Insulation monitoring device

ISOLGUARD HIG93, HIG93/L, HIG94

Operating instructions

Document's name: DOK-70915-V5.8

Content

Picture list

Tables

Used symbols

Warning, caution

This symbol informs about very important installation and operation instructions of the device or about hazardous situations that may happened during the installation and the operation.

Information

This symbol highlights particularly important characteristics of the device.

Note

This symbol indicates useful additional information.

1. ISOLGUARD Insulation monitoring devices HIG93, HIG93/L, HIG94

The insulation monitoring devices HIG93, HIG93/L, HIG94 produced by HAKEL for the ISOLGUARD series are designed for monitoring the insulation status of single-phase and 3-phase ungrounded IT power supply systems that are designed and operated according to standards IEC 61557-1:2007, IEC 61557-8:2014, HD 60364-4-41:2017.

Devices enable monitoring of single-phase and 3-phase ungrounded IT power supplies systems up to the maximum operating voltage 275V AC, eventually 3x275V AC. If insulation status monitoring of a single-phase or 3-phase ungrounded IT power supply system with higher operating voltage is required, it is necessary to create an artificial centre using TL inductors produced by HAKEL. Such a created centre is connected to the terminal of insulation monitoring device HIG93, HIG93/L or HIG94.

Insulation monitoring devices enable to display the numeric value of the measured insulation resistance, then there are buttons for setting device parameters and signalling LED diodes to display the status of monitored power supply system and of the device. To the insulation monitoring device, it is possible to connect MDS-D series remote monitoring modules to monitor the power supply system status, which are produced by HAKEL.

HIG93, HIG93/L and HIG94 devices are equipped with ISOLGUARD RS485 communication line and can communicate with a master computer via industrial RS485 bus with the protocol based on the PROFIBUS protocol. Description of the communication protocol is available on request.

Two inbuilt signalling relays with switching contacts enables alarm signalling for two independently set values of critical insulation resistance. The insulation monitoring device has an optional alarm memory function with the possibility to terminate the alarm using the button on the device. Local and remote testing of the insulation monitoring device function can be done.

Only one insulation monitoring device can be connected to the same ungrounded IT power supply system.

1.1 Variants of devices ISOLGUARD HIG93, HIG93/L, HIG94

Type	Display Menu	Signalling relay 1	Signalling relay 2	Range of displayed value	Critical insulation resistance	Communication bus bar	MDS-D connection	Device type according to IEC 61557-8	SW
HIG93	Yes	1x SPDT	1x SPDT	5 kΩ to 900 kΩ	Adjustable 5 kΩ to 300 kΩ	RS485 ISOLGUARD	Yes	AC	V5.8
*Art. no. **70 915***									
HIG93/L				0,1 kΩ to 90 kΩ	Adjustable 0,1 kΩ to 90 kΩ				
*Art. no. **70 915/L***									
HIG94				200 kΩ to 5 MΩ	Adjustable 200 kΩ to 900 kΩ				
*Art. no. **70 917***									

Table 1: Variants of devices

Notes: SPDT signalling relay with one switching contact
MDS-D remote monitoring module of HIG series devices, with display and communication via ISOLGUARD RS485 line

HIG93, HIG93/L, HIG94 complies with standards:

- HD 60364-4-41:2017 Low-voltage electrical installations- Protection against electric shock
- IEC 61557-8:2014 Insulation monitoring devices for IT systems
- IEC 61557-1:2007 Equipment for testing, measuring or monitoring of protective measures
- IEC 60664-1:2007 Insulation coordination for equipment within low-voltage system - Principles, requirements and tests

1.2 Basic characteristics

- Insulation monitoring device of AC systems with 0 to 275 V voltage without additional devices, for greater voltages additional inductor is needed
- Display of the measured insulation resistance R_{isol} in the range 0,1 kΩ to 90 kΩ, 5 kΩ to 900 kΩ or 200 kΩ to 5 MΩ
- Two insulation resistance status signalling relays equipped with switching contact
- Connection to ISOLGUARD RS485 bus, insulation strength 2500 V_{rms} against the internal circuits and network circuits
- Optional memory of the invoked alarm with possibility to unlock by button on the device
- Option to set two values of monitored insulation resistance R_{crit1} and R_{crit2} using the display and push-buttons, namely in the range 0,1 kΩ to 90 kΩ, 5 kΩ to 300 kΩ or 200 kΩ to 900 kΩ according to the device type
- Adjustable hysteresis of the insulation resistance limit value in the range 0 to 100 % using the display and push-buttons
- Adjustable delay in signalling relay response t_{ON} in the range 0 to 60 seconds using the display and push-buttons
- Access to the device settings with the pushbuttons can be locked. Unlock by a button combination.
- Separate supply voltage also allows to monitor IT power supply system, which is not under voltage
- 2M (36 mm) module width for assembling on DIN rail 35

2. ISOLGUARD HIG93, HIG93/L, HIG94 technical characteristics

Type		HIG93	HIG93/L	HIG94
Monitored IT power supply system type		AC		
Maximum IT power supply system operating voltage (without external inductor)	U_n	275 V~		
Nominal supply voltage	U_s	230 V~		
Supply voltage range		90 to 265 V~ (47 ÷ 63 Hz) or 90 to 370 V⎓		
Power consumption	P	max. 5 VA		
Measuring circuit				
Measuring voltage	U_M	12 V DC		
Measuring current	I_M	< 0,6 mA		
Alternating internal resistance of the measuring input	R_i	> 2 MΩ		
Displayed value's range	R_{isol}	5 kΩ to 900 kΩ	0,1 kΩ to 90 kΩ	200 kΩ to 5 MΩ
Measurement accuracy 5 kΩ ... 10 kΩ 10 kΩ ... 900 kΩ		2 kΩ ± 10 %		
Measurement accuracy 0,1 kΩ ... 10 kΩ 10 kΩ ... 90 kΩ			0,2 kΩ ± 10 %	
Measurement accuracy 200kΩ … 1MΩ 1MΩ … 5MΩ				± 10 % ± 15 %
Critical insulation resistance	Rcrit1, Rcrit2	adjustable 5 kΩ to 300 kΩ	adjustable 0,1 kΩ to 90 kΩ	adjustable 200 kΩ to 900 kΩ
Monitored insulation resistance hysteresis	R_{hyst}	adjustable 0 to +100 % R_{crit}		
Delay in response of signalling	t_{ON}	adjustable 0 to 60 sec		
Outputs				
Two signalling relays with switching contact electric strength to the internal circuits electric strength to the supply circuits		250 V AC / 1 A 3750 Vrms 3750 Vrms		
Communication line: RS485 type MASTER-SLAVE, 9600 Bd, even count parity Insulating strength to the internal circuits and to the network circuits		Yes 2500 Vrms	Yes 2500 Vrms	Yes 2500 Vrns
General data				
Degree of protection according to IEC 60529		front panel IP40 covers except front panel IP20		
Weight	m	160 g		
Housing material		PA – UL 94 V0		
Method of assembly		on 35 DIN rail		
Recommended section of the connected conductors	S	1 mm^2		
Article number		**70 915**	**70 915/L**	**70 917**

Table 2: HIG93, HIG93L, HIG94 technical characteristics, part 1

Operating conditions	
Operating temperature Storage temperature Shipping temperature	-10 °C ~ +60 °C -25 °C ~ +70 °C -25 °C ~ +70 °C
Altitude	Up to 2000 m a.s.l.
Protection class	II according to IEC 61140:2016
Electromagnetic compatibility	IEC 61326-2-4:2012
Overvoltage category	III, according to IEC 60664-1:2007
Pollution degree	2, according to IEC 60664-1:2007
Working position	any
Operation type	permanent

Table 3: HIG93, HIG93L, HIG94 technical characteristics, part 2

Measuring principle

DC voltage 12 V. Plus pole connected to a CENTRE terminal.

3. HIG93, HIG93/L, HIG94 controls and connecting terminals

Green indicator lamp ON

This control lights up when the device is ON (powered). It glimmers slightly after module activation.

Yellow indicator lamp FAULT1

The light indicates *FAULT1*, when the measured insulation resistance value is lower than the set critical resistance R_{crit1} value. It even lights after the fault status removal, if the fault memory function is active. At the same time, this status is signalled by the *FAULT1* relay contacts.

Yellow indicator lamp FAULT2

The light indicates *FAULT2*, when the measured insulation resistance value is lower than the set critical resistance R_{crit2}. It even lights after the fault status removal, if the fault memory function is active. At the same time, this status is signalled by the *FAULT2* relay contacts.

Display

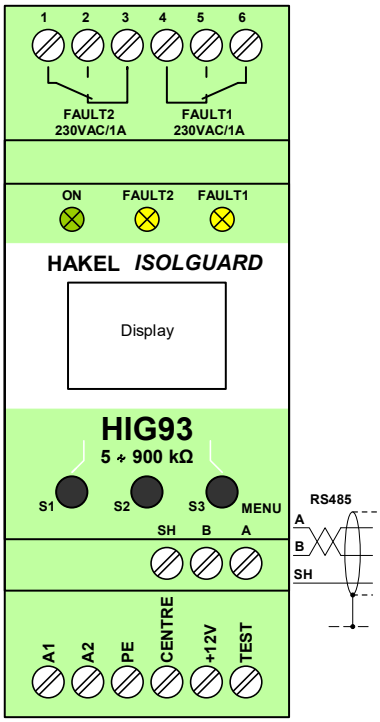
It serves to display the measured values, to show current function of the S1 – S3 pushbuttons, to set the parameters and to display information. For description of displayed information, see chapter *Information on the display*, page 8.

FAULT1 or *FAULT2* relay status change, eventually starting and ending device test, is signalled by short display flash.

The display goes off if no button is pressed for 5 minutes and is again restored by pressing any button. The insulation monitoring device is operational even if the display is not active.

Left push-button S1

This is a module control button whose meaning in each menu is shown on the display. When the insulation resistance R_{isol} is displayed, this button has the meaning of *TEST* push-button. See chapter *Information on the display*, page 8.



Picture 1: Terminals designation

Middle push-button S2

This is a module control button whose meaning in each menu is shown on the display. It releases the relay *FAULT*, when the fault memory function is active. It activates display of temperature inside the module if the insulation resistance value R_{isol} is displayed.

Right push-button S3 MENU

This is a module control button whose meaning in each menu is shown on the display. When the insulation resistance R_{isol} is viewed, it activates the parameter setting menu.

Within the parameters setting menu, the prolonged pressing of this push-button terminates the data entering with memorizing the new value, whereas the short pressing of this push-button causes exit from the menu without memorizing the new parameter value.

Terminals A1, A2

These terminals serve to connect the module's power supply. The power supply voltage is 90 to 265 V AC (47 ÷ 440 Hz) or 90 to 370 V DC.

Terminals CENTRE, PE

Input terminals for the insulation resistance measurement, see recommended connections of the insulation monitoring device. If the monitoring of IT power supply system with voltage higher than 275 V AC (without brought-out neutral conductor) is required, it is necessary to create an artificial centre using TL inductors. Such a created neutral is connected to the *CENTRE* terminal. The value of external inductor DC resistance is set within the Parameters setting menu.

Terminals of the signalling relay FAULT1 230 V AC /1 A

Terminals of the signalling relay FAULT2 230 V AC /1 A

Potential-free switching relay contact for signalling the status of the monitored IT power supply system.

FAULT1 and *FAULT2* relay status when insulation status fault occurs is determined by the setting of ***Set Relay FA*** parameter. This parameter can be set to one of two values ***N/C*** and ***N/O***.

The signalling is performed as follows when parameter ***Set Relay FA*** is set to ***N/C*** value:

Relay *FAULT1 (FAULT2)* **is released**, when the device is connected to the power supply, is functional (the indicator lamp ON glimmers slightly) and insulation status **fault** *FAULT1* (*FAULT2*) **is not indicated**. The insulation resistance of the monitored system is higher than the set critical value R_{crit1} (R_{crit2}).

The signalling is performed as follows when parameter ***Set Relay FA*** is set to ***N/O*** value:

Relay *FAULT1 (FAULT2)* **is released**, when the device is connected to the power supply, is functional (the indicator lamp ON glimmers slightly) and insulation status **fault** *FAULT1* (*FAULT2*) **is indicated**.

When R_{isol} is displayed the status of signalling relay's contacts is indicated by the symbol of contact. In case of fault, the close contact is displayed.

Terminal TEST

Terminal for connection with the remote test push-button. Remote test push-button is connected between TEST and +12V terminals.

Terminal +12 V

Terminal for connection with the remote monitoring push-button. See recommended connections of the insulation monitoring Device.

Terminals A, B, SH

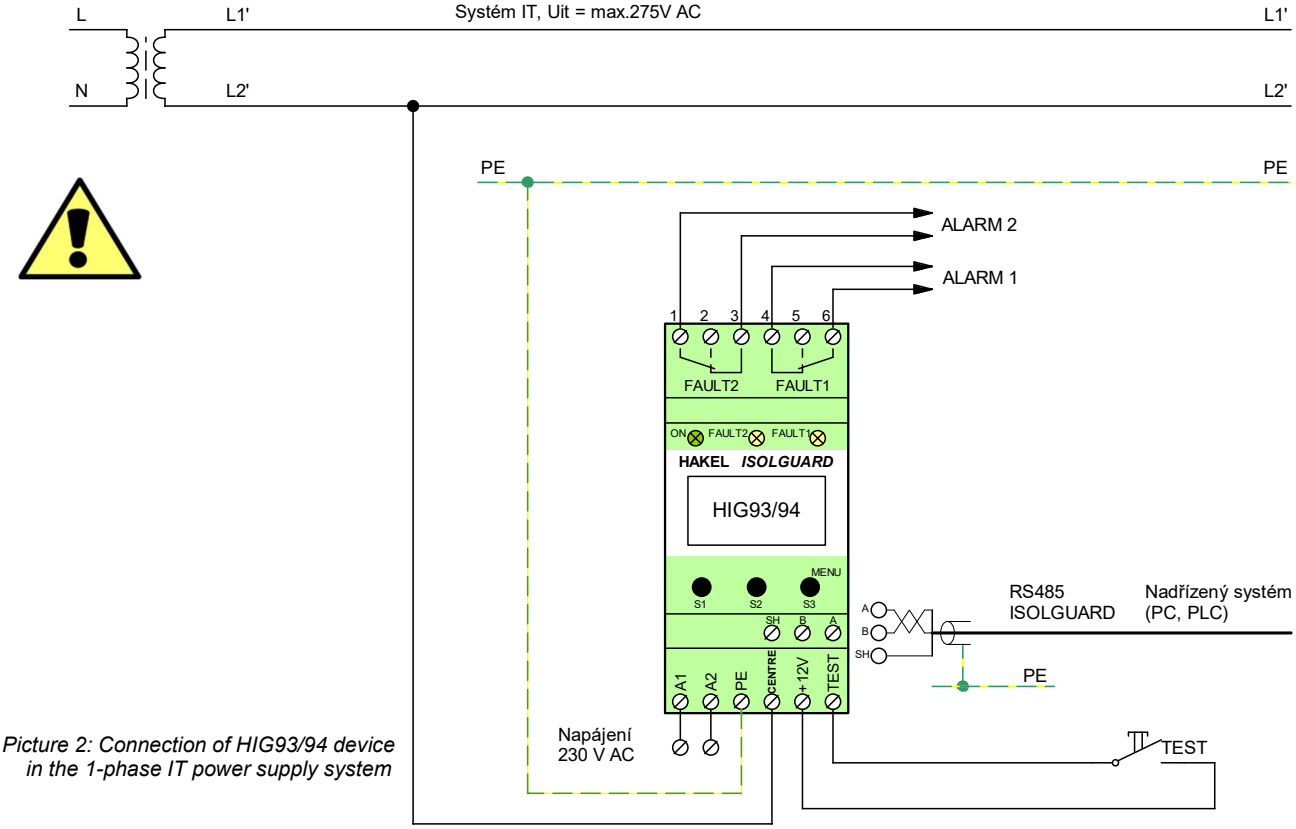
These terminals are intended for connection of galvanic isolated communication line ISOLGUARD RS485. Individual insulation monitoring devices are connected with twisted pair between *A* and *B* conductors. The SH terminal serves for connection of signal grounds by the interconnecting cable. For description of the communication line see chapter *Communication protocol* page 12. This line may be also connected with a remote monitoring module MDS-D with display.

Note:

Terminals +12V and TEST are exclusively intended for connection of the test push-button. These terminals cannot be used for connection of any other devices.

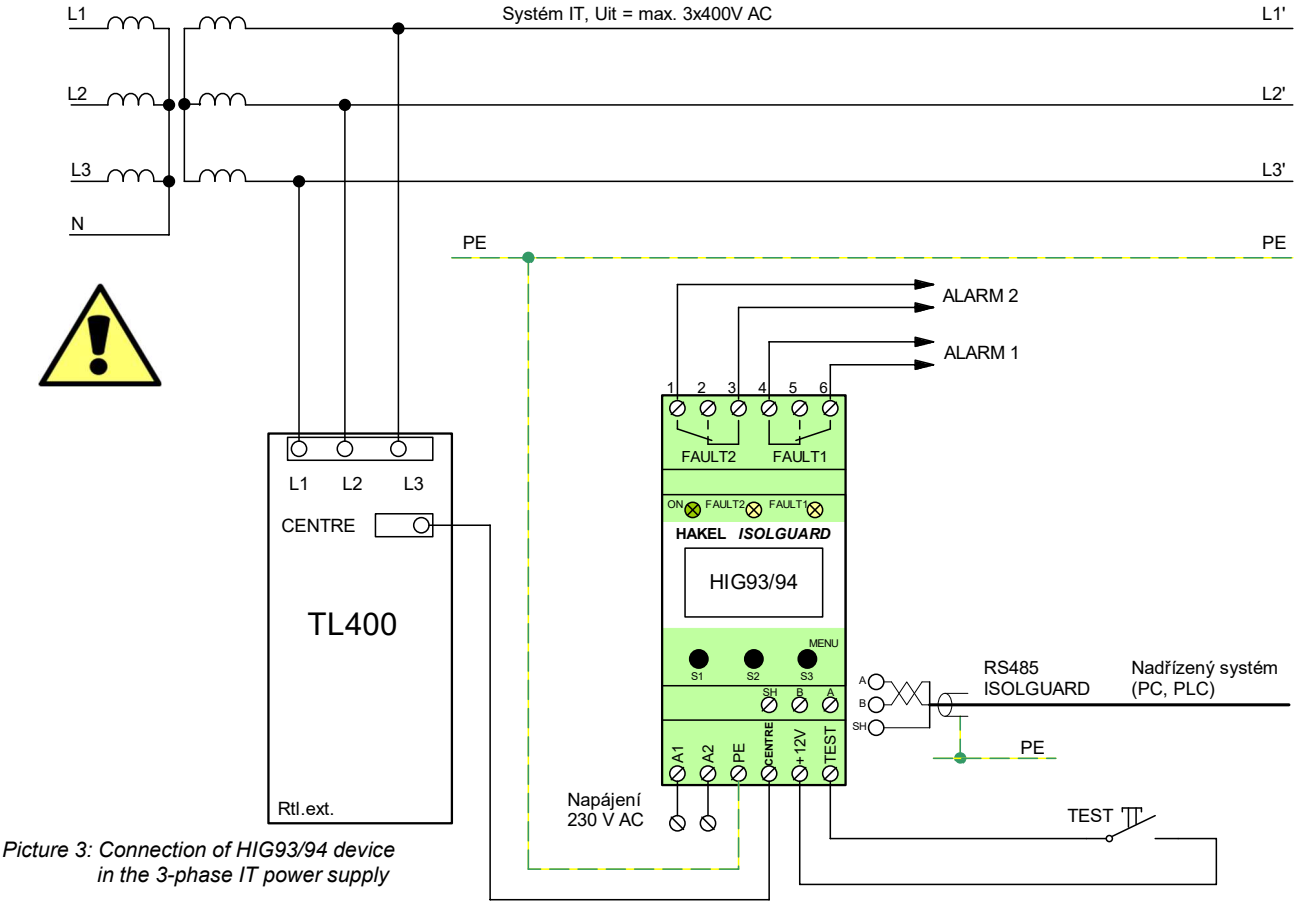
4. Recommended connection of HIG93, HIG93/L, HIG94 to the monitored IT power supply system

Single-phase IT power supply system (maximum 275 V AC), HIG93, HIG93/L, HIG94 modules with alarm signalling and with the remote test push-button



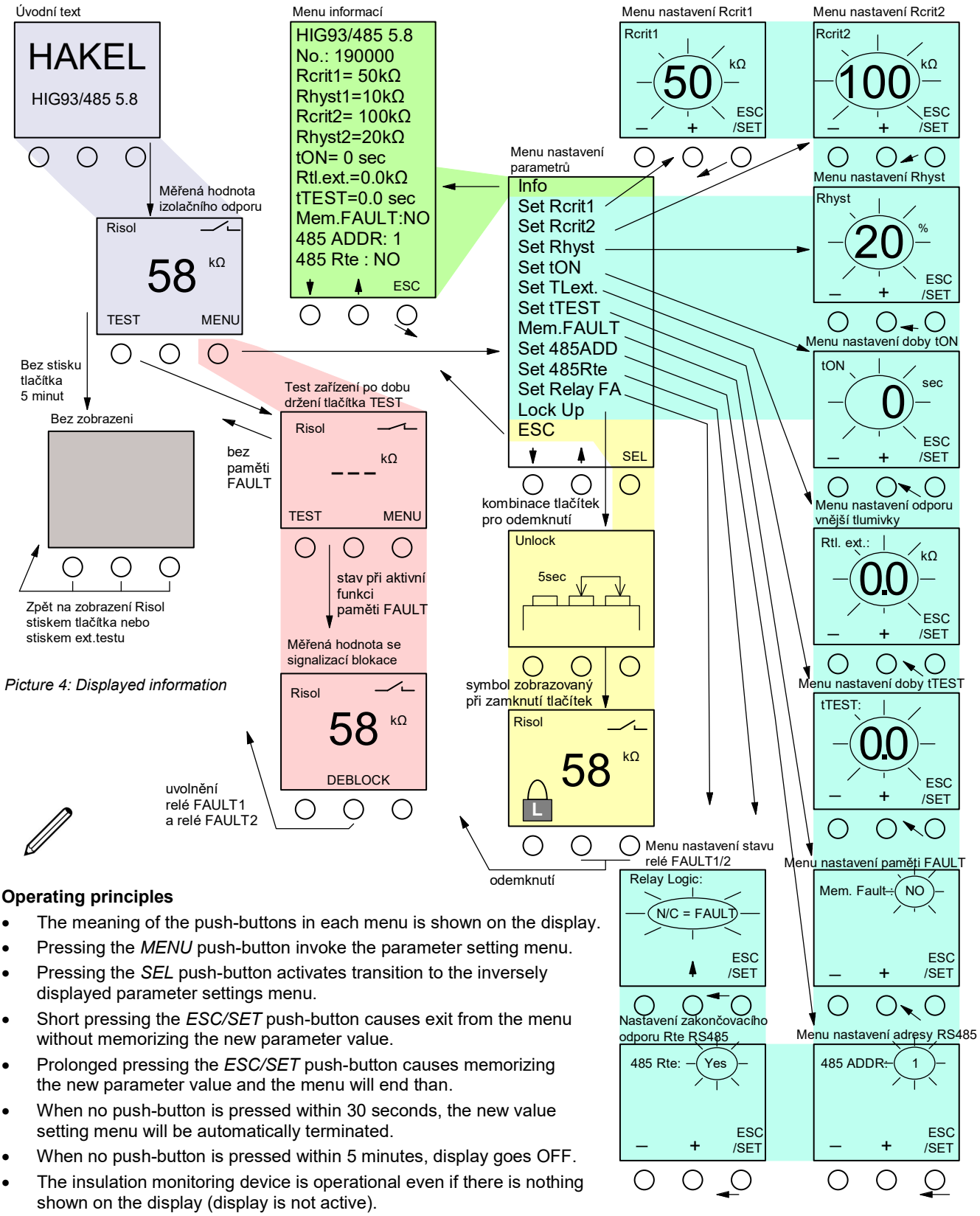
Picture 2: Connection of HIG93/94 device in the 1-phase IT power supply system

Three-phase IT power supply system (3x440 V AC), modules HIG93, HIG93/L, HIG94 with alarm signalling and with the remote test push-button



Picture 3: Connection of HIG93/94 device in the 3-phase IT power supply

5. Information on the display



Picture 4: Displayed information

Operating principles

- The meaning of the push-buttons in each menu is shown on the display.
- Pressing the *MENU* push-button invoke the parameter setting menu.
- Pressing the *SEL* push-button activates transition to the inversely displayed parameter settings menu.
- Short pressing the *ESC/SET* push-button causes exit from the menu without memorizing the new parameter value.
- Prolonged pressing the *ESC/SET* push-button causes memorizing the new parameter value and the menu will end than.
- When no push-button is pressed within 30 seconds, the new value setting menu will be automatically terminated.
- When no push-button is pressed within 5 minutes, display goes OFF.
- The insulation monitoring device is operational even if there is nothing shown on the display (display is not active).
- The display is recovered by pressing any of the push-buttons below the display.
- The display is restored by pressing the remote test button if tTEST is set to a value greater than zero.
- After selecting the menu *Lock Up* the control buttons are locked and the measured value is displayed.
- The unlocking of the device's control buttons is realized while holding the middle and right button for 5 seconds.
- Releasing the *FAULT1* or *FAULT2* relay is realized by the middle push-button on the device or by the RS485 ISOLGUARD communication line RS485 order.
- *FAULT1* or *FAULT2* relay status change, eventually initiation and termination the device test is indicated by a short display flash.

5.1 Displayed information HIG93, HIG93/L, HIG94

Opening text

It is displayed for a short time after switching ON the module. The name of the module and software version is displayed. After the insulation status measuring is started, the measured value of insulation resistance is displayed automatically.

Measured value of insulation resistance

It is displayed in a range as specified in the table of technical characteristics in units of kΩ or MΩ. The value is rounded to units of kΩ within the adjustable critical insulation resistance range and to tens of kΩ if lying beyond that range.

Pressing ***TEST*** push-button activates test of the device, pressing ***MENU*** push-button displays parameter settings menu. By pressing the middle push-button current temperature inside the module is indicated in the upper part of the display. The signalling relay's status is indicated by the symbol of contact. If both relays are released (there is no fault in the monitored power supply system) the open contact is displayed. If there is R_{crit1} or R_{crit2} fault signalled, the close contact is displayed.

In a case the non-zero value for the time t_{ON} (time until the fault signalling) is set, then when R_{isol} drops below the R_{crit} value the countdown of the time t_{ON} starts. The display shows the time until fault signalling. After the time is expired, the fault is signalled.

Insulation monitoring device test

Test may be performed by pressing push-button on the module, by remote ***TEST*** push-button or by the ISOLGUARD RS485 communication line order.

Testing of the insulation monitoring device is performed for 5 seconds or during the time of holding the button. The insulation resistance value is set lower than R_{crit1} and R_{crit2}. Invoked alarm is signalled by indicator lamp ***FAULT1, FAULT2*** and by *FAULT1* and *FAULT2* signalling relays' status according to ***Set Relay FA*** parameter. The insulation resistance value is not shown on the display while testing.

If the push-button on the module is used to initiate the test, then the test starts running immediately.

When using the remote test push-button, the test starts after t_{TEST} parameter delay. When the t_{TEST} value is set greater than zero the display is recovered immediately after pressing the remote test push-button and test is performed after t_{TEST} parameter delay.

Remote test via the communication line is performed immediately after receiving the order and takes 5 seconds. If the *FAULT* memory is set (***Mem.FAULT*** menu), the signal relay remains in a status of alarm indication even after the test is over, until it is released by the operator pressing the button on the module. It is also possible to release the relay by an order from the communication line in the case of remote test via communication line.

The initiation and termination of the device test is indicated by a short display flash.

FAULT memory

This parameter is set in the menu as *Mem.FAULT*.

If this parameter is set to *YES,* the *FAULT1*, *FAULT2* relay stays in the fault signalling status even after insulation resistance fault termination and the word *DEBLOCK* appears on the display. It is possible to release the relay by pushing device's middle button S2. This push-button can be also used when locked device is indicated by the padlock symbol on the display. *FAULT1*, *FAULT2* relay can be also released by the order from the communication line.

The usage of the *FAULT* memory including *FAULT* signalling status after termination is defined by the user.

Parameter settings Menu

Menu to set one of the following values can be selected by using push-buttons arrow up and down

- display of device's set parameters, menu ***Info***.
- monitored critical resistance, menu ***Set*** R_{crit1}, ***Set*** R_{crit2}.
- insulation resistance hysteresis, menu ***Set*** R_{hyst},
- delay in response of signalling the fault, menu ***Set*** t_{ON},
- external inductor resistance, menu ***Set*** $TL_{ext.}$,
- delay in start of module test by remote test push-button, menu ***Set*** t_{TEST}
- *FAULT* memory parameter, menu ***Mem.FAULT***
- device addresses on the RS485 bus, menu ***SET 485ADDR***
- terminating resistance R_{te} of the RS485 bus in the device, menu ***Set 485*** R_{te}
- *FAULT1* and *FAULT2* relay status when insulation status fault, menu ***Set Relay FA***
- device's control buttons can be locked, menu ***Lock Up***

For initiating of all menus use the push-button ***SEL*** and for exit select ***ESC***.

Information menu

Displays control program version of HIG93, HIG93/L, HIG94 and set operation parameters of the device. Serial number of the device is also displayed. For exit select the push-button ESC.

Menu set R_{crit1}, R_{crit2}

New value of the critical insulation resistance is set in kΩ by pressing or holding the **+** or **–** push-buttons. The value can be set in the range of 0,1 kΩ to 90 kΩ for HIG93/L, 5 kΩ to 300 kΩ for HIG93 or in the range of 200 kΩ to 900 kΩ for HIG94. New value is saved by long holding the ***ESC/SET***, pressing this push-button shortly ends setting procedure and R_{crit} value remains unchanged. Both R_{crit1}, R_{crit2} values can be set independently in the whole value range.

Menu set R_{hyst}

New value of the critical insulation resistance hysteresis is set in % by pressing or holding the **+** or **-** push-buttons. The setting range of this value is 0 to 100 % R_{crit}. New value is saved by long holding the ***ESC/SET***, pressing this push-button shortly ends setting procedure and the R_{hyst} value remains unchanged. The hysteresis level in % applies to both of the critical insulation resistance levels R_{crit1} and R_{crit2}.

Menu set t_{ON} time

New value of the delay in response of *FAULT1* or *FAULT2* is set in seconds by pressing or holding the **+** or **–** push-buttons. The value can be set in the range of 0 to 60 sec. New value is saved by long holding the ***ESC/SET***, pressing this button shortly ends setting procedure and t_{ON} value remains unchanged.

Menu set $TL_{ext.}$

External inductor connected in front of the HIG93, HIG93/L, HIG94 device is necessary when monitoring higher voltages, see recommended connection diagrams. Value of $R_{tl.ext}$ DC resistance of the connected inductor winding is set in this menu. This value must be set zero in case of application without the external inductor.

New value of the $R_{tl.ext}$ resistance is set in kΩ to one decimal place by pressing or holding the **+** or **–** push-buttons. The value can be set in the range of 0 to 20,0 kΩ. New value is saved by long holding the ***ESC/SET***, pressing this button shortly ends setting procedure and ***Rtl.ext*** value remains unchanged.

The value of $R_{tl.ext}$ inductor's DC resistance winding is indicated on the inductor's label as R_{in}. Typical values for three-phase HAKEL inductors are as follows: TL400 4,5 kΩ, TL500 4,5 kΩ, TL600 4,5 kΩ, TL1600 12,5 kΩ, TL6003 19,6 kΩ. Exact values may be obtained by measuring the inductor's winding resistance with interconnected L outlets at the operational temperature of the inductor.

Menu set t_{TEST} time

New value of the delay in module test start by pressing remote test push-button is set in seconds by pressing or holding the **+** or – push-buttons. The value can be set in the range of 0 to 6 seconds at 0,1 second step. New value is saved by long holding the ***ESC/SET***, pressing this button shortly ends setting procedure and t_{TEST} value remains unchanged.

When t_{TEST} value setting is greater than 0 the display is re-activated immediately after pressing the remote test button.

Menu Mem.FAULT

Menu for setting the *FAULT1/FAULT2* memory. This parameter can be set to ***YES***, when the *FAULT1*/*FAULT2* relay remains in alarm signalling status even after the fault is eliminated and the button on the device must be pressed to release the relay. Parameter can be also set to ***NO*** without fault memorizing. An order through the RS485 communication line can also release the relay.

Menu Set Relay FA

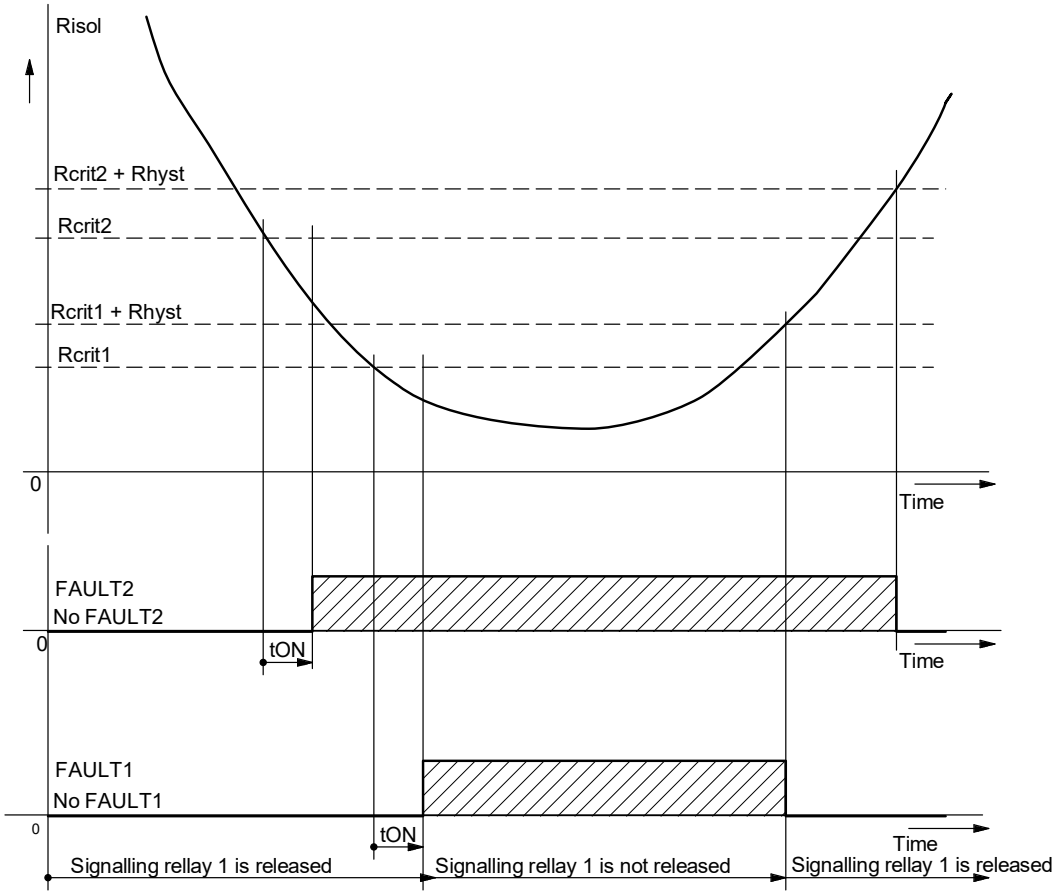
FAULT1 and *FAULT2* relay status when insulation status fault occurs is set in this menu. This parameter can be set to ***N/C*** or ***N/O*** value. The meaning is given in the terminals' description, page 5.

Menu Lock Up

Menu is intended for locking the device's control push-buttons. When selecting this menu, button combination for unlocking the module is displayed while holding down the push-button. Measured R_{isol} value and lock symbol are displayed after exiting the menu. The module is unlocked while holding the middle and right push-button at the same time for more than 5 sec.

6. Insulation resistance fault evaluation

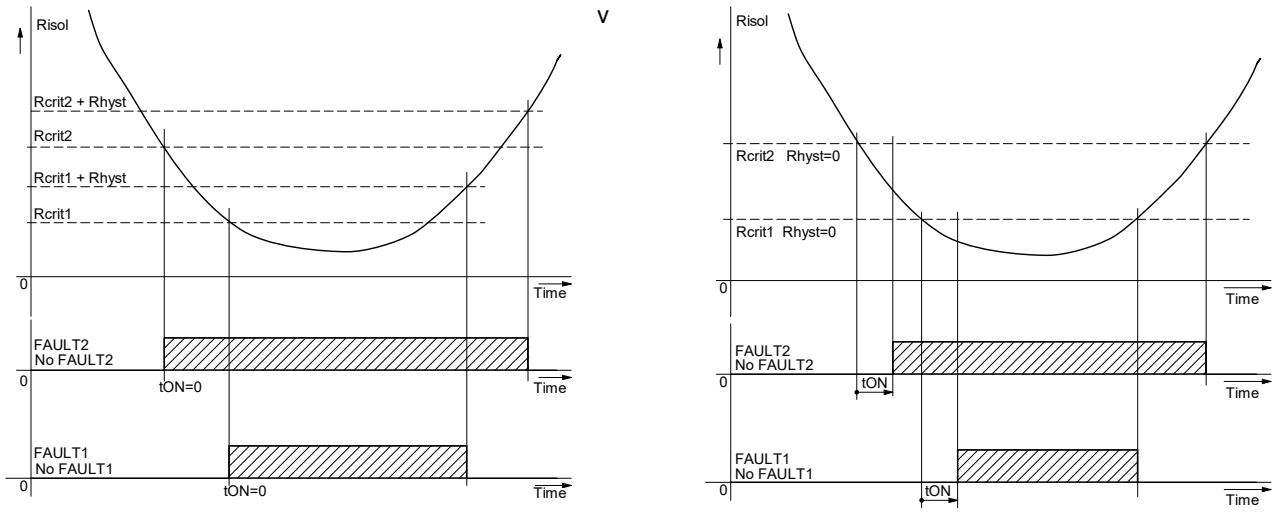
Evaluation of the *FAULT1, FAULT2* according to set t_{ON} and R_{hyst} parameters values is shown in the following figure.



Picture 5: Insulation resistance fault evaluation

In this example, the set non-zero value for t_{ON} and hysteresis R_{hyst} is shown without setting the *FAULT* memory parameter. When the insulation resistance value of the monitored power supply system decreases below R_{crit1} or R_{crit2}, the countdown of the time t_{ON} starts. The remaining time is displayed. Once the time t_{ON} is expired, the fault is signalized and the *FAULT1, FAULT2* indicator lamp on the device lights up. Particular signalling relay release is cancelled and its contacts are set to the rest position. The *FAULT1, FAULT2* is only terminated when the insulation resistance increases above the value R_{crit1}+R_{hyst} or R_{crit2}+R_{hyst}. Signalling relay is released and *FAULT1, FAULT*2 signalling is terminated.

The following left figure shows fault evaluation when insulation monitoring device is set with zero value t_{ON}. The following right figure shows example for setting of insulation monitoring device with the hysteresis zero value R_{hyst}.



Picture 6: Insulation status fault evaluation with time t_{ON} or hysteresis zero value

7. Communication protocol

Units HIG93, HIG93/L and HIG94 communicates via the industrial RS485 bus using the protocol based on the PROFIBUS protocol. Communication proceeds in the request – response mode. One MASTER station has to be connected to the bus, whereas this MASTER station sends requests to the other SLAVE stations. The slave stations only respond to requests, they never start communication. Unit HIG93/94 is in position of the slave station.

Individual stations are connected with TWISTED PAIR-TP. One conductor is labelled A, the second one B. Logical 1 (respectively 0) is determined by the voltage between these conductors. During an idle state (logical 1), the A conductor is more positive than the B conductor (at least by 200mV).

An individual address must be set for each station being connected to the bus. The address for the unit HIG93/94 is adjustable within a range 1 to 126 (address 0 is reserved for the MASTER station).

The length of the line can be up to 1200 meters; in view of proper installation, both ends of the line need to be terminated, namely by using the resistance of 120 Ω. At a given moment, each station connected to the line RS485 may transmit or receive. This mode is called half-duplex. In order to avoid any collision (i.e., two stations must not transmit simultaneously), the transmit right must be assigned by the MASTER station. In practice, the communication proceeds in such a way, that the MASTER station sends requests subsequently to all connected units and the SLAVE stations response. The accessibility of the station is ensured by its address, which must be unique for every station on the line.

For ISOLGUARD system PC computer or programmable logic controller with RS485 line can be used as a MASTER station. Also, remote monitoring module MDS-D/66 with protection degree IP66 from HAKEL production may be used. This module allows remote displaying of measured values and set parameters and also data transferring to the user's master system. Detailed description of HIG93/94 communication protocol is given in the programming manual.

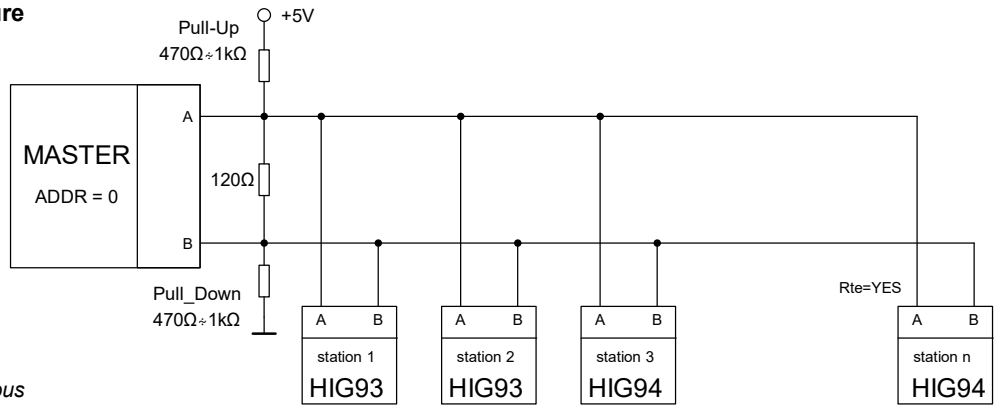
RS485 ISOLGUARD line parameter setting

In the menu ***Parameter settings*** may be selected the menu ***Set 485ADDR*** and ***Set 485Rte***.

Menu ***Set 485ADDR*** serves for setting of the address for HIG93/94 device on the RS485 bus. The setting range for the address is 1 to 126.

Menu ***Set 485Rte*** serves for setting the connection of an internal terminating resistor R_{te} to the RS485 line. This parameter may be set to ***YES*** (when the resistance 120Ω is internally connected to the RS485 line of the module), or ***NO*** (without connected resistance).

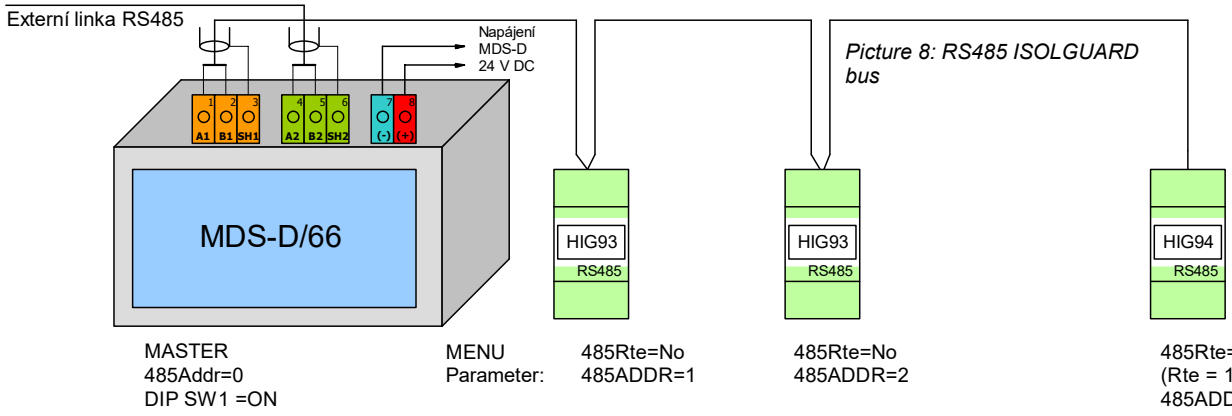
RS485 bus structure



Picture 7: RS485 bus

Communication between HIG devices and MDS-D remote monitoring module

Using MDS-D as the MASTER station allows the user smooth and convenient supervision of up to 24 IT power supply systems' status, monitored by HIG93/94 devices or other devices of HIG ISOLGUARD series. MDS-D/66 touch panel in industrial design with protection degree IP 66 communicates with insulation monitoring devices via ISOLGUARD protocol fully automatically, including the ability to search monitoring devices on the connected bus. For proper function it is only necessary to set unique addresses in the device menu and connect monitoring devices and MDS-D/66 panel by twisted pair. HIG monitoring devices are always connected to the internal RS485 line of the MDS-D module, i.e. A1 B1 terminals.



Picture 8: RS485 ISOLGUARD bus

RS485 bus termination on the MDS-D is done by a switch available inside the case. The switch labelled SWITCH1 connects terminating resistance 120 Ω to internal RS485 line (A1 B1) in the ON position. The switch labelled SWITCH2 connects terminating resistance 120 Ω to external RS485 line (A2 B2) in the ON position.

8. Data transmitted via RS485 bus

HIG93, HIG93/L, HIG94 devices communicate on the RS485 bus by using the ISOLGUARD communication protocol. This protocol was designed by HAKEL as a universal command system for reading data from insulation monitoring devices of HIG9x series and additional products.

ISOLGUARD communication protocol differentiates between 3 basic transmitted data types:

- Identification data, through which the device displays its type designation
- Measured data, information on currently measured quantities and their status
- Device parameters, that contain the device settings values

For identification data, the unit sends the codename of its design, the software version and program compilation date - which is not the date of device's production.

Measured data and parameters are sent in individual information blocks. Each information block contains the alphanumeric name, numerical value and units in which the value is sent. In addition, a character is added to the measurement data, determining the status of this measurement (e.g., fault occurrence). Parameter data are extended of priority character, determining the importance of the set parameter. This character divides parameters up into eight groups, when in group no. 1 are the most important and necessary parameters for the proper functioning of the device (e.g., critical limits) and group no. 7 is the least important parameters. Parameters with priority no. 0 are operating parameters serving to inform additional HAKEL devices and should be ignored by the user application.

The meaning of each character and the correct form of the protocol commands are described in the ISOLGUARD Protocol Programming Manual. Data that can be read from the HIG93/94 using this protocol are listed in the tables below.

Measurement data

Quantity	Symbol	Value (e.g.)	Units
Insulation resistance	Risol	500	kΩ

Table 4: Measurement data transmitted via ISOLGUARD bus

Parameters data

Parameter name	Symbol	Value (e.g.)	Units	Priority
Critical limit of insulation resistance 1	Rcrit1	50	kΩ	1
Critical limit of insulation resistance 2	Rcrit2	100	kΩ	1
Device address on the RS485 line	485ADDR	1	-	1
Insulation resistance hysteresis	Rhyst	50	%	2
Using the fault memory function	FA.MEM	1 = switch on 0 = switch off	-	2
Delay in response of signalling the insulation resistance fault	tON	0	sec	3
External inductor resistance	Rtl.ext	12,3	kΩ	3
Delay in device test start	tTEST	6	sec	4
Temperature inside the HIG module	mTEMP	32	°C	4
Connection of terminating resistance	485Rte	1 = connected 0 = disconnected	-	0

Table 5: Parameters data transmitted via ISOLGUARD bus

9. HIG93, HIG93/L, HIG94 parameters factory settings

Device parameters are set to default values during production:

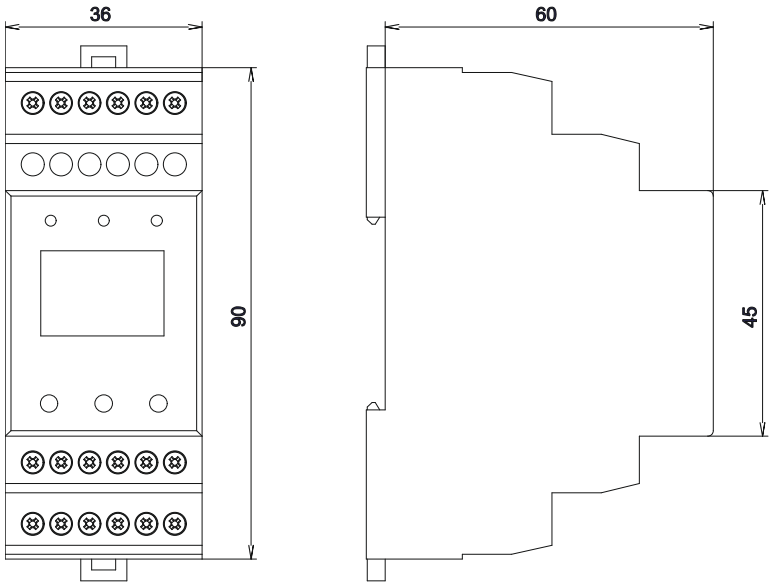
Parameter	Menu	Symbol	Value HIG93	Value HIG93/L	Value HIG94
Critical insulation resistance 1	Set Rcrit1	R_{crit1}	50 kΩ	5 kΩ	300 kΩ
Critical insulation resistance 2	Set Rcrit2	R_{crit2}	100 kΩ	50 kΩ	500 kΩ
Insulation resistance hysteresis	Set Rhyst	R_{hyst}	20 %	20 %	20 %
Delay in response of signalling the fault	Set tON	t_{ON}	0 sec	0 sec	0 sec
External inductor resistance	Set TLext.	$R_{tl.ext.}$	0 kΩ	0 kΩ	0 kΩ
Delay in device test start by remote test button	Set tTEST	t_{TEST}	0 sec	0 sec	0 sec
FAULT memory	Mem.FAULT	Mem.FAULT	NO	NO	NO
Module address	Set 485ADDR	485 ADDR	1	1	1
Terminating resistance of the line RS485	Set 485Rte	485 R_{te}	NO	NO	NO
FAULT1/2 relay status when fault occurs	Set Relay FA	Relay FA	N/C = FAULT	N/C = FAULT	N/C = FAULT

Table 6: Factory values of device's parameters

Note:

1. *Parameters meaning of RS485 line is given in communication protocol description.*

10. Device dimensions



Picture 9: Device dimensions

11. Device installation

HIG93, HIG93L, HIG94 are intended for assembling on 35 mm DIN rail according to IEC 60715:2017.
Any working position.

Operation, installation and maintenance can be done only by qualified personnel according to assembling and safety regulations. If the device is used in the way not specified by the producer, protection provided by the device could be disrupting.

12. Maintenance and service

It is necessary to follow specified conditions for reliable operation, do not expose the device to rough handling, keep it clean and ensure maximum admissible temperature of the environment.

Only qualified personnel are allowed to install and set up the device. Only the producer provides repairs of the device. No personnel are needed to operate the insulation monitoring device. Technology service is during the operation informed by local and remote monitoring signalization about the monitored power supply and transformer status.

13. Producer

Producer of HIG93/94 insulation monitoring device is
HAKEL spol. s r. o.,
Bratří Štefanů 980, 500 03 Hradec Králové
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