PRIME WELL SERVICE INSTRUMENTATION

Data Management Hardware
Data Acquisition Hardware for Well Service Applications
Technical Specification V1.1 (03/23/2021)

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1   General Description

This document describes the technical parameters of the Data Management Hardware as well as the included service for installation and commissioning for each supplied system.

The GOES DMH X series is a data acquisition hardware system for the reading of industrial sensor data and forwarding of this data to a notebook or similar devices via an Ethernet or WiFi connection. For applications were basic functionality like digital visualization is sufficient or wanted, embedded screens are available. The DMH is built for indoor- and outdoor-usage in rough environments as found in oilfields, also under extreme temperature conditions.

The DMH is a hardware system, also called sensor junction box that converts the electrical signals from sensors to numeric values. Depending on the desired application, the suitable model is chosen. GOES can provide suitcase versions as well as systems for permanent installation. The system can be equipped with cold- or hot-weather packages on demand. A variety of connections and also the usage of intrinsic safe sensors in Ex-zones is available. The system also provides digital relay outputs for the signalization to additional systems like alarm notification or overpressure shutdown. As an option, touch panels in different sizes are available. The DMH X series is based on an industrial Siemens PLC, this way long-term spare parts availability is ensured and GOES is able to modify the standard system in case of special requirements (screens, protocols, controls functions, …). Also complete systems with displays for use in Ex-zones are available.

Figure 1: GOES Data Acquisition System with DMS and DMH

GOES offers a wide range of input- and output channel configurations. This means that the most suitable and price efficient configuration for each application can be chosen. The DMH system is suitable and field tested for following applications:

- Hydraulic Fracturing
- Coiled Tubing
- Acidizing
- Cementing
- Gravel Packing
- General Purpose Pumping
- Workover Rigs
- Heating
- Pump Down
- Heating Jobs

- De-Paraffining
- Wireline

This variety of already served applications shows that the DMH system can be also used for a lot of other applications.

In case multiple units are working on site in conjunction, the data can be shared via wired or wireless connection between the units and it can be shown in any of the connected DMS instances. This way, data from various units can be collected and processed on a central point.


Figure 2: Symbolic connection between pressure sensor and DMH

GOES provides a free of charge configuration software (DMH Config Tool) for configuration of the DMH system.

2 Analog Inputs

Analog inputs are used to read continuous signals like pressures, temperatures, level, densities and others. In some applications, also pump rates are transmitted via analog signal. Since the DMH system translates the analog signal into a numeric value and saves it internally or forwards it to another system or software, any kind of analog sensor can be connected. The DMH is capable of reading active (4-wire) and passive (2-wire) analog sensors. Analog inputs can be found in any application within the Well Service business. The relation between signal and value is configured by offset and gain.

The standard input signal is an electrical current of 4-20 mA but also voltage or resistive inputs are available on demand.
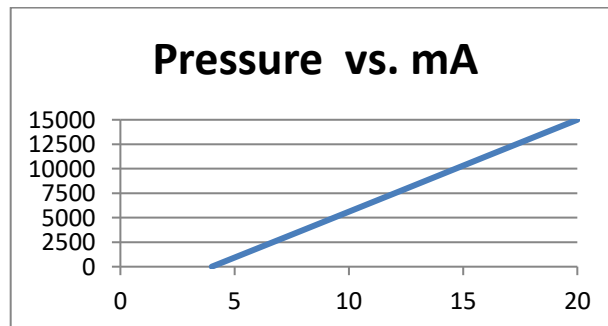
Figure 3: Example relation between analog signal and pressure for a 15k hammer union sensor

3 Pulse / Frequency Inputs

Pulse signals are typically used for reading some kind of speed signal. This signal is most often used for reading a pump flow rate from a pump drive shaft with a magnetic pick-up or proximity switch sensor. The higher the frequency of the pulses, the higher the volume flow rate. Zero frequency refers to 0 flow rate. The relation between frequency and physical size is set by a k-factor.

Every frequency and every encoder input channel is equipped with an especially for Well Service applications designed signal conditioning circuit. This circuit forms a rectangular pulse of 24 V heights, to be read by the industrial PLC. This circuit fits for reading proximity switches, amplified pickups and non-amplified pickups as well as encoders and similar sensors. The minimum input threshold can be set below 10 mV to make the DMH compatible to high pressure turbines with non-amplified pickups.

4 Quadrature Encoder

Quadrature encoders are sometimes also called AB-encoders or similar. The purpose is to read a speed signal as well as the direction of the physical dimension. The most typical application for this sensor is to read depth and speed of a Coiled Tubing or Wireline string. Encoder channels are equipped with the same signal conditioning module as pulse / frequency inputs.
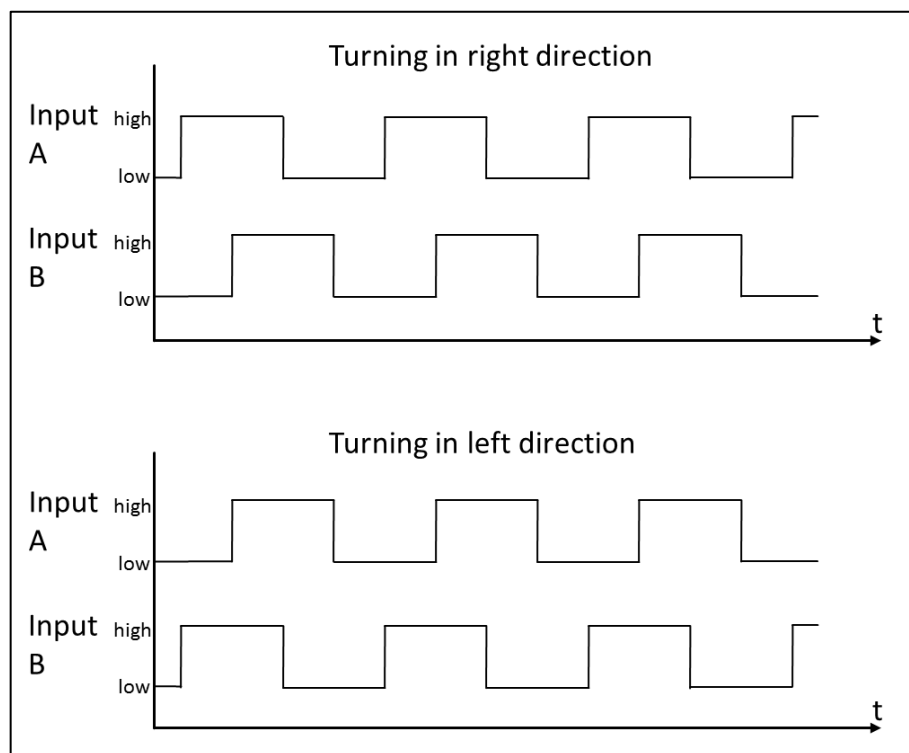

Figure 4: Encoder signal for different directions

5 Intrinsic safe inputs

Inputs that are labelled in blue with "(IS)" or "Ex-i" are equipped with a safety barrier for intrinsic safe circuits for the usage in an Ex-zone. Intrinsic safe sensors are used in the same way as standard sensors. The

difference to standard sensors consists of a certified safety barrier inside the box. The safety barrier ensures that even in a fault condition, no sparks and no excessive heat are created that would ignite flammable gases. These channels are typically used for wellhead sensors.

In IS-circuits, the voltage for supplying the sensor can be reduced and the maximum power is limited to ensure the safe operation.

6 Relay Outputs

The DMH system can be equipped with a variable number of relay outputs. These digital outputs provide an isolated normally open as well as normally close switching contact for any purpose. The usual application for these contacts, is to realize an overpressure kick-out for Well Service pumps or an emergency injector shutoff system for Coiled Tubing. These contacts can also be used for activation of any other device like notification lamps or horns and others. The relay contact can be set to engage or disengage if an user settable switching point for a user defined sensor channel is exceeded or undershot.
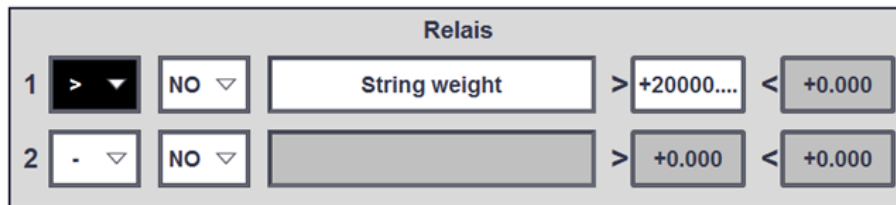

Figure 5: Relay settings in the DMH Touch Screen

7 Real-Time Data Output Stream

The DMH sends out real-time data via a standard Ethernet connection using TCP/IP. For this purpose, the DMH acts as a TCP-server and waits for incoming connections.

On port 2000, 2001 and 2004, the DMH reads and sends data in the proprietary and binary DMH protocol. This protocol is very efficient and it gives also the ability for configuring the DMH.

On port 2002 and 2003 DMH sends out unencrypted TCP-ASCII-data that can be read by any compatible device. It can be read on any standard computer by using a TCP/IP terminal program.

The data stream on port 2002 and 2003 with n channels is built as shown in the following:

HH:MM:SS;[Value 1]; [Value 2]; [Value 3]; [Value 4]; … [Value n-1]; [Value n];CRLF

HH:MM:SS	Timestamp in 24h format
[Value 1]	Floatingpoint Value
…	
[Value n]	Last floatingpoint Value
CR	Carriage Return

LF	Line Feed

As separator, there is always used a ";". For setting the order of these channels, refer to the GOES DMS software manual in the section DMH Config Tool.
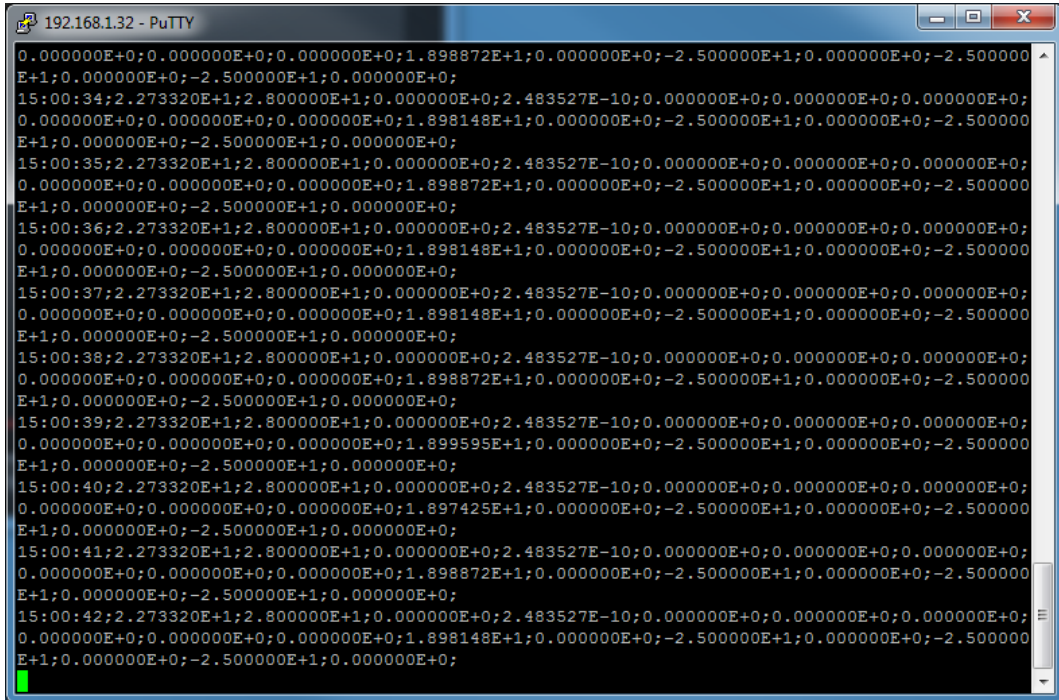

Figure 6: Example ASCII stream data output with 18 channels in terminal program

8 DMH Outdoor Touch Display

The optional DMH Touch Display offers a simple way for visualization of a user chose able set of values as well as easy access for frequently used functions as offset calibration, setting relay switch points and others.

The Touch Screen offers internal data logging and export to USB data sticks. The data storage format can be customized to match different countries number nomenclature for CSV files for easy import to different MS Excel versions and other software. The operator can decide to create files with dot or comma as decimal point and comma, semicolon or tab as separator between values.

The 7" display is waterproof and daylight readable for outside use.

Figure 7: DMH Outdoor Touch Display

The names and physical dimensions of any data channel can be chosen free by setting these parameters with the DMH Config Tool. The following example pictures show typical channel naming for a CTU.
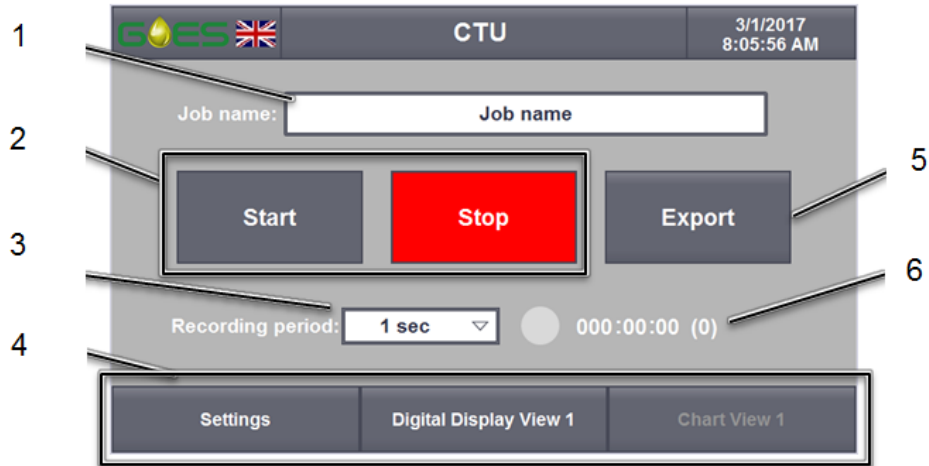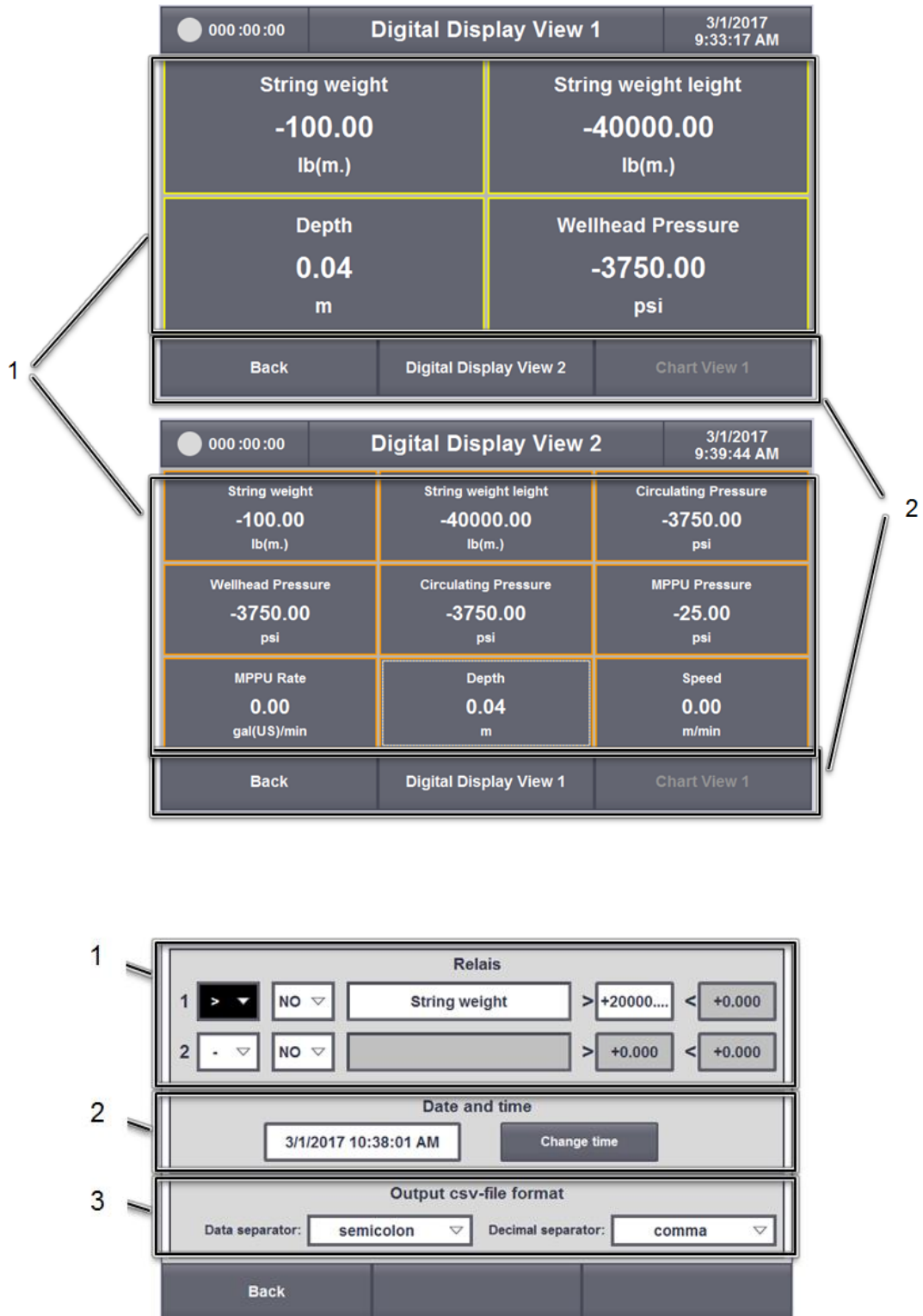
Figure 8: DMH Touch Display example screens

9 Identification

DMH is available in a wide range of configurations. This section describes the naming convention.

Portable	Series	Channel config	Dash	Connector style	Blank	Additional parameters
P	X	10	-	A		

Portable:

P = Portable suitcase

Blank = Stainless steel enclosure for permanent mounting

Series:

X = Current DMH series

Input channel config:

6 = 4 Analog, 2 Frequency

8 = 4 Analog, 4 Frequency

10 = 8 Analog, 2 Frequency

12 = 8 Analog, 4 Frequency

20 = 8 Analog, 4 Frequency, 2 Encoder (suitable for Coiled Tubing or similar applications)

Custom configurations are available upon request.

Dash:

Always a dash

Connector style:

A = MIL-Spec

B = Cable glands for permanent installation

C = Industrial rectangular connectors, "Harting connectors"

Blank:

Always blank

Additional parameters

Mostly used for custom solutions

10 Incorporated materials, brands and standards

The provided system will be made of industrial standard products and materials that meet the harsh environment found in oilfields and also under hot desert condition.

The system will be encapsulated IP 65 to prevent ingress of sand and dust bust also splash water.

The control system is designed to meet the European CE conformity. GOES as a European manufacturer has to follow this conformity for every locally supplied unit and earned a broad knowledge about this international recognized high quality regulation and the related standards. This ensures a safe and reliable operation according to European standards.

The incorporated PLC/touch monitor system is an industrial standard product from Siemens.

11 Technical Data

IO configuration:	<u>X6</u>
	4 Analog, 2 Pulse/Frequency, 2 Relay, 1 Ethernet
	<u>X8</u>
	4 Analog, 4 Pulse/Frequency, 1 Ethernet
	<u>X10</u>
	8 Analog(two of these Ex-i), 2 Pulse/Frequency, 2 Relay,
	1Ethernet
	<u>X12</u>
	8 Analog, 4 Pulse/Frequency, 2 Relay, 1 Ethernet, 1 Display
	<u>X20</u>
	8 Analog, 4 Pulse/Frequency, 2 Encoder, 2 Relay,
	1 Ethernet
Power supply standard:	11..29 VDC / 2.0..1.0 A / 24 W
Power supply with "Hot Weather Package":	22..26VDC
Ingress protection non portable ss box:	IP 65 / Nema4X when all connectors are connectors or closed correctly
Ingress protection portable/pelican style:	IP 54 / Nema3 when all connectors are connectors or closed correctly
Electrical component rating:	-20 °C..60 °C / 0 °F..140 °F (standard)

Analog input:	4-20 mA (shortcut proof up to power supply)
	12 bit / 16 bit resolution
Frequency input:	0..3 kHz / 10 mV..36 V rectangular or sinus / Ri = 10 kΩ
Encoder input:	0..3 kHz / 10 mV..36 V rectangular or sinus / Ri = 10 kΩ
Relay output:	24 V / 2 A
Sensor supply output:	24 V / max 2 A for all channels together
Open data output:	ASCII over TCP
Proprietary data output:	Binary DMH proprietary protocol
Dimensions:	DMH X6 (stainless steel wall mount)
	300 mm x 410 mm x 150 mm (W x H x D, Standard)
	12 ” x 16 ” x 6 ” (W x H x D, Standard)
	DMH PX8 (portable / pelican style)
	460 mm x 360 mm x 185 mm (W x H x D, Standard)
	18.1 ” x 14.2 ” x 7.3 ” (W x H x D, Standard)
	DMH X10 (stainless steel wall mount)
	300 mm x 410 mm x 150 mm (W x H x D, Standard)
	12 ” x 16 ” x 6 ” (W x H x D, Standard)
	DMH X12 (stainless steel wall mount)
	400 mm x 410 mm x 200 mm (W x H x D, Standard)
	16 ” x 16 ” x 6 ” (W x H x D, Standard)
	DMH PX12 (portable / pelican style)
	620 mm x 425 mm x 310 mm (W x H x D, Standard)
	24.5 ” x 17 ” x 12 ” (W x H x D, Standard)
	X20-A (stainless steel wall mount)
	400 mm x 410 mm x 200 mm (W x H x D, Standard)
	16 ” x 16 ” x 8 ” (W x H x D, Standard)
	X20-C (stainless steel wall mount)
	500 mm x 510 mm x 210 mm (W x H x D, Standard)

20 ” x 20 ” x 8.3 ” (W x H x D, Standard)

<u>Custom</u>

As per customers specification or applications needs.

12 Scope of supply

Data Acquisition hardware DMH as per this document.