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APPLICATION NOTES:
seddLED3.6 (A3J-FHG)

Introduction

seddLED (Smart Embedded Digital Driver LED) combines RGB LED, LED Driver and advanced communication protocol integrated into a single package. It is a revolutionary approach for automotive ambient lighting with fully-calibrated RGB LED to target coordinates. New added seddLED3.6 A3J-FHG is embedded with ILaS® communication and pre-calibrated to D65 white point with an accuracy within 3 SDCM steps at 1400mcd (day mode) and 280mcd (night mode). In addition, the device also functions as an ILaS® repeater and establishes 2 Mbit/s, low latency daisy-chain connectivity, over several meters of simple, unshielded twisted pair (UTP) cables.

This document provides guidelines on how to drive the seddLED3.6 with the focus on the LED package outline and pin-out, PCB design best practices, microcontroller selection and ILaS® unit to unit connection setup. All functions can be controlled via the microcontroller unit (MCU) and ILaS® Transceiver (INLT220Q) that provides the ILaS® serial communication protocol.

List of Abbreviations and Acronyms

API	Application Programming Interface
EMI	Electromagnetic Interference
ESD	Electrostatic Discharge
GND	Ground
MCU	Microcontroller Unit
PCB	Printed Circuit Board

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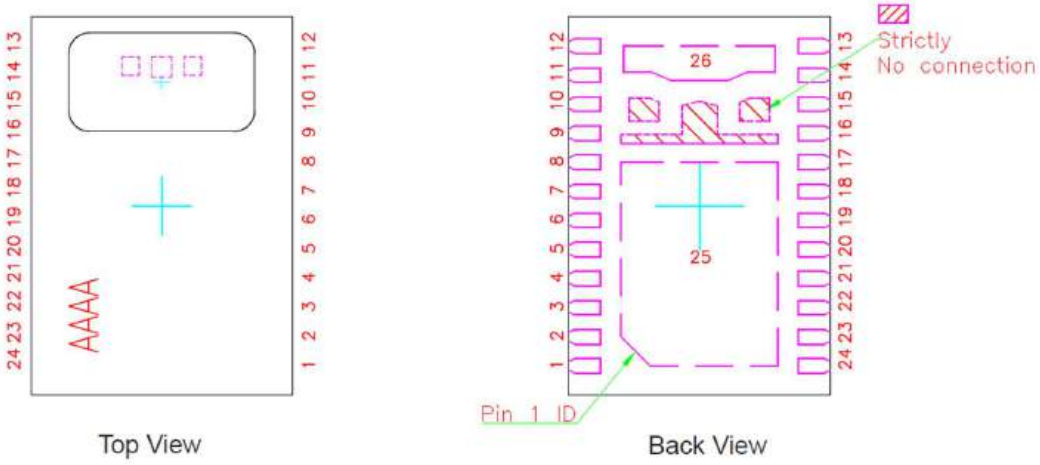
1.1 seddLED3.6 A3J-FHG-1400+280-1

Function and Features:

- Small package outline (LxWxH) of 6.5 x 4.5 x 0.9mm.
- D65 White point calibration.
- Serial communication with ILaS® compliance.
- Brightness & color stability over temperature.
- 12-bit brightness resolution for red, true green, and blue LED.
- Bi directional, half duplex, 2MBit/s CRC protected serial communication.
- Temperature compensation for all RGB channels.
- Built-in synchronous step-down DCDC buck controller with Oscillation frequency 1MHz.
- Build-in diagnostic functions.
- Auto addressing with maximum of 4079 devices in one LED chain.
- Qualified according to JEDEC moisture sensitivity Level 2.
- Environmentally friendly, RoHS compliance.
- Superior corrosion resistant
- Compliance to automotive standard; AEC-Q102 & AEC-Q100.

1.2 A3J-FHG Pin out

Please follow this pin-out for connection and pin functionality:



Pin	Pin	Direction	Description
1	CMP	I	Error amplifier output
2, 23, 25	GND	GND	Ground
3	SW	I	Switch
4	V_{SUP}	Power	Supply Voltage
5	BST	O	Bootstrap
6	V_{CCT}	Power	Supply Voltage Termination
7	V_{CCA}	Power	Supply Voltage Analog
11, 12, 13, 14, 26	V_{LED}	I	Supply Voltage LED
18	ISP_N	I/O	Initiator side port, Negative polarity
19	ISP_P	I/O	Initiator side port, Positive polarity
20	TERM	I/O	Termination
21	ESP_P	I/O	Extension side port, Positive polarity
22	ESP_N	I/O	Extension side port, Negative polarity
8, 9, 10, 15, 16,17, 24	NC	NC	Strictly Electrical Isolated

Notes:
ESP_P & ESP_N PIN need to be shorted on last device

2.0 ILaS® Network

An ILaS® network consists of individual nodes and is based on point-to-point connections and packet switched communication. A network node belongs to exactly one of four node types:

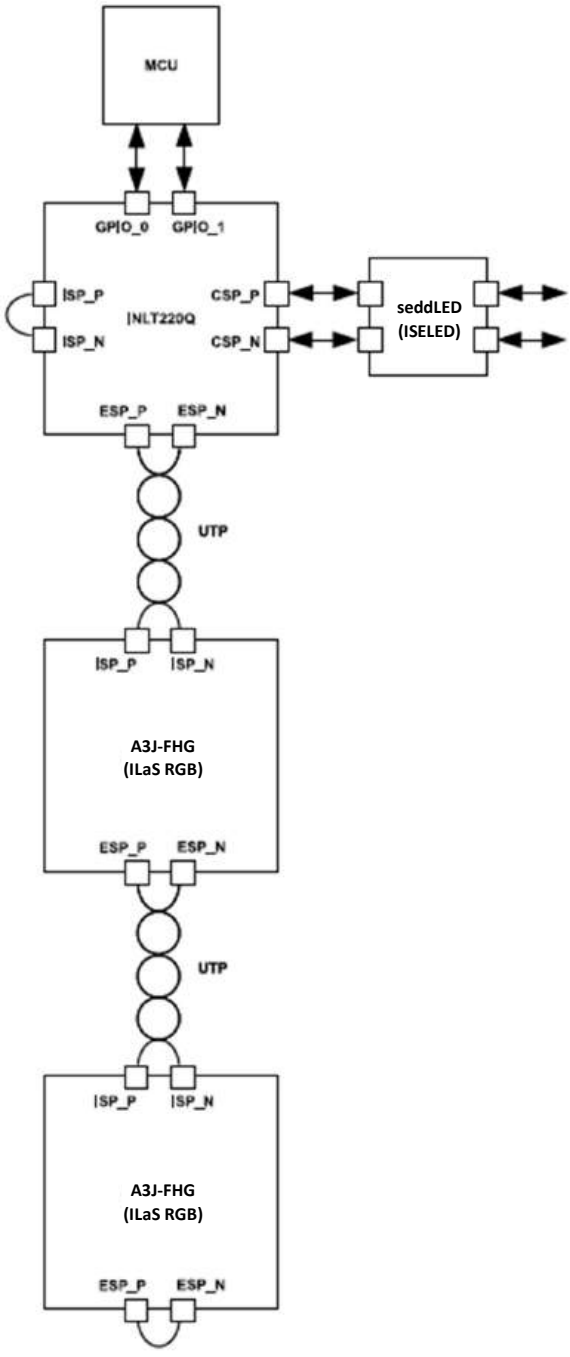


Figure 1: ILaS ® Network

- Initiator device (MCU)
- Branch device (INLT220Q)
- Client device (seddLED product with ISELED®)
- Repeater device (ILaS® RGB A3J-FHG)

An ILaS network has exactly one Initiator Device - typically a microcontroller or an FPGA. The Initiator Device is connected to a daisy-chain of Branch and Repeater Devices – ILaS® RGB A3J-FHG. The transmission medium between Branch and Repeater Devices shall be UTP (unshielded twisted pair) cables.

Please note:

A3J-FHG (Repeater device) shall not become the first position in the daisy chain connecting to the Initiator Device (MCU/FPGA). The GPIO pins are needed for such interconnection which is provided exclusively by the Branch Device (INLT220Q).

The ESP_P and ESP_N of the A3J-FHG device must be shorted if it is the last node in the network. An unpowered A3J-FHG provides a passive electrical path from ISP to ESP (failover path-through). This allows network operations with subsequent network participants, even if devices are unpowered or faulty. The path consists of two serial 50 Ω resistors, resulting in a 100 Ω path. When the A3J-FHG is powered up and error-free, the device enables its termination switch.

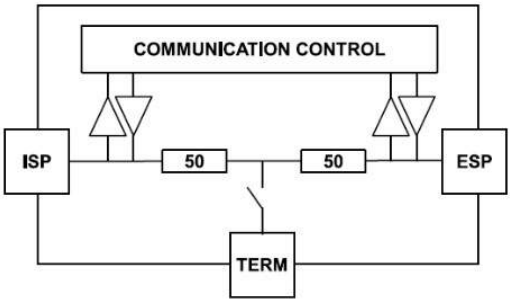


Figure 2: Fault Tolerance

Communication from initiator device to branch and client devices is referred to as downstream direction. Communication from branch and client devices to initiator devices is referred to as upstream direction.

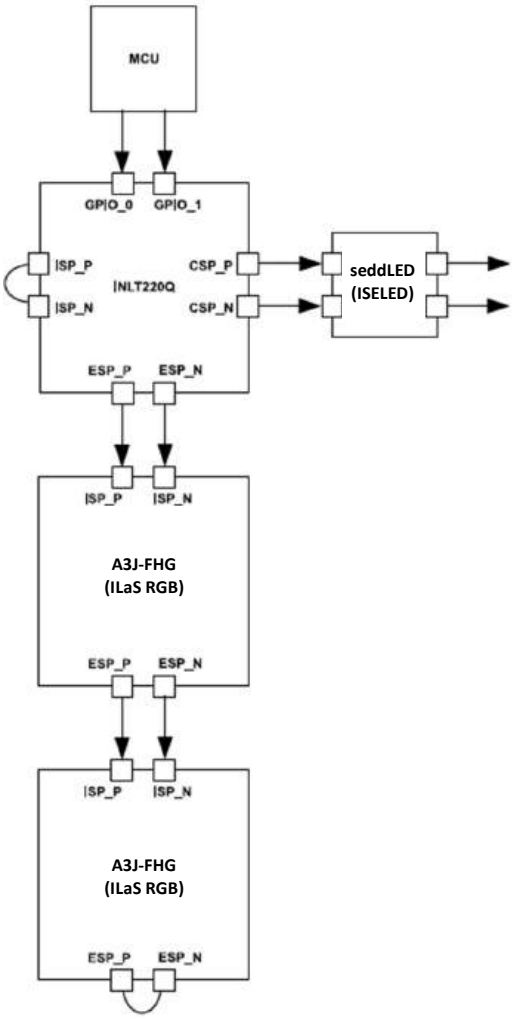


Figure 3: Downstream direction

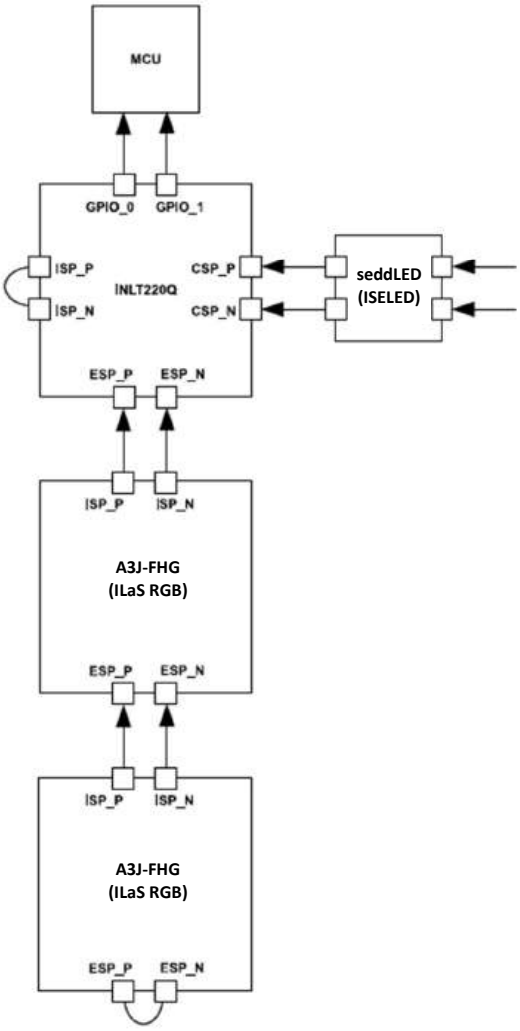


Figure 4: Upstream direction

*Please refer to ILaS Network Specification for more detail's description of ILaS network characteristic. User can get more information from Inova website:

https://inova-semiconductors.de/iseled/inlt220q.html

2.1. Microcontrollers (MCU)

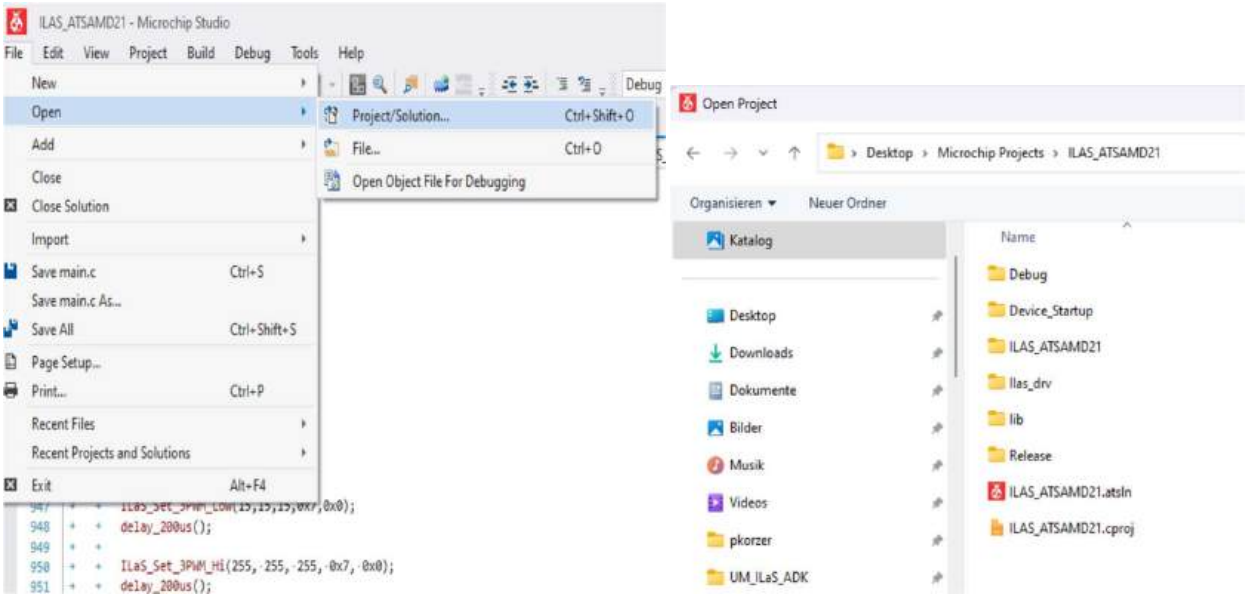
Please refer to ISELED.com to get more information on the broad portfolio of microcontrollers (MCUs) that support controlling of ILaS® based seddLED chains. In this application note, we demonstrate some of the A3J-FHG function by using Microchip MCU.

2.1.1 Microchip Technology Inc

Microchip offers a wide range of ISELED/ILAS-enabled MCUs for your application's specific features, performance, and memory resources. Microchip provides controller boards that represent most of the 8-bit, 16-bit or 32-bit MCUs for your ISELED/ILAS prototype project.
User also can get more information regarding the evaluation license and Microchip ISELED® / ILaS custom part number, please click below link:
https://www.microchip.com/en-us/solutions/automotive-and-transportation/body-electronics/iseled-protocol-ambient-lighting

To control the ILaS ADK, the Microchip SAMD21 board, as well as Microchip Studio is needed. Microchip Studio can be downloaded from the Microchip homepage via the following link: https://www.microchip.com/en-us/tools-resources/develop/microchip-studio.
The example project "ILaS_ATSAMD21" is provided on request.

After downloading the project, go to Microchip Studio and click on File -> Open -> Project/Solution. Open the project file '../ILAS_ATSAMD21/ILAS_ATSAMD21.cproj'. Please always open the file ending with *.cproj . This ensures that all project files, including headers etc., will be opened correctly.

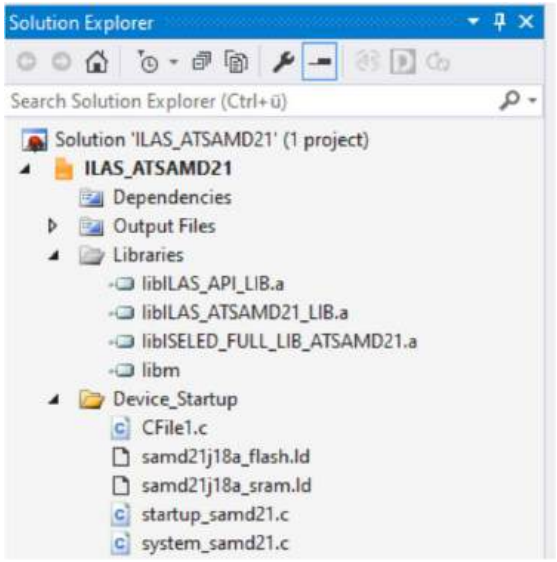


After the project is loaded, two libraries must be added.

For that purpose, go to 'Solution Explorer' on the right and select your project 'ILaS_ATSAMD21'.
Click Libraries -> Add Libraries -> Browse Libraries. Go to your project folder and open the embedded folder 'lib'. Add the following files:

- libILAS_API_LIB.a
- libILAS_ATSAMD21_LIB.a

If the files were added correctly, they will appear in the "Solution Explorer"



2.2 Branch device (INLT220Q)

The ILaS INLT220Q is a mixed signal transceiver for automotive Light and Sensor Networks. It establishes 2 Mbit/s, low latency daisy-chain connectivity, over several meters of simple, unshielded twisted pair (UTP) cables. seddLED3.6 A3J-FHG must work together with INLT220Q in a single daisy chain to enable proper serial downstream and upstream communication with master controller (MCU).

The device also supports ISELED® applications. User can get more information from Inova website:

https://inova-semiconductors.de/iseled/inlt220q.html

3. User Application Development Setup

This section provides guidelines to the development of seddLED3.6 A3J-FHG LED typical application setup. Selection of right external component and PCB layout is critical to ensure proper functionality and heat dissipation onto a small PCB surface.

3.1. Typical Application Layout of seddLED3.6 A3J-FHG with DCDC Enabled

Figure 5 shows a typical setup layout for seddLED3.6 A3J-FHG, connecting MCU to the next compatible ILaS branch device (INLT220Q) and next seddLED3.6 A3J-FHG

- seddLED3.6 A3J-FHG is a mixed signal digital LED driver. Each device is individually addressable via a bidirectional, half-duplex, 2Mbps, CRC-protected serial bus.
- seddLED3.6 A3J-FHG provides an easy-to-use circuitry to design synchronous step-down DC/DC converters over an input voltage range from 7.5V to 16V. The device provides automatic switch-off mechanisms in the event of overvoltage (>17.2V) and undervoltage (<7.3V).
- The output voltage of the step-down DC-DC Converter is set to nominal 5V via internal voltage divider resistors to power the on-chip VCCA and VCCT supplies, as well as connected LEDs.
- It is recommended to use external components as outlined in the Figure 5: Typical Application Schematic for ILaS Transceiver with DCDC Enabled and Figure 6: Recommended external component list.
- The serial communication I/O ISP_P/ISP_N of the first seddLED3.6 A3J-FHG in the chain must be connected to the ESP_P/ESP_N of the INLT220Q ILaS Transceiver. INLT220Q ILaS Transceiver will connect to the MCU via its GPIO0 and GPIO1.
- The serial communication I/O ESP_P/ESP_N must be connected to the next seddLED3.6 A3J-FHG I/O ISP_P/ISP_N. If seddLED3.6 A3J-FHG is a last device, then it's I/O ESP_P/ESP_N must be shorted together.

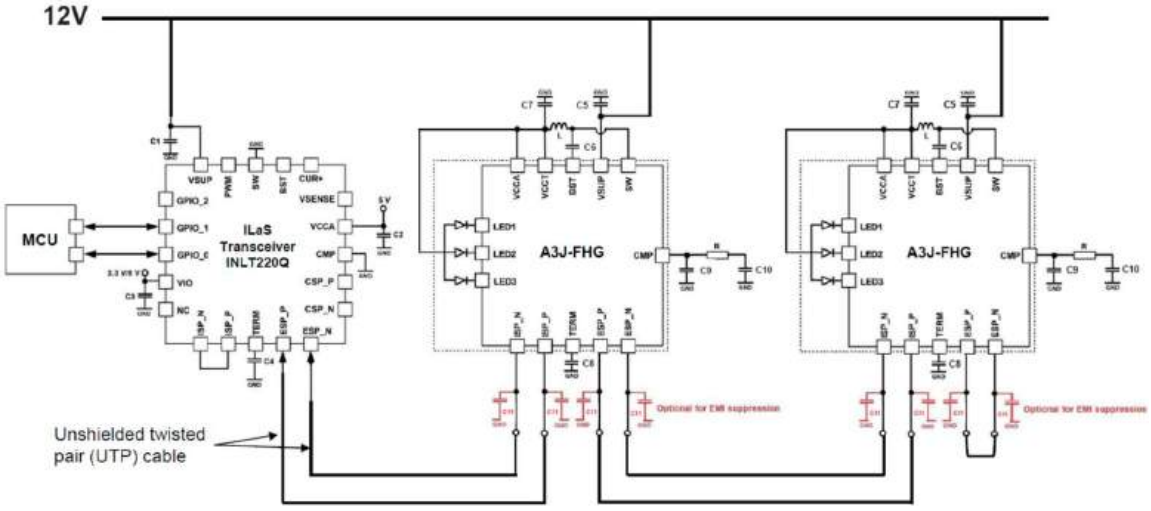


Figure 5: Typical Application Schematic for seddLED3.6 A3J-FHG with DC/DC Enabled

Symbol	Description	Value	Unit
C1	Decoupling capacitor	Please refer to INLT220Q Datasheet for the capacitor value.	
C2	Decoupling capacitor		
C3	Decoupling capacitor		
C4	Termination filter capacitor		
C5	Input capacitor	0.25	uF
C6	Bootstrap capacitor	4.7	nF
C7	Output capacitor	100	nF
C8	Termination capacitor	4.7	nF
C9	Error amplifier compensation network capacitor	100	pF
C10	Error amplifier compensation network capacitor	10	pF
C11	EMI filter capacitor (optional for EMI suppression)	220	pF
R	Error amplifier compensation network resistor	40	kohm
L	Power Inductor	85	uH

Figure 6: Recommended external component list for step down DC/DC converter

3.2. Typical Application Layout of seddLED3.6 A3J-FHG without DCDC Enabled

The seddLED3.6 A3J-FHG can be also operated with disabled step-down DC/DC converter. For that purpose, it is required to power VSUP, VCCA and VCCT with 5V. In addition, it is recommended to use a pull-down resistor at SW. The CMP pin can be unconnected in that use case.

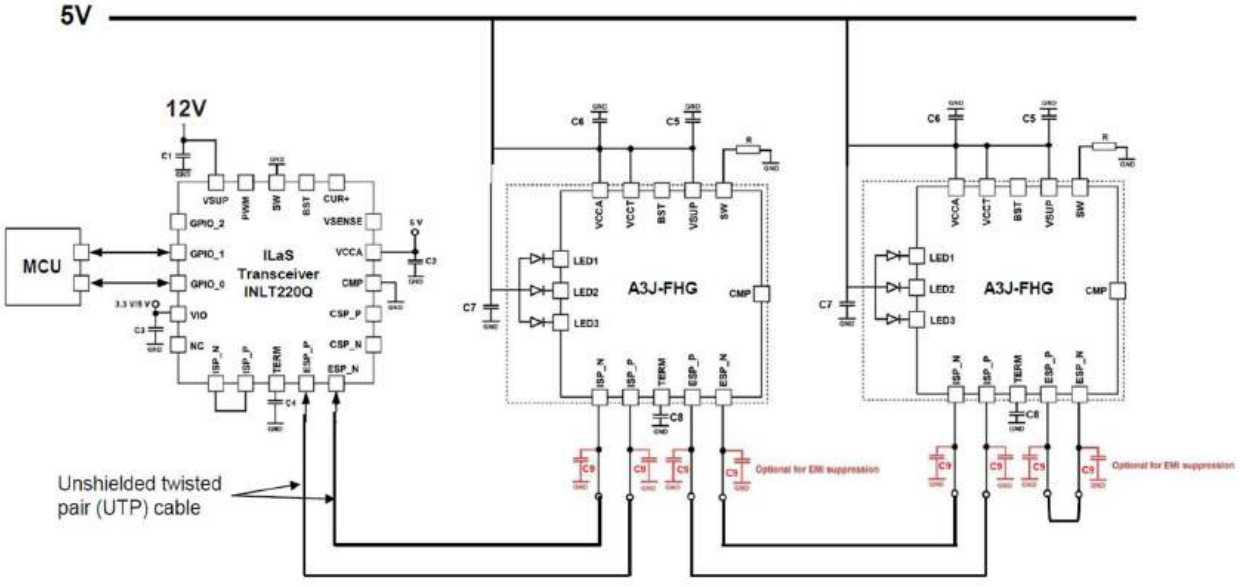


Figure 7: Typical Application Schematic for seddLED3.6 A3J-FHG without DC/DC Enabled

Symbol	Description	Value	Unit
C1	Decoupling capacitor	Please refer to INLT220Q Datasheet for the capacitor value.	
C2	Decoupling capacitor		
C3	Decoupling capacitor		
C4	Termination filter capacitor		
C5	Decoupling capacitor	0.25	uF
C6	Decoupling capacitor	4.7	nF
C7	Decoupling capacitor	1	uF
C8	Termination capacitor	4.7	nF
C11	EMI filter capacitor (optional for EMI suppression)	220	pF
R	Pull Down Resistor	1	kohm

Figure 8: Recommended external component list without DCDC Enabled

3.3 PCB design guide, pin-per-pin explanation:

Figure 9 below shows a brief schematic from ILaS transceiver (INLT220Q) to the first seddLED3.6 A3J-FHG LED.

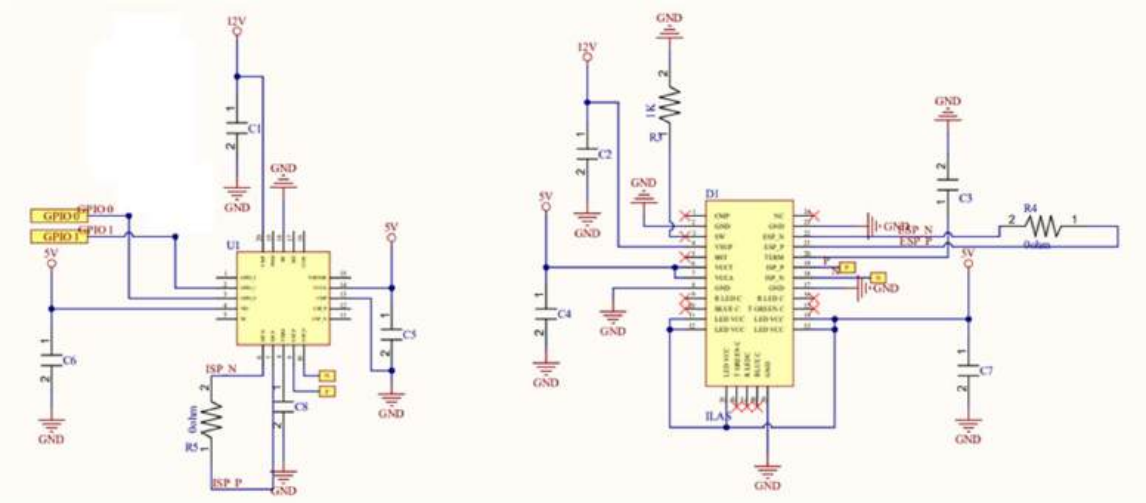


Figure 9: PCB schematic example of 5V supply (without DC/DC Enabled)

- seddLED3.6 A3J-FHG can be powered up with 12V supply (with DC/DC Enabled) or 5V supply (without DC/DC Enabled).
- The interface in between master controller to the first device shall be ILaS Transceiver. It has single ended communication I/O with data path (GPIO 0) and clock path (GPIO 1). The first device, ILaS Transceiver INLT220Q shall have the ISP_P/N shorted together.
- Please keep the first device to MCU within the same PCB to enable good reliability of single-ended data transmission.
- Connection from ILaS transceiver INLT220Q to next seddLED3.6 LED is configured with differential format. User does not need to worry about the conversion from single-ended format to differential format. All will be taken care by ILaS network. Communication protocol between ILaS devices is to be connected from ESP_P/N (transfer) to ISP_P/N (receive).
- The last ILAS device shall have the ESP_P/N to be shorted together so that this completes a daisy chain connection.
- All the grounds of each PCBs must be commonly connected at the overall system level.
- Please make sure PIN 8, 9, 10, 15, 16,17, 24 is Strictly Electrical Isolated.

4. Temperature Compensation

4.1 Linear & Non-Linear Compensation

A3J-FHG-280+400-1 is special calibrated to D65 white color at 1400mcd (Day Mode) and 280mcd (Night Mode). To further improve the D65 white color mixed homogeneity across full operating temperature, we recommend to use non-linear compensation. Figure 10, 11, 12 & 13 shows the D65 White, Red, True Green & Blue LED brightness in Linear & Non-Linear temperature compensation. Figure 14 show the in D65 white color mixed improvement of Linear vs Non-Linear temperature. We can observe significant D65 white color mixed improvement at extreme cold and hot temperature.

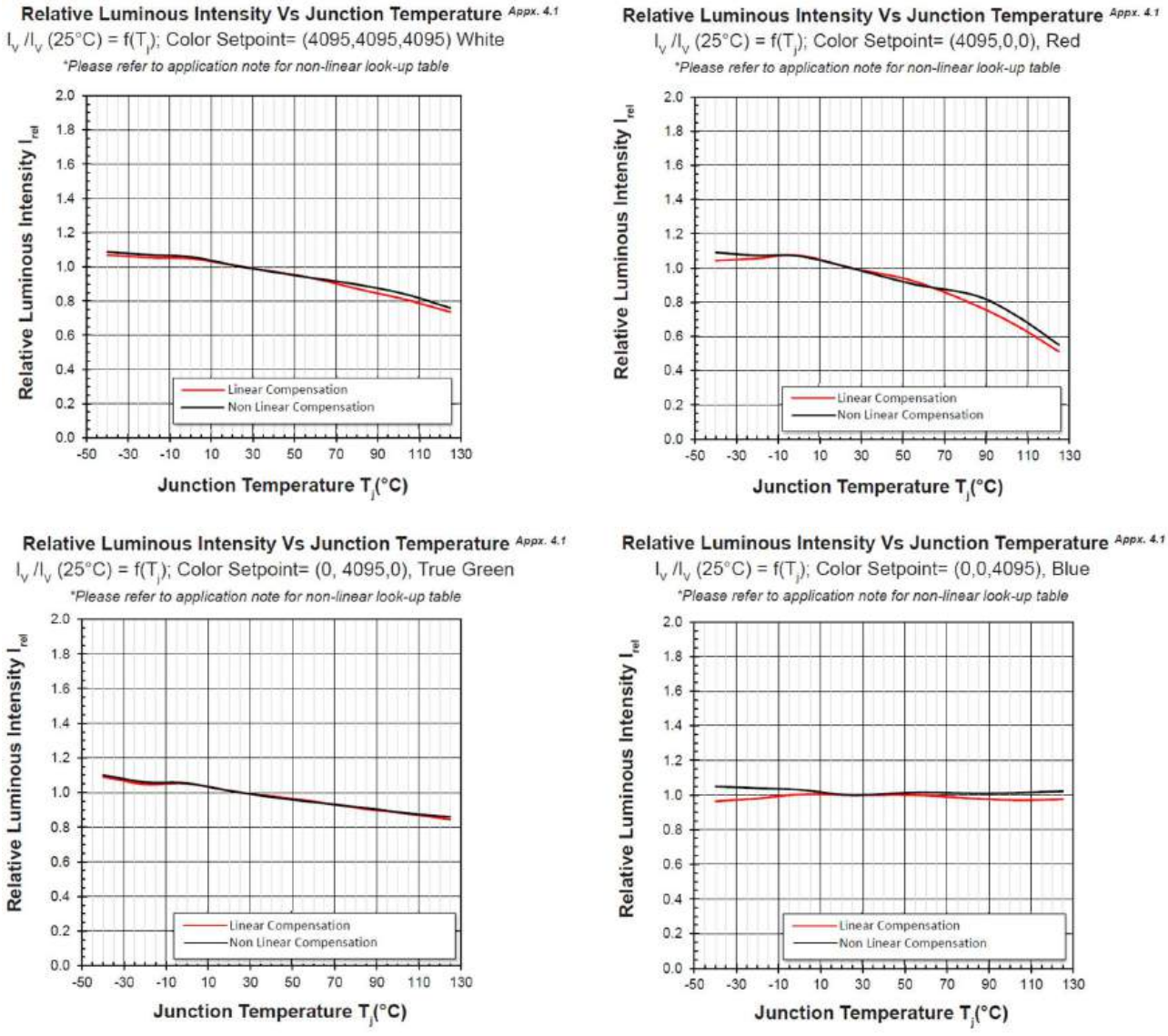


Figure 10,11,12 & 13: D65 White, Red, True Green & Blue LED Brightness shift vs Tj

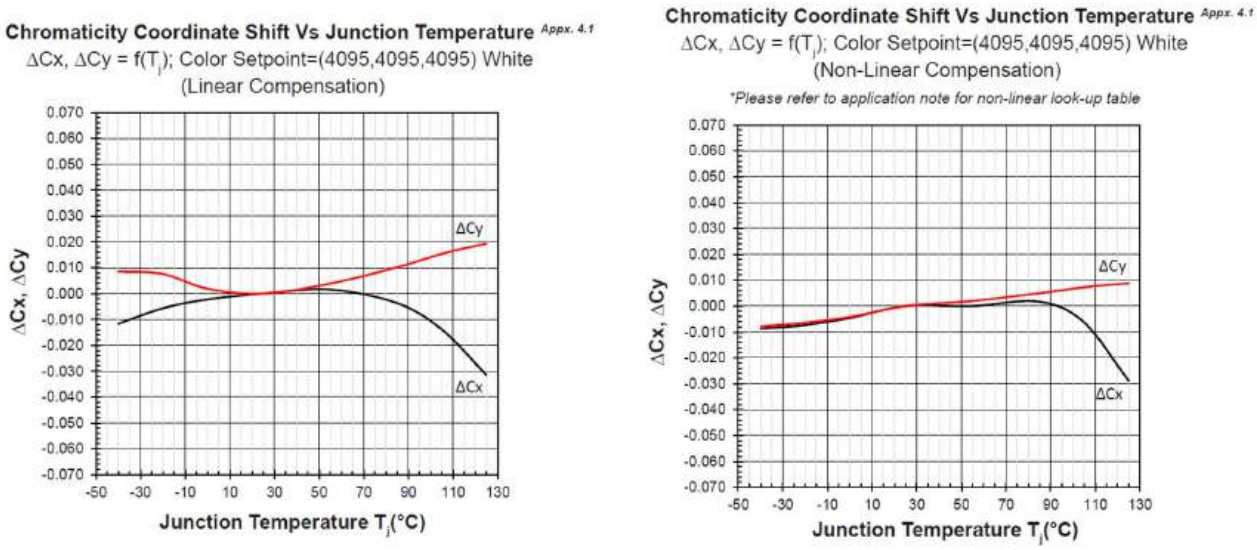


Figure 14: D65 White CxCy shift vs Tj for Linear (left) and Non-Linear (right) compensation

4.2 Non-linear temperature compensation look up table

Look-up table for non-linear temperature compensation entry for Red, True Green & Blue LED is written with sequential increasing/decreasing values from LUT Address 10 to LUT Address 0. LUT address 10 is linked to the coldest functional junction temperature at -40C and LUT 0 is linked to the hottest functional junction temperature at 105C.

A3J-FHG LED is provided with 6 sets of LUT tables. Each PWM channel (Red, True Green & Blue LED) has two individual LUT table sets: one for nightlight mode and one for daylight mode.

Figure 15 shows the example of the table for each entry. Look up Table API command need to be written into microcontroller source code main interface right after INIT strip command. During debugging mode, this source code will need to be flashed into MCU memory to operate as usual. These setting will manually overwrite the linear compensation TC_BASE and TC_OFFSET values pre-recorded in the OTP.

API command (based on Microchip Atmel Studio):

ILaS_ReturnType ILaS_Write_Register(uint16_t RegVal, uint16_t RegAdd, uint16_t Address, uint16_t NetworkNr);

uint16_t RegVal	0-65535: 9-bit look-up table value
uint16_t RegAdd	0-65535: Register address following Inova documents
uint16_t Address	0-65535: Address of the target LED. 0 addresses all LEDs of the chain.
uint16_t NetworkNr	0-65535: Number of the network on which the commands will be sent

LUT address	CH2, Red Channel	CH1, Green Channel	CH0, Blue Channel
0	345	430	445
1	305	426	446
2	262	425	447
3	235	424	448
4	220	423	449
5	205	420	450
6	188	415	470
7	178	405	496
8	170	402	501
9	160	400	506
10	128	390	511

Figure 15: Non-linear temperature compensation look-up table for both Day/Night mode.

These 11 values will not store permanently in the OTP and need to be set again by the host after every reset.

Below steps give an example command for the INIT of the strip and how to set these 11 values with the Microchip SAMD21 evaluation board. The INIT command may only be executed after power-up or hardware reset or after a CAL_RESET command has been executed. Otherwise, it is considered an illegal command and the undefined command error status bit is set, if an INIT command is encountered.

1. INIT of LED strip with example of **Microchip** digLED_Init_Strip command

```
/* setup the SPI */
SPI_Initialize();
DMA_Initialize();
/* doing the Initialization of the ILAS network and test the communication */
ILas_start();
delay_200us();
```

The main portion for the initialization to work from ILas_start function as below:

```
void ILas_start(void)

{
    /* initialize SERCOMx SPI as physical ILAS interface */
    ILaS_Network_Init_Interface(1, SPI_HOST);    // 1 is no. of network
   delay_200us();       // network settling time
   /* RESET the ILAS network communication line */
    ILaS_Reset(0, 0);
   delay_200us();       // network reset time
}
```

2. After Initialization, ILAS is ready to received command. To light up ILAS the coding examples as below:

```
ILaS_Write_Register(1, 0x0029 , 0, 0); // set day mode
delay_1000ms();
ILaS_Set_3PWM_Low(15, 15, 15, 0, 0);      // light up in white set rgb 4095
ILaS_Set_3PWM_Hi(255, 255, 255, 0, 0);    //Low register 4 bits, Hi register 8 bits
delay_1000ms();

ILaS_Write_Register(0, 0x0029 , 0, 0); // set night mode
delay_1000ms();
ILaS_Set_3PWM_Low(15, 15, 15, 0, 0);      // light up in white set rgb 4095
ILaS_Set_3PWM_Hi(255, 255, 255, 0, 0);    //Low register 4 bits, Hi register 8 bits
delay_1000ms();
```

3. Set 11 values of non-linear look-up table with example of Microchip ILaS Write Register command

```
//CH0_Blue LUT
ILaS_Write_Register(445, 0x0081 , 0, 0);
ILaS_Write_Register(446, 0x0082 , 0, 0);
ILaS_Write_Register(447, 0x0083 , 0, 0);
ILaS_Write_Register(448, 0x0084 , 0, 0);
ILaS_Write_Register(449, 0x0085 , 0, 0);
ILaS_Write_Register(450, 0x0086 , 0, 0);
ILaS_Write_Register(470, 0x0087 , 0, 0);
ILaS_Write_Register(496, 0x0088 , 0, 0);
ILaS_Write_Register(501, 0x0089 , 0, 0);
ILaS_Write_Register(506, 0x008A , 0, 0);
ILaS_Write_Register(511, 0x008B , 0, 0);

//CH1_Green LUT
ILaS_Write_Register(430, 0x008C , 0, 0);
ILaS_Write_Register(426, 0x008D , 0, 0);
ILaS_Write_Register(425, 0x008E , 0, 0);
ILaS_Write_Register(424, 0x008F , 0, 0);
ILaS_Write_Register(423, 0x0090 , 0, 0);
ILaS_Write_Register(420, 0x0091 , 0, 0);
ILaS_Write_Register(415, 0x0092 , 0, 0);
ILaS_Write_Register(405, 0x0093 , 0, 0);
ILaS_Write_Register(402, 0x0094 , 0, 0);
ILaS_Write_Register(400, 0x0095 , 0, 0);
ILaS_Write_Register(390, 0x0096 , 0, 0);

//CH2_Red LUT
ILaS_Write_Register(345, 0x0097 , 0, 0);
ILaS_Write_Register(305, 0x0098 , 0, 0);
ILaS_Write_Register(262, 0x0099 , 0, 0);
ILaS_Write_Register(235, 0x009A , 0, 0);
ILaS_Write_Register(220, 0x009B , 0, 0);
ILaS_Write_Register(205, 0x009C , 0, 0);
ILaS_Write_Register(188, 0x009D , 0, 0);
ILaS_Write_Register(178, 0x009E , 0, 0);
ILaS_Write_Register(170, 0x009F , 0, 0);
ILaS_Write_Register(160, 0x00A0 , 0, 0);
ILaS_Write_Register(128, 0x00A1 , 0, 0);
```

4. Set 11 values of non-linear look-up table with example of Microchip ILaS Write Register command (NIGHT MODE)

```
//CH0_Blue LUT
ILaS_Write_Register(445, 0x0060 , 0, 0);
ILaS_Write_Register(446, 0x0061 , 0, 0);
ILaS_Write_Register(447, 0x0062 , 0, 0);
ILaS_Write_Register(448, 0x0063 , 0, 0);
ILaS_Write_Register(449, 0x0064 , 0, 0);
ILaS_Write_Register(450, 0x0065 , 0, 0);
ILaS_Write_Register(470, 0x0066 , 0, 0);
ILaS_Write_Register(496, 0x0067 , 0, 0);
ILaS_Write_Register(501, 0x0068 , 0, 0);
ILaS_Write_Register(506, 0x0069 , 0, 0);
ILaS_Write_Register(511, 0x006A , 0, 0);

//CH1_Green LUT
ILaS_Write_Register(430, 0x006B , 0, 0);
ILaS_Write_Register(426, 0x006C , 0, 0);
ILaS_Write_Register(425, 0x006D , 0, 0);
ILaS_Write_Register(424, 0x006E , 0, 0);
ILaS_Write_Register(423, 0x006F , 0, 0);
ILaS_Write_Register(420, 0x0070 , 0, 0);
ILaS_Write_Register(415, 0x0071 , 0, 0);
ILaS_Write_Register(405, 0x0072 , 0, 0);
ILaS_Write_Register(402, 0x0073 , 0, 0);
ILaS_Write_Register(400, 0x0074 , 0, 0);
ILaS_Write_Register(390, 0x0075 , 0, 0);

//CH2_Red LUT
ILaS_Write_Register(345, 0x0076 , 0, 0);
ILaS_Write_Register(305, 0x0077 , 0, 0);
ILaS_Write_Register(262, 0x0078 , 0, 0);
ILaS_Write_Register(235, 0x0079 , 0, 0);
ILaS_Write_Register(220, 0x007A , 0, 0);
ILaS_Write_Register(205, 0x007B , 0, 0);
ILaS_Write_Register(188, 0x007C , 0, 0);
ILaS_Write_Register(178, 0x007D , 0, 0);
ILaS_Write_Register(170, 0x007E , 0, 0);
ILaS_Write_Register(160, 0x007F , 0, 0);
ILaS_Write_Register(128, 0x0080 , 0, 0);
```

Please refer to respective MCU supplier for the API command if different MCU is used. However, the non-linear temperature compensation look-up table entry (Figure 15) will remain the same.

5.0. Surface Mounting Guideline

5.1 A3J-FHG Package Outline

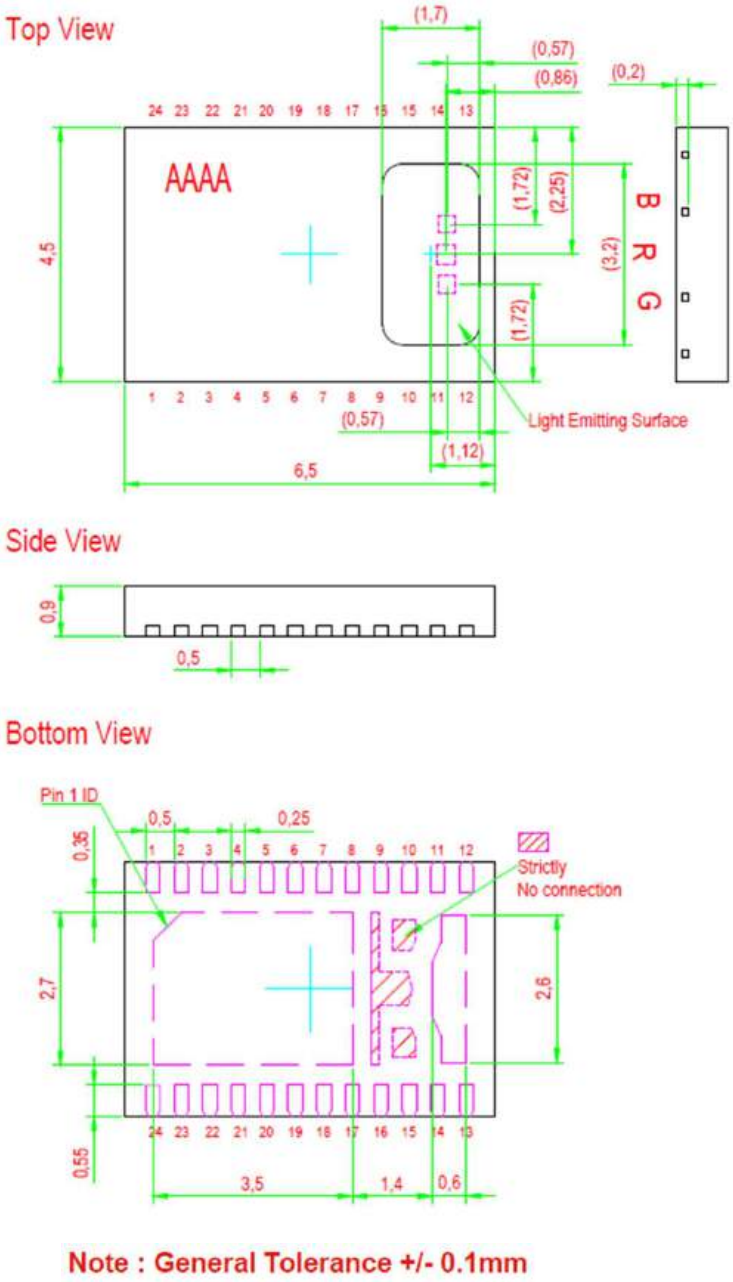


Figure 16: A3E-THG Package Outline

5.2 Standard Soldering Process:

The seddLED3.6 package soldering surfaces are plated with gold (Au) and are therefore RoHs compliant. The component is designed to be compatible to the existing industry SMT process and IR-reflow. The profile is as per described in the datasheet.

Product complies to MSL Level 2 acc. to JEDEC J-STD-020E

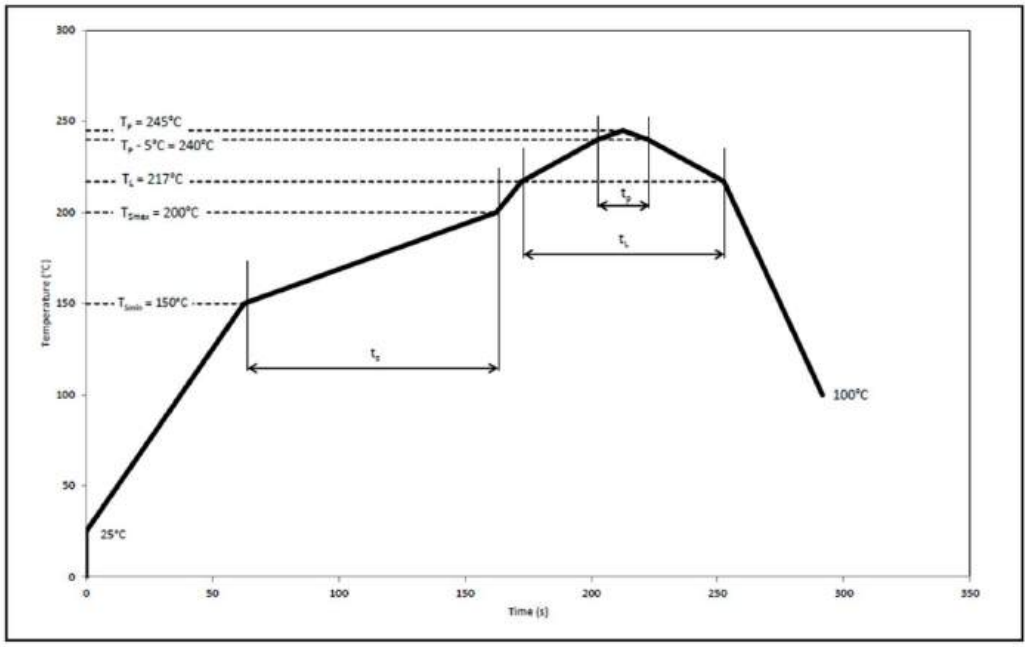


Figure 17: Recommended Reflow Soldering Profile

Profile Feature	Symbol	Pb-Free Assembly			Unit
		Min.	Recommended	Max.	
Ramp-up rate to preheat 25°C to T_{smin}	-	-	2	3	°C/s
Time t_S T_{smin} to T_{smax}	t_S	60	100	120	s
Ramp-up rate to peak T_L to T_P	-	-	2	3	°C/s
Liquidous temperature	T_L	-	217	-	°C
Time above liquidous temperature	t_L	60	80	150	s
Peak temperature	T_p	-	245	260	°C
Time within 5°C of the specified peak temperature T_p - 5°C	t_p	10	20	30	s
Ramp-down rate T_p to 100°C	-	-	3	6	°C/s
Time 25°C to T_p	-	-	-	480	s

5.3 Surface Mounting – Factors to Consider:

This application note provides a guideline for the surface mounting of seddLED3.6. The following parameters have to be considered in order to optimize the surface mounting performance.

- Solder pad size
- Solder stencil size
- Solder paste thickness
- Nozzle
- Solder quality check

Solder Pad Size

The recommended solder pad design is as illustrated in the data-sheet.

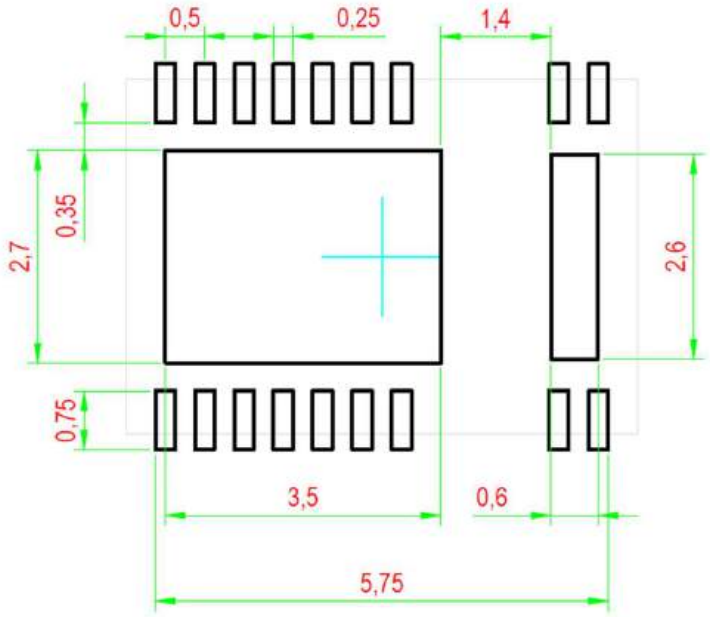


Figure 18: Recommended solder pad size

Solder Stencil Size

In order to minimize solder bridging problems, it is common to design stencil aperture size smaller than the recommended solder pad. Excessive amount of solder paste deployed will result to tilted parts and inaccurate placement position. It is recommended that the aperture is reduced to 75% of the recommended solder pad design.

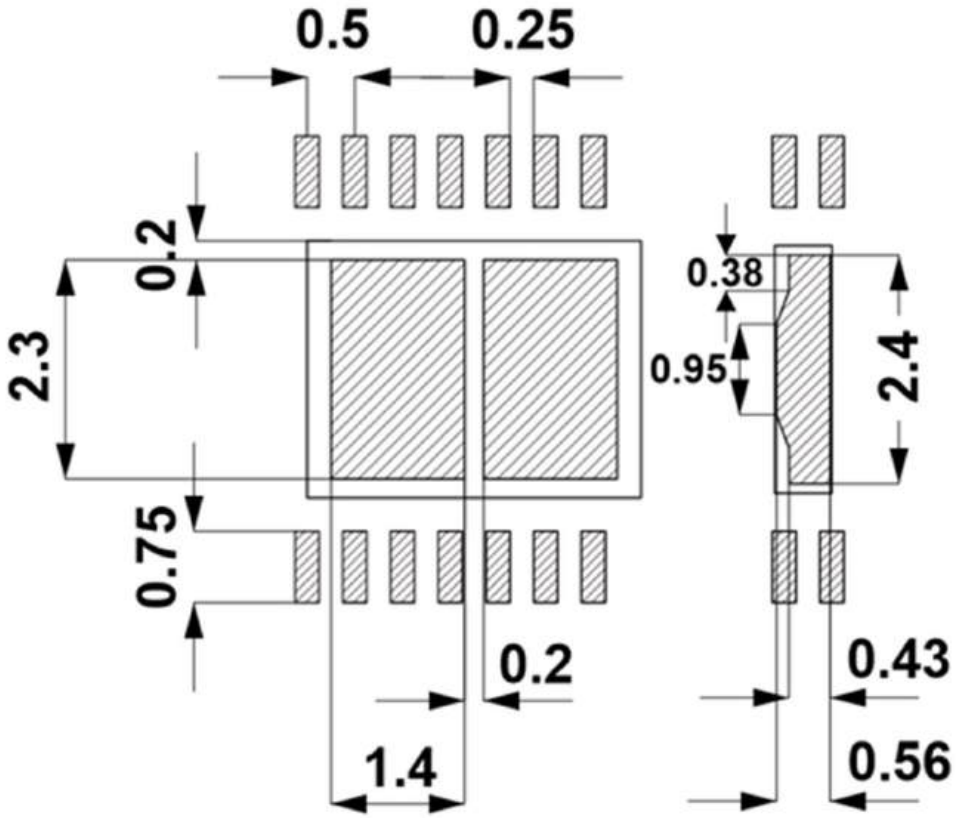


Figure 19: Recommended solder stencil size

Solder Paste Thickness

We recommend using minimum solder paste in order to achieve a good solder formation. A solder paste thickness of 0.125 mm will be optimum.

Nozzle

Pick and place machine should be able to process seddLED3.6 devices with the required placement accuracy. Care should be observed that the surface of the nozzle which is in contact with the LED is flat and smooth. Parameter settings for the pick and place process should also be evaluated to ensure no damage to the LEDs. For recommended nozzle design, please refer to our Recommended Pick and Place Tools for LEDs from DOMINANT Opto Technologies application note.

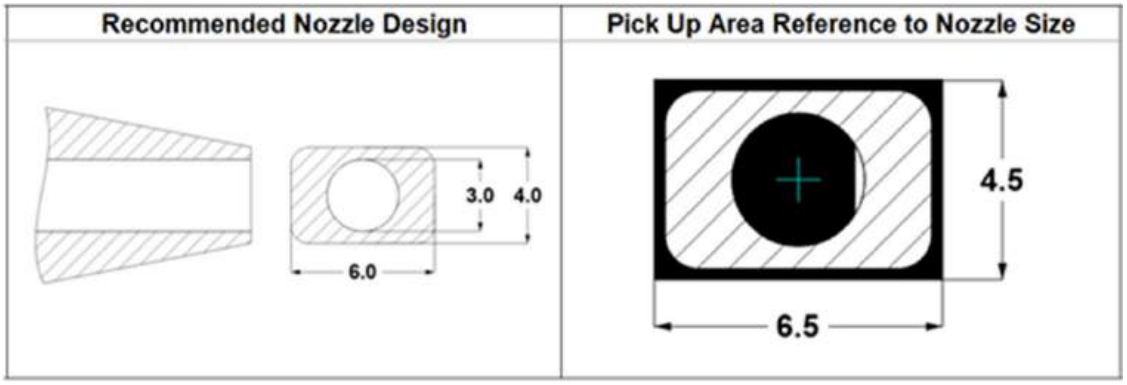


Figure 20: Recommended nozzle size and pick up area

Solder Quality Check after SMT Process

For seddLED3.6, the primary soldering surfaces are at the bottom of the LED component. Thus, no solder fillet will be observed on the part after SMT. Current industry practice is to install AOI after solder paste printing to ensure solder paste is perfectly print on pad before component landing. Alternately, inline X-ray can be used for solder void check after SMT process.

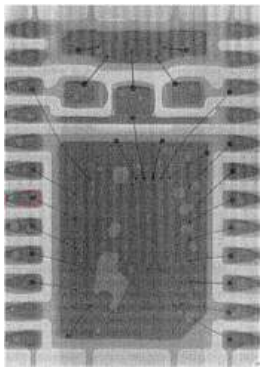


Figure 21: Inline X-Ray Solder Void Inspection after SMT

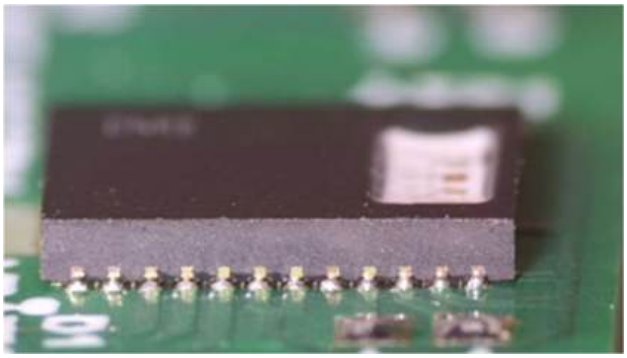


Figure 22: Example of good solder formation on lead

Solder Paste Type

Dominant has tested the SAC305 solder paste with satisfactory results. However, since application environments vary widely, we recommend that customers perform their own solder paste evaluation in order to ensure it is suitable for the targeted application.

Printed Circuit Design for Enhance Heat Dissipation

For seddLED3.6, the base lead-frame is built with high thermal conductivity Cu Alloy with Au Plating, so all the lead can be primary thermal path to carry heat away from the package. Since this package consists of a high-power RGB LED & IC, the heat density per area size is high, it is recommended to use MCPCB to surface mount this LED to enhance heat dissipation performance.

Storage Method after SMT

For PCB assembly that mounted with seddLED3.6, it should not be stack together after IR reflow, else it would have high chance of damaging the LED. Recommended method is having a dedicated carrier so that each PCB assembly is with at least 5mm away from each other.

Figure 23: Example of carrier to store the LED

Handling Precautions

- For manual handling, anti-static/conductive plastic tweezers should be use to pick up seddLED3.6. Avoid touching sensitive area such as the LES during pick up.

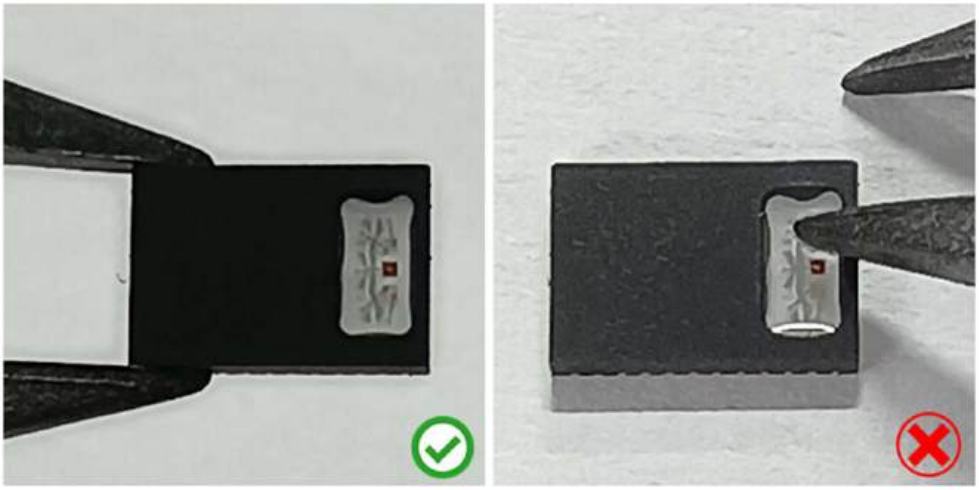


Figure 24: Example of correct and wrong method on LED handling

- A better alternative for manual handling of seddLED3.6 package is using vacuum suction pen. The suction tip should be made of a soft material such as rubber to minimize the mechanical force exerted onto sensitive area. Care should be taken to avoid the soft material from contaminating the top side surface of the LED emitting area.

Figure 25: Example of vacuum suction pen

6. Revision History

Changes	Date
Initial Release	12 Feb 2026