
# UPB
# US2-40 Series
# Quad Rocker Wall Switch with Dimmer
# Firmware Specification

**V 1.3**

**5/13/05**

# Revision History

| Spec. Rev. | Date | Firmware Rev. | Description |
|---|---|---|---|
| 1.1 | 4/19/05 | V1.00 | Adapted from US1/2 spec v1.9. Changes: Add ability to hear TX packets, Remove Rocker Action Table, Remove Local Connect & Last Level features, Add Rocker Transmit Options Register, Make Tx Comp. table contiguous, new Product ID, automatic shutdown when load triac overheats |
| 1.2 | 5/1/05 | V1.02 | Defined product ID, moved Tx Cmd Table & Tx Comp. Table |
| 1.3 | 5/13/05 | V1.07 | Add support for add/delete link commands |

# Table of Contents

# 1. The Quad Rocker Wall Switch Dimmer

The Quad Rocker Wall Switch Dimmer scalable firmware shall be utilized in the US2-40 series of wall mounted switches containing one dimmer and single, double, triple, or quad rocker switches. The switches maybe configured as pushbuttons with toggling functionality for US2-40 pushbutton devices. Any rocker or pushbutton may control the local load. The local load maybe included in scenes defined by any/all local rockers. The US2-40 device shall have three separate ways that can be employed to control its local dimmer: 1) rocker#1, 2) remote slave switch (associated with rocker#1), and 3) Universal Powerline Bus™ (UPB) Commands. Rocker#1 or Pushbutton#1 maybe configured to control the dimmer, or detached from the dimmer allowing independent dimmer control by a remote UPB controller. The US2-40 device shall contain a single bi-color LED to indicate status, modes, and events.

## 1.1. Light Dimmer

The US2-40 device shall have Light Dimmer logic capable of producing 200 different levels of light output as well as off. The Light Dimmer can be configured (or commanded) to change light levels immediately (“Snap”) as well as gradually (“Fade”).

## 1.2. Switches

The US2-40 device may have rocker switches, pushbutton switches, or a combination of both.

### 1.2.1. Rocker Switches

The US2-40 device may have decora-style rockers. The US2-40 firmware shall be configurable such that one to four rockers maybe present. The rockers shall be used to set new light levels, set new operating modes, and to trigger transmission of UPB messages.

### 1.2.2. Push Button Switches

The US2-40 device may have decora-style pushbuttons. The US2-40 firmware shall be configurable such that one to eight push buttons maybe present. The push buttons shall be used to set new light levels, set new operating modes, and to trigger transmission of UPB messages.

## 1.3. UPB Receiver

The US2-40 device has UPB Receiver Logic capable of receiving UPB Communication Packets from the powerline.

## 1.4. UPB Transmitter

The US2-40 device has UPB Transmitter Logic capable of transmitting UPB Communication Packets onto the powerline.

## 1.5. UPB Core Logic

The US2-40 firmware conforms to the UPB System Model as defined in the UPB System Description document. The US2-40 firmware has UPB Core Logic capable of responding to the UPB Core Command Message Set as described in the UPB System Description document.

## 1.6. LED Indicator

The US2-40 device shall have a bi-color LED indicator used to indicate its current status and mode of operation.

## 1.7. Slave Switch

The US2-40 device shall have a special input (wire) for connecting an optional Slave Switch. The Slave Switch is wired to local rocker #1 and will perform similiarly.

## 1.8. US2-40 device Connections

The US2-40 device **shall** have four wires that are used to connect it to power, load, and an optional slave switch. Figure 1 shows how the US2-40 devices connect to the lighting system.

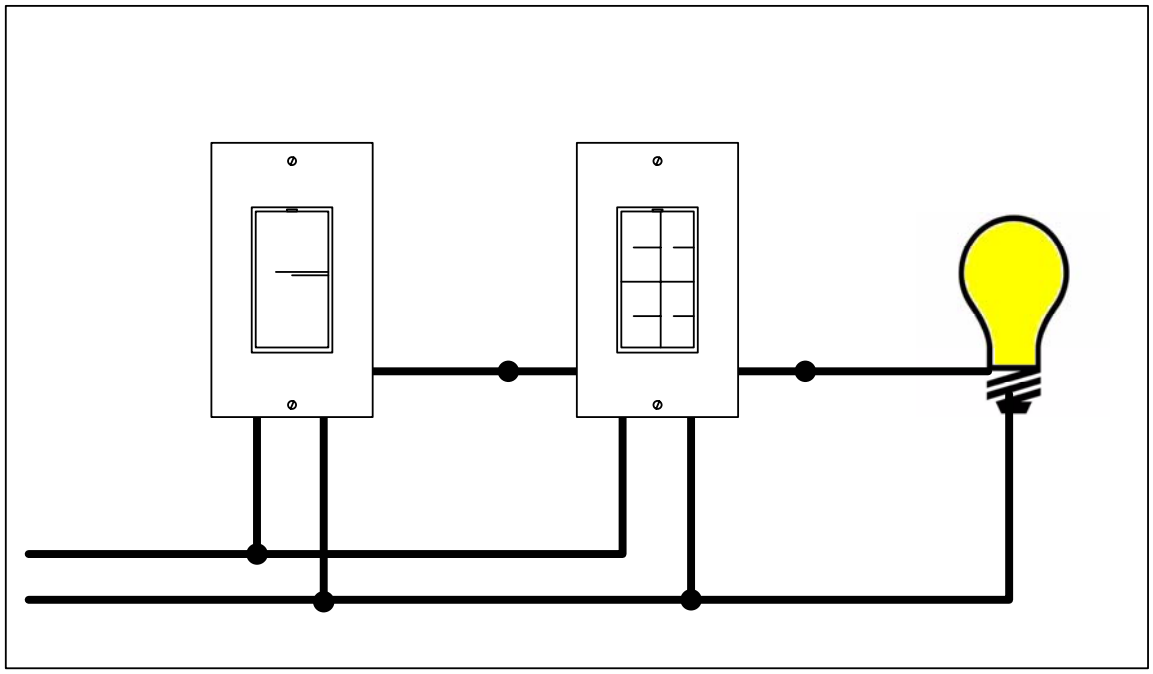

Figure 1 - US2-40 device connections to a lighting system

## 2. Modes Of Operation

The US2-40 device **shall** be capable of being put into any of three different modes of operation: Normal Mode, SETUP Mode, and Factory Default Mode.

## 2.1. Normal Mode

The US2-40 device **shall** be able to operate in the Normal Mode. The Normal Mode is the US2-40 device's default mode of operation. While in the Normal Mode the US2-40 device **shall** be able to perform all of its normal operations except that Setup Register Write Protection is enabled. While in the Normal Mode, the LED indicator **shall** indicate this mode of operation as defined in section 7.1.4 " Special Mode LED Indications".

## 2.2. SETUP Mode

The US2-40 device **shall** be able to operate in the SETUP Mode. The SETUP Mode is a special mode of operation that every UPB device that conforms to the UPB System Model must have. The UPB System Description document describes the SETUP Mode in more detail. The US2-40 device **shall** be able to enter into the SETUP Mode by two different methods. One is by receiving a valid "Start SETUP Mode" command message over the powerline as described in the UPB System Description document. The other method is by having its Rocker Switch (or Slave Switch) depressed in a special sequence as described in section 5.8.1 - "Entering SETUP Mode". While in the SETUP Mode, the LED indicator **shall** indicate this mode of operation as defined in section 7.1.4 " Special Mode LED Indications".

## 2.3. Factory Default Mode

The US2-40 device **shall** be able to operate in the Factory Default Mode. The Factory Default Mode is a special mode of operation that, when entered, sets the Setup Registers to their Factory Default values as defined in Table 1 and Table 2. The US2-40 device **shall** be able to enter into the Factory Default Mode as described in section 5.8.3 - "Entering Factory Default Mode". While in the Factory Default Mode, the LED indicator **shall** indicate this mode of operation as defined in section 7.1.4 " Special Mode LED Indications".

## 3. UPB Setup Registers

Like all UPB devices that conform to the UPB System Model, the US2-40 device **shall** have a set of non-volatile 8-bit registers known as UPB Setup Registers. The US2-40 device **shall** have a total of 256 UPB Setup Registers. These registers are used to define and configure how the US2-40 device will operate as well as to store other important information as described herein. The US2-40 device **shall** allow read/write access to its UPB Setup Registers via special UPB Messages communicated on the powerline. The US2-40 device's Setup Registers are partitioned into three main groups (the UPBID, the Configuration Registers, and the Scratch-Pad Registers) as described below.

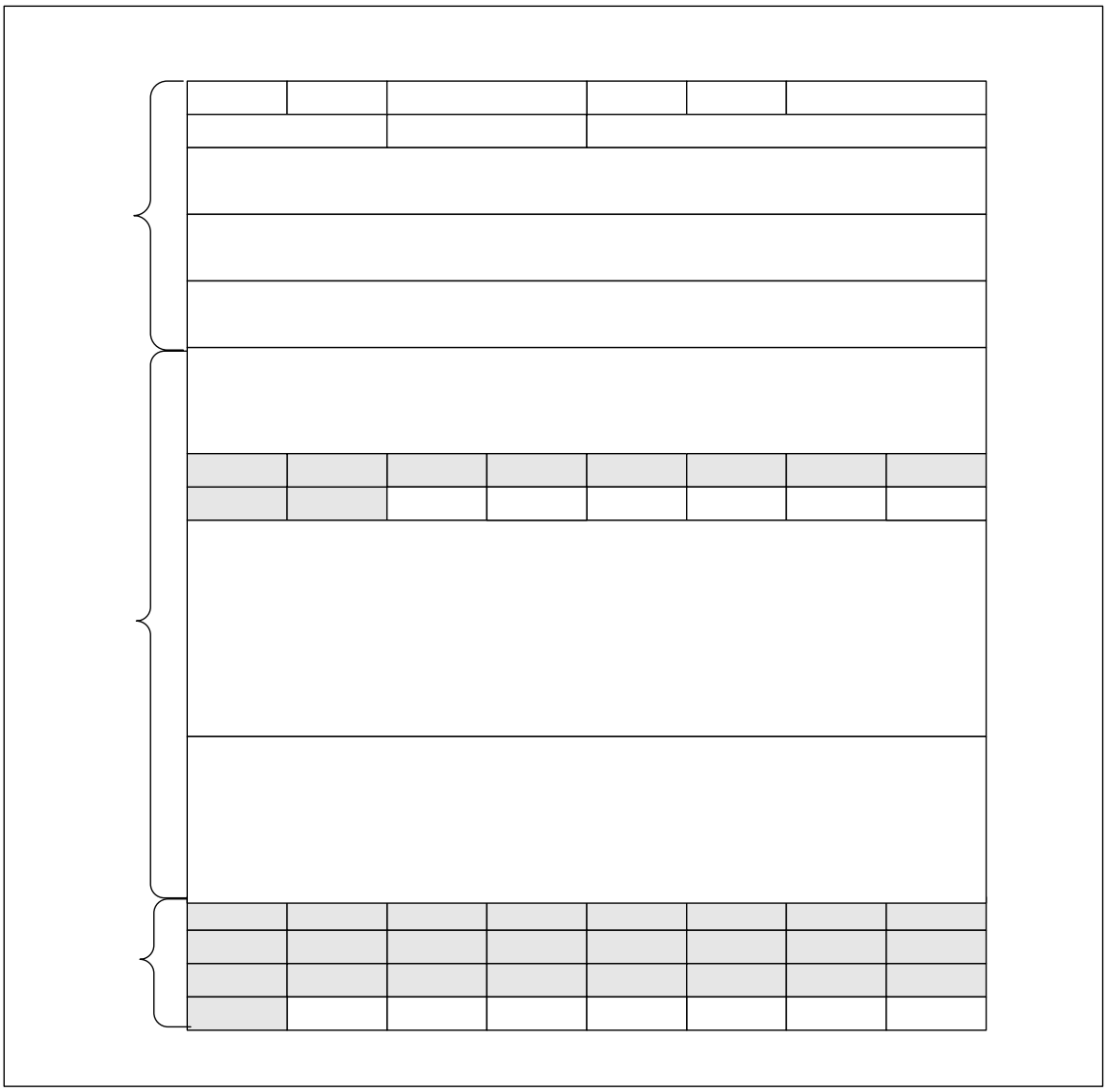

Figure 2 - UPB Setup Registers

## 3.1. The UPBID

The UPBID is a set of 64 non-volatile registers that contains information that uniquely identifies the individual UPB device. The US2-40 device **shall** implement the UPBID in the first 64 Setup Registers. Table 1 below describes the Setup Registers that make up the UPBID. The table describes each register's use as well as its factory default value. The UPB System Description document contains more detailed information about the UPBID.

| Setup Register Field Name | Reg. Num. | Factory Default | Description |
|---|---|---|---|
| Network ID (NID) | 0x00 | 255 (0xFF) | Unique identifier (1 – 255) for the UPB Network that this device communicates on. |
| Unit ID (UID) | 0x01 | 22 (0x16) | Unique identifier (1 – 255) for this UPB device. |
| Network Password (NPW) | 0x02 – 0x03 | 4660 (0x1234) | Password designed to keep unauthorized users from modifying the Setup Registers of this device. |
| UPB Options (UPBOP) | 0x04 | 00 (0x00) | Identifies UPB Options that are enabled for this device. |
| UPB Version (UPBVER) | 0x05 | 01 (0x01) | Identifies the version of the UPB specification this device conforms to. |
| Manufacturer ID (MID) | 0x06 – 0x07 | 04 (0x0004) SA | Unique identifier of the manufacturer of this UPB device. |
| Product ID (PID) | 0x08 – 0x09 | 29 (0x1D) US2-40 device | The manufacturer's unique product identifier for this UPB device. |
| Firmware Version (FWVER) | 0x0A – 0x0B | Depends on the current F/W | Identifies the version of firmware in this device. |
| Serial Number (SERNUM) | 0x0C – 0x0F | Set by the manufacturer | The manufacturer's unique serial number for this UPB device. |
| Network Name (NNAME) | 0x10 – 0x1F | "New Network Name" | A human readable (ASCII) name for the UPB Network that this device communicates on. |
| Room Name (RNAME) | 0x20 – 0x2F | "New Room Name " | A human readable (ASCII) name for the Room that this UPB device is installed in. |

| Setup Register Field Name | Reg. Num. | Factory Default | Description |
|---|---|---|---|
| Device Name (DNAME) | 0x30 – 0x3F | “New US2-40” | A human readable (ASCII) name for this UPB device. |

Table 1 - The US2-40 device’s UPBID

## 3.2. The Configuration Registers

The Configuration Registers are a set of non-volatile registers that configure how a device will operate. The US2-40 device **shall** implement the Configuration Registers in the next 128 Setup Registers. The definition of the Configuration Registers is application dependent. Table 2 describes the Configuration Registers for the US2-40 device application. The table describes each register’s use as well as its factory default value.

| Setup Register Field Name | Reg. Num. | Factory Default | Description |
|---|---|---|---|
| Receive Component Table | 0x40 – 0x6F | See Table 13 for factory defaults | Configuration table containing 16 Receive Component Records used for receiving UPB Link Packets. |
| Unused | 0x70-0x89 | 0xFF | Unused |
| Rocker Transmit Options | 0x8A | 0xFC | Enables rockers to transmit UPB, Default:Rocker#1=NO, Rocker#2-#4=YES |
| LED Options | 0x8B | 0x09 | Configurable options for the Status LED. |
| Rocker Config | 0x8C | 0xFF | Selects 1-8 button inputs |
| Dimmer Options | 0x8D | 0x83 | Configurable options for the light dimmer circuit. |
| UPB Tx Control | 0x8E | 0x84 | Configurable options for UPB Transmissions. |
| Rocker Options | 0x8F | 0x0F | Determines Rocker Action and defines variant type |
| Transmit Component Table | 0x90 – 0xB7 | See Table 15 for factory defaults | Configuration table containing Transmit Component Records used for transmitting UPB Link Packets. |

| Setup Register Field Name | Reg. Num. | Factory Default | Description |
|---|---|---|---|
| Transmit Command Table | 0xC0 – 0xEC | See Table 16 for factory defaults | Table for 16 Command IDs (CmdIds) with the 3-byte UPB Command Messages they represent. |
| | | | |

Table 2 - Configuration Registers

## 3.3. The Scratch-Pad Registers

The Scratch-Pad Registers are a set of non-volatile registers that the application can use for any purpose. Table 3 describes the Scratch-Pad Registers for the Wall Switch Dimmer. The table describes each register's location and use. Note: there are no factory default values for these registers.

| Setup Register Field Name | Reg. Num. | Description |
|---|---|---|
| Unused | 0xEA – 0xF8 | 255 (0xFF) |
| Reset Light Level | 0xF9 | Location to store the last Light Level before power-down. |
| Setup Mode Counter | 0xFA | Count of number of times this device went into Setup Mode. |
| WERR Counter | 0xFB | Count of number of times this device had a EEPROM Write Error. |
| POR Counter | 0xFC | Count of number of times this device had a Power-On Reset. |
| BOR Counter | 0xFD | Count of number of times this device had a Brown-Out Reset. |
| WDT Counter | 0xFE | Count of number of times this device had a Watchdog Timer Reset. |
| MCLR Counter | 0xFF | Count of number of times this device had a Master Clear Reset. |

Table 3 - Scratch-Pad Registers

# 4. Light Dimmer Operations

## 4.1. Light Levels

The US2-40 device dimmer output **shall** be capable of creating any of 200 distinct Light Levels (1 – 200) as well as OFF (0). Light Level #0 corresponds to 0% (OFF) and Light Level #200 corresponds to 100% (MAX). When the US2-40 device sets its Light Level to a new value, it can either do it immediately, called a "Snap", or it can do it gradually over time, called a "Fade". The US2-40 device can be configured (or commanded) to use one of sixteen possible Fade Rates in setting its new Light Level (see Section 4.1.3).

### 4.1.1. Pseudo-Logarithmic Dimming Curve

The US2-40 device **shall** implement a pseudo-logarithmic dimming curve for creating smooth lighting transitions between its 200 Light Levels.

### 4.1.2. The Reset Light Level

Approximately once every 2 seconds the US2-40 device **shall** save its current Light Level (in %) into non-volatile memory as the Reset Light Level. When the US2-40 device first powers up, it **shall** restore its current Light Level (%) to the saved Reset Light Level value.

### 4.1.3. The Last On Level

Approximately once every 2 seconds the US2-40 device **shall** save its current non-zero Light Level (in %) into non-volatile memory as the Last On Level. Whenever the US2-40 device is configured (or commanded) to go to a Light Level above 100% it **shall** use the Last On Level instead. The Last On Level shall be reset to 100% whenever the dimmer is driven to 100%.

## 4.2. Fade Rates

Whenever the US2-40 device sets its Light Level to a new value, it can either do it immediately, called a Snap, or it can do it a little bit at a time, called a Fade. The US2-40 device **shall** be able to be configured or commanded to use one of sixteen possible Fade Rates (including Snap) in setting its new Light Level as described in Table 4 below.

| Fade Rate | Fade Time (0% – 100%) | Time Per Step |
|---|---|---|
| 0 | Snap! | 0 |
| 1 | 0.8 seconds | 4.167mS |
| 2 | 1.6 seconds | 8.333 mS |
| 3 | 3.3 seconds | 16.67mS |
| 4 | 5 seconds | 25mS |
| 5 | 6.6 seconds | 33.3 mS |
| 6 | 10 seconds | 50 mS |
| 7 | 20 seconds | 100 mS |
| 8 | 30 seconds | 150 mS |
| 9 | 1 minute | 300 mS |
| 10 | 2 minutes | 600 mS |
| 11 | 5 minutes | 1.5 seconds |
| 12 | 10 minutes | 3 seconds |
| 13 | 15 minutes | 4.5 seconds |
| 14 | 0.5 hours | 9 seconds |
| 15 | 1.0 hour | 18 seconds |

Table 4 - Dimmer Fade Rates

## 4.3. Dimmer Options Register

The US2-40 device **shall** have an 8-bit Dimmer Options Register implemented at address 0x8D of its non-volatile Setup Registers. The Dimmer Options Register (Figure 3) has bits and fields that are used to customize the dimmer operation using a UPB Setup Tool.

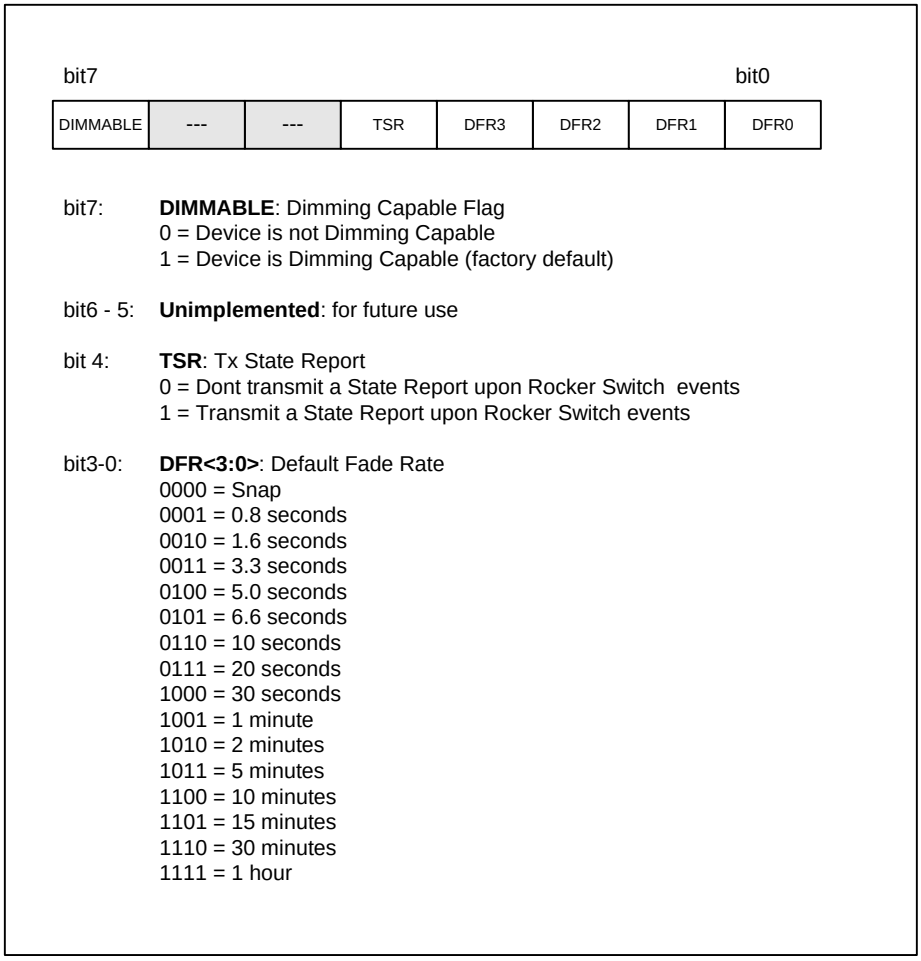


Figure 3 - Dimmer Options Register

### 4.3.1. The Dimming Capable Flag

The US2-40 device **shall** have a 1-bit Dimming Capable Flag implemented as part of its Dimmer Options Setup Register (Figure 3). When this flag is set to 1 (factory default state), the US2-40 device **shall** allow full 200 level light dimming capabilities. When this flag is cleared to 0, the US2-40 device **shall** only allow On (100%) and Off (0%) capabilities.

### 4.3.2. The Default Fade Rate

The US2-40 device **shall** have a 4-bit Default Fade Rate implemented as part of its Dimmer Options Register (Figure 3). Whenever the US2-40 device is commanded to use the “default fade rate” it **shall** use the value in the Default Fade Rate field of the Dimmer Options Register. Also, whenever the US2-40 device is commanded or configured to use a Fade Rate value above 15 it **shall** use the value in the Default Fade Rate field instead.

# 5. Local Rocker Switch Operations

The US2-40 device has a decora-style Rocker Switch that is used to control the lighting load, transmit UPB Messages, and to put the US2-40 device into special modes of operation. The Rocker Switch consists of eight momentary pushbutton switches: two pushbuttons for each of the four rockers.

## 5.1. Rocker Control of Local Load

Any of the four rockers or single pushbuttons may control the local load. This is accomplished by adding a common link between the Transmit Component Table and the Receive Component Table.

## 5.2. Rocker Transmission of Add/Delete Link Command

Rockers that are configured to transmit a link shall have the ability to transmit add/delete link commands. These functions allow the US2-40 to add and remove its transmit links in other UPB device receive component tables. The add link function may be used to set the US2-40 light level for the local load.

### 5.2.1. Adding A Link

It is very useful to command another device, such as a UML, to add the Link ID assigned to one of the rockers to its Receive Component Table. When a rocker's Transmit Component and another device's Receive Component have the same Link ID they are "linked" together. The pushbutton can now send commands to the other device to control it.

Whenever a rocker is pressed seven times quickly in a row the US2-40 **shall** transmit the command sequence to add that rocker's Transmit Link ID to any device that is in Setup Mode as described in Table 5.

| Cmd | Packet | DID | MDID | ARG1 | ARG2 | Description |
|---|---|---|---|---|---|---|
| 1 | Direct | 254 | 0B | LID | - | Add Link #LID |
| 2 | Link | LID | 31 | NPWH | NPWL | Store Preset |
| 3 | Direct | 254 | 04 | - | - | Exit Setup Mode |

Table 5: The Add Link Command Sequence

Note that the Add Link command sequence also includes a "Store Preset" command. This means that any device with a Receive Component Link ID that matches #LID will store its current Light Level or State. This means that pressing a rocker seven times quickly in a row will cause the US2-40 to transmit a command to have all devices linked to that rocker store their current Light Levels.

### 5.2.2. Deleting A Link

Whenever a rocker is pressed eight times quickly in a row the US2-40 **shall** transmit the command sequence to delete that rocker's Transmit Link ID out of any device that is in Setup Mode as described in Table 6 below.

| Cmd | Packet | DID | MDID | ARG1 | ARG2 | Description |
|---|---|---|---|---|---|---|
| 1 | Direct | 254 | 0C | LID | - | Delete Link #LID |
| 2 | Direct | 254 | 04 | - | - | Exit Setup Mode |

Table 6: The Delete Link Command Sequence

## 5.3. Rocker Transmit Options Register

The Rocker Transmit Options Register is a non-volatile register (location 0x8A) that determines whether a rocker/button shall transmit UPB. A rocker/button that is set not to transmit UPB may control the local load if the transmit link exists in the receive component table. If a rocker/button has its transmit link defined as 255, UPB will not be transmitted even if its Rocker Transmit Options bit is set. Link 255 is reserved to define a link as “Unused”.

| Bit | Name | Default | Description |
|---|---|---|---|
| 0 | Upper Rocker#1 | 0 | 0=No UPB transmit, 1=UPB transmit |
| 1 | Lower Rocker#1 | 0 | 0=No UPB transmit, 1=UPB transmit |
| 2 | Upper Rocker#2 | 1 | 0=No UPB transmit, 1=UPB transmit |
| 3 | Lower Rocker#2 | 1 | 0=No UPB transmit, 1=UPB transmit |
| 4 | Upper Rocker#3 | 1 | 0=No UPB transmit, 1=UPB transmit |
| 5 | Lower Rocker#3 | 1 | 0=No UPB transmit, 1=UPB transmit |
| 6 | Upper Rocker#4 | 1 | 0=No UPB transmit, 1=UPB transmit |
| 7 | Lower Rocker#4 | 1 | 0=No UPB transmit, 1=UPB transmit |

Table 7 – Rocker Transmit Options Register

## 5.4. Rocker Options Register

The Rocker Options Register is a non-volatile register (location 0x8F) that determines local control of the local dimmer and enables the Last Level feature.

| Bit | Name | Description |
|---|---|---|
| 7 | Not used | |
| 6 | Not used | |
| 5 | Tall Rocker | 0 = all other variants<br>1 = tall rockers installed on US2-40 body |
| 4 | Add/Delete Link | 0=disabled, 1=enabled |
| 3 - 0 | Variant Selection | Selects US2-40 model variant |

Table 8 – Rocker Options Register

### 5.4.1. Tall Rocker

This option allows single and double tall rockers to reside on the US2-40 body. When set, this option maps buttons 4 and 8 to buttons 2 and 6, respectively.

### 5.4.2. Variant Selection

The lower nibble of the Rocker Options Register is defines the variant field. The variant field is solely for use of UPB setup tool to identify the configuration of the US2-40 device. The US2-40 firmware does not use the variant value to configure the device. When model variant is set to 15, the UPB setup tool declares the device unknown (or new). The Rocker Configuration register and Transmit Component Table values actually configure the device to determine how many rockers/pushbuttons are active and whether they function as pushbuttons (toggle function) or rockers.

| Variant (RockerOptions LSB) | Model | Description |
|---|---|---|
| 0 | US24-40 | Half Height Quad Rocker |
| 1 | US22S-40 | Half Height Dual Rocker |
| 2 | US23-40 | Half Height Tripler Rocker |
| 3 | Not used | |
| 4 | Not used | |
| 5 | Not used | |
| 6 | Not used | |
| 7 | Not used | |
| 8 | Not used | |
| 9 | Not used | |
| 10 | US21-40 | Full Height Single Rocker |
| 11 | US22T-40 | Full Height Dual Rocker |
| 12 | US25-40 | Single Rocker, Four Pushbuttons |
| 13 | US26-40 | Dual Rocker, Four Pushbuttons |
| 14 | US28-40 | Eight Pushbuttons |
| 15 | Model undefined | Default |

Table 9 – Rocker Options Variant field definitions

### 5.4.3. Variant Pushbutton Layout

Variants shall have a variety of rocker and pushbutton layouts. Figure 1 maps switches (as defined in firmware) to rocker and pushbutton numbering of current US2-40 models.

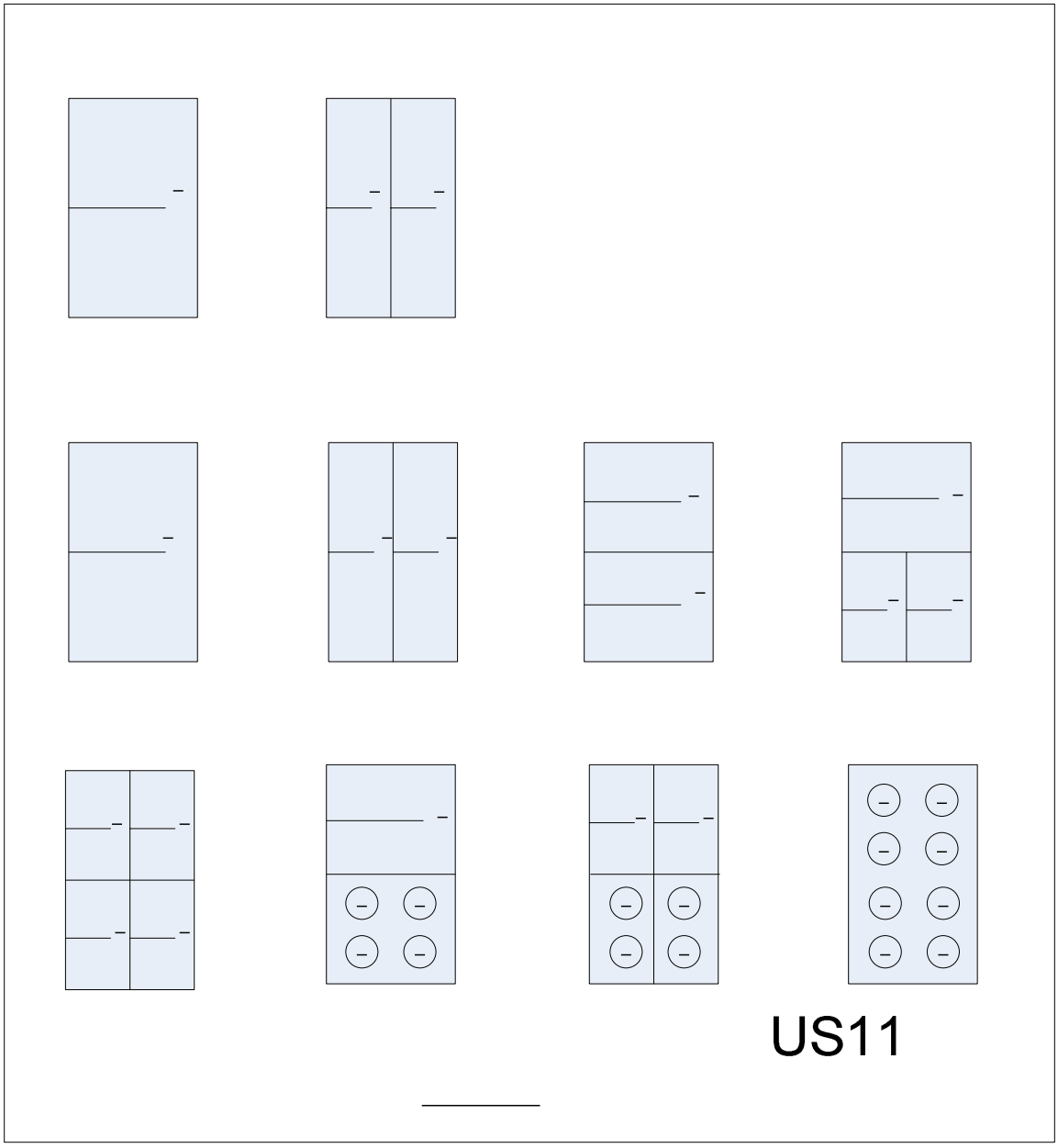


Figure 4 – Variant Switch Mapping

## 5.5. Rocker Configuration Register

The Rocker Configuration Register is a non-volatile register (location 0x8C) that specifies the number of active rockers as an eight bit mask. The default value of the Rocker Configuration Register shall be 0xFF declaring a four rocker device.

| Value | Description |
|---|---|
| 00000001 | Rocker #1, upper rocker active |
| 00000010 | Rocker #1, lower rocker active |
| 00000011 | Rocker #1 active |
| 00001111 | Rocker#1,#2 active |
| 00111111 | Rocker#1,#2,#3 active |
| 11111111 | Rocker#1,#2,#3,#4 active |

Table 10 – Rocker Configuration Register Setup Examples

## 5.6. Rocker Switch Events

The US2-40 device **shall** be capable of detecting any of the four types of Rocker Switch Events defined in Table 11 below on both of its Rocker Switches.

| Rocker Event | Definition |
|---|---|
| Single-Tap | The switch is pressed for at least 250 mS and then released before 750 mS and left released. |
| Multi-Tap (Double-Tap) | The switch is pressed for at least 250 mS and then released and pressed again before 750 mS and then released before 750 mS and left released. |
| Hold | The switch is pressed for at least 750 mS without being released. |
| Release | The switch was released after a Hold event. |

Table 11 - Rocker Switch Events

## 5.7. Rocker Switch Transmit Control

The US2-40 device can optionally be configured to transmit UPB Messages when any of the Rocker Switch Events listed in Table 11 occurs. Refer to section 5.1 for details on how to configure the US2-40 device for Rocker Switch Transmissions.

## 5.8. Rocker Switch Mode Control

The Rocker Switch **shall** be able to be used to put the US2-40 device into different modes of operation. The US2-40 device has three different modes of operation (Normal Mode, SETUP Mode, and Factory Default Mode) as defined in section 2.

### 5.8.1. Entering SETUP Mode

The US2-40 device **shall** enter SETUP Mode when any Rocker Switch is multi-tapped for exactly 5 times. When the US2-40 device enters the SETUP Mode it **shall** indicate so by flashing its dimmer's lighting load on and off and by blinking its LED as defined in section 7.1.4.

### 5.8.2. Exiting SETUP Mode

Once in the SETUP Mode, the US2-40 device **shall** exit SETUP Mode and enter the Normal Mode when any Rocker Switch is multi-tapped for exactly 2 times. When the US2-40 device exits the SETUP Mode it will indicate so by flashing its dimmer's lighting load on and off and by stopping the blinking of its LED as defined in section 7.1.4.

### 5.8.3. Entering Factory Default Mode

Once in the SETUP Mode, the US2-40 device **shall** exit SETUP Mode and enter the Factory Default Mode when any Rocker Switch is multi-tapped for exactly 10 times. When the US2-40 device enters the Factory Default Mode it will indicate so by flashing its dimmer's lighting load on and off and by blinking its LED as defined in section 7.1.4.

### 5.8.4. Exiting Factory Default Mode

Once in the Factory Default Mode, the US2-40 device **shall** exit Factory Defaults Mode and enter the Normal Mode when any Rocker Switch is multi-tapped for exactly 2 times. When the US2-40 device exits the SETUP Mode it will indicate so by flashing its dimmer's lighting load on and off and by stopping the blinking of its LED as defined in section 7.1.4.

## 6. Slave Rocker Switch Operations

The US2-40 device **shall** be capable of being connected to an optional Slave which can be used to control the US2-40 device in a similar fashion to the US2-40 device's own local Rocker Switch.

### 6.1. Slave Switch Connections

Figure 5 shows how the Slave Switch is connected to the US2-40 device.

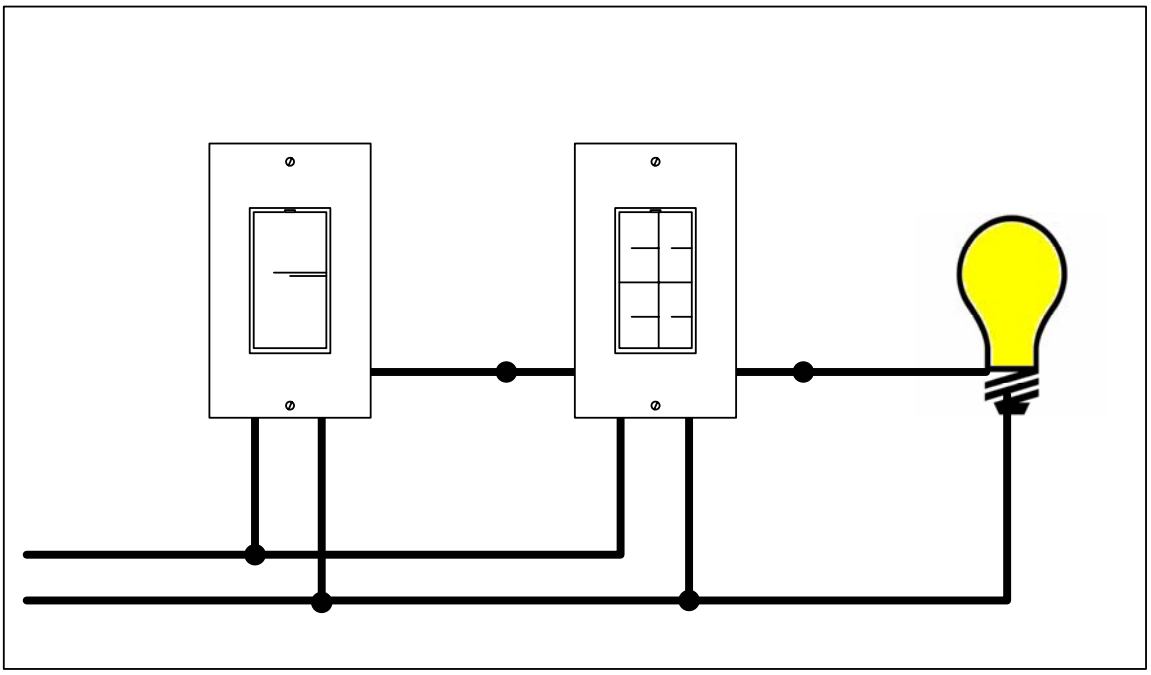

Figure 5 - Connecting A Slave Switch

### 6.2. Slave Switch Events

The US2-40 device **shall** be able to detect the slave switch events as if it were rocker#1. Slave Switch Events will be transmitted as rocker#1 events as defined in Table 11.

### 6.3. Slave Switch Load Control

The Slave Switch should be considered an extension of rocker#1. When rocker#1 is configured to control the local dimmer so shall the Slave Switch.

### 6.4. Slave Switch Transmit Control

The Slave Switch should be considered an extension of rocker#1. When rocker#1 is configured to transmit UPB commands, so shall the Slave Switch.

Slave S
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## 6.5. Slave Switch Mode Control

The Slave Switch is capable of initiating Mode Control operations just as the four local rockers.

# 7. Status LED Operation

The US2-40 device has a single bi-color Light Emitting Diode (LED) that it uses to indicate its current status. The Status LED is configured by the settings in the LED Options Register as defined in Table 12.

## 7.1. The LED Options Register

The US2-40 device shall have an 8-bit LED Options Register implemented at address 0x8B of its non-volatile Setup Registers. The LED Options Register (Table 12) has bits and fields that are used to customize the Status LED operation using a UPB Setup Tool.

| Bit | Name | Description |
|---|---|---|
| 7 | LED Mode | 0 = Load Indicator LED enabled<br>1 = Diagnostic LED enabled |
| 4-6 | Unused | Unused |
| 3 - 2 | Load On Color | 00 = Black (off)<br>01 = Red<br>10 = Green<br>11 = Orange |
| 1 - 0 | Load Off Color | 00 = Black (off)<br>01 = Red<br>10 = Green<br>11 = Orange |

Table 12 - LED Options Register

### 7.1.1. LED Mode Selection

Bit #7 of the LED Options Register is used to select between two different LED Modes: The Load Indicator LED Mode or the Diagnostic LED Mode. If bit #7 is clear (0) then the US2-40 device **shall** operate the Status LED in the Load Indicator LED Mode as described in Section 7.1.2. If bit #7 is set (1) then the US2-40 device **shall** operate the Status LED in the Diagnostic LED Mode as described in Section 7.1.3.

### 7.1.2. The Load Indicator LED Mode

If the Load Indicator LED Mode is enabled, the US2-40 device shall turn the Status LED to a color based on the on/off state of the dimmer output. If the dimmer output is set to 0% (off) the US2-40 device **shall** set the Status LED to the color specified by the Load Off Color bits (1 and 0) of the LED Options

Register as defined in Table 12. If the dimmer output is set above 0% the US2-40 device **shall** set the Status LED to the color specified by the Load On Color bits (3 and 2) of the LED Options Register as defined in Table 12.

### 7.1.3. The Diagnostic LED Mode

If the Diagnostic LED Mode is enabled, the US2-40 device **shall** turn the Status LED solid orange. Whenever the US2-40 device transmits a UPB message, it **shall** indicate so by blinking the status LED red. Whenever the US2-40 device receives a valid UPB message, it **shall** indicate so by blinking the status LED green. Whenever the US2-40 device receives an invalid UPB message, it **shall** indicate so by blinking the status LED black (off).

### 7.1.4. Special Mode LED Indications

The US2-40 device has two special modes that it can be put into: SETUP Mode and Factory Default Mode. When the US2-40 device is in SETUP Mode it **shall** indicate so by blinking its status LED alternately between green and black (off). When the US2-40 device is in Factory Default Mode it **shall** indicate so by blinking its status LED alternately between red and black (off). When the US2-40 device is in Normal Mode it **shall** indicate so by stopping the blinking and turning its status LED to solid orange.

### 7.1.5. Firmware Version LED Indication

When power is first applied, the US2-40 device **shall** use the status LED to indicate the version of the firmware it is running. It **shall** do this by blinking the LED four times. Each blink will either be red or green. The four blinks **shall** be such as to indicate the binary value that matches the least significant digit of the firmware version. A blink of red **shall** indicate a binary “zero” and a blink of green **shall** indicate a binary “one”. As an example, if the firmware version is 4.15, then the LED will indicate the binary value for 5, which is 0-1-0-1. The US2-40 device will therefore blink its LED four times upon power-up: red-green-red-green.

## 8. UPB Message Reception

The US2-40 device **shall** be capable of receiving UPB messages from the powerline.

### 8.1. Receive Components

The US2-40 device uses the concept of Receive Components (as described in the UPB System Description document) to configure its UPB Link Packet receiving behavior. The US2-40 device **shall** have sixteen 3-byte Receive Components implemented in its non-volatile Configuration Registers as shown in Table 13. All sixteen Receive Components (referred to as Presets) are associated with the dimmer's single light dimmer output. Each Receive Component **shall** have an associated Link ID byte that is used when receiving UPB Link Packets. Each Receive Component **shall** also have an associated byte for holding a Light Level and Fade Rate for use in processing the "Activate" and "Deactivate" commands (see section 0 for details).

| Setup Register Field Name | Register Numbers | Factory Default Values | | |
|---|---|---|---|---|
| | | Link ID | Light Level | Fade Rate |
| Preset #1 | 0x40 – 0x42 | 001 | 100 | 255 |
| Preset #2 | 0x43 – 0x45 | 255 | 255 | 255 |
| Preset #3 | 0x46 – 0x48 | 255 | 255 | 255 |
| Preset #4 | 0x49 – 0x4B | 255 | 255 | 255 |
| Preset #5 | 0x4C – 0x4E | 255 | 255 | 255 |
| Preset #6 | 0x4F – 0x51 | 255 | 255 | 255 |
| Preset #7 | 0x52 – 0x54 | 255 | 255 | 255 |
| Preset #8 | 0x55 – 0x57 | 255 | 255 | 255 |
| Preset #9 | 0x58 – 0x5A | 255 | 255 | 255 |
| Preset #10 | 0x5B – 0x5D | 255 | 255 | 255 |
| Preset #11 | 0x5E – 0x60 | 255 | 255 | 255 |
| Preset #12 | 0x61 – 0x63 | 255 | 255 | 255 |
| Preset #13 | 0x64 – 0x66 | 255 | 255 | 255 |
| Preset #14 | 0x67 – 0x69 | 255 | 255 | 255 |
| Preset #15 | 0x6A – 0x6C | 255 | 255 | 255 |
| Preset #16 | 0x6D – 0x6F | 241 | 100 | 255 |

Table 13 - Receive Component Table

### 8.1.1. Receiving UPB Link Packets

Whenever the US2-40 device receives a UPB Link Packet it will attempt to match its Destination ID to one of the valid Link IDs of its sixteen Receive Components. If a match is not found then that Link Packet is not for this US2-40 device and it **shall** be ignored. If a match is found then the US2-40 device **shall** accept the Link Packet for further processing. The particular Receive Component that had the Link ID match is "linked" to this Link Packet.

### 8.1.2. Activating/Deactivating Receive Components

The US2-40 device **shall** handle the special UPB Link Packet commands of "Activate" and "Deactivate". When the US2-40 device accepts the "Activate" command it **shall** set its dimmer's output using the Light Level and Fade Rate parameters of the "linked" Receive Component. When the US2-40 device accepts the "Deactivate" command it **shall** set its dimmer's output to 0% using the Fade Rate parameter of the "linked" Receive Component.

### 8.1.3. Changing Preset Light Levels and Fade Rates

The Receive Components Light Level and Fade Rate parameters can be changed (configured) with the use of a UPB Setup Tool. In addition, the US2-40 device **shall** handle the special UPB Link Packet command of "Store Preset". When the US2-40 device accepts the "Store Preset" command it **shall** store its current Light Level (%) into the "linked" Receive Component (Preset).

## 8.2. Receiving The Core Command Message Set

The US2-40 device **shall** be capable of handling received UPB Messages from the UPB Core Command Message Set as described in the UPB System Description document.

## 8.3. Receiving The Device Control Command Set

Besides handling the UPB Core Commands, the US2-40 device **shall** also handle the following set of UPB Commands from the UPB Device Control Command Set (see Table 14).

| MDID (Hex) | Command Name | Command Description |
|---|---|---|
| 0x20 | Activate | Commands the US2-40 device to “activate” its linked Receive Component’s (Preset) Light Level and Fade Rate. |
| 0x21 | Deactivate | Commands the US2-40 device to “deactivate” its linked Receive Component’s (Preset) Light Level and Fade Rate. |
| 0x22 | Goto | Commands the US2-40 device to set its dimmer output to the specified Light Level at the specified Fade Rate. |
| 0x23 | Fade Start | Commands the US2-40 device to set its dimmer output to the specified Light Level at the specified Fade Rate as long as the Dimming Option bit is set to 1 (i.e. Dimming-Capable). |
| 0x24 | Fade Stop | Commands the US2-40 device to stop fading and stay at the current Light Level. |
| 0x25 | Blink | Commands the US2-40 device to blink its dimmer output from 0% to 100% at the specified Blink Rate. |
| 0x30 | Report State | Commands the US2-40 device to send back a Device State Report containing the current dimmer Light Level (%). |
| 0x31 | Store Preset | Commands the US2-40 device to store its current dimmer Light Level (%) value as its linked Receive Component’s (Preset) new Light Level. |

Table 14 - US2-40 device UPB Device Control Commands

## 8.4. The “Activate” Command

When the US2-40 device receives and accepts an “Activate” Command message (MDID = 0x20) in a UPB Link Packet it **shall** set its Dimmer’s light level to the Light Level value of the linked Receive Component (Preset) using the Fade Rate of the linked Receive Component (Preset).

## 8.5. The “Deactivate” Command

When the US2-40 device receives and accepts a “Deactivate Link” Command message (MDID = 0x21) in a UPB Link Packet it **shall** set its Dimmer’s light level to 0% (OFF) using the Fade Rate of the linked Receive Component (Preset).

## 8.6. The “Goto” Command

When the US2-40 device receives and accepts a “Goto” Command message (MDID = 0x22) in a UPB Link Packet or a UPB Direct Packet it **shall** start its Light Dimmer fading its light level towards the specified Light Level using the specified Fade Rate. If no Fade Rate is specified in the command then the US2-40 device **shall** use its Default Fade Rate instead.

## 8.7. The “Fade Start” Command

When the US2-40 device receives and accepts a “Fade Start” Command message (MDID = 0x23) in a UPB Link Packet or a UPB Direct Packet it **shall** start its Light Dimmer fading its light level towards the specified Light Level using the specified Fade Rate. If no Fade Rate is specified in the command then the US2-40 device **shall** use its Default Fade Rate instead. This command **shall** be ignored if the Dimming Capable Flag in the Dimmer Options Register is set to 0 (not dimming capable).

## 8.8. The “Fade Stop” Command

When the US2-40 device receives and accepts a “Fade Stop” Command message (MDID = 0x24) in a UPB Link Packet or a UPB Direct Packet it **shall** stop its Light Dimmer from fading its light level any farther.

## 8.9. The “Blink” Command

When the US2-40 device receives and accepts a “Blink” Command message (MDID = 0x25) in a UPB Link Packet or a UPB Direct Packet it **shall** alternate its light level between 100% and 0% at the specified Blink Rate. The US2-40 device **shall** calculate the time between blinking as:

*Time between blinking = 16.667mS * Blink Rate value*

If no Blink Rate value is specified in the command then the US2-40 device **shall** use a default Blink Rate value of 30 (0.5 seconds) instead.

## 8.10. The “Store Preset” Command

When the US2-40 device receives and accepts a “Store Preset” Command message (MDID = 0x31) in a UPB Link Packet it **shall** store its current Light Level value into the linked Preset Component.

## 8.11. The “Report Status” Command

When the US2-40 device receives and accepts a “Report Status” Command message (MDID = 0x30) in a UPB Direct Packet it **shall** build and transmit a Device State Report message.

The “Device State” Report has a Message Data ID of **0x86** and has the following syntax:

| MDID | Arg1 |
|---|---|
| 0x86 | LL |

Where LL is the current Light Level % (0x00 – 0x64) of the US2-40 device dimmer.

# 9. UPB Message Transmission

The US2-40 device **shall** be capable of transmitting UPB messages from the powerline.

## 9.1. Transmit Components

The US2-40 device uses the concept of Transmit Components (as described in the UPB System Description document) to configure its UPB Link Packet transmission behavior. The US2-40 device **shall** have eight 5-byte Transmit Components implemented in its non-volatile Configuration Registers as shown in Table 134. The eight Transmit Components are associated with the eight rocker buttons. Each Transmit Component **shall** have an associated Link ID byte that is used when transmitting UPB Link Packets. Each Transmit Component **shall** have associated command bytes for rocker events; one-tap, two-tap, hold, and release.

## 9.2. Rocker Triggered UPB Transmissions

The rocker switches on the US2-40 device maybe programmed to trigger transmission of configured UPB Messages to other UPB devices. The US2-40 device can be configured to transmit UPB Messages whenever any of the defined Rocker Events occur.

## 9.3. Transmit Components Table

The US2-40 device uses the concept of Transmit Components (as described in the UPB System Description document) for programming its configurable 1-4 rockers for UPB Transmissions. The US2-40 device has ten Transmit Components for each rocker pair. See Figure 3.

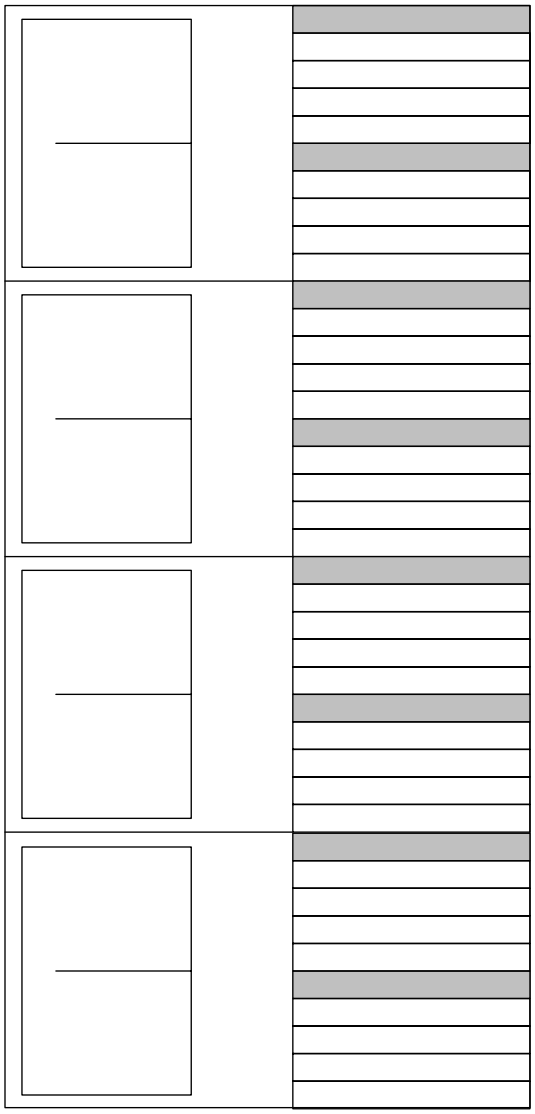

Figure 3 – Transmit Component Table

| Setup Register Field Name | EE Address | Factory Default Values of Rocker Events | | | | |
|---|---|---|---|---|---|---|
| | | Link ID | 1-Tap | 2-Tap | Hold | Release |
| Upper Rocker#1 | 0x90 – 0x94 | 0xF1 | ACTIVATE (0x66) | SNAP_ON (0x88) | FADE_UP (0x33) | FADE_STOP (0x44) |
| Lower Rocker#1 | 0x95 – 0x99 | 0xF1 | DEACTIVATE (0x55) | SNAP_OFF (0x77) | FADE_DOWN (0x22) | FADE_STOP (0x44) |
| Upper Rocker#2 | 0x9A – 0x9E | 0x01 | ACTIVATE (0x66) | SNAP_ON (0x88) | FADE_UP (0x33) | FADE_STOP (0x44) |
| Lower Rocker#2 | 0x9F – 0xA3 | 0x01 | DEACTIVATE (0x55) | SNAP_OFF (0x77) | FADE_DOWN (0x22) | FADE_STOP (0x44) |
| Upper Rocker#3 | 0xA4 – 0xA8 | 0x0A | ACTIVATE (0x66) | SNAP_ON (0x88) | FADE_UP (0x33) | FADE_STOP (0x44) |
| Lower Rocker#3 | 0xA9 – 0xAD | 0x0A | DEACTIVATE (0x55) | SNAP_OFF (0x77) | FADE_DOWN (0x22) | FADE_STOP (0x44) |
| Upper Rocker#4 | 0xAE – 0xB2 | 0x0B | ACTIVATE (0x66) | SNAP_ON (0x88) | FADE_UP (0x33) | FADE_STOP (0x44) |
| Lower Rocker#4 | 0xB3 – 0xB7 | 0x0B | DEACTIVATE (0x55) | SNAP_OFF (0x77) | FADE_DOWN (0x22) | FADE_STOP (0x44) |

Table 15 - Transmit Component Table

The US2-40 device **shall** implement Transmit Components in its non-volatile EE Configuration Registers as a 40-byte (8 x 5) Transmit Component Tables.

## 9.4. The Transmit Link ID

Each Transmit Component Record **shall** start with a 1-byte Link ID field. Each Transmit Component (Button) can either be assigned a Valid Link ID (from 1 to 254) or an Invalid Link ID (255). If it is assigned an Invalid Link ID then no Rocker Transmissions **shall** take place. If it is assigned a Valid Link ID, however, then it **shall** use that Link ID in the Destination ID field of any Rocker Switch Transmissions.

### 9.4.1. The Transmit Command IDs

Each Transmit Component record **shall** have four additional bytes that can be assigned a 4-bit Command IDs. There **shall** be a Transmit Command ID byte corresponding to each of the four defined Rocker Events: Single-Tap, Double-Tap, Hold, and Release.

## 9.5. Using Command IDs

The 4-bit Command ID that gets selected **shall** be used by the US2-40 device to determine what UPB Message to build and transmit. If the Command ID value is 15 then no UPB Message **shall** be built or transmitted. If the Command ID value is between 0 and 14 then the US2-40 device **shall** use the Command ID as an

index into the UPB Transmit Command Table to look-up a three-byte command message to be built and transmitted.

## 9.6. The UPB Transmit Command Table

The US2-40 device **shall** implement a UPB Transmit Command Table in its non-volatile Setup Registers that allows for the customization of up to fifteen 3-byte UPB Messages. Table 16 shows the UPB Transmit Command Table for the US2-40 device along with its factory default values. Each three-byte record corresponds to a Command ID value (0 – 14). The US2-40 device **shall** use the UPB Transmit Command Table to look-up the three-byte UPB Message to build and transmit onto the UPB bus for the selected Command ID. The UPB Transmit Command Table can be changed with the use of a UPB Setup Tool so that other custom commands can be formed.

| Setup Register Field Name | Reg. Num. | Cmd ID | Factory Default | Command Name |
|---|---|---|---|---|
| Tx Command #0 | 0xC0 – 0xC2 | 0 | 22 00 FF | Goto Off |
| Tx Command #1 | 0xC3 – 0xC5 | 1 | 22 64 FF | Goto On |
| Tx Command #2 | 0xC6 – 0xC8 | 2 | 23 00 FF | Fade Down |
| Tx Command #3 | 0xC9 – 0xCB | 3 | 23 64 FF | Fade Up |
| Tx Command #4 | 0xCC – 0xCE | 4 | 24 FF FF | Fade Stop |
| Tx Command #5 | 0xCF – 0xD1 | 5 | 21 FF FF | Deactivate |
| Tx Command #6 | 0xD2 – 0xD4 | 6 | 20 FF FF | Activate |
| Tx Command #7 | 0xD5 – 0xD7 | 7 | 22 00 00 | Snap Off |
| Tx Command #8 | 0xD8 – 0xDA | 8 | 22 64 00 | Snap On |
| Tx Command #9 | 0xDB – 0xDD | 9 | 22 00 01 | Quick Off |
| Tx Command #10 | 0xDE – 0xE0 | 10 | 22 64 01 | Quick On |
| Tx Command #11 | 0xE1 – 0xE3 | 11 | 22 00 08 | Slow Off |
| Tx Command #12 | 0xE4 – 0xE6 | 12 | 22 64 08 | Slow On |
| Tx Command #13 | 0xE7 – 0xE9 | 13 | 25 1E FF | Blink |
| Tx Command #14 | 0xEA – 0xEC | 14 | 00 FF FF | Null Command |

Table 16 - Transmit Command Table

## 9.7. The UPB Transmit Control Register

The US2-40 **shall** have an 8-bit UPB Transmit Control Register implemented in its non-volatile Setup Registers that allows for the further customization of its UPB transmissions. Figure 6 shows the UPB Transmit Control Register and explains the meanings of its various bits and fields. The UPB Transmit Control Register can be changed with the use of a UPB Setup Tool so that the UPB transmit behavior of the WMC8 can be customized.

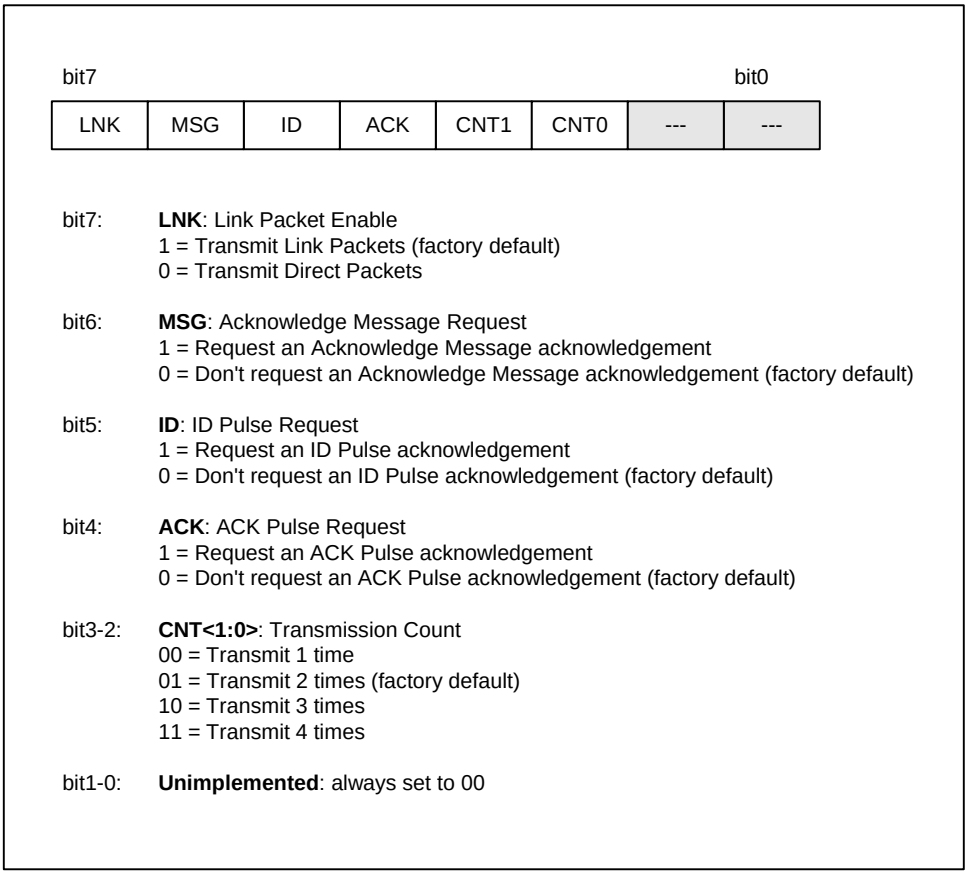


Figure 6: The UPB Transmit Control Register

### 9.7.1. Link Packet Enable

Bit #7 of the UPB Transmit Control Register is used to configure whether Rocker Triggered Transmissions are sent in Link Packets or Direct Packets. If this bit is set to '0' the US2-40 **shall** build and transmit all Rocker Triggered Transmissions with the LNK-bit cleared in its Control Word (Direct Packet). If this bit is set to '1' the US2-40 **shall** build and transmit all Rocker Triggered Transmissions with the LNK-bit set in its Control Word (Link Packet).

### 9.7.2. Acknowledge Message Request

Bit #6 of the UPB Transmit Control Register is used to configure whether an Acknowledge Message is requested from the receiver of any Rocker Triggered Transmissions. If this bit is set to '1' the US2-40 **shall** build and transmit all Rocker Triggered Transmissions with the MSG-bit set in its Control Word.

### 9.7.3. ID Pulse Request

Bit #5 of the UPB Transmit Control Register is used to configure whether an ID Pulse is requested from the receiver of any Rocker Triggered Transmissions. If this bit is set to '1' the US2-40 **shall** build and transmit all Rocker Triggered Transmissions with the ID-bit set in its Control Word.

### 9.7.4. ACK Pulse Request

Bit #4 of the UPB Transmit Control Register is used to configure whether an ACK Pulse is requested from the receiver of any Rocker Triggered Transmissions. If this bit is set to '1' the US2-40 **shall** build and transmit all Rocker Triggered Transmissions with the ACK-bit set in its Control Word.

### 9.7.5. Transmission Count

Bit #3 and #2 of the UPB Transmit Control Register are used to configure how many times to transmit a message in a row for each Rocker Triggered Transmission event. If this field is set to 00 the US2-40 **shall** transmit any Rocker Triggered Transmission one time only. If this field is set to 01 or 10 or 11 the US2-40 **shall** transmit any Rocker Triggered Transmission two times or three times or four times respectively.

# 10. Automatic State Report Transmissions

Besides controlling the US2-40 device's light level and modes of operation, the two Rocker Switches can be configured to trigger transmissions of State Reports whenever they are single-tapped, double-tapped, or released. These Automatic State Reports are perfect for letting home automation controllers know when someone has altered a light level via a rocker switch action.

## 10.1. Enabling Automatic State Reports

Automatic State Report Transmissions are enabled by setting bit#4 of the Dimmer Options Register (Figure 3). If Automatic State Report Transmissions are enabled the US2-40 device **shall** build and transmit a State Report message whenever a Rocker Switch is single-tapped, double-tapped, held or released.

## 10.2. Transmitting Automatic State Reports

The Automatic State Report Transmissions **shall** always be sent in a Link Packet. The Automatic State Report Transmissions **shall** always be directed to the same Network ID as the US2-40 device is assigned to. The Automatic State Report Transmissions **shall** always be directed to the Broadcast Destination ID (0x00).

The Data field of the Automatic State Report Transmissions **shall** contain a "Device State" Report. The "Device State" Report has a Message Data ID of **0x86** and has the following syntax:

| MDID | Arg1 |
|---|---|
| 0x86 | LL |

Where LL is the current Light Level % (0x00 – 0x64) of the US2-40 device dimmer.

# 11. Factory Default Operation

This section describes the operation of the US2-40 device with its factory default settings enabled. These settings will be enabled “right out of the box” or whenever Factory Default Mode is enabled as described in section 5.8.3.

## 11.1. Power-Up Operation

Upon power-up the US2-40 device will enter Normal Mode and will display its current firmware version by blinking its LED four times as described in section 7.1.5. It will then read the saved Reset Light Level from non-volatile memory and set its dimmer’s light level to the Reset Light Level at the Default Fade Rate (3.3 seconds). The US2-40 device will set its LED color to orange and await further events such as Local Rocker Switch Events, Slave Rocker Switch Events, or UPB Communication Packet Receptions.

## 11.2. Dimmer Operation

The US2-40 device factory default is for dimming-capable whereby its dimmer can produce 200 different light levels as well as off that it fades between using a pseudo-logarithmic dimming curve. The US2-40 device factory default value for its Default Fade Rate is 3. With this value, the US2-40 device will span the lighting range from 0% to 100% in approximately 3.3 seconds. The Default Fade Rate is used whenever the specified Fade Rate is an illegal value (above 15).

### 11.2.1. Dimmer Overload Shutdown

The US2-40 shall have the ability to automatically shutdown if an excessive load is applied. The firmware shall monitor a thermistor indicating triac temperature. When the thermistor indicates triac temperature above 210 degrees the firmware shall turn off the triac and maintain the triac in the off state until the temperature returns to a safe level.

## 11.3. Local Rocker Switch Events

The Local Rocker Switch can be used to change the US2-40 device dimmer’s light level as described in Table 17.

| Rocker Event | Dimmer Action (Top Rocker) | Dimmer Action (Bottom Rocker) |
|---|---|---|
| Single-Tap | Fade to 100% at the Default Fade Rate. | Fade to 0% at the Default Fade Rate. |
| Double-Tap | Snap to 100% at Fade Rate #0. | Snap to 0% at Fade Rate #0. |
| Hold | Start fading to 100% at the Default Fade Rate. | Start fading to 0% at the Default Fade Rate. |
| Release | Stop fading the Light Level. | Stop fading the Light Level. |

Table 17 - Local Rocker Switch Dimmer Actions

The Local Rocker Switch can also be used to put the US2-40 device into Setup Mode and Factory Default Mode as described in section 5.8

## 11.4. Slave Rocker Switch Events

The optional Slave Rocker Switch can be used to change the US2-40 device dimmer's light level as described in Table 18.

| Rocker Event | Dimmer Action (Top Rocker) | Dimmer Action (Bottom Rocker) |
|---|---|---|
| Single-Tap | Fade to 100% at the Default Fade Rate. | Fade to 0% at the Default Fade Rate. |
| Double-Tap | Snap to 100% at Fade Rate #0. | Snap to 0% at Fade Rate #0. |
| Hold | Start fading to 100% at the Default Fade Rate. | Start fading to 0% at the Default Fade Rate. |
| Release | Stop fading the Light Level. | Stop fading the Light Level. |

Table 18 - Slave Rocker Switch Dimmer Actions

The Slave Rocker Switch can also be used to put the US2-40 device into Setup Mode and Factory Default Mode as described in section 5.8

## 11.5. UPB Communication Packet Receptions

The US2-40 device has a factory default Network ID of 255 and a factory default Unit ID of 001. It is capable of handling the UPB Core Command Message Set (as described in the UPB System Description document) for Direct Packets sent to this NID/UID. Besides handling the UPB Core Commands, the US2-40 device also handles the set of UPB Commands described in Table 14.

## 11.6. UPB Receive Components

The US2-40 device has 16 Receive Components (called Presets) that are configured for receiving Link Packets addressed to its NID. The factory default Link IDs that the US2-40 device will accept are Link IDs #1 through #16 as shown in Table 19.

| Receive Component | Link ID | Light Level | Fade Rate |
|---|---|---|---|
| Preset #1 | 001 | 100% | Default Fade Rate |
| Preset #2 | 002 | 0% | Default Fade Rate |
| Preset #3 | Unused | Unused | Unused |
| Preset #4 | Unused | Unused | Unused |
| Preset #5 | Unused | Unused | Unused |
| Preset #6 | Unused | Unused | Unused |
| Preset #7 | Unused | Unused | Unused |
| Preset #8 | Unused | Unused | Unused |
| Preset #9 | Unused | Unused | Unused |
| Preset #10 | Unused | Unused | Unused |
| Preset #11 | Unused | Unused | Unused |
| Preset #12 | Unused | Unused | Unused |
| Preset #13 | Unused | Unused | Unused |
| Preset #14 | Unused | Unused | Unused |
| Preset #15 | Unused | Unused | Unused |
| Preset #16 | 241 | 100% | Default Fade Rate |

Table 19 - Factory Default Presets

## 11.7. Activate Link Command Operation

The US2-40 device has 16 Receive Components (called Presets) that are setup for receiving Link Packets with Link IDs #1 through #16. Each Preset has a Light Level and Fade Rate parameter associated with it that will be “activated” by the Link Activate command. Whenever the US2-40 device receives a Link Activate command addressed to its NID and one of these Link IDs it will set its dimmer output to the associated Light Level at the associated Fade Rate (see Table 19).

## 11.8. Deactivate Link Command Operation

The US2-40 device has 16 Receive Components (called Presets) that are setup for receiving Link Packets with Link IDs #1 through #16. Each Preset has a Light

Level and Fade Rate parameter associated with it that will be “deactivated” by the Link Deactivate command. Whenever the US2-40 device receives a Link Deactivate command addressed to its NID and one of these Link IDs it will set its dimmer output to 0% (off) at the associated Fade Rate (see Table 19).

## 11.9. Changing Preset Light Levels

The US2-40 device has 16 Receive Components (called Presets) that are setup for receiving Link Packets with Link IDs #1 through #16. Each Preset has a Light Level and Fade Rate parameter associated with it. Whenever the US2-40 device receives a Store State command addressed to its NID and one of these Link IDs it will store its current dimmer Light Level into the associated Light Level parameter of the Preset.

## 11.10. UPB Communication Packet Transmissions

The US2-40 device will transmit UPB Communication Packets onto the powerline in response to various commands from the UPB Core Command Message Set (as described in the UPB System Description document). The US2-40 device factory default setting is for no Rocker Switch Transmissions.