

UCS 2904B is a special circuit for 4-channel LED drive and control, which is internally integrated with MCU digital interface, data latch, LED high-voltage drive and other circuits. The single brightness and cascade control of the chip are realized through the peripheral MCU control to realize the color dot matrix lighting control of the outdoor large screen. The S-Drive drive technology and enhanced reception technology are added to extend the pull wire distance between points to more than 10 meters without reducing the transmission frequency (800K) (parallel extension of signal and power lines). Moreover, 10 meters of lines can be bridged at any point, regardless of the number of points requiring long line bridging. The product has excellent performance and reliable quality.

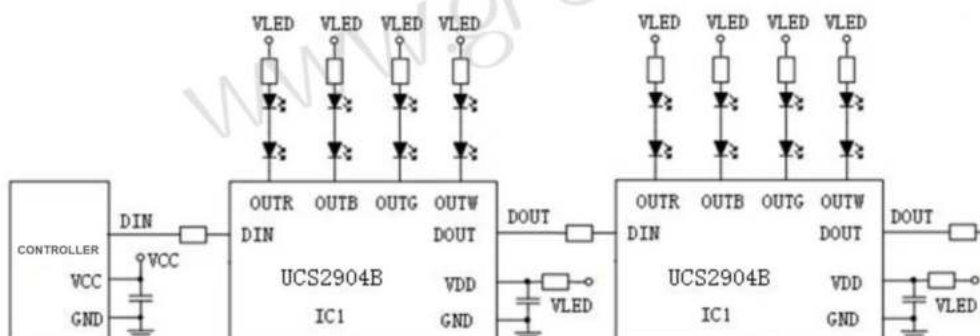
### Functional features

- Single line data transmission
- Shaping and forwarding optimization technology, unlimited number of cascaded points
- S-Drive drive technology and signal receiving enhancement technology, any two points (3-wire VCC, D, GND) can be bridged more than 10 meters, not limited by the number of points needed to span long lines
- Data transmission frequency 800K/s
- Output port PWM control can realize 256 level gray scale adjustment, and the port scanning frequency is 1.8KHz/s
- The chip VDD has a built-in 5V voltage regulator, and the voltage withstand of the output port is greater than 26V
- The preset 17mA/channel constant current mode is adopted. High constant current accuracy, internal error of 1.5%, and inter chip error of 3%.
- Power on self-test blue light function
- S-AI single line transmission anti-interference patented technology can significantly reduce and filter the radiated interference and conducted interference
- Industrial standard design, stable and reliable

### Application

Typical application diagram of pixel led light, Flexible strip light, Indoor and outdoor screen etc.

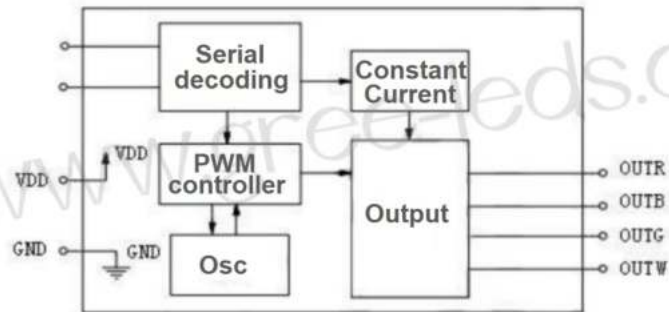
### Typical Circuit



Footprint (DIP8, SOP8)



Internal function block diagram



Foot position description

UCS2904B		
S/N	Symbol	Function description
1	OUTR	Red PWM control output
2	OUTG	Green PWM control output
3	OUTB	Blue PWM control output
4	GND	Grounding
5	DOUT	Display data cascade output (800K)
6	DIN	Display data input (800K)
7	VDD	Power Supply
8	OUTW	White PWM control output

Maximum rating (Ta=25 °C, Vss=0 V unless otherwise specified)

parameter	Symbol	Range	Company
Logic supply voltage	V <sub>dd</sub>	6.5	V
Output port withstand voltage	V <sub>out</sub>	30	V
Logic input voltage	V <sub>i</sub>	-0.5 ~ V <sub>dd</sub> + 0.5	V
working temperature	T <sub>opt</sub>	-45 ~ +85	°C
Storage temperature	T <sub>stg</sub>	-55 ~ +150	°C
Antistatic	ESD	8000	V
Rated output power	P <sub>d</sub>	400	mW

Recommended working range (unless otherwise specified, Ta=-40~+85 °C, Vss=0 V)

parameter	Symbol	minimum	typical	maximum	Company	Test conditions
Logic supply voltage	V <sub>dd</sub>	2.6	5.5	6	V	-
High level input voltage	V <sub>ih</sub>	0.7V <sub>dd</sub>	-	V <sub>dd</sub>	V	-
Low level input voltage	V <sub>il</sub>	0	-	0.3V <sub>dd</sub>	V	-
Output port withstand voltage	V <sub>out</sub>	26			V	

Electrical parameters (unless otherwise specified, Ta=-40~+85 °C, Vss=0 V, Vdd=4.5~5.5 V)

parameter	Symbol	minimum	typical	maximum	Company	Test conditions
Low level output current	I <sub>out</sub>		17		but	R, G, B, W
Low level output current	I <sub>do</sub>	20	-	-	but	V <sub>o</sub> = 0.4V, I <sub>out</sub>
Input current	I <sub>i</sub>	-	-	±1	μA	
Output pin current	I <sub>sink</sub>		17		but	
High level input voltage	V <sub>ih</sub>	0.7V <sub>dd</sub>	-		V	D., SET
Low level input voltage	V <sub>il</sub>	-	-	0.3V <sub>dd</sub>	V	D., SET
Hysteresis voltage	V <sub>h</sub>		0.35		V	D., SET
Current offset (between channels)	dI <sub>out</sub>		±1.5	±3.0	%	V <sub>ds</sub> =1V, I <sub>out</sub> =17mA
Current offset (between chips)	dI <sub>out</sub>		±3.0	±5.0	%	V <sub>ds</sub> =1V, I <sub>out</sub> =17mA
Current offset VS V <sub>ds</sub>	%dV <sub>ds</sub>		±0.1	±0.5	%/V	1V
Current offset VS V <sub>dd</sub>	%dV <sub>ds</sub>		±1.0	±2.0	%/V	4.5V
Dynamic current loss	IDDdyn	No load			1	but
Power consumption	PD	(Ta=25°C)			250	mW
Thermal resistance	R <sub>th(j-a)</sub>		80		190	°C/W

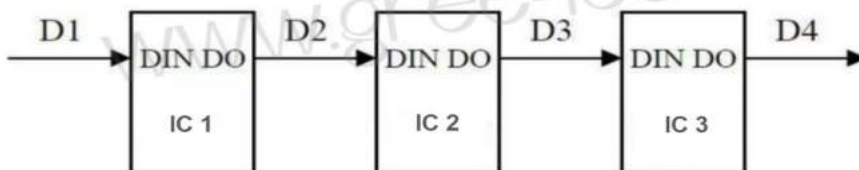
Switch characteristics (unless otherwise specified,  $T_a = -40 \sim +85 \text{ }^\circ\text{C}$ ,  $V_{SS} = 0 \text{ V}$ ,  $V_{DD} = 4.5 \sim 5.5 \text{ V}$ )

parameter	Symbol	minimum	typical	maximum	Company	Test conditions
oscillation frequency	FOSC1	-	800	-	KHz	V <sub>DD</sub> = 5V
	FOSC2	-	10	-	MHz	V <sub>DD</sub> = 5V
Transmission delay time	T <sub>flz</sub>	-	-	300	ns	C <sub>1</sub> = 15 pF, D <sub>IN</sub> → D <sub>OUT</sub> , R <sub>1</sub> = 10 kΩ
Descending time	T <sub>thz</sub>	-	-	120	μs	C <sub>1</sub> = 300 pF, OUT <sub>R</sub> / OUT <sub>G</sub> / OUT <sub>B</sub>
Data transmission rate	F <sub>d</sub>	800	-	-	Kbps	Duty cycle 50%
Input capacitance	Th <sub>ere</sub>	-	-	15	pF	

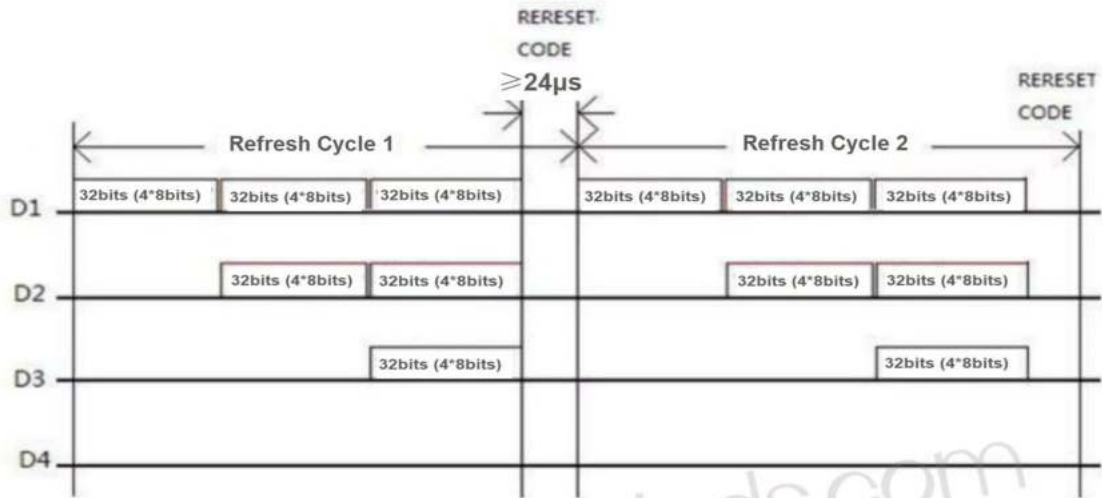
#### Function description

The chip adopts single line communication mode, and sends signals by returning to zero code. After the chip is powered on and reset, it receives the data from the DIN terminal. After receiving enough 32bit, the DO port starts to transmit data for the next chip to provide input data. Before forwarding, the DO port is always pulled down. At this time, the chip will not accept new data. The four PWM output ports of the chip OUT<sub>R</sub>, OUT<sub>G</sub>, OUT<sub>B</sub> and OUT<sub>W</sub> will send out corresponding signals with different duty cycles according to the received 32bit data. The signal cycle is 0 About 6 ms. If the input signal at the DIN end is a RESET signal, the chip will send the received data to the display, and the chip will accept new data after the end of the signal. After receiving the initial 32bit data, the chip will forward the data through the DO port. Before receiving the RESET code, the original output of the OUT<sub>R</sub>, OUT<sub>G</sub>, OUT<sub>B</sub>, and OUT<sub>W</sub> pins will remain unchanged. When receiving the low-level RESET code above 24 μs, The chip outputs the 24 bit PWM data pulse width just received to OUT<sub>R</sub>, OUT<sub>G</sub>, OUT<sub>B</sub> and OUT<sub>W</sub> pins.

#### 1) Chip cascade method



2) data transmission



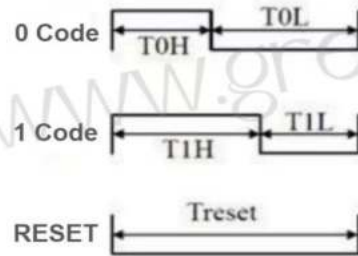
Note: D1 is the data sent by MCU, and D2, D3 and D4 are the data automatically reshaped and forwarded by cascade circuit.

3) 32bit data structure

R7	R6	R5	R4	R3	R2	R1	R0
G7	G6	G5	G4	G3	G2	G1	G0
B7	B6	B5	B4	B3	B2	B1	B0
W7	W6	W5	W4	W3	W2	W1	W0

Note: High bit first, send data in the

order of RGBW 4) Timing waveform



5) Chip internal regeneration signal standard (high-speed conventional mode)

name	describe	Typical value	Error range
T0H	0 code, high level time	0.4μs	± 40 ns
T1H	1 code, high level time	0.8μs	± 80 ns
T0L	0 code, low level time	0.85μs	
T1L	1 code, low level time	0.45μs	
Treset	Reset code, low level time	>24us	

Note:

The minimum IC low-level reset time is 8 μ s, and the maximum is 24us. When receiving low-level signals greater than 8us but less than 24us, the IC may consider them as RESET codes. Therefore, do not interrupt more than 8 μ s during the transmission of a frame of data, or the IC may consider them as reset codes. However, within 8 μ s, the controller can perform other operations. At the same time, the reset code sent by the controller should not be lower than 24us to ensure that all ICs can be confirmed as reset codes

6) Recommended value of controller (high speed normal mode)

name	describe	Typical value	
T0H	0 code, high level time	0.4us	
T1H	1 code, high level time	0.85us	
T0L	0 code, low level time	>0.9μs	
T1L	1 code, low level time	>0.45us	
T	"0" code or "1" code cycle	>1.3us	
Treset	Reset code, low level time	>24us	

UCS2904B has a built-in charging management module, which can automatically adapt to the "low-speed enhancement mode" of the following controllers and obtain stronger driving ability. In case of jitter or sometimes good or bad phenomena in the project, and it is inconvenient to check the product or wiring, 2903 low-speed enhancement can be selected on the controller

Mode and regenerate the effect file, which can solve some engineering problems. Low speed mode can only be used with 512 points/30 frames or 1024 points/15 frames. The use of low-speed enhancement mode can alleviate the following problems and restore the picture to normal when the problem is not particularly serious:

Problem: Poor wiring, insufficient voltage, and unreasonable wiring. When the product wiring is faulty soldered, PCB vias are poor and other factors cause jitter and other phenomena.

7) Recommended value of controller: (low-speed enhancement mode)

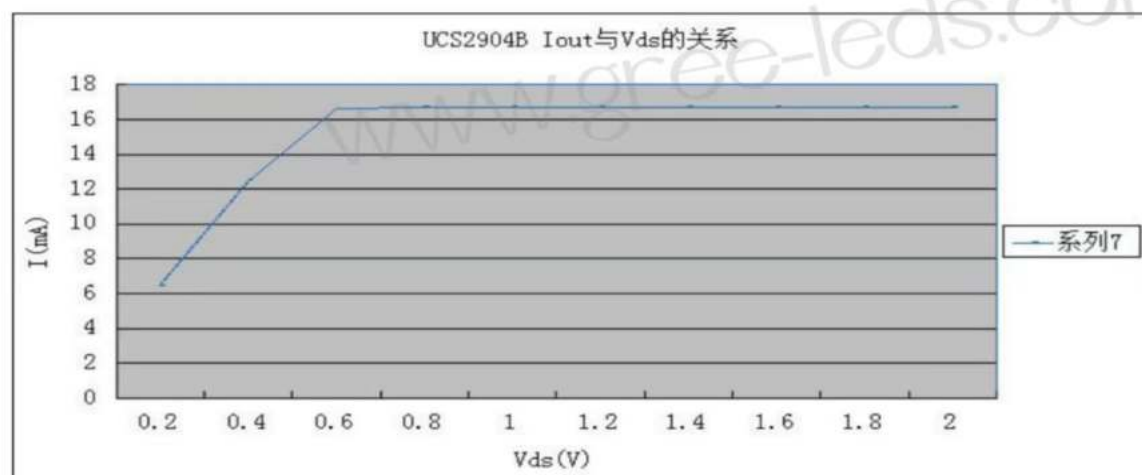
name	describ e	Typical value	
TOH	0 code, high level time	0.4us	
T1H	1 code, high level time	0.85us	
TOL	0 code, low level time	>2.1μs	
T1L	1 code, low level time	>1.65us	
T	"0" code or "1" code cycle	>2.5us	
Treset	Reset code, low level time	>24us	

Constant current curve

UCS2904B has excellent constant current characteristics, and the current difference between channels and even between chips is very small. (1) : The current error between channels is  $\pm 1.5\%$ , while the current error between chips is  $\pm 3\%$ .

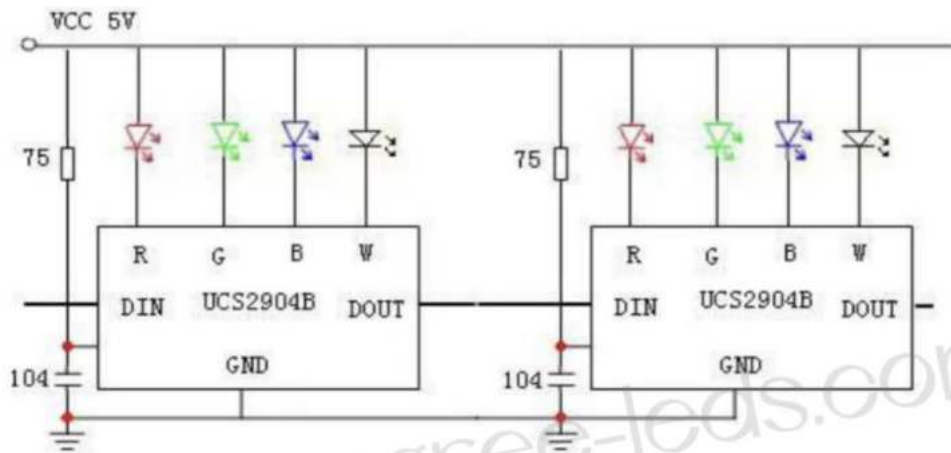
(2) When the load terminal voltage changes, the UCS2904B output current will not be affected, as shown in the figure below

(3) : As shown in the figure below, the  $V_{ds}$  of UCS2904B output port is 0.6V.



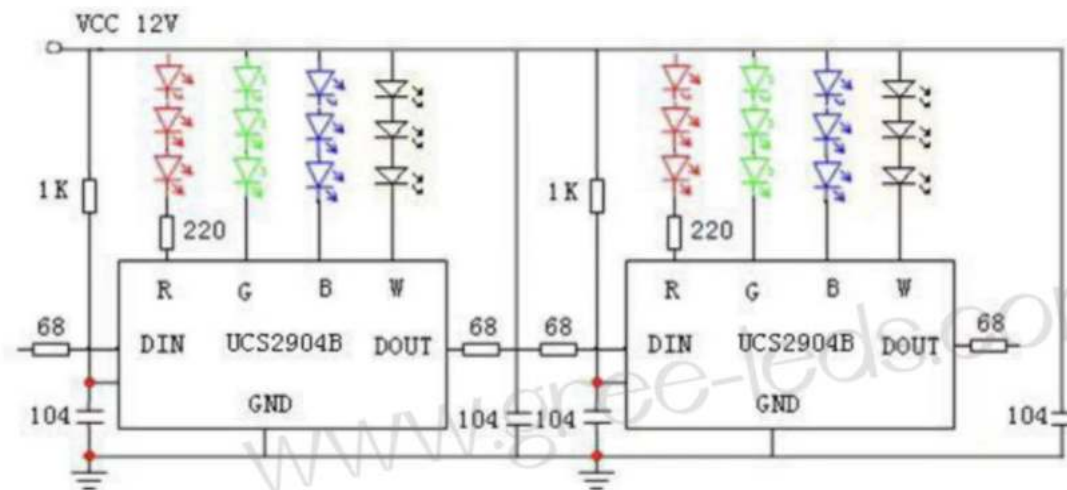
## Application circuit diagram

1. Power supply voltage 5V, with single LED



The constant current mode can achieve the ideal effect of keeping the brightness and color temperature unchanged while the voltage drops continuously.

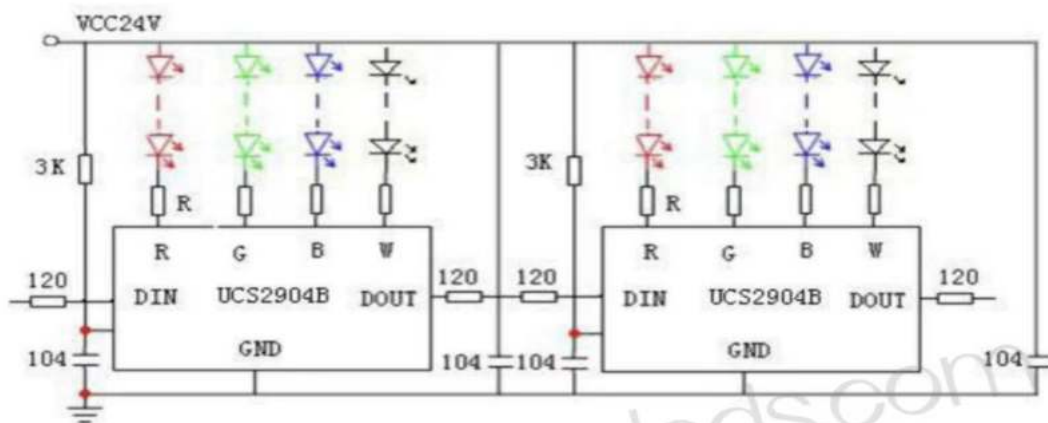
2. Application diagram of power supply voltage 12V, 3 LEDs per circuit



During 12V power supply, it is recommended that a 68-120 resistor be connected in series at the signal input and output ends of the IC to prevent damage to the IC input and output ends in case of live plugging or reverse connection of power and signal wires. In addition to the parallel connection of a 104 capacitor between VDD and GND of IC, a 104 capacitor must also be connected between VCC and GND to reduce ground wire surge interference.

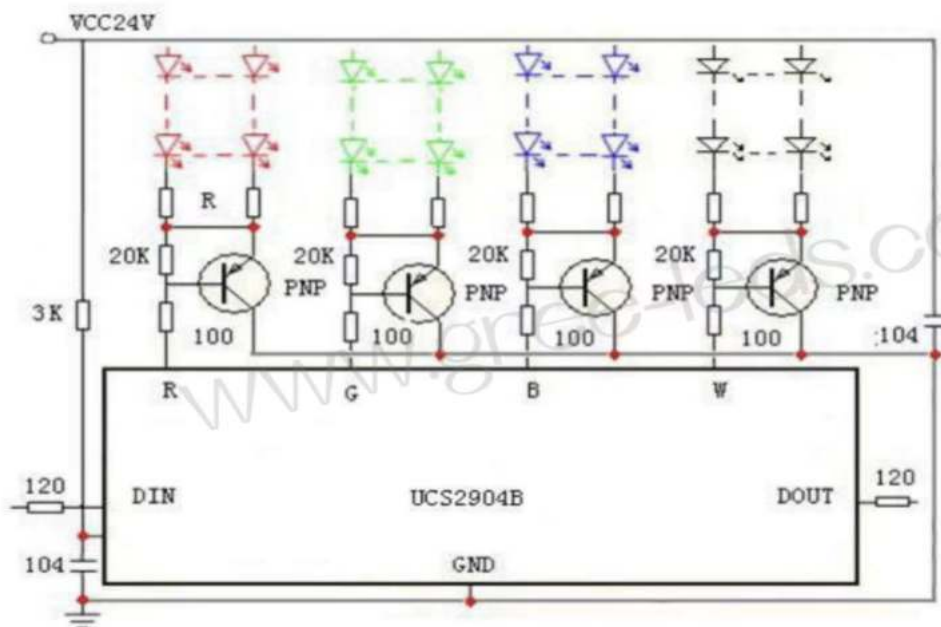


3. The power supply voltage is 24V, and the application of controlling 4-6 strings of LED lights



During 24V power supply, it is recommended that a 120 resistance be connected in series at the signal input and output ends of the IC to prevent damage to the IC input and output ends in case of live plugging or power supply and signal wires being wrongly connected. In addition to the parallel connection of a 104 capacitor between VDD and GND of IC, a 104 capacitor must also be connected between VCC and GND to reduce ground wire surge interference

4. Power supply voltage 24V, control (2 parallel and above) × Application diagram above (4-6) LED lights:



Note: PNP is selected for the triode, and the conventional 90128550, etc. can be selected.

During 24V power supply, it is recommended that a 120 resistance be connected in series at the signal input and output ends of the IC to prevent damage to the IC input and output ends in case of live plugging or power supply and signal wires being wrongly connected. In addition to the parallel connection of a 104 capacitor between VDD and GND of IC, a 104 capacitor must also be connected between VCC and GND to reduce ground wire surge interference

#### Voltage stabilizing characteristic

UCS2904B can be configured as 6~24V voltage power supply. The 104 P capacitor between the power supply and the ground is as close to the IC body as possible, and the circuit is the nearest. However, according to the input voltage, different power resistance R should be configured. The resistance value is listed as follows:

supply voltage	It is recommended to connect resistance between power interface and VDD
5V	75 Ohms
12V	750-1K
24V	2.4K-3K

#### Description of long line jumper between points:

UCS2904B has added S-Drive drive technology and enhanced reception technology, which can extend the distance between points to more than 10 meters without reducing the transmission frequency (800K) (parallel extension of signal and power lines), and can span 10 meters of lines at any point without being limited by the number of points that need to span long lines. However, the following items shall be strictly followed in engineering application:

1. Single head power supply can be used for power supply. At the last point (the lowest point of voltage) connected in series by a power supply head  
Power supply should not be lower than 20V, 12V power supply should not be lower than 10V, if the voltage is lower than the above voltage, make up the power.
2. When the connection between points required by the project exceeds 5 meters, attention shall be paid to the selection of components: when 12V power is supplied, 750  $\Omega$  shall be used for the step-down resistance on the board, and 51  $\Omega$  shall be used for the resistance of the signal line. When 24V switching power supply is used for power supply, the step-down resistance on the board is 2.4K, and the signal line protection resistance is 100  $\Omega$ .
3. One 104 or 105 must be connected to the VCC power line on the board in parallel to eliminate the interference of ground wire surge.
4. 3-core sheathed wire can be used for wiring, but 0.5 mm sheathed wire shall be used for long-distance wiring. Pure copper wire.

#### Voltage divider

The resistance on the OUT output port of UCS2904B chip can be adjusted according to the number of LEDs connected in series. After the resistance and LED lamp are connected in series to reduce voltage, the voltage at the OUT port should not exceed 3.5V, which can reduce the power consumption of the chip and reduce heat generation. UCS2904B output terminal can maintain constant current by automatically adjusting the voltage of IC output terminal (OUTRGBW) with the change of power supply voltage or load to keep the output current unchanged. The automatic regulation of UCS2904B output terminal voltage has a certain range, the minimum can reach 0.6V, and the maximum regulation upper limit is not limited, but will be limited by the maximum power consumption PD of IC. The UCS2904B PD is 350mW. Do not exceed 250mW when working with large power consumption for a long time, or the IC may be damaged.

1. Take the application figure 3, when 6 beads are in series, the port (OUTRGBW) current is set to 17mA, and the port (OUTRGB) voltage is designed to take 3.5V as an example, first explain the power consumption of the IC port (4 channels output at the same time, bright white light)

OUTR port power consumption: 17mA \*

3.5V=60mW OUTG port power consumption: 17mA

\* 3.5V=60mW

OUTB port power consumption: 17mA \*

3.5V=60mW OUTW port power consumption: 17mA

\* 3.5V=60mW

Total: 240mW does not exceed the maximum power consumption of IC. The power consumption of the normal picture generally does not exceed 2/3 of the full white light

$R_r = (24V - 3.5V - 6 * 1.9V) / 17mA = 535$  Power supply voltage is 24V, 6 strings, red light opening voltage is calculated as 1.9V  
 $R_g = (24V - 3.5V - 6 * 3.1V) / 17mA = 110$  Power supply voltage is 24V, 6 strings, green light opening voltage is 3.1V  
 $R_b = (24V - 3.5V - 6 * 3.1V) / 17mA = 110$  The power supply voltage is 24V, 6 strings, and the blue light opening voltage is calculated as 3.1V,  $R_w = (24V - 3.5V - 6 * 3.1V) / 17mA = 110$  The power supply voltage is 24V, 6 strings, and the blue light opening voltage is 3.1V

In this case, when the power supply voltage drops from 24V to 3V (3.5V-0.6V) to 20V, it can still maintain a constant current state.

UCS2904B value selection table of voltage divider

supply voltage	Number of lamp beads	Partial resistance (ohm)	Encapsulation type
12V	1 string (17mA)	R-388 B, G, W-318	R, G, B-1206
	2 strings (17mA)	R-276 B, G, W-135	R, G, B-0805
	3 strings (17mA)	R-220	0805
24V	4 strings	R-759 B, G-476	R, G, B-1206
	5 strings	R-647 B, G-295	R-1206, B, G-0805
	6 strings	R-535 B, G-110	R-1206, B, G-0805

List of components for conventional application:

element	5V (switching power supply)	12V (switching power supply)	24V (switching power supply)
Step down resistance	75	1K	3K
DIN protective resistor	nothing	68-120	120
DO protection resistor	nothing	68-120	120
IC filter capacitor	104	104/25V	104/25V
VCC-GND filter capacitor	nothing	104/50V	104/50V
RGB voltage divider	nothing	Select according to lamp beads	Select according to lamp beads

Application considerations

The normal and stable operation of IC is closely related to the correct application. Correct and good peripheral components and product design are the basis for stable operation of IC. Based on the above starting point, it is recommended that customers strictly follow the following suggestions in the production process to ensure the stability and reliability of products.

1. In cascading applications, the effective common ground between points can ensure the normal transmission of signals.
2. When applied to point light sources, it is better to adopt the connection mode of 2-core (24V positive, 24V negative)+2-core (D, GND). If a single 4-core head is used for connection, it is important to note that 24V+ and data wire D in the 4-core head are in the same connector, so as to avoid water leakage due to poor sealing of the waterproof head (or not inserted tightly during installation) or forced connection due to misalignment of the waterproof head, otherwise the IC may be burned.
3. During 24V power supply, the DIN input and DOUT output of each IC must be connected in series with a protection resistance of more than 120  $\Omega$ , and the resistance position should be closest to the IC input and output terminals. When 12V power is supplied, the signal input and output terminals must be connected in series with a resistance above 68  $\Omega$ .
4. The VDD end of UCS2904B is equipped with a built-in voltage stabilizing tube, and 78L05 is not needed. However, it should be noted that a resistance must be connected in series between 24V (when 24V power is supplied) and the VDD end. The value of this resistance is 3K, and the resistance power is 1/4W. 1K resistance is selected for 12V power supply.
5. When using UCS2904B on the drawing board, pay attention to the signal ground (GND) line. The ground wire should be drawn as thick as possible, and too thin ground wire may cause unstable signal transmission, jitter and other abnormal phenomena.
6. When wiring on the board, the wiring that may produce higher voltage (such as 24V power line, wiring between LEDs, etc.) should be far away from signal lines (DIN, DOUT) and 5V lines, so as to avoid burning the IC when the concealed wiring is caused by board manufacturing process problems.
7. In order to reduce high-frequency interference, a 104 capacitor should be connected in parallel between the power supply and ground of each IC. 104 should be closest to the power supply and ground of the IC, and the power line should pass through 104 before reaching the IC.
8. UCS2904B is a constant current output. Please pay attention to the selection of voltage divider connected in series on the RGB output terminal. The value of voltage dividing resistor selected for constant current IC and current limiting resistor selected for constant voltage output IC are completely different. Improper value selection can damage the IC.