ALED

Product Data Sheet

LTSA-E35BCEGBW

(Preliminary)

Spec No.：

Created Date: 2023/07/26.

Revision: 4.0

BNS-OD-FC001/A4

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LTSA-E35BCEGBW (Preliminary)

Rev	Description	By	Date
1.0	New data sheet	Ian Ding	2023/07/26
2.0	Add Current Consumption & temperature change curve	Ian Ding	2023/09/26
3.0	Add non-linear compensation curve	Ian Ding	2023/10/06
4.0	Add Functional Description & PWM Description	Ian Ding	2023/10/24
Above data for PD and Customer tracking only			

Customer Name:

Customer Signature: **Print Name:**

LiteON Sales Signature: **Print Name:**

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1.1. Description

SMD LEDs from Lite-On are available in miniature sizes and special configurations for automated PC board assembly and space-sensitive applications. These SMD LEDs are suitable for use in a wide variety of Automotive.

1.1 Features

- Meet RoHS
- Package in 12mm Tape On 7" Diameter Reels
- Ultra Bright InGaN / AlInGaP LED Chips
- Preconditioning: Accelerate to JEDEC Level 2
- Compatible with Automatic Placement Equipment
- Compatible with Infrared Reflow Solder Process
- Serial communication with ISELED compliance.
- Bi directional, half-duplex, 2MBit/s, serial communication
- 8 bit brightness resolution for red, green, and blue LED
- Temperature compensation on red for constant brightness.
- Maximum of 4079 LED's in one chain.
- Qualification is based on AEC-Q102 and driving IC: AEC-Q100.

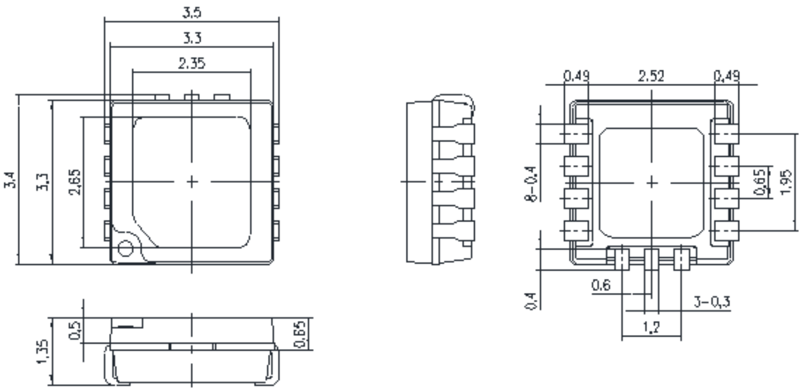
1.2 Applications

- Automotive: accessary applications

ISELED®

2.2. Package Dimensions\Pin Configuration

2.1 Package Dimension

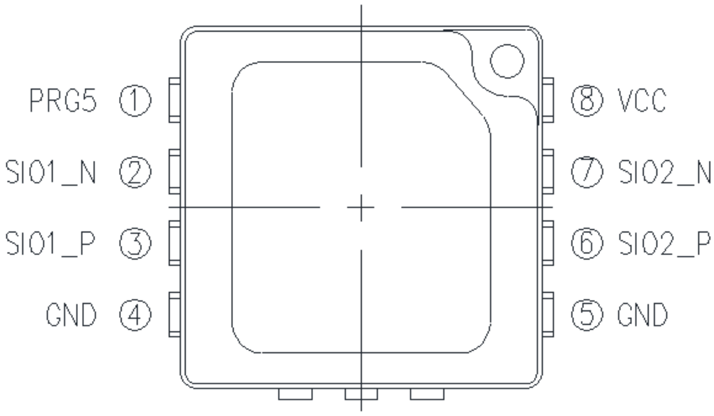


Part No.	Lens Color	Source Color
LTSA-E35BCEGBW	Diffused	AlInGaP Red
		InGaN Green
		InGaN Blue

Notes:

1. All dimensions are in millimeters.
2. Tolerance is ±0.2 mm (.004") unless otherwise noted

2.2 Pin configuration



PIN No.	Symbol	Function description
1	PRG5	Ground (for LED manufacture)
2	SIO1_N	Serial Communication Master Side, Negative
3	SIO1_P	Serial Communication Master Side, Positive
4	GND	Ground
5	GND	Ground
6	SIO2_P	Serial Communication Slave Side, Positive
7	SIO2_N	Serial Communication Slave Side, Negative
8	Vcc_5V	IC Power Supply (5V)

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3. Rating and Characteristics

3.1 Absolute Maximum Ratings at Ta=25°C

Parameter	Symbol	Rating	Unit
IC Supply Voltage	Vcc	4.5~5.5	V
Junction Temperature	Tj	125	°C
ESD-withstand voltage (HBM, Class H1C) acc. to AEC-Q101-001	V_{HBM}	2	kV
Storage Temperature Range	-40 ºC to + 125 ºC		
Infrared Soldering Condition	260 °C For 10 Seconds		

3.2 Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Unit
Vcc Voltage	4.5	5.0	5.5	V
VSIO1_P, VSIO1_N (Serial IO Voltage)	4.5	5.0	5.5	V
Ambient Temperature	-40		110	°C

3.3 Thermal Characteristics

Parameter	Symbol		TYP.			MAX.			Unit
			Red	Green	Blue	Red	Green	Blue	
Thermal Resistance (Junction – Solder Point)[Note]	$R_{th\ JS}$	1chip	-	-	-	125	133	105	°C /W
Junction Temperature	T_J		-	-	-	125			°C

Note: $R_{th\ JA}$ Measurement Condition

Substrate: FR4 (t=1.6mm) / Pattern Size: 16mm^2

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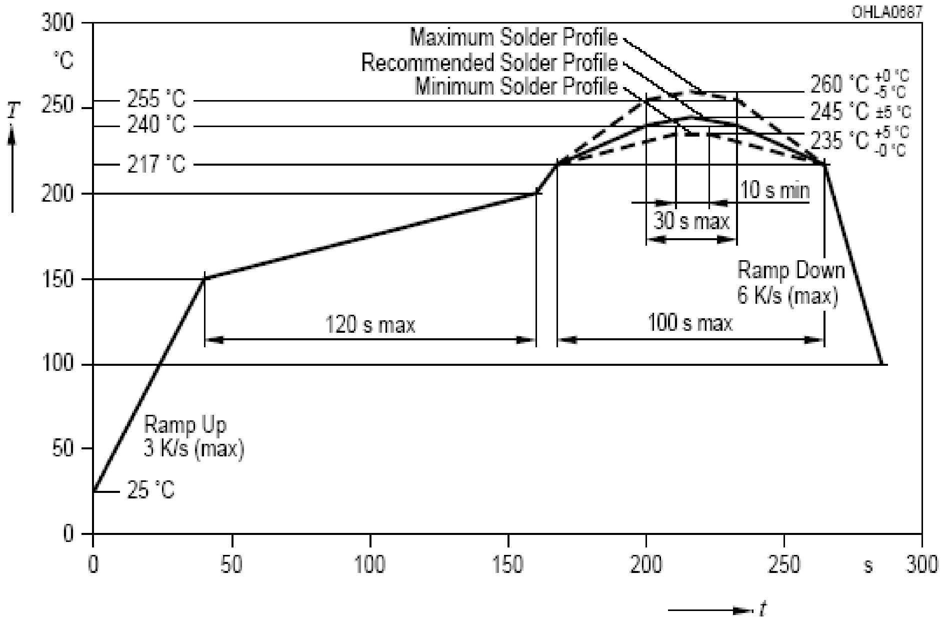
3.4 Suggest IR Reflow Condition for Pb Free Process:

IR-Reflow Soldering Profile for lead free soldering (Acc. to J-STD-020B)



3.5 Electrical / Optical Characteristics at Ta=25°C

Parameter	Symbol	MIN	TYP.	MAX	Unit	Test Condition (IC output)
Supply Voltage	Vcc	4.5		5.5	V	
Luminous Intensity, R	Iv_R		470		mcd	(255 ,0 ,0)
Luminous Intensity, G	Iv_G		1050		mcd	(0 ,255 ,0)
Luminous Intensity, B	Iv_B		70		mcd	(0 ,0 ,255)
Luminous Intensity	Iv		1600		mcd	(255, 255, 255)
Chromaticity Coordinates	x	-	0.3127	-		Note 5
	y	-	0.3290	-		
Dominant Wavelength, R	λD_R		622		mm	(255 ,0 ,0)
Dominant Wavelength, G	λD_G		527		mm	(0 ,255 ,0)
Dominant Wavelength, B	λD_B		461		mm	(0 ,0 ,255)
Viewing Angle	$2\theta_{1/2}$	120			deg	Note 2(Fig.4)

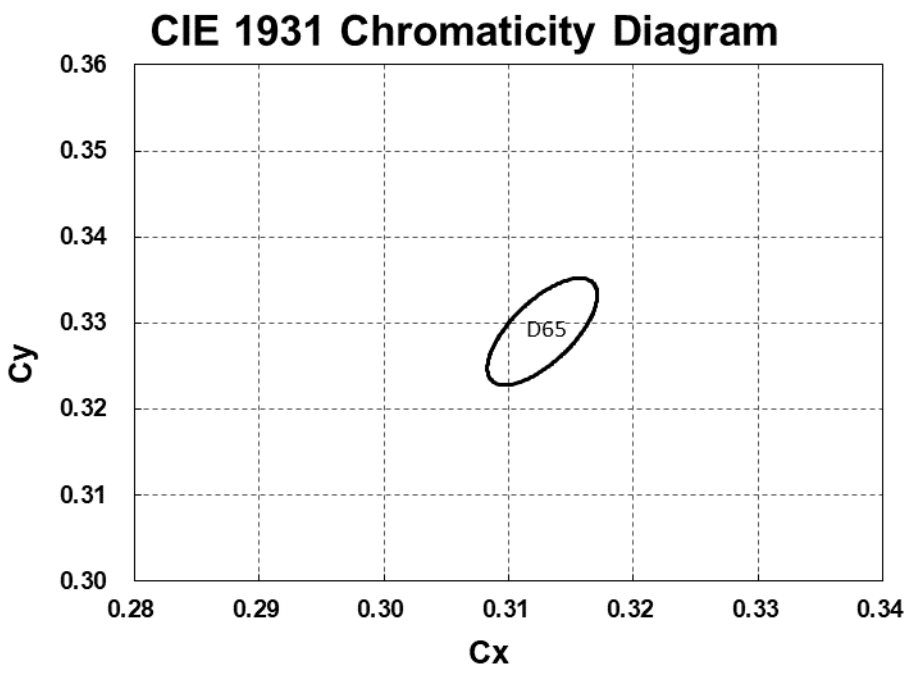
Notes:

1. Luminous intensity is measured with a light sensor and filter combination that approximates the CIE eye-response curve.
2. θ1/2 is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
3. Tolerance of measured luminous intensity: ±10%.
4. Tolerance of dominant wavelength : ±1nm.
5. Tolerance of chromaticity coordinate : ±0.01.
6. Test condition is based on the command digLED_Set_RGB(x,x,x).

3.6 Current Consumption

Parameter	Symbol	MIN	TYP.	MAX	Unit
Red	I_average	-	11.2	15.0	mA
Green	I_average	-	10.3	17.0	mA
Blue	I_average	-	4.9	6.8	mA
Driver	I_drv	0.9	1.2	1.5	mA

3.7 Color Coordinate



Rank	Description	CIE-x	CIE-y	a	b	Theta
D65	Macadams 3 steps	0.3127	0.3290	0.00669	0.00285	58.57

3.8 Power on Reset

Parameter	Min.	Typ.	Max.	Unit
Vcc	4.0	4.2	4.4	V

4. Product Naming Rule

(25℃ Ambient Temperature Unless Otherwise Noted)

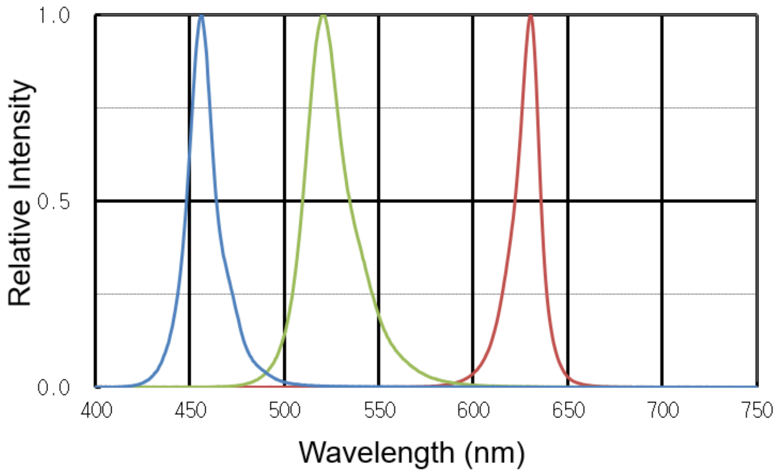


Fig. 1 Relative Intensity V.S. Wavelength

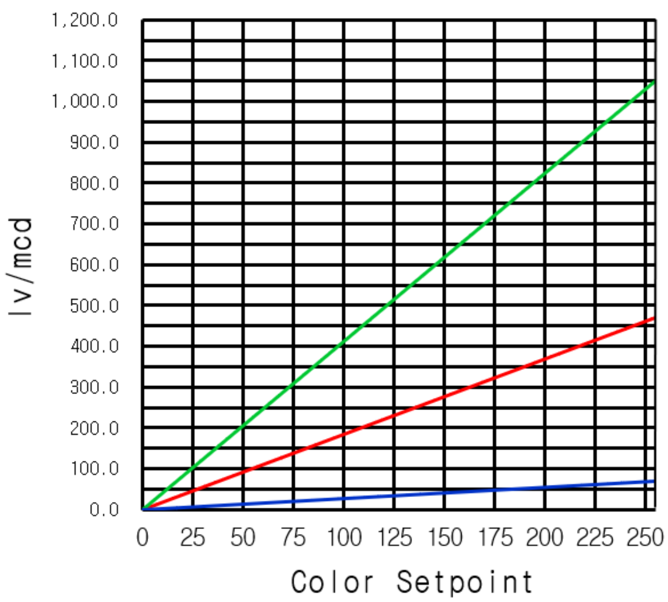


Fig. 2 Relative Luminous Intensity V.S. Color Set point

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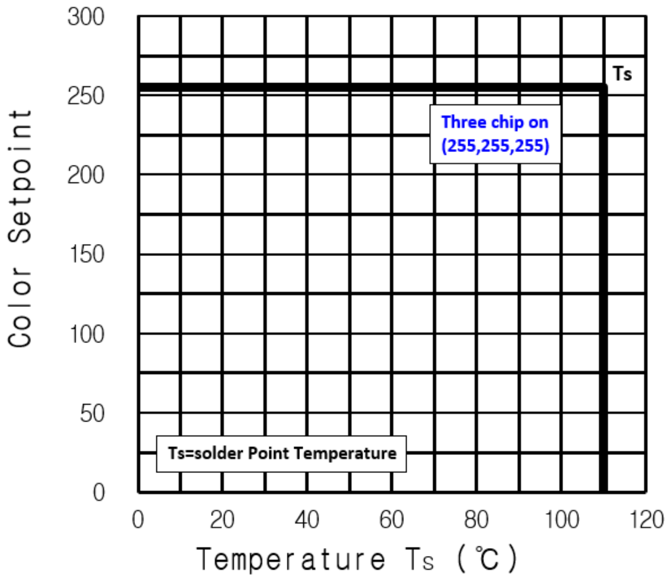

Fig.3 Maximum Color Setpoint
V.S. Temperature

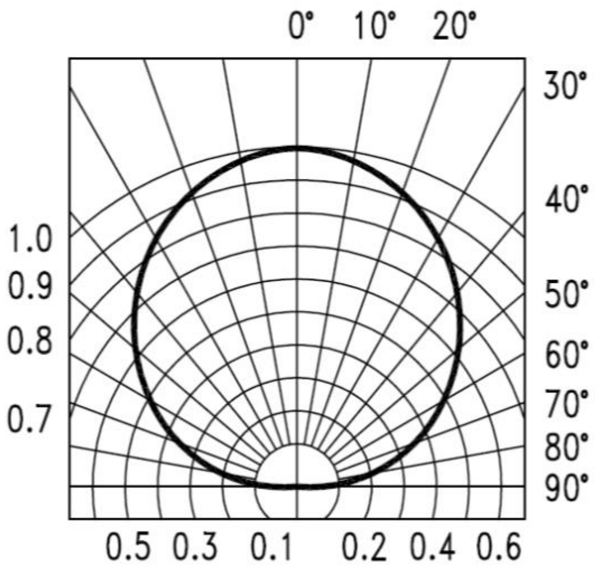

Fig.4 Spatial Disiribution

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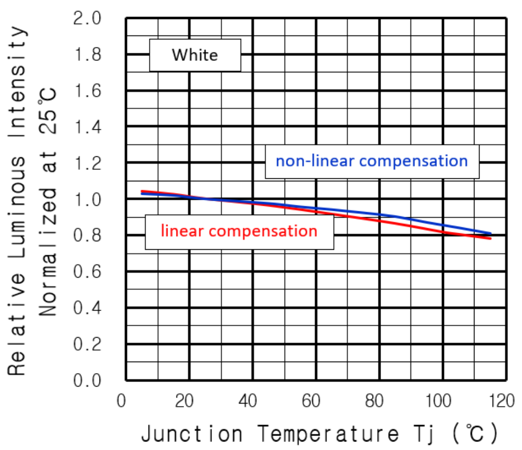
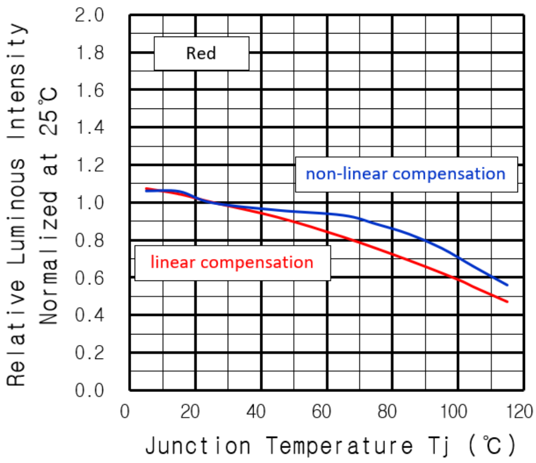
Relative Luminous Intensity V.S. Junction Temperature

Iv/Iv(25℃)=f((Tj), Color set point(255, 255, 255)



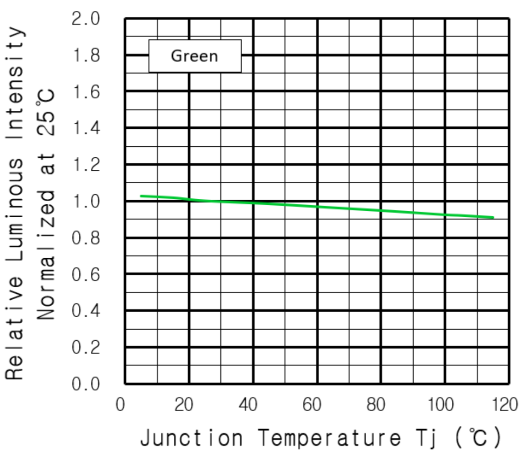
Relative Luminous Intensity V.S. Junction Temperature

Iv/Iv(25℃)=f((Tj), Color set point(255, 0, 0)



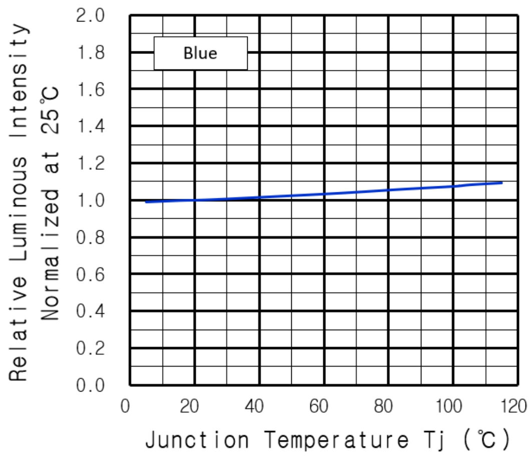
Relative Luminous Intensity V.S. Junction Temperature

Iv/Iv(25℃)=f((Tj), Color set point(0, 255, 0)



Relative Luminous Intensity V.S. Junction Temperature

Iv/Iv(25℃)=f((Tj), Color set point(0, 0, 255)



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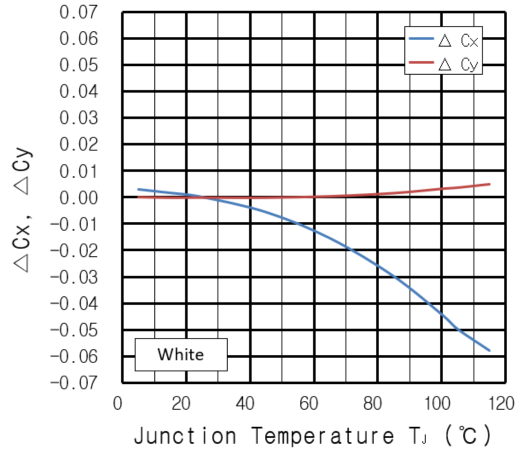
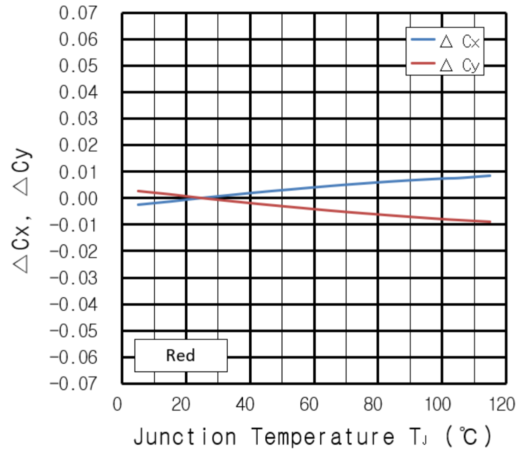
Chromaticity Coordinate Shift V.S. Junction Temperature

△Cx,△Cy,(25℃)=f((Tj), Color set point(255, 255, 255)
linear compensation



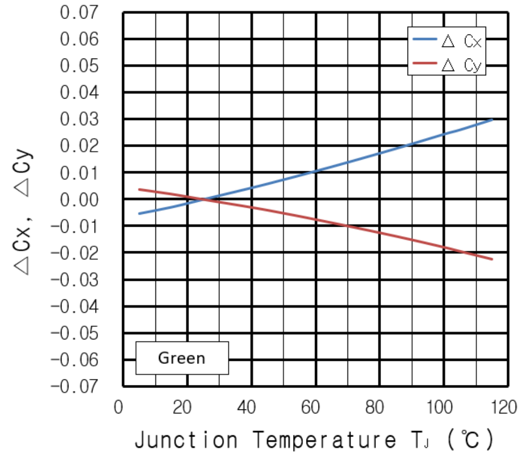
Chromaticity Coordinate Shift V.S. Junction Temperature

△Cx,△Cy,(25℃)=f((Tj), Color set point(255, 0, 0)



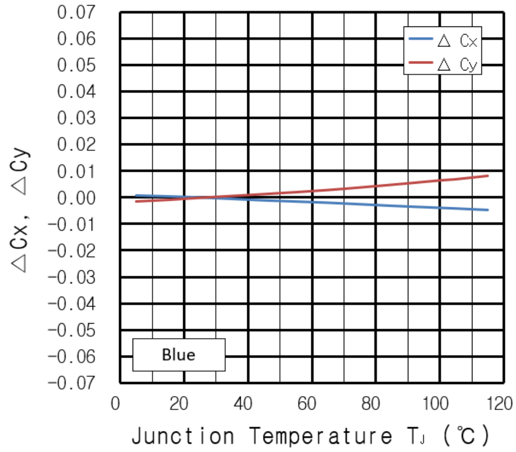
Chromaticity Coordinate Shift V.S. Junction Temperature

△Cx,△Cy,(25℃)=f((Tj), Color set point(0, 255, 0)

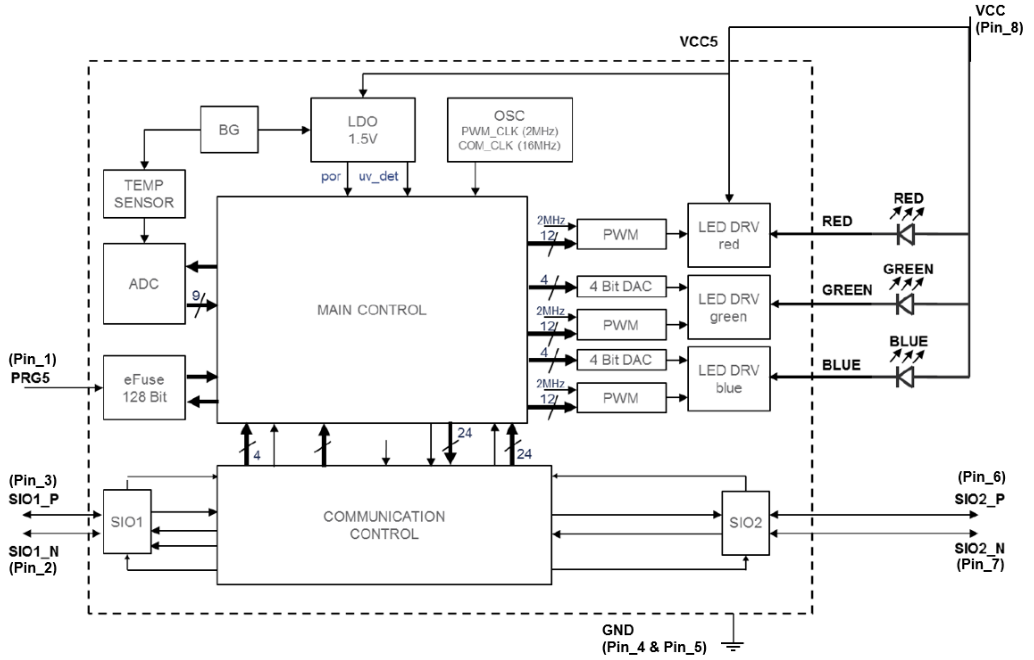


Chromaticity Coordinate Shift V.S. Junction Temperature

△Cx,△Cy,(25℃)=f((Tj), Color set point(0, 0, 255)



5. Functional Block Diagram



The device implements a communication for the reception of control commands and for providing device status and configuration data. Low side, configurable constant current sinks are provided for controlling 3 LEDs (RGB).

The Main Unit computes the PWM duty cycles from the incoming commands and applies the corresponding control values to the three PWM units.

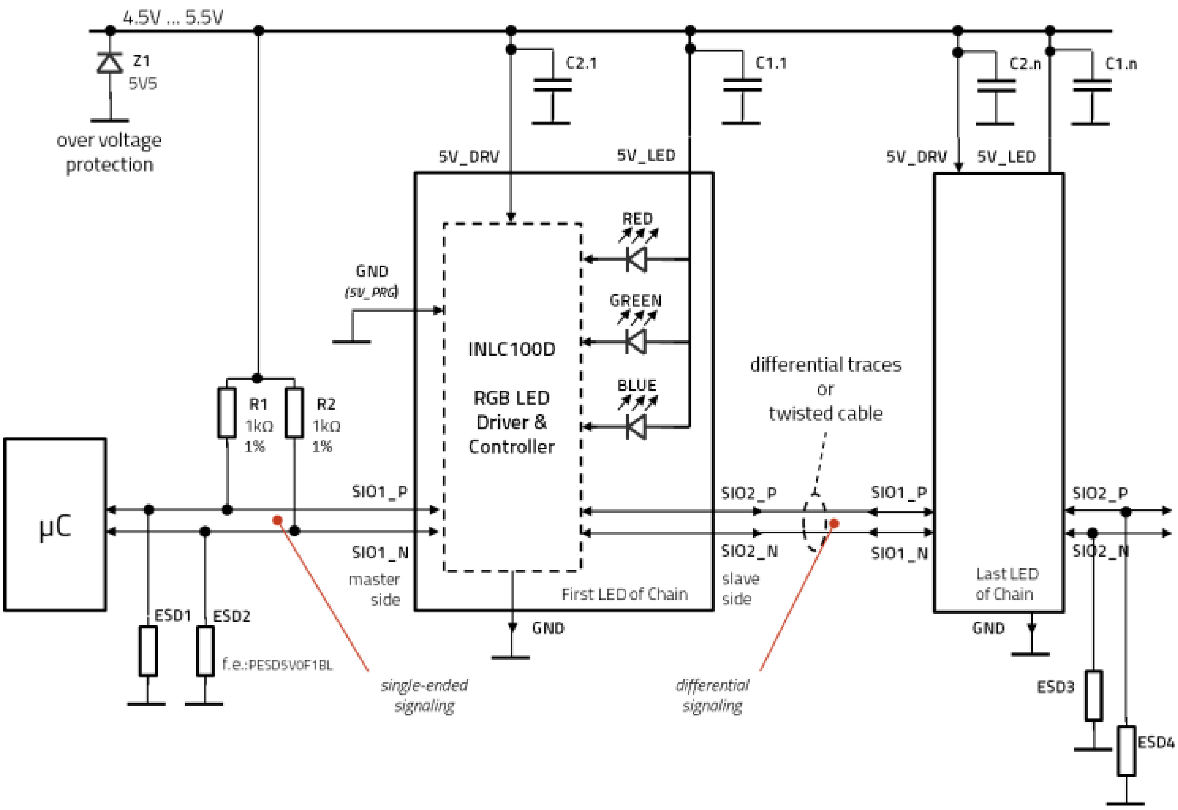
The Main Unit is also in charge of a periodic temperature measurement and an appropriate duty cycle adjustment for the red PWM channel.

The actual device temperature is obtained via an integrated analog-digital converter (ADC).

Besides the temperature the ADC can also measure various other analog values. These measurements are always triggered by a command from the host. The result of the corresponding A/D conversion is also retrieved by a host command. As each device is individually calibrated to compensate for production variations, the corresponding parameters can be stored in an on-die non-volatile memory.

This one-time-programmable memory (OTP) is read at hardware reset and the parameters are copied from the OTP to directly accessible registers.

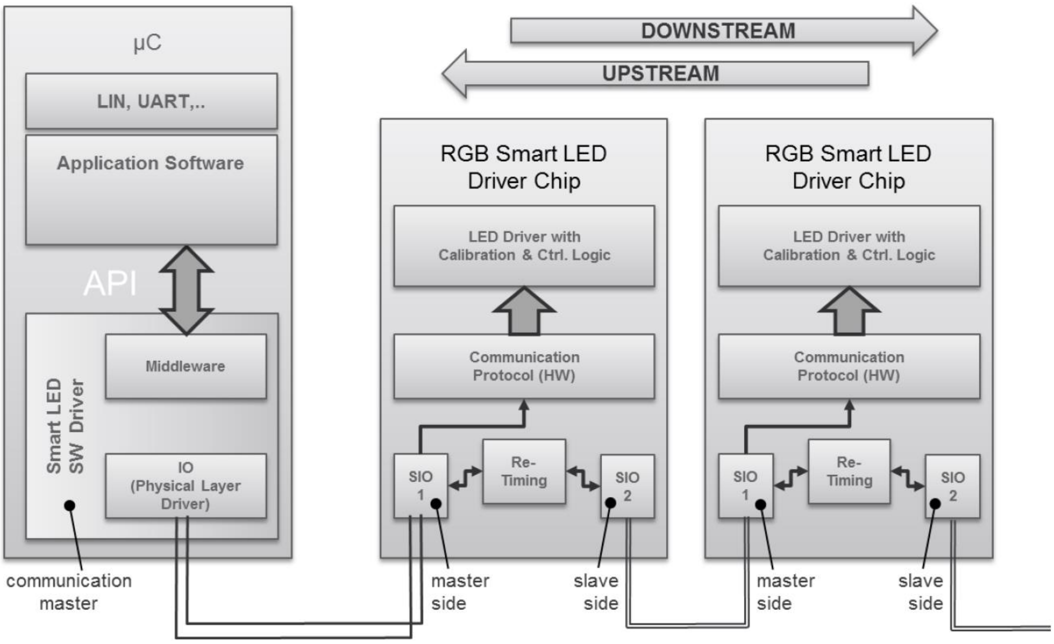
6. Typical Application Layout



To avoid voltage drops, it is recommended to mount capacitor C1 close to the Vcc pin. The dimensioning of the capacitors depends on the PCB layout and the supply concept.

7. Functional Description

Serial Communication



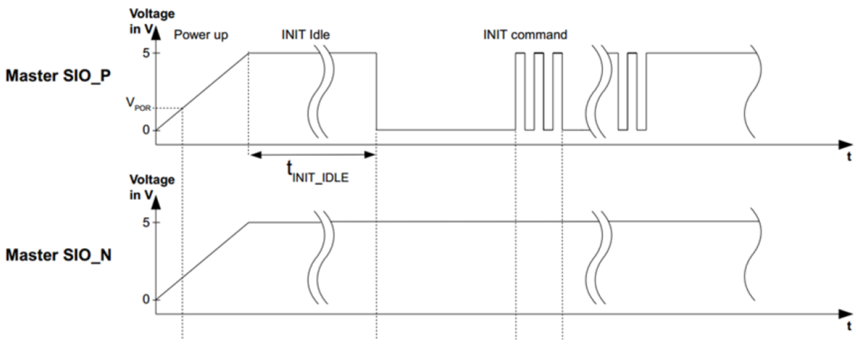
The attachment to the adjacent devices in the chain is made up by two bidirectional differential serial communication lines. The direction towards the controlling microcontroller device is referred to as the "upstream" connection. The opposite direction towards the end of the chain is the "downstream" link. Both links are controlled by the communication unit. Incoming command frames from upstream and responses from downstream are passed to the main unit which is responsible for command processing and overall device control. Commands always originate from the controlling microcontroller. The microcontroller is referred to as the "host" in this document.

The gross data rate on the serial line is 2Mbit/s, i.e. each bit has a nominal duration of 500 ns. As the on-die oscillator has a very limited accuracy, the actual bit time may vary significantly. The whole system is designed for a maximum oscillator variance of ±30%. With the nominal oscillator frequency being 16 MHz, the actual frequency range is 11.2-20.8MHz.

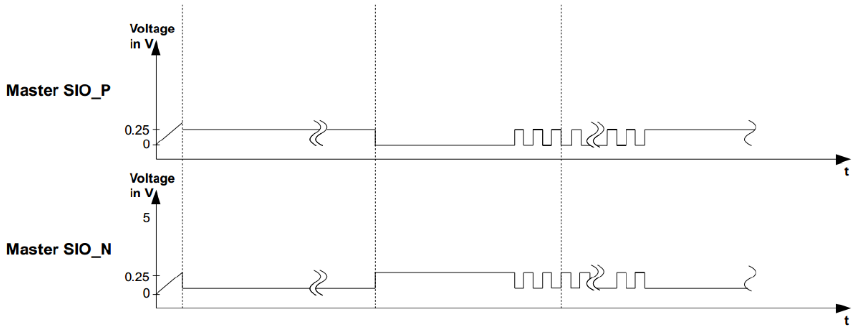
The device directly attached to the host does not use the differential line mode on the upstream side. Instead a single-ended line mode is used. The single-ended mode is intended to allow for an easy attachment to industry standard microcontrollers. Both single-ended lines require an external pull-up at the microcontroller to 5V.

Automatic Detection of the Serial Line Mode

During start-up, the devices automatically detect the mode of the upstream and the downstream link. The upstream link may be either single-ended or differential. If a device detects the upstream to be single-ended, it is the first in the chain of LEDs. The downstream link may be either differential or unconnected, i.e. the device is the last in the chain of LEDs. After power-up, an idle of $t_{INIT\ Idle}$ = 150μs is recommended before the initialization. If during the initialization, while receiving the enumeration command, the master SIO_N pin is single ended high (5V), the device is switched into single ended communication mode for this port. The detected mode is stored and used for all following communications until a power cycle or a reset command.



Single ended startup (first device in chain)



Differential startup (device in chain > 1)

Parameter	Description	Min.	Typ	Max.	Units
$t_{INIT\ Idle}$	Init Idle directly after power up	150	-	-	μs

Half-Duplex Communication

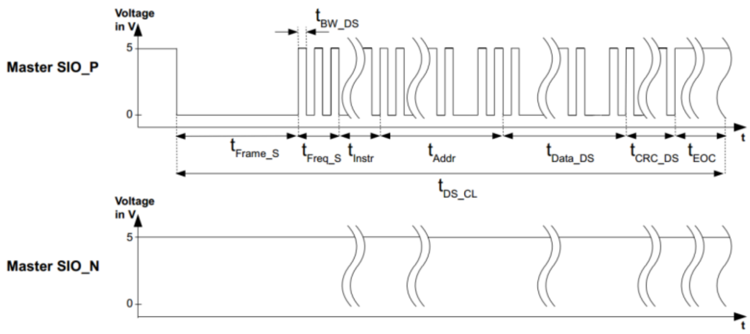
The communication operates in a strict master slave manner. I.e. the microcontroller as the master always initiates a communication. Depending on the type of command the LED devices may send a response (read access) or just silently execute the command (write access). There are three basic types of commands which are described in the following.

Basic Frame Format

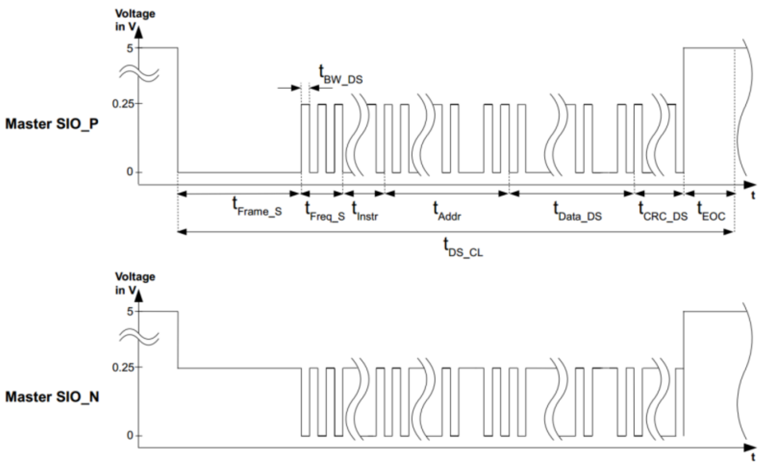
Commands and the response to commands are transmitted with serial frames. A serial frame always consists of a frame_sync section, followed by a frequency_sync section, followed by a run length coded command section and finally terminated with an optional CRC section. The command and the CRC sections differ in length between downstream and upstream frames.

The chosen bit encoding ensures a maximum number of adjacent zeros of 4 and a maximum number of adjacent ones of 5 on the serial line. Some of the bit patterns which cannot occur during regular data transmission are used for special purposes. A pattern of 6 or more 1-bits is considered as the bus-idle condition. The bus is idle, when no communication is currently ongoing. A pattern of 15 0-bits is recognized as the so-called frame synchronization. This is the sequence to begin a new frame. The pattern "10101" is the so-called frequency synchronization pattern. It is used after the frame synchronization to determine the transmitter's gross data rate.

Downstream communication is defined as data inputs at SIO1 and outputs at SIO2. This is the data flow for write commands. Upstream respectively is defined as data inputs at SIO2 and outputs at SIO1. This is the data flow for the read response.



Single ended downstream command frame



Differential downstream command frame

Downstream command frame parameters

Parameter	Description		Min.	Typ	Max.	Units
t_{BW_DS}	Downstream bit width		384	500	714	ns
t_{DS_CL}	Downstream Command duration	CRC enabled		86 x t_{BW_DS}		ns
		CRC disabled		76 x t_{BW_DS}		
t_{Frame_S}	Frame sync			15 x t_{BW_DS}		ns
t_{Freq_S}	Frequency sync			5 x t_{BW_DS}		ns
T_{inst}	Instruction			5 x t_{BW_DS}		ns
t_{Addr}	Address			15 x t_{BW_DS}		ns
t_{Data_DS}	Downstream data			30 x t_{BW_DS}		ns
t_{CRC_DS}	CRC downstream			10 x t_{BW_DS}		ns
t_{EOC}	End of command idle			6 x t_{BW_DS}		ns

Bit Retransmission

To ensure a correct bit-timing, the forwarded data is regenerated with the clock of the device. The retransmission starts with its own frame-sync when it can be guaranteed that a valid frame-sync timing can be created. A new frequency synchronization is only created after the freq-sync on the reception side has been received (the first four bits). Therefore, the minimum propagation delay t_{pd} introduced by the retransmission is four bit widths t_{BW}.

Name	Description	Min.	Typ	Max.	Units
t_{pd}	Propagation delay	2	4	5.2	µs

To guarantee a correct bit-timing the device uses its own clock as reference and will never transmit faster than its own bit-timing defines, but if the received freq-sync was slower, this timing is used for the retransmission.

The retransmission uses a FIFO to compensate for speed differences between reception and transmission.

Due to the variance in the oscillator clocks of different devices, after each transmission a pause of 43% of the nominal transmission time has to be introduced. If the transmission is created by a chip with ±30% oscillator clock variation the time has to be increased to a total of 70% of the transmission duration.

Initialization

The digLED_Init_Strip command initializes a particular ISELED chain by issuing the command on an associated ISELED communication channel.

This command is always the first command to be transmitted after power-up or reset. The command initializes a chain of devices by assigning the address of the device and by en- or disabling the phaseshift, the CRC and temperature compensation functions. The digLED_Init_Strip command is always executed with a CRC checksum. This is true for both, the command and the response frame.

If any command is received by a device before initialization, the command is always considered as illegal and the error status bit for an undefined command is set. This may happen in the chain's first device only, as a non-initialized device does not forward received messages.

If the first device in the chain receives a digLED_Init_Strip command, it takes the received address as its own device address and afterwards transmits another digLED_Init_Strip frame to the next device in the chain. It increments the address before the transmission. As the adjacent devices proceed in the same manner, the devices in the chain get enumerated with ascending addresses. When the final device in the chain recognizes there is no receiving device at its downstream link, it transmits a response frame upstream. The response frame to a digLED_Init_Strip command carries the configuration word read from the OTP. It also transmits the own devices address just initialized.

All upstream devices wait for the responses to be received and forward them towards the microcontroller. If a frame with an address equal to the adjacent device address (own address plus one) is received, the own response to the digLED_Init_Strip command is transmitted thereafter. If the first device has transmitted its response frame, the chain is ready to process regular commands (non-Init frames).

As soon as a device is initialized, it unconditionally forwards incoming correct frames (Frame-Sync, Freq-Sync and the RLC coding as well as the frame length are checked) to the adjacent node in the chain.

Frames received from upstream are forwarded downstream and vice versa. If an error is detected, the forwarding is stopped for this frame.

Name	Description	Equation
t_{INIT}	Initialization duration	n x (t_{DS_CL}+t_{US_CL} + 2 x t_{PD})

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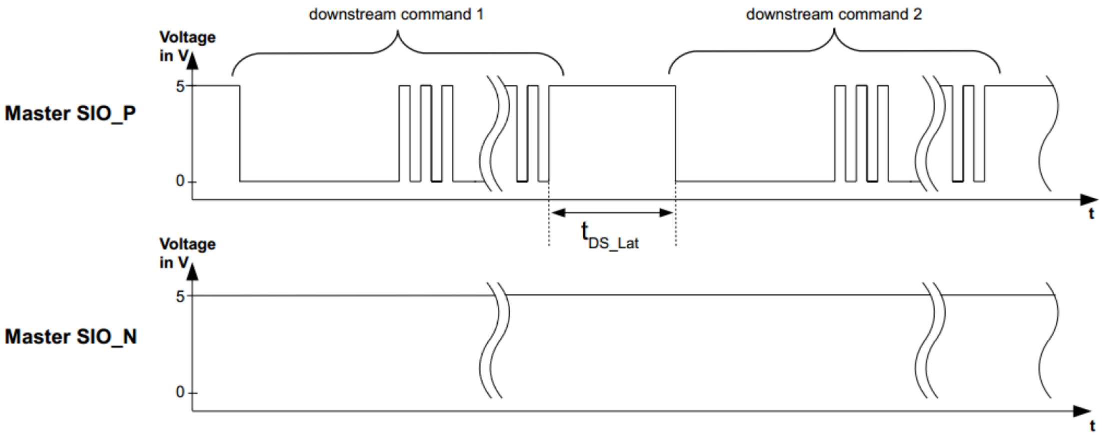
Write Access

Most commands of the LED Controller are write-only commands. I.e. the devices receive a command frame and execute the appropriate actions without any further communication. A write access command may be directed to a single device (unicast), to all devices (broadcast), or to a defined group of devices (multicast). As every command frame is forwarded downstream irrespective of its destination address, all stations always receive all commands. Only its execution depends on the command's destination address. To avoid communication issues, it is recommended to wait 30% of the command length between two consecutive commands.



Multiple single ended downstream commands

Recommended latency between downstream commands

Parameter	Description	Min.
t_{DS_Lat}	Latency between two downstream commands	0.3 x t_{DS_CL}

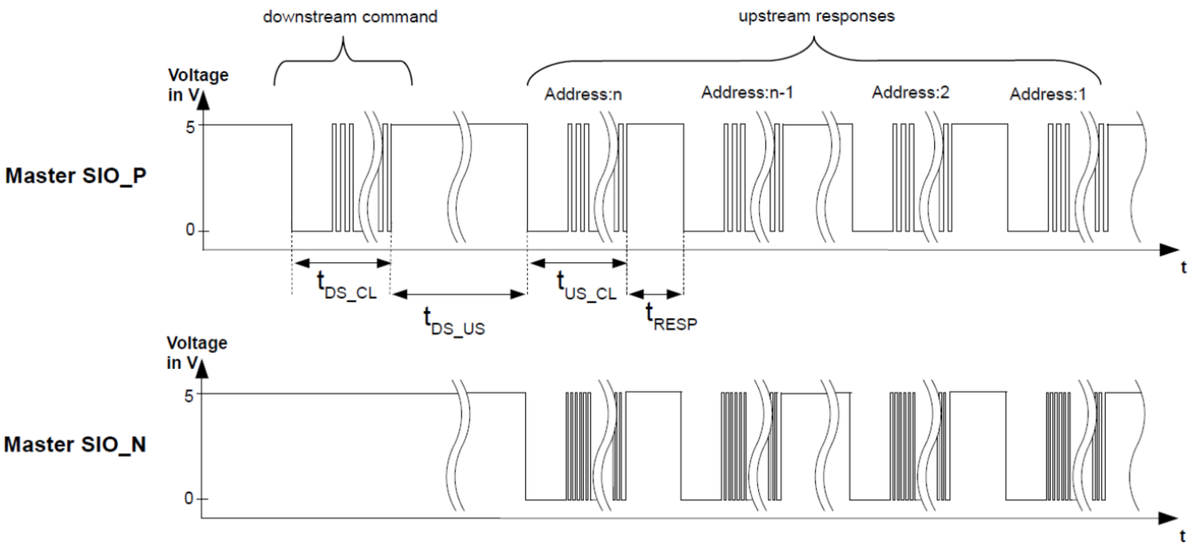
Read Access

A read access consists of two phases, the command and the response phase. The command phase uses downstream communication and the response phase uses upstream communication. Commands for read access do not use the command address, i.e. these commands may not be directed to a device based on the device address.

There are two commands for read access, digLED_Read and digLED_Ping. The digLED_Read commands retrieve a status information from all devices and the digLED_Ping command is used to check the device chain's integrity. Only the final node in the chain responds to a PING command.

A digLED_Read command is first received by all devices via the frame in downstream direction. The last node in the chain then immediately transmits its response frame upstream. The response frame's data field depends on the actual digLED_Read command. The response frame's address field is set according to the own device's address. All the nodes upstream forward all received response frames until a frame with the address of their adjacent node is received. Then the respective node transmits its own response frame. This procedure lasts until the chain's first node has transmitted its response frame.

A digLED_Ping command is similar to a digLED_Read command, but only the last device in the chain responds to a digLED_Ping. Thus, the digLED_Ping command is executed much faster than a regular digLED_Read command.



Single ended read command and responses

Down- and upstream delay, delay between responses

Parameter	Description	Min.
t_{DS_US}	Delay between down- and upstream	t_{DS_CL} + t_{US_CL} + 2 x n x t_{PD}
t_{RESP}	Delay between responses Oscillator variation of adjacent devices < ±30% Oscillator variation of adjacent devices > ±30%	 0.43 x tUS_CL 0.7 x tUS_CL

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Timeouts

The digLED_Init_Strip, all the digLED_Read, and the digLED_Ping commands initiate upstream data transmission. With the digLED_Init_Strip and the read commands all nodes are expected to send a response to the host. The digLED_Ping requires only the last node in the LED chain to respond. However, in all cases each node needs to await all responses originating from the nodes downstream. Thereafter either the node's own response is transmitted or new commands are accepted. Only the last node in the LED chain may immediately transmit its response.

In case there is an error with the chain downstream, not all expected responses may arrive. Thus, each of the commands expecting a response waits for a certain time only and then returns to its previous state without having transmitted the node's response data.

The lengths of the timeouts depend on the respective command. They are calculated to account for the worst-case oscillator frequency tolerance. I.e. the waiting node has a high-speed clock and all the nodes waited for have a low speed clock. The hardware implementation uses an internally divided clock for the timeout counter:

$$F_{[timeout]} = f_{[OSC]} / 2^{14}$$

With the nominal clock frequency of 16MHz the counter's resolution results to 1.024ms.

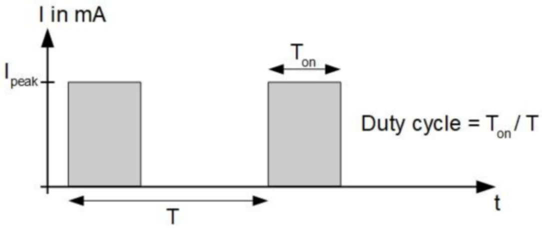
Timeouts

Command	Max. counter value	Min. timeout	Nom. timeout	Max. timeout	Units
digLED_Init_Strip	992	780.6	1015.3	1451.2	ms
digLED_Read_*	427	335.6	436.7	624.6	ms
digLED_Ping	62	48.0	63.0	90.7	ms

8. PWM Units

Basic Mode of Operation

The LED controller device incorporates three independent PWM channels, one for each LED.



PWM signal

The resolution is 12 bit. The supported duty cycles are 0/4095 to 4095/4095. The nominal PWM output frequency is 16MHz∕ 215 = 488.3Hz. The frequency is reduced to the half or the quarter of this frequency with low duty cycles. This ensures a minimum on-time of 2µs for the LEDs. The minimum output frequency is 122Hz. The output frequency is not derived from the actual PWM duty cycle but from the RGB value received from the host. As the DIM command also has impact to the LED intensity, it is accounted for as well. The actual relationship is given in the following table.

DIM parameter relationships between RGB parameters and PWM frequencies

DIM Parameter	RGB Parameter	PWM Frequency in Hz
0	8…255	488
	4…7	244
	0…3	122
1	16…255	488
	8…15	244
	0…7	122
2	32…255	488
	16…31	244
	0…15	122
3	64…255	488
	32…63	244
	0…31	122

The output frequency is determined independently for each of the PWM channels.

Update

When a new PWM duty cycle has to be applied, this is always done at the end of a PWM cycle. I.e. the PWM always completes an output cycle using the previously active duty cycle and starts the next output cycle using the updated duty cycle.

Phase Shift

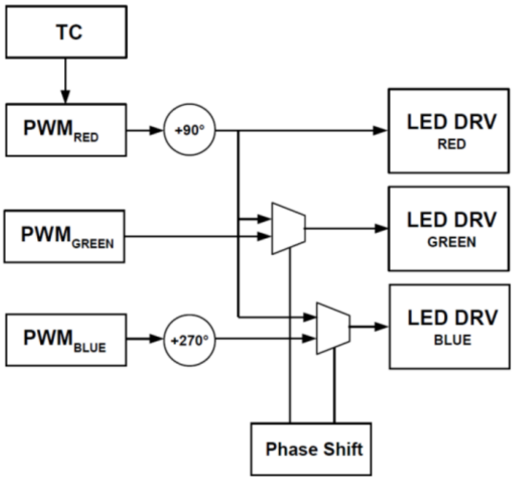
In order to spread the current consumption of the LEDs over time, a phase shift can be set between the three PWM channels. This optional function can be enabled/disabled during device initialization.

If the phase shift is deactivated, the red channel controls all three outputs and thus provides the temperature compensation function for all three channels.

If the phase shift is enabled, it retains even if the output frequency of the channels is different. If a channel is operating at a lower frequency, it may be considered to leave out one or three full PWM cycles. When leaving power save mode, the channels are restarted appropriately to again obtain the correct phase shift.

The fixed phase shift is defined in the following table. Please note the absolute phase shift times are nominal values. I.e. they are subject to vary with the internal oscillator's frequency.

PWM Channel	Rel. Phase Shift	Units	Abs. Phase Shift
Green	0	%	0
Red	25	%	0.25 / PWM Frequency
Blue	75	%	0.75 / PWM Frequency



Optional phase shift

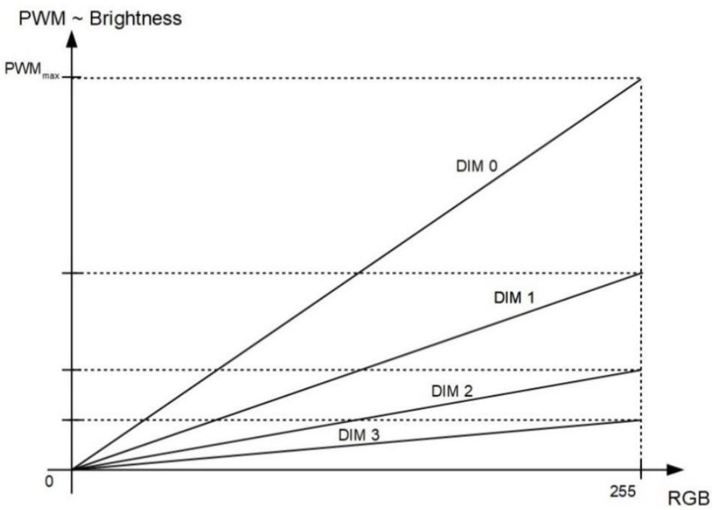
Power Save Mode

When all LED channels are set to an intensity of 0, the device enters a power save mode for the current sources driving the LEDs. I.e. the digLED_Set_RGB command must be issued with an RGB value of 0x000000 to enter the power save mode. Recovering from this mode does not require any particular measures. I.e. the host just needs to issue a digLED_Set_RGB command with the data field different from 0x000000 and the current sources are restarted again. There is a delay of approx. 1µs before the restart of the green PWM channel (no phase shift applies to the green channel).

This is due to an internal ramp-up required by the analog circuitry. The same procedure is applied after device power-up or a hardware reset, as the initial RGB value is 0x000000. I.e. the LEDs are all turned off after power-up or a hardware reset.

DIM Function for Accurate Low Light Colors

To extend the SET_RGB command's resolution for accurate low light colors, the LITEON-LED provides the DIM command. The command divides the PWM duty cycles computed from the RGB setting. There are four divisors available. Details are shown in Figure and table.



DIM Function

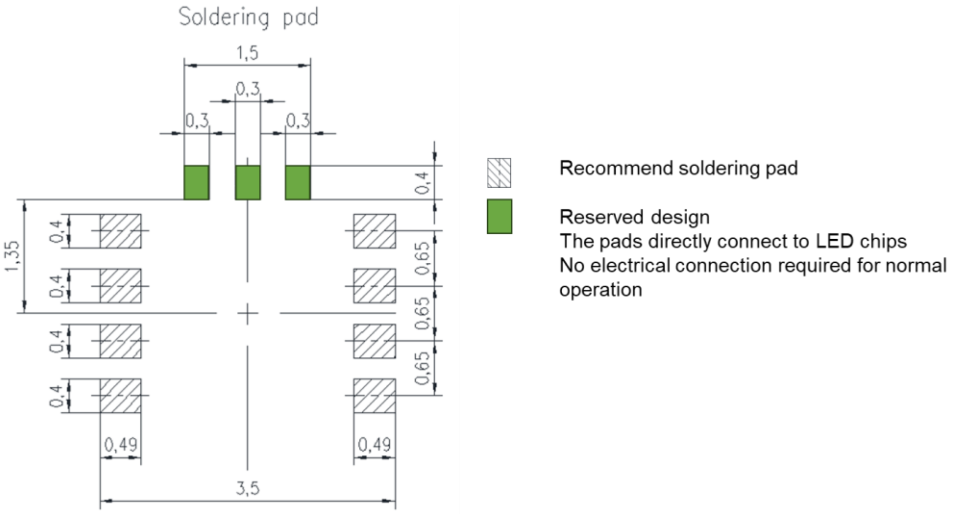
DIM	Relative PWM Ratio
0	1
1	1/2
2	1/4
3	1/8

9. User Guide

9.1 Cleaning

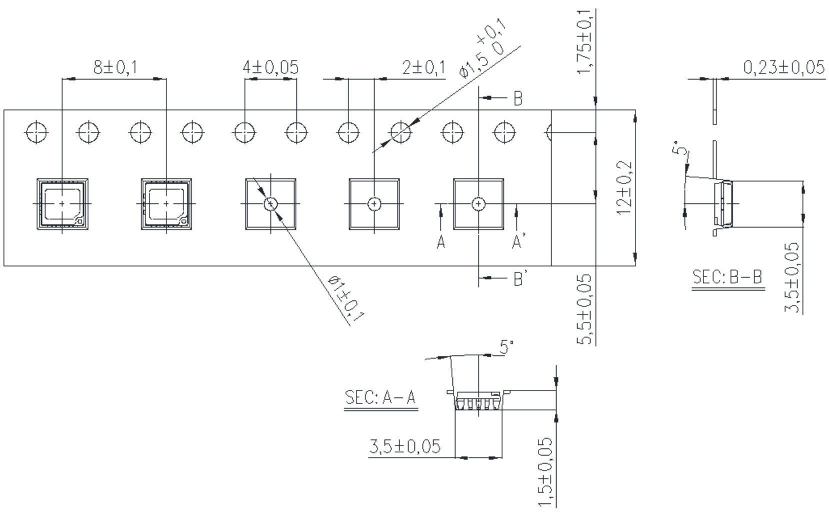
Do not use unspecified chemical liquid to clean LED they could harm the package.
If clean is necessary, immerse the LED in ethyl alcohol or in isopropyl alcohol at normal temperature for less one minute.

9.2 Recommend Printed Circuit Board Attachment Pad



Notes: Do not design any conductor or expose metal contact in the dashed zone for the PCB layout.

9.3 Package Dimensions of Tape And Reel

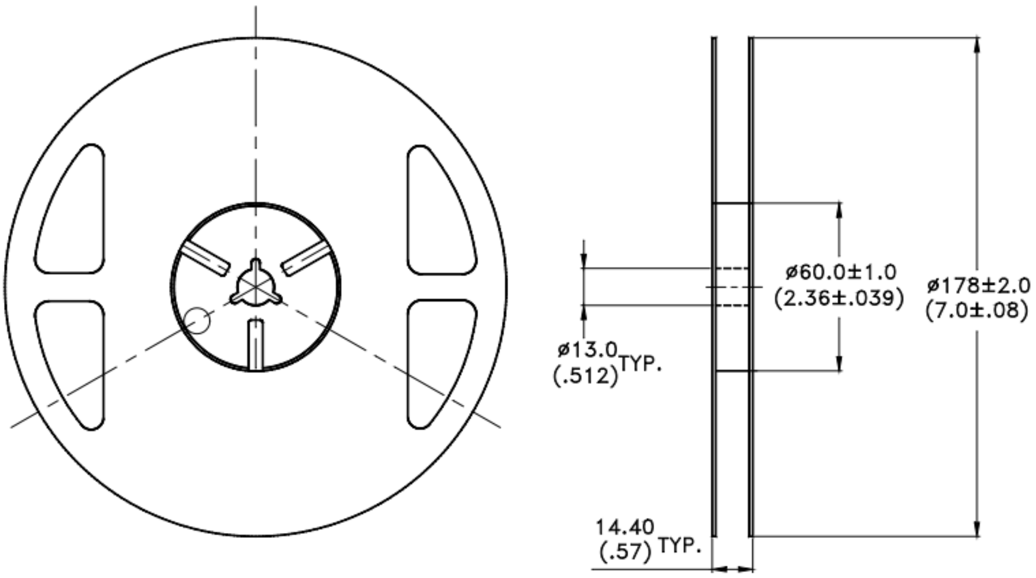


Note:

1. All dimensions are in millimeters (inches).

ALED
LTSA-E35BCEGBW (Preliminary)

9.4 Package Dimensions of Reel



Notes:

i. Empty component pockets sealed with top cover tape.

ii. 7- inch reel-1000 pieces per reel.

iii. Minimum packing quantity is 500 pieces for remainders.

iv. The maximum number of consecutive missing lamps is two.

v. In accordance with ANSI/EIA 481 specifications.

10. Cautions

10.1 Application

The LEDs described here are intended to be used for ordinary electronic equipment (such as office equipment, communication equipment and household applications). Consult Liteon's Sales in advance for information on applications in which exceptional reliability is required, particularly when the failure or malfunction of the LEDs may directly jeopardize life or health (such as in aviation, transportation, traffic control equipment, medical and life support systems and safety devices).

10.2 Storage

The package is sealed:
The LEDs should be stored at 30°C or less and 90%RH or less. And the LEDs are limited to use within one year, while the LEDs is packed in moisture-proof package with the desiccants inside.
The package is opened:
The storage ambient for the LEDs should not exceed 30°C temperature or 60% relative humidity.
It is recommended that LEDs out of their original packaging are IR-reflowed within one year. (MSL 2).
For extended storage out of their original packaging, it is recommended that the LEDs be stored in a sealed container with appropriate desiccant, or in a desiccator with nitrogen ambient.
LEDs stored out of their original packaging for more than one week should be baked at about 60 deg C for at least 20 hours before solder assembly.

10.3 Cleaning

Use alcohol-based cleaning solvents such as isopropyl alcohol to clean the LED if necessary.

10.4 Soldering

Recommended soldering conditions:

Reflow soldering		Soldering iron	
Pre-heat	150~200°C	Temperature	300°C Max.
Pre-heat time	120 sec. Max.	Soldering time	3 sec. Max.
Peak temperature	260°C Max.		(one time only)
Soldering time	10 sec. Max. (Max. two times)		

Notes:

Because different board designs use different number and types of devices, solder pastes, reflow ovens, and circuit boards, no single temperature profile works for all possible combinations.
However, you can successfully mount your packages to the PCB by following the proper guidelines and PCB-specific characterization.
LITE-ON Runs both component-level verification using in-house **KYRAMX98** reflow chambers and board-level assembly.
The results of this testing are verified through post-reflow reliability testing. Profiles used at LITE-ON are based on JEDEC standards to ensure that all packages can be successfully and reliably surface mounted.
Figure on page3 shows a sample temperature profile compliant to JEDEC standards. You can use this example as a generic target to set up you reflow process. You should adhere to the JEDEC profile limits as well as specifications and recommendations from the solder paste manufacturer to avoid damaging the device and create a reliable solder joint.

10.5 ESD (Electrostatic Discharge)

Static Electricity or power surge will damage the LED.
Suggestions to prevent ESD damage:

- Use of a conductive wrist band or anti-electrostatic glove when handling these LEDs.
- All devices, equipment, and machinery must be properly grounded.
- Worktables, storage racks, etc. should be properly grounded.
- Use ion blower to neutralize the static charge which might have built up on surface of the LED's plastic lens as a result of friction between LEDs during storage and handling.

ESD-damaged LEDs will exhibit abnormal characteristics such as high reverse leakage current, low forward voltage, or "no light up" at low currents.
To verify for ESD damage, check for "light up" and Vf of the suspect LEDs at low currents.
The Vf of "good" LEDs should be >2.0V@0.1mA for InGaN product and >1.4V@0.1mA for AlInGaP product.

11. Others

The appearance and specifications of the product may be modified for improvement without prior notice.

12. Suggested Checking List

Training and Certification

1. Everyone working in a static-safe area is ESD-certified?
2. Training records kept and re-certification dates monitored?

Static-Safe Workstation & Work Areas

1. Static-safe workstation or work-areas have ESD signs?
2. All surfaces and objects at all static-safe workstation and within 1 ft measure less than 100V?
3. All ionizer activated, positioned towards the units?
4. Each work surface mats grounding is good?

Personnel Grounding

1. Every person (including visitors) handling ESD sensitive (ESDS) items wears wrist strap, heel strap or conductive shoes with conductive flooring?
2. If conductive footwear used, conductive flooring also presents where operator stand or walk?
3. Garments, hairs or anything closer than 1 ft to ESD items measure less than 100V*?
4. Every wrist strap or heel strap/conductive shoes checked daily, and result recorded for all DLs?
5. All wrist strap or heel strap checkers calibration up to date?

Note: *50V for InGaN LED.

Device Handling

1. Every ESDS items identified by EIA-471 labels on item or packaging?
2. All ESDS items completely inside properly closed static-shielding containers when not at static-safe workstation?
3. No static charge generators (e.g., plastics) inside shielding containers with ESDS items?
4. All flexible conductive and dissipative package materials inspected before reuse or recycles?

Others

1. Audit result reported to entity ESD control coordinator?
2. Corrective action from previous audits completed?
3. Are audit records complete and on file?