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Originated by: MJW

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S123R E-METER MANUAL

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History

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1 Document Scope

This document is not intended to be a full operating manual for the S123R E-Meter. Throughout this document the term 'e-meter' will be used to refer to the meter, which has Z-Wave capability.

The Z-Wave part of the meter is the area of interest in this document, and the document does not form a full operating manual for the meter. The document provides information to help with Z-Wave certification detailing the Z-Wave capabilities of the e-meter, and instructions on how to operate its Z-Wave features, the role of the unit in a Z-Wave network and how command classes supported realise the intended operation of the system.

The information provided on the command classes announced in the Node Information Frame should be sufficient for a Test Engineer to verify the operation of these command classes.

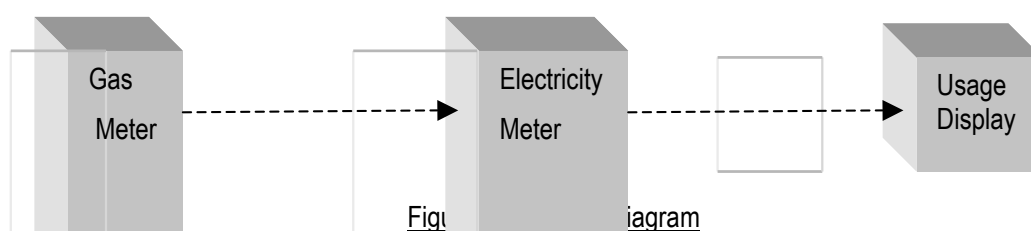
2 References

- [1] Z-Wave Device Class Specification, SDS10242, V17, 5 May 09.
- [2] Z-Wave Command Class Specification, SDS11060, V7, 5 May 09.
- [3] Z-Wave ZW0201/ZW0301 Appl. Prg. Guide V5.01, INS10247, V12, 18 Jan 08.

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3 Description of System and Unit

3.1 General Description of Horstmann System



The S123R element contains a Z-Wave module for communicating with an energy usage display and **one** gas meter. The primary function of this unit is to act as a Z-Wave controller for a single element even though it can support multiple elements.

Horstmann has developed the e-meter to use approved command class messages to communicate with a proprietary device called a ZMART, to gather consumption data from the Gas Meter. However, there is flexibility to use other units that are essentially Pulse Meter devices.

If an energy usage display device has been added to the e-meter network then the e-meter can send electricity and gas consumption data to it. For the HEM (Home Energy Monitor) developed by Horstmann, the e-meter will send unsolicited reports at scheduled times to it. Other display products need to request the information from the e-meter as and when required.

The electricity meter forms the centre of the system and has been designated a reduced static controller (not mobile) with primary role (as default) so that the network and system can be set up with the e-meter, without the need for a network installation tool. The system may also be set up without an energy usage display.

This document does not go in to any significant detail about the ZMART or HEM devices.

As a Z-Wave controller product the e-meter is capable of including and excluding other manufacturers' nodes to/from its network, and being included or excluded to other manufacturers' controller's network.

3.2 Unit Description

The S123R E-Meter unit is a self-contained, single element meter that requires a 230V 50Hz mains supply.

To power up the unit connect terminals 1 and 2 to mains and switch on the power (the electrical connections are detailed on the inside of the lower panel).



Figure 2 – Front View of the S123R Meter

The unit has a blue button, which can be used to step through a number of displays – figure 2 shows the rate register for rate 2. The displays generally cover the time, the date, total reading, rate totals, and Z-Wave options, more details in section 3.

NOTE: During certification testing it is recommended that a known load is connected to terminals 3 and 4 for testing the Z-Wave command classes.

3.3 Information Flow within the E-Meter

The e-meter contains a meter card and Z-Wave module linked by a UART interface. During normal operation the meter card will communicate with the Z-Wave module and provide a meter <-> Z-Wave communications indicator, when such communications are in progress, by briefly showing 4 small squares in a line.

The Z-Wave module shall make requests for the time, date, total electricity consumption, basic tariff information, and instantaneous power to the meter card at power up, and at association of a GENERIC DISPLAY DEVICE. After which these requests will be made at different times according to the following schedules:

1. Request the total electricity consumption register at 5 past, 25 past, 35 past and 55 past the hour.
2. Request the basic tariff information at 5 past, 25 past, 35 past and 55 past the hour.
3. Request the time and date at 5 past and 35 past the hour (the Z-Wave module will maintain time between the requests).
4. Request the Instantaneous power level every 15s.

If one or more display devices have been associated as display devices then the Z-Wave module will send unsolicited report messages to these device(s) at the time of receiving responses to the above meter card requests. See section 5.2.

If another device that does not meet the display association criteria requires the information, then the device can receive it by sending the relevant requests to the Z-Wave module.

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4 Network Functions

4.1 Network Initiator Sequences

The following table shows how to select the standard Z-Wave functions using the blue button.

Upon a selection, if the blue button is pressed again before the meter <-> Z-Wave communications indicator appears the selection will not have been made.

Z-Wave Function	Initiator Sequence	Mode Indication
Include Node on to this network (for meter = Primary or Inclusion controller)	Step round to 'Inc nodE' and wait ~5s for display to change to 'SENT'. If the request did not work the display will show 'FAIL' so try again later.	'Inc nodE' shown.
Association of Node (for meter = Secondary controller)		
Exclude Node from this network (for meter = Primary or Inclusion controller)	Step round to 'dEL nodE' and wait ~5s for display to change to 'SENT'. If the request did not work the display will show 'FAIL' so try again later.	'dEL nodE' shown.
Disassociation of Node (for meter = Secondary controller)		
Transmit a Node Information Frame network function	Step round to 'nEt' and wait ~5s for display to indicate the meter <-> Z-Wave communications indicator. If the request worked the display will show 'PASS' otherwise it will show 'FAIL' so try again later.	'nEt' shown.
Transmit a Node Information Frame (NIF) and update network info on node positions	If the e-meter has included or excluded a node within the last 6 minutes then using the Transmit a Node Information Frame initiator will send a NIF, and then perform actions for improved routing.	'nEt' shown.
Inclusion / Exclusion by another controller	Step round to 'LEArn' and wait ~10s for display to change to 'SENT'. If the request did not work the display will show 'FAIL' so try again later.	'LEArn' shown.
Inclusion and reception of primary role		
Protocol Reset	Step round to 'Pr rESEt' and wait ~10s for display to change to 'SENT'. If the request did not work the display will show 'FAIL' so try again later.	'Pr rESEt' shown.

Table 1 – Z-Wave Function Initiators

The e-meter has been designed for use with the HEM and a ZMART, but for the purposes of interoperability with other manufacturers, the above modes can be used to include / exclude any Z-Wave certified products on to / off its network. The e-meter can also become part of any Z-Wave network, and supports the capability to be removed from it.

There is no replication of group/scene data related to any associations, but the e-meter supports replication of protocol data to/from another manufacturer's controller that is Z-Wave compliant.

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4.2 Include Node on to this Network

When the e-meter enters this mode, the presentation frames are sent at normal power only, and the installer has up to 2 minutes to start including a node to its network.

The success of the inclusion is indicated by a brief 'PASS' or 'FAIL' message on the display. A timeout will also be indicated by a brief 'FAIL' message.

If the node included to the network has a Generic Device Class of DISPLAY GENERIC DEVICE then the e-meter will associate it to its HEM control group.

If the node included to the network has a Generic Device Class of PULSE METER GENERIC DEVICE then the e-meter will associate it as a ZMART if a ZMART has not already been associated.

NOTE: Any other nodes included to the e-meter with different Generic Device classes will 'just be another node'.

4.3 Exclude Node from this Network

When the e-meter enters this mode, the presentation frames are sent at normal power only, and the installer has up to 2 minutes to start excluding a node from the network or reset the node.

The success of the exclusion is indicated by a brief 'PASS' or 'FAIL' message on the display. A timeout will also be indicated by a brief 'FAIL' message.

If the node excluded from the network was associated as a HEM then the e-meter will disassociate it from its HEM control group.

If the node excluded from the network was associated as a ZMART then the e-meter will disassociate it as a ZMART.

4.4 Transmit Node Information Frame

This operation is very brief and no other displays are supported than those mentioned in Table 1. The Node Information Frame is sent at normal power. The e-meter in this case only indicates the success of the request being received by the Z-Wave module with a 'PASS' or 'FAIL' message.

4.5 Inclusion/Exclusion by another Controller

When the e-meter enters this mode, the installer has up to 2 minutes to include the e-meter to another controller's network or exclude it from another controller's network. The action taken depends on the mode of the primary controller carrying out the action.

The success of the action is indicated by a brief 'PASS' or 'FAIL' message on the display. A timeout will also be indicated by a brief 'FAIL' message.

NOTE: Any HEM or a ZMART associated to the e-meter will become disassociated with this process. Before re-associating them to the e-meter they will need to be excluded (to network reset each node) and then included on to the new network (same network as the e-meter).

NOTE: There is no replication of group/scene data related to any associations, but the e-meter supports replication of protocol data to/from another manufacturer's controller that is Z-Wave compliant.

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4.6 Inclusion and Reception of Primary Role

When the e-meter enters this mode, the installer has up to 2 minutes to include the e-meter to another controller's network and assume the primary role. The action taken depends on primary transfer being initiated by the primary controller carrying out the action.

The success of the action is indicated by a brief 'PASS' or 'FAIL' message on the display. A timeout will also be indicated by a brief 'FAIL' message.

NOTE: HEM or a ZMART associated to the e-meter will become disassociated with this process. To re-associate them they will need to be excluded (to network reset each node) and then re-included by the e-meter due to a change of network ID.

4.7 Association of Node

If the e-meter has become a secondary controller then the same initiator sequence to include a node can be used to associate the node as a HEM or a ZMART, whichever appropriate. The node to be associated needs to send its Node Information Frame to complete this action within 2 minutes of entering this mode.

The success of the action is indicated by a brief 'PASS' or 'FAIL' message on the display. A timeout will also be indicated by a brief 'FAIL' message.

If the node to be associated has a Generic Device Class of DISPLAY GENERIC DEVICE then the e-meter will associate it to its HEM control group. The e-meter will then send unsolicited reports to it, at the time of association, and then as per the schedule in section 3.3.

If the node to be associated has a Generic Device Class of PULSE METER GENERIC DEVICE then the e-meter will associate it as a ZMART if a ZMART has not already been associated. The e-meter will send out the GETs and Wake Up messages to the ZMART at the time of association, and upon receipt of a Wake Up Notification message as per section 5.3.

NOTE: Receiving a NIF from another type of node will end this mode with a 'FAIL' message.

4.8 Disassociation of Node

If the e-meter has become a secondary controller then the same initiator sequence to exclude a node can be used to disassociate the node as a HEM or a ZMART, whichever appropriate. The node to be disassociated needs to send its Node Information Frame to complete this action within 2 minutes of entering this mode.

The success of the action is indicated by a brief 'PASS' or 'FAIL' message on the display. A timeout will also be indicated by a brief 'FAIL' message.

If the node was associated as a HEM then the e-meter will disassociate it from its HEM control group and no longer send unsolicited reports to it.

If the node was associated as a ZMART then the e-meter will disassociate it as a ZMART, and clear the stored pulse count for the ZMART.

NOTE: Receiving a NIF from another type of node will end this mode with a 'FAIL' message.

4.9 Protocol Reset

This function provides a full protocol reset as documented by [3]. The e-meter will go back to being a primary controller with its factory set Home ID and no record of nodes included on its network or any associations.

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4.10 Network Updates

If a SUC/SIS is present in the network, and the e-meter is not the primary controller, the e-meter will request an update at 00:10:10 (HH:MM:SS time format) from the SUC/SIS i.e. once every 24 hours.

4.11 Improved Routing

To improve the routing between the ZMART and e-meter, as their positional freedom is limited, an initiator has been included to assign routing of unsolicited messages from the ZMART to the meter, so that the necessary dialog between e-meter and ZMART can take place via a router, if point to point communication is not possible.

For best results, all mains powered Z-Wave devices need to be on and in their intended positions, and the ZMART needs to be 'awake' and in its intended position. By following the same procedure to send a Node Information Frame within 6 minutes of including or excluding the last node, the e-meter will also request all nodes on its network to do a nodes neighbours update, to update its network topology to present conditions, and then if a ZMART is present send it return routes to improve its chances of getting an unsolicited message through to the e-meter (for the ZMART this will be the Wake Up Notification).

There is no visual indication for the completion of this action, but allow several seconds and then return the ZMART to its normal mode. To check end to end capability, and refresh ZMART configuration swipe the ZMART and ensure up to date gas information appears on the HEM.

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5 Device and Command Classes

5.1 Device Classes

The Z-Wave network role for the e-meter unit will be a static controller, listening at all times.

Basic Device Class = STATIC CONTROLLER.

NOTE: the e-meter uses Zensys' Library of a reduced static controller i.e. it has no SUC/SIS functionality.

Generic Device Class = METER GENERIC DEVICE CLASS.

Specific Device Class = Simple Meter Specific Device Class.

For further information refer to [1].

5.2 Command Classes Supported

Support requires that the unit is able to receive commands and respond within that command class. For further information on command classes refer to [1] and [2].

5.2.1 Meter Command Class (Version 1)

The e-meter shall respond to the GET command with a REPORT from the Meter Command Class that are of Electricity Meter type, with a kWh scale, 3 decimal place precision, and a 4 byte meter value.

The 4 byte meter value will always be positive, and will be the last total electricity consumption value received by the Z-Wave module from the meter card. Ordinarily it will be a near match of the meter reading value on the meter (unless the meter display has wrapped around).

If a HEM is included then the REPORT to the HEM will be sent unsolicited at 5 past, 25 past, 35 past and 55 past each hour to receive up to date values.

Other units can request the REPORT but it will be up to 10 or 20 minutes old depending on the time of the request.

NOTE: Use the e-meter blue button to view the Total Consumption Register to verify the message contents.

5.2.2 Manufacturer Specific Command Class (Version 1)

The e-meter shall respond to the GET command with the following REPORT parameters:

Product ID = 0x0059 (assigned by Z-Wave vendor)

Product Type ID = 0x0005 (assigned by Horstmann). This is the ID for a First Generation Electricity Meter – RF)

Product ID = 0x0001 (assigned by Horstmann). This is the ID for an S123R meter.

5.2.3 Version Command Class (Version 1)

The e-meter shall respond to the GET command with a REPORT containing version information for the Z-Wave code, and a two byte identifier for the application code (written by Horstmann). Production Code will start from Version 1 Revision 0 so the two byte identifier shall start from 0x01 0x00.

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The unit shall respond to the Version Command Class GET with the Version Command Class REPORT for any requested command class shown in the Node Information Frame i.e. classes from sections 5.2 and 5.3 plus Basic. For any other command classes, the version number returned is 0.

5.2.4 Basic Command Class (Version 1)

Zensys and Horstmann agree that there are no relevant commands available for mapping the Basic Command Class to. It is not appropriate to map the Basic Command Class to the Metering Command Class due to number of data bytes in the report. So the Basic SET and GET commands will only be ignored except for the ACK if enabled by the sender, and the Basic REPORT will not be supported.

5.2.5 Time Command Class (Version 1)

The e-meter shall respond to the TIME GET command with a TIME REPORT from the Time Command Class.

The TIME REPORT shall be transmitted with the RTC Failure and reserved bits set to 0 (clear).

The e-meter shall respond to the DATE GET command with a DATE REPORT from the Time Command Class.

If a HEM is included then the TIME and DATE reports to the HEM will be sent unsolicited at 5 past and 35 past each hour.

Other units can request the time and date reports which will be current at the time of request.

NOTE: Use the e-meter blue button to view the time and date displays to verify the message contents.

5.2.6 Basic Tariff Information Command Class (Version 1)

The e-meter shall respond to the GET command with a REPORT from the Basic Tariff Information Command Class.

The REPORT shall be transmitted with all reserved bits set to 0. The e-meter shall transmit a shortened message (no element 2 information so 5 bytes less) with the dual bit set to 0.

The 4 byte rate totals will always be positive, and will be the last electricity rate totals received by the Z-Wave module from the meter card. Ordinarily it will be a near match of the rate totals on the meter (unless the meter display has wrapped around).

The switching time field will be a real time in the format HH:MM:SS if the single element of the meter supports more than one rate, otherwise it will be 0xFF filled indicating that there is no switch over time to another rate.

If a HEM is included then the REPORT to the HEM will be sent unsolicited at 5 past, 25 past, 35 past and 55 past each hour to receive up to date values.

Other units can request the REPORT but it will be up to 10 or 20 minutes old depending on the time of the request.

NOTE: Use the e-meter blue button to view the relevant Rate Register display to verify the message contents.

5.2.7 Multilevel Sensor Command Class (Version 2)

The e-meter shall respond to the GET command with a REPORT from the Multilevel Sensor Command Class that are of Power Sensor type, with a W scale, 0 decimal place precision and a 2 byte value.

The 2 byte value will always be zero or positive, and will be the last instantaneous power level value received by the Z-Wave module from the meter card.

If a HEM is included then the REPORT to the HEM will be sent unsolicited at 15s intervals except ± 15 s of the 5 past, 25 past, 35 past and 55 past each hour time slots.

Other units can also request the REPORT.

NOTE: Verify the REPORT by comparing the value to the Instantaneous Power display on the meter and the power rating of the known load connected to the e-meter.

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5.2.8 Pulse Meter Command Class (Version 1)

The e-meter shall respond to the GET command with a REPORT from the Pulse Meter Command Class that has a 4 byte value.

If a ZMART has not been included to the e-meter's network then the 4 byte value of the REPORT shall be zero.

If a ZMART has been included to the e-meter's network then the 4 byte value of the REPORT shall be the last value received from the ZMART.

If a HEM is included then the REPORT to the HEM will be sent unsolicited at 25 past and 55 past each hour to receive up to date values from the ZMART.

Other units can request the REPORT but it will be the last pulse count value received from the ZMART.

5.3 Command Class for Control

Control requires that the unit is able to send commands and receive responses within that command class.

The command classes covered in this section are only used if a ZMART is associated to the e-meter. The e-meter will accept any of the following unsolicited reports at any time, but only from the associated ZMART. Refer to [2] for further information.

5.3.1 Wake Up Command Class (Version 1)

The e-meter sends the Wake Up Interval SET command and Wake Up No More Information message to the ZMART.

The e-meter sends the Wake Up Interval SET command to instruct the ZMART when to wake up next, and the node ID that the ZMART needs to send its Wake Up Notification message to. Wake Ups are scheduled for 25 past and 55 past the hour. When the meter has finished interrogating the ZMART it sends the Wake Up No More Information message to send the ZMART to sleep.

The e-meter receives the Wake Up Notification message from the ZMART, and this is used as a trigger to communicate with the ZMART while it is awake.

5.3.2 Pulse Meter Command Class (Version 1)

The e-meter sends the Pulse Meter GET command to the ZMART during interrogation and expects a Pulse Meter REPORT message in response.

The data content of the REPORT consists of 4 bytes representing an unsigned value, and this value is then available from the e-meter on request and is sent unsolicited to a HEM in the network.

5.3.3 Binary Sensor Command Class (Version 1)

The e-meter sends the Binary Sensor GET command and expects a Binary Sensor REPORT.

The data content of the REPORT is one byte indicating the status of the Gas Meter's tamper switch. It cannot be requested via Z-Wave from the e-meter but its data can be used by the e-meter.

5.3.4 Battery Level Command Class (Version 1)

The e-meter sends the Battery Level GET command and expects a Battery Level REPORT.

The data content of the REPORT is one byte indicating the battery level of the ZMART's internal battery. It cannot be requested via Z-Wave from the e-meter but its data can be used by the e-meter.

5.3.5 ZMART Interrogation Message Sequences

The following messages or dialog take place between the e-meter and ZMART at association or wake up in this order:

Message	Source	Destination
Wake Up Notification	ZMART	e-meter
Pulse Meter GET	e-meter	ZMART
Pulse Meter REPORT	ZMART	e-meter
Binary Sensor GET	e-meter	ZMART
Binary Sensor REPORT	ZMART	e-meter
Battery Level GET	e-meter	ZMART
Battery Level REPORT	ZMART	e-meter
Wake Up Interval SET	e-meter	ZMART
Wake Up No More Information	e-meter	ZMART

Table 2 – E-Meter ZMART Dialog

NOTE: After each GET the e-meter waits for a response or up to 200ms, whichever sooner, before moving on to the next GET. This prevents hang up and provides flexibility for a ZMART type device that does not support all the above command classes to still perform its primary function with the e-meter.

6 E-Meter Transmission Options

All unsolicited messages will be sent with the routing and acknowledgements options enabled, and at normal power.

Any response to a message will have acknowledgements enabled and be sent with the power setting of the message received. The response route will be back along the incoming message route by default of the protocol.

7 Factory Test Mode

No factory test mode is supported, where there is a special button sequence/combination on power up that will put the Z-Wave module in to a different working mode for testing.

During development, the Z-Wave software was created for the unit to transmit the 868.4MHz carrier indefinitely. This software can be requested, if required, for a one-off verification of the carrier during certification.