AL5958QEV1 User Guide

3x16-Channel Common-Cathode LED Driver with NMOS Switches

General Description

This user manual describes the functionality and characteristics of the AL5958Q RGB LED driver using demo board, which is an alike SPI bus controlled, 48 channel, constant current LED driver. This user manual includes hardware and software setup instructions, schematic diagram, bill of materials, printed-circuit board layout drawings and demo board images.

This demo board characterizes the features of AL 5958Q RGB LED driver. The main goal is to exercise clear and bright LED effects by communicating through MCU. This demo board has an additional feature of providing supply to the LEDs using power bank connected through USB Type-C connector or AAA battery.

Applications

- Indoor and Outdoor LED Video Displays
- Variable Message Sign (VMS)
- Dot Matrix Module

Key Features

- AEC-Q100 (Grade 1) qualification
- Built-in NMOS switches (0.65A per channel)
- 3.8V ~ 5V G/B-LED and IC supply voltage (±10%)
- Min. 2.8V R-LED supply voltage
- 0.5~20mA Constant current output range
- 3x16-Channel for full color application
- ±2.5%(max.) LED Current accuracy between channels
- ±2.5%(max.) LED Current accuracy between chips
- Current setting by 3 external resisters
- 6-bit global current control for each color group
- Build-in 3x16K bits SRAM
- For static and any dynamic systems from 1/2 scan to 1/32 scan
- Max. 16-bit grayscale resolution
- High Refresh rate achieved by Multiplex Pulse Density
- Modulation technology
- Selectable EMI reduction grayscale clock
- Automatic black frame insertion (Patent)
- Last scan and next scan line ghost image abatement
- Low brightness uniformity compensation
- Short LED caterpillar & open LED fail line abatement
- Current output staggered delay
- Grayscale enhancement
- Dynamic power saving & sleep mode
- Grayscale clock watchdog
- Flexible scan sequence
- Schmitt trigger input

Specifications

Parameter	Value
Input Voltage	USB-C / AAA batteries
Output Current	4.34mA
Output Voltage	5V
Dimension	165mm*85mm*20mm
RoHS Compliance	Yes

Evaluation Board

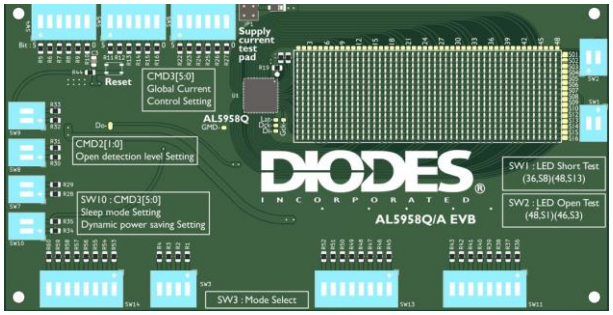


Figure 1: Top View

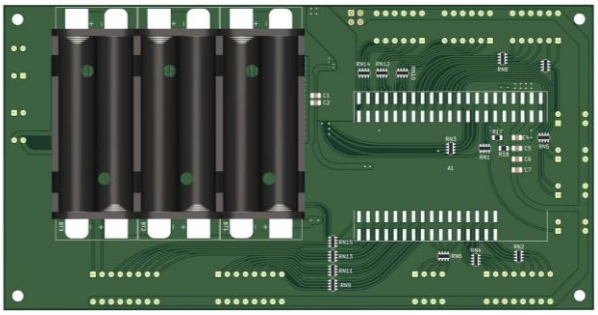


Figure 2: Button View

Connection Instructions:

- DC Input: USB-C / AAA dry batteries

Description:

The demo board consists of the following major components.

1. **AL5958Q_3x16-Channel Common-Cathode LED Driver**

The AL5958Q is a 48 channels constant current LED source driver with M-PDM (Multiplex Pulse Density Modulation) control, supports any dynamic applications from 1/2 scan to 1/16 scan. The distinctive M-PDM technology enhances the refresh rate of dynamic scanning systems without increasing the frequency of grayscale clock to prevent from EMI interference. And the technique of automatic black frame insertion could abate efficiently the influence of blurs caused by the scanning switch.

The device operates over a 2.8V to 5.5V input voltage range and provides 48 constant current sourcing outputs that delivers up to 20mA of high accuracy current to each string of LED. The current output of each color group is programmable by means of an external current-sensing resistor and could be adjusted by 6-bit global current control.

The AL5958Q's provides channel to channel current accuracy and device to device current matching ±2.5% (max.).

The device operates over –40°C to 125°C ambient temperature range. The AL5958Q is available in Wettable W-QFN9090-76/SWP package.

2. **Arduino 2560 mega Pro_ microcontroller board**

The Arduino Mega2560 Pro is a microcontroller board. 16 MHz ATmega 2560 microcontrollers are used in the product. It can be directly connected to the PC via the CH340G integrated on the card. You can program it with Arduino IDE via the com port formed on the PC.

Hardware description

The AL5958Q evaluation board as shown in Figure 3 and Figure 4:

Figure 3: Top Section Description

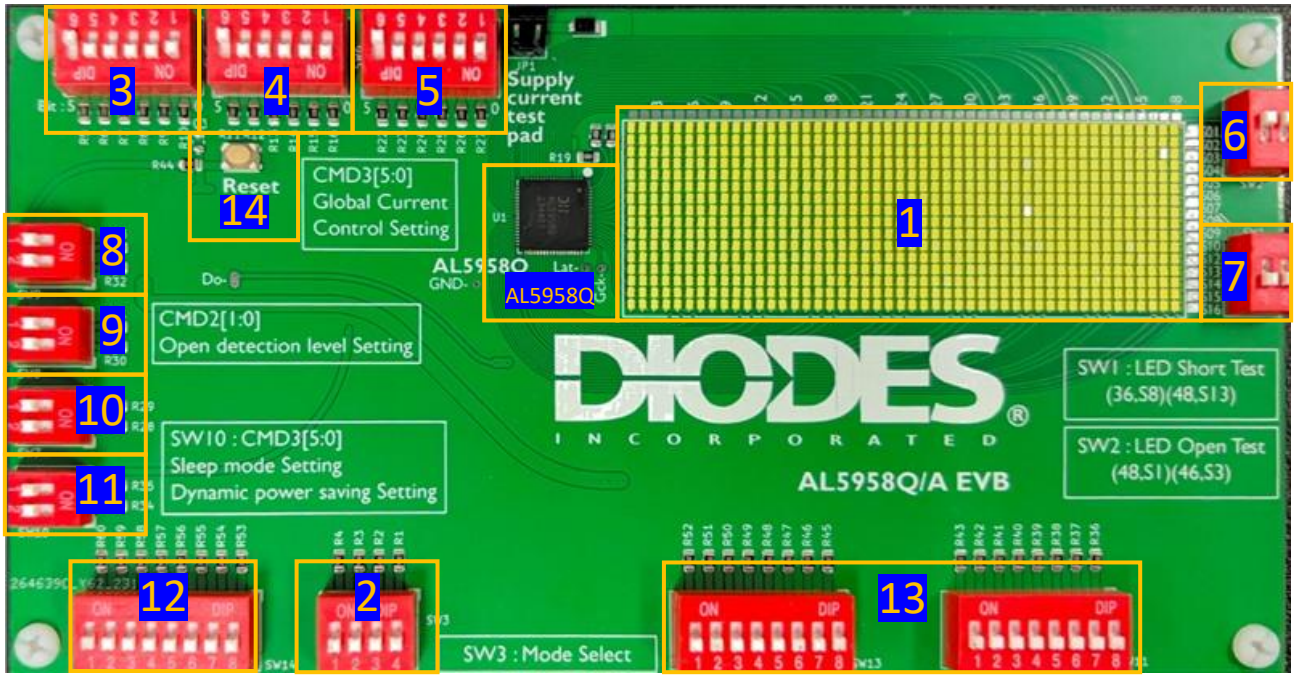


Figure 4: Bottom Section Description

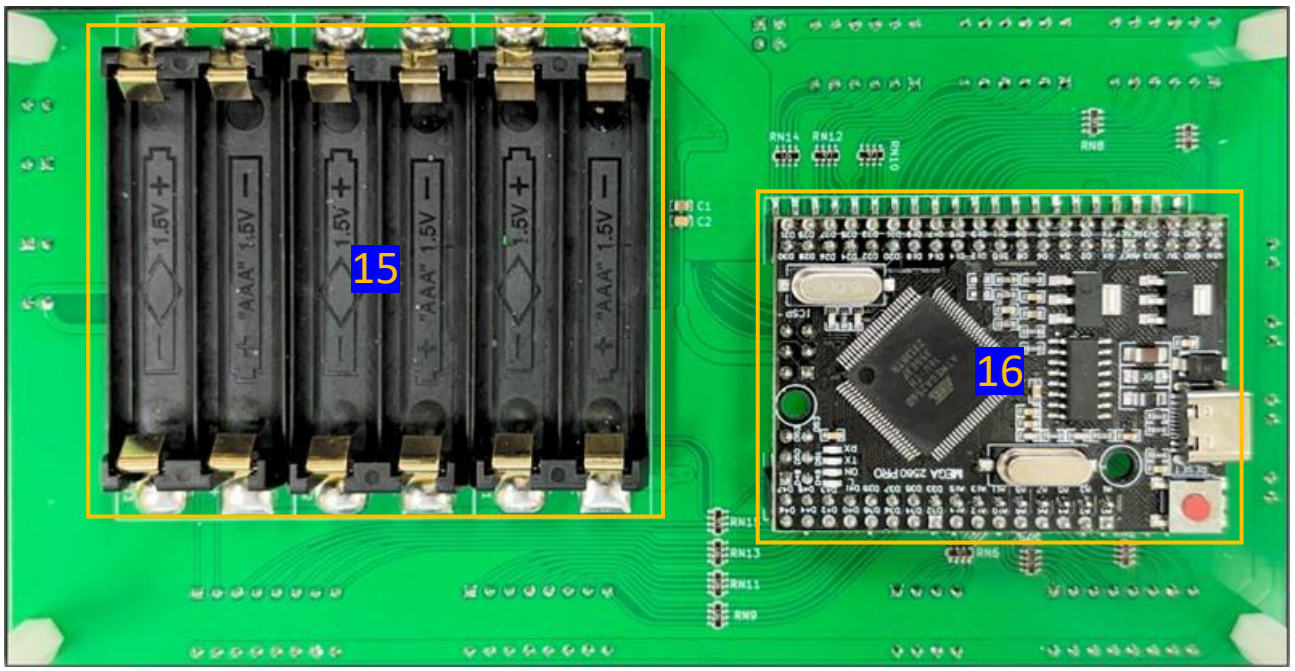


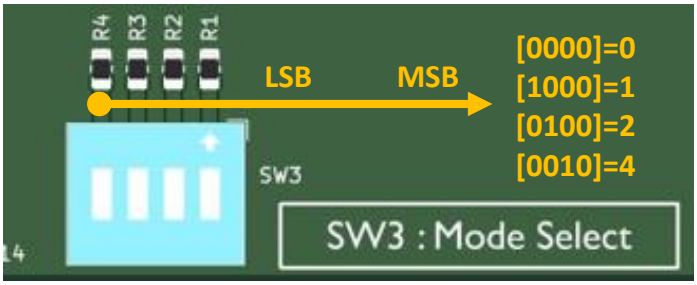
Table 1: EVB Section Description

Section	Description
1	LED Matrix Display
2	Mode Select switch
3	Current Gain_ R switch
4	Current Gain_ G switch
5	Current Gain_ B switch
6	LED Open Circuit Setting switch (default ON)
7	LED Short Circuit Setting switch (default OFF)
8	Open Detection level_ B switch
9	Open Detection level_ G switch
10	Open Detection level_ R switch
11	Sleep mode and Dynamic Power saving mode switch
12	Reserved
13	Reserved
14	System Reset button
15	AAA dry batteries box
16	Control board- Mega2560Pro

Table 2: Mode Select Description

Mode	Description	Mode	Description
0	DIODES Logo Static Display	7	Color Gradient (with gamma 2.6)
1	LED fully on	8	Movement Display
2	Fade In / Out	9	Motion Up Display
3	Flash	10	Motion Left in Display
4	slash line-1	14	Open Detection
5	slash line-2	15	Short Detection
6	Color Gradient (without gamma)		

Figure 5: Mode Select Method



Power Supply Options:

The device features two power supply options:

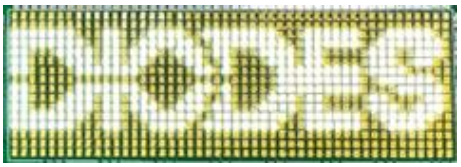
1. Utilizing six AAA dry batteries for portable convenience.
2. Connecting the ARDUINO control board via the USB interface (type C) to serve as the power source.

Note: The two power supply methods cannot be used simultaneously.

Quick Start Guide

Once the power is applied to the EVB, the LED Matrix Display defaults to static displaying the Diodes logo.

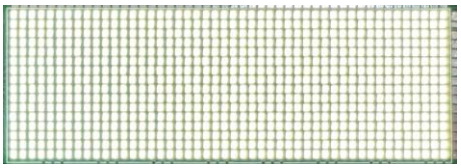
Figure 6: Diodes Logo Static Display



3. **Mode 1: Fully on**

Please refer to Figure 7 for the description. Set SW3 from left to right to 1000 to enter fully on mode. This mode demonstrates the uniformity of LED static brightness and refresh rate.

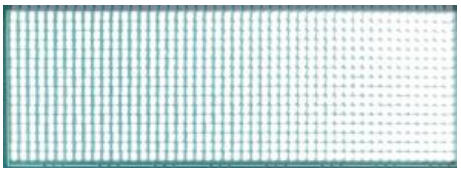
Figure 7: Fully on mode



4. **Mode 2: Fade in/out**

Please refer to Figure 8 for the description. Set SW3 from left to right to 0100 to enter fade in/out mode. This mode showcases the uniformity of brightness and refresh rate during dynamic scenes.

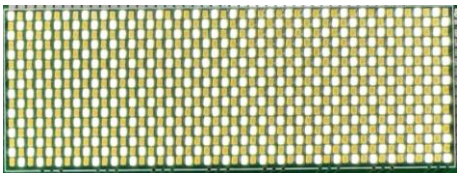
Figure 8: Fade in/out mode



5. **Mode 3: Flash**

Please refer to Figure 9 for the description. Set SW3 from left to right to 1100 to enter flash mode. This mode showcases the uniformity of brightness and refresh rate during dynamic scenes and the ability to eliminate residual images during scanning.

Figure 9: Flash mode



6. **Mode 4 and Mode 5: Slash line-1 and Slash line-2**

Please refer to Figure 10 and Figure 11 for the description. Set SW3 from left to right to 0010 or 1010 to enter slash mode. This mode showcases the ability to eliminate residual images during scanning.

Figure 10: Slash Line-1 mode

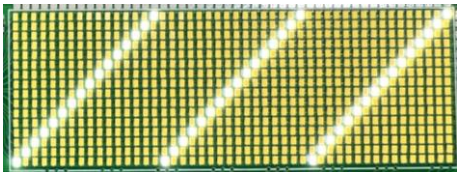
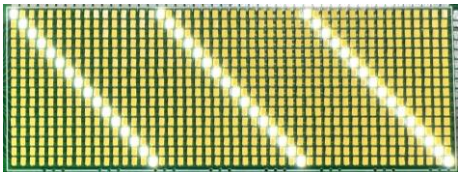


Figure 11: Slash Line-2 mode



7. **Mode 6 and Mode 7: Color Gradient without and Color Gradient Gamma with Gamma**

Please refer to Figure 12 and Figure 13 for the description. Set SW3 from left to right to 0110 or 1110 to enter color gradient mode. This mode showcases the smoothness of grayscale gradients, while different gamma settings demonstrate the wide range of adjustability.

Figure 12: Color Gradient without Gamma

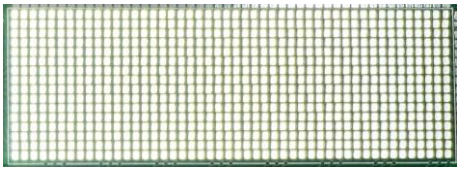
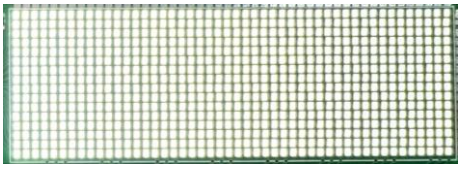


Figure 13: Color Gradient with Gamma



8. Mode 8: Movement Display

Please refer to Figure 14 and Figure 15 for the description. Set SW3 from left to right to 0001 to enter Movement Display mode. This mode shows the Diodes logo moving in from right to left to show the dynamic application.

Figure 14: Movement Display 1

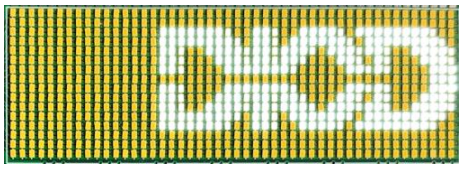
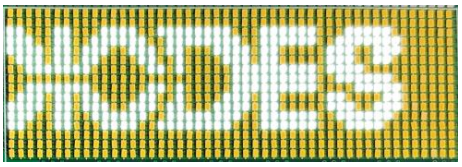


Figure 15: Motion Movement Display 2



9. Mode 9: Motion Up Display

Please refer to Figure 16 and Figure 17 for the description. Set SW3 from left to right to 1001 to enter Motion Up Display mode. This mode shows the Diodes logo appearing from up to low to show the dynamic application.

Figure 16: Motion Up Display 1

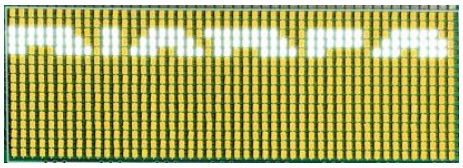
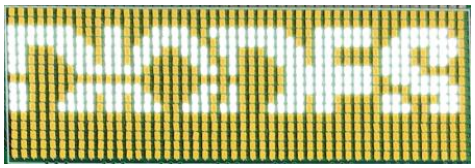


Figure 17: Motion Up Display 2



10. Mode 10: Motion Left in Display

Please refer to Figure 18 and Figure 19 for the description. Set SW3 from left to right to 0101 to enter Motion Left in Display mode. This mode shows the Diodes logo appearing from left to right to show the dynamic application.

Figure 18: Motion Left in Display 1

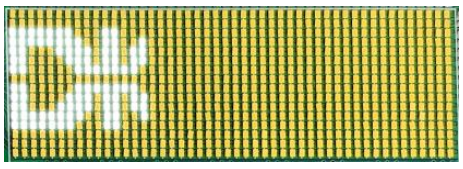
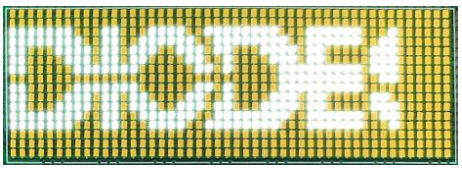


Figure 19: Motion Left in Display 2

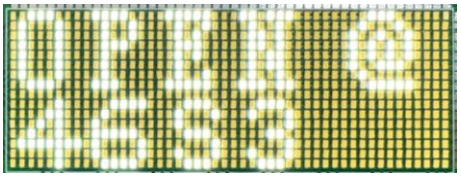


11. Mode 14: LED Open Detection

Please refer to

Figure **20** for the description. Set SW3 from left to right to 0111 to enter LED open detection mode. Then, change the SW2 status to simulate LED open circuit. Error location information will be sent through the AL5958Q Do pin when an open circuit is detected.

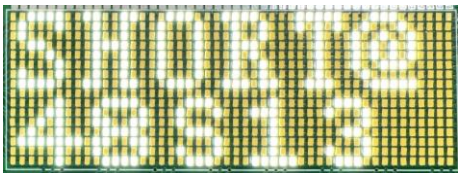
Figure 20: LED open detection



12. Mode 15: LED Short Detection

Please refer to Figure 21 for the description. Set SW3 from left to right to 1111 to enter LED short detection mode. Then, change the SW1 status to simulate LED short circuit. Error location information will be sent through the AL5958Q Do pin when a short circuit is detected.

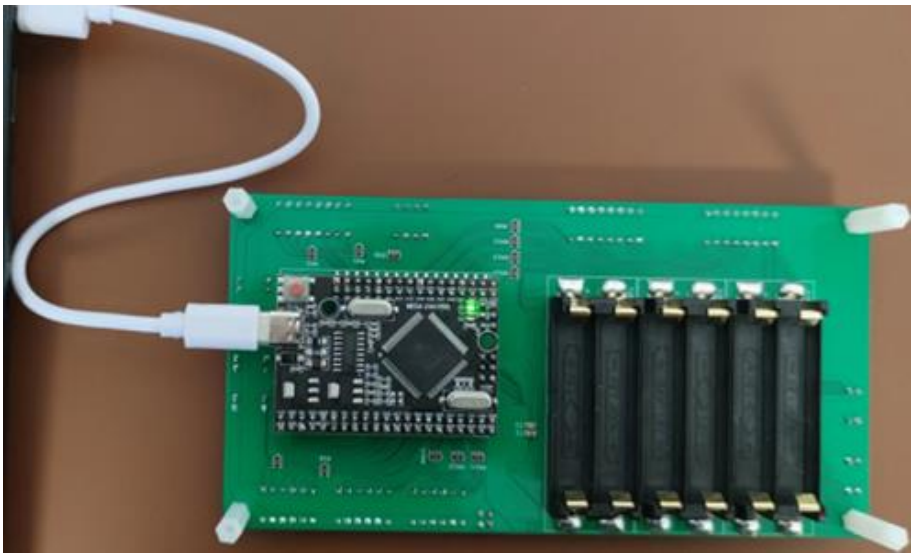
Figure 21: LED Short detection



Software Programming Procedure:

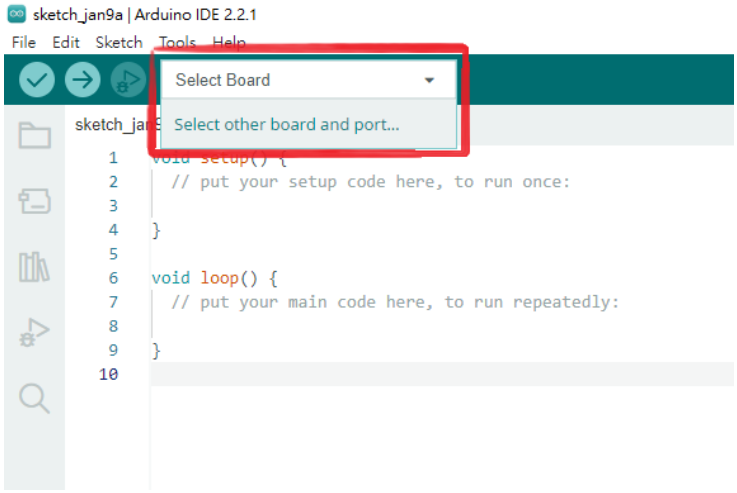
13. Connect USB -C cable from PC/Laptop to Demo board (Remove battery)

Figure 22: USB-C connection



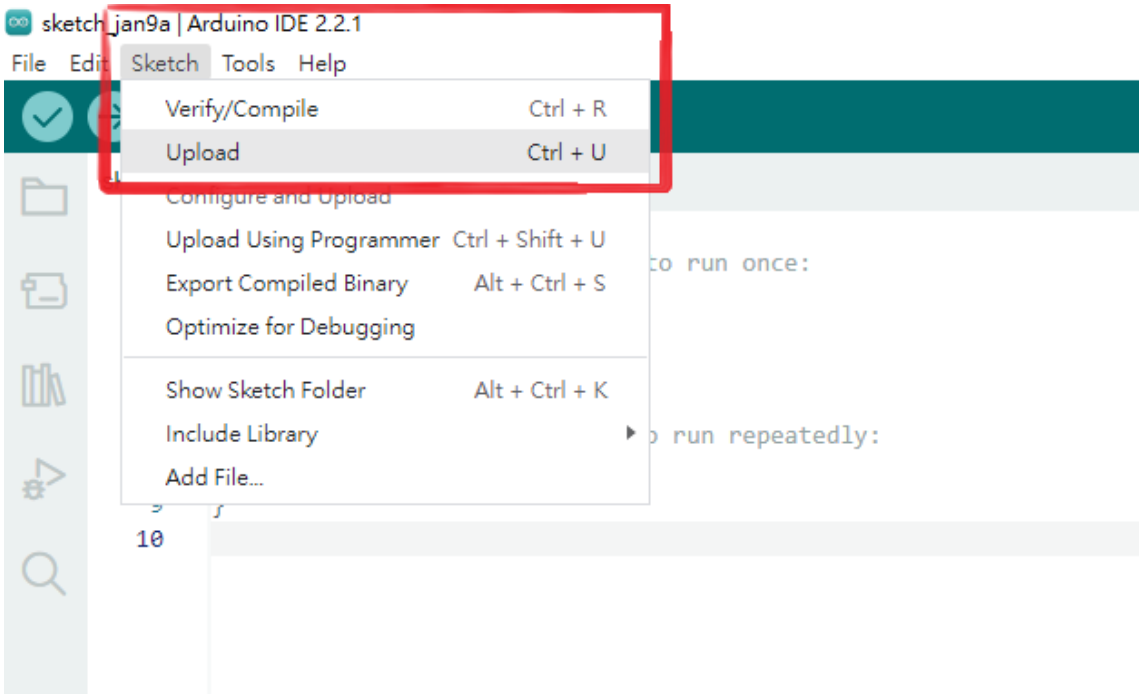
14. Download the latest version of the Arduino IDE from the official Arduino website.
15. Item 『File』-> 『Open』, Importing an Arduino programming language file with 『.ino』 extension.
16. Click 『Select Board』dialog box and search keyword 『2560』. Select 『mega 2560』（confirm that the file name of the existing version is correct）

Figure 23: Select 『mega 2560』control board



17. Select item『Sketch』-> 『Upload』, uploading it to the control board.

Figure 24: Uploading to the control board



Evaluation Board Schematic

Figure 25: Evaluation Board Schematic 1

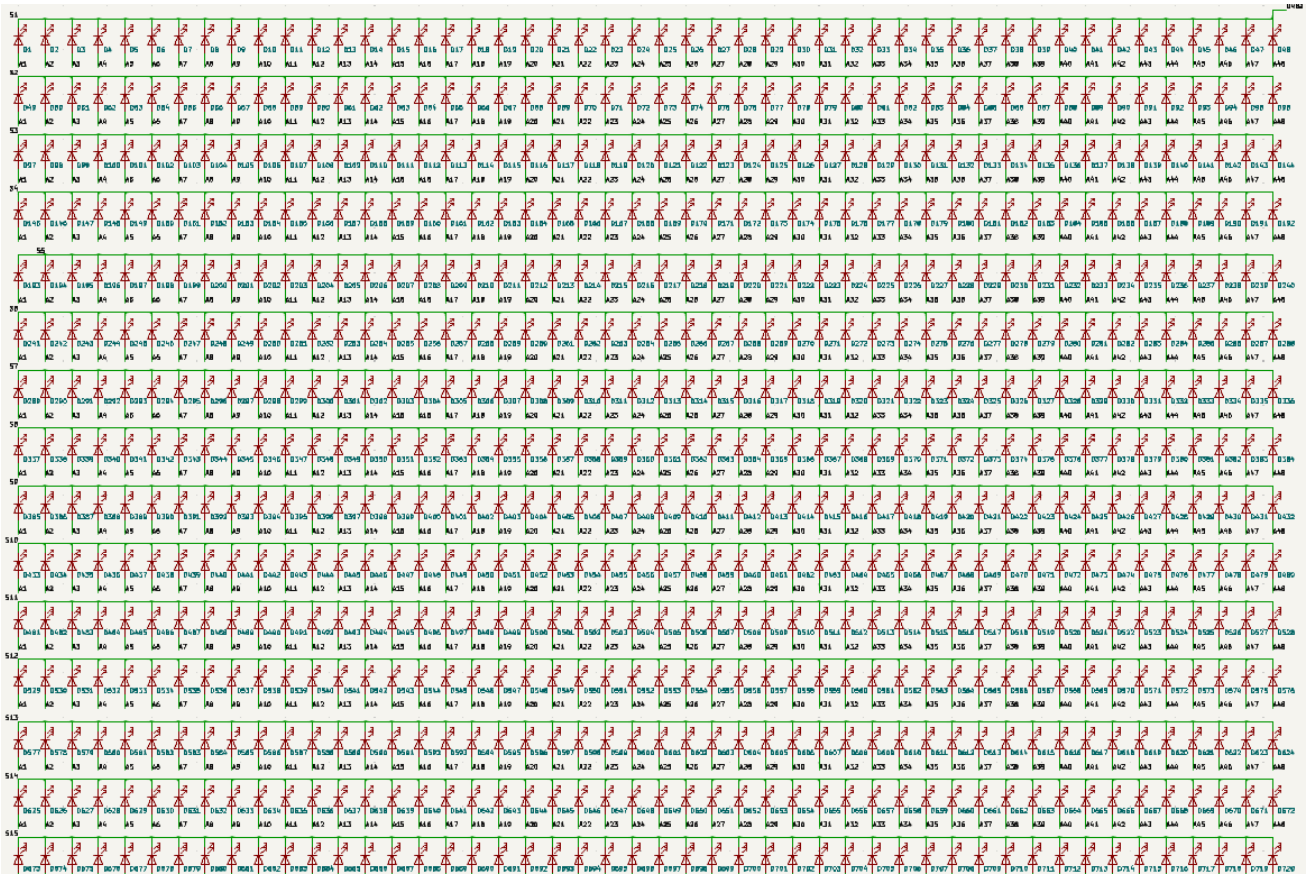
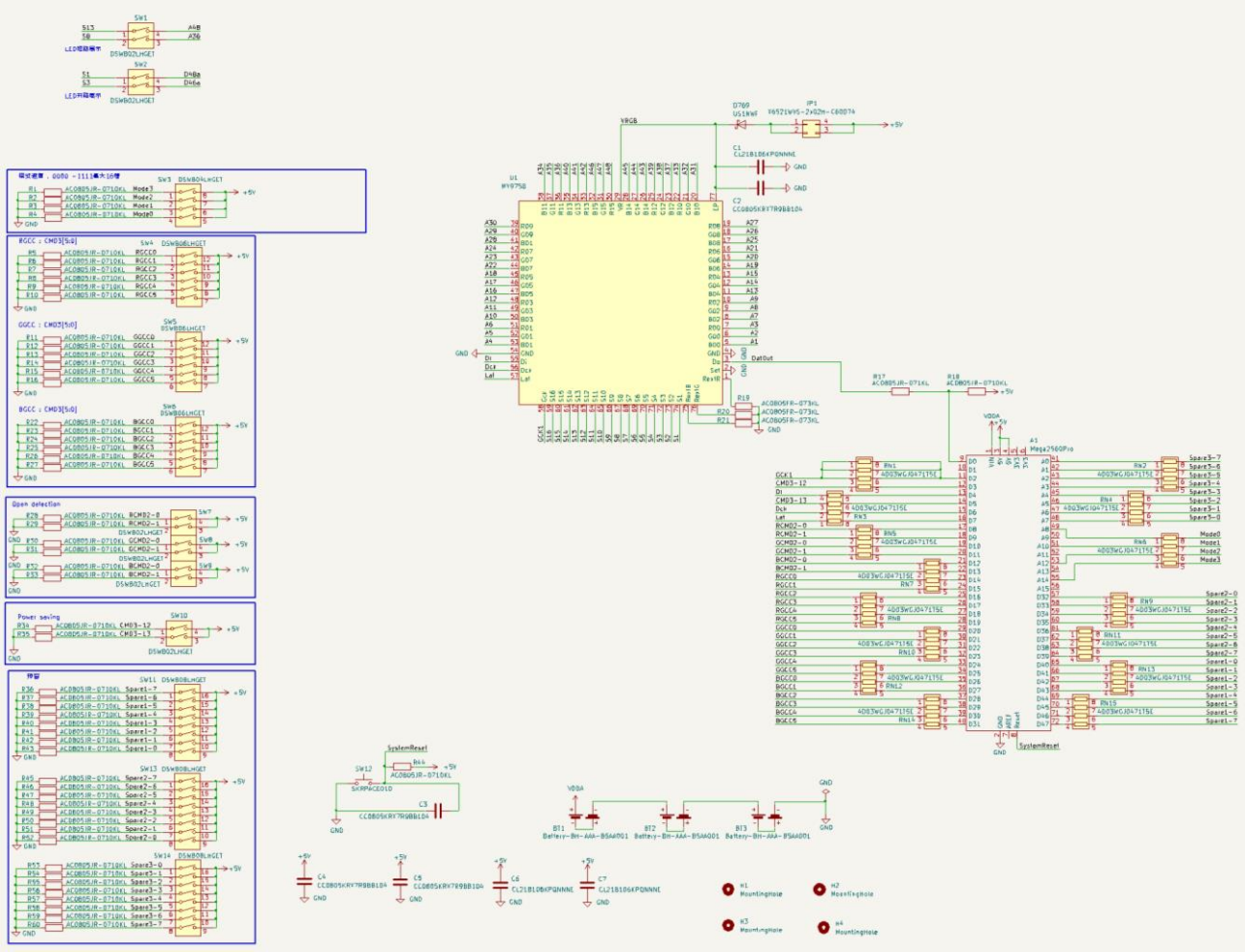


Figure 26: Evaluation Board Schematic 2



Evaluation Board Layout

Figure 27: PCB Top Layer View

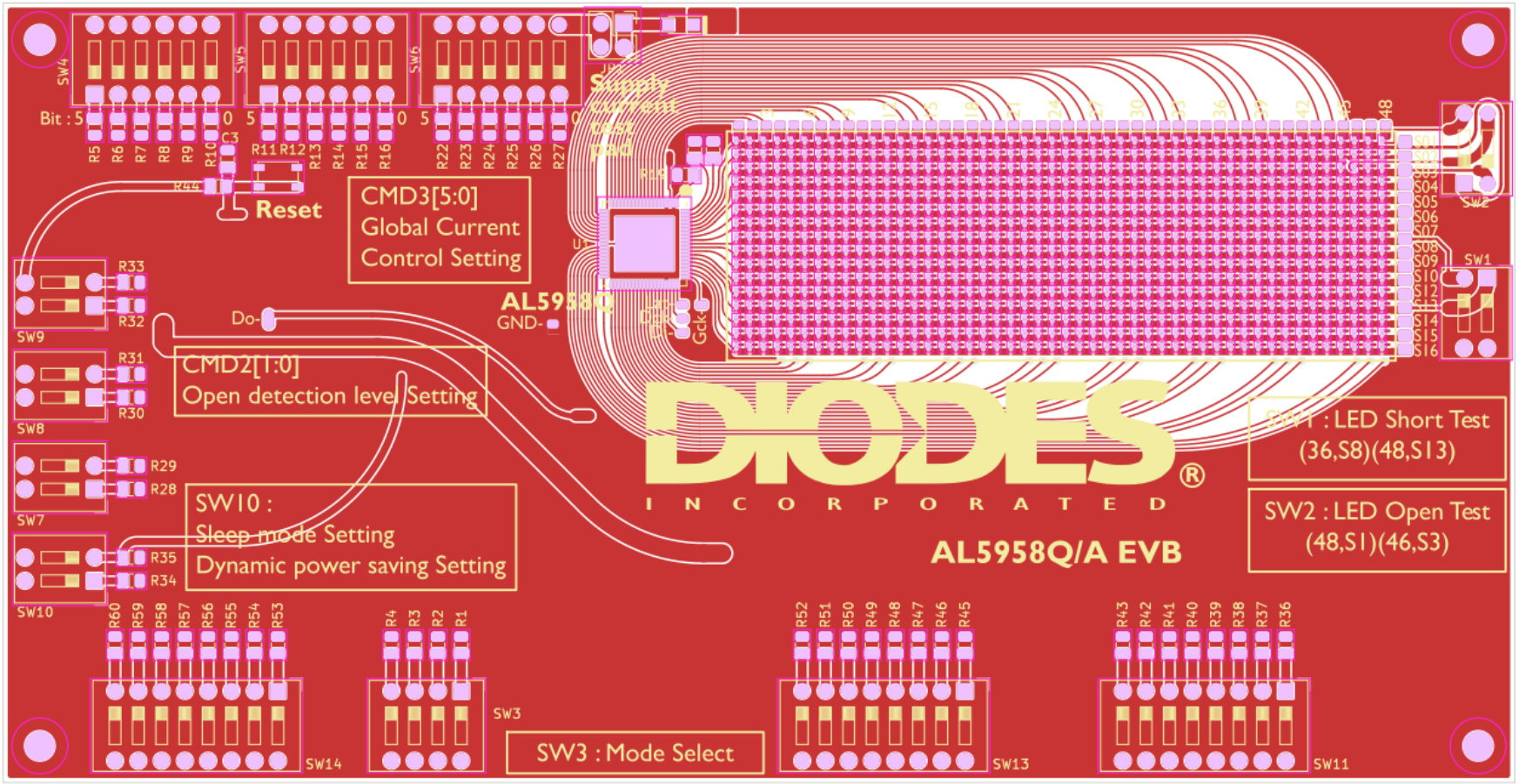
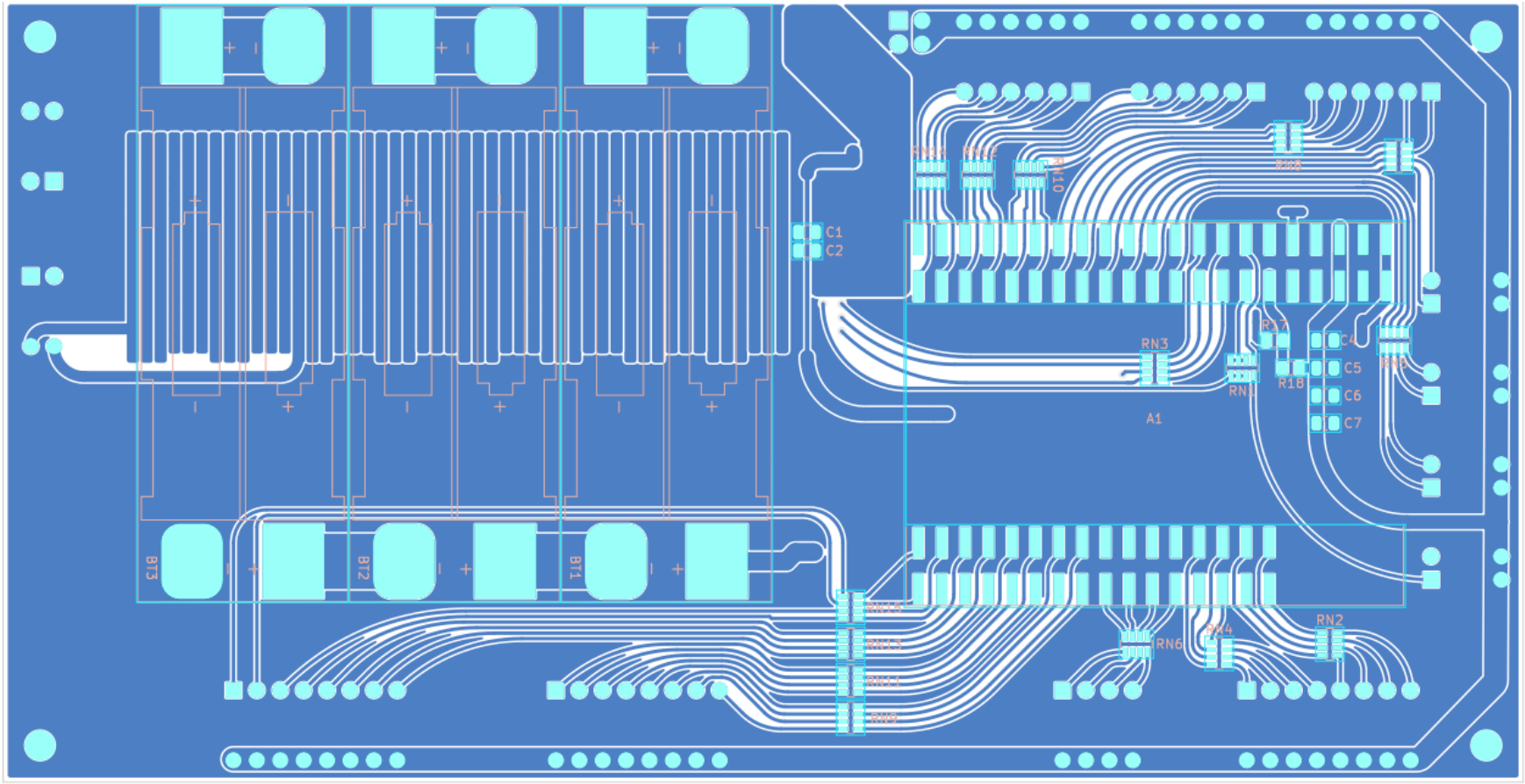


Figure 28: PCB Button Layer View



Bill of Material

Ref	Description	Manufacturer	Part Number	Package
U1	3x16-Channel Common-Cathode LED Driver with NMOS Switches	Diodes Inc	AL5958Q	W-QFN9090-76/SWP
D769	Fast Recovery Rectifiers, If=1A	Diodes Inc.	US1NWF-7	SOD-123F-2
C1, C6, C7	Capacitor, SMD: 10uF/10V X7R	Samsung Electro-Mechanics	CL21B106KPQNNNE	0805
C2~C5	Capacitor, SMD: 0.1uF/50V X7R	YAGEO	CC0805KRX7R9BB104	0805
R1~R16, R18, R22~R60	Resistor SMD, 10k ohm 5%, 1/8 W	YAGEO	AC0805JR-0710KL	0805
R17	Resistor SMD, 1k ohm 5%, 1/8 W	YAGEO	AC0805JR-071KL	0805
R19~R21	Resistor SMD, 3k ohm 5%, 1/8 W	YAGEO	AC0805FR-073KL	0805
RN1~RN15	Resistor array SMD, 470 ohm 5%, 1/16 W	Royal Ohm	4D03WGJ0471T5E	1206
D1~D768	SMD LED	Everlight	CSP0603	0603
SW1, SW2, SW7, SW8, SW9, SW10	2 Bit DIP Switches	KINGTEK	DSWB02LHGET	DIP-2
SW4, SW5, SW6	6 Bit DIP Switches	KINGTEK	DSWB06LHGET	DIP-2
SW11, SW13, SW14	8 Bit DIP Switches	KINGTEK	DSWB04LHGET	DIP-8
SW3	6 Bit DIP Switches	KINGTEK	DSWB06LHGET	DIP-8
SW12	Tactile Switches	Alps Alpine	SKRPACE010	-
A1	Mega2560Pro	-	-	--

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