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Silicon Application Corp. Group

基于Cypress PSoC4146 + Infineon TLD7002贯穿式尾灯方案

议程

- 汽车车灯发展史
- 汽车尾灯简述
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- 贯穿式尾灯设计框图
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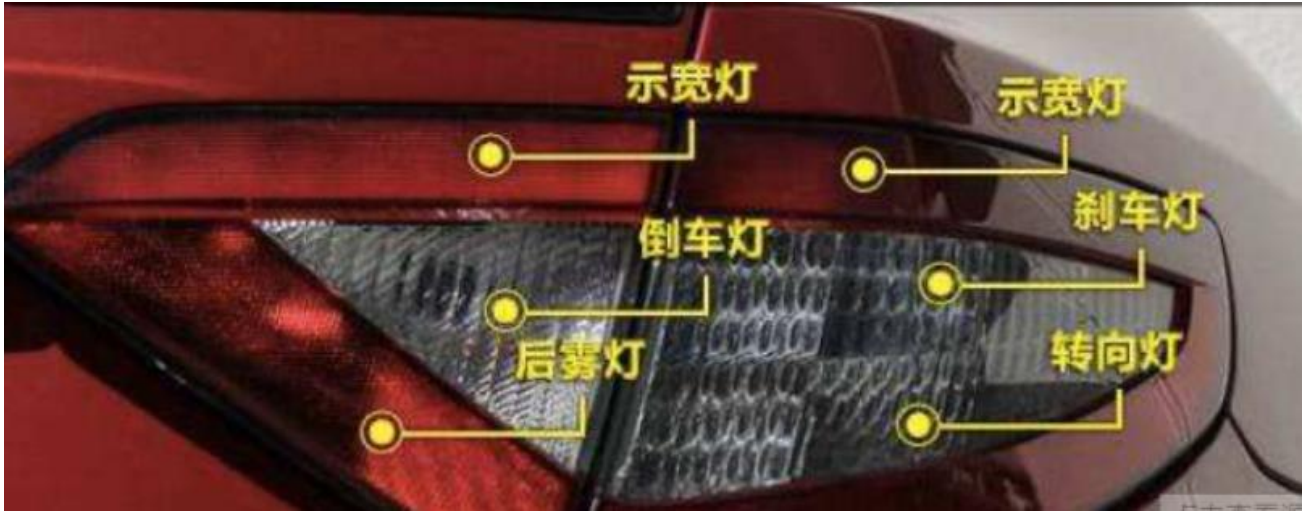
- 方案优势总结

汽车车灯发展史

- 1885年,第一辆汽车诞生。
- 1898年,美国首届汽车展览会,美国哥伦比亚号汽车将电灯作为前灯和尾灯,车灯从此诞生。
- 1908年, 第一套成套的汽车灯具产生，包括前照灯、侧照灯和尾灯，没有现在的车灯系统那么完善（比如就没有刹车灯和转向灯）。
- 1909年,首次把乙炔灯作为变光装置。
- 1916年,美国使用了行车灯。
- 1920年,当选用倒档装置时,使用了倒车灯。
- 1920年,美国通用汽车公司首次安装了内灯。
- 1938年,别克汽车制造商提供了转向灯作为选用的附件,但当时只在汽车尾部安装。

- 2006年,最早装备LED的是Lexus LS600h,该车上的LED只用于近光灯，远光、转向灯依然是传统灯泡。
- 2007年,Audi R8配备AL提供的全LED灯组，远近光、日行灯、转向灯、尾灯、刹车灯等所有灯组光源全部为LED。

汽车尾灯简述

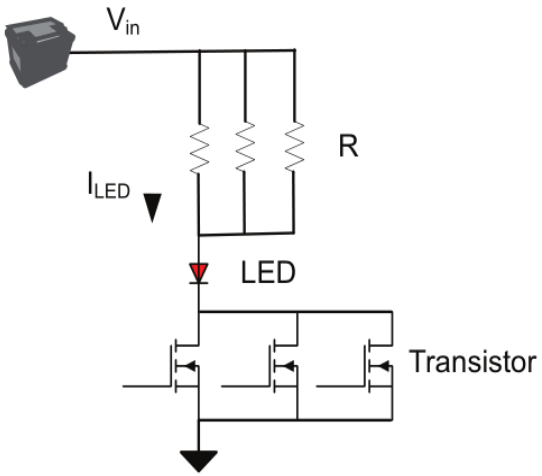


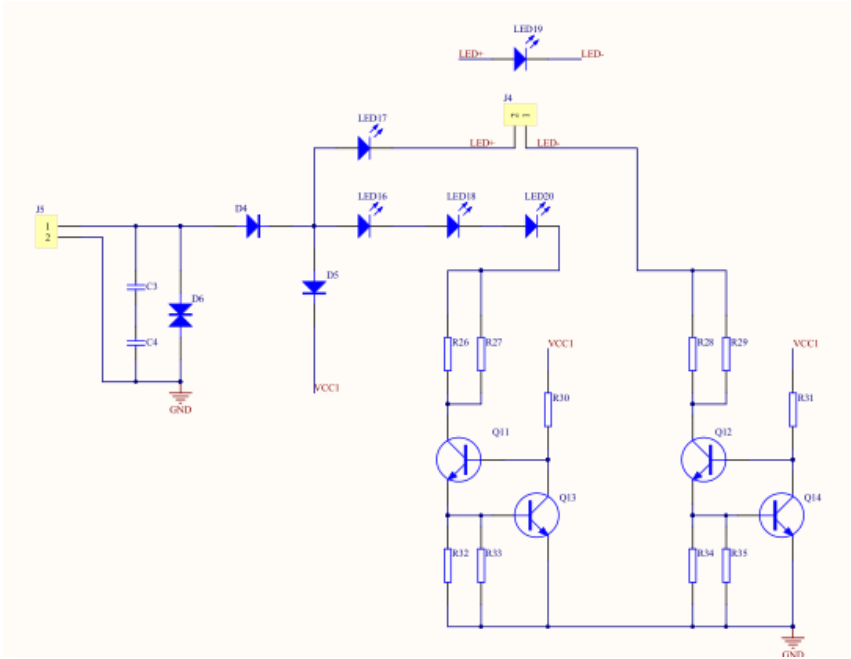
汽车尾灯部分包含：刹车灯、后雾灯、转向灯、位置灯（示宽灯）、倒车灯。

汽车尾灯简述

汽车尾灯驱动方式

- 三极管，电阻搭接方式



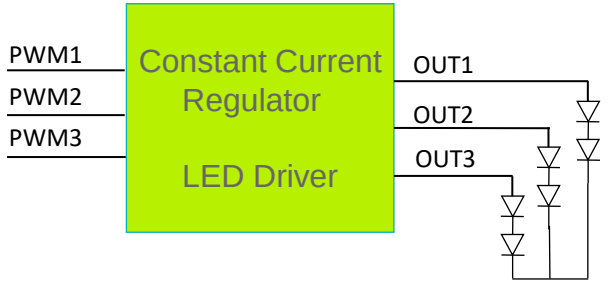


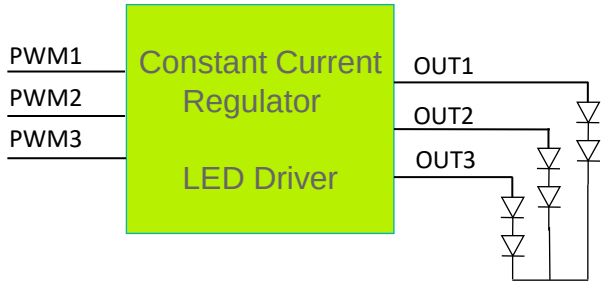
三极管做恒流

这种方式，成本低，电路简单，缺点是器件多，PCB板占用面积大，难做诊断及保护。

汽车尾灯驱动方式

- 专门线性恒流芯片做驱动：常见如TLD2314，TPS92630, e522.81等；
- 支持模拟和数字调光，带诊断保护功能，支持N-1功能 ；
- 相比于分立器件，自带诊断和保护，元器件少，占用PCB板面积减少。
- 单个芯片只能驱动6-9PCS LED，若有数量多的LED颗粒，比如贯穿式尾灯，成本增加，线束增多。





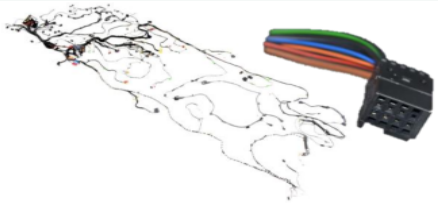
汽车尾灯发展趋势

随着LED在车灯上面的普及，尾灯的应用需求，已经从简单的替代传统灯泡到动态转向灯和尾灯迎宾功能逐渐普及；

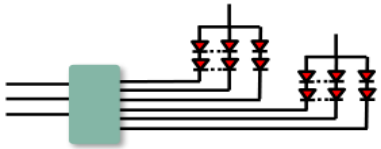
位置灯，刹车灯，转向灯也逐渐需要满足功能安全需求。目前的路面上，从豪华车到热销车，以及国产车，贯穿式尾灯也越来越常见，似乎已经成为了一种趋势。

汽车尾灯发展趋势

Expensive wiring BCM <-> LED



Complex wiring inside a rear light

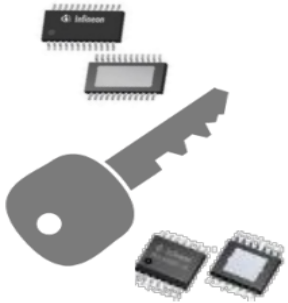


Dynamic rear light

MCU + high Software efforts

The key is....

Multichannel LED Driver with High-Speed Lighting Interface

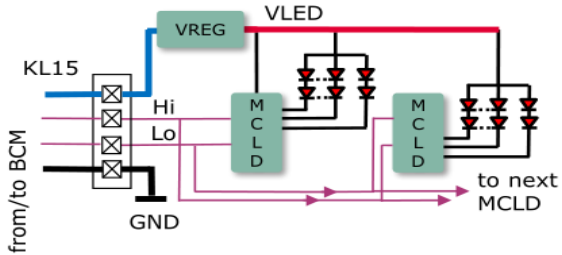


Switcher+ Integrated Buck convertors

SBCs as connectivity solutions

The solution

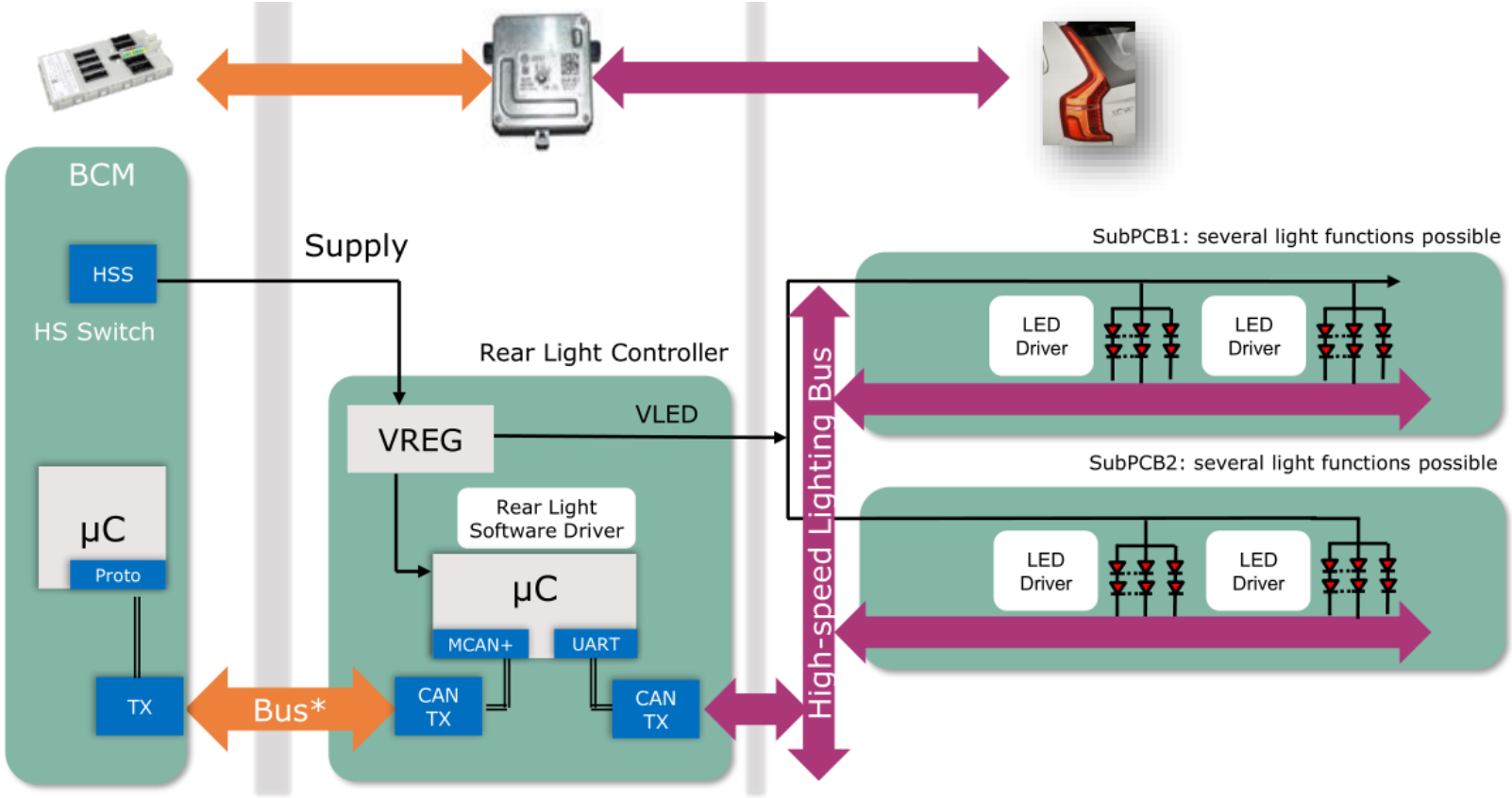
Multichannel LED driver with bus interface and **regulated** VLED supply.



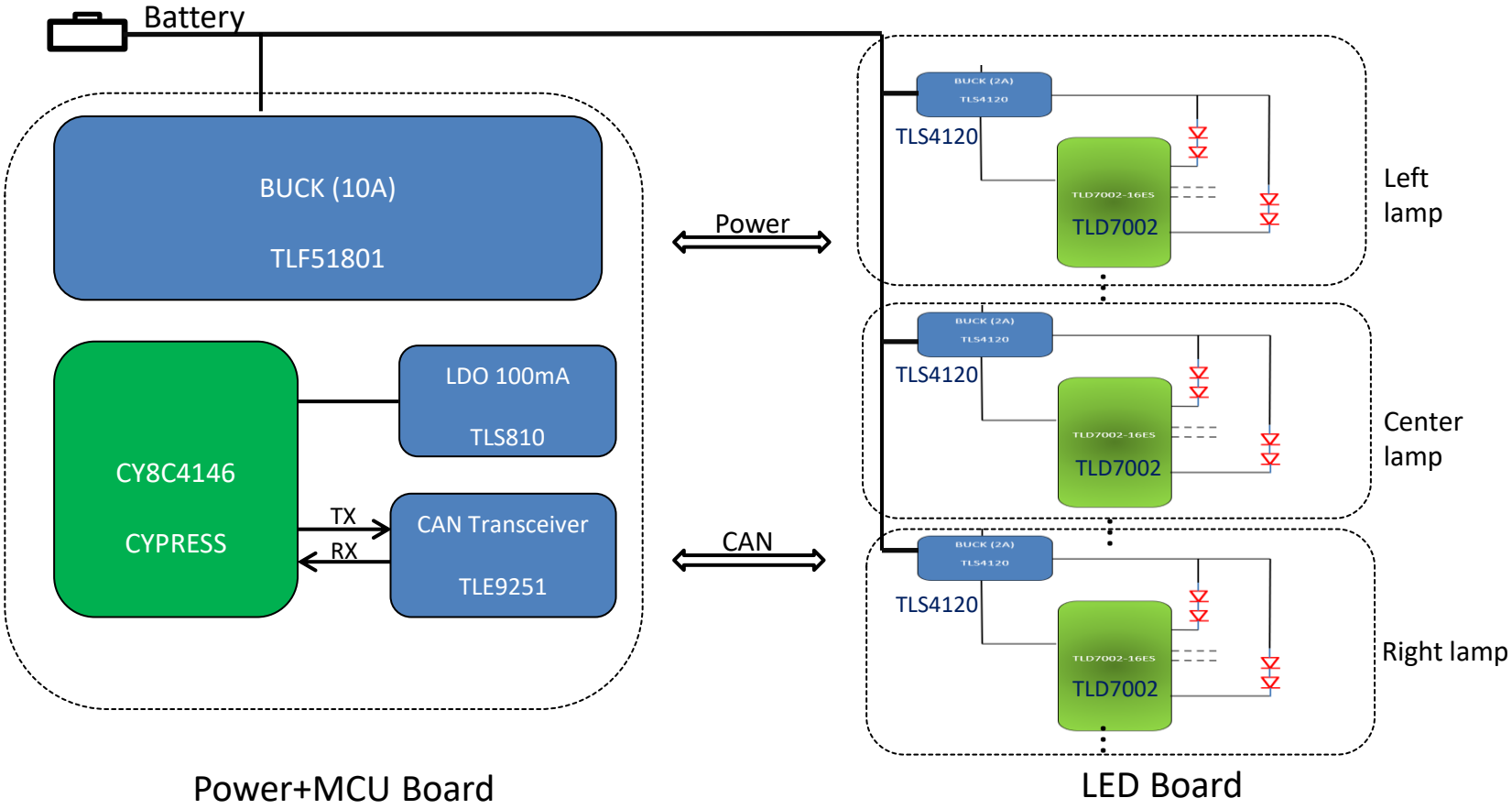
Smart LED driver and fast bus needs no MCU in the rear light

"remote control" from BCM via High-speed Lighting Bus

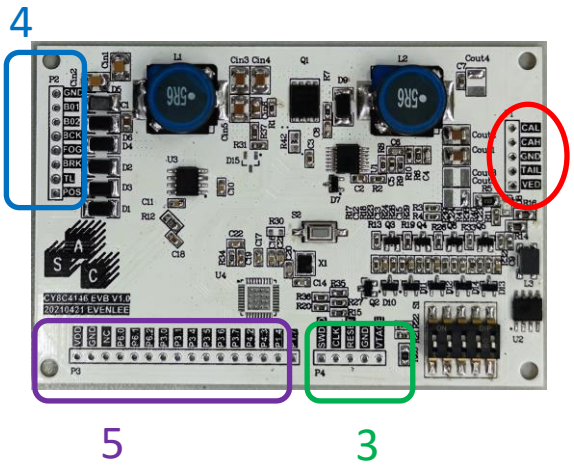
汽车尾灯发展趋势

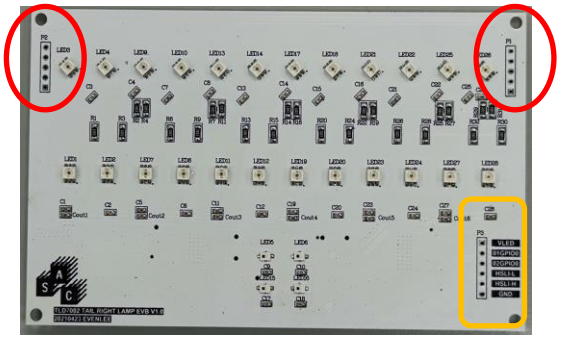

BCM
HSS
HS Switch
Supply
µC
Proto
TX
Bus*
Rear Light Controller
VREG
VLED
Rear Light Software Driver
µC
MCAN+
UART
CAN TX
CAN TX
High-speed Lighting Bus
SubPCB1: several light functions possible
LED Driver
LED Driver
SubPCB2: several light functions possible
LED Driver
LED Driver

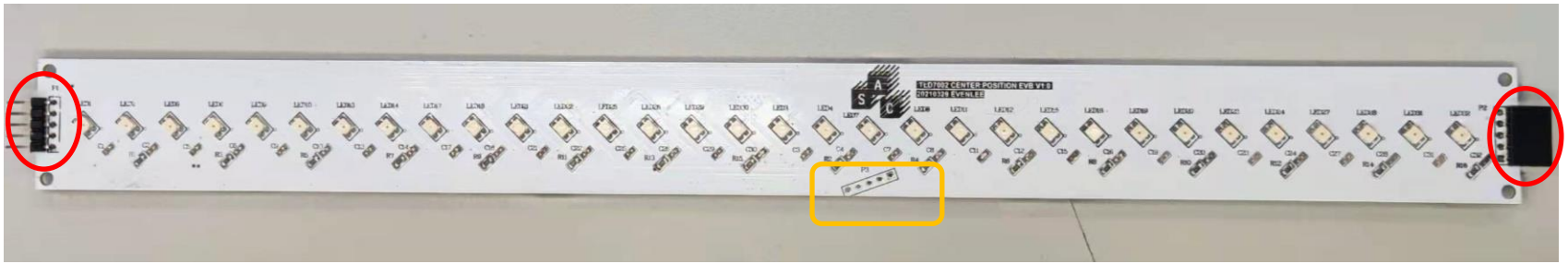
贯穿式尾灯DEMO板


Battery
BUCK (10A)
TLF51801
CY8C4146
CYPRESS
LDO 100mA
TLS810
TX
RX
CAN Transceiver
TLE9251
Power
CAN
BUCK (2A)
TLS4120
TLS4120
TLD7002-16ES
TLD7002
Left lamp
Center lamp
Right lamp
Power+MCU Board
LED Board

贯穿式尾灯DEMO板







1：CAN通讯和电源接口；2：OTP Program-TLD7002；3： MCU 程序烧录口 ；
4：和BCM及外部电源连接口； 5：MCU预留GPIO口

贯穿式尾灯DEMO板

Key System Specifications

PARAMETER	SPECIFICATIONS	
Input voltage range	8-35V	
Position Lamp	LED number: 2S16P+2s12P=56pcs	LED type: LA E67F + LA G6SP OSRAM
	Output current: 50mA	
Brake lamp	LED number: 2S12P=24pcs	LED type: LA G6SP OSRAM
	Output current: 120mA	
Turn Lamp	LED number: 2s6P+2s6P=24pcs	LED type: LY G6SP OSRAM
	Output current: 120mA	
Reversing Lamp	LED number: 2S2P=4pcs	LED type: KW DMLQ33 OSRAM
	Output current: 200mA	
Rear Fog Lamp	LED number: 3S1P=3pcs	LED type: KR DMLQ31 OSRAM
	Output current: 260mA	

贯穿式尾灯DEMO板

Key BOM

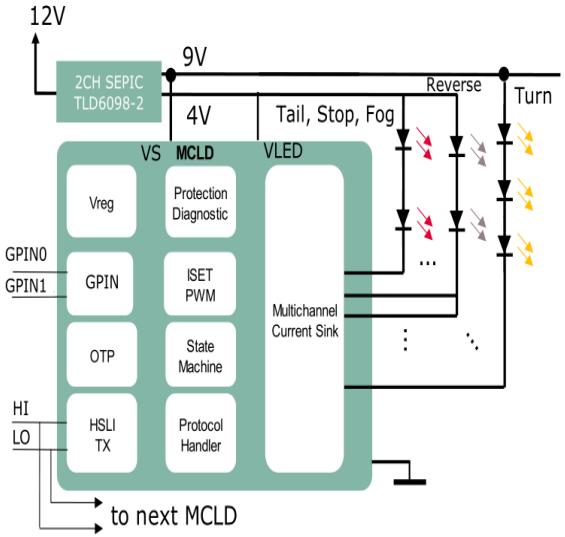
Vendor	Item	Description	Count
Infineon	TLD7002-16ES	LED Driver	5
CYPRESS	CY8C4146LQE-S243	MCU	1
Infineon	TLF51801ELV	Step-Down Controller	1(二选一)
Infineon	IPG20N06S4L-14	NMOS	1
Infineon	TLS4120D0EPV	Step-Down Regulator	3(二选一)
Infineon	TLE9251SJ	CAN Transceiver	1
Infineon	TLS810B1EJ V50	LDO	1
Nexperia	PMEG6030ELP	Diodes	9
Chilisin	AWCUKC453226513TM2	Inductor	多种
Nexperia	PTVS36VP1UP	TVS	4
ON SEMI	SZNUP2105LT_G	Dual Line CAN Bus Protector	3
Others	…	…	…

TLD7002-16ES 产品特点

Core Features

- **16** current sinks, **75 mA** single channel, 150mA dual channel load current cap.
- 16 independent **6-bit** configurable output current
- 16 independent **14-bit** PWM engines (up to 2kHz)
- High precision diagnosis (10bit) (VFWD, SLS, Open, Short, NTC, PTC)
- High-Speed Lighting Interface support up to **2 Mbit/s** without CMC, 8kV ESD (ISO11898-2:2016 compliant)

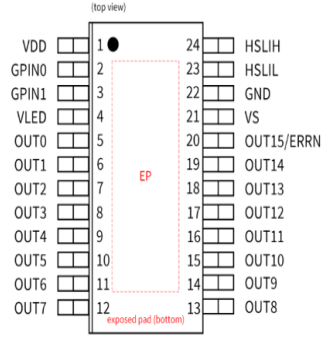
Development according to ISO26262 ASIL-B



Safety Features

- Configurable VFWD monitoring
- Programmable output current monitoring
- PWM duty cycle monitoring
- HSLI bus watchdog
- GPIn watchdog
- Integrated load diagnostic features for open load, short circuit, single LED short, short between two adjacent strings detection.
- Programmable safe state in case of loss of communication
- Internal over temperature sensor
- Internal clock monitoring
- Individual fault and status flags readable via HSLI
- Configurable fault management and common open-drain output error pin ERRN

Package and Pinout



TSDSO24-EP (6x8.65mm)

TLD7002-16ES 产品特点

Product	Channel	Interface	Bandwidth	Current	Functional safety level	Other
TLD7002-16ES	16	CAN	2Mbit/s	75mA	YES	In-CAN transceiver
A	12	UART	2Mbit/s	75mA	NO	Ex-CAN transceiver
B	16	CAN	500 kbit/s	100mA	YES	In-CAN transceiver
C	16	IIC	400 kbit/s	60mA	NO	NO

CY8C4146 产品特点

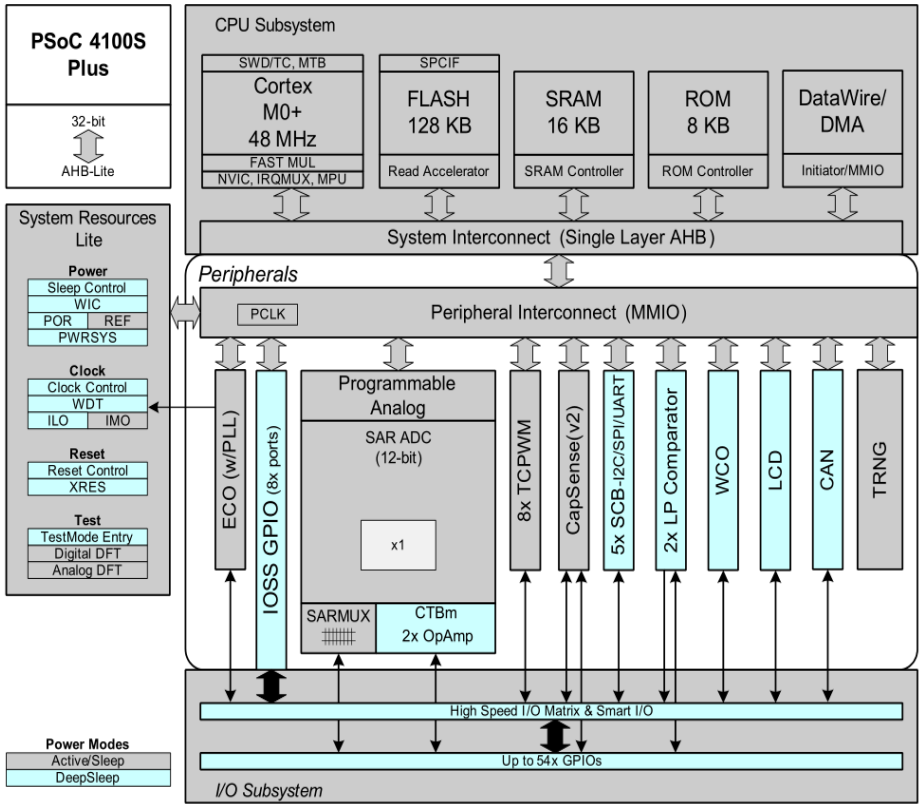
CY8C4146LQE-S243

■ Automotive Electronics Council (AEC) AEC-Q100 Qualified

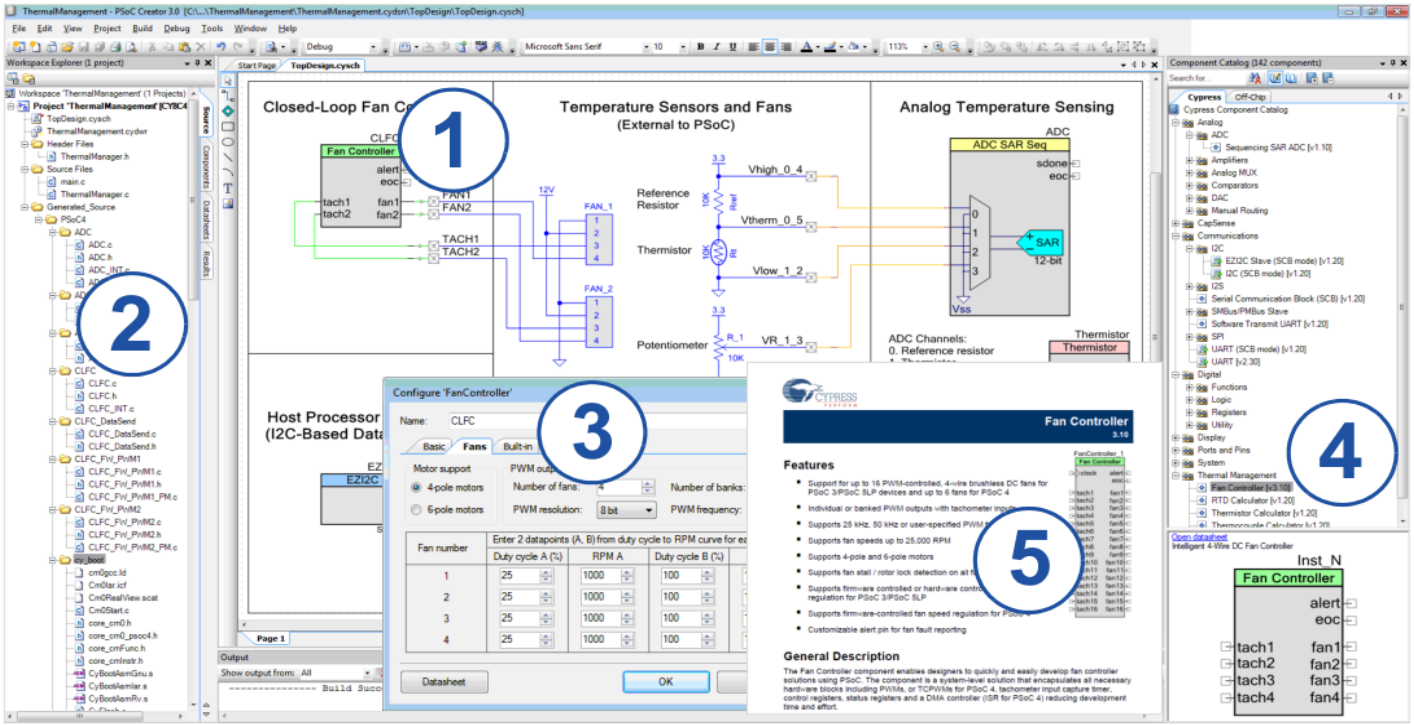
■ Temperature Range
❒ Grade-E: –40 ° C to +125 ° C

■ Up to 54 Programmable GPIO Pins
❒ 40-pin QFN and 64-pin TQFP packages
❒ Any GPIO pin can be CapSense, analog, or digital
❒ Drive modes, strengths, and slew rates are programmable

■ Low-Power 1.71 V to 5.5 V Operation



CY8C4146 产品特点



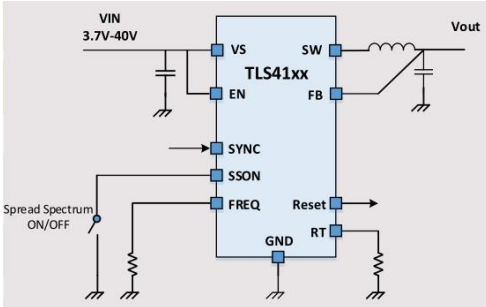
1. Drag and drop component icons to build your hardware system design in the main design workspace
2. Codesign your application firmware with the PSoC hardware, using the PSoC Creator IDE C compiler
3. Configure components using the configuration tools
4. Explore the library of 100+ components
5. Review component datasheets

CY8C4146 产品特点

Software Ecosystem

Tool Category	Tool Vendor	PSoC 4	PSoC 4 HV	Notes
Compilers	IAR SYSTEMS	✓	✓	
	arm	✓	✓	
IDE	IAR SYSTEMS	✓	✓	
		✓		
	eclipse	✓		
	PSoC Creator	✓		Established (= legacy) IFX tool chain for all devices up to 4100S Plus (128 KB)
		✓		New IFX tool chain for 4100S Plus/Max now (128-384 KB), smaller devices in 2021
Debugger / Programmer	Infineon	✓		MiniProg4 CY8CKIT-005
	Infineon		✓	Auto Flash Utility Programmer
	LAUTERBACH	✓		
	KEIL Tools by ARM	✓		
	I-SYSTEM	✓	✓	
	IAR SYSTEMS	✓	✓	
Protocol SW Driver				
SENT TX	Infineon	✓		PSoC Creator Component
CXPI	Infineon	✓		Driven by Japan (Toyota), prototype version available on request
LIN	Infineon	✓		PSoC Creator Component; 2 independent LIN Slaves via 2xSCB supported
LIN	VECTOR	✓	(Vector Evaluation)	CANbedded LIN available
CAN/CAN FD	Infineon	✓		Today no support from Vector; PDL via Modus Toolbox in 2021
LIN Bootloader	Infineon VECTOR	✓	(Vector Evaluation)	IFX: Example code; Vector: Flash Bootloader, EepM-Module (arm Compiler)

Step-Down Controller

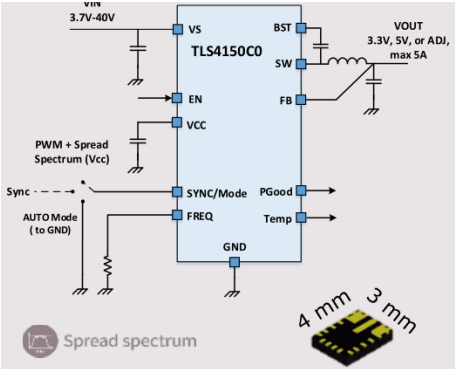


Competitive Advantages

- **Easy to use**
  (simple topology, min external components)
- **Energy saving**
  (Low quiescent current operation)
- **Low noise / EMC optimized**
  (Spread Spectrum + optimized design)

1st Products

TLS41**10**D0EPVx – 1A, 5V,3.3V,ADJ
TLS41**20**D0EPVX – 2A, 5V,3.3V,ADJ
TLS41**25**D0EPVx – 2.5A, 5V,3.3V,ADJ



Competitive Advantages

- **Easy to use**
  (simple topology, min external components)
- **High Power Small Package**
  (Enables low BOM size on PCB)
- **Low noise / EMC optimized**
  (Spread Spectrum + optimized design)
- **Chip Temperature Diagnostic**
  Junction Temperature Analog Output

Products

TLS41**35**D0ExVx – 3.5A 5V,3.3V,ADJ
TLS41**50**D0ExVX – 5A 5V,3.3V,ADJ

AEC Qualified

RoHS

1 Overview

- 10 A synchronous step down Controller
- Current limitation adjustable with Shunt resistor or Rdson
- Adjustable output voltage
- ± 2% output voltage tolerance
- External power transistors
- Integrated bootstrap diode
- PWM regulation
- Very Low Dropout Operation: max Duty Cycle higher than 99%
- Input voltage range from 4.75V to 45V
- Adjustable switching frequency from 100 to 700 kHz
- Synchronization input
- Very low shutdown current consumption (<2µA)
- Soft-start function
- Input undervoltage lockout
- Suited for automotive applications: T_j = -40°C to +150°C
- Green Product (RoHS compliant)
- AEC Qualified

TLF51801ELV

贯穿式尾灯DEMO板

DEMO板视频演示.....

方案总结

- 单个芯片16CH 输出通道，大大减少芯片的数量，电路设计简单可靠；
- 芯片内置收发器，灯板上无需再放置收发器；
- 灯板与控制板间，只需要4根线连接，线束少；
- 采用物理层CAN通讯，速度高达2Mbits/s，可以满足尾灯的各种动态功能需求，抗干扰能力强；
- 诊断保护功能齐全：(VFWD, SLS, Open, Short, NTC,PTC)
- 满足ASIL-B功能安全要求，通讯失效情况下可以调用OTP设置值控制相应的通道；
- 尾灯控制板标准化，平台化。针对不同的车型，只需要更改灯板，控制板只需调整软件即可。

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