

**NEMA Standards Publication 243-2004**

*Digital Addressable Lighting Interface (DALI) Control Devices Protocol*

**PART 2-2004**

*Specific Commands for Control Devices*

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## Foreword

This standard covers the specific commands for various lighting control devices used to control electronic ballasts conforming to IEC 60929, Annexes E and G. These ballasts are referred to as “DALI ballasts” (DALI—Digital Addressable Lighting Interface).

In the preparation of this Standards Publication input of users and other interested parties has been sought and evaluated. Inquiries, comments, and proposed or recommended revisions should be submitted to the concerned NEMA product Subdivision by contacting the:

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## **Section 1 GENERAL**

### **1.1 SCOPE**

This standard covers the specific commands for the various control devices connected to a DALI (Digital Addressable Lighting Interface) communications bus, as well as the bus and its power supply.

## **Section 2**

### **DALI SWITCH DEVICE**

#### **2.1 GENERAL**

Switch Devices (SD) type commands are used when a device at a specific individual address has been queried and determined to be an SD. Commands can be sent to all SD's by setting the address byte to a value of 0x81 (the SD type). Allowable commands, specified in the second byte of the message, can range in value from 0x80 to 0xbf. All non-specified commands are reserved.

Switch Devices shall be able to control each 8 single units.

#### **2.2 SPECIFIC COMMANDS**

The use of Generic Device Commands, as detailed in NEMA STANDARD 243-2004, Part 1-2004, section 5 is still required. These commands are used to establish the short address the SC (see Table 5.2), check error conditions, and set group membership (see Table 5.1 and 5.3).

#### **2.3 PARAMETER BANK SELECTION**

As with generic devices, parameter banks are optionally used to enable different operating modes for the device that corresponds to different building modes. While only a single parameter bank is required, manufacturers that implement more than one parameter bank allow the user to change the operating characteristics of the device at will. Manufacturers are only required to implement a single Parameter Bank (Bank 0). All other banks are optional. Note that the parameter bank count and pointers specified here are used in the same way as their equivalents in the generic devices, but they are separate and refer to a sensor specific parameter bank(s).

#### **2.4 SWITCH BANK SELECTION**

In every SD an additional selectable bank has been added. This will allow to select the functionality of up to 254 connected buttons. Each button will have the possibility to have assigned one of the following commands:

- Two byte commands sent to the ballast
  - o Commands sent one time only
    - Single command repeated every time the button will be pressed (e.g. to be used for a ON only button functionality) = Functionality A
    - Single Toggle command (e.g. to be used for a ON/OFF button functionality) = Functionality B
  - o Repeated commands
    - Repeated commands automatically repeated every 50ms as long as button is pressed (e.g. to be used for DIM UP functionality) = Functionality C
    - Repeated Toggle command (e.g. to be used for a DIM UP/ DIM DOWN functionality. = Functionality D
- Set of 3 Two Byte commands used for programming ballast
  - One single set of three DALI ballast 2 byte commands can be programmed in order to be able to e.g. memorize the actual level in the connected output units (e.g. ballast) = Functionality E
- Three byte command
  - One 3 byte command to allow communicating to other controllers (can be used to e.g. set a different parameter bank) = Functionality F

By recalling on of the functionalities A-F the SD shall execute the requested command.

## 2.5 DATA REQUIREMENTS FOR SWITCH DEVICES

The amount of data required to implement an Switch Device is minimal, and is detailed below in Table 2.1. The number of Parameter and Switch Banks that the vendor chooses to implement determines the total table size. With the required initial parameter bank (Bank 0) and one switch bank (switch bank 0) a total of 15 bytes is required (single functionality e.g. ON/OFF). Additional parameter banks and multiple button units require a higher number of bytes.

**Table 2-1  
DATA REQUIREMENTS FOR SWITCH DEVICE**

Read Byte # 0xXX=Hex (xxx)=Dec	Byte #	Description	Default
0x80 (128)	0	Parameter Bank Count (PBC): Ranges from 1 to 255, this indicates the number of implemented parameter banks. If 1, then a single parameter bank is supported. Zero is not a valid number.	N/A
0x81 (129)	1	Parameter Bank Read/Write (PBRW): Set to the desired parameter bank to be read from (command 0x00), or programmed (commands 0x81 to 0x8e).	0x01
0x82 (130)	2	Parameter Bank Operate (PBO): Set to the desired parameter bank to operate from given the current mode of the building	0x01
0x83 (131)	3	FB (Feature Byte): Read only byte that indicates the capabilities implemented by the vendor (0 means not supported, 1 means supported) Bit 7 – Reserved for future use Bit 6 – Reserved for future use Bit 5 – Reserved for future use Bit 4 – Supports status information Bit 3 – Supports 3-byte outputs Bit 2 – Supports programming feature outputs Bit 1 – Supports 2-byte outputs Bit 0 – Multiple switch implemented	N/A
		<b>PB The actual Parameter Bank (bytes 1 to 3)</b>	
0x84 (132)	1	Switch Bank Count (SBC): Ranges from 1 to 255, this gives the count of buttons the units is supporting. Zero is not a valid number.	0x01
0x85 (133)	2	Switch Bank Read/Write (SBRW): Set to the desired switch bank to be read from (command 0x80), or programmed to (commands 0x81 to 0x93).	0x01
0x86 (134)	3	Sensor Output Enable (SOE): Used to enable/disable two byte, programming and/or three byte commands: Bit 7 Reserved for future use Bit 6 Reserved for future use Bit 5 Reserved for future use Bit 4 Reserved for future use Bit 3 Reserved for future use Bit 2 set to 1 to enable 3-byte commands Bit 1 set to 1 to enable programming commands Bit 0 set to 1 to enable 2-byte commands	0x01

<b>SB The actual Switch Bank (Bytes 1 to 18)</b>			
0x87 (135)	1	<p>Button Status (BS): This byte shall reflect the status of the corresponding Switch Bank.</p> <p>Bit 7 Reserved for future use            Bit 6 set to 1 reflects last recalled function F            Bit 5 set to 1 reflects last recalled function E            Bit 4 set to 1 reflects last recalled function D            Bit 3 set to 1 reflects last recalled function C            Bit 2 set to 1 reflects last recalled function B            Bit 1 set to 1 reflects last recalled function A            Bit 0 set to 1 reflects lights to be on</p>	N/A
0x88 (136)	2	<p>Command Activated (CA) This byte reflects the activated Functions.</p> <p>Bit 7 Reserved for future use            Bit 6 Reserved for future use            Bit 5 set to 1 function F activated            Bit 4 set to 1 function E activated            Bit 3 set to 1 function D activated            Bit 2 set to 1 function C activated            Bit 1 set to 1 function B activated            Bit 0 set to 1 function A activated</p>	N/A
0x89 (137)	3	<p>Timer CD (TCD): This will set the time in 50ms increments on how long the command has to be recalled in order to send the commands specified in function C and D. If this timer is set Functions A and B only be executed if the command has been recalled for less then the set time.</p>	N/A
0x8a (138)	4	<p>Timer E (TE): This will set the time in 100ms increments on how long the command has to be recalled in order to send the commands specified in function E.</p>	N/A
0x8b (139)	5	<p>Timer F (TF): This will set the time in 100ms increments on how long the command has to be recalled in order to send the commands specified in function F. If set to 0 the command will sent after having executed Function AB, CD or E.</p>	N/A
<b>Commands set in A and B shall be sent only once.</b>			
0x8c (140)	6	<p>Function A first byte (FA1) defines first byte for function A            If set to 255 (MASK) the function is deactivated.</p>	N/A
0x8d (141)	7	<p>Function A second byte (FA2) defines the second byte for function A.</p>	N/A
0x8e (142)	8	<p>Function B second byte (FB2) defines the second byte for function B.            The same 1<sup>st</sup> byte shall be used as used in Function A.            If deactivated (byte 0x89 (137) / 2) function A shall be repeated.</p>	N/A
<b>Commands set in C and D shall be repeated every 50 ms as long as recalled.</b>			
0x8f (143)	9	<p>Function C first byte (FC1) defines first byte for function C            If set to 255 (MASK) the function is deactivated.</p>	N/A
0x90 (144)	10	<p>Function C second byte (FC2) defines the second byte for function C.</p>	N/A
0x91 (145)	11	<p>Function D second byte (FD2) defines the second byte for function D.            The same 1<sup>st</sup> byte shall be used as used for Function C.            If deactivated (byte 0x89 (137) / 2) function C shall be</p>	N/A

		repeated.	
		<b>Commands set in E shall be sent only once 1)</b>	
0x92 (146)	12	Function E first byte (FE1) defines first byte for function E.	N/A
0x93 (147)	13	Function E second byte (FE2A) defines the second byte for the first of the three commands.	N/A
0x94 (148)	14	Function E second byte (FE2B) defines the second byte for the second of the three commands.	N/A
		<b>Commands set in F shall be sent only once 2)</b>	
0x95 (149)	15	Function F first byte (FF1) defines first byte for function F	N/A
0x96 (150)	16	Function F second byte (FF2) defines the second byte for function F.	N/A
0x97 (151)	17	Function F third byte (FF3) defines the third byte for function F.	N/A

Commands set in E shall be sent:

- 1<sup>st</sup> byte (FE1), second byte A (FE2A)
- 1<sup>st</sup> byte (FE1), second byte B (FE2B) this command shall be repeated twice within 50 ms.

## 2.6 THREE-BYTE COMMANDS

It is also possible to broadcast a 3-byte command to other devices using sensor addressing. Such a command does not impact ballast light output directly (the ballasts ignore 3-byte commands), but another control device on the same bus can receive this information and react accordingly. This information can be sent once, on change only by specifying the functionality F. If the function F is specified, the command will be sent after sending all other commands.

## 2.7 SWITCH DEVICES CONTROL MESSAGES

In addition to the Common Control Commands detailed in table 2.3 of NS 243-2004, Part 1-2004, some additional command are specified in order to provide all possible features to be implemented.

**Table 2.3  
SWITCH DEVICE CONTROL COMMANDS**

Command		Purpose	Comments
Dec	Hex		
0	0x00	Query Data	Used to read data specified by the 3 <sup>rd</sup> byte (See table 6.1 for byte # and details). Note, PBRW must be set to the appropriate parameter bank before the read command is issued
128	0x80	Set Parameter Bank Read/Write (PBRW)	Used to select which bank to read from or write to. Note, this does not change the operating bank!
129	0x81	Set Parameter Bank Operate (PBO)	Used to select which

			parameter bank the sensor is operating from.
130	0x82	Set Switch Bank Read/Write (PBRW)	Used to select which bank to read from or write to. Note, all switch banks are always active.
131	0x83	Set Sensor Output Enable (SOE)	Sets the capability of the unit to send 2 byte, programming and/or 3 byte commands.
132	0x84	Set Command Activated (CA)	Sets what function will be activated (what button press will recall a command)
133	0x85	Set Timer CD (TCD)	Will specify the time, in 50mS increments, the button has to be pressed in order to send the commands C and /or D
134	0x86	Set Timer E (TE)	Will specify the time in 100mS increments, the button has to be kept press in order to sent the command set specified in E.
135	0x87	Set Timer F (F)	Will specify the time in 100mS increments, the button has to be kept press in order to sent the command set specified in E.
136	0x88	Set FA1	In this byte the first byte for command sent with function A and B is specified.
137	0x89	Set FA2	The second byte for function A is specified.
138	0x8a	Set FB2	The second byte for function B is specified.
139	0x8b	Set FC1	In this byte the first byte for command sent with function C and D is specified.
140	0x8c	Set FC2	The second byte for function C is specified.
140	0x8d	Set FD2	The second byte for function D is specified.
142	0x8e	Set FE1	In this byte the first byte for command sent with function E is specified.
143	0x8f	Set FE2A	The second byte for the first command in function E is specified.
144	0x90	Set FE2B	The second byte for the second command in function E is specified.
145	0x91	Set FF1	In this byte the first byte for command sent with function F is specified.

146	0x92	Set FF2	The second byte for function F is specified.
147	0x93	Set FF3	The third byte for function F is specified.

## 2.8 SWITCH DEVICE EXAMPLES OF COMMAND SETS

### 2.8.1 SINGLE BUTTON ON/OFF, RAISE/LOWER DEVICE

In the following table it is shown on how a momentary switch would be programmed that would be toggling between ON and OFF on a short push of the button and would DIM UP respectively DIM DOWN when the button is pressed for longer.

		<b>SB The actual Switch Bank for single toggle switch</b>	<b>Set to Command # (code)</b>
0x88 (136)	1	Button Status (BS)	N/A
0x89 (137)	2	Command Activated (CA)	(0000 1111)
0x8a (138)	3	Timer CD (TCD)	3 (0000 0011)
0x8b (139)	4	Timer E (TE)	N/A
0x8c (140)	5	Timer F (TF)	N/A
		<b>Commands set A and B</b>	
0x8d (141)	6	Function A first byte (FA1)	Group 1 (10000011)
0x8e (142)	7	Function A second byte (FA2)	RECALL MAX LEVEL 5 (0000 0101)
0x8f (143)	8	Function B second byte (FB2)	OFF 0 (00000000)
		<b>Commands set C and D</b>	
0x90 (144)	9	Function C first byte (FC1)	Group 1 (10000011)
0x91 (145)	10	Function C second byte (FC2)	UP 1 (0000 0001)
0x92 (146)	11	Function D second byte (FD2)	DOWN 2 (0000 0010)

If the button will be pressed for less then 150ms the switch will sent alternately the commands RECALL MAX and OFF to group 1. If the buttons are pressed for more then 150ms the send commands will be UP respectively DOWN to Group 1.

### 2.8.2 TWO BUTTON DEVICE ON/RAISE ON ONE BUTTON, OFF/LOWER ON THE SECOND

As we do have two buttons, two switch banks will need to be set. In the following table it is shown on how a momentary switch would be programmed to fulfill the function ON/UP and the second will list the settings for OFF/DOWN. The functions UP and DOWN shall be activated if the button is pressed and hold for more then 100ms.

		<b>SB The actual Switch Bank for ON/UP switch</b>	<b>Set to Command # (code)</b>
0x88 (136)	1	Button Status (BS)	N/A
0x89 (137)	2	Command Activated (CA)	(0000 0101)

0x8a (138)	3	Timer CD (TCD)	3 (0000 0011)
0x8b (139)	4	Timer E (TE)	N/A
0x8c (140)	5	Timer F (TF)	N/A
<b>Commands set A and B</b>			
0x8d (141)	6	Function A first byte (FA1)	Group 1 (10000011)
0x8e (142)	7	Function A second byte (FA2)	RECALL MAX LEVEL 5 (0000 0101)
0x8f (143)	8	Function B second byte (FB2)	N/A
<b>Commands set C and D</b>			
0x90 (144)	9	Function C first byte (FC1)	Group 1 (10000011)
0x91 (145)	10	Function C second byte (FC2)	UP 1 (0000 0001)
0x92 (146)	11	Function D second byte (FD2)	N/A

		<b>SB The actual Switch Bank for OFF/DOWN switch</b>	<b>Set to Command # (code)</b>
0x88 (136)	1	Button Status (BS)	N/A
0x89 (137)	2	Command Activated (CA)	(0000 0101)
0x8a (138)	2	Timer CD (TCD)	3 (0000 0011)
0x8b (139)	3	Timer E (TE)	N/A
0x8c (140)	4	Timer F (TF)	N/A
<b>Commands set A and B</b>			
0x8d (141)	5	Function A first byte (FA1)	Group 1 (10000011)
0x8e (142)	6	Function A second byte (FA2)	OFF 0 (00000000)
0x8f (143)	7	Function B second byte (FB2)	N/A
<b>Commands set C and D</b>			
0x90 (144)	8	Function C first byte (FC1)	Group 1 (10000011)
0x91 (145)	9	Function C second byte (FC2)	DOWN 2 (0000 0010)
0x92 (146)	10	Function D second byte (FD2)	N/A

All commands are sent to Group 1. By pressing button 1 for less than 150ms the unit shall recall ON, if pressed longer the command shall be UP. For the second button the command for a short press is OFF and for a long press it will be DOWN. The commands will be repeated every 50 ms for the time the button is pressed.

By setting the FC1 commands to MASK the same setting could be used for a manual 3 way switch that would switch the lights ON and OFF only.

### 2.8.3 SCENE SWITCH DEVICE INCLUDING MEMORIZING THE SCENE

The example will only specify one single button. To create a multiple button device the relative number of switch banks would need to be defined. As an additional feature the button would memorize the actual level as scene if hold for more then 10 seconds.

		<b>SB The actual Switch Bank for SCENE switch including Memorizing actual level as Scene</b>	<b>Set to Command # (code)</b>
0x88 (136)	1	Button Status (BS)	N/A
0x89 (137)	2	Command Activated (CA)	(0001 0001)
0x8a (138)	3	Timer CD (TCD)	N/A
0x8b (139)	4	Timer E (TE)	100 (0011 0100)
0x8c (140)	5	Timer F (TF)	N/A
		<b>Commands set A and B</b>	
0x8d (141)	6	Function A first byte (FA1)	Group 1 (10000011)
0x8e (142)	7	Function A second byte (FA2)	GO TO SCENE 5 21 (0001 1101)
0x8f (143)	8	Function B second byte (FB2)	N/A
		<b>Commands set C and D</b>	
0x90 (144)	9	Function C first byte (FC1)	N/A
0x91 (145)	10	Function C second byte (FC2)	N/A
0x92 (146)	11	Function D second byte (FD2)	N/A
		<b>Commands set E</b>	
0x93 (147)	12	Function E first byte (FE1)	Group 1 (10000011)
0x94 (148)	13	Function E second byte (FE2A)	STORE ACTUAL LEVEL IN THE DTR 33 (0010 0001)
0x95 (149)	14	Function E second byte (FE2B)	STORE THE DTR AS SCENE 5 69 (0100 0101)
0x96 (150)	15	Function E second byte (FE2C)	STORE THE DTR AS SCENE 5 69 (0100 0101)

### **Section 3**

## **DALI DIMMING SLIDE DEVICE**

#### **3.1 GENERAL**

To be determined.

#### **3.2 SPECIFIC COMMANDS**

To be determined.

## **Section 4**

### **OCCUPANCY/MOTION DETECTOR OR PRESENCE DETECTOR**

#### **4.1 GENERAL**

Occupancy sensor type commands are used when a device at a specific individual address has been queried and determined to be a motion/occupancy sensor. Commands can be sent to all occupancy/motion detectors by setting the address byte to a value of 0x85 (the motion/occupancy sensor type). Allowable commands, specified in the second byte of the message, can range in value from 0x80 to 0xbf. All non-specified commands are reserved.

#### **4.2 USE OF GENERAL COMMANDS**

The use of Generic Device Commands, as detailed in NS 243-2004, Part 1-2004, section 5 is still required. These commands are used to establish the short address the occupancy detector (see Table 5.2), check error conditions, and set group membership (see Table 5.1 and 5.3).

#### **4.3 PARAMETER BANK SELECTION**

As with generic devices, parameter banks are optionally used to enable different operating modes for the device that correspond to different building modes. While only a single parameter bank is required, manufacturers that implement more than one parameter bank allow the user to change the operating characteristics of the device at will. Manufacturers are only required to implement a single Parameter Bank (Bank 0). All other banks are optional. Note that the parameter bank count and pointers specified here are used in the same way as their equivalents in the generic devices, but they are separate and refer to a sensor specific parameter bank(s). Rather than have some parts of the parameters contained in the generic parameter bank, and other newer parts in the sensor specific section, it was decided to group the sensor related parameters into a sensor specific section for clarity and consistency.

#### **4.4 DATA REQUIREMENTS FOR OCCUPANCY/MOTION DETECTORS**

The amount of data required to implement an Occupancy/Motion Detector is minimal, and is detailed below in Table 6.1. The total table size is determined by the number of parameter banks that the vendor chooses to implement, but with the required initial parameter bank (Bank 0), a total of 17 bytes is required. Additional parameter banks require 13 bytes each.

**Table 6-1  
DATA REQUIREMENTS FOR OCCUPANCY/MOTION DETECTOR**

<b>Read Byte # 0xXX=Hex (xxx)=Dec</b>	<b>Byte #</b>	<b>Description</b>	<b>Default</b>
0x80 (128)	0	Parameter Bank Count (PBC): Ranges from 1 to 255, this indicates the number of implemented parameter banks. If 1, then a single parameter bank is supported. Zero is not a valid number.	N/A
0x81 (129)	1	Parameter Bank Read/Write (PBRW): Set to the desired parameter bank to be read from (command 0x00), or programmed (commands 0x81 to 0x8e).	0x00
0x82 (130)	2	Parameter Bank Operate (PBO): Set to the desired parameter bank to operate from given the current mode of the building	0x00
0x83 (131)	3	FB (Feature Byte): Read only byte that indicates the capabilities implemented by the vendor (0 means not supported, 1 means supported) Bit 7 – Reserved for future use Bit 6 – Reserved for future use Bit 5 – Supports 2-byte outputs Bit 4 – Adjustable Warning Delay Bit 3 – Adjustable Occupancy Delay Bit 2 – Adjustable Output Enables Bit 1 – Adjustable Sensitivity Bit 0 – Adjustable Repeat Intervals	N/A
	<b>4</b>	<b>PB The actual Parameter Bank (bytes 4 to 16)</b>	
0x84 (132)	4	Occupied Repeat Interval (ORI): Set number of minutes between 2-byte occupied broadcasts. Zero indicates no repeat will occur (broadcast will happen on change of occupancy only)	0x00
0x85 (133)	5	Unoccupied Repeat Interval (URI): Set number of minutes between 2-byte unoccupied broadcasts. Zero indicates no repeat will occur (broadcast will happen on change of occupancy only)	0x00
0x86 (134)	6	Sensor Repeat Interval (SRI): Set number of minutes between 3-byte sensor state broadcasts. Zero indicates no repeat will occur (broadcast will happen on change only)	
0x87 (135)	7	Sensor Sensitivity (SS): Specifies sensitivity to motion. 1 is least sensitive, 255 is the most sensitive, 0 is factory default	0x00
0x88 (136)	8	Sensor Output Enable (SOE): Used to enable/disable two byte and/or three byte sensor state messages as follows: Bit 2 set to 1 to enable 3-byte broadcasts Bit 1 set to 1 to enable 2-byte occupied broadcasts Bit 0 set to 1 to enable 2-byte unoccupied broadcasts	0x04
0x89 (137)	9	Occupancy Delay (OD): Specifies amount of time the sensor must remain unoccupied before reporting a lack of occupancy. Time is in minutes. 0 is reserved for factory default. 255 is reserved for a test interval less than 1 minute	0x00
0x8a (138)	10	Warn Timer (WT): Specifies the amount of time the area should remain in a dim (warning) mode before turning off. 0 indicates no delay, 255 is reserved for a test interval less than	0x05

		1 minute.	
0x8b (139)	11	2-byte occupied output, byte 1 (OO1): First byte of 2-byte command sent when occupied	N/A
0x8c (140)	12	2-byte occupied output, byte 2 (OO2): Second byte of 2-byte command sent when occupied	N/A
0x8d (141)	13	2-byte warn output, byte 1 (WO1): First byte of 2-byte command sent when warning	N/A
0x8e (142)	14	2-byte warn output, byte 2 (WO2): Second byte of 2-byte command sent when warning	N/A
0x8f (143)	15	2-byte unoccupied output, byte 1 (UO1): First byte of 2-byte command sent when unoccupied	N/A
0x90 (144)	16	2-byte unoccupied output, byte 2 (UO2): Second byte of 2-byte command sent when unoccupied	N/A

#### 4.5 OCCUPANCY/MOTION DETECTOR BROADCAST MESSAGES

##### 4.5.1 TWO-BYTE COMMANDS

The occupancy/motion detector can be configured to send control information to other devices in two ways. First, it can directly control ballasts when enabled and appropriate 2-byte ballast commands are programmed into the sensor. The 2-byte command that is sent is fully programmable (see table 6.1 above), and could correspond to a ballast command to turn a group off when unoccupied, for example. The 2-byte commands can repeat automatically at the rate specified in the ORI and URI bytes shown above in table 6.1.

##### 4.5.2 THREE-BYTE COMMANDS

It is also possible to broadcast a 3-byte command to other devices using sensor addressing. Such a command does not impact ballast light output directly (the ballasts ignore 3-byte commands), but another control device on the same bus can receive this information and react accordingly. This information can be sent once, on change only, or repeated automatically at the rate specified in the SRI byte shown above in table 6.1.

In the case of the 3-byte command, the sensor short address is placed in the address field (see the CA parameter in Table 5.1 from NEMA Standard 243-2004, Part 1-2004), with an offset of 0x40 to indicate the message is controller originated (the address byte will then range in value from 0x40 to 0x7f for sensors 0 to 63). The command field specifies the type of data being sent; and in the case of the Occupancy/Motion Detector, the command field is set to a value of 0x02, which indicates an Occupancy/Motion Detector Sensor value is being sent. The value, contained in the third byte of the message, is set per Table 6.2 below:

**Table 6.2  
THREE-BYTE OCCUPANCY SENSOR VALUE BROADCAST MESSAGES**

Address Byte	Command Byte	Data Byte	Description
0x40 to 0x7f	0x02	0x00	Occupancy Sensor Value (OSV)= Unoccupied (no people present)
	0x02	0x01	Occupancy Sensor Value (OSV)= Unoccupied and in warning interval
	0x02	0x02	Occupancy Sensor Value (OSV)= Occupied (people present)

#### 4.6 OCCUPANCY/MOTION DETECTOR CONTROL MESSAGES

In addition to the Common Control Commands detailed in table 5.3 of NS 243-2004, Part 1-2004, some Occupancy/Motion Detector Specific commands exist that are used to program or query the device. These commands are shown in table 6.3 below.

NOTE the Query Data command, a generic command, is repeated here for completeness.

**Table 6.3  
OCCUPANCY/MOTION DETECTOR CONTROL MESSAGES**

Command		Purpose	Comments
Dec	Hex		
0	0x00	Query Data	Used to read data specified by the 3 <sup>rd</sup> byte (See table 6.1 for byte # and details). Note, PBRW must be set to the appropriate parameter bank before the read command is issued
128	0x80	Set Parameter Bank Read/Write (PBRW)	Used to select which bank to read from or write to. Note, this does not change the operating bank!
129	0x81	Set Parameter Bank Operate (PBO)	Used to select which parameter bank the sensor is operating from.
130	0x82	Set Occupied Repeat Interval (ORI)	Sets the ORI field in the Parameter Bank specified by PBRW (see Table 6.1)
131	0x83	Set Unoccupied Repeat Interval (URI)	Sets the URI field in the Parameter Bank specified by PBRW (see Table 6.1)
132	0x84	Sensor Repeat Interval (SRI)	Sets the SRI field in the Parameter Bank specified by PBRW (see Table 6.1)
133	0x85	Sensor Sensitivity (SS)	Sets the SS field in the Parameter Bank specified by PBRW (see Table 6.1)
134	0x86	Sensor Output Enable (SOE)	Sets the SOE field in the Parameter Bank specified by PBRW (see Table 6.1)
135	0x87	Occupancy Delay (OD)	Sets the OD field in the Parameter Bank specified by PBRW (see Table 6.1)
136	0x88	Warn Timer (WT)	Sets the WT field in the Parameter Bank specified by PBRW (see Table 6.1)
137	0x89	2-byte occupied output, byte 1 (OO1)	Sets the OO1 field in the Parameter Bank specified by PBRW (see Table 6.1)
138	0x8a	2-byte occupied output, byte 2 (OO2)	Sets the OO2 field in the Parameter Bank specified by

			PBRW (see Table 6.1)
139	0x8b	2-byte warn output, byte 1 (WO1)	Sets the WO1 field in the Parameter Bank specified by PBRW (see Table 6.1)
140	0x8c	2-byte warn output, byte 2 (WO2)	Sets the WO2 field in the Parameter Bank specified by PBRW (see Table 6.1)
141	0x8d	2-byte unoccupied output, byte 1 (UO1)	Sets the UO1 field in the Parameter Bank specified by PBRW (see Table 6.1)
142	0x8e	2-byte unoccupied output, byte 2 (UO2)	Sets the UO2 field in the Parameter Bank specified by PBRW (see Table 6.1)

## Section 5 OPEN LOOP DAYLIGHT CONTROLLER

### 5.1 GENERAL

Open Loop Daylight Controller (OLDC) type commands are used when a device at a specific individual address has been queried and determined to be an OLDC. Commands can be sent to all OLD-Cs by setting the address byte to a value of 0x86 (the OLDC type). Allowable commands, specified in the second byte of the message, can range in value from 0x80 to 0xbf. All non-specified commands are reserved.

### 5.2 SPECIFIC COMMANDS

The use of Generic Device Commands, as detailed in NEMA STANDARD 243-2004, Part 1-2004, section 5 is still required. These commands are used to establish the short address the OLDC (see Table 5.2), check error conditions, and set group membership (see Table 5.1 and 5.3).

### 5.3 PARAMETER BANK SELECTION

As with generic devices, parameter banks are optionally used to enable different operating modes for the device that correspond to different building modes. While only a single parameter bank is required, manufacturers that implement more than one parameter bank allow the user to change the operating characteristics of the device at will. Manufacturers are only required to implement a single Parameter Bank (Bank 0). All other banks are optional. Note that the parameter bank count and pointers specified here are used in the same way as their equivalents in the generic devices, but they are separate and refer to a sensor specific parameter bank(s). Rather than have some parts of the parameters contained in the generic parameter bank, and other newer parts in the sensor specific section, it was decided to group the sensor related parameters into a sensor specific section for clarity and consistency.

### 5.4 DATA REQUIREMENTS FOR OCCUPANCY/MOTION DETECTORS

The amount of data required to implement an OLDC is minimal, and is detailed below in Table 7.1. The total table size is determined by the number of parameter banks that the vendor chooses to implement, but with the required initial parameter bank (Bank 0), a total of 21 bytes is required. Additional parameter banks require 17 bytes each.

**Table 7.1  
DATA REQUIREMENTS FOR OPEN LOOP DAYLIGHT CONTROLLER**

Read Byte # 0xXX=Hex (xxx)=Dec	Byte #	Description	Default
0x80 (128)	0	Parameter Bank Count (PBC): Ranges from 1 to 255, this indicates the number of implemented parameter banks. If 1, then a single parameter bank is supported. Zero is not a valid number.	N/A
0x81 (129)	1	Parameter Bank Read/Write (PBRW): Set to the desired parameter bank to be read from (command 0x00), or programmed (commands 0x81 to 0x8e).	0x00
0x82 (130)	2	Parameter Bank Operate (PBO): Set to the desired parameter bank to operate from given the current mode of the building	0x00

0x83 (131)	3	FB (Feature Byte): Read only byte that indicates the capabilities implemented by the vendor (0 means not supported, 1 means supported) Bit 7 – Reserved for future use Bit 6 – Reserved for future use Bit 5 – Supports 2-byte outputs Bit 4 – Adjustable Bright Delay Bit 3 – Adjustable Dark Delay Bit 2 – Adjustable Output Enables Bit 1 – Adjustable Scale Bit 0 – Adjustable Repeat Intervals	N/A
	<b>4</b>	<b>PB The actual Parameter Bank (bytes 4 to 20)</b>	
0x84 (132)	4	Dark Repeat Interval (DRI): Set number of minutes between 2-byte dark broadcasts. Zero indicates no repeat will occur (broadcast will happen on change of state only)	0x00
0x85 (133)	5	Bright Repeat Interval (BRI): Set number of minutes between 2-byte bright broadcasts. Zero indicates no repeat will occur (broadcast will happen on change of state only)	0x00
0x86 (134)	6	Sensor Repeat Interval (SRI): Set number of minutes between 3-byte OLDC broadcasts. Zero indicates no repeat will occur (broadcast will happen on change only)	0x00
0x87 (135)	7	Sensor Scale (SS): Specifies type of sensor or scale/range of sensor. 0 is factory default	0x00
0x88 (136)	8	Sensor Output Enable (SOE): Used to enable/disable two byte and/or three byte sensor state broadcasts as follows: Bit 4 set to 1 to listen to 3-byte Occ Sensor broadcasts Bit 3 set to 1 to enable 3-byte Level broadcasts Bit 2 set to 1 to enable 3-byte OLDC broadcasts Bit 1 set to 1 to enable 2-byte dark broadcasts Bit 0 set to 1 to enable 2-byte bright broadcasts	0x04
0x89 (137)	9	Dark Threshold byte 1 (DT1): Specifies number of lux beneath which it is considered dark. This is the lower 8 bits of the 16 bit threshold.	N/A
0x8a (138)	10	Dark Threshold byte 2 (DT2): Specifies number of lux beneath which it is considered dark. This is the upper 8 bits of the 16 bit threshold.	N/A
0x8b (139)	11	Bright Threshold byte 1 (BT1): Specifies number of lux above which it is considered bright. This is the lower 8 bits of the 16 bit threshold.	N/A
0x8c (140)	12	Bright Threshold byte 2 (BT2): Specifies number of lux above which it is considered bright. This is the upper 8 bits of the 16 bit threshold.	N/A
0x8d (141)	13	Dark Delay Timer (DDT): Set number of minutes that light must remain below threshold before 2-byte Dark output is sent	0x00
0x8e (142)	14	Bright Delay Timer (BDT): Set number of minutes that light must remain above threshold before 2-byte Bright output is sent	0x00
0x8f (143)	15	Tracking Occ Sensor (TOS): Specify address of Occupancy Sensor to track (prevents controlling lights if area is unoccupied). Must be enabled (see 0x88). See Occ Sensor info in Section 6.	N/A
0x90 (144)	16	2-byte Dark output, byte 1 (DO1): First byte of 2-byte command sent when light level is dark	N/A

0x91 (145)	17	2-byte Dark output, byte 2 (DO2): Second byte of 2-byte command sent when light level is dark	N/A
0x92 (146)	18	2-byte Bright output, byte 1 (BO1): First byte of 2-byte command sent when light level is dark	N/A
0x93 (147)	19	2-byte Bright output, byte 2 (DO2): Second byte of 2-byte command sent when light level is bright	N/A
0x94 (148)	20	Level Repeat Interval (LRI): Set number of minutes between 3-byte light level broadcasts. Zero indicates no repeat will occur (broadcast will happen on change only)	0x00

## 5.5 OPEN LOOP DAYLIGHT CONTROLLER BROADCAST MESSAGES

### 5.5.1 TWO-BYTE COMMANDS

The OLDC can be configured to send control information to other devices in two ways. First, it can directly control ballasts when enabled and appropriate 2-byte ballast commands are programmed into the controller. The 2-byte command that is sent is fully programmable (see table 7.1 above), and could correspond to a ballast command to turn a group off when unoccupied, for example. The 2-byte commands can repeat automatically at the rate specified in the DRI and BRI bytes shown above in table 7.1.

### 5.5.2 THREE-BYTE COMMANDS

It is also possible to broadcast a 3-byte command to other devices using sensor addressing. Such a command does not impact ballast light output directly (the ballasts ignore 3-byte commands), but another control device on the same bus can receive this information and react accordingly. This information can be sent once, on change only, or repeated automatically at the rate specified in the SRI byte shown above in table 7.1.

In the case of the 3-byte command, the controller short address is placed in the address field (see the CA parameter in Table 5.1 from NS 243-2004, Part 1-2004), with an offset of 0x40 to indicate the message is controller originated (the address byte will then range in value from 0x40 to 0x7f for controllers 0 to 63). The command field specifies the type of data being sent; and in the case of the OLDC, the command field is set to a value of **0x03**, which indicates an OLDC value is being sent. The value, contained in the 3<sup>rd</sup> byte of the message, is set per table 7.2 below:

**Table 7.2**  
**THREE-BYTE OPEN LOOP DAYLIGHT CONTROLLER VALUE BROADCAST MESSAGES**

Address Byte	Command Byte	Data Byte	Description
0x40 to 0x7f	<b>0x03</b>	0x00	Daylight Controller Value (DCV)= Level Beneath Dark Threshold
	<b>0x03</b>	0x01	Daylight Controller Value (DCV)= Level Between Dark and Bright Threshold
	<b>0x03</b>	0x02	Occupancy Sensor Value (OSV)= Level above Bright Threshold

### 5.5.3 CURRENT LIGHT LEVEL MESSAGES

Additionally, two messages which indicate the current light level can also be sent (always sent in pairs, low byte first). The controller short address is placed in the address field (see the CA parameter in Table 5.1 from NS 243-2004, Part 1-2004), with an offset of 0x40 to indicate the message is controller originated (the address byte will then range in value from 0x40 to 0x7f for controllers 0 to 63). The command field specifies the type of data being sent; and in the case of the OLDC Light Level, the

command field is set to a value of 0x04 (low byte) and 0x05 (high byte). The value, contained in the 3<sup>rd</sup> byte of the message, is set per Table 7.3 below:

**Table 7.3  
THREE-BYTE OLDC LIGHT LEVEL BROADCAST MESSAGES**

Address Byte	Command Byte	Data Byte	Description
0x40 to 0x7f	0x04	0x??	OLDC Light Level byte 1 (LL1)= Light Level (Low byte)
	0x05	0x??	OLDC Light Level byte 2 (LL2)= Light Level (High byte)

### 5.6 OPEN LOOP DAYLIGHT CONTROLLER MESSAGES

In addition to the Common Control Commands detailed in table 5.3 of NS 243-2004, Part 1-2004, some OLDC Specific commands exist that are used to program or query the device. These commands are shown in table 7.4 below. (Note, the Query Data command, a generic command, is repeated here for completeness.)

**Table 7.4  
OPEN LOOP DAYLIGHT CONTROLLER MESSAGES**

Command		Purpose	Comments
Dec	Hex		
0	0x00	Query Data	Used to read data specified by the 3 <sup>rd</sup> byte (See table 7.1 for byte # and details). Note, PBRW must be set to the appropriate parameter bank before the read command is issued
128	0x80	Set Parameter Bank Read/Write (PBRW)	Used to select which bank to read from or write to. Note, this does not change the operating bank!
129	0x81	Set Parameter Bank Operate (PBO)	Used to select which parameter bank the controller is operating from.
130	0x82	Set Dark Repeat Interval (DRI)	Sets the DRI field in the Parameter Bank specified by PBRW (see Table 7.1)
131	0x83	Set Bright Repeat Interval (BRI)	Sets the BRI field in the Parameter Bank specified by PBRW (see Table 7.1)
132	0x84	Set Sensor Repeat Interval (SRI)	Sets the SRI field in the Parameter Bank specified by PBRW (see Table 7.1)
133	0x85	Set Sensor Scale (SS)	Sets the SS field in the Parameter Bank specified by PBRW (see Table 7.1)

134	0x86	Set Sensor Output Enable (SOE)	Sets the SOE field in the Parameter Bank specified by PBRW (see Table 7.1)
135	0x87	Set Dark Threshold byte 1 (DT1)	Sets the DT1 field in the Parameter Bank specified by PBRW (see Table 7.1)
136	0x88	Set Dark Threshold byte 2 (DT2)	Sets the DT2 field in the Parameter Bank specified by PBRW (see Table 7.1)
137	0x89	Set Bright Threshold byte 1 (BT1)	Sets the BT1 field in the Parameter Bank specified by PBRW (see Table 7.1)
138	0x8a	Set Bright Threshold byte 2 (BT2)	Sets the BT2 field in the Parameter Bank specified by PBRW (see Table 7.1)
139	0x8b	Set Dark Delay Timer (DDT)	Sets the DDT field in the Parameter Bank specified by PBRW (see Table 7.1)
140	0x8c	Set Bright Delay Timer (BDT)	Sets the BDT field in the Parameter Bank specified by PBRW (see Table 7.1)
141	0x8d	Set Tracking Occ Sensor (TOS)	Sets the TOS field in the Parameter Bank specified by PBRW (see Table 7.1)
142	0x8e	Set 2-byte Dark output, byte 1 (DO1)	Sets the DO1 field in the Parameter Bank specified by PBRW (see Table 7.1)
143	0x8f	Set 2-byte Dark output, byte 2 (DO2)	Sets the DO2 field in the Parameter Bank specified by PBRW (see Table 7.1)
144	0x90	Set 2-byte Bright output, byte 1 (BO1)	Sets the BO1 field in the Parameter Bank specified by PBRW (see Table 7.1)
145	0x91	Set 2-byte Bright output, byte 2 (BO2)	Sets the BO2 field in the Parameter Bank specified by PBRW (see Table 7.1)
146	0x92	Set Level Repeat Interval (LRI)	Sets the LRI field in the Parameter Bank specified by PBRW (see Table 7.1)

## **Section 6**

### **CLOSED LOOP DAYLIGHT CONTROLLER**

#### **6.1 GENERAL**

To be determined.

#### **6.2 SPECIFIC COMMANDS**

To be determined.

## **Section 7 SCHEDULER**

### **7.1 GENERAL**

To be determined.

### **7.2 SPECIFIC COMMANDS**

To be determined.

## **Section 8 GATEWAY**

### **8.1 GENERAL**

To be determined.

### **8.2 SPECIFIC COMMANDS**

To be determined.

## **Section 9 SEQUENCER**

### **9.1 GENERAL**

To be determined.

### **9.2 SPECIFIC COMMANDS**

To be determined.

## **Section 10 POWER SUPPLY**

### **10.1 GENERAL**

To be determined.

### **10.2 SPECIFIC COMMANDS**

To be determined.

## **Section 11**

### **EMERGENCY LIGHTING CONTROLLER**

#### **11.1 GENERAL**

To be determined.

#### **11.2 SPECIFIC COMMANDS**

To be determined.