

Quick Start Summary:

The EGW Ethernet Gateway is a RasPi with a hardware hat that contains a power regulator, a button, three LEDs, and an RS485 transceiver with automatic bus release timeout circuit. Send serial commands out the linux comm port device and wait for a reply. 38400baud, No Parity, 8 bits, No stop bit. [Link](#) to how to use PUTTY to connect.

L2-DM “Dimming Modules” are Zone Controllers for sets of lights. They have an RS485 UART for communication, an input for a light switch button, and an output for controlling 1..64 lights connected to its control output signal. Light levels are 0-100% represented by a one byte level command of 0..255. 0=off, 1=minimum on level, 255=on 100%. Each L2-DM has an “ID” number from 0..240.

The most basic command is to control a zone level. All commands are clear text enclosed in square brackets []. Send [id,level]. So [5,255] will set zone 5 to level 255, or 100%. The L2-DM will reply with the same format message enclosed in parentheses, so the reply to above from the L2-DM is (5,255). To turn zone 5 off, send [5,0] and it will reply (5,0). If an L2-DM is responding to a physical switch event, it will simply send its present level. An L2-DM restoring its level to 210 would reply (5,210). And if someone held the up button it would send a string of updates (5,211)(5,212)(5,213)(5,215)(5,218)(5,219) etc until the user releases the button. The last level is the current setting of the output.

To query the current output level without changing it, send the command [id,256]. So if zone 6 is currently set to level 84, then the command [6,256] will reply (6,84).

Most replies will complete in under 25ms. Some response strings are longer, such as the configuration request. To ask ID 7 for its configuration, send [7,258] and the reply will look like: {7,2,3,200304.00,505136394231690C193E,5,1,2,30,220,255,0,1,0,0}. See Reply Format:A type response for the 15 parameters in the response. This reply can take up to 50ms.

Note the long string in parameter 5 is the Hardware Serial Number (Unique). When an L2-DM is supplied from the factory or reset to default, it's ID will be 0. A system full of new L2-DMs will all be ID #0 so they must be assigned IDs before they can be individually addressed using their new ID numbers. There are commands to “hail” L2-DMs with unassigned IDs (ID=0). ID 253 is a special ID used for the hail.

Host sends: [253,0] 253 is the special HAIL ID address. 0 is the ID number to hail.

An L2-DM replies: {0,2,3,200304.00,505136394231690C193E,5,1,2,30,220,255,0,1,0,0}

The HAIL command can take up to 2.5 seconds to complete. If no reply after 2.5 seconds then there are no unassigned L2-DMs with that ID. New L2-DMs are all ID #0.

Once the Hardware Serial Number is known, a command can set the ID number of that L2-DM. To assign an ID, add 100,000 to the desired ID number to be assigned, followed by the hardware serial number. Valid command range is 100001 to 100240 representing IDs 1..240. You can set an ID back to 0 using this technique as well using 100000.

Host sends: [100008,5042384E333269063716] assign ID #8 to the Hardware Serial Number

L2-DM replies: {8,2,3,200304.00,5042384E333269063716,5,1,2,30,220,255,0,1,0,0}

(this is the same reply as a 258 command response)

TCP/IP Socket Host:

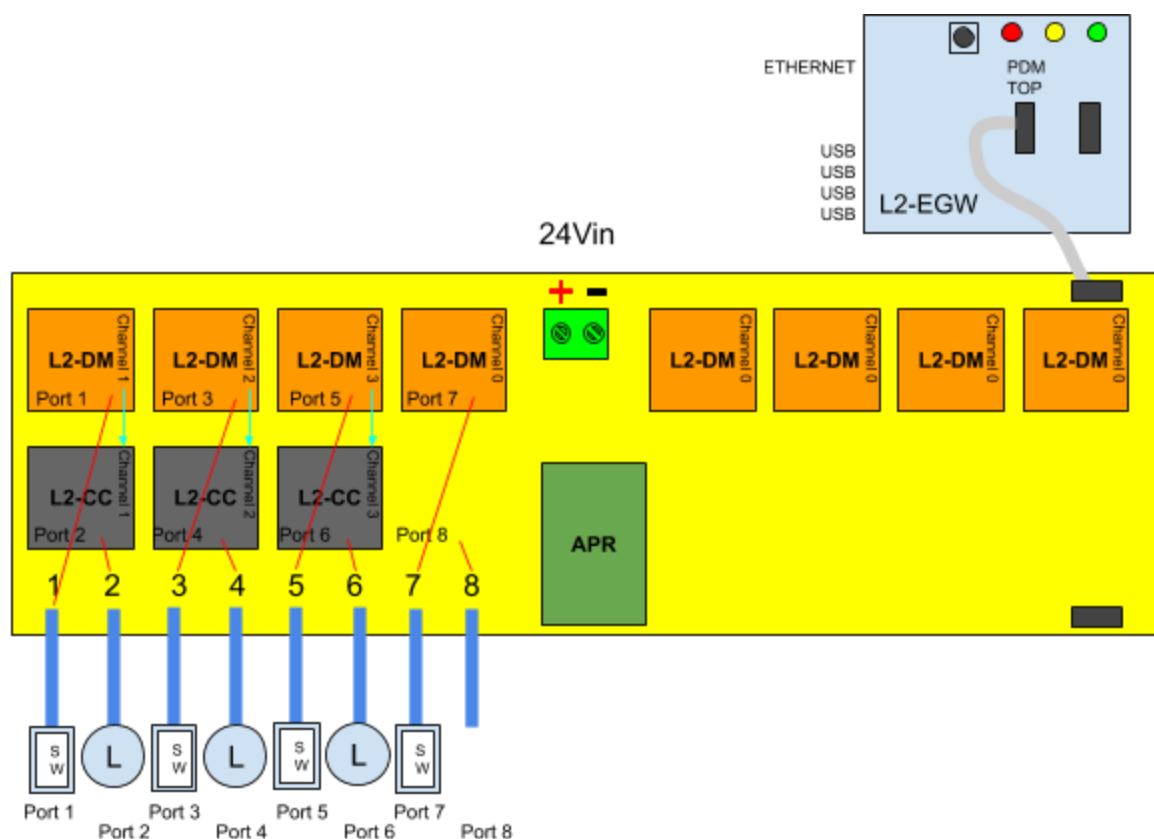
If an L2-EGW1 Ethernet Gateway is attached to the system as per the following page drawing, TCP/IP Sockets can be used to connect to the L2-EGW Host instead of connecting directly to the RS485 PDMbus.

This is sufficient to build the basic 2-way control interface to LumenCache Lighting!

Plugging in sample hardware components:

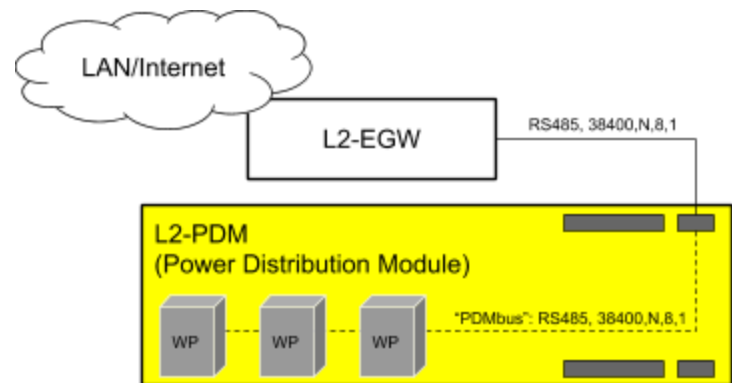
1. The L2-EGW Gateway gets 12V power from the APR in the middle of the PDM via the TOP communications port. There's no power in the bottom communication port. The middle 10-pin port on the EGW accepts power, not the one near the edge.
2. Feed the PDM Green power input connector with 24V DC with about 3A or more depending on how many lights you have connected.
3. The 16 ports at the bottom of the PDM correlate to a socket above. Plug in modules as shown for consistency or if you need support. Plug in a standard RJ45 patch cable to the devices like switches and lights. You can move a switch to other ports because all the commands are momentary so after the DM responds to the input from the switch and sets its output channel, you can move the switch and the output channel will stay as set. Multi-button keypads and touchpads are basically 2-8 buttons with 2-8 resistor values.
4. The channel jumpers bind the output signal of the L2-DM Input modules to Output modules like the L2-CC LED drivers. Drivers listening to the channel will follow the command of the L2-DM. Be sure only 1 DM is on a channel or their signals will conflict.

See Hardware Introduction here: <http://smart-e.lighting/forum/viewtopic.php?f=19&t=9937>



Introduction

LumenCache LibRE uses RS485 serial communication to control and monitor lighting Zone Control Modules (L2-DM “Dimming Module”). Lighting zones can be commanded from 0% (OFF) to 100% (ON full) using the **PDMbus** serial protocol. Up to 239 devices can communicate on the PDMbus and are addressed by their ID# (1..239).



ID#'s

ID#s can be 1..239 and should be assigned by the gateway without sequential gaps starting with ID#3. ID#1 is reserved for new or unassigned devices. ID#2 is reserved for the Gateway, leaving ID#s 3..239 for other devices. See chart below. There are situations where the same ID# may be assigned to more than one device on the PDMbus. For instance, when two L2-DM must respond to the same ID#, one is set to Mode 5 (Default) and another is set to Mode 7 “Silent Follower”. If more than one device have the same ID#, they will both receive commands from the gateway but will both transmit replies at the same time, stepping on each other resulting in garbage response. The silent follower will simply follow the commands being sent to the ID# they both share but only the other device will send replies. The device EEPROM stores the ID# so it should not be changed often as the EEPROM is rated for around 100,000 writes. It can be read an unlimited number of times.

ID	PURPOSE
0	New L2-DMs from factory.
1	New L2-FANCs from factory.
2	Gateway
3	Keypads can be assigned ID 3 via built-in setup macros. Usually only 1 per home would do this.
4	Keypads can set ID+0 and ID+1 to their buttons by setup macro, so it's best to avoid this ID
5..240	Recommended range for L2-DM IDs to be assigned by gateways
241..252	Reserved for Global Functions (System Mode Level (1=all ok, 2=meh, 3=bad, 4=whoa, 5=emerg...))
250	Devices with no IDs (only serial numbers) use this ID.
253	Hail address (deprecated)
254	Scene address (deprecated)

Hardware Serial Number

Each device has a unique 20 digit serial number. It can be used to locate devices and assign ID#s and Modes.

Communication Parameters

The PDMbus operates at 38400baud, No Parity, 8 bits, No stop bit. RS485. Only one device can talk on the bus at time. Most commands will produce a response within 200ms except the Hail Unassigned Devices command which can require up to 2.5 seconds for a reply.

Command Structure

All messages are human readable and start with a square bracket “[”, open parenthesis “(”, or open curly brace “{”. All messages end in the matching “]”, “)”, or “}”. Square brackets are used for commands. Parentheses are value replies or status replies from devices, and curly braces are configuration strings from the devices. All commands contain an ID# followed by a comma-separated list. The brace type and number of parameters can be used to determine the exact message type.

For example: A L2-DM with ID #3 can set its Output Value to 50% ON with the following command string:

Gateway sends: [3,128] *set ID# 3 to 50% (128 out of 255)*

The L2-DM will immediately reply with the new Output Value setting for L2-DM ID #3:

L2-DM replies: (3,128) *ID# 3 Output Value is at 128, or 50% ON*

Gateway sends: [3,256] *Code 256 means “send current output value” (for ID#3)*

L2-DM replies: (3,128) *ID# 3 Output Value is at 128, or 50% ON*

TCP/IP Socket Host

Authentication:

At this time, there is no authentication step.

Connection Check:

The status of the L2-EGW1 Socket connection can be confirmed by sending [WHO]. The EGW will respond with {WHO,EGW1_001200000014} where EGW1_001200000014 is the serial number of the L2-EGW1.

Configuration Request:

To gather an XML file of the zones and system configuration in the EGW, send [CFGXML]. The EGW will respond by sending xml data.

(see the <http://smart-e.lighting> forum for XML format)

Gathering device list and configurations

When a Gateway is first attached to a system, it should survey the attached L2-DMs and gather their configuration and current Output value settings. There are several commands in the protocol to support this.

All L2-DMs ship from the factory with ID #0. Requesting the current value from ID #0 in a system with several new L2-DMs attached will result in garbled reply as they all respond simultaneously to the request, because they all have the same ID of 0.

The Gateway should first request the current Output value from ID numbers 1 through 240 and set up a table containing all the ID'd L2-DMs. The L2-DM will reply within 25ms so the gateway can complete all 240 requests in under 7 seconds.

Host sends:	[2,256]	ask ID# 2 for its current Output level
L2-DM replies:	(2,0)	ID# 2 replies level is at 0
Host sends:	[3,256]	ask ID# 3 for its current Output level
L2-DM replies:	(3,128)	ID# 3 replies level is at 128
Host sends:	[4,256]	ask ID# 4 for its current Output level
L2-DM replies:	(4,0)	ID# 4 replies level is at 0
Host sends:	[5,256]	ask ID# 5 for its current Output level
(L2-DM does not reply within 25ms so there is NO ID #5)		
Host sends:	[6,256]	ask ID# 6 for its current Output level
L2-DM replies:	(6,0)	ID# 6 replies level is at 0
...etc...to ID 240		

An alternate command to the Output Value request is to gather the hardware and software attributes from each device in one step by sending the Get Config command [ID,258]. This method requires a little more time but will allow you to build the Unique Keys of the system from the unique Hardware Serial Numbers. The Scene and Keypad Button configurations are not included in this message.

Host sends:	[6,258]	258 is the command to request the full configuration from ID # 6
L2-DM replies:	{6,2,3,200304.00,505136394231690C193E,5,1,2,30,220,255,0,1,0,0}	

<i>ID</i>	6
<i>Hardware Type</i>	2
<i>Hardware Version</i>	3
<i>Firmware Version</i>	200304.00
<i>Hardware Serial Number</i>	505136394231690C193E
<i>Mode</i>	5
<i>Dimming Curve</i>	1
<i>PWM Frequency</i>	2
<i>Minimum Output PWM</i>	30
<i>Maximum Output PWM</i>	220
<i>Resume Level</i>	255
<i>Ramp Duration</i>	0
<i>Motion Sensor Enable</i>	1
<i>Mode 6 Alternate Action</i>	0
<i>Inverted Output</i>	0

Finding new L2-DMs with Unassigned ID numbers (ID = 0)

After the table of assigned IDs is created, the gateway should search for any unassigned IDs. There is a special HAIL function that only ONE unassigned ID L2-DM will reply to first, cancelling the others with the same ID from replying. The response string contains the Hardware Serial Number of the L2-DM that replied. This can then be used to assign an ID # above 0 to the L2-DM.

Host sends: [253,0] 253 is the special HAIL ID address. The 0 is the ID number to hail.

A L2-DM replies: {0,2,3,200304.00,505136394231690C193E,5,1,2,30,220,255,0,1,0,0}

The HAIL command can take up to 2.5 seconds to complete. If no reply after 2.5 seconds then there are no unassigned L2-DMs with that ID. New L2-DMs are all ID #0.

Be careful not to assign more than one L2-DM with the same ID, they are hard to find unless you know the Hardware Serial Number. If more than one L2-DM is assigned the same ID, this command sequence can help de-tangle them. You'll need to re-assign every ID that replies to a hail and re-try the ID after it is reassigned (and should be unused).

Assigning IDs to L2-DMs using their Hardware Serial Number

To assign an ID to a L2-DM, add 100,000 to the ID to be assigned, followed by the hardware serial number. Valid command range is 100001 to 100240.

Host sends: [100008,5042384E333269063716] assign ID #8 to x Serial Number

L2-DM replies: {8,5042384E333269063716} (this is the same reply as a 259 command)

All L2-DM Reply Formats

Format	Example
Used	Description
Reply: Value	(id,value) (2 params)
Values. Reply to [id, 256]	id=0..240, value=0..255
Reply Format: A	{6,2,3,200304.00,505136394231690C193E,5,1,2,30,220,255,0,1,0,0} {15 params}
EEPROM configurations. Reply to [id, 258] and setting change commands	id=0..240, hardware_type=1..255 hardware_version=0..255 firmware_version=<string:yymmdd.vv> hardware_serial_number=<hex:20 digits> mode=0..11 (see spec sheet) dimming_curve=1=exponential, 2=linear, 3=steep exponential pwm_frequency=1=60Hz, 2=122Hz, 3=576Hz, 4=1kHz, 5=2kHz minimum_output_pwm=1..255 (low range of pwm when output is set to 1) maximum_output_pwm=1..255 (high range of pwm when output is set to 255. >min) resume_level=1..255 (default resume level) ramp_duration=0..255 (1/10th seconds to reach new level) motion_sensor_enable=0=off, 1=enabled, 2>manual on, auto off mode_6_alternate_actions=0=Off/Resume/Full/Off, 1=Off/Resume/Off, 2=Off/Resume/Full/Resume/Off. inverted_output=0=normal, 1=inverted pwm
Reply Format: D	{1,3,4,603,604,605,606,251,252} {9 params}
Keypad buttons. Reply to [id, 260]	id=0..240 button1=0..240zone OR 601..664scene(1..64) OR 251="UP" OR 252="DOWN"
Reply Format: E	{1,2,-1,-1} ID1, Scene2, not participating {4 params} {1,3,255,20} ID1, Scene3, goto 255 level in 20/10th seconds (2 seconds) {1,4,0,5} ID1, Scene4, goto 0 level in 5/10th seconds (0.5 second)
Scene configuration. Reply to [id, 270+scene#]	id=0..240 scene=1..64 level=-1=not participating in scene OR 0..255=level target duration=-1=not participating in scene OR 0..255=1/10ths of seconds

Command Quick Reference

Set levels			
Function	Send:	Example:	LibRE Reply:
Set zone output level	[ID,VALUE]	[2,255]	(2,255)
Set zone output level (no confirmation reply)	[ID,5000+VALUE]	[2,5040]	
Replay a scene	[254,600+scene]	[254,601]	Imperfect Values list
Set scene participants to "Off"	[254,900+scene]	[254,901]	Imperfect Values list

Queries			
Function	Send:	Example:	LibRE Reply:
Request current output value for ID	[ID,256]	[2,256]	Value String
Request firmware settings by serial	[200257,serial]	[200257,5042 384E3332690 63716]	Reply Format:A
Request hardware & Serial Number	[ID,258]	[2,258]	Reply Format:A
Request keypad mode button settings	[ID,260]	[2,260]	Reply Format:D
Hail first module with ID number x	[253,x]	[253,0]	Reply Format:A (ID 0 is now factory default ID)
Request scene x (1..64) settings	[ID,10000+x]	[2,10003]	Reply Format:E x=0=all

Set EEPROM (default values upon reboot)			
Function	Send:	Example:	LibRE Reply:
Assign ID number	[100000+ID,serial]	[100008,50423 84E333269063 716]	Reply Format:A
Set and store the Mode	[ID,500+mode]	[3,505]	Reply Format:A
Set and store the Mode by serial	[200500+mode,serial]	[200505,,50423 84E333269063 716]	Reply Format:A
Set ramp curve (1=linear,2=log)	[ID,300+curve]	[3,301]	Reply Format:A
Set PWM frequency (1,2,3)	[ID,400+freq]	[3,402]	Reply Format:A
Set PWM Minimum (1,255)	[ID,1000+min]	[3,1001]	Reply Format:A
Set PWM Maximum (1..255)	[ID,4000+max]	[3,4255]	Reply Format:A
Set restore level (1..255)	[ID,2000+restore]	[3,2128]	Reply Format:A
Set switch ramp duration	[ID,3000+rate]	[3,3020]	Reply Format:A
Run setup macro	[200000+macro,serial]	[200005,50423 84E333269063 716]	Reply Format:A

Scene settings commands:			
Scene: Store level setting	[ID,1ssdddvvv]	[3,101020255]	Reply Format:E
Scene: Clear a scene from the device	[ID,700+scene]	[3,701]	Reply Format:E
Scene: Clear all scenes in the device	[ID,700]	[3,700]	Reply Format:E for all scenes 1..64

Keypad EEPROM settings			
Function	Send:	Example:	LibRE Reply:
Assign ID toggle action to a button	[ID,6bddd]		Reply Format:D b=1..8 ddd=ID 1..250, 251=up, 252=dn, 0=disable
Assign Scene to a button	[ID,7bsss]		Reply Format:D b=1..8, sss=1..64 scene, 0=disable

Other volatile settings (resets to default upon reboot)			
Function	Send:	Example:	LibRE Reply:
Disable Motion sensor	[ID,800]	[3,800]	Reply Format:A
Automatic ON/OFF occupancy mode	[ID,801]	[3,801]	Reply Format:A
Manual ON via switch, Automatic OFF when unoccupied	[ID,802]	[3,802]	Reply Format:A
Mode 6 Sequence A	[ID,810]	[3,810]	Reply Format:A Sets mode 6: Off, Resume, Full, Off
Mode 6 Sequence B	[ID,811]	[3,811]	Reply Format:A Sets mode 6: Off, Resume, Off.

Recalling Scenes

Each L2-DM can subscribe to any of the 64 scenes by responding to a stored scene Output level when the scene is requested.

To request a scene, send 600 + the Scene number 1 to 64. 601 to 664.

Host sends: [254,601] 254 is Scene Request special ID, 601 is scene 1

L2-DM replies: (1,601) ID# 1 replies the scene is heard and triggered

There is a special L2-APM device that sends the reply because no ID# 1 L2-DMs should exist in the system. Scenes can be assumed triggered because one or more L2-DMs will report their new Scenel level has been reached by sending Output value updates.

It is recommended to poll all known devices after scene commands to ensure all level values are up to date.

STORING SCENES:

These commands are issued per L2-DM that subscribes to the scene.

For each lighting zone ID in the list. Do this for EACH ID:

If included in the scene:

Store the Scene Level

[3,101020255] Set ID3 to respond to Scene 1, over 20/10th sec, to level 255 (100%).

[4,101010200] Set ID4 to respond to Scene 1, over 10/10th sec, to level 200 (78%).

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Clear the Scene from the zone ID

[5,701] Clear Scene 1 from ID5.

[6,701] Clear Scene 1 from ID6.

Command	Format	Example	Reply
Store Scene Level 101000000 - 116255255	[<id>,<1ssdddlll>] ss = scene, 01:64 ddd = ramp duration, 000:255 in 1/10 second ll = 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."	(<id>,<1ssdddlll>)
Resume Scene Level 601 - 664	[<id>,<6xx>] Each SP with a set level at this scene will resume that level.	[1,610] = "select scene 10" There is no individual Resume Scene Level command. ID is the device that will reply but all the devices listen. Only a puck with <ID> will send a Comm Bus reply.	(1,<6scene>) (1,<level>) Example: (1,610) (1,50) - ID1 Level (if changed)
Clear All Scenes 700	[<id>,<700>]	[13,700] = "ID13, clear all scenes"	(<id>,<700>)
Clear Scene 701 - 764	[<id>,<7xx>]	[1,710] = "ID1, clear scene 10 level"	(<id>,<7scene>) Example: (2,710)

Hardware_Type Listing

PART NAME	HARDWARE_TYPE
L2-DM	7
L2-CH16	16
L2-FANC	3
L2-EGW	12
L2-APM-12W	22

L2-DM Parameter Enums:

hardware_type= 1=DM,
 hardware_version= 0..255
 firmware_version= <string:yymmdd.vv>
 hardware_serial_number= <hex:20 digits>
 mode= 0..11 (see spec sheet)
 dimming_curve= 1=exponential, 2=linear, 3=steep exponential
 pwm_frequency= 1=60Hz, 2=122Hz, 3=576Hz, 4=1kHz, 5=2kHz
 minimum_output_pwm= 1..255 (low range of pwm when output is set to 1)
 maximum_output_pwm= 1..255 (high range of pwm when output is set to 255. >min)
 resume_level= 1..255 (default resume level)
 ramp_duration= 0..255 (1/10th seconds to reach new level)
 motion_sensor_enable= 0=off, 1=enabled, 2>manual on, auto off
 mode_6_alterate_actions= 0=Off/Resume/Full/Off, 1=Off/Resume/Off, 2=Off/Resume/Full/Resume/Off.
 interted_output= 0=normal, 1=inverted pwm