

## SwitchPuck (SP) MODES

The Green Status light on the SP will blink the Mode #. To increment the mode, press the recessed SET button.

Pressing the SET button when in Mode 7 will cycle back to Mode 0.

The REMOTE column describes whether or not the Mode responds to commands over the Comm Bus.

The Restore level is set in the firmware, but it can be changed via the Comm Bus or by any ramping switch command.

Motion sensors work in Modes 3-6, and only turn lights on (to the Restore level) when the lights are completely OFF. When motion is not longer detected, the lights always turn OFF.

MODE	NAME	SWITCH	REMOTE	DESCRIPTION
0	Remote	NONE	X	Ignores all switch inputs and only responds to commands over the Comm Bus. This mode <b>replies</b> (how it differs from Mode 7) with its level.
1	Normally Open	SW		Sets output to OFF when switch input is open. Sets output to {MAX} when switch input is shorted.
2	Normally Closed	SW		Sets output to OFF when switch input is shorted. Sets output to {MAX} when switch input is open.
3	Momentary ON/OFF	M MM*	X	Toggles output between OFF and {MAX} each time the momentarily shorted input is reopened. *Top and Bottom button do the same function.
4	Momentary ON/OFF w/ Restore Level	MM	X	Two exclusive, normally open momentary buttons produce separate resistances indicating which button was pressed. UP button shorts the input. DOWN button creates a 4.7k Ohm resistance. Tap UP button to set output to Restore Level. Tap UP button again to set output to {MAX}. Tap DOWN button to turn OFF LED.
5	Momentary ON/OFF w/ Restore Level and Ramping	MM	X	Tap UP button to set output to Restore Level. Tap UP button again to set output to {MAX}. Tap DOWN button to set output to OFF. Hold UP button (>0.75 sec) to raise output (up to {MAX}). Hold DOWN button (>0.75 sec) to lower output (until OFF).
6	Momentary ON/OFF w/ Ramping	M MM*	X	Tap (<0.75 sec) to toggle between Restore Level, {MAX}, and OFF. Hold (>0.75 sec) when output is below 50% will raise output. Holding when above 50% will dim output until button is released. *Top and Bottom button do the same function.
7	Follower	NONE	X	Ignores all switch inputs and responds to level replies from Masters with the same ID. This mode <b>does not reply</b> (how it differs from Mode 0) to a level change.

SW: Typical on/off (open/closed) switch or magnetic door switch.

M: Single momentary button or push button switch.

MM: Normally open, momentary ON (top), and momentary OFF (bottom) switch.

{MAX}: Maximum LED ON value.

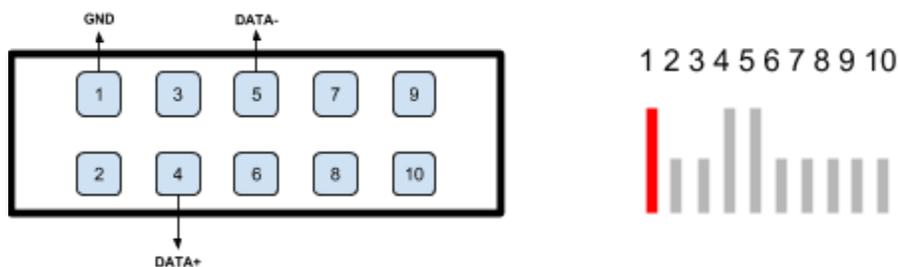
## Wiring Momentary Switch or Motion Sensor

Electrically, the SP input reads an open (>8k Ohm) as no change, a short (<100 Ohm) as the top button, and 4.7k Ohm (+/-10%) as the bottom button. These are between the S (Source) and C (Common) connections on the SIB-SE/P/K models. Connect the SIB “C” pin to the Common screw on the switch and the SIB “S” pin to the TOP screw. Connect a 4.7k Ohm resistor between the TOP and BOTTOM button screws.

Motion sensors should include a 7.5k Ohm resistor in series with the occupancy output. They can be wired in parallel with momentary switches. Multiple motion sensors in the same zone should be wired in parallel and attached to the same resistor connected to the SIB “S” terminal. Motion sensors turn on to the *resume level*.

## PDM Comm Port and Comm Bus

Use an RS232 to RS485 serial adapter to connect to the PDM Comm Bus by following the pin connections below:



When using the L-CBA, connect RJ45 pins as follows:

1 & 3 to Data +	W/ORG + W/GRN
2 & 6 to Data -	ORG + GRN
7 & 8 to GND	W/BRN + BRN

Up to 128 SwitchPucks can reside on the same Comm Bus. It is possible to extend the bus from enclosure to enclosure following common RS485 bus rules. Keep the total bus length below 1000 ft. A 120 Ohm terminating resistor is required for the adapter.

## SwitchPuck Comm Bus ID

Each SP communicates over the Comm Bus with an ID from 1..255, but they come factory set to ID0, which will keep them from talking over other SPs until their ID is intentionally set. An SP will not broadcast its configuration settings for any reason when the ID has not been set. Setting the ID allows the SP to listen to the Comm Bus for commands related to that ID, either from a control system or a Master SP. See the Comm Bus Protocol section for communications specifications.

**To read/set ID:** Press and HOLD the recessed SET button for 3 seconds then release. The current ID should blink. To set the ID *instead*, tap the ID number into the SP by pressing 1 to 255 times directly after releasing the SET button. Wait 5 seconds after the last tap to resume normal mode. The SwitchPuck *Standard Configuration Response* is sent over the Comm Bus whenever the ID is set. The control system interface driver may confirm this reply.

**To Factory Reset a SwitchPuck:** Press and HOLD the recessed SET button for 7 seconds. The Status light with blink rapidly, then remain on, indicating Mode 0.

## Follower Mode (Mode 7)

In some installations, it is desirable to have an SP that mimics a Master. This is called Follower Mode. To use Follower Mode, a Slave must have the same ID as the Master, and the Slave must be set to Mode 7. When in this

mode, a Slave listens to the Comm Bus, but never responds over it. Master SPs output a **Slave Switch Ramp To Target at Switch Ramp Rate** command in parentheses over the Comm Bus when a switch is pressed, causing all Slaves to mimic the ramp. Similarly, if a motion controller interrupts a ramp, SPs output the STOP RAMP command so that any potential slaves also stop their ramp.

## Ramping on the SwitchPuck

Switch Pucks have 4 different types of ramps: tap ramps, hold ramps, Comm Bus ramps, and scene ramps.

### Switch tap ramps

SwitchPucks have a switch ramp duration that is stored in memory, which only affects taps. A switch button tap ramp occurs when a switch button is pressed and released, but not held. For instance, in Mode 5 when a light is off and the up button is tapped, the light will ramp to the resume value over an amount of time derived from the switch ramp duration.

The switch ramp duration defines the amount of time required to ramp from 0 to 255, and is measured in 1/10th seconds. So if the switch ramp duration is 200 (20 seconds), a full ramp from 0 to 255 would take approximately 20 seconds. If a ramp were performed, however, from a value of 0 to, say, 128, the ramp would take approximately 10 seconds: the ramp occurs over half the spectrum, so the ramp would take half the time.

The default switch ramp duration is 0 (immediate, plus LED turn-on time). To set a different switch ramp duration, use the **Set Switch Ramp Duration** command. The ramping curve is applied to switch button tap ramps.

### Switch hold ramps

When a switch button is held, the LED value will ramp at a duration of 5s (unchangeable) from 0 to 255. This means that a full ramp from 0 to 255 would take 5s, and a shorter ramp will take a proportionate amount of time. This ramp is always a linear ramp.

### Comm Bus ramps

The ramp command **Ramp To Target Over Duration** contains a target LED value and a ramp duration specified in 1/10th seconds. The ramp will take the given duration to ramp from the current LED set point to the target LED value.

### Scene ramps

When restoring a scene from memory, the SP will ramp from the current LED set point to the scene's stored target LED value at the scene's stored ramp duration. The ramp duration does not overwrite the switch ramp duration. The duration is only used to restore the scene. This is applied to all scene ramps.

### Messages

Upon completion of a Comm Bus, scene, or tap ramp, the LED value is sent over the Comm Bus with a delay of (32ms \* ID) to help prevent any possible message collisions.

During long ramps (greater than 15 minutes), a periodic LED value update will be sent every 15 minutes, with a (32ms \* ID) offset to help prevent any possible message collisions, i.e. ID 3 will send a periodic update at 15m 96ms, 30m 96ms, 45m 96ms, etc.

When performing a switch hold ramp, the switch puck sends rapid LED value messages over the Comm Bus, allowing Slaves to follow in real time.

### Temporary ramp durations

Temporary ramp durations do not affect switch hold ramps. Temporary ramp durations are set using the **Set Temporary Ramp Duration** command. When this command is issued, the temporary ramp duration will **OVERRIDE** the normal duration used for the subsequently performed ramp **ONLY**.

### Scenes

SwitchPucks allow for the creation of 16 scenes which can then be restored through Comm Bus commands. Each scene is stored with an LED value and a ramp duration. When the **Restore Scene** command is issued, SwitchPucks subscribed to the scene will ramp from the current LED value to the scene's target LED value over the scene's stored duration.

The restore scene command is universal, and can only be issued to ID 254 (there does not need to be an SP with this ID). If any other ID is issued with the command, the command will be ignored. Every SwitchPuck in the system with a scene stored under the given scene number will then execute the scene restoration. Since scenes are universal, the SwitchPucks have been designed so that only a SwitchPuck with an ID of 1 will reply to the command over the Comm Bus to prevent message collisions. This means that systems that incorporate scenes **MUST have an SP of ID1!**

### SwitchPuck Comm Bus Protocol

SPs allow 2-way communication to set lighting levels, configure settings, and receive status changes from events triggered from the switch inputs. They communicate at **38400 baud, 8 bits, no parity, 1 stop bit**.

There are 3 message types indicated by the message start and stop characters below:

[ ] are used to enclose commands sent to the LumenCache system..

( ) indicate a reply from the SP that received the command.

{ } indicates a configuration string reply from the device.

SwitchPucks with an ID of 0 will not listen to the Comm Bus. See the SwitchPuck Comm Bus ID section for information on setting a SwitchPuck ID. All settings for should be set when the system is fully on-line, otherwise there is a risk that slaves will not share the same settings as their masters.

The level of an SP is the fraction (divided by 255) that the ON level will be between the MIN and MAX levels set below, with 0 being OFF, 1 being MIN and 255 being MAX. Typically MIN will be set to the lowest value at which the light turns on. *Example: Min: 40, Max: 255, Level: 1 -> Actual level 40; Min: 40, Max: 254, Level: 127 -> Actual level: 147.*

## CONFIGURATION COMMANDS:

Command	Format	Example	Reply
<b>Query Level</b> 256	[<id>,256]	[3,256]	{<id>,<level>} Example: (3,45) = "ID3 is at 45"
<b>Query Settings</b> 257	[<id>,257]	[3,257]	{<id>,<mode>,<curve>,<freq>,<min>,<max>,<restore_level>,<switch_ramp_duration>,<motion>} {4,6,1,2,25,220,180,11,1}= "ID4, Mode 6, exponential curve, 122Hz PWM, 25 MIN, 220 MAX, 180 restore level, 1.1s switch ramp duration, motion on"
<b>Query Hardware</b> 258	[<id>,258]	[3,258]	{<id>,<hw_model>,<hw_version>,<sw_version>} {4,1,2,130912}= "ID4, hardware model 1, hardware version 2, software version yymmd"

The default settings of an SP are: **{0,0,1,2,0,255,255,0,1}**

The default hardware is **{0,2,1,<sw\_version>}**

## SETUP PARAMETERS: (These are the only parameters that remain in memory after a power cycle.)

Command	Format	Examples	Reply
<b>Set Ramping Curve</b> 301 = Exponential 302 = Linear	[<id>,<30x>]	[4,301] = "ID4, exponential curve"	<i>Standard configuration response</i>
<b>Set PWM Frequency</b> 401 = 59Hz 402 = 122Hz 403 = 576Hz	[<id>,<40x>]	[1,402] = "ID1, 122Hz"	<i>Standard configuration response</i>
<b>Set Minimum LED On</b> 1000 - 1128	[<id>,<1xxx>]	[1,1043] = "ID1, MIN level to 43"	<i>Standard configuration response</i>
<b>Set Restore Level</b> 2000 - 2255	[<id>,<2xxx>]	[1,2200] = "ID1, restore level to 200"	<i>Standard configuration response</i>
<b>Set Maximum Level</b> 4000 - 4255	[<id>,<4xxx>]	[1,3220] = "ID1, MAX level to 220"	<i>Standard configuration response</i>
<b>Set Switch Ramp Duration</b> 3000 - 3255	[<id>,<3000+x>] X = 0.1 second	[1,3020] = "ID1, set ramp duration to 2 sec"	<i>Standard configuration response</i>

## LEVEL AND RAMP COMMANDS:

Command	Format	Example	Reply
<b>Set ID to LEVEL</b> 0 - 255	[<id>,<level>]	[1,0] = "ID1, off". [1,255] = "ID1, {MAX}".	(<id>,<level>)
<b>Ramp To Target Over Duration</b> 4000000 - 4255255	[<id>,<4dddlll>]  ddd = ramp duration, 000:255 in 1/10 seconds  lll = LED level, 000:255	[1,4100000] = "ID1, ramp to 000 over a duration of 100 (10s)"  [5,4150128] = "ID5, ramp to 128 over a duration of 150 (15s)"	(<id>,<4dddlll>) (<id>,<level>) - <i>Level at stop</i>  Ramps last the given ramp duration unless a <b>Temporary Ramp Duration</b> has been set. Note: There is no real-time clock in the LibRE SPs, so this is an estimated duration. <i>Standard configuration response</i>
<b>Set Temporary Ramp Duration</b> 3000000 - 3999999	[<id>,<3000000+x>] x = 0.1 second	[1,3000020] = "set ID1 ramp duration to 2 sec"	Only affects the NEXT <b>ramp to target</b> command.
<b>Stop Ramp</b> 260	[<id>,<260>]	[1,260] = "stop ramping ID1"	(<id>,<level>) - <i>Level at stop</i>
<b>Slave Switch Ramp To Target at Switch Ramp Rate - DO NOT USE</b> 5000 - 5255	(<id>,<5000+x>) x = Target	[1,5128] = "ramp to 128 at pre-defined ramp duration"	<b>This command exists so that a master puck can inform a slave puck that a button has been pressed whereby the slave puck should ramp at the switch ramp duration to the given target. This should not be used by the user.</b>

## MOTION SENSOR CONTROL:

Command	Format	Example	Reply
<b>Disable</b> 800	[<id>,<800>]	[5,800] = "ID5, disable"	<i>Standard configuration response</i>
<b>Automatic ON/OFF</b> 801	[<id>,<801>]	[1,801] = "ID1 enable fully automatic mode"	<i>Standard configuration response</i>
<b>Manual ON, Automatic OFF</b> 802	[<id>,<802>]	[1,802] = "ID1 enable manual ON, auto OFF mode"	<i>Standard configuration response</i>

**SCENES:**

Command	Format	Example	Reply
<b>Store Scene Level</b> 101000000 - 116255255	[<id>,<1ssdddlll>]  ss = scene, 01:16  ddd = ramp duration, 000:255 in 1/10 second  lll = led level, 000:255	[1,103000128] = "ID1, store scene 3 with a ramp duration of 0 (immediate), and an LED level of 128"  [3,114100255] = "ID3, Store scene 14 with a ramp duration of 100 (10 seconds), and an LED level of 255."	<b>(&lt;id&gt;,1&lt;ssdddlll&gt;)</b>
<b>Resume Scene Level</b> 601 - 616	<b>[254,&lt;6xx&gt;]</b> Each SP with a set level at this scene will resume that level.	[254,610] = "select scene 10"  There is no individual Resume Scene Level command. ID 254 MUST be used, and the command affects all pucks. Only a puck with ID1 will send a Comm Bus reply. If a reply is necessary, there <b>MUST be a puck with ID1.</b>	<b>(1,&lt;6scene&gt;)</b> <b>(1,&lt;level&gt;)</b> Example: (1,609) (1,50) - ID1 Level (if changed)
<b>Clear All Scenes</b> 700	<b>&lt;id&gt;,700]</b>	[13,700] = "ID13, clear all scenes"	<b>(&lt;id&gt;,700)</b>
<b>Clear Scene</b> 701 - 716	<b>&lt;id&gt;,&lt;7xx&gt;]</b>	[1,710] = "ID1, clear scene 10 level"	<b>(&lt;id&gt;,&lt;7scene&gt;)</b> Example: (2,710)