UCS1903

3-Channel LED Driver / Controller

GENERAL DESCRIPTION

The UCS1903 is a 3-channel LED display driver / controller with a built-in MCU digital interface, data latches and LED high voltage driving functions. It features superior performances and reliable functions. Under the control of the external MCU, it performs independent grayscale control and cascading control for driving large outdoor colour dot-matrix LED panels.

FEATURES

- 12V-rated output port.
- 6V to 12V operating voltage.
- Grayscle adjustment function (256-level adjustable grayscle).
- Built-in dual RC oscillators for clock synchronization with the signals on the data line. After the first data is received, the subsequent data will be shaped and forwarded automatically.
- Built-in power-on reset function.
- 256-level adjustment is possible through the PWM control, with the scanning frequency up to 400Hz/s.
- Serial cascade interface, with the data received and decoded on one wire.

- Unlimited cascading is possible in linear transfer mode.
- Over 10-meter transfer distance between any two points. No additional circuitry is necessary.
- At the refresh speed of 30 frames / s, up to 512 cascaded dots are possible at the low-speed mode, and up to 1024 cascaded dots are possible at the high-speed mode.
- Data transfer rates of up to 400kbps or 800kbps.

PIN CONFIGURATION
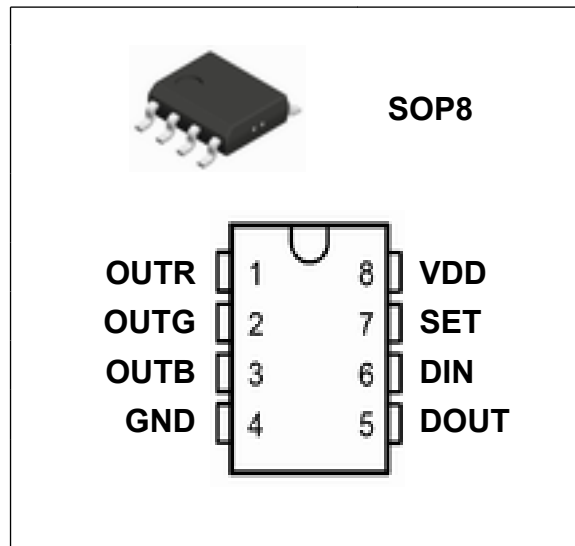
PIN DESCRIPTION

Number	Symbol	Name	Function Description
1	OUTR	LED drive output	Red PWM control output
2	OUTG	LED drive output	Green PWM control output
3	OUTB	LED drive output	Blue PWM control output
4	GND	Ground	Ground

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5	DOUT	Data output	Display data cascaded output
6	DIN	Data input	Display data input
7	SET	Mode setting	Connected to VDD: Low speed mode; Floating: High speed mode
8	VDD	Logic power supply	

ABSOLUTE MAXIMUM RATINGS (T_A =25℃, V_{SS} =0V, unless otherwise specified)

Parameter	Symbol	Value	Unit
Logic supply voltage	V_{DD}	+6.0 to +7.0	V
Output port rated voltage	V_{OUT}	12	V
Logic input voltage	V_I	−0.5 to V_{DD}+0.5	V
Operating temperature	T_{OPT}	−25 to +85	℃
Storage temperature	T_{STG}	−55 to +150	℃

RECOMMENDED OPERATNG RANGES (T_A =−20 to +70℃, V_{SS} =0V, unless otherwise specified)

Parameter	Symbol	Min.	Typ.	Max	Unit
Logic supply voltage	V_{DD}	-	6	-	V
High level input voltage	V_{IH}	$0.7V_{DD}$	-	V_{DD}	V
Low level input voltage	V_{IL}	0	-	$0.3V_{DD}$	V

ELECTRICAL CHARACTERISTICS (T_A =−20 to +70℃, V_{DD} =4.5 to 5.5V, V_{SS} =0V, unless otherwise specified)

Parameter	Symbol	Min.	Typ.	Max	Unit	Test conditions
Low level output current	I_{OL1}	-	17	-	mA	G, B
Low level output current	I_{OL2}	-	18	-	mA	R
Low level output current	I_{dout}	10	-	-	mA	V_O =0.4V, DOUT
Input current	I_I	-	-	±1	µA	$V_I = V_{DD} /V_{SS}$
High level input voltage	V_{IH}	$0.7V_{DD}$	-		V	DIN, SET
Low level input voltage	V_{IL}	-	-	$0.3V_{DD}$	V	DIN, SET
Voltage hysteresis	V_H	-	0.35	-	V	DIN, SET

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SWITCHING CHARACTERISTICS (T_A =−20 to +70℃, V_{DD} =4.5 to 5.5V, V_{SS} =0V, unless otherwise specified)

| Parameter	Symbol	Min.	Typ.	Max	Unit	Test conditions
Oscillation frequency	F_{OSC1}	-	400	-	kHz	-
	F_{OSC2}	-	800	-	kHz	-
Propagation delay time	t_{PLZ}	-	-	300	ns	C_L =15pF, DIN→DOUT, R_L =10kΩ
Fall time	t_{THZ}	-	-	120	µs	C_L =300pF, OUTR/OUTG/ OUTB
Data transfer rate	F_{MAX}	400	-	-	kbps	50% duty cycle
Input capacitance	C_I	-	-	15	pF	-

FUNCTIONAL DESCRIPTION

The UCS1903 sends signals in return to zero codes with a single-wire communication method. When the power-on reset is completed, the UCS1903 receives the data from the DIN pin. When all the 24 bits of data have been received, the DOUT port starts to forward the data to the next chip as its input data. The DOUT pin is held LOW before the data forwarding, and the chip does not receive new data. The three PWM output ports, OUTR, OUTG and OUTB, send signals in a 4-ms period, with different duty cycles corresponding to the 24-bit data received. If the input signal from the DIN pin is a RESET signal, the UCS1903 will send the received data for display. When the signal is completed, the UCS1903 will receive new data. When all the initial 24 bits of data have been received, the UCS1903 will forward the data through the DOUT pin. Before the RESET signal is received, the output at the OUTR, OUTG and OUTB pins will remain unchanged. When a low level RESET code longer than 24µs is received, the UCS1903 will output the 24-bit PWM data just received to the OUTR, OUTG and OUTB pins.

The UCS1903 employs an automatic shaping-forwarding technique, so the number of the cascaded chips is not limited by the signal transfer, and is only limited by the panel refresh speed. For example, in a 1024-chip cascaded design with the panel refresh time of 1024X0.4X2 =0.8192ms (the data delay time of the UCS1903 is 0.4µs), no flickering will appear.
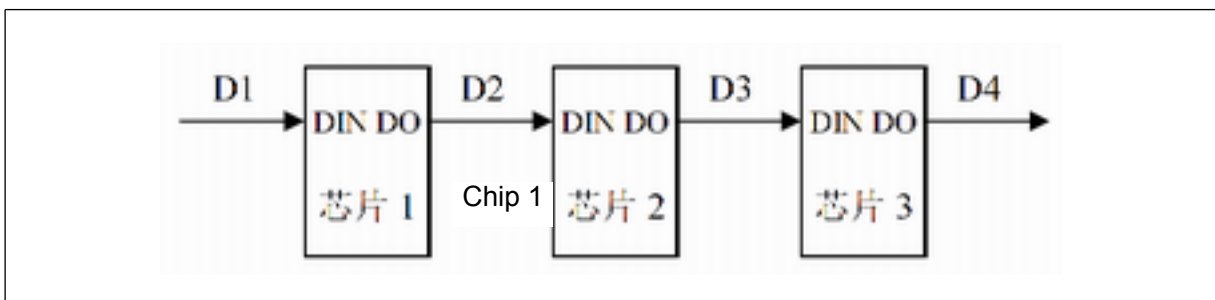
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TIMING WAVEFORMS

1 Input code
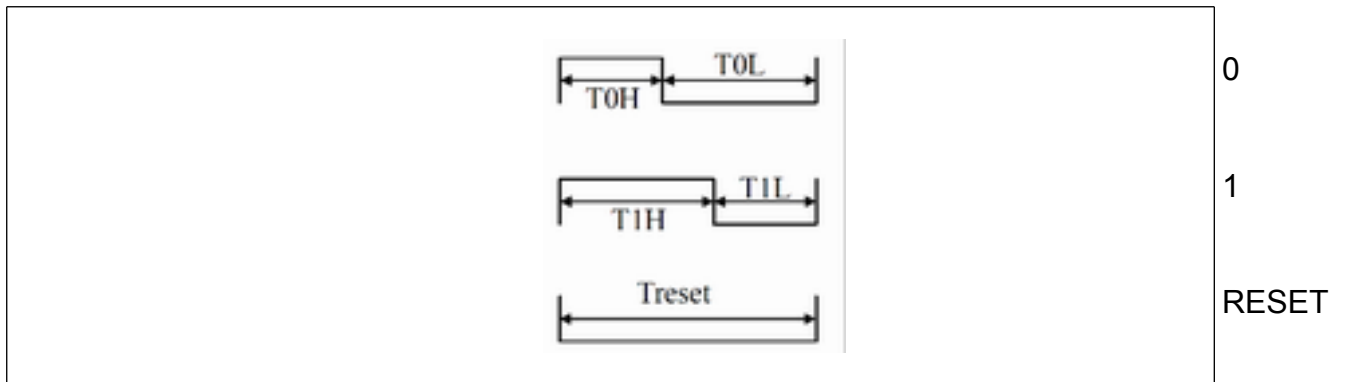
2 Low-speed mode time

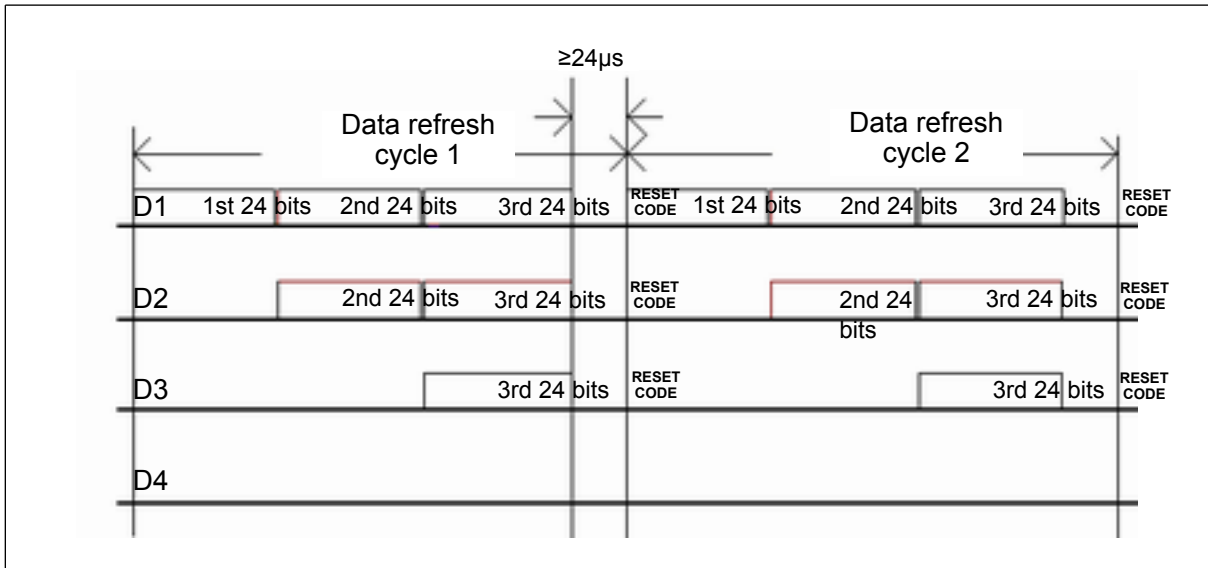| Name	Description	Typ. value	Allowable error
T0H	code 0, high level time	0.5µs	±150ns
T1H	code 1, high level time	2.0µs	±150ns
T0L	code 0, low level time	2.0µs	±150ns
T1L	code 1, low level time	0.5µs	±150ns

Note: In the high-speed mode, only half of the above time is needed (the time for code RESET is not changed).

3 Connection scheme

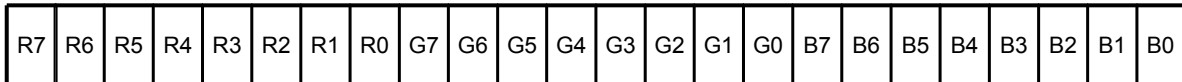## 4 Data transfer format

Note: D1 is the data sent from the MCU, D2, D3 and D4 are the data automatically shaped and forwarded by the cascaded circuit.
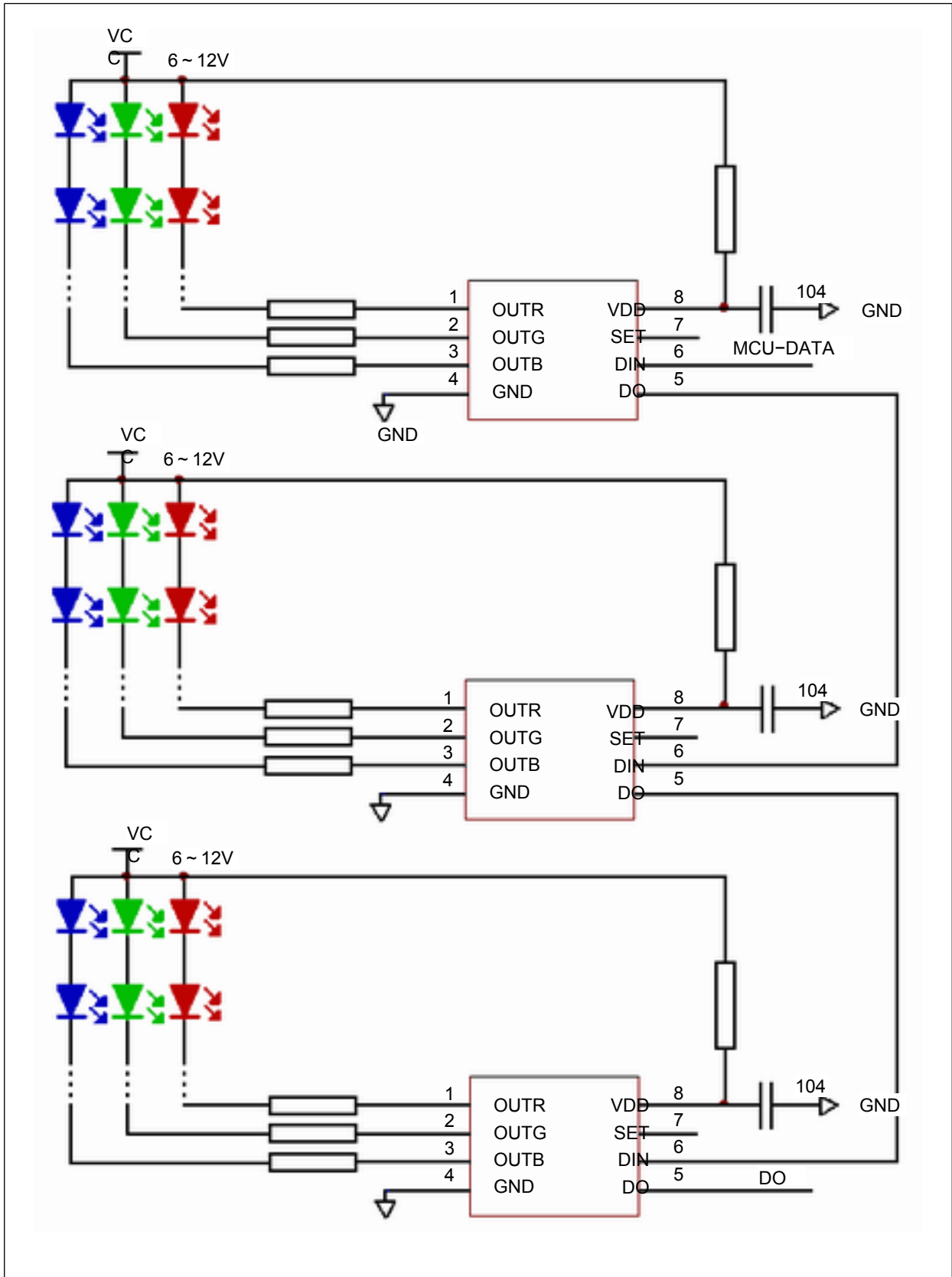
5 24-bit data format

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

Note: The data is sent in the sequence of RGB, and the MSB is sent first.

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APPLICATION DIAGRAM

The power supply voltage for the UCS1903 may be selected from 6V to 12V. A 104 capacitor between the power supply and the ground should be connected as close to the UCS1903 package as possible, and the PCB traces should be as short as possible. A resistor R should be connected between the power supply and the VDD pin, with the resistance value determined in reference to the supply voltage. The recommended resistance value is as follows:
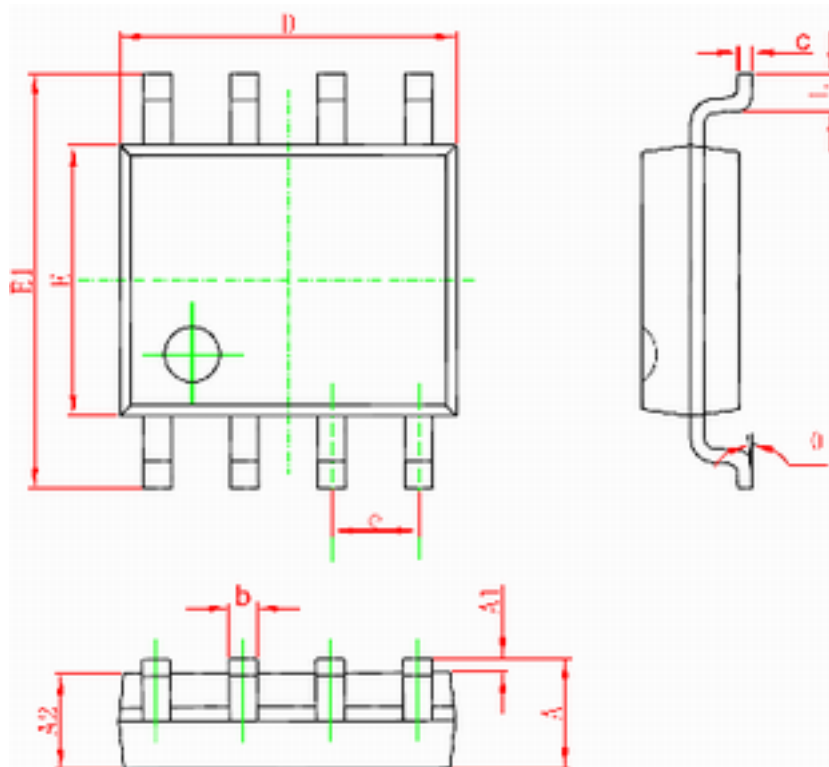
Supply Voltage	Recommended power supply resistor value
6V	1kΩ
9V	4kΩ
12V	7kΩ

In practical applications, the VDD voltage is constant at about 5V. When the SET pin is connected to high level, it should be connected to VDD. It should not be connected to external Power supply VCC, so as to prevent chip breakdown.

PACKAGE OUTLINE DRAWING AND DIMENSION

SOP 8

Symbol	In mm		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 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°