ML-525 (PCB type)
Low power remote Data loggers



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Manufacturer	:	Your Data Our Care B.V.			
Author	:	Hanko Milot			
Address	:	Da Vincilaan 13c 6716 WC, EDE The Netherlands			

WARNING

THE FOLLOWING OPERATING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID DAMAGE OR MALFUNCTION, DO NOT PERFORM ANY OPERATING OTHER THAN THAT CONTAINED IN THIS MANUAL. ANY OPERATOR SHOULD BE SKILLED WITH A TECHNCAL BACKGROUND BEFORE OPERATING THE DEVICE.

PREFACE

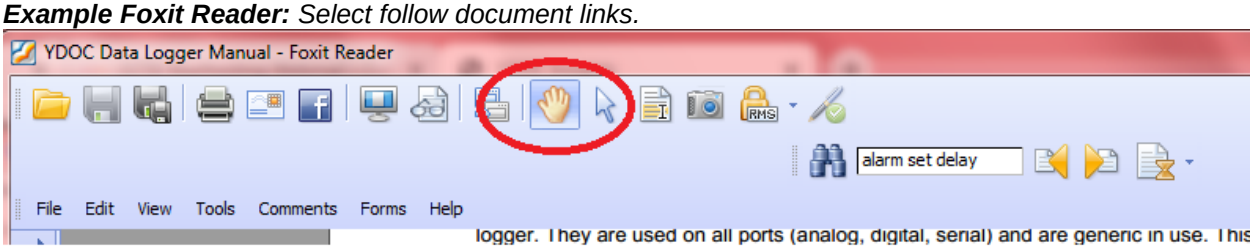
Congratulations!

With your purchase of an YDOC Low Power Data logger with mobile network capabilities.

This manual describes the operation and (hardware) installation of the ML-525xE Data logger.

The chapter *Getting Started* briefly describes the Data logger, prepares you to install it, and tells you how to get it into operational state using the internal configuration menu. Menu options in this manual are brows able. (Setup your PDF reader to follow links).

Example Foxit Reader: *Select follow document links.*



The Chapter *Operating Basics* covers basic principles of operation of the Data logger. The operating interface (menu) and the tutorial examples, rapidly help you to understand how your Data logger operates.

The Chapter *Reference* teaches you how to perform specific tasks and provides a complete list of operating tasks and useful background information.

The Appendices provide a list with all available options, and other useful information.

We recommend reading this manual carefully before installation of the Data logger.

Warranty

All YDOC instruments are warranted for 3 years against defective materials and workmanship. Any questions with respect to the warranty mentioned above should be taken up with your YDOC Distributor.

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1 Product description

A new serie of ML-525xE Main boards is available. ML-525LE-PCB, ML-525SE-PCB and ML-525PE-PCB. Depending on the enclosure, the PCB's will be shipped as RS-525xE or TS-525xE.

Note: *Available PCB and enclosure combinations can be found in the SKU table.*

Name:	***Implementation:***	***Documentation:***
RS /TS-525SE	Standard Edition, LTE-m/NB-IoT	RS-525xE Datasheet pages
RS-525LE	Light Edition, LTM-m/NB-IoT	
RS /TS-525PE	Planet-wide Edition, LTE Cat1 bis	

1.1 RS-525 Remote Data logger

The RS-525 Data logger is a compact weatherproof, low-power, cost-effective device featuring a built-in LTE-m /NB-IoT cellular modem. It includes an internal temperature and humidity sensor, internal 120MB flash data storage, a micro SD card holder, eSIM and Nano (4FF) SIM card slot. The ML-525 Data logger offers various power options, including 3.6V lithium batteries, 8 .. 28V DC input, 12V external solar panel input, or an integrated solar panel with a battery charger. The device can acquire physical signals through 2 current loop inputs, 2 voltage inputs, 1 potentiometer input, and 3 digital inputs. One analog input supports dead-band triggered 100Hz burst recording, capturing up to 5 seconds of a signal transition in detail. Additional or specialized inputs can be added via internal stackable option boards or converters. Equipped with three serial ports, the Data logger can capture measurements from MODBUS, NMEA, ASCII and SDI-12 compatible sensors. External sensors can be powered by the Data logger itself, preventing power consumption while the Data logger is in sleep mode. Up to 20 mathematical channels are available to calculate meaningful engineering values from sensor input values (e.g., using a polynomial to calculate flow from a stream level). The logger supports up to 10 aggregation channels (e.g., recording 2- or 10-minute wind speed averages sampled at 1Hz).The internal data storage has enough capacity to store one decade of typical log data (e.g. 8 parameters recorded each 5 minutes). If necessary, the storage capacity can be extended with an microSD card up to 32GB.Logged data can be pushed to up to six different servers of your choosing via HTTP(S), FTP(S), secure TCP, or MQTT(S) at configurable intervals and in various payload formats such as TXT, CSV, JSON, Sparkplug B, or customized formats.

1.2 Key Features RS-525SE

- LTE-m /NB-IoT Data logger
- Internal micro 128MB SD-card (120MB usable storage) and standard FAT-32 File system
- Solar, Battery or DC powered
- 3..21V Adjustable Sensor excitation voltage (200mA@3..12V, 100mA@12..21V)
- Serial sensors input (1x SDI-12, 1x RS232 and 1x RS485)
- MODBUS, NMEA-0183 or ASCII
- Analog & Digital Inputs
- Digital output
- Calculation channels
- Aggregation channels
- Log data transfer using TCP, FTP(S), HTTP(S), MQTT, e-Mail or SMS
- CSV, TXT, JSON or Custom defined payload
- IP68 Enclosure
- Local configuration (Windows with USB or Android app) and remote Configuration (OTA)
- Easy configuration by menu items of embedded terminal application
- Local or OTA firmware upgrades

1.3 Accessories

- Several option boards, analog and digital input, digital output, conversion, power and network board. (Supporting Bluetooth, WiFi and LoRa).
- Camera (JPG)

- GPS Receiver
- TFT Display

1.4 RS-525LE Remote Data logger

The RS-525LE outdoor Data logger is a compact weatherproof, low-power, very cost-effective device primarily targeting agriculture featuring a built-in LTE-M & NB-IoT cellular modem. It includes an internal temperature and humidity sensor, 120MB flash storage, eSIM and a Nano (4FF) SIM card slot. The Data logger is equipped with an integrated 18650 LiFePO4 battery charger and 1Wp solar panel which yields enough energy to let typical monitoring applications (e.g. soil moisture monitoring) run unattended for years without the need for regular visits to replace depleted batteries. Deployment is easy as you don't need to install an external solar panel or assemble and wire an encapsulating cabinet. Equipped with 2 serial ports, the Data logger can capture measurements from MODBUS/ASCII/NMEA and SDI-12 compatible sensors. External sensors can be powered by the Data logger itself, preventing power consumption while
the Data logger is in sleep mode. Up to 20 mathematical channels are available to calculate meaningful engineering values from sensor input values (e.g., using a polynomial to calculate flow from a stream level). The logger supports up to 10 aggregation channels (e.g., recording 2- or 10-minute wind speed averages sampled at 1Hz). The internal 120MB flash data storage has enough capacity to store one decade of typical log data (e.g. 8 parameters recorded each 5 minutes). Logged data can be pushed to up to six different servers of your choosing via HTTP(S), FTP(S), secure TCP, MQTT(S) or E-mail at configurable intervals and in various payload for-mats such as TXT, CSV, JSON, Sparkplug B or customized formats. The Data logger can be configured and upgraded remotely.

1.5 Comparison to the ML-x17 series

Comparison at a glance. (ML-x17 values between brackets).

- Internal eSIM and 120MB on-board flash storage, expandable by external SIM and 8..32GB SD card. (External SIM and 8..32GB external SD card).
- Up to 6 servers are addressable with one or a mixed type output network protocols. (2 or 3 servers depending on the configured protocols).
- Sensors can log up to 100 parameters with individual data log intervals. (64 parameters).
- Up to 30 drivers usable at the same time. (16 drivers).
- 10 Aggregation channels and 20 Calculated channels to pre-process. (8 Agregation and 8 Calculation channels).
- Standard or customer definable payload data record formats. (Same)
- Configurable excitation voltage: 3-21V, Max. 2.4W. (Fixed 12V, Max 2.4W).
- Iridium driver is canceled. (Alternative on ML-525PE edition).
- 2G is canceled. (2G is end of life).

1.6 Internal 120MB SD card

Is 120MB internal memory adequate to store data from years? Yes and no, depending on the number of parameters and data log interval…

Note: *SD card usage evaluation can be done using the tool in this FAQ*

For data intensive applications: ***From firmware version V5.2 B4*** (available on ML-x17 and ML-525xE), a Ringbuffer for the data log file is implemented.
The ringbuffer applies to both the internal and external SD storage.

When the ringbuffer is initialized, available storage space is evaluated.
10MB workspace is substracted from the available space. Depending on internal(120MB) or external (maximum file size on the SD card file system is limited to 4GB).

Note: *During the working time of the data logger, the ringbuffer size can vary (shrink) below the initial size. (Works as designed).*

Practically:
- On a ML-525xE internal SD card, the initial ringbuffer size will be 120MB - 10MB.
- On a external SD card the maximum size is limited to 4GB - 100MB. (Depending on the SD card size).

Note: *More information on Ring buffer data structure can be found here.*

1.7 Models and Editions

Typical, a Ydoc RS-525SE Data logger is a small, ultra-low power, high-end Data logger with built-in 4G cellular-modem. It is designed to retrieve, and store data from various types of sensors. (Analog or digital). The collected data is stored on the on-board 120MB flash memory or a customer installable SD-card. Data is stored, can be pre-processed in a calculation or aggregation channel, and sent to any remote computer you like, using one of the implemented network protocols. A alarm can be generated according to defined thresholds on sensor levels and can be used to send a message, or trigger a local external device. (like a pump motor) or take a picture (using the camera accessories). The Data logger is equipped with a eSIM, delivered by the manufacturer. This eSIM is valid for *at least* 5 years (with 500MB balance). It can be overruled by a customer installable SIM.

The SE model is available in various editions on power source. (Battery, Solar, Fixed DC or a combination of these).

The logger can be powered by an internal 3.6 Volt Lithium battery that will last for years when the logger is configured in a low-power mode.

Depending on model and edition a Data logger can acquire physical input signals by current loop, voltage, potentiometer and digital inputs. Digital inputs can be provided by physical level 0 .. 10V or serial data ports (RS232 /RS485 /SDI-12 /MODBUS) to capture data in ASCII, MODBUS-RTU /NMEA-0183, SDI-12 format. The Data logger can trigger a output port or to connect an accessory (Camera, GPS, Satellite modem) or digital switch. Input and output ports can be expanded by stackable option boards, which can be placed to a maximum of three onto the Data logger.

External sensors can be powered by the switched excitation power from the Data logger itself, to prevent drawing power while the Data logger is a sleep between measurement intervals.

For external communication is a built-in NB-IoT /LTE-m modem available.
(FCC ID: RI7ME910G1W1, TAC: 35681210).

The LE model is a simplified SE model and has integrated 18650 LiFePO4 battery charger that is powered by a 1Wp solar cell. The LE model is only equipped with 2 serial ports which can capture measurements from MODBUS /ASCII /NMEA and SDI-12 compatible sensors.

This model is equipped with same modem as mounted on the ML-525SE.

The PE model has the same data log and interfacing functionality as the SE model, the only difference is the external communication is based on a LTE Cat1 bis modem. (FCC ID: ?, TAC: ?)**

Note: *All models comply with the CE Radio Equipment Directive (RED) 2014/53/EU.*

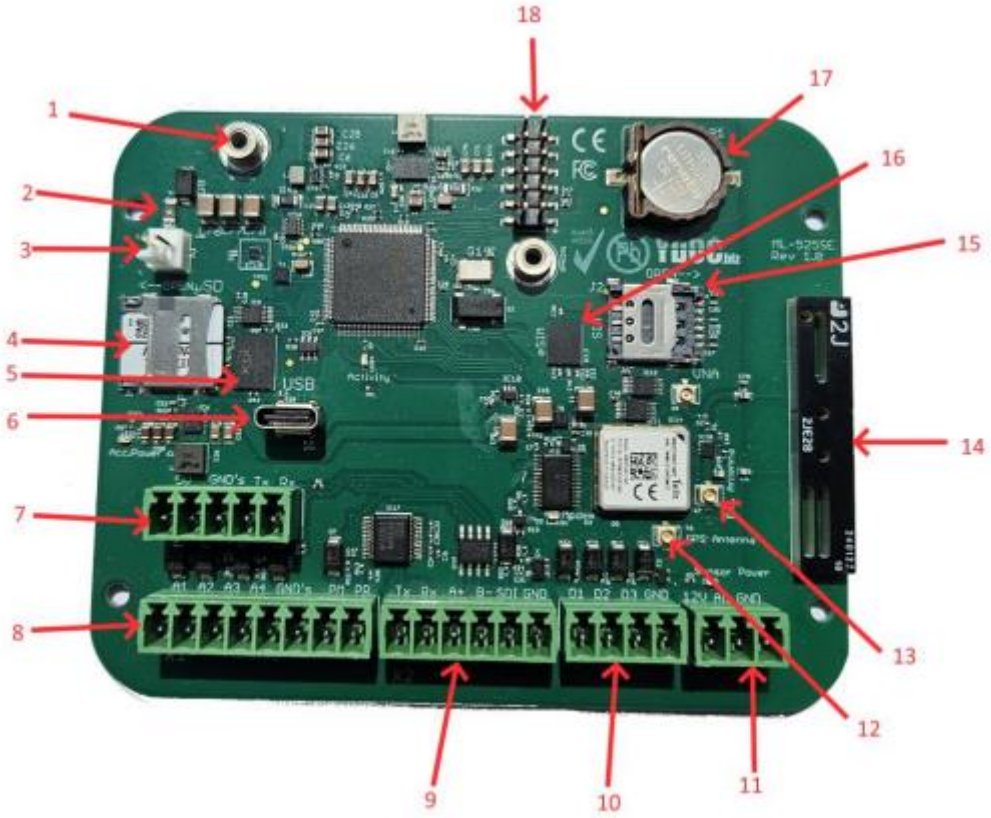
*** We are still waiting for Telit to supply us with modems. We expect availibilty of the Ml-525PE variant in Q2/ 2026.*

SKU Table RS-525	
SKU format:	**RS /TS 525xE-pp** (xx=Edition, pp=Power supply)
Edition	**Description** **Remarks**
RS-525LE	Light edition
RS-525SE	Standard edition
RS-525PE	Planet wide edition
TS-525SE	Standard wide edition with touch-screen
TS-525PE	Planet wide edition with touch screen
RS525LE	**Description**
RS-525LE-PV	With integrated 1Wp solar panel and 1x 26650 3.2V LiFePO4 holder &charger.

RS525SE/PE-pp	Description (Battery, DC and PV housing models)
RS-525xE-LI	Powered from a single 3.6V DC SAFT LSH20 or equivalent D-size lithium battery.
RS-525xE-3LI	Powered from 3x 3.6V DC SAFT LSH20 or equivalent D-size lithium batteries.
RS-525xE-DC	Powered from external 8..28V DC source.
RS-525xE-DC-LI	Powered from external 8..28V DC source or 3.6V DC SAFT LSH20 lithium battery.
RS-525xE-PV	With integrated 1Wp solar panel and 1x 26650 3.2V LiFePO4 holder &charger.
RS-525xE-LFP	With 4x 18650 3.2V LiFePO4 holder & charger for 12V (21VOC) ext. solar panels.
RS-525xE-SLA	With integrated 12V battery charger for 12V (21VOC) external solar panels.
RS-525xE- PV	With integrated 1Wp solar panel and 1x 26650 3.2V LiFePO4 holder &charger.
TS525SE/PE-pp	**Description (Touch screen housing models)**
TS-525xE-LI	Powered from a single 3.6V DC SAFT LSH20 or equivalent D-size lithium battery.
TS-525xE-DC	Powered from external 8..28V DC source.
TS-525xE-DC-LI	Powered from external 8..28V DC source or 3.6V DC SAFT LSH20 lithium battery.
TS-525xE-LFP	With 4x 18650 3.2V LiFePO4 holder & charger for 12V (21VOC) ext. solar panels.
TS-525xE-LFP	With 4x 18650 3.2V LiFePO4 holder & charger for 12V (21VOC) ext. solar panels.
TS-525xE-SLA	With integrated 12V battery charger for 12V (21VOC) external solar panels.

2 ML-525xE Main Board layouts

2.1 Board layout - ML-525SE (PE has same connectors)



2.2 SE /PE - Connectors

Number	Connector	Description
1		Mounting bus for option board
2		Main Fuse (Self recovering fuse)
3	J1	3.6V - 4V Power Supply Connector
4		Micro SD-card Holder (Removable)
5		SD memory (Fixed)
6	X6	USB-C Connector for configuration and testing
7	X5	Accessory port (TFT, CAM, etc.)
8	X1	Analog input port (D1, D2, D3)
9	X2	RS232 /RS485 /SDI-12 Port
10	X3	Digital input port
11	X4	Sensor Power Output & Alarm Output connector
12	X8	GPS Antenna connector
13	X7	u.FL Connector for external antenna
14		Octoband antenna for LTE/NB-IOT communications
15		(Nano) SIM connector (Removable)
16		eSIM (Fixed)
17		RTC Clock battery
18	J2	Option port

2.3 SE /PE Interface Connectors - Pin description

Connector	Pin		Name	Description
X1	1	A1	0, 4..20mA, input 1	Positive terminal analog input 1
	2	A2	0, 4..20mA, input 2	Positive terminal analog input 2
	3	A3	0..10V, input 3	Positive terminal analog input 3
	4	A4	0..10V, input 4	Positive terminal analog input 4
	5,6	GND's	Gnd	Ground
	7	PM	0..100% (0..2048mV), input 5	Positive terminal potentiometer/analog input 5
	8	PR	Reference voltage terminal	2048 mV potentiometer reference terminal
X2	1	Tx	RS232 TX	RS232 Tx (Transmit line)
	2	Rx	RS232 RX	RS232 Rx (Receive line)
	3	A+	RS485 A	+RS485 (Positive terminal)
	4	B-	RS485 B	-RS485 (Negative terminal)
	5	SDI	SDI-12 (0..5V)	Terminal for SDI-12 sensors
	6	GND	Gnd	Ground
X3	1	D1	Digital input 1 (0..5V)	Positive terminal digital input 1 or wake-up line
	2	D2	Digital input 2 (0..5V)	Positive terminal digital input 2
	3	D3	Digital input 3 (0..5V)	Positive terminal digital input 3
	4	GND	Gnd	Ground
X4	1	3..21V	Max. 2.4Watt	Sensor power terminal
	2	AO	Alarm output	Open collector output (Max. 100mA)
	3	GND	Gnd	Ground
X5	1	5V	Acc.power (600mA)	5V Accessory power (for TFT, CAM, GPS)
	2,3	GNDs	Gnd	Ground
	4	Tx	RS232 TX	RS232 Tx (Connect to accessory RX)
	5	Rx	RS232 RX	RS232 Rx (Connect to accessory TX)
X6	1		V+	USB power V+
	2		D-	USB data D-
	3		D+	USB data D+
	4		Gnd	USB Power Ground
X7			External antenna connector	u.FL connector for external antenna
J1	1		(3.6V - 4VDC)	Positive terminal for power source
	2		(3.6V - 4VDC)	Negative terminal for power source
J2	1..8			Option port

2.4 SE /PE Connectors - X1

The **ML-525SE** is provided with 5 factory-calibrated analog inputs with 12 bit ADC resolution.

2.4.1 0/4..20mA inputs

Input	Range	Accuracy	Impedance
1	4 .. 20mA	<0.1% FS	100 Ohm
2	4 .. 20mA	<0.1% FS	100 Ohm

The circuits are equipped with ESD protection.

2.4.2 0…10V inputs

Input	Range	Accuracy	Impedance
3	0 .. 10V	<0.1% FS	50.2 k Ohm
4	0 .. 10V	<0.1% FS	50.2 k Ohm

0..10V single ended. The circuits are equipped with ESD and over-voltage protection.

2.4.3 Potentiometer input

Input	Range	Accuracy	Impedance
5	Potentiometer (0..100%) or as 0..2048mV input	<0.1% FS	500 k Ohm

Recommended potentiometer resistance: 100K to 4M7.

Note: *There are terminals which are holding ground level. This provides both sensor-ground and battery ground. For your convenience, these terminals are connected to multiple pads on the main PCB connectors, because every single sensor will need his own ground. You can connect multiple sensors, just put the additional power connections in parallel. (And each sensor ground in it's own ground terminal).*

2.5 SE /PE Connectors - X2 (Serial interfaces)

2.5.1 RS232 RX & TX

These are the pins for RS232 communications. Use these pins together with ground. Al pins are protected against ESD. Voltage levels are according RS232 standard.

2.5.2 RS485 A & B

These are the pins for RS485 communication. Use these pins together with a ground signal. These signals are ESD-protected by the driver-circuit. The signal levels are according to the TIA /EIA-485 Standard.

2.5.3 SDI-12 Hi

This is the in/out terminal for SDI-12 communication. It is protected against overvoltage. Use this terminal together with ground. See www.sdi-12.org for more information.

2.6 SE /PE Connectors - X3 (Digital inputs)

2.6.1 Digital inputs

The digital inputs are interrupt-driven, with an internal pull-down or pull-up resistor.

Input voltage internal pull up: 0V (Switch connect to Gnd).
Input voltage internal pull-down: 3.3 - 5V ("Active output" switch to external power source).
There are three digital inputs available.

2.7 SE /PE Connectors - X4 (Power Switch and open collector output port)

2.7.1 Sensor power

This is an output for powering sensors up to 2.4Watt. (200mA@3..12V and 100mA@12..21V). The default output voltage is set to 12 Volt. Sensor power output voltage can be altered in the configuration.

2.7.2 Open collector output port

The middle connector pin is an open collector (alarm) output pin.

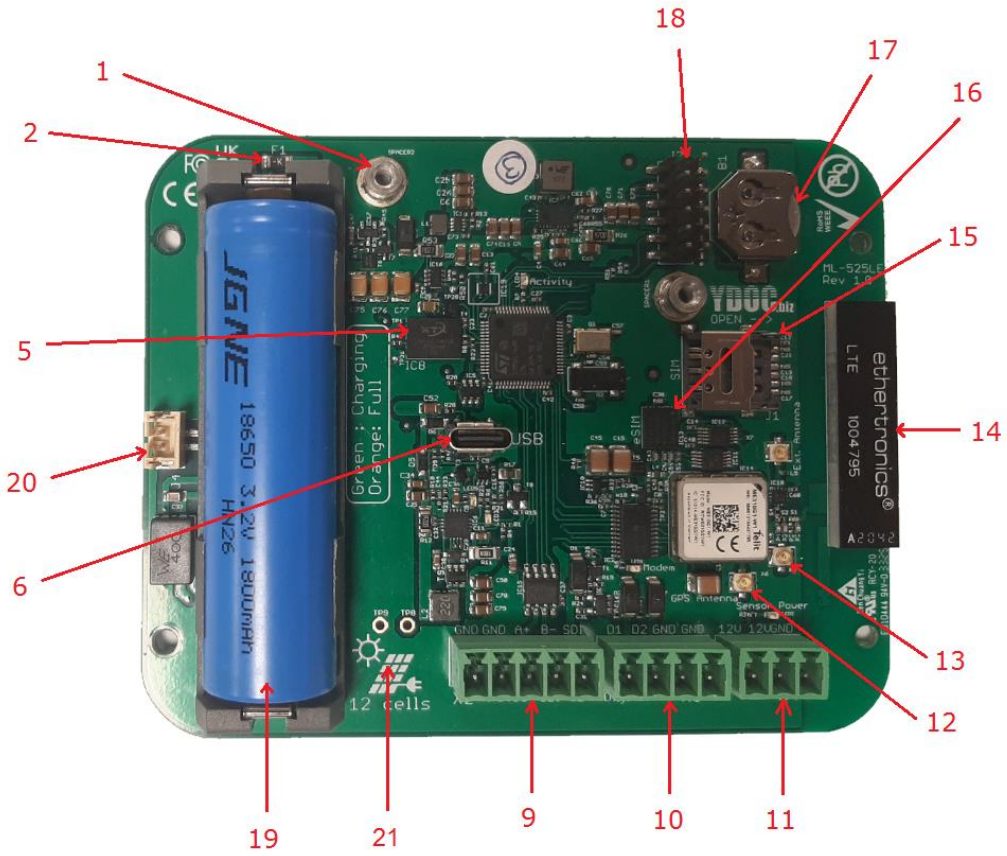
2.8 SE /PE Connectors - J1 Power (3.6V - 4V)

This is the main power supply input for the board, with the red-and-black wire and white connectors. Connect the desired power board output to the J1 power connector, using the red and black cable.

The actual voltage on this pin is monitored by the firmware. It is called "Primary input Voltage". The current, flowing through the wires, is monitored, and is called "Primary input Current".

Note: *This signal is not the same as the internal 3.6 volts level. The power-supply circuit converts this level to the fixed, internal, 3.6 Volts level. We strongly recommend using a ML-PB-DC power board when using an external power supply.*

2.9 Board layout - ML-525LE



2.10 LE - Connectors

Number	Connector	Description
1		Mounting bus for option board
2		Main Fuse (Self recovering fuse)
5		SD memory (Fixed)
6	X6	USB-C Connector for configuration and testing
9	X2	RS485 /SDI-12 port
10	X3	Digital input port (D1, D2)
11	X4	Sensor Power Output
12	X8	GPS Antenna connector
13	X7	u.FL Connector for external antenna
14		Octoband antenna for LTE/NB-IOT communications
15		(Nano) SIM connector (Removable)
16		eSIM (Fixed)
17		RTC Clock battery
18	J2	Option port
19		LFP battery (18650)
20	J4	PV panel connector
21		Soldering points for 12 cells solar panel

2.11 LE Interface Connectors - Pin description

Connector		Pin	Name	Description
X2	1	GND	Gnd	Ground
	2	GND	Gnd	Ground
	3	A+	RS485 A	+RS485 (Positive terminal)
	4	B-	RS485 B	-RS485 (Negative terminal)
	5	SDI	SDI-12 (0..5V)	Terminal for SDI-12 sensors
X3	1	D1	Digital input 1 (0..5V)	Positive terminal digital input 1 or wake-up line
	2	D2	Digital input 2 (0..5V)	Positive terminal digital input 2
	3	GND	Gnd	Ground
	4	GND	Gnd	Ground
X4	1	3..21V	Max. 2.4Watt	Sensor power terminal
	2	3..21V	Max. 2.4Watt	Sensor power terminal
	3	GND	Gnd	Ground
X6	1		V+	USB power V+
	2		D-	USB data D-
	3		D+	USB data D+
	4		Gnd	USB Power Ground
X7			External antenna connector	u.FL connector for external antenna
J1	1..8			Option port
J4	1..2		PV panel connector	

2.12 LE Connectors - X2 (Serial interfaces)

2.12.1 RS485 A & B

These are the pins for RS485 communication. Use these pins together with a ground signal. These signals are ESD-protected by the driver-circuit. The signal levels are according to the TIA /EIA-485 Standard.

2.12.2 SDI-12 Hi

This is the in/out terminal for SDI-12 communication. It is protected against overvoltage. Use this terminal together with ground. See www.sdi-12.org for more information.

2.13 LE Connectors - X3 (Digital inputs)

2.13.1 Digital inputs

The digital inputs are interrupt-driven, with an internal pull-down or pull-up resistor.
Input voltage internal pull up: 0V (Switch connect to Gnd).
Input voltage internal pull-down: 3.3 - 5V ("Active output" switch to external power source).
There are two digital inputs available.

2.14 LE Connectors - X4 (Power Switch)

2.14.1 Sensor power

This is an output for powering sensors up to 2.4Watt. (200mA@3..12V and 100mA@12..21V). The default output voltage is set to 12 Volt. Sensor power output voltage can be altered in the configuration.

2.15 LE Connectors - J4 PV panel (12 cells)

Connect the PV red and black power cable from the white cap to the J4 connector.

2.16 ML-525xE - Main board led 's explaned

On the board are four led 's mounted.

Colour	***Action***
Green	*On during power-on and reboot*
Yellow	*On when USB is connected On when data logger is awake. Blinking during config loading*
Blue	*On during modem active*
Red	*On when sensor power is applied*

3 Getting started

3.1 Precautions

A Data logger is a complex electronic device, remember these rules when opening.

- Always provide a dry and clean environment when you open the case of a Data logger
- When you open the case, use a Philips screwdriver of 2mm for loosening the screws
- “Handle with care”, protect the Data logger against mechanical stress, moisture and vibrations
- Avoid touching the main PCB and SMD components
- Remove the red and black power cable when inserting option boards or mounting sensor wires



ESD Attention: Although the Data logger is designed to withstand certain amounts of electrostatic discharge, it is advised to avoid discharged risks. Especially when the Data logger housing is opened. Please do not touch the PCB if you don’t have to.

It is strongly recommended to use an earthed wrist-band while working with the main PCB, Sensor connectors, SD card and SIM card on a opened Data logger.

3.2 Set up your environment to configure the Data logger

In order to operate, the Data logger must be configured. This can be done using the build-in menu.
There are two ways to establish a connection to the menu.

- Windows PC + USB C cable + YdocTerminal program.
- ML-OU-BLE option board is mounted, Android device, YdocTerminal App + BlueTooth enabled.

3.2.1 Windows PC

Connect to the Data logger using a Windows PC, USB C cable and YdocTerminal program for Windows.

Note: *YdocTerminal can be downloaded here.*

3.2.2 Android device (Tablet or Smart Phone)

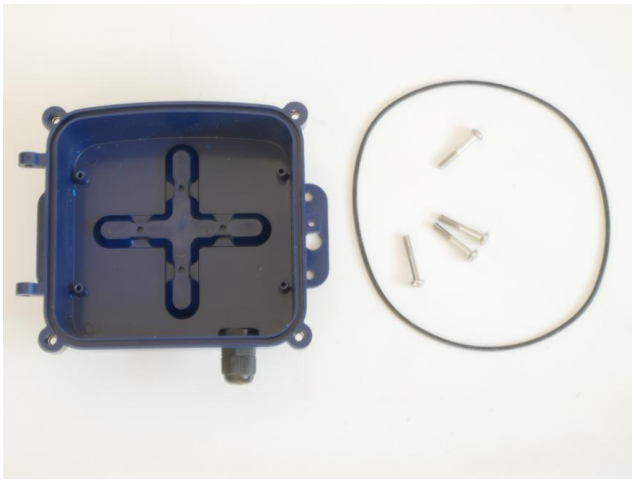
To connect to the Data logger equipped with a ML-OU-BLE option board, a Android device and YdocTerminal App can be used.
The App can be downloaded from the Android Playstore.

3.3 (Dis) assembling the Data logger

“Out of the box” a new Data logger case (blue) has the four hexagonal nuts installed. The cap (white) has four holes, the shafted screws must be installed.

The assembly process is explained and shown below, it must be done very carefully to prevent damage on the O-ring and housing. A careful assembled housing will prevent moisture ingress.

Basically the Data logger consist of: Blue base tub, O-ring, four screws and nuts, power cap, main board, power board, power cable and green connectors for sensors.



3.3.1 Preparing the housing

- If the four shafted screws are not factory installed: Use a Philips screw driver or power tool with Philips bit installed, to mount the shafted screws into the power cab.
- Press the O-ring in the slot of the blue base tub, *do not use a sharp object*.

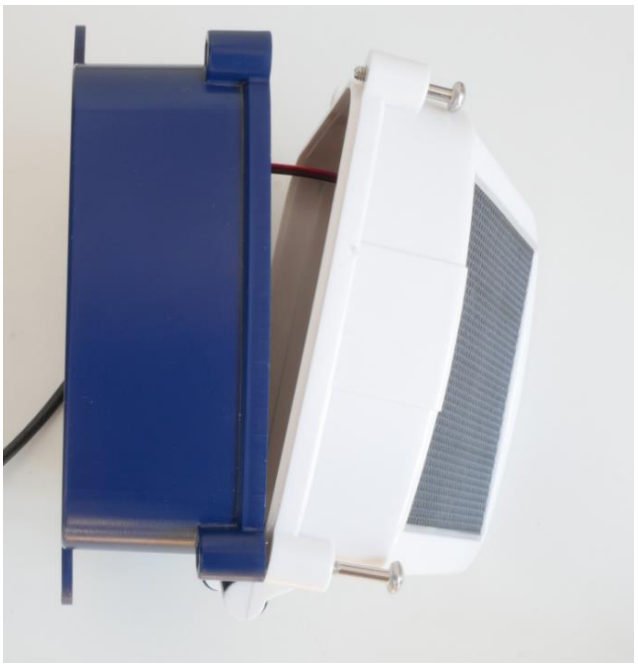


- Place the white power cap onto the blue base tub, carefully check if the power cap aligns.
- Holding the housing together by hand, place one-by-one, in each corner, the screw.
- ***Note:*** *If the four nuts are not factory installed, use a Philips screw driver or power tool with Philips bit installed, to pull the nut into the hexagonal hole in each corner of the blue base tub.*



Once the nut is withdrawn by the screw, it will stuck in place in the blue cab, when loosening the shafted screws.

- Release and retract the four shafted screws completely from the blue base tub, in a way they will last in the power cab, the shaft-type screws are preventing falling out the power cab.
- Normally, the nuts should remain in the nut holes when the shafted screws are loosened.
  To secure the nuts, apply a small piece of scotch tape on the nut hole, preventing falling out.
- When the screws are retracted from the blue base tub, you should be able to open the Data logger without mangling the hinge.



3.3.2 Cable glands

The Data logger will be supplied without pre-drilled cable glands, giving the user the freedom to choose the number and size of the glands them self to avoid unnecessary points of risk for moisture penetration.
Before mounting the main PCB, drill (or laser cut) the holes for the glands.
Remember the position of the glands, keeping them above the main PCB and align with the top of the cable blocks.

3.4 Preparing the Data logger for power up

In the factory, the Data logger main PCB is tested and programmed with the (at that moment available) latest firmware version and default system settings. The system information is viewable in the “General settings” tab from the menu.
The Data logger PCB is out of the box ready to use after some preparations have been made.

- If you don’t want to use the factory installed eSIM, install your own SIM card.
- If the available 120MB internal storage does not match your application needs, install an external SD card. (Maximum of 32GB card is supported).
- Install sensor wiring into the cable glands.
- Connect sensor wiring to the associated connector(s).
- If applicable, connect the external antenna.
- Depending on Data logger edition, install battery’s or DC power cable.
- Before configuring, check if the latest firmware is (factory) installed at: https://ydoc.biz/docs/datalogger-firmware/
- Configure the Data logger. (Chapter 4).
- After testing, close the housing.

3.4.1 Inserting your own SIM card

The wireless data functions will only work with a activated SIM card. Data loggers are factory default equipped with a eSIM with a subscription valid for *at least* 5 years. (With 500MB balance). Additional, your own Nano SIM with a valid subscription can be placed and activated in the Data logger.
In the menu, the used eSIM or SIM card can be selected, configuration and network settings must match the card provider.

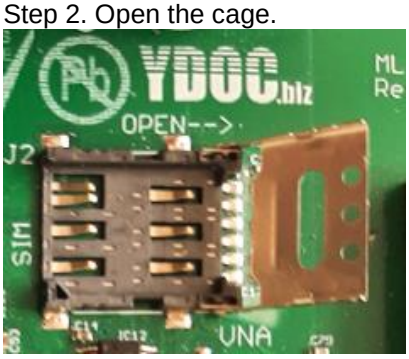
Warning: *When a external Nano SIM card is used.*

- *Remove power before changing or inserting a SIM card.*
- *Check your data card prescription on capability of data communication. (LTE-m/ NB-IoT).*
- *Installation of the SIM card has to be done in a clean and dry environment.*
- *Avoid contact with electronic components on the PCB when installing the SIM card.*
- *Remove the PIN code of your SIM card, this can be done with the use of a mobile phone.*
- *Check and remember the APN settings of your provider.*

Step 1. Slide the cage to the right, pins are no longer viewable in the three holes.



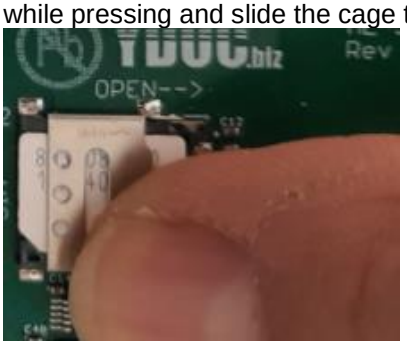
Step 2. Open the cage.



Step 3. Place the Nano SIM card as shown.



Step 4. Close the cage without mangling while pressing and slide the cage to the left.



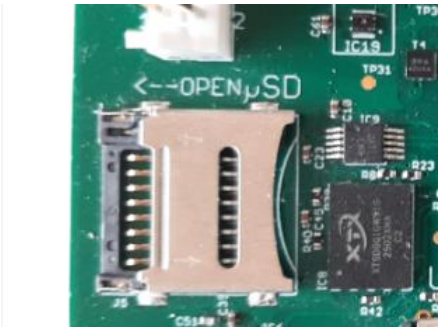
3.4.2 Inserting your own SD card

Memory is needed to store the firmware, configuration file, temporary files and the data log file.
To extend available 120MB memory, insert your own SD card.

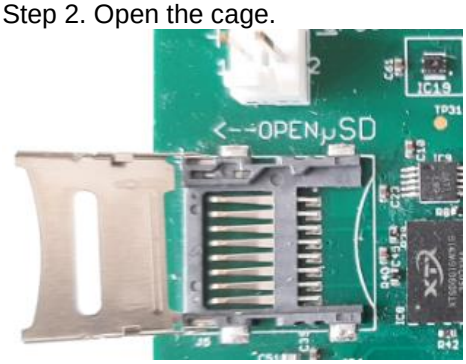
Warning: *When a external SD card is used.*

- Remove power before changing or inserting a SIM card.
- Only “heavy duty” (Industrial) card are to be used.
- Installation of the SD card has to be done in a clean and dry environment.
- Avoid contact with electronic components on the PCB when installing the SD card.

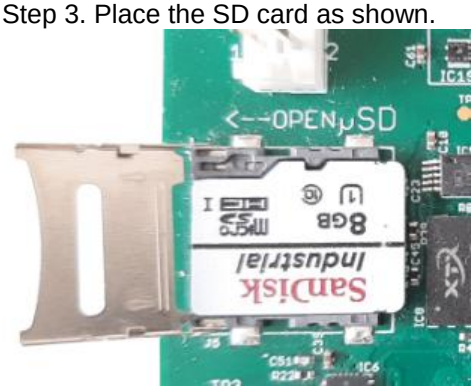
Step 1. Slide the SD card cage to the left, in the “Open” direction.



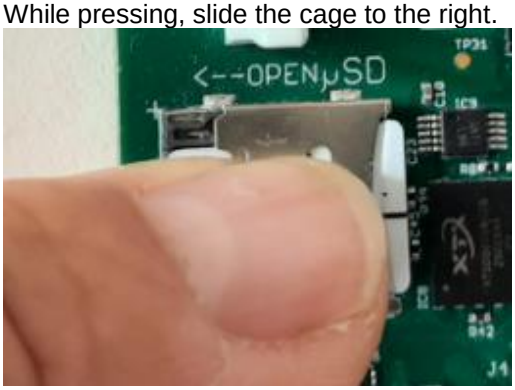
Step 2. Open the cage.



Step 3. Place the SD card as shown.



Step 4. Close the cage without mangling. While pressing, slide the cage to the right.



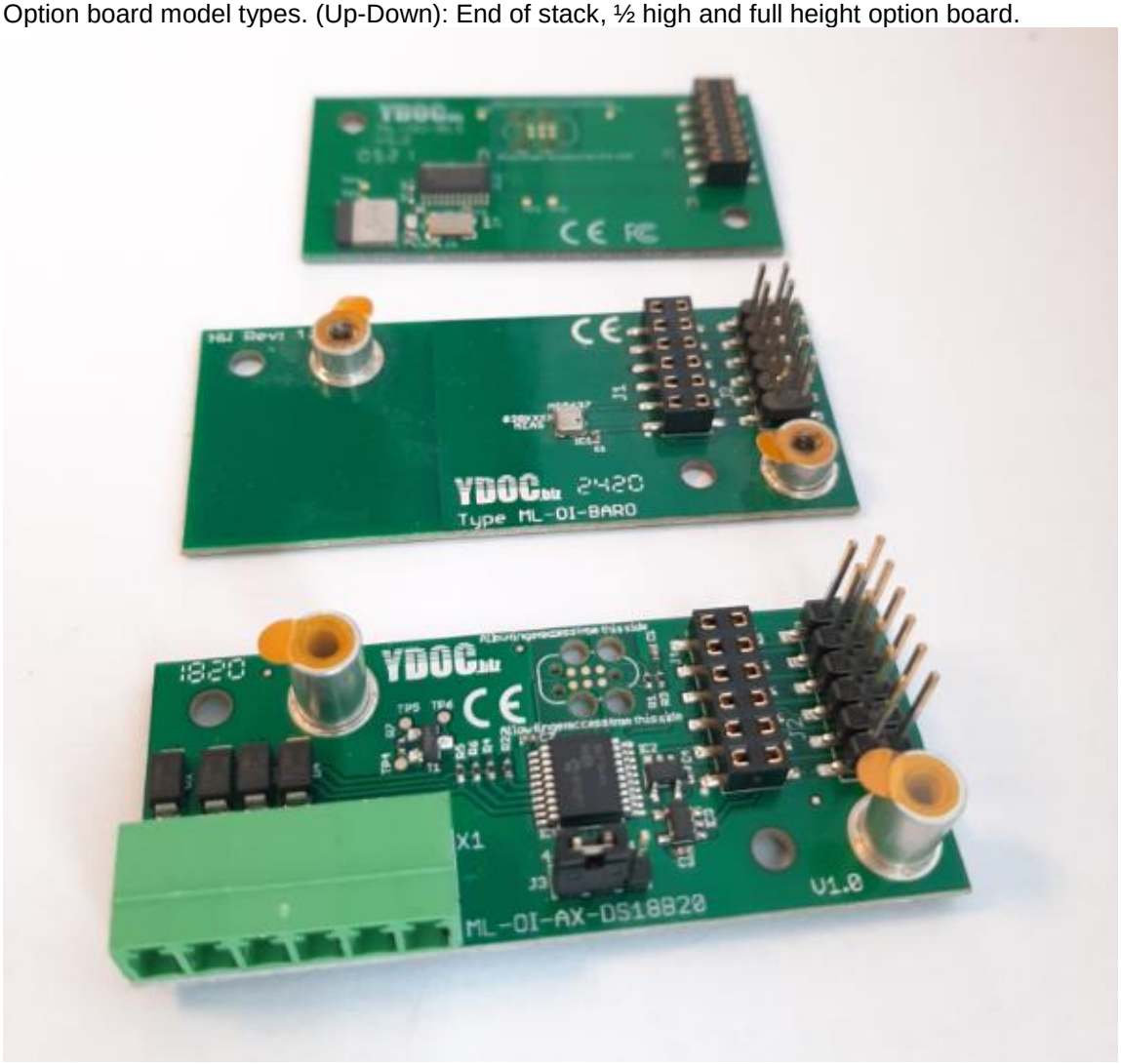
3.4.3 Installing option or convertor boards

When more sensor inputs, output or communication ports are needed, multiple option boards can be mounted on the main PCB.

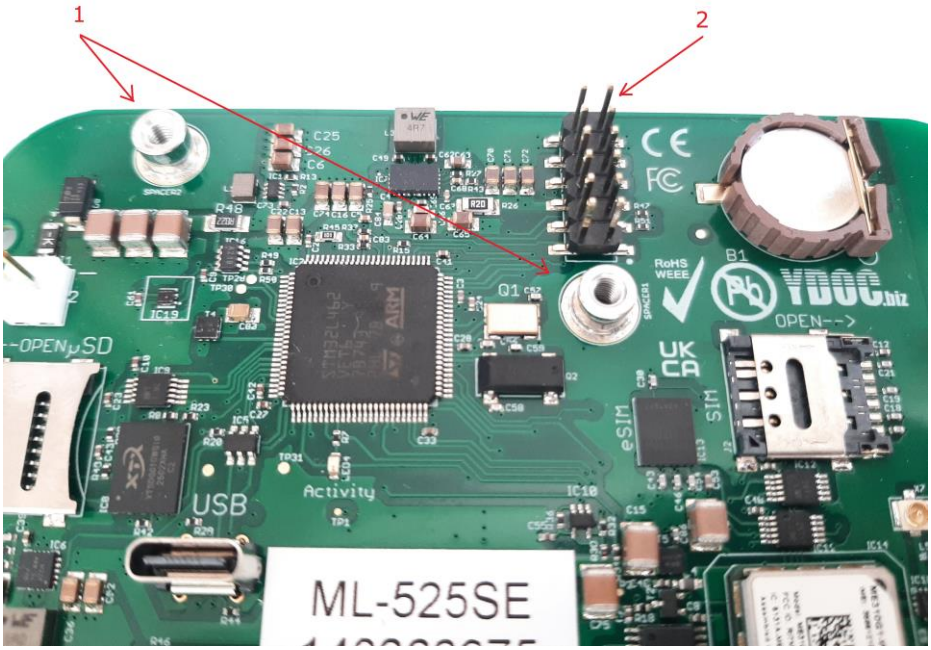
Available documentation:

- Read this FAQ on combining multiple option boards in the Data logger.
- Check the option board manual for available boards and specifications.

Option board model types. (Up-Down): End of stack, ½ high and full height option board.



The Option Board Connector of the ML-525xE is located in the upper right corner of the Data logger Main PCB. Option Boards are mounted with two screws, fitting in the screw thread drilled into the metal spacers.



1) Metal spacer.
2) Option Board Connector.

3.4.4 Installation proces

1. Disconnect the power from your Data logger. (If applicable).
2. Place the Option Board onto the main board, aligned with the spacers, and the connector.
3. Use the supplied Torx screws to mount the Option board. (Do not overtighten).
4. After Mounting, restore the power and perform the Option Board configuration. (If needed).

3.5 Power up the Data logger

Install the red and black power cable between the ML-PB-xx power board and the main PCB. When receiving power, the Data logger will boot and start running.

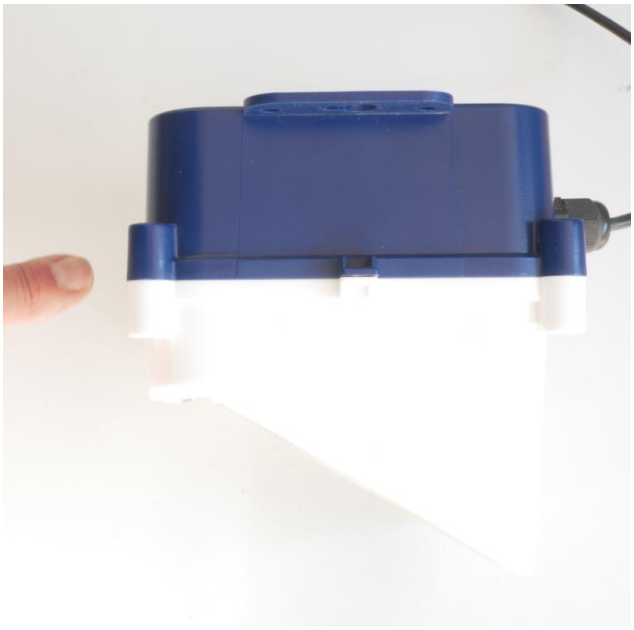
Note: *Before closing the housing:*

- *Configure the Data logger first, when using USB.*
- *When a BLE option board is used, the housing can be closed.*
- *Configuration process: Chapter 4.*

3.5.1 Closing the housing

After configuring and testing sensors and configuration, the housing can be closed.

- Carefully align power cab onto slot with the O-ring.
- Tighten the four screws.
- Check during tightening, if the blue base tub and power cap match each other completely.



3.6 Configuration menu

Typically, the shown configuration menu's apply to the ML-525SE model.

3.6.1 Entering configuration (Main) menu

Connect to the Data logger using YdocTerminal on a PC

- USB cable and YdocTerminal

Note: *Connecting OTA with YdocTerminal is only possible after configuring "Modem output" and "Send interval", that must be done in advance, using USB or BLE.*

Data logger with BLE and Android Smart Phone

- Android terminal app.

When successfully connected to the Data logger, the main menu will show up:

```
Running

ML-525SE Logger Version 5.2 Build 1 (RS-525 14043928)

- for Configuration Menu: Press <Ctrl>A<Shift>M<Ctrl>D
```

Before starting configuring, the Administrator password must be set.
Minimal length: 8 characters, containing 1 capital, 1 number, 1 special token.

```
Configuration Menu ML-525SE Logger Version 5.2 Build 1

[0] Run
[1] Date & time          >> 2025/08/13 08:41:01
[2] System information   >> 140432928
[3] Configuration setup >>
[4] Configuration overview
[5] Maintenance
[6] Users & rights
>
You first need to create a valid administrator password

Administrator password: ************

Confirm password: ************
```

(Password field length: 31 characters)

If the Data logger has a valid configuration file, these options are appended to the main menu:

```
- for Actual Values:      Press <Ctrl>A<Shift>V<Ctrl>D
- for Processing Status:  Press <Ctrl>A<Shift>S<Ctrl>D

- for Pausing Deployment: Press <Ctrl>A<Shift>P<Ctrl>D
```

Hidden from main menu, enable debug mode: <Ctrl>A<Shift>P<Ctrl>D

Note: *On the YdocTerminal (and BLE) screen, the mouse pointer can be used to select commands (and values) from the shown menu options.*

Return to Entering configuration (Main) menu

3.6.2 Actual values

The actual values screen is showing the last measured values from each parameter on the output list.

```
2026/01/14 12:54:24 Actual Values ML-525SE Logger Version 5.2 Build 5
SB      Signal                      4              bars
SDB     Signal strength             -80            dBm
AVGVi   Average voltage             3.34           V       Not recent
AVGCi   Average current             72             mA      Not recent
OCi     Operating cycle             8.3            sec     Not recent
PTi     Processor temperature       19.4           C       Not recent
RH      RH                          60.359         %       Not recent
T       T                           20.944         C       Not recent
MAXVi   Max voltage                 3.36           V       Not recent
MINVi   Min voltage                 3.29           V       Not recent
MINCi   Min current                 63             mA      Not recent
Vbatt   Analog                      3.207          V       Not recent
AVGPi   Power Usage                 0.667
```

Return to Entering configuration (Main) menu

3.6.3 Processing status

Processing status is showing busy and idle processes and the remaining time a driver will become operative.

```
2026/01/14 12:56:18 Status ML-525SE Logger Version 5.2 Build 5
Type    Driver                  Status  Powered Errors  Wait time
System  User interface          Busy            0       00:00:00.00
System  Modem interface         Idle            0       00:00:00.00
System  BLE interface           Idle            0       00:00:00.00
System  Calculations            Idle            0       00:03:42.50
System  SD card                 Idle            0       00:03:42.50
System  System monitor          Idle            0       00:00:00.00
System  TCP terminal            Idle            0       --:--:--.--
System  NTP time update         Idle            0       20:03:42.50
Output  MQTT                    Idle            0       11:03:42.75
Output  TCP                     Idle            0       03:03:42.75
Sensor  Network signal          Idle            0       00:03:42.50
Sensor  Internal                Idle            0       00:03:42.50
Sensor  Humidity sensor input   Idle            0       00:03:42.50
Sensor  AI3                     Idle            0       00:03:42.50
```

Return to Entering configuration (Main) menu

3.6.4 Pause and resuming

"Pause" will suspend the data logger operation until "Resume" command is given.

Press <Ctrl>A<Shift>P<Ctrl>D to put the data logger in pause mode.
Press <Ctrl>A<Shift>R<Ctrl>D to resume to working mode.

```
System log...SYS_PAUZED;123128883

ML-525SE Logger Version 5.2 Build 5 (123128883)

- for Configuration Menu: Press <Ctrl>A<Shift>M<Ctrl>D
- for Resuming Deployment:Press <Ctrl>A<Shift>R<Ctrl>D

> Deployment paused until resumed again


System log...SYS_RESUMED;123128883

ML-525SE Logger Version 5.2 Build 5 (123128883)

- for Configuration Menu: Press <Ctrl>A<Shift>M<Ctrl>D
- for Actual Values:      Press <Ctrl>A<Shift>V<Ctrl>D
- for Processing Status:  Press <Ctrl>A<Shift>S<Ctrl>D

- for Pausing Deployment: Press <Ctrl>A<Shift>P<Ctrl>D
```



Note & warning: *When YdocTerminal is used to schedule a remote connection and the data logger is switched to pause mode, the data logger will remain in pause mode when the remote connection is ended. A reboot doesn't change the pause state back to running state. Physical (or if mounted, BLE) access to the data logger is needed to switch it back into the running mode.*

From firmware version V5.4B1, a digital input port can be used to force the data logger into pause mode. This can be usefull when a looped wire is added to the sensor wiring and connected to the digital input: When the sensor connectors are detached from the main board, the data logger goes into pause mode, saving batteries.

To enable the hardware function, check the configuration menu:

```
Digital input (Pause/Resume)
```

Note: *The usage of a hardware wired pause/resume function on a digital port is mutual exclusive with the menu driven pause/resume function.*

Return to Entering configuration (Main) menu

3.6.5 Debug mode (hidden)

In debug mode, data logger activities, (Modem /ASCII /SDI-12 /MODBUS) commands and retrieved data from sensors is shown. This can be usefull verifying the data logger operation.

Press <Ctrl>A<Shift>D<Ctrl>D to enable debug mode and press it again to leave debug mode. (Toggle function).

```
<13:54:21>
```

```
Debug mode activated
Sensor power on
<14:00:01>
#00
>+020.7

2026/01/14 12:54:24 Actual Values ML-525SE Logger Version 5.2 Build 5
ATi      ADAMTECH Temp                          20.7            C
Data log… done

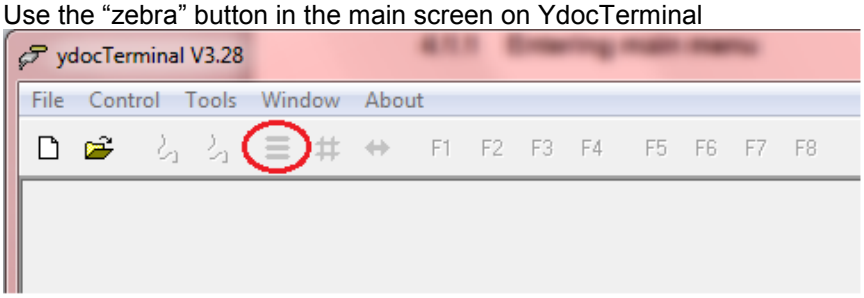
<14:12:15>
Debug mode deactivated
```

Return to Entering configuration (Main) menu

3.6.6 Navigate through menu options

The menu is *character* and *mouse* driven. There to start and select menu items choose one of these possibilities:

- (To start) Configuration menu:
  Use the “zebra” button in the main screen on YdocTerminal



  Or starting and navigating through the menu’s:

- Type the corresponding character(s).
- Place your pointing device on the desired menu number (or string to be selected) and press the left mouse button to activate.

3.7 [0-6] Configuration menu options

Summary:

- Set a device Password.
- “Run” returns the Data logger back into running mode. (Don’t forget to retract the USB cable if used).
- Check if the system information is matching your ordered Data logger type.
- Setup the Data logger configuration.
- Overview of parameters and devices.
- Check (and /or correct) date and time and zone info.
- Enter maintenance menu.
- Administrator and operator rights.

```
Configuration Menu ML-525SE Logger Version 5.2 Build 1

[0] Run
[1] Date & time          >> 2025/03/26 06:30:19
[2] System information   >> 140006329
[3] Configuration setup  >> RS-525 140006329
[4] Configuration overview
[5] Maintenance
[6] Users & rights
[7] Logout & Run
>
```

Return to Entering configuration (Main) menu

3.7.1 [0] Run

Run exits the main configuration menu and returns to running mode. (Disconnect USB /BLE to run unattended). When for a minute, no key strike is entered within a menu, de menu exits and the Data logger is returning to running mode automatically.

Note: *If the Data logger is in running mode with USB cable inserted, it will draw a minimal current of 25mA keeping the USB connection and Data logger awake.*

Return to Configuration (main) menu

3.7.2 [1] Date and time

Time is showed according to the current (date, time and zone) settings. Check (and /or correct) date, time and zone. A <Enter> will keep the current shown value. Default time zone is set to 0. (GMT).

Note: *Time zone, synchronisation and daylight savings can be found in “Configuration setup” menu.*

Return to Configuration (main) menu

3.7.3 [2] System Information

First, check if the system information is matching your ordered Data logger type:

```
System Information ML-525SE Logger Version 5.2 Build 1

[0] Exit
[-] Serial number           >> 140432928
[-] Hardware model          >> ML-525SE (Standard Edition)
[-] Hardware revision       >> 1.0
[-] Processor number        >> 5439529 1212633106 540553266
[-] Modem type              >> ME310G1-W1
[-] IMEI number             >> 356812104329287
[-] Production date         >> 2025/05/19
[-] FAT date                >> 2025/08/13
[-] RTC auto calibration    >> +0 pulses
[-] Low power sleep current >> 0.025 mA
>
```

System information line is showing the summary of hard and software information.
Additional information is showing various serial numbers, device type info and hard and software versions.

Return to Configuration (main) menu

3.7.4 [3] Configuration setup

Summary:

- Follow the numbers in “Configuration setup” menu to configure the Data logger basics.

```
System Information ML-525SE Logger Version 5.2 Build 1

[0] Exit
[1] General settings >> RS-525 140006329
[2] Time settings    >> Network; 2025/03/26 06:24:21
[3] Modem settings   >> LTE cat M1
[4] Alarm settings   >> Not used
[5] Option boards    >> <N/A or listed boards>
[6] Internal sensors >> Device parameters
[7] Analog inputs    >> Not used
[8] Digital inputs   >> Not used
[9] RS232 port       >> Not used
[A] RS485 port       >> Not used
[B] SDI12 port       >> Not used
[C] Accessory port   >> Not used
[D] Derived channels >> Not used
[E] Modem output     >> <N/A or list with output protocols>
[F] Wifi output      >> <N/A or list with used protocols>
>
```

Return to Configuration (main) menu

3.7.5 [3-1] General settings

Change the major settings on the Data logger.

Summary:

- Choose a system name (max 32 characters)
- Set Data log interval (First, evaluate send interval, sensor readings and usage of alarms)
- Modify the settings for the mounted power-board and battery type
- Check if sensor power (voltage) matches your sensors
- Choose for internal or external SD card
- Advise on permanent storage is to use “Data and Diagnostics”. (Diagnostic messages will help you debug when problems arise)
- Set deployments and time windows matching your needs

```
[0] Exit
[1] System name                              >> RS-525 140006329
[2] Data log interval                        >> 00:10:00
[3] Timestamp round down                     >> Not used
[4] Avoid equal timestamps                   >> Off
[5] Instant data log and output on startup   >> Off
[6] Power supply board                       >> (Select the mounted type)
[7] Battery type                             >> Other or none <or battery type>
[8] Sensor power                             >> 12 V (Default)
[9] SD storage                               >> Internal SD chip; 114 MB free
[A] Permanent SD storage                     >> Data & Diagnostics
[B] Deployment start date and time           >> Deployment has started
[C] Deployment end date and time             >> N/A
[D] Daily operating time slot                >> 24 hour
[E] Daily schedule time shift                >> Not used
>
```

Return to Configuration (main) menu

3.7.6 [3-1-1] System Name

Allows the user to give a name to the Data logger. This name will be used in the data files, produced by the logger. *(System name field length: 32 characters*).

Return to [3-1] General settings

3.7.7 [3-1-2] Interval settings

The can collect and store measurements from multiple sensors on various times.
A scheduler and watchdog timer are controlling the sensor readings and internal processes.

More info at Operating basics - Intervals

Return to [3-1] General settings

3.7.8 [3-1-3] Timestamp round down

This feature allows you to round down the timestamps in the data log to fixed time brackets. Some sensors will take a few seconds to finish data reading, and as a result you get timestamps like 12:50:07. If you want to round it down to 12:50:00, you can set the round down to 10 seconds.

Return to [3-1] General settings

3.7.9 [3-1-4] Avoid equal timestamps

A log file consist of time stamped records, but as some sensors are logged with an independent interval, it could occur to have multiple records with the same timestamp. If your collection software can't handle duplicated timestamps check ON this option to add 1 second to consecutive equal timestamped records.

Return to [3-1] General settings

3.7.10 [3-1-5] Instant data log and output on startup

If enabled, during Data logger start-up cycle, measurements are taken, data is written to the SD storage and send.

Return to [3-1] General settings

3.7.11 [3-1-6] Power supply board

An ML-525xE can be provisioned with various power supply boards working with different type of battery chemistries. Select the board type from the menu, matching with the mounted hardware.
If a ML-PB board is not specified or a ML-PB-DC board is choosen, the battery type will become "Other or none".

```
Select power supply board

[0] Exit
[1] ML-PB-LI        >> 1 Lithium (D) battery
[2] ML-PB-3LI       >> 1 to 3 Lithium (D) batteries
[3] ML-PB-PV12-LFP >> Solar powered, 1 LFP (26650) battery
[4] ML-PB-LFP       >> Solar powered, 1 to 4 LFP (18650) batteries
[5] ML-PB-SLA       >> Solar powered, 12V battery
[6] ML-PB-DC        >> DC powered
[7] ML-PB-DC-LI     >> DC powered, Lithium (D) battery backup
[8] Other unknown
```

Choose 'LFP' when using LiFePO4 3.2V batteries, in this mode the Data logger will not start if the voltage is below 2.8V, giving a DC-source (e.g. solar panel) the chance to sufficiently replenish a depleted battery and it will also if necessary prevent the batteries from over charging by applying a load (by staying awake) till voltage drops below a safe level.

Choose 'Lithium batteries' when primary batteries are used, this will prevent the batteries to be drained while connected to USB by going in to low-power sleep after 3 minutes of non-activity. In this mode the Data logger can also detect when the Lithium battery is used in a DC-LI edition, to be able to calculate the remaining Lithium battery capacity.

Choose 'None' when using an ML-PB-SLA or Ml-PB-DC type power boards. (External 12V battery or a DC-source without batteries).

Return to [3-1] General settings

3.7.12 [3-1-7] Battery type

The corresponding battery will show up in this menu. After ML-PB board selection, the shown battery type changes automatically to the battery type from the chosen ML-PB board.

Return to [3-1] General settings

3.7.13 [3-1-8] Sensor power

The sensor power voltage can be altered from default (12V) to a value 3..21V

```
>Sensor power (3-21 V; resolution 0.1 V): 12
```

Return to [3-1] General settings

3.7.14 [3-1-9] SD storage

Internal or external SD card (if installed) can be chosen.

```
>SD storage (0 = Internal SD chip, 1 = Removeable SD card):
```

Return to [3-1] General settings

3.7.15 [3-1-A] Permanent SD storage

Choose if Data, Diagnostic messages or boths are stored on the SD storage.

```
>Permanent SD storage (0 = Data & Diagnostics, 1 = Data, 2 = Diagnostics):
```

Note: *Advise is to select Data & Diagnostics, stored diagnostic messages are very useful finding Data logger internal or communication problems.*

Return to [3-1] General settings

3.7.16 [3-1-B] Deployment Date and Time

Enter the Date & Time on which the measurements should start for the first time. This feature allows to configure the Data logger on the workbench before installing it in the field. It prevents the device to measure and send fake data, due to the dislocation of the unit. If this feature is used, the unit will sleep until the deployment start date & time.

```
>Deployment start date (YY/MM/DD):

Deployment start time (hh:mm:ss):
```

Return to [3-1] General settings

3.7.17 [3-1-C] Deployment end date and time

If used, the Data logger will stop working on the specified Date & Time.

```
>Deployment end date (YY/MM/DD):

Deployment end time (hh:mm:ss):
```

Return to [3-1] General settings

3.7.18 [3-1-D] Daily operating time slot

This setting allows you to disable the Data logger from operation, outside this specified time slot. This makes sense when measurements are correlating with working hours or in other specific situations. E.g. a Data logger won't alarm, or log data, when the temperature of the boiler is too low, while no-one makes use of that. The logger will alarm you, when this happens during a working day.

```
>Daily operating start time (hh:mm:ss):
```

```
Daily operating end time (hh:mm:ss):
```



Warning: *This feature will move the starting point of the logging-interval to the beginning of the daily operating slot. Normally, a 24 hr. log interval will start at midnight, when a daily operation slot is used, it will start at the start time of the Daily operating slot.*

Return to [3-1] General settings

3.7.19 [3-1-E] Daily schedule time shift

All timing is standard relative to midnight. If one transmission per day is configured, it will occur at midnight.

```
>Daily schedule time shift (hh:mm:ss):
```

Example: *To change the daily transmission to 7:00 AM, specify a 7h time shift.*

Return to [3-1] General settings

Return to Configuration (main) menu

3.8 [3-2] Time settings

Time settings are used to identify data log and send moments according to the Data logger geographical position..

Summary:

- Check and correct actual date & time
- Choose your local time zone
- Advise is to enable day light savings
- Advise is to use NTP time synchronisation (Default, Network)

```
Time settings

[0] Exit
[1] Date & time                    >> 2025/03/26 06:25:18
[2] Time zone                      >> 0
[3] Summer time (daylight saving)  >> Not used
[4] Summer time start              >> N/A
[5] Summer time end                >> N/A
[6] Time synchronisation           >> Network
>
```

Return to Configuration (main) menu

3.8.1 [3-2-1] Date & time

Check (or correct) the current date & time according to current settings. On <CR>, the current setting is maintained.

```
Date & time

2025/08/25 09:00:27
Date (YY/MM/DD):

Time (hh:mm:ss):
```

Return to [3-2] Time settings

3.8.2 [3-2-2] Time zone

Zone offset to GMT.

```
>Time zone: 2
```

Return to [3-2] Time settings

3.8.3 [3-2-3] Summer time (daylight saving)

Select time zone definition to use.

```
>Summer time (0 = Don't use, 1 = Manual, 2 = Europe, 3 = USA)
```



When the user enables the summertime feature, as a consequence, there will be an anomaly in the data. At the beginning and at the end of the summertime-period.

Return to [3-2] Time settings

3.8.4 [3-2-4] Summer time start

Manual selected Summer time start date & time.

```
>Summer time start (YY/MM/DD):

Summer time start (hh:mm:ss):
```

Return to [3-2] Time settings

3.8.5 [3-2-5] Summer time end

Manual selected Summer time end date & time.

```
>Summer time end (YY/MM/DD):

Summer time end (hh:mm:ss):
```

Return to [3-2] Time settings

3.8.6 [3-2-6] Time synchronisation (parameters)

This feature enables the automatic synchronization of the internal clock, using the network time or a Network Time Protocol (NTP) server on the internet.

```
>Time synchronisation (0 = Off, 1 = Network, 2 = NTP)
```

Note: *Since "Network" time synchronisation has no parameters and test facility, switch to "NTP" settings, configure and test NTP time synchronisation and change back to "Network" syncronisation.*

```
Time settings

[0] Exit
[1] Date & time                    >> 2025/07/17 08:33:50
[2] Time zone                      >> 1
[3] Summer time (daylight saving)  >> Europe
[-] Summer time start              >> 2025/03/30 02:00:00
[-] Summer time end                >> 2025/10/26 03:00:00
[6] Time synchronisation           >> NTP
[7] Daily synchronisation          >> 24:00:00
[8] Server                         >> 0.pool.ntp.org
[9] NTP port                       >> 123
[T] Time synchronisation test      >> Not done
>
```

Return to [3-2] Time settings

3.8.7 [3-2-6-8] Server

IP-address or URL of the NTP-server.

Note: *Choose a server near to geographic area where the Data logger resides.*

Example: *For The Netherlands: nl.pool.ntp.org*

Return to [3-2] Time settings

3.8.8 [3-2-6-9] NTP Port

Port of the NTP protocol, default 123.

Return to [3-2] Time settings

3.8.9 [3-2-6-T] Time update test

Manually forces device to update time via NTP, in order to test the settings.

Return to [3-2] Time settings

3.9 [3-3] Modem settings

This section allows the user to setup the communication with the 4G network, according to the settings, received from the service provider. Please consult your service provider for the right settings, before consulting your YDOC dealer.

When entering the “Modem settings” menu, the modem is fired-up:

```
>Modem power on
Please wait.............


Modem settings

[0] Exit
[1] Technology                >> LTE-M
[2] Antenna                   >> Internal
[3] SIM                       >> eSIM chip; 89882280666035404874
[4] Provider PLMN code        >> Automatic
[5] Provider selection        >> Automatic
[6] APN settings              >> iot.1nce.net
[7] Internet protocol         >> IPV4
[8] CA Certificates           >> Not used
[9] Customization (FWSWITCH)  >> Global (ROW)
[A] Standby threshold time    >> 00:01:00
[S] Network signal test       >> Passed
[T] APN login test            >> Passed
>
```

3.9.1 [3-3-1] Technology

On a ML-525xE you can choose the cellular network technology to use, LTE-m or NB-IoT. If both technologies are available, its best to choose LTE-m. When using NB-IoT you have to enter a PLMN code matching with your provider (e.g. 20404 for Vodafone the Netherlands). The internet protocols used by the ML-525xE, like MQTT, are TCP-based. TCP-based communication requires a certain network performance, which is not everywhere guaranteed by NB-IoT, it’s a matter of trying…

```
Technology selection

Technology (0 = LTE-M, 1 = NB-IoT, 2 = LTE-M/NB-IoT, 3 = NB-IoT/LTE-M):

Return to [3-3] Modem settings
```

3.9.2 [3-3-2] Antenna

```
>Antenna (0 = Internal, 1 = External):

Return to [3-3] Modem settings
```

3.9.3 [3-3-3] SIM

The eSIM is valid for at least 5 years. (With 500MB balance), but has no SMS prescription.
If SMS is used for alarm (or data) sending, install a removable SIM card with SMS prescription.

Note: *eSIM validation and balance can be checked using YdocTerminal tooling “SIM balance checker”.*

```
>SIM (0 = eSIM chip, 1 = Removeable):

Return to [3-3] Modem settings
```

3.9.4 [3-3-4] Provider PLMN code

Default is “Automatic”. Advice is to choose a fixed PLMN code for your network operator, especially with weak network coverage or .

Note: *The PLMN codes are shown in 5th element in the provider return string, when a “Provider selection” is executed.*



Warning: *Manual PLMN selection is advised when the Data logger is situated near a country border or weak signal for the preferred provider is expected.*

```
>Provider PLMN code (or enter 0 for automatic):
```

Return to [3-3] Modem settings

3.9.5 [3-3-5] Provider Selection

This is an automated procedure which shows the network providers in the vicinity of the logger. Information about the provider and it’s capabilities are shown.

```
Provider selection

AT+COPS?
OK
AT+COPS?
+COPS: 0,0,"T-Mobile NL",8
OK
AT+COPS=?
Please wait...(this could take some minutes)
################################################################################
+COPS: (2,"T-Mobile NL","TMO NL","20416",8),(1,"vodafone NL","voda
NL","20404",8),(1,"NL KPN","NL KPN","20408",8),,(0-4),(0-2)
```

After the network scan, a selection can be made:

```
[0] Exit
[A] Automatic selection (roaming) >> On
[1] T-Mobile NL (LTE cat M1)      >> Automatic selected
[2] vodafone NL (LTE cat M1)
[3] NL KPN (LTE cat M1)
[D] Deregister network
>
```



Warning: *Manual network provider selection is advised when the Data logger is situated near a country border or weak signal for the preferred provider is expected.*

Return to [3-3] Modem settings

3.9.6 [3-3-6] APN settings

Perform an APN login test. If successful, you don’t need to specify any APN-settings.

```
APN settings

[0] Exit
[1] APN access point    >> iot.1nce.net
```

```
[2] APN username        >>
[3] APN password        >>
[4] APN authentication  >> PAP (plain)
[5] Managed by SIM card >> Off
>
```

(APN access point field length can hold 47 characters. APN username and APN password field lengths are combined to 62 characters).

***Note**: In case of several successive failures, advice is to use fixed APN settings. Please ask your provider for the correct settings first (being an Access Point Name with optionally a user name/ password and authentication method).*

Return to [3-3] Modem settings

3.9.7 [3-3-7] Internet protocol

Enable IPV4, IPV6, or both protocols.

```
>Internet protocol (0 = IPV4, 1 = IPV6, 2 = IPV4V6)
```

Return to [3-3] Modem settings

3.9.8 [3-3-8] CA certificates

If no certificates are installed, options [4] and [5] are not shown in the menu.

***Note:** The ML-525PE menu modem is supporting only one certificate and TLS V1.2.*

```
CA Certificates

[0] Exit
[1] Certificate 1     >> Not used       (Example manual procedure)
[2] Certificate 2     >> Not used       (Example automated procedure)
[3] Certificate 3     >> Not used
>
```

***Note:** On the ML-525LE, default, three certificates are loaded, covering 99% of available Server certificates. From YdocTerminal version 3.30, CA certificate files can be browsed and loaded using the Windows file manager.*

Three default certificates:

- *Lets Encrypt - ISRG Root X1*
- *Certigo - SHA-2*
- *GlobalSign Root E46*

(Available certificate storage space is limited to 8165 characters).

Return to [3-3-8] CA certificates

3.9.9 [3-3-8-1..3] Loading Certificates (Manual procedure)

- Enter the certificate name
- Using Notepad, copy the certificate text and paste it in YdocTerminal window
- Press ^Z, the certificate is evaluated for validation

```
>Certificate name: TEST

Paste CA certificate content below, then press <Ctrl>Z
```

```
-
MIIFjTCCA3WgAwIBAgIRAJY2TKc4C+SL3JDGzeC33mgwDQYJKoZIhvcNAQELBQAw
.
.
nm2yGEDtyVoMgJLp0rkiPlormgHxSkFDOJbY94J7yxRK
-

>
Valid certificate

Press any key! >
```

Return to [3-3-8] CA certificates

3.9.10 [3-3-8-1..3] Loading Certificates (Automated procedure)

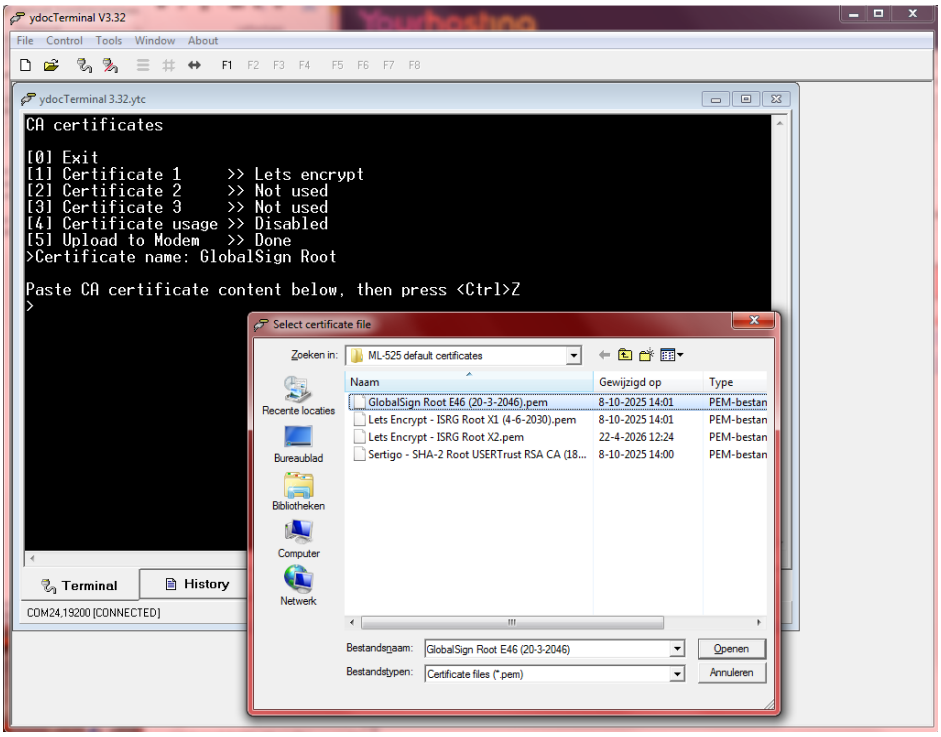
Adding a new certificate will ask for a certificate name and after filling in, opening the Windows File Browser.

```
CA certificates

[0] Exit
[1] Certificate 1     >> Lets encrypt
[2] Certificate 2     >> Not used       (Example automated procedure)
[3] Certificate 3     >> Not used
[4] Certificate usage >> Disabled
[5] Upload to Modem   >> Done

> 2

>Certificate name: GlobalSign Root
```



```
>Certificate name: GlobalSign Root

Paste CA certificate content below, then press <Ctrl>Z
>-----BEGIN CERTIFICATE-----
MIICCzCCAZGgAwIBAgISEdK7ujNu1LzmJGjFDYQdmOhDMAoGCCqGSM49BAMDMEYx
.
.
+RHUjE7AwWHCFUyqqx0LMV87HOIAl0Qx5v5zli/altP+CAezNIm8BZ/3Hobui3A=
-----END CERTIFICATE-----
Press any key! >
```

Return to [3-3-8] CA certificates (Automated)

3.9.11 [3-3-8-4] Certificate usage

Certificate usage is configurable. (Enable or disable).

```
CA Certificates

[0] Exit
[1] Certificate 1     >> Test CA
[2] Certificate 2     >>
[3] Certificate 3     >>
[4] Certificate usage >> Enabled
[5] Upload to Modem   >> Not done

>Certificate usage (0 = Disabled, 1 = Enabled): 0

ATE0;&K3;#FTPCFG=100,1,0;#SSLEN=1,1;#SSLCFG=1,1,0,40,10,1;#SSLSECCFG2=1,4,1,0,0
OK
AT#SSLSECCFG?
#SSLSECCFG: 1,0,1
OK
AT#SSLSECCFG=1,0,0
OK

Press any key! >
```

Return to [3-3-8] CA certificates (Automated)

3.9.12 [3-3-8-5] Upload to modem

Certificates added using the manual procedure, have to be loaded into the modem flash.

Return to [3-3-8] CA certificates (Automated)

Return to [3-3] Modem settings

3.9.13 [3-3-9] Customization (FWSWITCH)

(Modem) firmware customization. (Global is the default).

```
Firmware customization selection

>Customization (0 = AT&T (US), 1 = Verizon (US), 2 = Global (ROW)):
```

Return to [3-3] Modem settings

3.9.14 [3-3-A] Standby threshold time

During this time, the modem will be powered on, keeping the network alive.
Especially for configurations using a short send-interval (seconds /a few minutes) to send data to a server, this is a useful option. (Minimum and default is 60 sec.).

It saves (battery) power and time, because starting the modem and registering on the network is skipped as long as the modem is powered. With a modem already registered on the network, communication can start directly.

```
>Standby threshold time (sec): 60
```



Warning: *When a cellular modem switches on, it consumes a relatively high amount of power. If it encounters an unstable power source, such as depleted batteries, there's a risk of a modem crash at an inconvenient time, potentially resulting in permanent modem malfunction In "General settings", select the appropriate battery type and enable battery protection.*

Note: *Additional protection is implemented in the firmware to minimize the risk of damaging the modems. When the supply low-load voltage drops below a certain limit, upcoming modem operations will be suspended until a sufficient battery voltage level is restored.*

Return to [3-3] Modem settings

3.9.15 [3-3-S] Network signal test

This is no setting, but a test to check network reception. Check the network reception at the installation site.

```
Network signal test

<09:09:09>
Network signal start
AT#RFSTS
#RFSTS: "204 04",6300,-90,-64,-
11.0,4e95,30,,32,3,0,1976C01,"901405103540472","vodafone NL",3,20,720,3240,148
OK

Signal bars (0-5)     = 5 (Excellent)
Signal strength RSSI = -64 dBm (Excellent)
Signal strength RSRP = -90 dBm (Good)
Signal quality RSRQ  = -11 dB (Good)
Access technology    = 8 (LTE-M)
Operator PLMN code   = 20404
Area code            = 4E95
Cell ID              = 1976C01
Radio channel code   = 6300 (ARFCN)
Modem idle

Is the signal OK?
Choose yes/no >
```



Warning: *A logger, configured and tested successfully at the office, can suffer from weak network reception at the installation site. Perform this test on the installation site and make sure that the reception is sufficient. (1 bar absolute minimum, 3 or more bars is good).*

Return to [3-3] Modem settings

3.9.16 [3-3-T] APN login test

Test the APN login after changing provider or APN settings, to verify the network connection.

```
APN test

<09:08:31>
ATE0;+CMEE=2
OK
AT+ICCID;+CPIN?
+ICCID: 89882280666035404726
+CPIN: READY
OK
AT&D1;&K3
OK
AT+CGDCONT?
+CGDCONT: 1,"IP","iot.1nce.net","",0,0,0,0
OK
AT+CEREG=2;+CEREG?
+CEREG: 2,5,"4E95","1976C01",8
OK
Registered on LTE-M network
AT+CGREG=0;+COPS=3,0;+COPS?
+COPS: 0,0,"vodafone NL",8
OK
AT+CCLK?
+CCLK: "25/08/25,08:08:32+08"
OK
AT#SGACT?
#SGACT: 1,0
OK
AT#SGACT=1,1
#SGACT: 10.202.252.72
OK
Modem idle

APN test OK

Press any key! >
```

Return to [3-3] Modem settings

3.10 [3-4] Alarm settings

The Data logger can be configured to handle alarms. Alarm can consist of an E-mail message, entering alarming mode, or toggle the alarm or an option board port. During alarm conditions, the Data logger can alter the measurement intervals. (Entering the continuous alarm sampling mode).

```
Alarm settings

[0] Exit
[1] Continuous alarm sampling          >> Off
[2] Instant measurement on data alarm  >> On
[3] Exclude independent drivers        >> Off
[4] Instant data output on data alarm  >> Off
[5] Alarm messages                     >> Not used
[6] Alarm output port                  >> Disabled
[7] Alarm output port active           >> Closed
[8] Alarm output parameters            >> Not used
>
```

3.10.1 [3-4-1] Continuous alarm sampling

When switching-on “Continuous alarm sampling”, the Data logger will wake-up at “alarm” sample intervals as well. Define sample intervals shorter than the regular data log intervals.

```
>Continuous alarm sampling (0 = Off, 1 = On):
```

During sampling the logger performs a measurement cycle on parameters with configured alarm limits as well on those used in aggregation channels. Alarm conditions will be evaluated after the measurement cycle, but there will be no measurements stored to SD-card.

Note: *Using this feature, will draw extra power, it can cause depletion of battery powered systems.*

Example:

A user has chosen a data log (normal) data log interval of 10 minutes and continuous alarm sampling interval of 1 minute. The temperature-sensor must NOT get above 25 degrees. When the temperature exceeds the 25 degrees limit, it takes the logger up to 10 minutes, before it gets into the alarming mode. The continuous alarming mode, will change the parameter sample period from 10 to 1 minute. The Data logger will wake up every minute, and take a measurement. However, in continuous alarming mode, the sensor reading is NOT written on the SD storage, it is only used to check the alarm exceeding is still valid. Result is that a normal data file is created, with every 10 minutes a new data record and the system responding is within 1-minute (check) on an alarm situation.

Return to [3-4] Alarm settings

3.10.2 [3-4-2] Instant measurement on data alarm

When using a host system with its own advanced alarm handling and dispatching, you might want to feed the host with recent measurement data before the regular reporting interval occurs, which can be a multitude of the regular data log interval. When switching on this feature, the Data logger will perform a data output to all configured outputs as soon as the Data logger gets in alarm mode or falls back to normal when alarm condition is cleared.

```
>Instant measurement on data alarm (0 = Off, 1 = On):
```

Return to [3-4] Alarm settings

3.10.3 [3-4-3] Exclude independent drivers

By default, there is one data logging rhythm, following the “Normal data log interval” or the alarm intervals. For a number of sensors, a separate, independent data logging interval can be specified. These drivers can be excluded from alarms.

```
>Exclude independent drivers (0 = Off, 1 = On):
```

Return to [3-4] Alarm settings

3.10.4 [3-4-4] Instant data output on data alarm

If enabled, during alarm, measurements are taken, data is written to the SD card and send.

```
>Instant data output on data alarm (0 = Off, 1 = On):
```

Return to [3-4] Alarm settings

3.10.5 [3-4-5] Alarm messages

When the Data logger enters or leaves alarm mode you can dispatch a message to a recipient by SMS, MQTT or E-mail. Choose messages to receive: ‘System alarm messages’, ‘Data alarm messages’ or both. In case of E-mail or MQTT you need to enable or configure the corresponding output driver for the specific protocol. (Diasble data output on the driver).

```
Alarm messages

[0] Exit
[1] Alarm sending          >> MQTT
[2] Data alarm message     >> On
[3] System alarm message   >> Off
>
```

3.10.6 [3-4-5-1] Alarm sending

```
Alarm sending

[0] Exit
[1] Don't use
[2] SMS
[3] Email
[4] MQTT
>
```

3.10.7 [3-4-5-2] Data alarm messages

Check this option if you want to send data alarms messages (e.g. when a measurement is outside its defined limits).

Return to [3-4-5] Alarm messages

3.10.8 [3-4-5-3] System alarm messages

Check this option if you want to send system alarms messages (like Deployment start, sensor timeouts (sensor could be broken), or TCP/FTP/HTTP server not available, etc.)

Return to [3-4-5] Alarm messages

3.10.9 [3-4-6] Alarm output port

The “Alarm output port” can be used to “switch on” or “trigger” an external device in case of an alarm situation. The port can be found on terminal X4(A0).

More info at Generic information - Digital outputs

Return to [3-4-5] Alarm messages

3.10.10 [3-4-6-1..4] Alarm output port

When in “Continuous state” the output will be activated as long as an alarm situation exists. If you only want to trigger an external device when a new alarm situation occurs, you can specify a “One-time pulse” with a certain pulse width in seconds. If you want to re-trigger the external device at every sample interval, while in alarm, choose “Repeating pulse”.

Note: *If more than one alarm port is needed, a ML-OO-SW option board can be added to the Data logger. Extra port behaviour is configurable with the same possibilities as the build-in alarm port, independent from the Data logger alarm port settings, using the COM terminal.*

```
Alarm output port

[0] Exit
[1] Disabled
[2] Continuous state
[3] One-time pulse
[4] Repeating pulse
```

Note*: When a logger is awake (e.g. during USB connection) and frequently sampling its sensors and inputs then “repeating pulse” may look similar to “continuous state”, due to overlapping pulses.*

Note: *Alarm pulse values are selectable 1 .. 65535 seconds).*

Return to [3-4] Alarm settings

3.10.11 [3-4-7] Alarm output port active

The contact can be configured as “ Normally open” (NO) or “Normally closed” (NC).

Note: *Output active “Open” is a NC contact, output active “Closed” is a NO contact.*

```
>Alarm output port active (0 = Open, 1 = Closed)
```

Return to [3-4] Alarm settings

3.10.12 [3-4-8] Alarm output parameters

When using the alarm output port to trigger some device, it is possible to monitor metrics for predictive maintenance purpose. (Like device running hours).

```
Alarm output parameters

[0] Exit
[1] Name                  >> Alarm output
[2] Register value        >> 0 Alarms; 0 Hour
[3] Daily register reset  >> Not used
```

```
[4] Alarm count           >> Not used
[5] Alarm state           >> Not used
[6] Total on-time         >> Not used
[7] Interval on-time      >> Not used
[R] Remove
[T] Test measurement      >> Not done
>
```

3.10.13 [3-4-8-2] Register value

This is the internal registry which stores the total number of raised alarm conditions and the cumulated alarm duration.

Return to [3-4-8] Alarm output parameters

3.10.14 [3-4-8-3] Register reset

This registry can be cleared manually or on a daily basis at a given time.

Return to [3-4-8] Alarm output parameters

3.10.15 [3-4-8-4] Alarm count

This parameter monitors the total number of raised alarm conditions, since the previous registetry reset.

Return to [3-4-8] Alarm output parameters

3.10.16 [3-4-8-5] Alarm state

This parameter reflects the current alarm state (0=No alarm, 1=Alarm active).

Return to [3-4-8] Alarm output parameters

3.10.17 [3-4-8-6] Total on-time

This parameter monitors the cumulated time of alarm durations, since the previous registry reset.

Return to [3-4-8] Alarm output parameters

3.10.18 [3-4-8-7] Interval on-time

This parameter monitors the cumulated time of alarm durations, since the previous data log interval.

Return to [3-4-8] Alarm output parameters

3.11 [3-5] Option boards

A option board will add extra input or output channel(s) to the Data logger.
Option boards should be mounted previous to adding and configuring from the menu, elsewhere, it will not be detected using the “Add” option in the menu.

When removing a board, delete it from the menu before unmounting it from the Data logger.

A number of Option boards is running its own internal processor and configurable using the Maintenance “Serial port” terminals.

Note: *For your convenience, some examples and detailed information can be found, following the links in the “Option boards” menu.*

```
Option boards

[0] Exit
[1] Analog (OB1)            >> ML-OI-AD-80MV
[2] Analog (OB2)            >> ML-OI-AD-PT1000
[3] Barometric              >> ML-OI-BARO;Device parameters
[4] Serial port             >> ML-OI-COM-<xx>
[5] Accessory port          >> ML-OA-WIFI
[6] Auxiliary inputs (OB1) >> ML-OI-AX-<xx>
[7] Auxiliary inputs (OB2) >> None
[8] Auxiliary output (OB1) >> ML-OO-<xx>
[9] Auxiliary output (OB2) >> None
>
```

Summary:

- Add or remove option boards.

  Note: *Adding and removing option boards should be done with Data logger power disconnected. When the Option board configuration has changed, apply changes to the configuration after Data logger reboot.*

The menu is handling (de)configuring of option boards.

- ML-OI-AD (Input) boards are used to add additional analog input ports.
- ML-OI-COM (Input) boards are used to add an additional serial input port.
- ML-OI-BARO is a Barometric device.
- ML-OA (Accessory) boards are used to add a (secondary) accessory, like a TFT-display or camera and Wifi output channels.
- ML-OI-AX (Auxiliary Input) boards are used to add additional pre-processed sensors /inputs.
- ML-OO (Auxiliary Output) boards are used to add additional outputs. (Relay contact).
- ML-OU-BLE board is used to add a Bluetooth LE user interface for Android (Remote ydocTerminal).

Note: *ML-OI-BARO parameters [3] reside at Configuration [MAIN-3-6] Internal sensors menu. The ML-OU-BLE is a “Plug and play” type option board.*

Available board types: *Voltage(s), current and PT1000.*

```
Board type
```

```
[0] Exit
[1] ML-OI-AD-80MV
[2] ML-OI-AD-2000MV
[3] ML-OI-AD-10V
[4] ML-OI-AD-20MA
[5] ML-OI-AD-PT1000
>
```

3.11.1 [3-5-1..4] ML-OI-AD-10V/20MA/80MV/2000MV (Analog inputs)

More information *on Analog /Digital conversion type boards (ML-OI-AD-<xx>) can be found here.*

3.11.2 [3-5-5] ML-OI-AD-PT1000 (Analog inputs)

More information *on Analog /Digital conversion type boards (ML-OI-AD-<xx>) can be found here.*

More info at Operating basics – Analog inputs

Return to [3-5] Option boards

3.11.3 [3-5-3] Barometric

```
Barometric option board

[0] Exit
[-] Board type >> ML-OI-BARO
[2] Device parameters (via internal sensors menu)
[R] Remove
>
```

Note: *Configuring this board via "Internal sensors" menu.*

Return to [3-5] Option boards

3.11.4 [3-5-4] ML-OI-COM-<xx> (Serial port)

More information *on Communication type option boards (ML-OI-COM-<xx>) can be found here.*

Example: *RS232, RS485, SDI12 and UART.*

```
Board type

[0] Exit
[1] ML-OI-COM-RS232
[2] ML-OI-COM-RS485
[3] ML-OI-COM-SDI12
[4] ML-OI-COM-UART
>
```

Return to [3-5] Option boards

3.11.5 [3-5-5] ML-OA-WIFI (Accessory port)

More information *on Communication type option boards (ML-OA-<xx>) can be found here.*

Note: *RS232 Accessory port is commonly used for an extra camera. The associated output drivers for these boards (RS232 and Wifi) can be configured through the Main menu [3-C] and [3-F].*

Example: *Configuring WIFI options.*

```
Accessory port option board

[0] Exit
[1] Add board
>

Board type

[0] Exit
[1] ML-OA-RS232
[2] ML-OA-WIFI
>
```

3.11.6 [3-5-5-Wifi] Wifi settings

Find the Wifi access point (using the scan option) and fill with the associated credentials.
Use the test option to verify the credentials are working.

```
Wifi settings

[0] Exit
[1] Wifi access point >>
[2] Wifi password     >>
[S] Wifi scan
[T] Wifi login test
[R] Remove
>
```

3.11.7 [3-5-5-Wifi-S] Wifi scan

The Wifi scan is showing the 2,4 and 5 GHz access points.

Note: *The ML-OA-WIFO can only communicate with 2,4 GHz access points.*

```
Wifi scan

Wifi power on
AT+UWSCAN
"Michiel de Router Boven">> -93 dBm
"SmartLife-D19A"         >> -94 dBm
"Fritz!BoxMilot"         >> -50 dBm
"Fritz!BoxMilot"         >> -72 dBm
"Ziggo9216257"           >> -82 dBm
"Ziggo9216257"           >> -56 dBm
"Ziggo9216257"           >> -66 dBm
"Van Voorst"             >> -94 dBm
OK

Press any key! >


Return to [3-5-5] ML-OA-WIFI
```

3.11.8 [3-5-1-6,7] ML-OI-AX-<xx> (Auxiliary input ports)

More information *on Auxiliary digital input type option boards (ML-OI-AX-<xx>) can be found here.*

Example: Auxiliary input ports*: HART, I2C, 1 Wire and digital switches.*

```
Return to [3-5] Option boards
```

3.11.9 [3-5-8,9] ML-OO-<xx> (Auxiliary output ports)

More information *on Auxiliary digital output type option boards (ML-OO-<xx>) can be found here.*

Examples: *Auxiliary output ports:Optical isolated switches, MODBUS and LoRa End device.*

Return to [3-5] Option boards

3.11.10 [3-5-SW] ML-OO-SW (Auxiliary output ports)

Example: *Configuring and activating the Galvanic isolated switch option board.*

```
Galvanic isolated switches

[0] Exit
[1] Name            >> Galvanic isolated switc
[2] Output interval >> 01:00:00
[-] Channels        >> 3
[R] Remove
[X] Auxiliary terminal
>
```

3.11.11 [3-5-SW-1] Name

Change the default name of the device.

```
>Name: Galvanic isolated switc

Return to [3-5-SW] ML-OO-SW

Output interval

[0] Exit
[1] Normal mode >> 01:00:00
[2] Alarm mode  >> Not used
>
```

3.11.12 [3-5-SW-2] Output interval (Normal and alarm)

Change the normal mode output and alarm intervals.

```
Normal output interval

The normal interval must be greater than the alarm interval
and greater or equal to the highest used measurement interval

[0] Exit
[1] Seconds
[2] Minutes
[3] Hours
>

Alarm output interval

The alarm interval must be less than the normal interval
and greater or equal to the highest used alarm measurement interval

[0] Exit
[1] Seconds
[2] Minutes
```

```
[3] Hours
[4] Don't use
>
```

Return to [3-5-SW] ML-OO-SW

3.11.13 [3-5-SW-X] Auxiliary terminal (SW)

Configure and test the switches:

- Activation delay.
- Pulse with.
- One shot or repeating pulse. (Board version 1.2)

```
Galvanic isolated switches - Configuration Menu

[0] Exit
[1] Switch 1 >> Open
[2] Switch 2 >> Open
[3] Switch 3 >> Open
>

Galvanic isolated switches - Switch 1 Menu

[0] Exit
[1] Activation delay     >> None
[2] Pulse width          >> Infinite
[T] Test (Make or Break) >> Open
>
```

Return to [3-5-SW] ML-OO-SW

Return to [3-5] Option boards

3.11.14 [3-5-MODBUS] ML-OO-MODBUS (Auxiliary output ports)

More information *on Auxiliary digital output type option boards (ML-OO-<xx>) can be found here.*

Example: *Configuring and activating the MODBUS option board.*

```
Auxiliary output ML-OO-MODBUS

[0] Exit
[-] Board type >> ML-OO-MODBUS
[2] Auxiliary output driver
[R] Remove
>
```

3.11.15 [3-5-MODBUS] Auxiliary output driver

The MODBUS output has memory space for 64 data logger parameters.
(32 can be read per read cycle).
Parameter order will follow the data logger parameter order.

```
MODBUS/RTU Slave

[0] Exit
[1] Name            >> MODBUS/RTU Slave
[2] Output interval >> 00:10:00
[-] Channels        >> 32
[R] Remove
[X] Auxiliary terminal
>
```

3.11.16 [3-5-MODBUS-1] Name

Change the default name of the device.

```
>Name: MODBUS/RTU Slave

Return to [3-5-MODBUS] ML-OO-MODBUS
```

3.11.17 [3-5-MODBUS-2] Output interval (Normal and alarm)

Change the normal mode output and alarm intervals.

```
Output interval

[0] Exit
[1] Normal mode >> 00:10:00
[2] Alarm mode  >> Not used
>

Normal output interval

The normal interval must be greater than the alarm interval
and greater or equal to the highest used measurement interval

[0] Exit
[1] Seconds
[2] Minutes
[3] Hours
>

Alarm output interval

The alarm interval must be less than the normal interval
and greater or equal to the highest used alarm measurement interval

[0] Exit
[1] Seconds
[2] Minutes
[4] Don't use
>

Return to [3-5-MODBUS] ML-OO-MODBUS
```

3.11.18 [3-5-MODBUS-X] Auxiliary terminal (MODBUS)

Configure MODBUS address, baudrate and inactivity timeout.

```
MODBUS/RTU Slave - Configuration Menu

[0] Exit
[1] Slave address      >> 1
[2] Baudrate           >> 19200
[3] Inactivity timeout >> 4
>
```

3.11.19 [3-5-MODBUS-X-1] Slave address

```
>Slave address: 1

Return to [3-5-MODBUS-X] Auxiliary terminal
```

3.11.20 [3-5-MODBUS-X-2] Baudrate

```
MODBUS/RTU Slave - Baudrate Menu

[0] Exit
[1] 4800
[2] 9600
[3] 19200
[4] 38400
>
```

Return to [3-5-MODBUS-X] Auxiliary terminal

3.11.21 [3-5-MODBUS-X-3] Inactivity timeout

```
>Inactivity timeout (0 to 60s, 0=Infinite): 4
```

Return to [3-5-MODBUS-X] Auxiliary terminal

Return to [3-5-MODBUS] ML-OO-MODBUS

Return to [3-5] Option boards

3.11.22 [3-5-LoRa] ML-OO-LORA-9 (Auxiliary output on LoRaWAN end device)

The LoRa board can send up to 12 available Ydoc parameters. Select a parameter to send using the LoRaWAN can be done through the Main menu [4-6] “Parameter output”.

Note: *Find the OB<n> auxiliairy output port on which the LoRa option board is installed.*

Warning: *Only 12 parameters (from the selection list) can output to the LoRa option board.*

Example: *Configuring and activating the LoRa option board.*

```
LoRaWAN end device

[0] Exit
[1] Name            >> LoRaWAN end device
[2] Send interval   >> 00:10:00
[-] Channels        >> 12
[R] Remove
[X] Auxiliary terminal
```

3.11.23 [3-5-LoRa-1] LoRaWAN end device (Name)

Change the default device name.

```
>Name: LoRaWAN end device
```

3.11.24 [3-5-LoRa-2] Send interval

Configure the send interval.

```
[0] Exit
[1] Normal mode >> 00:10:00
[2] Alarm mode  >> Not used
>
```

Note: *10 minutes is a practical minimum value.*

3.11.25 [3-5-LoRa-X] Auxiliary terminal

This menu option is used to configure LoRaWAN end device specific settings.

```
LoRaWAN end device V1.02
- for Board Configuration Menu, Press: <Enter>
- to return to Driver Configuration Menu, press <Ctrl>Z

RAK3172 RUI3 AT-interface:

<Ctrl>Z

LoRaWAN end device - Configuration Menu

[0] Exit
[1] Region                  >> EU868
[2] Device activation       >> OTAA
[3] Application EUI         >> 0000000000000001
[4] Application Key
[5] Device EUI              >> AC1F09FFFE1ACB42
[6] Activate device
>
```

3.11.26 [3-5-LoRa-X-1] Region

Select the region frequency.

```
>Band (3=IN865, 4=EU868): 4

>Band (5=US915, 6=AU915, 7=KR920, 8=AS923-1, 9=AS923-2, 10=AS923-3, 11=AS923-4): 4
```

Return to [3-5-1-LoRa-X] Auxiliary terminal

3.11.27 [3-5-LoRa-X-2] Device activation

```
>Device activation (1 = ABP, 2 = OTAA):
```

Return to [3-5-1-LoRa-X] Auxiliary terminal

3.11.28 [3-5-LoRa-X-3] Application EUI

```
>Application EUI: 0000000000000001
```

Return to [3-5-1-LoRa-X] Auxiliary terminal

3.11.29 [3-5-LoRa-X-4] Application Key

```
>Application key: AC1F09FFFE1ACB42AC1F09FFF8683172
```

Return to [3-5-1-LoRa-X] Auxiliary terminal

3.11.30 [3-5-LoRa-X-5] Device EUI

```
>Device EUI: AC1F09FFFE1ACB42
```

Return to [3-5-1-Lora-X] Auxiliary terminal

3.11.31 [3-5-LoRa-X-6] Activate device

The LoRa device is activated to connect to the IoT network.

Note: *Activating must always be (re)done at the site. During the activation process, signal levels and channels are optimised for the local antenna environment. This process can take some time, rebooting the Data logger will start the LoRa (re)activation process.*

```
>
Are you sure?
Choose yes/no > Yes

Observe communication with RAK3172 till you see +EVT:JOINED or JOIN FAILED
Press any key when finished

AT+JOIN
OK
+EVT:JOIN_FAILED_RX_TIMEOUT
```

Return to [3-5-1-Lora-X] Auxiliary terminal

Return to [3-5] Option boards

3.12 [3-6] Internal sensors

Summary:

- Add or remove Data logger internal sensors

```
Internal sensors

[0] Exit
[1] Device parameters >> Device parameters
[2] Network signal    >> Network signal
[3] Modem GPS         >> Not used
>
```

3.12.1 [3-6-1] Device parameters (Internal sensors)

Add internal device parameters like voltage, current, operation cycles. Barometric option board parameters are configurable in this menu. We strongly recommend to add internal parameters like Max voltage, Max current and OCi

```
Device parameters

[0] Exit
[1] Name                >> Device parameters
[2] Sample interval     >> Data log interval
[3] Battery capacity    >> 0 mAh
[4] Battery replaced    >> No
[5] Rest capacity       >> Not used
[6] Rest power          >> Not used
[7] Max voltage         >> Max voltage
[8] Average voltage     >> Average voltage
[9] Min voltage         >> Not used
[A] Max current         >> Not used
[B] Average current     >> Average current
[C] Min current         >> Not used
[D] Operating cycle     >> Operating cycle
[E] Free storage space  >> Free storage space
[F] Relative humidity   >> Relative humidity
[G] Board temperature   >> Board temperature
[H] Barometric pressure >> Barometric pressure
[I] Casing temperature  >> Not used
[R] Remove
[T] Test measurement    >> Passed
>
```

3.12.2 [3-6-1-1] Name

Change the default name for “Device parameters”.

```
Return to [3-6-1] Device parameters
```

3.12.3 [3-6-1-2] Sample interval

Change the sample interval for “Device parameters” driver. Default is “Data log interval”.
To refresh the data while using USB or WiFi, adjust the sample interval to a higher rate.

```
Sample interval

[0] Exit
[1] Normal mode       >> Not used
[-] Alarm mode        >> Not used
[3] Data log interval >> Used
```

```
>

Normal sample interval
```

The normal interval must be greater than the alarm interval
and can't be greater than the normal data log interval.

```
[0] Exit
[1] Seconds
[2] Minutes
>
```

Return to [3-6-1] Device parameters

3.12.4 [3-6-1-3] Battery capacity

Used for keeping track of the remaining battery capacity or define the capacity of the new battery placed.

Return to [3-6-1] Device parameters

3.12.5 [3-6-1-4] Battery replaced

Select this option after (re)placing a new lithium battery. Remaining capacity calculation will start again, beginning at 100%.

Return to [3-6-1] Device parameters

3.12.6 [3-6-1-5] Rest capacity

Remaining capacity of the lithium battery. In percentage of a full battery.

Return to [3-6-1] Device parameters

3.12.7 [3-6-1-6] Rest power

Same parameter as “Rest capacity”, but in calculated in mAh.

Note: *the battery-full parameters are only representative when used in Lithium battery-only systems. When using a solar panel or external power it won’t work as expected, because there are no battery charging calculations. With solar powered systems, keep track of the minimum and maximum battery voltage instead of rest capacity (or rest power).*

Return to [3-6-1] Device parameters

3.12.8 [3-6-1-7] Max voltage

Battery Voltage, maximum during the sample interval. The maximum voltage is a measurer for the battery rest capacity.

Return to [3-6-1] Device parameters

3.12.9 [3-6-1-8] Average voltage

The average voltage of the installed battery, averaged during the sample interval.

Return to [3-6-1] Device parameters

3.12.10 [3-6-1-9] Min voltage

Battery voltage, minimum value measured during the sample interval. This parameter is a measurer for voltage drop (especially when the modem sends data).

Return to [3-6-1] Device parameters

3.12.11 [3-6-1-A] Max current

Maximum current drawn during the sample interval.

Return to [3-6-1] Device parameters

3.12.12 [3-6-1-B] Average current

Current, averaged during the sample interval.

Return to [3-6-1] Device parameters

3.12.13 [3-6-1-C] Min current

Minimum current, measured during the sample interval.

Return to [3-6-1] Device parameters

3.12.14 [3-6-1-D] Operating cycle

This virtual sensor measures the time that the Data logger is awake, performing tasks. The Operating cycle is measured in seconds. This will provide you diagnostic information on times, the Data logger is spending on Sensor measures and Data sending.

Return to [3-6-1] Device parameters

3.12.15 [3-6-1-E] Free storage space

Shows the remaining disk space on the SD Card. With the "Data logger Power consumption tool" choose TCP and predictions can be made noticing "Monthly usage".

Note: *To guard the available free storage space (especially when the 120 MB internal SD card is used), enable this parameter. When continue free space monitoring is not of interest, disable "Data log" ([9]) and enable "Low alarm limit" ([H]). Only an alarm will be generated when the low-threshold is hit, no free space values are written to the data log file.*

Return to [3-6-1] Device parameters

3.12.16 [3-6-1-F] Relative humidity

Value read from ML-OI-BARO option board. (If installed).

Return to [3-6-1] Device parameters

3.12.17 [3-6-1-G] Board temperature

Temperature from the main-PCB.

Return to [3-6-1] Device parameters

3.12.18 [3-6-1-H] Barometric pressure

Value read from ML-OI-BARO option board. (If installed).

Return to [3-6-1] Device parameters

3.12.19 [3-6-1-I] Casing temperature

Not implemented yet.

Return to [3-6-1] Device parameters

3.12.20 [3-6-1-R] Remove

Use this option to remove the Internal sensor driver and the Internal parameters.

Return to [3-6-1] Device parameters

3.12.21 [3-6-1-T] Test measurement

A test measurement will show if all internal sensors are working.

Return to [3-6-1] Device parameters

3.12.22 [3-6-2] Network signal (Internal sensors)

This is an internal sensor that measures the quality of the network signal. This is a very important status measurement, because it is directly related to the connectivity of the Data logger.

Note: *to measure the signal quality, the modem must be fired-up. Be aware that the Data logger can use more power than calculated when "Independent log interval" is used.*

```
Network signal sensor

[0] Exit
[1] Name                        >> Network signal
[2] Independent log interval    >> 04:00:00
[3] Signal bars (0-5)           >> Signal
[4] Signal strength RSSI        >> Signal strength RSSI
[5] Signal strength RSRP        >> Not used
[6] Signal quality RSRQ         >> Not used
[7] Access technology           >> Not used
[8] Operator PLMN code          >> Not used
[9] Area code                   >> Not used
[A] Cell ID                     >> Not used
[B] Radio channel code          >> Not used
[R] Remove
[T] Signal test                 >> Not done
>
```

3.12.23 [3-6-2-1] Name

Change the default name for "Network signal".

Return to [3-6-2] Network signal

3.12.24 [3-6-2-2] Independent log interval

The interval on which this sensor is sampled. This sensor is a virtual sensor, the information is obtained from the internal modem.



Note & Warning: *Advise is to set the "Independent log interval" to the same value as "Send interval". Because the modem draws a lot of current, it is not a good idea to use this sensor along with the other sensors at the same data log interval. (The modem is fired up anyway at "Send interval").*

Return to [3-6-2] Network signal

3.12.25 [3-6-2-3] Signal bars (0 - 5)

A comprehensive presentation of the quality of the sensor. (To test the network coverage at your installation site). 0 bars = no reception, no network, data transfer.
The modem (and data transfer) will work from one bar.

Note: *Three or more bars is very good reception and an useful (test) option to setup the (external) antenna for optimum reception.*

Return to [3-6-2] Network signal

3.12.26 [3-6-2-4..B] Signal strength RSSI (a.o)

Enable and parameter set-up for all available modem related sensors.

Return to [3-6-2] Network signal

3.12.27 [3-6-3] Modem GPS (Internal sensors)

Setup for the internal modem if GPS parameters and settings are to be used.

Note: *Before enableling the modem GPS parameters, installation of an external antenna is obligated.*

```
GPS settings

[0] Exit
[1] Name                              >> Modem GPS
[-] Port settings                     >> N/A
[-] Power settings                    >> N/A
[4] Independent log interval          >> 06:00:00
[5] Minimum satellites to use         >> 3
[6] Minimum wait time to Fix          >> 00:00:00
[7] Maximum wait time to Fix          >> 00:01:00
[8] Log raw data string               >> Off
[-] Time synchronisation              >> Network
[A] Determine location on deployment  >> Off
[B] Geofence settings                 >> Disabled
[C] Satellites                        >> Satellites
[D] Latitude                          >> Latitude
[E] Longitude                         >> Longitude
[F] Drift                             >> Not used
[G] Altitude                          >> Not used
[H] Direction                         >> Not used
[I] Speed                             >> Not used
[J] GPS quality                       >> Not used
[R] Remove
[T] Test measurement                  >> Not done
>
```

3.12.28 [3-6-3-1] Name

Change the default name for “Modem GPS”.

Return to [3-6-3] Modem GPS

3.12.29 [3-6-3-4] Independent data log interval

The interval on which this sensor is sampled. This sensor is a virtual sensor, the information is obtained from the internal modem.



Note & Warning: *Advise is to set the “Independent log interval” to the same value as “Send interval”. Because the modem draws a lot of current, it is not a good idea to use this sensor along with the other sensors at the same data log interval. (The modem is fired up anyway at “Send interval”).*

Return to [3-6-3] Modem GPS

3.13 [3-7] Analog inputs

Five analog inputs are available on the main PCB and (if mounted) through ML-AI-xxx option boards.

```
Analog inputs

[0] Exit
[1] Port 1 (mA)        >> Not used
[2] Port 2 (mA)        >> Not used
[3] Port 3 (V)         >> Not used
[4] Port 4 (V)         >> Not used
[5] Potmeter           >> Not used
[T] Analog input test >> Not done
>
```

3.13.1 [3-7-1,2] Analog Input (0,4..20mA)

The ML-525SE is provided two analog 12 bits AD-Conversion current loop inputs.

```
Analog input

[0] Exit
[1] Name                      >> AI1
[2] Sensor power              >> Enabled; Warm up 00:00:01
[3] Sample interval           >> Data log interval
[4] Port mode                 >> Port 1; 4-20 mA
[5] Parameter settings        >> Analog
[6] Parameter value at 4 mA  >> 0 units
[7] Parameter value at 20 mA >> 100 units
[8] Determine linear offset only (1 calibration point)
[9] Determine linear conversion function (2 calibration points)
[R] Remove
[T] Test measurement
>
```

3.13.2 [3-7-1,2-2] Sensor power

Enable sensor power and warm-up time.

```
>Sensor power (0 = Disabled, 1 = Enabled): 1

Warm up time (resolution 0.25 sec): 1

Return to [3-7-1,2] Analog input (0,4..20mA)
```

3.13.3 [3-7-1,2-3] Sample interval

Interval on which the sensor is measured. Default is set to “Data log interval”.

```
Sample interval

[0] Exit
[1] Normal mode        >> Not used
[-] Alarm mode         >> Not used
[3] Data log interval >> Used
>

Return to [3-7-1,2] Analog input (0,4..20mA)
```

3.13.4 [3-7-1,2-4] Port mode

Select the port mode for reading at “0 units”: 0mA or 4mA.

```
>Port mode (0 = 4-20 mA, 1 = 0-20 mA):
```

Return to [3-7-1,2] Analog input (0,4..20mA)

3.13.5 [3-7-1,2-5] Parameter settings

Set the parameters for the Current-loop sensor output.

More info at Operating basics – Parameter settings

Return to [3-7-1,2] Analog input (0,4..20mA)

3.13.6 [3-7-1,2-6,7] Parameter value at (min & max range)

Specify the mapping between the physical values (0 and 100 units) to be measured and the sensor current loop output. A linear interpolation will be performed on all values in between.

More info at Operating basics – Analog inputs

Return to [3-7-1,2] Analog input (0,4..20mA)

3.13.7 [3-7-1,2-8] Determine linear offset only (1 calibration point)

This features is an automated calibration function for the offset only. First, set the specified theoretic range of the conversion. A measure is taken on one physical value. (Calibration point).

Note: *This procedure is convenient when a level sensor is installed, but the exact top and bottom positions are not known. (Like in a well).*

More info at Operating basics – Analog inputs calibration

Return to [3-7-1,2] Analog input (0,4..20mA)

3.13.8 [3-7-1,2-9] Determine linear conversion function (2 calibration points)

This procedure will use two physical readings to setup the conversion.

More info at Operating basics – Analog inputs calibration

Return to [3-7-1,2] Analog input (0,4..20mA)

Return to [3-7] Analog inputs

3.13.9 [3-7-3,4] Analog Input (0..10 V)

The ML-525SE is provided two analog 0..10V voltage inputs. Higher voltages must be reduced to a maximum of 10 V using resistors. (Voltage divider).

Note: *An ML-525SE is not provided with differential voltage inputs, they can be added by installing a ML-OI-AD-80MV or ML-OI-AD-2000MV option board. These inputs are very sensitive and particularly suitable for measuring signals from load cells or pyrometers.*

```
Analog input

[0] Exit
[1] Name                    >> AI3
[2] Sensor power            >> Enabled; Warm up 00:00:01
[3] Sample interval         >> Data log interval
[-] Port mode               >> Port 3; 0-10 V
[5] Parameter settings      >> Analog
[6] Parameter value at 0 V  >> 0 units
[7] Parameter value at 10 V >> 100 units
[8] Determine linear offset only (1 calibration point)
[9] Determine linear conversion function (2 calibration points)
[R] Remove
[T] Test measurement
>
```

3.13.10 [3-7-3,4-2] Sensor power

Enable sensor power and warm-up time.

```
>Sensor power (0 = Disabled, 1 = Enabled): 1

Warm up time (resolution 0.25 sec): 1
```

Return to [3-7-3,4] Analog input (0..10V)

3.13.11 [3-7-3,4-3] Sample interval

Interval on which the sensor is measured. Default is set to “Data log interval”.

```
Sample interval

[0] Exit
[1] Normal mode       >> Not used
[-] Alarm mode        >> Not used
[3] Data log interval >> Used
>
```

Return to [3-7-3,4] Analog input (0..10V)

3.13.12 [3-7-3,4-5] Parameter settings

Set the parameters for the Voltage sensor output.

More info at Operating basics – Parameter settings

Return to [3-7-3,4] Analog input (0..10V)

3.13.13 [3-7-3,4-6,7] Parameter value at (min & max range)

Specify the mapping between the physical values (0% and 100%) to be measured and the sensor output voltages. A linear interpolation will be performed on all values in between.

More info at Operating basics – Analog inputs

Return to [3-7-3,4] Analog input (0..10V)

3.13.14 [3-7-3,4-8] Determine linear offset only (1 calibration point)

This features is an automated calibration function for the offset only. First, set the specified theoretic range. A measure is taken on one the physical value. (Calibration point).

Note: *This procedure is convenient when a level sensor is installed, but the exact top and bottom positions are not known. (Like in a well).*

More info at Operating basics – Analog inputs calibration

Return to [3-7-3,4] Analog input (0..10V)

3.13.15 [3-7-3,4-9] Determine linear conversion function (2 calibration points)

This feature will use two physical readings to setup the conversion.

More info at Operating basics – Analog inputs calibration

Return to [3-7-3,4] Analog input (0..10V)

Return to [3-7] Analog inputs

3.13.16 [3-7-5] Potentiometer input

The ML-525SE is equipped with a potentiometer input. This input is a 0..2048 mV voltage input, mostly used on wind direction and angle meters.

```
Analog input

[0] Exit
[1] Name                    >> PM
[-] Sensor power            >> N/A
[3] Sample interval         >> Data log interval
[-] Port mode               >> Port 5; 0-2 V
[5] Parameter settings      >> Potmeter
[6] Parameter value at 0 V  >> 0 %
[7] Parameter value at 2 V  >> 100 %
[8] Determine linear offset only (1 calibration point)
[9] Determine linear conversion function (2 calibration points)
[R] Remove
[T] Test measurement
>
```

3.13.17 [3-7-5-3] Sample interval

Interval on which the sensor is measured. Default is set to “Data log interval”.

```
Sample interval

[0] Exit
[1] Normal mode        >> Not used
[-] Alarm mode         >> Not used
[3] Data log interval  >> Used
>
```

3.13.18 [3-7-5-5] Parameter settings

Set the parameters for the Potentiometer output.

More info at Operating basics – Parameter settings

Return to [3-7-5] Potentiometer input

3.13.19 [3-7-5-6,7] Parameter value at (min & max range)

Specify the mapping between the physical values (0% and 100%) to be measured and the sensor output voltages. A linear interpolation will be performed on all values in between.

More info at Operating basics – Analog inputs

Return to [3-7-5] Potentiometer input

3.13.20 [3-7-5-8] Determine linear offset only (1 calibration point)

This features is an automated calibration function for the offset only. First, set the specified theoretic correct range. A measure is taken on one the physical value. (Calibration point).

Note: *This procedure is convenient when a level sensor is installed, but the exact top and bottom positions are not known. (Like in a well).*

More info at Operating basics – Analog inputs calibration

Return to [3-7-5] Potentiometer input

3.13.21 [3-7-5-9] Determine linear conversion function (2 calibration points)

This feature will use two physical readings to setup the conversion.

More info at Operating basics – Analog inputs calibration

Return to [3-7-5] Potentiometer input

Return to [3-7] Analog inputs

3.14 [3-8] Digital inputs

The ML-525SE is equipped with 3 digital inputs. These inputs are interrupt-driven. This mechanism ensures that a input signal-change is never missed. On a input signal-change, the Data logger will wake-up from sleep and process it. Maximum pulse frequency is 10 kHz.

```
Digital inputs

[0] Exit
[1] Port 1              >> Not used
[1] Port 2              >> Not used
[1] Port 3              >> Not used
[T] Digital input test >> Not done
>
```

First, select on of the available (marked “Not used”) port numbers.

3.14.1 [3-8-<p>] Digital inputs (Type selection)

```
Digital inputs

[0] Exit
[1] Pulse
[2] Alarm
[3] State
[4] Trigger
[5] Pause/Resume
>
```

3.14.2 [3-8-<p>-1] Digital input (Pulse)

This mode is used to count (digital) pulses.

Note: *(Where <p> is the number of the selected port).*

```
Digital pulse input

[0] Exit
[1] Name                    >> Digital pulse
[2] Sample interval         >> Data log interval
[3] Port mode               >> Port 1; Internal pull up
[4] Trigger on              >> Falling edge
[5] Register mode           >> Pulse (low frequency)
[6] Anti bounce filter      >> Off
[7] Units per pulse         >> 1
[8] Register value          >> 0 pulses
[9] Daily register reset    >> Not used
[A] Log each counter change >> Off
[B] Counter (unit)          >> Counter
[C] Quantity (unit)         >> Not used
[D] Mean rate (unit/h)      >> Not used
[E] Max rate (unit/h)       >> Not used
[F] Min rate (unit/h)       >> Not used
[G] Pulse event (unit)      >> Not used
[H] Activity period         >> Not used
[R] Remove
[T] Test measurement        >> Not done
>
```

3.14.3 [3-8-<p>-1-1] Name

Change the default name.

Return to [3-8-<p>-1] Digital inputs (Pulse)

3.14.4 [3-8-<p>-1-2] Sample interval

Change the sample interval.

Return to [3-8-<p>-1] Digital inputs (Pulse)

3.14.5 [3-8-<p>-1-3] Port mode selection

The (electrical) usage for the input port is chosen.

Available modes:

```
>Port mode (0 = Internal pull down, 1 = Internal pull up, 2 = Coil floating)
```

The signal level needs to be between 0..5 Volt. (Typical 0..3.3V). Higher input voltags need to be adapted to the right range before connecting.

More info at Generic information – Digital inputs

Return to [3-8-<p>-1] Digital inputs (Pulse)

3.14.6 [3-8-<p>-1-4] Trigger on

Trigger selection on rising or falling edge.

```
>Trigger on (0 = Falling edge, 1 = Rising edge)
```

Return to [3-8-<p>-1] Digital inputs (Pulse)

3.14.7 [3-8-<p>-1-5] Register mode

“Pulse” is the default and selected when each pulse should be registered in flash memory. (Low frequency, like rain gauges, generating a few pulses per second).
“Units” is derived from pulses and stored in flash memory, usable for high frequency’s. (Like a flow meter, generating hundredth pulses per second).

```
>Register mode (0 = Pulse (low frequency), 1 = Unit (high frequency))
```

Return to [3-8-<p>-1] Digital inputs (Pulse)

3.14.8 [3-8-<p>-1-6] Anti bounce filter

If your pulse source is not bounce free (like a momentary switch or relay contact), unwished counts can be suppressed by enabling a bounce-filter.

Note: *With bounce filter enabled: the maximum count frequency is limited to 250Hz.*

Return to [3-8-<p>-1] Digital inputs (Pulse)

3.14.9 [3-8-<p>-1-7] Units per pulse

Factor for transforming input pulses into unit values. It also depends on (the next) register mode setting.

Return to [3-8-<p>-1] Digital inputs (Pulse)

3.14.10 [3-8-<p>-1-8] Register value

For some applications, the counter to start with an offset or correction. This is the initial value the counter must start with. (Default is 0).

Return to [3-8-<p>-1] Digital inputs (Pulse)

3.14.11 [3-8-<p>-1-9] Daily register reset

When selected, at midnight, the counter value is reset to “Register value”.

Return to [3-8-<p>-1] Digital inputs (Pulse)

3.14.12 [3-8-<p>-1-A] Log each counter change

Enable this option only with low frequency sensors. The parameter is logged and updated independently of the data log interval and is recorded every time a counter change occurs. For an occasional change, the logged counter value will increase by one unit, or by more if multiple changes occur in a short time. At regular data logging intervals, the value of this parameter will reflect the last counter value.



Warning: *Each recorded change creates its own data log record in the data storage. As a result, log files may contain multiple records or lines with the same timestamp if they happen to be recorded at the same moment. Additionally, in CSV files, such records or lines may contain empty fields.*

Return to [3-8-<p>-1] Digital inputs (Pulse)

3.14.13 [3-8-<p>-1-B] Counter (unit)

This value holds the total number of pulses read from last reboot or register reset.

Return to [3-8-<p>-1] Digital inputs (Pulse)

3.14.14 [3-8-<p>-1-C] Quantity (unit)

The Quantity is the number of units occurred during the log interval. So, if you add up all Quantities, the value is the same as the counter. This is convenient with i.e. rain measurements. The counter gives you a total of all precipitation since installation (or last automatic reset), and the quantity gives you the value per log interval.

Return to [3-8-<p>-1] Digital inputs (Pulse)

3.14.15 [3-8-<p>-1-D,E,F] Mean-, Max- and Min Rate

This is the incremental speed of the counter value. The unit is: “Units /Hour”

Return to [3-8-<p>-1] Digital inputs (Pulse)

3.14.16 [3-8-<p>-1-G] Pulse event

This parameter is logged and updated independently of the data log interval and is recorded every time a pulse event occurs. For an occasional pulse, the logged value will be 1 unit, but it may be greater than 1 if a pulse burst occurs. At the regular data logging intervals, the value of this parameter will be zero.



Warning: *Each recorded event creates its own data log record in the data storage. As a result, log files may contain multiple records or lines with the same timestamp if they happen to be recorded at the same moment. Additionally, in CSV files, such records or lines may contain empty fields.*

Return to [3-8-<p>-1] Digital inputs (Pulse)

3.14.17 [3-8-<p>-1-H] Activity period

This can be used to detect the length of the activity period. The time is measured from the first pulse untill pulsing stops for a certain amount of time. (End detection time). The start time will be logged with a 0 value and the end time will be logged with the time since the start time. Regular data logs in between will be logged with a value representing the time since the data log timestamp and the start time.

Return to [3-8-<p>-1] Digital inputs (Pulse)

3.14.18 [3-8-<p>-2] Digital inputs (Alarm)

This mode is using a change on the digital input signal to generate an exception, putting the logger into alarming mode (using alarm intervals). It starts a measurement on all sensors, handle derived channels and configured alarms and write all data to the log. If “Direct data output on alarm” is enabled (general settings), the logger will also trigger the output drivers.

Note: *(Where <p> is the number of the selected port).*

```
Digital alarm input

[0] Exit
[1] Name            >> Digital alarm
[2] Port mode       >> Port 2; Internal pull up
[3] Digital input   >> Low active
[4] Trigger delay   >> 00:00:01
[5] Register value  >> 0 alarms
[6] Alarm           >> Alarm
[7] Counter         >> Not used
[R] Remove
[T] Test measurement >> Not done
>
```

3.14.19 [3-8-<p>-2-1] Name

Change the default name.

```
>Name: Digital alarm
```

3.14.20 [3-8-<p>-2-2] Port mode selection

The (electrical) usage for the input port is chosen.

Available modes:

```
>Port mode (0 = Internal pull down, 1 = Internal pull up):
```

The signal level needs to be between 0..5 Volt. (Typical 0..3.3V). Higher input voltags need to be adapted to the right range before connecting.

More info at Generic information – Digital inputs

Return to [3-8-<p>-2] Digital inputs (Alarm)

3.14.21 [3-8-<p>-2-3] Digital input

Note: *(Where <p> is the port number).*

Select activation on input signal “low” or “high”.

```
>Digital input (0 = Low active, 1 = High active)
```

Return to [3-8-<p>-2] Digital inputs (Alarm)

3.14.22 [3-8-<p>-2-4] Trigger delay

The amount of time the Data logger waits before changing to the alarm state (when the input condition is true). When the logger measures an alarming input-condition it enters the pre-alarming mode. This mode

will change into alarming mode when the trigger delay has finished. If the alarming condition disappears during this time, the logger will NOT enter alarming mode, but will continue in normal mode.

>Trigger delay (sec): 1

Return to [3-8-<p>-2] Digital inputs (Alarm)

3.14.23 [3-8-<p>-2-5] Register value

Number of alarms that occurred. (Register value is editable).

Return to [3-8-<p>-2] Digital inputs (Alarm)

3.14.24 [3-8-<p>-2-6] Alarm

The alarm settings can be configured here.

Return to [3-8-<p>-2] Digital inputs (Alarm)

3.14.25 [3-8-<p>-2-7] Counter

This value holds the total number of pulses read from last reboot or register reset.
Parameter settings for counter can be configured here.

Return to [3-8-<p>-2] Digital inputs (Alarm)

3.14.26 [3-8-<p>-3] Digital inputs (State)

This driver can be used to log state transitions (on-off and off-on) and count the time the input port was activated.

Note: *(Where <p> is the number of the selected port).*

```
Digital state input

[0] Exit
[1] Name                    >> Digital state
[2] Port mode               >> Port 3; Internal pull up
[3] Digital input           >> Low active
[4] Register value          >> 0 hour
[5] Daily register reset    >> Not used
[6] Log each state change   >> Off
[7] Input state             >> Not used
[8] Total on-time           >> Total on-time
[9] Interval on-time        >> Not used
[R] Remove
[T] Test measurement        >> Not done
>
```

3.14.27 [3-8-<p>-3-1] Name

Change the default name.

```
>Name: Digital state
```

Return to [3-8-<p>-3] Digital inputs (State)

3.14.28 [3-8-<p>-3-2] Port mode selection

The (electrical) usage for the input port is chosen.

Available modes:

```
>Port mode (0 = Internal pull down, 1 = Internal pull up):
```

The signal level needs to be between 0..5 Volt. (Typical 0..3.3V). Higher input voltags need to be adapted to the right range before connecting.

More info at Generic information – Digital inputs

Return to [3-8-<p>-3] Digital inputs (State)

3.14.29 [3-8-<p>-3-3] Digital input

Select activation when input signal is “low” or “high”.

```
>Digital input (0 = Low active, 1 = High active)
```

Return to [3-8-<p>-3] Digital inputs (State)

3.14.30 [3-8-<p>-3-4] Register value

The latest know total on-time, you can set to another value if required.

Note: *Typical applicate to reset the register value to zero, after replacing the monitored device. (Like a pump).*

Return to [3-8-<p>-3] Digital inputs (State)

3.14.31 [3-8-<p>-3-5] Daily register reset

The total on-time counter can run for ever or automatically be set to 0 at particular time on a daily base.

Return to [3-8-<p>-3] Digital inputs (State)

3.14.32 [3-8-<p>-3-6] Log each state change

Enable only with low frequency sensors. The event is logged and a timestamp is added. (Data record is written).

Return to [3-8-<p>-3] Digital inputs (State)

3.14.33 [3-8-<p>-3-7] Input state

Use to record the state of the input at every log interval and at every state transition.

Return to [3-8-<p>-3] Digital inputs (State)

3.14.34 [3-8-<p>-3-8] Total On-time

Counter keeping track of the input port total on-time.

Return to [3-8-<p>-3] Digital inputs (State)

3.14.35 [3-8-<p>-3-9] Interval on time

On-time counter (state changes during the log interval).

Return to [3-8-<p>-3] Digital inputs (State)

3.14.36 [3-8-<p>-4] Digital inputs (Action trigger)

This feature uses the same electrical input as the previous digital sensors, but it handles the signal differently. This driver can be used to initiate an instantaneous action.
A typical application for a trigger port: A momentary push button, to start a data log cycle.

Note: *(Where <p> is the number of the selected port).*

```
Digital trigger input

[0] Exit
[1] Name            >> Digital trigger
[2] Port mode       >> Port 3; Internal pull up
[3] Trigger on      >> Falling edge
[4] Trigger action  >> All tasks
[5] Register value  >> 0 triggers
[6] Triggers        >> Triggers
[R] Remove
[T] Test measurement >> Not done
>
```

3.14.37 [3-8-<p>-4-1] Name

Change the default name.

Return to [3-8-<p>-4] Digital inputs (Trigger)

3.14.38 [3-8-<p>-4-2] Port mode selection

The (electrical) usage for the input port is chosen.

Available modes:

```
>Port mode (0 = Internal pull down, 1 = Internal pull up)
```

The signal level needs to be between 0..5 Volt. (Typical 0..3.3V). Higher input voltags need to be adapted to the right range before connecting.

More info at Generic information – Digital inputs

Return to [3-8-<p>-4] Digital inputs (Trigger)

3.14.39 [3-8-<p>-4-3] Trigger on

The edge of the input signal where triggering must take place: trigger on rising or falling edge.

```
>Trigger on (0 = Falling edge, 1 = Rising edge)
```

Return to [3-8-<p>-4] Digital inputs (Trigger)

3.14.40 [3-8-<p>-4-4] Trigger action

Choose type of action to perform when the trigger is activated.

```
Trigger action

[0] Exit
[1] All tasks
[2] Measurements
[3] Measurements & data log
```

```
[4] Data output
[5] Take a picture
>
```

Note: *Picture taking is available when a camera is connected and camera triggering is enabled*

Return to [3-8-<p>-4] Digital inputs (Trigger)

3.14.41 [3-8-<p>-4-5] Register value

Number of triggers, counted since reset (or reboot).

Return to [3-8-<p>-4] Digital inputs (Trigger)

3.14.42 [3-8-<p>-4-6] Triggers (parameter)

Setup the Triggers parameters.

Return to [3-8-<p>-4] Digital inputs (Trigger)

3.14.43 [3-8-<p>-5] Digital inputs (Pause/Resume)

From firmware version V5.4B1, a digital input port can be used to force the data logger into pause mode. This can be useful when a looped wire is added to the sensor wiring and connected to the digital input. When uncoupling the sensor connectors from the main board, the data logger goes automatically into pause mode, stopping modem activity and saving batteries.

Note: *The usage of a hardware wired pause/resume function on a digital port is mutual exclusive with the menu driven pause/resume function.*
If the hardware option is not used, the menu option is active in the Main menu.

Return to Entering configuration (Main) menu

Note: *A wiring example is available in this FAQ.*

```
Digital pause/resume input

[0] Exit
[1] Name            >> Digital pause/resume
[2] Port mode       >> Port 1; Internal pull up
[3] Paused on       >> Low active
[4] Register value  >> 0 pauses
[5] Pauses          >> Pauses
[R] Remove
[T] Test measurement
>
```

3.14.44 [3-8-<p>-5-1] Name

Change the default name.

```
>Name: Digital pause/resume
```

Return to [3-8-<p>-5] Digital inputs Pause/Resume

3.14.45 [3-8-<p>-5-2] Port mode

Select the port inactive mode: Internal pull down or internal pull up.

```
>Port mode (0 = Internal pull down, 1 = Internal pull up):
```

Return to [3-8-<p>-5] Digital inputs Pause/Resume

3.14.46 [3-8-<p>-5-3] Pause on active Hihg/Low

Select port activation on High/Low input voltage.

Note: *Check with internal pull up/down mode: Low active uses internal pull up, high active uses internal pull down.*

```
>Pause on (0 = Low active, 1 = High active):
```

Return to [3-8-<p>-5] Digital inputs Pause/Resume

3.14.47 [3-8-<p>-5-4] Register value

Here, the register value can be set to a desired value.

```
>Register value:
```

Return to [3-8-<p>-5] Digital inputs Pause/Resume

3.14.48 [3-8-<p>-5-5] Pause parameter settings

Setup the Pauses parameters.

```
Parameter settings

[0] Exit
[1] Name                >> Pauses
[2] Code                >> PCNT
[3] Unit                >>
[4] Initial value       >> 0
[5] Value factor        >> 1
[6] Value offset        >> 0
[7] Decimals            >> 0
[8] Data log            >> On
[9] Data output         >> Modem
[A] Boundary control    >> None
[-] Low boundary limit  >> N/A
[-] High boundary limit >> N/A
[-] Alarm message       >> Disabled
[E] Alarm log           >> Off
[-] Alarm output        >> Disabled
>
```

Return to [3-8-<p>-5] Digital inputs Pause/Resume

3.15 [3-9] RS232 port

This port allows to connect to sensors, equipped with a RS232 interface.

```
[0] Exit
[1] Generic MODBUS
[2] Generic ASCII
[3] Generic NMEA
[4] RS232 port tunnel
>
```

3.15.1 [3-9-1] Generic MODBUS

This is a versatile protocol that can be used with RS232. (And also available on RS485).

Note: *Multiple instances can be added.*

```
MODBUS sensor

[0] Exit
[1] Name                  >> MODBUS*
[2] Port settings         >> RS232 8N1; 19200 Baud; Address 1
[3] Sensor power          >> Enabled; Warm up 00:00:01
[4] Sample interval       >> Data log interval
[5] Protocol type         >> RTU
[6] Measurement commands  >> Not used
[7] Register type         >> Holding
[8] Data type             >> WORD (unsigned 2 bytes)
[9] Data start register   >> 0 (40001)
[A] Parameter 1           >> Par1
[B] Parameter 2           >> Not used
[C] Parameter 3           >> Not used
[D] Parameter 4           >> Not used
[E] Parameter 5           >> Not used
[F] Parameter 6           >> Not used
[G] Parameter 7           >> Not used
[H] Parameter 8           >> Not used
[I] Parameter 9           >> Not used
[M] More parameters       >> Not used
[R] Remove
[T] Test measurement      >> Not done
>
```

3.15.2 [3-9-1-2] Port Settings

Select the number of data bits, parity, stop bit(s), baud rate and Modbus Addres of the sensor.

Note: *On a multi-sensor network, use unique addresses for each sensor.*

```
Port mode

[0] Exit
[1] RS485 8N1
[2] RS485 7E1
[3] RS485 8E1
[4] RS485 8O1
[5] RS485 8N2
>
```

```
Baud rate

[0] Exit
[A] 300
[B] 600
[C] 1200
[D] 2400
[E] 4800
[F] 9600
[G] 19200
[H] 38400
[I] 57600
[J] 115200
[K] 230400
>

Port settings

[0] Exit
[1] Mode      >> RS485 8N1
[2] Baud rate >> 9600
[3] Address   >> 1
>Address (1-254): 1

Return to [3-9-1] Generic MODBUS
```

3.15.3 [3-9-1-5] Protocol type

Choose the MODBUS protocol type: RTU or ASCII

```
Return to [3-9-1] Generic MODBUS
```

3.15.4 [3-9-1-6] Measurement commands (MODBUS)

Some sensors do not automatically start sampling after power on or might require a maintenance cycle now and then (e.g. wiping a lens of a turbidity sensor). If necessary measurement and maintenance commands can be configured with the menu shown below:

```
MODBUS Measurement commands

[0] Exit
[1] Start maintenance command >> Not used
[2] Maintenance interval      >> N/A
[3] Maintenance ready status  >> N/A
[4] Maintenance ready within  >> N/A
[5] Start measurement command >> Not used
[6] Measurement ready status  >> Not used
[7] Measurement ready after   >> Not used
>
```

3.15.5 [3-9-1-6-1] Start maintenance command

A Maintenance command is issued to clear a sensor. (Like activating a whiper or pump cycle).

```
>Maintenance start write function (0 = Single <06>, 1 = Multiple <10>):

>Maintenance start register:

>Maintenance start value:
```

Note: *Maintenance address register values: 0x0 - 0xFFFF.*

```
Return to [3-9-1-6] MODBUS Measurement commands
```

3.15.6 [3-9-1-6-2] Maintenance interval

If it's not necessary to perform a maintenance cycle at every measurement sample, then please specify the maintenance interval in number of samples, this will possible reduced power consumption and wear of the maintenance device.

Return to [3-9-1-6] MODBUS Measurement commands

3.15.7 [3-9-1-6-3] Maintenance ready status

If available specify the register and its expected value indicating when a maintenance cycle is concluded.

Return to [3-9-1-6] MODBUS Measurement commands

3.15.8 [3-6-9-6-4] Maintenance ready within

If the device does not support a maintenance ready status register, please indicate how long a maintenance cycle takes to complete.

Return to [3-9-1-6] MODBUS Measurement commands

3.15.9 [3-9-1-6-5] Start Measurement command

Specify which value should be written to which register to instruct the device to take a sample.

```
>Measurement start write function (0 = Single <06>, 1 = Multiple <10>):

>Measurement start register:

>Measurement start value:
```

Return to [3-9-1-6] MODBUS Measurement commands

3.15.10 [3-9-1-6-6] Measurement ready status

If available specify the register and its expected value indicating when a sample is concluded.

Return to [3-9-1-6] MODBUS Measurement commands

3.15.11 [3-9-1-6-7] Measurement ready after

If the device does not support a measurement ready status register, please indicate how long a measurement sample takes to complete.

Return to [3-9-1-6] MODBUS Measurement commands

3.15.12 [3-9-1-7] Register type

Consult the manual of your sensor for this. 3 types are supported:

- Bit register
- Holding register (default register)
- Input register

Return to [3-9-1] Generic MODBUS

3.15.13 [3-9-1-8] Data type

Choose the data format for the memory map of the sensor. (At the starting address).

```
Choose data type

[0] Exit
[1] WORD (unsigned 2 bytes)
[2] Short (signed 2 bytes)
[3] DWORD (unsigned 4 bytes)
[4] DWORD reversed (unsigned 4 bytes)
[5] Integer (signed 4 bytes)
[6] Integer reversed (signed 4 bytes)
[7] Float (4 bytes IEEE 754)
[8] Float reversed (4 bytes IEEE 754)
[9] Double precision (8 bytes IEEE 754)
[A] Double precision reversed (8 bytes IEEE 754)
>
```

Note: *All multi register data types are also available for reverse logic (Word swapping).*
Check the manual of your device to find which data type applies.

Return to [3-9-1] Generic MODBUS

3.15.14 [3-9-1-9] Data start register

MODBUS is a protocol to read from and write data to a memory map of a device, which is constructed of a list of 16 bit registers. How this memory map is formatted is up to the manufacturer of the device. Please specify the register in the memory map where the first parameter of your interest starts.

Return to [3-9-1] Generic MODBUS

3.15.15 [3-9-1-A..M] Parameter 1..20

Parameter 1 starts at the chosen ‘Start register’ and the next parameter on 1, 2 or 4 registers further, depending on the chosen ‘Data type’. You can read-out up to 20 parameters. If not all positions are of interest or registers don’t appear in consecutive order, these parameter positions can be skipped. If more than 20 parameters are to be read, define another instance of the MODBUS-driver, starting at the 21th parameter.

More info at Operating basics – Parameter settings

Note: *Timing. The logger expects the sensor to respond within 1..3 seconds after issuing a request.*

Return to [3-9-1] Generic MODBUS

3.15.16 [3-9-2] Generic ASCII

This is based upon a serial device that autonomous outputs sentences of data, like an GPS device. The user can capture this data, split it into various parameters, by specifying a separator character and by specifying the start and stop characters of a data sentence. If a serial sensor outputs multiple different sentences, like an NMEA-0183 device, a parameter can be linked to a matching sentence by supplying a sentence filter text.

```
ASCII sensor

[0] Exit
[1] Name                        >> ASCII
[2] Port settings               >> RS232 8N1; 9600 Baud
[3] Sensor power                >> Enabled; Warm up 00:00:03
[4] Sample interval             >> Data log interval
[5] Maximum wait time           >> 00:00:10
[6] Log raw data string         >> Off
[7] Decimal symbol              >> '.'
[8] Separator character         >> (Space)
[9] Start character             >> (None)
[A] Start character 2           >> (None)
[B] Stop character              >> (CR)
[C] Output request string       >>
[D] Output request terminator   >> (None)
[P] Parameters                  >> 0
[R] Remove
[T] Test measurement            >> Not done
>
```

3.15.17 [3-9-2-6] Log raw data String

The user can select this to log the whole data string, including separator char's, checksums etc. This is convenient when debugging / testing a new sensor.

Return to [3-9-2] Generic ASCII

3.15.18 [3-9-2-7] Decimal symbol

The user can select which decimal symbol is used by the sensor, being a dot or a comma.

Return to [3-9-2] Generic ASCII

3.15.19 [3-9-2-8] Separator Character

Character which separates the various data fields (numbers). Very often a space (0x20) is used. This is the default-setting. A comma, semi-colon or tab-character are commonly in use as well.

Return to [3-9-2] Generic ASCII

3.15.20 [3-9-2-9..B] Start and stop characters

These characters define start and end characters in a data sentence.

Example: *NMEA sentence starts with a '$' and terminates with a carriage return (CR).*

Note: *Start /Stop characters (SOH) and (STX) /(ETX) and (EOT) are implemented.*

Return to [3-9-2] Generic ASCII

3.15.21 [3-9-2-C..D] Output request string and terminators

Most serial probes start transmitting data directly when powered up.
For probes that start sending data on request, pecify an “Output request string” and /or “Output request terminator”. The request string will send to the probe, followed by the request terminator. (Like a carriage return or line feed).

Note: *(CR)(LF) is available as a valid output request terminator and special characters in sentence filter and output request string e.g "STX, ACK, LF" are as applicable as "<02>, <06>, <0A>"*

Return to [3-9-2] Generic ASCII

3.15.22 [3-9-2-P] Parameters

Set the values to capture the parameter data from the sentence(s).

```
ASCII parameter input settings

[0] Exit
[1] Sentence filter    >>
[2] Field position     >> 0
[3] Field type         >> Numeric
[4] Parameter settings >> P1
>
```

Example: An NMEA-0183 compliant weather station could output the wind direction and speed with the following sentence. This sentence contains 6 comma separated fields.

$WIMWV,190.0,R,11.0,N,A*1B

```
ASCII parameter input settings

[0] Exit
[1] Sentence filter    >> MWV
[2] Field position     >> 1
[3] Field type         >> Numeric
[4] Parameter settings >> Wind direction
>
```

Return to [3-9-2] Generic ASCII

3.15.23 [3-9-2-P-1] Sentence filter

If a serial device can output multiple different sentences you can distinguish them from each other by specifying a sentence filter text to capture your parameter from the correct matching sentence. You can leave the filter ‘blank’, if the device outputs one type of sentence only.

Return to [3-9-2-P] Parameters

3.15.24 [3-9-2-P-2] Field position

A captured sentence is split up in multiple fields based on the chosen separator character. The first field starts has position number 0.

Return to [3-9-2-P] Parameters

3.15.25 [3-9-2-P-3] Field type

The format of the field vale, this can be a ‘Numeric’ ASCII presentation (e.g. -123.45), a ‘Hexadecimal’ ASCII presentation (e.g. 00FF) or a single character.

Note: *a single character will be recorded as a its ASCII numeric value (e.g. ‘A’ will be recorded as 65).*

The ‘Wind direction’ value is found at position 1 in the sentence and the sentence can be distinguished from other NMEA sentence by specifying ‘MWV’ as the ‘Sentence filter’.

Return to [3-9-2-P] Parameters

3.15.26 [3-9-3] Generic NMEA

Start/stop and separation characters as defined by the NMEA-0183 protocol and supports checksum verification.

3.15.26.1 GPS on NMEA port

Note: *When using the 'Generic NMEA' driver instead of the 'GPS' driver to get GPS coordinates, a conversion from dddmm.mmmm N/S/E/W format to +/- ddd.dddddd format can be accomplished by using two calculated channels.*

Example:

Latitude formula:

```
(floor(:GGA2/100)+((:GGA2/100)-floor(:GGA2/100))/0.6)*eq(:GGA3;83;-1;1)
```

Longitude formula:

```
(floor(:GGA4/100)+((:GGA4/100)-floor(:GGA4/100))/0.6)*eq(:GGA5;87;-1;1)
```

Assuming: GGA2 is the latitude (2nd field position), GGA3 is the direction (3th field, 83='S')
GGA4 is the longitude (4th field position), GGA5 is the direction (5th field, 87='E')

$GPGGA,172814.0,3723.46587704,N,12202.26957864,W,2,6,1.2,18.893,M,-25.669,M,2.0,0031*4F

Example: *Generic NMEA sentence starts with a '$' and terminates with a carriage return (CR).*

Note: *Special characters in sentence filter and output request string e.g "STX, ACK, LF" are as applicable as "<02>, <06>, <0A>"*

3.15.27 [3-9-4] RS232 port tunnel

On this type of port, a serial device, what isn't used to record measurements can be accessed.
(Like the COM-port terminal in the Maintenance-menu).

```
Serial port tunnel settings

[0] Exit
[1] Name          >> RS232 port tunnel
[2] Port settings >> RS232 8N1; 9600 Baud
[3] Sensor power  >> Enabled; Warm up 00:00:01
[R] Remove
>
```

3.15.28 [3-9-4-2] Port settings

Specify it the device is connected by RS485 or RS232, along with its serial communication characteristics (baud rate & parity).

```
Port settings

[0] Exit
[1] Mode      >> RS232 8N1
[2] Baud rate >> 9600
[-] Address   >> Not used
>
```

Return to [3-9-4] RS232 port tunnel

3.15.29 [3-9-4-3] Sensor power

Note: *Specify "warm up time" to time the device is ready for communication.*

```
>Sensor power (0 = Disabled, 1 = Enabled):
```

Return to [3-9-4] RS232 port tunnel

3.16 [3-A] RS485 port

Attach Modbus sensors, equipped with a RS485 interface.
The MODBUS configuration process is similar as shown on the [3-9-2] Generic RS232 port.

Generic information: *Modbus /RTU*

```
Attached RS485 sensors

[0] Exit
[1] MODBUS
[2] Next sensor
>
```

3.17 [3-B] SDI12 port

When SDI-12 is selected, the digital input port acts like a SDI-12 recorder .
Specific SDI-12 commands are embedded in the driver for the input-sensor.

More information *on the SDI12 interface can be found in this document here.*

```
SDI12 sensor

[0] Exit
[1] Name                >> SDI12
[2] Port settings       >> SDI12; 1200 Baud; Address 1
[3] Sensor power        >> Enabled; Warm up 00:00:02.50
[4] Sample interval     >> Data log interval
[5] Measurement command >> 1CC!
[6] Request CRC usage   >> Yes
[7] Wake up preambles   >> 1
[8] Parameter 1         >> Depth SDI12
[9] Parameter 2         >> Not used
[A] Parameter 3         >> Not used
[B] Parameter 4         >> Not used
[C] Parameter 5         >> Not used
[D] Parameter 6         >> Not used
[E] Parameter 7         >> Not used
[F] Parameter 8         >> Not used
[G] Parameter 9         >> Not used
[M] More parameters     >> Not used
[R] Remove
[T] Test measurement    >> Passed
>
```

3.17.1 [3-B-5] Measurement command

The user can choose between concurrent measurements (C), or non-concurrent (M). When the sensor supports concurrent measurements, we strongly advise to use it. Because it saves a lot of energy. (all sensors are measuring simultaneously). The command number is asked by the firmware, for retrieving the right data value. For more info consult your sensors manual. After selecting the right measurement command, the command is displayed in the menu, so the user can check this against the sensors manual.

```
>Measurement command (C = Concurrent, M = Non concurrent): M
 Command number (0 = aM!, 1 = aM1! ... 9 = aM9!):

>Measurement command (C = Concurrent, M = Non concurrent): C
 Command number (0 = aC!, 1 = aC1! ... 9 = aC9!):
```

3.17.2 [3-B-6] Request CRC usage

Enable CRC check.

```
>Request CRC usage (0 = No, 1 = Yes):
```

3.17.3 [3-B-7] Wake up preambles

Add a number wake-up preambles. Some sensors go into sleep mode after a period of idle time. A preamble will wake up the sensor.

```
>Wake up preambles:
```

3.17.4 [3-B-8] Parameters 1..20

The various data values that were retrieved from the SDI-12 sensor, can be stored into different parameters.

More information at Generic information – Parameter settings

3.18 [3-C] Accessory port

```
Accessory port

[0] Exit
[1] Camera
[2] GPS
[3] ASCII output
[4] Radio
[5] Accessory port tunnel
[6] Display
>
```

3.18.1 [3-C-1] Camera

Only YDOC cameras can be connected. It can take still pictures only, which can be stored on the SD-card or transferred to a host system.

Note: *Installation and use of an external SD card in the data logger is obliged when the camera is used.*

```
Camera settings

[0] Exit
[1] Name                        >> Camera
[-] Port settings               >> RS232 8N1; 115200 Baud
[3] Accessory power             >> Enabled; Warm up 00:00:07
[4] Picture taking              >> Interval; Any alarm; Digital trigger
[5] Independent log interval    >> 06:00:00
[6] Interval shift              >> Not used
[7] Daily operating time        >> 24 hour
[8] Picture size                >> Medium
[9] Picture sending             >>
[A] Picture storage             >> Delete after send
[B] Picture number              >> Picture
[R] Remove
[T] Camera test                 >> Not done
>
```



Note: *More info on the camera can be found here: www.ydoc.biz/datalogger-accessories.html*

Return to [3-C] Accessory port

3.18.2 [3-C-1-3] Accessory power

The camera is powered with the 5V excitation on the accessory power connector.
Default warm-up time for the camera is 7 seconds.

Note: *during picture taking at night, (and IR leds are lit), a warm-up time of 10 seconds is advised to stabilize the picture brightness level.*

Return to [3-C-1] Camera

3.18.3 [3-C-1-4] Picture taking

Pictures can be taken on or-independent from the normal data logging interval. (Just once a day).
A picture can also be taken on any alarm. A digital input port can be configured to take an picture instantaneous. (See chapter: "Digital inputs - Action trigger").

```
Picture taking

[0] Exit
[1] Interval        >> On
[2] Any alarm       >> On
[3] Digital trigger >> On
>
```

Return to [3-C-1] Camera

3.18.4 [3-C-1-5] Independent log interval

```
Independent log interval

[0] Exit
[1] Normal mode       >> 06:00:00
[2] Alarm mode        >> Not used
[3] Data log interval >> Not used
[4] Sample interval   >> Not used
>
```

Return to [3-C-1] Camera

3.18.5 [3-C-1-6] Interval shift

Intervals are standard aligned with midnight, so an interval of 12h occurs at 00:00 and 12:00. You can apply an interval shift to deviate from the standard alignment, e.g. when applying an 8h shift the above mentioned intervals will occur at 08:00 and 16:00.

```
>Interval shift (min):
```

Return to [3-C-1] Camera

3.18.6 [3-C-1-7] Daily operating time

Using start and end time, a period is included where pictures might been taken. (Excluding picture taking at night).

```
>Daily operating start time (hh:mm:ss):

Daily operating end time (hh:mm:ss):
```

Return to [3-C-1] Camera

3.18.7 [3-C-1-8] Picture size

Pictures can be taken in these sizes: 160x120, 320x180, 640x360, 1280x720, and 1920x1080.

```
Picture size

[0] Exit
[1] Tiny
[2] Small
[3] Medium
[4] Large
[5] Huge
>
```

Note: *The aspect ratio can differ depending on camera firmware version.*
Read more about the camera here: https://ydoc.biz/data-logger-accessoires/data-logger-camera/

Return to [3-C-1] Camera

3.18.8 [3-C-1-9] Picture sending

Tip: *Enable (and test) at least one modem output protocol (check this chapter) before selecting one from the "Picture sending" menu.*

```
Select picture sending output

[0] Exit
[1] HTTP(image/jpeg)
[2] None
>
```

Return to [3-C-1] Camera

3.18.9 [3-C-1-9-1] HTTP (Content type selection)

```
Select picture sending output

[0] Exit
[1] HTTP(image/jpeg)
[2] None
>Post with Content-Type (0 = image/jpeg, 1 = multipart/form-data):
```

If an HTTP-driver is selected to send a picture, you can choose how the image is transmitted:

- **Raw JPEG**, The picture is sent as the HTTP request body with the content type **image/jpeg**.
- **Multipart form-data** , The picture is sent as part of a **multipart/form-data** request using the following header: *Content-Disposition: form-data; name="file"; filename="<filename>.jpg"* This format is commonly required by web applications and REST APIs that expect uploaded files.

Return to [3-C-1] Camera

Tip: If the web application does not accept pictures and log data at the same URL, configure a second HTTP-driver instance for picture uploads. Set it to the same schedule as the picture capture task and select **Heartbeat** as the output type. This ensures that only the picture is sent and prevents log data from being included in the same HTTP session.

3.18.10 [3-C-1-A] Picture storage

```
>Picture storage (0 = Delete after send, 1 = Permanent):
```

Return to [3-C-1] Camera

3.18.11 [3-C-1-B] Picture number

```
Picture number

Parameter settings

[0] Exit
[1] Name                >> Picture
[2] Code                >> PICT
[3] Unit                >>
[4] Initial value       >> 0
[5] Value factor        >> 1
[6] Value offset        >> 0
[7] Decimals            >> 0
[8] Data log            >> On
[9] Data output         >> Modem
[A] Boundary control    >> None
[-] Low boundary limit  >> N/A
[-] High boundary limit >> N/A
[-] Alarm message       >> Disabled
[E] Alarm log           >> Off
[F] Alarm output        >> Off
>
```

Return to [3-C-1] Camera

3.18.12 [3-C-2] GPS

This is the driver for a standard NMEA-GPS. Some settings are discussed below. Although every standard NMEA-GPS can be used, it is convenient to use an YDOC–GPS, because it can be powered from the accessory port also.

Note: *Information on YDOC-GPS receiver: https://ydoc.biz/datalogger-GPS-E3329-receiver.html*

Note: *If GPS sentences have to be combined with other NMEA sentences and measurement data to log, advice is to use the "Generic NMEA" driver, which can be found at section [3-9] ASCII port.*

```
GPS settings

[0] Exit
[1] Name                              >> GPS
[2] Port settings                     >> RS232 8N1; 9600 Baud
[3] Accessory power                   >> Enabled; Warm up 00:00:10
[4] Independent log interval          >> 06:00:00
[5] Minimum satellites to use         >> 3
[6] Minimum wait time to Fix          >> 00:00:00
[7] Maximum wait time to Fix          >> 00:01:00
[8] Log raw data string               >> Off
[-] Time synchronisation              >> Network
[A] Determine location on deployment  >> Off
[B] Geofence settings                 >> Disabled
[C] Satellites                        >> Satellites
[D] Latitude                          >> Latitude
[E] Longitude                         >> Longitude
[F] Drift                             >> Not used
[G] Altitude                          >> Not used
[H] Direction                         >> Not used
[I] Speed                             >> Not used
[J] GPS quality                       >> Not used
[R] Remove
[T] Test measurement                  >> Not done
>

Return to [3-C] Accessory port
```

3.18.13 [3-C-2-5] Minimum satellites to use

The GPS will calculate a position based upon the data of multiple satellites, the minimum amount of satellites for this calculation is 3. Use of more satellites will refine the calculated position. This parameter defines the minimum number of satellites that is used during the calculation. The Data logger will wait for the SVS in the data string to be equal or more than the defined minimum.

3.18.14 [3-C-2-6,7] Minimum and maximum wait time to fix

A GPS receiver has a certain time to fix (TTF). This is the time from power-on to the calculation of a valid position. The Data logger has a minimum and maximum limit to define the timeframe in which it waits for a fix. Use these values according the specs of the mounted GPS. Of course, when a position is found, If the maximum time is exceeded, a timeout (WDT) will occur.

Return to [3-C-2] GPS

3.18.15 [3-C-2-B] Geofence settings

```
GPS geofence settings
```

```
[0] Exit
[1] Calculate geofence alarm limits on deployment >> Off
[2] Latitude hi/lo alarm drift                    >> N/A
[3] Longitude hi/lo alarm drift                   >> N/A
[4] Latitude hi-hi/lo-lo alarm drift              >> N/A
[5] Longitude hi-hi/lo-lo alarm drift             >> N/A
>
```

3.18.16 [3-C-2-B-1] Calculate geofence alarm limits on deployment

This feature is used to set up a region which will be guarded by the Data logger. This region can be setup at the office (not necessary on the installation site). The region is setup by defining the size of a rectangular, in which the Data logger is supposed to operate.

Return to [3-C-2] GPS

3.18.17 [3-C-2-B-2..4] Latitude/Longitude hi/lo alarm drift

Both limits represent (geographical) seconds, and likewise, a box is created with the size of 2 times the latitude hi/lo alarm drift by 2 times longitude hi/lo alarm drift. So, this box has a user defined size, but is unrelated to the position of deployment. At deployment, these values are automatically related to the (starting) position of the system. It automatically calculates the alarm limits for the parameters latitude and longitude. Thanks to this, the user can define a “box of allowed movement” at the office, and during deployment, the absolute alarm limits for latitude and longitude are calculated.

Also, the user can define a second, bigger, box, which corresponds with the hi/hi limits of the Data logger. So, a second level of alarming can be defined.

Return to [3-C-2] GPS

3.18.18 [3-C-2-C] Satellites

The amount of satellites, used in the calculation of the position. This parameter is retrieved from the standard NMEA string.

Return to [3-C-2] GPS

3.18.19 [3-C-2-D..I] Latitude /Longitude /Drift /Altitude /Direction /Speed

Notation of the position, in the WSG84 system.

Return to [3-C-2] GPS

3.18.20 [3-C-2-J] GPS Quality

Quality of the measurement.

Note: *More info on QoS can be found in the manual of your GPS.*

Return to [3-C-2] GPS

3.18.21 [3-C-3] ASCII output

This driver can be used to send serial data (RS232) to a custom system using a cable connected to the accessory port. The output is a line with ASCII values (formatted as a “D-record”).

```
ASCII output settings

[0] Exit
[1] Name            >> ASCII output
[2] Port settings   >> RS232 8N1; 115200 Baud
[3] Output interval >> 00:10:00
[R] Remove
[T] ASCII output test >> Not done
>
```

Note: *only parameters marked for ASCII output will be included.*

Note: *The “Output interval” determines how often the data is outputted to the accessory port. The value is not depending on “Data log interval” and can have any value.*

Return to [3-C] Accessory port

3.18.22 [3-C-4] Radio output

This feature is designed to transmit measurement values over a radio connection. The used radio modem input port has to simulate a “virtual serial cable” and generate a transparent transfer of offered data.

```
Radio settings

[0] Exit
[1] Name                                >> Radio
[2] Port settings                       >> RS232 8N1; 4800 Baud
[3] Accessory power                     >> Enabled; Warm up 00:00:01
[4] Send interval                       >> 00:10:00
[5] Send delay                          >> Not used
[6] Power down delay                    >> 00:00:05
[7] Repeat previous messages (0..2)     >> 0
[8] Output format                       >> NMEA-0183
[9] Sentence identifier                 >>
[A] Parameter indicators                >> Disabled
[B] Quality indicators                  >> Disabled
[R] Remove
[T] Radio test                          >> Not done
>
```

Note: *Only parameters marked for Radio output will be included in a radio message.*

3.18.23 [3-C-4-3] Accessory power

The radio modem can be powered continue or switched-on and off using the “Accessory power” terminal. The warm-up time determines the time needed by the radio modem, before it is fully operational.

```
>Accessory power (0 = Disabled, 1 = Enabled): 1

Warm up time (resolution 0.25 sec): 1

Return to [3-C-4] Radio
```

3.18.24 [3-C-4-4] Send interval

The send interval determines how often the data is outputted to the accessory port.

Note: *It must be equal or greater than the data log interval.*

```
Send interval

[0] Exit
[1] Normal mode >> 00:10:00
[2] Alarm mode  >> Not used
>

Return to [3-C-4] Radio
```

3.18.25 [3-C-4-5] Send delay

When using multiple simple radio transmitters sending transmissions simultaneously, they can jam each other. To avoid this, specify a different or random send delay for each transmitter.

```
Send delay

[0] Exit
```

```
[1] Fixed  >> Not used
[2] Random >> Not used
>
```

Return to [3-C-4] Radio

3.18.26 [3-C-4-6] Power down delay

Once the logger has sent the data to the radio modem, the radio modem will require some time to transmit the data over the air. The default power down delay time is 5 seconds.

```
>Power down delay (sec): 5
```

Return to [3-C-4] Radio

3.18.27 [3-C-4-7] Repeat previous messages

When using a simple radio transmitter, transmissions can be jammed. To minimize the chance of missing data, specify to include up to two previous messages in each transmission.

```
>Repeat previous messages (0..2):
```

Return to [3-C-4] Radio

3.18.28 [3-C-4-8] Output format

The data can be transmitted in YDOC format or as custom NMEA-0183 sentences. Advice is to use of the NMEA-0183 format as it is not proprietary.

```
>Output format (0 = YDOC, 1 = NMEA-0183):
```

Return to [3-C-4] Radio

3.18.29 [3-C-4-9] Sentence identifier

Create a custom identifier.

```
>Sentence identifier:
```

Note: *More info on NMEA-1803 protocol at Interfaces NMEA-1803 output*

Return to [3-C-4] Radio

3.18.30 [3-C-4-A] Parameter indicators

Enable Parameter indicators.

```
>Parameter indicators (0 = Disabled, 1 = Enabled):
```

Return to [3-C-4] Radio

3.18.31 [3-C-4-B] Quality indicators

Enable Quality indicators.

```
>Quality indicators (0 = Disabled, 1 = Enabled):
```

Return to [3-C-4] Radio

3.18.32 [3-C-5] Accessory port tunnel

This port allows to connect to sensors, equipped with a RS232 interface.

Note: *Usage description matches [3-9-4] RS232 accessory port.*

Return to [3-C] Accessory port

3.18.33 [3-C-6] Display

This driver communicates with the Ydoc 3.5'' TFT display.
The TFT display is intended to use "inside" (a building or factory environment) for displaying actual values and historical data graphs.



Return to [3-C] Accessory port

```
Display settings

[0] Exit
[1] Name                >> Display
[-] Port settings       >> RS232 8N1; 115200 Baud
[3] Power down delay    >> 00:01:00
[R] Remove
>
```

3.18.34 [3-C-6-1] Name

Change the default display name.

```
>Name: Display
```

Return to [3-C-6] Display

3.18.35 [3-C-6-3] Power down delay

Auto power down delay when display is no longer touched. (Default: 60s).

```
>Power down delay (sec): 60
```

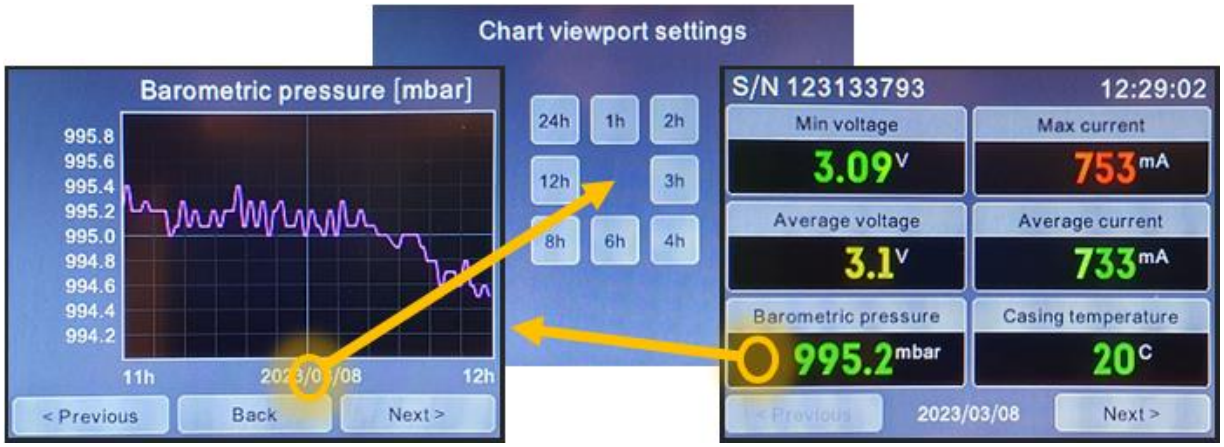
To preserve power the display can be switched on /off with a push button, mounted on the front. When activated by pressing the button, the display will show the last known values of up to 6 parameters simultaneously in a matrix of 3 rows and 2 columns. The values of additional parameters can be shown by stepping through available columns. The columns are ordered from left to right and their row items from top to bottom.

Values will be displayed in various colours, where: green is okay, yellow is low /high limit exceeded, red is parameter invalid or low-low /high-high exceeded. Not recently acquired values are shown in grey.

By touching a parameter area, a graph with historical data over a viewport of the last 24h will be shown. The viewport can be changed to 24h, 12h, 8h, 6h, 4h, 3h, 2h or 1h by touching the date in the y-axis of the graph.

Note: *Parameter order can be changed using "Parameter overview" menu.*

Extra info: *Impression operating the display to browse through different parameters and view's.*



Return to [3-C-6] Display

Return to [3-C] Accessory port

3.19 [3-D] Derived Channels

The logger is also equipped with “Derived Channels”. The channels are programmed in the Data logger firmware and each channel is using a set of memory registers for sensor values. These channels are used to pre-process or convert (sensor) data. There are 10 “Aggregation” and 20 “Calculation” channels available.

```
Derived channels

[0] Exit
[1] Aggregations >> Not used
[2] Calculations >> Not used
>
```

3.19.1 [3-D-1] Aggregations (1..10)

Available aggregation methods: Average, minimum, maximum, gust and standard deviation. Calculations are made over a configurable period. The number of samples taken during the aggregation period, is depending on the period duration and the “Sample interval” (as configured for the used input parameter or sensor).

Note: Each channel has an aggregation buffer, which can hold maximal 600 values.

```
Aggregations

[0] Exit
[1] Channel 1  >> Not used
[2] Channel 2  >> Not used
[3] Channel 3  >> Not used
[4] Channel 4  >> Not used
[5] Channel 5  >> Not used
[6] Channel 6  >> Not used
[7] Channel 7  >> Not used
[8] Channel 8  >> Not used
[9] Channel 9  >> Not used
[A] Channel 10 >> Not used
[R] Remove
>
```

3.19.2 [3-D-1-<n>] Aggregation channel <n>

Note: *(Where <n> is the number of the selected channel).*

```
Aggregation channel <n>

[0] Exit
[1] Input parameter         >>
[2] Input type              >> Scalar
[3] Aggregation period      >> 00:01:00
[4] Average                 >> Not used
[5] Minimum                 >> Not used
[6] Maximum                 >> Not used
[7] Gust                    >> Not used
[8] Deviation               >> Not used
[9] Percentage of change    >> Not used
[A] Rate of change (unit/h) >> Not used
[B] Percentile 1            >> Not used
[C] Percentile 2            >> Not used
[D] Percentile 3            >> Not used
[R] Remove
```

```
>
```

3.19.3 [3-D-2] Calculations (1..20)

```
Calculations

[0] Exit
[1] Channel 1 >> Not used
[2] Channel 2 >> Not used
[3] Channel 3 >> Not used
[4] Channel 4 >> Not used
[5] Channel 5 >> Not used
[6] Channel 6 >> Not used
[7] Channel 7 >> Not used
[8] Channel 8 >> Not used
[9] Channel 9 >> Not used
[A] Channel 10 >> Not used
[B] Channel 11 >> Not used
[C] Channel 12 >> Not used
[D] Channel 13 >> Not used
[E] Channel 14 >> Not used
[F] Channel 15 >> Not used
[G] Channel 16 >> Not used
[H] Channel 17 >> Not used
[I] Channel 18 >> Not used
[J] Channel 19 >> Not used
[K] Channel 20 >> Not used
[R] Remove
>
```

3.19.4 [3-D-2-<n>] Calculation channel <n>

Note: *(Where <n> is the number of the selected channel).*

"Result" is showing the outcome value of the formula. The value will be stored in "Parameter".

```
Calculation channel <n>

[0] Exit
[1] Formula   >>
[2] Parameter >> Calculation <n>
[-] Result    >> 0
[R] Remove
>
```

3.19.5 [3-D-2-<n>-1] Formula editor

The formula editor has (logical) functions, operators, comparisons, empirical formula's and can use of alarm attributes. If the formula is valid, the outcome will be shown using the current available input parameters.

```
Formula editor

Functions (arg1): abs, sqrt, ln, exp, sin, cos, tan,
 asin, acos, atan, torad, todeg, floor, round, ceil
Functions (arg1; arg2): mod, or, and, xor, pow, atan2
Function (arg1; arg2; arg3): clip

Comparisons (arg1; arg2): gt, ge, lt, le
  returns arg1 when comparison of arg1 with arg2 is true, otherwise arg2
Comparisons (arg1; arg2; arg3; arg4): gt, ge, lt, le, eq
```

```
 returns arg3 when comparison of arg1 with arg2 is true, otherwise arg4
Comparision (arg1; arg2; arg3; arg4; arg5): bt
 returns arg4 when arg1 lies between arg2 and arg3, otherwise arg5

Empirical formulas: ntc(Vin[; R0[; RD[; B[; DC]]]]), dp(t; rh), wc(t; v)
Operators and miscellaneous functions: +-*/() pi, time, day, wday

Parameters: parameter code with : in front (e.g. :BTi)
Attributes: LOLO, LO, HI, HIHI, HYS, AGE, ALR, MIN, MAX, IV

Examples: floor(:BTi+271), abs(:AIN.MAX-:AIN.MIN)

979 characters formula space left

>Formula:
```

Note: *Formula;'s can be tested using (integer or floating) values, check this example:*

```
Calculation channel 1

[0] Exit
[1] Formula   >> bt(3;1;5;1;0)
[2] Parameter >> Calculation 2
[-] Result    >> 1
[R] Remove
>
```

Note: *The .IV attribute returns the "Initial Value" of a parameter allowings to use it as a literal /reference value in calculations*

Return to [3-D-2-<n>] Calculation channel <n>

3.19.6 [3-D-2-<n>-2] Parameter

The standard parameter settings menu is opened.

More info at Operating basics – Parameter settings

```
Parameter settings

[0] Exit
[1] Name                >> Calculation <n>
[2] Code                >> CCH<n>
[3] Unit                >>
[4] Initial value       >> 0
[5] Value factor        >> 1
[6] Value offset        >> 0
[7] Decimals            >> 3
[8] Data log            >> On
[9] Data output         >> Modem
[A] Boundary control    >> None
[-] Low boundary limit  >> N/A
[-] High boundary limit >> N/A
[-] Alarm message       >> Disabled
[E] Alarm log           >> Off
[F] Alarm output        >> Off
>
```

3.20 [3-E] Modem output

Up to six (same or different type of) output drivers can be configured.
Choose one of the protocols (TCP, HTTP, MQTT, SMTP or FTP) to send the collected data and /or system messages to your own application (or YdocInsights), running on a (cloud) Server.

```
Modem output

[0] Exit
[1] Next output
>
```

3.20.1 [3-E-<n>] Modem output

Modem output redirects the Data logger output to a Server using a selectable IP protocol or SMS service.

```
Modem output

[0] Exit
[1] TCP output
[2] HTTP output
[3] MQTT output
[4] Email output
[5] FTP output
[6] SMS output
>
```

3.20.2 [3-E-<n>-1] TCP output

Advice is to use TCP protocol to send data to (YdocInsights) Server.
The TCP protocol is robust, has less payload (overhead) and shorter transfer time than one of the other selectable IP protocols.

Note: *Download YdocInsights server here: https://ydoc.biz/docs/ydoc-insights-software/*

```
TCP settings

[0] Exit
[1] Name          >> TCP
[2] Send interval >> 06:00:00
[3] Send delay    >> Not used
[4] Server        >> collector.ydoc.biz
[5] Port          >> 37
[6] Security      >> PBKDF2 & AES128/CTR
[7] Username      >> YDOCINSIGHTS
[8] Password      >> ******
[9] Output type   >> Log data
[A] Data format   >> YDOC
[B] Max payload   >> 1000 kB
[C] Data filter   >> Data & Diagnostics
[R] Remove
[T] TCP test      >> Passed
>
```

3.20.3 [3-E-<n>-1-2] Send interval

The Send interval defines the daily time schedule that data is send to your Server.

Return to [3-E-<n>-1] TCP output

3.20.4 [3-E-<n>-1-3] Send delay

A delay will introduce a time shift (offset) for the send interval. It can also be applied to avoid overload on a constraint server due to simultaneous transmissions from the units. (Data loggers).

Return to [3-E-<n>-1] TCP output

3.20.5 [3-E-<n>-1-4] Server

The TCP-server's IP-address or domain name.

Return to [3-E-<n>-1] TCP output

3.20.6 [3-E-<n>-1-5] Port

Port on which the TCP-server is listening. (Default is 37). When running your own TCP-server (with YdocInsights) for data collection.

Note: *Use port-forwarding in your internet router to the local IP-address of the system /computer running the YdocInsights (or your own TCP) server.*

Return to [3-E-<n>-1] TCP output

3.20.7 [3-E-<n>-1-6] Security

The Data logger supports basic TCP (Credentials and data unencrypted) or encrypted. Default setting is PBKDF2 & AES128/CTR.

```
>Security (0 = Basic, 1 = MD5 & AES128/ECB, 2 = PBKDF2 & AES128/CTR):
```

Return to [3-E-<n>-1] TCP output

3.20.8 [3-E-<n>-1-9] Output type

Type of data to send: "Log data", "Actual values" or "Heartbeat" only.

Note: *Heartbeat only applies typical to a second output driver which is not used for sending "Log data" but Alarm message or camera pictures.*

```
>Output type (1 = Log data, 2 = Actual values, 3 = Heartbeat):
```

Return to [3-E-<n>-1] TCP output

3.20.9 [3-E-<n>-1-A] Data format

Choose the data output format: Native ASCII text (YDOC), Excel readable (CSV, two versions), JavaScript Object Notation (JSON) and ASCII (DAS format).

```
>Data format (0 = YDOC, 1 = CSV (.,), 2 = CSV (,;), 3 = JSON, 4 = DAS):
```

Return to [3-E-<n>-1] TCP output

3.20.10 [3-E-<n>-1-B] Max payload

The payload for data transfer is limited to the number of kB.

```
>Max payload (10..1000 kB): 1000
```

Return to [3-E-<n>-1] TCP output

3.20.11 [3-E-<n>-1-C] Data filter

Filter for the message contents: Data and /or Diagnostic messages.

```
>Data filter (0 = Data & Diagnostics, 1 = Data, 2 = Diagnostics):
```

Return to [3-E-<n>-1] TCP output

3.20.12 [3-E-<n>-2] HTTP output

Select HTTP(S) output when you are hosting your own monitoring Web or Cloud server.

```
HTTP settings

[0] Exit
[1] Name           >> HTTP
[2] Send interval  >> 06:00:00
[3] Send delay     >> Not used
[4] Server         >>
[5] Extended path  >>
[6] Port           >> 443
[7] Security       >> HTTPS
[8] Username       >>
[9] Password       >>
[A] Output type    >> Log data
[B] Data format    >> JSON
[C] Max payload    >> 1000 kB
[D] Data filter    >> Data & Diagnostics
[R] Remove
[T] HTTP test      >> Not done
>
```

Note on field lengths, available from firmware V5.4B2 and higher:
Number of fields are combined into data logger memory space to hold more characters.
Username /Device /Token /Header field lengths are combined to hold 192 characters.
Password /Key /Value /Extended path field lengths are combined to hold 192 characters.

3.20.13 [3-E-<n>-2-2] Send interval

The Send interval defines the daily time schedule that data is send to your Server.

Return to [3-E-<n>-2] HTTP output

3.20.14 [3-E-<n>-2-3] Send delay

A delay will introduce a time shift (offset) for the send interval. It can also be applied to avoid overload on a constraint server due to simultaneous transmissions of units.

Return to [3-E-<n>-2] HTTP output

3.20.15 [3-E-<n>-2-4] Server

The HTTP-server's IP-address or domain name where data and camera pictures will be posted to.

Note (Firmware pre V5.4B2): *Maximum length for the "Server" URL is 63 characters. If the required URL exceeds this length, store the remaining path in "Extended path" parameter.(Combined 189 characters).*

Note: *If the server is sharing the same URL path for multiple Data loggers, the loggers can be distinguished from each other by examining the custom HTTP-header 'X-DeviceSN' which will contain a logger's unique serial number.*

Return to [3-E-<n>-2] HTTP output

3.20.16 [3-E-<n>-2-5] Extended path

The extended path can be used of the URL is to long to be specified under server or if you need to specify server application required parameters.

Note (Firmware pre V5.4B2): *Extended path field length can hold 127 characters.*

In the extended path, available substitutions can be used: System name (<sysname>), serial number (<sn>) driver name <name> as well as various timestamp tokens.

Note: *<y>, <yy> or <yyyy> is used for year, <m> or <mm> for months, <d> or <dd> for days, <h> or <hh> for hour of the day, <n> or <nn> for minutes and <s> or <ss> for seconds. A single variable is used for presentation without a leading zero.*

Example: *Assume the HTTP- server application requires to pass the name and serial number of the device as URL parameters sn & name, enter:* `?sn=<sn>&name=<sysname>` *as extended path.*

Return to [3-E-<n>-2] HTTP output

3.20.17 [3-E-<n>-2-6] Port

HTTP(S) Server listening port. The defaults (80 for HTTP or 443 for HTTPS), are automatically changed with the security selection.

Return to [3-E-<n>-2] HTTP output

3.20.18 [3-E-<n>-2-7] Security

The Data logger supports basic HTTP (credentials and data unencrypted) or HTTPS (using SSL/TLS to encrypt credentials and data).

```
>Security (0 = Basic, 1 = HTTPS, 2 = Azure-IoT SAS, 3 = Token, 4 = Header):
```

Note: *Username and Password depend on chosen security settings.*

Return to [3-E-<n>-2] HTTP output

3.20.19 [3-E-<n>-2-7-0] Security - Basic

Plain unencrypted HTTP using basic authorization.

```
[7] Security      >> Basic
[8] Username      >>
[9] Password      >>
```

Return to [3-E-<n>-2-7] Security

3.20.20 [3-E-<n>-2-7-1] Security - HTTPS

TLS encrypted HTTPS using basic authorization.

```
[7] Security      >> HTTPS
[8] Username      >>
[9] Password      >>
```

Return to [3-E-<n>-2-7] Security

3.20.21 [3-E-<n>-2-7-2] Security - Azure-IoT SAS

TLS encrypted HTTPS using Azure Shared Access Token authorization.
The HTTP Azure-IoT driver is the same driver as the HTTP(S)-driver, but used in a special Azure-IoT security mode generating the “Shared Access Token”.

Note: *To enable this mode, select security mode “Azure-IoT SAS” first.*

```
[7] Security      >> Azure-IoT SAS
[8] Device ID     >>
[9] Device key    >>


HTTP settings

[0] Exit
[1] Name          >> HTTP
[2] Send interval >> 06:00:00
[3] Send delay    >> Not used
[4] Server        >> <your-IoT-hub-name>.azure-devices.net
[-] Extended path >>
[6] Port          >> 443
[7] Security      >> Azure-IoT SAS
[8] Device ID     >> <your-device-ID>
[9] Device key    >> <your-base64-device-key>
[A] Output type   >> Log data
[B] Data format   >> JSON
[C] Max payload   >> 1000 kB
[D] Data filter   >> Data & Diagnostics
[R] Remove
[T] HTTP test     >> Not done
>Security (0=Basic, 1=HTTPS, 2=Azure-IoT SAS, 3=Token, 4=Header):
```

3.20.22 [3-E-<n>-2-7-2-4] Azure-IoT - Server

This is your IoT-Hub name concatenated with a dot and with the domain name of the Azure-IoT hub server (azure-device.net)

Note (Firmware pre V5.4B2): *Maximum length for the “Server” URL is 63 characters. If the required URL exceeds this length, store the remaining path in “Extended path” parameter.(Combined 189 characters).*

Return to HTTP Azure-IoT

3.20.23 [3-E-<n>-2-7-2-7] Azure-IoT - Security

Select Azure-IoT SAS.

Return to HTTP Azure-IoT

3.20.24 [3-E-<n>-2-7-2-8] Azure-IoT - Device ID

Enter the device ID given by your Azure-portal

Return to HTTP Azure-IoT

3.20.25 [3-E-<n>-2-7-2-9] Azure-IoT - Device Key

This is the primary or secondary key in base64 as generated given by you in your Azure-portal. If the generated key is to long to fit, please use a manual chosen base64 key in your Azure-portal.

Note (Firmware pre V5.4B2): *Device ID, key and extended path value field lengths are combined to hold 189 characters).*

Return to HTTP Azure-IoT

3.20.26 [3-E-<n>-2-7-3] Security - Token

TLS encrypted HTTPS using shared token authorization.

```
[7] Security      >> Token
[8] Token name    >>
[9] Token value   >>
```

Note (Firmware pre V5.4B2): *Token name, value and extended path value field lengths are combined to hold 189 characters).*

Return to [3-E-<n>-2-7] Security

3.20.1 [3-E-<n>-2-7-4] Security - Header

TLS encrypted HTTPS using custom HTTP-header authorization.

```
[7] Security      >> Header
[8] Header name   >>
[9] Header value  >>
```

Note: *Header value e.g. X-ApiKey.*

Return to [3-E-<n>-2-7] Security

3.20.2 [3-E-<n>-2-8..9] Username and password

Username and password should match the Server credentials.

Note (Firmware pre V5.4B2): *Username and password field lengths are combined to hold 62 characters.*

Return to [3-E-<n>-2] HTTP output

3.20.3 [3-E-<n>-2-A] Output type

Type of data to send: “Log data”, “Actual values” or “Heartbeat” only.
Note: *Heartbeat only applies typical to a second output driver which is not used for sending “Log data” but Alarm message or camera pictures.*

```
>Output type (1 = Log data, 2 = Actual values, 3 = Heartbeat):
```

Return to [3-E-<n>-2] HTTP output

3.20.4 [3-E-<n>-2-B] Data format

Choose from: Native ASCII text (YDOC), Excel readable (CSV "," or ";"), JavaScript Object Notation (JSON) and ASCII (DAS format).

```
>Data format (0 = YDOC, 1 = CSV (.,), 2 = CSV (,;), 3 = JSON, 4 = DAS):
```

Return to [3-E-<n>-2] HTTP output

Note: *Depending on the data format the following "Content-Type" HTTP header will be added to the post.*

text/plain	YDOC format	**application/json**	JSON format
text/csv	CSV format	**image/jpeg**	A camera picture

Note: *If the camera is used, pictures are posted to the same URI as the log files. The Web Server application has to examine the "Content-Type" header to distinguish the posted data type.*

Return to [3-E-<n>-2] HTTP output

3.20.5 [3-E-<n>-2-C] Max payload

The payload for data transfer is limited to the number of kB.

```
>Max payload (10..1000 kB): 1000
```

Return to [3-E-<n>-2] HTTP output

3.20.6 [3-E-<n>-2-D] Data filter

Message contents: Data and /or Diagnostic messages.

```
>Data filter (0 = Data & Diagnostics, 1 = Data, 2 = Diagnostics):
```

Return to [3-E-<n>-2] HTTP output

3.20.7 [3-E-<n>-3] MQTT output

Posting data to an MQTT-broker, third party IoT monitoring system or smart phone apps supporting generic MQTT.

```
MQTT settings

[0] Exit
[1] Name              >> MQTT
[2] Send interval     >> 06:00:00
[3] Send delay        >> Not used
[4] Server            >>
[5] Port              >> 8883
[6] Security          >> SSL/TLS
[7] Username          >>
[8] Password          >>
[9] Root topic        >> YDOC/140432928
[A] Omit subtopics    >> No
[B] Client ID         >> 356812104329287
[C] Clean session     >> No
[D] Output type       >> Log data & Actual values
[E] Data format       >> JSON
[F] Max payload       >> 1000 kB
[G] Data filter       >> Data & Diagnostics
[P] Input parameters  >> 0
[R] Remove
[T] MQTT test         >> Not done
>
```

3.20.8 [3-E-<n>-3-2] Send interval

The Send interval defines the daily time schedule that data is send to your Server.

Return to [3-E-<n>-3] MQTT output

3.20.9 [3-E-<n>-3-3] Send delay

A delay will introduce a time shift (offset) for the send interval. It can also be applied to avoid overload on a constraint server due to simultaneous transmissions of units.

Return to [3-E-<n>-3] MQTT output

3.20.10 [3-E-<n>-3-4] Server

The TCP-server's IP-address or domain name.
(Server name field length: 63 characters).

Return to [3-E-<n>-3] MQTT output

3.20.11 [3-E-<n>-3-5] Port

Port on which the MQTT server is listening. Default selected port value depends on "Security" selection: 1883 for Basic and 8883 for TLS.

Return to [3-E-<n>-3] MQTT output

3.20.12 [3-E-<n>-3-6] Security

The method used to logon to the TCP-server, this can be ‘Basic’, ‘Secure Authentication’ SSL/TLS encrypted’. When using ‘Basic’ the credentials are transferred by TCP in plain text. This method is, fast, has low power consumption, but unsafe.

```
>Security (0 = Basic, 1 = SSL/TLS):
```

Return to [3-E-<n>-3] MQTT output

3.20.13 [3-E-<n>-3-9] Root topic

The MQTT protocol works with so called “Topics”. MQTT Clients can subscribe to the “Topics” of their interest. A “Root topic” is used as prefix for all "Sub topics". The default “Root topic” is "YDOC/<device serial number>", it can be changed according to your needs.
(The Root topic field length: 47 characters).

Example: *Start with your own “Root topic” ACME and use a classification “METEOSTATION” for all connected Meteo stations. (Root Topic will be: ACME/METEOSTATIONS). The central monitoring system can subscribe to all topics starting with ACME and when a “METEOSTATION” logger publishes, the data can be found at the station name "STATION_<n>".*

Note: *The Data logger uses the following publishing topics:*

- ***<root>/sensors/<parameter code>*** *to publish an "Actual value" of a specific parameter.*
- ***<root>/data/jsn*** *to publish the "Log data" in JSON format.*
- ***<root>/data/csv*** *to publish the "Log data" in CSV file format.*
- ***<root>/data/txt*** *to publish the "Log data" in YDOC native text format.*
- ***<root>/alarm/sys*** *to publish "System alarms" in plain text, e.g. about a failing sensor.*
- ***<root>/alarm/data*** *to publish "Data alarms" in plain text, e.g. about reaching a low tank level.*
- ***<root>/jpg/<yymmdd_hhmmss>*** *to publish "Camera pictures with timestamp" in JPEG format.*
- ***<root>/status/time*** *the time of the logger at start of the MQTT session (yyyy/mm/dd hh:mm:ss).*

Return to [3-E-<n>-3] MQTT output

3.20.14 [3-E-<n>-3-A] Omit subtopics

This option can be used when the Client has no read, write (or create) rights on subtopics or FTP-server directory tree.

Note: *Client rights mismatches will generate an "Unauthorized” type error, while the username and password combination is valid on the Server.*

Return to [3-E-<n>-3] MQTT output

3.20.15 [3-E-<n>-3-B] Client ID

Every MQTT client should connect with a unique client identification (default is the unique IMEI-number of the built in modem used). If necessary you can specify your own Client ID.
(Client ID field length: 47 characters).

Return to [3-E-<n>-3] MQTT output

3.20.16 [3-E-<n>-3-C] Clean session



Only check this option if your MQTT-broker requires it, else you won't be able to do any remote configuration, update or firmware upgrades anymore.

Return to [3-E-<n>-3] MQTT output

3.20.17 [3-E-<n>-3-D] Output type

Type of data to send: "Log data", "Actual values" or "Heartbeat" only.

Note: *Heartbeat only applies typical to a second output driver which is not used for sending "Log data" but Alarm message or camera pictures.*

```
>Output type (1 = Log data, 2 = Actual values, 3 = Heartbeat):
```

Return to [3-E-<n>-3] MQTT output

3.20.18 [3-E-<n>-3-E] Data format

Choose the data output format: Native ASCII text (YDOC), Excel readable (CSV, two versions), JavaScript Object Notation (JSON) and ASCII (DAS format).

```
>Data format (0 = YDOC, 1 = CSV (.,), 2 = CSV (,;), 3 = JSON, 4 = DAS):
```

Return to [3-E-<n>-3] MQTT output

3.20.19 [3-E-<n>-3-F] Max payload

The payload for data transfer is limited to the number of kB.

```
>Max payload (10..1000 kB): 1000
```

Return to [3-E-<n>-3] MQTT output

3.20.20 [3-E-<n>-3-G] Data filter

Filter for the message contents: Data and /or Diagnostic messages.

```
>Data filter (0 = Data & Diagnostics, 1 = Data, 2 = Diagnostics):
```

Return to [3-E-<n>-3] MQTT output

3.20.21 [3-E-<n>-3-P] Input parameters

Another MQTT-client is able to transmit up to 8 different parameters to the Data logger. Such a parameter can, like any other sensor parameter, be logged, alarmed up on or used as input to a "Derived channel".

```
MQTT input parameter menu

[0] Exit
[1] Input parameter 1 >> Not used
[2] Input parameter 2 >> Not used
[3] Input parameter 3 >> Not used
[4] Input parameter 4 >> Not used
```

```
[5] Input parameter 5 >> Not used
[6] Input parameter 6 >> Not used
[7] Input parameter 7 >> Not used
[8] Input parameter 8 >> Not used
>
```

Example: *An MQTT-client can publish a numeric value to one of the defined input parameters with the following topic format: "YDOC/<device serial number>/inputs/<parameter code>" (YDOC/1234567/inputs/MAXLEV).*
The payload should contain the numeric value in plain text presentation, using "dot" as decimal separator.

Note*: The topic must be published with QOS=1, else the broker will not retain it untill the next logger connection.*

Return to [3-E-<n>-3] MQTT output

3.20.22 [3-E-<n>-4] Email output

This output driver is used to send the collected data (and /or system messages) from the SD Card to a mailbox of the user. The data is included in an attachment of the email.

```
Email settings

[0] Exit
[1] Name                >> Email
[2] Send interval       >> 06:00:00
[3] Send delay          >> Not used
[4] SMTP server         >>
[5] SMTP port           >> 465
[6] Security            >> TLS(implicit)
[7] Username            >>
[8] Password            >>
[9] Originator address  >>
[A] Destination address >>
[B] Subject             >>
[C] Output type         >> Log data
[D] Data container      >> File attachment
[E] File name           >> YDOC_ML-525SE 140432928_140432928_250731_195212.txt
[F] Data format         >> YDOC
[G] Max payload         >> 1000 kB
[H] Data filter         >> Data & Diagnostics
[R] Remove
[T] Email test          >> Not done
>
```

3.20.23 [3-E-<n>-4-2] Send interval

The Send interval defines the daily time schedule that data is send to your Server.

Return to [3-E-<n>-4] E-mail output

3.20.24 [3-E-<n>-4-3] Send delay

A delay will introduce a time shift (offset) for the send interval. It can also be applied to avoid overload on a constraint server due to simultaneous transmissions from the units. (Data loggers).

Return to [3-E-<n>-4] E-mail output

3.20.25 [3-E-<n>-4-4] SMTP server

This is the IP-address or domain name of the ISP's (or your own) SMTP-server to use for E-mailing. *(SMTP Server address length: 63 characters, Username and password field lengths combine to 63 characters).*

Return to [3-E-<n>-4] E-mail output

3.20.26 [3-E-<n>-4-5] SMTP port

The port on which the SMTP server is listening. Port 25 or 587 are typically used for unencrypted (plain text) SMTP. Port 465 is used for secure SMTP with implicit TLS.

Note: *Explicit TLS (STARTTLS) over port 587 is not supported by the Data logger.*

```
>SMTP port: 465
```

Return to [3-E-<n>-4] E-mail output

3.20.27 [3-E-<n>-4-6] Security

The Data logger supports basic SMTP (credentials and data unencrypted) or encrypted SMTP over TLS (implicit).

```
>Security (0 = Basic, 1 = TLS(implicit)):
```

Return to [3-E-<n>-4] E-mail output

3.20.28 [3-E-<n>-4-9] Originator address

This is the “From”-address, the email address of the used e-mail account.
(Originator address length: 47 characters).

Return to [3-E-<n>-4] E-mail output

3.20.29 [3-E-<n>-4-A] Destination address

The email “To”-address (list) where the data should be send to. Use a comma as separator to send the data to multiple addresses. *(Destination address length: 47 characters).*

Note: *To minimize entry space when using an address list, omit the “@<domain>” part of addresses when the same “@<domain>” is used in the previous address entry of the list.*

Return to [3-E-<n>-4] E-mail output

3.20.30 [3-E-<n>-4-B] Subject

The subject placed in the mail heading. *(Subject length: 31 characters).*

```
>Subject:
```

Return to [3-E-<n>-4] E-mail output

3.20.31 [3-E-<n>-4-C] Output type

Contents of the mail body or attachement: Log data, Actual values and /or Hartbeat.

```
>Output type (1 = Log data, 2 = Actual values, 3 = Heartbeat):
```

Return to [3-E-<n>-4] E-mail output

3.20.32 [3-E-<n>-4-D] Data container

Select for mail contents in attachment or in the mail body.

```
>Data container (0 = File attachment, 1 = Email body):
```

Return to [3-E-<n>-4] E-mail output

3.20.33 [3-E-<n>-4-E] File name

Format the attachment file name. Available substitutions can be used: System name (<sysname>), serial number (<sn>) FTP-driver name <name> as well as various timestamp tokens.

Note: *<y>, <yy> or <yyyy> is used for year, <m> or <mm> for months, <d> or <dd> for days, <h> or <hh> for hour of the day, <n> or <nn> for minutes and <s> or <ss> for seconds. A single variable is used for presentation without a leading zero.*

```
>File name: YDOC_<sysname>_<sn>_<yy><mm><dd>_<hh><nn><ss>
```

(Filename field length: 21 characters).

Return to [3-E-<n>-4] E-mail output

3.20.34 [3-E-<n>-4-F] Data format

Choose the data output format: Native ASCII text (YDOC), Excel readable (CSV, two versions), JavaScript Object Notation (JSON) and ASCII (DAS format).

```
>Data format (0 = YDOC, 1 = CSV (.,), 2 = CSV (,;), 3 = JSON, 4 = DAS):
```

Return to [3-E-<n>-4] E-mail output

3.20.35 [3-E-<n>-4-G] Max Payload

The payload for data transfer is limited to the number of kB.

```
>Max payload (10..1000 kB): 1000
```

Return to [3-E-<n>-4] E-mail output

3.20.36 [3-E-<n>-4-H] Data filter

Filter for the message contents: Data and /or Diagnostic messages.

```
>Data filter (0 = Data & Diagnostics, 1 = Data, 2 = Diagnostics):
```

Return to [3-E-<n>-4] E-mail output

3.20.37 [3-E-<n>-5] FTP output

```
FTP settings

[0] Exit
[1] Name              >> FTP
[2] Send interval     >> 06:00:00
[3] Send delay        >> Not used
[4] Server            >>
[5] Port              >> 21
[6] FTP mode          >> Active
[7] Security          >> TLS(explicit)
[8] Username          >>
[9] Password          >>
[A] Directory         >>
[B] Output type       >> Log data
[C] File name         >> YDOC_ML-525SE_140432928_250818_073055.txt
[D] Verification      >> Yes
[E] Data format       >> YDOC
[F] Max payload       >> 1000 kB
[G] Data filter       >> Data & Diagnostics
[P] Input parameters  >> 0
[R] Remove
[T] FTP test          >> Not done
>
```

3.20.38 [3-E-<n>-5-2] Send interval

The Send interval defines the daily time schedule that data is send to your Server.

Return to [3-E-<n>-5] FTP output

3.20.39 [3-E-<n>-5-3] Send delay

A delay will introduce a time shift (offset) for the send interval. It can also be applied to avoid overload on a constraint server due to simultaneous transmissions from the units. (Data loggers).

Return to [3-E-<n>-5] FTP output

3.20.40 [3-E-<n>-5-4] Server

The FTP-server's IP-address or domain name.
(Server address length: 63 characters, Username and password field lengths combine to 63 characters).

Return to [3-E-<n>-5] FTP output

3.20.41 [3-E-<n>-5-6] FTP mode

Both Active and passive FTP mode TCP are supported by the Data logger. Active mode FTP is using a data and a communication port during file transfer.

```
>FTP mode (0 = Active, 1 = Passive):
```

Return to [3-E-<n>-5] FTP output

3.20.42 [3-E-<n>-5-7] Security

The port on which the FTP server is listening. Port 21 is typically used for unencrypted (plain text) FTP and secure FTP with explicit TLS. (To encrypt credentials and data).

```
>Security (0 = Basic, 1 = TLS(explicit)):
```

Return to [3-E-<n>-5] FTP output

3.20.43 [3-E-<n>-5-A] Directory

The relative path to the destination on the FTP-server. *(Directory field length: 123 characters).*

Return to [3-E-<n>-5] FTP output

3.20.44 [3-E-<n>-5-B] Output type

Select the file contents.

```
>Output type (1 = Log data, 2 = Actual values, 3 = Heartbeat):
```

Return to [3-E-<n>-5] FTP output

3.20.45 [3-E-<n>-5-C] File name

The default FTP-file name is formatted as “YDOC_<sysname>_<sn>_<yy><mm><dd>_<hh><nn><ss>” and appended with the file extension (.txt. .csv. or .json, depending on the chosen Data format).

File name customization can use substitutions for System name (<sysname>), serial number (<sn>) FTP-driver name <name> as well as various timestamp tokens.

Note: *<y>, <yy> or <yyyy> is used for year, <m> or <mm> for months, <d> or <dd> for days, <h> or <hh> for hour of the day, <n> or <nn> for minutes and <s> or <ss> for seconds. A single variable is used for presentation without a leading zero.*

```
>File name: YDOC_<sysname>_<sn>_<yy><mm><dd>_<hh><nn><ss>
```

(Filename field length: 21 characters).

Return to [3-E-<n>-5] FTP output

3.20.46 [3-E-<n>-5-D] Verification

To check if the file is successfully transferred, the Data logger will verify if the transferred file has the expected file size. If the transferred file is removed before the Data logger can check the file size or the FTP-server does not allow the verification, set it to “Off”. When switching off verification there is a limited chance on data loss. (on FTP-server side).
Note: *All logged data will always be available on the SD-card.*

```
>Verification (0 = No, 1 = Yes):
```

Return to [3-E-<n>-5] FTP output

3.20.47 [3-E-<n>-5-E] Data format

Choose the data output format: Native ASCII text (YDOC), Excel readable (CSV, two versions), JavaScript Object Notation (JSON) and ASCII (DAS format).

```
>Data format (0 = YDOC, 1 = CSV (.,), 2 = CSV (,;), 3 = JSON, 4 = DAS):
```

Return to [3-E-<n>-5] FTP output

3.20.48 [3-E-<n>-5-F] Max payload

The payload for data transfer is limited to the number of kB.

```
>Max payload (10..1000 kB): 1000
```

Return to [3-E-<n>-5] FTP output

3.20.49 [3-E-<n>-5-G] Data filter

Filter for the message contents: Data and /or Diagnostic messages.

```
>Data filter (0 = Data & Diagnostics, 1 = Data, 2 = Diagnostics):
```

Return to [3-E-<n>-5] FTP output

3.20.50 [3-E-<n>-5- P] Input parameters

An (external) FTP-client is able to transmit up to 8 different parameters to be processed in the Data logger. Such a parameter can, like any other sensor parameter, be logged, alarmed up on or used in a derived channel.

The FTP-client should place the file with input parameters on the FTP-server in the same directory where data log files are transferred to.

The name of the file should be formatted as **YDOC_<SN>.dat** and contain one or multiple lines separated from each other with a carriage return or carriage return line feed, with one <**name>=<value>** pair per line. The name should match with a parameter code of one of the defined input parameters.

Example file contents:

MAXLEV=3.2
MAXFLOW=4.5

Note: *The decimals should be separated with a dot. The Data logger will remove the file from the server once processed.*

Return to [3-E-<n>-5] FTP output

3.20.51 [3-E-<n>-6] SMS output

The SMS driver is used to send the collected data from the SD storage to a cell phone number by SMS. A SMS has a limited data transfer size of 140 characters. Advice is to use this driver only if not other alternatives are feasible.

```
SMS settings

[0] Exit
[1] Name          >> SMS
[2] Send interval >> 00:10:00
[3] Send delay    >> Not used
[4] Phone number  >>
[5] Output type   >> Actual values
[R] Remove
[T] SMS data test >> Not done
>
```

Note: *To use SMS output, a SIM card with SMS prescription is obligatory. Remote configuring is not supported.*

3.20.52 [3-E-<n>-6-4] Phone number

The cell phone number you want to send data messages to.

Return to [3-E-<n>-6] SMS output

3.20.53 [3-E-<n>-6-5] Output type

An SMS message is limited to 160 characters. It's not possible to send a complete log file in one SMS message. Choose to configure this driver to only send the last logged record (Actual Values) or all logged records since the last successful data transmission (Log data). Each log record will be sent as an individual SMS message**.**

Note: *Each SMS data record starts with an asterisk, followed by a logger serial number, timestamp and followed by one or more parameter code/value pairs in the same format as with D-record.*

More info at Operating basics - Data formats

Example:

*<logger s/n>;<yyddmmhhmmss;<par code1>;<par value1>;…;<par code_n>;<par value_n>

**5304783;160513140000;TEMP;23.6;LEVEL;3.32*A;BATT;4.2*

Return to [3-E-<n>-6] SMS output

3.21 [3-F] Wifi Output

Wifi output configuration is similar to the Modem output configuration. Main menu, [3-E].

Note: *When using the Wifi output (instead of the modem output) the SMS driver is not available.*

Return to [3] Configuration setup menu

4 [4] Configuration overview

The parameter overview gives the user the possibility to generate different type of views of the configuration. Maximum of 16 parameters are showed on one page.
To browse between pages use “Next page” and “Previous page” selection in the overview.

```
Configuration overview

[0] Exit
[1] Sensor list      >> <number of sensors>
[2] Output list      >> <number of output devices>
[3] Parameter list   >> <number of parameters>
[4] Parameter order
[5] Measurement list
[6] Parameter output
[7] Alarm list
[8] Alarm limits
>

Return to Configuration (main) menu
```

4.1.1 [4-1] Sensor list

Used sensor view.

```
Sensor list

Sensor                  Sample interval Alarm interval  Power   Warm up

Device parameters       00:10:00        Not used                00:00:00
MODBUS                  00:10:00        Not used        Sensor  00:00:01
SDI12                   00:10:00        Not used        Sensor  00:00:02.50
Network signal          04:00:00        Not used                00:00:10

[0] Exit
[N] Next page (optional)
>
```

4.1.2 [4-2] Output list

Used output view.

```
Output list

Output                   Send interval   Alarm interval  Power   Warm up

TCP                      06:00:00        Not used                00:00:10
Galvanic isolated switch 00:10:00        Not used                00:00:00

[0] Exit
[N] Next page (optional)
>
```

4.1.3 [4-3] Parameter list

By clicking the character between brackets in front of the concerned parameter brings you directly to the parameter configuration screen.

```
Parameter list

Parameter       Name                    Initial value   Unit            Min / Max

[1] MAXVi       Max voltage             0               V
[2] AVGCi       Average current         0               mA
[3] OCi         Operating cycle         0               sec
[4] RHi         Relative humidity       0               %
[5] BPi         Barometric pressure     0               mbar
[6] AVGVi       Average voltage         0               V
[7] BTi         Board temperature       0               C
[8] DptRS       Depth RS485             0               m
[9] DptSDI      Depth SDI12             0               m
[A] FSSi        Free storage space      0               MB
[B] SB          Signal                  0               bars
[C] RSSI        Signal strength RSSI    0               dBm
[D] RSSIcor     RSSI corrected          0               dbm+
[E] SBGT2       SB gt 2                 0

[0] Exit
[N] Next page (optional)
>
```

4.1.4 [4-4] Parameter order

Change the order of a parameter in the list. Select a parameter and specify a new position in the list.

Note: *If a ML-OO-MODBUS option board is installed, the same parameter list order is used in the output board registers.*

```
Parameter order

Order   Code            Name

[1] 1   MAXVi           Max voltage
[2] 2   AVGCi           Average current
[3] 3   OCi             Operating cycle
[4] 4   RHi             Relative humidity
[5] 5   BPi             Barometric pressure
[6] 6   AVGVi           Average voltage
[7] 7   BTi             Board temperature
[8] 8   DptRS           Depth RS485
[9] 9   DptSDI          Depth SDI12
[A] 10  FSSi            Free storage space
[B] 11  SB              Signal
[C] 12  RSSI            Signal strength RSSI
[D] 13  RSSIcor         RSSI corrected
[E] 14  SBGT2           SB gt 2

[0] Exit
[N] Next page (optional)
>
```

4.1.5 [4-5] Measurement list

Overview of used sample rates, alarm intervals and parameter definitions.

```
Measurement list

Parameter       Sample interval Alarm interval  Factor  Offset  Decimals
```

```
[1] MAXVi       00:10:00        Not used        1       0       2
[2] AVGCi       00:10:00        Not used        1       0       0
[3] OCi         00:10:00        Not used        1       0       2
[4] RHi         00:10:00        Not used        1       0       1
[5] BPi         00:10:00        Not used        1       0       1
[6] AVGVi       00:10:00        Not used        1       0       2
[7] BTi         00:10:00        Not used        1       0       1
[8] DptRS       00:10:00        Not used        1       0       2
[9] DptSDI      00:10:00        Not used        1       0       3
[A] FSSi        00:10:00        Not used        1       0       0
[B] SB          04:00:00        Not used        1       0       0
[C] RSSI        04:00:00        Not used        1       0       0
[D] RSSIcor     00:10:00        Not used        1       0       3
[E] SBGT2       00:10:00        Not used        1       0       3

[0] Exit
[N] Next page (optional)
>
```

4.1.6 [4-6] Output list

Overview of intervals and selected outputs.

```
Parameter output

Parameter       Log interval    Alarm interval  Log     Output

[1] MAXVi       00:10:00        Not used        On      Modem
[2] AVGCi       00:10:00        Not used        On      Modem
[3] OCi         00:10:00        Not used        On      Modem
[4] RHi         00:10:00        Not used        On      Modem
[5] BPi         00:10:00        Not used        On      Modem
[6] AVGVi       00:10:00        Not used        On      Modem
[7] BTi         00:10:00        Not used        On      Modem
[8] DptRS       00:10:00        Not used        On      Modem
[9] DptSDI      00:10:00        Not used        On      Modem
[A] FSSi        00:10:00        Not used        On      Modem
[B] SB          04:00:00        Not used        On      Modem
[C] RSSI        04:00:00        Not used        On      Modem; Auxiliary (OB2)
[D] RSSIcor     00:10:00        Not used        On      Modem
[E] SBGT2       00:10:00        Not used        On      Modem; Auxiliary (OB1)

[0] Exit
[N] Next page (optional)
>
```

Note: *To find out what output Auxiliary output type OB1 and OB2 are, check Main menu [3-5-8..9] "Option boards".*

4.1.7 [4-7] Alarm list

Alarming overview.

```
Alarm list

Parameter       Alarm message   Alarm log       Alarm output

[1] MAXVi       Disabled        Off             Off
[2] AVGCi       Disabled        Off             Off
[3] OCi         Disabled        Off             Off
[4] RHi         Disabled        Off             Off
```

```
[5] BPi          Disabled        Off             Off
[6] AVGVi        Disabled        Off             Off
[7] BTi          Disabled        Off             Off
[8] DptRS        Disabled        Off             Off
[9] DptSDI       Disabled        Off             Off
[A] FSSi         Disabled        Off             Off
[B] SB           Disabled        Off             Off
[C] RSSI         Disabled        Off             Off
[D] RSSIcor      Disabled        Off             Off
[E] SBGT2        Disabled        Off             Off

[0] Exit
[N] Next page (optional)
>
```

4.1.8 [4-8] Alarm limits

Alarm limit overview of alarm limits.

```
Alarm limits

Parameter        Lo-lo   Lo      Hi      Hi-hi   Hys     Set / Reset delay

[1] MAXVi
[2] AVGCi
[3] OCi
[4] RHi
[5] BPi
[6] AVGVi
[7] BTi
[8] DptRS
[9] DptSDI
[A] FSSi
[B] SB
[C] RSSI
[D] RSSIcor
[E] SBGT2

[0] Exit
[N] Next page (optional)
>
```

5 [5] Maintenance Menu

Menu with tooling to perform diagnostic tests for attached hardware ports and modem.
Configuration down /upload and firmware maintenance.

Note: *Advise is to perform these tests when a Data logger failure is expected.*

```
Maintenance Menu ML-525SE Logger Version 5.0 Build 11

[0] Exit
[1] Field testing
[2] Serial port terminals
[3] Data download
[4] SD storage maintenance
[5] Configuration download
[6] Configuration upload
[7] Firmware upgrade
[8] Modem maintenance
[9] Bootloader menu
[A] Bootloader upgrade
[B] Reset option boards
[R] Reboot
>
```

5.1.1 [5-1] Field testing

If individual test values are Ok, enter “yes” to confirm.
As result, in the Field testing menu overview the “Failed” (or “Not done”) will change in “Passed”.

```
Field testing

[0] Exit
[1] Device parameters   >> Failed
[2] Analog inputs       >> Failed
[3] Digital inputs      >> Failed
[4] SD storage          >> Passed
[5] Network signal      >> Not done
[6] SMS alarm           >> N/A
[7] APN login           >> Not done
[8] NTP synchronisation >> Not done
[9] Camera              >> Passed
[A] TCP                 >> Passed
>
```

5.1.2 [5-1-1] Device parameters test

Device parameters are concerning voltage, current, temperatures and RTC battery state.

```
Device parameters test

Observe values refreshed every second
When finished press any key

Supply voltage        = 4.04 V
Supply current        = 34 mA
Relative humidity     = 53.6 %
Board temperature     = 22.6 C
Clock battery voltage = 3.14 V
Barometric pressure   = 1024.8 mbar
Casing temperature    = 22.6 C

Are the device parameter values OK?
```

```
Choose yes/no >
```

Return to [5-1] Field testing

5.1.3 [5-1-2] Verify Analog inputs

This feature allows the user to check the operation of the analog inputs. It shows the exact voltage, measured at the input. It shows the plain voltage /current without the addition of multipliers /offset values, that are present in the configuration. The use of this feature is to let the user check the calibration of the Data logger against a well-known voltage /current source.

The internal reference is 2048mV (+/- 0,1%). For using this feature in the field, just disconnect your sensor and attach your calibrator and check the value.

```
Verify analog inputs

Observe values refreshed every second
When finished press any key

Internal Vref = 2.046 V
Port 1        = 0.000 mA (ADC = 0)
Port 2        = 0.000 mA (ADC = 0)
Port 3        = 0.000 V  (ADC = 0)
Port 4        = 0.000 V  (ADC = 0)
Potmeter      = 0.471 V  (ADC = 943)
```

Return to [5-1] Field testing

5.1.4 [5-1-3] Digital input test

Test the digital inputs. (Collect and process input pulses).

```
Digital input test

Apply interrupts on the Digital input pin
When finished press any key

Port 1 Counter = 0

Port 2 Counter = 0

Port 3 Counter = 0
```

Note: *The pulses generated during this test will not interfere with the current (paused) measurements, defined in the configuration.*

Return to [5-1] Field testing

5.1.5 [5-1-4] SD storage test

Use this feature to test the SD card. There will be data written on the card, and afterwards erased. The health of the SD card is tested. Possible driver exceptions are logged in Output file 1..6. Output file 1..6 are used for diagnostic purposes. During normal Data logger operation, these files should have zero size.

Note: *the test will be executed on the selected (internal /removable) SD card.*

```
Removeable SD card test
```

```
Manufacturer ID = 3
OEM ID          = SD
Product name    = SA08G

Data log file  = 1613 kB
Output file 1  = 4322 Bytes
Output file 2  = 0 Bytes
Output file 3  = 0 Bytes
Output file 4  = 0 Bytes
Output file 5  = 0 Bytes
Output file 6  = 0 Bytes
Free space     = 7564 MB

File write/read test OK
```

Note: *Output file 1..6 are containing output driver messages. The contents is depending on the order that output drivers are configured.*

Return to [5-1] Field testing

5.1.6 [5-1-5] Network signal test

```
Network signal test

<09:46:38>
Network signal start
AT#RFSTS
#RFSTS: "204 16",6200,-84,-59,-11.0,020f,30,,64,3,0,1084E79,"901405103540472","T-
Mobile NL",3,20,720,3240,141
OK

Signal bars (0-5)     = 5 (Excellent)
Signal strength RSSI = -59 dBm (Excellent)
Signal strength RSRP = -84 dBm (Excellent)
Signal quality RSRQ  = -11 dB (Good)
Access technology    = 8 (LTE cat M1)
Operator PLMN code   = 20416
Area code            = 20F
Cell ID              = 1084E79
Radio channel code   = 6200 (ARFCN)
Modem idle

Is the signal OK?
Choose yes/no >
```

Return to [5-1] Field testing

5.1.7 [5-1-6] SMS test

Applies only when a SIM card with SMS prescription is mounted.

Return to [5-1] Field testing

5.1.8 [5-1-7] APN test

```
APN test

<07:27:45>
ATE0;+CMEE=2
```

```
OK
AT+ICCID;+CPIN?
+ICCID: 89882280666035404726
+CPIN: READY
OK
AT&D1;&K3
OK
AT+CGDCONT?
+CGDCONT: 1,"IP","iot.1nce.net","",0,0,0,0
OK
AT+CEREG=2;+CEREG?
+CEREG: 2,5,"020F","1084E79",8
OK
Registered on LTE cat M1 network
AT+CGREG=0;+COPS=3,0;+COPS?
+COPS: 0,0,"T-Mobile NL",8
OK
AT+CSDF=,2;+CCLK?
+CCLK: "2025/08/07,07:27:44+08"
<07:27:44>
TIME_FIX;Time adjusted;-1 sec
OK
AT#SGACT?
#SGACT: 1,0
OK
AT#SGACT=1,1
#SGACT: 10.202.252.72
OK
Modem idle

APN test OK

Press any key! >
```

Return to [5-1] Field testing

5.1.9 [5-1-8] NTP test

Test APN settings to access the selected provider network.

```
NTP test

<07:29:29>
NTP start
AT#SD=1,1,123,"0.pool.ntp.org"
CONNECT
Modem data mode
NTP command send
<07:29:32>
TIME_FIX;Time adjusted;+2 sec
NTP time: 2025/08/07 07:29:32
Modem command mode
<07:29:33>
OK
AT#SH=1
OK
End NTP
Modem idle

NTP test OK

Press any key! >
```

Return to [5-1] Field testing

5.1.1 [5-1-9] Camera test

The camera test will generate a picture according to the settings, it is transferred to the system YdocTerminal resides.

Note: *Pictures can be transferred via HTTP, E-mail, FTP, TCP, or MQTT. Configure the corresponding output driver for the specific protocol. If you don't want to transmit log data as well, it is recommended to configure the driver's "Output type" to send just a "Heartbeat" (once a day) to avoid unnecessary payload and reduce power consumption.*

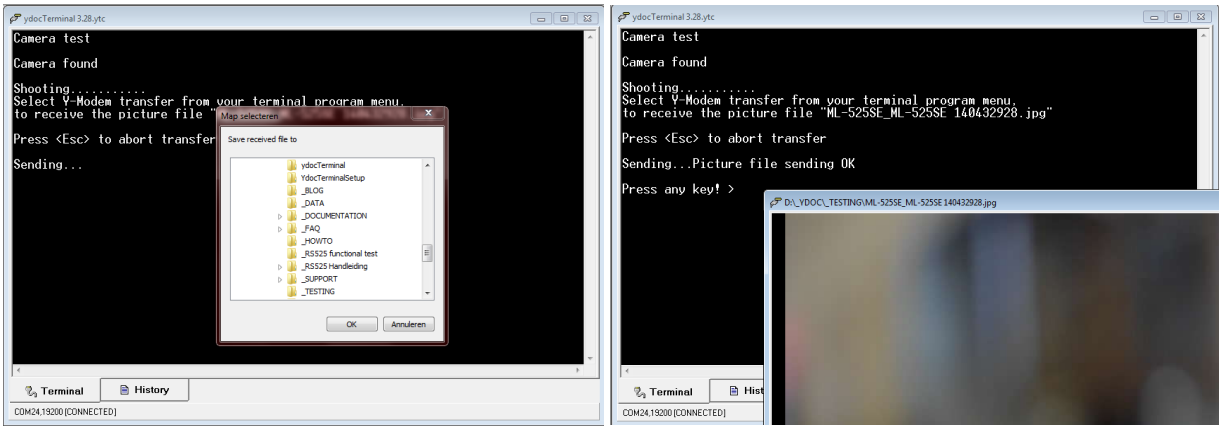
```
Camera test

Shooting...........
Select Y-Modem transfer from your terminal program menu,
to receive the picture file "ML-525SE_ML-525SE 140432928.jpg"

Press <Esc> to abort transfer

Sending...Picture file sending OK

Press any key! >
```



Return to [5-1] Field testing

5.1.2 [5-1-A..F] Modem output tests

Each configured output protocol can be tested from this menu.

```
Output test

<07:31:48>
Init TCP
TCP start
AT#SD=1,0,37,"collector.ydoc.biz"
CONNECT
Modem data mode
CMD=1&MODULE=YDOC&V=5.1B1&SN=140432928&NAME="ML-525SE
140432928"&INT=21600&SIZE=2154&CNT=1&USR="HANKO"&PSW="******"
<07:31:49>
Data sent
ACK
Modem command mode
<07:31:50>
```

```
OK
AT#SH=1
OK
End TCP OK
Modem idle

Output test OK

Press any key! >
```

Return to [5-1] Field testing

5.2 [5-2] Serial port terminals

This feature allows to communicate with the attached sensors directly. It offers a direct, transparent connection, from the YdocTerminal screen, to the sensor. Bits, parity and baud rate settings can be selected to match the connected sensor. During the session, the sensor power is switched on. This is a very convenient way of testing, troubleshooting, configuring or upgrading the sensor firmware of the attached sensor(s).

```
Serial port terminals

[0] Exit
[1] RS232 port          >> Not used
[2] RS485 port          >> MODBUS
[3] SDI12 port          >> SDI12
[4] Accessory port      >> Camera
[-] OB Serial port      >> N/A
[-] OB Accessory port >> N/A
[-] OB BLE port         >> N/A
[M] Modem port
>
```

5.2.1 [5-2-1] RS232 port

```
Port mode

[0] Exit
[1] RS232 8N1
[2] RS232 7E1
[3] RS232 8E1
[4] RS232 8O1
>

Baud rate

[0] Exit
[A] 300
[B] 600
[C] 1200
[D] 2400
[E] 4800
[F] 9600
[G] 19200
[H] 38400
[I] 57600
[J] 115200
[K] 230400
>

RS232 port

When finished, wait 3 seconds and press <Ctrl>Z
Serial port terminal started
Serial port terminal ended

Press any key! >

Return to [5-2] Serial port terminals
```

5.2.2 [5-2-2] RS485 (Modbus)

```
MODBUS

Sensor power on
Be aware of the warm up time for responsiveness of commands

When finished, wait 3 seconds and press <Ctrl>Z
Serial port terminal started
Serial port terminal ended

Press any key! >
```

Return to [5-2] Serial port terminals

5.2.3 [5-2-3] RS485 (SDI-12)

```
SDI12

Sensor power on
Be aware of the warm up time for responsiveness of commands

When finished, wait 3 seconds and press <Ctrl>Z
Serial port terminal started
Serial port terminal ended

Press any key! >
```

Return to [5-2] Serial port terminals

5.2.4 [5-2-M] Modem port

The direct port connecting to the modem can be used to execute “AT” commands to modify settings or upload an certificate.

```
Modem port

When finished, wait 3 seconds and press <Ctrl>Z
Modem power on
Please wait.............
Serial port terminal started
ATE1;&K3

OK
Serial port terminal ended

Press any key! >
```

Return to [5-2] Serial port terminals

5.2.5 [5-3] Data Download

This option is available to extract the data directly from the (internal) SD card, using the USB interface. There are four file formats available to save the selected data. (YDOC TXT, JSON and 2 CSV formats). Enter start date &time and end date & time. A location on the lap-top or PC can be chosen to store the download data. After downloading a graphical or text presentation is started.

Note: *If “Data & diagnostics” are saved to the data file during runtime, the data file can be used for diagnostic purposes.*

```
Data download

Start date or <CR> for this day (YY/MM/DD):
Start time or <CR> for midnight (hh:mm:ss):


End date or <CR> for this day (YY/MM/DD):
End time or <CR> for midnight (hh:mm:ss):


Download data from 2025/08/15 00:00:00 till 2025/08/16 00:00:00

Data format (0 = YDOC, 1 = CSV (.,), 2 = CSV (,;), 3 = JSON, 4 = DAS): 0


Searching...
Start record found: D;250815000008;SB;5;RSSI;-66

Press <Esc> to abort copying data to output file
Copying...

Select Y-Modem transfer from your terminal program menu,
to receive the data file "ML-525SE_ML-525SE 140432928.txt"

Press <Esc> to abort transfer

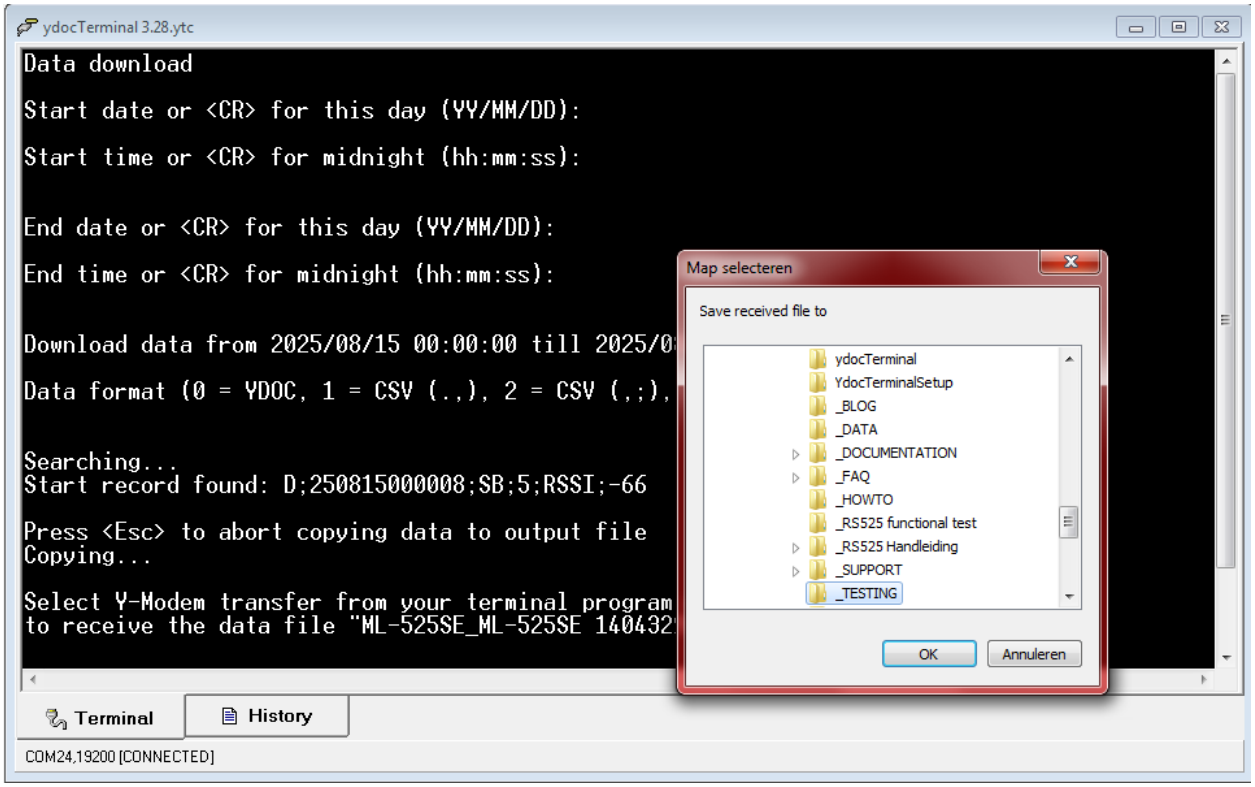
Sending...

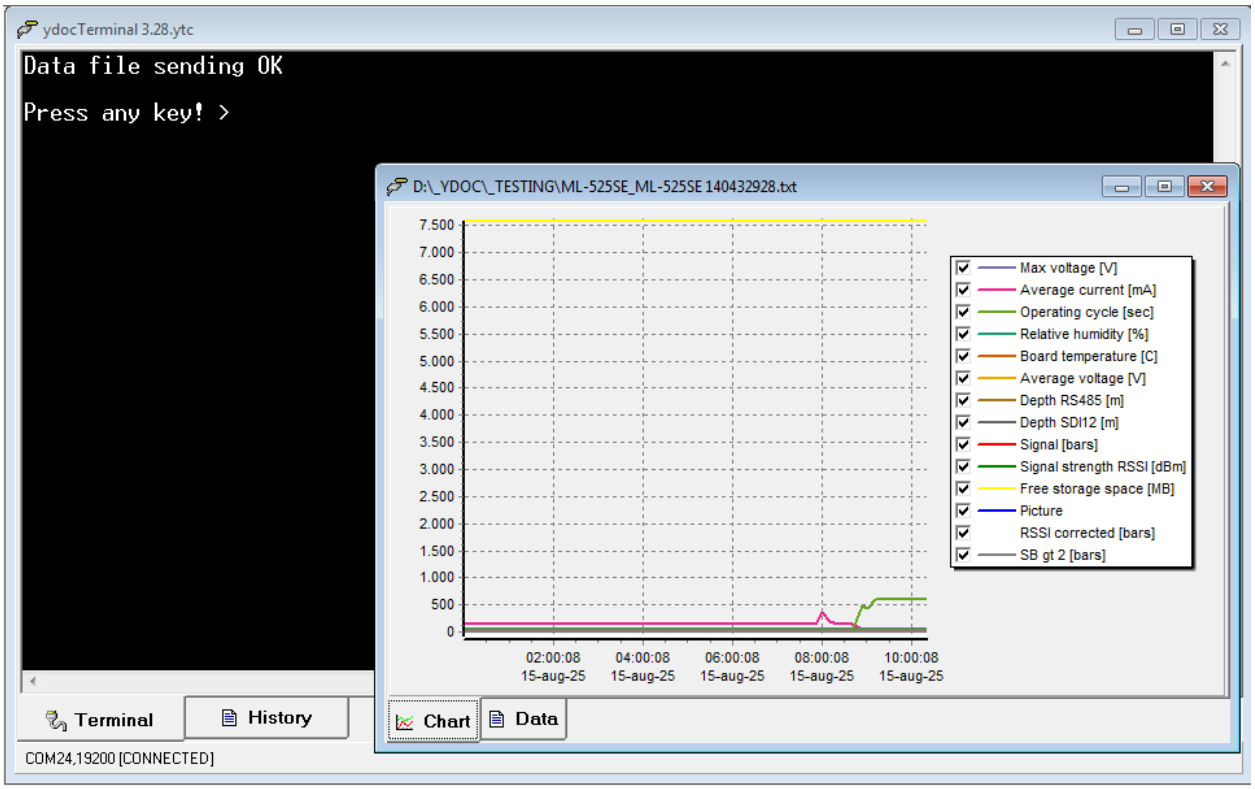

Data file sending OK

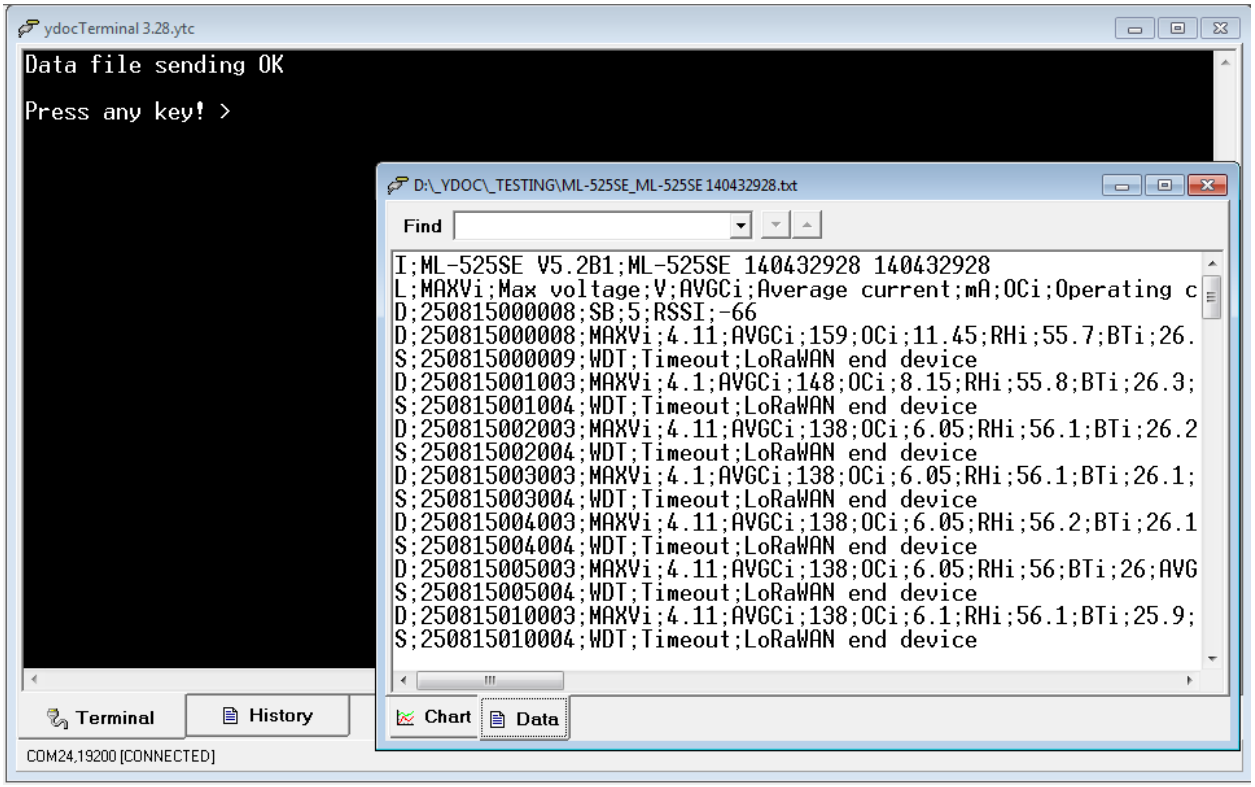
Press any key! >
```

Return to [5] Maintenance menu

Example:


ydocTerminal 3.28.ytc
Data download
Start date or <CR> for this day (YY/MM/DD):
Start time or <CR> for midnight (hh:mm:ss):
End date or <CR> for this day (YY/MM/DD):
End time or <CR> for midnight (hh:mm:ss):
Download data from 2025/08/15 00:00:00 till 2025/0
Data format (0 = YDOC, 1 = CSV (.,), 2 = CSV (,;),
Searching...
Start record found: D;250815000008;SB;5;RSSI;-66
Press <Esc> to abort copying data to output file
Copying...
Select Y-Modem transfer from your terminal program
to receive the data file "ML-525SE_ML-525SE 140432
Map selecteren
Save received file to
ydocTerminal
YdocTerminalSetup
_BLOG
_DATA
_DOCUMENTATION
_FAQ
_HOWTO
_RS525 functional test
_RS525 Handleiding
_SUPPORT
_TESTING
OK
Annuleren
Terminal
History
COM24,19200 [CONNECTED]


ydocTerminal 3.28.ytc
Data file sending OK
Press any key! >
D:_YDOC_TESTING\ML-525SE_ML-525SE 140432928.txt
7.500
7.000
6.500
6.000
5.500
5.000
4.500
4.000
3.500
3.000
2.500
2.000
1.500
1.000
500
0
02:00:08 15-aug-25
04:00:08 15-aug-25
06:00:08 15-aug-25
08:00:08 15-aug-25
10:00:08 15-aug-25
Max voltage [V]
Average current [mA]
Operating cycle [sec]
Relative humidity [%]
Board temperature [C]
Average voltage [V]
Depth RS485 [m]
Depth SDI12 [m]
Signal [bars]
Signal strength RSSI [dBm]
Free storage space [MB]
Picture
RSSI corrected [bars]
SB gt 2 [bars]
Chart
Data
Terminal
History
COM24,19200 [CONNECTED]



Return to [5] Maintenance menu

5.2.6 [5-4] SD storage maintenance

These options apply to the selected storage: Internal storage or External SD card. ([3-1] “General settings” menu). On the SD card, the FAT32 file system format is used. These options are available ***from firmware version V5.2 B4***, earlier firmware versions will point to “SD card format”.

```
SD storage maintenance

[0] Exit
[1] Download data log file
[2] Reduce data log file size
[3] Delete data log file
[4] Format SD storage
[T] SD storage test
>
```

5.2.7 [5-4-1] Download data log file

Warning: *The complete data log file will be downloaded. (No configurable start /end date and time).*

On a data logger, using internal SD storage, only 110MB will be downloadable. (It will take a few minutes, with YdocTerminal V3.31 and higher).

If external SD card storage is used, maximum of 4GB will be downloaded thru Y-modem /YdocTerminal.

Advise: *For downloading a large data log file from the external SD card, remove the card from the data logger and use a Windows PC to directly download the data log file from the card.*

When entering the download data log option, a warning is shown.

```
>Password: ************

Are you sure? It can take a long time, depending on the file size
Choose yes/no >

Data log file download

Select Y-Modem transfer from your terminal program menu,
to receive the data log file "ML-525SE_140064343.txt"

Press <Esc> to abort transfer
Sending...

Data log file sending OK

Press any key! >
```

Return to [5-4] SD storage maintenance

5.2.8 [5-4-2] Reduce data log file size

Return to [5-4] SD storage maintenance

5.2.9 [5-4-3] Delete data log file

Return to [5-4] SD storage maintenance

5.2.10 [5-4-4] Format SD storage

Return to [5-4] SD storage maintenance

5.2.11 [5-4-T] SD storage test

Return to [5-4] SD storage maintenance

Note: *When an external SD card is used as storage, the card (FAT32 formatted) is readable /writable on a Windows PC or Laptop using a card reader.*

Note: *To speed up data download using YdocTerminal, minimum version V3.31 is advised.*

Return to [5] Maintenance menu

5.2.12 [5-5] Configuration download

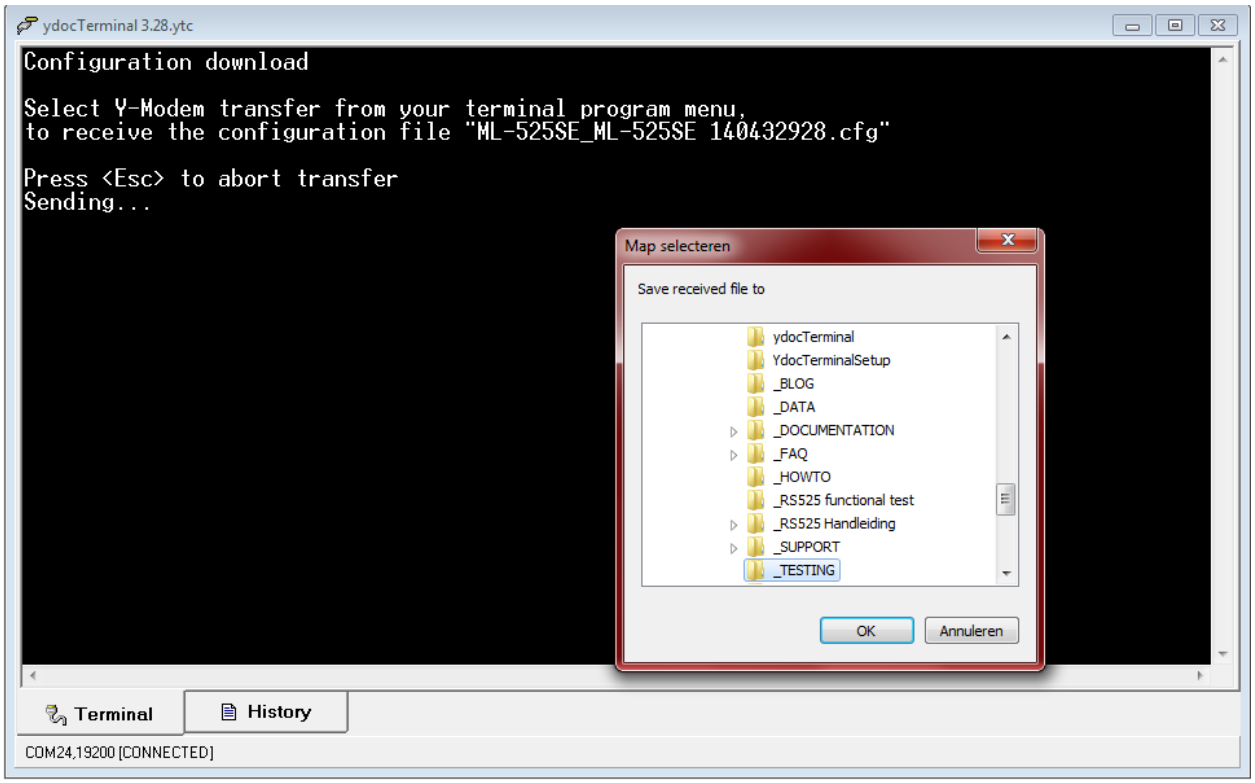
This option is useable for diagnostic and backup purposes.
The configuration file is encrypted. During download, it is stored on a selectable location on the Windows PC or Laptop.

```
Configuration download

Select Y-Modem transfer from your terminal program menu,
to receive the configuration file "ML-525SE_ML-525SE 140432928.cfg"

Press <Esc> to abort transfer
Sending...
```

Warning: *Without the associated password, the configuration file cannot be read or modified.*



Return to [5] Maintenance menu

5.2.13 [5-6] Configuration upload

This option is very useful to upload a (pre-edited standard) configuration file and personalize it on the Data logger manually after uploading.

Note: *System name and MQTT root topic (serial number) are not included in an uploaded configuration and must be verified and /or changed.*

Return to [5] Maintenance menu

5.2.14 [5-7] Firmware Upgrade

The firmware is the kernel of the Data logger. The latest firmware version can be downloaded from the ydoc website here: https://ydoc.biz/docs/datalogger-firmware/

After downloading, select this menu option to upgrade the firmware.

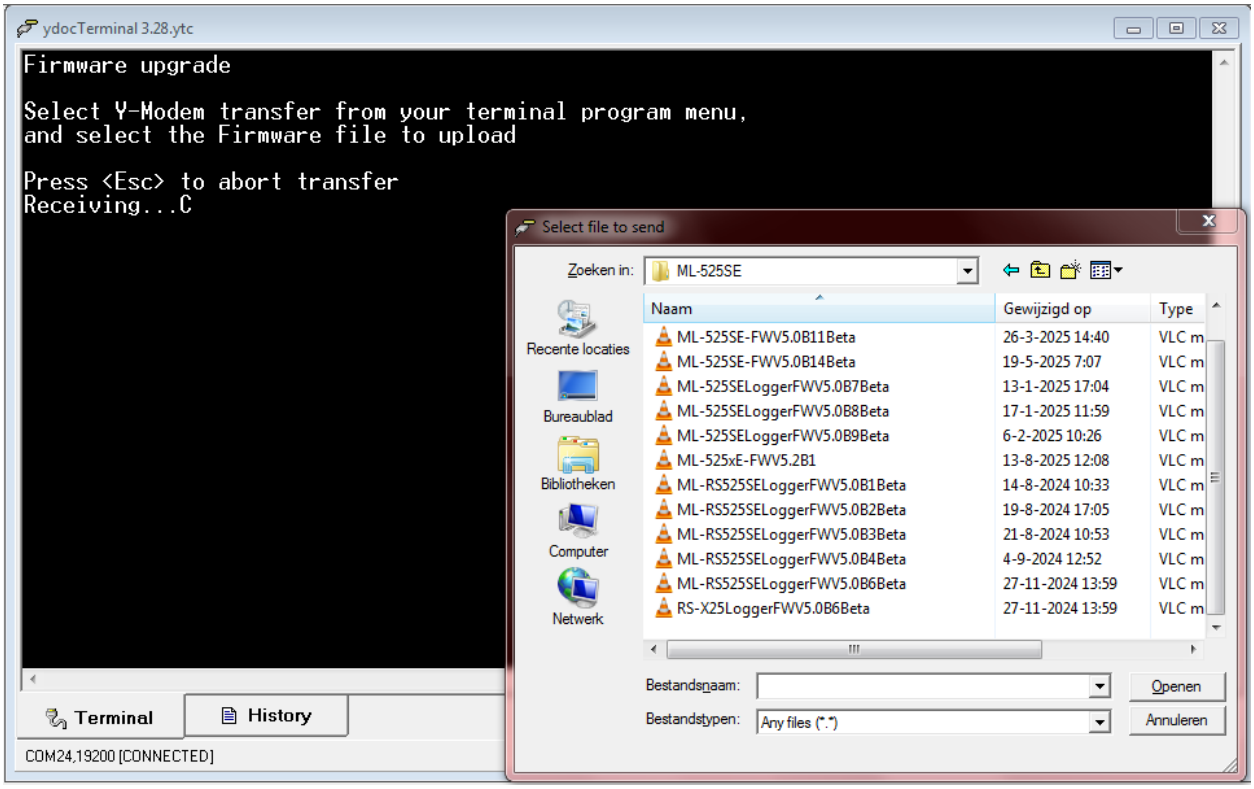
More information on at Firmware upgrades - Fota

Note: *Advice is to keep up with the latest firmware version, bugs are fixed and new features added. When making a support call, first upgrade the Data logger firmware to the latest version and retest if the problem persists.*

```
Firmware upgrade

Select Y-Modem transfer from your terminal program menu,
and select the Firmware file to upload

Press <Esc> to abort transfer
Receiving...
```



Return to [5] Maintenance menu

5.2.15 [5-8] Modem Maintenance

The Data logger modem is equipped with the firmware version from the factory manufacturing date. In case of (modem factory firmware) bug fixes, the (new) modem firmware can be uploaded. The procedure of upgrading modem firmware is not covered in this manual. For more information, consult your local YDOC dealer.

Return to [5] Maintenance menu

5.2.16 [5-9] Bootloader Menu

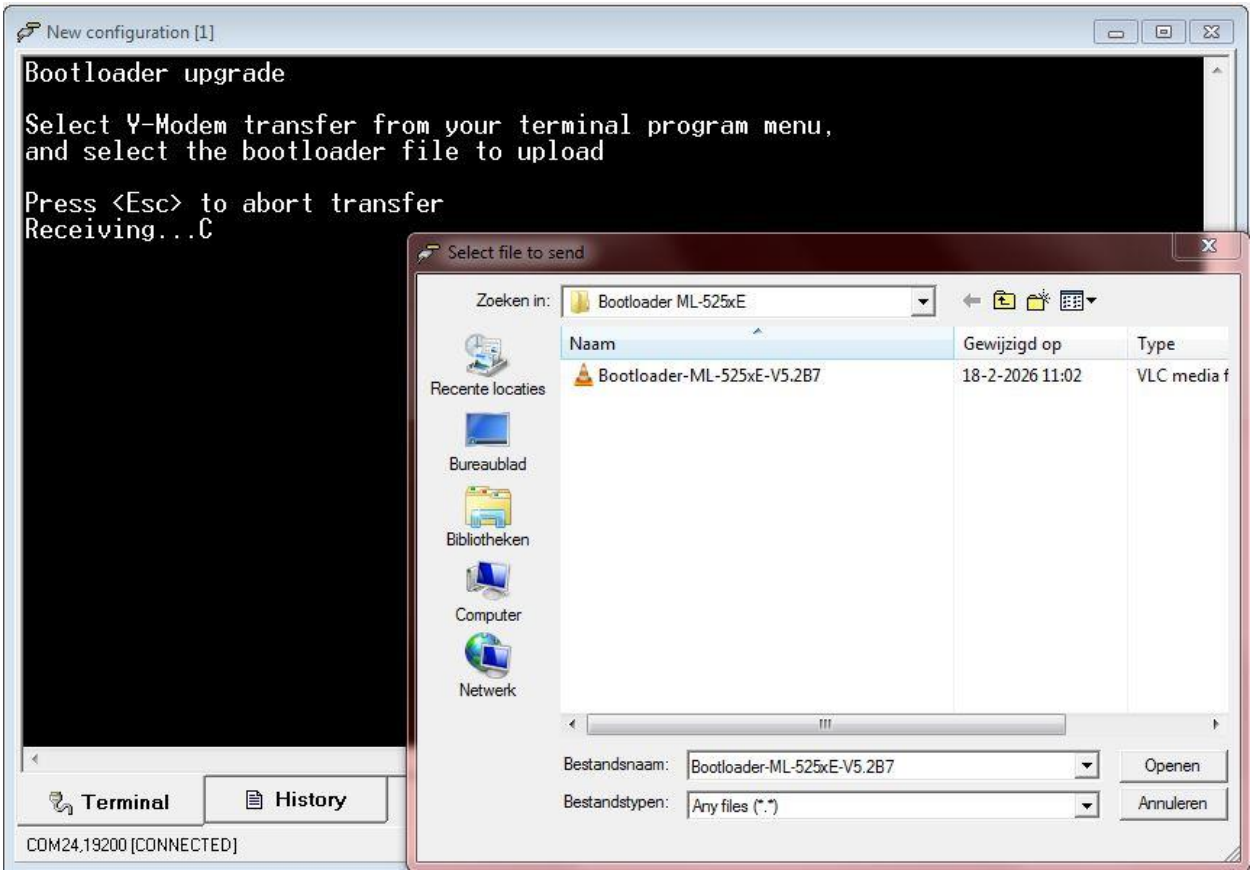
This menu is for expert-use only when the data logger has severe problems.

Return to [5] Maintenance menu

5.2.17 [5-A] Bootloader upgrade

This menu is for expert-use only when the data logger has severe problems.

Warning: *Do not upload a Firmware file with this option, only a special Bootloader file may be uploaded here.*



Return to [5] Maintenance menu

5.2.18 [5-B] Reset option boards

Only the mounted option boards will receive a hardware reset signal, without disturbing the Data logger hardware. (Processor and modem).

Note: *This option can be used while remote connected to the Data logger through the modem.*

```
>
Resetting option boards..........
```

Return to [5] Maintenance menu

5.2.19 [5-R] Reboot

This is a “warm” reboot of the Data logger.

Return to [5] Maintenance menu

6 [6] Users & rights

The User login password is obligatory. Administrator an operator passwords can be used to limit access to user groups.

```
Users & rights

[0] Exit
[1] User login              >> Local (USB)
[2] Administrator password  >> ********
[3] Operator password       >> Not set
[-] Operator rights         >> None
[5] Clear all passwords
>
```

6.1.1 [6-1] User login

The password is protecting the data logger to unwanted access. The default is “Enabled”.

```
>User login (0 = Disabled, 1 = Enabled):
```

Removing password can be done on users responsibility, the data logger can be accessed and configuration changed, without password protection.

```
For safety and security reasons, we recommend keeping password protection
enabled at all times, especially in public or semi-public installations.

Disabling the password protection may only be considered in controlled,
physically secured environments.

You acknowledge and accept responsibility for any security issues
that may arise from disabling this protection.

Are you sure you want to proceed with disabling the local password?
Choose yes/no >
```

Return to Users & rights menu

6.1.2 [6-2] Administrator

An Administrator has all rights, including the right to upgrade the firmware and make changes to the configuration and specify an Operator password.

Note: *When the local Administrator password is forgotten, it can only be reset by executing the “Expert” procedure, described in this FAQ.*

Return to Users & rights menu

6.1.3 [6-3] Operator

An Operator has limited rights as specified by the Administrator. The following rights can be specified:

- Configuration edit
- Parameter edit
- Parameter view
- Data download

- Firmware upgrade

To set passwords: Modify “User login” to local ([1]) and fill Administrator and /or Operator passwords.

Note: *An administrator can chage both Administrator and Operator passwords. An Operator can only change his own (Operator) password.*

Return to Users & rights menu

6.1.4 [6-5] Clear all passwords

Clear all the passwords and User login password.

```
Are you sure to clear all passwords
Choose yes/no >
```

Return to Users & rights menu

7 [7] Logout & run

Logout and return to running mode.
Re-entering maintenance or configuration menu will need to login with the User login password again.

Return to Configuration (main) menu

8 Operating basics

This chapter contains various information.

8.1 Operating basics - Intervals

There are three different (“Normal”) intervals:

1) Sample Interval (Sensor reading)
2) Data Log Interval (Measurement data will be written to the SD card)
3) Send Interval (Send the collected data to a remote system)

8.1.1 Intervals - Sample interval

On the sample interval a measurement from the sensor can be taken. The sample interval is valid ONLY when the Data logger is in the active state. When the Data logger is in sleep-mode, the tasks, triggered by the sample interval will NOT execute, unless the sensor measurement is used in a aggregation channel, scheduled for Alarm (“Continuous Alarm Sampling”) or if a pending alarm is detected and “Alarm set delay” is set to a number of samples.
When not using Alarms or Aggregations, use the default “Data log interval” to take a sample.

8.1.2 Intervals - Data log interval

This interval is ALWAYS valid, when the Data logger is in sleep-mode, it will wake up on “Data logging Interval”. The Data logger will write a measurements to the internal storage (or SD-card). The written records are appended to the stored data file.

The data log interval has two different modes:

8.1.3 Normal mode (Data log interval)

Normal data logging mode, the regular data will be logged



The normal interval must be greater than the alarm interval
and can't be greater than the smallest normal send interval
and can't be smaller than the highest normal sample interval

8.1.4 Alarm mode (Continious alarm mode)

Alarm mode data log interval defines the (often faster) rate of data logging, during alarming conditions



The alarm interval must be less than the normal interval
and can't be greater than the smallest alarm send interval
and can't be smaller than the highest alarm sample interval

8.1.5 Intervals - Independent data logging interval

By default, there is only one data logging rhythm, either following the normal data log interval or the alarm interval. However, for power- or time-consuming serial sensors or accessory port inputs, you can specify a separate, independent data logging interval.



Warning: *Each sensor or input with an independent data logging interval will create its own data log record in the SD storage. As a result, log files may contain multiple records or lines with the same timestamp if they happen to be recorded at the same moment. Additionally, in CSV files, such records or lines may contain empty fields.*

8.1.6 Intervals - Send Interval

The send interval determines the interval on which data is send to a remote system, using the WiFi or the internal modem. This interval is ALWAYS valid, even when the Data logger is in sleep-mode.

8.1.7 Intervals - Example

Let's evaluate the following settings of the Data logger:

- Sample Interval: 5 seconds
- Data Log Interval: 10 minutes
- Send Interval: 3 hours

When the configuration is ready and the USB cable is disconnected:

1. Data logger is switched into sleep-mode, and current draw is reduced to a minimum level.
2. The Sample interval of 5 seconds is discarded (except for special alarming modes), because this interval is only active when the Data logger is NOT in sleep-mode. Nothing happens until the Data log interval has reached his count. (On 0, 10, 20, 30, 40, 50 minutes every hour).
3. On the Data log interval, the Data logger will awake from the sleep mode, take a sample. After the sample is taken and written to the SD storage, the Data logger goes into sleep-mode again. This is repeated, until the time has matched the Send interval. In this example, 3 hours.
4. When Data Send interval is reached, the Data logger will wake-up, and starts to send the previously collected data (stored on the SD storage) to the server. In this example, every 10 minutes a sample is taken, and every 3 hours, 18 samples are send.

Note: *If the USB is connected, the Data logger does not perform any averaging. Even if the sample interval is much faster than the data log interval, only one sample is stored. The user can observe the value's obtained from the sensor in real time. In this case, and evaluate the average values every 5 seconds.*

Return to [3-1] General settings

8.2 Operating basics - Data Formats

There are several data formats available to format the output data.

8.2.1 Data formats - Modifiers

Normally a data value, is recorded without a "Data Modifier", but in case of a malfunction, or rare circumstances, a "Data Modifier" is marking the data is not reliable or missing:

Data Modifier	Description	Remarks
***T**	Timeout	The sensor did not provide the Data logger with a data value, and the timeout has expired. The previous data value is recorded, with the addition of this exception.
***I**	Data Invalid	The Data logger did receive a data value from the sensor, but it was out of boundary. This exception is very rare.
***A**	Alarm Value	The Data logger has received a value, triggering the (alarming) limits of the parameter.

Note: *The "data modifiers" apply to all available data formats.*

8.3 Data formats - Native TXT

The log file exits out of plain text record lines terminated by a carriage return line feed. Record fields are separated with a semicolon and the dot is used as decimal separator.

Every log file starts with two header records, the I- and the L-record. The remainder of the file exists out of multiple D- and/or S-records.

8.3.1 Native TXT - Header records

The I-record provides “information” about the Data logger and has the following syntax:

<’I’> <’;’> <Model><space><FW version><’;’><Name><space><S/N>[<’;’> <IMEI#> <’;’><SIM#>]

Example I-record:

```
I;ML-E417ADS V4.7B2;Station-01 1234567;IMEI 358310512720047;SIM 8931081521098598837
```

This means that the line starts with an ‘I’ character, followed by hardware model with firmware version, Station name with S/N and optional in case of modem transfer IMEI- and SIM-number.

The L-record provides information about the “logged parameters” and has the following syntax:

<’L’> <’;’> [<Parameter Code> <’;’> < Parameter Name > <’;’> < Parameter Unit> <’;’>]

The line starts with an ‘L’ character, followed by the code, name and unit of a logged parameter. These last 3 elements are repeated for each logged parameter.

Example L-record:

```
L;RCi;Rest Capacity;%;PTi;Processor Temperature;C;Vi;Voltage;V;AVGCi;Average
Current;mA;OCi;Operating Cycle;sec;S%;GSM Signal;%;MAXCi;Max Current;mA
```

8.3.2 Native TXT - Parameter code

The abbreviation of the full parameter name, it may be up to 7 characters long.

8.3.3 Native TXT - Parameter Name

The name of the logged parameter, it may be up to 31 characters long.

8.3.4 Native TXT - Parameter unit

The unit representing the physical dimensions of the measurement, it may be up to 15 characters long.

All characters are allowed except ‘;’ this is reserved for the field separator.

8.3.5 Native TXT - Data records

Most of the data is logged into D-records containing (sensor) “data records”.

The syntax of a D-record is:

1. D (Type: data record)
2. <Timestamp> (format: YYMMDDhhmmss)
3. <Parameter code>
4. <Parameter value>
5. [<Data modifier>] (Optional)

<’D’> <’;’>,<Timestamp> <’;’> [<Parameter Code> <’;’> < Parameter Value >[<Data Modifier>] <’;’>]

The D-record consists of a 'D' character followed by a timestamp, one or more series of parameter code and parameter value. The D-record consists of these elements:

8.3.6 Native TXT - Parameter code

The abbreviation of the full parameter name, it may be up to 7 characters long.

8.3.7 Native TXT - Parameter value

A dara record element is formed by the numeric value of the measurement, with optional, a data modifier.

Example Data-record(s):

```
D;250928030200;RCi;95.8;PTi;50.1;Vi;3.6;AVGCi;71;OCi;0.25;MAXCi;71
D;250928030300;RCi;95.8;PTi;49.3;Vi;3.6;AVGCi;71;OCi;0.25;MAXCi;72
D;250928030400;RCi;95.8;PTi;49.5;Vi;3.6;AVGCi;72;OCi;0.25;MAXCi;72*T
D;250928030500;RCi;95.8;PTi;49.1;Vi;3.6;AVGCi;72;OCi;0.25;MAXCi;54
D;250928030600;RCi;95.8;PTi;49.1;Vi;3.6;AVGCi;54;OCi;0.25;MAXCi;72
```

8.3.8 Native TXT - System records

The System-records are used to log system related information. System-records do not contain normal measurements. A system-record is made, when a deviating situation has occurred, for instance, when a sensor is not replying to a request from the logger. System-records are used for monitoring system-performance.

The syntax of an S-record is:

1. S (Type: system record)
2. <Timestamp> (Format: YYMMDDhhmmss)
3. <Suplemental code /text>
4. <Explnatory text>

S;<Timestamp>;<Message code>[;<Supplemental code or text;["<Explanatory text>"]]
So, the S-record consists of an 'S' character followed by a timestamp, and after that, one or more series of parameter code and parameter name.

See Appendix - System messages for a list of possible messages and explication.

Example S-records:

```
S;110922202054;CFG_RESET
S;110922202054;CFG_CHANGED;Brasil_3002389
S;110922202124;MODEM_WDT;STATE 10
```

Note: *Compared to the other data formats and when "YdocInsights" is used as Scada System, the "Native TXT" format has less overhead, resulting in time, power and cost effective data transfer*.

8.4 Data formats - SMS records

Each SMS data record starts with an asterisk, followed by a logger serial number, timestamp and followed by one or more parameter code/value pairs in the same format as with D-record.

Example:

*<logger s/n>;<yyddmmhhmmss;<par code1>;<par value1>;…;<par code_n>;<par value_n>

**5304783;160513140000;TEMP;23.6;LEVEL;3.32*A;BATT;4.2*

8.5 Data formats - JSON

The JSON Data Format contains the same info as our native TXT data format, but is presented in JavaScript Object Notation (JSON) format. This format is preferred by web developers as the data can be easily accessed by JavaScript or other scripting languages like PHP.

The JSON object contained in the file exists out of three main objects

8.5.1 JSON objects - Device

The “device” object has three variables:

1. “sn” a string giving the unique serial number of the logger.
2. “name” a string giving a user chosen name for the Data logger.
3. “v” a string giving the version of the Firmware

```
"device":{"sn":5152860,"name":"Demo 1","v":"2.2B2"},
```

8.5.2 JSON objects - Channels

The “channels” object is an array of objects listing all configured data log parameters, each channel/parameter object has 3 variables:

1. “code” a string specifying the Parameter’s user defined code, e.g. PTi
2. “name” a string specifying the Parameter’s user defined name, e.g. Processor Temperature
3. “unit” a string specifying the Parameter’s user defined unit, e.g. °C

```
"channels":[
{"code":"PTi","name":"Processor Temperature","unit":"°C"},
{"code":"CHx","name":"Channel x","unit":"Unit x"},
{"code":"SB","name":"Signal quality","unit":"bars"},
{}],
```

The “channels” array is, for convenience, terminated by an empty object {}

8.5.3 JSON objects - Data

The “data” object is an array of objects listing timestamped events.

1. A timestamped object always starts with a timestamp variable “$ts”, followed by one or more variables, where a variable can be a logged channel value or a system (error) message.
2. A system message variable is always identified by $msg and a channel variable is always identified by its Parameter code (see: “channels”). Variables not being $msg or not occurring in the “channels” array can be ignored.

The “data” array is, for convenience, terminated by an empty object {} as well.

```
"data":[
{"$ts":160225105846,"$msg":"POWER_ON;ML-215;V2.2B2"},
{"$ts":160225105900,"CHx":”0*T”, “PTi”:23.5},
{"$ts":160225110000,“SB”:4},
{}]
```

$ts is a timestamp formatted as a number yymmddhhmmss
$msg is a string giving some system message (See Appendix ‘System messages’ for a list of possible messages and their meanings). Other variables starting with $ can be added in the future and can be ignored.

Variables NOT starting with $ are considered to be logged channel variables of which the variable name should occur as “code” in the “channels” array.

A channel variable can be a number (the logged value) or a string being the logged value concatenated with a data modifier. See: Data formats - Modifiers.

8.6 Data formats - NMEA

8.6.1 Data output - NMEA-0183

Our custom NMEA sentences have the following format:

```
$<custom sentence identifier>,<s/n>,<ddmmyy>,<hhmmss>
{[,parameter indicator],<parameter value>[,<quality indicator>]}
*<checksum><CR><LF>
```

Date/time fields are in UTC. Parameters marked for Radio output are included in a sentence in their defined parameter order. Each parameter value can optionally be preceded by a parameter indicator (the parameter code) and optionally trailed by a parameter indicator. The possible indicators are: good (G), alarm (A), timeout (T), and invalid (I).

Please find below various examples of a sentence containing temperature (T), humidity (RH), and battery values (BATT).

Without parameter and quality indicators:
```
$YDC,125718987,170424,102724,21.9,41.9,4.22*7A
```

With parameter indicators:
```
$YDC,125718987,170424,102912,T,21.9,RH,41.9,BATT,4.22*10
```

With quality indicators:
```
$YDC,125718987,170424,103204,21.9,G,0.0,I,3.1,A*17
```

With parameter and quality indicators:
```
$YDC,125718987,170424,103332,T,21.9,G,RH,41.9,G,BATT,3.1,A*72
```

Return to [3-C-4] Radio

8.7 Data formats - Compacted Data Format

The compacted data format is meant for use in case of message size constrained or payload expensive communication, like satellite communication.

Compacting is required to get sufficient measurements in a size constrained message or to reduce expensive payload costs.

A common method to compact data is by using algorithms like “zip” and “rar”, but those algorithms are not suitable to compress size constrained messages and would make the payload rather bigger than smaller.

A first stage in compacting, is eliminating data that is not strictly necessary and to include the real interesting data only. The compacted data contains timestamped measurement values only, it does not contain diagnostic data or supportive info like system identifications, parameter codes, names or units.

The compacted format is limited to contain up to 15 logger parameters/channels. As textual parameter codes would use to much data, the identification of the individual channels is based on a number between 1 and 15. Assigning the numbers to individual parameters is a matter of configuration by starting their code names with a capital P followed by a number between 1 and 15. The P will be stripped of, as well as any trailing characters, so you could specify meaning full codes like: P1TMP or P02HUM or P15LEV. Make sure that the number parts are unique.

The compacted data is a binary and unreadable format as representing times and values in ASCII format would take too much space. Storing values as IEEE floats is out of the question either, because every value would take at least 4 bytes, while less bytes would be sufficient in most cases.

The compacted data exists out of time and value records. Each record specifies the delta to the previous corresponding record. So, in case of big numbers (like with time or totalizers) only the first occurrence will take the max required bytes, while consecutive occurrence might need just one byte.

When a time record is specifying a delta of 5 minutes, all value records following will be 5 minutes younger than the ones before. When a value record is specifying a delta of 0 it means that the measured parameter value did not change since the previous measurement.

The starting reference time for each message is 1-jan-2017 00:00:00. The first record in the message will be a time record specifying the difference in time since 1-jan-2017 00:00:00 for the first value records.

The starting reference value is 0.0 for each individual parameter.

Note*: The "Source" of the "Compacted Data" can be identified by the info contained in the encapsulating "Delivery Message" (e.g. the IMEI number of an Iridium Satellite Transceiver). The format and transfer method of the "Delivery Message" is dependent of the used "communication provider" (e.g. an Iridium TCP-direct message).*

8.7.1 Compacted Data Format - Records

A record has a variable length.

8.7.1.1 First byte of record

Bit 7	6	5	4	3	2	1	0
Type of record							

The most significant nibble of the first byte describes the type of record, the least significant nibble is record type dependent. See paragraphs "Time/Value-record" for more details.

The first byte can be followed by zero or more bytes depending on the record type.

8.7.1.2 Number-bytes

The "number"-bytes form an unsigned integer (mantissa), which can be converted to a real number by applying the scaling and sign.

Bit 7	6	5	4	3	2	1	0
Following byte bit	7-bits value * 2^0 (0 to 127)						

Bit 7	6	5	4	3	2	1	0
Following byte bit	7-bits value * 2^7 (128 to 16383)						

Bit 7	6	5	4	3	2	1	0
Following byte bit	7-bits value * 2^{14}						

Bit 7	6	5	4	3	2	1	0
Following byte bit	7-bits value * 2^{21}						

Bit 7	6	5	4	3	2	1	0
0	7-bits value * 2^{28}						

Each “number” byte contains a 7-bits value (0 to 127) and a bit to indicate that another “Number” byte is following or not. If “1” then another 7-bits value is following, which should be multiplied by 128 (2^7) and added up to the first byte, if there is a next byte it should be multiplied by 16384 (2^{14}) etc, etc., until the “following byte” bit is set to “0”. When the “following byte” bit is “0”, then a next record starts unless the end of message is reached.

Number examples:

- 00000001 = 1
- 10000001 00000010 = 1 + (2*128) = 257
- 10000001 10000010 00000011 = 1+(2*128)+(3*16384) = 49409
- 10000001 10000010 10000011 00000100 = 1+(2*128)+(3*16438)+(4*2097152) = 8438017

8.7.1.3 Time-record

Bit 7	6	5	4	3	2	1	0
Type of record=0				Sign	Single byte	Scaling value	

When the most significant nibble of the first record byte equals 0, then the record specifies a change in timestamp for all following value records.

Bit 0 & 1 indicates the scaling of the “Time”-record: 00= Day, 01=Hour, 10=Minute and 11=Second.

Bit 2, When this bit is set to “1” it indicates that there are no “Number”-bytes following this record, the record exists out of just one byte where the value equals to the scaling value (e.g. 1 day). When this bit is set to “0” the delta time is given by the value constructed from the following “Number”-bytes.

Bit 3 is the sign bit and when set to “1” it indicates that the time difference given in this record should be subtracted from the current timestamp and when “0” added to it.

Important: When the sign-bit of the first record in a compacted message is set, the total message should be ignored or processed as a picture (jpg) transfer record. See paragraphs “JPG-header/data-record” for more details.

8.7.1.4 Value-record

Bit 7	6	5	4	3	2	1	0
Parameter number (1 to 15)				Sign	Scaling value		

When the most significant nibble of the first record byte is unequal to 0, then the record is about a value measured at the current timestamp of a parameter with the specified number.

Note: a “Value”-record has at least one following “Number”-byte.

Bit 0,1 and 2 is a 3 bits scaling value (a value between 0 to 7). To get the real number, the integer number, constructed from the following “Number”-bytes, should be divided by 10 to the power of the scaling value. (e.g. 1= divide by 10, 2=divide by 1000).

Bit 3 is the sign bit and when set to “1” it indicates that the given delta value in this record should be subtracted from the current parameter value and when “0” added to it.

8.7.1.5 JPG-header-record

Bit 7	6	5	4	3	2	1	0
Type of record=0				1	0	Scaling value	

The most significant nibble of this record is 0 and can be distinguished from a Time-record, because it can only be a first record in a message with bit 3=1 and bit 2=0.

Bit 0 & 1 indicates the scaling of the “Timestamp”-value of the picture.: 00= Day, 01=Hour, 10=Minute and 11=Second.

The first byte is followed by 5 values (Number-bytes series): Timestamp, Reserved value, Sequence#, File size and CRC16

Timestamp is an integer value representing the time in number of days, hours, minutes or seconds since 1-jan-2017 00:00:00

Reserved value, this value is reserved for future use and should be 0. If not 0 the assembled file should be discarded as it might not be a valid JPG picture.

Sequence# this number is used to be able to correlate JPG-header and JPG-data records belonging to the same JPG-picture. To minimize payload the Data logger will probably wrap this number at value 100.

File size, the size of the file in bytes. This number can be used in your administration together with the sequence# to determine if all messages to assemble a complete picture are received.

CRC16, This values is a CRC16 (same as used for MODBUS/RTU) calculated over all bytes of the file contents.

The JPG-header record will immediately be followed by a JPG-data-record consuming the remaining space of the compacted message.

8.7.1.6 JPG-data-record

Bit 7	6	5	4	3	2	1	0
Type of record=0				1	1	Reserved	

The most significant nibble of this record is 0 and can be distinguished from a Time-record, because its directly following a JPG-header-record or it’s the first record in a message. It has bit 3 2 set to 1.

The first byte is followed by 2 values (Number-bytes series) : Sequence# and File position

Sequence# this number is used to be able to correlate JPG-header and JPG-data records belonging to the same JPG-picture.

File position, this value indicates the position in the file where the data bytes should be written to.

Data bytes, the File position value is followed by picture data bytes up to the end of the compacted message.

8.8 Data formats - Sparkplug-B Data format (V1.0)

Sparkplug™ provides an open and freely available specification for how Edge of Network (EoN) gateways or native MQTT enabled end devices and MQTT Applications communicate bi-directionally within an MQTT Infrastructure.

This chapter details how Sparkplug™ can be deployed with YDOC Data loggers as EoN Nodes.

Because Sparkplug defines a dedicated topic namespace, all other topics used by the Data logger can coexist, not jeopardising the native features like remote configuration update, firmware upgrade, etc.

As well, this chapter details how you can specify ‘group_id’, ‘edge_node_id’, ‘Metrics’ and ‘Properties’, where its assumed that the reader is already familiar with how to configure an YDOC Data logger.

8.8.1 Sparkplug B - Configuring MQTT

How to configure the MQTT-driver is already described in a previous chapter, so only the items concerning Sparkplug-B will be detailed.

```
MQTT settings

[0] Exit
[1] Name                    >> sp-grp-x
[2] Send interval           >> 01:00:00
[3] Send delay              >> Not used
[4] Server                  >> m21.cloudmqtt.com
[5] Port                    >> 22656
[6] Security                >> SSL/TLS
[7] Username                >> sp-user-y
[8] Password                >> ******
[9] Root topic              >> YDOC/5025064
[-] Omit subtopics          >> N/A
[B] Client ID               >> 359180082361087
[C] Clean session           >> No
[D] Data output             >> Log data
[E] Data format             >> Sparkplug B
[F] Max payload             >> 1000 kB
[G] Data filter             >> Data & Diagnostics
[H] NDATA QoS               >> 1
[P] Input parameters        >> 0
[R] Remove
[T] MQTT test               >> Passed
>
```

8.8.2 Sparkplug B - Name (Group_id)

The name of the driver is used as a place holder for the Sparkplug group_id. In example, if you specified “sp-grp-x” as name, the topic namespace for the NBIRTH and NDATA messages will be generated as follows: “spBv1.0/sp-grp-x/message_type/edge_node_id”.
(The Name or Group_id can hold 31 characters).

The “edge_node_id” is substituted by the name you specified for the Data logger under “General settings”. This name can only be entered manually and will not be overwritten by a future configuration update. *(The edge_node_id can hold 31 characters).*

When no name for the Data logger is specified the unique serial number of the Data logger will be taken as “edge_node_name” and the generated topic namespace would look similar to:

“spBv1.0/sp-grp-x/message_type/5025064”

Return to Sparkplug-B Configuring MQTT

8.8.3 Sparkplug B - Root topic

As Sparkplug works with a dedicated topic namespace, the “root topic” of this driver is of no concern to the Sparkplug feature and can be ignored.

Return to Sparkplug-B Configuring MQTT

8.8.4 Sparkplug B - Data output

At regular intervals the Data logger connects with the server to transfer its readings and depending on the applications and/or power constrains it can be any minute, once a day or something in between. The Data logger can be instructed to send just the last known values (actual values) or the total history recorded between now and the previous succeeded transfer session (log data).

In case of “Actual Values” only, the Data logger will publish an NBIRTH message with the last know values and gracefully disconnect from the server.

In case of “Log Data”, the Data logger will first publish an NBIRTH message with the last know values along with their “aliases” and followed by one NDATA message containing the total history recorded between now and the previous succeeded transfer session. “Aliases” are used to keep the payload limited in size.

Return to Sparkplug-B Configuring MQTT

8.8.5 Sparkplug B - NDATA QoS

NDATA QoS is selectable on Sparkplug B data output.

Return to Sparkplug-B Configuring MQTT

8.9 Operating basics - Parameter settings

All through the configuration-settings of the Data logger, you will encounter parameters to setup your logger. They are used on all ports (analog, digital, serial) and are generic in use. This section describes the use and properties of parameters.

Note: *To configure alarm options [G..M],set parameter [E] "Alarm log" to "On" first.*

```
Parameter settings

[0] Exit
[1] Name                    >> Average voltage
[2] Code                    >> AVGVi
[3] Unit                    >> V
[4] Initial value           >> 0
[5] Value factor            >> 1
[6] Value offset            >> 0
[7] Decimals                >> 2
[8] Data log                >> On
[9] Data output             >> Modem
[A] Boundary control        >> None
[B] Low boundary limit      >> N/A
[C] High boundary limit     >> N/A
[D] Alarm message           >> Disabled
[E] Alarm log               >> On
[F] Alarm output            >> Disabled
[G] Low-low alarm limit     >> N/A
[H] Low alarm limit         >> N/A
[I] High alarm limit        >> N/A
[J] High-high alarm limit   >> N/A
[K] Alarm set delay         >> 0 samples
[L] Alarm reset hysteresis  >> 0.5 Volts      (Example, real level in "Volts")
[M] Alarm reset delay       >> 0 samples
>
```

Return to [3-7] Analog inputs

8.9.1 [<param>-1] Name

A appropriate name for the parameter (Example physical parameter name "Averige voltage"). Maximum parameter length for "Name" is 23 characters.

Return to Operating basics – Parameter settings

8.9.2 [<param>-2] Code

A short alphanumeric code to designate the parameter. This code will be used in the data files. Maximum parameter length for "Code" is 11 characters.

Example: *parameter code AVGVi.*

Return to Operating basics – Parameter settings

8.9.3 [<param>-3] Unit

The unit of the physical parameter (Example parameter unit "V", for Volts)

Return to Operating basics – Parameter settings

8.9.4 [<param>-4] Initial value

This is the value assigned to a parameter at re-boot. This value has is importance for parameters that are not immediately sampled after re-boot. The initial value can also be used as a literal /reference value in calculation channels.

Return to Operating basics – Parameter settings

8.9.5 [<param>-5] Value factor

Multiplier to transform the sensor output signal into a real-life value. Default is 1.

Example in math: *F(x) = ax+b, where "a" equals the value factor).*

Note: *Value factor can hold 9 digit resolution.*

Return to Operating basics – Parameter settings

8.9.6 [<param>-6] Value offset

Also to transform the electrical signal into a real life value, but now an addition to the default value. (Default = 0).

Example in math: *F(x) = ax+b, where "b" equals value offset. This is very convenient while using 4..20 mA sensor, because they introduce an "zero offset". (4mA must represent 0 "units").*

Note: *Value offset can hold 9 digit resolution.*

Return to Operating basics – Parameter settings

8.9.7 [<param>-7] Decimals

The numeric precision of the value, displayed and stored on the SD card.

Note: *The precision does not represent the real-life sensor precision, it is the numeric presentation of the measured sensor value.*

Return to Operating basics – Parameter settings

8.9.8 [<param>-8] Data log

Setting which enables the storage of the parameter to the SD card. When set to off it will be measured and displayed, but NOT stored on the SD card. Default set to "ON".

Return to Operating basics – Parameter settings

8.9.9 [<param>-9] Data output

Specify the data output mode for this parameter, the default is output by cellular Modem.

Note: *Parameter output can be send to the Alarm port. With additional option boards installed, the parameter output applies also to WiFi, ML-OO-MODBUS slave or ML-OO-SW output board.*

Note: *The modem output can be configured for multiple protocols: TCP, MQTT, FTP, HTTP, E-mail (and SMS).*

Return to Operating basics – Parameter settings

8.9.10 [<param>-A] Boundary control

If enabled you can specify boundary limits for the parameter and indicate if values should be clipped to the specified boundaries or skipped and invalidated when outside the specified bou ndaries.

Note: *Boundaries are mutual exclusive with LoLo & HiHi alarm limits.*

Return to Operating basics – Parameter settings

8.9.11 [<param>-B] Low boundary limit

Define the low boundary limit. If the sensor value is below the “Low boundary limit” value, it will be minimized to the “Low boundary limit” value.

Return to Operating basics – Parameter settings

8.9.12 [<param>-C] High boundary limit

Define the high boundary limit. If the sensor value is exceeding the “High boundary limit” value, it will be maximized to the “High boundary limit” value.

Return to Operating basics – Parameter settings

8.9.13 [<param>-D] Alarm message

Enable sending an alarm message on this parameter. (When triggering the alarming condition).

Note: *Alarm messages are only send using SMS (Check your SIM card prescription), E-mail or MQTT.*

Return to Operating basics – Parameter settings

8.9.14 [<param>-E> Alarm log

Setting which enables the storage of the alarm condition of the parameter to the SD storage. When set to on it will store an unscheduled data log in a single data record, and the passing of the alarm limits in a system record.

Return to Operating basics – Parameter settings

8.9.15 [<param>-F] Alarm output

Setting which sets or clears the digital alarm output port when the selected alarm limit is passed (Low, High or both).

Return to Operating basics – Parameter settings

8.9.16 [<param>-G..J] Alarm limits and delays

Within every parameter settings menu, the user can define all limits and delays to customize his alarming mode.

More information at Operating basics - Alarming

Return to Operation basiscs – Parameter settings

8.9.17 [<param>-K] Alarm set delay

Number of data samples to wait (if the alarm situation remains) and raise the alarm.

Return to Operation basiscs – Parameter settings

8.9.18 [<param>-L] Alarm reset hysteresis

Value (real “Units”) on which the alarm is reset.

Return to Operation basiscs – Parameter settings

8.9.19 [<param>-M] Alarm reset delay

Number of data samples to wait (if the alarm situation has been reset) and clear the alarm.

Return to Operation basiscs – Parameter settings

8.10 Operating basics - Alarming

When a Data logger is running, and a measurement is out of boundary, the Data logger will immediately switch over to the alarm interval. So, the first-time an out of boundary-value will be detected is at the normal interval and from this moment on, the Data logger will increase its interval to the alarm interval. The “alarm sample delay” determines what happens next. If this value is equal to zero, action is taken immediately. If the interval delay is 1, the logger will wait for one more sample before taking action. If the alarm interval delay is 2, it will take 2 samples, etc.
When the alarm-state is entered, the Data logger will add the ‘*A’ data modifier to the data-records. The user has the following options for the requested action:

1) Alarm log (log an alarm level)
2) Alarm message (SMS, E-mail or MQTT)
3) Direct log data output on alarm (HTTP, E-mail, FTP, TCP or MQTT)
4) Activate alarm output.

So, when the conditions of alarming are met (data value out of bounds and the alarm sample delay is counted down) one or more of these actions can take place.

Note: *The alarm log is a log of synoptically data into an S-record. The data modifier *A is automatically placed into the D-records.*

More information at Operating basics – Data modifiers

8.10.1 Alarming - Advanced alarming

Alarm situations are evaluated, only when the Data logger is awake to perform a task, typically a data log cycle.

From firmware-version V2.1B1 and above, we implemented an extended alarming feature that enables the use of calculated channels. This feature was implemented to calculate meaningful engineering values derived from raw sensor input values, however they could also be used for advanced alarming using multiple input conditions. It was already possible to raise an alarm (SMS or trigger a digital output) on exceeding of configured limits for a single input value (e.g. alarm to warn for reservoir overflow). By using calculated channels, it is now possible to alarm on a combination of input values.

Example:

Assume an open water reservoir for irrigation purpose and you want to be warned when the water in the pond falls below a certain level or when the water level reaches the edge of the reservoir. But why ring any bells if the pond level is just falling below the warning level (due to vaporization) while there is no demand for water or why alarm when water is just over a high limit (due to precipitation) while there is no forced supply.

To avoid unnecessary level alarms, you could define a calculated channel with the following equation:

ALARMLEVEL = gt(:FLOWIN; 0; :LEVEL; gt(:FLOWOUT; 0; :LEVEL; LEVELOK))

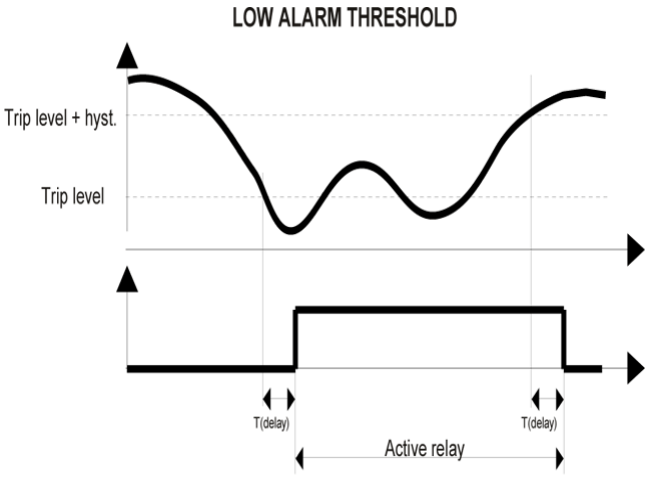
Where:
gt(a; b; c; d) is a function that returns the value c when a>b otherwise it returns d.
:FLOWIN is the monitored supply flow or a digital switch indicating an open valve/floodgate
:FLOWOUT is the monitored demand flow or a digital switch indicating an open valve/floodgate
:LEVEL is the monitored level in the pond
LEVELOK should be substituted by a level value that does not ring any bells, a pond level somewhere between low and high limit.

ALARMLEVEL is the defined calculated channel, which will be set to the same value as :LEVEL when there is a supply (:FLOWIN > 0) or demand (:FLOWOUT > 0) flow, else it will return a level that does not ring any bells (LEVELOK value).
Instead of setting low /high limits to :LEVEL you should set the warning limits to the ALARMLEVEL channel.

In some circumstances, normal data-logging is not sufficient for managing your process. For keeping track of certain, often critical, conditions, the Data logger is equipped with direct alarming options. Alarming-limits and hysteresis are used to manage these special events. The table shows the different types of alarming-limits.

Alarm Limit	Description	Remarks
Low-Low	Alarm level for lowest value	This alarm level is reached when the Data logger encounters a value which is lower than the low-low Limit, this is the 2nd and most urgent state of alarming. This type of alarming is used for very rare and critical conditions. (often called STOP level)
Low	Alarm level for low value	This alarm level is reached when the Data logger encounters a value which is Lower than the Low Limit, but Higher than the Low-Low Limit. This is the first stage of alarming. (often called WARNING level)
High	Alarm level for high value	This alarm level is reached when the Data logger encounters a value which is higher than the high Limit, but lower than the High-High Limit. This is the first stage of alarming. (often called WARNING level)
High-High	Alarm level for highest value	This alarm level is reached when the Data logger encounters a value which is higher than the high-high Limit, this is the 2nd and most urgent state of alarming. This type of alarming is used for very rare and critical conditions (often called STOP level).

8.10.2 Adavanced alarming - Hysteresis

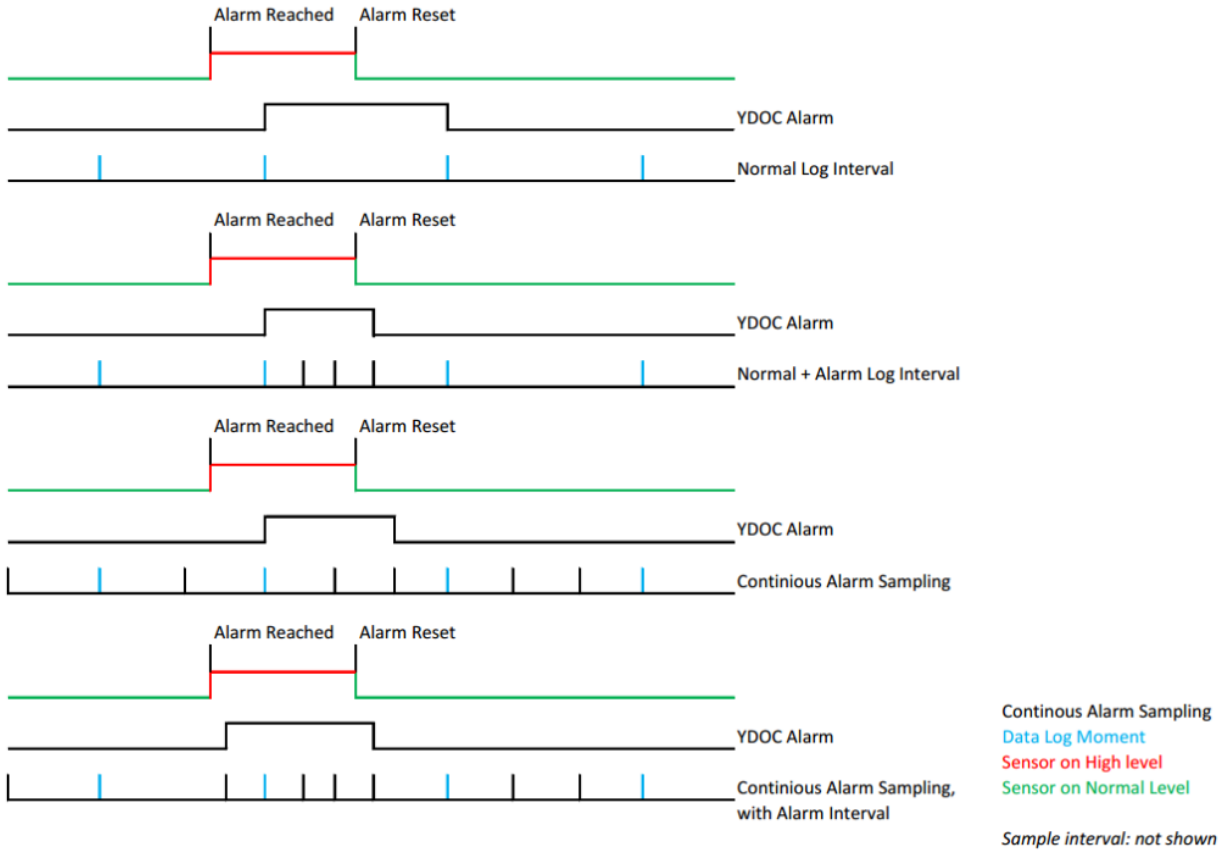


The entry of an alarm state is NOT affected by a hysteresis. Entering a alarm depends on the sensor reading moment Hysteresis is used exclusively to switch back to normal mode. The level of hysteresis influences the sensitivity of the alarm system, reducing messages on the rapid, repeated alarms. Introducing a certain level of hysteresis is strongly recommended to stabilize alarming by preventing

premature 'resolved' messages from quickly being followed by new alarm triggers. The optimal amount of hysteresis is typically determined based on experience with a given application. Additionally, the return to normal mode can be further delayed by waiting for a few additional samples.

8.10.3 Advancced alarming - Alarm timing

This sheet shows the behaviour of the Normal and Alarm log intervals in conjunction to switching on and off an alarm.



8.11 Operating basics - Analog inputs

8.11.1 Analog inputs - Differential input ports theory of operation

Differential inputs are very convenient for measuring differential or floating signals. The performance of a differential input is much better than a normal, single ended one, especially with small mV signals. Therefore, the differential inputs are very suitable for measuring load cells, pyranometers and other low-level mV output sensors. A differential input consists of a negative (-) and a positive (+) input. The voltage difference between these two inputs is the signal to be measured.

8.11.2 Analog inputs - Common mode noise rejection

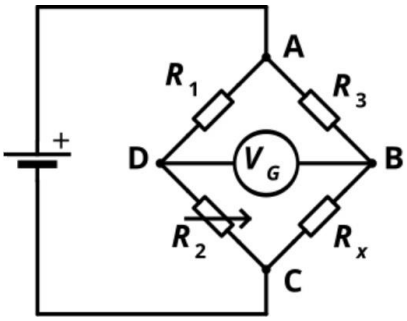
One of the major advantages over a single ended input is the common mode noise rejection. It “removes” practically all noise that is present on the input signal. Especially with long cables, noise is always present on the leads. Since the input acts like a differential amplifier, the noise on the negative input is subtracted from the noise on the positive input. What is left is the sensor-signal.

8.11.3 Analog inputs - Using load cells

The ML-x17 when equipped with differential inputs is very suitable for connecting load cells and other resistive elements. A load cell acts as a bridge of Wheatstone and is a very sensitive and precise passive component.

8.11.4 Analog inputs - Wheatstone bridge

The bridge of Wheatstone (the principle of operation of a load cell) is a circuit, consisting of 4 resistors. This circuit consist a measure tree (A-D-C) and a compensating tree (A-B-C). On D-B the result signal can be measured. The signal is zero when the trees are balanced.

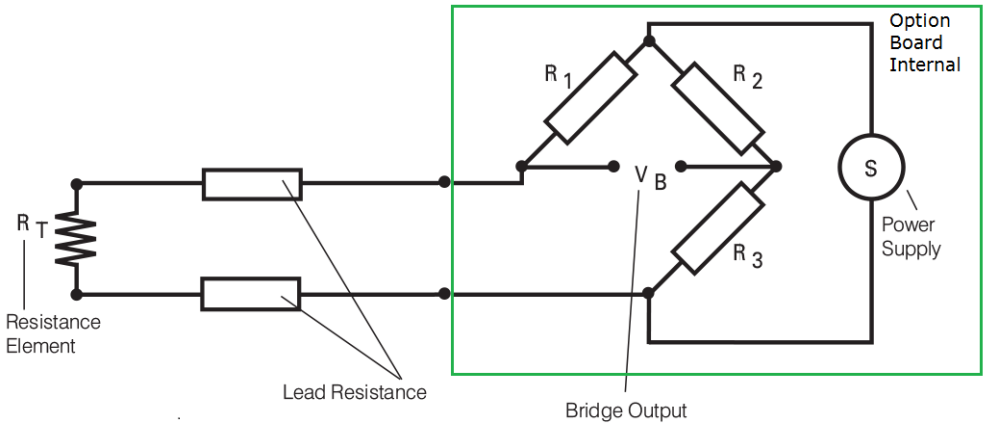


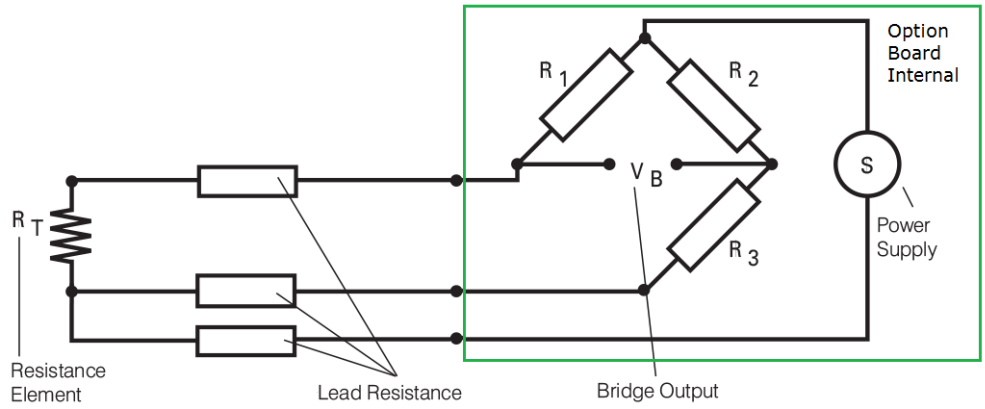
Return to [3-7] Analog inputs

8.11.5 Analog inputs - PT1000 - 2 or 3 wires

The ML-OI-AD-PT1000 board provides two PT1000 temperature sensor inputs using a “bridge of Wheatstone” measure the resistance to accurately. Because sensing is resistance based, any deviations in cable resistance in the loop will affect the reading. Cable resistance can be ruled out by using 3 wires instead of 2 and setting the board jumpers accordingly.

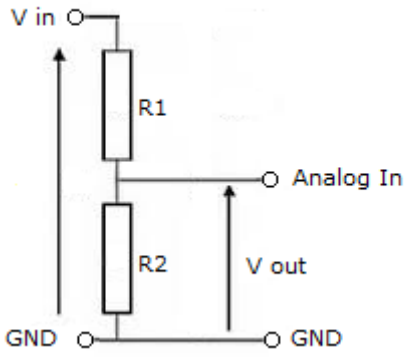
Note: *Check and check the selection jumper for the chosen configuration.*





8.11.6 Analog inputs - Voltage divider

When a voltage is out-of-range for a analog (option board) input on the Data logger, a voltage divider can be used to lower the voltage.



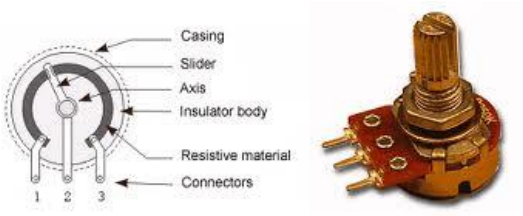
Note: *More info and a calculation example can be found in this FAQ.*

8.11.7 Analog inputs - Potentiometers

Potentiometer sensor type input is supported. A potentiometer is a variable voltage divider.
Connect the potentiometer (See example) between the 2048 mV (1 to X1-8), Output (2 to X1-7) and Ground (3 to X1-5) terminals. All types and all values of potentiometers are supported.
A potentiometer output value is reading 0..100% and can be re-scaled to engineering values in the parameter setup.

Warning: *Although all values are supported,we strongly recommend to use high values only. This is because the lower values are draining more power from the Data logger. Values between 100K and 4M7 are recommended.*

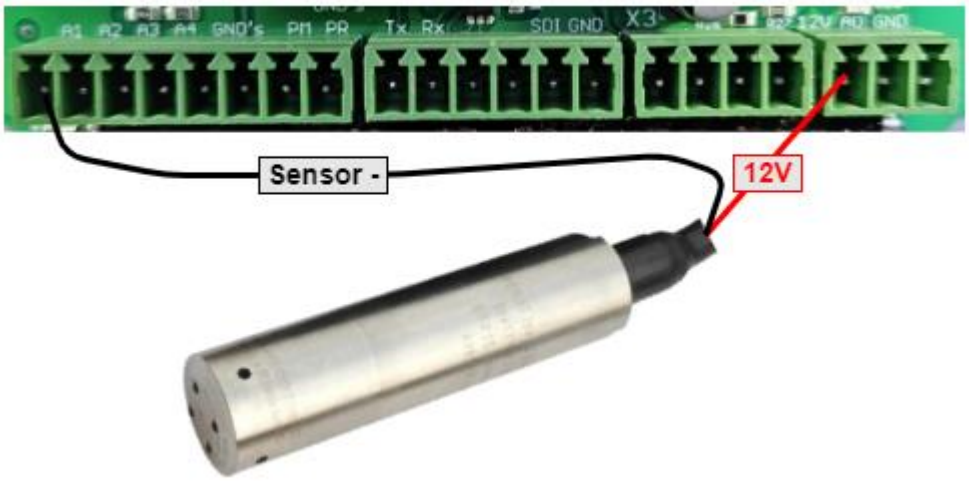
Example:



More info *and a calculation example can be found in this FAQ.*

8.11.8 Analog inputs - Loop Powered Devices

Some loop powered devices don't need an external power supply, but draw their power from the current loop. The example below is showing how this type of sensors can be connected to the switched sensor power connector into the Data logger.



Return to [3-7] Analog inputs

8.11.9 Analog inputs - Calibration

To get the best accuracy from your analog inputs we recommend to perform a two point user calibration . When a two point calibration is not feasible due to the nature of the input source, we recommend to do a 1 point calibration. If a one point calibration is not feasible either, perform a zero-calibration.

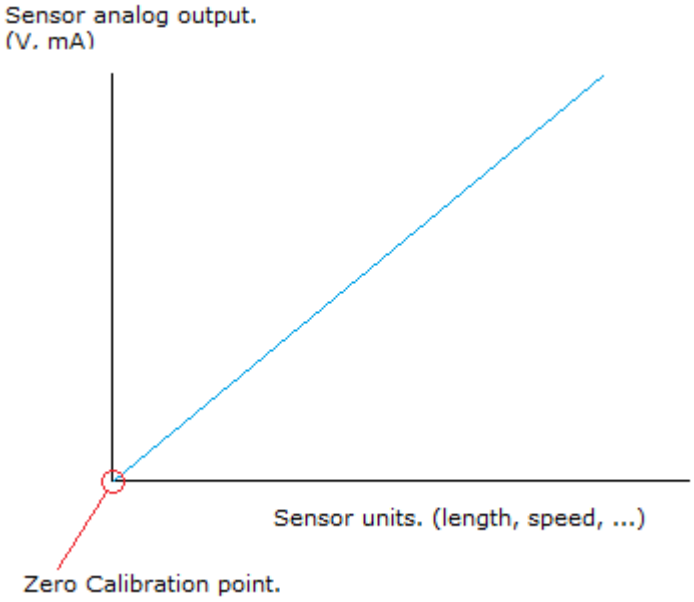
Analog sensor devices will generate a linear output voltage or current, representing the measured units. (This will form a line, from sensor output). The slope of the line is defined by two points.

8.11.10 Analog inputs - Zero calibration

This procedure will calibrate the “Zero” point.

- Specify the correct theoretic range of your sensor in the parameter settings.
- Disconnect your sensor.
- For single ended inputs connect the input to ground, for differential inputs short-cut the two differential inputs and connect to the ground.
- Perform a 1 point calibration.
- For the calibration point enter the expected physical value when the sensor output signal is zero.

Example: *Zero point calibration.*



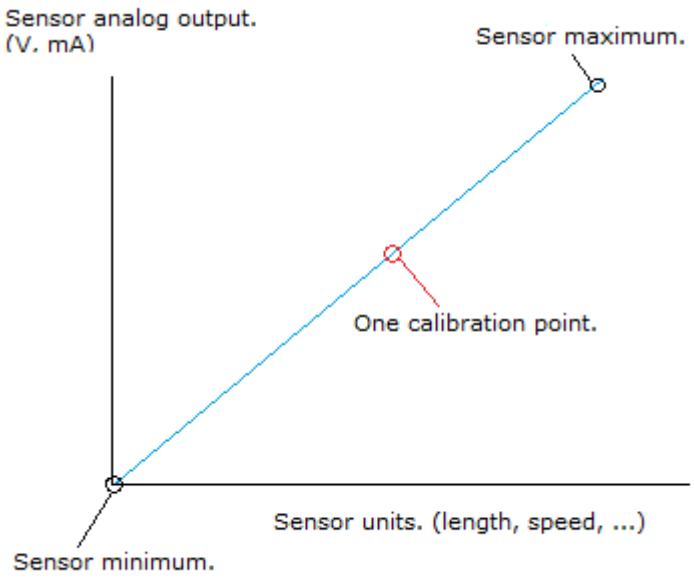
8.11.11 Analog inputs – Zero offset (or null point) calibration

The ML-OI-AD-80MV has an offset of approximately 150 µV, which can be negated by performing a null-point calibration using a short circuit between the differential inputs.

8.11.12 Analog inputs - 1 point calibration

This features is an automated calibration function for the offset only. First, set the specified theoretic correct range. (These points define the “slope” of the linear line). A measure is taken on one physical value of the range. (Calibration point). The measurement corrects the defined, theoretical line.

Example: *One point calibration.*

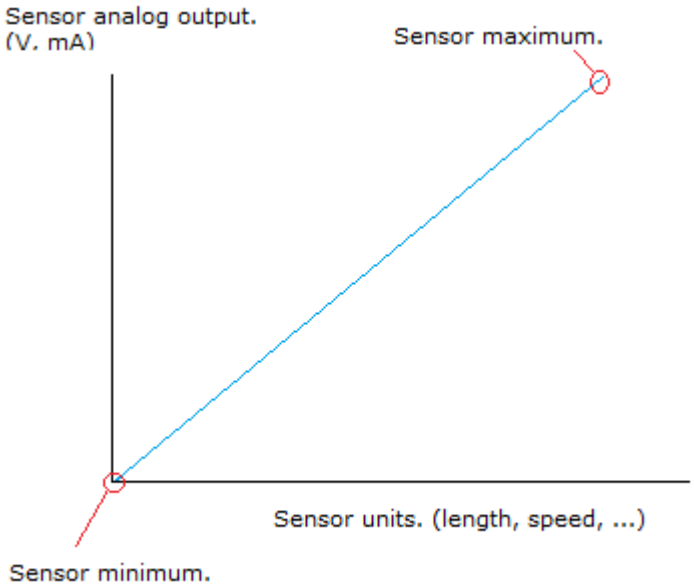


8.11.13 Analog inputs - 2 point calibration

This features is an automated calibration function for the slope and two real points on the linear line. Two measures are taken to calibrate these values of the range. (Calibration points). The measurements define the line.

Note: *A precision power source (Voltage or current) can be used to calibrate these points without sensor.*

Example: *Two point calibration.*



8.11.14 Analog inputs - PT1000 calibration

To calibrate the PT1000:

- Perform the 2 points calibration method.
- On the “0” input, perform the above described “zero offset calibration” (using a short circuit to the between the differential inputs).

More info at Analog inputs – PT1000 2 or 3 wires

8.12 Operating basics - Derived channels (Calculations)

8.12.1 Calculations - Supported mathematical functions with one argument:

8.12.1.1 abs(x)
returns the absolute value of x
Example: abs(-10.7) returns 10.7

8.12.1.2 sqrt(x)
returns the square root of x

8.12.1.3 ln(x)
returns the natural logarithm of x

8.12.1.4 exp(x)
calculates the exponent of e to x

8.12.1.5 log(x)
returns the base 10 logarithm of x

8.12.1.6 sin(radians)
returns the sinus of radians

8.12.1.7 cos(radians)
returns the cosine of radians

8.12.1.8 tan(radians)
returns the tangent of radians

8.12.1.9 asin(x)
returns the arc sinus of x in radians

8.12.1.10 acos(x)
returns the arc cosine of x in radians

8.12.1.11 atan(x)
returns the arc tangent of x in radians

8.12.1.12 torad(degrees)
converts degrees to radians

8.12.1.13 todeg(radians)
converts radians to degrees

8.12.1.14 floor(x)
returns the largest integer not greater than x, e*xample: floor(10.7 returns 10*

8.12.1.15 ceil(x)
returns the smallest integer not less than x, example: ceil(10.3) returns 11

8.12.1.16 round(x)

rounds to the nearest integer

8.12.2 Calculations - Supported mathematical functions with multiple arguments:

8.12.2.1 atan2(x;y)

return the arc tangent of x/y

8.12.2.2 mod(x;y)

return the reminder of x/y

8.12.2.3 pow(x;y)

returns x to the power of y

8.12.2.4 clip(x;min;max)

returns x clipped between min & max

Example: clip(5;0;100) returns 5
Example: clip(-10;0;100) returns 0
Synonym: If(x<min) return min; Else if(x>max) return max; Else return x

8.12.3 Calculations - Supported comparisons with 2 arguments:

8.12.3.1 lt(x;y)

returns x if x smaller than y else return y
Example: lt(10;11) returns 10; Synonym: If (x<y) return x; else return y

8.12.3.2 le(x;y)

returns x if x smaller or equal than y else return y
Example: le(10;11) returns 10; Synonym: If (x<=y) return x; else return y

8.12.3.3 gt(x;y)

returns x if x greater than y else return y
Example: gt(10;11) returns 11; Synonym: If (x>y) return x; else return y

8.12.3.4 ge(x;y)

returns x if x greater or equal than y else return y
Example: ge(10;11) returns 11; Synonym: If (x>=y) return x; else return y

8.12.4 Calculations - Supported comparisons with 4 arguments:

8.12.4.1 eq(x;y;q;p)

returns q if x is equal to y else return p
Example: eq(10;11;0;3) returns 0; Synonym: If (x==y) return y; else return p

8.12.4.2 lt(x;y;q;p)

returns q if x smaller than y else return p
Example: lt(1;2;3;4) returns 3; synonym: if(x<y) return q; else return p

8.12.4.3 le(x;y;q;p)

returns q if x smaller or equal than y else return p
Example: le(1;2;3;4) returns 3; synonym: if(x<=y) return q; else return p

8.12.4.4 gt(x;y;q;p)

returns q if x greater than y else return p
Example: gt(1;2;3;4) returns 4; synonym: if(x>y) return q; else return p

8.12.4.5 ge(x;y;q;p)

returns q if x greater or equal to y else return p
Example: ge(1;2;3;4) returns 4; synonym: if(x>=y) return q; else return p

8.12.5 Calculations - Supported comparisons with 5 arguments:

8.12.5.1 bt(x,a,b,y,z)

returns y if x lies between a and b else return b
Example: bt(1;2;3;4;5) returns 5, synonym if ((x>a) & (x<b)) return y; else return z

8.12.6 Calculations - Supported bitwise functions with 2 arguments

These functions accept two arguments which are both converted to discrete unsigned values on which bitwise operations are performed and the result returned as a number. These functions can be handy when controlling ML-OO-SW output switches (all bits 0 will cause a break, one bit set a make).

8.12.6.1 and(x;y)

returns the bitwise result of x AND y
Example: and(1;3) returns 1;

8.12.6.2 or(x;y)

returns the bitwise result of x OR y
Example: or(1;3) returns 3;

8.12.6.3 xor(x;y)

returns the bitwise result of x XOR y
Example: xor(1;3) returns 2;

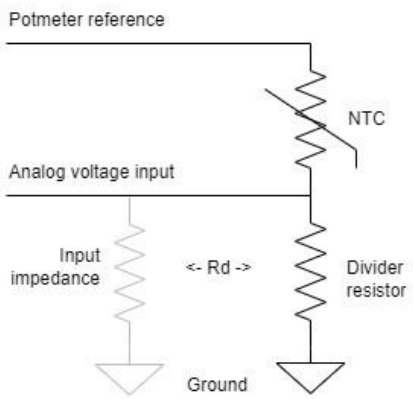
8.12.7 Calculations - Supported empirical formulas

A list of implemented empirical formula's:

8.12.7.1 ntc(Vin[;R0[;Rd[;B[;D]]]])

returns the temperature calculated from the voltage drop measured across a divider resistance in a voltage divider configuration with an NTC thermistor.

The thermistor should be connected between the 2048 mV potentiometer reference output and an analog voltage input, preferably the potentiometer input. Set the potmeter parmeter to 0..2048 mV instead of 0..100%



A divider resistor should be connected between the analog voltage input and ground. It is recommended that this resistor has approximately the same resistance as the NTC thermistor.

The formula accepts 1 to 5 arguments.

Vin, the measured voltage drop across the divider resistance.
R0, the nominal resistance of the NTC (default 10kohm).
Rd, the value of the divider resistance (default 10kohm).
B, the so called B-Value of the used thermistor (default 3950).
D, the self-heating dissipation constant of the used thermistor in mW/°C (default 2).

Tips to increase the accuracy of temperature measurements:

1. Choose a high-accuracy NTC thermistor, ideally with 0.1% tolerance.
2. Enter the exact divider resistance: Calculate the exact divider resistance, taking into account the input impedance of the system. If the input impedance of the measurement circuit is high (e.g., the potentiometer input), it can often be neglected. However, this is not true for lower impedance analog inputs, which need to be considered. To measure the divider resistance accurately, temporarily replace the NTC with a precise resistor (0.1% tolerance, labeled R1) and measure the voltage across the divider resistor. The formula to calculate divider resistance Rd is: *(VRd * (R1 + 150Ω)) / (2048 mV - VRd)* where 150 Ω is the internal protection resistor in series with the reference voltage. The voltage can be measured with the Data logger [T] test function.
3. Optionally optimize the divider resistance: Select a divider resistor value so that the divider resistance corresponds to the value of the NTC thermistor at the midpoint of the temperature range of interest.
4. Enter the correct B-Value as provided by the manufacturer.
5. Enter the correct dissipation factor as provided by the manufacturer.

8.12.7.2 wc(t;v)

Returns the wind chill factor calculated from ambient temperature in °C and wind speed in m/s

8.12.7.3 dp(t;rh)

Returns the dewpoint calculated from ambient temperature in °C and relative humidity in %

8.12.8 Calculations - Functions

There are various supported functions:

8.12.8.1 pi

Returns 3.1415926

8.12.8.2 time

Returns seconds since midnight local time. *Example: 43200 is 12:00:00 and 86399 is 23:59:59*

8.12.8.3 day

Returns number of days since 1 Januari of the current year.

8.12.8.4 wday

Returns number of days since the start of the current week. *(Sunday .. Saturday is represented by 0 .. 6)*

8.12.9 Calculations - Parameter attributes

A parameter code can be trailed with an attribute code to use the value of the concerned attribute instead of the last measured value of a parameter.

8.12.9.1 Alarm limits

Limit atributes: .LOLO, .LO, .HI, .HIHI, .HYS, .ALR

The attribute codes for the alarm limits are .LOLO, .LO, .HI, and .HIHI. The alarm hysteresis is provided by the .HYS attribute. The .ALR attribute can be used to check the alarm status of a parameter, so you don't have to evaluate the hysteresis and various alarm levels to determine if a particular parameter is in alarm itself. The attribute value is assembled from 4 bits where bit0=LOLO, bit1=LO, bit2=HI and bit3=HIHI indicates the various alarm limit violations.

8.12.9.2 Initial value

Initial attribute: .IV

This is the value assigned to a parameter at re-boot. The initial value can be used with .IV attribute as a literal /reference value in calculations. The outcome of the calculations can be manipulated remotely by sending a configuration snippet altering the initial value.

Note: *More info at MQTT - Configuration snippets*

8.12.9.3 Age

Age attribute: .AGE

When an input value is acquired successfully it will be timestamped, you can use the .AGE attribute to check the age of a value in seconds since the last valid acquisition.
This attribute can be usefull for alarms or occasionally received input parameters from remote sources through MQTT or FTP.

8.12.9.4 Range

Range attributes: .MIN, .MAX
Analog inputs are having a user defined /calibrated slope, to convert analog input values to engineering values. The minimum and maximum engineering values of the slope can be used in the calculations by trailing a parameter code with the attribute codes .MIN or .MAX (e.g. :AIN1.MAX).
(This can be used to calculate a percentage from a water level).

8.13 Operating basics - Firmware upgrade

The Data logger is equipped with a boot loader, which enables the firmware upgrade feature.
Firmware upgrading allows a user to overwrite the internal firmware of the Data logger with a (newer) updated version of the firmware. Firmware upgrading can be done by using:

- USB connection
- Wireless via 4G (TCP, HTTP or MQTT) or optionally BLE

8.13.1 Firmware upgrade - When to perform

Normally, a user never uses this feature, as long as he is satisfied with the performance of the system.
In time however, the need for additional features may arise. For example, a new serial sensor is introduced on the market and a customer wants to connect this sensor to the Data logger. When YDOC has extended the firmware to support that sensor, a new version of the firmware is released. After the user has performed the firmware upgrade, his “old” Data logger, now supports the new sensor. Normally, when the system is running fine, and no additional requests exists, we recommend NOT to perform a firmware-upgrade.

8.13.2 Firmware upgrade - How to perform using USB

- First download the latest version of the firmware from www.ydoc.biz/datalogger-firmware.html
- Download the YDOC Terminal setup from www.ydoc.biz/datalogger-utilities.html
- Use the menu and select the option “Maintenance”.
- Follow instructions from the menu.
- Use “Y-Modem protocol” to send the new firmware to the Data logger.
- Don’t remove the USB nor power from the Data logger
- When these steps are completed, the new firmware is active.

We recommend the use of the USB-connection over the wireless function. This is because of possible drop outs in communication. When a firmware upgrade procedure is interrupted, the upgrade will fail, but the unit continues to operate, with the previous version. The USB- connection is faster and more reliable.

8.13.3 Firmware upgrade - Over the air (hands-off)

It is also possible to perform a firmware upgrade over the air. This can be done by ydocTerminal in combination with YDOC Java TCP-server or YdocInsights data collector. It can also be perfomed by YdocTerminal in combination with an MQTT-broker or by HTTP from your webserver.

Note: *The hands-off upgrade procedure will be explained in chapter “Operating basics - Remote access”*

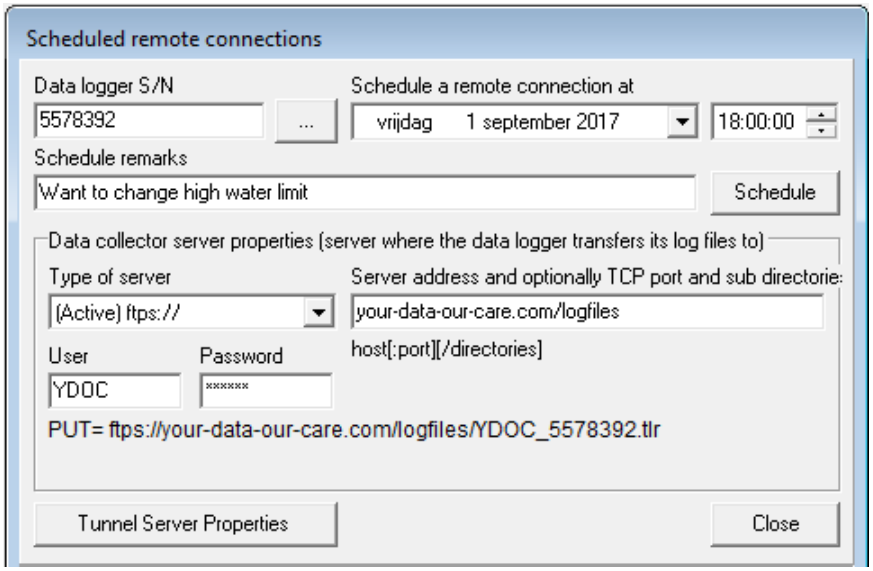
8.14 Operating basics - Remote access

8.14.1 Remote access - FTP

If the logger has FW V3.0B1 or newer, remote access to the Data logger can be scheduled by ydocTerminal V3.0. using our secure tunnel server (tunnel.ydoc.biz).

Note: The Data logger should be configured to use NTP time synchronization.

Within ydocTerminal click: File->New->Schedule a remote connection.



Specify the S/N of the Data logger you want to access and when you think it's a convenient moment to access the logger.

Obviously: A tunnel cannot be established before the next scheduled data transfer interval of the Data logger.

A tunnel can only be established if ydocTerminal is running at the scheduled moment. When running, ydocTerminal will pop-up a terminal window a few minutes before the scheduled moment.

Type of Server

ydocTerminal supports 4 different types of FTP-server (Passive FTP, Active FTP, Passive FTP with Explicit TLS or Active FTP with Explicit TLS.

Server address: Specify the same server and directory as used by the Data logger (e.g. ydoc.biz/logfiles)

User/Password: Specify the exact same credentials as used by the Data logger as they are a/o used in the encryption keys. The user should have read, write and delete rights in the specified directory.

Tunnel Server Properties

This is the Server servicing the secure and encrypted channel between Data logger and ydocTerminal. Standard our server is used (tunnel.ydoc.biz), don't worry we can't eavesdrop your data.

8.14.2 Remote configuration and firmware upgrade

It is possible to update the Data logger configuration or upgrade the FW by placing a file on the FTP-server in the same directory where data log files are transferred to.

The names of the files should be formatted as follows:

- **YDOC_<SN>.bin** for a FW file.
- **YDOC_<SN>.cfg** for a config file, this can be a complete binary configuration file or a file containing just some changes by means of tiny configuration snippets (See chapter configuration snippets).

The Data logger will remove the file from the server once processed.

8.14.3 Remote access - HTTP

If the logger has FW V3.0B1 or newer, remote access to the Data logger can be scheduled by ydocTerminal V3.0. using our secure tunnel server (tunnel.ydoc.biz).

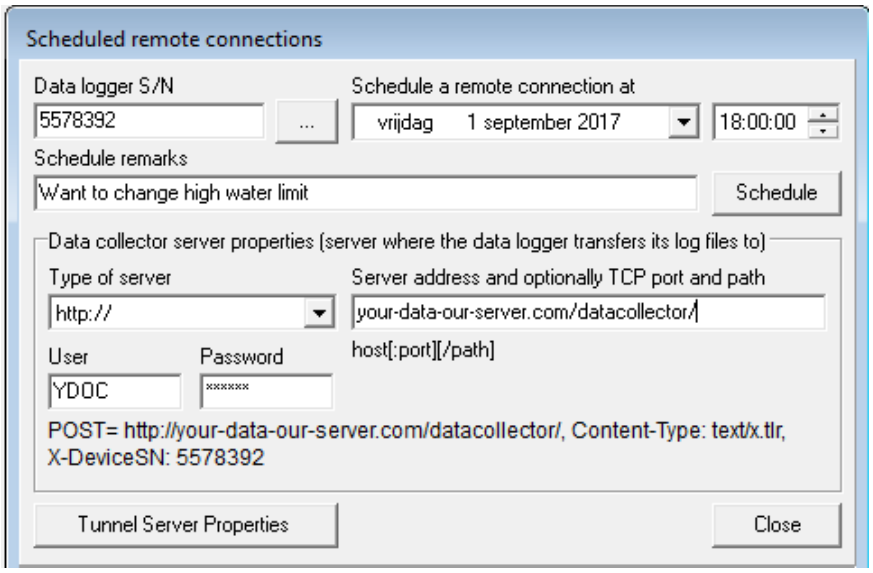
Note: The Data logger should be configured to use NTP time synchronization.

Within ydocTerminal click: File->New->Schedule a remote connection.

Specify the S/N of the Data logger you want to access and when you think it's a convenient moment to access the logger.

Obviously: A tunnel cannot be established before the next scheduled data transfer interval of the Data logger.

A tunnel can only be established if ydocTerminal is running at the scheduled moment. When running, ydocTerminal will pop-up a terminal window a few minutes before the scheduled moment.



Type of Server: HTTP or HTTPS with basic authorization.

Server address: The HTTP-server must honor POST requests from ydocTerminal at the specified URL.

ydocTerminal will POST the request with 'content-type: **text/x.tlr'**. The S/N of the concerned Data logger is given in the custom HTTP-header 'X-DeviceSN' The tunnel link request string itself is contained in the body of the POST. This request string should be stored until the concerned Data logger performs a POST itself (its log data). The HTTP-server should copy the request string as the value of the custom HTTP-header 'X-Command' in the response to the Data logger.

User/Password: Specify the exact same credentials as used by the Data logger as they are a/o used in the encryption keys.

Tunnel Server Properties

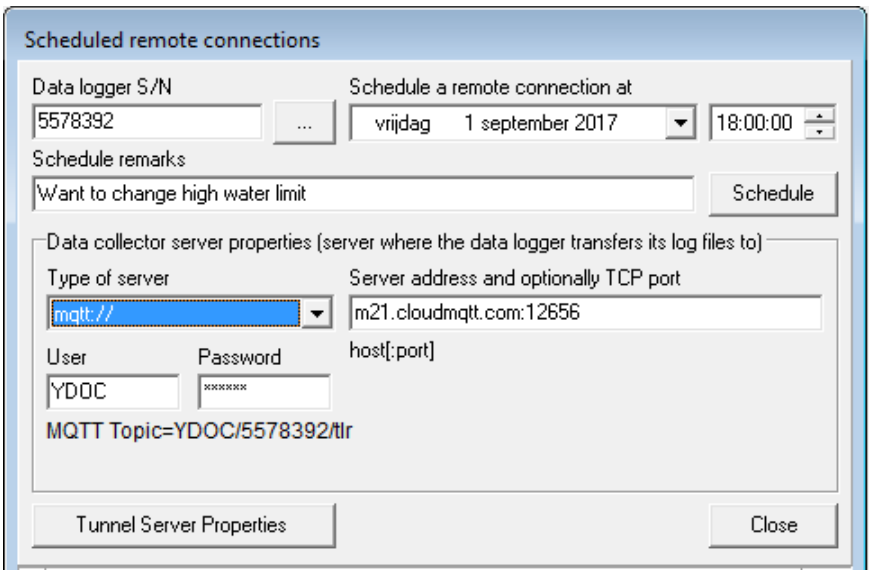
This is the Server servicing the secure and encrypted channel between Data logger and ydocTerminal. Standard our server is used (tunnel.ydoc.biz), don't worry we can't eavesdrop your data as the communication is 'Peer-to-Peer' encrypted by security keys not know to the tunnel server. If having doubts, please feel free to run your own tunnel server, please ask our staff how to do it.

8.14.4 Remote access - MQTT

If the logger has FW V3.0B1 or newer, remote access to the Data logger can be scheduled by ydocTerminal V3.0. using our secure tunnel server (tunnel.ydoc.biz).

Note: The Data logger should be configured to use NTP time synchronization.

Within ydocTerminal click: File->New->Schedule a remote connection.



Specify the S/N of the Data logger you want to access and when you think it's a convenient moment to acces the logger.

Obviously: A tunnel cannot be established before the next scheduled data transfer interval of the Data logger.

A tunnel can only be established if ydocTerminal is running at the scheduled moment. When running, ydocTerminal will pop-up a terminal window a few minutes before the scheduled moment.

Type of Server: MQTT

Server address: Specify the same server and port as used by the Data logger (e.g. m21.cloudmqtt.com:12656)

User/Password: Specify the exact same credentials as used by the Data logger as they are a/o used in the encryption keys.

Tunnel Server Properties

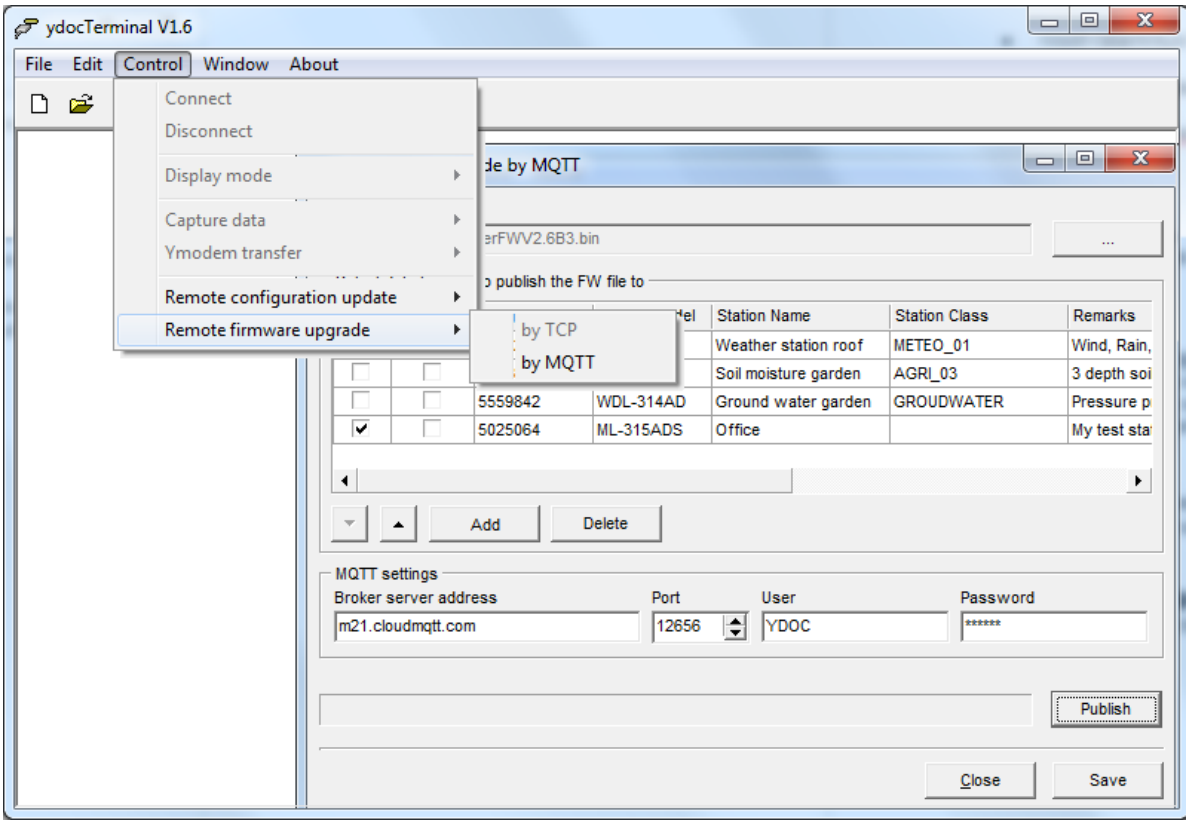
This is the Server servicing the secure and encrypted channel between Data logger and ydocTerminal. Standard our server is used (tunnel.ydoc.biz), don't worry we can't eavesdrop your data as the communication is 'Peer-to-Peer' encrypted by security keys not know to the tunnel server. If having doubts, please feel free to run your own tunnel server, please ask our staff how to do it.

8.14.5 MQTT - Remote configuration and firmware upgrade

It's possible to update the Data logger configuration or upgrade the FW by publishing to the following topics:

- **YDOC/<SN>/fw/set** where the payload should contain the contents of a FW file.
- **YDOC/<SN>/cfg/set** where the payload should contain the contents of a complete binary config file or just some changes by means of tiny configuration snippets (See chapter configuration snippets).

You can also use ydocTerminal to publish config or FW files to a Data logger. If you want to publish a configuration snippets by ydocTerminal, please save the snippets to a file first.



8.15 Operating basics - MQTT

8.15.1 MQTT - COM-Tunnel

With MQTT its possible to send/receive data to/from serial devices connected to the Data logger. In example you could send commands to change some device specific settings. Commands can be send to the serial sensor or accessory port on the main PCB as well as on option boards. The (binary) data contained in the MQTT payload will be passed transparently 1 to 1 to the concerned serial device and the response will be replied as (binary) payload 1 to 1 as well, it's up to the MQTT-client to format and interpret the data to/from the serial device (which could be MODBUS/RTU, SDI-12, NMEA-0183 or any other protocol).

When a COM-tunnel message is received for a device connected at a serial sensor port and the device requires power from the 12V sensor power switch, the Data logger will switch on the 12V power and wait a certain warm-up time before sending the command to the device (See chapter: Serial port).The warm-up time will not be applied in case of sequential commands in the same MQTT-session.

When a COM-tunnel message is received for a device connected at an accessory port and the device requires power from the 5V accessory power switch, the Data logger will switch on the 5V power and wait a certain warm-up time before sending the command to the device (See chapter: Accessory port).The warm-up time will not be applied in case of sequential commands in the same MQTT-session.

After sending data to the serial device, the Data logger will wait max 3 seconds for reply from the connected device. In case of no response, the Data logger will publish an MQTT message with empty payload. If the serial device replies, the reply is considered complete after a character silence time of 0.25s. The Data logger will publish an MQTT message with the full 1 to 1 (binary) reply as the payload.

8.15.2 MQTT - Topics

An MQTT-client should format a command publishing topic as follows:

"**YDOC**/<device serial number>/**comtx**/<port>[/<client defined sup-topics]" (QoS=1)

Where <port> can be (if installed and configured in the Data logger):
- "sp1", the serial sensor port on the main PCB
- "ap1", the accessory port on the main PCB
- "sp2", the serial sensor port on an option board
- "ap2", the accessory port on an option board.

The MQTT-client can specify optional sub-topics for its own internal management, the used sub-topics are also included in the MQTT reply messages. Such sub-topics could be used for grouping or matching commands with replies (e.g. by using some sequence# as sub-topic).

Example: "YDOC/99091660/**comtx**/sp1" or "YDOC/99091660/**comtx**/sp1/S123/METEO/"

The Data logger will publish the reply with the same topic as the command, but will replace the text "com**t**x" with "com**r**x" (Example: "YDOC/99091660/**comrx**/sp1/S123/METEO/")

An MQTT-client can use wildcards to subscribe to any COM-tunnel message from any Data logger, by subscribing to: "**YDOC**/+/**comrx**/#" (QoS=1)

8.15.3 MQTT - Topic limits

Topic size: 128 characters.
Payload size: 256 bytes for commands, 512 bytes for replies.
Device reply timeout: 3s (The device should answer within 3 sec).

Silence time: 0.25s (A reply is considered complete after a communication silence time of 0.25s).

8.16 MQTT - Examples

8.16.1 MQTT - Datatype

All parameters will be exposed as datatype 10 (double) even totalizers and digital inputs.

8.16.2 MQTT - Message examples

Examples of YDOC NBIRTH, NDEATH and NDATA messages. Sparkplug-B payload is formatted in Google Protocol Buffer format and therefor human unreadable. We have represented the examples below in JSON format for readability purpose only.

8.16.3 Messages - NBIRTH

Topic: spBv1.0/sp-grp-x/NBIRTH/5025064

Up to 64 parameters/channels can be included and referred to by aliases 1 till 64. Their names, as described before, are user definable.

```
{
  "timestamp": 1486144902122,
  "metrics":
  [
    { "name":"bdSeq", "timestamp":1486144902122, "dataType":"Uint64",
      "value":0 },

    { "name":"Properties/Hardware Make", "timestamp":1486144902122,
      "dataType":"String", "value":"YDOC"},
    { "name": "Properties/Hardware Model", "timestamp": 1486144902122,
      "dataType": "String", "value": "ML-417ADS" },
    { "name": "Properties/FW", "timestamp": 1486144902122,
      "dataType": "String", "value": "4.4B8" },
    { "name": "Properties/SN", "timestamp": 1486144902122,
      "dataType": "String", "value": "1234567890"},

    { "name": "System/Battery", "alias":1, "timestamp": 1486144902122,
      "dataType": "Double", "value": 3.3}
    { "name": "Inputs/AI1", "alias":2, "timestamp": 1486144902122,
      "dataType": "Double", "value": 14.2}
    { "name": "Inputs/AI2", "alias":3, "timestamp": 1486144902122,
      "dataType": "Double", "value": 9.5}
    { "name": "Counters/CNT1", "alias":4, "timestamp": 1486144902122,
      "dataType": "Double", "value": 1234567}
    { "name":"Calculations/FLW1", "alias":5, "timestamp":1486144902122,
      "dataType":"Double","value":84.7}
  ],
  "seq": 0
}
```

8.16.4 Messages - NDEATH

Topic: spBv1.0/sp-grp-x/NDEATH/5025064

Please find below an example of the NDEATH message in JSON.

```
{
  "timestamp": 1486144902122,
  "metrics":
  [
    { "name":"bdSeq", "timestamp":1486144902122, "dataType":"Uint64",
      "value":0 }
  ]
}
```

8.16.5 Messages - NDATA

Topic: spBv1.0/sp-grp-x/NDATA/5025064

This payload will contain all values recorded between now and a previously succeeded transfer session. To keep the payload limited the recorded values will be referred to by their aliases as given in the preceding NBIRTH payload.

```
{
  "timestamp": 1486144902222,
  "metrics":
  [
    { "alias":1, "ts": 1486144300000, "dataType": "Double", "value": 3.32}
    { "alias":2, "ts": 1486144300000, "dataType": "Double", "value": 14.0}
    { "alias":3, "ts": 1486144300000, "dataType": "Double", "value": 8.7}
    { "alias":4, "ts": 1486144300000, "dataType": "Double", "value": 1234507}
    { "alias":5, "ts": 1486144300000, "dataType": "Double", "value":79.6}

    { "alias":1, "ts": 1486144600000, "dataType": "Double", "value": 3.31}
    { "alias":2, "ts": 1486144600000, "dataType": "Double", "value": 14.4}
    { "alias":3, "ts": 1486144600000, "dataType": "Double", "value": 9.1}
    { "alias":4, "ts": 1486144600000, "dataType": "Double", "value": 1234537}
    { "alias":5, "ts": 1486144600000, "dataType": "Double", "value":81.3}

    { "alias":1, "ts": 1486144900000, "dataType": "Double", "value": 3.3}
    { "alias":2, "ts": 1486144900000, "dataType": "Double", "value": 14.2}
    { "alias":3, "ts": 1486144900000, "dataType": "Double", "value": 9.5}
    { "alias":4, "ts": 1486144900000, "dataType": "Double", "value": 1234567}
    { "alias":5, "ts": 1486144900000, "dataType": "Double", "value":84.7}
  ],
  "seq": 1
}
```

8.17 MQTT - Configuration snippets

A Data logger can be configured manually through the terminal interface or by loading a file containing a complete configuration in binary format. For fast deployment you could build up a list of configuration files for your different classes of monitoring stations (e.g. soil moisture, weather, hydrology, etc.) where each different class uses the same type of sensors/devices. However the need could arise to make little changes afterwards, changes like setting a level offset or an alarm limit and preferable automated from your own application server. Updating these changes could be done by uploading a complete binary config file, but it's a bit cumbersome to maintain many varieties of various classes of configuration on your server or to patch changes in a complex binary configuration file.

As of FW 4.6B1 it is possible to make small changes to the configuration of a Data logger by uploading "configuration snippets". Snippets are expressed in JSON and can be transferred to a Data logger in the same way as a regular configuration, with the content /payload being a tiny readable JSON object.

E.g. a snippet to change the data log & alarm interval to one hour resp. one quarter is just a few bytes.

```
{"gs":{"ni":3600,"ai":900}}
```

8.17.1 MQTT - Payload format

The contents/payload should contain valid formatted JSON and the very first byte should be an opening brace **{** else the Data logger will not interpret the payload as JSON and report an error.

Objects or members unknow to the Data logger will be ignored. Supplying invalid values for known members will be ignored as well, but an error will be reported and stored in the data log.

To keep the payload as small as possible, to support payload constrained media, names of objects, arrays and members are expressed in short abbreviated notation.

The following root objects and arrays can be included in the payload:

- **"gs"** an object { } containing Global system Settings, like system name and data log interval.
- **"as"** an object { } containing Alarm Settings, like SMS alarm phone numbers (since FW4.8B16).
- **"ds"** an array [ ] with Driver Setting objects, like send intervals and warm-up times.
- **"ps"** an array [ ] with Parameter Setting objects, like parameter offset and alarm limits.

8.17.2 MQTT - Global system Settings

The following members can be included in the global settings object:

- **"dn"** a "string" of max 31 tokens providing the device/station name.
- **"ni"** a number providing the normal data log interval in seconds. **ni** can't be any arbitrary value, it should be in discrete divisors of 60 seconds, 60 minutes or 24 hours (e.g. "ni":11 is invalid, while "ni":12 is not.
- **"ai"** a number providing the alarm data log interval in seconds. **ai** should be equal or lower than **ni** and should be in discrete divisors of **ni** (e.g. "ai":17 is invalid when "ni":60 is provided). Specifying 0 will make **ai** equal to **ni**.
- **"tz"** a number in the range of -12 to +13 in steps of 0.25 to provide the time zone.
- **"dt"** a "string" formatted as "(yy)yymmdd hh:mm:ss" to set the deployment time, the Data logger will go in deep sleep until the deployment time is reached. This feature could come in handy when the end of a monitoring season and you want to start it at the beginning of the next season.

8.17.3 MQTT - Alarm settings

The following members can be included in the alarm settings object:

- **"r1"** a "string" of max 15 tokens providing the phone# of SMS recipient 1
- **"r2"** a "string" of max 15 tokens providing the phone# of SMS recipient 2

8.17.4 MQTT - Driver Settings

The following members can be included in a driver settings object:

- **"id"** a "string" to identify the concerned driver by its name in the current active configuration.
- **"dn"** a "string" of max 31 tokens providing the new driver name.
- **"ni"** a number providing the driver initiation interval in seconds. **ni** can't be any arbitrary value, it should be in discrete divisors of 60 seconds, 60 minutes or 24 hours (e.g. "ni":11 is invalid, while "ni":12 is not. If the driver is concerning input(sensors) the interval should be equal or in discrete divisors of the data log interval. If the driver is concerning outputs (e.g. modem) the interval should be equal or in multiples of the data log interval. Specifying 0 will make the interval equal to the normal data log interval.
- **"ai"** a number providing the driver initiation alarm interval in seconds. **ai** can't be longer than **ni** and should be in discrete divisors of **ni** (e.g. "ai":1700 is invalid when "ni":3600 is provided). Specifying 0 will make **ai** equal to **ni**.
- **"wu"** a number providing the "warm-up" time in seconds of the connected device, this is the time needed by the external device to provide stable service after applying power.

From firmware version V4.8B16, the following member can be included in a driver settings object:

- **"ct"** to preset a cumulative counter (if the driver has one) to a certain start value, e.g. 0 to reset the cumulative counter of a digital input driver.

From firmware version V5.3B2, the following members can be included in a MODBUS driver settings object:

- **"smar"** To set which holding register is used in the sensor to start a sensor maintenance cycle.
- **"smav"** The value (u16) to write to the "smar" register to start a maintenance cycle.
- **"smer"** To set which holding register is used in the sensor to start a measurement cycle.
- **"smev"** The value (u16) to write to the "smer" register to start a measurement cycle.

8.17.5 MQTT - Parameter Settings

The following members can be included in a parameter settings object:

- **"id"** a "string" to identify the concerned parameter by its code in the current active configuration.
- **"pc"** a "string" of max 7 tokens providing the new parameter code.
- **"pn"** a "string" of max 23 tokens providing the new parameter name.
- **"pu"** a "string" of max 15 tokens providing the new parameter unit.
- **"nd"** an integer up to 6 to specify the number of decimals to display.
- **"vf"** a number providing a multiplication factor to the raw input value.
- **"vo"** a number providing an offset to add to the input value.
- **"iv"** initial value of the parameter if not sampled yet after a re-start.
- **"ll"** a number providing the low-low alarm limit.
- **"lo"** a number providing the low alarm limit.

- **"hi"** a number providing the high alarm limit.
- **"hh"** a number providing the high-high alarm limit.
- **"ad"** an integer up to 9 specifying how many consecutive samples should be violating limits before an alarm situation is set.
- **"ah"** a number providing the hysteresis before an alarm situation will be reset.
- **"rd"** an integer up to 9 specifying how many consecutive samples should be within boundaries before an alarm situation will be reset.

8.17.6 MQTT - Payload example

Example *containing multiple snippets.*

Note: *The comment (Preceded by "//") is included for informative purposes only and should not be included in real JSON.*

```
{
  "gs":                        // Global Settings
  {
    "dn":"Station 1",          //New device name
    "ni":60,                   //New normal data log interval in seconds
    "ai":30,                   //New alarm data log interval in seconds
    "tz":3,                    //New time zone   in hours
    "abc":"xyz"                //Unknown members will be ignored
  },

  "ds":                        // Driver Settings
  [
    {
        "id":"MODBUS",         //Current name of the addressed driver
        "ni":0,                //Set sample interval equal to data log interval
        "wu":10,               //New warm-up time of connected sensor
        "dn":"Probe 1"         //New driver name
      },
      {
        "id":"MQTT",           //name of the addressed driver
        "ni":1800              //New send interval
      }

  ],

  "ps":                        // Parameter/channel Settings
  [
    {
        "id":"P3",             //Current code of addressed parameter
        "pu":"F",              //New unit text
        "vf":1.85,             //New value factor
        "vo":-31,              //New value offset
        "pc":"TMP",            //New parameter code
        "pn":"Temperature"     //New parameter name
      },
      {
        "id":"P4",             //Current code of addressed parameter
        "pu":"NTU",            //New unit text
        "vf":1.85,             //New value factor
        "vo":-31,              //New value offset
        "pc":"TURB",           //New parameter code
        "pn":"Turbidity"       //New parameter name
      }
  ],

  "abc":                       //Unknown objects will be ignored
  {
      "xyz":123
  }
}
```

8.18 Integrated MQTT serial communication bridge (MQTT-Com-tunnel)

Although our data loggers can capture measurements from various serial devices or smart sensors by standard serial communication protocols (e.g MODBUS, NMEA-0183 or SDI-12), the data logger itself has no knowledge about how to apply changes to these often proprietary devices. The integrated MQTT serial communication bridge, which we call “MQTT-Com-tunnel”, enables to send/receive data to/from serial devices connected to the data logger remotely (e.g. to reset something in a device or to occasionally give a sensor a command to do some cleaning or internal house keeping).

Commands can be send to the serial sensor (RS232/RS485/SDI-12) or accessory (RS232) port on the main PCB as well as on option boards. The (binary) data contained in the MQTT payload will be passed transparently 1 to 1 to the concerned serial device and the response will be replied as (binary) payload 1 to 1 as well, it’s up to the MQTT-client to format and interpret the data to/from the serial device (which could be MODBUS/RTU, SDI-12, NMEA-0183 or any other protocol).
Commands can be initiated from an automated task on some server, but they can also be initiated manual from an MQTT smart phone app (e.g. the Android app: MQTT Terminal)
An MQTT-client should format a command publishing topic as follows:

```
“YDOC/<device serial number>/comtx/<port>[/<client defined sup-topics]”
(QoS=1)
```

Where <port> can be (if installed and configured in the ML-525 data logger):

- “sp1”, the RS-232 port on the main PCB
- “sp2”, the RS-485 port on the main PCB
- “sp3”, the SDI-12 port on the main PCB
- “sp4”, the serial port on an ML-OI-COM option board
- “ap1”, the accessory port on the main PCB
- “ap2”, the accessory port on an ML-OA-COM option board

The MQTT-client can specify optional sub-topics for its own internal management, the used sub-topics are also included in the MQTT reply messages. Such sub-topics could be used for grouping or matching commands with replies (e.g. by using some sequence# as sub-topic).

Examples:

```
“YDOC/99091660/comtx/sp1” or “YDOC/99091660/comtx/sp1/S123/METEO/”
```

The data logger will publish the reply with the same topic as the command, but will replace the text “comtx” with “comrx”.

```
“YDOC/99091660/comrx/sp1/S123/METEO/”
```

An MQTT-client can use wild-cards to subscribe to any COM-tunnel message from any data logger within the scope of the MQTT-account, by subscribing to:

```
“YDOC/+/comrx/#” (QoS=1)
```

Note: *Detailed inforomation can be found here: https://ydoc.biz/mqtt-communication-bridge/*

8.19 Operating basics - LoRaWAN

More information *on LoRaWAN can be found at [The Things Network Fundamentals](#).*

8.19.1 LoRaWAN end device - Identification, registration and activation

The DevEUI is an ID in the IEEE EUI64 address space used to identify a device.
It is supplied by the device manufacturer.
During over the air activation a DevAddr is assigned to the device.
This DevAddr is used in the LoRaWAN protocol afterwards.
The DevEUI is sent unencrypted.

The JoinEUI (formerly called AppEUI) is a global application ID in the IEEE EUI64 address space identifying the join server during the over the air activation. For non-private networks it corresponds to a subdomain of joineuis.lora-alliance.org. This server name is used to find the IP address of the join server via DNS. This is described in LoRaWAN™ Back-End Interfaces v1.0.

AppKey is the encryption key used for messages during every over the air activation. After the activation the AppSKey is used. A listener knowing the AppKey can derive the AppSKey. So you want to keep the AppKey secret. Which side of the communication channel creates it is not important. You simply want to be sure that it is random.

Every end device must be registered with a network before sending and receiving messages. This procedure is known as activation. There are two activation methods available:

Over-The-Air-Activation (OTAA) - the most secure and recommended activation method for end devices. Devices perform a join procedure with the network, during which a dynamic device address is assigned and security keys are negotiated with the device.
Activation By Personalization (ABP) - requires hardcoding the device address as well as the security keys in the device. ABP is less secure than OTAA and also has the downside that devices can not switch network providers without manually changing keys in the device.

8.20 Operating basics - Power supply, power usage and batteries

The ML-525 PCB can be supplied with different Power boards, mounted in the enclosure cover.

Power supply	Description
ML-PB-LI	Powered from a single 3.6V DC SAFT LSH20 or equivalent D-size lithium battery.
ML-PB-3LI	Powered from 3x 3.6V DC SAFT LSH20 or equivalent D-size lithium batteries.
ML-PB-DC	Powered from external 8..28V DC source.
ML-PB-DC-LI	Powered from external 8..28V DC source or 3.6V DC SAFT LSH20 lithium battery.
ML-PB-PV	With integrated 1Wp solar panel and 1x 26650 3.2V LiFePO4 holder &charger.
ML-PB-LFP	With 4x 18650 3.2V LiFePO4 holder & charger for 12V (21VOC) ext. solar panels.
ML-PB-SLA	With integrated 12V battery charger for 12V (21VOC) external solar panels.

8.20.1 Power - Internal RTC backup battery

The Data logger contains an internal coin cell battery to keep the internal real-time-clock running. The lifetime of the battery is at least 10-20 years. Under normal conditions, battery exchange is not required during the lifetime of the Data logger.

8.20.2 Power - Consumption & Battery Life

Average current consumption @3.6V

Subject	Value	Remarks
Data logger in low power sleep	<100uA	Preferred mode of operation.

Data logger in MODEM sleep	2mA	MODEM in stand-by during SMS ACVA reception.
Data logger is awake	20mA	The logger is awake to be able to take and log a measurement.
Data logger is transferring LTE data	220mA	Requires a good LTE signal.

The Data logger is equipped with an internal power monitor. During the active mode of the Data logger, this power monitor keeps track of the power consumption of the device. When the device is going into sleep-mode, a fixed value is used to calculate the power consumption. Both are calculated and offer a fairly accurate measurement of the power consumption. Unfortunately, the behaviours of batteries are, in practice, much more complicated than the calculation made inside the Data logger. So, the capacity, written on the back of the battery is only a typical value. Things like: Shelf life, ambient temperature, current draw, and peak current draw, affect the performance of the battery.

Therefore, we strongly advise to use the measurements regarding battery life as an indication only. We also recommend replacing the battery, fairly above 0%. If you want the best performance and the most optimized settings for your particular measurement location, contact the supplier of the Battery Saft Batteries. They can provide you more specific details and advise on your application. You can provide them information by sending them a bit of previously measured data, for analysis. When you have received the advice, you probably decrease the value of “Battery Capacity” in the configuration setup, to a bit lower value than the default (14 Ah)

Please consult the ydoc.biz website for an online power consumption calculator.

8.21 Operating basics - Limitations

8.21.1 Limitations - Firmware Drivers

The Data logger is equipped with various drivers, for several tasks. The number of total drivers is limited to 30. Each driver can handle (collect or send) a number of parameters. The total number of parameters is limited to 100. Theoretically, the Data logger can handle up to 30 sensors with a total of 100 parameters. But choosing that option, there is no output possible. In most cases at least two drivers are needed for minimum operation: One Internal driver and one Output-driver.

Example:
A user wants to connect a large number of INW CT2X sensors to an ML-525xE. This sensor measures temperature and conductivity. So, each sensor "uses" two parameters. Also, he likes to send the data via FTP, and he enables the following internal sensors: Rest Capacity, Battery Voltage, and Current. So, besides the Sensor drivers there are 2 drivers needed:

- *Internal Driver (Also requires 1 parameter)*
- *Output Driver (Also requires 1 parameter)*

The maximum number of Sensor-drivers is: 30 - 2 = 28
there are 28 Sensor-drivers left for use with the CT2x sensors.
*The total number of parameters is: 28 * 2 + 1 + 1 = 58*
The number of parameters is no problem (58 < 100)

Note: *You can use this FAQ to check whether your application fits within the 30-slot Data logger limit.*

8.21.2 Limitations - Power Switch

The output voltage is selectable 3..24 Volts.(12V default). The sensor output is capable of powering sensors up to 200mA@3..12V and 100mA@12..21V.

8.21.3 Limitations - Input-driver sensor power

Input-drivers obtain data from sensors. Various types of sensors can be connected to the Data logger. When a sensor needs a "warm-up time" the sensor power output can be used to power the sensor before the measurement is taken. (Sensor "warm up time") The maximum delay time before a sensor reading is 5 minutes



Warning: *The Power Switch output is consuming a lot of (battery) power, keep "warm up times" to the minimum required. (Consult the sensor manual). A warm up time of 5 minutes can be used in rare situations, but the battery-life will be shortened dramatically. Consult your local YDOC-supplier for a calculation of battery-life, before exploiting your Data logger.*

8.21.4 Limitations - External antenna - Placement and field strength

An antenna is required for GSM operation.

Depending on local field strength the integrated antenna or a simple whip antenna direct connected to the Data logger will work, a better antenna and/or better antenna placement might be required.

The actual field strength can be monitored through the configuration software (menu). The field strength may vary on atmospheric conditions, we recommend to make sure that the indication is maximized at the installation site.
The field strength may also vary on the growth of vegetation (trees tend to block the signal). It is recommend configuring the Data logger in such a way that the 4G field strength is recorded during data transfer. In this way you can get an early warning when the field strength gets low.

Actions to optimize the field strength signal:

- Make sure the antenna is mounted in accordance with the manufacturer's instructions. Note there are antennas (whip antennas) that require a metal surface below the antenna; others (dipole antennas) do not.
- Make sure that all connectors on the antenna and antenna cable are tightened and free of moisture.
- Make sure the antenna is in vertical position; as the GSM and 4G radio signals are vertically polarized, the antenna should be vertical positioned for maximum performance.
- Do not place the antenna near metal surfaces or structures. Be aware that various building structures contain metal (e.g. steel mesh as reinforcement for concrete).
- Place the antenna outdoors.
- Identify the nearest GSM tower of your provider. Place the antenna in a location that provides a free line-of-sight to the tower.
- If you cannot identify the nearest GSM tower of your provider, place the antenna on a higher position; generally, higher is better.
- Use good quality (low-loss) antenna cables. Generally, the thicker the cable, the better.
- Avoid unnecessary adaptors and connectors in the antenna cable, as every "joint" cause a significant signal loss (0.5 to 1 dB).
- Use an antenna with a higher antenna gain. (simple stubby antennas can have a gain of -9db, a rod antenna can have an antenna gain of 0 or 4 dB or higher; Note that the allowed radio power is limited to 1W/2W. An antenna with a higher gain is only allowed when this only compensates for the cable and connector losses).
- Seal your antenna-connector with vulcanizing tape, to prevent from oxidation.
- When the integrated antenna is used, make sure that the Data logger is NOT mounted on a metal plate.



Warning: *When the Data logger is encapsulated in a metal enclosure, cage of faraday or mounted on a metal plate, you may not use the integrated antenna. Use an external antenna to avoid damaging the Data logger Modem.*

8.22 Operating basics - Trouble shooting

Most parts of the Data logger are tested during start up (or reboot).
Connect to the Data logger using YdocTerminal (USB or remote) and reboot the Data logger.
Watch system messages (containing problems) during the start up process.

Advice is to enable system messages to be stored on SD memory. It will help to find the root cause in case of Data logger problems or malfunctioning.

If the problem is concerning a sensor, test its functionality using the COM port terminal option.

When connected through USB, enable Debug mode to verify sensor commands and reply.

Check power, cables, connectors and fuses. Check the raw data file for WDT, PVD_DIP or power to low messages.

Use the Maintenance - Field tests to verify the Data logger basic functions.

Before dropping a call to support:

- Check the FAQ pages if your problem is known.
- Check firmware version information if your problem is solved in a (recent) firmware upgrade.
- If the current Data logger firmware is outdated, upgrade it first and retest if the problem persists.

When making support call:

- Send (section of) the raw data file (best in ydoc format) including a period of time around the fault.
- Configuration file and password.
- What steps are taken to isolate and recover the problem.



Warning: *If the Data logger has to be opened, follow the procedure as described installing the Data logger and do it in a dry and clean environment.*

9 References - Interfaces

9.1 Interface - SDI-12

The ML-525xE is provided with a SDI-12 port. An additional ML-OI-COM-SDI12 option board can be added.

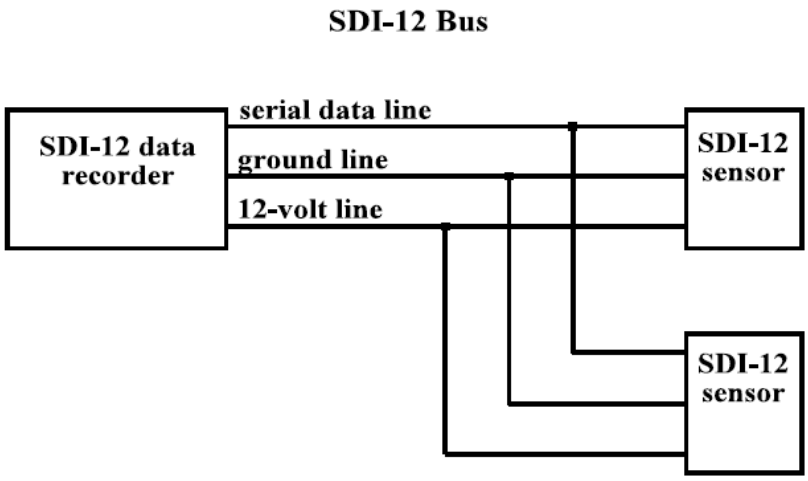
When SDI-12 is selected, it acts like a SDI-12 recorder and its specific SDI-12 commands are embedded in the driver of the input-sensor. So, the user can easily select his sensor and specify its SDI-12-adress. For more information see the description of your SDI-12 sensor.

9.1.1 SDI-12 Hardware

The SDI-12 standard is a very commonly used interface-standard. The signal levels are quite different from those of RS232 and RS485. So, you cannot connect a SDI-12 sensor to a RS232 or RS485 port, it won't work. The use of convertors between RS232/485 and SDI-12 is discouraged, because of the high pricing of the convertors and the bad performance (see note).

9.1.2 SDI-12 Wiring

The SDI-12 electrical interface uses the SDI-12 bus to transmit serial data between SDI-12 data recorders and sensors. The SDI-12 bus is the cable that connects multiple SDI-12 devices. This is a cable with three conductors:



The wiring length between a sensor and the data-recorder may not exceed 60 meters. The maximum number of sensors connected to a SDI-12 bus is limited to 10. The Data logger is protected against transients on the SDI-12 bus.

9.1.3 SDI-12 Baud Rate and Frame Format

The baud rate for SDI-12 is 1200 baud.

Frame format:
1 Start bit
7 Data bits, least significant bit transmitted first
1 Parity bit, even parity
1 Stop bit

For more information on the SDI-12 protocol see: www.sdi-12.org

Note: *SDI-12 is a half-duplex protocol, the data-recorder has to switch between transmitting and receiving. Do not use a RS232 ⇔ SDI-12 convertor, it is not aware of SDI-12 timing. Advice is to use the internal SDI-12 port or an (additional) option board, with SDI-12 capabilities.*

9.2 Interface - RS232

The ML-525SE and ML-525PE are provided with and RS-232 port. An additional ML-OI-COM-RS232 option board can be added.

RS232 is a widely spread interface standard, which uses 3 wires (minimum) for data communication. It is a so called asymmetric interface, that uses one wire for TX, one for RX and one for ground. It is called asymmetrical, because it uses only one wire per signal. Therefore, it's susceptible for interference, the maximum cable length is limited to 15meters.

RS232 is not a bus system, and therefore it is only allowed for one device to be connected to a RS232 port. The maximum number of serial devices to connect to your ML-525 is 1. RS232 sensors should be connected to the Data logger with their signals crossed. (Sensor RX ⇔ Data logger TX).

We strongly recommend using RS485 instead of RS232, when cable length exceeds the 15m.

9.3 Interface - RS485

The ML-525xE is provided with and RS-485 port. An additional ML-OI-COM-RS485 option board can be added.

RS485 is a serial bus-system, which uses 3 wires for its communication. It uses a “differential balanced line”, which can span relatively large distances, up 1200 m. A rule of thumb is that the speed in bit/s multiplied by the length in meters should not exceed 10^8: A 50-meter cable should not signal faster than 2 Mbit /s.

Instead of RS232, RS485 is capable of communicating with more than one device. After all, it is a bus-system.

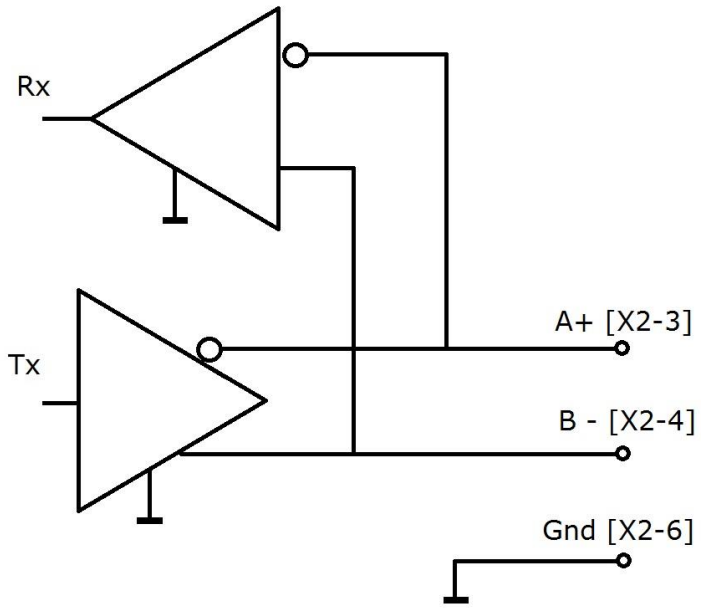
RS485 sensors are called “slaves” and must have their unique address. The Data logger acts as a master and retrieves the information from the slaves. Only one slave can respond to the requests of the master at a time.

To set up your RS485 sensor for use with the Data logger, make sure that the address is programmed correctly, and that the sensor address is unique.

9.3.1 RS485 Wiring

RS485 is often used with MODBUS /RTU-sensors, and is less susceptible for Electrical interference than RS232.

Your Data logger has one RS485 port which is capable of driving multiple sensors. (Maximum number is 10). The maximum number of slaves, defined by EIA /RS485 is 32.



Note: *We recommend using twisted pair cable to connect to the sensors.*

More information *on supported RS-485 bus topology, read this FAQ.*

9.4 Data input - MODBUS (ASCII /RTU)

9.4.1 MODBUS - Protocol Description

MODBUS© Protocol is a messaging structure, widely used to establish master-slave communication between intelligent devices. A MODBUS message sent from a master to a slave contains the address of the slave, the 'command' (e.g. 'read register' or 'write register'), the data, and a check sum (LRC or CRC). Since Modbus protocol is just a messaging structure, it is independent of the underlying physical layer. It is traditionally implemented using RS232, RS422, or RS485.

9.4.2 MODBUS - The Request

The function code in the request tells the addressed slave device what kind of action to perform. The data bytes contains any additional information that the slave will need to perform the function. For example, function code 03 will request the slave to read holding registers and respond with their contents. The data field must contain the information telling the slave which register to start at and how many registers to read. The error check field provides a method for the slave to validate the integrity of the message contents.

9.4.3 MODBUS - The Response

If the slave makes a normal response, the function code in the response is an echo of the function code in the request. The data bytes contain the data collected by the slave, such as register values or status. If an error occurs, the function code is modified to indicate that the response is an error response, and the data bytes contain a code that describes the error. The error check field allows the master to confirm that the message contents are valid.

Controllers can be setup to communicate on standard MODBUS networks using either of two transmission modes: ASCII or RTU.

9.4.4 MODBUS - ASCII Mode

When controllers are setup to communicate on a Modbus network using ASCII (American Standard Code for Information Interchange) mode, each eight-bit byte in a message is sent as two ASCII characters. The main advantage of this mode is that it allows time intervals of up to one second to occur between characters without causing an error.

9.4.5 MODBUS ASCII - Coding System

Hexadecimal ASCII printable characters 0 ... 9, A ... F

Bits per Byte:
1 Start bit
7 Data bits, least significant bit sent first
1 Bit for even / odd parity-no bit for no parity
1 Stop bit if parity is used-2 bits if no parity

Error Checking:
Longitudinal Redundancy Check (LRC)

9.4.6 MODBUS - RTU Mode

When controllers are setup to communicate on a Modbus network using RTU (Remote Terminal Unit) mode, each eight-bit byte in a message contains two four-bit hexadecimal characters. The main advantage of this mode is that its greater character density allows better data throughput than ASCII for the same baud rate. Each message must be transmitted in a continuous stream.

9.4.7 MODBUS /RTU - Coding System

Eight-bit binary, hexadecimal 0 ... 9, A ... F
Two hexadecimal characters contained in each eight-bit field of the message

Bits per Byte:
1 Start bit
8 Data bits, least significant bit sent first
1 Bit for even / odd parity-no bit for no parity
1 Stop bit if parity is used-2 bits if no parity

Error Check Field:
Cyclical Redundancy Check (CRC)

More info *can be found here: https://www.modbus.org/*

9.5 Generic information - Digital input

The ML-525SE is equipped with 3 digital inputs. These inputs are interrupt-driven. Activation on a signal-change (the Data logger will wake up when sleeping) . These inputs are ideal to use for counting events (like the pulses from an energy-meter or a rain gage), or to set an Alarm state (e.g. level or float switch). The signal level needs to be 0..5V ("0" level and "1" level). Any other voltage needs to be adapted to the right range, before connecting. The input can be configured as "pull-up" or "pull down".

9.5.1 Digital input - Pull up type

The pull up type of input has an internal resistor (40 K) mounted between the input and the Vcc Power supply. When no (ground) signal is applied, the input will be logical high. This type of inputs is very convenient for use with "open collector" systems or connect to "NPN output" sensors and devices.

9.5.2 Digital input - Pull down type

The pull up type of input has an internal resistor (40K) mounted between the input and the ground. When no (positive) signal is applied, the input will be logical low. This type of inputs is very convenient for use with "active output" systems or "PNP outputs" sensors and devices.

Note: *The maximum input voltage on digital inputs using pull-down may not exceed 5V.*

9.5.3 Digital input - Coil (floating) type

Waveform to digital pulse converter. Converts a Sine form to a digital pulse.

Note: *Typically used to connect flow or anemo-meters with a passive coil output.*

9.5.4 Digital input - Electrical specifications

The table is an overview of the Electrical specifications of the Digital inputs.
Vlow level is representing the "logical low level" on the input port. Vhigh level is representing the "logical high level" on the input port. Internal Pull up/ down resistors are 30..50k, 40k typical.

Parameter	Min	Max	Description
Vlow	0V	1.25V	Logical "Low" level
Vhigh	1.67V	5 V	Logical "High" level
Impedance	40K	40K	Internal pull up /down resistor

Return to [3-8-<p>-1] Digital inputs (Pulse)

Return to [3-8-<p>-2] Digital inputs (Alarm)

Return to [3-8-<p>-3] Digital inputs (State)

Return to [3-8-<p>-4] Digital inputs (Trigger)

9.5.5 Digital input - Pulse sensor

Digital Pulse sensors like Rain gauges, are based on the "Reed contact" principle. The rain gauge has an internal bucket with a very precise volume. It is constructed to tip over when it reaches a specified amount of water. The water is drained while the bucked is turning. A magnet (connected to the bucket) is operating a magnetic switch. ("Reed contact"). The rain gauge itself works like a passive switch. The Data logger has a special input to trigger on these events. Even when the Data logger is sleeping, the event of a tipping bucked is never missed. The Data logger uses a "Interrupt-driven input" to make this possible. Connect the rain-gauge read contact to the Ground and a digital input port. Configure the input port as "pulse input" with "internal pull-up".

Note: *The digital input offers the most energy-friendly measurements available. This is because the Data logger is allowed to sleep most of the time, and only capture the events of the digital interrupt (e.g. the tipping bucket of a rain gauge). In the situation where only one digital sensor is used, the battery is probably going to last much longer than any other measurement method. To confirm proper battery usage, include internal measurements in the configuration, to allow monitoring of the performance of the system. (iVmax).*

Example: *Configuration Rain Measurement*

This example is showing the setup for a tipping Bucket Rain Gauge, connected to a "Digital input"

```
Digital pulse sensor

[0] Exit
[1] Name                    >> Rain
[2] Sample interval         >> Data log interval
[3] Port mode               >> Port 1; Internal pull up
[4] Register mode           >> Pulse (low frequency)
[5] Units per pulse         >> 0.2
[6] Register value          >> 16979 pulses
[7] Register reset          >> Off
[8] Log each counter change >> On
[9] Counter (unit)          >> Counter
[A] Quantity (unit)         >> Quantity
[B] Mean rate (unit/h)      >> Mean Rate
[C] Max rate (unit/h)       >> Max Rate
[D] Min rate (unit/h)       >> Min Rate
[R] Remove
>
```

Change the name "Digital Pulse" into a more comprehensive one, like "Rain".

The "Unit per pulse" is a factor that converts the input pulses into a physical value.
It is advised to test the hardware (counter) first, before proceeding to selecting the right settings for bucket-size etc. Apply a known amount of pulses tot the Data logger.
Verify the counter using the command `<Ctrl>A<Shift>V<Ctrl>D` It shows the actual parameter values.

Enter the physical details of your rain-gauge.
When your rain-gauge has a tipping bucket size of 0.2 mm rain, enter 0.2 "Units per Pulse".
The counter-value can be reset to zero, by entering "0" into the "Register value"
The counter can automatically be reset at midnight enabling "Register reset", resulting in showing rain quantity on a daily base.

Notes: *"Counter" parameter will count every pulse, because the pulse counter is interrupt driven, it also works when the data logger is in sleep mode. The counter value is stored in NVRAM, it won't be lost when the data logger is powered off. (During battery replacement or power failure).*

"Quantity" is the difference between the actual counter value and the previous counter value.
When the data log interval is set to 10 minutes, this parameter shows the number of pulses per 10 minutes. Every dat log interval, the quantity value is writte to SD memory and reset to zero. It is a running value.

"Rate" is defined as time between the last two pulses applied to the Data logger, scaled to one hour. For rain measurements, the rate can be used for calculating "rain intensity". It shows the difference in rain intensity from a rain shower or drizzling rain.

Rate example:

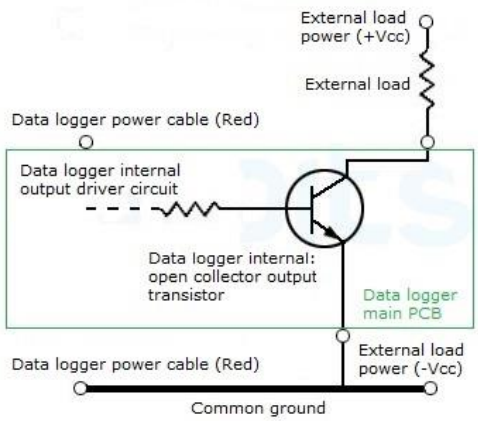
Every (bucket) pulse represents 0.2 mm rain. Whith a delay of 5 seconds between two pulses, the rate is: 1 mm per 25 seconds = 144 mm / hour.

9.6 Generic information - Digital outputs

9.6.1 Open Collector output - Pull down to Ground

In electronics a common way of driving external loads is the use of an “open collector” output. This is a transistor, with its collector left unconnected, for the benefit of user to connect to its load of interest. The open collector (OC) is very versatile, and provides the possibility to use various voltages.

The Open collector output is only capable of sinking current. The “load” is connected directly to the external power source (“high side”) . The transistor will sink to Ground.

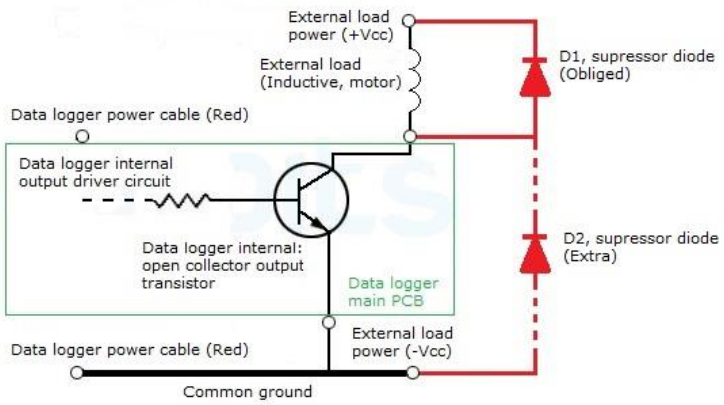


The voltage level can vary, the transistor acts as a switch and is not supplying any voltage. The maximum “supply voltage” for the load connected to the OC output (transistor) is limited to 40Vdc. (Typical 8..28V).

Note: *The transistor is an internal part of the Data logger PCB.*

9.6.2 Open collector output - Using a relay

When switching a relay or small motor (as an external “load”) , the Data logger must be protected to spikes generated when a inductive load (coil) is switched off. Always use a diode (D1), connected in parallel with the “load”. and cathode to +Vcc. (D2 is alternative protection on the external load power circuit).



10 Risk and Threat Assessment

10.1 Overview

This risk and threat assessment addresses the **525 Series Environmental Data loggers**, which fall under the scope of the **EU Radio Equipment Directive (RED)** and the **Cyber Resilience Act (CRA)** due to their integrated **cellular modem** for wireless data communication.

10.2 Intended Use

The 525 Series Environmental Data Loggers are intended for use by professional organizations, not consumers. They record non-sensitive environmental and physical parameters for integration into decision-making systems. The devices must be installed and deployed by qualified technicians. They do not process personal or financial data or any data classified as sensitive under the GDPR or CRA. If data is considered sensitive, tamperproof enclosures or restricted areas are recommended.

10.3 Identified Threats and Mitigations

Threat	Potential Risk	Mitigation Measures
Unauthorized physical access	Configuration tampering or misuse	Mandatory local password access per RED
Eavesdropping or MITM attacks	Data interception or manipulation	TLS with server certificate verification (standard protocols); AES-128/CTR encryption (native TCP)
Replay or spoofing attacks on custom protocol	Forged communication	Challenge–response mechanism using using **PB**KDF2-derived password and HMAC-SHA256 with secure random values
Configuration file exposure	Credential leakage	AES-128/CTR encryption using a strong factory secret and HMAC-SHA256 with secure random values
Unauthorized firmware installation	Malicious or vulnerable code execution	Secure bootloader with salted SHA-256 HMAC verification and protected firmware signing key
Firmware downgrade	Reintroduction of vulnerable versions	Version control enforced during firmware checks
Debugging/tampering	Extraction or modification of firmware or secrets	JTAG/SWD interfaces disabled at factory provisioning

10.4 Cryptographic Foundations

Communication using industry-standard protocols (MQTT, HTTP, FTP, SMTP) is secured with TLS and server certificate validation, as well as a native encryption and authentication mechanism for power-optimized communication, with:

- Authentication via PBKDF2 (10,000 iterations) with 16-byte cryptographically secure salt
- AES/CTR encrypted data transmission using unique session keys and IVs
- Tamper detection using per-block sequence numbers
- Firmware updates authenticated and encrypted with factory-only secrets
- Local access secured with strong passwords; all login attempts logged
- Configuration data exported encrypted (AES/CTR + HMAC-SHA256)
- SWD/JTAG disabled after factory commissioning
- Downgrade protection enforced through version checks

10.5 Update & Incident Response Policy

Critical security issues are communicated via website announcements, reseller notifications, and newsletters. Firmware updates are distributed either manually via our website or automatically via client infrastructure. Only firmware signed and encrypted with factory secrets is accepted. All update attempts are logged.

10.6 Data Communication

The device always initiates communication and acts as a TCP client. Upon session termination, the device closes all internet access. It does not expose open ports, preventing unsolicited external connections. Data transfer is supported over MQTT, HTTP, FTP, and SMTP using TLS. A native low-power protocol is also available, using password-derived keys with PBKDF2 (10,000 iterations), HMAC-SHA256 authentication, and AES/CTR encryption.

10.7 Initial Configuration and Communication Security Responsibility

Out of the box, the data logger has no preconfigured communication services (e.g., HTTP, FTP). Professional users must configure endpoints manually.

By default, only secure communication protocols (e.g., HTTPS, TLS-enabled MQTT) are enabled. If a user deliberately activates non-encrypted or unauthenticated communication, this is restricted to private, VPN-secured networks, and the user must acknowledge that this configuration does not comply with CRA baseline security recommendations.

Legacy or on-premises IoT platforms may require non-secure protocols for interoperability. Such options remain available for backward compatibility, but they are disabled by default, clearly documented, and intended only for controlled environments (e.g., testing or migration).

10.8 Data Storage and Configuration Security

Since the logger is not designed to store sensitive or personal data, measurement data is stored in plain format for functional and performance reasons. The data resides in on-board soldered flash memory and is only accessible through authorized physical access to the device.

Configuration data, including passwords, is stored in read-protected memory.

Any external configuration files, whether transferred or stored, are encrypted using AES-128/CTR with a 16-byte salted 32-byte secret key of high complexity stored in protected memory and known only to us.

10.9 Evaluation

All key cybersecurity threats such as unauthorized firmware updates, credential theft, MITM, replay, and tampering have been assessed and mitigated. Residual risks are rated low, and risk controls include secure key derivation, authenticated sessions, update logging, and physical protection.

Based on the nature of the data and implemented security mechanisms, the **overall cyber risk level is low**. The device design meets the CRA's expectation of "security by design and by default" through strong cryptographic safeguards, authenticated updates, and a hardened hardware interface.

10.10 Firmware Update Process

10.10.1 Update Policy

Firmware updates are **not mandatory** unless a confirmed **resilience vulnerability** is identified. This approach aligns with CRA principles of minimizing unnecessary intervention while maintaining security.

10.10.2 Notification and Distribution

- Users subscribed to the manufacturer's **newsletter** are notified of new firmware releases.
- Firmware can be obtained directly from the manufacturer's **official website**.

10.10.3 Update Methods

Users can perform updates in one of the following secure ways:

- **Manual update via USB**: Using a validated firmware package.
- **Remote update (hands-on session)**: Via the native TCP protocol under secure supervision.
- **Deferred server-based update**: Firmware is placed on a customer-controlled server, and the Data logger retrieves it during its next communication session.

10.10.4 Verification and Integrity Check

Before installation, the bootloader performs the following checks:

- Verifying as originating from the manufacturer via a **SHA-256 hash**, **salted** with a **16-byte secure random number**, and authenticated using a **32-character secret** with high complexity stored in protected memory.
- Checking for **version number validity** to prevent downgrade attacks.
- Validating as **untampered** and intact. Any failure results in immediate rejection by the bootloader.

10.10.5 Hardware Protections

- Firmware can only be installed if signed with a **factory-held key**.
- The **secure bootloader** is stored in **read/write-protected memory**.
- Debug interfaces (**JTAG/SWD**) are **disabled** at the factory to block firmware extraction or modification.

11 Maintenance and Repair

11.1 RTC Lithium Battery replacement

The RTC battery of the Data logger is designed to last for the lifetime of the instrument. It should not be necessary to replace this battery.

Note: *The RTC battery can be checked using Field testing menu at:*

[5-1-1] Devices, Clock battery state

11.2 Recalibration

Calibration of the Data logger has been performed while manufacturing. YDOC guarantees the calibration to last for 2 years. However in most cases the calibration will last for the lifetime of the instrument.
Calibration is important for high accuracy measurements and in situations where time stamping is very important. The logger has a NTP-time-synchronize option, which is selectable by the user. The parts of the Data logger that could need re-calibration are:

- Analog inputs
- Real time clock

For most applications, the analog inputs are sufficiently accurate, and need no re-calibration for the lifetime of the instrument. But in special cases, where the user demands a high precision measurement, the analog interface may be re-calibrated after that period. High temperature deviations and harsh environment are factors that needed to be considered. Please contact your local supplier for more information on recalibration needs and –support. The real time clock is also calibrated during the manufacturing process, and has very good long life stability (see spec. sheet). Also, when operating in a harsh environment, the need for a recalibration can be applicable. YDOC can perform overall calibrations any time you like.

11.3 XRAY

In the uncommon event of exposure to XRAY, extra precautions are needed. When the device is shipped many times, and is scanned for a security check, the analog input calibration will be harmed. Although the level of radiation is very low, the Data logger can be harmed if the number of times that it is exposed to radiation exceeds 10. What will happen is that the analog interface will drift outside its spec's. As a precaution the user can shield his device, with a metal can, to prevent from damage. Normally, the impacts of these security-scans are very low and cause no problems.

12 Safety

Don't work on the wiring of the Data logger when powered from an external supply.

12.1 Power supply

The Data logger is protected against reversed polarity of the battery power. The mains power supply is protected by a 4AT fuse type TR5.

12.2 ESD

The Data logger is equipped with an ESD (Electronic Static Discharge) protection on all "outside world" leads. i.e. comports and analog inputs etc. Though it is designed to withstand a certain amount of electrical discharge (human body model) it is strongly advised to take precautions while operating or servicing the Data logger.

13 Environment and disposal

The Data logger is manufactured in compliance with the RoHS directive (Reduction of Hazardous Substances) EU directive 2002/95/EC, which means in popular terms that the product is "lead-free".

When the Data logger is taken out of service, dispose the Data logger in accordance to the local regulations at the time the product is disposed.

Regulations for disposal of batteries may be different. Remove the batteries and dispose them in accordance to the local regulations for batteries.

14 Transport and Storage

The following requirements are applicable for transport and storage of the Data logger.

Storage:

Humidity	< 95% (Non condensing)
Temp	10 .. 30 °C

Transport:

Humidity	< 95% (Non condensing)
Temp	10 .. 30 °C

If the Data logger is delivered in its standard protecting enclosure, it is strongly recommended to use this case for all transportation, until the final location of operation. This enclosure is especially designed to protect the Data logger from being damaged.

15 Appendix

15.1 Specifications

Power Supply					
Protection	Overvoltage and reverse polarity protection. (By transorp and Fuse)				
Input Range	0.8 .. 5 Vdc				
Type of Power	Battery				
Power Consumption *	Sleep mode		Operating mode		Send mode
	360 uW	100 uA @ 3.6 Volts	180 mW	50 mA @3.6 Volts	~1 Watt	~ 300 mA @ 3.6 Volts
General Enviroment					
Temperature	Operating: -30 .. +75 °C; Storage -40 .. +85 °C				
Humidity	5 .. 100 % RH				
IP Protection	IP68 (When operated in the original enclosure)				
Operation					
Batterylife	Up to 10 years, consult the User manual for more information				
Configuration Programming	Via USB port or remote. (No extra softw are needed, Ydocterminal or other terminal program)				
Data Retrieval	Manually exchange via optional micro SD-card Automatic via LTE (Email / FTP / Native protocol) Via USB-Connection by means of data dow nload on a Computer (Windows)				
Alarming	On pre-defined thresholds of measurements;				
Sensor Excitation	Internal boost convertor for supplying remote sensors ; 200 mA @ 12 Volts				
System					
CPU	ARM Cortex M4				
Clock Frequency	80 Mhz (Max.)				
Watchdog	Yes				
RTC (Real Time Clock)	Yes, internally. Accuracy < 100 ppm. Battery Backuped				
FLASH Memory	512 KB				
SRAM	160 KB				
NVRAM	84 bytes , battery backup, data valid up to 20 years				
Analog inputs	12 bits				
Temperature sensor	Yes				
Pow er Sensor	Yes, Monitors pow er consumption, rest-capacity of battery				
Expansion bus	One, for optional modules. Extra I/O, Wifi, BLE, future functionality.				
USB port	USB 2.0 full speed interface				
Sample Frequency	Max. 10 Hz				
Datalog Frequency	Max. 10 Hz				
Rohs Complient	Yes				
Analog Inputs					
Number of Channels	4				
Resolution	12 bits				
Input type	Current 0 or 4..20 mA. (Channel 1 & 2)				
Input type	Voltage 0..10 V. (Channel 3 & 4)				
Memory Card					
Type	micro-SD				
Capacity	Max. 32 GB				
Filesystem	FAT 32				
Communication Ports					
SER1	RS232. TxD, RxD. Non-isolated. Enhanced ESD Specification: ±15kV Human Body Model.				
	Speed: Max. 230400 Bps				
	RS485				
	SDI12				
SER2	RS232. TxD, RxD. Non-isolated. Enhanced ESD Specification: ±15kV Human Body Model.				
	Speed: Max. 230400 Bps				
Counter input					
Type	One Digital input 0..3.6 Volt. Internal pull-up /down. Max. 50 kHz max.				
	Storage of value in NVR. (Even after battery replacement)				
LTE-M /NB-IOT Modem					
Frequency Range	850 / 900/ 1700 / 1800 / 1900 / 2100 MHz				
Capabilities	LTE-m /SMS /EMAIL /FTP /HTTP /MQTT				
Dimensions					
W x H	110 x 88 mm (PCB), 150 x 121 x 95 mm (Enclosure)				
Weight					
Netto Weight	PCB: 59 Grams (PCB). Enclosure: 355 grams				

15.2 CE Declarations of Conformity

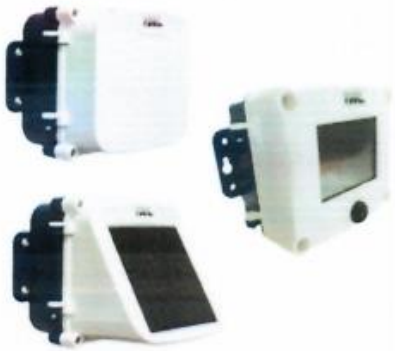
The document can be found here: https://ydoc.biz/docs/525-eu-declaration-of-conformity/

EU Declaration of Conformity

Product identification

ML-525xx Environmental Data Logger

Device for recording and transmitting non-sensitive environmental and physical parameters (e.g., temperature, humidity, soil moisture) using connected sensors, with wireless communication for data transfer.



Main PCB Versions:

- ML-525LE-PCB – Lite Edition
- ML-525SE-PCB – Standard Edition
- ML-525PE-PCB – Planetwide Edition

Assembled product variants:

- LE Edition with enclosure: RS-525LE-PV
- SE & PE Editions with enclosure and power supply boards: RS-525xe-LI, RS-525xe-3LI, RS-525xe-DC, RS-525xe-DC-LI, RS-525xe-LFP, RS-525xe-SLA and RS-525xe-PV
- SE & PE Editions with Touch Screen enclosure and power supply boards: TS-525xe-LI, TS-525xe-DC, TS-525xe-DC-LI, TS-525xe-LFP, TS-525xe-SLA

EU Declaration of Conformity

We, Your Data Our Care B.V., declare under our sole responsibility that the product described above is in conformity with the relevant Union harmonisation legislation:

- Radio Equipment Directive (RED) 2014/53/EU, including Article 3(3)(d) as mandated by Delegated Regulation (EU) 2022/30

- Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU, as amended by Directive (EU) 2015/863

Essential requirements met:

- Article 3(1)(a): Health and Safety
- Article 3(1)(b): Electromagnetic Compatibility
- Article 3(2): Efficient Use of Radio Spectrum
- Article 3(3)(d): Safeguards for Network Protection

Applied Standards: EN 62368-1, EN 301 489-1/-52, EN 301 908-1/-13, ETSI EN 303 645

Signed for and on behalf of Your Dara Our Care B.V., Da Vincilaan 13C, 6716WC, Ede, The Netherlands:

Remco Kleine
Chief Technology Officer

Ede, 15-Sep-2025

15.3 System messages

System messages list with codes and explanation. (S-records in TXT and CSV files or $Msg-lines in JSON data log files).

CODE	CODE or text	Meaning	Possible reasons
SYS_START	"System name & S/N"	System is started and deployed	At power on, or reset
SYS_DEPLOYED	"System name & S/N"	System is deployed	After a resume command or a delayed deployment
SYS_SUSPENDED	"System name & S/N"	System is suspended until deployment is started	When not yet deployment start time is reached
SYS_UPGRADED	"System name & S/N"	Firmware upgrade detected	After firmware upgrade
CFG_CHANGED	"System name & S/N"	Configuration has changed	After configuration editing
CFG_ERR		Configuration error	Firmware downgrading, or configuration upload with different version
NO_CFG		No configuration detected	Data logger is not yet configured
BLE_INIT	"BLE module init failure"	BLE option board was detected, but BLE module does not respond as expected	Lack of power or module defect
CFG_UPL	"cause of failure"	Configuration upload failed	Disruption in the data transfer, or SD card failure
SNP_UPL	"cause of failure"	Configuration snippet upload failed	Wrong settings or unknown drivers or parameters
FW_UPG	"cause of failure"	Firmware upgrade failed	Disruption in the data transfer, or SD card failure
POWER_ON	“logger type and version”	System is powered on	The external power was cut off and put on again
CFG_RESET	“logger type and version”	Configuration has changed	After a configuration upload or configuration menu change
UPG_RESET	“logger type and version”	Firmware is upgraded	After a successful firmware upgrade
SW_RESET	“logger type and version”	Software reset by the system	After a flash failure or CRC error (which usually results in a non-functioning logger)
USR_RESET	“logger type and version”	The user has issued the reboot command in the maintenance menu	Up to the user
HW_RESET	“logger type and version”	Unscheduled reboot has occurred	Unknown to us, else it would not occur
PVD_RESET	“logger type and version”	After a internal power voltage detection lower than 2.6V which takes longer then 8 seconds	Batteries are depleted, or the external power adapter can’t deliver enough power
WDT_RESET	“logger type and version”	Firmware reset after a possible software deadlock	Unknown
BL_RESET	“logger type and version”	The user has issued the bootloader command in the maintenance menu	E.g. to erase the configuration or to perform a firmware upgrade via the bootloader
HARD_EXCP	“logger type and version”	Auto system reset	Unknown hardware failure
MEM_EXCP	“logger type and version”	Auto system reset	Unknown software failure

BUS_EXCP	“logger type and version”	Auto system reset	Unknown hardware failure
USAGE_EXCP	“logger type and version”	Auto system reset	Unknown software failure
PVD_DIP	"Internal power too low, X dip's at 2.6 V"	Power voltage detection dips	When the internal power (temporarily) drops unexpectedly below 2.6V (power has returned before switch off occurred)
SD_FAIL	"number"	Number of temporarily SD card failures	SD card failure
SYS_PAUZED	"System name & S/N"	Operation is suspended until resume command is given	When the user gives a suspend command
SYS_RESUMED	"System name & S/N"	Operation is resumed again	When the user gives a resume command
CFG_MENU	"Operation suspended"	Edit mode	When entering the configuration menu
CFG_MENU	"Operation resumed"	Run mode	When leaving the configuration menu
LP_SLEEP	"Start voltage too low"	LFP battery power has dropped to 2.8 Volt	System goes to sleep until batteries are recharged again
WDT	"Sensor name"	Shows the sensor driver name were the watchdog timeout occurred	Sensor defect, or wrongly connected, or warmup time too short
WDT	WIFI_INIT	Watchdog timeout while initializing Wi-Fi module	No response from Wi-Fi Module
WDT	APN_SET	Watchdog timeout while setting Wi-Fi APN	No response from Wi-Fi Module
WDT	IMEI_CHECK	Watchdog timeout while getting IMEI number	Modem not responding due to lack of power or Modem has died because of flash corruption due to power failures
WDT	SIM_DETECT	Watchdog timeout while getting SIM status	Modem not responding due to lack of power or Modem has died because of flash corruption due to power failures
WDT	MODEM_INIT	Watchdog timeout while initializing Modem	Modem not responding
WDT	NETWORK_REG	Watchdog timeout while trying to register on a network	No response, or (temporarily) no network coverage, or SIM subscription failure (inactive/invalid/blocked or black listed)
WDT	SECURITY_SET	Watchdog timeout during security setting	No response
WDT	APN_CHECK	Watchdog timeout while checking the internet access point	No response, or APN access point name wrong
WDT	APN_LOGIN	Watchdog timeout while trying to login to the internet access point	No response, or APN user or password wrong, or authentication failure
WDT	SERVER_LOGIN	Watchdog timeout while trying to login to the Email/FTP/TCP/HTTP/MQTT server	No response, or server not available, or credentials wrong
WDT	FILE_OPEN	Watchdog timeout while trying to open a file on the FTP server	No response, or unexpected network disruption, or server error
WDT	SERVER_CLOSE	Watchdog timeout while closing the sever	No response, or unexpected network disruption, or server error
WDT	CHANGE_DIR	Watchdog timeout while changing directory on the FTP server	No response, or unexpected network disruption, or server error

WDT	FILE_OPEN	Watchdog timeout while opening a file on the FTP server	No response, or unexpected network disruption, or server error
WDT	FILE_GET	Watchdog timeout while reading a file on the FTP server	No response, or unexpected network disruption, or server error
WDT	FILE_SIZE	Watchdog timeout while getting the file size on the FTP server	No response, or unexpected network disruption, or server error
WDT	DATA_SENDING	Watchdog timeout while sending data to the server	No response, or unexpected network disruption, or server error
WDT	TCP_RESPONCE HTTP_RESPONCE	Watchdog timeout while waiting for acknowledge from the TCP/HTTP server	No response, or unexpected network disruption, or server error
WDT	DATA_END	Watchdog timeout while trying to disconnect from the server connection	No response, or unexpected network disruption, or server error
WDT	TCP_TERMINAL	Watchdog timeout during remote TCP session	Unexpected network disruption, or server error
WDT	SMS_SEND	Watchdog timeout during SMS sending	No response, or unexpected network disruption, or server error
WDT	"STATE number"	State machine step where the watchdog timeout occurred	No response
ERR	"Driver name"	Shows the driver name were an error occurred, with if applicable some additional information	Sensor defect, or unknown failure
ERR	WIFI_INIT	Error while initializing Wi-Fi module	Error in Wi-Fi settings
ERR	APN_SET	Error while setting Wi-Fi APN	Error in APN settings
ERR	IMEI_CHECK	Error while getting IMEI number	Wrong IMEI number reported
ERR	SIM_DETECT	Error while getting SIM status	No SIM, or SIM not detected, or PIN on SIM or Modem not responding due to power failure due to lack of power
ERR	MODEM_INIT	Error while initializing Modem	Modem not responding
ERR	NETWORK_REG	Error while trying to register on a network	(Temporarily) no network coverage, or SIM subscription failure (inactive/invalid/blocked or black listed)
ERR	SECURITY_SET	Error during security setting	Error in security settings
ERR	APN_CHECK	Error while checking the internet access point	Error in APN and authentication settings
ERR	APN_LOGIN	Error while trying to login to the internet access point	APN access point, user name or password wrong, or authentication failure
ERR	SERVER_LOGIN	Error while trying to login to the Email/FTP/TCP/HTTP/MQTT server	Server not available or credentials wrong
ERR	SERVER_CLOSE	Error while closing the sever	Unexpected network disruption, or server error
ERR	CHANGE_DIR	Error while changing directory on the FTP server	Wrong or none existing directory on FTP server

ERR	FILE_OPEN	Error while trying to open a file on the FTP server	File handling error on the server (read/write rights)
ERR	FILE_GET	Error while reading a file on the FTP server	File handling error on the server (read/write rights)
ERR	FILE_SIZE	Error while getting the file size on the FTP server	File is removed to quickly on FTP server
ERR	DATA_SENDING	Error while sending data to the server	Unexpected network disruption, or server error
ERR	TCP_RESPONCE HTTP_RESPONCE	Error while waiting for acknowledge from the TCP/HTTP server	Unexpected network disruption, or server error
ERR	DATA_END	Error trying to disconnect from server	Unexpected network disruption, or server error
ERR	TCP_TERMINAL	Error during remote TCP session	Unexpected network disruption, or server error
ERR	SMS_SEND	Error during SMS sending	Unexpected network disruption, or server error
ERR	TLR	Error in Terminal Link Request	When security verification failed or when scheduled time is in the past
ERR	PAR	Error in processing FTP input parameter	Wrong or none existing parameter
ERR	"STATE number"	Modem state machine step were the error occurred	Unknown
REG_SET	"digital sensor name"	Shows the setting of the counter register	When the register is set during a configuration change
REG_RESET	"digital sensor name"	Shows the reset of the counter register	When daily reset is on, or after manual change
STR	"Driver name; raw data"	Shows the raw data log	When this option is enabled (generic serial string and GPS)
TIME_FIX	"+/- number of sec"	Shows the number seconds the internal clock was adjusted	After a NTP time synchronization
TIME_FIX	"Summer time started"	Shows that the clock is adjusted to the start of summer time	When summer time (daylight saving) option is enabled
TIME_FIX	"Summer time ended"	Shows that the clock is adjusted to the end of summer time	When summer time (daylight saving) option is enabled
ALARM_SET	"Code; limit; value"	Shows the parameter code, alarm limit and actual value	When the alarm is raised
ALARM_RESET	"Code; limit; value"	Shows the parameter code, alarm limit and actual value	When the alarm is cleared
ALARM_SEND_OK		The Alarm message has been send	When the message has send
ALARM_SEND_ERR		The Alarm message has not been send	There will also be a Modem or Wi-Fi failure shown
INV	"Driver name"	"Has invalid data"	For aggregations: There are no samples to aggregate. For sensors: The data is invalid
INV	"Driver name"	"Maximum value reached"	If pulse rate is higher than 1 per second, the Max rate parameter value is invalid
STATUS	"Power too low"	When starting the logger and detecting (depending on power board and battery type setting), that the power is not sufficient to properly operate the logger	Batteries are flat, or the external power adapter can't deliver enough power

STATUS	"Power too low; Modem temporarily disabled"	Modem is disabled due to lack of sufficient power	Batteries are flat, or the external power adapter can't deliver enough power
STATUS	"Analog burst start" or "Analog burst end"	To indicate the start and end of the Analog burst log	
DEBUG	"Deregistering from the not responding network"	In order to try to reregister on to the Network	When it takes to long to register on to the Network (3 minutes)
DEBUG	"BLE interface terminated due to inactivity timeout"	The BLE connection is terminated in order to save power	When there is 3 minutes no user interaction on the BLE connection
DEBUG	"option board not detected"	Specified option board is not detected	Option board is not present, removed or broken