

Document number: 72.120.601

Document title: FGM 160 Operating Instructions

Scope:	ISO 9001:2015 §8.6 Release of products and services
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Additional Information (when applicable):

**Due to Inmetro certification requirements any update to this document must be followed by Portuguese translation and update of document 72.120.613.**

<b>G</b>	2020.12.17	Updated dual-path terminology	SPA	ST	-	KO	ST
F	2019.03.15	Updated to include FGM 260 System	NB	MW	ST	MM	MM
E	2018.09.17	Updated Abbreviations and removed O&SC	AK	NB	MR	MM	MB
D	2014.01.20	Proofread and updated	JB	AP	CT	MB	MW
C	2013.01.30	Removed from User Manual, updated: changes in text formatting; modifying graphics in Appendix II and Electronic modules	MKJ	KH	-	MW	MW
B	2009.06.02	Updated information	AAJ	RT	N/A	N/A	AAJ
A	2007.11.30	Issued for Fluenta release; moved to User Manual	MS	RT	-	N/A	AAJ
Rev. index	Issue date	Reason for issue	Author	Review	Review	Review by QA	Approved
Replacement for:	<b>n/a</b>					Total pages: <b>28</b>	
Fluenta source doc. (for translations):	<b>n/a</b>						

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## 1. PURPOSE

This document describes the Fluenta Flow Computer, FGM 160, hardware and software, and includes instructions for operating the device.

The FGM 160 flow computer can be used in a flare gas meter system which employs 1 pair of ultrasonic sensors (the FGM 160 Flare Gas Meter), or in a flare gas meter system which employs 2 pairs of ultrasonic sensors (the FGM 160 dual-path configuration).

## 2. ABBREVIATIONS/DEFINITIONS

### 2.1 Abbreviations

FGM	Flare Gas Meter
TFS	Transducer Full Size
DCS	Distributed Control System

### 2.2 Definitions

FGM 160	Fluenta FGM 160 flow computer
FGM 160 System	Fluenta FGM 160 flare gas meter (single pair of sensors)
FGM 160 Dual-Path Configuration	Fluenta FGM 160 flare gas meter (two pairs of sensors)
TFS Series	Ultrasonic sensors based on the TFS. See document 72.050.001 for details on this range
Transducer	The term 'Transducer' is used interchangeably with 'Sensor' in the context of the FGM160.

## 3. GENERAL INFORMATION

### 3.1 Hardware Description

The FGM 160 flow computer, illustrated in figure 1, is designed as a distributed system. The FGM 160 consists of five or six modules, the Digital Signal Processing (DSP) module, the Analog Front End (AFE) module, the Pressure & Temperature (P&T) module, Input/Output (I/O) module, Intrinsic Safe Barrier (IS Barrier) module, Surge Protection module and the Local Display. A distributed system gives several advantages. This design will be more flexible with respect to future expansions and modifications, as the total processing load for the system can be divided in several modules. Thus, the danger of overloading a single CPU unit is reduced.



Figure 1: FGM 160 Flow Computer.

The FGM 160 is certified for operation in a Hazardous Area.

For detailed information regarding Hazardous Area installation and operation, please refer to Fluenta Doc. no. 62.120.006 (Hazardous Area Installation Guidelines [1]) and 75.120.215 (FGM 160 Hazardous Area Certificates [2]).

The FGM 160 flow computer is designed for use in flow measurement systems that employ 1 pair of ultrasonic sensors (a single path system) or two pairs of ultrasonic sensor a (a dual-path configuration). Simplified diagrams of the two configurations are shown in figure 2 and 3, respectively.

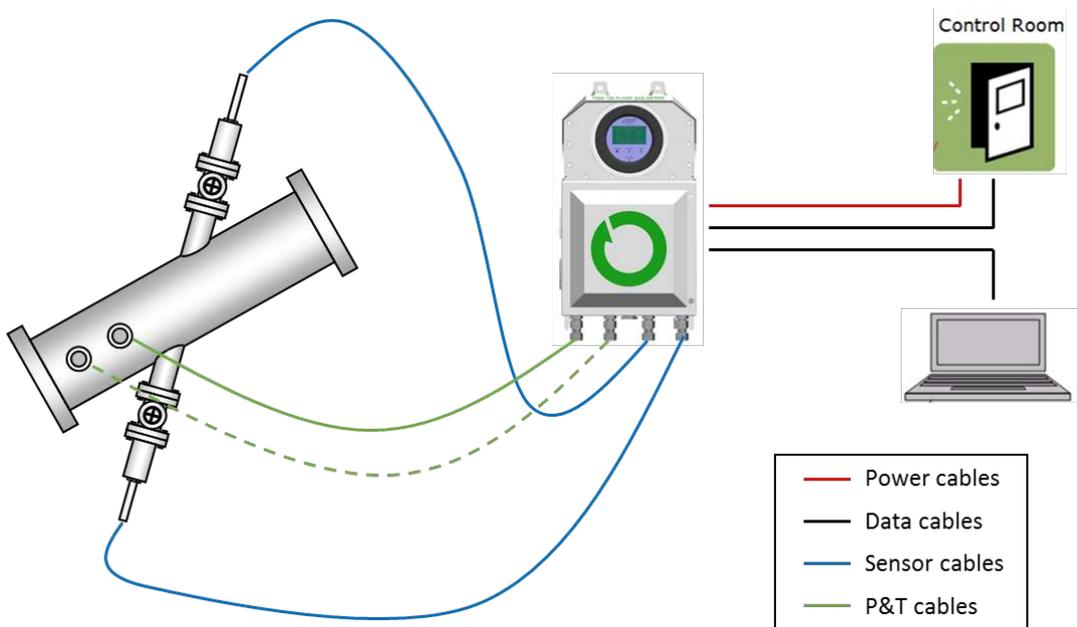


Figure 2: FGM 160 Flare Gas Meter – hook-up diagram.

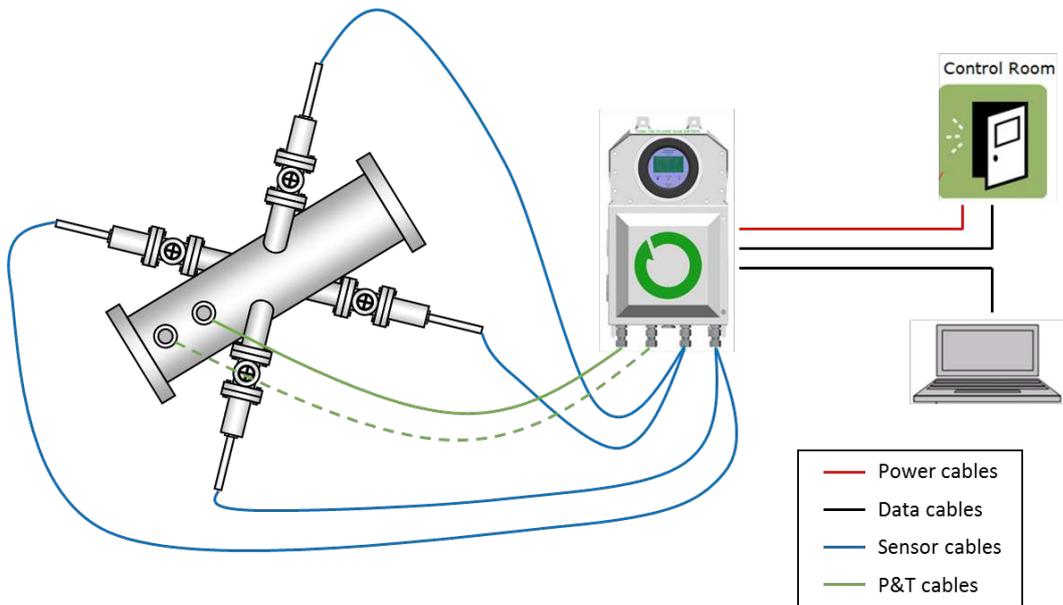


Figure 3: FGM 160 Flare Gas Meter in dual-path configuration – hook-up diagram.

### 3.1.1 Electrical Connections

For detailed information regarding all electrical connections, please refer to Installation & Hook-Up Instructions [3].

### 3.1.2 Power Supply

The FGM 160 flow computer requires 24 Vdc power supply (nominal). If 24 Vdc is not available, an optional 110-230 Vac/24 Vdc converter can be supplied by Fluenta.

For detailed equipment information and equipment ratings, please refer to Hazardous Area Installation Guidelines [1].

### 3.1.3 Input Signals

#### 3.1.3.1 Ultrasonic Transducers

FGM 160 ultrasonic transducers are connected to the FGM 160 flow computer by means of prefabricated signal cables included.

#### 3.1.3.2 Pressure and Temperature Transmitters

The FGM 160 flow computer can be configured to accept analog 4-20 mA transmitters or HART compatible transmitters. The pressure and temperature transmitters may be omitted if the system is configured to get the pressure and temperature data from the DCS system (Modbus communication link).

## 3.1.4 Output Signals

### 3.1.4.1 Modbus Communication (RS-485)

The FGM 160 flow computer has two separate Modbus communication ports. One is dedicated for communication with a DCS system. The second is a service port for configuration and monitoring of the FGM 160 system. In the FGM 160 Foundation Fieldbus configuration, DCS Output is disabled.

### 3.1.4.2 Foundation Fieldbus Output

A maximum of four (4) parameters can be predefined according to customer requirements. The list of parameters available for the customer can be found in Fluent AS doc. No. 72.120.305 (all parameters available by using Modbus Serial Interface are accessible using Foundation Fieldbus output).

### 3.1.4.3 Current Loop Outputs

Up to six (6) current loop outputs are available for output of selectable parameter values, where three (3) analog outputs are configured as the default. The 4-20 mA current loop output channels can be configured as active or passive outputs. 4-20 mA Outputs are replaced by FF Outputs in FGM 160 Foundation Fieldbus Configuration.

### 3.1.4.4 HART Output

One of the current loop outputs can be also configured for HART output communication. Refer to HART Output Interface Specification [5] for details.

### 3.1.4.5 Pulse/Frequency Output

The FGM 160 flow computer can be also configured to provide a pulse or frequency output signal. The pulse output will represent an incrementation of the totalizer (of e.g. volume or mass), whereas the frequency output will represent a process parameter (e.g. volume flow rate, mass flow rate etc.)

## 3.1.5 Electronic Modules in FGM 160 Flow Computer

### 3.1.5.1 Digital Signal Processing (DSP) Module

The Digital Signal Processing module is the processing module in the system. The DSP Module generates the ultrasound measurement signals and controls the measurement sequences. It collects data from the other module registers and performs flow calculations based on this data. All calculated parameters are stored in defined registers. All of these registers are available for UFM Manager software through the Modbus service port at the I/O Module. A selection of these registers is also available for the DCS system (through the DCS port at the I/O Module).

### 3.1.5.2 Analog Front End (AFE) Module

The Analog Front End Module is the interface between the DSP Module and the ultrasonic transducers via the IS-Barrier unit. At the AFE Module, measurement signals are multiplexed and switched between upstream and downstream direction.

### 3.1.5.3 Pressure & Temperature (P&T) Module

The Pressure & Temperature Module collects pressure and temperature information from external sensors via 4-20 mA current loop or HART Interface. All pressure and temperature data are stored in predefined registers available for the DSP Module. Accordingly, the DSP unit can retrieve P&T parameters in a minimum amount of time.

### 3.1.5.4 Input/Output (I/O) Module

The Input/Output Module is the interface between the FGM 160 flow computer in hazardous areas and equipment in safe areas. At the I/O Module, 24 VDC (nom.) supply voltage is converted to the required operational voltages for the other modules. Furthermore, all signals and communications to and from the DCS system and UFM Manager are handled by this unit.

### 3.1.5.5 Intrinsic Safety Barrier (IS Barrier) Module

The Intrinsic Safety Barrier Module ensures the intrinsic safety for operation of the ultrasonic sensors mounted in hazardous area. In addition, the IS-Barrier Module includes safety barriers for the P&T transmitters. Therefore, the P&T transmitters with "Ex i" certification can be interfaced directly to the FGM 160. For specifications regarding the P&T transmitter barriers, please refer to Hazardous Area Installation Guidelines [1].

### 3.1.5.6 Surge Protection Module

The Surge protection Module protects the power input and the signal output lines from externally generated spikes, surges and overvoltage.

### 3.1.5.7 Local Display Module

The Local Display (LD) Module is the front unit, visible through the Ex-d safety glass. At the LD, a set of predefined metering process parameters can be viewed. In addition, four LEDs give the status of Power, Alarms, Measurement and Communication.

### 3.1.6 Non-Resettable Counter Function

The non-resettable counter function will record and keep the totaled volume and mass. The totaled values are accessible through the DCS Modbus interface or through UFM Manager.



Figure 4: FGM 160 flow computer electronic modules.

## 3.2 Firmware Description

In the following sections a general description of the firmware for the different modules is outlined.

### 3.2.1 DSP Module

- The DSP Module initializes the system at start-up. Tasks are set to initial states and the system is ready for operation.
- The signals transmitted by the ultrasound transducers are generated by the DSP Module. The sequencing is controlled by this module, and, depending on the velocity of the medium in the pipe, either both Chirp and CW signals or just Chirp signals are used for the flow measurements. One ultrasonic transit time measurement is always succeeded by an ultrasonic transit time measurement in the opposite direction.
- Data sampling and signal processing are carried out after a specified number of sequences. Then, the DSP module calculates the difference in transit time measurements and calculates the parameters available in the FGM system.
- Flow velocity and volume flow rate calculations run continuously, calculating new values based on data from the P&T module and transit time measurements from the ultrasonic transducers.
- Gas density and mass flow calculations are calculated based on calculated velocity of sound and measured pressure and temperature.
- Volume and mass totalizing calculations are continuously updated based on volumetric and mass flow rate calculations.
- All system configuration parameters are stored in the Flash memory (non-volatile memory) at the DSP Module.

- The DSP Module carries out self-checking and evaluation of input and calculated parameters.

### 3.2.2 P&T Module

- The P&T Module continuously collects pressure and temperature values from the external pressure and temperature transmitters mounted downstream of the FGM 160 flow computer. These readings are used in calculations performed by the DSP module.
- In addition to the external temperature reading, the P&T also reads the internal temperature value. This value is used to monitor the internal temperature in the Ex-d enclosure.

### 3.2.3 I/O Module

- The I/O Module handles all signals and communication with systems in Safe Area.
- Data requests and commands from UFM Manager are processed by the I/O Module. A predefined number of accessible parameters are available from the FGM. Accessible parameters depend on whether 4-20 mA, HART or Modbus is utilized.
- Software downloads to the DSP-, P&T- and I/O Module are carried out by the I/O-module.
- All data requests from DCS system are handled by the I/O Module; either through Modbus or HART interfaces.

## 3.3 Device Integrity

### 3.3.1 Self-Checking

The FGM 160 flow computer performs a self-checking sequence, where it checks that inputs from the transducers and Temperature and Pressure transmitters are within a valid range, and that other functions are operating as intended.

### 3.3.2 Watchdog Timer

The Watchdog Timer is initialized at start-up, and cannot be disabled, ensuring that in the unlikely situation of system hang-up occurring, the Watchdog Timer will reset the system forcing a complete reboot and start-up.

### 3.3.3 Flash Memory

System configuration is stored in Flash Memory (non-volatile memory). In case of a power break, all system configurations are reloaded from the Flash memory

## 3.4 Configuration and Operating Software

Via the Ultrasonic Flare Meter Manager software (UFM Manager), the operator can monitor process data, configure the meter and specify process data to be saved to a data log file for later analysis. UFM Manager further enables the operator to operate the meter remotely, by using e.g. a RS 485/TCP/IP converter and remote-control software.

It should be noted, UFM Manager is required to replace the default settings with actual applicable settings provided by customer. Fluenta service engineers and partners will always

set up the FGM 160 system according to the latest submitted parameters from the Client during installation and commissioning. Fluenta service engineers and partners always have the UFM Manager with them.

## 4. OPERATING PROCEDURE

### 4.1 Introduction

This section provides information about how to operate the FGM 160 flow computer. The FGM 160 flow computer does not require any safe area communication device in order to operate. However, in order to continuously monitor data and the meter performance, it is recommended to use the UFM Manager software package. This program will provide hands-on process and status data continuously with possible remote access to the FGM 160 flow computer from any remote system with the appropriate remote-control software installed.

### 4.2 Power-Up Sequence

The power-up sequence describes the necessary handling of the FGM 160 flow computer in order to ensure correct operation. The power-up sequence is as follows:

1. Connect all power, input and output signals and communication cables according to the project specification and all relevant procedures and instructions.
2. Make sure that the power cable is connected to a suitable power source, either directly to a 24 Vdc supply or through a 110-240 Vac/24 Vdc converter.
3. Turn on the power to the FGM 160 flow computer. There is no power switch on the FGM 160 flow computer, so the power must be switched by an external switch or similar, preferably in safe area.
4. On startup, the FGM 160 will go through a boot and an initialization sequence before entering the standard operational (measurement) mode.
5. When the FGM 160 has entered the standard operational (measurement) mode, the meter will, according to the system configuration, carry out transit time measurements, retrieve pressure and temperature data, calculate volumetric and mass flow rates and either actively output a set of predefined parameters at the analog 4-20mA outputs, or make a set of process parameters available for DCS HART or Modbus communication.

### 4.3 Flow Computer Configuration

The FGM 160 flow computer can be configured by using UFM Manager. During manufacturing, default configuration is entered into the flow computer. The system configuration will be modified by Fluenta service engineers or partners when installing and commissioning the meter. This configuration can be changed at any time by using The UFM Manager software. All system configuration parameters are stored in a non-volatile memory, ensuring that no configuration parameters are lost in case of power loss. Appendix II explains how to insert or modify system configuration according to a Client parameter list.

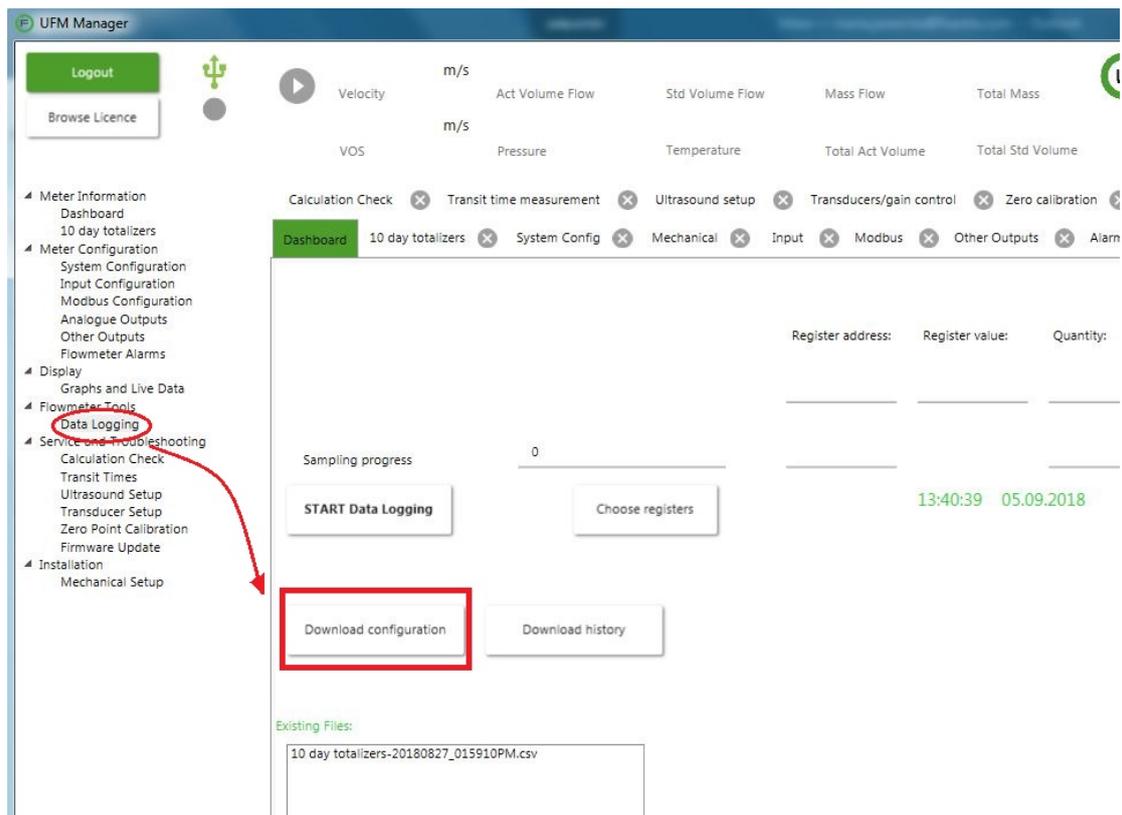


Figure 5: Download of system configuration using the UFM Manager.

The system configuration parameter file can be downloaded from the FGM 160 flow computer using the UFM Manager (figure 4) by pressing the “Download configuration” button in the “Data Logging” tab. The system configuration can either be copied to the clipboard and pasted into a document or saved directly to a file.

For a full listing of a system configuration file, refer to Appendix I.

Some of the system configuration parameters are also available through the DCS Modbus registers. However, parameters that should only be accessed by authorized personnel are not accessible through this communication line. For a full listing of accessible configuration parameters through the DCS Modbus interface, refer to DCS Modbus Interface Specifications [4].

#### 4.4 Local Display Functions

The FGM 160 flow computer is equipped with a local LCD display mounted at the front, and visible through the Ex-d safety glass. The display shows predefined process parameters from the FGM 160. Further, 4 status LEDs are visible at the front for the following status information:

- **Power**  
This LED will have a green light when the system power is ON.
- **Status**  
This LED will light:  
GREEN; if no Alarms are active (system status OK).

- **Comm**  
This LED will light:  
GREEN; during Modbus frame reception or sending.
- **Meas**  
This LED will blink GREEN at a regular cycle, indicating that ultrasonic measurement cycle sequence is active.

## 4.5 Error Check and Troubleshooting

The operator should not perform extensive troubleshooting beyond the scope that is described in this section. For repair and module replacement, contact Fluenta AS.

Fluenta AS  
Haraldsgate 90  
P.O. Box 420  
N-5501 Haugesund  
NORWAY

Phone: +47 21 02 19 27  
E-mail: [support@fluenta.com](mailto:support@fluenta.com)

### **NOTE!**

**Before any work can be carried out with the FGM 160 flow computer, a hot work permit must be obtained.**

**Do not connect or disconnect any signal wires unless the power is turned OFF!**

**Do not open the Ex-d enclosure containing the field electronics in hazardous area, without making sure first that the conditions permit such action. Preferably, and as a general rule; the Ex-d enclosure should only be opened indoors in e.g. a workshop in safe area.**

### 4.5.1 Error Check with Local Display

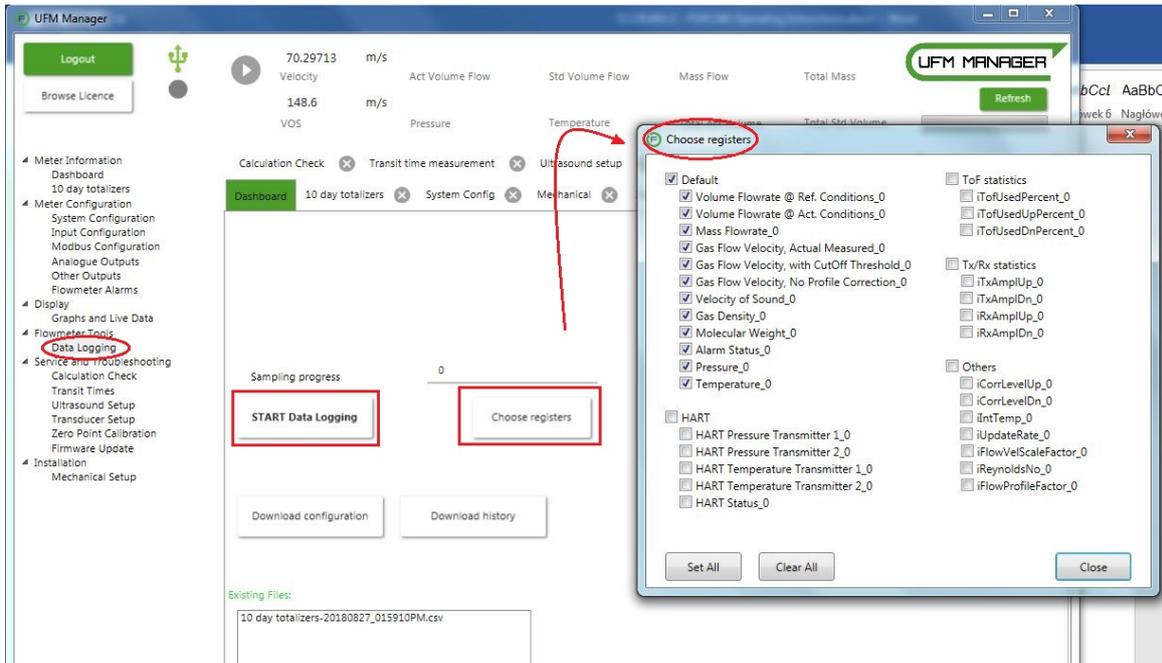
As described in Section 4.4, Four (4) LEDs are visible at the front with status information. If one or more of these LEDs do not have a GREEN light color indicating OK status, the following status is present, and actions should be taken:

- **Power**  
Indication: The LED is not ON (no green light).  
Status: System Power is OFF, or LED does not work.  
Action: Check that the system Power wires are connected and that 24 VDC is present at the power input terminals.
- **Meas**  
Indication: The LED is steady OFF or steady GREEN.  
Status: The FGM 160 is not in standard operational (measurement) mode.

**Action:** Check the Alarm log for any error messages indicating any cause for the problem. Turn the system Power OFF and ON again. If the situation remains unchanged, contact Fluenta AS for guidance.

### 4.5.2 Error Check with UFM Manager

Via the UFM Manager, data can be logged for trend analysis and evaluation.



**Figure 6:** By pressing the “START Data Logging” button at the “Data Logging” tab, any or most parameters can be logged to a data file. The data log file name will be generated automatically based on the current date and time. The registers for the data log can be chosen by pressing the “Choose registers” button.

## 5. REFERENCES

- [1] FGM 160 – Hazardous Area Installation Guidelines
- [2] FGM 160 – Hazardous Area Certificates
- [3] FGM 160 – Installation & Hook-Up Instructions
- [4] FGM 160 – DCS Modbus Interface Specifications
- [5] FGM 160 – HART Output Interface Specification



HART Output Communication: Enabled  
 Poll address: 1  
 Primary Variable: Total Volume @ Ref. Conditions  
 Secondary Variable: Volume Flowrate @ Ref. Conditions  
 Tertiary Variable: Temperature  
 Quaternary Variable: Pressure

\*\*\*\*\* Service port \*\*\*\*\*

-----  
 Slave address: 1  
 Type: RTU  
 Baud rate: 38400  
 Data bits: 8  
 Parity: None  
 Stop bits: 2  
 Register Values: 32 bit floating point (IEEE-754)

\*\*\*\*\*  
 \*\*\*\*\* System Configuration \*\*\*\*\*  
 \*\*\*\*\*

Pipe diameter: 0.3800 m  
 Transducer distance (M): 0.5370 m  
 Transducer angle: 45.0 deg



\*\*\*\*\* Units \*\*\*\*\*

Velocity: m/s  
 Volume: m3  
 Volume flow: m3/h (Cubic meter pr. hour)  
 Mass: kg  
 Mass flow: kg/h  
 Pressure: BarA  
 Temperature: Celsius

Log time for 24h acc. values:06:00:00

\*\*\*\*\*  
 \*\*\*\*\* Input Signal Parameters \*\*\*\*\*  
 \*\*\*\*\*

Pressure input Current Loop (4-20mA)  
 Temperature input Current Loop (4-20mA)  
 Current loop ranges  
     Temperature, 4mA value: 255.15 [Kelvin]  
     Temperature, 20mA value: 533.15 [Kelvin]  
     Pressure, 4mA value: 1.013 [BarA]  
     Pressure, 20mA value: 12.044 [BarA]

Current loop calibration coefficients  
     Temperature, offset: 0.0070



Temperature, scale: 0.9963  
 Pressure, offset: 0.0220  
 Pressure, scale: 0.9980

Alarm limits

Temperature, Hi limit: 533.15 [Kelvin]  
 Temperature, Lo limit: 255.15 [Kelvin]  
 Pressure, Hi limit: 12.044 [BarA]  
 Pressure, Lo limit: 1.013 [BarA]

\*\*\*\*\*  
 \*\*\*\*\* Output signal parameters \*\*\*\*\*  
 \*\*\*\*\*

\*\*\*\*\* Current loops, 4-20mA \*\*\*\*\*

Current loop 1, Parameter: Volume Flowrate @ Act. Conditions  
 Current loop 2, Parameter: Molecular Weight  
 Current loop 3, Parameter: Testvalue Current Loop 3  
 Current loop 4, Parameter: Testvalue Current Loop 4  
 Current loop 5, Parameter: Testvalue Current Loop 5  
 Current loop 6, Parameter: Testvalue Current Loop 6

Current loop ranges

Current loop 1, 4mA value: 0.00  
 Current loop 1, 20mA value: 2124000.00  
 Current loop 2, 4mA value: 0.00  
 Current loop 2, 20mA value: 50.00  
 Current loop 3, 4mA value: 4.00  
 Current loop 3, 20mA value: 20.00  
 Current loop 4, 4mA value: 4.00  
 Current loop 4, 20mA value: 20.00  
 Current loop 5, 4mA value: 4.00  
 Current loop 5, 20mA value: 20.00  
 Current loop 6, 4mA value: 4.00  
 Current loop 6, 20mA value: 20.00

Current loop calibration coefficients

Current loop 1, offset: -0.1217  
 Current loop 1, scale: 0.9980  
 Current loop 2, offset: -0.1647  
 Current loop 2, scale: 1.0045  
 Current loop 3, offset: -0.1633  
 Current loop 3, scale: 1.0018  
 Current loop 4, offset: -0.2105  
 Current loop 4, scale: 1.0025  
 Current loop 5, offset: -0.0232  
 Current loop 5, scale: 1.0078  
 Current loop 6, offset: -0.1358  
 Current loop 6, scale: 1.0058

\*\*\*\*\*  
 \*\*\*\*\* Measurement/Signal Parameters \*\*\*\*\*  
 \*\*\*\*\*

CW velocity limit up (CW/Chirp -> Chirp): 15 m/s  
 CW velocity limit down (Chirp -> CW/Chirp): 14 m/s  
 Chirp Pattern: LinFM  
 Chirp Limit1 (ArcTan FM -> Lin FM): 25 m/s  
 Chirp Limit2 ( Lin FM ->ArcTan FM): 50 m/s

Low cutoff velocity: 0.05 m/s  
 Max. velocity: 100 m/s  
 Min. velocity: 0 m/s  
 Max. velocity jump: 50 m/s

Max. sound velocity: 500 m/s  
 Min. sound velocity: 250 m/s  
 Max. sound velocity jump: 70 m/s

Historical sound vel. weight factor: 40.0

Z Standard: 1.000  
 Z Operational: 1.000  
 Ref Temperature (std. conditions): 15.00 °C  
 Ref Pressure (std. conditions): 1.01325 BarA

EXAMPLE

\*\*\*\*\*  
 \*\*\*\*\* Sensor Calibration Parameters \*\*\*\*\*  
 \*\*\*\*\*

Serial No., Upstream Transducer (A): 022U-11  
 Serial No., Downstream Transducer (B): 022D-11

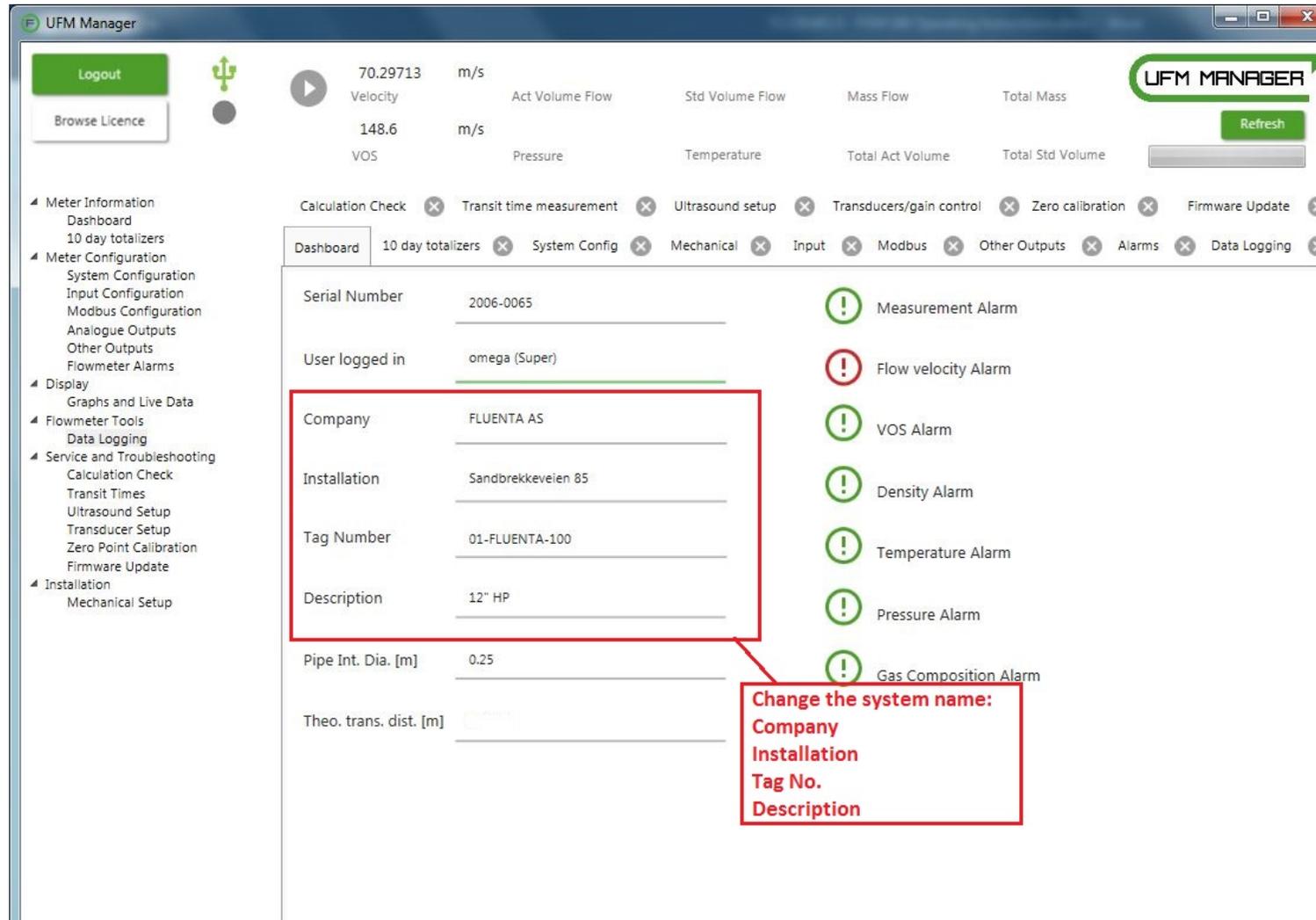
CW frequency: 68.00 kHz

\*\*\* Transducer delays (calibration coefficients) \*\*\*

Chirp upstream: 31818.0 nsec  
 Chirp downstream: 33318.0 nsec  
 CW upstream: 12557.0 nsec  
 CW downstream: 12576.0 nsec  
 Delta CW correction: 0.0 nsec

----- END -----

## 7. APPENDIX II – INSERTING SETTINGS FROM CLIENT PARAMETER LIST



The screenshot shows the UFM Manager software interface. On the left is a navigation menu with categories like Meter Information, Meter Configuration, Display, Flowmeter Tools, Service and Troubleshooting, and Installation. The main area displays various parameters such as Velocity (70.29713 m/s), VOS (148.6 m/s), and Pressure. Below these are several configuration tabs, including 'System Config', which is currently selected. The 'System Config' tab shows fields for Serial Number (2006-0065), User logged in (omega (Super)), Company (FLUENTA AS), Installation (Sandbrekkeveien 85), Tag Number (01-FLUENTA-100), Description (12" HP), Pipe Int. Dia. [m] (0.25), and Theo. trans. dist. [m]. To the right of these fields is a list of active alarms, each with a green exclamation mark icon: Measurement Alarm, Flow velocity Alarm, VOS Alarm, Density Alarm, Temperature Alarm, Pressure Alarm, and Gas Composition Alarm. A red box highlights the Company, Installation, Tag Number, and Description fields, with a callout box pointing to them that reads: "Change the system name: Company Installation Tag No. Description".

The screenshot displays the UFM Manager software interface. On the left is a navigation menu with categories like Meter Information, Meter Configuration, Display, Flowmeter Tools, Service and Troubleshooting, and Installation. The 'Modbus Configuration' option is circled in red. The main area shows a dashboard with various data points and a 'Modbus' configuration window. This window contains the following settings:

- Enable Modbus:
- Modbus mode: RTU
- Baud rate: [dropdown]
- Parity: no parity
- Register base address: [text input]
- Register size in request: 32 bit
- Byte ordering: DCBA
- Register spacing: 1
- Data/stop bits (auto): 7
- Termination:
- TX enable delay [ms]: [text input]
- DCS port slave address: 224

A red callout box on the right side of the Modbus configuration window contains the text: "Change MODBUS settings according to project specification."

**UFM Manager**

Logout | Browse Licence

Velocity | Act Volume Flow | Std Volume Flow | Mass Flow | Total Mass

VOS | Pressure | Temperature | Total Act Volume | Total Std Volume

Refresh

Dashboard | 10 day totalizers | **Mechanical** | Input | Modbus | Data Logging | Zero calibration | Firmware Update

Pipe internal diameter [m]	0.25
Ultrasonic path angle [deg]	ERROR
Theoretical transducer distance [m]	0.3535536
Measured transducer distance [m]	0.38

**Change values and settings according to project specification.**

- Meter Information
  - Dashboard
  - 10 day totalizers
- Meter Configuration
  - System Configuration
  - Input Configuration
  - Modbus Configuration
  - Analogue Outputs
  - Other Outputs
  - Flowmeter Alarms
- Display
  - Graphs and Live Data
- Flowmeter Tools
  - Data Logging
- Service and Troubleshooting
  - Calculation Check
  - Transit Times
  - Ultrasound Setup
  - Transducer Setup
  - Zero Point Calibration
  - Firmware Update
- Installation
  - Mechanical Setup**

**UFM Manager**

Logout | Browse Licence | UFM MANAGER | Refresh

Velocity | Act Volume Flow | Std Volume Flow | Mass Flow | Total Mass

VOS | Pressure | Temperature | Total Act Volume | Total Std Volume

Analog Out | Other Outputs | Data Logging | Zero calibration | Firmware Update

Dashboard | 10 day totalizers | System Config | Mechanical | Input | Modbus

Serial Number: 2006-0065

Instrument Time: \_\_\_\_\_

PC Time: \_\_\_\_\_

24h Accumulation reset time: \_\_\_\_\_

Synchronize time with PC

Velocity unit setup: m/s

Volume unit setup: m<sup>3</sup>

Volume flow unit setup: m<sup>3</sup>/h

Mass unit setup: kg

Mass flow unit setup: kg/h

Pressure unit setup: BarA

Temperature unit setup: ° Celsius

Calculation parameters:

Flow velocity threshold [m/s]: \_\_\_\_\_

STD Temperature [C]: \_\_\_\_\_

STD Pressure [barA]: \_\_\_\_\_

Viscosity: \_\_\_\_\_

Upload configuration file

**Change units according to project specification.**

UFM Manager

Logout | Browse Licence

UFM MANAGER | Refresh

Velocity | Act Volume Flow | Std Volume Flow | Mass Flow | Total Mass

VOS | Pressure | Temperature | Total Act Volume | Total Std Volume

Dashboard | 10 day totalizers | System Config | Mechanical | Input | Modbus

Analog Out | Other Outputs | Data Logging | Zero calibration | Firmware Update

Meter Information  
 Dashboard  
 10 day totalizers  
 Meter Configuration  
 System Configuration  
 Input Configuration  
 Modbus Configuration  
 Analogue Outputs  
 Other Outputs  
 Flowmeter Alarms  
 Display  
 Graphs and Live Data  
 Flowmeter Tools  
 Data Logging  
 Service and Troubleshooting  
 Calculation Check  
 Transit Times  
 Ultrasound Setup  
 Transducer Setup  
 Zero Point Calibration  
 Firmware Update  
 Installation  
 Mechanical Setup

Pulse/Freq1 mode: Pulse | variable: Test val | polarity: Active H  
 Pulse/Freq2 mode: Pulse | variable: Standar | polarity: Active H  
 Frequency scale: | Frequency offset: | Range scale: | Range offset: | Test value:  
 Pulse/Freq1 setup: 1 | 0 | 1 | 0 |  
 Pulse/Freq2 setup: 1 | 0 | 1 | 0 |  
 Enable Pulse/Frequency: Output 1:  Output 2:   
 Enable HART:  Poll adr: 1  
 HART variables: Gas Flov | Volume | Temper: | Pressure |

**Change values and settings according to project specification.**

UFM Manager

Logout | Browse Licence | UFM MANAGER | Refresh

Velocity | Act Volume Flow | Std Volume Flow | Mass Flow | Total Mass

VOS | Pressure | Temperature | Total Act Volume | Total Std Volume

Dashboard | 10 day totalizers | System Config | Mechanical | Input | Modbus

Analog Out | Other Outputs | Data Logging | Zero calibration | Firmware Update

- Meter Information
  - Dashboard
  - 10 day totalizers
- Meter Configuration
  - System Configuration
  - Input Configuration
  - Modbus Configuration
  - Analog Outputs**
  - Other Outputs
  - Flowmeter Alarms
- Display
  - Graphs and Live Data
- Flowmeter Tools
  - Data Logging
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  - Calculation Check
  - Transit Times
  - Ultrasound Setup
  - Transducer Setup
  - Zero Point Calibration
  - Firmware Update
- Installation
  - Mechanical Setup

CL1 variable:	Test Value	Test value:	0	<input type="checkbox"/>
CL2 variable:	Test Value	Test value:	0	<input type="checkbox"/>
CL3 variable:	Test Value	Test value:	0	<input type="checkbox"/>
CL4 variable:	Test Value	Test value:	0	<input type="checkbox"/>
CL5 variable:	Test Value	Test value:	0	<input type="checkbox"/>
CL6 variable:	Test Value	Test value:	0	<input type="checkbox"/>

	Scale:	Offset:	4 mA	20 mA
CL1 setup:	1.004217	-0.086359	4	20
CL2 setup:	1.001377	-0.043958	4	20
CL3 setup:	1.005378	-0.067555	4	20
CL4 setup:	1.00065	-0.121477	4	20
CL5 setup:	1.007252	-0.112609	4	20

**Change values and settings according to project specification.**

Reading Data

Packets: 99  
Failed packets: 45  
Communication quality: 45%

ID: TestVersion  
Expires: 18/10/2018 09:24:07  
Version 1.1A-1

UFM Manager

Logout

Browse Licence

UFM MANAGER

Refresh

Velocity Act Volume Flow Std Volume Flow Mass Flow Total Mass

VOS Pressure Temperature Total Act Volume Total Std Volume

Dashboard 10 day totalizers System Config Mechanical Input Modbus

Analog Out Other Outputs Alarms Data Logging Zero calibration Firmware Update

- Meter Information
  - Dashboard
  - 10 day totalizers
- Meter Configuration
  - System Configuration
  - Input Configuration
  - Modbus Configuration
  - Analogue Outputs
  - Other Outputs
  - Flowmeter Alarms**
- Display
  - Graphs and Live Data
- Flowmeter Tools
  - Data Logging
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  - Calculation Check
  - Transit Times
  - Ultrasound Setup
  - Transducer Setup
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  - Firmware Update
- Installation
  - Mechanical Setup

	Minimum	Maximum	Maximum change
Sound velocity [m/s]	200	500	70
Flow velocity [m/s]	0	100	70
Temperature [K]	268.15	348.15	
Pressure [barA]	0.5	3	

**Change values according to project specification.**

**UFM Manager**

Logout | Browse Licence

Velocity | Act Volume Flow | Std Volume Flow | Mass Flow | Total Mass

VOS | Pressure | Temperature | Total Act Volume | Total Std Volume

Dashboard | 10 day totalizers | System Config | Mechanical | Input | Modbus | Analog Out | Other Outputs

Alarms | Data Logging | **Ultrasound setup** | Transducers/gain control | Zero calibration | Firmware Update

**Chirp signal settings:**

- Center frequency [kHz] \_\_\_\_\_
- Band width [kHz] \_\_\_\_\_
- Burst width [us] \_\_\_\_\_
- Amplitude [V] \_\_\_\_\_
- Sweep direction: Decrease ▾
- Chirp pattern: Velocity ▾
- Chirp configuration: Automatic ▾

**Signal averaging:**

- Raw data: 1
- Process data: 1
- Transit times (ToF): 1
- Minimum ping rate [ms]: 20
- Chirp sample rate [ns]: 1000
- CW sample rate [ns]: 500
- Chirp preprocessing: None ▾
- No of periods used for phase detection: 10
- Update rate (readout): 0.55705

**Features:**

- Averaging: None ▾

**CW signal settings**

- Frequency [kHz] \_\_\_\_\_
- Burst width [us] \_\_\_\_\_
- Amplitude [V] \_\_\_\_\_

**Change values according to sensor calibration certificate.**

The screenshot shows the UFM Manager software interface. On the left is a navigation menu with categories like Meter Information, Meter Configuration, Display, Flowmeter Tools, Service and Troubleshooting, and Installation. The 'Firmware Update' option is circled in red. The main area displays a table of components with their current versions and 'Refresh' buttons. A red box highlights the 'Version: Error' entry for the 'Upload IO' component, with a red arrow pointing to a callout box that says 'Check the latest firmware version installed.' Below the table is a 'Block 0' button.

Component	Version	Action
Upload DSP	0.07	Refresh
Upload IO	Error	Refresh
Upload PT	0.257	Refresh

Block 0

Transducer set up for FGM 160 Flare Gas Meter (one pair of ultrasonic sensors):

**UFM Manager**

Logout  
Browse Licence

Refresh tab

- Meter Information
  - Dashboard
  - 10 day totalizers
- Meter Configuration
  - System Configuration
  - Input Configuration
  - Modbus Configuration
  - Analogue Outputs
  - Other Outputs
  - Flowmeter Alarms
- Display
  - Graphs and Live Data
- Flowmeter Tools
  - Data Logging
- Service and Troubleshooting
  - Calculation Check
  - Transit Times
  - Ultrasonic Setup
  - Transducer Setup**
  - Zero Point Calibration
  - Firmware Update
- Installation
  - Mechanical Setup

Dashboard: Transducers/gain control

Gain control:

Manual GC

Manual gain settings

CW upstream \_\_\_\_\_

CW downstream \_\_\_\_\_

Chirp upstream \_\_\_\_\_

Chirp downstream \_\_\_\_\_

Automatic gain settings

No of samples outside allowance range \_\_\_\_\_

Maximum chirp sample value \_\_\_\_\_

Low limit for correlation top level \_\_\_\_\_

Serial numbers:

Upstream transducer (xxx.YY) \_\_\_\_\_

Downstream transducer (xxx.YY) \_\_\_\_\_

Transducer type \_\_\_\_\_

Installation date (YYMMDD) \_\_\_\_\_

Transit time delays

Chirp delay upstream [ns] \_\_\_\_\_

Chirp delay downstream [ns] \_\_\_\_\_

CW delay upstream [ns] \_\_\_\_\_

CW delay downstream [ns] \_\_\_\_\_

**Input correct transducer serial number. Enter, for example, '182.18' in both fields (the U and D will automatically appear).**

**Change the transit time delays according to the sensor calibration certificate**

Packets: 1  
Failed packets: 0  
Communication quality: 100%

ID: MASO003  
Expires: 13/03/2019 09:40:11  
Version 3.0A-1

Transducer set up for FGM 160 dual-path configuration (two pairs of ultrasonic sensors). The procedure for setting up the 2<sup>nd</sup> pair of transducers (system 2) is the same that used for setting up the 1<sup>st</sup> pair of transducers (system 1).

The screenshot shows the UFM Manager interface with the following elements:

- Top Bar:** Logout, Browse Licence, Refresh tab, UFM Manager logo, Refresh all button.
- Dashboard:** Velocity, Act Volume Flow, Std Volume Flow, Mass Flow, Total Mass, VOS, Density, Pressure, Temperature, Total Act Volume, Total Std Volume.
- Left Menu:** Meter Information, Meter Configuration, Display, Flowmeter Tools, Service and Troubleshooting, Installation. 'Transducer Setup' is circled in red.
- Transducers/gain control Page:**
  - Gain control:** Manual GC (System 1 and System 2 toggle switches).
  - Manual gain settings:** CW upstream, CW downstream (System 1 and System 2 input fields).
  - Automatic gain:** No of sam allowance, Maximum sample val, Low limit f correlation.
  - Serial numbers:** Upstream transducer (xxx.YY), Downstream transducer (xxx.YY), Transducer type (dropdown), Installation date (YYMMDD).
  - Transit time delays:** Chirp delay upstream/downstream [ns], CW delay upstream/downstream [ns].

**Callout Box (Red Border):**

**Input correct transducer serial number for both transducer pairs. Enter, for example, '182.18' in both fields (the U and D will automatically appear). Change the transit time delays according to the sensor calibration certificate**