# User Manual for ICP DAS Power Management IoT Kit

## -Microsoft Azure IoT Starter Kit-

[Version 1.0.0]







## Warning

ICP DAS Inc., LTD. assumes no liability for damages consequent to the use of this product. ICP DAS Inc., LTD. reserves the right to change this manual at any time without notice. The information furnished by ICP DAS Inc. is believed to be accurate and reliable. However, no responsibility is assumed by ICP DAS Inc., LTD. for its use, or for any infringements of patents or other rights of third parties resulting from its use.

## **Copyright and Trademark Information**

© Copyright 2017 by ICP DAS Inc., LTD. All rights reserved worldwide

## **Trademark of Other Companies**

The names used for identification only maybe registered trademarks of their respective companies.

## License

The user can use, modify and backup this software on a single machine. The user may not reproduce, transfer or distribute this software, or any copy, in whole or in part.

## **Table of Contents**

1	Introduction	1
2	Create an IoT Hub	4
3	Register a device for PMC-5231 in the IoT Hub	7
4	Setup Power Management IoT Kit	9
5	Connect PMC-5231 to Azure IoT Hub	12
6	Resource	18

## 1 Introduction

Microsoft and ICP DAS have teamed up to bring you the easy way to implement the Energy monitoring and management IoT (Internet of Things) Cloud system. The ICP DAS Power Management IoT Kit has been designed to help you seamlessly connect the ICP DAS power meters to the cloud with the Microsoft Azure IoT. This kit includes an ICP DAS PMC-5231, a ICP DAS PM-3114-100 4 Loops single-phase Power Meter, and a 24W Industrial Power Supply. There are also a LED Indicator and wires to help you set up your Energy monitoring and management system. Once your PMC-5231 is connected to Microsoft Azure you can start visualizing and analyzing your data.

Microsoft Azure is a leading provider of cloud computing and Microsoft Azure IoT Hub enables secure, reliable bi-directional communications between IoT endpoints such as sensors and the cloud. Azure IoT Hub supports a broad set of operating systems (Linux, Windows, RTOS etc.), protocols and common languages, so you can configure your connections to the devices.

PMC-5231 is a product developed by ICP DAS that functions as concentrator of ICP DAS Power Meter for the Energy monitoring and management system in the IoT age. It provides flexible integration with the ICP DAS power meters, and features various functions such as: measure the power consumption of the devices, data logger, energy usage analysis, power demand management and alarm notification functions. PMC-5231 offers a user-friendly and intuitive web site interface that allows users to implement an Energy monitoring and management system just a few clicks away; no programming is required. PMC-5231 also supports powerful Network connection ability for seamless integration with the Microsoft Azure IoT. So that the administrator can monitor the status of power consumption of each device and perform statistics and analysis of the power information, thus improving the overall efficiency in electricity consumption to save costs on utility bills. All of these features make PMC-5231 a perfect concentrator of power meter in the Energy monitoring and management application for Microsoft Azure IoT Cloud platform in the IoT age.



#### **Features:**

- Runs on browsers, no extra software tool is required.
- No more programming, user-friendly web pages are provided for building the IoT Cloud system.
- Ready-to-run Energy monitoring and management IoT Cloud solution: Includes an Intelligent Power Meter Concentrator, a power meter, and Microsoft Azure service.
- Completed Application Scenario: the power consumption measurement, power demand management and alarm notification can be performed at the field-site, and the power data can be transferred to Microsoft Azure IoT platform for energy using analysis.

  - ♦ Flexible power demand management, data logger and alarm notification functions at field site.
  - ♦ Seamless integration with Microsoft Azure IoT service without programming.

ICP DAS PMC-5231	ICP DAS PM-3114-100	ICP DAS MDR-20-24
Industrial IoT Power Meter	4 Loops single-phase	24W Industrial Power
Concentrator	Power Meter	Supply
Pure Neur Gancelorator PMC-5231 \$\vec{b}{2}\$ \$\vec{b}{3}\$		
LED Indicator (RED)	Power cable	

#### What's in the Box?

## 2 Create an IoT Hub

i. In the Azure portal, click **New > Internet of Things > IoT Hub**.

≡ + New	New	_ 🗆 ×	Internet of Things	_ 🗆 ×
Resource groups	Browse		Aarketplace	€
All resources	Compute		Azure IoT Hub Create your own IoT I	
🕒 Recent	Web + Mobile Data + Storage		hook it to your Azure	lol services
🔇 Web Apps	Data + Analytics	>	HDInsight Microsoft's cloud-bas service, Apache Hado	
👼 SQL databases	Internet of Things	>	service. Apache Hado popular Big Data solu	
🝳 Virtual machines (classic)	Networking Media + CDN		Machine Learning Build, deploy and sha	
Virtual machines	Hybrid Integration	>	analytics solutions	

ii. In the IoT hub pane, enter the following information for your IoT hub:

IoT hub _
* Name Wame your hub
* Pricing and scale tier > S1 - Standard
* IoT Hub units <b>®</b>
Device-to-cloud partitions     4 partitions
<ul> <li>★ Subscription</li> <li>✓ Visual Studio Ultimate with MSDN</li> </ul>
<ul> <li>Resource group </li> <li>Create new </li> <li>Use existing</li> </ul>
Enable Device Management—PREVIEW <b>0</b>
By checking "Device Management" you create a PREVIEW IoT hub not intended for production scenarios.
* Location West Europe
Pin to dashboard
Create

- In the **Name** box, enter a name to identify your IoT hub. When the **Name** is validated, a green check mark appears in the **Name** box.
- Change the **Pricing and scale tier** as desired. The getting started samples do not require a specific tier.
- In the **Resource group** box, create a new resource group, or select and existing one. For more information, see Using resource groups to manage your Azure resources.
- Use **Location** to specify the geographic location in which to host your IoT hub.

iii. Once the new IoT hub options are configured, click Create. It can take a few minutes for the IoT hub to be created. To check the status, you can monitor the progress on the Startboard. Or, you can monitor your progress from the Notifications section.



iv. After the IoT hub has been created successfully, open the blade of the new IoT hub, take note of the hostname URI, and click **Shared access policies**.

getStartedWithIoTHub	w	* _ □		
	🗲 Devices 🔅 Settings 🛅 Delete			
	Essentials $\land$			
🕅 Overview	Resource group iothubs Status	Hostname getStartedWithIoTHub.azure-devices.net Pricing and scale tier		
Activity log	Active	Finding and scale tier		
Access control (IAM)	Location East US Subscription name	loT Hub units 1		
SETTINGS	Visual Studio Ultimate with MSDN Subscription ID			
Locks	<your id="" subscription=""></your>			
😫 Export template	Usage	Add tiles ⊕		
GENERAL	12/08/2016 UTC getstartedwithiothub			
💡 Shared access policies	MESSAGES 0 / 8k			
Messaging	0% TOTAL			
File upload	DEVICES			
Pricing and scale	L			

v. In the **Shared access policies** pane, click the **iothubowner** policy, and then copy and make a note of the **Connection string** of your IoT hub. For more information, see <u>Control access to IoT Hub</u>.

loTGetStarted - Shared ac	cess policies	iothubowner
	+ Add	R Save X Discard ···· More
X Overview	POLICY	PERMISSIONS Access policy name
Activity log	iothubowner	registry write, servic Permissions
Access control (IAM)	service	service connect
🗲 Device Explorer	device	device connect  V Service connect
SETTINGS	registryRead	registry read
Shared access policies	registryReadWrite	registry write Shared access keys
• Pricing and scale		Primary key ● fky+kg960fVX19XDOJ02WjNMPb6DaLhG
Operations monitoring		Secondary key 🖤
₽ IP Filter		bPFekUT+b/QGNdl/B/pYWs4xJnMFpJCOJ
Properties		Connection string—primary key● HostName=IoTGetStarted.azure-devices.r

## 3 Register a device for PMC-5231 in the IoT Hub

i. Download SetupDeviceExplorer.msi like link as below and install it.

https://github.com/Azure/azure-iot-sdks/releases

Device Explorer	Twin							
Configuration	Management	Data N	lessages To Device	Call Meth	od on Device			
Connection In IoT Hub Conr	formation nection String:							
	<u> </u>							
Protocol Gateway HostName:								
Update	•							
Shared Acces	ss Signature							
Key Name	iothubowner							
Key Value	wUfKeA8kaK0	NTIGc9j	3VKr4UQw1vDR/oltAz	zjs1XhM8=				
Target	ICPDASIoTH	ub.azure-o	levices.net					
TTL (Days)	365			[	Generate	SAS	_	

ii. Open and go to **Configuration** window, paste the **Connection String** of your IoT hub, and click the Update button, and then the Device Explorer connects to your IoT hub successfully

	r Twin			<u>25 A</u>
Configuration	Management	Data	Messages To Device	Call Method on Device
Connection I IoT Hub Cor	nformation mection String:			
			ne=iothubowner,SharedA	ccessKey=wUfKeA8kaKQNTIGc9j3VKr4
			Info	X III
Protocol Gat	teway HostNan	1e:	Info	
Protocol Gal		ie:		idated successfully
Upda		ne:		idated successfully
Upda	te	ne:		
Updat Shared Acce	te ess Signature iothubowner			idated successfully 確定

iii. Switch to the Management window and click the Create button to add the device. Key in the Device ID and press the Create button to create a new device in your IoT hub.

Devices Total: 7				BstActi
V V V V	Create Device Device ID Primary Key: Secondary Key:		KuOwyv7RBjpwC1ffcP190qEDRs= IEmwlf+Ma1 T+WfCOq Wmv2zUaE= I Auto Generate Keys	17/4/20 16/11// 17/3/3 17/1/7 17/4/19
•		Create	Cancel	

iv. Click the SAS Taken button to get SAS Token of the new device:

- Select the Device ID of PMC-5231.
- Set the TTL (Days) to 365. The TTL (Days) means the Time-To-Live days of this SAS Token.
- Press the **Generate** button.
- Copy and make a note of this SAS Token.

Device Explorer     Configuration Management Data Messages To Device     Actions     Create Refresh Update Delete	e SAS Token
SASTokenForm	SASTokenForm
PeviceID PMCS231   DeviceKeys (Hqxvu7ewUteOqo62/29dbt72abBwDbJj2rc4Yko=  TTL (Deys) 365	DeviceHD PMCS231    DeviceKeys ff4qxvu7cedUfeOqc62/29s0br2abBwDblJ;2rx4Yko=  TTL (Days)
Generate Done	HostName=asure- devices net_DeviceId=PMC5231 SharedAccessSignature=SharedAccessSignature 5

## 4 Setup Power Management IoT Kit

Connect the modules as bellow provided by the IoT Kit.

- PMC-5231
- PM-3114-100
- MDR-20-24
- LED Indicator (Red)
- Power cable
- i. Please refer to the figure as below for the wiring of power.



Step	Description
1	Use the red wire(30CM) to connect MDR-20-24 DC V+ with WAGO 1
2	Use the black wire(30CM) to connect MDR-20-24 DC V- with WAGO 2
3	Use the red wire(15CM) to connect PMC-5231 PWR with WAGO 1
4	Use the black wire(15CM) to connect PMC-5231 P.GND with WAGO 2
5	Use the red wire(15CM) to connect PM-3114 PWR with WAGO 1
6	Use the black wire(15CM) to connect PM-3114 GND with WAGO 2

ii. Please refer to the figure as below for the wiring of RS-485 communication.



Step	Description
7	Use the yellow wire(30CM) to connect PM-3114 D+ with PMC-5231 COM3 D+
8	Use the green wire(30CM) to connect PM-3114 D- with PMC-5231 COM3 D-

iii. Please refer to the figure as below for the wiring of LED.

			(+)				
	WAGO 1 WAGO 2						
Step	Description						
9	Connect LED Pin+ with WAGO1						
10	Connect LEDPin- with PM-3114 RL0 NO						
11	Use the black wire(30CM) to connect PM-3114 RL C	COM0 with WAGO 2					

iv. Please refer to the figure as below for the wiring of AC power.



v. Please refer to the figure as below to connect CT for the wiring of power measurement(If you don't need to measure the load, skip this section.)



## 5 Connect PMC-5231 to Azure IoT Hub

#### Step1: Prepare your Device

- Follow the instruction described in this <u>Quick Start</u> to Connect to the Web interface of PMC-5231.
- Follow the instruction described in this <u>Quick Start</u> to set PM-3133-100 and Meter parameters following table.

Module Name	Serial port parameters	Modbus Address
DL-100tM-485	19200 N,8,1 (Default)	1 (Default)

#### **Step 2: Build the sample**

i. Connect to PMC-5231's webpage server via browser, login with the default password "Admin".

<b>Power Monitoring &amp; Management Solution</b> ICP DAS Co., Ltd.	Nickname: PMC-5231 Password: Language: English Remember me Login	•

ii. Go to the "System setting >> COM Port Interface Setting" page to complete the setting of COM3.

Power Monitoring 8	& Management Solution			PMC-5	231 📄 🛃	<b>A</b>
Main Page System Setting	Meter / Module Setting Lo	gger Setting IoT Pla		49.1MB(Approx.1 anced Setting	26 Days) 🔯 Ins Rules Setting	-
System Setting // I/O Interface Setting						
Time Setting	I/O Interface Setti	ng Page	COM2	COM3	COM4	LAN
Network Setting	Function	Modbus RTU Maste	er 🔻			
SNMP Setting	Baudrate	19200 V bps				
Security Setting //O Interface Setting	Parity	● None ○ Odd ○ E	ven			
Other Setting	Stop bits	●1 ○2				
Power Meter Group Setting	Silent Interval	100 millisec	ond(s)			
			Save			

iii. Go to the "Meter/Module Setting >> Power Meter Setting" page to add the PM-3114 power meter.

				@2849.1MB(Approx.1	111 Days) 🚺 Inst	tant Messag
Main Page System Setting	Meter / Module Setting	Logger Setting	IoT Platform Setting	Advanced Setting	Rules Setting	4
Meter / Module Setting Power Met	er Setting			_		
Power Meter Setting	Power Meter L	ist (Modbus	RTU)	COM3	COM4	LAN
XV-Board Setting	Q No.	Address	*Power Meter		Nickname	
I/O Module Setting	2 •	2 •	Search	?		
	. 1	1	ICP DAS PM-3114		PM-3114	

iv. Complete the settings, download the setting to PMC-5231, and then go to the"Main Page" to check the communication status with the power meter.

					C2849.1MB(Appro	x.126 Days) 🔯 Ins	tant Message
Main Page System Setting	Meter / Module Set	ting Logg	er Setting	IoT Platform Setting	Advanced Settin	g Rules Setting	4
lain Page							
Power Meter Information	Power Data	Overvie	ew				
Power Data Information	Power Data C	lassificatio	n				
Real-Time Chart		a - 140 - 14					
Historical Chart	Data C	lassification	11	Data Classifica	tion2	Data Classificati	on3
Historical Data Report	V		۲	1	▼ kW	1	۲
Historical Energy Analysis							
PUE Information	Power Meters	5					
/O Information	R PM-3114	_					
		V		kW			
/O Real-Time Chart							
/O Real-Time Chart /O Historical Chart	CT1	111.648	1.005	0.101			
	CT1 CT2	111.648 111.648	1.005 13.221	0.101			
/O Historical Chart				CANADA PAR			
O Historical Chart Event Log Dther Information	CT2	111.6 <mark>4</mark> 8	13.221	1.436			
/O Historical Chart Event Log	CT2 CT3	111.648 110.091	13.221 17.882	1.436 1.825			

v. Go to the "Microsoft Azure Platform Setting" page.

ICP DAS Co., Ltd.		Casha and the state of the stat
Main Page System Setting	Meter / Module Setting Lo	ogger Setting IoT Platform Setting Advanced Setting Rules Setting
T Platform Setting Microsoft Azure	Platform Setting	
Microsoft Azure Platform	Microsoft Azure S	Setting Page
Setting	Function Status	☑ Enable
BM Bluemix Platform Setting		
MQTT Setting		
	*SAS Token	
	Keep Alive Time	60 second(s)
	Periodical Publish	5 second(s)
	Interval	

vi. Input the SAS Token generated by Device Explorer. (please refer previous section)

ICP DAS Co., Ltd.	& Management Solution	<b>G</b> 20	PMC-5231 (1949) 49MB(Approx.5251 Days) anced Setting Rules Se	Ølinstant Message tting ∢
IoT Platform Setting Microsoft Azure	e Platform Setting Microsoft Azure S	Setting Page	Devicel	D [PMC5231
Setting	Function Status	Image: Enable	DeviceKe	rfHqxru7swdUfeOqc62/29a0brf2abBwDbblj2ac4Yko=
IBM Bluemix Platform Setting	*SAS Token	HostName=ICPDASIoTHub azure-devi SharedAccessSignature=SharedAcces b azure-devices net%2tdevices%2tPN0 0J8%2tppw%2thcCOsYNRh0F5G8PA	Signature sr=IC	nae-CEDLED Hok name- ardDevizM-PMCSD1 (Manekk confliguture-Danek konstliguture DATio Hak mare devian artifizikoare/02746/231 YTPR/UMP5LAQ/pooleg51 typh Deal.egn Int@64danet/52472531
	Keep Alive Time	60 second(s)		
	Periodical Publish Interval	5 second(s) Input 0 represent disable periodical publish.		Gearate Done
	Connection Testing	Testing		

vii. Complete the Publish Message editing.

KCP DAS Co., Ltd.	& Management Solution	PMC-5231 DF C 5231 C 525	Publish & Subscribe Setting Publish Subscribe
oT Platform Setting Microsoft Azure	Platform Setting Publish Mes	sage Message 2 Setting	Nickname Message
Microsoft Azure Platform		Message 2 Setting	+ Add new Publish Message
Setting BM Bluemix Platform Setting	"Nickname	Current	· Muu incir i uulisii incissaye
IQTT Setting	Description		Voltage     PM-3114 CT1 V
	Message Type	Channel Data	
	Channel Data	Interface COUIS •  Indexie Prustrat(1) • Channel CT1 • Into I •  8. JSON Format	Current PM-3114 CT1  Setting Copy Remove
	Auto Publish	When the I/O channel data changed and the variation exceeds 1.	Save
		OK Cancel	
	© ICP I	DAS Co., Ltd. All Rights Reserved	

viii. Complete the Subscribe Message editing and click the "**Save**" button to save the settings.

Keep Alive Time	60 second(s)		
Periodical Publish Interval	5 second(s) Input 0 represent disable periodical publish.		
Connection Testing	Testing		
Publish & Subscr	ibe Setting	Publish	Subscribe
Publish & Subscr Variable Name	ibe Setting RelayOnMeter Remove Add	Publish	Subscribe

ix. Go to the "**Rule Setting**" page to add a rule to turn the relay on when receive the message from Azure, then remember to download the setting to PMC-5231.

Main Page System	Setting Meter / Module S	Setting Logger Setting	IoT Platform Setting	g Advanced Setting	Rules Setting	4
Rules Setting Add new						
*Nickname	Rule 1					
Description						
Status	● Enable ODisable					
Rule Content Se	etting					
	F	THE	EN		ELSE	
	v Condition: Indition 👻	Add a nev Set an A			dd a new Action: Set an Action 👻	
Microsoft Azure Sub Message(RelayOnMe		COM3 PM-3114(1:PM	3114) DO0 = ON	COM3 PM-3	14(1:PM-3114) DO0 =	OFF
		Save	Cancel			

x. Use the Device Explorer utility to verify if the IoT Hub receives the messages from PMC-5231.

Device Explorer
Configuration Management Data Messages To Device
Monitoring
Event Hub: ICPDASIoTHub
Device ID: PMC5231
Start Time: 04/26/2017 11:41:21
Consumer Group: SDefault
Monitor Cancel Clear
Event Hub Data
Receiving events 2017/4/26 L+1142:29> Device: [PMC5231], Data: [("msg_type":"CH1*L42:34> Device: [PMC5231], Data: [("msg_type":"CH1*L42:34> Device: [PMC5231], Data: [("msg_type":"CH1*L42:34> Device: [PMC5231], Data: [("msg_type":"CH1*L42:34> Device: [PMC5231], Data: [("msg_type":"CH1*L42:35> Device: [PMC5231], Data: [("msg_type":"CH1*L42:35> Device: [PMC5231], Data: [("msg_type":"CH1*L42:35> Device: [PMC5231], Data: [("msg_type":"CH1*L42:35> Device: [PMC5231], Data: [("msg_type":"CH1*L42:35])

xi. Go to the "Main Page >> Power Meter Information >> I/O(Tab)" page to observe that the relay status changes when PMC-5231 gets the message send by Device Explorer.

Main Page System Setting	Meter / Module Setting Logger Setting IoT Platform Setting Advanced Setting Rules Setting 4
Main Page Power Meter Information	
Power Meter Information	Power Meter Information
Power Data Information	Power Meter List PM-3114
Real-Time Chart	Overview Statistics Overview Other I/O
Historical Chart	
Historical Data Report	
Historical Energy Analysis	Channel0 Channel1 Configuration Management Data Messages To Device
PUE Information	ON OFF
I/O Information	Send Message to Device:
I/O Real-Time Chart	IoT Hub: ICPDASIoTHub Device ID: IPMC5231
I/O Historical Chart	Message: ("RelayOnMeter"."ON")
Event Log	Add Time Stamp Monitor Feedback Endpoint
Other Information	Properties:
Polling Time Information	Key Value
Modbus Table Information	
UID Information	
	© ICP DAS Co., Ltd. All Rights I Output Sent to Device ID: [PMC5231], Message:"("RelayOnMeter""ON")", message ld: f1141482-2e6f4cce- bb34-11a92545c90d

Main Page Power Meter Informat	ion
Power Meter Information	Power Meter Information
Power Data Information	Power Meter List PM-3114
Real-Time Chart	Overview Statistics Overview Other I/O
Historical Chart	
Historical Data Report	
Historical Energy Analysis	Channel0 Channel1 Configuration Management Data Messages To Device
PUE Information	
I/O Information	Send Message to Device:
I/O Real-Time Chart	IoT Hub: ICPDASIoTHub Device ID: PMC5231
I/O Historical Chart	Message: ("RelayOnMeter"."OFF")
Event Log	Add Time Stamp Monitor Feedback Endpoint
Other Information	Properties:
Polling Time Information	Key Value
Modbus Table Information	
UID Information	
	© ICP DAS Co., Ltd. All Rights
	Output
	Sent to Device ID: [PMC5231], Message:"("RelayOnMeter":"ON")", message Id: f1141482-2e6F4cce- bb34-11a92545c90d

### 6 Resource

- <u>ICP DAS Power Management IoT Kit URL:</u> <u>http://pmms.icpdas.com/en/PMC\_IoTKit\_01.html</u>
- <u>Microsoft Azure IoT Starter Kits URL: http://aka.ms/iotstarterkits</u>