SUPERINTEND IM-01.MED/IC-01/TC-01/RD-01/PEC-01/FLI-01/CTM-01

IMD Insulation Monitoring device for non-grounded (IT) electrical networks for medical locations

Instructions for installation and use v1.161

AC/DC MED

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Superintend IM-01.MED/IC-01/TC-01/RD-01/PEC-01/FLI-01/CTM-01 Manual v1.161 English

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INSTRUCTIONS

These instructions for use are intended for trained electrical engineering professionals. The IM-01.MED, PEC-01 and FLI-01 devices are marked with the symbol shown below, which indicates that if the device has been installed incorrectly or used in violation of instructions, safety could be jeopardised. The description of the symbol is presented in this manual instead of on the device due to space constraints. Such sections are marked with the symbol shown below.

A symbol indicating possible danger. A description of the symbol may be placed on the device or provided in the instructions for use.

SYSTEM DESCRIPTION

IM-01.MED, PEC-01, TC-01, IC-01, RD-01, FLI-01, CTM-01 and CLT-01 form a system of devices that can be used to measure and monitor the insulation resistance and capacitance as well as the continuity of the PE wire of floating electricity networks (Medical IT systems in accordance with standard IEC 60364-7-710). Of the aforementioned devices, IM-01.MED is necessary, while the other devices are accessories.

INSTALLATION

PHYSICAL CONNECTION

The devices are connected to the electrical network, which may contain dangerous voltage. The device may be installed by a trained electrical engineering professional only. The device contains no user-serviceable parts and must not be opened. Using the device in violation of these instructions may compromise safety.

The IM-01.MED unit is the control unit of the system and is installed in the switchboard. Two IM-01.MED devices may not be installed galvanically in the same network, for example on the secondary side of the same transformer. The connection is performed as presented in Figure 1. The installation and wiring should be performed in accordance with standards IEC 60364 as well as EN 50110. The operating voltage connection of IM-01.MED must always be equipped with a coupler or a circuit breaker so that the electricity supply can be disconnected for the duration of maintenance work, for example. The location of the disconnectors must be clearly marked in the switchboard. The coupler or line protection switch should also control a relay or contactor, which separates the measuring wires from the network to be measured. The IM-01.MED device is equipped with an internal 1 A fuse. In spite of this, the wires of the operating voltage supply should still be protected with an external fuse. A suitable size is, for example, 6 A. In a DC operating voltage supply, an external Schurter 0001.2503 (T800mA) fuse should be used.

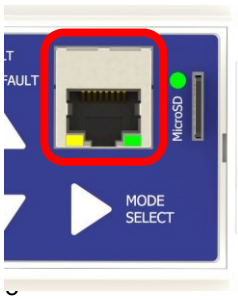
DEVICE MOUNTING

The IM-01.MED, PEC-01, FLI-01, CTM-01 and CLT-01 devices are intended for installation in a DIN TS35 rail in accordance with standard IEC 60715. They are installed by inserting the upper edge of the DIN TS35 rail in the groove intended for the DIN TS35 rail on the back of the device and by pushing the bottom edge of the device backward until the retaining latch clicks into place.

The IM-01.MED unit comes with the connections shown in the following table. The shaded parts are optional and are installed as needed, while installing the other parts is mandatory.

Category	Connector	Description
Operating voltage connection	⏚	Protective earth, to be connected to the earthing circuit connector
	L	110…240 VAC, 48…62 Hz phase conductor, internal fuse 1A slow +/-110…300 VDC, use an external fuse Schurter 0001.2503 (T800mA)
	N	110…240 VAC neutral conductor -/+110…300 VDC
RS-485	SH	RS-485 cable shield, internally connected to PE
	+12V	+12V output for the TC, IC, RD, PEC, FLI, CTM and CLT units, current limit 0.5 A, twisted pair 2
	A	RS-485 data+ (two-way data/twisted pair 1)
	B	RS-485 data- (two-way data/twisted pair 1)
	-	RS-485 network and 12V connection earth, twisted pair 2
Measuring connectors	Imeas	Load current measurement input, to be connected to the S1 terminal of the current transformer. A 50 mΩ resistance is also installed between S1–S2. Measuring range ±1.25Vpk
	Imeas	Load current measurement input, to be connected to the S2 terminal of the current transformer. Internally connected to PE
	TEMP	Isolation transformer temperature sensor's (NTC/PT100) input. Internally connected to PE
	TEMP	Isolation transformer temperature sensor's (NTC/PT100) input. Measuring range 0…2.5VDC
	TG	Alarm terminal of protective earth, to be connected to the PE rail
	MG	Electronics protective earth, to be connected to the PE rail
	M1	Connection 1 of the network to be monitored 1; Max 240VAC/280VDC
	M2	Connection 2 of the network to be monitored 1; Max 240VAC/280VDC
Alarm relays	AUX. ALARM NO	AUXiliary alarm relay. NO-COM is an open circuit when the alarm in inactive and closes when the alarm is active. NC-COM functions in a reverse manner. Max load 250VAC/3A or 30VDC 1A
	AUX. ALARM NC	
	AUX. ALARM COM	
	TRF. ALARM NO	Transformer's alarm relay. NO-COM is an open circuit when the alarm in inactive and closes when the alarm is active. NC-COM functions in a reverse manner. Max load 250VAC/3A or 30VDC 1A
	TRF. ALARM NC	
	TRF. ALARM COM	
	INS. ALARM NO	Alarm relay of the insulation resistance. NO-COM is an open circuit when the alarm in inactive and closes when the alarm is active. NC-COM functions in a reverse manner. Max load 250VAC/3A or 30VDC 1A
	INS. ALARM NC	
	INS. ALARM COM	

The Ethernet cable is connected to the RJ45 connector in the front panel.



Before connecting the device to the local area network, set the TCP/IP parameters suitable for the LAN (SETUP→IP Settings).

The PEC-01 units are also installed in the switchboard. The PEC-01 unit comes with the connections shown in the following table. The shaded parts are optional and are installed as needed, while installing the other parts is mandatory. The installation is performed as shown in Figure 1.

Category	Connector	Description
Operating voltage connection		
	L	220…240 VAC, 48…62 Hz phase conductor, internal fuse 80 mA slow
	N	220…240 VAC neutral conductor
RS-485	+12V	+12V input for RS-485 with opto isolation, twisted pair 2
	A	RS-485 data+ (two-way data/twisted pair 1)
	B	RS-485 data- (two-way data/twisted pair 1)
	TR	A RS-485 network terminal. Connect a short lead in TR-B if the device is the last one in the chain.
	-	RS-485 network and 12V connection earth, twisted pair 2
	SH	The shields of the RS-485 cables are joined together here
Measuring connectors	PE0	The reference for the earthing resistance measuring connectors, to be connected to the PE rail
	PE1	Measuring channels for earthing resistance. Each channel is connected to the last PE connector in the wall socket chain with a 2.5mm² wire.
	PE2	
	PE3	
	PE4	
	PE5	
	PE6	

The measuring connectors of the PEC-01 units are cabled with 2.5mm² installation wires. PE0 is connected to the PE rail of the switchboard, and the measuring channels are connected to the earthing connector of the last wall socket of each wall socket branch. Thus, the PE wire of each wall socket branch makes a loop, and the PEC-01 unit measures the resistance of that loop. If there are several PEC-01 units, their PE0 wires do not need to be in the same point.

The TC-01, IC-01 and RD-01 units are installed in mounting boxes. The units have the following connections, all of which must be installed. The CLT-01 unit to be installed in the switchboard has equivalent connections, all of which must always be installed.

RS-485	A	RS-485 data+ (two-way data/twisted pair 1)
	B	RS-485 data- (two-way data/twisted pair 1)
	-	RS-485 network and 12V connection earth, twisted pair 2
	SH	Chaining of the RS-485 cable shield
	+12V	+12V input from the IM-01.MED unit, twisted pair 2

The FLI-01 unit is installed in the switchboard and it comes with the connections shown in the following table. The shaded parts are optional and are installed as needed, while installing the other parts is mandatory. The installation is performed as shown in Figure 2.

Category	Connector	Description
Measuring connectors	TG	Alarm terminal of protective earth, to be connected to the PE rail
	MG	Electronics protective earth, to be connected to the PE rail
	M1	Connection 1 of the network to be monitored; Max 240VAC
	M2	Connection 2 of the network to be monitored; Max 240VAC
Operating voltage connection	-	RS-485 network and 12V connection earth, twisted pair 2
	+12V	+12V input from the IM-01.MED unit, twisted pair 2
	ISOL.	Not used
RS-485-2	TR	A RS-485-2 network terminal. Connect a short lead in TR-A if the device is the last one in the RS-485-2 chain.
	A	RS-485-2 data+ (two-way data/twisted pair 1) to the CTM-01 units
	B	RS-485-2 data- (two-way data/twisted pair 1) to the CTM-01 units
RS-485-1	TR	A RS-485-1 network terminal. Connect a short lead in TR-A if the device is the last one in the RS-485-1 chain.
	A	RS-485-1 data+ (two-way data/twisted pair 1) from the IM-01.MED unit
	B	RS-485-2 data- (two-way data/twisted pair 1) from the IM-01.MED unit

The FLI-01 unit has two separate RS-485 buses: RS-485-1 is for connection to the IM-01.MED unit and RS-485-2 is for connection to the CTM-01 units. The shields of the RS-485-1 and RS-485-2 cables shall be joined together with an external connector.

The CTM-01 units are installed in the switchboard. The CTM-01 unit comes with the connections shown in the following table. The shaded parts are optional and are installed as needed, while installing the other parts is mandatory. The installation is performed as shown in Figure 2.

Category	Connector	Description
Operating voltage connection	-	RS-485 network and 12V connection earth, twisted pair 2
	+12V	+12V input from the IM-01.MED unit, twisted pair 2
RS-485	SH	Chaining of the RS-485 cable shield
	TR	A RS-485 network terminal. Connect a short lead in TR-A if the device is the last one in the RS-485 chain.
	A	RS-485 data+ (two-way data/twisted pair 1) from the FLI-01 unit
	B	RS-485 data- (two-way data/twisted pair 1) from the FLI-01 unit

In addition to the connections described above, the phase conductor pairs shall be routed through the CTM-01 current transformers T1 – 6. The phase conductors of one circuit shall be routed through one current transformer. The direction of the conductors can be whichever. The earth conductors must not be routed through the current transformers. For this reason, shielded cables must not be used either. To prevent measurement errors, it is recommended to install the CTM-01 unit so that there will be enough distance from external magnetic fields, for example transformers or high current conductors.

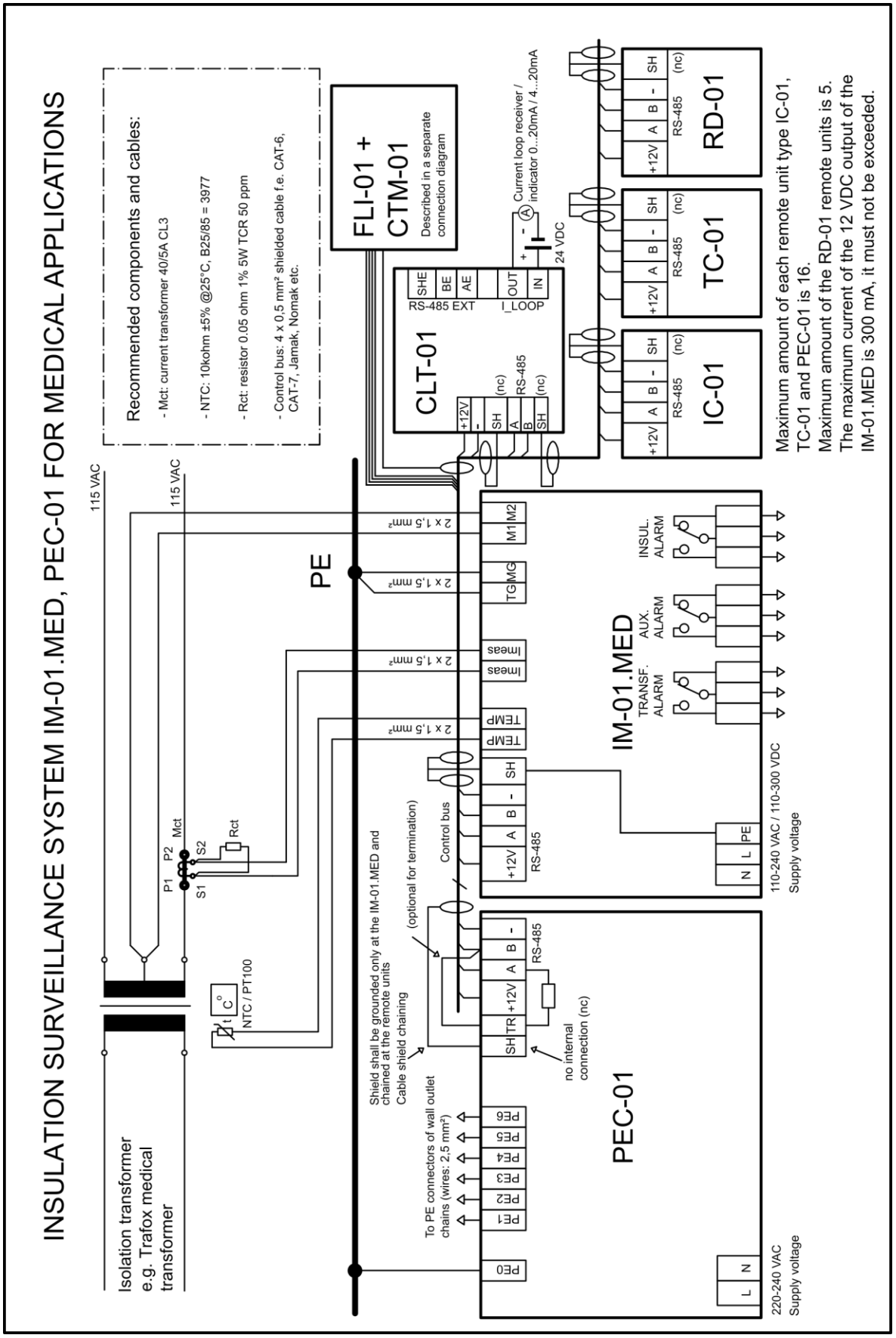


Figure 1. System connection.

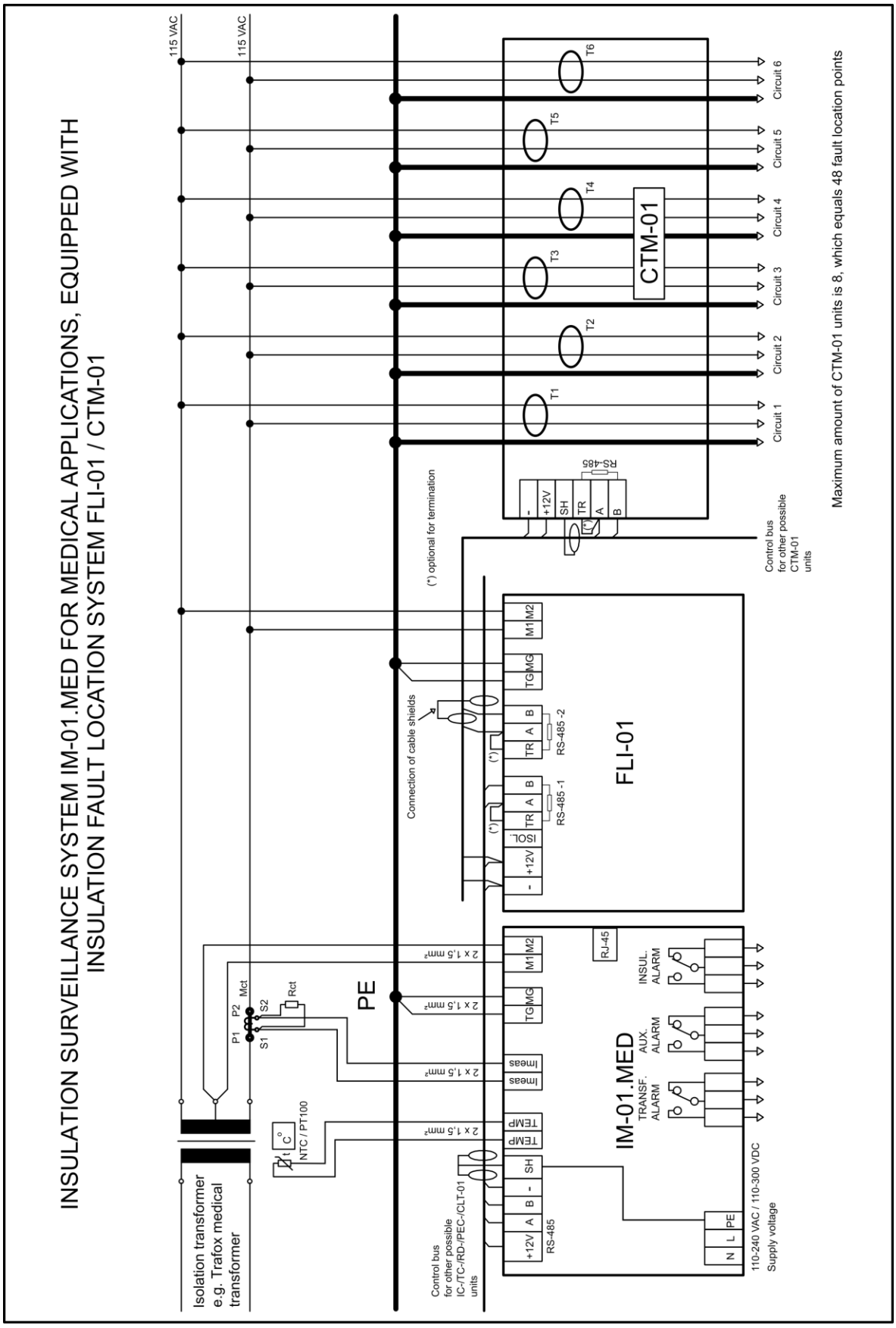


Figure 2. System connection, fault location system.

RS-485 NETWORK CONNECTION

Each unit type comes with its own address area in the range of 0–15 (IC-01, TC-01, PEC-01) or in the range of 0-4 (RD-01). The IM-01.MED unit distinguishes between units of different type in the same address from each other. Although the total number of addresses is 53, the maximum number of devices that can be connected to one IM-01.MED device is smaller in practice: it must be ensured that the combined power consumption of the devices does not exceed the maximum value set for the IM-01.MED as shown in the table below.

IM-01.MED power supply (12 VDC)	**300 mA**
Device	**Power consumption (12 VDC)/device**
IC-01	8 mA
TC-01	8 mA
RD-01	35 mA
PEC-01	14.5 mA
FLI-01	38 mA
CTM-01	15 mA
CLT-01	32 mA

The unit address is set by means of a rotary switch (IC-01, TC-01, PEC-01, CTM-01) or buttons (RD-01). The IM-01.MED unit has no address settings. It is always the host of the bus, in other words, it gives the commands to different units and then waits for their answers. The FLI-01 and CLT-01 units have no address settings either.

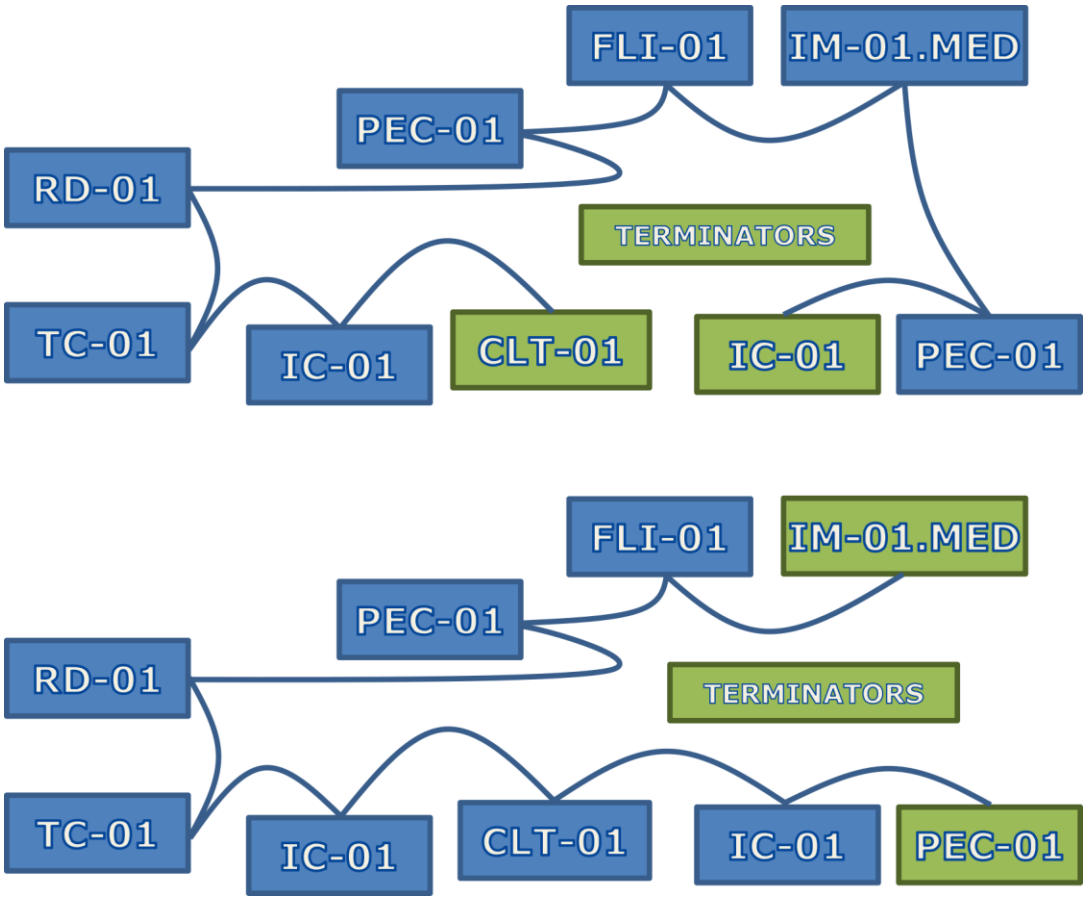
The IM-01.MED unit and PEC-01 units are installed in the switchboard and connected to the mains current. Remote units are installed in mounting boxes. They as well as the FLI-01, CTM-01 and CLT-01 units to be installed in the switchboard, receive the 12VDC supply electricity from the IM-01.MED unit.

All units are connected to each other via the RS-485 network. The main RS-485 network is hosted by the IM-01.MED unit and the devices IC-01, TC-01, RD-01, PEC-01, FLI-01 (RS-485-1 connectors) and CLT-01 shall be connected to it. The secondary RS-485 network shall be hosted by THE FLI-01 unit (RS-485-2 connectors) and the CTM-01 units shall be connected to it. Each network must form an uninterrupted chain, which is open at both ends, and contains no branches. Thus, a maximum of two RS-485 cables are installed in any unit (except the FLI-01 unit which can have up to two RS-485 cables in the both RS-485-1 and RS-485-2 connectors); in other words, an incoming and an outgoing cable. A terminator is installed in the first and the last unit by means of a jumper or wire jumper equipped with the unit. In all other units, the resistance must be

left open. The network units can be physically in any order. If the network is long (>200 m), it is recommended that the IM-01.MED unit is physically located in the middle of the chain.

The cable shield is also connected to each unit and connected to protective earth in the IM-01.MED unit. In other devices, the shields are floating and the connector only acts as a joining connector between two shields. At the FLI-01 unit, the cable shields of each RS-485-1 and RS-485-2 cable must be joined together with an external connector.

The RS-485 connection is made using a 2*2 twisted paired cable equipped with a shield (e.g. AWG22=0.32 mm²=106 Ω/km). In that case, the maximum length of the chain from the IM-01.MED unit to the last remote unit is 500 m. If a thinner cable is used, the allowed length shortens inversely proportionately to the cable resistance. The cable shield is connected to the SH terminal of each unit. The shield is connected to the network protective earth in the IM-01.MED unit. In other devices, the shields are floating and the connector only functions as a joining connector of two shields. The twisted pairs are connected so that the A–B signals are in one pair and the +12V–earth are in another pair.



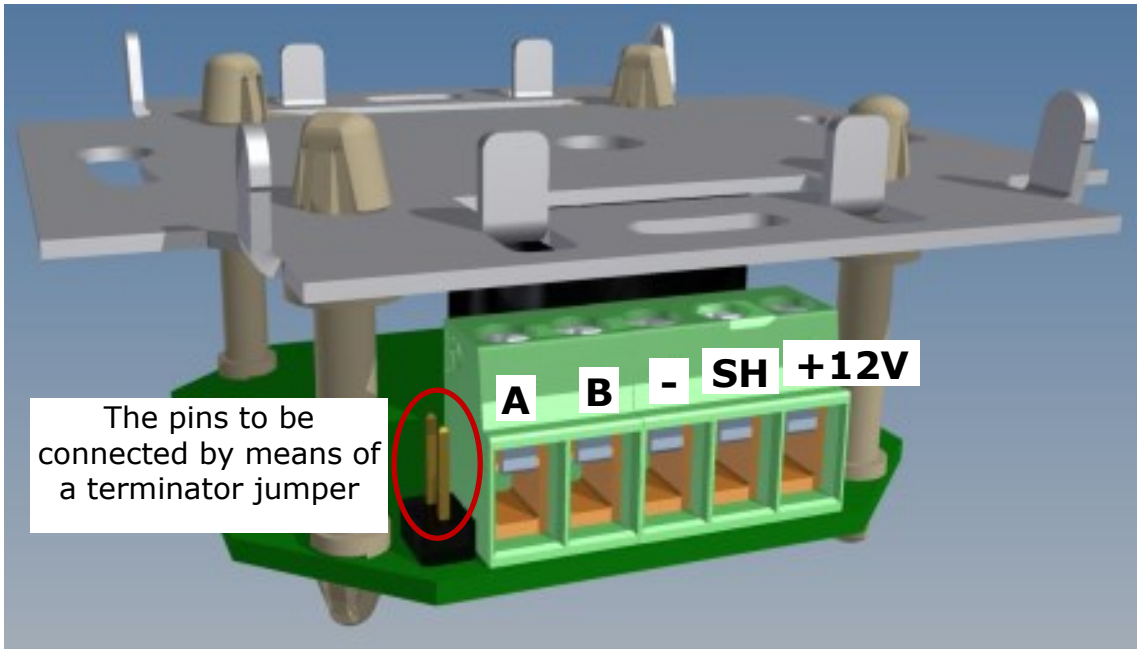
Examples of network connection. In the upper Figure, the IM-01.MED unit is in the middle of the chain, and in the lower Figure, it is at the end of the chain. Terminators are installed in the green units.

Checklist for the installation of the bus:

- Each unit of the same type must have a unique address.
- No more than two RS-485 cables may be installed in any unit (except FLI-01). Otherwise, the bus does not form an uninterrupted chain but has branches.
- The shields of the cables are connected to the SH terminal of each unit. If FLI-01 is installed, the shields of each RS-485-1 and RS-485-2 cable must be joined together with an external connector.
- The twisted pairs are connected so that the A–B signals are in one pair and the +12V–GNDs are in another pair.
- A terminator is installed at both ends of the bus, in other words, to those units that only have one of each wire. The TC-01, IC-01, RD-01, CLT-01 and IM-01.MED units are equipped with a jumper for this purpose. In the PEC-01 unit, the terminator is installed by connecting a short wire between the TR and B terminals. In the FLI-01 and CTM-01 units, the terminator is installed by connecting a short wire between the TR and A terminals.
- There is always a terminator in only two devices per chain.

HW SETTINGS OF THE TC-01 AND IC-01 UNITS

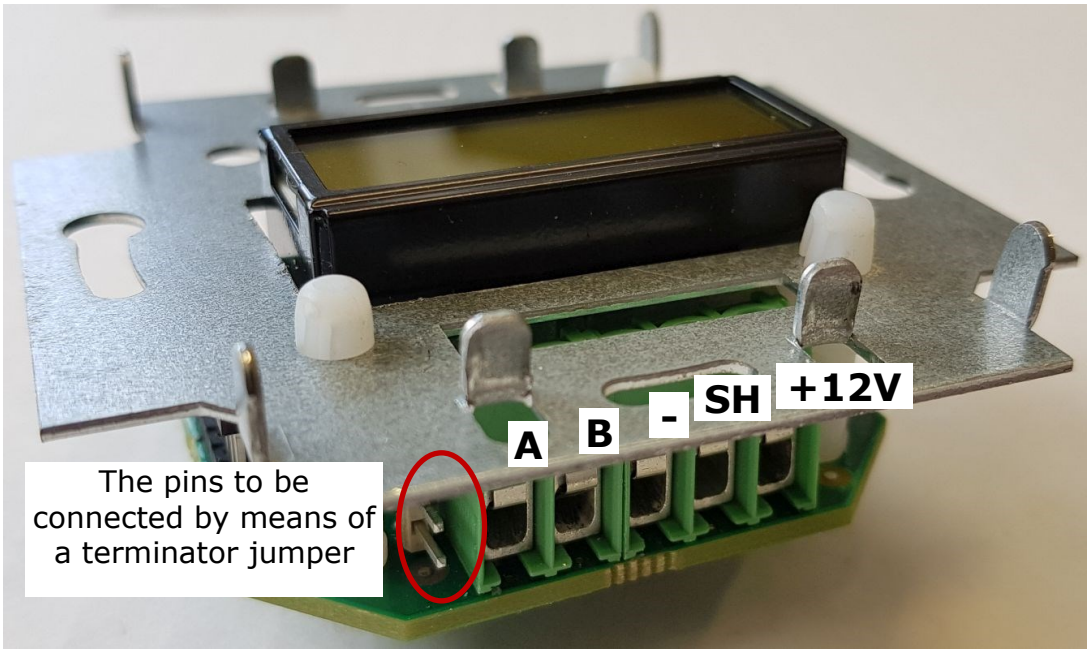
The addresses of the TC-01 and IC-01 units are set so that there is only one address per unit in the range of addresses for either unit type. A TC unit may have the same address as an IC unit, but no TC unit may have the same address as another TC unit (the same applies to the IC units). If a TC-01-/IC-01 unit is the first or last device of the bus, connect the two pins next to the terminal strip to each other with a terminator jumper. The order of pins in TC-01 and IC-01 is shown in the Figure below.



The device address is set with a rotary switch, shown in the Figure. The addresses corresponding to the switch texts are: A = 10, B = 11, C = 12, D = 13, E = 14 and F = 15. The other addresses (0–9) function in the manner marked on the switch.

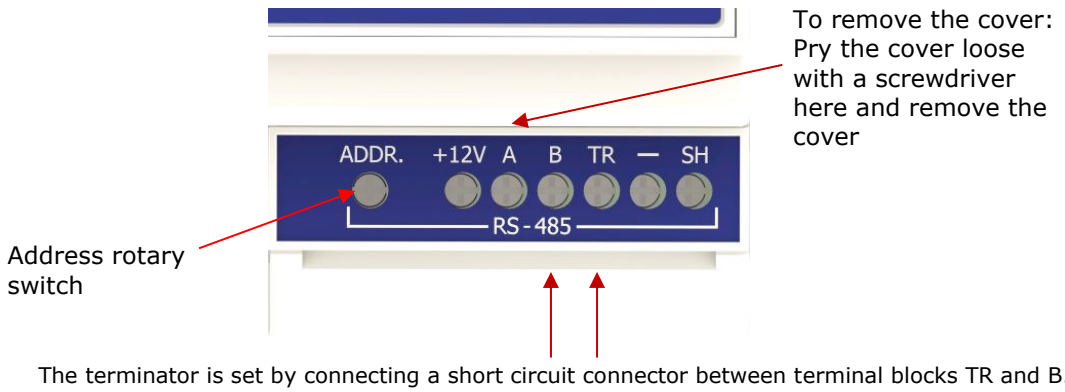
HW SETTINGS OF THE RD-01 UNIT

In RD-01 units, the address is set so that each RD-01 unit has its own individual address in the range of 0-4. The address is set using buttons, see section INSULATION RESISTANCE AND TRANSFORMER REMOTE ALARM UNIT RD-01, Setup mode for more information. If the RD-01 unit is the first or last device of the bus, connect the two pins next to the terminal strip to each other with a terminator jumper. The order of pins in RD-01 is shown in the Figure below.



HW SETTINGS OF THE PEC-01 UNIT

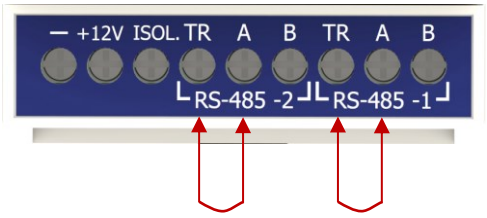
In PEC-01 units, the device address is set using a rotary switch as shown in the Figure. When the switch is at the far counter-clockwise position, the address is 0. In the other far end, the address is 15. The cover can be removed by using a screwdriver between the cover and the case to pry the cover loose. The addresses corresponding to the switch texts are: A = 10, B = 11, C = 12, D = 13, E = 14 and F = 15. The other addresses (0–9) function in the manner marked on the switch. Each PEC-01 unit must have a unique address between 0–15. The address may be the same as that of a TC-01 or IC-01 unit. If a PEC-01 unit is the first or last device of the bus, connect the TR and B pins of the terminal strip with a wire jumper.



The terminator is set by connecting a short circuit connector between terminal blocks TR and B.

HW SETTINGS OF THE FLI-01 UNIT

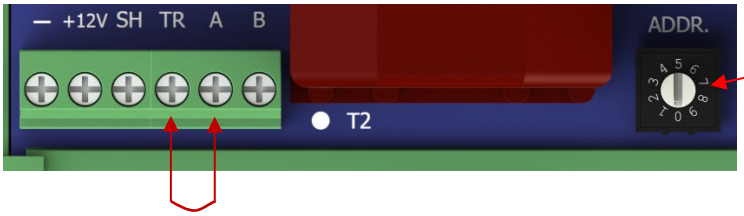
Setting a device address is not necessary in the FLI-01 unit. If the FLI-01 unit is at the end of the main RS-485 bus (RS-485-1), connect the TR and A pins of the RS-485-1 terminal strip with a wire jumper. Likewise, if the FLI-01 unit is at the end of the secondary RS-485 bus (RS-485-2), connect the TR and A pins of the RS-485-2 terminal strip with a wire jumper.



The terminator is set by connecting a short circuit connector between terminal blocks TR and A.

HW SETTINGS OF THE CTM-01 UNIT

In CTM-01 units, the device address is set using a rotary switch as shown in the Figure. Each CTM-01 unit must have a unique address between 1–8. In other words, the addresses 0 and 9 must not be used. If the CTM-01 unit is at the end of the bus, connect the TR and A pins of the terminal strip with a wire jumper.

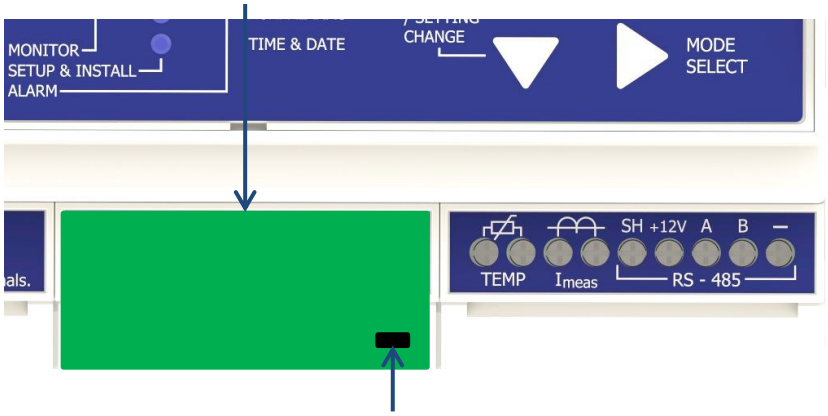


The terminator is set by connecting a short circuit connector between terminal blocks TR and A.

HW SETTINGS OF THE IM-01.MED UNIT

Setting a device address is not necessary in the IM-01.MED unit. If the IM-01.MED unit is at the end of the bus, a terminator must be connected. The terminator jumper is located under the centre cover in the location indicated in the Figure. Open the cover by using a small screwdriver between the cover and the case to pry the cover loose.

To open the cover: pry the cover loose with a screwdriver here and remove the cover

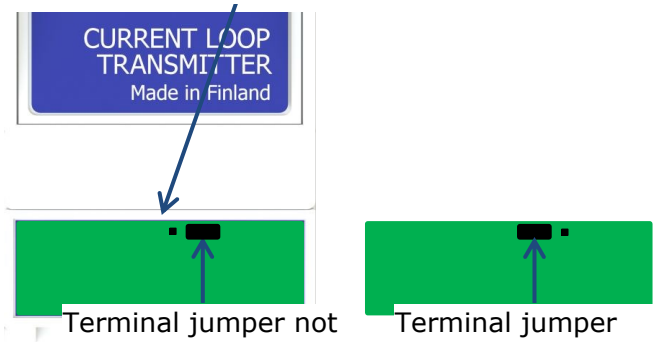


Terminator jumper

HW SETTINGS OF THE CLT-01 UNIT

Setting a device address is not necessary in the CLT-01 unit. If the CLT-01 unit is at the end of the bus, a terminator must be connected by changing the location of the terminator jumper to the left and middle pins. The terminal jumper is under the connector cover, above the terminal strip, as shown in the Figure. Open the cover by using a small screwdriver between the cover and the case to pry the cover loose.

To open the cover: pry the cover loose with a screwdriver here and remove the cover



Terminal jumper not connected

Terminal jumper connected

SYSTEM CONFIGURATION

The entire system must be configured before use. Configuration is performed from the IM-01.MED unit. The PEC-01 units do not perform measurements and the IC-01/TC-01/RD-01 units do not give alarms until the bus has been inspected. This is carried out with the Network Scan function, which is described separately (the SETUP menu). After the bus inspection, the IM-01.MED unit displays the type and address of each unit on the screen. For the PEC-01 units, the number of channels used and the resistance measured

from each channel during bus inspection are also displayed. The user must approve and verify all measured PE resistances and addresses. The IM-01.MED unit creates a table of the device addresses and the measured PE resistances, to which future alarm limits will be proportioned. Special attention should be paid to ensure that two similar units with the same address have not been connected to the system. The most sensible configuration order for the settings is as follows:

- If a microSD memory card has been connected to the device, enable it (SETUP→Mem Card: in use) and restart the device.
- Set the correct time. (SETUP→Time)
- Set the load current measurement and isolation transformer parameters (SETUP→ TranSize, Nom.Cur)
- Set the alarm parameters (SETUP→InsLimit, PrInsLim, Temp Lim, TsensTyp (Pt Calib, if needed), LoadLim, PEalarm%, AlarmDly). Remember to disable TempLim if temperature measurement has not been connected and to disable LoadLim if the load current measurement has not been connected.
- Set the AUX. ALARM mask (SETUP→AUXalarm), which defines the faults that cause the AUX. ALARM relay to trigger.
- Perform bus scanning using the menu SETUP→Network Scan. ENSURE that all installed units (IC, TC, RD, PEC) are identified and have the correct addresses, and that the measured PE resistances correspond to the physical lengths of the installed earthing wires.

During network scanning, the resistances from all channels of all PEC-01 units connected to the system are measured. Therefore, performing a Network Scan / Network View is permitted in medical locations only when there is no activity in the premises to be monitored.

- When needed, set the range for CLT-01 unit's current loop output (SETUP→LoopCurr)
- When needed, set the TCP/IP parameters (SETUP→IP Settings)
- If needed, enable the pre-alarm automatic acknowledgement (SETUP→Pre ACK)
- If the system is equipped with fault location system (FLI-01 and CTM-01), disable the automatic fault location, if needed (SETUP→Loc AUTO)
- If the system is equipped with fault location system, save the CTM-01 configuration by pressing the T and S buttons of the FLI-01 unit for 5 seconds

A more detailed description of the configuration is provided in the Manual section "SETUP menu". A more detailed description of the configuration of the fault location system is provided in the Manual section "INSULATION FAULT LOCATION SYSTEM".

USE

GENERAL

The Superintend IMD MED consists of several separate modules integrating into an insulation monitoring system through an electronic communication bus. The system includes the following components:

- The **IM-01.MED unit** is the central unit of the system. It performs most of the measurements independently and controls the operations of the other units and the alarm relays. The IM-01.MED unit is installed in the switchboard.
- The **PEC-01 unit** measures the continuity and resistance, if needed, of the earthing wire of wall socket chains. A maximum of six separate chains to be monitored can be connected to one unit. The system may contain a maximum of 16 PE units. The PEC-01 unit is installed in the switchboard.
- The **TC-01 and IC-01 units** are alarm units to be installed in the operating premises. The TC-01 unit gives an alarm of the isolation transformer overload or over temperature, and the IC-01 unit gives an alarm of insulation errors or a faulty earth conductor. One system can include 16 of each alarm units.
- The **RD-01 unit** is an alarm unit to be installed in the operating premises. The unit gives an alarm of the isolation transformer overload or over temperature, insulation errors or a faulty earth conductor. One system can include 5 RD-01 alarm units.
- The **FLI-01 unit** functions as a fault location injector. During the fault location process, it injects a small test current to the network so that the CTM-01 unit can detect the test current at the channel at which the insulation fault is and indicate that channel. A maximum of eight CTM-01 units can be connected to one FLI-01 unit. The FLI-01 unit is installed in the switchboard.
- The **CTM-01 unit** is a fault location current transformer module. During the fault location process, it monitors the fault locating currents (injected by the FLI-01 unit) of its channels. If the current of a channel exceeds the detection threshold, the CTM-01 indicates that the channel has an insulation fault. The CTM-01 unit has six channels. In other words, there can be up to 48 fault location channels in one IMD MED system. The CTM-01 unit is installed in the switchboard.
- The **CLT-01 unit** is a current loop transmitter for insulation resistance with a standard 0…20 / 4…20 mA current message. It is installed in the switchboard.

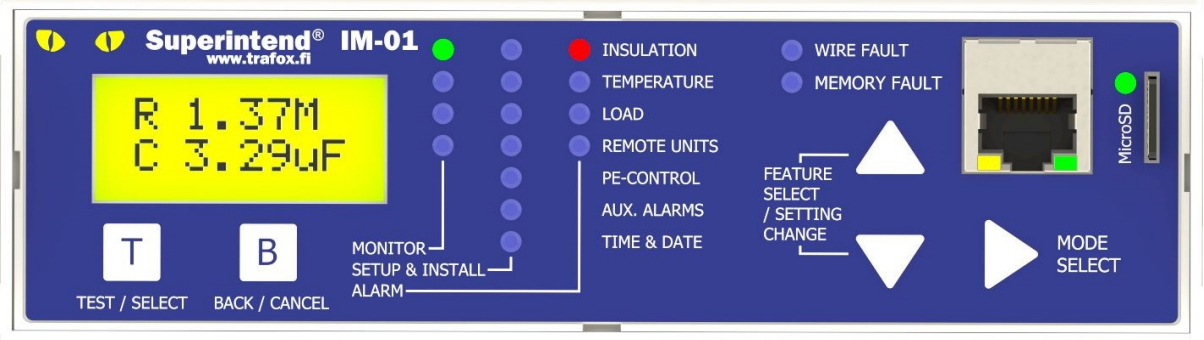
IM-01.MED UNIT

The IM-01.MED unit is the central unit of the system and the master of the RS-485 bus connected to it. The IM-01.MED contains the user interface of the entire system, and it controls all TC-01, IC-01, RD-01, PEC-01, FLI-01, CTM-01 and CLT-01 units connected to it. The IM-01.MED unit continuously reads the measurement results of the PEC-01 units and determines any fault situations based on them. The IM-01.MED unit also controls the optional fault location system (FLI-01 and CTM-01). The error notifications are displayed on the screen of the IM-01.MED unit and in the TC-01, IC-01 and RD-01 units, and the fault information can be forwarded to another user-defined system through alarm relays. All alarm parameters are set through the user interface of the IM-01.MED system.

In addition, the IM-01.MED unit maintains three separate log files on the microSD memory card if the memory card is inserted in the card slot and enabled in the Setup menu. They are Excel-compatible text files, which can be transferred to any computer for more detailed analysis. For more detailed information, see section "Log files". If the memory card function is not enabled, only the most recent information of each log entry is stored in the device memory. The information that is not stored on the memory card will not be preserved in the memory if the device loses operating voltage.

Measurement values can be monitored and settings can be changed using the Modbus/TCP protocol via the IM-01.MED unit's Ethernet connection. For this purpose, the device RJ45 must be connected to the local area network and the TCP/IP parameters must have been configured in the Setup menu.

The IM-01.MED unit independently measures the insulation resistance and capacitance of the IT network to be monitored, in relation to protective earth. The measurement is performed by feeding two separate low-frequency alternating voltages between the network and the PE conductor. These generate a low current that travels through the insulation resistance and capacitance to be measured. The insulation resistance and capacitance are calculated by measuring the current amplitude and phase. In addition, the device measures the secondary current and temperature of the isolation transformer if the current transformer and the NTC/PT100 sensor have been connected to the measurement couplers reserved for them and have been enabled in the Setup menu.



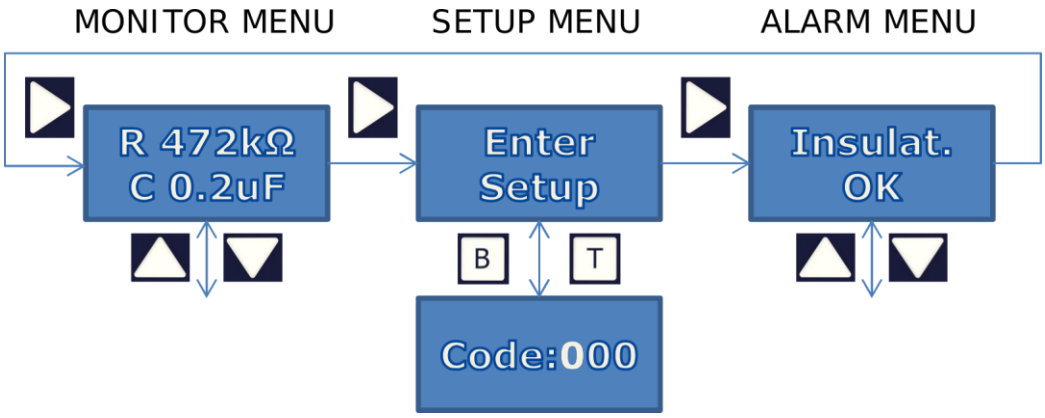
The system functioning can be tested by pressing the T button of the IM-01.MED unit when the IM-01.MED unit displays the Monitor menu. The device will test the functioning of the internal measurement circuit. More detailed information on this is provided in the description of the Monitor menu.

MENU STRUCTURE

The menus of the IM-01.MED unit have three main levels: MONITOR, SETUP and ALARM. The ▶ button is used to navigate between the main levels when the topmost parameter of each menu is highlighted on the screen. The first item of the menu is accessed by pressing the B button at any menu level item. The LED lights, in addition to the LCD display, indicate the selection in the menu in question.

The menus can be browsed up and down with the ▲ and ▼ buttons. Access to the Setup menu is password-protected.

The Monitor menu is the default of the IM-01.MED unit, to which the system returns in 20 minutes after the last time a button was pressed, or after a sufficient number of presses on the B button in any screen mode.



- The Monitor menu mainly has one level. Nearly all information to be displayed can be viewed by browsing the menu with the ▼ and ▲ buttons.
- The Alarm menu has two levels. The first level displays the reason for the alarm and the second level shows the alarm start time, the measured parameters, and alarm limits.
- The Setup menu mainly has two levels. The first level displays the valid parameter, which can be changed on the second level.

Hereafter, the screen modes are called as follows:

- The **main level** of the menu is the topmost menu level (MONITOR, SETUP and ALARM)

- The **menu level** is the sub-level of the aforementioned, and it is browsed using the ▼ and ▲ buttons
- The **screen mode** is the mode following the menu level, and it displays the value of the parameter/time; also displays a stopped AutoScroll mode. The screen mode can be accessed from the menu level by pressing the T button.
- The **AutoScroll** mode is in use in the Setup menu items where there are several parameters to display. In that case, the displayed parameters change every few seconds. You can stop the display with the ▼ and ▲ buttons and return from the screen mode to the AutoScroll mode with the B button. Use the T button to go to the edit mode or screen mode.
- The **Edit mode** is a Setup menu mode where the parameters to be displayed can be changed. In the Edit mode, the parameter to be changed flashes and it can be changed with the ▼ and ▲ buttons. If there are several parameters to be changed in the same screen, you can move to the next one by pressing the ▶ button. After the editing is completed, press the T button, after which the values given must be approved by selecting "Yes" in the Confirm menu and pressing T. By selecting "No" or pressing the B button in the conformation stage you return to the previous mode without saving the changes.

As a rule, the buttons function as follows:

Moving to the next parameter on the menu level and screen level. Reduces the parameter on the edit level. In the AutoScroll mode, stops the display.

Moving to the previous parameter on the menu level and screen level. Increases the parameter on the edit level. In the AutoScroll mode, stops the display.

Moving to the next menu on the main level. Moves to the next editable parameter on the edit level.

A general "approval button". On the menu level, takes you to the AutoScroll or edit mode. On the edit level, approves the changes made. Pressing the button in the first three items of the Monitor menu and approving the start of the test begins the system test.

A general "reject button". Returns to the previous mode from all modes. Pressing the B button an appropriate number of times takes you to the default mode of the main menu (insulation resistance/capacitance) from any mode.

MONITOR MENU

The Monitor menu is the default menu of the IM-01.MED unit during use. All modes of the menu always return to the topmost item on the Monitor menu after 20 minutes from the last press of a button.

The following measured parameters are available in the Monitor menu screen:

- IT network's insulation resistance and capacitance in relation to protective earth. Displayed in kOhms and micro farads.
- Temperature of the isolation transformer in degrees.
- Secondary current of the isolation transformer. Displayed in a percentage of the transformer's nominal current.
- The number of the TC-01, IC-01, RD-01 and PEC-01 units configured in the system and, if needed, the software versions of the units and IM-01.MED.
- The manual resistance measurement of the PEC-01 units can be started.

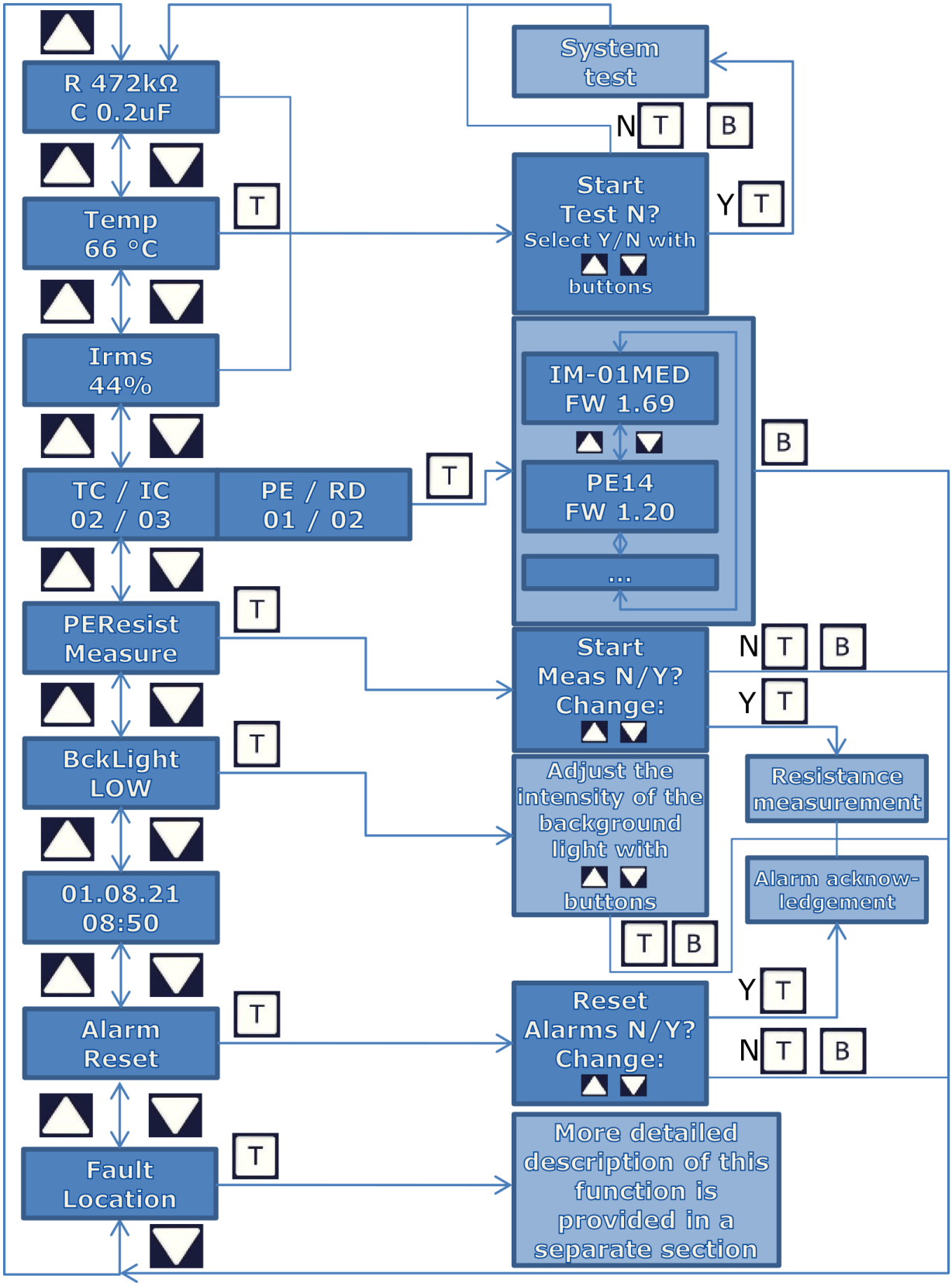
During the manual resistance measurement, test current pulses are fed into all channels of all PEC-01 units connected to the system. Therefore, the manual resistance measurement is permitted in medical locations only when there is no activity in the area to be monitored.

- The intensity of the background light can be adjusted to four different levels. (LOW / MED-LOW / MED-HIGH / HIGH)
- Time and date
- All fixed alarms can be acknowledged on one go.
- Fault location process can be started and the results of it can be reviewed. If there is not a FLI-01 unit connected, the menu item text is Injector No Conn. For more detailed information, see section "INSULATION FAULT LOCATION SYSTEM".

The default display is insulation resistance and capacitance. Other parameters and functions can be viewed by using the ▽ and △ buttons.

The system test is started from the Monitor menu by pressing T and then selecting Y in the Start test menu and pressing T. This starts the test of the internal measurement circuit of the IM-01.MED unit. If the test is completed successfully, the screen displays momentarily the text Test OK; otherwise the text shown in Test FAILED, and an insulation fault alarm is given to indicate that the insulation resistance can no longer be measured.

The Monitor menu functions as follows:

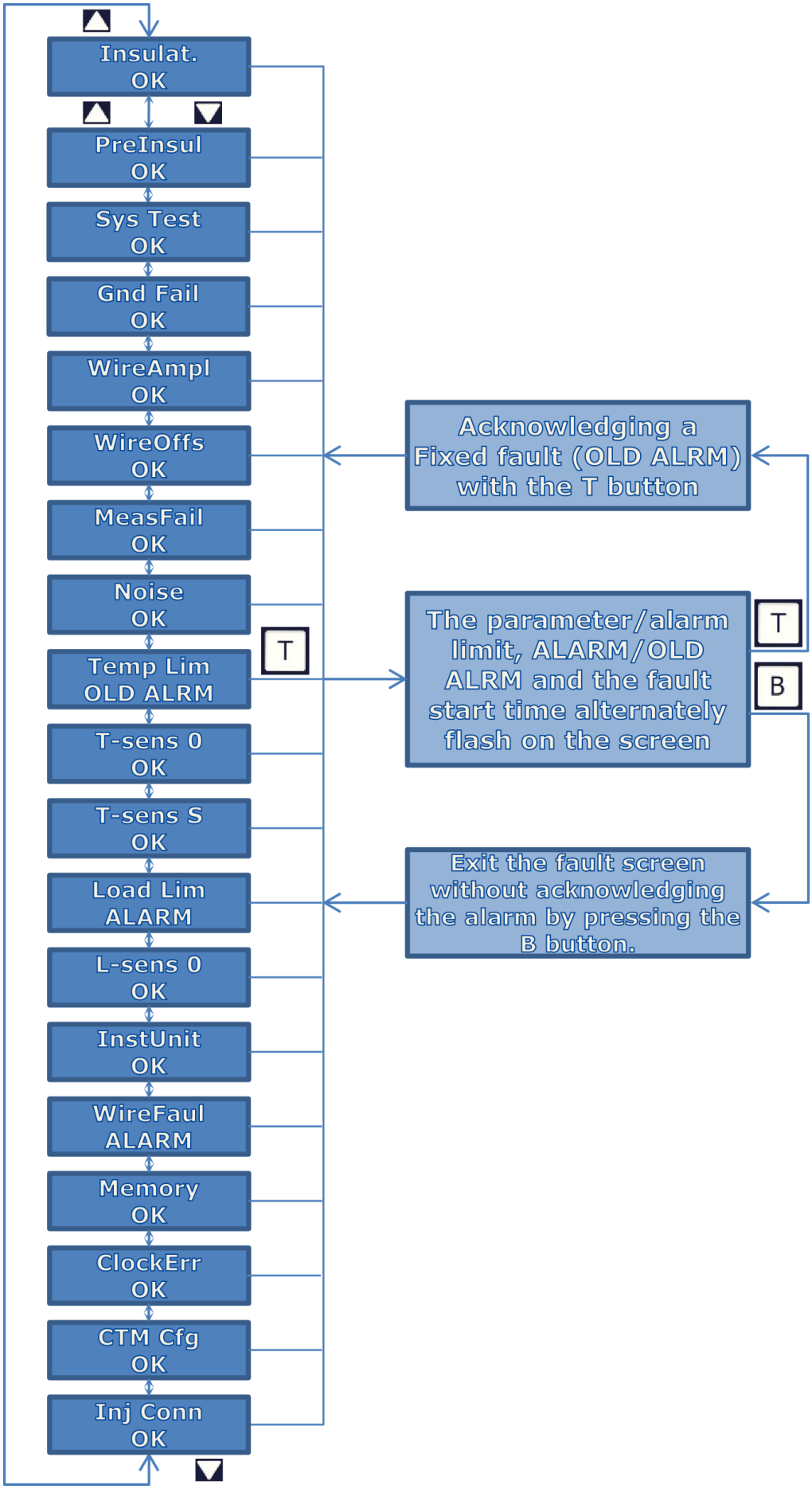


ALARM MENU

The alarm menu has two levels. The menu level shows if the alarm is active (ALARM), inactive but not acknowledged (OLD ALRM) or if the situation is normal (OK). The screen mode shows the value, alarm limit and time of the parameter that caused the alarm. Acknowledging the fault will remove the fault from the screen, but an entry of it remains in the event log of the memory card.

An alarm always indicates that the fault in question is still active. An active fault cannot be acknowledged until the issue that caused it has been fixed. The fixed fault is acknowledged when its time is checked and the T button is pressed. The B button takes you back to the menu level without acknowledging the fault. Faults in the PEC-01 units can also be acknowledged by means of the RESET switch located on the PEC-01 unit. This also inactivates the alarm in the IM-01.MED unit.

All fixed faults can also be acknowledged on one go by means of the Alarm reset function in the Monitor menu.



The most important alarms are indicated by a red LED light, which BLINKS in fault situations and is on STEADILY if the fault has been fixed but not acknowledged (the OLD ALRM mode).

When navigating the menu, the warning LED lights indicate which menu item is in use.

The insulation resistance fault activates IMMEDIATELY when the measured parameter drops below the alarm limit. The delay set for the alarms applies to all faults except the insulation resistance measurement. The value to be measured must consistently be above the alarm limit for the length of the delay before an alarm is given. If the measured quantity drops below the alarm limit during the delay, time counting restarts.

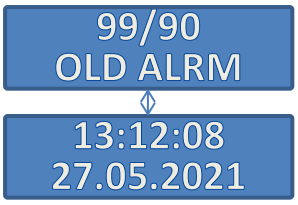
In addition, all alarms have a five-percent hysteresis. In other words, an alarm becomes active when the set limit is reached, but it is deactivated only when the measured value deviates by 5% in a safe direction from the limit given.

The screen mode of each parameter alternately displays the following:

- On the top row, the value / fault limit of the parameter that caused the fault, and on the bottom row, the current status: OK, ALARM or OLD ALRM
- Fault start time and date

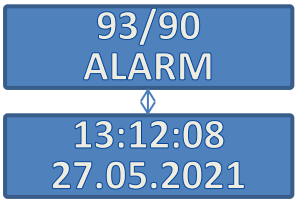
If the fault has been deactivated and becomes active again, the start time of the active fault is displayed. In items InstUnit, WireAmpl and WireOffs, there may be several faults, which are displayed one after the other. In the OK mode, nothing is displayed in the screen mode.

The screen always displays the smallest value (insulation resistance) or largest (all other measurements) value / fault limit measured during the fault first, followed by the fault start time.



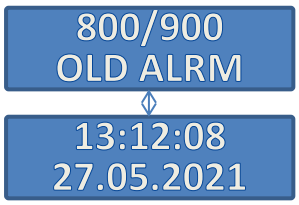
The temperature alarm has been deactivated but not acknowledged.

The largest value measured during the fault, the alarm limit's set value and the fault start time are displayed.



The temperature alarm is active.

The highest temperature measured during the fault is 93 degrees and the alarm limit is 90 degrees.



The insulation fault alarm has been deactivated but not acknowledged.

The smallest value measured during the fault, the alarm limit's set value and the fault start time are displayed.

The **Insulat.** and **PreInsul** alarms are active if the measured insulation resistance is smaller than the alarm or pre-alarm limit.

The **Sys Test** alarm is active if the manual system test fails. In that case, the insulation resistance can not be measured either, so an insulation resistance alarm is also given.

The **GND Fail** alarm is active if the TG or MG wire of the IM-01.MED unit is disconnected. In that case, the insulation resistance can not be measured either, so an insulation resistance alarm is also given.

The **WireAmpl** or **WireOffs** alarm is activated if the M1 or M2 wire of the IM-01.MED unit is disconnected or the insulation resistance is short-circuited. In that case, the insulation resistance can not be measured either, so an insulation resistance alarm is also given.

The **MeasFail** alarm is active if the system is unable to measure the insulation resistance. In that situation, an insulation resistance alarm is also always given. Reasons for the fault may include capacitance that is too high.

The **Noise** alarm is active if network disturbances are too extensive.

The **Temp Lim** alarm is active if the temperature of the isolation transformer is too high.

The **T-sens 0** alarm is active if one of the measurement wires of the NTC/PT100 sensor measuring the temperature of the isolation transformer has been disconnected from the IM-01.MED unit.

The **T-sens S** alarm is active if the wires of the NTC/PT100 sensor measuring the temperature of the isolation transformer are short-circuited.

The **Load Lim** alarm is active if the secondary current of the isolation transformer is too high.

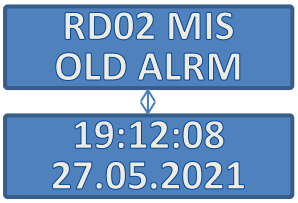
The **L-sens 0** alarm is active if one of the measurement wires of the current transformer measuring the output current of the isolation transformer has been disconnected from the IM-01.MED unit.

The **InstUnit** screen mode shows the unit which caused the error and text MIS if the device is missing. Such a unit is detected within four seconds.

IC-01 unit 9 is missing.

Alarm is active,

the device disappeared from the system at 1:12 pm.



RD-01 unit 2 has been missing from the system but functions now.

The alarm is no longer active but indicates that a fault occurred.

The device went missing for the first time at 7:12 pm.

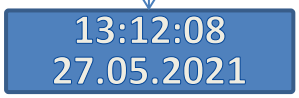
In the **WireFaul** screen mode, the top row indicates the address and channel of the PEC-01 unit and the bottom row shows the measured resistance / the initial value of resistance measured when the bus scan was performed. The measured parameter shows ERR if the channel is defective.

If there are several simultaneous PE faults in the system, all faults are shown one by one. ALARM is always displayed on the menu level if even one of the faults displayed is an active alarm. If only inactive alarms are shown, OLD ALRM is displayed in the menu mode.

If the PEC-01 unit is completely missing, an error for each channel connected in the configuration and an Installed Units error are given.

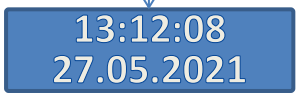
The PEC-01 units' errors are acknowledged from either the IM-01.MED unit or the PEC-01 unit

The screen modes of the alarm menu may be as follows, for example:



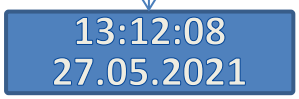
The resistance of the measurement loop of channel 2 of the PEC-01 unit in address 3 is outside the measurement range, in other words, resistance is between 2.55Ω…500kΩ. The initial value of resistance measured when the bus was scanned is 0.60Ω.

Fault start time.



The measurement loop of channel 2 of the PEC-01 unit in address 3 is broken, in other words, resistance is higher than 500kΩ. The initial value of resistance measured when the bus was scanned is 0.60Ω.

Fault start time.



The resistance measured by channel 2 of the PEC-01 unit in address 5 is 1.24Ω. The initial value of resistance measured when the bus was scanned is 0.50Ω.

The alarm limit was exceeded at 1:12 pm.

The **Memory** alarm is active if writing on the memory card fails or the card has been removed. These alarms are activated only if the memory card has been enabled in the SETUP menu.

The **ClockErr** alarm is active if the operating voltage of the real time clock circuit has been too low. The fault is caused by a depleted battery. The fault can only be acknowledged once the time has been set. The device battery cannot be changed by the

user. Send the device to maintenance if the battery is empty. Under normal conditions, the useful life of the battery is more than 10 years.

The **CTM Cfg** alarm is active if connection to some of the CTM-01 units saved in the FLI-01 memory has been lost.

The **Inj Conn** alarm is active if the FLI-01 unit has been previously connected to the IM-01.MED unit and the connection has been lost.

SETUP MENU

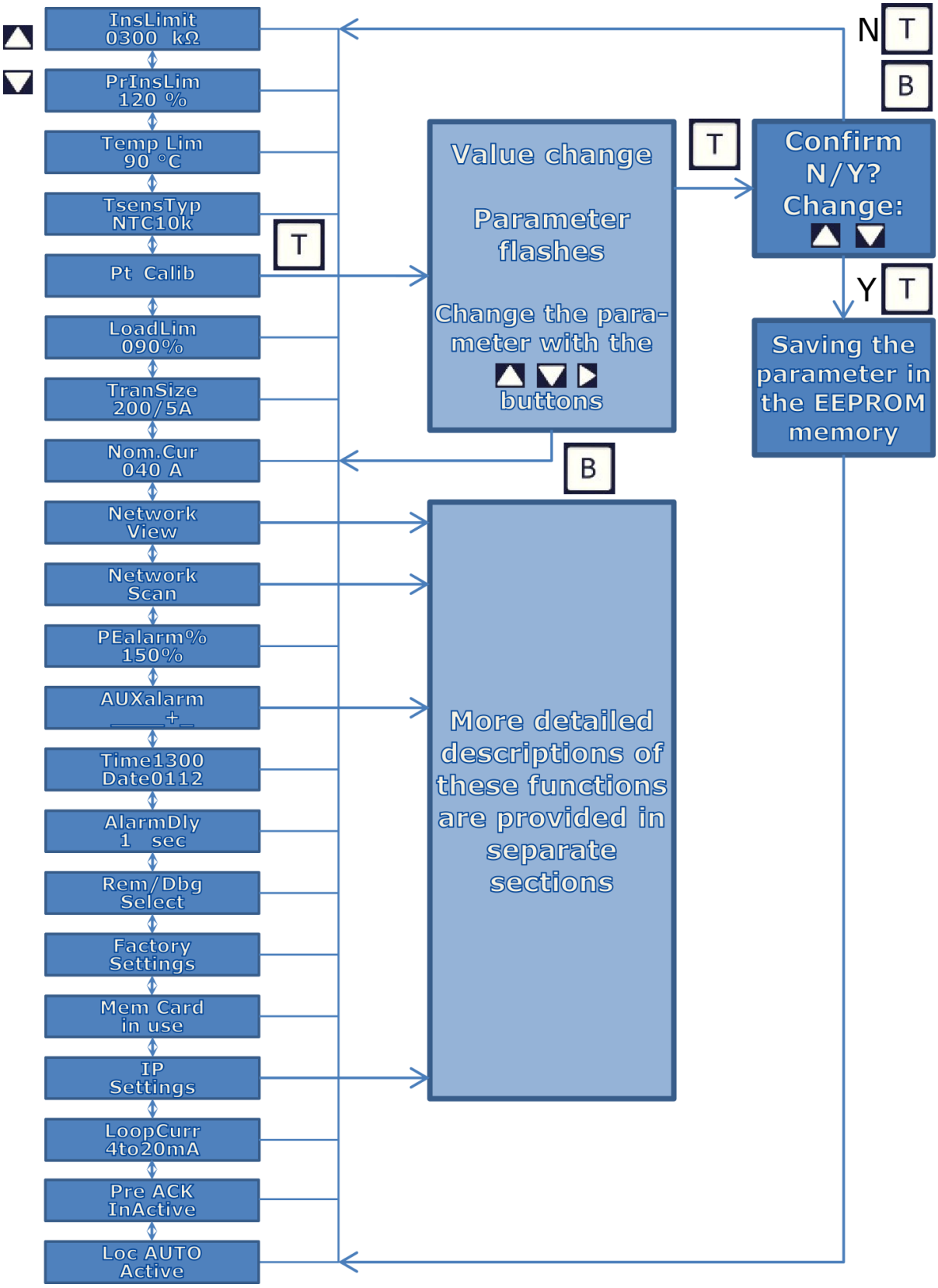
The Setup menu can be used to change system settings, alarm limits, time etc. Before using the system, a Network Scan must be performed. The PEC-01 units do not perform any measurements and the IC-01/TC-01/RD-01 units do not give any alarms until the devices connected to the IM-01.MED unit have been identified and their data has been saved in the memory.

The Setup menu is password-protected and accessed as follows:

- Go to the Setup menu in the main menu. The screen displays "Enter Setup". Press T.
- Change the blinking number with the ▼ and ▲ buttons and press the ▶ button to move to the next digit. Enter the three digits and press T. After this, you can navigate the menu with the ▼ and ▲ buttons.
- The B button takes you to the initial mode.

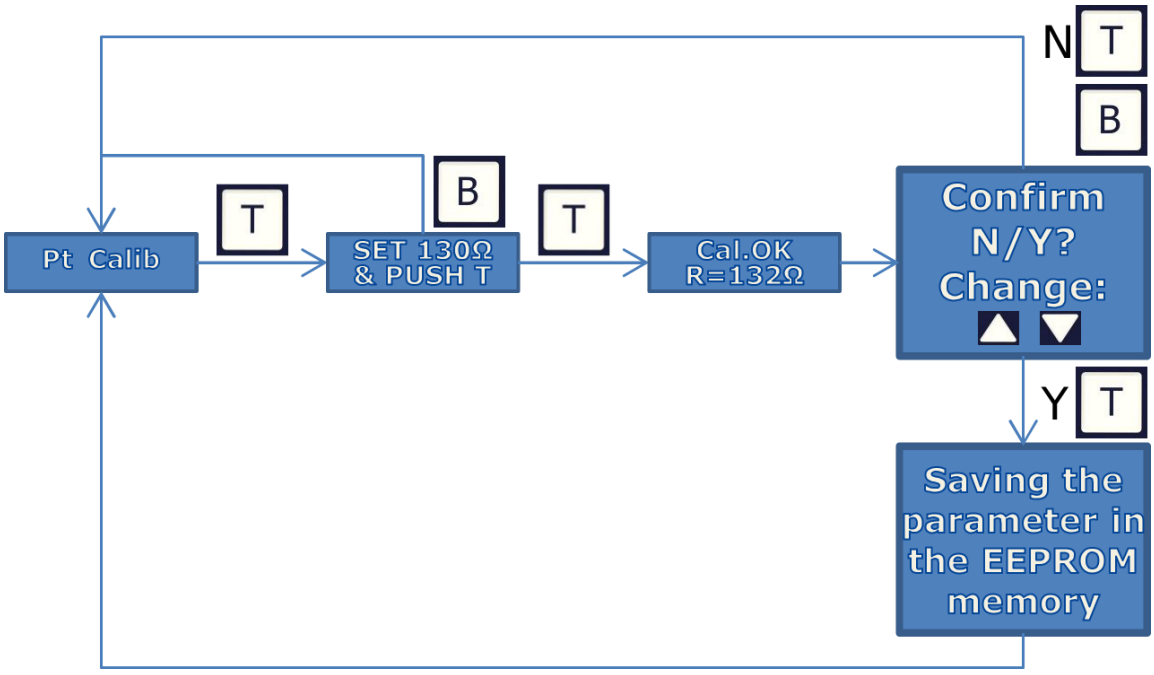
The default password is "123". The password is saved in the setup log of the microSD card and can be changed by editing the setup log file in a text editor. The password change will become effective at the next start-up. If the password could not be read from the card during start-up (the card was removed or defective), the default password 123 can be used.

All information on the other settings of the device alarm limits and the system are saved in the internal EEPROM memory of the IM-01.MED unit. The device addresses and a list of the PE channels' resistances are saved after the first Network Scan. The microSD card's setup log always includes a time-stamped copy of the EEPROM values.



The following parameters can be changed in the Setup menu:

- **INSULATION LIMIT**: Alarm limit of the insulation resistance. If the measured value is lower than the alarm limit, an alarm is given. The setup range is 50 kΩ…1,000 kΩ. It can be set at 50 kΩ intervals.
- **PRE INSULATION LIMIT:** The pre-insulation limit of the insulation resistance. Given as a percentage of the insulation limit. Activates the AUX. ALARM relay, unless it is removed from the AUX alarm mask. The setup range is 100…200%, at 10% intervals.
- **TEMPERATURE LIMIT:** The alarm limit of the transformer temperature. Can be set between 30…140 °C or switched OFF if temperature measurement is not used.
- **TEMPERATURE SENSOR TYPE:** The type of the temperature sensor used (NTC or PT100).
- **PT100 CALIBRATION:** This setting is only used when PT100 is selected as the temperature sensor. It can compensate for the error caused by long measurement wires (the maximum loop resistance is 20 Ω) in the temperature value. A 130 Ω resistor is connected to the end of the measurement wires in the place of the PT100 sensor, after which calibration is performed:



If the resistance measured in calibration is too low or too high, the message displayed is Failed, instead of Cal.OK. In that situation, check the connection.

- **LOAD LIMIT:** The current limit of the transformer as a percentage of the transformer's nominal current. Can be set between 50…100% or switched OFF if load current measurement is not used.
- **TRAN SIZE:** The nominal value of the current transformer. The primary current that provides a current transformer output current of 5A. The setup range is 10–100 A.
- **NOMINAL CURRENT:** The nominal current of the isolation transformer at full power. SETUP RANGE 1–100 A.

- **NETWORK VIEW:** The menu is similar to the Network Scan menu. Devices can be added, removed or changed one by one here. More detailed information is provided in section ADDING/REMOVING DEVICES
- **NETWORK SCAN:** Scans the entire address space of the RS-485 bus. Thereafter, shows all connected units and the resistance of the connected channel of each PEC-01 unit and its measured resistance. The user approves ALL parameters at the same time. If you want to review devices one by one, use the Network View option. A more detailed description is provided below.
- **PE ALARM %:** The highest allowed resistance increase as a percentage of the initial value of the table. The resistance of each channel connected to the PEC-01 unit is measured and entered in the table when the bus is scanned. After that, the resistance measurement functions by separate request only (MONITOR→PEResist Measure, the detection of a broken measurement loop does function all the time). If the percentage relation of the measured PE resistance and the corresponding table value is higher than this limit, an alarm is given. The available settings are OFF/100…200%. Note the thermal coefficient of the nominal resistance of copper when setting the value. For example, an increase of 40 degrees in temperature causes a 16% increase in the measured resistance value.

  When the **PE Alarm %** setting is OFF, the equipment does not give alarms of a broken measurement loop or a PE resistance that is too high. This setting is permitted only temporarily under exceptional conditions.
- **AUX ALARM MASK:** Defines, which errors affect the functioning of the AUX.ALARM relay. The alternatives are: An erroneous number of devices, a microSD card fault, insulation fault pre-alarm, PE wire fault, a wrong time, insulation level and transformer sum alarm. All parameters are switched on/off one by one. A more detailed description is provided below.
- **TIME:** The time of the realtime clock and date.
- **ALARM DELAY:** The alarm delay in seconds, the setup range of 1…30 s. Not applicable to the insulation resistance measurement.
- **DEBUG MODE:** Debug/normal mode. In the Debug mode, the IM-01.MED unit becomes a slave and stops scanning the bus. Using this is permitted only during maintenance under supervision. The device exits the Debug mode automatically in 60 seconds after the last command has been received from the PC. During debugging, ALL remote units switch to the System Fail mode.
- **FACTORY SETTINGS:** Returns all settings to their original values and removes all RS-485 bus devices from the database.
- **MEM CARD:** Enables or disables the memory card. The factory setting is "not used", so when the memory card is inserted, it must be separately enabled here. The setting becomes effective when the device is restarted.
- **IP SETTINGS:** The device TCP/IP settings when using the Modbus/TCP remote management. A more detailed description is provided in the IP settings section.
- **LOOP CURRENT:** This setting determines the output current range of any current loop transmitters CLT-01 connected to the RS-485 bus. The options are 0…20 mA and 4…20 mA.

- **PRE-ALARM ACKNOWLEDGEMENT:** This setting determines whether the insulation pre-alarm shall be acknowledged automatically as soon as the insulation pre-alarm is deactivated.
- **AUTOMATIC LOCATION:** This setting determines whether the fault location process shall be initiated automatically when a new insulation alarm is activated (if IM-01.MED is equipped with the fault location system FLI-01 / CTM-01).

NETWORK SCAN

The Network Scan function scans ALL possible device addresses in the network. The scan is started by approving Start? Y/N in the screen mode of the menu: select Y and press T. If the device has not been used before, all devices detected are displayed after the scan and the connected PE unit channels toggle on the screen at one second intervals in the Autoscroll mode. The screen can be stopped with the ▽ and △ buttons, and the results can be browsed with these buttons.

During bus scanning, resistance is measured from all channels of all PEC-01 units connected to the system. Therefore Network Scan / Network View is permitted in medical locations only when there is no activity in the area to be monitored.

If the device already has a previously approved configuration, the AutoScroll mode displays the measured value of each parameter and the approved value from the earlier configuration saved in the EEPROM memory.

The results are approved with the T button, after which a confirmation is requested: CONFIRM ALL/NONE. When ALL is selected, the values are saved in the memory of the IM-01.MED unit. Note that all parameters must be approved at the same time. In other words, at this phase the number and addresses of the devices and, in particular, the number of PE unit channels and resistance accuracy must be checked carefully.

If you don't want to change/approve all values simultaneously, use the Network View function. It should be used when a small change is made in the system, for example, one remote unit or one PE channel is added or removed and remeasuring all PE resistances is not desired.

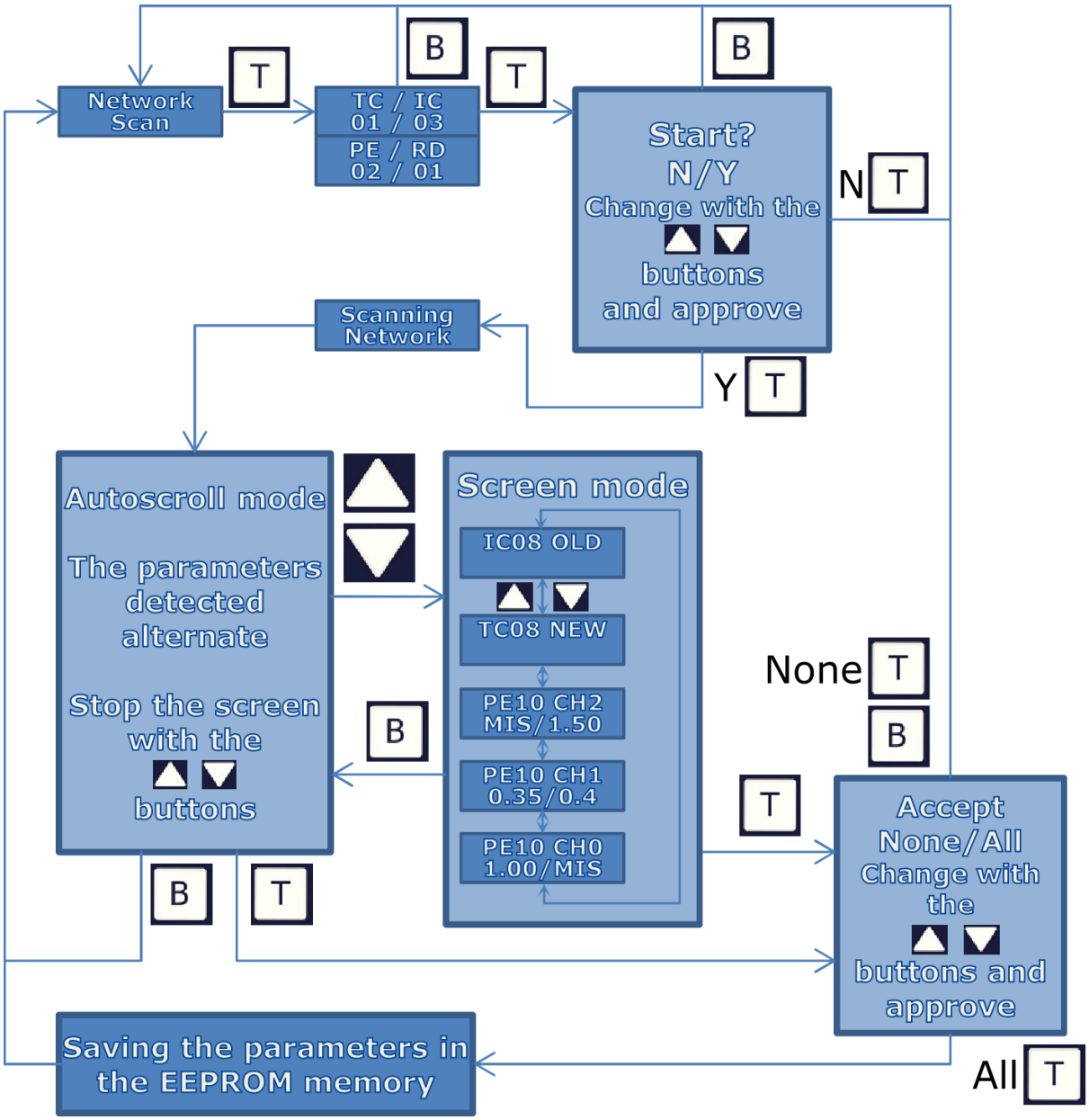
The texts shown in the AutoScroll and screen modes, including their descriptions, are presented below. The xxx/yyy parameter displayed on the screen always means the MEASURED/SAVED value. In addition to the numerical values, the following abbreviations are used:

- MIS: A missing unit or PE channel (a measurement loop is broken, in other words, the resistance is higher than 500kΩ)
- OLD: The device was also included in the previous approved configuration.
- NEW: The device is new, and was not included in the previous approved configuration.
- ERR: The device is defective but communicates, or the resistance of the PE channel is 2.55Ω…500kΩ
- --: The resistance of the PE channel has not been measured yet

- INACTIVE: A PEC-01 unit channel that has not been connected (the resistance is higher than 500kΩ)

If the system includes even one defective device, the Network Scan results should not be approved until the fault has been fixed. Such faults include, for example:

- A defective remote unit
- A defective channel in the PE unit
- Resistance that is too high in a PE unit channel
- Duplicate addresses



Examples of the screens of the Network Scan screen mode:

Channel 1 of the PEC-01 unit is not connected.

Channel 2 of the PEC-01 unit 15 is connected, the measured new value is 0.70 Ω and the previous approved value was 1.2 Ω.

Channel 1 of the PEC-01 unit 9 is connected but its resistance is more than 2.55 Ω. The previous approved value was 0.4 Ω.

Channel 2 of the PEC-01 unit 8 is connected but its resistance is more than 2.55 Ω. The channel was not connected at all in the previous approved configuration.

Channel 1 of the PEC-01 unit 8 is connected and its resistance is 0.20 Ω. The channel was not registered in the previous approved configuration.

The IC-01 unit 8 is connected, and it was also included in an earlier approved configuration.

The TC-01 unit 8 is new.

The RD-01 unit 2 has been removed from the previous approved configuration.

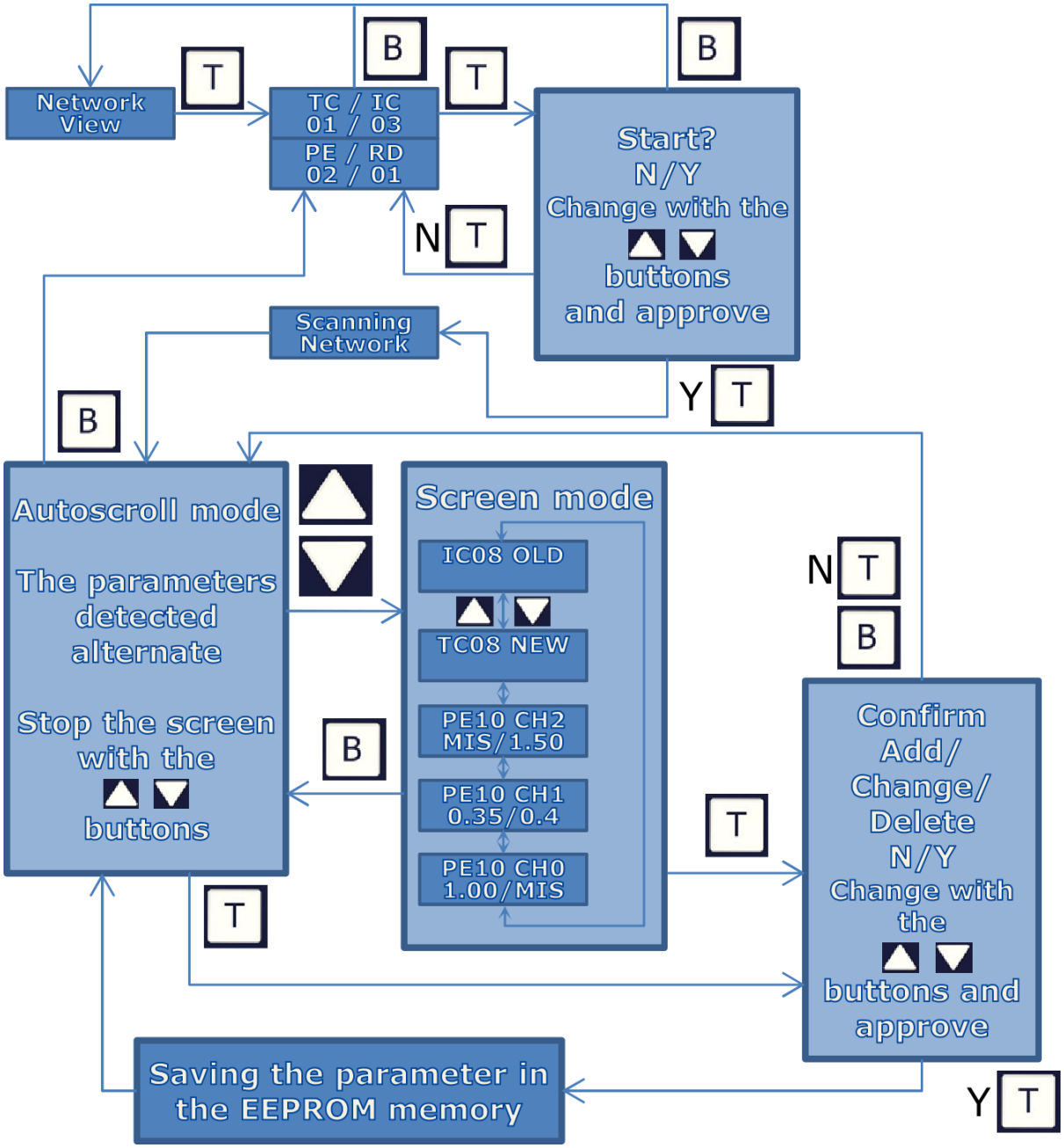
NETWORK VIEW / ADDING AND REMOVING DEVICES

The Network View function, as well as the Network Scan function, scans ALL possible device addresses in the entire network. The scan is started by approving SCAN? Y/N in the screen mode of the menu: select Y and press T. After the scan, all devices detected and the connected PE unit channels in the AutoScroll mode toggle on the screen at one second intervals. The screen can be stopped with the ▽ and △ buttons, and the results can be browsed manually using those buttons.

If the device already has a previously approved configuration, the AutoScroll mode displays the measured value of each parameter and the approved value from an earlier configuration saved in the EEPROM memory.

The results are approved with the T button, and a confirmation is then requested: Confirm Add?/Confirm Delete?/Confirm Change?, as applicable. When Y is selected, the changed value is saved in the memory of the IM-01.MED unit. All changed parameters (when adding a PE unit, also all its channels being used) must be approved one by one. The values that are not approved separately will retain their previous value.

The screen mode of the Network View is similar to that of the Network Scan mode.

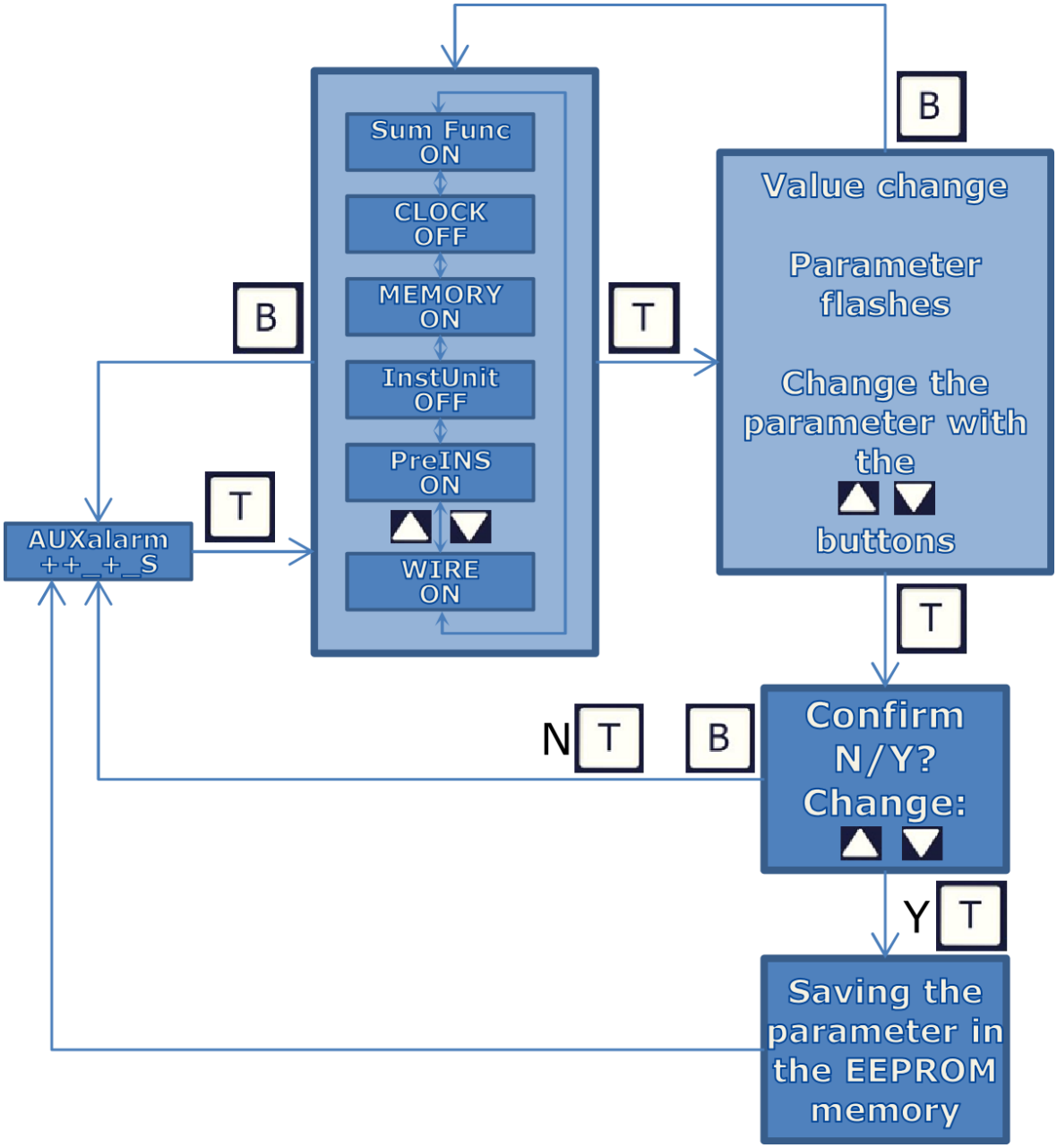


AUX. ALARM MASK

The alarm mask is used to select the alarms that cause the AUX. ALARM relay to activate. An alarm is given if any of the selected (ON) conditions is met. The options are as follows:

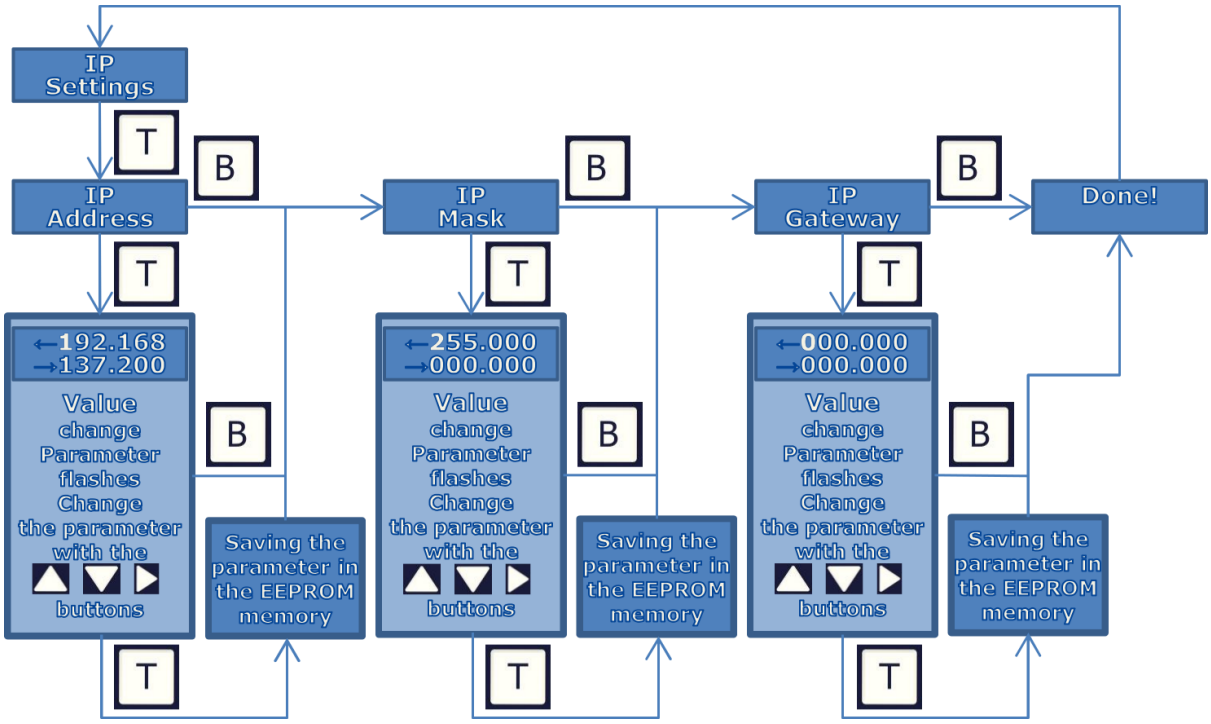
- **WIRE FAULT**: A break, or resistance that is too high in a protective conductor, or a device fault of the PEC-01 unit.
- **PREINSULATION ALARM**: The insulation resistance is lower than the insulation resistance alarm limit provided, plus the percentage of the PreInsulation Alarm. For example, if the Insulation Limit is 300 kΩ and the PreInsulation Limit is 150%, the AUX alarm is given at 450 kΩ.
- **INSTALLED UNITS**: There are too few devices in the system. The missing devices are detected within three seconds of the end of communication.
- **MEMORY**: The microSD memory card is defective, full or missing.
- **CLOCK**: The time is incorrect. An alarm is given if the operating voltage of the circuit maintaining the real time clock has dropped too low. In that case, the time is incorrect. This alarm is a sign of a depleted battery, and the battery needs to be changed.
- **SUM FUNCTION**: Insulation and transformer sum alarm. Causes activation of AUX.ALARM relay if there is an insulation level, transformer overload or transformer over temperature alarm.

The screen level of the menu displays the status ON or OFF for each alarm. The menu level provides an illustrative presentation of the settings: Parameters marked with "+" (in the case of a sum alarm "S") cause an alarm. The parameter order is as shown above. The setting is changed on the edit level by setting the ON/OFF mode with the ▽ and △ buttons and approving the changes with the T button.



IP SETTINGS

When enabling the Modbus/TCP remote control of the IM-01.MED device, the correct TCP/IP settings must be configured in the IP Settings menu item. The IP address, subnet mask and gateway are set in accordance with the following chart:



The IP address, subnet mask and gateway consist of four series of digits separated by dots, which are called octets (e.g. 192.168.137.200). The value range of each octet is 000…255. Whenever you move to the next octet with the ▶ button, the device verifies that the value of the previous octet is not more than 255. If this is not the case, the cursor returns to the beginning of the erroneous octet. Also, when saving the parameter with the T button, the device verifies the validity of all octets. If any octet is erroneous, the display returns to the edit mode of the erroneous octet.

Contact your network administrator for the correct TCP/IP settings parameters. If parameters that are not suitable for the local area network being used are entered in the settings, problems may occur in the functioning of the entire LAN to be used.

ERRORS

The following table lists the functioning of the IM-01.MED, IC-01, TC-01, RD-01 and PEC-01 units in various error situations. The errors of the fault location system are listed in the section "INSULATION FAULT LOCATION SYSTEM".

Error	IM-01.MED ALARM LEDs	IM-01.MED ALARM menu	IC-01	TC-01	RD-01	PEC-01	Alarm relay
PEC-01 unit is missing	REMOTE UNITS	InstUnit WireFaul	PE FAULT		ALARM	SYSTEM FAIL (1)	AUX*
The IM-01.MED is not communicating with any device (2)	REMOTE UNITS WIRE FAULT	InstUnit WireFaul	SYSTEM FAULT	SYSTEM FAULT	SYSTEM FAULT	SYSTEM FAIL	AUX*
The IM-01.MED unit without operating voltage						SYSTEM FAIL	INS AUX TRF
The IC-01/TC-01 remote display is missing	REMOTE UNITS	InstUnit	SYSTEM FAULT(3)	SYSTEM FAULT(3)	SYSTEM FAULT (3)		AUX*
Memory fault (microSD card)	MEMORY FAULT	Memory					AUX*
Overload	LOAD	Load Lim		OVERLOAD ALARM	ALARM		TRF
Over temperature	TEMPERATURE	Temp Lim		OVERTEMP. ALARM	ALARM		TRF
Insulation fault (R under InsLimit)	INSULATION	Insulat.	INSULATION FAULT		ALARM		INS
Insulation fault (R under PrInsLim)	INSULATION	PreInsul	INSULATION WARNING		WARNING		AUX*
PE fault (a break in the channel of the PEC-01 remote unit or resistance exceeds the alarm limit)	WIRE FAULT	WireFaul	PE FAULT		ALARM	FAIL	AUX*
Incorrect time		ClockErr					AUX*
The IM-01.MED unit TG wire is disconnected	INSULATION	Gnd Fail	INSULATION FAULT		ALARM		INS
The IM-01.MED unit MG wire is disconnected	INSULATION	Gnd Fail	INSULATION FAULT		ALARM		INS
The IM-01.MED unit M1 wire is disconnected	INSULATION(4)	WireAmpl WireOffs	INSULATION FAULT		ALARM		INS(4)
The IM-01.MED unit M2 wire is disconnected	INSULATION(4)	WireOffs	INSULATION FAULT		ALARM		INS(4)
IM-01.MED is not capable of measuring insulation resistance and capacitance	INSULATION(5)	MeasFail(5)	INSULATION FAULT		ALARM		INS(5)
System fault (manual test)	INSULATION	Sys Test	INSULATION FAULT		ALARM		INS

(1) The PEC-01 unit display shows an error if this is only a communications fault. The device may also be broken, in which case it may not display the error.

(2) RS-485 circuits are faulty or the wire is cut. The IM-01.MED unit is still able to measure insulation resistance, temperature and load current independently.

(3) Communication fault; the remote unit is otherwise ok.

(4) The IM-01.MED device monitors that measurement wires M1 and M2 are connected.

(5) Detecting a measurement error may take several minutes.

Alarm relays:

- TRF transformer alarm
- INS insulation alarm
- AUX alarm (*Can be configured through the alarm mask in the Setup menu)

Error situations are displayed by means of ALARM LEDs and the alarm menu of the IM-01.MED unit and in the TC-01, IC-01 and RD-01 remote display units and the PEC-01 unit. The alarm sound is available in the remote display units only and it can be muted by pressing the MUTE ALARM button. A blinking LED always means that an alarm is active, and a steady indicator indicates a fixed and unacknowledged fault.

LOG FILES

IM-01.MED stores event history on the microSD memory card. Compatible card types are microSD and microSDHC. The card type microSDXC is not compatible. The card must be pre-formatted to FAT32 and its maximum storage capacity is 32 GB. The maximum amount of card storage capacity used is 4 GB.

The event history is stored only when the card is inserted into the device and enabled in the SETUP menu. Once the memory card has been enabled, the device begins storing the event history after restart. The card is normally kept in the device and only removed when data is read from the card. When the card is removed (and set up for use), the MEMORY FAULT alarm is active.

The device maintains three different logs: an event log, measurement log and setup log. They are saved in the root directory of the microSD card with names EVENTLOG.TXT, MEASLOG.TXT and SETUPLOG.TXT. These are active files; in other words, they always contain the most recent data. In addition, the root directory may contain archives of each file.

Each active log file is updated for one year. After that, a new active log is created and the old one is archived by renaming it. The name format of the archived file is NAMEMMYY.TXT, where NAME is the file type (EVNT, MEAS, STUP), MM is the month and YY is the year of archiving. For example, the file EVNT0221.TXT is an event file of the EVENTLOG.TXT file from February 2021.

All files are text-based and can thus be read with any text editor. The separator used in the files is the tab, so the files are easier to read in Excel, for example.

Event log (EVENTLOG.TXT)

The event log stores all relevant events as plain text with a time stamp.

Power OFF (*)	The device operating voltage was lost.
Power ON	The device was restarted.
SD Card removed	The memory card was removed.
SD Card inserted	The memory card was reinserted.
Insulation Alarm ON [*N*kOhm][*L*kOhm]	The insulation resistance alarm activated with value *N*, whereas the limit value has been *L.*
Insulation Alarm OFF	The insulation alarm is no longer active.
Insulation Alarm Acknowledge	The insulation alarm that is no longer active was acknowledged manually.
Alarm Limit changed [Insulation] [*L1*kOhm]->[*L2*kOhm]	The insulation resistance alarm limit value was changed from *L1* to *L2.*
Insulation Prealarm ON [*N*kOhm][*L*kOhm]	The insulation pre-alarm activated with value *N*, whereas the limit value has been *L.*
Insulation Prealarm OFF	The insulation pre-alarm is no longer active.
Insulation Prealarm Acknowledge	The insulation pre-alarm that is no longer active was acknowledged manually.
Alarm Limit changed [PreInsulation] [*L1*%]->[*L2*%]	The insulation resistance pre-alarm limit value was changed from *L1* to *L2.*
OverTemperature ON [*N*C][*L*C]	The transformer temperature alarm activated with value *N*, whereas the limit value has been *L.*
OverTemperature OFF	The transformer temperature alarm is no longer active.
OverTemperature Acknowledge	The transformer temperature alarm was acknowledged manually.
Alarm Limit changed [Temperature] [*L1*C]->[*L2*C]	The transformer temperature limit value was changed from *L1* to *L2.*
Temperature Sensor Type Changed to NTC Temperature Sensor Type Changed to Pt100	The type of the transformer's temperature sensor was changed.
Temperature Sensor Calibrated [*O1* ADP]->[*O2* ADP]	The transformer's temperature sensor of type Pt100 was calibrated. The old offset value

	is *O1* as AD points, and the new measured offset value is *O2*.
Temperature Sensor Cut Alarm ON	The measuring circuit of the transformer's temperature sensor is cut.
Temperature Sensor Cut Alarm OFF	The measuring circuit of the transformer's temperature sensor recovered from an outage.
Temperature Sensor Cut Alarm Acknowledge	The measuring circuit of the transformer's temperature sensor recovered from an outage. The alarm was acknowledged manually.
Temperature Sensor Shortcut Alarm ON	The measuring circuit of the transformer's temperature sensor short-circuited.
Temperature Sensor Shortcut Alarm OFF	The measuring circuit of the transformer's temperature sensor recovered from a short-circuit.
Temperature Sensor Shortcut Alarm Acknowledge	The measuring circuit of the transformer's temperature sensor recovered from a short-circuit. The alarm was acknowledged manually.
Overload ON [*N*A][*L*A]	The overload alarm activated with value *N*, whereas the limit value has been *L.*
Overload OFF	The overload alarm is no longer active.
Overload Acknowledge	The overload alarm was acknowledged manually.
Alarm Limit changed [Load] [*L1*%]->[*L2*%]	The overload limit value was changed from *L1* to *L2.*
Load Sensor Cut Alarm ON	The transformer's current measuring circuit is cut.
Load Sensor Cut Alarm OFF	The transformer's current measuring circuit has recovered from an outage.
Load Sensor Cut Alarm Acknowledge	The transformer's current measuring circuit has recovered from an outage. The alarm was acknowledged manually.
Ground Failure ON	TG or MG has disconnected from PE.
Ground Failure OFF	The connection from the measurement connectors TG and MG to PE is fine after a detected outage.
Measure Failure ON	The insulation resistance measurement cannot be performed due to an internal fault.

Measure Failure OFF	The insulation resistance measurement can be performed after an internal fault has been corrected.
Wire Ampl Test Fail [*N*][*L*]	The Wire Test amplitude is too low (*N*, whereas the alarm limit is *L*) -> M1 has been disconnected from the network to be measured.
Wire Ampl Test OK	The Wire Test amplitude has recovered to the correct level; M1's connection to the network to be measured has been restored.
Wire Offset Test Fail [*N*ADP][*L*ADP]	The Wire Test offset is too small (*N*, whereas the alarm limit is *L*) -> M1 or M2 has been disconnected from the network to be measured.
Wire Offset Test OK	The Wire Test offset has recovered to the correct level; the M1 and M2 connections to the network to be measured have been restored.
Too much noise [*N*%][*L*%]	The insulation resistance measurement continuously has a noise level too high (N) whereas the alarm limit is *L*.
Noise normal level	The noise level of the insulation resistance measurement has returned to normal.
PE Alarm ON [PE*XX* CH*CC*][*N*][*L*]	The resistance fault of channel *CC* of the PEC-01 unit in the PE address of *XX* has been activated with value *N*, whereas the limit value has been *L*.
PE Alarm OFF [PE*XX* CH*CC*]	The resistance fault of channel *CC* of the PEC-01 unit in the PE address of *XX* is no longer active.
PE Alarm Acknowledge [PE*XX* CH*CC*]	The resistance fault of channel *CC* of the PEC-01 unit in the PE address XX is no longer active. The alarm was acknowledged manually.
Alarm Limit changed [PEresist] [*L1*%]->[*L2*%]	The limit value of the resistance fault of the PEC-01 units was changed from *L1* to *L2*.
Missing TC Alarm ON [TC*XX*]	The TC-01 unit configured in the TC address *XX* is not responding.
Missing TC Alarm OFF [TC*XX*]	The TC-01 unit configured in TC address *XX* is responding

	again or has been removed.
Missing TC Acknowledge [TC*XX*]	Identification or removal of the TC-01 unit from the TC address *XX* was acknowledged manually.
TC Unit Removed [TC*XX*]	The TC-01 unit configured to TC address *XX* has been removed from the network.
TC Unit Added [TC*XX*]	The TC-01 unit has been added to TC address *XX*.
Missing IC Alarm ON [IC*XX*]	The IC-01 unit configured in the IC address *XX* is not responding.
Missing IC Alarm OFF [IC*XX*]	The IC-01 unit configured in IC address *XX* is responding again or has been removed.
Missing IC Acknowledge [IC*XX*]	Identification or removal of the IC-01 unit from the IC address *XX* was acknowledged manually.
IC Unit Removed [IC*XX*]	The IC-01 unit configured to IC address *XX* has been removed from the network.
IC Unit Added [IC*XX*]	The IC-01 unit has been added to IC address *XX*.
Missing RD Alarm ON [RDXX]	The RD-01 unit configured in the RD address *XX* is not responding.
Missing RD Alarm OFF [RDXX]	The RD-01 unit configured in RD address *XX* is responding again or has been removed.
Missing RD Acknowledge [RD*XX*]	Identification or removal of the RD-01 unit from the RD address *XX* was acknowledged manually.
RD Unit Removed [RD*XX*]	The RD-01 unit configured to RD address *XX* has been removed from the network.
RD Unit Added [RD*XX*]	The RD-01 unit has been added to RD address *XX*.
Missing PE Alarm ON [PE*XX*]	The PEC-01 unit configured in the PE address *XX* is not responding.
Missing PE Alarm OFF [PE*XX*]	The PEC-01 unit configured in PE address *XX* is responding again or has been removed.
Missing PE Acknowledge [PE*XX*]	Identification or removal of the PEC-01 unit from the PE address *XX* was acknowledged manually.
Missing PE Channel Alarm ON [PE*XX* CH*CC*]	The channel *CC* of the PEC-01 unit configured in PE address *XX* has been disconnected.
Missing PE Channel Alarm OFF [PE*XX* CH*CC*]	The channel *CC* of the PEC-01 unit configured in PE address *XX* has been restored from an

	outage or removed from the configuration.
Missing PE Channel Alarm Acknowledge [PE*XX* CH*CC*]	The channel *CC* of the PEC-01 unit configured in PE address *XX* has been restored from an outage or removed from the configuration. The alarm was acknowledged manually.
PE Unit Removed [PE*XX*]	The PEC-01 unit configured to PE address *X*X has been removed from the network.
PE Unit Added [PE*XX*]: CH*CC* R=*N* Ohm	The PEC-01 unit has been added to PE address *XX*. The channel *CC* with *N* set as a reference has been connected to the unit. All channels connected to the unit are listed here.
PE Channel Added [PE*XX* CH*CC*] R=*N* Ohm	The channel *CC* with *N* set as a reference has been connected to the PEC-01 unit configured in the PE address *XX*.
Network Scan Done, not confirmed	The Network Scan has been performed but the configuration identified was not approved.
Network Scan Confirmed: TC*XX*	The Network Scan was performed and the TC-01 unit in the TC address XX was approved in the network.
Network Scan Confirmed: IC*XX*	The Network Scan was performed and the IC-01 unit in the IC address XX was approved in the network.
Network Scan Confirmed: RD*XX*	The Network Scan was performed and the RD-01 unit in the RD address XX was approved in the network.
Network Scan Confirmed: PE*XX*CH*CC* R=*N* Ohm	The Network Scan has been performed, and a PEC-01 unit in the PE address *XX* has been approved in the network. The channel *CC*, for which *N* was approved as a reference, was connected to the unit.
System Parameter changed [TranSize] [*N1*A]->[*N2*A]	The value of the TranSize parameter (the primary current of the current transformer in load measuring, with which the transformer secondary current is 5 A) was changed from *N1* to *N2*.
System Parameter changed [Nom.Cur] [*N1*A]->[*N2*A]	The value of the Nom.Cur parameter (the nominal current of the isolation transformer) was changed

	from *N1* to *N2*.
System Parameter changed [AUXalarm] [*XXX*]->[*YYY*]	The value of the AUXalarm parameter (situations which trigger an alarm in the AUX. ALARM relay) was changed from *XXX* to *YYY*.
New Time [DD.MM.YYYY HH:MM:SS]	The new time was set: DD=day MM=month YYYY=year HH=hour MM=minute SS=second
System Parameter changed [AlrmDly] [*T1*s]->[*T2*s]	The value of the AlrmDly parameter (the alarm delay in other than isolation level alarms) was changed from *T1* to *T2*.
Debug Mode ON	The RS-485 connection functions in the DEBUG mode (no communication with remote units).
Debug Mode OFF	The RS-485 connection functions in the normal mode (communication with remote units functions again).
Factory Settings activated	The factory settings were restored.
SD Card not in use	The memory card was disabled in the settings.
System Test Failed: too low amplitude (**)	The system test detected a measurement voltage that was too low.
System Test Failed: too high amplitude (**)	The system test detected a measurement voltage that was too high.
System Test Failed: too short group delay (**)	The system test detected a measurement delay that was too short.
System Test Failed: too long group delay (**)	The system test detected a measurement delay that was too long.
System Test OK	The system test was completed successfully.
System Time Reset	The real time clock was reset due to a low battery voltage. The time must be set again.
AUTO pre-ins ACK changed INACTIVE->ACTIVE AUTO pre-ins ACK changed ACTIVE->INACTIVE	The value of the insulation pre-alarm automatic acknowledgement parameter was changed.
Injector AUTO-start changed ACTIVE->INACTIVE Injector AUTO-start changed INACTIVE->ACTIVE	The value of the fault location process automatic initiation parameter was changed.
Injector disconnected	The previously connected FLI-01 unit is not responding

Injector connected	The FLI-01 unit is responding again
CTM config failure ON	A CTM-01 unit previously saved in the FLI-01 unit is not responding
CTM config failure OFF	A CTM-01 unit is responding again

(*) When the system detects that the operating voltage drops below the critical threshold, it enters the time stamp for that moment in EEPROM. In the next start-up, the system retrieves that time stamp and enters an event for the time stamp.

(**) The values measured in the system test are displayed in the following format:
Ampl=*N1*V [*L1*V...*L2*V] delay=*N2*rad [*L3*rad...*L4*rad]
in which
N1 = the measured amplitude in volts with the range between *L1*, *L2* volts.
N2 = the measured group delay in radians with the limit between *L3*, *L4* radians.

Measurement log (MEASLOG.TXT)

The measurement log is used to store all measured data every hour on the hour. In addition, data is always saved when a measurement alarm (insulation resistance, overload or over temperature) is activated or deactivated. The data is written in the file in the following order:

[TIME][Rer(kOhm)][Cer(uF)][Load(A)][Ttra(C)][Tenv(C)][Active PE Channels]

[TIME] = time stamp

[Rer(kOhm)] = insulation resistance (in kOhms)

- If insulation resistance is "R>10M", the measurement range has been exceeded. This could be due to a disconnected wire, for example. Details of it can be found in the event log.
- If the value of insulation resistance is -1, a row has been added before the first measurement was completed after the start-up.

[Cer(uF)] = capacitance (in micro farads)

- If capacitance is "C<0.1", the measurement range has been exceeded. This could be due to a disconnected wire, for example. Details of it can be found in the event log.
- If the value of capacitance is -1, a row has been added before the first measurement was completed after the start-up.

[Load(A)] = load (in amperes)

[Ttra(C)] = transformer temperature (in Centigrade)

[Tenv(C)] = device temperature (in Centigrade)

[Active PE Channels] = a list of all active (configured) PE channels

- The format for one channel is PE*XX*CH*CC NN*%, in which *XX* = the PE address and *CC* = the channel number (1–6) and NN = channel resistance in relation to its reference value in then table as a percentage.
- If NN = -1.0, channel resistance has not been measured after the latest start-up.
- All active and configured channels are listed one after the other (separated by tabs).

After that, detailed information on the measurements that are not needed in normal use is printed on the row. Therefore, they are not discussed here in greater detail.

All fields are separated with tabs, so the file is easy to handle in Excel.

Setup log (SETUPLOG.TXT)

The setup log is a file in which ALL system parameters which the user can change in the Setup menu are entered. The Setup menu passcode is the only exception. It cannot be changed in the Setup menu but is always read from the card during start-up. The passcode default is always 123, which also works when the card cannot be read. If you want to change the passcode, the file must be changed.

A new row is added to the file only if the user changes a system parameter, or a new SETUPLOG.TXT file is created. The most recent parameter values are entered on the new row.

The data is written in the file in the following order:

[TIME][Password][InsLimit][PreInsLim][AlarmDly][Temp Lim][Load Lim][TC/IC/PE/RD][PEresist][TranSize][Nom.Cur][AUXalarm]

[TIME] = time stamp

[Password] = the passcode of the Setup menu

- The field format is PW=*NNN*, where *NNN* is a three-digit ID code.
- The ID code cannot be changed in the Setup menu; in the file, the value *NNN* must be changed.
- A new passcode will only become valid at the start-up.
- The passcode read at the start-up will be valid until the next start-up.

[InsLimit] = the limit value of the insulation resistance alarm (kOhms)

[PreInsLim] = the limit value of the pre-alarm of the insulation resistance measurement (percentage)

[AlarmDly] = measurement alarm delay (seconds), not applicable to the insulation resistance measurement

[Temp Lim] = the limit value of temperature alarms (transformer, device) (in Centigrade)

[Load Lim] = the limit value of load measurement (percentage of the nominal load of the isolation transformer)

[TC/IC/PE/RD] = the latest approved configuration at the unit level

[PEresist] = the limit value of the PE channel resistance measurement (percentage)

[TranSize] = the provided nominal primary/secondary current of the current transformer (amperes)

[Nom.Cur] = the provided nominal current of the isolation transformer (amperes)

[AUXalarm] = a configuration of alarms that will activate the AUX alarm relay

MODBUS/TCP REMOTE CONTROL

When IP settings suitable for a local area network are defined in the IM-01.MED unit, the device can be connected to a LAN. The unit's Modbus/TCP slave server is now ready for use. The unit's Modbus/TCP register map is provided below. The Modbus functions to be used are Read Holding Registers (0x03) and Write Multiple Registers (0x10).

Register	R/W	Name	Type	Unit	Description
1	R	Measured insulation resistance	uint16	kOhm	The measurement result is provided as kOhms. The register value 100 corresponds to insulation resistance of 100,000 ohms. At the fastest, it updates in seconds and at the slowest in hundreds of seconds, depending on the measurement frequency used.
2	R	Measured capacitance	uint16	0.1 uF	The measurement result is provided as 0.1uF intervals. The register value 5 corresponds to capacitance of 0.5uF. It is updated at the same time as the insulation resistance.
3	R	Measured load	uint16	%	The measurement result is provided as a percentage of the announced nominal value. The register value 90 corresponds to the current value of 90% of the announced nominal value. It is updated once per second.
4	R	Measured temperature	uint16	°C	The measurement result is the transformer temperature and it is provided as degrees. The register value 50 corresponds to 50°C. It is updated four times per second.
5	R/W	Limit parameter of the insulation resistance alarm	uint16	kOhm	Read and written in kOhms. The register value 100 corresponds to 100,000 ohms. The minimum, maximum and interval values are in channels 16, 17 and 18.
6	R/W	The limit parameter of the insulation resistance pre-alarm.	uint16	%	Read and written in percentages. The register value 150 corresponds to 150%. The minimum, maximum and interval values are in channels 19, 20 and 21.
7	R/W	Limit parameter of the load alarm	uint16	%	Read and written in percentages. The register value 90 corresponds to 90%, The minimum, maximum and interval values are in channels 22, 23 and 24.
8	R/W	Limit parameter of the temperature alarm	uint16	°C	Read and written in degrees. The register value 90 corresponds to 90°C, The minimum, maximum and interval values are in channels 25, 26 and 27.
9	R/W	Current transformer's nominal value (primary current corresponding to 5 A secondary current), a device parameter	uint16	A	Read and written in amperes. The register value 40 corresponds to 40A. The minimum, maximum and interval values are in channels 28, 29 and 30.

10	R/W	Alarm delay, a device parameter	uint16	s	Read and written in seconds. The register value 2 corresponds to 2 seconds. The minimum, maximum and interval values are in channels 31, 32 and 33.
11	R	Password of the local user interface	uint16	none	A three-digit password. Range 000…999. Default value 123. When needed, this can be used to prevent the parameters from being set through the Modbus/TCP.
12	R	Device alarm and status register	uint16	none	Bit mask: 0x0001 = a fault or alarm related to insulation resistance, corresponds to the INSULATION alarm LED of the local user interface 0x0002 = insulation resistance pre-alarm 0x0004 = system test fault 0x0008 = fault in the M1 or M2 wire 0x0010 = fault in the TG or MG wire 0x0020 = load alarm 0x0040 = PE fault 0x0080 = temperature alarm 0x0100 = system test active 0x0200 = internal calibration active (the insulation level measurement values are invalid) the statuses remain active until their cause has been eliminated
13	R/W	Start of the device system test	uint16	none	Start of the system test. Value 1 starts the test, other values are not taken into account. IM-01.MED resets the request after reading it.
14	R/W	Start of the resistance measurement of the PEC-01 units connected to the device	uint16	none	Start of the resistance measurement of the PE units. Value 1 starts the measurement, other values are not taken into account. IM-01.MED resets the request after reading it.
15	R/W	Joint acknowledgement of alarms	uint16	none	Joint acknowledgement of unacknowledged alarms. Value 1 acknowledges all alarms, other values are not taken into account. IM-01.MED resets the request after reading it. This does not acknowledge/inactivate active alarms.
16	R	The lowest allowed value of the limit parameter of the insulation resistance alarm	uint16	kOhm	50
17	R	The highest allowed value of the limit parameter of the insulation resistance alarm	uint16	kOhm	1000
18	R	The resolution (jog) of the limit parameter of the insulation resistance alarm	uint16	kOhm	50
19	R	The lowest allowed value of the limit parameter of the insulation resistance pre-alarm	uint16	%	100
20	R	The highest allowed value of the limit parameter of the insulation resistance pre-alarm	uint16	%	200
21	R	The resolution (jog) of the limit parameter of the insulation resistance pre-alarm	uint16	%	10
22	R	The lowest allowed value of the limit parameter of the load alarm	uint16	%	50, with an exception of value 0, which sets the alarm function to OFF mode
23	R	The highest allowed value of the limit parameter of the load alarm	uint16	%	100
24	R	The resolution (jog) of the limit parameter of the load alarm	uint16	%	5
25	R	The lowest allowed value of the limit parameter of the temperature alarm	uint16	°C	30, with an exception of value 0, which sets the alarm function to OFF mode
26	R	The highest allowed value of the limit parameter of the temperature alarm	uint16	°C	140
27	R	The resolution (jog) of the limit parameter of the temperature	uint16	°C	5

		alarm			
28	R	The nominal value of the current transformer, the lowest allowed value of the device parameter	uint16	A	10
29	R	The nominal value of the current transformer, the highest allowed value of the device parameter	uint16	A	100
30	R	The nominal value of the current transformer, the device parameter resolution (jog)	uint16	A	5
31	R	Alarm delay, the lowest allowed value of the device parameter	uint16	s	1
32	R	Alarm delay, the highest allowed value of the device parameter	uint16	s	30
33	R	Alarm delay, the device parameter resolution (jog)	uint16	s	1
34	R	Status register of the unacknowledged alarms of the device	uint16	none	Bit mask: 0x0001 = a fault or alarm related to insulation resistance is inactivated, corresponds to the INSULATION alarm LED of the local user interface 0x0002 = insulation resistance pre-alarm deactivated 0x0004 = system test fault deactivated 0x0008 = fault in the M1 or M2 wire deactivated 0x0010 = fault in the TG or MG wire deactivated 0x0020 = load alarm deactivated 0x0040 = PE fault deactivated 0x0080 = temperature alarm deactivated the statuses will activate when the corresponding active alarm has been deactivated and remain active until the cause has been acknowledged
35	R	PE units in the network	uint16	none	Bit mask: PE addresses 0…15, the corresponding bit is active if the PE unit has been approved in the network
36	R	PE#00 configuration	uint16	none	Bit mask: bit8 = if 1, the device is approved in the network bit0…5 = PE unit channels CH1…CH6: if 1, the channel is in use
37	R	PE#00 status	uint16	none	Bit mask: bit0…5 = PE unit channels CH1…CH6: if 1, the channel alarm is active bit8…13 = PE unit channels CH1…CH6: if 1, the channel alarm has been deactivated but not acknowledged
38	R	PE#01 configuration	uint16	none	Bit mask: bit8 = if 1, the device is approved in the network bit0…5 = PE unit channels CH1…CH6: if 1, the channel is in use
39	R	PE#01 status	uint16	none	Bit mask: bit0…5 = PE unit channels CH1…CH6: if 1, the channel alarm is active bit8…13 = PE unit channels CH1…CH6: if 1, the channel alarm has been deactivated but not acknowledged
40	R	PE#02 configuration	uint16	none	Bit mask: bit8 = if 1, the device is approved in the network bit0…5 = PE unit channels CH1…CH6: if 1, the channel is in use
41	R	PE#02 status	uint16	none	Bit mask: bit0…5 = PE unit channels CH1…CH6: if 1, the channel alarm is active bit8…13 = PE unit channels CH1…CH6: if 1, the channel alarm has been deactivated but not acknowledged

42	R	PE#03 configuration	uint16	none	Bit mask: bit8 = if 1, the device is approved in the network bit0…5 = PE unit channels CH1…CH6: if 1, the channel is in use
43	R	PE#03 status	uint16	none	Bit mask: bit0…5 = PE unit channels CH1…CH6: if 1, the channel alarm is active bit8…13 = PE unit channels CH1…CH6: if 1, the channel alarm has been deactivated but not acknowledged
44	R	PE#04 configuration	uint16	none	Bit mask: bit8 = if 1, the device is approved in the network bit0…5 = PE unit channels CH1…CH6: if 1, the channel is in use
45	R	PE#04 status	uint16	none	Bit mask: bit0…5 = PE unit channels CH1…CH6: if 1, the channel alarm is active bit8…13 = PE unit channels CH1…CH6: if 1, the channel alarm has been deactivated but not acknowledged
46	R	PE#05 configuration	uint16	none	Bit mask: bit8 = if 1, the device is approved in the network bit0…5 = PE unit channels CH1…CH6: if 1, the channel is in use
47	R	PE#05 status	uint16	none	Bit mask: bit0…5 = PE unit channels CH1…CH6: if 1, the channel alarm is active bit8…13 = PE unit channels CH1…CH6: if 1, the channel alarm has been deactivated but not acknowledged
48	R	PE#06 configuration	uint16	none	Bit mask: bit8 = if 1, the device is approved in the network bit0…5 = PE unit channels CH1…CH6: if 1, the channel is in use
49	R	PE#06 status	uint16	none	Bit mask: bit0…5 = PE unit channels CH1…CH6: if 1, the channel alarm is active bit8…13 = PE unit channels CH1…CH6: if 1, the channel alarm has been deactivated but not acknowledged
50	R	PE#07 configuration	uint16	none	Bit mask: bit8 = if 1, the device is approved in the network bit0…5 = PE unit channels CH1…CH6: if 1, the channel is in use
51	R	PE#07 status	uint16	none	Bit mask: bit0…5 = PE unit channels CH1…CH6: if 1, the channel alarm is active bit8…13 = PE unit channels CH1…CH6: if 1, the channel alarm has been deactivated but not acknowledged
52	R	PE#08 configuration	uint16	none	Bit mask: bit8 = if 1, the device is approved in the network bit0…5 = PE unit channels CH1…CH6: if 1, the channel is in use
53	R	PE#08 status	uint16	none	Bit mask: bit0…5 = PE unit channels CH1…CH6: if 1, the channel alarm is active bit8…13 = PE unit channels CH1…CH6: if 1, the channel alarm has been deactivated but not acknowledged
54	R	PE#09 configuration	uint16	none	Bit mask: bit8 = if 1, the device is approved in the network bit0…5 = PE unit channels CH1…CH6: if 1, the channel is in use
55	R	PE#09 status	uint16	none	Bit mask: bit0…5 = PE unit channels CH1…CH6: if 1, the channel alarm is active bit8…13 = PE unit channels CH1…CH6: if 1, the channel alarm has been deactivated but not acknowledged

56	R	PE#10 configuration	uint16	none	Bit mask: bit8 = if 1, the device is approved in the network bit0…5 = PE unit channels CH1…CH6: if 1, the channel is in use
57	R	PE#10 status	uint16	none	Bit mask: bit0…5 = PE unit channels CH1…CH6: if 1, the channel alarm is active bit8…13 = PE unit channels CH1…CH6: if 1, the channel alarm has been deactivated but not acknowledged
58	R	PE#11 configuration	uint16	none	Bit mask: bit8 = if 1, the device is approved in the network bit0…5 = PE unit channels CH1…CH6: if 1, the channel is in use
59	R	PE#11 status	uint16	none	Bit mask: bit0…5 = PE unit channels CH1…CH6: if 1, the channel alarm is active bit8…13 = PE unit channels CH1…CH6: if 1, the channel alarm has been deactivated but not acknowledged
60	R	PE#12 configuration	uint16	none	Bit mask: bit8 = if 1, the device is approved in the network bit0…5 = PE unit channels CH1…CH6: if 1, the channel is in use
61	R	PE#12 status	uint16	none	Bit mask: bit0…5 = PE unit channels CH1…CH6: if 1, the channel alarm is active bit8…13 = PE unit channels CH1…CH6: if 1, the channel alarm has been deactivated but not acknowledged
62	R	PE#13 configuration	uint16	none	Bit mask: bit8 = if 1, the device is approved in the network bit0…5 = PE unit channels CH1…CH6: if 1, the channel is in use
63	R	PE#13 status	uint16	none	Bit mask: bit0…5 = PE unit channels CH1…CH6: if 1, the channel alarm is active bit8…13 = PE unit channels CH1…CH6: if 1, the channel alarm has been deactivated but not acknowledged
64	R	PE#14 configuration	uint16	none	Bit mask: bit8 = if 1, the device is approved in the network bit0…5 = PE unit channels CH1…CH6: if 1, the channel is in use
65	R	PE#14 status	uint16	none	Bit mask: bit0…5 = PE unit channels CH1…CH6: if 1, the channel alarm is active bit8…13 = PE unit channels CH1…CH6: if 1, the channel alarm has been deactivated but not acknowledged
66	R	PE#15 configuration	uint16	none	Bit mask: bit8 = if 1, the device is approved in the network bit0…5 = PE unit channels CH1…CH6: if 1, the channel is in use
67	R	PE#15 status	uint16	none	Bit mask: bit0…5 = PE unit channels CH1…CH6: if 1, the channel alarm is active bit8…13 = PE unit channels CH1…CH6: if 1, the channel alarm has been deactivated but not acknowledged
68	R/ W	Isolation transformer nominal current, device parameter	uint16	A	Read and written in amperes. The register value 40 corresponds to 40A. The minimum, maximum and interval values are in channels 69, 70 and 71.
69	R	Isolation transformer nominal current, the lowest allowed value of the device parameter	uint16	A	1
70	R	Isolation transformer nominal current, the highest allowed value of the device parameter	uint16	A	100

71	R	Isolation transformer nominal current, the device parameter resolution (jog)	uint16	A	1
72	R/W	The type of the transformer's temperature sensor	uint16	none	0= NTC, 1=Pt100
73	R/W	Operating mode of the current loop	uint16	none	0= 4–20mA, 1=0–20mA

REMOTE CONTROL UNITS

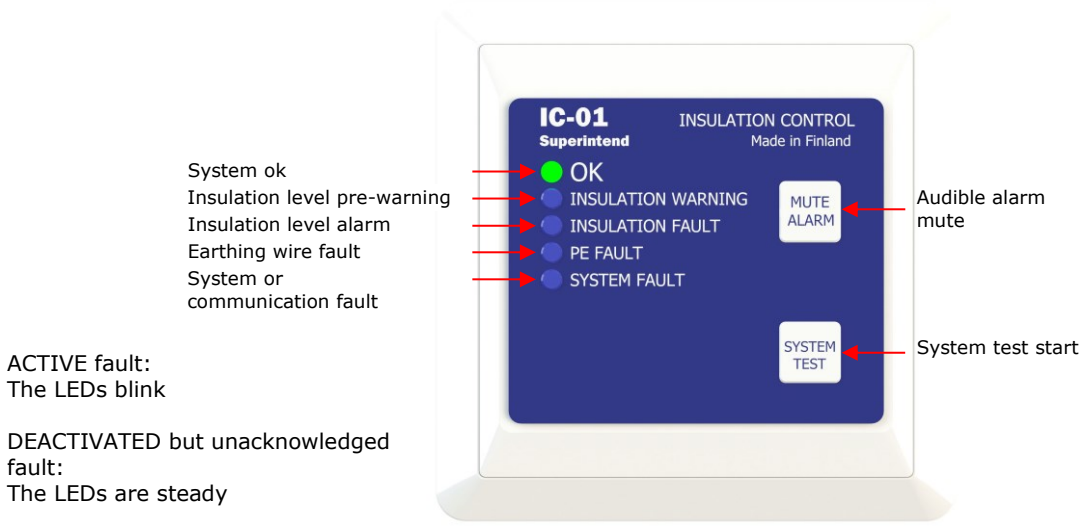
The remote control units are display/warning panels installed on the mounting box as close to the use location as possible. The system may contain a maximum of 16 similar IC-01 and TC-01 units and a maximum of 5 RD-01 units. All similar units function in an identical manner, in other words, alarms are displayed in all panels. There are three types of units:

- IC-01 INSULATION CONTROL, which is the control and alarm unit for insulation resistance and protective wire resistance
- TC-01 TRANSFORMER CONTROL, which is the display and alarm unit for the isolation transformer measurements
- RD-01 REMOTE DISPLAY, which is the combined display and alarm unit for the isolation transformer measurements, insulation resistance and protective wire resistance

All units are equipped with alarm LEDs and an audible alarm, which indicate a fault. During the alarm, the red LED fault indicator BLINKS. If the fault has been deactivated but not acknowledged from the IM-01.MED unit, the alarm LED indicator is steady. The audible alarm is muted with the MUTE ALARM button, which only silences the sound but has no other effect on system functioning. An alarm silenced from one unit does not mute the other panels. The audible alarm is also deactivated when the fault situation is deactivated, but the related LED indicator remains active until it the alarm has been acknowledged from the IM-01.MED unit.

INSULATION RESISTANCE REMOTE CONTROL UNIT IC-01

The alarm unit of the insulation control gives an alarm if the system's insulation resistance is lower than the limit provided, or if the earthing wire resistance measured by any PEC-01 unit exceeds the limit provided, or if there is a break in the wire. An alarm limit can be set for both parameters through the SETUP menu. IC-01 also gives an alarm if the unit cannot connect to the IM-01.MED unit. In addition, the unit issues a warning if the system's insulation resistance is lower than the pre-alarm limit set.

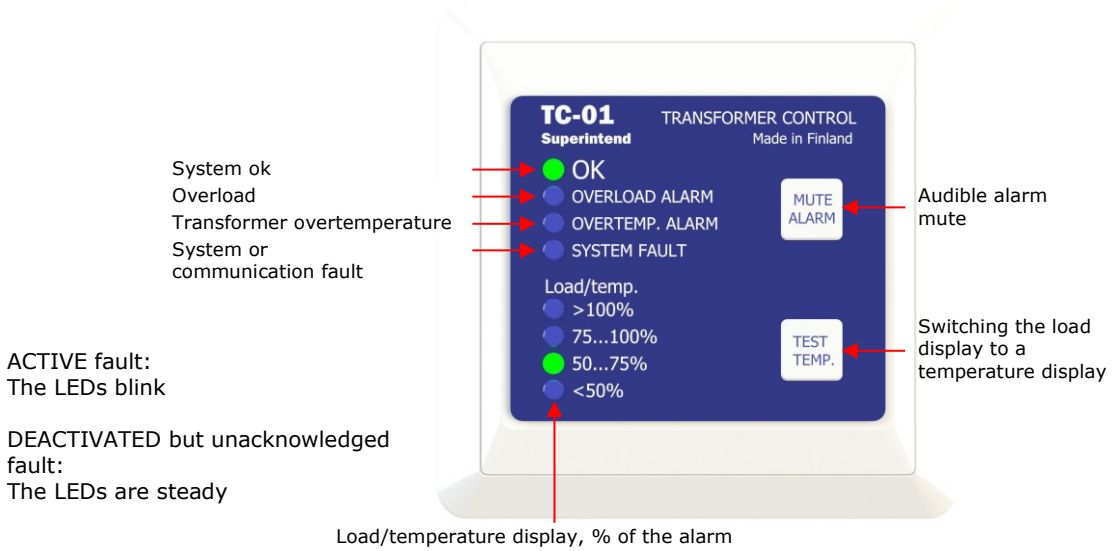


- The OK LED is on if the unit functions normally. It switches off if any fault is active. In other words, at least one LED indicator is on in the unit in all situations.
- The INSULATION WARNING LED blinks if the insulation resistance drops below the pre-alarm limit. The alarm is deactivated and the LED is on steadily when insulation resistance rises 5% above the pre-alarm limit. The pre-alarm limit is set as a percentage of the alarm limit in SETUP→PrInsLim.
- The INSULATION FAULT LED blinks if the insulation resistance drops below the alarm limit. The alarm is deactivated and the LED is on steadily when insulation resistance rises 5% above the alarm limit. The alarm limit is set in ohms in SETUP→InsLimit.
- The PE FAULT LED blinks if there is a break in the earthing wire of the measurement channel in any PEC-01 unit connected to the system or if the increase in the wire resistance exceeds the alarm limit. The alarm deactivates and the LED is steadily on when the break is fixed or resistance drops 5% below the alarm threshold (initial value * PEalarm%). The alarm limit is set as a percentage of the initial resistance value in SETUP→PEalarm%. Also gives an alarm if any PEC-01 unit is defective or no longer responds to commands.
- The SYSTEM FAULT LED blinks if the system has not received a command from the IM-01.MED unit within three seconds. The alarm is deactivated if the connection is restored. The error is always unit-specific; in other words, it is only displayed in the affected unit. In the IM-01.MED unit, the error is displayed as a REMOTE UNITS error.
- The MUTE ALARM button silences the audible alarm. It does not have any other effect on the functioning of the system as a whole.
- Pressing the SYSTEM TEST button gives the IM-01.MED unit a command to perform the system test. If the test fails, the INSULATION FAULT LED indicator switches on.

TRANSFORMER REMOTE ALARM UNIT TC-01

The transformer's remote alarm unit displays the current and temperature of the isolation transformer, which are expressed as percentages of the alarm limit given. Normally, the screen always displays the load current. You can display the temperature by pressing the TEST TEMP. button.

The TC-01 unit gives an alarm if the transformer's load current or temperature limit is exceeded. An alarm limit can be issued for both parameters through the SETUP menu in the IM-01.MED unit. TC-01 also gives an alarm if it is not connected to the IM-01.MED unit.

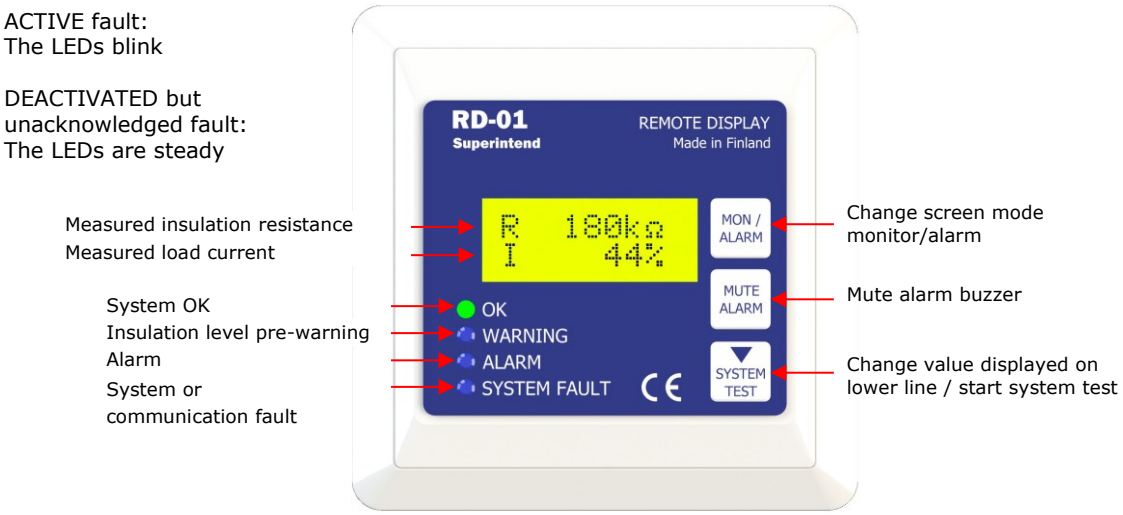


- The OK LED is on if the unit functions normally and off if any fault is active. In other words, at least one LED indicator is on in the unit at all times.
- OVERLOAD ALARM blinks when the transformer's load current alarm limit has been exceeded. The alarm is deactivated and the LED is on steadily when the load current drops 5% below the alarm limit. The alarm limit is set in SETUP→LoadLim, and it is a percentage of the nominal current of the isolation transformer. The nominal current of the isolation transformer is set in SETUP→Nom.Cur. The current measurement is also affected by the SETUP→TranSize setting, which is used to define the primary current of the current measurement transformer when its secondary current is 5A.
- OVERTEMP. ALARM blinks when the transformer's temperature alarm limit has been exceeded. The alarm is deactivated and the LED is on steadily when the temperature drops 5% below the alarm limit. The alarm limit is set in degrees in SETUP→Temp Lim.
- The SYSTEM FAULT LED blinks if the system has not received a command from the IM-01.MED unit within three seconds. The alarm is deactivated if the connection is restored. The error is always unit-specific; in other words, it is only displayed in the affected unit. In the IM-01.MED unit, the error is displayed as a REMOTE UNITS error.

- The MUTE ALARM button silences the audible alarm. It does not have any other effect on the functioning of the system as a whole.
- The TEST TEMP. button switches the load display to a temperature display. The display blinks when the button is pressed and indicates the temperature in relation to the alarm limit given. When the button is released, the display returns to the load display.

INSULATION RESISTANCE AND TRANSFORMER REMOTE ALARM UNIT RD-01

The alarm unit of the insulation resistance and transformer RD-01 gives an alarm if the system's insulation resistance is lower than the limit provided, or if the earthing wire resistance measured by any PEC-01 unit exceeds the limit provided, or if there is a break in the wire. It also gives an alarm if the transformer's load current or temperature limit is exceeded. Alarm limits can be issued for all parameters through the SETUP menu in the IM-01.MED unit. RD-01 also gives an alarm if it is not connected to the IM-01.MED unit. In addition, the unit issues a warning if the system's insulation resistance is lower than the pre-alarm limit set.



- The OK LED is on if the unit functions normally and off if any fault is active. In other words, at least one LED indicator is on in the unit at all times.
- The WARNING LED blinks if the insulation resistance drops below the pre-alarm limit. The alarm is deactivated and the LED is on steadily when insulation resistance rises 5% above the pre-alarm limit. The pre-alarm limit is set as a percentage of the alarm limit in SETUP→PrInsLim.
- The ALARM LED blinks if the insulation resistance is lower than the limit provided, if the transformer's load current or temperature limit is exceeded or if the

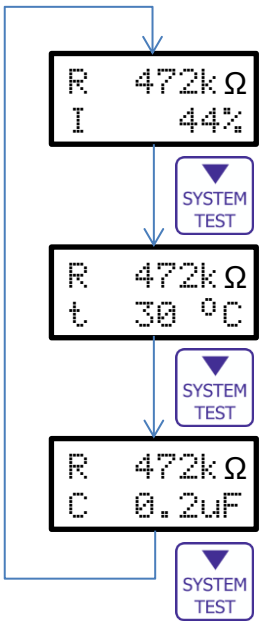
earthing wire resistance measured by any PEC-01 unit exceeds the limit provided, or if there is a break in the wire. The alarm is deactivated and the LED is on steadily when all the above-mentioned values have returned to 5% below the alarm limit. The alarm limits are set in the SETUP menu.

- The SYSTEM FAULT LED blinks if the system has not received a command from the IM-01.MED unit within three seconds. The screen also goes into System Fault mode. The alarm is deactivated if the connection is restored. The error is always unit-specific; in other words, it is only displayed in the affected unit. In the IM-01.MED unit, the error is displayed as a REMOTE UNITS error.
- The MON/ALARM button changes the screen mode between monitor and alarm modes.
- The MUTE ALARM button silences the audible alarm. It does not have any other effect on the functioning of the system as a whole.
- A short press of the SYSTEM TEST button changes the value displayed on the bottom line of the display. A long press of the button (5 s) gives the IM-01.MED unit the command to perform a system test.

The RD-01 unit has two screen modes: monitor and alarm. In addition, the system test mode and setup mode are accessed through the monitor mode.

Monitor mode

In the monitor mode, the unit always displays the insulation resistance value on the upper line. Additionally, it displays the transformer load current, transformer temperature or insulation capacitance on the lower line. The value displayed on the lower line can be changed by shortly pressing the SYSTEM TEST button.



Alarm mode

The alarm mode can be accessed through the monitor mode by pressing the MON/ALARM button. In the alarm mode, the screen displays all active alarms and removed alarms, which have not been acknowledged. The active alarms are displayed first and after that the removed alarms, which have not been acknowledged. You can move down the alarm list by pressing the SYSTEM TEST button. The display modes in the alarm mode can, for example, be as follows (in the parallel display pictures, the lower line of the text switches between the two examples automatically every 2 seconds):

180/300k Insulat. / 180/300k ALARM	Insulation resistance alarm. The upper line displays the lowest insulation resistance measured during the fault / alarm limit.
400/450k PreInsul / 400/450k WARNING	Insulation resistance pre-alarm. The upper line displays the momentary insulation resistance / pre-alarm limit.
145/105C Temp Lim / 145/105C ALARM	Temperature alarm. The upper line displays the momentary temperature / alarm limit.
39/ 36A Load Lim / 39/ 36A ALARM	Load current alarm. The upper line displays the momentary load current / alarm limit.
C1 T3 M1 FaultLoc / C3 T6 M1 FaultLoc	Result of the fault location process. The fault location system has detected an insulation fault at the CTM-01 unit with address indicated with C, channel indicated with T and phase line indicated with M. If the system has detected insulation fault at several points, the results are shown sequentially (the upper line of the text switches between the points with detected insulation faults automatically every 2 seconds).
PE 3 ALARM	PE wire alarm, in which the address of the PEC-01 that caused the alarm (disconnected channel or broken connection) is displayed.
NO ALARMS	There are no active alarms in the system.

Additionally, the following upper line alarm texts are possible:

- Sys Test System test alarm

- Gnd Fail — Gnd Fail alarm (disconnected TG or MG wire)
- M1M2Fail — WireAmpl or WireOffs alarm (disconnected M1 or M2 wire, or short-circuited insulation resistance)
- Noise — Noise alarm
- T-sens 0 — Alarm caused by disconnected temperature sensor measurement wire
- T-sens S — Alarm caused by short circuited temperature sensor measurement wires
- L-sens 0 — Alarm caused by a disconnected transformer measurement wire

The text on the lower line is always ALARM, if the alarm is active and OLD ALRM, if the alarm has been removed but not acknowledged.

Press the MON/ALARM button to return to the monitor mode from the alarm mode.

System test mode

The system test mode is entered by pressing the SYSTEM TEST button for 5 seconds in the monitor mode.

The RD-01 unit sends a system test request to the IM-01.MED unit. During the test the screen displays System testing, the LEDs blink and there is a short audible alarm. After the test, the test's result is displayed for a moment, Test OK or Test FAIL. After the test, the screen returns to monitor mode.

System fault mode

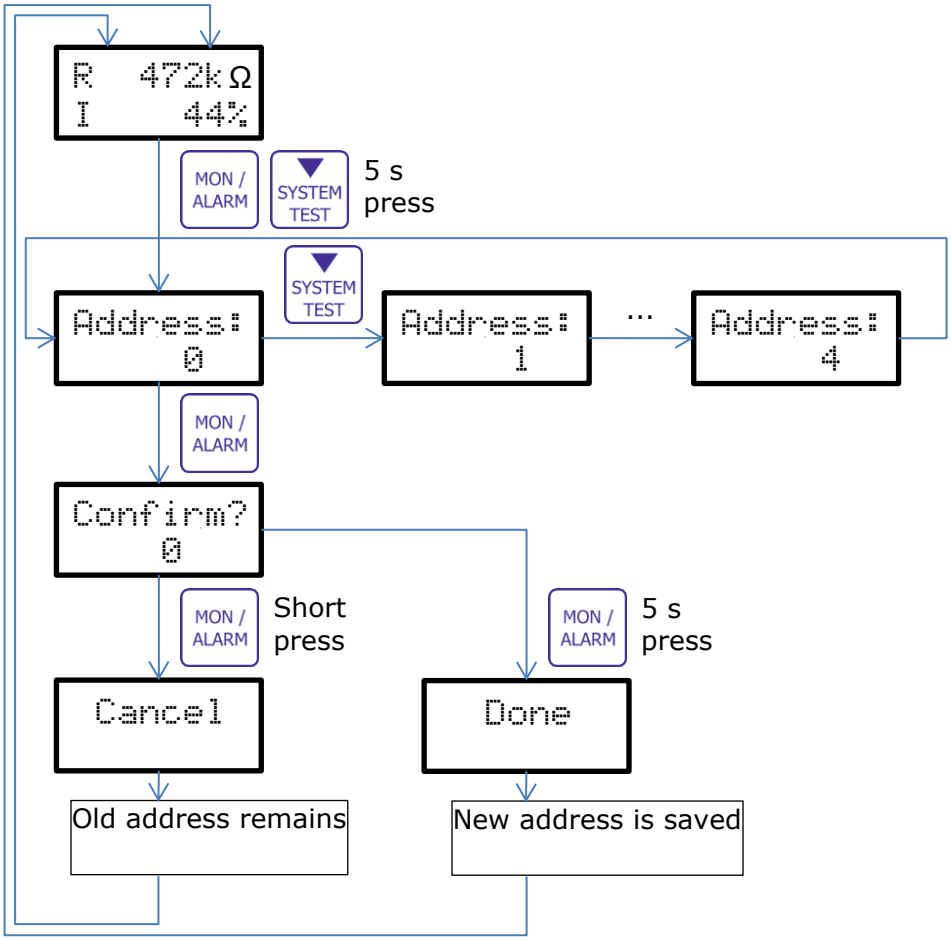
The system fault mode is entered from any screen mode, if there are no commands from the IM-01.MED unit for 3 seconds.

The screen displays COMM FAULT, the SYSTEM FAULT LED blinks and there is a audible alarm from the alarm buzzer. When a command is received from the IM-01.MED unit, the monitor mode is entered.

Setup mode

The setup mode is entered by simultaneously pressing the MON/ALARM and SYSTEM TEST buttons for 5 seconds in the monitor mode.

The mode is used to define the RD-01 unit device address between 0 and 4 in accordance with the following diagram.



PEC-01 UNIT

The PEC-01 unit measures the continuity and resistance of the PE wires connected to it. The PE wire reference point (PE0) is connected to the switchboard's PE rail and continuity and resistance are measured against it from the last socket of each wall socket chain (PE1…6). The IM-01.MED unit controls the functioning of the PEC-01 unit. It gives the measurement commands via the bus, reads the measurement results and based on these, determines the fault situations. If the PEC-01 unit does not respond to the commands of the IM-01.MED unit within three seconds, the IM-01.MED unit gives the REMOTE UNITS and WIRE FAULT errors. The PEC-01 unit displays a SYSTEM FAIL error.

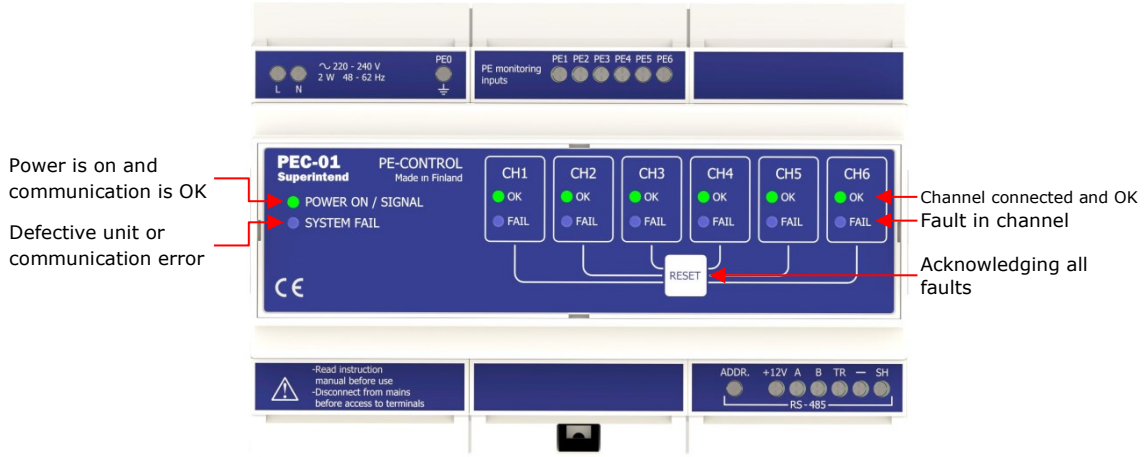
At the implementation, the IM-01.MED unit requests the PEC-01 unit to measure the resistance of all channels connected to it and compiles a table. After that, the resistance measurement only functions by separate request (MONITOR→PEResist Measure). IM-

01.MED compares the measured resistance values to the table values. If any resistance value is higher than the alarm limit (the table value multiplied by the percentage parameter PEalarm%), an alarm is given. The measurement range is 0…2.54 Ω. The detection of a measurement loop break is constantly on.

During the bus scanning and manual resistance measurement, test current pulses are fed into all channels of all PEC-01 units connected to the system. Therefore Network Scan / Network View and manual resistance measurement are permitted in medical locations only when there is no activity in the area to be monitored.

When setting the alarm limit, the thermal coefficient of the nominal resistance of copper (+0.4%/ºC) must be taken into account. Therefore, a 40-degree increase in temperature causes a 16% increase in the measured resistance value, for example. Due to the thermal change, the measured resistance may thus also be smaller than the one provided in the table.

The errors of the PEC-01 unit can be acknowledged either from the IM-01.MED unit or from the PEC-01 unit itself if the cause of the error has been eliminated. During the alarm, the red LED fault indicator BLINKS. If the fault has been deactivated but not acknowledged from the IM-01.MED or PEC-01 unit, the alarm LED indicator is on steadily.



- The RESET button acknowledges a fault only if the fault situation has been fixed, in other words, the PE wire break has been repaired or resistance is below the provided limit. The faults of all channels are acknowledged at the same time. Note that if the FAIL LED blinks, the fault is still active and cannot be acknowledged. The acknowledged faults are also removed from the alarm menu of the IM-01.MED unit.

- The POWER ON / SIGNAL indicator is on when the power is on and the connection to the IM-01.MED unit is OK.

- SYSTEM FAIL blinks if there is an internal fault in the device, or if no correctly interpreted command has been received from the IM-01.MED unit within three seconds. The IM-01.MED unit interprets the fault situation as a REMOTE UNITS and WIRE FAULT error and gives an alarm.

- The channel-specific OK indicator is on if the channel is connected and OK. It switches off if there is an active or unacknowledged fault in the channel. In other words, one of the channel LED indicators is always on if the channel has been configured for use. If the PEC-01 unit is in the SYSTEM FAIL mode, in other words, does not communicate with the IM-01.MED unit, the OK LED indicator is on in all connected channels.
- FAIL blinks if the channel is connected and has a fault. It is steadily on if the fault has been deactivated but not acknowledged. The fault can be acknowledged either by using the RESET button in the PEC-01 unit or from the alarm menu of the IM-01.MED unit.

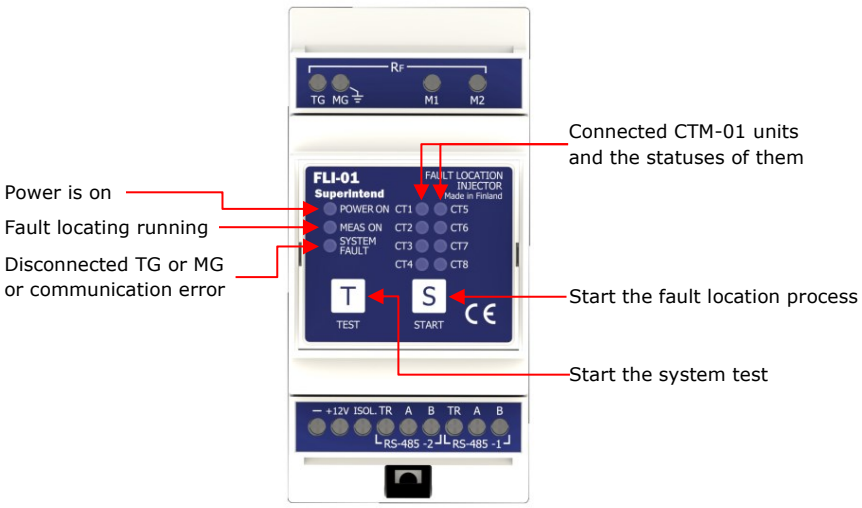
INSULATION FAULT LOCATION SYSTEM

With the insulation fault location system, it is possible to get a more accurate information about the insulation fault location. The fault location system consists of the following units:

- FLI-01, which is the fault location injector unit
- CTM-01, which is the fault location current transformer module

FAULT LOCATION INJECTOR UNIT FLI-01

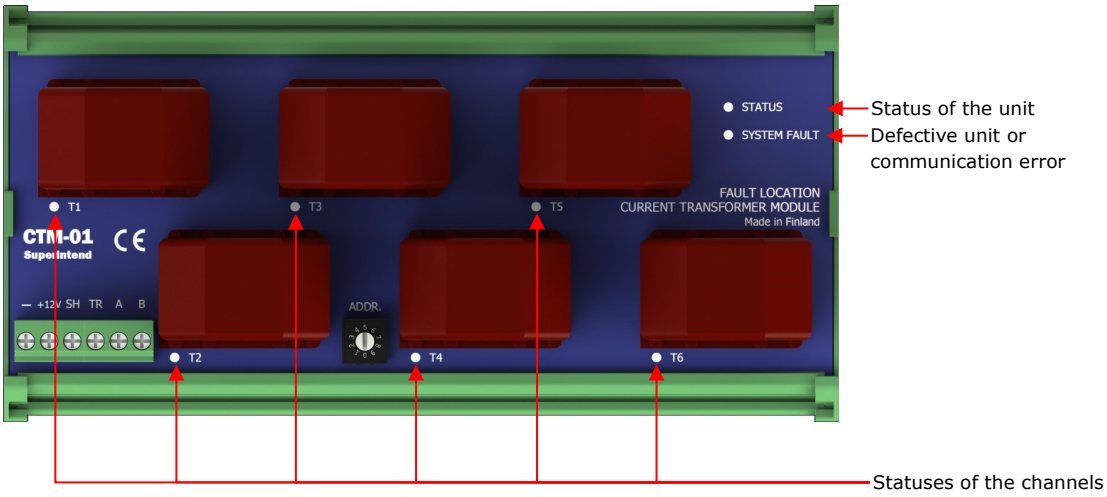
The fault location injector unit FLI-01 injects a test current signal to the phase lines alternately during the fault location process. The status of the fault location process is indicated with the LED indicators of FLI-01.



- The T button can be used to start the FLI-01 system test. During the system test, the POWER ON, MEAS ON and SYSTEM FAULT indicators blink.
- The S button can be used to start the fault location process manually during an insulation alarm or pre-alarm situation.
- By pressing the T and S buttons for 5 seconds, the currently connected CTM-01 units are saved. The successful saving is indicated with all FLI-01 indicators blinking six times. If the connection to a saved CTM-01 is lost, it will be indicated at the FLI-01 and IM-01.MED units. The saving affects only the connection surveillance of the CTM-01 units – the fault location works at the CTM-01 units also if they have not been saved in the FLI-01 unit.
- The POWER ON indicator is on when the power is on.
- The MEAS ON indicator blinks during the fault location process.
- The SYSTEM FAULT indicator has three modes:
    - fast blinking with a synchronously blinking CT indicator indicates that the connection between the FLI-01 unit and the previously saved CTM-01 unit is not working
    - fast blinking without any synchronously blinking CT indicators indicates that the connection between the FLI-01 unit and IM-01.MED unit is not working
    - slow blinking indicates that the FLI-01 unit TG or MG wire is disconnected
- The unit specific CT indicators indicate the statuses of the CTM-01 units:
    - a steadily lit indicator indicates that the CTM-01 unit with the corresponding address is connected to the FLI-01 unit
    - a slowly blinking indicator indicates that the corresponding CTM-01 unit has detected an insulation fault at some of its channels during the fault location process
    - a fast-blinking indicator indicates that the connection to the corresponding, previously saved, CTM-01 unit is not working

FAULT LOCATION CURRENT TRANSFORMER MODULE CTM-01

The fault location current transformer module CTM-01 measures the fault locating currents of its channels during the fault location process. A current which exceeds the detection threshold means that there is an insulation fault under that specific channel. In that case, the CTM-01 unit indicates the detected insulation fault with the channel indicator and reports it to the FLI-01 and IM-01.MED units.



- The STATUS indicator indicates the status of the unit. When the unit is on and ready to start a new fault location, it is steadily on. During a fault location, it blinks. If an insulation fault is detected at some channel, the STATUS indicator will blink until the insulation alarm and pre-alarm are deactivated by the IM-01.MED unit or the CTM-01 unit has not detected any insulation faults with a new fault location process.
- The SYSTEM FAULT indicator indicates that the unit is defective or that the connection between the CTM-01 unit and FLI-01 unit is not working. In both cases, the CTM-01 unit cannot be used for the fault location.
- The channel specific T1…T6 indicators indicate the statuses of the channels. A blinking indicator has two different meanings:
    - if the STATUS indicator is blinking, it means that the CTM-01 unit has detected an insulation fault at that channel during the fault location process
    - if also the SYSTEM FAULT indicator is blinking, it means that the channel is defective
- All indicators blink when the CTM-01 is powered on. Then, after a few seconds, the CTM-01 performs a calibration during which the STATUS and the T1…T6 indicators blink. The fault location is not able to be started during the calibration.

FAULT LOCATION SYSTEM CONFIGURATION

The fault location system shall be configured as follows:

- If the automatic fault locating shall not be used, disable it (SETUP→Loc AUTO).
- Check that the CT indicators of the FLI-01 unit are lit according to the addresses of the connected CTM-01 units.
- Save the CTM-01 configuration by pressing the T and S buttons of the FLI-01 unit for 5 seconds.

CALIBRATION OF THE CTM-01 UNITS

When the CTM-01 units are powered on, first all of their indicators blink three times. Then, after a few seconds, they perform a calibration. During the calibration, the STATUS and the T1…T6 indicators of the CTM-01 units blink. The fault location is not able to be started during the calibration.

USING THE FAULT LOCATION SYSTEM

The fault location process can be executed only when the insulation alarm or pre-alarm of the IM-01.MED is active. It can be started in 3 different ways:

- By selecting the MONITOR menu item Fault Location→New Locating of the IM-01.MED unit and Start Locat Y
- By pressing the 

button of the FLI-01 unit
- If the automatic fault locating has been enabled, the fault location process starts automatically whenever a new insulation alarm is activated.

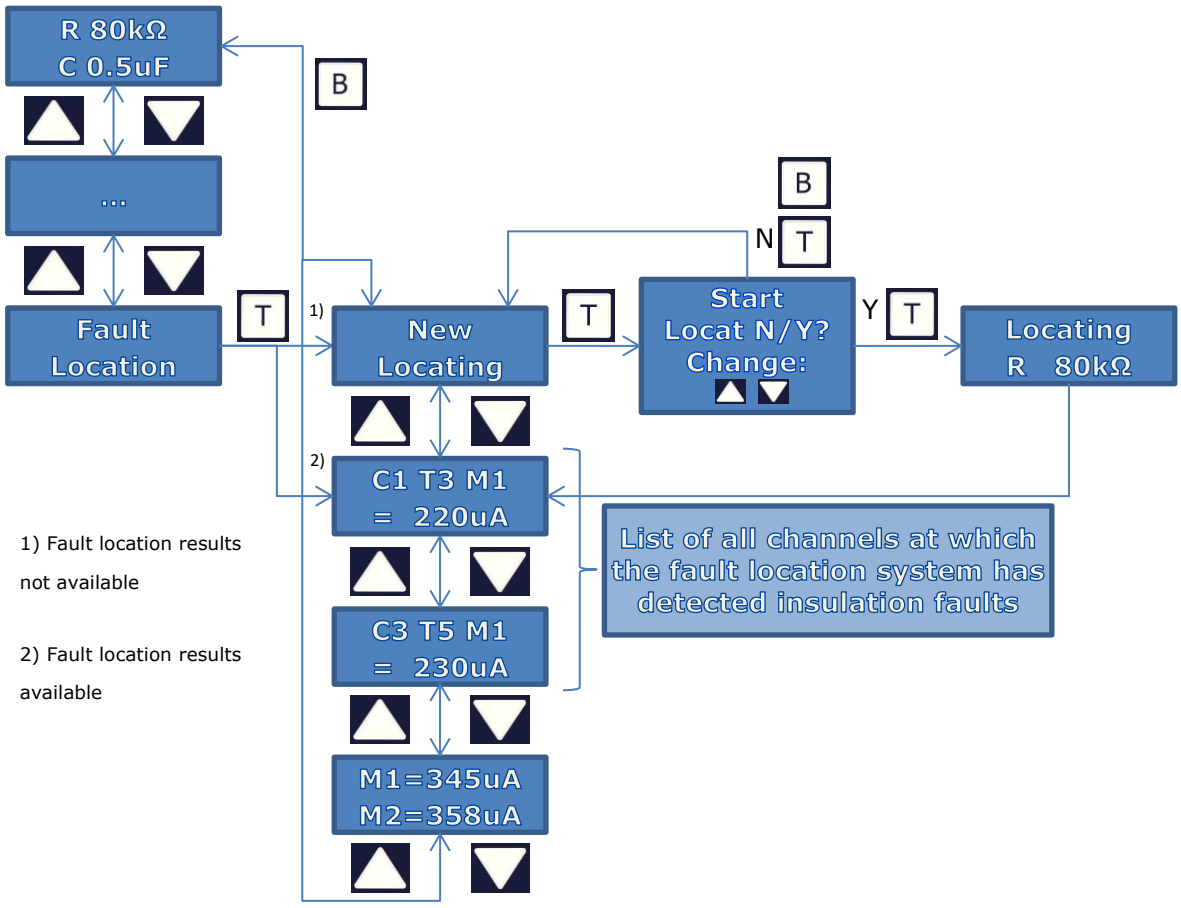
Regardless of the used starting method for the fault location, the active fault location process is indicated in 3 different ways:

- The topmost item of the MONITOR menu of the IM-01.MED display (normally insulation resistance and capacitance) shows Locating.
- The MEAS ON indicator of the FLI-01 unit blinks.
- The STATUS indicators of the CTM-01 units blink.

Note that during the fault location process, the insulation level monitoring of the IM-01.MED unit is deactivated.

After the fault location, if the display of the IM-01.MED showed Locating, it shows also if the location was done successfully or failed. The blinking CT indicators of the FLI-01 unit indicate the CTM-01 units which detected insulation faults. The STATUS indicator blinks at the CTM-01 units which detected insulation faults, and at those units, the blinking T indicators indicate the channels at which the insulation faults have been detected.

The complete results of the fault location can be reviewed at the Fault Location sub menu of the MONITOR menu of the IM-01.MED unit.



The results of the fault location are available at the menu until a new fault location process is executed or the insulation alarm and pre-alarm are deactivated. If fault location results are available, a list of them is shown first when entering the menu. The display mode in the fault location result list can be, for example, as follows:

C1 T3 M1 = 220uA	C1: the address of the CTM-01 unit which has detected the insulation fault T3: the channel number at which the insulation fault has been located M1: the phase line (M1 or M2) at which the insulation fault has been located 220uA: the locating current which has been detected at the channel's phase line

The phase line information is indicative. Insulation capacitance can divide fault locating signal to both phase lines even though the insulation fault is only at one phase line.

If the fault location process fails, the type of the failure is shown instead of the fault location results:

Location Failed	The FLI-01 injection has succeeded but the CTM-01 units have not detected current exceeding the detection threshold.
Inject Failed	The FLI-01 injection has failed.

The Location Failed failure means that the FLI-01 unit has been able to inject a sufficient locating current, but the locating current has not exceeded the detection threshold at any CTM-01 channel. The most possible cause for that is a load with wiring which has not been routed through any CTM-01 channel. Another possibility is that there are several insulation faults and the fault locating current is distributed between them so that the currents of each separate channel remain below the detection threshold.

The Inject Failed failure means that the FLI-01 unit has not been able to inject a sufficient locating current. Possible causes for that are disconnected M1 or M2 wire, too high insulation resistance or too low network voltage.

Below the fault location results are shown the currents which the FLI-01 unit has injected to the phase lines. If the result of the fault location process has been Location Failed, the currents of the FLI-01 unit are shown, however. If the result has been Inject Failed, the currents of the FLI-01 unit are not shown.

ERRORS OF THE FAULT LOCATION SYSTEM

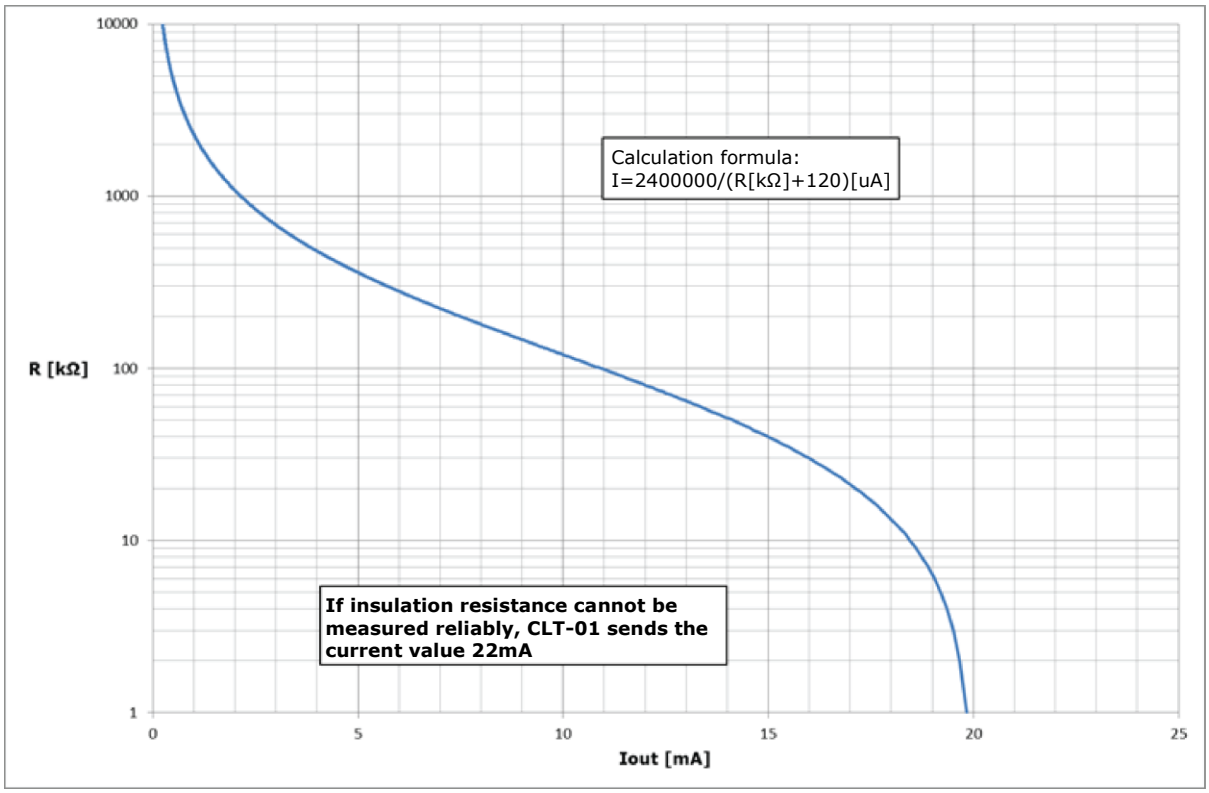
The following table lists the functioning of the IM-01.MED, FLI-01 and CTM-01 units in various error situations.

Error	IM-01.MED ALARM LEDs	IM-01.MED ALARM menu	IM-01.MED Fault Location menu	FLI-01	CTM-01
FLI-01 is not communicating with IM-01.MED	REMOTE UNITS	Inj Conn	Injector No Conn	SYSTEM FAULT blinks fast	
CTM-01 is not communicating with FLI-01	REMOTE UNITS	CTM Cfg		SYSTEM FAULT and the CT led of the missing CTM-01 (1) blink fast	SYSTEM FAULT
The FLI-01 unit TG wire is disconnected			(2)	SYSTEM FAULT blinks slowly	
The FLI-01 unit MG wire is disconnected			(2)	SYSTEM FAULT blinks slowly	
The FLI-01 unit M1 wire is disconnected	INSULATION (3)		Inject Failed		
The FLI-01 unit M2 wire is disconnected	INSULATION (3)		Inject Failed		
Too low network voltage for fault locating	INSULATION (3)		Inject Failed		
Too high insulation resistance for fault locating	INSULATION (3)		Inject Failed		
Locating current has not exceeded the detection threshold at any CTM-01 channel (current distributed between too many channels or routed outside the channels)	INSULATION (3)		Location Failed		
The CTM-01 unit is defective			Location Failed Sys Busy (4)	SYSTEM FAULT blinks slowly	SYSTEM FAULT Tx (5)

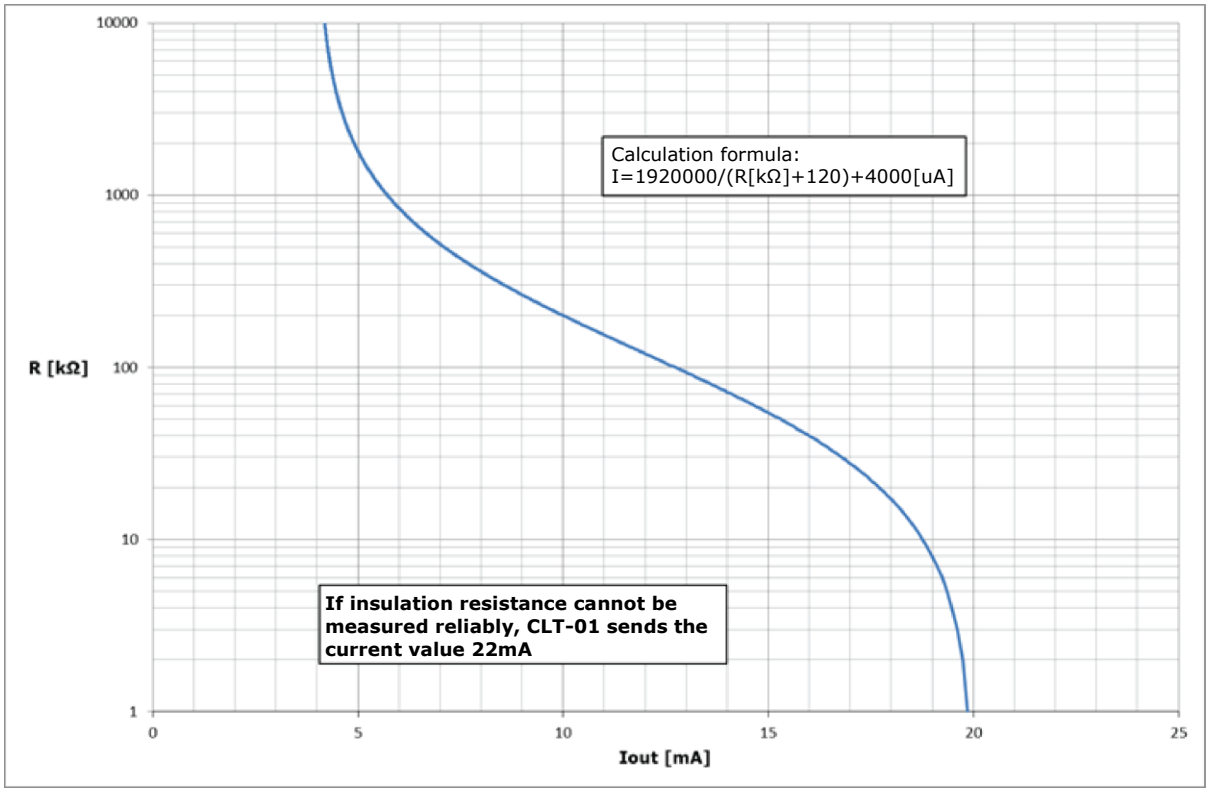
(1) If the CTM-01 configuration has been previously saved in the FLI-01 unit
(2) New fault location process is not started because the locating current circuit is broken
(3) The fault location process can be executed only when the insulation alarm or pre-alarm of the IM-01.MED is active
(4) The CTM-01 units do not perform the fault location process
(5) Tx means the channel indicator of the defective channel

CLT-01 UNIT

The CLT-01 unit sends 0…20 / 4…20 mA standard current messages to the current loop of its output in accordance with the insulation resistance measured by IM-01.MED. For the output to function, an external 24 VDC voltage source is needed.



The output current of CLT-01 as a function of insulation resistance at the loop current setting of 0…20 mA



The output current of CLT-01 as a function of insulation resistance at the loop current setting of 4…20 mA

TECHNICAL SPECIFICATIONS

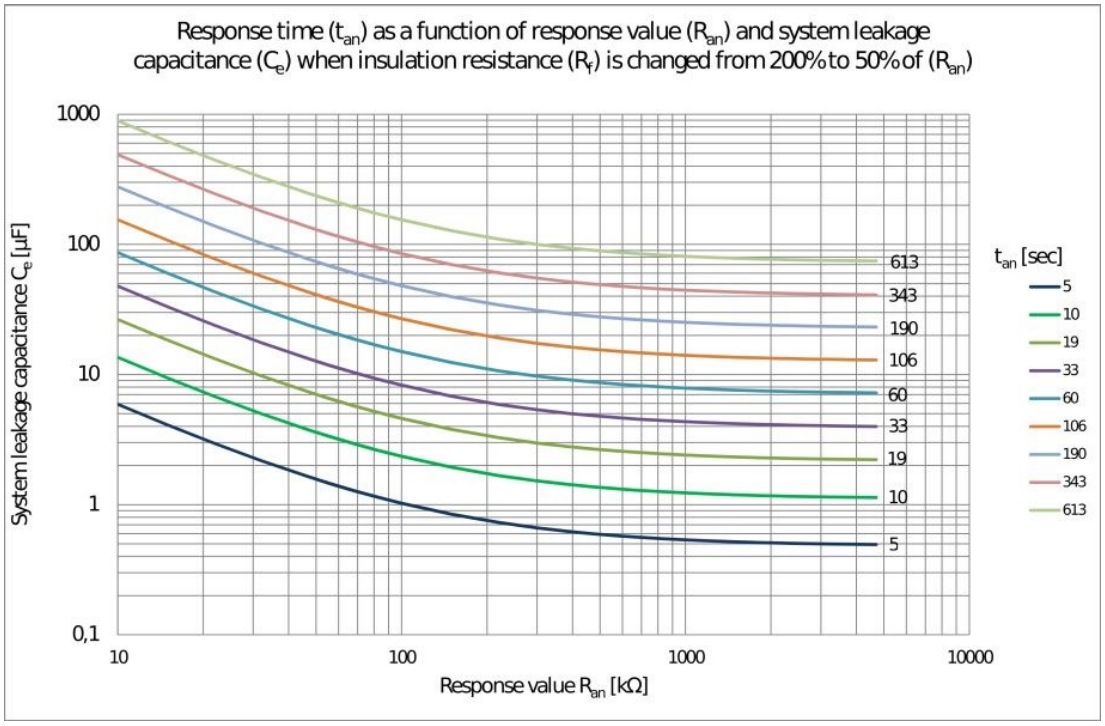
IM-01.MED UNIT

Voltage ranges

- Operating voltage [U_S]:
  110…240VAC, frequency 48…62 Hz
  110…300VDC (use an external fuse Schurter 0001.2503 (T800mA))
- Maximum voltage at the measurement connectors M1 and M2 [U_N]: 240VAC or 280VDC
- Frequency range of the network to be monitored: 10…500Hz
- Input power: 6W, when the 12VDC output is not loaded; 11W when it is loaded. Internal fuse of the operating voltage: 1AT

Monitoring of the insulation level:

- Measurement voltage [U_m]: ± 25Vp
- Highest measurement current ([R_f] = 0 Ω): 150uA
- Measurement circuit resistance: 225kΩ, impedance: 225kΩ (50…400Hz)
- Highest allowed [U_{fg}]: 1000V
- Alarm limit [R_{an}]: 50kΩ…1MΩ
- Relative uncertainty (22kΩ…5MΩ): ±15%
- Hysteresis: 5%



The response time of the insulation level alarm as a function of the alarm limit and insulation capacitance

Load monitoring

- Alarm limit: 0.5…100A
- Hysteresis: 5%
- Sensor: current transformer 10…100/5A CL3 + resistor 0.05Ω 1% 5W

Temperature monitoring

- Alarm limit: 30…140°C
- Hysteresis: 5%
- Sensor:
  NTC thermistor 10kΩ ±5% @25°C, $B_{25/85}$ = 3977K
  or PT100

Alarm switches

- 5A (NO) / 3A (NC) @ 30VDC for resistive load
- 5A (NO) / 3A (NC) @ 277VAC for resistive load
- Maximum power: 1400VA / 150W (NO) and 850VA / 90W (NC)
- Insulation strength between contacts: 750VAC 50/60Hz 1 min
- Useful life: 100,000 connections with the maximum nominal load

Serial bus

- RS-485, speed 9600bps, half duplex
- +12VDC supply for the RS-485 bus devices, maximum current: 300mA
- Maximum cable length: 500m

Other details

- For indoor use only
- Altitude up to 2000 m above sea level
- Operating temperature: 0…50ºC, relative humidity: < 90%, non-condensing
- Overvoltage category III
- Pollution degree 2
- Impact resistance: IK06 = 1J
- IP class (front panel): IP40
- IP class (other casing): IP20
- Connector tightening torque: 0.45…0.5 Nm
- Stripping length: 6,5 mm
- Weight: 0.38 kg
- Not suitable for connecting in parallel
- Voltage test (IEC 61010-1:2010, Annex F): 2.2 kVAC
- EMC standards: EN61326-2-4, EN55011, EN61000-3-2, EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6, EN61000-4-11
- Other standards: IEC61557-8, IEC61010-1:2010+AMD1:2016

PEC-01 UNIT

- Operating voltage 220…240VAC 48…62Hz
- Input power 2W (35mA / 230VAC), internal fuse 80mAT PTC
- Operating temperature: 0…50ºC, relative humidity: < 90%, non-condensing
- Resistance measurement range: 0…2.55Ω, accuracy ±0.2Ω
- RS-485 speed 9600bps
- Connector tightening torque: 0.45…0.5 Nm
- Weight: 0.47 kg
- EMC standards: EN61326-2-4, EN55011, EN61000-3-2, EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6, EN61000-4-11 (Tested on the system level)
- Other standards: IEC61557-8, IEC61010-1:2010-3

TC-01 and IC-01 UNITS

- Operating voltage: 6-15VDC, max. 30mA @ 6V, typical 8mA @ 12V
- Operating temperature 0…70ºC, relative humidity: < 90%, non-condensing
- RS-485 speed 9600 bps
- Connector tightening torque: 0.45…0.5 Nm
- Weight: 86 g
- EMC standards: EN61326-2-4, EN55011, EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6, EN61000-4-11 (Tested on the system level)
- Other standards: IEC61557-8

RD-01 UNIT

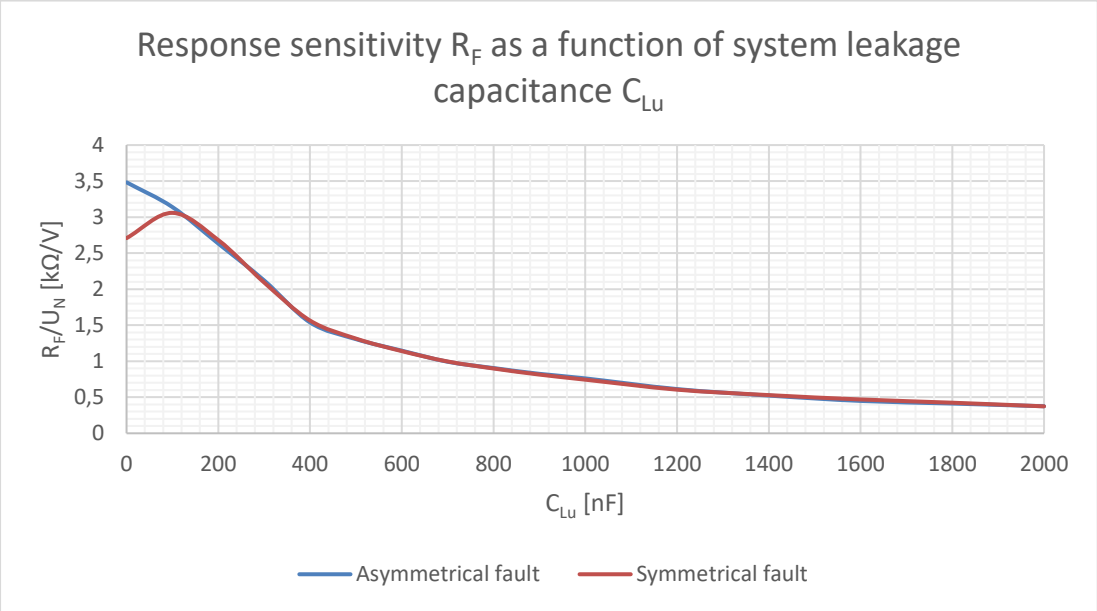
- Operating voltage: 6-15VDC, max. 71mA @ 6V, typical 35mA @ 12V
- Operating temperature 0…70ºC, relative humidity: < 90%, non-condensing
- RS-485 speed 9600 bps
- Connector tightening torque: 0.45…0.5 Nm
- Weight: 89 g
- EMC standards: EN61326-2-4, EN55011, EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6, EN61000-4-11
- Other standards: IEC61557-8

FLI-01 UNIT

- Operating voltage: 12VDC, 38mA
- Operating temperature 0…70ºC, relative humidity: < 90%, non-condensing
- Network system voltage [U_N]: 180…240VAC
- Frequency range of the network system voltage: 48…62Hz
- Locating current [I_L]: max. 0.5mA
- RS-485 speed 9600 bps
- Connector tightening torque: 0.45…0.5 Nm
- Weight: 131 g
- EMC standards: EN61326-2-4, EN55011, EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6, EN61000-4-11
- Other standards: IEC61557-9

CTM-01 UNIT

- Operating voltage: 12VDC, 15mA
- Operating temperature 0…70ºC, relative humidity: < 90%, non-condensing
- Response sensitivity: 80uA



The response sensitivity resistance value of an insulation fault as a function of the leakage capacitance

The response sensitivity resistance value depends on the system leakage capacitance and the network system voltage. Determining the response sensitivity resistance is performed as follows:

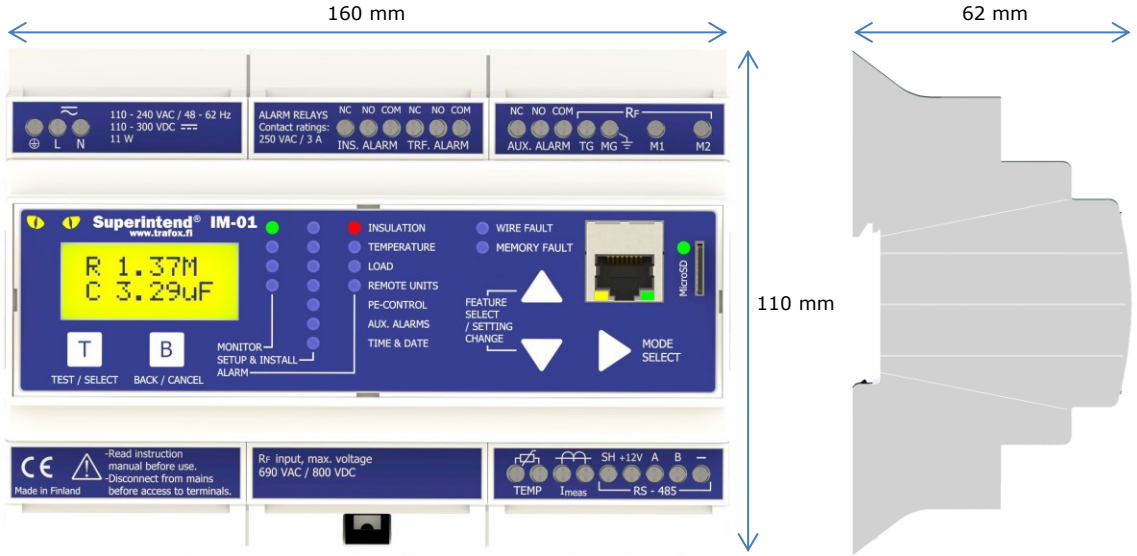
1. Find the R_F/U_N value from the diagram based on the system leakage capacitance and the fault type
2. Calculate the response sensitivity resistance value by multiplying the R_F/U_N value with the network system voltage

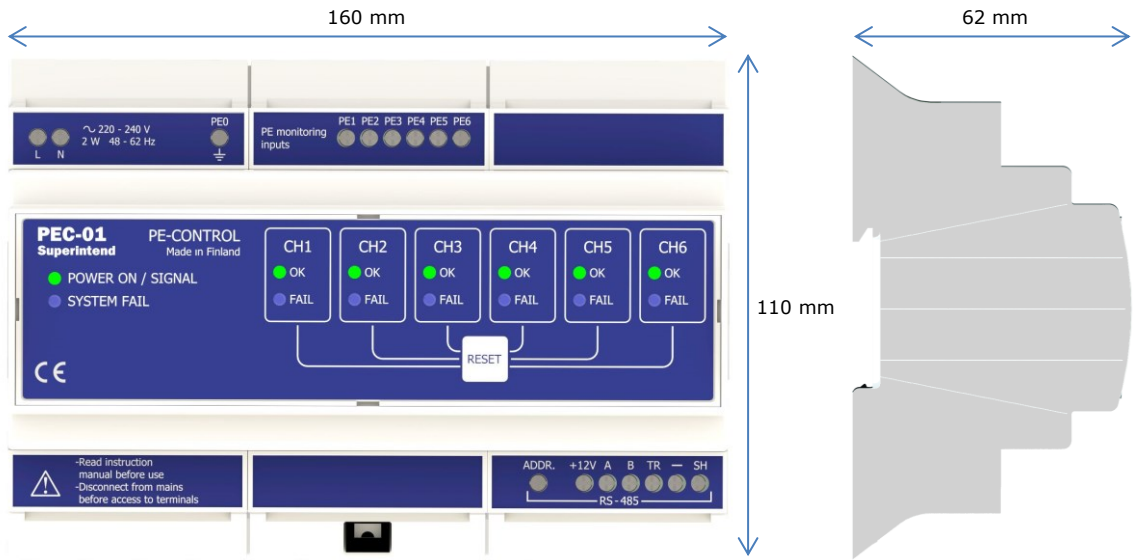
Example: network system voltage 230 V, system leakage capacitance 0 nF, asymmetrical fault:

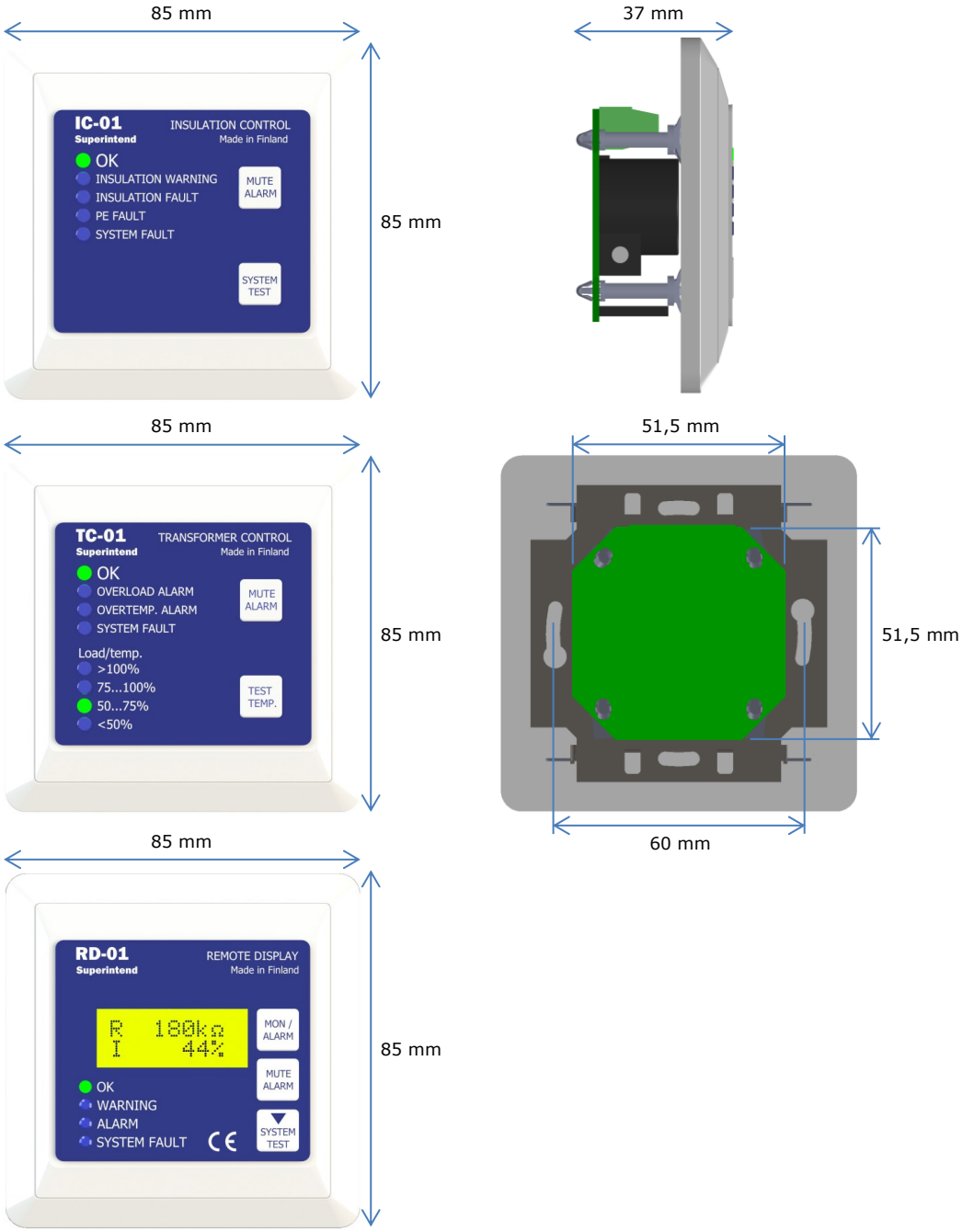
1. R_F/U_N for asymmetrical fault and 0 nF capacitance is 3,5 kΩ/V
2. Response sensitivity resistance value: 230 V * 3,5 kΩ/V = 805 kΩ

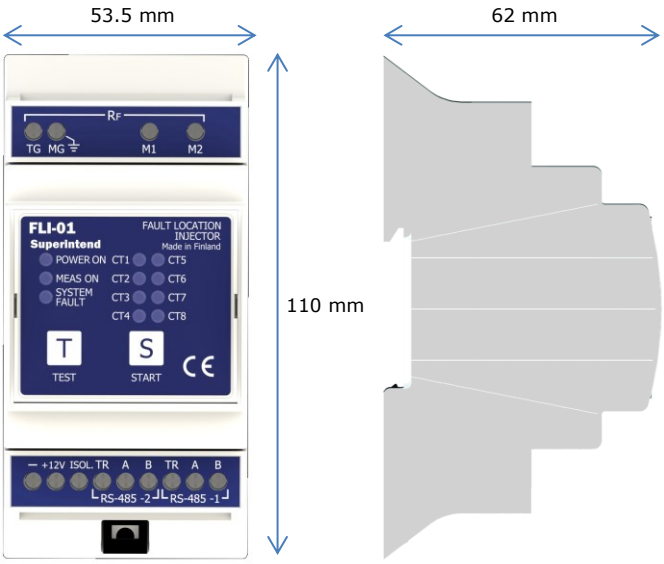
- Relative uncertainty of response sensitivity: ±20%
- Response time (IEC 61557-9 A.4.2): max. 42s
- RS-485 speed 9600 bps
- Connector tightening torque: 0.45…0.5 Nm
- Weight: 560 g
- EMC standards: EN61326-2-4, EN55011, EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6, EN61000-4-11
- Other standards: IEC61557-9

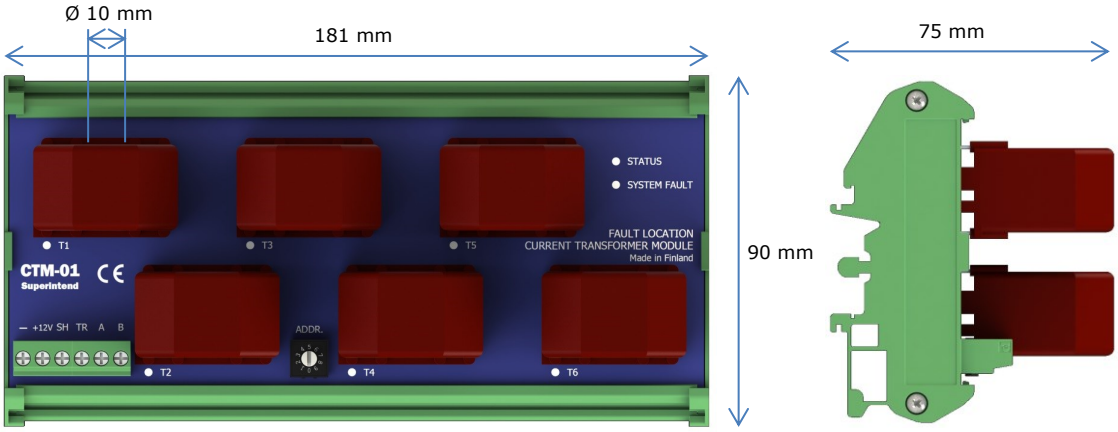
MECHANICAL DIMENSIONS

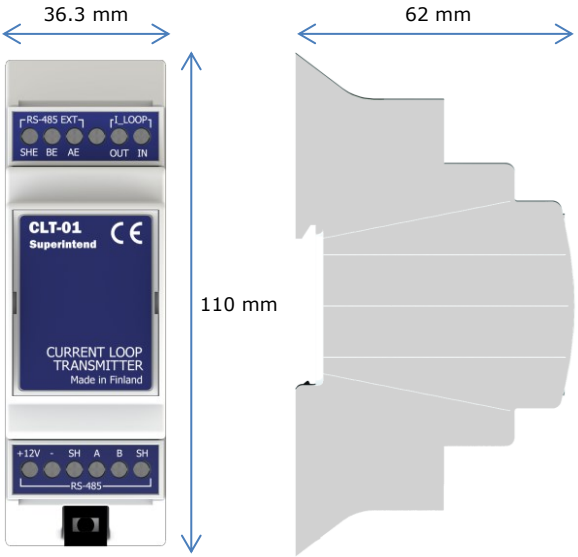












QUICK INSTRUCTION TEMPLATES OF IC-01 AND TC-01 FOR MEDICAL LOCATIONS

The device indicates the insulation level of the IT network. When all is fine, the OK indicator is lit.

If either INSULATION indicator blinks, a low insulation level alarm is active. If this is the case, disconnect devices from wall sockets, starting from the one added last, until the INSULATION indicators no longer blink.

The PE FAULT indicator means there is an earthing break in the wall socket.

The SYSTEM FAULT indicator means a disturbance in IC-01.

In the case of any alarm: silence the audible alarm with the MUTE ALARM button and notify

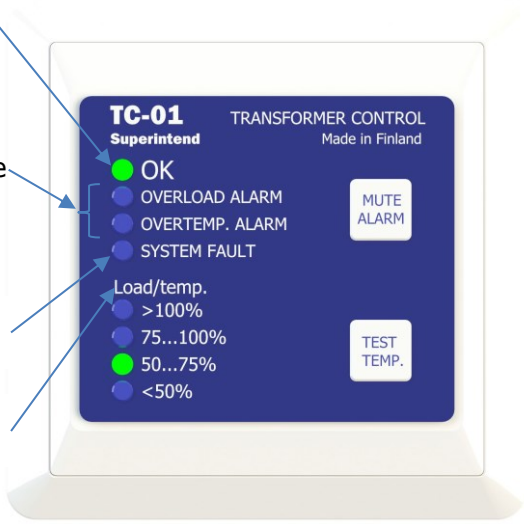
_____ tel. _____

The device indicates the load level and temperature of the IT network isolation transformer. When all is fine, the OK indicator is lit.

If either ALARM indicator blinks, the IT network is overloaded. If this is the case, disconnect devices from wall sockets until the ALARM indicators no longer blink.

The SYSTEM FAULT indicator means a disturbance in TC-01.

Load/temp. indicates the momentary load level of the IT network.



In the case of any alarm: silence the audible alarm with the MUTE ALARM button and notify

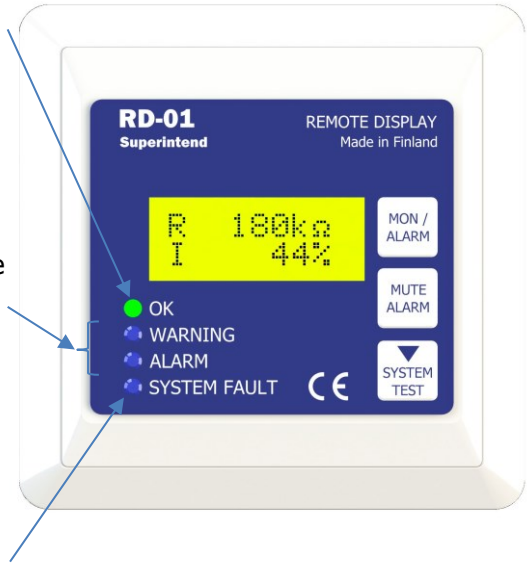
_____ tel. _____

QUICK INSTRUCTION TEMPLATE OF RD-01 FOR MEDICAL LOCATIONS

The device indicates the insulation level of the IT network and the load level of the isolation transformer. When all is fine, the OK indicator is lit.

- If WARNING and possibly ALARM indicators blink, a low insulation level alarm is active.
- If only the ALARM indicator blinks, the IT network is overloaded or there is an earthing break in the wall socket.
- If this is the case, disconnect devices from wall sockets, starting from the one added last, until the indicators no longer blink.

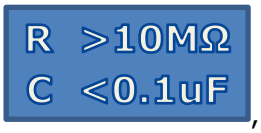
The SYSTEM FAULT indicator means a disturbance in RD-01.



In the case of any alarm: silence the audible alarm with the MUTE ALARM button and notify

_____ tel. _____

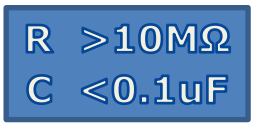
IM-01.MED - QUICK INSTRUCTION FOR ACKNOWLEDGING ALARMS

1. Start situation: 

, R and C values are in accordance with the ones measured from the IT network.
2. Press ▲ twice, the screen displays 

3. Press T, the screen displays 

4. Press ▲, the screen displays 

5. Press T, the screen returns to the start situation 

and the removed faults are now acknowledged.