Application Solutions

M100

Modbus Programmers Guide

METTLER TOLEDO

Content

1 General Modbus Information

1.1 Documentation of the Modbus protocol

For detailed information about Modbus specifications, please refer to the following documents:

– Modbus_over_serial_line_V1_02.pdf
– Modbus_Application_Protocol_V1_1b3.pdf

These documents are available on the Modbus website: www.modbus.org
Go to tab „Technical Resources".

1.2 Modbus testing tool

On the web, there are plenty of Modbus testing tools or modbus libraries available for C++, Phyton or other programming languages.
For manually accessing the M100 over Modbus, for instance to predefine the Modbus address, baudrate, or other items, the tool "Modbus Poll" is a feasible choice. It can be purchased at www.modbustools.com.

1.3 Protocol definitions, as implemented in M100

Modbus mode:	RTU
Start bits:	1
Data bits:	8
Stop bits:	1
Parity:	None
Baudrate:	4800, 9600, 19200, 38400 (default), 57600, 115000
Device address:	1 (default) to 247

The device does not implement any line polarization nor any line termination.
External line polarization and line termination is required.

1.4 Modbus RTU function codes implemented in M100

#3	Read Holding Registers
#4	Read Input Registers
#6	Write Single Register
#16	Write Multiple Registers

For detailed description of these functions please consult the document "Modbus_Application_Protocol_V1_1b3.pdf".

With the M100, reading any register is performed by either command #3 or #4.
There is no difference in handling the information between these two commands.

1.5 Data representation

Each Modbus register contains two bytes, the data length of a command and an answer is always a multiple of two registers.

The high byte (first byte) of a register contains the last digit of a value or string, the first digit of a value or string is found on the low byte (second byte) of the last register of the interesting register chain.
The first byte of a register always contains the higher order bits, the second byte contains the lower order bits.

Decimal values:
Integer decimal values are translated to hexadecimal numbers.
Non-integer decimal values are represented as single precision float values.
See below for examples.

For integer 16 bit values:

Example:	A 16-bit value of 22’354.
Converted to hex:	5752
First register:	Value (bytes 1, 2): 0x5752

When using Modbus Poll select “Signed/Unsigned” to correctly interpret values.

For integer 32 bit values:

Example:	A 32-bit value of 12’345’678.
Converted to hex:	BC614E
First register:	Higher bytes of the value (bytes 1, 2): 0x00BC
Second register:	Lower bytes of the value (bytes 3, 4): 0x614E

When using Modbus Poll select “Long ABCD” to correctly interpret long values.

For float values:
The mantissa of the value is stored on the second register, its exponent in the first register.
The float data format is implemented according to IEEE 754, single precision.

Example:	2.5, converted to a 32-bit float value → (Hex value 0x40200000).
First register:	0x4020
Second register:	0x0000

When using Modbus Poll select “float ABCD” to correctly interpret float values.

For ASCII-text strings:
Same data order as for integer values.

Example:	Text sample: “Text”. ASCII-code is: 0x54 0x65 0x78 0x74
First register:	0x5465
Second register:	0x7874

1.6 Addressing scheme

The addressing scheme of M100 is “Base 0” (first register number is 0).

A register offset is available on register number 0000.
Using this register offset, one can adjust the absolute starting point of the register bank to fit for instance already existing implementations.
The register offset is unsigned with a range of –32768 … 32767.
For instance by setting the offset to 1, the sensor is becoming „Base 1“.
By default, the register offset is set to 0, thus the first user register is on number 100.

Please note: The register offset is always found on register number 0000, independent of its value.
The offset affects only register numbers 0002 and up.

The register numbers given on the following pages are always relative numbers.
The absolute number of a register is calculated by adding the register offset to the relative address.

Examples:
Register offset as default (999), the device address shall be read:
Relative register number of device address is 3096.
The effective absolute register number to be transmitted in the command is: 4095.

1.7 Error handling

Transmission errors (corrupt telegrams) are detected by the M100. Corrupt telegrams are discarded and the sensor is waiting for a next, correct telegram.

Errors on application layer are answered with an error message. In case the answer consists of an error code, the leading bit (0x80) of the function code is set, signaling the error condition.

The following error codes are implemented in the M100:

Error code, hex	Error type
0x00	No error
0x01	Illegal function code was sent to the sensor
0x02	Illegal data address (invalid register number, access denied)
0x03	Illegal data value (value out of range)
0x04	Slave device error (operation not successfully completed)

Error code 0x01 is returned when a function code other than #3, #4, #16 is sent to the sensor.

Error code 0x02 is returned in the following cases:
– Any attempts to undefined registers
– Any attempts to registers on a higher operator level then actually selected (access denied)
– When reading too many registers, so undefined registers would be attempted
– When writing too many or not enough registers at once, or on a wrong starting address

Error code 0x03 is returned when writing invalid data to a register. Invalid data means any value out of the range of the specific register (value below or above limits, value not part of a list of possible values).
In this case, the last valid data is restored on the specific Modbus register and no change is active.

Error code 0x04 is typically returned when trying to log-in to a higher user level with a wrong password or to an inexistent user level. In these cases, the log-in fail, the operation is not successfully completed.

1.8 User levels, password protection

M100 transmitters have implemented three user levels, level 0, 1 and 2.
Reading registers is possible on any user level, except some specific registers used for calibration.
Writing registers of the sensor typically means changing the configuration, which also changes the behavior of the transmitter. To prevent of any unwanted configuration changes, most writing attempts are possible only on user level 2.
For all user levels, default passwords are stored in the transmitter. These passwords can be changed by the user. Changed passwords are stored in the non-volatile memory of the sensor.

User levels and default passwords of M100 transmitter:

User level	Code, hex	Default password, hex
0	0x00000003	0x00000000
1	0x0000000C	0x01145DEA
2	0x00000030	0x00F479CE

After each power-up, the sensor is reset to user level 0.
When trying to change the user level to an invalid level or using a wrong password, the sensor remains on the last valid user level, error code 0x04 is returned.

1.9 Writing registers, data retention

In nearly all cases, writing any registers of the M100 means changing the configuration of the sensor. Any configuration data are stored in the non-volatile memory (FLASH) of the sensor. Thus, the changed configuration will not get lost by a power-down of the sensor.

It is a well-known fact, that FLASH memories only allows about 100’000 write attempts.
By exceeding this limit, the FLASH memory might get damaged; resulting in data lost or corrupted data. A device with a damaged FLASH is no longer operable.

Attention!
The Modbus Master controller must make sure to write any configuration data only upon change and only during the commissioning phase of a system!
Automatic, periodic writes of data during normal operation must be prohibited!

Exceptions:
The Salinity (register 341) and Process Pressure (register 340) are not written into the internal EEPROM and therefore have no write cycle limit.

2 Implemented Modbus registers in M100

2.1 M100 Modbus registers

Except register 0000, all register addresses are relative to the offset stored in register 0000.

Example:

Register offset is 999, as by default. Register 3288 shall be read.
The controller must read from register 4287. Default register offset is 0.

Registers sorted in ascending register number order:

Register			Access Levels		Data Type
Start-Register	**Name**	**Count**	**Read**	**Write**	
0000 fixed	Register Offset	1	0	2	int16
32	User End Firmware Version	8	0	–	string
	Measuring Value Page of attached Sensor				
100	Primary Measuring Channel	2	0	–	float32
102	Secondary Measuring Channel	2	0	–	float32
104	Tertiary Measuring Channel	2	0	–	float32
106	Quaternary Measuring Channel	2	0	–	float32
120	Primary Measuring Channel Unit**	2	0	0*	uint32
122	Secondary Measuring Channel Unit**	2	0	0*	uint32
124	Tertiary Measuring Channel Unit**	2	0	0*	uint32
126	Quaternary Measuring Channel Unit**	2	0	0*	uint32
	Diagnostics Value Page				
200	DLI	2	0	–	float32
202	ACT	2	0	–	float32
204	TTM	2	0	–	float32
206	CIP	1	0	–	uint16
208	SIP	1	0	–	uint16
210	Autoclave Counter	1	0	–	uint16
218	Flag Sensor Disconnected	1	0	–	uint16
219	Flag Wrong Sensor	1	0	–	uint16

* For persistent change of these registers unlock the M100 EEPROM first. To unlock write 0x5752 to register 3999. Otherwise changed values will be lost after the next power cycle.

** See table 2.3 Measuring Channel Units on page 10

Register			Access Levels		Data Type
Start-Register	**Name**	**Count**	**Read**	**Write**	
	M100 Transmitter Information Page				
280	Part Number	8	0	–	string
312	Serial Number	8	0	–	string
320	Manufacturer	8	0	–	string
336	Sensor Type	1	0	1*	uint16
	M100 Sensor Parameter Page				
340	Process Pressure	1	0	1	uint16
341	Salinity	1	0	1	uint16
	– oDO Sensor				
350	oDO Sampling Rate	2	0	1**	float32
352	oDO Switch off Temperature	2	0	1**	float32
354	oDO LED Mode	1	0	1**	uint16
	– DO Sensor				
370	Polarization Voltage	1	0	1**	int16
	Sensor Information Page				
380	Article Number	4	0	–	string
412	Serial Number	4	0	–	string
436	Sensor Model	8	0	–	string
444	Firmware Version	9	0	–	string
	Diagnostics Setup Page				
1000	ISM CIP Counter Max	1	0	1**	uint16
1002	ISM CIP Temperature	1	0	1**	uint16
1004	ISM SIP Counter Max	1	0	1**	uint16
1006	ISM SIP Temperature	1	0	1**	uint16
1008	ISM Autoclave Counter Max	1	0	1**	uint16
1020	ISM Counter Code	1	0	1	uint16
1022	ISM Counter Write Result Code	1	0	–	uint16
1024	ISM Counter Reset	1	–	1	uint16
1026	ISM Counter Increment	1	–	1	uint16
	Calibration Page				
2000	Status Calibration	2	0	–	uint32
2004	Control Calibration	1	0	1	uint16
2010	Calibration Unit	2	0	1	uint32

* For persistent change of these registers unlock the M100 EEPROM first. To unlock write 0x5752 to register 3999. Otherwise changed values will be lost after the next power cycle.

** EEPROM must be unlocked. Write 0x5752 to register 3999 to unlock the EEPROM.

Register			Access Levels		Data Type
Start-Register	Name	Count	Read	Write	
2012	Calibration Method	1	0	1	uint16
2013	Calibration Stability	1	0	1	uint16
2014	Calibration Buffer Tab	1	0	1	uint16
2016	Calibration Point Offset	2	0	1	float32
2018	Calibration Point Slope	2	0	1	float32
2020	Calibration Point Process	2	0	1	float32
2030	Calibration Pressure	1	0	1	uint16
2031	Calibration Salinity	1	0	1	uint16
2032	Calibration Humidity	1	0	1	uint16
2040	Check Offset	2	0	–	float32
2042	Check Slope	2	0	–	float32
2050	Calibration Date	2	0	1	uint32
2052	Calibration Time	1	0	1	uint16
	M100 Setup Page				
3096	Device Address	1	0	2*	uint16
3098	Address Limit Minimum	1	0	–	uint16
3100	Address Limit Maximum	1	0	–	uint16
3102	Baudrate	1	0	2*	uint16
3104	Baudrate Limit Minimum	1	0	–	uint16
3106	Baudrate Limit Maximum	1	0	–	uint16
3108	Uart Modus Mode	1	0	2*	uint16
3288	User Level	2	0	0	uint32
3292	User Level Passwords	2	–	2*	uint32
3300	Bluetooth Enabled	1	0	2*	uint16
3999	Unlock M100 EEPROM	1	0	0	uint16

* For persistent change of these registers unlock the M100 EEPROM first. To unlock write 0x5752 to register 3999. Otherwise changed values will be lost after the next power cycle.

** EEPROM must be unlocked. Write 0x5752 to register 3999 to unlock the EEPROM.

Note: An unlocked EEPROM becomes automatically locked after 2 minutes.

2.2 Sensor type

Sensor	Sensor Code
M100 1W pH	0x0100
M100 1W CO_2	0x0101
M100 1W DO	0x0102
M100 RS oDO	0x0200

2.3 Measuring channel units

Units pH	**Unit Code**	**Units DO**	**Unit Code**
DLI	0x0001′0000	DLI	0x0002′0000
ACT	0x0001′0001	ACT	0x0002′0001
TTM	0x0001′0002	TTM	0x0002′0002
Temperature °C	0x0001′0003	Temperature °C	0x0002′0003
Temperature °F	0x0001′0004	Temperature °F	0x0002′0004
Temperature K	0x0001′0005	Temperature K	0x0002′0005
pH Value pH	0x0001′0006	O_2 Part. Press. mbar	0x0002′0006
pH Value ORP	0x0001′0007	O_2 Part. Press. hPa	0x0002′0007
Resistance Glass	0x0001′0008	O_2 Part. Press. mmHg	0x0002′0008
Resistance Reference	0x0001′0009	%Air Saturation	0x0002′0009
pH Value mV	0x0001′000A	% O_2 Concentration	0x0002′000A
pH Value V	0x0001′000B	ppm Concentration	0x0002′000B
		ppb Concentration	0x0002′000C
		ppt Concentration	0x0002′000D
		% O_2 Gas Concentr.	0x0002′000E
		ppm O_2 Gas Concentr.	0x0002′000F
		O_2 Concentration g/l	0x0002′0010
		O_2 Concentration mg/l	0x0002′0011
		O_2 Concentration µg/l	0x0002′0012
		Process Pressure	0x0002′0013
		Amperom. Current µA	0x0002′0014
		Amperom. Current nA	0x0002′0015

Units CO_2	**Unit Code**	**Units oDO**	**Unit Code**
DLI	0x0003′0000	DLI	0x0004′0000
ACT	0x0003′0001	ACT	0x0004′0001
TTM	0x0003′0002	TTM	0x0004′0002
Temperature °C	0x0003′0003	Temperature °C	0x0004′0003
Temperature °F	0x0003′0004	Temperature °F	0x0004′0004
Temperature K	0x0003′0005	Temperature K	0x0004′0005
CO_2 Part. Press. mbar	0x0003′0006	O_2 Part. Press. mbar	0x0004′0006
CO_2 Part. Press. hPa	0x0003′0007	O_2 Part. Press. hPa	0x0004′0007
CO_2 Part. Press. mmHg	0x0003′0008	O_2 Part. Press. mmHg	0x0004′0008
% CO_2 Concentration	0x0003′0009	%Air saturation	0x0004′0009
CO_2 Concentration mg/l	0x0003′000A	% O_2 Concentration	0x0004′000A
CO_2 ORP mV	0x0003′000B	ppm Concentration	0x0004′000B
CO_2 UpH mV	0x0003′000C	ppb Concentration	0x0004′000C
Process Pressure mbar	0x0003′000D	ppt Concentration	0x0004′000D
CO_2 UpH cal	0x0003′000F	% O_2 Gas Concentr.	0x0004′000E
		ppm O_2 Gas Concentr.	0x0004′000F
		O_2 Concentration g/l	0x0004′0010
		O_2 Concentration mg/l	0x0004′0011
		O_2 Concentration µg/l	0x0004′0012
		Process Pressure	0x0004′0013

3 Detailed description of the implemented Modbus registers

Almost all writable registers are write protected. For persistent change of these registers unlock the M100 EEPROM first. To unlock write 0x5752 to register 3999. Otherwise changed values will be lost after the next power cycle.

Note: An unlocked EEPROM becomes automatically locked after 2 minutes.

3.1 User levels and passwords

After power-up, M100 is set to user level 0.
User levels 1 or 2 can be selected by logging in with password.
The password of each access level can be changed by the user.

Set user level

To change or check the user level, write or read relative register number 3288:

Register		**Register Usage**		**Access User Level**	
Start	Count	Register 1/2	Register 3/4	Read	Write
3288	4	User Level Code	Password	0	0
Example		0x0000, 0x0030	0x00F4, 0x79CE		

The selected user level stays active until next power-down of the sensor. After power-up, user level 0 is active. Invalid login trials are discarded and user level 0 is activated.

Change passwords for user levels

To change the password of a user level, write relative register number 3292:

Register		**Register Usage**		**Access User Level**	
Start	Count	Register 1/2	Register 3/4	Read	Write
3292	4	User Level Code (hex)	Password (hex)	–	2
Example		0x0000, 0x0030	0x1905, 0x0202		

Invalid user level settings are discarded and no password will be changed.
Checking the valid passwords is performed by reading the user level.

3.2 Modbus register offset

By default, the Modbus register offset is defined to 0. If necessary, this offset can be changed to any number in the range of –32768 … 32767.
To change or check the Modbus register offset, write or read absolute register number 0000:

Register		**Register Usage**	**Access User Level**	
Start	Count	Register 1	Read	Write
0000	1	Modbus Register Offset (unsigned integer)	0	2
Example		999 (hex-value on register #1: 0x03E7)		

3.3 Configuration of the RS485 interface

The factory settings of the RS485 interface are mentioned in chapter 1.3 Protocol definitions, as implemented in M100. The device address, as well as the baudrate and the UART Mode can be adjusted to fit the needs of your installation. **Please verify the new settings by reading them back before powering the unit off. After the next power cycle, the settings will be in effect and if wrong, no further communication will be possible.**

Device address

By default, the device address is set to 1. By reading relative registers 3098 and 3100, the valid address range can be evaluated. The device address can be changed to any number within this range by writing register 3096:

Register		**Register Usage**		**Access User Level**	
Start	Count	Register 1 / 2		Read	Write
3096	2	Device Address (unsigned int)		0	2
3098	2	Min Address (unsigned int)		0	–
3100	2	Max Address (unsigned int)		0	–

Baudrate

By default, the baudrate is set to 38400. Relative registers 3104 and 3106 report the baudrate limits. The baudrate can be changed to any number within this range by writing register 3102:

Register		**Register Usage**		**Access User Level**	
Start	Count	Register 1 / 2		Read	Write
3102	2	Baudrate Code (unsigned int)		0	2
3104	2	Min. Baudrate Code (unsigned int)		0	–
3106	2	Min. Baudrate Code (unsigned int)		0	–

The baudrate is represented as a decimal code:

Baudrate	4800	9600	19200	**38400**	57600	115200
Code	2	3	4	**5**	6	7

Modbus Mode

By default, the mode is set to 8bit data, no parity, 1 stop bit (8,None,1).

Register		**Register Usage**		**Access User Level**	
Start	Count	Register 1		Read	Write
3108	1	Mode		0	2

Possible values:

0x0000	0x0001	0x0002	0x0003	0x0004	0x0005
8,None,1	8,None,2	8,Even,1	8,Even,2	8,Odd,1	8,Odd,2

3.4 Measuring value page

3.4.1 Measuring channel registers

Register		**Register Usage**	**Access User Level**	
Start	Count	Register 1	Read	Write
100 102 104 106	2	Readout measuring value of primary, secondary, tertiary and quaternary measuring channel. Float32bit value.	0	–

3.4.2 Measuring channel unit registers

Register		**Register Usage**	**Access User Level**	
Start	Count	Register 1	Read	Write
120 122 124 126	2	Setup measuring channel unit of primary, secondary, tertiary and quaternary measuring channel. uint32bit value see 2.3 Measuring channel units for corresponding sensor type. For persistent change of the channel unit please unlock the eeprom fist.	0	0

Attention: Channel unit must correspond to the attached sensor type.

3.4.3 Sensor type registers

Register		**Register Usage**	**Access User Level**	
Start	Count	Register 1	Read	Write
336	1	Setup type of attached sensor on the M100. uint16bit value see 2.2 Sensor type for sensor specific coding. For persistent change of the channel unit please unlock the eeprom fist.	0	0

3.5 Diagnostics setup page

3.5.1 Diagnostic registers

Set maximum CIP counter

Register		**Register Usage**	**Access User Level**	
Start	Count	Register 1	Read	Write
1000	1	Setup CIP Counter Max. uChar 8bit value	0	1

Set CIP temperature

Register		**Register Usage**	**Access User Level**	
Start	Count	Register 1	Read	Write
1002	1	Setup CIP Counter Temperature. uChar 8bit value [°C]	0	1

Set maximum SIP counter

Register		Register Usage	Access User Level	
Start	Count	Register 1	Read	Write
1004	1	Setup SIP Counter Max. uChar 8bit value	0	1

Set SIP temperature

Register		Register Usage	Access User Level	
Start	Count	Register 1	Read	Write
1006	1	Setup SIP Counter Temperature. uChar 8bit value [°C]	0	1

Set maximum Autoclave counter

Register		Register Usage	Access User Level	
Start	Count	Register 1	Read	Write
1008	1	Setup Autoclave Counter Max. uChar 8bit value	0	1

3.5.2 Manipulation of diagnostic counters

The diagnostic counters can be modified. To modify a diagnostic counter, the counter to be modified is selected by writing the desired counter code into register 1020.

Available Counters	Code
SIP	0x01
CIP	0x02
Autoclaving	0x03
ACT	0x05
DLI	0x06
TTM	0x07

Now select the counter to be modified and send the corresponding code to register 1020.

Setup counter code

Register		Register Usage	Access User Level	
Start	Count	Register 1	Read	Write
1020	1	Setup ISM Counter Code	0	1

The status of the manipulation is shown in the ISM setup counter write result code register 1022. Before any manipulation this register should be idle. The following table shows the possible status codes available for register 1022.

Status ISM Manipulations of Register 1022	Code
Idle	0x00
Counter Reset in Progress	0x01
Counter Reset Failed	0x02
Counter Not Allowed For This Sensor	0x80
Counter Reset No Sensor Present	0x81
Counter Reset Wrong Code	0x82
Counter Reset Busy	0x83

Read status of counter manipulation

Register		Register Usage	Access User Level	
Start	Count	Register 1	Read	Write
1022	1	ISM Setup Counter Write Result Code	0	–

If the counter status in register 1022 is Idle, the counter previously selected with register 1020 can be either reset by writing 0x01 to register 1024 or incremented by writing 0x01 to register 1026.

Note: Not all counters can be incremented, some can only be reset.

Manipulation	Sensor Type
CIP Reset	pH, CO_2, DO, oDO
SIP Reset	pH, CO_2, DO, oDO
DLI Reset	DO, oDO
TTM Reset	pH, CO_2, DO
Autoclave Reset	pH, CO_2, DO, oDO
Autoclave Increment	pH, CO_2, DO, oDO

Setup counter reset

Register		Register Usage	Access User Level	
Start	Count	Register 1	Read	Write
1024	1	ISM Setup Counter Reset	–	1

Setup counter increment

Register		Register Usage	Access User Level	
Start	Count	Register 1	Read	Write
1026	1	ISM Setup Counter Increment	–	1

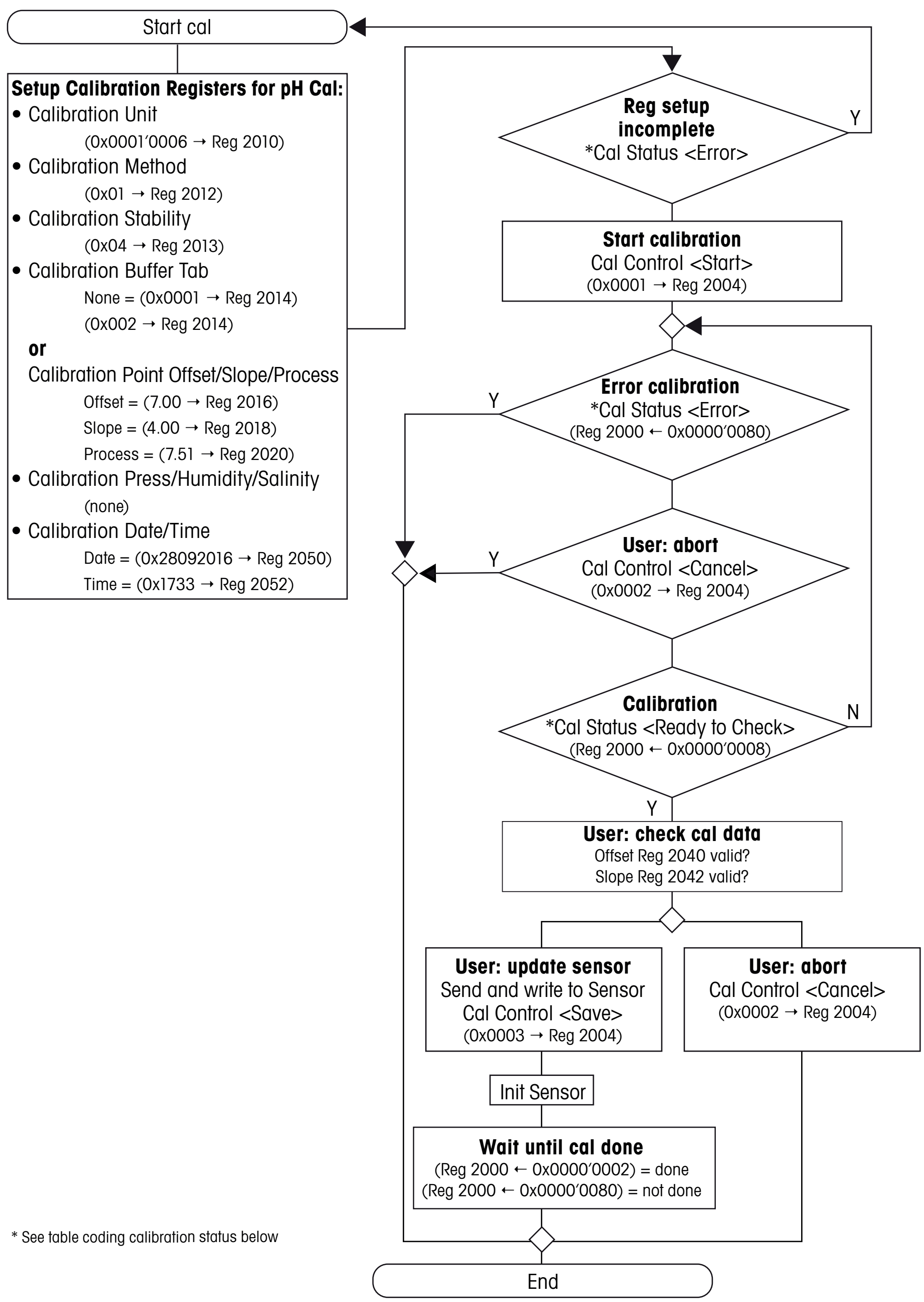
After writing a 0x01 to either register 1024 or 1026, the writing process can be monitored when reading register 1022 as described above.

3.6 Calibration page

The M100 calibration is done with a standard procedure which remains the same for all sensors. Therefore, the procedure has to be implemented only once. Only the setup of the calibration registers will change, when another sensor is calibrated.

Below there is an example of a complete pH calibration procedure (3.6.1). For all other calibrations, the procedure remains the same except for the "Setup Calibration Register" setup box. This box is explained in the chapter 3.6.2 and following.
Also the meaning of errors and status registers is explained in tables after the calibration examples.

3.6.1 Complete calibration example of a pH sensor



* See table coding calibration status below

3.6.2 Setup Calibration Registers for Cal pH sensor pH

The table describes the same values of the box Setup Calibration Registers in 3.6.1 Setup Calibration Registers:

Item	Value	Modbus Register #	Unit/Command
Calibration Unit	0x0001'0006	2010	pH
Calibration Method			Range
Offset	0x01	2012	–2 …16 pH
Slope	0x02	2012	
Process Offset	0x10	2012	
Process Slope	0x20	2012	
Calibration Stability			
Manual	0x01	2013	
Low	0x02*	2013	1.25 mV
Medium	0x04*	2013	0.8 mV
Strict	0x08*	2013	0.4 mV
Calibration Buffer Tab			
None	0x0001 (none use Reg 2016/ 2018/2020)	2014	—
All	0x0002	2014	See Calibration Buffer Tab below
Calibration Point			
Offset	7.0 pH	2016	Insert actual value
Slope	4.0 pH	2018	as floating point
Process	7.51 pH	2020	number
Calibration			
Pressure	none	2030	—
Humidity	none	2032	—
Salinity	none	2031	—
Calibration			
Date	0x2809'2016	2050	Date 28.09.2016
Time	0x1733	2052	Time 17h33

* pH criteria: 20 s interval within 300 s

Example:
Calibration of a pH Sensor pH, offset calibration, manual stability, buffer tab none, 7.00 pH offset, on September 30th 2016, 15h30

Write the following values to the registers:

0x0001'0006	→	2010
0x01	→	2012
0x01	→	2013
0x0001	→	2014
7.0 (IEEE float)	→	2016 & 2017
0x2809'2016	→	2050 & 2051
0x1530	→	2052

After this setup, start the calibration by sending:

0x0001	→	2004

3.6.3 Setup Calibration Registers for Cal pH sensor mV

The table describes the same values of the box Setup Calibration Registers in 3.6.1 Setup Calibration Registers:

Item	Value	Modbus Register #	Unit/Command
Calibration Unit	0x0001'0007	2010	mV
Calibration Method			Range –1500 mV … 1500 mV
Offset	0x01	2012	
Process Offset	0x10	2012	
Calibration Stability			
Manual	0x01	2013	
Calibration Buffer Tab			
None	0x0001 (none use Reg 2016/2020)	2014	—
Calibration Point			
Offset	–15.5 mV	2016	Insert actual value as floating point number
Process	+45.3 mV	2020	
Calibration			
Pressure	none	2030	—
Humidity	none	2032	—
Salinity	none	2031	—
Calibration			
Date	0x2809'2016	2050	Date 28.09.2016
Time	0x1733	2052	Time 17h33

Example:
Calibration of a pH Sensor mV, process offset calibration, manual stability, buffer tab none, +45.3 mV process offset, on September 30th 2016, 15h30

Write the following values to the registers:

0x0001'0007	→	2010
0x10	→	2012
0x01	→	2013
0x0001	→	2014
45.3 (IEEE float)	→	2020 & 2021
0x2809'2016	→	2050 & 2051
0x1530	→	2052

After this setup, start the calibration by sending:

0x0001	→	2004

3.6.4 Setup Calibration Registers for Cal DO sensor %Air

The table describes the same values of the box Setup Calibration Registers in 3.6.1 Setup Calibration Registers:

Item	Value	Modbus Register #	Unit/Command
Calibration Unit	0x0002'0009	2010	%Air
Calibration Method			Range
Offset	0x01	2012	0…5 %Air
Slope	0x02	2012	5…500 %Air
Process Offset	0x10	2012	0…5 %Air
Process Slope	0x20	2012	5…500 %Air
Calibration Stability			
Manual	0x01	2013	Manual
Auto	0x10*	2013	Auto
Calibration Buffer Tab			
None	0x0001	2014	—
Calibration Point			
Offset	3.0 % Air	2016	Insert actual value
Slope	100.0 % Air	2018	as floating point
Process	21.2 % Air	2020	number
Calibration			
Pressure	1013	2030	1013 mbar
Humidity	50	2032	50 %
Salinity	none	2031	—
Calibration			
Date	0x2809'2016	2050	Date 28.09.2016
Time	0x1733	2052	Time 17h33

* DO criteria: 60 s interval within 300 s: $|nA_{max} - nA_{min}| \leq \frac{nA_{act}}{256}$ (only for 1-point slope)

Example:

Calibration of a DO Sensor %Air, offset calibration, manual stability, 3 % offset, pressure 1008 mbar, humidity 45 %, on September 30th 2016. 15h30

Write the following values to the registers:

0x0002'0009	→	2010
0x01	→	2012
0x01	→	2013
0x0001	→	2014
3.0 (IEEE float)	→	2016 & 2017
1008	→	2030
45	→	2032
0x2809'2016	→	2050 & 2051
0x1530	→	2052

After this setup, start the calibration by sending:

0x0001 → 2004

3.6.5 Setup Calibration Registers for Cal DO sensor ppm, ppb, mg/l, µg/l

The table describes the same values of the box Setup Calibration Registers in 3.6.1 Setup Calibration Registers:

Item	Value	Modbus Register #	Unit/Command
Calibration Unit	0x0002'000B 0x0002'000C 0x0002'0011 0x0002'0012	2010 2010 2010 2010	ppm ppb mg/l µg/l
Calibration Method Offset Slope Process Offset Process Slope	 0x01 0x02 0x10 0x20	 2012 2012 2012 2012	Range 0 … 70 ppm 0 … 70 mg/l
Calibration Stability Manual Auto	 0x01 0x10*	 2013 2013	 Manual Auto
Calibration Buffer Tab None	 0x0001	 2014	 —
Calibration Point Offset Slope Process	 0.5 ppm 65.0 mg/l 55.6 mg/l	 2016 2018 2020	 Insert actual value as floating point number
Calibration Pressure Humidity Salinity	 1013 50 10 g/l	 2030 2032 2031	 1013 mbar — 10 g/l
Calibration Date Time	 0x2809'2016 0x1733	 2050 2052	 Date 28.09.2016 Time 17h33

* DO criteria: 60 s interval within 300 s: $\left| nA_{max} - nA_{min} \right| \leq \frac{nA_{act}}{256}$ (only for 1-point slope)

Example:
Calibration of a DO Sensor mg/l, offset calibration, auto stability, 0.48 mg/l offset, pressure 1018 mbar, salinity 10 g/l, on September 30th 2016, 15h30

Write the following values to the registers:

0x0002'0011	→	2010
0x01	→	2012
0x10	→	2013
0x0001	→	2014
0.48 (IEEE float)	→	2016 & 2017
1018	→	2030
10	→	2031
0x2809'2016	→	2050 & 2051
0x1530	→	2052

After this setup, start the calibration by sending:

0x0001	→	2004

3.6.6 Setup Calibration Registers for Cal DO sensor $\%O_2$

The table describes the same values of the box Setup Calibration Registers in 3.6.1 Setup Calibration Registers:

Item	Value	Modbus Register #	Unit/Command
Calibration Unit	0x0002'000A	2010	$\%O_2$
Calibration Method			Range
Offset	0x01	2012	0 … 1.05 $\%O_2$
Slope	0x02	2012	1.05 … 100 $\%O_2$
Process Offset	0x10	2012	0 … 1.05 $\%O_2$
Process Slope	0x20	2012	1.05 … 100 $\%O_2$
Calibration Stability			
Manual	0x01	2013	Manual
Auto	0x10*	2013	Auto
Calibration Buffer Tab			
None	0x0001	2014	—
Calibration Point			
Offset	0.75 $\%O_2$	2016	Insert actual value
Slope	95.7 $\%O_2$	2018	as floating point
Process	21.2 $\%O_2$	2020	number
Calibration			
Pressure	1013	2030	1013 mbar
Humidity	50	2032	50 %
Salinity	none	2031	—
Calibration			
Date	0x2809'2016	2050	Date 28.09.2016
Time	0x1733	2052	Time 17h33

* DO criteria: 60 s interval within 300 s: $|nA_{max} - nA_{min}| \leq \frac{nA_{act}}{256}$ (only for 1-point slope)

Example:

Calibration of a DO Sensor $\%O_2$, slope calibration, manual stability, 99.2 $\%O_2$ slope, pressure 1001 mbar, humidity 47 %, on September 30th 2016, 15h30

Write the following values to the registers:

0x0002'000A	→	2010
0x02	→	2012
0x01	→	2013
0x0001	→	2014
99.2 (IEEE float)	→	2018 & 2019
1001	→	2030
47	→	2032
0x2809'2016	→	2050 & 2051
0x1530	→	2052

After this setup, start the calibration by sending:

0x0001	→	2004

3.6.7 Setup Calibration Registers for Cal DO sensor %O_2Gas

The table describes the same values of the box Setup Calibration Registers in 3.6.1 Setup Calibration Registers:

Item	Value	Modbus Register #	Unit/Command
Calibration Unit	0x0002’000E	2010	%O_2Gas
Calibration Method			Range
Slope	0x02	2012	1.05 … 100 %O_2Gas
Process Slope	0x20	2012	1.05 … 100 %O_2Gas
Calibration Stability			
Manual	0x01	2013	Manual
Auto	0x10*	2013	Auto
Calibration Buffer Tab			
None	0x0001	2014	—
Calibration Point			
Slope	95.7 %O_2Gas	2018	Insert actual value
Process	21.2 %O_2Gas	2020	as floating point number
Calibration			
Pressure	1013	2030	1013 mbar
Humidity	50	2032	50 %
Salinity	none	2031	—
Calibration			
Date	0x2809’2016	2050	Date 28.09.2016
Time	0x1733	2052	Time 17h33

* DO criteria: 60 s interval within 300 s: $\left| nA_{max} - nA_{min} \right| \leq \frac{nA_{act}}{256}$ (only for 1-point slope)

Example:

Calibration of a DO Sensor %O_2Gas, slope calibration, manual stability, 99.2 %O_2Gas slope, pressure 1001 mbar, humidity 47 %, on September 30th 2016, 15h30

Write the following values to the registers:

0x0002’000E	→ 2010
0x02	→ 2012
0x01	→ 2013
0x0001	→ 2014
99.2 (IEEE float)	→ 2018 & 2019
1001	→ 2030
47	→ 2032
0x2809’2016	→ 2050 & 2051
0x1530	→ 2052

After this setup, start the calibration by sending:

0x0001	→ 2004

3.6.8 Setup Calibration Registers for Cal DO sensor ppmO_2Gas

The table describes the same values of the box Setup Calibration Registers in 3.6.1 Setup Calibration Registers:

Item	Value	Modbus Register #	Unit/Command
Calibration Unit	0x0002'000F	2010	ppmO_2Gas
Calibration Method			Range
Offset	0x01	2012	0 … 9999 ppmO_2Gas
Process Offset	0x10	2012	
Calibration Stability			
Manual	0x01	2013	Manual
Calibration Buffer Tab			
None	0x0001	2014	—
Calibration Point			
Offset	70.0 ppmO_2Gas	2016	Insert actual value
Process Offset	45.0 ppmO_2Gas	2020	as floating point number
Calibration			
Pressure	1013	2030	1013 mbar
Humidity	50	2032	50 %
Salinity	none	2031	—
Calibration			
Date	0x2809'2016	2050	Date 28.09.2016
Time	0x1733	2052	Time 17h33

Example:
Calibration of a DO Sensor ppmO_2Gas, offset calibration, manual stability, 70.0 ppmO_2Gas offset, pressure 1013 mbar, humidity 47 %, on September 30th 2016, 15h30

Write the following values to the registers:

0x0002'000F	→	2010
0x01	→	2012
0x01	→	2013
0x0001	→	2014
70.0 (IEEE float)	→	2016 & 2017
1013	→	2030
47	→	2032
0x2809'2016	→	2050 & 2051
0x1530	→	2052

After this setup, start the calibration by sending:

0x0001	→	2004

3.6.9 Setup Calibration Registers for Cal DO sensor mbar

The table describes the same values of the box Setup Calibration Registers in 3.6.1 Setup Calibration Registers:

Item	Value	Modbus Register #	Unit/Command
Calibration Unit	0x0002'0006	2010	mbar
Calibration Method			Range 0 … 630 mbar
Offset	0x01	2012	
Slope	0x02	2012	
Process Offset	0x10	2012	
Process Slope	0x20	2012	
Calibration Stability			
Manual	0x01	2013	Manual
Auto	0x10*	2013	Auto
Calibration Buffer Tab			
None	0x0001	2014	—
Calibration Point			
Offset	15.0 mbar	2016	Insert actual value
Slope	625.0 mbar	2018	as floating point
Process	320.0 mbar	2020	number
Calibration			
Pressure	1013	2030	1013 mbar
Humidity	none	2032	—
Salinity	none	2031	—
Calibration			
Date	0x2809'2016	2050	Date 28.09.2016
Time	0x1733	2052	Time 17h33

* DO criteria: 60 s interval within 300 s: $|nA_{max} - nA_{min}| \leq \frac{nA_{act}}{256}$ (only for 1-point slope)

Example:
Calibration of a DO Sensor mbar, slope calibration, manual stability, 625.0 mbar slope, pressure 1001 mbar, on September 30th 2016, 15h30

Write the following values to the registers:

0x0002'0006	→ 2010
0x02	→ 2012
0x01	→ 2013
0x0001	→ 2014
625.0 (IEEE float)	→ 2018 & 2019
1001	→ 2030
0x2809'2016	→ 2050 & 2051
0x1530	→ 2052

After this setup, start the calibration by sending:

0x0001	→ 2004

3.6.10 Setup Calibration Registers for Cal CO_2 sensor pH

The table describes the same values of the box Setup Calibration Registers in 3.6.1 Setup Calibration Registers:

Item	Value	Modbus Register #	Unit/Command
Calibration Unit	0x0003'000F	2010	pH
Calibration Method			Range
Offset	0x01	2012	–2 … 16 pH
Slope	0x02	2012	–2 … 16 pH
Calibration Stability			
Manual	0x01	2013	Manual
Low	0x02*	2013	1.25 mV
Med	0x04*	2013	0.8 mV
Strict	0x08*	2013	0.4 mV
Calibration Buffer Tab			
None	0x0001 (none use Reg 2016/2018/2020)	2014	—
MT-9	0x0002	2014	Select MT-9 Buffer
Calibration Point			
Offset	7.0	2016	Insert actual value as floating point number
Slope	4.0	2018	
Calibration			
Pressure	none	2030	—
Humidity	none	2032	—
Salinity	none	2031	—
Calibration			
Date	0x2809'2016	2050	Date 28.09.2016
Time	0x1733	2052	Time 17h33

* pH criteria: 20 s interval within 300 s

Example:

Calibration of a CO_2 Sensor pH, offset calibration, manual stability, buffer tab none, 7.02 pH offset, on September 30th 2016, 15h30

Write the following values to the registers:

0x0003'000F → 2010
0x01 → 2012
0x01 → 2013
0x0001 → 2014
7.02 (IEEE float) → 2016 & 2017
0x2809'2016 → 2050 & 2051
0x1530 → 2052

After this setup, start the calibration by sending:

0x0001 → 2004

3.6.11 Setup Calibration Registers for Cal CO_2 sensor hPa, mbar, mmHg, %CO_2, mg/l

The table describes the same values of the box Setup Calibration Registers in 3.6.1 Setup Calibration Registers:

Item	Value	Modbus Register #	Unit/Command
Calibration Unit	0x0003'0007 0x0003'0006 0x0003'0008 0x0003'0009 0x0003'000A	2010 2010 2010 2010 2010	hPa mbar mmHg %CO_2 mg/l
Calibration Method Process Offset	 0x10	 2012	Range 0…2000 hPa 0…2000 mbar 0…1500 mmHg 0…200 %CO_2 0…5000 mg/l
Calibration Stability Manual	 0x01	 2013	 Manual
Calibration Buffer Tab None	 0x0001 (none use Reg 2020)	 2014	 —
Calibration Point Process Offset	 120.0 hPa	 2020	 Insert actual value as floating point number
Calibration Pressure Humidity Salinity	 none* none none	 2030 2032 2031	 — — —
Calibration Date Time	 0x2809'2016 0x1733	 2050 2052	 Date 28.09.2016 Time 17h33

* For a CO_2 process calibration, the process pressure Modbus Register 340 has to be correct.

Example:

Calibration of a CO_2 Sensor %CO_2, process offset calibration, manual stability, buffer tab none, 190.5 %CO_2, process pressure 1013 mbar, on September 30th 2016, 15h30

Write the following values to the registers:

0x0003'0009	→ 2010
0x10	→ 2012
0x01	→ 2013
0x0001	→ 2014
190.5 (IEEE float)	→ 2020 & 2021
0x2809'2016	→ 2050 & 2051
0x1530	→ 2052
1013	→ 340*

* %CO_2 only

After this setup, start the calibration by sending:

0x0001	→ 2004

3.6.12 Setup Calibration Registers for Cal oDO sensor ppm, ppb, mg/l, µg/l

The table describes the same values of the box Setup Calibration Registers in 3.6.1 Setup Calibration Registers:

Item	Value	Modbus Register #	Unit/Command
Calibration Unit	0x0004’000B 0x0004’000C 0x0004’0011 0x0004’0012	2010 2010 2010 2010	ppm ppb mg/l µg/l
Calibration Method Offset* Slope Process Slope	 0x01 0x02 0x20	 2012 2012 2012	Range 0 mg/l, 0 ppb 8.24 mg/l, 8240 ppb 0 … 45 mg/l, ppm 0 … 45’000 µg/l, ppb
Calibration Stability Manual Auto	 0x01 0x10**	 2013 2013	 Manual Auto
Calibration Buffer Tab None	 0x0001 (none use Reg 2016/2018/2020)	 2014	 —
Calibration Point Offset Slope Process	 0 8.24 9.55	 2016 2018 2020	 Insert actual value as floating point number
Calibration Pressure Humidity Salinity	 1013 none 10	 2030 2032 2031	 1013 mbar — 10 g/l
Calibration Date Time	 0x2809’2016 0x1733	 2050 2052	 Date 28.09.2016 Time 17h33

* For 2-point calibration only. First perform a slope calibration. When the M100 responses with a successful calibration then start the offset calibration.

** Timeout for 100 %Air max. 600 s, for N_2(Zero) 3600 s.

Example:

Calibration of an oDO Sensor mg/l, slope calibration, auto stability, 0.48 mg/l offset, pressure 1018 mbar, salinity 10g/l, on September 30th 2016, 15h30

Write the following values to the registers:

0x0004’0011	→ 2010
0x02	→ 2012
0x10	→ 2013
0x0001	→ 2014
0.48 (IEEE float)	→ 2016 & 2017
1018	→ 2030
10	→ 2031
0x2809’2016	→ 2050 & 2051
0x1530	→ 2052

After this setup, start the calibration by sending:

0x0001	→ 2004

3.6.13 Setup Calibration Registers for Cal oDO sensor ppmO_2Gas

The table describes the same values of the box Setup Calibration Registers in 3.6.1 Setup Calibration Registers:

Item	Value	Modbus Register #	Unit/Command
Calibration Unit	0x0004'000F	2010	ppmO_2Gas
Calibration Method Process Offset	0x10	2012	Range 0 … 9999 ppmO_2Gas
Calibration Stability Manual	0x01	2013	Manual
Calibration Buffer Tab None	0x0001 (none use Reg 2016/2018/2020)	2014	—
Calibration Point Process Offset	70.5 ppm	2020	Insert actual value as floating point number
Calibration Pressure Humidity Salinity	1013 none none	2030 2032 2031	1013 mbar — —
Calibration Date Time	0x2809'2016 0x1733	2050 2052	Date 28.09.2016 Time 17h33

Example:
Calibration of an oDO Sensor ppmO_2Gas, process offset calibration, manual stability, 70.5 ppmO_2Gas process offset, pressure 1018 mbar, on September 30th 2016, 15h30

Write the following values to the registers:

0x0004'000F	→ 2010
0x10	→ 2012
0x01	→ 2013
0x0001	→ 2014
70.5 (IEEE float)	→ 2020 & 2021
1018	→ 2030
0x2809'2016	→ 2050 & 2051
0x1530	→ 2052

After this setup, start the calibration by sending:

0x0001	→ 2004

3.6.14 Setup Calibration Registers for Cal oDO sensor %Air, $\%O_2$, $\%O_2$Gas, mbar

The table describes the same values of the box Setup Calibration Registers in 3.6.1 Setup Calibration Registers:

Item	Value	Modbus Register #	Unit/Command
Calibration Unit	0x0004’0009 0x0004’000A 0x0004’000E 0x0004’0006	2010 2010 2010 2010	%Air $\%O_2$ $\%O_2$Gas mbar
Calibration Method Offset* Slope Process Slope	 0x01 0x02 0x20	 2012 2012 2012	Range 0 %Air, $\%O_2$, mbar 100 %Air, 20.95 $\%O_2$ 230 mbar 0 … 300 %Air 0 … 63 $\%O_2$, O_2Gas 0 … 630 mbar
Calibration Stability Manual Auto	 0x01 0x10**	 2013 2013	 Manual Auto
Calibration Buffer Tab None	 0x0001 (none use Reg 2016/2018/2020)	 2014	 —
Calibration Point Offset Slope Process	 0 20.95 30.0	 2016 2018 2020	 Insert actual value as floating point number
Calibration Pressure Humidity Salinity	 1013 45 % none	 2030 2032 2031	 1013 mbar 45 % —
Calibration Date Time	 0x2809’2016 0x1733	 2050 2052	 Date 28.09.2016 Time 17h33

* For 2-point calibration only. First perform a slope calibration. When the M100 responses with a successful calibration then start the offset calibration.

** Timeout for 100 %Air max. 600 s, for N_2(Zero) 3600 s.

Example:
Calibration of an oDO Sensor %Air, process slope calibration, auto stability, 99.5 %Air process cal, pressure 1018 mbar, humidity 45 %, on September 30th 2016, 15h30

Write the following values to the registers:

0x0004'0009	→	2010
0x20	→	2012
0x10	→	2013
0x0001	→	2014
99.5 (IEEE float)	→	2020 & 2021
1018	→	2030
45	→	2032
0x2809'2016	→	2050 & 2051
0x1530	→	2052

After this setup, start the calibration by sending:

0x0001	→	2004

3.6.15 Calibration units

Sensor	Unit	Code
pH	pH	0x00010006
pH	ORP	0x00010007
DO	%Air	0x00020009
DO	ppm	0x0002000B
DO	ppb	0x0002000C
DO	mg/l	0x00020011
DO	µg/l	0x00020012
DO	$\%O_2$	0x0002000A
DO	$\%O_2G$	0x0002000E
DO	$ppmO_2G$	0x0002000F
DO	mbar	0x00020006
CO_2	pH	0x0003000F
CO_2	hPa	0x00030007
CO_2	mbar	0x00030006
CO_2	mmHg	0x00030008
CO_2	$\%CO_2$	0x00030009
CO_2	mg/l	0x0003000A
oDO	%Air	0x00040009
oDO	ppm	0x0004000B
oDO	ppb	0x0004000C
oDO	mg/l	0x00040011
oDO	µg/l	0x00040012
oDO	$\%O_2$	0x0004000A
oDO	$\%O_2G$	0x0004000E
oDO	$ppmO_2G$	0x0004000F
oDO	mbar	0x00040006

3.6.16 Coding calibration status

Calibration status	**all/RO**
Idle	0x0000'0001
Calibration Done	0x0000'0002
Calibration In Progress	0x0000'0004
Calibration Ready To Check	0x0000'0008
Calibration Write Data In Progress	0x0000'0010
Spare	0x0000'0020
Spare	0x0000'0040
Calibration Not Done	0x0000'0080
No Sensor	0x0000'0100
Wrong Sensor Type	0x0000'0200
Wrong Calibration Unit	0x0000'0400
Wrong Calibration Method	0x0000'0800
Wrong Calibration Stability	0x0000'1000
Wrong Calibration Buffer	0x0000'2000
Wrong Calibration Points (out of edit range)	0x0000'4000
Stability Timeout 300 s	0x0000'8000
No Calibration Data to Write	0x0001'0000
Cal Out of Limit, continue?	0x0002'0000
Write Error	0x0004'0000
Spare	0x0008'0000
Buffer Recognize Failed	0x0010'0000
Spare	0x0020'0000
(pH)2pnt Cal Difference between Cal Point < 60 mV	0x0040'0000
Spare	0x0080'0000
Spare	0x0100'0000
(oDO)Phi0 is Out of Range	0x0200'0000
(oDO)Phi100 is Out of Range	0x0400'0000
(oDO)deltaPhi is Out of Range	0x0800'0000
(oDO)KSV is Out of Range	0x1000'0000
(oDO)Perform Slope Cal First	0x2000'0000
Spare	0x4000'0000
Spare	0x8000'0000

3.6.17 Calibration stability (drift control, not for process calibration)

Description	**Value**	**pH**	**CO2**	**DO**	**oDO**
Manual	0x01				
Low	0x02	1.25 mV*	1.25 mV*	NA	NA
Medium	0x04	0.8 mV*	0.8 mV*	NA	NA
Strict	0x08	0.4 mV*	0.4 mV*	NA	NA
Auto	0x10	NA	NA	**	***

* 20 s stable interval within a 300 s timeout
** 60 s stable interval within a 300 s timeout
*** Timeout for 100 %Air max 600 s, for N_2(Zero) 3600 s

3.6.18 Calibration method

	all/RW
1-point Calibration Offset	0x01
1-point Calibration Slope	0x02
1-point Process Calibration Offset	0x10
1-point Process Calibration Slope	0x20

3.6.19 Calibration buffer tab

Type	**pH/CO_2**
None (use register 2016/2017/2018 instead)	0x0001
MT-9	0x0002
MT-10	0x0004
NIST Tech	0x0008
NIST Std	0x0010
HACH	0x0020
CIBA	0x0040
MERCK	0x0080
WTW	0x0100
JIS Z 8802	0x0200
Na^+ 3.9M	0x0400

4 Setting up the M100

4.1 Setting up the M100 1W for a pH sensor

Example:
Set up M100 for a pH sensor, select pH/°C for primary and secondary measuring channel, observe Dynamic Lifetime Indicator (DLI) and Time To Maintenance (TTM) on the tertiary and quaternary measuring channel.

Write the following values to the registers:

0x5752	→	3999	unlock eeprom
0x0000'000C	→	3288	
0x0114'5DEA	→	3290	get user level 1
0x0100	→	336	change sensor type to M100 1W pH
0x0001'0006	→	120	select primary channel units to pH
0x0001'0003	→	122	select secondary channel units to °C
0x0001'0000	→	124	select tertiary channel units to DLI
0x0001'0002	→	126	select quaternary channel units to TTM

Read register 100/102/104/106 for float value of primary, secondary, tertiary and quaternary measuring channel.

4.2 Setting up the M100 1W for a DO sensor

Example:
Set up M100 for a DO sensor, select mbar/°C for primary and secondary measuring channel, observe Dynamic Lifetime Indicator (DLI) and Time To Maintenance (TTM) on the tertiary and quaternary measuring channel.

Write the following values to the registers:

0x5752	→	3999	unlock eeprom
0x0000'000C	→	3288	
0x0114'5DEA	→	3290	get user level 1
0x0102	→	336	change sensor type to M100 1W DO
0x0002'0006	→	120	select primary channel units to mbar
0x0002'0003	→	122	select secondary channel units to °C
0x0002'0000	→	124	select tertiary channel units to DLI
0x0002'0002	→	126	select quaternary channel units to TTM

Read register 100/102/104/106 for float value of primary, secondary, tertiary and quaternary measuring channel.

4.3 Setting up the M100 1W for a CO_2 sensor

Example:
Set up M100 for a CO_2 sensor, select mbar/°C for primary and secondary measuring channel, observe Dynamic Lifetime Indicator (DLI) and Time To Maintenance (TTM) on the tertiary and quaternary measuring channel.

Write the following values to the registers:

0x5752	→	3999	unlock eeprom
0x0000'000C	→	3288	
0x0114'5DEA	→	3290	get user level 1
0x0101	→	336	change sensor type to M100 1W CO_2
0x0003'0006	→	120	select primary channel units to mbar
0x0003'0003	→	122	select secondary channel units to °C
0x0003'0000	→	124	select tertiary channel units to DLI
0x0003'0002	→	126	select quaternary channel units to TTM

Read register 100/102/104/106 for float value of primary, secondary, tertiary and quaternary measuring channel.

4.4 Setting up the M100 1W for an oDO sensor

Example:
Set up M100 for a oDO sensor, select %Air/°C for primary and secondary measuring channel, observe Dynamic Lifetime Indicator (DLI) and Adaptive Calibration Timer (ACT) on the tertiary and quaternary measuring channel.

Write the following values to the registers:

0x5752	→	3999	unlock eeprom
0x0000'000C	→	3288	
0x0114'5DEA	→	3290	get user level 1
0x0200	→	336	change sensor type to M100 RS oD
0x0004'0009	→	120	select primary channel units to %Air
0x0004'0003	→	122	select secondary channel units to °C
0x0004'0000	→	124	select tertiary channel units to DLI
0x0004'0001	→	126	select quaternary channel units to ACT

Read register 100/102/104/106 for float value of primary, secondary, tertiary and quaternary measuring channel.

4.5 Enable and disable Bluetooth module

In order to increase operational security of the M100, the Bluetooth module may be disabled.

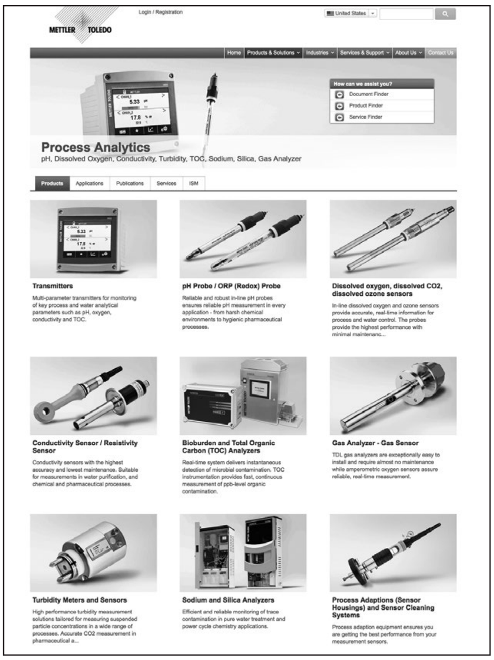
Register		**Register Usage**	**Access User Level**	
Start	Count	Register 1	Read	Write
3000	1	Bluetooth enabled/disabled	0	2

Bluetooth status	**Code**
Bluetooth Disabled	0x0000
Bluetooth Enabled	0x0001

Notes

The information you want is at www.mt.com/pro

The METTLER TOLEDO Process Analytics website contains a vast amount of up-to-date information on all our products and services. Content is localized for your country and tailored to suit your selections. Simple layout allows you to quickly find the information and features you are looking for.



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