ISOLGUARD Insulation monitoring devices HIG93/CL400

The insulation monitoring device HIG93/CL400 produced by HAKEL for the ISOLGUARD series is designed for monitoring the insulation status of single-phase and 3-phase ungrounded IT power supply systems, is designed and operated according to standards IEC 61010-1:2010, EN 50522, IEC 61936-1:2010.

Device enables monitoring of single-phase and 3-phase ungrounded IT power supplies systems up to the maximum operating voltage 275V AC, eventually 3x275V AC. If the insulation status monitoring of a single-phase or 3-phase IT 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/CL400.

The insulation monitoring device enables to display the numeric value of the measured insulation resistance. Device is equipped with buttons for setting module parameters and with signalling LED diodes to display the status of monitored power supply system and status of the device.

HIG93/CL400 device is equipped with active current loop output 4 ÷ 20 mA, which indicates actual measured insulation resistance value. Current loop is galvanic isolated from the monitored system and from the internal circuit of the device.

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 option to terminate the alarm using the button on the insulation monitoring 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.

HAKEL ISOLGUARD HIG93/CL400

Model	Signalling relay 1	Signalling relay 2	Range of displayed value	Critical insulation resistance	Current output	SW
HIG93/CL400	1P	1P	5 kΩ to 900 kΩ	Adjustable 5 kΩ to 300 kΩ	Active galvanic isolated current loop 4 ÷ 20 mA R_{max}=500 Ω	V5.6
Art. no. 70 931						

Notes: 1P signalling relay with one switching contact

Basic characteristics

- Insulation monitoring device for 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 5 kΩ to 900 kΩ
- Two insulation resistance status signalling relays equipped with switching contact
- Active galvanic isolated current loop 4 ÷ 20 mA for value output of the isolation resistance R_{isol}
- Optional memory of the invoked alarm with a possibility to be 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 from 5 kΩ to 300 kΩ
- Adjustable hysteresis of the insulation resistance limit value in the range from 0 to 100 % using the display and push-buttons
- Adjustable delay in signalling relay response t_{ON} in the range from 0 to 60 seconds using the display and push-buttons
- 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
- 2M (36 mm) wide module for mounting on 35 mm DIN rail

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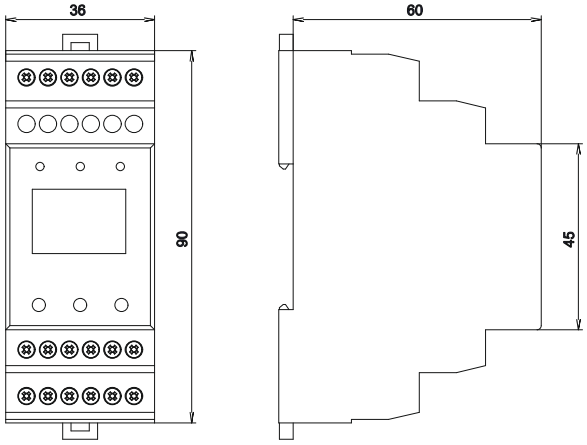
Technical characteristics – ISOLGUARD HIG93/CL400

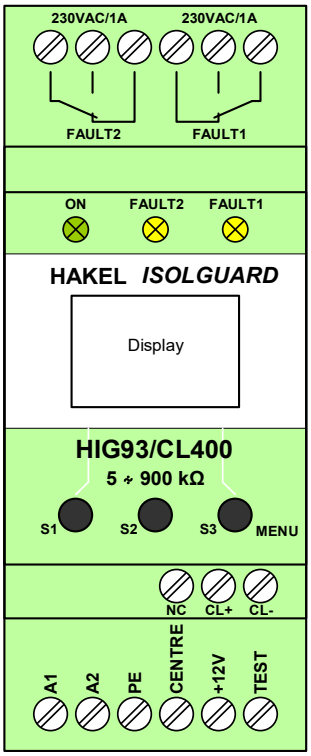
Type		HIG93/CL400
Supply voltage range	U_n	90 ÷ 264 V AC (47 ÷ 63 Hz) or 120 ÷ 370 V DC
Insulation voltage between power supply and internal circuits		3000 V AC
Maximum IT power supply system operating voltage (without external inductor)	U_{it}	275 V AC
Power consumption	P	max. 5 VA
Measuring voltage	U_m	24 V DC
Measuring current	I_m	< 1 mA
Internal resistance of the measuring input	R_i	> 1 MΩ
Displayed value's range	R_{isol}	5 kΩ ÷ 900 kΩ
Measurement accuracy 5 kΩ ... 10 kΩ 10 kΩ ... 900 kΩ		2 kΩ ± 10%
Critical insulation resistance	R_{crit1}, R_{crit2}	adjustable 5 kΩ ÷ 300 kΩ
Insulation resistance hysteresis	R_{hyst}	adjustable 0 ÷ +100 % R_{crit}
Delay in response of signalling	t_{ON}	adjustable 0 to 60 sec
Potential-free outputs		
Signalling relay 1: Potential-free switching contact Electrical strength to the internal circuits and supply circuits		230 V AC / 1A 3750 V_{rms}
Signalling relay 2: Potential-free switching contact Electrical strength to the internal circuits and supply circuits		230 V AC / 1A 3750 V_{rms}
Current loop		
Current output type		Isolated active current loop
Isolation strength to the internal circuits and supply circuits		1500 V
Maximum load resistor of the loop		500 Ω (power supply from a 24V DC source inside the module)
Operating range of insulation status value signalling		4 ÷ 20 mA
Maximum range of current output		0 ÷ 25 mA
Uncertainty of Risol value signalling	Typ.	< 1 %
	Max.	± 5 %
General data		
Degree of protection according to IEC 60 529		IP20
Weight	m	160 g
Housing material		PA - UL 94 V0
Method of assembly		on the 35 DIN rail
Recommended section of the connected conductors	S	1 mm^2
Article number		70 931

Operating conditions	
Operating temperature	-10°C ÷ +60°C
Atmospheric pressure	86 ÷ 106 kPa
Operating position	any
External magnetic and electric field	According to IEC 61 326-24
Overvoltage category / testing voltage	III, according to standard IEC 60 664-1:2007
Pollution degree	2, according to standard IEC 60 664-1:2007
Duty type	permanent

Dimensional sketch



Controls and connecting terminals of HIG93/CZL400 module



Green indicator lamp ON

Lights up when the power supply is connected. It glimmers slightly after module activation.

Yellow indicator lamp FAULT1

It lights up, 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

It lights up, when the measured insulation resistance value is lower than the set critical resistance R_{crit2} 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 FAULT2 relay contacts.

Display

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

FAULT1 or *FAULT2* relay status change, eventually starting and ending device 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. 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* button. See the section *Information on the di*splay, page 6.

Middle push-button S2

This is a module control button whose meaning in each menu is shown on the display. When the fault memory function is active, it releases the relay FAULT. It activates display of temperature inside the module if the insulation resistance ***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 parameter setting menu, prolonged pressing of this push-button terminates the data entering with memorizing new value, whereas short pressing of this push-button causes exit from the menu without memorizing new parameter value.

Terminals A1, A2

These terminals serve to connect the module's power supply. The power supply voltage is 90 to 264 V AC (47÷63 Hz) or 120 to 370 V DC.

Terminals CENTRE, PE

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

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

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

Potential-free switching contact for signalling the status of the monitored IT power supply system. Relay ***FAULT1*** or ***FAULT2*** is released, i.e. monitored system is without any fault, when the device is connected to the power supply, is functional (the indicator lamp *ON* glimmers slightly) and the insulation resistance of the monitored system is higher than the set critical value ***R_{crit1}*** or ***R_{crit2}***.

When ***R_{isol}*** is displayed the status of signalling relay's contacts is indicated by the symbol of contact. If both relays are released, the open contact is displayed. In case of fault, the close contact is displayed.

Terminal TEST, +12V

Terminals for connection with the remote test push-button. Remote test push-button is connected between *TEST* and *+12V* terminals, see recommended connections of the insulation monitoring device.

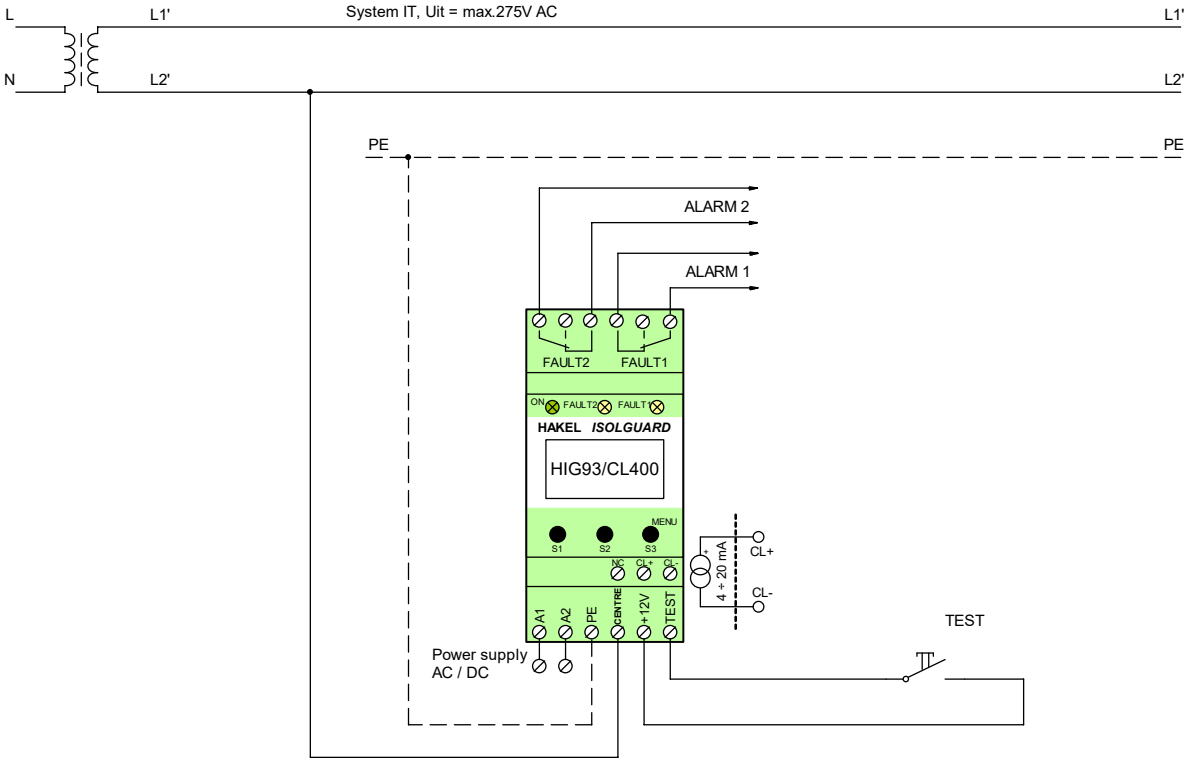
Terminal CL+ and CL-

Output terminals of current loop 4 – 20mA of the HIG93/CL400. CL+ terminal indicates positive pole of the current source and CL- terminal indicates negative pole. It is about active current loop with galvanic isolation and with integrated power supply source of the current loop. Voltage of the power supply source is 24V DC. For current loop description see *Current signalling output, page 10.*

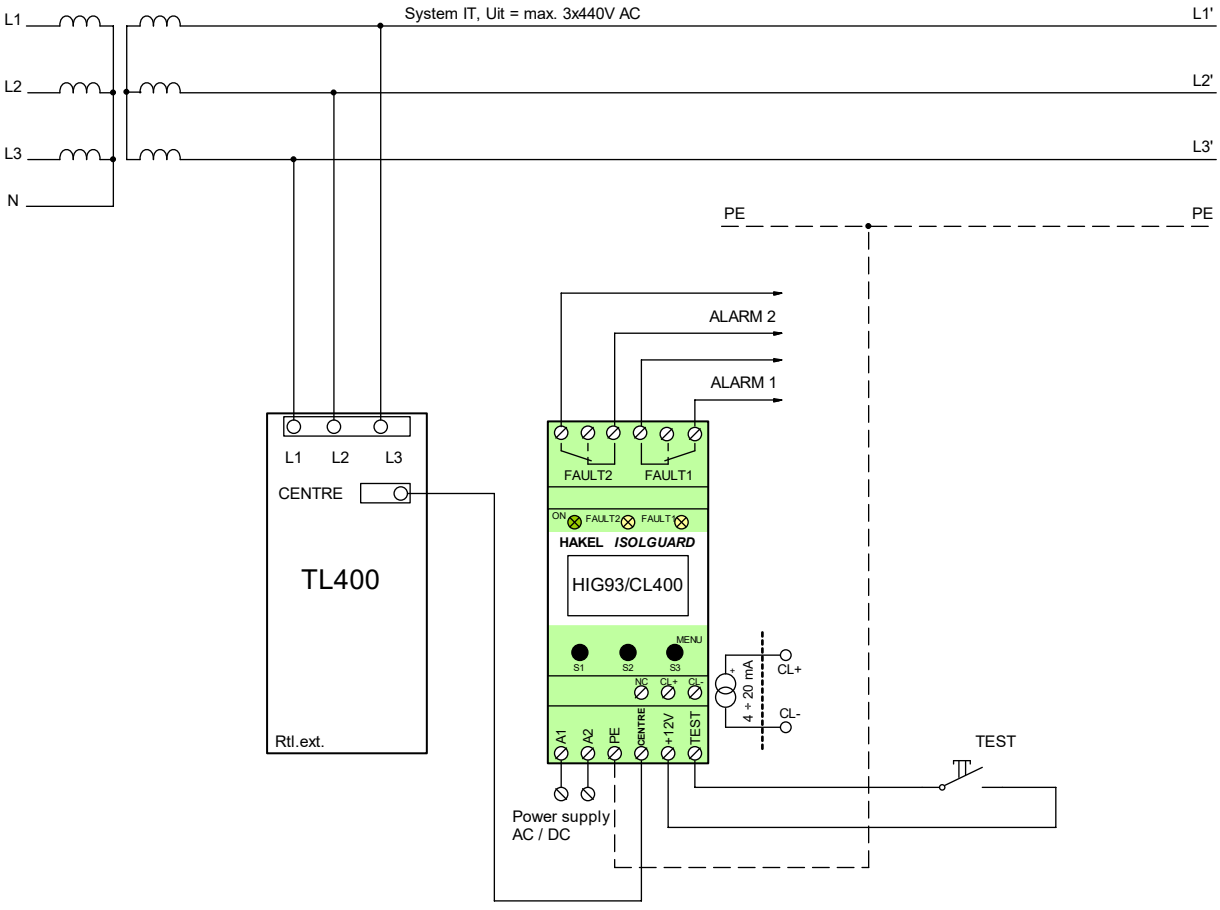
Note: Terminals +12V and TEST are exclusively intended for connection of the test push-button. These terminals cannot be used for connection of any other devices.

Recommended connection of HIG93/CL400

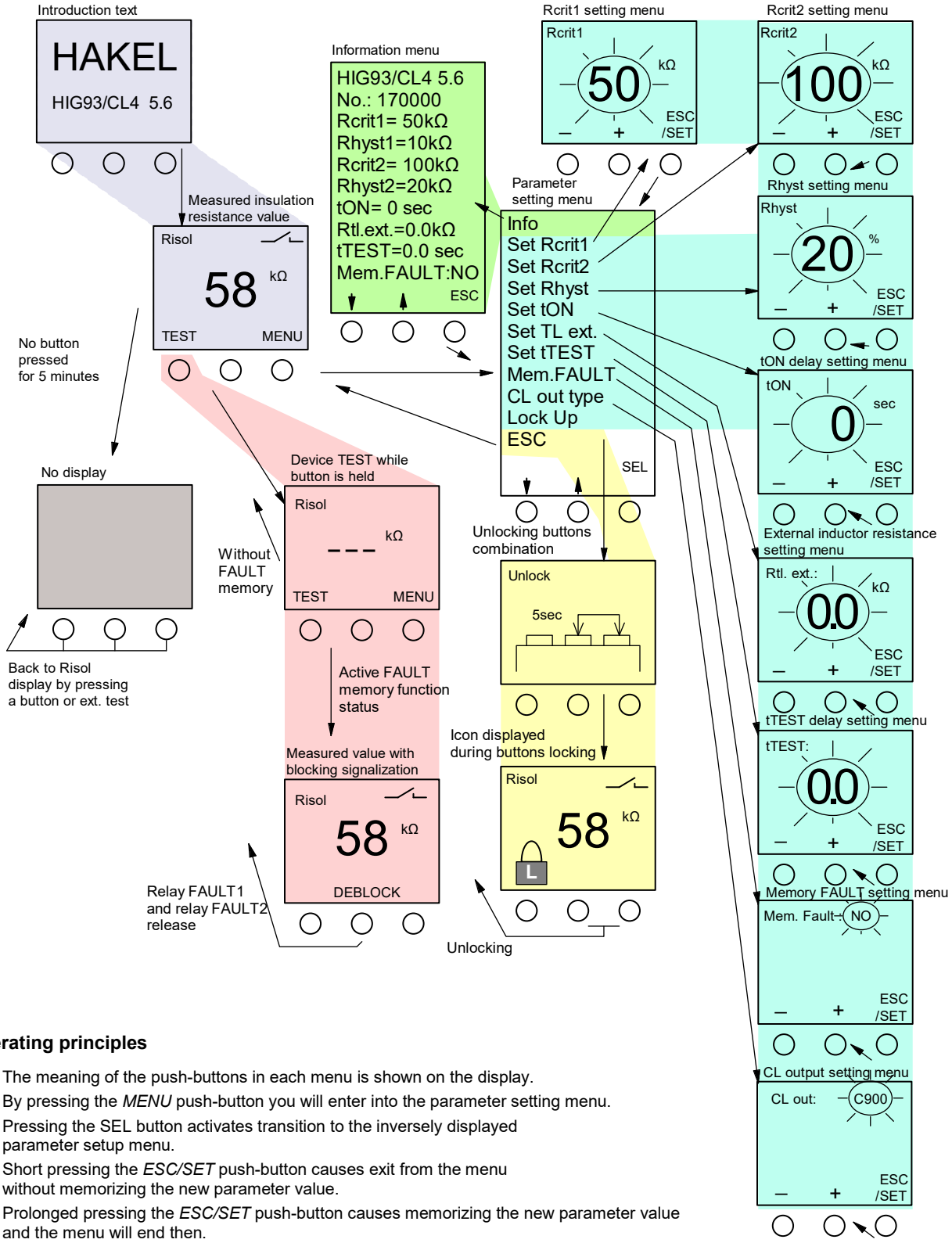
Single-phase IT system (maximum 275 VAC), HIG93/CL400 module with alarm signalling and with the remote test push-button



Three-phase IT system (3 x 440 VAC), HIG93/CL400 module with alarm signalling and with the remote test push-button



Information on HIG93/CL400 display



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 button activates transition to the inversely displayed parameter setup 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 then.
- 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 will be recovered by pressing any of the push-buttons below the display.
- The display is also 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 of the FAULT1 or FAULT2 relays is realized by the middle device button.
- FAULT1 or FAULT2 relay status change, eventually initiation and termination the device test is indicated by a short display flash.

Displayed information

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 insulation status measuring 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. 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 HIG module, pressing ***MENU*** push-button displays parameter setting 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} will drop below the R_{crit} value the countdown of the time t_{ON} will start. The display shows the time until fault signalling. After the time is expired, the fault will be signalled.

Test of the insulation monitoring device

Test may be performed by pressing ***TEST*** push-button on the HIG module or by remote ***TEST***.

Testing of the insulation monitoring device is performed for at least 5 seconds or during the time of holding the button. The insulation resistance value is set lower than R_{crit1} and R_{crit2}. The fault is signalled by indicator lamp ***FAULT1***, ***FAULT2*** and by an inactive status of signalling relays. 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 the t_{TEST} time delay.

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. 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 button can be also used when locking the device is indicated by the padlock symbol on the display. The usage of the *FAULT* 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 values: menu ***Set R_{crit1}*** , ***Set R_{crit2}***.
- Insulation resistance hysteresis: menu ***Set R_{hyst}***
- Delay in response of signalling the insulation status fault: menu ***Set t_{ON}***
- External inductor resistance: menu ***Set $TL_{.ext}$***
- Delay in module test start by remote test button: menu ***Set t_{TEST}***
- FAULT memory parameter: menu ***Mem.Fault***
- Current output characteristic type: menu **CL out type**
- Device's control buttons can be locked

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

Information menu

Displays version of HIG93/CL400 module software, serial number and key set parameters for operating device. For exit select the menu ***ESC***.

Menu set R_{crit1}, 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_{crit} value remains unchanged.
Both R_{crit1} and R_{crit2} parameter can be set independently across the entire value range.

Menu set R_{hyst}

In order to set new value for hysteresis of critical insulation resistance in %, 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 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 signalling *FAULT1* or *FAULT2* 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_{ON} value remains unchanged.

Menu set $R_{tl.ext}$

External inductor connected in front of the HIG93/CL400 is necessary when monitoring higher operational 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 - 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 $R_{tl.ext}$ value remains unchanged.

The value of $R_{tl.ext}$ inductor's AC 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 resistance winding with interconnected L outlets at the operational temperature.

Menu set t_{TEST} time

New value of the delay in device 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 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 relay continues signalling even after the fault has been eliminated and the button on the module to release the relay must be pressed by operator. Parameter can be set to **NO** without fault memorizing.

Menu CL out type

Menu for selecting current output characteristic. Insulation resistance dependence on output current of the signalling current loop CL can be selected in this menu.

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.

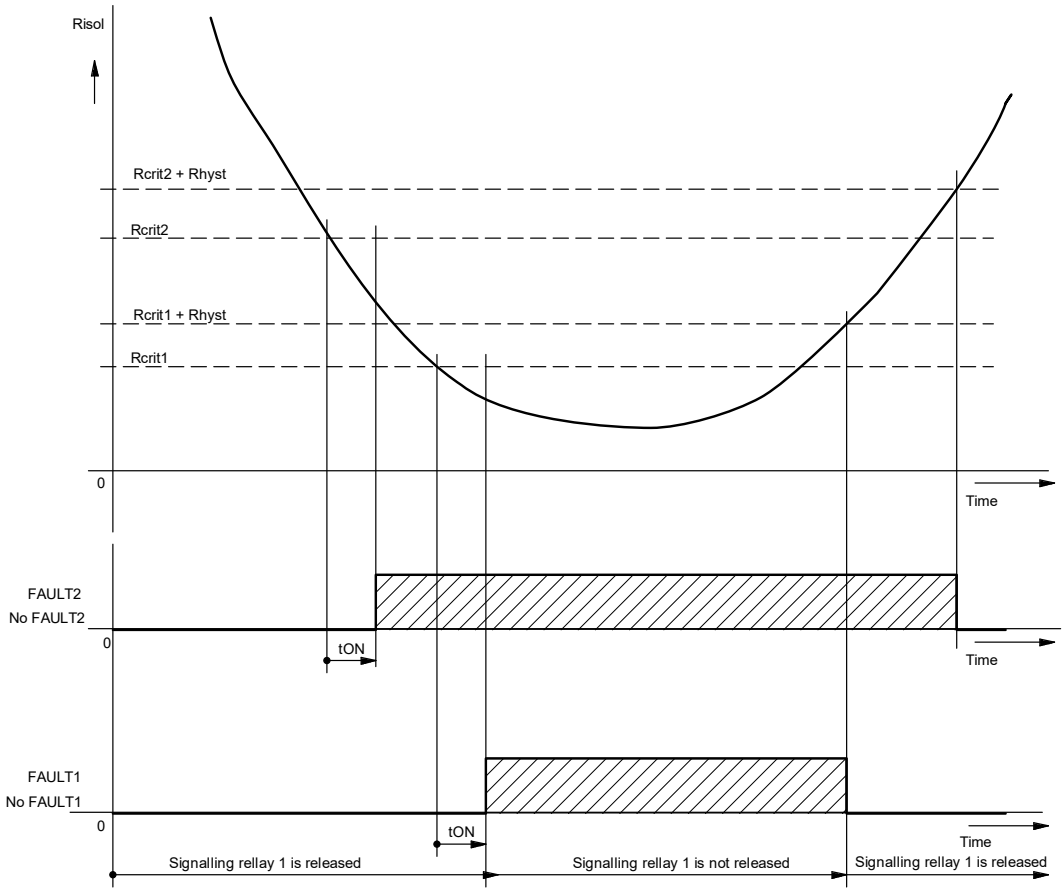
Factory setting - parameters of HIG93/CL400

Factory settings of the insulation monitoring device are as follows:

Parameter	Menu	Symbol	HIG93 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 %
Delay in response of signalling the fault	Set tON	t_{ON}	0 sec
External inductor resistance	Set TLext.	$R_{tl.ext.}$	0 kΩ
Delay in module test start by remote TEST button	Set tTEST	t_{TEST}	0 sec
FAULT memory	Mem. FAULT	Mem.FAULT	NO
Current output type (characteristic)	CL out type	CL out	C900

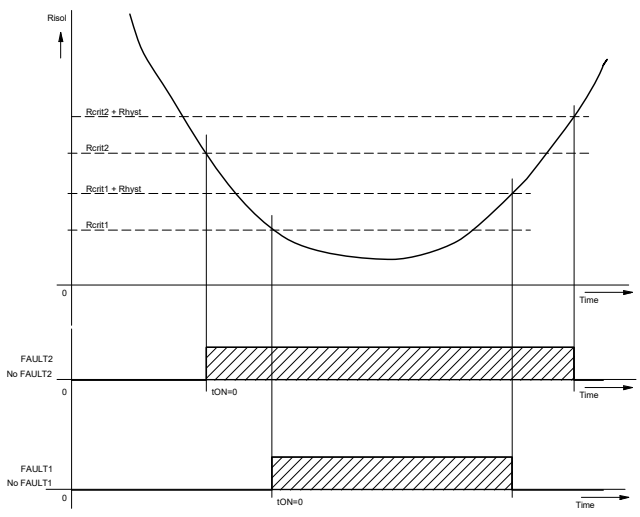
Insulation resistance fault evaluation

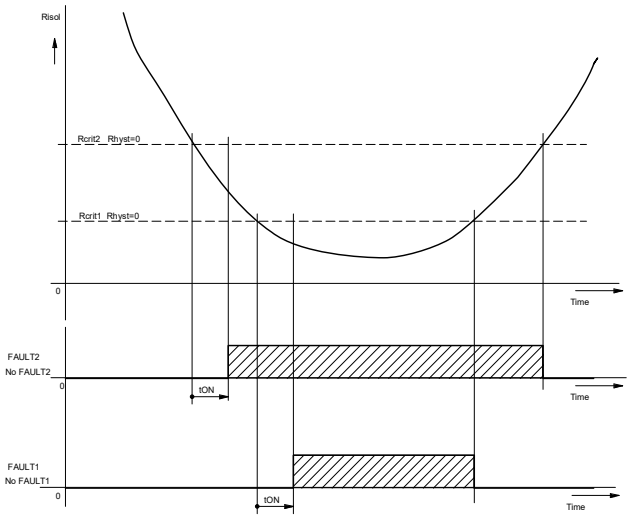
Evaluation of the *FAULT1, FAULT2* according to set t_{ON} and R_{hyst} parameter values is shown in the following figure.



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 lamps on the device light up. Particular signalling relay release is cancelled and its contacts are set to the rest position. The *FAULT1 and 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, FAULT2 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}.





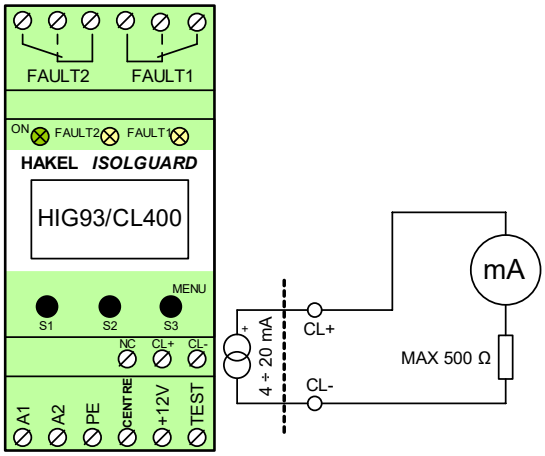
Current signalling output

HAKEL ISOLGUARD Insulation monitoring device HIG93/CL400 is equipped with analogue current loop 4 – 20 mA (CL – Current Loop). This output is active current loop. Device has integrated internal insulated 24 V DC source just to power this output. External source to power CL is not required and not even is possible to use it.

Using current in a range 4 – 20 mA, HIG93/CL400 signals the actual value of measured insulation resistance. The only acceptable value out of the range is 21 mA, which signals that the real value of insulation resistance in not known (typical while switching on the device, before the first set of measurements is evaluated).

One of five possible characteristics of the current output can be selected using the *CL out type* menu. Current output choice is fully left to the user and depends on the specific device application.

HIG93/CL400 current output connection



Usage principles of the HIG93/CL400 current output

- Power supply of the loop is done by the device
- Maximum load resistance of the loop is 500 Ω
- The loop should be towed using a twisted pair of wires

Current output characteristic types

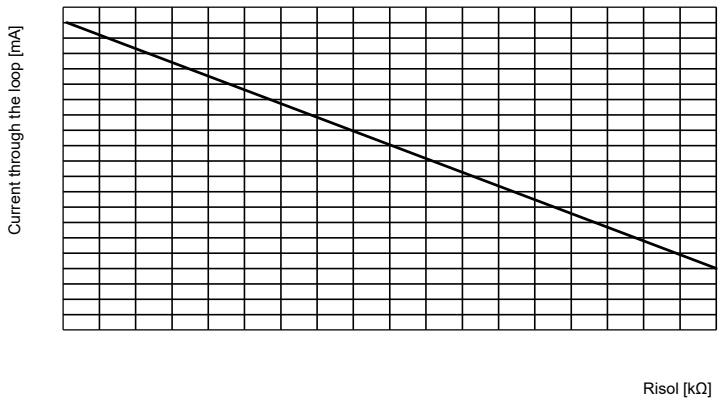
The current flowing through the current loop is directly dependent on the actual insulation resistance value.

There are 5 different characteristics of output current dependence on insulation resistance available to assure easy integration of the insulation monitoring device HIG93/CL400 into the users system. These characteristics are selected in the device menu using key words.

Available characteristics are ***C900***, ***W900***, ***W1000***, ***W500***, ***W100***. Features of these characteristics are described below.

C900 output characteristic (initial characteristic)

Characteristics graph



Equation of Risol calculation from loop current

$$Risol = \frac{Iout - 20{,}08938}{-0{,}01788}$$

Selected values

Risol [kΩ]	*Current through the loop [mA]*
5	20
50	19,2
100	18,3
300	14,7
500	11,2
700	7,6
900	5

W900 output characteristic

Characteristics graph

Equation of Risol calculation from loop current

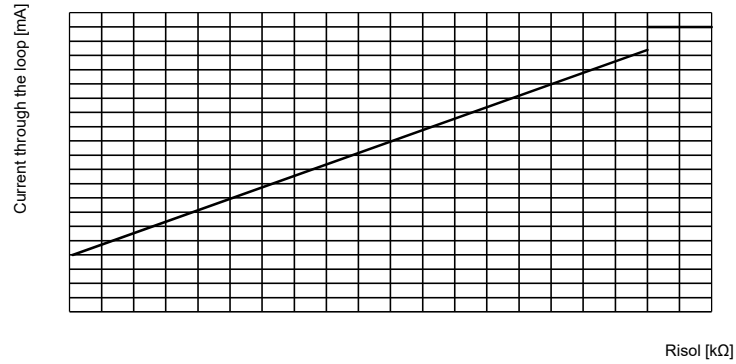
$$Risol = \frac{Iout - 3{,}9106}{0{,}01788}$$

Selected values

Risol [kΩ]	*Current through the loop [mA]*
5	4
50	4,8
100	5,7
300	9,3
600	14,6
900	20

W1000 output characteristic

Characteristics graph



Equation of Risol calculation from loop current

$$Risol = \frac{Iout - 3{,}9196}{0{,}01608}$$

Selected values

Risol [kΩ]	*Current through the loop [mA]*
5	4
100	5,5
300	8,7
600	13,6
900	18,4
> 900	20

W500 output characteristic

Characteristics graph

Equation of Risol calculation from loop current

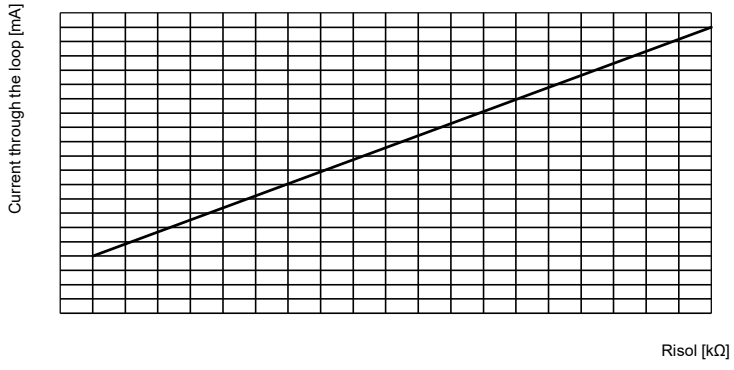
$$Risol = \frac{Iout - 3{,}8383}{0{,}03232}$$

Selected values

Risol [kΩ]	*Current through the loop [mA]*
5	4
100	7,1
200	10,3
400	16,8
500	20
> 500	20

W100 output characteristic

Characteristics graph



Equation of Risol calculation from loop current

$$Risol = \frac{Iout - 3{,}1579}{0{,}16842}$$

Selected values

Risol [kΩ]	*Current through the loop [mA]*
5	4
25	7,4
50	11,6
80	16,6
100	20
>100	20