SM18512P

Feature

- Built-in power regulator voltage stabilizing function, input power supply voltage: 5V~36V
- Compliant and extended DMX512 (1990) protocol
- Differential signal transmission rate:200kbps~750kbps
- The differential parallel signal transmission, support maximum 4096-channel addressing.
- Customizing OUT R/G/B/W port the default display effect
- The first chip lights up red and the remaining chips light green when succeeding writing address
- The first chip lights up red and the remaining chips light the preset lights when succeeding writing parameters.
- The first chip lights red and the remaining chips light yellow when succeeding writing current gain
- the first chip will light up in red, and the remaining light in purple after writing the automatic addressing/automatic addressing/adaptive function successfully
- OUT port opening width compensation 7 levels adjustable
- Chip address line open circuit self-check function
- No input signal for 2 seconds, switch the default display effect or maintain the last frame display state.
- SPWM port setting OUT output polarity reverse phase:
  High level(default), OUT PWM frequency: 4KHz
  Low level, reversal output, OUT PWM frequency: 4KHz
- SPWM Gray scale: 256 levels
- Built-in 1/2/3/4 channel selection function
- Default OUT R/G/B/W output current: 18mA (REXT: floating
-), maximum current can be adjusted to 60mA through external REXT
- OUT R/G/B/W each 5 bits current gain adjustment
- OUT R/G/B/W withstand voltage: 40V
- Built-in OTP
- Package: SOP16

Description

The SM18512P is a 4-channel, parallel differential signal transmission LED driver, It is compatible and extends the DMX512 (1990) communication protocol. It has a variety of characteristics, including signal differential transmission, with a lot of load points, strong anti-interference ability, far transmission distance etc.

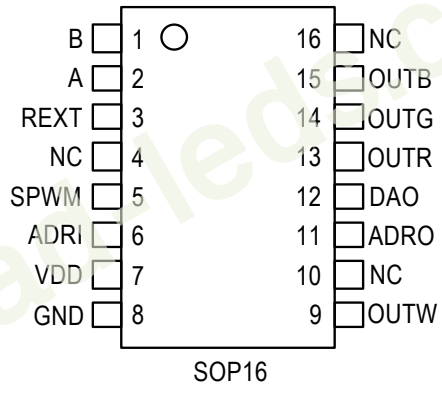
The default OUT R/G/B/W port output current 18mA (REXT: floating), Each OUT port output current can be extended to 60mA through the external circuit of the REXT port, and the 32 level current gain of OUT R/G/B/W can be set separately through the controller parameters. At the same time, the PWM refresh rate of OUT port 4KHz greatly improves the refresh rate of the screen.

SM18512P supports output polarity reversal. It is suitable for OUT ports to plug MOSFET or high power driver chips.

Application

- LED decorative lighting indoor
- Architectural LED appearance / scene lighting
- Wash-wall lights, curtain screens
- Pointolite, LED hurdle lamp

Pin Diagram



SOP16

Internal Function Diagram

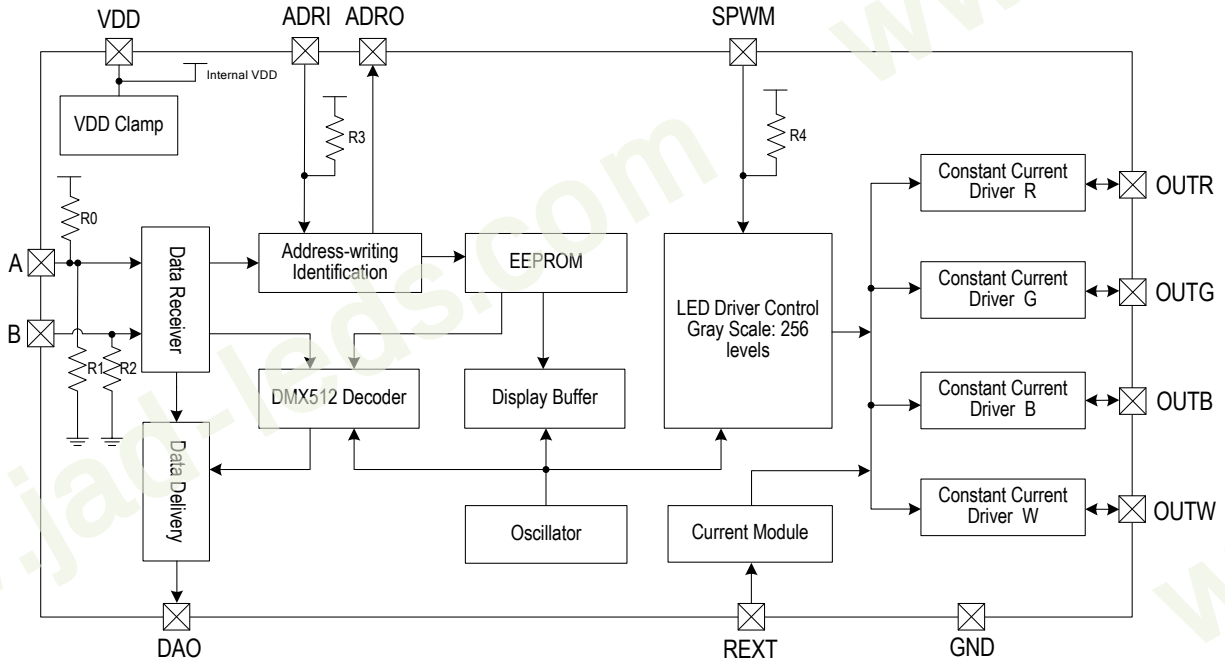


Fig.SM18512P Internal function diagram

Pin Description

Pin No.	Pin Name	Pin Description
1	B	Differential signal input port-
2	A	Differential signal input port+
3	REXT	External REXT resistor to GND, to set OUTR/G/B/W output current.
4,10,16	NC	No connection, can be routed
5	SPWM	When SPWM is suspended (internal pull up), OUTR/G/B/W outputs normally, and OUT port output frequency is 4KHZ. When the SPWM is grounded, the output is inverting, and the OUT R/G/B/W port output frequency is 4KHZ, which is used for the external large current switch tube.
6	ADRI	Enable signal input port of writing address
7	VDD	Power supply port, built-in 5V LDO circuit
8	GND	Ground
9,13~15	OUT W/R/G/B	Constant current driver port
11	ADRO	Enable signal output port of writing address
12	DAO	Cascaded signal output port

Order Information

Type	Package	Packing		Reel Size
		Tube	Tape	
SM18512P	SOP16	100000 pcs/box	4000 pcs/tape	13 inches

Absolute Maximum Parameter (Note 1)

Unless otherwise stated, T_A=25°C.

Symbol	Parameter	Range	Unit
VDD	Operating voltage	-0.4~5.5	V
V_I	Logic input voltage	-0.4~VDD+0.4	V
BV_{OUT}	OUTR/G/B/W withstand voltage	45	V
I_{OUT}	OUTR/G/B/W maximum output current	65	mA
Idamp	Maximum clamping current of VDD port	20	mA
RθJA	PN junction to ambient thermal resistance (Note 2)	90	°C/W
P_D	Power consumption (Note 3)	0.9	W
T_J	Operating junction temperature	-40~150	°C
T_{STG}	Storage temperature	-55~150	°C
V_{ESD}	HBM ESD	2	KV

Note 1: The maximum output power is limited to chip junction temperature, the maximum limit means that the chip can be damaged beyond the scope of the work. The maximum limit value is the work in the limit parameter range, the device function is normal, but it is not completely guaranteed to meet the individual performance indexes.

Note 2: RθJA measures the flow of water according to the JEDEC JESD51 thermal measurement standard on the single-layer thermal conductivity test board under T_A=25°C.

Note 3: The maximum power consumption is decreased when temperature rising, this depends on T_{JMAX}, RθJA and T_A Maximum allowable power consumption is $P_D = (T_{JMAX}-T_A)/$ RθJA or the lower value of the value given in the limit range.

Electric Operating Parameter (Note 4, 5)

Unless otherwise stated, VDD=5V, T_A=25°C.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
VDD	Internal clamp voltage	External power supply: VCC=12V, R_D (current-limit resistor between VCC and VDD) =1KΩ	4.8	5.2	5.4	V
I_{DD}	Quiescent current(energy saving mode)	VDD = 5V, REXT:NC, I_{OUT} "OFF"	-	3.8	-	mA
	Quiescent current(working mode)	VDD = 5V, REXT:NC, I_{OUT} "ON"	-	5.1	-	mA
V_{REXT}	REXT voltage	REXT connects to 10K resistor	-	1.18	-	V
I_{OH}	DAO drive	DAO high output, connects to GND	-	-37	-	mA
I_{OL}		DAO low output, connects to VDD	-	36	-	mA
I_{OUT_RGBW}	OUT R/G/B/W output current	REXT:NC, current gain setting: D5:D4:D3:D2:D1=11111	-	18	-	mA
		REXT connects to Rext=1.8KΩ, current gain setting: D5:D4:D3:D2:D1=11111	-	60	-	
dI_{OUT_RGBW}	OUT R/G/B/W output current accuracy	REXT:NC, I_{OUT}=18mA	-	±3	-	%
		REXT connects 1.8KΩ resistor to GND, I_{OUT}=60mA	-	±5	-	%
R_{down_AB}	Resistance to ground of A/B port	VDD=4.5V	-	200	-	KΩ
R_{UP_A}	Pull-up resistor of A port	VDD=4.5V	-	250	-	KΩ
V_{CM}	Differential-input common-mode voltage	-	-	-	12	V
I_{AB}	Differential-input current	-	-	-	28	uA
VTH	Differential-input threshold voltage	VDD = 5V,B=2.5V,A input high and low level.	-200	-	200	mV
△VTH	Differential-input hysteresis voltage	VDD = 5V,B=2.5V,A input high and low level.	-	80	-	mV
V_{DS_S}	I_{OUT} constant current knee point voltage	I_{OUT} = 18mA	-	0.3	-	V
		I_{OUT} = 30mA	-	0.6	-	V
		I_{OUT} = 60mA	-	1.1	-	V
% VS V_{DS}	OUT R/G/B/W output current variation	I_{OUT} =18mA, VDS=1~3V	-	1	-	%
%VS VDD		I_{OUT} =18mA, VDS=4.5~5.5V	-	1	-	
%VS T_A		I_{OUT} =18mA, T_A =-40~+85℃	-	4	-	
R_{UP}	ADRI pull-up resistor	-	-	23	-	KΩ
OTP	Initiate junction temperature of over temperature protection	-	-	135	-	℃
I_{leak}	OUT R/G/B/W leak current	I_{OUT} "OFF", V_{DS} = 40V	-	-	1	uA

Note 4: The electrical operating parameters define the DC parameters of the device within the working range and under test conditions that ensure a specific performance indicator. The specification does not guarantee the accuracy of the parameters that are not given the upper and lower limit values, but the typical values reflect the performance of the device.

Note 5: The minimum and maximum parameter range of the datasheet is guaranteed by the test, and the typical value is guaranteed by design, test or statistical analysis.

Switch Characteristic

Unless otherwise stated, VDD=5V, T_A=25°C.

Symbol	Parameter	Condition		Min.	Typ.	Max.	Unit
f_{PWM}	OUT R/G/B/W output PWM frequency	I_{OUT}=18mA, OUT R/G/B/W series connects 200Ω resistor to VDD	SPWM:NC	-	4K	-	Hz
			SPWM connects to GND	-	4K	-	
t_{PLH}	Signal transmission delay (Note 6)	DAO loads 30pF capacitor to ground, signal transmission delay from DAI to DAO		-	270	-	ns
t_{PHL}				-	270	-	ns
t_{TLH}	DAO transfer time (Note 7)	DAO loads 30pF capacitor to ground		-	15	-	ns
t_{THL}				-	15	-	ns
t_r	OUT R/G/B/W transfer time (Note 8)	I_{OUT}=16mA，OUT R/G/B/W connects 100Ω resistor to VDD, loads 15pF capacitor to ground		-	100	-	ns
t_f				-	170	-	ns

Note 6, note 7, note 8: shown as below.

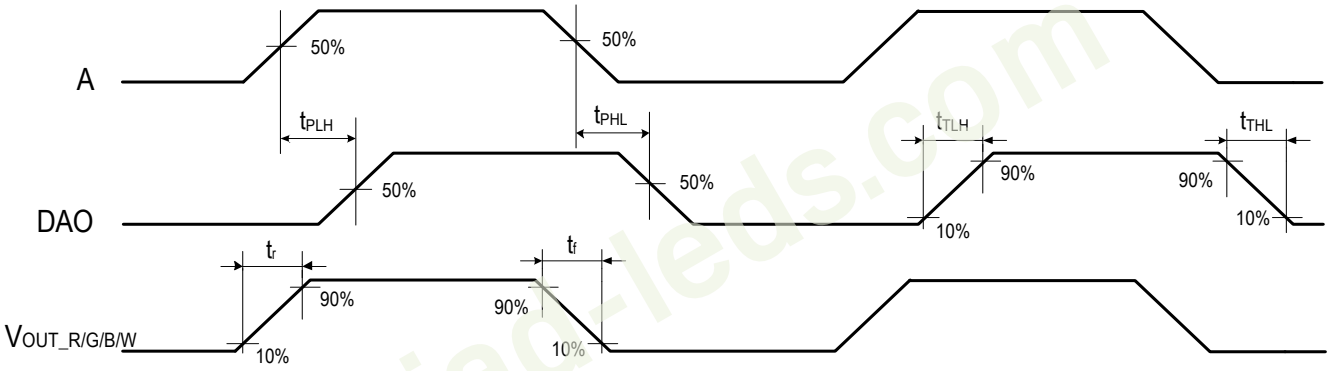


Fig. SM18512P dynamic parameter test diagram

Data Communication Protocol

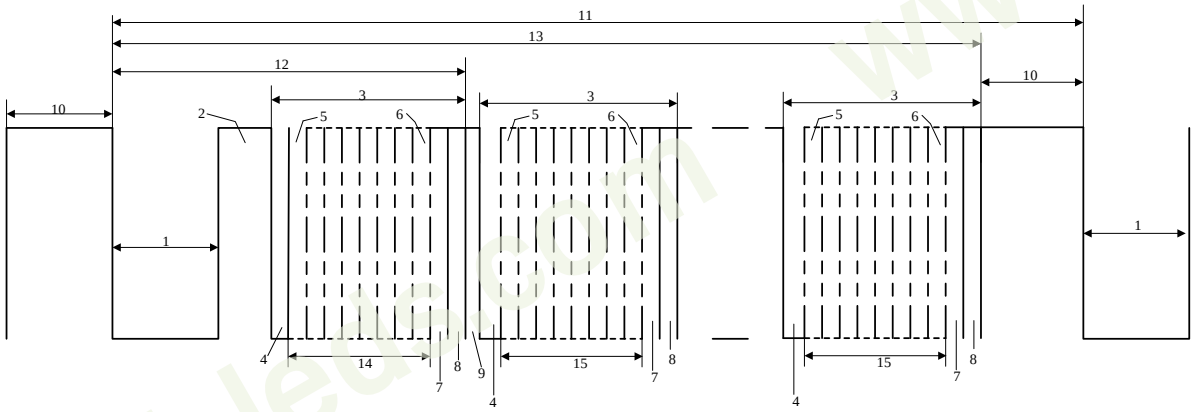


Fig. DMX512(1990) Data Communication Protocol Diagram

Figuer Key

1- "SPACE" for BREAK
2- "MARK" After BREAK (MAB)
3- Slot Time
4- START Bit
5- LEAST SIGNIFICANT Data BIT
6- MOST SIGNIFICANT Data BIT
7- STOP Bit
8- STOP Bit
9- "MARK" Time Between slots
10- "MARK" Before BREAK (MBB)
11- BREAK to BREAK Time
12- RESET Sequence (BREAK,MAB,START Code)
13- DMX512 Packet
14- START CODE (Slot 0 Data)
15- SLOT 1 DATA
16- SLOT nnn DATA (Maximun 512)

Designation	Description	Min	Typical	Max	Unit
-	Bit Rate	245	250	255	kbit/s
-	Bit Time	3.92	4	4.08	us
-	Minimum Update Time for 513 slots	-	22.7	-	ms
-	Maximum Update Rate for 513 slots	-	44	-	/s
1	"SPACE" for BREAK	88	-	-	us
2	"MARK" After BREAK (MAB)	8	-	-	us
9	"MARK" Time Between slots	0	-	<1.00	s
10	"MARK" Before BREAK (MBB)	0	-	<1.00	s
11	BREAK to BREAK Time	1196	-	-	us
13	DMX512 Packet	1196	-	-	us

Note:

(1) The above data format is completely compatible with DMX512(1990).

(2) This product needs to receive at least two frames of data before refreshing the port output. The corresponding port output of the currently received data needs to be refreshed after identifying the next frame of data MAB.

Constant Current Characteristic

When it gets to constant current knee point, the SM18512P output current is not affected by OUT voltage(V_{DS}). relationship between I_{OUT} and V_{DS} is shown below.

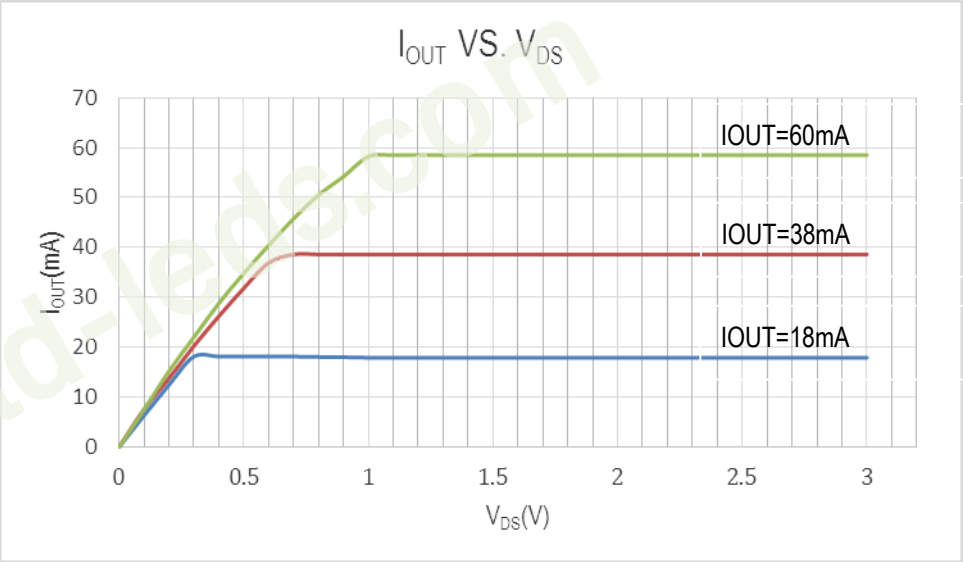


Fig. Relationship diagram between I_{OUT} and V_{DS}

Output Current Setting

When REXT is not connected, OUTR/G/B/W output current of SM18512P is 18mA(default). External REXT resistor can also be used to extend the maximum output current to 60mA.The output current of SM18512P is set by the following equation(G represents current gain):

IOUT=（18+80/REXT(KΩ)）*（0.07+0.03*G） (mA)

When setting the Iout current, it is recommended to set the maximum value of current gain (G) to 31 to calculate the Rext resistance.

For example, when R_{EXT}=1.9KΩ, G=31, the OUT RGBW output current value is 60mA.

Current Gain

The OUT RGBW of SM18512P has 5bits current gain adjustment bit. The corresponding relationship between the output current value and the current gain bit is shown in the table below. D5~D1 ranged from high to low and the REXT is floating.

Current gain	D5	D4	D3	D2	D1	Corresponding current value（mA）
0	0	0	0	0	0	1.13
1	0	0	0	0	1	1.67
2	0	0	0	1	0	2.2
3	0	0	0	1	1	2.74
4	0	0	1	0	0	3.32
5	0	0	1	0	1	3.86
6	0	0	1	1	0	4.39
7	0	0	1	1	1	4.92
8	0	1	0	0	0	5.52
9	0	1	0	0	1	6.06
10	0	1	0	1	0	6.59
11	0	1	0	1	1	7.12
12	0	1	1	0	0	7.7
13	0	1	1	0	1	8.24
14	0	1	1	1	0	8.77
15	0	1	1	1	1	9.31
16	1	0	0	0	0	9.87
17	1	0	0	0	1	10.4
18	1	0	0	1	0	10.93
19	1	0	0	1	1	11.46
20	1	0	1	0	0	12.04
21	1	0	1	0	1	12.57
22	1	0	1	1	0	13.1
23	1	0	1	1	1	13.63
24	1	1	0	0	0	14.24
25	1	1	0	0	1	14.76
26	1	1	0	1	0	15.3
27	1	1	0	1	1	15.82
28	1	1	1	0	0	16.41
29	1	1	1	0	1	16.94
30	1	1	1	1	0	17.46
31	1	1	1	1	1	18

Automatic function selection

Description of automatic address writing function

1) Turn on the automatic address writing function: first set the chip automatic address writing step through the parameter writing function, and then use the controller to enable the automatic address writing function. After the instruction is written successfully, the first light will be red, and the rest will be purple.

2) When the automatic address writing function is turned on, the automatic addressing operation will be performed every time the power is turned on again (the controller needs to send a normal gray-scale data signal), the first chip(that is, the ADRI is suspended) at the signal input terminal is judged to be the first address 1, and The chip is automatically addressed according to the setting step number, and the new address data will be automatically saved.

3) After the automatic address writing is successful, the first chip lights up in red, and the other chips lights up in green for 2 seconds.

Description of automatic addressing function

1) Turn on the automatic addressing function: first set the step by writing parameters, and then use the controller to enable the automatic addressing function. After the instruction is written successfully, the first light will be red, and the rest will be purple;

2) After the lamp is powered on and the automatic addressing succeeds, the chip lights up green for 2 seconds; at the same time, the chip automatically exits the automatic addressing mode.

Adaptive function description

1) Turn on the adaptive function: use the controller to enable the adaptive function, the first light will be red after the instruction is successfully written, and the rest will be purple;

2) After the lamp is powered on and auto-adapted successfully, the chip will turn on green for 2 seconds; at the same time, the chip will automatically exit the auto-adaptation mode.

Note of automatic function:

1. When the automatic function is selected through the controller, only one of the automatic addressing/automatic address writing/adaptive functions can be selected; after the selection is successful, the first light will be red and the other bright purple lights are signs;
2. Automatic addressing/self-application can be used for lamp repair. Lamps with automatic addressing function can be automatically identified when they are repaired; lamps with adaptive function turned on, and addresses, parameters and current gains can be automatically identified when they are repaired;
3. The headlight does not support automatic addressing/adaptive function;
4. After the controller writes the address, all automatic functions will be automatically closed;
5. After the project debugging is completed, it is recommended to turn off the automatic address writing function.

Address line open circuit self-check function

SM18512P built-in address open circuit self-checking function is as follows:

1) Turn on the self-check function: turn on the self-check function through the parameter writing function;

2) After the self-check function is turned on, each time the power is turned on, the chip automatically detects whether it is connected to the previous-level lamp address line normally. If the line is open or the lamp is the first light, it will light up in red, and the normally connected lamp will not light up.

Note: The self-check function is not effective for chips with automatic function.

OUT port opening width compensation

SM18512P opening width compensation function as follows:

1) Turn on the self-check function: turn on the width compensation function through the parameter writing function;

2) OUT port opening width compensation is level 0~6, each level increases the OUT port opening time by about 260ns, level 0 means no compensation.

Typical Application

SM18512P uses differential parallel transmission, it adopts the international DMX512 (1990) protocol, and supports the maximum number of channel up to 4095.

In the engineering application, the controller does not need to connect four wires to the first lamp point, only need to connect the A/B differential signal line and ground wire to complete the operation of writing address and display control, which improves the flexibility of engineering installation.

1、SM18512P RGBW Typical Combination Application Circuit

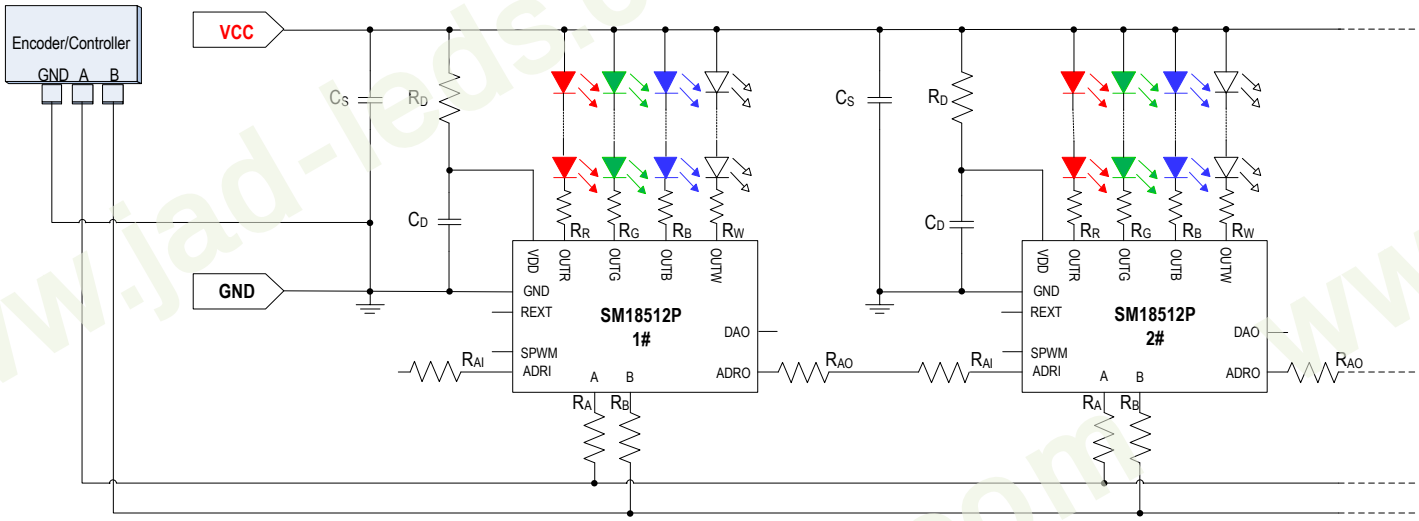


Fig. SM18512P Typical application diagram

The typical application circuit of SM18512P includes VCC (input voltage of power supply), R_D (current-limit resistor) ,C_S (system power filtering capacitor), and R_R, R_G, R_B, R_W (divider resistor of R/G/B/W LED), R_{AI}(address signal input protection resistor), R_{AO} (address signal output protection resistor) and R_A, R_B (A/B bus signal cascaded resistor).

(1)VCC is external input voltage, RD is current-limit resistor for limiting the internal voltage-stabilizing operation current when turns on the chip voltage-stabilizing function. Chip operation voltage: V_{DD}: V_{DD}=VCC-(I_{DD}+I_{IN})*R_D

I_{IN} is the internal voltage-stabilizing operation current, I_{DD} is the chip quiescent current, the value of R_D must keep V_{DD}>3V. The higher the R_D is, the lower the system power consumption is, and the anti-interference capability is weak; the lower the R_D is, the higher the system power consumption is, and the operating temperature is higher, therefore the R_D should be selected compromisingly based on the system application environment in the design. The relation between VCC and R_D is given by:

VCC（V）	5V	6V	9V	12V	15V	18V	24V	36V
R_D（Ω）	33	68	300	1.0K	1.5K	2.0K	3.0K	2.4K+2.4K

(2)Cs is system power capacitance to the ground for reducing the power fluctuations, select 0.1uF-10uF according to actual load situation.

(3)C_D is chip filter capacitor for keeping VDD voltage stable and guarantee normal operation. Recommend to choose 100nF.

(4)R_A and R_B are A/B signal input protection resistor, prevent A, B port from damage that makes bus data abnormal.

(5)R_{AI} is address signal input protection resistor for preventing electric plug, positive and negative pole and signal wire in reverse which would damage the signal input port.

(6)R_{AO} is address signal output protection resistor for preventing electric plug, positive and negative pole and signal wire in reverse

which would damage the signal output port.

(7)R_R, R_G, R_B, R_W is divider resistor for OUTR/G/B/W for reducing the OUTR/G/B/W voltage and the power consumption. The value is given by: $R_R/R_G/R_B/R_W = \frac{VCC - N * V_{LED} - V_{DS}}{I_{LED}}$, VCC is input voltage, V_{LED} is LED conduction voltage drop, I_{LED} is output current, V_{DS} is OUTR/G/B/W voltage which is constant output on 1V. Consider voltage loss in actual application, OUTR/G/B/W voltage should be considered to guarantee constant current output. Recommend to design OUTR/G/B/W voltage (V_{DS}) as 3.0V. Concrete will be subject to actual application. Different LED color pressure drop, reference as follows. Red: 2.2V, green, blue and white: 3.2V, concrete will be subject to actual specification.

In typical application, according to different input voltage, different number of beads, the parameters of corresponding recommended values as follow (Default REXT: floating).

voltage V_{IN}	LED cascaded in OUTR/G/B/W (piece)	R_D(Ω)	C_D(nF)	R_A(Ω)	R_B(Ω)	R_{AI}(Ω)	R_{AO}(Ω)	R_R(Ω)	R_G(Ω)	R_B(Ω)	R_W(Ω)
12V	3	1K	100	10K	10K	510	510	150	-	-	-
24V	6	3K	100	10K	10K	510	510	510	150	150	150

2、SM18512P+SM15133E Typical Combination Application Circuit

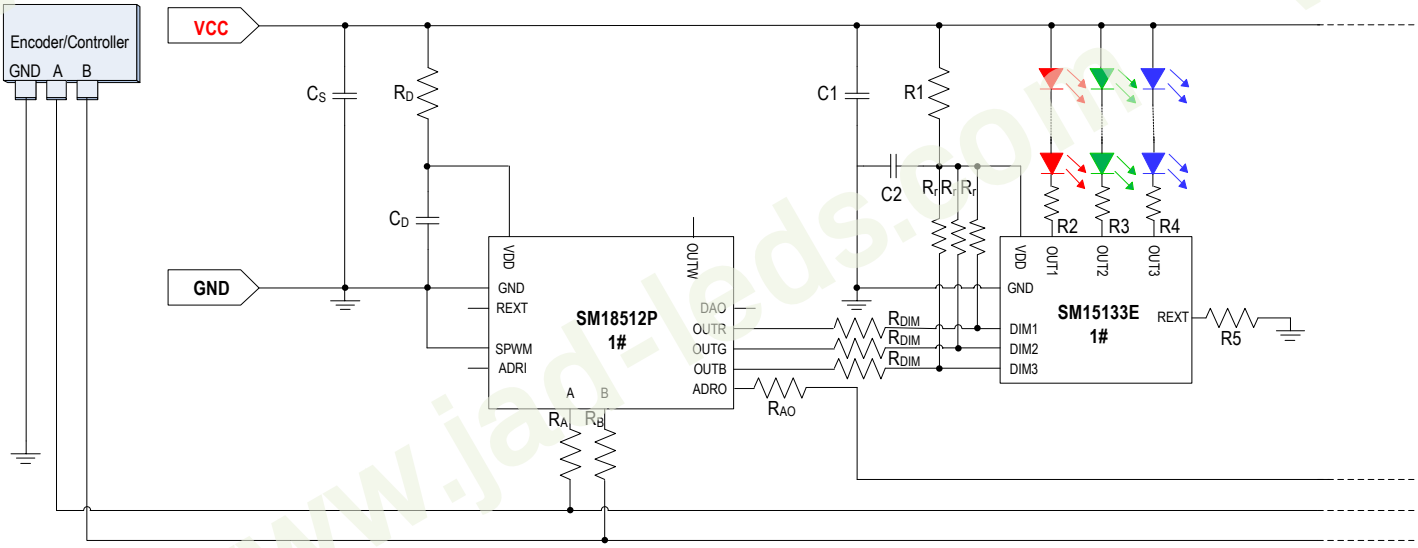


Fig. SM18512P+SM15133E Combination application diagram

Description:

(1) The above current-extending application, SM18512P is mainly used for control chip.

(2) Low voltage linear constant current application, simple peripheral circuit, high production efficiency, low cost, good EMC test;

(3) Differential RS485 bus transmission, strong anti-interference capability and far transmission distance.

(4) In the diagram above, maximum single channel current of SM15133E is 150mA, with OTP function.

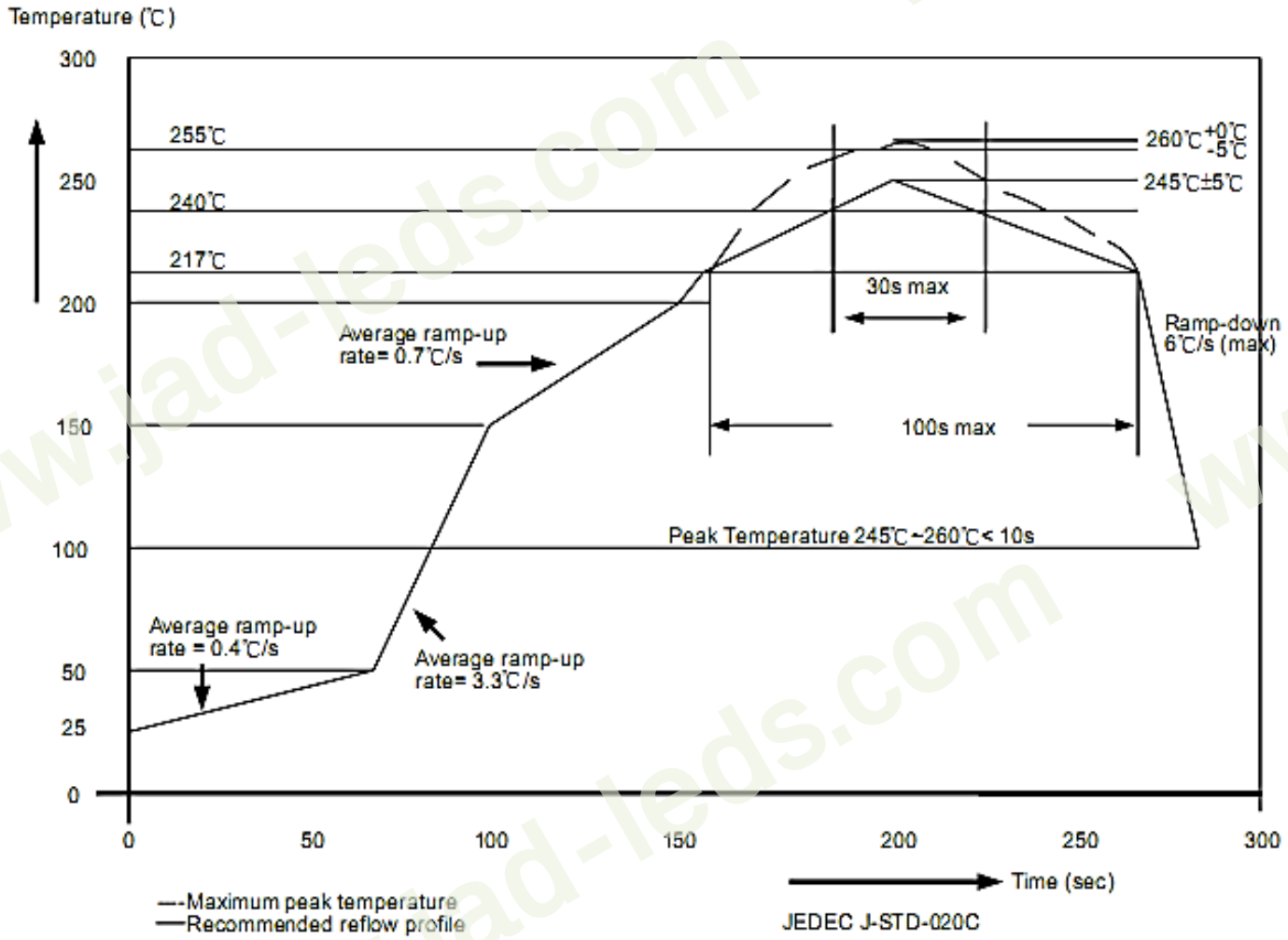
(5) Value of SM15133E peripheral device in this application refers to datasheet of corresponding chip.

(6) When driving high-power chips, a 5.1K pull-up resistor needs to be added to the OUT port.

Note: the relative component parameters can refer to the previous circuit.

Encapsulation Soldering Process

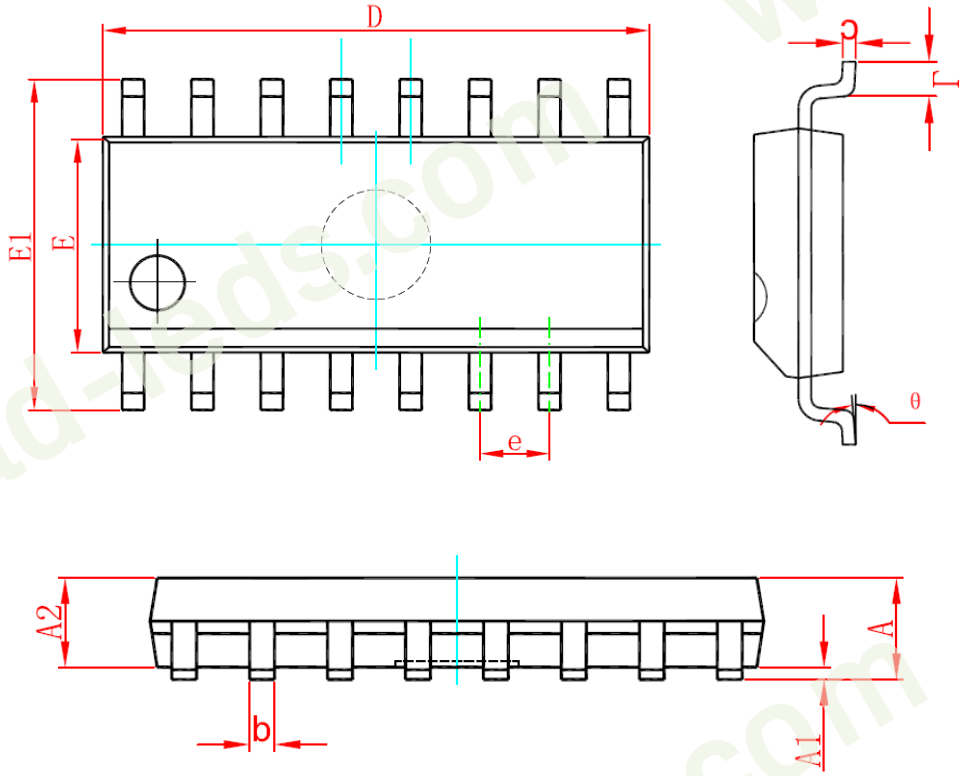
Semiconductors of Sunmoon follow the European RoHs standard, solder temperature in encapsulation soldering process follows J-STD-020 standard.



Encapsulation Thickness	Volume mm^3 < 350	Volume mm^3：350~2000	Volume mm^3 ≥ 2000
<1.6mm	260+0°C	260+0°C	260+0°C
1.6mm~2.5mm	260+0°C	250+0°C	245+0°C
≥2.5mm	250+0°C	245+0°C	245+0°C

Package

SOP16



Symbol	Min(mm)	Max(mm)
A	-	1.95
A1	-	0.25
A2	1.25	-
b	0.25	0.7
c	0.1	0.35
D	9.7	10.4
E	3.7	4.2
E1	5.7	6.4
e	1.27(BSC)	
L	0.2	1.5
θ	0°	10°

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