UNIVERSAL AC EARTH FAULT PROTECTION SYSTEM

ISOPAK1xx

- **24 channel earth leakage monitoring of LIVE AC networks**
- **Tailored to any voltage or current range**
- **Reads each channel's RMS leakage. Range 100mA to 10A**
- **Set parameters and view on unit screen**
- **Optional supervision module and slave unit**
- **Healthy/Warning/Alarm and Supervision C/O relay outputs**
- **"Highest up" 4-20mA signal & RS-485 Modbus RTU outputs**

Specifications

Auxiliary voltage: (min-max)	90-264VAC / 110-340VDC *(standard)* 9-18VDC (nom: 12VDC) *(optional 1)* 18-36VDC (nom: 24VDC) *(optional 2)* 36-75VDC (nom: 48VDC) *(optional 3)* (Fuse 1A)	
ISOPAK models: 	ISOPAK106 (6 channels) ISOPAK112 (12 channels) ISOPAK118 (18 channels) ISOPAK124 (24 channels)	
	ISOPAK106W (6 channels) ISOPAK112W (12 channels) ISOPAK118W (18 channels) ISOPAK124W (24 channels)	
Factory settings: (FSD)	Individual channel measuring range: 30, 100, 300, 500mA or 1, 2, 3, 5, 10, 20A	
Measuring method:	RCT	
Response time:	Max 1200mS	
Repeatability:	0,5% FSD	
Warning trip level:	0-100% FSD *(individually user setable)*	
Alarm trip level:	0-100% FSD *(individually user setable)*	
Relay time delay:	1-30 secs. *(individually user setable)*	
Analogue output:	4/20mA, *(max 500ohm)* *(proportional to highest up earth leakage)*	
Communication:	RS485 Modbus RTU	
Outputs relays:	Volt free changeover	
Relay contact rating:	AC: 100VA - 250V/2A max. DC: 50W - 100V/1A max.	
Temperature:	-20 to +54ºC	
Front protection:	IP21	
Dimensions:	L x H x D:	Weight:
ISOPAK100 *(standard)*	157 x 95 x 78mm	0,3kgs
ISOPAK100W *(optional)*	157 x 95 x 65mm	0,3kgs
ISOVIEW100 *(optional)*	96 x 96 x 58mm	0,2kgs
MML15xx	100 x 110 x 75mm	0,3kgs
Communication cable: *(optional)*	Length from 1 meters upwards	

Unit meets IEC60092-504 and relevant environmental and EMC tests specified in IEC60068/60092 and IEC61000/60533 respectively, to comply with Classification Societies requirements.

Description

The digitally controlled ISOPAK1xx adds to Megacon's wide range of ISOGUARD products for insulation and earth fault monitoring and protection.

The ISOPAK1xx technology is also used in Megacon's IsoMedical systems for monitoring of ultra-safe AC supply systems in hospital installations.

ISOPAK1xx can be configured for operation in **FLOATING** and **GROUNDED** single phase, 3-wire and 4 wire three phase AC networks. The measuring range is factory pre-programmed.

"Highest up function" gives peace-of-mind
The purpose of ISOPAK1xx is to selectively detect and address earth faults in live 50 or 60 Hz networks. An intelligent **highest up** function highlights the highest level of hazard in the system, and only alerts the operator when conditions for an impending danger are present.

The LED bargraph meter continuously displays the earth current of the highest channel in the system at any time, as a percentage of the channel's set trip level. This **silent** annunciation will not distract the operator's attention, but at any time a glance at the colour of the bar reveals the present safety status of the whole system.

The Modbus communication port provides information on each channel's measured data and safety status:

- **Warning flags**
- **Alarm flags**
- **Individual channel measured data**
- **"Highest Up" channel**

Multiple parallelled ISOPAK1xx
Any number of ISOPAK1xx may be parallelled in a chain with a common master PC, to supervise and log any number of channels and networks.

ISOPAK1xx

Introduction

Earth Fault Monitoring
Earth faults arise when insulation levels decrease and residual current (earth current) flows from one or more of the network conductors to ground. The actual earth fault (the ohmic/resistive residual current) may be caused by many factors, but faults can be defined into two categories:

1- Spontaneous earth faults
Typical unpredictable earth faults are flash over, arching, lightning strikes and incorrect wire connections. Spontaneous earth faults are by nature difficult to avoid.

2- Predictable earth faults
Typical Predictable earth faults may be caused by insulation degradation in switchboard wiring and generator windings, engine or transformer fade, climatic stress (temperature and moisture), mechanical stress (vibration, friction, wear and tear), dirt, or deposit of soot and foreign bodies.

Predictable earth faults on the other hand can be avoided through continuous measurement of insulation levels combined with preventive maintenance. Earth faults usually arise in peripheral equipment, seldom in the actual distribution circuit, and therefore continuous isolation monitoring of a circuit can give a good indication of the total system's **general health**.

Among the main reasons for earth fault monitoring are:

- **Personnel safety, trip limits based on medical recommendations**
- **Fire prevention, removing ignition sources**
- **Eliminating electrolytic corrosion between dissimilar metals**
- **Preventing damage to electronic equipment caused by stray potentials**

Product Information

ISOPAK1xx (Standard)
This is an all-in-one ISOPAK1xx module for DIN rail mounting inside the switchboard.

ISOPAK1xx

ISOPAK1xxW (optional package)
This special solution provides greater freedom for those who want more flexible placement of units.

All supervision functions are moved to the remote front-of-panel mounted DIN96 unit ISOVIEW100, parameters can be viewed and set on the unit screen. No restrictions on length of the communication cable between units. All standard inputs and outputs remain in the ISOPAK1xxW, which is DIN rail mounted for easy access in the switchboard.

ISOPAK1xxW — ISOVIEW100

System Expansion

Multiple parallelled ISOPAK1xx
Any number of ISOPAK1xx may be parallelled in a chain with a common master PC, to supervise and log any number of channels and networks.

Expandable ISOPAK1xx

IS range

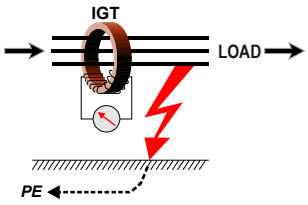
ISOPAK1xx

General Information

The ISOPAK1xx performs continuous selective measurement, using directional core balanced current transformers, of earth current level in up to 24 live circuits in grounded (TN) or isolated (IT) 50Hz or 60Hz networks.

The inputs can be individually programmed for channel identification, **Warning** and **Alarm** trip levels and trip delays. All current carrying conductors must pass through the toroidal transformer to get correct reading. Protective earth, metal sheaths or braiding of any cables must NOT be passed through the CBCT.

The measuring technique is based on the principle that the phase currents in a fault free circuit sum to zero. If an earth fault is present in the load circuit, the sum of the phase currents is not zero. This current differential produces an error signal, proportional to the earth leakage.



Measurement of earth fault current

Operation

User Interface

A functional test can be performed by pressing the navigator knob during power up. This illuminates all LEDs and sounds the internal buzzer. Operation of the ISOPAK1xx is simple and user-friendly. Information is displayed and adjusted on the back-lit 4x20 character LCD-display via the navigator knob. The Navigator Knob is rotated left or right to select parameters and pushed to confirm selection.

LEDs indicate the triple zone safety status of the **system**:

ALARM	The system has unacceptably high earth leakage
WARNING	The system has earth leakage which will not affect operation but requires attention
NORMAL	The system is healthy

Two rows of LEDs indicate the safety status of each individual **channel**:

ALARM	Set alarm level is exceeded
WARNING	Set warning level is exceeded

Relay 1 is **fail safe** to indicate loss of auxiliary supply to the unit. The standard unit has the following relay outputs:

ALARM (Relay 1)	Will notify if the alarm limit of any channel is exceeded
WARNING (Relay 2)	Will notify if the warning limit of any channel is exceeded
Common (Relay 3)	Is a common relay, which latch until all alarms are reset

The RS485 Modbus RTU communication port provides information on each channel's measured data and safety status:

- **Warning flags**
- **Alarm flags**
- **Individual channel measured data**
- **"Highest Up" channel**

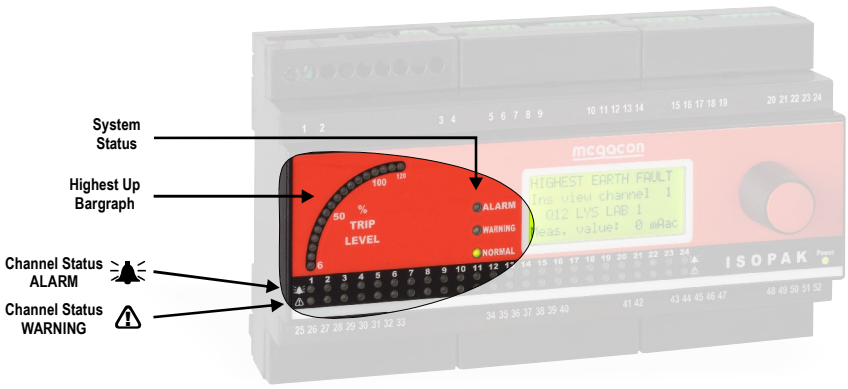
The internal buzzer can be programmed individually for each channel.

Highest Up

ISOPAK1xx automatically **locks** the indicating bargraph to the channel that has the system's highest relative earth current. The LED bargraph presents the instantaneous overall condition of the system. The bargraph indicates the earth current as a percentage of any channel's alarm trip level and shows the status for the channel which is closest to its alarm trip level.

LED Bargraph

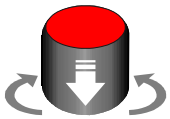
The bargraph will display the individual channels reading when the operator scrolls through the status of each channel and reads each channel's earth current directly in mA on the LCD screen.



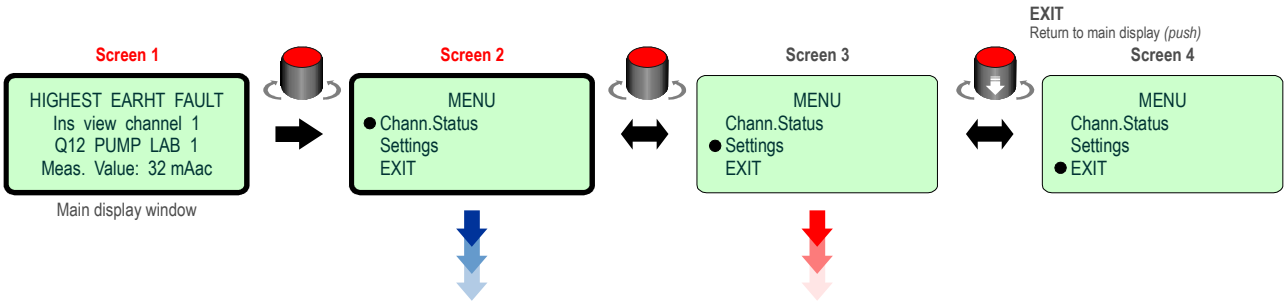
Menu Summary

Main Navigation

Navigator Knob



Navigate	: Rotate left or right
Enter (confirm selection)	: Push (1 click)
Back (to upper level in menu)	: Push & hold for 2 secs.



MAIN - Display Window (screen 1)

- This is the default screen displayed if the unit is left unattended for more than three minutes.

- The display shows the level of the channel that has the system's highest relative leakage current. For a channel to be included on this display, the channel's **Highest Up** parameter must be set to **ON.** *(see screen 3.2.2)*

- In an installation with negligible leakage current levels the screen may display a channel at random. The channel's location will be displayed if programmed.

- If the channel is blocked the measured earth current is not displayed.

MENU - Channel Status (screen 2)

- Select **Chann.Status** to read the safety status for all channels by rotating the Navigator Knob .

- In this mode the screen displays the measured earth current and the bargraph reads the relative trip level for the selected channel. The location or identification code will also be displayed if programmed.

- Each channel will show one of these safety levels: **NORMAL** - **WARNING** - **ALARM**

- If a channel's **WARNING** or **ALARM** trip level is exceeded for more than the channel's set time delay the unit will ”record” this condition until the user resets the alarm, even if the earth leakage drops below the trip level. The alarm can not be reset if the trip level is still exceeded.

- For isolated (non-grounded) supply systems it may be appropriate to block earth current monitoring if the system's insulation level is within safe limits (note that in a 240V system total ohmic leakage current at 100kΩ is below 2mA). If this option is included in the unit linking terminals 37 and 39, either with a fixed link or by an external Insulation Relay (KRM161) will activate channel blocking.

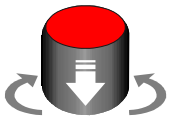
- During blocked operation unit displays **INSULATION OK** for all channels. The resetting of trips is not affected by the blocked operation.

Operation continues in next page

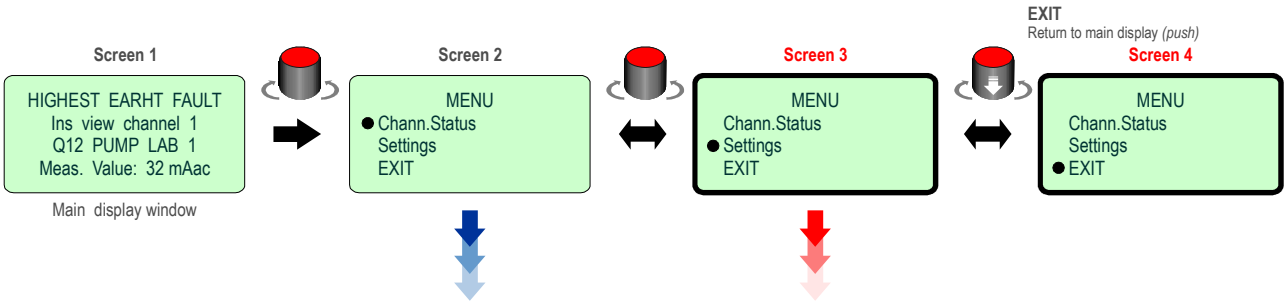
Menu Summary

Main Navigation

Navigator Knob



Navigate	: Rotate left or right
Enter (confirm selection)	: Push (1 click)
Back (to upper level in menu)	: Push & hold for 2 secs.



MENU - Settings (screen 3)

- Select **Settings** to read or change parameters.

- Rotate the Navigator Knob until the selected channel is displayed and push the Navigator Knob to access the channel.

- All user setable parameters are password protected against unauthorised or accidental setting **(default password: 9876)**. If an incorrect password is used the system will deny access. Push the Navigator Knob to revert and try again. Once the password has been accepted you can change the settings.

- Each channel has a unique text field identifying the location of the monitored channel. To edit the text, push the Navigator Knob to display the dot cursor on the screen. Select the location text and push the Navigator Knob to confirm the option. The screen cursor should now change shape to an arrow. Edit the text with the Navigator Knob. Rotating the knob will change the letter displayed and a push verifies the selected letter.

- **Sensor mode (Sens.)** and **Presentation mode (Pres.)** are both factory set.

- **Highest Up** selects whether this channel is included (**ON**) in the Highest Up display.

- **Full Scale** (FSD) is the input signal that determines the channels upper trip level (this parameter is factory set).

- The **offset parameter** must be set/programmed after installation. If the option **ON** is chosen, the unit automatically reads and offset the capacitive earth current on the specific channel. After a few seconds the display message will change to **ON** option. Now the unit will subtract the offset current. It is possible to cancel offset compensation in the **OFF** position.

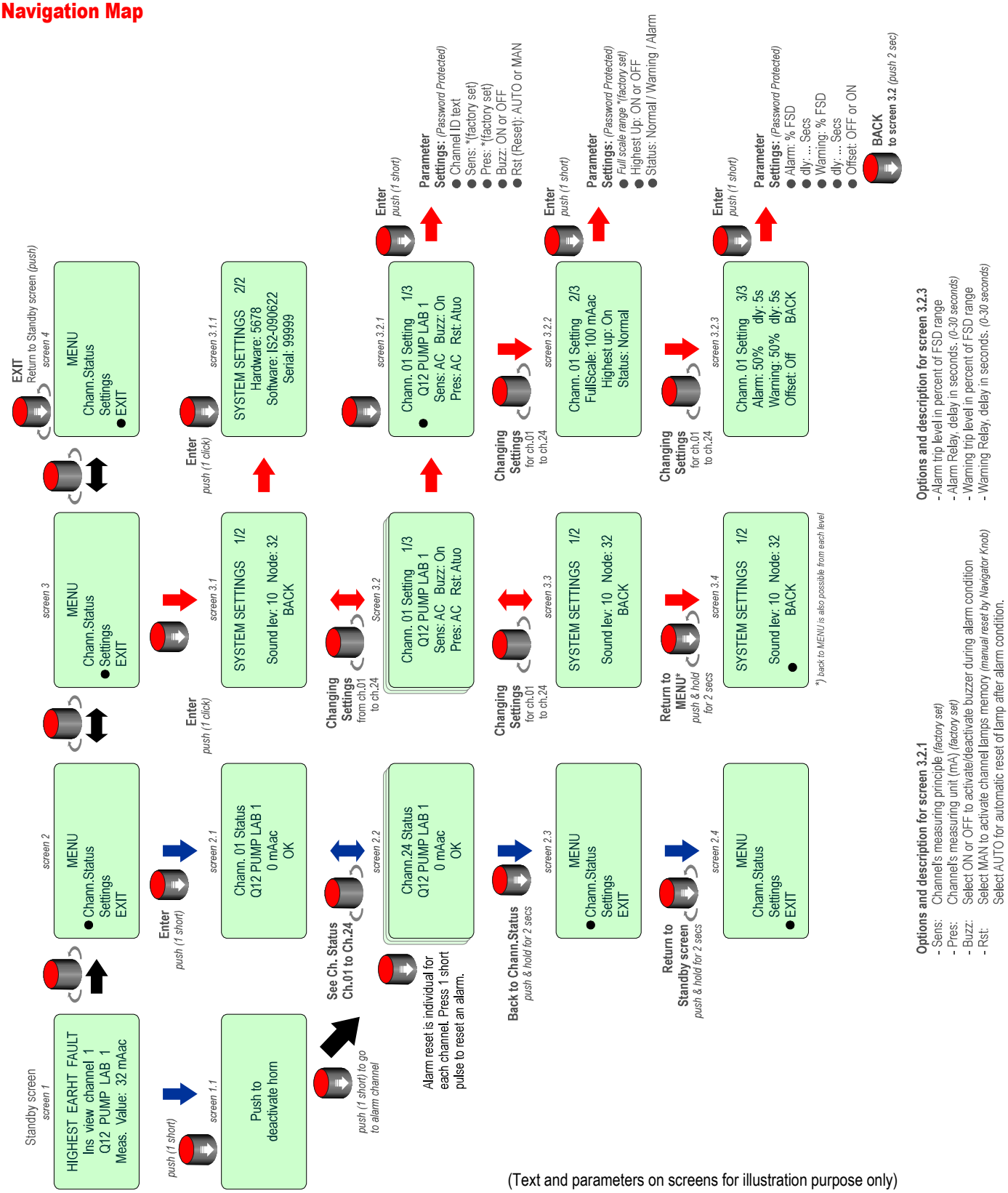
- The built in alarm buzzer is activated when a channel's alarm limit is exceeded (**ALARM**). Push the Navigator Knob to mute the buzzer. It is also possible to change the sound level.

MENU - EXIT (screen 4)

- Select **Exit** to return to the main display window.

Operation continues in next page

Navigation Map



(Text and parameters on screens for illustration purpose only)

The MEGACON policy is one of continuous improvement, consequently equipment supplied may vary in detail from this publication.

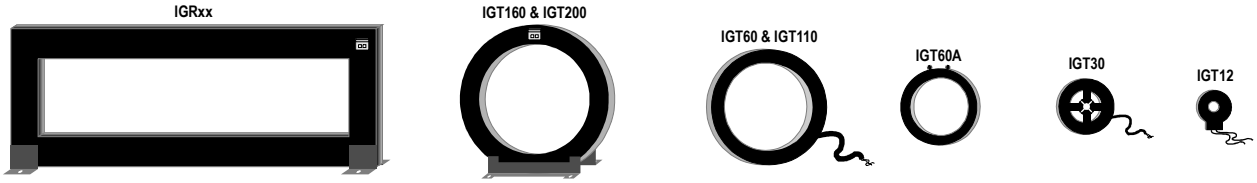
ISOPAK1xx

Installation Guide

ISOPAK1xx is constructed for vertical mounting on a DIN35 rail. The unit is light and compact for ease of installation. Connections are via plug-in connectors (except for the auxiliary supply). 3 programmable relay outputs (terminals 25 to 33). Relay 1 has **fail to safety** functionality. This means that the relay normally operates with a hold current, and will notify loss of auxiliary voltage.

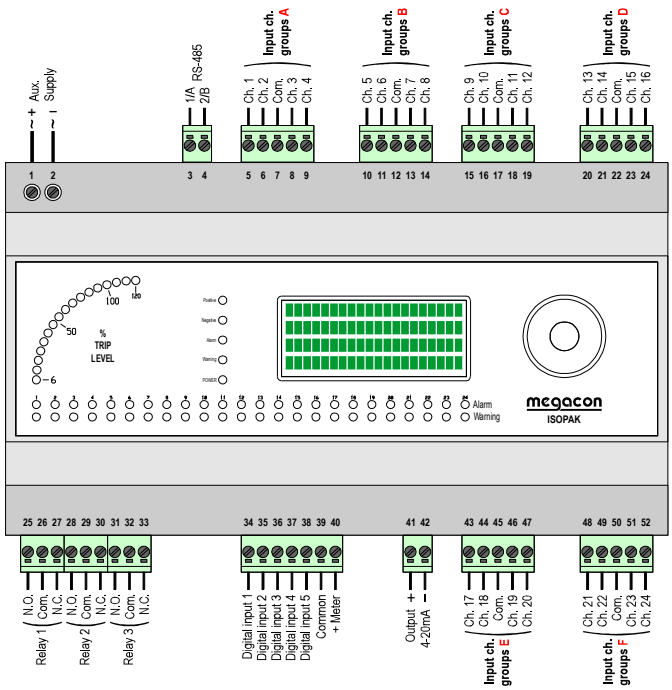
ISOPAK1xx uses IG-transformers for directional, **selective** measurement of earth current in both single and three phase 50 or 60Hz networks. IG-Transformers are available in many variations to meet all applications (see separate datasheet for IG-transformers).

Typical IG-Transformers



NOTE:

- An IG-transformer must be fitted in each monitored circuit
- It measures earth faults on the load side of the IG-transformer
- All loaded wires (including the neutral wire in four wire systems) must pass through the transformer
- Protective earth (PE), screening braids and armament must not be through the transformer
- The connection wire from the IG-transformer secondary should be screened if over 5 meters
- Connect auxiliary voltage to terminals 1 and 2
- RS485 output for connection to external PC or bus. (more information in following pages 8 to 11)



Relay 1 (**ALARM**) : Operates when the danger limit of a channel is exceeded
Relay 2 (**WARNING**) : Operates when the warning limit of a channel is exceeded
Relay 3 : Is a common relay, which latches until all alarms are reset

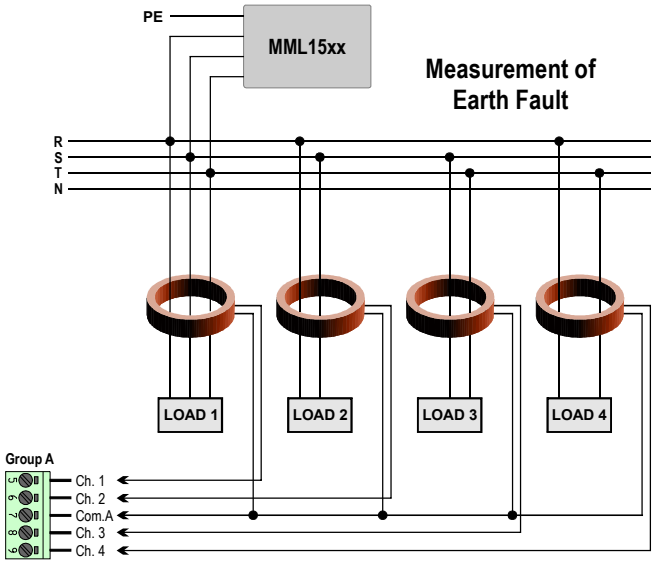
CONSTANT IMPEDANCE MODULE MML15xx

In a grounded AC supply system any earth fault leakage current will return via the ground connection path to the supply neutral.

If ISOPAK1xx is used in a non-grounded (fully isolated) system a common Constant Impedance Module MML15xx must be connected as shown below.

MML15xx provides a low-impedance, balanced earth leakage current return path to the supply neutral.

It ignores the influence of the network's spread capacitance differential, and improves the measuring sensitivity at low leakage levels.



The residual current transformer inputs are split in groups of four channels. Connect remaining RCT input groups (**B**, **C**, **D**, **E** and **F**) following the pattern as shown for group **A** above.

Description and protocol - ISOPAK on Modbus

ISOPAK on Modbus General Description

Port
The ISOPAK unit has an insulated RS485 port (1000V) intended for system configuration by ISOPAK IsoPC program and for Modbus RTU communication through the same port. Baud rate is 19200 bits/sec. Only function 03 - Read holding register is implemented.

ISOPAK Modbus communication
The ISOPAK Modbus protocol is a subset of the Modbus protocol as described in this documentation. ISOPAK's native protocol is the Megabus L protocol with ISOPAK functionality described in the ISOPAK protocol documentation.

The ISOPAK unit is able to communicate according to both protocols at the same time, as the unit will recognise the protocol of each message received.

Initial configuration
A normal procedure would be to connect the ISOPAK unit RS485 port via a converter to USB Comport of PC with IsoPC program for configuration and testing and then connect the ISOPAK unit to the Modbus.

The IsoPC program has facilities for reading data from the ISOPAK as well as downloading parameters etc. For setting parameters IsoPC must be used. When system parameters have been set Modbus communication may be used for reading data from the ISOPAK.

IsoPC has a facility for testing Modbus communication under the Modbus tab.

In the IsoPC program prepare for Modbus configuration:

- Open **Settings** tab, make sure correct serial port is set and baud rate is set to 19200 bits/sec.
- Open the Instrument identity flip and set and download the address to be used on ModBus. Start with 1 on the first Isopak in a system.

Use IsoPC for system configuration:

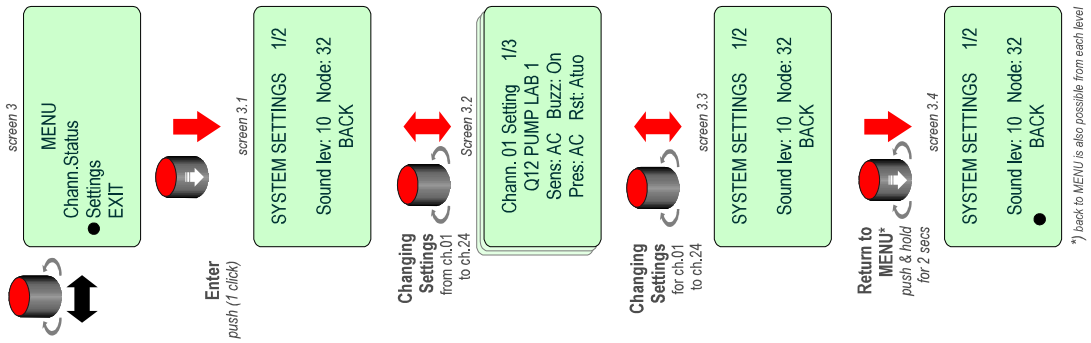
- Flip open "Parameters" see IsoPC documentation for parameter setting.

Test Modbus protocol under Modbus tab

Set ISOPAK unit address according to downloaded address.

Click on buttons for:
- Reading input 1..8
- Reading input 9..16
- Reading input 17..24
- Reading 4 control lines
- Reading alarm and warning flags
- Reading highest up channel and value

Node address
Set ISOPAK node address according as showed below (can be set from 1 to 32):



Description and protocol - ISOPAK on Modbus

ISOPAK Modbus Protocol

- The ISOPAK protocol is implemented as Modbus RTU.
- Function 03- Read-holding registers is the only implemented function.
- There are no start/stop markers in the Modbus protocol.
- Separation between messages is based on separation time.
- In our implementation no parity is used pr. byte.
- CRC frame checking is used for testing integrity of a complete message.

Query

Field name	Example
Slave address	11
Function	03
Starting address hi	00
Starting address lo	23
Number of points hi	00
Number of points lo	02
Error check	CRC

Response

Field name	Example
Slave address	11
Function	03
Byte count	04
Data register hi	03
Data register lo	FF
Data register hi	03
Data register lo	FF
Error check	CRC

Memory map for ISOPAK registers

Reg no.	
0	Input 1, 16 bits of measured data
to	
23	Input 24, 16 bits of measured data
24	Digital control inputs 4 lsb holds state of input. Bit 0 is first bit closed contact=1
25	Alarm flags for chan 1..16
26	Alarm flags for chan 17..24 and warn flags for chan 1..8
27	Warn flags for chan 9..24
28	Highest up chan no
29	Highest up value

Reg data additional description

Reg 0..23	Holds 16 bits data that has been scaled relative to FSD = 10 000.
Reg 25..27	Is a 48 bit array where msb in reg 25 is first bit and lsb in reg 27 is last bit. This 48 bit array is split so that 24 alarm flags appear first, then 24 warn flags.
Reg 28	The highest up channel appears in the 5 lsb bits as 0..23 for chan 1..24.
Reg 29	Highest up in range 0..1023 =0..120 % relative to the alarm level for the highest up channel.

Any register from 0 to 29 can be read first from up to 30 registers (all) read in one message. Register 30 and up will read zero.

Note:
The unit will not respond to register polls higher than Reg. 29.

Description and protocol - ISOPAK on Modbus

ISOPAK Modbus message types

The following registers in ISOPAK may be read by Modbus: *(all start registers and lengths between registers 0 and 29 are allowed)*

Input, channel 1..8 Query

Starting register address hi/lo	$0000	(Chan 1 is in register 0)
Number of points hi/lo	$0008	

Input, channel 1..8 Response

Byte count $10 (16 bytes to receive)
Followed by register 0..7,
8x16 bits = 16 bytes of Data hi/Data lo from chan 1..8.

Input, channel 9..16 Query

Starting register address hi/lo	$0008	(Chan 9 is in register 8)
Number of points hi/lo	$0008	

Input, channel 9..16 Response

Byte count $10 (16 bytes to receive)
Followed by register 8..15
8x16 bits = 16 bytes of Data hi/Data lo from chan 9..16.

Input, channel 17..24 Query

Starting register address hi/lo	$0010	(Chan 17 is in register 16)
Number of points hi/lo	$0008	

Input, channel 17..24 Response

Byte count $10 (16 bytes to receive)
Followed by register 16..23.
8x16 bits = 16 bytes of Data hi/Data lo from chan 17..24.

Input, 4 digital control inputs Query

Starting address hi/lo	$0018	(register 24 holds control inputs)
Number of points hi/lo	$0001	

Input, 4 digital control inputs, Response

Byte count $02 (2 byte to receive)
Followed by register 24, digital control inputs.
16 bits = Data hi/Data lo.
State of the 4 inputs is in the 4 least significant bits of Data lo.

Flags, alarm and warning, Query

Starting register address hi/lo	$0019	(register 25..27 holds flags)
Number of points hi/lo	$0003	

Description and protocol - ISOPAK on Modbus

Flags, alarm and warning, Response

Byte count	$0006	(2 x 24 flags = 48 bits = 6 bytes = 3 16 bits words).
Data hi register 25	8 bits Alarm chan	1..8
Data lo register 25	8 bits Alarm chan	9..16,
Data hi register 26	8 bits Alarm chan	17..24
Data lo register 26	8 bits Warn chan	1..8
Data hi register 27	8 bits Warn chan	9..16
Data lo register 27	8 bits Warn chan	17..24

Highest up Query

Starting address hi/lo	$0028
Number of points hi/lo	$0002

Highest up Response

Byte Count	$0002
Data register 28	Highest up channel 0 = chan 1, 23=chan 24.
Data register 29	Highest value relative to alarm limit. Range 0..1023 where 1023 is 120% of alarm limit. Alarm limit (100%) is at 852.

ORDERING INFORMATION

Type	: ISOPAK112W
Aux. Supply	: 18-36VDC (nom: 24VDC)
Input Current C.T.	: IGT30
Range	: 0-300mA