





MQTT, SNMP, NTP

Getting Started



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1. MQTT protocol

1.1 MQTT basics

The MQTT protocol (Message Queuing Telemetry Transport) is an event-driven protocol based on the TCP / IP stack that uses the Publisher / Subscriber network model. Currently, MQTT is the de facto standard for data exchange in Industrial Internet of Things (IIoT) applications.



Advantages of MQTT:

- low network traffic due to asynchronous data exchange
- compactness of message
- the ability to work in an unstable data transmission channel
- different levels of quality of service (QoS)

The MQTT architecture defines three types of devices on the network:

- publishers clients that are data sources for subscribers
- subscribers clients that needs data from publishers
- broker a device (usually a PC with server software) that receives messages from publishers and sends them to subscribers

A device can be a publisher and a subscriber at the same time.

Published messages are organized in a hierarchy of *topics*. When a publisher has a new data to distribute, it sends a message with the data under the particular topic to the connected broker. The broker distributes the message to any clients that have subscribed to that topic.

1.2 Topic names

The name of the topic is a UTF-8 encoded character string that the broker uses to filter messages for each connected client. Topic names are case sensitive.

The full topic name, which must be entered in the query, consists of one or more topic *levels*, which are separated by forward slashes (*topic level separators*). The *topic name* is understood to be the code word on the last level.

When a client subscribes to a topic, it can subscribe to the exact topic of a published message or it can use wildcards to subscribe to multiple topics simultaneously. There are two kinds of wildcards: *single-level* (+) and *multi-level* (#) (see Example).

Structure of topic name:

Device_series/Device_name/Function/Node/Topic_name

where

- **Device_series** MX210
- **Device_name** name specified in the **Device name** parameter
- *Function* GET (read the input and output values) or SET (write the output values)
- Node I/O type (DI, DO, AI, AO)
- **Topic_name** see **Topic name** column in Table 1.



Device model	Function	Node	Topic name	Description	Format
202, 204, 212, 214, 221, 301, 302, 311, 312	GET	DI	MASK	Bitmask of digital inputs	UINT
202, 204, 212, 214, 301, 302, 311, 312	GET	DIn	COUNTER	Value of a counter or of an optional function	UINT
301, 302, 311, 312, 402, 403, 410	SET	DO	MASK	Bitmask of digital outputs	UINT
301, 302, 311, 312, 401, 402, 403, 410	GET	DO	STATE	Bitmask of digital outputs	UINT
311, 312, 410	GET	DO	DIAGNOSTICS	Diagnostics bitmask of digital outputs	UINT
101	GET	Aln	VALUE	Value of an analog input	REAL
	SET		VALUE_PERCENT	Value of analog output in %	REAL
501	GET	AOn	VALUE_PHYS	Value of analog output in mV or μA	REAL

Table 1. Topic levels

Example:

MK210-311

- Read the bitmask of digital inputs MX210/Device_name/GET/DI/MASK Received value: 15 (HIGH on inputs 1-4)
- Write the bitmask of digital outputs MX210/Device_name/SET/DO/MASK New value: 15 (outputs 1-4 set)
- Single-level wildcard usage MX210/Device_name/GET/+/COUNTER Received value: counter values of all digital inputs. The topic is equivalent to the group of topics:

MX210/Device_name/GET/DI1/COUNTER MX210/Device_name/GET/DI2/COUNTER MX210/Device_name/GET/.../COUNTER MX210/Device_name/GET/DIn/COUNTER

 Multi-level wildcard usage MX210/Device_name/GET/# Received value: all module parameters available for reading. The topic is equivalent to the group of topics:

MX210/Device_name/GET/DI/MASK MX210/Device_name/GET/DI1/COUNTER MX210/Device_name/GET/DI2/COUNTER MX210/Device_name/GET/.../COUNTER MX210/Device_name/GET/DIn/COUNTER



1.3 Configuration in akYtecToolPro

The module of MX210 series supports the MQTT v3.1.1 protocol and can be used as a client. It can publish information about the status of its inputs and outputs and can be subscribed to topics which control its outputs.

To configure the MQTT parameters, open the node **MQTT** in the parameter tree.



When using the MQTT protocol, it is recommended to set the parameter "Safe state timeout" (Modbus Slave group) to 0, since writing is usually event-driven and not cyclic in this case.

Parameter	Description	Range	Default value	Access
Presence detection. Enable	If On , the module publishes the message "Online" to the topic specified in the parameter Topic name after powering on. If no messages are received from the module, the broker pub- lishes an "Offline" message in this topic.	On / Off	Off	RW
Presence detection. Topic name	Topic name used for presence detection.	-	MQTT- status	RW
Connect to broker	Set to On to establish connection	On / Off	Off	RW
User name	Used for device authentication on the broker	-	-	RW
Password	side. If the values are not specified, the authenti- cation is disabled.	-	-	RW
Device name	Device name used in the topic name (see 1.2 / Example)	-	-	RW
Broker address	Broker IP or URL. If the broker is located in an external network, check the correct values for the parameters <i>Gateway</i> and <i>DNS</i> (<i>Network</i> group)	-	-	RW
Port	Port for broker	06553 5	1883	RW
Store last message	If On , other clients subscribed to the module's topics will receive the latest messages from these topics.	On / Off	Off	RW
Publishing interval	Publishing interval in seconds	5600	10	RW
Quality of service	QoS0 - at most once (without guarantee of delivery)QoS1 - at least once (with guarantee of delivery)QoS2 - exactly once (with guarantee of delivery)and of no duplicate messages)	QoS0 / QoS1 / QoS2	QoS0	RW
Keep Alive	Keep Alive interval in seconds	0600	0	RW
Status	Status of connection to broker	-	-	R

Table 2	MOTT	parameters
	ivi Q I I	parameters

1.4 MQTT connection test

There are many ways to test the MQTT connection. We will show one of them. For test purposes we will use:

- Public MQTT Broker (online-tool)

Link: <u>https://www.hivemq.com/public-mqtt-broker/</u>



MQTT client *MQTT.fx* (will receive messages from the module)

Download: https://softblade.de/download/

Download *MQTT.fx* and install it on the PC.

Connection test:

1. Note the access information of *Public MQTT Broker*.

You can access the broker at:
Broker: broker.hivemq.com
TCP Port: 1883
Websocket Port: 8000

- 2. Connect the module to Ethernet and power it on. We will take MV210-101 (8 AI).
- 3. Start the configurator akYtecToolPro and add the device to the project.

G		Add devices		
Network parameters				S
Interface		Name	Address	
Ethernet 🗸		MK210-311 S/N 67610171132365489	192.168.1.99	
Find all devices	\checkmark	MV210-101 S/N 76264180832277348	192.168.1.101	
First IP address 192.168.1.99 Last IP address 192.168.1.101				
IP address 10.2.11.123 Find				

4. MV210-101: select the signal for one input and connect the respective sensor to it.

4	AI	1		
		Input signal	Pt100 (a = 0.00385)]
		Curve offset	0	
		Curve slope	1	
		Upper limit	250	
		Lower limit	-50	
		Sampling time	3000	
		Filter bandwidth	10	
		Digital point offset	1	
		Filter time constant	3	
4	AI	2		
		Input signal	4-20 mA	
		Curve offset	0	1
		Curve slope	1	
		Upper limit	250	
		Lower limit	-50	
		Sampling time	3000	

5. Enable the MQTT connection for the module and set the MQTT parameters: device name, broker address, port number. Click the item *Write parameters* to save the settings.



	M	QTT				
	•	Presence messages				
		Connecting to a broker	On	~		•
		Login				3
		Password				
		Device name	akytec_101		Device	
		Broker address	broker.hivemq.com			
		Port	1883		1883	
		Storing of last message	Off	\checkmark		
		Publication interval	5		10	
		Service quality	QoS0	~		
		Keep Alive Interval	0			
		Status	Connection error	\sim		

6. Start *MQTT.fx* and open *Settings*.

QTT.fx Extras Help		
HiveMQ Cloud	Connect Disconnect	
Publish Subscribe Scripts B	roker Status Log	
Jubbenbe Scripts D	LOE LOE	
	-	
		Publish
	> User Properties	Publish

7. Enter Broker Address and Broker Port.

100

8. Click Generate to generate Client ID and then OK to confirm.

HiveMQ Cloud	Profile Name
MQTT Broker	Profile Type
	MQTT Broker Profile Settings
broker.hivemq.com	Broker Address
 1883	Broker Port

- 9. When the dialog box is closed, click the button *Connect*. The gray circle on the right turns green. The connection is established. The module publishes data on the broker and the client on PC can subscribe them.
- 10. Write the correct topic and click **Subscribe**.

/QTT.fx Extras Help			
HiveMQ Cloud		Connect	Disconnect
Publish Subscribe	Scripts Broker	Status Log	
/X210/akYtec_101/GET	AI1/VALUE	Subjeribe	

11. Now you can see the measured value on the input AI1 in the right pane...

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MX210/akYte	_101/GET/AI1/VAL	UE		
MX210/akY	/tec_101/GET/AI	1/VALUE		
30.427670	-			

...and in the akYtecToolPro.

4	Measured values (REAL)	
	AI 1 REAL	30.38717
	AI 2 REAL	Sensor is off
	AL3 REAL	Sensor is off

2. SNMP protocol

2.1 SNMP basics

Simple Network Management Protocol (SNMP) is an Internet standard protocol for collecting and organizing information about managed devices on IP networks and for modifying that information to change device behavior.

An SNMP-managed network consists of three key components:

- Managed devices network nodes with an SNMP interface that allows unidirectional (read-only) or bidirectional (read-write) access to node-specific information
- Agent software which runs on managed devices
- Network management station (NMS) software which runs on the manager (administrative computer)

Managers can read (GET) and write (SET) agent parameters. Agents can send messages (*traps*) to managers about parameter changes.

Management data is exposed in the form of variables on the managed device organized in a Management Information Base (MIB) as a hierarchical tree structure. Each variable (parameter) in MIB has a unique identifier OID (object identifier), represented as a sequence of decimal numbers separated by dots. SNMP requests use OID to retrieve the desired information.

All module parameters are available via SNMP protocol. The complete list of parameters is given in the User Guide in Table D.1 "Modbus registers".

2.2 Configuration in akYtecToolPro

To configure the SNMP parameters of the device, connect the device to the PC with the running akYtecTool-Pro and add this to a project.

Parameter	Description Ran		Default value	Ac- cess
Enable Enable SNMP connection		On / Off	Off	RW
Read community Community name for read access level		-	public	RW
<i>Write community</i> Community name for read/write access level		-	private	RW
Trap IP address	IP address to which a trap will be sent in case of changing the mask of the digital inputs (modules with digital inputs only)	-	10.2.4.78	RW
Trap port	Number of the port to which traps will be sent	065535	162	RW
SNMP version	Protocol version	SNMPv1 / SNMPv2	SNMPv1	RW

Table 3. SNMP parameters

- Set the *Enable* parameter to *On* to enable the SNMP connection

- Set the *Trap IP address* parameter to the IP address of the manager (PC with NMS software)
- Set the Trap port
- Select the SNMP version

The module supports SNMPv1 and SNMPv2c protocol versions.

2.3 SNMP connection test

Check the availability of the Mx210 module in the SNMP network using the installed NMS software (e.g. **OPC server for SNMP**).

Alternatively you can use one of freeware tools available in internet. In the proposed example, **MIB Browser Free Personal Edition** is used.



Connection test:

- 1. Start the tool.
- 2. Enter the IP address of the module.

😚 iReasoning MIB Browser							
File	Edit	Operations	Tools	Book	marks	Help	
Addres	s: 19	2.168.1.99		×	Adv	anced	
SNMP MIBs							
🐢 MIB Tree							

3. Select *File > Load MIBs* in the menu.

🕤 il	😚 iReasoning MIB Browser						
File Edit Operations Tools Bookmarks Help							
	Load MIBs Ctrl+L	V Advanced OID:					
	UnLoad MIBs		Result Table				
MIB Modules							
	Open Session	nib-2					
	Save Session						
	Exit						

- 4. Select the MIB file in the open dialog box and click **Open** to confirm.
- 5. Unfold the hierarchical tree, select the module, right click it and select the item *Walk* in the context menu.

P MIB Tree		
🖹 📙 iso.org.dod.internet		
🗄 📙 mgmt		
🖨 📙 private		
enterprises		
🖃 📙 akYtec		
🖨 🔂 mx210		
🖨 🔚 mv101		
🕀 📙 batt	Find in subtree	
🕀 📙 log	Export to CSV	
🕀 📙 dev	Export to XML	
🕀 📙 univ	Expand subtree	
🖶 🔂 mod	Graph View	Ctrl+R
teal	Cat Nant	Crel+N
🖶 🔜 netv	Get Next	Cuitin
🖶 📑 snm	Get Bulk	Ctrl+B
🖶 🔄 mqt	Get Subtree	Ctrl+E
ntp	Walk	Ctrl+W
trap	Table View	Ctrl+T

6. In the right pane, you can see all variables available in the module



	· · · · · · · · · · · · · · · · · · ·	4
MIB Iree	Name/OID	Value
iso.org.dod.internet	.1.3.6.1.4.1.51014.2.101.91392.4220	100.0
mgmt	.1.3.6.1.4.1.51014.2.101.91392.4222	0.0
	.1.3.6.1.4.1.51014.2.101.91392.4225	3000
	.1.3.6.1.4.1.51014.2.101.91392.4214	10
iakYtec	.1.3.6.1.4.1.51014.2.101.91392.4215	1
ian mx210	.1.3.6.1.4.1.51014.2.101.91392.4224	3
i⊟- <mark></mark> mv101	.1.3.6.1.4.1.51014.2.101.88576.4000	-2.5961484E33
batteryStatus	.1.3.6.1.4.1.51014.2.101.88576.4003	27.748764
🕀 📙 log	.1.3.6.1.4.1.51014.2.101.88576.4006	-2.5961484E33
deviceStatus	.1.3.6.1.4.1.51014.2.101.88576.4009	-2.5961484E33
universalAnalogInputs	.1.3.6.1.4.1.51014.2.101.88576.4012	-1.0633824E37
in measured Values REAL	.1.3.6.1.4.1.51014.2.101.88576.4015	-1.0633824E37
ailREAL	.1.3.6.1.4.1.51014.2.101.88576.4018	-1.0633824E37
ai2RE/	.1.3.6.1.4.1.51014.2.101.88576.4021	-1.0633824E37

7. The variables with the pen icon can be changed using the command **Set** in the context menu.

🔟 👝 14	colusuit	00112		0.00
	coldJunc	coldJunction3		
inputSignal	Find in subtree		2.101.88320.89600.4100	0
✓ IlterBandv	T main sublice		2.101.88320.89600.4104	0.0
🖉 digitalPoint	Export to CSV		2.101.88320.89600.4106	1.0
🛛 🖉 curveOffse	Export to XML		2.101.88320.89600.4108	250.0
🖉 curveSlope	Expand subtree		2 101 88320 89600 4110	-50.0
🛛 🖉 upperLimit	Graph View	Ctr1+R	2 101 88320 89600 4113	3000
🖉 lowerLimit	Orapii view	Curric	101 88320 89600 4102	10
🖉 filterTimeC	Get	Ctrl+G	101 88320 89600 4103	1
🖉 samplingTi	Get Next	Ctrl+N	101 88220 80600 4112	2
⊞ ai2	Get Bulk	Ctrl+B	2.101.88320.89600.4112	3
a:2			2.101.89856.4116	11
	Get Subtree	Ctrl+E	2.101.89856.4120	0.0
🖽 🖬 ai4	Set	Ctrl+S	2.101.89856.4122	1.0
⊞ <mark>–</mark> ai5	Walk	Ctrl+W	2.101.89856.4124	250.0
i 🕮 📃 aiƙ			101 00056 4106	50.0



3. NTP protocol

The module supports the synchronization of the RTC with an NTP server v4.

Open the node *NTP* to configure NTP parameters.

Table 4. NTP parameters

Parameter	Description	Range	Default value	Access
Enable	Enable NTP connection	On / Off	Off	RW
NTP server pool	IP or URL of NTP pool. If the server is located in an external network, check the correct val- ues for the parameters <i>Gateway</i> and <i>DNS</i> (<i>Network</i> group)	-	pool.ntp.org	RW
NTP server 1	IP or URL of the primary NTP server	-	192.168.1.1	RW
NTP server 2	IP or URL of the secondary NTP server		192.168.1.2	RW
Synchroniza- tion period	Time synchronization period in seconds. Ensure the set value is not less than the mini- mum value for the selected NTP server.	565535 s	5	RW
Status	Server connection status	-	_	R

All specified NTP servers, including the servers from the pool, have the same polling priority.