OPERATING MANUAL
RECEIVER INSERT EM-42-SD

LEVEL MEASUREMENT OF LIQUID

TYPE	EM-42-SD
Part number	040-5040

DATE: 01/20/2025
VERSION: D 1.0

**LEVEL
MEASUREMENT**

TABLE OF CONTENTS

1. SYMBOLS AND SIGNS USED IN THE OPERATING MANUAL

CAUTION

Indicates potential damaging of the device or injury of the operator or user in the event of non-observance of the instructions.

WARNING

Indicates potential damaging of the device in the event of non-observance of the instructions.

SAFETY INFORMATION

For equipment intended for use in explosion-hazardous areas in accordance with directive 2014/34/EU (ATEX) and IECEx scheme.

2. SAFETY INFORMATION AND WARNINGS

The manufacturer is not liable for damage caused by the non-observance of the safety information and warnings.

Read this manual before using the device.

The insert may only be used for its intended purpose.

For safety reasons, this module may not be used differently than specified.

Improper use can endanger people and damage system parts.

Only qualified and trained personnel may install, service and operate these devices.

Proper handling guarantees correct and safe operation.

Please observe the following for the operation of the devices:
- All components may only be installed when the electricity supply is switched off.
- Ideally, hold the EM-42-SD by the front panel or the front panel holder to avoid damaging the electronic board.

Please contact WEKA AG, Switzerland (www.weka-ag.ch) should problems occur during the correct use that are not described in this manual or not described comprehensively enough.

3.   PROPER USE

The cell content measuring systems have been specially developed for tanks with an irregular shape and non-linear tank characteristics, such as the tanks of underwater vessels or tanks in the shape of a horizontal cylinder. In the past, the following three criteria had to be met for precise content measurement:

1. The deviation of the measured values from the ideal characteristic curve must just be extremely small. Tolerances, rounding errors, welding tolerances as well as curved or additional interior parts in the tank (e.g., pipes) inevitably lead to measuring faults.

2. The mounting dimensions of the sensors were precisely matched to the tank characteristic curve and had to be kept exactly to the calculated base line.

3. Subsequent changes to the tank geometry required new sensors.

These facts, in conjunction with our expertise, led to the development of the tank content measuring systems, as they are used today and have been designed optimally for irregular tank shapes, in particular for marine applications.

Changing the tank geometry, merely requires the software to be adjusted.

The main function of the system is to record, process and forward the measurement data to the control and display unit. In this manner, the measuring data is utilized for the trimming and navigation of the ship or for the controlling of the industrial process.

The tank content measurement system must comply with the following requirements:

• Integration of all sensors

• Processing and calculation of all tank content measurement data and forwarding it to the computer system

• Self-test of all transducers (fault detection in the event of the exceeding or falling short of the range as well as the precise localization of the fault)

• Compatibility with all standardized 4...20 mA input signals

• Simple and service-friendly operation of the system

Each sensor for ships or industrial applications can be constructed individually, since the receiver unit utilizes standard signals. The difference is then configured in the SD card.

For optimal system data, only high-quality sensors should be used.

The system is comprised of the following basic units:

- Level sensors / transmitters
- 4...20 mA transducers
- Supply and receiver unit.

A shortened EURO card (100 mm x 100 mm) is used as the format for the receiver unit, with the advantage that the unit can be constructed in a highly compact manner.

Most tanks are not proportional in fill level to volume. However, the EM-42-SD calculates and provides the precise volume for each fill level.

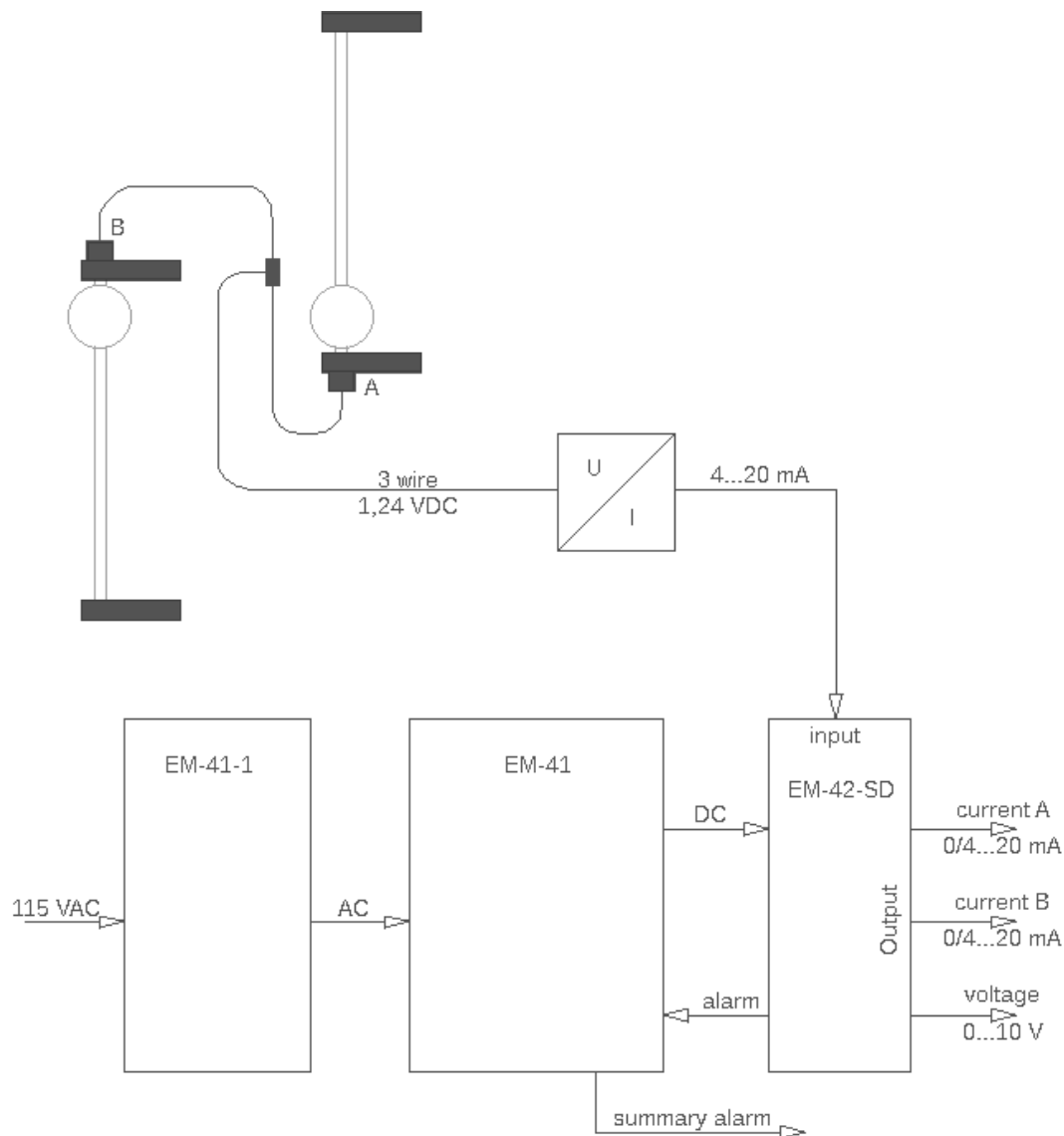All analog signals are processed directly and forwarded as 0/4...20 mA or 0...10 VDC output.

Figure 1

4.   RECEIVER MODULE EM-42-SD

In each case, the receiver modules EM-42-SD are mounted on a EURO card (100 mm x 100 mm).

The entire card with the exception of the SD card is coated with an insulation and protection varnish that also protects the electronics against high air humidity.

The modules are interchangeable.

The SD card is also interchangeable to enable modifications to the configuration, which are required in the event of changes of the tank characteristic curve.

The EM-42-SD features two analog current outputs 0...20 mA or 4...20 mA (configurable) and a voltage output 0...10 VDC.

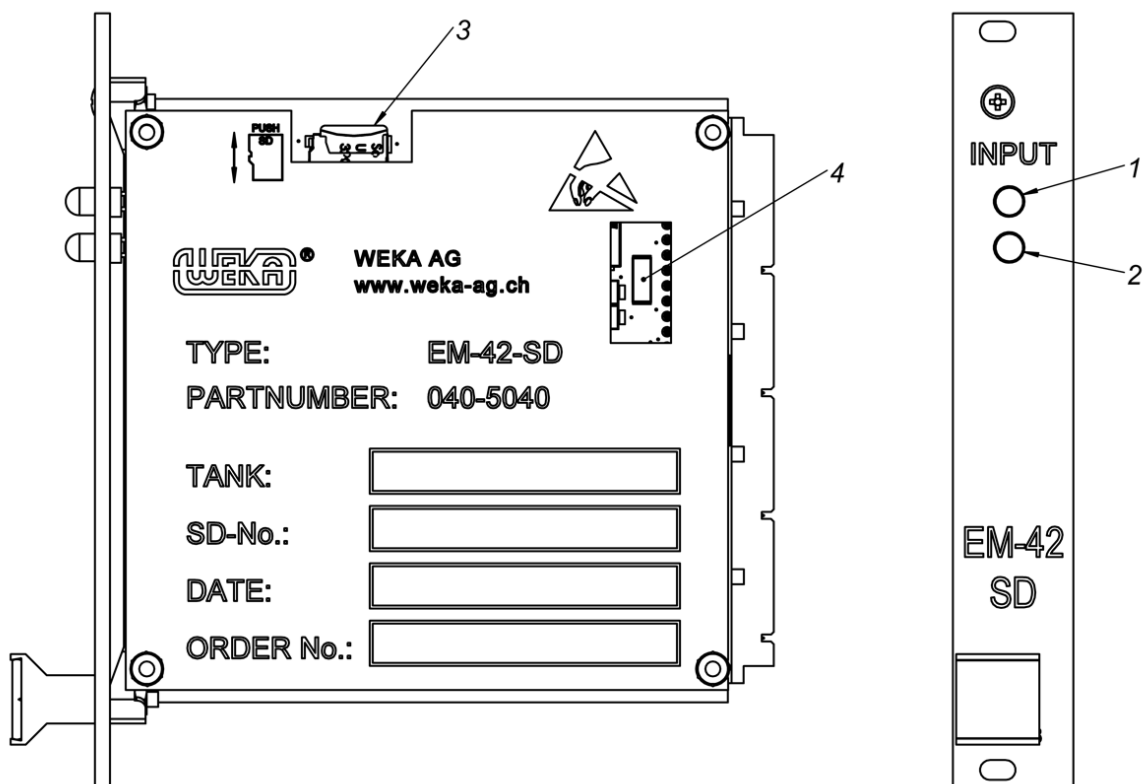🛑 **The unit is not intended for use in potentially explosive areas.**

Figure 2

1	LED green	Operating display
2	LED red	Error display
3	SD card slot	
4	Fuse F1	

5. FUNCTION OF THE RECEIVER INSERT EM-42-SD

The voltage signal of the transmitter is converted into a current signal 4...20 mA by the measuring transducer MU-80 / MU-80-Ex. This analog signal is then digitized by the D/A converter of the EM-42-SD and converted back into a voltage signal 0...10 VDC with the configured characteristic curves on the SD card by a D/A converter and processed.

The EM-42-SD provides two separate voltage outputs of 4...20 mA or 0...20 mA.

The configuration of the tank characteristic curve is performed by a CSV table in the SD card.

5.1 Hardware

The newly designed hardware is 100% compatible with the EM-42 version with EPROM.

The hardware V2.03 consists of:

- Microcontroller
- SD card
- 2 status LEDs
- 2x parallel 12-bit analog outputs. (0...20 mA / 4...20 mA)
- 1x 12-bit analog output (0...10 VDC)
- 3 digital alarm outputs
- 1 digital input (alarm acknowledgment)
- 1 lamp test signal (not controlled by the microcontroller)
- 1 digital output for the collective alarm

5.1.1 SD card

The hardware is configured by means of an SD card using a CSV file (see Configuration).

The hardware configuration is loaded into the microcontroller's memory each time it is started. Both LEDs will flash for 5 seconds, and the internal configuration will be applied when no SD card is present or if an error occurs during loading.

A report file is written to the SD card when the alarm acknowledgment is pressed for 5 seconds (see Report file (report.csv)).
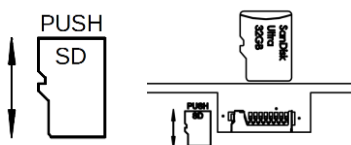

Figure 3

Insert the SD card into the corresponding slot as indicated on the cover plate.

Each SD card is numbered (e.g., 936-0100). This is necessary so that the specific characteristic curve of the SD card can be assigned to the respective tank.

5.1.2   LED displays

If the input signal of the EM-42-SD leaves the range of 4...20 mA (defective transducer, short-circuit, signal interruption), the green LED goes out and the error is indicated by the flashing red LED.
Once the error has been rectified, the green LED indicates error-free operation again.

- LED green lights up: Signal of the analog input is within the defined range, "normal operation"
- LED red flashes: Signal of the analog input is outside the defined range.
- LED red lights up: Signal of the analog input is outside the defined range and the alarm has been acknowledged.
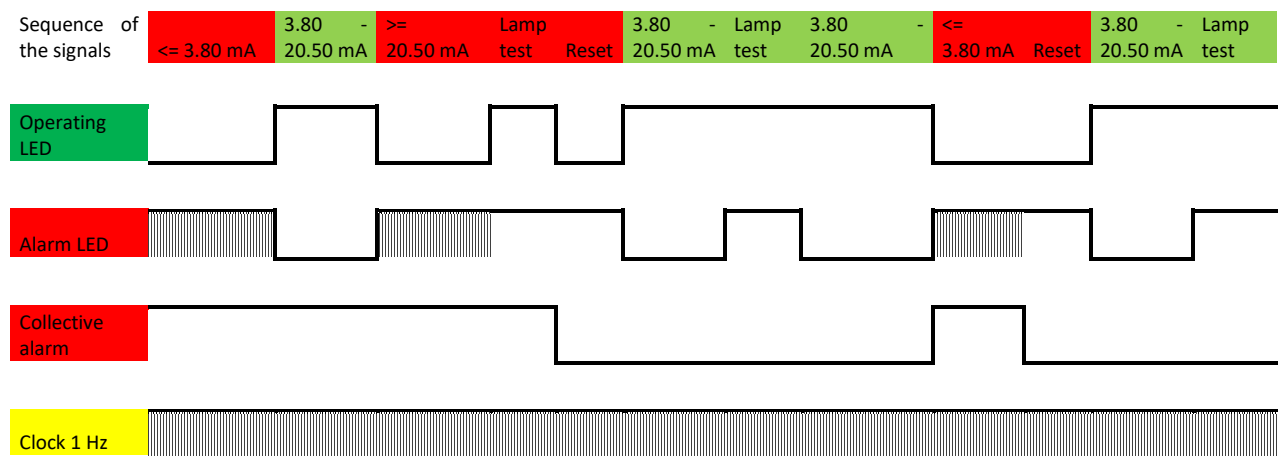

Figure 4

5.1.3   Lamp test

Irrespective of the firmware, the lamp test signal is used to test if both LEDs turn on.

5.1.4   Alarm acknowledgment

When this input is set and an alarm is present, an acknowledgement report (REPORT ALARMS ACK) is saved to the microcontroller's internal memory and the red LED will light up
(see 5.1.2 LED displays).
If the input is set for 4 seconds, the message REPORT REQUEST is stored in the internal memory and a report file is written to the SD card.

The green LED flashes rapidly for 2 seconds after the successful writing to the card. When no SD card is present, both LEDs flash rapidly to indicate that the writing operation has failed.

5.1.5   Alarm outputs

There are 3 alarm outputs. The corresponding alarm output is set when the analog signal at the output is within the configured alarm values. The alarm ranges are defined as a percentage in the configuration file and relates to the analog output signal. See 5.3 Field description – File EM-42.csv
The specified hysteresis is used during the reset of the alarms.

Examples:
Alarm range 0% – 30%, hysteresis 1%
Alarm is switched on between 0 and 30% and switched off at 31%.
Alarm range 70% – 90%, hysteresis 1%
Alarm is switched on between 70% and 90% and switched off at 69% and 89%.

5.1.6   Collective alarm

The collective alarm is signaled when the input signal of the EM-42-SD has left the range of 4...20 mA (defective transducer, short-circuit, signal interruption). The collective alarm also remains set when the input signal returns to the range of 4...20 mA until the alarm acknowledgment is actuated.

5.1.7   Analog input

The input range of the analog input signal lies at 0 – 22.00 mA.
Resolution: 5.34 µA.

5.1.8   Analog outputs

Current output: 2 configurable analog outputs 0...20 mA / 4...20 mA connected in parallel
Voltage output: 1 output 0...10 VDC
The output values are output to the analog outputs depending on the configuration.
In the configuration file, the current output range 0...20 mA or 4...20 mA, linear or non-linear, inverting or non-inverting and the filters are configured.
Resolution of the current output: 5.34 µA
Resolution of the voltage output: 2.67 mVDC

5.1.9   Fuse

The analog input is protected by a fuse with the identification F1. The fuse is located underneath the small recess in the cover plate.

Identification: F1

Type: OMF125 63 mA   Manufacturer's number: 3404.0003.11

5.1.10   Clock 1 Hz

Digital output with 1 Hz frequency.

Output voltage: 5 VDC

Max. output curent: 10 mA

5.2   Configuration of the SD card

The modules are delivered with a standard SD card from the factory. This means that each module is equipped with a 1:1 SD card on which the output signal corresponds to the input signal. This facilitates the commissioning of the system without having to program the tank characteristic curve beforehand.

5.3   Field description – File EM-42.csv

The configuration of the EM-42-SD is performed using the file EM-42.csv in the SD card.
The following data is present in the Em-42.csv file:

SD_NO: Here, the SD card number is given
TANK: Here, the tank designation is given
INVERTER: Type of measurement. Input: NO, YES
I_OUT: Analog outputs. Input: 0_20; 4_20
LINEAR: NO; YES
FILTER: Output filter in seconds (0.1 s – 15 s)

Alarm1:   Initial range   End range   Hysteresis
Alarm2:   Initial range   End range   Hysteresis
Alarm3:   Initial range   End range   Hysteresis

Characteristic curve:

HVPx	Input value in %	Output value in %
HVPx	Input value in %	Output value in %
HVPx	Input value in %	Output value in %
HVPx	Input value in %	Output value in %
HVPx	Input value in %	Output value in %

⚠️ **The characteristic curve must be specified in the non-inverted case.**

The customer must prepare a table with the height and volume proportional values (characteristic curve) to be able to configure the definite SD card.
The two values of height (%) and volume (%) are required:

Example:

H (%)	V (%)
0.0	0.0
20.0	10.0
40.0	30.0
50.0	50.0
60.0	70.0
80.0	90.0
100.0	100.0

WEKA AG then creates a diagram with the tank characteristic curve on the basis of the provided table (see the example featured below).

5.4   Example of configuration table EM-42.csv

SD_NO	936-0100		
TANK	Trim tank 4 Stb.		
INVERT	NO		
I_OUT	4_20		
LINEAR	NO		
Filter	6		
Alarm1	0	30	1
Alarm2	70	100	1
Alarm3	90	100	1
	Input %	Output %	
HVP1	0	0	
HVP2	20	30	
HVP3	40	30	
HVP4	50	50	
HVP5	60	70	
HVP6	80	90	
HVP7	100	100	

5.5   Report file (report.csv)

The report file is a CSV-table and consists of:

SD_NO:	SD number
Tank:	Tank designation
Firmware:	Firmware version
Event time:	Event time (hh:mm:ss)
Description:	Event description

Here, the latest event appears in first place, while the oldest recorded event appears last.

5.5.1   Event time

The time from the last report request is displayed. The report request is performed by setting the alarm acknowledgment for 5 seconds.

5.5.2 Event description

NO ALARM   No alarm, alarm was canceled

ALARM WIRING OPEN   < 3.6 mA

ALARM FAILURE LOW   3.6 – 3.8 mA

NORMAL UNDER RANGE 3.8 – 4.0 mA

NO ALARM   4.0 – 20.0 mA

NORMAL OVER RANGE   20.0 – 20.5 mA

ALARM FAILURE HIGH   20.5 – 21.5 mA

ALARM WIRING SHORT   > 21.5 mA

REPORT START MCU   Restart of the microcontroller

REPORT ALARMS ACK   Alarm acknowledgment

REPORT REQUEST   Write report file on SD card (report.csv)

         (Actuate 4 s alarm acknowledgment)
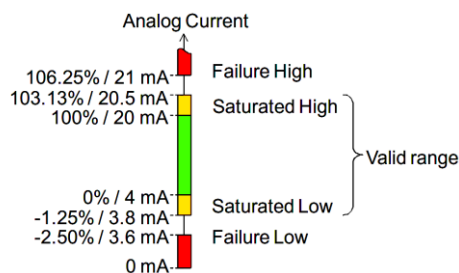
NAMUR Standard NE-43		
>22.0 mA	Wiring Problem (short)	
20.5 – 22.0 mA	Transmitter Failure	
20.0 – 20.5 mA	Normal Over Range	
4.0 – 20.0 mA	Normal Operation	
3.8 – 4.0 mA	Normal Under Range	
3.6 – 3.8 mA	Transmitter Failure	
0 – 3.6 mA	Wiring Problem (open)	

Figure 5

5.5.3 Example report file

SD NO: 936-0100
Tank: Trim tank 4 Stb. - 2
Firmware: V1.000

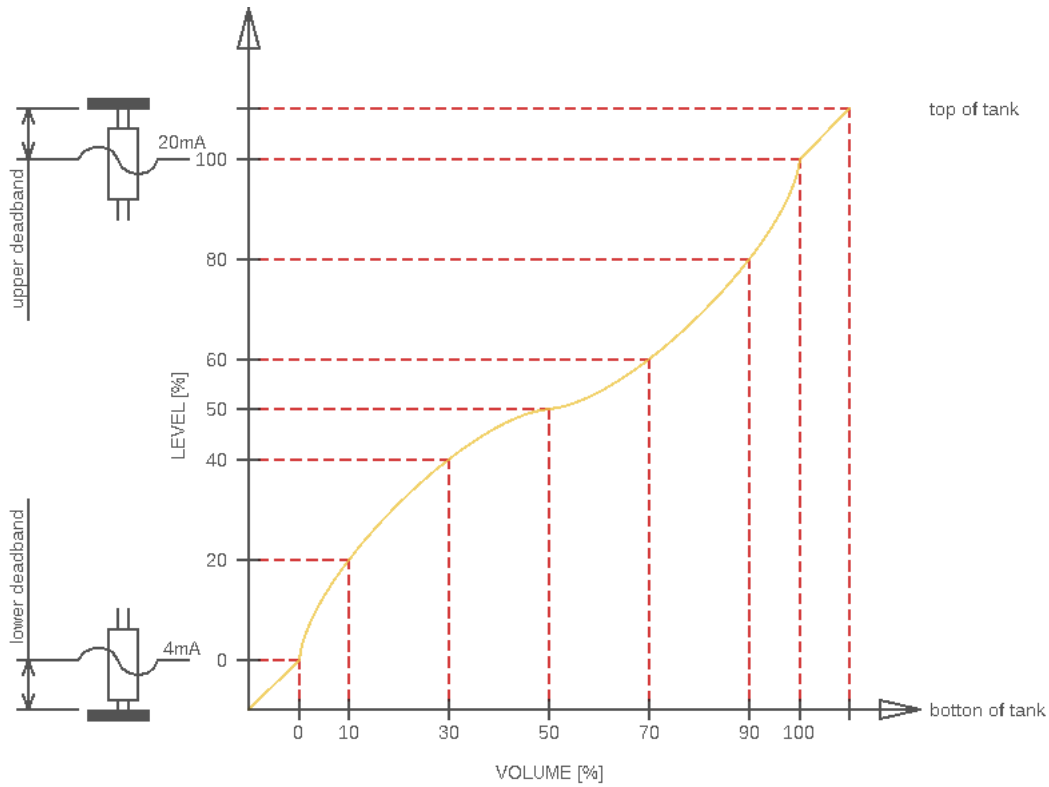| Event time	Description
-0:00:00	REPORT REQUEST
-0:00:04	REPORT ALARMS ACK
-0:00:06	ALARM WIRING OPEN
-0:00:39	NO ALARM
-0:00:55	REPORT ALARMS ACK
-0:01:07	ALARM WIRING OPEN
-0:01:08	REPORT START MCU

5.6   Example of a tank characteristic curve

Figure 6

Due to the structural design of the transmitter, the upper and lower "dead bands" cannot be recorded (see the following Figure 7).

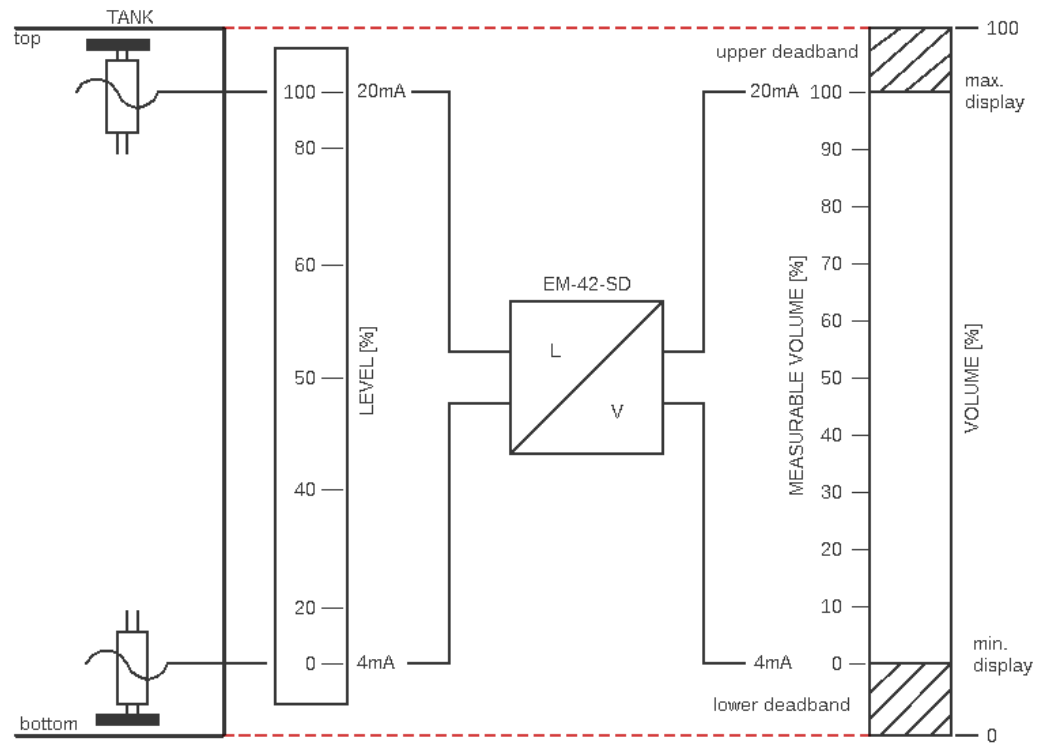⚠️ **Please take this into consideration during the spatial integration**

Figure 7

6.   TECHNICAL DATA

Outputs: Output with configurable current signal 0…20 mA or 4…20 mA for each tank. (Volume-proportional characteristic curve configured in the SD card.)

CAUTION: Never connect the positive and negative poles of the input lines with each other. This will lead to the failure of the fuse and the overall function.

Type	EM_42-SD
Order number	040-5040
Description	Plug-in receiver module for EM-40 systems
Voltage supply	+15 VDC
	+5 VDC
	-15 VDC
	+24 VDC
	(all from control module EM-41)
Input	4…20 mA
Output	1 x 0…10 VDC
	2 x 0/4…20 mA (configurable)
Display	1 x operation (LED, green)
	1 x alarm (LED, red)
Width	4TE / 20.3 mm
Height/depth	3HE / 128.4 mm x 155 mm (19" system)
Operating temperature	-20 °C…+85 °C
Weight	0.2 kg
Notes	Receiver with programmable transfer function.
	SD card must be ordered separately.

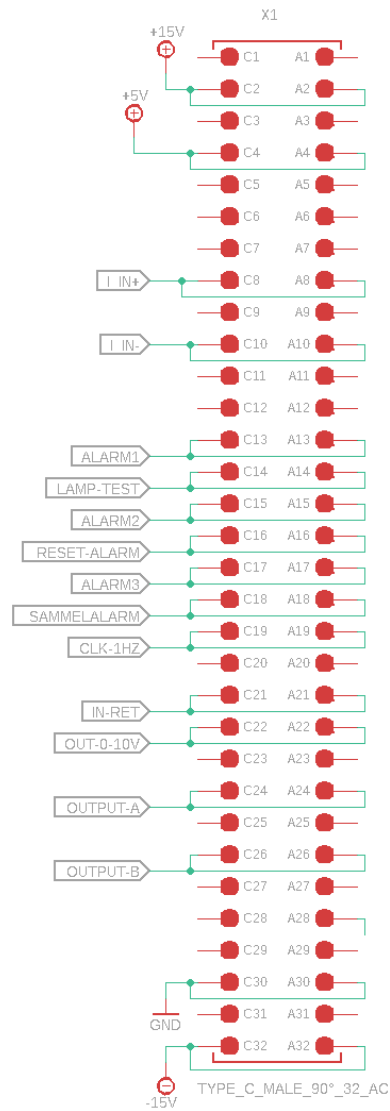|	Min.	Max.	Unit
Analog input (4-20 mA)	0	50	mA
Analog output (0/4-20 mA)	0	20	mA
Analog output (0/4-20 mA) resolution		5.34	µA
Analog output (0-10 VDC)	0	10	V
Analog output (0-10 VDC) resolution		2.67	mV
Digital output, voltage	0	5	V
Digital output, current		10	mA
Digital input, voltage		5	V
Digital input, current		0.5	mA
Burden		500	ohm

7.   PIN ASSIGNMENT

Figure 8

+15 V	Supply +15 VDC
-15 V	Supply -15 VDC
+5 V	Supply +5 VDC
GND	Supply 0 V
I_IN+	Analog input (4-20 mA)
I_IN-	
OUTPUT-A	Analog output (0/4-20 mA)
OUTPUT-B	Analog output (0/4-20 mA)
OUT-0-10V	Analog output (0-10 VDC)
ALARM1	Digital output
ALARM2	Digital output
ALARM3	Digital output
CLK-1HZ	Digital output
COLLECTIVE ALARM	Digital output
RESET-ALARM	Digital input
IN-RET	Not connect

8.   INSTALLATION

⚠️ **Please observe the following for the operation of the devices:**
- All components may only be installed when the electricity supply is switched off.
- Preferably hold the electronic circuit board on the front panel or the front panel holder to avoid damaging it.

- Carefully push the EM-42-SD into the correct position in the rack insert.

- Take care to insert the edge connector correctly into the rack slot.

- Secure the EM-42-SD with the two mounting screws

Figure 9

9.   STORAGE AND PACKAGING REQUIREMENTS

Please store the unit in its original packaging.

Temperature:	-10 °C…+50 °C
Relative humidity:	10%...95%

WEKA AG SWITZERLAND
SCHÜRLISTRASSE 8 | 8344 BÄRETSWIL
+41 43 833 43 43 | info@weka-ag.ch

www.weka-ag.ch

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