



Instruction

Secure Development Controller (ATmega) User Guide

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REVISION RECORD

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1	20071025	IHM JFR	All	The first version has been prepared
1	20071119	IHM	All	Standardized names have been applied. More details for supported Security Schemes during the node inclusion. Figures and figure captions have been updated.

Table of Contents

1	ABBREVIATIONS.....	1
2	INTRODUCTION.....	1
2.1	Purpose.....	1
2.2	Audience and prerequisites.....	1
3	GETTING STARTED	2
4	USER INTERFACE.....	4
4.1	D1 LED indication.....	5
4.2	D2 LED indication.....	6
4.3	D6 LED indication.....	7
5	SAMPLE APPLICATION DESCRIPTION	8
5.1	Features of the Secure Development Controller sample application.....	8
5.2	Include a Node to the Z-Wave Network	9
5.2.1	Slave Node	9
5.2.2	Controller Node	9
5.3	Associate a Slave Node to a Group	10
5.4	Switching a Group of Nodes On and Off.....	10
5.4.1	Aborting a Group On or Off command	11
5.5	Dimming a Group of Nodes.....	11
5.6	Assigning a Route to a Routing Slave.....	11
5.7	Excluding a Node from the Z-Wave Network (reset Node).....	11
5.8	Resetting the Secure Development Controller.....	12
5.9	Automatic updates of Network topology from SUC.....	12
5.10	Manual update of Network topology from SUC.....	13
5.11	Using Inclusion Controllers.....	13
6	FUNCTION OVERVIEW	14
7	REFERENCES	16

List of Figures

Figure 1.	ZDP02A Z-Wave Development Platform Unit.....	2
Figure 2.	User Interface for ZDP02A Z-Wave Development Platform	4
Figure 3.	Position of D1 light-emitting diode.....	5
Figure 4.	Position of D2 light-emitting diode.....	6
Figure 5.	Position of D6 light-emitting diode.....	7
Figure 6.	ZW0102 Controller/Slave Unit.....	9
Figure 7.	Summary of the functions of the Secure Development Controller	14

1 ABBREVIATIONS

Abbreviation	Explanation
SIS	SUC ID Server
SUC	Static Update Controller
ISP	In-System Programmer
USB	Universal Serial Bus

2 INTRODUCTION

2.1 Purpose

The purpose of this document is to describe the functionalities and features of the Secure Development Controller for Atmel AVR ATmega128 processor operated at ZDP02A Z-Wave Development Platform.

2.2 Audience and prerequisites

The audience of this document is Z-Wave partners and Zensys. It is assumed that the Z-Wave partner already is familiar with the Z-Wave Developer's Kit.

3 GETTING STARTED

The Secure Development Controller sample application is designed for the ZDP02A Z-Wave Development Platform Unit, which is an assembly of the ZW010x Development Module [2] and a ZW0102/ZW0201/ZW0301 based Z-Wave module.

ZDP02A Z-Wave Development Platform unit is a part of the Developer's Kit and it is usually used as USB Z-Wave Programmer for flash programming the Z-Wave 100/200/300 Series single chips.

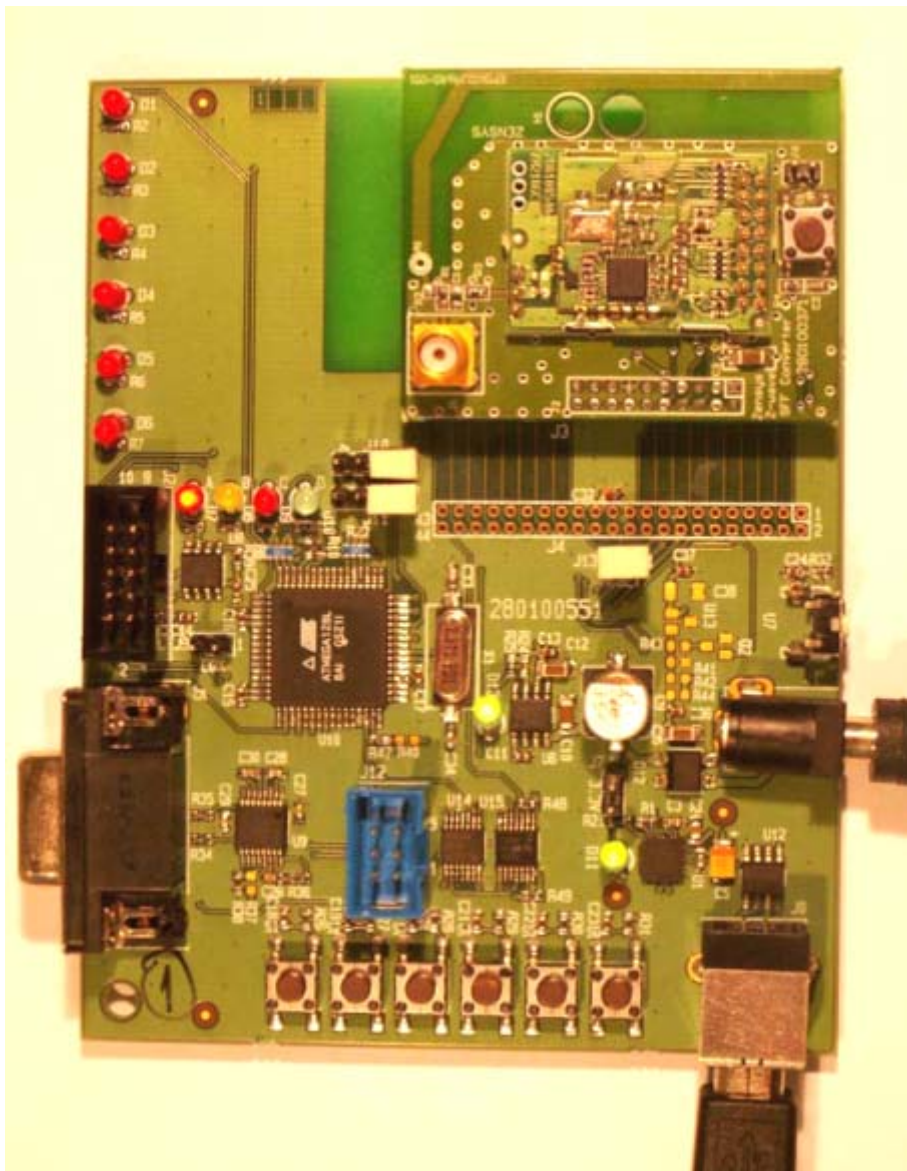


Figure 1. ZDP02A Z-Wave Development Platform Unit

To use ZDP02A Z-Wave Development Platform Unit as Secure Development Controller, follow the steps as described below:

1. Flash the Z-Wave module placed at ZDP02A platform. Refer to [1] for instructions on how to do this.

The following files from SerialAPI_Controller_Portable folder should be flashed/programmed:

- serialapi_controller_portable_ZW0N0x_XX.hex to Z-Wave module, where **N** is Z-Wave module series you are going to use and **XX** is required frequency mode, e.g. "serialapi_controller_static_nosuc_ZW020x_US.hex"
- extern_eep.hex to EEPROM

Attention! Please make sure you are using the correct firmware.

2. Flash the Atmel AVR ATmega128 placed at ZDP02A platform.

The file you need depends on the Inclusion Security Scheme you are going to implement in the Development Controller – the file template is "controller_portable_AVR_SS.hex", where **SS** is Security Scheme ("0" for Scheme 0, "0_20" for Scheme 0/20 and "20" for Scheme 20). Use the appropriate.HEX file in "/build/" sub-folder, e.g. "controller_portable_AVR_0_20.hex".

You need a special programmer and connector. It is recommended to use AVR ISP mkII programmer or similar programmer to flash the Atmel AVR ATmega128. Please refer to [8] for more details and instructions on how to do this.

Attention! Please make sure you are using the correct firmware.

4 USER INTERFACE

The user interface of Secure Development Controller sample application is based on 6 pushbuttons (named S1, S2, S3, S4, S5 and S6) and 3 LED's (named D1, D2 and D6) on the ZDP02A Z-Wave Development Platform.

Note please, that ZDP02A Z-Wave Development Platform is equipped with 6 pushbuttons and 12 LED's, as shown at the Figure 2 below. But only 3 LED's are used in this version of the Secure Development Controller sample application.

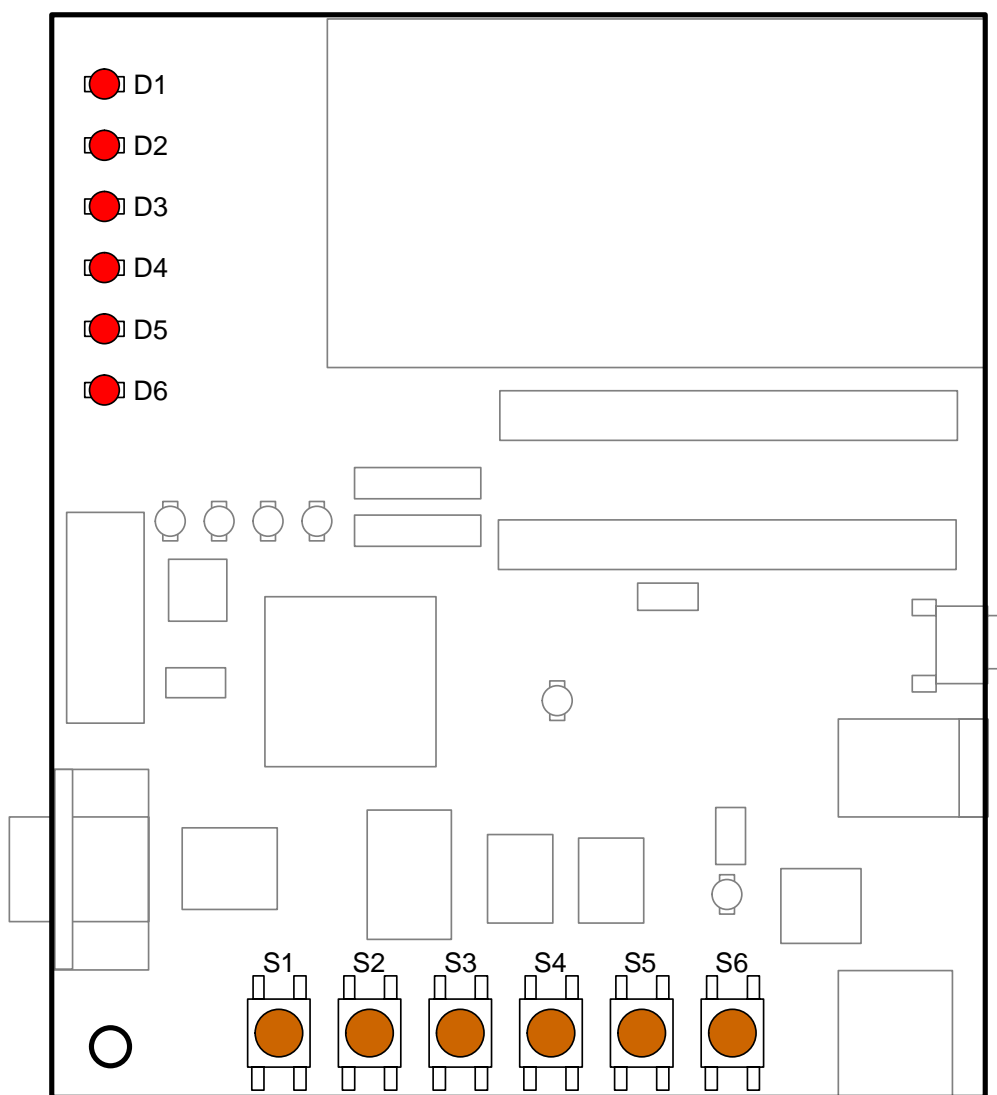


Figure 2. User Interface for ZDP02A Z-Wave Development Platform

The three LED's are the users only indication of the status of the Secure Development Controller and the various states of those three LED's will be described below.

4.1 D1 LED indication

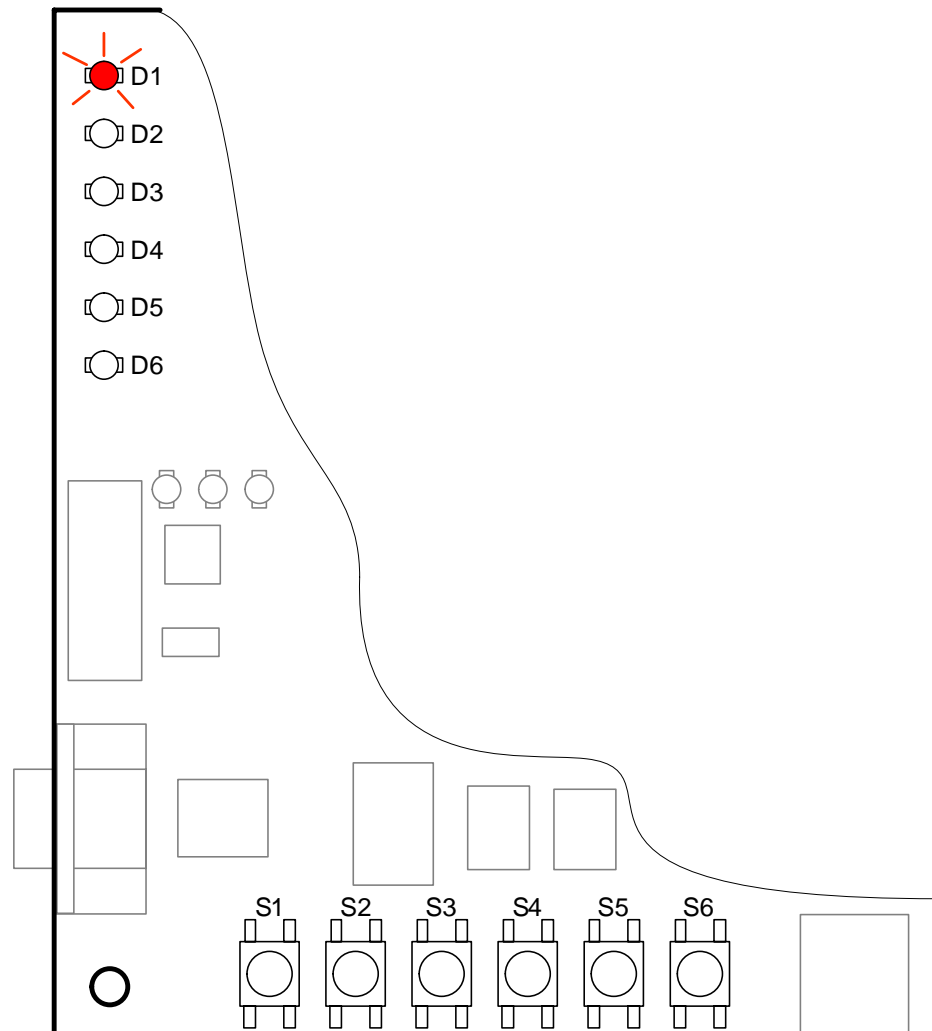


Figure 3. Position of D1 light-emitting diode

D1 light-emitting diode indicates the following states:

- | | |
|-----------------|--|
| ON | Waiting for Z-Wave frame from another Node |
| Flashing | Controller is processing |
| OFF | Controller is idle |

4.2 D2 LED indication

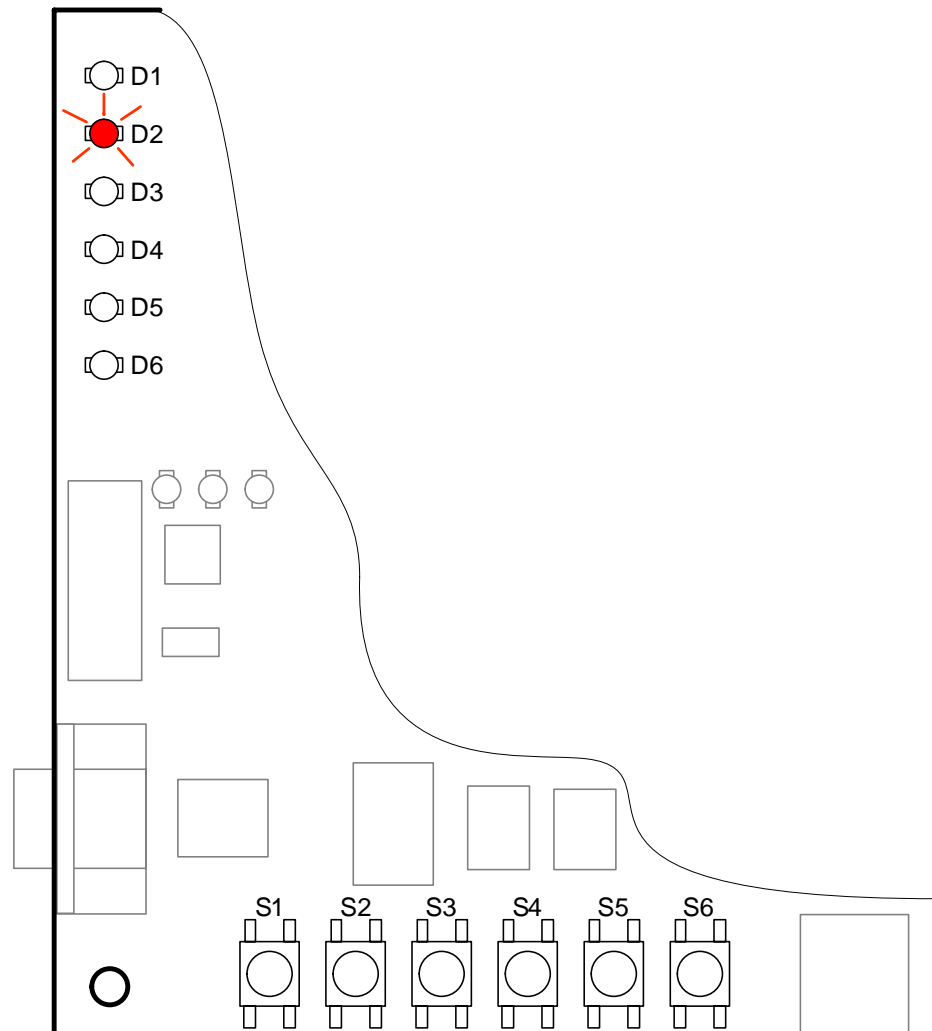


Figure 4. Position of D2 light-emitting diode

D2 light-emitting diode indicates the following states:

ON

- System error – errors can be reset by pushing any of the push buttons
- Assigning routes to a binary sensor: D2 LED will go ON when awaiting signal (Z-Wave frame) from the Binary sensor
- When resetting the Controller: Reset in progress

Please refer to the descriptions of the various system functionalities in the chapters below.

Flashing

Not used

OFF

System is ready

4.3 D6 LED indication

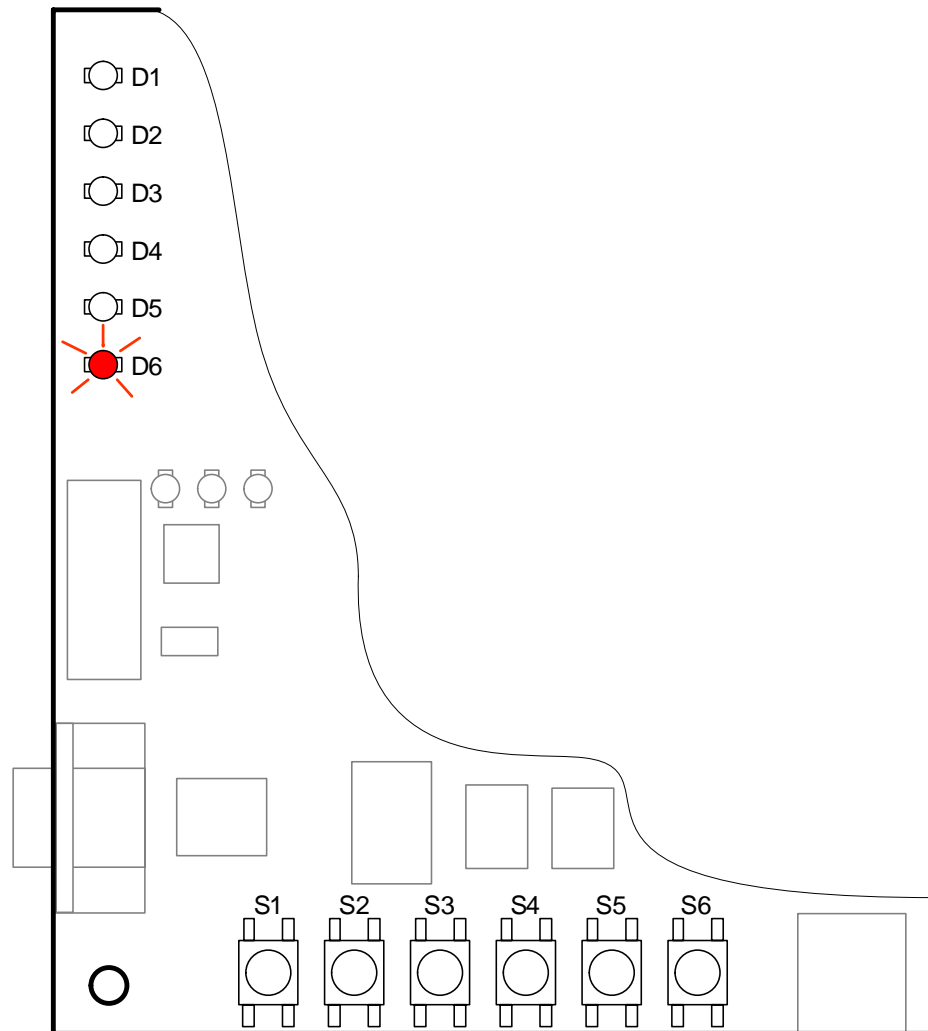


Figure 5. Position of D6 light-emitting diode

D6 light-emitting diode indicates the following states:

ON	Any button is pressed.
Flashing	Not used
OFF	Not used

5 SAMPLE APPLICATION DESCRIPTION

5.1 Features of the Secure Development Controller sample application

The Secure Development Controller (for Atmel AVR ATmega128) sample application implements the following features of the Z-Wave protocol:

1. Include Slave and Controller Nodes to the Z-Wave Network
2. Associate a Node to a Group
3. Switching a Group of Nodes on or off (toggle function)
4. Dimming a Group of multilevel switches (e.g. LED Dimmers)
5. Assigning a Route to a routing slave (e.g. a Binary Sensor)
6. Excluding a Node from the Z-Wave Network
7. Resetting the Secure Development Controller
8. Requesting network updates to a Secondary Controller from a Static Update Controller (SUC) in case it is present in the network
9. Work as Inclusion Controller when a SUC ID Server (SIS) is present in the network

In the following sections is each feature described in details.

5.2 Include a Node to the Z-Wave Network

Adding a slave node and a controller node is done in a generic way on Z-Wave protocol level, but the user interface can differ depending on the hardware and software implementation.

When building a new Z-Wave Network using the Secure Development Controller sample application, make sure that all units are reset in order to avoid problems with duplicate Node ID's when including Nodes to the network. Please refer to section 5.7 for information on how to reset nodes or section 5.8 for information on how to reset the Secure Development Controller.

5.2.1 Slave Node

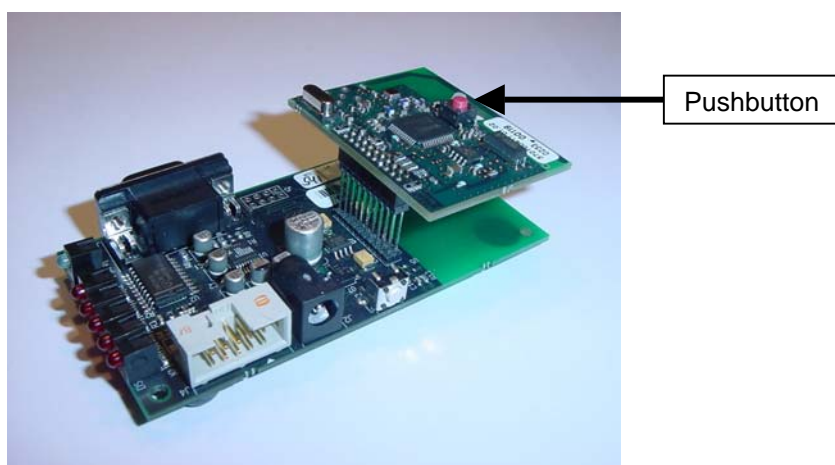


Figure 6. ZW0102 Controller/Slave Unit

The slave applications LED Dimmer, Binary Sensor or Binary Sensor Battery are designed for the Controller/Slave Unit, which is an assembly of the of the ZW010x Interface Module [4] and a ZW0102/ZW0201/ZW0301 based Z-Wave Module. To include this type of module to the Z-Wave Network when using an Secure Development Controller as primary controller, follow the steps are described below:

1. On the primary Secure Development Controller, press and hold S2 – this will turn D1 LED On, indicating that the system is awaiting node information from the Node which is being included to the Network
2. Press shortly the pushbutton on the Z-Wave slave Node being included in the network. The pushbutton (red) is located on the ZM1220 Z-Wave Module.
3. When D1 LED starts to flash on the primary Secure Development Controller, S2 pushbutton can be released. When the node information has been received and processed by the Secure Development Controller, D2 LED will turn Off, which means that the Node has now been successfully included into the network.
4. Repeat steps 1 to 3 to include all the Nodes in the Network.

5.2.2 Controller Node

The controller application is provided on the ZM1220 Z-Wave Module connected to the ZW010x Development Module. To include this type of module to the Z-Wave Network when using a Secure Development Controller as primary requires the following steps:

1. On the primary Secure Development Controller, press and hold S2 pushbutton– this will turn D1 LED On, indicating that the system is awaiting node information from the Node which is being included to the Network
2. Press and hold S5 pushbutton on the Secure Development Controller that you want to include into the network as a secondary controller. Remember to keep the S5 pushbutton pressed until D1 LED lights up. If D2 LED lights up then the inclusion failed and should be repeated.
3. When the node information has been received and processed by the Secure Development Controller, D1 LED will turn Off, which means that the Node has now been included in the network and S2 pushbutton can be released.
4. Repeat steps 1 through 3 to include more controller nodes into the Network.

Please note that the process of replication does include transfer of information about which nodes are included in the Group – so the new controller will be able to control the same group as the controller used to include it.

When additional nodes are included to the network then the secondary Secure Development Controller's network topology is incomplete in case a static update controller (SUC) is not present. By repeating the inclusion process on the secondary Secure Development Controller it will receive the updated network topology. To read more about network updates initiation refer to the section 5.9.

5.3 Associate a Slave Node to a Group

The Secure Development Controller has only one Group that nodes can be associated to – this Group is controlled with S1 pushbutton.

To associate nodes to the Group, please follow the steps as described below:

1. Make sure that the Node which you want to associate to the Group is already included in the Z-Wave network
2. Press and hold S1 pushbutton on the Secure Development Controller – this will turn D1 LED On, indicating that the system is awaiting node information from the Node you want to associate.
3. Press shortly on the pushbutton on the Z-Wave module mounted on the Node being associated. This will prompt the Z-Wave Module to send out a node information frame.
4. When the node information has been received and processed by the Secure Development Controller, D1 LED is flashing. The Node has now been associated to the Group. D1 LED will turn Off when S1 pushbutton is released.
5. Repeat steps 1 through 4 to associate more Nodes to the Group.

To remove an association from the group hold down S1 pushbutton and press shortly on the pushbutton located at the Z-Wave module to be removed. The node is still a part of the Z-Wave network.

5.4 Switching a Group of Nodes On and Off

The switching On and Off of the Secure Development Controller Group is done by pressing S1 pushbutton shortly. When S1 pushbutton is pressed, D1 LED turns briefly On and then turns Off again, indicating that controller is processing the signal.

5.4.1 Aborting a Group On or Off command

When a group On or Off command is issued the Secure Development Controller will start to send commands to each node in the group. If that process has to be aborted then the S1 pushbutton can be pressed again to abort the commands to the remaining nodes.

5.5 Dimming a Group of Nodes

The dimming of a Group of Nodes is done by pressing and holding S1 pushbutton. While dimming is ongoing, D1 LED will be On indicating that the processor is busy.

Dimming will continue for as long as S1 pushbutton is pressed, but the Nodes will only continue to either Full ON or Full OFF. Releasing S1 pushbutton and then keep pressing again will toggle the direction of the dimming.

5.6 Assigning a Route to a Routing Slave

The Secure Development Controller can also be used for assigning a Route to a Routing Slave e.g. a Binary Sensor. Please refer to [1] for detailed information on how the assigning of routes is actually handled by the protocol.

Assigning a Route to a Routing Slave is done to make the Routing Slave capable of reaching another Node even via routing when certain conditions are met. An example could be a setup consisting of a Binary Sensor and a LED Dimmer (or any other kind of Node). The user would like the LED Dimmer turned on, when the Binary Sensor is activated – this would require the assigning of a route to the Binary Sensor in order to make this Node know, which Node to control.

To assign a Route to the Binary Sensor, follow the steps as described below:

1. Press S4 pushbutton shortly that will turn D1 LED ON, indicating that the system is awaiting node information from the LED Dimmer that the Binary Sensor should get a route to.
2. Shortly press the pushbutton on the Z-Wave module which is a part of the LED Dimmer. This will prompt the Z-Wave Module to send out a node information frame.
3. When the node information has been received and processed by the Secure Development Controller, D1 LED will turn OFF and D2 LED will turn ON, indicating that the system is awaiting node information from the Binary Sensor to which you want to assign a route.
4. Now press and hold the pushbutton on the Z-Wave module, which is a part of the Binary Sensor.
5. When the node information has been received and processed by the Secure Development Controller, D2 LED will turn Off, and a route has been assigned from the Binary Sensor to the LED Dimmer.
6. When the Binary Sensor is activated (in this case by pressing the pushbutton on the Binary Sensor) the LED Dimmer will turn on for a few seconds and then it turns off again.

5.7 Excluding a Node from the Z-Wave Network (reset Node)

The Secure Development Controller application is capable of excluding Nodes and deleting them from the Z-Wave Network. The procedure is as follows:

1. Press and hold S3 pushbutton on the Secure Development Controller – this will turn D1 LED ON, indicating that the system is awaiting node information from the Node to be excluded from the Network.
2. Press shortly the pushbutton on the Z-Wave slave Node to be excluded from the network. Or press and hold the S5 pushbutton on the secondary Secure Development Controller to be excluded from the network.
3. When D1 LED turns OFF on the Secure Development Controller then the Node has been excluded and reset. S3 pushbutton can now be released.

5.8 Resetting the Secure Development Controller

Attention! When resetting a Secure Development Controller all information about the network topology is removed.

Attention! Remember that resetting the primary Secure Development Controller does not reset the nodes that are included in the network that the Secure Development Controller hosts. Each node must be reset individually and this can be done either before or after having reset the primary Secure Development Controller.

To reset the Secure Development Controller:

1. Press both S1 and S5 pushbuttons on the Secure Development Controller and hold them for 2 seconds, then D2 LED will turn ON signaling that the reset is in progress, and the pushbuttons can be released.
2. After a few seconds D2 LED will turn OFF and D1 LED will flash shortly, meaning that the Secure Development Controller has been reset.

5.9 Automatic updates of Network topology from SUC

The secondary controllers will have an outdated network topology when the primary Secure Development Controller includes/excludes new nodes. Having a static update controller (SUC) present in the Network allows the secondary controllers to obtain the latest network topology by requesting network updates from the SUC. The PC based Controller application [5] can be used as SUC.

All changes in the network are transferred from the primary Secure Development Controller to the SUC. The SUC can hold up to 64 changes of the network. A network change can be a node inclusion or exclusion to/from the Z-Wave network.

To update the Network topology, follow the steps below:

1. Use the primary Secure Development Controller to include a static controller to the network. The primary Secure Development Controller will automatically try to allocate the first static controller included in the network to be a SUC. Refer to section 5.2 regarding how to include a node.
2. Add a new Development Controller to the network. During the inclusion process the new secondary Controller is informed about the presence of a SUC.
3. Now the secondary Controller will start requesting network updates from the SUC. A random request interval is used between 1 and 4 minutes.

When a new node is included to the network then the secondary Development Controller will receive this information at the next request to the SUC and will then be able to control it. Similar will the secondary Development Controller be updated when a node is removed.

5.10 Manual update of Network topology from SUC

To do a manual update of the network topology in the Secure Development Controller acting as secondary controller, follow the steps below:

1. Use the primary Controller to include a static controller to the network. The primary Secure Development Controller will automatically try to allocate the first static controller included in the network to be a SUC. Refer to section 5.2 regarding how to include a node.
2. Add a new Development Controller to the network. During the inclusion process the new secondary Secure Development Controller is informed about the presence of a SUC.
3. After moving the Secure Development Controller to the new location, press S6 pushbutton on it to request the network updates from the SUC.

5.11 Using Inclusion Controllers

Only the primary Secure Development Controller has the capability to include/exclude nodes to/from the Z-Wave network. Having a SUC ID Server (SIS) present in the network allows all controllers to include/exclude nodes on its behalf. A SIS is a SUC with enabled node ID server functionality. The PC based Controller application [5] can be used as SIS.

To use this functionality the following should be done:

1. Use the primary Secure Development Controller to include a static controller to the network. The primary controller will automatically try to allocate the first static controller included in the network to be a SIS. Refer to section 5.2 regarding how to include a node. In case a PC based Controller is used then remember to configure it to be a SIS when included to the network.
2. Add a new Secure Development Controller to the network. During the inclusion process the new inclusion controller is informed about the presence of a SIS.
3. Now the inclusion Secure Development Controller will start requesting network updates from the SIS. A random request interval is used between 1 and 4 minutes. In addition it can include/exclude nodes in the network. The D1 LED will flash on the inclusion controller until a node ID is allocated from the SIS. When D1 LED turns ON then the inclusion controller is ready to include the node.

The SIS becomes the primary controller in the network because it has the latest update of the network topology and capability to include/exclude nodes in the network. The old primary Development Controller becomes an inclusion Development Controller. The SIS enables the inclusion Development Controller to include/exclude nodes in the network on its behalf.

6 FUNCTION OVERVIEW

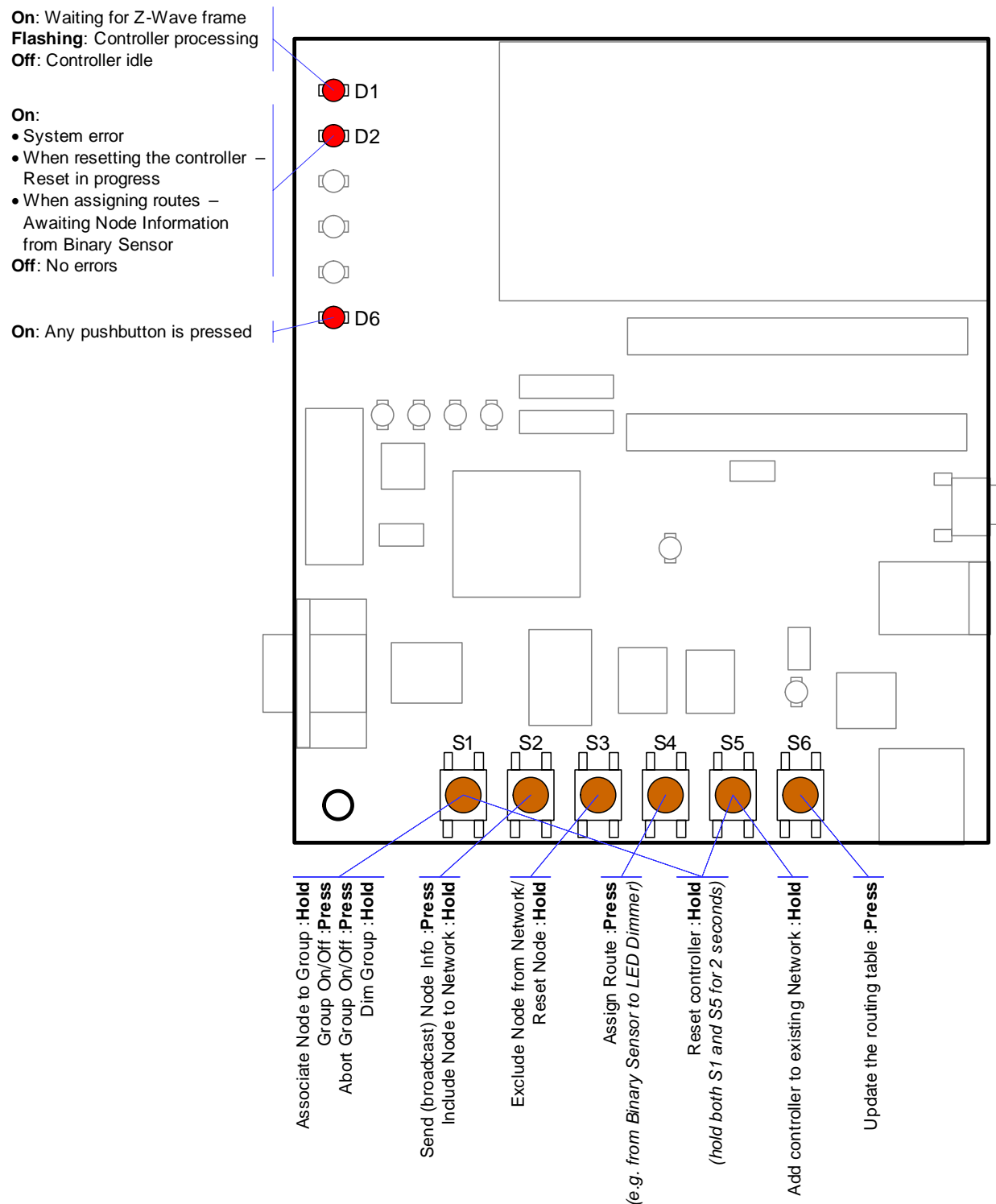


Figure 7. Summary of the functions of the Secure Development Controller

The figure above summarizes the functions of the Secure Development Controller (for Atmel AVR ATmega128 processor) and the descriptions that have been given in the previous sections.

7 REFERENCES

- [1] Zensys, INS10244, Instruction, Z-Wave Node Type Overview and Network Installation Guide
- [2] Zensys, DSH10087, Datasheet, ZW0102 Z-Wave Development Module
- [3] Zensys, DSH10033, Datasheet, ZM1220 Z-Wave Module
- [4] Zensys, DSH10086, Datasheet, ZW0102 Z-Wave Interface Module
- [5] Zensys, INS10240, Instruction, PC based Controller User Guide
- [6] Zensys, DSH10275, Datasheet, ZM2120C Z-Wave Module
- [7] Zensys, DSH10857, Datasheet, ZM3120C Z-Wave Module
- [8] ATMEL, AVRISP mkII User Guide
[\[http://www.atmel.com/dyn/resources/prod_documents/AVRISPmkII_UG.pdf\]](http://www.atmel.com/dyn/resources/prod_documents/AVRISPmkII_UG.pdf)