Insulation monitoring device

ISOLGUARD HIG99/3k6

CAN Communication module

HIG99 KM CAN

and Coupling device for IMD

ISOLGUARD HIG-CD 3k6

Operating manual

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Used symbols

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

Information
This symbol highlights particularly important characteristics of the device.

Note
This symbol indicates useful additional information.

1 HAKEL ISOLGUARD HIG99/3k6 + HAKEL ISOLGUARD HIG-CD 3k6

The set consisting of the insulation monitoring device produced by HAKEL, type ISOLGUARD HIG99/3k6 and the coupling device HIG-CD 3k6, is designed for monitoring the insulation status of single-phase, multiphase and DC ungrounded high-voltage IT power supply systems. Device is also able to monitor combined IT power supply systems, type AC/DC according to standard IEC 61557-8. HIG99 is mainly designed for use on rail vehicles and industrial systems containing rectifiers, inverters and frequency converters.

Maximum operating voltage of monitored IT power supply system is 3600 V DC / 2500 V AC. IMD HIG99/3k6 is connected to the monitored IT power supply system via coupling device HIG-CD 3k6.

HIG99/3k6 is monitoring two insulation status's critical levels, it is equipped with signalling diodes for local signalization of the device status and of IT power supply system. Local signalization is completed by a pair of switching relays for IT power supply fault status signalization. It is possible to attach remote signalization using communication module type HIG99 KM by CAN interface with CAN OPEN protocol.

Using the CAN communication module, numeric information about insulation resistance status and value can be read, the device's settings can be checked and changed or test cycles can be performed.

Device is also equipped with a blocking function, which allows to disconnect the HIG99/3k6 from the monitored system.

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

HAKEL ISOLGUARD HIG99/3k6

Type	Display menu	Signalling relay	Range of measured R_F value	Critical insulation resistance	Remote signalization	Device type according to IEC 61557-8
HIG99/3k6 ***Art. No. 70 970/3k6***	No	2x SPST	1 kΩ ÷10 MΩ	Adjustable 1 ÷ 2 500 kΩ	Communication modules type HIG99 KM	AC/DC

Table 1: IMD HIG99/3k6, type and article number

Note: SPST – signalling relay with one switching contact, type NO

Coupling device ISOLGUARD HIG-CD/3k6

Type	Maximum operating voltage	Installation	Encasement	Ambient temperature
HIG-CD 3k6 ***Art. No. 70984***	3600 V⎓ / 2500 V~	On distribution board	Aluminium case with wires	-40 °C ÷ +70 °C*

Table 2: Coupling device HIG-CD 3k6, type and article number

* When ambient temperature is above +40 °C, there have to be used active cooling of the housing.

Communication modules ISOLGUARD HIG99

Type	Communication interface type	Protocol	Isolation voltage	Other features		
HIG99 KM CAN ***Art. No. 70 972***	CAN	CAN OPEN 2.0	3000 V⎓	Bus communication speed 50, 125, 250, 500, 1 000 kbit/s (LSS)	Possible bus termination by switch	The node address number is assigned via the bus (LSS)

Table 3: Communication module, type and article number

2 Basic characteristics

HIG99/3k6, HIG-CD 3k6, HIG99 KM CAN modules comply with standards:

- HD 60364-4-41:2017 Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock
- IEC 61557-8:2014 Insulation monitoring devices for IT systems
- IEC 61557-1:2007 Equipment for testing measuring or monitoring of protective measures
- IEC 60664-1:2007 Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests
- EN 50155:2017 Railway applications – Rolling stock – Electronic equipment
- EN 45545-2:2013 Railway applications – Fire protection on railway vehicles
- EN 50121-3-2:2016 Railway applications – Electromagnetic compatibility
- EN 50125-1:2014 Railway applications – Environmental conditions for equipment
- IEC 61373:2010 Railway applications – Rolling stock equipment – Shock and vibration tests

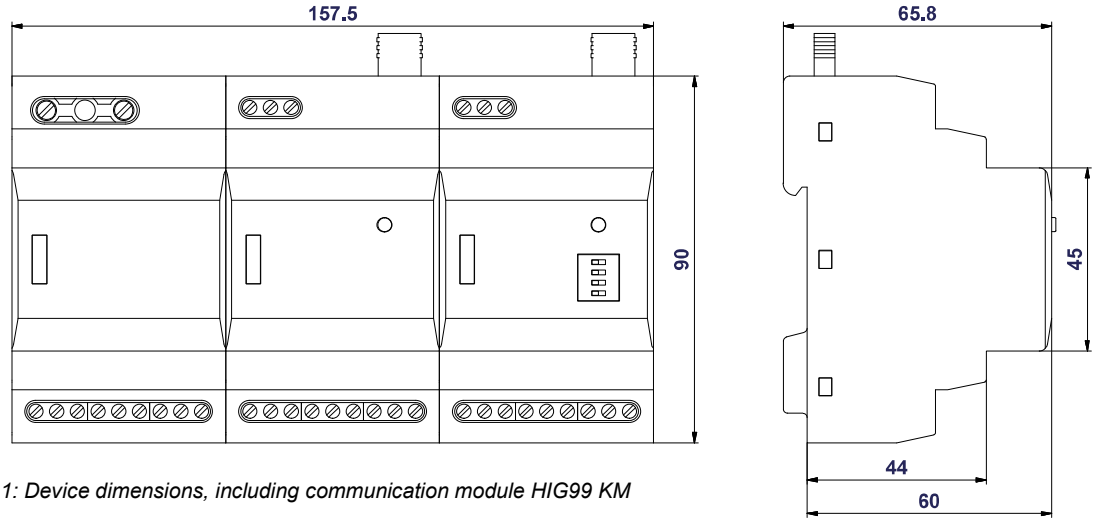
Basic characteristics of set HIG99/3k6 and HIG-CD 3k6

- Insulation monitoring device for AC, DC, AC/DC systems according to IEC 61557-8 with voltage 40 to 3600 V⎓ / 2500 V~, 10–440 Hz frequency.
- Device is designed for use on rail vehicles and industrial systems containing rectifiers, inverters and frequency converters.
- Device is powered from an independent 110 V DC power supply.
- Loss of connection with the measured power supply system and the ground is indicated.
- Automatic internal test for malfunction detection.
- Device evaluates two insulation resistance critical limits.
- Two signalling relays with switching contact. Insulation status signalling of monitored power supply for two insulation resistance critical limits, warning and fault.
- Option to start device test by push-button on the module.
- Option to connect communication module, type HIG99 KM, for device's connection to master bus.
- Option to set critical values, hysteresis values and other control parameters by KM type module.
- HIG99, in combination with any HIG99 KM type communication module, is 9M (157,5 mm) wide and is designed for assembling on 35 DIN rail. The coupling device HIG-CD 3k6 is mounted to distribution board using screws.

HIG99 KM CAN basic characteristics

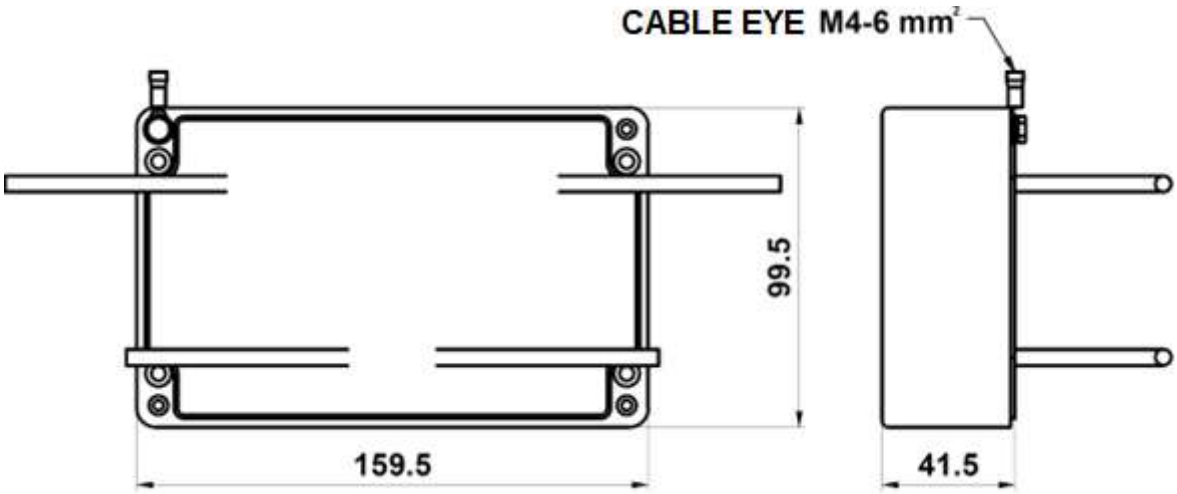
- Communication module for HIG99 device.
- Enables to connect HIG99 device on CAN industrial bus.
- Module is using CAN OPEN 2.0 protocol, according to EN 50325-4.
- Basic communication speed is 500 kbit/s, another speeds 50, 125, 250, 500, 1 000 kbit/s can be set via LSS protocol.
- Enables information forwarding about insulation resistance value and its faults as PDO/SDO information.
- Enables to read and change device's settings as SDO command.
- Integrated switch enables CAN bus termination in four different modes.
- Enables device function block and device disconnection from monitored power supply system by external input.
- Enables device test using external input.
- Communication module is powered from the IMD.

2.1 HIG99/3k6 device dimensions including HIG99 KM CAN communication module



Picture 1: Device dimensions, including communication module HIG99 KM

2.2 Coupling device HIG-CD 3k6 dimensions



Picture 2: Coupling device HIG-CD 3k6 dimensions

3 Technical characteristics

Type		ISOLGUARD HIG99/3k6
Monitored IT power supply system type, according to IEC 61557-8		AC, DC, AC/DC
Voltage of monitored IT system*	U_n	9 ÷ 170 V⎓ or 9 ÷ 120 V~ (10 ÷ 440 Hz)
Nominal supply voltage	U_s	110 V⎓
Supply voltage range		45 ÷ 450 V⎓ **
Power consumption	P	max. 5 VA
Measuring circuit		
Measuring voltage	U_m	± 40 V⎓
Measuring current	I_m	< 0,5 mA
Measuring input's internal impedance*	Z_i	> 300 kΩ
Internal DC resistance*	R_i	> 300 kΩ
Permissible system leakage capacitance	C_e	1 µF
Measuring range (accuracy guaranteed)	R_F	100 kΩ ÷ 10 MΩ
Absolute measuring range		1 kΩ ÷ 10 MΩ
Measuring accuracy		± 15 %
Limit value setting range R_{an1} and R_{an2}	R_{an}	adjustable 1 kΩ ÷ 2 500 kΩ
Insulation resistance hysteresis	R_{hyst}	adjustable 0 ÷ +100 % R_{an}
Delay in response of signalling the insulation status	RtON	adjustable 0 ÷ 300 sec, with 1 sec step
Outputs		
Two signalling switching contacts with optional position NO or NC Isolation barrier to the internal circuits Isolation barrier to supply circuits		24 V~ / 1 A 24 V⎓ / 1 A 3000 V⎓ ** 3000 V⎓ **
Remote signalization		Using communication modules type HIG99 KM.

** Only when used without coupling device. Else consider values mentioned in coupling device description*

** When operating on IT power supply system with higher voltage than stated isolation barrier, the requirement of galvanic isolation is to be ensured with additional isolation ensured by user

Table 4: HIG99 technical parameters

Communication module		ISOLGUARD HIG99 KM CAN
Module power supply		Provided by HIG99
Communication interface for user		CAN bus
Communication protocol		CAN OPEN 2.0
Default communication setting		Node address (Node-ID): 0x60h Communication speed: 500 kbit/s
Communication speed		50, 125, 250, 500, 1 000 kbit/s (set via LSS protocol)
Bus termination		Can be realized by integrated *Rte* switch. Termination resistance value is 120 Ω.
Bus isolation barrier to internal module circuits, operational inputs		3000 V⎓**
Operational inputs		E.Blck for remote device's disconnection from monitored IT power supply system. E.Test for remote device test.
Voltage for logic 1 of external inputs		12 ÷ 36 V⎓
Voltage for logic 0 of external inputs		0 ÷ 5 V⎓
Operational inputs isolation barrier to module internal circuits, CAN bus and HIG99		3000 V⎓**

** When operating on IT power supply system with higher voltage than stated isolation barrier, the requirement of galvanic isolation is to be ensured with additional isolation ensured by user

Table 5: HIG99 KM CAN communication module's technical parameters

General data		HIG99/3k6	HIG99 KM CAN
Degree of protection according to IEC 60529		front panel IP40 protection except front panel IP20	
Weight	m	222 g	112 g
Housing material		PA – UL 94 V0	
Method of assembly		On the DIN 35 rail	
Recommended cross-section of connected wires	S	Terminal box X1: 2,5 mm^2 Other: 1 mm^2	1 mm^2
Recommended protection		6 A	-
SW version		V1.0	V1.1
Article number		70 970/3k6	70 972

Table 6: Technical parameters, general data HIG99/3k6, HIG99 KM CAN

Operating conditions	HIG99/3k6, HIG99 KM CAN
Operating ambient temperature	-40 °C ÷ +70 °C (OT4 according to EN 50155)
Storage temperature	-40 °C ÷ +70 °C
Transport temperature	-40 °C ÷ +70 °C
Altitude	Up to 2000 meters above sea level
Protection class	II according to IEC 61140:2016
Overvoltage category	III, according to IEC 60664-1:2007
Pollution degree	2, according to IEC 60664-1:2007
Operating position	any
Duty type	permanent

Table 7: Technical parameters, operating conditions HIG99/3k6, HIG99 KM CAN

Type		ISOLGUARD HIG-CD 3k6
Monitored IT power supply voltage	U_n	40 ÷ 3600 V⎓ or 40 ÷ 2500 V~ (10 ÷ 440 Hz)
Power consumption	P	max. 18 VA
Measuring input's internal impedance	Z_i	> 1 100 kΩ
Internal DC resistance	R_i	> 1 100 kΩ
Isolation barrier (P1,P2,S1,S2 to case)		±6 000 V⎓ / 5000 V~ (1 min.)
Surge (P1,P2,S1,S2 to case)		±20 kV (1,2/50 µs)
Degree of protection according to IEC 60529		IP65, except connecting wires
Weight		1360 g
Housing material		Aluminium, potted with isolation compound
Method of assembly		On board, see chapter *Installation*
Cross-section of connecting wires		2,5 mm^2
Length of connecting wires		2 m
Operating conditions		
Operating ambient temperature without additional cooling		-40 °C ÷ +40 °C
Operating ambient temperature with additional cooling (conditions in chapter *Installation*)		-40 °C ÷ +70 °C
Storage temperature		-40 °C ÷ +70 °C
Transport temperature		-40 °C ÷ +70 °C
Altitude		Up to 2000 meters above sea level
Protection class		I according to IEC 61140:2016
Overvoltage category		III, according to IEC 60664-1:2007
Pollution degree		2, according to IEC 60664-1:2007
Operating position		any
Duty type		permanent
Article number		70984

Table 8: Technical parameters HIG-CD 3k6

3.1 Measuring principle

DC voltage ±40 V connected to the *FE* terminal. Measuring current is limited to the value mentioned in the technical parameters table, see *Table 4: HIG99 technical parameters*.

4 Connecting terminals

4.1 Terminals of HIG99 PM connecting Module

- **Terminals X1:**
  Terminals X1.1 and X1.3, marked *L1/L+*, *L2/L-,* are used to device's connection to monitored power supply system, eventually to coupling device HIG-CD.
- **Terminals X2:**
  These are used to connect PM connection module to MM measuring module, terminals X4. Connection of X2 and X4 terminals is done by the producer and cannot be changed.

4.2 Terminals of HIG99 MM measuring Module

- **Terminals X3:**
  Two potential free relays *Ran1* and *Ran2* with switching contact and COM common pole. They are used to give information about insulation resistance status.
- **Terminals X4:**
  They are used to connect the connection module to the measuring module. Furthermore, it is used to supply low voltage for HIG device and to provide functional (terminal *FE*) and control grounding (terminal *KE*). Connection of X2 and X4 terminals is done by the producer and cannot be changed.
- **Connector X5:**
  Used to connection HIG99 MM measuring module and HIG99 KM CAN communication module (connector X7). Connection of X5 and X7 connectors is done by a cable supplied by the producer, connection cannot be changed. Connecting cable is added to communication module. Another connection is not allowed.

4.3 Terminals of HIG99 KM CAN Communication Module

- **Terminals X6:**
  Galvanic isolated inputs for device commanding. The inputs have a common ground potential on an *E.COM* terminal. Inputs are activated by voltage supply connected to corresponding input terminal. Parameter ***ExtInputLogic*** value determines signal logic. The parameter is set to 0 (active zero) or 1 (active one). See description in chapter 6.2 *Control parameters of the IMD*, page 15.
  E.Test input is used to device test start.
  E.Blck input is used for remote start or stop of R_F measuring (insulation resistance), command REDC according to EN 61557-8 ed.3. Also it causes IMD connection or disconnection to the monitored power supply system
- **Connector X7:**
  Used to connection of HIG99 KM CAN communication module and HIG99 MM measuring module (connector X5). Connection of X5 and X7 connectors is done by a cable supplied by the producer, connection cannot be changed. Another connection is not allowed.
- **Terminals X8:**
  CAN bus output. *V+* and *SH* terminals are not internally connected, they can be used for bus connection. *NC* terminals are not used.

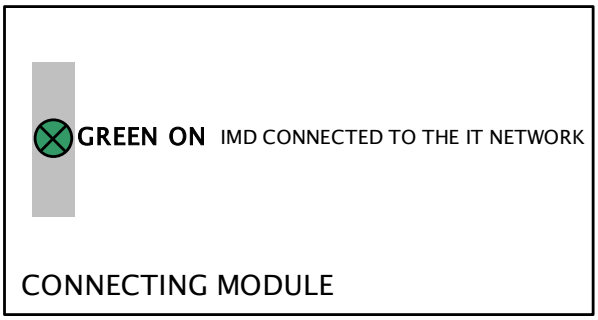
4.4 Connection wires of coupling device HIG-CD 3k6

- **Wires P1, P2:**
  Wires marked HIG-CD 3k6 – P1 and HIG-CD 3k6 – P2 are used to connection to measured IT power supply. Wires have ferrule at the end.
- **Wires S1, S2:**
  Wires marked HIG-CD 3k6 – S1 and HIG-CD 3k6 – S2 are used to connection with insulation monitoring device HIG99/3k6. Wire S1 is connected to X1.1 terminal, wire S2 is connected to X1.3 terminal. Wires have ferrule at the end.
- **Earth connection:**
  Protective bonding with earth, required to keep electrical safety. Minimum cross-section of wire 4 mm^2.

5 Controls and indicator lamps

5.1 HIG99 PM connecting module signalization

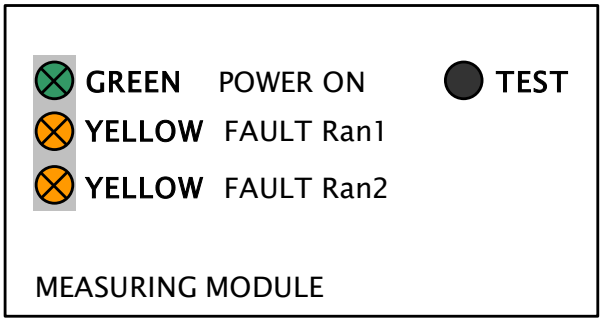
The connection module has one relay status indicator.



- **Indicator lamp *GREEN ON*:**
  It shines when device is connected to the monitored power supply. Device connection is controlled by logical input *E.Blck* on the communication module or by request via communication bus line. Insulation status measuring is done only when the device is connected to the monitored power supply, see *E.Blck description chapter 4.3.*

5.2 HIG99 MM (Measuring Module) signalization

HIG99 MM measuring module has three indicators and test push-button on the front panel.



- **TEST push-button function**
  Short press of the push-button invokes internal device test (auto test) and also insulation status fault signalization test. The test is performed for at least ten seconds after pressing the push-button or while holding the push-button. Test process is signalled by measuring module settings to operation status *TEST* according to a description in a *Table 9: MM measuring module operation statuses signalization.*

  The device can be also tested remotely using the logical input *E.Test* on the KM communication module or by CAN communication bus with relevant request.

  Device test is done even if the device is disconnected from the monitored power supply by the blocking input *E.Blck*. Device test performing does not affect the insulation resistance of the monitored power supply.

- **Green indicator GREEN POWER ON**
- **Yellow indicator YELLOW FAULT Ran1**
- **Yellow indicator YELLOW FAULT Ran2**

They signal operating status of the measuring module device. Operating statuses overview is listed in a following table.

Status signalization of HIG99 measuring module					
MM module operating status	**LED ON**	**LED FAULT Ran1**	**LED FAULT Ran2**	**Relay Ran1**	**Relay Ran2**
Even measurement	Light flashing 980/20	According to R_F insulation resistance status. Signals shine while insulation status fault, relay is set to fault status[1].			
Odd measurement	Light flashing 900/100				
Auto test	Flashing 500/500				
Test		Shines	Shines	Fault status[1]	Fault status[1]
FE/KE fault	Fast flashing 100/100	Flashes 2x		Fault status[1]	Fault status[1]
FUcrit1 fault		Flashes 3x		According to R_F	According to R_F
Internal fault		Flashes 4x		Fault status[1]	Fault status[1]
R_F limit fault		Flashes 5x		Fault status[1]	Fault status[1]

Table 9: MM measuring module operating status signalization

Notes:

1. *Real relay status is affected by a parameter RelayLogic.*
   RelayLogic = 0: Warning/fault signal is done by closing the relay, no fault status signalled by opening.
   RelayLogic = 1: Warning/fault signal is done by opening the relay, no fault status signalled by closing.
   Default value is 0.

5.3 Device measuring module operating statuses

- **Even measurement**

Insulation resistance measurement is done in this status. Output signalizations reflect insulation fault status.
Signal ON flashes slightly in 980/20 regime while even measurement, i.e. flashes faster than while odd measurement. Reason of the difference is easier identification of the measuring cycle completion.

- **Odd measurement**

Insulation resistance measurement is done in this status. Output signalizations reflect insulation fault status.
Signal ON flashes slightly in 900/100 regime while odd measurement, i.e. flashes slower than while even measurement. Reason of the difference is easier identification of the measuring cycle completion.

- **Auto test**

Automatic internal device test is done in this status. Output signalizations reflect status of insulation fault. Signal ON flashes in 500/500 regime while auto test, i.e. flashes in 0,5 sec rhythm.

- **Test**

User device's testing is done in this status. Output signalizations are set to fault status to verify outputs functions. Device also invokes auto test start to verify internal circuits. Signal *ON* flashes in 500/500 regime while test, i.e. flashes in 0,5 sec rhythm.

- **FE/KE fault**

This status occurs when the device is not properly connected to the measured system. It is necessary to check connection of functional grounding *FE* and control grounding *KE*. Output signalizations are set to fault status. Signal *ON* flashes in 100/100 regime, i.e. flashes in 0,1 sec rhythm.

- **FUcrit1 fault**

Voltage of monitored IT power supply system is lower than set *UnCrit* level. It is necessary to check presence of voltage at the device terminals and possibly change *UnCrtit* level. Output signalizations are set to fault status. Signal *ON* flashes in 100/100 regime, i.e. flashes in 0,1 sec rhythm.

- **Internal fault**

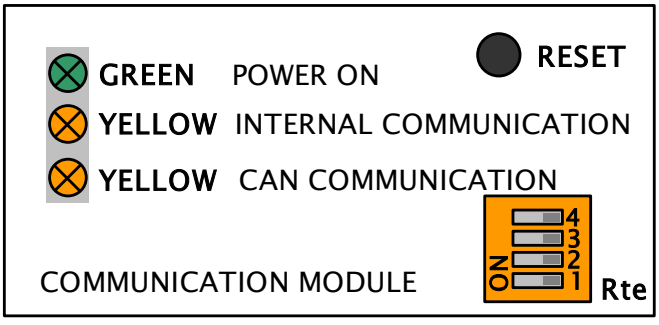
Device detects a fault in internal circuits and is unable to do the normal activity of insulation measurement. Output signalizations are set to fault status. Signal *ON* flashes in 100/100 regime, i.e. flashes in 0,1 sec rhythm.

- **R_F limit fault**

Device was not able to correctly evaluate the new insulation resistance sample. The IT network conditions are unsuitable for the measuring method used, with which the HIG99 monitor is equipped. Output signalizations are set to fault status. Signal *ON* flashes in 100/100 regime, i.e. flashes in 0,1 sec rhythm.

5.4 HIG99 KM CAN communication module signalization

HIG99 KM CAN communication module has three indicators on the front panel, which signal communication status. Also, there are communication reset push-button and switch for selecting CAN bus termination.



- **Green indicator lamp GREEN POWER ON**

  Flashes slightly (light flash once in a second) means normal operation. If signalization is in this regime, HIG99 KM CAN module is in normal status and no system fault occurred.

  Fast flashing means system fault. Fault can be associated with some communication signalization, see below.

  If fast flashing occurs, it is necessary to do system diagnostics. Information about fault meaning is accessible by communication protocol.

Following system faults are possible:

1. Problem in connection of communication module KM with measuring module MM, see further signalization *YELLOW INTERNAL COMMUNICATION*.
2. Problem with version of each HIG99 modules. Measuring module MM does not provide communication module KM with all the data that KM module needs for its function.

- **Yellow indicator lamp YELLOW INTERNAL COMMUNICATION**

  It signals the communication progress between KM module and measuring module MM. LED flashes regularly in normal regime.

  Permanently lit *YELLOW INTERNAL COMMUNICATION* signalization together with fast flashing of *GREEN POWER ON* means that KM module is unable to connect with measuring module MM.

- **Yellow indicator lamp YELLOW CAN COMMUNICATION**

  It is signalization of communication progress on CAN bus. LED flashes, if KM module sends a message on the CAN bus bar.

- **RESET push-button**

  Short press of the push-button resets communication on CAN bus (*NMT Reset Communication Protocol*). Long push-button pressing resets communication module HIG99 KM CAN (*NMT Reset Node Protocol*).

- ***Rte* switch for selecting CAN bus termination**

  CAN bus termination of HIG99 KM CAN module is determined by the setting of *Rte* switch according to following table.

CAN bus termination type	*Rte* switch settings			
	Position 1	Position 2	Position 3	Position 4
Not terminated Default status	OFF	OFF	OFF	any
Standard	ON	OFF	OFF	any
Split	ON	ON	OFF	any
Biased split	ON	ON	ON	any

Table 10: Setting CAN bus termination

Other *Rte* switch settings than specified in the table *"Table 10: Setting CAN bus termination"* are excluded. Such a termination will not be done correctly.

6 HIG99 device parameters

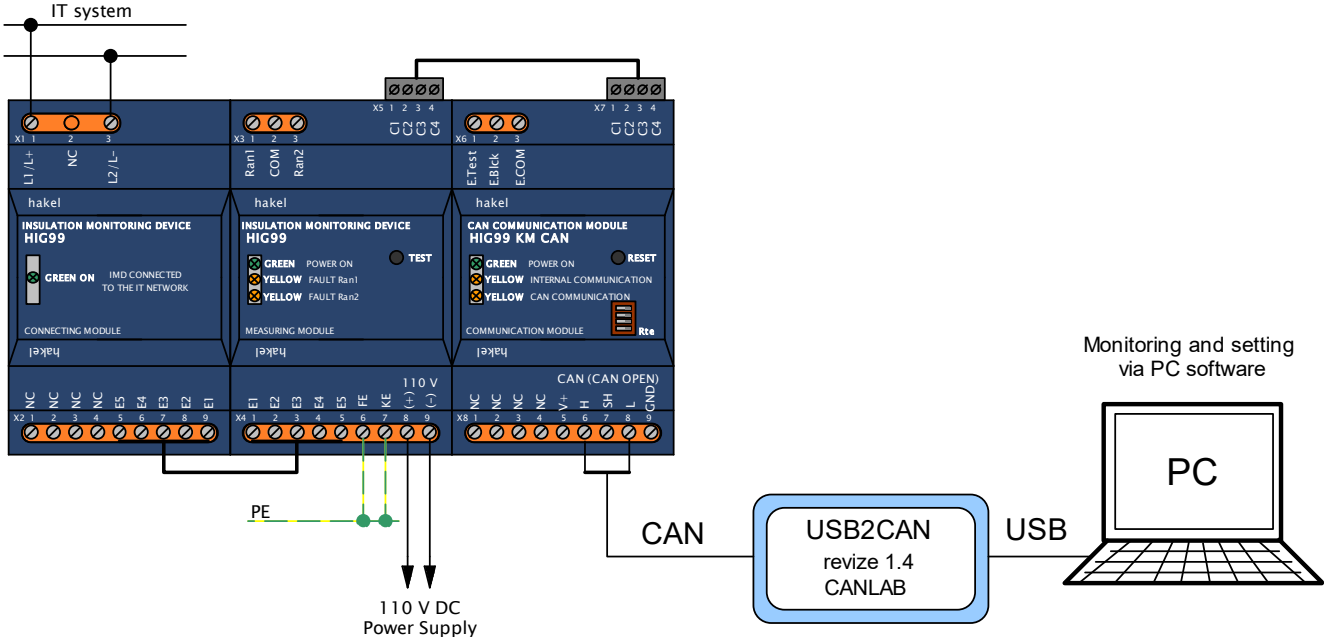
Device's operating features are determined by the control parameters settings.

Basic parameters are set by the producer to default values, which are listed in *Table 11: HIG 99 parameters default values*. It is possible to read or set all the device parameters using the communication line through connected KM module.

6.1 Device connection for parameters monitoring and setting

User's program for PC computers (Windows 10, .NET Framework 4.5.2. and higher) is provided by the producer to monitor device function and for control parameters setting.

Connection to PC computer is provided by CAN to USB converter. Verified type of converter is CANLAB CAN2USB, revision 1.4 (high speed).



Picture 3: Connection for device monitoring

6.2 Control parameters of the IMD

- Parameter ***Ran1*** – insulation resistance *RF* critical level.
  Insulation resistance *RF* critical level value at which (condition *RF* < *Ran1*) insulation status fault is signalled. Fault is signalled by *Ran1* relay settings. *RelayLogic* parameter determines *Ran1* relay status (closed/opened) when insulation status fault occurs. Critical level value is set as an integer expression in *k*Ω units, in 1 to 2 500 kΩ interval. Setting the relationship between *Ran1* and *Ran2* limit values, see Note 1.
- Parameter ***Ran2*** – insulation resistance *RF* warning limit.
  Insulation resistance *RF* warning level value at which (condition *RF* < *Ran2*) insulation status fault warning is signalled. Warning is signalled by *Ran2* relay settings. *RelayLogic* parameter determines *Ran2* relay status (closed/opened) when warning is signalled. Warning level value is set as an integer expression in *k*Ω units, in 1 to 2 500 kΩ interval. Setting the relationship between *Ran1* and *Ran2* limit values, see Note 1.
- Parameter ***Rhyst1*** – insulation status *Ran1* fault cancelation hysteresis.
  Insulation resistance *RF* hysteresis value for insulation status *Ran1* fault cancelation. The value is set as an integer expression in % units, in 0 to 100%.

Note:

1. *Described logic of Ran2 warning signalization before Ran1 insulation status fault signalization also assumed corresponding Ran1 and Ran2 values setting. This setting is completely done by the user. Device itself allows Ran1 and Ran2 setting in the whole range of values listed in technical parameters. The check of relation between Ran1 and Ran2 set values is not performed.*

- Parameter ***Rhyst2*** – hysteresis of insulation status fault *Ran2* warning cancelation.
  Insulation resistance R_F hysteresis value for insulation status fault *Ran2* warning cancelation. The value is set as an integer expression in % units, in 0 to 100% interval.

- Parameter ***RtON1*** – delay time to fault *Ran1*.
  Time value until insulation status fault signalization. This time can be set in 0 to 300 seconds range. The countdown is started when R_F falling below the *Ran1* value at a non-zero *RtON1* time value setting. The fault is evaluated and signalled by *Ran1* relay only after the *RtON1* time has elapsed.

- Parameter ***RtON2*** – delay time to warning *Ran2* emergence.
  Time value until reduced insulation resistance warning signalization. This time can be set in 0 to 300 seconds range. The countdown is started when R_F falling below the *Ran2* value at a non-zero *RtON2* time value setting. The warning is evaluated and signalled by *Ran2* relay only after the *RtON2* time has elapsed.

- Parameter ***UnCrit*** – monitored critical voltage level of IT power supply system.
  Parameter for setting the critical voltage value of IT power supply system. *UnFault* fault is announced if IT power supply system voltage falls below this limit. The value is set as an integer expression in volts, limit belongs to used coupling device.

- Parameter ***tTest*** – required external signal *E.Test* duration to the device test start.
  Parameter for setting the time for which the active state must be present (see parameter *ExtInputLogic)* at the *E.Test* input (X6.1 terminal) until the device test starts. This time is used to supress possible noise at the input. The time can be set in 1 to 60 seconds range.

- Parameter ***tBLCK*** – required external signal *E. Blck* duration to the device disconnection from monitored power supply.
  Parameter for setting the time for which the active state must be present (see parameter *RelayLogic)* at the *E.Blck* input (X6.2 terminal) until the device unblocking. This time is used to supress possible noise at the input. The same time is then applied to the request to connect the device to the monitored power supply. The time can be set in 1 to 60 seconds range.

- Parameter ***RelayLogic*** – setting of signalling relay *Ran1* and *Ran2* output logic.
  Parameter can be set to the value zero or one. The value determines signalling relay *Ran1* and *Ran2* logic.
  Possible statuses:

  RelayLogic = 0 … The fault is signalled by closed relay, no fault status is signalled by opened relay.
  RelayLogic = 1 … The fault is signalled by opened relay, no fault status is signalled by closed relay.

- Parameter ***ExtInputLogic*** – setting of *E.Blck* and *E.Test* inputs logic.
  Parameter value determines *E.Blck* and *E.Test* inputs signals logic. The parameter is set as an integer with 0 or 1 value.
  Possible statuses:

  ExtInputLogic = 0 (active zero):
  - The *tTEST* countdown begins and the test then starts by setting the GND level (i.e. *E.COM* terminal potential to *E.Test* terminal). Test termination is done by connecting +24 V voltage to this terminal.
  - The device is blocked (i.e. disconnected from the power supply) by setting the GND level (i.e. *E.COM* terminal potential to *E.Blck* terminal). The device is connected to the monitored power supply by connecting +24 V voltage to the terminal.

  ExtInputLogic = 1 (active one):
  - The *tTEST* countdown begins and the device test then starts by setting +24 V voltage (against *E.COM* terminal to *E.Test* terminal).
  - The device is blocked (i.e. disconnected from the power supply) after *tBLCK* time by setting the +24 V voltage (against *E.COM* terminal to *E.Blck* terminal). The device is connected to the monitored power supply at GND level at this terminal.

- Parameter ***HIG-CD*** – setting of used coupling device
  Parameter can be set to zero or two. The value sets if the coupling device is used and what type.

  Possible settings:

  HIG-CD = 0 … Coupling device is not used. IMD measures on its default range.
  HIG-CD = 2 … Type HIG-CD 3k6 is used.

Setting of parameter HIG-CD is necessary for properly function of IMD – measuring insulation resistance and voltage. If the parameter is set incorrectly, HIG99/3k6 will not measure correctly.

6.3 Values measured by the IMD

Communication via CAN bus allows reading device parameters and measured values. These values include:

- Device identification
- Device status, device test, connection to the measured power supply
- Actual value of insulation resistance
- IT power supply system voltage
- Monitored IT power supply system frequency
- Temperature inside the device
- Settings of all control parameters
- Additional system information

Complete description of measured values and additional information available via CAN bus is kept in a separate document *"HIG99 KM CAN Programming manual for CAN OPEN 2.0"*. The document is available at the producer.

6.4 Default values of HIG99/3k6 control parameters

Parameter	Symbol	Units	Value	Minimum	Maximum
RF critical level	***Ran1***	kΩ	250 kΩ	1	2 500
RF warning level	***Ran2***	kΩ	500 kΩ	1	2 500
Ran1 fault hysteresis	***Rhyst1***	%	20 %	0	100
Ran2 fault hysteresis	***Rhyst2***	%	20 %	0	100
Time to *Ran1* fault	***RtON1***	sec	0	0	300
Time to *Ran2* fault	***RtON2***	sec	0	0	300
Monitored critical value of IT power supply system voltage, note3)	***UnCrit***	V	40 V	40	4000
Duration of the external signal *E.Test*	***tTest***	sec	1	1	60
Duration of the external signal *E.Blck*	***tBLCK***	sec	1	1	60
Relay *Ran1* and *Ran2* logic*, note1)*	***RelayLogic***	-	0	0	1
Inputs *E.Blck* and E.*Test* logic, *note2)*	***ExtInoutLogic***	-	1	0	1
Used coupling device *HIG-CD*	***HIG-CD***		2	0	2

Table 11: Default values of HIG99 parameters

Notes:

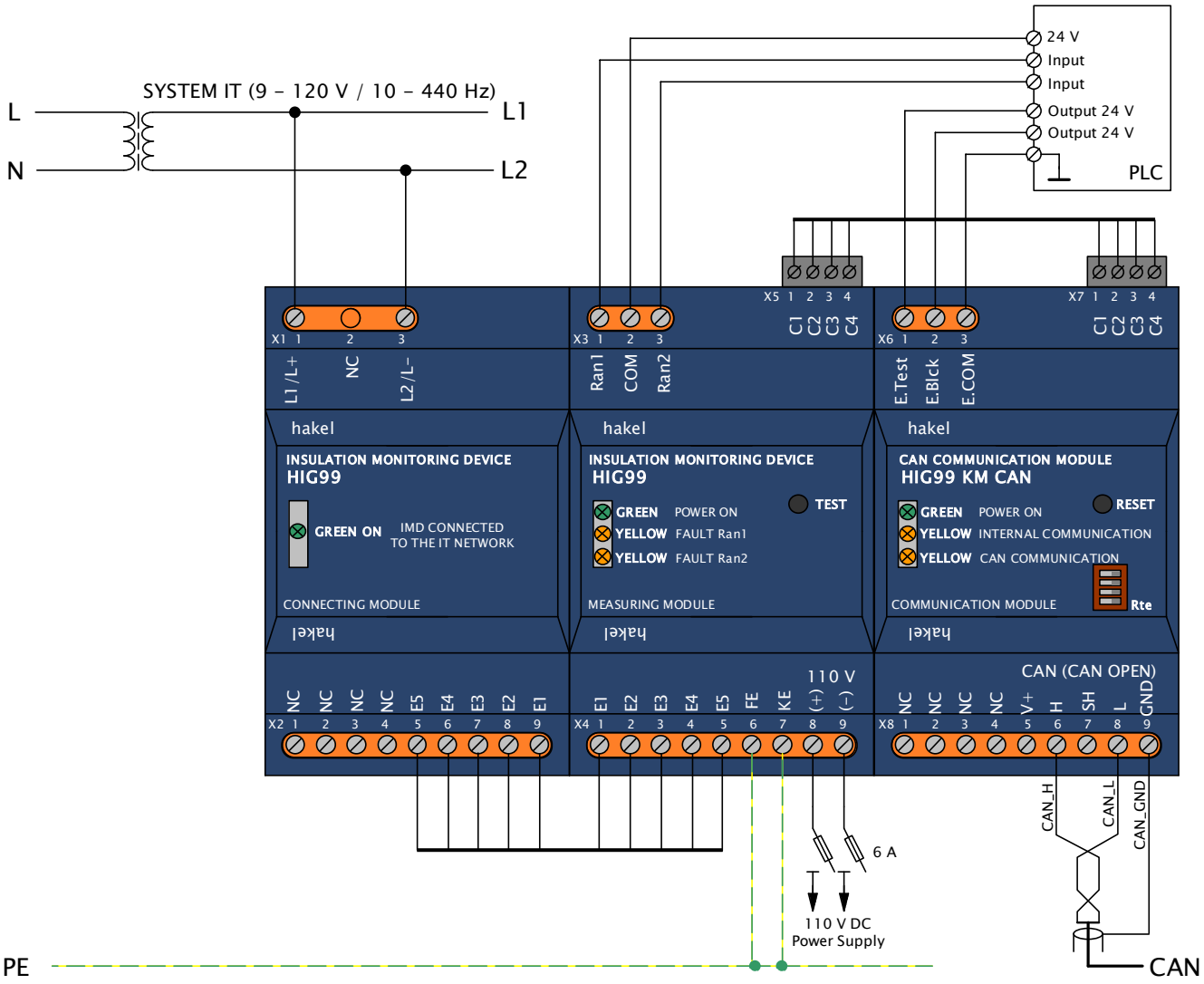
1. *Ran1 and Ran2 relay logic: default value 0 sets signalization of insulation resistance fault by relay closing.*
2. *E.Blck and E.Test inputs logic: default value 1 sets the activation of the input by setting the voltage +24 V (against the E.COM terminal).*
3. *Setting of critical value of IT power supply system voltage depends on used coupling device*

6.5 Communication with HIG99 KM CAN module

Communication module HIG99 KM CAN allows to communicate via CAN OPEN 2.0 protocol. Description of this protocol is kept in separate document *"HIG99 KM CAN Programming manual for CAN OPEN 2.0"*. The document is available at the producer.

7 Recommended connection to the monitored IT power supply system

7.1 Connection for single phase IT power supply monitoring

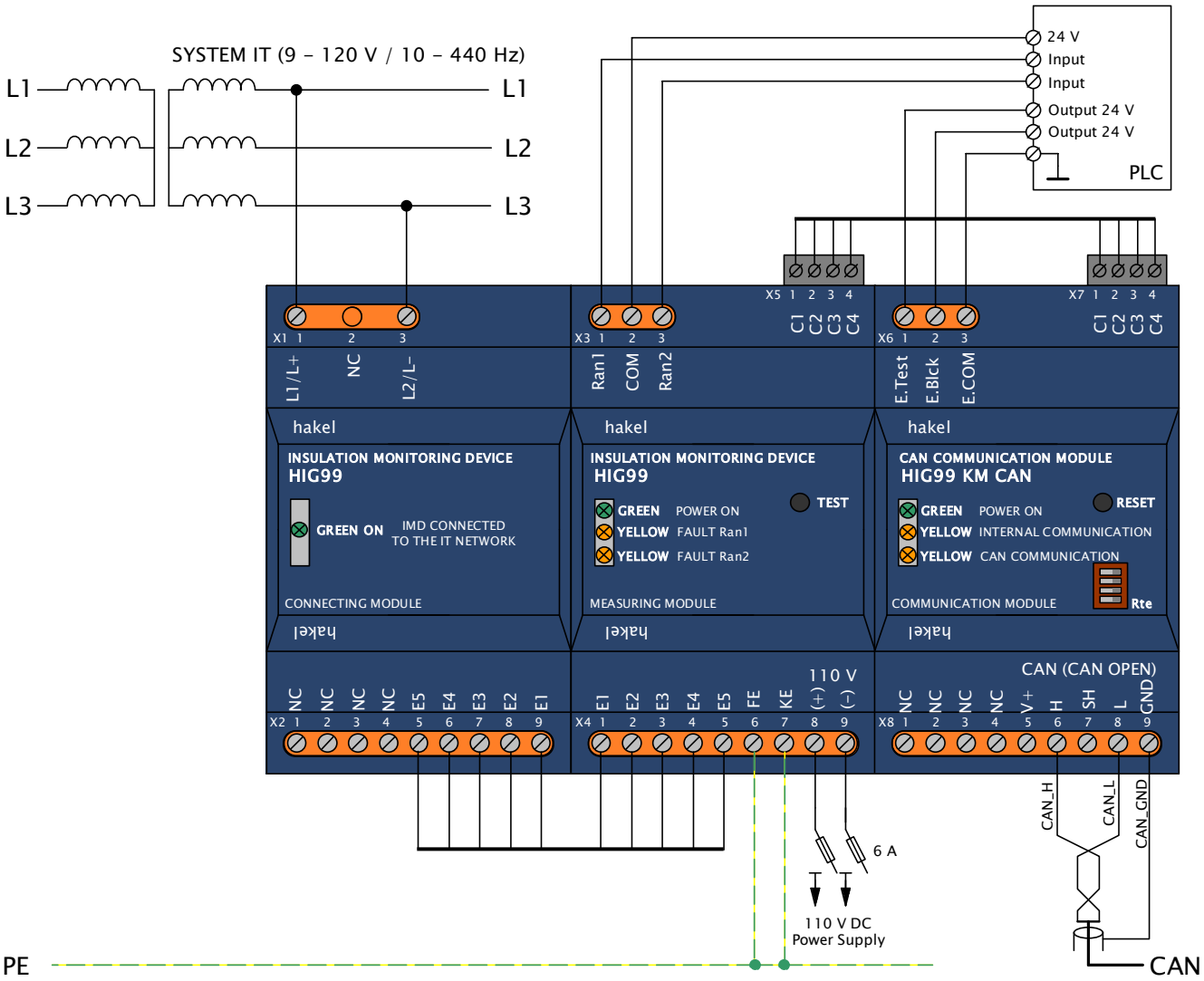


Picture 4: Single phase IT power supply connection diagram

Notes:

1. *FE and KE terminals must be connected by separate wire to the PE bridge.*
2. *NC (Not Connected) terminals remain unconnected.*
3. *X2.5-9 terminals and X4.1-5 (E1-E5) terminals are connected by the producer. This connection cannot be changed.*
4. *X5 connector, 1-4 terminals and X7 connector, 1-4 (C1-C4) terminals are connected by the producer. This connection cannot be changed.*
5. *CAN bus termination is set by Rte switch.*
6. *Follow the CAN bus line connection, any taps are not allowed.*
7. *When using a shielded cable for the CAN bus, bus shielding has to be connected across whole length and grounded at one point.*
8. *Install only one cable type along the whole length of the bus. Use twisted shielded pair for connection.*

7.2 Connection for three phase/multiphase IT power supply monitoring

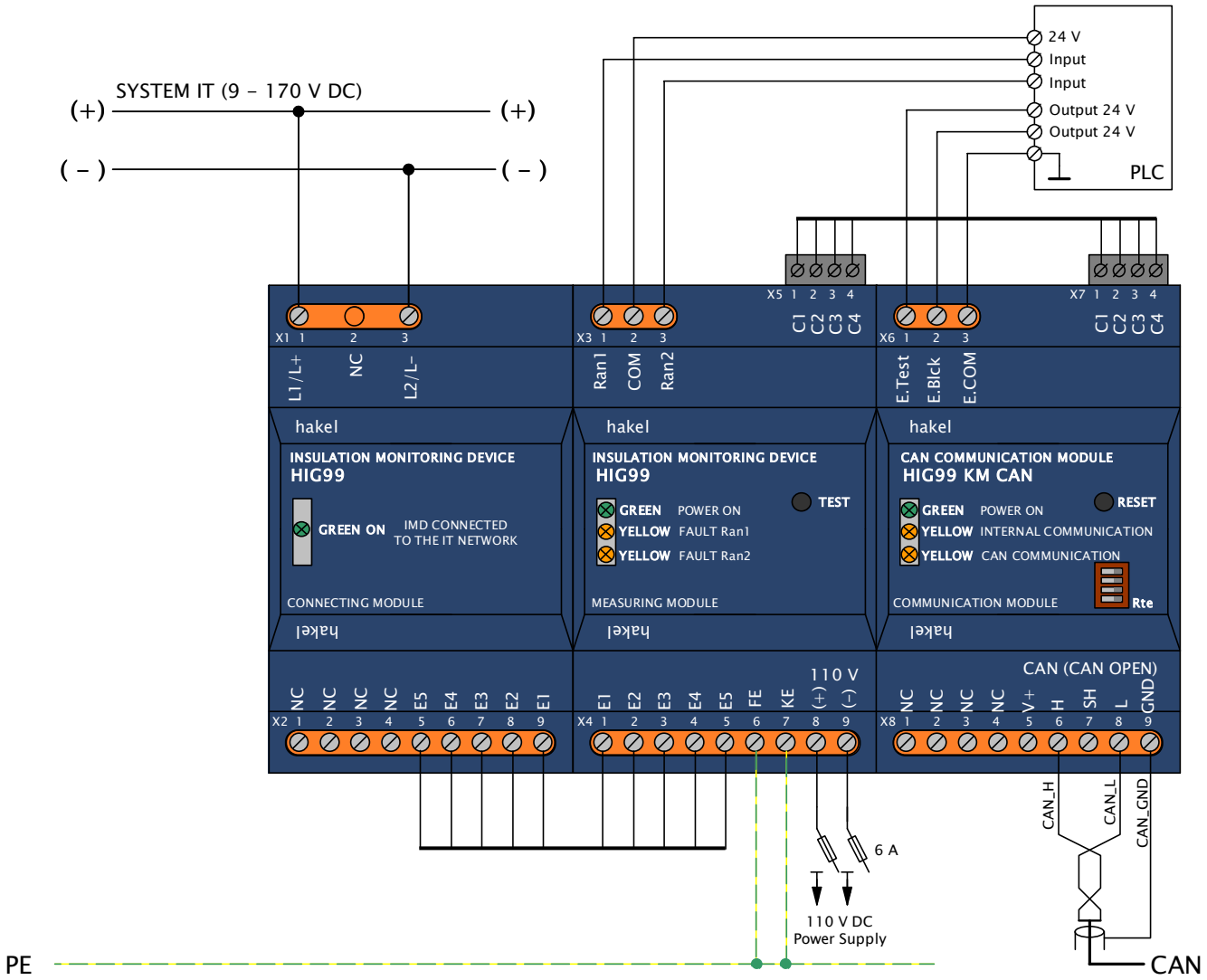


Picture 5: Multiphase IT power supply connection diagram

Notes:

1. *FE and KE terminals must be connected by separate wire to the PE bridge.*
2. *NC (Not Connected) terminals remain unconnected.*
3. *X2.5-9 terminals and X4.1-5 (E1-E5) terminals are connected by the producer. This connection cannot be changed.*
4. *X5 connector, 1-4 terminals and X7 connector, 1-4 (C1-C4) terminals are connected by the producer. This connection cannot be changed.*
5. *CAN bus termination is set by Rte switch.*
6. *Follow the CAN bus line connection, any taps are not allowed.*
7. *When using a shielded cable for the CAN bus, bus shielding has to be connected across whole length and grounded at one point.*
8. *Install only one cable type along the whole length of the bus. Use twisted shielded pair for connection.*

7.3 Connection for DC power supply

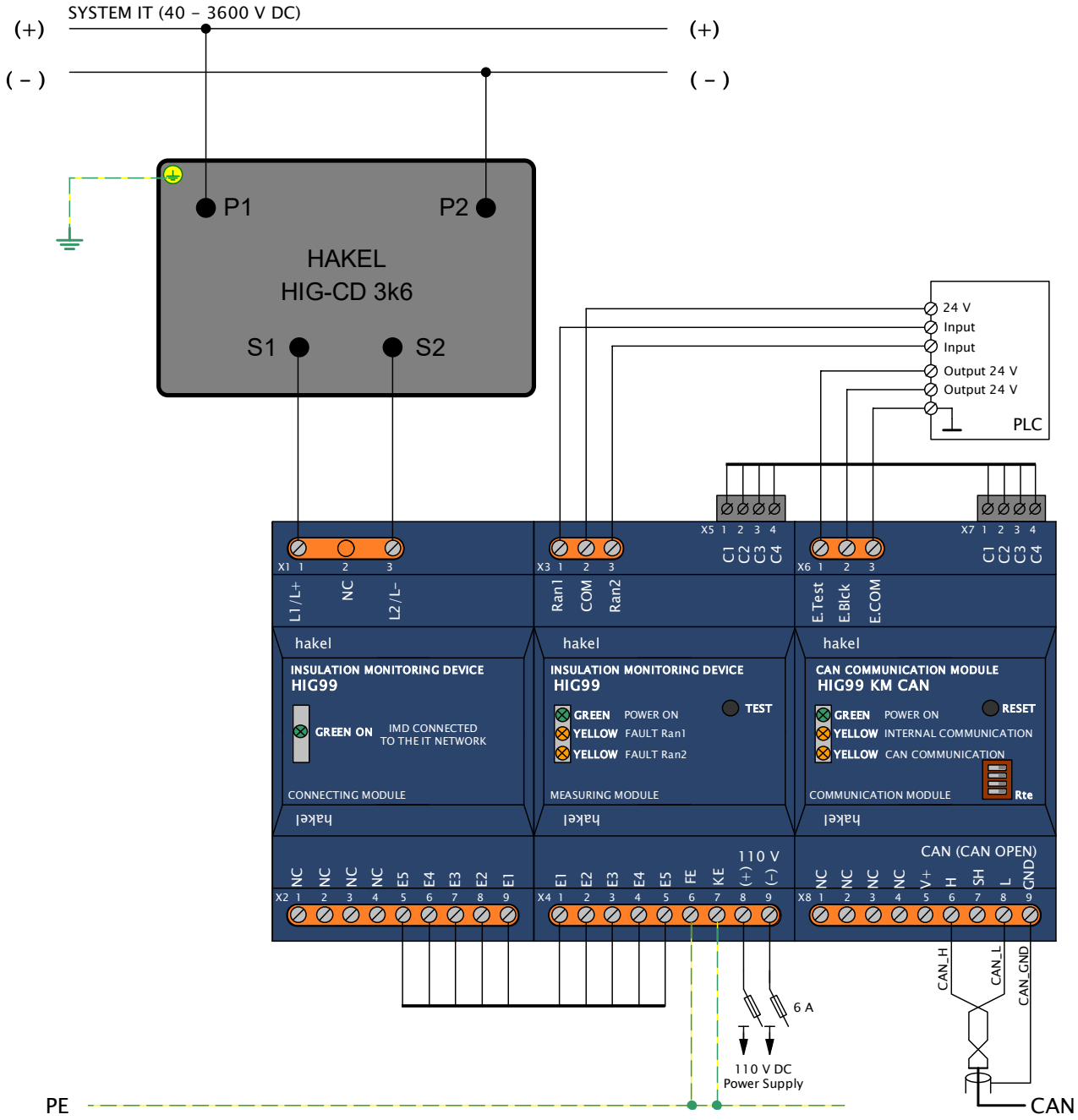


Picture 6: DC IT power supply connection diagram

Notes:

1. *FE and KE terminals must be connected by separate wire to the PE bridge.*
2. *NC (Not Connected) terminals remain unconnected.*
3. *X2.5-9 terminals and X4.1-5 (E1-E5) terminals are connected by the producer. This connection cannot be changed.*
4. *X5 connector, 1-4 terminals and X7 connector, 1-4 (C1-C4) terminals are connected by the producer. This connection cannot be changed.*
5. *CAN bus termination is set by Rte switch.*
6. *Follow the CAN bus line connection, any taps are not allowed.*
7. *When using a shielded cable for the CAN bus, bus shielding has to be connected across whole length and grounded at one point.*
8. *Install only one cable type along the whole length of the bus. Use twisted shielded pair for connection.*

7.4 Connection for IT power supply monitoring using coupling device HIG-CD 3k6



Picture 7: DC IT power supply connection diagram using coupling device

Notes:

1. *If the voltage of IT power supply exceeds 3000V DC, for galvanic isolation of input, output and power supply circuit there is need of additional external galvanic isolation*
2. *Coupling device HIG-CD 3k6 have to be connected to protective bonding.*
3. *FE and KE terminals must be connected by separate wire to the PE bridge.*
4. *NC (Not Connected) terminals remain unconnected.*
5. *X2.5-9 terminals and X4.1-5 (E1-E5) terminals are connected by the producer. This connection cannot be changed.*
6. *X5 connector, 1-4 terminals and X7 connector, 1-4 (C1-C4) terminals are connected by the producer. This connection cannot be changed.*
7. *CAN bus termination is set by Rte switch.*
8. *Follow the CAN bus line connection, any taps are not allowed.*
9. *When using a shielded cable for the CAN bus, bus shielding has to be connected across whole length and grounded at one point.*
10. *Install only one cable type along the whole length of the bus. Use twisted shielded pair for connection.*

8 Installation instructions for HIG99/3k6 a HIG99 KM CAN

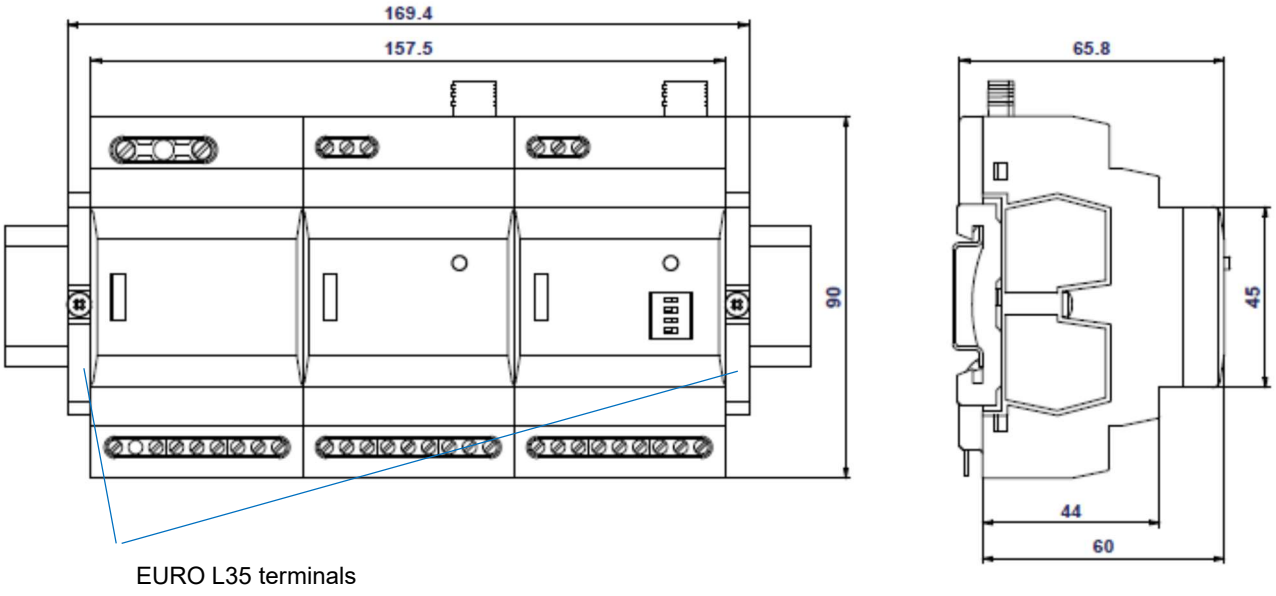
Operation, installation and maintenance can be done only by qualified personnel according to assembling and safety regulations. If the device is used in the way not specified by the producer, protection provided by the device could be disrupted.

ISOLGUARD HIG99/3k6 a HIG99 KM CAN is intended for assembling on 35 mm DIN rail according to IEC 715:1981. Any working position.

- *NC (Not Connected)* terminals remain unconnected, it is forbidden to connect them.
- *FE* and *KE* terminals must be connected by separate wire to the PE bridge.
- X2 and X4 terminals connection is done by the producer and cannot be changed.
- X5 and X7 connectors' connection is done by the producer and cannot be changed.
- It is possible to use *Rte* switch for CAN bus termination.
- Follow the CAN bus line connection, any taps are not allowed.
- Install only one cable type along the whole length of the bus.

Installation for rail vehicles

In rail vehicles applications apply, that the device including the communication module is installed on DIN35 rail between two EURO L35 terminals. These EURO L35 terminals are part of the HIG99 delivery.



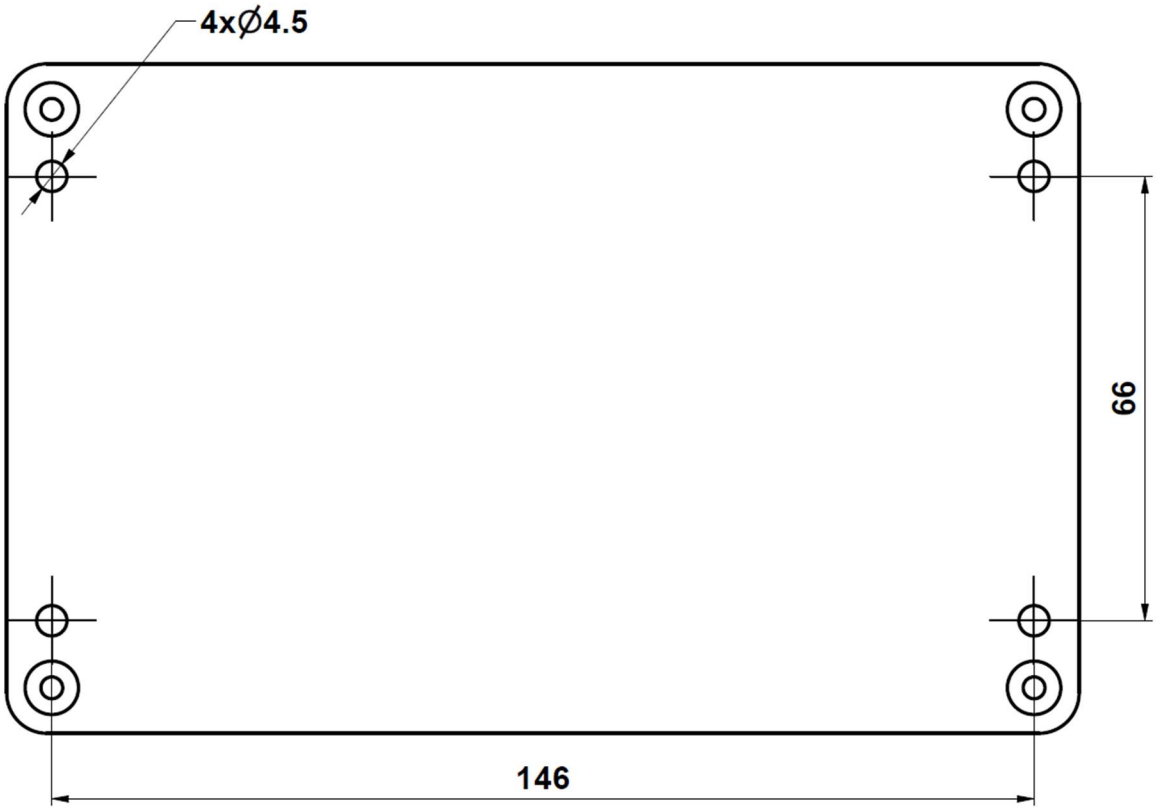
Picture 8: Device installation for applications on rail vehicles

9 Installation of HIG99-CD 3k6

Operation, installation and maintenance can be done only by qualified personnel according to assembling and safety regulations for work on high-voltage. If the device is used in the way not specified by the producer, protection provided by the device could be disrupted.

During operation of HIG-CD 3k6, the generated power loss may cause getting the housing hot. The temperature on surface may reach 100 °C. The user has to ensure that the touch of surface of HIG-CD 3k6 will not be possible.

ISOLGUARD HIG-CD 3k6 coupling device is intended for installation on distribution board, using 4 screws. Maximum diameter of screw is 4,5 mm.



Picture 9: Mounting holes on HIG-CD 3k6 housing

Maximum ambient temperature

When the product is operating at maximum voltage (3 600 V DC), surface of the device warms up by approx. 20 °C. However, this temperature can rise rapidly in case of insulation resistance failure. In the worst possible case (short circuit between IT power supply and related protective earth) it may warm up the surface of the device by 60 °C.

It follows that:

- The ambient temperature must not exceed 40 °C in case that the generated heat is not taken away from the product. Surface temperature of coupling device does not exceed 100 °C in this case.
- The ambient temperature must not exceed 70 °C in case that the active cooling is ensured and the product is mounted on aluminium board, so that the maximum surface temperature is 100 °C.

10 Maintenance and service

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

Only the producer provides repairs of the device. No personnel are needed to operate the insulation monitoring device. During operation, the operator of the technological unit is informed about the state of the monitored power supply and transformer by local and remote signalization.

11 Producer

Producer of HIG99/3k6 insulation monitoring device, HIG99 KM CAN module and HIG-CD 3k6 coupling device is:

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