COMMUNICATION PROTOCOL

Original

QMG 800 HiQuad Neo

OPC UA Communication Protocol

PFEIFFER VACUUM

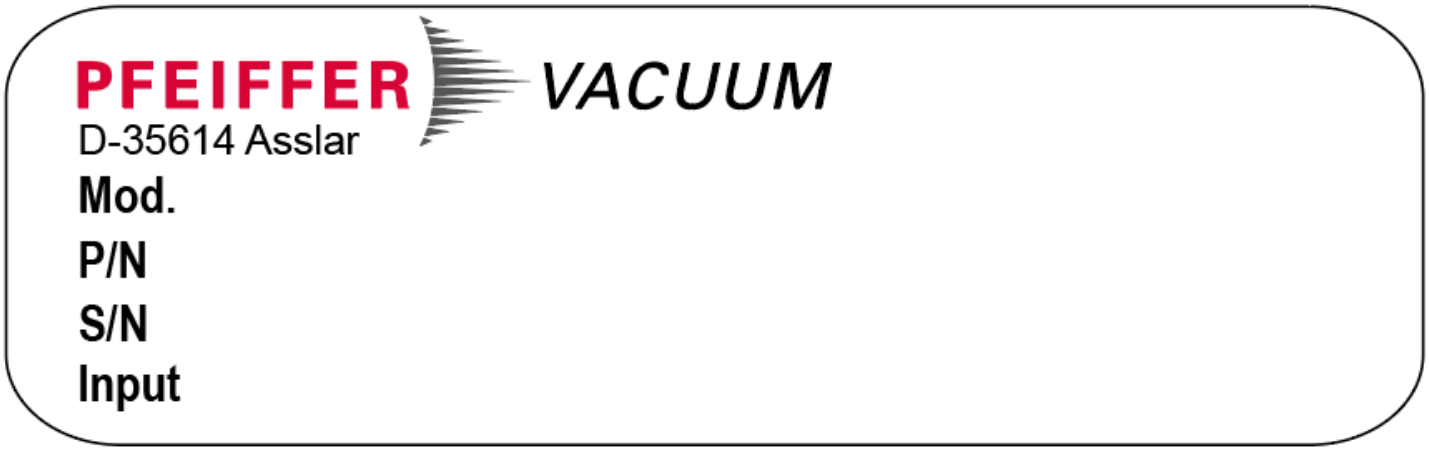
1 About this Document

This document describes the functionality and programming of the OPC UA interface of the QMG 800 Quadrupole Mass Spectrometer System.

NOTICE: For safety information on and further technical data of the device, please refer to the respective operating manual (see section 4 and section 5).

1.1 Product Identification

In all communications with Pfeiffer Vacuum, please specify the information on the product nameplate. For convenient reference copy of all system information into the spaces provided below.



1.2 Validity

This document applies to devices with the following firmware versions:

CI 800 – SW	1.00.05.00
SI 800 – Firmware	2.07.00.00

CI 800 software version can be found using the Hardware.Modules.Analyzer.CI700.FirmwareVersion OPC endpoint

SI 800 firmware version can be found using the Hardware.Modules.Analyzer.SI700.FirmwareVersion OPC endpoint

NOTE: The OPC UA commands contain some designations of QMG 700 components to ensure backward compatibility and to avoid reprogramming of existing programs.

2 Table of Contents

3 Important Information

3.1 Revision History

Version	Description	Date	Approver
1.0.0	Initial Release		

Table 3-1

3.2 Liability and warranty

Pfeiffer Vacuum assumes no liability and the warranty becomes null and void if the end-user or third parties.

- Disregard the information in this document.
- Use the product in a non-conforming manner.
- Make any kind of interventions (modifications, alterations etc.) on the product.
- Use the product with accessories and options not listed in the corresponding product documentation.

The end-user assumes the responsibility in conjunction with the process media used.

3.3 Training

Pfeiffer Vacuum offers application, operating and maintenance courses for the best use of this product. Please contact your local Pfeiffer Vacuum representative for more information.

4 Technical Data

Refer to operating instructions BG6013.

5 Installation

Refer to operating instructions BG6013.

6 Introduction to OPC UA

6.1 What is OPC?

OPC stands for Openness, Productivity, Collaboration (formerly: OLE for Process Control). OPC is a standard software interface which enables data communication between applications of different manufacturers. Today, OPC is the worldwide standard for information exchange between different hardware and software components.

6.2 OPC Client/Server Architecture

In order to obtain maximum independence between process linking and the actual application, process linking is implemented as an independent application called “OPC server”. An application which accesses the data of an OPC server is called an “OPC client”. The relationship between the two applications is a typical client/server architecture in which server provides its services to a client. In this case, the server provides access to process data. A client/server architecture has the advantage that one OPC server can provide its service to several clients simultaneously, and that one client can use the service of several servers simultaneously.

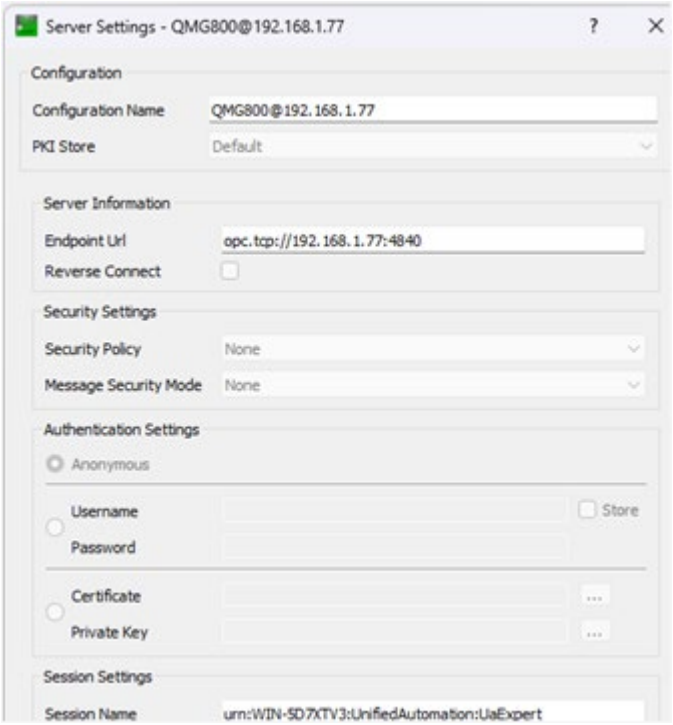
Further references

- Further information on OPC can be found on the website of the OPC Foundation:
  - https://opcfoundation.org/
- OPC Programmers' Connection with useful tips:
  - https://www.opcconnect.com/
- Softing AG:
  - https://company.softing.com/

6.3 Testing the QMG Server

For testing the QMG Server you may for example use the Demo OPC Client made by Softing AG. (https://industrial.softing.com/products/opc-ua-and-opc-classic-sdks/opc-ua-demo-client.html)

Below is an example of connecting to a QMG Server using the UaExpert OPC UA Client made by Unified Automation. (https://www.unified-automation.com/products/development-tools/uaexpert.html):



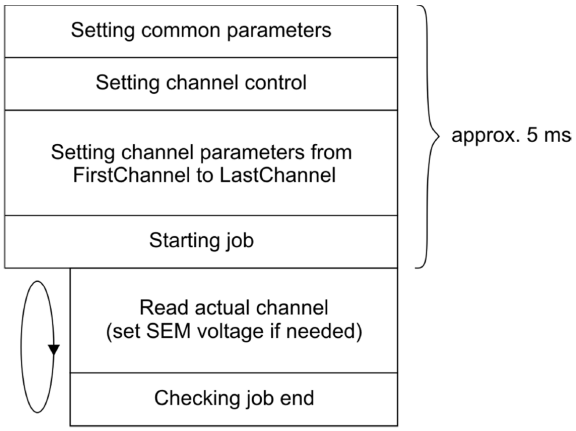
6.4 Communication Basics

6.4.1 START / STOP

Run

In multichannel mode (item General.Cycle.CycleMode = Multi), the channel run is indicated (breaks possible in fast run). START / STOP start and stop the measurement that is defined in General.Cycle.MeasureMode. Starting the measurement when a measurement job is already active will result in the job restart.

The following diagram schematically shows the sequence when a measurement is started.



Stop

Set the General.Cycle.Command = 2 to stop the current measurement job.

6.4.2 Login/Logout (Security – Items)

Login

The General.Security.LoggedInUser item prevents two or more clients from configuring the measuring device at the same time. In fact, login is not required to change parameters, however, the client should inhibit this. For example, at first the login screen should appear. Changing values should only be possible after successful login.

Proceed as follows to login:

1. Set the required values for the following items:
    - General.Security.Name
    - General.Security.Phone
    - General.Security.Password
2. Set General.Security.Command = 1 to start login.
3. Use the General.Security.Status item to check that the login has been performed (0 = “logged off”, 1 = “logged on”, 2 = “logon failed”).

The General.Security.LoggedInUser item indicates the currently logged in user name, and the phone number: “Name(phone)”.

Logout

Logout works in the same way like login but does not require the items “Name”, “Phone”, and “Password”. Set General.Security.Command = 2 to logout. Thus, you can force a logout at any time which may be needed if another user is already logged in and not found for logging out. The “Status” item indicates the status.

6.5 Data Types

The following data types are used for the various types of OPC variables:

Data Type	OPC Vartype
BYTE 8 bit	Byte
Unsigned Integer 16 bit	UInt16
Unsigned Integer 32 bit	UInt32
Signed Integer 16 bit	Int16
Signed Integer 32 bit	Int32
Float 4 BYTE	Float
Character Array	String

Table 6-1

7 OPC Items – Allowed Range

Changing a parameter can affect the measurement. When a parameter that is relevant for the current measurement cycle is changed, the measurement cycle will be restarted.

The following table lists the allowed range for the OPC UA items, sorted by the OPC UA name in alphabetical order.

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
Analyzer.Detector.ActualParameters.CdSEMVoltage_ActualValue: Output of CD voltage (actual value)						
	output read	0.0 ... 7000.0	[V] Float	-	0	-
Analyzer.Detector.ActualParameters.CdSEMVoltage_SetValue: Defined CD voltage (set value)						
	input r and w	0.0 ... 7000.0	[V] Float	5000.0	1	
Analyzer.Detector.ActualParameters.CommonSEMVoltage_ActualValue: Output of common SEM voltage (actual value)						
	output read	0.0 ... 3500.0	[V] Float	-	0	Operating voltage of the SEM 0t defined in a measurement channel.
Analyzer.Detector.ActualParameters.CommonSEMVoltage_SetValue: Defined common SEM voltage (set value)						
	input r and w	0.0 ... 3500.0	[V] Float	1000.0	1	SEM voltage not defined in a measurement channel. NOTE: Writing to this endpoint also writes value to Hardware.Modules.Analyzer.HV701-1.HighVoltage_SetValue
Analyzer.Detector.Command: Control SEM high voltage status On/Off						
	input r and w	0 = 0 command 1 = SEM on 2 = SEM off	Byte	0	0	Enable / disable the SEM high voltage + output of SEM voltage (actual value)
Analyzer.Detector.Status: SEM voltage status						
	output read	0 = SEM off 1 = SEM on	Byte	-	0	SEM high voltage + output of SEM voltage (actual value) disabled / enabled
Analyzer.Detector.Type: Type of ion detector						
	input r and w	0 = FARAD 1 = SEM 2 = CD-SEM 3 = H-SEM	Byte	0	Indirectly	Defines the type of ion detection
Analyzer.Filament.ActiveFilament: Filament selection						
	input r and w	1 = filament 1 2 = filament 2	Byte	1	1	Filament selection for ion sources containing two filaments 0te: When selection of filament 1 or 2, IS operating parameters associated with that filament is automatically loaded
Analyzer.Filament.Command: Filament emission On/Off						
	input r and w	0 = 0 command 1 = filament on 2 = filament off	Byte	0	0	Define filament emission status On / Off
Analyzer.Filament.Degas.Command: Degassing Start/Stop						
	input r and w	0 = 0 command 1 = degas start 2 = degas stop	Byte	0	0	Define filament degas status On / Off

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
Analyzer.Filament.Degas.EmissionCurrent_SetValue: Emission current for degas (set value)						
	input r and w	0.0 ... 20.0	[mA] Float	20.0	1	Emission current for Degas
Analyzer.Filament.Degas.ProtectionCurrent_SetValue: Maximum filament current for degas (set value)						
	input r and w	0.00 ... 5.00	[A] Float	4.00	1	Maximum filament current, used to protect the filament
Analyzer.Filament.Degas.Status: Filament degas status						
	output read	1 = degas 1 active 2 = degas 2 active	Byte	-	0	Indicates degassing of filament 1 or 2
Analyzer.Filament.Degas.Time: Duration of filament degas						
	input r and w	0 ... 99	[min] Byte	30	1	0 = Continue degas until stop command is entered manually
Analyzer.Filament.EmissionStatus: Filament emission status						
	output read	0 = filament off 1 = filament on	Byte	-	0	Filament emission disabled / enabled
Analyzer.Filament.ProtectionPressure.LevelOff:						
	input r and w	0.0 ... 1000.0	[mbar] Float	5.0E-5	1	Duplicate of Hardware.Modules.External.IO720.TotalPressure.TP_001.LevelOff
Analyzer.Filament.ProtectionPressure.LevelOn:						
	input r and w	0.0 ... 1000.0	[mbar] Float	0.0	1	Duplicate of Hardware.Modules.External.IO720.TotalPressure.TP_001.LevelOn
Analyzer.IonLens.Type:						
	input r and w	0 = 0ne 1 = 1-lens 2 = 2-lens 3 = 3-lens 4 = 4-lens	Byte	0	1	Number of Ion Lens in the Analyzer
Analyzer.IonPolarity: Polarity of Ion Source						
	input r and w	0 = positive 1 = negative	Byte	0	1	Special ion source -- Positive ions Special ion source -- Negative ions
Analyzer.IonSource.ActiveParameterSet: Ion source voltages parameter set						
	input r and w	0 = Set 1 1 = Set 2 2 = Set 3 3 = Set 4	Byte	0	1	The system supports 4 ion source voltages parameter sets. Each set can be used to hold different filament and ion source type configurations.
Analyzer.IonSource.Copy.Command: Copy the current ion source parameters						
	input r and w	0 = 0 command 1 = copy to all 2 = copy to .ToParameterSet	Byte	0	0	Copies the parameters from the currently active set to the target set. (See Analyzer.IonSource.Copy.ToParameterSet)
Analyzer.IonSource.Copy.ToParameterSet: Destination parameter set for the copy command						
	input r and w	0 = Set 1 1 = Set 2 2 = Set 3 3 = Set 4	Byte	0	1	Destination parameter set. Related to Analyzer.IonSource.Copy.Command

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
Analyzer.IonSource.Type: Ion source type						
	input r and w	0 = Axial 1 = CB 2 = Grid 3 = SPM 4 = SPECIAL 5 = NONE	Byte	3	1	Selection of the installed ion source type
Analyzer.Protection: Protection of filament and SEM						
	input r and w	0 = INTERN-OFF 1 = EXTERN-ONOFF 2 = EXTERN_OFF	Byte	2	1	See section: IS/QMA/SEM Protection against Plasma*
Channels.Actuality.ActualChannel.Channel: Number of actual measurement channel						
	output read	0 ... 127	Byte	-	0	Currently active measurement channel.
Channels.Actuality.ActualChannel.MassMode: Operation mode of measurement in actual channel						
	output read	0 = SAMPLE 1 = SCAN-N 2 = SCAN-F 3 = STAIR-T 4 = PEAK-L 5 = PEAK-F 6 = ADJUST-C 7 - ADJUST-F 12 = ANALOG-IN 13 = DEGAS 14 = RF-TUNE 15 = OFFSET	Byte	-	0	0 = Standard measurement of a single mass 1 = Standard scan 2 = Scan with FIR filter 3 = Scan of whole number of masses 4 = Peak processor level criterion 5 = Peak processor FIR filter criterion 6 = Mass number coarse adjustment 7 = Mass number fine adjustment 12 = Analog Input 13 = Filament degassing 14 =Tuning the RF generator 15 = Offset management
Channels.Actuality.ActualChannel.MassValue: Current mass value in actual channel						
	output read	0.00 ... 2047.99	Float	-	0	See section Mass Scan Modes
Channels.Actuality.ActualChannel.MeasureValue: Current measuring value in actual channel						
	outputr ead	1.0000000 E-27... 9.9999999 E+5	Float	-	0	IEEE 754-format floating point value
Channels.Actuality.MassValue: Array of mass numbers for the 128 channels						
	output read	0.00 ... 2047.99	Float Array 128	-	0	See section Mass Scan Modes
Channels.Actuality.MeasureValue: Array of measuring values for the 128 channels						
	output read	1.0000000 E-27... 9.9999999 E+5	Float Array 128	-	0	IEEE 754-format floating point value
Channels.Actuality.Status: Array of statuses for the 128 channels						
	output read	Bit 0...1: Out of Range Bit 2...3: Unit Bit 4...5: Mass resolu. Bit 6...7: 0t used Bit 8...15: Adjust mode status	UInt 16 Array 128	-	0	Channel information for saving the measuring data
Channels.Actuality.TimeStamp: Array of time stamps for the 128 channels						

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
	output read	0 ... 4 294 967 295	UInt32 Array 256	-	0	Timestamp of the measuring values. 64-bit FileTime format (100 ns ticks since 1601).
Channels.Parameters.Amplifier.AnalogSignalFilter: Analog filter setting						
	input r and w	16 = AUTO 0 = 18 us 1 = 85 us 2 = 400 us 3 = 1.7ms 4 = 8 ms 5 = 40 ms 6 = 180 ms 7 = 800 ms 8 = 5 us	Byte Array 128	16	1	Auto = appropriate for <<SPEED>>
Channels.Parameters.Amplifier.AutoRangeMode: Measuring range change-over mode						
	input r and w	0 = FIX 1 = AUTO 2 = AUTO-DOWN	Byte Array 128	1	1	Operating mode of the electrometer amplifier.
Channels.Parameters.Amplifier.DetectorRange: Electrometer range						
	input r and w	0 ... 10	Byte Array 128	0	1	Measuring range for the ion current 0 = 1E-5 A 1 = 1E-6 A 2 = 1E-7 A 3 = 1E-8 A 4 = 1E-9 A 5 = 1E-10 A 6 = 1E-11 A 7 = 1E-12 A EXTERN1 a. 2 operation 0 = x1 1 = x10 *Table 7-1*
Channels.Parameters.Amplifier.DownRange: Lowest electrometer range for AUTO-DOWN						
	input r and w	0 = 1E-5 1 = 1E-6 2 = 1E-7 3 = 1E-8 4 = 1E-9 5 = 1E-10 6 = 1E-11 7 = 1E-12	Byte Array 128	0	1	Most sensitive measuring range for the ion current. For <<FARAD>> or <<SEM>>
Channels.Parameters.Amplifier.PauseCalibrate: "Break" factor for changing the measurement channel in multichannel operation						
	input r and w	0.00 ... 9.99	Float Array 128	1.0	1	Pause time calibration factor.
Channels.Parameters.Detector.AnalogInputChannel: Analog input channel number						

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
	input r and w	1 = AI-1 IO700-1 ... 8 = AI-8 IO700-1 9 = AI-1 IO700-2... 16 = AI-8 IO700-2 17 = AI-1 IO700-3 ... 24 = AI-8 IO700-3 25 = AI-1 IO720 ... 28 = AI-4 IO720	Byte Array 128	1	1	Number of the analog input for measuring data
Channels.Parameters.Detector.DetectorType: Signal source selection						
	input r and w	0 = FARAD 1 = ION COUNT 2 = EXTERN1 3 = EXTERN2 4 = SEM 5 = ANALOG-IN 6 = TOTAL-PRESSURE	Byte Array 128	4	1	Used detector type
Channels.Parameters.Detector.SEMVoltage: SEM high voltage for a channel						
	input r and w	0 1.0 ... 3500.0	[V] Float Array 128	1000.0	1	A channel with 0 means Common SEM voltage is used for the channel.
Channels.Parameters.General.State: Enables measurement channel						
	input r and w	0 = ENABLE 1 = SKIP	Byte Array 128	0	1	The channel is enabled/skipped.
Channels.Parameters.Mass.DwellSpeed: Measurement speed / measurement time						
	input r and w	0 = 0.000125 s/amu 1 = 0.00025 s/amu 2 = 0.0005 s/amu 3 = 0.001 s/amu 4 = 0.002 s/amu 5 = 0.005 s/amu 6 = 0.01 s/amu 7 = 0.02 s/amu 8 = 0.05 s/amu 9 = 0.1 s/amu 10 = 0.2 s/amu 11 = 0.5 s/amu 12 = 1 s/amu 13 = 2 s/amu 14 = 5 s/amu 15 = 10 s/amu 16 = 20 s/amu 17 = 60 s/amu	Byte Array 128	12	1	Dwell: Measurement time for sample measurements Speed: Measuring time per mass for scan measurements
Channels.Parameters.Mass.FirstMass: First mass for a scan / mass number						
	input r and w	0.00 ... 2047.99	Float Array 128	0	1	Minimal steps = 0.01

<table>
<tr><th>OPC UA Name</th><th>Type</th><th>Allowed Values</th><th>Dimension / Data Type</th><th>Default Value</th><th>Saved /w Load/ Save See NOTE*</th><th>Comments</th></tr>
<tr><td colspan="7">Channels.Parameters.Mass.MassMode: Spectrum scan operating mode</td></tr>
<tr><td></td><td>input
r and w</td><td>0 = SAMPLE
1 = SCAN-N
2 = SCAN-F
3 = STAIR
4 = PEAK-L
5 = PEAK-F</td><td>Byte Array 128</td><td>2</td><td>1</td><td>0 = Standard measurement of a single mass
1 = Standard/Normal Scan
2 = Scan with FIR filter
3 = Scan of whole number masses (Scan Stair)
4 = Peak processor level criterion
5 = Peak processor FIR filter criterion</td></tr>
<tr><td colspan="7">Channels.Parameters.Mass.Resolution: Resolution</td></tr>
<tr><td></td><td>input
r and w</td><td>0 ... 255</td><td>Byte Array 128</td><td>25</td><td>1</td><td>0 = Off (integral spectrum)
1 = narrowest peak width
255 = largest peak width</td></tr>
<tr><td colspan="7">Channels.Parameters.Mass.Threshold: Peak processor threshold</td></tr>
<tr><td></td><td>input
r and w</td><td>0 ... 7</td><td>Byte Array 128</td><td>7
(0.01%,
1E-15A,
1E-2cps)</td><td>1</td><td><table><tr><th>Fix-Range</th><th>Auto-Range</th></tr><tr><td>7 = 0.01;
6 = 0.03;
5 = 0.1;
4 = 0.3;
3 = 1;
2 = 3;
1= 10;
0 = 30;
in % F.S.
referenced
to RANGE</td><td>1 × 10^{-15} A
1 × 10^{-14} A
1 × 10^{-13} A
1 × 10^{-12} A
1 × 10^{-11} A
1 × 10^{-10} A
1 × 10^{-9} A
1 × 10^{-8} A</td></tr></table>Table 7-2</td></tr>
<tr><td colspan="7">Channels.Parameters.Mass.Width: Width of a scan</td></tr>
<tr><td></td><td>input
r and w</td><td>-2047.99 ... +2047.99</td><td>Float Array 128</td><td>0</td><td>1</td><td>Mass range to be scanned (starting with the first mass). Not for sample measurements.

Limited by the measurement range; reverse scans, i.e., from right to left, are performed for negative values.</td></tr>
<tr><td colspan="7">Channels.Parameters.Output.AnalogOutputChannel: Analog output channel number</td></tr>
<tr><td></td><td>input r and w</td><td>0 = NONE
1 = AO-1 QC
2 = AO-2 QC
3 = AO-1 IO700-1
10 = AO-8 IO700-1
11 = AO-1 IO700-2
18 = AO-8 IO700-2
19 = AO-1 IO700-3
26 = AO-24 IO700-3
27 = AO-1 IO720
30 = AO-4 IO720</td><td>Byte Array 128</td><td>0</td><td>1</td><td>Measured values are output to this AO.0 = No analog output channel is used.</td></tr>
<tr><td colspan="7">Channels.Parameters.Output.AnalogOutputMode: Analog output mode</td></tr>
</table>

<table>
<tr><th>OPC UA Name</th><th>Type</th><th>Allowed Values</th><th>Dimension / Data Type</th><th>Default Value</th><th>Saved /w Load/ Save See NOTE*</th><th>Comments</th></tr>
<tr><td></td><td>input
r and w</td><td>0 = LIN
1 = LOG1D
2 = LOG2D
3 = LOG3D
4 = LOG4D
5 = LOG5D
6 = LOG6D
7 = LOG7D
8 = LOG8D
9 = LOG9D
10 = LOG10D</td><td>Byte Array 128</td><td>0</td><td>1</td><td>Scales the measurement signal output (0 ... 10 V). Parameter valid only for specified AO Channel.

0 = Linear scaling
1 ... 10 = Logarithmic scaling over the indicated number of decades</td></tr>
<tr><td colspan="7">Channels.Parameters.Output.AnalogOutputRange: Measurement range for analog output</td></tr>
<tr><td></td><td>input
r and w</td><td>0 ... 10</td><td>Byte Array 128</td><td>0
(1E-5A, 1E+8cps)</td><td>1</td><td>Adjusts the measurement range to the maximum measured signal output. Parameter valid only for specified AO Channel.
<table><tr><th>Electrometer operation</th></tr><tr><td>0 = 1E-5 A
1 = 1E-6 A
2 = 1E-7 A
3 = 1E-8 A
4 = 1E-9 A
5 = 1E-10 A
6 = 1E-11 A
7 = 1E-12 A
Full Scale</td></tr><tr><th>EXTERN1 a. 2 operation</th></tr><tr><td>0 = x1
1 = x10</td></tr></table>Table 7-3</td></tr>
<tr><td colspan="7">Channels.Parameters.Trip.DigitalOutputA,B,: Digital output channel number for trip function A, B</td></tr>
<tr><td></td><td>input
r and w</td><td>0 = none
1 = DO-1 IO700-1 …
32 = DO-32 IO700-1
33 = DO-1 IO700-2 …
64 = DO-32 IO700-2
65 = DO-1 IO700-3 …
96 = DO-32 IO700-3
97 = DO-1 IO720
108 = DO-12 IO720</td><td>Byte Array 128</td><td>0</td><td>1</td><td></td></tr>
<tr><td colspan="7">Channels.Parameters.Trip.LevelA: Trip function A / upper threshold for trip function</td></tr>
<tr><td></td><td>input
r and w</td><td>1.00E-24 ... 9.99E+24</td><td>Float Array 128</td><td>0.00</td><td>1</td><td>Threshold value A (available only for trip types ABS and HYST)</td></tr>
<tr><td colspan="7">Channels.Parameters.Trip.LevelB: Trip function B / lower threshold for trip function</td></tr>
</table>

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
	input r and w	1.00E-24 ... 9.99E+24	Float Array 128	0.00	1	Threshold value B (available only for trip types ABS and HYST)
Channels.Parameters.Trip.Type: Type of trip function						
	input r and w	0 = OFF 1 = ABS 2 = HYST	Byte Array 128	0	1	0 = The trip function is switched off 1 = Trip function without hysteresis 2 = Trip function with hysteresis
General.Cycle.CyclesCompleted: Number of cycles completed						
	output read		UInt32	0	0	Reset to "0" at start of cycle Increments at the end of each cycle Can be subscribed to for PUSH notifications
General.Cycle.Command: Start/Stop						
	input r and w	0 = no command 1 = start 2 = stop	Byte	0	0	Enable / disable cycle measurement.
General.Cycle.CycleMode: Measurement cycle sequence						
	input r and w	0 = MONO 1 = MULTI	Byte	1	1	0 = Single channel cycle 1 = Multichannel cycle
General.Cycle.EndChannel: Last channel in the cycle						
	input r and w	0 ... 127	Byte	0	1	Only for cycle mode "MULTI", otherwise the first channel is always the selected channel.
General.Cycle.MeasureMode: Defines the type of measurement cycle						
	input r and w	0 = CYCLE 1 = ADJ_FINE 2 = ADJ_COARSE 3 = RF-TUNE 4 = OFFSET	Byte	0	1	0 = Measurement operation 1 = Mass number fine adjustment 2 = Mass number coarse adjustment 3 = RF tune 4 = Offset measurement (see section 13.1)
General.Cycle.NumberOfCycles: Number of measurement cycles						
	input r and w	0 ... 10 000	Int16	0	1	0 = Continuous cycle (infinite number of cycles)
General.Cycle.Status: Measurement cycle status						
	output read	1 = halt 2 = halt extern 3 = run mono 4 = run mono extern 5 = run multi 6 = run multi extern	Byte	-	9	Indicates the status of the current measurement job. 1 or 2 = Halted. No measurement job active. 3 or 4 = Measurement job with a single channel is active. 5 or 6 = Measurement job with multiple channels is active.
General.Cycle.Trigger: Selection of measurement cycle start						
	input r and w	0 = INTERN 1 = EXTERN-AUTO 2 = EXTERN-NORM 3 = EXTERN-SINGLE	Byte	0	0	0 = Start/Stop is performed via General.Cycle.Command 1,2 or 3 = Trigger for external Start/Stop of measuring cycle
General.DataPump.BufferLevel: Ringbuffer usage in %						

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
	output read	0 ... 100	[%] Byte	-	0	100% = ringbuffer full. Size of ringbuffer is factory defined and can change, thus there is no correlation between % and number of bytes available.
General.DataPump.BytesCompleteCycle						
	output read		Int32	-	0	Returns the number of bytes in the ring buffer up to the last complete cycle
General.DataPump.BytesValidLastRead						
	output read		Int32	-	0	Returns the number of bytes actually read in the last read Returns 0 if no bytes read
General.DataPump.Command: Clear the measured data in the ringbuffer						
	input r and w	0 = no command 1 = clear buffer	Byte	0	0	Resets the ringbuffer to the initial condition. Note: Existing data in the ringbuffer will be deleted.
General.DataPump.Data: Supplies the measurement results in data packets						
	output read	-	Byte Array	-	0	Data is a complex data structure encoded into a byte array of variable size. See Section Measure Data/Ring Buffer
General.DataPump.MaxTransferSize: Sets the maximum transfer size (in bytes) for each General.DataPump.Data read						
	input r and w	1024 ... 65536	UInt32	32768	1	Note: Only values up to 65536 have been tested using commercial off the shelf OPC UA clients. Values up to 204800 can be set, although this is not advised.
General.DataPump.Mode: Define the type of ringbuffer access						
	input r and w	0 = DATA-LOOSE 1 = HOLD 2 = HOLD-EMPTY	Byte	0	1	Ringbuffer behavior when full. 0 = New data is dropped (lost) until space in ringbuffer is available 1 = The measurement is paused until space is available 2 = The measurement is paused until the ringbuffer is empty
General.DataPump.Status: Ringbuffer status						
	outputr ead	0 = undefined 1 = ok, writing enabled 2 = waiting to write new data 3 = ignore new data	Byte	-	0	Indicates the ringbuffer status for writing new data
General.DeviceName: Device Name of the mass spectrometer						
	input r and w	ASCII String	String	-	QMG800	Device name encoded as an ASCII string
General.DeviceType: Device type of the mass spectrometer						
	output read	0 = not defined 1 = QMG700 2 = QMG220 3 = QMG800	Byte	-	3	The type is automatically detected
General.ErrorsWarnings.Actual.Error: Actual error messages from the QMG800						
	error read	-	Byte Array 12	-	0	The bit number (=high) corresponds to the error number The error message is displayed as long as it is pending. See Section OPC-Items details/General.ErrorsWarnings.Actual.Error
General.ErrorsWarnings.Actual.Warning: Actual warning messages from the QMG800						

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
	warning read	-	UInt32	-	0	The bit number (=high) corresponds to the error number. The warning message is displayed as long as it is pending.
General.ErrorsWarnings.Static.Command: Clear error and warning messages						
	input r and w	0 = no command 1 = clear errors and warnings	Byte	0	0	Clear all error and warning messages
General.ErrorsWarnings.Static.Error: List of error messages for the QMG800						
	output read	-	Byte Array 12	-	0	The bit number (=high) corresponds to the error number. The error message is displayed until it is cleared via the General.ErrorsWarnings.Static.Command endpoint. See Section OPC-Items details General.ErrorsWarnings.Actual.Error
General.ErrorsWarnings.Static.Status: Status of the displayed error and warning messages (interface only)						
	output read	0 = no command 1 = errors and warnings cleared	Byte	-	0	Indicates when error and warning messages are cleared.
General.ErrorsWarnings.Static.Warning: List of warning messages for the QMG800						
	output read	-	UInt32	-	0	The bit number (=high) corresponds to the warning number. The warning message is displayed until it is deleted via the General.ErrorsWarnings.Static.Command endpoint.
General.Fan.HighestSystemTemperature: Highest measured system temperature						
	output read	0 ... 150	[°C] Byte	-	0	Used to monitor the system temperature to indicate insufficient cooling. This value stores the highest temp of any module in the system since last power cycle.
General.Fan.Mode						
	input r and w	0 = Manual 1 = AUTO	Byte	1	1	Set the fan mode to AUTO or Manual
General.Fan.Speed						
	input r and w	0 ... 100	[%] Byte	50	1	If General.Fan.Mode is set to Manual, sets speed to % of max speed.
General.LanConfiguration.DHCP: DHCP configuration of the network						
	output read	0 = DHCP off 1 = DHCP on	Byte	-	0	DHCP enabled or disabled
General.LanConfiguration.DeviceName: Name of the computer in the LAN						
	output read	ASCII String	String	-	0	Determined device name
General.LanConfiguration.IPAddress: IP address of the device in the LAN						
	output read	xxx.xxx.xxx.xxx	String	-	0	IPv4 address of the device
General.LanConfiguration.PhysicalAddress: Physical address of the device in the LAN						
	outputr ead	xx-xx-xx-xx-xx-xx	String	-	0	Physical address of the device (MAC address)
General.LanConfiguration.SubnetMask: Subnet mask of the device in the LAN						
	output read	255.255.xxx.xxx	String	-	0	Subnet mask of the device.
General.LoadSave.Command: Load and save the device settings						

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
	input r and w	0 = no command 1 = load settings 2 = save settings 5 = load Ion Source settings 6 = Save Ion Source Settings	Byte	0	0	Load or save parameters for the device from/to filesystem. See General.LoadSave.ParameterSet. The ftp site is the QC800 module opt/ftp/upload directory
General.LoadSave.ParameterSet: Specify the parameter set for the device settings						
	input r and w	0 = user 1 = factory	Byte	0	0	Specifies which User or Factory parameter sets (includes all 4 Analyzer.IonSource.Parameter Sets, plus scan settings, and other settings) to load or save with General.LoadSave.Command. Note: Users should avoid writing to the FACTORY parameter set so it can be used as a known good backup.
General.LoadSave.Status: Status of the loading or saving process for device settings						
	output read	0 = none 1 = loaded 2 = saved 3 = no access rights	Byte	-	0	Indicates the loading/saving status. Also See General.Security.*
General.Security.Command: User logon/logoff						
	input r and w	0 = no command 1 = logon 2 = logoff	Byte	0	0	User logon or logoff
General.Security.LoggedInUser: Currently logged in user						
	output read	Name(phone)	String	-	0	Currently logged in user's information
General.Security.Name: Username input						
	input r and w	ASCII string	String	-	0	Type in the username
General.Security.Password: Password input						
	input r and w	ASCII String	String	-	0	A password. Note: The system does not yet support user accounts. Therefore, password is a string placeholder.
General.Security.Phone: Phone number input						
	input r and w	ASCII string	String	-	0	A phone number
General.Security.Status: Status of the General.Security.Command						
	output read	0 = none 1 = logged in 2 = logoff	Byte	-	0	Indicates the status of the command
General.Time.Command: Define the device time						
	input r and w	0 = no command 1 = set	Byte	0	0	Set the device time
General.Time.DateTime_ActualValue: Current device date and time						
	output read	YYYY-MM-DD hh:mm:ss	String	-	0	Current device date and time (actual value)
General.Time.DateTime_SetValue: Set value for device date and time						

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
	input r and w	YYYY-MM-DD hh:mm:ss	String	-	0	Device date and time to be set (set value)
General.Time.Status: Status of the device date and time						
	outputr ead	0 = none 1 = successful 2 = error	Byte	-	0	Indicates the status of the current command
Hardware.MassRange: Available type of mass range						
	output read	0 ... 4096	Int16	-	0	Depends on the installed hardware QMH type and QMA type, then set by firmware
Hardware.Modules.Analyzer.CI700.FirmwareVersion:QMS800 Application version						
	output read	0 … 2^32 - 1	UInt32	-	0	Automatically detected. Bits 31:24 = Major Version Bits 23:16 = Minor Version Bits 15:0 = Patch Level
Hardware.Modules.Analyzer.CI700.McuFirmwareVersion: QC800/DSP Communication Interface						
	output read	0 … 2^32 - 1	UInt32	-	0	Automatically detected Bits 31:16 = Major Version Bits 15:8 = Minor Version Bits 7:0 = Patch Level
Hardware.Modules.Analyzer.CI700.OSVersion: QC800 operating system version						
	output read	0 … 2^32 - 1	UInt32	-	0	Automatically detected Bits 31:24 = Major Version Bits 23:16 = Minor Version Bits 15:0 = Patch Level
Hardware.Modules.Analyzer.HV701-1.Detection …. .HV701-4.Detection: Detection of high voltage supply-module						
	output read	0 = not found 1 = found, ok 2 = found, error	Byte	-	0	0 = No HV-module detected 1 = HV-module detected and OK 2 = HV-module detected but not OK
Hardware.Modules.Analyzer.HV701-1.FirmwareVersion ... HV701-4.FirmwareVersion: High voltage supply firmware version						
	output read	0 ... 255	Byte	-	0	Automatically detected reported in decimal format Bits 7:0 = Major version and Minor version Minor version reported as lower
Hardware.Modules.Analyzer.HV701-1.HighVoltage_ActualValue ... HV701-4.HighVoltage_ActualValue: Output of the high voltage supply (actual value)						
	output read	0.0 ... 4 095.00	[V] Float	-	0	High voltage supply HV701 for the SEM
Hardware.Modules.Analyzer.HV701-1.HighVoltage_SetValue ... HV701-4.HighVoltage_SetValue: Set value for the high voltage supply (nominal value)						
	input r and w	0.0 ... 3 500.00	[V] Float	See Note	1	High voltage supply HV701 for the SEM Note: HV701-1 is set to 1000.0 by default. Others are set to 0.
Hardware.Modules.Analyzer.IL700-1.Detection: Detection of ion lenses supply module						
	output read	0 = not found 1 = found, ok 2 = found, error	Byte	-	0	0 = No IL-module detected 1 = IL-module detected and OK 2 = IL-module detected but not OK
Hardware.Modules.Analyzer.IL700-1.FirmwareVersion: ion lenses supply firmware version						

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
	output read	0 ... 255	Byte	-	0	Automatically detected reported in decimal format Bits 7:0 = Major version and Minor version Minor version reported as lower digit
Hardware.Modules.Analyzer.IL700-1.V03_ActualValue: ion lenses supply voltage 3 (actual value)						
	output read	0 ... ±450	[V] Float	-	0	Electrode name: FOCUS
Hardware.Modules.Analyzer.IL700-1.V03_SetValue: ion lenses supply voltage 3 (set value)						
	input r and w	0 ... ±150 OR 0 ... ±450	[V] Float	-1.0	1,2	Electrode name: FOCUS Maximum value depends on the type of Module (150V or 450V)
Hardware.Modules.Analyzer.IL700-1.V03_Type ... IL700-1.V08_Type: ion lenses supply Type						
	output read	1 = Module 150V 3 = Module 450V	[V] Byte	-	0	1 = ±150V-power source (Module 150V) 3 = ±450V-power source (Module 450V)
Hardware.Modules.Analyzer.IL700-1.V04_ActualValue: ion lenses supply voltage 4 (actual value)						
	output read	0 ... ±450	[V] Float	-	0	Electrode name: F-AXIS
Hardware.Modules.Analyzer.IL700-1.V04_SetValue: ion lenses supply voltage 4 (set value)						
	input r and w	0 ... ±150 OR0 ... ±450	[V]Float	-5.0	1,2	Electrode name: F-AXISMaximum value depends on the type of Module (150V or 450V)
Hardware.Modules.Analyzer.IL700-1.V05_ActualValue: ion lenses supply voltage 5 (actual value)						
	output read	0 ... ±450	[V] Float	-	0	Electrode name: EXTRACT
Hardware.Modules.Analyzer.IL700-1.V05_SetValue: ion lenses supply voltage 5 (set value)						
	input r and w	0 ... ±150 OR 0 ... ±450	[V] Float	-70.0	1,2	Electrode name: EXTRACT Maximum value depends on the type of Module (150V or 450V)
Hardware.Modules.Analyzer.IL700-1.V06_ActualValue: ion lenses supply voltage 6 (actual value)						
	output read	0 ... ±450	[V] Float	-	0	Electrode name: DEF-I
Hardware.Modules.Analyzer.IL700-1.V06_SetValue: ion lenses supply voltage 6 (set value)						
	input r and w	0 ... ±150 OR 0 ... ±450	[V] Float	-400.0	1,2	Electrode name: DEF-I Maximum value depends on the type of Module (150V or 450V)
Hardware.Modules.Analyzer.IL700-1.V07_ActualValue: ion lenses supply voltage 7 (actual value)						
	output read	0 ... ±450	[V] Float	-	0	Electrode name: DEF-O
Hardware.Modules.Analyzer.IL700-1.V07_SetValue: ion lenses supply voltage 7 (set value)						
	input r and w	0 ... ±150 OR 0 ... ±450	[V] Float	0.0	1,2	Electrode name: DEF-O Maximum value depends on the type of Module (150V or 450V)
Hardware.Modules.Analyzer.IL700-1.V08_ActualValue: ion lenses supply voltage 8 (actual value)						
	output read	0 ... ±450	[V] Float	-	0	Electrode name: RES
Hardware.Modules.Analyzer.IL700-1.V08_SetValue: ion lenses supply voltage 8 (set value)						

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
	input r and w	0 ... ±150 OR 0 ... ±450	[V] Float	0.0	1,2	Electrode name: RES Maximum value depends on the type of Module (150V or 450V)
Hardware.Modules.Analyzer.IS700-1.Detection ... IS700-2.Detection: Detection of ion supply module						
	output read	0 = not found 1 = found, ok 2 = found, error	Byte	-	0	0 = No IS-module detected 1 = IS-module detected and OK 2 = IS-module detected but not OK
Hardware.Modules.Analyzer.IS700-1.EmissionCurrent_ActualValue ... IS700-2.EmissionCurrent_ActualValue: Output of the emission current (actual value)						
	output read	0.0 ... 25.0	[mA] Float	-	0	Ion source supply IS700 for filament emission current
Hardware.Modules.Analyzer.IS700-1.EmissionCurrent_SetValue IS700-2.EmissionCurrent_SetValue: Set value for the emission current (nominal value)						
	input r and w	0.0 ... 10.0	[mA] Float	0.3	1,2	Ion source supply IS700 for filament emission current
Hardware.Modules.Analyzer.IS700-1.FilamentCurrent_ActualValue ... IS700-2.FilamentCurrent_ActualValue: Output of the filament current (actual value)						
	output read	0.00 ... 5.12	[A] Float	-	0	Ion source supply IS700 for filament current
Hardware.Modules.Analyzer.IS700-1.FirmwareVersion ... IS700-2.FirmwareVersion: ion supply firmware version						
	output read	0 ... 255	Byte	-	0	Automatically detected reported in decimal format Bits 7:0 = Major version and Minor version Minor version reported as lower digit
Hardware.Modules.Analyzer.IS700-1.ProtectionCurrent_SetValue ... IS700-2.ProtectionCurrent_SetValue: Maximum filament current (set value)						
	input r and w	0.01 ... 5.00	[A] Float	4.0	1,2	Maximum filament current of the ion source supply IS700, used to protect the filament
Hardware.Modules.Analyzer.IS700-1.V01_ActualValue: Ion source voltage 1 (actual value)						
	output read	0.00 ... 150.00	[V] Float	-	0	V01 Electrode name: Ion Reference
Hardware.Modules.Analyzer.IS700-1.V01_SetValue: Ion source voltage 1 (set value)						
	output read	0.00 ... 150.00	[V] Float	150.0	1,2	V01 Electrode name: Ion Reference
Hardware.Modules.Analyzer.IS700-1.V02_ActualValue: Ion source voltage 2 (actual value)						
	output read	-125.00 ... 0.00	[V] Float	-	0	V02 Electrode name: Cathode
Hardware.Modules.Analyzer.IS700-1.V02_SetValue: Ion source voltage 2 (set value)						
	output read	-125.00 ... 0.00	[V] Float	-40.0	1,2	V02 Electrode name: Cathode
Hardware.Modules.Analyzer.IS700-1.V09_ActualValue: Ion source voltage 9 (actual value)						
	output read	-125.00 ... 0.00	[V] Float	-	0	V09 Electrode name: Wehnelt
Hardware.Modules.Analyzer.IS700-1.V09_SetValue: Ion source voltage 9 (set value)						
	output read	-60.00 ... 0.00	[V] Float	0.0	1,2	V09 Electrode name: Wehnelt
Hardware.Modules.Analyzer.QMH800.QmhAppSettings.QmhTimeDate.QmhDate						

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
	input r and w		String	-	00	QMH Date
Hardware.Modules.Analyzer.QMH800.QmhAppSettings.QmhTimeDate.QmhTime						
	input r and w		String	-	0	QMH Time of Day
Hardware.Modules.Analyzer.QMH800.QmhAppSettings.QmhTuneLoadSave.Command						
	input r and w	1 - Load Tune File 2 - Save Tune File	String	-	0	Command to Load/Save TuneFileNumber into current TuneTable file. Note: When Load command is executed, QMH power must be cycled for TuneTable to be loaded
Hardware.Modules.Analyzer.QMH800.QmhAppSettings.QmhTuneLoadSave.TuneFileNumber						
	input r and w	0 - 9	String	-	0	TuneFileNumber indicates the tune file number that will be used for the Load/Save feature. 10 different Tune files are possible
Hardware.Modules.Analyzer.QMH800.QmhFpga1.QmhSystem.QmhSystemMain.apiVersion: API Version of QMH						
	output read	-	UInt32	-	0	version of QMH app/api hexadecimal YYMMDDVV VV is built for that day Bit 31:24 = Year Bit 23:16 = Month Bit 15:8 = Day Bit 7:0 = Build for that day
Hardware.Modules.Analyzer.QMH800.QmhFpga1.QmhSystem.QmhSystemMain.fpgaVersion: Version of QMH FPGA						
	output read	-	UInt32	-	0	version of QMH FPGA hexadecimal YYMMDDVV VV is built for that day Bit 31:24 = Year Bit 23:16 = Month Bit 15:8 = Day Bit 7:0 = Build for that day
Hardware.Modules.Analyzer.QMH800.QmhFpga1.QmhMonitor.QmhMonitorMain.match: QMH RF match						
	output read	-	Float	-	0	QMH RF match indicator best match ~=2.5 volts
Hardware.Modules.Analyzer.QMH800.QmhFpga1.QmhMonitor.QmhMonitorMain.power:						
	output read	-	Float		0	QMH RF operating power in watts
Hardware.Modules.Analyzer.QMH800.QmhFpga1.QmhMonitor.QmhMonitorMain.resol:						
	output read	-	Float	-	0	Value of QMH resolution adjust input
Hardware.Modules.Analyzer.QMH800.QmhFpga1.QmhMonitor.QmhMonitorMain.scanIn:						
	output read	-	Float	-	0	Value of QMH ScanIN Input
Hardware.Modules.Analyzer.QMH800.QmhFpga1.QmhMonitor.QmhMonitorMain.status:						
	output read	-	UInt32	-	0	QMH Status
Hardware.Modules.Analyzer.QMH800.QmhFpga1.QmhMonitor.QmhMonitorMain.tempAmb:						
	output read	-	Float	-	0	QMH Ambient temperature degrees C
Hardware.Modules.Analyzer.QMH800.QmhFpga1.QmhMonitor.QmhMonitorMain.tempDC:						

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
	output read	-	Float	-	0	temperature of QMH DC Oven section degrees C
Hardware.Modules.Analyzer.QMH800.QmhFpga1.QmhMonitor.QmhMonitorMain.tempRf:						
	output read	-	Float	-	0	Temperature of QMH RF Oven section degrees C
Hardware.Modules.Analyzer.SI700.EPOffsetValues.Command: Define offset correction for the electrometer						
	input r and w	0 = no command 1 = clear offsets 2 = save offsets 3 = restore offsets 4 = read offsets	Byte	0	0	Define offset correction for the electrometer preamplifier of the detector
Hardware.Modules.Analyzer.SI700.EPOffsetValues.EP1.RangeE-05 ... EP2.RangeE-12: Offset value for the electrometer						
	output read	32-BIT IEEE floating point value	[A] Float	-	1	Offset value for the measuring range 10^-5 A ... 10^-12 A of the detector
Hardware.Modules.Analyzer.SI700.EPOffsetValues.Mass: Mass for the offset measurement						
	input r and w	0.00 ... 2047.00	Float	50.5	1	Maximum value depends on the type of mass range (Hardware.MassRange)
Hardware.Modules.Analyzer.SI700.EPOffsetValues.Status: Status of the offset correction for the electrometer						
	output read	0 = no command 1 = offsets cleared 2 = offsets saved 3 = offsets restored 4 = offsets read	Byte	-	0	Current offset correction for the electrometer preamplifier of the detector
Hardware.Modules.Analyzer.SI700.FirmwareVersion: SI 700 firmware version						
	output read	0 ... 2^32 - 1	UInt32	-	0	Automatically detected. Bits 31:24 = Major Version Bits 23:16 = Minor Version Bits 15:0 = Patch Level
Hardware.Modules.Analyzer.SI700.MassScaleCalibration.Offset: Parameter for coarse tuning of the mass scale						
	input r and w	-0.12 ... +0.12	Float	0.0	1	Shift the mass scale to the left and right for negative and positive values, respectively
Hardware.Modules.Analyzer.SI700.MassScaleCalibration.Slope: Parameter for mass scale coarse tuning						
	input r and w	0.9850 ... 1.0150	Float	1.0	1	Shrink and stretch the mass scale for values < 1.0 and > 1.0, respectively
Hardware.Modules.Analyzer.SI700.ScanStairTable.ActualValues: Measured mass number for mass scale fine tuning						
	input r and w	0.50 ... 4095.50	Float Array 48		0	±0.5 amu around the nominal mass number (reference values)
Hardware.Modules.Analyzer.SI700.ScanStairTable.Command: Define data points for mass scale fine tuning						
	input r and w	0 = no command 1 = save table 2 = restore table 3 = set default values 4 = set values 5 = get values	Byte	-	0	Define data points for mass scale fine tuning in a table
Hardware.Modules.Analyzer.SI700.ScanStairTable.Count: Number of data points for mass scale fine tuning						

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
	input r and w	0 1 ... 48	Byte	0	0	0 = no fine tuning is performed 1 ... 48 = Each data point consists of nominal and actual mass number. Max. 48 data points (table rows) are allowed
Hardware.Modules.Analyzer.SI700.ScanStairTable.ReferenceValues: Nominal mass number for mass scale fine tuning						
	input r and w	0 1 ... 4095	Float Array 48	0.0	0	Reference value for the mass number
Hardware.Modules.Analyzer.SI700.ScanStairTable.Status: Status of the data points for mass scale fine tuning						
	output read	0 = no error 1 = stairtable saved 2 = stairtable restored 3 = stairtable set to default 4 = stairtable set 5 = stairtable gotten 253 = error stairtable not correct 254 = error stairtable not loaded 255 = internal error	Byte	-	0	Indicates the status of the stair table for mass scale fine tuning
Hardware.Modules.Analyzer.SI700.SimulationMode: Spectrum simulation for testing purposes						
	input r and w	0 = OFF1 = INTERN2 = EXTERN	Byte	0	0	0 = Simulation off1 = Internal simulation2 = External simulation
Hardware.Modules.External.IO720.AnalogInput.AI_025_ActualValue ... AnalogInput.AI_029_ActualValue: Analog input value						
	output read	-10.00 ... +10.00	[V] Float	-	0	Numerical value of the AI voltages in [V] of the corresponding AI channel
Hardware.Modules.External.IO720.AnalogOutput.AO_027_SetValue ... AnalogOutput.AO_030_SetValue: Analog output value						
	input r and w	0.00 ... 10.00	[V] Float	0	0	Numerical value of the AO voltage in [V] at the corresponding AO channel
Hardware.Modules.External.IO720.Detection: Detection of input/output-module IO720						
	output read	0 = not found 1 = found, ok 2 = found, error	Byte	-	0	0 = No IO-module detected 1 = IO-module detected and OK 2 = IO-module detected but not OK
Hardware.Modules.External.IO720.DigitalInput.ActualValues_004: Digital input status						
	output read	Per bit 0 = LOW / OFF 1 = HIGH / ON	UInt32	-	0	Read bit status of DI channel. Bits 0, 1, 2 and 3 correspond to Pins 11, 12, 13 and 25 on the DB25 connector respectively. Bits 4 to 31 are unused.
Hardware.Modules.External.IO720.DigitalOutput.SetValues_004: Digital output control						
	input r and w	Per bit 0 = LOW / OFF 1 = HIGH / ON	UInt32	0	0	Value of the DO channel (LOW/HIGH) Bits 0 - 7 and 8 - 15 correspond to Pins 1 - 8 and 14 - 21 on the DB25 connector respectively. Furthermore, Bits 12 - 15 are reserved for System Status Bit 12 - System Ready Bit 13 - Power OK Bit 14 - Filament ON Bit 15 - Pressure OK
Hardware.Modules.External.IO720.FirmwareVersion: IO720 firmware version						

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
	output read	0 ... 2^32 - 1	UInt32	-	0	Automatically detected Bits:31:0 = Major and minor versions reported in decimal format Minor version reported as lower digit
Hardware.Modules.External.IO720.TotalPressure.TP_001.ActualValue: Total pressure						
	output read	0.0 ... 1000.00	[mbar] Float	0.0	0	Measured value of total pressure
Hardware.Modules.External.IO720.TotalPressure.TP_001.Command: Define total pressure gauge status ON/OFF						
	input r and w	0 = none 1 = TP_ON 2 = TP_OFF	Byte	0	0	Enable/Disable the total pressure gauge. If gauge is off, the value of .TotalPressure.TP_001.ActualValue will be 0.
Hardware.Modules.External.IO720.TotalPressure.TP_001.Degas_Command: Define total pressure gauge degas status ON/OFF						
	input r and w	0 = none 1 = DEGAS_ON 2 = DEGAS_OFF 3 = gauge supply voltage on 4 = gauge supply voltage off	Byte	0	0	Enable/Disable the total pressure gauge degassing
Hardware.Modules.External.IO720.TotalPressure.TP_001.LevelOff:						
	input r and w	0.0 ... 1000.0	[mbar] Float	5.0E-5	1	Monitoring the QMG via total pressure measurement Pressure threshold to switch filament and SEM automatically off When Analyzer.Protection = 1 or 2 Pressure threshold for activation of Plasma Protection state, setting all sensor voltages TO "0"
Hardware.Modules.External.IO720.TotalPressure.TP_001.LevelOn:						
	input r and w	0.0 ... 1000.0	[mbar] Float	0.0	1	Monitoring the QMG via total pressure measurement. Pressure threshold to switch filament and SEM automatically on When Analyzer.Protection = 1 . Pressure threshold for exiting Plasma Protection state
Hardware.Modules.External.IO720.TotalPressure.TP_001.RS485Address: Address of the installed digital pressure gauge						
	input r and w	0 = no gauge 1 ... 15	Byte	1		RS485 node number
Hardware.Modules.External.IO720.TP_001.Status: Total pressure gauge status						
	output read	Bit1 Bit 0 0 0 = no defect 0 1 = sensor defect 1 0 = under range 1 1= over range Bit 8: Degas ON/OFF Bit 9: V-Gauge ON/OFF	UInt16	-	0	Interpreted as a bit mask (e.g., 257 = 1 0000 0001b = Sensor Defect and Degas ON) V-Gauge indicates gauge supply voltage
Hardware.Modules.External.IO720.TotalPressure.TP_001.Type: Type of the installed analog/digital pressure gauge						

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
	output read	0 = none 1 = PKR 2x1 or 36x 2 = PBR 360 3 = TPR 2xx 4 = HPT 200 5 = PPT 200 6 = RPT 20x	Byte	0	0	0 = No gauge installed 1 = Pirani/cold cathode transmitter 2 = Pirani/Bayard-Alpert transmitter 3 = Pirani transmitter 4 = Digital Pirani/Bayard-Alpert transmitter 5 = Digital Pirani transmitter 6 = Digital Piezo/Pirani transmitter 7 = Pirani/cold cathode transmitter
Hardware.Modules.External.IO820.AnalogInput.AI_025_ActualValue ... AnalogInput.AI_029_ActualValue: Analog input value						
	output read	-10.00 ... +10.00	[V] Float	-	0	Numerical value of the AI voltages in [V] of the corresponding AI channel
Hardware.Modules.External.IO820.AnalogOutput.AO_027_SetValue ... AnalogOutput.AO_030_SetValue: Analog output value						
	input r and w	0.00 ... 10.00	[V] Float	0		Numerical value of the AO voltage in [V] at the corresponding AO channel
Hardware.Modules.External.IO820.Detection: Detection of input/output-module IO720						
	output read	0 = not found 1 = found, ok 2 = found, error	Byte	-	0	0 = No IO-module detected 1 = IO-module detected and OK 2 = IO-module detected but not OK
Hardware.Modules.External.IO820.DigitalInput.ActualValues_004: Digital input status						
	output read	Per bit 0 = LOW / OFF 1 = HIGH / ON	UInt32	-	0	Read bit status of DI channel. Bits 0, 1, 2 and 3 correspond to Pins 11, 12, 13 and 25 on the DB25 connector respectively. Bits 4 to 31 are unused.
Hardware.Modules.External.IO820.DigitalOutput.SetValues_004: Digital output control						
	input r and w	Per bit 0 = LOW / OFF 1 = HIGH / ON	UInt32	0	0	Value of the DO channel (LOW/HIGH) Bits 0 - 7 and 8 - 15 correspond to Pins 1 - 8 and 14 - 21 on the DB25 connector respectively. Furthermore, Bits 12 - 15 are reserved for System Status
Hardware.Modules.External.IO820.FirmwareVersion: IO820 firmware version						
	output read	0 ... 2^32 - 1	UInt32	-	0	Automatically detected Bits:31:0 = Major and minor versions reported in decimal format Minor version reported as lower digit
Hardware.Modules.External.IO820.TotalPressure.TP_001.ActualValue: Total pressure						
	output read	0.0 ... 1000.00	[mbar] Float	0	0	Measured value of total pressure
Hardware.Modules.External.IO820.TotalPressure.TP_001.Command						
	input r and w	0 = none 1 = TP_ON 2 = TP_OFF	Byte	0	0	Enable/Disable the total pressure gauge. If gauge is off, the value of .TotalPressure.TP_001.ActualValue will be 0.
Hardware.Modules.External.IO820.TotalPressure.TP_001.LevelOff						
	input r and w	0.0 ... 1000.0	[mbar] Float	5.0E-5	1	Monitoring the QMG via total pressure measurement Pressure threshold to switch filament and SEM automatically off When Analyzer.Protection = 1 or 2 pressure threshold for activation of Plasma Protection state
Hardware.Modules.External.IO820.TotalPressure.TP_001,LevelOn						

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
	input r and w	0.0 ... 1000.0	[mbar] Float	0.0	1	Monitoring the QMG via total pressure measurement. Pressure threshold to switch filament and SEM automatically on When Analyzer.Protection = 1 or 2. pressure threshold for exiting Plasma Protection state
Hardware.Modules.External.IO820.TotalPressure.TP_001.RS485Address						
	input r and w	0 = no gauge 1 ... 15	Byte	1	1	RS485 node number
Hardware.Modules.External.IO820.TotalPressure.TP_001.Status						
	output read	Bit1 Bit 0 0 0 = no defect 0 1 = sensor defect 1 0 = under range 1 1= over range Bit 8: Degas ON/OFF Bit 9: V-Gauge ON/OFF	UInt16	-	0	Interpreted as a bit mask (e.g., 257 = 1 0000 0001b = Sensor Defect and Degas ON) V-Gauge indicates gauge supply voltage
Hardware.Modules.External.IO820.TotalPressure.TP_001.Type						
	output read	0 = none 1 = PKR251 2 = PBR260 3 = TPR280 4 = HPT100 5 = PPT100 6 = RPT100 8= PKR 360 9 = PKR 261 10 = HPT 200 11 = PPT 200 12 = RPT 200 13 = MPT 200 14 = CPT 200	Byte	0	0	0 = No gauge installed 1 = Pirani/cold cathode transmitter 2 = Pirani/Bayard-Alpert transmitter 3 = Pirani transmitter 4 = Digital Pirani/Bayard-Alpert transmitter 5 = Digital Pirani transmitter 6 = Digital Piezo/Pirani transmitter 7 = Pirani/cold cathode transmitter
Hardware.Modules.External.IO820.TotalPressure.TP_001.DeviceException						
	output read	0 = No error 1 = Timeout EEPROM memory access 2 = EEPROM CRC error 4 = EEPROM error 8 = Pirani Filament rupture 2048 = CCIG short circuit	UInt32		0	Device exceptions
Hardware.Modules.External.IO820.TotalPressure.TP_001.RunHours						
	output read		Float		0	Number of operating hours
Hardware.Modules.External.IO820.TotalPressure.TP_001.ProductName						
	output read		String		0	Name of the product

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
Hardware.Modules.External.IO820.TotalPressure.TP_001.ManufacturerName						
	output read		String		0	Manufacturer Name
Hardware.Modules.External.IO820.TotalPressure.TP_001.ManufacturerModelNumber						
	output read		String		0	Gauge Model number
Hardware.Modules.External.IO820.TotalPressure.TP_001.SoftwareVersion						
	output read		String		0	Gauge Software version
Hardware.Modules.External.IO820.TotalPressure.TP_001.ActiveInstanceNumber						
	output read	1 = CCIG sensor active 2 = Pirani sensor 3 = Mixed signal range; Pirani and CCIG sensor active	Byte		0	current Sensor in use
Hardware.Modules.External.IO820.TotalPressure.TP_001.CCIGIgnitionStatus						
	output read	0 = CCIG Off 1 = CCIG On, but not ignited yet 2 = CCIG on and ignited	Byte		0	Status of CCIG
Hardware.Modules.External.QC700.AnalogOutput.AO_001_SetValue ... AO_002_SetValue: Analog output value						
	input r and w	-10.0 ... +10.0	[V]Float	0.0	0	Numerical value of the AO voltage in [V] at the corresponding AO channel
Hardware.Modules.External.QC700.AnalogOutput.SI_Modes.MonitorMode:						
	input r and w	0 = AO-Mode 1 = Monitor-Mode	Byte	0	1	Enable/Disable the Monitor Mode
Hardware.Modules.External.QC700.AnalogOutput.SI_Modes.RemoteModeChannel1 ... RemoteModeChannel2:						
	input r and w	0 = INTERN 1 = REMOTE	Byte	0	1	
Hardware.QMA: Device type of the QMA						
	input r and w	0 = 400 1 = 410 2 = 430 5 = 100 6 = 200 7 = 256 8 = 4096 9 = 125 10 = 430 /w resistors	Byte	2	1	
Hardware.QMH: Device type of the QMH						

OPC UA Name	Type	Allowed Values	Dimension / Data Type	Default Value	Saved /w Load/ Save See NOTE*	Comments
	input r and w	0 = 400-1 1 = 400-5 2 = 410-1 3 = 410-2 4 = 410-3 5 = 100 6 = 200 7 = 256 8 = 4096 9 = 725-1 10 = 725-2 11 = 800	Byte	1	1	Default Value, May be updated with Analyzer.AutoDetectQmaQmh
NamespaceVersion: Version of the OPC namespace						
	output read	0 ... 65535	UInt16	-	0	Indicates the OPC namespace version used

NOTE*
0 = Setting is not saved to SettingsUser or SettingsFactory file when General.LoadSave.Command = 1 or 6
1 = Setting is loaded when General.LoadSave.Command = 1 and saved General.LoadSave.Command = 2
2 = Setting is loaded when General.LoadSave.Command = 5 and saved General.LoadSave.Command = 6

8 OPC Items – Details

Changing a parameter can affect the measurement. When a parameter that is relevant for the current measurement cycle is changed, the measurement cycle will be restarted.

The following table gives detailed information on the OPC UA items, sorted by the OPC UA name in alphabetical order.

OPC Name	Value	Details
Analyzer.Detector.ActualParameters.BiasSEMVoltage_ActualValue: Output of Bias voltage (actual value)		
Analyzer.Detector.ActualParameters.BiasSEMVoltage_SetValue: Defined Bias voltage (set value)		
Analyzer.Detector.ActualParameters.CdSEMVoltage_ActualValue: Output of CD voltage (actual value)		
Analyzer.Detector.ActualParameters.CdSEMVoltage_SetValue: Defined CD voltage (set value)		
Analyzer.Detector.ActualParameters.CommonSEMVoltage_ActualValue		
	0.0 ... 3500.0	Output of global SEM high voltage. It is applied to all measurement channels for which no individual setting has been defined with Channels.Parameters.Detector.SEMVoltage.
Analyzer.Detector.ActualParameters.CommonSEMVoltage_SetValue		
		with Analyzer.Detector.Type = SEM
	0 ... 3500.0 V	Defined global SEM high voltage. It is valid for all measurement channels for which no individual setting has been defined with Channels.Parameters.Detector.SEMVoltage.
Analyzer.Detector.Command		
		Enable / disable the SEM high voltage + output of SEM voltage (actual value). with Analyzer.Protection = INTERN-OFF, EXTERN-OFF
	0 = no command	A command is executed when the command item is unequal zero. Afterwards the command item is reset to zero. This implies that the command has been accepted.
	1 = SEM On	Enable the SEM high voltage
	2 = SEM Off	Disable the SEM high voltage
Analyzer.Detector.Status		
		Status of the SEM high voltage.
	0 = SEM Off	SEM voltage off.
	1 = SEM On	SEM voltage on.
Analyzer.Detector.Type		
		Specification of the existing signal source (ion collector).
	0 = FARAD	Faraday collector.
	1 = SEM	90° SEM
	2 = CD-SEM	90° SEM with conversion dynode
	3 = H-SEM	High SEM, only with config-SYSTEM-OPTION:CP
Analyzer.Filament.ActiveFilament		
		Filament selection for ion sources containing two filaments.
	1 = Filament 1	Filament 1 is used for measurements.
	2 = Filament 2	Filament 2 is used for measurements.
Analyzer.Filament.Command		
		Switch the active filament on and off. with Analyzer.Protection = INTERN-OFF, EXTERN-OFF
	0 = no command	A command is executed when the command item is unequal zero. Afterwards the command item is reset to zero. This implies that the command has been accepted.
	1 = Filament On	On filament emission
	2 = Filament Off	Off filament emission

OPC Name	Value	Details
Analyzer.Filament.Degas.EmissionCurrent_SetValue		
	0.0 ... 20.0 mA	Emission current for degas (set value).
Analyzer.Filament.Degas.ProtectionCurrent_SetValue		
	0.00 ... 5.00 A	Maximum filament current for degas, used to protect the filament.
Analyzer.Filament.Degas.Status		
		Filament degas status.
	1 = Degas 1 active	Degassing Filament 1
	2 = Degas 2 active	Degassing Filament 2
Analyzer.Filament.Degas.Time		
		Duration of filament degas.
	0	Degas runs until stop command is given.
	1 ... 99 min	Degas duration.
Analyzer.Filament.EmissionStatus		
		Status of the filament emission.
	0 = Filament Off	Filament emission off.
	1 = Filament On	Filament emission on.
Analyzer.Filament.ProtectionPressure.LevelOff		
		Duplicate of Hardware.Modules.External.IO720.TotalPressure.TP_001.LevelOff
Analyzer.Filament.ProtectionPressure.LevelOn		
		Duplicate of Hardware.Modules.External.IO720.TotalPressure.TP_001.LevelOn
Analyzer.IonLens.Type:		
Analyzer.IonPolarity:		
Analyzer.IonSource.ActiveParameterSet		
		The QMG800 provides 4 parameter sets per ion source type, containing ion source voltages ("Active Set").
	0 = Set 1	Set 1 is the active set
	1 = Set 2	Set 2 is the active set
	2 = Set 3	Set 3 is the active set
	3 = Set 4	Set 4 is the active set
Analyzer.IonSource.Copy.Command		
		Copies the current ion source parameters to the selected destination.
	0 = no command	A command is executed when the command item is unequal zero. Afterwards the command item is reset to zero. This implies that the command has been accepted.
	1 = copy to all	Copies the current ion source set to all sets.
	2 = copy to param set	Copies the current parameters to the set defined in Analyzer.IonSource.Copy.ToParameterSet.
Analyzer.IonSource.Copy.ToParameterSet		
		Select parameter set when copying the current ion source parameters.
	0 = Set 1	Set 1 is the destination for copying
	1 = Set 2	Set 2 is the destination for copying
	2 = Set 3	Set 3 is the destination for copying
	3 = Set 4	Set 4 is the destination for copying
Analyzer.IonSource.Type		
		Selection of the ion source type. The electrode names are replaced and the relevant potentials are made accessible. Select only components that are actually installed in your device.
	0 = Axial	Axial ion source
	1 = CB	Cross-Beam ion source.
	2 = Grid	Grid ion source.

OPC Name	Value	Details
	3 = SPM	Sputter Process Monitor.- (ASML Ion Source)
	4 = SPECIAL	Special ion source (with Analyzer.IonPolarity = positive or negative)
	5 = NONE	None ion source
Analyzer.Protection		
		Control of filament, SEM supply and Plasma Protection NOTE: With "EXTERNAL-ON-OFF" or "EXTERNAL-OFF", as with "INTERN-OFF", the filament and SEM supply are switched off when the protection current is exceeded (Hardware.Modules.Analyzer.IS700-1.ProtectionCurrent_SetValue).
	0 = INTERN-OFF	When protection is set to 0, Plasma Protection is inactive, the filament is only protected by the protection current Filament, SEM, and RF supply are switched off when the protection current of the filament is exceeded. The event is saved in the error recorder.
	1 = EXTERN-ON-OFF	An external system, i.e., floating contact or total pressure gauge, controls filament, SEM, RF. and all sensor ion source voltages Filament and SEM cannot be switched on and off. • Total pressure gauge detected: control exclusively by the gauge. The floating contact will be ignored. • No total pressure gauge detected: control exclusively by the floating contact. The event is saved in the error recorder.
	2 = EXTERN-OFF	An external system, i.e., floating contact or total pressure gauge, switches filament, SEM, and RF off. • Total pressure gauge detected: switching off exclusively by the gauge. The floating contact will be ignored. • No total pressure gauge detected: switching off exclusively by the floating contact. The event is saved in the error recorder.
Channels.Actuality.ActualChannel.Channel		
	0 ... 127	Number of actual measurement channel. See SECTION 6.1 and following for details on data recording.
Channels.Actuality.ActualChannel.MassMode		
		Operation mode of current measurement.See item "Channels.Parameters.Mass.MassMode" for details on operation mode and SECTION 7 and following for details on data recording.
	0 = SAMP	Standard measurement of a single mass.
	1 = SCAN-N	Standard scan.
	2 = SCAN-F	Scan with FIR filter.
	3 = STAIR-T	Scan of whole number masses.
	4 = PEAK-L	Peak processor level criterion.
	5 = PEAK-F	Peak processor FIR filter criterion.
	6 = ADJUST-C	Mass number coarse adjustment
	7 = ADJUST-F	Mass number fine adjustment
	12 = ANALOG-IN	Analog Input
	13 = DEGAS	Filament degassing
	14 = RF-TUNE	Tuning the RF generator
	15 = OFFSET	Offset measurement
Channels.Actuality.ActualChannel.MassValue		
	0.00 ... 2047.99	Current mass value in actual channel. See SECTION 6.1 and following for details on data recording. The maximum value depends on the mass range.
Channels.Actuality.ActualChannel.MeasureValue		

OPC Name	Value	Details
	1.0000000 E-27... 9.9999999 E+5	Current measuring value in actual channel. See SECTION 6.1 and following for details on data recording.
Channels.Actuality.MassValue		
	0.00 ... 2047.99	Array of mass numbers for the 128 channels. Contains the mass values where last measuring has been done in sample mode. See SECTION 6.2 and following for details on data recording.
Channels.Actuality.MeasureValue		
	1.0000000 E-27... 9.9999999 E+5	Array of measuring values for the 128 channels. Contains the values that have been last measured in sample mode. See SECTION 6.2 and following for details on data recording.
Channels.Actuality.Status		
		Array of statuses for the 128 channels. Indicates information on and validity of the measuring values.
	Bit0…1: Out of Range Bit2…3: Unit Bit4…5: Mass resolution Bit6…7: not used Bit8…15: Adjust mode status	Status 1 [1 Byte]: Bit 0…1: Out of Range (0=okay, 1=Overflow, 2= Underflow) Bit 2…3: Unit (0 = Ampere, 1 = cps, 2 = Volt, 3 = mbar) Bit 4…5: Mass-Resolution (0 = 1/64, 1 = 1/32, 2 = 1/16, 3 = 1/8) Bit 6…7: not used Status 2 [1 Byte]: Bit8…15: Adjust mode status See SECTION 6.2 and following for details on data recording.
Channels.Actuality.TimeStamp		
	0 ... 4 294 967 295	Time stamp of the 128 measuring values. File time format (100 ns TICs). 64-Bit integer, number of 100 ns intervals since 1 January 1601. See SECTION 6.2 and following for details on data recording.
Channels.Parameters.Amplifier.AnalogSignalFilter		
Channels.Parameters.Amplifier.AutoRangeMode		
		Operating mode of the electrometer amplifier.
	0 = Fix	Manual range selection via Channels.Parameters.Amplifier.DetectorRange.Use FIX mode for fastest measurements with limited dynamics. FIX is recommended to obtain very exact measurements, such as isotope ratios, because the interdependent range tolerances are avoided or can be calibrated.Advantages of FIX range: • Avoids relative errors in measured values that are caused by measuring range change-over (change-over of measuring resistors with a characteristic measure of tolerance and individual temperature coefficients). • Very fast measurements.

OPC Name	Value	Details
	1 = AUTO	Automatic range selection across all measurement ranges, very universal. Use AUTO mode whenever adequate. It provides enormous dynamics over more than 10 decades, i.e 200 dB, results in full resolution of the measuring values, and avoids overdriving of the amplifier. Advantages of AUTO range: • Enormous dynamics of measurement range (10 decades, i.e 200 dB). The whole dynamics of a mass spectrum is covered. • In MID mode (sample), AUTO range (above 2 ms) is nearly as fast as FIX range. AUTO is started with the range that has been used for the last measurement (last range). Thus, normally no measuring range change-over is required. In contrast, when the measuring signal has changed the AUTO range provides full resolution of the measuring values.
	2 = AUTO-DOWN	Automatic range selection between the largest (least sensitive) range and the lower range limit. Use AUTO-DOWN mode to confine the lower range. This can be useful for poor signal-to-noise ratios and result in faster measurements. The available dynamics is defined by Channels.Parameters.Amplifier.DownRange.
Channels.Parameters.Amplifier.DetectorRange		
		Manually selected electrometer measuring range for the ion current.
	0 = 1E-5 1 = 1E-6 2 = 1E-7 3 = 1E-8 4 = 1E-9 5 = 1E-10 6 = 1E-11 7 = 1E-12	With Channels.Parameters.Amplifier.AutoRangeMode = FIX, and Channels.Parameters.Detector.DetectorType = FARAD or SEM
Channels.Parameters.Amplifier.DownRange		
		Most sensitive measuring range for the ion current.
	0 = 1E-5 1 = 1E-6 2 = 1E-7 3 = 1E-8 4 = 1E-9 5 = 1E-10 6 = 1E-11 7 = 1E-12	With Channels.Parameters.Amplifier.AutoRangeMode = AUTO-DOWN, and Channels.Parameters.Detector.DetectorType = FARAD or SEM
Channels.Parameters.Amplifier.PauseCalibrate		
	0.00 ... 9.99	A factor used to multiply the pause time determined in the device. In order to wait for transient effects, no measurements are performed during the pause time between two measurement tasks.
Channels.Parameters.Detector.AnalogInputChannel		
		with Channels.Parameters.Detector.DetectorType = ANALOG-IN

<table>
<tr><th>OPC Name</th><th>Value</th><th>Details</th></tr>
<tr><td></td><td>1 = AI-1 IO700-1 ... 8 = AI-8 IO700-19 = AI-1 IO700-2…16 = AI-8 IO700-217 = AI-1 IO700-3 …24 = AI-8 IO700-325 = AI-1 IO720 …28 = AI-4 IO720</td><td>Number of the analog input for measuring data.</td></tr>
<tr><td colspan="3">Channels.Parameters.Detector.DetectorType</td></tr>
<tr><td></td><td>0 = FARAD
1 = ION COUNT
2 = EXTERN1
3 = EXTERN2
4 = SEM
5 = ANALOG-IN
6 = TOTAL-PRESSURE</td><td>Selection of signal source, depends on the configuration.</td></tr>
<tr><td colspan="3">Channels.Parameters.Detector.SEMVoltage</td></tr>
<tr><td></td><td></td><td>With
Channels.Parameters.Detector.DetectorType = C-SEM</td></tr>
<tr><td></td><td>0</td><td>The global value entered with
Analyzer.Detector.ActualParameters.CommonSEMVoltage_SetValue is applicable</td></tr>
<tr><td></td><td>1 ... 3500</td><td>Individual SEM high voltage for the selected measurement channel. The individual SEM high voltage leads to long settling times and makes sense only in special cases.</td></tr>
<tr><td colspan="3">Channels.Parameters.General.State</td></tr>
<tr><td></td><td></td><td>Enable or skip a channel in multichannel mode.</td></tr>
<tr><td></td><td>0 = ENABLE</td><td>Measure channel and preserve the parameters.</td></tr>
<tr><td></td><td>1 = SKIP</td><td>Skip channel, but the parameters are preserved.</td></tr>
<tr><td colspan="3">Channels.Parameters.Mass.DwellSpeed</td></tr>
<tr><td></td><td></td><td>with
Channels.Parameters.Detector.DetectorType = FARAD, SEM, EXTERN, ANALOG-IN</td></tr>
<tr><td></td><td>0 = 0.000125 s/amu
1 = 0.00025 s/amu
2 = 0.0005 s/amu
3 = 0.001 s/amu
4 = 0.002 s/amu
5 = 0.005 s/amu
6 = 0.01 s/amu
7 = 0.02 s/amu
8 = 0.05 s/amu
9 = 0.1 s/amu
10 = 0.2 s/amu
11 = 0.5 s/amu
12 = 1 s/amu
13 = 2 s/amu
14 = 5 s/amu
15 = 10 s/amu
16 = 20 s/amu
17 = 60 s/amu</td><td>The measured value is determined by averaging across the dwell time.
<table>
<tr><th rowspan="2">Operation mode</th><th colspan="2">Scan-Speed [us/u, ms/u, s/u] / Dwell-Time [us, ms, s]</th></tr>
<tr><th>Fix-Range</th><th>Auto-Range</th></tr>
<tr><td>Sample</td><td>125 us ... 60 s</td><td>0.5 ms ... 60 s</td></tr>
<tr><td>Scan-Normal</td><td>125 us/u ... 60 s/u</td><td>5 ms/u ... 60 s/u</td></tr>
<tr><td>Scan-FIR</td><td>125 us/u ... 60 s/u</td><td>5 ms/u ... 60 s/u</td></tr>
<tr><td>Scan-Stair</td><td>125 us/u ... 60 s/u</td><td>5 ms/u ... 60 s/u</td></tr>
<tr><td>Peak-Level</td><td>125 us/u ... 60 s/u</td><td>5 ms/u ... 60 s/u</td></tr>
<tr><td>Peak-FIR</td><td>125 us/u ... 60 s/u</td><td>5 ms/u ... 60 s/u</td></tr>
<tr><td>Adjust-Coarse</td><td>2 ms/u ... 60 s/u *</td><td>5 ms/u ... 60 s/u</td></tr>
<tr><td>Adjust-Fine</td><td>2 ms/(u/15) ... 60 s/(u/15) *</td><td>2 ms/(u/15) ... 60 s/(u/15)</td></tr>
</table>
* It is Auto-Range Mode recommended
Table 8-1</td></tr>
<tr><td colspan="3">Channels.Parameters.Mass.FirstMass</td></tr>
<tr><td></td><td></td><td>Starting mass number of the mass scan or mass number by sample.</td></tr>
<tr><td></td><td>0.00 ... 2047.99</td><td>The mass number is displayed as a decimal value. The minimum step width is 0.01.</td></tr>
</table>

<table>
<tr><th>OPC Name</th><th>Value</th><th>Details</th></tr>
<tr><td colspan="3">Channels.Parameters.Mass.MassMode</td></tr>
<tr><td></td><td></td><td>Mass scan mode.

Not with
Channels.Parameters.Detector.DetectorType = ANALOG-IN or TOTAL-PRESSURE
See SECTION 7 and following. for further details.</td></tr>
<tr><td></td><td>0 = SAMPLE</td><td>Measurement on mass value with averaging across dwell time
(Channels.Parameters.Mass.DwellSpeed).</td></tr>
<tr><td></td><td>1 = SCAN-N</td><td>Normal spectrum from the start mass (Channels.Parameters.Mass.FirstMass) across the scan width (Channels.Parameters.Mass.Width) at the set speed
(Channels.Parameters.Mass.DwellSpeed).</td></tr>
<tr><td></td><td>2 = SCAN-F</td><td>Same as SCAN-N, with FIR filter.</td></tr>
<tr><td></td><td>3 = STAIR</td><td>Spectrum with integer mass jumps.</td></tr>
<tr><td></td><td>4 = PEAK-L</td><td>Peak search (level criterion) from the start mass via the scan width with the set speed.
Significant data reduction because only the intensities and mass number of detected peaks are output.</td></tr>
<tr><td></td><td>5 = PEAK-F</td><td>Same as PEAK-L, with FIR filter.</td></tr>
<tr><td colspan="3">Channels.Parameters.Mass.Resolution</td></tr>
<tr><td></td><td></td><td>Setting of the mass peak separation (resolution).

With
Channels.Parameters.Detector.DetectorType = FARAD, SEM</td></tr>
<tr><td></td><td>0</td><td>Integral mass spectrum (DC OFF). See **TODO 58** for further details.</td></tr>
<tr><td></td><td>1 ... 255</td><td>Mass peak separation. The peak width is approximately proportional to the set number (small number = clear separation of peaks). Typical values are approx. 50 for the QMG700.</td></tr>
<tr><td colspan="3">Channels.Parameters.Mass.Threshold</td></tr>
<tr><td></td><td></td><td>Minimum intensity at which a peak is detected by the peak processor and adjust algorithm.

With
Channels.Parameters.Detector.DetectorType = FARAD, SEM</td></tr>
<tr><td></td><td>0 ... 7</td><td>
<table>
<tr><th>Fix-Range</th><th>Auto-Range</th></tr>
<tr><td>7 = 0.01;
6 = 0.03;
5 = 0.1;
4 = 0.3;
3 = 1;
2 = 3;
1= 10;
0 = 30;
in % F.S.
referenced
to RANGE</td><td>1×10^{-15} A
1×10^{-14} A
1×10^{-13} A
1×10^{-12} A
1×10^{-11} A
1×10^{-10} A
1×10^{-9} A
1×10^{-8} A</td></tr>
</table>
Table 8-2</td></tr>
<tr><td colspan="3">Channels.Parameters.Mass.Width</td></tr>
<tr><td></td><td></td><td>Mass scan width of the measurement channel.

Not with
Channels.Parameters.Mass.MassMode = SAMPLE, or
Channels.Parameters.Detector.DetectorType = ANALOG-IN,TOTAL-PRESSURE</td></tr>
<tr><td></td><td>-2047.99 ... +2047.99</td><td>The maximum value depends on the mass range. Negative width results in a backward scan. In this way small peaks that are one mass above a very large peak can be measured more effectively.</td></tr>
</table>

OPC Name	Value	Details
Channels.Parameters.Output.AnalogOutputChannel		
		Not with Channels.Parameters.Detector.DetectorType = ANALOG-IN,TOTAL-PRESSURE
	0 = NONE	No analog output assigned.
	1 = AO-1 QC 2 = AO-2 QC 3 = AO-1 IO700-1 ... 10 = AO-8 IO700-1 11 = AO-1 IO700-2 ... 18 = AO-8 IO700-2 19 = AO-1 IO700-3 ... 26 = AO-24 IO700-3 27 = AO-1 IO720… 30 = AO-4 IO720	Output channel for the measured value of the selected channel. In halt condition the outputs are set to 0 V, except when they are seized by computer outputs.
Channels.Parameters.Output.AnalogOutputMode		
		Format selection for analog output (0…10 V) to AO channel. Not with Channels.Parameters.Output.AnalogOutputChannel = none
	0 = LIN	Linear output within the selected measurement range (Channels.Parameters.Amplifier.AutoRangeMode).
	1 = LOG1D2 = LOG2D3 = LOG3D4 = LOG4D5 = LOG5D6 = LOG6D7 = LOG7D8 = LOG8D9 = LOG9D10 = LOG10D	Logarithmic output within the selected measurement range.1 decade (LOG1D): 10 V / dec....10 decade (LOG10D): 1 V / dec.
Channels.Parameters.Output.AnalogOutputRange		
	0 … 10	Adjusts the measurement range to the maximum measured signal output. Parameter valid only for specified AO Channel. Not with Channels.Parameters.Output.AnalogOutputChannel = none

OPC Name	Value	Details
		Electrometer operation 0 = 1E-5 A 1 = 1E-6 A 2 = 1E-7 A 3 = 1E-8 A 4 = 1E-9 A 5 = 1E-10 A 6 = 1E-11 A 7 = 1E-12 A Full Scale EXTERN1 a. 2 operation 0 = x1 1 = x10 *Table 8-3*
Channels.Parameters.Trip.DigitalOutputA,B		
		Assignment of a trip function A or B to any bit of a DO. If several switching functions are assigned to the same bit they are combined in an AND function. The DO outputs can also be operated manually or via interfaces. with Channels.Parameters.Detector.DetectorType = AI, EXTERN, and Channels.Parameters.Trip.Type = ABS, HYST
	0 = none	No assignment, output remains high impedance.
	1 = DO-1 IO700-1 … 32 = DO-32 IO700-1 33 = DO-1 IO700-2 … 64 = DO-32 IO700-2 65 = DO-1 IO700-3 … 96 = DO-32 IO700-3 97 = DO-1 IO720 … 108 = DO-12 IO720	Assignment of the trip functions to the DO bit
Channels.Parameters.Trip.LevelA (B)		
		Threshold values of the trip functions A and B. with (Channels.Parameters.Mass.MassMode = SAMPLE or Channels.Parameters.Detector.DetectorType = ANALOG-IN) and Channels.Parameters.Trip.Type = ABS, HYST
	1.00E-24 ... 9.99E+24	TripType = ABS: Threshold value of the trip function A or B. TripType = HYST: Upper (A) and lower (B) threshold value. If with TripType = HYST : LevelA < 1.1 × LevelB this minimum hysteresis is automatically set.
Channels.Parameters.Trip.Type		
		Mode of trip functions. See Section 8 and following for details on trip functions and watch logic.
	0 = OFF	Trip function not active. The DO bit is available for other applications.
	1 = ABS	A and B are independent trip functions with one threshold value each. Used for vacuum monitoring, differential pressure monitoring, and as comparator.

OPC Name	Value	Details
	2 = HYST	A and B form a trip function with hysteresis. The status changes when the upper or lower threshold value is exceeded. Used to prevent permanent switching for fluttering signals.
General.Cycle.BeginChannel		
		with General.Cycle.MeasureMode = CYCLE, and General.Cycle.CycleMode = MULTI
	0 ... 127	Start channel of the measurement cycle.
General.Cycle.CycleMode		
		Measurement cycle mode. The cycle is started/stopped with the General.Cycle.Command.
	0 = MONO	Single channel measurement in the selected channel.
	1 = MULTI	Measurement of the channels between General.Cycle.BeginChannel and General.Cycle.EndChannel. Channels with Channels.Parameters.General.State = SKIP will be skipped.
General.Cycle.EndChannel		
		with General.Cycle.MeasureMode = CYCLE, and General.Cycle.CycleMode = MULTI
	0 ... 127	Ending channel of the measurement cycle.
General.Cycle.MeasureMode		
		Measurement cycle mode, can only be changed in General.Cycle.Status = halt.
	0 = CYCLE	Normal measurement operation.
	1 = ADJ_FINE	Fine adjustment of the mass scale to peak top with Channels.Parameters.Mass.MassMode = SAMP. Used to compensate nonlinearity of the mass scale. See Section 7.7.1 for further details.
	2 = ADJ_COARSE	Coarse adjustment of the mass scale to peak top with Channels.Parameters.Mass.MassMode = SAMP. Used to shift and to shrink or stretch the mass scale. See Section 7.7.1for further details.
	3 = RF-TUNE	Tuning the RF generator (tuning voltage)
	4 = OFFSET	Offset correction: Determine the offset for the electrometer preamplifier and detector. See Section 7.7.1 for further details.
General.Cycle.NumberOfCycles		
		with General.Cycle.MeasureMode = CYCLE
	0	The measurement cycle is repeated endlessly.
	1 ... 10 000	Number of measurement cycles to be executed.
General.Cycle.Status		
		Status of the measurement cycle mode.
	1 = halt 2 = halt extern	The measurement is halted.
	3 = run mono	The measurement runs with General.Cycle.CycleMode = MONO and is controlled internally by the device.
	4 = run mono extern	The measurement runs with General.Cycle.CycleMode = MONO and is controlled external.
	5 = run multi	The measurement runs with General.Cycle.CycleMode = MULTI and is controlled internally by the device.
	6 = run multi extern	The measurement runs with General.Cycle.CycleMode = MULTI and is controlled external.
General.DataPump.BufferLevel		
		Ringbuffer usage in %
	0 ... 100%	100 % = ringbuffer full It is recommended that this is used for diagnostics purposes only. The size of the ringbuffer might change, therefore ringbuffer % does not indicate size in bytes.
General.DataPump.Command		

OPC Name	Value	Details
	0 = no command	A command is executed when the command item is unequal zero. Afterwards the command item is reset to zero. This implies that the command has been accepted.
	1 = clear buffer	Reset the ringbuffer to the initial condition. Existing data will be deleted.
General.DataPump.Data		
		Supplies the measurement results in data packets. See details on data recording and ringbuffer.
General.DataPump.Mode		
		See Section 10.3.1
	0 = DATA-LOOSE	Further measuring data will no longer be copied into the ringbuffer when it is full (100 % usage). Data will be lost. The measurement keeps on running.
	1 = HOLD	The ringbuffer is checked for free space to hold the data before a channel run is started. The measurement is stopped in case of too high ringbuffer usage, and will be continued when the ringbuffer usage is sufficient.
	2 = HOLD-EMPTY	The ringbuffer retrieves data only when the ringbuffer is empty and all OPC items have been sent.
General.DataPump.Status		
	0 = undefined	The ringbuffer status is undefined.
	1 = ok, writing enabled	Writing data into the ringbuffer is enabled.
	2 = waiting to write new data	The ringbuffer is waiting to write new data.
	3 = ignore new data	The ringbuffer ignores new data.
General.DeviceName		
		Device Name of the mass spectrometer
General.DeviceType		
		Device type of the mass spectrometer. The unit detects its modules automatically, as far as possible, and displays them.
	0 = not defined	Unknown device type.
	1 = QMG700	Device QMG700.
	2 = QMG220	Device QMG220.
	3 = QMG800	Device QMG800.
General.ErrorsWarnings.Actual.Error		
		Normally, meaningful operation of the device is not possible. A user action is required.

<table>
<tr><th>OPC Name</th><th>Value</th><th>Details</th></tr>
<tr><td></td><td>Bit 0 ... Bit 95</td><td>The bit number (=high) corresponds to the error number. The relevant bit is deleted when an error disappears.

List of error messages:
<table>
<tr><th>Bit No.</th><th>Description</th></tr>
<tr><td>1</td><td>Error: External Protection triggered</td></tr>
<tr><td>10</td><td>Error: CAN, Bus error</td></tr>
<tr><td>11</td><td>Error: CAN, Module error</td></tr>
<tr><td>20</td><td>Error: IS700-1, Emission error</td></tr>
<tr><td>21</td><td>Error: IS700-1, Filament out of range</td></tr>
<tr><td>22</td><td>Error: IS700-1, Filament wide out of range</td></tr>
<tr><td>23</td><td>Error: IS700-1, V1 Ion Ref outside of the range</td></tr>
<tr><td>24</td><td>Error: IS700-1, V2 Cathode outside of the range</td></tr>
<tr><td>25</td><td>Error: IS700-1, V9 outside of the range</td></tr>
<tr><td>26</td><td>Error: IS700-1, Filament 1 defect Set only during Filament Start</td></tr>
<tr><td>27</td><td>Error: IS700-1, Filament 2 defect Set only during Filament Start</td></tr>
<tr><td>30</td><td>Error: IL700-1, CH0 V3 Focus outside of the range</td></tr>
<tr><td>31</td><td>Error: IL700-1, CH1 V4 Field Axis outside of the range</td></tr>
<tr><td>32</td><td>Error: IL700-1, CH2 V5 Extractor outside of the range</td></tr>
<tr><td>33</td><td>Error: IL700-1, CH3 V6 Inner Deflection outside of the range</td></tr>
<tr><td>40</td><td>Error: HV701, SEM outside of the range</td></tr>
<tr><td>50</td><td>Error: DSP, Initialization of communication</td></tr>
<tr><td>51</td><td>Error: DSP, RUN flag not set</td></tr>
<tr><td>52</td><td>Error: DSP, EEPROM data error</td></tr>
<tr><td>53</td><td>Error: DSP, Communication error</td></tr>
<tr><td>54</td><td>Error: DSP, Updating error 1: firmware file not found</td></tr>
<tr><td>55</td><td>Error: DSP, Updating error 2: could not open COM1</td></tr>
<tr><td>56</td><td>Error: DSP, Updating error 3: could not change to setup mode</td></tr>
<tr><td>57</td><td>Error: DSP, Updating error 4: could not send command: upload file</td></tr>
<tr><td>58</td><td>Error: DSP, Updating error 5: comm. error while firmware download</td></tr>
<tr><td>59</td><td>Error: DSP, Updating error 6: CPLD file not found</td></tr>
<tr><td>60</td><td>Error: DSP, Updating error 7: could not send comm. program CPLD</td></tr>
<tr><td>61</td><td>Error: DSP, Updating error 8: error while CPLD download</td></tr>
<tr><td>Other</td><td>Error: not defined</td></tr>
</table>
Table 8-4</td></tr>
<tr><td colspan="3">General.ErrorsWarnings.Actual.Warning</td></tr>
<tr><td></td><td></td><td>Normally, further operation of the device is possible. However, measuring data can be corrupt.</td></tr>
</table>

<table>
<tr><th>OPC Name</th><th>Value</th><th>Details</th></tr>
<tr><td></td><td>Bit 0 ... Bit 31</td><td>The bit number (=high) corresponds to the warning number. The relevant bit is deleted when a warning disappears.

List of warning messages:<table><tr><th>Bit No.</th><th>Description</th></tr><tr><td>5</td><td>Warning: Data, ringbuffer full</td></tr><tr><td>10</td><td>Warning: CAN, driver error count</td></tr><tr><td>11</td><td>Warning: IS700-1, degas on and emission off</td></tr><tr><td>12</td><td>Warning: IS700-2, degas on and emission off</td></tr><tr><td>Other</td><td>Warning: not defined</td></tr></table>Table 8-5</td></tr>
<tr><td colspan="3">General.ErrorsWarnings.Static.Command</td></tr>
<tr><td></td><td>0 = no command</td><td>A command is executed when the command item is unequal zero. Afterwards the command item is reset to zero. This implies that the command has been accepted.</td></tr>
<tr><td></td><td>1 = clear errors and warnings</td><td>Delete all errors and warnings.</td></tr>
<tr><td colspan="3">General.ErrorsWarnings.Static.Error</td></tr>
<tr><td></td><td></td><td>96 Bits are provided for the error status. One Bit per error is set. The Bits will only be deleted via the General.ErrorsWarnings.Static.Command item.</td></tr>
<tr><td></td><td>Bit 0 ... Bit 95</td><td>See General.ErrorsWarnings.Actual.Error</td></tr>
<tr><td colspan="3">General.ErrorsWarnings.Static.Status</td></tr>
<tr><td></td><td>0 = no command</td><td></td></tr>
<tr><td></td><td>1 = errors and warnings cleared</td><td>All errors and warnings have been deleted.</td></tr>
<tr><td colspan="3">General.ErrorsWarnings.Static.Warning</td></tr>
<tr><td></td><td></td><td>32 Bits are provided for the warning status. One Bit per warning is set. The Bits will only be deleted via the General.ErrorsWarnings.Static.Command item.</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td>Bit 0 … Bit 31</td><td>See General.ErrorsWarnings.Actual.Warning</td></tr>
<tr><td colspan="3">General.Fan.HighestSystemTemperature</td></tr>
<tr><td></td><td></td><td>Highest measured system temperature</td></tr>
<tr><td></td><td>0 ... 150°C</td><td>Monitors the system temperature to indicate insufficient cooling.</td></tr>
<tr><td colspan="3">General.Fan.Mode</td></tr>
<tr><td colspan="3">General.Fan.Speed</td></tr>
<tr><td colspan="3">General.LanConfiguration.NetworkName</td></tr>
<tr><td></td><td></td><td>Name of the computer in the LAN</td></tr>
<tr><td></td><td>ASCII String</td><td>Actual device name</td></tr>
<tr><td colspan="3">General.LanConfiguration.DHCP</td></tr>
<tr><td></td><td></td><td>DHCP stands for Dynamic Host Configuration Protocol, and is used to centrally allocate and manage TCP/IP configurations of client nodes.</td></tr>
<tr><td></td><td>0 = DHCP Off</td><td>Disable DHCP</td></tr>
<tr><td></td><td>1 = DHCP On</td><td>Enable DHCP</td></tr>
<tr><td colspan="3">General.LanConfiguration.IPAddress</td></tr>
</table>

OPC Name	Value	Details
	xxx.xxx.xxx.xxx	IP address of the device
General.LanConfiguration.PhysicalAddress		
	xx-xx-xx-xx-xx-xx	Every network interface has a MAC address (Media Access Controller) also known as the physical address. This is the actual hardware address that the lowest level of the network uses to communicate. The MAC address is used to assign the TCP/IP address by means of DHCP.
General.LanConfiguration.SubnetMask		
	255.255.xxx.xxx	Looking at a network address and a subnet mask, it can be determined which part of the address is the network address and which part is the host address.
General.LoadSave.Command		
		Load or save parameter sets for the device settings.
	0 = no command	A command is executed when the command item is unequal zero. Afterwards the command item is reset to zero. This implies that the command has been accepted.
	1 = Load settings	Load the device settings
	2 = Save settings	Save the device settings NOTE: to save to User file must be logged in to system. In order to save to Factory must be logged in as special user
	5 = Load Ion Source Settings	Load only Ion Source Settings
	6 = Save Ion Source Settings	Save Ion Source Settings only
General.LoadSave.Status		
		Status of the loading or saving process for device settings
	0 = none	Current, nothing is being performed
	1 = Loaded	Settings have been loaded (for commands 1,3,5,7)
	2 = Saved	Settings have been saved (for command 2,4,6,8)
	3 = no access rights	The access rights of the currently logged in user are not adequate to perform the required action.
General.Security.Command		
		Perform logon or logoff of a user.
	0 = no command	A command is executed when the command item is unequal zero. Afterwards the command item is reset to zero. This implies that the command has been accepted.
	1 = logon	Logging on
	2 = logoff	Logging off
General.Security.LoggedInUser		
	Name(Phone)	User name of the currently logged in user.
General.Security.Name		
	ASCII string	User name input. Required to logon the user.
General.Security.Password		
	ASCII string	Password input. Required to logon the user.
General.Security.Phone		
	ASCII string	Phone number input. Required to logon the user.
General.Security.Status		
		Status of the current user. See **TODO 9** and following for details
	0 = Logged Off	The user is logged off
	1 = Logged On	The user is logged on
	2 = Logon Failed	Logon of the user has failed. Possible reasons: Typing error for user name or password; inadequate access rights.
General.Time.Command		

OPC Name	Value	Details
		For example, the device time is required for time dependent measurements, i.e., to assign measured data to the time flow of the measurement.
	0 = no command	A command is executed when the command item is unequal zero. Afterwards the command item is reset to zero. This implies that the command has been
	1 = Set time	Set the device date and time, see also General.Time.DateTime_SetValue
General.Time.DateTime_ActualValue		
	YYYY-MM-DD hh:mm:ss	Actual value of the date and time that is used by the device
General.Time.DateTime_SetValue		
	YYYY-MM-DD hh:mm:ss	Set value for the date and time that is to be used by the device.
General.Time.Status		
		Status of the device date and time setting command
	0 = no command	Date and time have not yet been set.
	1 = Time set	Date and time have been set.
	2 = Error	An error occurred when setting date and time. E.g., incorrect format.
Hardware.MassRange		
		Specifies the existing measurement range (HF generator). Depends on your hardware configuration.
	0 ... 4096	
Hardware.Modules.Analyzer.CI700.FirmwareVersion		
		Communication Interface 700 firmware version
	0 … 2^32 - 1	Firmware version of the installed CI700. Automatically detected. The Communication Interface CI700 is located on the Quadrupole Controller QC700.
Hardware.Modules.Analyzer.QMH800.QmhFpga1.QmhSystem.QmhSystemMain.apiVersion: API Version of QMH		
		This is the version of the api/app on the QMH
	0 … 2^32 - 1	hexadecimal YYMMDDVV VV is built for that day
Hardware.Modules.Analyzer.QMH800.QmhFpga1.QmhSystem.QmhSystemMain.fpgaVersion: Version of QMH FPGA		
		hexadecimal YYMMDDVV VV is built for that day
	0 … 2^32 - 1	
Hardware.Modules.Analyzer.QMH800.QmhFpga1.QmhMonitor.QmhMonitorMain.match: QMH RF match		
		QMH/Quadrupole RF match Relative number nominal value around 2.5
	Float 0 ...5	
Hardware.Modules.Analyzer.QMH800.QmhFpga1.QmhMonitor.QmhMonitorMain.power:QMH RF output power watts		
		this should be read only
	float	
Hardware.Modules.Analyzer.QMH800.QmhFpga1.QmhMonitor.QmhMonitorMain.resol: Value of the QMH resolution input		
	float	
NamespaceVersion		
	0 … 65535	Namespace version of the OPC items.

9 Device Settings

9.1 Parameter Sets

The QMG 800 software supports 4 parameter sets, (0 – 3) for device configuration. These parameters sets are stored in non-volatile memory which is the SettingsUser.dat file.

Each of the 4 parameter sets contain a subset of Ion Source parameters which consist of the following:

- Ion source type (0 – 5) has a subset of the following: (see **Analyzer.IonSource.Type)**
- Filament parameters for filament 1 and filament 2
- IS Module Voltages Set-Values V01 – V09

NOTE: When **Analyzer.IonSource.Type** is set/changed to a different type, the Ion Source parameters for that Ion source type are loaded from the selected parameter. (See **Analyzer.IonSource.ActiveParameterSet)**

When **Analyzer.Filament.ActiveFilament** is changed the Ion source parameters for that filament are loaded from the selected parameter set.

There are many other device settings that are included in the 4 parameter sets

When the QMG 800 is powered-up and the system is initialized, the working parameter set is populated from the SettingsUser.dat file based on the ActiveParameterSet, Ion Source type, and Active filament.

When and if changes are made to and of the parameters (device settings), the changes are made to the (volatile) working parameter set. In order to preserve these changes (after a power cycle), the working parameter set needs to be saved to the SettingsUser.dat file. This is accomplished with **General.LoadSave.Command. (**See section below)

9.2 Load and Save

NOTE: In order to **Load and Save Device Settings** must be logged into system. See Section 6.4.2.

The endpoint **General.LoadSave.Command** provides the means to Load or Save device settings from the SettingsUser.dat file or the SettingsFactory.dat file.

NOTE: Endpoint **General.LoadSave.ParameterSet** defines which non-volatile storage file is selected. There are 2 files; SettingsUser.dat and SettingsFactory.dat. Typically, SettingsUser.dat is selected. (SettingsFactory.dat is used for factory settings). When **General.LoadSave.ParameterSet** is set to “0”, SettingsUser file is selected, and when set to a “1”, the SettingsFactory file is selected.

There are a large number of device settings in these files. A subset of these settings are the Ion Source settings. The Load/Save command options (1 and 2) provide for operating on the complete parameter set, and options 5 and 6 operate on the Ion Source settings only. The Ion Source settings contains the following: Set Value for V01 – V09, for each filament and Ion Source Type. The QMS software provides for (4) sets of

parameters (device settings). Endpoint **Analyzer.IonSource.ActiveParameterSet** allows for selection of the desired set (0 – 3).

9.2.1 General.LoadSave.Command

Endpoint **General.LoadSave.Command** provides the following functions when set to the following settings:

General.LoadSave.Command	
0	No action
1	Load all device settings
2	Save all device settings
5	Load Ion Source Settings
6	Save Ion Source Settings

Table 9-1

Ion Source Settings managed with General.LoadSave.Command option 5 and 6:

- Hardware.Modules.Analyzer.IS700-1.V01,V02,V09_SetValue
- Hardware.Modules.Analyzer.IS700-1.EmisionCurrent_SetValue
- Hardware.Modules.Analyzer.IS700-1.ProtectionCurrent_SetValue
- Hardware.Modules.Analyzer.IL700-1.V03-V08_SetValue
- Analyzer.IonSource.ActiveParameterSet
- Analyzer.IonSource.Type
- Analyzer.Filament.ActiveFilament

9.3 Storage of Device Settings on QMH 800 Module

During QMG 800 qualification at the factory system settings are saved to the QMH 800 module. These settings are specific to the RGA QMA analyzer. The QMH 800 module and the QMA analyzer are matched. The QMS controller is a component of the system that can be swapped. Having the system settings stored on the QMH 800 allows for the user to retrieve the system settings from the QMH 800 module and load on to a swapped QMS controller. The **SavedSensorConfig** endpoints provide access to the saved system settings.

9.3.1 QmhLoadSave

Endpoint **SavedSensorConfig.QmhLoadSave.Command** provides options for loading of the SavedSensorConfig settings to the QMS controller working parameter set.

The table below details the SavedSensorConfig.QmhLoadSave.Command options.

Value	Function
0	No Action
1	Load from QMH all Ion Source Settings for Filament 1 and Filament 2 parameters into working parameter set
2	Save/Write Working Ion Source parameters to QMH **Note:** Requires special login for this to be active. (*User: PV MassSpec* and *Phone: PV MassSpec*)
3	Load from QMH SEM Initial voltages for H2, N2 and DeepVac State into QC module new temporary SEM VacuumState variables, temp_SEM_H2, temp_SEM_N2, temp_SEM_DeepVac
4	Load from QMH SEM Working voltages for H2, N2 and DeepVac State into QC module new temporary SEM VacuumState variables, temp_SEM_H2, temp_SEM_N2, temp_SEM_DeepVac
5	Save/Write all temporary SEM values to QMH SEM Initial Values, also copy to QMH SEM Working values **Note:** Requires special login
6	Save/Write QC SEM temporary VacuumState variables to the corresponding QMH SEM Working parameters for H2, N2 and DeepVac states
7	Read Hardware.QMS.SerialNumber and write to QMH SavedSensorConfig.QMS-Serialnumber Read Hardware.QMS.Model and write to QMH SavedSensorConfig.Model

Table 9-2

9.3.2 SEM Initial and Working Voltages

The system settings saved on the QMH 800 include settings for the SEM voltage at the 3 Vacuum States; which are H2, N2 and deep vacuum.

For each of these vacuum states, there is setting for Initial SEM voltage and a working SEM voltage. The working value is updated over time, as the SEM ages.

NOTE: The endpoint **SavedSensorConfig.QmhLoadSave.VacuunState** must be set by the client to indicate to the QMS 800 controller the proper vacuum state.

The defined states of **SavedSensorConfig.QmhLoadSave.VacuunState** are:

Value	Vacuum State
0	Power on state
1	H2

2	N2
3	Deep Vacuum

Table 9-3

At the time of system qualification , the Initial SEM voltage for each vacuum state will also be written to each vacuum state working voltage settings.

The client must load the SEM working voltages from the QMH 800 to the QMS 800 by setting endpoint **SavedSensorConfig.QmhLoadSave.Command to "4".** This will load vacuum state temporary SEM voltage variables on the QMS controller.

The QMS firmware will monitor the VacuumState value and will load the corresponding SEM temporary parameter into the **Analyzer.Detector.ActualParameters.CommonSEMVoltage_SetValue**.

When a SEM voltage adjustment is made, using endpoint Analyzer**.Detector.ActualParameters.CommonSEMVoltage_SetValue**, the value is automatically mirrored to the corresponding Vacuum State temporary SEM voltage variable.

In order to save the changed SEM voltage to the QMH 800 module, the client must set endpoint **SavedSensorConfig.QmhLoadSave.Command** to "6", to save the QMS SEM temporary voltages to the QMH 800 module. (see table above)

NOTE: Temporary vacuum state SEM voltage variables are not saved during a power cycle. They must be saved back to the QMH 800 module. See above

9.4 QMH and QMA Type

During QMG 800 system initialization the QC firmware checks the communication to the QMH800 module on LAN2 Ethernet port. If the communication check is successful, the QC firmware then checks the value of endpoint **SavedSensorConfig.QMH-Model**. If this value = "QMH800", the QC firmware will set the endpoint **Hardware.QMH** to 11. The QC firmware will then check the value of **SavedSensorConfig.QMA-Type,** if this value is 430-ED, then the QC firmware will set the endpoint **Hardware.QMA** to 10.

NOTE: SavedSensorConfig device settings are only available if **Hardware.QMH** equals "11"

If the QMH communication check is unsuccessful, the endpoint **Hardware.QMH** will be set to the value that was loaded from the SettingsUser.dat file which is 1 by default and the endpoint for **Hardware.QMA** will also be set to the value in the SettingsUser.dat file which 2 by default.

If the QMH 800 communication check is unsuccessful error bit 86 is set in endpoint **General.ErrorsWarnings.Actual.Error** and **General.ErrorsWarnings.Static.Error**.

After initialization, and during normal operation, if a problem develops with the QMH communications, error bit 86 will be set, the QMH communication is periodically checked and if successful, bit 86 is cleared in endpoint

General.ErrorsWarnings.Actual.Error. To clear the error bit(s) in **General.ErrorsWarnings.Static.Error** endpoint, a “1” must be written to **General.ErrorsWarnings.Static.Command**.

10 Data Handling

This chapter describes the measurement data handling of the QMG 800. Three ways are used to read out measuring data.

10.1 Channels.Actuality.ActualChannel.~

OPC items of the "Channels.Actuality.ActualChannel.~" type contain the current measuring data using a refresh rate of 250 ms:

- Channels.Actuality.ActualChannel.Channel
- Channels.Actuality.ActualChannel.MassMode
- Channels.Actuality.ActualChannel.MassValue
- Channels.Actuality.ActualChannel.MeasureValue

Example: Displaying the continuous variation of the mass.

10.2 Channels.Actuality.~

OPC items of the "Channels.Actuality.~" type contain arrays of all 128 channels. For sample measurements, the measuring data of each channel are separately saved and continuously updated:

- Channels.Actuality.MassValue
- Channels.Actuality.MeasureValue
- Channels.Actuality.Status
- Channels.Actuality.TimeStamp

Example: Sample measurements of several channels which are to be read in cycles (polling).

10.3 General.DataPump.

OPC UA items of the “General.DataPump.~” type read the data out from ring buffer:

- General.DataPump.Data

Example: Measurements that require no data loss (scan). You have to set the ring buffer mode to “Data loose” when no data is read out from the ring buffer.

10.3.1 Ring buffer access

Ring buffer mode

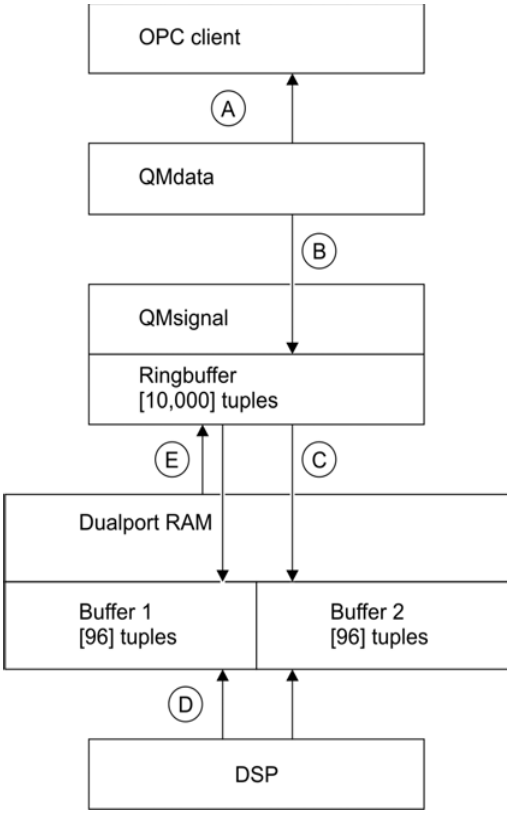
The following ring buffer modes are defined:

Value	Mode
0	The ring buffer retrieves data from the signal processor at maximum speed. The data are deleted when the ringbuffer is full.
1	The ring buffer retrieves data from the signal processor only when there is free space in the ring buffer.
2	The ring buffer retrieves data from the signal processor only when the ring buffer is empty and all OPC items have been sent.

Table 10-1

Data

The "ComplexData" item (namespace "General.DataPump.Data") outputs the results of the measurement. The following diagram illustrates the data handling.



A. Client contains the “data item in a group of “update Rate” = 0
B. Read out contents of the ring buffer every 1 ms. Forward modifications to the client(s)
C. Read out buffer after an interrupt, and add header to tuples. Write result into ring buffer
D. Write into buffer, and trigger interrupt in case of QM signal
E. Interrupt

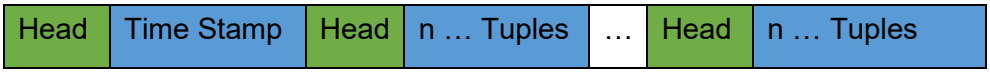
QMdata forwards the data only to those clients for which the "Data" item has been added. These clients will then be notified that new data can be read in the item. If no client has created a "Data" item also no data will be read out from the ringbuffer. This can quickly result in a ring buffer overflow.

The "Data" item is notified when a modification occurs. Therefore, the "Update Rate" zero is required for the group that contains this item

10.3.2 Data Description

SCAN and PEAK Data

For fast measurements, n corresponds to the maximum buffer width (96-tuples). For slower measurements, the interrupt will be triggered in advance resulting in lesser n. Therefore, n is specified in every head.



SAMPLE Data

See section 10.3.4 for a detailed description of the data.

10.3.3 Measurement Data

Description

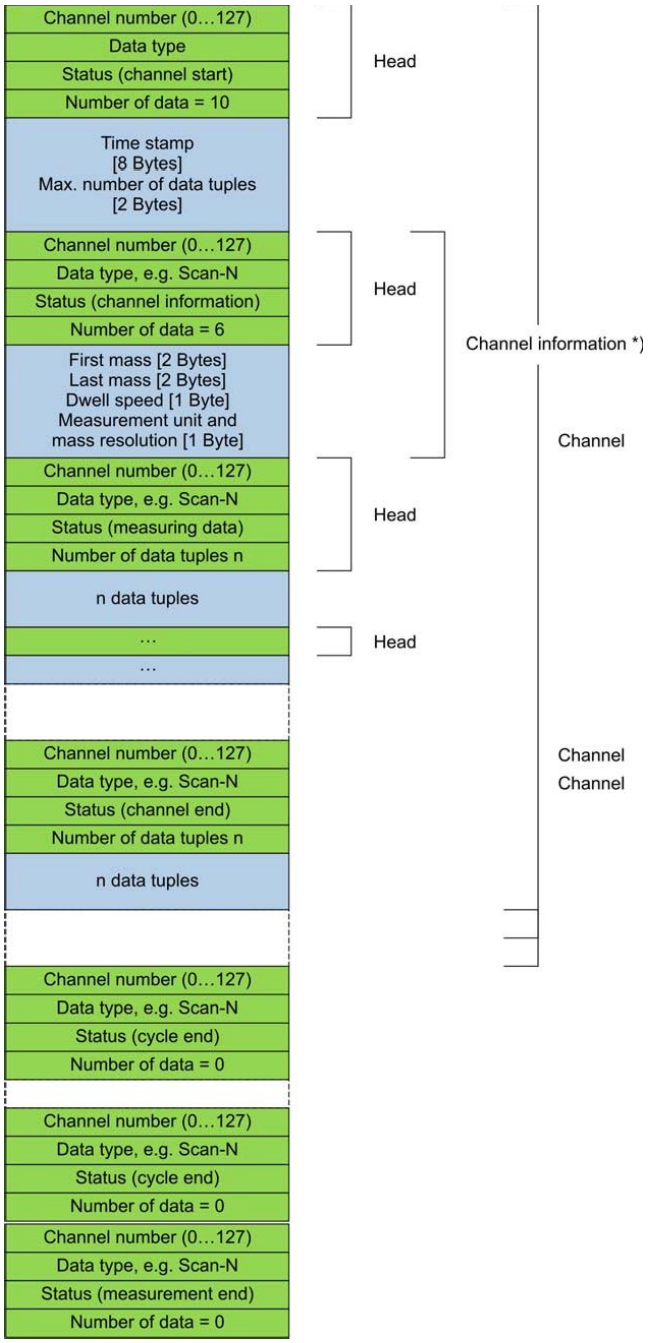
A very fast transfer rate is required for the measuring data. Therefore, the measuring data are read out from the shared memory and written immediately into the ring buffer (FIFO).

Actual measuring data for Sample measurement

In the course of a Sample measurement the measuring data of each channel are saved separately, and are continuously updated.

The pointers to the 128 channel measuring data are passed when the program starts.

10.3.4 Ring buffer



10.3.4.1 Data Packets

The measuring data are stored in packets into the ring buffer. Each data packet starts with a header. Amongst others the header contains the length of the data packet (number of data tuples) to determine the end of the data packet.

All measuring data of one channel are combined. A channel starts with the data packet "Channel Start" that contains the time stamp and the maximum number of data tuples. The data packet "Channel Information"

follows, except for Sample. After the last data packet of a channel the additional data packet "Channel End" is stored into the ring buffer

The data packet "Channel End" can also contain measuring data. As a consequence, at least two data packets per channel are stored into the ring buffer:

- Data packet "Channel Start" (always)
- Data packet "Channel Information" (except for Sample)
- (Data packets "Continuous Measuring Data")
- Data packet "Channel End (always)

One measurement interval, i.e., channel start to channel end, can be run repeatedly (multiple cycles). After each cycle a block with status "Cycle End" is written into the ring buffer

Channel Information*:

The "Sample-Table", "Offset-Measure", and "Analog-Input" jobs do not require the "Channel Information" data block. Therefore, the data block is not sent for these jobs to avoid needless data load.

10.3.4.2 Data Elements

Channel number [1 Byte]	0 … 127	
Data type (JobMode) [1 Byte]	0	Sample-Table
	1	Scan-Normal
	2	Scan-FIR
	3	Scan-Stair-Table
	4	Peak-Level
	5	Peak-FIR
	6	Adjust-Course
	7	Adjust-Fine
	15	Offset-Measure
	16	Analog-Input
	17	Total Pressure
	255	Job Break
Status [1 Byte]	0	Continuous measuring data
	1	Channel start (time stamp, max. number of data tuples)

	2	Channel end
	3	Channel aborted
	4	Cycle end
	5	Channel information
	6	Measure end
Number of Data [1 Byte]	With “Channel Start” and “Channel Information”: Size in Bytes of the following data.	
Date and time stamp [8 Bytes]	64 Bit Integer, number of 100 ns intervals since 1 January 1601	
Max. number of data tuples [2 Bytes]	Maximum number of data tuples	
First-Mass [2 Bytes]	FirstMass in integer format	
Last-Mass [2 Bytes]	LastMass in integer format	
Dwell-Speed [1 Byte]	DwellSpeed in integer format	
Measurement unit and Mass-Resol [1 Byte]	Bit0 … 1:	Not used
	Bit2 … 3:	Unit (0 = Ampere, 1 = cps, 2 = Volt, 3 = mbar)
	Bit4 … 5:	Mass resolution (0 = 1/64, 1 = 1/32, 2 = 1/16, 3 = 1/8)
	Bit6 … 7:	Not used
Number of data tuples [1 Byte]	With “Continuous Measuring Data” and Channel End”: Number of the following data tuples.	
Data tuple [1 data tuple = 8 Bytes]	Intensity [4 Bytes]:	Floating format, Ampere, Volt, mbar Data type “Analog Input” indicates the voltage (0 … 10V) Data type “Total Pressure” indicates the pressure in mbar
	Mass [2 Bytes]:	Mass in integer format
	Status1 [1 Byte]:	Bit0 … 1: out of range (0 = Okay, 1 = overflow, 2 = underflow) Bit2 … 3: unit (0 = Ampere, 1 = cps, 2 = Volt, 3 = mbar)

		Bit4 … 5: mass resolution (0 = 1/64, 1 = 1/32, 2 = 1/16, 3 = 1/8)
		Bit6 … 7: not used
	Status2 [1 Byte]:	Adjust mode status
Data Tuple [1 data tuple = 8 Bytes]	With data type = “Analog-Input”	
	AnalogIn-Wert [4 Bytes]:	Floating format, 0 … 10 Volt
	Mass [2 Bytes]:	Mass in integer format = 0
	Status1 [1 Byte]:	Bit0 … 1: out of range (0 = Okay, 1 = overflow, 2 = underflow)
		Bit2 … 3: unit (0 = Ampere, 1 = cps, 2 = Volt, 3 = mbar)
		Bit4 … 5: mass resolution (0 = 1/64, 1 = 1/32, 2 = 1/16, 3 = 1/8)
		Bit6 … 7: not used
	Status2 [1 Byte]:	Adjust mode status = 0
Data Tuple [1 data tuple = 8 Bytes]	With data type = “Analog-Input”	
	AnalogIn-Wert [4 Bytes]:	Floating format, 0 … 10 Volt
	Mass [2 Bytes]:	Mass in integer format = 0
	Status1 [1 Byte]:	Bit0 … 1: out of range (0 = Okay, 1 = overflow, 2 = underflow)
		Bit2 … 3: unit (0 = Ampere, 1 = cps, 2 = Volt, 3 = mbar)
		Bit4 … 5: mass resolution (0 = 1/64, 1 = 1/32, 2 = 1/16, 3 = 1/8)
		Bit6 … 7: not used
	Status2 [1 Byte]:	Adjust mode status = 0

10.3.4.3 Technical Data

Size:	2 MB
Start position:	QMdata starts reading from the start position and afterwards modifies this position
End position:	QMsignal starts writing from the end position and afterwards modifies this position

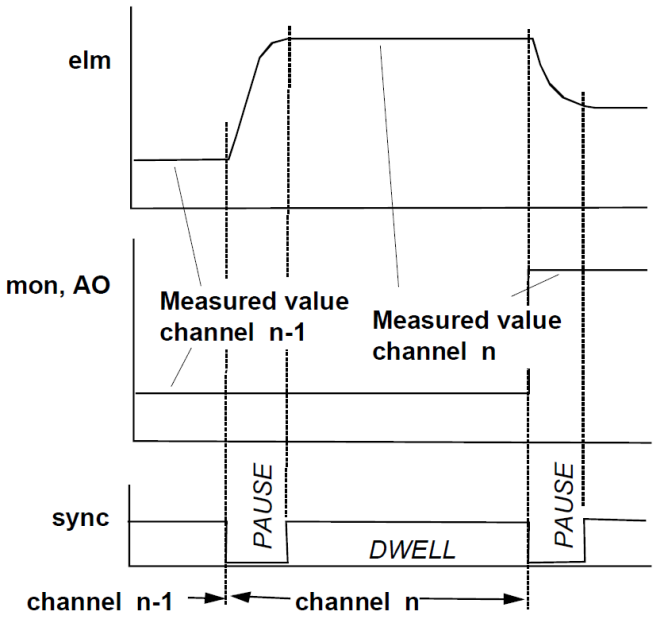
11 Mass Scan Modes

11.1 Mass Scan Modes

This chapter describes the available options for the OPC UA item Channels.Parameters.Mass.MassMode.

11.1.1 Sample

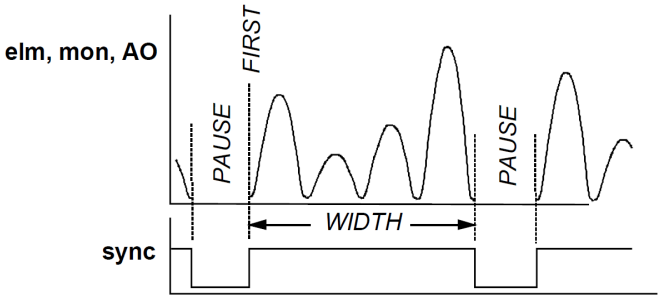
With "SAMPLE" (Channels.Parameters.Mass.MassMode = SAMPLE) the measurement is performed on the constant mass number. In most cases it will be set to a peak top (see section 11.3 and following).



After the *DWELL* time has expired the measured value averaged across this time is output.

11.1.2 SCAN-N

The "SCAN-Normal" mode (Channels.Parameters.Mass.MassMode = SCAN-N) is used for recording an analog spectrum across the range defined with "FirstMass" and "Width" (OPC items Channels.Parameters.Mass.FirstMass and Channels.Parameters.Mass.Width).



The number of steps per mass depends on Speed and the mass range (OPC items Channels.Parameters.Mass.DwellSpeed and Hardware.MassRange).

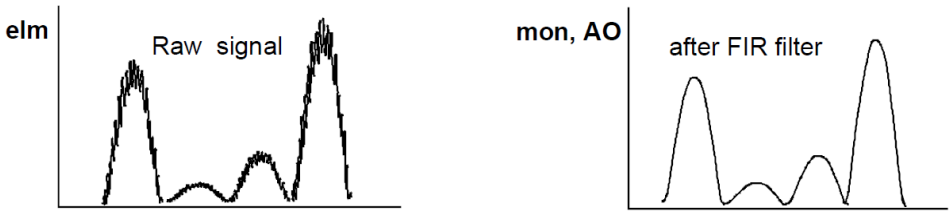
With *SCAN-N* the average value of the mass signal is output with each mass step.

EXAMPLE: With "Speed" 0.1 s/amu and mass scale resolution 1/32 amu there is an integration time per step of 100 ms/amu × 1/32 amu = 3.125 ms

With *SCAN-N* you obtain a direct image of the measured values captured by the measuring amplifier. This mode is particularly suitable for analyzing raw data, e.g., for optimizing parameter values.

11.1.3 SCAN-F

With "SCAN-F" (Channels.Parameters.Mass.MassMode = SCAN-F) the measured values are additionally subjected to an FIR filter algorithm (Finite Impulse Response).

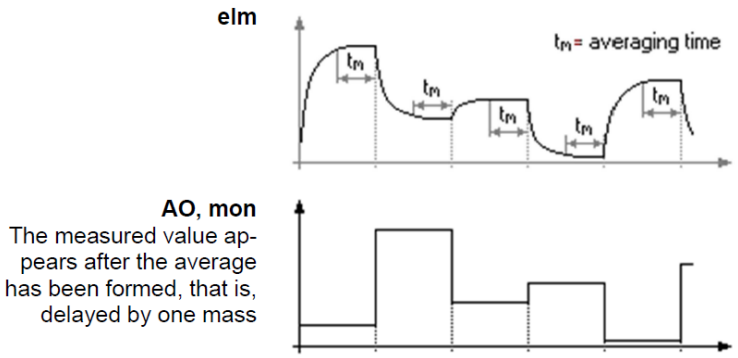


The FIR filter largely eliminates noise and interference so that also very small peaks can be detected against the background. Statistical intensity fluctuations frequently account for the major portion of the noise is particularly well suppressed by the FIR filter. For this reason, you should always use *SCAN-F*, except in the few special cases where raw data are actually required.

11.1.4 SCAN-STAIR

With mass mode "STAIR" (Channels.Parameters.Mass.MassMode = STAIR) integer mass jumps across the range "FirstMass"…"Width" is performed. A bar graph spectrum is created. After each mass jump the average value across approx. half the dwell time is formed.

Example: With "Speed" 0.1 s/amu the averaging time is ≈ 50 ms.

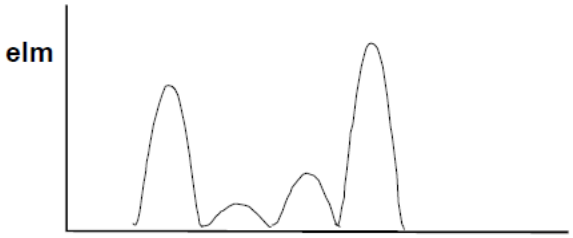


The start mass of each channel must be on a peak maximum. See section 11.2 and following. If the peak maximums are not hit, large measuring errors are unavoidable. For this reason, you should limit "Width" per channel to approx. 10 % of the mass range. In this way you can compensate deviations of the mass scale by correcting the corresponding starting mass "FirstMass".

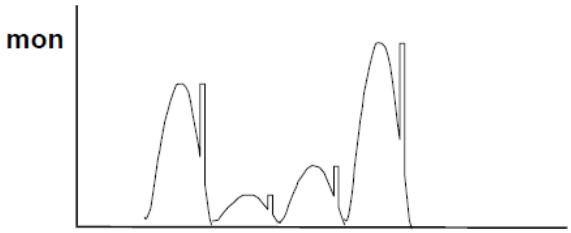
11.1.5 PEAK

The "PEAK" mode (Channels.Parameters.Mass.MassMode = PEAK-L or PEAK-F, peak processing) is an intelligent data reduction process which searches the spectrum for peaks in real time mode. Instead of 64 measured values per amu only the **intensity and mass number** of detected peaks are output on the computer interface.

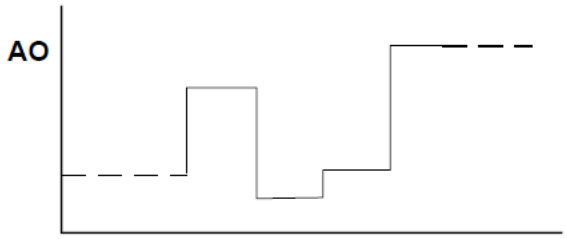
Mass scan is same as with *SCAN*



The marker at **mon** means that a peak of the displayed height has been detected.



The value at **AO** remains until a new peak is detected.



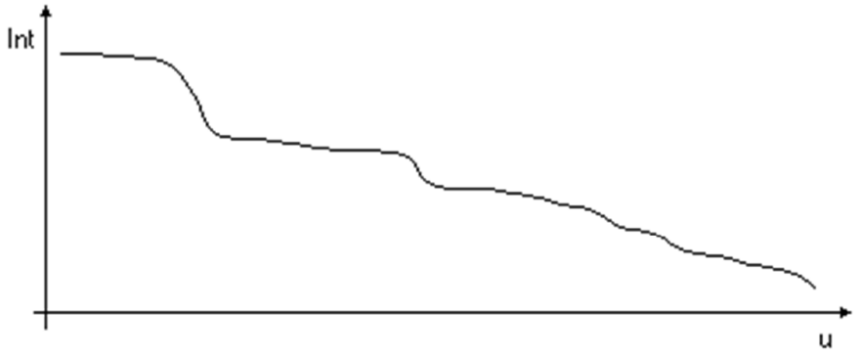
Peak Processing runs with all "Speed" (Channels.Parameters.Mass.DwellSpeed) settings. The peak search extends across the range defined with "FirstMass" and "Width". The peak criteria of General.Cycle.MeasureMode = ADJ_COARSE apply, see section 11.3 and following.

There are two methods:

- With "PEAK-L" (Level) the peak processing algorithm is applied to the normal spectrum ("SCAN-N").
- With "PEAK-F" the peak processing algorithm is applied to the measured values processed with the FIR filter. This is advantageous because parasitic signals have largely been removed from the measured values so that a very low threshold (Channels.Parameters.Mass.Threshold) can be used.

11.2 Integral Spectrum

With Channels.Parameters.Mass.Resolution = 0 an integral spectrum is created that can be used, e.g., for total pressure measurement.



11.3 Adjust

With General.Cycle.MeasureMode = ADJ_COARSE or ADJ_FINE you can automatically optimize the mass number *MASS* to the peak maximum in "Sample" or "STAIR" mode. The measurement channel must be enabled (Channels.Parameters.General.State = ENABLE). This possibility is advantageously used, for example, to optimize the system after turn on and particularly after several parameters have been changed.

11.3.1 Adjust COARSE

With General.Cycle.MeasureMode = ADJ_COARSE a range of ±½ u around the mass number Channels.Parameters.Mass.FirstMass is normally searched for a peak. The search range will possibly be enlarged by ±¼ u.

If possible, use Channels.Parameters.Amplifier.AutoRangeMode = AUTO, it will be easier to obtain a result.

Peak Criteria:

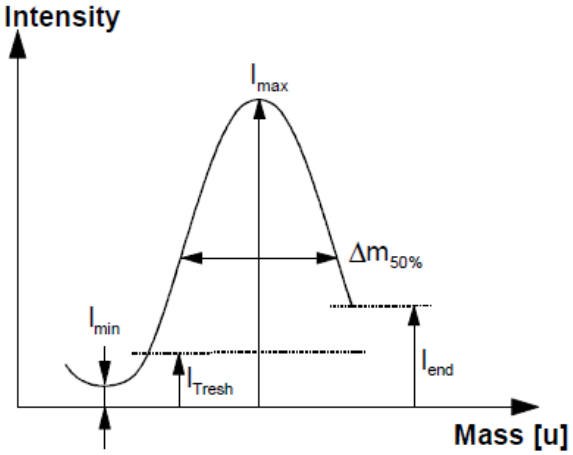
Four criteria must be met for a peak to be detected:

a) $I_{max} > 2\ I_{min}$

b) $I_{end} < 0.5\ I_{max}$

c) $I_{max} > I_{Tresh}$

d) $\Delta m_{50\%} \geq ½\ u^{*)}$ at $½\ I_{max}$



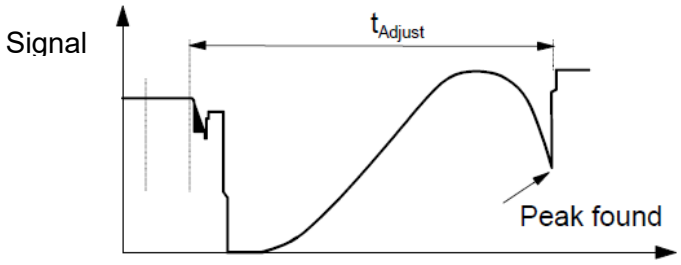
*) ¼ u with Channels.Parameters.Mass.MassMode = PEAK Time: $t_{adjust} \approx 0.5 \ldots 1.25$ “Dwell”

Start:

- Stop measuring cycle: General.Cycle.Command = stop
- Choose "SAMPLE" mode: Channels.Parameters.Mass.MassMode = SAMPLE
- Choose General.Cycle.MeasureMode = ADJ_COARSE
- Choose General.Cycle.CycleMode = MONO, or MULTI
- Start ADJUST measurement: General.Cycle.Command = run

Procedure:

With successful ADJUST the mass number "FirstMass" of the measured channel is updated with the new value. If unsuccessful it remains unchanged.



Status Message:

Channels.Actuality.Status or ComplexData Adjust mode status

Status code:

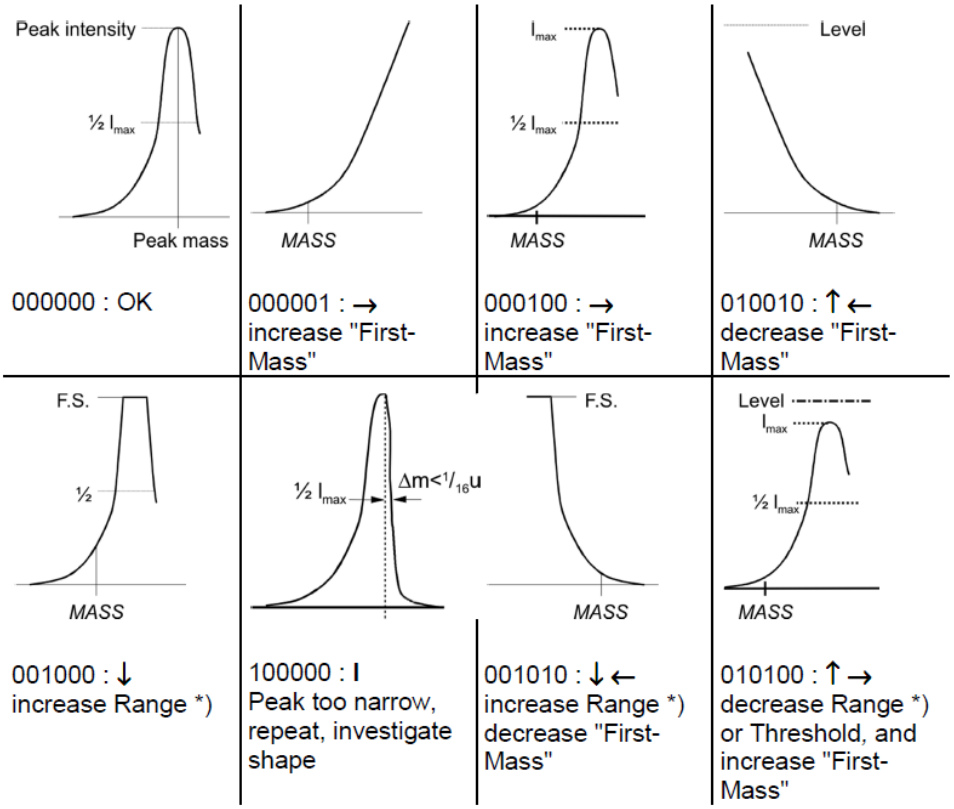
	Peak width	Intensity		Mass number MASS		
	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Bit = 1:	Too narrow	<THRESH	Too high	Too low *)	Too high	Too low
Symbol:	|	↑	↓	→	←	→

*) and intensity not dropped back to ½

Adjust the actual peak positions to the nominal mass numbers: change the parameters while the measurement is running. You can observe the effect of modified parameters during the next measurement task and iteratively tune the mass scale.

- "Hardware.Modules.Analyzer.SI700.MassScaleCalibration.Offset" shifts the mass scale,
- "Hardware.Modules.Analyzer.SI700.MassScaleCalibration.Slope" shrinks and stretches the mass scale.

Examples:



*) or preferably use Channels.Parameters.Amplifier.AutoRangeMode = AUTO

11.3.2 Adjust FINE

A peak maximum within the range of ± ½ u around the mass number "FirstMass" is searched. In this case Channels.Parameters.Amplifier.AutoRangeMode = AUTO is recommended, too.

Peak criteria:

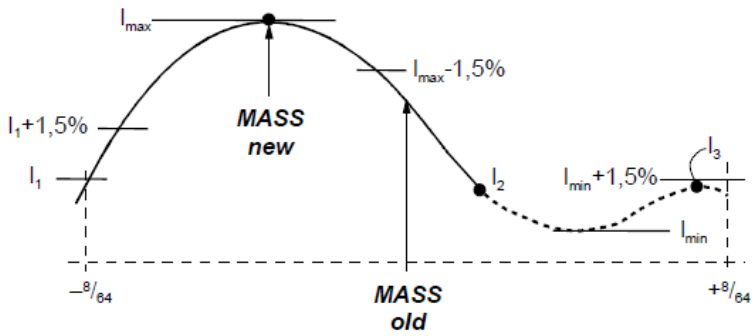
a) $I_{max} > I_1 + 1.5\%$

b) $I_2 < I_{max} – 1.5\%$

c) $I_{max} >$ THRESH

d) No overdriving

e) $I_3 < I_{min} + 1.5\%$



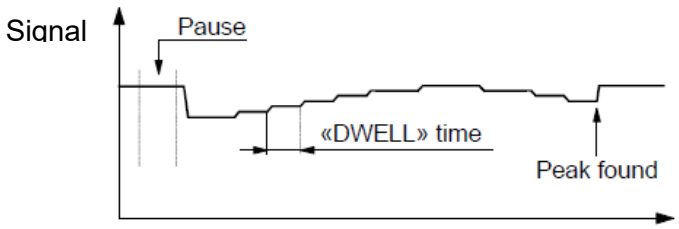
Time: t_{adjust} ≈ 16 “Dwell”

Start:

If you are not sure that a peak is located within the searched range, first perform an ADJUST COARSE. Start as described under COARSE, however with General.Cycle.MeasureMode = ADJ_FINE.

Procedure:

With successful ADJUST the mass of the measured channel is updated with the new value, if it was unsuccessful, it remains unchanged.



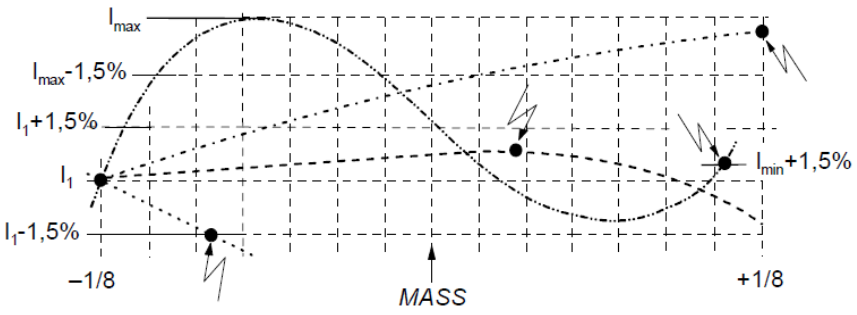
Status Message:

As in ADJUST-COARSE, however, without information on mass number and peak width.

Bits 1, 2 and 5 are always zero.

	---	Intensity		Mass number MASS		
	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Bit = 1:	---	<THRESH	Too high	---	---	No Peak
Symbol:		↑	↓			→ ←

Examples of unsuccessful fine searches:



12 Trip Functions and Watch Logic

12.1 Description

The TRIP functions can monitor measurement values of sample measurements (mass mode SAMPLE) and analog input measurements (detector type ANALOGIN).

With "halt", the trip function status is OFF.

Each measurement channel provides two trip functions, TRIP A and TRIP B. They can be assigned without restriction to the output bits of the CAN modules.

Two or more trip functions are conjunct (logic AND) if they are assigned to the same DO bit. No warning appears if a DO bit is already used.

Each measurement channel provides the following trip variables:

- Type
- Level A
- DO-A
- Level B
- DO-B

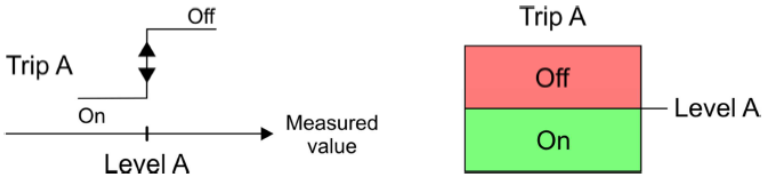
12.2 Functions

12.2.1 Vacuum Monitor

Procedure:

- Select trip type "ABS".
- Enter the threshold value "Level A".
- Set the digital output Bit "DO-A".

DO-A is set to "high" if the measured value falls below the reference value "Level A". Otherwise, DO-A is set to "low".

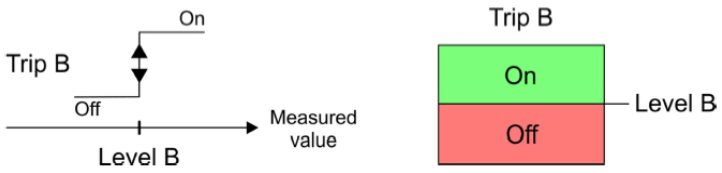


12.2.2 Pressure Monitor

Procedure:

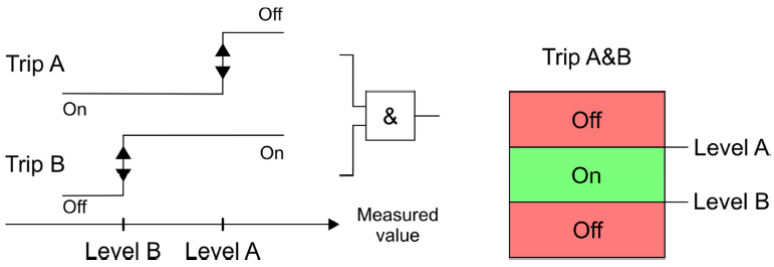
- Select trip type "ABS".
- Enter the threshold value "Level B".
- Set the digital output Bit "DO-B".

DO-B is set to "high" if the measured value exceeds the reference value "Level B". Otherwise, DO-B is set to "low".



12.2.3 Windows Comparator

Assign the vacuum monitor and the pressure monitor to the same output. The return of the two trip functions will be conjunct (logic AND) thus resulting the windows comparator.



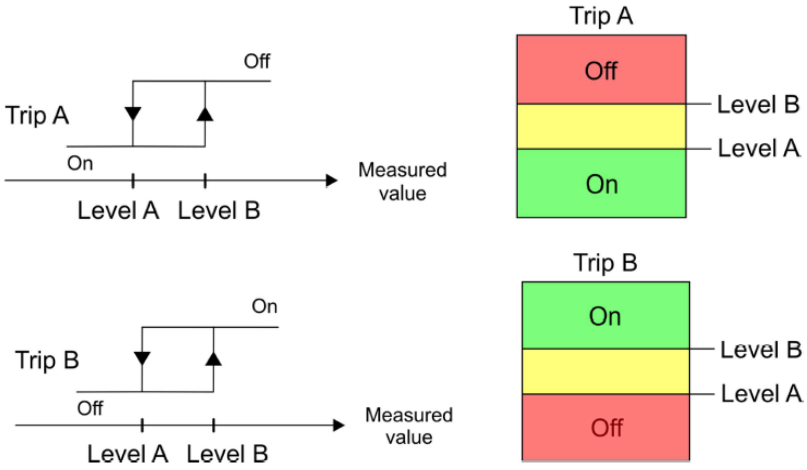
12.2.4 Hysteresis Function

Use the hysteresis to prevent permanent switching due to fluttering signals.

Procedure:

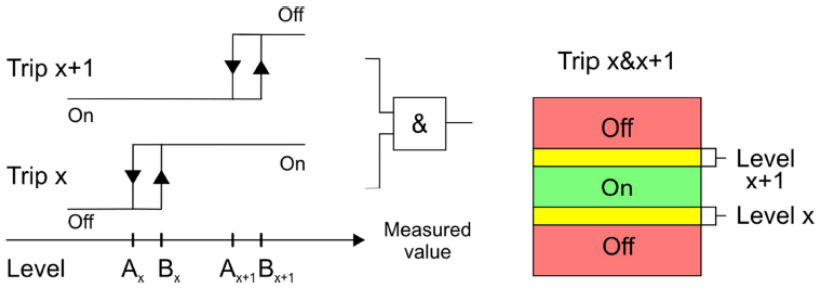
- Select trip type "HYST".
- Enter the lower threshold value "Level A".
- Enter the upper threshold value "Level B".
- Set the digital output Bits "DO-A" and "DO-B".

DO-A is set to "high" if the measured value falls below "Level A", and set to "low" if the measured value exceeds "Level B". DO-B is inverse to DO-A.



12.2.5 Windows and Hysteresis

Use the trip function "hysteresis" for two channels and the same output (DO). The two signals will be conjunct (logic AND).



The outputs for "hysteresis" are set when a measurement cycle is finished.

13 Offset and Simulation

13.1 Offset Measurement

The offset values of the electronic circuit for signal processing (electrometer EP422, amplifier, Mux, filter, etc.) are individually determined for the 8 available detector measuring ranges. The values are stored into a memory array. The determined offset values will be applied to future measurements (sample, scan, etc.) by automatically correcting the measured values. Entire measuring time to determine the offset value: approx. 6.35 s

13.2 Simulated Spectrum

The simulation approximates the spectrum of air up to mass number 64, i.e., the intensity is output as a function of the mass number. For higher mass numbers, this spectrum is repeated "modulo 64 (mass number)".

The simulated spectrum allows you to start and test all measuring modes, such as SCAN-N, SCAN-F, SCAN-Stair, SAMPLE, PEAK-PROCESSING, ADJUST etc., without using an analyzer. You can choose between an internal and an external simulation.

13.2.1 Internal Simulation of Ion Currents

The mass number DAC outputs the simulated spectrum using the" Fix Range Mode" (Channels.Parameters.Amplifier.AutoRangeMode). The following table lists the intensities for various gases (mass numbers) resulting from the signal processing.

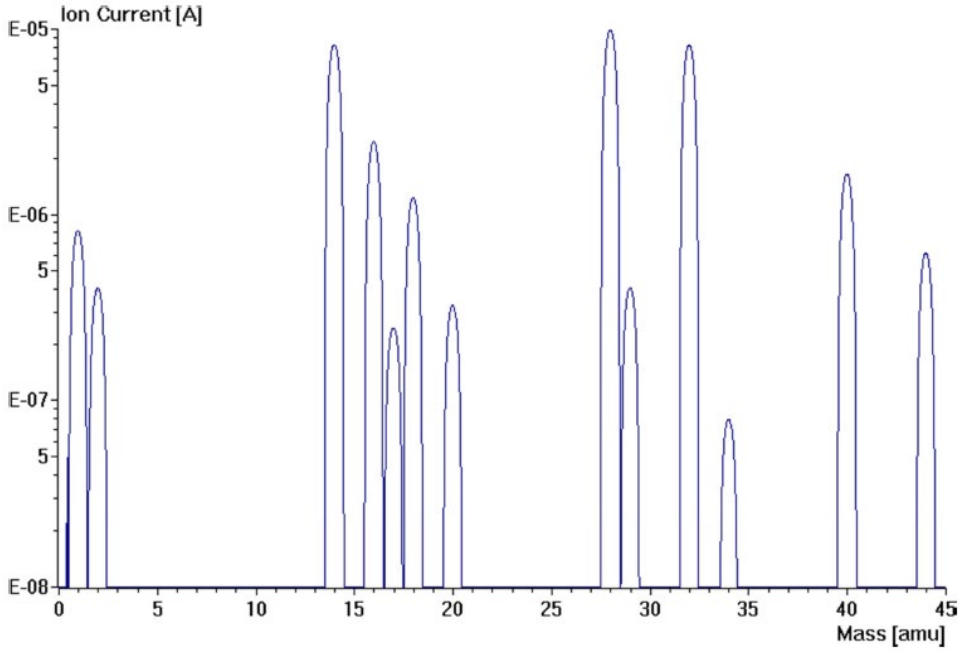
Mass number	Gas type	Intensity [A]
1	H^+	8.290×10^{-7}

2	H_2^+	4.095 x 10^{-7}
14	$N^+ + N_2^{++}$	8.153 x 10^{-6}
16	$O^+ + O_2^{++}$	2.438 x 10^{-6}
17	OH^+	2.445 x 10^{-7}
18	H_2O^+	1.225 x 10^{-6}
20	Ar^{++}	3.232 x 10^{-7}
28	N_2^+	9.698 x 10^{-6}
29	$^{14}N^{15}N^+$	3.941 x 10^{-7}
32	O_2^+	7.835 x 10^{-6}
34	$^{16}O^{18}O^+$	7.299 x 10^{-8}
40	Ar^+	1.542 x 10^{-6}
44	CO_2^+	5.807 x 10^{-7}

Table 13-1

As an example, the following figures shows the related simulated spectrum:

- Scan speed 1s/u
- Scan-N



14 Application Examples

14.1 MID Measurement

This chapter uses an MID (Multiple Ion Detection) measurement as application example of the OPC interface for the QMS700.

Application example:

The QMG800 should be started after a "Power on“, and then measuring seven gases.

14.1.1 Using Simulation (SAMPLE = Single mass)

Prerequisites:

- A QMS800 is connected, with or without analyzer.

Device Configuration:

OPC Name	Value	Details
Hardware.Modules.Analyzer.SI700.SimulationMode		
	1	Internal simulation ON
General.DataPump.Mode		
	0	DATA-LOOSE

Channels Parameters 0 … 6:

OPC Name	Value	Details
Channels.Parameters.Mass.FirstMass		
	14;16;18;28;32;40;44	Mass
Channels.Parameters.Mass.DwellSpeed		
	5;5;5;5;5;5;5	Dwell per amu 100 ms
Channels.Parameters.Mass.MassMode		
	0;0;0;0;0;0;0	SAMPLE measurement on mass value
Channels.Parameters.Amplifier.AutoRangeMode		
	0;0;0;0;0;0;0	FIX Range
Channels.Parameters.Amplifier.DetectorRange		
	0;0;0;0;0;0;0	1E-5 A electrometer range

Channels.Parameters.Detector.DetectorType		
	0;0;0;0;0;0;0	FARADAY ion detection

Cycle Parameters:

OPC Name	Value	Details
General.Cycle.CycleMode		
	1	MULTI
General.Cycle.MeasureMode		
	0	CYCLE normal measurement operation
General.Cycle.NumberOfCycles		
	0	The measurement cycle is repeated endlessly
General.Cycle.BeginChannel		
	0	Start channel of the measurement cycle
General.Cycle.EndChannel		
	6	Ending channel of the measurement cycle

NOTICE: New or modified parameters for the measurement tasks are accepted by the device only after the measurement has been restarted.

Start MID:

OPC Name	Value	Details
General.Cycle.Command		
	1	RUN, i.e., start of the measurement
General.Cycle.Status		
	-	1 = halt, 5 = run multi

The measuring cycle for the seven gasses takes about 0.756 s: 0.1 s/gas + pause time

Read the measured values:

OPC Name	Value	Details
Channels.Actuality.MeasureValue		
		Display the peak intensity

Channels.Actuality.MassValue		
		Display the mass
Channels.Actuality.Status		
		Display the status

Disconnect System:

OPC Name	Value	Details
General.Cycle.Command		
	2	STOP the measurement
Hardware.Modules.Analyzer.SI700.SimulationMode		
	0	Simulation OFF

14.1.2 Using Simulation (SAMPLE = Single mass) + Filament ….

Prerequisites:

- A QMS800 is connected, with analyzer.
- The ion source is optimized.
- Feed a suitable test gas, such as air, into the vacuum chamber.

Device Configuration:

OPC Name	Value	Details
Hardware.Modules.Analyzer.SI700.SimulationMode		
	1	Internal simulation ON
General.DataPump.Mode		
	0	DATA-LOOSE

Ion Source Configuration:

OPC Name	Value	Details
Analyzer.Detector.Type		
	0	FARADAY
Analyzer.Filament.Command		

	1	Filament ON
Analyzer.Filament.EmissionStatus		
	-	0 = filament off, 1 = filament on
General.ErrorsWarnings.Static.Error		
	-	See Table 8-4

Channels Parameters 0 … 6:

OPC Name	Value	Details
Channels.Parameters.Mass.FirstMass		
	14;16;18;28;32;40;44	Mass
Channels.Parameters.Mass.DwellSpeed		
	5;5;5;5;5;5;5	Dwell per amu 100 ms
Channels.Parameters.Mass.MassMode		
	0;0;0;0;0;0;0	SAMPLE measurement on mass value
Channels.Parameters.Amplifier.AutoRangeMode		
	1;1;1;1;1;1;1	AUTO Range
Channels.Parameters.Detector.DetectorType		
	0;0;0;0;0;0;0	FARADAY ion detection

Cycle Parameters:

OPC Name	Value	Details
General.Cycle.CycleMode		
	1	MULTI
General.Cycle.MeasureMode		
	0	CYCLE normal measurement operation
General.Cycle.NumberOfCycles		
	0	The measurement cycle is repeated endlessly
General.Cycle.BeginChannel		

	0	Start channel of the measurement cycle
General.Cycle.EndChannel		
	6	Ending channel of the measurement cycle

NOTICE: New or modified parameters for the measurement tasks are accepted by the device only after the measurement has been restarted.

Start MID:

OPC Name	Value	Details
General.Cycle.Command		
	1	RUN, i.e., start of the measurement
General.Cycle.Status		
	-	1 = halt, 5 = run multi

The measuring cycle for the seven gasses takes about 0.756 s: 0.1 s/gas + pause time

Read the Measured Values:

OPC Name	Value	Details
Channels.Actuality.MeasureValue		
		Display the peak intensity
Channels.Actuality.MassValue		
		Display the mass
Channels.Actuality.Status		
		Display the status

Disconnect System:

OPC Name	Value	Details
General.Cycle.Command		
	2	STOP the measurement
Analyzer.Filament.Command		
	2	Filament OFF
Analyzer.Filament.EmissionStatus		

	-	0 = filament off, 1 = filament on

14.2 Scan Measurement

This chapter uses a SCAN measurement as application example of the OPC interface for the QMS800.

Application example:

The QMG800 should be started after a "Power on“, and then scanning the mass range from 0 to 50.

14.2.1 Using Simulation (SCAN-N = Mass range)

Prerequisites:

- A QMS800 is connected, with or without analyzer.

Device Configuration:

OPC Name	Value	Details
Hardware.Modules.Analyzer.SI700.SimulationMode		
	1	Internal simulation ON
General.DataPump.Mode		
	0	DATA-LOOSE

Channels Parameters 0:

OPC Name	Value	Details
Channels.Parameters.Mass.FirstMass		
	0	Mass
Channels.Parameters.Mass.Width		
	50	Mass range to be scanned
Channels.Parameters.Mass.DwellSpeed		
	8	Speed, 1 s per amu
Channels.Parameters.Mass.MassMode		
	1	SCAN-N (standard scan)
Channels.Parameters.Amplifier.AutoRangeMode		
	0	FIX Range

Channels.Parameters.Amplifier.DetectorRange		
	0	1E-5 A electrometer range
Channels.Parameters.Detector.DetectorType		
	0	FARADAY ion detection

Cycle Parameters:

OPC Name	Value	Details
General.Cycle.CycleMode		
	1	MULTI
General.Cycle.MeasureMode		
	0	CYCLE normal measurement operation
General.Cycle.NumberOfCycles		
	0	The measurement cycle is repeated endlessly
General.Cycle.BeginChannel		
	0	Start channel of the measurement cycle
General.Cycle.EndChannel		
	0	Ending channel of the measurement cycle

NOTICE: New or modified parameters for the measurement tasks are accepted by the device only after the measurement has been restarted.

Start Scan:

OPC Name	Value	Details
General.Cycle.Command		
	1	RUN, i.e., start of the measurement
General.Cycle.Status		
	-	1 = halt, 5 = run multi

The scan over the mass range 50 takes about 50.008 s: 1 s/amu + pause time

Read the measured values:

OPC Name	Value	Details

Channels.Actuality.ActualChannel.MassValue		
		Display the current mass value
Channels.Actuality.ActualChannel.MeasureValue		
		Display the current measuring value

You can also use the ring buffer to read the measured values. This is absolutely required when a faster scan speed is used. Otherwise, measured data will be lost. See also section 10.

Read the ring buffer:

OPC Name	Value	Details
General.DataPump.Mode		
	1	HOLD
General.DataPump.Data		
		Complex data structure

Disconnect system:

OPC Name	Value	Details
General.Cycle.Command		
	2	STOP the measurement
Hardware.Modules.Analyzer.SI700.SimulationMode		
	0	Simulation OFF

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