DEVELCO PRODUCTS

External Meter Interface – ZHEMI-101

Technical manual

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RoHS CE

1 Cautionary notes

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2 Features

2.1 External Meter Interface – ZHEMI-101

The ZigBee HA meter serves as external ZigBee interface for electronic meters. It collects meter readings from existing meters already installed and sends data via ZigBee to appliances in the building. This way, you can follow your energy consumption at an in-house display, at your computer, or at your mobile phone. The meter unit can be used with different kinds of meters; power, water, gas, or heating. The ZigBee External Meter Interface works with all meters regardless of manufacturer and brand. The data can be collected by an external gateway and stored in a data flash.

The integrated ZigBee module has extended RF performance (10 mW/10dBm) and is available as ZigBee Home Automation. The ZigBee profile secures very high security in order to protect personal data and prevent hacking.

The meter interface can be delivered with two probes:

- IR probe for two way communication with supported meters.
- LED probe for interfacing to meters with blinking LED.
- As an option, the meter interface can be delivered with a S0 interface or pulse probe counting for a reed contact.

The optical probe is attached either by magnets or by Velcro.

Battery lifetime is over two years with updates every five seconds.

3 Endpoints

The device has two endpoints:

3.1 ZigBee Device Object (ZDO)

- Application profile Id 0x0000
- Application device Id 0x0000
- Supports all mandatory clusters

3.2 Develco Utility

- Application profile Id 0xC0C9 (Develco Products private profile)
- Application device Id 0x0001
- Develco ZigBee Manufacturer code 0x1015
- Private profile for internal Develco Products use only.

The DevUtil end point support a Develco products specified bootloader.
New firmware can be downloaded to the device using the SmartAMM server + SamrtAMM client tool.

3.3 Metering Device – End Point 0x02, 0x40 and 0x41

- Application profile Id 0x0104 (Home Automation)
- Application device Id 0x0007 (Combined Interface)
- Clusters
    - Clusters supported as server
        - Basic
        - Identify
        - Metering (ZSE specified cluster)

Each attribute is described in ZigBee Smart Energy specification.

End point 0x40 and 0x41 is created runtime when the meter is configured to interface mode P1 – “Dutch Smart Meter Standard” version 4.0. Endpoint 0x40 is mapped to MBus channel 1, and endpoint 0x41 is mapped to MBus channel 2.ZigBee Clusters

4 Clusters

4.1.1 Basic cluster

The Basic cluster has 2 attribute sets defined. In the following sections the attributes of these sets is listed. Refer to [Z2] for ZigBee specification of the basic cluster.

Id#	Name	Type	Range	Man/Opt	Note
0x0	ZCLVersion	Uint8	Type range	M	
0x4	ManufacturerName	String	0-32 byte	O	
0x5	ModelIdentifier	String	0-32 byte	O	
0x7	PowerSource	8 bit enum	Type range	M	

4.1.1.1 ManufacturerName

"Develco"

4.1.1.2 ModelIdentifier

"ZHEMI101"

4.1.1.3 PowerSource

Battery

4.1.1.4 Manufacture Specific Attribute

Id#	Name	Type	Man/Opt	Relevance and ref.
0x8000	Primary SW Version	OctetString	M	Read only

ZCL header setting – Manufactor code for Develco Products is 0x1015

4.1.2 Identify – Cluster id 0x0003

The identify cluster serves as a way to make a device identify itself either visually or by sound.
Normally this is done by toggling an LED at some interval.
Refer to [Z2] for ZigBee specification of the identify cluster.
The Identify cluster only defines one attribute.

4.1.2.1 Attribute

Id#	Name	Type	Range	Man/Opt	Relevance and ref.
0x0000	IdentifyTime	Uint16	Type range	M	

4.1.2.2 Commands

The identify cluster has 2 commands as server.

Id#	Name	Payload	Man/Opt	Relevance and ref.
0x00	Identify	Uint16 - Identify Time (seconds)	M	
0x01	Identify Query	none	M	

The identify cluster has 1 command as client.

Id#	Name	Payload	Man/Opt	Relevance and ref.
0x00	Identify Query Response	Uint16 - Identify Time (seconds)	M	

4.1.3 Metering cluster for EP 0x02

ZigBee SE metering cluster, is listed. Refer to the ZigBee specification of the metering cluster.

4.1.3.1 0x00 Reading Information attribute set

Id#	Name	Type	Range	SE Req.	Note
0x00	CurrentSummationDelivered	Uint48	Type range	M	ZCL configure reporting is supported
0x01	CurrentSummationReceived	Uint48	Type range	O	ZCL configure reporting is supported
0x07	ReadingSnapshotTime	UTC	Type range	O	Set based on current time "0-0:1.0.0"
0x14	SupplyStatus	Enum8		O	Set based on "0-0:96.3.10" '0': SUPPLY_OFF '1': SUPPLY_ON '2': SUPPLY_OFF_ARMED
0x20	ActiveRegisterTierDelivered	Enum8		O	
0x21	ActiveRegisterTierReceived	Enum8		O	

4.1.3.2 0x01 TOU Information attribute set

Id#	Name	Type	Range	SE Req.	Note
0x00	CurrentTier1SummationDelivered	Uint48	Type range	O	ZCL configure reporting is supported
0x01	CurrentTier1SummationReceived	Uint48	Type range	O	ZCL configure reporting is supported

0x02	CurrentTier2SummationDelivered	Uint48	Type range	O	ZCL configure reporting is supported
0x03	CurrentTier2SummationReceived	Uint48	Type range	O	ZCL configure reporting is supported

Note: The attributes above is only supported when using - IEC62056-21 IR communication protocol.

4.1.3.3 0x02 Meter Status attribute set

Id#	Name	Type	Range	Man/Opt	Note
0x00	Status	8 bit bitmap	Type range	M	ZCL configure reporting is supported

MeterStatus cover low battery detection of the External Meter Interface.

The following table describe the meter status bits per metering type:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	Not supported	Not supported	Not supported	Not supported	Not supported	Low Battery	Check Meter

Check Meter: Is set if communication problems with meter is experienced.

Low Battery: Set to true when the battery needs maintenance ~ 2.45V

4.1.3.4 0x03 Formatting attribute set

The following set of attributes provides the ratios and formatting hints required to transform the received summations, consumptions or demands/rates into displayable values. If the Multiplier and Divisor attribute values are non-zero, they are used in conjunction with the *SummationFormatting*, *ConsumptionFormatting*, and *DemandFormatting* attributes. Equations required to accomplish this task are defined below:

Summation = Summation received * Multiplier / Divisor
(formatted using *SummationFormatting*)

Consumption = Summation received * Multiplier / Divisor
(formatted using *ConsumptionFormatting*)

Demand = Demand received * Multiplier / Divisor
(formatted using *DemandFormatting*)

If the Multiplier and Divisor attribute values are zero, just the formatting hints defined in *SummationFormatting, ConsumptionFormatting*, and *DemandFormatting* attributes are used.

The following set of attributes provides the ratios and formatting hints required to transform the received summations, consumptions or demands/rates into displayable values. If the Multiplier and Divisor attribute values are non-zero, they are used in conjunction with the *SummationFormatting, ConsumptionFormatting*, and *DemandFormatting* attributes.

Id#	Name	Type	Range	Man/Opt	Note
0x00	UnitofMeasure	8 bit enum	0x00 to 0xFF	M	MFG attribute id 0x0302 – Interface mode (kWh or m3h)
0x01	Multiplier	Uint24	0x000000 to 0xFFFFFF	O	Fixed to 1
0x02	Divisor	Uint24	0x000000 to 0xFFFFFF	O	Fixed to 1000
0x03	SummationFormatting	8 bit bitmap	0x00 to 0xFF	M	
0x04	DemandFormatting	8 bit bitmap	0x00 to 0xFF	O	
0x06	MeteringDeviceType	8 bit bitmap	0x00 to 0xFF	M	Depends on Interface Mode

Above attribute description is to be found in section D.3.2.2.4 "Formatting" ZigBee Smart Energy Profile Specification provided by the ZigBee alliance.

4.1.3.5 0x04 Historical attribute set

Id#	Name	Type	Range	Man/Opt	Note
0x00	InstantaneousDemand	Int24	-8,388,607 to 8,388,607	O	ZCL configure reporting is supported

Above attribute description is to be found in section D.3.2.2.5 "Historical Consumption" document "ZigBee Smart Energy Profile Specification" provided by the ZigBee alliance.

4.1.4 Metering cluster - Manufacture Specific Attributes

Develco Manufacture code is 0x1015.

Table 1 : Formatting Attribute Set (Manufacture Specific)

Identifier	Name	Type	Range	Access	Default	Man./Opt.
0x0300	PulseConfiguration	Unsigned 16-bit integer	0x0000 – 0xFFFF	Read/ Write	0x03E8	O
0x0301	CurrentSummation	Unsigned 48 bit integer	0x000000 - 0xFFFFFFF	Write Only	0x0000	O
0x0302	InterFaceMode	Enum16	0x0000 – 0xFFFF	Read/ Write	0x0000	

4.1.4.1.1 PulseConfiguration

PulseConfiguration represents the number of pulses the meter outputs per unit.
Default value is 1000 imp/kWh, 0x03E8 = 1000 dec.

4.1.4.1.2 CurrentSummation

CurrentSummation represents the present value for current summation delivered send to the display.
The value must be scaled according to divider and multiplier.

MFG attribute id 0x0302 – Interface mode	
Attribute value	Description
0x0000	Pulse counting on a Electricity meter – Unit KWh Typically LED or IR probe is used.
0x0001	Pulse counting on a Gas meter – Unit m3 Typically S0 or Pulse probe is used
0x0002	Pulse counting on a Water meter – Unit m3 Typically S0 or Pulse probe is used
0x0100	Kamstrup KMP protocol – IR communication using IR probe
0x0101	Not supported - Linky protocol
0x0102	DLMS-COSEM - IEC62056-21 mod A IR communication using IR probe.

	The current standard IR probe supports 300-1200 BAUD. IR probe supporting 9600 BAUD is available on request.
0x0103	P1 dutch standard – DSMR 2.3 version
0x0104	P1 dutch standard – DSMR 4.0 version

Example: Preset value = 0,570 kWh
Divider = 1000
Multiplier = 1
That give a *CurrentSummation* value of 570

It is important that the *PulseConfiguration* attribute has been configured correctly before sending the *CurrentSummation* setting because *PulseConfiguration* is used when calculating the total amount of detected pulses.

4.1.5 Metering cluster for EP 0x40 and 0x41

End point 0x40 and 0x41 is created runtime when the meter is configured to interface mode P1 – "Dutch Smart Meter Standard" version 4.0. Endpoint 0x40 is mapped to MBus channel 1, and endpoint 0x41 is mapped to MBus channel 2.

ZigBee SE metering cluster, is listed. Refer to the ZigBee specification of the metering cluster.

4.1.5.1 0x00 Reading Information attribute set

Id#	Name	Type	Range	SE Req.	Note
0x00	CurrentSummationDelivered	Uint48	Type range	M	Set based on "0-n:24.2.1"
0x07	ReadingSnapshotTime	UTC	Type range	O	Set based on timestamp of "0-n:24.2.1"
0x14	SupplyStatus	Enum8		O	Set based on "0-1:24.4.0" '0': SUPPLY_OFF '1': SUPPLY_ON '2': SUPPLY_OFF_ARMED

4.1.5.2 0x03 Formatting attribute set

The following set of attributes provides the ratios and formatting hints required to transform the received summations, consumptions or demands/rates into displayable values. If the Multiplier and Divisor attribute values are non-zero, they are used in conjunction with the SummationFormatting, ConsumptionFormatting, and DemandFormatting attributes.

Id#	Name	Type	Range	Man/Opt	Note
0x00	UnitofMeasure	8 bit enum	0x00 to 0xFF	M	Set based on unit in "0-n:24.2.1"
0x01	Multiplier	Uint24	0x000000 to 0xFFFFFF	O	Fixed to 1
0x02	Divisor	Uint24	0x000000 to 0xFFFFFF	O	Fixed to 1000
0x03	SummationFormatting	8 bit bitmap	0x00 to 0xFF	M	
0x06	MeteringDeviceType	8 bit bitmap	0x00 to 0xFF	M	Set based on "0-n:24.1.0" Supported: Gas, Water and Electricity

Above attribute description is to be found in section D.3.2.2.4 "Formatting" ZigBee Smart Energy Profile Specification provided by the ZigBee alliance.

4.1.5.3 OBIS code mapped into ZigBee attributes

When the interface mode is configured to "P1 dutch standard – DSMR 4.0 version" the following OBIS code are mapped into the following ZigBee attributes:

OBIS Code	ZigBee Attribute Name	ZigBee Attribute Id	ZigBee Endpoint	Comment
1-0:1.8.0	CurrentSummationDelivered	0x0000	0x02	If OBIS code not present, will be the sum of 1-0:1.8.1 and 1-0:1.8.2
1-0:2.8.0	CurrentSummationReceived	0x0001	0x02	If OBIS code not present, will be the sum of 1-0:2.8.1 and 1-0:2.8.2
1-0:1.8.1	CurrentTier1SummationDelivered	0x0100	0x02	
1-0:2.8.1	CurrentTier1SummationReceived	0x0101	0x02	
1-0:1.8.2	CurrentTier2SummationDelivered	0x0102	0x02	

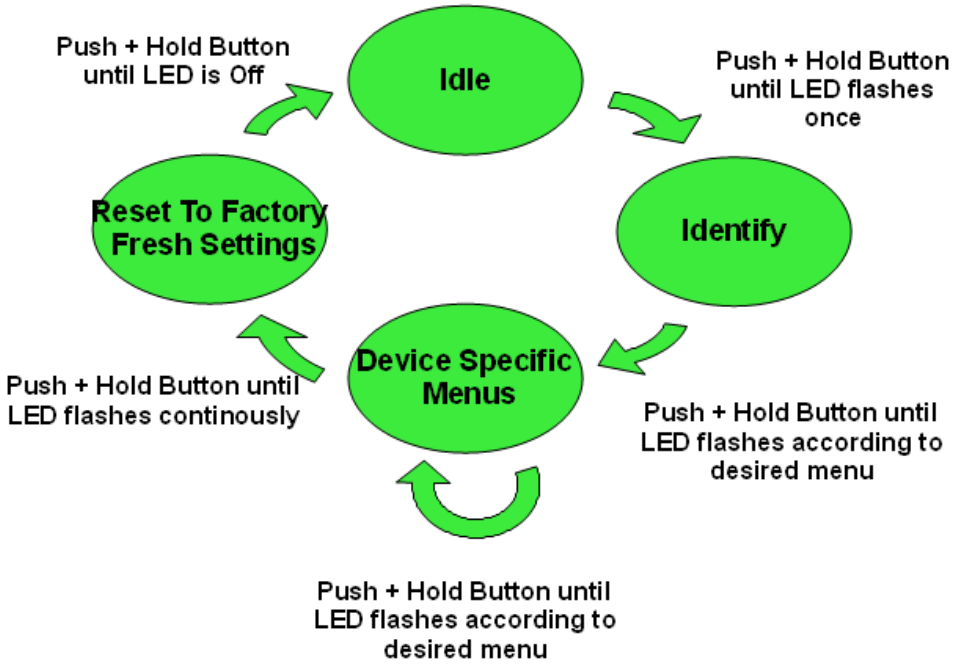
1-0:2.8.2	CurrentTier2SummationReceived	0x0103	0x02	
0-0:96.14.0	ActiveRegisterTierDelivered	0x0020	0x02	
0-0:96.14.0	ActiveRegisterTierReceived	0x0021	0x02	
1-0:1.7.0 1-0:2.7.0	InstantaneousDemand	0x0400	0x02	InstantaneousDemand = (1-0:1.7.0)-(1-0:2.7.0)
0-0:96.1.1	MeterSerialNumber	0x0308	0x02	If OBIS code not present, will use meter identification string instead
0-0:1.0.0	Reading SnapShot Time	0x0007	0x02	
0-0:96.3.10	Supply Status	0x0014	0x02	
	Status	0x0200	0x02	Check meter bit will be set if no telegrams, or only telegrams with invalid CRC is received from meter
0-1:96.1.0	MeterSerialNumber	0x0308	0x40	
0-1:24.2.1	Reading SnapShot Time	0x0007	0x40	
0-1:24.2.1	Current Summation Delivered	0x0000	0x40	
0-1:24.2.1	UnitofMeasure	0x0300	0x40	
0-1:24.1.0	MeteringDeviceType	0x0306	0x40	
0-1:24.4.0	Supply Status	0x0014	0x40	
0-2:96.1.0	MeterSerialNumber	0x0308	0x41	
0-2:24.2.1	Reading SnapShot Time	0x0007	0x41	
0-2:24.2.1	Current Summation Delivered	0x0000	0x41	
0-2:24.2.1	UnitofMeasure	0x0300	0x41	
0-2:24.1.0	MeteringDeviceType	0x0306	0x41	
0-2:24.4.0	Supply Status	0x0014	0x41	

5 MMI user guide

5.1 Push Button Menu:

Pushing the button on a device provides the user with several possibilities.

A single short push has a specific meaning for the given device, for this sensor a single short push will toggle the occupancy status (occupied/unoccupied.). Pushing the button for longer (push, hold for a few seconds, and release) allows the user to set the device into a desired mode. A mode change happens at 5 second interval. Below, these modes are illustrated in a state chart.



When cycling through the menu modes, the state is indicated by a number of 100ms blinks on the LED. As illustrated in the figure, the menu system allows for device specific modes (e.g. Pair Devices for Devices such as relays and occupancy sensors).

5.2 Action upon Push Button Release

The number of blinks associated with a given mode entry is shown in the below table along with the associated action performed upon user button release. As indicated, if the user holds the button past the Reset to Factory Fresh Settings no action will result from the push button and the device stays in the idle state.

Mode	Number of flashes on mode menu entry	Availability	Action Taken upon Button Release
Idle	None	All devices	None
Identify	1	All devices	Toggle Identify Mode (On/Off)
Reset To Factory Fresh Settings	Continuous flash (>8)	All Devices	Reset device to factory fresh settings

5.3 Action on Power On

As a general rule, all end devices and routers that have not previously joined a network (or have been reset to factory default) will start up and search for a coordinator on the channels enabled for that device. In this mode, the LED will flash once every second.

Once a device has joined a network, the device will be in Identify Mode for 15 minutes indicated by a flash of the LED once every three seconds.

If a device has joined a network and is powered down, it will attempt to rejoin this network upon power up. For the first 30 seconds hereafter, the device will be in Identify Mode.

5.4 Join Device on a Network

To allow a device to join a network, one either has to power up a device that has not previously joined a network or push the button until the Reset To Factory default mode is indicated – and subsequently release the button. This will cause the device to reset to its factory default state and scan for a suitable coordinator.

5.5 Toggle Identify Mode

To enter Identify Mode, the user may push and hold the button until the Identify Mode menu is indicated. If the device was not already in Identify Mode, the mode will be entered. Vice versa, if the device was already in Identify Mode, the mode will be disabled

6 General network behaviour

6.1 Installation

When the device is virgin and powered for the first time it will start looking for a ZigBee PAN Coordinator or router to join. The device will scan each ZigBee channel starting from 11 to 26. The LED will flash once every second until it joins a device.

#Scan mode - 1	**#Sleep mode**	**#Scan mode - 2**	**#Sleep mode**	**#Scan mode - 2**
Scan all 16 ZigBee channel until join network or 15 minutes	MCU is in sleep mode (Radio off) 15 minutes	Scan all 16 ZigBee ch x 4 or until join network ~ 2 minutes	MCU is in sleep mode (Radio off) 15 minutes	Scan all 16 ZigBee ch x 4 or until join network ~ 2 minutes

The device will start up using scan mode 1. To increase battery lifetime when the device is joining a network for the first time a scan mode 2 will be used after scan mode 1 has expired. Scan mode 1 it will only be executed one time when the devise is powered.

In section 5 “MMI” it is explained how to put the device into a join or leave network mode.

Network settings are stored in NV-memory are after a power cycle the device re-join the same network.

If the device has to join a new PAN coordinator the MMI menu supports a “**Reset To Factory Fresh Settings”** mode. This will erase all current network information.

6.2 Normal – Keep alive

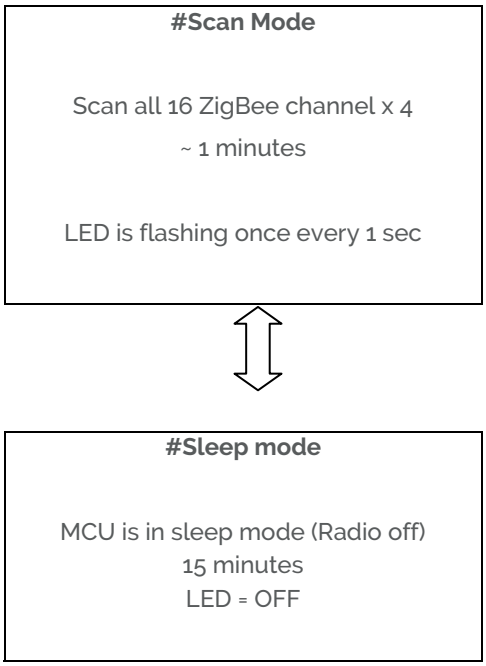
The device is sending a “keep alive” message to the PAN coordinator every 15 minute to verify that the device is still connected to the network.

6.2.1 Network lost

If the devices loss connection with the Coordinator it will start scanning every ZigBee channel for the PAN coordinator and try to re-join it. After scanning all 16 channels 4 times in a row the device will enter sleep mode. The device will toggle between each mode until a re-join occur.

When the device is in scan mode the LED will flash once every second until it re-joins the network.

According to the ZigBee specification TX is NOT allowed to be enabled all the time and a TX silent period has to be defined.



6.3 Configuration

A Bind/Unbind messages can be send to the metering cluster on End Point 0x02. After the binding is completed a default set of attributes will start sending data every 60 seconds to the device specified in the binding messages.

The binding and reporting information is stored in NVM memory and after an power cycle the current settings is read from NVM memory.

6.4 Low battery

The status attribute on the metering cluster is reporting “Low battery”.

There is no led indication for low battery on the devices itself.

Reference documents:
053474r18ZB_CSG-ZigBee-Specification.pdf
075123r03ZB_AFG-ZigBee_Cluster_Library_Specification.pdf
053520r27ZB_HA_PTG-Home-Automation-Profile.pdf
075356r15ZB_ZSE-ZSE-AMI_Profile_Specification.pdf

They can all be downloaded from:
http://www.zigbee.org/Products/DownloadZigBeeTechnicalDocuments.aspx

7 Specifications

7.1 External Meter Interface – ZHEMI-101

Dimensions	115 x 35 x 70 mm
Colour	Black
Operation temperature	-10˚C to +60˚C
Storage temperature	-40˚C to +85˚C
Supply voltage	Optional 5V power supply
Battery lifetime	With 3xAA Alkaline batteries: >2 years (updating every 5 seconds, at room temperature)
RF performance	• 10 mW/10dBm • Range: LOS ≤ 1600m, Indoor ≤ 100m
Microcontrollers	• MSP430 • DevCom 06
ZigBee stack version	2007
ZigBee stack profile	ZigBee Pro
ZigBee application profiles	Smart Energy and Home Automation
IR/LED Communication	• Supports IEC62056-21 compliant Electricity Meters • Supports LED/IR pulse (configurable pulse range from 50 to 10000 pulses per kWh)
IP-class	Optional IP 55 enclosure available
Mounting	• Optical probe attachment either by magnets or by Velcro • Cable-length is approx. 800mm

8 Contact Information

Technical support: Please contact Develco Products for support.
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Sales: Please contact Develco Products for information on prices, availability, and lead time.
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