WS2816A

16bit 3-channel Constant-current digital LED light source

Features and Benefits

- The control circuit and RGB chip are integrated in a package of 5050 components, to form a complete addressable pixel.
- Built-in signal reshaping circuit, after wave reshaping to the next driver, ensure wave-form distortion not accumulate.
- OUTR / G / B output gray level: 65536 gray scale levels.
- The port scanning frequency is 10KHz.
- Data transmission speed up to 800Kbps
- Dual input and output signals, in case of damage of the single pixel, does not affect the overall display effect.
- Serial cascade interface, it's able to receiveand decodie data through a single signal line.
- Color mixing consistency is excellent, high cost and performance ratio.
- Each channel carries a 32 level current gain.

Applications

- LED transparent screen, LED pixel screen, LED special-shaped screen, and various crystalline film screen.
- A variety of electronics.

General Description

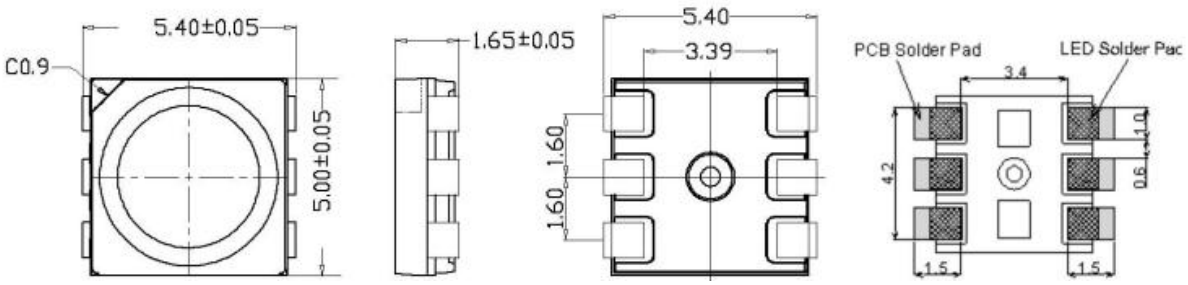
The WS2816A is a new generation of digital LEDs developed for high-definition image display applications, with up to 16bit grayscale data per channel, the port refresh rate is up to 10KHz, while each channel carries a 32 level current gain, which is ideal for large image displays.

With highly integrated driver and RGB chips in a 5050 component, no external capacitors are required.

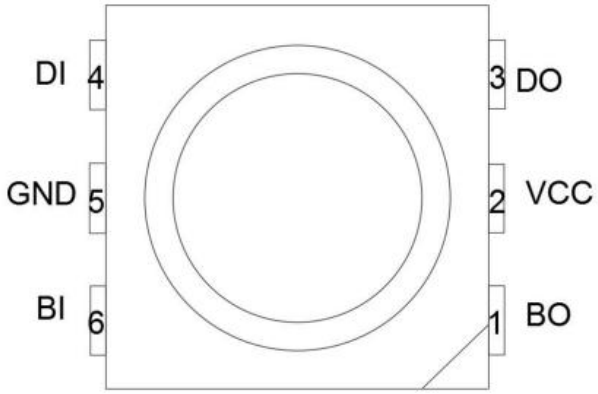
The data protocol adopts single NZR communication mode, after the pixel is power reset, the DIN reveives the data transmitted from the controller, the 48bit data sent over first is extracted by the first pixel and sent to the data latch inside the driver, the remaining data is amplified by the internal shaping amplication 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 48bit for each transmission of one pixel. The signal is reduced by 48 bits for each pixel.

The driver adopst automatic reshaping and forwarding technology, so that the number of cascaded pixels are not limited by signal transmission, but the signal transmission speed.

Mechanical Dimensions (Unit:mm)



PIN Configuration



PIN Function

NO.	Symbol	PIN	Function description
1	BO	Backup data output	Backup control data signal output
2	VCC	Power supply	Power supply
3	DO	Data out	Control data signal output
4	DI	Data in	Control data signal input
5	GND	Ground	Ground, data & power grounding
6	BI	Backup data input	Backup control data signal input

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Power supply voltage	V_{DD}	+3.7~+5.3	V
Logical Input Voltage	V_I	**-0.3V ~ VDD+0.7**	V

Electrical Characteristics (T_A=25℃, Vcc=5V, V_{SS}=0V)

Parameter	Symbol	Min	Tpy	Max	Unit	Conditions
Port output current	Iout	——	——	13	mA	
Input Current	I_I	——	——	±1	μA	V_I=V_{DD}/V_{SS}
High-level input voltage	V_{IH}	0.55V_{DD}	——	——	V	
Low-level input voltage	V_{IL}	——	——	0.3V_{DD}	V	
Hysteresis voltage	V_H	——	0.35	——	V	
Dynamic current consumption	IDDdyn	——	0.7	1	mA	OUTR,OUTG,OUTB =OFF DO=open circuit
Power consumption	PD	——	70	——	mW	T_a=25℃
Signal output sink current	Iodo	——	——	45	mA	

Switching Characteristics (T_A=25℃, Vcc=5V, V_{SS}=0V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition (Working current)
Transmission delay time	t_{PLZ}	——	——	300	ns	CL=15pF, DIN→DOUT, RL=10KΩ
Fall time	t_{THZ}	——	——	120	μs	CL=300pF, OUTR/OUTG/OUTB
Input capacity	C_I	——	——	15	pF	——

LED Characteristics

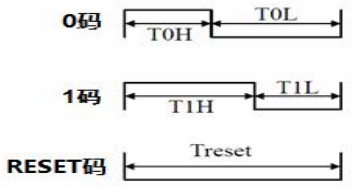
Parameter	Symbol	Color	Test Condition (VDD=5V, Working Current=13mA)			
			Min.	Typ.	Max.	Unit
Luminous intensity	IV	Red	300	310	500	mcd
		Green	600	780	1000	
		Blue	200	215	300	
Wavelength	λd	Red	620	621	630	nm
		Green	515	520	525	
		Blue	465	471	475	

Data Transfer Time

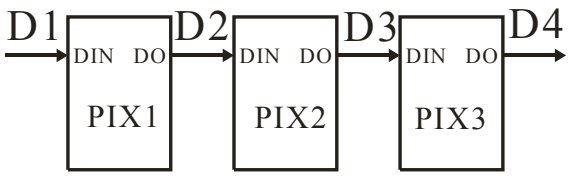
T0H	0 code, high voltage time	220ns~380ns
T1H	1 code, high voltage time	580ns~1μs
T0L	0 code, low voltage time	580ns~1μs
T1L	1 code, low voltage time	580ns-1μs
RES	Frame unit, low voltage time	>280μs
Data Cycle: T0H+TOL≥1.25μs; T1H+T1L≥1.25μs		

Timing waveform Diagram

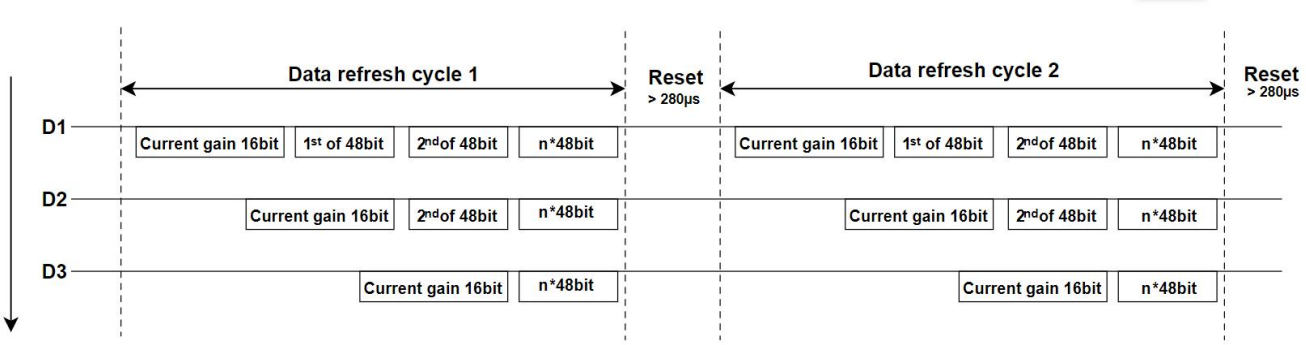
Sequence Chart



Cascade Method



Data Transmission Method



Note: The data of D1 is sent from MCU, and D2, D3, D4 through pixel internal reshaping amplification to transmit.

Data Structure

IG4	IG3	IG2	IG1	IG0	IR4	IR3	IR2	IR1	IR0	IB4	IB3	IB2	IB1	IB0	校验码

Note: Send "1" for the check digit.

Composition of 48bit Data

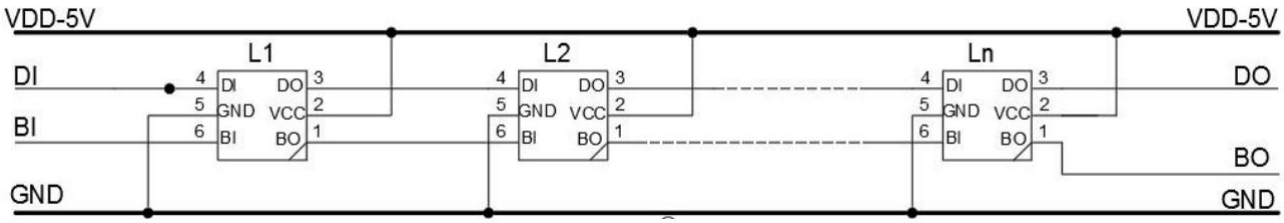
G15	G14	G13	G12	G11	G10	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0	⋯next to⋯
⋯from above⋯	R15	R14	R13	R12	R11	R10	R9	R8	R7	R6	R5	R4	R3	R2	R1	R0	⋯next to⋯
⋯from above⋯	B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0	

Note: Data transmit in order of GRB, high bit data at first.

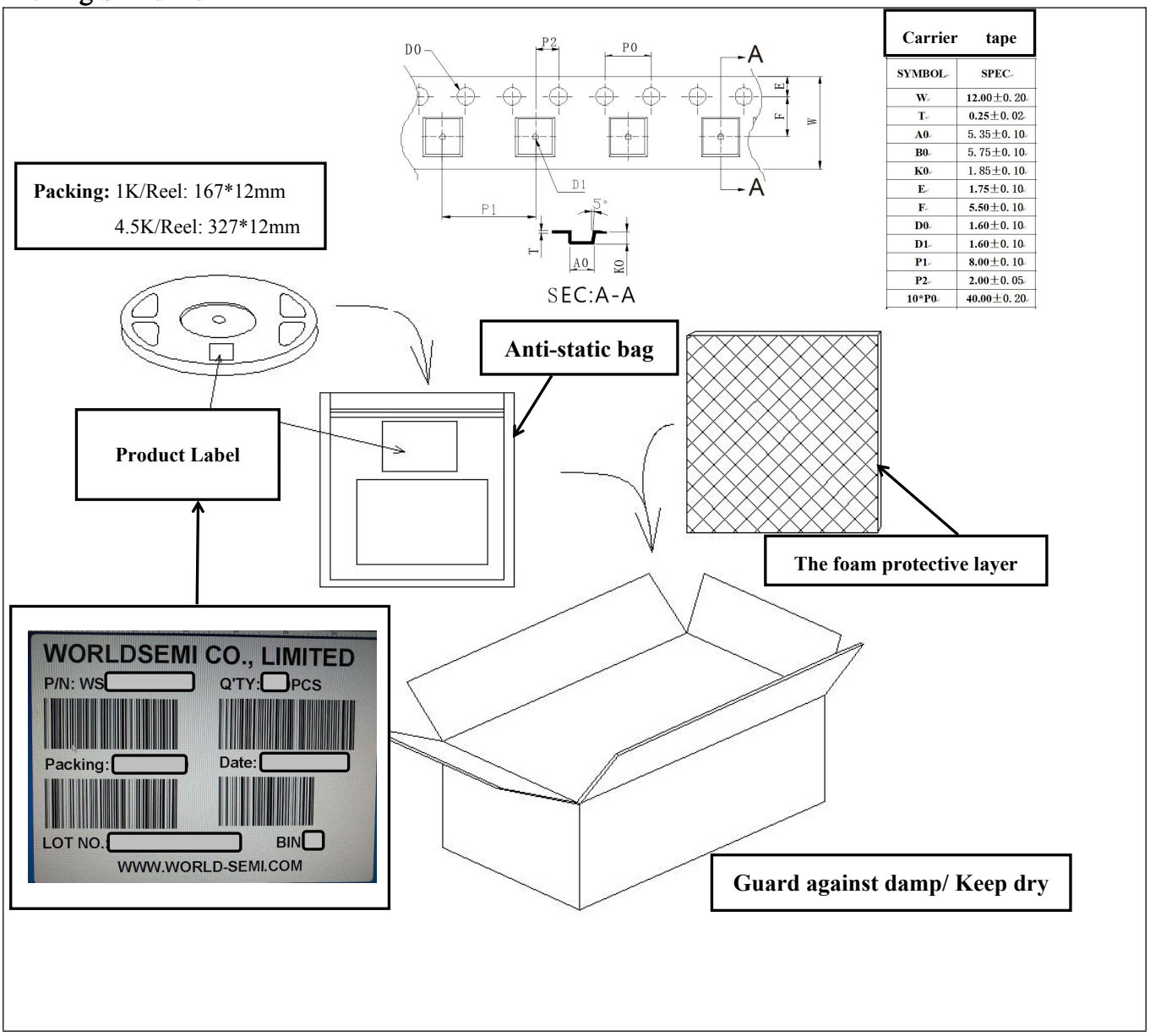
Current Gain

Current Gain Settings	RGB Current (mA)
0	0
1	0.42
2	0.84
3	1.26
4	1.68
5	2.10
6	2.52
7	2.94
8	3.36
9	3.78
A	4.20
B	4.62
C	5.04
D	5.46
E	5.88
F	6.30
10	6.72
11	7.14
12	7.56
13	7.98
14	8.40
15	8.82
16	9.24
17	9.66
18	10.08
19	10.50
1A	10.92
1B	11.34
1C	11.76
1D	12.18
1E	12.60
1F	13.02

Typical Application Circuit



Packing Standard



Top SMD LED Using Instructions

1. Summary

To make the best use of WORLDSEMI's LED, please refer to the below precautions, they are of same usage method as other electronic components.

2. Cautions

2.1. Dust & Cleaning

The surface of the LED is encapsulated with modified epoxy resin because it plays a very good role in protecting the optical performance and aging resistance. The modified epoxy resin is easy to stick with dust and must be kept clean. When there's a certain amount of dust on the surface of the LED, it won't affect brightness, but dust proof should be taken care of. Promoting the use of unsealed package in preference to others and the assembled LEDs should be placed in a clean container.

Avoid using the organic solvents to clean the dust on the LED surface and it's necessary to confirm whether the cleaning fluid will dissolve the LED.

Do not clean the LEDs by the ultrasonic. Some parameters affecting the LED performance must be evaluated if have no alternative but to the ultrasonic cleaning method, such as ultrasonic power, baking time and assembly conditions, etc.

2.2. Moisture-proof packaging

TOP SMD LEDs are moisture sensitive components. LEDs are packaged in aluminum foil bag to prevent the from absorbing moisture during transport and storage. A desiccant is placed in the bags to absorb moisture. If the LED absorbs moisture, then it evaporates and expands when in reflow process, which may break the colloid from the bracket and damage the optical performance of LED. For this reason, moisture-proof packaging is to prevent the from absorbing moisture during transport and storage. The moisture resistance rating of WORLDSEMI's LED is: **LEVEL 5a.**

Tabel I - IPC/JEDEC J-STD-020 Moisture/Reflow Sensitivity Classification

MSL Level	Workshop Life	
	Time	Conditions
LEVEL1	Unlimited	≤30℃/85%RH
LEVEL2	1 Year	≤30℃/60%RH
LEVEL2a	4 Weeks	≤30℃/60%RH
LEVEL3	168 Hours	≤30℃/60%RH
LEVEL4	72 Hours	≤30℃160%RH
LEVEL5	48 Hours	≤30℃/60%RH
LEVEL5a	**24 Hours**	**≤30℃/60% RH**
LEVEL6	Take-out and Use immediately	≤30℃/60%RH

2.3 SMT Attention Points

2.3.1 It is recommended to unpack the LED before SMT and put the whole roll into the oven for dehumidification and drying (baking at 70 ~ 75 ℃ for ≥ 24h);

2.3.2 The product is taken out of the oven to the completion of high-temperature soldering (including multiple high-temperature operations/operations such as reflow soldering, tin immersion, wave soldering, and heating maintenance), and the time period is controlled within 24 hours (under the conditions of T<30℃, RH<60%) ;

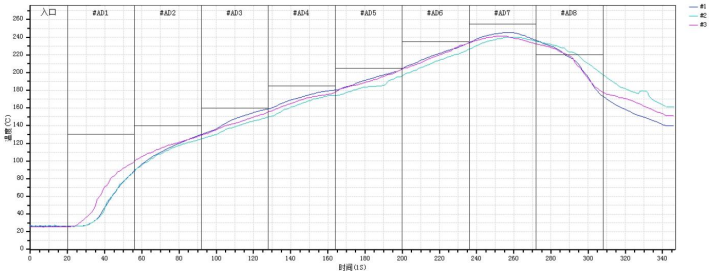
2.3.3SMT shall be completed as soon as possible for LED pastes on PCBA after printing solder paste, and it is recommended not to exceed 1H;

2.3.4 Bulk LEDs such as production surplus, machine throwing materials, and maintenance materials cannot be used directly if they are exposed to the air for a long time. It is recommended to dehumidify and dry before use. Whole reel baking: 70 ~ 75℃*≧24H or bulk material baking: 120℃*4H.

3. SMT Reflow

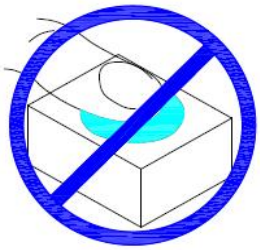
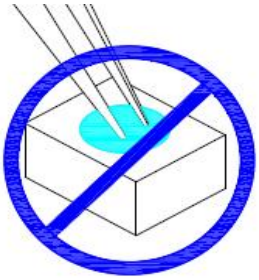
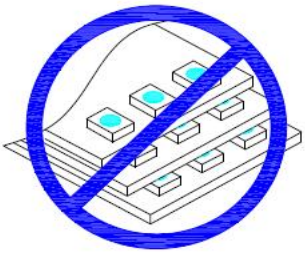
Refer to the parameters listed below, the experimental results prove that the TOP SMD LED meets the JEDEC J-STD-020C standards. As a general guideline, it is recommended to follow the SMT reflow temperature curve recommended by the solder paste manufacturer.

Temperature curve description	Range
30 ℃ ~ 150 ℃ preheating slope	1 ~ 4 ℃/s
30 ℃ ~ 150 ℃ preheating time	60 ~ 120 s
Constant temperature slope of 150 ℃ ~ 200 ℃	0 ~ 3 ℃/s
Constant temperature time of 150 ℃ ~ 200 ℃	60 ~ 120 s
LIQUID REGION temperature	217℃
Peak Temperature (Tp)	245℃
Reflow slope	0 ~ 3 ℃/s
Reflow time	45-90 s
cooling rate	-4 ~ 0 ℃/s
Room Temperature to Peak Holding Time	<6 min



Remarks: All temperatures referred are measured on the surface of the package body.

4. Assembly Precautions

1. Clip the LED from its side.	2. Neither directly touch the gel surface with the hand or sharp instrument, it may damage its internal circuit.	3. Not to be double stacked, it may damage its internal circuit.	4. Can not be stored in or applied in the acidic sites of PH<7.
			

Modify Record

Version №	Status Bar	Modify Content Summary	Date	Reviser	Approved
V1.0	N	New-Official release	20230925	Hu Jin	Yin HuaPing

Remarks: Initial version: V1.0; Version number plus "0.1" after each revision;

Status bar: N--New, A--Add, M--Modify, D--Delete.