UNIVERSAL DC EARTH FAULT PROTECTION SYSTEM

ISOPAK2xx

- 24 channel earth leakage monitoring of LIVE 6 to 60VDC networks
- Tailored to any current range in any number of networks
- Reads each channel's leakage current 0 to 100mA
- “Pathfinder” function displays polarity of earth leakage
- Set and view parameters on unit screen
- Healthy / Warning / Alarm C/O relay outputs
- "Highest up" 4-20mA signal & RS-485 Modbus RTU outputs

Specifications

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifications</th>
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</thead>
<tbody>
<tr>
<td>Auxiliary voltage</td>
<td>24–240V universal AC or DC (Fuse 2A)</td>
</tr>
<tr>
<td>Model for DC networks</td>
<td>ISOPAK2xx (up to 24 channels)</td>
</tr>
<tr>
<td>Factory settings (FSD)</td>
<td>Individual channel measuring range: 30, 100, 300, 500mA</td>
</tr>
<tr>
<td>Measuring method</td>
<td>MCR</td>
</tr>
<tr>
<td>Response time</td>
<td>Max 1200mS</td>
</tr>
<tr>
<td>Repeatability</td>
<td>0.5% FSD</td>
</tr>
<tr>
<td>Warning trip level</td>
<td>0-100% FSD (individually user settable)</td>
</tr>
<tr>
<td>Alarm trip level</td>
<td>0-100% FSD (individually user settable)</td>
</tr>
<tr>
<td>Relay time delay</td>
<td>1-30 sels. (individually user settable)</td>
</tr>
<tr>
<td>Analogue output</td>
<td>4/20mA, (max 500Ω) (proportional to highest up earth leakage)</td>
</tr>
<tr>
<td>Communication</td>
<td>RS485 Modbus RTU</td>
</tr>
<tr>
<td>Outputs relays</td>
<td>Volt free changeover</td>
</tr>
<tr>
<td>Relay contact rating</td>
<td>AC: 100VA - 250V/2A max. DC: 50W - 100V/1A max.</td>
</tr>
<tr>
<td>Temperature</td>
<td>-20 to +54°C</td>
</tr>
<tr>
<td>Front protection</td>
<td>IP21</td>
</tr>
<tr>
<td>Dimensions:</td>
<td>L x H x D:</td>
</tr>
<tr>
<td>ISOPAK200 (standard)</td>
<td>157 x 95 x 78 mm</td>
</tr>
<tr>
<td>ISOPAK200W (optional)</td>
<td>157 x 95 x 65 mm</td>
</tr>
<tr>
<td>ISOVIEW200 (optional)</td>
<td>96 x 95 x 58 mm</td>
</tr>
<tr>
<td>MML204-24VDC</td>
<td>70 x 95 x 58 mm</td>
</tr>
<tr>
<td>MML204-110VDC</td>
<td>116 x 95 x 58 mm</td>
</tr>
<tr>
<td>SAG204</td>
<td>156 x 46 x 60 mm</td>
</tr>
<tr>
<td>SAG404</td>
<td>156 x 46 x 60 mm</td>
</tr>
</tbody>
</table>

Communication cable: yellow 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 ISOPAK2xx adds to Megacon’s wide range of ISOGUARD products for insulation and earth fault monitoring and protection.

"Highest-up function" and "First-up function" give peace-of-mind

The purpose of ISOPAK2xx is to selectively address level and polarity of earth faults in live battery and DC power supply 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 first-up function latches the safety status lamps until reset. In this way the operator is immediately notified, but can await additional details following the next sequences of polarity scanning.

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.

High sensitivity DC leakage current AG sensor

The DC leakage current is measured by electronic AG-sensors, inserted in each monitored load circuit. The measuring method is based on the principle that the POSITIVE and the NEGATIVE current in a fault free load circuit sum to zero.

If an earth fault is present the fast response sensor detects the difference between the two currents and produces a proportional error signal. The sensor is rated max 500VDC. A single ISOPAK2xx can be used in up to 4 galvanically separated 6 to 60VDC networks.

Pathfinder function

This function performs selective scanning of leakage current alternately from POSITIVE or NEGATIVE pole. POLARITY lamps (POS/NEG) indicate the polarity of the earth fault and may ease fault finding.

ISOPAK2xx automatically configures to operate in either a FLOATING (fully isolated).

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

- Warning flags
- Alarm flags
- Individual channel measured data
- “HighestUp” Channel

Multiple paralleled ISOPAK2xx

Any number of ISOPAK2xx with its Sensors Controller MML204x may be paralleled in a chain with a common master PC, to supervise and log any number of channels and networks.
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:

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

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 electrolyte, 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:
- Fire prevention, removing ignition sources
- Eliminating electrolytic corrosion between dissimilar metals
- Preventing damage to electronic equipment caused by stray potentials
- Operational malfunction (false signalling, measuring errors)

Battery banks today play an important role as prime and backup power sources for electronic systems. New methods for faster and time efficient detection of earth faults in battery systems and DC distribution networks have long been in demand.

Early warning ability to trace an earth fault at its very origin is a must for preventive maintenance. ISOPAK2xx is designed for high resolution measurements at very low levels and will maintain its accuracy and linearity within its measuring range. The AG Sensor can selectively detect leakage current and polarity down to 1mADC.

Product Information

ISOPAK2xx (Standard)
This is an all-in-one ISOPAK2xx module for DIN rail mounting inside the switchboard.

Standard and optional version are to be used with a Sensor Controller MML204x

ISOPAK2xxW (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 ISOVIEW200, 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 ISOPAK2xxW, which is DIN rail mounted for easy access in the switchboard.

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

The ISOPAK2xx performs continuous selective measurement, using non-saturating AG-sensors, of earth current level in up to 24 live circuits. 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 sensor to get correct reading. Protective earth, metal sheaths or braiding of any cable must NOT be passed through the CBCT.

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

**Current Sensor Assembly SAG204 and SAG404**

To ease installation the DIN rail mounted SAG204 unit contains a group of four interconnected AG current sensors. As each galvanic isolated AG-sensor is potential-free the SAG204 can freely be installed in up to four separate battery or DC supply systems having a common protective earth, at any voltage from 12 to 60V DC.

The group of 4 sensors are pre-wired for easy connection to ISOPAK2xx. Each SAG204 unit receive a sensor excitation signal from the common Sensor Controller MML204x.

SAG404 is for connection of up to 4 of the IGT60-A (60mm) sensor.

**Sensor Controller MML204x**

An ISOPAK2xx system requires one common Sensor Controller MML204x, which provides an excitation/reference signal to each of the system’s total of 24 AG-sensors. MML204x also controls the leakage current polarity detection, an important feature for fault finding and preventive maintenance. ISOPAK2xx will alternately measure leakage current from positive or negative pole for intervals of preset duration.

The POS LED lamp on ISOPAK2xx is lit during monitoring of the POSITIVE pole. The NEG LED lamp is lit during monitoring of the NEGATIVE pole. In order to detect the polarity of the earth fault in each of multiple separate DC supply networks. The MML204x can receive voltage input from a total of 4 DC networks. MML204x units can be paralleled for higher number of DC networks. The MML204x is rated to withstand an enduring single pole full grounding.

MML204x automatically configures ISOPAK2xx to operate in either a FLOATING (fully isolated), a POSITIVE pole grounded or a NEGATIVE pole grounded DC network.

**System Integration**

One ISOPAK2xx in multiple DC supply systems

A single ISOPAK2xx with its Sensor Controller MML204x may monitor a total of 24 channels in up to 5 separate battery or DC supply systems (Net A, B, C, D, E). All 5 networks must have a common protective ground reference.

**System Expansion**

Multiple parallelled ISOPAK2xx

Any number of ISOPAK2xx units with a Sensor Controller MML204x may be paralleled in a chain with a common master PC, to supervise and log any number of channels and networks.
**Operation**

**User Interface**
A functional test can be performed by pressing the navigator knob during power up. This illuminates all LEDs.

Operation of the ISOPAK2xx 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 status of the system:

- **POSITIVE**: Polarity of scanning process
- **NEGATIVE**: Polarity of scanning process
- **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

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**
ISOPAK2xx 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 individual channel measurement when the operator scrolls through the status of each channel and reads each channel’s earth current directly in mA on the LCD screen.

First UP
ISOPAK2xx automatically locks a lit safety status warning lamp, until reset.
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:
  - ALARM
  - WARNING
  - NORMAL
- 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. If this option is included in the unit linking terminals 37 and 39, either with a fixed link or by an external Insulation Relay (KRM169) 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.
**Menu Summary**

**Main Navigation**

- **Screen 1**
  - **Highest Earth Fault**
  - Ins view channel 1
  - Q12 Batt Net A
  - Meas. Value: 32 mAdc

- **Screen 2**
  - **Main display window**
  - **MENU**
  - Chann. Status
  - Settings
  - EXIT

- **Screen 3**
  - **MENU**
  - Chann. Status
  - Settings
  - EXIT

- **Screen 4**
  - **EXIT**
  - Return to main display (push)

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

**Operation continues in next page**

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<no text content>
**Installation Guide**

ISOPAK2xx, the Sensor Controller MML204x and the SAG204 / SAG404 Sensor Assembly are for DIN35 rail mounting. ISOPAK2xx has 2 relay outputs (terminals 25 to 30). 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. ISOPAK2xx uses AG sensors for directional, selective measurement of earth current in DC networks.

ISOPAK2xx uses AG31 sensors for directional, selective measurement of earth current in DC networks.

- Install one common MML204x for each group of 24 AG-sensors
- An AG type sensor must be fitted in each monitored circuit
- The sensor measures earth faults on the load side of the sensor (see next page)
- Both loaded wires must pass through the sensor (see next page)
- Protective earth (PE), screening braids and armament must not pass through the sensor
- The output cable from the sensor should be screened if over 10 meters
- RS485 port for connection to external PC or bus (more information in following pages 13 to 16)
- Pluggable terminals are used throughout

Connect outputs from each SAG204 or SAG404 (up to 6 units) to ISOPAK2xx channel groups A, B, C, D, E, F as shown below

<table>
<thead>
<tr>
<th>Group</th>
<th>Term. 1 (Ch. 1)</th>
<th>Term. 5 (Ch. 9)</th>
<th>Term. 10 (Ch. 13)</th>
<th>Term. 15 (Ch. 17)</th>
<th>Term. 20 (Ch. 21)</th>
<th>Term. 43 (Ch. 17)</th>
<th>Term. 48 (Ch. 21)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Term. 2 (Ch. 2)</td>
<td>Term. 6 (Ch. 3)</td>
<td>Term. 11 (Ch. 6)</td>
<td>Term. 16 (Ch. 10)</td>
<td>Term. 21 (Ch. 14)</td>
<td>Term. 44 (Ch. 16)</td>
<td>Term. 49 (Ch. 20)</td>
</tr>
<tr>
<td>B</td>
<td>Term. 7 (Ch. 3)</td>
<td>Term. 12 (Ch. 7)</td>
<td>Term. 17 (Ch. 11)</td>
<td>Term. 22 (Ch. 15)</td>
<td>Term. 45 (Ch. 19)</td>
<td>Term. 50 (Ch. 23)</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Term. 8 (Ch. 4)</td>
<td>Term. 13 (Ch. 8)</td>
<td>Term. 19 (Ch. 12)</td>
<td>Term. 24 (Ch. 16)</td>
<td>Term. 47 (Ch. 20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Term. 9 (Ch. 4)</td>
<td>Term. 14 (Ch. 8)</td>
<td>Term. 19 (Ch. 12)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Term. 10 (Ch. 5)</td>
<td>Term. 15 (Ch. 9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Term. 11 (Ch. 6)</td>
<td>Term. 16 (Ch. 10)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Connect DC system voltage (externally fused 2 amps) to appropriate MML204 NET

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UNIVERSAL DC EARTH FAULT PROTECTION SYSTEM

ISOPAK2xx

SAG204 with attached AG12A sensor (4 standard AG sensors for each SAG204)

AG12A sensor (Inner diameter 12mm)

Connect outputs from each SAG204 (up to 6 units) to ISOPAK2xx channel groups A, B, C, D, E, F

To MML204 term. 13, 14, 15, 16

SAG404 with AG60A sensor (up to 4 AG sensors for each SAG404)

AG60A (IGT60-A) sensor (Inner diameter 60mm)

LOAD from DC sources pass through the AG60A sensors connected as shown to SAG404 terminal groups 10 to 13, 14 to 17, 18 to 21 and 22 to 25

Detection link must pass through AG60A sensor in the same direction as LOAD

Connect outputs from each SAG204 (up to 6 units) to ISOPAK2xx channel groups A, B, C, D, E, F

To MML204 term. 13, 14, 15, 16

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Connection for multiple paralleled ISOPAK2xx with SAG204

![Diagram of the connection](attachment:connection_diagram.png)

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UNIVERSAL DC EARTH FAULT PROTECTION SYSTEM

Norway Denmark United Kingdom

www.megacon.com

Innovation Beyond Tradition

Uniquely MEGACON, simpler it can’t be!
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
**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 per byte.
- CRC frame checking is used for testing integrity of a complete message.

<table>
<thead>
<tr>
<th>Query Field name</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slave address</td>
<td>11</td>
</tr>
<tr>
<td>Function</td>
<td>03</td>
</tr>
<tr>
<td>Starting address hi</td>
<td>00</td>
</tr>
<tr>
<td>Starting address lo</td>
<td>23</td>
</tr>
<tr>
<td>Number of points hi</td>
<td>00</td>
</tr>
<tr>
<td>Number of points lo</td>
<td>02</td>
</tr>
<tr>
<td>Error check</td>
<td>CRC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Response Field name</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slave address</td>
<td>11</td>
</tr>
<tr>
<td>Function</td>
<td>03</td>
</tr>
<tr>
<td>Byte count</td>
<td>04</td>
</tr>
<tr>
<td>Data register hi</td>
<td>03</td>
</tr>
<tr>
<td>Data register lo</td>
<td>FF</td>
</tr>
<tr>
<td>Data register hi</td>
<td>03</td>
</tr>
<tr>
<td>Data register lo</td>
<td>FF</td>
</tr>
<tr>
<td>Error check</td>
<td>CRC</td>
</tr>
</tbody>
</table>

**Memory map for ISOPAK registers**

<table>
<thead>
<tr>
<th>Reg no. to</th>
<th>Input 1, 16 bits of measured data</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 23</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reg no. 24</th>
<th>Digital control inputs 4 lab holds state of input. Bit 0 is first bit closed contact = 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reg no. 25</th>
<th>Alarm flags for chan 1..16</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reg no. 26</th>
<th>Alarm flags for chan 17..24 and warn flags for chan 1..8</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reg no. 27</th>
<th>Warn flags for chan 9..24</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reg no. 28</th>
<th>Highest up chan no</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reg no. 29</th>
<th>Highest up value</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td></td>
</tr>
</tbody>
</table>

**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.

*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

<table>
<thead>
<tr>
<th>Byte count</th>
<th>00006</th>
<th>(2 x 24 flags = 48 bits = 6 bytes = 316 bits words).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data hi register 25</td>
<td>8 bits Alarm chan</td>
<td>1..8</td>
</tr>
<tr>
<td>Data lo register 25</td>
<td>8 bits Alarm chan</td>
<td>9..16,</td>
</tr>
<tr>
<td>Data hi register 26</td>
<td>8 bits Alarm chan</td>
<td>17..24</td>
</tr>
<tr>
<td>Data lo register 26</td>
<td>8 bits Warn chan</td>
<td>1..8</td>
</tr>
<tr>
<td>Data hi register 27</td>
<td>8 bits Warn chan</td>
<td>9..16</td>
</tr>
<tr>
<td>Data lo register 27</td>
<td>8 bits Warn chan</td>
<td>17..24</td>
</tr>
</tbody>
</table>

#### Highest up Query

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

#### Highest up Response

<table>
<thead>
<tr>
<th>Byte Count</th>
<th>0002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data register 28</td>
<td>Highest up channel 0 = chan 1, 23=chan 24.</td>
</tr>
<tr>
<td>Data register 29</td>
<td>Highest value relative to alarm limit.</td>
</tr>
<tr>
<td></td>
<td>Range 0..1023 where 1023 is 120% of alarm limit.</td>
</tr>
<tr>
<td></td>
<td>Alarm limit (100%) is at 852.</td>
</tr>
</tbody>
</table>