CA3208VGBMDN1 Datasheet

iC LED Series (L* W*H): 3.2*0.8*1.0mm

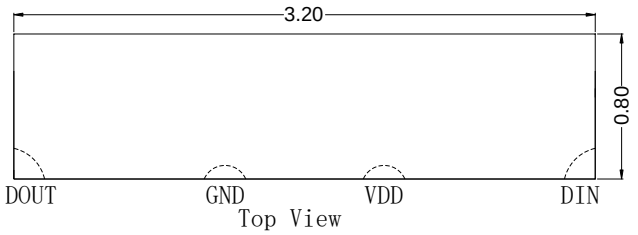
Applications

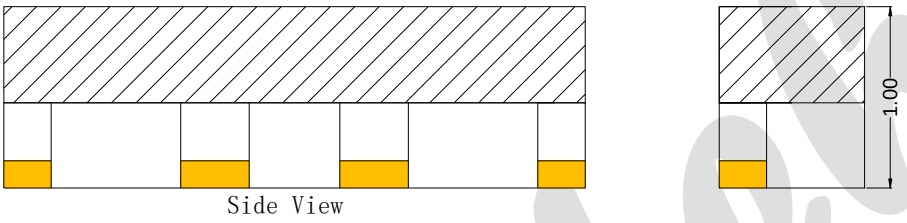
- Telecommunication, office automation, home appliances, industrial equipment
- Full-color strip
- Consumer electronics
- Other applications

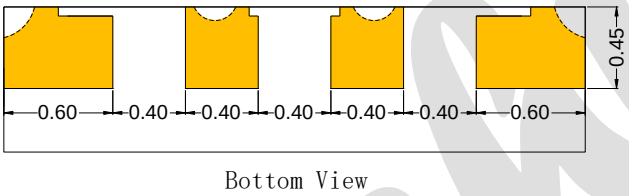
Features

- Serial data transmission signal by single wire.
- RGB and driver chip are integrated in a package, to form a complete control of pixel point with constant current.
- One pixel contains R, G, and B color that each can achieve 256 level brightness grayscale, which forms 16, 777, 216 combination colors. Internal clock frequency operates at 800 kHz.
- Support bi-directional data transfer protocol to feedback LED strip information, including quantity of the cascaded LED devices and the maximal sink current capability of driver chip
- Lens color: White diffused
- RoHS2.0 and REACH-compliant
- ESD level 2kV(HBM)
- Preconditioning: accelerate to JEDEC level 3
- Typical view angle 50% Iv:140°

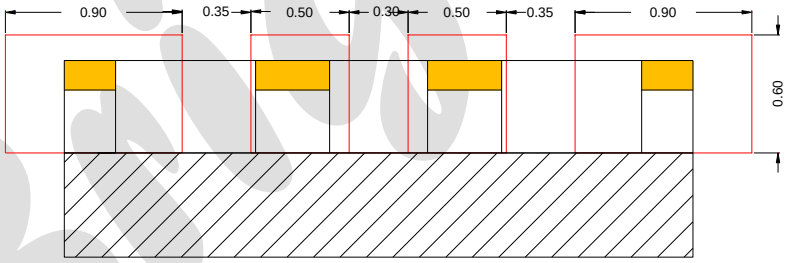
Dimensional Drawing







Recommended Solder Pad



1. Dimensions are in millimeters.
2. General tolerance is ± 0.1mm.

No.	Symbol	Function description
1	DIN	Control data signal input
2	VDD	Power supply LED
3	DOUT	Control data signal output
4	GND	Ground

Naming Rule

CA-3208-VGB-M-D-N1

CA	3208	VGB	M	D	N1
Type	Package Size	Color	Lens color	Output current	Serial number
CA: With IC Series	3208: 3.2*0.8mm	V:red G:green B:blue	M:White diffused	D:12mA	N1: Serial number

Maximum Ratings

T_A : 25 °C

Parameter	Symbol	Values	Unit
Forward current	I_F	12	mA
IC Power Supply Voltage	VDD	+3.8~+5.5	V
IC Input Voltage	VI	-0.4~VDD+0.4	V
Operating Temperature Range	/	-40℃to+85	°C
Storage Temperature Range	/	-40℃to+105	°C
Soldering temperature	T_{SD}	260	°C

1. The maximum of soldering time is 10 seconds in T_{SD}.

Characteristics

VDD:5V | T_A : 25 °C

Characteristics	Symbol		Min.	Typ.	Max.	Unit	Test condition
Luminous Intensity	Iv	R	160	230	500	mcd	VDD=5V
		G	320	530	800		
		B	63	100	160		
		W	500	780	1000		VDD=5V
Dominant Wavelength	λd	R	615	-	630	nm	VDD=5V
		G	520	-	535		
		B	460	-	475		
Color Coordinate	x		-	0.2650	-	-	VDD=5V
	y		-	0.2899	-	-	
View Angle	2θ1/2		-	140	-	-	VDD=5V

1. Luminous intensity is measured with a light sensor and filter combination that approximates the CIE eye-response curve.
2. 2θ1/2 is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
3. The dominant wavelength, λd is derived from CIE chromaticity diagram and represents the single wavelength which defines the color of the device. Peak Emission Wavelength Tolerance is ±1nm.

Bin groups

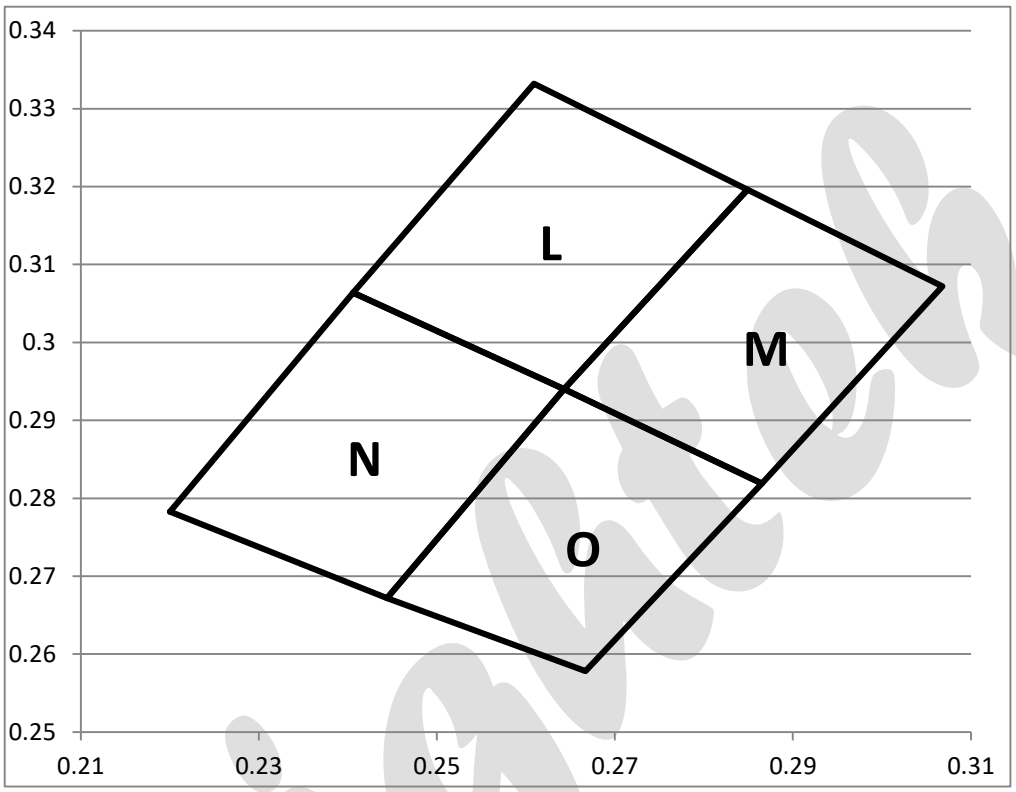
1. Luminous Intensity-White

VDD:5V | IF : 12mA*3

Bin Code	Min. IV (mcd)	Max. IV (mcd)
19	500	630
20	630	800
21	800	1000

2. Chromaticity Coordinate Groups

VDD:5V | IF : 12mA*3



Bin	X	Y	X	Y	X	Y	X	Y
L	0.2406	0.3064	0.2609	0.3332	0.2849	0.3196	0.2643	0.294
M	0.2643	0.294	0.2849	0.3196	0.3068	0.3072	0.2865	0.2819
N	0.22	0.2783	0.2406	0.3064	0.2643	0.294	0.2444	0.2672
O	0.2444	0.2672	0.2643	0.294	0.2865	0.2819	0.2667	0.2578

Tolerance of X/Y：±0.005

Electrical Characteristics

T_A : 25 °C

Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit
Standby current	I_{STB}	V_{DD}=4.5v,Iout= "OFF" "	-	0.5		mA
Input voltage level	V_{IH}	D_{IN}, Input high level voltage	2.7	-	-	V
	V_{IL}	D_{IN}, Input low level voltage	-	-	1.0	V

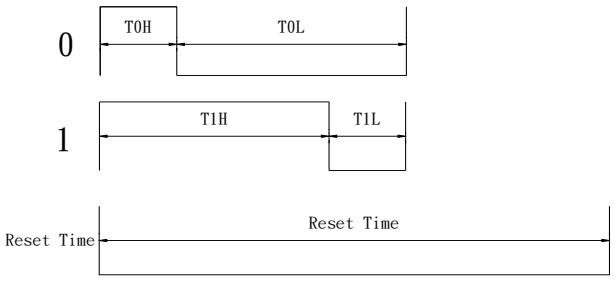
Switching Characteristics

T_A : 25 °C

Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit
Rate of data signal	F_{DIN}	-	-	800	-	kHz
Transfer time	T_{PLH}	D_{IN}→D_{OUT} D_{OUT} port to GND CL=30pF	-	-	80	ns
	T_{PHL}		-	-	80	ns
Conversion time of IOUT R/G/B	T_R	I_{OUT} R/G/B =12mA RL=200Ω, CL=30pF	-	50	-	ns
	T_F		-	50	-	ns

Data transfer time

1. Timing Wave Form



2. Data transfer time

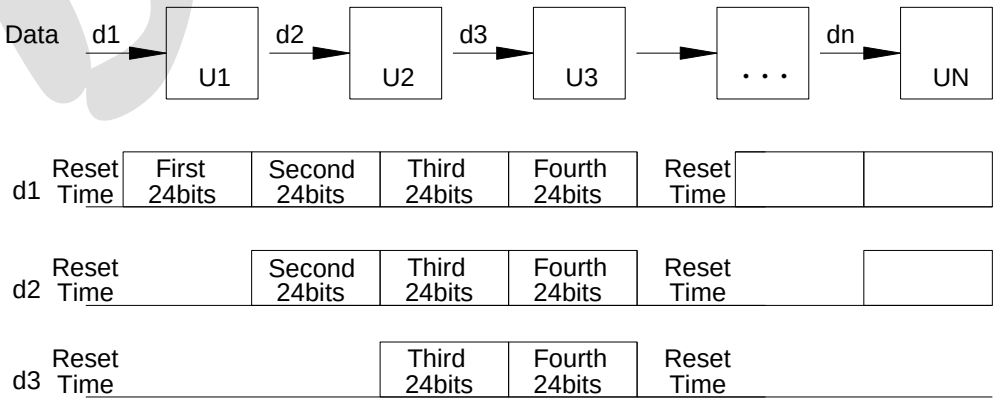
Item	Description	Typical	Allowance
T_{0H}	0 code, high voltage time	0.3μs	±0.15μs
T_{0L}	0 code, low voltage time	0.9μs	±0.15μs
T_{1H}	1 code, high voltage time	0.9μs	±0.15μs
T_{1L}	1 code, low voltage time	0.3μs	±0.15μs
RES	reset time	>250μs	-

3. Composition of 24 bit data

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

The single wire data transfer protocol supports 24-bit data for each LED's RGB display data refresh. ICLED receives 24-bit data and passes the remaining data to next ICLED. The 24-bit data consist of green, red and blue data, each with 8-bit width, and are transferred with MSB first

3.1 Data transmission method

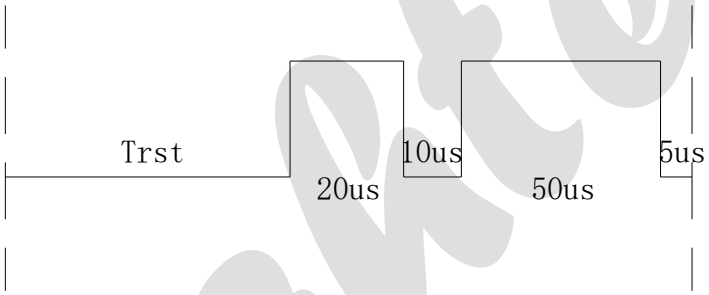


Advanced Function Mode (feedback mode and high level setup mode)

A host MCU can issue special commands to make ICLED get into advanced function mode. In the advanced mode, ICLED supports bi-direction data transfer. Through the single wire protocol, ICLED can feedback the information about the cascaded number of LEDs or maximal sink current capability of R/G/B channel on the LED lamp strip to MCU. For dimming purpose, ICLED also features the current gain control function for the individual R/G/B channel for every single LED on the strip. Programmable PWM refresh rate is also available.

Enable feedback mode

Command and Wave form: Trst+Th50



Timing and waveform of Th50：the pulse width shown as above stands for the typical data, the maximal or minimal value should be controlled within the typical data±20%.

Setup

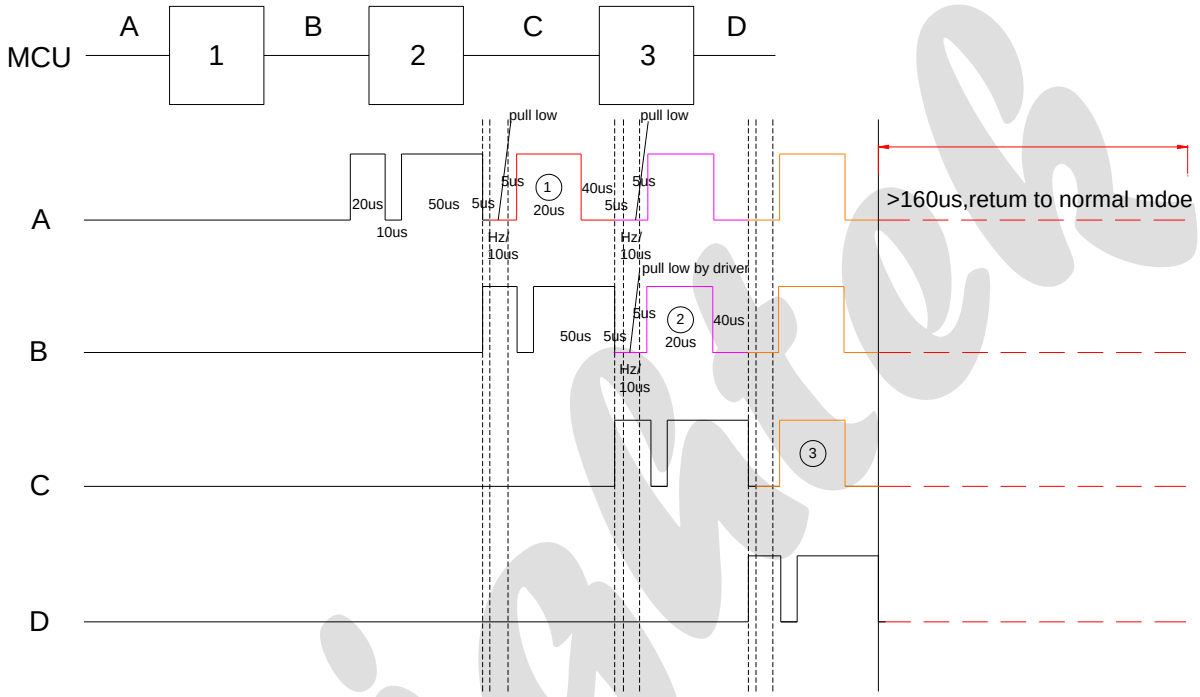
After system power-on, the MCU issues the Trst+Th50 command through a GPIO port. While the command ends, MCU must change the GPIO port attribute from output mode to input mode to wait for signal returned from ICLED. Once ICLED recognizing the Trst+Th50 command is recognized, it will enter into feedback function mode from normal mode by switching GPIO function from input mode to output for Din, and from output to input mode for D out. Then ICLED waits for 10us and generates a positive pulse with width “Trev” on Din port, either back to MCU GPIO port or to the D out port of the predecessor ICLED (the detailed waveform is shown as below). If ICLED receives a “Trev” waveform on D out port, it will also generate a “Trev” waveform on Din port. The interval of a “Trev” waveform is 80us. Hence, the number of “Trev” waveforms received by the MCU represents the number of ICLED chips on the LED strip.

While ICLED or MCU does not receive any “Trev” pulse within 160us, ICLED or MCU will get out of feedback mode and go back to normal function mode. MCU may then determine the following information:

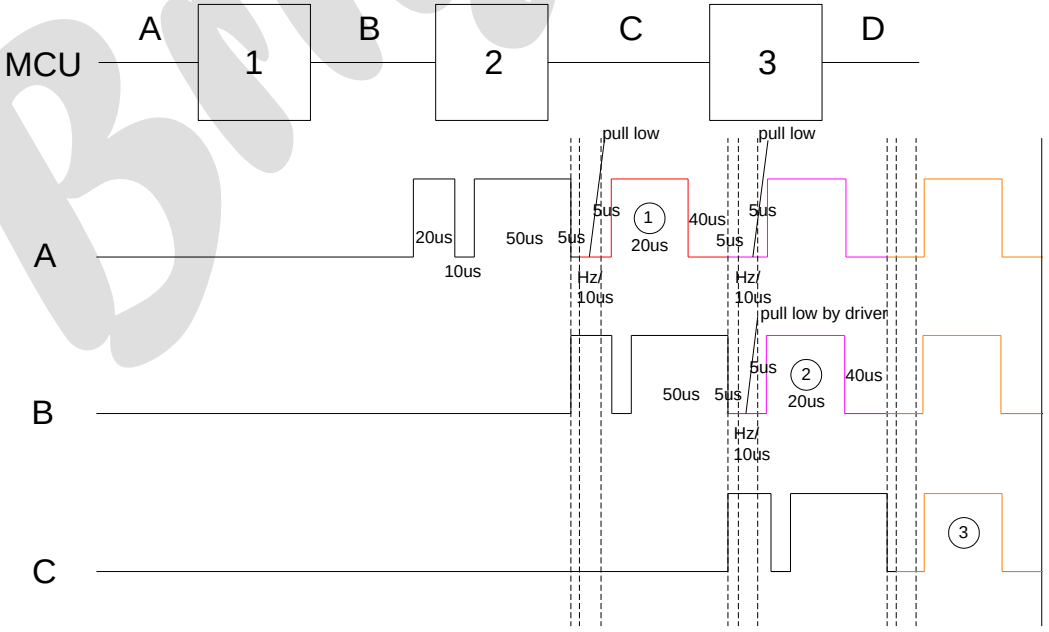
a. the number of cascaded ICLED’s on the LED strip.

b. the high pulse width in the “Trev” waveform denotes the maximum sink current of the G/R/B channel in ICLED (20us high pulse for 12mA sink current, 10us for 5mA)

Example: as an example, the following diagram is for 12mA channel current



(Zoom-in)

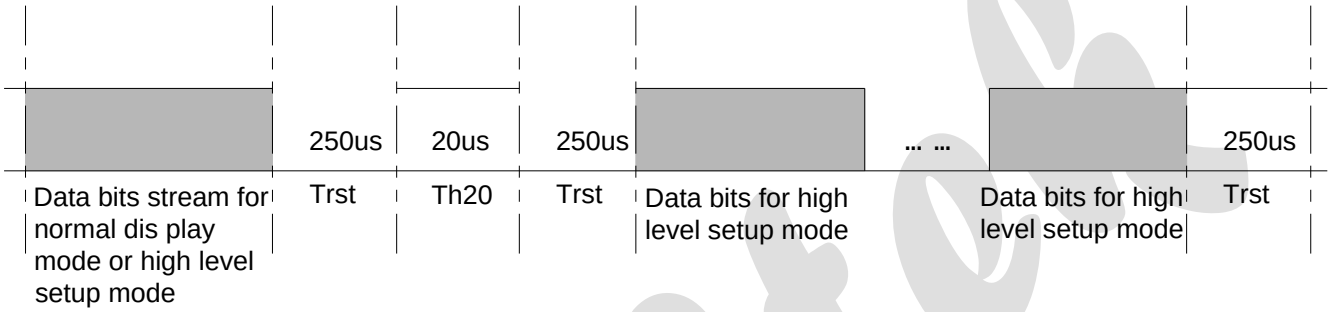


High Level Setup Mode

Data format of high level setup mode: The data format (24 bits) in high level setup mode is the same as in normal mode. Note that the “High Level Setup mode” can be enabled whenever needed

Waveform and format:

Th20+Trst+24bits data of 1 st chip+ 24bits data of 2 nd chip+...+ 24bits data of Nth chip with MSB bit transferred first.



Timing to setup Th20:

Th20 can be issued after the data bits of a normal display function are transferred or after the command of enabling high level setup mode.

Current Gain Control

MCU can issue commands to program and adjust the maximal sink current capability of G/R/B channel individually of ICLED in the high level setup mode.

The calculation formula:(example to adjust sink current capability for channel G)

Io=Im*(15.5+0.5*G[0]+1*G[1]+2*G[2]+4*G[3]+8*G[4])/31

Im=12ma Default Value :G=1F; R=1F ; B=1F;

S23	S22	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S09	S08	S07	S06	S05	S04	S03	S02	S01	S00
SS <5>	SS <4>	0	G <4>	G <3>	G <2>	G <1>	G <0>	SS <3>	SS <2>	SS <6>	R <4>	R <3>	R <2>	R <1>	R <0>	SS <1>	SS <0>	SS <7>	B <4>	B <3>	B <2>	B <1>	B <0>

The other function supported and setting in high level setup mod

SS<0>	PWM reset and synchronization command setting: 0 non-synchronization (default), 1 synchronized for PWM (PWM internal counter is reset, re-started and synchronized with Trst end point),default =0
SS<2><1>	Reserved
SS<3>	1. display data update and validation: 0 display (PWM data) is valid and synchronized with Trst end point; 1 non-synchronized with Trst end point (data is valid immediately after PWM data is received), default=0
SS<5><4>	display re-fresh rate: 00 1.25khz ; 01 2.5khz; 10 10khz; 11 20khz (default 11)
SS<6>	Optional bit to change the feedback information. 0: feedback the max. sink current of R\G\B port 1; feedback the strip fixed ID (Default 0)
SS<7>	Reserved (default

Sleep mode for power saving

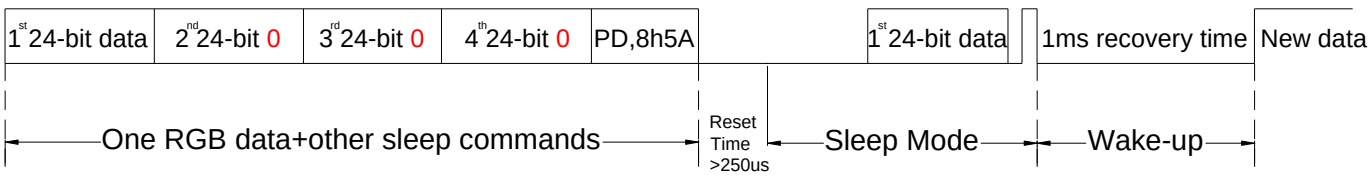
ICLED supports sleep/wake-up modes for power-saving purpose. When receiving 24-bit 0's RGB data, 8-bit 0x5A special data, and a reset command, ICLED will enter sleep mode. In sleep mode, the built-in oscillator and associated circuitry is disabled. The quiescent current of ICLED is approximately 5uA (typ) in sleep mode. A sleeping ICLED wakes up from sleep mode when detecting an input rising edge on Din pin. Normally a positive pulse on Din pin can be used as a wake-up trigger. After waking up, all sleeping circuits in ICLED return to normal working mode within 1ms. To wake-up the next cascaded ICLED, the received positive pulse on Din pin is passed to Dout pin, which connected to Din pin of the next ICLED, and in turn wakes up the next ICLED. Hence, all cascaded sleeping ICLEDs can wake up successively.

Since it takes 1ms for a sleeping ICLED returning to normal functioning mode, it is recommended for MCU to wait for 1ms to send display data and commands after issuing a wake-up pulse.

In an LED strip, it is possible to set certain ICLEDs active, while the others in sleep mode. As an example, the following commands are for two leading active ICLEDs and other sleeping ICLEDs

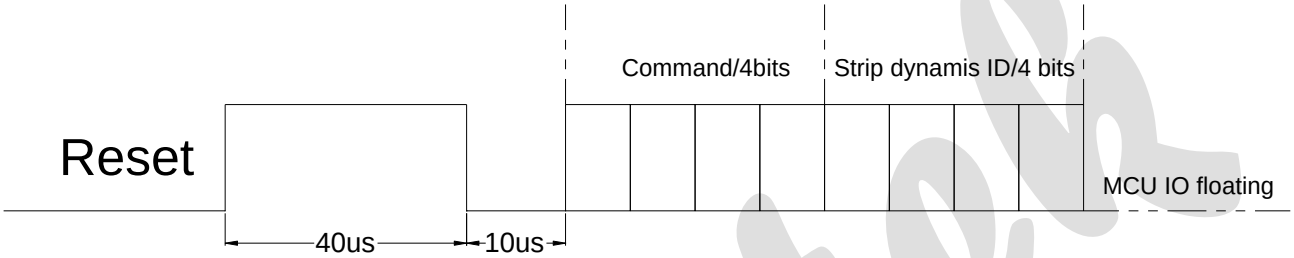
GRB 24`h100FFF	GRB 24`h235678	GRB 24`h000000	GRB 24`h000000	… … … …	PD 8`h5A	+ Reset code >250 us

As an example of sleep/wake-up commands shown below, the first ICLED is kept active and the remaining ICLED's enter sleep mode by 24-bit 0's and an ending 0x5A byte. Later on, a positive pulse wakes up all sleeping ICLED's.″



Control Commands for multiple strips

ICLED supports the scenarios of controlling multiple strips with parallel connection (up to 15 strips). With appropriate commands, each of the strips can be identified and assigned a unique strip dynamic ID (by set dynamic ID command). After the commands is completed, MCU host can individually control and send the display data to each strip with the help of "Clean ID"\"Check ID"\"specify ID" commands.
Command format to setup strip dynamic ID:



Command	Strip dynamic ID(4-bit)
4’b0001	Set_ID(1~15)
4’b0010	Clean_ID(1~15)
4’b0011	Cleck_ID(1~15)
4’b0100	Specify_ID(assign a specific strip to receive data)

Command to set dynamic strip ID /set ID（4’b0001)

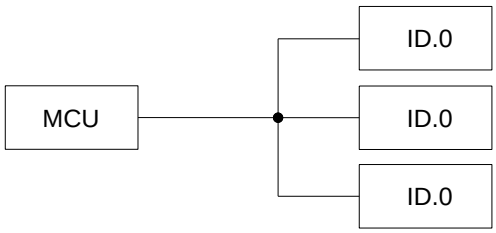
In a multi-strip ICLED LED application, the default dynamic ID number of each strip is 0 after power-on reset. MCU may encode and change the strip dynamic ID by issuing the setup command with 4'b0001 and 4-bit new dynamic ID number (4’b0001~4b’1111). After the command is issued, the leading ICLED of each strip starts the encoding procedure. While some leading ICLED finishes the encoding procedure first, it generate a positive pulse on Din port for 77us(+/-20%), and the associate ID number is registered as the ID number of that strip.

If a leading ICLED finds a positive pulse on Din port before generating its own pulse, it will cease the encoding procedure and wait for another MCU’s setup command.

MCU may repeatedly issue the setup commands and ID numbers to strips for each strip’s leading ICLED to grab a unique dynamic ID number. MCU may cease to issuing setup commands if no positive pulse is found for 60us period. It means all the strips can be individually identified by the ID number on its leading ICLED.

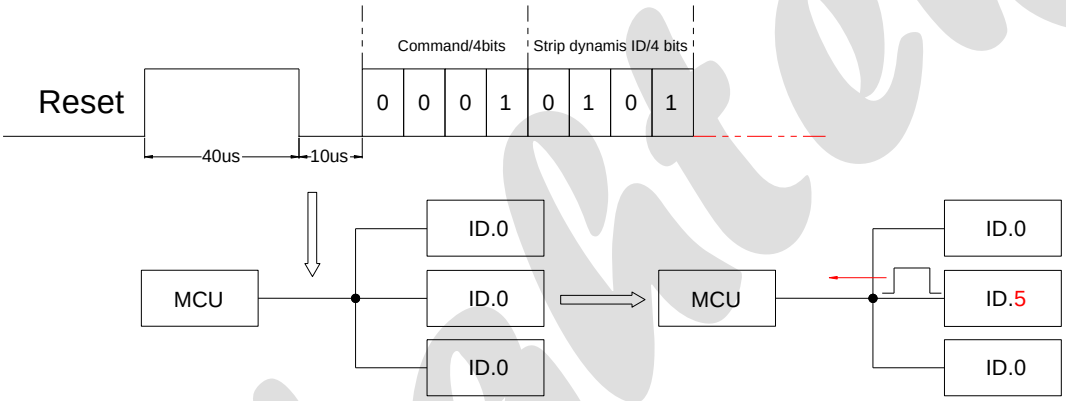
In the multi-strip application, if a strip’s leading LED controller is not ICLED (not with set ID feature) or not featured with set_Strip_ID command, MCU may use ID 0 for the strip.

In order to avoid the signal level conflict between output from MCU GPIO and the feedback pulse from Din port of ICLED, it is recommended to change MCU GPIO attribute to a floating state within 8us after issuing the set ID command, and then to monitor if there is a 77us positive pulse generated from any leading ICLED.



After power-on reset, the default strip dynamic ID is “0” for each leading

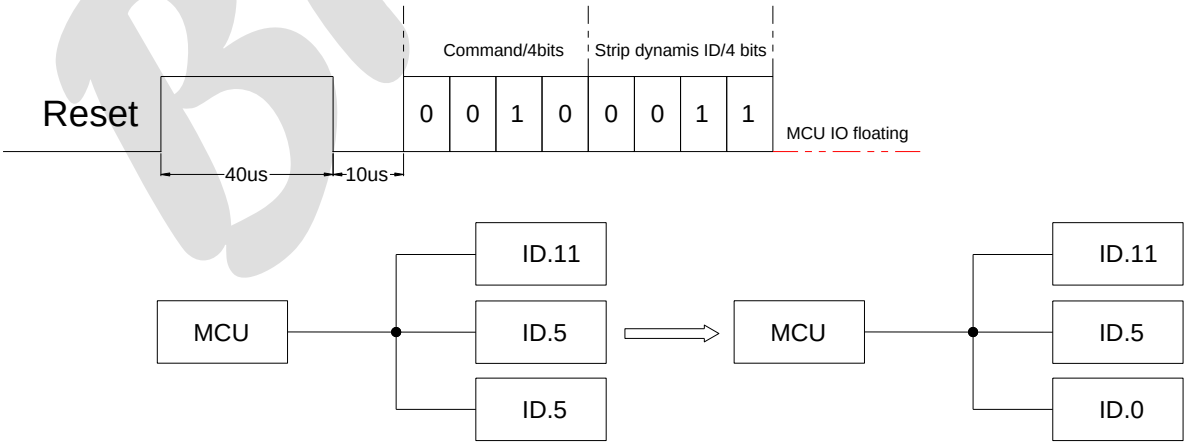
Example : set a strip with dynamic ID



Command to clean dynamic strip ID /CLN_ID(4’b0010):

MCU can clean the dynamic ID of a specific strip to default value (ID=”0”)through clean Strip ID command.

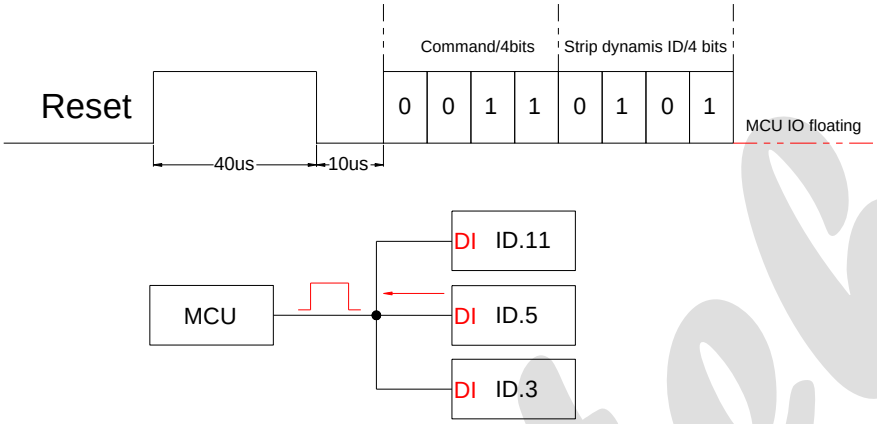
Example : clean the ID of Strip 3 to 0.



Host MCU can issue clean command + ID=”0” to clean all existing dynamic strip IDs in a time

Command to check dynamic strip ID/CHK_ID(4’b0011):

MCU can use the check Strip ID command to confirm if a strip with a specific ID already exists. For example, while the Strip 5 receives the command and ID data as below, its leading ICLED will return a positive pulse with about 77us width via Din port.,(the related timing waveform is similar to the one of SET_ID command)



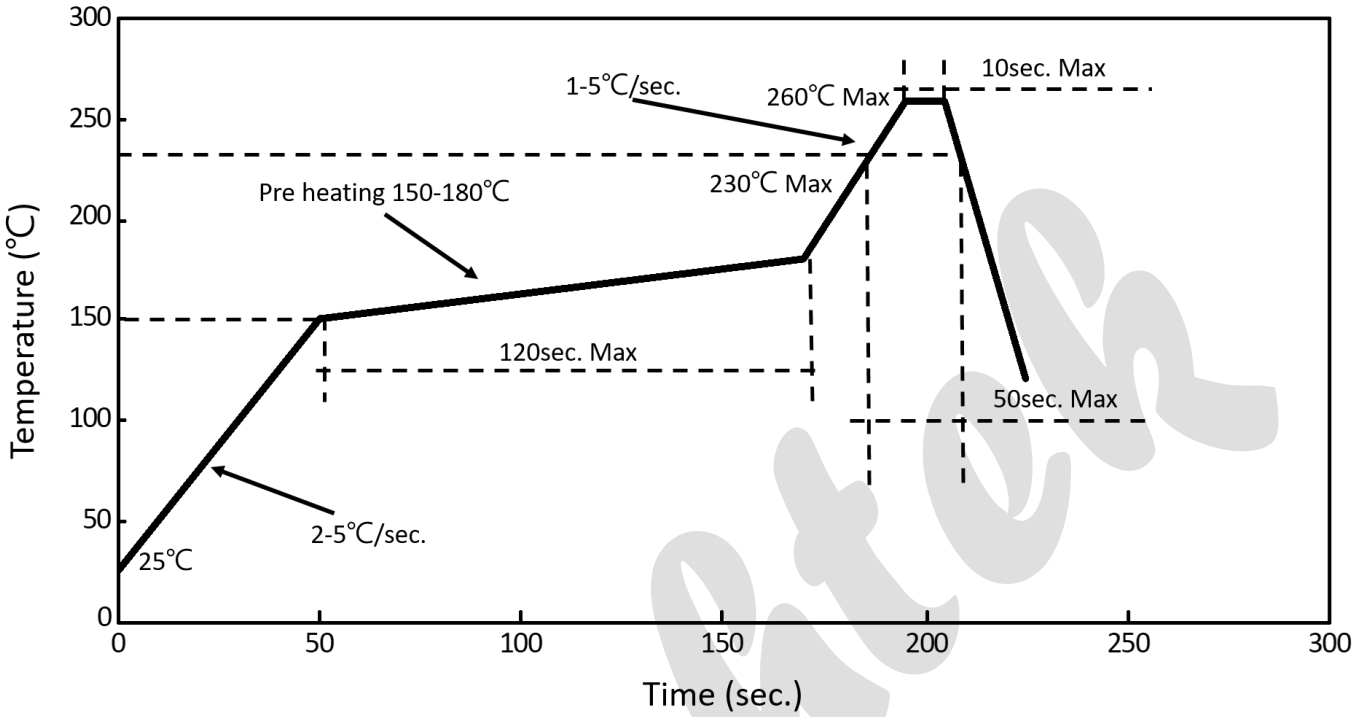
Command to specify a unique Strip to receive data /specify_ID(4'b0100):

MCU can issue "specify ID command" to force a specific strip to receive RGB display data or execute special actions (such as executing feedback mode command or setup mode command).

On the other hand, MCU also can issue broadcast command by "specify command + ID="0"/4'b000 "to force all existing dynamic ID strips to receive the following display data or execute setup mode command together

If MCU does not execute "specify ID command" to select a specific strip before sending RGB data or executing feedback or setup mode command, all strips with ID="0" will receive the data and execute actions

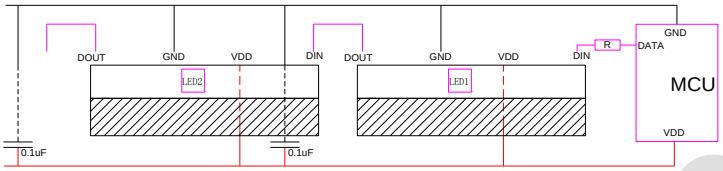
Reflow Soldering Profile



1. We recommend the reflow temperature 240℃ (±5℃).the maximum soldering temperature should be limited to 260℃.
2. Do not stress the silicone resin while it is exposed to high temperature.
3. The reflow process should not exceed 3 times.

Test Circuit and Precautions for User

1. Typical application circuit



Notes:

When the first LED is connected to the MCU, a resistance R is needed in series between its signal input line and the MCU. The size of R depends on the number of cascade beads. The more cascades, the smaller resistance R is used. It is generally recommended that the value be between 100-1K. Usually the recommended value is around 300 R. In order to make the LEDs work more stably, a parallel capacitor is needed between VDD and GND of each LED.

In order to avoid harmful effects in use, please try to add resistance and capacitance when using. If capacitors and resistors are not added, the number of LEDs on the lamp should be minimized, but this way still does not exclude the risk of problems.

2. Handling precautions

2.1 Over-current-proof

Customer must apply resistors for protection; otherwise slight voltage shift will cause big current change (Burn out will happen).

2.2 Storage

① It is recommended to store the products in the following conditions:

- Humidity: 60% R.H. Max.
- Temperature : 5℃~30℃(41℉~86℉)

② Shelf life in sealed bag: 12 month at ＜5℃~30℃ and ＜60% R.H. after the package is Opened, the products should be used within 1 weeks or they should be keeping to stored at ≦20%R.H. with zip-lock sealed.

2.3 Baking

Suggest packing open after 1 weeks, before use baking products, conditions as follows:

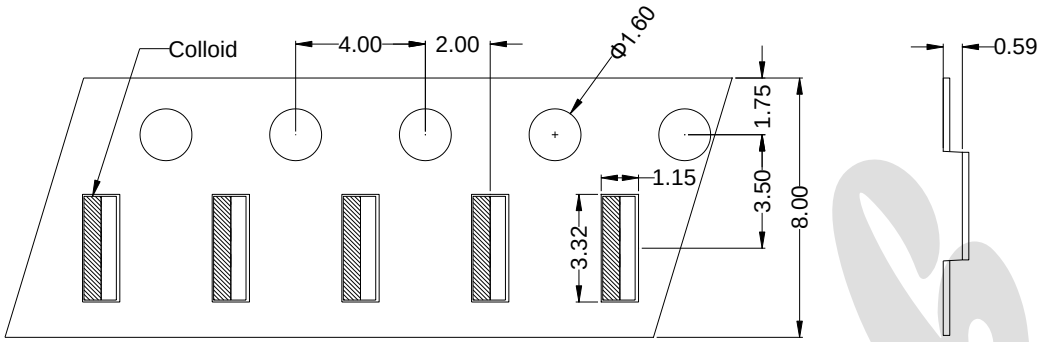
① 60±3℃ X 6hrs and ＜5%RH, for reel

② 125±3℃ X 2hrs, for single LED

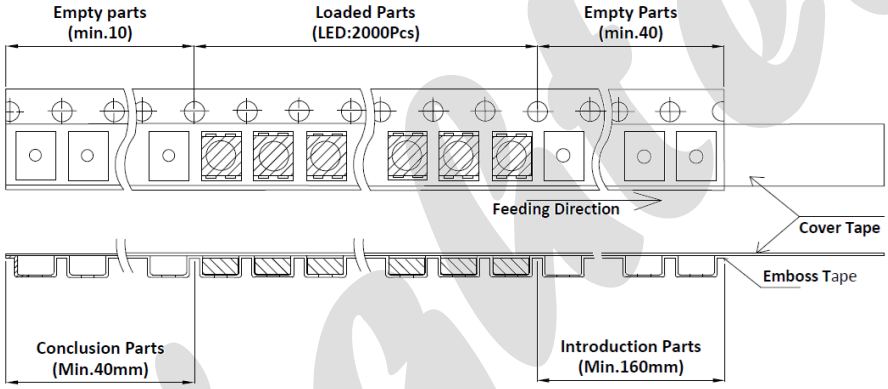
It shall be normal to see slight color fading of carrier (light yellow) after baking in process.

Tapping

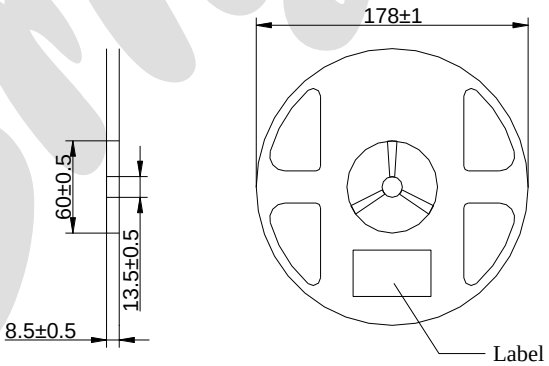
1. Dimensions of Tape (Unit: mm)



2. Arrangement of Tape



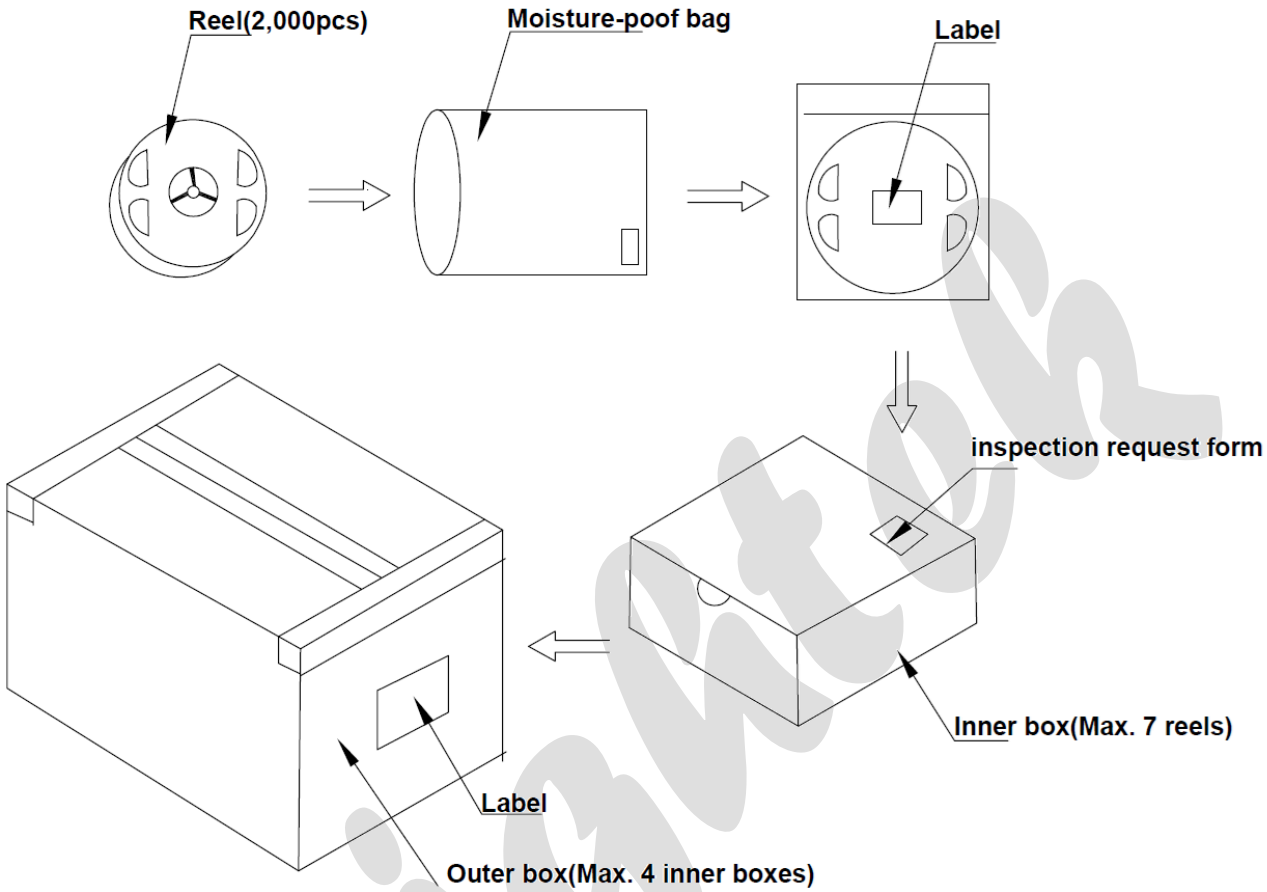
3. Dimensions of Reel (Unit: mm)



Notes:

1. Empty component pockets are sealed with top cover tape
2. The max loss number of SMD is 2pcs
3. The cathode is oriented towards the tape sprocket hole in accordance with ANSI/EIA RS-481 specifications
4. 2,000pcs per reel
5. The remainder packing in multiples of 500pcs.

Packing



Reeled product (max.2,000) is packed in a sealed moisture-proof bag. Seven bags are packed in an inner box (size: about 260 X 230 X 100 mm) and four inner boxes are in an outer box (size: about 480 X 275 X 215 mm). On the label of moisture-poof bag, there should be the information of Part No., Lot No. and quantity number; also the total quantity number should be on inspection request form on outer box.

Precautions

1. Abnormal situation caused by improper setting of collet

To choose the right collet is the key issue in improving the product's quality. LED is different from other electronic components, which is not only about electrical output but also for optical output. This characteristic made LED more fragile in the process of SMT. If the collet's lowering down height is not well set, it will bring damage to the gold wire at the time of collet's picking up and loading which will cause the LED fail to light up, light up now and then or other quality problems.

2. How to choose the collet

During SMT, please choose the collet that has larger outer diameter than the lighting area of lens, in case that improper position of collet will damage the gold wire inside the LED. Different collets fit for different products, please refer to the following pictures cross out.

Outer diameter of collet should be larger than the lighting area

Picture 1 (√) Picture 2 (X)

3. Other points for attention

- No pressure should be exerted to the epoxy shell of the SMD under high temperature.
- Do not scratch or wipe the lens since the lens and gold wire inside are rather fragile and cross out easy to break.
- CLED should be used as soon as possible when being taken out of the original package, and should be stored in anti-moisture and anti-ESD package.

4. This usage and handling instruction is only for your reference.

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