

# Anybus® Wireless Bolt IoT™

Set Up IO-Link Master and Bolt IoT with MQTT

# **APPLICATION NOTE**

SCM-1202-174 1.0 en-US ENGLISH





# **Important User Information**

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# 1 Preface

## 1.1 About This Application Note



#### Fig. 1

In this application note, we describe how to connect a ifm pushbutton to an IO-Link Master using the Modbus TCP interface with a Wireless Bolt IoT by pushing the data from the push-button to a MQTT-server/broker on the internet via the Wireless Bolt IoT.

### **1.2** Target Audience

It is recommended that the reader is familiar with the equipment and have a good knowledge of wireless communication and network technology.

### **1.3** Trademarks

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# 2 Preparation

## 2.1 Required Equipment

In this application note we use the following equipment:

Equipment	Article Number	Version	Туре
ifm IO-Link master with Modbus TCP interface	AL1340	AL1x4x_fw_mo_f7_v2.3.23	N/A
ifm Capacitive illuminated pushbutton	KT6101	N/A	N/A
ifm USB Stick with IO-Link parameter setting software, LR DEVICE	QA0011	N/A	N/A
ifm Power supply, 24 VDC with M12 connector	N/A	N/A	N/A
ifm Connection Cable	E12490	N/A	0.5 m PVC- Cable; M12/ RJ45 connector
Anybus Wireless Bolt IoT black, NB-IoT, LTE- M/CAT-M1, 2G GPRS/EDGE	AWB1000	N/A	N/A
IoT SIM-card Netmore M2M	SP2824	N/A	N/A
Netgear ProSafe 5-Port Gigabit Switch	GS105v4	N/A	N/A
Power adapter, 12VDC	N/A	N/A	N/A
2 Ethernet Cables	N/A	N/A	N/A

#### **Optional equipment**

This kit can be used as an option to the AL1340, Ifm IO-Link master with Modbus TCP interface:

Equipment	Article Number
ifm IO-Link master starter kit - MQTT JSON	ZZ1350

### 2.2 Support and Resources

For additional documentation and software downloads, FAQs, troubleshooting guides and technical support, please visit <u>www.anybus.com/support</u> and <u>ifm.com</u>.

Have the product article number available, to search for the product specific support web page. You find the product article number on the product cover.

3 Connecting the Devices



Fig. 2

#### **IP** settings

The IP address of the IO-Link master needs to be configured before it can start to communicate with the Wireless Bolt IoT, refer to *IO-Link Configuration, p. 6*.

#### Connect and configure one device at a time

Connect one device at a time to the switch and configure it, before continuing with the next device and so on.

#### **Connecting cables**

- Connect the Wireless Bolt IoT to the switch with an ethernet cable (A).
- Connect the IO-Link master to the switch with the ifm connection cable (E12490) (B).
- Connect your computer to the switch with an ethernet cable (C).

#### **IO-Link master ports used**

- Connect the ifm connection cable (E12490) to port X23.
- Connect the ifm power supply to port X31.
- Connect the ifm pushbutton to port X01.

#### ifm power supply

Connect all the devices to the ifm power supply.

# 4 IO-Link Configuration

### 4.1 Installing the LR DEVICE Application

To configure the IO-Link master parameter settings, you need to install the LR DEVICE application on your computer.

#### Procedure

- 1. Plug in the ifm USB-stick to your computer and download the LR DEVICE installation exe file.
- 2. Run the LR DEVICE installation exe file and follow the instructions on the screen.



#### Fig. 3

- 3. Navigate to the folder where the LR DEVICE was installed and start the application.
  - $\rightarrow$  The LR DEVICE start screen opens.

😌 LR DEVICE	× +								-	σx
$\leftrightarrow \rightarrow \mathbf{C}$ (i) local	host:45234/lrd/								1 🖌 🐐	θ:
C DEVICE						Date: 7/23/20	Time: 11:31:24 AM	<b>i</b>		iło
Fast access	vice catalogue			Device parameters		<b>É</b> (	5 🛍 🛔		>	0
Setup Devices Costpat	ONLINE OFFLINE	X	Product ID: Vendor:	Device ID: - Serial number: -	Revision: - / - Device type: -		Device state:			

Fig. 4

#### 4.2 Load Data From IO-Link Master

#### **Before You Begin**

The IO-Link master factory default IP address starts with 169.254.

When the DHCP client of the IO-Link master is enabled, the IO-Link master is assigned the IP address 192.168.0.144 by the Wireless Bolt IoT.

#### Procedure

- 1. To search for IO-Link master, click **Read from device** in the top right menu.
  - $\rightarrow$  The **Finding devices** pop-up window appears. Wait until a Found device appears, showing the IO-Link master article number and IP address.

	– 🗆 ×
	🖈 💉 🏞 😝 🗄
Date: 7/30/20 Time: 3:	27:58 PM 🚯
Device parameters	
Device ID: - Revision: -/- Device	e state:
Serial number: - Device type: -	
Found devices AL1340 (192.168.0.144) Found device: AL1340 (192.168.0.144) Search for USB and Ethernet master	

#### Fig. 5

- 2. To load data from the IO-Link master to the LR DEVICE application, click **AL1340A** in the **ONLINE** menu.
  - → The **Reading data from device** pop-up window appears. Wait until all the data has been loaded from the IO-Link master.

🤕 LR DEVIC	e × +						
$\leftrightarrow \rightarrow G$	localhost:45234/lrd/						
DE.	VICE						
2.00	Device catalogue Fast access	Q	<		Device pa	rameters	
Setup	ONLINE			Product ID:	AL1340	Device ID:	4294967295 d
	Devices	+		Vendor:	ifm electronic gmbh	Serial number:	
Cockpit	AL1340 (192.168.0.144)	0		Cyclic polling:			
ooonph	P1	1					
	P2	1					
	P3	1					
	P4	1					
(	OFFLINE		Reading data from	n device			
	Vendor						

Fig. 6

### 4.3 IO-Link Master Configuration

In this section, we configure the IO-Link master IP address, Subnet mask and the Default gateway IP address.

#### **Before You Begin**

#### **DHCP** server

Ensure that there is a DHCP server available on the network, where the IO-Link master is connected.

If there is no DHCP server available when you reboot the IO-Link master, the device connected to the IO-Link master will not be able to find it.

#### Static IP address

If the IO-Link master uses a static IP address:

- and is connected to a network with DHCP mode enabled, the IO-Link master will not be configurable.
- ensure that the IP address is in the same subnet as the device connected to it.

#### **IO-Link master factory default settings**

IP address	169.254.x.x
Subnet mask	255.255.0.0
Gateway IP address	0.0.0.0

#### Procedure



#### Fig. 7

To configure the IO-Link master:

- 1. In the **ONLINE** menu, click **AL1340**.
- 2. Select the IoT tab, where the IO-Link master IoT parameters are listed.
- 3. Select **DHCP** from the **DHCP** drop-down menu.
- 4. To finish the configuration, click **Write to device** in the top right menu.

To make the changes take effect, you need to reboot the IO-Link master:

5. Disconnect the IO-Link master from power and then reconnecting it again.

#### Result

 $\rightarrow$  The IP address, Subnet mask and the Default gateway IP address are updated.

### 4.4 Ifm Pushbutton Configuration

When the capacitive illuminated ifm pushbutton is connected to the IO-Link master, it appears in the ONLINE menu.



#### Fig. 8

#### Procedure

To configure the ifm pushbutton settings:

- 1. Click on **KT6101**.
  - $\rightarrow$  The LR DEVICE reads and shows the ifm pushbutton parameter values.
- 2. Configure the desired parameters.
- 3. To make the changes take effect, reboot the IO-Link master.

5 Wireless Bolt IoT Setup

#### Procedure

Connect the Wireless Bolt IoT to internet:

#### 1. Insert SIM card

Insert a cellular SIM card in the Wireless Bolt IoT SIM card holder.

Ensure that the SIM card contact surface is facing towards the Ethernet port.



Fig. 9

#### 2. Connect to Computer and Power

- a. Connect the Wireless Bolt IoT Ethernet port to your computer.
- b. Connect the Wireless Bolt IoT Power connector to a power supply.



Fig. 10

#### 3. Wireless Bolt IoT IP settings

To access the Wireless Bolt IoT built-in web interface, ensure that the Wireless Bolt IoT IP address and your computer IP address are within the same IP address range.

The default IP address is 192.168.0.98.





#### 4. Access the Wireless Bolt IoT built-in web interface

The Wireless Bolt IoT default username is **admin**. Written in lowercase letters.

You find the default password on the Wireless Bolt IoT product housing.

- a. Enter the Wireless Bolt IoT IP address in your web browser and click **Enter**.
- b. Login to the Wireless Bolt IoT built-in web interface.

#### 5. Ethernet Settings

On the Ethernet Settings page, configure the **IP Settings**:

- a. IP Address
- b. Internal DHCP Server, select Enabled.



Fig. 12



#### Fig. 13 IP Settings example

#### 6. APN Settings

On the **Cellular Settings** page, configure the **APN Settings**.

APN Assignment	Manual	•
APN	lpwa.telia.iot	
APN Authentication	Yes (PAP)	•
User		
Password		

#### Fig. 14 APN Settings example

#### 7. Save and Reboot

In the left sidebar menu, click **Save and Reboot**.

→ The Wireless Bolt IoT automatically reboots, for the settings to take effect.

Verify the configuration:

#### 8. Verify the Wireless Bolt IoT IP address

To verify that the Wireless Bolt IoT IP address is configured.

The default IP address is 192.168.0.98.



Fig. 16

#### 9. Verify the system settings

System Overview	Ethernet		
Ethernet Settings	Internal DHCP Server	Enabled	
Cellular Settings	DHCP Table		
Firmware Update	IP Address		MAC Address
Logs	192.168.0.144		00:02:01:0a:e4:d9
	192.168.0.159		a4:4c:c8:d7:15:f2
System	192.168.2.3		b2:0e:05:ff:c8:91
Save and Reboot	Cellular Data Connection	Yes	
Cancel All Changes	Signal Strength	Strong signal (4	
	Operator	I ELIA S	
	SIM Card	SIM card insert	ed and unlocked
	SIM Card Status	SIM card insert Registered to a	ed and unlocked roaming network
	SIM Card Status Network Type	SIM card insert Registered to a LTE network (C	ed and unlocked roaming network IT-M1)
	SIM Card Status Network Type APN	SIM card insert Registered to a LTE network (C www.internet.)	ed and unlocked roaming network IT-M1) ntelia.dk
	SIM Card Status Network Type APN System	SIM card insert Registered to a LTE network (C www.internet.i	ed and unlocked roaming network NT-M1) ntelia.dk
	SIM Card Status Network Type APN System Firmware	SIM card insert Registered to a LTE network (C. www.internet. 1.00.34-dev	ed and unlocked roaming network NT-M1) ntelia.dk
	SIM Card Status Network Type APN System Firmware Time (UTC)	SIM card insert Registered to a LTE network (C www.internet. 1.00.34-dev 1980-01-06 01:	ed and unlocked roaming network AT-M1) ntelia.dk 3:15

#### Fig. 17

On the System Overview page, verify that the:

- c. Internal DHCP Server is Enabled.
- d. IP address of the IO-Link master is displayed in the DHCP Table.
- e. That cellular Data Connection has status Yes.
- f. **APN** settings are correct.

#### **10. Verify internet connection**

Verify internet access by sending a ping to *Google Public DNS*:

- 1. On the **Diagnostics** page, select **Ping** from the **Method** drop-down menu.
- 2. In the **Target** field, enter the IP address *8.8.8.8*.
- 3. To Perform Action, click Start.
  - $\rightarrow$  The ping request is sent.
  - → When the ping response return, a message appears.

Method	Ping •
Target	8.8.8.8
Perform Action	Start
Starting: ping -w 30 - c 4 PING 8.8.8.8 (8.8.8.8): 5 64 bytes from 8.8.8.8: se 64 bytes from 8.8.8.8: se 64 bytes from 8.8.8.8: se 64 bytes from 8.8.8.8: se	4 -4 -s 56 8.8.8.8 56 data bytes cq=0 ttl=52 time=521.234 ms cq=1 ttl=52 time=196.823 ms cq=2 ttl=52 time=174.440 ms cm=3 ttl=52 time=175.135 ms

Fig. 18 Example, Ping response from Target 8.8.8.8

# 6 Computer IP Configuration

The ethernet port on your computer that is connected to the switch must be configured to get IP address settings automatically.

#### Procedure

atworking Sharing				
Connect using:		Alternate Configuration		
🛃 Dell Giga Ethemet	Continum	You can get IP settings assigned au this capability. Otherwise, you need for the appropriate IP settings.	utomatically if your network supports d to ask your network administrator	5
This connection uses the following items:	conigare	Obtain an IP address automati	tically	
Client for Microsoft Networks	^	Use the following IP address:		
☑ 🕎 File and Printer Sharing for Microsoft N	etworks	IP address:	a a a	
Y Pocap Packet Driver (NPCAP)     Cos Packet Scheduler		Subnet mask:		
<ul> <li>Internet Protocol Version 4 (TCP/IPv4)</li> </ul>	6	Default gateway:		
Microsoft Network Adapter Multiplexor	Protocol			
Inicrosoft LLDP Protocol Driver	×	Obtain DNS server address au	utomatically	
		Use the following DNS server a	addresses:	
Install Uninstall	Properties	Preferred DNS server:		
Description Transmission Control Protocol/Internet Protoc	ol. The default	Alternate DNS server:		
wide area network protocol that provides com across diverse interconnected networks.	munication	Validate settings upon exit	Advanced	

#### Fig. 19

To change the IP address settings of the ethernet port:

- 1. Navigate to the Control Panel and click Network Connections.
- 2. Right-click the network connected to the switch and click **Properties**.
- 3. Click Internet Protocal Verion 4 (TCP/IPv4).
- 4. Verify that the **Obtain an IP address automatically** and **Obtain DNS server address automatically** radio buttons are selected.
- 5. Click OK.

#### Result

 $\rightarrow$  Now the Wireless Bolt IoT can generate IP addresses to the IO-Link master.

# 7 Publish Data From IO-Link

HTTP/JSON-requests are used to fetch and write data to the IO-Link master and devices connected to the ports on the master.

To publish data from the IO-Link master, a subscribe request must be sent to the IO-Link master via a HTTP/JSON-request.

Before sending subscribe requests the timer must be set on the IO-Link master.

The timer controls the cycle time of when data is pushed on the MQTT publish channel.

#### **Before You Begin**

The most efficient way is to send data from the IO-Link master when data changes.

The approach used in this application note was the best solution at the time it was written.

#### Procedure

To set the timer:

- 1. Visit <u>curl.haxx.se/download.html</u> and download curl.
- 2. When the curl download is finished, open a command prompt on your computer.
- 3. Write the code from *Example 1* and *Example 2*.
  - "adr": "/timer[1]/interval/setdata"
    specifies which timer to use, timer[1] or timer[2].
  - Set the timer [1] to a value between 500 ms and 2147483647 ms.

Example, the timer is set to 500 ms: "newvalue": 500

- http://192.168.0.144 is the IP address of the IO-Link master.

#### Example 1: Request

```
"code": "request",
"cid": 4712,
"adr": "/timer[1]/interval/setdata",
"data": {
    "newvalue": 500
}
}
```

Example 2: Request in curl

```
curl --header "Content-Type: application/json"
--request POST
--data '{
   "code": "request",
   "cid": 4712,
   "adr": "/timer[1]/interval/setdata",
   "data": {
   "newvalue": 500
   }
   }
   '
http://192.168.0.144
```

In Windows, there can be issues with single and double quotes, write the following:

```
curl --header "Content-Type: application/json"
--request POST
--data "{
    \"code\": \"request\",
    \"cid\": 4712,
    \"adr\": \"/timer[1]/interval/setdata\",
    \"data\": {
    \"newvalue\":500
    }
    }"
http://192.168.0.144
```

#### 4. Send the request.

 $\rightarrow$  If the request is successful, the response is according to *Example 3: Response*.

#### Example 3: Response

```
{
"cid": 4712,
"code": 200
}
```

5. Write the code from *Example 4* and *Example 5*.

- The public Mosquitto MQTT broker: https://test.mosquitto.org/.
- The Mosquitto brokers IP address: 5.196.95.208
- Port: 1883
- Topic: test.

Example 4: Subscribe Request

```
"code": "request",
"cid": 4712,
"adr": "timer[1]/counter/datachanged/subscribe",
"data": {
"callback": "mqtt://5.196.95.208:1883/test",
"datatosend": [
"iolinkmaster/port[1]/iolinkdevice/pdin"
]
}
```

#### Example 5: Subscribe Request in curl

```
curl --header "Content-Type: application/json"
--request POST
--data ' {
  "code": "request",
  "cid": 4712,
  "adr": "timer[1]/counter/datachanged/subscribe",
  "data": {
  "callback": "mqtt://5.196.95.208:1883/test",
  "datatosend": [
  "iolinkmaster/port[1]/iolinkdevice/pdin"
  ]
  }
} '
http://192.168.0.144
```

In Windows, there can be issues with single and double quotes, write the following:

```
curl --header "Content-Type: application/json"
--request POST
--data "{
    \"code\": \"request\",
    \"cid\": 4712,
    \"adr\": \"timer[1]/counter/datachanged/subscribe\",
    \"data\": {\"callback\": \"mqtt://5.196.95.208:1883/test\",
    \"datatosend\": [
    \"iolinkmaster/port[1]/iolinkdevice/pdin\"
    }
  }
  http://192.168.0.144
```

6. Send subscribe request to the IO-Link master.

 $\rightarrow$  If the request is successful, the response is according to *Example 6: Response*:

#### Example 6: Response

```
{
"cid": 4712,
"code": 200
}
```

To unsubscribe:

 $ig( \big)$  When unsubscribing, always use the same cid that was used for subscribing to the event.

7. Write the code according to *Example 7: Unsubscribe Request*.

Example 7: Unsubscribe Request

```
{
"code": "request",
"cid": 4712,
"adr": "timer[1]/counter/datachanged/unsubscribe",
"data": {
"callback": "mqtt://5.196.95.208:1883/test",
"datatosend": [
"iolinkmaster/port[1]/iolinkdevice/pdin"
]
}
```

To verify that the IO-Link master is sending data from the ifm pushbutton to the Mosquitto broker, there must be an additional device connected that subscribes to the same topic that the IO-Link master is publishing to.

As an additional device, we use an MQTT Client.

The devices subscribe to the topic: test



Fig. 20

#### Procedure

1. Visit mqttfx.org and download the JavaFX based MQTT Client installation file MQTT.fx.

⊗ MQTLfx × +	
← → C ( <sup>®</sup> ) Not secure   mgttfs.org	MQTT.FX HOME REFERENCES DONATE DOWALGAD ISSUETRACKER LICENSE ABOUT
	Welcome to the home of MQTT.fx
	Matt
	The JavaFX based MQTT Client.
	Download MQTT.fx

#### Fig. 21

- 2. Install the JavaFX based MQTT Client on your computer.
- 3. Start the MQTT Client.
- 4. Open the MQTT Broker Profile Settings.

File Extras Help mosquitto-test Publish Subscribe Scripts Broker Status Log	🐵 MQTT.fx - 1.7.0			
mosquitto-test     Connect     Disconnect       Publish     Subscribe     Scripts     Broker Status     Log	File Extras Help		_	
Publish Subscribe Scripts Broker Status Log	mosquitto-test		Connec	ct Disconnect
	Publish Subscrib	Scripts Broker St	tatus Log	_

Fig. 22

5. Enter the Brokers IP address and the Broker Port and then click OK.

mosquitto-test	Profile Name mosquitto-te	est	
	Profile Type MQTT Broke	ar 💌	NOT I
	MOTT Durling Des file Cottingen		
	MQ11 Broker Profile Settings		,
	Broker Address 5.196.95.208	3	
	Broker Port 1883		
	Client ID 2cd3444365	/104a73a4366b577976c731	Generate
	Clean Session V Auto Reconnect May Triversion V Use Defau 311 Clear Publis Clear Subsc	it A History ription History	

Fig. 23

6. Click Connect.

🙂 MQ	TT.fx - 1.7.0					
File	Extras Help					
	mosquitto-test		× 4	Connect	Disconnect	
Pul	blish Subscribe	Scripts	Broker Status Lo	g		

Fig. 24

#### Result

MQTT.fx - 1.7.0			- 🗆 X
File Extras Help			
local mosquitto	- 🔅 Connect	Disconnect	<b>■</b> ●
Publish Subscribe Scripts	Broker Status Log		
test	▼ Subscribe	Q	050 QoS1 QoS2 Autoscroll OCT
test	40 Dumn Messages Mitte Lingubscribe	test	30 QoS 0
	Pump messages made on substitute	test	31 QoS 0
		test	32 QoS 0
		test	30
		<pre>23-07-020 15:05:27:54327894 {"code": "event", "cid":1337, "adr": "/ rcurt": "00-02-01-0A-EA-D9/timer[1]// timer[1]/counter": {"code": 200, "data linkdevice/pdin": {"code": 200, "data"</pre>	Qos0 test","data":{"eventno":"25842","s counter/datachanged","payload":{"/ ":25842},"/iolinkmaster/port[1]/io :"0B880001"}}}

#### Fig. 25

- $\rightarrow$  The indicator at the top right of the page, turns green.
- $\rightarrow~$  The data from the ifm pushbutton connected to the IO-Link master appear in the bottom right corner.