User & Maintenance MANUAL

Slurry Density and Slurry Massflow Analyzer / Easidens

Doc No: KWR-7QA03-901-220923-EN-C7E
For Software Version KWR_7QA03_522_220902R

Thank you for purchasing and using

Arenal's Slurry Density Analyzer for continuous monitoring of Specific Gravity, Density, Total Suspended Solids, Water concentration in dry tailings and temperature of mining, dredging, drilling and other slurries, muds, pastes up to 5 kg/l, based on ultrasonic spectroscopy.

Since 2011, Arenal is the first and only producer in the world of ceramic ultrasonic spectroscopy density and massflow analyzers. As the stability and accuracy from 2021 is higher than nuclear analyzers, they will replace most nuclear densitometers and also offer accurate monitoring under water and in subsea mining applications. The technology is based on measuring physical acoustical properties in combination of Acoustical Spectroscopy of the slurry, which are, in a chemometry model, directly related to the physical properties of the slurry, like slurry density, solids concentration, water concentration and temperature. The temperature is also measured by a separate PT1000 element.

For liquid density applications between 0.7<SG<1.4, we offer PEEK, PI, Quartz and PBI sensors.

Due to continuous improvement of the software to comply with customer requirements, the software changes rapidly and this manual is updated on a continuous basis. If your software needs an update or upgrade, please refer to the Maintenance & Support section 5 of this manual to support you in your decision and to lead you through the updating or upgrading procedure.

This manual is only valid for the software version on the front page.

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1. Preface

1.1 *Our philosophy*

Thank you for purchasing and using the slurry density and slurry massflow analyzer from Arenal PCS. Our goal is to produce the most accurate ultrasonic and thermal sensors and transmitters on the market for most demanding applications in all global markets. Secondly, we aim to give you the most comprehensive calculations available for controlling most industrial processes, based on the measuring values in combination with multi parameter calculations. As our PLC/HMI can be connected to any control valve or other equipment, local processes can be fully automated with Arenal's Slurry Density and Massflow Analyzer. For more sophisticated processing and HMI interaction, we advise to use the QA01 Process Chemometry Analyzer.
Finally, Arenal has a philosophy for ongoing continuous improvement to suit most demanding applications in the world. We hope that we can contribute eventually to all of your process systems on site.

Arenal aims to satisfy end users with regards to optimization and control of all their processes.

1.2 *Purpose of this manual*

This manual explains the installation, configuration, operation, calibration and maintenance of the Arenal QA03 Slurry Density Analyzer and Slurry Massflow Analyzer, including probes, transmitters, modules and cables.

1.3 *Symbols and conventions*

The following words and symbols indicate special messages:

	Caution! This sign indicates that failure to follow directions could result in damage to the equipment or loss of information.
	Warning! This sign indicates that failure to follow directions in the warning could result in bodily harm.
	Important! This word indicates that the text that follows contains clarifying information or specific instructions.

	Interesting! This word indicates that the text that follows contains comments or interesting points of information.

1.4 *Abbreviations*

All abbreviations in the manual are listed here.

QA03-SDA	Slurry Density Analyzer
QA03-SMA	Slurry Massflow Analyzer
QT016-UDT	Ultrasonic Density Transmitter. Electronic module to send high voltage pulses to the probe and receives and analyses returning echo's. The SDA and SMA however further analyses these raw values and calculates the SG, Density, TSS and temperature.
QP015-UDP	Ultrasonic Density Probe to determine Slurry Density
QC000-QQ	Connection cable between transmitters or modules to the SDA or SMA
QC014-UDC	Coaxial cable for harsh conditions in mining industry, to connect the UDP with the UDT
QT656-TMT	Thermal Massflow Transmitter
QP654-TMP	Thermal Massflow Probe
QM132-IOM	See Chapter 10: IO Module. An Extended IO Module, which offers galvanic isolated mA inputs and outputs and digital inputs and outputs. The mA signals have a sensitivity of 16 bits. The module is connected on the base motherboard.
SDA	See QA03-SDA
SMA	See QA03-SMA
UDT	See QT014-UDT
UDP	See QP015-UDP
UDC	See QC014-UDC
TMT	See QT656-TMT
TMP	See QP654-TMP
IOM	See QM132-IOM

1.5 *Document updates*

Name	
KWR-7QA03-901-221007-EN	Revamp for C7E HMI screens
KWR-7QA03-901-220112-EN	Complete upgrade due to new displays, new software
KWR-7QA03-901-191218-EN	Par.1.5 added to follow improvements in the document, according to our ISO9001:2015
KWR-7QA03-901-191203-EN	Calibration “Step 3”procedure modified in Par 7.3

2. Technical specifications

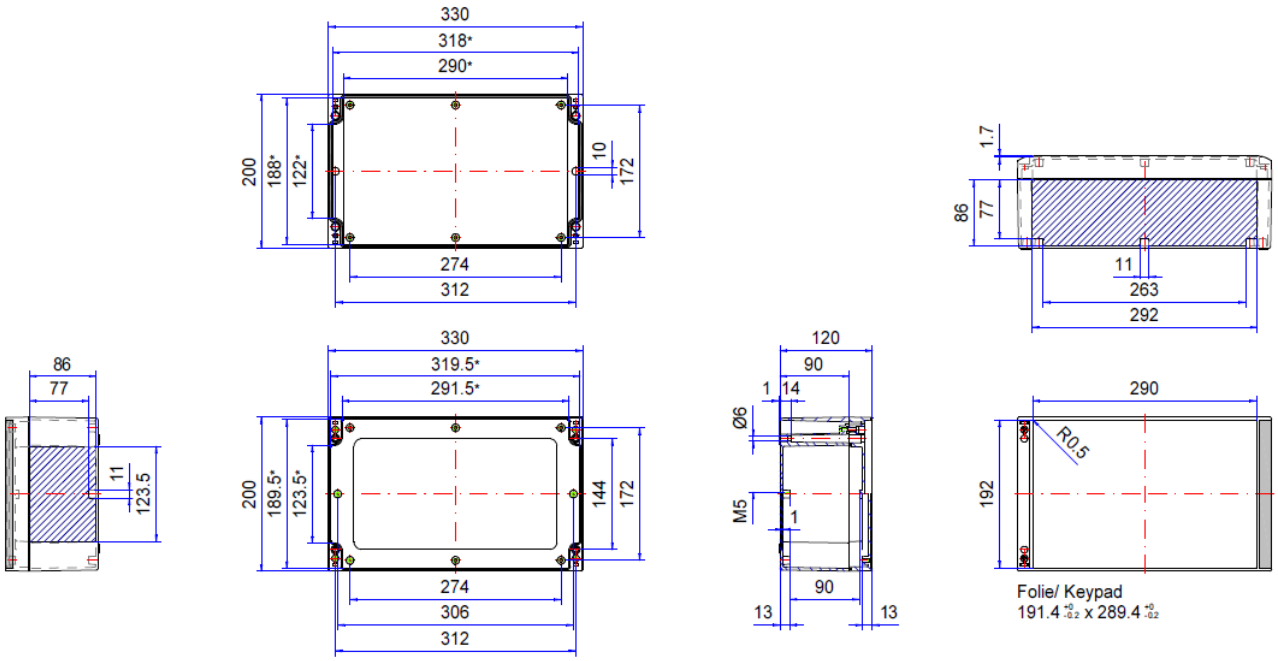
2.1 Environmental characteristics

Ingress Protection	QA03: IP65 (Limited due to touch screen display on front side. We recommend mounting the analyzer inside a protective FRM or GRP cabinet) QT0161: IP66. We recommend mounting the electronics NOT in direct sunlight. QP015: IP68
Temperature	Operating: 0-50 degC Storage: -10ºC to +60ºC
RH	Relative humidity 10-90% (non condensing)
Leakage protection	Double NBR o-ring and dual packing in case of QB021-WDL

2.2 Operation characteristics

Interfaces	Ethernet LAN RJ-45 10Base-T/100Base-TX	
	USB2.0 type A	
	Modbus RTU over 2 wire RS485	
Power	90-263 Vac. 50-60Hz	Standard (select VAC model)
	18-32 Vdc	Standard (select 24V model)
	Consumption: 15W	
Display	5,7” Color LCD soft touch screen display 256 colors, 320x240 pixels, 6MB FEPROM	
Response time	Sensor pulse repeat frequency: 0,001 seconds, averaged over 1 second. Updated every second in the analyzer. Moving average can be set between 1-60 seconds.	
Measurement absolute error	In tap water within calibrated temperature range: 3 g/l. In slurry: average error is 9-15 g/l, due to changing morphology of particles, inhomogeneous state of slurry and temperature sensitivity of dissolved solids.	
Measurement relative error	15 g/l in the range 1000-2500 g/l is 1%	
Ageing	About 1% per year. Perform a water calibration each 3 months.	
Weight	2,5 kg	
Dimensions	Outside dimensions: 330x200 mm. Depth: 120 mm	
Housing	Aluminum die case with dry coating	
Mounting	Mounting holes available: just remove the aluminum panels, no need for opening the lid of the enclosure	

2.3 Dimensional drawing Rolec AC202

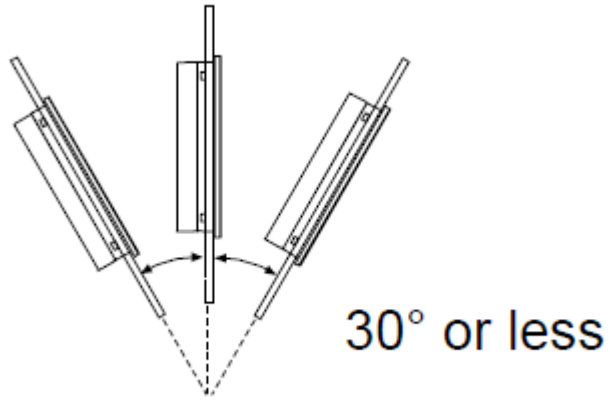


2.4 Panel cut-out

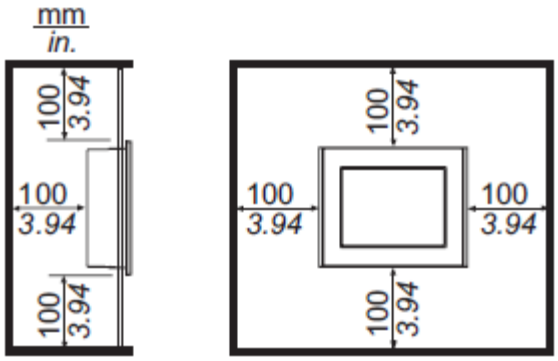
In case the HMI is not mounted in Arenal's standard enclosure, the HMI shall be mounted in another enclosure to protect it against dust and water. Due to the lack of components on the market, Arenal offers several HMI's. Each has different panel cut outs. Find below the panel cut-out specification of ProFace GP4301-TAD and GP4301-TADW:

Length: 156 mm (6.14 in)
Hight: 123.5 mm (4.86 in)
Panel thickness 1.6...5 mm (0.06...0.2 in)
Radius in each corner: 3 mm (0.12 in) maximum

When installing the GP unit in a slanted position, the GP unit face should not incline more than 30°.



For easier maintenance, operation and improved ventilation, install the GP unit at least 100 mm (3.94 in.) away from adjacent structures and other equipment as shown in the following illustration.



2.5 Spare parts

Item	Description
4-000-02	Spare fuse. One spare fuse is always supplied on the main PCB board. Fuse medium delay 2,5A. Farnell 1354586, model 023402.5MXP, about 0,21 Euro
4-QA03-USB-16GB	Spare industrial USB stick for QA03, 16 GB. Do not replace this USB stick for a non-industrial USB stick, as they do not comply to the temperature ranges.
4-POWER CONVERTER 24V->24VDC 60W	Spare Power Converter for QT65 (24-24 vdc)
4-QA03-GP4301	Spare Display and IO set: GP4301TAD and QM132-IOM
4-QA03-GP4301TAD	Spare Display and IO set: GP4301TAD and QM132-IOM
4-QA03-GP4301TADW	Spare Display and IO set: GP4301TADW and QM132-IOM
4-QA03-LT4301TADAC	Spare Display LT4301TADAC
4-QA03-PLC+DISPLAY	Spare Complete set PLC and display. Display is removable
4-QA03-XT07CD-DE	Spare Display and IO set: XT07CD-DE and QM132-IOM
4-QB021-393C-EPDM-1MM	Spare EPDM 1mm packing with inner ring for SPC
4-QB021-393C-EPDM-2MM	SpareEPDM 2mm packing with inner ring for SPC
4-QB021-393C-EPDM-3MM	Spare EPDM 3mm packing with inner ring for SPC
4-QB021-350	Spare Wrench with handle L=100mm
4-QB021-354	Spare Saddle flange mounting assy for UDP-WFC probe
4-QB021-356	Spare Saddle flange mounting assy for TMP-SPC probe
4-QP015-UDP-SIC-LT	Spare Ultrasonic Density Probe. Is only sold at the same time as the initial order or only in combination with 4-QT0161-UDT-SPC
4-QT0161-UDT-SPC	Spare UDT
4-QT65-PCB	Spare Thermal Massflow Transmitter PCB board Rev3
4-ANTENNA-GSM-4G-600	Spare part - high power antenna with RG58 to SMA
4-O-RING-28X2 NBR	Spare o-ring for SPC sensor
4-O-RING-28X4 NBR	Spare o-ring for SPC sensor
4-O-RING-35X1.00 NBR	Spare o-ring for WFC assembly
4-O-RING-35X1.50 NBR	Spare o-ring for WFC assembly
4-O-RING-35X2.00 NBR	Spare o-ring for WFC assembly
4-O-RING-35X2.50 NBR	Spare o-ring for WFC assembly
4-O-RING-35X3.00 NBR	Spare o-ring for WFC assembly

3. Installation

3.1 Generic configuration information

A complete Slurry Density Analyzer (SDA) and Slurry Massflow Analyzer (SMA) system comprises of the following components:

1. QA03-SDA or SMA. The analyzer can be separated into different parts, depending on the requirements:
   a) Housing
   b) Power convertor
   c) Main PCB board
   d) IO Module
   e) HMI
2. QT0161-UDT – Ultrasonic Density Transmitter
3. QC013-UDC - Coaxial cable, in case of QP015-UDP probe, this item is included and not mentioned in the list
4. QC000-QQ-01000-XXX-XXX Connection cable 100m from UDT to QA03
5. QP013-UDP - Ultrasonic Density Probes for submersible applications
6. QP014-UDP-PRC – Small Ultrasonic Density Probe
7. QP015-UDP – Ultrasonic Density Probes for mounting in spool pieces are wafer cells
8. QB03-WFC – Wafer cell
9. QB05-SWC – Steel wafer cell
10. QB06-SPC – Spool Piece of carbon steel (QB06-SPS is of Stainless Steel)
11. QS – Services: like Remote Monitoring Services, local service assistance, System Integration Services, Spare Parts
12. When the massflow meter is supplied:
    a) QT656-TMT – Thermal Massflow Transmitter
    b) QP654-TMP – Thermal Massflow Probe
    c) QC000-QQ-00100-XXX-XXX Connection cable from TMT to UDT

As the QA03-SDA or SMA is the main part of every installation, where all settings are done and where all information is gathered. Additional information, needed to set up the Ultrasonic Density Transmitters, can be found in the enclosure of this manual.

3.2 Mounting

Arenal uses AluCase enclosure from Rolec Germany (www.rolec.de). To mount the enclosure to the wall, the lid does not need to open. Just remove the aluminum panels on each side: they are clamped and easily removable. Arenal supplies a mounting set in each delivery.

Fix the enclosure to the backpanel by standard available screws, like M5x25 socket head cap screws, DIN 912.

3.3 Electrical cables installation

The QA03-SDA is always supplied with four M20x1.5 threads for cable glands on the bottom side of the enclosure. It has the following cable entries (from left to right):

1. Power supply cable gland
2. mA input (ext flow, density or level meter) and mA output cable gland
3. Modbus RTU cable to remote UDT transmitter
4. External RMM (Remote Monitoring Module)

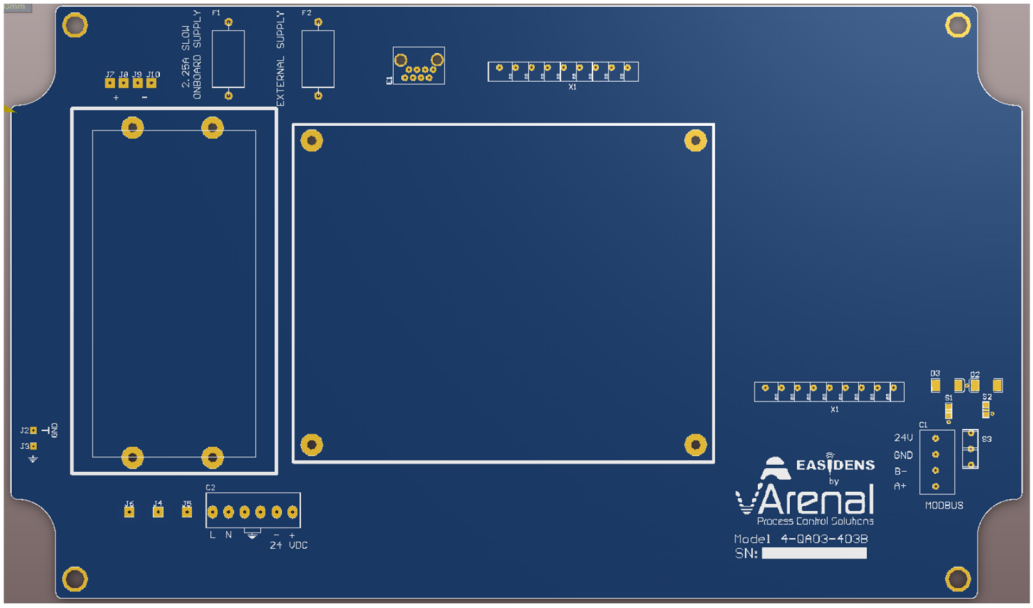
3.4 Internal wiring

The power AC/DC convertor is situated on the left side of the main board. In case of DC supply voltage, this module is replaced by a DC/DC convertor. The fuses are just on the top-right of it. The 24Vdc power output of the power convertor is connected through the main board to the power supply of the HMI and the IO Module. Also external transmitters are powered by this 24Vdc.

After opening the lid, the baseboard is visible.

On the left side, the power convertor is placed.
The IO module will be place in the middle.
The UDT is connected to the Modbus connector, see drawings in enclosures.
The RMM is connected to the PoE Ethernet adapter.

Below the special mainboard for customers in South Africa, supplied by our partner KRT Instruments.



3.5 Connecting the QT0161-UDT

Check Chapter 8 and drawings A1..A8 for the electrical connections on the main board. Connect these wires to the corresponding connections (A+, B-, 0Vdc, 24Vdc) on the UDT.

3.6 Connecting the QT656-TMT

Check Chapter 9 to learn how to connect the TMT to the corresponding connections (A+, B-, 0Vdc, 24Vdc) on the spare connector of the UDT.

Connect the thick cables to the H Force and H GND. Connect the thin cables to their corresponding Sense (H SenseP for H Force and H SenseN for H GND).

3.7 Connecting the QM132-IOM

For information on how to connect and configure the mA in and out signals as well as digital inputs and outputs, refer to chapter 10 or the installation manual.

4. Configuration

4.1 First time starting the system

Only power the SDA when all cables are connected and the probe is connected. Do not disconnect probes or transmitters when the system is powered up, as many transmitters are not hot-swappable.

Check again that the AC voltage is not connected to the 24Vdc connector

Once the unit is powered up, the lamp inside the SDA or SMA and UDT turns green and the lamp inside the HMI turns red.

If a display is connected, it automatically comes into measurement and control mode. The display now shows the measuring values. Wait for at least 15 minutes after start-up if you wish to perform calibration. For more information about calibration procedures, see chapter 4.

4.2 Menu structure

The menus can be reached by the Menu Bar on the top and the functions by the Function Bar on the bottom. All these functions are explained in the next paragraphs. In this paragraph, you get an overview of the most used required actions and the menu operation that is needed.

Some examples are given below. In the next subsections, the menus are explained in more detail.

Requirement	1st step	2nd step	3rd step	4th step
Change name of the Measuring Site Change date & Time & Language	Press:  In Menu Bar	Press “System Settings”	Press “User Settings”	Change and save.
Change parameter settings and calibrate		See Chapter 4		
Check or change UDT settings or calibrate raw measurement values	Press:  In menu Bar	Press “Ultrasonic Density Transmitter”	See Chapter 8	
Check or change IO settings	Press:  In menu Bar	Press “IO Module”	See Chapter 10	

4.3 Menu screen and functions overview

In this chapter, you find information about the generic hardware and software configuration, about how to set up the analyzer and the parameters.

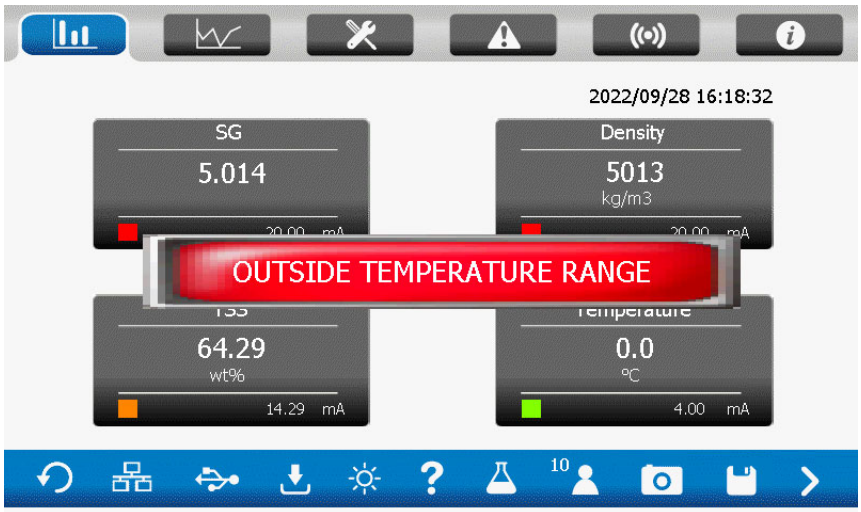
MENU BAR → Parameter values → (example display) FUNCTION BAR →	

The picture above shows the main measurement screen. It consists of three parts: the MENU BAR on the top is for navigation through all setup and information menu's. The FUNCTION BAR on the bottom is for checking the status of important settings and offers special functions in specific menu's.
The middle the screen shows the four measurement parameters.

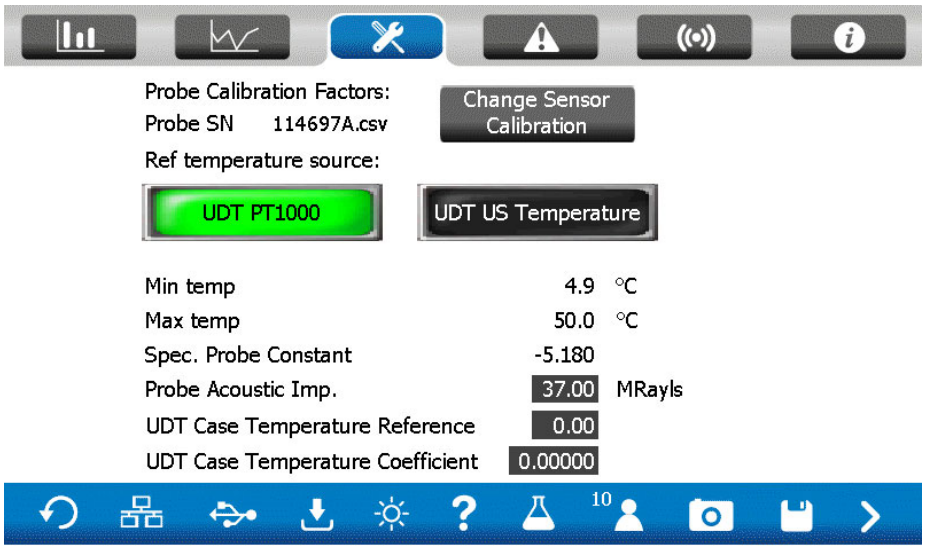
	Press this button to go to the home screen (see picture above)
	Press this button to go the graph screen, described in Par 3.4
	Press this button to go the configuration screen, described in Par 3.5
	Press this button to go the diagnose screen, described in Par 3.6
	Press this button to go the alarm screen, described in Par 3.7
	Press this button to go the information screen, described in Par 3.8
	When pressing this icon you return to the previous viewed screen
	Press this icon to get info how to set up the Ethernet network (IP address and Subnet Mask)
	Press this button to go to the File Manager Menu and see if the USB is connected/recognized.
	Press this button to configure the logging interval time and to start and stop logging.
	Press this icon to change the intensity of the screen. Press the button again to close.
	Press this icon when taking a sample. Press the button on the next screen so the system registers in the logging file that a sample is taken for calibration.
	This button shows the current status of the security level, normally 0. Press this button to log in.
	Press this button to make a screen shot. The jpg file can be found on the USB Stick in the “ScreenCapture” directory.
	Save all settings to the files on the USB Stick. This icon pops up when user gets into the configuration pages.

	Go to the next page. In some cases, there is no following page: then it stays on this page or returns to the main page where you originally came from.
	To configure one of the four parameters, you can press the corresponding value button.

Furthermore, a warning can be shown on top of the start screen when the temperature is outside of the calibration range. The warning will show “Outside Temperature Range”.

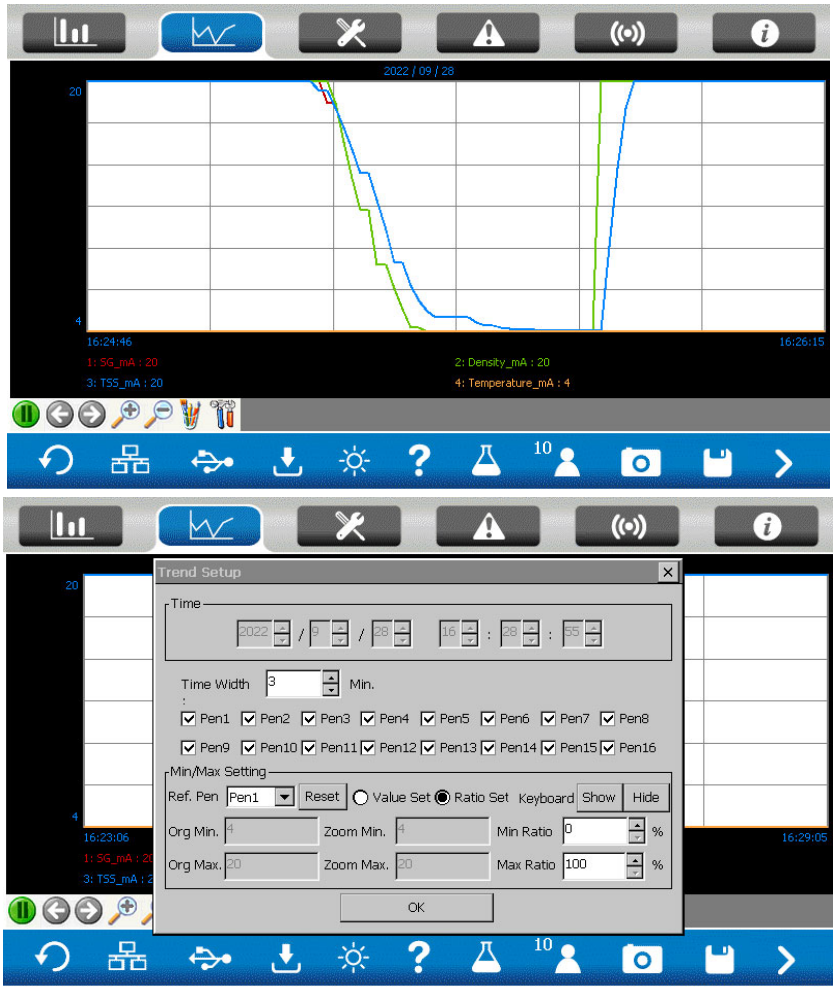


The minimum and maximum temperature for the calibration range can be found in the Calibration screen. In the following example, a warning will show when the temperature is below 4.9 degrees or above 50.0 degrees. The system will continue operating, but measurements are less reliable when operating outside of the calibration temperature range.



4.4 Graph Setup Procedure

Pressing the graph icon brings you to the time graph of the parameters. For each parameter, a graph is available. Currently all 4 graphs are highlighted. Press the setting button (first from the right) to select or deselect certain parameters.



4.4.1 Timing settings (horizontal X-axis)

The time of the first measurement on the screen is written on the left bottom of the graph. The time of the latest measurement on the screen is written on the right bottom of the screen. When pressing the zoom-in button, the time of the first measurement on the screen is set to a later time, so less data points are shown.

When pressing the zoom-out button, the time of the first measurement on the screen is set to an earlier time (if available), so more data points are shown. Each second, a data point is created.

4.4.2 MIN/MAX setting (vertical Y-axis)

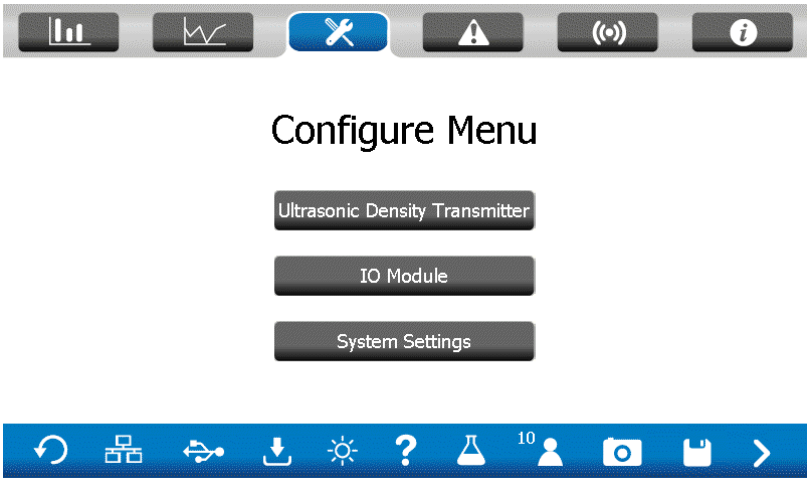
The height of the graph is determined by the 4-20 mA value of that parameter, see the last page of the Parameter Setting.

4.4.3 Select the graphs of your choice on the screen

The analyzer remembers which graphs need to be shown on the screen.

4.5 Configure Menu

Pressing the configure icon brings you to the configure menu:



4.5.1 Ultrasonic Density Transmitter Setup Procedure

To check and setup the performance of connected ultrasonic density transmitters, press the corresponding bar. Further explanation of these modules can be found in Chapter 8.

4.5.2 IO Module Setup Procedure

To check and setup the connected IO module, for 4-20 mA in- and outputs and digital in- and outputs, press the corresponding bar. Further explanation of these modules can be found in Chapter 10.

4.5.3 System Settings Setup Procedure

In the System Settings Menu, a new menu bar appears, which corresponds to the current security level.

4.5.4.1 User Settings

After pressing the User Settings bar, the following screen appears:

Change the language by pressing the green button (and after that press "X") to change to English, Dutch, French, German. SAVE the settings in the function bar when they are changed, otherwise, the language setting is not stored permanently.

The current date and time are shown in the table. These are important for the datalogging. Change the date or time using the button.

The name of the measuring site is displayed on the measurement page. It is convenient in a network of analyzers and with remote monitoring that it is visible where the actual analyzer is installed.

4.5.4.2 Factory Settings

This is a restricted area for users with login code 8.

4.5.4.3 Restart system

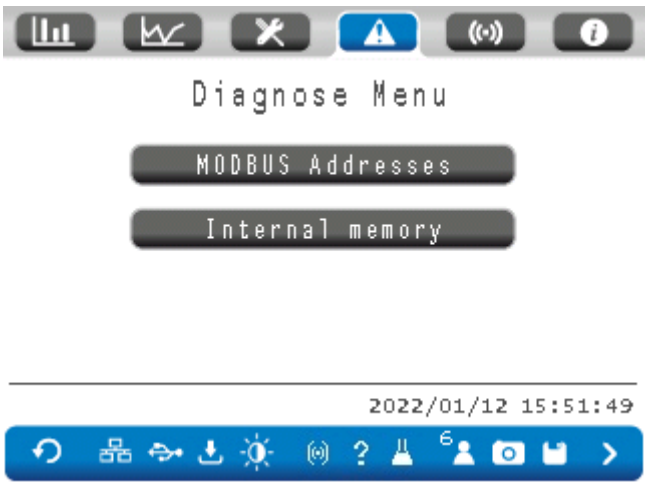
To restart the system and load settings from USB.

4.5.4.4 Shutdown system

To shut down the system and access the ethernet loader of Windows.

4.6 Diagnose Menu

The diagnose screen is specially made for service engineers to check the settings in the SDA/SMA.



For a list of available Modbus TCP/IP addresses, see chapter 12. If specific values are needed, ask the Arenal R&D team.

4.7 Alarm Menu

Alarms in the SDA are generated when the values are outside of the range that is set.

More likely, alarms are generated in case of a problem in one of the transmitters or in the evaluation of measured data. The number of failures that can exist are numerous and therefor a clear explanation in this screen is helpful for the client to figure out what the cause of the problem is.

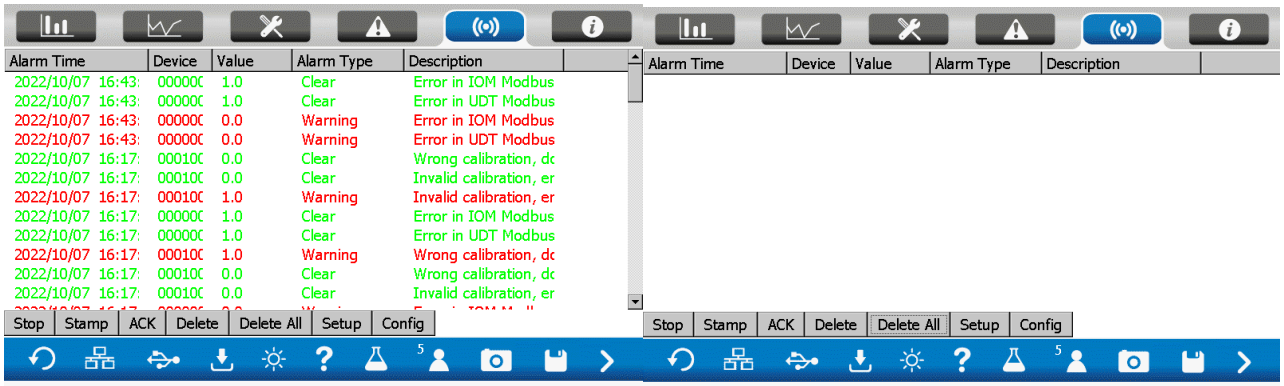
4.7.1 Active Alarm Handling Procedure

As part of the PLC functionality alarms can be generated if measured values are beyond their set boundaries, when an operation failure of the PLC exists or when data cannot be verified anymore.

Arenal offers two different methods to alarm the user:

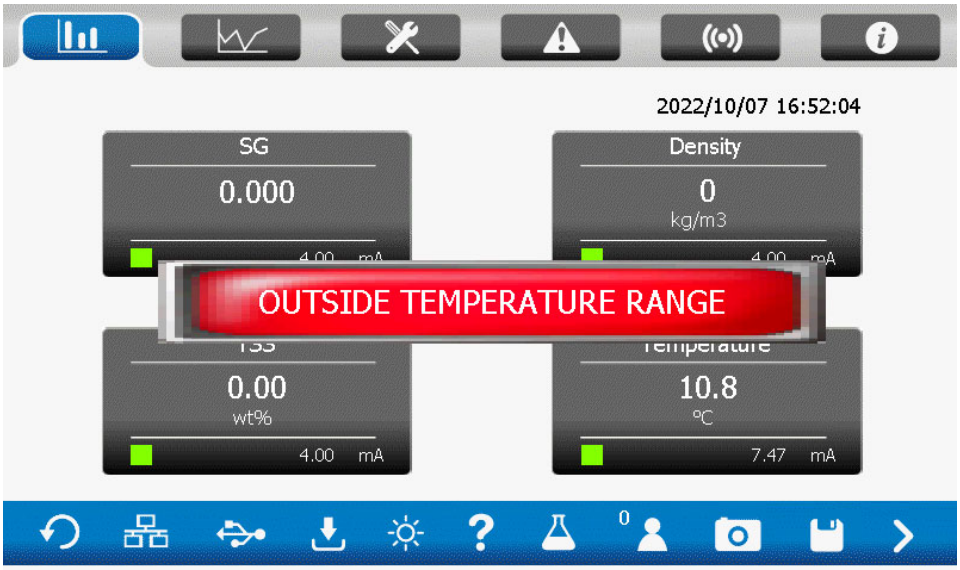
1. By reading the measured values in the Modbus registers, alarms can be read out by Master PLC's.
2. By using the Arenal optional IO Module (see Chapter 10), QM132-IOM. In this module 2x DI and 2x DO contacts can be programmed to switch flash lights, horns or it may control other safety equipment, like pumps and valves. Note that this IO Module is also used to control pumps and valves in automatic sampling equipment. Currently in this SDA software, these DO contacts can only be programmed for tons produced or for flow pulses.

Active alarms are automatically de-activated when the alarm is not present anymore. Or when a new alarm is generated. In the historic alarm data, you can see the old alarms.



4.7.2 Screen warnings

The QA03 offers some warnings on the screen that will indicate that the unit is running, but will give wrong values. Example:



When the analyzer is out of its calibrated measurement range, the readings are most likely not accurate. The reading of Density, SG and TSS% can be inaccurate. To solve this, request a new calibration from Arenal after consultation. Costs are involved to create new calibration files. This file shall be added to the USB stick and shall be selected by the user. Alternatively, Arenal can handle this procedure when the RMM is installed.

Other similar errors are: too low voltage on the flow meter. Check the power supply.

4.8 Help Menu

This is the information and support screen. It gives you information about the model, the software version, the serial number and distributing company contact details.

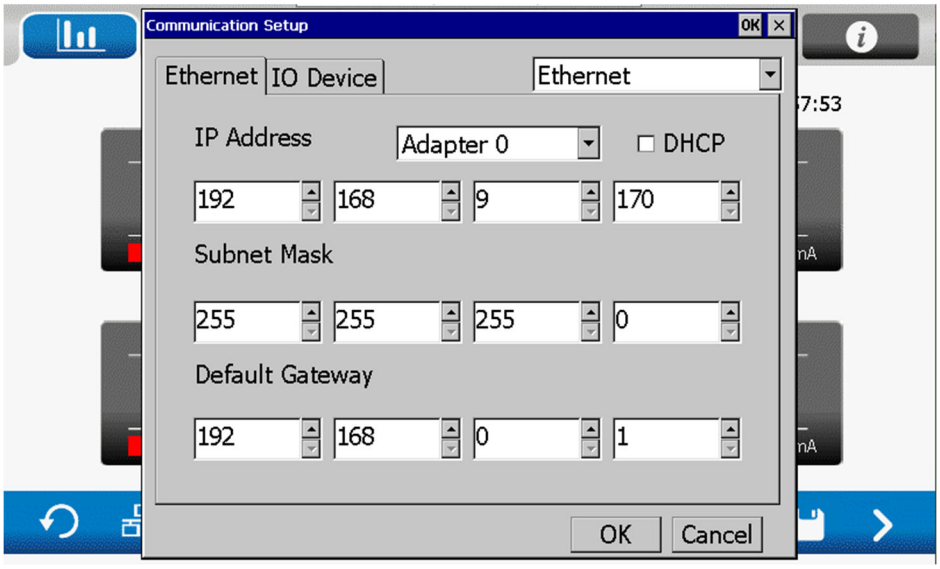
After pressing the “Company info” bar, the following, or similar, page is shown:

4.9 Function bar

The analyzer offers many functions directly available from the bottom bar menu.

4.9.1 Ethernet Network

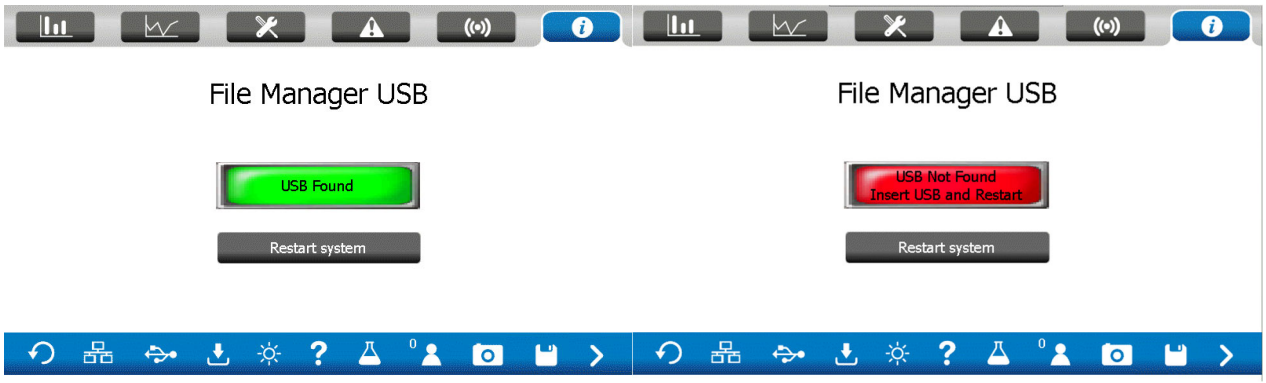
The SDA can only be connected to Ethernet networks as a slave. This allows the user to get full control over the analyzer by remote monitoring.



The communication protocol is from manufacturer Schneider Electric SA. It communicates according to IEC61131, syntax=off, low word first. The IP address is predefined by Arenal and are part of the 192.168.9.x network, sub-mask 255.255.255.000. But they can be changed in the Pro-Face menu, see chapter 5.

4.9.2 File Manager

Press the File Manager icon to go to the File Manager. If there is no USB recognized, check if the USB is inserted correctly and restart the system or wait for a minute for the system to recognize the USB.

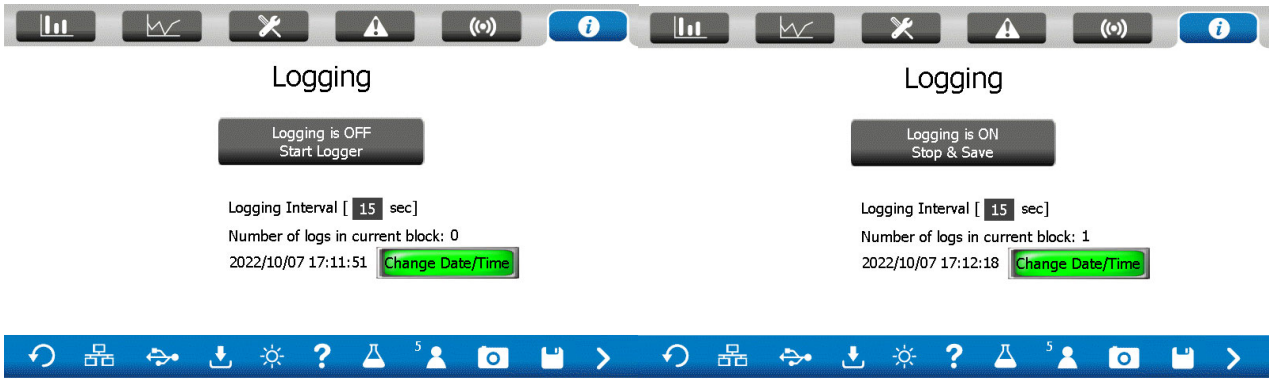


4.9.3 Data Logging

Data Logging or Data Sampling is a commonly used function to store the measured data from all the parameters and additionally raw measurement values and the sampling number.

You can press the logger icon to go to the Logging Screen.

Before entering the Logging Screen, the level 1 password shall be entered. Then one of the following screens will appear:



In the first case, the logging is OFF and logging can be started by pressing the button.

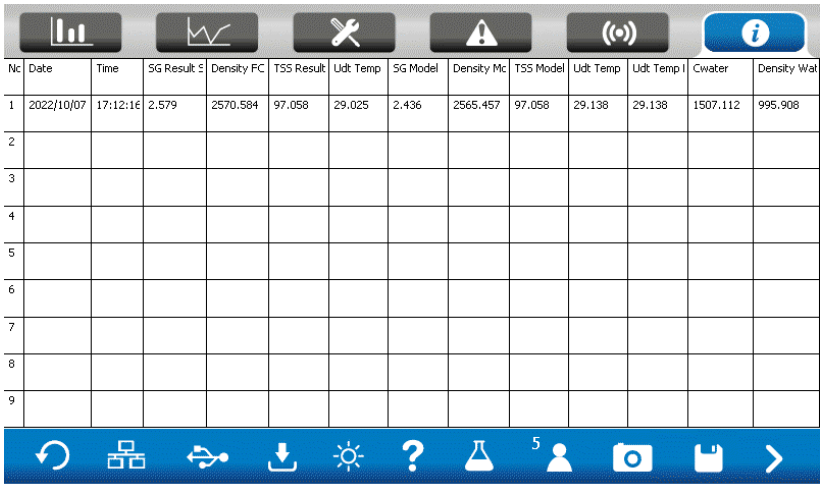
In the second case, the logging is ON and logging can be stopped and saved by pressing the button.

You may change the Logging Interval. The internal memory is saved during power failure.

When logging, CSV files are automatically created on the USB stick. In the table below, it is shown which folders on the USB contain which data.

End Results	All end results and UDT data
Raw Measurements	Raw measurements from different types of data
Auto Water Calibration	Auto Water Calibration log
Sampling	Sampling log data

By pressing Next Page you find the current data storing process in the way you see it in the CSV file. By pressing up, down, left, right you can scroll through this data.



Nc	Date	Time	SG Result S	Density FC	TSS Result	Udt Temp	SG Model	Density Mc	TSS Model	Udt Temp	Udt Temp I	Cwater	Density Wat
1	2022/10/07	17:12:16	2.579	2570.584	97.058	29.025	2.436	2565.457	97.058	29.138	29.138	1507.112	995.908
2													
3													
4													
5													
6													
7													
8													
9													

By pressing the next page, the logging data of the raw measurements and then auto water calibration log is shown.

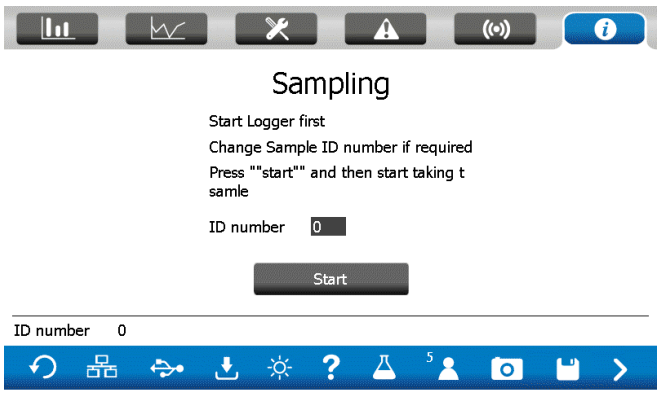
4.9.4 Alarm

When the alarm flashes in the function menu, an alarm is active. Press this button to go to the alarm screen, see 3.7.1.

4.9.5 Take Sample

Press the Erlenmeyer icon if you want to take a sample from the slurry for analysis in the laboratory. The idea is that the values of the parameters are linked with the laboratory values by means of an ID number, date and time. When the sampling is started, the frequency of the logger is set to 1 (highest frequency) so that as many data is logged as possible. After finishing the logger, the frequency is reset to its former setting.

1) Insert the ID number.
2) Press START, when you are going to take a sample.
3) The next screen pops up:

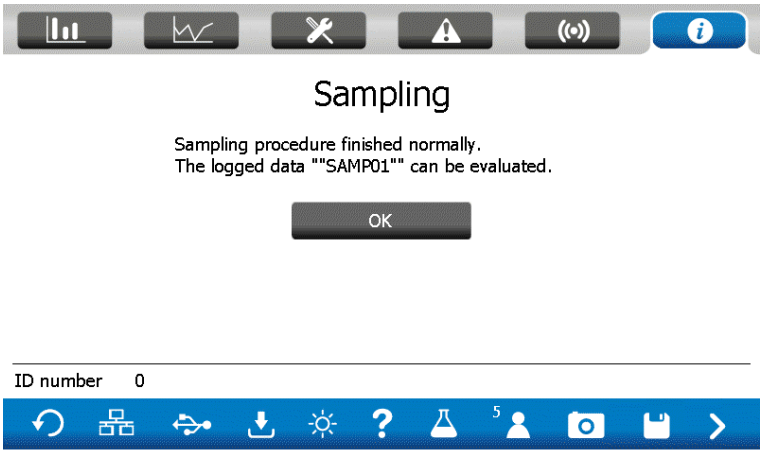


5) When you finished taking a sample (advise is that this takes at least 30 seconds), press STOP.

6) The following screen pops up:

7) Press OK when you wrote down the ID number, date and time on the sample bottle. The ID can be found in the screen and this is the same date and time as in the logged data.

8) The following screen pops up:



9) Like informed to you in this screen: the logged data can be evaluated, together with the laboratory values. Copy the content of the USB stick to your PC and compare the results.

4.9.6 Security Level

Most interactions between user and SDA are secured by a password. When the “Security Level” icon is pressed, or when a screen is entered for which a higher level of security is needed, the SDA requests an ID and a password, required for the level that is needed.

After login, the level is shown in the icon.

The security level will be restored when the icon is pressed again.

Find your ID and password below. Logging in will be tracked by the Operation Log.

Multiple users for same levels can be made as per your requirement.

	Level	Settings	ID	Password
Standard	0			none
User	1	User Settings	USER	none

Service Engineer	5	Calibration Settings	SERVICE	26
Arenal Engineer	8	Advanced Settings	ARENAL	****
Factory	10	Software Settings	DEVELOPER	****

4.9.7 Screen Shot

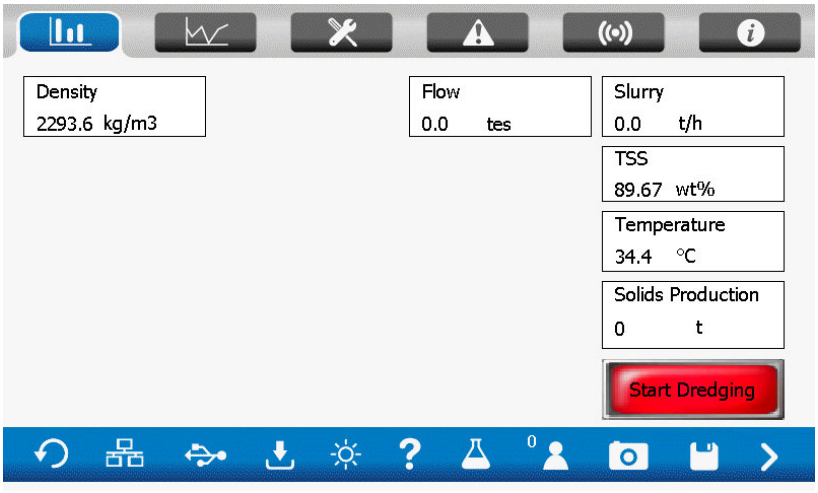
Press this button to make a screen shot in BMP format of the current screen. The file is saved to folders on the USB per hour. Taking screenshots therefor only works when the USB is present. The folders with the screenshots can be found on the USB under the folder 'ScreenCapture'.

4.9.8 Save and Store Data on USB

This icon pops up when user gets into the configuration pages. Pressing this icon will save all settings to the files on the USB stick.

4.10 Dredging – Reset Production

In the dredging industry operators could determine to calculate the total produced solids during a shift. At any desired moment, press "Stop Dredging" and the "Start Dredging" at the button with the cross meter. From that moment the totalizer starts again.



On the home page, press next screen twice to get to the screen above.

5. Start Up and Commissioning Guide

In all above chapters the density and the flow meter were explained. In this chapter the steps for commissioning are explained. Pictures can be found in this manual. This chapter is intended to assist you in getting the system online in minutes.

1. Check and unpack shipment
2. Install the wafer, weldolet(s) or spoolpiece in the system
3. Install the analyzer on the desired location
4. Mount the HMI
5. Connect the internal cables
6. Connect the Massflow transmitter
7. Power Up
8. Water calibration for Density or SG
9. Slurry calibration
10. Configure digital and analog outputs

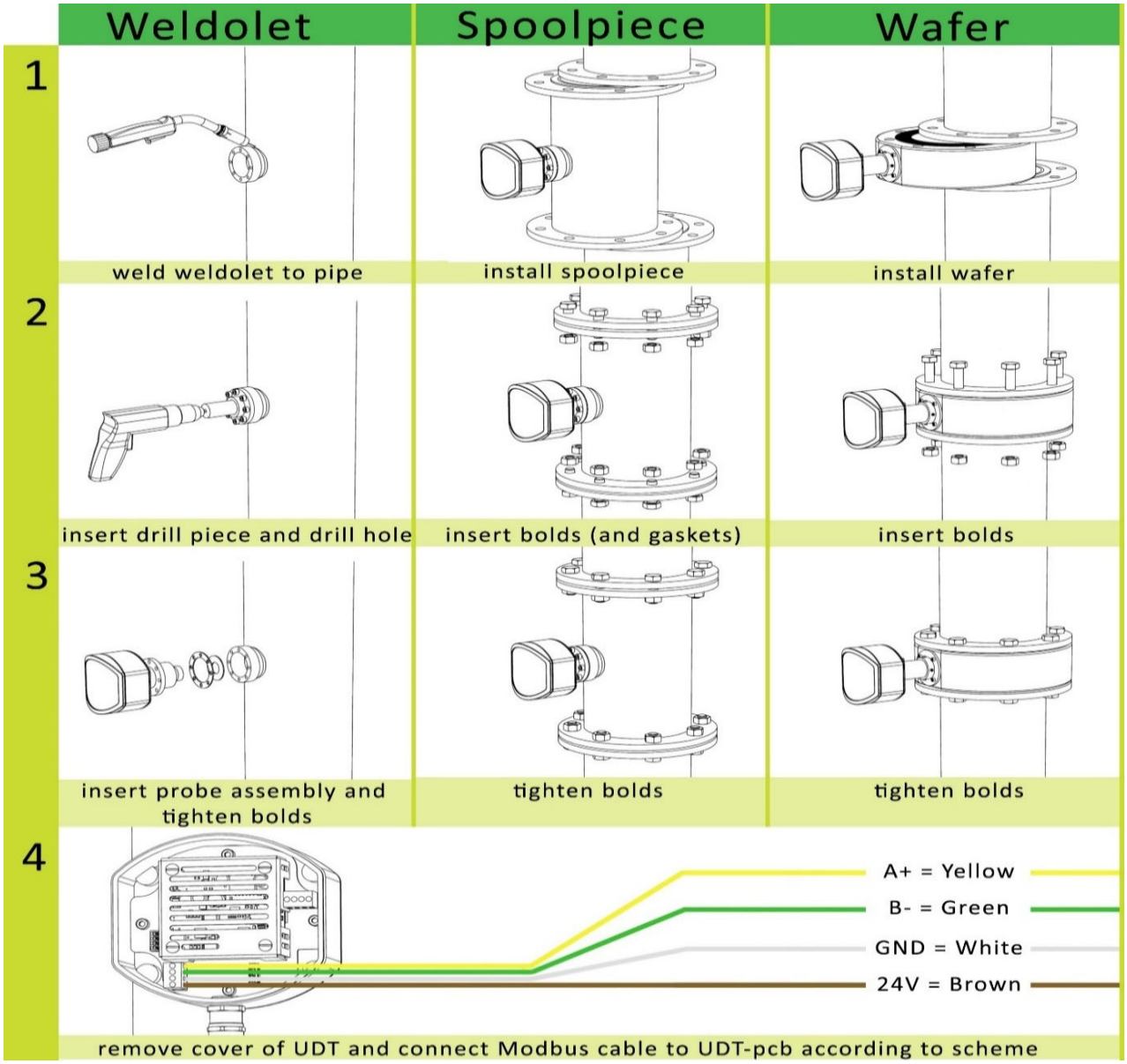
5.1 *Check and unpack shipment*

a. Check if box is complete and not damaged.
b. In case of more than 1 system make sure all components (Analyzer, HMI screen with USB, Cable, transmitters UDT/TMT and Probes) are kept with correct system! The parts are labeled with: “order number”-“system number”.

5.2 *Install the wafer, weldolet(s) or spoolpiece in the system*

Before installation measure internal diameter (ID) of existing pipe. ID of existing pipe must be equal to ID of wafercell or spoolpiece! If not contact Arenal!
-In case of horizontal pipe make sure probe is placed at 4-5 or 7-8 o’clock.
-In case of weldolet: Drill hole 36mm for WFC probe using insert for drill. See weldolet installation guide for more information.
-Insert and secure probe flush with pipe.
-In case probe does not come pre-connected to UDT. Connect inner core of the coax cable to

PULSE and the shielding of the Coax cable to SIG GND. Make sure to wear electronic static discharge (ESD) protection!
-Make sure all cable glands, lids and screws are tightened firmly.



5.3 *Install the analyzer on the desired location*

Maximum distance to the UDT and the TMT is 100 meters. This cable can be cut to length.

5.4 *Mounting the "C7E" HMI*

The HMI is the C7E screen with the computer. In the past we supplied other models, like "DIS", "GPT" etc. Tighten the screen with provided plastic black wrench.

5.5 *Connect the internal cables*

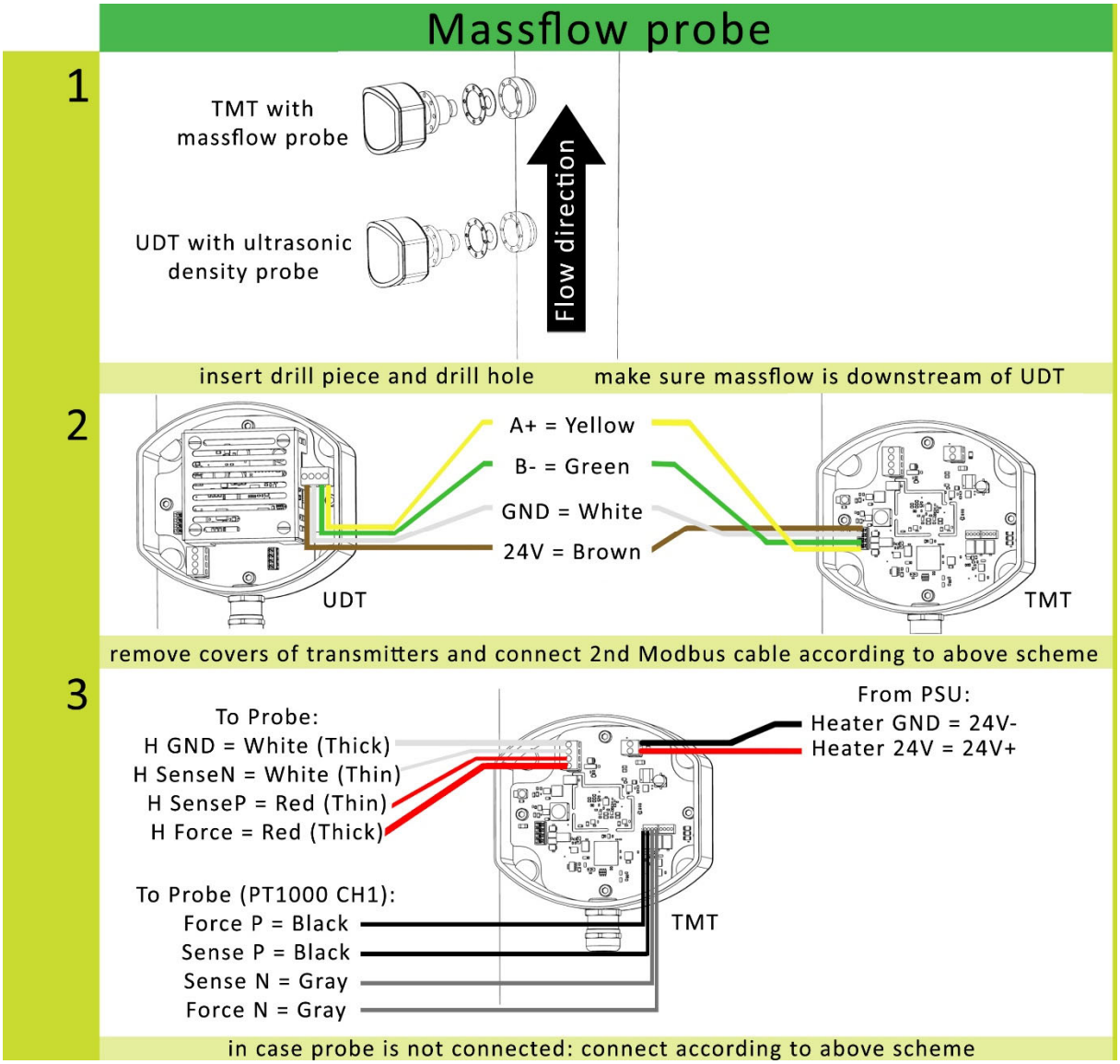
Connect the:

- COM cable to COM1/COM2 into HMI and the COM3 port on the right on the analyzer PCB.
- Internal power cable to HMI

- Modbus cable to connector bottom middle on analyzer PCB
- 4-20mA signal out. Standard setting: E1 = SG+, E2= SG GND, E3 = TEMP+, E4= TEMP GND
- Protective earth cable to bottom left connector on analyzer PCB

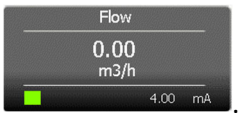
5.6 *Connect the Massflow transmitter*

If the systems come with a Massflow transmitter, connect it now.



-In case of weldolet: Drill hole 36mm for Massflow probe.
-Insert and secure probe flush with pipe.
-Make sure massflow probe is placed after (downstream of) ultrasonic probe in flow direction for optimal result.
-Always unplug analyzer (power of complete system) when working on UDT / TMT.
-The massflow transmitter (TMT) uses 24VDC from Modbus cable.
-The massflow probe requires its own additional 24VDC 150W power supply.
-Power for massflow probe cannot be drained from analyzer PSU power.
-Use DC:DC converter for stable power supply when not using Arenal PSU's.

5.7 *Power Up*

- Do not power up just yet! For warranty purposes please send pictures of all made connections in analyzer and UDT to Arenal before fist power up and wait for approval!
- Turn on the analyzer (Only after approval of Arenal or Arenal appointed service provider)
- In case the user is using the "DIS" (ProFace LT4301TADAC) display and the I/O module is not (correctly) connected, a mA signal error is displayed on the screen. Go to the I/O menu to disable the communication with the I/O module.
- Press  -> system settings -> user settings and set your personal settings and time. Do not forget to press OK after each change and finally the save  button. (In case of password prompt use ID: "USER" with password: "")
- Press  -> Ultrasonic Density Transmitter -> Calibration and make sure next to 'Probe SN' there is a file name "XXXXXX?.csv". If it is empty, contact Arenal or Arenal appointed service provider.
- In case of external flow sensor, press  -> Next page () -> 

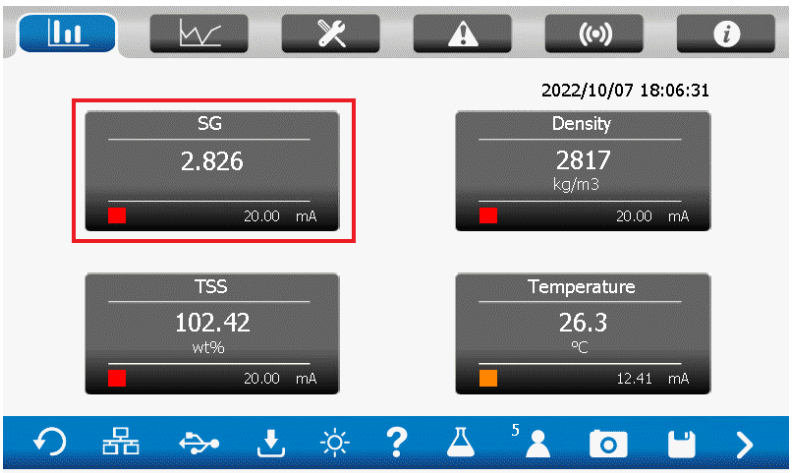
. Fill in the configuration to set up the flow settings.
- Go back to the main screen (). The display shows the actual measuring values. Wait for at least 15 minutes after start-up if you wish to perform calibration.
- Check if logging is on, 4.9.3 Data Logging

5.8 *Water calibration*

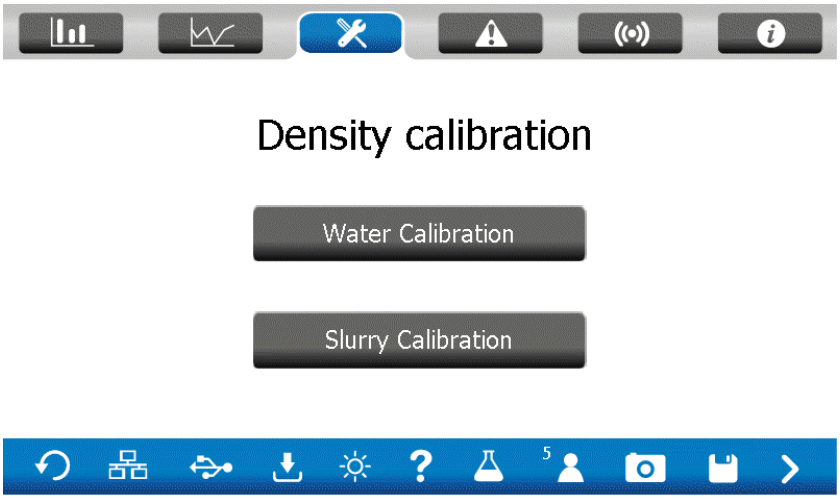
To perform a water calibration, follow the next steps.

a) Make sure there are no alarms on the display. If there are any alarms shown, please refer to the Alarm Section in this manual to resolve them first before the Slurry Calibration is attempted.

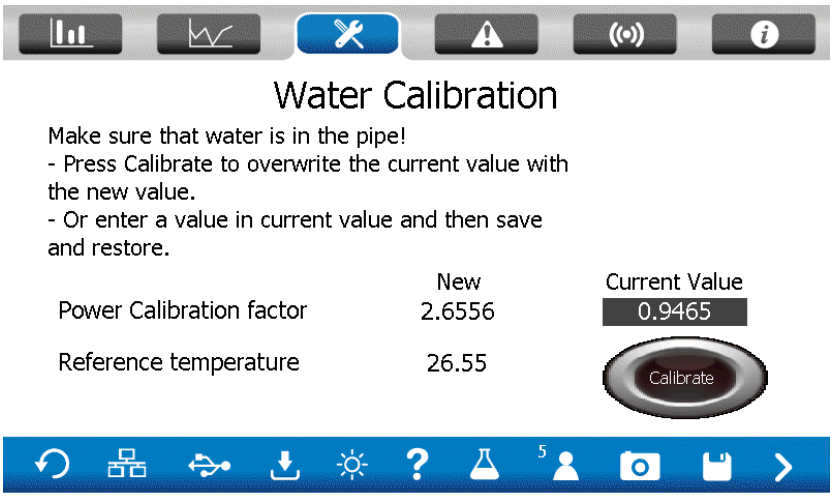
b) Press the SG box (or density box) as shown in the figure below.



c) Press Water Calibration.



d) The following menu will open with a prompt for a level 5 User ID and Password code in order to gain access. See par 3.9.7 for the code list.



e) Make 100% sure that:

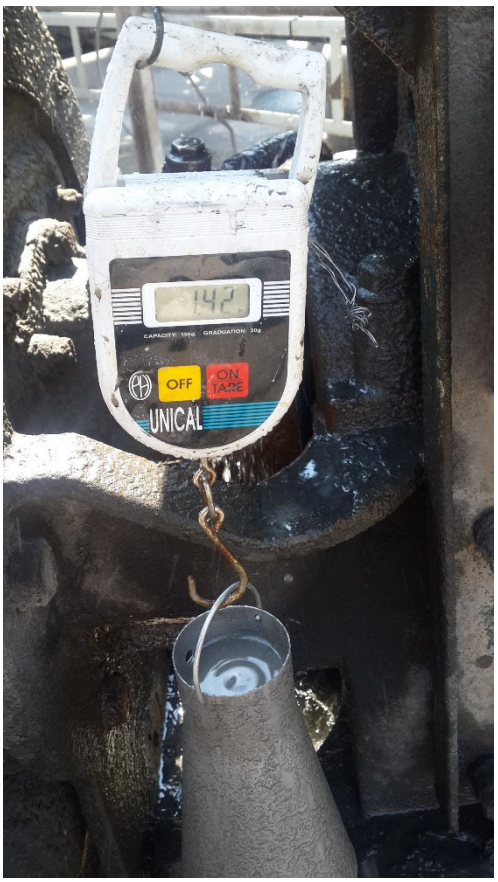
1. The medium is water and pumped at a normal rate; Take a sample to be sure!
2. The medium is as clean as possible. Take a sample to check it;
3. The process SG and temperature readings are stable.

Then, press Calibrate. Now, apply slurry to the pipe and perform the slurry calibration.

5.9 *Slurry calibration*

The conditions in our lab will be different from the conditions in the field. Therefore, an initial calibration is needed.

- Apply high dense slurry until a stable measurement of SG is given.
- Calibrate the density as well on this slurry, following the next steps.

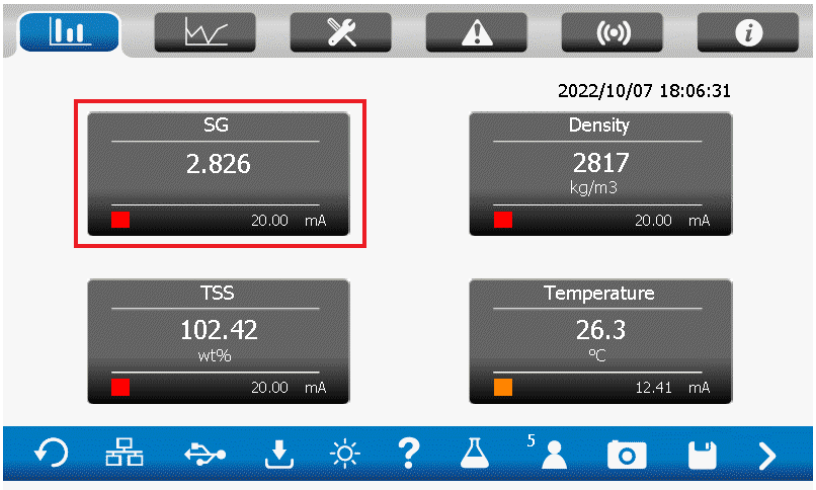


a) Obtain a representative grab sample of the slurry in the line and to weigh it accurately. This sample has to be exactly 1 liter and is best to be drawn from a sample point in a vertical part of the line where the sample is already homogeneously mixed. A 1L slurry grab sample beaker is preferred but if this is not available then a standard lab beaker of over 2L can be used. **Please note**: It is important to weigh the dry empty beaker before the sample is drawn since this weight has to be deducted from the total weight once the sample is drawn. Fill the glass beaker between 1 and 2 L. Make sure you do not need to drain, after filling the beaker.

b) The next step is to weigh the grab sample with an accurate electronic scale with at least a 2-digit kg readout. If needed, deduct the weight of the empty beaker. Divide the measured weight by the volume of the sample in the beaker.

c) Once the result is known, the actual Slurry Calibration can be done.

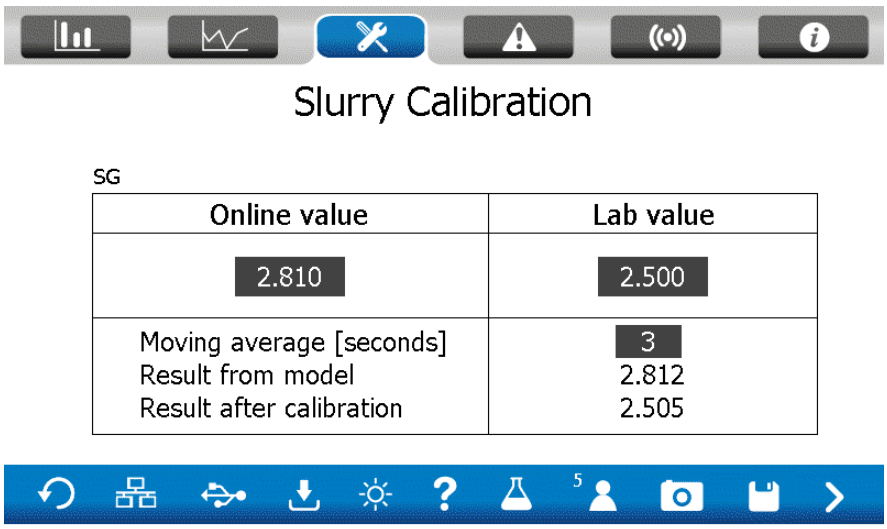
d) To calibrate one of the four parameters, press the corresponding grey box. However, always start with calibrating the SG / density.



e) After pressing the SG box (or density box) in above picture, the following menu will open with a prompt for a level 5 User ID and Password code in order to gain access. See par 3.9.7 for the code list.

f) Press OK, which will then open the Calibration Menu. Select “Slurry Calibration”.

g) Calibration is done with a linear function between a low value (process water) and a high value (f.e. high dense slurry). The initial setting could be:



h) Note that you can choose to calibrate SG.

i) Read the value in the right column next to "Result from model" and insert it in the High block in the left "Online value" column. That is the SG / density reading of the Arenal analyzer at that moment, based on the physical model.

j) Next, insert the SG / density value of the grab sample in the right-hand High block in the "Lab value" column.

k) The last action to complete the calibration procedure **(Very important)** is to save all the new settings by pressing on the "Stiffy Icon"  at the bottom of the screen.

l) The system is now calibrated with a new factor to the exact same value as the grab sample and is back online.

The other parameters can be calibrated in a similar manner by pressing the corresponding box. The Slurry Calibration of TSS is slightly different. The percentage is set from 0 to 100%. The TSS can only be calculated when the density of the solids is entered and saved.

- From time to time or after some part was replaced a Slurry Calibration may be necessary to compare the measurement with the lab results. It is at this stage assumed that all other set-up parameters such as measuring ranges, polynomials and output settings etc. are still the same as when the system was originally commissioned. In case these parameters have changed or need adjustment for whatever reason, please get in touch with Arenal's support team. The Slurry Calibration corrects the density reading and can be done online within a few minutes. There is no need to switch the system off or to remove any parts from the line.
- The best way to do multi-point slurry calibration is to follow the next steps.

a. Set Moving average to 1.

b. Start the logger on a frequency of 1 Hz. The logger contains raw measurement data and results from its original model, as well as the calibrated values. With the logging file Arenal can assist you with increasing the accuracy of your calibration.

c. Pump process water through the line at the same temperature as the slurry temperature. Keep it running for at least 20 minutes. The laboratory value of process water ("Lab Value/Low") shall be 1.000. Enter the "Result from Model" in the box "Online Value/Low".

d. Pump high dense slurry through the line. After 15 minutes, press the Erlenmeyer  button on the bottom.

d.1. Press "Start" just before taking the sample from the process.

d.2. Press “Stop” just after taking a sample from the process.

d.3. Write down ID number

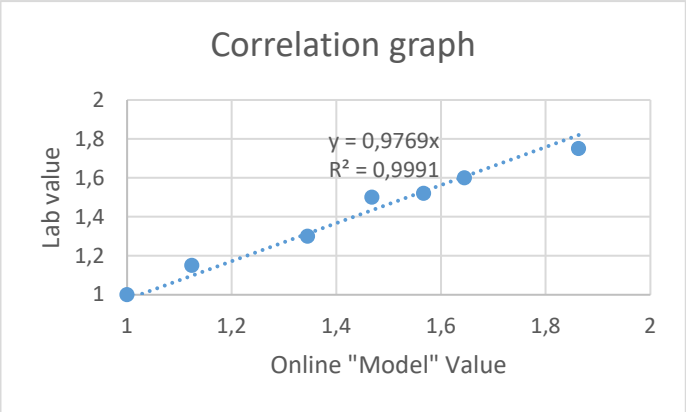
d.4. This ID number is written down in the logging file.

e. Repeat [3] several times for different slurry densities. Present the data in a xy graph in Excel to determine the best fit for the new calibration. Take a high point on this fit and add this point to the “high” calibration. SAVE.

f. If you have any questions, ask Arenal for assistance.

Each second a new value is presented. If this interval frequency is not needed, one may choose to increase the moving average.

The Result from Model shows the value before this calibration.



Example Multi-point calibration

Sample ID	Date	Time	Online value "Model"	Lab Va-lue
			1	1
1	18-apr	9:00	1,567	1,520
2	18-apr	11:30	1,468	1,500
3	18-apr	14:00	1,124	1,150
4	19-apr	9:30	1,645	1,600
5	19-apr	11:00	1,345	1,300
6	19-apr	13:30	1,863	1,750

Fictive high point calibration:

Online 2,0000

Lab 1,9538 (=0,9769 * online value)

In case of the slurry properties are temperature sensitive, perform a Temperature Sensitive Slurry Correction.

When a temperature drift appears to be present, after all previous calibrations, proceed as follows:

a) Press the “SG” box, login and press “Water Calibration”. Make a screenshot ( ).

b) Remove USB stick by Pressing ( ) and “Remove USB Stick”

c) Send a complete copy of the data on the USB stick to the Arenal service team (service@arenal-pcs.com) by www.WeTranfer.com and add the data from the laboratory measurements (indicating date, time and SG) as well.

d) Arenal service team will send you temperature correction coefficients, see below in the table. Press the “Temperature” box.

e) Enter the given value for “Temperature Correction Coefficient”.

f) Press the stiffy icon to SAVE and save to USB.

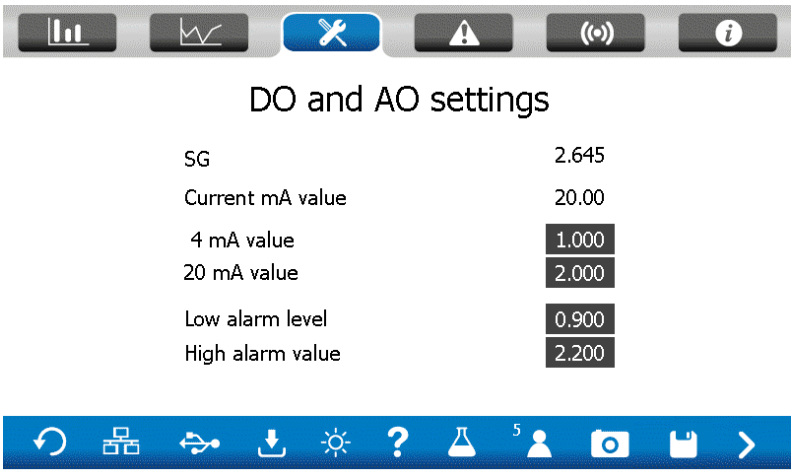
g) It is expected that a new slurry Slurry Calibration needs to be done. We made an initial suggestion in the table above.

5.10 *Configure digital and analog outputs*

Standard settings for 4-20mA output:

- SG: 1,0 … 2,0. To change in main screen press -> slurry calibration -> click . Here settings may be changed.
- Temperature: 0°C … 50°C. To set own values in main screen press -> click . Here settings may be changed.

Correct mA outputs can be set by pressing -> IO module -> mA out settings.
In case of IO module in analyzer output can be set to desired parameter number. (through the pages).
To get to the different mA values and alarm levels per parameter, go to the parameter calibration by clicking the grey box of the corresponding parameter at the start screen and pressing the next page button. That will show the following page:



On this page, you can change the mA output range, the alarm levels and the model boundaries. Press the save icon to use and store the new values.

6. Calculations

In this chapter an explanation can be found on the background of our measurements.

6.1 *Temperature*

The temperature (T) of the slurry can be measured by an ultrasonic sensor, only when the ultrasonic signals in the sensor are influenced by a temperature change. It appears that the speed of sound in the probe is depending on the probe's temperature. During lab tests the relation between temperature and speed of sound is determined and the coefficients of a polynomial equation are entered into the ultrasonic transmitter. As speed of sound is accurately determined, the sensitivity of ultrasonic probes is better than PT1000 elements.

6.2 *Density and SG calculation*

According to physical laws, the acoustic impedance (Z) is equal to the speed of sound (c) in the liquid and the density (ρ) of the liquid, as a specific temperature (T). So ρ = Z/c. c is a function (polynomial equation) of Z and T, so ρ = f(Z, T), or a little different and better: SG = f(Z,T). This is a polynomial equation given in the ultrasonic transmitter.

Density is calculated by multiplying the SG with the density of water (polynomial equation with the temperature as an input) at the same temperature.

6.3 *TSS calculation*

The amount, or weight percent suspended solids, are calculated by the next formula (ref: Wikipedia)

$$\phi_{sl} = \frac{\rho_s(\rho_{sl} - \rho_l)}{\rho_{sl}(\rho_s - \rho_l)}$$

Where,

ϕ_{sl} is the solids fraction of the slurry (state by mass)

ρ_s is the solids density, entered in the ultrasonic transmitter

ρ_{sl} is the slurry density, calculated before

ρ_l is the liquid density, which is as a standard water

In aqueous slurries, as is common in mineral processing, the specific gravity of the species is typically used, and since is taken to be 1, this relation is typically written:

$$\phi_{sl} = \frac{\rho_s(\rho_{sl} - 1)}{\rho_{sl}(\rho_s - 1)}$$

Even though specific gravity with unit tonnes/m^3 (t/m^3) is used instead of the SI density unit, kg/m^3.

Above function is implemented and can be locally calibrated if needed. As a basis for the calculation, the model result of SG is used, not the field calibrated value.

6.4 *Flow calculation*

Assume ID of pipe DN100 = 98 mm = 0,098 m. >> Surface of the cross section = pi/4*D^2 = 3.14/4*(0,098^2) = 0,00754 m2

If velocity is 5 m/s, the flow is: 5*0,00754 = 0,0377 m3/s = 136 m3/h

6.5 *Massflow calculation*

Assume:

SG of solids= 4200 kg/m3

Slurry density=1250 kg/m3

Flow= 136 m3/h

Slurry Massflow= density*flow = 1250 * 136 = 45000 [kg/m3 * m3/h] = 45 t/h slurry massflow

$$\phi_{sl} = \frac{\rho_s(\rho_{sl} - \rho_l)}{\rho_{sl}(\rho_s - \rho_l)}$$

TSS= 4200*(1250-1000)/(1250*(4200-1000)) = 4200*250/1250*3200 = 26,25%

Solids massflow = 26,25% * 45 = 11,8 t/h

Production time = 24h -> Solids Massflow production = solids massflow * 24 = 284 t/day

7. QT01 – UDT (Ultrasonic Density Transmitter)

This chapter explains all connections, functions and settings for the QT01x-UDT. This module controls the Ultrasonic Density Probe.

7.1 *General information*

The Ultrasonic Density Transmitter (UDT) produces an electronic high voltage pulse for the Ultrasonic Density Probe (UDP) and samples, digitizes, conditions and averages the analog measurement information. The information is stored in the Modbus registers to make it available to the SDA.

The SDA saves its measured values to its internal user memory. In addition, according to the user Parameter setup, calculations are done on raw, digitized and filtered measurement values.

To control the UDT, the SDA runs a small program to receive the digitized, raw measured values, evaluate them, change settings in the UDT or starts an error.

The UDT is not hot swappable, so remove power from the SDA before connecting it to the UDT. Also first connect the Ultrasonic Density Probe (UDP) to the UDT before powering up. Once powered up, it runs automatically.

For Slurry density monitoring we offer 9 product variations:

QT011..QT017 and QT019: UDT is mounted in a separate enclosure

QT01x…QT019 UDT: UDT can be preinstalled on the base board or mounted remotely

When changing the UDC, always note that the inner core of the coaxial cable shall be connected to “+” on the bottom terminal of the UDT. The shielding shall be connected to “-“. Mounting reverse wise will depolarize the UDP.

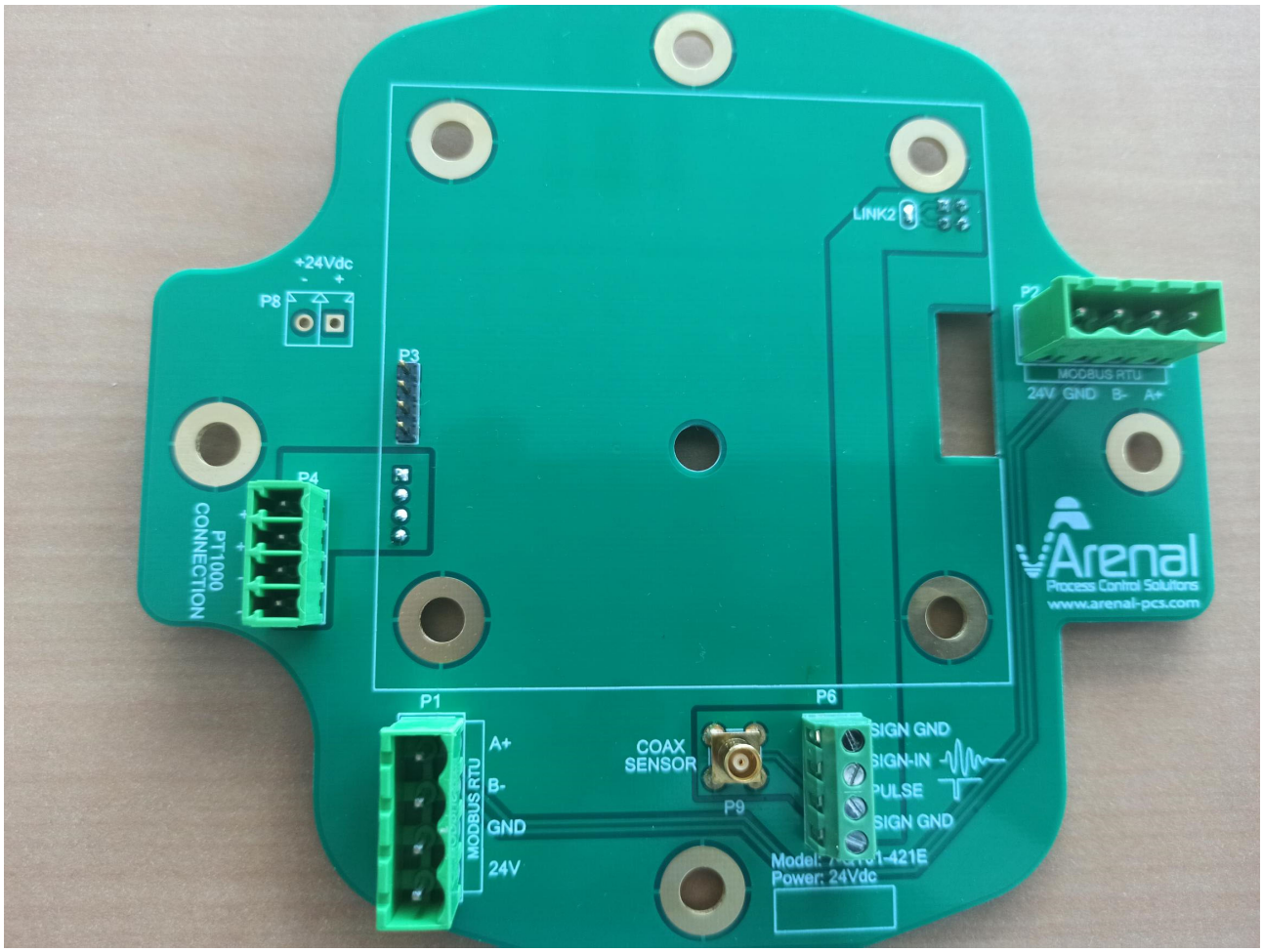
Do not (never!) short circuit the “+” and “-“. The 180 Volt pulse will cause too high currents, that the pulser circuitry will get defect within 1 ms.

Do not switch the connectors of the power supplies.

Do not power the 24Vdc circuitry with 90-263 Vac power. Also not when the fuse is not in place. The fuse only is a security for the 24V+, not the 0V. This will affect all electronics on board.

7.2 Electrical connections

Connect the inner core of the coax cable to the coax connector, or to the SIGN-IN. Connect the shielding of the coax cable to SIGN- GND. Different versions of UDT's are available, but the names are the same.

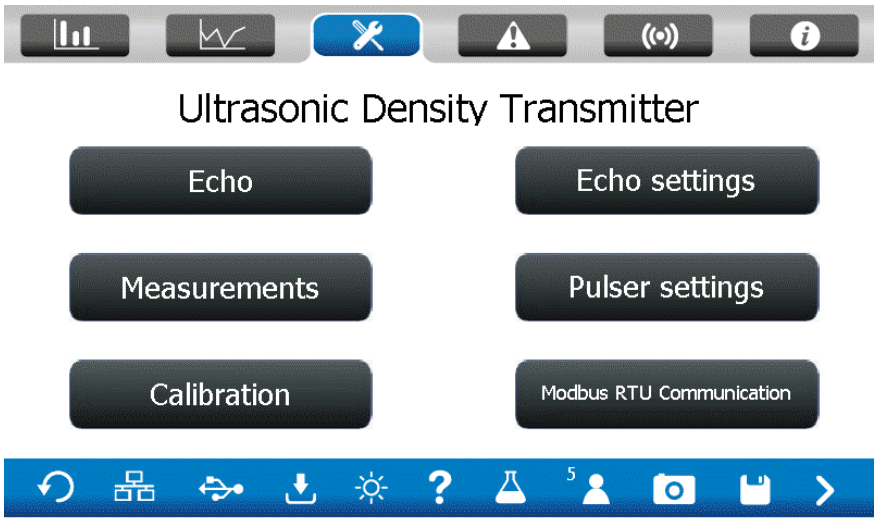


The connections on the baseboard 4-QT01-422A are available on the 12 pin terminals:

F-	White/Brown: Forced current of the PT1000
S-	White/White: Sense of the PT1000
S+	Red/Green: Sense of the PT1000
F+	Red/Yellow: Forced current of the PT1000
24V, GND, A+, B-	Modbus cable from analyzer or TMT: follow the color coding!
SIGN-IN	Signal in, pulser signal and echo's (inner core of the coax)
SIGN-GND	Ground of the Ultrasonic Density Probe (shield of coax)

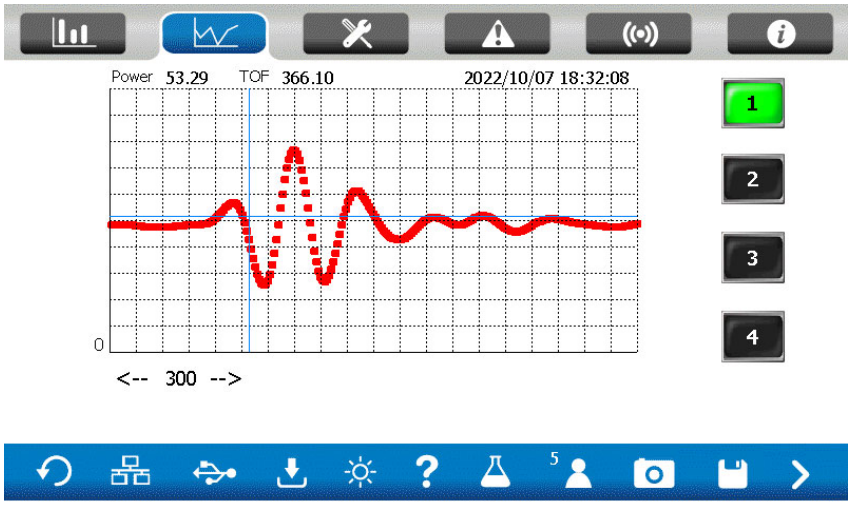
7.3 *Advanced Setup*

To set up the UDT in the analyzer, go to Configuration Menu and press “Ultrasonic Density Transmitter”.



7.4.1 Echo

Press “Echo” in the menu bar to show the actual echo from the probe. This echo is updated each second.

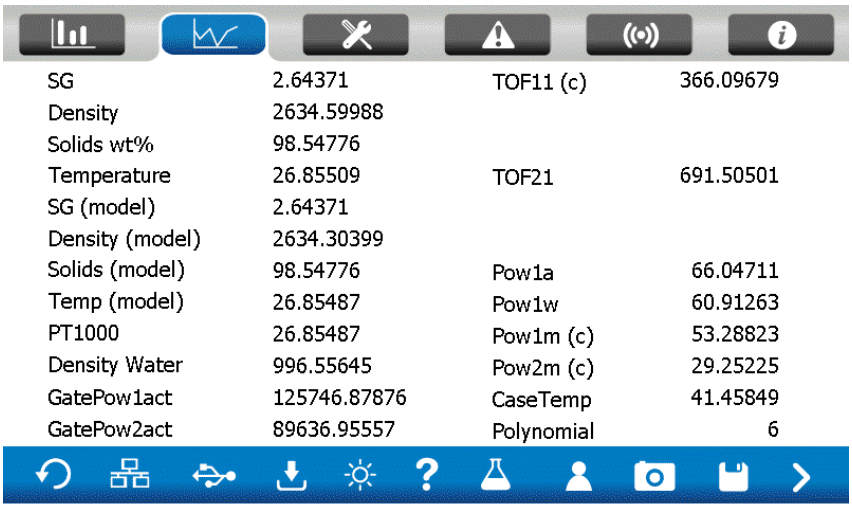


Important is the shape of the echo. This one looks great; it should always look like this. Only in case of air bubbles, the shape of the echo changes.

The scope shows the amplitude of the echo within the ADC range of the circuitry. The x-as shows the time of flight after the initial pulse in microseconds.

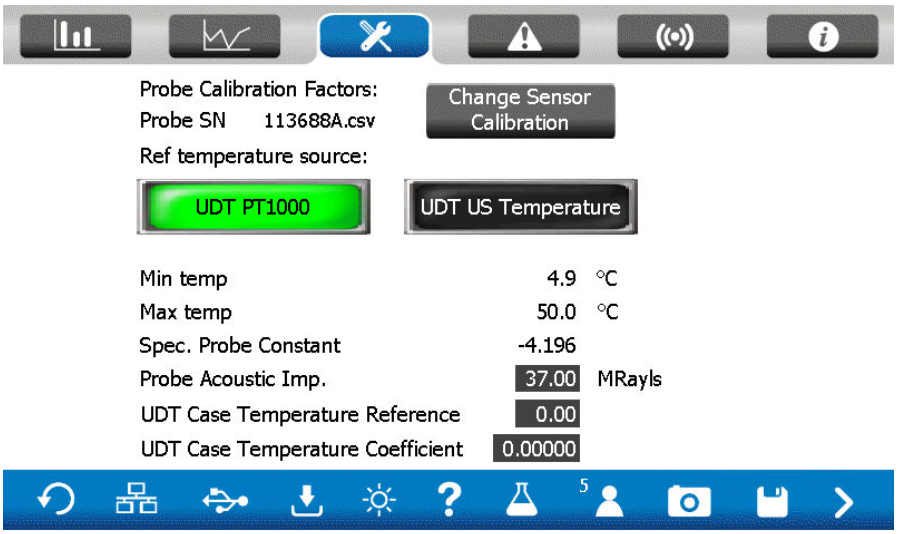
7.4.2 Measurements

Press the bar “Measurements” to find the end results of the UDT: in the left column the results are shown, in the right column the raw values are shown. If a PT1000 is not connected, the result of the calculation is -588.



7.4.3 Menu Bar: Calibration

Press the bar “Calibration” to find the calibration coefficients of the probe.

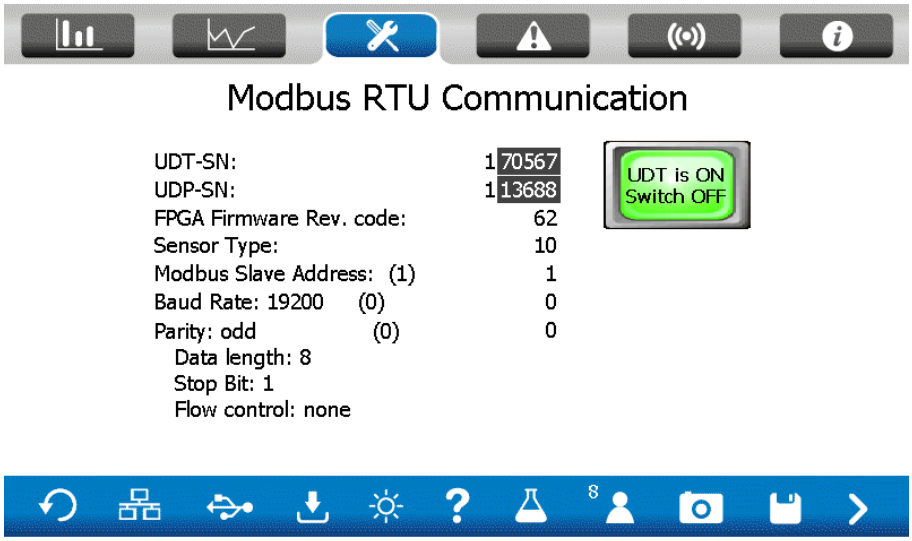


The coefficients are read by the calibration file on the USB, starting with the Serial Number of the probe, followed by a version number given by Arenal and shall be exactly filled in. This name is shown in “Probe SN”. If you change it to another probe, then change the Probe SN and press “Change sensor calibration”.

No coefficients should be changed, unless requested by Arenal.

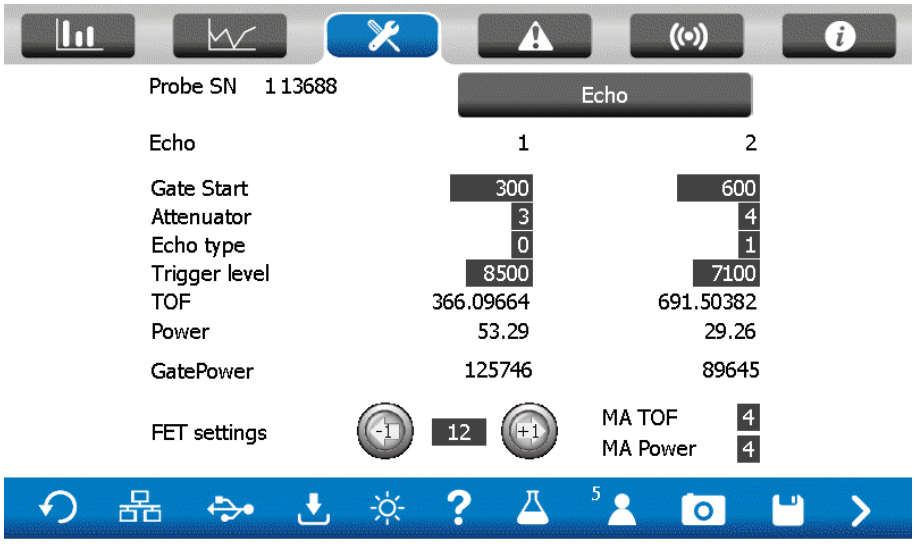
7.4.4 Modbus RTU Settings

To check the communication and the serial numbers of the UDT and the UDP, choose Modbus RTU Communication in the menu. The password will separately be given by the Arenal Service team.



Do not change these settings unless requested by Arenal.

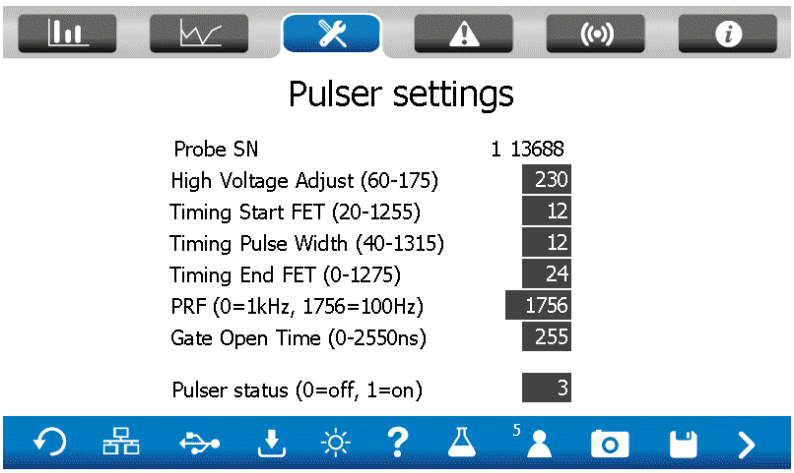
7.4.5 Echo settings



All settings of the echoes can be viewed in the Echo Settings. Advise the calibration sheet of the corresponding Probe SN about these settings. These settings should normally never change.

7.4.6 Pulser settings

All settings of the pulser can be viewed in the Pulser Settings. These settings should not change as the calibration will change.


Pulser settings
Probe SN
1 13688
High Voltage Adjust (60-175)
230
Timing Start FET (20-1255)
12
Timing Pulse Width (40-1315)
12
Timing End FET (0-1275)
24
PRF (0=1kHz, 1756=100Hz)
1756
Gate Open Time (0-2550ns)
255
Pulser status (0=off, 1=on)
3
5

8. QM132-IOM

Analog in- and outputs are controlled by the IO Module. There are 2 mA inputs, 2 mA outputs, 2 digital inputs and 2 digital outputs available via the IO Module. All available outputs are described in this section.

8.1 *General information of the QM132-IOM*

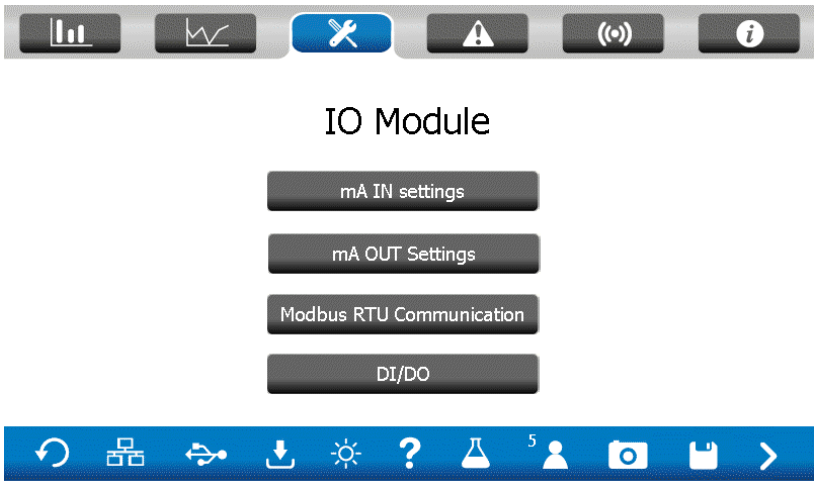
The Arenal Modbus Serial I/O Module operates as a Modbus RTU slave device when connected to the baseboard of the analyzer. The IOM is a general-purpose data acquisition or DAQ card that is multi dropped onto a serial 2-wire RS485 link to a Modbus Master, the C7E PLC.

The module features

· 2x 16 bit Analog Inputs 4-20mA, galvanically isolated from the PCB
· 2x 16 bit Analog Output 4-20mA, galvanically isolated from the PCB
· 2x DI & 2xDO

8.2 *Set-up*

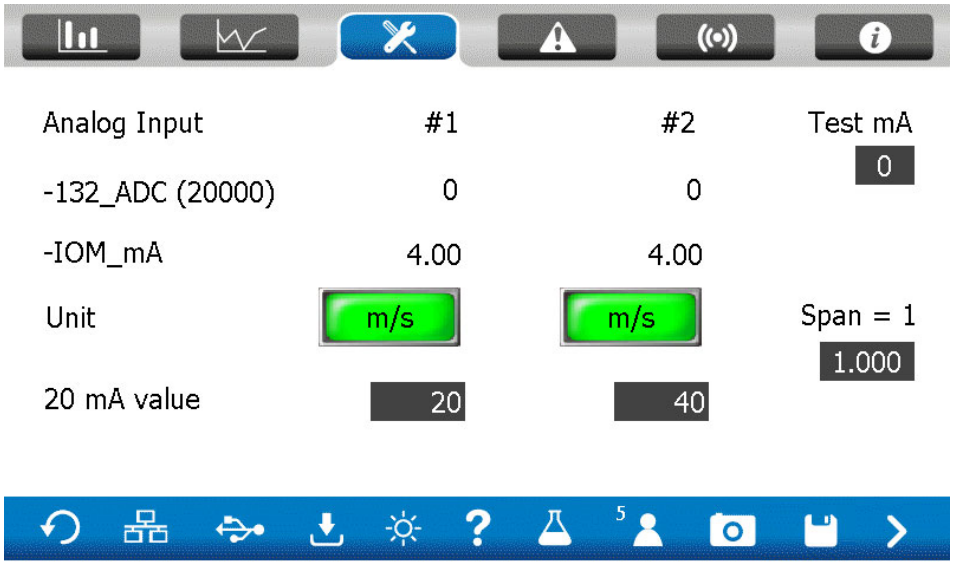
To set-up the IOM, go to the Configuration Menu and press “IO Module”.



8.2.1 Menu bar: mA IN Settings

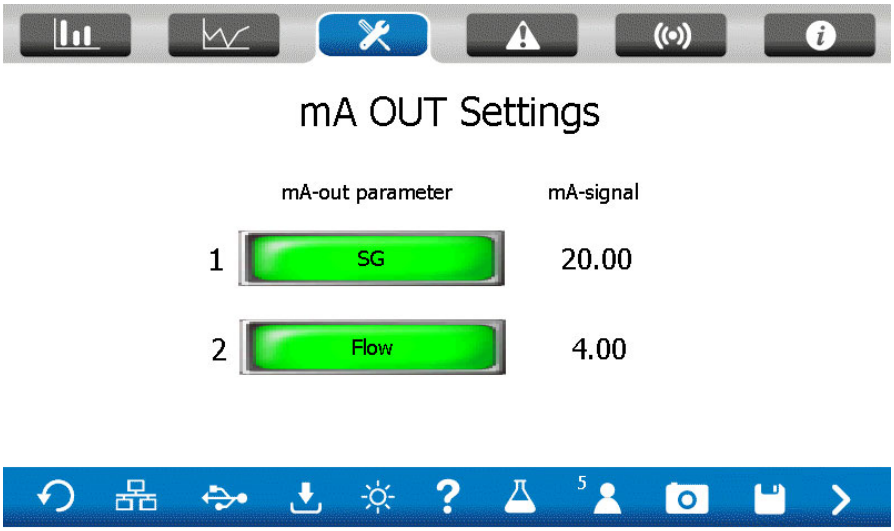
Press “mA IN Settings” in the main menu. After connecting a mA to the IO module, these signals are digitized and can be read out immediately:

Insert the unit and the range for the 20 mA signal. Initial Span shall be at 1.0. To test what happens with an imaginary mA input, enter a value of choice in “Test mA”



8.2.2 Menu bar: mA OUT Settings

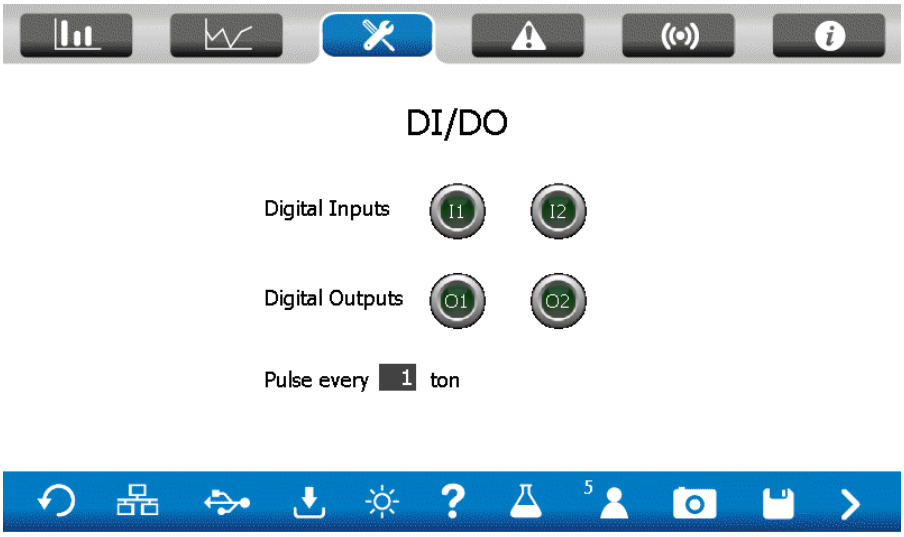
Maximum 2 mA output signals can be configured in the IOM. Select the parameter of interest for the selected output channel, like SG connected to the AO-1. Flow to AO-2.



8.2.3 Menu bar: DI/DO

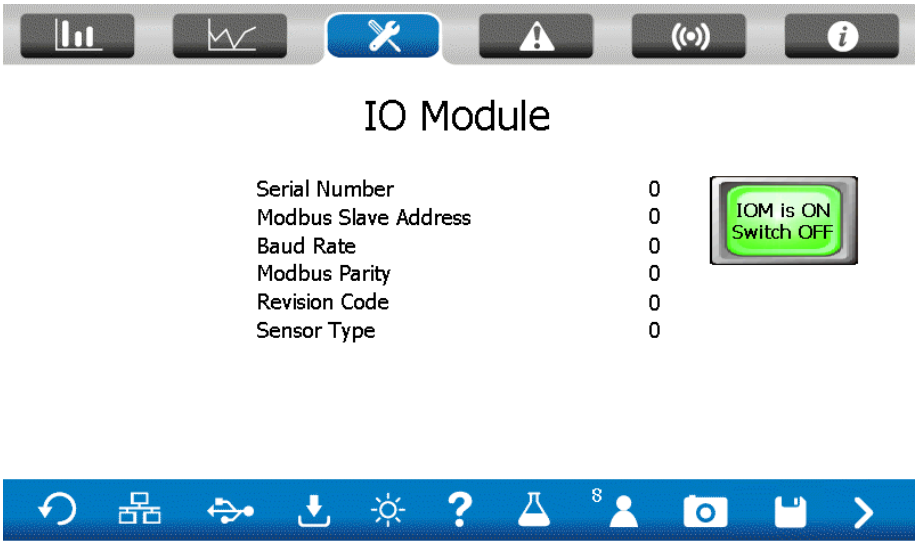
The QM132-IOM has digital inputs and outputs.

In this screen the status of each is shown. The lamps will turn ON when high.



The tonnage Dry Solids is available on the open collector output, as per Installation Manual. You can select for how many tons produced dry solids, a pulse is provided on the output.

8.2.4 Menu bar: Modbus RTU Communication



The slave address of the IOM is 13.
This screen shows the current communication settings. Note that starting the IOM without a physical connection, can make the system stop and difficult to recover.

8.3 Ground loops

When connecting an externally powered 2-wire 4-20 mA signal, be warned about ground loops! Avoid ground loops: they can have influence measurement results. Here is some information how this works and how it can be solved:

The IOM has two passive mA inputs. That means that no power is provided to a loop, but only measure the current that is streaming through the connectors. A difference in power and in grounding, can cause ground loops that affect mA inputs.

Secondly, when the distance between transmitters and receivers increases, the ground resistance increases, due to the resistance in the cable. Many transmitters require a 'ground' potential for their measurement, and many transmitters are not protected from ground currents leaking into the system. So good grounding is a big issue.

In the third place, mA transmitters are powered by 24Vdc, but sometime a HF ac current is applied to the power supply, due to bad design. These HF currents can influence the isolation barrier in the IOM.

The cure is called "isolation" and "filtering".

Isolating each single mA in- and output is not always needed but very costly, so Arenal isolated only the mA signals from the Modbus convertor, so that big failures on the mA lines cannot harm the rest of the network. HF signals can influence the isolation properties.

Ground loops are a common problem in instrumentation and several solutions can be found.

1. Power the mA transmitter and receiver by the same power supply. We have 24Vdc available in the IOM or in the analyzer.
2. Install a common mode filter, which reduce HF current frequencies, in the mA connection cable, like:
    1. Würth, 27MH, 0.4A (Farnell: 1748631)
    2. Würth, 39MH, 0.4A (Farnell: 1748632)
3. If this cannot be done, install a galvanic isolator. First test the common mode voltage of the mA transmitter: take a voltmeter, set it to the DC Volts scale and measure between earth ground on the recorder and the disconnected, freestanding positive wire from a transmitter. Do the same for the negative leg. Report back to Arenal PCS.

    Then select a "loop isolator" or “analog isolation amplifier/barrier” from the list below:

    1. WAGO 857-400. Farnell 1630505 around Euro 550
    2. Drago DN28 P-12. 89 euro. Power it from the IOM

9. QM146-RMM – Remote Monitoring Module

This chapter is left open intentionally. Will be filled with information about the RMM shortly.

10 TCP/IP Register

The HMI can be approached via a TCP-IP connection. Via the Modbus register, the user can obtain measurement values and interact with the HMI.

10.1 *Results of parameters*

For the C7E HMI, measurement values are available as floats.

All the values are 32-bit which are written to 2 consecutive 16-bit word addresses in **Little Endian with a byte swap**. It is very important that the decoding of the values is done correctly to ensure the correct values are returned.

It is also important to fill in the correct start address for all the values. The addresses in the table below show the PLC addresses, it can sometimes be that Modbus masters start at 0 instead of 1 for the first address. This means it can be that you need to fill in start address 97 if you want to read PLC address 98.

You can test if all the settings are correct by trying to read the test value at address 98. If you get '123456' as its value, it can be assumed all other values are correct as well. A list of the available values can be found in the table below:

Modbus Register	Size (words)	Data Type	Description
40098	2	Signed Integer	Test value (Value is always '123456')
40100	2	Signed Integer	Dredging Counter Seconds
40102	2	Float	SG
40104	2	Float	Density (kg/m^3)
40106	2	Float	TSS
40108	2	Float	Temperature (Celsius)
40110	2	Signed Integer	Massflow Solids (mA)
40112	2	Signed Integer	Massflow Solids (t/h)
40114	2	Signed Integer	Massflow Slurry (mA)
40116	2	Signed Integer	Massflow Slurry (t/h)
40118	2	Float	Flow (m/s)
40120	2	Float	Flow (m^3/h)
40130	2	Unsigned Integer	Shift Solids Production (t)
40132	2	Unsigned Integer	Shift Slurry Production (t)
40140	2	Float	mA Input 1
40142	2	Float	mA Input 2
40144	2	Float	mA Output 1
40146	2	Float	mA Output 2

11. Maintenance, Troubleshooting & Support

This chapter lead you through the most common maintenance and troubleshooting topics. When you are unable to solve the problem using the manual, please contact Arenal PCS through the service request form that can be found on https://www.arenal-pcs.com/service-request.html. Note that service fees may be applicable when the issue is not caused by a manufacturing defect.

11.1 *Arenal/C7E Software and firmware configuration*

The software of the SDA is frequently updated. When new evaluations take place, it is easy to update the software and to make use of the new possibilities.
Besides, it is easy to get remote support from Arenal. In this chapter all questions should be answered.

The SDA contains of two layers of software:

1) The C7E software. This software is on all C7E HMI's and contains settings, which are needed to control all IO, IP addresses and security passes. We use this software layer to update our software and to change IP address. This layer can be reached by tipping your finger first to the top left of the screen, then the bottom right, top left again, bottom right again, until a grey menu bar is activated in the bottom of the screen. This software is never updated.
2) The Arenal software, which is running the program with the measuring screens. All Arenal SDA's have the same software, but sometimes it can be updated. This program is securely stored in the inner memory of the HMI. The Arenal software is updated with new and improved functions almost weekly, but it is not always needed to update. A list of improvements is available and which can be compared to your current software. Software updates are free of charge.

Besides this software, the firmware in the transmitter is sometimes improved. The firmware can only be updated at Arenal R&D Facility. As the SDA read and writes to these transmitters, a software update of the SDA may be required as well.

11.2 *Updating Arenal Software*

If you are about to update the software, then first stop the logger, otherwise the last data is not stored on the USB stick. Unsaved data from parameters cannot be recovered, so save this data as well.

Make a backup copy of the USB stick, compress it into a zip file and send it to Arenal. Arenal uses the settings to validate the software, so that no problems occur in the field.

Warning: variables in the internal memory will be lost when updating the software.

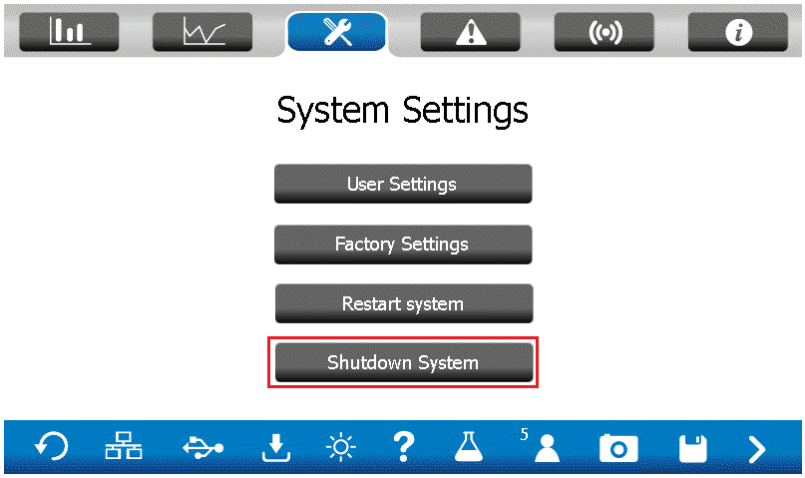
Keep the power of the system on. Do not disconnect transmitters: keep it all connected.

For updating the current software, an extra password is supplied by Arenal. When updating, the old software is removed from the HMI and cannot be recovered anymore.

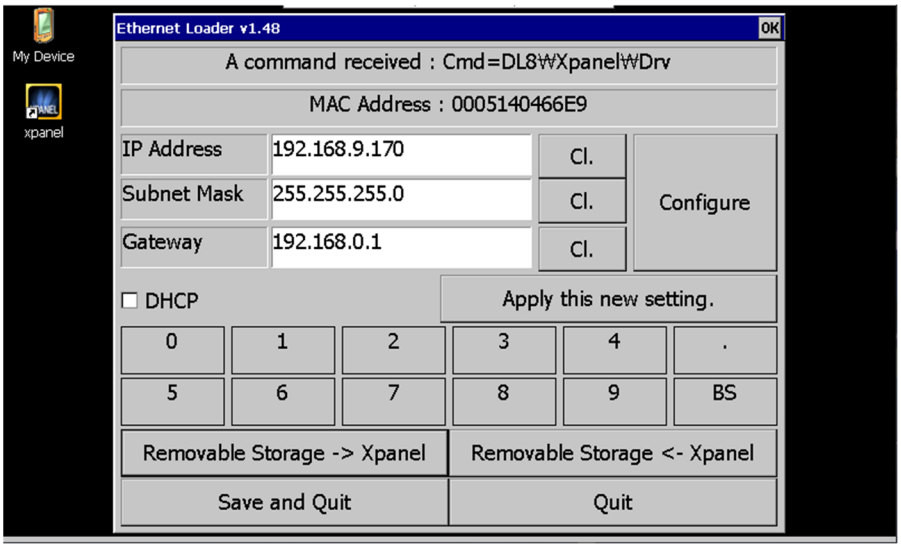
Once you updated the system, it will immediately start measuring.

1. Updating software is done with the USB Stick, first remove the USB stick from the HMI.

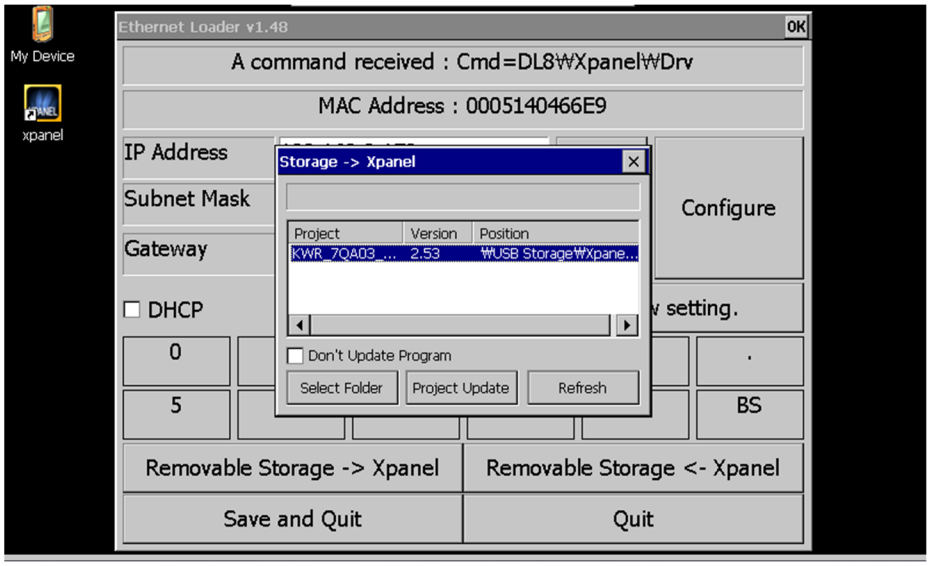
2. Download the zip file from WeTransfer.com that we have send you. Extract the zip file to the root of the USB stick. The size is about 20 MB.
3. Insert the USB stick in the SDA. Now you need to go to the C7E ethernet loader. Go to the user settings and shutdown the system:



4. When the program is shut down, you should see the following screen:



5. Then click the button “Removable Storage -> Xpanel” and the following screen should show:



6. Make sure a project is showing, if you cannot select a project, check if the USB is correctly inserted and the project is indeed on the USB.
7. After selecting the project, press “Project Update” and wait until it says “All file update: OK”.
8. Updating software takes less than 1 minute. After successful update, power cycle the HMI. Check in the information screen (serial number) the current software version (SW version), which should be the same as the number of this manual.

11.3 *How to get Remote Support*

Arenal offers Remote Support when the software or application files does not do the expected things. We offer three ways of support:

1) By GSM/GPRS Module QM146-RMM Remote Monitoring Module
2) By VPN connection
3) By AnyDesk

11.3.1 QM146-RMM

When the QM146-RMM is connected to the HMI, Arenal is able to take over control of the HMI. Download the quick set up manual from the internet to learn more.

11.3.2 VPN Remote Control

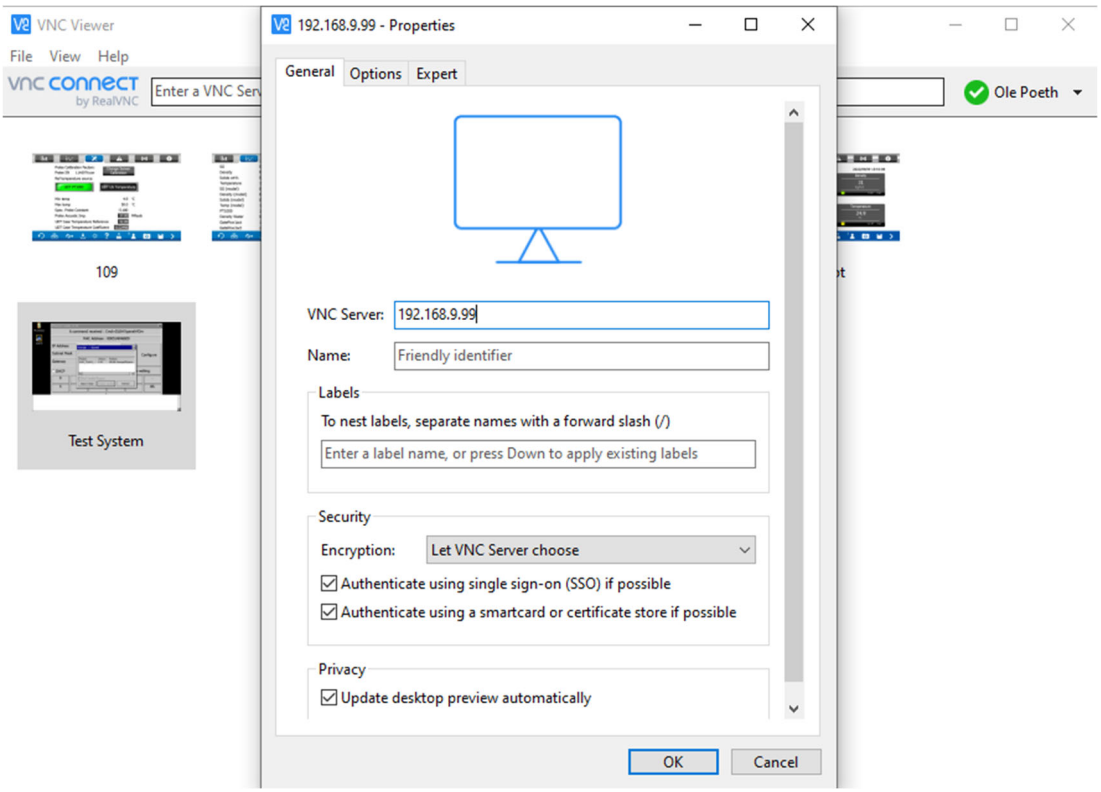
When the SDA is connected to an external VPN Modem, we can take over control of the analyzer and check the causes of the problems. More info can be requested at Arenal.

11.3.3 AnyDesk

TeamViewer was easier to get access to the system, but lacks all security. Therefor Arenal uses Anydesk software. The benefit is that we can discuss by Skype the problems and the way it can be solved. Herewith the instructions to follow:

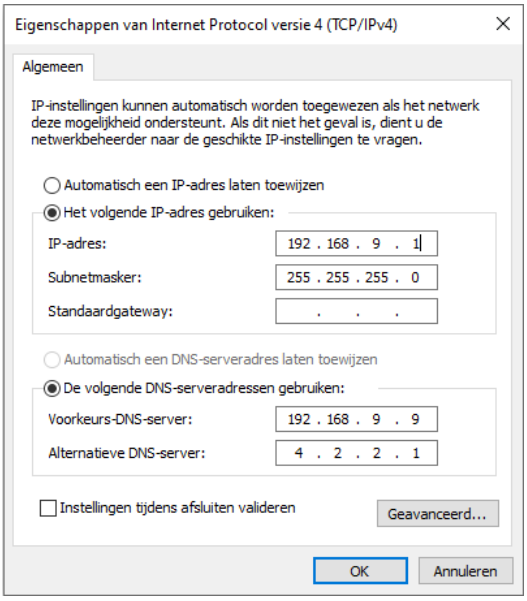
Your laptop must have installed Anydesk and A VNC Viewer client like VNCViewer. Ask Arenal PCS for assistance.

1. Connect the laptop to the C7E HMI by a LAN cable. Start-up VNC viewer client.



2. Enter the IP address of the SDA into the corresponding field (in the range 192.168.9.x). To check the IP address, go to the ethernet menu, see chapter 9.

   a) If a connection cannot be made, check the properties in your laptop's Internet Protocol version 4 (TCP/IP). Use the following IP address: 192.168.9.1 and subnetmask: 255.255.255.0.



3. Enter the password, the same as for installing new software.
4. Enter the user's service level and password.

If Arenal takes over your PC, only the echo's cannot be transmitted: if asked, please make a picture and send by WhatsApp.

If the session is finished, do not forget to restore the LAN IP setting of your PC to the automatic mode.

11.4 *FAQ and Troubleshooting*

Find a solution for FAQ's:

11.6.1 The screens do not show a language or a wrong language

This can happen after an update of the software, as in this case the internal memory is reset. But how to find the language settings, if no words are displayed in the menu bars? In that case we advised to compare the actual display with the manual. This will lead you to the System Settings Menu, then User Settings and the language. Once set, save the setting and it cannot happen again.

11.6.2 The logging data is not stored on the USB stick

If you have set the logger on the SDA will log all the data in its internal memory. When the logger is set OFF, this data is stored to the USB stick in directory "Sampling". In addition, the data is stored to the USB stick when the internal memory is full. When you cannot find the data on the USB stick, then writing to the USB stick failed. It could be that the USB stick is in the LOCK position, or that the USB stick is not ok.

11.6.3 The mA signal does not give a value

Check the corresponding value in the Configuration Menu/ mA outputs. If the output has a specific mA value, like 4 mA, then it should be available on the mA signal. If not, check all cables.

11.6.4 The HMI does not work.

Check if there is 24Vdc power available at the fuse in the analyzer, before and after the fuse. If so, remove the power connector of the analyzer and measure the power there as well, also 24Vdc. If so, measure the power at the entry of the HMI, also 24Vdc. If so, reconnect that connector. If you hear a beep sound, the HMI works. Go to the Offline menu and set the brightness to a higher level. If that is not working as well, the HMI is defective. We have units on stock, as for a replacement.

12 Warranty

12.1 *Probes*

The ceramic and metal slurry density probes are consumables with an expected lifetime of 10 year. Lifetime will be lowered due to the technology developments, wear and vibrations. The internal parts however are made according to highest standards and have a life expectance of 10 years in clean and simple fluid applications. Since the probes are used in extreme conditions and in most cased usage cannot be controlled the warranty on a probe is 6 months after commissioning by an Arenal appointed service engineer with a maximum of 1 year from invoice date. For the use in abrasive and turbulent fluids, warranty can be given under specific conditions:

Warranty can be claimed for all SIC sensors that were flush mounted in the process.
However, when the sensor was intruded in the slurry, no warranty can be claimed. In that case, the tip of the sensor can chip off, due to wear of the wafer cell or pipe ID. Customer shall check regularly the wear of the pipe and the reduce the intrusion of the sensor. Leniency is in this case given for 6 months after supply: 50% discount on a new sensor.

Warranty can be claimed for all SIC sensors that were mounted 5x internal pipe diameter after last obstruction.
When the sensor was mounted before 5x internal pipe diameter after last obstruction. A high turbulence could influence the reading of the sensor and also effect wear. No leniency is offered.

Warranty can be claimed for all sensors that were defective on its fixed cable within 6 month after supply. However, when the sensor is re-located after the first commissioning within 6 months, no warranty is given.

11.2 *Transmitters*

Transmitters in the field, like Ultrasonic Density Transmitter (UDT) shall not be opened anymore after commissioning. Its electronics is sensitive for moist, dust and electrostatic discharge. Best practice is to protect this transmitter by tape.
In some cases, it happened that FETs break without reason. In that case, you hear a clipping noise. You can shut off the instrument and ship it back within the original housing.
Warranty is given for all UDT's that break during the first 24 months after invoice date.
However is some cases Arenal does not give warranty:

- When the unit is commissioned without an appointed commissioning engineer of Arenal.
- When the Modbus driver of the UDT is defective: that is caused by wrong cabling
- When the electronics of the UDT are damaged by moist, dust or electrostatic discharge, or shortage caused by wrong handling.

11.3 *Analyzers*

Analyzers are warranted for 24 months after invoice date. However is some cases Arenal does not give warranty:

- When the unit is commissioned without an appointed commissioning engineer of Arenal.
- When the Modbus driver of the HMI is defective: that is caused by wrong cabling

11.4 *Performance of the application*

The slurry density analyzer suits most or all mineral processing slurries. In case the application does not work well, a service request can be filed via https://www.arenal-pcs.com/service-request.html. If the issue is related to a manufacturing defect and Arenal cannot solve the issue, the system can be returned for 75% money return within 24 months after supply.

In case sets of systems are mixed up, USB sticks are lost, cables are changed or any other issue not caused by a manufacturing defect, the service rate applies and warranty is not applicable on the application.

In case it is unclear what happened, Arenal will discuss with distributor how to solve the issue.

A1 Declaration of Conformity

Date:	April 20, 2016
Application of Council Directives:	EMC Directive (2004/108/EC) Low Voltage Directive (2006/95/EC)
Standards to Which Conformity is Declared:	EN61010-1:2010
Manufacturer's Name: **Manufacturer's Address:**	Arenal Process Control Solutions BV Boezemweg 23H 2641 KG Pijnacker The Netherlands
Product Name:	Ultrasonic Density Analyzer
Model Numbers:	QA03-SDA-DIS-VAC-XXX-XXX QA03-SDA-DIS-VAC-IOM-XXX QA03-SDA-DIS-VAC-XXX-UDT QA03-SDA-DIS-VAC-IOM-UDT QA03-SDA-DIS-VAC-XXX-PORT

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s).

Marius de Vries
CEO of Arenal PCS B.V.

Arenal Process Control Solutions BV
Boezemweg 23-H
2641 KG PIJNACKER
The Netherlands

Tel: +31-153010071
www.arenal-pcs.com
info@arenal-pcs.com
Chamber of Commerce Den Haag : 54416493

A2 Service support rates

Arenal offers remote monitoring service support and local assistance. Some of these services are free of charge, most are against our service rate tariff.

For remote commissioning work, the first 4 hours are free of charge. This work includes:

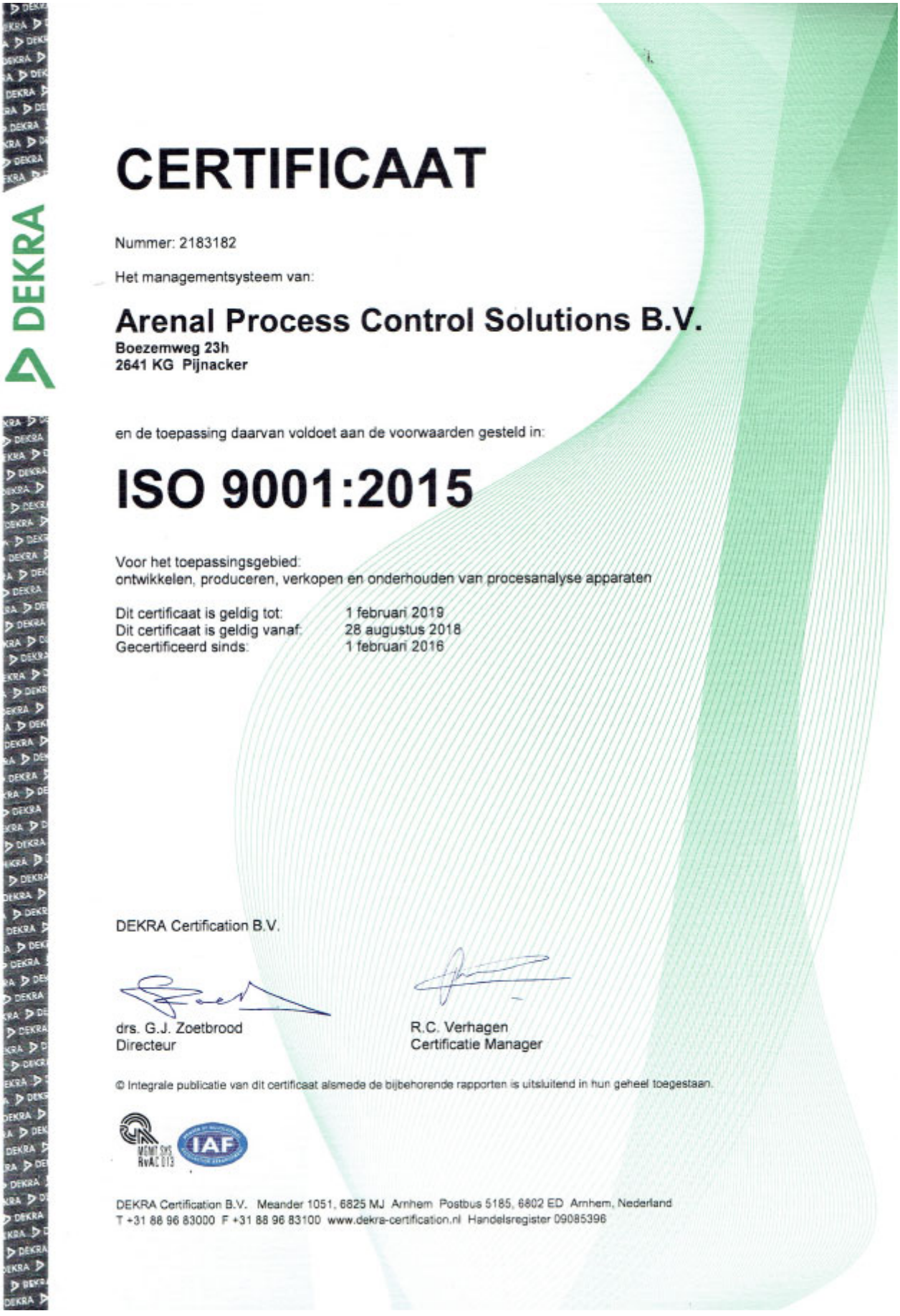
- Checking pictures for installations and wiring.
- Giving step-by-step instructions until power up.
- Data evaluation after 1 week of monitoring.

Other services are against hourly rate or contractual rate. This includes:

- Design of wafer cells, spool pieces and assemblies for local production
- Slurry Calibration assistance
- Revise probe calibration with calibration sheet
- Remote Monitoring by GP-Viewer/TeamViewer or VPN
- Service support on site
- Training
- All other services

The price list includes rates for service support KWR-5PL019-Q1 Price list.

A3 ISO-9001:2008 certificate



CERTIFICAAT

Nummer: 2183182

Het managementsysteem van:

Arenal Process Control Solutions B.V.
Boezemweg 23h
2641 KG Pijnacker

en de toepassing daarvan voldoet aan de voorwaarden gesteld in:

ISO 9001:2015

Voor het toepassingsgebied:
ontwikkelen, produceren, verkopen en onderhouden van procesanalyse apparaten

Dit certificaat is geldig tot:	1 februari 2019
Dit certificaat is geldig vanaf:	28 augustus 2018
Gecertificeerd sinds:	1 februari 2016

DEKRA Certification B.V.

drs. G.J. Zoetbrood
Directeur

R.C. Verhagen
Certificatie Manager

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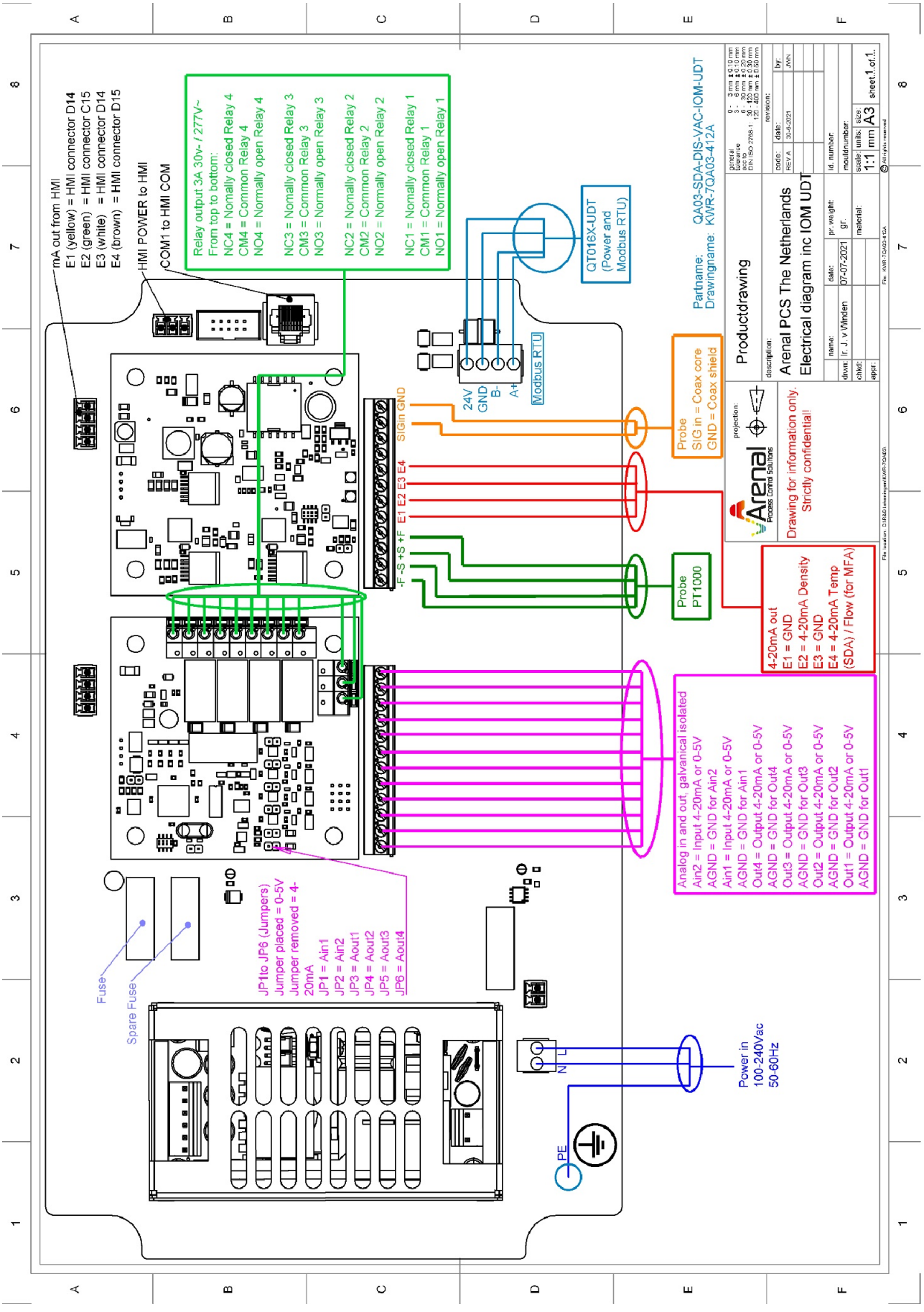
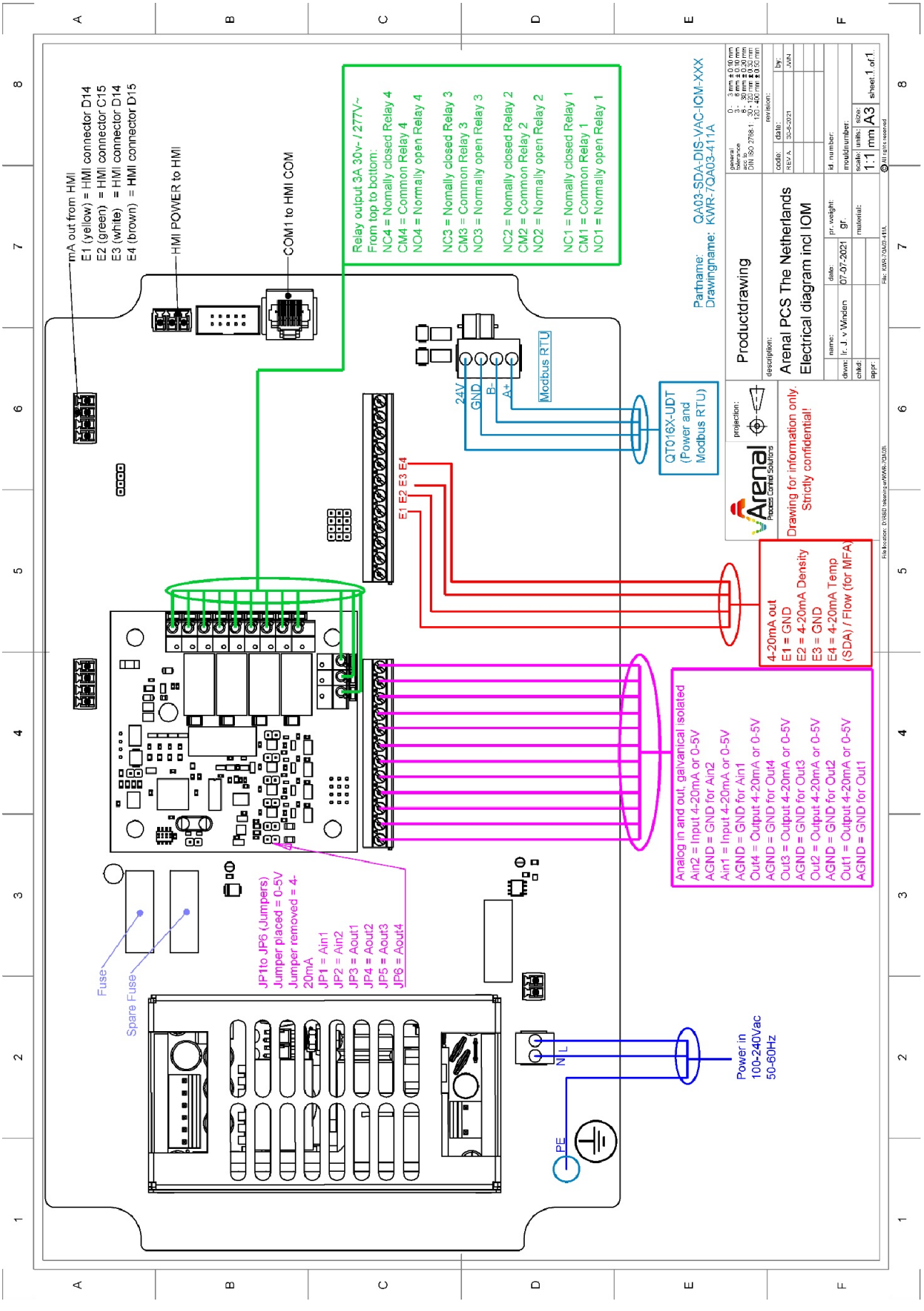
T +31 88 96 83000 F +31 88 96 83100 www.dekra-certification.nl Handelsregister 09085396

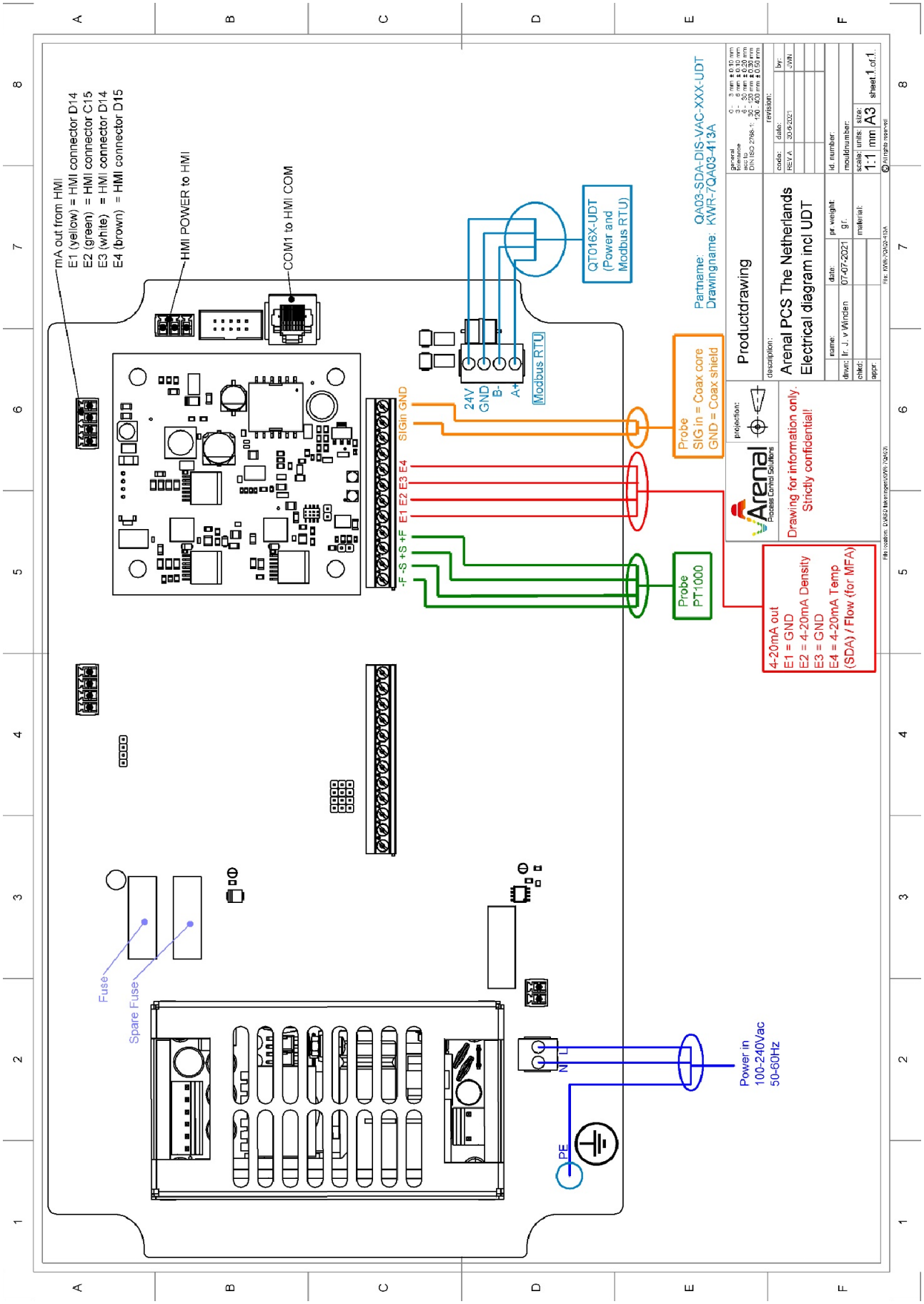
A4 Electrical diagram QA03-SDA-DIS-VAC-IOM-UDT



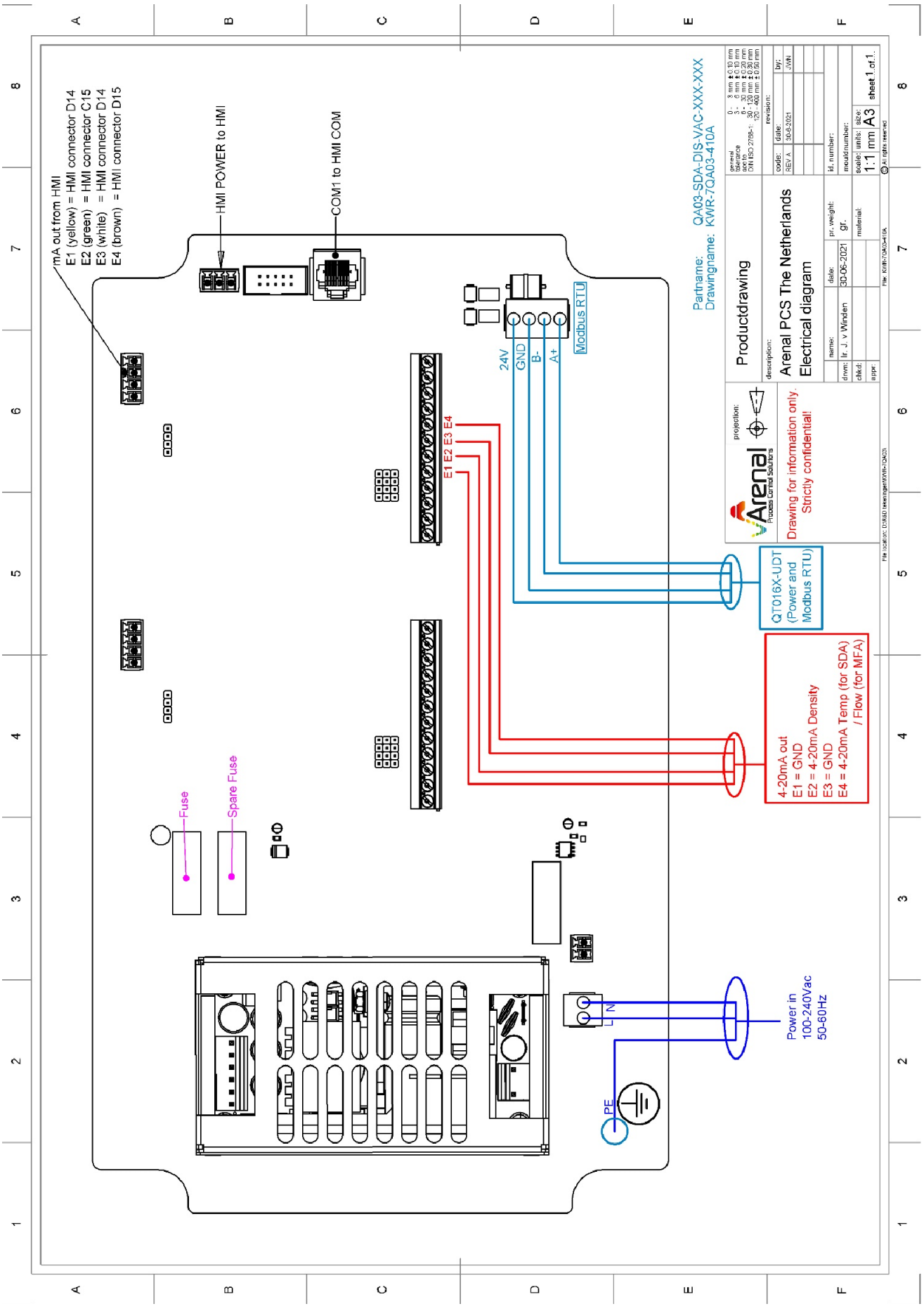
A5 Electrical diagram QA03-SDA-DIS-VAC-IOM-XXX



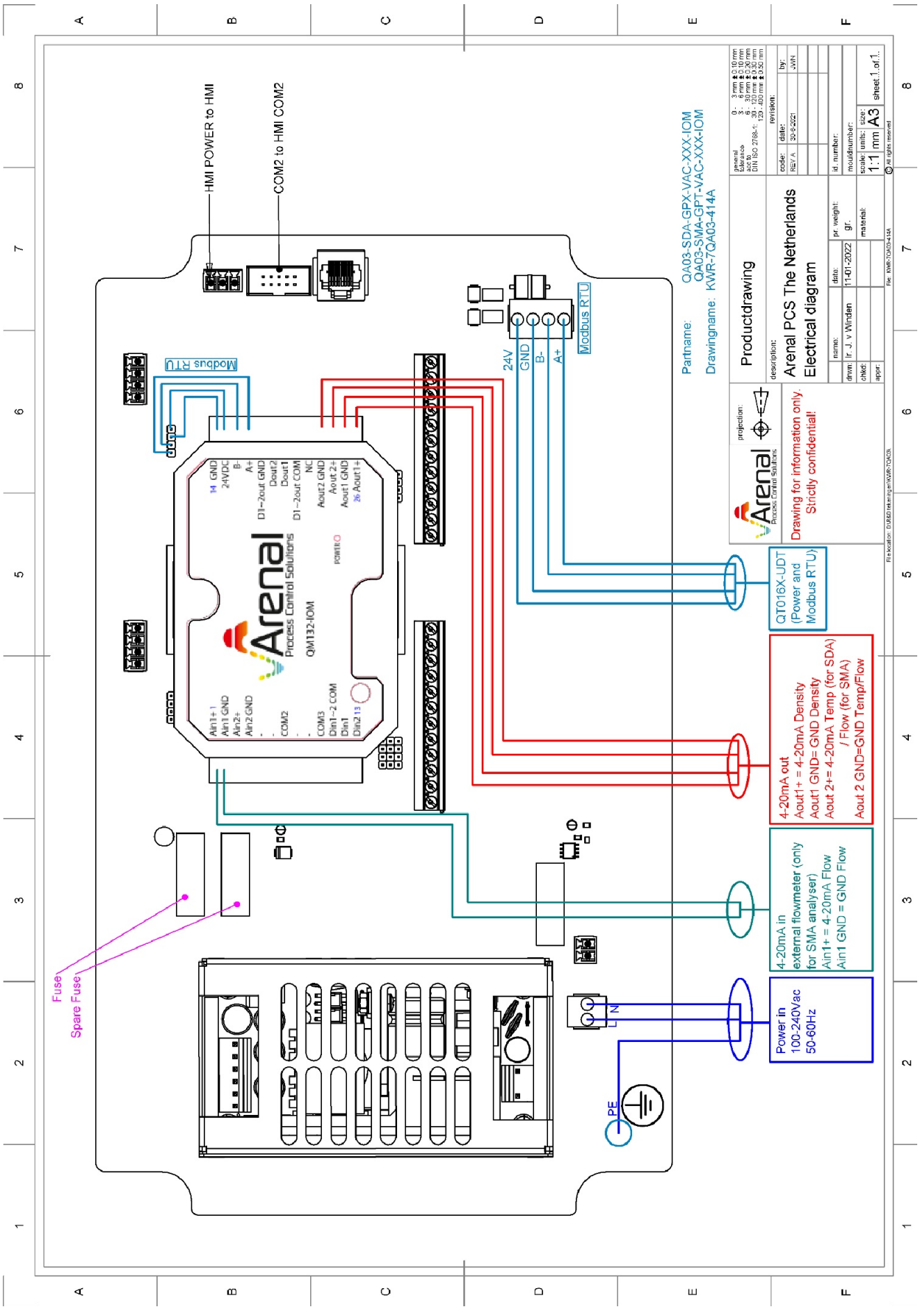
A6 Electrical diagram QA03-SDA-DIS-VAC-XXX-UDT



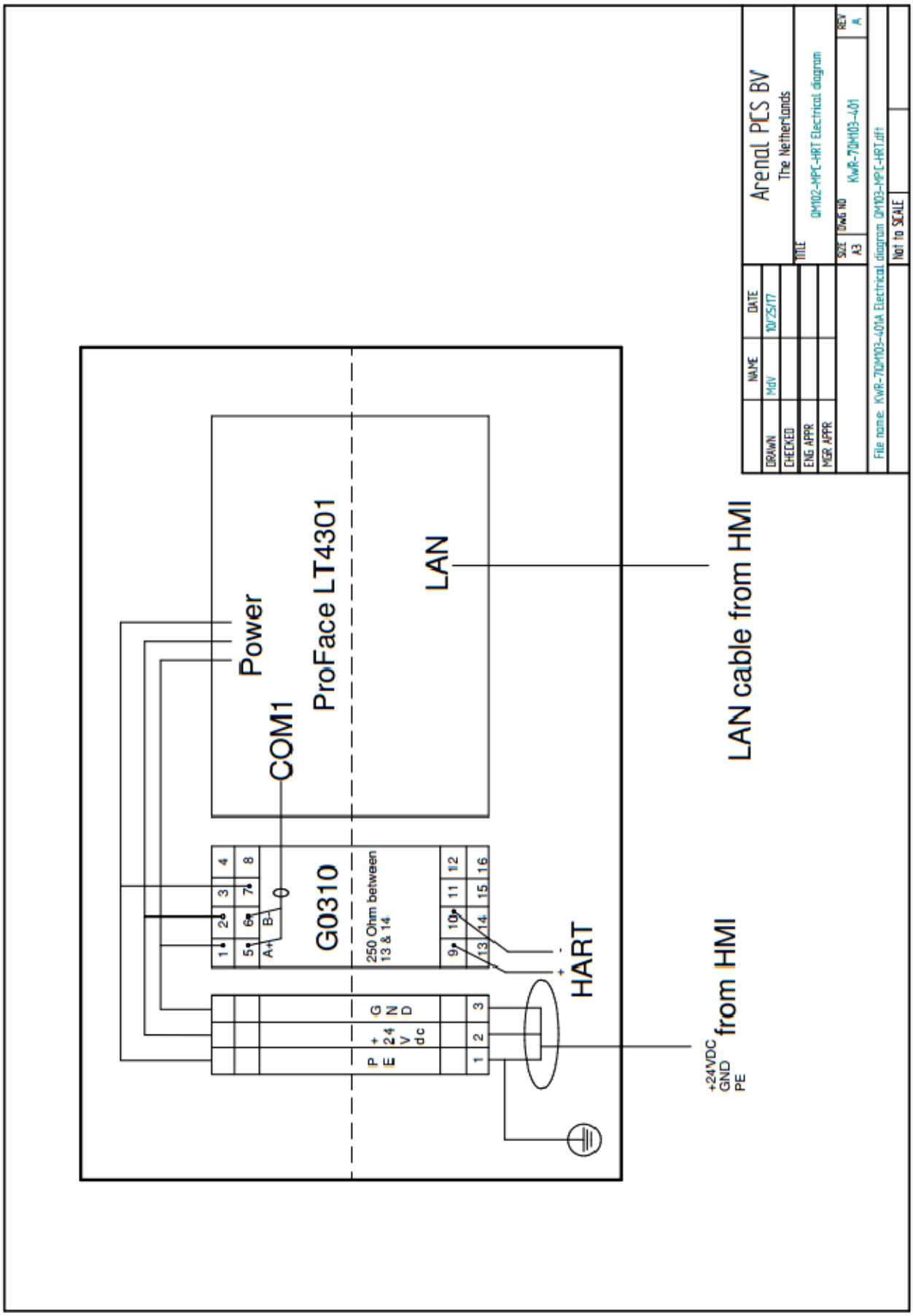
A7 Electrical diagram QA03-SDA-DIS-VAC-XXX-XXX



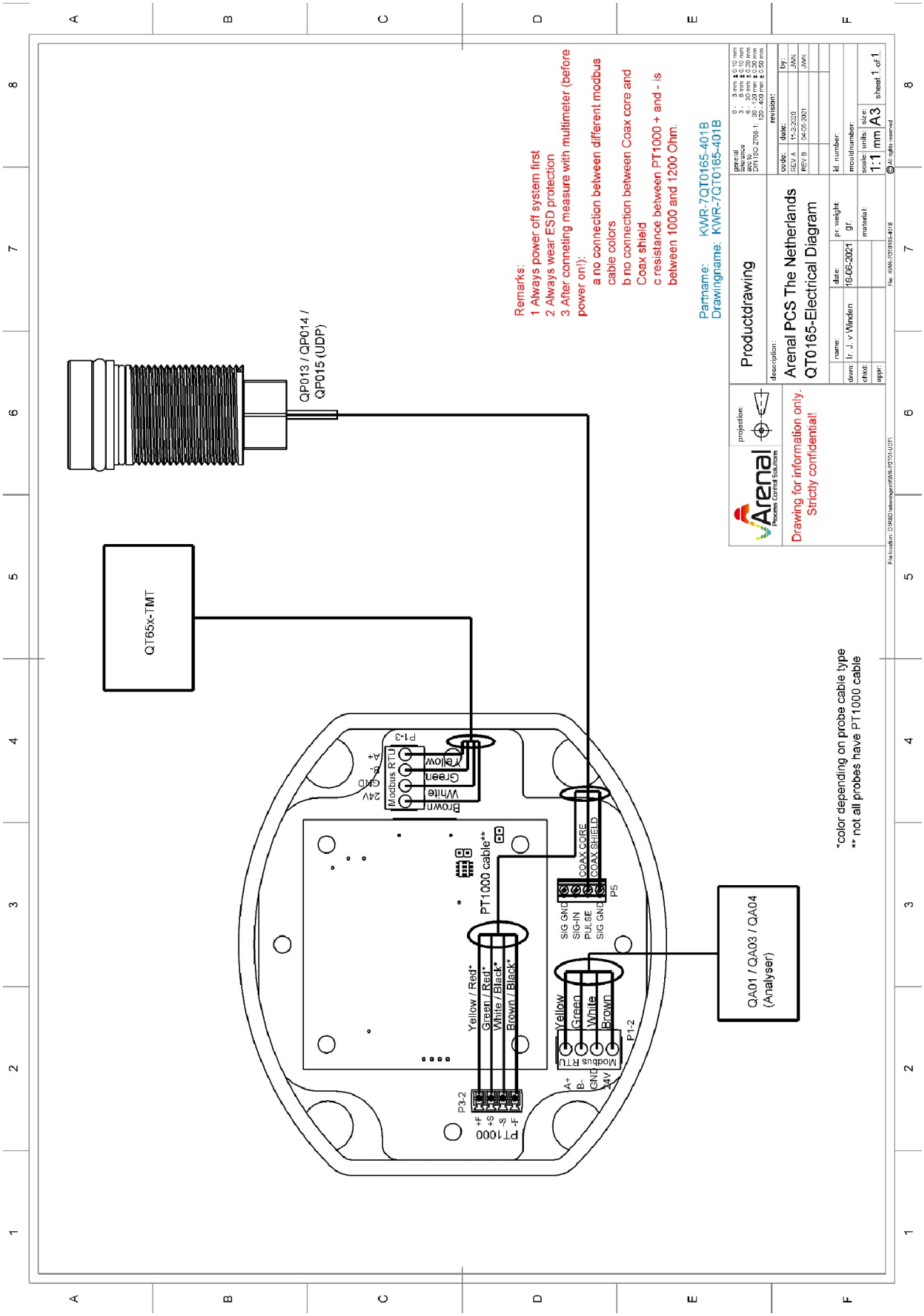
A8 Electrical diagram QA03-SDA-GPX-VAC-XXX-IOM and QA03-SMA-GPT-XXX-IOM



A9 Electrical diagram QM102-MPC-HRT Remote Module



A10 Electrical diagram QT016(5) UDT (with QT65x TMT)



A11 Electrical diagram QT065x TMT