BRIGHTEK

BRIGHTEK (EUROPE) LIMITED

Brighten Up The World With LED !

ISO/TS 16949:2009 BS EN ISO 14001:2004 QC 080000 IECQ HSPM

PRODUCT DATASHEET

- PCB Side View SMD with IC
- 3210ICSV 0.8t Series
- Red/Green/Blue

Release Date: 11 December 2024 Version: A1.4

N0M66S78ICSV

3210 IC Integrated

3210 IC-Integrated

RoHS Compliant

FEATURES:

- **Package:** PCB Side View STD Package with Integrated IC
- **Forward Current:** 12mA
- **Forward Voltage (typ.):** +3.8~+5.5V
- **Luminous Intensity (typ.):** 780mcd mixed white
- **Colour:** Red/Green/Blue with White Diffused Lens
- **Dominant Wavelength:** 622/527/467nm
- **Viewing angle:** 140°
- **Operating Temperature:** -40~+85°C
- **Storage Temperature:** -40~+105°C
- **IC Feature:** 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 colour that each can achieve 256 level brightness grayscales, which forms 16,777,216 combination colours. Internal clock frequency operates at 800kHz. 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
- **Soldering methods:** IR Reflow soldering
- **MSL Level:** acc. to JEDEC Level 3
- **Packing:** 8mm tape with max 2000pcs/reel, ø178mm (7'')

APPLICATIONS:

- Telecommunication
- Indicator
- Home Appliance
- Decoration Lighting
- Full Colour LED Strip
- Gaming Device

CHARACTERISTICS:

Absolute Maximum Characteristics (T_a=25°C)

Parameter	Symbol	Ratings	Unit
Forward Current	I_F	12	mA
IC Power Supply Voltage	V_{DD}	+3.8~+5.5	V
IC Input Voltage	V_I	-0.4~V_{DD}+0.4	V
Operating Temperature	T_{OPR}	-40~+85	°C
Storage Temperature	T_{STG}	-40~+105	°C
Soldering Temperature	T_{SD}	260 for 10s	°C
Electrostatic Discharge (HBM)	ESD	2	kV

Electrical & Optical Characteristics (T_a=25°C; V_{DD}=5V)

Parameter		Symbol	Values			Unit	Test Condition
			Min.	Typ.	Max.		
Luminous Intensity	R	I_V	160	230	500	mcd	V_{DD}=5V
	G		320	530	800		
	B		63	100	160		
Mixed White	W		500	780	1000	mcd	V_{DD}=5V
Dominant Wavelength	R	λ_D	615	---	630	nm	V_{DD}=5V
	G		520	---	535		
	B		460	---	475		
Colour Coordinate	X	---	---	0.2650	---	---	V_{DD}=5V
	Y		---	0.2899	---	---	
Viewing Angle		$2\theta_{1/2}$	---	140	---	deg	V_{DD}=5V

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

Electrical & Optical Characteristics (T_a=25°C)

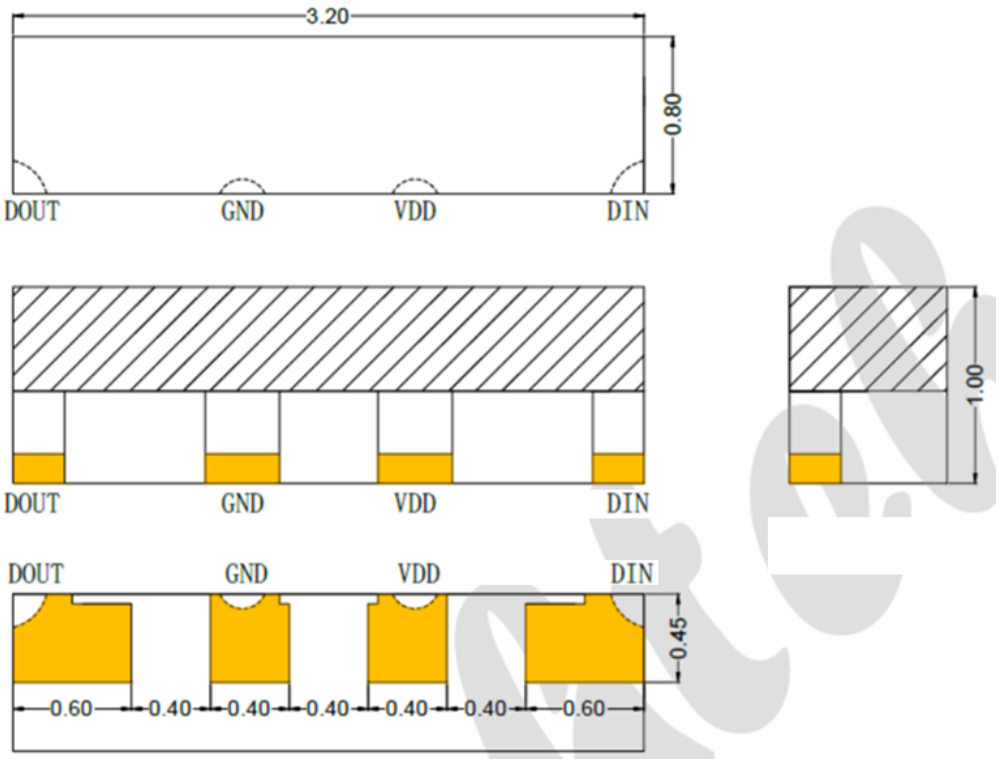
Parameter	Symbol	Values			Unit	Test Condition
		Min.	Typ.	Max.		
Standby Current	I_{STB}	---	0.5	---	mA	V_{DD}=4.5V I_{OUT}="OFF"
Input Voltage Level	V_{IH}	2.7	---	---	V	D_{IN}, Input High Level V
	V_{IL}	---	---	1.0	V	D_{IN}, Input Low Level V

Switching Characteristics (T_a=25°C)

Parameter	Symbol	Values			Unit	Test Condition
		Min.	Typ.	Max.		
Rate of Data Signal	F_{DIN}	---	800	---	kHz	---
Transfer Time	T_{PLH}	---	---	80	ns	D_{IN} -> D_{OUT} D_{OUT} Port to GND CL=30pF
	T_{PHL}	---	---	80	ns	
Conversion Time of I_{OUT} R/G/B	T_r	---	50	---	ns	I_{OUT} R/G/B=12mA RL=200Ω CL=30pF
	T_f	---	50	---	ns	

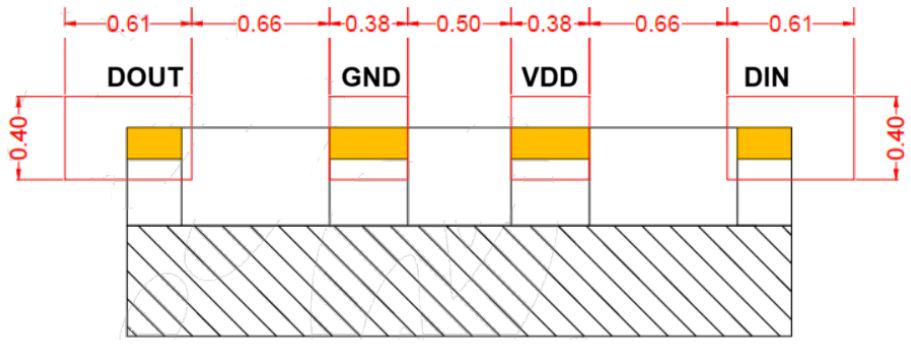
OUTLINE DIMENSION:

Package Dimension:



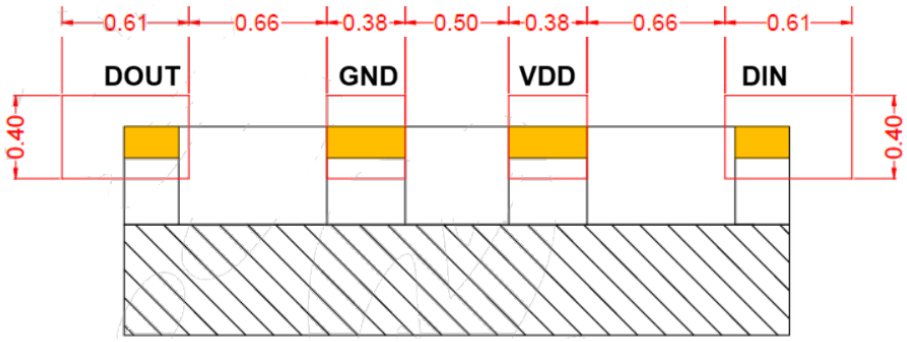
1. All dimensions are in millimetre (mm).
2. Tolerance ±0.2mm, unless otherwise noted.

Recommended Soldering Pad Dimension:



1. Dimensions are in millimetre (mm).
2. Tolerance ±0.1mm with angle tolerance ±0.5°.

PIN CONFIGURATION:



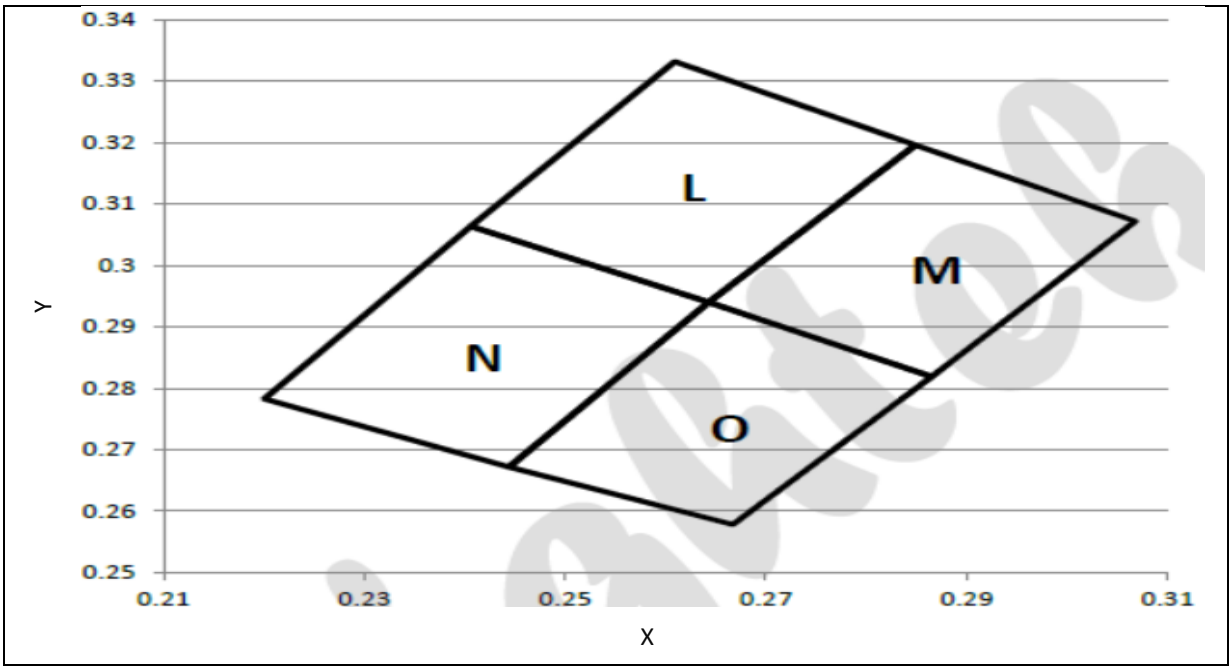
No.	Symbol	Function Description
1	DIN	Control Data Signal Input
2	VDD	Power Supply LED
3	GND	Ground
4	DOUT	Control Data Signal Output

BINNING GROUPS:

Luminous Intensity Classifications (White) (I_F = 3*12mA, V_{DD}=5V):

Code	Min.	Max.	Unit
19	500	630	mcd
20	630	800	
21	800	1000	

Chromaticity Diagram:

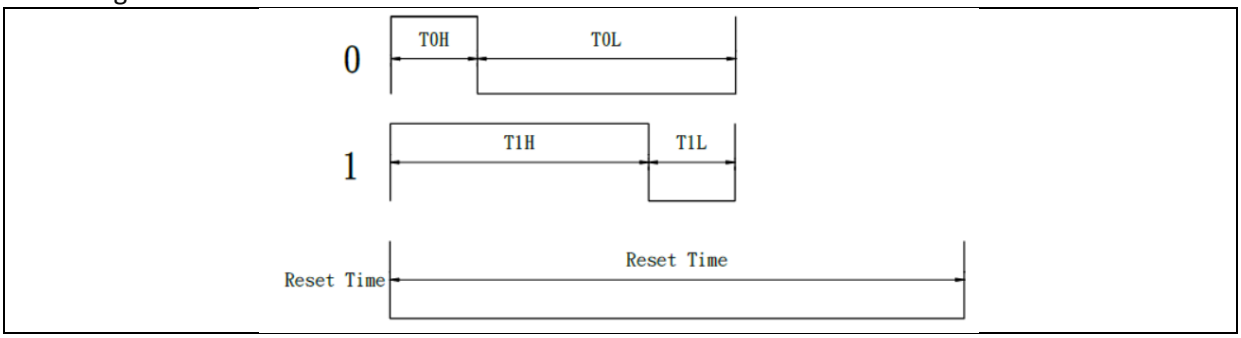


Chromaticity Coordinates Classifications (I_F = 3*12mA; V_{DD}=5V):

	1		2		3		4	
	X	Y	X	Y	X	Y	X	Y
L	0.2406	0.3064	0.2609	0.3332	0.2849	0.3196	0.2643	0.2940
M	0.2643	0.2940	0.2849	0.3196	0.3068	0.3072	0.2865	0.2819
N	0.2200	0.2783	0.2406	0.3064	0.2643	0.2940	0.2444	0.2672
O	0.2444	0.2672	0.2643	0.2940	0.2865	0.2819	0.2667	0.2578

DATA TRANSFER TIME:

1. Timing Wave Form



2. Data Transfer Time:

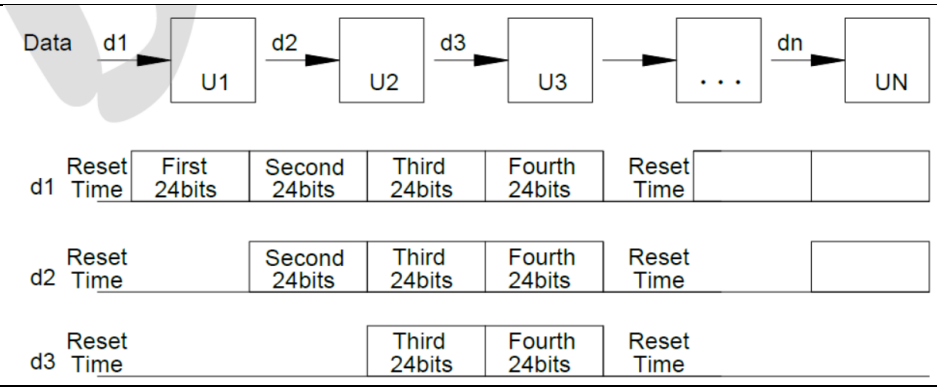
Item	Description	Typical	Allowance
T_{0H}	0 code, high voltage time	0.3μs	±0.15μs
T_{0L}	0 code, low voltage time	0.9μs	±0.15μs
T_{1H}	1 code, high voltage time	0.9μs	±0.15μs
T_{1L}	1 code, low voltage time	0.3μs	±0.15μs
RES	Reset Time	>250μs	---

3. Composition of 24 Bits 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 the next ICLED. The 24-bit data consist of green, red and blue data, each with 8-bit width, and are transferred with MSB first.

4. Data Transmission Method



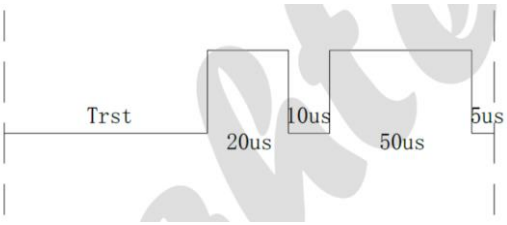
ADVANCED FUNCTION MODE:

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 purposes, 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.

1. Feedback Mode

Command and Wave form: Trst+Th50



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

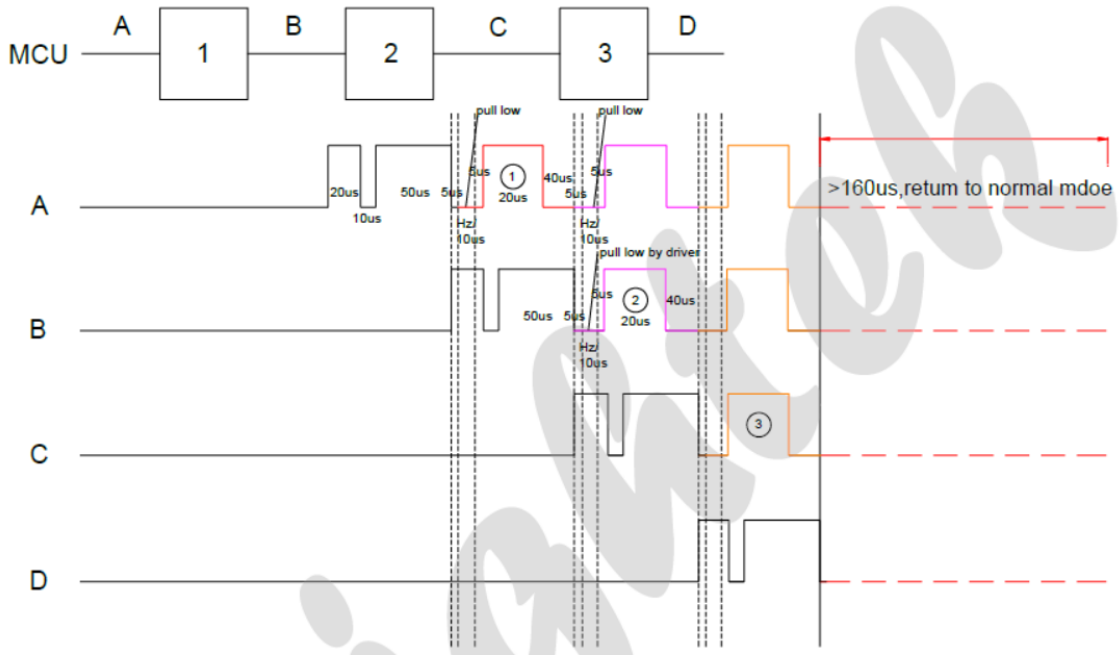
Setup:

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.

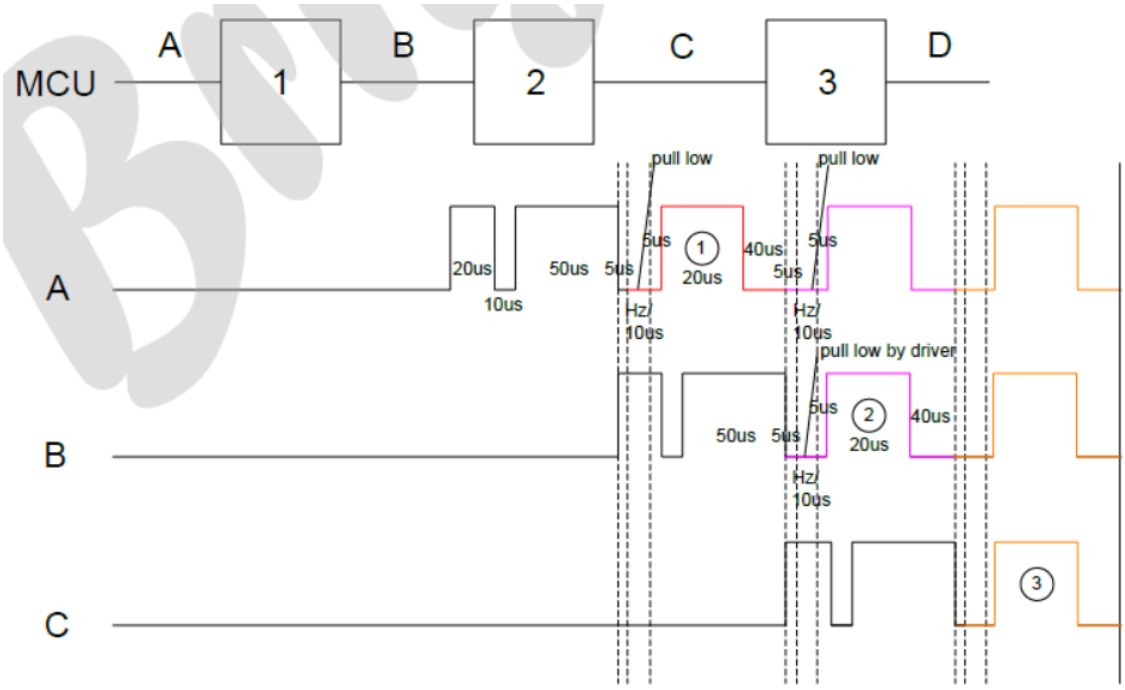
While ICLED or MCU does not receive any “Trev” pulse within 160us, ICLED or MCU will get out of feedback mode and go back to normal function mode. MCU may then determine the following information:

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:



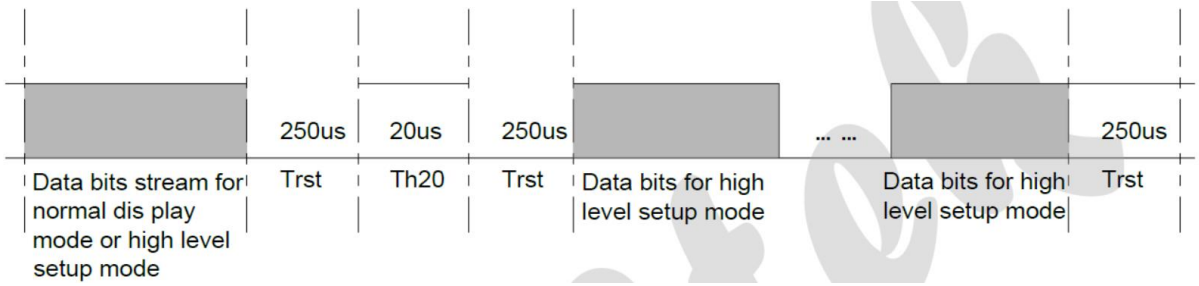
Zoom in:



2. 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.

3. 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>

4. Other Function Supported and Setting in High Level Setup Mode

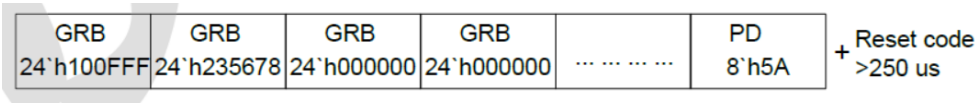
SS<0>	PWM reset and synchronization command setting: 0 non-synchronization (default), 1 synchronized for PWM (PWM internal counter is reset, re-started and synchronized with Trst end point),default =0
SS<2><1>	Reserved
SS<3>	1. display data update and validation: 0 display (PWM data) is valid and synchronized 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

5. Sleep Mode for Power Saving

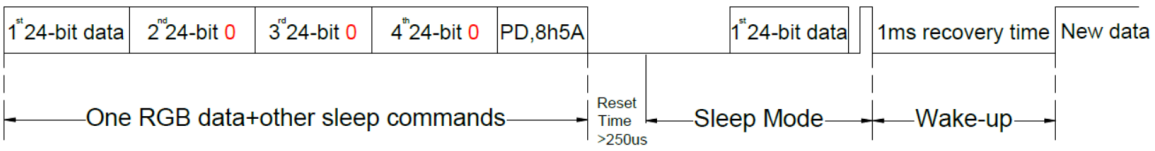
ICLED supports sleep/wake-up modes for power-saving purposes. When receiving 24-bit 0's RGB data, 8-bit 0x5A special data, and a reset command, ICLED will enter sleep mode. In sleep mode, the built-in oscillator and associated circuitry is disabled. The quiescent current of ICLED is approximately 5uA (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 to return 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.



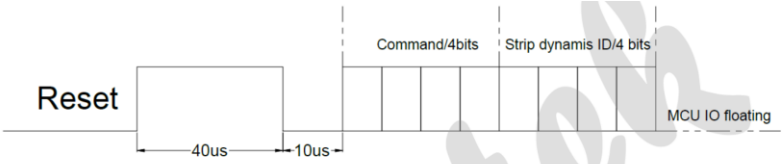
As an example of sleep/wake-up commands shown below, the first ICLED is kept active and the remaining ICLED's enter sleep mode by 24-bit 0's and an ending 0x5A byte. Later on, a positive pulse wakes up all sleeping ICLED's.



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 are 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):

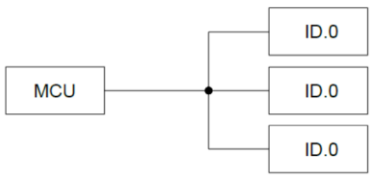
In a multi-strip ICLED LED application, the default dynamic ID number of each strip is 0 after power-on reset. MCU may encode and change the strip dynamic ID by issuing the setup command with 4'b0001 and 4-bit new dynamic ID number (4'b0001~4b'1111). After the command is issued, the leading ICLED of each strip starts the encoding procedure. While some leading ICLED finishes the encoding procedure first, it generates 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 issue 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.

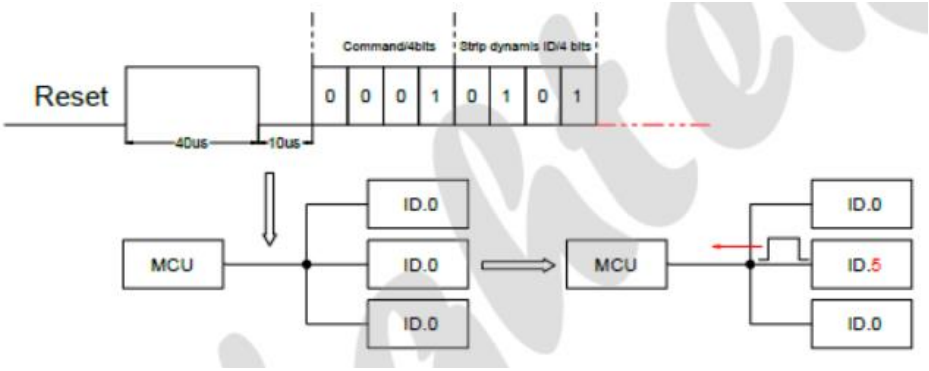
In the multi-strip application, if a strip's leading LED controller is not ICLED (not with set ID feature) or not featured with set_Strip_ID command, MCU may use ID 0 for the strip.

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

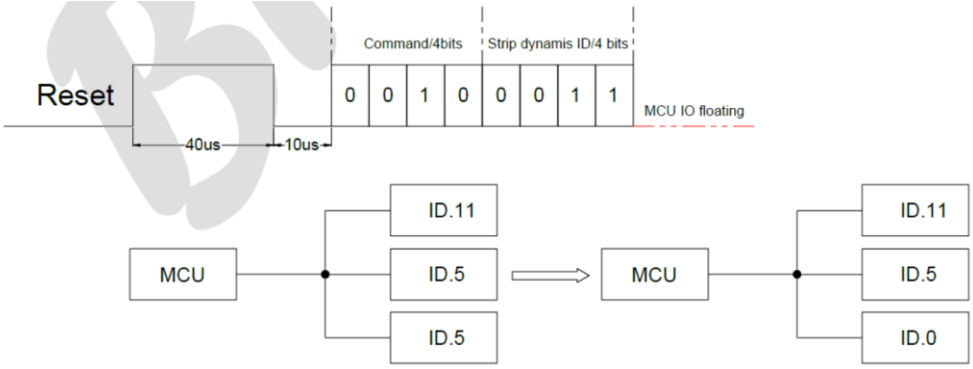
Example: set a strip with dynamic ID



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.

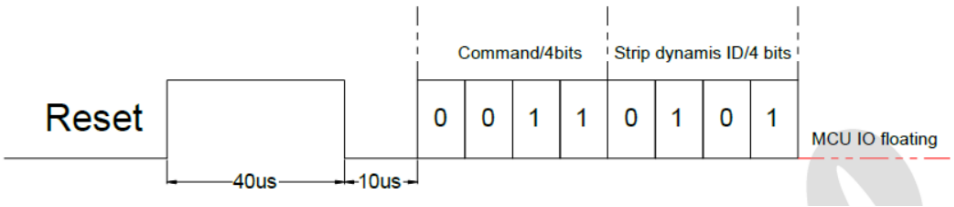
Example: clean the ID of Strip 3 to 0.

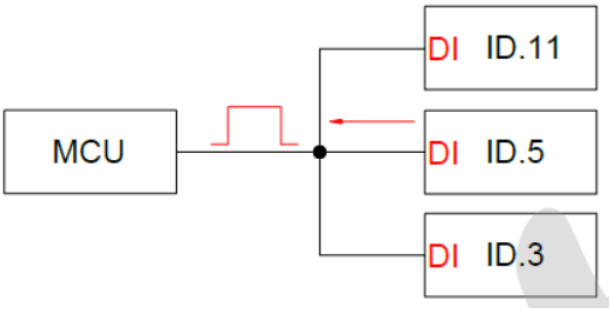


Host MCU can issue clean command + ID="0" to clean all existing dynamic strip IDs in a time

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):

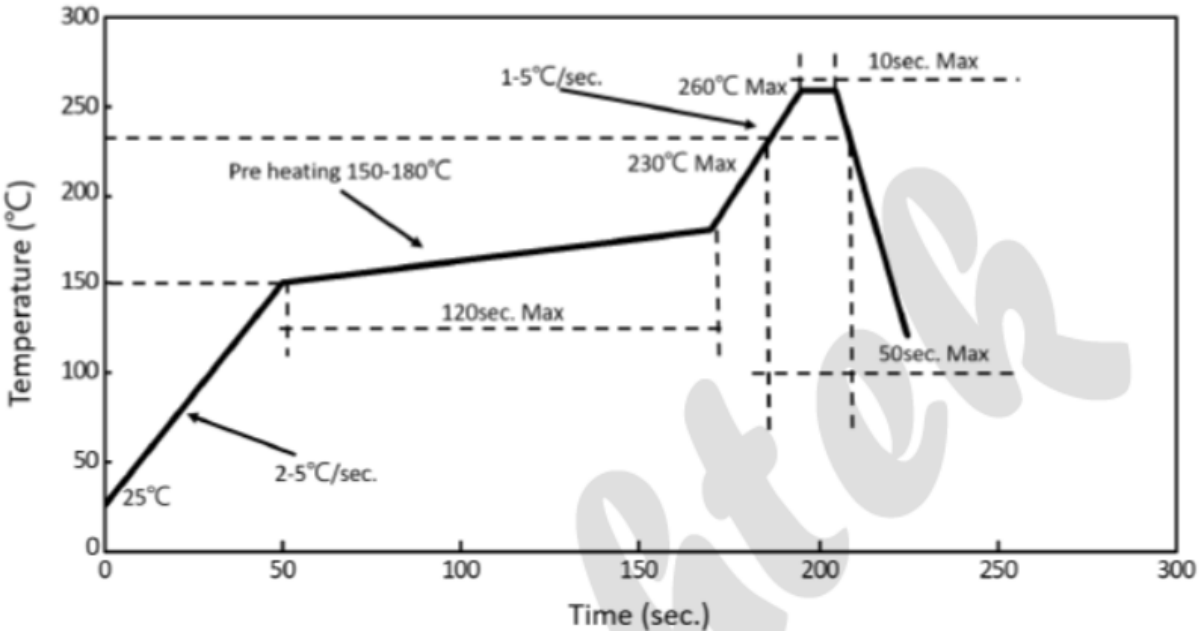
MCU can issue "specify ID command" to force a specific strip to receive RGB display data or execute special actions (such as executing feedback mode command or setup mode command).

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.

RECOMMENDED SOLDERING PROFILE:

Lead-free Solder IR Reflow:



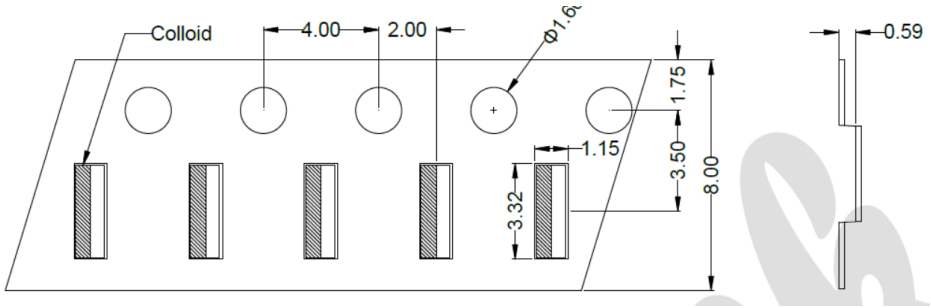
Note:

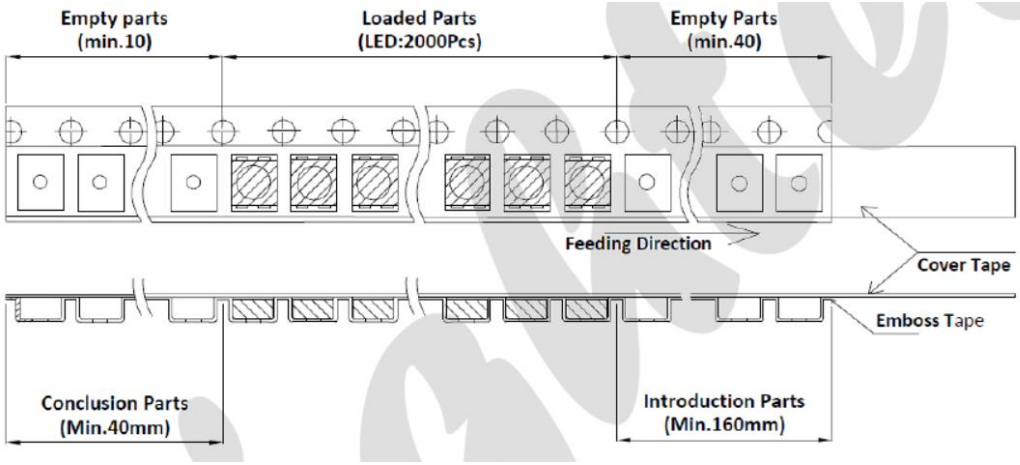
1. We recommend the reflow temperature 240°C (±5°C). The maximum soldering temperature should be limited to 260°C.
2. Maximum reflow soldering: 3 times.
3. Before, during, and after soldering, should not apply stress on the components and PCB board.

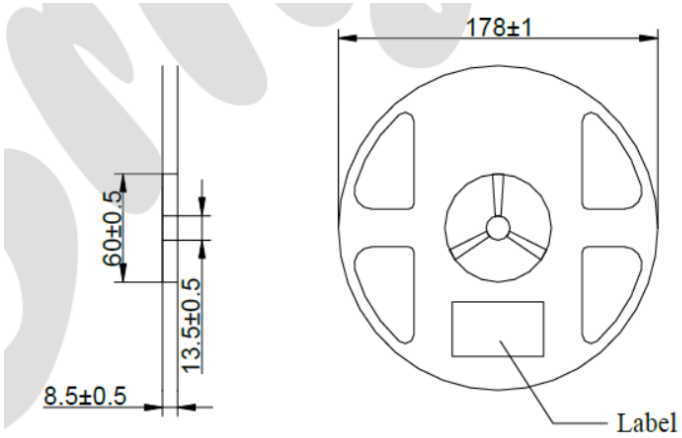
PACKING SPECIFICATION:

Reel Dimension:

Max.2000pcs/reel







PRECAUTIONS OF USE:

Storage:

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

- Humidity: 60% R.H. Max.
- Temperature: 5°C~30°C (41°F ~86°F).

Shelf life in sealed bag: 12 months at 5°C~30°C and <60% R.H.

Once the package is opened, the products should be used within 1 week. Otherwise, they should be kept in a damp-proof box with descanting agent <10% R.H. and apply baking.

Over-Current Proof:

Must apply resistors for protection otherwise slight voltage shift will cause big current change and burn-out will happen.

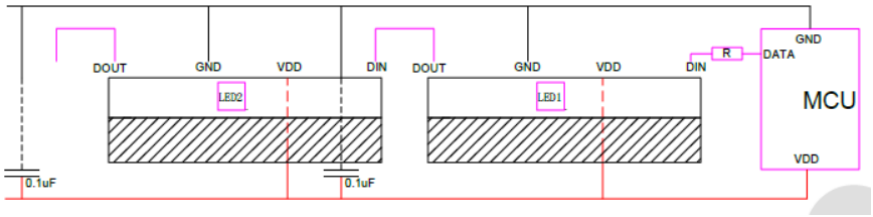
Baking:

It is recommended to bake the LED before soldering if the pack has been unsealed for longer than 24hrs. The suggested baking conditions are as followings:

- 60±3°C x 6hrs and <5%RH, taped / reel package.

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

Typical Application Circuit:



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.

ESD (Electrostatic Discharge):

Static Electricity or power surge will damage the LED. Use of a conductive wrist band or anti-electrosatic glove is recommended when handing the LED all time. All devices, equipment, machinery, work tables, and storage racks must be properly grounded.

REVISION RECORD:

Version	Date	Summary of Revision
A1.0	17/07/2024	Datasheet set-up.
A1.1	30/08/2024	Revised package naming system.
A1.2	19/09/2024	Add polarity mark on drawings.
A1.3	23/09/2024	Revise pin table.
A1.4	11/12/2024	Revised suggested solder pad design.