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LED drivers – reliability, and performance factors

Today's general lighting industry targets more and more LED based solutions. The fixtures' performance, reliability and also the return of investment are significantly influenced by the quality of the LED driver. According to failure analysis of LED lighting fixtures, the results show fewer than 5% probability of LED chip failures, other 5% may be the fault of other elements and 90% of cases originate from LED driver failures. To take critical performance factors in consideration, – as well as understanding the reliability scores, such as MTBF and lifetime – are necessary to be able to select the right driver from the wide range of available solutions on the market. This paper tries to summarize some of the measures, and point out possible issues of a driver in order to help fixture designers to specify right solutions for the optimum financial and the operational requirements.

1. LED drivers

LEDs require a power supply that can convert AC power to the DC voltage, and regulate the current flowing through the LED during operation, and protects the LEDs from line-voltage fluctuations, such as the ballast used to be to a fluorescent light. LED drivers may be constant voltage types or constant current types.

With the use of these electronic drivers variety of extra functions can be integrated into the fixture, integration of all electronic components is a trend against using of discrete components to simplify application.
Drivers with dimming capability can change light output over the full range from 100% down to 5-10%. Dimmable drivers can dim LEDs by reducing the forward current (constant current reduction CCR), by pulse width modulation (PWM) via digital control, or by more sophisticated methods like DALI. Most dimming drivers operate using the PWM method. With this method, the frequency can grow up to few hundred Hz to kHz range, so that the LED light appears to be continuous without flicker. The sensitive electronics of the driver is exposed directly to the environmental effects, that fixture should

Designers should really take care of mounting the loudspeaker into the final place in the application, most commonly into cabinets as shown on the figure. Closing the edges of the speaker the length of the sound wave paths increase, causing better sound quality.

The easiest way to avoid the acoustic short circuit is to mount the speaker into a large plate (open wall), the sound waves of the front and end side of the membrane cannot eliminate each other (A).

Even better (longer wave path) solution is the folded wall solution (B), which is used for those electric equipments where the backside is open, mainly for thermal cooling considerations, like e.g. guitar amplifiers.

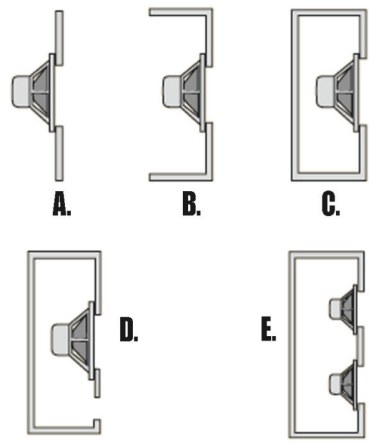
The completely closed boxed systems, with appropriate sealing is many times the best and easiest solution (C and E), but with subwoofers the losses are too high, the efficiency goes down.

As an inherited solution of the closed housing, the bass reflex-housing (D) has an additional hole and a channel on the front panel next to the speaker. The system is designed on the way, that the air cushion in the rest of the housing works as resonator. Near the resonance frequency, a higher sound pressure level can be achieved. Below this frequency, due to the acoustic short-circuit sound is damped while above this frequency no positive or negative effect can be noted.

In this way, the bandwidth of the loudspeaker can be extended by approximately one octave.

Besides the best possible tightening of the speaker's edge in an appropriate manner, there is another, ready-made and quite practicable solution, buying loudspeaker systems in „boxed" version, that means pre-mounted in a completely closed environment (minibox).

Here, the sound wall is so to say „folded



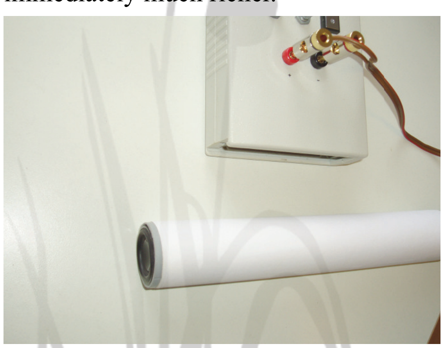
backwards" and then closed, to that an unwanted pressure compensation (=the „acoustic short circuit") is practically not possible any more. By doing this, it is possible to exploit the full (=maximum possible by the specific design) frequency spectrum for any specific loudspeaker system given.

Such „boxed" solutions can be found in our portfolio, for example from the manufacturer Vansonic („VECO").

Possible countermeasures

• One way out is extending the "bypass" for the sound, to simply make the shortest possible way a longer one, before it comes to pressure compensation. This can be done for example as a long tube like shown on the photos. The loudspeaker is mounted into a tube that has holes on the surface. When applying

music on the speaker, we can hear thinner sound. The high pressure in front of the membrane and the low pressure behind it will generate acoustic wind; the waves will find the shortest path through the holes. In order to make its way longer, we can cover the holes by a paper roll, and the perceived sound becomes immediately much richer.



• It is to point out that any "successful" pressure compensation is finally to understand as „lost sound energy“, which is no longer available to create sound as wanted.

• A second way is the tight closure of the loudspeaker's edge while mounting it. To reach this, there are different practical measures possible and commonly used, like for example „gentle“ pressing from inside direction towards the housing front by using a backward foam piece, pressing/clamping, elastic frontal edge sealing ring from suitable material (like for example rubber, foam rubber, silicone etc.).

Also gluing or potting (total sealing) can be considered as possible ways where applicable.

Practical help

By the measures as described above, the unwanted direct pressure compensation around the membrane edge can be effectively prevented. Depending on the specific mounting situation and the design of the device now the sound will try to compensate via the shortest possible bypass, i. e. the closest opening. And depending on the distance of this opening (hole) from the speaker (it's mostly several centimeters), this results in a gain for the usable frequency range towards the lower frequency band.