深圳君略科技有限公司
Shenzhen Genesis Technology Co,.Ltd

GS8802

RDM-4 Channel LED Constant Current Driver Chip

Product Description

GS8802 is a 4-channel LED constant current driver chip with parallel RDM differential signal transmission. GS8802 includes four constant current output terminals with open drain, built-in grayscale pulse modulation, input supply range of 7V-36V, and can withstand 40V port voltage. Connect the REXT pin of GS8802 to one end of an external resistor, and then connect the other end of the resistor to GND to set the size of the channel current, with a range of 8-240mA. The chip is equipped with a 16 bit GAMMA correction module and provides a channel current update offset processing method that can reduce electromagnetic interference and supply clutter. GS8802 uses standard RDM encoding as the signal transmission method, and the chip can provide real-time feedback on the open circuit, short circuit status, power supply voltage, and over temperature status of the RGBW channel. At the same time, it is compatible with standard DMX512 signals, with a transmission frequency range of 200kHz-500kHz, and has automatic decoding function. The chip has built-in EEPROM, supports online addressing, and has supply on and supply off protection functions, thereby enhancing the service life of the chip. GS8802 offers ESOP16, SOP16, and SSOP10 packaging forms, with a working environment temperature range of -40 °C to+85 °C.

Applications

- LED floodlight/wall wash light/line light/point light source/soft light strip
- LED decorative lighting/lighting engineering/stage lighting

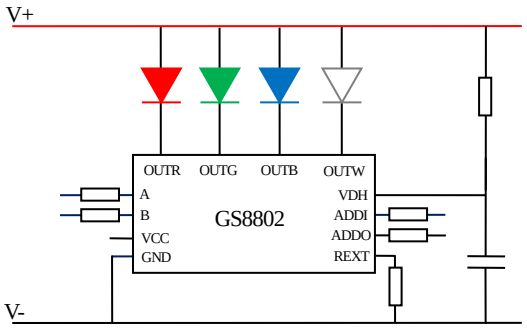
Features

- Chip built-in 7805, operating voltage: 7V-36V
- Channel current: 8-240mA
- Support W channel 3x current mode
- Support independent adjustment of channel current for software 6bits
- No signal state: Keep the last frame/LED on/off
- Standard RDM encoding, data frequency 200k-500kHz
- Real time feedback of LED output status, chip over temperature detection, and power supply voltage characteristics
- Data transmission of 8 bits, internal GAMMA correction of 16 bits, GAMMA2.2，Grayscale 65536 levels
- Built in PWM regulation technology, with a maximum refresh rate of 31kHz
- Grayscale smoothing function, achieving low gray display without jitter
- Automatic addressing, no need for manual addressing operation
- Support HDR dynamic display
- Supports PWM minimum/maximum refresh rate, minimum pulse width, and maximum duty cycle adjustment
- Support reverse PWM output
- ESD：4kV

Device Information

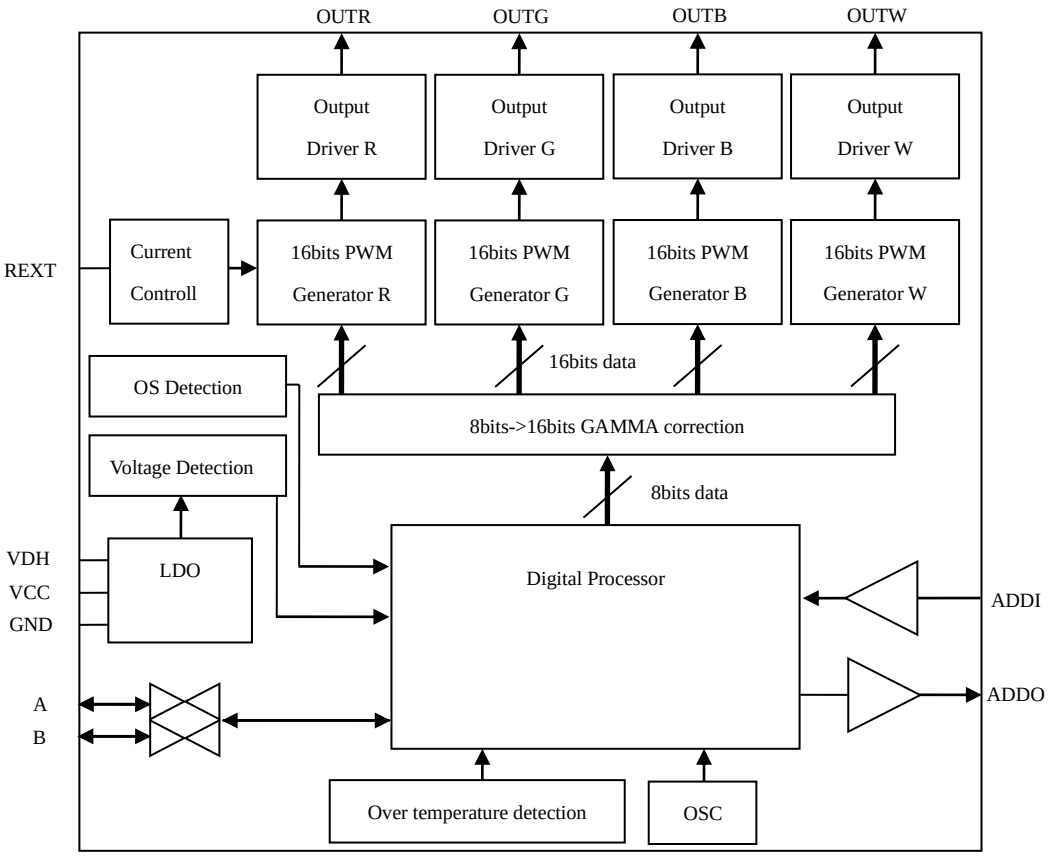
Part Number	Package	Body Size (Nom)
GS8802	ESOP16	9.90mm x 3.90mm
	SOP16	9.90mm x 3.90mm
	SSOP10	4.90mm x 3.90mm

Typical Application Diagram



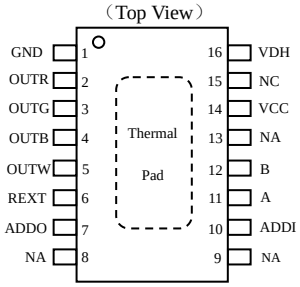
For quotation, delivery time, and ordering information, please email to shirley@genesis-systech.com

Functional Block Diagram



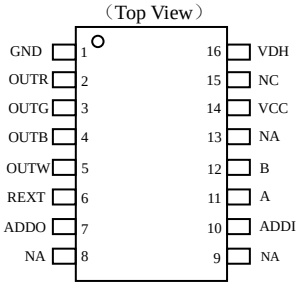
Pin Diagram

GS8802
（Top View）



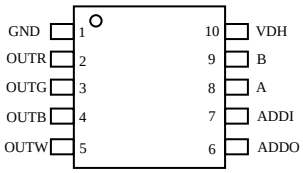
ESOP16

GS8802S
（Top View）



SOP16

GS8802S
（Top View）



SSOP10

Pin Description

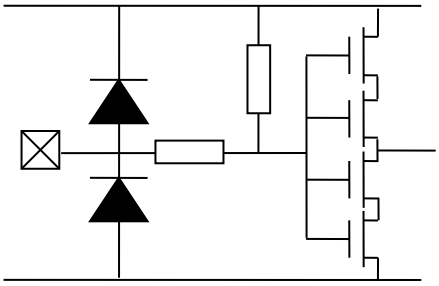
Pin				Type	Describe
Name	**ESOP16**	**SOP16**	**SSOP10**		
GND	1	1	1	G	Chip ground
OUTR～OUTW	2,3,4,5	2,3,4,5	2,3,4,5	O	Constant current output terminal
REXT	6	6	-	I	LED current setting terminal
ADDO	7	7	6	O	Address output terminal
NA	8,9	8,9	-	-	Empty foot position
ADDI	10	10	7	I	Address input terminal
A、B	11,12	11,12	8,9	I/O	Differential signal terminal
NA	13	13	-	-	Empty foot position
VCC	14	14	-	P	Not connected
NC	15	15	-	-	Not connected
VDH	16	16	10	P	Chip supply
Thermal Pad	-	-	-	-	Heat sink, can be connected to GND (ESOP16 only)

Chip Selection

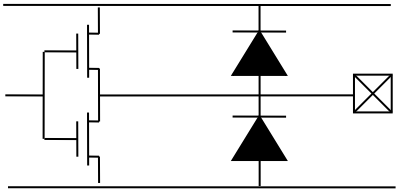
Device model	Current range	Current level	Package	Factory settings
GS8802	8-240mA	Level 64	ESOP16	Built in current output mode Current level: 16 levels Channel current: 18mA
GS8802S	8-72mA	Level 64	SOP16	
	8-27mA	Level 24	SSOP10	

Input-Output Equivalent Circuit

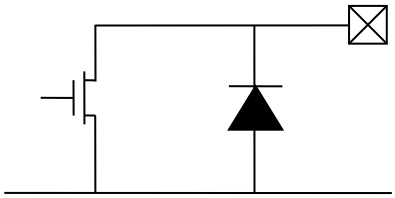
1 ADDI



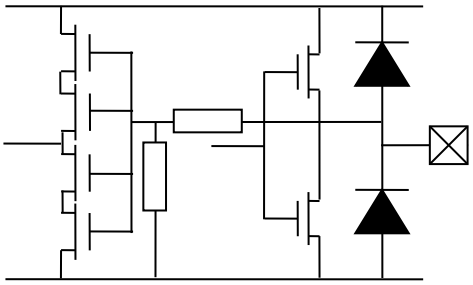
2 ADDO



3 OUTR/OUTG/OUTB/OUTW



4 A/B



Absolute Maximum Rating

Characteristic		Symbol	Maximum rated value range	Unit
Supply voltage		V_{DH}	-0.4～40	V
Internal power supply voltage		V_{CC}	-0.4～6	V
Input logic voltage		V_{IN}	-0.5～V_{CC}+0.5	V
Input logic voltage 2		$V_{A/B}$	-12～+15	V
Output terminal withstand voltage		V_{DS}	40	V
Maximum current at output end		I_{OUT}	240	mA
Ground terminal current		I_{GND}	1	A
Rated power consumption	ESOP16	P_D	1.4	W
	SOP16		0.6	
	SSOP10		0.4	
Connected to environmental thermal resistance	ESOP16	$R_{\theta JA}$	39.2	℃/W
	SOP16		90	
	SSOP10		125	
Junction temperature		T_{J-MAX}	140	℃
Operation temperature		T_{OPR}	-40～+85	℃
Storage temperature		T_{STG}	-55～+150	℃
ESD		HBM	4000	V

(1) All voltage values are based on the ground terminal as a reference point.

(2) Operating beyond the absolute maximum rated value may cause permanent damage to the device. It should be noted that the absolute maximum rated value does not mean that the device can operate normally under these conditions or other recommended operating conditions. If the device is briefly operated outside the recommended operating conditions but still within the absolute maximum rated range, it may not be damaged, but it may not fully function properly. Running the device in this way may affect its reliability, functionality, and performance, and shorten its lifespan.

(3) The R θ JC data was measured on a single-layer FR4 test plate according to the JEDEC JESD51 thermal measurement standard. The heat dissipation performance is closely related to the size of the heat sink, the thickness and number of layers of the PCB. The measured thermal resistance value may differ from the simulated value, so users should choose appropriate packaging and PCB layout to achieve the best heat dissipation effect.

Electrical Characteristics (VDH=24V,Ta=25℃)

Characteristic		Symbol	Measurement conditions	Min	Typ	Max	Unit
Supply voltage		V_{DH}	-	7	24	36	V
Internal power supply voltage		V_{CC}	-	-	5.5	-	V
Logic high input voltage		V_{IH}	-	0.7*V_{CC}	-	V_{CC}	V
Logic low input voltage		V_{IL}	-	0	-	0.3*V_{CC}	V
Differential signal common mode range		V_{CM}	V_{DM}=200mV	-7	-	12	V
Differential signal differential mode range		V_{DM}	-	200	-	-	mV
LED open circuit detection voltage value		V_{OSTH}	-	0.2	-	0.5	V
Output terminal (OUT) voltage range * 4		V_{DS}	-	-	1.2	40	V
Output terminal (OUT) leakage current * 4		I_{OH}	Channel fully closed V_{DH}=40V OUTx=40V	-	-	1	μA
static current		I_{chip}	V_{DH}=24V	-	7.8	-	mA
			V_{DH}=12V	-	6.8	-	
External current	ESOP16	I_{OUT}	V_{DH}=24V	8	-	240	mA
	SOP16			8	-	72	
Built-in current	ESOP16	I_{INT}	V_{DH}=24V R_{EXT}= dangling	8	18	72	mA
	SOP16			8	18	72	
	SSOP10			8	18	27	
Power consumption	ESOP16	P_D	-	-	-	1.2	W
	SOP16		-	-	-	480	mW
	SSOP10		-	-	-	250	mW
Current offset (between channels)		dI_{OUT1}	I_{OUT}=18mA V_{OUT}=1.2V	-	±1.5%	±3%	%
Current offset (between chips)		dI_{OUT2}		-	±3%	±5%	%
Current offset vs. output voltage		%/dV_{DS}	V_{DS}=1V-3V		±0.1%	±0.3%	%/V
Current offset vs. power supply voltage		%/dV_{DH}	V_{DH}=12V-24V	-	±0.1%	±0.3%	%/V

*1 The formula for the channel-to-channel current offset is defined as follows：

$$\triangle(\%) = \left[\frac{Iout_n}{\frac{(Iout_0 + Iout_1 + Iout_2 + Iout_3)}{4}} - 1\right] * 100\%$$

*2 The formula for chip-to-chip current offset is defined as follows:

$$\triangle(\%) = \left[\frac{\frac{(Iout_0 + Iout_1 + Iout_2 + Iout_3)}{4} - (Ideal\ Output\ Current)}{(Ideal\ Output\ Current)}\right] * 100\%$$

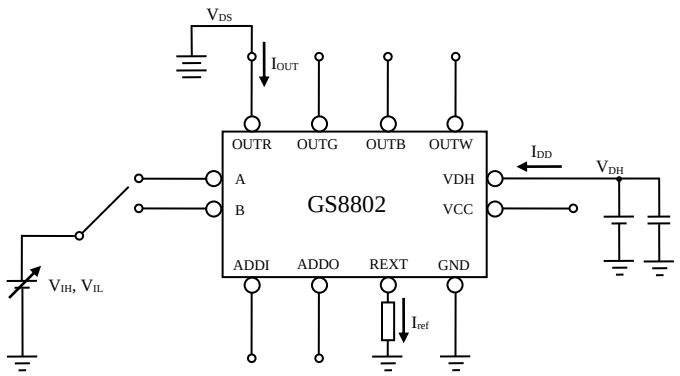
*3 The offset formula for the output current to the change in the supply voltage is defined as follows:

$$\triangle(\%/\mathrm{V}) = \left[\frac{Iout_n(@V_{DH} = 24V) - Iout_n(@V_{DH} = 20V)}{Iout_n(@V_{DD} = 20V)}\right] * \frac{100\%}{24V - 20V}$$

*4 The formula for the offset of the output current from the change in the output voltage is defined as follows:

$$\triangle(\%/\mathrm{V}) = \left[\frac{Iout_n(@Vout_n = 3V) - Iout_n(@Vout_n = 1V)}{Iout_n(@Vout_n = 3V)}\right] * \frac{100\%}{3V - 1V}$$

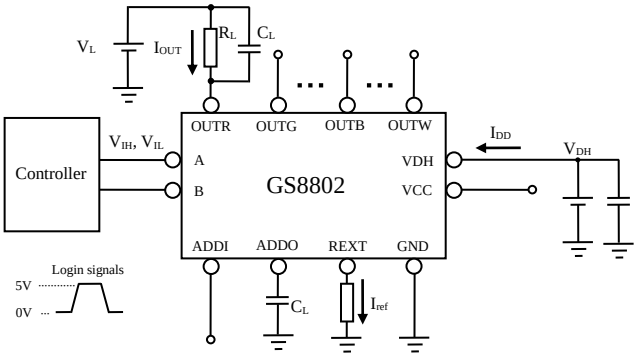
Testing Circuit For DC Characteristics



Communication Characteristics (VDH=24V,Ta=25℃)

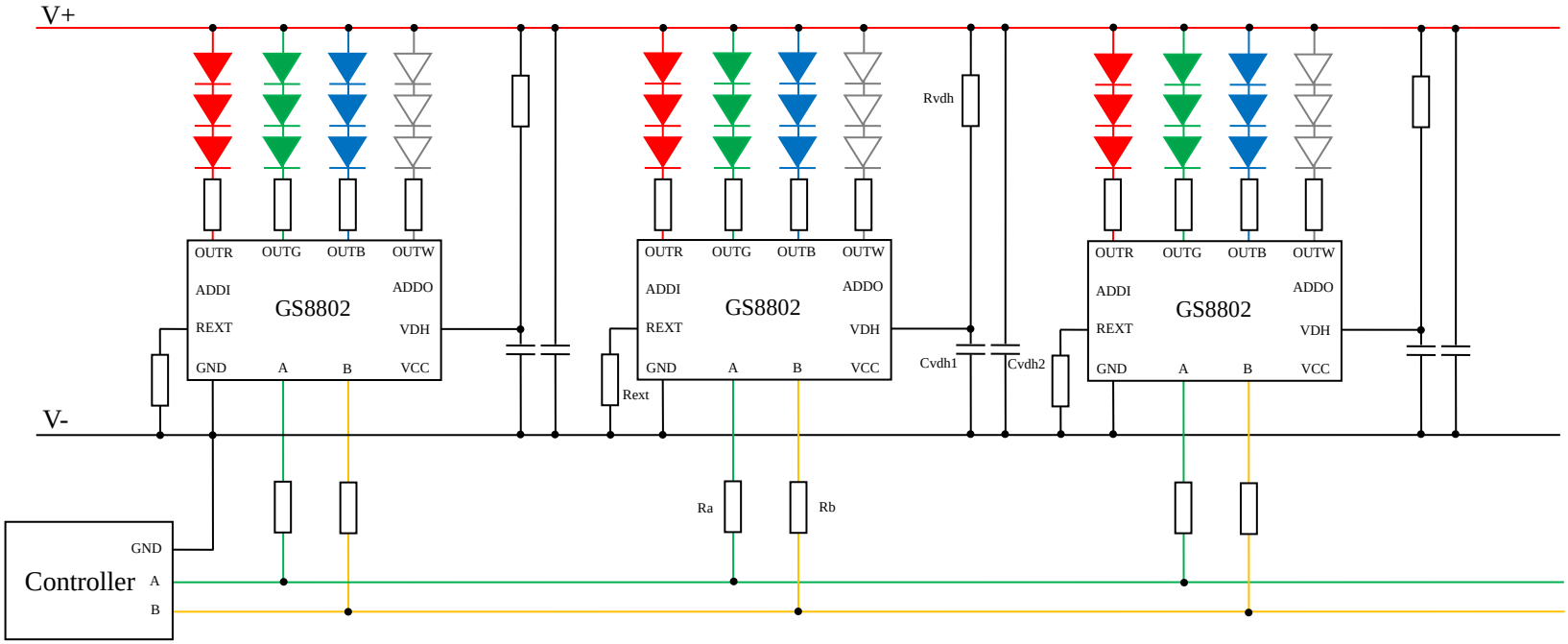
Characteristic	Symbol	Measurement conditions	Min.	Typ.	Max.	单位
Built in oscillator frequency	F_{OSC}			16		MHz
PWM refresh rate	F_{REQ1}		0.24	7.8	31	kHz
Data refresh rate	F_{REQ2}	V_{DH}=24V		30	1017	Hz
Screen update delay	t_{SUD}	V_{DS}=1V		NA		us
Channel output delay time	t_{COD}	V_{IH}=5V		200		ns
Current output terminal potential ramp time	t_{OR}	V_{IL}=0V R_{EXT}=14K		100		ns
Current output terminal potential drop time	t_{OF}	V_L=4V R_L=150Ω		100		ns
Minimum pulse width of current output	t_W	C_L=10pF		125		ns
Parallel data frequency	F_{DATA}		200	250	500	kHz

Test Circuit For Communication Characteristics



Typical Application Scheme (UID addressing mode)

The UID addressing mode does not require address lines. The controller uses the discovery instruction of the RDM protocol for addressing and assigns different address codes to each UID.

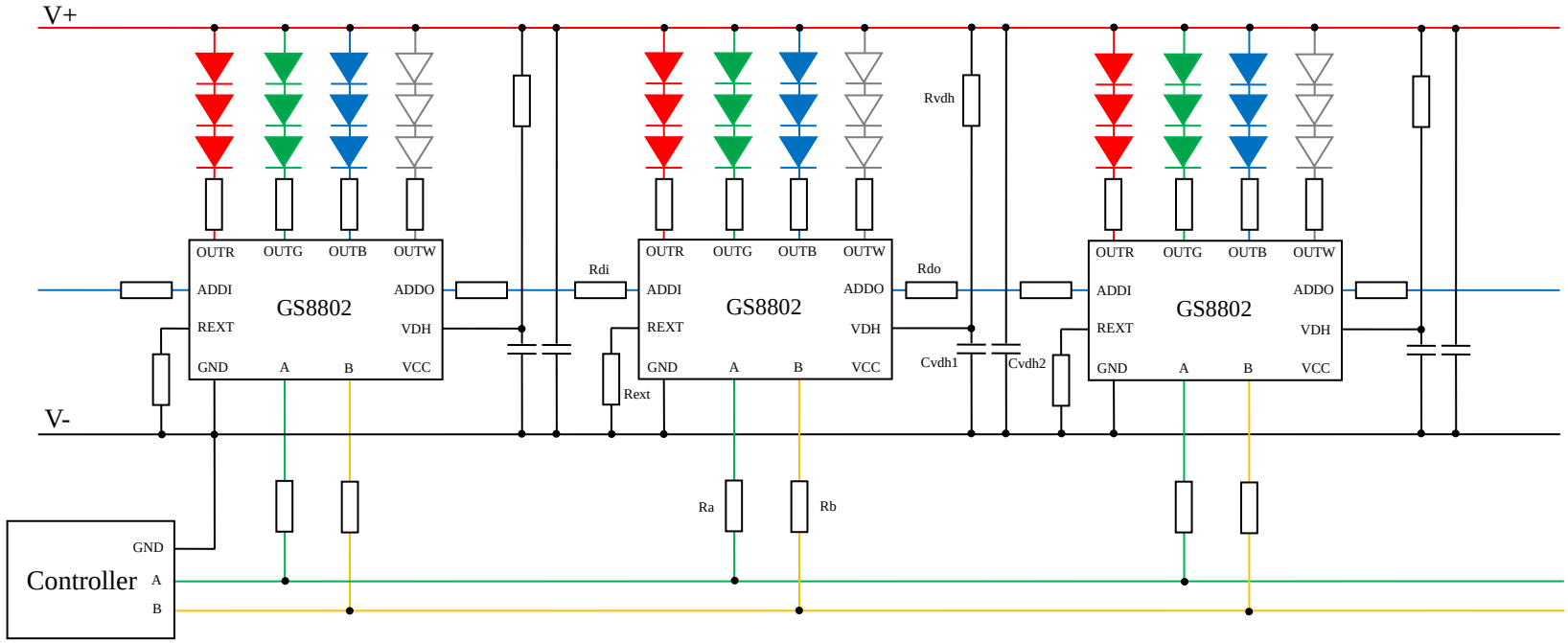


Component selection table:

Item	Rvdh	Ra	Rb	Cvdh1	Cvdh2
12V	100Ω	100Ω/220Ω	100Ω/220Ω	100nF(104)	100nF(104)
24V	430Ω	100Ω/220Ω	100Ω/220Ω	100nF(104)	100nF(104)

Typical Application Scheme (DMX512 code writing mode)

The DMX512 code writing mode requires connecting the address ports of all driver chips in series and encoding the addresses at once through instructions.

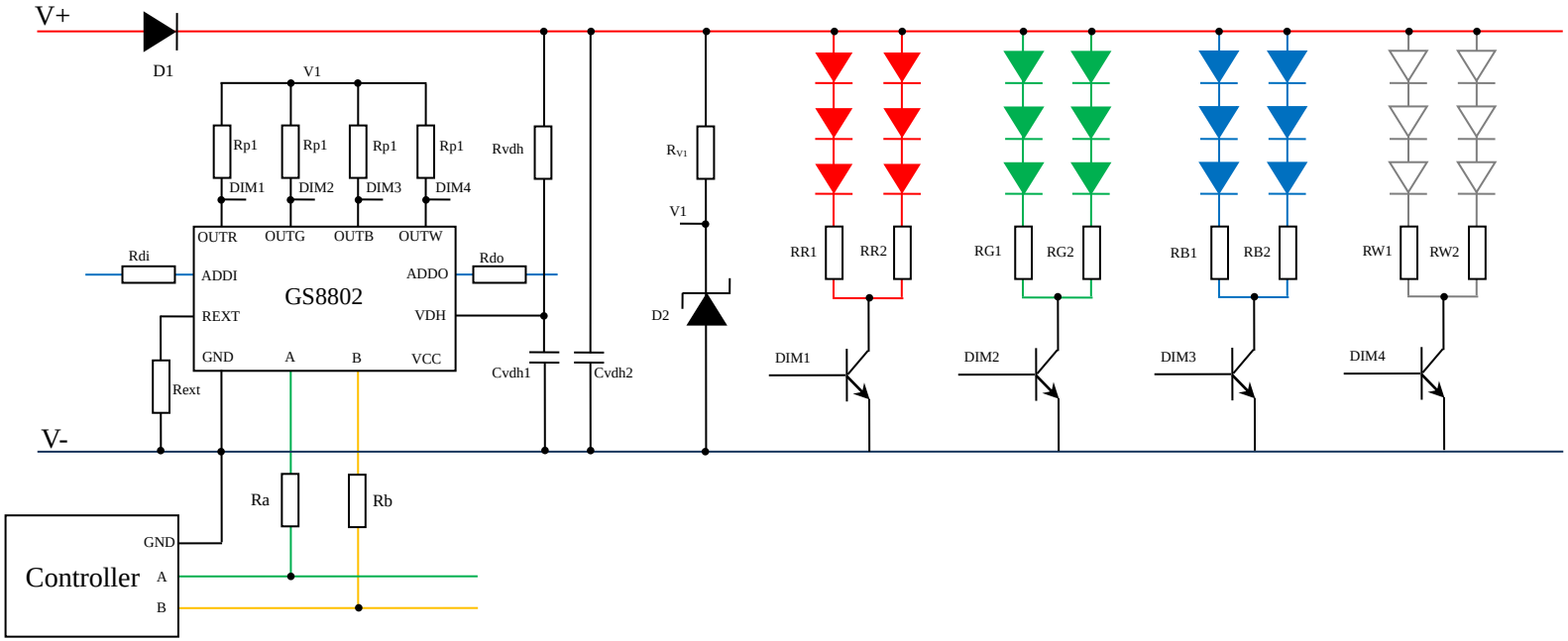


Component selection table:

Item	Rvdh	Rdi	Rdo	Ra	Rb	Cvdh1	Cvdh2
12V	100Ω	510Ω	510Ω	100Ω/220Ω	100Ω/220Ω	100nF(104)	100nF(104)
24V	430Ω	510Ω	510Ω	100Ω/220Ω	100Ω/220Ω	100nF(104)	100nF(104)

Typical Application Solution (external NPN)

In practical applications, when the GS8802 chip employs an external current expansion or reverse PWM drive scheme, the output current of the OUT terminal will no longer be determined by the resistance of the REXT terminal. Therefore, it is recommended to default to a 14kΩ resistor as the standard configuration.

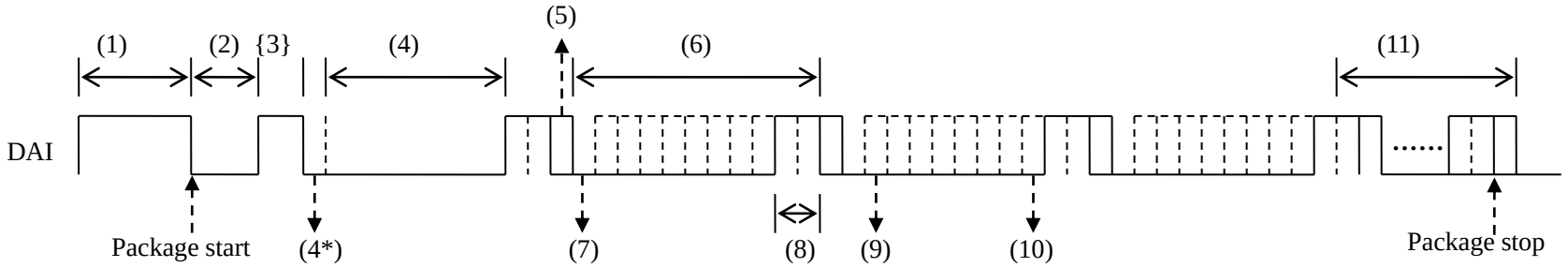


***Note:**

1. When the GS8802 is used in systems with low-power point light sources and linear lights, a 100Ω protection resistor should be selected for the A/B signal terminals.
2. When the GS8802 is used in systems with high-power floodlights and wall washer lights, a 220Ω protection resistor should be selected for the A/B signal terminals.

RDM Parallel Transmission Extension Protocol (compatible with standard protocols)

The GS8802 series adopts the standard RDM protocol, compatible with the USITT DMX512-A protocol, and implements functions such as automatic addressing, chip query, working status feedback, and display data transmission on this basis. The transmission speed is 200k-500kHz, and the length can be infinitely cascaded.



Grade	Description	Controller timing		Responder timing	
		Receive	Transmit	**Receive**	**Transmit**
(1)	Signal before reset (MBB)	0us-1s		(1)	Signal before reset (MBB)
(2)	Reset signal (BREAK)	88us-352us	176us-352us	(2)	Reset signal (BREAK)
(3)	Marking after reset (MAB)	8us-88us	12us-88us	(3)	Marking after reset (MAB)
(4)	Start byte （0/SC_RDM）	32us	32us	(4)	Start byte （0/SC_RDM）
(4*)	Start code (field AAH data)	4us	4us	(4*)	Start code (field AAH data)
(5)	Idleness between fields (inter-slot time)	0-2.1ms	0-2ms	(5)	Idleness between fields (inter-slot time)
(6)	Data/Start Code (sub_SC_RDM)	32us	32us	(6)	Data/Start Code (sub_SC_RDM)
(6*)	field (SLOT)	44us	44us(max_ave 76us)	(6*)	field (SLOT)
(7)	Start bit	4us	4us	(7)	Start bit
(8)	Stop bit	8us	8us	(8)	Stop bit
(9)	Lowest data bits	4us	4us	(9)	Lowest data bits
(10)	Highest data bits	4us	4us	(10)	Highest data bits
(11)	The number of fields in the data chain	There is no limit	There is no limit	(11)	The number of fields in the data chain
(12)	Total packet time(max)	NA	440us+n*44us+(n-1)*76us	(12)	Total packet time(max)

RDM Data Communication Protocol

1.DMX512 - Data Frame

When start code=0, DMX512 display data is transmitted on the data bus. In this mode, the channel is in simplex communication mode, and the controller transmits display data unidirectionally to GS8802, supporting unlimited display expansion.

2. RDM control frame

When the start code is SC_RDM, RDM command data is transmitted on the data bus. In this mode, the channel is a half-duplex communication mode, and both the controller and the GS8802 can send information to and receive data to the data bus.

The data frame structure is as follows:

Slot#	description	value	remark
0	Start code	0xCC	SC_RDM
1	Sub-start code	0X01	SC_SUB_MESSAGE，RDM reserved bits
2	Massage length	25	The length of data from slot0 to slot24, rang 24-255
3-8	Destination UID		High 16bits enterprise code, low 32bits hardware code
9-14	Source UID		
15	Transaction number(TN)	0	Receive/feedback frame checksum, controller +1,255->0 per frame, responder replies the same value every frame
16	Port ID/response type		Controller/responder Feedback status
17	Message count	0	Response
18-19	Sub-device	0	Root device=0，All=0xffff
20	Command class(CC)		
21-22	Parameter ID(PID)		
23	Parameter data length(PDL）		Slot of PD，range 0-231，0 be PD=0
24	Parameter data(PD)		Frame data
25	Checksum high		
26	Checksum low		

RDM Instruction Set

The standard RDM transmission system is a half-duplex structure consisting of standard DMX512 (SC_0) frames and six RDM-specific data frames (SC_RDM). Among them, SC_0 frames are used to transmit normal display data and are compatible with the existing DMX512 operating system, while SC_RDM frames are used to execute configuration commands and feedback chip information.

The standard SC_RDM frame contains,

●SET_COMMAND/SET_COMMAND_RESPONSE

SET_COMMAND the controller sends a setting command to the device, when the device receives the command, it sends feedback information based on the execution of the command SET_COMMAND_RESPONSE.

●GET_COMMAND/GET_COMMAND_RESPONSE

The controller must send GET_COMMAND to a UID, and the device corresponding to the UID will start sending GET_COMMAND_RESPONSE instructions after receiving the command.

●DISCOVERY_COMMAND/DISCOVERY_COMMAND_RESPONSE

The controller sends a search DISCOVERY_COMMAND command to the device to confirm the online device, and after the device receives the command, it selects whether to send the DISCOVERY _COMMAND_RESPONSE based on the actual situation.

Manufacturer Label/Device Label

In the RDM system, manufacturers can indicate the manufacturer information through the manufacturer label, and the luminaire information through the device label, and let this information be read by the customer in the RDM system.

The GS8802 supports the writing of manufacturer labels and device labels, with 16 ASCII characters each. The system can set and obtain the manufacturer/device label by sending GET/SET MANUFACTURER_LABEL and DEVICE_LABEL commands to the device.

No Signal Shows Status

If GS8802 fails to receive the correct RDM signal for more than 2 seconds, the chip will enter a no signal display state. The no signal display status can be set by the controller, and you can choose one of three modes: keep the last frame displayed, and turn on/off the lights after power on display.

In the off light state, GS8802 will turn off the LED output channel current and maintain the last frame state to maintain the existing LED drive current output. By setting the 8-bit display data of the chip's RGBW channel, any grayscale combination can be obtained to meet the power on and lighting requirements during engineering installation.

Chip Field Mode

The fields of GS8802 are set by the controller through parameter writing. Through different field setting methods, the chip can achieve normal RGB or RGBW display, and multiple constant current output interfaces can be connected in parallel to expand the current driving ability, making it convenient for customer engineering to flexibly choose. Through field selection, GS8802 can achieve a constant current output of up to 960mA, with a factory default setting of 4 field mode.

Mode	Channel Selection
1 field	Intercept 1 field, corresponding to RGBW
2 field	Intercept 2 fields, corresponding to RG and BW
3 field	Intercept 3 fields, corresponding to R, G, and B
4 field	Intercept 4 fields, corresponding to R, G, B, and W

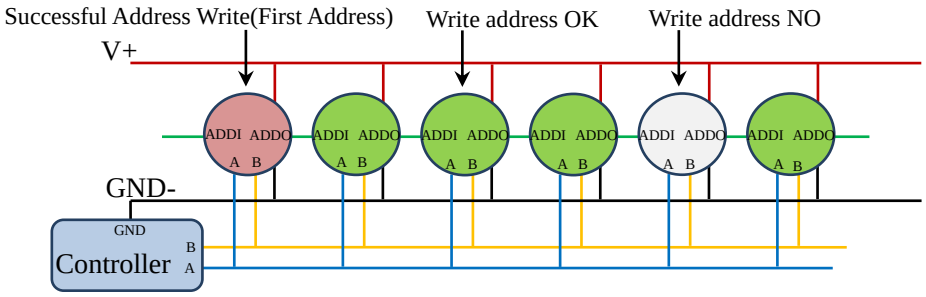
DMX512 Address Initialization

GS8802 sends an address initialization command to the AB port of the chip through the parallel port data line, and the ADDI address line of the first chip is suspended, and the address line connection between the chips must be normal, as shown in the following figure. After the address is successfully written, the chip with the first address will be bright red, the other chips will be bright cyan, and the chip with unsuccessful address writing will turn off.

Installation and debugging mode: The debugging function of the chip will calculate the chip address in real time, making it convenient for installation personnel to troubleshoot address line errors and omissions on site, and finally complete the code writing operation in one go.

Maintenance mode: The maintenance personnel need to confirm the first IC address of the replaced light string and input it to the controller, and then follow the initialization steps to write codes for a single string or single light..

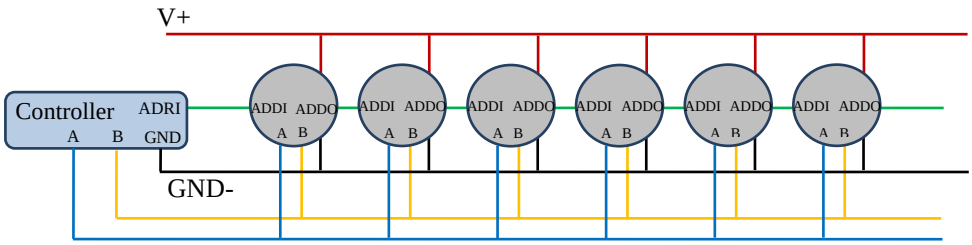
Easy maintenance mode: If the previous chip of the faulty light is working properly and the ADDO output is normal, the maintenance personnel can use the controller to reset the address of a single light or a single string light, and directly replace the damaged light. At this point, there is no need to perform a write address operation, and the chip will automatically read the address from the previous chip and work.



Automatic Coding

After enabling the automatic code writing mode, the chip will automatically complete the code writing based on the serial sequence of address lines, without the need for manual code writing operations. This feature can reduce the engineering installation and coding steps of RDM lighting fixtures, achieving a simple installation mode similar to serial drive products, greatly improving the efficiency of engineering installation and debugging. At the same time, there is no need to confirm the address code and write the code when replacing faulty lighting fixtures in the engineering after-sales service. The lighting fixtures can automatically recognize and complete the code writing steps, effectively reducing after-sales maintenance costs.

In automatic code writing mode, the first chip must connect the address line ADDI to the controller ADRI/PO+port, or solve the problem of automatically obtaining the first chip address by customizing a special light board (placed in front of the first chip during engineering installation). The maximum length of the address line between the controller ADRI/PO+port/special light board and the first chip is 50 meters.



- Engineering installation, debugging, and after-sales maintenance in automatic coding mode

1. After the installation of the project, the controller sends the overall jump/gradient display effect to troubleshoot the display fault point.
2. Identify abnormal fault points in the address through the dynamic effect of lighting up one by one. When a malfunction is detected, there is no need to stop the display or cut off the power, and a new light fixture can be replaced directly.
3. The lighting fixtures on the construction site may have defects after long-term operation and require maintenance. At this point, simply replace the defective lighting equipment with a new one, without the need to rewrite the address code or cut off the power, making the operation simple.

Internal/External Current Modes and Current Regulation

GS8802 can be configured with built-in current output mode through software. In this mode, the REXT port of the chip does not require an external resistor. In the built-in current mode, the maximum output current of each channel of the chip is 72mA (NO.64), and the factory default setting is 18mA output (NO.16). This chip supports 6bits software to adjust the current output ratio, with an output range of 1.56% to 100%, and has parameter storage function after power failure.

The GS8802 external current mode connects an external resistor to ground (GND) through the REXT port of the chip to set the current output value, ranging from 8 to 240mA. This mode provides a software adjustment function of 6 bits, allowing for independent setting of the current output ratio for a single channel. The current regulation process will not affect the grayscale display, and the set current parameters will be stored inside the chip.

In the built-in or external current mode, the minimum current output by the channel cannot be lower than 8mA through 6bits software adjustment. The following is the correspondence between the 6bits current regulation bit and the channel current output:

NO.	Iout	NO.	Iout	NO.	Iout	NO.	Iout
1	1.56%	17	26.56%	33	51.56%	49	76.56%
2	3.13%	18	28.13%	34	53.13%	50	78.13%
3	4.69%	19	29.69%	35	54.69%	51	79.69%
4	6.25%	20	31.25%	36	56.25%	52	81.25%
5	7.81%	21	32.81%	37	57.81%	53	82.81%
6	9.38%	22	34.38%	38	59.38%	54	84.38%
7	10.94%	23	35.94%	39	60.94%	55	85.94%
8	12.50%	24	37.50%	40	62.50%	56	87.50%
9	14.06%	25	39.06%	41	64.06%	57	89.06%
10	15.63%	26	40.63%	42	65.63%	58	90.63%
11	17.19%	27	42.19%	43	67.19%	59	92.19%
12	18.75%	28	43.75%	44	68.75%	60	93.75%
13	20.31%	29	45.31%	45	70.31%	61	95.31%
14	21.88%	30	46.88%	46	71.88%	62	96.88%
15	23.44%	31	48.44%	47	73.44%	63	98.44%
16	25.00%	32	50.00%	48	75.00%	64	100.00%

Note: When using GS8802S-SSOP10, the current regulation output ratio must not exceed the specified range (NO.24), otherwise it may affect the reliability of the chip.

W-Channel 3x Current Mode

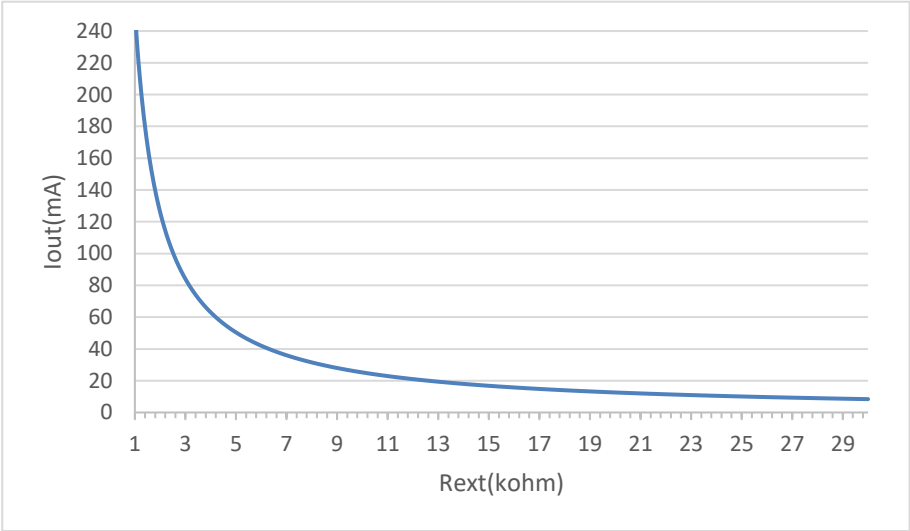
GS8802 can configure the W channel to triple current mode through the controller. By default, the current value of RGBW is set through the REXT resistor, and the output current of all channels remains consistent. When the 3x current mode of the W channel is enabled, the output current of the RGB channel remains unchanged, while the output current of the W pin will reach 3 times the set current value of the REXT resistor.

Output Current Adjustment

The constant current values of the four channels are set by external resistors. By changing this resistor value, the chip can adjust the output current within the range of 8-240mA. The current value can be calculated by the following equation. When the external resistance is 14kohm, the output current is 18mA.

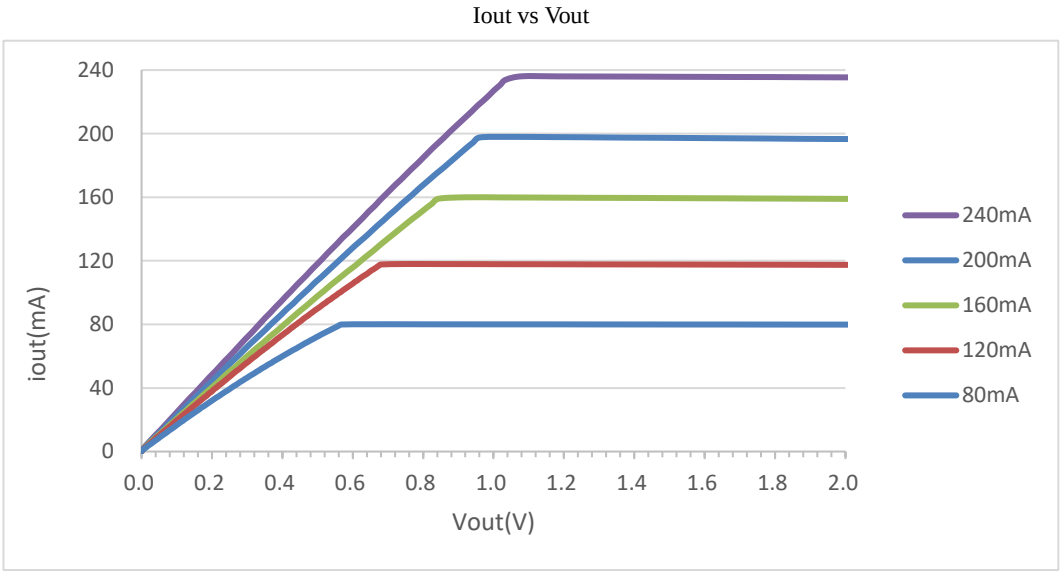
$$I_{OUT}(mA) = \frac{615(mV) * 409.6}{R_{ext}(ohm)}$$

Iout vs Rext



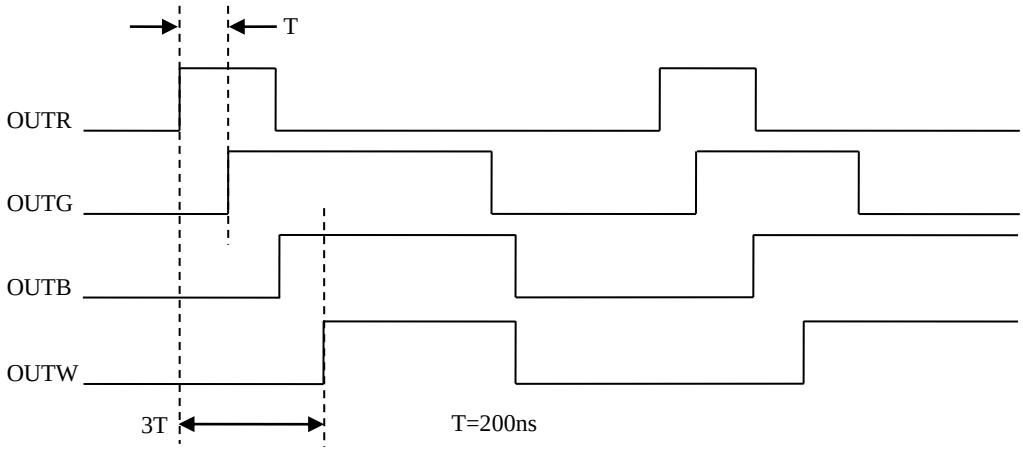
Output Current Voltage Relationship

When users apply GS8802 to LED light source drivers, the current difference between channels and chips is extremely small, which is due to the excellent characteristics of GS8802: the maximum current difference between channels is less than ± 3%, and the maximum current difference between chips is less than ± 5%.



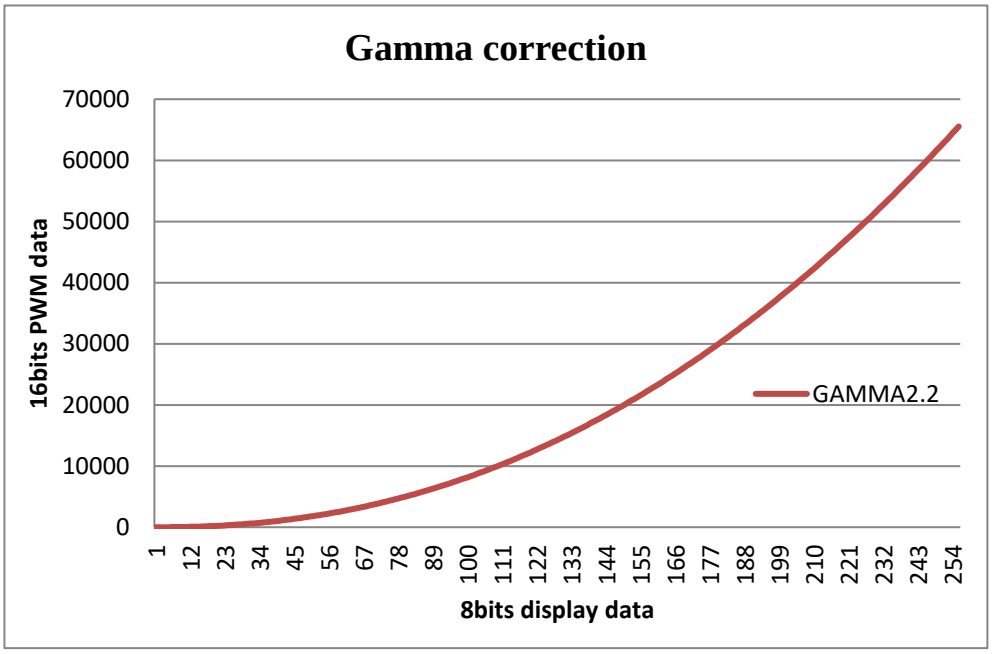
LED Channel Current Switching Mode

In order to prevent the instantaneous current caused by LED brightness switching from causing significant interference to the power supply and reduce voltage fluctuations on the power circuit, GS8802 has a built-in output hysteresis function. OUTR, OUTG, OUTB, and OUTW will output current in sequence at 200ns intervals to reduce interference with the power supply. At the same time, staggered current output can also reduce system EMI radiation and meet environmental requirements.



GAMMA Correction Technique

The chip has built-in GAMMA correction function, and the 8-bit display data is corrected to 16 bit grayscale data by the GAMMA module. The 16 bit grayscale data accurately controls the LED output current value. 16bits grayscale combined with 31kHz PWM refresh rate meets the requirements of high gray and high refresh rate.



Grayscale Smoothing Function

For high brightness LED lamps, the human visual sense of step is very obvious during low gray gradient, and the smoothness of brightness changes is poor, causing the lamp display to shake visually. Therefore, GS8802 has added a grayscale smoothing function design, which can be turned on or off through software control.

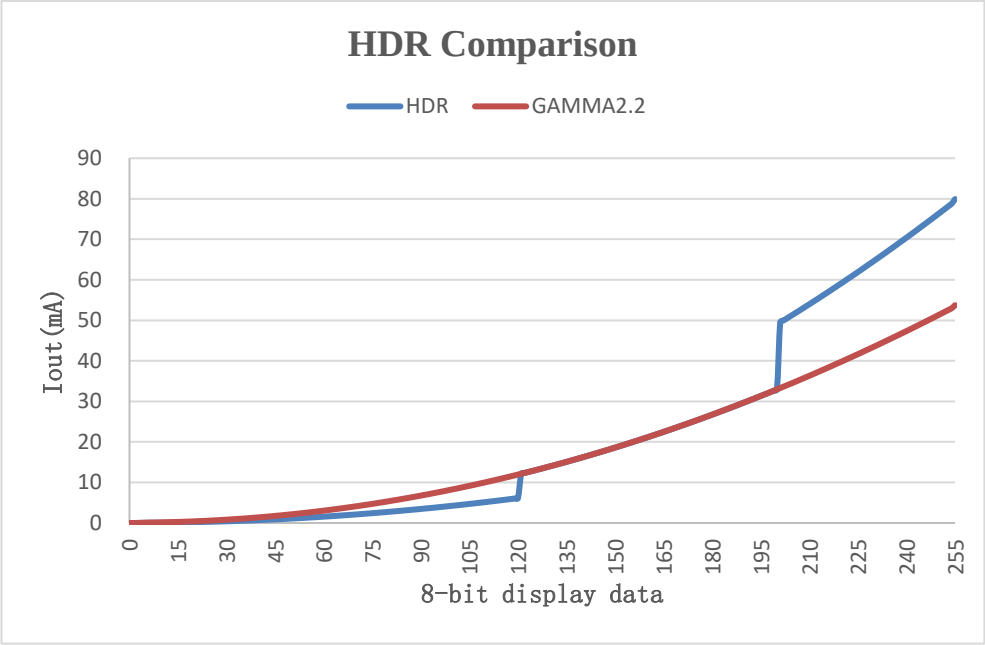
After the grayscale smoothing function is enabled, the chip will detect the length of the interval between the display data of the two frames that have changed before and after, in order to calculate the number of frames to be inserted (per frame/4ms, up to 250 frames/second can be supported). When there are consecutive frames with the same display data, or when the PWM difference between the display data of two frames before and after is too large (>128), frame interpolation is not performed.

GS8802 inserts multiple frames of display data between each level of grayscale increment to reduce the speed of grayscale changes, making LED lighting fixtures appear relatively soft when gradually turning on or off, making the transition of low gray gradients smoother and more delicate, and achieving a low gray gradient image without shaking.

HDR Dynamic Display Technology

HDR, which stands for High Dynamic Light Rendering, is a processing technique used to enhance image brightness and contrast. Compared with ordinary images, HDR can provide more dynamic range and image details, making the details in the dark areas richer and the highest brightness higher, making the entire picture look more transparent and bright.

The HDR dynamic display function of GS8802 divides the overall brightness into three levels: dark, normal display, and high brightness, to match the display of dark and highest brightness, thereby raising the gray level from 65536 to 4194304. By cutting the overall brightness of the image, HDR mode is made easier to display.

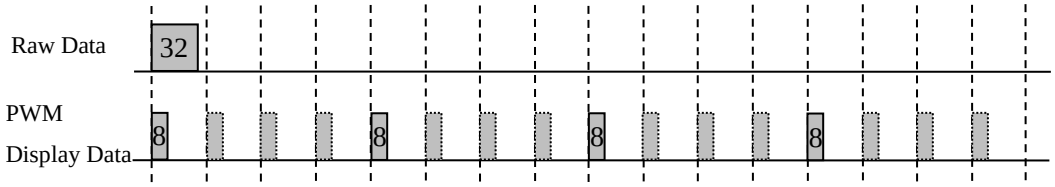


Display Control Mode

The GS8802 features multiple modes for modulating the PWM output signal. This modulation mode can be used for both forward constant current output and reverse PWM drive mode.

- MPWM

In order to improve the PWM output refresh rate, GS8802 adopts MPWM technology, a unique scattering method, which evenly distributes the period N in the display time, as shown in the following waveform. The chip display effect is soft, and the maximum PWM refresh rate can be adjusted from 240Hz to 31kHz without affecting the accuracy of the output current.



- PWM Output Modulation

In order to meet the display effect of luminaire engineering, the PWM refresh rate and output pulse width of GS8802 can be set by software, and each function does not affect each other.

In order to reduce visual jitter, the maximum PWM refresh rate and the minimum refresh rate can be adjusted, but the increase of the minimum PWM refresh rate will affect the display grayscale. The PWM output pulse width compensation function can ensure the brightness of the first level of LED, which is suitable for high-power constant current driver ICs with slow response speed.

Function	PWM refresh rate（Hz）	Grayscale is displayed (bits)	illustrate
The minimum refresh rate is adjustable	240	16	240Hz （default）
	1k	14	
	4k	12	
	8k	11	
	range（Hz）		illustrate
The maximum refresh rate is adjustable	240-7.8k-15.5k-31kHz		7.8kHz（default）
	range（ns）		illustrate
PWM output pulse width compensation	0-60-120-180…… ……1800-1860ns		180ns（default）

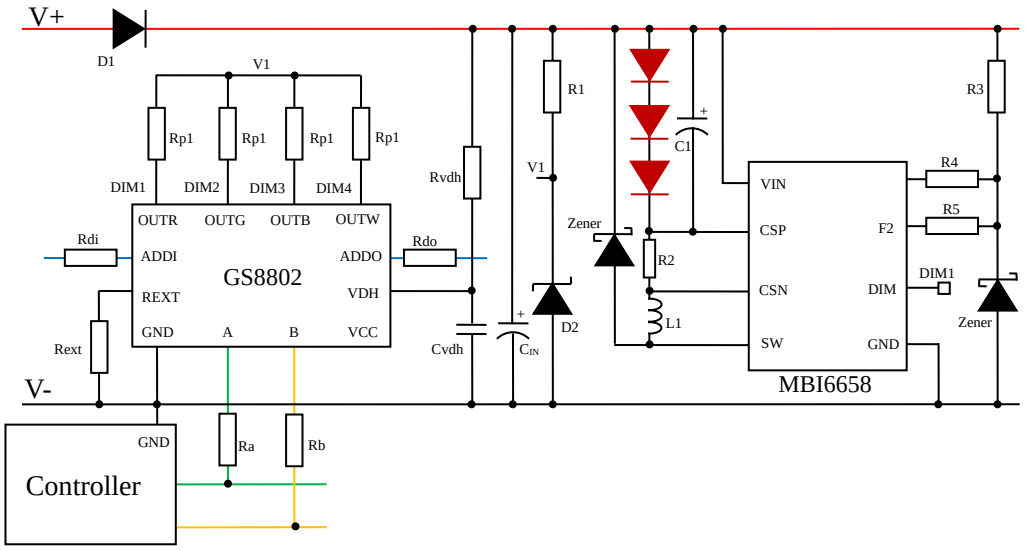
- Maximum PWM Value

This function is used for GS8802 driver amplification circuit or high-power constant current driver IC. Set the maximum open circuit duty cycle of each channel PWM through software, support 64 level parameter writing, and adjust the maximum brightness and power of the light bulb without sacrificing grayscale.

Set	Iout	Set	Iout	Set	Iout	Set	Iout
1	1.56%	17	26.56%	33	51.56%	49	76.56%
2	3.13%	18	28.13%	34	53.13%	50	78.13%
3	4.69%	19	29.69%	35	54.69%	51	79.69%
4	6.25%	20	31.25%	36	56.25%	52	81.25%
5	7.81%	21	32.81%	37	57.81%	53	82.81%
6	9.38%	22	34.38%	38	59.38%	54	84.38%
7	10.94%	23	35.94%	39	60.94%	55	85.94%
8	12.50%	24	37.50%	40	62.50%	56	87.50%
9	14.06%	25	39.06%	41	64.06%	57	89.06%
10	15.63%	26	40.63%	42	65.63%	58	90.63%
11	17.19%	27	42.19%	43	67.19%	59	92.19%
12	18.75%	28	43.75%	44	68.75%	60	93.75%
13	20.31%	29	45.31%	45	70.31%	61	95.31%
14	21.88%	30	46.88%	46	71.88%	62	96.88%
15	23.44%	31	48.44%	47	73.44%	63	98.44%
16	25.00%	32	50.00%	48	75.00%	64	100.00%

- Reverse PWM Output

GS8802 can be set to reverse PWM output drive through the controller, and the chip still supports PWM refresh rate, pulse width compensation and other functional parameter adjustments in this mode, which is suitable for the application of external high-power constant current driver IC.



Detect Interactive Features

GS8802 has built-in multiple detection functions, including power supply voltage detection, LED working status detection, and over-temperature detection.

- Voltage Detection

By sending detection instructions through the control system, the chip will provide feedback on power supply voltage information. There are a total of 64 levels of power supply voltage detection, and the corresponding relationship between detection levels and voltage is as follows.

Item	Voltage (V)	Item	Voltage (V)	Item	Voltage (V)	Item	Voltage (V)
1	6.8	17	13.4	33	20.2	49	27.1
2	7.0	18	13.8	34	20.6	50	27.5
3	7.4	19	14.2	35	21.0	51	27.9
4	7.8	20	14.6	36	21.4	52	28.3
5	8.3	21	15.1	37	21.9	53	28.8
6	8.7	22	15.5	38	22.4	54	29.2
7	9.1	23	15.9	39	22.8	55	29.6
8	9.5	24	16.3	40	23.2	56	30.0
9	10.0	25	16.8	41	23.7	57	30.5
10	10.4	26	17.2	42	24.1	58	30.9
11	10.8	27	17.6	43	24.5	59	31.3
12	11.2	28	18.0	44	24.9	60	31.7
13	11.7	29	18.5	45	25.4	61	32.2
14	12.1	30	18.9	46	25.8	62	32.6
15	12.5	31	19.3	47	26.2	63	33.0
16	12.9	32	19.7	48	26.6	64	33.5

- LED Working Status Detection

There are two types of LED output pin working status detection modes: forced detection and real-time detection.

In the forced detection mode, the GS8802 will forcibly turn the LED on and off to determine the working state of the LED. This detection mode is performed only once at a time and affects the display of the LEDs.

When in real-time detection mode, GS8802 will detect the working status of the LED in real-time based on its display mode. Once activated, this mode will continue to detect and will not affect the display effect of the LED light, but the integrity of the detection results will be affected by the display effect of the LED light.

GS8802 can detect the working status of LED and confirm the short circuit or open circuit of RGBW pins. The system sets the detection voltage threshold through software to ensure accurate feedback of short circuit or open circuit information under different application conditions. At the same time, when abnormal LED working status is detected, GS8802 can be set to automatically turn off the LED display, reducing the impact of abnormal conditions on the display.

- Over-Temperature Detection

When the over-temperature detection function is turned on, the chip will detect the operating temperature in real time.

When the operating temperature exceeds 140°C, the GS8802 will turn on the over-temperature flag and linearly reduce the LED output current according to the actual temperature, preventing permanent damage to the chip due to excessive temperature. When the chip operating temperature returns to normal, the chip returns to normal LED current output.

Under-Voltage Protection Function

The chip has a built-in under-voltage protection function, which will turn off the PWM output when the power supply voltage does not meet the working conditions, preventing it from entering abnormal working mode and improving system reliability.

Appendix 1: GS8802 Factory Parameter Settings Default Values

Function	Range	Factory settings	illustrate
Field selection	1/2/3/4 field	4 field	The fields are independent and optional. After successfully setting the fields, the first chip will light up in red and the other chips will light up in blue.
Automatic coding	on/off	off	
Address light on without signal	on/off	off	
Current level	Level: 1-64 Proportion: 1.56% -100%	Level 16 25%	Note: When PWM positive polarity is applied, this function is to set the channel current level; When PWM reverse polarity is applied, this function is to set the maximum PWM value
Pulse width compensation	0-1860ns	180ns	
Grayscale smoothing	on/off	off	
Minimum refresh rate	240Hz/1kHz/4kHz/8kHz	240Hz	
Maximum refresh rate	240Hz/7.8kHz/15.5kHz/31kHz	7.8kHz	
Over temperature alarm threshold	125℃/140℃/155℃/off	140℃	
Internal/external current setting	Internal current/external current	Internal current	The factory default setting is "built-in current", with a current level of 16 and a channel output current value of 18mA
W current setting	1x/3x current	1x current	
No signal display status	When there is no signal after power on, light up the LED Keep the last frame displayed turn off the light	When there is no signal after power on, light up the LED	
Grayscale setting when there is no signal after power	R：0-255 G：0-255 B：0-255	R：128 G：128 B：128	The default grayscale setting value for RGBW when there is no signal after power on is set to 128 when the chip

on	W：0-255	W：128	leaves the factory
Port output polarity	Positive/Negative Polarity	positive polarity	
LED output pin working status detection	Detection type: Simple detection/Detailed detection	Detailed detection	
	Detection mode: forced detection/real-time detection	forced detection	
	Is the display turned off when the LED output pin is abnormal	Do not close	
	Detection threshold 0.2V/0.3V/0.4V/0.5V 1st/2nd/3rd/4th gear	0.2V	
Is the parameter successfully written with a fixed blue light	yes/no	No	After activation, the blue light will be fixed on after successful parameter writing

Package Heat Dissipation Power

When four output channels are opened, the actual power consumption of the chip is determined by the following formula:

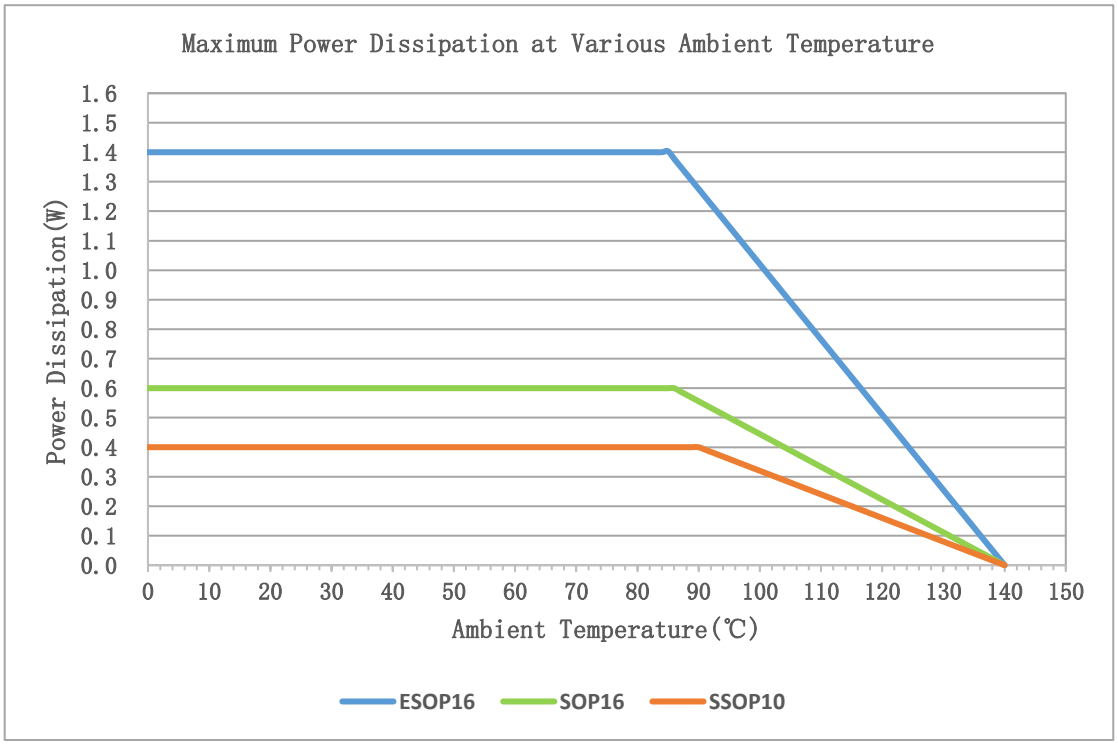
(Vout represents the output voltage when the current is turned on; Duty represents the proportion of time the current is turned on.

$$\text{PD(practical)} = V_{vdh}xI_{vdh} + V_{out3}xI_{out3}xDuty_3 + \cdots + V_{out0}xI_{out0}xDuty_0$$

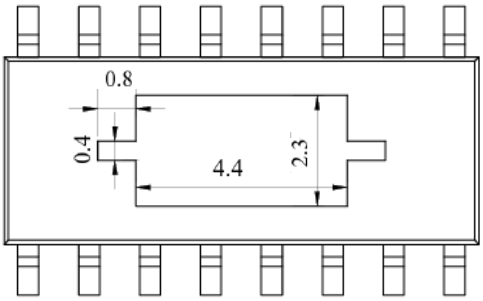
In order to operate under safe conditions, the power consumption of the chip must be less than the maximum allowable power, which is determined by the ambient temperature and packaging type. The formula for maximum power consumption is as follows:

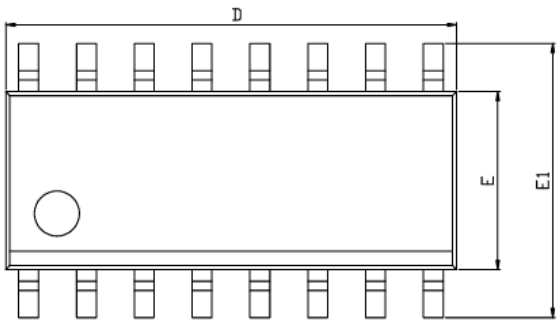
$$PD(max) = \frac{Tj(max)\,(℃) - Ta(℃)}{Rth(j-a)(℃/Watt)}$$

PD (max) will decrease as the ambient temperature rises, so careful design of operating conditions based on packaging type and ambient temperature is required. The following chart describes the relationship between maximum power consumption and ambient temperature for different packaging types.



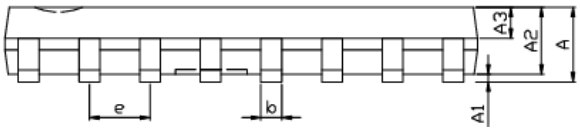
ESOP16



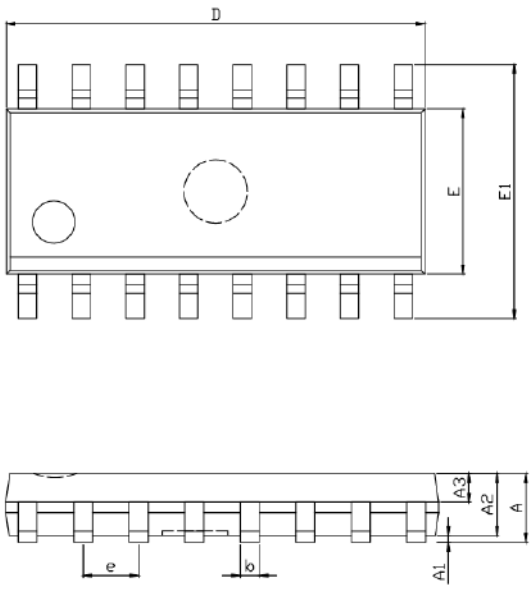


Symbol	Millimeter	
	Min.	Max.
A	—	1.75
*A1	0.00	0.07
A2	1.40	1.50
A3	0.61	0.71
*b	0.39	0.45
c	0.21	0.26
D	9.70	10.10
E	3.70	4.10
*E1	5.80	6.20
*e	1.24	1.30
*L	0.60	0.80
L1	0.99	1.10
θ	0°	8°

Note: The size marked with "*" is the measurement size.

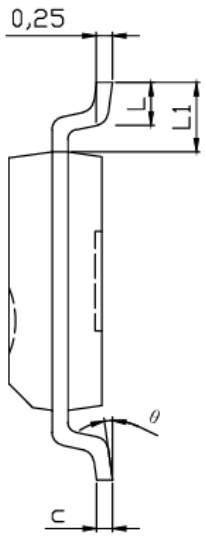


SOP16

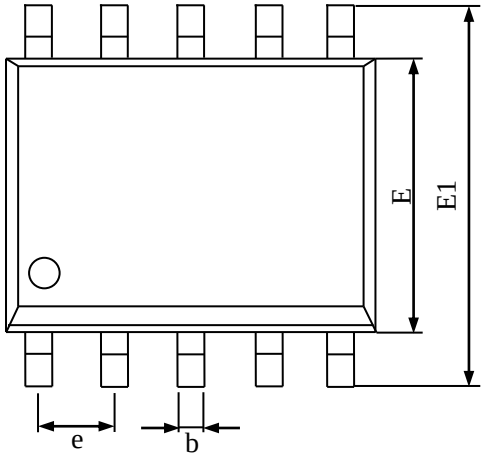


Symbol	Millimeter	
	Min.	Max.
A	—	1.75
*A1	0.10	0.25
A2	1.40	1.50
A3	0.61	0.71
*b	0.39	0.45
c	0.21	0.26
D	9.70	10.10
E	3.70	4.10
*E1	5.80	6.20
*e	1.24	1.30
*L	0.60	0.80
L1	0.99	1.10
θ	0°	8°

Note: The size marked with "*" is the measurement size.

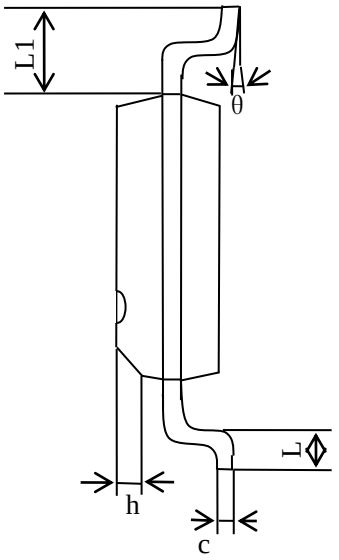


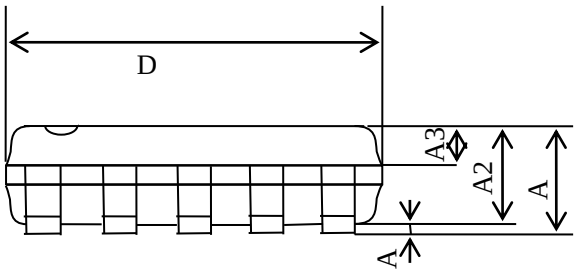
SSOP10



Symbol	Millimeter	
	Min.	Max.
A	1.50	1.70
*A1	0.10	0.20
A2	1.35	1.45
A3	0.60	0.70
*b	0.30	0.50
c	0.19	0.25
D	4.80	5.00
E	3.80	3.95
*E1	5.80	6.20
*e	1.0(bsc)	
*L	0.55	0.75
*L1	0.99	1.10
θ	0°	8°
h	0.25	0.50

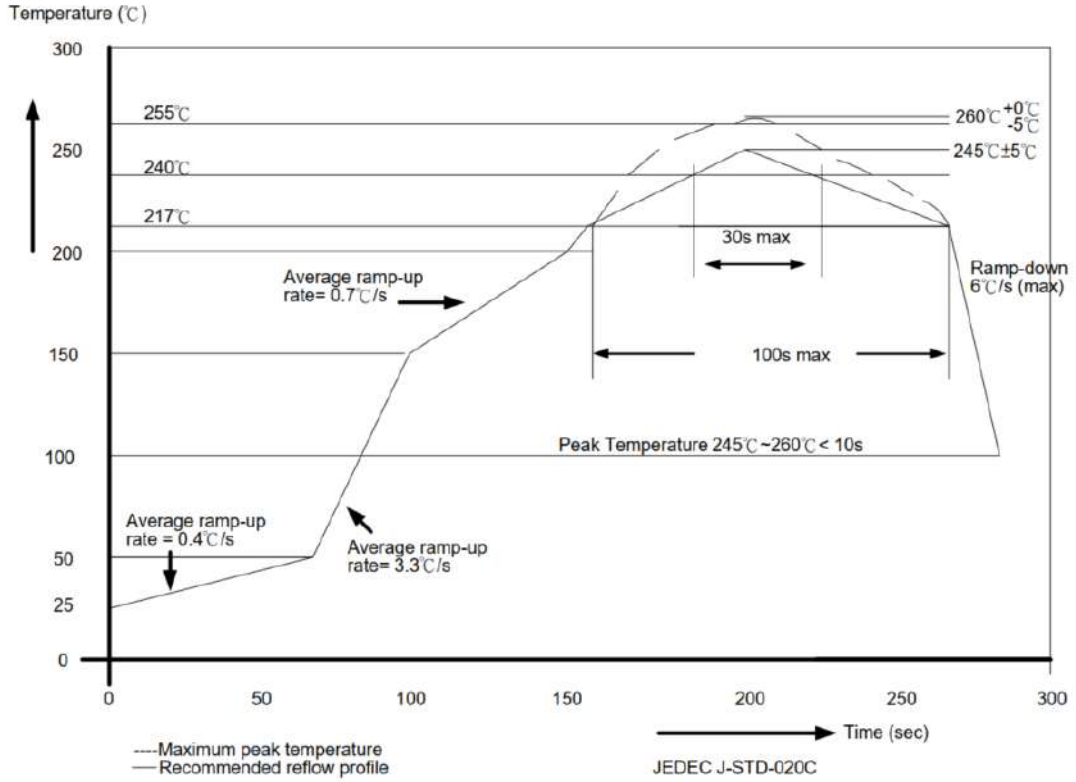
Note: The size marked with "*" is the measurement size.





Encapsulation And Soldering Process

The semiconductor products produced by Genesis Technology comply with the European RoHS standard, and the temperature of the solder pot in the packaging and soldering process conforms to the JEDEC J-STD-020C standard, as shown in the figure below.



Package thickness	Volume mm^3 ＜350	Volume mm^3 350-2000	Volume mm^3 ＞2000
＜1.6mm	260℃	260℃	260℃
1.6mm-2.5mm	260℃	250℃	245℃
＞2.5mm	250℃	245℃	245℃

The products listed in this datasheet are designed for general electronic applications such as appliances, visualization devices, communication products, etc. Therefore, it is recommended that these products should not be used in medical facilities, surgical equipment, spacecraft, nuclear power control systems, disaster/crime prevention equipment, and similar equipment. The misuse of these products may directly or indirectly threaten people's lives or cause injury and property damage.

Genesis Technology will not be responsible for any incorrect use of these products. Any person who purchases any of the products described herein with the above intentions or misuses them shall be solely responsible and compensated. Genesis Technology and its distributors and all officers and employees shall defend themselves against all claims, lawsuits, and all damages, costs and expenses arising out of or in connection with the foregoing intent or operation.