

# Intelligent external control integrated LED light source

## Main features

- The IC control circuit shares a common power supply with the LED point light source.
- The control circuitry is integrated with the RGB chip in a single 4020-packaged component to form a complete externally controlled pixel point.
- Built-in signal shaping circuit, any pixel point receives the signal after waveform shaping and then output, to ensure that the line waveform distortion will not accumulate.
- Built-in power-on reset and power-off reset circuits.
- Each pixel point of the three-color color can achieve 256 levels of brightness display, complete with 16777216 colors of full true color display.
- Port scanning frequency 2KHz.
- Serial cascade interface, capable of receiving and decoding data over a single signal line.
- The number of cascades is not less than 1024 points when the refresh rate is 30 frames per second.
- Data can be sent at speeds up to 800Kbps.
- The color of the light is highly consistent and cost effective.
- **With power reverse connection will not be damaged.**
- **The periphery does not require any electronic components including capacitors.**

## Main application areas

- Consumer electronics sector.
- LED lighting field.
- Computer and peripheral equipment\game equipment\various electrical equipment field.

## Product Overview

WS2812B-4020 is an intelligent externally controlled LED light source integrating control circuit and light-emitting circuit, each component is a pixel point. The pixel point contains an intelligent digital interface data locking signal shaping amplification drive circuit, also contains a high-precision internal oscillator and programmable fixed current control part, which effectively ensures that the pixel point light color is highly consistent.

The data protocol adopts the single-wire zeroing code communication method. After the pixel point is reset, the DIN terminal accepts the data transmitted from the controller, and the first 24bit data is extracted by the first pixel point and then sent to the data latch inside the pixel point, and the rest of the data is amplified by the internal shaping processing circuit and then begins to be forwarded and outputted to the next cascade of pixels through the DO port, and the signal is reduced by 24bit for every one pixel point transmission. Every time a pixel point is transmitted, the signal is reduced by 24bit. The pixel point adopts the automatic shaping and forwarding technology, which makes the number of cascade of the pixel point is not limited by the signal transmission, but only limited by the signal transmission speed requirement.

With a port scanning frequency of up to **2KHz**, there is no flicker even when captured by HD cameras, making it ideal for high-speed mobile products.

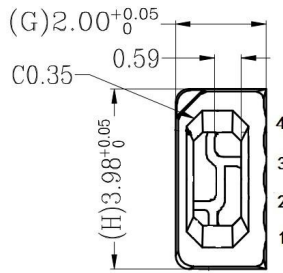
With a **RESET** time of **280μs** or more, an interrupt does not cause a false reset, and can support lower frequency, less expensive MCUs.

LED has the advantages of low voltage drive, environmental protection and energy saving, high

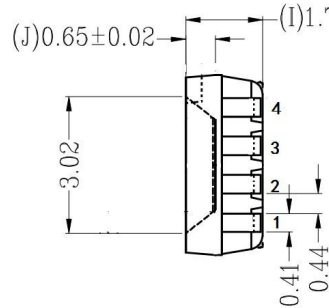
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brightness, large scattering angle, good consistency super, low power and ultra-long life. The control circuit is integrated in the LED above, the circuit becomes more simple, small size, easier to install.

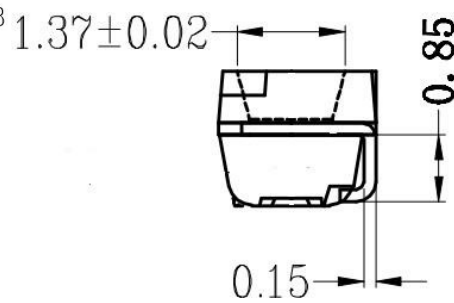
## Mechanical dimensions (in mm)



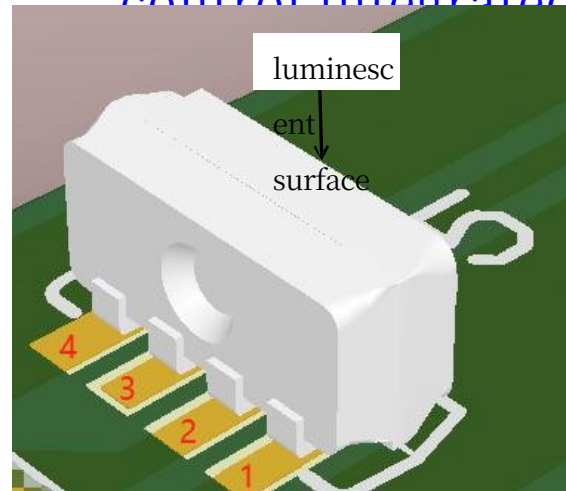
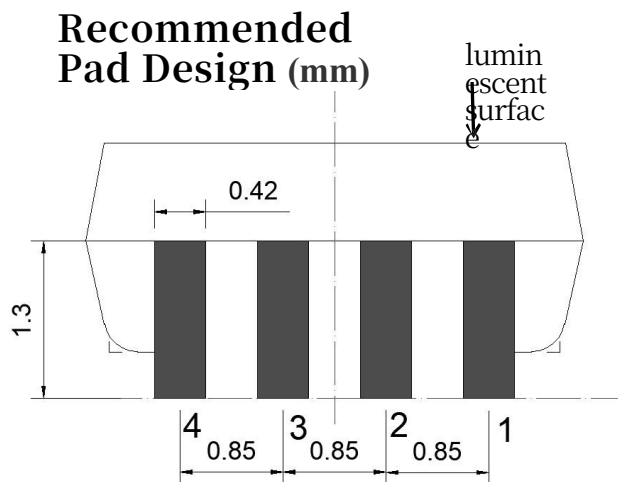
**Top**



**ViewSide**



**ViewSide View**



3D  
Schematic

### Pin Function

serial number	notation	pin name	Function Description
1	DIN	data entry	Control data signal input
2	VDD	power supply	Power supply pins
3	DOUT	data output	Control data signal output
4	VSS	structural particle: used before a verb or adjective, linking it preceding the verb or adjective	Signal ground and power ground

### Maximum rating (if not specified, TA=25°C, VSS=0V)

parameters	notation	realm	unit (of measure)
Supply Voltage	VDD	+3.7~+5.3	V
Logic Input Voltage	VI	-0.3V to VDD+0.7V	V

### Electrical parameters (if not specified, TA=25°C, VDD=5V, VSS=0V)

parameters	notation	minimal	typical case	greatest	unit (of measure)	test condition
Input Current	II	--	--	±1	μA	VI=VDD/VSS
High Level Input	VIH	2.7V	--	VDD+0.7V	V	DIN, SET
Low Level Input	VIL	-0.3V	--	0.7V	V	DIN, SET

### Switching characteristics (if not specified, TA=25°C, VDD=5V, VSS=0V)

parameters	notation	minimal	typical case	greatest	unit (of measure)	test condition
transmission delay time	t <sub>PLZ</sub>	--	--	300	ns	CL=15pF, DIN→DOUT, RL=10KΩ
descent time	t <sub>THZ</sub>	--	--	120	μs	CL=300pF, OUTR/OUTG/OUTB
Input Capacitance	C <sub>I</sub>	--	--	15	pF	--

### LED Characteristics

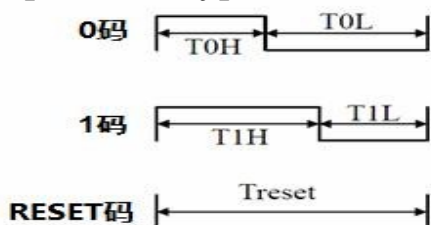
parameters	notation	color	Static current (center value): 0.6mA				test condition (Operating current)
			minimum value	typical value	maximum values	unit (of measure)	
luminous intensity	IV	Red	300		500	mcd	12mA
		Green	600		1000		
		Blue	200		300		
wavelength	$\lambda_d$	Red	620	--	625	nm	12mA
		Green	515	--	525		
		Blue	465	--	475		

### data transmission time

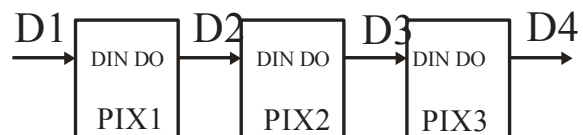
T0H	0 code. High Level Time	220ns~380ns
T1H	1 code. High Level Time	580ns~1 $\mu$ s
T0L	0 code. Low Level Time	580ns~1 $\mu$ s
T1L	1 code. Low Level Time	580ns~1 $\mu$ s
RES	Frame Unit, Low Level Time	280 $\mu$ s or more

### Timing Waveforms

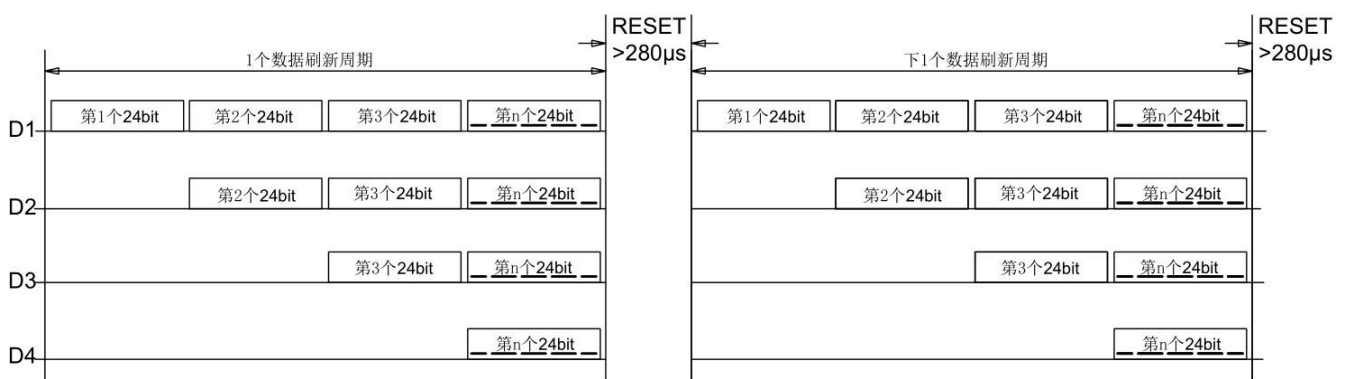
#### Input Code Type.



#### Connection Method:



### Data transfer method



Note: D1 is the data sent from the MCU side, and D2, D3 and D4 are the data automatically shaped and

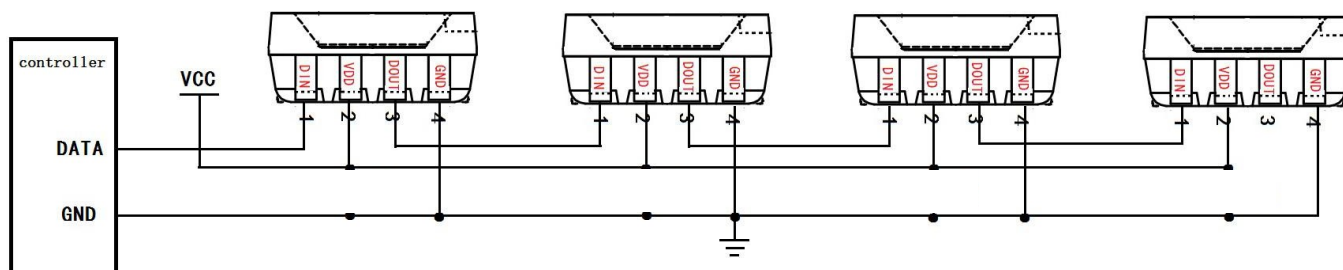
forwarded by the cascade circuit.

### 24bit data structure

G7	G6	G5	G4	G3	G2	G1	G0	R7	R6	R5	R4	R3	R2	R1	R0	B7	B6	B5	B4	B3	B2	B1	B0
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Note: High first, sends data in the order of GRBs.

**Typical application circuits: peripheral circuits do not need to add filter capacitors**



# Precautions for Using Surface Mount LEDs

## 1. descriptive

Usually LEDs have the same usage method as other electronic components, in order to let customers better use WACCW electronic

For LED products, see LED protection precautions below.

## 2. caveat

### 2.1 Dust & Cleaning

The surface of the LED is encapsulated with a modified epoxy adhesive, which protects the LED's optical system and anti-aging properties. Epoxy adhesive is easy to stick dust and keep the working environment clean. When there is a certain limit of dust on the surface of LED, it will not affect the luminous brightness, but we should still avoid dust falling on the surface of LED. Opened bags are preferred, and components with LEDs installed should be stored in clean containers.

When the LED surface needs to be cleaned, if you use a solution such as triaminoethylene or acetone, the LED surface will be dissolved, etc. You should not use a solution that has the ability to dissolve LEDs, but rather use a solution that is isopropyl, and you should check to make sure that the LEDs will not be dissolved before you use any cleaning solution.

Please do not use ultrasonic method to clean LEDs. If the product must use ultrasonic, then evaluate some parameters affecting the LEDs, such as ultrasonic power, baking time, and assembly conditions, etc. A trial run must be made before cleaning to confirm whether the LEDs will be affected.

### 2.2 Moisture-proof packaging

TOP SMD LEDs are moisture-sensitive components. LEDs are packaged in bags of aluminum film to prevent the LEDs from absorbing moisture during transportation and storage, and desiccants are placed in the bags to absorb the moisture. If the LED absorbs moisture, it will evaporate and expand when the LED passes through reflow soldering, potentially detaching the gel from the holder and damaging the LED's optics. For this reason, moisture-proof packaging is used to keep moisture out of the bag. This product has a moisture proof rating of **LEVEL5a**.

Table I: Definition of Material Moisture Survival Levels (MSL) according to IPC/JEDEC J-STD-020

Damp proof grade	Workshop life after unpacking	
	timing	prerequisite
LEVEL 1	limitless	$\leq 30^{\circ}\text{C}/85\%\text{RH}$



LEVEL 2	1 year	$\leq 30^{\circ}\text{C}/60\%\text{RH}$
LEVEL2a	4 weeks	$\leq 30^{\circ}\text{C}/60\%\text{RH}$
LEVEL 3	168 hours	$\leq 30^{\circ}\text{C}/60\%\text{RH}$
LEVEL 4	72 hours	$\leq 30^{\circ}\text{C}/160\%\text{RH}$
LEVEL 5	48 hours	$\leq 30^{\circ}\text{C}/60\%\text{RH}$
LEVEL5a	24 hours	$\leq 30^{\circ}\text{C}/60\%\text{RH}$
LEVEL 6	ready-to-use	$\leq 30^{\circ}\text{C}/60\%\text{RH}$

### 2.3 SMT mounting instructions:

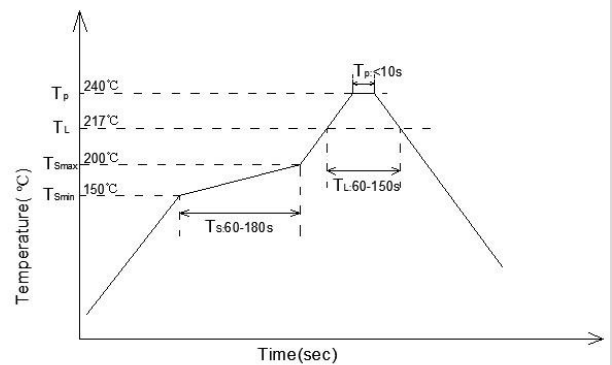
1. Please use at  $T < 30^{\circ}\text{C}$  and  $\text{RH} < 60\%$ ;
2. The time period between the opening of the bag and the completion of reflow soldering is controlled within 24H;
3. If the timeout period is exceeded, dehumidification and baking of the LED product is required;

### 2.4 Dehumidification requirements: $75^{\circ}\text{C}/>24\text{H}$

## 3. reflow soldering

Surface mount LEDs have been tested using the parameters listed below to demonstrate compliance with the JEDEC J-STD-020C standard. As a general guideline, it is recommended to follow the solder temperature profile recommended by the manufacturer of the solder paste used.


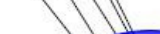


Temperature profile description	Lead-free reflow soldering
Minimum preheating temperature (T <sub>sm</sub> )	150°C
Maximum preheating temperature (T <sub>smax</sub> )	200°C
Preheating zone time (T <sub>smin</sub> to T <sub>smax</sub> ) (ts)	60-180 S
Average temperature rise rate (T <sub>smax</sub> to T <sub>p</sub> )	<3°C/S
Liquid phase temperature (T <sub>L</sub> )	217°C
Holding time in liquid phase (t <sub>L</sub> )	60-150 S
Peak temperature (T <sub>p</sub> )	240°C
High temperature zone (peak temperature -5°C) residence time (t <sub>p</sub> )	<10 S
cooling rate	<6°C/S
Residence time from room temperature to peak temperature	<6 min



Note: 1. The above general guidelines may not apply to all PCB designs and reflow configurations.

2. All temperatures are those measured at the upper surface of the package body.

## 5. Precautions for the product assembly process

1. Clamping from the side of the material through the use of appropriate tools <a href="http://www.world-semi.com">http://www.world-semi.com</a>	2. Do not press the surface of the gel directly with your hands or sharp metal, it may damage internal circuitry	3. Do not stack module materials together, it may damage the internal circuitry.	4. Cannot be used in acidic places with PH<7.
			

## Document Change Log

version number	state of affairs	Summary of changes	revision date	proposer	ratifiers
V1.0	N	newly built	20180913	Shen Jinguo	Yin Huaping
V1.1	M	revised parameter	20190125	Shen Jinguo	Yin Huaping
V1.2	M	Fix recommend ed pad modificatio n patch description	20190708	Shen Jinguo	Yin Huaping

Version number naming rules:

1. Add a new parameter or modify a parameter, modify the second digit of the version number, e.g.:  
V1.0 → V1.1.
2. Significant version design or modify more parameters, modify the first bit of the version number, such as: V1.0 → V2.0, the product model plus the first bit of the version number, such as:  
WS28xx-V1 → WS28xx-V2
3. Statuses include: N - New, A - Add, M - Modify, D - Delete