BUSINESS CONFIDENTIAL

USER MANUAL

CONNECTIVITY GUIDE

v1.19.0

Original Instructions

Contents

1. Disclaimer

This document is not an Operating Instruction for the OnRobot devices, but a complementary document. Always read and follow the Operating Instructions before using the OnRobot devices. OnRobot A/S cannot be held responsible for any damages caused to any of OnRobot tools, the robot, or any other equipment.

Note that the low-level communication interface described in this document is a confidential information. This information is only shared with expert users who can do the device integration on his/her own. Only start your integration if you can finish it based on the information provided here, as no further support can be provided by OnRobot.

Also note that by misusing the low-level communication interface the OnRobot device's can be damaged and therefore warranty can be void.

OnRobot A/S disclaims any and all liability if any of OnRobot tools are damaged, changed or modified in any way. OnRobot A/S cannot be held responsible for any damages caused to any of OnRobot tools tooling, the robot, or any other equipment due to programming errors or malfunctioning of any of OnRobot tools.

2. Connectors and Pinouts

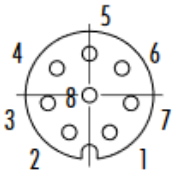
The tools are connected through the OnRobot Quick Changer interface.

There are 3 different Quick Changer types, that are known as mounting options:

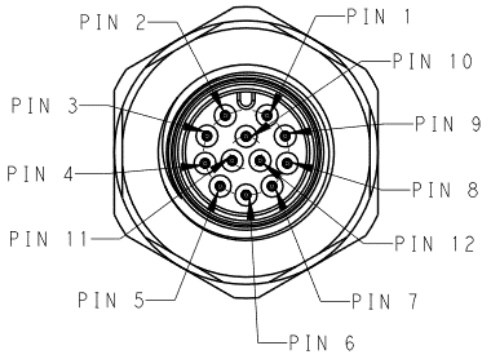
- Quick Changer
- Dual Quick Changer
- HEX-E/H QC

These mounting options have connectors that could be used for interfacing the tools to the robots.

The Quick Changer and Dual Quick Changer have an M8-8 pin FEMALE connector:

Connector	Pin number	Function
	1	RS485+
	2	RS485-
	3	GND
	4	Power (24V)
	5	Power (24V)
	6	GND
	7	Power (24V)
	8	GND

The HEX-E/H QC has an M12-12pin MALE connector:

Connector	Pin number	Function
	1	RS485+
	2	CAN + (Hi)
	3	RS485-
	4	Power (24V)
	5	Power (24V)
	6	Power (24V)
	7	GND
	8	GND
	9	CAN - (Lo)
	10	GND
	11	GND
	12	GND

3. Communication Protocols

3.1. Modbus RTU and TCP

MODBUS RTU uses RS485 as the physical layer. For further details on the protocol, please refer to modbus.org's MODBUS over Serial Line Specification and Implementation Guide (**http://www.modbus.org/docs/Modbus_over_serial_line_V1_02.pdf**) and MODBUS Application Protocol Specification (**http://www.modbus.org/docs/Modbus_Application_Protocol_V1_1b.pdf**).

The following OnRobot products support MODBUS RTU:

- 2FG7
- 2FGP20
- 3FG15
- Lift100
- MG10
- RG2
- RG6
- SG
- VG10
- VGC10
- VGP20

MODBUS TCP uses Ethernet as the physical layer, otherwise it is very similar to Modbus RTU. MODBUS TCP can be only used with a Compute Box / Eye Box. For further details on the protocol, please refer to modbus.org's MODBUS Application Protocol Specification (**http://www.modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf**).

The following OnRobot products only support MODBUS TCP:

- Compute Box / Eye box
- Eyes
- HEX-E/H QC
- RG2-FT
- Screwdriver

NOTE:

In this section the address and register values are written in the following format:

DD (HH) where the DD is in decimal and the HH is in hexadecimal format.

3.1.1. Settings

The following table below shows the required settings to be used when communicating with the OnRobot products over MODBUS RTU.

Settings	
Baud rate [bit/sec]	1 000 000
Start bits	1
Data bits	8
Parity	Even
Stop bits	1
CRC Check	16 bit (MODBUS default)
CRC Polynomial	0xA001 (MODBUS default)

The following table below shows the required settings to be used when communicating with the OnRobot products over MODBUS TCP. See 3.1.2. Ethernet Interface Setup on how to set up the Ethernet interface for the Compute Box / Eye Box.

Settings	
Modbus TCP server IP address	Compute Box / Eye Box IP address (default is 192.168.1.1)
Port number	502
Number of concurrent connections	1

For the tools and devices not specified in the below tables, the Device address depends only on the mounting option and not on the tool type:

	via Quick Changer	via HEX-E/H QC	via Dual Quick Changer
Device address	65 (0x41)	65 (0x41)	Primary side (1) - 66 (0x42) Secondary side (2) - 67 (0x43)

For LIFT100, the device address is fixed:

	LIFT100
Device address	165 (0xA5)

For HEX-E/H QC and RG2-FT, the Device address is fixed (it only works when communicating over MODBUS TCP and when connecting to the Compute Box):

	HEX-E/H QC	RG2-FT
Device address	64 (0x40)	65 (0x41)

For the Compute Box / Eye Box, the Device address is fixed (it has only one functionality to reset the tool power):

	Compute Box / Eye Box
Device address	63 (0x3F)

For the Eyes, the Device address is fixed:

	Eyes
Device address	62 (0x3E)

3.1.2. Ethernet Interface Setup

A proper IP address must be set for the Compute Box/Eye Box and the robot/computer to be able to use the Ethernet interface. The IP address can be configured using DIP switches 3 and 4.

WARNING:

Stop the robot program before you change any Ethernet interface settings.

NOTE:

Configuring DIP switch 3 will remove any previously set static IP address.

To change between modes, first change the DIP switches and then cycle the Compute Box/Eye Box power so the changes will take effect.

DIP 3 - sets the Compute Box / Eye Box IP address

- **ON**: Fixed IP (192.168.1.1)
- **OFF**: Dynamic or Static IP *(can be configured via the Web Client)*

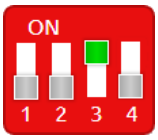
DIP 4 - sets whether the connected robot or laptop will receive IP address from the Compute Box / Eye Box

- **ON**: DHCP server is disabled
- **OFF**:DHCP server is enabled

We recommend to set the DIP switches according to either of the two options below:

- **Fix IP/Auto mode** - in simple installations (no external network and/or no PLC connected)
- **Advanced mode** - in more complex installations (external network and/or PLC are used)

Fix IP/Auto mode (factory default)

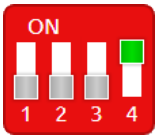


Set the DIP switch 3 to ON and the DIP switch 4 to OFF position and cycle the power so the changes will take effect.

IP Address of the Compute Box/Eye Box	IP Address of the Robot/Computer
The IP address of the Compute Box/Eye Box is fixed 192.168.1.1. This IP address cannot be changed.	The Compute Box/Eye Box will automatically assign an IP address to the connected robot/computer if it was configured to obtain an IP address automatically. **NOTE:** The assigned IP address range is 192.168.1.100-105 (with subnet mask 255.255.255.0). If the Compute Box/Eye Box is used in a company network where a DHCP server is already in use, it is recommended to use Advanced mode.

In this mode, the DHCP server of the Compute Box/Eye Box is enabled.

Advanced mode (any static or dynamic IP/subnet mask)



Set the DIP switch 3 to OFF and the DIP switch 4 to ON position and cycle the power so the changes will take effect.

IP Address of the Compute Box/Eye box	IP Address of the Robot/Computer
Case 1: Static IP address The IP address 192.168.1.1 is already in use in your network or a different subnet needs to be configured.	The Compute Box/Eye Box will not assign an IP address to the robot/computer. Set the IP address of the robot/computer manually. Make sure to have a matching IP setting to your robot/ computer network for a proper communication. Use the same subnet but different IP address.
Case 2: Dynamic IP address *	The IP address of the robot/computer is set dynamically. An external DHCP server assigns the IP address to the robot/computer.

* By default, the IP address of the Compute Box/Eye Box is set to Dynamic IP.

The IP address of the Compute Box/Eye Box can be set to any value by using the Web Client. For more details, see section Web Client: Configuration Menu. Under **Network settings**, set the **Network mode** to either **Static IP** or **Dynamic IP**.

In this mode, the DHCP server of the Compute Box/Eye Box is disabled.

3.1.3. Function Codes

OnRobot products currently support the function codes listed below. The products will respond with an appropriate exception code, if the function is not executed correctly. Please refer to MODBUS Application Protocol page 48 for detailed description of the different exception codes. Note that the product will provide no response if the settings are not correct.

3 (0x03) Read Holding Registers

Use this function code to read out one or multiple consecutive registers. Please refer to MODBUS Application Protocol page 15 for frame and response details.

6 (0x06) Write Single Register

Use this function code to set the value of a single register. Please refer to MODBUS Application Protocol page 19 for frame and response details.

16 (0x10) Write Multiple Registers

Use this function code to set the values of multiple consecutive registers. Please refer to MODBUS Application Protocol page 19 for frame and response details.

23 (0x17) Read/Write Multiple Registers

Use this function code to set the values and read out one or multiple consecutive registers. Note that the registers to be set are set before the registers to be read are read. Please refer to MODBUS Application Protocol page 38 for frame and response details.

3.1.4. Common Registers

Common registers are implemented by all OnRobot devices and they are always at the same position.

Address		Device	Product code
1536	0x600	VG10	0x10
		VGC10	0x11
		VGP20	0x18
		RG2	0x20
		RG6	0x21
		RG2-FT	0x22
		SG	0x50
		3FG15	0x70
		Screwdriver	0x80
		Lift100 v1	0x100
		Lift100 v2	0x101
		MG10	0xA0
		Sander	0xB0
		2FG7	0xC0
		2FGP20	0xF0

This register can be used to easily identify the currently connected device on the Quick Changer.

The firmware version running on the devices is stored in registers 0x604 and 0x605 in the following format:

Address		Firmware version major and minor of the device
1540	0x604	Upper 8 bit is the major, lower 8 bit is the minor version
1541	0x605	Build number of the firmware version stored as a 16 bit number

Serial number

The 32 byte long serial number of the connected device can be read from registers 0x609-0x618.

Every register in this range contains two ASCII characters in the following format:

Address		ASCII character
1545	0x609	ASCII char index 0 and ASCII char index 1 of the serial
1560	0x618	ASCII char index 30 and ASCII char index 31 of the serial

3.1.5. Device Specific Registers

3.1.5.1. 2FG7

The table below provides an overview of the available MODBUS registers in the 2FG7.

All writable registers can be accessed using function codes 6, 16 or 23 and all readable registers can be accessed using function codes 3 or 23.

Address		Register	Access
0	0x0000	Target width	Write
1	0x0001	Target force	Write
2	0x0002	Target speed	Write
3	0x0003	Command	Write
256	0x0100	Status	Read only
257	0x0101	External width	Read only
258	0x0102	Internal width	Read only
259	0x0103	Min external width	Read only
260	0x0104	Max external width	Read only
261	0x0105	Min internal width	Read only
262	0x0106	Max internal width	Read only
263	0x0107	Force	Read only
1024	0x0400	Finger length	Read/Write
1025	0x0401	Finger height	Read/Write
1026	0x0402	Finger orientation	Read/Write
1027	0x0403	Fingertip offset	Read/Write
1029	0x0405	Max force	Read only

0 (0x0000) Target width (Write)

This register sets the target width of the gripper in 1/10 mm.

 When the workpiece is gripped externally, the target with is measured between the inside of the fingers.

 When the workpiece is gripped internally, the target with is measured between the outside of the fingers.

1 (0x0001) Target force (Write)

This register sets the target force to be reached when gripping and holding a workpiece in N.

2 (0x0002) Target speed (Write)

This register sets the target speed of the gripper closure as a percentage value between 10-100%.

3 (0x0003) Command (Write)

This register sets the selected command.

Command (Enum)	Description
1	Do grip external
2	Do grip internal
3	Stop

256 (0x0100) Status (Read only)

This register indicates the status of the gripper.

Code			Description
bit	hex	dec	
0	0x0001	1	Busy
1	0x0002	2	Grip detected
3	0x0008	8	Error: Not calibrated
4	0x0010	16	Error: Linear sensor

257 (0x0101) External width (Read only)

This register indicates the external width of the gripper fingers in 1/10 mm signed.

258 (0x0102) Internal width (Read only)

This register indicates the internal width of the gripper fingers in 1/10 mm signed.

259 (0x0103) Min external width (Read only)

This register indicates the minimum external width of the gripper fingers in 1/10 mm.

260 (0x0104) Max external width (Read only)

This register indicates the maximum external width of the gripper fingers in 1/10 mm.

261 (0x0105) Min internal width (Read only)

This register indicates the minimum internal width of the gripper fingers in 1/10 mm.

262 (0x0106) Max internal width (Read only)

This register indicates the maximum internal width of the gripper fingers in 1/10 mm.

263 (0x0107) Force (Read only)

This register indicates the gripper finger force in N.

1024 (0x0400) Finger length (Read/Write)

This register sets the gripper finger length value in 1/10 mm.

1025 (0x0401) Finger height (Read/Write)

This register sets the gripper finger height value in 1/10 mm.

1026 (0x0402) Finger orientation (Read/Write)

This register sets the gripper finger orientation to face 0 inward or 1 outward.

1027 (0x0403) Fingertip offset (Read/Write)

This register sets the gripper fingertip offset in 1/100 mm.

1029 (0x0405) Maximum force (Read only)

This register indicates the maximum force of the gripper in N.

3.1.5.2. 2FGP20

The table below provides an overview of the available MODBUS registers in the 2FGP20.

All writable registers can be accessed using function codes 6, 16 or 23 and all readable registers can be accessed using function codes 3 or 23.

Address		Register	Access
1	0x0001	VG commands	Write

Address		Register	Access
2	0x0002	FG Width	Write
3	0x0003	FG Force	Write
4	0x0004	FG Speed	Write
5	0x0005	FG Commands	Write
256	0x0100	Status	Read only
258	0x0102	Max force	Read only
259	0x0103	External width	Read only
261	0x0105	Min external width	Read only
262	0x0106	Max external width	Read only
265	0x0109	Force	Read only
266	0x010A	VG vacuum percent	Read only
1024	0x0400	Moving finger length	Read/Write
1025	0x0401	Moving finger height	Read/Write
1026	0x0402	Moving fingertip offset	Read/Write
1027	0x0403	Fixed finger length	Read/Write
1028	0x0404	Fixed finger height	Read only
1029	0x0405	Fixed fingertip offset	Read only
1031	0x0407	Vacuum cups offset	Read only

1 (0x0001) VG commands (Write)

This register sets the vacuum grip command.

Bit	Name	Description
0–7	Grip vacuum in %	The target vacuum that the channels will try to achieve.
15	Ignore	When set to high (1), the command is ignored for the channel.

2 (0x0002) FG Width (Write)

This register indicates the width of the gripper fingers in 1/10 mm signed.

3 (0x0003) FG Force (Write)

This register indicates the gripper finger force in 1/10 N.

4 (0x0004) FG Speed (Write)

This register indicates the gripping speed in 1/10 %.

5 (0x0005) FG Commands (Write)

This register sets the selected command.

FG Commands (Enum)	Description
0	No commands
1	FG do grip external
3	FG stop

256 (0x0100) Status (Read only)

This register indicates the status of the gripper.

Bits 5-4	Bits 3-2
vg_release_status	vg_grip_status

vg_grip_status (Enum)	Description
0	Not gripped
1	Grip detected
2	Grip timeout
3	Grip lost

vg_release_status (Enum)	Description
0	Not released
1	Release ok
2	Release fail

Code			Description
bit	hex	dec	
0	0x0100	1	Busy (both the finger and the vacuum gripper)
1	0x0100	2	FG grip detected
6	0x0100	64	Error: Motor not calibrated
7	0x0100	128	Error: Solenoid not calibrated
8	0x0100	256	Error: Encoders not calibrated

259 (0x0103) External width (Read only)

This register indicates the external width of the gripper fingers in 1/10 mm.

261 (0x0105) Min external width (Read only)

This register indicates the minimum external width of the gripper fingers in 1/10 mm.

262 (0x0106) Max external width (Read only)

This register indicates the maximum external width of the gripper fingers in 1/10 mm.

265 (0x0109) Force (Read only)

This register indicates the gripper finger force in 1/10 N.

266 (0x010A) VG vacuum percent (Read only)

This register indicates the vacuum percentage in 1/10 %.

1024 (0x0400) Moving finger length (Read/Write)

This register sets the moving gripper finger length value in 1/10 mm.

1025 (0x0401) Moving finger height (Read/Write)

This register sets the moving gripper finger height value in 1/10 mm.

1026 (0x0402) Moving fingertip offset (Read/Write)

This register sets the moving gripper fingertip offset in 1/100 mm.

1027 (0x0403) Fixed finger length (Read/Write)

This register sets the fixed gripper finger length value in 1/10 mm.

1028 (0x0404) Fixed finger height (Read/Write)

This register sets the fixed gripper finger height value in 1/10 mm.

1029 (0x0405) Fixed fingertip offset (Read/Write)

This register sets the fixed gripper fingertip offset in 1/100 mm.

1031 (0x0407) Vacuum cups offset (Read/Write)

This register sets the vacuum cups offset in 1/100 mm.

3.1.5.3. 3FG15

The table below provides an overview of the available MODBUS registers in the 3FG.

All writable registers can be accessed using function codes 6, 16 or 23 and all readable registers can be accessed using function codes 3 or 23.

Address		Register	Access
0	0x0000	Target force	Write
1	0x0001	Target diameter	Write
2	0x0002	Grip type	Write
3	0x0003	Control	Write
256	0x0100	Status	Read only
257	0x0101	Raw diameter	Read only
258	0x0102	Diameter with fingertip offset	Read only
259	0x0103	Force applied	Read only
270	0x010E	Finger length	Read only
272	0x0110	Finger position	Read only
273	0x0111	Fingertip offset	Read only
513	0x0201	Minimum diameter	Read only
514	0x0202	Maximum diameter	Read only
1025	0x0401	Set finger length	Read/Write
1027	0x0403	Set finger position	Read/Write
1028	0x0404	Set fingertip offset	Read/Write

0 (0x0000) Target force (Write)

This field sets the target force to be reached when gripping and holding a workpiece. It must be provided in %. The valid range is 0 to 1000.

1 (0x0001) Target diameter (Write)

This field sets the target diameter to achieve. It must be provided in 1/10th millimeters. The valid range depends on the finger position, finger length and fingertip diameter. For more information see the Technical sheet section.

2 (0x0002) Grip type (Write)

This field sets whether the grip will be external 0 or internal 1. It also sets the if the diameter is measured from the inside of the fingertips (external grip) or from the outside of the fingertips (internal grip).

3 (0x0003) Control (Write)

The control field is used to start and stop gripper motion. Only one option should be set at a time. Please note that the gripper will not start a new motion before the one currently being executed is done (see busy flag in the Status field). The valid commands are:

Value	Name	Description
1 (0x0001)	grip	Start the motion, with the preset target force and diameter. Please note that the gripper will ignore this command if the busy flag is set in the status field.
2 (0x0002)	move	Start the motion without applying the target force
4 (0x0004)	stop	Stop the current motion.
5 (0x0005)	flexible grip	The fingers will move from the current diameter towards the target diameter, and do a grip with the desired force. Maximum force is 140 N when 100% is selected, and payload is maximum 8 kg.

256 (0x0100) Status (Read only)

This status field indicates the status of the gripper and its motion. It is composed of 7 flags, described in the table below.

Bit	Name	Description
0 (LSB)	busy	High (1) when a motion is ongoing, low (0) when not. The gripper will only accept new commands when this flag is low.
1	grip detected	High (1) when an internal- or external grip is detected.
2	Force grip detected	High (1) when an internal- or external grip with the target force is detected.
3	calibration	Whether calibration is OK or not.
4-16	Reserved	Not used

257 (0x0101) Raw diameter (Read only)

Indicates the current diameter measured from the center of the fingertips.

258 (0x0102) Diameter with fingertip offset (Read only)

Indicates the current diameter considering the fingertip offset in 1/10 millimeters. Please note that the value is a signed two's complement number.

259 (0x0103) Force applied (Read only)

Indicates the force applied in 1/10 %.

270 (0x010E) Finger length (Read only)

Indicates the length of the finger in 1/10 mm

272 (0x0110) Finger position (Read only)

Indicates how the finger is mounted. Positions available are 1, 2 and 3.

273 (0x0111) Fingertip offset (Read only)

This field sets the Fingertip offset in 1/100 mm.

275 (0x0113) Actual width with offset (Read only)

Indicates the current width between the gripper fingers in 1/10 millimeters. The set fingertip offset is considered.

513 (0x0201) Minimum diameter (Read only)

Indicates the minimum reachable diameter depending on the finger position, finger length and fingertip diameter. For more information see the **Technical sheet** section.

514 (0x0202) Maximum diameter (Read only)

Indicates the maximum reachable diameter depending on the finger position, finger length and fingertip diameter. For more information see the **Technical sheet** section.

1025 (0x0401) Set Finger length (Read/Write)

This field sets the finger length in 1/10 mm.

1027 (0x0403) Set Finger position (Read/Write)

This field sets the finger position 1, 2 or 3.

1028 (0x0404) Set Fingertip offset (Read/Write)

This field sets the fingertip offset diameter in 1/100 mm.

3.1.5.4. Eyes

The table below provides an overview of the available MODBUS registers in the Eyes.

NOTE:

The Eyes only works on MODBUS TCP.

All writable registers can be accessed using function codes 6, 16 or 23 and all readable registers can be accessed using function codes 3 or 23.

Address		Register	Access
0	0x0000	Robot Position x	Write
1	0x0001	Robot Position y	Write
2	0x0002	Robot Position z	Write
3	0x0003	Robot Orientation 1	Write
4	0x0004	Robot Orientation 2	Write
5	0x0005	Robot Orientation 3	Write
6	0x0006	Robot Orientation 4	Write
7	0x0007	Program ID to Execute	Write
8	0x0008	Gripper Selection	Write
9	0x0009	Robot Type	Write
10	0x000A	Workpiece Type	Write
100	0x0064	Command	Write
256	0x0100	Status Register	Read only
257	0x0101	Object Count	Read only
258	0x0102	Workpiece Type	Read only
259	0x0103	Inspection Evaluation	Read only
260	0x0104	Inspection Match Percentage	Read only
272	0x0110	Object Position x	Read only
273	0x0111	Object Position y	Read only
274	0x0112	Object Position z	Read only
275	0x0113	Object Orientation 1	Read only

Address		Register	Access
276	0x0114	Object Orientation 2	Read only
277	0x0115	Object Orientation 3	Read only
278	0x0116	Object Orientation 4	Read only

0 (0x0000) Robot Position x (Write)

1 (0x0001) Robot Position y (Write)

2 (0x0002) Robot Position z (Write)

These registers set the Tool Center Point position coordinate on the x, y and z axes respectively. They must be provided in 1/10 millimeters.

3 (0x0003) Robot Position Orientation 1 (Write)

4 (0x0004) Robot Position Orientation 2 (Write)

5 (0x0005) Robot Position Orientation 3 (Write)

6 (0x0006) Robot Position Orientation 4 (Write)

These registers set the orientation of the Tool Center Point in 1/100 degree/rad. Depending on the robot type the value of the orientation is either measured in Euler angles or quaternions. They must be provided as 1/100 value. The (0x0006) Robot Orientation 4 register is optional and is only needed if the value of the orientation is measured in quaternions.

7 (0x0007) Program ID to Execute (Write)

This register sets the program ID to execute.

8 (0x0008) Gripper Selection (Write)

This register sets the gripper to be selected.

Value	Description
0	Ignore
1	Single/Primary
2	Secondary

9 (0x0009) Robot Type (Write)

This register sets the manufacturer of the robot.

Value	Description
0	Ignore
1	UR
2	KUKA
3	Yaskawa
4	Kawasaki
5	Nachi
6	Techman
7	Fanuc
8	Doosan
9	Hanwha
10	ABB
11	Kassow
12	Denso
13	Omron TM
14	Epson
255	Other

10 (0x000A) Workpiece Type (Write)

This register sets the workpiece type.

100 (0x0064) Command (Write)

This register sets the selected command.

Value	Description
1	Command Run Program
2	Command Calibrate
3	Command Get Workpiece Pose
4	Command Set Robot Pose for Camera View

Value	Description
5	Command Get Robot Pose for Camera View

256 (0x0100) Status register (Read only)

This register indicates the status of the Eyes.

Value	Description
0-1	Run counter
2	Error
3-10	Object count
11-15	Unused

257 (0x0101) Object Count (Read only)

This register indicates the number of the detected workpieces as an unsigned byte.

258 (0x0102) Workpiece type (Read only)

This register indicates the workpiece type of the detected object as an unsigned byte.

259 (0x0103) Inspection Evaluation (Read only)

This register returns the result of an inspection.

Value	Description
0	Invalid
1	Pass
2	Fail

260 (0x0104) Inspection Match Percentage (Read only)

This register returns the inspection match in percentage.

272 (0x0110) Object Position x (Read only)

273 (0x0111) Object Position y (Read only)

274 (0x0112) Object Position z (Read only)

These registers return the workpiece position coordinate on the x, y and z axes respectively in 1/10 millimeters.

275 (0x0113) Object Orientation 1 (Read only)

276 (0x0114) Object Orientation 2 (Read only)

277 (0x0115) Object Orientation 3 (Read only)

278 (0x0116) Object Orientation 4 (Read only)

These registers return the orientation of the workpiece as 1/100 degree/rad value. Depending on the robot type the value of the orientation is either measured in Euler angles or quaternions. The (0x0116) Object Orientation 4 register is optional and is dependent on the robot type. It is only available if the value of the orientation is measured in quaternions.

3.1.5.5. HEX-E/H QC

The table below provides an overview of the available MODBUS registers in the HEX-E/H QC.

All writable registers can be accessed using function codes 6, 16 or 23 and all readable registers can be accessed using function codes 3 or 23.

Address		Register	Access
0	0x0000	Zero	Read + Write
257	0x0101	Status	Read only
259	0x0103	Fx	Read only
260	0x0104	Fy	Read only
261	0x0105	Fz	Read only
262	0x0106	Tx	Read only
263	0x0107	Ty	Read only
264	0x0108	Tz	Read only

0 (0x0000) Bias (Read + Write)

Zero the force and torque values to cancel any offset.

Value	Description
0x0000	Un-Zero
0x0001	Zero

256 (0x0100) Status (Read only)

Reads low (0x0000) when there is no error.

259 (0x0103) Fx (Read only)

Force value along the X axis (in the sensor coordinate system) in 1/10 N. The value is signed INT.

260 (0x0104) Fy (Read only)

Force value along the Y axis (in the sensor coordinate system) in 1/10 N. The value is signed INT.

261 (0x0105) Fz (Read only)

Force value along the Z axis (in the sensor coordinate system) in 1/10 N. The value is signed INT.

262 (0x0106) Tx (Read only)

Torque value about the X axis (in the sensor coordinate system) in 1/100 Nm. The value is signed INT.

263 (0x0107) Ty (Read only)

Torque value about the Y axis (in the sensor coordinate system) in 1/100 Nm. The value is signed INT.

264 (0x0108) Tz (Read only)

Torque value about the Z axis (in the sensor coordinate system) in 1/100 Nm. The value is signed INT.

3.1.5.6. Lift100

The table below provides an overview of the available MODBUS registers in the Lift100.

All writable registers can be accessed using function codes 6, 16 or 23 and all readable registers can be accessed using function codes 3 or 23.

Address		Register	Access
0	0x0000	Position	Write
1	0x0001	Speed	Write
2	0x0002	Command (enum)	Write
256	0x0100	Status	Read only
257	0x0101	Error	Read only
261	0x0105	Position	Read only
264	0x0108	Temperature	Read only
265	0x0109	Speed	Read only

Address		Register	Access
1024	0x0400	Payload	Read/Write

0 (0x0000) Position (Write)

This register sets the target position in 1/10 mm unsigned.

1 (0x0001) Speed (Write)

This register sets the target moving speed in 1/10 mm unsigned.

2 (0x0002) Command (enum) (Write)

This register sets the selected command.

FG Commands (Enum)	Description
0	No command
1	Move
2	Stop
3	Initialize

256 (0x0100) Status (Read only)

This register indicates the status of the Lift100.

Code			Description
bit	hex	dec	
0	0x0100	1	Busy
1	0x0100	2	Maximum height reached
2	0x0100	4	Minimum height reached
3	0x0100	8	Moving up
4	0x0100	16	Moving down

257 (0x0101) Error (Read only)

This register shows the error code if any is present.

Code			Description
bit	hex	dec	
0	0x0101	1	E-stop
1	0x0101	2	Error moving/ can not move
2	0x0101	4	Move command out of range
3	0x0101	8	Mismatch between position
4	0x0101	16	Not calibrated
5	0x0101	32	Hardware error
6	0x0101	64	SPI MotorDriverError

261 (0x0105) Position (Read only)

This register indicates the target position in 1/10 mm unsigned.

264 (0x0108) Temperature (Read only)

This register indicates the temperature in temperature degrees/10 unsigned.

265 (0x0109) Speed (Read only)

This register indicates the target moving speed in 1/10 mm/s signed.

1024 (0x0400) Payload (Read/Write)

This register indicates the user provided payload in kg * 10 unsigned.

3.1.5.7. MG10

The table below provides an overview of the available MODBUS registers in the MG10.

All writable registers can be accessed using function codes 6, 16 or 23 and all readable registers can be accessed using function codes 3 or 23.

Address		Register	Access
0	0x0000	Magnet engage	Write
1	0x0001	Strength	Write
256	0x0100	Status	Read only
257	0x0101	Error code	Read only
258	0x0102	Magnet strength	Read only
1025	0x0401	Finger height	Read/Write
1026	0x0402	Finger type	Read/Write

0 (0x0000) Control (Write)

This register controls the magnet.

Value	Description
0	Disengage the magnet.
1	Engage the magnet.
2	Engage the magnet with smart grip.
6	Perform auto-calibration. Before auto-calibration, disengage the magnet. Wait until it is finished and then perform auto-calibration. During the auto-calibration process, the (0x0100) Status register's busy bit and the (0x0101) Error code register's noHallCalibration bit becomes high (1). At the end of the process it is recommended to disengage the magnet.

1 (0x0001) Strength (Write)

This register sets the target magnet strength in [%] for the grip command. The value range is [0–100].

256 (0x0100) Status (Read only)

This register indicates the status of the gripper.

Bit	Name	Description
0	part_gripped	High (1) when the gripper grips a detected workpiece.
1	near_part	High (1) when the proximity sensor detects a ferromagnetic part.
2	busy	High (1) when the gripper is moving.
3	magnet_strength_not_reached	High (1) when the target magnet strength is not reached.
4	smart_grip_available	High (1) when the Smart grip feature is available. Note: The Smart grip feature cannot be used together with the Eyes Location application.
5	smart_grip_failed	High (1) when the Smart grip feature has failed.
6	part_dropped	High (1) if the gripper has lost the workpiece since the last grip.
7	internalTemperatureWarning	High (1) if the internal temperature exceeds 55 °C.
8-15	Reserved	Not used.

257 (0x0101) Error code (Read only)

This register indicates the error code of the gripper.

Bit	Name	Description
0	overHeating	High (1) if the error is raised.
1	sensorTargetMismatch	High (1) if the error is raised.
2	noMotorCalibration	High (1) if the error is raised.
3	noMagnetCalibration	High (1) if the error is raised.
4	noHallCalibration	High (1) if the error is raised.
5	overCurrent	High (1) if the error is raised.
6	positionError	High (1) if the error is raised. To resolve the error, remove the part and then power cycle the gripper.
7-15	Reserved	Not used.

258 (0x0102) Magnet strength (Read only)

This register shows the current magnet strength in [%]. The value range is [0–100].

1025 (0x0401) Finger height (Read/Write)

This register sets or returns the actual value of the gripper finger height in 1/10 mm.

1026 (0x0402) Finger type (Read/Write)

This register sets or returns the actual value of the gripper finger type.

Finger type	Finger type register value (to write to register 0x0402)	Finger height [mm]	Finger height register value [1/10 mm] (to write to register 0x0401)
No Pads	1	0	0
Protective Pads	2	0.5	5
Custom	3	user defined	user defined

3.1.5.8. RG2/6

The table below provides an overview of the available MODBUS registers in the RG2/6.

All writable registers can be accessed using function codes 6, 16 or 23 and all readable registers can be accessed using function codes 3 or 23.

Address		Register	Access
0	0x0000	Target force	Write
1	0x0001	Target width	Write
2	0x0002	Control	Write

Address		Register	Access
258	0x0102	Fingertip offset	Read only
263	0x0107	Actual depth	Read only
264	0x0108	Actual relative depth	Read only
267	0x010B	Actual width	Read only
268	0x010C	Status	Read only
275	0x0113	Actual width with offset	Read only
1031	0x0407	Set Fingertip offset	Write only

0 (0x0000) Target force (Write)

This field sets the target force to be reached when gripping and holding a workpiece. It must be provided in 1/10th Newtons. The valid range is 0 to 400 for the RG2 and 0 to 1200 for the RG6.

1 (0x0001) Target width (Write)

This field sets the target width between the finger to be moved to and maintained. It must be provided in 1/10th millimeters. The valid range is 0 to 1100 for the RG2 and 0 to 1600 for the RG6. Please note that the target width should be provided corrected for any fingertip offset, as it is measured between the insides of the aluminum fingers.

2 (0x0002) Control (Write)

The control field is used to start and stop gripper motion. Only one option should be set at a time. Please note that the gripper will not start a new motion before the one currently being executed is done (see busy flag in the Status field). The valid flags are:

Value	Name	Description
1 (0x0001)	grip	Start the motion, with the preset target force and width. Width is calculated without the fingertip offset. Please note that the gripper will ignore this command if the busy flag is set in the status field.
8 (0x0008)	stop	Stop the current motion.
16 (0x0010)	grip_w_offset	Same as grip, but width is calculated with the set fingertip offset.

258 (0x0102) Fingertip offset (Read only)

Indicates the current fingertip offset in 1/10 millimeters. Please note that the value is a signed two's complement number.

263 (0x0107) Actual depth (Read only)

Indicates the current depth of the gripper, to be used for depth compensation. The depth is relative to the fully closed position, provided in 1/10 millimeters. Please note that the value is a signed two's complement number.

264 (0x0108) Actual relative depth (Read only)

Indicates the current depth of the gripper, to be used for depth compensation. The depth is relative to the position at which the latest motion was initiated and is provided in 1/10 millimeters. Please note that the value is a signed two's complement number.

267 (0x010B) Actual width (Read only)

Indicates the current width between the gripper fingers in 1/10 millimeters. Please note that the width is provided without any fingertip offset, as it is measured between the insides of the aluminum fingers.

268 (0x010C) Status (Read only)

This status field indicates the status of the gripper and its motion. It is composed of 7 flags, described in the table below.

Bit	Name	Description
0 (LSB)	busy	High (1) when a motion is ongoing, low (0) when not. The gripper will only accept new commands when this flag is low.
1	grip detected	High (1) when an internal- or external grip is detected.
2	S1 pushed	High (1) when safety switch 1 is pushed.
3	S1 trigged	High (1) when safety circuit 1 is activated. The gripper will not move while this flag is high; can only be reset by power cycling the gripper.
4	S2 pushed	High (1) when safety switch 2 is pushed.
5	S2 trigged	High (1) when safety circuit 2 is activated. The gripper will not move while this flag is high; can only be reset by power cycling the gripper.
6	Safety error	High (1) when on power on any of the safety switch is pushed.
10-16	Reserved	Not used

275 (0x0113) Actual width with offset (Read only)

Indicates the current width between the gripper fingers in 1/10 millimeters. The set fingertip offset is considered.

1031 (0x0407) Set Fingertip offset (Write only)

This field sets the Fingertip offset in 1/10 mm. Positive number means an inward offset (decreases how much the gripper can be closed).

3.1.5.9. RG2-FT

The table below provides an overview of the available MODBUS registers in the RG2-FT.

All writable registers can be accessed using function codes 6, 16 or 23 and all readable registers can be accessed using function codes 3 or 23.

Address		Register	Access
0	0x0000	Zero	Read + Write
2	0x0002	Target force	Write
3	0x0003	Target width	Write
4	0x0004	Control	Write
5	0x0005	Proximity Offset (L)	Read + Write
6	0x0006	Proximity Offset (R)	Read + Write
256	0x0100	Left HEX sensor status HIGH	Read only
257	0x0101	Left HEX sensor status LOW	Read only
259	0x0103	Fx (L)	Read only
260	0x0104	Fy (L)	Read only
261	0x0105	Fz (L)	Read only
262	0x0106	Tx (L)	Read only
263	0x0107	Ty (L)	Read only
264	0x0108	Tz (L)	Read only
266	0x0100	Right HEX sensor status HIGH	Read only
267	0x0101	Right HEX sensor status LOW	Read only
268	0x010C	Fx (R)	Read only
269	0x010D	Fy (R)	Read only
270	0x010E	Fz (R)	Read only
271	0x010F	Tx (R)	Read only

Address		Register	Access
272	0x0110	Ty (R)	Read only
273	0x0111	Tz (R)	Read only
274	0x0112	Proximity Status (L)	Read only
275	0x0113	Proximity Value (L)	Read only
277	0x0115	Proximity Status (R)	Read only
278	0x0116	Proximity Value (R)	Read only
280	0x0118	Actual gripper width	Read only
281	0x0119	Gripper Busy	Read only
282	0x011A	Grip detected	Read only

(L) is for the left fingertip HEX sensor.

(R) is for the right fingertip HEX sensor.

0 (0x0000) Bias (Read + Write)

Zero the force and torque values to cancel any offset.

Value	Description
0x0000	Un-Zero
0x0001	Zero

2 (0x0002) Target force (Write)

This field sets the target force to be reached when gripping and holding a workpiece. It must be provided in 1/10 Newtons. The valid range is 0 to 400.

3 (0x0003) Target width (Write)

This field sets the target width between the finger to be moved to and maintained. It must be provided in 1/10th millimeters. The valid range is 0 to 1000. Please note that the target width should be provided corrected for any fingertip offset, as it is measured between the insides of the aluminum fingers.

4 (0x0004) Control (Write)

The control field is used to start and stop gripper motion. Only one bit should be set at a time. Please note that the gripper will not start a new motion before the one currently being executed is done (see busy flag in the Status field). The valid flags are:

Value	Name	Description
0x0000	stop	Stop the current motion.
0x0001	grip	Start the motion, with the preset target force and width. Please note that the gripper will ignore this flag if the busy flag is set in the status field.

5 (0x0005) Proximity Offset L (Read + Write)

This field sets the offset of the left proximity sensor that is subtracted from the raw signal. It must be provided in 1/10 millimeters.

6 (0x0006) Proximity Offset R (Read + Write)

Same as the left above.

256 (0x0100) Left HEX sensor status HIGH (Read only)

Reads low (0x0000) when there is no error with the left finger sensor.

257 (0x0101) Left HEX sensor status LOW (Read only)

Reads low (0x0000) when there is no error with the left finger sensor.

259 (0x0103) Fx (L) (Read only)

Left finger sensor's force value along the X axis (in the sensor coordinate system) in 1/10N. The value is signed INT.

260 (0x0104) Fy (L) (Read only)

Left finger sensor's force value along the Y axis (in the sensor coordinate system) in 1/10N. The value is signed INT.

261 (0x0105) Fz (L) (Read only)

Left finger sensor's force value along the Z axis (in the sensor coordinate system) in 1/10N. The value is signed INT.

262 (0x0106) Tx (L) (Read only)

Left finger sensor's torque value about the X axis (in the sensor coordinate system) in 1/100 Nm. The value is signed INT.

263 (0x0107) Ty (L) (Read only)

Left finger sensor's torque value about the Y axis (in the sensor coordinate system) in 1/100 Nm. The value is signed INT.

264 (0x0108) Tz (L) (Read only)

Left finger sensor's torque value about the Z axis (in the sensor coordinate system) in 1/100 Nm. The value is signed int.

266 (0x0100) Right HEX sensor status HIGH (Read only)

Same as the left above.

267 (0x0101) Right HEX sensor status LOW (Read only)

Same as the left above.

268 (0x010C) Fx (R) (Read only)

Same as the left above.

269 (0x010D) Fy (R) (Read only)

Same as the left above.

270 (0x010E) Fz (R) (Read only)

Same as the left above.

271 (0x010F) Tx (R) (Read only)

Same as the left above.

272 (0x0110) Ty (R) (Read only)

Same as the left above.

273 (0x0111) Tz (R) (Read only)

Same as the left above.

274 (0x0112) Proximity Status (L) (Read only)

Reads low (0x0000) when there is no error with the left proximity sensor.

275 (0x0113) Proximity Value (L) (Read only)

Reads the current distance from the left proximity sensor in 1/10 mm. The value is signed INT.

277 (0x0115) Proximity Status (R) (Read only)

Same as the left above.

278 (0x0116) Proximity Value (R) (Read only)

Same as the left above.

280 (0x0118) Actual gripper width (Read only)

Indicates the current width between the gripper fingers in 1/10 millimeters. Please note that the width is provided without any fingertip offset, as it is measured between the insides of the aluminum fingers.

281 (0x0119) Gripper busy (Read only)

High (1) when a motion is ongoing, low (0) when not. The gripper will only accept new commands when this flag is low.

282 (0x011A) Grip detected (Read only)

High (1) when an internal- or external grip is detected.

3.1.5.10. Sander

The table below provides an overview of the available MODBUS registers in the Sander.

All writable registers can be accessed using function codes 6, 16 or 23 and all readable registers can be accessed using function codes 3 or 23.

Address		Register	Access
0	0x0000	Command (enum)	Write
1	0x0001	Target RPM	Write
256	0x0100	Status flags	Read only
257	0x0101	Warning flags	Read only
258	0x0102	Current RPM	Read only
259	0x0103	Current temp	Read only
260	0x0104	Motor Power	Read only
261	0x0105	MAX RPM deviation of cycle	Read only
262	0x0106	Vibration	Read only
273	0x0111	Error flags	Read only
274	0x0112	Target RPM	Read only
517	0x0205	Temp limit level	Read only
518	0x0206	Disk diameter	Read only
519	0x0207	Orbit size	Read only
1024	0x0400	RPM deviation level	Write

Address		Register	Access
1025	0x0401	Vibration limit level	Write

0 (0x0000) Command (Write)

This register sets the command.

Value	Description	Requirements
0	Motor stop	No requirement
1	Motor start	Target RPM should not be lower than ~900RPM
3	Button LED off	No requirement
4	Button LED on	No requirement

1 (0x0001) Target RPM (Write)

This register sets the target RPM of the Sander.

256 (0x0100) Status flags (Read only)

This register returns the status of the Sander motor or button.

Value	Description
0	Motor stopped
1	Motor running
2	Motor in ramp up
3	Motor in ramp down
4	Button pressed longer than 100ms

257 (0x0101) Warning flags (Read only)

This register returns a warning flag as follows in the table.

Value	Description
0	RPM deviation
1	Motor voltage

Value	Description
2	Motor current
3	Temperature
4	Vibration
5	30V level
6	24V level
7	12V level
8	5V level
9	Motor ramp error
10	Motor RPM range error
11	Motor missed zero crossing error
12	Motor RPM change error
13	Motor stopped due to communication error

258 (0x0102) Current RPM (Read only)

This register returns the current rotation speed of the Sander in unsigned RPM.

259 (0x0103) Current temp (Read only)

This register returns the current temperature of the Sander in signed 1/10 °C value.

260 (0x0104) Motor Power (Read only)

This register returns the power of the motor in unsigned W.

261 (0x0105) Maximum RPM Deviation of Cycle (Read only)

This register returns the maximum RPM deviation in a cycle, which is the time range between a motor start and motor stop, in unsigned RPM.

262 (0x0106) Vibration (Read only)

This register returns the vibration of the Sander in signed 1/100 g.

273 (0x0111) Error flags (Read only)

This register can be used to determine what caused the last stop of the motor. The register is only cleared on new start motor command.

Value	Description
0	30V Error
1	24V Error
2	12V Error
3	5V Error
4	Current Error
5	Vibration Error
6	Temperature Error
7	Modbus timeout Error
8	Motor ramp Error
9	Motor RPM range Error
10	Motor Missed Zero Cross Error
11	Motor RPM Change Error
12	Firmware update started during motor run

274 (0x0112) Target RPM (Read only)

This register returns the target RPM of the Sander.

517 (0x0205) Temp limit level (Read only)

This register returns the current temperature of the Sander in unsigned 1/10 °C value.

518 (0x0206) Disk diameter (Read only)

This register returns the disk diameter of the Sander.

Value	Description
0	Invalid
1	5” Disk
2	6” Disk

519 (0x0207) Orbit size (Read only)

This register returns the orbit size of the Sander.

Value	Description
0	Invalid
1	0 mm
2	2.5 mm
3	5 mm

1024 (0x0400) RPM deviation level (Write)

This register sets the accepted RPM deviaton level boundary in RPM as an absolue value. This sets a +/- boundary with the provided value.

1025 (0x0401) Vibration limit level (Write)

This register sets the accepted vibration limit level in unsigned 1/100 g.

3.1.5.11. Screwdriver

The table below provides an overview of the available MODBUS registers in the Screwdriver.

NOTE:

The Screwdriver only works on MODBUS TCP.

Address		Register	Access
0	0x0000	Shank position	Write
1	0x0001	Z axes Force	Write
2	0x0002	Screw length	Write
3	0x0003	Target torque	Write
4	0x0004	Command	Write
7	0x0007	Extender length	Write
256	0x0100	Status/Errors	Read only
257	0x0101	Current torque	Read only
258	0x0102	Shank / Z Axes Position	Read only
259	0x0103	Z Force	Read only

Address		Register	Access
260	0x0104	Torque angle gradient	Read only
261	0x0105	Achieved torque	Read only
262	0x0106	Additional results	Read only
269	0x010D	Current extender	Read only
270	0x010E	Maximum shank position	Read only
271	0x010F	Corrected shank with extender	Read only
512	0x0200	Quick Changer Version	Read only

0 (0x0000) Shank position (Write)

This field sets the target shank position to be reached when the command is executed. It must be provided in mm. The valid range is 0 to 55.

1 (0x0001) Z axes Force (Write)

This field sets the target Z axes force to be achieved and maintained. It must be provided in N. The valid range is 18 - 30.

2 (0x0002) Screw length (Write)

This field sets the screw/screwing/unscrewing length. It must be provided in micrometers.

3 (0x0003) Target torque (Write)

This field sets the output torque the Screwdriver will try to reach. It must be provided in mNm.

4 (0x0004) Command (Write)

This field sets the command.

Value	Name
0 (0x0000)	Tighten screw
1 (0x0001)	Loosen screw
2 (0x0002)	Pick up screw
4 (0x0004)	Stop
8 (0x0008)	Pick up bit holder
16 (0x0016)	Screw by length

Value	Name
32 (0x0032)	Screw in self-tapping screw

Overview of commands and parameters

	Tighten screw	Loosen screw	Pick up screw	stop
Z_POS_MM	not relevant	not relevant	not relevant	
Z_FORCE_N	18 to 30	18 to 30	18 to 30	
SCREW_LEN_muM	0 to 35000	0 to 35000	0 to 35000	
TORQUE_Nmm	100 to 5000	not relevant	not relevant	
COMMAND	0	1	2	4

7 (0x0007) Extender length (Write)

This field sets the length of the bit extender when it is used.

256 (0x0100) Status/Errors (Read only)

This field sets the status/errors.

Error Code	Description
1 (0x0001)	Screwdriver busy
2 (0x0002)	Z-axis (or general initialization) busy
4 (0x0004)	Error: Z-axis safety activated
8 (0x0008)	Error: not calibrated
16 (0x0010)	initialize: Z stall current not reached
32 (0x0020)	initialize: No Z index mark found
48 (0x0030)	initialize: Unable to home Z axis
64 (0x0040)	initialize: Z index placement not ok
80 (0x0050)	initialize: No index mark found on torque encoders
96 (0x0060)	Initialize: too big torque difference during initialization
112 (0x0070)	Index mark value has changed

Error Code	Description
256 (0x0100)	Error QC type
512 (0x0200)	Error power supply

257 (0x0101) Current torque (Read only)

This field indicates the measured current torque in mNm.

258 (0x0102) Shank / Z Axes Position (Read only)

This field indicates the shank / Z Axes current position in micrometers.

259 (0x0103) Z Force (Read only)

This field indicates the Z force in mN.

260 (0x0104) Torque angle gradient (Read only)

This field indicates current torque angle gradient in mNm/rad.

261 (0x0105) Achieved torque (Read only)

This field indicates latest achieved torque in mNm after a tighten command.

262 (0x0106) Additional results (Read only)

This field indicates additional information of the outcome of a command.

Result code	Description
0 (0x0000)	no additional result data
1 (0x0001)	Screwdriver: command unknown
2 (0x0002)	Screwdriver: not screwing in
3 (0x0003)	Screwdriver: timeout waiting for correct torque (2 sec)
4 (0x0004)	Screwdriver: torque exceeded unexpected (premature)
5 (0x0005)	Screwdriver: unable to loosen screw (max torque exceeded)
6 (0x0006)	Screwdriver: Z-axis reached the end
7 (0x0007)	Screwdriver: Z-axis obstructed during move

269 (0x010D) Current extender (Read only)

This field indicates the length of the bit extender when it is used.

270 (0x010E) Maximum shank position (Read only)

This field indicates the maximum shank position.

271 (0x010F) Corrected shank with extender (Read only)

This field indicates the shank position corrected with the length of the bit extender when it is used.

512 (0x0200) Quick changer version (Read only)

This field indicates what Quick Changer version is installed. 1 for QC-R v2 and 2 for QC-R v2-4.5A

3.1.5.12. SG

The table below provides an overview of the available MODBUS registers in the SG.

All writable registers can be accessed using function codes 6, 16 or 23 and all readable registers can be accessed using function codes 3 or 23.

Address		Register	Access
0	0x0000	Target width	Write
1	0x0001	Command	Write
2	0x0002	Set Gentle grip	Write
3	0x0003	Gripper model ID	Write
256	0x0100	Gripper width	Read only
259	0x0103	Status	Read only
261	0x0105	Max width	Read only
262	0x0106	Min width	Read only

0 (0x0000) Target width (Write)

This field sets the target width between the finger to be moved to and maintained. It must be provided in 1/10th millimeters.

1 (0x000a) Command (Write)

This field sets the command.

NOTE:

Gripper model id must be set before Init and Init must be called before Move.

Address	Type
0x1	Move
0x2	Stop
0x3	Init

2 (0x0002) Gentle grip (Write)

1 set it as true and 0 as false. If true the gripping speed is reduced at 12.5mm before the specified target width, this results in a gentler grip, compared to normal grip settings.

3 (0x0003) Gripper model ID (Write)

This filed sets the model ID (silicone tool attached).

id	Type
1	None
2	a-H
3	a-S
4	b-H

256 (0x0100) Gripper Width (Read only)

Indicates the gripper current width in 1/10 millimeters.

259 (0x0103) Status (Read only)

This status field indicates the status of the gripper and its motion. It is composed of 7 flags (bits), described in the table below.

Bit	Name	Description
0 (LSB)	busy	High (1) when a motion is ongoing, low (0) when not. The gripper will only accept new commands when this flag is low.
1	initialized	High (1) when the gripper is initialized.
2-3	-	Reserved
4-6	error	High (1) any of these bits when there is an error

262 (0x0106) Max width (Read only)

Indicates maximum open width in mm.

261 (0x0105) Min width (Read only)

Indicates minimum close width in mm.

3.1.5.13. VG10/VGC10

The table below provides an overview of the available MODBUS registers in the VG grippers.

All writable registers can be accessed using function codes 6, 16 or 23 and all readable registers can be accessed using function codes 3 or 23.

Address		Register	Access
0	0x0000	Channel A Control	Read + Write
1	0x0001	Channel B Control	Read + Write
2	0x0002	Current limit	Read + Write
258	0x0102	Channel A actual vacuum	Read only
259	0x0103	Channel B actual vacuum	Read only

0 (0x0000) Channel A Control (Read + Write)

This register allows for control of channel A. The register is split into two 8-bit fields:

Bits 15-8	Bits 7-0
Control mode	Target vacuum

The Control mode field must contain one of these three values:

Value	Name	Description
0 (0x00)	Release	Commands the channel to release any work item and stop the pump, if not required by the other channel.
1 (0x01)	Grip	Commands the channel to build up and maintain vacuum on this channel.
2 (0x02)	Idle	Commands the channel to neither release nor grip. Workpieces may “stick” to the channel if physically pressed towards its vacuum cups, but the VG will use slightly less power.

The Target vacuum field sets the level of vacuum to be build up and maintained by the channel. It is used only when the control mode is 1 (0x01) / Grip. The target vacuum should be provided in % vacuum. It should never exceed 80.

Examples:

- Setting the register value 0 (0x0000) will command the VG to release the work item.

- Setting the register value 276 (0x0114) will command the VG to grip at 20 % vacuum.
- Setting the register value 296 (0x0128) will command the VG to grip at 40 % vacuum.
- Setting the register value 331 (0x014B) will command the VG to grip at 75 % vacuum.
- Setting the register value 512 (0x0200) will command the VG to idle the channel.

1 (0x0001) Channel B Control (Read + Write)

Same as in channel A above.

2 (0x0002) Current limit (Read + Write)

Set and read the current limit. The limit is provided and must be given in mA (milli-amperes). The limit is 500mA per default and should never be set above 1000 mA.

258 (0x0102) Channel A actual vacuum (Read only)

Reads the actual vacuum on Channel A. The vacuum is provided in (1/1000 of relative vacuum. Please note that this differs from the setpoint given in percent, as extra accuracy is desirable on the actual vacuum.

259 (0x0103) Channel B actual vacuum (Read only)

Same as in channel A above.

3.1.5.14. VGP20

The table below provides an overview of the available MODBUS registers in the VGP20.

All writable registers can be accessed using function codes 6, 16 or 23 and all readable registers can be accessed using function codes 3 or 23.

Address		Register	Access
0	0x0000	Channel A control	Write
1	0x0001	Channel B control	Write
2	0x0002	Channel C control	Write
3	0x0003	Channel D control	Write
256	0x0100	Channel status	Read only
257	0x0101	Status	Read only
258	0x0102	Channel A vacuum in %	Read only
259	0x0103	Channel B vacuum in %	Read only
260	0x0104	Channel C vacuum in %	Read only
261	0x0105	Channel D vacuum in %	Read only

0 (0x0000) Channel A Control (Write)
1 (0x0001) Channel B Control (Write)
2 (0x0002) Channel C Control (Write)
3 (0x0003) Channel D Control (Write)

These registers control the channels:

- 0 (0x0000) Channel A Control (Write) - controls channel A
- 1 (0x0001) Channel B Control (Write) - controls channel B
- 2 (0x0002) Channel C Control (Write) - controls channel C
- 3 (0x0003) Channel D Control (Write) - controls channel D

Bit	Name	Description
0–6	Grip vacuum in %	The target vacuum that the channels will try to achieve.
7	Require	When set to high (1), the channel must achieve the target vacuum within 3 seconds, otherwise it will go to a grip error state and the status becomes Required grip timeout. When set to low (0), the status never becomes Required grip timeout.
8–14	Reserved	Not used.
15	Ignore	When set to high (1), the command is ignored for the channel.

256 (0x0100) Channel Status (Read only)

This register indicates the status of the channel.

Status Channel A							
Grip				Release			
	Bit 1	Bit 0	Status		Bit 3	Bit 2	Status
Value	Low (0)	Low (0)	Not gripped	Value	Low (0)	Low (0)	Not released
	Low (0)	High (1)	Grip detected		Low (0)	High (1)	Release ok
	High (1)	Low (0)	Required grip timeout		High (1)	Low (0)	Release fail
	High (1)	High (1)	Grip lost		High (1)	High (1)	Reserved

Status Channel B							
Grip				Release			
	Bit 5	Bit 4	Status		Bit 7	Bit 6	Status
Value	Low (0)	Low (0)	Not gripped	Value	Low (0)	Low (0)	Not released
	Low (0)	High (1)	Grip detected		Low (0)	High (1)	Release ok
	High (1)	Low (0)	Required grip timeout		High (1)	Low (0)	Release fail
	High (1)	High (1)	Grip lost		High (1)	High (1)	Reserved

Status Channel C							
Grip				Release			
	Bit 9	Bit 8	Status		Bit 11	Bit 10	Status
Value	Low (0)	Low (0)	Not gripped	Value	Low (0)	Low (0)	Not released
	Low (0)	High (1)	Grip detected		Low (0)	High (1)	Release ok
	High (1)	Low (0)	Required grip timeout		High (1)	Low (0)	Release fail
	High (1)	High (1)	Grip lost		High (1)	High (1)	Reserved

Status Channel D							
Grip				Release			
	Bit 13	Bit 12	Status		Bit 15	Bit 14	Status
Value	Low (0)	Low (0)	Not gripped	Value	Low (0)	Low (0)	Not released
	Low (0)	High (1)	Grip detected		Low (0)	High (1)	Release ok
	High (1)	Low (0)	Required grip timeout		High (1)	Low (0)	Release fail
	High (1)	High (1)	Grip lost		High (1)	High (1)	Reserved

257 (0x0101) Status (Read only)

This register indicates the status of the gripper.

Bit	Description
0	Busy
1–13	Not used
14	Indicates PSU error
15	Indicates QC error

258 (0x0102) Channel A Vacuum (Read only)

This register indicates the actual vacuum in % for channel A.

259 (0x0103) Channel B Vacuum (Read only)

This register indicates the actual vacuum in % for channel B.

260 (0x0104) Channel C Vacuum (Read only)

This register indicates the actual vacuum in % for channel C.

261 (0x0105) Channel D Vacuum (Read only)

This register indicates the actual vacuum in % for channel D.

3.1.5.15. Compute Box / Eye Box

The table below provides an overview of the available MODBUS registers for the Compute Box / Eye Box.

All writable registers can be accessed using function codes 6, 16 or 23 and all readable registers can be accessed using function codes 3 or 23.

Address		Register	Access
0	0x0000	Reset tool power	Write

0 (0x0000) Reset tool power (Write)

Writing 2 to this field powers the tool off for a short amount of time and then powers them back. This can be used to reset the RG2 or RG6 after the safety switch is triggered. It could take 1-2 seconds.

3.1.5.16. Compute Box I/O

To read the digital input and output when using the Pallet Station, follow the instructions below.

Write 4 to the **2 (0x0002) Command ID (Write)** field and 0 to the **3 (0x0003) Subcommand ID (Write)** field to initialize. After initializing, the digital input can be read from the **259 (0x0103)** register field and the digital output can be read from the **260 (0x0104)** register field.