

Matrix Platform LUXEON XF-3535L

Assembly and handling information



Introduction

This application brief addresses the recommended assembly and handling procedures for the LUXEON XF-3535L family of flex strips. LUXEON XF-3535L is a family of fully integrated solutions optimized for lighting applications requiring linear arrays that can easily fit into any luminaire housing form factor. The overall solution delivers optimized performance in combination with the quality of light needed for distributed light source applications. Proper assembly, handling, and thermal management, as outlined in this application brief, ensure high optical output and reliability of these integrated solutions.

Scope

The assembly and handling guidelines in this Application Brief apply to the following LUXEON XF-3535L products:

L235-xyyyAHLxByAC0

L235-xyyyAMLf5WAD0

L235-xyyyAULM5JAIO

x and y refer to variables as defined in the product nomenclature section of the datasheet. In the remainder of this document the term “LUXEON XF-3535L” or “flex strip” refers to any of the products listed above.

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1. Product Description

LUXEON XF-3535L features LUXEON 3535L LEDs, flexible substrate, electrical connections, and backside adhesive for easy attachment to a heat sink. LUXEON XF-3535L comes in four main configurations.

- A 600mm length x 10mm wide strip with 36 LEDs at 16.67mm LED pitch
- A 300mm length x 10mm wide strip with 36 LEDs at 8.0mm LED pitch
- A 525mm length x 5.25mm wide strip with 56 LEDs at 8.45mm LED pitch
- A 1150mm length x 5.25mm wide strip with 108 LEDs at 10.0mm LED pitch

The 525mm and 1150mm strips come with IDC connectors at each end. 600mm and 300mm strips are available with two IDC connectors at one end or without connectors and tin contacts only.

The polyimide-based copper-clad laminate Flex substrate has very good bending stability. The absolute minimum bending diameter is 5cm. A smaller diameter is possible, but then the product should not be flattened. Strips should not be bent at solder joints (where strips are daisy chained).

A high reflectivity white silicone coating is applied to the strip providing an initial reflectivity ~90 %.

2. Handling Precautions

The LUXEON XF-3535L is designed to maximize light output and reliability. However, improper handling of the strips may damage the Flex and affect the overall performance and reliability. In order to minimize the risk of damage to the LUXEON XF-3535L during handling, it should only be picked up via the foil and bending with a radius of less than 5cm on the flex should be avoided as it may cause damage.

Although in general bending the LUXEON XF-3535L by less than 5cm should be avoided during handling, the strip can withstand greater bending when mounted. For example the LUXEON XF-3535L can be folded or bent at right angles.

Caution: this must only be done midway ($\pm 2\text{mm}$) between the LEDs and only once. Folding the strip more than once will cause the strip to fail (see Figure 1 and Figure 2). I.e. once folded it should not be flattened again.

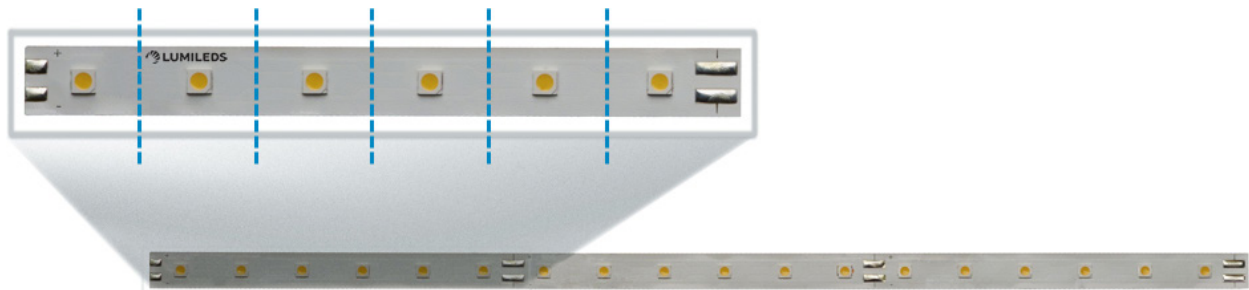


Figure 1. Fold/bend at dotted lines only.

2.1 Cleaning

LUXEON XF-3535L emitters should not be exposed to dust and debris. Dust and debris may cause a decrease in optical output. In the event that a LUXEON XF-3535L emitter(s) require cleaning, first try a gentle swabbing using a lint-free swab. If needed Isopropyl alcohol (IPA) can be used to gently remove dirt from the top of the LED. Do not use other solvents as they may adversely react with the LED assembly.

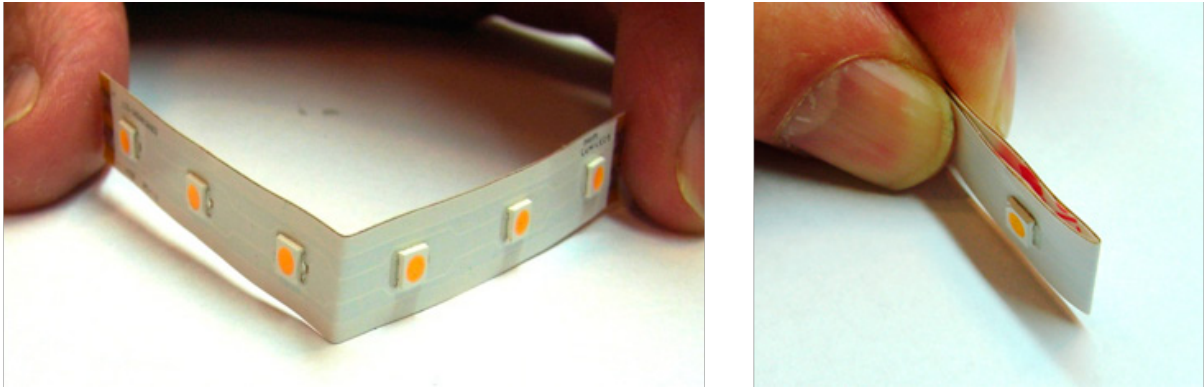


Figure 2. Example of one-off Bend and Fold.

3. Electrical Connection

Care must be taken to correctly identify the positive and negative connection points on the ends of the flex. $\pm$ marks are printed on the flex as shown in Figure 3.



Figure 3. Identifying +/- connection.

3.1 Parallel Connection

Two or more 600mm strips could be wired in the configuration shown in Figure 4. In this case, we have 12 x 6 LED cells in parallel so the driver should be capable of supplying 18V at a nominal current of 1.2A. For a full list of allowable parallel/series configurations, refer to Table 1.

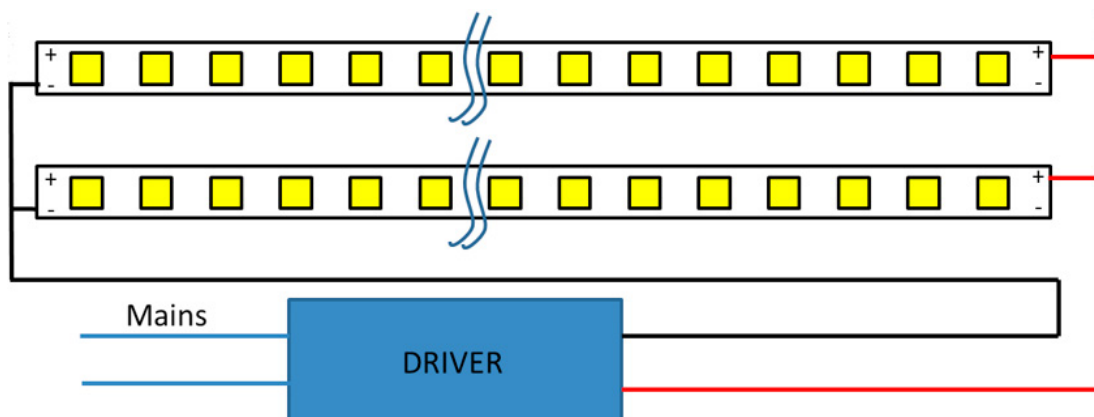


Figure 4. Parallel connection.

When making parallel connections of multiple flex strips, the total forward voltage remains constant, but the current has to be multiplied by the number of strips. Care has to be taken to distribute the current evenly over the strips. Daisy chaining will force the combined current to go through the thin Flex circuits and will cause voltage drops over longer lengths (i.e. if 2 or more strips daisy chained). The light output of the LEDs may drop depending on the electrical distance to the driver.

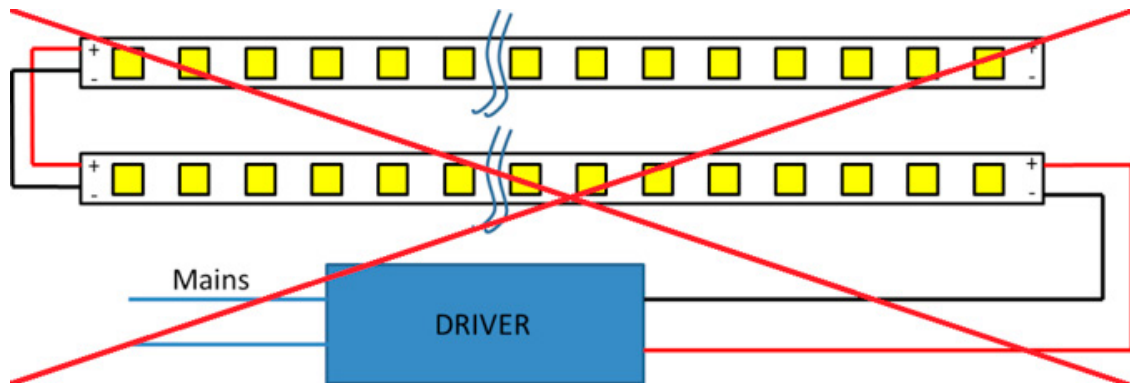


Figure 5. Caution: This configuration is possible but not recommended.

Figure 5 is possible, but could lead to LOP non uniformity along the length of the 2 LED strips. In general, the wiring in Figure 4 is electrically equivalent and requires fewer wires.

Another alternate method is to power in/out at the middle of (in between) the 2 strips. If more strips are needed and if optimal uniformity needs to be maintained along the length of the strips, then multiple input/output power nodes and wires can be added.

3.2 Series Connection

When making a series connection, the required driver current remains the same, but the forward voltage has to be multiplied by the numbers of Flex strips in series. Care has to be taken that higher voltages may require different protection than low voltages. Please refer to local jurisdictional requirements.

Two Flex strips can be wired in the following configuration. For example in Figure 6 cells from one strip are in series with the cells from the other strips.

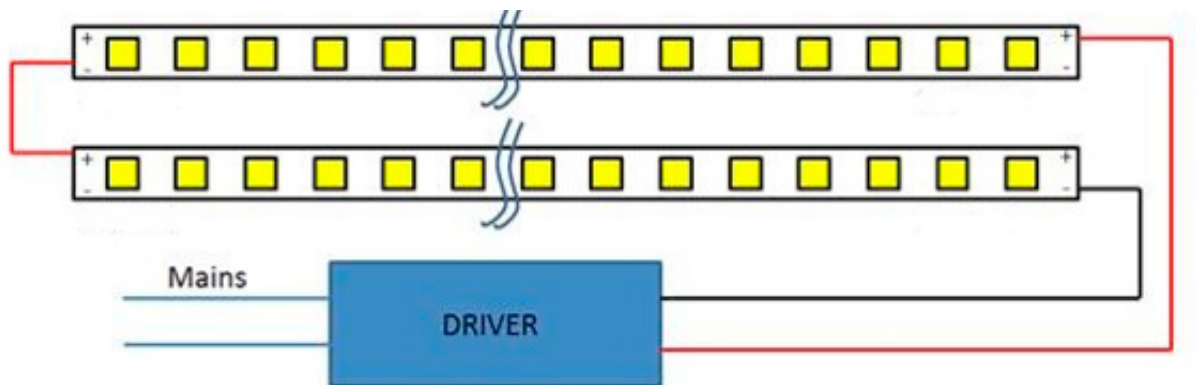


Figure 6. Series connection.

The driver for Figure 6, should be capable of supplying 36V (2x 18V) at a nominal current of 600mA.

3.3 Drivers

A suitable driver for use with the previous configuration is shown in Figure 7.



Figure 7. Lumileds Xitanium LD-R 30W 700mA (suitable for indoor use)

With this driver the LED current will be $700\text{mA} / 6 = 116.7\text{mA}$ with a max total forward voltage of $2 \times 18.6\text{V} = 37.2\text{V}$. Thus the total max power output of the driver will be $0.7\text{A} \times 37.2\text{V} = 26\text{W}$.

For other compatible drivers visit the online Design Tools at: lumileds.com/designtools

3.4 Allowable Series / Parallel Configurations per Class 2 Driver

Table 1. Allowable Series / Parallel Configurations per Class 2 driver

LUXEON XF PRODUCT	NUMBER OF SERIES LEDS PER LED STRING	NUMBER OF PARALLEL LED STRINGS PER L2 STRIP	CURRENT PER LED STRING (A)	MAX VOLTAGE PER LED STRING (V)	NUMBER OF PARALLEL L2 STRIPS NEEDED	NUMBER OF SERIAL L2 STRIPS NEEDED	TOTAL CURRENT REQUIRED* (A)	TOTAL VOLTAGE REQUIRED (V)	TOTAL POWER REQUIRED (W)
LUXEON XF-3535L 300 & 600mm	6	6	0.1	18.6	1	1	0.6	18.6	11
	6	6	0.1	18.6	2	1	1.2	18.6	22
	6	6	0.1	18.6	3	1	1.8	18.6	33
	6	6	0.1	18.6	4	1	2.4	18.6	45
	6	6	0.1	18.6	5	1	3	18.6	56
	6	6	0.1	18.6	6	1	3.6	18.6	67
	6	6	0.1	18.6	7	1	4.2	18.6	78
	6	6	0.1	18.6	8	1	4.8	18.6	89
	6	6	0.1	18.6	9	1	5.4	18.6	100
	6	6	0.1	18.6	1	2	0.6	37.2	22
	6	6	0.1	18.6	2	2	1.2	37.2	45
	6	6	0.1	18.6	3	2	1.8	37.2	67
	6	6	0.1	18.6	4	2	2.4	37.2	89
	6	6	0.1	18.6	1	3	0.6	55.8	33
	6	6	0.1	18.6	2	3	1.2	55.8	67
	6	6	0.1	18.6	3	3	1.8	55.8	100
	6	6	0.2	19.8	1	1	1.2	19.8	24
	6	6	0.2	19.8	2	1	2.4	19.8	48
	6	6	0.2	19.8	3	1	3.6	19.8	71
	6	6	0.2	19.8	4	1	4.8	19.8	95
	6	6	0.2	19.8	1	2	1.2	39.6	48
	6	6	0.2	19.8	2	2	2.4	39.6	95
	6	6	0.2	19.8	1	3	1.2	59.4	71
LUXEON XF-3535L 525mm	7	8	0.1	21.7	1	1	0.8	21.7	17
	7	8	0.1	21.7	2	1	1.6	21.7	35
	7	8	0.1	21.7	3	1	2.4	21.7	52
	7	8	0.1	21.7	4	1	3.2	21.7	69
	7	8	0.1	21.7	5	1	4	21.7	87
	7	8	0.1	21.7	1	2	0.8	43.4	35
	7	8	0.1	21.7	2	2	1.6	43.4	69
	7	8	0.2	23.1	1	1	1.6	23.1	37
	7	8	0.2	23.1	2	1	3.2	23.1	74
	7	8	0.2	23.1	1	2	1.6	46.2	74
LUXEON XF-3535L 1150mm	12	9	0.1	37.2	1	1	0.9	37.2	33
	12	9	0.1	37.2	2	1	1.8	37.2	67
	12	9	0.1	37.2	3	1	2.7	37.2	100
	12	9	0.2	37.2	1	1	1.8	37.2	67

Notes for Table 1:

1. These are operational boundaries per Class 2 Driver.
2. Each configuration can be duplicated with additional Class 2 drivers.
3. Vf drops can cause light output loss in series/parallel configurations.
4. *Orange cells are above AWG24 wire gauge max current rating. IDC connectors are designed for AWG24. Higher rated wire gauge should be soldered to contact pads if required.

4. Electrical Isolation and Safety

Most jurisdictions around the world impose some basic safety requirements on electrical appliances. For the US this is covered by UL standards (UL 8750). Within the EU, equipment must conform to the Low Voltage Directive (LVD) 2006/95/EC. The LVD ensures that electrical equipment within certain voltage limits provides a high level of protection. The Directive covers electrical equipment with a voltage between 50 and 1000 V for alternating current and between 75 and 1500 V for direct current. It should be noted that these voltage ratings refer to the voltage of the electrical input or output, not to voltages that may appear inside the equipment. For most electrical equipment, the health aspects of emissions of Electromagnetic Fields are also under the domain of the Low Voltage Directive.

It is also recommended that care should be taken to provide sufficient isolation at the strip ends when mounted to metal parts.

5. Manual Assembly and Mounting

To securely apply LUXEON XF-3535L onto a substrate, follow these general steps:

- (optional) Cut the strip to the desired length
- Note: Only 300mm and 600mm strips are cuttable (in 100mm increments)
- Clean the mounting surface
- Apply the strip
- Solder the strip
- (if needed) Rework

These steps are detailed in the following slides.

5.1 Cutting

The LUXEON XF-3535L can be trimmed to the desired length by cutting with sharp scissors at the cell boundaries, see Figure 8. If a large number of strips are to cut ceramic scissors could be considered.

Do not cut the strip at the reflective foil as this will render the strip unusable.

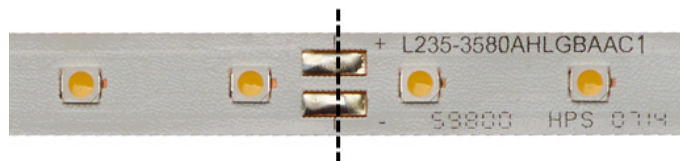


Figure 8. Indication where to cut.

5.2 Surface Cleaning

Use a new lint-free swab and IPA to clean the mounting surface (heat sink) and let it dry.

5.3 Mounting Strip to Surface or Heatsink

The LUXEON XF-3535L is supplied with a high performance 3M adhesive tape. This tape has high bond and sheer strength on materials with a high surface energy. These materials include glass, stainless steel, aluminium and high surface energy plastics (e.g. ABS and PC). The recommended methods for mounting a strip is by using a wallpaper seam roller, e.g. from Perfax: <http://www.wallpaperwebstore.com/perfax-naadroller>



Figure 9. Roller to apply the Flex strip.

It is recommended the roller is made from non-porous foam modulus so it can be easily cleaned, and thus avoiding damaging the strip or the LEDs. The strip can also be mounted without a roller by applying pressure to the strip with the hands; do not press on the LEDs directly as this may damage the LEDs. If so desired, ESD-safe polyester clean-room gloves can be used.

To ensure desired alignment of the strip, mark the mount points for the end of the strip. This can be done with removable tape as shown in Figure 10.

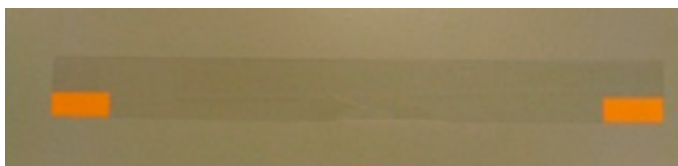


Figure 10. Mark surface with alignment strips.

Remove a few centimeters of the liner from the LUXEON XF-3535L strip and carefully place using the alignment strips as reference. Take care the other end of the strip is properly aligned with the marker. Once part of the strip is fixed to the surface, it is difficult to adjust.

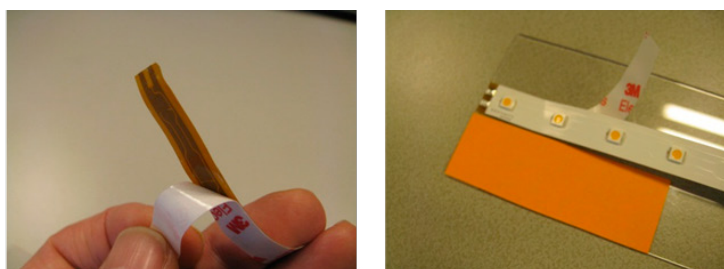


Figure 11. Remove 3-4cm of the protective foil and fix one end of the strip.

When the one side of the strip is fixed, remove most of the liner. Leave just enough liner to hold the strip at the end without getting glue on the fingers. Ensure the strip remains straight preventing the strip from accidentally gluing itself to the surface and avoid kinking the strip at the mount point.

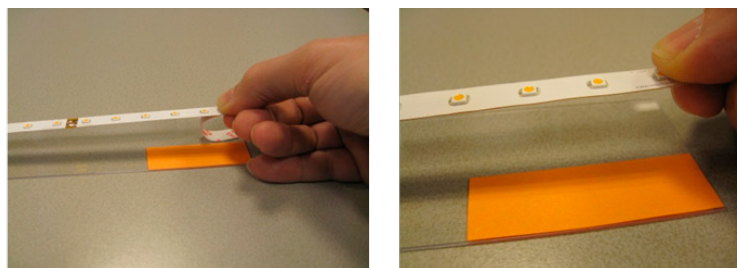


Figure 12. Remove almost all of the protective foil and align the end, but do not place.

Keep the strip stretched tight to the second marker without touching the surface with the glue (Figure 12: Remove almost all of the protective foil and align the end, but do not place). Apply the roller with steady pressure at the starting (glued) end and run smoothly towards the far end maintaining alignment as the tool travels. (Figure 13)

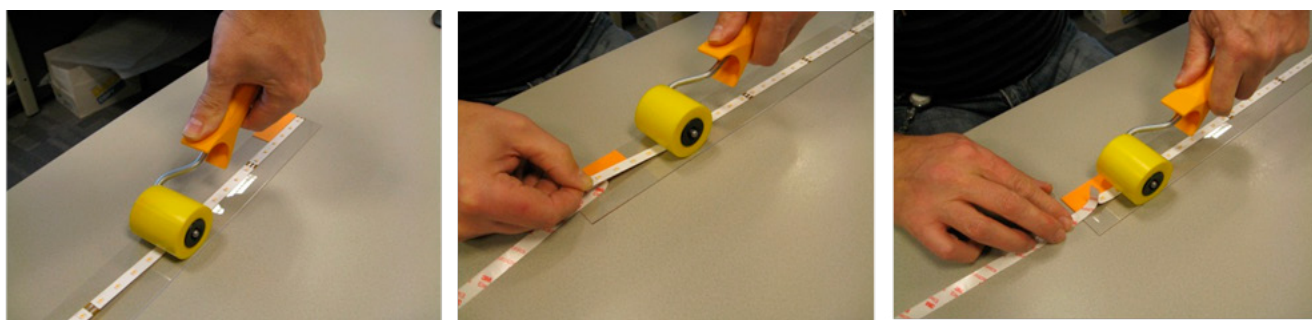


Figure 13. Using the roller to fix the strip.

When the roller is near the end, the remainder of the liner can be removed.



Figure 14. Finished.

It may happen that small pockets of air are trapped below the strip. This can be visible as a small bump. In general, this does not impact the long-term performance of the LUXEON XF-3535L.

The adhesion of the PSA to the mounting surface will reach 90% of its peak strength after 1 day. Heat and pressure can be used to accelerate the curing cycle. For example, good adhesion has been achieved by storing LUXEON XF-3535L for one hour at 80°C. Results may vary with different heat sink materials. Lumileds recommends that customers always perform their own testing.

5.4 Soldering Wires to the Flex Strip

Wires can be soldered before or after fixing the strip to the surface. The following process is suggested.

Pre-requisites:

- Grounded soldering iron, capable of reaching 350°C
- Stranded copper wire of 24 AWG or larger
- SAC305 solder wire

Prepare the electrical wires:

- Cut the wires to size.
- Strip a few millimetres of insulating material from the ends of the wires.
- Pre-tin the wires with a small amount of solder.

Prepare the LUXEON XF-3535L flex strip:

- Clean the electrical pads of the LUXEON XF-3535L flex strip with a lint-free swab and isopropyl alcohol to remove any debris or particles.

Solder the pre-tinned wires to the pre-tinned electrical pads:

- Place the pre-tinned LUXEON XF-3535L flex strip on a thermally insulating surface



Figure 15. Solder points.

- Place the pre-tinned wire on the pre-tinned electrical pad.
- Place the tip of the soldering iron on the electrical pad and allow the solder to reflow around the wire. Do not place the soldering iron on the electrical pad for more than 3 seconds to prevent any damage to the LUXEON XF-3535L flex strip. If a solder joint cannot be established within this time, allow the LUXEON XF-3535L flex strip to cool before reapplying the heat.
- Remove the soldering iron and allow the solder joint to cool.

5.5 Rework

If a flex strip was not placed correctly, it should be removed promptly. The longer it remains in place, the stronger the bond. After 3 minutes it cannot be re-glued. It is recommended that if the flex needs to be removed it should be done within 1 minute of application.

Note: the angle between the surface and the strip being pulled should not exceed 20 degrees, see Figure 16. Carefully inspect the flex for damage, especially the copper traces right next to the LEDs. These are stressed the most during removal. If in doubt, replace the flex.



Figure 16. Removal of strip from surface.

In case the strip has been in place too long, the LUXEON XF-3535L flex strip may be very hard to remove without causing damage to the flex or the luminaire. The strip should not be re-used in that case. Removal could be done in various ways:

Cutting:

Cutting the bondline is effective on small assemblies. This can be done with a sharp cutting tool or a fine tooth saw or a textured wire, using liquid soap as a lubricant.

High Frequency Shock:

Small parts can be cooled to below -40°C where the 3M Tape will become rigid. A sharp impact focused near the bondline, should fracture the adhesive. Once the part is warmed up to room temperature, the residual adhesive can be removed.

5.6 Rework – Removing the Adhesive

The residual adhesive can be removed using several methods:

Using the Stripe Off Wheel (3M part number 07498: Figure 17) is a special rubber disk which mounts onto a standard 3/8" electric drill.



Figure 17. Stripe off wheel.

When the rotating disk is brought in contact with the adhesive residue, it lifts the adhesive from the surface. When used properly the wheel does not damage painted surfaces. It helps to remove the bulk of the adhesive residue with a razor scrapper or knife before using the wheel. This operation can be followed by using a cleaning wipe to remove debris.

Abrading:

If surface damage is not an issue, residual adhesive can be removed with a porous abrasive disk or wheel. A detackifying agent such as detergent/water solution or dry talc may be used to facilitate removal and help prevent clogging of the abrasive. Low speeds are generally more effective than high speeds for removal to prevent excessive heat buildup. Once the adhesive is lifted off the surface, a cleaning wipe can be used to remove the debris.

Solvents:

The adhesive residue can be wet with a solvent then covered with a plastic film and allowed to soak for 5-15 minutes. Once the adhesive is softened use a scraper to remove the adhesive. The Solvents to use include:

- 3MTM Citrus Base Cleaner
- MEK (Methyl-Ethyl-Ketone)
- Other commercial adhesive removers

Note: Follow all manufacture's safety precautions when using solvents. These cleaning recommendations may not be compliant with the requirements of certain Air Quality Management jurisdictions – Consult applicable rules before use.

If in doubt follow the guide '3M VHB™ Tape – Disassembly of VHB Tape bonded materials and removal of residue adhesive' Technical Bulletin

5.7 ESD Measures During Mounting

ESD precautions should be followed during mounting/assembling of the LUXEON XF-3535L flex strip onto a product.

Production Environment:

The LUXEON XF-3535L flex strip requires ESD measures in a production environment where values can exceed the values shown in the ESD specifications table below. An ESD-safe production environment comprises of, among other things, a grounded floor, work tables as well as other attributes. ESD-safe clothing and grounding of workers should also be considered. (Figure 18)

Servicing and Installing Luminaires:

When servicing luminaires on site, grounding of the service field engineer should be considered

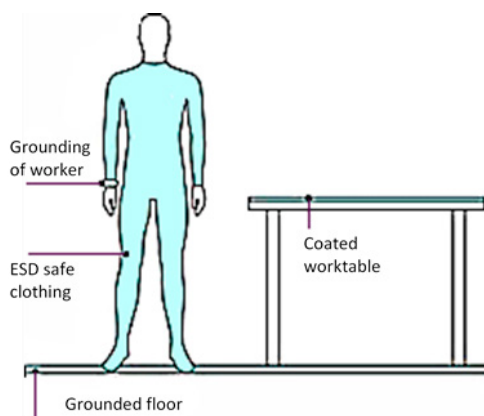


Figure 18. ESD measures.

6. Thermal Considerations

The LUXEON XF-3535L is provided with a copper layer that spreads the heat of the LEDs across the strip. This heat-spreading function allows the LUXEON XF-3535L to be used without a large heat-sink. This allows flexibility in choosing a housing and heat sink. For some applications, this built-in heat sink is sufficient. See Figure 19 for an indication of the generated heat when the LUXEON XF-3535L flex strip hangs freely in an office environment at room temperature.

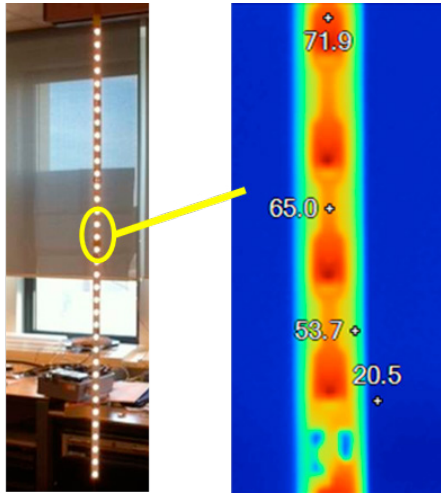


Figure 19. Free hanging Flex strip with zoomed in thermal image.

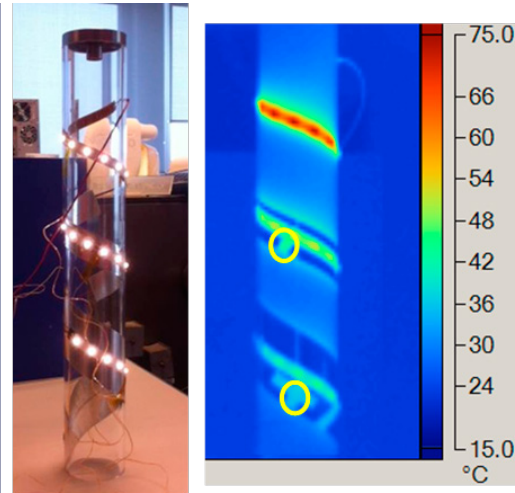


Figure 20. Flex cells mounted on a tube with alu tape: center 2.5cm, bottom 5cm wide.

When needed, an easy way of increasing the heat dissipation of the LUXEON XF-3535L flex strip is the use of aluminium tape; see Figure 20. Since the tape is reflective, the thermal image shows the temperature of the aluminium tape incorrectly: the area marked by the yellow circles does show the correct temperature of the tape (by using a small piece of Kapton tape). From Figure 20 it is clear that the temperature of the LUXEON XF-3535L flex strip is lower when mounted on aluminium tape. The advantage of using aluminium tape is that it adapts to the shape of the surface on which the strip is mounted. Care should be taken that the adhesive used with the aluminium tape is temperature resistant.

Other more traditional heat sinks, or thin metal plates made of steel or aluminium are also possible.

7. Thermal Verification

Given the length of the LUXEON XF-3535L flex strip and the various methods by which it could be applied in a product, there could be a significant temperature differences between different parts of the strip. It is recommended that to ensure the maximum junction temperature of the LEDs is not exceeded the following procedure is followed:

Determine the hottest LED in the product.

A thermocouple or alternatively a contactless infra-red camera could be used.

Use a thermocouple on the hottest LED to measure the temperature of the LED solder pad (T_s).

Using this measured T_s , calculate the junction temperature (T_j) of the LED using the following formula $T_j = T_s + R\theta_{j-s} \times P$, where $R\theta_{j-s}$ is specified in product datasheet and P is the electrical power applied to the LED in Watts.

Verify T_j thus obtained is below the maximum junction temperature allowed for the LUXEON 3535L emitter; i.e. T_j must be below 125°C. If T_j is above 125°C, an additional heat-sink is needed.

8. Mounting the Thermocouple

Before mounting the thermocouple first determine the location of the hottest LED with the LUXEON XF-3535L mounted in the application. Attach all fixtures (e.g. heat sink, lens and any cover) to closely simulate the actual application environment, and use a drive current that corresponds to normal operating conditions. The preferred mounting method for the thermocouple is to glue it to the solder pad. Soldering is also possible, but this carries a risk of either overheating the LED or overheating the adhesive of the LUXEON XF-3535L.

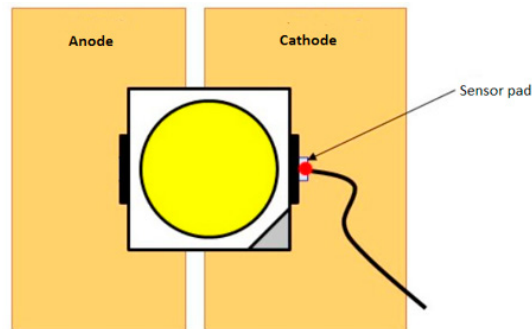


Figure 21. Location of sensor pad.

The location of the sensor pad is right next to the cathode of the LUXEON emitter on the Flex strip, as shown in Figure 21. To ensure accurate readings, the thermocouple must make direct contact with the copper of the foil onto which the LUXEON emitter pads are soldered, i.e. any solder mask or other masking layer must be first removed before mounting the thermocouple onto the sensor pad of the LED.

About Lumileds

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For 100 years, Lumileds commitment to innovation has helped customers pioneer breakthrough products in the automotive, consumer and illumination markets.

Lumileds is shaping the future of light with our LEDs and automotive lamps, and helping our customers illuminate how people see the world around them.

To learn more about our portfolio of light engines, visit lumileds.com.



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