

## Getting started with the LED matrix evaluation board with constant current LED sink driver using Bluetooth Low Energy and Android app

### Introduction

The [STP16CPC26](#) low voltage 16-bit constant current LED sink driver on the STEVAL-LLL005V1 evaluation board ensures a cost effective 6x10 LED matrix with individual LED control.

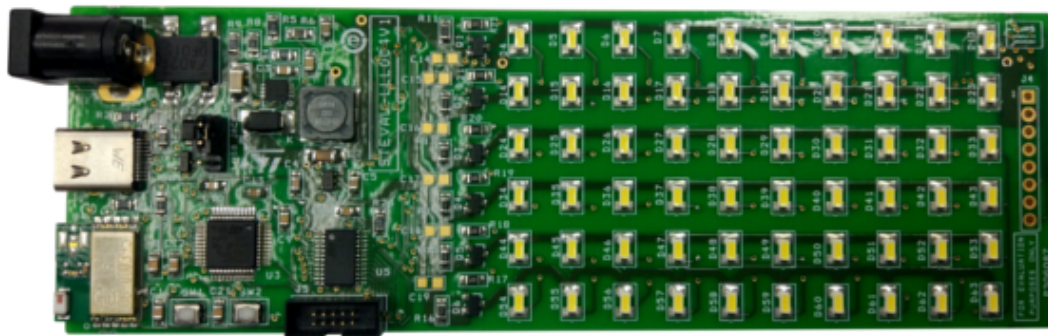
The LED driver evaluation board includes a jumper to select between powering the board through a standard DC jack input or a USB Type-C connector, as well as two control switches.

An Android app is also available for enhanced user experience and control.

The [SPBTLE-RF](#) very low power module for Bluetooth Smart v4.1 allows communication with the board via your smartphone.

The [STM32F030](#) mainstream ARM Cortex-M0 Value line MCU with 64 Kbytes of Flash, 48 MHz CPU manages driving and transmission of data over BLE.

**Figure 1. STEVAL-LLL005V1 LED matrix evaluation board**



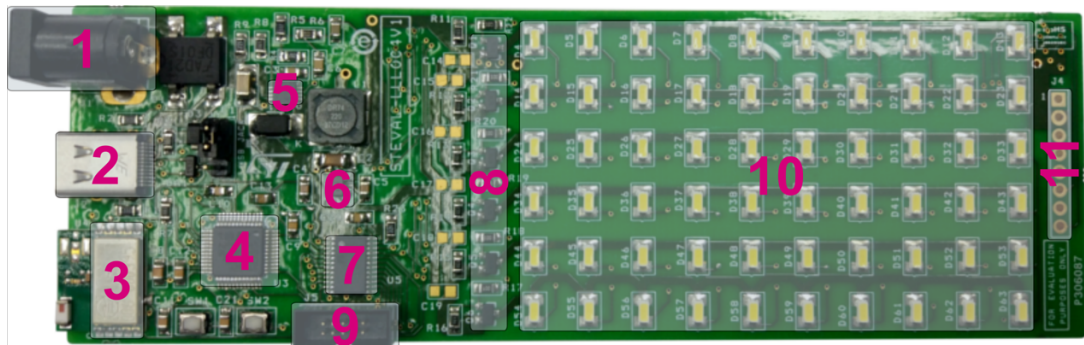
## 1 LED matrix evaluation board overview

### 1.1 Features

- Cost effective 16-bit LED driving scheme
- Driver for 6x10 LED matrix with individual LED control and row-wise scanning
- USB Type-C and DC jack connector for DC input power
- Bluetooth Smart connectivity and Android application for hassle free demonstration
- Connector for stacking multiple LED drivers in daisy chain configuration
- Preconfigured demos (selected through on-board switches):
  - with brightness control
  - with speed control
  - with blink rate (flashing) control

### 1.2 Hardware components

Figure 2. STEVAL-LLL005V1 board components



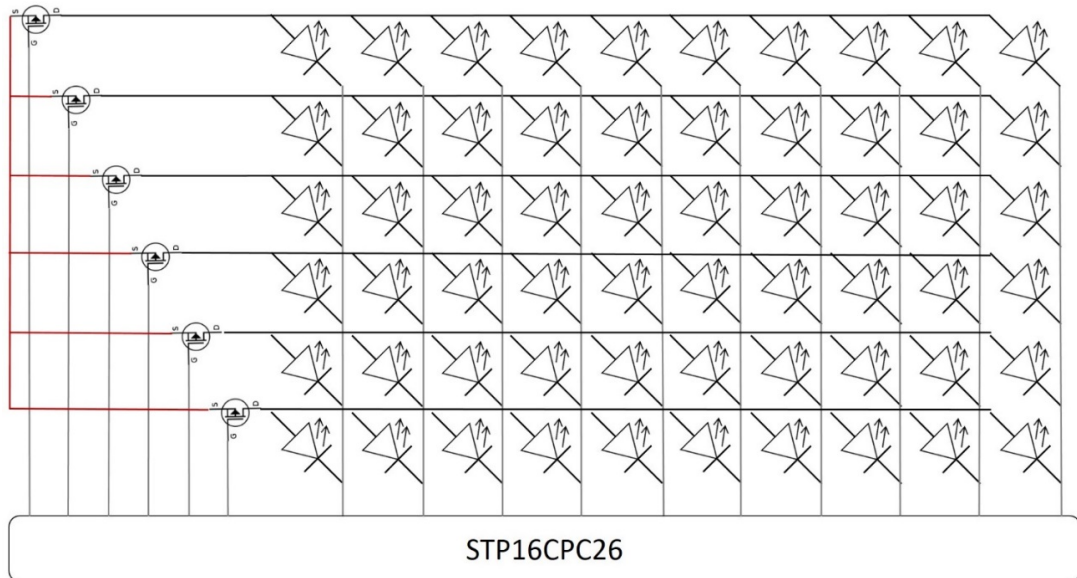
The main evaluation board components are listed below:

1. Input DC jack connector
2. USB Type-C input connector
3. SPBTLE-RF Bluetooth Smart v4.1 module
4. STM32F030 MCU
5. L7981 switching regulator
6. LKD220 low quiescent current and low noise LDO
7. STP16CPC26 Low voltage 16-bit constant current LED sink driver
8. STR1P2UH7 P-channel Power MOSFET
9. Programming connector
10. LED matrix
11. Connector for stacking additional LED driver matrices

### 1.3 Architecture

The 6x10 LED matrix on the STEVAL-LLL005V1 evaluation board is controlled through the STP16CPC26 low voltage 16-bit constant current LED sink driver.

Figure 3. 6x10 LED matrix control scheme



Individual LED control is achieved through specific row and column selection, and frame data is transferred between the MCU and LED driver via the SPI.

## 2 LED matrix evaluation board operation

### 2.1 Configure input power source

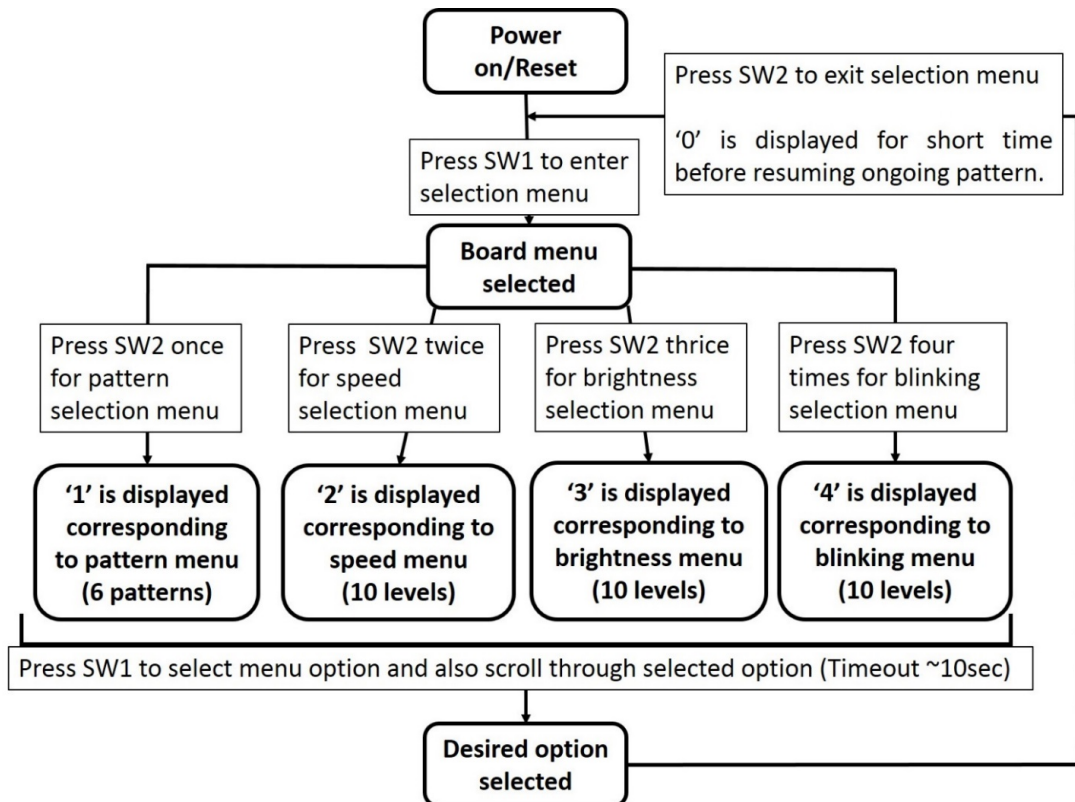
You can power the evaluation board in one of the following ways:

1. standard DC jack input (5V - 20V) – place jumper J3 on “JACK”
2. USB Type-C input (of appropriate power rating) – place jumper J3 on “USB”

### 2.2 Board power up

On power up, the STEVAL-LLL005V1 runs a default demonstration sequence. Use the following procedure to select from 6 demos, 10 scrolling speed levels, 10 brightness levels and 10 blinking frequencies.

Figure 4. Figure 4: STEVAL-LLL005V1 parameter and option selection



- Step 1.** Power on or reset the board.
- Step 2.** Press the SW1 button once.
- Step 3.** Select one of the following parameters and corresponding option, or level:
- Press the SW2 button once for **pattern** selection.
    - a. Press the SW1 button to scroll through and select a pattern.
    - b. Press SW2 to confirm the option.
 The number '0' is displayed briefly before the desired option is activated.
  - Press the SW2 button twice for **speed** selection.
    - a. Press the SW1 button to scroll through and select a speed.

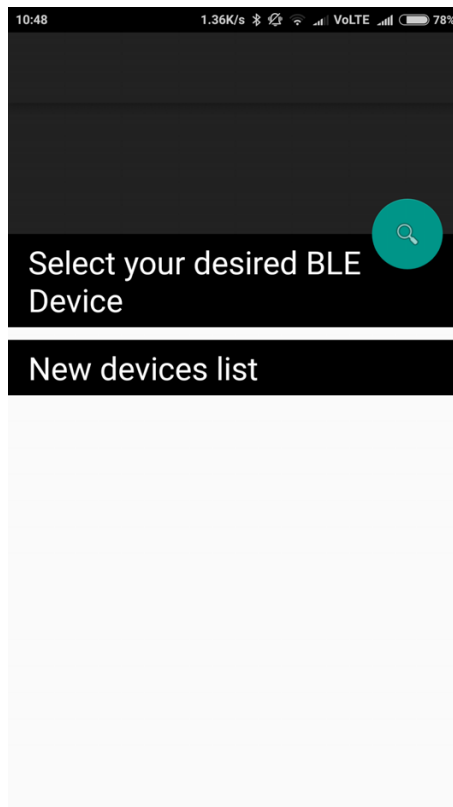
- b. Press SW2 to confirm the option.  
The number '0' is displayed briefly before the desired option is activated.
- Press the SW2 button three times for **brightness** selection.
  - a. Press the SW1 button to scroll through and select a brightness level.
  - b. Press SW2 to confirm the option.  
The number '0' is displayed briefly before the desired option is activated.
- Press the SW2 button four times for **frequency** selection.
  - a. Press the SW1 button to scroll through and select a blink frequency.
  - b. Press SW2 to confirm the option.  
The number '0' is displayed briefly before the desired option is activated.

### 3 Led Drawer Android application

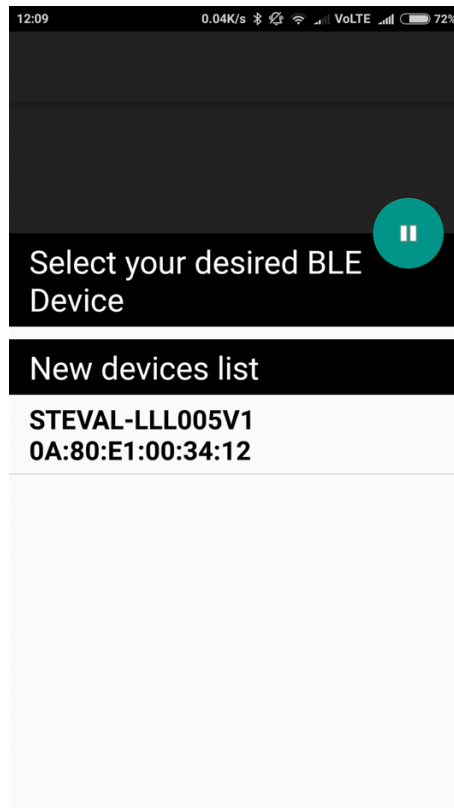
You can also control the LEDs with an Android app through Bluetooth Smart.

- Step 1.** Ensure Bluetooth is enabled on your Android device
- Step 2.** Run the Led Drawer app

**Figure 5. Led Drawer app home screen**

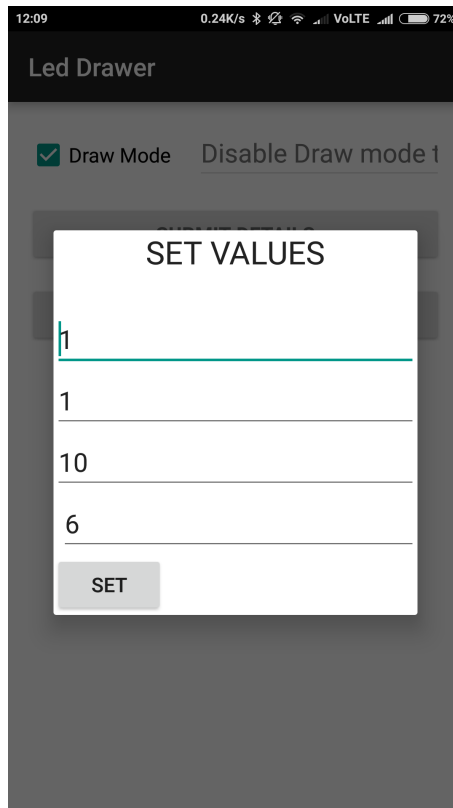


- Step 3.** Click the search button  
The STEVAL-LLL005V1 evaluation board should appear in the list of available boards.

**Figure 6. List of available boards**

- Step 4.** Select the STEVAL-LLL005V1 board.  
A window appears with default values.

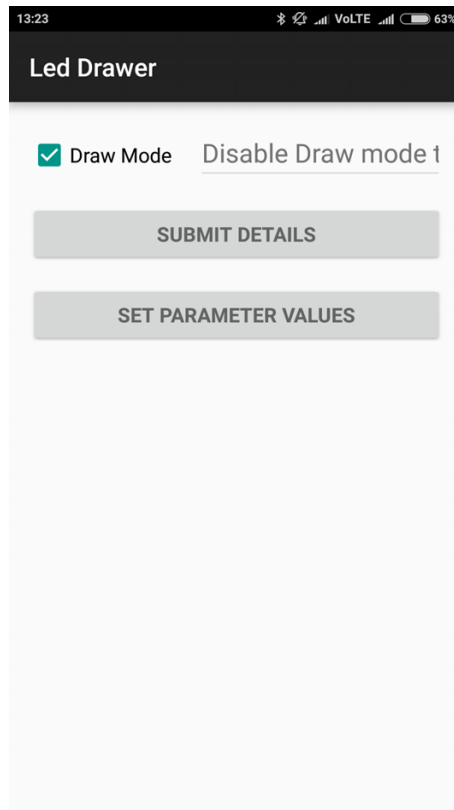
Figure 7. Set values window



- Step 5.** Accept the default values and press the SET button.  
The Draw Mode selection screen appears

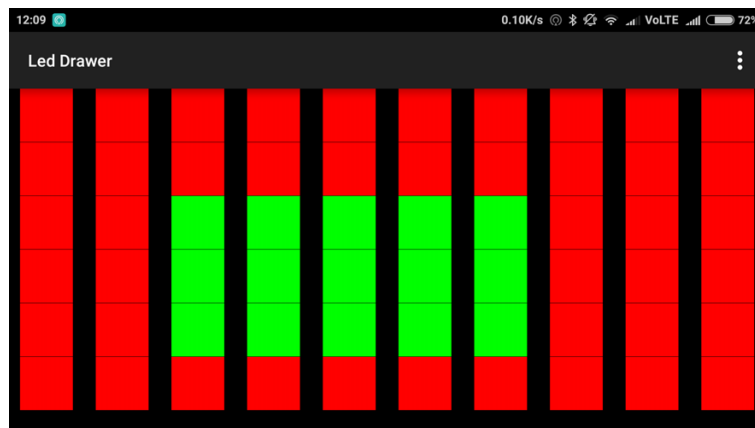


Figure 8. Draw Mode selection



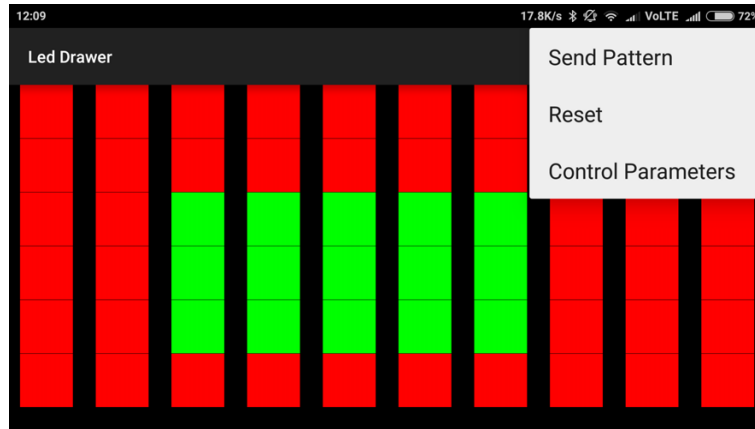
- Step 6.** Check the Draw Mode box and press the SUBMIT DETAILS button  
A drawing screen appears
- Step 7.** Swipe over the pixel boxes to create a pattern

Figure 9. Pattern creation screen



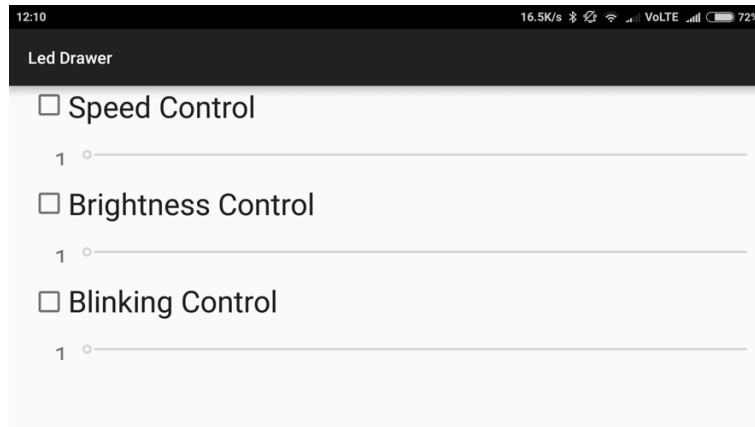
- Step 8.** Open the overflow menu on top right corner of the screen

Figure 10. Overflow menu options



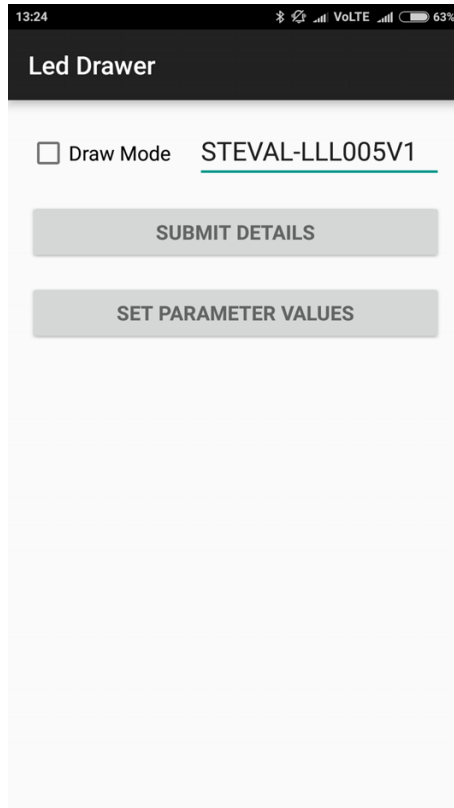
- Step 9.** Select Control Parameters
- Step 10.** Set Speed Control, Brightness Control and Blinking Control parameters to your liking

Figure 11. Android app control parameter screen



- Step 11.** Return to the pattern screen and open the overflow menu again
- Step 12.** Select Send Pattern  
The pattern is rendered on the LED matrix board with the parameter settings applied
- Step 13.** Return to the Draw Mode selection screen
- Step 14.** Uncheck the Draw Mode box, enter a text string and press SUBMIT DETAILS  
In the example below, the string “STEVAL-LLL005V1” is rendered on the LED matrix board.

Figure 12. Draw Mode deselection



## 4 LED matrix evaluation board schematics and bill of materials

### 4.1 STEVAL-LLL005V1 schematic diagrams

Figure 13. Input power jack and USB Type-C section

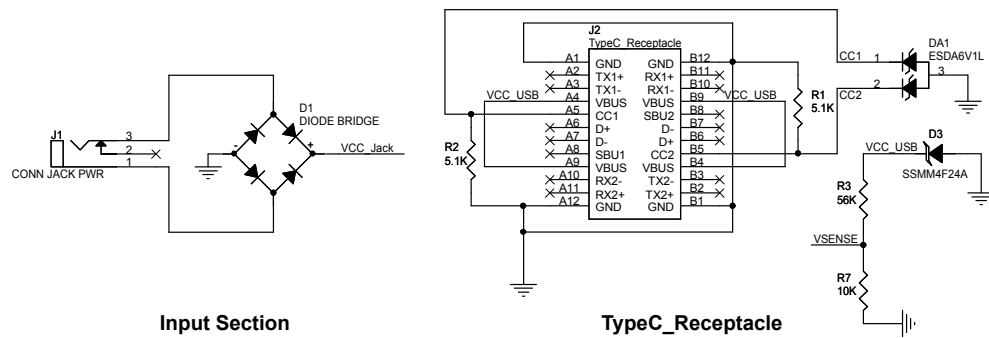


Figure 14. DC-DC step down and LDO regulator section

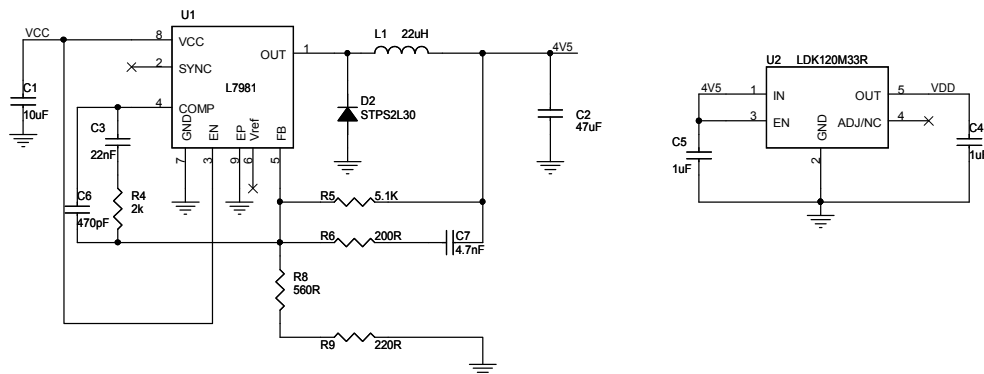


Figure 15. Microcontroller section

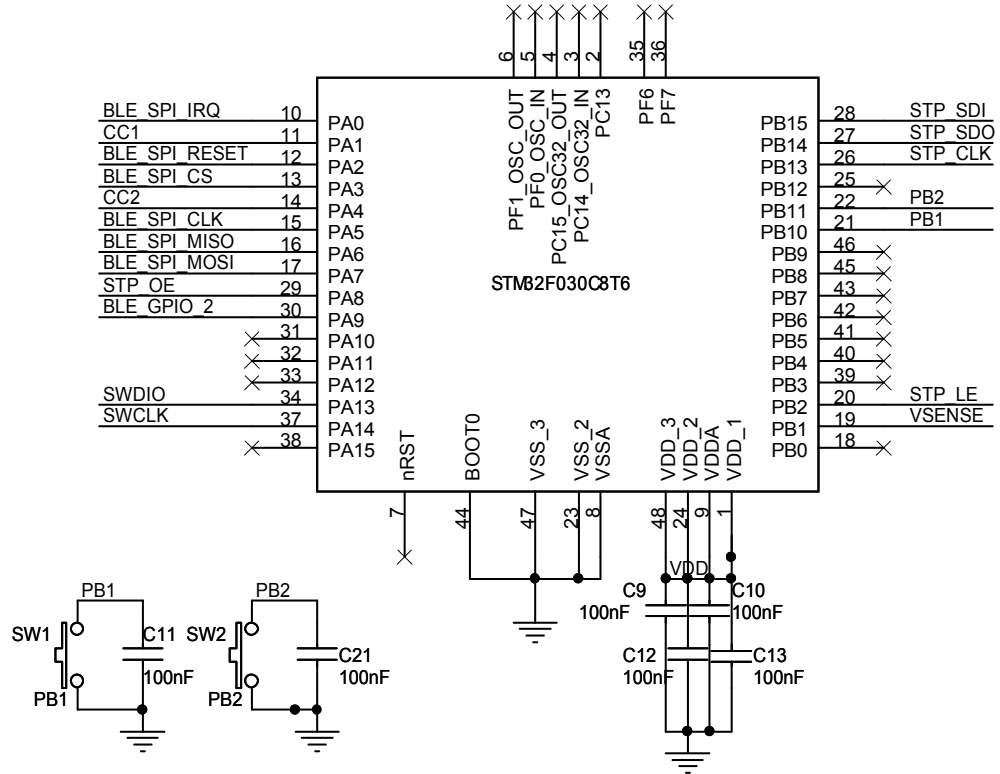
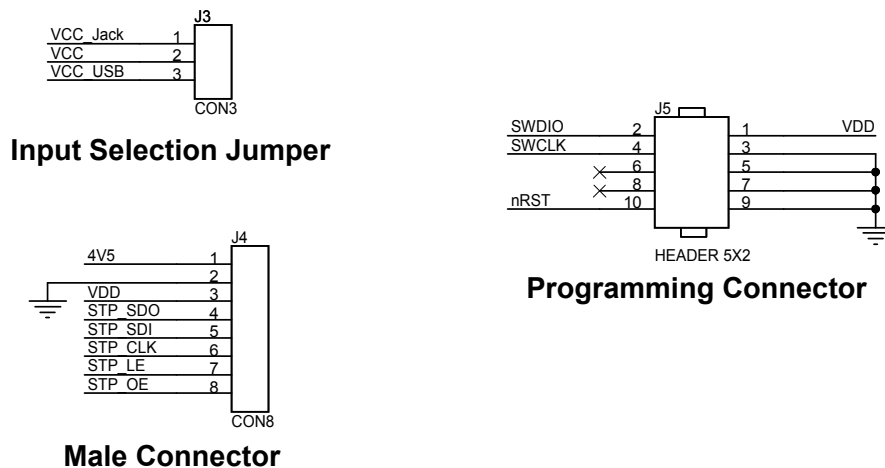
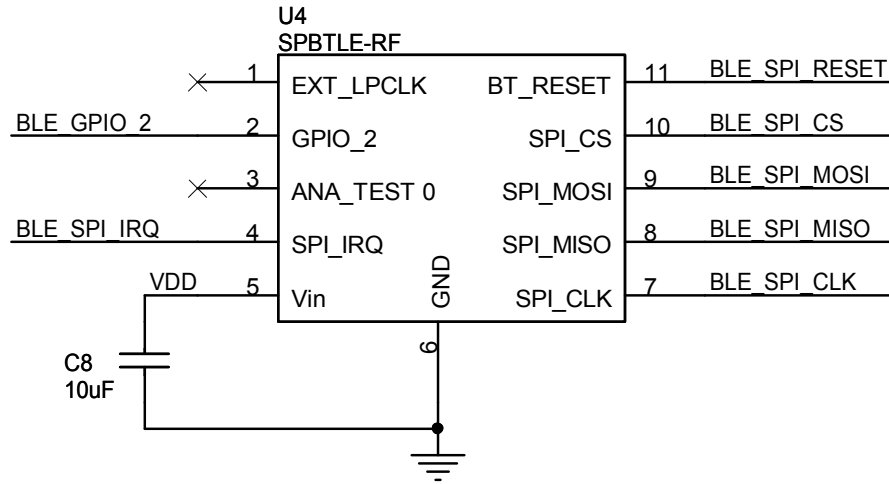
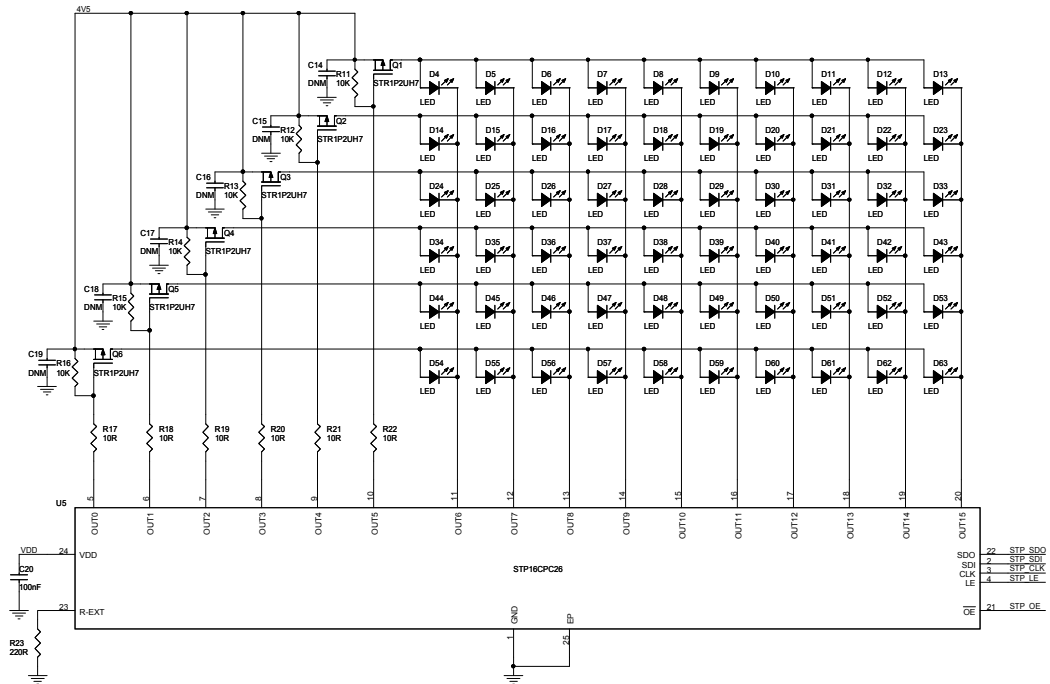


Figure 16. Input power selection, board extension and programming connector section



**Figure 17. SPBTLE-RF section**

**Figure 18. LED driver and LEDs section**


## 4.2 Bill of materials

**Table 1. STEVAL-LLL005V1 bill of materials**

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	1	C1	10 $\mu$ F, 35 V, X7R, $\pm$ 20%, SMD, 1206	Ceramic capacitor	ANY	ANY
2	1	C2	47 $\mu$ F, 16 V, X5R, $\pm$ 20%, SMD, 1206	Ceramic capacitor	ANY	ANY
3	1	C3	22 nF, 50 V, X7R, $\pm$ 10%, SMD, 0805	Ceramic capacitor	ANY	ANY
4	2	C4, C5	1 $\mu$ F, 16 V, X7R, $\pm$ 10%, SMD, 0805	Ceramic capacitors	ANY	ANY
5	1	C6	470 pF, 50 V, X7R, $\pm$ 10%, SMD, 0805	Ceramic capacitor	ANY	ANY
6	1	C7	4.7 nF, 50 V, X7R, $\pm$ 10%, SMD, 0805	Ceramic capacitor	ANY	ANY
7	1	C8	10 $\mu$ F, 10 V, X5R, $\pm$ 10%, SMD, 0805	Ceramic capacitor	ANY	ANY
8	7	C9, C10, C11, C12, C13, C20, C21	100 nF, 50 V, X7R, $\pm$ 20%, SMD, 0805	Ceramic capacitors	ANY	ANY
9	6	C14, C15, C16, C17, C18, C19	DNM	-	-	-
10	1	DA1	ESDA6V1, 6.1 V, Transil, SOT23	DUAL TRANSIL ARRAY FOR ESD PROTECTION	ST	<a href="#">ESDA6V1L</a>
11	1	D1	1.5 A, SMD	Diode bridge	Fairchild	DF01S
12	1	D2	STPS2L, 30 V/1 A, SMA	Low drop power Schottky rectifier	ST	<a href="#">STPS2L30A</a>
13	1	D3	SMM4F24A, 24 V, Transil, STmite Flat	400 W TVS in flat package	ST	<a href="#">SMM4F24A-TR</a>
14	60	D4 to D63	120 mA, 6500 K, 3014	White LED	Lumileds	L130-6580001400001
15	1	J1	DC IN CONNECTOR	DC power jack	CUI Inc	PJ-102AH
16	1	J2	Surface mount, right angle, TH	USB TypeC	Würth Electronics Inc	632723100021
17	1	J3	3 pins, 2.54 mm, pitch male	Input power selector	ANY	ANY
18	1	J4	8 pins, 2.54 mm, pitch male	Extension connector	ANY	ANY
19	1	J5	5x2 box type, 1.27 mm, pitch male	Debug connector	CNC Tech	3220-10-0100-00
20	1	L1	22 $\mu$ H, 1.75 A, $\pm$ 20%, SMD	Surface mount inductor	Eaton	DR74-220-R
21	6	Q1, Q2, Q3, Q4, Q5, Q6	P-MOS, SOT-23	P-channel STRIPFET H7 Power MOSFET	ST	<a href="#">STR1P2UH7</a>
22	3	R1, R2, R5	5.1 k, 1/8 W, $\pm$ 1%, SMD, 0805	Resistors	ANY	ANY

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
23	1	R3	56 k, 1/8 W, $\pm 1\%$ , SMD, 0805	Resistor	ANY	ANY
24	1	R4	2 k, 1/8 W, $\pm 10\%$ , SMD, 0805	Resistor	ANY	ANY
25	1	R6	200 R, 1/8 W, $\pm 10\%$ , SMD, 0805	Resistor	ANY	ANY
26	1	R7	10 k, 1/8 W, $\pm 1\%$ , SMD, 0805	Resistor	ANY	ANY
27	1	R8	560 R, 1/8 W, $\pm 1\%$ , SMD, 0805	Resistor	ANY	ANY
28	2	R9, R23	220 R, 1/8 W, $\pm 1\%$ , SMD, 0805	Resistors	ANY	ANY
29	6	R11, R12, R13, R14, R15, R16	10 k, 1/8 W, $\pm 10\%$ , SMD, 0805	Resistors	ANY	ANY
30	6	R17, R18, R19, R20, R21, R22	10 R, 1/8 W, $\pm 10\%$ , SMD, 0805	Resistors	ANY	ANY
31	2	SW1, SW2	SMD	Push button	Panasonic	EVP-AA402W
32	1	U1	3 A, L7981, VFQFPN8	Step-down switching regulator	ST	<a href="#">L7981TR</a>
33	1	U2	200 mA, LDK120, SOT323-5L	Low quiescent current very low noise LDO	ST	<a href="#">LDK120M33R</a>
34	1	U3	STM32F030C8T6, LQFP48	Mainstream ARM Cortex-M0 Value line MCU	ST	<a href="#">STM32F030C8T6</a>
35	1	U4	SPBTLE-RF, SMD	Bluetooth low energy master/slave network processor module	ST	<a href="#">SPBTLE-RF</a>
36	1	U5	STP16CPC26, TSSOP24 EP	Low voltage 16-bit constant current LED sink driver	ST	<a href="#">STP16CPC26XTR</a>



## Revision history

**Table 2. Document revision history**

Date	Revision	Changes
04-May-2018	1	Initial release

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