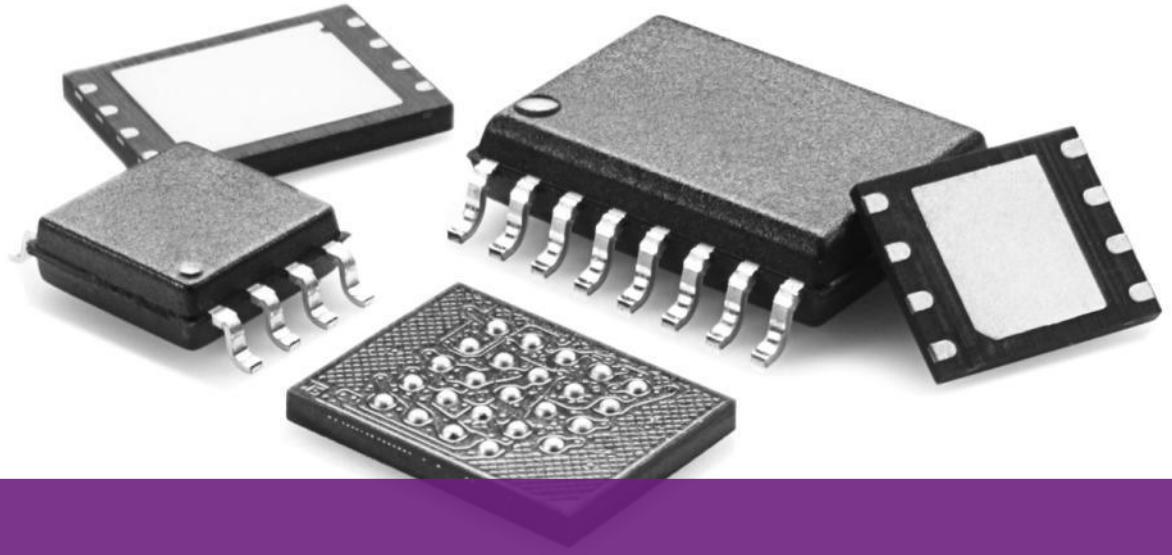


Spansion Intelligent LED Solution Introduction

Analog Business Unit, Spansion Inc.

Who is Spansion?

Spansion Corporate Overview

Spansion (NYSE: CODE)

Annual Revenue ~ $1.3B

Employees ~ 4,000

Products ~ 10,000+

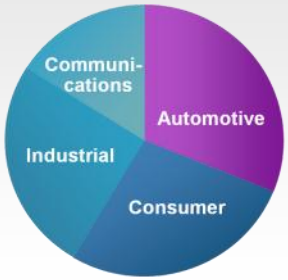
Patents ~ 5,000

Customers 10,000+

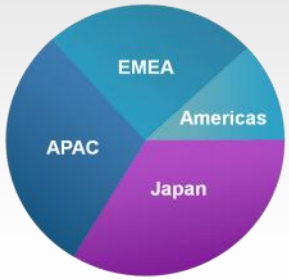
Flash	#1 Embedded NOR Flash Memory Supplier
MCU	ARM Cortex / Proprietary – #2 in Japan
Analog	PMICs, LED Lighting, Energy Harvesting

- Innovative Technology and Products
- Embedded Systems Focus
- Rich and Broad Ecosystem
- Superior Customer Support

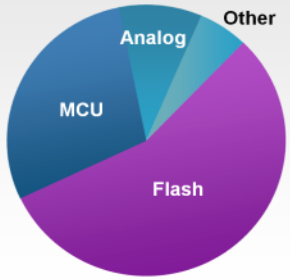
Segment Profile



Regional Profile



Business Profile



Overarching Focus	**PROFITABLE GROWTH**

World Class Solutions for Embedded Applications

Microcontroller

- Strong product portfolio of proprietary and ARM core microcontrollers
- High quality, high performance, low power, with embedded Flash memory

Flash

- Charge-Trap technology leadership
- Broadest offering of Serial and Parallel NOR
- High quality SLC NAND

Analog and Mixed Signal

- Power management technology leadership
- Portfolio of high margin discrete analog products

Embedded System on Chip Solutions leverage embedded Flash technology to integrate multiple components into a single solution with application specific reconfigurable software

LED Driver IC

Spansion's Values of LED lighting drivers

TRIAC Dimmer-use Demand

Dimming

Noise

Flicker

EMI

Flicker-less

(Analog Technology for PMIC)

Efficiency

Power saving

Size

Cost

Spansion's LED Driver IC

Power Factor

Cost

(Mixed signal Technology)

Multi-Function

Color Mixing

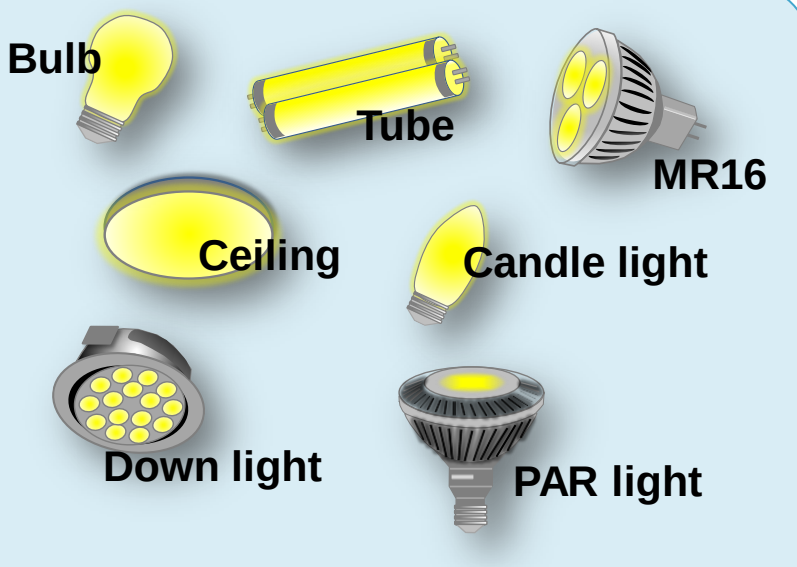
Fine Dimming Control

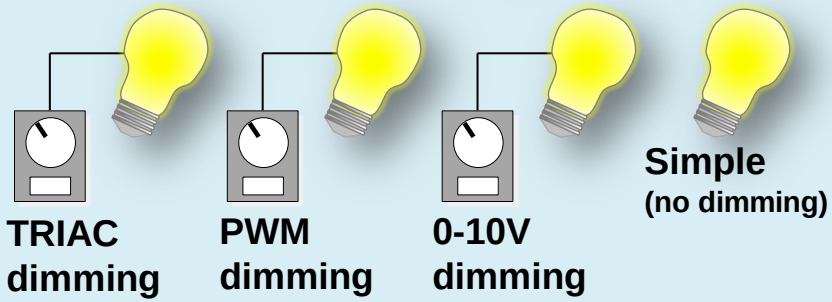
Dimming

Communication Control

LED Lighting Application Category

Simple Lighting

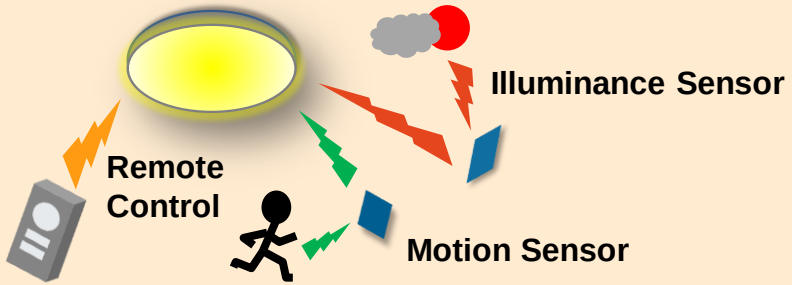




Intelligent Lighting

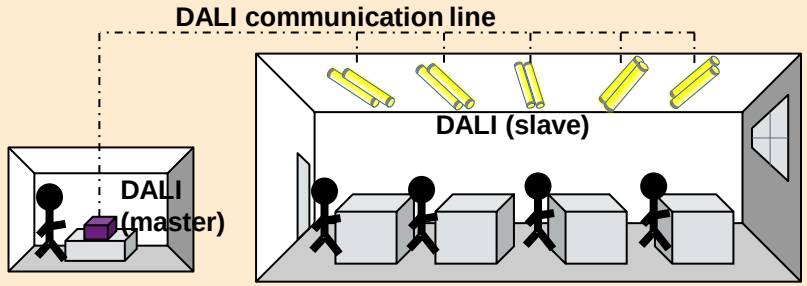
Low-end

Sensor/PWM dimming control of lighting with MCU



High-end

Centralized control or color control of lighting by DALI/DMX communication



Market trend and Spansion product line up

High volume

High-end

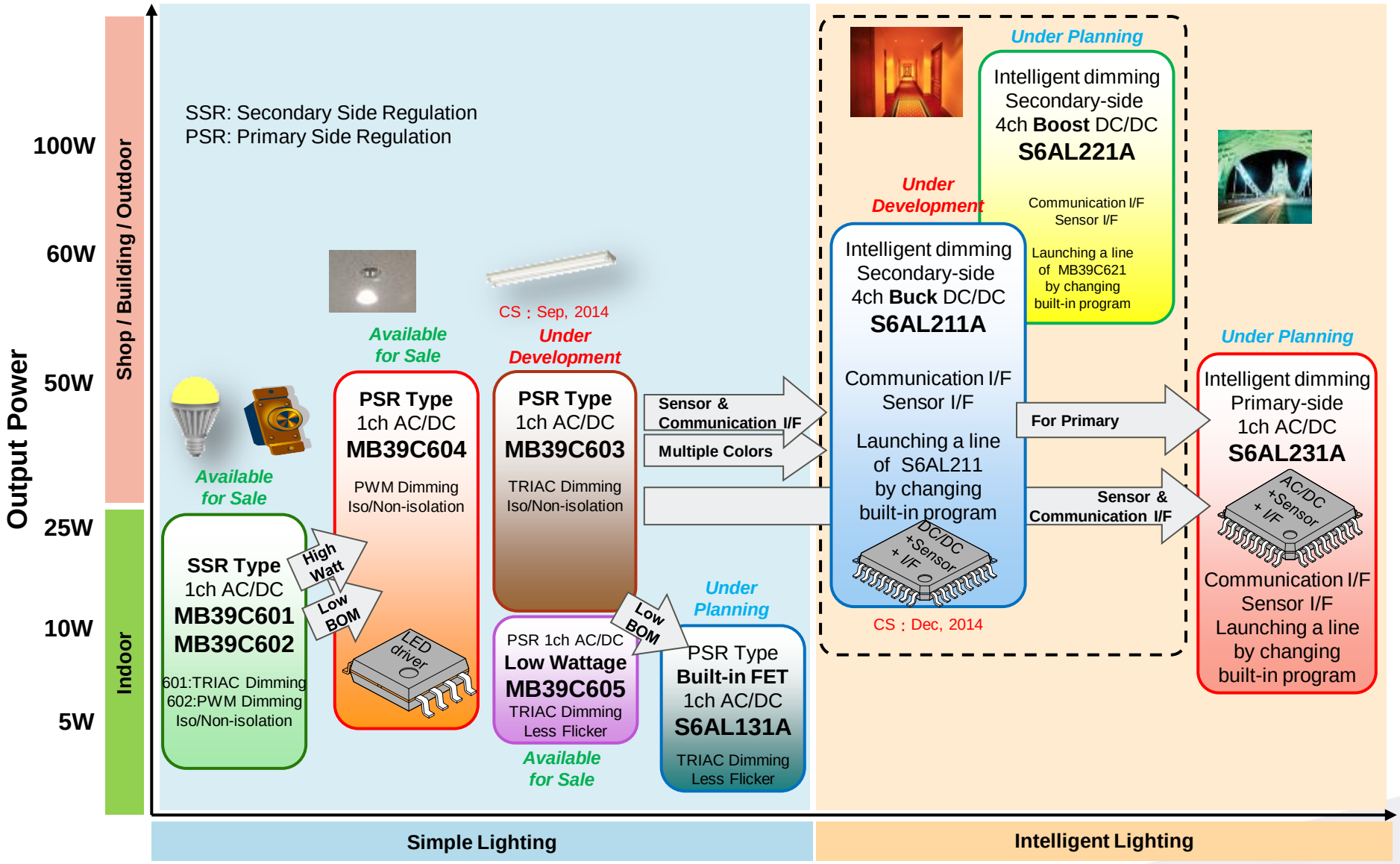
Simple Lighting

Intelligent Lighting

Application		Market trends / Requirements	Products					
			MB39 C601	MB39 C602	MB39 C603	MB39 C604	MB39 C605	S6AL 211A
Residential Lighting		Simple lighting, TRIAC dimming/PWM dimming	Triac ● SSR	PWM ● SSR		PWM ● PSR	Triac ● PSR	
Industrial Lighting		High brightness and high power lighting (more than 100W) at high altitude		PWM ● SSR	Triac ● PSR	PWM ● PSR		●
Shop Lighting		Modular-type Driver Spotlight		PWM ● SSR	Triac ● PSR	PWM ● PSR		●
Office Lighting		Central control system by DALI,RS485 etc.						●
Illumination		RGBW color support						●
Stage Lighting		RGB colored LED Lighting in quick action Technically-demanding LED driving				▲ (w/FM3)		

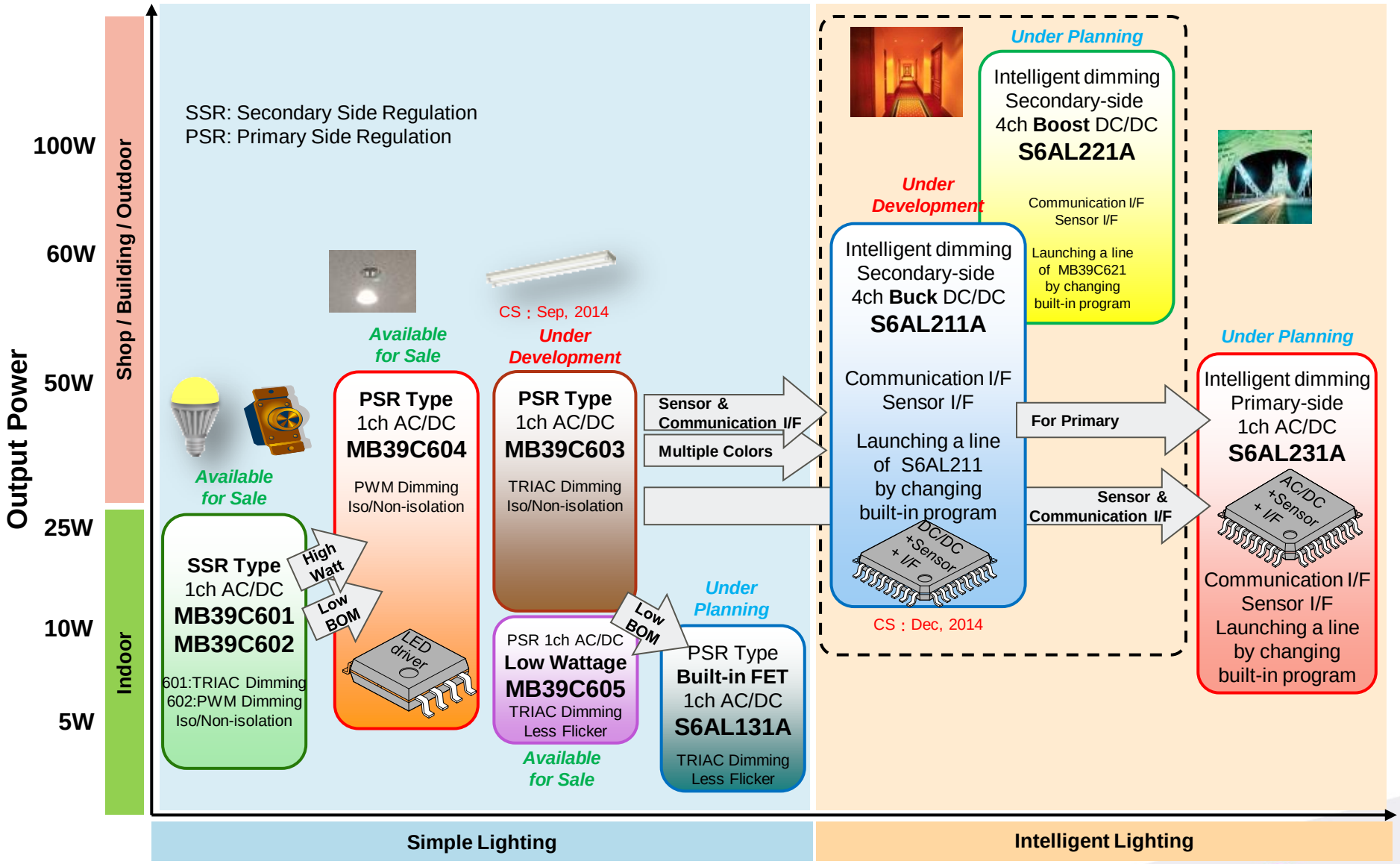
Available / **New Products (under development)**

Product Roadmap



LED Driver IC for Intelligent Lighting

Product Roadmap



Intelligent Lighting LED Driver IC

Feature

1. Deep Dimming

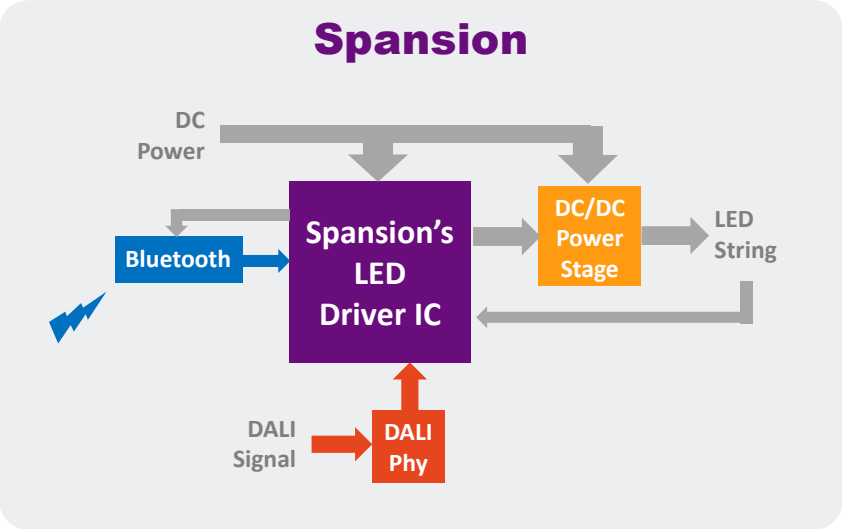
⇒ *Dimming deeper (down to 0.1%), Extending brightness range of expression*

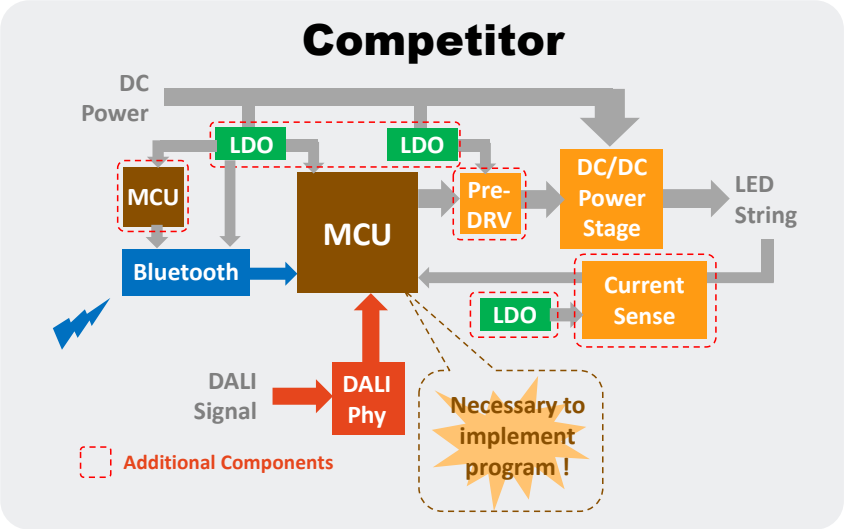
2. Supporting DALI, DMX protocol,
Including Bluetooth・Sensor・PWM/0-10V dimming interface

⇒ *Elimination of implementing program at customer side, Easy to develop intelligent lighting*

3. Including peripheral components

⇒ *Downsize the PCB size and reduce BOM number*





Easy designing of Intelligent Lighting solution with low BOM

Application Examples

Network-based lighting system for building with DALI

- Application Examples
  - Office lighting System
- Product
  - S6AL211A

Sensor-based lighting system

(Bluetooth, Motion sensor, Illuminance sensor etc)

- Application Examples
  - Office and Residential
  - Display purpose at Commerce Facility
  - Floodlight, Desk light, Street Light
- Product
  - S6AL211A, MB39C604, MB39C602

Network-based color dimmable lighting system with DMX

- Applicatuon Examples
  - Shop Lighting for Display
  - Museum
- Product
  - S6AL211A

Low-end, Simple lighting

(PWM dimmer, 0-10V dimmer)

- Application Examples
  - Residential Lighting
  - Floodlight
- Product
  - S6AL211A, MB39C604, MB39C602

Customized lighting system

(Using external MCU helps to configuring these new functions)

- Applicatuon Examples
  - Outdoor Illumination
  - Office, Plant Cultivation, Interior
- Product
  - S6AL211A

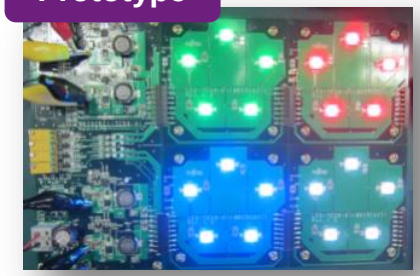
S6AL211A Overview

ES : Jul,2014 (DALI)

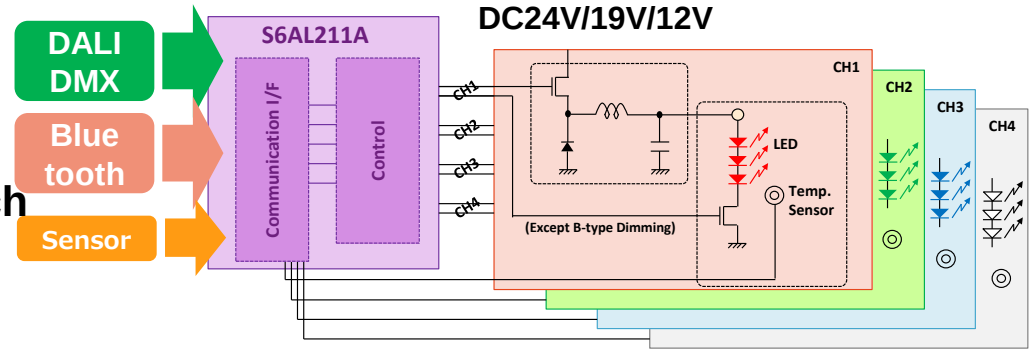
4ch Buck DC/DC LED Driver IC for Intelligent Lighting

Deep Dimming, supporting DALI and DMX protocol, Bluetooth and Sensor I/F

Prototype



Support Max. 72W totally with 4ch

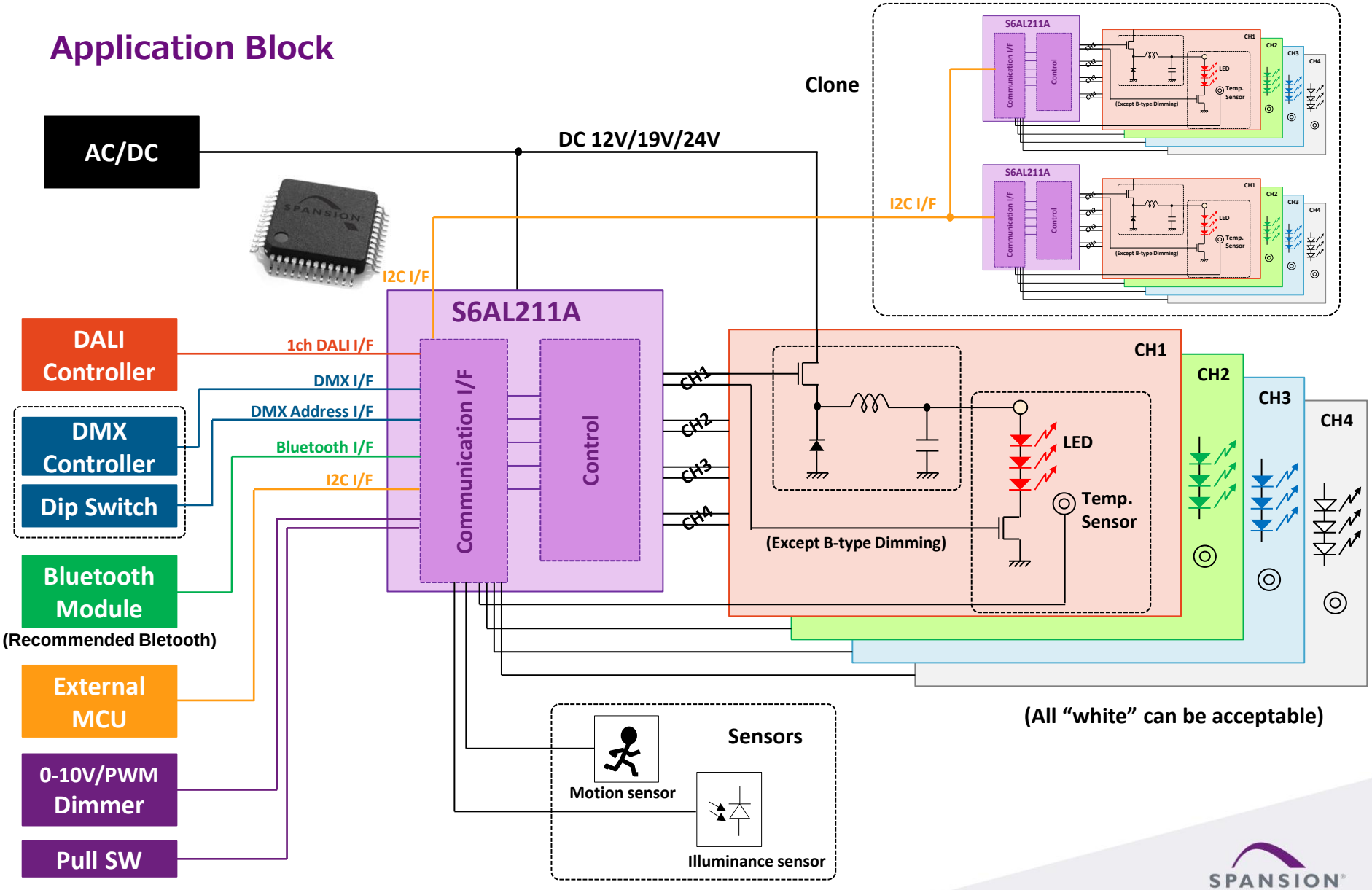


Input Voltage	Dimming	Communication	Clone function
DC 24V LED 4~5pcs	Constant Current 256 level + PWM 64level	DALI	Be able to expand wattage with chained MB39C621s
DC 12V LED 2~3pcs	PWM 256 level	DMX512	
DC 19V LED 3~4pcs	Constant Current 256 level	RF+Sensor +Pull SW dimming	
		PWM dimming	
		0~10V Analog dimming	

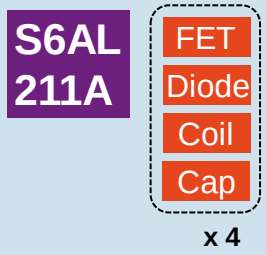
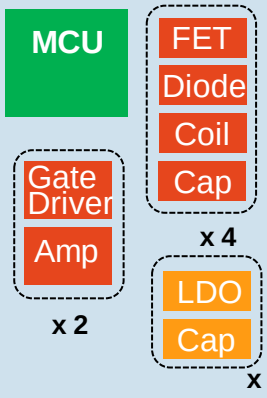
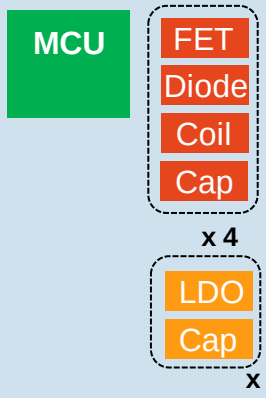
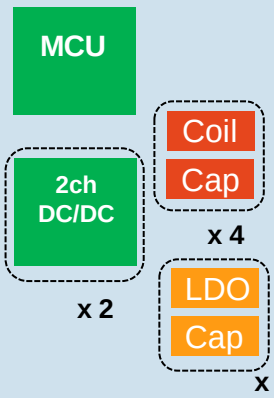
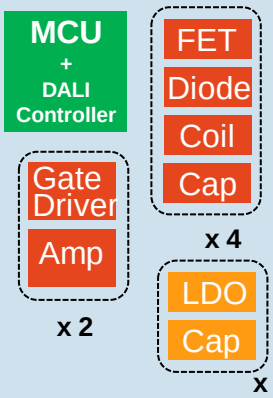
Launching a line of solutions compatible with various application

S6AL211A Application Block

Application Block



S6AL211A

	Spansion	A Company	B Company	C Company	D Company
Products					
BOM number	17	25 (+47%)	19 (+12%)	13 (-24%)	25 (+47%)
PCB Area Ratio	1.00 (35x35mm^2)	1.20 (+20%)	1.14 (+14%)	1.10 (+10%)	1.24 (+24%)
Built-in Program	✔	×	×	×	✔

Benefit

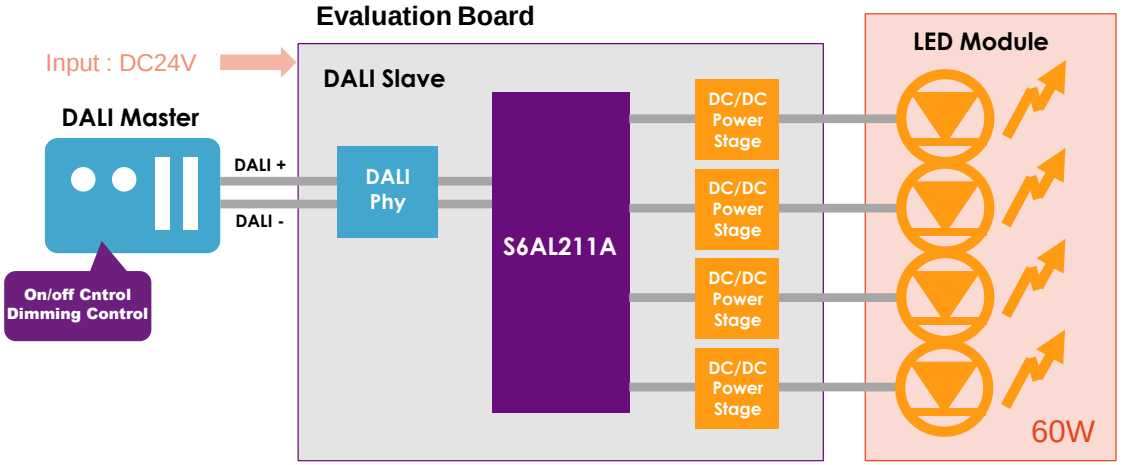
- ✓ Easy to implement : Customer don't need to write program of communication I/F
- ✓ Total PCB Area is reduced by 10%~24%

S6AL211A Evaluation Board (DALI)

◆ Evaluation Board

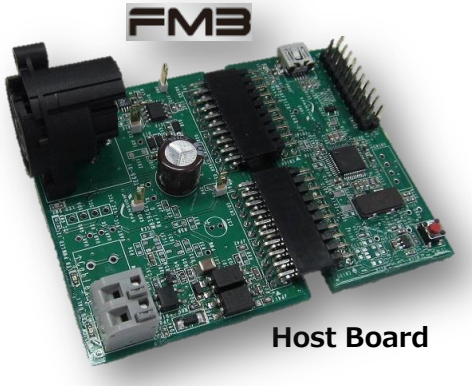
Spansion provides DALI Slave and LED Module
(Customer can easily evaluate by simply connecting your DALI Master)

(Size:71.5mm×53mm)



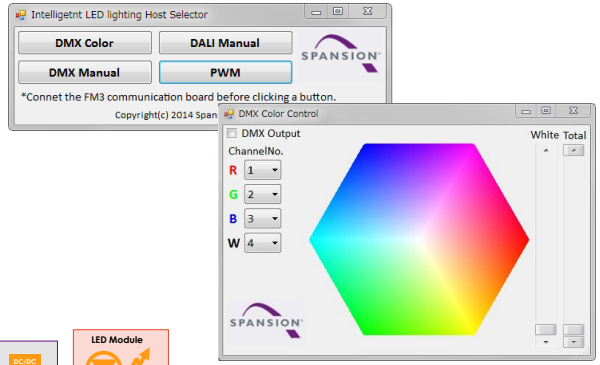
◆ Evaluation Support Tool

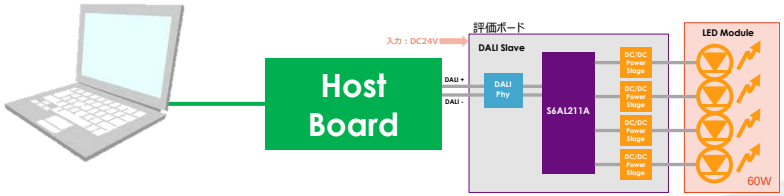
If customer doesn't have DALI master…



Evaluation by GUI Host tool with PC

- ✓ DALI
- ✓ DMX : Full Color + White (4ch)
- ✓ PWM : 256Steps

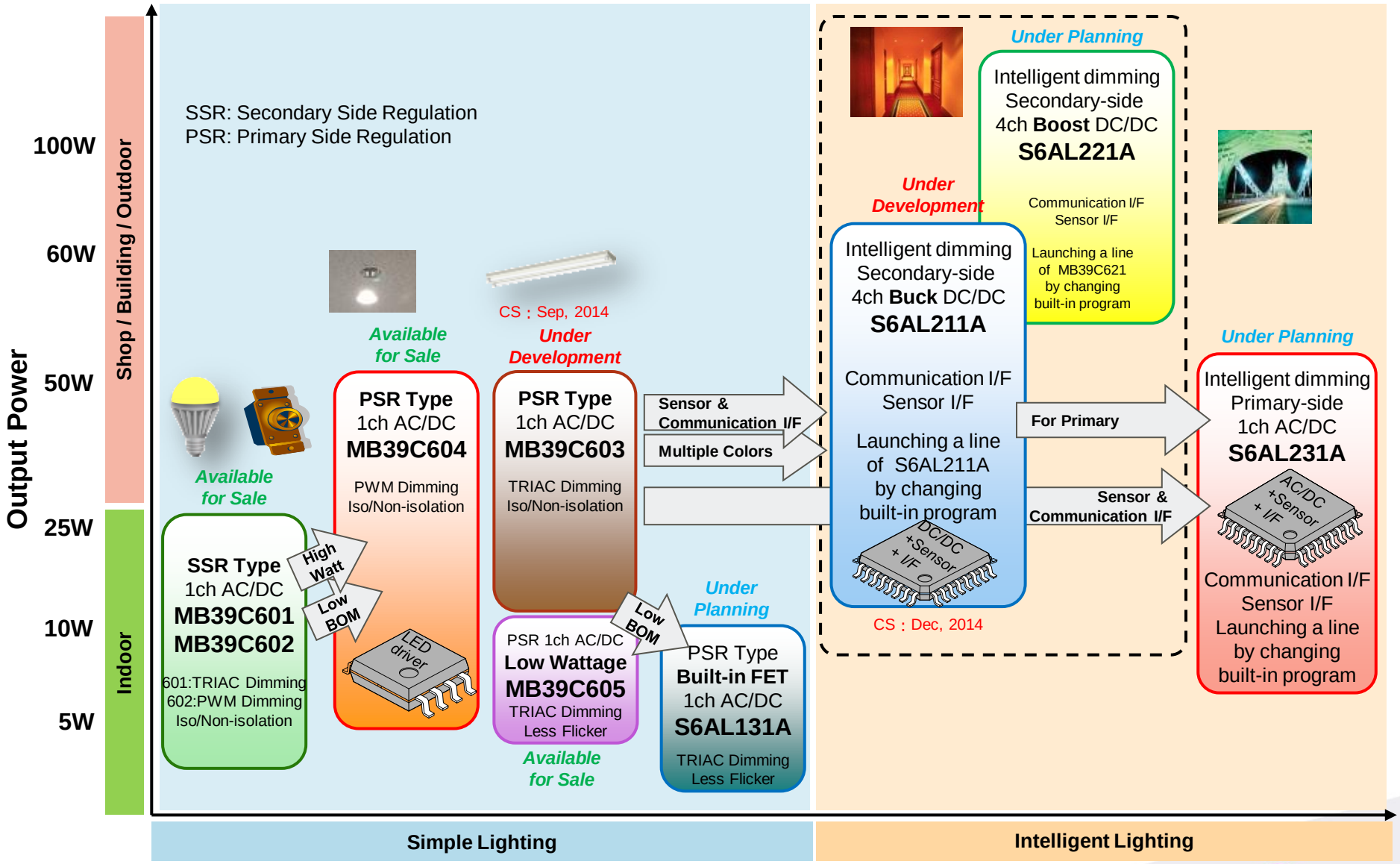




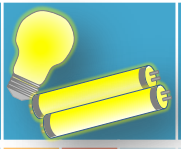
www.spansion.com

LED Driver IC for Simple Lighting

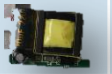
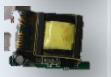
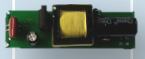
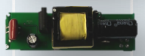
Product Roadmap



Simple Lighting LED Driver IC (Product Line up)

Product	Application							Feature					Status
	Dimming	Wattage			Input Voltage	Iso/ Non-iso			PF	Efficiency	Dimming Range	Output Accuracy	
MB39C601 (SSR)	TRIAC Dimming	3W~10W	10W~15W	15W~25W	100V /200V	Iso/ Non-iso	Candle	Bulb	• SSR Type • Low BOM, Small Size	>0.9	>85%	10%~ 100%	1% (Iso)	MP
MB39C605 (PSR)					100V /200V				• PSR Type • Camera Flicker-less	0.6	>80%	5%~ 100%	<1.5% (Non-iso)	MP
MB39C603 (PSR)			15W~25W	25W~50W	100V				PAR, Downlight	• PSR Type • Flicker-less • Stable Dimming Curve	>0.9	>85%	5%~ 100%	<3% (Iso) <1.5% (Non-iso)	ES Available
MB39C602 (SSR)	No Dimming	3W~25W			100V /200V	Iso/ Non-iso	Candle, Bulb	PAR, Tube		• SSR Type • High Efficiency, High Power Factor	>0.9	>90%	5%~ 100%	<3% (Iso) <1.5% (Non-iso)	MP
MB39C604 (PSR)	PWM Dimming		25W~50W		100V /200V				Down light, Street light	• PSR Type • High Power Factor • Stable Regulation	>0.9	>80%	5%~ 100%	<1.5% (Non-iso)	MP

Simple Lighting Evaluation Board list

Solution Type		Form	Dimming	Wattage	Input Voltage	Iso/ Non-iso	LED Driver IC	DC Output	Efficiency	PF	Noise	Size (mm)	BOM	Remarks
Candle Lamp	E17		TRIAC Dimming	3W	100V	Isolation	MB39 C601	20V 150mA	>75%	>0.97	-	26x18.5 (H)15	25	
	E17		TRIAC Dimming	3W	220V	Isolation	MB39 C601	18V 170mA	>75%	>0.91	-	26x18.5 (H)15	25	
Bulb	E17		TRIAC Dimming	5W	85V ~140V	Non Isolation	MB39 C601	30V 140mA	87% @100V	0.98 @100V	EN55015	19.1x32.7 (H)13	29	
	E17	-	TRIAC Dimming	5W	180V ~240V	Non Isolation	MB39 C601	30V 140mA	-	-	-	-	-	Under Designing
	E17		No Dimming	9W	85V ~115V	Non Isolation	MB39 C604	67V 130mA	87% @100V	0.61 @100V	-	30.5x35 (H)12.5	25	Reference Design
	E26		TRIAC Dimming	8.5W	90V ~110V	Non Isolation	MB39 C605	74V 120mA	83% @100V	0.63 @100V	THD: 100% @100V	42.5x22 (H)12.5	47	
	E26	-	TRIAC Dimming	8.5W	100V	Non Isolation	MB39 C601	60V 120mA	-	-	-	-	-	Under Designing
	E26	-	TRIAC Dimming	8.5W	220V	Non Isolation	MB39 C601	60V 120mA	-	-	-	-	-	Under Designing
	E26		PWM Dimming	9W	110V	Isolation	MB39 C602	30V 304mA	80%	0.99	-	70x20 (H)20	48	
	E26		PWM Dimming	9W	220V	Isolation	MB39 C602	30V 304mA	80%	0.99	-	70x20 (H)20	48	
	E26		No Dimming	7W	90V ~300V	Isolation	MB39 C604	37V 160mA	83% @220V	0.95 @220V	THD:15% @220V	40x22.2 (H)13.5	32	Reference Design

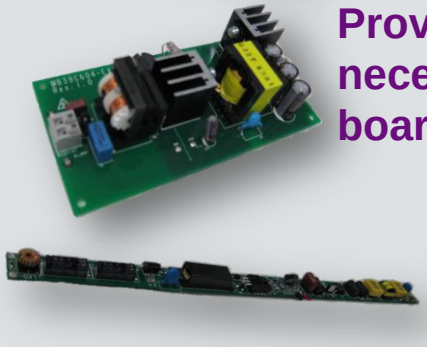
Simple Lighting Evaluation Board list

Solution Type	Form	Dimming	Wattage	Input Voltage	Iso/ Non-iso	LED Driver IC	DC Output	Efficiency	PF	Noise	Size (mm)	BOM
Tube 		No Dimming	19W	85V ~265V	Isolation	MB39 C602	36V 485mA	85%	0.99	THD:<10%	295x18 (H)9	41	
		No Dimming	18W	85V ~265V	Isolation	MB39 C604	40V 450mA	87%	>0.9	EN55015	300x18 (H)10	48	
		PWM Dimming	18W	85V ~265V	Isolation	MB39 C604	40V 450mA	85%	>0.9	EN55015	311x18 (H)10	56	
	-	No Dimming	18W	85V ~265V	Non Isolation	MB39 C604	40V 450mA	-	-	-	-	-	Under Designing
Down Light 		No Dimming	11W	85V ~265V	Isolation	MB39 C602	26V 390mA	90%	0.99	THD:<10%	55x55 (H)32	52	
PAR Light 		TRIAC Dimming	18.5W	85V ~145V	Isolation	MB39 C603	35V 473mA	80%	0.9	-	44x84 (H)32	46	
Street Light 		PWM Dimming	50W	85V ~265V	Isolation	MB39 C604	33V 1500mA	85%	0.95	THD:<15%	130x65 (H)30	36	

Design Support

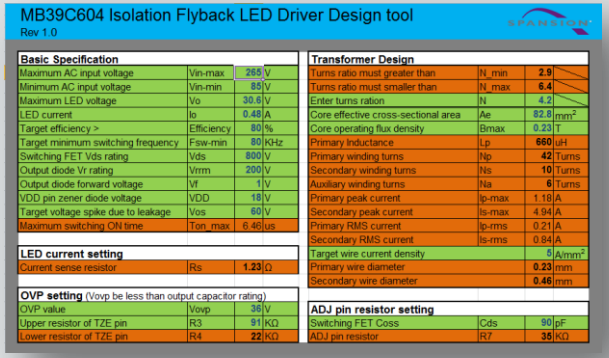
EVB Manual

- How to measure
- Characteristics
- Circuit, Layout
- Transformer Spec.



Provide information necessary to make board

Transformer Design Tool



MB39C604 Isolation Flyback LED Driver Design tool
Rev 1.0

Basic Specification			
Maximum AC input voltage	Vin-max	265	V
Minimum AC input voltage	Vin-min	85	V
Maximum LED voltage	Vo	30.6	V
LED current	Io	0.48	A
Target efficiency >	Efficiency	80	%
Target minimum switching frequency	Fsw-min	80	KHz
Switching FET Vds rating	Vds	800	V
Output diode Vr rating	Vrrm	200	V
Output diode forward voltage	Vf	1	V
VDD pin zener diode voltage	VDD	18	V
Target voltage spike due to leakage	Vos	60	V
Maximum switching ON time	Ton_max	6.46	us

LED current setting			
Current sense resistor	Rs	1.23	Ω

OVP setting (Vovp be less than output capacitor rating)			
OVP value	Vovp	36	V
Upper resistor of TZE pin	R3	91	KΩ
Lower resistor of TZE pin	R4	22	KΩ

Transformer Design			
Turns ratio must greater than	N_min	2.9	
Turns ratio must smaller than	N_max	6.4	
Enter turns ration	N	4.2	
Core effective cross-sectional area	Ae	82.8	mm^2
Core operating flux density	Bmax	0.23	T
Primary Inductance	Lp	660	uH
Primary winding turns	Np	42	Turns
Secondary winding turns	Ns	10	Turns
Auxiliary winding turns	Na	6	Turns
Primary peak current	Ip-max	1.18	A
Secondary peak current	Is-max	4.94	A
Primary RMS current	Ip-rms	0.21	A
Secondary RMS current	Is-rms	0.84	A
Target wire current density		6	A/mm^2
Primary wire diameter		0.23	mm
Secondary wire diameter		0.46	mm

ADJ pin resistor setting			
Switching FET Coss	Cds	90	pF
ADJ pin resistor	R7	36	KΩ

Automatically calculation of optimal transformer specification according to Input/Output conditions

Easy DesignSim (Online Design Simulator)

Support Tool for Board Design

- **Design Support of MB39C601,MB39C602 are available**

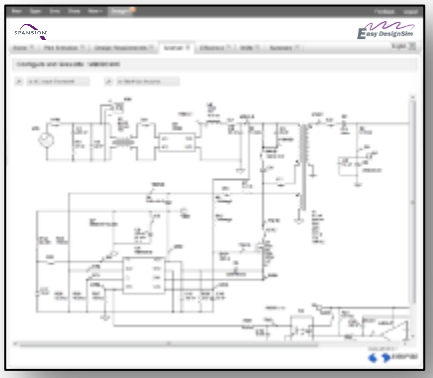
  - **Information of circuit, parts, operation necessary for the product selection can be gotten**
  - **Operation is checked** by desired setting of input/output.
  - **Selection and Buy of external parts**.

Easy DesignSim

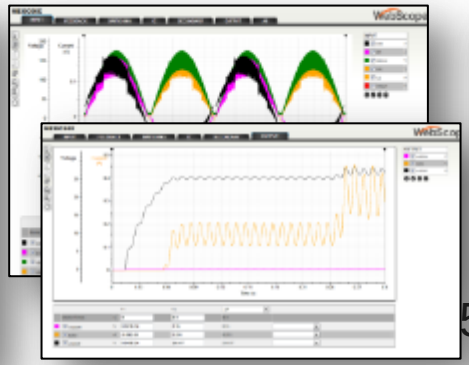
http://spansion.transim.com

Because LED drive has extra high voltage, simulation is effective

Circuit & Parts select



Simulation waveform



BOM List & Buy

LED Lighting Board

Introduction video can seen in YouTube/ SOKU / YOUKU

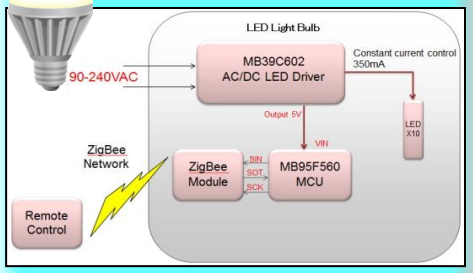
SPANSION

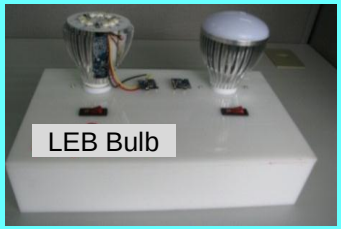
Application Demo Board with MCU

Demo Board	Feature	Status
1. Zigbee Wireless Dimming	Support Zigbee used Worldwide	-
2. Bluetooth Wireless Dimming	Available to control by Smart Phone	Available for demo
3. Remote Dimming Control with solar charger	Wireless Control by Energy Harvesting PMIC with MCU	-

Controlled by MCU

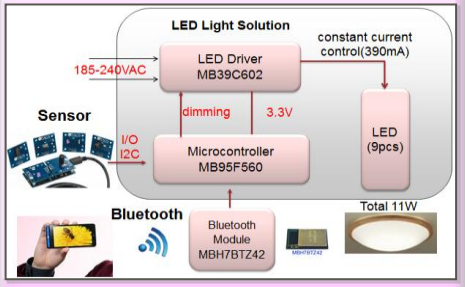
1st LED Bulb system
Control by Zigbee + MCU





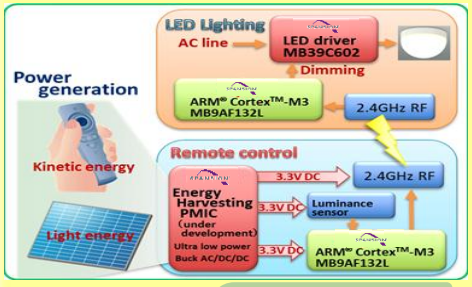
Driver IC :MB39C602
MCU :MB95F560 (New8FX)
Function :Zigbee dimming
Application :Ceiling

2nd LED Ceiling lamp system
Control by Bluetooth + MCU



Driver IC :MB39C602
MCU :MB95F560 (New8FX)
Function :Bluetooth dimming
MBH7BTZ42 (FCL)
Application :Ceiling

3rd LED lighting system
Remote control which used Energy harvesting technology



Driver IC :MB39C602
Power IC :Energy Harvesting PMIC
MCU :MB9AF132L (FM3)
Function :2.4GHz RF
Application :Down Light, Ceiling