OPERATING MANUAL ARC-1

Contents

ARC-1

For years, KELLER's GSM-2 has provided a simple way of remotely tracking pressure measurements, fill and water levels, and monitoring limit values. Now, this proven data logger with remote data transmission unit has been upgraded and given a new name: ARC-1, the Autonomous Remote Data Collector.

1.1 Overview

The ARC-1 is a combination of an autonomous data logger and a remote data transmission unit in one device. When linked to a pressure transmitter or water level sensor, ARC-1 can autonomously collect up-to-date measurement values for pressure and temperature (and optionally for conductivity as well) and then transmit this data via SMS, E-mail or FTP using the cellular wireless network.

The remote data transmission unit ARC-1 is normally used in hydrology and hydrogeology applications as a means of recording water levels. It is also used by construction companies for pressure measurements. The remote data transmission unit is offered in various housings that accommodate different installation requirements in the locations where it is to be used. With its wide range of water level sensors and pressure transmitters, KELLER is able to offer the right solution for virtually any measuring situation.

Complete with energy-efficient electronics and a premium-quality lithium battery (3,9 V/32 Ah), the logger can transmit the results of 24 measurements every day by e-mail, SMS or FTP for up to ten years. Its fastest measurement rate is 1 measurement per minute. With two input voltages (0...5 V), two digital inputs, one bus interface (RS485) to operate up to five level sensors and an optional SDI12 interface for water analysis devices, the ARC-1 data logger is a universal data collection module for wide area measurement networks.

The transmitted measurement data are received, processed, stored and displayed by the free computer software "Datamanager". Remote configuration is conveniently carried out via software from the workplace.

1.2 ARC-1 Features and Benefits

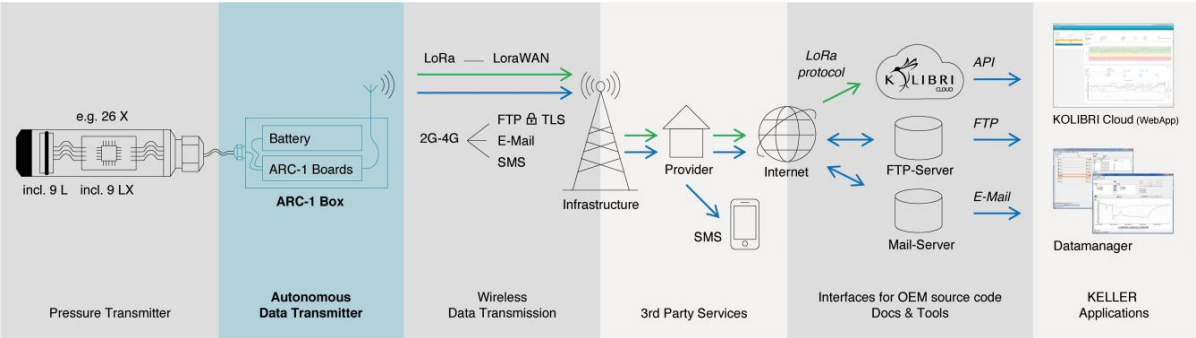
- High level of data security (internal, non-volatile memory)
- Low maintenance (battery operated, service life up to 10 years)
- Robust stainless steel housing and temporary floodable
- Available in various versions for ideal integration
- Free data management software (data manager or cloud)
- Sensor interfaces: compatible with all KELLER level sensors and pressure transmitters
- Internal measured values: barometer, temperature and moisture sensor and real-time clock (RTC)

1.3 Differences to GSM-2

In the interests of compatibility, the ARC-1 incorporates the same functions as the GSM-2 but also includes some new features:

- It now communicates via the 3G mobile network, or 4G if required. The new radio modules also allow the device to be located via the mobile network.
- The mini SIM card has given way to a micro SIM card. The data logger can also be supplied with an e-SIM upon request.
- The system status information, including battery status and signal strength, has been supplemented by a moisture sensor.
- A real-time clock (RTC) has been integrated into the data logger which is more accurate and continues running autonomously when the battery is changed.
- Existing GSM-2 data loggers can also be upgraded easily to ARC-1 data loggers if the existing 2G network at the measuring point is no longer available.

2 General Description / ARC-1 Communication



2.1 Data Manager

The flexible, easy-to-use, open-source “DataManager” software covers the key functions of a monitoring, collection, control, and organisational unit for the ARC-1. The DataManager collects the measurement data, assigns it, puts it in charts, reports any limits that have been exceeded, and stores it in an open-source mySQL database. Third parties can access the measurement data by means of various export and Internet functions for integration into their own data collection systems. The DataManager software also enables users to fully parameterise and monitor each individual ARC-1 data logger. How the DataManager works is described in the “DataManager” manual.

2.2 Kolibri Cloud

The Kolibri Cloud from KELLER offers simple and convenient access to your measurement data with your own personal login and SSL encryption. You can enjoy readily available data without the need to set up and maintain a database, FTP or mail server. The measurements can be displayed as graphs in no time at all and the export function allows you to download your data as Excel or CSV files. Measuring points are effortlessly and efficiently monitored with the integrated alarm system. For instance, a warning can be triggered via e-mail if there is an increase in water level or a battery is running low. The Kolibri Cloud API allows customer-specific software to call up measurements in a standardised JSON format via HTTPS.

2.3 Data transmission

- The data transfer takes place via FTP, email or SMS.
- The ARC-1 transmits the recorded or measured data at configurable intervals.
- Data transmission takes place in two directions: from and to the ARC-1, the latter e.g. for changes of the configuration.
- The FTP server or the e-mail inbox is used to store the data until the "Datamanager" or ARC-1 has read it.
- The ARC-1 can send alarm messages or measurements via FTP, email or SMS.

2.4 Configuration

The initial configuration is carried out on site during installation by the GSM Setup program via a cable connection from the PC to the ARC-1. The settings are stored in the ARC-1 and sent to the “GSM Data-manager” by FTP or email. The new unit is registered automatically.

Changes in the ARC-1 configuration are made remotely in the “Datamanager” and transferred to the ARC-1 by FTP or email. The ARC-1 checks its email inbox in a configurable interval and, if a new configuration is available, the configuration is applied and stored.

2.5 Measurement / data acquisition

The ARC-1 measures in a configurable interval all sensors/channels and stores the data in an EEPROM. The data is transferred once a configurable amount of stored data has been accumulated. Alarm functions are configurable and messages are sent immediately if the alarm condition is true.

2.6 Energy management

The unit is in a sleep mode; only the real-time clock is active. For measurements, the supply to the sensors is switched on for a short time (~ 1 second) and, after the measurement is complete, the data is stored and the supply switched off.

To send a message, the radio module is turned on and the messages are sent within a few seconds.
Even though this task consumes the most power, the battery will still last for many years due to its high capacity and low self-discharge. For example, if you measure every hour and send the data once per day, the battery will last for up to 10 years.

3 Minimum equipment for the ARC-1 measuring system

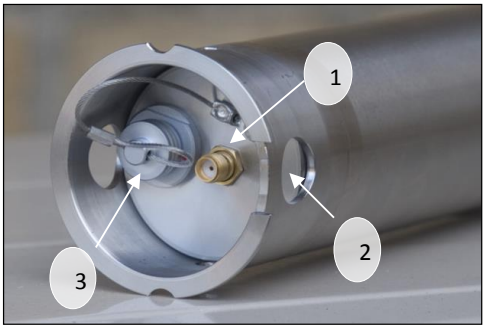
To run a data-logging system you need at least:

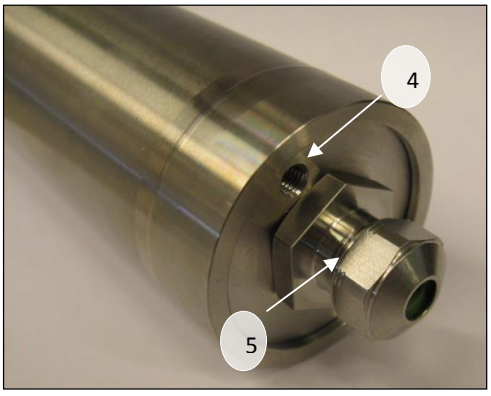
- ARC-1 unit
- water level sensor
- Micro SIM card (3FF)
- PC with “Datamanager” software and Internet connection
- One FTP or email account (with SMTP/POP function)
- “ARC Configuration” software and data cable K103-A (RS232) / K104-A (USB) or K-114 BT-A (Bluetooth)

4 Hardware

4.1 ARC-1 Tube

The new generation has not changed in appearance. At just 48 mm in diameter, the cylindrical design of the ARC-1 can simply be placed into the top of a two-inch-wide sounding tube standard in the groundwater measuring industry. It can be installed in a matter of seconds. The housing is designed to withstand condensation and temporary flooding. The sealed antenna is covered by a lockable protective cap made of robust plastic. This protects the data logger against theft and damage by people or wild animals when level measurements are being taken in the open country-side.





1. Antenna connector SMA (F)
2. Holes (for pull-out and water outlet)
3. Interface to PC with protection cap
4. Barometric pressure sensor hole/tube
5. PG adapter

4.2 ARC-1 Accessories (delivered with ARC-1)

1. Stub antenna with SMA plug (m)
2. Silica gel bag
3. 2 rubber seals with different diameters
4. PG connetor
5. Circlip

4.3 How to open and to close the housing

4.3.1 To open

To open the ARC-1 housing, just push against the bottom of the housing/piston.

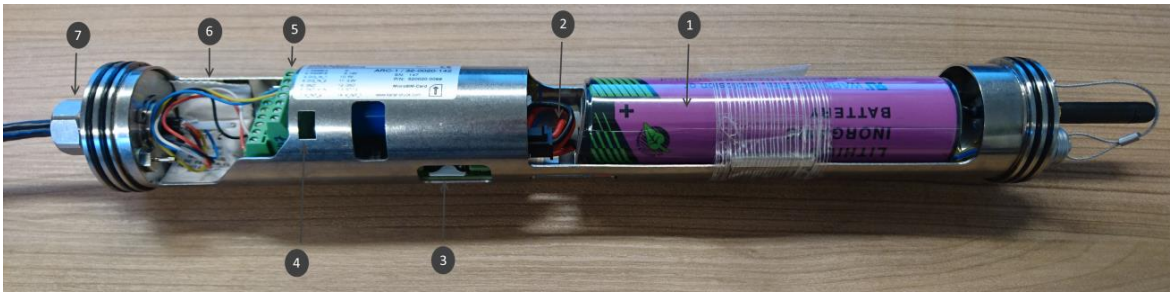
4.3.2 To close

To close the unit, push against the top of the housing/piston until it stops. Be sure that that the piston is completely inserted. Ensure that the holes on the top of the housing are completely visible. The holes allow water to drain off so that it does not remain inside the unit.

A bag containing silicate desiccant is used to protect the sensitive electronics from humidity. Push this bag into the sleeve.

The module can now be installed at the measuring point together with the appropriate sensor.

4.4 The Inside of the ARC-1



1. Battery
2. Battery plug
3. SIM card holder
4. LEDs for diagnosis
5. Connector for sensors
6. Silica gel bag
7. PG adapter

4.5 Insert or Release the SIM Card

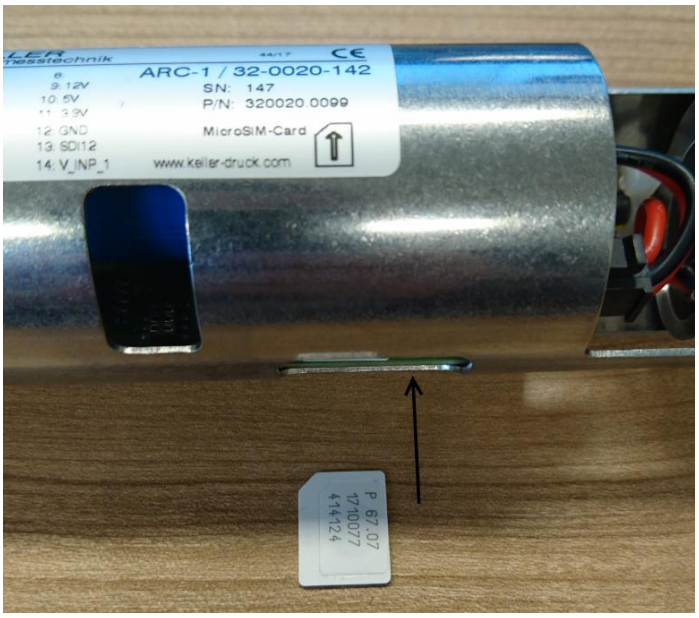
For communication via the mobile network, you need a SIM card (type micro SIM card).

Hint:
We recommend the use of a prepaid card. Thus, in case of an incorrect configuration, only the current credit on the card is used up. Before using the SIM card, all SMS messages stored on the card must be deleted (this applies to send and received SMS messages).

Make sure that there is always sufficient credit on the card. Contact your phone provider for information on recharging options.

Insert the SIM card:

1. Do not touch the gold-colored contacts of the SIM card when inserting!
2. Insert the SIM card as shown in the illustration into the silver SIM card compartment as far as it will go (bevelled corner facing left). Make sure that the SIM card is fully inserted.



Replace / remove SIM card

1. by simultaneously pressing and pulling on the SIM card, it can be pulled out

4.6 Connect / replacing the battery

To power the unit, the black 4-pole battery-plug must be connected to the corresponding socket on the circuit board. The connector tab must face upwards (see illustration).

After plugging in the battery plug, push the battery into the battery holder.

Hint:
When the battery is changed, the device continues to run for half an hour (red LED flashes), which has the advantage that the time no longer needs to be readjusted. To reset the device, the battery must be removed for more than half an hour.

4.7 Connecting the antenna

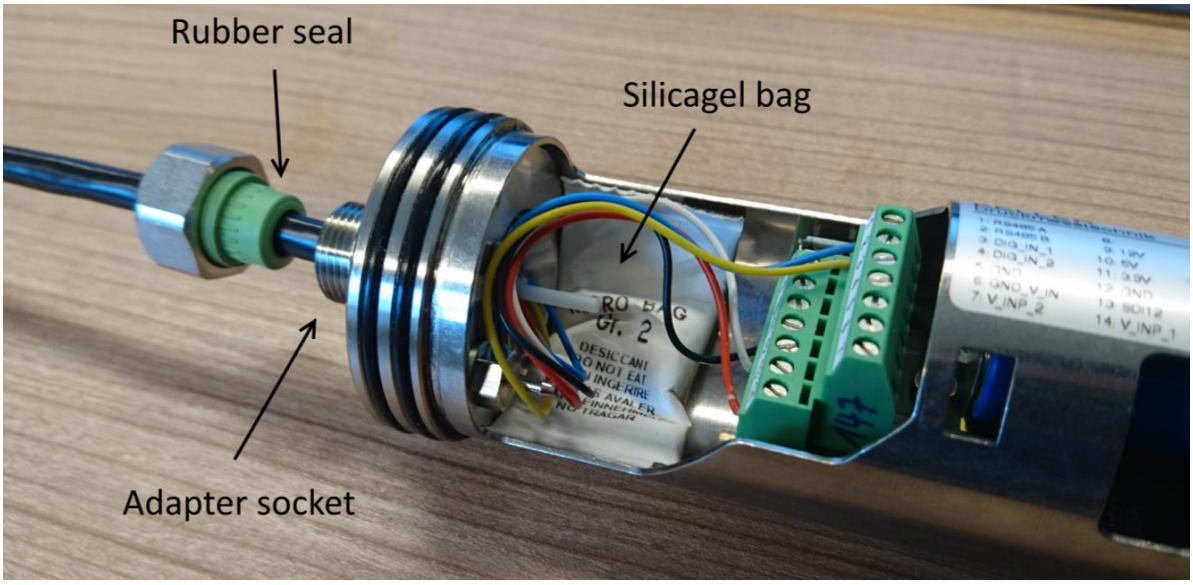
Screw the stub antenna into the corresponding SMA plug located at the top of the ARC-1 and **tighten by hand only**. Make sure it is tight enough.

Hint:
The antenna is provided with a seal. If you use other antennas or connectors, make sure that they are equipped with a seal.

4.8 Adapter socket / level sensor connection

The plug to connect several sensors is located at the end of the ARC-1.

The adapter socket is required to connect a level sensor. Feed the sensor cable through the adapter socket and connect the cable ends to the corresponding terminal strip.



Hint:
The entire weight of the level sensor has to be carried by the adapter socket. Make sure you tighten it well. There are two rubber seals available with different diameters for different cable sizes.

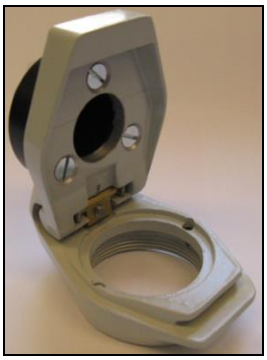
If a level sensor with a reference tube is used, the tube must not be connected to the hose adapter, otherwise the pressure compensation to the outside of the ARC-1 housing is no longer given. The reference tube is simply inserted into the housing as shown in the figure.

Important:
After opening the ARC-1 case, always make sure that the ARC-1 case is still tight. A small bag of silica gel desiccant is used to protect the sensitive electronics from humidity. Always make sure that a functioning bag of silica gel is in the ARC-1 housing (see illustration).

The circlip is mounted at the inside of the adapter socket to prevent the thread from loosening.

5 Locking unit

The locking unit for the ARC-1 with antenna cover fits standard size 2 inch measuring points. It is an accessory.



6 Battery lifetime

The value displayed in the “ARC Configuration” and the “Datamanager“ is the battery capacity calculated by the ARC-1 as a percentage of remaining capacity. It is recommendable to change the battery if the value is less than **15%**. Once the battery has been changed the value is once again shown as **99%**.

Hint:
Please note that a battery change or disconnection of the battery always results in resetting the capacity indication to 99%! For this reason, the battery should be disconnected for battery replacement only.

The calculated lifetime in the table below indicates how long the battery can last in different conditions. This gives you an idea of how to configure the ARC-1 and how long the battery can last.

The calculation is based on the following conditions:
Temperature profile: Switzerland, with peak temperature -20°C / 40°C
Radio connection: Strong signal quality

Fall	Messintervall	Intervall der Datenübertragung	Berechnete Lebensdauer
A	---	24 h	> 10 Jahre
B	1 h	24 h	> 5 Jahre
C	---	1 h	3 Jahre
D	1 min	1 h	1.6 Jahre

Hint:
The calculated lifetime values in the table are merely calculations. External conditions (like temperature and storage time) have an influence on the battery capacity and its lifetime.

Batteries are also self-discharging. We therefore recommend replacing the battery every 5 years!

7 Connection Terminal for Sensors

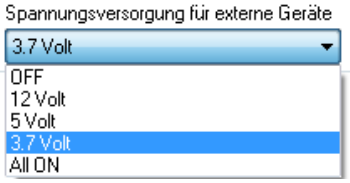
7.1 Pin Table

1. RS485-A
2. RS485-B
3. Switch Input 1
4. Switch Input 2
5. GND
6. GND (Voltage Input 1 & 2)
7. Voltage Input 2 (0…5V)
8. Not connected
9. Supply 12 Volt (switched, 100 mA)
10. Supply 5 Volt (switched, 100 mA)
11. Supply 3,7 Volt (switched, 100 mA)
12. GND
13. SDI12 communication Interface
14. Voltage Input 1 (0…5V)

7.2 Supply

External devices can be supplied with different voltages. The supply is turned on while the ARC-1 reads the connected devices. You can select different voltage sources in the “ARC Configuration” program.

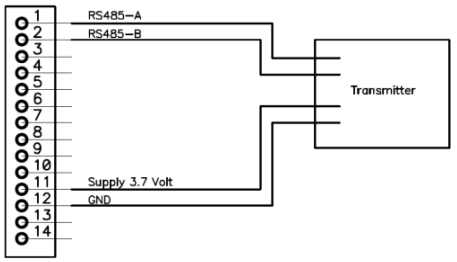
OFF	No supply during measurements
12 V	12 Volt output active during measurements (**Pin 9**)
5 V	5 Volt output active during measurements (**Pin 10**)
3.7 V	3,7 Volt (battery) output active when measuring (**Pin 11**)
ALL ON	All supplies are switched on when measuring



7.3 RS485-Interface for Sensors

The RS485 interface enables communication with KELLER digital instruments (transmitters, data loggers…).

Connect RS485 A (**Pin 1**) and RS485 B (**Pin 2**) with the instrument. The measurement takes place at the selected interval. The supply is turned on 1 second before measurement. The values (channels 0…5) are read out and processed in the ARC-1. The supply is switched off when the measurements have been taken.

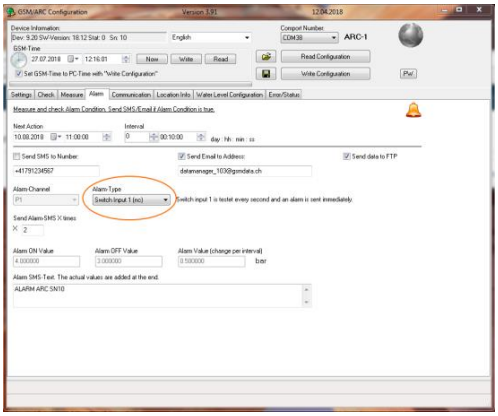


Up to 5 Series 30 transmitters can be connected to the ARC-1 if you select “Type 6” in Hardware-settings (ARC Configuration). In this case you have to configure each transmitter separately with an address in the range of 1 to 5.

Hint:
We recommend using Series 30 transmitters from KELLER with the option “low voltage” to keep the battery consumption low (in this case select 3,7 V power supply)**.**

7.4 Voltage Input

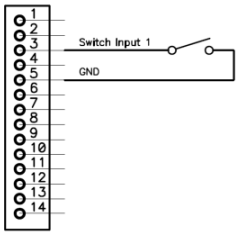
The voltage inputs (**Pin 7 & 14**) measure signals from sensors in the range of 0 … 5 Volt. Use the corresponding GND voltage input (**Pin 6**)



7.5 Switch Input 1 (Alarm Input)

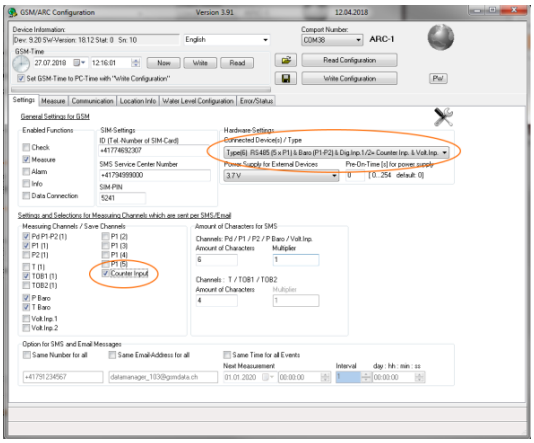
Switch 1 input (**Pin 3**) is a normally closed input (nc) for monitoring a switch. If the switch alarm function is enabled, the ARC-1 tests the input every second and, if the switch is open, an alarm message is sent immediately. After this alarm message, the switch state is tested (and an alarm message sent) at the seleced alarm interval.

The alarm is sent a maximum of X times (X is a selectable value). If the input status is tested and it has turned from open (alarm) to closed (no alarm), the test interval reverts back from alarm interval to once per second; if the alarm condition is detected again the alarm is sent again a maximum of X times.



7.6 Switch Input 2 (Count Input)

Switch 2 Input (**Pin 4**) is a counter input. It is designed for connecting an external device with reed relay output (for example from a rain catcher).



7.6.1 Configuration

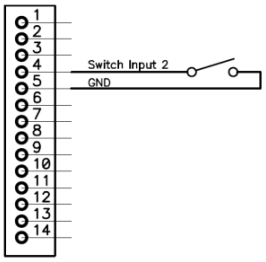
To enable the “Counter Input” function, select “Type 6” in Hardware settings.
Select “Counter Input” in “Measuring Channels”.

7.6.2 Connection

Connect the relay output to the switch input 2 (Pin 4) and GND (Pin 5).

7.6.3 Function

The counter starts counting if the externally connected switch closes. Please note that the counter function is limited to one count per second. If more counts are triggered within a second, the counter will only increase by one.
The counter value is saved at the measuring interval. After saving the counter value the counter is reset to zero. This gives the user an opportunity to measure the amount of counts within the defined (measuring interval) time.



7.7 SDI12 Communication interface

The SDI-12 protocol is based on version 1.3. The SDI-12 probe must be parameterized according to the configuration below before connecting to the ARC-1 to ensure correct operation.

Hint:
Check SDI-12 probe for compatibility with ARC-1.

7.7.1 Communication parameters

Description	Settings
Data rate	1200 Baud
Byte Frame Format	1 start bit / 7 data bits / 1 parity bit (even) / 1 stop bit
SDI12-Adsresse	0
Channels / Values	max 10
Measurement time (Maximum time for performing a measurement)	max. 300 seconds

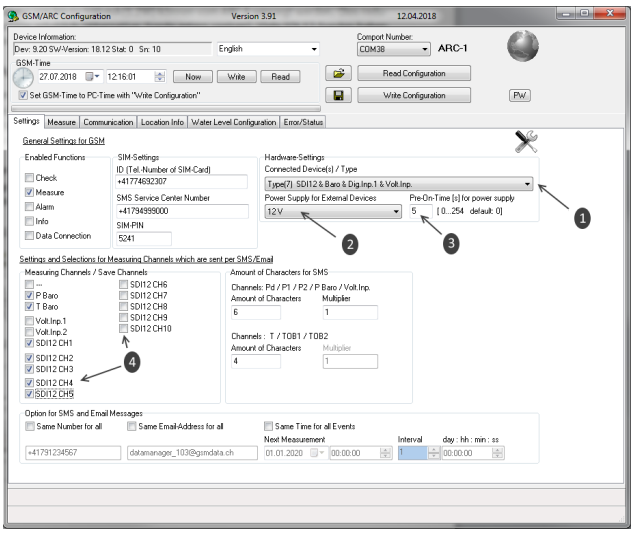
7.7.2 Connection assignment

SDI12 probe	ARC-1
VCC	12 V (Pin 9)*
GND	GND (Pin 12)
Data connection	SDI12-Communication interface (Pin 13)

*Hint:
SDI-12 probes with a current consumption of up to 100 mA (1.2W) can be supplied by the ARC-1. However, this considerably reduces the battery lifetime (alternative: power the probe externally). Many SDI-12 probes also have a long start-up time until they are initialized (setting the "Pre-On-Time for power supply").

7.7.3 Settings in the „ARC Configuration“

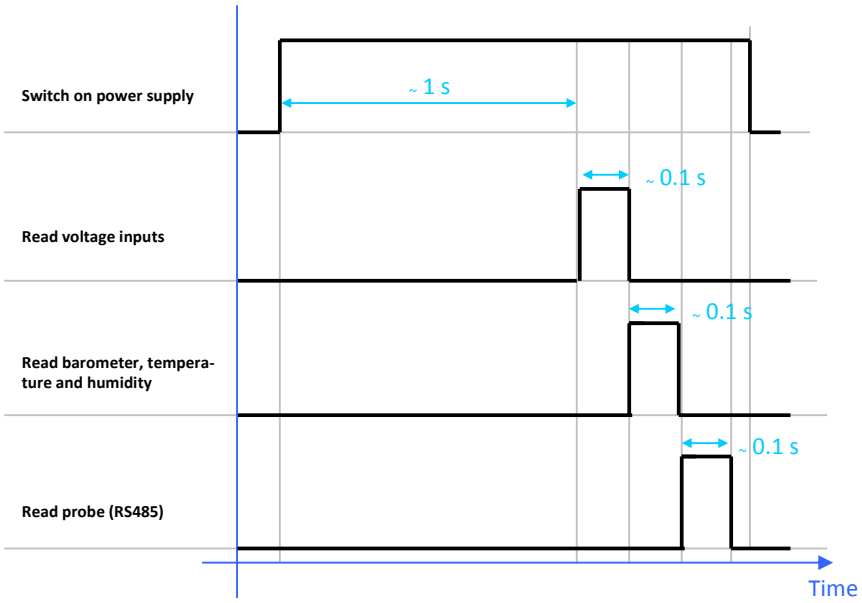
1. Choose “Type 7” in the Hardware settings.
2. The ARC-1 will switch on the external power supply 5V (Pin 10) while communicating with the YSI Sensor (no matter what you have selected in the “ARC Configuration”). If you need the power supply for other external devices, select the required supply; otherwise select “OFF”.
3. Select the required "Pre-On-Time for power supply" for your SDI-12 probe.
4. Select the channels that should be transferred. The channels are saved in the ARC-1 in the same order in which they are read / transferred from the YSI Sensor. The maximum amount of values is 10.



8 Measuring process and timing

8.1 Power Supply

1. The power supply is switched on 1 second before the measurement takes place.
2. Power is on during measurement.
3. The supply is switched off after measurement.



8.2 Read RS485

The values from the connected transmitter(s) are read within ~0,2 seconds. If there is a communication error, the command is repeated 3 times with a pause of 0,2 seconds between each command.

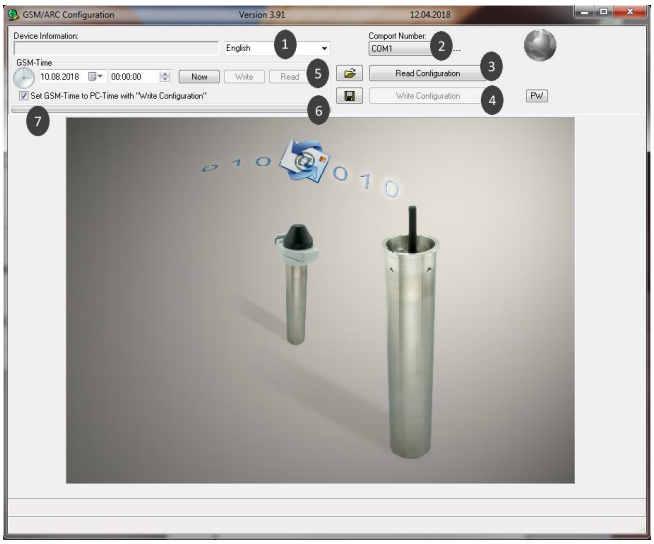
The communication address is 250 if only one transmitter is connected. For configuration with up to 5 transmitters, the communication address is 1…5. However, the communication address must be assigned in advance.

8.3 SDI12

The measurement takes place after reading the voltage inputs. The measurement can take up to 300 seconds (depending on YSI sensor configuration/type).

9 Description „ARC Configuration“

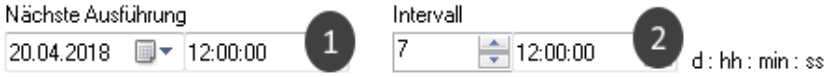
9.1 Overview



Number	Description	Explanation / Function
1	Language Selector	Select the preferred language
2	Serial Communication Port	Select the appropriate port number
3	Read Configuration Button	Press button to read configuration from connected device
4	Write Configuration Button	Press button to write configuration to connected device
5	Open Configuration File	Press button to open an existing (previously saved) configuration file
6	Save Configuration	Press button to save all settings to a configuration file
7	Checkbox “Set ARC time to PC time at write configuration”	Enable checkbox -> The ARC clock will automatically be synchronized with PC clock if you press the “Write Configuration Button” -> see number #4
	Date and Time Selector and Edit Field	You may manually set a date and time by selection or editing the fields
	“Now” Button	Press button to set the ARC-1 time field to PC time.
	“Write” Button	Press button to write time and date to the device. Please notice the button may be disabled according to the state of checkbox number #7
	“Read“ Button	Press button to read time and date from the device

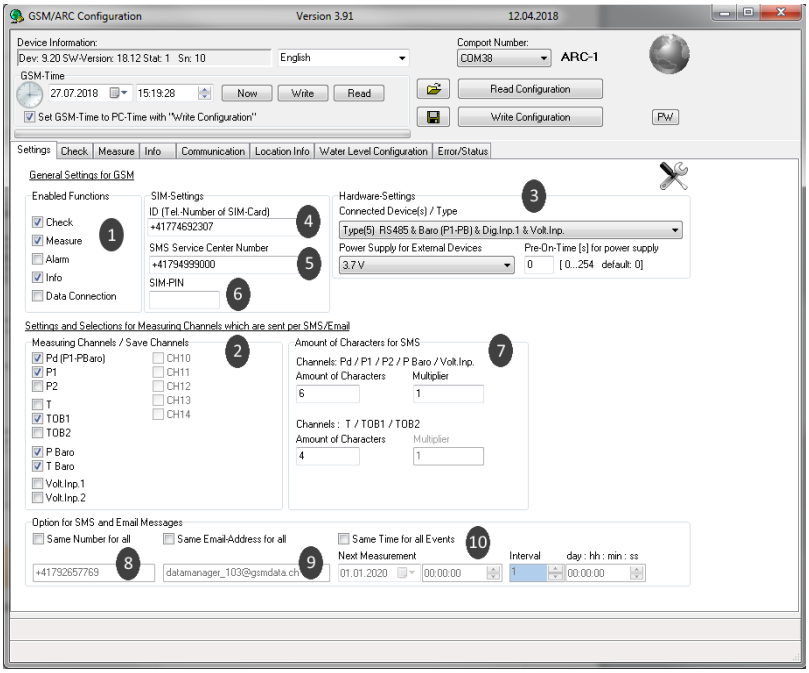
Next Action / Interval
There are several selectable functions. Clicking them will make the corresponding register card appear.
Most functions consist of a “Next Action” and “Interval” time information.

All functions can run at different time intervals and can take place at different times. Messages are sent by FTP, email or by SMS (selectable). The recipient number (SMS) or Email (Email address) is selectable for each function.



Number	Description	Explanation / Function
1	Next Action	Select the date and the time when the task takes place the first (next) time.
2	Interval	Enter the time interval at which the task takes place.

9.2 Settings



Number	Description	Explanation / Function
1	Enabled Functions	Activates the indicated function (i.e. “Measure” -> the radio module sends data messages according to the set interval)
2	Measuring Channels	Activates the desired channels to be measured and saved. **P1-P Baro** Pressure difference between pressure gauge P1 in media and ambient pressure measured by on board barometer **P1** Level sensor [pressure / bar] **P2** Second pressure sensor [pressure / bar] (e.g. for AA devices as barometric sensor) **T** Temp. of PT100/P1000 thermocouple [temperature / °C] (availability depends on design of pressure transmitter) **TOB1** Temp. sensor of level sensor P1 [temperature / °C] (temperature over bridge pressure gauge 1) **TOB2** Temp. sensor of pressure sensor 2 [temperature / °C] **P Baro** Barometric pressure (ARC-1) [pressure / bar] **T Baro** Air temperature (ARC-1)[temperature / °C] **Analog1** Voltage Input 1 (0...5 Volt) [voltage / V] **Analog2** Voltage Input 2 (0...5 Volt)[voltage / V] **P1 (X)** Pressure (or Level) sensor with BUS Address (**X**)
3	Hardware Settings	Select connected sensor types. Choose supply for the connected devices.
4	ID Phone Number	Enter the phone number of the SIM card used in the GSM module. The phone number is the identifier of the ARC-1.
5	SMS service center	SMS service center phone number of your provider (SMS messages cannot be sent without this number)

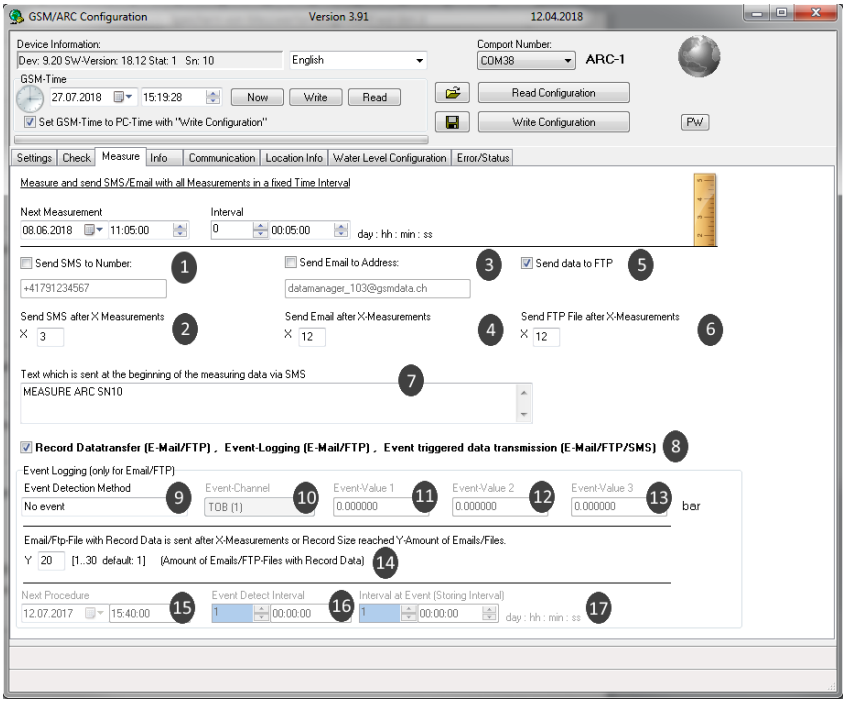
Number	Description	Explanation / Function
6	Pin Code	Pin Code of the SIM Card. If PIN is deactivated, leave this box blank.
7	Amount of Chars used in SMS	SMS has a limitation of 160 characters. The number of characters used to transmit one measurement value can be adapted.
8	Options for SMS-Number	The module allows messages to be sent to independent phone numbers. The checkbox “Same number for all” synchronizes all edit fields to the phone number entered.
9	Options for Email Address	The module allows messages to be sent to independent Email addresses. The checkbox “Same Email-Address for all” synchronizes all edit fields to the Email address entered.
10	Same Time for all Events	The module allows to proceed sending the different functions at different times and time intervals. The checkbox “Same Time for all Events” synchronizes the time fields to the time entered.

9.3 Hardware Settings Connected Device

Connected Device(s) / Type	Explanation
Type(0) RS485	➢ One transmitter/level sensor with BUS address 250 is connected to the RS485 interface
Type(1) RS485 & 2 Dig.Inp	➢ One transmitter/level sensor with BUS address 250 is connected to the RS485 interface ➢ Digital input can be used for alarm
Type(2) RS485 & Baro (P1-P2) & Dig.Inp.1	➢ One transmitter/level sensor with BUS address 250 is connected to the RS485 interface ➢ Barometric and temperature sensor in ARC-1 available ➢ CH0 is calculated from P1-P2 ➢ Digital input 1 can be used for alarm
Type(3) RS485 & Baro (P1-PB) & Dig.Inp.1	➢ One transmitter/level sensor with BUS address 250 is connected to the RS485 interface ➢ Barometric and temperature sensor in ARC-1 available ➢ CH0 is calculated from P1-PB ➢ Digital input 1 can be used for alarm
Type(4) RS485 & Baro (P1-P2) & Dig.Inp.1 & Volt.Input	➢ One transmitter/level sensor with BUS address 250 is connected to the RS485 interface ➢ Barometric and temperature sensor in ARC-1 available ➢ CH0 is calculated from P1-P2 ➢ Digital input 1 can be used for alarm ➢ Voltage inputs are available
Type(5) RS485 & Baro (P1-PB) & Dig.Inp.1 & Volt.Input	➢ One transmitter/level sensor with BUS address 250 is connected to the RS485 interface ➢ Barometric and temperature sensor in ARC-1 available ➢ CH0 is calculated from P1-PB ➢ Digital input 1 can be used for alarm ➢ Voltage inputs are available
Type(6) RS485 (5x) & Baro (P1-P2) & Dig.Inp.1/2= Counter Input & Volt.Input	➢ Five transmitter/level sensors with BUS address 1…5 are connected to the RS485 interface ➢ Barometric and temperature sensor in ARC-1 available ➢ CH0 is P1-P2 from address 1 (if available) ➢ Digital input 1 can be used for alarm Digital input 2 can be used as a counter ➢ Voltage inputs are available
Type(7) SDI12 & Baro & Dig.Inp.1 & Volt.Input	➢ CH0 is not available ➢ Barometric and temperature sensor in ARC-1 available ➢ Voltage inputs are available ➢ SDI12 interface for YSI sensor
Type(8) RS485 (5xP1+5xTOB1) & Baro & Dig.Inp.1/2= Counter Inp. & Volt.Input	➢ Five transmitter/level sensors with BUS address 1…5 are connected to the RS485 interface ➢ Barometric and temperature sensor in ARC-1 available ➢ Digital input 1 can be used for alarm Digital input 2 can be used as a counter ➢ Voltage inputs are available

Type(9) RS485 CTD & Baro (P1-P2) & Dig.Inp.1 & Volt.Input	➢ One multiparameter probe (pressure, temperature and conductivity) ➢ Barometric and temperature sensor in ARC-1 available ➢ CH0 is P1-P2 from address 1 (if available) ➢ Digital input 1 can be used for alarm ➢ Voltage inputs are available
Type(10) RS485 CTD & Baro (P1-PBaro) & Dig.Inp.1 & Volt.Input	➢ One multiparameter probe (pressure, temperature and conductivity) ➢ Barometric and temperature sensor in ARC-1 available ➢ CH0 is calculated from P1-PB ➢ Digital input 1 can be used for alarm ➢ Voltage inputs are available
Type(11) RS485 CTD (3x (P1+TOB1+Cond+Tcon))& Baro & Dig.Inp.1/2= Counter Inp.	➢ Up to 3 multiparameter probe (pressure, temperature and conductivity) ➢ Barometric and temperature sensor in ARC-1 available ➢ Digital input 1 can be used for alarm Digital input 2 can be used as a counter
Type(12) RS485 & Baro (P1-PBaro) & Modbus ABB Aquamaster 3	➢ One transmitter/level sensor with BUS address 250 is connected to the RS485 interface ➢ Barometric and temperature sensor in ARC-1 available ➢ CH0 is calculated from P1-PB ➢ Digital input 1 can be used for alarm Digital input 2 can be used as a counter ➢ Flow rate, pressure, flow volume and voltage level of the Aquamaster 3 are read out

9.4 Measure



Number	Description	Explanation / Function
1	Send SMS to Number:	Enables SMS transfer. The edit field underneath shows the phone number where the SMS are sent to.
2	Send SMS after X Measurements	A single SMS message may contain several measurements carried out in the set time interval. The entered number specifies the amount of measurements per SMS message.
3	Send Email to Address:	Enables Email transfer. The edit field underneath shows the Email address where it is sent to.
4	Send Email after X Measurements	A single Email message may contain several measurements carried out in the set time interval. The entered number specifies the amount of measurements per Email message. *
5	Send data to FTP	A single FTP message may contain several measurements carried out in the set time interval. The entered number specifies the amount of measurements per FTP message. *
6	Send FTP after X Measurements	Enables FTP transfer. The storage location can be set in the communication window.
7	User Text	Any text that is transferred with the measurements (could be used as an identification of the message type).

Number	Description	Explanation / Function
8	Record Data Transfer (only at FTP and Email) and Event Logging	If unchecked the data (values) is transferred in a text format. If checked the data is transferred in a binary (base64) format and event logging can take place.
9	Event Detection Method	Different methods to measure and save data.
10	Event Channel	Choose the channel to be used to test the event condition.
11	Event-Val 1	Event value 1
12	Event-Val 2	Event value 2
13	Event-Val 3	Event value 3
14	Y (amount of FTP files or Emails with record data)	If enough data is collected for Y amount FTP files or Emails, they will be send.*
15	Next action	Select the date and the time when the task takes place the first (next) time.
16	Event detect interval	Enter the time interval at which the measurement is made and the event condition is tested.
17	Interval at event (save interval)	Enter the time interval at which the measurement takes place and the values are stored.

If record transfer is on, the transfer over FTP or email takes place if one of the conditions (#4 or #12) is true.

That means:

- the amount (X) measurements are made
- the amount of data for (Y) FTP files or Email(s) are available

9.5 Event Logging Description

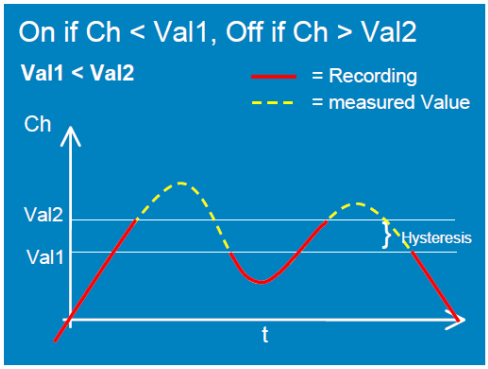
9.5.1 No event

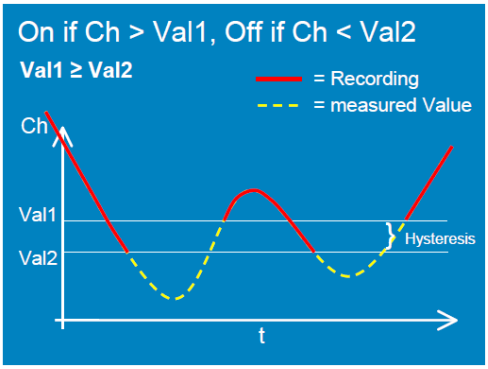
Record data transfer (binary data format) is on and data is collected at a fixed time interval.

9.5.2 On at Val 1, Off at Val 2

- If **Val1 ≥ Val2** then recording will take place above a certain level.
Recording takes place if the measured value of the selected channel (#8) is greater than Val1 until the measured value is less than Val2 (hysteresis = Val1-Val2).
If the condition is not true, the condition is checked in the “Event detect interval” (#14) and data is not saved. If the condition is true, the measurement interval changes to “Interval at event (save interval, #15)” and the data is also stored in this interval.

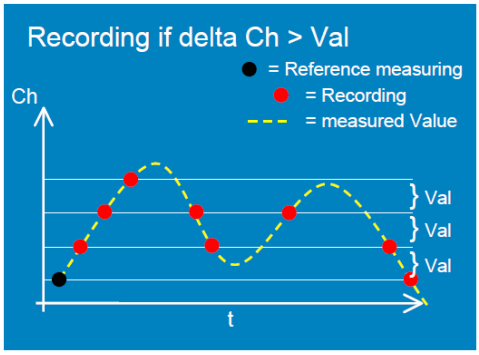
- If **Val1 < Val2** then recording will take place below a certain level.
Recording takes place if the measured value of the selected channel (#8) is less than Val1 until the measured value is greater than Val2 (hysteresis = Val2-Val1).
If the condition is not true, the condition is checked in the “Event detect interval” and data is not saved. If the condition is true, the measurement interval changes to “Interval at event (save interval, #15)” and the data is also stored in this interval.



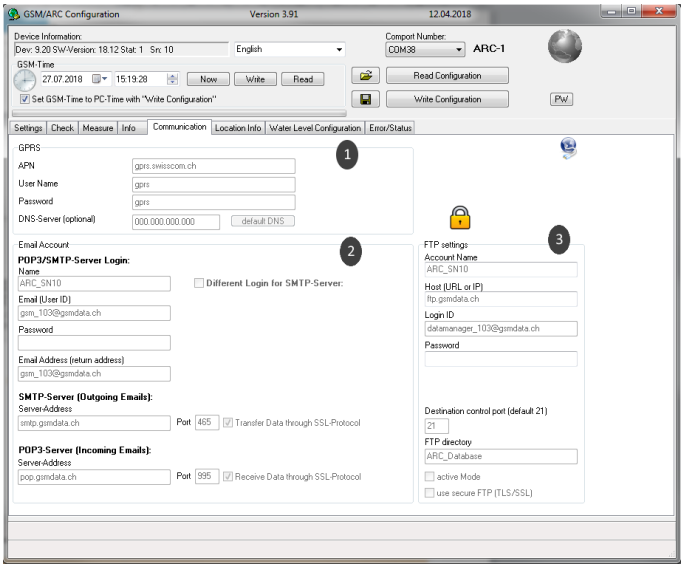


9.5.3 Save if delta CH > Val 3

The measurement takes place in the “Interval at event (save interval, #15)” and the data is stored if the measured “Event-Val 3” value is greater than the last recorded value.

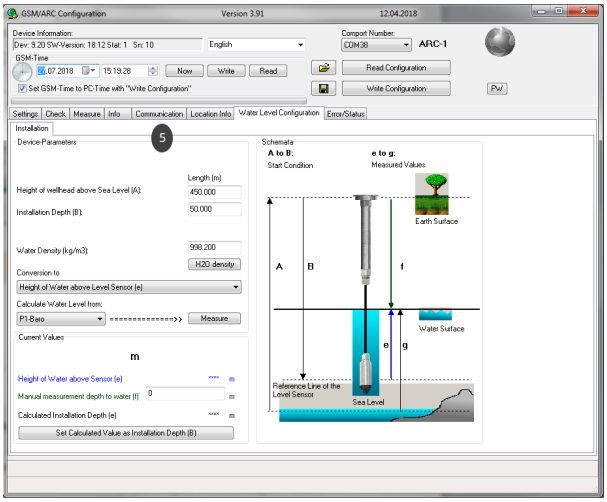


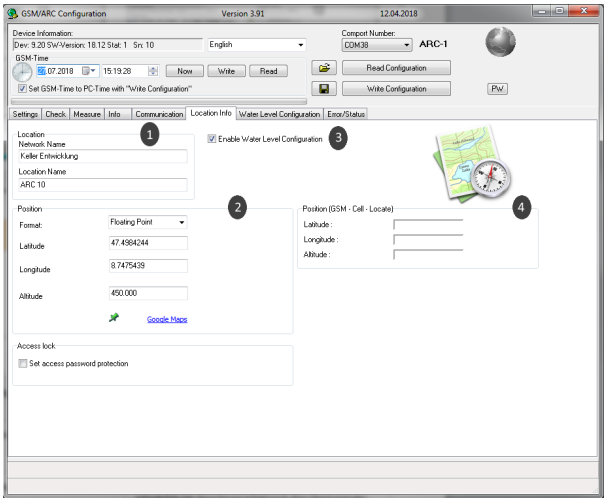
9.6 Communication



Number	Description	Explanation / Function
1	GPRS	APN = Access Point Name You need to enter the correct APN (Access Point Name) settings which differ based on your wireless carrier provider. Settings are available from your provider or can be found in the internet.
2	Email Account	**POP3/SMTP-Server Login:** In order to receive Emails, the ARC-1 needs a POP3 Email account. The two most important configuration items are the User ID and the corresponding password for proper authentication. **SMTP-Server** Outgoing mails are sent via an SMTP-server. You need a valid URL for the SMTP-server. Port 25 is commonly used for this purpose. **POP3-Server:** Incoming mails are accessed via a POP3-server. You need a valid POP-server URL. Port 110 is the standard port. **Different Login for SMTP-Server:** Depending on your mail provider, you may need different authentication for the POP and the SMTP server. Activate the checkbox if two different login names and passwords are required. **Security:** Depending on your mail provider, you may need SSL protocol (transfer data through SSL protocol).
3	FTP Account	**FTP-Server Login:** In order to receive FTP files, the ARC-1 needs a valid URL or IP address of the FTP server. The two most important configuration items are the Login ID and the corresponding password for proper authentication.

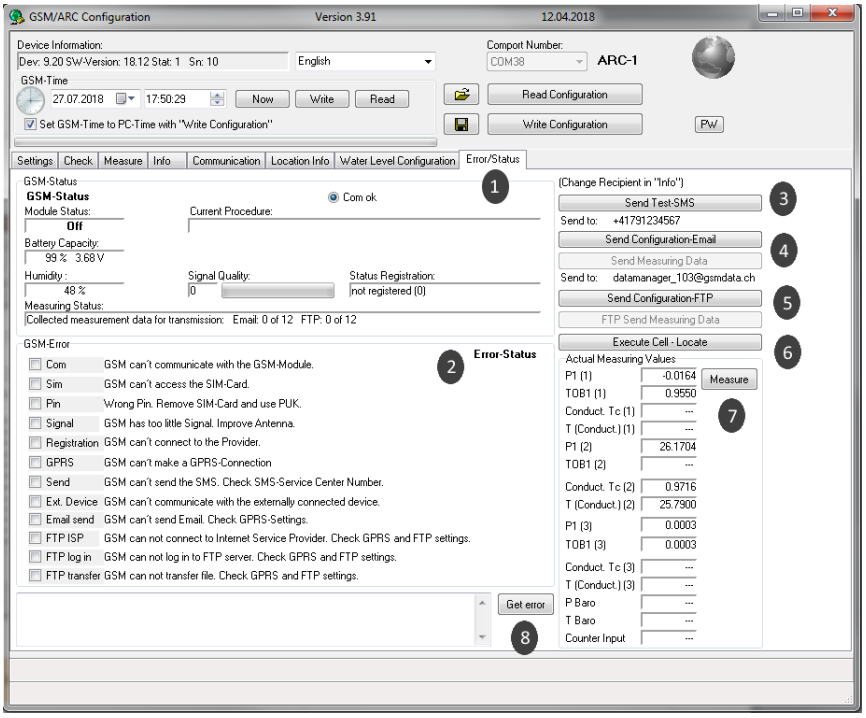
9.7 Location info and Water level configuration





Number	Description	Explanation / Function
1	Location	You may define a network name. “Network” helps you to organize your measuring locations. “Location name” allows defining a name for the measuring location.
2	Position	Assigns the coordinates (longitude, latitude, altitude) to a measuring location.
3	Water Level Configuration	Enables the water level configuration. The graphical user interface will appear (4).
4	Position Cell-Location	The ARC-1 has the possibility to locate his coordinates through a triangulation of his prostitution of the provider antenna. This action can be executed in the register Error/Status.
5	Water Level Configuration	These settings are required to calculate the water level (i.e. by the Datamanager).

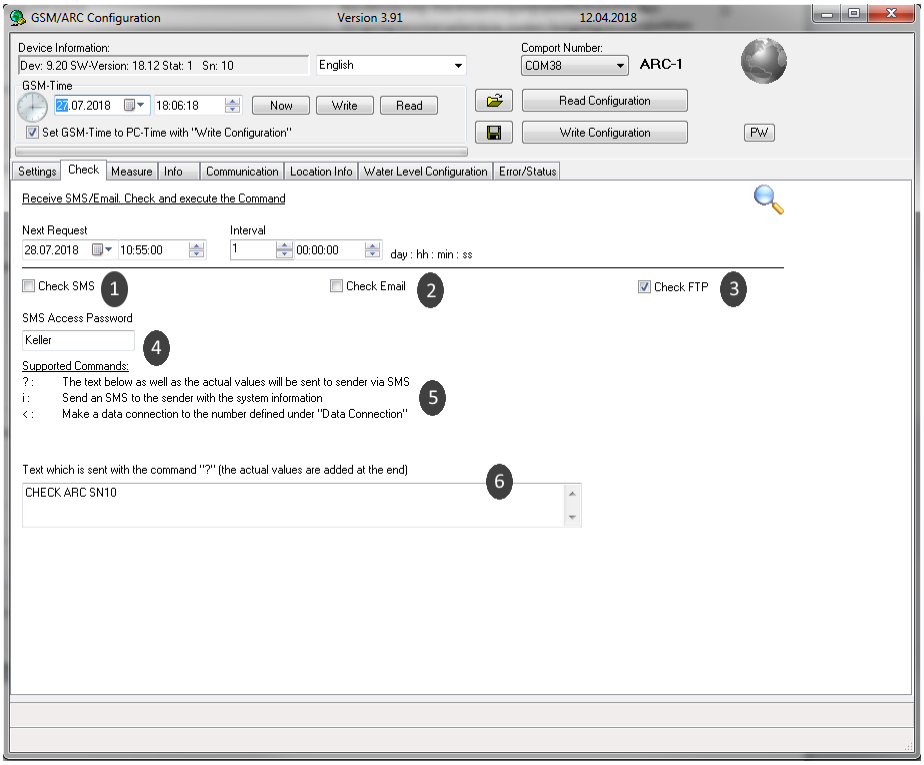
9.8 Error / Status



Number	Description	Explanation / Function
1	Status	This window is updated every second and indicates the state of the ARC-1.
2	Error Status	Errors are listed in the error state window.
3	SMS	To test the SMS transfer, click the button and check whether the message is sent without error.
4	Email	**Send Configuration Email** To test the Email transfer and to send the configuration via Email to the corresponding recipient, click the button and check whether the message is sent without error. **Send measuring data** Click this button to transfer the actual stored data in the ARC-1 (before you change a configuration).
5	FTP	**Send Configuration FTP** To test the FTP transfer and to send the configuration via FTP to the corresponding recipient, click the button and check whether the message is sent without error. **FTP send measuring data** Click this button to transfer the actual stored data in the ARC-1 (before you change a configuration).

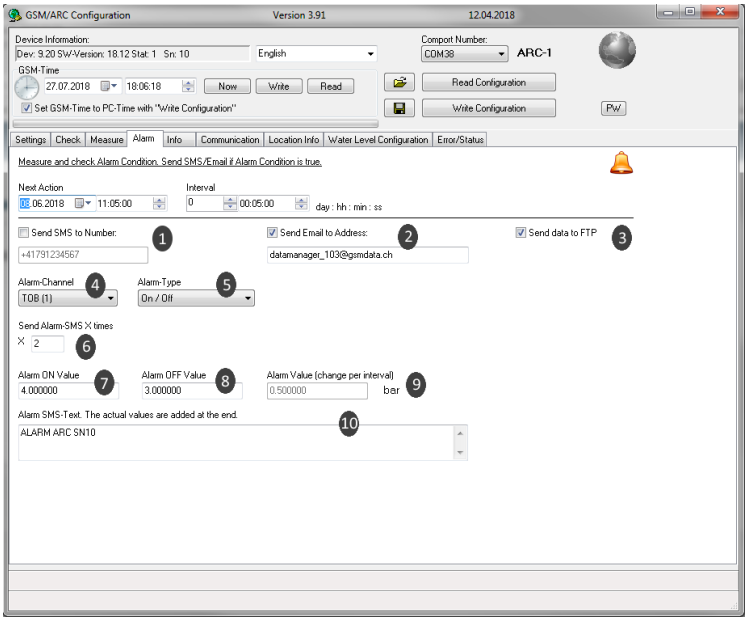
Number	Description	Explanation / Function
6	Execute Cell-Locate	A query of the current position by a triangulation of the antennas is executed and displayed in the location info.
7	Measure	All currently measured values are listed. If you want to start a new measurement, click on the "Measure" button.
8	Get Error	The entire error memory of the ARC-1 is read out.

9.9 Check



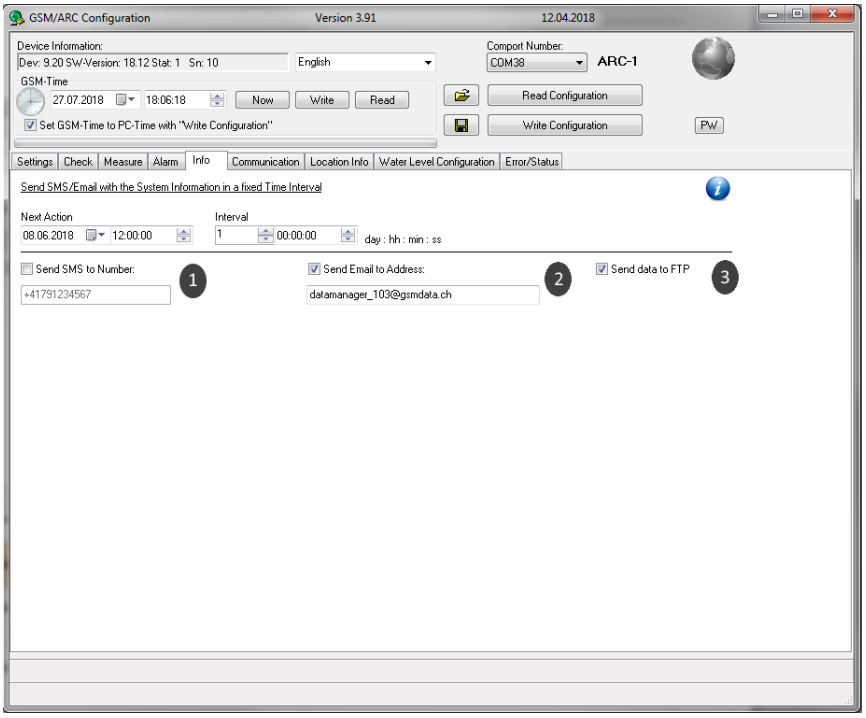
Number	Description	Explanation / Function
1	Check SMS	If activated, the SMS are checked at the set interval/time.
2	Check Email	If activated, the Email In-Box is checked (downloaded) at the set interval/time.
3	Check FTP	If activated, the FTP server is checked (downloaded) at the set interval/time.
4	SMS Access Password	Enter a password. Only those messages (SMS) that begin with this password (case sensitive!) will trigger a function in the ARC-1.
5	Supported Commands	The listed characters support the described command. If this character is transmitted from any mobile phone to the ARC-1 it will carry out the corresponding task. For example, send an SMS with the text “password i” to the ARC-1. After checking the SMS, the ARC-1 will return an SMS to the sender with the current measured values.
6	Text	Any text that is transferred with the reply SMS to the command “?” (could be used as an identification of the message type).

9.10 **Alarm**



Number	Description	Explanation / Function
1	Send SMS to Number	If activated, an SMS with alarm content is sent.
2	Send Email	If activated, an Email with alarm content is sent.
3	Send data to FTP	If activated, an FTP file with alarm content is sent.
3	Alarm-Channel	Choose the channel to be checked.
4	Alarm-Type	On/Off hysteresis, value change (delta/time: pressure or temperature change between two measurements) or other functions.
5	Send Alarm X-Times	Determines how often an message is sent when the alarm condition is true (only with On/Off alarm)
6	Alarm ON Value	Switch-on value (for alarm type On/Off)
7	Alarm OFF Value	Switch-off value (for alarm type On/Off)
8	Alarm Value (change per interval)	The minimum value by which a parameter must have changed since the last alarm measurement to trigger the alarm. The parameter must be specified as a positive value. This value then applies both to positive and negative changes by this amount.
9	Alarm Text	Any text that is transferred with the alarm message (could be used as an identification of the message type).

9.11 **Info**



Number	Description	Explanation / Function
1	Send SMS to Number	If activated, an SMS with the system information is sent.
2	Send Email to Address	If activated, an Email with the system configuration is sent.
3	Send data to FTP	If activated, an FTP file with the system configuration is sent.

10 Record Data Storage

The record data storage offers the advantage that the measuring data doesn't get lost if the data transfer (connection to the internet) is temporarily out of function. In this case, the data which hasn't been transferred yet will automatically be transferred (along with the new data) with the next successful connection.
If for any reason the data transfer can't take place at all, the data can also be read out on site.

10.1 Data Security

All measured values are stored in the ARC-1's EEPROM and are automatically transferred by FTP, Email or SMS. The memory is organized as a circular memory. This means that always the latest data is available whilst the oldest data is overwritten.

As an option the user can read the data with Logger 5 software directly from the ARC-1 by connecting the PC to ARC-1's programming interface.

10.2 Storage Capacity

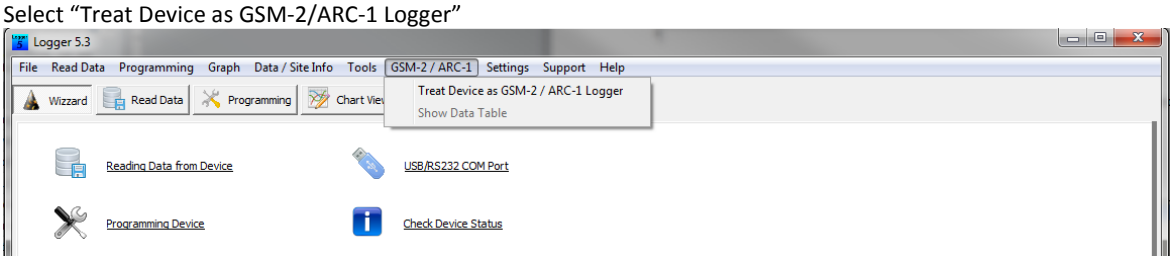
The table below gives an idea of how much data is stored in the ARC-1 memory.

Speicher-Intervall	Anzahl Kanäle	Anzahl Messwerte pro Kanal	Aufzeichnungs-Zeit
1 min	1	57288	40 Tage
1 min	4	24552	17 Tage
1 min	14	8184	5 Tage
10 min	4	24552	170 Tage
10 min	14	8184	56 Tage
1 h	4	24552	2 Jahre
1 h	14	8184	1 Jahre
8 h	4	24552	22 Jahre
8 h	14	8184	7 Jahre

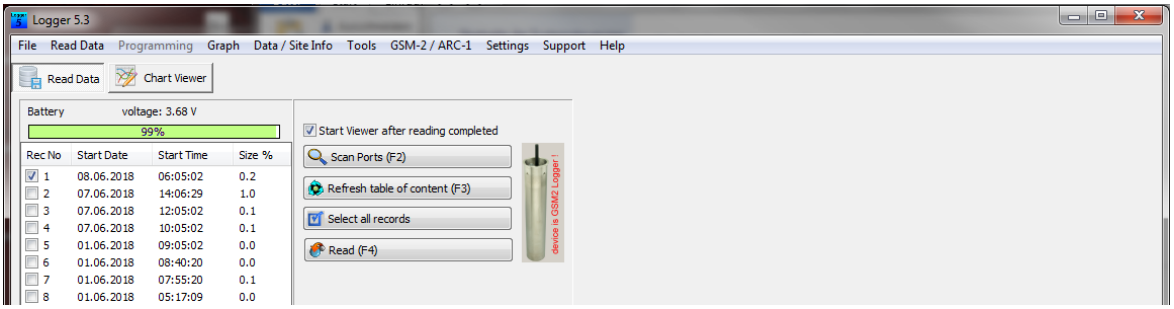
10.3 How to read data directly from the ARC-1 with a data cable

Connect the ARC-1 to the interface and start the "Logger 5.3" PC software. The correct COM port must be selected under "USB/RS232 connection

Select “Treat Device as GSM-2/ARC-1 Logger”



The connection to ARC-1 is now established automatically and all available records appear



Select the desired record and click on the button “read (F4)”

- The recorded data will be read from the ARC-1 and automatically stored onto the PC's hard disk.
- This data file can be imported with the Datamanager (PC-Software).

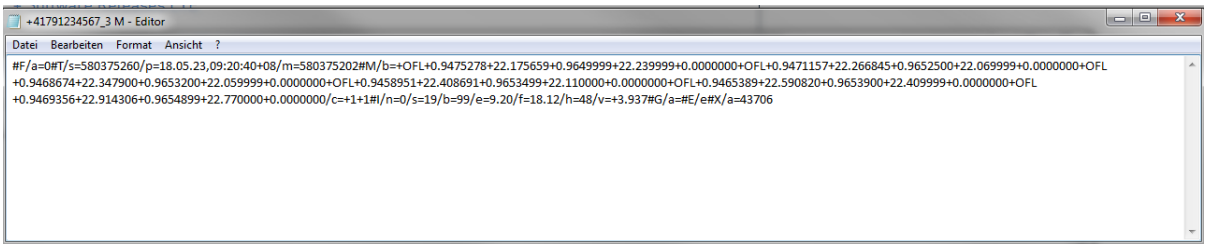
11 Message format

11.1 FTP / Email

The FTP/Email messages are sent in a defined format that is parsed and interpreted by the “Datamanager” program.
The description of this format is available on request.

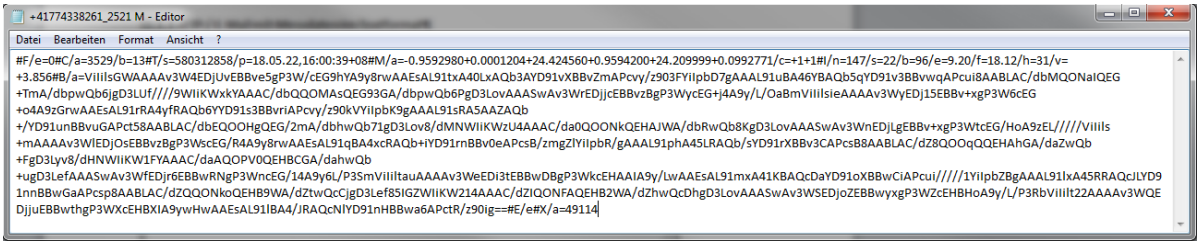
\# # Sign is used as a main command separator
/ / Sign is used as a command separator

11.1.1 FTP / E-Mail with measurement data in text format



<u>Attention:</u>
With this setting, no measurement data is stored in the EEPROM (Record)

11.1.2 FTP / E-Mail with measurement data in binary (Base64) format

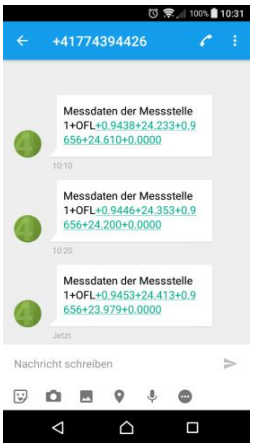


11.2 SMS

The SMS messages are sent in a defined format.

11.2.1 Measurement data (in text format only)

This example shows how the measurement data are displayed on the mobile phone.

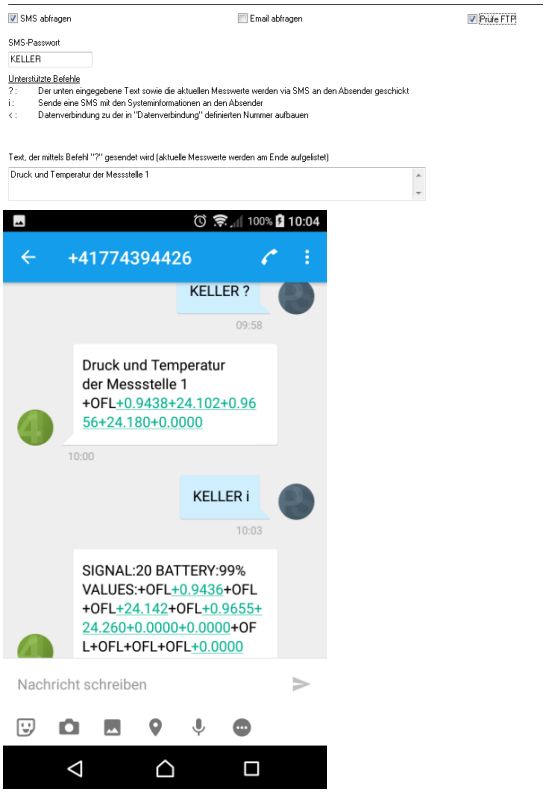


The measurement data can be preceded by a user-defined text. Then follow the measurement data (set measurement channels), which are separated from each other with positive / negative signs.

Hint:
The number of digits displayed and a multiplier for pressure and temperature values can also be defined.

11.2.2 Query

This example shows how a command message is sent to the ARC-1 and how it processes the command (Responds).



To request the current measurement data ("?") or the system information ("i"), an SMS with the password and the command must be sent to the telephone number of the ARC-1.

„?“:

The requested measurement data are preceded by the user-defined text (in the "Check" tab). Then follow the measurement data (set measurement channels), which are separated from each other with positive / negative signs.

„i“:

The requested system information starts with the signal strength and the remaining battery capacity. Then follow the measurement data (set measurement channels), which are separated from each other with positive / negative signs.

Hint:
The number of digits displayed and a multiplier for pressure and temperature values can also be defined.

12 Email Configuration

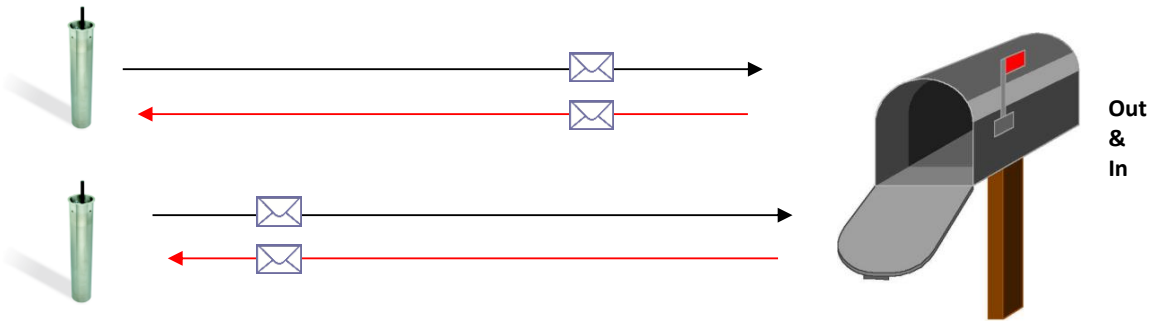
We recommend using at least two Email accounts in conjunction with the Datamanager: one Email account where the ARC-1 modules send the measurements and the configurations to. The other Email account is for configurations that are sent from the Datamanager to the ARC-1. The ARC-1 then only downloads configurations. This helps to save battery power and data transfer cost.

12.1 One email account

Same email account for outgoing and incoming messages.

Advantage: Only one Email account for incoming and outgoing messages

Disadvantage: All messages (configuration and measurements) are downloaded to each ARC-1 module in use. This produces a lot of traffic and higher costs; it also limits battery life.

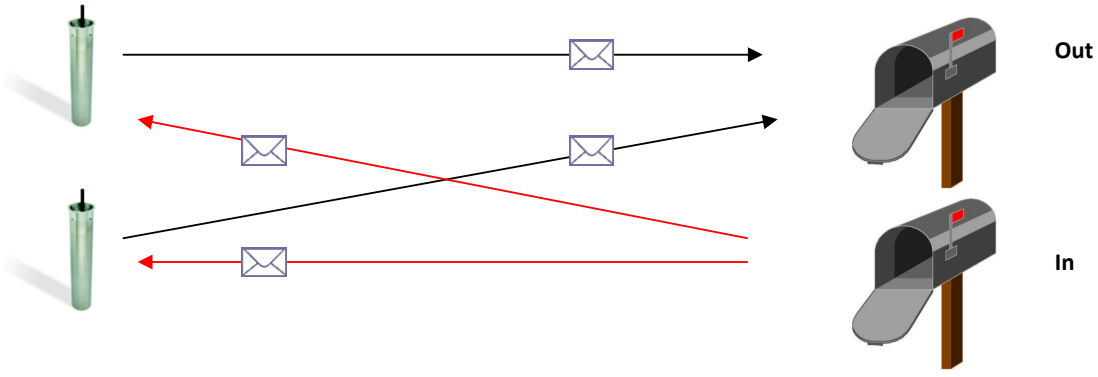


12.2 Two email accounts

An email account for outgoing and incoming messages.

Advantage: Separate Email account for incoming and outgoing messages.
All measurements are sent to the same Email account.
All configuration mails are downloaded from a separate mailbox.

Disadvantage: The configuration messages are downloaded to each used ARC-1 module. This means more traffic, additional costs and reduced battery life.

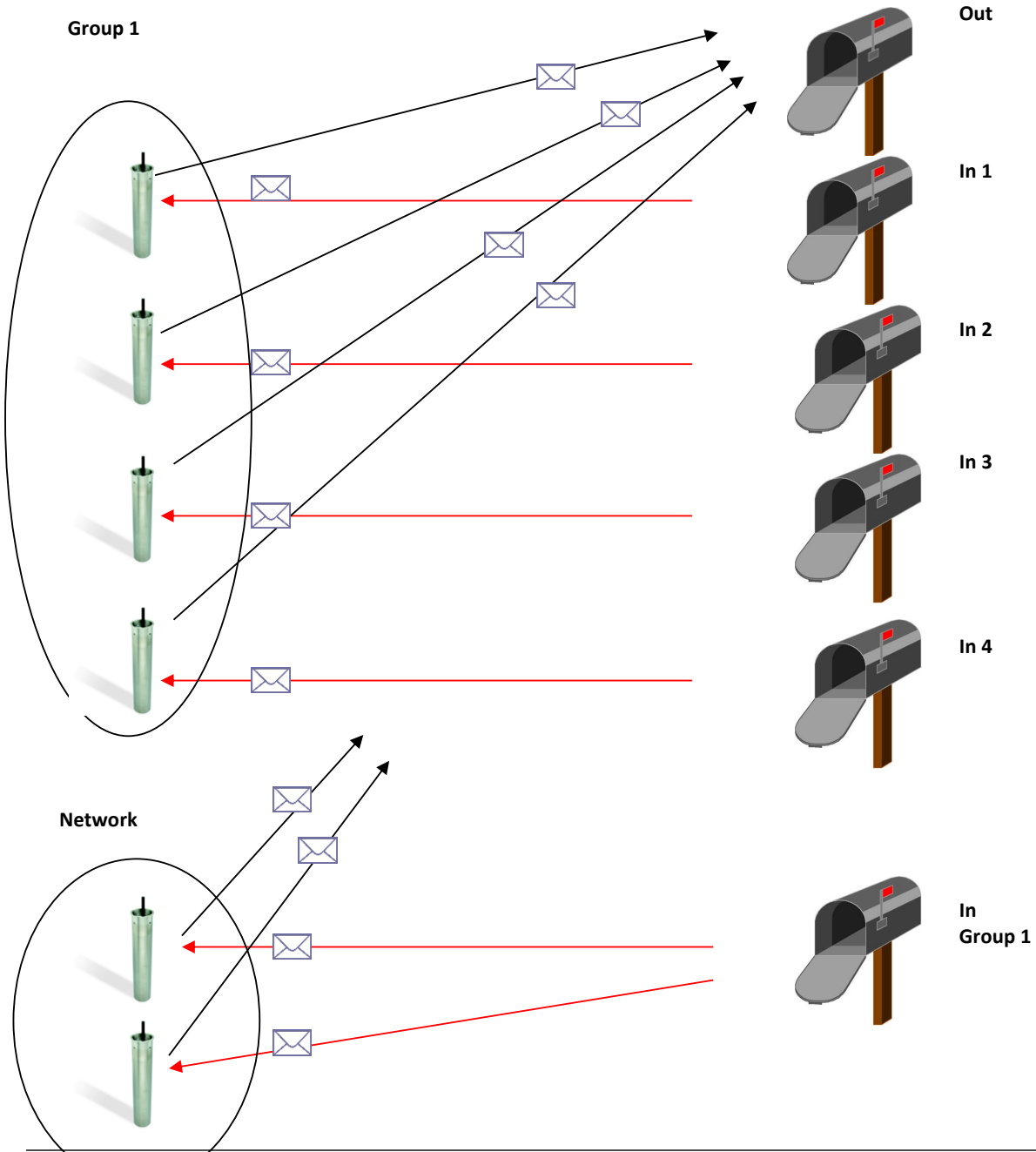


12.3 Many email accounts

Advantage: One Email account for outgoing messages and a separate Email account for each ARC-1 (Incoming message).
All measurements are sent to the same Email account.
Only configuration mails for the corresponding ARC-1 are downloaded to ARC-1.

Disadvantage: You need many Email accounts

Hint: You can build groups (measurement networks), which use the same inbox.

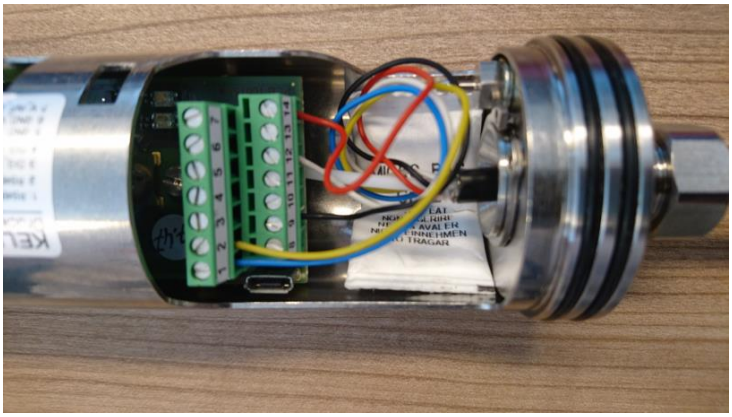


13 Step-by-step installation instructions

The configuration below shows how installation and configuration can take place. It is a standard configuration suitable for most applications:

- ARC-1 with level senor (Series 36 XW) connected. Connection RS485 and 12 Volt supply.
- Two Email accounts. Datamanager@measure.ch to send messages with measurements to the Datamanager, arc1@measure.ch to send new configuration from the Datamanager to the ARC-1.
- Measuring interval is 1 hour, sending an Email with 24 measuring values every day (24 hours)
- Check interval for incoming Email (configuration from Datamanager to ARC-1) every day (24 hours), same time as for sending measurements to the Datamanager.

13.1 Connect Level Sensor



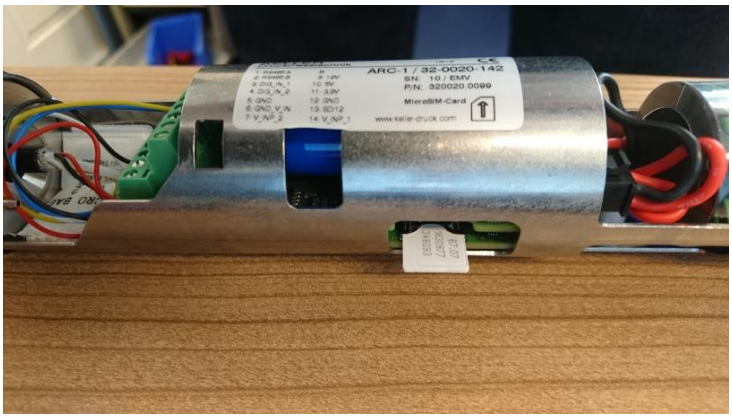
Feed the sensor cable through the sleeve and connect the cable ends to the terminal strip.

Connect the Series 36 XW level sensor as follows:

Blue:	RS485A
Yellow:	RS485B
Black:	+ 12 VDC
White:	GND

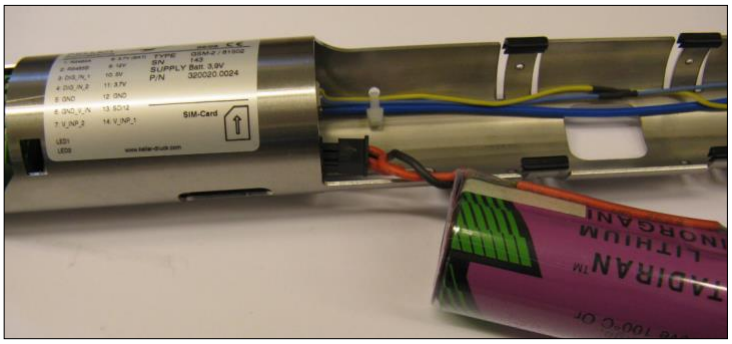
Tighten the cable gland.

13.2 Insert SIM Card



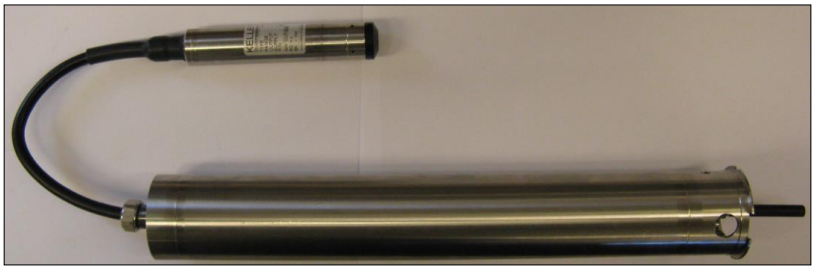
Insert the SIM card until it locks.

13.3 Insert Battery



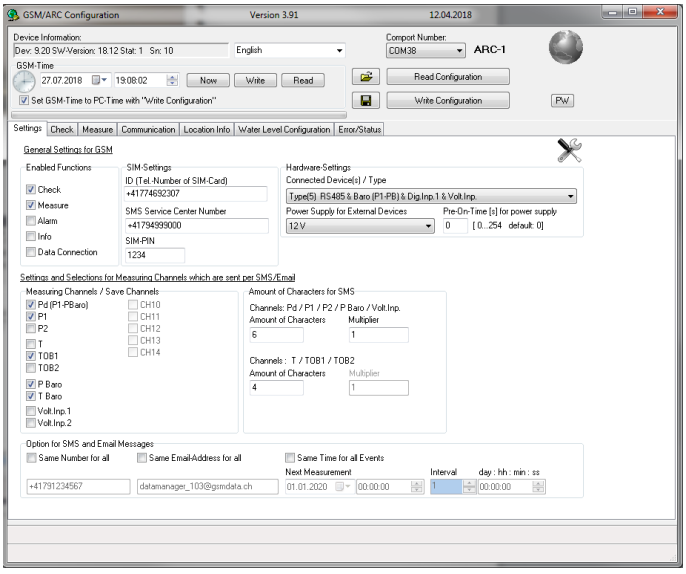
Connect the battery and push it into the battery holder.

13.4 Close the ARC-1 Housing and connect Antenna



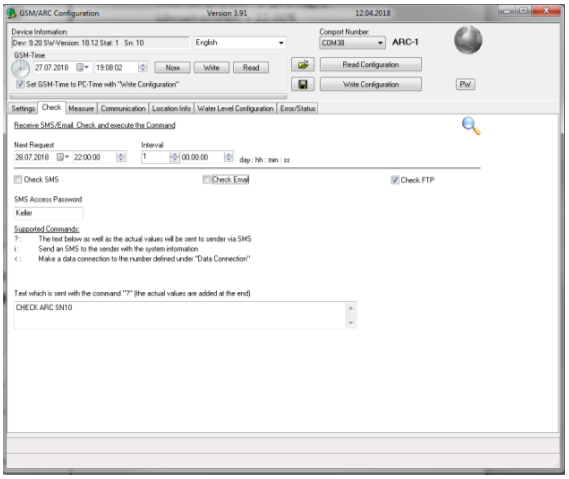
13.5 Configure the ARC-1 with the "ARC Configuration" program

13.5.1 General Settings



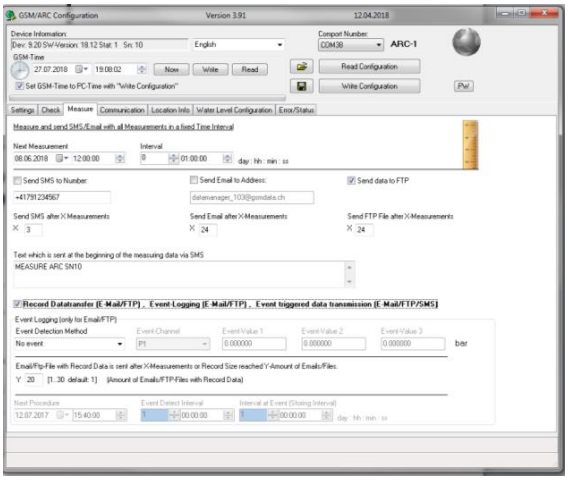
Make selections and settings as shown in the picture.

13.5.2 **Check time and interval**



Check interval: 1 (per day)
Check time: 22.00

13.5.3 **Measure interval and send time**

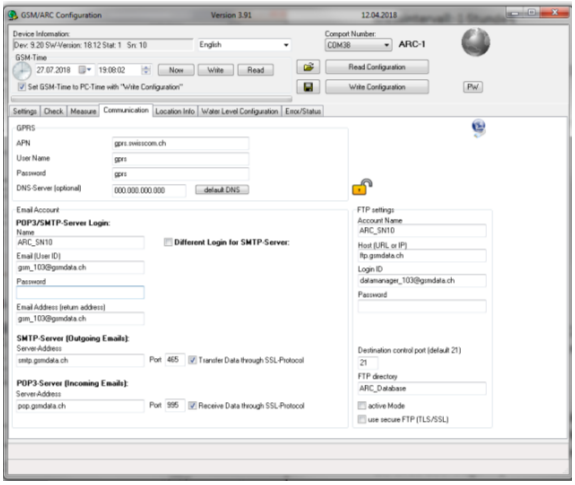


Measuring interval: 1 hour
Number of measurements: 24

Message will be sent every day at
11.00 to the FTP server ftp.gsmdata.ch

- record transfer enabled

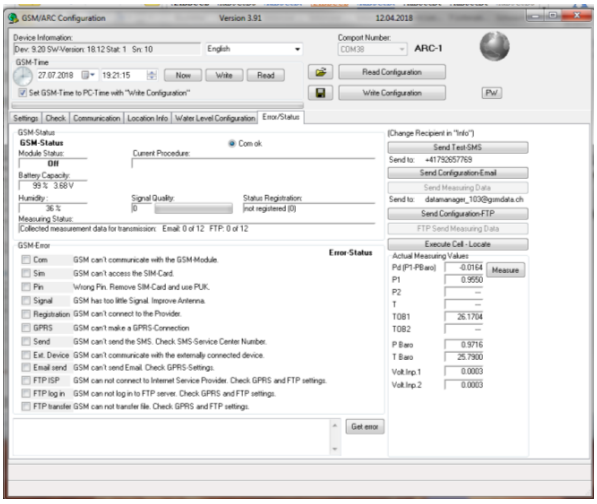
13.5.4 **Communication Settings**



Here we have to define the FTP account settings to which address the file has to be uploaded.

After having changed the settings, proceed with the "Write Configuration" button to transfer the settings to the connected device!

13.5.5 **Send Configuration**



Now click on the “Send Configuration FTP” button to transfer the settings and to register the device in the Datamanager.

Make sure that the transfer takes place without error.

After sending, disconnect the communication interface cable and protect the interface with the protection cap.

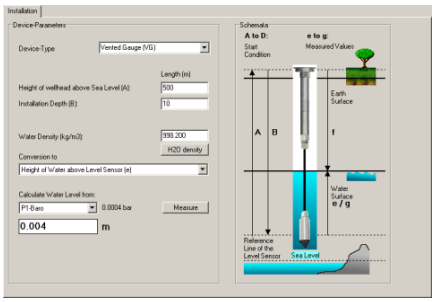
The ARC-1 is now configured and will send the measurements on a daily basis.

Close the lock unit and lock it.

13.6 **Installation at a measuring point with the locking unit**

1. Attach the locking unit at the measuring point.

The locking unit with the antenna protection cap mounted to the upper part is suitable for 2 inch standard pipes.



2. Prepare the installation data

- Actual water level (to be measured by hand)
- Network name, location name
- Location position (longitude, latitude, altitude)
- Height of wellhead above sea level
- Installation depth of level sensor

This installation data is entered into the „ARC Configuration” software and later transferred to the Datamanager.

3. Insert the ARC-1

Insert the module at the measuring point together with the appropriate sensor.

4. Configure the ARC-1 with the „ARC Configuration" program

Connect the ARC-1 to the PC and configure it with the program.
The configuration is sent by FTP to the Datamanager, where the new location is automatically registered.

Make sure that the configuration has been sent. Also check the signal quality and the actual measured values.

5. Close the cap

The antenna will fit into the plastic cover.

6. Lock the cover

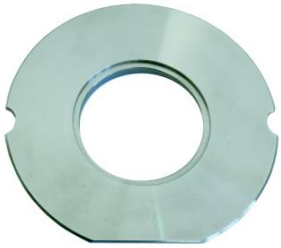
Lock the unit as shown.

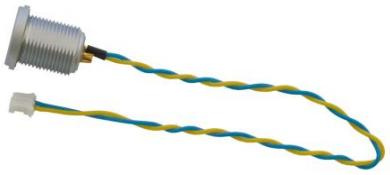
7. The installation is now complete.

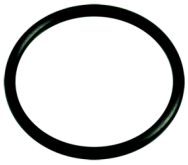
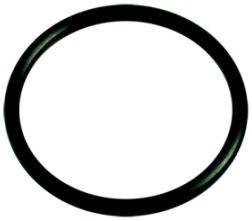
14 ARC-1 Order information

14.1 Variants and options

Description	Product number	Picture
ARC-1 Tube Without accessories (no stub antenna, no screw fittings, no plug, no level sealing cap)	320020.0094	
ARC-1 Tube Stub antenna, cable gland preinstalled	320020.0099	
ARC-1 Stub antenna, cable gland preinstalled, level sealing cap 2”	320020.0105	
ARC-1 Tube Stub antenna, LEMO plug preinstalled	320020.0102	
ARC-1 Tube Stub antenna, LEMO plug preinstalled, level sealing cap 2”	320020.0103	
ARC-1 Box Stub antenna, cable glands preinstalled	320020.0104	
ARC-1 Box SB With integrated Zener barriers (ATEX), stub antenna, cable gland pre-installed	320022.0003	
ARC-1 Electronic For upgrading existing GSM-2 remote transmitters	320020.0097	

Description		Product number	Picture
Locking Unit	**2''** **3''** **4''** **5''** **6''**	320020.0026 320020.0056 320020.0045 320020.0046 320020.0042	
Adapter ring suitable for the locking unit	**3''** **4''** **5''** **6''**	506810.0118 506810.0119 506810.0102 506810.0120	
Battery 3,9 V with Plug Capacity: 35 Ah		557005.0019	
K-114 A Interface Converter For communication between the PC and the ARC-1 over USB interface Cable length: 0.75m		309010.0075	
K-114 BT A For communication between the PC and the ARC-1 over Bluetooth radio interface Cable length: 0.75m		309010.0101	
Stub Antenna UMTS with SMA connection		320020.0092	

Antenna for manhole cover with SMA connection Cable length: 2m	320020.0110	
Antenna Cable with MMCX / SMA connection Cable length: 182 mm	320020.0093	
Adapter Set with LEMO Lemo Plug 70012	320020.0101	
Adapter Cable with Fischer Plug for datalogger “DCX” Connection Cable length: 100 mm	320020.0009	
Fischer Plug (configuration interface) Cable length: 190 mm	320020.0039	
Circlip DIN: 471 (BN: 682) ø 18 mm	508830.0002	
AGRO Set ø 3,5…6,5 mm Adapter, screw nut, seal, circlip	320020.0061	
AGRO Set ø 6,6…8 mm Adapter, screw nut, seal, circlip	320020.0062	

Description	Product number	Picture
Closure Cap for Fischer Plug Includes screw (M3 x 6 Inox)	508415.0004	
O-Ring ø 19 x 1,5 mm (Nitrile) for AGRO adapter	508610.0091	
O-Ring ø 40 x 1,5 mm (Nitrile) sealing ring for casing (tube)	508620.0007	
Tube Adapter Incl. venting element, sealing ring	702505.0005	 
Silica Gel Bag Size 2	702515.0001	

14.2 Range of suitable level sensors and pressure transmitters

Level sensors – Series 36 Xi W		
highest accuracy and resolution	• Pressure ranges for 3, 10, 30, 100 and 300 mH2O • Accuracy 0.02 %FS • RS485 (and SDI-12) interface	
Multi-parameter sensors – Series 36 Xi W CTD		
with conductivity sensor and maximum temperature accuracy	• Pressure ranges for 3, 10, 30 and 100 mH2O • Accuracy 0.02 %FS • RS485 (and SDI-12) interface • Conductivity measuring ranges 0 µS/cm…200 mS/cm • Temperature accuracy 0.1 °C	
Intrinsically safe level sensors – Series 36 XW Ei		
for installation in explosive atmospheres	• Pressure ranges for 3, 10, 30, 100 and 300 mH2O • Accuracy 0.02 %FS • RS485 and analogue interfaces	
Level sensors with plastic membrane – Series 36 XKY		
with Kynar membrane for brackish water and wastewater	• Pressure ranges for 10, 30 and 100 mH2O • Accuracy 0.3 %FS • RS485 and analogue interfaces	
Capacitive level sensors – Series 46 X		
with measuring cell for low pressure ranges	• Pressure ranges for 0.3, 1 and 3 mH2O • Accuracy 0.1 %FS • RS485 and analogue interfaces • Intrinsically safe series 46 X Ei	
Pressure transmitter – 33 X/35 X series		
with thread connection for pressure-retaining systems	• Pressure ranges from 0.3 to 1,000 bar • Accuracy 0.02 %FS • RS485 and analogue interfaces • Intrinsically safe series 33 X Ei/35 X Ei	

Notes:
- Level sensors and pressure transmitters are not included with the ARC-1
- Low-voltage versions are available for longer battery service life
- All level sensors can be ordered with enhanced lightning protection
- A range of cables is available for application in water, drinking water and fuels