SECO-NCV7685RGB-GEVB

NCV7685 RGB Lighting Evaluation Board User's Manuals

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EVAL BOARD USER'S MANUAL

Description

SECO−NCV7685RGB−GEVB is an evaluation board for RGB LEDs lighting application with BLE in automotive which driven by NCV7685 and controlled by RSL10. It is also an interior or exterior lighting reference design for tail or ambient lights to realize general sequential or high end pixelated LEDs controlling in−vehicle network. The user can set RGB LED's color and intensity by mobile APP to show customized information or animation.

In general, the user prefers to use fixed address in multiple NCV7685 applications. It leads to additional procedure to pre−program each chips' address in mass production stage. In addition, it is inconvenient for maintenance in the aftermarket. In firmware of this evaluation board, it uses floating address setting method, each time when power on the board, NCV7685 will be assigned an address which is defined by user, but it's not locked into OTP registers. The user can realize this function by using either RSL10's GPIO or IO expender (PAC9655).

In firmware, the driver APIs are divided into four levels: Peripheral, Chip, Board and customer application. User can directly include the chips and board APIs in their own project, and modify the application APIs according to their applications. This will accelerate developing period to market.

The board conceived for use as a plug and play environment to testing.

Nominal supply voltage is 12 V (Supply voltage range 12−24 V). In switch mode, four fixed animations shown; the RGB LEDs' color and intensity setting by user mobile APP in BLE mode.

Features

- Plug and Play; Switch and BLE Mode to Show Animations
- 16 RGB LEDs (48 Channels), each Current Programmable Sources up to 60 mA
- Independent PWM Duty Cycle Control for each Channel
- On−Chip 150, 300, 600 and 1200 Hz PWM
- Logarithmic or linear independent PWM dimming
- Diagnostic and Protection against Open Load and Under−Voltage, Over Temperature…
- Dynamic Addressing Method for No−Worries in mass production
- Bluetooth® 5 Certified with LE 2M PHY Support
- Rx Sensitivity (Bluetooth Low Energy Mode, 1 Mbps): −94 dBm
- Transmitting Power: −17 to +6 dBm
- Arm Cortex−M3 Processor and LPDSP32
- AEC−Q100 Qualified and PPAP Capable

Architecture and Key Parts

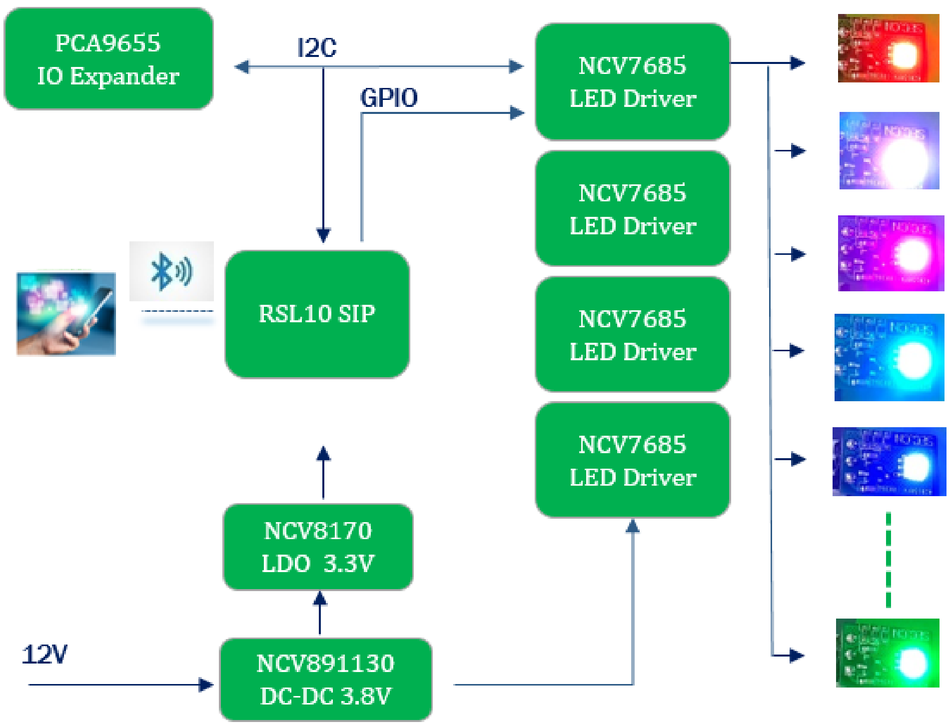


Figure 1. Board Architecture

KEY PARTS

Chip Part	Description
NCV7685	12 Channels 60 mA LED Linear Current Driver I2C Controllable for Automotive
RSL10 SIP	System−in−Package, Bluetooth 5 Certified
PCA9655	Remote 16−bit I/O Expander for I2C Bus with Interrupt
NCV8170	Ultra - Low IQ 150 mA CMOS LDO Regulator
NCV891330	3 A, 2 MHz Low−IQ Dual−Mode Step−Down Regulator for Automotive

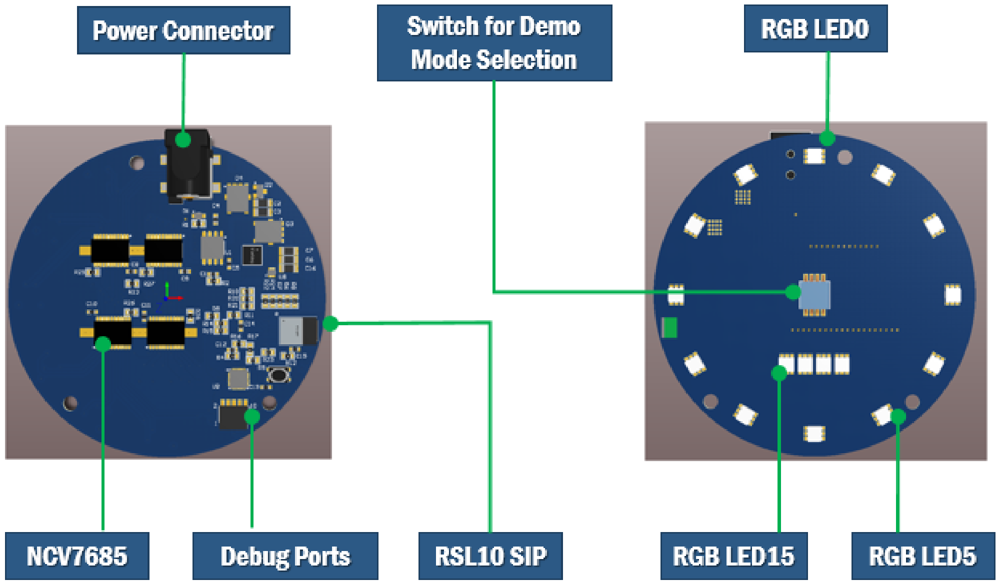


Figure 2. Top and Bottom Layer and Key Components

Operations of NCV7685 RGB LEDs Board

After power on, the board shows the "Welcome" animation, then according to the setting of the switch, the board shows four kinds of fixed animations or turns into BLE mode. The functions and operations descripted as below figures:

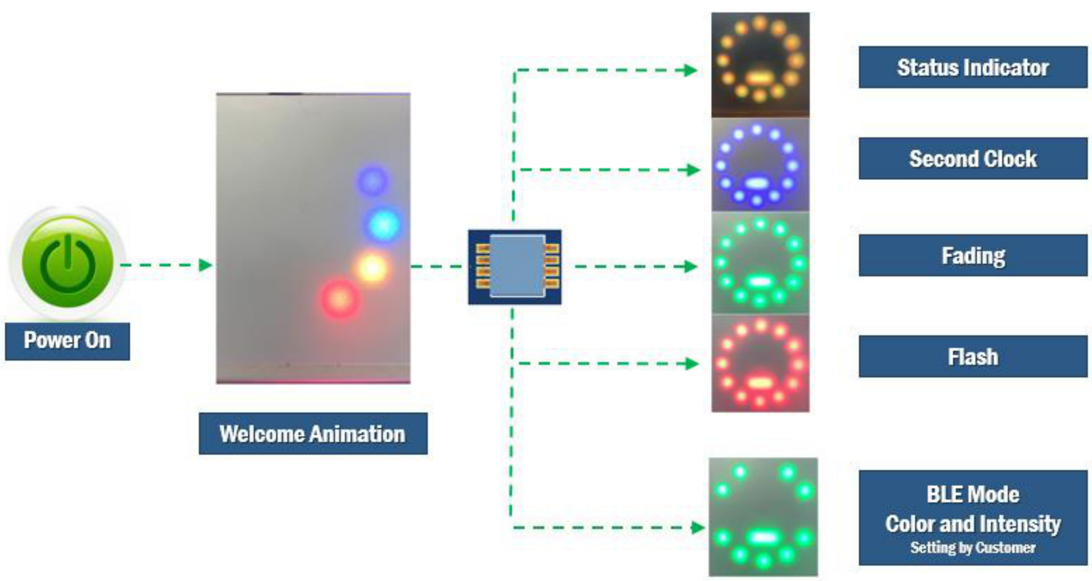


Figure 3. Sequence after Power On

Switch Setting:

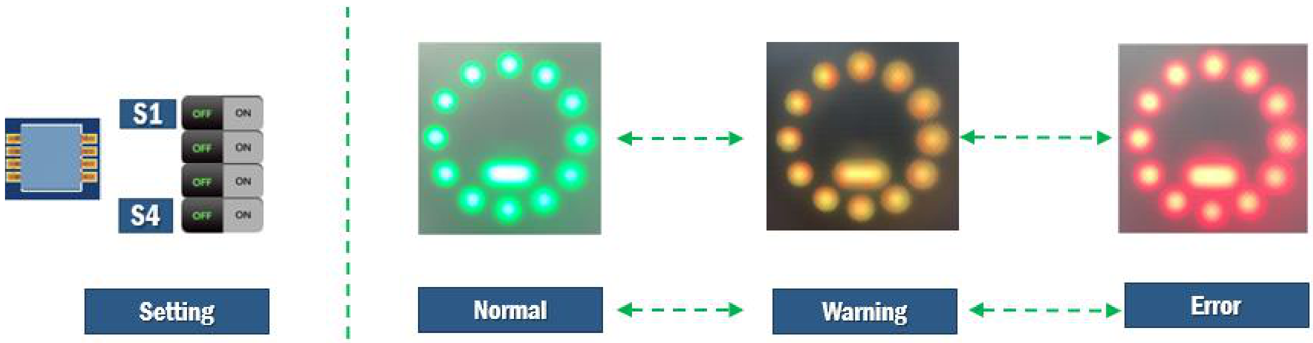


Figure 4. Status Indicator Mode

Status Indicator Mode:

Keep all Switches off; the board comes into status indicator mode. Green means good, orange means warning and red means error. The color of LEDs changes in gradient from green to orange, then to red; and goes back from red to green. This can be used as the status indicator for dashboard.

Switch Setting:

Figure 5. Second Clock Mode

Second Clock

Keep Switch S1 on and S2, S3, S4 off, every second, only one LED in blue lights up clockwise direction in turn.

Switch Setting:

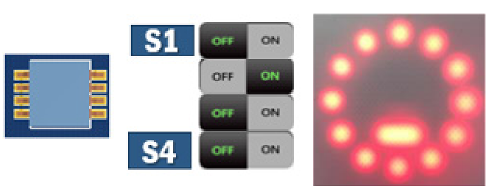


Figure 6. Flash Mode

Flash Mode

Keep Switch S2 on and S1, S3, S4 off, all LEDs flash in red.

Switch Setting:

Figure 7. Fading Mode

Fading Mode

Keep Switch S1, S2 on and S3, S4 off, all LEDs fade in green.

Switch Setting:

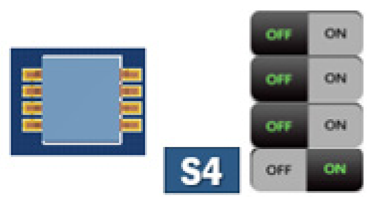


Figure 8. BLE Mode

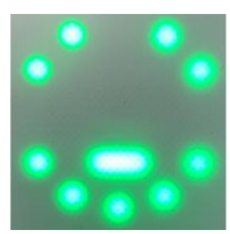


Figure 9. Standby interface in BLE Mode

BLE Mode

Keep Switch S4 on and never mind of the setting of S2, S3, S4, the board turns into BLE mode. User can use general mobile App to control LED's color and intensity for individual or all LEDs. For example, using "Light Blue" in iOS®; "BLE Scanner" or "nRF Connect" in Android® OS. It shows a green "smile face" firstly, and then changes the color and intensity according to the received five bytes data through BLE. The first three bytes stand for R, G, B values to mix the color, and the fourth data stands for intensity (4 level brightness For V1). The fifth byte stands for LED number, if this value is greater than 0x0f, all LEDs response. Here are several examples:

Examples: (R, G, B, I, LED_No)

(Four level of Intensity, Depends on Firmware)

800080FF00: LED0 in Purple

FF00003F01: LED1 in Red

XXXXXX0010: All LEDs turn off as the he intensity is 0

(Never mind RGB's values)

00BFFFFF10: All LEDs in deep sky blue

Here is an example using "Light Blue" App to control RGB lighting board:

1. Find and choose Peripheral of "NCV7685 RGB Kit"
2. Tap "Send RGB Setting" character
3. Set RGB and Intensity values
4. The board change color, intensity and LED_No

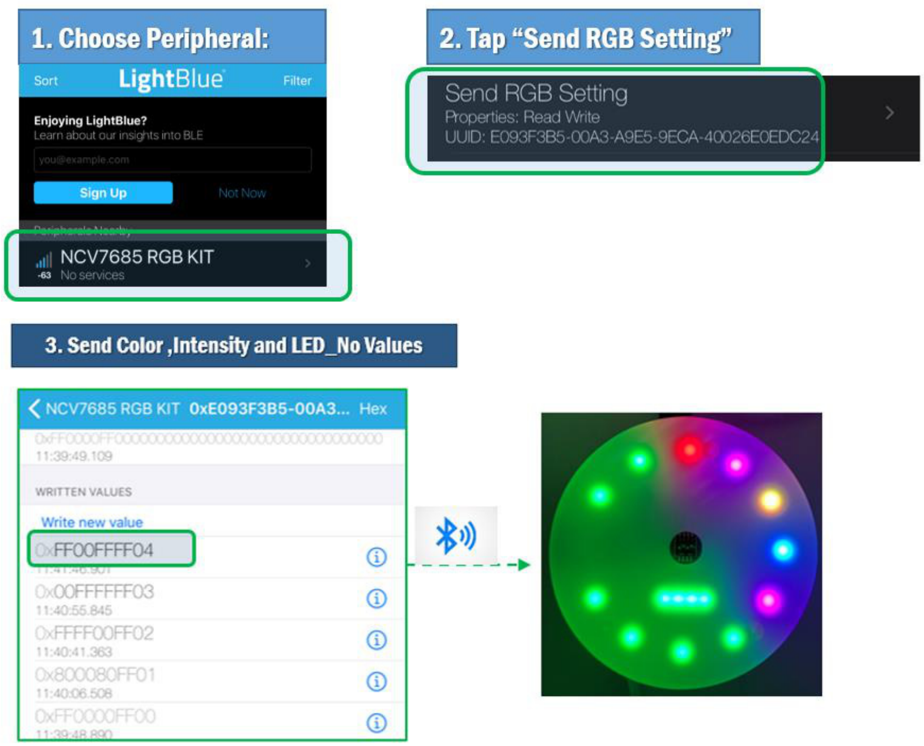


Figure 10. Using 'Light Blue' App to Control the Board

Firmware Setting

Generally, floating address method is used in firmware; the configurations can changed in the “ncv7685.h” file. Here are options:

1. Floating Address method using SOC GPIO:

```
#define NCV7675_CHIPS_NUM       0x04            /* Chips number  */
#define PCA9655_Address         0x22            /* PCA9655 I2C address */
#define BY_SOC                     0            /* SOC or PCA9655  */
#define BY_PCA9655                 1
#define ADDRESS_SETTING            BY_SOC
#define Fix_Address                0
#define Address_Had_Set            0
```

2. Floating Address method using PCA9655:

```
#define NCV7675_CHIPS_NUM       0x04            /* Chips number  */
#define PCA9655_Address         0x22            /* PCA9655 I2C address */
#define BY_SOC                     0            /* SOC or PCA9655  */
#define BY_PCA9655                 1
#define ADDRESS_SETTING            BY_PCA9655
#define Fix_Address                0
#define Address_Had_Set            0
```

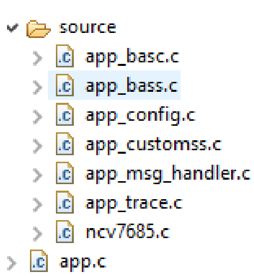
3. Fix Address method using PCA9655 or SOC GPIO:

```
#define NCV7675_CHIPS_NUM       0x04            /* Chips number  */
#define PCA9655_Address         0x22            /* PCA9655 I2C address */
#define BY_SOC                     0
#define BY_PCA9655                 1
#define ADDRESS_SETTING            BY_PCA9655   /* SOC or PCA9655  */
#define Fix_Address                1
#define Address_Had_Set            0
```

4. For the board which address had programmed, just set “Address_Had_Set” to 1, So it will skip address setting function:

```
#define NCV7675_CHIPS_NUM       0x04            /* Chips number  */
#define PCA9655_Address         0x22            /* PCA9655 I2C address */
#define BY_SOC                     0
#define BY_PCA9655                 1
#define ADDRESS_SETTING            BY_PCA9655   /* SOC or PCA9655  */
#define Fix_Address                1
#define Address_Had_Set            1
```

Files Structure of Project



- **app_basc.c: Battery level indication handler**
- **app_bass.c: Battery Service code**
- **app_config.c: Application configuration source file**
- **app_customss.c: Bluetooth custom service**
- **app_msg_handler.c: Customer defined functions and data**
- **app_trace.c: Trace functions**
- **ncv7685.c: APIs of NCV7685 Chip and Board**
- **app.c: main function**

Figure 11. Files Structure of Project

Flow Chart of App.c

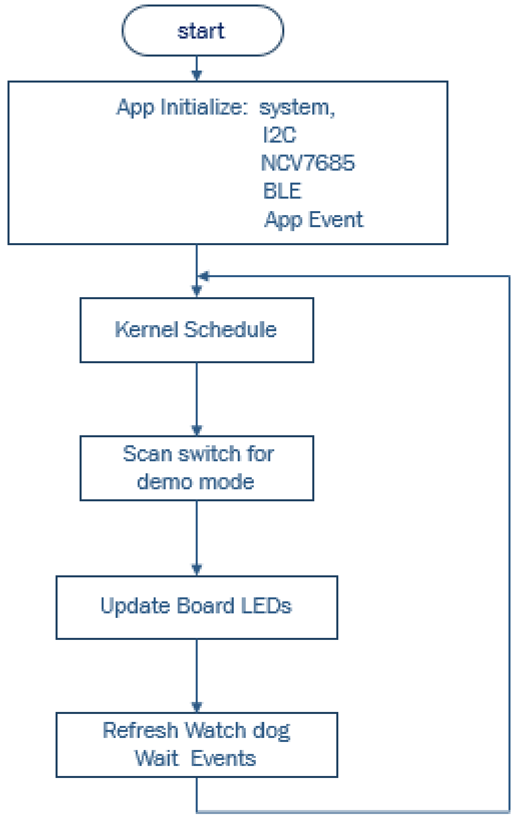


Figure 12. Flow chart of App.c

Schematic

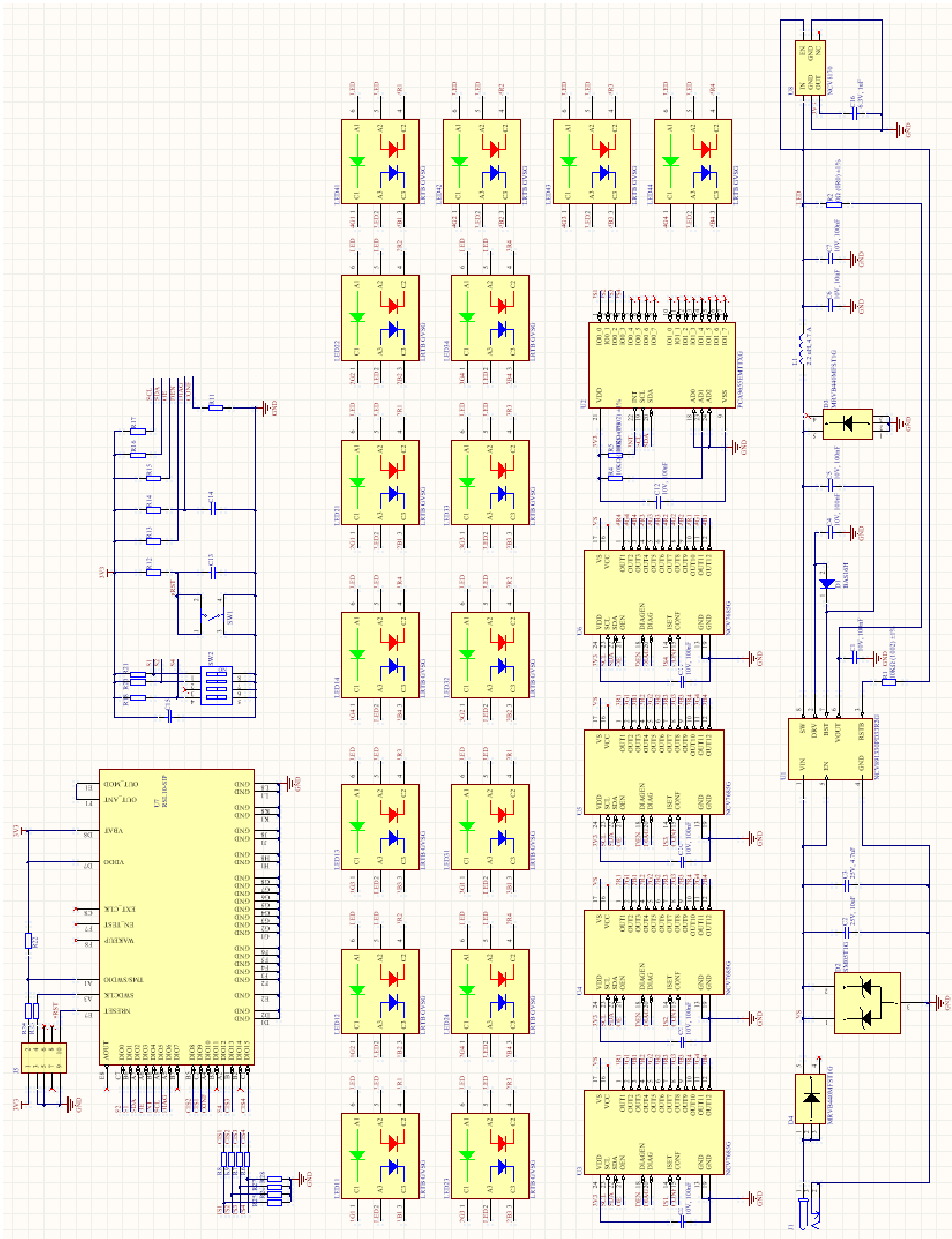


Figure 13. Schematic of Board

Assembly

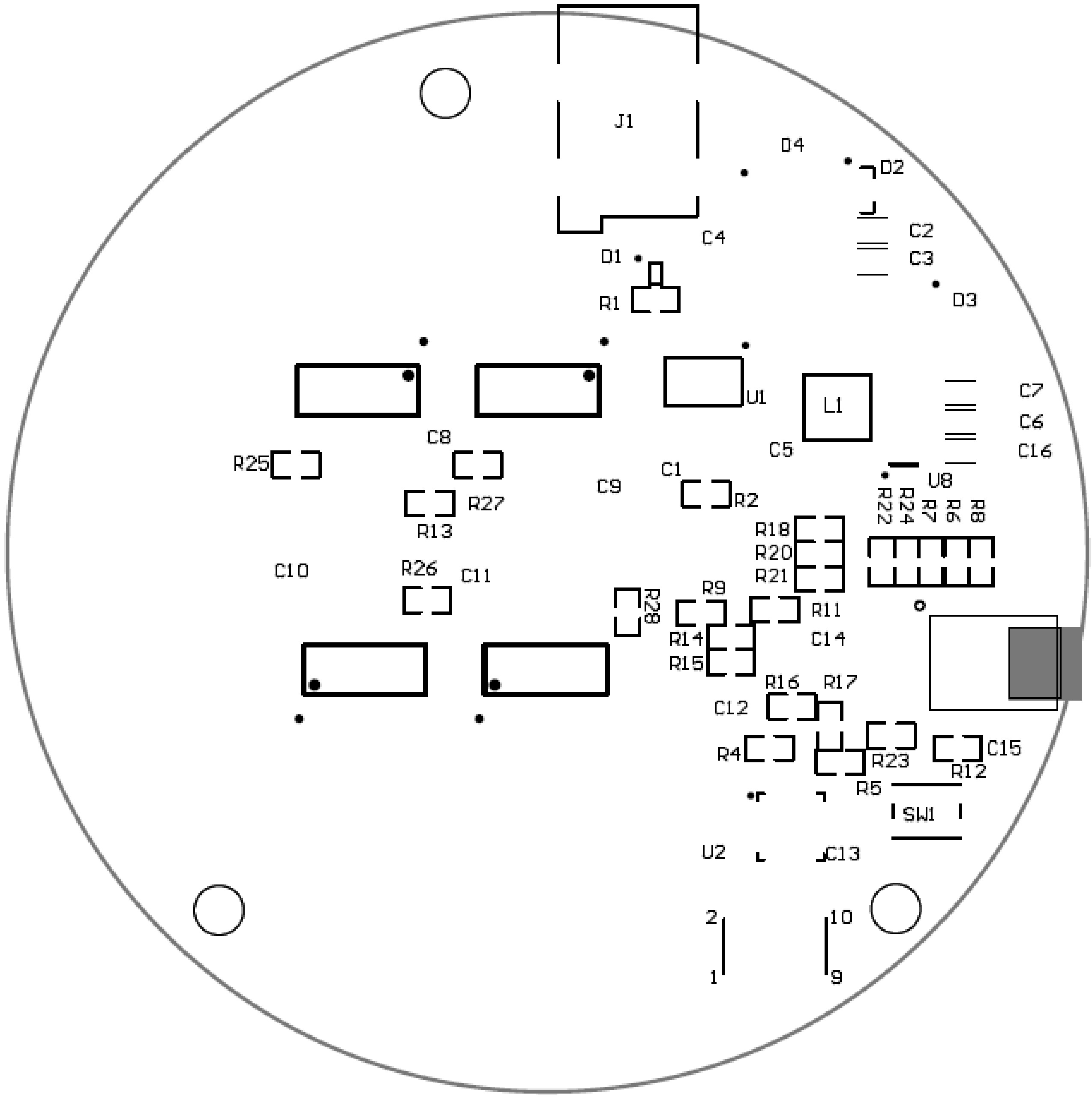


Figure 14. Bottom Side Assembly

Table 1. BILL OF MATERIALS

Item	Designator	Manufacturer	Comment	Description	Quantity
1	C1, C4, C5, C8, C9, C10, C11, C12, C13, C14, C15	–	10 V, 100 nF	WCAP−CSGP Ceramic Capacitors, 0603	11
2	C2	–	25 V, 10 μF	WCAP−CSGP Ceramic Capacitors, 1206	1
3	C3	–	25 V, 4.7 μF	WCAP−CSGP Ceramic Capacitors, 1206	1
4	C6	–	10 V, 10 μF	WCAP−CSGP Ceramic Capacitors, 1206	1
5	C7	–	10 V, 100 nF	WCAP−CSGP Ceramic Capacitors, 1206	1
6	D1	ON Semiconductor	BAS16H	Schottky Barrier Diode,	1
7	D3, D4	ON Semiconductor	NTS560	Trench Schottky Rectifier, Low Forward Voltage, 60 V, 5 A	2
8	J1	–	694106106102	DC Power Jack Connector, 5 A, 24 V	1
9	J5	–	1.27mm_SMD_Vertical_10 pin	Pin Header WR−PHD, pitch 1.27 mm,	1
10	L1	–	2.2 μH, 4.7 A	SMT Shielded Power Inductor	1
11	LED11, LED12, LED13, LED14, LED21, LED22, LED23, LED24, LED31, LED32, LED33, LED34, LED41, LED42, LED43, LED44	–	LRTB GVSG	–	16
12	R1, R4, R5, R12, R13, R14, R18, R20, R21	–	10 kΩ (1002) ±1%	Chip Resistor	9
13	R2, R3	–	0 Ω (0R0) ±1%	’Chip Resistor	2
14	R6, R7, R8, R9, R23, R24	–	68 Ω (68R0) ±1%	’Chip Resistor	6
15	R10	–	2.7 kΩ (2701) ±1%	’Chip Resistor	1
16	R11	–	10 Ω (10R0) ±1%	’Chip Resistor	1
17	R15, R22	–	100 kΩ (1003) ±1%	’Chip Resistor	2
18	R16, R17	–	1.5 kΩ (1501) ±1%	’Chip Resistor	2
19	R25, R26, R27, R28	–	2 kΩ (2001) ±1%	’Chip Resistor	4
20	SW1	–	434133025816	4.2x3.2 mm J−Bend SMD Tact Switch	1
21	SW2	–	416131160804	SMD Dip Switch	1
22	U1	ON Semiconductor	NCV891330PD38R2G	–	1
23	U2	ON Semiconductor	PCA9655EMTTXG	–	1
24	U3, U4, U5, U6	ON Semiconductor	NCV7685G	–	4
25	U7	ON Semiconductor	RSL10−SIP	–	1
25	U8	ON Semiconductor	NCV8170BMX330TCG	–	1

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