

General Description

WS2816C-1313-4P is specially designed for high resolution display application, each channel with 16bit gray scale, 4bit gamma correction inside, can achieve 20bit display effect. With 10KHZ Port refresh frequency, RGB color balance 3:6:1, pretty suitable for large display screen image.

High-tech integrated digital LED, no need any external components including capacitor, with high stability dual-signal function, make the design more simple and convenient, performance more stable.

The data transfer protocol use single NZR communication mode. After the pixel power-on reset, the DIN port receive data from controller, the first pixel collect initial 24bit data then sent to the internal data latch, the other data which reshaping by the internal signal reshaping amplification circuit sent to the next cascade pixel through the DO port. After transmission for each pixel, the signal to reduce 24bit. pixel adopt auto reshaping transmit technology, making the pixel cascade number is not limited the signal transmission, only depend on the speed of signal transmission.

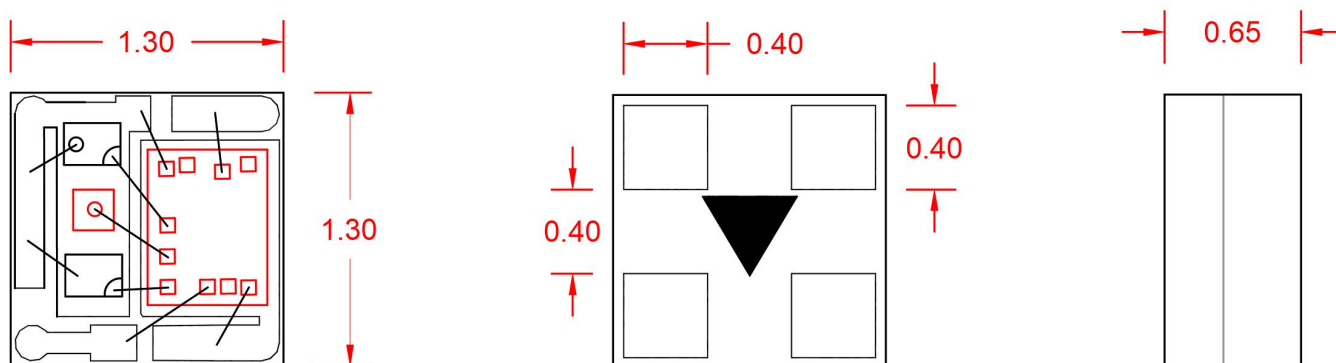
Features and Benefits

- The control integrated circuit and the LED share the only power supply source.
- Control circuit and RGB chip are integrated in a package of 1313 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.
- Built-in power-on reset and power-down reset circuits
- OUT R / G / B output gray level: 65536 gray scale levels (Built-in 4Bit GAMMA correction)
- RGB Port with 10KHz refresh frequency
- Cascading port transmission signal by single line.
- 1.3mm*1.3mm*0.65mm(L*W*H), ultra-small and ultra-thin size.

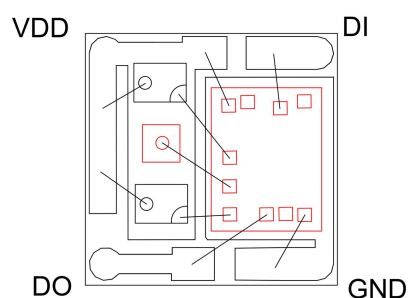
Applications

- LED transparent screen, LED pixel screen, LED special-shaped screen and other high-definition display projects, and various electronic products.

Mechanical Dimensions (Unit:mm)



PIN Configuration



NO.	Symbol	PIN	Function description
1	VDD	POWER SUPPLY	Power supply
2	DO	DATA OUT	Control data signal output
3	GND	GROUND	Ground, data & power grounding
4	DI	DATA IN	Control data signal input

Absolute Maximum Ratings ($T_A=25^{\circ}\text{C}$, $V_{SS}=0\text{V}$)

Parameter	Symbol	Ratings	Unit
Power supply voltage	V_{DD}	+3.5~+5.5	V
Logical Input Voltage	V_I	-0.3V~ $V_{DD}+0.7$	V
Quiescent Current	I_{DD}	<0.8	mA
Operation temperature	T_{opt}	-25~+65	$^{\circ}\text{C}$
Storage temperature range	T_{stg}	-40~+85	$^{\circ}\text{C}$

Electrical Characteristics ($T_A=25^{\circ}\text{C}$, $V_{DD}=5\text{V}$, $V_{SS}=0\text{V}$)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Port output current	I_{out}	10	10.5	11.5	mA	OUTR+OUTG+OUTB
Input Current	I_I	—	—	± 1	μA	$V_I=V_{DD}/V_{SS}$
High-level input voltage	V_{IH}	$0.7V_{DD}$	—	—	V	
Low-level input voltage	V_{IL}	—	—	$0.3 V_{DD}$	V	
Hysteresis voltage	V_H	—	0.35	—	V	
Dynamic current consumption	I_{DDdyn}	—	0.7	1	mA	OUTR, OUTG, OUTB =OFF DO=open circuit
Power consumption	PD	—	—	70	mW	$T_a=25^{\circ}\text{C}$
Signal output perfusion current	I_{odo}	—	—	45	mA	

Switching Characteristics ($T_A=25^{\circ}\text{C}$, $V_{DD}=5\text{V}$, $V_{SS}=0\text{V}$)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition (Working current)
Transmission delay time	t_{PLZ}	—	—	300	ns	$CL=15\text{pF}$, $DIN \rightarrow DO$ UT, $RL=10\text{K}\Omega$
Fall time	t_{THZ}	—	—	120	μs	$CL=300\text{pF}$, OUTR/OUTG/OUTB
Input capacity	C_I	—	—	15	pF	—

LED Characteristics

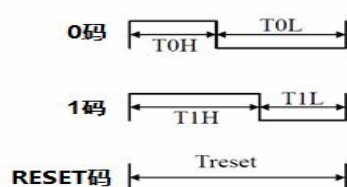
Parameter	Symbol	Color	Test Condition($V_{DD}=5\text{V}$)			
			Min.	Typ.	Max.	Unit
Luminous intensity	IV	Red	60	90	120	mcd
		Green	150	190	230	
		Blue	15	25	35	
Wavelength	λ_d	Red	625	627	630	nm
		Green	525	527.5	530	
		Blue	465	467	470	
Color Coordinate	X	CCT: 6500~10000K	-	0.29	-	/
	Y		-	0.31	-	
Luminous Angle			-	120	-	Deg

Data Transfer Time

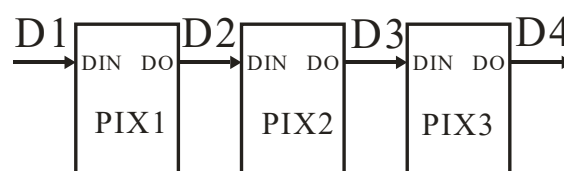
T0H	0 code, high voltage time	200ns~320ns
T1H	1 code, high voltage time	520ns~800ns
T0L	0 code, low voltage time	800ns~1.2μs
T1L	1 code, low voltage time	480ns~1μs
RES	Frame unit, low voltage time	>280μs
Data Cycle: T0H+T0L≥1.25μs; T1H+T1L≥1.25μs		

Timing waveform diagram

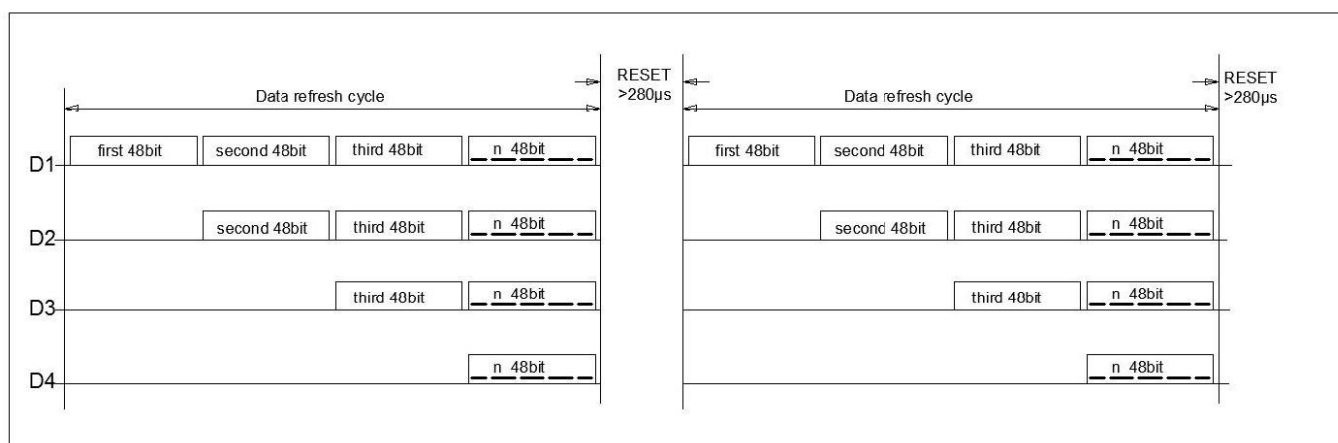
Sequence Chart



Cascade Method:



Data Transmission Method



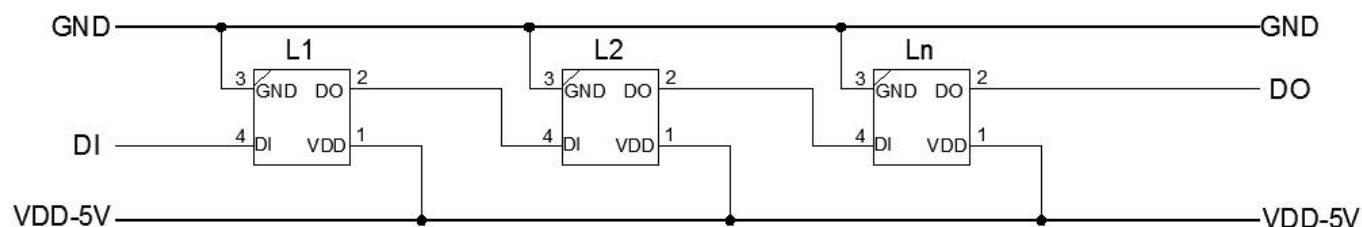
Note: The data of D1 is send by MCU, and D2, D3, D4 through pixel internal reshaping amplification to transmit.

Composition of 48bit Data

G15	G14	G13	G12	G11	G10	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0	...continued...		
...continued...		R15	R14	R13	R12	R11	R10	R9	R8	R7	R6	R5	R4	R3	R2	R1	R0	...continued...
...continued...		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.

Typical Application Circuit



Note: Add filter capacitor between GND and VDD (recommended value is 100nf), depends on the power supply quality.

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**.

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

MSL Level	Workshop Life	
	Time	Conditions
LEVEL1	Unlimited	$\leq 30^{\circ}\text{C}/85\%\text{RH}$
LEVEL2	1 Year	$\leq 30^{\circ}\text{C}/60\%\text{RH}$
LEVEL2a	4 Weeks	$\leq 30^{\circ}\text{C}/60\%\text{RH}$
LEVEL3	168 Hours	$\leq 30^{\circ}\text{C}/60\%\text{RH}$
LEVEL4	72 Hours	$\leq 30^{\circ}\text{C}/60\%\text{RH}$
LEVEL5	48 Hours	$\leq 30^{\circ}\text{C}/60\%\text{RH}$
LEVEL5a	24 Hours	$\leq 30^{\circ}\text{C}/60\%\text{RH}$
LEVEL6	Take-out and Use immediately	$\leq 30^{\circ}\text{C}/60\%\text{RH}$

2.3 SMT Requirement

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 $70 \sim 75^{\circ}\text{C}$ for $\geq 24\text{h}$);

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 $T < 30^{\circ}\text{C}$, $\text{RH} < 60\%$);

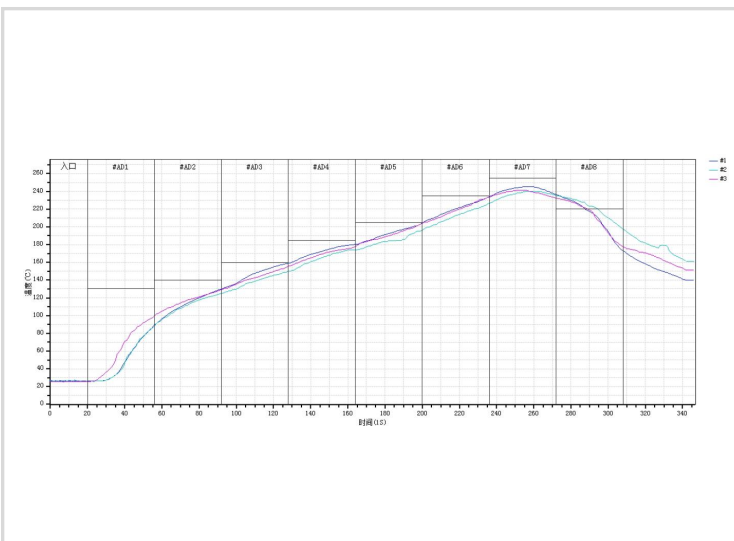
2.3.3 SMT shall be completed as soon as possible for LED pastes on PCBA after printing solder paste, and it is recommended not to exceed 1H;

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 roll baking: $70 \sim 75^{\circ}\text{C} * \geq 24\text{H}$ or bulk material baking: $120^{\circ}\text{C} * 4\text{H}$.

3. SMT Reflow

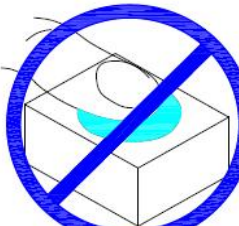
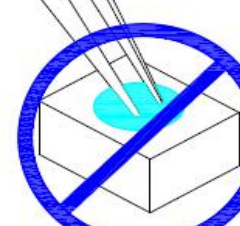
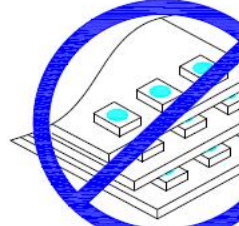

Refer to the parameters listed below, the experimental results prove that the TOP SMD LED meets the JEDEC J-STD-020C standards. As a general guideline, it is recommended to follow the SMT reflow temperature curve recommended by the solder paste manufacturer.

Temperature curve description	Range
30 °C ~ 150 °C preheating slope	1~4 °C/s
30 °C ~ 150 °C preheating time	60~120 s
Constant temperature slope of 150 °C ~ 200 °C	0~3 °C/s
Constant temperature time of 150 °C ~ 200 °C	60~120 s
LIQUID REGION temperature	217°C
Peak Temperature (Tp)	245°C
Reflow slope	0~3 °C/s
Reflow time	45-90 s
cooling rate	-4~0 °C/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	20210317	Yu XingHui	Yin HuaPing
V1.1	M	PCB pad size trimming	20220429	Yu XingHui	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.