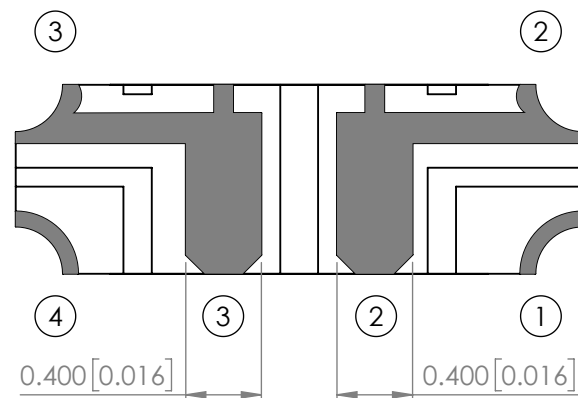
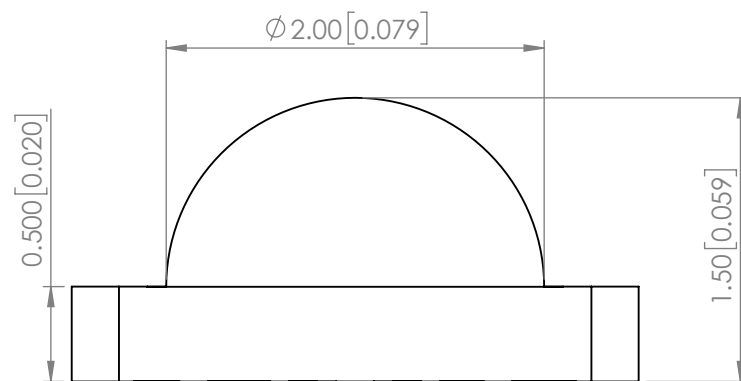
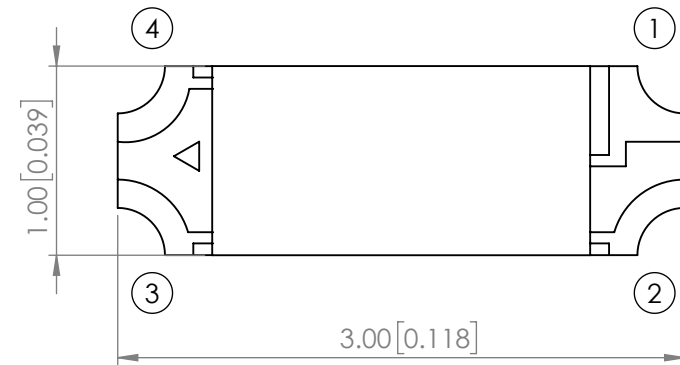
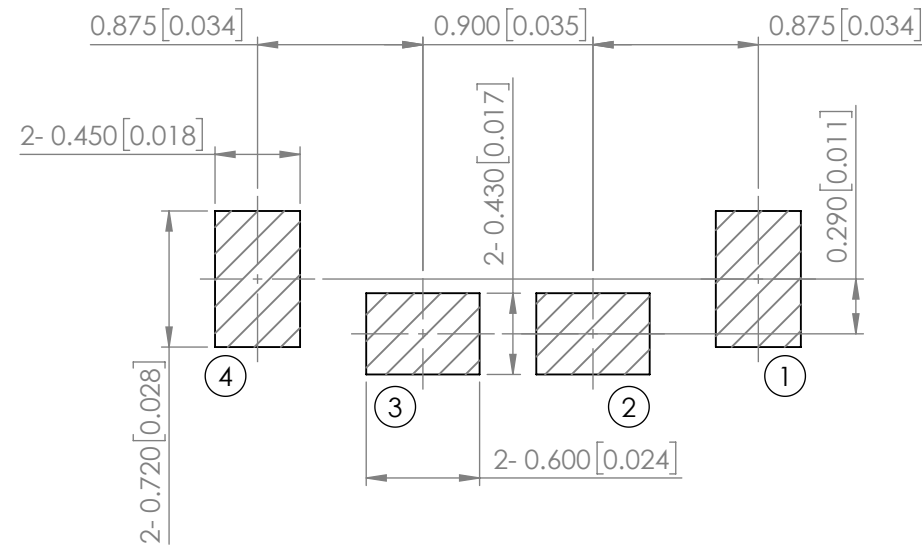


PART NUMBER		SMD-LXR3010RGBSWC	REV	A
REV	E.C.N. NUMBER AND REVISION COMMENTS			DATE
A	ECN-Lumex202300117			11.09.23



RECOMMENDED SOLDER PAD LAYOUT



PIN ASSIGNMENT

PIN NO	SYMBOL	DEFINITION
1	DOUT	DATA OUT
2	GND	GROUND
3	VDD	POWER VOLTAGE
4	DIN	DATA IN

ELECTRICAL CHARACTERISTICS (Ta=-20~+85°C, VDD=5V, VSS=0V)

PARAMETER	MIN	TYP	MAX	UNITS	TEST COND	
SUPPLY VOLTAGE	VDD	3.3	5	5.5	V	-
OUTPUT CURRENT	IoL	-	12	-	mA	-
INPUT VOLTAGE(HIGH)	VIH	2.7	-	VDD	V	-
INPUT VOLTAGE(LOW)	VIL	0	-	1.0	V	-
OPERATION CURRENT	IDD	-	1.2	-	mA	LED NO LOAD

ELECTRO-OPTICAL CHARACTERISTIC TA=25°C

PARAMETER	MIN	TYP	MAX	UNITS	TEST COND
PEAK WAVELENGTH*	R	-	630	-	nm
	G	-	520	-	
	B	-	470	-	
WHITE COLOR CHROMATICITY COORDINATES	X	-	0.26	-	@VDD=5V OUT_R/G/B [7:0]= 8b'11111111
	Y	-	0.30	-	
LUMINOUS INTENSITY	R*	-	215	-	mcd
	G*	-	725	-	
	B*	-	85	-	
	W	-	918	-	
VIEWING ANGLE	-	120	-	2x theta1/2	
EMITTED COLOR	RED / GREEN / BLUE				
EPOXY LENS FINISH	WATER CLEAR				

*JUST FOR REFERENCE

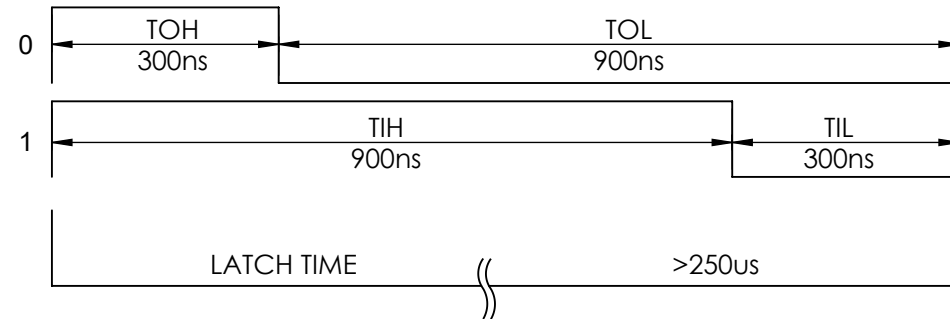
ABSOLUTE MAXIMUM RATINGS TA=25°C

PARAMETER	MAX	UNITS
SUPPLY VOLTAGE	VDD	6.5
FORWARD CURRENT	IF	25
CLOCK FREQUENCY	CLK	800
INTERNAL SCAN FREQUENCY	-	800
STORAGE TEMPERATURE	-	-40 TO +90
OPERATING TEMPERATURE	-	-20 TO +85

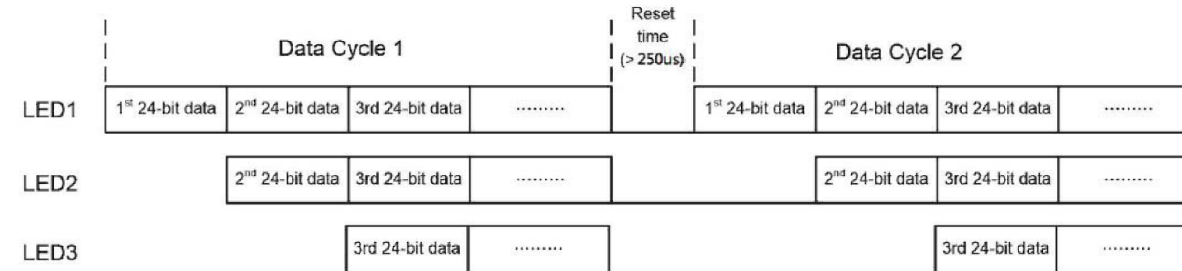
MOISTURE SENSITIVE DEVICE
PER JEDEC LEVEL 3 STANDARDS

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TIMING WAVE FORM



DATA TRANSFER PROTOCOL



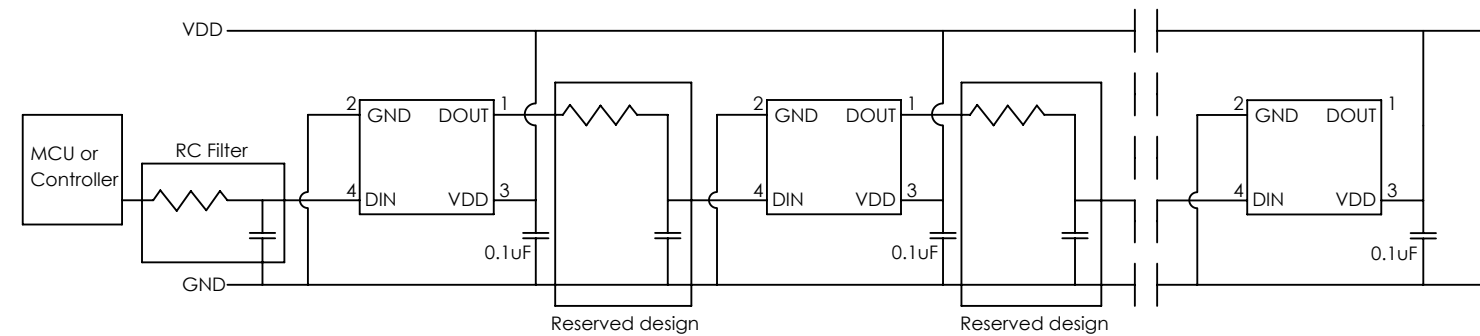
SINGLE DATA IN 24BIT FOR RGB



HIGH SPEED MODE

ITEM	DESCRIPTION	TYP.	ALLOWANCE
T0H	0 CODE, HIGH-LEVEL TIME	300ns	±150ns
T0L	0 CODE, LOW-LEVEL TIME	900ns	±150ns
T1H	1 CODE, HIGH-LEVEL TIME	900ns	±150ns
T1L	1 CODE, LOW-LEVEL TIME	300ns	±150ns
LATCH	LATCH TIME	>250us	-

5V APPLICATION CIRCUIT

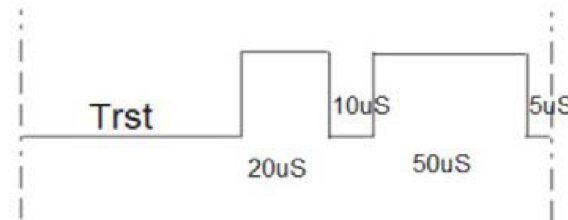


Note: RC Filter and R1 must be added or reserved on the board for better waveform of signals in different applications. The suggested value of R1 is 10KΩ~100KΩ. The value is subject to the practical system environment.

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Enable feedback mode

Command and Waveform: 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 \pm 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 SMD-LXR3010RGBSWCTR. Once SMD-LXR3010RGBSWCTR 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 Dout.

Then SMD-LXR3010RGBSWCTR waits for 10us and generates a positive pulse with width "Trev" on Din port, either back to MCU GPIO port or to the Dout port of the predecessor SMD-LXR3010RGBSWCTR (the detailed waveform is shown as below).

If SMD-LXR3010RGBSWCTR receives a "Trev" waveform on Dout 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 SMD-LXR3010RGBSWCTR chips on the LED strip.

While SMD-LXR3010RGBSWCTR or MCU does not receive any "Trev" pulse within 160us, SMD-LXR3010RGBSWCTR or MCU will get out of feedback mode and go back to normal function mode. MCU may then determine the following information:

- the number of cascaded SMD-LXR3010RGBSWCTR's on the LED strip.
- the high pulse width in the "Trev" waveform denotes the maximum sink current of the G/R/B channel in SMD-LXR3010RGBSWCTR (20us high pulse for 12mA sink current, 10us for 5mA).

High Level Setup Mode

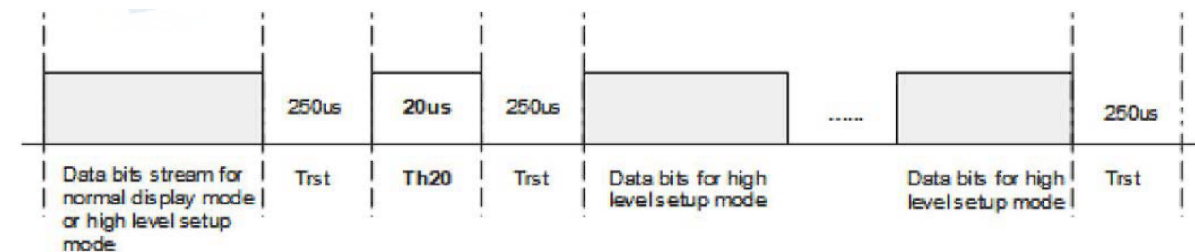
Data format of high level setup mode :

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 1st chip+ 24bits data of 2nd 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.

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 <p>425 N. GARY AVE. CAROL STREAM, IL 60188 PHONE : 800-278-5666 FAX : 630-315-2150 WEB : WWW.LUMEX.COM</p>	3.0(L)*1.0(W)*1.5(H)mm, SURFACE MOUNT SIDE VIEW LED, RGB FULL COLOR, 8-BIT PWM FOR EACH RGB CHIP, SIGNAL-WIRE LINE, WATER CLEAR LENS, TAPE & REEL.	DATE : 2023.11.09	DRAWN BY : T.S.	
	THE SPECIFICATIONS MAY CHANGE AT ANY TIME WITHOUT NOTICE.	PAGE : 3 OF 7	CHKD BY : E.C.	
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Current Gain Control

MCU can issue commands to program and adjust the maximal sink current capability of G/R/B channel individually of SMD-LXR3010RGBSWCTR in the high level setup mode.

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

$$I_o = I_m * (15.5 + 0.5 * G[0] + 1 * G[1] + 2 * G[2] + 4 * G[3] + 8 * G[4]) / 31$$

$I_m = 12mA$

Default Value: $G<4:0> = 1F$; $R<4:0> = 1F$; $B<4:0> = 1F$;

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	SS	0	G	G	G	G	G	SS	SS	SS	R	R	R	R	R	SS	SS	SS	B	B	B	B	B
<->	<->		<->	<->	<->	<->	<->	<->	<->	<->	<->	<->	<->	<->	<->	<->	<->	<->	<->	<->	<->	<->	<->

The 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>	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 0)

Sleep mode for power saving

SMD-LXR3010RGBSWCTR 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, SMD-LXR3010RGBSWCTR will enter sleep mode. In sleep mode, the built-in oscillator and associated circuitry is disabled. The quiescent current of SMD-LXR3010RGBSWCTR is approximately 5uA (typ) in sleep mode.

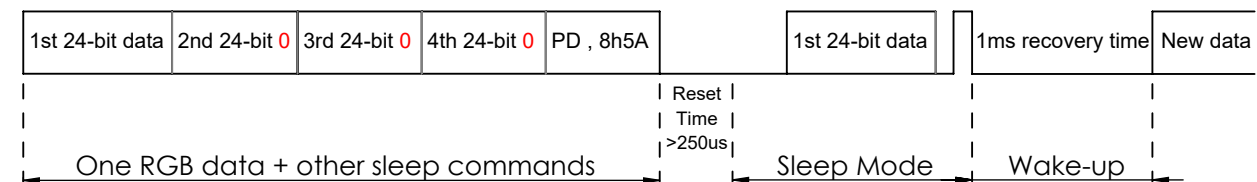
A sleeping SMD-LXR3010RGBSWCTR wakes up from sleep mode when detecting an input rising edge on Din pin. Normally a positive pulse on Din pin can be used as a wake-up trigger. After waking up, all sleeping circuits in SMD-LXR3010RGBSWCTR return to normal working mode within 1ms.

To wake-up the next cascaded SMD-LXR3010RGBSWCTR, the received positive pulse on Din pin is passed to Dout pin, which connected to Din pin of the next SMD-LXR3010RGBSWCTR, and in turn wakes up the next SMD-LXR3010RGBSWCTR. Hence, all cascaded sleeping SMD-LXR3010RGBSWCTR can wake up successively.

Since it takes 1ms for a sleeping SMD-LXR3010RGBSWCTR 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 SMD-LXR3010RGBSWCTR active, while the others in sleep mode. As an example, the following commands are for two leading active SMD-LXR3010RGBSWCTR and other sleeping SMD-LXR3010RGBSWCTR.



As an example of sleep/wake-up commands shown below, the first SMD-LXR3010RGBSWCTR is kept active and the remaining SMD-LXR3010RGBSWCTR enter sleep mode by 24-bit 0's and an ending 0x5A byte. Later on, a positive pulse wakes up all sleeping SMD-LXR3010RGBSWCTR.

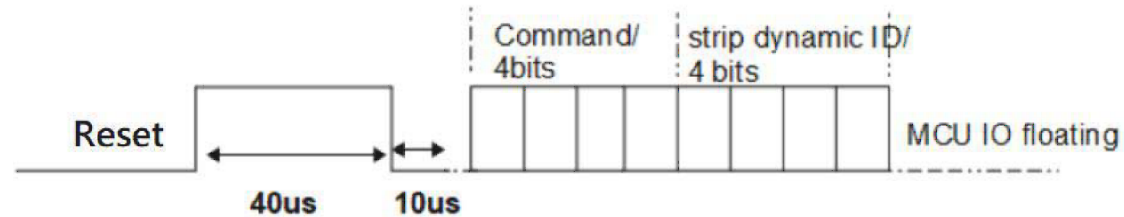


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Control Commands for multiple strips connected parallelly

SMD-LXR3010RGBSWCTR 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 :



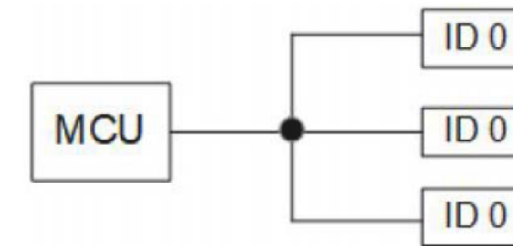
Command	Strip dynamic ID(4-bit)
4'b0001	Set_ID (1~15)
4'b0010	Clean_ID (1~15)
4'b0011	Check_ID (1~15)
4'b0100	Specify_ID(assign a specific strip to receive data)

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

In a multi-strip SMD-LXR3010RGBSWCTR 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 SMD-LXR3010RGBSWCTR of each strip starts the encoding procedure. While some leading SMD-LXR3010RGBSWCTR 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 SMD-LXR3010RGBSWCTR 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 SMD-LXR3010RGBSWCTR 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 SMD-LXR3010RGBSWCTR.

In the multi-strip application, if a strip's leading LED controller is not SMD-LXR3010RGBSWCTR (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 SMD-LXR3010RGBSWCTR, 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 SMD-LXR3010RGBSWCTR.



After power-on reset, the default strip dynamic ID is "0" for each leading SMD-LXR3010RGBSWCTR.

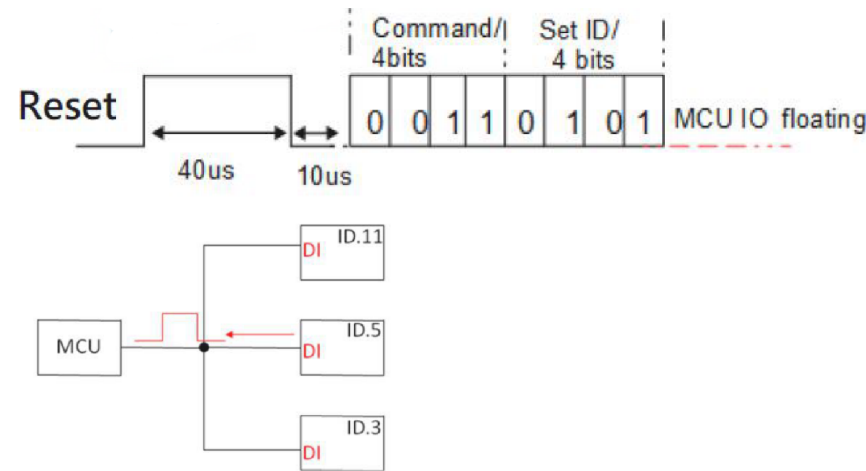
Command to clean dynamic strip ID /CLN_ID(4'b0010):

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

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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 SMD-LXR3010RGBSWCTR 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)



Feedback the fixed strip ID

SMD-LXR3010RGBSWCTR also features the function and capability to feedback the fixed strip ID.

Command to feedback fixed strip ID

1. Execute “specify dynamic ID command” first and specify the specific strip to accept the following command.
2. Issue feedback mode command to get the information, what’s the numbers to be connected in this strip.
3. Then issue “high level setup mode” command and data with SS<6> bit =“1” for each chip in the strip.
4. Execute “feedback mode command”
5. The DI port of leading SMD-LXR3010RGBSWCTR will generate and feedback “M” pulses if there are “M” numbers of SMD-LXR3010RGBSWCTR cascaded on the LED strip. 10us high pulse in each 80us period is denoted as “0”, otherwise, 40us high pulse within 80us is denoted as “1”. Note: data “0” or “1”is random for each SMD-LXR3010RGBSWCTR chip.
6. While MCU does not receive any high pulse within 160us, MCU and SMD-LXR3010RGBSWCTR should get out of feedback mode and go back to normal function mode.
7. MCU collects and combines the feedback data string of “0” or “1” in order ,that is coming from each SMD-LXR3010RGBSWCTR on the strip to be a serial number, the serial number is to stand for the fixed strip ID for this strip.
8. Repeatedly issue the commands from item 1 to 7 to get the fixed strip ID number of strips for each strip. Appropriate combination of dynamic ID and fixed ID information of LED strips in system, users can flexibly design the light effects with limited software efforts.

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

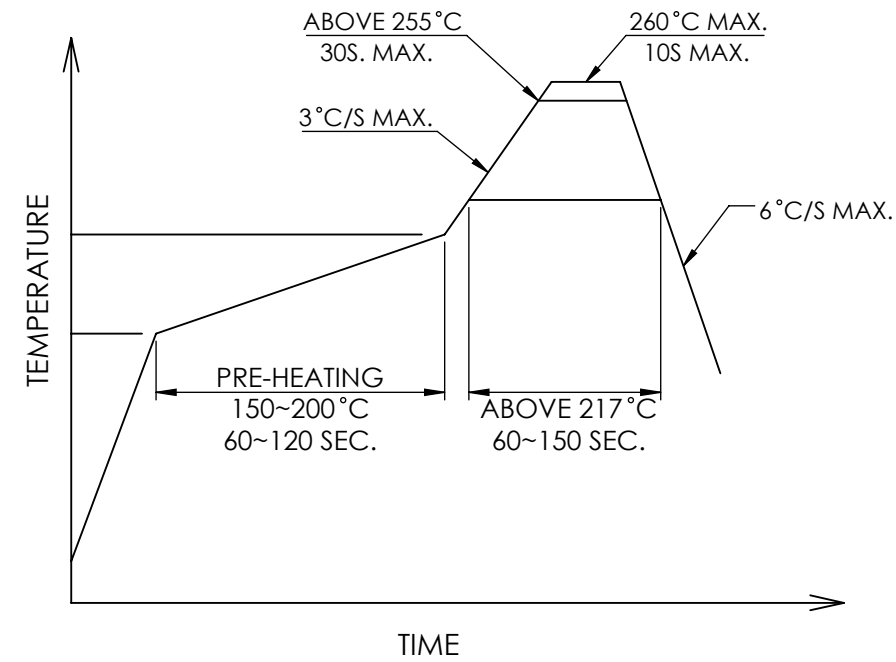
MCU can issue “specify ID command “to force a specific strip to receive RGB display data or execute special actions (such as executing feedback mode command or setup mode command). On the other hand, MCU also can issue broadcast command by “specify command + ID=“0”/4'b000 “ to force all existing dynamic 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.

Recommendation to execute the feedback mode command as follows:

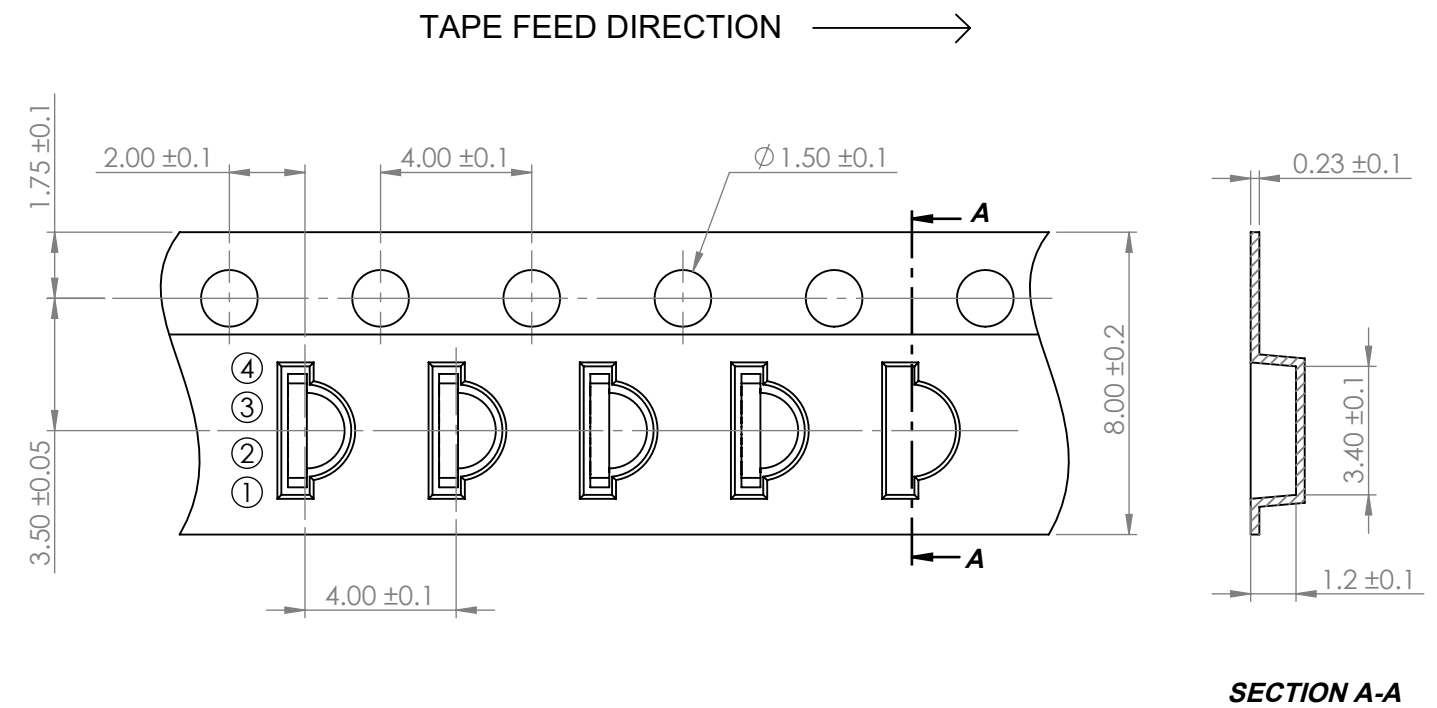
1. After the power-on reset, MCU execute set ID command first to obtain the unique ID for every strip with leading SMD-LXR3010RGBSWCTR.
2. After the ID assignment process is done, MCU sequentially issues the specify command to the target strip, and then issues the feedback command with pulse of 12us+10us+50us (only the strip that conforms to the ID number will perform the feedback action).
3. After finishing the feedback mode actions for all SMD-LXR3010RGBSWCTR strips, then MCU re-issues the feedback mode with pulse width of “20us+10us+50us” to check if there is any strip with leading AP6112.

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PROFILE




CARRIER TAPE DIMENSION



NOTE:
1. PACKAGE: 2000 PCS/REEL

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	THE SPECIFICATIONS MAY CHANGE AT ANY TIME WITHOUT NOTICE.	PAGE : 7 OF 7	CHKD BY : E.C.	
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