Monitoring Technique

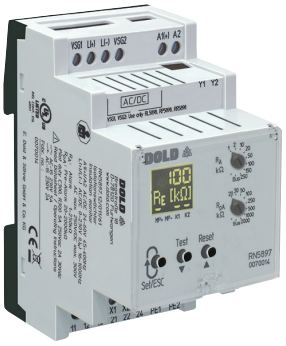
VARIMETER IMD
Insulation monitor
RN 5897/011

Translation
of the original instructions

Modbus MEMBER

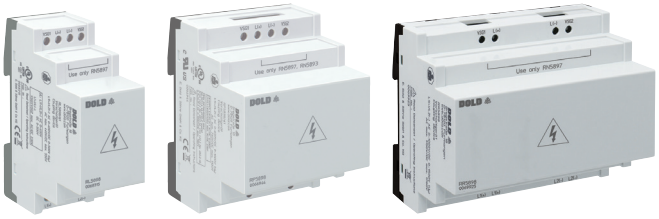
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RN 5897/011

Coupling devices



RL 5898 RP 5898 RR 5898*)

Product Description

The insulation monitor RN 5897/011 of the VARIMETER IMD family is a solution for optimal insulation monitoring of modern IT systems. The device can be used in the most flexible way for AC, DC and AC/DC systems even with large leakage capacity to earth (PE). The adjustment of the setting values is simple and user friendly done on 2 rotary switches on the front of the device. Via display and LEDs the measured value, device parameters and device status are indicated easy to read. With a sealable transparent cover the device is protectet against manipulation. The RN 5987/011 has an additonal Modbus RTU-interface. All measured values, device states and parameters can be read out, set and parameterized. All functions available on the device can also be operated via Modbus.

Your Advantages

- Preventive fire and system protection
- Detection of symmetric and asymmetric insulation faults
- Quick fault localisation through selective earth fault detection to L+ and L-
- Universal application in non-earthed AC, DC, AC/DC networks up to AC max. 250 V or DC max. 300 V
- With connection facility of an external coupling device:
  RL 5898 for voltages up to AC 400 V / DC 500 V
  RP 5898 for voltages up to AC 690 V / DC 1000 V
  RR 5898*) for voltages up to AC 1000 V / DC 1500 V
- Easy adjustment of response values and setting parameter via rotational switch and menu display or via Modbus RTU-interface
- Suitable for large leakage capacitances up to 1000 µF
- Optimised reaction time for large leakage capacitances
- Monitoring also with voltage-free mains
- Measuring circuit L(+)/L(-) with broken wire detection (can be switched off)
- Protective conductor PE1/PE2 with broken wire detection (can't be switched off)
- 2 changeover contacts each for insulation failures-Pre-alarm and -alarm each galvanically isolated
- With galvanic separated Modbus RTU interface

Features

- Insulation monitoring according to IEC/EN 61557-8
- Trigger output for insulation fault locating system
- 2 separate adjustable response thresholds (using e.g. for pre-Alarm and Alarm)
- Setting range of 1st response value (Pre-Alarm): 1 kΩ … 2 MΩ
- Setting range of 2nd response value (Alarm): 1 kΩ … 2 MΩ
- Energized or de-energized on trip can be selected for indicator relay
- Display for indication of measured value, device parameters and device status
- Setting the maximum leakage capacitance to shorten the response time
- Automatic and manual device self-test
- Alarm storage selectable
- Protection against manipulation by sealable transparent cover
- External control input for combined Test-/Reset-button
- 2 wide voltage input for auxiliary voltage
- Width 52.5 mm

Approvals and Markings

CE | c UL us LISTED 1) Canada / USA | AC/DC

1) RN 5897 and RL / RP 5898 only

Applications

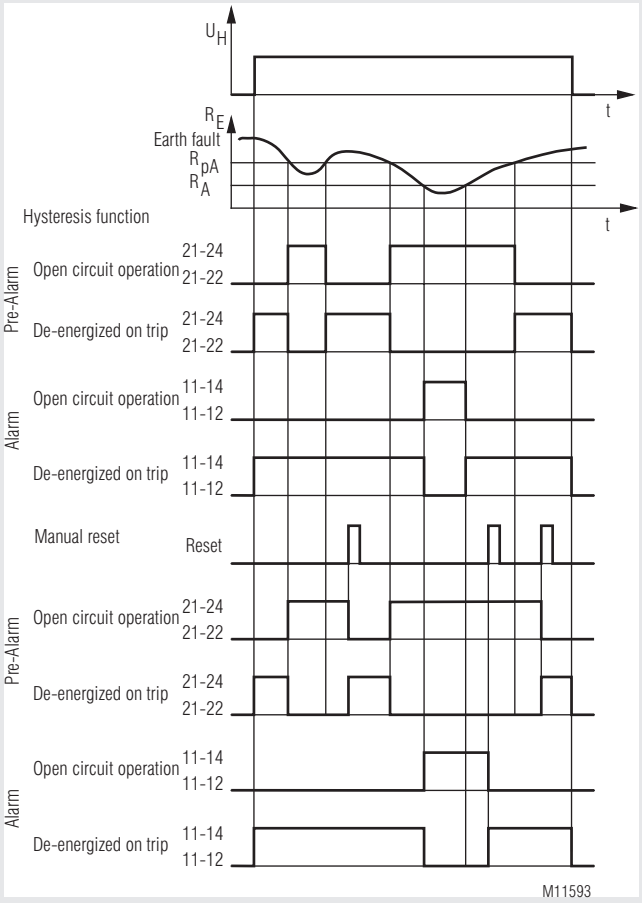
Insulation monitoring of:

- Non-earthed AC, DC, AC/DC networks
- UPS systems
- Networks with frequency inverters
- Battery networks
- Networks with direct current drives
- Hybrid and battery-powered vehicles
- Mobile generator sets

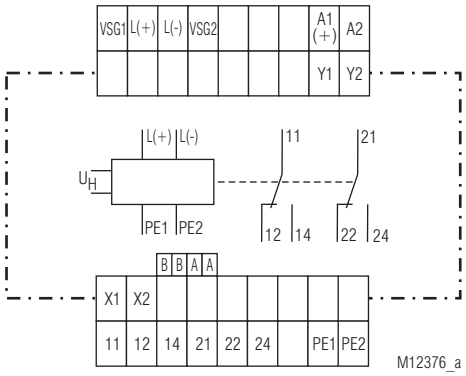
*) From firmware version 02.00

All Technical Data in this list relate to the state at the moment of edition. We reserve the right for technical improvements and changes at any time.

Function Diagram



Circuit Diagram



Connection Terminals

Terminal designation	Signal description
A1(+), A2	Auxiliarx voltage AC or DC
L(+), L(-), VSG1, VSG2	Connection for measuring ciruit or Connection for coupling device
PE1, PE2	Connection for protective conductor
X1, X2	Control input (combined external Test- and Reset-input)
Y1, Y2	Alarm trigger output for insulation fault locating system
11, 12, 14	Alarm signal relay K1(1 changeover contact)
21, 22, 24	Prewarning signal relay K2 (1 changeover contact)
A	Modbus signal A
B	Modbus signal B

Modbus RTU

For communication between motor controller and a supervising control the Modbus RTU protocol according to Specification V 1.1b3 is used.

Function

The device is supplied with DC auxiliary voltage via terminals A1(+) / A2. Switching on the auxiliary voltage (Power-On) is followed by an internal self-test for 12 sec (see „Device test functions“). The test process is visible in the display. After this, measurement of the insulation resistance in the measuring circuits begins and the the colour of the backlight changes into green.

Measuring circuit
(Insulation measurement between terminals L(+) / L(-) and PE1/PE2)
The insulation monitor RN 5897/011 can be operated either with or without coupling device. Max. mains voltage and connection diagrams have to be observed!
If the insulation monitor is operated without coupling device the terminals L(+) and L(-) have to be connected directly to the voltage system to be monitored. and the terminals VSG1/L(+) and VSG2/L(-) each have to be bridged (see also operation with coupling device).
A broken wire detection that can be disabled provides a fault signal if both terminals L(+) and L(-) are not linked by the connected network.
The type of network (AC, DC, 3NAC) has to be selected.
Also the terminals PE1 and PE2 have to be connected with 2 separate wires to the protective earth. An interruption of a wire also causes a fault signal (see section ”Behavior on faulty connection”). The monitoring of the PE connection cannot be de-activated.
To measure the insulation resistance an active measuring voltage with changing polarity is connected between L(+)/L(-) and PE1/PE2.The momentary polarity of the measuring cycle is shown on the display by 2 curser segments („MP+“ for positive phase and „MP-“ for negative phase). The duration of the positive and negative measuring phase depends on the setting of the max. leakage capacity („CE[µF]“ in programming mode), the actual leakage capacity of the monitored system and in DC systems also on the level and duration of possible voltage variations. This allows a correct and fast measurement in different network conditions.
At the end of a measuring cycle the actual insulation resistance is produced and indicated. The actual value is shown on the display. The relays for alarm K1 and pre-alarm K2 switch when dropping under the adjusted response values. In addition the backlight of the display changes to orange color on pre-alarm or to red color on alarm. An asymmetric earth fault either to „+“ or „-“ is also indicated on the display (only in DC- systems, or with a fault on the DC-side of a system).

Manual reset of fault message
Using the display menu in programming mode or programming via Modbus, the manual reset function for insulation failures can be selected. If manual reset is activated the insulation fault signals of the measuring circuit are stored when dropping under the adjusted response values also if the insulation resistance goes back to healthy state. The minimum value is stored and can be shown on the display and via Modbus. Pressing the „Reset“ button on the front side for 2 s, the alarm signal and the stored minimum value are reset if the actual insulation resistance is in healthy state.
The device can also be reset with a Modbus command.

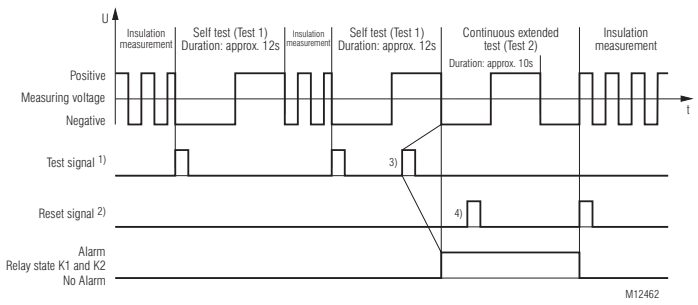
Indicator relay for insulation fault signal
For the indicator relays K1 (contacts 11-12-14, for alarm) and K2 (contacts 21-22-24, for pre-alarm) the function can be set in programming mode via display menu or Modbus to energized on trip or de-energized on trip when the insulation resistance drops below the adjusted response value. The status of the indicator relays is shown on the display with the two cursor segments "K1" and "K2". When the relay is energized, the corresponding curser lights up. The status of the indicator relays is also shown via Modbus.

Using the insulation fault locating system via trigger output
There is an additional trigger output for an insulation fault detection system on the insulation monitor RN 5897/011.
This trigger output (Y1-Y2) can be coupled with the trigger input Y1-Y2 of RR 5886 to initiate automatic fault location with the insulation fault locating system, consisting of RR 5886 and RR 5887. The trigger output is activated when the measuring value drops under the alarm response value ($R_E < R_A$). As long as it stays under the response value or an alarm is stored, the trigger output Y1-Y2 remains active.

Via Modbus
The locating current injector RR 5886 has also a Modbus RTU interface. This allows the master PLC to control the insulation fault location system via the same bus system according to the specifications of the RR 5886, if the fault location is to be started after evaluation of the corresponding registers of the insulation monitor.

Broken wire detection
As described in section "Measuring circut", the measuring circuits L(+)/L(-) and the protective conductors PE1/PE2 are constantly monitored for wire breaks – not only at Power-On or a manual or occasional automatic test. The response time of monitoring is only a few seconds. Broken wire detection between L(+) and L(-) is performed via coupled alternating voltage. This alternating voltage is short-circuited if the terminals are connected to the connected mains at low-resistance. The device detects that the mains to be monitored is properly connected.
Since this broken wire detection is carried out with alternating voltage, large capacitances should be avoided between L(+) and L(-), since the capacitive reactance of these capacitances also short-circuits this alternating voltage. The device would no longer detect a connection fault on L(+)/L(-). Especially parallel lines should be prevented over larger distances. If larger capacitances between L(+)/L(-) cannot be avoided or if the coupled alternating voltage interferes with the system, the broken wire detection can be de-activated using the display menu in programming mode or programming via Modbus. Monitoring deactivated, monitoring only during device test or continuous monitoring (every 2 minutes for 10 s) are the possible options. If the broken wire detection on L(+)/L(-) is de-activated no AC voltage is injected. The broken wire detection on PE1/PE2 cannot be de-activated.

Device test functions
Principally, 2 different test functions are implemented: The "self-test" and the "expanded test":
The self-test of the device is performed automatically after Power-On and every full operating hours. It can also be triggered manually at any time by pressing the "Test" button at the device front for 2 s or via Modbus command. With the self-test, contrary to the expanded test, the status of the Indicator relays is not affected; the sequence is as follows:
The display backlight colour changes into orange. For approx. 2 s all pixels and segments of the LCD are shown. After that the text “Test1” comes up and the measuring pulse is switched for approx. 5 s to negative test phase. Additionally the test mode is shown via Modbus. The polarity of the test voltage is also indicated on the display by curser segments. Within these 5 s the internal measuring circuit is checked for failures. Then the measuring pulse is switched for approx. 5 s to positive test phase and more internal tests take place. If no failures turned up and had been recognized, the measurement continuous. The extended test
procedure is started when during or at the end of the above described 12 s self-test the test button is pressed again for 2 s or via a Modbus command. The sequence is similar to the self-test (2 measuring phases of 5 s each) but in addition the output relays go in alarm stated. The display shows “Test2” and via the Modbus the extended test is indicated, too. The test phases of the extended test will be repeated continuously. The extended test can be finished after the first complete sequence (approx. 10 s) by pressing the "reset" button for 2 seconds. The device starts the insulation monitoring again. The extended test can be finished via a Modbus command, too.



1) Test signal: Button Test > 2 s or X1/X2 < 3 s
2) Reset signal: Button Reset > 2 s or X1/X2 > 3 s
3) To initiate the extended test (Test 2) the test signal must be operated within the self test (Test 1) again.
4) The reset signal has here no function, as the first complete sequence of extended test (Test 2) is not finished.

Behaviour with internal device faults
If internal device faults were detected during the test function, the display backlight changes into red and an error messages (failure code: „Int.1“) is indicated. The indicator relays K1 and K2 switch to the alarm state. The device faults are also indicated via Modbus.

Behavior on faulty connection
When detecting broken wire on terminals L(+)/L(-), the measurement is disabled. The reaction time could be up to 2 min. The monitoring relays K1 and K2 go in alarm state, the backlight changes to red. The display shows the fault message „L+/L-“. After removing the interruption the fault is automatically reset (max. reaction time up to 2 min) and the measurement of the insulation resistance is continued.
Stored alarm values remain stored. An interruption of the protective earth connections PE1/PE2 causes the same reaction as interrupting the measuring circuit, only the display shows „PE1-PE2“.
Broken wire detection on terminals L(+)/L(-) and PE1/PE2 are also indicated via Modbus.

External control input
To terminals X1/X2 an external combined Test-/Reset button can be connected. If the terminals X1/X2 are bridged for approx. 1 s the test mode is started. This has the same function as pressing the internal test button or sending the coreresponding Modbus command. When bridging X1/X2 for > 3 s, a stored alarm will be reset. This has the same function as pressing the internal reset button.

Connection of an external coupling device
An external coupling device (VSG) RL 5898, RP 5898 or RR 5898*) can be connected to extend the input voltage range of the monitored voltage system on RN 5897/011. The terminals with the same legend of the insulation monitor and the coupling device (VSG1, VSG2, L(+), L(-)) are connected together. The network to be monitored is connected to terminals L1(+) und L2(-) on the coupling device. Using the display menu in programming mode or programming via Modbus the connection of the coupling device has to be selected and activated. The broken wire detection is active on the terminals L1(+)/L2(-) on the coupling device. A broken wire between coupling device and insulation monitor cannot be detected immediately but the measured values on interruption of 1 or 2 wires between coupling device and insulation monitor are much lower as the real values, which will cause an early response of the device.

Programming/setting of parameters/set-up of the insulation monitor (local directly on the the unit)
The response values for alarm and pre-alarm can be adjusted via 2 rotary switches „R_A“ and „R_{pA}“ on the front of the device. New setting are immediately active and do not require a restart of the unit. More settings can be done with the 3 buttons and the display menu in programming mode. To start the programming mode, the button „Set/ESC“ has to be pressed for approx. 2 s. To avoid unauthorized manipulation, this button as well as the rotary switches „R_A“ and „R_{pA}“ are located behind a sealable transparent cover. When the device changes to programming mode, the measurement is stopped, the display back light changes to orange color and the first parameter is displayed. To scroll the different parameters, the button „Set/ESC“ has to be pressed short.
The programming mode is also indicated via Modbus. To scroll the different parameters, the button „Set/ESC“ has to be pressed short. With the 2 scroll buttons (Scroll-Up „▲“ and Scroll-Down „▼“) the settings can be modified.
The first parameter is the broken wire detection in the measuring circuit „BrWiD“. Possible setting are continuously on („on“), continuously off („oFF“) or only active during self-test. The default is „on“.
The second parameter is alarm memory „Mem.“. Here are 2 options available manual reset („on“) und auto reset („oFF“). The default value is „oFF“.
The third parameter is the relay operation principle „Rel.“ Settings are: de-energized on trip („n.c.“) and energized on trip („n.o.“). The default value is „n.c.“.
The fourth parameter is the type of network connection „Net“. Selection are AC Network(„Ac“),DC-Network („dc“) or 3NAC-Network („3nAc“). The default value is „Ac“.
The fifth parameter ist the setting oft the maximum leakage capacity („CE[µF]“). This can be adjusted to 30 µF („30“), 100 µF („100“), 300 µF („300“) and 1000 µF („1000“). The default value is „30“.
The device allow the connection of a coupling device, the sixth parameter activates („on“) or de-activates („oFF“) the coupling device. This can be completely deactivated ("oFF") if no VSG is connected. If a VSG is connected, either "VSG1" or "VSG2" can be activated ("on"). In this case, "VSG1" = RL /RP 5898 and "VSG2" = RR 5898*). Standard adjustment is de-activates („oFF“).
The seventh parameter is the setting of the Modbus Baudrate ("kBaud").

*) From firmware version 02.00

Function

Possible setting values are:

Baudrate kBaud	1.2	2.4	4.8	9.6	19.2	38.4	57.6	115.2

Default setting is 1.2 kBaud.
The eighth parameter is the Modbus adress, which can be set between 1 and 99. Default setting is adress 1. To exit the programming mode, the "Set/ESC" button must be pressed for 2 s. The settings are applied and saved permanently. After that, the device performs a restart (like Power-On).

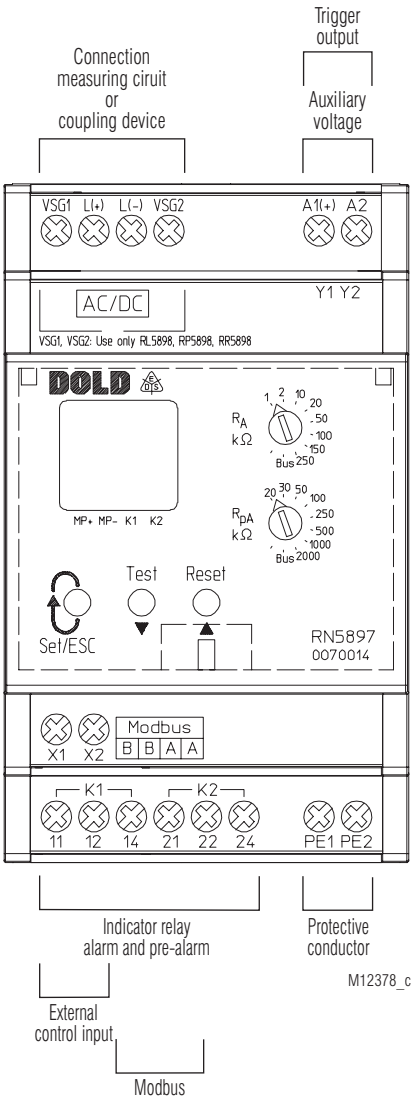
Programming/setting of parameters/set-up of the insulation monitor (via Modbus)
If the device should be parameterized via Modbus, the rotary switches "R_A" and "R_{pA}" on the front of the device must be set to "Bus".
Then the parameters and setting values can be send via bus to the device. These will be directly applied without a restart of the device.
The Modbus baudrate and adress can only be set locally via the display menu.

Behaviour at parameter failures
If the rotary switches "R_A" and "R_{pA} are set to an undefinded postionen (e. g. position 10 - which is not used), the device goes to parameter failure. The backlight changes into red, the indicator relays switch to alarm state an the error message "Param" is indicated. The device fault is also indicated via Modbus. The rotary switches must be set to a defined position to reset the failure. The device will also go to parameter failure if only one rotary switch is set to "Bus".
Both rotary switches must always be set to "Bus".
If setting values and parameters are sent via Modbus to the device while the rotary switches are not set to "Bus", the device will also go to parameter failure. In this case the reset is only possible with a reset command via Modbus.

Default-Setting of Parameters

Nr.	Parameter	Default-Set
1	Broken wire detect in measuring circuit “Broken Wire Detect”	on
2	Storing insulation fault message “Memory”	off
3	Switching mode of output relays “Relay”	n.c. (normally closed) de-energized on trip
4	Power supply type “Net”	AC
5	Max. line capacitance “CE[µF]”	30
6	Ext. coupling device “VSG”	off
7	Modbus baud rate "kBaud"	1.2
8	Modbus adress "Adr."	1

Indicators



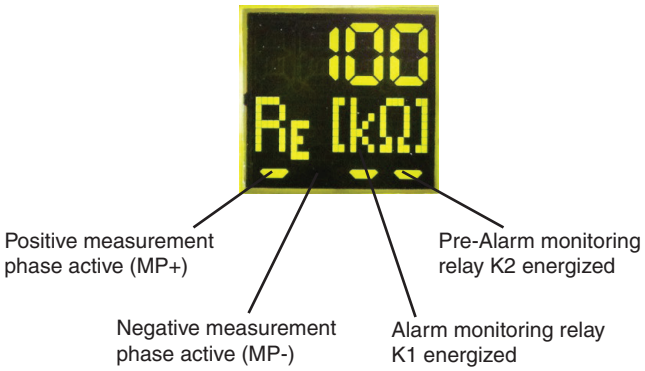
Indicators

The colour of the backlight indicates the operating status of the device.

Off: No auxiliary voltage connected
Green: Normal operation (Insulation resistance in healthy state)
Red: Alarm (measured value below alarm response value, device failure, connection failure)
Orange: Warning (measured value below pre-alarm response value, test mode, Parameter set-up mode)

Actual value display
The actual insulation resistance „R_E [kΩ]“ is displayed. If the actual value is R_E < 10 kΩ, the value in kΩ is displayed with 1 decimal place. With values 10 kΩ ≤ R_E < 500 kΩ the display shows the value without decimal place, with values 500 kΩ ≤ R_E < 1 MΩ the value is rounded to 10 kΩ. Insulation resistance values 1 MΩ ≤ R_E < 2 MΩ are displayed in MΩ with one decimal place. If the resistance is R_E > 2 MΩ the display indicates ---- showing the value is higher the 2 MΩ. In a DC Network an asymmetric insulation resistance to „+“ or „-“ is indicated by displaying „R_E+[kΩ]“ or „R_E-[kΩ]“.
By pressing the scroll buttons (Scroll-Up „▲“ und Scroll-Down „▼“) more measured values can be shown. Another value is the mains voltage on L(+)/L(-).This is indicated with „U_N [V_{AC}]“ or „U_N [V_{DC}]“ in V depending on the type of network and voltage. If the unit is connected single pole to a 3NAC network the mains voltage cannot be measured. With this setting the voltage value is not displayed. When manual reset is selected, the display shows the minimum stored value of the resistance „R_M [MΩ]“ or „R_M [kΩ]“ after the value dropped below the response value also when the value goes back to healthy state. The stored minimum value will only be reset when acknowledging the stored Alarm signal (with the reset button). Also the firmware version can be displayed.

All measured values are provided via Modbus. The actual insulation resistance, and the stored minimum insulation resistance are transmitted with one decimal place. The measured values are transmitted rounded exactly as they are displayed on the device.
For insulation restistances RE > 2 MΩ the value 0xFFFF is transmitted.



Indicators

Display-Indication	Measuring- resp. display value
	Insulating resistance in kΩ resp. MΩ („----“ complies RE ≥ 2 MΩ)
	Asymmetrical insulating resistance in kΩ against L+ or L- at DC-mains
	Measured mains voltage in V at AC- or DC-mains („----“ indicates invalid voltage value or voltage < 5 V)
	Stored min. insulating resistance in kΩ resp. MΩ
	Currently set Alarm value "R_A"
	Currently set Pre-warning value "R_{pA}"
	Latest firmware-version

Display-Indication	Test function
	Display-Test
	Selftesting (measuring switching, measuring voltage, internal tests)
	Advanced Test (additional control of indicator relay)

Error Indication

Display-Indication	Failure cause	Failure recovery
	Broken wire detection on L(+)/L(-).	Check measuring circuit L(+) and L (-)
	Broken wire detection on PE1/PE2.	Check protective conductor connections PE1 and PE2
	Rotary switch "R_A"/"R_{pA}" in an undefined position. Only one of the two rotary switches "R_A"/"R_{pA}" is set to "Bus". Parameters sent via Modbus although the rotary switch "R_A"/"R_{pA}" is not set to "Bus".	Move rotary switch "R_A"/"R_{pA}" to a defined postition. Set both rotary switches to "Bus". Send reset command via Modbus.
	Modbus timeout detected	Lock Modbus timeout, extend timeout time, adjust communication with the master
	Internal failure detected in test mode	Press test button again or restart the unit by interrupting the auxiliary supply temporarily. If the fault remains permanent, send device back to manufacturer for examination.
	Faulty calibration values detected in device memory.	Send device back to manufacturer for recalobration and examination.
	Internal communication error occured	Restart the unit by interrupting the auxiliary supply temporarily. If the fault remains permanent, send device back to manufacturer for examination.
	Internal software error occured	Restart the unit by interrupting the auxiliary supply temporarily. If the fault remains permanent, send device back to manufacturer for examination.

Notes

Risk of electrocution!
Danger to life or risk of serious injuries.

- Disconnect the system and device from the power supply and ensure they remain disconnected during electrical installation.
- The display of the voltage is not in real time. The Value on the display is updated at the end of a measuring cycle. Determine voltage free status by using appropriate instruments.
- The terminals of the control input X1-X2 have no galvanic separation to the measuring circuit L(+) and L(-) and are electrically connected together, therefore they have to be controlled by volt free contacts or bridge. These contacts ore bridges must provide a sufficient separation depending on the mains voltage on L(+)-L(-).
- Please do not connect external voltage to terminals X1/X2. The control must only be made by bridging X1 and X2.
- The coupling unit RL 5898, RP 5898 or RR 5898*) must only be used in conjunction with the RP5897/011 on a voltage system and not just by itself.

Attention!

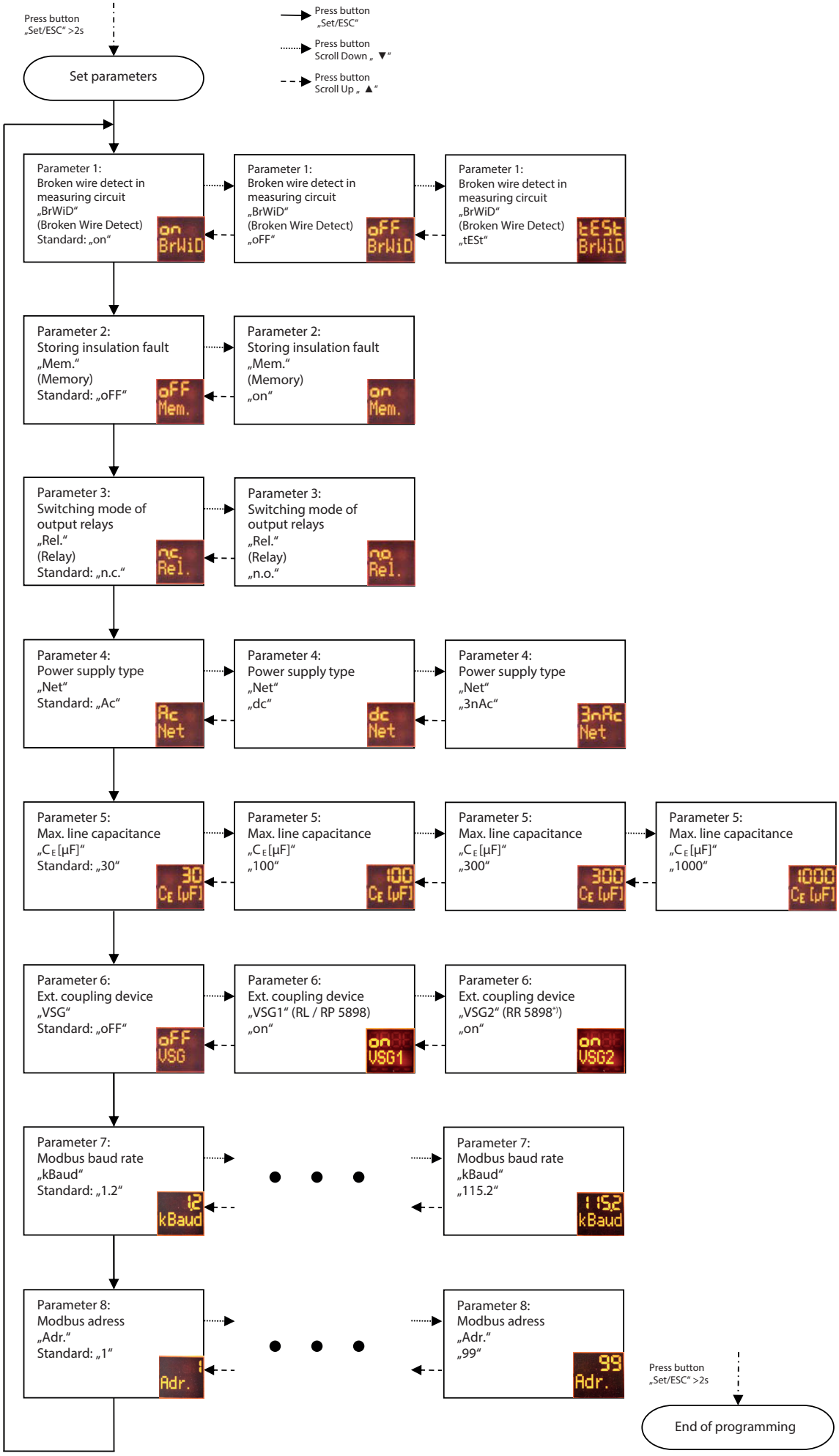
- Before checking insulation and voltage, disconnect the monitoring device RN 5897 from the power source!
- In one voltage system only one insulation monitor can be used. This has to be observed when interconnecting two separate systems.
- Device terminals PE1 and PE2 must always be connected via separate lines to different terminal points of the protective-conductor system.
- The device must not be operated without PE1/PE2 connection!
- If telegrams fail in the bus communication due to EMC interference, grounding the bus cable screening on both sides could be a remedy. With this earthing, attention must be paid to possibly occuring equalizing currents, which could occur with larger potential differences between the bus participants.
- To ensure correct measurement of the insulation resistance, there must be a low-impendance connection (≤ 10 kΩ) or a low-impendance internal mains resistance across the source or across the load between the measuring circuit connections L(+) and L(-) (or L1(+) and L2(-) when using the ballast unit).

Attention!

- The main measuring circuit can be connected with its terminals L(+) and L(-) both to the DC and also AC side of a mixed network; it is done most practically where the primary incoming power supply takes place e.g. with battery networks with connected inverters on the DC side, with Generators/Transformers with connected Rectifiers or inverters on the AC-side. To monitor a 3NAC system the device can be connected single pole, (L(+) and L(-) are bridged, to the neutral of the 3p4w system. The 3 phases have a low-ohmic (approx. 3 – 5 Ω) connection via the transformer windings so also insulation failures of the not directly connected phases are detected. Via the display menu in programming mode the correct type of network needs to be selected (see „Connection Examples“).
- If a monitored AC system includes galvanically connected DC circuits (e.g. via a rectifier), an insulation failure on the DC side can only be detected correctly, when a current of min 10 mA can flow via the semiconductor connections.
- If a monitored DC system includes galvanically connected AC circuits (e.g. via an inverter), an insulation failure on the AC side can only be detected correctly, when a current of min 10 mA can flow via the semiconductor connections.
- The measuring circuit of the RN 5897/011 are designed for leakage capacities up to 1000 µF. The measurement of the insulation resistance will not be influenced but for the measuring phases longer time periods are necessary as with smaller capacities. If the max. possible leakage capacity is known, the device can be adjusted to the required lower level, which will reduce the response time and measurement time.
- The trigger output Y1/Y2 at RN 5897/011 is galvanic separated from the rest of the circuit. It determined to be connected to a DOLD insulation fault location system RR 5886 and RR 5887. Please do not connect external voltages.
- For the register of the Insulating resistance the value 0xFFFF is transmitted via Modbus if R_E > 2 MΩ. If no valid mains voltage value was measured or the mains voltage is < 5 V, the value 0xFFFF is transmitted for the register of the measured mains voltage via Modbus (see Parameter table).

*) From firmware version 02.00

Running chart



*) From firmware version 02.00

Measuring ciruit L(+)/L(-) to PE1/PE2 (without coupling device)

Nominal voltage U_N: AC / DC 0 ... 230 V
Max. voltage range U_N: AC 0 ... 250 V
DC 0 ... 300 V
Frequency range: DC or 16 ... 1000 Hz
Max. line capacitance: 1000 µF
Internal resistance (AC / DC): > 90 kΩ
Measuring voltage: Approx. ± 90 V
Max. mesured current (R_E = 0): < 1.10 mA
Response inaccuracy: ± 15 % ± 1.5 kΩ IEC 61557-8
Response value hysteresis: Approx. + 25 %; min. + 1 kΩ
On delay
at C_E = 1µF,
R_E of ∞ to 0.5 * response value: < 30 s
Measuring time:
at C_E = 1 … 1000 µF,
R_E from ∞ to 1000 kΩ,
R_E from ∞ to 100 kΩ,
R_E from ∞ to 1 kΩ: See characteristics
Response values
Adjustable directly on the device
Pre-warning („R_{pA}“):

kΩ:	20	30	50	100	250	500	1000	2000

Alarm („R_A“)

kΩ:	1	2	10	20	50	100	150	250

Each adjustable via rotational switches

Adjustable via Modbus
Pre-warning "R_{pA}": In the range of 1 ... 2000 kΩ in 1 kΩ steps
Alarm "R_A": In the range of 1 ... 2000 kΩ in 1 kΩ steps
Response value broken wire detection L(+)/L(-): > Approx. 90 kΩ
Response value broken wire detection PE1/PE2: > Approx. 0.5 kΩ

Meas. ciruit L1(+)/L2(-) to PE1/PE2 (with coupling device RL / RP 5898)

	RL 5898	RP 5898
Nominal voltage U_N:	AC 0 ... 400 V DC 0 ... 500 V	AC 0 ... 690 V DC 0 ... 1000 V
Max. voltage range U_N:	AC 0 ... 440 V DC 0 ... 550 V	AC 0 ... 760 V DC 0 ... 1100 V

Frequency range: DC or 16 ... 1000 Hz
Max. line capacitance: 1000 µF
Internal resistance (AC / DC): > 240 kΩ
Meas voltage: Approx. ± 90 V
Max. mesured current (R_E = 0): < 0.40 mA
Response inaccuracy: ± 15 % ± 1.5 kΩ IEC 61557-8
Response value hysteresis: Approx. + 25 %; min. + 1 kΩ
On delay
at C_E = 1µF,
R_E of ∞ to 0.5 * response value: < 30 s
Measuring time:
at C_E = 1 … 1000 µF,
R_E from ∞ to 1000 kΩ,
R_E from ∞ to 100 kΩ,
R_E from ∞ to 1 kΩ: See characteristics
Response values
Adjustable directly on the device
Pre-warning („R_{pA}“):

kΩ:	20	30	50	100	250	500	1000	2000

Alarm („R_A“)

kΩ:	1	2	10	20	50	100	150	250

Each adjustable via rotational switches

Adjustable via Modbus
Pre-warning "R_{pA}": In the range of 1 ... 2000 kΩ in 1 kΩ steps
Alarm "R_A": In the range of 1 ... 2000 kΩ in 1 kΩ steps
Response value broken wire detection L1(+)/L2(-): > Approx. 500 kΩ
Response value broken wire detection PE1/PE2: > Approx. 0.5 kΩ
Max. wire length between insulation monitor and coupling device: < 0.5 m

Measuring ciruit L1(+)/L2(-) to PE1/PE2 (with coupling device RR 5898*))

Nominal voltage U_N: AC 0 ... 1000 V
DC 0 ... 1500 V
Max. voltage range U_N: AC 0 ... 1150 V
DC 0 ... 1760 V
Frequency range: DC or 16 ... 1000 Hz
Max. line capacitance: 1000 µF
Internal resistance (AC / DC): > 550 kΩ
Measuring voltage: Approx. ± 90 V
Max. mesured current (R_E = 0): < 0.20 mA
Response inaccuracy: ± 15 % ± 1.5 kΩ IEC 61557-8
Response value hysteresis: Ca. + 25 %; min. + 1 kΩ
On delay
at C_E = 1 µF,
R_E of ∞ to 0,5 * response value: < 30 s
Measuring time:
at C_E = 1 … 1000 µF,
R_E from ∞ to 1000 kΩ,
R_E from ∞ to 100 kΩ,
R_E from ∞ to 1 kΩ: See characteristics
Response values
Pre-warning („R_{pA}“):

kΩ:	20	30	50	100	250	500	1000	2000

Alarm („R_A“)

kΩ:	1	2	10	20	50	100	150	250

Each adjustable via rotational switches

Adjustable via Modbus
Pre-warning "R_{pA}": In the range of 1 ... 2000 kΩ in 1 kΩ steps
Alarm "R_A": In the range of 1 ... 2000 kΩ in 1 kΩ steps
wire detection L1(+)/L2(-): > Approx. 950 kΩ
Response value broken wire detection PE1/PE2: > Approx. 0.5 kΩ
Max. wire length between iso-monitor and coupling device: < 0.5 m

Auxiliary voltage input A1(+)/A2

Nom. Voltage	Voltage range	Frequency range
AC/DC 24 ... 60 V	AC 19 ... 68 V	45 … 400 Hz; DC 48 % W*)
	DC 16 ... 96 V	W*) ≤ 5 %
AC/DC 100 ... 230 V	AC 68 ... 276 V	45 … 400 Hz; DC 48 % W*)
	DC 67 ... 300 V	W*) ≤ 5 %

*) W = Permitted residual ripple of auxiliary supply

Nominal consumption:
DC 24 V, 48 V: Max. 3 W
AC 230 V: Max. 3.5 VA

Control input X1/X2 for combinied external Test-/Reset-Taste

Current flow: Approx. 3 mA
No-load operation voltage X1 to X2: Approx. 12 V
Permissible wire length: < 50 m
Activation time for test signal: Approx. 1 s
Activation time for reset signal: > 3 s

Outputs

Indicator contact: 2 x 1 changeover contact for Alarm (K1) and Pre-Alarm (K2) energized or de-energized on trip (programmable)
Thermal current I_{th}: 4 A
Switching capacity
to AC 15:
NO contact: 5 A / AC 230 V IEC/EN 60947-5-1
NC contact: 2 A / AC 230 V IEC/EN 60947-5-1
To DC 13: 2 A / DC 24 V IEC/EN 60947-5-1
Electrical life
at 5 A, AC 230 V: 1 x 10^5 switching cycles
Short circuit strength
max. fuse rating: 4 A gG / gL IEC/EN 60947-5-1
Mechanical life: 50 x 10^6 switching cycles

*) From firmware version 02.00

Technical Data

General Data

Operating mode:	Continuous operation	
Temperature range		
Operation:	- 30 ... + 60 °C (at range 0 … - 30 °C limited function of the LCD displaye)	
Storage:	- 30 ... + 70 °C	
Altitude:	≤ 2000 m	IEC 60664-1
Clearance and creepage distances		
Rated insulation voltage:	300 V	
Overvoltage category:	III	
Rated impuls voltage / pollution degree:		IEC 60664-1
Measuring circuit L(+)/L(-) to auxiliary voltage A1(+)/A2 and indicator relay contacts K1, K2 and trigger output Y1/Y2:	6 kV / 2	
Auxiliary voltage A1(+)/A2 to indicator relay contacts K1, K2 and trigger output Y1/Y2:	6 kV / 2	
Indicator relay contact K1 to indicator relay contacts K2:	4 kV / 2	
Trigger output Y1/Y2 to indicator relay contacts K1, K2:	6 kV / 2	
Bus A, B to measuring circuit L(+)/L(-) and auxiliary voltage A1(+)/A2 and indicator relay contacts K1, K2:	6 kV / 2	
Insulation test voltage		
Routine test:	AC 2.5 kV; 1 s AC 4 kV; 1 s	
EMC		IEC/EN 61326-2-4
Electrostatic discharge (ESD):	8 kV (air)	IEC/EN 61000-4-2
HF irradiation		
80 MHz … 1 GHz:	20 V / m	IEC/EN 61000-4-3
1 GHz … 2.7 GHz:	10 V / m	IEC/EN 61000-4-3
Fast transients:	2 kV	IEC/EN 61000-4-4
Surge voltage between		
wires for power supply:	1 kV	IEC/EN 61000-4-5
Between wire and ground:	2 kV	IEC/EN 61000-4-5
HF-wire guided:	20 V	IEC/EN 61000-4-6
Interference suppression:	Limit value classe B	EN 55011
Degree of protection		
Housing:	IP 30	IEC/EN 60529
Terminals:	IP 20	IEC/EN 60529
Housing:	Thermpolastic with V0 behaviour according to UL subject 94	
Vibration resistance:	Amplitude 0.35 mm, Frequency 10 ... 55 Hz, IEC/EN 60068-2-6 Amplitude ± 1 mm, Frequency 2 ... 13.2 Hz, 13.2 ... 100 Hz, acceleration ± 0.7 gn IEC/EN 60068-2-6	
Shock resistance:	10 gn / 11 ms, 3 pulses IEC/EN 60068-2-27	
Climate resistance:	30 / 060 / 04	IEC/EN 60068-1
Terminal designation:	EN 50005	
Wire connection		DIN 46228-1/-2/-3/-4
Cross section:	0.5 ... 4 mm² (AWG 20 - 10) solid or 0.5 ... 4 mm² (AWG 20 - 10) stranded wire without ferrules 0.5 ... 2.5 mm² (AWG 20 - 10) stranded wire with ferrules	
Stripping length:	6.5 mm	
Wire fixing:	Cross-head screw / M3 box terminals	
Wire connection Y1/Y2 Bus		
pluggable cage-clamp terminal (PC):	0.14 ... 0.5 mm² solid or 0.14 ... 0.25 mm² stranded ferruled	
Insulation of wires or sleeve length:	7 mm	
Fixing torque:	0.5 Nm	
Mounting:	DIN rail	IEC/EN 60715
Mounting position:	Vertical (air flow trough ventilation slots must be ensured)	
Weight:	Approx. 205 g	

Dimensions

Width x height x depth:	52.2 x 90 x 71 mm

Classification to DIN EN 50155

Vibration and shock resistance:	Category 1, Class B	IEC/EN 61373
Service temperature classes:	OT1 compliant	
Protective coating of the PCB:	No	

UL-Data

Meas. ciruit L1(+)/L2(-) to PE1/PE2 (with coupling device RL / RP 5898)

	RL 5898	RP 5898
Max. voltage range U_N:	AC 0 ... 400 V DC 0 ... 500 V	AC 0 ... 600 V DC 0 ... 600 V

Output voltage at L(+)/L(-), VSG1/VSG2:	Max. AC / DC 230 V
Switching capacity:	Pilot duty C300, R300 5A 250Vac 2A 30Vdc
Wire connection:	60 °C / 75 °C copper conductors only Torque 0.5 Nm
Test specification:	ANSI/UL 60947-1, 5th Edition ANSI/UL 60947-5-1, 3rd Edition CAN/CSA-C22.2 No. 60947-1-13, 2nd Edition CAN/CSA-C22.2 No. 60947-5-1-14, 1st Edition

Technical data that is not stated in the UL-Data, can be found in the technical data section.

Standard Types

RN 5897.12/011/61	AC/DC 24 … 60 V
Article number:	0070014
• Auxiliary voltage:	AC/DC 24 … 60 V
RN 5897.12/011/61	AC/DC 100 … 230 V
Article number:	0070015
• Auxiliary voltage:	AC/DC 100 … 230 V
• Outputs:	1 changeover contact for pre-warning 1 changeover contact for alarm
• Setting range Pre-Alarm:	20 kΩ … 2 MΩ (via rotary switch)
• Setting range Pre-Alarm:	1 kΩ … 2 MΩ (via Modbus)
• Setting range Alarm:	1 kΩ … 250 kΩ (via rotary switch)
• Setting range Alarm:	1 kΩ … 2000 kΩ (via Modbus)
• With Modbus RTU interface	
• Trigger output for insulation fault locating system	
• With connection facility of a coupling device RL / RP 5898 resp. RR 5898*)	
• Adjustable line capacitance	
• Energized or de-energized on trip	
• Selection of type of network	
• Width:	52.5 mm

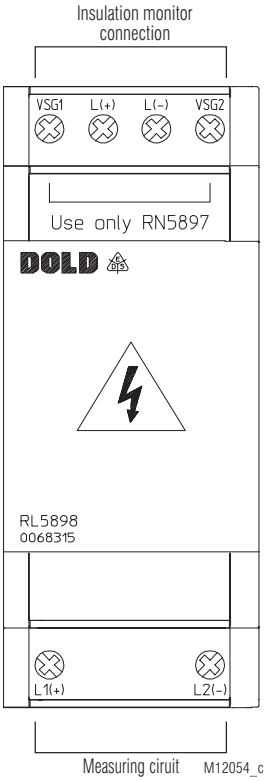
Ordering Example for variants

RN 5897 .12 /011 /61 AC/DC 24 … 60 V 1 kΩ - 250 kΩ 20 kΩ - 2 MΩ

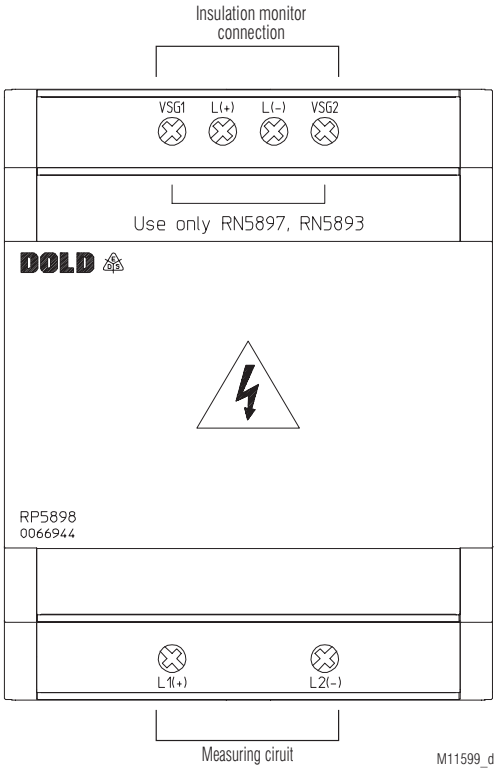
- 20 kΩ - 2 MΩ: Setting range Pre-warning
- 1 kΩ - 250 kΩ: Setting range alarm
- AC/DC 24 … 60 V: Auxiliary voltage
- /61: UL approval
- /011: Variant, if required
- .12: Contacts
- RN 5897: Type

*) From firmware version 02.00

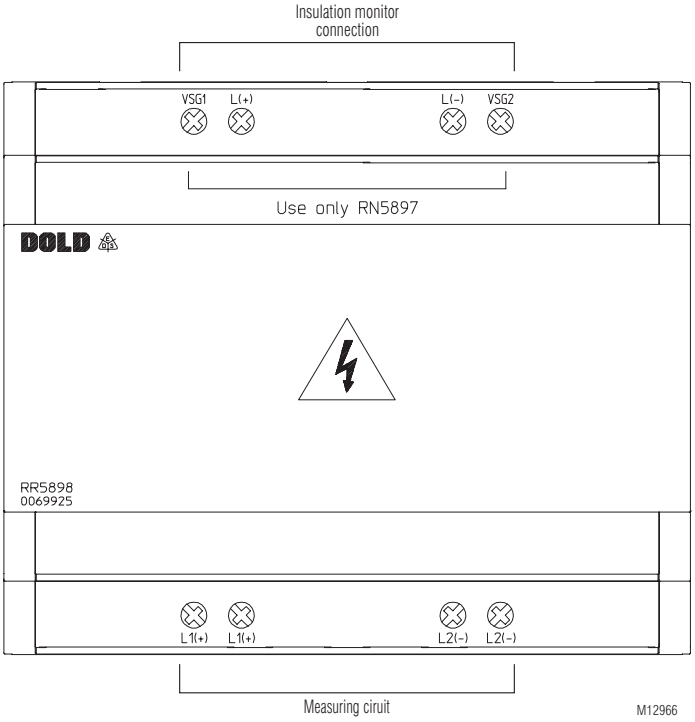
RL 5898/61:
Article number: 0068315
- Coupling device for RN 5897.12/011
- Extension of nominal voltage range U_N to DC 500 V, AC 400 V
- Weight: Approx. 60 g
- Dimensions
  - Width x height x depth: 35 x 90 x 71 mm



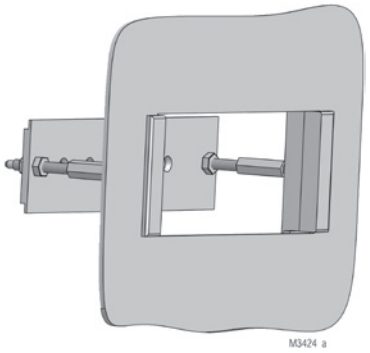
RP 5898/61:
Article number: 0066944
- Coupling device for RN 5897.12/011
- Extension of nominal voltage range U_N to DC 1000 V, AC 690 V
- Weight: Approx. 110 g
- Dimensions
  - Width x height x depth: 70 x 90 x 71 mm



RR 5898:
Article number: 0069925
- Coupling device for RN 5897.12/010 (from firmware version 02.00)
- Extension of nominal voltage range U_N to DC 1500 V, AC 1000 V
- Weight: Approx. 140 g
- Dimensions
  - Width x height x depth: 105 x 90 x 71 mm



Flush mounting kit
Order reference: KU 4087-150/0056598

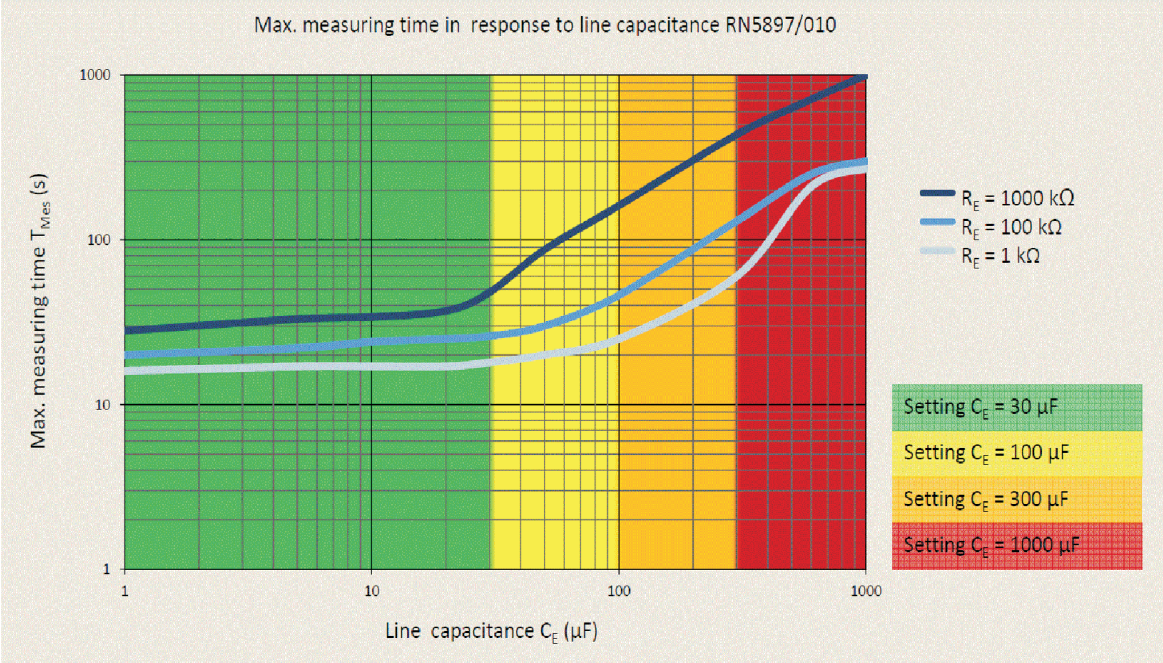


For universal use with:
- R-series devices of 17.5 to 105 mm width
- Easy mounting

IK 3050.11 AC/DC 24 V:
Coupling relay with gold contacts and 6 kV isolation between contacts and relay coil. Suitable for potential-free control of the control input.
Articel number: 0067057

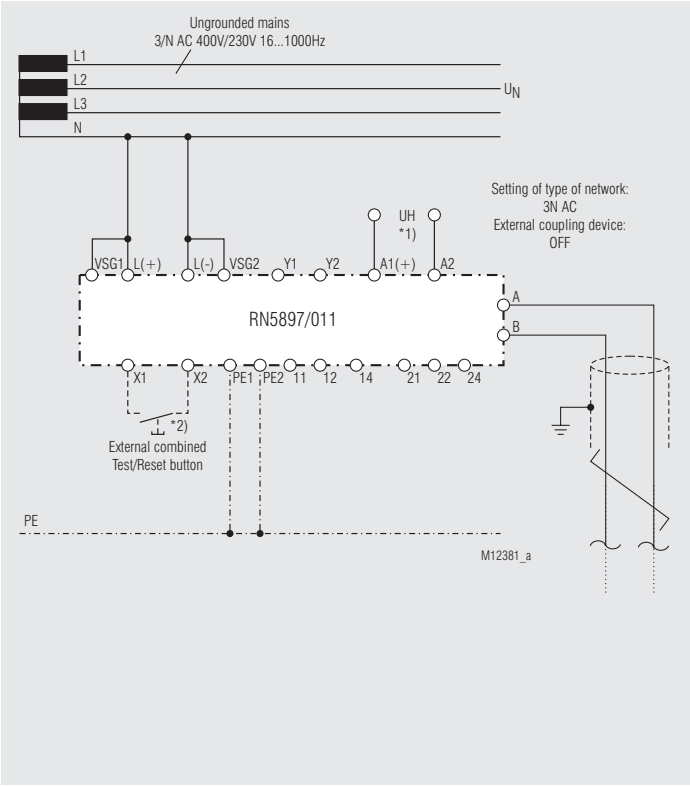
RK 8832 AC/DC 24 V:
Alarm transmitter
Acoustic alarm transmitter for signalling an insulation fault.
Articel number: 0059905

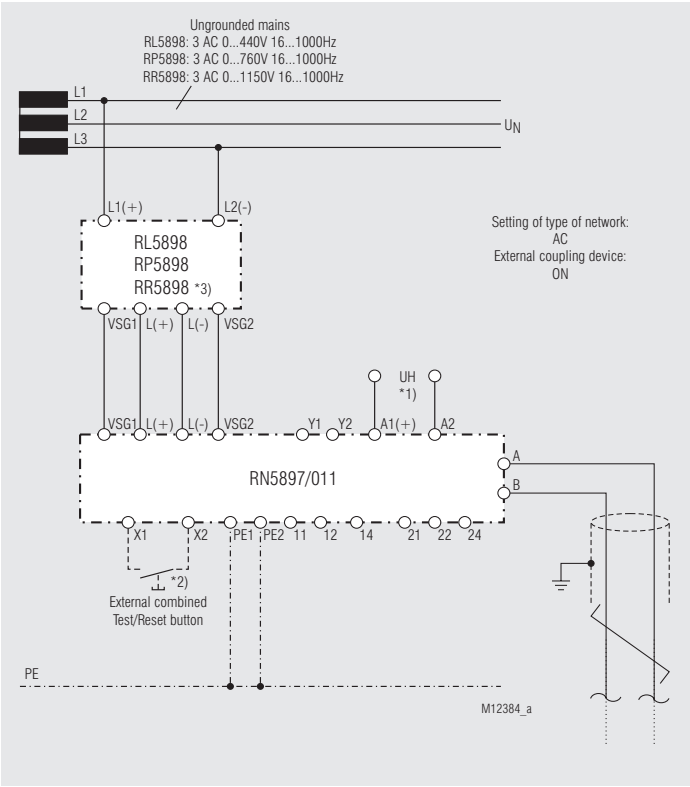
Characteristics



M11605

Connection Examples



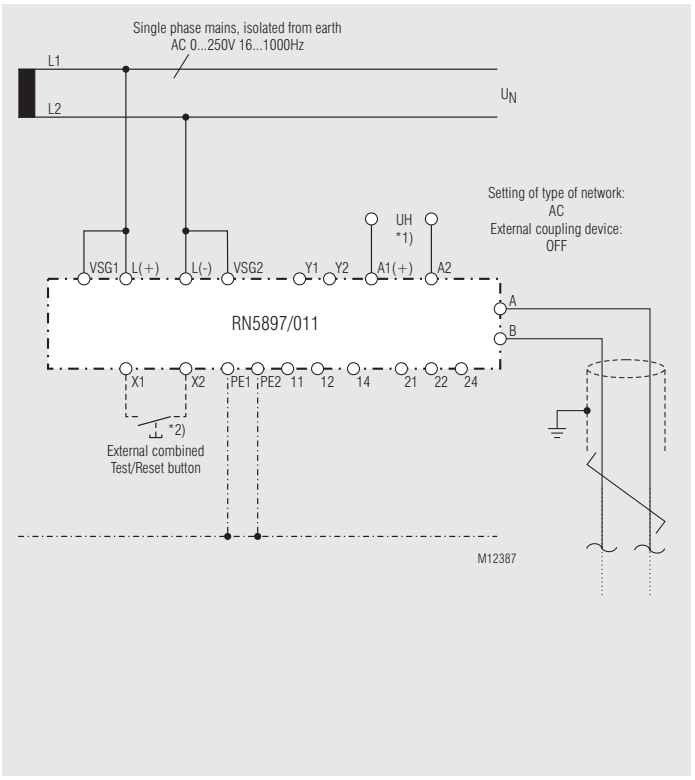


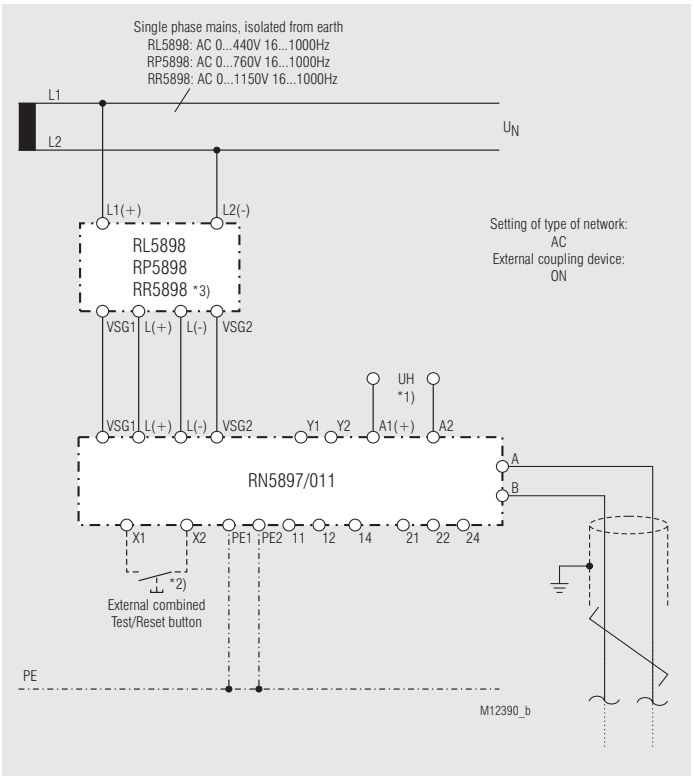
*1) Auxiliary voltage U_H (A1(+)/A2) can also be sourced from the monitored voltage system.
The voltage range of the auxiliary supply has to be taken into account.

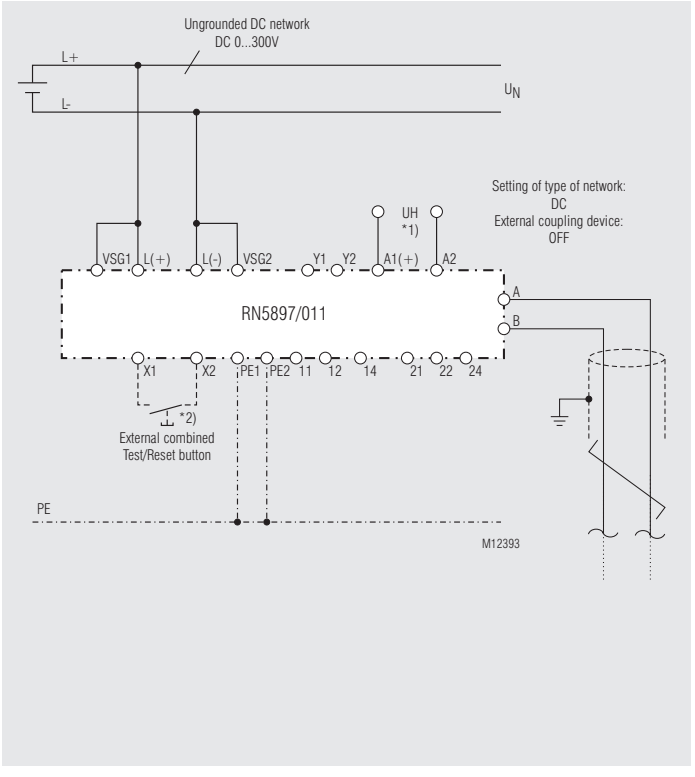
*2) Control input X1/X2 for external combined Test-/Reset-button:
- Control approx. 1 s: Test function
- Control > 3 s: Reset function

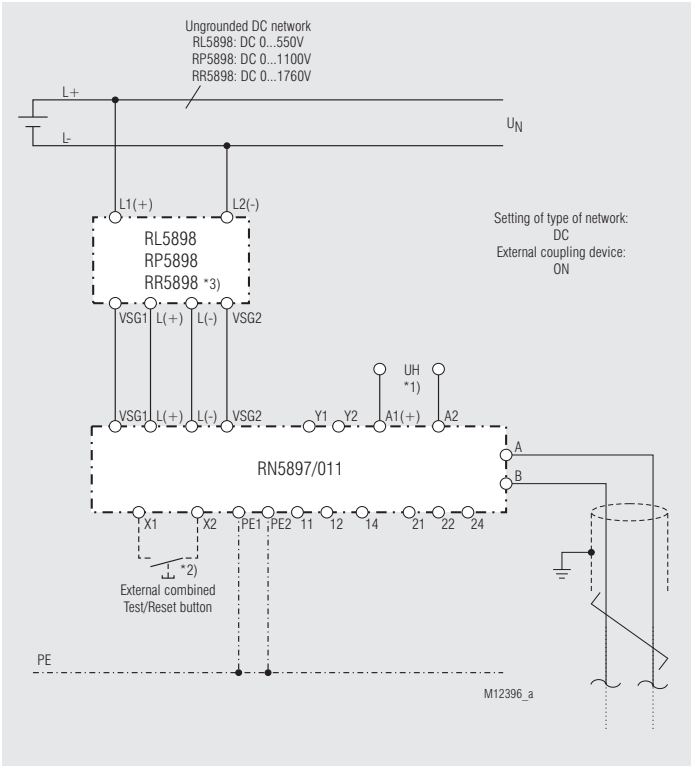
*3) From firmware version 02.00

Connection Examples









*1) Auxiliary voltage U_H (A1(+)/A2) can also be sourced from the monitored voltage system.
The voltage range of the auxiliary supply has to be taken into account.

*2) Control input X1/X2 for external combined Test-/Reset-button:
- Control approx. 1 s: Test function
- Control > 3 s: Reset function

*3) From firmware version 02.00

Bus Interface

Protocol	Modbus Seriell RTU
Adress	1 to 99
Baud rate	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud
Data bit	8
Stop bit	2
Parity	None

More information about the interface, wiring rules, device identification and communication monitoring can be found in the Modbus user manual.

Function-Codes

At RN 5897/011 the following function codes are implemented:

Function-Code	Name
0x01	Read Coils
0x03	Read Holding Register
0x04	Read Input Register
0x05	Write Single Coil
0x06	Write Single Register
0x10	Write Multiple Register

Device configuration

Device configuration data (parameters and setting values from register 42001, as well as the "factory setting" command) are directly stored in the EEPROM in non-volatile memory when writing via Modbus. As the write cycles of an EEPROM are limited, the write operation with these registers or this command must not be cyclic.

Parameter table

Coils

Register-Adress	Protocol-Adress	Name	Value range	Initial value	Description	Data type	Access rights
1	0	Reset	0x0000 0xFF00	0x0000	No Function Error acknowledgement device error	BIT	Write / read
2	1	Device reset	0x0000 0xFF00	0x0000	No Function Device restart	BIT	Write / read
3	2	Reserved	0x0000 0xFF00	0x0000	-	BIT	-
4	3	Factory setting	0x0000 0xFF00	0x0000	No Function Factory setting of the parameters	BIT	Write / read
5	4	Device selftesting	0x0000 0xFF00	0x0000	No Function Selftesting	BIT	Write / read
6	5	Fault memory indicator relay K1 + K2	0x0000 0xFF00	0x0000	No Function Fault memory acknowledgement indicator relay K1 and K2	BIT	Write / read
7	6	Reserved	0x0000 0xFF00	0x0000	-	BIT	-
8	7	Advanced Test	0x0000 0xFF00	0x0000	No Function Advanced Test	BIT	Write / read

Parameter Table

Input Registers

Register-Adress	Protocol-Adress	Name	Value range	Description	Data type	Access rights
30001	0	Device failure	0 … 12	0: No failure 1: Broken wire detection L(+)/L(-) 2: Broken wire detection PE1/PE2 3: Internal failure detected in test mode (Int. 1) 4: Parameter failures (Incorrect setting of potentiometers on the device) 9: Communication fault Modbus 10: Checksum failure EEPROM (Int. 2) 11: Internal communication fault (Int. 3) 12: Internal error 4 (Int. 4)	UINT16	Read
30002	1	State of device	0 … 4	0: Device initialize 1: Device is ready and in measuring mode 2: Device in error mode 3: Device in selftesting 4: Device in advanced test	UINT16	Read
30003	2	Device flags	0 … 3	Bit 0: Indicator relay K1 energized Bit 1: Indicator relay K2 energized	UINT16	Read

Register-Adress	Protocol-Adress	Name	Value range	Description	Data type	Access rights
32001	2000	Insulating resistance	0 … 20000, 65535	In 1/10 kΩ	UINT16	Read
32002	2001	Asymmetrical insulating resistance	1,2,4	Bit 0: Resistance is symmetrical Bit 1: Asymmetrical against L+ Bit 2: Asymmetrical against L-	UINT16	Read
32003	2002	Measured mains voltage	5 … 300, 65535 5 … 1100, 65535 5 ... 1760, 65535	Without VSG in V Value outside the measuring range (U_N < 5 V or U_N > 300 V) With VSG RL /RP 5898 in V Value outside the measuring range (U_N < 5 V or U_N > 1100 V) With VSG RR 5898 in V Value outside the measuring range (U_N < 5 V or U_N > 1760 V)	UINT16	Read
32004	2003	Stored min. insulating resistance	0 … 20000, 65535	In 1/10 kΩ	UINT16	Read

Parameter Table

Holding Registers

Register-Adress	Protocol-Adress	Name	Value range	Initial value	Description	Data type	Access rights
40001	0	Control word 1	0 … 65535	0	Bit 0 = Reset Bit 1 = Device reset Bit 2 = Reserved Bit 3 = Factory settings Bit 4 = Device selftesting Bit 5 = Fault memory acknowledgement indicator relay K1 and K2 Bit 6 = Reserved Bit 7 = Advanced test	UINT16	Write / read
40002	1	Timeout release	0 … 1	0	Bit 0 = Enable	UINT16	Write / read
40003	2	Timeout	100 …10000 0 …10000	1000	Timeout Value in ms (write) Timeout Value in ms (read)	UINT16	Write / read

Register-Adress	Protocol-Adress	Name	Value range	Initial value	Description	Data type	Access rights
42001	2000	Broken wire detect in measuring circuit	1,2,4	1	Bit 0 = On Bit 1 = Off Bit 2 = Only during the device selftesting	UINT16	Write / read
42002	2001	Storing insulation fault message indicator relay K1 + K2	0 … 1	0	0 = Off 1 = On	UINT16	Write / read
42003	2002	Switching mode of output relays indicator relay K1 + K2	0 … 1	0	0 = De-energized on trip 1 = Energized on trip	UINT16	Write / read
42004	2003	Power supply type	1,2,4	1	Bit 0 = AC mains Bit 1 = DC mains Bit 2 = 3N AC mains	UINT16	Write / read
42005	2004	Line capacitance CE	1,2,4,8	1	Bit 0 = 30 µF Bit 1 = 100 µF Bit 2 = 300 µF Bit 3 = 1000 µF	UINT16	Write / read
42006	2005	Response value indicator relay K1	1 … 2000	2000	Response value indicator relay K1 in kΩ	UINT16	Write / read
42007	2006	Response value indicator relay K2	1 … 2000	2000	Response value indicator relay K2 in kΩ	UINT16	Write / read
42008	2007	Coupling device	1,2,4	1	Bit 0 = Off Bit 1 = RL 5898 or RP 5898 Bit 2 = RR 5898	UINT16	Write / read