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Design a matrix LED headlamp to achieve the complete dynamism in lighting System

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Abstract:This paper introduce a matrix LED headlamp to achieve the complete dynamism in lighting system. Adaptive headlights are an active safety feature designed to make driving at night or in low-light conditions safer by increasing visibility around curves and over hills. When driving around a bend in the road, standard headlights continue to shine straight ahead, illuminating the side of the road and leaving the road ahead of you in the dark. Adaptive headlights, on the other hand, turn their beams according to your steering input so that the vehicle's actual path is lit up. Similarly, when a vehicle with standard headlights crests a hill, the headlight beams temporarily point upwards towards the sky. This makes it difficult for drivers to see the road ahead and for oncoming motorists to see the driver approaching. In contrast, adaptive headlights use a self-levelling system that points the light beam up or down, according to the position of the vehicle.

Keywords:Adaptive,Self- Levelling,Matrix LED ,Headlamp

I.Introduction

Recognizing the limitations of traditional adaptive headlights, matrix LED lighting systems have been developed to provide intelligent front lighting with dynamic control and split-second beam adaption in response to changing driving conditions. Although matrix LED headlight systems demand sophisticated engineering, they work on a very straightforward principle of operation - pixel-level digital control over the high beam. Unlike gas burning and arc type lamps, LEDs are semiconductor devices which produce photon flux (light) by passing an electric current through a p-n junction biased in the forward direction. Light intensity can be dynamically and precisely controlled by regulating the current flow through the LEDs. These semiconductor diodes can be instantly activated and require no warm up time. The ability to withstand tens of thousands switch cycles reinforces LED's application advantage in digital lighting system. Excellent dim ability lends LED headlight modules unprecedented versatility. High beam LEDs can be dimmed down to take the role of daytime running lights. Moreover, LED's compact form factor, solid state nature as well as flexibility in optical control offer incomparable design freedom and engineering applicability in smart ADB systems. Matrix LED headlights comprise a plurality of LED engines assembled in a joint module. Each LED engine is equipped with a dedicated driving circuit for variable control of luminous intensity and on/off switching. Use of reflectors and/or lenses allows the LED module to provide a huge number of variations in optical distribution without the need for any pivoting mechanism. Thus matrix LED technology splits up the previously one-spot high beam into multiple sub-beams that can be independently controlled. High power LEDs deliver high efficacy and high flux density that enable tight beam control as well as exceptional high luminance, making these individually produced beams equally as powerful as the one-spot halogen beam. In conjunction with a substantially higher colour temperature (around 6,000 Kelvin) which causes less driver fatigue and delivers enhanced visibility, the high beam LED light packs a powerful punch, all without taking up a ton of room in the headlight assembly and drawing a ton of power.

II.LiteratureSurvey

This paper discuss optical concepts to realize the required angular resolutions for the matrix segments. They present the beam performance of a solution using a matrix of 3x11 ceramic LED packages assembled on one board with one near die collimator as primary optic and a projection lens as secondary optic. An angular resolution of 1.5° is achieved for the individual addressable segments of the high beam on the street. Due to the dense LED array the electrical routing is performed on two layers to realize individual addressability of the LEDs. The potential board technologies, i.e. double layer IMS boards or advanced Fr4 boards with copper inlay, are discussed for this kind of LED matrix application. The thermal performance is evaluated by FE simulation. The solution realized in our application is a special IMS with two electrical layers and vias through the metal core. In dependence of the required beam up to 50W thermal load is dissipated.[1]
The literature survey is carried out to know the state-of-the-art in applications of automobile industry and other allied areas. Studied literature is organized into various parts i.e. Matrix LED driver, CAN bus, Night time traffic detection. This paper presents a low-cost, high performance solution for single LED control in a matrix LED configuration. The integrated solutions on the chip market are evaluated and an improved discrete, robust LED bypass circuit is designed und simulated. A complex prototype PCB with the proposed LED bypass circuit has been designed and thoroughly investigated. The performance of the proposed LED bypass solution has been

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evaluated in terms of speed, resolution and power losses. [4]

This paper explained the importance about detection of vehicle at night time for traffic flow control by supervising the number of vehicles. This system uses the mechanism of accurate vehicle counting by analyzing the image of road. At first process of filter out reflections and segmentation of headlights and lamp pairing and mask training is done. This work gives the robust and effective system for vehicle detection at nighttime.[5]

This paper described that Steering angle-based adaptive headlight controller system. This work proposes the adaptive front lighting system by providing optimized visibility at night time driving. There is the body control module which provides the vehicle information for controller. Body control module consists of vehicle speed sensor and steering anglesensor. Controller receives the all information and according to that controls the headlamps in required angle.[6]

This paper presents control system which is used for controlling the headlights in horizontal and vertical direction. Data transmission is takes place through CAN bus. Here CAN bus is used as data transmission channel. Also this system ensures that it can give proper visibility to driver and also illuminates the actual way by adjusting headlamps of vehicle in horizontal and vertical direction. This system helps for enhancing the intelligent degree of the headlights and the safety of the automobile atnight.[7]

III.Proposed System

Conventional AFS headlights react only to vehicle's driving status such as the wheel rotation speed, yaw (motion along the vehicle's vertical axis), and movement of steering wheel. Matrix LED systems take a leap forward with its ability to interact with driving environment via the car's on board camera system in which an imaging sensor monitors the road environment in front of the vehicle. The vehicle-mounted camera which is sensitive to visible and near infrared light can detect virtually all traffic within its detection range. Data collected by the camera are interpreted by the ECU which then sends directions to the control circuitry regulating the light output of each LED engine. Upon detection of an object in front of the vehicle, the adaptive lighting system will mask out the oncoming vehicle by dimming or switching off LED engines that produce distracting glare while other LED engines of the high beam light continue to illuminate everywhere else on the road. When driving in curves, the high beam LEDs of the matrix headlight will shift the focal point of the light along the curve and illuminate the side of the road more than the road itself. Computer vision can extract the road lane information, which can help improve the precision of adaptive lighting.

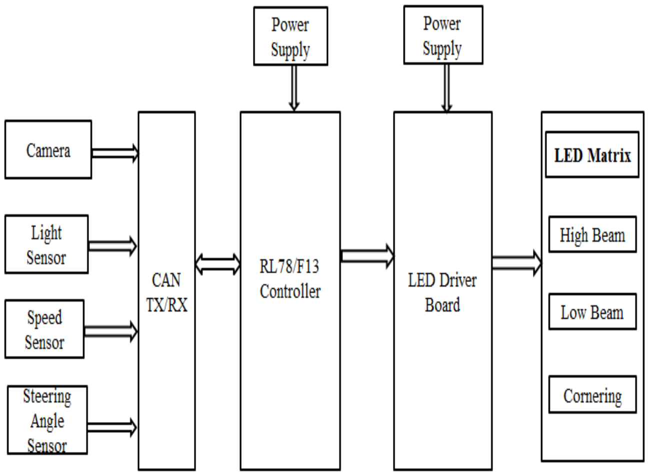

Figure 1.Block Diagram

- **Renesas RL78/F13 microcontroller**

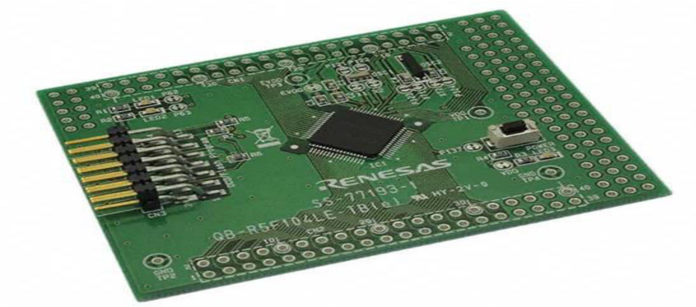

Figure 2.RL78/F13 Controller Board

RL78/F13 microcontrollers are successors to the 78K0R and R8C, and have the industry's lowest level of consumption current. Functions necessary for automotive application communications and implementing functional safety have been furthered enhanced. Due to high reliability, these automotive general-purpose low-end microcontrollers can be used not only for automotive applications but also industrial applications. RL78/F13 microcontrollers are successors to the 78K0R and R8C, are available in a 20 to 80-pin, 16 to 128 KB flash memory line-up, and realize the industry's lowest level of consumption current. They have a built-in CAN module and LIN module for automotive interfaces, and in addition to the functional safety features of the RL78/F12 a RAM ECC function, PLL lock function, port output state monitoring, stack overflow detection, dedicated WDT oscillator and more have also been added. Since a more highly reliable system can be built, these microcontrollers can be used for industrial applications and of course automotive applications.

- **MAX20092 Matrix Manager IC**

Benefits and Features

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- Automotive Ready: AEC-Q100 Qualified
- Flexible Configuration Allows the Use of the Same Device in Different Applications
    - Single-, Dual-, and Quad-String Configurations
    - Up to 12 Switches in Series in Single-String Configurations
    - Up to 6 Switches in Series in Dual-String Configurations
    - Up to 3 Switches in Series in Quad-String Configurations
    - Up to 2 LEDs per Switch

- Optimal PWM Dimming Arrangement Provides Excellent Dimming Performance
    - Programmable 12-Bit PWM Dimming
    - Fade Transition Between PWM Dimming States
    - Internal Clock Generator or External Clock for PWM Dimming

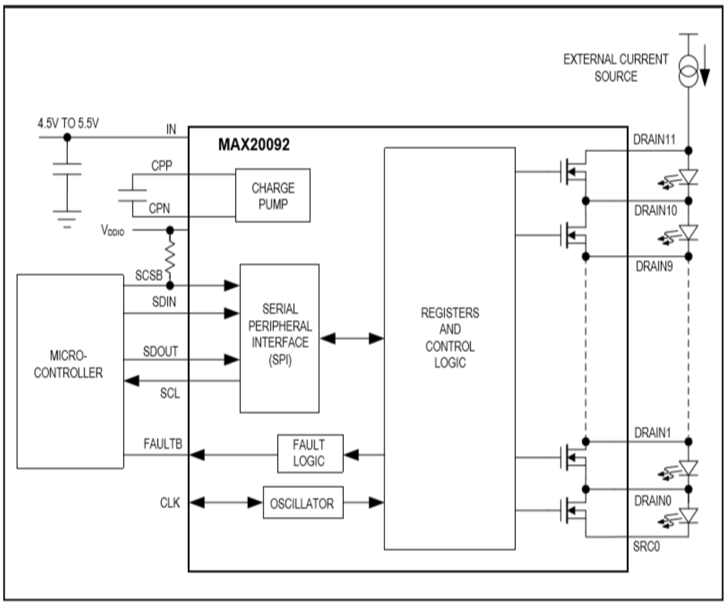

Figure3. MAX20092 Matrix Manager IC

4.5 A6217 constant current LED driver

Benefits and Features

- AEC-Q100 qualified
- 6 to 48 V supply voltage
- True average output current control
- 3 A maximum output over operating temperature range
- (1.5 A for A6217-1)
- Cycle-by-cycle current limit
- Integrated MOSFET switch
- Enable / PWM dimming via direct logic input or power
- supply voltage
- Internal control loop compensation
- Under voltage lockout (UVLO) and thermal shutdown
- Protection

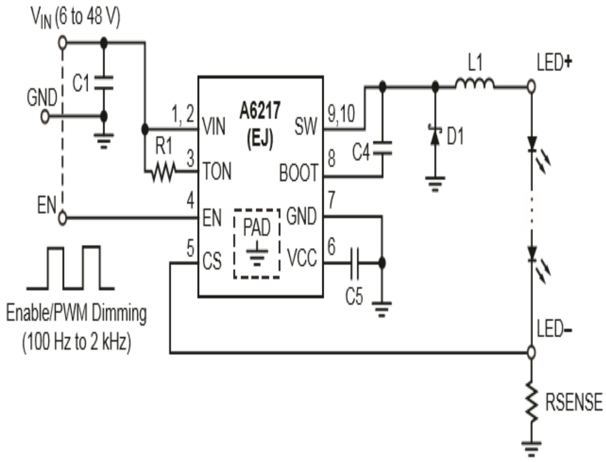

Figure 4. A6217

Terminal List Table

Number		Name	Function
EJ	LJ		
1, 2	1	VIN	Supply voltage input terminals
3	2	TON	Regulator on-time setting resistor terminal; determines the switching frequency of the converter
4	3	EN	Input for Enable and PWM dimming; rated up to V_{IN} and logic-level compatible
5	4	CS	Drive output current sense feedback
6	5	VCC	Internal linear regulator output; add filter capacitor of 0.1 µF from this pin to GND
7	6	GND	Ground terminal
8	7	BOOT	DMOS gate driver bootstrap terminal
9, 10	8	SW	Switched output terminals
-	-	PAD	Exposed pad for enhanced thermal dissipation; connect to GND

Table 1.Pinout Description for A6217

- **E522.31 DC-DC Converter**

Benefits and Features

- Switched-Mode, PWM LED Controller
- 5V to 55V input voltage range, up to 80V boosted
- output voltage

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- Boost-, SEPIC, Buck-Boost- or Buck Topology
- supported
- Constant Current Regulation implemented
- High-Precision Differential High-Side Sense up to 60V
- High-Frequency PWM Dimming Capability for
- constant LED Color
- Analog 10:1 Dimming Capability for LED Binning
- Integrated Softstart
- Advanced Error Detection (e.g. Over-Voltage,
- Open-Load Detection, different Shorts or GND Loss)
- Integrated Automotive LDOs for 5V & 3.3V
- AEC-Q100 Qualified
- Junction temperature range -40°C to +150°C

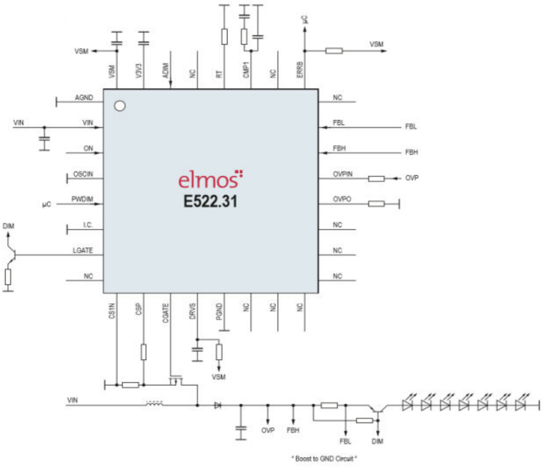


Figure 5. E522.31

- **LED KW CELNM1.TG**

Figure 6.LED

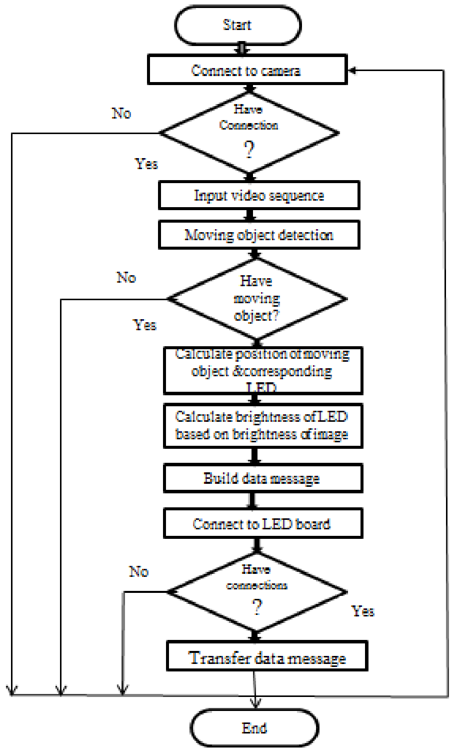
If = 1000 mA; Ts = 25 °C

Parameter	Symbol	Values
Chromaticity Coordinate	Cx Cy	0.32 0.33
Viewing angle at 50% Iv	2φ	120 °

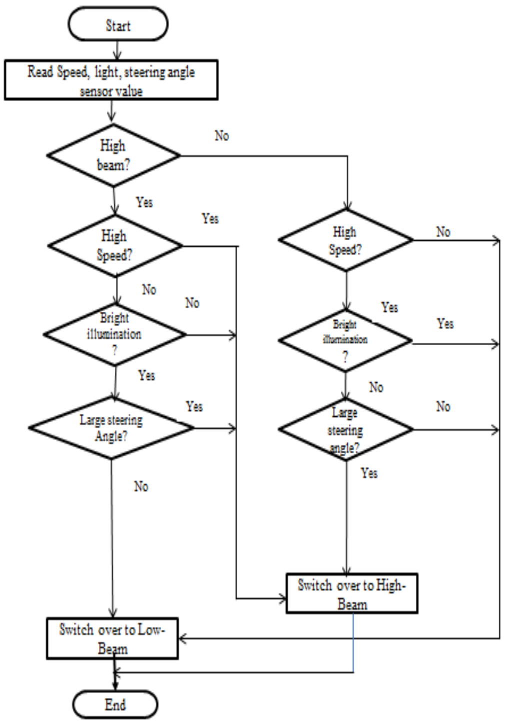
Forward Voltage IF = 1000 mA	Vf	Min 2.75 V Typ 3 V Max 3.4V
Reverse voltage (ESD device)	Vr ESD	Min 45V
Reverse voltage Ir = 20 mA	Vr	Max 1.2V
Real thermal resistance junction/solderpoint	RthJS real	Typ 4.6 K/W Max 5.6 K/W

Table No.2 LED Characteristics

IV. Flowchart



Flowchart 1



Flowchart 2

V.Result

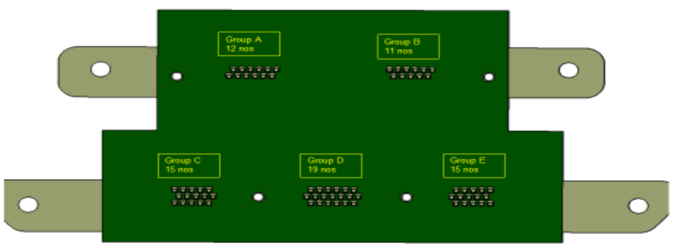


Figure 7. LED Matrix

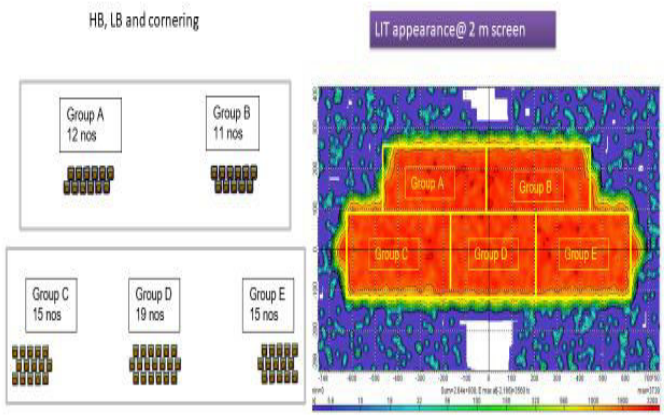


Figure 8.High Beam, Low Beam and Cornering LED

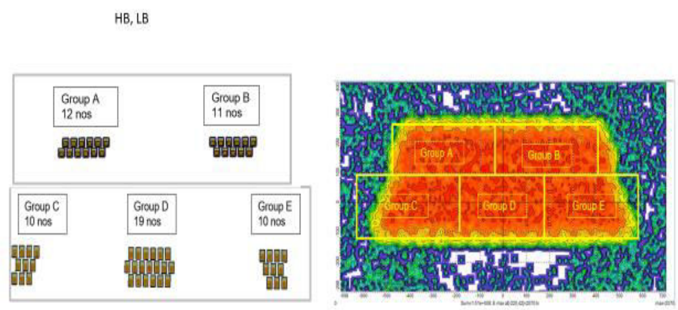


Figure 9.High Beam and Low Beam LED

VI. Conclusion

This project was created to demonstrate a more sophisticated approach to modern/standard headlight technology used in present cars. In addition to having mandatory low and high beams, this project aims to demonstrate how the flexibility of LEDs can be used to create safer driving environment under low light/dark conditions. The main objective of this technology is to illuminate as much of the road as possible while not dazzling other drivers for both oncoming and preceding traffic. This is made possible in this project with 2 sub-systems in communication. First is the module to control the hardware (LED matrix), second is a camera feed with a trained object detection model to detect vehicles, locate them and determine where to lighten/darken.

VII. References

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