# USER MANUAL

# IC LED FEATHERWING

# 150015

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

# MUST READ

## Check for software updates

Before using the product, make sure you use the most recent version of the control software, data sheet, and user manual. This is especially important for ICLED products that were not purchased directly from Würth Elektronik eiSos. A control software update on these respective products may be required.

We strongly recommend including in the customer system design the possibility for a control software update of the product.

# CAUTIONS AND WARNING

**This product is highly sensitive to electrostatic discharge (ESD). As such, always use proper ESD precaution when handling. Failing to fallow the aforementioned recommendations can result in severe damage to the part.**

**The ICLED FeatherWing can get hot during operation. Please avoid touching the surfaces of the board while it is in use and wait approximately one minute after turning off the power supply before handling it.**

**Warning against optical radiation: View the FeatherWing from a safe distance and use adequate protection as needed.**

# TABLE OF CONTENTS

# 1. GENERAL DESCRIPTION

## 1.1 Introduction

The Würth Elektronik eiSos ICLED FeatherWing is a development board fully compatible to the popular Adafruit Feather line of development boards. It extends the Feathers with a compact 7 x 15 ICLED display, which is controlled by just 1 GPIO pin of feather microcontroller. The published libraries and example-code make it easy to build up a prototype and kick-start the application development.

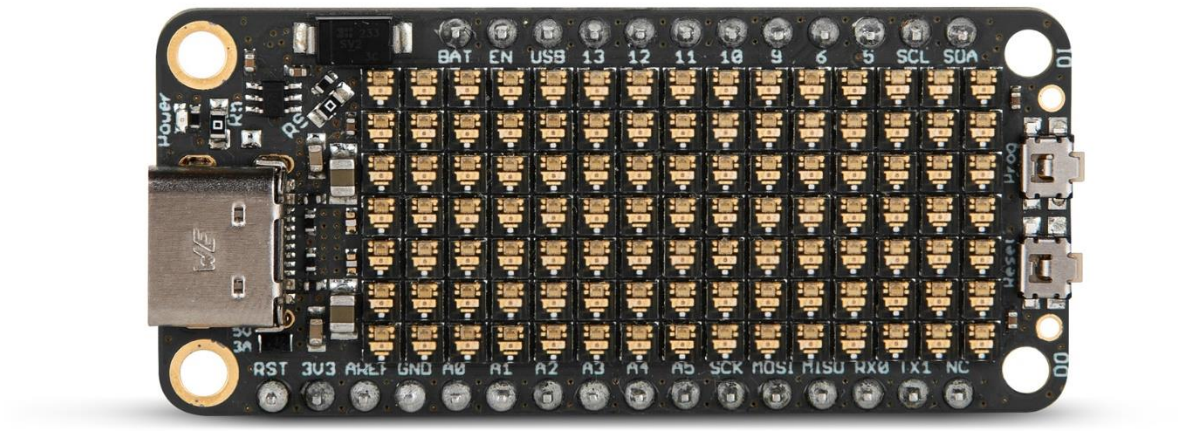


*Figure 1: ICLED FeatherWing*

## 1.2 Contents

| Description | Quantity |
|---|---|
| WE ICLED FeatherWing | 1 |
| ESD Foam | 1 |
| Packaging: ESD safe bag | 1 |

*Table 1: Contents article 150015 ICLED FeatherWing numbers*

Remove the ESD foam before using the FeatherWing to prevent any potential short circuits. Additionally, use the board on a non-conductive surface under laboratory conditions to ensure proper functionality.

## 2. FUNCTIONAL DESCRIPTION

The ICLED FeatherWing was designed with rapid prototyping in mind. Being fully compatible with the Adafruit ecosystem, this FeatherWing allows the user the flexibility to choose the preferred host microcontroller. The inherent modularity of the ecosystem allows the FeatherWing to be easily integrated into any project.

The next sections provide a brief introduction to Adafruit's Feather ecosystem and details on the Würth Elektronik eiSos ICLEDs.

### 2.1 Adafruit Feather

The Adafruit Feather ecosystem consists of two types of boards apart from a host of accessories:

- Feather: Adafruit Feathers are a complete line of development boards from Adafruit that are standalone and stackable. They can be powered either over the on-board micro-USB plugs or using a Li-Po battery. Feathers are portable, flexible and light as their namesake.
- FeatherWing: FeatherWings are stackable boards that when used along with a Feather add a certain functionality to the system.

The Feather system with more than 50+ Wings, several different types of accessories and Arduino/Circuit python-based code support provides a perfect ecosystem for rapid prototyping. Please refer to adafruit.com/feather for more details on the Adafruit Feather ecosystem.

### 2.2 ICLED FeatherWing (1312020030000)

#### 2.2.1 Key features

The Würth Elektronik eiSos ICLED FeatherWing contains 105 ICLEDs in a 7x15 display shape with a pitch of 2.38 mm. It can be controlled by any Adafruit feather microcontroller board and is powered by USB-C (5 V@3 A) or LiPo battery. The display is controlled by only 1 pin while a second GPIO-pin is used to trigger an interrupt by pushing the "Prog"-button on the FeatherWing. Internal Level-shifter makes logic-levels lower than 3.3 V possible and with that usage of other micro-controllers than Adafruit feathers. Table 2 and Table 3 show the key characteristics and figure 2 the wavelength spectrum of this FeatherWing.

| Properties | Value | Unit |
|---|---|---|
| Supply voltage | 3.3 - 5 | V |
| Logic level high In (min) | 1.65 - 3.6 | V |
| Logic level high In (R5 switched) | 2.7 - Vdd | V |
| Logic level high Out | 0.9 * Vdd | V |
| Power intake (USB-C) max | 15 | W |
| Power Consumption max | 8 | W |
| Power Consumption max (limitation) | 2.5 | W |
| Power Consumption typ. | 1.5 | W |
| Emitting power density max | 16 000 | cd/m² |
| Emitting power density (limitation) | 10 000 | cd/m² |

*Table 2: Key characteristics ICLED FeatherWing*

| Properties | Value | Unit |
|---|---|---|
| Peak wavelength Red | 630 | nn |
| Peak wavelength Green | 520 | nn |
| Peak wavelength Blue | 465 | nn |
| Sleep current | 90 | mA |
| Frame rate max. | 150 | Hz |

*Table 3: Continuation key characteristics ICLED FeatherWing*

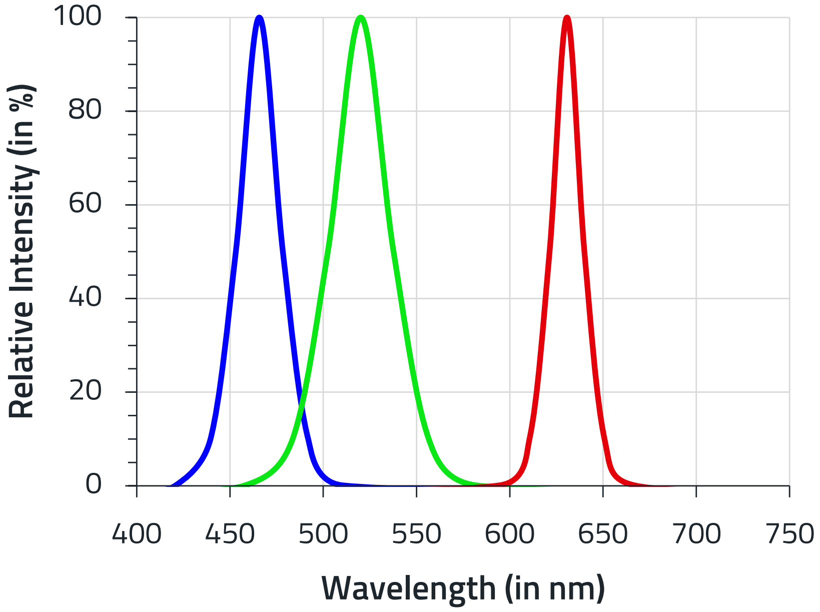


*Figure 2: Wavelength spectrum of the ICLED FeatherWing*

### 2.2.2 ICLEDs

The Würth Elektronik eiSos ICLEDs are compact RGB-LEDs with an 8-Bit PWM for each color. This allows 16.777.216 different color mixing values controlled by a single wire. Every ICLED has an integrated signal reshaping, which guarantees optimal signal-shape for all LEDs in row.

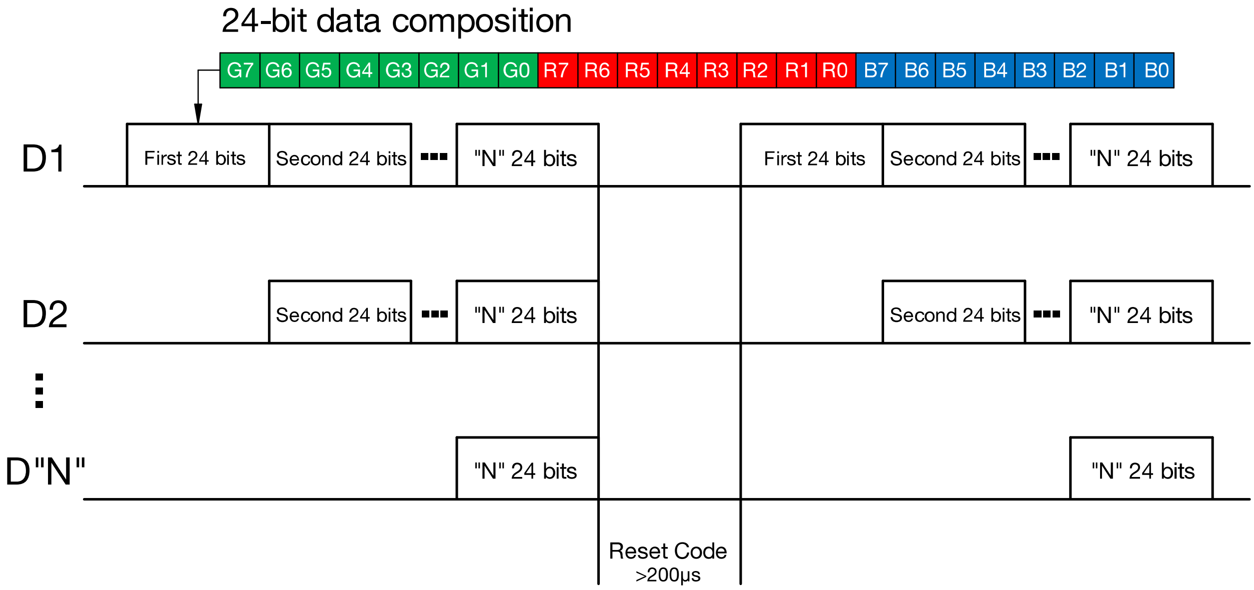


*Figure 3: Data transmission method*

ICLEDs are driven by a single data line. The data transmission method (as shown in figure 3) begins with the first ICLED in the sequence, which reads the initial 24 bits from the data stream. This ICLED then regenerates and forwards the remaining bits to the subsequent ICLED in the chain. A unique end-of-data signal, characterized by a low signal level lasting more than 200 µs on the data line, signifies the end of the data packet. Upon detecting this signal, the first ICLED prepares to interpret the next sequence of 24 bits as the starting point for a new transmission cycle.

The data transmission protocol is designed with a specific order: it reads the most significant bit (MSB) first. This begins with the 8-bit pulse-width modulation (PWM) code for the green LED component. This is followed in sequence by the PWM codes for the red and blue LED components, respectively. This method ensures a structured and efficient way to control the colour and brightness of each ICLED individually.

# 3. HARDWARE DESCRIPTION

This section contains a detailed description of the hardware features of the ICLED FeatherWing.

## 3.1 Connectors

This section explains all connectors of the ICLED FeatherWing.

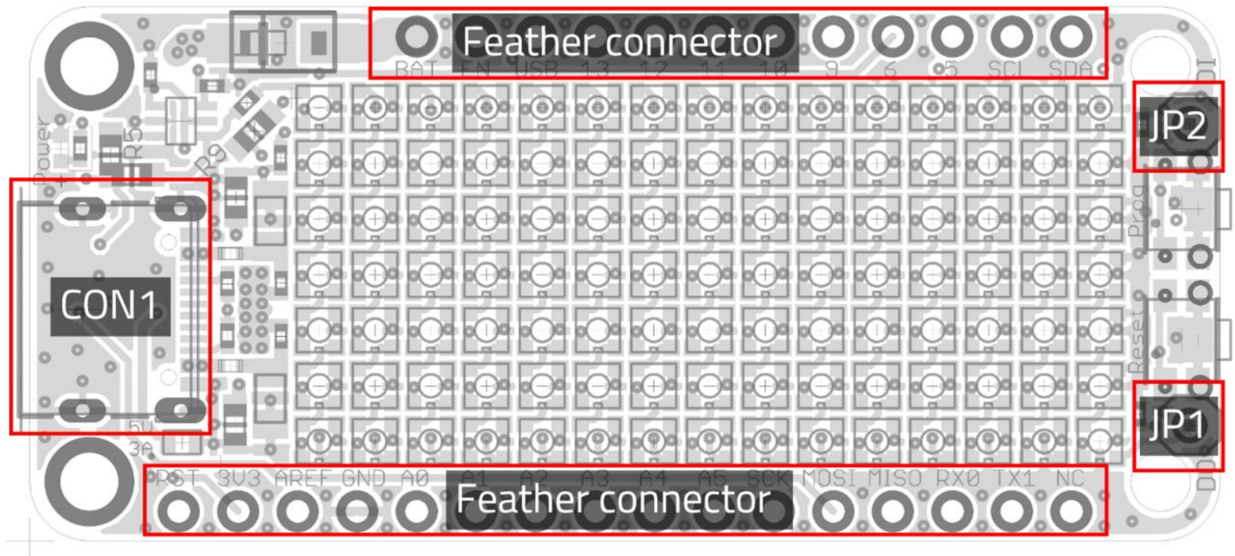


*Figure 4: ICLED FeatherWing connnectors (top view)*

| Pin header | Function | WE- article number |
|---|---|---|
| Feather connector | Connection to Feather M0 or FeatherWings | 61301211121 \| 61301611121 |
| CON1 | USB-C connector for VDD bus supply | 629722000214 |

*Table 4: Default assembled connectors and pin headers*

### 3.1.1 Feather connector

This is the standard set of connectors that is used across the Feather ecosystem. The table below describes the functions of each of the 28 pins as applicable to this FeatherWing.

| Pin Number | Pin name | Function |
|---|---|---|
| 1 | $\overline{RST}$ | $\overline{Reset}$ |
| 2 | 3V3 | 3.3V reference level |
| 3 | AREF | Not connected |
| 4 | GND | Ground |
| 5 | A0 | Not connected |
| 6 | A1 | Not connected |
| 7 | A2 | Not connected |
| 8 | A3 | Not connected |
| 9 | A4 | Not connected |
| 10 | A5 | Not connected |
| 11 | SCK | Not connected |
| 12 | MOSI | (Optional) DI via R10 |
| 13 | MISO | Not connected |
| 14 | U0RX | Not connected |
| 15 | U0TX | Not connected |
| 16 | NC | Not connected |
| 17 | SDA | Not connected |
| 18 | SCL | Not connected |
| 19 | 5 | S2 |
| 20 | 6 | DI via R9 |
| 21 | 9 | Not connected |
| 22 | U1TX | Not connected |
| 23 | U1RX | Not connected |
| 24 | 12 | (Optional) DI via R4 |
| 25 | 13 | Not connected |
| 26 | 5V | (Optional) USB power via R8 |
| 27 | EN | Not connected |
| 28 | VBAT | Battery Power via D2 |

*Table 5: Pin description from Feather connector*

### 3.1.2 CON1

Connector CON1 is a USB-C connector designed for connecting to a power source (e.g. PC) using a standard USB-C cable. It is strongly advised against using a USB-Type-A to USB- Type-C adapter. The 5.1 kΩ resistors placed on the CC-lines will handle out up to 3 A from power source. However, the actual maximum current delivered will depend on what the power source can safely provide.

| CON1 | Function |
|---|---|
| - | USB-C connector for VDD bus supply |

*Table 6: USB-C connector*

### 3.1.3 JP1

Connector JP1 is an optional standard 2.54 mm pinheader, which is not mounted by default. It can be used to combine multiple ICLED FeatherWings or with other ICLED screens. JP1 is directly connected to the DOUT Pin of ICLED105.

| JP1 | Function |
|---|---|
| 1 | Data Out of last ICLED |

*Table 7: Data Out connector*

### 3.1.4 JP2

Connector JP2 is an optional standard 2.54 mm pinheader, which is not mounted by default. It can be used to combine multiple ICLED FeatherWings or with other ICLED screens. JP2 is connected to DIN Pin of ICLED1 via U1 and R5 or optional directly to DIN of ICLED1 via R3.

| JP2 | Function |
|---|---|
| 1 | Data In of Level-Shifter (U1) |

*Table 8: Data In connector*

By switching boards in series it is important to remove R5 and replace the 0 Ω resistor for R3, on every board except the first one. First board will output data on 5 V logic level. If input signal level is higher than 3.6 V, there is a risk of damaging the level-shifter.

### 3.1.5 DIN Pin

The Data In (DIN) Pin is Pin 20 (GPIO 6) by default. It can be changed by removing R9 from board. If a 0 Ω resistor is placed for R4, pin 24 (GPIO 12) is the new DIN pin. By soldering a 0 Ω resistor for R10 it is also possible to use pin 12 (MOSI) for data input. Instead of soldering a 0 Ω resistor, it is also an option to short-circuit pads with solder. If needed, JP2 can be used as data input pin.

DIN is connected to level-shifter (U1) via R5 by default. If R5 is removed and a 0Ω resistor is placed for R3, DIN is directly connected to DIN pin of LED1. This is highly recommended, if input logic level is higher than 3.6 V, to avoid damaging U1. Please remind, that the maximum input voltage level is 5.5 V for ICLED FeatherWing.

Input reference level for U1 is 3V3. By supplying 3V3 pin with input logic voltage, any logic level between 1.65 V and 3.6 V can be shifted to 5 V.

## 3.2 Push buttons

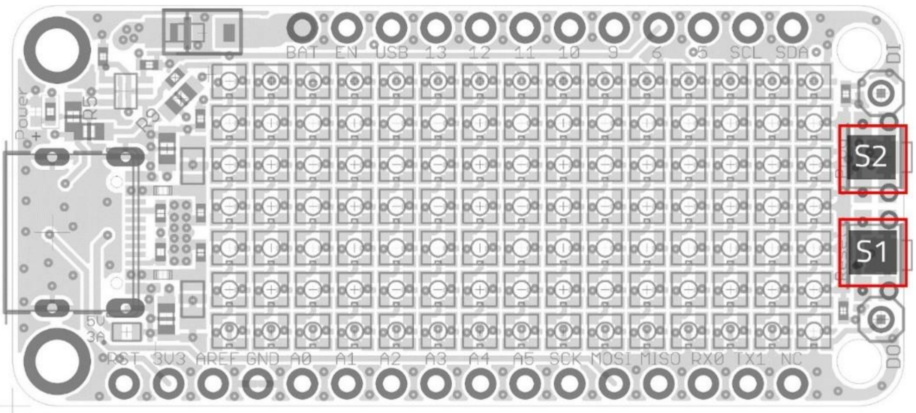


*Figure 5: ICLED FeatherWing push buttons (top view)*

### 3.2.1 S1

This push button is connected to the /RESET pin of the Feather connector. Pressing this button resets m0.

### 3.2.2 S2

This push button is connected to Pin 5 of the Feather connector. Pressing this button pulls pin 5 to signal low. It is recommended to set this pin as an input with internal pull-up by software. It is recommended to use this pin for interrupt functions for example to change displayed data.

## 3.3 Power supply

The ICLED FeatherWing is powered with 5 V by USB-C or with 3.7 V by battery connected to Feather M0. It is highly not recommended to use an USB-Type-A to USB-Type-C adapter. The 5.1 kΩ resistors placed on the CC-lines will handle out up to 3 A from power source. However, the actual maximum current delivered will depend on what the power source can safely provide. It can also be powered by the Feather M0 Board with USB-Type-B via charging IC of the Feather M0. In this case, board is powered with 4.2 V and current is limited to max. 100 mA. If battery is connected, it can buffer higher currents fo a while.

By soldering a 0 Ω resistor on R8 it is possible to connect VDD nodes of ICLED FeatherWing and Feather M0 board. In this case ICLED FeatherWing can be powered from the M0 USB- connection, or the M0 can be powered from USB-C-Connector connection of ICLED FeatherWing. Please remind limited maximum current consumption of USB-Type-B. For this reason, it is recommended to power Feather-stack from USB-C of ICLED FeatherWing.

If the FeatherWing is power sourced, the power LED (D1) lights up.

The 3V3 pin is only the reference-level for U1. It should be supplied with logic level high (be- tween 1.65 V and 3.6 V) if used. It will be supplied by M0/M4 3.3 V power-rail if connected. For more information see chapter 3.1.5.

If R8 is soldered, it is highly not recommended to connect USB-C plug of ICLEDFeatherWing and USB-B plug of Feather M0 to PC at same time. The USB-standard specifies a voltage between 4.45 V and 5.25 V. This can result in an short-circuit of 0.8 V between USB-connectors, as there is no Schottky- diode between them.

## 3.4 Fuses and temperature safety

To prevent board from overheating, there is a PWM limit of 210 included in the WE-ICLED library uploaded on Github. All 3 colour coordinates of a LED are summed up and if they are above 210, they will be reduced step by step. The R:G:B colour mixing ratio will be kept the same but the intensity will be reduced. When writing own code, please keep in mind that the board will heat up, if all ICLEDs are operated at full power. For this reason, F1 & F2 will shut down VDD, if board gets too hot. The cutoff temperature depends on the current floating through them. For more details see datasheets of F1 and F2 (part number can be found in BOM on section 3.7).

It is possible, but not recommended to short-circuit F1 and F2. In this case all LEDs can be used on full power without restrictions, but board will heat up uncontrolled. Please keep this in mind and be careful, when doing this. On full power, the ICLED FeatherWing can reach more than 150 °C

### 3.5 Schematics

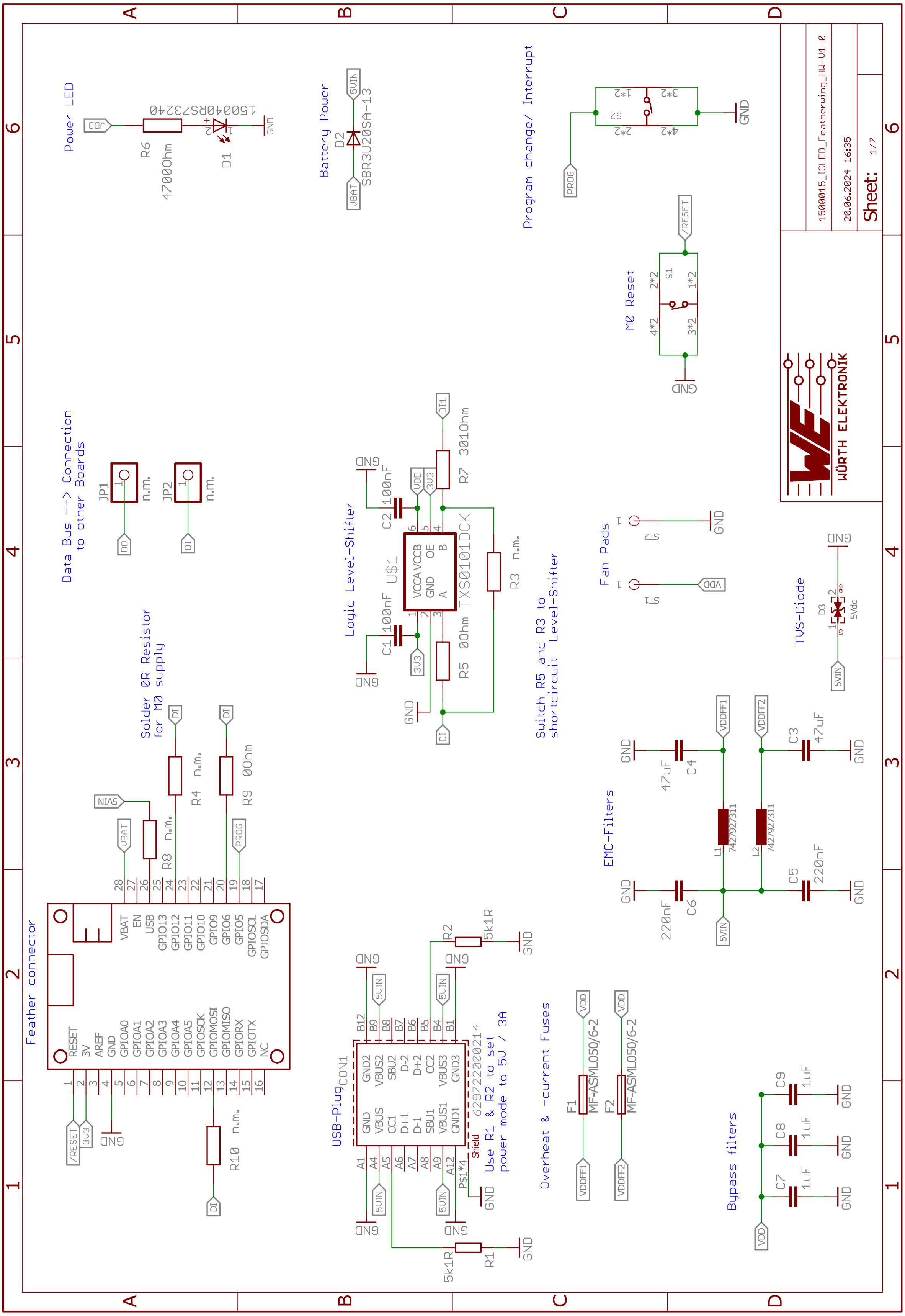


*Figure 6: Schematics Sheet 1*

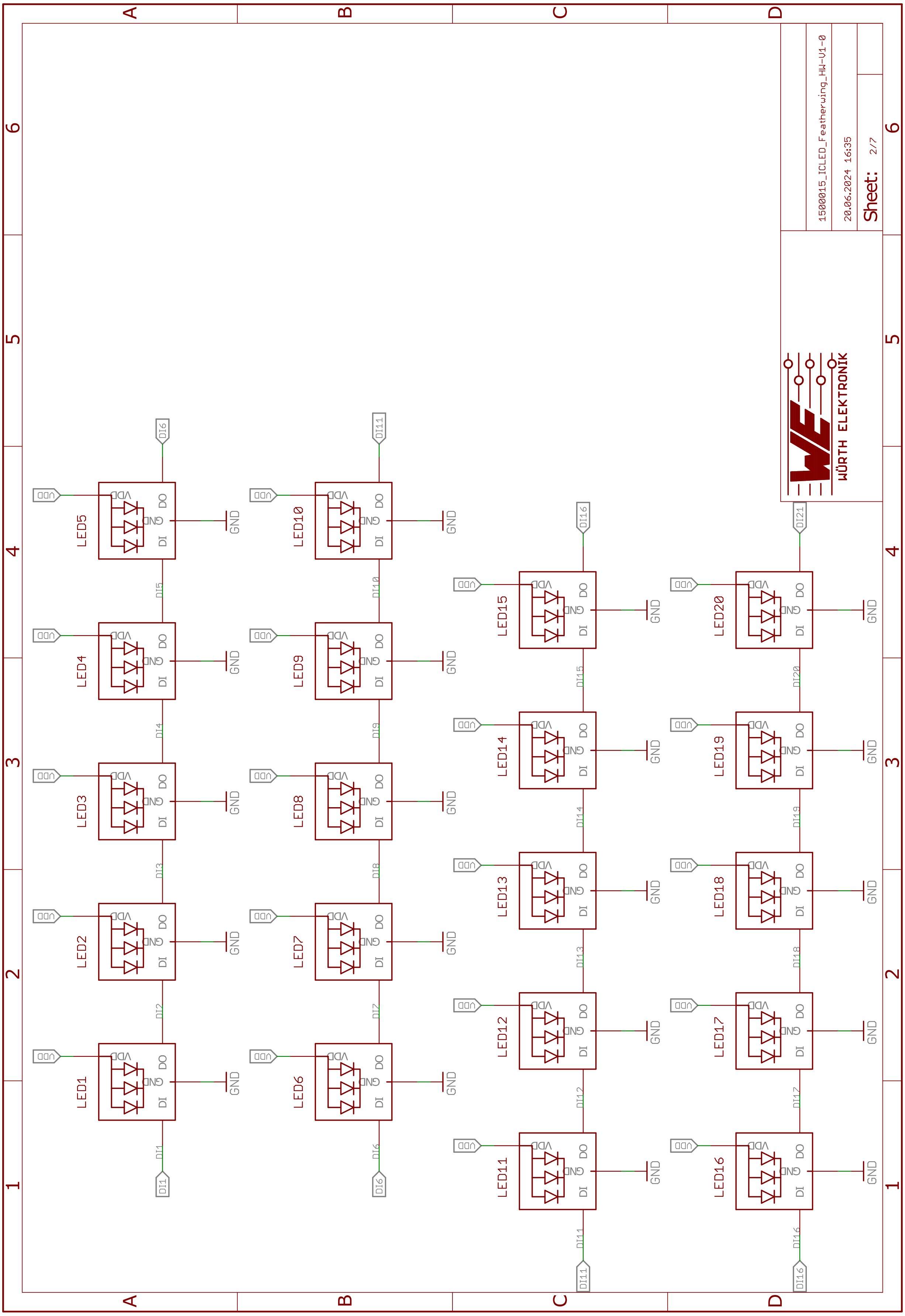


*Figure 7: Schematics Sheet 2*

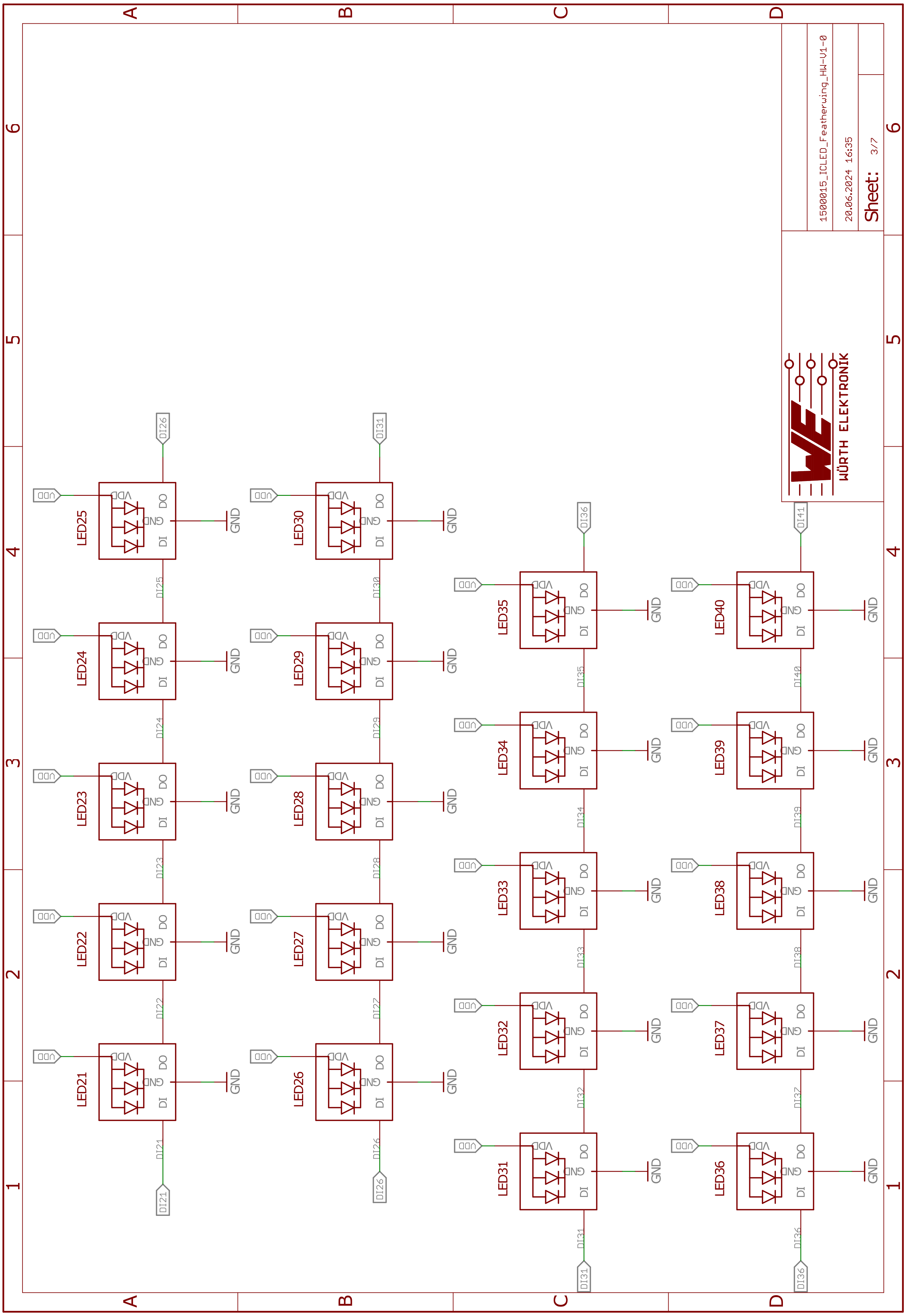


*Figure 8: Schematics Sheet 3*

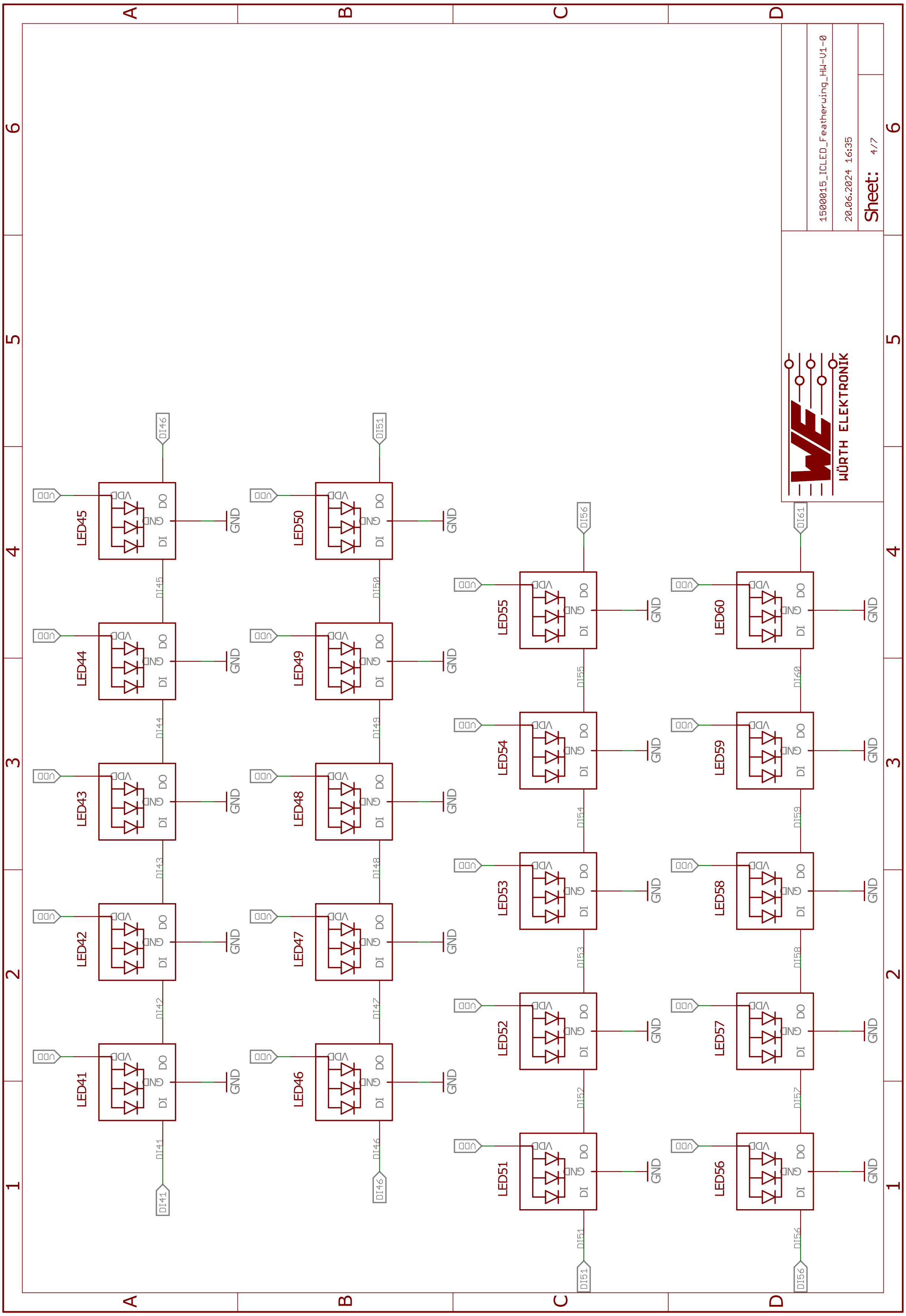


*Figure 9: Schematics Sheet 4*

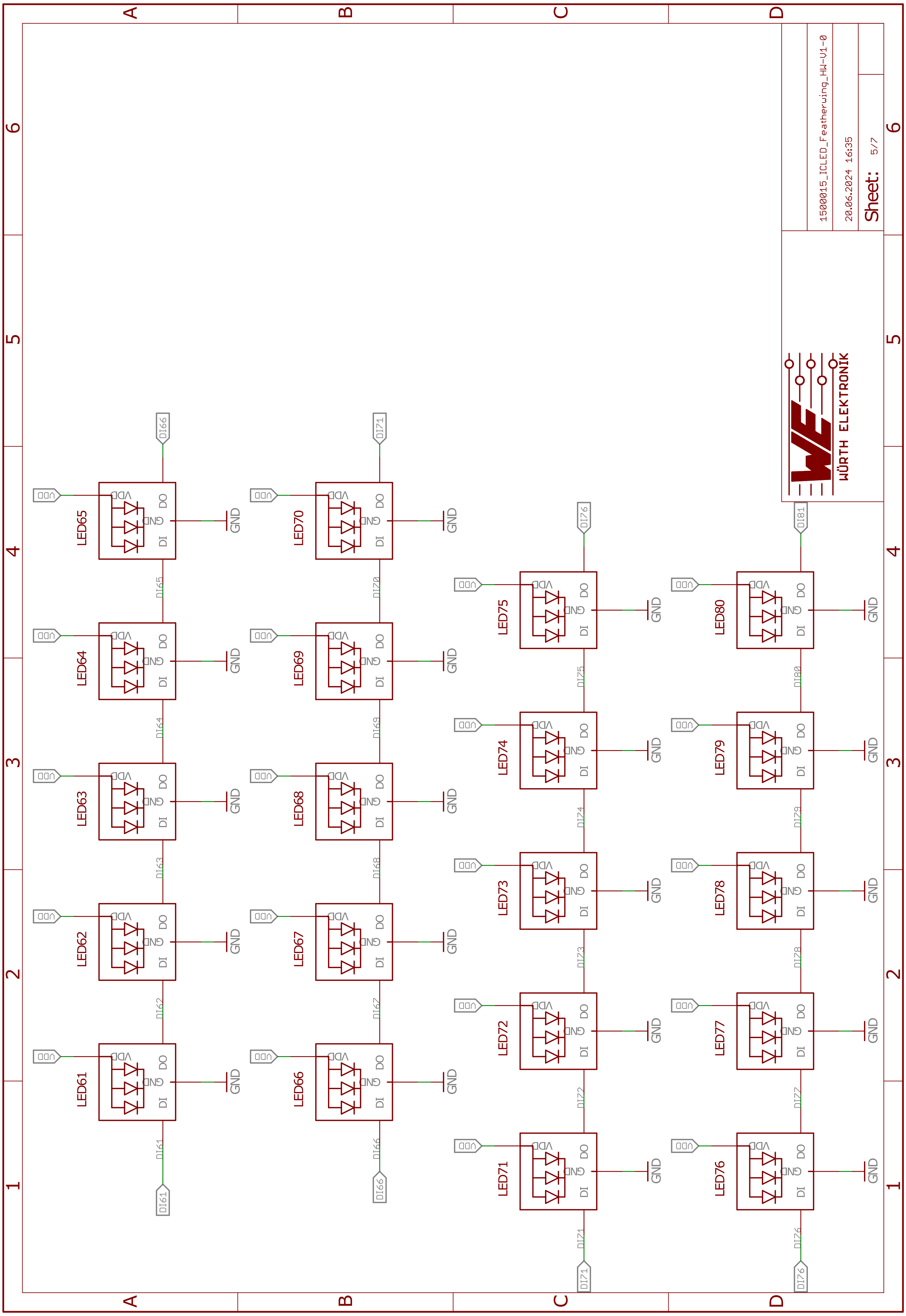


*Figure 10: Schematics Sheet 5*

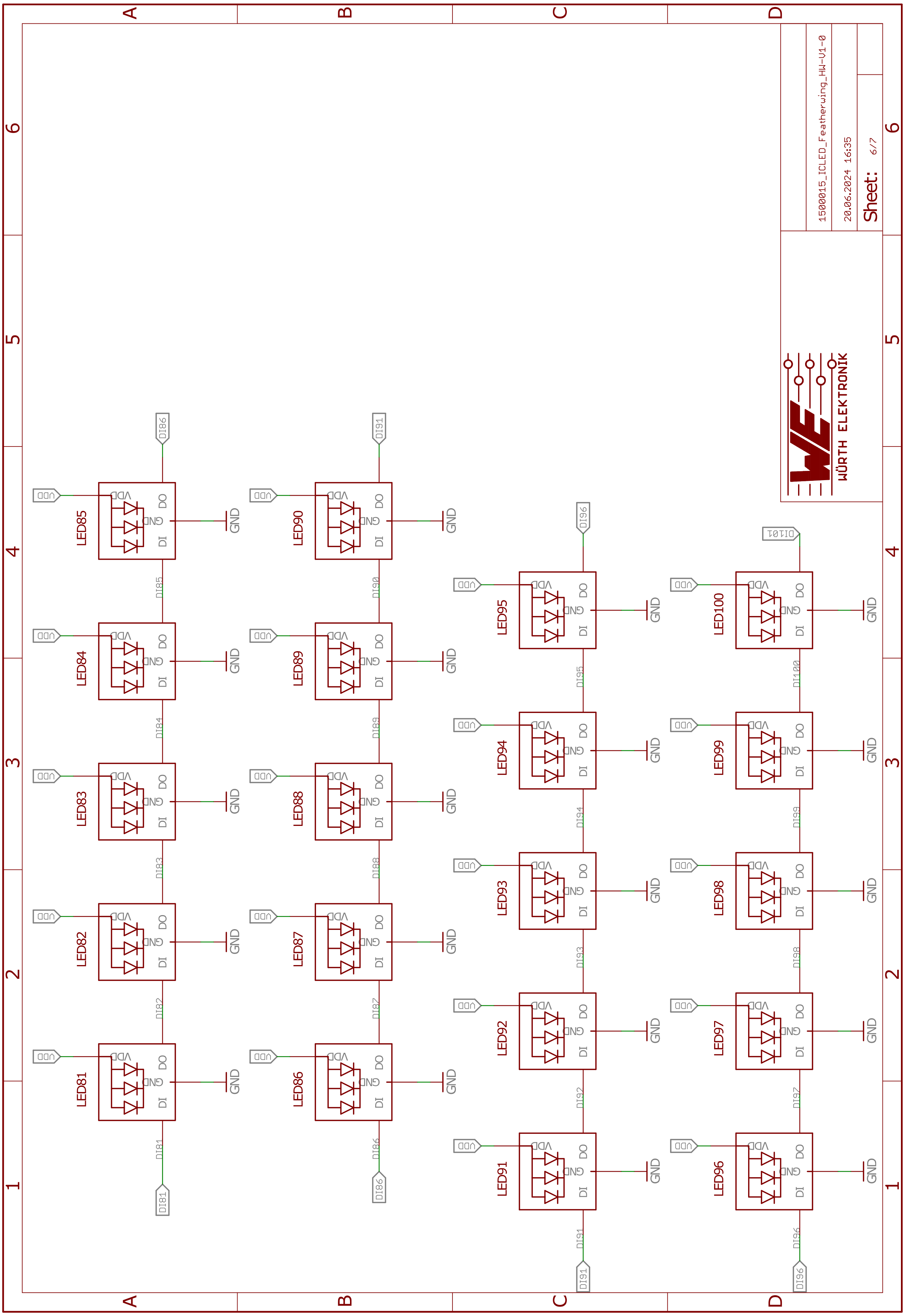


*Figure 11: Schematics Sheet 6*

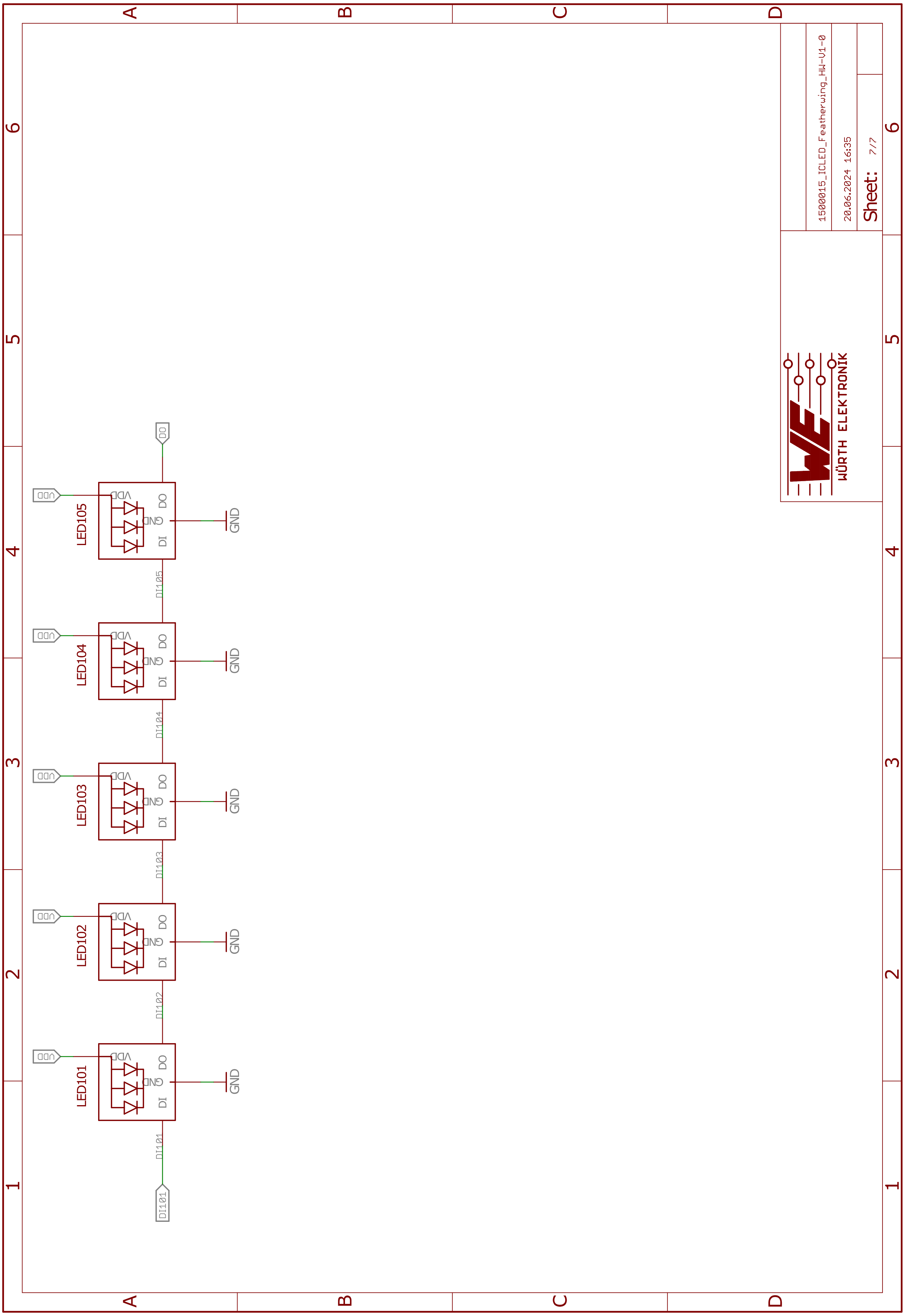


*Figure 12: Schematics Sheet 7*

### 3.6 Layout

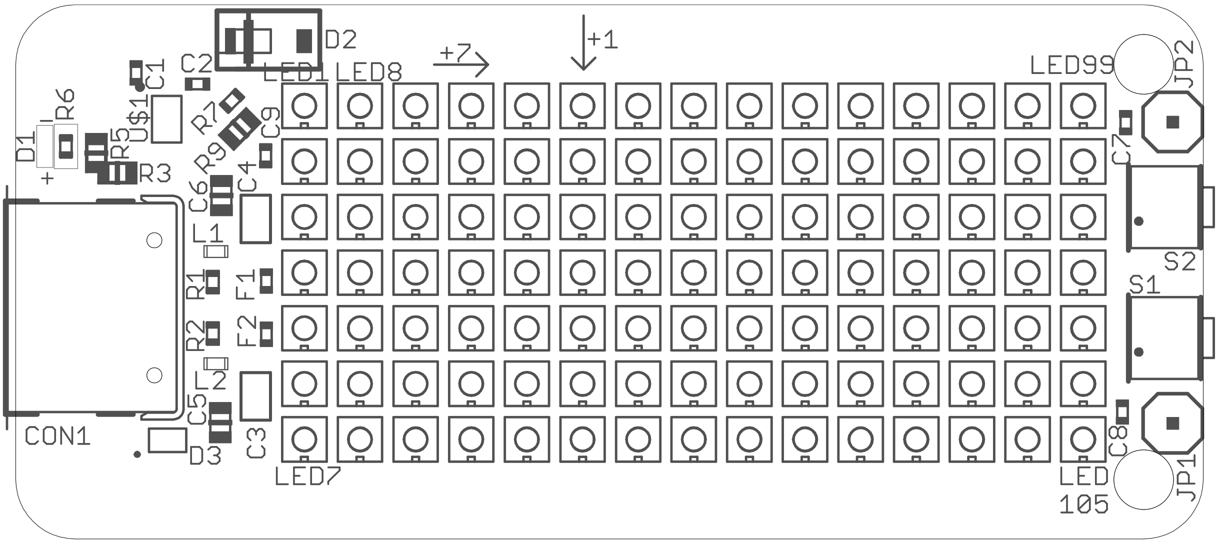


*Figure 13: Assembly diagram TOP*


*Figure 14: Assembly diagram BOTTOM*

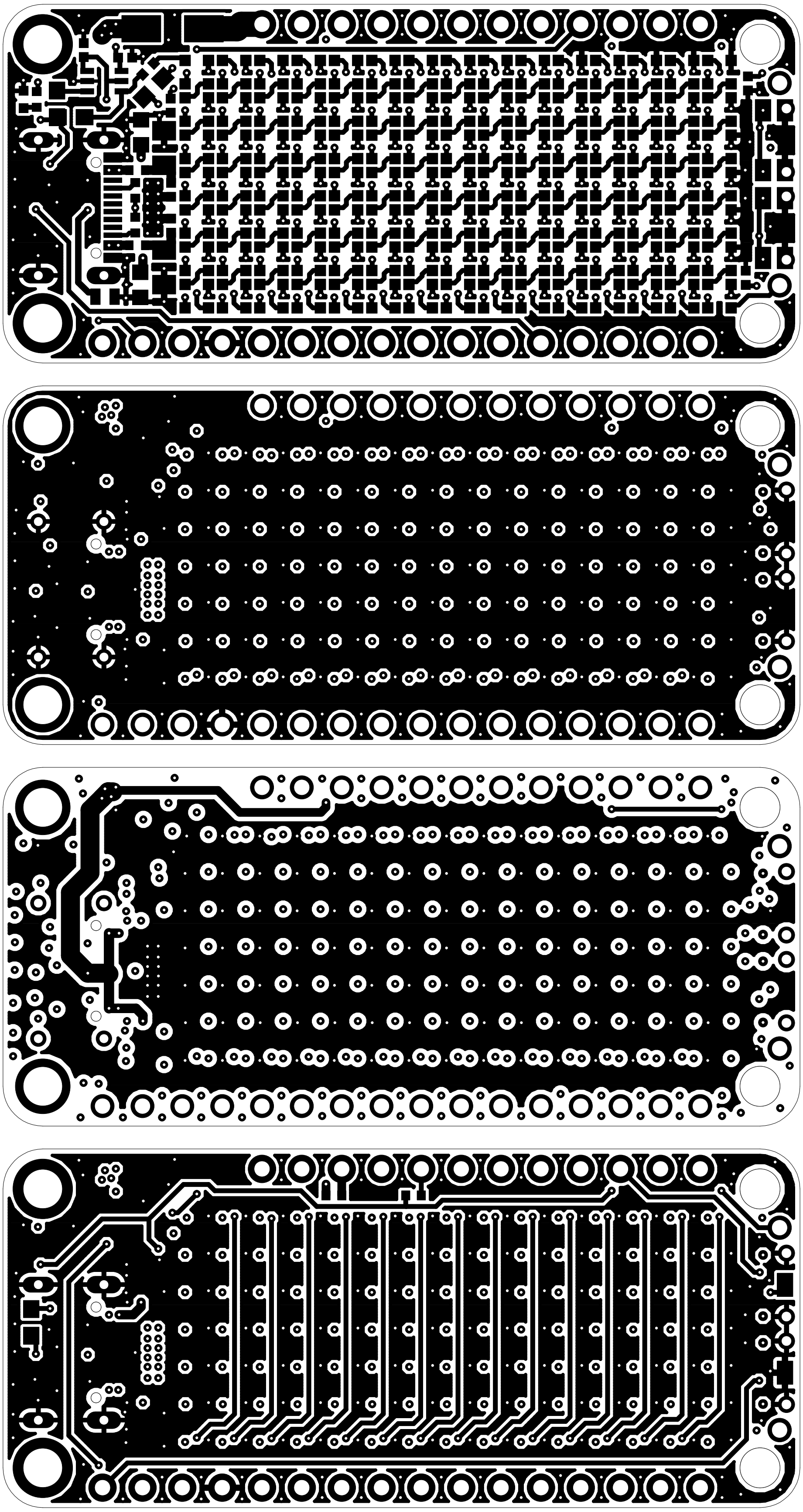

*Figure 15: Top layer (upper), layer 2 (second), layer 15 (third) and bottom layer (bottom)*

### 3.7 Bill of materials

| Part | Value | Pack | Manufacturer | NR |
|---|---|---|---|---|
| CON1 | WR-COM | SMT | Würth Elektronik eiSos | 629722000214 |
| C1, C2 | 100 nF | 0402 | Würth Elektronik eiSos | 885012205037 |
| C3, C4 | 47 $\mu$F | 0805 | Würth Elektronik eiSos | 885012107006 |
| C5, C6 | 220 nF | 0603 | Würth Elektronik eiSos | 885012206125 |
| C7 – C9 | 1 $\mu$F | 0402 | Würth Elektronik eiSos | 885012105012 |
| D1 | WL-SMCC | 0402 | Würth Elektronik eiSos | 150040RS73240 |
| D2 | SBR3U20SA-13 | SMT | Diodes inc | SBR3U20SA-13 |
| D3 | WE-TVS | SMT | Würth Elektronik eiSos | 824032815 |
| F1, F2 | MF-ASML050/6-2 | 0402 | Bourns | MF-ASML050/6-2 |
| JP1, JP2 | n.m. | THT | Würth Elektronik eiSos | 61300111121 |
| L1, L2 | WE-CBF | 0402 | Würth Elektronik eiSos | 7427927311 |
| ICLED1 – ICLED105 | WL-ICLED | 2020 | Würth Elektronik eiSos | 1312020030000 |
| R1, R2 | 5,1 kΩ | 0402 | Yageo | RC0402FR-075K1L |
| R3, R10 | n.m. | 0603 | Würth Elektronik eiSos | 560112116001 |
| R4, R8 | n.m. | 0402 | Würth Elektronik eiSos | 560112110001 |
| R5, R9 | 0 Ω | 0603 | Würth Elektronik eiSos | 560112116001 |
| R6 | 4,7 kΩ | 0402 | Würth Elektronik eiSos | 560112110245 |
| R7 | 330 Ω | 0402 | Würth Elektronik eiSos | 560112110231 |
| S1, S2 | WS-TASU | SMT | Würth Elektronik eiSos | 434331013822 |
| U1 | TXS0101DCK | SMT | Texas Instruments | TXS0101DCK |

*Table 9: Bill of materials ICLED FeatherWing*

# 4. SOFTWARE DESCRIPTION

Würth Elektronik eiSos provides a software development kit (SDK) with examples to support all the WE FeatherWings. Here are the salient features of the WE FeatherWing SDK.

- The SDK is open-source and well documented.
- It uses popular open-source tool chain including an IDE.
- The examples are written in Arduino-styled C/C++ for quick prototyping.
- Development platform independent (Windows, Linux or MAC).
- Modular structure of the software stack makes it easy to integrate into any project.

The SDK can be accessed on Github at github.com/WurthElektronik/FeatherWings.

## 4.1 Software architecture

The WE FeatherWing SDK is built up in a modular way using a set of open-source tools to enable complete flexibility for the user.

The figure 16 shows the architecture of the WE FeatherWing SDK.

- PlatformIO: is a cross-platform, cross-architecture, multiple framework professional tool for embedded software development. It provides the tool chain necessary for the software development including building, debugging, code-upload and many more. PlatformIO works well on all the modern operating systems and supports a host of development boards including the Feathers from Adafruit. Further details about PlatformIO can be found under platformio.org
- Platform interface: This layer provides abstraction to the peripheral drivers for the plat- form being used. Currently, this SDK implements an abstraction to the Arduino peripheral drivers for the Feather M0 express platform.
- WE SDK: This is a layer of C++ drivers for the ICLEDFeatherWingfrom Würth Elektronik eiSos which implement all the necessary functions to utilize full feature set of the ICLED- module offered.
  More details on the SDK and dowloads under: github.com/WurthElektronik/FeatherWings.
- Board files: This layer provides abstraction at a board level and provides functions to configure and control individual FeatherWings from WE.
- User application: The SDK currently implements a quick start example for each of the FeatherWings.

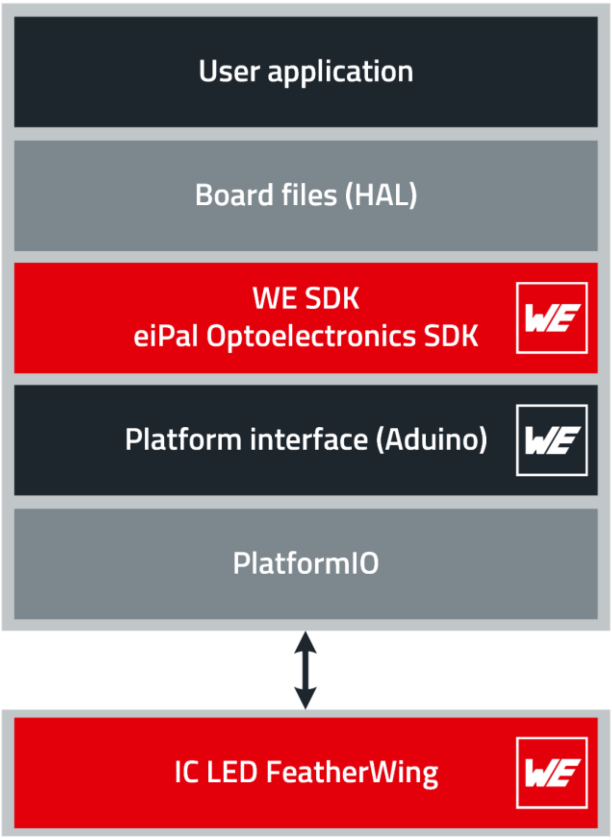


*Figure 16: Software architecture*

## 4.2 Installing the tools

### 4.2.1 IDE

Although, platformIO provides a versatile command line interface for development, the SDK provides quick start projects for the Visual Studio Code. This popular IDE makes for better code organization as well as code editing. Visual Studio Code is available on all modern operating systems. Support for extensions, built-in Git and a versatile code editor make it a well rounded tool for embedded software development. Please refer to code.visualstudio.com for more details on Visual Studio Code.

### 4.2.2 Installation steps

- Install Visual Studio Code on the platform of your choice following the instructions under code.visualstudio.com/docs
- Follow the instructions under platformio.org/install/ide?install=vscode to install PlatformIO IDE extension.

## 4.3 Hardware setup

The quick start examples in the SDK are written to be run on Adafruit's Feather M0 express. The hardware setup is as simple as stacking up the FeatherWing on top of the M0 Feather and powering up the board.

### 4.4 Running the quick start example

- Clone or download the WE FeatherWing SDK from Github: github.com/WurthElektronik/FeatherWings
- Open the workspace of interest with the filename <FeatherWing> code-workspace in Visual Studio code.
- Build and upload the code from the PlatformIO tab as shown in the below Figure.
- After successful upload, click on Monitor to view the debug logs in the serial terminal (See Figure 17).

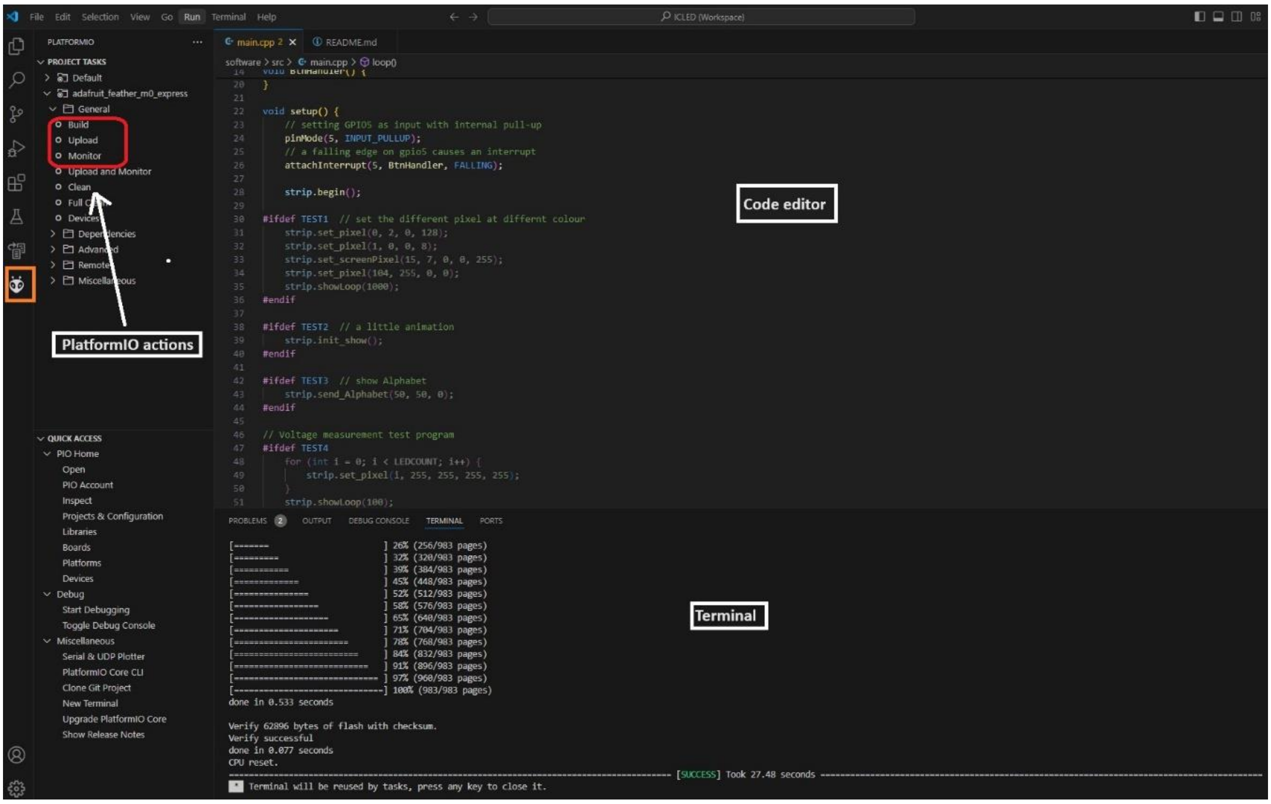


*Figure 17: Running the quick start example*

### 4.5 Application examples

Several example programs are included in the **main.cpp file**. Users can change between these **TEST Examples** by pressing the **S2** button at side of ICLED board.

| Test number | Description | Required FeatherWing |
|---|---|---|
| 1 | Initializing sequence | - |
| 2 | Set different pixels at different colour | - |
| 3 | Show alphabet | - |
| 4 | Display "Hello World!" | - |
| 5 | Display rainbow effect | - |
| 6 | Display prices | - |
| 7 | Show emojis | - |
| 8 | HSV and RGB color model test | - |
| 9 | Display data from Proteus III Bluetooth Module | SensorBLE FeatherWing Kit |
| 10 | Display ambient temperature (in °C) from the WE temperature sensor | SensorBLE FeatherWing Kit |
| 11 | Display relative humidity (rH) from the WE humidity sensor | SensorBLE FeatherWing Kit |

*Table 10: Application example definition according to TEST number*

**Note:**

In the **main.cpp** file, ensure you set **PROTEUSIIIFEATHERWING** and/or **SENSORFEATHERWING** to true if you plan to use the Bluetooth and sensor reading features, respectively.

## 5. REGULATORY COMPLIANCE INFORMATION

This evaluation board destined for professionals to be used solely at research and development facilities for such purposes. This board has been tested to satisfy general EMC requirements and to ensure the photobiological safety for the user. Following standards have been applied:

- CISPR32-FAR
- 61000-4-4 CDN coupling
- EN 55015_MAINS
- IEC 61000-4-3
- IEC 61000-4-6
- IEC 62471:2006
- EN 62471:2008

### 5.1 Exemption clause

Relevant regulation requirements are subject to change. Würth Elektronik eiSos does not guarantee the accuracy of the before mentioned information. Directives, technical standards, procedural descriptions and the like may be interpreted differently by the national authorities. Equally, the national laws and restrictions may vary with the country. In case of doubt or uncertainty, we recommend that you consult with the authorities or official certification organizations of the relevant countries. Würth Elektronik eiSos is exempt from any responsibilities or liabilities related to regulatory compliance.

Notwithstanding the above, Würth Elektronik eiSos makes no representations and warranties of any kind related to their accuracy, correctness, completeness and/or usability for customer applications. No responsibility is assumed for inaccuracies or incompleteness.

# A APPENDIX

## A.1 Revision history

| Manual Version | Hardware version | Notes | Date |
|---|---|---|---|
| V1.0 | 1.0 | Initial Version | August 2024 |
| V1.1 | 1.0 | Correction "General Description" | September 2024 |

## A.2 Abbreviations

| Abbreviation | Name | Description |
|---|---|---|
| CISPR | Comité International Spécial des Perturbations Radioélectriques | International Special Committee on Radio |
| EV | Evaluation | |
| ESD | Electro Static Discharge | |
| EMC | Electro Magnetic Compatibility | |
| GND | Ground | |
| HIGH | High signal level | |
| IC | Integrated Circuit | |
| IDE | Integrated development environment | |
| IEC | International Electrotechnical Commission | |
| IEEE | Institute for electrical and electronic engineers | |
| JTAG | Joint Test Action Group | |
| LED | Light Emitting Diode | |
| Li-Po | Lithium-Polymer | |
| LOW | Low signal level | |
| PC | Personal Computer | |
| PCB | Printed Circuit Board | |
| PWM | Pulse Width Modulation | |
| USB | Universal Serial Bus | |
| VDD | Positive supply voltage | |
| VSS | Negative supply voltage | |

### A.3 List of figures



### A.4 List of tables

## Important notes

The following conditions apply to all goods within the optoelectronic product range of Würth Elektronik eiSos GmbH & Co. KG:

**GENERAL CUSTOMER RESPONSIBILITY**

Some goods within the product range of Würth Elektronik eiSos GmbH & Co. KG contain statements regarding general suitability for certain application areas. These statements about suitability are based on our knowledge and experience of typical requirements concerning the areas, serve as general guidance and cannot be estimated as binding statements about the suitability for a customer application. The responsibility for the applicability and use in a particular customer design is always solely within the authority of the customer. Due to this fact, it is up to the customer to evaluate, where appropriate to investigate and to decide whether the device with the specific product characteristics described in the product specification is valid and suitable for the respective customer application or not. Accordingly, the customer is cautioned to verify that the documentation is current before placing orders.

**CUSTOMER RESPONSIBILITY RELATED TO SPECIFIC, IN PARTICULAR SAFETY-RELEVANT APPLICATIONS**

It has to be clearly pointed out that the possibility of a malfunction of electronic components or failure before the end of the usual lifetime cannot be completely eliminated in the current state of the art, even if the products are operated within the range of the specifications. The same statement is valid for all software source code and firmware parts contained in or used with or for products in the optoelectronic product range of Würth Elektronik eiSos GmbH & Co. KG. In certain customer applications requiring a high level of safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health, it must be ensured by most advanced technological aid of suitable design of the customer application that no injury or damage is caused to third parties in the event of malfunction or failure of an electronic component.

**BEST CARE AND ATTENTION**

Any product-specific data sheets, manuals, application notes, PCN's, warnings and cautions must be strictly observed in the most recent versions and matching to the products firmware revisions. These documents can be downloaded from the product specific sections on the opto- electronic homepage.

**CUSTOMER SUPPORT FOR PRODUCT SPECIFICATIONS**

Some products within the product range may contain substances, which are subject to restrictions in certain jurisdictions in order to serve specific technical requirements. Necessary information is available on request. In this case, the field sales engineer or the internal salesperson in charge should be contacted who will be happy to support in this matter.

**PRODUCT IMPROVEMENTS**

Due to constant product improvement, product specifications may change from time to time. As a standard reporting procedure of the Product Change Notification (PCN) according to the JEDEC-Standard, we inform about major changes. In case of further queries regarding the PCN, the field sales engineer, the internal salesperson or the technical support team in charge should be contacted. The basic responsibility of the customer as per section 7.1 and 7.2 remains unaffected. All optoelectronic module source codes as well as all PC software tools are not subject to the Product Change Notification information process.

**PRODUCT LIFE CYCLE**

Due to technical progress and economical evaluation, we also reserve the right to discontinue production and delivery of products. As a standard reporting procedure of the Product Termination Notification (PTN) according to the JEDEC-Standard we will inform at an early stage about inevitable product discontinuance. According to this, we cannot ensure that all products within our product range will always be available. Therefore, it needs to be verified with the field sales engineer or the internal salesperson in charge about the current product availability expectancy before or when the product for application design-in disposal is considered. The approach named above does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.

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**FIRMWARE UPDATE(S)**

You have the opportunity to request the current and actual firmware for a bought Würth Elektronik eiSos eiPal optoelectronics product within the time of warranty. However, Würth Elektronik eiSos has no obligation to update a modules firmware in their production facilities but can offer this as a service on request. The upload of firmware updates falls within your responsibility, e.g. via ACC or another software for firmware updates. Firmware updates will not be communicated automatically. It is within your responsibility to check the current version of a firmware in the latest version of the product manual on our website. The revision table in the product manual provides all necessary information about firmware updates. There is no right to be provided with binary files, so called "Firmware images", those could be flashed through JTAG, SWD, Spi-Bi-Wire, SPI or similar interfaces.

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