Insulation monitoring device

ISOLGUARD HIG97

Operating instructions

Document's name: DOK-70936

1 Content

2 Picture list

3 Tables

4 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 device HIG97

The insulation monitoring device HIG97 produced by HAKEL for the ISOLGUARD series is designed to monitor the insulation status of three-phase IT power supply systems, where extremely fast evaluation and signalling of the monitored system status is required. HIG97 devices are designed and operated according to standards IEC 61557-8.

Using an external TL1200 inductor to create an artificial centre enables the device to monitor three-phase IT power supply systems up to the maximum operating voltage 3x1000 V AC. So created centre is connected to the terminal of HIG97 insulating monitoring device.

The insulation monitoring device is equipped with display showing the measured insulation resistance values. Further there are parameter setting push-buttons and LED indicator lamps indicating the status of monitored IT power supply system and the device itself. HIG97 can communicate with a master computer via RS485 industrial bus using protocol based on the PROFIBUS protocol. Built in signalling relays enable to connect equipment for supervising and signalling monitored IT power supply system status. Device includes four signalling relays.

FAULT1 fast-response signalling relay signals current status of monitored IT power supply system.

FAULT1 MEM fast-response signalling relay with memory signals the first fault of monitored IT power supply system. Operator's intervention is required to remove the fault status. This signalling relay will preserve its configuration even if the device is switched off and on again.

FAULT2 slow-response signalling relay signals the status of monitored IT power supply system. In device's parameter menu can be selected relay's function with or without memory. If the function with memory is selected, operator must cancel the signalling manually. Switching the power supply off brings the *FAULT2* relay to its basic configuration.

ERR signalling relay signals the function of the device itself. The relay is released if device is on and monitored IT power supply system measurement proceeds.

It is possible to perform both on-site and remote device function test.

No more than one insulation monitoring device may be connected to an IT power supply system.

1.1. ISOLGUARD HIG97 IMD variants

Model	Display Menu	Signalling relay	Display range	Critical insulation resistance	RS485	Type of IMD acc. IEC 61557-8	SW version
HIG97 ***Art. no. 70 936***	Yes	4x SPDT	5 kΩ to 900 kΩ	Adjustable 5 kΩ to 300 kΩ	Yes	AC	V5.2

Table 1: Model and article number

Notes: SPDT signalling relay with single-pole double-throw contact

1.2. HIG97 complies with standard:

- ČSN 33 2000-4-41 ed.2 (HD 60364-4-41:2017) Low-voltage electrical installations - Part 4-41
- ČSN EN 61557-8 ed. 3 (IEC 61557-8:2014) Insulation monitoring devices for IT systems
- ČSN EN 61557-1 ed. 2 (IEC 61557-1:2007) Equipment for testing measuring or monitoring of protective measures
- ČSN EN 60664-1 ed. 2 (IEC 60664-1:2007) Insulation coordination for equipment within low-voltage systems
- ČSN EN 60079-11 ed.2 (IEC 60079-11:2011) Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"

1.3. Basic characteristics

- Fast response insulation monitoring device for AC systems with voltage 230 VAC / 500VAC / 1000VAC
- Fast-response signalling relay of current insulation resistance status
- Fast-response signalling relay of insulation resistance status with memory; the fault status must be cancelled manually by push-button on the device or remote button
- Slow-response signalling relay of insulation resistance status memory; the fault status must be cancelled manually by push-button on the device or remote button
- Device function signalling relay
- Display of the measured insulation resistance R_{isol} in the range 5 kΩ to 900 kΩ or 200 kΩ to 5 MΩ
- Connection to RS485 bus, insulation strength 2500 V_{rms} against the internal circuits and network circuits
- Option to set monitored insulation resistance R_{crit1} using the display and push-buttons in the range from 5 kΩ to 300 kΩ
- Adjustable hysteresis of the insulation resistance limit value in the range 0 - 100 % using the display and push-buttons
- Adjustable response delay t_{ON1} of the *FAULT1* fast-response signalling relay in the range 0 - 9.99 sec with a 0.01 sec step
- Adjustable response delay t_{ON2} of the *FAULT2* slow-response signalling relay in the range 0 - 60 sec with a 1 sec step
- Adjustable response delay t_{START} of the *FAULT1 and FAULT2* signalling relays after activating the device

- Access to the IMD parameter setting with the pushbuttons can be locked/unlocked by a button combination
- Separate supply voltage also allows to monitor IT power supply systems, which are not under voltage
- Two modules 2M width, total width 4M (72mm) for assembling on DIN rail 35

2 Technical characteristics – ISOLGUARD HIG97

Type		**HIG97**
Supply voltage range	U_S	90 ÷ 265 V AC (47 ÷ 440 Hz) or 120 ÷ 370 V DC
Maximum IT power supply system operating voltage (with external inductor)	U_n	Options: 230 V AC / 500 V AC / 1000 V AC
Power consumption	P	max. 5 VA
Measuring circuit		
Measuring voltage	U_m	18 V DC
Measuring current	I_m	<0.48 mA
Internal resistance of the measuring input	R_i	> 100 kΩ
Display value's range	R_{isol}	5 kΩ ÷ 900 kΩ
Measuring accuracy 5 kΩ ... 100 kΩ 100 kΩ ... 900 kΩ		10 kΩ ± 10%
Fast-response signalling:		
Fast-response of critical insulation resistance	R_{crit1}	adjustable 5 kΩ ÷ 300 kΩ
Fast-response signalling of basic response time	t	< (80 to 500) msec according to service parameter setting
Fast-response signalling of additional delay time	t_{ON1}	adjustable from 0 to 9.99 sec (step 0.01 sec)
Slow-response signalling:		
Slow-response of critical insulation resistance	R_{crit2}	adjustable 50 kΩ ÷ 300 kΩ
Slow-response signalling of basic response time	t	< 3 sec
Slow-response signalling of additional delay time	t_{ON2}	adjustable from 0 to 60 sec, with a 1 sec step
Insulation resistance hysteresis	R_{hyst}	adjustable 0 ÷ +100 % R_{crit}
Outputs		
FAULT1 MEM fast-response signalling with status memory Potential-free switching contact: electrical strength to the internal circuits and to the supply circuits		250 V AC / 1 A 3750 V_{rms}
FAULT1 fast-response signalling without status memory Potential-free switching contact: electrical strength to the internal circuits and to the supply circuits		250 V AC / 1 A 3750 V_{rms}
FAULT2 slow-response signalling Potential-free switching contact: electrical strength to the internal circuits and to the supply circuits		250 V AC / 1 A 3750 V_{rms}
ERR device function signalling Potential-free switching contact: electrical strength to the internal circuits and to the supply circuits		250 V AC / 1 A 3750 V_{rms}
Communication line: RS485 – type MASTER-SLAVE, 9600 Bd, even count parity Insulating strength to the internal circuits and to the network circuits		Yes 2500 V_{rms}

Table 2: HIG97 technical parameters, part 1

General data		
Degree of protection according to IEC 60529		front panel IP40 covers except front panel IP20
Weight	m	290 g
Housing material		PA – UL 94 V0
Method of assembly		DIN 35 rail
Recommended section of the connected conductors	S	1 mm^2
Recommended protection		6 A
Article number		70 936

Table 3: HIG97 technical parameters, part 2

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

Table 4: HIG97 technical parameters, part 3

2.1. Measuring principle

DC voltage 12V. Plus pole connected to the CENTER terminal.

2.2. Non-flammability of the measuring circuit in mining operations

The HIG97 IMD, in combination with the TL1200 inductor (HAKEL), is equipped with an measuring output circuit that meets the requirements for non-flammability in mining operations. The non-flammability of the circuit applies to group I with a safety factor of 1.5 according to the standard EN 60079-11 ed.2. The non-ignition test was performed by the Physical Technical Testing Institute, a state enterprise, Ostrava - Radvanice.

3. Controls and connecting terminals of the HIG97 module

HIG97 IMD consists of 2 modules: HIG display module and HIG97 expander measuring module. The modules are interconnected via 4-wire cable.

Green indicator lamp ON

This control lights up when the device is ON (powered). It glimmers slightly after module activation and flashes in the event of a fault. The ON indicator lamp is identical on both modules.

Yellow indicator lamp ERR

Signals the status of device function. It lights up when the device is not operating and no system measurement proceeds. *ERR* relay is not released and signals device fault. If the device is functional, the *ERR* relay is released and the indicator lamp does not light.

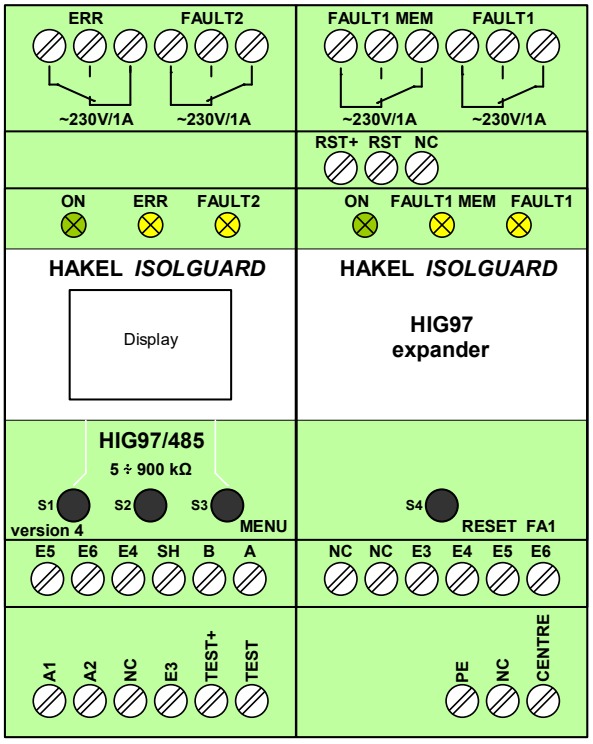
Yellow indicator lamp FAULT1

Signals the status of *FAULT1* fast-response relay. It lights up when the measured insulation resistance value is or was lower than the set R_{crit1} critical resistance value.

Yellow indicator lamp FAULT1 MEM

Signals the status of *FAULT1 MEM* fast-response relay with memory. It lights up when the measured insulation resistance values are or were lower than the set R_{crit1} critical resistance value and *FAULT1* has occurred. The *FAULT1 MEM* signalisation must be cancelled manually by the operator by pressing the *RESET FAULT1* push-button or the *RST* remote button. If the monitored system is still in the fault status than the fault signalling and relay are setting back to the fault status mode after pressing the push-button.

FAULT1 MEM signalling relay doesn't change the status even when switching on and off the device power supply. *FAULT1 MEM* indicator lamp doesn't light until the first fault occurs after the switching on.



NC - nepřipojeno (Not Connected)

Picture 1: Terminal designation

Yellow indicator lamp FAULT2

Signals the status of *FAULT2* slow-response relay. It lights up when the measured insulation resistance value is lower than the set R_{crit1} critical resistance value. If the *FAULT2* memory function is active, the indicator lamp still lights even after eliminating the fault and operator's intervention is required. *FAULT2* signalling can be removed only after the monitored system is not *FAULT2* status. The word *DEBLOCK* will appear on the display's bottom line. The operator must press the *S2* push-button to remove the signalling.

Display unit

It serves to display the measured values, shows current function of the S1 – S3 push-buttons, serves to set the parameters and displays important information. For description of displayed information, see page 6.

Relay status change, eventually starting and ending IMD test is signalled by short display flash.

Display will go off if no button is pressed during a 5-minute period and will be restored by pressing any button, including short pressing of the remote test button. See the description of the t_{TEST} parameter, page 6. 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. It has the function of *TEST* button when the insulation resistance R_{isol} is displayed. See the section information on the display, page 6.

Middle push-button S2

This is a module control button whose meaning in each menu is shown on the display. It releases the relay when the *FAULT2* memory function is active. It activates display of temperature inside the module and some other values if the insulation resistance R_{isol} is displayed. Long pressing this button will deactivate the display.

Right push-button S3 MENU

This is a module control button whose meaning in each menu is shown on the display. It will activate the parameter setup menu if the insulation resistance R_{isol} is displayed.

Within the parameter 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.

Middle push-button S4 RESET FAULT1

This is a control button for resetting the *FAULT1 MEM fast-response signalling relay*. When the *FAULT1* is released, this push-button switches over *FAULT1 MEM* relay to the faultless configuration. Measuring module continues evaluating the monitored system fault and if the fault remains, the *FAULT1* relay is set back to the fault status.

Terminals A1, A2

These terminals serve to connect the module power supply. The power supply voltage is 90 to 265 V AC (47÷440 Hz) or 120 to 370 V DC.

Terminals CENTRE and PE

Input terminals for evaluation of the insulation resistance, see recommended connections of the insulation monitoring device. The artificial centre created by the external inductor is connected to the *CENTRE* terminal. The external inductor's DC resistance is entered in the parameter setup menu.

ERR signalling relay terminals

Potential-free switching contact for device function signalling. *ERR* signalling relay is released when the device module is connected to the power supply, is functional (the indicator lamp *ON* is slightly flashing) and the monitored IT power supply system is under measurement. The relay contacts are rated to 230 V AC/1A. In a case of no-power status the *ERR* relay is in the device fault status.

FAULT1 signalling relay with fast-response terminals

Potential-free switching contact *FAULT1* for fast-response signalling of the monitored system current status. The relay is released when the device module is connected to the power supply, is functional and the monitored system's insulation resistance is greater than the set critical level R_{crit1}. The relay contacts are rated to 230 V AC/1A.

FAULT1 MEM signalling relay with fast-response terminals

Potential-free switching contact *FAULT1* with memory for fast-response signalling of the monitored system fault. *FAULT1 MEM* signals the first fault in the monitored system. The internal or external *RESET FAULT1* button must be pressed to remove fault status and over switching the *FAULT1 MEM* relay into faultless condition.

The measuring module still continues to evaluate the monitored system fault. If the fault remains, *FAULT1 MEM* relay is set back to the fault configuration. This signalling relay doesn't change the status even when switching on and off the device power supply. The relay contacts are rated to 230 V AC/1A.

FAULT2 signalling relay terminals

Potential-free switching contact *FAULT2* signalling relay. The relay is released when the device module is connected to the power supply, is functional and the monitored system's insulation resistance is greater than the set critical level R_{crit2}.

When the R_{isol} value is displayed, the status of the *FAULT2* signalling relay contacts is indicated by the symbol of contact. If the relay is released, the open contact is displayed. If fault occurs, the close contact is displayed. The relay contacts are rated to 230 V AC/1A.

Terminals TEST+ and TEST

Terminals serve to connect the remote test button. This button is connected between the *TEST+* and *TEST* terminal. Terminals can also be used to restore the display. See the t_{TEST} parameter setting.

Terminals RST+ and RST

Terminals serve to connect the *FAULT1 MEM* signalling relay's remote resetting button.

Terminals A B SH

Terminals intended for connection of galvanic isolated RS485 communication line. 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 page 14.

Terminals NC

Terminals without connection (Not Connected) and cannot be connected in the application.

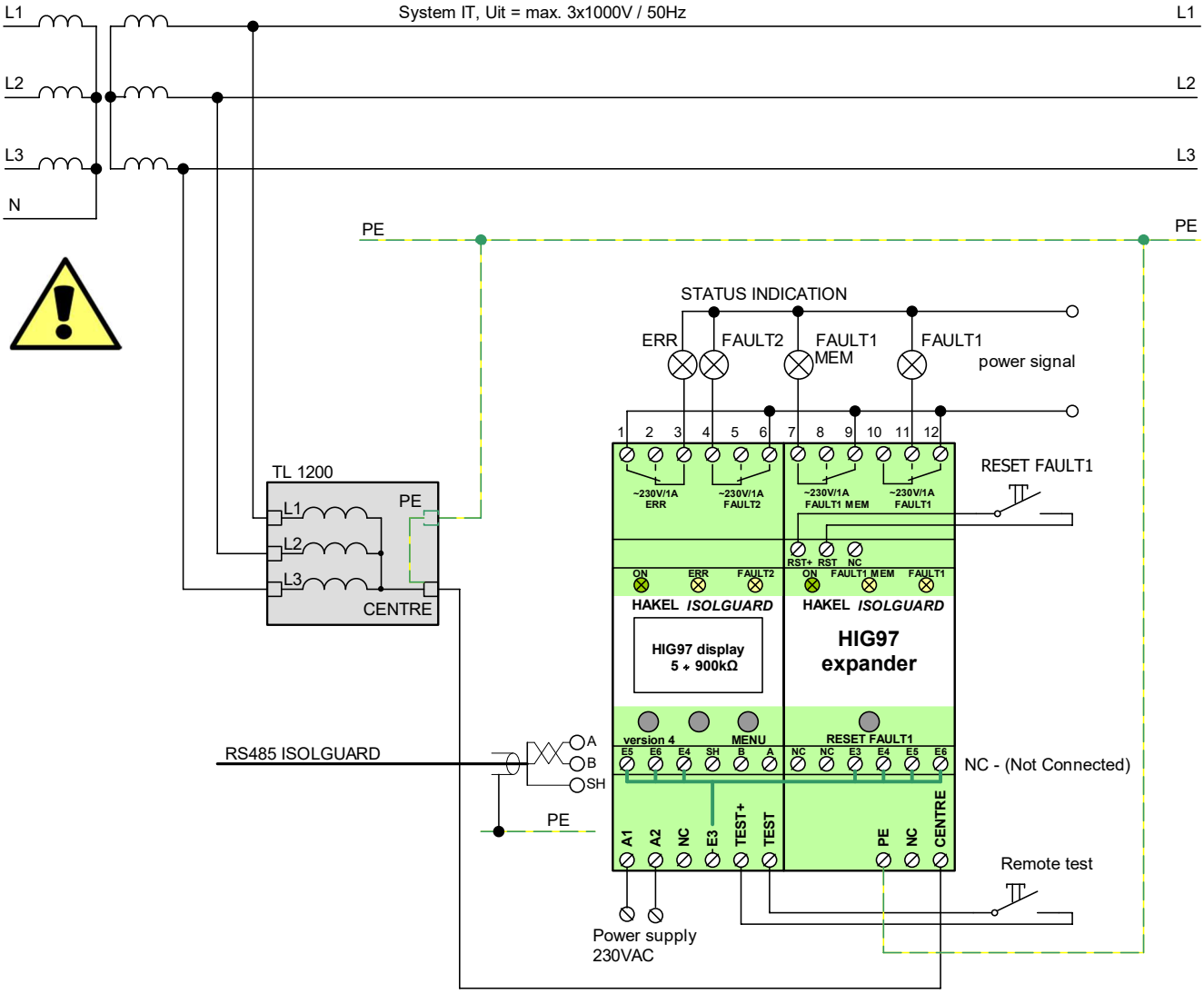
Signalization of IMD error

In case of incorrect interconnection of HIG97 module and expander the function of IMD is suspended and ERR signal relay is in fault status. Information about communication lost is displayed on the device.

Note: Terminals are intended only for connection as indicated in the recommended device connection and description. No other devices must be connected with these terminals.

4. Recommended connection of HIG97 to the monitored IT power supply system

3-phase IT system (3x500 VAC), HIG97 module in the connection with TL1200 inductor



Picture 2: Multiphase IT power supply connection diagram

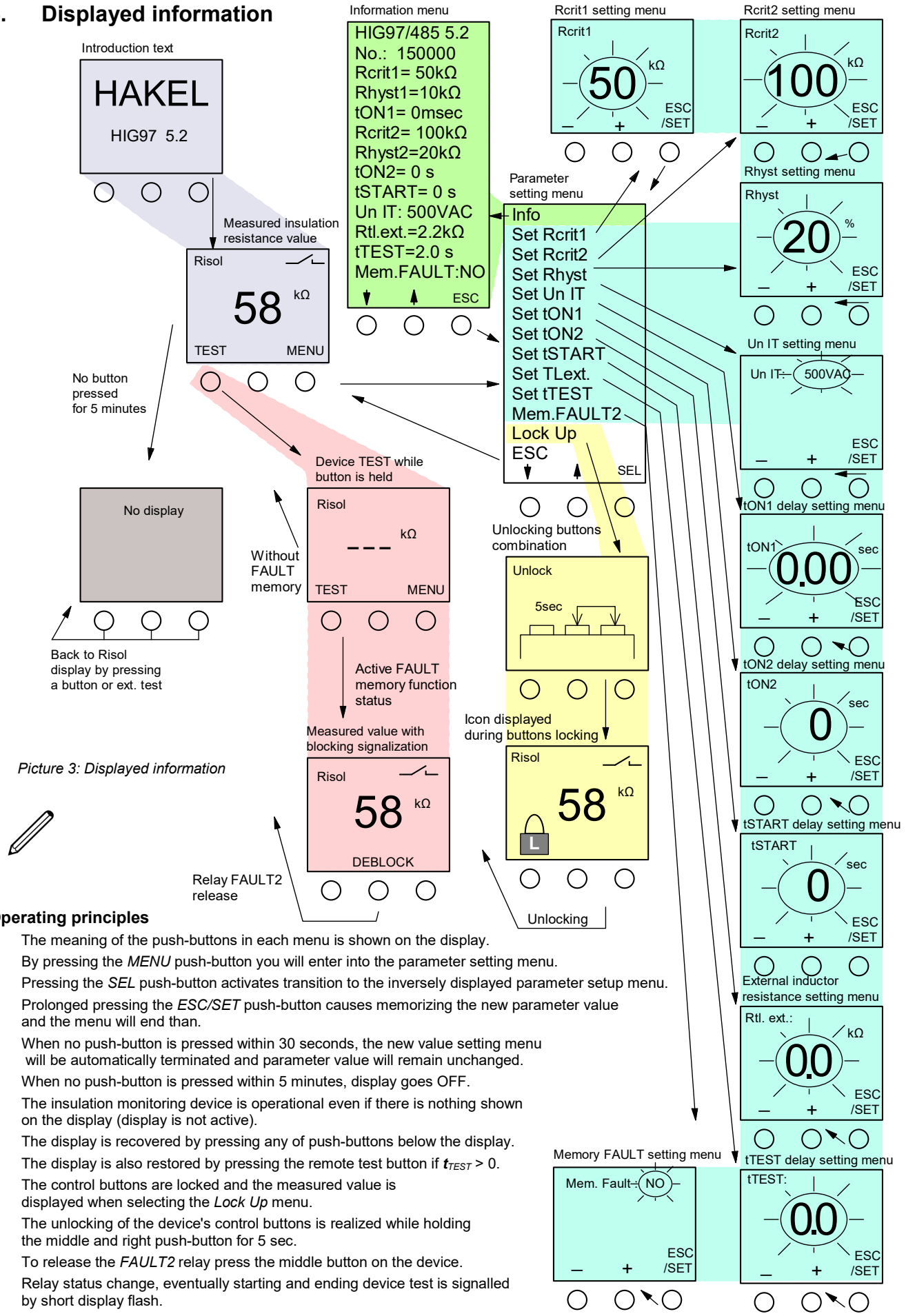
Relay contacts status shown on the modules indicates the status of *ERR*, *FAULT1* and *FAULT2* signalling relays when the device is not powered.

Statuses are signalled as follows:
ERR relay - device is in the "does not measure" status
FAULT2 relay - occurrence of *FAULT2*
FAULT1 relay - occurrence of *FAULT1*

FAULT1 MEM memory relay contacts status is determined by the condition prior to switching the power supply off.

The drawn status signals:
FAULT1 MEM relay – occurrence of *FAULT1 MEM*

5. Displayed information



Picture 3: Displayed information

Operating principles

- The meaning of the push-buttons in each menu is shown on the display.
- By pressing the *MENU* push-button you will enter into the parameter setting menu.
- Pressing the *SEL* push-button activates transition to the inversely displayed parameter setup menu.
- 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 and parameter value will remain unchanged.
- 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 push-buttons below the display.
- The display is also restored by pressing the remote test button if $t_{TEST} > 0$.
- The control buttons are locked and the measured value is displayed when selecting the *Lock Up* menu.
- The unlocking of the device's control buttons is realized while holding the middle and right push-button for 5 sec.
- To release the *FAULT2* relay press the middle button on the device.
- Relay status change, eventually starting and ending device test is signalled by short display flash.

5.1 Information on the HIG97 display

The introductory 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 measuring of resistance is started, the measured value of insulation resistance is displayed automatically.

R_{isol} – Measured value of insulation resistance

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

Pressing ***TEST*** push-button activates test of the HIG module, pressing ***MENU*** push-button displays parameter setting menu. The middle push-button activates displaying the temperature inside the imaging and measuring module. *FAULT2* signalling relay status is indicated by the symbol of contact. The open contact is displayed if the relay is released (no *FAULT2 occurs*). The close contact is displayed if *FAULT2* is signalled.

In a case the non-zero value for the time t_{ON2} (=time until the fault signalling) is set, then when R_{isol} drops below the R_{crit2} value the countdown of the time t_{ON2} starts. The display shows the time until fault signalling. After the time t_{ON2} has expired the fault is signalled by the *FAULT2* relay status and indicator lamp *FAULT2*

Test of the insulation monitoring device

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

Testing of the insulation monitoring device is performed for at least 5 seconds or during the time of holding the button and is signalled by displaying dash lines instead of R_{isol}. Device switches *FAULT1*, *FAULT1 MEM* a *FAULT2* over into fault configuration. The insulation resistance value is set to a lower level than R_{crit1}/R_{crit2}. Invoked alarm is also signalled by ***FAULT1***, ***FAULT1 MEM*** and ***FAULT2*** indicator lamp. Insulation resistance is not displayed during the test.

If the push-button on the module is used to initiate the test, then the test will start 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.

Even when the test is over *FAULT1 MEM* memory relay remains in the fault configuration until the operator's release by pressing the internal or external *RESET FAULT1 button.*

If the *FAULT2* memory is set *FAULT2* signalling 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.

FAULT2 memory

This parameter is set in the menu as ***Mem.FAULT2***.

If this parameter is set to ***YES,*** the ***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 ***FAULT2*** relay by pushing device's middle button. This button can be also used when locked device is indicated by the padlock symbol on the display. ***FAULT2*** relay can be also released by an order from RS485 communication line if connected.

The usage of the *FAULT2* memory including its signalling after termination is defined by the user.

Parameter setup menu

The following menus can be selected by scrolling up and down by means of the buttons:

- IMD parameter display: menu ***Info***
- Critical resistance value: menu ***Set R_{crit1}***
- Critical resistance value: menu ***Set R_{crit2}***
- Insulation resistance hysteresis: menu ***Set R_{hyst}***
- Monitored IT system's U_n voltage: ***Set U_n IT***
- Delay in response of signalling the insulation status fault: menu ***Set t_{ON1}***
- Delay in response of signalling the insulation status fault: menu ***Set t_{ON2}***
- Delay in response of signalling the insulation status fault after switching the device on: ***Set t_{START}*** menu
- External inductor resistance: menu ***Set TL.ext***
- Delay in module test start by remote test button: menu ***t_{TEST}***
- Fault memory parameter: menu ***Mem.Fault2***
- Setting the device address for communication via RS485 line: menu ***SET 485ADDR***
- Connecting R_{te} terminating resistance of the RS485 line: menu ***Set 485R_{te}***
- IMD control buttons can be locked: menu ***Lock up***

For initiating all menus, use the push-button ***SEL***, for exit, select the menu ***ESC***. Module bus-bar address and connection of the terminal resistor can also be set if the device uses RS485 serial communication line

Information menu

Displays version of HIG97 module software, serial number and key set parameters for operating device. For exit select the menu ***ESC***.

Menu Set R_{crit1}

New value of the critical insulation resistance is set in kΩ by pressing or holding the + or – buttons. The value can be set in the range of 5 kΩ to 300 kΩ. New value is saved by long holding the ***ESC/SET***, pressing this button shortly ends setting procedure and R_{crit1} value remains unchanged.

Menu Set R_{crit2}

New value of the critical insulation resistance is set in kΩ by pressing or holding the + or – buttons. The value can be set in the range of 5 kΩ to 300 kΩ. New value is saved by long holding the ***ESC/SET***, pressing this button shortly ends setting procedure and R_{cri2} value remains unchanged.

Both R_{crit1} and R_{crit2} can be set independently across the entire range.

Menu Set R_{hyst}

In order to set new value for hysteresis of critical insulation resistance (%), press or hold 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 button shortly ends setting procedure and the R_{hyst} value will remain unchanged. The hysteresis level (%) applies to both of the critical insulation resistance levels R_{crit1} and R_{crit2}.

Menu Set U_n voltage

New value of U_n monitored IT system voltage can be selected from three options *230 V AC, 500 V AC* and *1000 V AC* using the + or – buttons. New value is saved by long holding the ***ESC/SET***, pressing this button shortly ends setting procedure and U_n value remains unchanged.

Menu Set t_{ON1} time

New value of *FAULT1* delay in response of signalling the fault is set in seconds with 10 msec. step by pressing or holding the + or – buttons. The value can be set in the range of 0 to 99,9 sec. New value is saved by long holding the ***ESC/SET***, pressing this button shortly ends setting procedure and t_{ON1} value remains unchanged.

Menu Set t_{ON2} time

New value of *FAULT2* delay in response of signalling the fault is set in seconds by pressing or holding the + or – 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_{ON2} value remains unchanged.

Menu Set t_{START} time

New value of *FAULT1* and *FAULT2* delay in response of signalling the fault after the switching the device on is set in seconds by pressing or holding the + or – buttons. The value can be set in the range of 0 to 120 sec. New value is saved by long holding the ***ESC/SET***, pressing this button shortly ends setting procedure and t_{START} value remains unchanged.

If t_{START} value is set greater than 0, the activation of *FAULT1* and *FAULT2* is kept until this time delay. This applies only after switching the device on. The current t_{START} value is displayed during the t_{START} period.

Menu Set $R_{tl.ext}$

External inductor connected in front of the HIG97 is necessary for 3-phase IT power supply system monitoring, see recommended connection diagrams. Value of $R_{tl.ext}$ DC resistance of the connected inductor winding is set in this menu.

New value of the $R_{tl.ext}$ resistance is set in kΩ to one decimal place by pressing or holding the + or - buttons. The value can be set in the range of 0 to 12,0 kΩ. New value is saved by long holding the ***ESC/SET***, pressing this button shortly ends setting procedure and $R_{tl.ext}$ value remains unchanged.

Typical value of TL120 3-phase inductor is 2.2 kΩ. Exact values may be obtained by measuring the inductor's resistance winding with interconnected L outlets at the operational temperature.

Menu Set t_{TEST} time

New value of the delay in module test by pressing remote test button is set in seconds by pressing or holding the + or – buttons. The value can be set in the range of 0 to 60 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 Set Mem.Fault2

Menu for setting the ***FAULT2*** memory. This parameter can be set to ***YES***, when the relay continues signalling even after the fault has been eliminated and the button on the module must be pressed to release the relay. Parameter can be set to **NO** without fault memorizing. ***FAULT2*** relay can be also released by an order from RS485 communication line if connected.

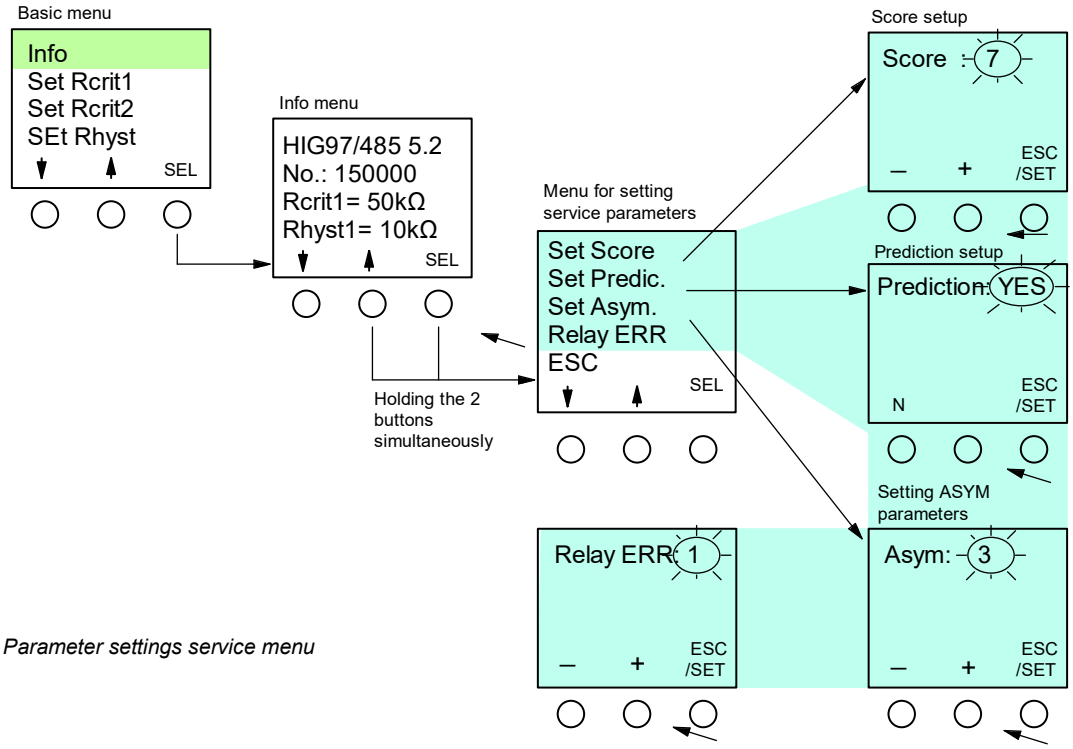
Menu Lock Up

Menu is intended for locking the device's control buttons. After selecting this menu, button combination for unlocking the module is displayed. When setting is finished measured R_{isol} value and lock symbol are displayed. The module is unlocked while holding the middle and right button for 5 sec.

5.2 Service menu

This menu allows service parameters setting of the device and is private in the V5.2 software version.
How to access the service menu:

- Select INFO in the standard device menu, press and hold the right-hand S3 push-button
- At the same time press and hold the middle push-button S2 for 5 seconds
- The service menu will appear



Picture 4: Parameter settings service menu

Menu Set Score

This function sets the service parameter value that determines the method and time of fast-response ***FAULT1*** evaluation. New ***Score*** value is set in non-dimensional unit by pressing or holding the + or – buttons. The value can be set in the range 1 to 20 [-]. New value is saved by long holding the ***ESC/SET***, pressing this button shortly ends setting procedure and ***Score*** value remains unchanged.

Recommended value setting is within the interval from 6 to 8. Value expresses number of evaluations with positive result when voltage measuring procedure of monitored IT system is measured. ***FAULT1*** occurs when the set ***Score*** level is reached. Fault evaluation is also determined by set R_{crit1} value and by set ***Un*** voltage of the monitored IT power supply system.

Lower ***Score*** value means faster fault evaluation but also lower resistance against transition states on the monitored IT system. Higher ***Score*** value means reverse device's behaviour.

Menu Set Prediction

Setting the ***YES*** value ensures prediction of the voltage measuring procedure in the next monitored IT system's voltage period.

Menu Set Asym parameter

This function sets the service parameter value that determines evaluation of asymmetric faults with a low leakage resistance value occurring in the monitored IT system. New ***Asym*** value is set in non-dimensional unit by pressing or holding the + or – buttons. The value can be set in the range 3 to 10 [-]. New value is saved by long holding the ***ESC/SET***, pressing this button shortly ends setting procedure and ***Asym*** value remains unchanged.

Recommended value setting is within the interval from 3 to 5. Value approximately expresses the time of monitored IT system voltage procedure until ***FAULT1*** evaluation

Menu Set ERR relay parameter

This function sets ***ERR relay*** behaviour after switching the device on. The parameter can be set to value 0 or 1 with the meaning as follows:

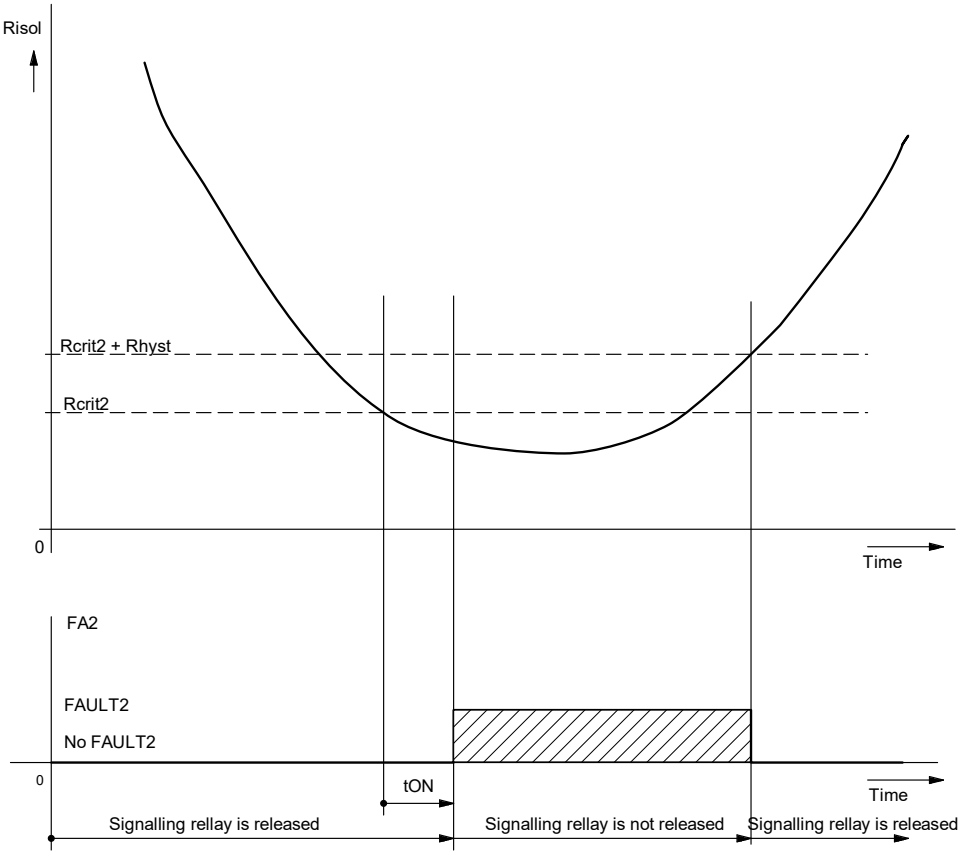
0. ***ERR relay*** is set according to the fault status, i.e. relay and signalling LED ERR flashes shortly after switching on.
1. ***ERR relay*** is set to the no fault status after switching on and this is until measurement is started (i.e. during the word HAKEL is displayed), after that the actual measuring status is set

Recommended service parameters setting for the response time

	Score	***Prediction***	***Asym***
< 80 msec	5	YES	3
< 500 msec	20	YES	10

6. Evaluation of FAULT2 insulation resistance with slow-response

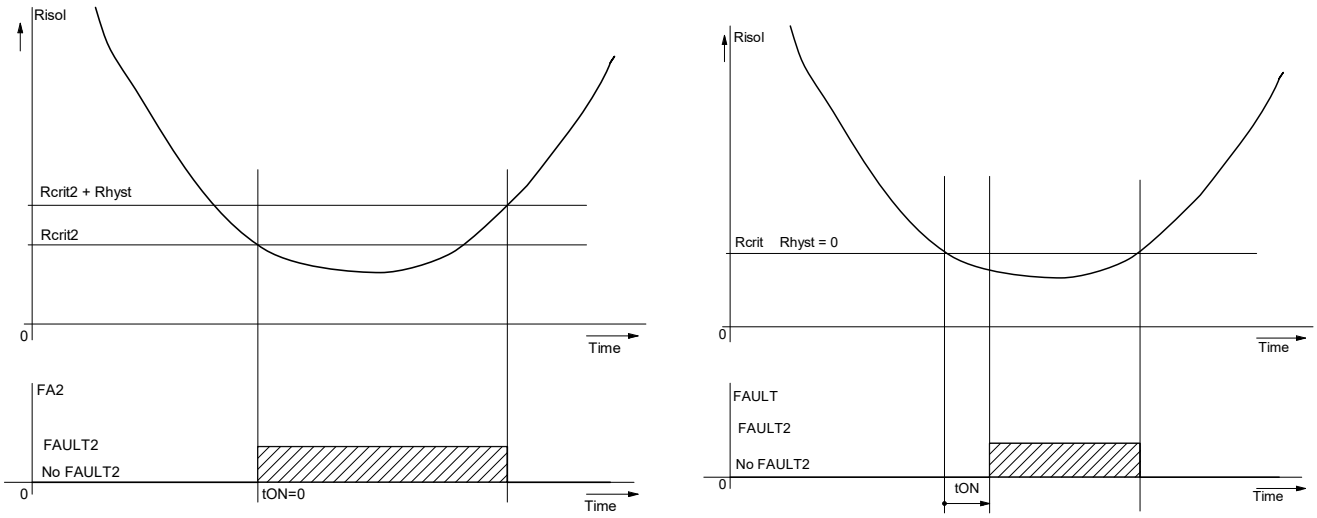
Evaluation of *FAULT2* with slow-response according to set t_{ON} and R_{hyst} parameters value is shown in the following figure.



Picture 5: Insulation resistance fault evaluation

In this example the set non-zero value for time t_{ON2} and hysteresis R_{hyst} is shown while the *FAULT2* memory parameter is set not. When the insulation resistance value of the monitored power supply system decreases below R_{crit2}, the countdown of the time t_{ON2} starts. The time remaining time is shown on the display. Once the time t_{ON2} is expired the fault is signalled and the *FAULT2* indicator lamp lights up. *FAULT2* signalling relay releasing is cancelled and its contacts are set to the rest position. *FAULT2* status will be terminating when insulation resistance increases above the $R_{crit2}+R_{hyst}$ level. *FAULT2* relay is released and indicator lamp goes off.

The following left figure shows fault evaluation when insulation monitoring device is set with zero value t_{ON2}. The following right figure shows example for setting of insulation monitoring device with the hysteresis zero value R_{hyst}.



Picture 6: Insulation resistance fault evaluation with tON or hysteresis zero value.

7. Communication protocol

The unit HIG97 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. The unit HIG97 is a slave station.

Individual stations are interconnected with TWISTED PAIR-TP. The first 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 HIG97 is adjustable within range 1 to 126 (address 0 is reserved for the MASTER station).

The maximum length of the line is 1200 meters. In a view of proper installation, both ends of the line need to be terminated using the resistance of 120 Ω. Usually one of the ends is a computer with RS485 converter which is able to realize this termination. Moreover, the converters are able to define the rest status on the line by means of PULL-UP and PULL-DOWN resistors with the value of 470 to 1000 Ω. It is efficient to connect these resistors. The line should also be terminated at the other end. This can be done at the very last HIG97 station by setting 485 R_{te} parameter in the menu to YES. This is all graphically shown in the RS485 bus-bar diagram.

At a given moment, each station connected to the line RS485 may transmit or receive. This operational 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 the 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.

Details regarding to HIG97 programming are described in the unit's programming manual.

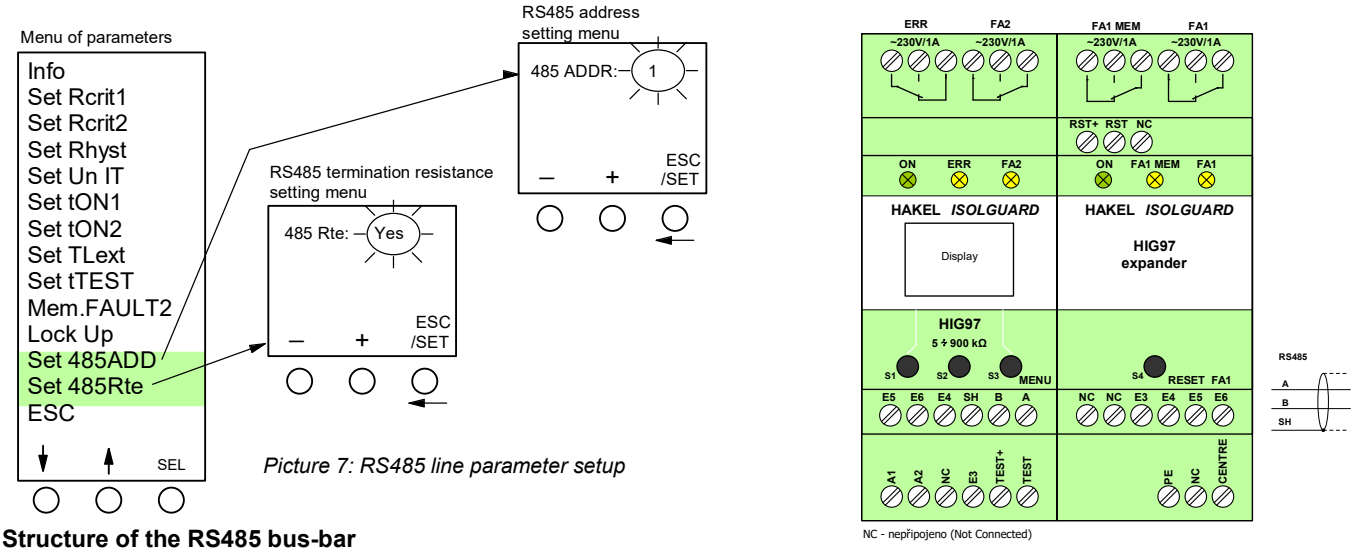
RS485 line parameter setup

In the parameter setting menu menus ***Set 485ADD*** and ***Set 485Rte*** may be selected.

Menu ***Set 485ADDR*** serves for setting of the address for insulation monitoring device HIG97 on the RS485 bus. The setting range for the address is 1 to 126.

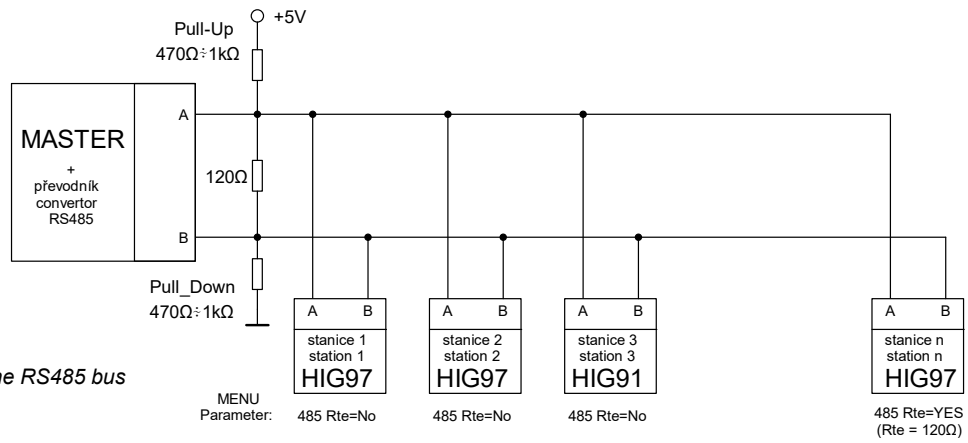
Menu ***Set 485Rte*** serves for setting of connection for an internal terminating resistor ***R_{te}*** to the RS485 line. This parameter may be set to ***YES*** (in case, that the resistance 120Ω is internally connected to the line RS485 of the module), or ***NO*** (without connected resistance).

This menu is activated by pressing ***SEL*** push-button and for exit press ***ESC/SET*** push-button.



Picture 7: RS485 line parameter setup

Structure of the RS485 bus-bar



Picture 8: Structure of the RS485 bus

8. Data transmitted via RS485 bus

HIG97 IMD communicates via RS485 bus by using the ISOLGUARD communication protocol. This protocol was designed by HAKEL as a universal command system for reading data from the insulation monitoring devices of HIG9x series and additional products.

ISOLGUARD communication protocol differentiates between 3 basic data types:

- Identification data through which the device displays its type designation
- Measured data, information on the currently measured quantities and their states
- Equipment parameters, including the IMD setup values

For data identification the unit sends the codename of its design, the version of used software and program assembly date - this 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 measuring unit. In addition, a character is added to the measurement data, determining the state 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 products 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 HIG97 are identified in the tables below.

Measured data

Quantity	Symbol	Value (e.g.)	Unit
Insulation resistance	R_{isol}	500	kΩ

Table 5: Measurement data transmitted via ISOLGUARD bus

Parameters

Name	Symbol	Value (e.g.)	Unit	Priority
Critical limit of insulation resistance 1	R_{crit1}	50	kΩ	1
Critical limit of insulation resistance 2	R_{crit2}	100	kΩ	1
Device address on the RS485 line	485 ADDR	1	-	1
Insulation resistance hysteresis	R_{hyst}	50	%	2
Error memory function usage	FA2MEM	1 = ON 0 = OFF	-	2
Delay in response of signalling	t_{ON1}	0	sec	3
Delay in response of signalling	t_{ON2}	0	sec	3
Delay in response of signalling the fault after switching the device on *tSTART*	tSTART	0	sec	3
External inductor resistance	Rtl.ext	12.3	kΩ	3
Delay in module test start by remote TEST button	tTEST	6	sec	3
Temperature inside HIG module	temp.ZM	32	°C	4
Temperature inside the expander module	temp.MM	32	°C	4
Terminal resistor connection	485 Rte	1 = connected 0 = disconnected	-	1

Table 6: Parameters data transmitted via ISOLGUARD bus

9. Factory settings – parameters of HIG97

Factory settings of the insulation monitoring devices are as follows:

Parameter	Menu	Symbol	HIG97 Value
Critical insulation resistance R_{crit1}	Set Rcrit1	R_{crit1}	50 kΩ
Critical insulation resistance R_{crit2}	Set Rcrit2	R_{crit2}	100 kΩ
Insulation resistance hysteresis	Set Rhyst	R_{hyst}	20 %
Un IT system's voltage	Set Un IT	U_n IT	500 V AC
Delay in response of signalling the *FAULT1*	Set tON1	t_{ON1}	0.00 sec
Delay in response of signalling the *FAULT2*	Set tON2	t_{ON2}	0 sec
Delay in response of signalling the fault after switching the device on *tSTART*	Set tSTART	t_{START}	0 sec
External inductor resistance	Set TL ext.	$R_{tl.ext.}$	2.2 kΩ
Delay in module test start by remote TEST button	Set tTEST	t_{TEST}	2.0 sec
FAULT2 memory	Mem.FAULT2	Mem. FAULT	No
Keypad lockup	Lock Up		No

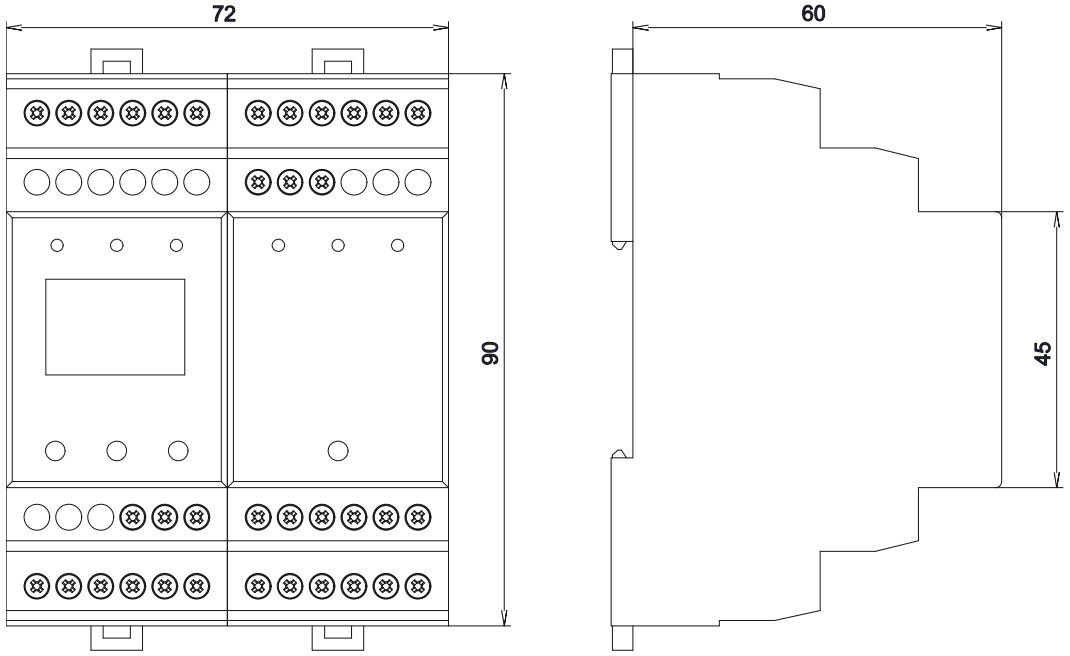
Table 7: Factory values of device's operating parameters

Parameters of RS485 serial communication line are set as follows:

Parameter	Menu	Symbol	Value HIG97
Module address	Set 485ADD	485 ADDR	1
Terminating resistance of the RS485 line	Set 485Rte	485 R_{te}	No

Table 8: Factory values of device's service parameters

10. Dimensional sketch



Picture 9: Device dimensions

11. Installation instructions

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.

ISOLGUARD HIG97 is intended for assembling on 35 mm DIN rail according to IEC 715:1981. Any working position.

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 environment.

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 HIG97 insulation monitoring device is:

HAKEL spol. s r. o.,
Bratří Štefanů 980, 500 03 Hradec Králové
Česká republika
www.hakel.com