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Tel +44 (0) 116 464 7480
www.starkstrom.com
33, Turn Street, Leicester LE7 1HP

Insulation Monitor (IPM)

Product Description

The IPM is designed to monitor ohmic insulation resistance between line/neutral and earth in isolated power systems up to 240VAC/300VDC. The IPM is designed to meet EN61557-8 requirements for insulation monitors in industrial and medical environments.

The IPM can detect AC and DC faults in AC or DC power systems (Type AC/DC). This includes failure detection in AC power systems with rectifiers and failure detection in DC power systems with inverters.

The IPM has several additional features such as included search current generator for failure location detection (additional device for localisation required), one change over relay contact, two NO-Solid-State-Relays contacts, four digital inputs, transformer load monitoring, transformer temperature monitoring, one RS485 with Modbus Protocol for reading device measurement values and alarms and one RS485 to communicate with fault localisation devices.

The IPM shows current measurement values, status, and alarms to the user with a 1,6” full colour screen and four LEDs displaying the IPM status. The user can access password secured menu to change device settings with 4 integrated buttons.

Function

Isolation monitoring

The measurement circuit is continuously connected to the monitored IT power system (line/neutral) and earth (PE).

A pulsing dc voltage is superimposed into the monitored network and the earth for the insulation fault measurement. Because of an ohmic insulation fault the flowing measurement current is captured and evaluated through a special evaluating principle.

All capacitance from line to earth extends the measurement time. Therefore, the IPM is automatically adjusting the measurement time to the actual network conditions. The greater the capacitance from line to earth is, the longer the measurement time is.

The IPM can detect insulation faults behind rectifiers on dc-voltage side, while the IPM is connected to the ac-voltage side of a rectifier. The IPM is shows the detected type of insulation failure as an ac, dc+ or dc failure.

Warning: Galvanically coupled rectifiers and inverters must carry a minimum load current of 5mA to their valves for proper insulation fault detection.

The current insulation measurement value and IPM status are displayed on the screen. Additionally, the measurement values and IPM status are readable via the RS485 interface.

The connection of the unit to earth is evaluated in a continuous way to prevent the loss of information and safety. Therefore, you must connect the terminals E and KE directly and separate from each other to the earth bar in your system.

Warning: A direct and short connection near the terminals will work but will decrease the safety of the system.

The IPM has two independent trip points, which can be set in the range of 50kΩ to 1000kΩ. Each trip point can be assigned to one of the three alarm relays. If one of the trip-point is exceed, an insulation alarm generated by the assigned relay and on the device screen/status LEDs.

After switching on the IPM, the unit will prepare an automatic self-test procedure. The internal measurement circuits, as well as the correct connection to earth are tested. This check is repeated continuously using a time interval, which is adjustable in the device settings. The self-test function needs around 15 seconds, during the self-test execution all measurement functions are interrupted.

During normal operation a test alarm can be manually started by holding the “ESC”-button for at least 3 seconds on the main screen. It is also possible to start the test function via the Modbus. For checking the function of the alarm relay, the alarm-hold-state is settable to 5 seconds by the user. Additionally, when a unit self-test is performed all four LEDs light up white to check their functionality.

Transformer load monitoring

A current transformer with ratio 1 by x is need for performing the transformer load monitoring function. The load value is calculated by the processor based on the measured current and the set Ct ratio/power-system-voltage. The load value is readable on the screen or via the RS485 interface.

If the measured load exceeds the set trip point for an adjustable delay time, an alarm is shown. Short and open transformer-load circuits are also detected from the IPM.

Warning: The transformer load monitoring circuit is **not** galvanically separated from isolated power system/earth circuit. Connections between transformer load monitoring circuit and earth or power system can influence isolation measurement.

Transformer temperature monitoring

The isolation transformer temperature can be monitored with the IPM, temperature sensors bi-metal NO/NC, PTC, 2xPTC, PT100 and 2xPT100 are available.

The status/measured temperature value is displayed on screen and can be read via the RS485 interface.

Where the measured temperature exceeds set trip point (PT100, 2xPT100 only, other sensors have only good/bad determination), an alarm will be generated after an adjustable delay time.

Short/open temperature sensor (not available for bi-metal NO/NC) will be detected from the IPM and will give an alarm.

Note: If using PT100/2xPT100 temperature sensor, wire resistance will influence temperature measurement. Higher wire resistance will cause higher temperature measurement.

Warning: The transformer load monitoring circuit is **not** galvanically separated from isolated power system/earth circuit. Connections between transformer load monitoring circuit and earth or power system can influence isolation measurement.

Search Current Generator

The IPM also includes a search current generator, which enables the IPM to locate insulation faults if a CS device is connected to the system communication bus (CB).

If the search function is set to Auto, the search cycle starts immediately, if the isolation value drops below the set trip point and a CS device is connect to the IPM. This search cycle will be repeated if measured isolation value changes ±50% from the value measured on last search cycle or every 60s after last search cycle was complete. If a CS device locates a failure, the device and Ct address where the failure was located is displayed on an alarm banner.

Warning: When a search cycle is running, isolation value measurement is disabled.

Alarm Relays

The IPM has three independent alarm relays. Each relay is configurable in active or failsafe mode (NO/NC).

K1 has a changeover contact, K2 and K3 are solid-state-relays with a NO contact.

All alarms from the IPM can be assigned individually and independent to the three alarm relays.

Additionally, alarms can be stored to require a user to reset an alarm.

The relays can be configured to switch to alarm mode when a test alarm is started or not.

Note: Each of the three alarm relays are galvanically separated from all other IPM electronic circuits.

Digital inputs

The IPM contains four external digital inputs.

Warning: The digital inputs are not galvanically separated from isolated power system/earth circuit.

Connections between the digital inputs and earth or power system can influence isolation measurement.

The four inputs are **not** volt-free

Due to this reason, the usage of volt-free contacts for switching the digital inputs is recommended.

The digital inputs have a voltage rating of max 12VDC when open, and when short the current will be less than 5mA.

The inputs can be configured as normally open (NO) or normally closed (NC) contacts. Additionally, inputs can be configured to be used for an external test button. The actual state of the digital inputs can be seen on the display or read out via RS485 interface.

It is also possible to assign the state of the digital input to an alarm relay.

CB – Communication Bus Interface

The CB interface (RS485) is for communication with additional devices, such as the CS device or other future devices. The IPM collects all data from connected devices. All stored data received from connected devices are readable via the MB interface.

Note: CB interface is galvanically separated from all other circuits in the IPM

MB – Modbus Interface

With the MB interface (RS485) it is possible to read the actual device state and measurement values using the Modbus protocol.

It's possible to set the registers to be downwards compatible with the registers from previous IPM/EDS. There is no change in Modbus communication required when replacing an old IPM/EDS for a new IPM device.

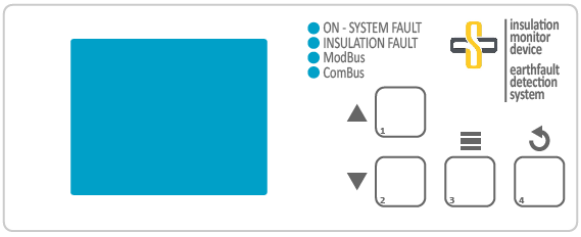
The Modbus interface will generate an alarm where there are communication issues or if the device was not polled in the last 15 seconds.

It is possible to disable the Modbus interface where it is not needed to suppress communication failure alarm.

It is possible to start a test alarm and self-test on the IPM via the MB interface.

Note: MB interface is galvanically separated from all other circuits in the IPM

Control and Signalling



LED "On/System Fault"

During normal operation the "ON" LED is green. In case of a pending failure, with exception of an insulation fault, the LED is red.

LED "Insulation Fault"

During normal operation the "Insulation Fault" LED is off. In case of a detected insulation fault, the LED will be yellow.

LED "MB"

This LED is for signalling the Modbus communication state. Bad communication is red, good communication is green. The LED is off during no communication.

LED "CB"

This LED is for signalling the CB communication. Bad communication is red, good communication is green. The LED is off during no communication.

▲ - Button

The “Plus” push-button is for menu navigating and for increasing a value in edit mode.

▼ - Button

The “Minus” push-button is for menu navigating and for decreasing a value in edit mode.

☰ - Button

The “Menu/Enter” push-button is for entering the set-up menu, for selecting an edit point and for storing the adjusted values.

↺ - Button

The “ESC” push-button is for exiting the set-up menu and to abort a current edit state. The push-button is also for calling the test function (if no alarm is pending). If an alarm is pending, but no longer active the push-button quits the fault.

Device Menu Overview

To enter device menu, press “Menu/Enter ☰ “ Button when main screen is displayed. Before you can enter the device menu, the correct password is required. Use the “Plus ▲ “/“Minus ▼ “ Buttons to adjust each digit, press “Menu/Enter ☰ “ Button to adjust next digit. After entering the last digit, the display will show the main menu when entered password was correct, otherwise the device will go back to main screen.

To protect the unauthorised change of settings, the device returns automatically back to main screen, when no action has taken place since 120s. This protects IPM from setting changes from unauthorised persons.

The following menu points are available from main menu:

Main menu	Sub menu	Value Range Factory Setting	Description
Iso Trip 1	Trip Value	50kΩ - 1000kΩ **100kΩ**	Trip point for alarm activating. If current value drops below this trip point, the alarm becomes active.
	Hysteresis	1% - 25% **20%**	Hysteresis for alarm reset. Alarm will/can reset if current value is higher than trip value + hysteresis. For example: Trip point is 200kΩ and hysteresis is 10% → alarm is/can be reset when current value is higher than 220kΩ.
	Reset Mode	Auto, Manual **Auto**	“Auto” setting means alarm reset by automatic if current value exceeds trip point + hysteresis. When “Manual” setting is used, the alarm must manually reset by the user. The user must press “Reset ↺ “-Button on main screen to reset alarm. The alarm reset is only possible if current value exceeds trip point + hysteresis.
Iso Trip 2	Trip Value	50kΩ - 1000kΩ **50kΩ**	Trip point for alarm activating. If current value drops below this trip point, the alarm becomes active.

	Hysteresis	1% - 25% **20%**	Hysteresis for alarm reset. Alarm will/can reset if current value is higher than trip value + hysteresis. For example: Trip point is 200kΩ and hysteresis is 10% → alarm is/can be reset when current value is higher than 220kΩ.
	Reset Mode	Auto, Manual **Auto**	"Auto" setting means alarm reset by automatic if current value exceeds trip point + hysteresis. When "Manual" setting is used, the alarm must manually reset by the user. The user must press "Reset ↻ "Button on main screen to reset alarm. The alarm reset is only possible if current value exceeds trip point + hysteresis.
TFO Temp	Sensor Type	NO; NC, PT100, 2xPT100, PTC, 2xPTC **PTC**	Temperature sensor types which can used with the IPM. 2xPTC and 2xPT100 means two sensors from this type connected in series. Changing sensor type from NO/NC/PTC/2xPTC to PT100/2xPT100 requires check / adjustment from temperature trip value and hysteresis.
	Trip Value	1800Ω (NO, NC, PTC, 2xPTC) 50°C-160°C (PT100, 2xPT100) **1800Ω**	Trip point for activating alarm. If current value exceeds this value, the alarm becomes active. Changing sensor type from NO/NC/PTC/2xPTC to PT100/2xPT100 requires check / adjustment from temperature trip value.
	Hysteresis	10% (NO, NC, PTC, 2xPTC) 1-25°C (PT100, 2xPT100) **10%**	Hysteresis for alarm reset. Alarm will/can be reset if current value is lower than trip value - hysteresis. For NO, NC, PTC, 2xPTC sensors reset value has fix setting to 1620Ω. For example (PT100, 2xPT100): Trip point is 120°C and hysteresis is 10°C → alarm is/can be reset when current value is lower than 110°C. Changing sensor type from NO/NC/PTC/2xPTC to PT100/2xPT100 requires check / adjustment from hysteresis.
	Reset Mode	Auto, Manual **Auto**	"Auto" setting means alarm reset by automatic if current value drops below trip point - hysteresis. When "Manual" setting is used, the alarm must reset by the user. The user must press "Reset ↻ "Button on main screen to reset alarm. The alarm reset is only possible if current value is below trip point - hysteresis.
	Trip Delay	0s – 99s **0s**	Trip delay is time span between alarm condition becomes true and alarm will be tripped. If measured value drops below trip value – hysteresis during trip delay is running, tripping will be aborted.
TFO Load	Line Voltage	85V - 240V **230V**	Line voltage value is required to calculate load in VA with measured current and Ct-ratio.
	CT Ratio	1:100 – 1:9999 **1:1000**	Ct-ratio value is required to calculate load in VA with measured current and line voltage value.
	Trip Value	100VA – 99999VA **3400VA**	Trip point for activating alarm. If current value exceeds this value, the alarm becomes active.
	Hysteresis	1% – 25% **20%**	Hysteresis for resetting alarm. Alarm will/can be reset if current value is lower than trip value – hysteresis. For example: Trip point is 5000VA and hysteresis is 10% →

			alarm is/can be reset when current value is lower than 4500VA.
	Reset Mode	Auto, Manual **Auto**	Setting “Auto” means the alarm is reset automatic if current value drops below trip point - hysteresis. When used setting “Manual” the alarm is not reset automatic, user must press “Reset ↻ “Button on main screen to reset alarm. The alarm can be reset only if current value is below trip point - hysteresis.
	Trip Delay	0s – 99s **0s**	Trip delay is time span between alarm condition becomes true and alarm will be tripped. If measured value drops below trip value – hysteresis during trip delay is running, tripping will be aborted.
Relays	Trip Point 1	K1, K2, K3 **K1**	Alarm relay selection for alarm type.
	Trip Point 2	K1, K2, K3 **K2**	Alarm relay selection for alarm type.
	Earth Connection	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	Measure Voltage Failure	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	Comm fault internal	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	Failure Settings	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	Failure Calibration	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	Comm fault Modbus	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	Comm fault CB	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	Alarm Temperature	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	Temperature open	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	Temperature short	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	Alarm Load	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	Load open	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	Load short	K1, K2, K3 **K3**	Alarm relay selection for alarm type.

	Test Alarm K1	On, Off **On**	Relay K1 should display test alarm
	Test Alarm K2	On, Off **On**	Relay K2 should display test alarm
	Test Alarm K3	On, Off **On**	Relay K3 should display test alarm
	Input 1	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	Input 2	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	Input 3	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	Input 4	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	Alarm CB Device	K1, K2, K3 **K3**	Alarm relay selection for alarm type.
	K1	Open circuit, closed circuit **Closed circuit**	Setting “Open circuit” means that relay contact has same state in non-alarm state as in device turned off state. Setting “Closed circuit” means that relay contact has same state in alarm state as in device turned off state.
	K2	Open circuit, closed circuit **Closed circuit**	Setting “Open circuit” means that relay contact has same state in non-alarm state as in device turned off state. Setting “Closed circuit” means that relay contact has same state in alarm state as in device turned off state.
	K3	Open circuit, closed circuit **Closed circuit**	Setting “Open circuit” means that relay contact has same state in non-alarm state as in device turned off state. Setting “Closed circuit” means that relay contact has same state in alarm state as in device turned off state.
Search Current	Trip Point 1	Auto, Off **Auto**	“Auto” setting starts search cycle if insulation value falls below trip point and at least one CS device is configured.
	Trip Point 2	Auto, Off Auto	“Auto” setting starts search cycle if insulation value falls below trip point and at least one CS device is configured.
Inputs	Input 1	NO, NC, external test button (NO/NC) **NO**	Setting “NO” rise an alarm if input contact is closed. Setting “NC” rise an alarm if input contact is open. Setting “external test button” starts device self-test if contact is closed/open.
	Input 2	NO, NC, external test button (NO/NC) **NO**	Setting “NO” rise an alarm if input contact is closed. Setting “NC” rise an alarm if input contact is open. Setting “external test button” starts device self-test if contact is closed/open.

	Input 3	NO, NC, external test button (NO/NC) **NO**	Setting “NO” rise an alarm if input contact is closed. Setting “NC” rise an alarm if input contact is open. Setting “external test button” starts device self-test if contact is closed/open.
	Input 4	NO, NC, external test button (NO/NC) **NO**	Setting “NO” rise an alarm if input contact is closed. Setting “NC” rise an alarm if input contact is open. Setting “external test button” starts device self-test if contact is closed/open.
Modbus	Baud rate	2400 – 19200 **9600**	Defines baud rate for Modbus communication.
	Parity	No parity/1 Stop bit, No parity/2 Stop bits, Even parity/1 Stop bit Odd parity/1 Stop bit **Even parity/1 Stop bit**	Defines parity and stop bit number in Modbus communication
	Address	1 – 247 **1**	IPM500 Modbus Address
	Register Mode	IPM500 IPM/EDS400 **IPM500**	Register Mode, with settings IPM/EDS400 Modbus registers are downwards compatible to IPM/EDS400.
CB	Device 1…5	Empty, CS6 (6CT), EDS (18CT) **All slots empty**	List of CB interface registered devices. To start the registration process, press the “Menu/Enter” button and in following the “Add Device” menu entry. The user must confirm the registration process at the device to be register. Please read manual from specific devices to see how the registration process is to perform. Press “ESC” -Button to abort the registration process. To unregister an EDS, you must press the “Menu / Enter “button and in following the “Delete Dev.” Menu entry. The selected device will be unregistered. EDS400 compatible Modbus register are available if the EDS is registered on positions 1 (CT1 – CT16) or CS6 device registered on positions 1, 2, 3. On position 3 only CTs 1-4 are readable via Modbus (16 CTs maximum).
		Add Dev. Delete Dev.	Add new device to empty slot or delete device from used slot.
		CT Type: CTV200 CTS600 **CTS600**	Select connected ct type. All connected ct’s have to be from this type.
		CTxx: ON, OFF **OFF**	Select if a Ct is connected or not.
		SxxxxxxRxx	Software revision used on device
System	Self-Test Interval	1min – 1440min **360min**	Time interval for automatic self-test and earth connection check.

	Temperature Monitor	Disable, Enable **Enable**	Temperature monitor and alarm function on IPM.
	Load Monitor	Disable, Enable **Enable**	Load monitor and alarm function on IPM.
	Modbus Communication	Disable, Enable **Enable**	Modbus communication and alarm function on IPM.
	Factory Settings	Yes, No	Choosing “Yes” will reset all device settings to factory settings, “No” keeps all device settings as they are.
	Change Password	0000 – 9999 **7875**	New password for entering device menu. 1971 is unchangeable master password.
	Software Rev		Software revisions actually used on IPM.

Warning: Failure to use the equipment as described in this data sheet may affect the protection provided by the equipment**.**

Note: Read the manual before starting installation, connection, or commissioning. Keep the manual handy after startup.

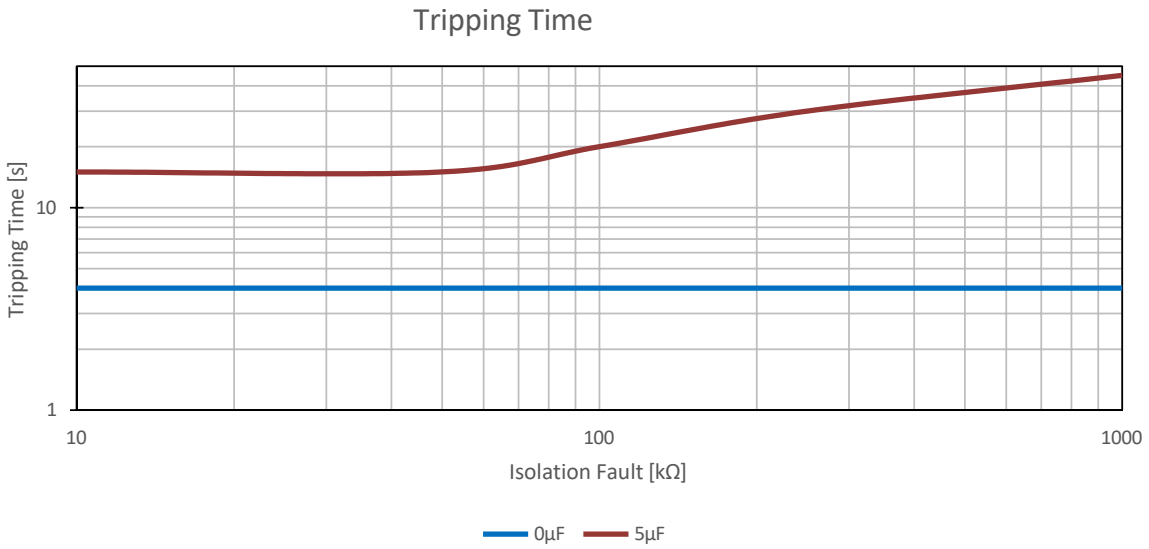
Note: The installer is responsible for the safety of the system in which the device is used.

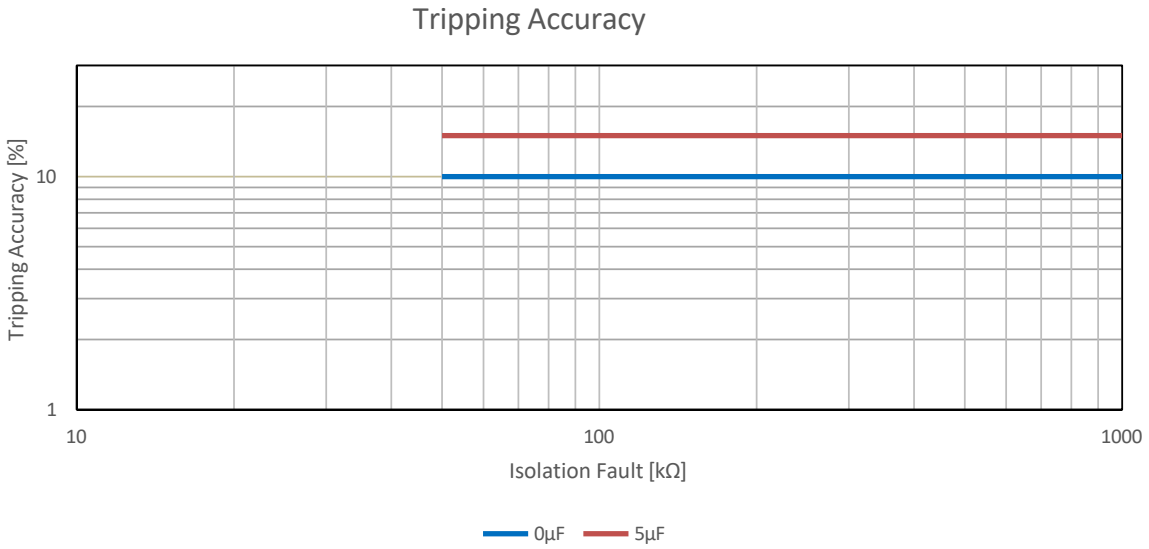
Tripping-accuracy and tripping-time

The following diagrams are showing the tripping-accuracy and the tripping-time of the device, in dependence from insulation resistance and leakage capacitance of the monitored network.

The diagrams are valid for AC networks with 50Hz, 0µF and 5µF leakage capacitance, with an insulation failure on one or more AC or DC wires.

Depending on the real network parameters (leakage capacitance, frequency, DC failure, disturbance, time the failure occurs) deviations are possible.





Insulation

Overvoltage category	III
Air and creepage distance	EN61010-1
Pollution degree	2
Voltage test IEC61010-1	
Circuit I:	L1/L2/E/KE/Z1/Z2/CT k/CT l/I1/I2/I3/I4/I Com
Circuit II:	11/12/14
Circuit III:	23/24
Circuit IV:	33/34
Circuit V:	MB a/MB b
Circuit VI:	CB a/CB b
I – II	51kV
I – III	51kV
I – IV	51kV
I – V	21kV
I – VI	21kV
II – IV	51kV
V – VI	21kV

Supply Voltage

Supply voltage Us	85 - 300VDC
	85 – 240VAC, 47 - 440Hz
Self-consumption	< 6VA

Monitored IT Power Network

Nominal voltage Un	85 - 300VDC 85 - 240VAC
Nominal frequency	0Hz, 50Hz
Max. capacitance to earth	5µF
Max. allowed external voltage	340VDC
Measurement voltage	<25VDC
Measurement current	<0,1mA
Internal measurement circuit resistance	>290kΩ
Measurement circuit impedance (50Hz)	>290kΩ

Temperature Monitor

Sensor types	Bi-Metal NO/NC, PT100, 2xPT100, PTC, 2xPTC
Measure range PT100/2xPT100	0 – 200°C
Trip resistance Bi-Metal NO/NC, PTC	1800Ω
Trip resistance 2xPTC	3600Ω
Hysteresis Bi-Metal NO/NC, PTC, 2xPTC	10%
Accuracy Bi-Metal NO/NC, PTC, 2xPTC	<10%
Short circuit detect PTC	<20Ω
Short circuit detect 2xPTC	<40Ω
Trip temperature PT100, 2xPT100	50-160°C
Hysteresis PT100, 2xPT100	1-25°C
Accuracy PT100/2xPT100	±2°C
Short circuit detection PT100/2xPT100	<80Ω/<160Ω
Open circuit detection PT100/2xPT100	>190Ω/>380Ω
Response time	<5s
Adjustable tripping delay	0 - 99s

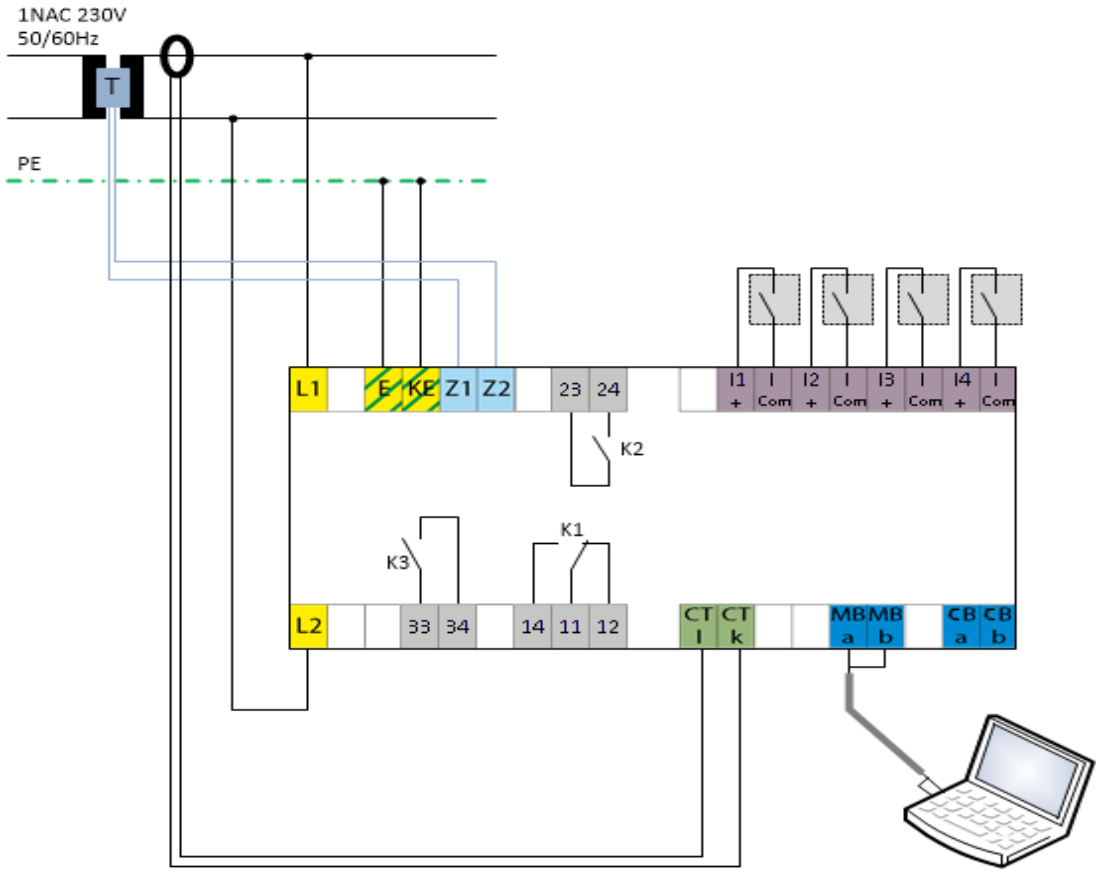
Transformer Load Monitor

Internal load resistance	~15Ω
Max. current through load resistor	100mA
Ratio range for calculation load in VA	1:100-1:9999
Voltage range for calculation load in VA	85-240V
Trip value	100 – 99999VA
Nominal frequency	50Hz
Hysteresis	1-25%
Accuracy	<±2% (min. ±0,5mA)
Response time load alarm <5mA	<10s
Response time load alarm >5mA	<5s
Minimum dc resistance ct	20Ω
Maximum dc resistance ct	100Ω
Response time open/short circuit	<15s
Adjustable tripping delay	.. 0 - 99s

Response time at Ce = 0,5µF (EN61557-8)	<5s
Response time at Ce = 5µF	<60s
Relative uncertainty (EN61557-8)	<±10% (min. ±5kΩ)
Relative uncertainty (Ce = 5µF)	<±20% (min. ±10kΩ)
Trip Points	
Alarm 1	
Trip-value	50kΩ - 1000 kΩ
Hysteresis	1 - 25%
Alarm 2	
Trip-value	50kΩ - 1000 kΩ
Hysteresis	1 - 25%
Search Current Generator	
Search voltage	<25 VDC
Search current	<1 mA
Modbus Communication	
Interface	RS485, isolated
Cable type	Screened
Communication protocol	Modbus RTU slave
Baud rate	2400-19200Baud
Parity/stop bit	None/1, None/2, Even/1, Odd/1
Address range	1-247
Communicationbus Communication	
Interface	RS485, isolated
Cable type	Screened
Environment/EMC	
EMC	EN61326-2-4[1]
Temperature	
Operation	-5°C - +45°C
Transport	-25°C - +70°C
Storage	-25°C - +70°C
Relative humidity (non-condensing)	10 - 90%
Climate class (IEC60721)	
Operation (IEC60721-3-3)	3k5
Transport (IEC60721-3-2)	2k3
Storage (IEC60721-3-1)	1k4
Mechanical load (EN61557-8)	

Display	
Display range insulation value	0kΩ - 10000kΩ
max. difference from measured value	+/- 15%
Password	0000 – 9999
Switching Element K1	
Contact	volt-free changeover
Contact material	AgSnO2 + Au or AgNi + Au
Switching capacity AC1/230V	1500VA
Nominal contact voltage	V
Continuous current	5A
without destroying the gold plating	30V / 50mA
Behaviour	Active/Failsafe mode
Alarm storage	Auto/Manual reset
Switching Elements K2/K3	
Contact	volt-free NO solid state
Max. switching voltage	25VAC/30VDC
Continuous current	300mA
Behaviour	Active/Failsafe-mode
Alarm storage	Auto/Manual reset
Digital Inputs	
Numbers	4
Supply	Internal
Voltage	<12VDC
max. current	<5mA
Interfacing	
Type	plug able screw terminal
Wire capacity	0,2 - 2,5mm²
Others	
Operating mode	Continuous
Installation position	display oriented
Mounting on rail	to EN60715
Protection to IEC60529	
Electronic	P40
Terminals	P00
Dimension (B x H x T)	106 x 95 x 75 mm
Weight	<350g

Connection E619001



Note: Pay attention to the correct voltage connection! For voltage value see type label. As protection, line protection according to the regulations is needed. The line protection must be installed near the device.

Note: Installation, commissioning and operation of the device must be performed by a skilled person (electrically) as defined in accordance with BS7671.

Danger: All lines (even extra-low voltage leads) that are connected to the device must be considered as a dangerous voltage lead (and must be safe to touch) as the air gaps in the device for increased insulation are not enough.

Danger: Before working on live parts, make sure that the system is de-energised.

Warning: Connecting more than one IPM device to an isolated power system can cause incorrect isolation resistance measurement.

Warning: The terminals K and KE are required to have a connection to the protective conductor PE with separate wires. A disconnection of the earth connection when the IT network is powered is not permitted.

Warning: To prevent damage to the IPM during insulation and voltage tests, disconnect from the system.

Symbols

Danger: Dangerous situation that can result in death if not avoided.

Warning: Dangerous situation that can result to serious injury if not avoided.

Note: Possible danger and malfunction

Remember: Additional information.

Tip: Recommended action.

Appendix

MODBUS QUERIES AND REGISTER CHART FOR IPM REGISTERS (Setting ModBus->Register Mode is IPM)
A valid query to read registers from IPM have to use function code “0x03” (Read holding registers). The query has to be in the following format:

Function	IPM500 Address	Function Code	Start Address High	Start Address Low	Number of Registers High	Number of Registers Low	CRC
Size	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	2 bytes
Content	xx	0x03	xx	xx	xx	xx	Xx

The start address must be a valid register number from charts below. If devices are connected on CB, their last received data are also readable with register numbers, which are following the IPM registers.

The answer will be in the following format:

Function	IPM500 Address	Function Code	Byte Count	Data	CRC
Size	1 byte	1 byte	1 byte	“Byte Count” bytes	2 bytes
Read xx register	xx	0x03	2xNumber of Registers from query	See chart below	Xx

Register Chart

Register 0

Byte 1								Byte 2							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Load circuit short	Load circuit open	Overload alarm	Temperature sensor circuit short	Temperature sensor circuit open	Temperature tripping delay running	Overtemperature alarm	Communication failure CB	Communication failure MB	Memory failure (read calibration)	Memory failure (read settings)	Communication failure internal	Failure measure circuit	Connection failure E/KE	Insulation trip point 2 alarm	Insulation trip point 1 alarm
0 – no alarm, 1 – alarm															

Register 1

Byte 1								Byte 2							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Fault search running	Insulation failure DC-	Insulation failure DC+	Insulation failure AC	Not used	Not used	Not used	Not used	Not used	Alarm CB Device	Digital input 4	Digital input 3	Digital input 2	Digital input 1	Test alarm	Load tripping delay running
0 – no alarm, 1 – alarm															

Register 2

Byte 1								Byte 2							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Insulation value [kΩ] – UINT16															

Register 3

Byte 1								Byte 2							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Transformer load value [VA] – UINT16 High word															

Register 4

Byte 1								Byte 2							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Transformer load value [VA] – UINT16 Low word															

Register 5

Byte 1								Byte 2							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Transformer temperature value [°C] (PT100/2xPT100 sensor only) – INT16															

Register 256

Byte 1								Byte 2							
b7	b6	b5	b4	b3	b2	b1	b0	b7	b6	b5	b4	b3	b2	b1	b0
Total devices count connected on CB – UINT8								Total register count available from CB connected devices – UINT8							

The following registers contains information from connected devices. For every address/slot in the IPM CB menu, at least one register is available. This register contains the address/slot number from the IPM CB menu and the configured device type.

If no device is configured, the following register contain information about the next address/slot.

If a device is configured, the following register contain last received data from this device. For content and length see devices specific data sheet.

Register 257 - xxx

Byte 1								Byte2							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Device address from first device. See configured devices on CB menu.								Configured device type: 0x00 – No device (Empty), next register contains information about next device address. 0x01 – CS6 (6CT), next registers contain information from device, for content and length see devices specific data sheet. 0x02 – EDS (18CT), next registers contain information from device, for content and length see devices specific data sheet							
Last received data from configured device. For content and length see devices specific data sheet.															

Register xxx

Byte 1								Byte2							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Last register from CB connected devices. Number from last register = 256 + (Total register count available from CB connected devices; see Register 256 Byte 2)															

Example: No devices linked

Register 256

Byte 1	Byte 2
0x00	0x05
No devices linked	Only one register per slot, no data from linked devices

Register 257

Byte 1	Byte 2
0x01	0x00
Device address/slot 1	No devices linked

Register 258

Byte 1	Byte 2
0x02	0x00
Device address/slot 2	No devices linked

Register 259

Byte 1	Byte 2
0x03	0x00
Device address/slot 3	No devices linked

Register 260

Byte 1	Byte 2
0x04	0x00
Device address/slot 4	No devices linked

Example: EDS linked on slot 1

Register 256

Byte 1	Byte 2
0x01	0x08
1 device linked	One register per slot, additionally 3 registers with data from linked EDS

Register 257

Byte 1	Byte 2
0x01	0x02
Device address/slot 1	EDS linked

Register 258, 259, 260

Byte 1	Byte 2
Data received from linked device	Data received from linked device
See device specific datasheet	See device specific datasheet

Register 259

Byte 1	Byte 2
0x03	0x00
Device address/slot 2	No devices linked

Register 260

Byte 1	Byte 2
0x04	0x00
Device address/slot 3	No devices linked

A valid query to start a unit self-test and test alarm on IPM500 via Modbus have to use function code "0x06" (Preset Single Registers) or "0x10" (Preset Multiple Registers).

The query must be in the following format for "0x06" (Preset Single Registers):

Function	IPM Address	Function Code	Start Address High	Start Address Low	Data High	Data Low	CRC
Size	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	2 bytes
Write test alarm	xx	0x06	0x00	0x01	0x00	0x02	xx

The answer will be in the following format:

Function	IPM Address	Function Code	Start Address High	Start Address Low	Data High	Data Low	CRC
Size	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	2 bytes
Write test alarm	xx	0x06	0x00	0x01	0x00	0x80	xx

The query must be in the following format for "0x10" (Preset Multiple Registers):

Function	IPM Address	Function Code	Start Address High	Start Address Low	Number of Registers High	Number of Registers Low	Byte Count	Data High	Data Low	CRC
Size	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	2 bytes
Write test alarm	xx	0x10	0x00	0x01	0x00	0x01	0x02	0x00	0x02	xx

The answer will be in the following format:

Function	IPM Address	Function Code	Start Address High	Start Address Low	Data High	Data Low	CRC
Size	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	2 bytes
Write test alarm	xx	0x10	0x01	0x00	0x00	0x01	xx

If an alarm is active, or a self-test is already running, test alarm cannot be performed. The IPM will answer with exception code 0x04 (Failure in device).

MODBUS QUERIES AND ANSWERS FOR DOWNWARDS COMPATIBLE USE TO IPM/EDS400 (Setting Modbus->Register Mode is IPM/EDS400)

A valid query to read registers from the IPM must use function code "0x03" (Read holding registers). The query must be in the following format:

Function	IPM Address	Function Code	Start Address High	Start Address Low	Number of Registers High	Number of Registers Low	CRC
Size	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	2 bytes
Content	xx	0x03	xx	xx	xx	xx	xx

To read registers downwards compatible with IPM/EDS400 the following chart shows the possible queries and answers.

Remember: Downwards compatible registers are not recommended for use in new installations!

Valid Queries:

Function	IPM Address	Function Code	Start Address High	Start Address Low	Number of Registers High	Number of Registers Low	CRC
Size	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	2 bytes
Content	xx	0x03	xx	xx	xx	xx	Xx
Read 1 register	xx	0x03	0x00	0x00	0x00	0x01	Xx
Read 2 register	xx	0x03	0x00	0x00	0x00	0x02	Xx
Read 4 register	xx	0x03	0x00	0x00	0x00	0x04	Xx
Read 6 register	xx	0x03	0x00	0x00	0x00	0x06	Xx

The answer will be in the following format:

Function	IPM Address	Function Code	Byte Count	Data	CRC	Note
Size	1 byte	1 byte	1 byte	"Byte Count" bytes	2 bytes	
Read 1 register	xx	0x03	0x02	See chart below	xx	Only without connected CS module
Read 2 register	xx	0x03	0x04	See chart below	xx	
Read 4 register	xx	0x03	0x08	See chart below	xx	
Read 6 register	xx	0x03	0x0C	See chart below	xx	Only without connected CS module

Data field content: Read 1 register (only without connected CS module).

Byte 1								Byte 2							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Not used	Not used	Not used	Not used	System fault	Temperature alarm	Load alarm	Insulation alarm	Connection fault earth	Transformer load 0x1000 - < 20% 0x0000 - > 20% 0x0001 - >40% 0x0010 - > 50% 0x0011 - >60% 0x0100 - >70% 0x0101 - >80% 0x0110 - >90% 0x0111 - >100% of load trip point			Insulation Value 0x000 - < 50kΩ 0x001 - >50 kΩ 0x010 - > 250 kΩ 0x011 - >450 kΩ 0x100 - >650 kΩ 0x101 - >850 kΩ 0x110 - >1000 kΩ 0x111 - >9999 kΩ			
0 – no alarm, 1 - alarm															

Data field content: Read 2 register (only without connected CS module).

Byte 1								Byte 2							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Not used	Not used	Not used	Not used	System fault	Temperature alarm	Load alarm	Insulation alarm	Connection fault earth	Transformer load 0x1000 - < 20% 0x0000 - > 20% 0x0001 - >40% 0x0010 - > 50% 0x0011 - >60% 0x0100 - >70% 0x0101 - >80% 0x0110 - >90% 0x0111 - >100% of load trip point					Insulation Value 0x000 - < 50kΩ 0x001 - >50 kΩ 0x010 - > 250 kΩ 0x011 - >450 kΩ 0x100 - >650 kΩ 0x101 - >850 kΩ 0x110 - >1000 kΩ 0x111 - >9999 kΩ		
0 – no alarm, 1 - alarm															

Byte 3								Byte 4							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Digital input 1	Digital input 2	Digital input 3	Digital input 4	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used
0 – no alarm, 1 – alarm															

Read 2 Register (with connected CS module):

Byte 1								Byte 2							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS
3	3	3	3	2	2	2	2	2	2	1	1	1	1	1	1
CT	CT	CT	CT	CT	CT	CT	CT	CT	CT	CT	CT	CT	CT	CT	CT
4	3	2	1	6	5	4	3	2	1	6	5	4	3	2	1
0 – no failure found, 1 – failure found															

Byte 1								Byte 2							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Digital Input 1	Digital Input 2	Digital Input 3	Digital Input 4	System fault	Temperature alarm	Load alarm	Insulation alarm	Connection fault earth	Transformer load 0x1000 - < 20% 0x0000 - > 20% 0x0001 - >40% 0x0010 - > 50% 0x0011 - >60% 0x0100 - >70% 0x0101 - >80% 0x0110 - >90% 0x0111 - >100% of load trip point					Insulation Value 0x000 - < 50kΩ 0x001 - >50 kΩ 0x010 - > 250 kΩ 0x011 - >450 kΩ 0x100 - >650 kΩ 0x101 - >850 kΩ 0x110 - >1000 kΩ 0x111 - >9999 kΩ		
0 – no alarm, 1 - alarm															

Read 4 Register (without connected CS module)

Byte 1								Byte 2							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Not used	Not used	Not used	Not used	System fault	Temperature alarm	Load alarm	Insulation alarm	Connection fault earth	Not used	Not used	Not used	Not used	Not used	Not used	Communication check bit (fixed to 1)
				0 – no alarm, 1 - alarm											

Byte 3								Byte 4							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Digital input 1	Digital input 2	Digital input 3	Digital input 4	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used
0 – no alarm, 1 - alarm															

Byte 5								Byte 6							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Insulation value [kΩ] – UINT16															

Byte 7								Byte 8							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Transformer load value [VA] – UINT16															

Read 4 Register (with connected CS module)

Byte 1								Byte 2							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS	EDS
3	3	3	3	2	2	2	2	2	2	1	1	1	1	1	1
CT	CT	CT	CT	CT	CT	CT	CT	CT	CT	CT	CT	CT	CT	CT	CT
4	3	2	1	6	5	4	3	2	1	6	5	4	3	2	1
0 – no earth fault found, 1 – earth fault found															

Byte 3								Byte 4							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Insulation value [kΩ] – UINT16															

Byte 5								Byte 6							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Transformer load value [VA] – UINT16															

Byte 1								Byte 2							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Digital Input 1	Digital Input 2	Digital Input 3	Digital Input 4	System fault	Temperature alarm	Load alarm	Insulation alarm	Connection fault earth	Not used	Not used	Not used	Not used	Not used	Not used	Communication check bit (fixed to 1)
0 – no alarm, 1 – alarm															1

Read 6 Register (without connected CS module)

Byte 1								Byte 2							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Not used	Not used	Not used	Not used	System fault	Temperature alarm	Load alarm	Insulation alarm	Connection fault earth	Not used	Not used	Not used	Not used	Not used	Not used	Communication check bit (fixed to 1)
				0 – no alarm, 1 - alarm											1

Byte 3								Byte 4							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Digital input 1	Digital input 2	Digital input 3	Digital input 4	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used
0 – no alarm, 1 – alarm															

Byte 5								Byte 6							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Insulation value [kΩ] – UINT16															

Byte 7								Byte 8							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Transformer load value [VA] – UINT16															

Byte 9								Byte 10							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Insulation alarm value [kΩ] – UINT16															

Byte 11								Byte 12							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Transformer load alarm value [VA] – UINT16															

A valid query to start a unit self-test and test alarm on IPM500 over Modbus must use function code "0x10" (Preset Multiple Registers). The IPM will send no response to this query. The query must be in the following format:

Function	IPM Address	Function Code	Start Address High	Start Address Low	Number of Registers High	Number of Registers Low	Byte Count	Data High	Data Low	CRC
Size	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	2 bytes
Test alarm	xx	0x10	0x00	0x01	0x00	0x01	0x02	0x00	0x01	Xx

Remember: Downwards compatible registers are not recommended for use in new installations!

Product legislation and standards of conformity

EU Ref	EU Title	UK Ref	UK Title
2014/ 35/EU	Low Voltage Directive	2016/ 1101	Electrical Equipment (Safety) Regulations 2016
2014/ 30/EU	Electromagnetic Compatibility Directive	2016/ 1091	Electromagnetic Compatibility Regulations 2016
2011/ 65/EU	Restriction of Hazardous Substances (RoHS) Directive	2012/ 3032	The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

Reference	Title	Edition
EN IEC 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use - General requirements.	2010+A1:2019
EN IEC 61557-1	Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring, or monitoring of protective measures Part 1: General requirements	2019
EN IEC 61557-8	Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. - Equipment for testing, measuring, or monitoring of protective measures - Part 8: Insulation monitoring devices for IT systems	2014
EN IEC 61557-9	Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. - Equipment for testing, measuring, or monitoring of protective measures - Part 9: Equipment for insulation fault location in IT systems	2015