

Main Features

- **OUTR, G, B** ports compression 35V. **DOUT, DIN** port withstand voltage 24V
- Built-in voltage-regulator tube, only a resistor needed in series to VDD, no need external regulator.
- Built-in resistors, DIN&DOUT have over voltage protection. Instantaneous short-circuiting to 24V won't cause damage.
- Gray-scale adjustment circuit (65,536 levels gray-scale adjustable).
- Built-in signal shaping circuit. After receiving signal, any IC will shape the waveform before outputting it, ensuring that waveform distortion does not accumulate along the circuit.
- Built-in power-on reset and power-off reset circuits.
- The PWM control terminal can achieve 65,536 levels adjustment, scan frequency is 2KHz.
- Serial interface and cascading interface, capable of receiving and decoding data through a single signal line.
- Any two pixel's distance less than 4 Meters' transmission signal without any increase circuit.
- When the refresh rate is 30fps, the cascading number is no less than 400 pixels.
- The data transmission speed can reach 800Kbps.

Main Applications

- Full-color LED decorative lighting, such as LED strings, LED strips, LED modules, etc.
- Indoor/outdoor LED video or irregular screens.
- LED consumer electronic products.
- Various LED lighting products.

General description

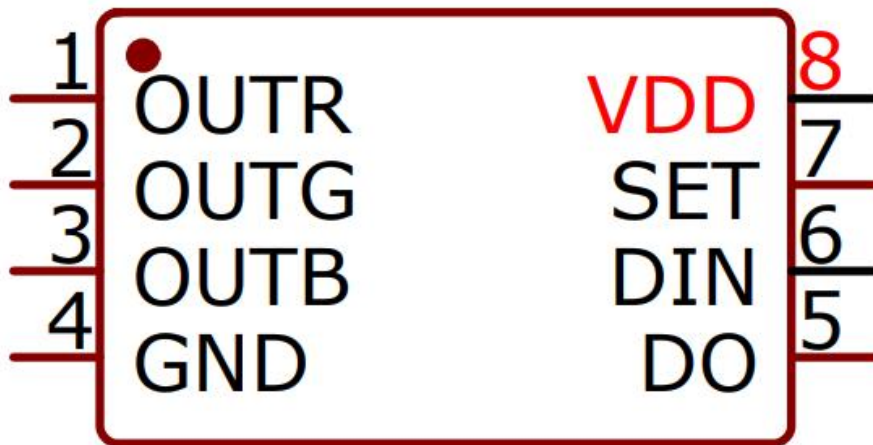
WS2913 is a dedicated circuit for three-channel LED drive control. The chip contains intelligent digital interface, data latch, signal shaping, and amplification, as well as an internal oscillator and a 20V high-voltage programmable constant current output driver. To reduce power supply ripple, OUTR, G, and B channels have a delayed turn-on function. During frame refreshing, it can reduce circuit ripple.

IC use single NZR communication mode. After the chip power-on reset, the DIN port receive data from controller, the first IC collect initial 48 bits 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 IC through the DO port. With each chip transmission, the signal reduces by **48bits**. IC adopt auto reshaping transmit technology, making the chip cascade number is not limited the signal transmission, only depend on the speed of signal transmission.

The data latch inside IC generates different duty cycle control signals at the OUTR, OUTG, and OUTB control terminals based on the received 48-bit data. When the DIN terminal receives the RESET signal, all chips synchronously send the received data to each segment. IC will receive the data after the signal ends and forward the data through the DO port. Before receiving the RESET code, the OUTR, OUTG, OUTB pins of the chip maintain the original output. When receiving a **RESET** code more than **280μs**, the chip will output the 48-bit PWM data pulse width to the OUTR, OUTG, and OUTB pins.

Two packaging options: SOP8 and FSOP8 are provided.

PIN configuration



PIN function

NO.	Symbol	PIN	Function description
1	OUTR	LED Driver Output	Output of RED PWM control
2	OUTG	LED Driver Output	Output of GREEN PWM control
3	OUTB	LED Driver Output	Output of BLUE PWM control
4	GND	Ground	Data & Power Grounding
5	DO	DO	Data Output
6	DIN	Data Input	Control data input
7	SET	Set Pin	NC = 8-bit grayscale PWM output VDD = 16-bit grayscale PWM output
8	VDD	Power Voltage	IC power supply

Absolute Maximum Ratings (T_A=25°C, V_{SS}=0V)

Parameter	Symbol	Ratings	Unit
Power Supply Voltage	V _{DD}	+3.5~+5.7	V
R/G/B Channel Output Port Withstand Voltage	V _{OUT}	V _{SS} -0.7~35	V
DIN Logical Input Voltage	V _I	V _{SS} -0.7~24	V
DOOUT Logical Input Voltage	V _O	V _{SS} -0.7~24	V
Working Temperature	T _{opt}	-40~+85	°C
Storage Temperature Range	T _{stg}	-40~+85	°C

Single line 65536 Gray level 3 channel Constant current LED driver IC

Electrical Characteristics ($T_A=25^{\circ}\text{C}$, $V_{DD}=4.5\sim 5.5\text{V}$, $V_{SS}=0\text{V}$)

Parameter	Symbol	Min	Tpy	Max	Unit	Conditions
Static current	I_o	—	0.8	—	mA	DC=5V
R/G/B Low voltage output current	I_{OL}	15.0	17.0	19.0	mA	DC=5V, DIN(FFH)
Single RGB current difference	Dif	—	—	1.5	mA	DC=5V, DIN
Low voltage output current	I_{dout}	10	—	—	mA	$V_o=0.4\text{V}$, D_{OUT}
Input current	I_I	—	—	± 1	μA	$V_I=V_{DD}/V_{SS}$
High voltage input	V_{IH}	$0.55V_{DD}$	—	—	V	D_{IN}
Low voltage input	V_{IL}	—	—	$0.3 V_{DD}$	V	D_{IN}
Hysteresis voltage	V_H	—	0.35	—	V	D_{IN}

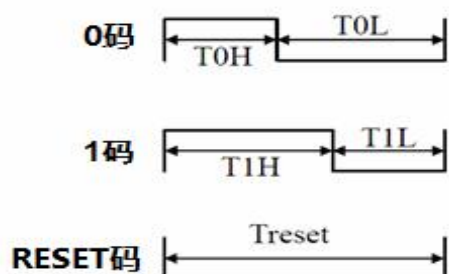
Switching characteristics ($T_A=25^{\circ}\text{C}$, $V_{DD}=4.5\sim 5.5\text{V}$, $V_{SS}=0\text{V}$)

Parameter	Symbol	Min	Tpy	Max	Unit	Condition
Oscillation frequency	F_{osc}	—	800	—	KHz	—
Transmission delay time	T_{PLZ}	—	—	300	ns	$CL=15\text{pF}$, $DIN \rightarrow DOUT$, $RL=10\text{K}\Omega$
Fall time	T_{THZ}	—	—	120	μs	$CL=300\text{pF}$, $OUTR/OUTG/OUTB$
Data transmission rate	F_{MAX}	600	—	—	Kbps	Pulse width ratio: 50%
Input capacity	C_I	—	—	15	pF	—

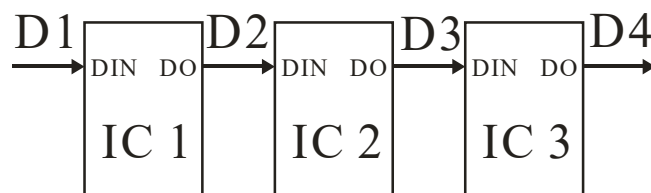
Data Transfer Time

T0H	0 code, high voltage time	220ns~380ns
T1H	1 code, high voltage time	580ns~1us
T0L	0 code, low voltage time	580ns~1us
T1L	1 code, low voltage time	580ns~1us
RES	Frame unit, low voltage time	>280 μs
T0H+T0L, T1H+T1L $\geq 1.25\mu\text{s}$		

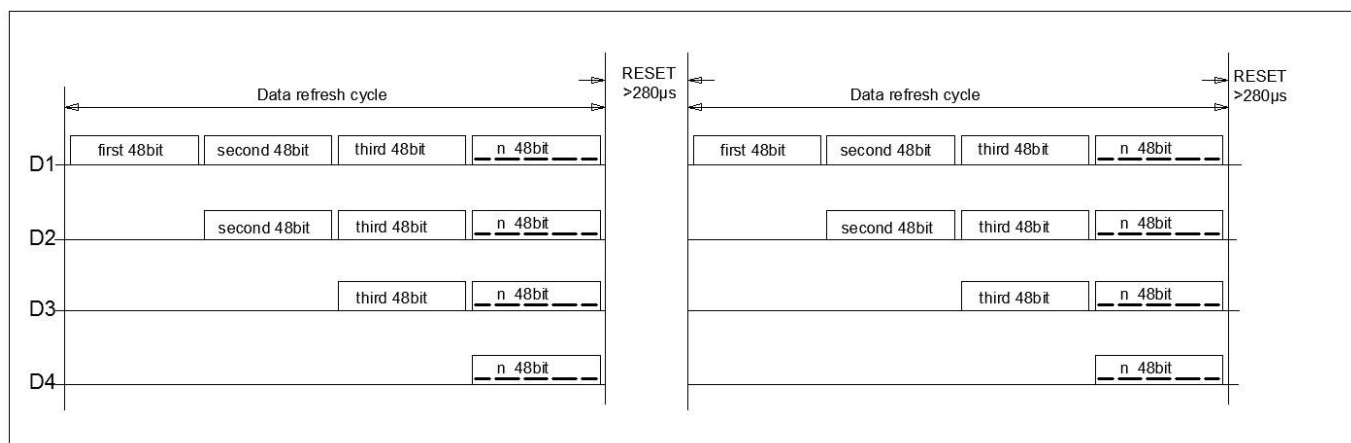
Sequence Chart



Cascade Method



Data Transmission Method



Note: D1 represents the data sent by the MCU end, while D2, D3, D4 are the data automatically processed and forwarded by the cascaded circuit.

16bit current gain data structure

Data transmit in order of RGB, high bit data at first.

IR4	IR3	IR2	IR1	IR0	IG4	IG3	IG2	IG1	IG0	IB4	IB3	IB2	IB1	IB0	校验码
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Note: To verify the number, please send "1".

Composition of 48bit Data

R15	R14	R13	R12	R11	R10	R9	R8	R7	R6	R5	R4	R3	R2	R1	R0	...Continued...
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...Continued...	G15	G14	G13	G12	G11	G10	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0	...Continued...
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...Continued...	B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
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Note: Data transmit in order of RGB, high bit data at first.

Single line 65536 Gray level 3 channel Constant current LED driver IC

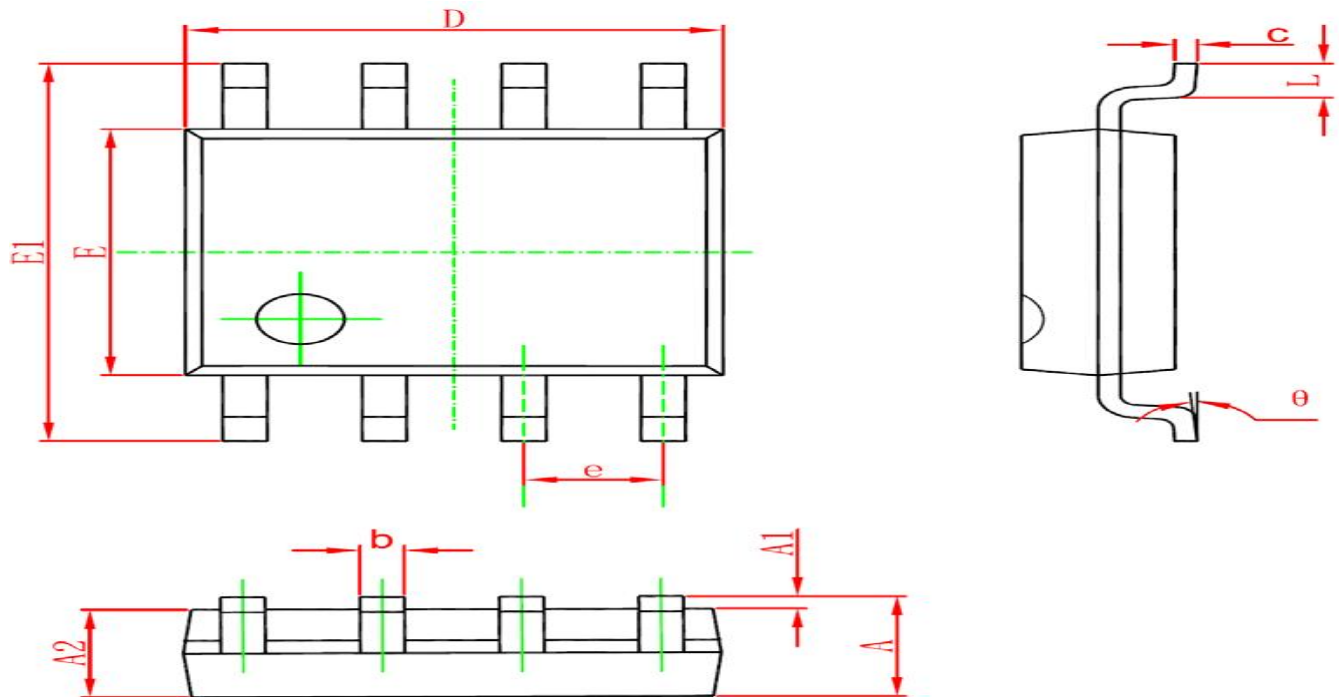
Current gain

Current gain setting	RGB current (mA)
0	0.00
1	0.57
2	1.18
3	1.77
4	2.40
5	2.96
6	3.56
7	4.14
8	4.68
9	5.25
A	5.84
B	6.40
C	6.99
D	7.55
E	8.13
F	8.67
10	9.21
11	9.77
12	10.36
13	10.90
14	11.49
15	12.02
16	12.60
17	13.12
18	13.61
19	14.14
1A	14.71
1B	15.23
1C	15.79
1D	16.30
1E	16.86
1F	17.36



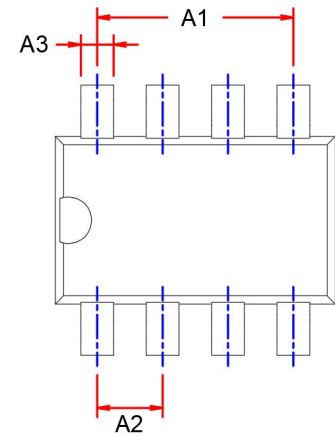
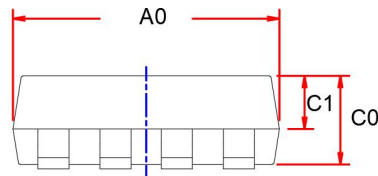
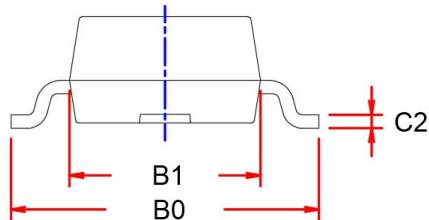
Package information

- SOP8 Package



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270		0.050	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

● FSOP8 Package



Dimension Position	Position Name	Typical size(mm)
A0	Total length	3.25
A1	Total PIN distance	2.40
A2	Single PIN distance	0.80
A3	PIN Width	0.35
B0	Total Width	2.85
B1	Colloid width	1.65
C0	Colloid height	1.00
C1	Bonding wire height	0.55
C2	PIN thickness	0.15

Modify Records

Version №	Status Bar	Modify Content Summary	Date	Reviser	Approved
V1.0	N	New	20240801	He WenBin	Yin HuaPing
V1.1	M	Revise parameters	20240907	He WenBin	Yin HuaPing
V1.2	M	Revise parameters	20241011	He WenBin	Yin HuaPing
V1.3	M	Add the current gain	20241129	He WenBin	Yin HuaPing
V1.4	M	Revise parameters	20250614	He WenBin	Yin HuaPing
V1.5	M	Revise the application Circuit	20250701	OuYang Yu	Yin HuaPing
V1.6	M	Add refresh rate parameter	20251015	OuYang Yu	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.