PlugZ Switch & Dimmer Z-Wave Integration Guide

Version 1.0

Table of Contents

Revision History

Version	Date	Author	Comments
0.1	11/04/2015	A. Lorenzana	Initial Document.
0.2	12/03/2015	A. Lorenzana	Updated command classes supported Added Icon types & User Icon types Association group updated Z-Wave Specification Specifics Double press to include/exclude
0.3	12//11/2015	A. Lorenzana	Configuration CC Specifics updated Meter CC Specifics updated Reset Device Locally procedure updated
0.4	01/22/2016	T. Kazi	Updated with Child Protection feature
0.5	02/17/2016	T. Kazi	Updated Intro with summary table of configurable features
0.6	06/16/2016	T. Kazi	Updated to reflect spec revisions
1.0	11/04/2016	T. Kazi	Updated to reflect Z-wave Certified Release

1 Introduction

1.1 Overview

This guide is intended to help Z-Wave alliance members to quickly and effectively integrate the Nortek Security & Control LLC's PlugZ Switch & Dimmer into their existing Z-Wave controller.

All versions of the PlugZ Switch & Dimmer Z-Wave are covered in this document.

All documentation is based on Z-Wave development kit 6.51.08.

From this point on the PlugZ Switch Z-Wave will be referred to as the "Switch Device", PlugZ Dimmer Z-Wave will be referred to as the "Dimmer Device" and for either Switch or Dimmer will be referred to as the "Device".

1.2 Target Audience

This document is written for developers who are well versed in Z-Wave protocols and technologies. Readers are expected to have detailed knowledge of:

Z-Wave Command Classes
Z-Wave Security
Z-Wave Device inclusion/interrogation/exclusion
The Z-Wave Zniffer network trace utility

1.3 Z-Wave SDK

The Device is based on Sigma Designs 500 Series Z-Wave module. All nodes that wish to communicate with a Device must be using the Z-Wave API version 6.51 or higher.

NOTE: The Device is Z-Wave Plus Certified.

1.4 Z-Wave Specification Specifics

1.4.1 Device Type

The Switch and Dimmer Devices follows the Z-Wave On/Off Power Switch and Light Dimmer Switch Device type specification respectively. Please refer to the Sigma Designs, SDS11847-8 Z-Wave plus Device Type Specification.

1.4.2 Command Classes Supported

- COMMAND_CLASS_ZWAVEPLUS_INFO
- COMMAND_CLASS_VERSION
- COMMAND_CLASS_MANUFACTURER_SPECIFIC
- COMMAND_CLASS_DEVICE_RESET_LOCALLY
- COMMAND_CLASS_POWERLEVEL
- COMMAND_CLASS_ASSOCIATION
- COMMAND_CLASS_ASSOCIATION_GRP_INFO
- COMMAND_CLASS_BASIC
- COMMAND_CLASS_FIRMWARE_UPDATE_MD
- COMMAND_CLASS_CONFIGURATION
- COMMAND_CLASS_SWITCH_ALL
- COMMAND_CLASS_SCENE_ACTIVATION
- COMMAND_CLASS_SCENE_ACTUATOR_CONF
- COMMAND_CLASS_SWITCH_BINARY
- COMMAND_CLASS_SWITCH_MULTILEVEL
- COMMAND_CLASS_METER
- COMMAND_CLASS_PROTECTION

1.4.3 Manufacturer Specific Command Class Implementation Specifics

1.4.3.1 Switch Device Manufacturer Specific w/ Power monitoring featured

```
APP_MANUFACTURER_ID  = 0x014F      //Nortek Security & Control
APP_PRODUCT_TYPE_ID  = 0x5053      // “PS”
APP_PRODUCT_ID       = 0x3531      // “51”
```

1.4.3.2 Switch Device Manufacturer Specific w/o Power monitoring featured

```
APP_MANUFACTURER_ID  = 0x014F      //Nortek Security & Control
APP_PRODUCT_TYPE_ID  = 0x5053      // “PS”
APP_PRODUCT_ID       = 0x3532      // “52”
```

1.4.3.3 Dimmer Device Manufacturer Specific w/Power monitoring featured

```
APP_MANUFACTURER_ID  = 0x014F      //Nortek Security & Control
APP_PRODUCT_TYPE_ID  = 0x5044      // “PD”
APP_PRODUCT_ID       = 0x3533      // “53”
```

1.4.3.4 Dimmer Device Manufacturer Specific w/o Power monitoring featured

```
APP_MANUFACTURER_ID  = 0x014F      //Nortek Security & Control
APP_PRODUCT_TYPE_ID  = 0x5044      // “PD”
APP_PRODUCT_ID       = 0x3534      // “54”
```

1.4.4 Z-WavePlus Info Command Class Implementation Specifics

1.4.4.1 Switch Device Z-WavePlus Specific

Role Type = ZWAVEPLUS_INFO_REPORT_ROLE_TYPE_SLAVE_ALWAYS_ON

Node Type = ZWAVEPLUS_INFO_REPORT_NODE_TYPE_ZWAVEPLUS_NODE

Icon Type = ICON_TYPE_SPECIFIC_ON_OFF_POWER_SWITCH

User Icon Type = ICON_TYPE_SPECIFIC_ON_OFF_POWER_SWITCH

1.4.4.2 Dimmer Device Z-WavePlus Specific

Role Type = ZWAVEPLUS_INFO_REPORT_ROLE_TYPE_SLAVE_ALWAYS_ON

Node Type = ZWAVEPLUS_INFO_REPORT_NODE_TYPE_ZWAVEPLUS_NODE

Icon Type = ICON_TYPE_GENERIC_LIGHT_DIMMER_SWITCH

User Icon Type = ICON_TYPE_GENERIC_LIGHT_DIMMER_SWITCH

1.4.1 Binary Switch Command Class Implementation Specifics

The Binary Switch CC is only available on the following SKU’s: PS15Z5-1 & PS15Z5-1-PM.

Binary switch commands are supported and control the attached load. Basic command class command also control the attached load but it is recommended to use the Binary Switch CC.

1.4.2 Multilevel Switch Command Class Implementation Specifics

The Multilevel Switch CC in only available on the following SKU’s: PD300Z5-1 & PD300Z5-1-PM

Multilevel Switch commands are supported and gives dimming capabilities on the attached load. Basic command class command also control the attached load, when basic turning on is sent last dim level will be set.

1.4.3 Switch All Command Class Implementation Specifics

The Switch All Command Class allows many devices to be controlled with a single command. This reduces the "popcorn" effect when a number of lights are controlled where each light turns on/off at a slightly different time instead of all at the same time.

By default, the Switch All commands are enabled. Switch All can be configured or disabled using the SWITCH_ALL_SET command.

1.4.4 Scene Activation & Scene Actuator Conf Command Class Specifics

Scenes define a specific state for the load when the Scene Activation SET command is sent. Scenes make much more sense for dimmers but simple switches can be part of a scene. Up to 255 different SceneIDs can be programmed and each can have its own state. Use the Scene Actuator Conf SET command to set the value for the load for a specific SceneID. The Duration field is ignored since this is a simple binary switch.

1.4.5 Meter Command Class Implementation Specifics

The Meter CC is only available on the following SKU's: PS15Z5-1-PM & PD300Z5-1-PM.

The Meter command class provides the accumulated kWh and instantaneous Watts being consumed by the load. The kilowatt hours (kWh) value is an accumulation of the amount of power consumed by the load since the last time the METER_RESET command was received. Send the METER_RESET command to reset the kWh value to zero and restart the accumulation. The Watts value is the number of Watts being consumed by the load at the instant the command was received. The METER_SUPPORTED_GET command informs the controller of the support scales and meter type.

The device advertises following meter readings:

- KWh 0x00
- W 0x02
- V 0x04
- I (Current) 0x05

"KWh" should be read as a variable of 4 Bytes with 5 decimal fixed point,
e.g. 0x000FD52E should be read as 10.37614 KWh

"W" should be read as a variable of 2 Bytes with no decimal.
e.g. 0x0096 should be read as 150 Watts.

"V" should be read as a variable of 2 bytes with two decimal fixed point.
e.g. 0x0096 should be read as 1.50 Volts.

"I" should read as a variable of 2 bytes with three decimal fixed point.
e.g. 0x0096 should be read as .150 Amps.

The accumulated kWh is stored in non-volatile memory so that in the event of a power loss, the value will continue to be recorded. Note that the current kWh value is only stored into NVM once per hour to avoid wearing out the NVM. Thus, up to 1 hour of accumulated kWh could be lost due to a power loss.

1.4.6 Configuration V2 Command Class Implementation Specifics

They are listed below the parameters the Device has. However the Switch Device only implements "Nightlight" and "LED Brightness" parameters. These parameter can be configured using the configuration CC as follows:

Command Class = COMMAND_CLASS_CONFIGURATION
Command = CONFIGURATION_SET
Parameter Number = Parameter Specific
Size = 1
Value = to be assigned

1.4.6.1 LED Brightness

Defines LED Indicator Brightness.

Parameter Number	Valid Values	Default
0x02	1-100	100

1.4.6.2 Nightlight

Inversion of LED indicator when Load is ON or OFF; LED indicator ON when Load is OFF, and OFF when Load is ON.

Parameter Number	Valid Values	Default
0x03	0=Nightlight Mode OFF 1=Nightlight Mode ON 2=Nightlight always ON 3=Nightlight always OFF	1

1.4.6.3 Ignore dim start level

Defines if the Start Level sent in a Dim command is ignored or not. Typically the dim level should start from the current level and dim from there instead of suddenly changing to the Start Level and then dimming.

Parameter Number	Valid Values	Default
0x05	0=Use the Start Level in the Dim command 1=Ignore the Start Level in the Dim command	1

1.4.6.4 Remote On/Off Command Dim step

Step size of a received dim command (except All On/Off). Each step corresponds to 1% on the triac.

Parameter Number	Valid Values	Default
0x07	1-99	1

1.4.6.5 Remote On/Off Command Dim Time

Time in 10s of milliseconds to change the dim level by the Dim Step increment when a dim command is received (except All On/Off). When a Dim command is received, the dimmer level is

changed by the Dim Step every Dim Time. The combination of the two parameters allow for a wide variety of dimming ramp rates. Each value reflects 10ms.

Parameter Number	Valid Values	Default
0x08	1-255	3 (30ms)

1.4.6.6 Local On/Off Command Dim Step

Step size of a button press dim command.

Parameter Number	Valid Values	Default
0x09	1-99	1

1.4.6.7 Local On/Off Command Dim Time

Time in 10s of milliseconds of a button press to change the dim level by the Dim Step. When the button is pressed and held, the dimmer level is changed by the Dim Step every Dim Time. The combination of the two parameters allow for a wide variety of dimming ramp rates. The default results in changing the dim level 1% every 3/100th of a second.

Parameter Number	Valid Values	Default
0x10	1-255	3

1.4.6.8 All On/Off Command Dim Step

Step size of a received ALL On/Off command.

Parameter Number	Valid Values	Default
0x11	1-99	1

1.4.6.9 All On/Off Command Dim Time

Time in 10s of milliseconds to increment the dim level by Dim Step after receiving an All On/Off command. When an All On/Off command is received, the dimmer level is changed by the Dim Step every Dim Time.

Parameter Number	Valid Values	Default
0x12	1-255	3

1.4.6.10 Power Monitoring Mode

LED displays power consumption, see 6.6.3 for further information. If Nightlight is ON and Load is turned ON, the LED will show for a defined period of time power consumption then go off.

Parameter Number	Valid Values	Default
0x11	0=Power Monitoring OFF 1=Power Monitoring ON	1

1.4.6.11 Power Monitoring Display Time

Period of time in seconds that Power monitoring will be displayed when Nightlight is enabled. If the user wishes to have Power monitoring shown at all times, set this parameter to 255.

Parameter Number	Valid Values	Default
0x12	1-255	60

1.5 Device Firmware Upgrade

Over the Air (OTA) firmware upgrading is supported by the Device.

1.6 Child Protection feature

The PD300Z5 and PS15EMZ5 feature a child protection feature. When enabled, the button on the physical unit is disabled to prevent a child from accidentally turning an attached appliance on and off. In addition, the standard operation of double tap to perform network operations is disabled. This feature can be turned on and off through either a specific combination of button taps or through the Z-Wave protection command class. It is important to note that while protection is enabled, the unit will still respond to all remote commands.

To enable or disable protection at the unit, press the button three times in quick succession. The behavior of the device will follow the following behavior:

Device Element	Action	Description
Button	Three Taps	Three Taps to trigger child protection
RGB LED	Blinking	Purple blinking at half second interval for two seconds
Load Output		State unchanged

To enable or disable protection using the Z-wave command class, utilize Protection Command Class V1:

Command Class Operation	Parameter	Description
PROTECTION_SET	0x00,0x01,0x02	0x00 : Standard unprotected operation 0x01 : Protection by sequence (Currently unsupported by both PD300Z5 and PS15EMZ5) 0x02 : Protection enabled to disable button
PROTECTION_GET	NA	Requests PROTECTION_REPORT from device
PROTECTION_REPORT	Protection State	Responds with 0x00,0x01,0x02 as set by device or previous command

2 Supported Command Classes

This table summarizes the command classes implemented on the Device. All of these command classes shall be reported by the Device in its node info message. Command classes not included in this table are not supported by the Device.

Command Class	Version	Description
Z-Wave Plus Info	V2	Allows access to information of the Device
Firmware Update MD	V2	Allows a firmware image to be transferred and updated OTA
Association	V2	Allows the controller to associate nodes to send unsolicited reports/alarms
Association Group Info	V1	Allows a device to report the capabilities of each association group supported by a given application resource
Basic	V1	Allows a controlling device to operate the primary functionality of another device without any further knowledge.
Version	V2	Allows access to the firmware versions of the various Device sub-systems
Manufacturer Specific	V2	Allows access to manufacturer and device specific information
Device Reset Locally	V1	Allows the Device to notify the network that it is being reset and update routing tables accordingly.
Power Level	V1	Allow RF power controlling commands
Configuration	V2	Allows for configuration of the Device
Binary Switch	V1	Allows control to devices with On/Off capability
Multilevel Switch	V3	Allows control devices with Multilevel capability
Meter	V4	Allows devices capable of reporting energy measurements
Switch All	V1	Allows the device to be controlled across many Z-Wave devices quickly and with a single command
Scene Activation	V1	Set the load to a predetermined level per each Scene
Scene Actuator Conf.	V1	Configure the switch state for each Scene
Protection	V1	Set state of child protection on physical button

2.1 Node Information

The Device's node info frame always contains the non-secure command classes. After inclusion on a secure network, a Security Commands Supported Get command can be used to retrieve the additional command classes that are supported. Again, this is available only after secure inclusion is successful.

See section “Z-Wave Inclusion” for more information on the inclusion process and the contents of the node info frame.

3 Device Enrollment Process

The addition/subtraction of the Device into a Z-Wave the network is discussed in two parts:

Z-Wave Inclusion – This is the portion of the process whereby the Device is added as a valid node to the Z-Wave network. Classic inclusion will be tried first. If Classic inclusion fails then Network-Wide-Inclusion (NWI) will be tried. After the Node ID and Home ID are assigned, the secure inclusion phase will start. If the network key is successfully exchanged, then the supported commands will be exchanged between the controller and the Device.

Z-Wave Exclusion – This is the portion of the process whereby the Device is remove from the Z-Wave network. If the controller receives the NodeInfo frame it can remove the Device from the Z-wave network if desired.

If the Device was previously joined to another Z-Wave network that is no longer present, it may take several seconds for the NodeInfo frame to be sent. Excluding the Device from the Z-wave network resents the Device to the factory default settings. All configuration parameters are reset to their defaults and all Associations are removed.

4 Association

The Device supports one level of Z-Wave association.

Group 1 – association is used to identify another Z-Wave Device in the network that will receive unsolicited state changes and notification (alarm) events.

5 References

The following files were utilized to develop this documentation:

Sigma Design, SDS11847	Z-Wave+ Device Types Specification
Sigma Design, SDS12657	Z-Wave Command Class Specification A-M
Sigma Design, SDS12652	Z-Wave Command Class Specification N-Z
Sigma Design, SDS10865-9	Z-Wave Application Security Layer
Sigma Design, INS10247-12	Z-Wave ZW0201-ZW0301 Programmers Guide v5_01
ZW_classcmd.h	
ZW_basis_api.h	

6 Appendix A – User Interface

6.1 Device Initial Power Up

After Power up delay, LED operates as follows:

6.2 Device included

Device Element	Action	Description
Button		
RGB LED	Operation Mode	LED will resume to previous operation mode
Load Output		Recovers previous Lamp state

6.3 Device not included

Device Element	Action	Description
Button		
RGB LED	Blinking RED	1Hz Blinking to indicate device has not been included
Load Output		Recovers previous Lamp state

6.4 Device Inclusion

To include the Device into a Z-Wave network:

Device Element	Action	Description
Button	Button single or double press	If device is not included to a Z-wave network will send Inclusion Command
RGB LED	White LED	White LED ON if was successfully included to network
Load Output	Toggle	

6.5 Device Exclusion

The Device will be removed from the Z-wave network after exclusion is completed.

Device Element	Action	Description
Button	Button double press	If device is not included to a Z-wave network will send Inclusion Command, otherwise send exclusion command
RGB LED	Red Blinking	1Hz Blinking to indicate device has successfully excluded from network
Load Output	Unchanged	

6.6 Operating Mode

6.6.1 Nightlight Mode OFF

Condition	Button (Action)	LED Activity	Load Activity (Switch Device)	Load Activity (Dimmer Device)
Lamp OFF	Tap	EM for Timeout; then LED ON	Lamps turns on	Lamp turns on and automatically increases in brilliance from Minimum Level to Last known ON Dim Level at default Dim rate.
Lamp OFF	Press & Hold	EM for Timeout; then LED ON	No Change	Lamp level will increase while button is held. The device will not reverse direction when Max level is reached.
Lamp ON	Tap	LED Off	Lamps turns off	Lamp Load automatically dims to minimum level and turns off.
Lamp ON	Press & Hold	LED Off	No Change	Lamp level will alternate decrease/increase with each button press and hold. Lamp will not reverse direction when Maximum is reached. User will have to release the button and press and hold again to achieve the reverse action.

6.6.2 Nightlight Mode ON

Condition	Button (Action)	LED Activity	Load Activity (Switch Device)	Load Activity (Dimmer Device)
Lamp OFF	Tap	EM for Timeout; then LED OFF	Lamps turns on	Lamp turns on and automatically increases in brilliance from Minimum Level to Last known ON Dim Level at default Dim rate.
Lamp OFF	Press & Hold	EM for Timeout; then LED OFF	N/a	Lamp level will increase while button is held. The device will not reverse direction when Max level is reached.
Lamp ON	Tap	LED ON	Lamps turns off	Lamp automatically dims to minimum level and turns off.
Lamp ON	Press & Hold	LED ON	N/a	Lamp level will alternate decrease/increase with each button press and hold. Lamp will not reverse direction when Maximum is reached. User will have to release the button and press and hold again to achieve the reverse action.

6.6.3 Power Monitoring Mode

Power monitor featured product.

Only available on the following SKU's: PS15Z5-1-PM & PD300Z5-1-PM

Load (Dimmer Device)	Load (Switch Device)	LED Activity	Description
0 to 2 Watts	0 to 0.02 Amps	White LED ON	
2 to 60 Watts	0 to 2 Amps	Green LED ON	
61 to 100 Watts	2.01 to 5 Amps	Blue LED ON	

Load (Dimmer Device)	Load (Switch Device)	LED Activity	Description
101 to 200 Watts	5.01 to 10 Amps	Yellow LED ON	
201 to 300 Watts	10.01 to 16.5 Amps	Red LED ON	

6.6.4 Overload Monitoring

Only available on the following SKU's: PS15Z5-1-PM & PD300Z5-1-PM

Device Element	Action	Description
Button	Tap button	By pressing the button Overload condition will be cleared
RGB LED	Blinking Red/Yellow	continue blinking after load has been turned off by an overload condition
Load Output	Load OFF	Load will turned off when load has exceeded maximum allowed level by 10%

6.7 Device Reset Locally

Reset is used to return the Device to a factory default mode.
All previously learned Z-Wave network information stored in the Device is lost.

Device Element	Action	Description
Button	Press 5 Times and then Held for 15 seconds	Executed by pressing button at least 5 times in less of 2 second then holding for one half second. Must hold for 15 seconds otherwise reset is cancelled.
RGB LED	Blinking White	Starts blinking faster and faster for 10 seconds then go off, Blinking Red starts when device reset has been successfully done.
Load Output	N/a	

6.8 OTA upgrade

HUB controller will initiate OTA upgrade process when FW update is available, while upgrade is active Load control is not allowed.

Device Element	Action	Description
Button	N/a	
RGB LED	Blinking	Blue/Green Blinking at half second interval to indicate an upgrade is performing
Load Output		Reset of Product when Upgrade is complete, Load ON/OFF State Prior to upgrade will be remembered and returned

6.9 Child Protection

In order to protect against false activation by a child, this feature enables or disables single and double button press actions. The feature is enabled and disabled through a triple tap. If protection

is enabled, double and single taps will output a quick purple pattern to signify that the protection is enabled.

Device Element	Action	Description
Button	Three Taps	Three Taps to trigger child protection
RGB LED	Blinking	Purple blinking at half second interval for two seconds
Load Output		State unchanged

6.10 Local Control

In the event that a user wishes to turn the attached lamp on through the lamp switch rather than the Z-wave hub, the user can do so by turning the lamp switch off, then on again. This feature is only available on the Dimmer unit.

Device Element	Action	Description
Attached Dimmer Circuit	Lamp switch opened, then closed	The dimmer will power the appliance even if previously set to the OFF state