bodine

Emergency Lighting

LED drivers

The reliable, flexible choice for easy LED emergency driver design-in

Contents

Introduction to this guide

Figure 1. BSL310 Emergency LED Driver

Thank you for choosing Bodine LED driver products for your emergency lighting needs. In this guide you will find the information you need to design your Bodine emergency LED driver into a luminaire. We advise you to consult our website for the latest up-to-date information (www.bodine.com).

Bodine emergency LED drivers are designed to operate LED light sources for indoor and many outdoor lighting applications such as offices, schools, hospitals, public buildings, industrial applications, retail environments and even parking garages. Bodine emergency LED drivers can operate in conjunction with most normal LED drivers and LED modules including Advance Xitanium family of LED drivers and Philips Fortimo family of LED modules.

This design-in guide (DIG) is intended to provide basic design-in/application information to help the user successfully incorporate their emergency LED driver into a luminaire so that it functions properly and reliably. More information is available through the Signify OEM portal (www.na.mytechnology.portal.signify.com/login.html) or by contacting your Bodine sales representative.

Information and support

If you require any further information or support, please consult your local Bodine sales office or representative or visit:

• Bodine Emergency LED Drivers	www.signify.com/en-us/brands/bodine/products/led-emergency-drivers
• Advance Xitanium LED Drivers	www.signify.com/en-us/brands/advance/led-drivers/xitanium
• OEM General	www.signify.com/en-us/portfolio/oem
• Signify Easy Design-in Tool (EDiT)	www.na.easydesignintool.philips.com/

Safety precautions

Warnings:

- Avoid touching live parts!
- Do not use drivers with damaged wiring!
- Ensure AC power and converter or emergency engage connector are both disconnected before servicing

Safety warnings and instructions to be taken into account during design-in and manufacturing.

- Do not use damaged or defective contacts or housings.
- Do not service the driver when the mains voltage is connected; this includes connecting or disconnecting the LED load.
- Do not use damaged products.
- Cap off all unused wires to prevent accidental contact with the luminaire, driver housing or other conductive surface.
- The luminaire manufacturer is responsible for its own luminaire design and must comply with all relevant safety standards.
- Bodine emergency LED drivers are intended for built-in use and should not be exposed to the elements such as snow, rain, ice and other types of moisture. Exposure can lead to corrosion of the driver housing and should be avoided. It is the luminaire' manufacturer's responsibility to prevent exposure. Bodine emergency LED drivers are specified for UL damp and dry locations only.
- These emergency drivers must be installed in accordance with national and local electrical codes.
- Design-in support is available to answer other safety concerns not mentioned here; contact your Bodine sales representative for more information.

Introduction to Bodine emergency LED drivers

Application note

Energy saving, flexible in design, long lasting and low maintenance, LED-based lighting sources are an excellent solution of indoor environments. For optimal performance, these lighting applications require reliable emergency drivers matching the long lifetime of the LEDs.

Bodine emergency LED drivers allow normal LED luminaires to be converted into code required emergency light sources as well.

A good resource to help with selecting the best Bodine emergency LED driver for your application is the LED Selection Guide (see www.signify.com/en-us/brands/bodine/resources/literature). Some of the information included in this selection guide is explained in more detail in the following pages of this design-in guide.

Bodine emergency LED drivers install easily and are provided with a detailed set of instructions to help with installation even further.

If questions arise during installation, Bodine provides free technical support during normal business hours (8 a.m. to 5 p.m. CT). The technical support hotline is 888-263-4638.

For more in depth review of a particular application, design-in services are available at no charge. Contact your local Bodine sales representative for more information.

Explanation of commercial naming for Bodine emergency drivers

The former naming convention of a Bodine emergency LED driver is shown in the example below:

For a BSL310, the “BSL” means Bodine Solid-State Lighting. The “3” signifies the average output current of emergency driver in 100mA increments (so, the “3” means 300mA). The “10” signifies the output power (constant, regulated or unregulated profile).*

Some model names do not specify output current. These only describe output power. In a similar way, newer models do not necessarily follow this naming convention. Many will only reference output power.

*Constant power means the output power of the emergency driver remains at the specified level throughout the 90-minute discharge. Regulated power profile maintains a consistent power profile that is in compliance with UL 924 and NFPA 101(R) across all specified loads. A regulated power profile meets the required UL 924 Battery Discharge Test requirements and also permits a reduced battery capacity to allow miniaturization of the overall emergency LED driver size. Unregulated power profile means the output power varies during the battery discharge while maintaining compliance with UL 924 and NFPA 101 with the specified loads. Most Bodine emergency LED drivers do not use an unregulated profile.

Features of Bodine emergency LED drivers

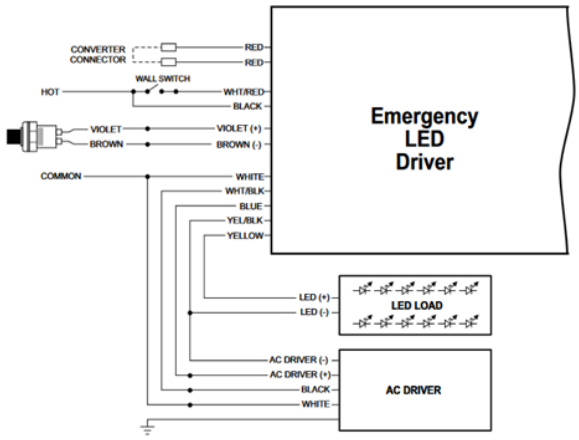

Figure 2. Typical Emergency LED Driver Wiring Diagram

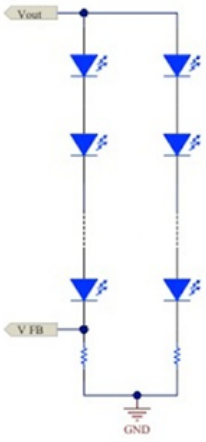

Figure 3. Forward Voltage of an LED String

Emergency LED driver connections and wiring

Typical connections to the normal AC LED driver and LED light engine load are shown in Figure 2.

These connections are typical for most emergency LED drivers. Some other connections may be present and necessary for external batteries and for ground connections (typically for polycarbonate enclosures).

Important

Wiring distances between all devices should be kept to a minimum. Most emergency drivers can be remotely installed from the LED light engine load up to 50 feet using the existing 18 AWG wire provided. However, care should be taken to account for voltage drop for the normal AC driver as well. See Advance Xitanium indoor LED driver design-in guide https://www.na.mytechnology.portal.signify.com/dam/jcr:e4d1c4c2-b192-4bf8-a351-b79db41b1470/Advance%20Xitanium%20Indoor%20Linear%20&%20Point%20LED%20Drivers%20Design-in%20Guide%20(PAd-1615DG).pdf for more information.

Emergency LED driver output voltage range

In order to select the proper emergency LED driver for your application, it is important to know the forward voltage drop of your LED light source. The forward drop of your LED light source is the total voltage measured across the most positive point of your LED string and the most negative point. See example in Figure 3. The forward voltage is the voltage between the two points Vout and VFB.

The emergency LED driver must have an output voltage range that is compatible with the forward voltage of the LED light source. For example, the output voltage range of the popular BSL310 emergency LED driver is 15 - 50VDC (see BSL310 spec sheet). The forward voltage of your LED light source must fall within this range for the BSL310 to operate properly during normal use. If the forward voltage is too high or too low, the BSL310, like most of our emergency LED drivers, will detect this condition and shut down the output.

The Bodine emergency LED driver product offering covers a wide range of forward voltages. Designers can use the Easy design-in tool (EDiT) to help make the best choice for their applications. Forward voltage is one of these parameters the tool uses to make the best product selection. See the EDiT online for more information.
https://www.na.easydesignintool.philips.com/

Emergency LED driver output power

Another parameter that must be considered in order to select the best Bodine emergency LED driver for your application is the required output power. As mentioned previously in this DIG, the last digit(s) of the Bodine emergency LED driver model number signifies the product's output power. Also mentioned previously in this DIG, the output power can be constant, regulated or unregulated.

Constant output power is exactly as the name implies. The output power starts at its rated level during discharge is maintained throughout. So, if the product is rated for 10W constant output power, it will provide 10W to the LED light source throughout the 90-minute discharge provided the forward voltage of the LED light source is within the product's approved range.

Regulated output power is a term used to describe how the product operates during discharge in that it controls the output power at certain levels throughout. For example, a product rated for 10W with regulated output power may maintain full power to the LED light source for a predetermined duration. It may then decrease its output power, at a predetermined rate, to a lower power level to conserve battery capacity while maintaining required levels necessary to meet UL 924 standards.

Unregulated output power is exactly as the name implies. The output power follows the battery voltage without any controls. It follows a typical NiCd battery discharge curve for a fluorescent emergency battery pack as shown in Figure 4.

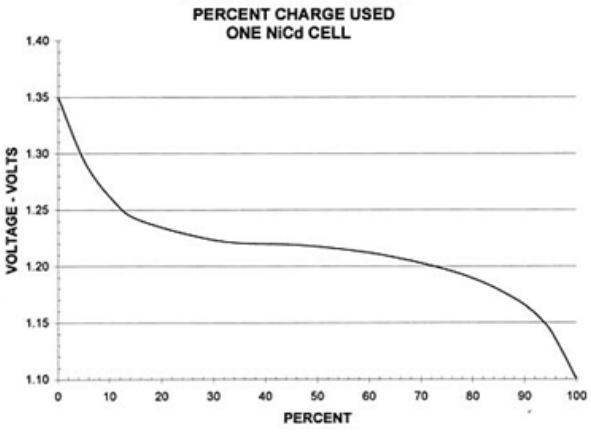

Figure 4. Typical Discharge Curve for a NiCd Battery Cell

So, now we understand how the output power will vary during discharge, we can determine which emergency product is best suited for our application. The best way to do this is by determining the power required to achieve the proper egress path illumination. This is based on the NFPA 101(R) Life Safety Code(R) (LSC) minimum of one foot-candle illuminance average over the path of egress after one minute of emergency operation. At a mounting height of approximately 8'-10', this can typically be achieved with a light source producing 300-400 lumens of luminous flux. Most LED luminaires being installed today have efficacies of at least 115 lumens per watt. So, a light source driven by 3-4W will produce the required lumens to achieve the required one-foot candle of illuminance. This is the baseline to use to determine the best emergency LED driver for various applications.
For example, if an application requires mounting the light source at heights greater than 15'-20', the light source will need to be driven at a higher power to achieve the LSC required minimum illuminance on the path of egress. A typical example of this is a high bay luminaire in a warehouse. In this case, the best choice of emergency LED driver would be something with the highest output power available (20W), like a BSL20 family product (BSL20 family spec sheet — https://www.na.mytechnology.portal.signify.com/dam/jcr:5bcd0cac-2bda-4c86-872d-c5fbe499896d/BSL20LV.MV.HV.spec.L8000058.pdf). For most applications with typical ceiling heights of 8'-10', a 10W product like the BSL310 would perform at a premium level (see BSL310 spec sheet — https://www.na.mytechnology.portal.signify.com/dam/jcr:0bf011fc-bb41-4b8a-915c-191f35d66af1/BSL310.spec.L8000065.pdf). If lowest cost is critical, products like the BSL4L will achieve the minimum required illuminance levels assuming typical ceiling heights (8'-10') and typical luminaire efficacies (115 lumens/W).

The previous discussion only considered the initial light output in determining the proper emergency LED driver. The designer should use the type of output power discharge profile needed for a specific application. In most cases, regulated output power is sufficient. In some cases, like for hospitals or other slower traffic occupancies, constant power may be preferred since it will maintain consistent illumination on the path of egress over the entire discharge cycle. This is not a requirement for any occupancies, but it may be preferred considering other factors.

Emergency LED driver output current

Since the LED light source forward voltage and emergency LED driver output power will typically determine the output current, this feature is usually not a design concern other than ensuring the output current will not overdrive the LED light source. For example, if LED light source with a forward voltage of 20VDC and rated power of 5W is connected to a 20W emergency LED driver like the BSL20LV, damage could result from the excess output current. The maximum current for the LED light source is 250mA while the emergency driver would attempt to deliver approximately 1A causing potential damage to the LED light source. Care must be taken to ensure the LED light source power and current limits are not exceed during emergency operation.

There are some Bodine emergency LED driver product offerings that operate in a constant current mode with a limited forward voltage operating range. One of these is the BSL722 (BSL722 spec sheet — https://www.na.mytechnology.portal.signify.com/dam/jcr:e7f1b65e-52a4-4a20-80ef-f9ca3573a68d/BSL722.spec.L8000055.pdf). This product was designed for a specific LED light source with a forward voltage range of 28-33VDC and operates it at approximately 700mA. This is not a typical Bodine emergency LED driver product, but it does offer some flexibility if the LED light source is well-established and its operating specifications fall within those of the BSL722.

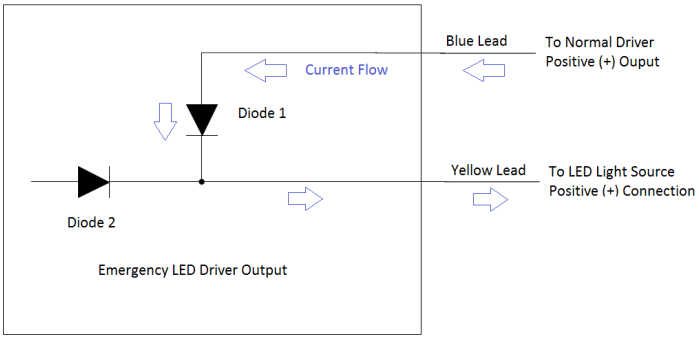

Figure 5. Steering Diode Circuit in Emergency LED Driver Output

Maximum normal driver current limits

Another consideration for the designer when specifying a Bodine emergency LED driver is the maximum current for the normal driver. The designer might ask, “Why should this matter?” Well, the answer is quite simple. Since the emergency driver must operate the LED light source directly when a utility power outage occurs and the normal driver must operate the LED light source when utility power is present, there must be a way to connect the two devices together in order to make this happen. In order to do this, the output current of the normal driver is routed through the emergency driver during normal operation (see blue arrows in Figure 5). When a power outage occurs, the normal driver output current is interrupted and the output of the emergency driver is connected directly across the LED light source in order to operate it.

Referring to Figure 5 again, all the output current from the normal driver passes through Diode 1 in the emergency driver output circuit during normal operation. Since diodes have limited current carrying capacity ratings, there is a maximum normal driver current that can safely be carried through Diode 1 before it reaches its thermal limitations. This is the reason there is a maximum normal driver current rating for all Bodine emergency LED drivers. Designers must check this rating to ensure the emergency driver can carry the maximum current of the normal driver. The maximum normal driver current limit for most of the Bodine product offering is at least 2 amps, but the product specifications and/or installation instructions should be checked to ensure the Bodine emergency LED driver can accommodate the maximum normal driver current.

Emergency LED driver surge rating

All Bodine emergency LED drivers are surge tested per the UL 924 Standard for emergency Lighting. However, this testing is not the same as typical surge testing to achieve an actual published surge rating. This requires a much higher test sample size and adherence to the IEEE C62.41.2-2002 Standard. This is not typically a performance requirement of Bodine emergency LED drivers. However, surge ratings of luminaires equipped with Bodine emergency LED drivers can be increased to much higher levels (10kA and above) using other products such as the Philips SP1 (SP1 datasheet — http://www1.futureelectronics.com/doc/PHILIPS%20LIGHTING/SP1Specification.pdf). This is typically only required in outdoor luminaires and other applications that may be subject to high line surges.

Emergency LED driver extended temperature range

Bodine also offers extended temperature range emergency LED drivers for use in locations where the ambient temperature drops to -20°C (-4°F). Typical applications for these products include parking garages and warehouses without temperature controls. These products operate LED light sources in a similar way to their normal temperature range counterparts. The main difference is either the use of a battery heater or a different battery with a chemistry that can withstand the lower temperatures. The products with extended temperature will have the tradename "Cold-Pak" in their model number (see Figure 6).

Figure 6. BSL36 Cold-Pak Emergency LED Driver for Extended Temperature Range

Other emergency LED driver features

There are other features offered by Bodine in their emergency LED driver portfolio. These include self-testing capability, integral flexible metal conduit (single or dual) for downlight applications, optional IP67 test switch (mainly used for outdoor luminaires), low profile and hazardous location rating (Class I Division 2). Not all models offer all of these options. Check the website and the EDiT for more information (use the links provided previously on page 3 of this document).

Thermal management

This section covers the key aspects in determining the suitability of the mounting location for the Bodine emergency LED driver from a thermal management perspective. There are typically two ways to determine this. The first is monitoring the maximum case temperature at a specific location on the emergency LED driver typically designated by the Tc symbol (see example in Figure 7).

The second method that can be used to determine the suitability of the emergency LED driver mounting location is by simply measuring its ambient temperature under the same luminaire conditions above (operating at full power in an ambient environment at its maximum rated temperature). In this method, multiple thermocouples are typically placed within 1/2" of each exposed side of the emergency LED driver and temperatures are measured and recorded once the ambient temperature(s) reaches thermal equilibrium. These temperatures are then averaged and compared to the maximum rated ambient temperature for the emergency LED driver. The mounting location is considered suitable if the average of the measured temperatures does not exceed the maximum rated ambient temperature of the emergency LED driver.

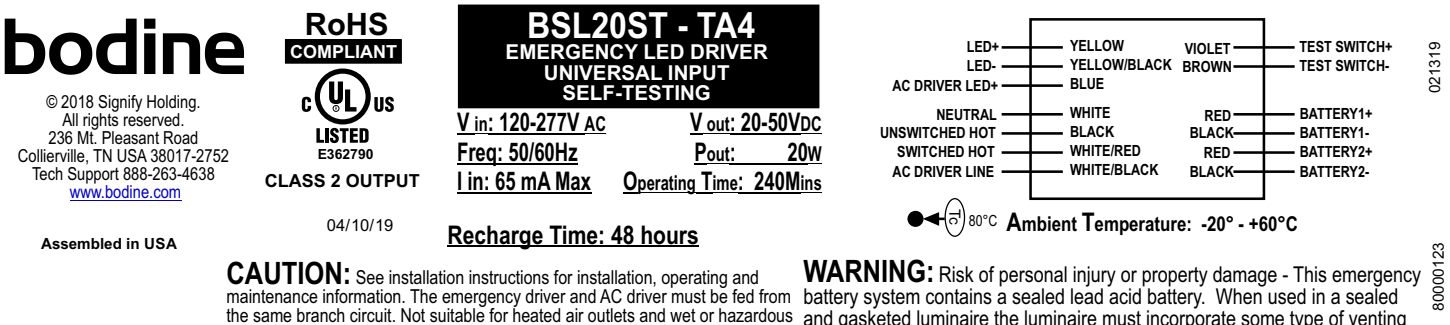

Figure 7. Sample Product Label Showing Maximum Case Temperature Point

Thermal management continued

UL 924 requires the ambient temperature method to be used, in general. The Tc point method should only be used as a quick check or for field installations.

The temperature of this location should be measured with a suitable thermocouple with battery charging. The luminaire should be operating at full power in an ambient environment at its maximum rated temperature. The temperature measured at the Tc location should not exceed the rated temperature for this location (marked on the emergency LED driver label).

Example:
Thermocouples were placed on each side and top of an emergency LED driver with a maximum rated ambient temperature of 55°C. These five thermocouples measured the following temperatures at these locations once the luminaire reached thermal equilibrium while operating at full power in its maximum rated ambient temperature — 55.6°C, 53.7°C, 52.5°C, 56.1°C and 54.2°C. The average of these five temperatures is 54.4°C [(55.6 + 53.7 + 52.5 + 56.1 + 54.2) / 5]. Since the average is less than the maximum rated ambient of the emergency LED driver, the mounting location is suitable.

Electromagnetic compatibility (EMC)

Bodine emergency LED drivers are designed to meet EMC requirements set forth in the FCC Title 47 Part 15 Class A regulation (https://www.ecfr.gov/cgi-bin/text-idx?SID=ccdd213aa155b63ba85775d5a31de4e0&mc=true&node=pt47.1.15&rgn=div5#sp47.1.15.b). These products are classified as Unintentional Radiators as defined in Subpart B. Compliance with this regulation means our products are suitable for commercial and industrial applications. See FCC Title 47 CFR Part 15 for details regarding performance requirements in the FCC regulation.

CEC compliance (Title 20)

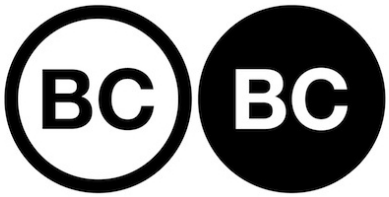

Figure 8. Battery Charger Logo

Most Bodine emergency LED drivers are designed to meet battery charger requirements per California Energy Commission's (CEC) Regulation Title 20. Compliance to this standard means our products are suitable for commercial and industrial use in California, Oregon and Washington. Products with the BC logo, shown in Figure 8, signify they comply with the CEC Title 20 requirements.

A complete list of registered products can be found using the MAEDBS search tool. Use the following search instructions:

a) Go to this link http://energy.ca.gov/appliances/.

b) Under the Appliance Efficiency Database section, click on "Advanced Search."

c) Select Category: **Electronics**.

d) Select Appliance: **Small Battery Chargers**.

e) Select FIlter: **Manufacturer**, **Equals** and **Signify**.

f) Click on Search.

g) The results will show every SKU that is certified for California.

Mechanical mounting

Grounding strap installation instructions:

Step 1) Choose any open emergency ballast mounting tab hole and remove the paint or coating from grounding contact area.

Step 2) Insert the machine screw through the mounting tab hole from the underside.

Step 3) Place the external tooth lock washer, grounding strap, and kep nut on the machine screw from the top, as illustrated.

Step 4) Tighten the kep nut for a secure connection.

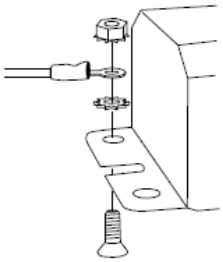

Figure 9. Grounding Kit Instructions

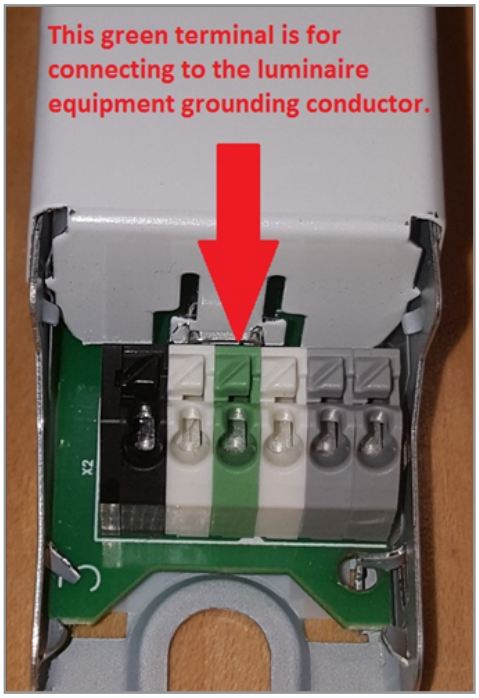

Figure 10. BSL6ST Green Terminal for Equipment Ground

Mounting of the emergency LED driver must satisfy the following criteria:

1) Solid fastening of the driver in order to avoid movement of the driver relative to the luminaire.
The size of the mounting hardware must be the maximum size allowed by the size of the driver mounting holes/slots. Tightening torque should be to hardware manufacturer's specifications. If using the #8-18 sheet metal screws provided in most Bodine emergency LED driver parts kits, the recommended tightening torque is 12-16 in.-lbs.

2) Electrical grounding of the driver
The driver enclosure is painted. It is recommended to use one of the following two methods to ensure the driver is properly grounded.

a. Bodine emergency drivers with metal enclosures are provided with a separate grounding kit (PRT00088) that should be used during installation to ensure the driver enclosure is properly grounded. An example of the kit instructions is shown in Figure 9.

b. Some Bodine emergency drivers come equipped with a green terminal on their integral leadless connectors for the equipment ground (e.g., BSL6LST). This terminal should be connected to the equipment grounding conductor for the luminaire. See Figure 10 for an example.

Sealed & gasketed luminaires

Sealed and gasketed (vapor-tight) luminaires require the use of some type of venting means when emergency LED drivers with sealed lead acid (SLA) batteries are installed. Guidelines to assist in selecting the proper vent size are available from Bodine (see technical document on venting enclosures with SLA batteries).

Disclaimer

Note that the information provided in this document is subject to change.

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