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gasQS™ flonic NG

Quickstart Guide

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WARNING! *Please read the safety instructions carefully before installing and operating the instrument. Nonobservance of those guidelines could result in personal injury and/or damage to the equipment.*

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Contents

General Information

Aim of Document

This quick start guide describes the general functions of the gasQS flonic NG and gives important information about its handling. This document is intended as an aid for the integration of a gas QS flonic into a control system. It is an extension to the "gasQS flonic V2 Modbus Specification". The status of the device firmware used is Version 01.01.14.

For additional information please refer to the following documents:

- **gasQS flonic User Manual**
- **gasQS flonic Datasheet**
- **gasQS flonic Safety Instructions**
- **gasQS flonic Calibration Document**
- **gasQS flonic Modbus-RTU Protocol Specs**

gasQS™ Technology

With gasQS, Mems AG provides the technology to use natural gas and biogas in an efficient and environmentally friendly manner.

Natural gas has been used as a source of energy in countries around the world for many years and it is vital to many applications from industry to transport. However, power output, efficiency and environmental compatibility of the various gas applications are affected by the ever more rapidly changing gas compositions of new gas sources (biogas, LNG, power-to-gas). The effect of these fluctuations can be compensated, and processes optimized through determination of the gas quality – which has previously been the domain of expensive process and laboratory analytics.

gasQS flonic

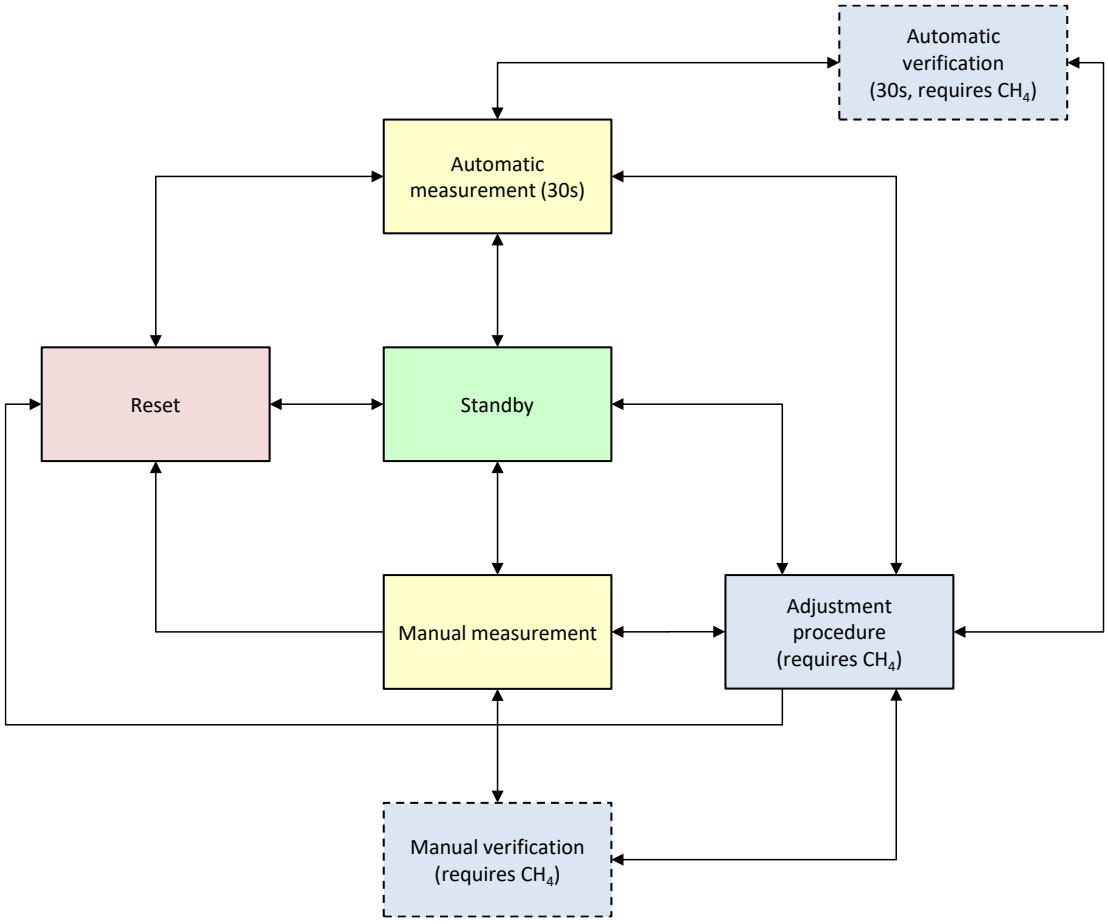
The flonic is a microelectromechanical gas quality measurement device. Based on a CMOS chip microthermal flow sensor in combination with a sonic nozzle and two on/off valves, thermal conductivity, heat capacity and relative density of the natural gas are measured. From these parameters, calorific value or compressibility factors are correlated.

Compared to process gas chromatographs, the typical analytical tool to determine gas parameters, this standalone device needs no carrier gas, is robust, compact, and inexpensive. It also provides a control output for automatic calibration in the field.

gasQS flonic Commissioning & Operation

Measurement Data Acquisition

After switching on the power supply, it takes approximately 7-8 seconds until the device is ready for operation. The device can be set so that measurements are started automatically at a specified measuring period, or so that measurements must be triggered manually (via coil address 0x0000). If the automatic measuring mode is activated, the measurement starts immediately after start-up, otherwise the device remains in stand-by mode.

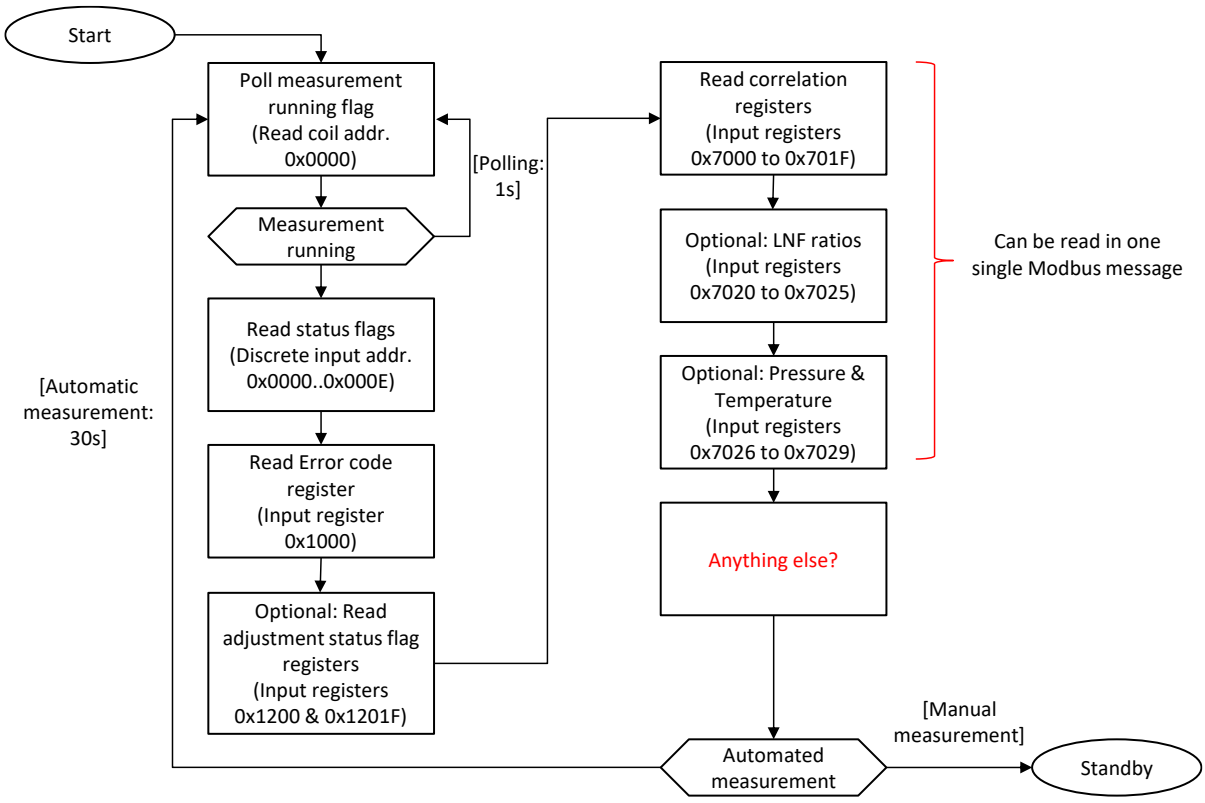


Device state transition diagram.

In principle, it is possible to communicate with the device while a measurement is in progress. However, excessive communication with the device should be avoided as it may disturb the measurement. Polling of the "Measurement running" flag (measurement sequence running status, Modbus coil address 0x0000) every second is no problem, neither is the one-time readout of the correlation registers every 30 seconds. However, continuous reading of all the measurement and control variables could be problematic.

Recommended procedure for measurement operation:

1. Polling of the flag once per second: "Measurement sequence running".
   (coil address 0x0000) until the measurement is finished.
2. Readout the status flags (function code 0x02).
3. Readout of the error register
   (input register address 0x1000)
4. Readout of the correlation registers
   (input register address 0x0000, number of registers 32, or address 0x7000, number of registers 32)
5. Reading of further data as required (e.g. LNF ratios or pressure and temperature data).
6. Continue with point 1.



Measurement data acquisition in automatic measurement mode.

Automatic Measuring Cycle

At the holding register address 0x0000 the time interval for starting the automatic measurements is set. The measurement period is defined as time in seconds. To ensure compliance with OIML R 140, the measuring period must be 30s.

Holding Register Address	Register Value	Description	Modbus Function	Function Code
0x0000	0 (0x0000)	The automatic measurement is switched off. Measurements are started manually by setting the coil address 0x0000 to "True"	Write Single Register	6
0x0000	30 (0x001E)	The automatic measurement is switched on. The measuring period is 30s. After writing the measuring period, the automatic measurement is started immediately.	Write Multiple Registers	16

Manual Measuring Cycle

The automatic measurement must be switched off. The measuring cycle is specified by an external device. To ensure compliance with OIML 140, the measuring period must also be 30s in manual mode. Depending on the density of the gas, a measurement cycle typically takes 20 to 25 seconds.

Holding Register Address	Register Value	Description	Modbus Function	Function Code
0x0000	0 (0x0000)	The automatic measurement is switched off. The start of the measurement is then done manually by setting the coil address 0x0000 to "True"	Write Single Register	6
			Write Multiple Registers	16

Coil Address	Register Value	Description	Modbus Function	Function Code
0x0000	False	The device responds, but no measurement is started.	Write Single Coil	5

0x0000	True	The manual measurement starts immediately. If a measurement is already in progress, another measurement is triggered immediately after it is completed.	Write Multiple Coil	15

Query the Device Status

Querying the status flags is particularly useful when the device is put into operation but can also be performed periodically.

Coil Address	Description	Modbus Function	Function Code
0x0000	Device ready[1]	Read Discrete Inputs	2
0x0001	Flow sensor OK?		
0x0002	Pressure sensor OK?		
0x0003	Internal supply voltage 3.3V OK?		
0x0004	External supply voltage 12V OK?		
0x0005	Internal isolated supply voltage der GPIOs 3.3V OK?		
0x0006	External isolated supply voltage der GPIOs 12V OK?		
0x0007	Internal operating voltage 5V (obsolete and always "True").		
0x0008	Microcontroller temperature OK?		
0x0009	Flow sensor temperature OK?		
0x000A	Upstream pressure OK? (Updated only during a measurement).		
0x000B	Bootloader checksum OK?		
0x000C	Application checksum OK?		
0x000D	Configuration checksum OK?		
0x000E	Microcontroller quartz OK? (Only available from FW version 02.00.xx.)		

[1] Combined information: This discrete input comes TRUE if all relevant checks were successful. The state of the isolated GPIO (address 0x0007) and the input pressure (address 0x000A) is ignored).

Query the Measurement Status

Modbus Function	Function Code	Coil Address	Response Value	Description
Read Coils	1	0x0000	False	The device is in stand-by mode and is waiting for the next measurement to be triggered.
		0x0000	True	A measurement is currently being performed.

Provision of the Parameters T & P

To be able to determine compressibility Z at operating conditions, a pressure and a temperature value at operating conditions are required. These parameters must be written from the control system via Modbus to the gasQS flonic NG.

Write parameters as floating point numbers:

Name	Modbus Address	Modbus Address	Preparation	Interpretation
Holding register (Function code 6 & 16)	Factor m (16bit unsigned integer)	Exponent n (16bit unsigned integer)		
Operating pressure for calculation of the compressibility Z: P [mbara].	0x7010	0x7011	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit float
Operating temperature for calculation of the compressibility Z: T [K].	0x7012	0x7013	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit float

The floating point numbers comply with the IEEE standard for floating point arithmetic (IEEE 754).

Reading out the Measured Values (correlation registers)

All correlation registers (measurement results) can be read out via Modbus input register (function code 0x04) with a single Modbus request. The update of all values takes place synchronously after a measurement, so that there is always a coherent data set. It is therefore recommended to read out all registers from address 0x7000 to 0x701F at once.

Read correlation registers as floating point numbers:

Name	Modbus Address	Modbus Address	Evaluation	Interpretation
Input register (Function code 4)	m = MSW (16bit unsigned integer)	n = LSW (16bit unsigned integer)	Combination of the two Modbus register values m & n	Typecast to 32bit data
Analysis counter: Incremented after successful completion of each data analysis	0x7000	0x7001	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit unsigned integer
Downstream pressure at the end of the measurement: Pout [mbara]	0x7002	0x7003	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit float
Normal density: Dn [kg/m^3]	0x7004	0x7005	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit float
Calorific value: Hs [MJ/m^3]	0x7006	0x7007	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit float
n/a	0x7008	0x7009	ignore	ignore
n/a	0x700A	0x700B	ignore	ignore
n/a	0x700C	0x700D	ignore	ignore
Operating pressure for calculation of the compressibility Z: P [mbara]	0x700E	0x700F	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit float
Operating temperature for calculation of the compressibility Z: T [K]	0x7010	0x7011	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit float
Compressibility at base conditions: Zn	0x7012	0x7013	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit float
Compressibility at operating conditions: Z	0x7014	0x7015	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit float
n/a	0x7016	0x7017	ignore	ignore

n/a	0x7018	0x7019	ignore	ignore
n/a	0x701A	0x701B	ignore	ignore
n/a	0x701C	0x701C	ignore	ignore
Hydrogen content [mol-%][2]	0x701E	0x701F	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit float

The floating point numbers comply with the IEEE standard for floating point arithmetic (IEEE 754).

Operating Parameters

- "Measurement running" flag (coil 0x0000): The polling of this coil is used to determine when a measurement is completed and new measured values are available. If the coil is set to FALSE the device is in idle mode.
- Analysis counter: Is read out together with the correlation registers. Only if the counter is incremented, have the measured values been updated.
- Error Code Register (Update on measurement)
- Status flags: Used to check the most important operating parameters.

Reading out further operating parameters is not necessarily useful, since they are primarily intended for internal Mems use and are already implicitly evaluated with the measures mentioned above.

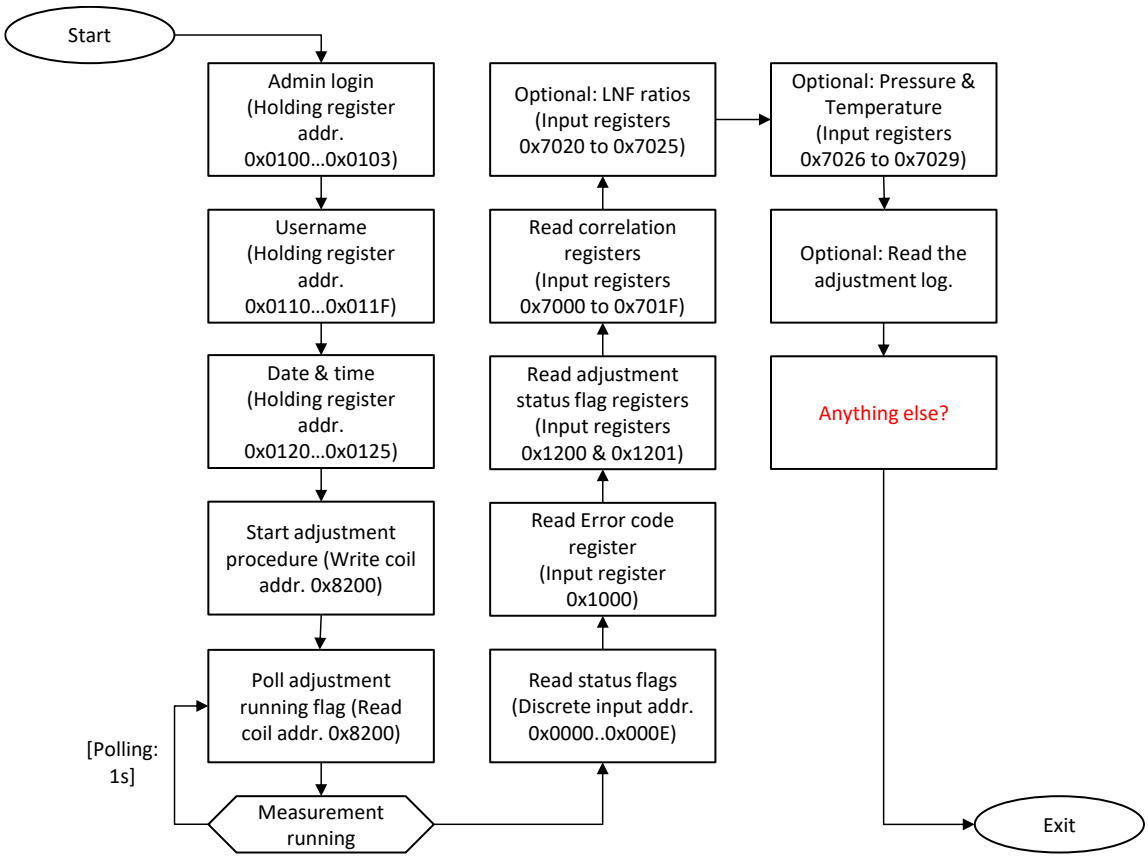
Adjustment Procedure

Before an adjustment procedure can be started, the function must be enabled with the administrator password and a username and a time stamp for the log entry must be sent to the device. Then the adjustment procedure can be triggered via the coil address 0x8200.

Before starting the adjustment procedure, the reference gas (pure methane, minimum purity: 3.5) must be connected to the device. The volume of the supply fittings should be kept as small as possible and flushed with the reference gas.

[2] Not available on standard devices.

Recommended procedure for adjustment operation:



Adjustment procedure flow chart.

Password

An ASCII string with a length from 1 to 8 bytes. An odd number of bytes must terminate the string with a terminating null character. (The default password is "1234").

Name	Modbus Address	Example	Interpretation
Holding register (Function code 6 & 16)	Holding register address	(16bit unsigned integer)	ASCII characters
Administrator password: Bytes [B0, B1]	0x0100	0x3132	"12"
Administrator password: Bytes [B2, B3]	0x0101	0x3334	"34"

Administrator password: Bytes [B4, B5]	0x0102	0x0000	"\0\0"
Administrator password: Bytes [B6, B7]	0x0103	0x0000	"\0\0"

The registers with the value 0x0000 do not have to be written, the string is terminated automatically. The admin access is automatically locked again after…

- 15 minutes of operation, or
- a device reset or power cycle, or
- writing an incorrect password to the device.

Username

An ASCII string with the length from 1 to 32 bytes. In the following example, the username is "Felix".

Name	**Modbus Address**	**Example**	**Interpretation**
Holding register (Function code 6 & 16)	Holding register address	(16bit unsigned integer)	ASCII characters
Username: Bytes [B0, B1]	0x0110	0x4A65	"Fe"
Username: Bytes [B2, B3]	0x0111	0x6C69	"li"
Username: Bytes [B4, B5]	0x0112	0x7800	"x\0"
Username: Bytes [B6, B7]	0x0113	0x0000	"\0\0"
…	…	…	…
Username: Bytes [B30, B31]	0x011F	0x0000	"\0\0"
Username: Bytes [B30, B31]	0x011F	0x0000	"\0\0"

A username must start with a letter or a number and it must be at least one ASCII character long. The registers with the value 0x0000 do not have to be written. The string is automatically terminated.

Date & Time

In the following example, the date appears in the adjustment log as the ASCII string "2023-12-31 23:59:59".

Name	Modbus Address	Example	Interpretation
Holding register (Function code 6 & 16)	Holding register address	(16bit unsigned integer)	Decimal
Year (0…9999)	0x0120	0x07E7	2023
Month (0…12)	0x0121	0x000C	12
Day (1…31)	0x0122	0x001F	31
Hours (0…23)	0x0123	0x0017	23
Minutes (0…59)	0x0124	0x003B	59
Seconds (0…59)	0x0125	0x003B	59

Start an Adjustment Procedure

Coil Address	Register Value	Description	Modbus Function	Function code
0x8200	False	The device responds, but no adjustment procedure is started.	Write Single Coil	5
0x8200	True	The adjustment procedure starts immediately. If a measurement is already in progress, the adjustment procedure is started after the measurement has been completed.	Write Multiple Coil	15

Query the Adjustment Procedure Status

Coil Address	Register Value	Description	Modbus Function	Function code
0x0000	False	The adjustment procedure is not in progress or the adjustment procedure is finished.	Read Coils	1
0x0000	True	An adjustment procedure is currently being executed.		

The following values can optionally be read out to observe the progress during an adjustment procedure.

Name	Modbus Address	Modbus Address	Evaluation	Interpretation
Input register (Function code 4)	m = MSW (16bit unsigned integer)	n = LSW (16bit unsigned integer)	Combination of the two Modbus register values m & n	Typecast to 32bit data
Total number of measuring cycles for an adjustment procedure.	0x8204	0x8205	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit unsigned integer
Number of measuring cycles remaining until the end of the adjustment procedure.	0x8208	0x8209	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit unsigned integer

Name	Modbus Address	Modbus Address	Evaluation	Interpretation
Input register (Function code 4)	m = MSW (16bit unsigned integer)	n = LSW (16bit unsigned integer)	Combination of the two Modbus register values m & n	Typecast to 32bit data
Adjustment alarm status flags.	0x1200	0x1201	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit unsigned integer

Interpretation of the 32bit bit pattern of the adjustment alarm status flags:

Bit No.	Name	Description
Control flags		
BIT_0	ADJUSTMENT_PENDING	A new adjustment procedure is required.
BIT_1	ADJUSTMENT_RUNNING	An adjustment procedure is currently being carried out.

BIT_2	ADJUSTMENT_FAILED	The last adjustment procedure failed.
Adjustment error flags		
BIT_3	ADJUSTMENT_MEAS_ERR	General error in the acquisition of measured values.
BIT_4	ADJUSTMENT_STABILITY	Stability of the mean value is insufficient.
BIT_5	ADJUSTMENT_HALF_MPE	Deviation between two adjustments exceeded by half MPE.
BIT_6	ADJUSTMENT_MAX_DRIFT	Maximum deviation between two adjustments exceeded.
BIT_7	ADJUSTMENT_MAX_OFFSET	Maximum total deviation was exceeded.
BIT_8	ADJUSTMENT_UPPER_LIMIT	Upper measurement limit was exceeded.
BIT_9	ADJUSTMENT_LOWER_LIMIT	Lower measuring limit was undershot.
Reserved Flags		
…	Reserved	Unused bit values are always ‘0’.
Correlation registers alarm flags		
BIT_16	ADJUSTMENT_REG_CORR_0	During the adjustment procedure, an alarm flag was raised for correlation register 0.
BIT_17	ADJUSTMENT_REG_CORR_1	During the adjustment procedure, an alarm flag was raised for correlation register 1.
…	…	…
BIT_31	ADJUSTMENT_REG_CORR_15	During the adjustment procedure, an alarm flag was raised for correlation register 15.

The status of BIT_0 (ADJUSTMENT_PENDING) corresponds to the readout value of coil 0x8201 and BIT_1 (ADJUSTMENT_RUNNING) corresponds to the readout value of coil 0x8201. It is therefore also sufficient to read out or poll the adjustment status flags instead of these coils.

Reading the Adjustment Log

The Adjustment Log is read out via an address in the file (file pointer) and a range of Modbus input registers mapped to it. This register data can be interpreted as a byte stream. The beginning of the file

always corresponds to the file pointer address 0. The data length is limited to the maximum number of 125 registers that can be read at once with the Modbus function “Read Input Registers” (function code 4). The readout can be terminated when the file size (in bytes) is reached or when one or more EOF (0xFF) are read out. The file size can be determined via the corresponding input registers (0x847E & 0x847F). Administrator rights are required to read out the logfile, therefore the device must be unlocked with the admin password beforehand.

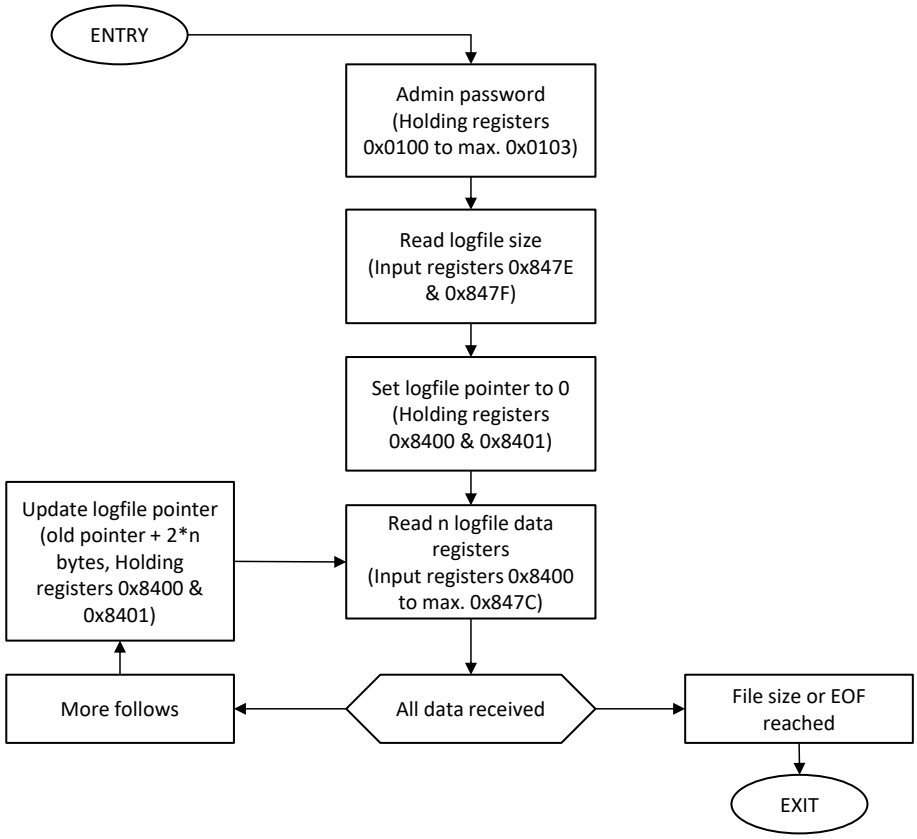
Name	**Modbus Address**	**Modbus Address**	**Evaluation**	**Interpretation**
Holding register (Function code 6 & 16)	Holding register address	(16bit unsigned integer)	Decimal	Holding register (Function code 6 & 16)
Logfile pointer: File pointer for reading out the log file data.	0x8400	0x8401	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit unsigned integer

Name	**Modbus Address**	**Modbus Address**	**Evaluation**	**Interpretation**
Input register (Function code 4)	Holding register address	(16bit unsigned integer)	Decimal	Holding register (Function code 6 & 16)
Logfile length: File size in bytes	0x847E	0x847F	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit unsigned integer

Example of reading the log file: "Text…"

Name	**Modbus Address**	**Example**	**Interpretation**
Input register (Function code 4)	Holding register address	(16bit unsigned integer)	ASCII character
Logfile: Bytes [B0, B1]	0x8400	0x5465	"Te"

Logfile: Bytes [B2, B3]	0x8401	0x7874	"xt"
Logfile: Bytes [B4, B5]	0x8402	0x2E2E	".."
Logfile: Bytes [B6, B7]	0x8403	0x2E00	".\0"
Logfile: Bytes [B8, B9]	0x8404	0xFFFF	"\xFF\xFF"
…	…	…	…
Logfile: Bytes [B246, B247]	0x847B	0xFFFF	"\xFF\xFF"
Logfile: Bytes [B248, B249]	0x847C	0xFFFF	"\xFF\xFF"



Modbus communication flow chart for reading the Adjustment Log.

Verification

There is no built-in verification function for the device. To check the calibration of the device, the reference gas (pure methane) must be connected. Data can then be recorded with the normal measurement cycle, in either manual or automatic measuring mode. The gas lines must be properly purged to ensure only the calibration gas is present and measurements made until the measured values are stable. Afterwards, the measurements can be compared with the nominal values for the calorific value and optionally also for the density, according to the calibration certificate.

Malfunctions & Fault Diagnosis

Fault diagnosis

The error code register (Modbus input register address 0x1000) is primarily used to detect errors in the operating sequence.

If faults occur during measurement, the correlation registers are set to the value NaN (Not a Number).

To find the cause, further information can be read out from the device. With the error counters (Modbus Input Registers: address 0x1001 to 0x1014) the frequency of occurrence of errors can be observed.

The status flags (Modbus Discrete Inputs: address 0x0000 to 0x000D) show information about the state of the device. These flags must all be TRUE, except for the isolated voltage input, if no additional external voltage is applied there.

Error Code Register (Input Register Address 0x1000)

Internal device errors that occur during the operating time are stored in the error code input register at address 0x1000. This register contains the first error code detected and is not overwritten by subsequent errors until it is reset by setting coil address 0x1000 to TRUE or by an automatic error code reset. If an error or warning is manually reset before the current measurement sequence that caused the error or warning is completed, an additional error from the current sequence may occur and be stored in the error code register. An automatic reset of the error code register occurs when a new measurement is performed and no further errors occur.

Code	Name	Interpretation
No exception error occurred		
0x0000	EXCEPTION_NONE	No error has occurred; the device is working properly.
Microcontroller hardware exceptions		
0x0001	EXCEPTION_ADC_ERROR	In case of an error due to an overflow when using ADC with DMA transfer.
0x0002	EXCEPTION_ADC_RECALIB_ERROR	Automatic self-calibration of the ADC failed.
0x0003	EXCEPTION_I2C_ERROR	I2C communication error occurred with the sensor or the EEPROM.
0x0004	EXCEPTION_CLOCK_SOURCE_ERROR	Quartz oscillator is not functioning correctly. The time source is not reliable.
0x0005	EXCEPTION_FLASH_CRC_ERROR	CRC check in Flash memory failed
Peripheral hardware exceptions		
0x1000	EXCEPTION_EEPROM_ACCESS_ERROR	EEPROM communication error occurred.
0x1001	EXCEPTION_TITAN_SENSOR_ERROR	Communication error of the flow sensor occurred.
0x1002	EXCEPTION_PRESSURE_SENSOR_ERROR	Invalid data from the pressure sensor.
0x1003	EXCEPTION_POWER_SUPPLY_ERROR	Power supply voltage error
Application exceptions		
0x2000	EXCEPTION_OS_UNKNOWN_ERROR	Unspecified operating system error.
0x2001	EXCEPTION_OS_SIGNAL_TIMEOUT	Unspecified timeout of the operating system.
0x2002	EXCEPTION_CALIBRATION_ERROR	The device does not have any calibration data.
0x2003	EXCEPTION_VALVE_ERROR	Invalid valve configuration setting.

0x2004	EXCEPTION_UPSTREAM_PRESSURE	Upstream pressure level too low for measurement.
0x2005	EXCEPTION_DOWNSTREAM_PRESSURE	Downstream pressure level too high.
0x2006	EXCEPTION_NOT_READY	Pressure not in range, data evaluation not possible.
0x2007	EXCEPTION_MEASUREMENT_ERROR	Errors in the data acquisition.
0x2008	EXCEPTION_EVALUATION_ERROR	Error in the evaluation of the acquired data.
0x2009	EXCEPTION_PRESSURE_MODE_ERROR	Invalid pressure operating mode setting.
0x200A	EXCEPTION_NOZZLE_TIMEOUT_ERROR	The pressure drops too slowly.
0x200B	EXCEPTION_LAMBDA_TIMEOUT_ERROR	Error in the determination of thermal conductivity
0x200C	EXCEPTION_CONFIGURATION_ERROR	Invalid configuration data.
0x200D	EXCEPTION_ADJUSTMENT_ERROR	Invalid adjustment parameters.
Communication exceptions		
0x3000	EXCEPTION_MODBUS_ERROR	Internal Modbus driver error occurred.
Correlation warnings[3]		
0x8001	EXCEPTION_CORRELATION_ID_UNKNOWN	The specified correlation does not exist.
0x8002	EXCEPTION_CORRELATION_TEMP_WARNING	A temperature parameter is outside the specified range.
0x8003	EXCEPTION_CORRELATION_PRESSURE_WARNING	A pressure parameter is outside the specified range.
0x8004	EXCEPTION_CORRELATION_OVERRANGE_WARNING	The correlation result is too high and outside the calibrated range.
0x8005	EXCEPTION_CORRELATION_UNDERRANGE_WARNING	The correlation result is too low and outside the calibrated range.

[3] Warnings: The instrument is functioning properly, but the measurement input parameters or results may be out of range.

0x8006	EXCEPTION_CORRELATION_RATIO_WARNING	The flow and pressure ratios could not be determined.
0x8007	EXCEPTION_CORRELATION_UPPER_LIMIT_WARNING	The correlation result is too high and is outside the specified measuring range.
0x8008	EXCEPTION_CORRELATION_LOWER_LIMIT_WARNING	The correlation result is too low and outside the specified measuring range.
0x8009	EXCEPTION_ADJUSTMENT_PENDING_WARNING	The adjustment interval has expired and an adjustment is due.
0x800A	EXCEPTION_uC_TEMPERATURE_WARNING	Microcontroller temperature out of specified range.
0x800B	EXCEPTION_TITAN_TEMPERATURE_WARNING	Flow sensor temperature out of specified range.

Error Code Reference

The error code reference is a "timestamp" based on the settings in the holding register at address 0x8004. Since the device does not have a real-time clock, the selectable sources are measurement counter, analysis counter (default setting) and the operating hours counter. Measurement and analysis counters are not incremented in the event of an error. They show the last successful event before an error occurred.

Error Counter

While the error code register stores the first exception error that occurred, the error counters register all errors, including subsequent errors. In case of an overflow, the counters stop at a maximum value of 65535 and do not start again from zero.

In addition to the error counters for each individual error code, there is also a total error counter for the sum of all errors. The error counters can be reset to zero via coil address 0x8005.

Device Reset

The gasQS flonic V2 triggers a restart when a TRUE is written to the coil address 0x1001. The measured values are reset, and the device settings are retained after the restart.

Device Information

The Modbus function "Device Identification" (function code 0x2B/0x0E, conformity level: extended) can be used to retrieve information about the device and the assignment of the correlation registers.

Metrological Sealing

For the bootloader and the application firmware, as well as for the configuration with the calibration of the device, the respective checksums can be read from the input registers, whereby the configuration is device specific.

Name	Modbus Address	Modbus Address	Evaluation	Interpretation
Input register (Function code 4)	m = MSW (16bit unsigned integer)	n = LSW (16bit unsigned integer)	Combination of the two Modbus register values m & n	Typecast to 32bit data
Bootloader checksum	0x8020	0x8021	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit unsigned integer
Application checksum	0x8022	0x8023	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit unsigned integer
Configuration checksum (device-specific)	0x8024	0x8025	$[m_{15}, \dots m_0, n_{15}, \dots n_0]$	32bit unsigned integer

These checksums are checked at startup and then periodically once every hour. The result of this check can be queried via the discrete inputs already described.

Discrete Input Address	Description	Modbus Function	Function Code
0x000C	Application checksum OK?	Read discrete inputs	2
0x000D	Configuration checksum OK?		

Switching off the Supply

Various data on settings and states of the device are stored in an internal non-volatile memory (EEPROM). If the power supply is switched off abruptly, it is possible that data that has just been updated could not yet be saved in the EEPROM. To ensure that no data is lost when the power supply is interrupted, a data backup can be forced via a coil function before switching off. With a reset via coil address 0x1001 this backup is executed automatically.

Coil Address	Register Value	Description	Modbus Function	Function Code
0x1004	False	The device responds, but no function is executed.	Write Single Coil	5
0x1004	True	Start backup of pending data to EEPROM.	Write Multiple Coils	15

Coil Address	Register Value	Description	Modbus Function	Function Code
0x1004	False	Data backup completed.	Read Coils	1
0x1004	True	Data backup pending.		

LED Status Description

Normal Measurement Operation:

LED		Color	State	
1 (upper) Status		**Yellow**	Switched ON:	Device busy (measuring).
		Green	Switched ON:	Device is in standby mode and ready for measurement.
2 (lower) Com		**Yellow**	Flashing:	Modbus frame reception or sending.
		Green	Switched ON:	Device powered.

Alarms during regular use:

LED		Color	State	
1 (upper) Status		**Red**	Flashing:	Measurement boundaries out of range, internal or adjustment fault.
2 (lower) Com/Sys		**Red**	Flashing:	The gasQS flonic is booting (after power up or after a restart)

Device states during adjustment procedure:

LED		Color	State	
1 (upper) Status		**Yellow**	Flashing:	Adjustment procedure ongoing, be patient.
		Red	Flashing:	Measurement boundaries out of range, internal or adjustment fault.
		Green	Switched ON:	Device ready, adjustment successful.
2 (lower) Com/Sys		**Yellow**	Flashing	Modbus frame reception or sending.
		Red	Flashing:	The gasQS flonic is booting (after power up or after a restart).
		Green	Switched ON:	Device powered.

Revisions

Nr.	Prepared		Overview	Checked		Approved	
1	Name Date	Thomas Kleiner 27.10.2023	Initial release	Name Date	Florian Krischker 08.11.2023	Name Datum	Alexander Diethelm 08.11.2023
2	Name Date	Thomas Kleiner 16.01.2024	WELMEC compliant firmware	Name Date	Bradley Visser 17.01.2024	Name Datum	Alexander Diethelm 17.01.2024
3	Name Date	Thomas Kleiner 16.04.2024	Updated diagrams, text improvements	Name Date	Bradley Visser 16.04.2024	Name Datum	Marco Siragna 25.04.2024
4	Name Date			Name Date		Name Datum	
5	Name Date			Name Date		Name Datum	
6	Name Date			Name Date		Name Datum	