Optimize the architecture and light designing system with webench led online method

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Abstract

In this paper we present a new method to optimize the architecture and to exceed the speed of light designing system with webench led online method. In this essay we introduce an important method of online ,which consist of two different parts : the first is the webench architecture led,and the second is the webench design led. In later chapters, as we summarize here , we would consider and investigate the advantages and the use of webench architecture led andwebench design led. In this system light designers can create a hundred different topologies for light designing system just in a few minutes. They can start it by specifyingthe amount of illumination(light output) they need (up to 100,000 lumens) , adjust variable keys to make it's size , cost and etc.. moreefficient.The advantages of this system can be easily seen of light output .first ,to create the heat sink design, select an amount of led. Second ,every combination should be optimized for thermal management and stable operations. So select your preferred electronic drive from our recommended topologies, then optimize the overall size , it's efficiency and it's cost for the whole solution .tune each component selection algorithm with the change of optimizer. Save your precious time with exploration system and the real time calculation .this system have a wide range of applications.

Key words::topology-optimize-architecture-webench-illumination.

1. Introduction

When designing LED-based lighting systems, engineers need to understand LED lumen maintenance and mortality in similar terms to those used when designing with conventional light sources. However, comparable data has been nearly impossible to find. In addition, designers need extra information to predict the lifetime of LEDs under a variety of operating conditions. A number of techniques to predict LED lifetimes have been proposed, but these have not been sufficient to generate the clear and unambiguous data that lighting engineers can use easily. The wenbench led provides lighting designers with an understanding of a new tool introduced by Philips Lumileds Lighting Company that simplifies the process allowing full flexibility in design options. This one tool provides designers with information that they need to make decisions about product lifetimes, driver constraints, number of LEDs required, and thermal management.For starters to professional designers this tool gives plenty of solutions and highly referable. we suggest that every designer can use this during their design phase. All the design inputs like Vmin V max AC or DC , line frequency, lumens output, color of light, ambient operating temperature, lumens per LED in the array for a given luminance , selectable LED manufacturer from a drop down list and a distributor are available. The LED optimizer works with three more inputs such as foot print size, BOM cost and efficiency. Upon feeding the required input values a project can be created and to get the results one need to login into National Semiconductor.The outputs are Schematic, Operating values and charts, BOM and its cost. The complete design section gives the Design documents,Gerber files, Board layput and assembly documents. Over all Webench LED Architect gives us start to product finish in detail.

2.Data and Material

2.1Webench Led Architect Overview

WEBENCH LED Architect is a quick visual tool for complete lighting system design up to 100,000 lumens in output. LED performance, electronic drive current and heat compensation are balanced in seconds. The tool analyzes 350 of the latest LEDs from 12 leading manufacturers, 30 heat sinks, 35 LED drivers, and a library of 21,000 electronic passive components. Users can focus on system level results and leave the burden of complex electrical and thermal mathematics to the tool. Electrical simulation is included as an option for additional testing, validation or component selection. Regardless of type, color, size, or power, all LEDs work best when driven with a constant current. LED manufacturers specify the characteristics (such as lumens, beam pattern, color) of their devices at a specified forward current (IF), not at a specific forward voltage (VF). Most power supply ICs are designed to provide constant voltage outputs over a range of currents (see below); hence, it can be difficult to ascertain which parts will work for a given application from the device datasheet alone. With an array of LEDs, the main challenge is to ensure every LED in the array is driven with the same current. Placing all the LEDsin a series string ensures that exactly the same current flows through each device.

2.2Webench Led Architect Dashboard

For the WEBENCH Architects like Power Architect and LED Architect, a project summary panel has been added on the left side of the basic WEBENCH client dashboard. Just click on any section of the dashboard where you would like to examine the information more closely and it will enlarge to fill the entire screen. A click on the back arrow at the top of the dashboard will return you back to the main view. The user can exercise everything about the circuit in the dashboard including in many cases simulating your circuit electrically for transient response or thermally to look at the interaction of the power dissipation for the drive electronics fig.1.

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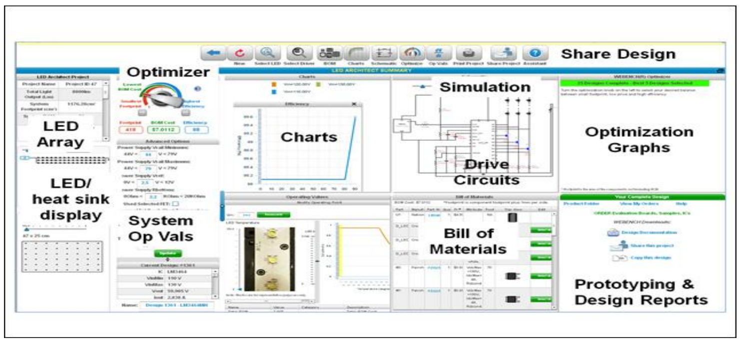
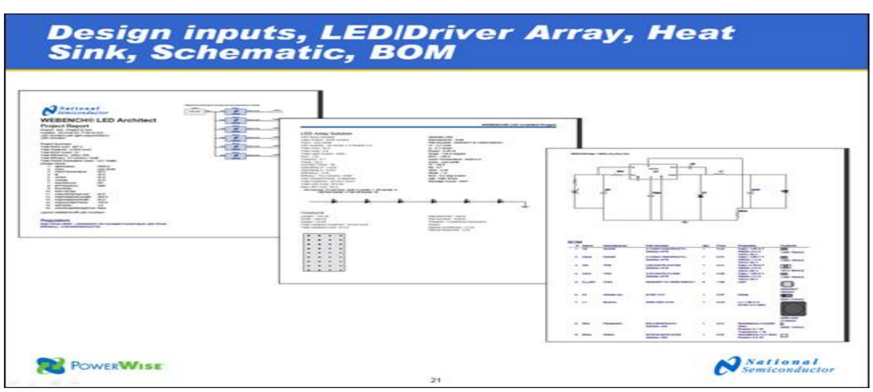


Fig.1 Webench Led Architect Dashboard

2.3Prototyping the design inWebench Led Architect

With one click, you can generate a complete project report for your custom design solution. This is a dynamically generated PDF containing extensive information with all of the details of the project including the inputs, the LED array, heat sink information, driver information, schematics, and BOMs.For convenience, you can export the complete bill of materials with ordering part numbers from the Bill Of Materials tab. For Build It! Supported devices, you can order the complete BOM with same day shipment depending on component availability selections. This entire project design can be shared with partners through the Share Design button at the top of the dashboard fig.2.



2.4Webench Designer Tools over view

Use the popular Webench designer tools to simultaneously compare the performance of multiple devices in multiple circuit requirements. Get instant access to the latest simulation models, parametric data and package nformation for power, lighting, and sensing applications. Today, WEBENCH designer tools create and display all of the possible power, lighting, or sensing circuits to meet a create a range of intermediate rail topologies and design requirement even faster. This enables value-based comparisons at a system and supply chain level before a Specify a desired light outp ... CH designer tools feature both funda ... ced tools for and select based on price, eficiency, and footprint.creating system-level designs fig.3.

Fig.2 Prototyping the design inWebench Led Architect

2.4.1Single-circuit Design Tools :

WebenchPower Designer ,Webench Led Designer, WebenchSensor Designer

2.4.1Advanced Hierarchical Design Tools:

WebenchPower Architect, WebenchLed Architect, Webench FPGA Power Designer

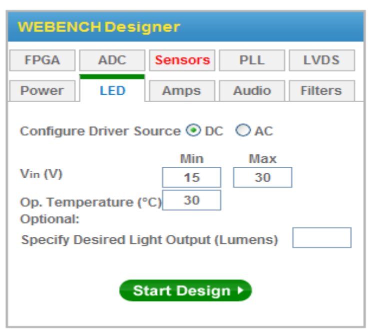


Fig. 3: Webench Designer Tools dash board

Use these tools to compare design alternatives side-by-side. Tune results across footprint, eficiency, or system cost in a single step. Find solutions from more than 110 component manufacturers and electronic distributors and more than 21,000 components with price and availability updated hourly.WEBENCH designer tools are tried and true with more than 1.5 million designs and counting. Try it out for free at: www.national.com/webench

2.5Webench Led Designe

With National's WEBENCH LED Designer suite of tools, engineers can configure a system with up to 300 LEDs in serial or parallel strings. With a single keystroke, the tool selects from hundreds of high brightness LEDs, matches an LED with one of National's PowerWise energy-efficient LED drivers and creates an optimized constant current source power supply circuit. The engineer can easily “dial-in” their size and efficiency requirements, and then simulate the circuit behavior under dynamic conditions, including start-up, steady state, pulse-width modulation dimming and line transient. After fine-tuning the system in just minutes, the ‘BuildIt!’ feature provides a complete bill of materials for the LED circuit and the ability to quickly ship a custom prototype kit containing the selected LED, PC board, driver ICpassive components.

Webench Visualizer

A powerful comparison and selection tool, Webench Visualizer creates a graphical snapshot of options across multiple criteria, such as power efficiency, footprint and system bill of materials (BOM) cost. It draws from 25 different switching power supply architectures and21,000 components. Use the optimizer dial to “dial-in” a preference for footprint, system BOM cost and power efficiency and get instant access to 50-70 designs from 48 billion possible design options. Use the visualize control panel to adjust design options for voltage, current and temperature. In seconds, get an updated set of solutions highlighting each design’s topology, schematic, footprint, efficiency, operating valuesand BOM cost/count.fig 4.

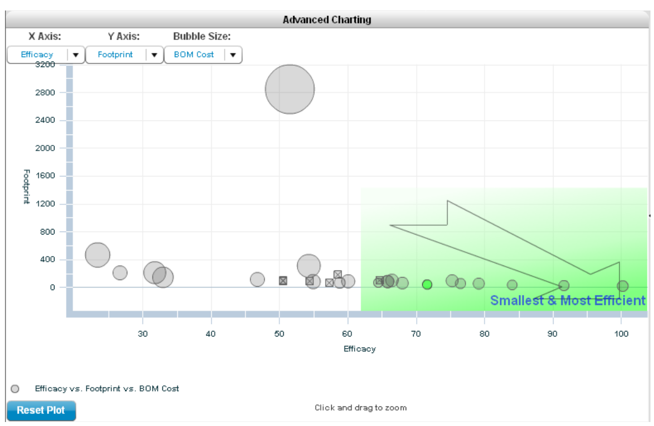


Fig.4 Webench Visualizer

Webench Optimize

This feature is unique to National and makes it easy to tune the Webench designer circuit creation algorithms with the turn of a dial. Review the output, tune again, and instantly compare the alternatives.fig 5.

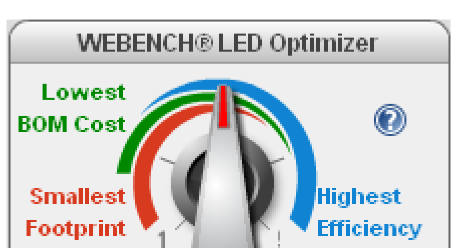


Fig.5 Webench Optimizer Dial

3.Research Methodology

3.1Established lighting industry definitions of useful life : To enable designers to meet people requirements for:

a) minimum illumination
b) relamping interval
c) initial purchase price
d) ongoing energy costs

the lighting industry historically rated devices in terms of the time by which a certain percentage of the population is expected to have failed (see figure 1). For example, a B10 value for any given lamp denotes the time by which 10% of the population is expected to fail. Also used is the B50 value; the point where the failure rate is 50% - sometimes called the rated or average life fig6

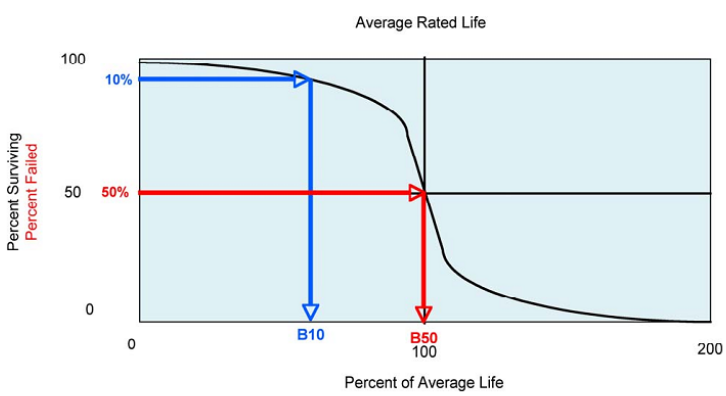


Fig. 6: the standard industry expression for failure rates of lighting devices

3.2Established LED industry definitions: Lumen maintenance

Recently, the growing adoption of power LEDs in lighting applications presented designers with a new set of metrics for lifetime. It is rare for an LED to fail completely. Instead, the intensity of light emitted tends to fall over time, as shown in figure 2. This effect is termed "lumen maintenance". In a lighting installation, this reduction in lumen maintenance may, eventually, result in a drop in light output to below agreed limits for the environment. Fig 7.

Light Output normalized to 1 at 24 hours

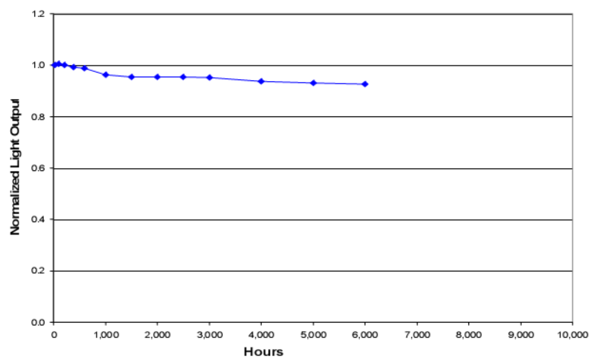


Fig. 7: graph showing the light output of a webenchLumileds K2 LED declines over time

4.Results and Analysis

General Description

The LM3406/06HV are monolithic switching regulators designed to deliver constant currents to high power LEDs. Ideal for automotive, industrial, and general lighting applications,they contain a high-side N-channel MOSFET switch with a current limit of 2.0A (typical) for step-down (Buck) regulators.Controlled on-time with true average current and an external current sense resistor allow the converter output voltage to adjust as needed to deliver a constant current to series and series-parallel connected LED arrays of varying number and type. LED dimming via pulse width modulation (PWM) isachieved using a dedicated logic pin or by PWM of the power input voltage. The product feature set is rounded out with lowpower shutdown and thermal shutdown protection.

application

LED Driver-Constant Current Source-Automotive Lighting-General Illumination-Industrial Lighting-Medical device-Backlight lcd

Typical application

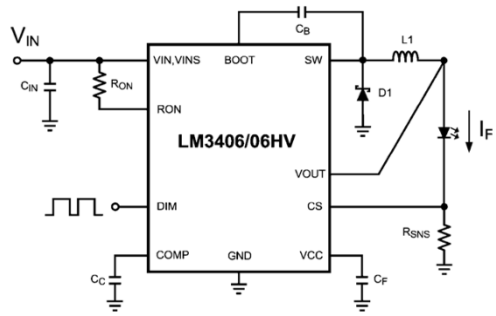


Fig 8 Typical application

Design Example 1

The first example circuit uses the LM3406 to create a flexible LED driver capable of driving anywhere from one to five white series-connected LEDs at a current of 1.5A ±5% from a regulated DC voltage input of 24V ±10%. In addition to the ±5% tolerance specified for the average output current, the LED ripple current must be controlled to 10%P-P of the DC value, or 150 mAP-P. The typical forward voltage of each individual LED at 1.5A is 3.9V, hence the output voltage ranges from 4.1V to 19.7V, adding in the 0.2V drop for current sensing. Fig 9.

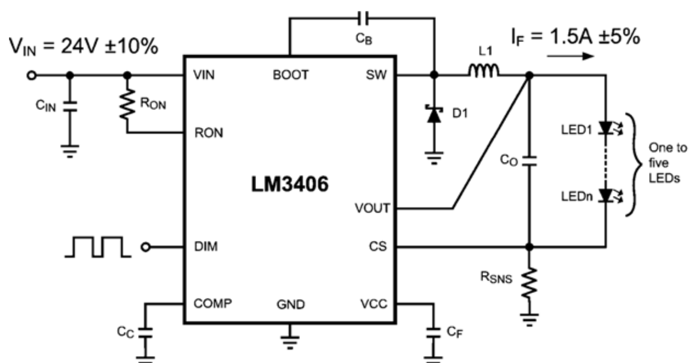


Fig 9 Design Example 1

RON and tON

A moderate switching frequency of 500 kHz will balance the requirements of inductor size and overall power efficiency.The LM3406 will allow some shift in switching frequency when VO changes due to the number of LEDs in series, so the calculation for RON is done at the mid-point of three LEDs in series, where VO = 11.8V. Note that the actual RON calculation
is done with the high accuracy expression listed in the Appendix.

$$R_{ON} = \frac{1}{f_{SW} \times 1 \times 10^{-11}}$$

RON = 144 kΩ

The closest 1% tolerance resistor is 143 kΩ. The switching frequency and on-time of the circuit should be checked for one, three and five LEDs using the equations relating RON and tON to fSW. As with the RON calculation, the actual fSW and tON values have been calculated using the high accuracy expressions listed in the Appendix.

$$f_{SW} = \frac{1}{1 \times 10^{-11} \times R_{ON}}$$

fSW(1 LED) = 362 kHz
fSW(3 LEDs) = 504 kHz
fSW(5 LEDs) = 555 kHz

$$t_{ON} = 1 \times 10^{-11} \times R_{ON} \times \frac{V_O}{V_{IN}}$$

tON(1 LED) = 528 ns
tON(3 LEDs) = 1014 ns
tON(5 LEDs) = 1512 ns

OUTPUT INDUCTOR

Since an output capacitor will be used to filter some of the AC ripple current, the inductor ripple current can be set higher than the LED ripple current. A value of 40%P-P is typical in many buck converters:

$$\Delta iL = 0.4 \times 1.5 = 0.6AP\text{-}P$$

With the target ripple current determined the inductance can be chosen:

$$L = \frac{V_{IN} - V_O}{\Delta i_L} \times t_{ON}$$

$$LMIN = [(24 – 11.8) \times 1.01 \times 10\text{-}6] / (0.6) = 20.5\ \mu H$$

The closest standard inductor value is 22 μH. The average current rating should be greater than 1.5A to prevent overheating overheating in the inductor. Inductor current ripple should be calculated for one, three and five LEDs:

$$\Delta iL(1\ LED) = [(24 - 4.1) \times 5.28 \times 10\text{-}7] / 22 \times 10\text{-}6$$
$$= 478\ mAP\text{-}P$$
$$\Delta iL(3\ LEDs) = [(24 - 11.8) \times 1.01 \times 10\text{-}6] / 22 \times 10\text{-}6$$
$$= 560\ mAP\text{-}P$$
$$\Delta iL(5\ LEDs) = [(24 - 19.7) \times 1.51 \times 10\text{-}6] / 22 \times 10\text{-}6$$
$$= 295\ mAP\text{-}P$$

The peak LED/inductor current is then estimated. This calculation uses the worst-case ripple current which occurs with three LEDs.

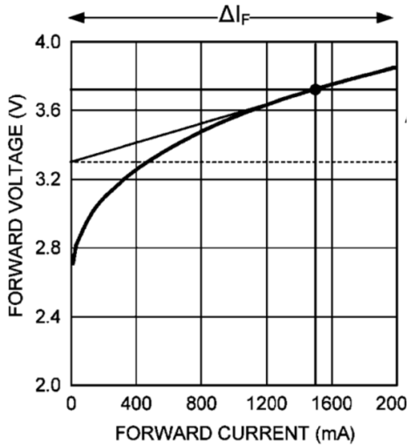
$$IL(PEAK) = IL + 0.5 \times \Delta iL(MAX)$$
$$IL(PEAK) = 1.5 + 0.5 \times 0.56 = 1.78A$$

In order to prevent inductor saturation the inductor's peak current rating must be above 1.8A. A 22 μH off-the shelf inductor rated to 2.1A (peak) and 1.9A (average) with a DCR of 59 mΩ will be used.

USING AN OUTPUT CAPACITOR

This application does not require high frequency PWM dimming, allowing the use of an output capacitor to reduce the size and cost of the output inductor while still meeting the 10% P-P target for LED ripple current. To select the proper output
capacitor the equation from Buck Regulators with Output Capacitors is re-arranged to yield the following:

The dynamic resistance, rD,of one LED can be calculated by taking the tangent line to the VF vs. IF curve in the LED datasheet. *Figure 10* shows an example rD calculation.



$$Z_C = \frac{\Delta i_F}{\Delta i_L - \Delta i_F} \times r_D$$

FIG 10. Calculating rD from the VF vs. IF Curve

Extending the tangent line to the ends of the plot yields values for ΔVF and ΔIF of 0.7V and 2000 mA, respectively. Dynamic
resistance is then:

rD = ΔVF / ΔIF = 0.5V / 2A = 0.25Ω

The most filtering (and therefore the highest output capacitance) is needed when rD is lowest, which is when there is
only one LED. Inductor ripple current with one LED is 478mAP-P. The required impedance of CO is calculated:

ZC = [0.15 / (0.478 - 0.15] x 0.35 = 0.114Ω

A ceramic capacitor will be used and the required capacitance is selected based on the impedance at 362 kHz:

CO = 1/(2 x π x 0.16 x 3.62 x 105) = 3.9 μF

This calculation assumes that CO will be a ceramic capacitor and therefore impedance due to the equivalent series resistance (ESR) and equivalent series inductance (ESL) of of the device is negligible. The closest 10% tolerance capacitor value is 4.7 μF. The capacitor used should be rated to 25V or more and have an X7R dielectric. Several manufacturers produce ceramic capacitors with these specifications in the 1206 case size. A typical value for ESR of 3 mΩ can be read from the curve of impedance vs. frequency in the product datasheet.

Automotive Lighting

From headlights to LCD backlighting in infotainment systems,LEDs are an integral part of the driving experience. National’s portfolio of LED drivers offers key features like PWM dimming, accurate UVLO, and high-side current sensing.Plus, low LED ripple current and external oscillator sync capabilities allow designers to reduce issues with EMI. These LED drivers provide maximum efficiency and effectiveness in anyautomotive lighting system.

Design 1: Driving Daytime Running Lamp (DRL) with LM3423 Boost LED Driver Description:

• This circuit is designed to drive a single string of 12 series connected 1W LEDs from the battery input for daytime running lamps (DRL) in passenger cars.

• Since the total forward voltage of the LED string is higher than the battery input voltage, a boost (step-up) LED driveris required.

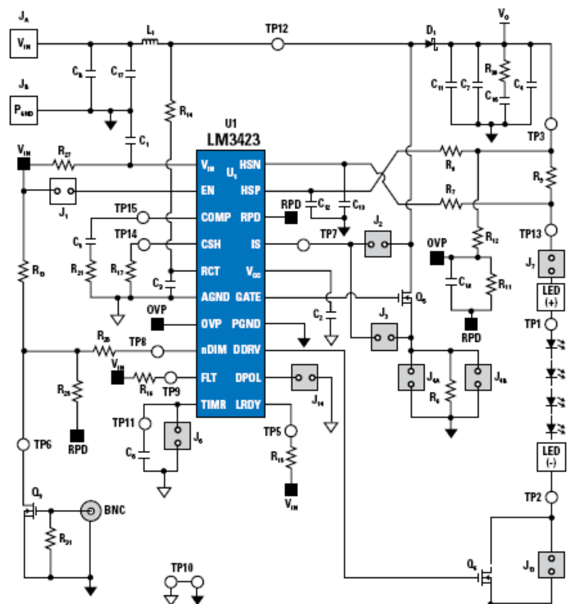


Fig 11 Driving Daytime Running Lamp (DRL) with LM3423 Boost LED Driver Description

Conclusions :

In this system made of the national semiconductor in use of LM IC wich this boat chip and have many substitution.and this system is efficacy richable andchip.and we can designing circuit in least capacity Regardless of type, size, or power, all LEDs work best when driven with a constant current since LED color changes with small variations to driving current. LEDs often support varying system voltages and forward voltages, which can further cause variations in LED brightness and color. National's LED drivers provide the benefit of constant current to single LEDs or arrays of LEDs,enabling color and brightness matching over a wide temperature range. High-brightness LEDs can require more than 1W of power, making thermal management and drive circuitry an important design consideration. Improper thermal management can significantly degrade the lifetime and performance of the LEDs. Along with temperature sensors, National Semiconductor's LED drivers offer thermal protection and management to improve the performance of the LEDs in a variety of applications.

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