2GCS214015A0070– rev. 5

PQF Modbus data table

Programmer's manual

1 INTRODUCTION

1.1 Intended audience

This manual is intended for programmers, commissioning people, supervision people who need to start communication, access data, and to develop supervision software which will interact with the LV Active Filters PQFI-PQFM-PQFK-PQFS.

1.2 Before you start

This manual describes the PQF Modbus data table.

All information available from the keyboard of the PQF-Manager will be available through the Modbus data table. Addresses, access levels and storage types information are of concerns.

To be able to access data of the LV Active Filters PQFI-PQFM-PQFK-PQFS consistently, a basic knowledge of it is needed. Functionality of the PQF, meaning of various measurements, logging of data are some particular aspects that should be familiar. Look in the PQF installation, operation and maintenance instructions to know more about it.

1.3 How to use this manual

Chapter 2 gives details concerning the Modbus protocol.

Chapter 3 describes Modbus functions and how Modbus is implemented in the filter.

Chapter 4 contains the formats and access rights information to exchange data.

Chapter 5 contains the table reference and formats to access measurement data.

Chapter 6 contains the table reference and formats to access setting data.

Chapter 7 contains the table reference for bit reads & writes.

Chapter 8 describes device specific Modbus functions.

Chapter 9 give a way to calculate the Cyclical Redundancy Check (CRC)

Chapter 10 is dedicated to annexes.

2 MODBUS PROTOCOL OVERVIEW

2.1 Overview

MODBUS RTU is a non-proprietary serial communications protocol that is widely used in the process control industry. The protocol was developed by Modicon for PLC communications and later released for public use.

This protocol is available in all major Human Machine Interface (HMI) software packages and terminals. Many of the major controller and PLC manufacturers also offer MODBUS protocol as a standard or optional protocol in their instrumentation.

The hardware over which MODBUS RTU communications are performed is not defined by the protocol. MODBUS RTU is supported on RS-232, RS-422, RS-485, Ethernet and other electrical standards. It should be noted that MODBUS RTU, MODBUS ASCII and

MODBUS Plus are unique communication formats, and are not compatible with each other. This document will discuss MODBUS RTU only.

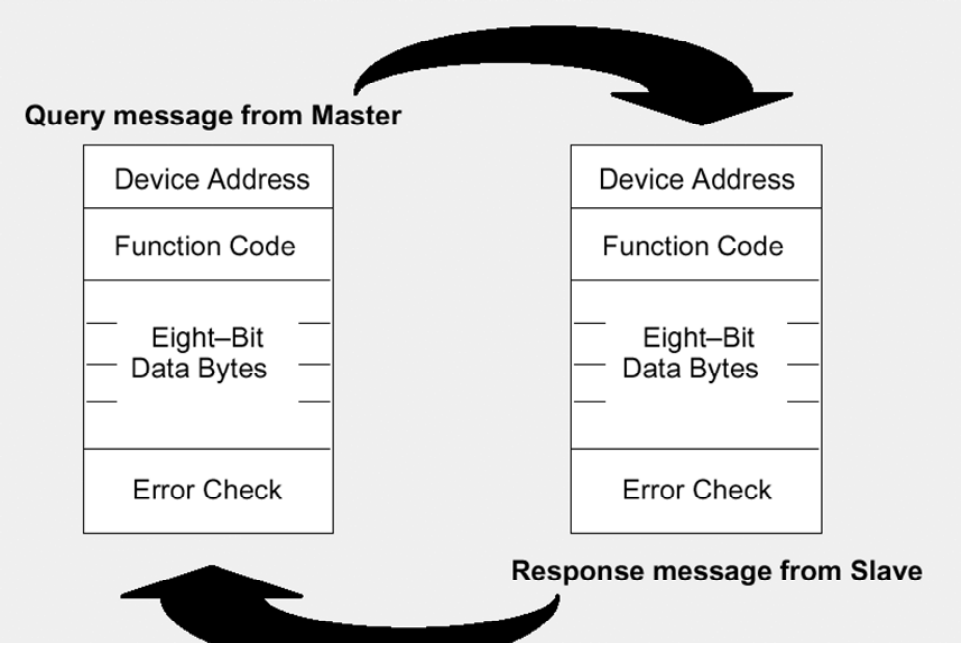
2.1.1 Transactions on Modbus Networks

Modbus protocol uses a master–slave technique, in which only one device (the master) can initiate transactions (called ‘queries’). The other devices (the slaves) respond by supplying the requested data to the master, or by taking the action requested in the query. Typical master devices include host processors and programming panels. Typical slaves include programmable controllers.

The master can address individual slaves, or can initiate a broadcast message to all slaves.

Slaves return a message (called a ‘response’) to queries that are addressed to them individually. Responses are not returned to broadcast queries from the master.

The Modbus protocol establishes the format for the master’s query by placing into it the device (or broadcast) address, a function code defining the requested action, any data to be sent, and an error–checking field. The slave’s response message is also constructed using Modbus protocol. It contains fields confirming the action taken, any data to be returned, and an error–checking field. If an error occurred in receipt of the message, or if the slave is unable to perform the requested action, the slave will construct an error message and send it as its response.



The Query:

The function code in the query tells the addressed slave device what kind of action to perform. The data bytes contain any additional information that the slave will need to perform the function.

The data field must contain the information telling the slave which register to start at and how many registers to read.

The error check field provides a method for the slave to validate the integrity of the message contents.

The Response:

If the slave makes a normal response, the function code in the response is an echo of the function code in the query. The data bytes contain the data collected by the slave, such as register values or status. If an error occurs, the function code is modified to indicate that the response is an error response, and the data bytes contain a code that describes the error.

The error check field allows the master to confirm that the message contents are valid.

2.1.2 Serial Transmission Mode

The transmission mode defines the bit contents of message fields transmitted serially on the networks. It determines how information will be packed into the message fields and decoded.

Modbus defines two transmission modes: ASCII or RTU.

Only RTU mode will be used here. The mode and serial parameters must be the same for all devices on a Modbus network.

RTU Mode

The main advantage of this mode is that its greater character density allows better data throughput than ASCII for the same baud rate.

Each message must be transmitted in a continuous stream.

The format for each byte in RTU mode is:

Bits per Byte:

1 start bit

8 data bits, least significant bit sent first

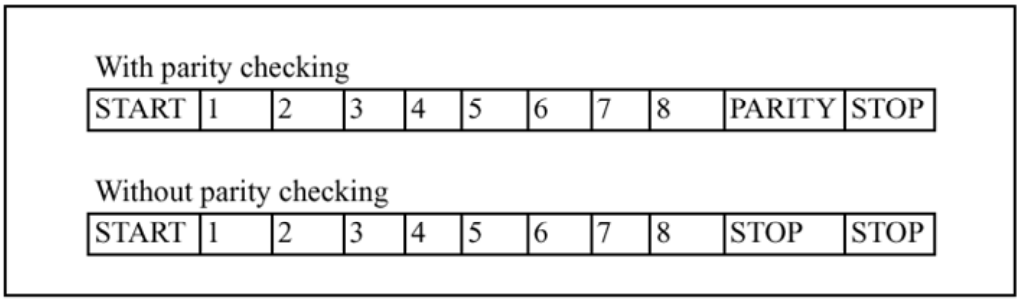
1 bit for even/odd parity; no bit for no parity

1 stop bit if parity is used; 2 bits if no parity

Error Check Field: Cyclical Redundancy Check (CRC)

The messages are transmitted in the network from left to right, i.e. the Least

Significant Bit (LSB) first and the Most Significant Bit (MSB) last.



Description of the bit sequence for the RTU mode

2.1.3 Modbus Message Framing

A Modbus message is placed by the transmitting device into a frame that has a known beginning and ending point. This allows receiving devices to begin at the start of the message, read the address portion and determine which device is, and to know when the message is completed.

Partial messages can be detected and errors can be set as a result.

RTU Framing

In RTU mode, messages start with a silent interval of at least 3.5 character times.

This is most easily implemented as a multiple of character times at the baud rate that is being used on the network (shown as T1–T2–T3–T4 in the figure below).

Another factor to consider is that each device has its own response time. This response time can be anywhere from a few milliseconds to a few hundred milliseconds. The Host must be configured to allow adequate time for the slowest device to respond.

The first field then transmitted is the device address.

Networked devices monitor the network bus continuously, including during the ‘silent’ intervals. When the first field (the address field) is received, each device decodes it to find out if it is the addressed device.

Following the last transmitted character, a similar interval of at least 3.5 character times marks the end of the message. A new message can begin after this interval.

The entire message frame must be transmitted as a continuous stream. If a silent interval of more than 1.5 character times occurs before completion of the frame, the receiving device flushes the incomplete message and assumes that the next byte will be the address field of a new message.

Similarly, if a new message begins earlier than 3.5 character times following a previous message, the receiving device will consider it a continuation of the previous message. This will set an error, as the value in the final CRC field will not be valid for the combined messages. A typical message frame is shown below.

START	ADDRESS	FUNCTION	DATA	CRC CHECK	END
T1–T2–T3–T4	8 BITS	8 BITS	*n* x 8 BITS	16 BITS	T1–T2–T3–T4

RTU Message Frame

For a complete description of the Modbus protocol, please look at the Modicon

Modbus Protocol Reference Guide (PI–MBUS–300 Rev. J).

3 MODBUS FUNCTION CODES

3.1 Data Addresses in Modbus Messages

Modbus defines 4 address spaces : 2 address spaces for bit addressable data and 2 address spaces for 16 bits addressable data .

Address space	Data	readable / writable	Modbus name
0XXXX	Output bit	read & write	Coil Status
1XXXX	Input bit	read	Input Status
3XXXX	Input word	read	Input Register
4XXXX	Output word	read & write	Holding Register

Input register address space will be mainly used for measurements.

Holding register address space will contain settings.

All data addresses in Modbus messages are referenced to zero.

For example:

The coil known as ‘coil 1’ in a programmable controller is addressed as coil 0000 in the data address field of a Modbus message.

Coil 127 decimal is addressed as coil 007E hex (126 decimal).

Holding register 40001 is addressed as register 0000 in the data address field of the message.

The function code field already specifies a ‘holding register’ operation. Therefore the ‘4XXXX’ reference is implicit.

Holding register 40108 is addressed as register 006B hex (107 decimal).

3.2 Supported function codes

The following table gives the Modbus functions which are implemented and supported.

The code is the one used in function field of the Modbus message.

The address space concerned and the purpose of the function are given below.

Code	Function	Address range / Remark
1	**Read Coil Status**	**0XXXX** Reads the on/off status of discrete outputs
	Read Input Status	**1XXXX** Reads the on/off status of discrete inputs
3	**Read Holding Registers**	**4XXXX** Reads contents of output registers
4	**Read Input Registers**	**3XXXX** Reads contents of input registers
5	**Force Single Coil**	**0XXXX** Sets the status of a discrete output
6	**Preset Single Register**	**4XXXX** Sets the value of a holding register
7	**Read Exception Status**	device specific (see chapter 8)
8	**Diagnostics**	Checks the communication system between the master and the slave
11	**Fetch Comm. Event Ctr.**	Returns the amount of successful read/write operations on data points
12	**Fetch Comm. Event Log**	Returns log registers of communication events
15	**Force Multiple Coils**	**0XXXX** Sets the status of multiple discrete outputs
16	**Preset Multiple Registers**	**4XXXX** Sets the value of multiple holding registers
17	**Report Slave ID**	device specific (see chapter 8)
22	**Mask Write 4X registers**	**4XXXX** And / Or write of a holding register
23	**Read/Write 4X registers**	**4XXXX** Reads a set of holding registers and writes a set of holding registers in one query

Remark: please note that for security reasons broadcast is not supported by the PQF.

3.3 Master's queries and Slave's responses

When a master device sends a query to a slave device it expects a normal response. One of four possible events can occur from the master's query:

- If the slave device receives the query without a communication error, and can handle the query normally, it returns a normal response.
- If the slave does not receive the query due to a communication error, no response is returned. The master program will eventually process a timeout condition for the query.
- If the slave receives the query, but detects a communication error (parity or CRC), no response is returned. The master program will eventually process a timeout condition for the query.
- If the slave receives the query without a communication error, but cannot handle it (for example, if the request is to read a non–existent coil or register), the slave will return an exception response informing the master of the nature of the error.

3.4 Reads and writes to Modbus addresses (functions 1,2,3,4,5,6,15,16,22,23)

The format of a read function (read coil status (01), read input status (02), read input registers (04), read holding registers (03)) is as follows:

QUERY	
Slave address	1 byte
Function	1 byte
Starting data address	2 bytes
Quantity of points	2 bytes
Error check field CRC	2 bytes

RESPONSE	
Slave address	1 byte (echo of master's query)
Function	1 byte (echo of master's query)
Byte count	1 byte
Data values	N bytes
Error check field CRC	2 bytes

The format of a force single coil (05) or a preset single register (06) function is as follows:

QUERY	
Slave address	1 byte
Function	1 byte
Data address	2 bytes
Data value	2 bytes
Error check field CRC	2 bytes

RESPONSE	
Slave address	1 byte (echo of master's query)
Function	1 byte (echo of master's query)
Data address	2 bytes
Data value	2 bytes
Error check field CRC	2 bytes

The format of a force multiple coil (15) or a preset multiple registers (16) function is as follows:

QUERY	
Slave address	1 byte
Function	1 byte
Data address	2 bytes
Quantity of points	2 bytes
Byte count	1 byte
Data values	N bytes
Error check field CRC	2 bytes

RESPONSE	
Slave address	1 byte (echo of master's query)
Function	1 byte (echo of master's query)
Data address	2 bytes
Quantity of points	2 bytes
Error check field CRC	2 bytes

The format of a read/write multiple registers (23) function is as follows:

QUERY	
Slave address	1 byte
Function	1 byte
Read data address	2 bytes
Read quantity of points	2 bytes
Write data address	2 bytes
Write quantity of points	2 bytes
Byte count	1 byte
Write data values	N bytes
Error check field CRC	2 bytes

RESPONSE	
Slave address	1 byte (echo of master's query)
Function	1 byte (echo of master's query)
Byte count	1 byte
Data values	N bytes
Error check field CRC	2 bytes

The format of a Mask/write register (22) function is as follows:

QUERY	
Slave address	1 byte
Function	1 byte
Data address	2 bytes
And mask	2 bytes
Or mask	2 bytes
Error check field CRC	2 bytes

RESPONSE	
Slave address	1 byte (echo of master's query)
Function	1 byte (echo of master's query)
Data address	2 bytes
And mask	2 bytes
Or mask	2 bytes
Error check field CRC	2 bytes

3.5 Fetch comm event counter (function 11)

The controller's event counter is incremented once for each successful message completion. It is not incremented for exception responses, poll commands, or fetch event counter commands. It returns amount of successful read/write operations on data points.

The format of a Fetch comm event counter (11) function query is as follows:

QUERY	
Slave address	1 byte
Function	1 byte
Error check field CRC	2 bytes

RESPONSE	
Slave address	1 byte (echo of master's query)
Function	1 byte (echo of master's query)
Status word	2 bytes (0)
Event counter	2 bytes
Error check field CRC	2 bytes

3.6 Fetch comm event log (function 12)

Returns a status word, the comm event counter (see function 11) , the bus message counter (see function 08 subfunction 11), and a field of event bytes from the slave.

The format of a Fetch comm event log (12) function query is as follows:

QUERY	
Slave address	1 byte
Function	1 byte
Error check field CRC	2 bytes

RESPONSE	
Slave address	1 byte (echo of master's query)
Function	1 byte (echo of master's query)
Byte count	1 byte
Status word	2 bytes (0)
Event counter	2 bytes
Bus message counter	2 bytes
Event log buffer	N bytes
Error check field CRC	2 bytes

The 64 bytes wide Event log buffer is filled with communication events. The most recent communications event is shown in the Event 0 byte.

Event bytes are stored in the Even log buffer for 4 different reasons.

The bit will be set to a logic '1' if the corresponding condition is TRUE.

<u>Slave Modbus Receive Event</u>

This type of event byte is stored by the slave when a query message is received.

It is stored before the slave processes the message.

Bit	Contents
0	Not Used
1	Communications Error
2	Not Used
3	Not Used
4	Character Overrun
5	Currently in Listen Only Mode

6 Broadcast Received

7 1

Slave Modbus Send Event

This type of event byte is stored by the slave when it finishes processing a query message.

It is stored if the slave returned a normal or exception response, or no response.

Bit Contents

0 Read Exception Sent (Exception Codes 1-3)

1 Slave Abort Exception Sent (Exception Code 4)

2 Not used

3 Not used

4 Write Timeout Error Occurred

5 Currently in Listen Only Mode

6 1

7 0

Slave Entered Listen Only Mode

This type of event byte is stored by the slave when it enters the Listen Only Mode.

The event is defined by a content of ‘04’ hex.

Slave Initiated Communication Restart

This type of event byte is stored by the slave when its communications port. Is restarted. The slave can be restarted by the Diagnostics function (code 08), with subfunction Restart Communications Option (code 01).

The event is defined by a contents of ‘00’ hex.

3.7 Diagnostics function and subfunctions (function 8)

The format of a diagnostics (08) function query is as follows:

QUERY	
Slave address	1 byte
Function	1 byte
Subfunction	2 bytes
Data field	2 bytes
Error check field CRC	2 bytes

The format of a response to a diagnostics function query is an echo of the query itself.

If the request is directed to a counter, however, the slave returns the counter’s value in the data field.

00 Return Query Data

The data in the query data field is to be returned (looped back) in the response. The entire response should be identical to the query.

01 Restart Communication Option

The slave’s peripheral port is to be initialized and restarted, and all of its communication event counters are to be cleared. If the port is currently in the Listen Only Mode, no response will be sent. If the port is not currently in the Listen Only Mode, a normal response will be sent. This occurs before the restart is executed.

02 Return Diagnostic Register (Not supported)

03 (Not supported)

04 Force Listen Only Mode

Forces the addressed slave to enter the Listen Only Mode for Modbus communications.

10 Clear Counters and Diagnostic Register

Clears all counters and the diagnostic register.

11 Return Bus Message Count

The response data field returns the total quantity of messages that the slave has detected in the communications system since its last restart, clear counters operation, or power-up.

12 Return Bus Communication Error Count

The response data field returns the quantity of CRC errors encountered by the slave since its last restart, clear counters operation, or power-up.

13 Return Bus Exception Error Count

The response data field returns the quantity of Modbus exception responses returned by the slave since its last restart, clear counters operation, or power-up.

14 Return Slave Message Count

The response data field returns the quantity of messages addressed to the slave, or broadcast that the slave has processed since its last restart, clear counters operation, or power-up.

15 Return Slave No Response Count

The response data field returns the quantity of messages addressed to the slave for which it sent no response (neither a normal response nor an exception response) since its last restart, clear counters operation, or power-up.

16 Return Slave NACK Response Count (Not supported)

17 Return Slave Busy Response Count (Not supported)

18 Return Bus Character Overrun Count

The response data field returns the quantity of messages addressed to the slave that it could not handle due to a character overrun condition since its last restart, clear counters operation, or power-up

19 (Not supported)

20 (Not supported)

21 (Not supported)

Diagnostic counters

Bus Message Counter	The total number of messages that the slave device has detected in the communications system since its last restart, clear counters operation, or power-up.
Bus Communication Error Counter	The number of CRC or LRC errors encountered by the slave device since its last restart, clear counters operation, or power-up.
Bus Exception Error Counter	The number of Modbus exception responses sent by the slave device since its last restart, clear counters operation, or power-up.
Slave Message Counter	The number of messages addressed to the slave device or broadcast that the slave device has processed since its last restart, clear counters operation, or power-up.
Slave No Response Counter	The number of messages addressed to the slave device for which it sent no response (neither a normal response nor an exception response) since its last restart, clear counters operation, or power-up.
Bus Character Overrun Counter	The number of messages addressed to the slave device that it could not handle due to a character overrun condition since its last restart, clear counters operation, or power-up .

3.8 Exception responses

Exception responses are sent when the slave device cannot handle the query. The format of an exception response to a master's query is as follows:

01 ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the slave device (see paragraph 3.2).
02 ILLEGAL DATA ADDRESS	The data address or number of items received in the query is not allowable or correct for the slave device. The slave device will send this exception response if an attempt to read or write part of a multiple register database object is detected. Possible objects are time, strings and counters
03 ILLEGAL DATA VALUE	A value contained in the query data field is out of range. The contents of the register or the status of the coil has not changed (see paragraph 4.3).
04 SLAVE DEVICE ABORT	An unrecoverable error occurred while the slave was attempting to perform the requested action. This

	may happen when the access level for changing a parameter is not reached (see paragraph 4.2) .
05 ACKNOWLEDGE	Not supported
06 SLAVE DEVICE BUSY	Not supported
07 NEGATIVE ACKNOWLEDGE	Not supported
08 MEMORY PARITY ERROR	Not supported

An application program in the master is responsible for handling exception responses. Typical processes include successive attempts to send a query, sending diagnostic messages to the slave, and notifying the operators.

4 DATA ACCESS

4.1 Formats

Various formats are used depending on the type of data and the number bits used.

BITS

0 or 1. Used in the address range 0XXXX to 1XXXX.

SIGNED CHAR (CHAR°

Signed chars are 8 bit values. These values vary in the range -128 to +127 although some registers have a limited range of acceptable values. The most significant bit defines the sign, zero indicating positives. Signed chars are converted to signed integers and transmitted as two 8 bit bytes for protocol compatibility.

UNSIGNED CHAR (BYTE)

Unsigned chars are 8 bit values. These values vary in the range 0 to 255 although some registers have a limited range of acceptable values. Unsigned chars are converted to unsigned integers and transmitted as two 8 bit bytes for protocol compatibility.

SIGNED INTEGER (INT)

Signed Integers are 16 bit values transmitted as two 8 bit bytes. The most significant byte is always transmitted first. These values vary in the range -32768 to +32767 although some registers have a limited range of acceptable values. The most significant bit defines the sign, zero indicating positives.

UNSIGNED INTEGER (WORD)

Unsigned Integers are 16 bit values transmitted as two 8 bit bytes. The most significant byte is always transmitted first. These values vary in the range 0 to 65535 although some registers have a limited range of acceptable values.

SIGNED LONG INTEGERS (LONG)

Signed long integers are 32 bit values transmitted as four 8-bit bytes. These values vary in the range -2147483648 to 2147483647 although some registers have a limited range.

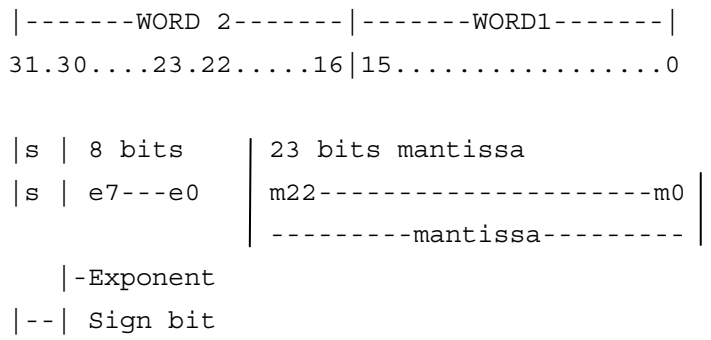
The most significant bit defines the sign, zero indicating positives.

UNSIGNED LONG INTEGERS (DWORD)

Unsigned long integers are 32 bit values transmitted as four 8-bit bytes. These values vary in the range 0 to 4294967295 although some registers have a limited range.

SINGLE-PRECISION IEEE FLOAT NUMBERS (FLOAT)

These numbers implement the IEEE-754 standard for binary floating point arithmetic (32 bits). The format is described below:



s: 1 sign bit; explains the sign (0 = positive, 1 = negative)

e: 8 bits two's complement exponent. The true value is the exponent minus 127.

m: 23 bits . The "most significant bit" of the normalized mantissa before the decimal point is implicitly 1, but is not stored. The value range is also between 1.0 (included) and 2.0 (excluded).

The value may be computed using $(-1)^s \ (1.m_{22}m_{21}...m_0)\ 2^{e-127}$

IEEE float numbers (4-byte IEEE format) are transmitted in two subsequent 16-bit registers.

Both registers must always transmit a 32-bit value in sequence to get the consistency of the display.

When writing to an IEEE float number, both registers must be sent in sequence.

Note: For some data, because of internal conversions (from integer to float) the 7 or 8 least significant bits of the mantissa could be always zero. Consequently, the 7 least significant bits are lost, which may give slightly different values.

4.2 Access levels

The access levels of the Modbus writings are roughly similar to the access levels in the PQFManager menus.

LOCKING SWITCH (LS): the locking switch (blue button at the back of the PQFManager) has to be released in order to allow write operation.

ISTALLATION LOCK (IL): if a data is protected by I.L., the "UserSettings.InstallationLocked" parameter must be cleared for Modbus to be allowed to modify it. It should be noted that the parameters in the "InstallationSettings" GROUP can not directly be written by means of the PQFManager menus, but require to run one of the commissioning functions; these are locked by the "UserSettings.InstallationLocked"

parameter so nor the parameters neither the functions are accessible through MODBUS (set as Read only).

The parameter “Communication.ModbusLocked” is used to add an access level to Modbus users. When locked, all parameter settings modifications (except the Modbus lock item setting) from the PQFManager keyboard are forbidden. Parameters may meanwhile be modified by Modbus access only (provided all others access levels are fulfilled).

4.3 Minimum and maximum values

Parameters settings values have a limited range. If a written value exceeds the minimum and maximum allowable values, the written value will be overridden with this minimum or maximum value.

An ILLEGAL DATA VALUE exception error will be sent back.

Please refer to the Modbus data table for more details.

4.4 Modbus Data table

4.4.1 Reference

Any data that can be accessed through Modbus is referred by means of a GROUP and a NAME (in the present document, the reference is “GROUP.NAME”). Table data may be read only or read/write access.

4.4.2 Address

Data in each table is pointed to in a Modbus command by two consecutive data address bytes. The first byte defines the table number, and the second byte the offset of the data in the table. These two bytes are called either the ‘Modbus address’ or the ‘Modbus register’

Access (read or write) to a non-referenced Modbus address results in an ILLEGAL DATA ADDRESS exception error.

4.4.3 Type

The format (see 4.1) of the data describes:

- What has to be transferred (how many data bytes) to perform an access;
- How the transferred bytes have to be converted before use;

If the type is LONG, DWORD or FLOAT, four bytes have to be transferred by means of a first transfer of 2 bytes (Least significant) located at the corresponding modbus address followed by another transfer of two bytes (Most significant) at this address +1.

4.4.4 Access

- **Read (R)** only.
- **Read/Write (R/W)**: the write operation is only valid if the current access level allows it;
- The access level is based on the status of:
- **LS** : Most of the R/W parameters cannot be written when LS is pressed;

- **IL** : Some more sensitive parameters, that should not be modified after PQF installation, are also protected by the “UserSettings.InstallationLocked” flag.

4.4.5 Data storage

- **RAM: (R)**: Value is stored into RAM and can be modified.
- **Non volatile: (NV)** : Value is stored into Non volatile memory and can be modified but a maximum of 100000 number of write cycles must not be exceeded.
- **Constant: (C)**: Value is stored into ROM (can not be modified)

4.4.6 Description

Defines the physical meaning of the data, unit and range if relevant, and how to use it.

5 Modbus table

5.1 AuxUserSettings

Reference	Address	Type	Access		Storage	Description
Curve1	41401	FLOAT	R/W	LS	NV	The curve level defines the amount of current that is allowed to flow into the network for each harmonic. The curve has to be defined in Arms. Set the filter in mode 3 if the only harmonic requirement is to respect the curve settings.
Curve2	41403	FLOAT	R/W	LS	NV	
Curve3	41405	FLOAT	R/W	LS	NV	
Curve4	41407	FLOAT	R/W	LS	NV	
Curve5	41409	FLOAT	R/W	LS	NV	
Curve6	41411	FLOAT	R/W	LS	NV	
Curve7	41413	FLOAT	R/W	LS	NV	
Curve8	41415	FLOAT	R/W	LS	NV	
Curve9	41417	FLOAT	R/W	LS	NV	
Curve10	41419	FLOAT	R/W	LS	NV	
Curve11	41421	FLOAT	R/W	LS	NV	
Curve12	41423	FLOAT	R/W	LS	NV	
Curve13	41425	FLOAT	R/W	LS	NV	
Curve14	41427	FLOAT	R/W	LS	NV	
Curve15	41429	FLOAT	R/W	LS	NV	
Curve16	41431	FLOAT	R/W	LS	NV	
Curve17	41433	FLOAT	R/W	LS	NV	
Curve18	41435	FLOAT	R/W	LS	NV	
Curve19	41437	FLOAT	R/W	LS	NV	

<table>
<tr><td>Curve20</td><td>41439</td><td>FLOAT</td><td>R/W</td><td>LS</td><td>NV</td><td></td></tr>
<tr><td>FilterMode</td><td>41501</td><td>LONG</td><td>R/W</td><td>LS</td><td></td><td>To choose for the auxiliary settings the order in which filter resources will be allocated.
Mode 1: Curve filtering/Max. filtering/Reactive power;
Mode 2: Curve filtering/Reactive power/Max. filtering;
Mode 3: Curve filtering/Reactive power.
Default value is 3. Refer to the PQF Manual table 8.7 for more information on the filter mode.</td></tr>
<tr><td>Reactive Compensation Type</td><td>41503</td><td>LONG</td><td>R/W</td><td>LS</td><td></td><td>Auxiliary setting to select which kind of reactive power compensation has to be implemented
(dynamic inductive, dynamic capacitive, static inductive or static capacitive). The possible values are:
<table>
<tr><th></th><th></th><th>Meaning</th></tr>
<tr><td>0</td><td>Disabled</td><td>No reactive power injected by the filter</td></tr>
<tr><td>1</td><td>Dyn. ind.</td><td>Compensates till the inductive target co phi is reached (TargetCosphi)</td></tr>
<tr><td>2</td><td>Dyn. cap.</td><td>Compensates till the capacitive target cos phi is reached (TargetCosphi)</td></tr>
<tr><td>3</td><td>Static ind.</td><td>Injects the inductive amount of static reactive power specified (StaticReactivePower)</td></tr>
<tr><td>4</td><td>Static cap.</td><td>Injects the capacitive amount of static reactive power specified (StaticReactivePower)</td></tr>
</table>
Refer to the PQF Manual table 8.9 for more information on the reactive power injection.</td></tr>
<tr><td>SelectedOrder1</td><td>41201</td><td>LONG</td><td>R/W</td><td>LS</td><td></td><td rowspan="5">Twice the harmonic order to be considered by the filter.</td></tr>
<tr><td>SelectedOrder2</td><td>41203</td><td>LONG</td><td>R/W</td><td>LS</td><td></td></tr>
<tr><td>SelectedOrder3</td><td>41205</td><td>LONG</td><td>R/W</td><td>LS</td><td></td></tr>
<tr><td>SelectedOrder4</td><td>41207</td><td>LONG</td><td>R/W</td><td>LS</td><td></td></tr>
<tr><td>SelectedOrder5</td><td>41209</td><td>LONG</td><td>R/W</td><td>LS</td><td></td></tr>
</table>

SelectedOrder6	41211	LONG	R/W	LS		
SelectedOrder7	41213	LONG	R/W	LS		
SelectedOrder8	41215	LONG	R/W	LS		
SelectedOrder9	41217	LONG	R/W	LS		
SelectedOrder10	41219	LONG	R/W	LS		
SelectedOrder11	41221	LONG	R/W	LS		
SelectedOrder12	41223	LONG	R/W	LS		
SelectedOrder13	41225	LONG	R/W	LS		
SelectedOrder14	41227	LONG	R/W	LS		
SelectedOrder15	41229	LONG	R/W	LS		
SelectedOrder16	41231	LONG	R/W	LS		
SelectedOrder17	41233	LONG	R/W	LS		
SelectedOrder18	41235	LONG	R/W	LS		
SelectedOrder19	41237	LONG	R/W	LS		

SelectedOrder20	41239	LONG	R/W	LS		
Selection1	41301	LONG	R/W	LS		When set, the corresponding harmonic order is filtered according to the Filter Mode.
Selection2	41303	LONG	R/W	LS		
Selection3	41305	LONG	R/W	LS		
Selection4	41307	LONG	R/W	LS		
Selection5	41309	LONG	R/W	LS		
Selection6	41311	LONG	R/W	LS		
Selection7	41312	LONG	R/W	LS		
Selection8	41315	LONG	R/W	LS		
Selection9	41317	LONG	R/W	LS		
Selection10	41319	LONG	R/W	LS		
Selection11	41321	LONG	R/W	LS		
Selection12	41323	LONG	R/W	LS		
Selection13	41325	LONG	R/W	LS		When set, the corresponding harmonic order is filtered according to the Filter Mode.

Selection14	41327	LONG	R/W	LS		
Selection15	41329	LONG	R/W	LS		
Selection16	41331	LONG	R/W	LS		
Selection17	41333	LONG	R/W	LS		
Selection18	41335	LONG	R/W	LS		
Selection19	41337	LONG	R/W	LS		
Selection20	41339	LONG	R/W	LS		
StaticReactive Power	41507	FLOAT	R/W	LS		Enter the amount of static reactive power that the filter has to generate here. Use ReactiveCompensationType to define whether the power should be capacitive (Static cap.) or inductive (Static ind.). Units: kvar
TargetCosphi	41509	FLOAT	R/W	LS		Enter the target displacement power factor here. Use ReactiveCompensationType to define whether the compensation type is (dynamic) inductive or (dynamic) capacitive. Range: [-0.6 ; 1.0]
Unbalance Compensation	41505	LONG	R/W	LS		Enable this feature if the filter has to do load balancing. When 1, the line to line loads are balanced; when 2, the line to neutral loads are balanced; when 3, full balancing, for line to line and line to neutral loads, is enabled.

5.2 Communication

<table>
<tr><th>Reference</th><th>Address</th><th>Type</th><th colspan="2">Access</th><th>Storage</th><th>Description</th></tr>
<tr><td>Address</td><td>40101</td><td>WORD</td><td>R/W</td><td>LS+IL</td><td>NV</td><td>Enter a slave address here which will identify the filter on the Modbus network. Make sure that the address chosen is not used by any other equipment present in the network. Range: [1 ; 247]</td></tr>
<tr><td>BaudRate</td><td>40105</td><td>BYTE</td><td>R/W</td><td>LS+IL</td><td>NV</td><td>Set up the Baud rate used by the Modbus communication interface here. Valid values are:
<table>
<tr><th>Value</th><th>Meaning</th></tr>
<tr><td>0</td><td>110 bauds</td></tr>
<tr><td>1</td><td>300 bauds</td></tr>
<tr><td>2</td><td>600 bauds</td></tr>
<tr><td>3</td><td>1200 bauds</td></tr>
<tr><td>4</td><td>2400 bauds</td></tr>
<tr><td>5</td><td>4800 bauds</td></tr>
<tr><td>6</td><td>9600 bauds</td></tr>
<tr><td>7</td><td>19200 bauds</td></tr>
<tr><td>8</td><td>38400 bauds</td></tr>
<tr><td>9</td><td>57600 bauds</td></tr>
</table></td></tr>
<tr><td>Enabled</td><td>40102</td><td>BYTE</td><td>R/W</td><td></td><td>NV</td><td>Choose 0 if PQF-Link or printer communication is desired. Choose 1 if Modbus communication is desired. In the latter case the Modbus parameters have to be set up appropriately. Also, the Modbus adapter has to be inserted at the rear of the PQF-Manager.</td></tr>
<tr><td>Modbus Locked</td><td>40103</td><td>BYTE</td><td>R/W</td><td></td><td>NV</td><td>Switch on the Modbus lock (set parameter to 1) if settings may only be changed through Modbus communication. In this case, the filter settings cannot be changed locally. To unlock, set to 0.</td></tr>
<tr><td>Parity</td><td>40106</td><td>BYTE</td><td>R/W</td><td></td><td>NV</td><td>Set up the parity used by the Modbus communication interface here.
<table>
<tr><th>Value</th><th>Signification</th></tr>
<tr><td>0</td><td>No parity</td></tr>
<tr><td>1</td><td>Even</td></tr>
<tr><td>2</td><td>Odd</td></tr>
</table></td></tr>
<tr><td>StopBit</td><td>40107</td><td>BYTE</td><td>R/W</td><td></td><td>NV</td><td>Set up the number of stopbits used by the Modbus communication interface here. Set 0 for one stop bit and 1 for two stop bits.</td></tr>
</table>

5.3 Error

Reference	Address	Type	Access	Storage	Description
CurrentDSP Error	31503	DWORD	R	R	Current global error status in the DSP. When the bit is set in the double word, the corresponding error is present. Bit index:

0	Overvoltage RMS	11	No synchronisation	22	IGBT temporary
1	Overvolt. transient (SW)	12	DC overvoltage (SW)	23	IGBT permanent
2	n.a.	13	DC overvoltage (HW)	24	IGBT check cooling
3	Undervoltage RMS	14	DC undervoltage (SW)	25	SPI timeout
4	Loss of phase	15	Preload problem	26	Mismatch between units
5	Wrong phase rotation	16	DC Top overvoltage	27	n.a.
6	Unbalanced supply	17	DC Bot overvoltage	28	n.a.
7	n.a.	18	Overcurrent peak (SW)	29	Bad message sequence
8	Bad CT connection	19	Overcurrent RMS	30	Bad ratings parameters
9	Out of mains freq. limit	20	Overcurrent peak (HW)	31	Critical
10	Unstable mains frequ.	21	Ground fault		

Refer to the PQF Manual table 8.17 for more information on the errors reported by DSP.

Reference	Address	Type	Access	Storage	Description
CurrentDSP Warning	31560	DWORD	R	R	Current global warning status in the DSP. When the bit is set in the double word, the corresponding warning is present. Bit index:

0	Overvoltage RMS	6	Unbalanced supply	24	IGBT check cooling
3	Undervoltage RMS	21	Ground fault		

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="6">Refer to the PQF Manual table 7.13 for more information on the warning reported by DSP.</td></tr>
<tr><td>CurrentUC Error</td><td>31501</td><td>DWORD</td><td>R</td><td></td><td>R</td><td colspan="6">Current global error status in the UC.
When the bit is set in the double word, the corresponding error is present.
Bit index:
<table><tr><td>0</td><td>Ctrl overtemperature</td><td>8</td><td>Power supply fault</td><td>16</td><td>Corrupted DSP code</td></tr><tr><td>1</td><td>Real time clock problem</td><td>9</td><td>Internal uC fault</td><td>17</td><td>n.a.</td></tr><tr><td>2</td><td>Com. problem (CAN bus)</td><td>10</td><td>n.a.</td><td>18</td><td>Different firmwares</td></tr><tr><td>3</td><td>Com. problem (RS232)</td><td>11</td><td>Watchdog fault</td><td>19</td><td>n.a.</td></tr><tr><td>4</td><td>Preload time-out</td><td>12</td><td>n.a.</td><td>20</td><td>DSP watchdog</td></tr><tr><td>5</td><td>Breaker/Cont trip</td><td>13</td><td>n.a.</td><td>21</td><td>SPI Timeout</td></tr><tr><td>6</td><td>Preload time-out</td><td>14</td><td>n.a.</td><td>24</td><td>Several units same id</td></tr><tr><td>7</td><td>Breaker/Cont trip</td><td>15</td><td>Corrupted uC code</td><td></td><td></td></tr></table>Refer to the PQF Manual table 8.18 for more information on the errors reported by controller.</td></tr>
<tr><td>CurrentUC Warning</td><td>31559</td><td>BYTE</td><td>R</td><td></td><td>R</td><td colspan="6">Current global warning status in the UC.
When the bit is set in the byte, the corresponding warning is present.
Bit index:
<table><tr><td>0</td><td>n.a.</td><td>1</td><td>n.a.</td><td>2</td><td>Ctrl overtemperature</td></tr></table>Refer to the PQF Manual table 7.13 for more information on the warning reported by controller.</td></tr>
<tr><td>NumberDSP Error1</td><td>31527</td><td>WORD</td><td>R</td><td></td><td>R</td><td colspan="6">Number of times the error described at bit index 0 in the DSP error table (see “CurrentDSPError” description) has occurred since the filter controller has been initialised.</td></tr>
<tr><td>NumberDSP Error2</td><td>31528</td><td>WORD</td><td>R</td><td></td><td>R</td><td colspan="6" rowspan="2"></td></tr>
<tr><td>NumberDSP Error3</td><td>31529</td><td>WORD</td><td>R</td><td></td><td>R</td></tr>
</table>

NumberDSP Error4	31530	WORD	R		R	Same as above but for other bit indexes.
NumberDSP Error5	31531	WORD	R		R	
NumberDSP Error6	31532	WORD	R		R	
NumberDSP Error7	31533	WORD	R		R	
NumberDSP Error8	31534	WORD	R		R	
NumberDSP Error9	31535	WORD	R		R	
NumberDSP Error10	31536	WORD	R		R	
NumberDSP Error11	31537	WORD	R		R	
NumberDSP Error12	31538	WORD	R		R	
NumberDSP Error13	31539	WORD	R		R	
NumberDSP Error14	31540	WORD	R		R	
NumberDSP Error15	31541	WORD	R		R	
NumberDSP Error16	31542	WORD	R		R	
NumberDSP Error17	31543	WORD	R		R	

NumberDSP Error18	31544	WORD	R		R	Same as above but for other bit indexes.
NumberDSP Error19	31545	WORD	R		R	
NumberDSP Error20	31546	WORD	R		R	
NumberDSP Error21	31547	WORD	R		R	
NumberDSP Error22	31548	WORD	R		R	
NumberDSP Error23	31549	WORD	R		R	
NumberDSP Error24	31550	WORD	R		R	
NumberDSP Error25	31551	WORD	R		R	
NumberDSP Error26	31552	WORD	R		R	
NumberDSP Error27	31553	WORD	R		R	
NumberDSP Error28	31554	WORD	R		R	
NumberDSP Error29	31555	WORD	R		R	
NumberDSP Error30	31556	WORD	R		R	
NumberDSP Error31	31557	WORD	R		R	

NumberUC Error1	31505	WORD	R		R	Number of times the error described at bit index 0 in the UC error table (see “CurrentUCError” description) has occurred since the filter controller has been initialised.
NumberUC Error2	31506	WORD	R		R	Same as above but for bit index 1.
NumberUC Error3	31507	WORD	R		R	
NumberUC Error4	31508	WORD	R		R	
NumberUC Error5	31509	WORD	R		R	
NumberUC Error6	31510	WORD	R		R	
NumberUC Error7	31511	WORD	R		R	
NumberUC Error8	31512	WORD	R		R	
NumberUC Error9	31513	WORD	R		R	
NumberUC Error10	31514	WORD	R		R	
NumberUC Error11	31515	WORD	R		R	
NumberUC Error12	31516	WORD	R		R	
NumberUC Error13	31517	WORD	R		R	
NumberUC Error14	31518	WORD	R		R	

NumberUC Error15	31519	WORD	R		R	Same as above but for other bit indexes
NumberUC Error16	31520	WORD	R		R	
NumberUC Error17	31521	WORD	R		R	
NumberUC Error18	31522	WORD	R		R	
NumberUC Error19	31523	WORD	R		R	
NumberUC Error20	31524	WORD	R		R	
NumberUC Error21	31525	WORD	R		R	
NumberUC Error22	31526	WORD	R		R	
Tripped Phase	31558	BYTE	R		R	This number represents the (hottest) filter phase in which the temperature exceeded the maximum permissible level. As a result the filter was stopped (tripped). 1 represents L1, 2 represents L2 and 3 represents L3. Always 1 for PQFK, PQFM and PQFS.

5.4 Event

Reference	Address	Type	Access		Storage	Description
Control	**41705**	**INT**	**R/W**		**R**	**Register controlling the transfer of one element from the event list to the MODBUS readable event buffer: When zero, the buffer is free for another transfer; set it to n between 1and 200 for transferring the nth element of the event list in the event buffer; transfer is done when it is -1; don't forget to clear it after retrieving the event buffer.**
Day	**31408**	**BYTE**	**R**		**R**	**Absolute day at which the event of the event buffer took place.**

<table>
<tr><td>Error</td><td>31402</td><td>DWORD</td><td>R</td><td></td><td>R</td><td>When not zero, this register contains the error (Dword) that has caused the event.
If the "Event" is 1, the current error was detected by the DSP. Please refer to the description of "CurrentDSPError" for the list of possible DSP errors.
If the "Event" is 2, the current error was detected by the UC. Please refer to the description of "CurrentUCError" for the list of possible UC errors.
For any other value of "Event", the error is zero.</td></tr>
<tr><td>Event</td><td>31401</td><td>BYTE</td><td>R</td><td></td><td>R</td><td>Event that is stored in the event list at the location indexed by the control register.
Values:
<table>
<tr><td>0</td><td>No event</td><td>5</td><td>Start request</td><td>9</td><td>System reset</td></tr>
<tr><td>1</td><td>Fault (DSP)</td><td>6</td><td>Stop request</td><td>10</td><td>Download DSP</td></tr>
<tr><td>2</td><td>Fault (uC)</td><td>7</td><td>Energisation</td><td>11</td><td>DSP stop</td></tr>
<tr><td>3</td><td>No more fault</td><td>8</td><td>Power outage</td><td></td><td></td></tr>
</table>
Refer to the PQF Manual table 8.16 for more information on the warning reported by controller.</td></tr>
<tr><td>Hour</td><td>31407</td><td></td><td></td><td></td><td></td><td>Absolute hour at which the event of the event buffer took place.
Range: [0; 23].</td></tr>
<tr><td>Latest EventIndex</td><td>31411</td><td></td><td></td><td></td><td></td><td>Index of the latest event. When zero, the latest event is stored at location 200 in the event list.</td></tr>
<tr><td>Millisecond</td><td>31404</td><td></td><td></td><td></td><td></td><td>Contains the millisecond at which the event of the event buffer took place.
Range: [0; 999].</td></tr>
<tr><td>Minute</td><td>31406</td><td></td><td></td><td></td><td></td><td>Absolute minute at which the event of the event buffer took place.
Range: [0; 59].</td></tr>
<tr><td>Month</td><td>31409</td><td></td><td></td><td></td><td></td><td>Absolute month at which the event of the event buffer took place.
Range: [1; 12].</td></tr>
</table>

Second	31405					**Absolute second at which the event of the event buffer took place.** **Range: [0; 59].**
Year	31410					**Absolute year at which the event of the event buffer took place. Add 2000 to the value read for absolute year.** **Range: [0; 99].**

5.5 Function

Reference	Address	Type	Access		Storage	Description
AutoRestart	40604	BYTE	R/W	LS+IL	NV	When enabled (set to 1), the filter will restart automatically after a power supply outage. When disabled (set to 0), the filter will not restart automatically after a power supply outage. Default setting is 'Enabled'. The timer after which the filter restarts is programmable by means of “AutoRestartDelay”.
AutoRestart Delay	40605	WORD	R/W	LS+IL	NV	When the “AutoRestart” function is enabled, determines the time delay between the power coming back and the automatic filter restart. Units: Second. Range: [1; 43200 (12H00)].
Reset	40603	BYTE	R/W	LS	R	Must be set (1) to acknowledge the fault that has caused the filter stop.
Start	40601	BYTE	R/W	LS	R	Must be set (1) to start filter, provided no error is currently present.
Stop	40602	BYTE	R/W	LS	R	Must be set (1) to stop the filter or prevent if from restarting as soon as the error has disappeared.

5.6 FunctionSettings

Reference	Address	Type	Access		Storage	Description
StandBy	41601	LONG	R/W	LS+IL	NV	Shows whether the standby function is enabled (1) or disabled (0).
StandByDelay	41603	LONG	R/W	LS+IL	NV	When the standby function is enabled, determines the time that the load has to be lower than “StandByLevel” –“ StandByHysteresis” before the IGBTs will be switched off. Units: Second. Range: [1; 43200 (12H00)].

StandBy Hysteresis	41607	FLOAT	R/W	LS+IL	NV	When the standby function is enabled, determines the % hysteresis that is used to determine the lower and upper threshold of the standby level. The lower threshold is “StandByLevel” –“ StandByHysteresis” and the upper threshold is “StandByLevel” +“ StandByHysteresis”. Units: Percent. Range: [0;23].
StandByLevel	41605	FLOAT	R/W	LS+IL	NV	When the standby function is enabled, determines the nominal % load value around which the standby levels are offset (by means of “ StandByHysteresis”). The standby level is expressed as a % of the nominal filter rating. Units: Percent. Range: [0;99].
StartUpDelay	41609	LONG	R/W	LS+IL	NV	When the standby function is enabled, determines the time that the load has to be higher than “StandByLevel” +“ StandByHysteresis”, before the IGBTs will be switched on. Units: Second. Range: [1; 43200 (12H00)].

5.7 GeneralMeasurements

Reference	Address	Type	Access		Storage	Description
ActivePower	30401	FLOAT	R		R	Active power, P (kW), measured at the location of the CTs. If P > 0, the load absorbs active power, if P < 0, the load generates active power. Units: kW.
Apparent Power	30405	FLOAT	R		R	Apparent power, S (kVA), measured at the location of the CTs. Units: kVA.
Cosphi	30409	FLOAT	R		R	Displacement power factor (DPF) or cos², measured at the location of the CTs. The DPF is independent of the harmonic content of the network. A special coding is used for allowing four quadrant indication in only one number. The only two first decimal digits are significant and third is used for Inductive/capacitive indication as explained in table below:

Value	Meaning
1.000	Resistive load only drawing active power.
0.710	Inductive load drawing almost the same amount of active and reactive power.
-0.710	Inductive generator injecting the same active power than the reactive power drawn.
0.711	Capacitive load drawing almost the same amount of active and reactive power.

						-0.711	Capacitive generator injecting the same active power than the reactive power drawn.
						-1.000	Generator only injecting active power.
						The range is made of discrete values belonging to: [-1.000;-0.991;-0.990;-0.981;-0.980;…;0.000;0.001;…;0.980;0.981;0.990;0.991;1.000].	
Frequency	30119	FLOAT	R		R	Frequency of the supply system. Units: Hetz.	
HottestPhase	30509	LONG	R		R	This number shows the hottest filter phase in the hottest filter module, 1 represents the phase L1, 2 represents the phase L2 and 3 represents the phase L3. It is always 1 for PQFK, PQFM and PQFS.	
In1L1rms	30215	FLOAT	R		R	The rms value of the current at fundamental frequency measured in line L1. Units: Ampere	
In1L2rms	30217	FLOAT	R		R	The rms value of the current at fundamental frequency measured in line L2. Units: Ampere	
In1L3rms	30219	FLOAT	R		R	The rms value of the current at fundamental frequency measured in line L3. Units: Ampere	
InL1rms	30201	FLOAT	R		R	The rms current measured in line L1. Units: Ampere	
InL2rms	30203	FLOAT	R		R	The rms current measured in line L2. Units: Ampere	
InL3rms	30205	FLOAT	R		R	The rms current measured in line L3. Units: Ampere	
InZero Sequencerms	30207	FLOAT	R		R	The rms value of the current flowing in the neutral at the location of the CTs. Only valid if PQFK or PQFS connected in 4 wire mode. Units: Ampere	
IpL1rms	30301	FLOAT	R		R	The rms value of the filter current measured in phase L1. Units: Ampere	
IpL2rms	30303	FLOAT	R		R	The rms value of the filter current measured in phase L2. Units: Ampere	
IpL3rms	30305	FLOAT	R		R	The rms value of the filter current measured in phase L3. Units: Ampere	
IpZero Sequencerms	30307	FLOAT	R		R	The rms value of the filter current measured in the neutral N. Only valid if PQFK or PQFS connected in 4 wire mode. Units: Ampere	
PowerFactor	30407	FLOAT	R		R	Power factor (PF), the ratio between P(kW) and S(kVA), measured at the location of the CTs. The power factor is influenced by the harmonic content of the network.	

Reactive Power	30403	FLOAT	R		R	Reactive power, Q (kvar), measured at the location of the CTs. If Q > 0, the load is inductive, if Q < 0, the load is capacitive. Units: kvar.
THDInL1	30209	FLOAT	R		R	The Total Harmonic Distortion (THDi) of the current measured in line L1. Units: Percent.
THDInL2	30211	FLOAT	R		R	The Total Harmonic Distortion (THDi) of the current measured in line L2. Units: Percent.
THDInL3	30213	FLOAT	R		R	The Total Harmonic Distortion (THDi) of the current measured in line L3. Units: Percent.
THDUL1L2	30107	FLOAT	R		R	The Total Harmonic Distortion (THDv) of the voltage measured between the phases L1 and L2 (L1 and Neutral for PQFK or PQFS connected in 4 wire mode). Units: Percent.
THDUL2L3	30109	FLOAT	R		R	The Total Harmonic Distortion (THDv) of the voltage measured between the phases L2 and L3 (L2 and Neutral for PQFK or PQFS connected in 4 wire mode). Units: Percent.
THDUL3L1	30111	FLOAT	R		R	The Total Harmonic Distortion (THDv) of the voltage measured between the phases L3 and L1 (L3 and Neutral for PQFK or PQFS connected in 4 wire mode). Units: Percent.
Temperature Control	30501	FLOAT	R		R	Temperature of the main controller board. Units: Celsius degree.
Temperature ControlMax	30503	FLOAT	R		R	Highest temperature observed on all main controller boards of all units. Units: Celsius degree.
Temperature IGBT	30505	FLOAT	R		R	Highest temperature observed on all phases of the IGBT. Units: Celsius degree.
Temperature IGBTMax	30507	FLOAT	R		R	Highest temperature observed on all phases of the IGBT of all units. Units: Celsius degree.
U1L1L2rms	30113	FLOAT	R		R	The rms value of the voltage at fundamental frequency measured between the phases L1 and L2 (L1 and Neutral for 4W units PQFK or PQFS connected in 4 wire mode). Units: Volt
U1L2L3rms	30115	FLOAT	R		R	The rms value of the voltage at fundamental frequency measured between the phases L2 and L3 (L2 and Neutral for 4W units PQFK or PQFS connected in 4 wire mode). Units: Volt
U1L3L1rms	30117	FLOAT	R		R	The rms value of the voltage at fundamental frequency measured between the phases L3 and L1 (L3 and Neutral for 4W units PQFK or PQFS connected in 4 wire mode). Units: Volt
UL1L2rms	30101	FLOAT	R		R	The rms voltage measured between the phases L1 and L2 (L1 and Neutral for PQFK). Units: Volt.

UL2L3rms	30103	FLOAT	R		R	The rms voltage measured between the phases L2 and L3 (L2 and Neutral for PQFK). Units: Volt.
UL3L1rms	30105	FLOAT	R		R	The rms voltage measured between the phases L3 and L1 (L3 and Neutral for PQFK). Units: Volt.
Udc	30123	FLOAT	R		R	The DC voltage present on the active filter DC bus. Units: Volt.
UdcMax	30125	FLOAT	R		R	The highest DC voltage present on the active filter DC bus on all units. Units: Volt.
Voltage Imbalance	30121	FLOAT	R		R	The network imbalance expressed in %. The network voltage imbalance is calculated as the ratio of the nps (negative phase sequence) over the pps (positive phase sequence) component of the voltage.

5.8 Identification

Reference	Address	Type	Access		Storage	Description
FilterType	42136	BYTE	R		C	Filter type:Industrial PQFI (if zero), PQFM (if one), Commercial PQFK (if two), or PQFS (if three). The PQFK is a 4-wire filter where the PQFI and PQFM are 3-wire filters and PQFS can work in both configurations
PQFAbbId1	42101	BYTE	R		C	MODBUS/AIP manufacturer parameter. Filter identification number 1.
PQFAbbId2	42102	WORD	R		C	MODBUS/AIP manufacturer parameter. Filter identification number 2.
PQFAbbId3	42103	DWORD	R		C	MODBUS/AIP manufacturer parameter. Filter identification number 3.
PQFSerial Number	42132	LONG	R		C	The PQF serial number. Note this number for future reference.
PQFType1	42105	WORD	R		C	MODBUS/AIP manufacturer parameter. Two first ASCII characters describing the filter type MSB is first character.
PQFType2	42106	WORD	R		C	MODBUS/AIP manufacturer parameter. Two next ASCII characters describing the filter type MSB is first character.
PQFType3	42107	WORD	R		C	MODBUS/AIP manufacturer parameter. Two last ASCII characters describing the filter type MSB is first character.
System Description1	42108	WORD	R/W	LS+IL	NV	
System Description2	42109	WORD	R/W	LS+IL	NV	

System Description3	42110	WORD	R/W	LS+IL	NV	MODBUS/AIP parameter that can be written at installation of the filter.
System Description4	42111	WORD	R/W	LS+IL	NV	
System Description5	42112	WORD	R/W	LS+IL	NV	
System Description6	42113	WORD	R/W	LS+IL	NV	
System Description7	42114	WORD	R/W	LS+IL	NV	
System Description8	42115	WORD	R/W	LS+IL	NV	
System Description9	42116	WORD	R/W	LS+IL	NV	
System Description10	42117	WORD	R/W	LS+IL	NV	
System Description11	42118	WORD	R/W	LS+IL	NV	
System Description12	42119	WORD	R/W	LS+IL	NV	
System Description13	42120	WORD	R	LS+IL	NV	
SystemId1	42121	WORD	R		C	MODBUS/AIP manufacturer parameter.
SystemId2	42122	WORD	R		C	
SystemId3	42123	WORD	R		C	

SystemId4	42124	WORD	R		C	
SystemId5	42125	WORD	R		C	
SystemId6	42126	WORD	R		C	
SystemId7	42127	WORD	R		C	
SystemId8	42128	WORD	R		C	
SystemId9	42129	WORD	R		C	
SystemId10	42130	WORD	R		C	
SystemId11	42131	WORD	R		C	
UMaximum	42134	LONG	R		C	Maximum rated network voltage for the components.

5.9 InstallationSettings

Reference	Address	Type	Access		Storage	Description
CTScaleL1	31801	FLOAT	R		NV	The ratio of the CT connected in phase L1 of the supply system. E.g. 200 means a CT of 1000A/5A. The value must always be positive.
CTScaleL2	31803	FLOAT	R		NV	The ratio of the CT connected in phase L2 of the supply system. E.g. 200 means a CT of 1000A/5A. The value must always be positive.
CTScaleL3	31805	FLOAT	R		NV	The ratio of the CT connected in phase L3 of the supply system. E.g. 200 means a CT of 1000A/5A. The value must always be positive
Derating	31813	FLOAT	R		NV	Expresses in % of the nominal filter current, the maximum output that the filter can generate. Default value is 100%. Reduce to a lower value if the ambient conditions are excessive.
Input1Origin	31807	LONG	R		NV	Tells which line CT (CT in line L1, L2 or L3) is connected to the filter CT terminal 1 ('Input 1'). If the CT connection is inversed, a - sign precedes the label (i.e. -Line 1, -Line 2 or -Line 3). Values: 1 Line 1, 4 -Line 1; 2 Line 2, 5 -Line 2; 3 Line 3, 6 -Line 3
Input2Origin	31809	LONG	R		NV	
Input3Origin	31811	LONG	R		NV	
						Refer to the PQF Manual table 8.12 for more information on the CT input redirection.

Neutral Connected	31815	LONG	R		NV	Tells if the neutral wire is connected to the PQF. This is a hard coded parameter except for PQFS, when 1, the unit has its fourth wire connected to the neutral.

5.10 MainUserSettings

Reference	Address	Type	Access		Storage	Description
Curve1	41001	FLOAT	R/W	LS	NV	The curve level defines the amount of current that is allowed to flow into the network for each harmonic. The curve has to be defined in Arms. Set the filter in mode 3 if the only harmonic requirement is to respect the curve settings.
Curve2	41003	FLOAT	R/W	LS	NV	
Curve3	41005	FLOAT	R/W	LS	NV	
Curve4	41007	FLOAT	R/W	LS	NV	
Curve5	41009	FLOAT	R/W	LS	NV	
Curve6	41011	FLOAT	R/W	LS	NV	
Curve7	41013	FLOAT	R/W	LS	NV	
Curve8	41015	FLOAT	R/W	LS	NV	
Curve9	41017	FLOAT	R/W	LS	NV	
Curve10	41019	FLOAT	R/W	LS	NV	
Curve11	41021	FLOAT	R/W	LS	NV	
Curve12	41023	FLOAT	R/W	LS	NV	
Curve13	41025	FLOAT	R/W	LS	NV	
Curve14	41027	FLOAT	R/W	LS	NV	
Curve15	41029	FLOAT	R/W	LS	NV	
Curve16	41031	FLOAT	R/W	LS	NV	
Curve17	41033	FLOAT	R/W	LS	NV	
Curve18	41035	FLOAT	R/W	LS	NV	
Curve19	41037	FLOAT	R/W	LS	NV	
Curve20	41039	FLOAT	R/W	LS	NV	

<table>
<tr><td>FilterMode</td><td>41101</td><td>LONG</td><td>R/W</td><td>LS</td><td>NV</td><td>To choose for the main settings the order in which filter resources will be allocated.
Mode 1: Curve filtering/Max. filtering/Reactive power;
Mode 2: Curve filtering/Reactive power/Max. filtering;
Mode 3: Curve filtering/Reactive power.
Default value is 3. Refer to the PQF Manual table 8.7 for more information on the filter mode.</td></tr>
<tr><td>Reactive Compensation Type</td><td>41103</td><td>LONG</td><td>R/W</td><td>LS</td><td>NV</td><td>Main setting to select which kind of reactive power compensation has to be implemented (dynamic inductive, dynamic capacitive, static inductive or static capacitive). The possible values are:
<table>
<tr><th></th><th></th><th>Meaning</th></tr>
<tr><td>0</td><td>Disabled</td><td>No reactive power injected by the filter</td></tr>
<tr><td>1</td><td>Dyn. Ind.</td><td>Compensates till the inductive target co phi is reached (TargetCosphi)</td></tr>
<tr><td>2</td><td>Dyn. Cap.</td><td>Compensates till the capacitive target cos phi is reached (TargetCosphi)</td></tr>
<tr><td>3</td><td>Static ind.</td><td>Injects the inductive amount of static reactive power specified (StaticReactivePower)</td></tr>
<tr><td>4</td><td>Static cap.</td><td>Injects the capacitive amount of static reactive power specified (StaticReactivePower)</td></tr>
</table>
Refer to the PQF Manual table 8.9 for more information on the reactive power injection.</td></tr>
<tr><td>SelectedOrder1</td><td>40801</td><td>LONG</td><td>R/W</td><td>LS</td><td>NV</td><td rowspan="10">Twice the harmonic order to be considered by the filter.</td></tr>
<tr><td>SelectedOrder2</td><td>40803</td><td>LONG</td><td>R/W</td><td>LS</td><td>NV</td></tr>
<tr><td>SelectedOrder3</td><td>40805</td><td>LONG</td><td>R/W</td><td>LS</td><td>NV</td></tr>
<tr><td>SelectedOrder4</td><td>40807</td><td>LONG</td><td>R/W</td><td>LS</td><td>NV</td></tr>
<tr><td>SelectedOrder5</td><td>40809</td><td>LONG</td><td>R/W</td><td>LS</td><td>NV</td></tr>
<tr><td>SelectedOrder6</td><td>40811</td><td>LONG</td><td>R/W</td><td>LS</td><td>NV</td></tr>
<tr><td>SelectedOrder7</td><td>40813</td><td>LONG</td><td>R/W</td><td>LS</td><td>NV</td></tr>
<tr><td>SelectedOrder8</td><td>40815</td><td>LONG</td><td>R/W</td><td>LS</td><td>NV</td></tr>
<tr><td>SelectedOrder9</td><td>40817</td><td>LONG</td><td>R/W</td><td>LS</td><td>NV</td></tr>
<tr><td>SelectedOrder10</td><td>40819</td><td>LONG</td><td>R/W</td><td>LS</td><td>NV</td></tr>
</table>

SelectedOrder11	40821	LONG	R/W	LS	NV	
SelectedOrder12	40823	LONG	R/W	LS	NV	
SelectedOrder13	40825	LONG	R/W	LS	NV	
SelectedOrder14	40827	LONG	R/W	LS	NV	
SelectedOrder15	40829	LONG	R/W	LS	NV	Twice the harmonic order to be considered by the filter.
SelectedOrder16	40831	LONG	R/W	LS	NV	
SelectedOrder17	40833	LONG	R/W	LS	NV	
SelectedOrder18	40835	LONG	R/W	LS	NV	
SelectedOrder19	40837	LONG	R/W	LS	NV	
SelectedOrder20	40839	LONG	R/W	LS	NV	
Selection1	40901	LONG	R/W	LS	NV	When set, the corresponding harmonic order is filtered according to the Filter Mode.
Selection2	40903	LONG	R/W	LS	NV	
Selection3	40905	LONG	R/W	LS	NV	
Selection4	40907	LONG	R/W	LS	NV	
Selection5	40909	LONG	R/W	LS	NV	
Selection6	40911	LONG	R/W	LS	NV	
Selection7	40913	LONG	R/W	LS	NV	
Selection8	40915	LONG	R/W	LS	NV	
Selection9	40917	LONG	R/W	LS	NV	
Selection10	40919	LONG	R/W	LS	NV	
Selection11	40921	LONG	R/W	LS	NV	
Selection12	40923	LONG	R/W	LS	NV	
Selection13	40925	LONG	R/W	LS	NV	
Selection14	40927	LONG	R/W	LS	NV	

Selection15	40929	LONG	R/W	LS	NV	
Selection16	40931	LONG	R/W	LS	NV	
Selection17	40933	LONG	R/W	LS	NV	
Selection18	40935	LONG	R/W	LS	NV	
Selection19	40937	LONG	R/W	LS	NV	
Selection20	40939	LONG	R/W	LS	NV	
StaticReactive Power	41107	FLOAT	R/W	LS	NV	Enter the amount of static reactive power that the filter has to generate here. Use ReactiveCompensationType to define whether the power should be capacitive (Static cap.) or inductive (Static ind.). Units: kvar
TargetCosphi	41109	FLOAT	R/W	LS	NV	Enter the target displacement power factor here. Use ReactiveCompensationType to define whether the compensation type is (dynamic) inductive or (dynamic) capacitive. Range: [-1.0 ; 1.0]
Unbalance Compensation	41105	LONG	R/W	LS	NV	Enable this feature if the filter has to do load balancing. When 1, the line to line loads are balanced; when 2, the line to neutral loads are balanced; when 3, full balancing, for line to line and line to neutral loads, is enabled.

5.11 ManagerParameters

Reference	Address	Type	Access		Storage	Description
Contrast	41804	CHAR	R/W	LS	NV	Contrast adjustment of the display (to be set between -2 and +2).
Fahrenheit	41801	BYTE	R/W	LS	NV	To select the temperature unit displayed on the PQFManager screen (not for Modbus data): zero for °C or one for °F.
PrintDelay	41802	DWORD	R/W	LS	NV	Sets the interval between two print sessions when “Print cont.” (which can only be set though the menus) is selected. Units: minutes. Range: [1; 43200 (30Days)].

5.12 ManagerState

Reference	Address	Type	Access		Storage	Description
DigitalIn	30001	BYTE	R		R	Byte with two LSBits depicting the state of the digital INPUT of PQFManager.
DigitalOut	30002	BYTE	R		R	Byte with six LSBits depicting the state of the digital OUTPUT of PQFManager.
DigitalOut Alarm	30003	BYTE	R		R	Byte depicting if alarm output is active or not.
Hour	30004	BYTE	R		R	Hours since last power outage (Limited to one day).
Minute	30005	BYTE	R		R	Minute since last power outage (0 to 59).
Second	30006	BYTE	R		R	Seconds since last power outage (0 to 59).

5.13 Manager_Id

Reference	Address	Type	Access		Storage	Description
AbbId1	41903	BYTE	R		C	MODBUS/AIP PQFManager manufacturer parameter. Filter identification number 1.
AbbId2	41904	WORD	R		C	MODBUS/AIP PQFManager manufacturer parameter. Filter identification number 2.
AbbId3	41905	DWORD	R		C	MODBUS/AIP PQFManager manufacturer parameter. Filter identification number 3.
ProductId1	41907	WORD	R		C	MODBUS/AIP PQFManager manufacturer parameter.
ProductId2	41908	WORD	R		C	
ProductId3	41909	WORD	R		C	
ProductId4	41910	WORD	R		C	
ProductId5	41911	WORD	R		C	
ProductId6	41912	WORD	R		C	
ProductId7	41913	WORD	R		C	
ProductId8	41914	WORD	R		C	
ProductId9	41915	WORD	R		C	

ProductId10	41916	WORD	R		C	
ProductId11	41917	WORD	R		C	
ProductType1	41918	WORD	R		C	MODBUS/AIP PQFManager manufacturer parameter. Two first ASCII characters describing the filter type MSB is first character.
ProductType2	41919	WORD	R		C	MODBUS/AIP PQFManager manufacturer parameter. Two next ASCII characters describing the filter type MSB is first character.
ProductType3	41920	WORD	R		C	MODBUS/AIP PQFManager manufacturer parameter. Two last ASCII characters describing the filter type MSB is first character.
SerialNumber	41901	DWORD	R		C	PQFManager serial number.

5.14 MinMaxLogging

Reference	Address	Type	Access		Storage	Description
ActivePower Duration	40419	DWORD	R/W	LS	NV	Duration during which the measured active power is higher than “ActivePowerThreshold”. Reset by writing on it. Units: Seconds.
ActivePower Peak	40319	FLOAT	R/W	LS	NV	Maximum of the measured active power. Reset by writing on it. Units: kW.
Apparent Power Duration	40419	DWORD	R/W	LS	NV	Duration during which the measured apparent power is higher than “ApparentPowerThreshold”. Reset by writing on it. Units: Seconds.
Apparent PowerPeak	40323	FLOAT	R/W	LS	NV	Maximum of the measured apparent power. Reset by writing on it. Units: kVA
FMaxDuration	40425	DWORD	R/W	LS	NV	Total time since the last reset that the network frequency has been than “FMaxThreshold”. Reset by writing on it. Units: Seconds.
FMaxPeak	40325	FLOAT	R/W	LS	NV	The maximum recorded value of the network frequency. Reset by writing on it. Units: Hertz
FMinDuration	40427	DWORD	R/W	LS	NV	Total time since the last reset that the network frequency has been lower than “FMinThreshold”. Reset by writing on it. Units: Seconds.

FMinPeak	40327	FLOAT	R/W	LS	NV	The minimum recorded value of the network frequency. Reset by writing on it. Units: Hertz
InL1rms Duration	40412	DWORD	R/W	LS	NV	Duration during which the measured rms current in line 1 is higher than “InL1rmsThreshold”. Reset by writing on it. Units: Seconds.
InL1rmsPeak	40313	FLOAT	R/W	LS	NV	Maximum of the measured rms current in line 1. Reset by writing on it. Units: Ampere.
InL2rms Duration	40415	DWORD	R/W	LS	NV	Duration during which the measured rms current in line 2 is higher than “InL2rmsThreshold”. Reset by writing on it. Units: Seconds.
InL2rmsPeak	40315	FLOAT	R/W	LS	NV	Maximum of the measured rms current in line 2. Reset by writing on it. Units: Ampere.
InL3rms Duration	40416	DWORD	R/W	LS	NV	Duration during which the measured rms current in line 3 is higher than “InL3rmsThreshold”. Reset by writing on it. Units: Seconds.
InL3rmsPeak	40317	FLOAT	R/W	LS	NV	Maximum of the measured rms current in line 3. Reset by writing on it. Units: Ampere.
Reactive Power Duration	40419	DWORD	R/W	LS	NV	Duration during which the measured reactive power is higher than “ReactivePowerThreshold”. Reset by writing on it. Units: Seconds.
Reactive PowerPeak	40321	FLOAT	R/W	LS	NV	Maximum of the measured reactive power. Reset by writing on it. Units: kvar.
THDUL1L2 Duration	40407	DWORD	R/W	LS	NV	Duration during which the measured THDv between L1 and L2 (or between L1 and N for PQFK and PQFS in 4 wire mode) is higher than “THDUL1L2Threshold”. Reset by writing on it. Units: Seconds.
THDUL1L2 Peak	40307	FLOAT	R/W	LS	NV	Maximum of the measured THDv between L1 and L2 (or between L1 and N for PQFK and PQFS in 4 wire mode). Reset by writing on it. Units: Percent.
THDUL2L3 Duration	40408	DWORD	R/W	LS	NV	Duration during which the measured THDv between L2 and L3 (or between L2 and N for PQFK and PQFS in 4 wire mode) is higher than “THDUL2L3Threshold”. Reset by writing on it. Units: Seconds.
THDUL2L3 Peak	40309	FLOAT	R/W	LS	NV	Maximum of the measured THDv between L2 and L3 (or between L2 and N for PQFK and PQFS in 4 wire mode). Reset by writing on it. Units: Percent.

THDUL3L1 Duration	40409	DWORD	R/W	LS	NV	Duration during which the measured THDv between L3 and L1 (or between L3 and N for PQFK and PQFS in 4 wire mode) is higher than “THDUL3L1Threshold”. Reset by writing on it. Units: Seconds.
THDUL3L1 Peak	40311	FLOAT	R/W	LS	NV	Maximum of the measured THDv between L3 and L1 (or between L3 and N for PQFK and PQFS in 4 wire mode). Reset by writing on it. Units: Percent.
Temperature ControlMax Duration	40431	DWORD	R/W	LS	NV	Duration during which the highest temperature measured on the control boards of all units is higher than “TemperatureControlMaxThreshold”. Reset by writing on it. Units: Seconds.
Temperature ControlMax Peak	40331	FLOAT	R/W	LS	NV	Maximum temperature measured on the control boards of all units. Reset by writing on it. Units: Celsius degree.
TemperatureI GBTDuration	40429	DWORD	R/W	LS	NV	Duration during which the maximum measured IGBT temperature on all units is higher than ” TemperatureIGBTThreshold”. Reset by writing on it. Units: Seconds.
TemperatureI GBTPeak	40329	FLOAT	R/W	LS	NV	Maximum of the measured IGBT temperatures on all units. Reset by writing on it. Units: Celsius degree.
UL1L2rms Duration	40401	DWORD	R/W	LS	NV	Duration during which the measured rms voltage between L1 and L2 (or between L1 and N for PQFK and PQFS in 4 wire mode) is higher than “UL1L2rmsThreshold”. ”. Reset by writing on it. Units: Seconds
UL1L2rms Peak	40301	FLOAT	R/W	LS	NV	Maximum of the measured rms voltage between L1 and L2 (or between L1 and N for PQFK and PQFS in 4 wire mode). Reset by writing on it. Units: Volt.
UL2L3rms Duration	40403	DWORD	R/W	LS	NV	Duration during which the measured rms voltage between L2 and L3 (or between L2 and N for PQFK and PQFS in 4 wire mode) is higher than “UL2L3rmsThreshold”. ”. Reset by writing on it. Units: Seconds
UL2L3rms Peak	40303	FLOAT	R/W	LS	NV	Maximum of the measured rms voltage between L2 and L3 (or between L2 and N for PQFK and PQFS in 4 wire mode). Reset by writing on it. Units: Volt.
UL3L1rms Duration	40405	DWORD	R/W	LS	NV	Duration during which the measured rms voltage between L3 and L1 (or between L3 and N for PQFK and PQFS in 4 wire mode) is higher than “UL3L1rmsThreshold”. ”. Reset by writing on it. Units: Seconds
UL3L1rms Peak	40305	FLOAT	R/W	LS	NV	Maximum of the measured rms voltage between L3 and L1 (or between L3 and N for PQFK and PQFS in 4 wire mode). Reset by writing on it. Units: Volt.

5.15 MinMaxLoggingSettings

Reference	Address	Type	Access		Storage	Description
ActivePower Threshold	40219	FLOAT	R/W	LS	NV	Active power threshold. If the value of the measured active power is higher than this level, “ActivePowerDuration” will increment. Units: kW.
Apparent Power Threshold	40223	FLOAT	R/W	LS	NV	Apparent power threshold. If the value of the measured apparent power is higher than “ApparentPowerThreshold”, “ApparentPowerDuration” will increment. Units: kVA.
FMax Threshold	40225	FLOAT	R/W	LS	NV	“FMaxDuration” timer will start/continue when the network frequency becomes higher “FMaxThreshold”. The timer will stop when the network frequency becomes lower than “FMaxThreshold”. Units: Hertz.
FMin Threshold	40227	FLOAT	R/W	LS	NV	“FMinDuration” timer will start/continue when the network frequency becomes lower than “FMinThreshold”. The timer will stop when the network frequency becomes higher than “FMinThreshold”. Units: Hertz.
InL1rms Threshold	40213	FLOAT	R/W	LS	NV	Irms threshold. If the value of the measured rms current in line 1 is higher than “InL1rmsThreshold”, “InL1rmsDuration” will increment. Units: Ampere.
InL2rms Threshold	40215	FLOAT	R/W	LS	NV	Irms threshold. If the value of the measured rms current in line 2 is higher than “InL2rmsThreshold”, “InL2rmsDuration” will increment. Units: Ampere.
InL3rms Threshold	40217	FLOAT	R/W	LS	NV	Irms threshold. If the value of the measured rms current in line 3 is higher than “InL3rmsThreshold”, “InL3rmsDuration” will increment. Units: Ampere.
Reactive Power Threshold	40221	FLOAT	R/W	LS	NV	Reactive power threshold. If the value of the measured reactive power is higher than “Reactive PowerThreshold”, “ReactivePowerDuration” will increment. Units: kvar.
THDUL1L2 Threshold	40207	FLOAT	R/W	LS	NV	THDv threshold. If the value of the measured THDv between L1 and L2 (or between L1 and N for PQFK and PQFS in 4 wire mode) is higher than “THDUL1L2Threshold”, “THDUL1L2Duration” will increment. Units: Percent.
THDUL2L3 Threshold	40209	FLOAT	R/W	LS	NV	THDv threshold. If the value of the measured THDv between L2 and L3 (or between L2 and N for PQFK and PQFS in 4 wire mode) is higher than “THDUL2L3Threshold”, “THDUL2L3Duration” will increment. Units: Percent.

THDUL3L1 Threshold	40211	FLOAT	R/W	LS	NV	THDv threshold. If the value of the measured THDv between L3 and L2 (or between L3 and N for PQFK and PQFS in 4 wire mode) is higher than “THDUL3L2Threshold”, “THDUL3L2Duration” will increment. Units: Percent.
Temperature ControlMax Threshold	40231	FLOAT	R/W	LS	NV	Control board temperature threshold. If the temperature measured on the control board of all units is higher than “TemperatureControlMaxThreshold”, “TemperatureControlMaxDuration” will increment. Units: Celsius Degree.
Temperature IGBT Threshold	40229	FLOAT	R/W	LS	NV	IGBT temperature threshold. If the maximum value of the measured IGBT temperatures is higher than “TemperatureIGBTThreshold”, “TemperatureIGBTDuration” will increment. Units: Celsius Degree.
UL1L2rms Threshold	40201	FLOAT	R/W	LS	NV	Vrms threshold. If the value of the measured rms voltage voltage between L1 and L2 (or between L1 and N for PQFK and PQFS in 4 wire mode) is higher than “UL1L2rmsThreshold”, “UL1L2rmsDuration” will increment. Units: Volt.
UL2L3rms Threshold	40203	FLOAT	R/W	LS	NV	Vrms threshold. If the value of the measured rms voltage voltage between L2 and L3 (or between L2 and N for PQFK and PQFS in 4 wire mode) is higher than “UL2L3rmsThreshold”, “UL2L3rmsDuration” will increment. Units: Volt.
UL3L1rms Threshold	40205	FLOAT	R/W	LS	NV	Vrms threshold. If the value of the measured rms voltage voltage between L3 and L1 (or between L3 and N for PQFK and PQFS in 4 wire mode) is higher than “UL3L1rmsThreshold”, “UL3L1rmsDuration” will increment. Units: Volt.

5.16 RealTime

Reference	Address	Type	Access		Storage	Description
Day	40503	WORD	R/W	LS+IL	NV	Present day. Range: [1; 31]
Hour	40504	WORD	R/W	LS+IL	NV	Present hour in 24H format. Range: [0; 23]
Minute	40505	WORD	R/W	LS+IL	NV	Present minutes. Range: [0; 59]
Month	40502	WORD	R/W	LS+IL	NV	Present month. Range: [1; 12]
Second	40506	WORD	R/W	LS+IL	NV	Present seconds. Range: [0; 59]
Year	40501	WORD	R/W	LS+IL	NV	Present year. Range: [0; 99]

5.17 Settings

Reference	Address	Type	Access		Storage	Description
Fnominal	31703	LONG	R		NV	Nominal network frequency. In case the value entered does not correspond to the network frequency actually present, the filter will refuse to start. The only valid values are 50Hz or 60Hz.
Rating Module1	31708	LONG	R		NV	Current rating in Arms of the unit to which the PQFManager is connected (considered as the master).
Fundamental ControlType	31705	LONG	R		NV	Indicates the way the system synchronises on the fundamental frequency. Possible values: 1 when synchronised on single phase; 3 when synchronised on three phases.
NumberUnits AtCommissioning	31707	LONG	R		NV	Gives the number of units that were interconnected at commissioning stage. Values from 1 to 8.
UNominal	31701	LONG	R		NV	Nominal network voltage. When the voltage actually present differs a lot from the filter's rated voltage (cf. nameplate), the supply voltage to the filter auxiliaries may become too high/low. As a result the filter may operate incorrectly and/or may refuse to start.

5.18 SoftVersion

Reference	Address	Type	Access		Storage	Description
Controller	31603	DWORD	R		R	This is the firmware revision number of the software controlling the PQF-Manager. Note this number for future reference. The double word is made of four bytes WXYZ so the software is Version X.Y revision Z.
DSP	31605	DWORD	R		R	This is the firmware revision number of the software controlling the filter microcontroller. Note this number for future reference. The double word is made of four bytes WXYZ so the software is Version X.Y revision Z.
Manager	31601	DWORD	R		R	This is the firmware revision number of the software controlling the filter DSP controllers. Note this number for future reference. The double word is made of four bytes WXYZ so the software is Version X.Y revision Z.

5.19 Spectrum

<table>
<tr><th>Reference</th><th>Address</th><th>Type</th><th colspan="2">Access</th><th>Storage</th><th>Description</th></tr>
<tr><td>Control</td><td>41703</td><td>LONG</td><td>R/W</td><td></td><td>R</td><td>Register controlling the spectrum analysis and which data has to be analysed: When zero, the spectrum analyser is free for another analysis; set it to 1-11 for starting a new analysis; analysis is done when it is -1; don't forget to clear it after retrieving the measurement so the analyser is free for another ananlysis.

To perform a new spectrum acquisition provided that "Control" is zero (spectrum function is free), do as follows :

1. Select the channel to be measured:
<table>
<tr><th>Value to be set in "Control"</th><th colspan="2">Channel analysed</th></tr>
<tr><th></th><th>PQFI/PQFM</th><th>PQFK or PQFS in 4 wire mode</th></tr>
<tr><td>1</td><td>UL1-L2</td><td>UL1-N</td></tr>
<tr><td>2</td><td>UL2-L3</td><td>UL2-N</td></tr>
<tr><td>3</td><td>UL3-L1</td><td>UL3-N</td></tr>
<tr><td>4</td><td>IL1</td><td>IL1</td></tr>
<tr><td>5</td><td>IL2</td><td>IL2</td></tr>
<tr><td>6</td><td>IL3</td><td>IL3</td></tr>
<tr><td>7</td><td>IFilter1</td><td>IFilter1</td></tr>
<tr><td>8</td><td>IFilter2</td><td>IFilter2</td></tr>
<tr><td>9</td><td>IFilter3</td><td>IFilter3</td></tr>
<tr><td>10</td><td>Not available</td><td>IN</td></tr>
<tr><td>11</td><td>Not available</td><td>IFilterN</td></tr>
</table>
2. Wait until "control" is -1 (65535) then retrieve the spectrum (Order1 to Order50).

3. Clear "Control" to let the function free.</td></tr>
<tr><td>Order1</td><td>31101</td><td>FLOAT</td><td>R</td><td></td><td>R</td><td>Magnitude measured for fundamental (in volt or ampere)</td></tr>
<tr><td>Order2</td><td>31103</td><td>FLOAT</td><td>R</td><td></td><td>R</td><td>Magnitude measured for order 2 (in volt or ampere)</td></tr>
</table>

Order3	31105	FLOAT	R		R	Magnitude measured for order 3 (in volt or ampere)
Order4	31107	FLOAT	R		R	…
Order5	31109	FLOAT	R		R	
Order6	31111	FLOAT	R		R	
Order7	31113	FLOAT	R		R	
Order8	31115	FLOAT	R		R	
Order9	31117	FLOAT	R		R	
Order10	31119	FLOAT	R		R	
Order11	31121	FLOAT	R		R	
Order12	31123	FLOAT	R		R	
Order13	31125	FLOAT	R		R	
Order14	31127	FLOAT	R		R	
Order15	31129	FLOAT	R		R	
Order16	31131	FLOAT	R		R	
Order17	31133	FLOAT	R		R	
Order18	31135	FLOAT	R		R	
Order19	31137	FLOAT	R		R	Magnitude measured for order 19 (in volt or ampere)
Order20	31139	FLOAT	R		R	…
Order21	31141	FLOAT	R		R	
Order22	31143	FLOAT	R		R	
Order23	31145	FLOAT	R		R	
Order24	31147	FLOAT	R		R	
Order25	31149	FLOAT	R		R	
Order26	31201	FLOAT	R		R	

Order27	31203	FLOAT	R		R	
Order28	31205	FLOAT	R		R	
Order29	31207	FLOAT	R		R	
Order30	31209	FLOAT	R		R	
Order31	31211	FLOAT	R		R	
Order32	31213	FLOAT	R		R	
Order33	31215	FLOAT	R		R	
Order34	31217	FLOAT	R		R	
Order35	31219	FLOAT	R		R	
Order36	31221	FLOAT	R		R	
Order37	31223	FLOAT	R		R	
Order38	31225	FLOAT	R		R	
Order39	31227	FLOAT	R		R	
Order40	31229	FLOAT	R		R	
Order41	31231	FLOAT	R		R	
Order42	31233	FLOAT	R		R	
Order43	31235	FLOAT	R		R	
Order44	31237	FLOAT	R		R	
Order45	31239	FLOAT	R		R	
Order46	31241	FLOAT	R		R	
Order47	31243	FLOAT	R		R	
Order48	31245	FLOAT	R		R	
Order49	31247	FLOAT	R		R	
Order50	31249	FLOAT	R		R	Magnitude measured for order 50 (in volt or ampere)

5.20 Status

Reference	Address	Type	Access		Storage	Description
ActiveSetting	31357	BYTE	R		R	Tells what are the currently active settings. When set (1), the filter is using the Main settings as operation target; when cleared, it uses the Auxiliary settings.
CurrentState	31366	BYTE	R		R	Reports where the filter controller stands in it's state diagram. Stable values are 1 for filter stopped, 0 for filter running and 2 for filter in error.
FilterLoad Ipeak	31347	FLOAT	R		R	Gives the filter load expressed in % of the nominal peak current rating.
FilterLoadIrms	31345	FLOAT	R		R	Gives the filter load expressed in % of the nominal rms current rating.
FilterLoad Temperature	31351	FLOAT	R		R	Gives the filter load expressed in % of the nominal temperature rating.
FilterLoadUdc	31349	FLOAT	R		R	Gives the filter load expressed in % of the nominal DC bus voltage rating.
Limitation	31353	LONG	R		R	When set, the filter is at full load on the peak current, rms current, temperature or DC bus voltage.
NumberOf Harmonics	31303	LONG	R		R	Gives the number of harmonics that can be selected: 20 for PQFI/M and PQFS in 3 wire mode and 15 for PQFK and PQFS in 4 wire.
Operation Duration	31355	DWORD	R		R	The total time that the fan has been running expressed in hours (h).
Standby	31301	LONG	R		R	Set when the filter has stopped switching IGBT’s because it has entered the standby mode.
StandbyOrder1	31305	LONG	R		R	Set if the filter can not currently filter the selected order
StandbyOrder2	31307	LONG	R		R	Set if the filter can not currently filter the selected order
StandbyOrder3	31309	LONG	R		R	Set if the filter can not currently filter the selected order
StandbyOrder4	31311	LONG	R		R	Set if the filter can not currently filter the selected order.
StandbyOrder5	31313	LONG	R		R	Set if the filter can not currently filter the selected order.
StandbyOrder6	31315	LONG	R		R	Set if the filter can not currently filter the selected order.
StandbyOrder7	31317	LONG	R		R	Set if the filter can not currently filter the selected order.
StandbyOrder8	31319	LONG	R		R	Set if the filter can not currently filter the selected order.

StandbyOrder9	31321	LONG	R		R	Set if the filter can not currently filter the selected order.
StandbyOrder10	31323	LONG	R		R	Set if the filter can not currently filter the selected order.
StandbyOrder11	31325	LONG	R		R	Set if the filter can not currently filter the selected order.
StandbyOrder12	31327	LONG	R		R	Set if the filter can not currently filter the selected order.
StandbyOrder13	31329	LONG	R		R	Set if the filter can not currently filter the selected order.
StandbyOrder14	31331	LONG	R		R	Set if the filter can not currently filter the selected order.
StandbyOrder15	31333	LONG	R		R	Set if the filter can not currently filter the selected order.
StandbyOrder16	31335	LONG	R		R	Set if the filter can not currently filter the selected order.
StandbyOrder17	31337	LONG	R		R	Set if the filter can not currently filter the selected order.
StandbyOrder18	31339	LONG	R		R	Set if the filter can not currently filter the selected order.
StandbyOrder19	31341	LONG	R		R	Set if the filter can not currently filter the selected order.
StandbyOrder20	31343	LONG	R		R	Set if the filter can not currently filter the selected order.
Unit1Status	31358	BYTE	R		R	Reports the status of the unit1. Values can be : -0 : Not present (not connected on the CAN bus) -1 : Ready (connected and alive on the CAN bus) -2 : Fault (connected, but in fault)
Unit2Status	31359	BYTE	R		R	Reports the status of the unit2.
Unit3Status	31360	BYTE	R		R	Reports the status of the unit3.
Unit4Status	31361	BYTE	R		R	Reports the status of the unit4.
Unit5Status	31362	BYTE	R		R	Reports the status of the unit5.
Unit6Status	31363	BYTE	R		R	Reports the status of the unit6.
Unit7Status	31364	BYTE	R		R	Reports the status of the unit7.
Unit8Status	31365	BYTE	R		R	Reports the status of the unit8.

5.21 UserSettings

<table>
<tr><th>Reference</th><th>Address</th><th>Type</th><th colspan="2">Access</th><th>Storage</th><th>Description</th></tr>
<tr><td>Activation Setting</td><td>40001</td><td>BYTE</td><td>R/W</td><td>LS</td><td>NV</td><td>Choose here whether the filter should use the Main settings, the Auxiliary settings or whether the choice should be determined by an external signal connected to a digital input (Ext. Input). In the latter case, the digital input should be set up and cabled correctly.
The possible values are:
<table>
<tr><td>0</td><td>Main</td><td>2</td><td>Ext. Input</td></tr>
<tr><td>1</td><td>Auxiliary</td><td></td><td></td></tr>
</table>
Refer to the PQF Manual Table 8.6 for more information.</td></tr>
<tr><td>Alarm1Setting</td><td>40002</td><td>BYTE</td><td>R/W</td><td>LS+IL</td><td>NV</td><td rowspan="3">Any of the listed alarm conditions can be assigned to the Programmable alarm 1,2 or 3. The possible values are:
<table>
<tr><td>0</td><td>Disabled</td><td>6</td><td>Vdc max</td><td>12</td><td>T ctrl max</td></tr>
<tr><td>1</td><td>Vrms max</td><td>7</td><td>Prel. err.</td><td>13</td><td>PS fault</td></tr>
<tr><td>2</td><td>Vrms min</td><td>8</td><td>Overcur.</td><td>14</td><td>Ctrl board</td></tr>
<tr><td>3</td><td>Phase loss</td><td>9</td><td>Gnd fault</td><td>15</td><td>Any fault</td></tr>
<tr><td>4</td><td>Imbalance</td><td>10</td><td>IGBT fault</td><td>16</td><td></td></tr>
<tr><td>5</td><td>Fq change</td><td>11</td><td>IGBT temp.</td><td>17</td><td></td></tr>
</table>
Refer to the PQF Manual Table 8.10 for more information on the alarm conditions.</td></tr>
<tr><td>Alarm2Setting</td><td>40003</td><td>BYTE</td><td>R/W</td><td>LS+IL</td><td>NV</td></tr>
<tr><td>Alarm3Setting</td><td>40004</td><td>BYTE</td><td>R/W</td><td>LS+IL</td><td>NV</td></tr>
<tr><td>AlarmDelay</td><td>40018</td><td>WORD</td><td>R/W</td><td>LS</td><td>NV</td><td>Defines the time during which the programmed and/or system alarm condition has to present before the digital output and the alarm contact will be activated.
Units : Seconds. Range : [180;43200 (12H00)].</td></tr>
<tr><td>AlarmReset Delay</td><td>40017</td><td>WORD</td><td>R/W</td><td>LS</td><td>NV</td><td rowspan="3">Defines the time during which the programmed and/or system alarm condition has to disappear before the digital output and the alarm contact will be deactivated.
Units : Seconds. Range : [1;43200 (12H00)].
Any of the listed functions can be assigned to Digital Input 1 or 2. When using this function, the inputs should be cabled appropriately. The possible values are:
<table>
<tr><td>0</td><td>Disabled</td><td>3</td><td>Edg ON/OFF</td><td>6</td><td>Activ. aux.</td></tr>
</table></td></tr>
<tr><td>DigitalIn1 Setting</td><td>40008</td><td>BYTE</td><td>R/W</td><td>LS+IL</td><td>NV</td></tr>
<tr><td>DigitalIn2</td><td>40009</td><td>BYTE</td><td>R/W</td><td>LS+IL</td><td>NV</td></tr>
</table>

<table>
<tr><td>Setting</td><td></td><td></td><td></td><td></td><td></td><td>
<table>
<tr><td>1</td><td>Edge ON</td><td>4</td><td>Remote ON</td><td></td><td></td></tr>
<tr><td>2</td><td>Edge OFF</td><td>5</td><td>Activ. main</td><td></td><td></td></tr>
</table>
Refer to the PQF Manual Table 5.6 for more information.
</td></tr>
<tr><td>DigitalOut1 Setting</td><td>40010</td><td>BYTE</td><td>R/W</td><td>LS+IL</td><td>NV</td><td rowspan="6">Any of the listed functions can be assigned to Digital Outputs 1-6. When using this function, the outputs should be cabled appropriately. The possible values are:
<table>
<tr><td>0</td><td>Disabled</td><td>5</td><td>In standby</td><td>10</td><td>Pg. alarm 2</td></tr>
<tr><td>1</td><td>Auxil. ON</td><td>6</td><td>Activ. main</td><td>11</td><td>Pg. alarm 3</td></tr>
<tr><td>2</td><td>PQF runs</td><td>7</td><td>Activ. aux.</td><td>12</td><td>Warning 1</td></tr>
<tr><td>3</td><td>Full load</td><td>8</td><td>Armed</td><td>13</td><td>Warning 2</td></tr>
<tr><td>4</td><td>T limit</td><td>9</td><td>Pg. alarm 1</td><td>14</td><td>Warning 3</td></tr>
</table>
15 Unit miss.
Values :
Refer to the PQF Manual Table 5.7 for more information.</td></tr>
<tr><td>DigitalOut2 Setting</td><td>40011</td><td>BYTE</td><td>R/W</td><td>LS+IL</td><td>NV</td></tr>
<tr><td>DigitalOut3 Setting</td><td>40012</td><td>BYTE</td><td>R/W</td><td>LS+IL</td><td>NV</td></tr>
<tr><td>DigitalOut4 Setting</td><td>40013</td><td>BYTE</td><td>R/W</td><td>LS+IL</td><td>NV</td></tr>
<tr><td>DigitalOut5 Setting</td><td>40014</td><td>BYTE</td><td>R/W</td><td>LS+IL</td><td>NV</td></tr>
<tr><td>DigitalOut6 Setting</td><td>40015</td><td>BYTE</td><td>R/W</td><td>LS+IL</td><td>NV</td></tr>
<tr><td>Installation Locked</td><td>40016</td><td>BYTE</td><td>R/W</td><td>LS</td><td>NV</td><td>Software lock. Switch on the software lock (value 1) to prevent people from changing basic installation settings but still giving them access to high-level user settings (e.g. harmonics selection). Set this parameter to 0 to unlock the software lock.</td></tr>
<tr><td>Warning1 Setting</td><td>40005</td><td>BYTE</td><td>R/W</td><td>LS+IL</td><td>NV</td><td rowspan="3">Any of the listed warning conditions can be assigned to the Programmable warnings 1,2 or 3. When using this function, appropriate warning levels should be defined. Refer to the PQF Manual for more information on the warning conditions. The possible values are:
<table>
<tr><td>0</td><td>Disabled</td><td>3</td><td>Imbalance</td><td>6</td><td>T ctrl max</td></tr>
<tr><td>1</td><td>Vrms max</td><td>4</td><td>Gnd fault</td><td>7</td><td></td></tr>
<tr><td>2</td><td>Vrms min</td><td>5</td><td>IGBT temp.</td><td>8</td><td></td></tr>
</table>
Refer to the PQF Manual Table 8.11 for more information.</td></tr>
<tr><td>Warning2 Setting</td><td>40006</td><td>BYTE</td><td>R/W</td><td>LS+IL</td><td>NV</td></tr>
<tr><td>Warning3 Setting</td><td>40007</td><td>BYTE</td><td>R/W</td><td>LS+IL</td><td>NV</td></tr>
</table>

Warning Delay	40020	WORD	R/W	LS	NV	Defines the time during which the programmed warning condition has to present before the digital output will be activated. This setting is only relevant if the digital output has been set up to monitor the programmable warnings. Units : Seconds. Range : [1;43200 (12H00)].
Warning Reset Delay	40019	WORD	R/W	LS	NV	Defines the time during which the programmed warning condition has to disappear before the digital output will be deactivated. This setting is only relevant if the digital output has been set up to monitor the programmable warnings. Units : Seconds. Range : [1;43200 (12H00)].

5.22 UserStorage

Reference	Address	Type	Access		Storage	Description
Data1	42001	BYTE	R/W		NV	General purpose user data storage.
Data2	42002	BYTE	R/W		NV	
Data3	42003	BYTE	R/W		NV	
Data4	42004	BYTE	R/W		NV	
Data5	42005	BYTE	R/W		NV	
Data6	42006	BYTE	R/W		NV	
Data7	42007	BYTE	R/W		NV	
Data8	42008	BYTE	R/W		NV	General purpose user data storage.

5.23 Warnings

Reference	Address	Type	Access		Storage	Description
GroundFault	40707	FLOAT	R/W	LS	NV	Percentage of the ground current of the nominal filter current above which a ground current warning is generated. Units: Percent. Range: [0; 300].

TControlMax	40711	FLOAT	R/W	LS	NV	If the temperature of the main controller board is higher than “Warnings.TcontrolMax”, a control board temperature warning is generated. During normal operation controller board temperatures can reach 70°C. Units: Celsius Degree. Range: [-40; 105].
TIGBTMax	40709	FLOAT	R/W	LS	NV	If the temperature of the hottest IGBT module is higher than “Warnings.TIGBTMax”, an IGBT temperature warning is generated. During normal operation IGBT module temperatures can reach 100°C. Units: Celsius Degree. Range: [-40; 105].
UMax	40701	FLOAT	R/W	LS	NV	Percentage of the rms value of the nominal network voltage above which an overvoltage warning is generated. The nominal voltage value is represented as 100%. The value of the nominal voltage is entered at the commissioning stage. Units: Percent. Range: [0; 300].
UMin	40703	FLOAT	R/W	LS	NV	Percentage of the rms value of the nominal network voltage under which an undervoltage warning is generated. The nominal voltage value is represented as 100%. The value of the nominal voltage is entered at the commissioning stage. Units: Percent. Range: [0; 300].
Unbalance	40705	FLOAT	R/W	LS	NV	Percentage of the network voltage imbalance above which an imbalance warning is generated. Units: Percent. Range: [0; 300].

5.24 Waveform

Reference	Address	Type	Access		Storage	Description
Control	41701	LONG	R/W		R	Register controlling the waveform acquisition and which data has to be recorded. When zero, the waveform recorder is free; set it to 1-11 for starting a record; acquisition is done when it is -1; don't forget to clear it after retrieving the measurement so the recorder is free for another acquisition. To perform a new waveform provided that "Control" is zero (waveform function is free), do as follows: 1. Select the channel to be measured:

Value to be set in "Control"	Channel analysed	
	PQFI/PQFM	PQFK or PQFS in 4 wire mode
1	UL1-L2	UL1-N

						2. Wait until "control" is -1 (65535) then retrieve the waveform. The number of samples depends on the nominal frequency of the network. For 50 Hz, Sample1 to Sample180. For 60 Hz, Sample1 to Sample150. 3. Clear "Control" to let the function free.
NegativePeak	30605	FLOAT	R		R	Minimum instant value found in the waveform. It is helpful for auto scaling the graph.
Number Samples	30601	LONG	R		R	Number of samples in one period (180 for 50Hz network and 150 for 60Hz networks).
PositivePeak	30603	FLOAT	R		R	Maximum instant value found in the waveform. It is helpful for auto scaling the graph.
Sample1	30701	FLOAT	R		R	Waveform sample.
Sample2	30703	FLOAT	R		R	
Sample3	30705	FLOAT	R		R	
Sample4	30707	FLOAT	R		R	
Sample5	30709	FLOAT	R		R	

2	UL2-L3	UL2-N
3	UL3-L1	UL3-N
4	IL1	IL1
5	IL2	IL2
6	IL3	IL3
7	IFilter1	IFilter1
8	IFilter2	IFilter2
9	IFilter3	IFilter3
10	Not available	IN
11	Not available	IFilterN

Sample6	30711	FLOAT	R		R	
Sample7	30713	FLOAT	R		R	
Sample8	30715	FLOAT	R		R	
Sample9	30717	FLOAT	R		R	
Sample10	30719	FLOAT	R		R	
Sample11	30721	FLOAT	R		R	
Sample12	30723	FLOAT	R		R	
Sample13	30725	FLOAT	R		R	
Sample14	30727	FLOAT	R		R	
Sample15	30729	FLOAT	R		R	
Sample16	30731	FLOAT	R		R	
Sample17	30733	FLOAT	R		R	
Sample18	30735	FLOAT	R		R	
Sample19	30737	FLOAT	R		R	
Sample20	30739	FLOAT	R		R	
Sample21	30741	FLOAT	R		R	
Sample22	30743	FLOAT	R		R	
Sample23	30745	FLOAT	R		R	
Sample24	30747	FLOAT	R		R	
Sample25	30749	FLOAT	R		R	Waveform sample.
Sample26	30751	FLOAT	R		R	
Sample27	30753	FLOAT	R		R	
Sample28	30755	FLOAT	R		R	
Sample29	30757	FLOAT	R		R	

Sample30	30759	FLOAT	R		R	
Sample31	30761	FLOAT	R		R	
Sample32	30763	FLOAT	R		R	
Sample33	30765	FLOAT	R		R	
Sample34	30767	FLOAT	R		R	
Sample35	30769	FLOAT	R		R	
Sample36	30771	FLOAT	R		R	
Sample37	30773	FLOAT	R		R	
Sample38	30775	FLOAT	R		R	
Sample39	30777	FLOAT	R		R	
Sample40	30779	FLOAT	R		R	
Sample41	30781	FLOAT	R		R	
Sample42	30783	FLOAT	R		R	
Sample43	30785	FLOAT	R		R	
Sample44	30787	FLOAT	R		R	
Sample45	30789	FLOAT	R		R	
Sample46	30801	FLOAT	R		R	
Sample47	30803	FLOAT	R		R	
Sample48	30805	FLOAT	R		R	
Sample49	30807	FLOAT	R		R	
Sample50	30809	FLOAT	R		R	
Sample51	30811	FLOAT	R		R	
Sample52	30813	FLOAT	R		R	
Sample53	30815	FLOAT	R		R	

Sample54	30817	FLOAT	R		R	
Sample55	30819	FLOAT	R		R	
Sample56	30821	FLOAT	R		R	
Sample57	30823	FLOAT	R		R	
Sample58	30825	FLOAT	R		R	
Sample59	30827	FLOAT	R		R	
Sample60	30829	FLOAT	R		R	
Sample61	30831	FLOAT	R		R	
Sample62	30833	FLOAT	R		R	
Sample63	30835	FLOAT	R		R	
Sample64	30837	FLOAT	R		R	
Sample65	30839	FLOAT	R		R	
Sample66	30841	FLOAT	R		R	
Sample67	30843	FLOAT	R		R	Waveform sample.
Sample68	30845	FLOAT	R		R	
Sample69	30847	FLOAT	R		R	
Sample70	30849	FLOAT	R		R	
Sample71	30851	FLOAT	R		R	
Sample72	30853	FLOAT	R		R	
Sample73	30855	FLOAT	R		R	
Sample74	30857	FLOAT	R		R	
Sample75	30859	FLOAT	R		R	
Sample76	30861	FLOAT	R		R	
Sample77	30863	FLOAT	R		R	

Sample78	30865	FLOAT	R		R	
Sample79	30867	FLOAT	R		R	
Sample80	30869	FLOAT	R		R	
Sample81	30871	FLOAT	R		R	
Sample82	30873	FLOAT	R		R	
Sample83	30875	FLOAT	R		R	
Sample84	30877	FLOAT	R		R	
Sample85	30879	FLOAT	R		R	
Sample86	30881	FLOAT	R		R	
Sample87	30883	FLOAT	R		R	
Sample88	30885	FLOAT	R		R	
Sample89	30887	FLOAT	R		R	
Sample90	30889	FLOAT	R		R	
Sample91	30901	FLOAT	R		R	
Sample92	30903	FLOAT	R		R	
Sample93	30905	FLOAT	R		R	
Sample94	30907	FLOAT	R		R	
Sample95	30909	FLOAT	R		R	
Sample96	30911	FLOAT	R		R	
Sample97	30913	FLOAT	R		R	
Sample98	30915	FLOAT	R		R	
Sample99	30917	FLOAT	R		R	
Sample100	30919	FLOAT	R		R	
Sample101	30921	FLOAT	R		R	

Sample102	30923	FLOAT	R		R	
Sample103	30925	FLOAT	R		R	
Sample104	30927	FLOAT	R		R	
Sample105	30929	FLOAT	R		R	
Sample106	30931	FLOAT	R		R	
Sample107	30933	FLOAT	R		R	
Sample108	30935	FLOAT	R		R	
Sample109	30937	FLOAT	R		R	Waveform sample.
Sample110	30939	FLOAT	R		R	
Sample111	30941	FLOAT	R		R	
Sample112	30943	FLOAT	R		R	
Sample113	30945	FLOAT	R		R	
Sample114	30947	FLOAT	R		R	
Sample115	30949	FLOAT	R		R	
Sample116	30951	FLOAT	R		R	
Sample117	30953	FLOAT	R		R	
Sample118	30955	FLOAT	R		R	
Sample119	30957	FLOAT	R		R	
Sample120	30959	FLOAT	R		R	
Sample121	30961	FLOAT	R		R	
Sample122	30963	FLOAT	R		R	
Sample123	30965	FLOAT	R		R	
Sample124	30967	FLOAT	R		R	
Sample125	30969	FLOAT	R		R	

Sample126	30971	FLOAT	R		R	
Sample127	30973	FLOAT	R		R	
Sample128	30975	FLOAT	R		R	
Sample129	30977	FLOAT	R		R	
Sample130	30979	FLOAT	R		R	
Sample131	30981	FLOAT	R		R	
Sample132	30983	FLOAT	R		R	
Sample133	30985	FLOAT	R		R	
Sample134	30987	FLOAT	R		R	
Sample135	30989	FLOAT	R		R	
Sample136	31001	FLOAT	R		R	
Sample137	31003	FLOAT	R		R	
Sample138	31005	FLOAT	R		R	
Sample139	31007	FLOAT	R		R	
Sample140	31009	FLOAT	R		R	
Sample141	31011	FLOAT	R		R	
Sample142	31013	FLOAT	R		R	
Sample143	31015	FLOAT	R		R	
Sample144	31017	FLOAT	R		R	
Sample145	31019	FLOAT	R		R	
Sample146	31021	FLOAT	R		R	
Sample147	31023	FLOAT	R		R	
Sample148	31025	FLOAT	R		R	
Sample149	31027	FLOAT	R		R	

Sample150	31029	FLOAT	R		R	
Sample151	31031	FLOAT	R		R	Waveform sample.
Sample152	31033	FLOAT	R		R	
Sample153	31035	FLOAT	R		R	
Sample154	31037	FLOAT	R		R	
Sample155	31039	FLOAT	R		R	
Sample156	31041	FLOAT	R		R	
Sample157	31043	FLOAT	R		R	
Sample158	31045	FLOAT	R		R	
Sample159	31047	FLOAT	R		R	
Sample160	31049	FLOAT	R		R	
Sample161	31051	FLOAT	R		R	
Sample162	31053	FLOAT	R		R	
Sample163	31055	FLOAT	R		R	
Sample164	31057	FLOAT	R		R	
Sample165	31059	FLOAT	R		R	
Sample166	31061	FLOAT	R		R	
Sample167	31063	FLOAT	R		R	
Sample168	31065	FLOAT	R		R	
Sample169	31067	FLOAT	R		R	
Sample170	31069	FLOAT	R		R	
Sample171	31071	FLOAT	R		R	
Sample172	31073	FLOAT	R		R	
Sample173	31075	FLOAT	R		R	

Sample174	31077	FLOAT	R		R	
Sample175	31079	FLOAT	R		R	
Sample176	31081	FLOAT	R		R	
Sample177	31083	FLOAT	R		R	
Sample178	31085	FLOAT	R		R	
Sample179	31087	FLOAT	R		R	
Sample180	31089	FLOAT	R		R	

6 OUTPUT & INPUT BITS

6.1 Output bits

This table contains free bytes for bit change testing. This has no effect on the PQF behavior.

General description	Description	Variable	Variable name	Modbus register	Table number	offset	Access Set	LS	BL	R	NV	C	Units	Datatype
			OUTPUTBIT_0	00001	00	01				X				BIT
			OUTPUTBIT_0	00002	00	02				X				BIT
			OUTPUTBIT_0	00003	00	03				X				BIT
			OUTPUTBIT_0	00004	00	04				X				BIT
			OUTPUTBIT_0	00005	00	05				X				BIT
			OUTPUTBIT_0	00006	00	06				X				BIT
			OUTPUTBIT_0	00007	00	07				X				BIT
			OUTPUTBIT_0	00008	00	08				X				BIT
			OUTPUTBIT_1	00101	01	01					X			BIT
			OUTPUTBIT_1	00102	01	02					X			BIT
			OUTPUTBIT_1	00103	01	03					X			BIT
			OUTPUTBIT_1	00104	01	04					X			BIT
			OUTPUTBIT_1	00105	01	05					X			BIT
			OUTPUTBIT_1	00106	01	06					X			BIT
			OUTPUTBIT_1	00107	01	07					X			BIT
			OUTPUTBIT_1	00108	01	08					X			BIT
			OUTPUTBIT_2	00201	02	01						X		BIT
			OUTPUTBIT_2	00202	02	02						X		BIT
			OUTPUTBIT_2	00203	02	03						X		BIT
			OUTPUTBIT_2	00204	02	04						X		BIT
			OUTPUTBIT_2	00205	02	05						X		BIT
			OUTPUTBIT_2	00206	02	06						X		BIT
			OUTPUTBIT_2	00207	02	07						X		BIT
			OUTPUTBIT_2	00208	02	08						X		BIT

6.2 Input bits

This table contains free bytes for bit read testing. This has no effect on the PQF behaviour.

Note (30) : INPUTBIT_0 contains HEX value 0x55

Note (31) : INPUTBIT_1 contains HEX value 0xAA

Note (32) : INPUTBIT_2 contains HEX value 0xFF

General description	Description	Variable	Variable name	Modbus register	Table number	offset	Access Set	LS	BL	R	NV	C	Units	Datatype
			INPUTBIT_0	10001	00	01							Note (30)	BIT
			INPUTBIT_0	10002	00	02							Note (30)	BIT
			INPUTBIT_0	10003	00	03							Note (30)	BIT
			INPUTBIT_0	10004	00	04							Note (30)	BIT
			INPUTBIT_0	10005	00	05							Note (30)	BIT
			INPUTBIT_0	10006	00	06							Note (30)	BIT
			INPUTBIT_0	10007	00	07							Note (30)	BIT
			INPUTBIT_0	10008	00	08							Note (30)	BIT
			INPUTBIT_1	10101	01	01							Note (31)	BIT
			INPUTBIT_1	10102	01	02							Note (31)	BIT
			INPUTBIT_1	10103	01	03							Note (31)	BIT
			INPUTBIT_1	10104	01	04							Note (31)	BIT
			INPUTBIT_1	10105	01	05							Note (31)	BIT
			INPUTBIT_1	10106	01	06							Note (31)	BIT
			INPUTBIT_1	10107	01	07							Note (31)	BIT
			INPUTBIT_1	10108	01	08							Note (31)	BIT
			INPUTBIT_2	10201	02	01							Note (32)	BIT
			INPUTBIT_2	10202	02	02							Note (32)	BIT
			INPUTBIT_2	10203	02	03							Note (32)	BIT
			INPUTBIT_2	10204	02	04							Note (32)	BIT
			INPUTBIT_2	10205	02	05							Note (32)	BIT
			INPUTBIT_2	10206	02	06							Note (32)	BIT
			INPUTBIT_2	10207	02	07							Note (32)	BIT
			INPUTBIT_2	10208	02	08							Note (32)	BIT

7 DEVICE SPECIFIC MODBUS FUNCTIONS

7.1 Read Exception Status (function 7)

The read exception status function provides a simple and quick method for accessing PQF status conditions. The format of a read exception status (07) function is as follows:

QUERY	
Slave address	1 byte
Function	1 byte
Error check field CRC	2 bytes

RESPONSE	
Slave address	1 byte (echo of master's query)
Function	1 byte (echo of master's query)
Data value	1 byte
Error check field CRC	2 bytes

The format of the exception status for the PQF is given hereafter:

PQF exception status signification			
bit	signification	0	1
0	Operation of the filter	OFF	Running
1	Current error status	No error	Error
2	Only if B1 is set, B6B5B4B3B2 = number belonging to [0; 31] giving the bit index of the least significant bit set in the current error: - if B7 is set “Error.CurrentDSPError” - else “Error.CurrentUCError”. For the meaning of this bit index, please see point 5.3 in the present document or PQF Manual Table 8.17 or Table 8.18		
3			
4			
5			
6			
7	Only if B1 is set, origin of the error.	UC/no error	DSP

7.2 Report Slave ID (function 17)

The Report Slave ID function gives all information on the type of filter, serial number, type number. A free memory space may be used to store data needed for level 1 certification for an ABB higher-level system.

The format of the Report Slave ID (17) function is as follows:

QUERY	
Slave address	1 byte
Function	1 byte
Error check field CRC	2 bytes

RESPONSE	
Slave address	1 byte (echo of master's query)
Function	1 byte (echo of master's query)
Byte count	Device specific (see below)
Slave ID	Device specific (see below)
Run indicator status	0x00 or 0xFF (see below)
Additional data	Device specific (see below)
Error check field CRC	2 bytes

The format of the Report Slave ID for the PQF is given hereafter:

		Description	Example
byte count	Index	96	96
slave ID for ABB products	1	3 = PQFMGR	3
Run indicator status	2		00/FF
Type	3	Manager_Id.ProductType1 HI	‘P'
	4	Manager_Id.ProductType1 LO	‘Q'
	5	Manager_Id.ProductType2 HI	‘F'
	6	Manager_Id.ProductType2 LO	‘M'
	7	Manager_Id.ProductType3 HI	‘G'
	8	Manager_Id.ProductType3 LO	‘R'
Additional data	9		empty
	10	SoftVersion.Manager HL	ex : 1
	11	SoftVersion.Manager LH	ex : 4
	12	Manager_Id.SerialNumber HH	xx
	13	Manager_Id.SerialNumber HL	xx
	14	Manager_Id.SerialNumber LH	xx
	15	Manager_Id.SerialNumber LL	xx
	16	Character depending on filter type	‘K, I or M’
	17	Settings. RatingModule1 HI	0
	18	Settings. RatingModule1 LO	70
	19	Settings. RatingModule2 HI	
	20	Settings. RatingModule2 LO	
	21	Settings. RatingModule3 HI	
	22	Settings. RatingModule3 LO	
	23	Settings. RatingModule4 HI	
	24	Settings. RatingModule4 LO	
	25	Settings. RatingModule5 HI	
	26	Settings. RatingModule5 LO	
	27	Settings. RatingModule6 HI	
	28	Settings. RatingModule6 LO	
	29	Settings. RatingModule7 HI	
	30	Settings. RatingModule7 LO	
	31	Settings. RatingModule8 HI	
	32	Settings. RatingModule8 LO	
level 1	33	Identification.SystemId1 HI	
information	34	Identification.SystemId1 LO	
for	35	Identification.SystemId2 HI	
higher	36	Identification.SystemId2 LO	

level	37	Identification.SystemId3 HI	
ABB systems	38	Identification.SystemId3 LO	
	39	Identification.SystemId4 HI	
	40	Identification.SystemId4 LO	
	41	Identification.SystemId5 HI	
	42	Identification.SystemId5 LO	
	43	Identification.SystemId6 HI	
	44	Identification.SystemId6 LO	
	45	Identification.SystemId7 HI	
	46	Identification.SystemId7 LO	
	47	Identification.SystemId8 HI	
	48	Identification.SystemId8 LO	
	49	Identification.SystemId9 HI	
	50	Identification.SystemId9 LO	
	51	Identification.SystemId10 HI	
	52	Identification.SystemId10 LO	
	53	Identification.SystemId11 HI	
	54	Identification.SystemId11 LO	
	55	SoftVersion.Controller HL	
	56	SoftVersion.Controller LH	
	57	SoftVersion.Controller LL	
	58	SoftVersion.DSP HL	
	59	SoftVersion.DSP LH	
	60	SoftVersion.DSP LL	
	61	Identification.PQFSerialNumber HH	
	62	Identification.PQFSerialNumber HL	
	63	Identification.PQFSerialNumber LH	
	64	Identification.PQFSerialNumber LL	
level 1	65	Manager_Id.ProductId1 HI	
information	66	Manager_Id.ProductId1 LO	
for	67	Manager_Id.ProductId2 HI	
higher	68	Manager_Id.ProductId2 LO	
level	69	Manager_Id.ProductId3 HI	
ABB systems	70	Manager_Id.ProductId3 LO	
	71	Manager_Id.ProductId4 HI	
	72	Manager_Id.ProductId4 LO	
	73	Manager_Id.ProductId5 HI	
	74	Manager_Id.ProductId5 LO	
	75	Manager_Id.ProductId6 HI	

	76	Manager_Id.ProductId6 LO	
	77	Manager_Id.ProductId7 HI	
	78	Manager_Id.ProductId7 LO	
	79	Manager_Id.ProductId8 HI	
	80	Manager_Id.ProductId8 LO	
	81	Manager_Id.ProductId9 HI	
	82	Manager_Id.ProductId9 LO	
	83	Manager_Id.ProductId10 HI	
	84	Manager_Id.ProductId10 LO	
	85	Manager_Id.ProductId11 HI	
	86	Manager_Id.ProductId11 LO	
Manufacturer reference	87	Identification.PQFAbbId1	20
number	88	Identification.PQFAbbId2 HI	0
	89	Identification.PQFAbbId2 LO	50
	90	Identification.PQFAbbId3 HH	xx
	91	Identification.PQFAbbId3 HL	xx
	92	Identification.PQFAbbId3 LH	xx
	93	Identification.PQFAbbId3 LL	xx
	94		
	95		
	96		

8 CRC GENERATION

The Cyclical Redundancy Check (CRC) field is two bytes, containing a 16–bit binary value. The CRC value is calculated by the transmitting device, which appends the CRC to the message. The receiving device recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error results.

Placing the CRC into the Message:

When the 16–bit CRC (two 8–bit bytes) is transmitted in the message, the low-order byte will be transmitted first, followed by the high-order byte.

Example: here is an example of calculating directly the CRC.

/*----------

FUNCTION :This routine calculates the crc high and low byte of a message.

INPUT PARAMETERS: buf -> Array containing message to be sent to controller

start -> Start of loop in crc counter, usually 0.

```
                                cnt  ->  Amount of bytes in message being sent to
                                controller
  ------------------------------------------------------------------
OUTPUT:                         temp  ->  Returns crc byte for message.
  ------------------------------------------------------------------
*/
word crc(byte *buf,word start,word cnt)
{
word        i,j;
word        temp,temp2,flag;
      temp=0xFFFF;
      for (i=start; i<cnt; i++)
      {
            temp=temp ^ buf[i];
            for (j=1; j<=8; j++)
            {
                  flag=temp & 0x0001;
                  temp=temp >> 1;
                  if (flag) temp=temp ^ 0xA001;
            }
      }

      /* Reverse byte order. */
      temp2=temp >> 8;
      temp=(temp << 8) | temp2;
      temp &= 0xFFFF;
      return(temp);
}
```

9 APPENDIX

9.1 List of abbreviations

ASCII	American Standard Code for Information Interchange
Baud rate	Unit for measuring transmission speed in bits/s;
Bit	A binary digit, representing a one or zero
Bus	An electrical circuit over which data is transmitted
Byte	A whole number value represented by eight bits (0 to 255)
Chassis or Chassis Ground	A connection to an electrically conductive housing or frame of a device. It may or may not be connected to Earth Ground.
Coil	The telegram structure for Modbus transmission is implemented in registers (WORD) or coils (BOOL). A coil may be either 8 or 16 bits in length.
Common	Tte voltage reference point of a circuit. It may or may not be connected to earth ground, though it is generally assumed to be at zero volts, unless otherwise indicated. In floating circuits, the common is sometimes at a relatively high potential. This term is sometimes used interchangeably with the term “Ground” or GND
CRC	Cyclic Redundancy Check. Complex error checking on a message block.
CTS	ClearToSend hardware handshaking signal. Used with RequestToSend.
Earth or Earth Ground	Global zero voltage reference point. Physical connection is made to the earth through a grounding rod, water pipe or other reliable connection.
Ground	Voltage reference point of a circuit. It may or may not be connected to earth ground, though it is generally assumed to be at zero volts. Sometimes used interchangeably with the term “Common”.
Handshaking	method of data flow control for serial communications
Hexadecimal or HEX	A number system using a decimal 16 as its base. A single digit number in HEX ranges from 0 to 15, represented by 0 to 9 and A to F.
HMI	Human-Machine Interface (formerly MMI)
Loopback	A test used for checking functionality of a serial port, utilizing a test plug that connects send, receive and handshaking signals
Long Integer	Analog value consisting of two consecutive 16-bit registers
LRC	Longitudinal Redundancy Check
Measurement	A measurement is a value computed by the controller through its analog and digital inputs. Measurements can be read from the PQF-Manager front plate, or through the Modbus protocol.
Modbus adapter	It is an optional small interface module through which the PQF-Manager is connected to an external Modbus serial communication bus. It performs an optical to

	RS485 conversion. The communication with the Modbus adapter is activated with a PQF-Manager parameter.
OPC	OLE™ for Process Control. OPC is Plug-n-Play in the field of Automation and HMI. OLE™ for Process Control (OPC™) is the most standard way for connecting hardware and data devices with HMI client applications. OPC is a concept agreed upon by a committee of members from the OPC foundation. Most automation companies in the market place including ABB are members of this foundation. OPC uses state-of-the art technologies like COM, DCOM, ActiveX of Microsoft and makes development and programming easier. In the OPC world, there are two major types of applications:OPC Servers and OPC Clients.
OPC Servers	OPC Server applications are used to collect data from the data sources like hardware devices. At the bottom level, the servers are mainly for reading inputs and writing outputs of the data sources. At the upper level, the servers make the data available in a standard way to the OPC client applications.
OPC Clients	The OPC Client applications can communicate directly with the OPC servers and get the data. This way OPC enhances the interface between client and server applications by providing a standard mechanism to communicate data from a data source to any client application.
Parameter	A parameter is an operating data for the controller. Parameters can be read and programmed with the PQF-Manager front plate, or through the Modbus protocol.
Parity	Simple method of data error checking performed at the byte level. May be user-specified as Odd, Even or None with most equipment and software.
PC	Personal Computer
Receive	Incoming communication signal. (Rx)
RTS	RequestToSend hardware handshaking signal. Used with ClearToSend.
Rx	See Receive
PLC	Programmable Logic Controller
RTS	Request To Send
RTU	Remote Terminal Unit
Time-out	Parameter specifying the max. wait time in ms. waiting for a response in the range 0..10000 ms.
Signed Integer	Whole number value represented by 16 bits (-32768 to 32767)
Transmit	Outgoing communication signal. (Tx)
Tri-State	The ability of a communications transmitter to turn its circuitry off, reducing the load on the network
Tx	see Transmit
Unsigned Integer	

	Positive whole number value represented by 16 bits (0 to 65535)
Word	A group of 16 bits
Xon/Xoff	Software implementation of data flow control

9.2 References

- PQF Installation, operation and maintenance instructions:
  - PQFI: 2GCS211013A0070
  - PQFM: 2GCS212016A0070
  - PQFK: 2GCS213015A0070
  - PQFS: 2GCS217014A0070
- Modicon Modbus Protocol Reference Guide (PI–MBUS–300 Rev. J).

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