Lumenetix-araya Logic Module
Warm/Dynamic Dimming Round LED Arrays (DDM2)
24V DC Input (Constant Voltage)
5000 Maximum Peak Lumens

Data Sheet
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1 DESCRIPTION AND KEY FEATURES

Description
Lumenetix-araya Logic Modules (ALM) connect to high-power round LED arrays (DDM2) that mix five colors of LEDs to deliver tunable white light that warms as it dims at 90+ CRI* and color consistency of <2 MacAdam ellipses. Delivered light dims from 3050K at full intensity to 1800K at 5% intensity, and then maintains 1800K to 1%. An MR16 halogen dimming profile is offered.

The ALM is connected to one LED array via low-cost ribbon cables, and features on-board driver electronics and the Lumenetix-araya control logic for precise control of LED light output while tuning and dimming. On-board closed loop thermal feedback compensates each color channel for thermally induced variations in light output due to dimming or changes in ambient temperatures. On-board closed loop optical feedback measures the lumen depreciation of each channel and re-balances the color model to ensure color consistency over the 50,000 hour life of the LED array. A patented in-line manufacturing process captures and stores the spectral characteristics of each LED on the array, rapidly generating a unique color model for each array.

The Zhaga-compliant LED arrays are compatible with traditional 0 - 10V wired controls and feature on-board Bluetooth Low Energy (BLE) for commissioning. The arrays can access DMX512-A-RDM, Legrand Wattstopper’s Digital Light Management (DLM) control interface, DALI Type 8 or Lutron® EcoSystem inputs via an optional control card that connects to an electrically isolated expansion port within the ALM. For simple deployment, scene set allows up to five scenes to be pre-programmed into the LED array during production and recalled at the venue using a 0 - 10V recommended dimmer or via Bluetooth. Commissioning of the LED array and the re-programming of scenes is done via the wireless Lumenetix-araya Tunable Color 2.0 iOS app that connects to the embedded Bluetooth radio.

The arrays can also access the patented wireless Avi-on™ Bluetooth Low Energy (BLE) Mesh platform to enable many-to-many device communication in a connected system “cloud”, via an optional control card that connects to an electrically isolated expansion port within the ALM. The proprietary Avi-on mobile app (for iOS or Android) is used for setting up the network, commissioning the various system components, grouping devices, creating associated schedules and scenes, and providing manual adjustment of color temperature and/or intensity.

Key Features
- Dimming profile that warms as it dims, launching at 3050K at full intensity to 1800K from 5% down to 1%
- 90+ CRI*
- Integrated driver electronics and Lumenetix-araya logic
- On board thermal and optical feedback for color consistency of <2 step MacAdam ellipse over 50,000 hour life
- In-line spectral capture and storage creates an unique color model for each Zhaga-compliant LED array, resulting in consistent CRI and CCT across all arrays
- On-board thermal turndown
- Compatible with 0 - 10V wired controls
- On-board Bluetooth Low Energy (BLE) for commissioning
- DMX512-A-RDM, Wattstopper DLM, DALI Type 8 or Lutron EcoSystem control accessibility via an optional control card that connects to an electrically isolated compartment within the ALM
- DMX slots set by RDM or via wireless Lumenetix-araya Tunable Color 2.0 iOS app
- Scene set enables up to five scenes to be preprogrammed and recalled using a 0 - 10V recommended dimmer or via Bluetooth
- Avi-on BLE Mesh control accessibility via an optional control card that connects to an electrically isolated compartment within the ALM, with system setup, commissioning and control of networked devices using the proprietary Avi-on app.
2 ORDERING INFORMATION

Photometrics and Ordering Codes (DDM2 Kits)^1

<table>
<thead>
<tr>
<th>Dimming Range:</th>
<th>Dimming Profile</th>
<th>LES(\text{mm})</th>
<th>Peak Source Lumens</th>
<th>Peak Delivered Lumens(^*)</th>
<th>Nominal Wattage (±10%)</th>
<th>Ordering Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>3050 - 1800K</td>
<td>MR16</td>
<td>31.6 mm</td>
<td>5000</td>
<td>4350</td>
<td>60W</td>
<td>80.002.019.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19.7 mm</td>
<td>3000</td>
<td>2600</td>
<td>50W</td>
<td>80.002.018.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12.6 mm</td>
<td>2000</td>
<td>1700</td>
<td>30W</td>
<td>80.002.017.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9.6 mm</td>
<td>1500</td>
<td>990</td>
<td>20W</td>
<td>80.002.016.01</td>
</tr>
</tbody>
</table>

CRI (Ra) Across Tuning Range: >90*

Nominal Color Consistency: <2 MacAdam ellipse (±0.002 Duv from ANSI curve)*

Color Consistency Over Life: Calibration maintains original color points over life*

Lumen Maintenance: L70 (70% of initial lumens) at 50,000 hours

1. Kits include round LED array and ALM with on-board 0-10V and Bluetooth LE, as a factory pre-matched set which MUST be kept that way during installation for proper operation and control and CANNOT be separated. The kits do not include ribbon cables, power cable assembly, control cable assembly, or control cards (see below for accessory ordering specifications).
2. Specifications are within +/- 10% of the nominal value. Peak efficacy is not necessarily at typical peak lumens.
3. LES = Light Emitting Surface.
4. Peak delivered lumen values are listed for modules tested with the included dome diffuser.
*From 2000 - 3050K, down to 5% dim level.

Accessories (Ordered Separately)

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Ordering Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18” long flexible tape-wrapped 16-pin ribbon cable (16-pin Tyco Connector at one end, 20-pin JST connector at other end) (for connecting ALM to round array)</td>
<td>28.700.004.02</td>
</tr>
<tr>
<td>1</td>
<td>18” long jacketed/round 16-pin ribbon cable (16-pin Tyco Connector at one end, 20-pin JST connector at other end) (for connecting ALM to round array)</td>
<td>28.700.003.03</td>
</tr>
<tr>
<td>1</td>
<td>18” long flat 16-pin ribbon cable (16-pin Tyco Connector at one end, 20-pin JST connector at other end) (for connecting ALM to round array)</td>
<td>28.700.001.05</td>
</tr>
<tr>
<td>1</td>
<td>24” long 2-wire ALM power cable assembly</td>
<td>28.030.001.01</td>
</tr>
<tr>
<td>1</td>
<td>24” long 4-wire ALM control cable assembly</td>
<td>28.002.002.02</td>
</tr>
<tr>
<td>1</td>
<td>DMX512-A-RDM Control Card***</td>
<td>80.003.002.01</td>
</tr>
<tr>
<td>1</td>
<td>Lutron® Control Card***</td>
<td>80.003.002.02</td>
</tr>
<tr>
<td>1</td>
<td>DALI Control Card***</td>
<td>80.003.004.01</td>
</tr>
<tr>
<td>1</td>
<td>Avi-on Wireless BLE Mesh Networking Control Card***</td>
<td>80.003.005.01</td>
</tr>
<tr>
<td>1</td>
<td>Legrand Wattstopper DLM - LMLM Interface***</td>
<td>80.003.003.03</td>
</tr>
</tbody>
</table>

***Control cards are shipped pre-attached to the ALM, & cannot be shipped individually.
Control cards for different controls should NOT be interchanged in the field. This will void the Lumenetix warranty.
3 ELECTRICAL SPECIFICATIONS

3.1 Electrical Specifications (Lumenetix-araya LOGIC MODULE)

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>24V DC (Constant Voltage)</td>
</tr>
<tr>
<td>Nominal Power Input*</td>
<td>20W, 30W, 50W, and 60W</td>
</tr>
<tr>
<td>Nominal Current Input</td>
<td>0.83A (20W); 1.25A (30W); 2.08A (50W); 2.5A (60W)</td>
</tr>
<tr>
<td>Power Supply Classification</td>
<td>Class 2 (UP TO 100W RATED POWER)</td>
</tr>
<tr>
<td>Power and Control Connector</td>
<td>Power Connector: Molex 5023520200; Control Connector: Molex 874380743</td>
</tr>
<tr>
<td>Ribbon Cable Connector (supplied by third parties)</td>
<td>TE Micro-Match 215460-4 (requires TE mating connector 2-215083-0)</td>
</tr>
<tr>
<td>Control Options**</td>
<td>0–10V, DMX512-A-RDM, Wattstopper DLM, Lutron EcoSystem, DALI Type 8, Avi-on BLE Mesh</td>
</tr>
<tr>
<td>CCT and Dimming Control Connections</td>
<td>Plug-in connector for 24 gauge leads</td>
</tr>
</tbody>
</table>

*Lumenetix-araya Logic Module (ALM) power dissipation is up to 10% of total power dissipation. Therefore ALM must be provided with adequate heat sink capability when applicable.

**DMX512-A-RDM, Lutron EcoSystem, DALI Type 8, Avi-on wireless BLE Mesh, or Wattstopper Digital Light Management control compatibility requires optional control card.

3.1a Control Specifications

<table>
<thead>
<tr>
<th>CONTROL SYSTEM / PROTOCOL</th>
<th>1 DIMMING</th>
<th>NOTES</th>
</tr>
</thead>
</table>
| DMX512-A-RDM 1, 2         | 1% (3050 - 1800K) 3 | 1. Requires control card connected to ALM.  
2. Refer to the separate DMX Lookup Tables for specific programming values and information.  
3. Factory setting or RDM command. |
| 0 - 10V                   | ~1% (3050 - 1800K) 4 | 4. Factory setting. |
| LUTRON ECOSYSTEM 5, 6     | 1% (3050 - 1800K) 7 | 5. Requires control card connected to ALM.  
6. Refer to the separate Lutron EcoSystem Lookup Tables for specific programming values and information.  
7. Factory setting. |
| AVI-ON (WIRELESS BLE MESH CONNECTIVITY) 8 | 1% (3050 - 1800K) 9 | 8. Requires control card connected to ALM.  
| DALI TYPE 8 10            | 1% (3050 - 1800K) 11 | 10. Requires control card connected to ALM.  
11. Factory setting. |
| WATTSTOPPER DLM 12        | 1% (3050 - 1800K) 13 | 12. Requires control card connected to ALM.  
13. Factory setting. |
3 ELECTRICAL SPECIFICATIONS

3.2 Recommended Power Supplies (Constant Voltage)

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Part Number</th>
<th>Rated Power</th>
<th>9 mm array (20W)</th>
<th>12 mm array (30W)</th>
<th>19 mm array (50W)</th>
<th>32 mm array (60W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Well</td>
<td>APV-25-24</td>
<td>25W</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efore / Roal</td>
<td>Strato RSLP035-24</td>
<td>35W</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean Well</td>
<td>APV-35-24</td>
<td>35W</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERP</td>
<td>VLM40W-24</td>
<td>40W</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Amperor</td>
<td>ANP-101-24P1-277-2500L-1-P</td>
<td>60W</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>ERP</td>
<td>VLM60W-24</td>
<td>60W</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Mean Well</td>
<td>IRM-60-24ST</td>
<td>60W</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Mean Well</td>
<td>LPV-60-24</td>
<td>60W</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Efore / Roal</td>
<td>Strato RSLP070-24</td>
<td>70W</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Mean Well</td>
<td>LPF-90-24</td>
<td>90W</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>ERP</td>
<td>VLM100W-24</td>
<td>96W</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean Well</td>
<td>GST120A24-R7B</td>
<td>120W</td>
<td>✓*</td>
<td>✓*</td>
<td>✓*</td>
<td>✓*</td>
</tr>
</tbody>
</table>

IMPORTANT

The Lumenetix-araya Logic Module (ALM) has on-board drive electronics, including dimming. A dimming driver should NOT be used.

CAUTION:

- Using a constant current power supply will damage the module, and will void the Lumenetix warranty.
- Using a triac or dimming driver will damage the module, and will void the Lumenetix warranty.
- The power supply MUST be evaluated with the module(s) that it will be operated with.
- If a recommended power supply from the above list is not used, it will void the Lumenetix warranty.
- If unqualified power supplies are used in a fixture, it will void the Lumenetix warranty.
- It is the responsibility of the fixture manufacturer to ensure that the power supply performance does not change over time. The Lumenetix warranty is void if problems occur as a result of such changes.

*U.L. CLASS 1 — NON-NORTH AMERICA ONLY.

NOTES:

- Recommendations are subject to change. Consult your Lumenetix representative for the most updated list.
- Please contact the power supply manufacturer to verify that the current version of the listed power supply still meets the latest Lumenetix testing approvals / qualifications.
- Power supply qualification process: if a power supply that is not part of the above list is submitted for testing to Lumenetix (during the design-in phase), it will be qualified or disqualified within two weeks of submission.
4 MECHANICAL SPECIFICATIONS

4.1 Round LED Array Kits

<table>
<thead>
<tr>
<th>Array Dimensions (LES; Diameter ‘D’; Height ‘H’)</th>
<th>LES = 31.6 mm (nominal 1.24 in.)</th>
<th>D = 60 mm (nominal 2.36 in.); H = 16.3 mm (nominal 0.64 in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LES = 19.7 mm (nominal 0.78 in.)</td>
<td>D = 50 mm (nominal 1.97 in.); H = 15 mm (nominal 0.59 in.)</td>
<td></td>
</tr>
<tr>
<td>LES = 12.6 mm (nominal 0.50 in.)</td>
<td>D = 50 mm (nominal 1.97 in.); H = 12.9 mm (nominal 0.51 in.)</td>
<td></td>
</tr>
<tr>
<td>LES = 9.6 mm (nominal 0.38 in.)</td>
<td>D = 40 mm (nominal 1.57 in.); H = 10.1 mm (nominal 0.40 in.)</td>
<td></td>
</tr>
</tbody>
</table>

LES = Light Emitting Surface.

Round LED Array (31.6 mm LES; 5000 lumens)
All dimensions are in millimeters.

Round LED Array (19.7 mm LES; 3000 lumens)
All dimensions are in millimeters.

Round LED Array (12.6 mm LES; 2000 lumens)
All dimensions are in millimeters.

Round LED Array (9.6 mm LES; 1500 lumens)
All dimensions are in millimeters.
## 4 MECHANICAL SPECIFICATIONS

### 4.2 Lumenetix-araya Logic Module

<table>
<thead>
<tr>
<th>ALM Dimensions (H x W x L)</th>
<th>H = 15.11 mm (0.60 in.); W = 30 mm (1.18 in.); L = 133 mm (5.24 in)</th>
</tr>
</thead>
</table>

Dimensions provided are for the ALM without optional control cards.

Lumenetix-araya Logic Module (ALM)

All dimensions are in millimeters. The mounting holes are 5 mm in diameter.
5 DMX512-A CONTROL CARD

5.1 ALM with DMX512-A-RDM Control Card (PHOENIX CONNECTORS) - OLD

ALM Dimensions (H x W x L)

H = 18.13 mm (0.71 in.); W = 30 mm (1.18 in.); L = 133 mm (5.24 in.)

ALM with DMX Control Card and Cover
Dimensions outside parentheses are in millimeters. Dimensions within parentheses are in inches. The mounting holes are 5 mm in diameter.

5.1a Mechanical Specifications – DMX512-A-RDM Control Card (PHOENIX CONNECTORS) - OLD

Lumenetix part #:
80.003.001.01

Wire Specifications:
22-24 AWG, stranded tinned copper (TC) only

Connector:
Phoenix Contact 1771033
5.1b Mounting Specifications – DMX Control Card (PHOENIX CONNECTORS) - OLD

The Control Card is mounted on the 10-pin header and located on the two bosses, and then captured in place to the ALM with two (2) self-tapping screws.

**Screw Specifications:** Phillips Rounded Head Thread-Forming Screws for Plastic, 18-8 Stainless Steel, Number 4 Size, 1/8" Long; McMasterCarr # 99461A105.

**Torque Specifications:** 2.0 to 2.5 in-lb

**CAUTION:** The screws are very small and are self-threaded into small plastic bosses. Overtorquing will strip the plastic and damage the ALM housing.
5 DMX512-A CONTROL CARD

5.2 ALM with DMX512-A-RDM Control Card (WAGO CONNECTORS)

ALM Dimensions (H x W x L)

| H = 23.61 mm (0.93 in.) | W = 30 mm (1.18 in.) | L = 133 mm (5.24 in.) |

ALM with DMX Control Card and Cover
Dimensions outside parentheses are in millimeters. Dimensions within parentheses are in inches.
The mounting holes are 5 mm in diameter.

5.2a Mechanical Specifications – DMX512-A-RDM Control Card (WAGO CONNECTORS)

Lumenetix part #:
80.003.002.01

Wire Specifications:
22-24 AWG, stranded tinned copper (TC) only

Connector:
Wago 805

DMX Control Card
All dimensions are in millimeters.
5.2b Mounting Specifications – DMX Control Card (WAGO CONNECTORS)

The Control Card is mounted on the 10-pin header and located on the two bosses, and then captured in place to the ALM with two (2) self-tapping screws.

**Screw Specifications:** Phillips Rounded Head Thread-Forming Screws for Plastic, 18-8 Stainless Steel, Number 4 Size, 1/8" Long; McMasterCarr # 99461A105.

**Torque Specifications:** 2.0 to 2.5 in-lb

**CAUTION:** The screws are very small and are self-threaded into small plastic bosses. Overtorquing will strip the plastic and damage the ALM housing.
6 LUTRON CONTROL CARD

6.1 ALM with Lutron® EcoSystem Control Card

| ALM Dimensions (H x W x L) | H = 20.53 mm (0.81 in.); W = 30 mm (1.18 in.); L = 133 mm (5.24 in.) |

ALM with Lutron Control Card and Cover
Dimensions outside parentheses are in millimeters. Dimensions within parentheses are in inches.
The mounting holes are 5 mm in diameter.

6.2 Mechanical Specifications (Lutron EcoSystem Control Card)

Lumenetix part #: 80.003.002.02

Wire Specifications:
18-22 AWG, solid wire or tin-dipped stranded

Connector:
TE 2834006-2

Lutron Control Card
All dimensions are in millimeters.
6 LUTRON CONTROL CARD

6.3 Mounting Specifications (Lutron® EcoSystem Control Card)

The Control Card is mounted on the 10-pin header and located on the two bosses, and then captured in place to the ALM with two (2) self-tapping screws.

**Screw Specifications:** Phillips Rounded Head Thread-Forming Screws for Plastic, 18-8 Stainless Steel, Number 4 Size, 1/8" Long; McMasterCarr # 99461A105.

**Torque Specifications:** 2.0 to 2.5 in-lb

**CAUTION:** The screws are very small and are self-threaded into small plastic bosses. Overtorquing will strip the plastic and damage the ALM housing.
7 AVI-ON BLE MESH CONTROL CARD

7.1 ALM with Avi-on Wireless BLE Mesh Control Card

| ALM Dimensions (H x W x L) | H = 17.58 mm (0.69 in.); W = 30 mm (1.18 in.); L = 133 mm (5.24 in.) |

ALM with Avi-on BLE Mesh Control Card and Cover
Dimensions outside parentheses are in millimeters. Dimensions within parentheses are in inches.
The mounting holes are 5 mm in diameter.

7.2 Mechanical Specifications – Avi-on Wireless BLE Mesh Control Card (with Antenna)

Lumenetix part #:
80.003.005.01

Avi-on BLE Mesh Control Card
All dimensions are in millimeters.
7 AVI-ON BLE MESH CONTROL CARD

7.3 Mounting Specifications – Avi-on Wireless BLE Mesh Control Card

The Control Card is mounted on the 10-pin header and located on the two bosses, and then captured in place to the ALM with two (2) self-tapping screws.

**Screw Specifications:** Phillips Rounded Head Thread-Forming Screws for Plastic, 18-8 Stainless Steel, Number 4 Size, 1/8” Long; McMasterCarr # 99461A105.

**Torque Specifications:** 2.0 to 2.5 in-lb

**CAUTION:** The screws are very small and are self-threaded into small plastic bosses. Overtorquing will strip the plastic and damage the ALM housing.
8 DALI TYPE 8 CONTROL CARD

8.1 ALM with DALI Type 8 Control Card

| ALM Dimensions (H x W x L) | H = 20.53 mm (0.81 in.); W = 30 mm (1.18 in.); L = 133 mm (5.24 in.) |

ALM with DALI Control Card and Cover
Dimensions outside parentheses are in millimeters. Dimensions within parentheses are in inches.
The mounting holes are 5 mm in diameter.

8.2 Mechanical Specifications (DALI Type 8 Control Card)

Lumenetix part #: 80.003.004.01

Wire Specifications:
18-22 AWG, solid wire or tin-dipped stranded

Connector:
TE 2834006-2

DALI Control Card
All dimensions are in millimeters.
8.3 Mounting Specifications (DALI Type 8 Control Card)

The Control Card is mounted on the 10-pin header and located on the two bosses, and then captured in place to the ALM with two (2) self-tapping screws.

**Screw Specifications:** Phillips Rounded Head Thread-Forming Screws for Plastic, 18-8 Stainless Steel, Number 4 Size, 1/8” Long; McMasterCarr # 99461A105.

**Torque Specifications:** 2.0 to 2.5 in-lb

**CAUTION:** The screws are very small and are self-threaded into small plastic bosses. Overtorquing will strip the plastic and damage the ALM housing.
9 WATTSTOPPER DLM — LMLM INTERFACE

9.1 ALM with Legrand Wattstopper’s DLM LMLM Interface

| ALM Dimensions (H x W x L) | H = 20.27 mm (0.80 in.); W = 30 mm (1.18 in.); L = 133 mm (5.24 in.) |

ALM with LMLM Interface and Cover
Dimensions outside parentheses are in millimeters. Dimensions within parentheses are in inches.
The mounting holes are 5 mm in diameter.

9.2 Mechanical Specifications (LMLM Interface)

Lumenetix part #:
80.003.003.03

Wire Specifications:
Solid 20/3 AWG, red/blue/black

Connector:
TE 2834006-3

Legrand Wattstopper DLM LMLM Interface
Dimensions outside parentheses are in millimeters. Dimensions within parentheses are in inches.
9 WATTSTOPPER DLM — LMLM INTERFACE

9.3 Mounting Specifications (LMLM Interface)

The LMLM Interface is mounted on the 10-pin header and located on the two bosses, and then captured in place to the ALM with two (2) self-tapping screws.

**Screw Specifications:** Phillips Rounded Head Thread-Forming Screws for Plastic, 18-8 Stainless Steel, Number 4 Size, 1/8" Long; McMasterCarr # 99461A105.

**Torque Specifications:** 2.0 to 2.5 in-lb

**CAUTION:** The screws are very small and are self-threaded into small plastic bosses. Overtorquing will strip the plastic and damage the ALM housing.

Please refer to the Legrand Wattstopper website for detailed specifications, wiring diagrams and installation instructions: https://www.legrand.us/categories/lightingcontrolsbuildingsystems/human-centric-lighting/led-light-engines.aspx
10 HEAT SINKING RECOMMENDATIONS

The Dynamic Dimming Module requires an external heat sink in order to ensure proper operating temperature of the LEDs. The DDM has a conductive aluminum case and an efficient thermal path to the LED array. These features promote efficient thermal management and allow for a simple heat sink design in most applications.

Examples of heat sinking methods are cast or extruded heat sinks. Both carbon and stainless steel are much less efficient at transferring heat than aluminum and therefore are not recommended as heat sink materials. The heat sink mounting surface should be flat and smooth. Metal-to-metal contact surfaces will result in best performance; anodized or unfinished mounting surfaces are recommended. Mounting the DDM on a painted aluminum surface will reduce the performance of the heat sink material.

In many fixtures, the air flow to the heat sinks is obstructed or the heat sink is in an enclosed container with no path to reject heat. The thermal design of the fixture must be optimized so that the maximum temperature is less than the $T_{c_{\text{max}}}$ (maximum case temperature) as indicated in the drawings in the following section. If the $T_{c_{\text{max}}}$ is exceeded in the application, the junction temperature of the LEDs will be higher than that required to meet the L70 life, and the Lumenetix warranty will be void.

**IMPORTANT:** Most heat sinks are qualified in “free air” at an approximate ambient temperature of 25°C. If the DDM is installed in an insulated can fixture (IC Can), the module may exceed the recommended operating temperature. The heat sink must be evaluated and temperature tested in the fixture at applicable ambient temperatures for the desired application.
11 CASE TEMPERATURE MEASUREMENT POINTS

11.1 Lumenetix-araya Logic Module (ALM) Case Temperature (Tc) Measurement Points

Maximum Case Temperature (Tc) for ALM: 70°C

11.2 Round LED Array Case Temperature (Tc) Measurement Point

Maximum Case Temperature (Tc) for Round LED Array: 90°C
12 SECONDARY OPTICS

12.1 Attaching Compatible Reflectors for DDM2

The round LED arrays with 19mm LES (Light Emitting Surface) accept twist-to-lock reflectors with an attachment collar. The fastener specifications are shown in the following table while mounting hole locations are shown in Figures 1, 2 and 3.

DDM2 Secondary Optics Fastener Specifications

<table>
<thead>
<tr>
<th>Attachment Type</th>
<th>Fastener specifications</th>
<th>Screw length</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twist-Lock (with Adaptor Ring)</td>
<td>M3 x 6; quantity of two</td>
<td>6 mm (1/4&quot;)</td>
<td>Pan head screws</td>
</tr>
<tr>
<td>Twist-Lock (with Adaptor Ring &amp; Adaptor)</td>
<td>M3 x 6; quantity of two</td>
<td>6 mm (1/4&quot;)</td>
<td>Pan head screws</td>
</tr>
<tr>
<td>TE Type 2 Clip</td>
<td>M3 x 10; quantity of two</td>
<td>10 mm (3/8&quot;)</td>
<td>Rounded head screws</td>
</tr>
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</table>

Figure 1: Round LED Array with XSA-242 Adaptor Ring (by Xicato)

Figure 2: Round LED Array with XSA-242 Adaptor Ring (by Xicato) with Adaptor, used for Reflectors by Diffractive Optics (p/n: P14008) or Khatod (p/n: KE1950W)

Figure 3: Round LED Array with Lumawise Z50 Type 2 Clip (by TE)
## 12 SECONDARY OPTICS

### 12.2.1 Compatible Reflectors List (DDM 219)

Compatible Reflectors for 19mm LES round LED arrays (continued on next page)

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>M. Part Number</th>
<th>beam angle (deg)</th>
<th>outer dim (mm)</th>
<th>height (mm)</th>
<th>optical finish</th>
<th>optical finish 2</th>
<th>attach method</th>
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<td>P13302 (XSA-220)</td>
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<td>28.6</td>
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<td>33</td>
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<td>superfacet, diamond</td>
<td>XSA242 + P14008</td>
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<td>superfacet, diamond</td>
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<td>superfacet, diamond</td>
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<td>specular</td>
<td>superfacet, diamond</td>
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<td>92</td>
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<td>specular</td>
<td>superfacet, diamond</td>
<td>XSA242 + P14008</td>
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<td>43.3</td>
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<td>75</td>
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<td>faceted</td>
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<td>75</td>
<td>37</td>
<td>specular</td>
<td>faceted</td>
<td>XSA242 + P14008</td>
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</tbody>
</table>

| JORDAN | 11324 10 10101 | 25 | 111 | 66 | specular | super facet | none |
| JORDAN | 11324 00 10101 | 40 | 111 | 66 | specular | super facet | none |

| Khatod EASY | KCLP 1858CR | 12 | 72 | 52 | combination | none | Zhaga Screw 35mm |
| Khatod EASY | KCLP 1858ME | 30 | 72 | 52 | honeycomb lens | none | Zhaga Screw 35mm |
| Khatod EASY | KCLP 1858WI | 50 | 72 | 52 | bugeye lens | none | Zhaga Screw 35mm |
| Khatod EASY | KCLP 1859CR | 12 | 110 | 61 | combination | none | Zhaga Screw 35mm |
| Khatod EASY | KCLP 1859ME | 30 | 110 | 61 | honeycomb lens | none | Zhaga Screw 35mm |
| Khatod EASY | KCLP 1859WI | 50 | 110 | 61 | bugeye lens | none | Zhaga Screw 35mm |
| Khatod EASY | KCLP 1799 CR | asym | | | | | |
| Khatod | KCLP 1682 CR (1429CR) | 11 | 65 | 35 | specular | none | TE Type II / XSA242 + KE1950W |
| khatod | KCLP 1682 ST (1429ST) | 20 | 65 | 35 | diffuse | none | TE Type II / XSA242 + KE1950W |
| khatod | KCLP 1683 CR (1430CR) | 26 | 65 | 35 | specular | none | TE Type II / XSA242 + KE1950W |
| khatod | KCLP 1683 ST (1430ST) | 24 | 65 | 35 | diffuse | none | TE Type II / XSA242 + KE1950W |
| khatod | KCLP 1431 CR | 65 | 35 | 35 | specular | none | TE Type II / XSA242 + KE1950W |
| khatod | KCLP 1432 CR | 65 | 35 | 35 | specular | none | TE Type II / XSA242 + KE1950W |
| khatod | KCLP 1685 ST (1432ST) | 32 | 65 | 35 | diffuse | none | TE Type II / XSA242 + KE1950W |
| khatod | KCLP 1684 ST | 28 | 65 | 35 | diffuse | none | TE Type II / XSA242 + KE1950W |
| khatod | KCLP 1686 CR | 44 | 65 | 35 | specular | none | TE Type II / XSA242 + KE1950W |
| khatod | KCLP 1687 CR | 27 | 65 | 35 | specular | none | TE Type II / XSA242 + KE1950W |
| khatod | KCLP 1687 ST | 31 | 65 | 35 | diffuse | none | TE Type II / XSA242 + KE1950W |
| khatod | KCLP 1688 CR | 37 | 65 | 35 | specular | none | TE Type II / XSA242 + KE1950W |
| khatod | KCLP 1688 ST | 38 | 65 | 35 | diffuse | none | TE Type II / XSA242 + KE1950W |
| khatod | KCLP 1689 ST | 42 | 65 | 35 | diffuse | none | TE Type II / XSA242 + KE1950W |
| khatod | KCLP 1690 ST | 50 | 65 | 35 | diffuse | none | TE Type II / XSA242 + KE1950W |
| khatod | KCLP 1691 ST | 56 | 65 | 35 | diffuse | none | TE Type II / XSA242 + KE1950W |
| khatod | PLJT 1866 | n/a | | | diffuse ball | | XSM242 |

NOTE: Reflectors have been recommended based on independent optical tests conducted by Lumenetix, and should be used as guidelines. Final reflector evaluation should be made by fixture manufacturers with all optics in place.
## 12 SECONDARY OPTICS

### 12.2.2 Compatible Reflectors List (DDM 219)

Compatible Reflectors for 19mm LES round LED arrays *(continued from previous page)*

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>M. Part Number</th>
<th>beam angle (deg)</th>
<th>outer dim (mm)</th>
<th>height (mm)</th>
<th>optical finish</th>
<th>optical finish 2</th>
<th>attach method</th>
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<td>75</td>
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</tbody>
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**NOTE:** Reflectors have been recommended based on independent optical tests conducted by Lumenetix, and should be used as guidelines. Final reflector evaluation should be made by fixture manufacturers with all optics in place.
12 SECONDARY OPTICS

12.3 Compatible Reflectors List (DDM 232)

Compatible Reflectors for 32mm LES round LED arrays

<table>
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<tr>
<th>Manufacturer</th>
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<th>height (mm)</th>
<th>optical finish</th>
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<th>attach method</th>
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</tbody>
</table>

NOTE: Reflectors have been recommended based on independent optical tests conducted by Lumenetix, and should be used as guidelines. Final reflector evaluation should be made by fixture manufacturers with all optics in place.
13 RIBBON CABLE ASSEMBLIES

13.1 Flexible Tape-Wrapped 16-Pin Ribbon Cable (Nominal 18” Length)

Lumenetix part #: 28.700.004.02

16-pin Tyco Connector at one end, 20-pin JST connector at other end; for connecting ALM to round array.

Note: All dimensions are in millimeters.

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>PART NUMBER</th>
<th>QTY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16 PIN RIBBON CABLE 3M 3365-16 WRAPPED WITH BLACK ACETATE CLOTH TAPE</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>16 PIN CONNECTOR 1-215083-6 TE CONNECTIVITY</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>CONNECTOR SHR-20V-S-B JST</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>CRIMP SSSH-003T-P0.2-H JST</td>
<td>16</td>
</tr>
</tbody>
</table>
13 RIBBON CABLE ASSEMBLIES

13.2 Jacketed / Round 16-Pin Ribbon Cable (Nominal 18” Length)

Lumenetix part #:
28.700.003.03

16-pin Tyco Connector at one end, 20-pin JST connector at other end; for connecting ALM to round array.

Note: All dimensions are in millimeters.

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
<th>QTY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16 PIN CONNECTOR 1-215083-6</td>
<td>CONNECTOR 16 PIN 1-215083-6</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>476.011 CRIMP SSH-003T-PO.2-H</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3M ROUND JACKED FLAT CABLE 3759-16</td>
<td>3M ROUND JACKED FLAT CABLE 3759/16</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>460.042 CONNECTOR SHR-20V-S-B</td>
<td>CONNECTOR SHR-20V-S-B</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>LABEL, LUMENETIX, PART#, DESCRIPTION, REVISION</td>
<td>LUMENETIX, P/N, DESCRIPTION, REVISION</td>
<td>1</td>
</tr>
</tbody>
</table>
13 RIBBON CABLE ASSEMBLIES

13.3 Flat 16-Pin Ribbon Cable (Nominal 18” Length)

Lumenetix part #:
28.700.001.05

16-pin Tyco Connector at one end, 20-pin JST connector at other end; for connecting ALM to round array.

Note: All dimensions are in millimeters.

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>PART NUMBER</th>
<th>QTY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LABEL, LUMENETIX, PART#, DESCRIPTION, REVISION</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>16 PIN RIBBON CABLE 3M 3365-16</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>16 PIN CONNECTOR c-1-215083-6-1-3d</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>460.042 CONNECTOR SHR-20V-S-B</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>CRIMP SSH-003T-PO-2</td>
<td>16</td>
</tr>
</tbody>
</table>
14 POWER / CONTROL CABLE ASSEMBLIES

14.1.1 Power Cable Assembly (Nominal 24” Length)

Provides power to each module.

Lumenetix part #: 28.030.001.01

Note: All dimensions are in millimeters.

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
<th>QTY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RED WIRE 24AWG</td>
<td>HOOK -UP WIRE STRANDED 7/32 24AWG RED</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>BLACK WIRE 24AWG</td>
<td>HOOK -UP WIRE STRANDED 7/32 24AWG BLACK</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>CONNECTOR MOLEX 5023510200</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>CRIMP MOLEX 0503728000</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

14.1.2 Pin Allocation Chart for Power Cable Assembly

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Lead Color</th>
<th>Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 1</td>
<td>Red</td>
<td>Power 24V DC (+)</td>
</tr>
<tr>
<td>Pin 2</td>
<td>Black</td>
<td>Power Common (-)</td>
</tr>
</tbody>
</table>
14 POWER / CONTROL CABLE ASSEMBLIES

14.2.1 Control Cable Assembly (Nominal 24” Length)

Provides 0-10V control and RS-485 signals to each module.

Lumenetix part #: 28.002.002.02

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
<th>QTY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>874390700</td>
<td>MOLEX CONNECTOR</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>874210000</td>
<td>CRIMP</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>A2015V-100-ND</td>
<td>24 AWG WIRE, VIOLET</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>A2015L-100-ND</td>
<td>24 AWG WIRE, BLUE</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>A2015S-100-ND</td>
<td>24 AWG WIRE, GREY (SLATE)</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>A2015W-100-ND</td>
<td>24 AWG WIRE, WHITE</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: All dimensions are in millimeters.

14.2.2 Pin Allocation Chart for Control Cable Assembly

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Lead Color</th>
<th>Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 1</td>
<td>Violet</td>
<td>0-10V Dimming (+)</td>
</tr>
<tr>
<td>Pin 2</td>
<td>Blue</td>
<td>0-10V Color (+)</td>
</tr>
<tr>
<td>Pin 3</td>
<td>N/A</td>
<td>NOT USED</td>
</tr>
<tr>
<td>Pin 4</td>
<td>N/A</td>
<td>NOT USED</td>
</tr>
<tr>
<td>Pin 5</td>
<td>N/A</td>
<td>NOT USED</td>
</tr>
<tr>
<td>Pin 6</td>
<td>Gray</td>
<td>0-10V Dimming (-)</td>
</tr>
<tr>
<td>Pin 7</td>
<td>White</td>
<td>0-10V Color (-)</td>
</tr>
</tbody>
</table>
15 0-10V PROTOCOL & WIRING DIAGRAMS

15.1 0-10V Best Wiring Practice

Any manufacturer that makes a dimmer that sinks will work with Lumenetix modules since we source the voltage.

0-10V is a topology defined by the International Electrotechnical Commission (IEC) 60929 Annex E standard and uses a varying DC voltage between 1 and 10V to determine the lighting level. The fixture outputs a minimum light level below 1V which is defined as low-end. Between 1 and 10V, the signal corresponds to levels between the minimum and maximum output level. A signal above 10V corresponds to the maximum light level. Sometimes it is referred to as 1-10V, as that is the actual range in which the light levels will vary. Each dimmer will have their own distinct dimming profile.

Best practice is to limit the distance run for the analog control wiring from the controller to the last driver to 300’, as a common 0-10V DC wiring type is stranded-copper twisted-pair 18AWG wiring. The wiring is stranded copper because it provides a more stable current path (as DC signals tend to be transferred by the outer edges of the conductor) while being relatively easy to work with; solid wire is usually acceptable in low-voltage systems that use AC control power.

Whenever any part of the control circuit (the driver, dimer, or wire used) is designed for use in a Class 2 installation, it is critical that the entire control circuit be kept separate from Class 1 line voltage wiring per the requirement of National Electric Code, section 725.136. The electrical drawings must be very clear that class 1 and class 2 wiring cannot be combined. There must be separation because: a) it is possible for higher voltage wiring to induce an AC voltage into the low voltage signal wiring, and, b) undesirable visual artifacts in the dimmed lighting can be caused when the line and low voltage wiring is run together (especially for long distances). We do not recommend installing the low voltage signal wiring in the same conduit or raceway as line voltage wiring even when all elements of the control circuit are listed for Class 1 wiring methods.

NOTE: Lumenetix modules operate between 1-10V. All dimmers that have minimum and maximum trim pots should be set at a minimum of 1 volt and a maximum of 10 volts, measuring the voltage at the end of the line.

0-10V Dimmers (recommended list)*

Crestron
ETC
Fresco
Legrand
Leviton
Lutron
Nexlight
N-Light
Pass & Seymour
Vantage
Wattstopper

*Recommendations are subject to change. Consult your Lumenetix representative for the most updated list.
INDEX TAB ON RED END OF CABLE CONNECTOR SHOULD LINE UP WITH INDEX SLOT ON ALM.

MAKE SURE TO ALIGN INDEX TAB TO INDEX SLOT.

THE CONSTANT HOT/LIVE MUST BE WIRED TO A SWITCHING DEVICE.
16 BLUETOOTH LE OPERATION

16.1 Bluetooth Operation using the Tunable Color 2.0 iOS App

 MAKE SURE TO ALIGN INDEX TAB TO INDEX SLOT.

NOTE: BLUETOOTH OPERATION IS FOR COMMISSIONING THE MODULES ONLY, NOT FOR CONTROLLING THEM.
17 DMX512 PROTOCOL & WIRING DIAGRAMS

17.1 DMX512-A-RDM Protocol

DMX512-A is an acronym for Digital Multiplex, a communication protocol used to remotely control lighting dimmers and intelligent fixtures. It is designed to provide a common communications standard between these lighting devices regardless of the manufacturer. The 512-A after the DMX refers to the number of control channels used on one network segment (often called a ‘universe’) of devices. In a simple dimming system, one channel controls the intensity of the fixture. A single intelligent fixture such as the araya5 requires several channels to control its various parameters (one channel each for DIM, CCT, SAT, HUE).

DMX512A Specifications:
• DMX 512-A (Controller).
• A universe is 512 Channels.
• DMX value is between 0 and 255, where 0 is off and 255 is full on.
• The maximum number of devices in a daisy-chain wire run is 32, which include the controller and opto-splitter.
• The maximum network wire run is a distance of up to 1600 feet for non-RDM systems and up to 1000 feet for RDM systems.
• One device functions as the master (DMX controller) on a network, while the rest function as slaves (mergers, splitters, intelligent fixtures, etc.).
• Only the controller (master) transmits over the network, and all fixtures receive the same data.
• The final device in the daisy-chain must be terminated with a 120 ohm resistor between DMX+ and DMX- pins.
• It is recommended that the terminator for the final device be located in the control panel, if it falls within the recommended wiring distance.
• All wiring must be in a continuous run and daisy-chained.
• Star wiring is only allowed in conjunction with an opto-splitter.
• Do not run DMX control cable in close proximity to AC power lines. EM spikes from switching of high-current devices such as HVAC equipment or generators will induce noise into the DMX cable.
• The shield must be carried through between modules and properly grounded at one point only.
• Connections to DMX512-A-RDM accessory board: wire size to be 24AWG, and solid or stranded cables may be used. Stranded wire used must be tinned or installed with ferule connector.

RDM

DMX512-A control protocol that enables Remote Device Management for two-way communications for configuration, monitoring and system setup. Allows two way communication between lighting controller and the fixtures. Allows for remote setting of DMX start addressing. RDM signals are sent back the other way, but not constantly. Controller can ask one or more devices for query feedback. RDM packets are inserted in-between the existing DMX data packets being used to control the lighting. The DMX Control Console will broadcast up to 512 channels over one DMX cable (max. run of 1000 feet for RDM). Some of these channels may not be used, but will still be transmitted, as required by the protocol. It must be set to a desired channel (001, 002, 003, 004, etc.) to control the connected light fixture. This is usually accomplished using RDM. This desired ‘channel’ is commonly known as the DMX address. When addressing fixtures, it is not recommended to skip addresses.

When RDM is not available with the control system, it is permissible to use the Lumenetix commissioning tool (the araya5 Tunable Color 2.0 iOS App) to set the address of the slots. The instructions to configure the DMX channels can be found in the separate araya5 Tunable Color Instruction Manual.

The DMX512-A interface follows the ANSI E1.11-2008 (R21013) standard. Four address slots are allocated to each interface board and control the Dim level, CCT, Saturation and Hue of the araya5 modules connected to the board.

Default DMX512-A Slot Allocation:

<table>
<thead>
<tr>
<th>Slot</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dim Level</td>
</tr>
<tr>
<td>2</td>
<td>CCT</td>
</tr>
<tr>
<td>3</td>
<td>Saturation Level</td>
</tr>
<tr>
<td>4</td>
<td>Hue</td>
</tr>
</tbody>
</table>
17 DMX512 PROTOCOL & WIRING DIAGRAMS

17.2 DMX512-A Electrical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESD Protection</td>
<td>±15KV (air), ±8KV (conducted)</td>
<td>Per IEC 61000-4-2</td>
</tr>
<tr>
<td>Termination</td>
<td>Recommended</td>
<td>The DMX512 bus termination rules apply</td>
</tr>
<tr>
<td>Directionality</td>
<td>Receive only</td>
<td></td>
</tr>
<tr>
<td>Frequency stability</td>
<td>±20ppm</td>
<td></td>
</tr>
<tr>
<td>Load per port</td>
<td>1/256</td>
<td>1/8 of Nominal RS-485</td>
</tr>
<tr>
<td>Isolation</td>
<td>3KVRMS</td>
<td></td>
</tr>
</tbody>
</table>

**DMX512-A Control Systems (recommended list)**

- Choreo
- Cognito
- Crestron Greenlight System
- Entec
- ETC Mosaic
- ETC Paradigm
- Fresco
- Interactive Technologies
- Lutron HomeWorks QS
- Lutron Quantum
- Nicolaudie
- Pathway Connectivity
- Pharos
- Traxon Ecue
- Vantage Controls

*Recommendations are subject to change. Consult your Lumenetix representative for the most updated list.

**DMX512-A Recommended Internal / Field Wiring**

**TMB Cable ProPlex DMX**

**PC224T:** 2-pair DMX512 cable, overall foil and braid shielding with drain wire. UV and fungus resistant. Fully rated for installations, yet easy handling for light duty portable applications.

**PC224TW:** Same as above, with white jacket.

For use as DMX in/out under one jacket:

**PC244T:** Two individually shielded pairs and drain wires. UV resistant. Color coded foil shielding for easy reference.
17.3 DMX512-A Recommended Field Wiring

Liberty 24-2P-485 (Non-Plenum), 24 AWG, 2 pair dual 120 ohm, 11.2 pf/ft low capacitance (Wago, XLR and PHX connectors)
Liberty 24-2P-P485 (Plenum), 24 AWG, 2 pair dual 120 ohm, 11.2 pf/ft low capacitance (Wago and PHX connectors)
Belden #9842 (Non-Plenum), 24 AWG, 2 pair dual shielded 120 ohm, 12.8 pf/ft low capacitance (Wago and PHX connectors)
Belden #98942 (Plenum), 24 AWG, 2 pair dual shielded 120 ohm, 12.8 pf/ft low capacitance (Wago and PHX connectors)

Please refer to wire manufacturer’s lighting catalog for and/or equal as required by code.

Category Wire or Equal

The Entertainment Services and Technology Association (ESTA) does not define a maximum run length for DMX over Cat5 since many factors will affect the maximum run length, such as number of devices, number of splices in the cable, the strength of the DMX transmitter(s), if Remote Device Management (RDM) is being used, and sources of interference. ESTA does state (again, in ANSI E1.21-2):

“A properly selected and installed DMX512 cable should provide acceptable signal strength for runs of 300m (1000ft). Please note that the technical requirements, such as run-length and topology for other networking technologies, such as Ethernet, should be considered if using the installed cable for another networking technology in the future is anticipated.”

Cat5 or equivalent is not preferred as a portable cable since it is not as rugged as other DMX cables. Male RJ45 connectors are especially prone to breakage over repeated re-connections.

LUMENETIX RECOMMENDATION:
CAT 5E -150 FEET
CRESTRON
DM-CBL-8G-NP
DM-CBL-8G-P

CAT 7- 330 FEET
CRESTRON
DM-CBL-ULTRA-NP
DM-CBL-ULTRA-P

DMX512-A Recommended Field Connectors (or Equal)

WAGO 221
PHOENIX CONTACT
XLR NEUTRIK
CRESTRON
RJ45 DM-8G-CONN
RJ45 IDC DM-CONN

DMX512-A Wiring Connections

<table>
<thead>
<tr>
<th>Signal</th>
<th>Description</th>
<th>Pin Colors (4-Pair Cable)</th>
<th>Pin Colors (2-Pair Cable)</th>
<th>3-pin XLR connector</th>
<th>5-Pin XLR connector</th>
<th>5-Pin PHX connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal Common</td>
<td>White/Brown and Brown</td>
<td>White/Blue and Blue</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Data (-)</td>
<td>Primary Data Link</td>
<td>Orange</td>
<td>Orange</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Data (+)</td>
<td>Primary Data Link</td>
<td>White/Orange</td>
<td>White/Orange</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Data2 (-), or not used</td>
<td>Optional Secondary Data Link</td>
<td></td>
<td></td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Data2 (+), or not used</td>
<td>Optional Secondary Data Link</td>
<td></td>
<td></td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

XLR Connectors (5-Pin)

RJ-45 Connector Pin-Out (T568B)
17.4 DMX512-A Controller Example

*Fixture refers to a luminaire with one Lumenetix module, and with one address (DDM) or four addresses (CTM).

DMX512-A Drain Wire Connections

Drain wire connections are required as follows.

Shielding

To add another level of protection from electromagnetic noise, a grounded shield is added over the twisted pair wires. When this is enclosed in a protective jacket, to avoid ground loops and electromagnetic contamination of the ground system, all control ground wiring, including cable shields and drain wires, should be treated like sensitive current-carrying conductors. All control ground wires should be insulated (not bare) and the same wiring practices should be observed with ground wires as with other sensitive signals. Care must also be taken when designing control wiring to ensure that each shield is connected to only a single ground point. You should establish this point at a central location, like a control panel or cabinet, and avoid all connection to grounds in the field. A control ground is sometimes referred to as an isolated ground (an oxymoron) for this reason, but the term single-point ground is more accurate.

Method-1

A typical two-pair shielded cable can be prepared for termination to the terminals with the drain wire cut off. This is usually done at the field end of the cable where no shield grounding is desired. You will then use insulating tape or heat-shrink tubing to protect the cable from contamination and to prevent accidental grounding of the shield or drain wire. An accidental ground at this point would almost certainly create an undesirable ground loop.

Method-2

A typical two-pair shielded cable can be prepared for termination to the terminals with the drain wire cut off. The drain wire, which is an uninsulated conductor, is sleeved with an insulating tubing to prevent accidental grounding. The crimp-on lug is valuable in this instance to retain the tubing. Insulating tape or heat-shrink tubing is again used to protect the cable from contamination and to prevent accidental grounding, since any accidental connection between the drain wire and a chassis, frame, or enclosure would almost certainly create a ground loop.
17 DMX512 PROTOCOL & WIRING DIAGRAMS

17.5 DMX512-A-RDM Control Card Wiring Diagram

Notes:

1. 24V power (red/black) is Class-2 rated.
2. Adapter is configured at factory for DMX inputs.
3. If more than one line of DMX is needed, then a DMX Splitter must be used to create multiple independent branches of a DMX signal and/or to extend the usable distance of each branch. Each of the splitter’s 4, 6, 8, or 16 output ports generates an independently protected DMX signal.

NOTE: BLUETOOTH OPERATION IS FOR COMMISSIONING THE MODULES ONLY, NOT FOR CONTROLLING THEM.
18.1 Lutron® EcoSystem Control Method

EcoSystem technology is a control method for LEDs that provides addressing of individual fixtures and status feedback. This makes it easy to digitally assign one or many fixtures without complicated wiring. This opens up an entire suite of energy-saving, system-monitoring and system-control schemes where the design, setup and re zoning are all done within software, making the electrical and control design simple.

The araya® modules attached to different interface boards can be controlled independently or assigned to a single group by the EcoSystem controller.

The EcoSystem control is responsible for saving any configuration settings. Once an interface board is assigned a pair of addresses, assigned addresses are saved in NVRAM. During the EcoSystem discovery process, the user pairs the desired dimming control in the controller to the Dim channel address in the interface board. The same applies for the CCT channel.

- 1 pair 16AWG Eco Loop, 900 feet (field wiring).
- Maximum of 64 addresses on each loop.

EcoSystem Control Systems (recommended list)*

- Quantum System
- HomeWorks QS
- Grafik Eye QS Control Unit with EcoSystem
- EnergiSavr Node with EcoSystem
- Power Module with EcoSystem

*Recommendations are subject to change. Consult your Lumenetix representative for the most updated list.

Lutron EcoSystem Controller Example

*Fixture refers to a luminaire with one Lumenetix module, and with one address (DDM) or two addresses (CTM).
18.2 Lutron® EcoSystem Field Wiring

- EcoSystem Digital Loop can be wired as Mains voltage or IEC PELV/NECR Class 2 for maximum wiring flexibility.
- The Loop is polarity insensitive and can be wired in any topology.
- Consult all national and local electrical codes for separation requirements.

<table>
<thead>
<tr>
<th>Wire Gauge</th>
<th>Maximum EcoSystem-Compliant Loop Wire Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0 mm² (12 AWG)</td>
<td>671 m (2200 ft)</td>
</tr>
<tr>
<td>2.5 mm² (14 AWG)</td>
<td>427 m (1400 ft)</td>
</tr>
<tr>
<td>1.5 mm² (16 AWG)</td>
<td>275 m (900 ft)</td>
</tr>
<tr>
<td>1.0 mm² (18 AWG)</td>
<td>175 m (570 ft)</td>
</tr>
</tbody>
</table>

Drain Wire Connections

Drain wire connections are required as follows.

Shielding

To add another level of protection from electromagnetic noise, a grounded shield is added over the twisted pair wires. When this is enclosed in a protective jacket, to avoid ground loops and electromagnetic contamination of the ground system, all control ground wiring, including cable shields and drain wires, should be treated like sensitive current-carrying conductors. All control ground wires should be insulated (not bare) and the same wiring practices should be observed with ground wires as with other sensitive signals. Care must also be taken when designing control wiring to ensure that each shield is connected to only a single ground point. You should establish this point at a central location, like a control panel or cabinet, and avoid all connection to grounds in the field. A control ground is sometimes referred to as an isolated ground (an oxymoron) for this reason, but the term single-point ground is more accurate.

Method-1

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Method-2

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18.3 Lutron® EcoSystem Control Card Wiring Diagram

Notes:
1. 24V power (red/black) is Class-2 rated.
2. EcoSystem Channel 1 is always Intensity control. EcoSystem Channel 2 is always CCT control.
3. In the EcoSystem programming mode, EcoSystem Channel 1 controls the intensity from 100%-1%. EcoSystem Channel 2 controls the CCT range from 1650 - 8000K.
4. The Lumenetix-araya Tunable Color 2.0 iOS App should be turned on, and the DMX channels should be set to 2, 4, 6, 8.

The Constant Hot/Live must not be wired to a switching device. This may be put on a relay for maintenance.

Fixture manufacturer to provide minimum 18 AWG of Lutron EcoSystem wire tail (labeled E1 and E2) to junction box. Consult Lutron for field wiring.
19 AVI-ON WIRELESS BLE MESH NETWORK

19.1 Avi-on Wireless BLE Mesh Connectivity

Avi-on Pro Bluetooth Lighting controls employ low-power, long-range Bluetooth technology, and secure patented networking (U.S. Patent 9781245) to provide an efficient, programmable and reconfigurable lighting experience.

Bluetooth with Mesh

Bluetooth Low Energy is a standardized radio technology used in billions of devices worldwide, notably cell phones, tablets, automobiles and wireless headphones. Bluetooth Low Energy Radios have much longer range (100+feet) and lower power, and better security options than conventional Bluetooth radios. As a result, Bluetooth has a growing base in commercial and industrial applications including building automation and lighting controls. Bluetooth operates in the 2.4GHz unlicensed industrial, scientific, and medical (ISM) frequency band meaning that devices can be used as certified by the manufacturer without license.

Avi-on Pro Bluetooth Lighting Controls use high quality Bluetooth Low Energy radios in a mesh topology developed by Qualcomm and Avi-on (CSR Mesh™) resulting in very low power, but highly reliable long range operation with much higher security than either standard Bluetooth or Bluetooth Low Energy. The many-to-many device communication of the mesh topology optimizes the creation of large-scale networks for full-building coverage capability in lighting and building automation solutions. The Avi-on network does not require a central gateway or controllers.

Network Functions

The Avi-on Pro Bluetooth Lighting Controls solution leverages Bluetooth Mesh technology to create a “cloud” of coverage around each component in the system. Once components are commissioned during the installation process, the components self-configure into a network, connecting the individual components to create a system cloud. Any component within the system may then communicate with any other component forming a completely distributed network. If a component, an Avi-on Movable Switch for example, is moved, it will seamlessly reintegrate with the new adjacent components with no required updates of gateway, routing tables, or interaction with other devices. As a result, the network can be reconfigured at will without change in operation as long as individual component ranges are not exceeded. Components typically achieve a 60 to 100 foot point to point range in office, hospitality, and residential settings, with double or triple that in open air settings like warehouse, outdoor, or manufacturing. Because all components work in concert, there is no limit to the range of the entire system cloud as long as individual component ranges are not exceeded. The figure below conceptually demonstrates complete building coverage using the Avion Pro Bluetooth Lighting Controls solution.
19.2 Avi-on Wireless BLE Mesh Setup

Avi-on App (iOS or Android)

The Avi-on iOS/Android App enables mobile phone and tablet users to easily set up and change the system, using schedules, 
scenes, groups, sensors and more, with no wires, complex programming or central controller. The mobile phone or tablet 
(Mobile) running the Avi-on App must support Bluetooth Low Energy (Bluetooth 4.0 or later) and an Internet connection via 
WiFi or cellular. The Mobile runs the Avi-on App and forms a bridge to the Bluetooth mesh system. The Mobile only connects to 
(generally) the closest system component and can “see” and control every element in the network.

The figure below shows a simple representation of an Avi-on Pro Bluetooth Lighting Controls system. The Avi-on App manages 
the user account on a phone or tablet called the Mobile, and is used to set up the network by commissioning system components 
such as high-bay luminaires, wall switches and occupancy sensors. Once the system is set up with the Avi-on App, a Remote 
Access Bridge may also be added to remotely control the system across the Internet.

For more information and assistance, please refer to the various links on the Avi-on website at avi-on.com/resources.
19.3 Avi-on Wireless BLE Mesh Control Card Wiring Diagram

INDEX TAB ON RED END OF CABLE CONNECTOR SHOULD LINE UP WITH INDEX SLOT ON ALM.

ALM WITH AVI-ON CONTROL CARD & ANTENNA

MAKE SURE TO ALIGN INDEX TAB TO INDEX SLOT.

ALM WITH AVI-ON BT MESH CONTROL CARD AND ANTENNA

ALM 24V POWER CABLE (28.030.001.01)

JUNCTION BOX

WHITE (NEUTRAL)
BLACK (HOT)
LINE-IN VOLTAGE (REFER TO POWER SUPPLY)

CLASS-2 AC TO DC 24V POWER SUPPLY (SUPPLIED BY OEM)

TUNABLE COLOR ROUND LED ARRAY

FIXTURE

RIBBON CONNECTOR CABLE
20  DALI TYPE 8 PROTOCOL & WIRING DIAGRAMS

20.1 DALI Type 8 Protocol Specifications

Digital Addressable Lighting Interface (DALI) is a communication language. DALI facilitates the communication and therefore control of multiple devices such as drivers, transformers and other lighting equipment. Devices which speak the same language can exchange information, in much the same way people can exchange information when they communicate using the same language.

DALI Devices:

Designed on a distributed intelligent framework, each DALI device has on-board memory that stores all relevant information about the device, including diagnostics, which reduces the technical requirements on the control system and the amount of data to be transmitted over the line.

DALI Standards:

- DALI is a lighting control standard defined under the European Standard IEC 62386.
- IEC stands for International Electrotechnical Commission and is a non-profit organization.
- DALI was designed to replace traditional 1-10 V analog systems and proprietary digital systems such as DSI (Digital Serial Interface).
- At a maximum there can be 64 DALI devices on a single DALI line and it has a data baud rate of 1200 baud.

DALI Technical Specifications:

Numbers of units: max. 64
Numbers of addresses: 64
Signal level: +/- 16V
Cable length: max. 300m, and less than 2V voltage drop
Cable type: any 2 wire unshielded cable
Cable topology: any (line, star, tree, ring)
Refresh rate: max 40 messages /second +/- 1200 baud
Safety
DALI is not SELV, cable must be treated like mains wiring

Maximum DALI-compliant Bus Wire Length:
1.5 mm² (300 m)
0.75 mm² (150 m)
0.50 mm² (100 m)

A DALI system contains one current source, a controller and input(s). In idle state the current signal is “high” so there is current. A driver input current is 2mA in idle state. Nominal current for 64 inputs is 128mA. Information is transferred by short circuiting the current, (controller / input). Communication is always started by the controller. An input can only “answer” (=back channel info). Random addressing is possible. DALI units have no address from factory. Any address can be changed via the DALI connection. An input can detect if the DALI current is present.
20 DALI TYPE 8 PROTOCOL & WIRING DIAGRAMS

20.2 DALI Type 8 Wiring Specifications

DALI Wiring can be run up to 300m using 1.5mm cable. (15 awg) The DALI specification allows for maximum 2V drop in the communication signal. The DALI line does not require termination of the line and supports all wiring typologies except rings and closed loops (trees, branches and chains are all acceptable).

The following are National Electric Code (NEC 70) requirements.

DALI Class 1 and Class 2 Wiring Overview:

DALI dimming ballasts and drivers are connected together by a 2-wire low voltage bus that is suitable for Class 1 or Class 2 wiring installations. This application note explains how both Class 1 and 2 wiring are made and how they both meet National Electric Code (NEC) regulations.

DALI Dimming Ballast and Driver Wired Class 2:

For more information on Class 2 wiring and additional Class 2 wiring requirements see National Electric Code Article 725. With regards to factory installed wiring, as per UL1598 section 6.17.1: Factory-installed power limited wiring and branch circuit wiring that come in random contact within the luminaire shall have insulation rated for the maximum voltage that exists in any of the circuits.

If wiring with the properly rated insulation is used, then no spacing or separation is required regardless of the circuit conductor voltage although shielding may be required.

Class 2 wiring of the DALI dimming ballast and driver follows the NEC Requirement 725.136(D) (references to Class 3 are eliminated).

Class 2 circuit conductors in compartments, enclosures, device boxes, outlet boxes, or similar fittings shall be permitted to be installed with electric light, power, Class 1 circuits where they are introduced solely to connect the equipment connected to Class 2 circuits and where (1) or (2) applies:

1. The electric light, power, Class 1 circuit conductors are routed to maintain a minimum of 6 mm (.25 in) separation from the conductors and cables of Class 2.

2. The circuit conductors operate at 150 volts or less to ground and also comply with one of the following:
   A. The Class 2 circuits are installed using Type CL3, CL3R, or CL3P or permitted substitute cables provided these Class 3 cable conductors extending beyond the jacket are separated by a minimum of 6 mm (0.25 in) or by a nonconductive sleeve or nonconductive barrier from all other conductors.
   B. The Class 2 circuit conductors are installed as a Class 1 circuit.

The DALI dimming ballast and driver have a minimum spacing of 0.25 inches between line voltage and the bus terminals (purple and grey wires) for Class 2 installations.

DALI Bus Wired Class 1:

Class 1 wiring methods follow the NEC Requirement 725.48.

Class 1 circuits shall be permitted to be installed with other circuits as specified in 725.48 (A) and (B):

A. Class 1 circuits shall be permitted to occupy the same cable, cable tray, enclosure, or raceway without regard to whether the individual circuits are alternating or direct current, provided all conductors are insulated for the maximum voltage of any conductors in the cable, cable tray, enclosure or raceway.

B. Class 1 circuits shall be permitted to be installed with power supply conductors as specified:
   1. Class 1 and power supply circuits shall be permitted to occupy the same cable, enclosure, or raceway only when functionally associated.

Since the DALI dimming ballast and driver meets Class 2 installation requirements, it can also be installed in a Class 1 configuration when Class 2 markings are not present. The NEC allows the reclassification of Class 2 circuits per Article 725.130 Exception No.2:

Class 2 and circuits shall be permitted to be reclassified and installed as Class 1 circuits if the Class 2 markings are eliminated and the entire circuit is installed using the wiring methods and materials in accordance with Part II, Class 1 circuits.

Note: For more information regarding Class 2 wiring and additional requirements see the National Electrical Code Article 725.

Reference Information:

Code quotation, guidance, and wiring guides above are listed for reference only. Always follow local and national wiring requirements. NEC 2008 was used as a reference in this Application Note. More recent releases of the National Electrical Code should always be consulted. The National Electrical Code (NEC) is a registered trademark of the National Fire Protection Association, Quincy, MA.
20  DALI TYPE 8 PROTOCOL & WIRING DIAGRAMS

20.3 DALI Type 8 Control Card Wiring Diagram

Notes:
1. 24V power (red/black) is Class-2 rated.
2. One DALI address per linear array / ALM kit.

The Constant Hot/Live must not be wired to a switching device. This may be put on a relay for maintenance.

Fixture manufacturer to provide minimum 18 AWG of DALI wire tail to junction box. Consult DALI specifications for field wiring.
21 PRE-INSTALLATION NOTES

DYNAMIC DIMMING ROUND LED ARRAYS

- Exercise caution when connecting the ribbon cables to the LED arrays. Do not press the domed lens against a hard surface (like a table or workbench) as they can be damaged. Do not break off the indexing tabs.

RIBBON CABLE CONNECTORS

- The ribbon cable connector slot is located on one side of the round LED array.

Lumenetix-araya LOGIC MODULE

- Mount the ALM to the fixture with 6 mm - 8 mm (M2.5 - M4) screws in desired location.

Test-fit all components prior to installation. Mark edges for correct alignment.