a computer, a crossed Ethernet cable should be used. The IP addresses should conform to the rules of a local area network, that is they should start with 192.168 and the following can be either 0 or 1 then a different number for the computer than that for the HMI. For example, the HMI can have an IP address of 192.168.1.135 and the computer can be 192.168.1.136. The default subnet mask is 255.255.255.0, and there is no need to worry about the default gateway.

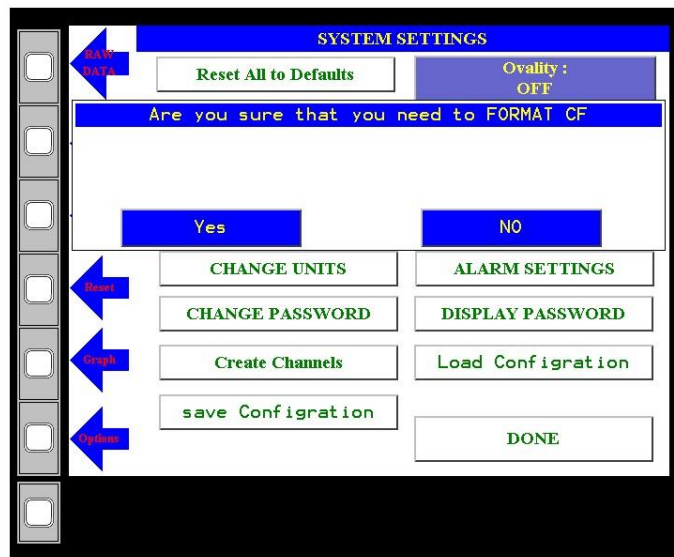
If a local area network (LAN) is used with a router, wired or wireless, then you will need to ascertain that the default gateway is properly entered. Consult your router manual to find out the appropriate gateway, most likely 192.168.1.1.

For use in a wide area network (WAN), IP Service provider will provide a range of IP addresses that are valid. WAN settings will require a competent IT/Networking technician to configure.



MENU OPTION - Format CF

Only use this option if you wish to format the Compact Flash. A pop-up window will appear to confirm that you wish to proceed with the formatting.



MENU OPTION - Channel Mapping

This option should only be used if it is desired to change the channel assignments. Users are advised to consult with MEDCO before making changes here.

Furthermore, if an MC-III Flow Analyser is available for reading Fluid Flow or Nitrogen Flow, then the option to dictate to the HMI that the readings will come from the MC-III Flow Analyser is available here. If using MC-III Flow Analyser for measuring Fluid Flow, then MC-III should be set to *Slave Address* 242, and if used for Nitrogen Flow then the *Slave Address* is 243.

MAP CHANNELS		
Analogue Channels	Channel Number	Use MC-III
Weight Indicator	1	
Light Weight	2	
Wellhead Pressure	3	
Circulation Pressure	4	
Counter/Frequency Channels		
Fluid Flow	10	OFF
Nitrogen	11	OFF
Depth	9	

DONE NEXT

MENU OPTION - Change Units

For users in different world locations, it is possible to change the units of measure for any or all the parameters, as well as changing the scales for the real-time graph and schematic displays. Note that the system will not change the calibration data to reflect any changes made here, it assumes that the calibrations and settings are appropriately set by the user using the appropriate measure units. For example, if the user calibrates the Weight Indicator using LBF as the units of measure, then change the Weight Indicator units to KgF or daN, the Weight Indicator channel should be re-calibrated.

By default, the system will be set in API English units, and the scales will be those shown in the picture below.

CHANGE UNITS			
Parameter	Units	Minimum	Maximum
Weight	LBF	- 10000	50000
Pressure	PSI		10000
Fluid Flow	BPM		10
N2 Flow	SCF/MIN		10000
Tubing Speed	FT/MIN	- 200	200
Fluid Total	BBLs		1000
N2 Total	SCF		1000000
Depth	FEET		20000

DONE

MENU OPTION - Alarm Setting

Channel	Status	Channel	Status
Weight Indicator	ON	Nitrogen Total	OFF
Light Weight	OFF	Channel Total 12	OFF
Wellhead Pressure	OFF	Channel Total 13	OFF
Circulation Pressure	OFF	Channel Total 14	OFF
Analogue 05	OFF	Fluid Flow	OFF
Analogue 06	OFF	Nitrogen Flow	OFF
Analogue 07	OFF	Tubing Speed	OFF
Analogue 08	OFF	Channel Total 14	OFF
Depth	ON	Fluid Flow	OFF
Fluid Total	OFF	Nitrogen Flow	OFF

RESET ALL ALARMS TEST ALARM

Over-ride Interval 5 Seconds Change Over-ride Interval

DONE

Systems equipped with REAM v 4 will have a RELAY, which can be used for control and raising alarms. This feature is not applicable to earlier versions of REAM. With earlier versions of REAM, it is possible to have the Emergency Injector Stop System (EISS) which is an add-on to the REAM HMI. The alarms settings page is very different to the above.

The alarms can be set by the user. For each channel, there is an Upper Alarm, Lower Alarm, and Rate Alarm. The Rate Alarm is used for analogue channels ONLY, and need not be used with frequency channels because the rate of frequency channels are available as individual channels. An example of using an Analogue Channel Rate Alarm would be to set the Rate of Weight to a value such as 5,000 lbs/sec. In this case, if the coiled tubing string is locking up or stuck in the well, then the weight will change dramatically in a very short time, and even before reaching the upper or lower limit for the weight, the alarm can be triggered by this criteria.

Weight Indicator

Upper Value 20000.00 Update Turn Off

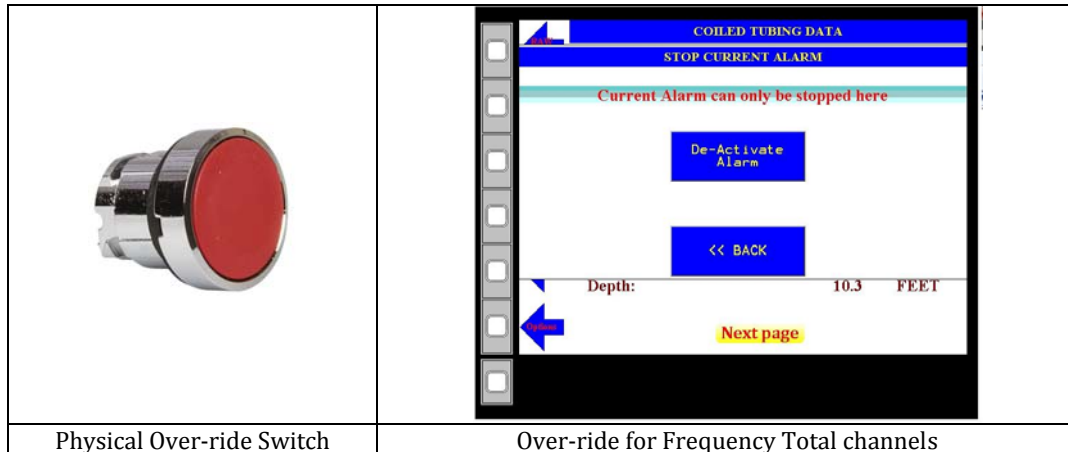
Lower Value - 999999.00 Update Turn Off

Rate Value 999999.00 Update Turn Off

<< BACK

When an alarm is triggered, and a controller is used, the user/operator will no longer have control of the coiled tubing unit. Therefore, an over-ride switch is provided and this can be used to de-activate the alarm for a limited number of seconds, as set by the user. If the condition that triggered the alarm remains, then the alarm will be re-activated. Therefore, the over-riding is essentially an acknowledgement by the operator that an alarm has been triggered, and gives the operator the opportunity to remedy the situation. Failure to remedy the situation within the time limit of the over-ride will re-trigger the alarm.

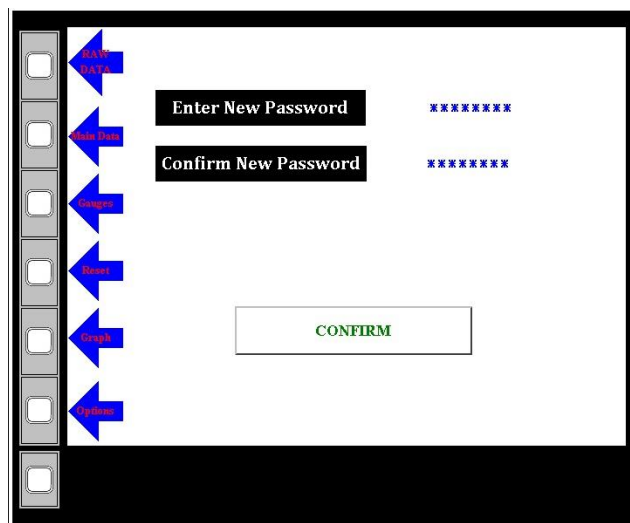
The over-ride switch is a physical switch that the operator can press. However, for reasons beyond the scope of this manual, Frequency Totals channels cannot be de-activated using this switch. Instead, the over-ride is only available from the HMI software.



The over-ride interval is set by the user on the Channels Alarms screen. Once this value is changed, the CHANGE OVER-RIDE INTERVAL button needs to be pressed to validate the new over-ride interval.

MENU OPTION – Change Password

When the system is shipped, the password is set to “290992”. This password can be remembered as the date of MEDCO’s incorporation, 29th September 1992. As this password becomes known to all users who are reading this manual, the supervisor may wish to change it to prevent others altering the system configuration.



MENU OPTION – Display Password

If the password has been changed and the supervisor forgot the password, then MEDCO can still access the system and display the password. This is only for MEDCO use, and will require access to the system via Team Viewer. MEDCO staff are not allowed to disclose the master password.

MENU OPTION – Create Channels

The REAM HMI often comes with spare channels. Users may decide to use these channels to measure some parameters, which may not be included in a standard configuration. The user is free to name the channel by any name, set a minimum and maximum value, as well as associate any units with the particular channel. The channels available for renaming do not include the standard parameters channels.

CREATE NEW CHANNELS					
Analogue Channels		Units	Minimum	Maximum	
Analogue 05		mA	0	20	RESET
Analogue 06		mA	0	20	RESET
Analogue 07		mA	0	20	RESET
Analogue 08		mA	0	20	RESET
Counter/Frequency Channels		Units	Minimum	Maximum	
Channel Total 12		Pulses	0	10000	RESET
Channel Rate 12		Pulses/min	0	100	RESET
Channel Total 13		Pulses	0	10000	RESET
Channel Rate 13		Pulses/min	0	100	RESET
Channel Total 14		Pulses	0	10000	RESET
Channel Rate 14		Pulses/min	0	100	RESET

DONE

MENU OPTION – Save Configuration

Once the REAM HMI has been completely configured, it is a good idea to save the configuration. The configuration will be saved on the Compact Flash memory.

Configuration File

Supervisor:

Job Description:

Create Configuration File

MENU OPTION – Load Configuration

If for any reason the configuration has been altered but need to revert back to the older, then Load Configuration can be used to retrieve Configuration Data from a previously saved file (see MENU OPTION – Save Configuration).

System Memory

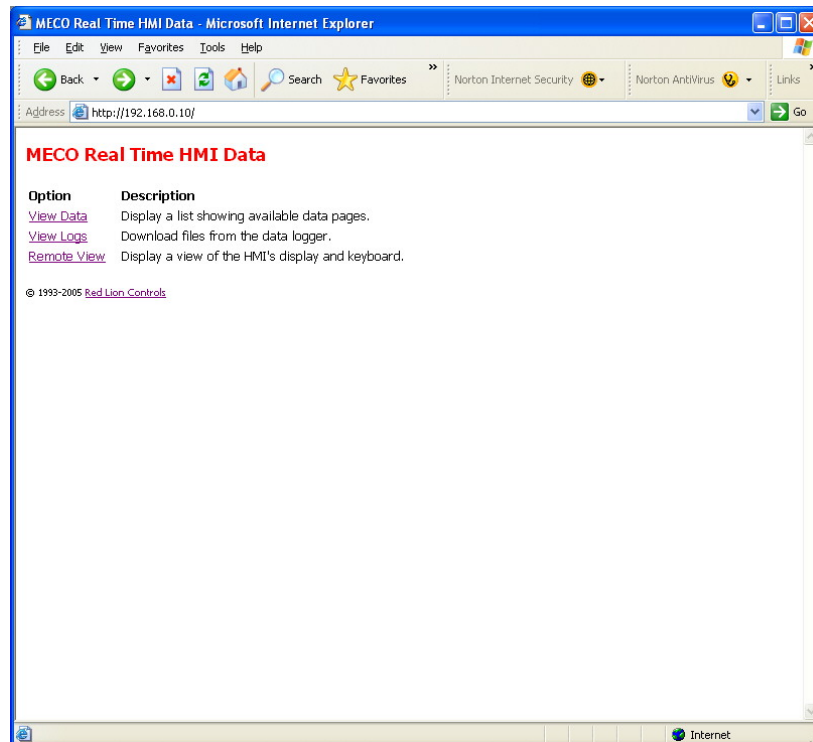
REAM HMI has a 4 Gbyte CompactFlash memory that is used for storing data. The data storage is done automatically at a once per second sampling rate. The maximum length of time for continuous recording of data is variable and depends largely on the number of logs being used.

To read data from the Compact-Flash, the user can do this by going to Web Browser and enter the HMI IP Address, then select the VIEW LOGS and then list of logs will be available. Alternatively, the Compact Flash can be taken out of the HMI (power must be OFF) and inserted into the supplied card reader which can then be used with any computer to read the data. As a caution, never use the computer to format the Compact Flash, always use the FORMAT CF command on the HMI.

Communication

The user can access the data in REAM HMI using the IP Address of the system. The IP Address, subnet mask, and Gateway information can be found on the *Raw Data Page* (top button). The user can access the pages simply by typing the IP Address in the address bar of a web browser, example in Internet Explorer. The default html page is “auto/001/”, which is used to display the actual data. Other programs, such as DART software, use this page to capture the data from the HMI.

A local area network has to be present to enable browsing the pages. When crossed RJ45 cable is used a direct connection to a computer (laptop) is possible. Alternatively, if a router is used, then a straight RJ45 cable should be used.



The first page that will appear will have the following hyperlinks:

View Data

Will display data with variable names. This is not meant for end users, it is meant for transmitting data to other devices capable of logging data through TCP/IP, example DART software on a laptop.

View Logs

Will display all the data logs available. "Onehour" will contain all the one-hour long files. The files format is Comma Separated Variables (extension CSV) and this can be opened directly by Microsoft Excel. The log files follow a naming convention, which is made up of the year, month, day, and hour. Each file contains 1 hour worth of data as a maximum. The CompactFlash memory can hold anything up to 200 files (more than a week worth of data recorded from all channels at 1 per second). The other logs available are the "Oneday" and Ovality. For the one-day logs, a maximum of 10 files are stored, while for the ovality, 100 files. The OneDay logs are recommended.

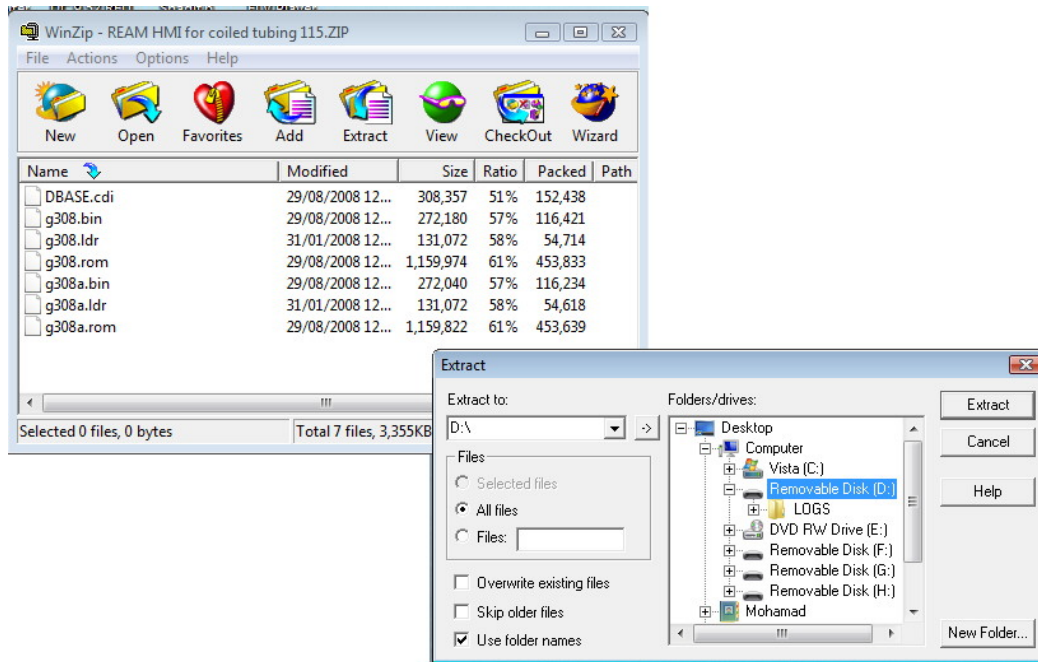
Remote View

Gives access to all the pages described earlier in this manual. The current page being displayed on the HMI is the page that will be shown.

Updating the HMI Software

Occasionally, MEDCO will release new versions of the HMI software. One of the major advantages of the HMI hardware is that it may be easily re-programmed or updated. The following is a step-by-step procedure for updating the HMI software:

1. Ensure that you have a copy of all your system settings, such as Gains, Offsets, and K-Factors.
2. Ensure that the REAM HMI is switched off.
3. Remove the Compact Flash card. Ensure that you remember the card's orientation, this will help you when re-inserting the card back into the HMI.
4. Insert the Compact Flash card into the card reader supplied with the system.
5. Connect the card reader to your computer (USB port).
6. Download the new software version from MEDCO's web site by going to <http://www.medcotas.com/reamhmi.htm>. Look for the latest version, download it to your computer and remember where you saved it.
7. The new software files will be packed together in Zipped file. Extract all the files to the root folder of the Compact Flash.
8. Ensure that you stop the card reader, then disconnect the card reader from the computer.
9. Remove the Compact Flash card from the card reader and insert it back into the HMI.
10. Power up the HMI, you will see a message "Loading from CF", wait until the system starts then wait for at least two minutes to allow the system to write to the Compact Flash.
11. Note that you may need to re-configure the system, for example, your old calibration data may be lost. Here, we deliberately say that you MAY need to re-configure the system because if the changes in the software are significant from the version that you already have, then there is a good chance that some of the settings will be lost.

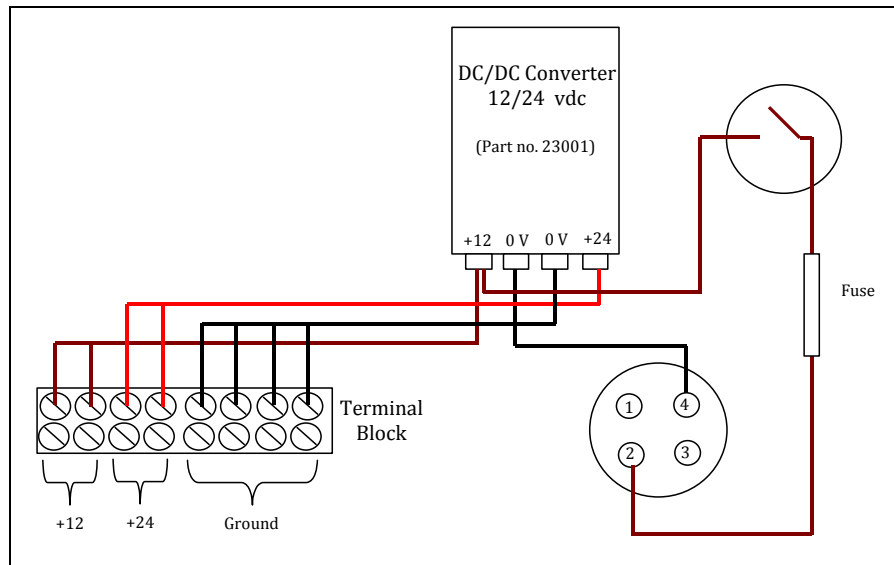


Power Supply

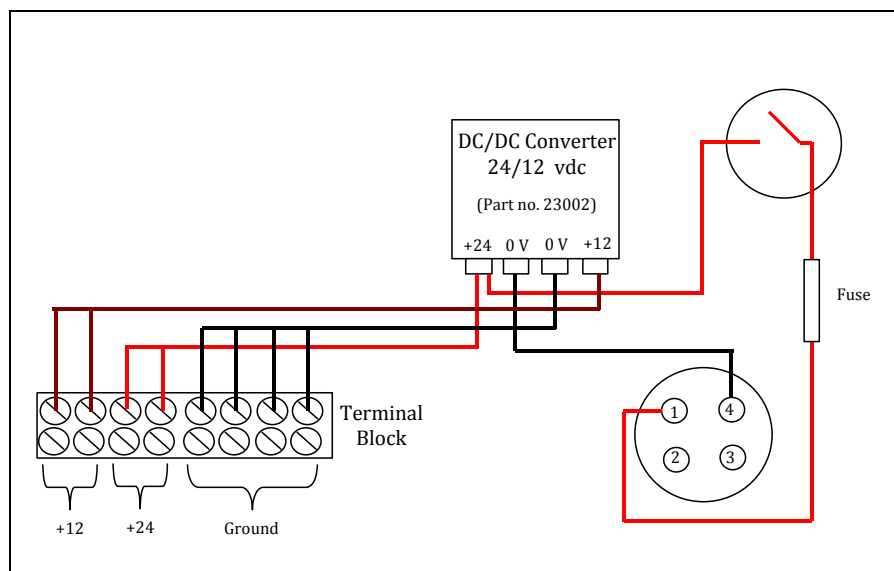
Customers can choose the REAM HMI to be operated by 12 or 24 vdc. The system comes with an AC to DC converter, which takes 95-250 VAC and outputs the required dc voltage. The complete system will require less than 20-watt.

Internally, various parts will require either 12 or 24 vdc to operate. Therefore, a DC/DC converter will be used to ensure that the complementary voltage is available. The REAM board requires 12 v (except earlier REAM v 2 boards, which require 24 v). The HMI requires 24 v. If there are IS Barriers or other components, these will require either 12 or 24 v, depending on the model.

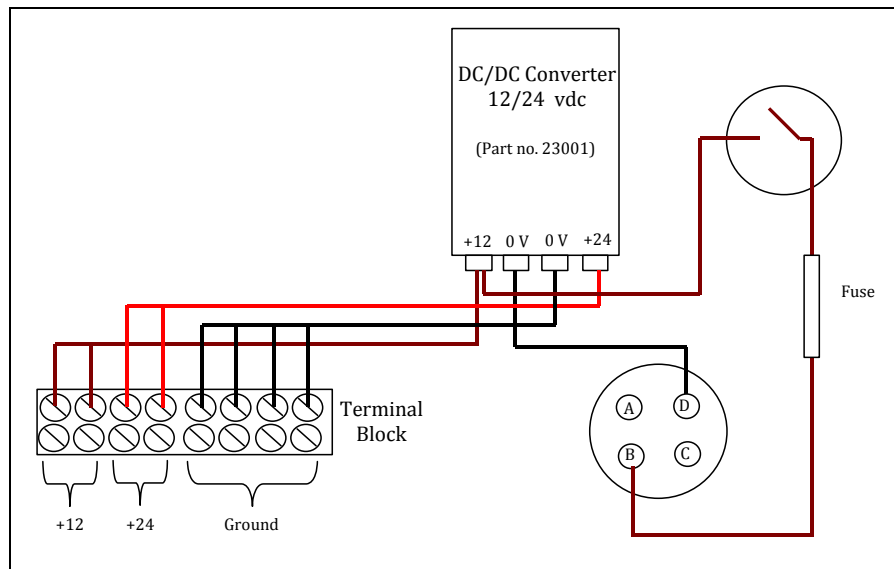
Below are the wiring diagrams for the DC voltage conversion and distribution inside the REAM HMI enclosure.



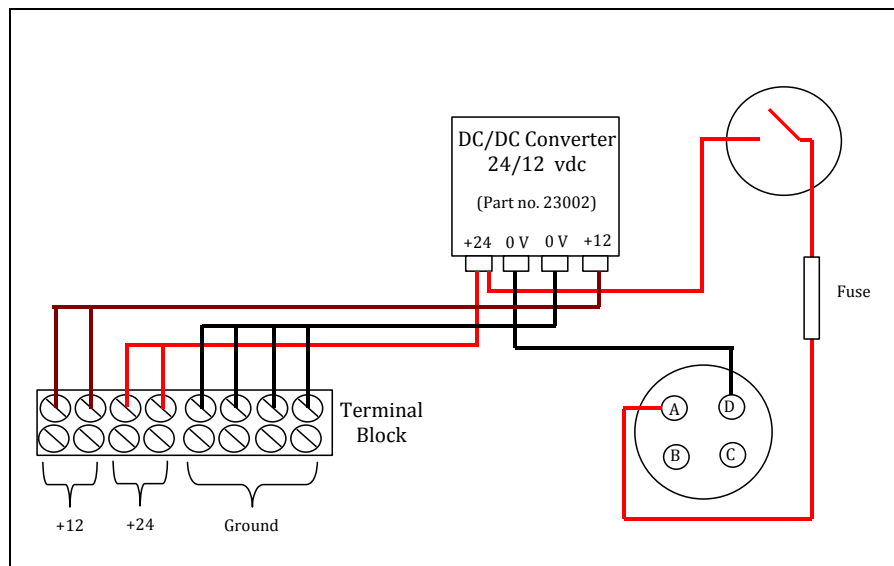
System Operated by +12 vdc Power Supply
With XLR Connectors



System Operated by +24 vdc Power Supply
With XLR Connectors



System Operated by +12 vdc Power Supply
With Military Connectors



System Operated by +24 vdc Power Supply
With Military Connectors

Sensors

Shaft (Depth)Encoder



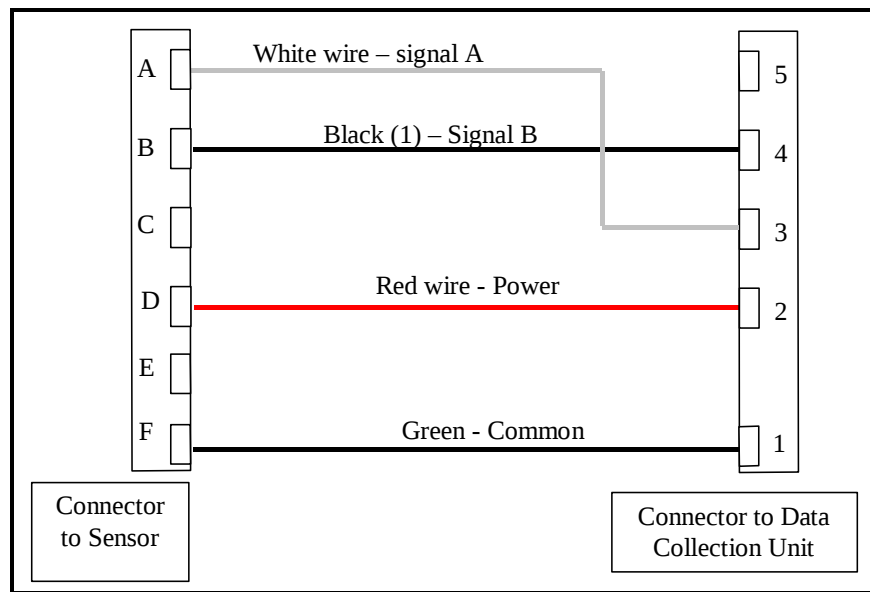
Quadrature Optical Encoder (Shaft encoder)
(Part No. 01007)

Specifications

Pulses per revolution:	600
Operating Voltage:	5 – 24 vdc
Mounting:	Flange mount 1.181"
Shaft size:	3/8"
Ingress:	IP65

Connectors for Shaft Encoder Cable

	
Connector - data collection unit side (Part No. 08154)	Connector - sensor side (Part No. 01003)



Wiring diagram of cable for shaft encoder (20m)
(Part No. 10022)

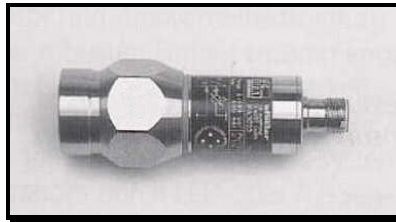
Pressure Sensors

There are a variety of pressure sensors that may be used. Some will have a voltage output, while others will have a current output. Below, some of the most popular types are listed and users who have sensors not listed below are advised to check with MEDCO for the wiring diagram.

A. MEDCO's part number: 04004, 04005, and 04006:

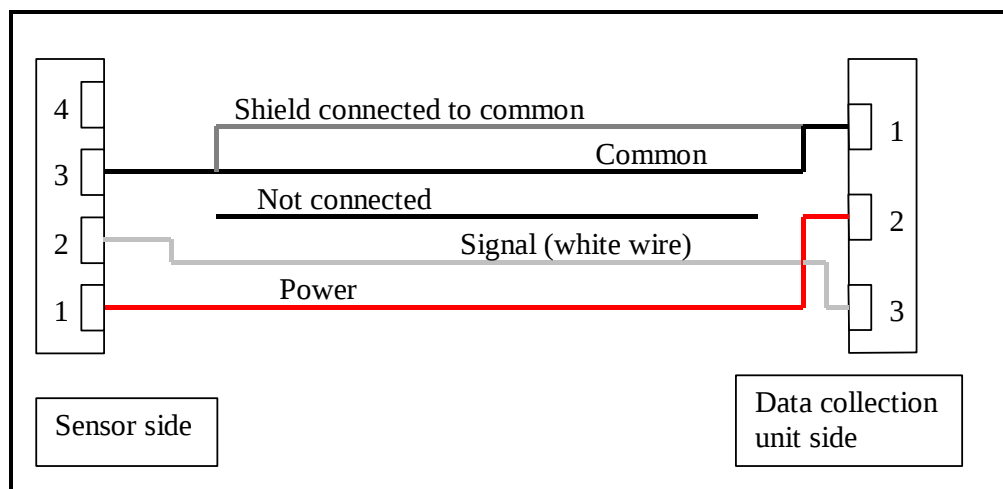
Specifications:

Part No.	Output	Measuring Range	Operating Voltage	Temp. Range	Protection	Mechanical Connection
04004	0-10 vdc	0-100 bar (0-1450 psi)	18-30 vdc	-25 to 80 °C	IP67	G ¼" Female
04005	0-10 vdc	0-250 bar (0-3625 psi)	18-30 vdc	-25 to 80 °C	IP67	G ¼" Female
04006	0-10 vdc	0-400 bar (0-5800 psi)	18-30 vdc	-25 to 80 °C	IP67	G ¼" Female



Pressure sensor type – A
(Part No. 04004, 04005, and 04006)

	
Connector - data collection unit side (Part No. 08152)	Connector - pressure sensor (type A) side (Part No. 04002)

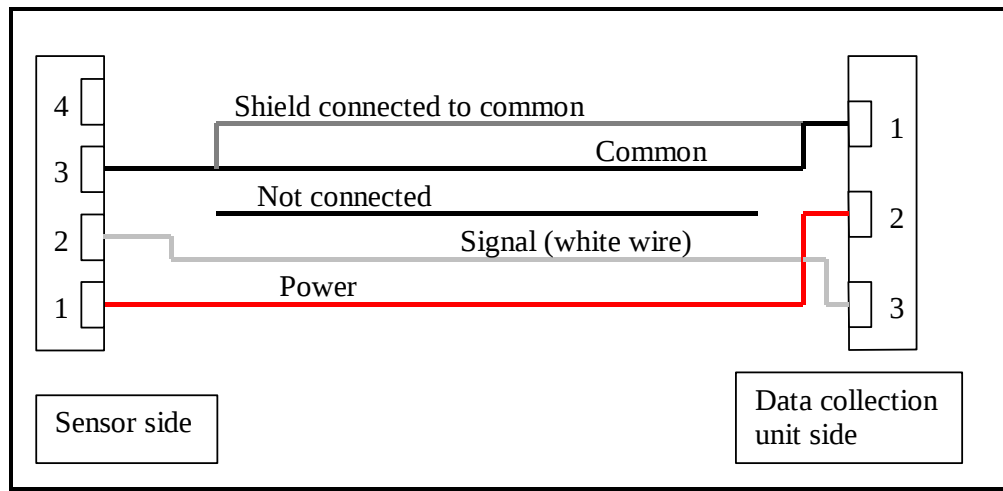


(Part No. 10025 for Pressure sensors 04004, 04005, and 04006)

B. MEDCO's part number 09001:

Specifications: Output: Measuring range: Operating voltage: Temperature range: Mechanical connection:	0-5 vdc To client's requirement, up to 15,000 psi 18-30 vdc -29 to 94 °C G ¼" Female	
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Connector - data collection unit side (Part No. 08152)	Connector – pressure sensor (type B) side (Part No. 08128)



(Part No. 10026 for Pressure sensor 09001)

Proximity Switch



Proximity Switch Sensor
(Part No. 04012)

Specifications:

Operating voltage:	10 – 36 vdc
Current rating:	250 mA
Switching frequency:	800 Hz
Temperature range:	-25 to 80 °C
Thread size:	M12

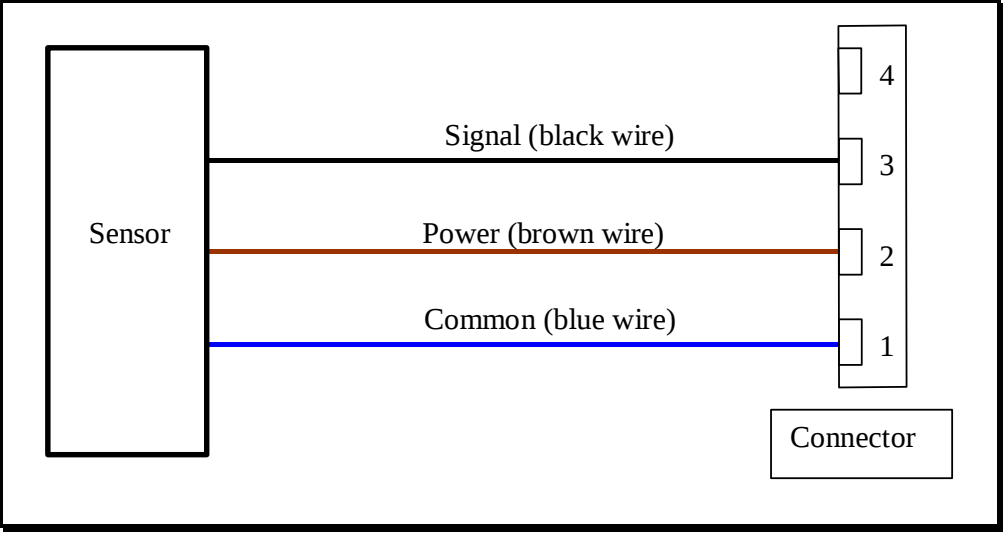
Electrical Connection for Proximity Switch:

The proximity switch comes with a short cable and a 4-way in-line sensor plug connector.



Connector for Proximity Switch
(Part No. 08153)

The wiring inside the connector is as shown in the diagram below.



Wiring diagram for proximity switch
(Part No. 10017)

Magnetic Pickup



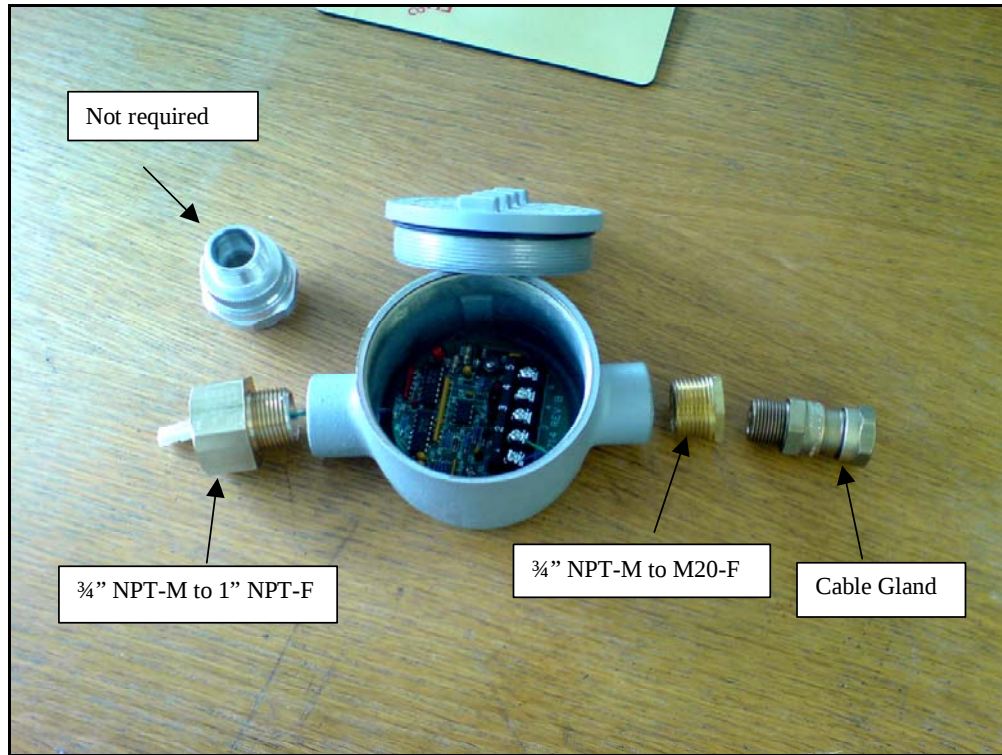
Magnetic Pickup Sensor
(Part No. 16002)

Magnetic Pickup Amplifier

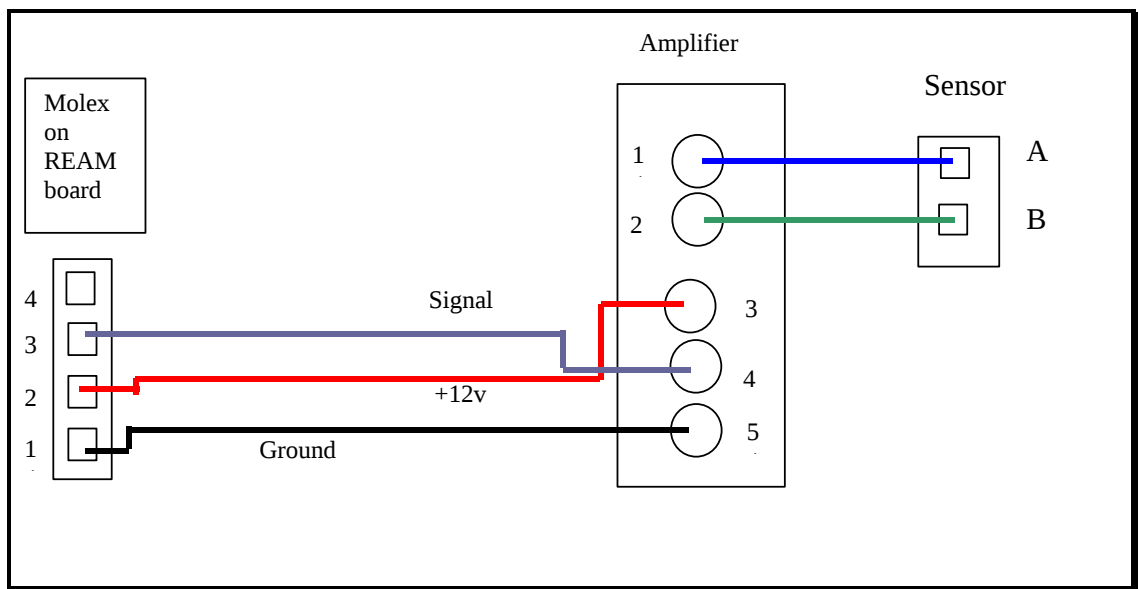


The magnetic pickup amplifier shown above is supplied with the following adaptors:

1. $\frac{3}{4}$ " NPT-M to 1" NPT-F. This adaptor is to be used to connect the amplifier to the flow meter.
2. Wires connector: The wires connector connects directly to the magnetic pickup sensor. Most likely, the blue wire should connect to the left pin of the magnetic pickup when viewing the magnetic pickup pins with the alignment notch on the topside. If no signal is received, then reverse the connection.
3. $\frac{3}{4}$ " NPT-M to M20-F: This connector is used to connect the amplifier to the cable gland.
4. M20 Cable Gland: Use this to hold the cable and stop it from rotating.



Magnetic Pickup Amplifier
(Part No. 18001)

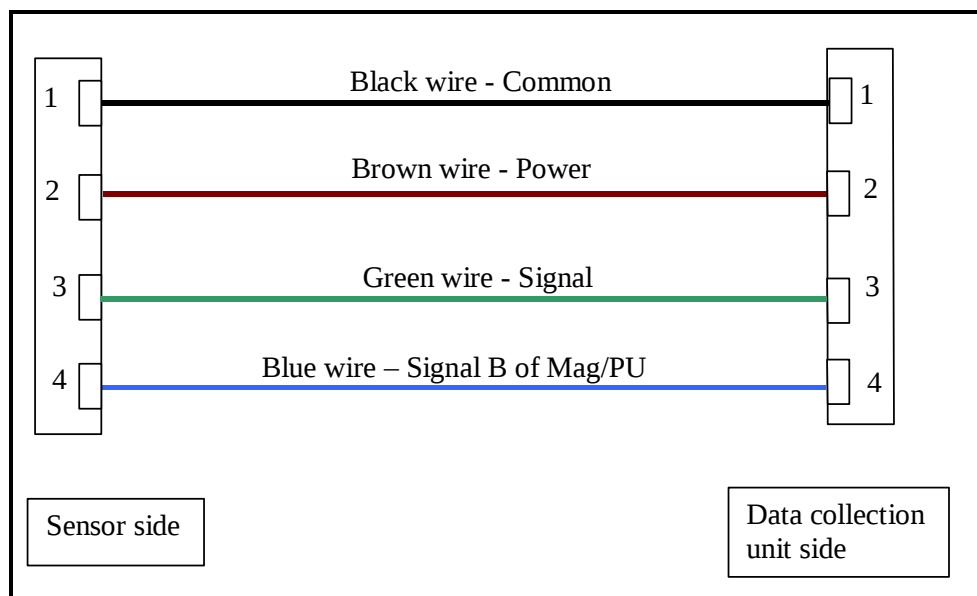


Final Assembly



Cable for Proximity Switch/Magnetic Pickup to Data Collection Unit:

The wiring of the cable (30m) to the data collection unit is as shown in the diagram below:



(Part No. 10023)

Connectors on Cable for Proximity Switch/Magnetic Pickup:



Connector - sensor side
(Part No. 08155)



Connector - data collection unit side
(Part No. 08153)

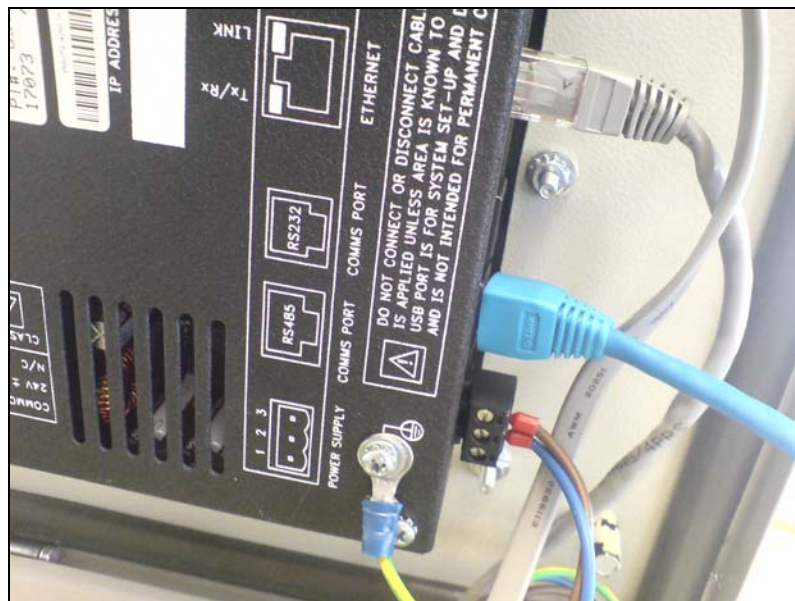
MC-III Flow Analyser

Overview

With the new REAM HMI software version 1.23, the user has the choice of reading data directly through the MC-III flow analyser instead of using a magnetic pickup amplifier. This applies to both Fluid Flow and Nitrogen Flow (rates and totals).

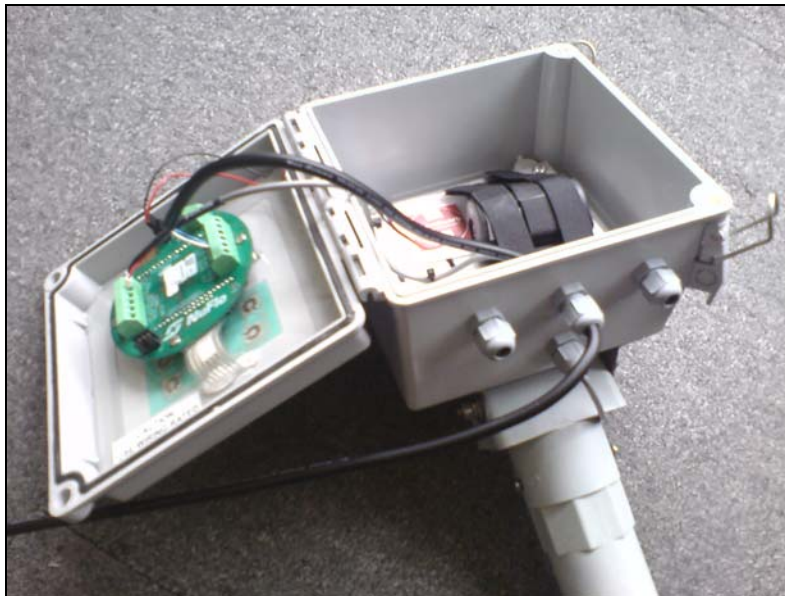
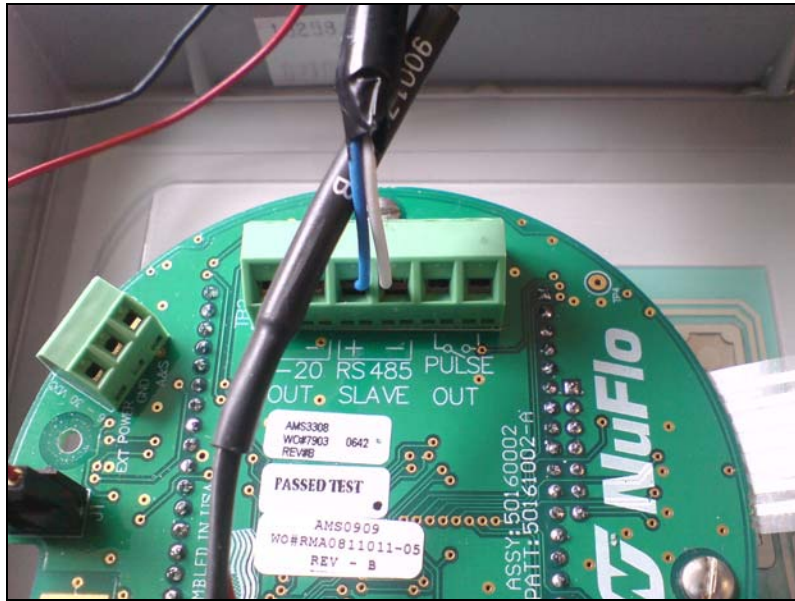
The readings that will be reported on the REAM HMI will be exactly the same as those reported by the MC-III flow analyser. This means that if the K-Factor of MC-III flow analyser is wrong, or the MC-III is mal-functioning, then the REAM HMI will report the same data regardless, i.e. the accuracy will be solely dependent on the MC-III accuracy. Note also that the data will be reported in the same units of measure as those specified in the MC-III.

From the outside, the REAM HMI has a XLR 3-pin male plug for connecting to the MC-III, and internally from the RJ45 through a UTP cable to the RS485 port on the HMI.



Connect to MC-III

A long cable (approx. 15m) is provided. One side of the cable has an XLR 3-pin cable mount socket to connect to REAM HMI. The other side of this long cable has three wires. Feed this cable through one of the cable glands on the body of the MC-III then connect such that Pin2 on the XLR goes to RS485+, Pin1 on the XLR goes to RS485- inside the MCI-III, and Pin3 is earth and must be connected to the next MC-III. The cable from the magnetic pickup is connected across the TFM terminals.



Programming the MC-III

If using this modification to measure Fluid Flow, then the MC-III should be re-programmed to have a slave address of 242. On the other-hand, if this modification is intended for use with Nitrogen Flow, then the MC-III slave address needs to be 243.

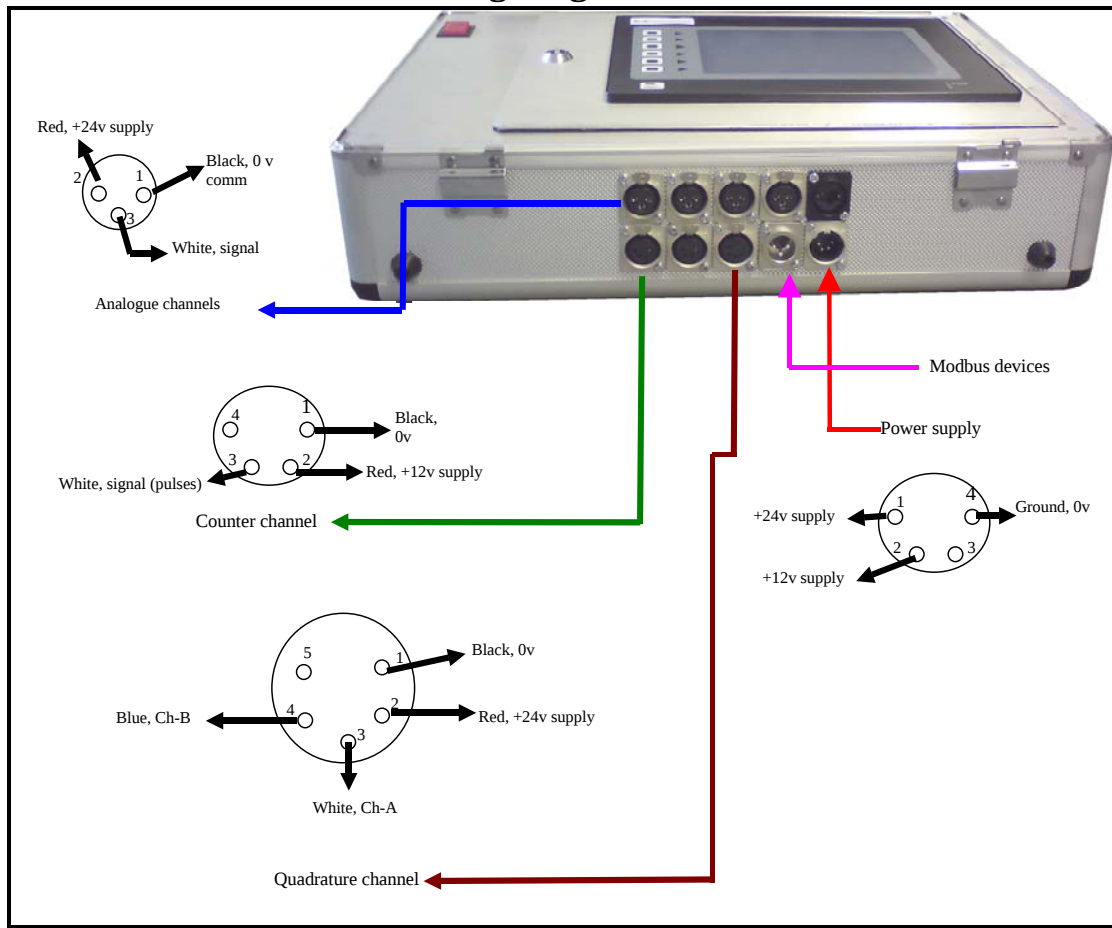
1. Enter the Output menu. Press OUTPUT MENU.
2. Locate the Slave Address setting: Press ENTER repeatedly until the words "Slave Address" appear in the lower display. The right-most digit in the upper display will begin blinking.
3. Enter the Slave Address: Press UP ARROW until the correct digit is displayed. Then press LEFT ARROW to select the next digit to the left. Repeat using UP and LEFT arrows to enter all remaining digits.
4. Save the changes: Press ENTER.

All other settings of the MC-III should remain as per manufacturer's default values. If any has been changed, then refer to the MC-III manual for instructions on how to change back to manufacturer defaults. Of particular interest here, is the BAUD RATE which should be 9600.

Configure REAM HMI Software to read from MC-III

On the HMI, go to MENU, enter the passcode "290992", then select the button "Channel Mapping". In the column titled "Use MC-III", turn ON the appropriate field, i.e. if using MC-III to measure Fluid Flow, then on the row with FLUID FLOW on left-hand-side, toggle the button on the right hand side of the row to "ON", then click DONE.

Wiring Diagram



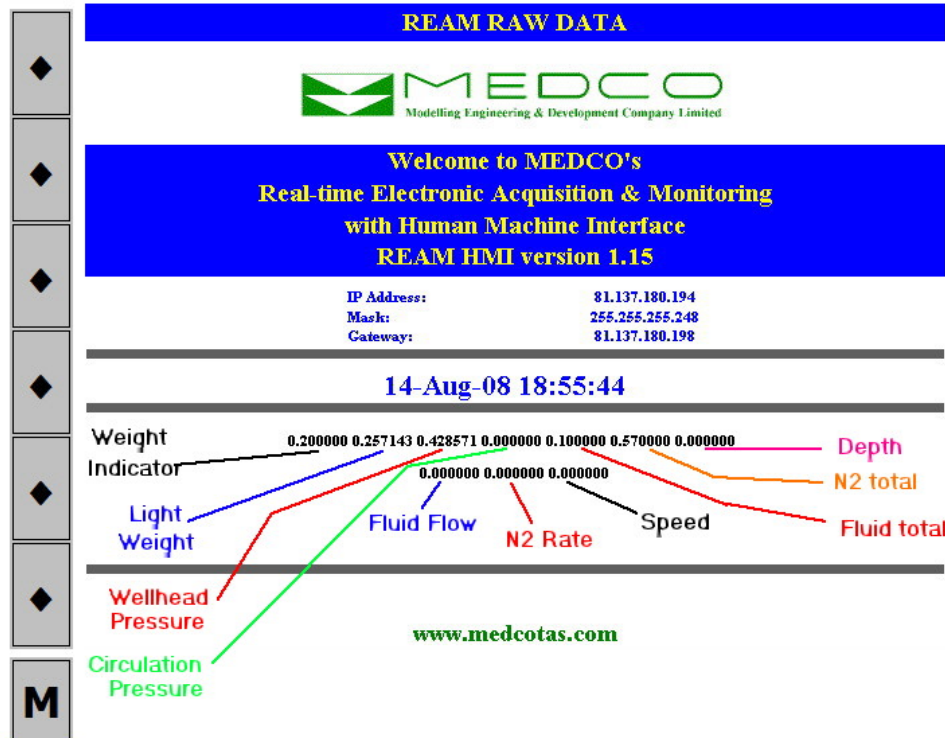
Trouble Shooting

This part of the manual is intended to help the user resolve problems. Troubleshooting is a process of elimination, thus this section will give some details of common problems and how to troubleshoot. If after checking the procedure below, you are still unable to find and resolve the fault, then contact MEDCO for further advice.

No data:

The system is not displaying data on the first page, the “Raw Data Page” accessed through the first button. This implies that there is no communication between the HMI and the REAM board. The possible causes could be one of the following:

1. Missing link on the RS232 cable between the HMI and the REAM board.
 - a. First ensure that the cable is connected to the RJ11 socket on the HMI labelled “RS232 PGM PORT”.
 - b. Ensure that the other side of the same cable is connected to the REAM board. Three wires are used, Yellow goes to Pin 1 on the Molex connector, Black goes to Pin 3, and Red goes to Pin 4. Also ensure that these wires are securely connected in the Molex connector.
 - c. If you have access to another REAM HMI, try swapping the RS232 cable. Do not remove or connect the cable while the system is on.
2. No power: Check that the REAM board is actually powered. To do this, do the following steps:
 - a. On any of the analogue channels connectors, check to see if there is +24vdc power between Pin 2 (+ve) and Pin 1 (Ground).
 - b. On any of the counters (not the quadrature), check to see if there is +12vdc power between Pin 2 (+ve) and Pin 1 (Ground).



Raw Data Available:

If the data on the “Raw Data Page” is making sense, for one or more channels, but with one or more channels not making sense, then probably the REAM board needs to be re-configured. The data here should be as follows:

1. Analogue channels: As these are 11-bit ADC channels, in theory they should display values in the range of 0 to 2047, where 0 corresponds to 0 vdc and 2047 corresponds to 10 vdc or 5 vdc. If using 4 to 20 mA sensors, then the values should be 409 to 2047. Due to some variations in resistors and other electronic components, most systems will actually give approximately 1900 for a 10 vdc signal. To check that a particular channel is displaying the correct value:
 - a. Apply a physical measurable quantity to the sensor. For example, if using a pressure sensor with a range of 0 to 5,800 psi and output of 0 to 10 vdc, then at 0 psi the reading should be approximately 0, and at 2,900 psi the reading should be approximately 950.
 - b. It is also possible to apply voltage directly using some battery or another source for voltage. Compare the results and the ratio should be approximately the same. That is, if applying 5 vdc, then should get a reading of approximately 950. Care should be taken when applying voltage directly, ensuring that the +ve voltage is applied to Pin 3 (signal) on the connector while ground should be connected to Pin 1 (Ground).
2. Counter Channels: These should display a value of 0.01 for every pulse applied. The easiest way to check either of these channels is to connect a proximity switch to the channel and with a small metal object, such as the tip of a screw driver, generate one pulse at a time and check that the reading corresponding to the channel is incrementing by 0.01.

3. Quadrature Channel: Again, this channel should display 0.01 for every pulse applied. The depth encoder will have a Pulses Per Revolution (PPR) value written on the encoder body, for example the most common is 600 PPR. Thus for every revolution the readings should change by 6.00. Again, this figure will be approximate as it is not always possible to turn the encoder by hand exactly one revolution with an accuracy of 1 in 600.
4. If the readings of counter and/or encoder channels are not 0.01 per pulse, then it is sometimes possible to reset these from the HMI. The procedure is as follows:
 - a. Go to MENU, enter the passcode.
 - b. Select the RESET REAM K-FACTORS, then go back and check 2 and 3 above. If one or more of these channels is still not displaying 0.01 for every pulse, then repeat until all are responding appropriately.

Individual channels having a problem

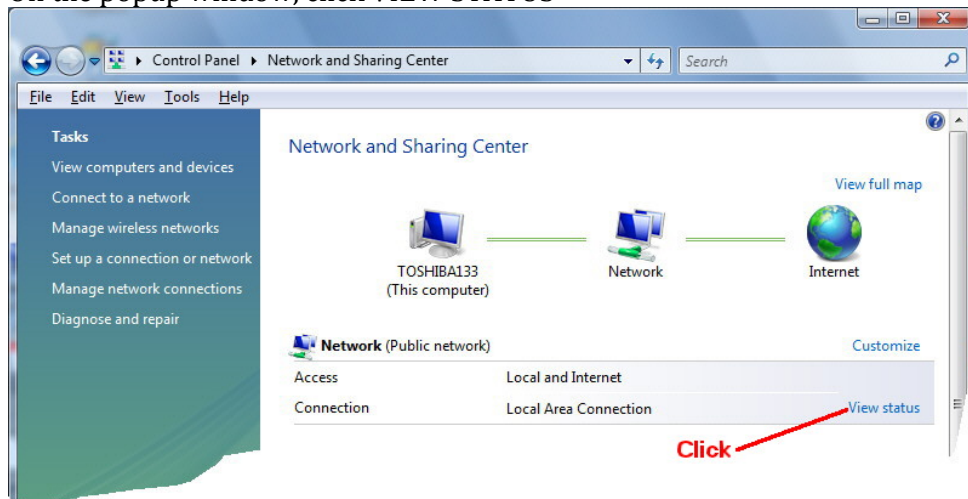
If an individual channel is exhibiting a problem, then there are a few steps to take to determine the cause of the problem:

1. Note that Fluid Flow (Flow Rate) and Fluid Total are both obtained from the same sensor. Thus, if there is a problem with both of these then it is likely to be one problem and not two. Similarly for the N2 Rate & N2 Total, and Depth & Speed.
2. In the REAM RAW DATA page, check to see if the readings for the channel are making sense, i.e. in accordance of the description above. If they do make sense, then you probably need to correct the calibration or the K-factor, otherwise go to step 3 below.
3. If there is no data relating to this channel in the REAM RAW DATA page, or the values are not changing when you vary the physical quantity, then it is likely that you have a hardware problem. Since, other channels are working properly then it is unlikely that the problem is inside the REAM HMI, rather it could be either the cable or the sensor itself that is causing a problem. It is very simple to determine the source of the problem by getting another sensor of the same type that you know works well and try it, if that still does not resolve the problem then try another cable.
4. When you have determined that the problem is in the sensor, then you will need to replace the sensor. If you already have one in stock, then simply replace it, otherwise contact MEDCO for replacement parts.
5. If, on the other hand, you have determined that the problem is in the cable, then most of the time you will be able to repair the cable. Use the wiring diagrams for the relevant cable and re-solder the wires. Note here that you should always check a cable by performing two tests:
 - a. Continuity: If you measure the resistance between two pins that are supposed to be connected, then it should be near zero, allowing for the cable resistance.
 - b. Insulation: If you measure the resistance between two pins on one side the cable that are not supposed to be connected to each other, then it should be infinite.
 - c. Example: Take the depth encoder cable. This should have the wiring as follows:

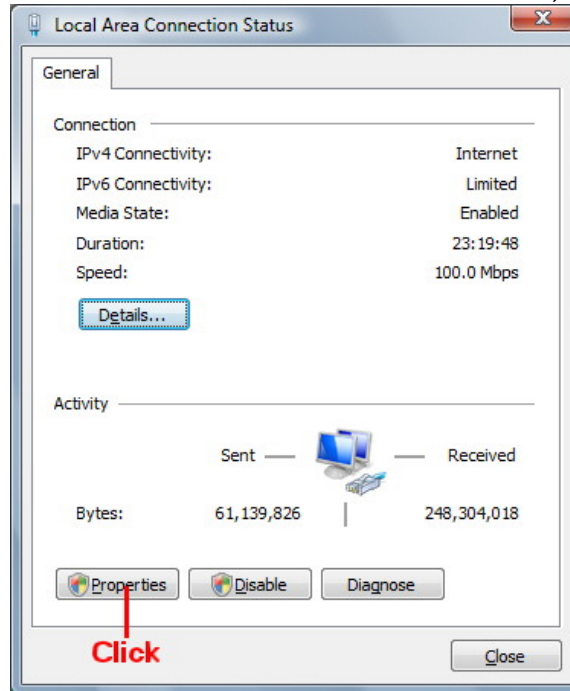
- i. Pin 1 on REAM side to Pin F on sensor side – do a continuity test
- ii. Pin 2 on REAM side to Pin D on sensor side – do a continuity test
- iii. Pin 3 on REAM side to Pin A on sensor side – do a continuity test
- iv. Pin 4 on REAM side to Pin B on sensor side – do a continuity test
- v. Insulation tests on the sensor between Pin F and D, A, & B
- vi. Insulation tests on the sensor between Pin D and A, & B
- vii. Insulation tests on the sensor between Pin A and B

Other Types of Problems

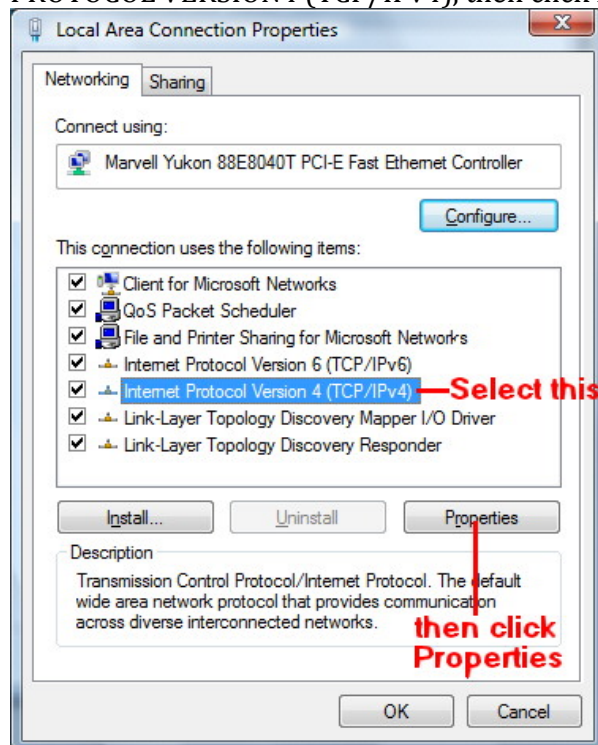
- No data recorded on CompactFlash:
 - a. Go to DATA LOGGERS AND COMMENTS page by clicking button 6 and ensure that you have either the ONE HOUR or ONE DAY LOG turned on.
 - b. Ensure that you have a CompactFlash card inserted correctly in the slot on the side of the HMI.
 - c. Ensure that the CompactFlash is either 512 Mbytes or if using 1 Gbytes then only use SanDisk make.
 - d. Never format the CompactFlash on the computer.
 - e. Ensure that there is sufficient space on the CompactFlash. If not, then delete some of the old files to make space for recording new files (you can this by connecting the CompactFlash to your computer).
- Unable to see REAM HMI on Computer: There are two possible ways to connect the HMI to Local Area Network:
 - a. If using the crossed Ethernet cable supplied by MEDCO, then follow these steps:
 - i. On your computer, click START > CONTROL PANEL > NETWORK AND SHARING CENTER
 - ii. On the popup window, click VIEW STATUS



- iii. On the Local Area Network Status window, click PROPERTIES

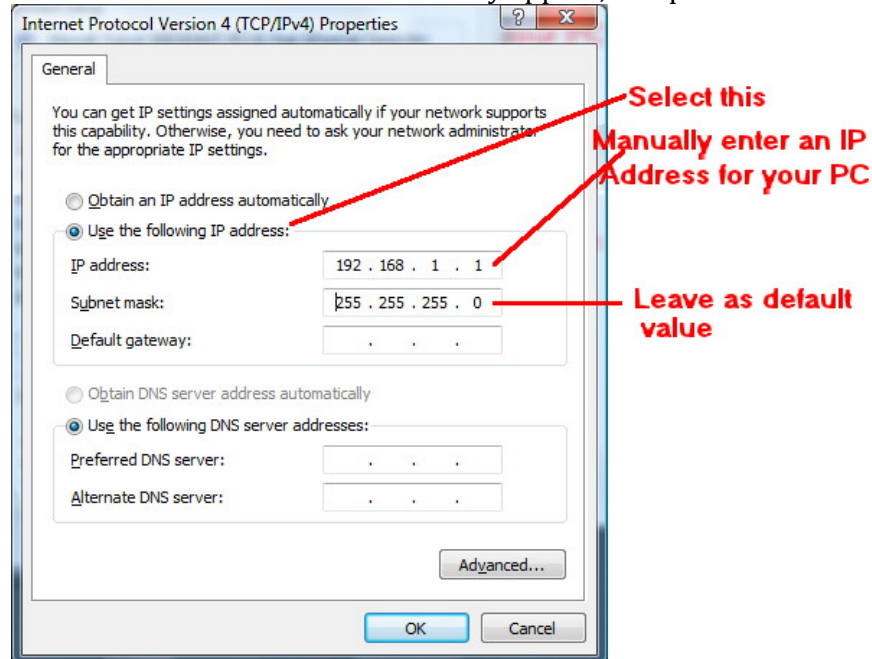


- iv. On the Local Area Network Properties window, select INTERNET PROTOCOL VERSION4 (TCP/IPv4), then click PROPERTIES



- v. On the Internet Protocol Version 4 (TCP/IPv4) Properties, select USE THE FOLLOWING IP ADDRESS, then enter the IP Address as 192.168.1.1, when you move to the SUBNET MASK, the default values

of 255.255.255.0 should automatically appear, accept these.



- vi. Click OK on all opened windows and they are all closed. Now, start your Internet Explorer and in the address bar enter the IP Address of the REAM HMI, 192.168.1.10.
- b. If using a router, then you should procure a straight Ethernet cable to connect the HMI to the router. Follow the same steps above, but in step (a.v.) select the option OBTAIN AN IP ADDRESS AUTOMATICALLY. You also need to ensure that the first three blocks of the HMI IP Address match those of the router, i.e. 192.168.1.xx.