Project Documentation

C64 WiFi-Modem for User Port

Project number: 120

Revision: 2

Date: 05.02.2020

C64 WiFi-Modem for User Port Rev. 2

Module Description

This board is a WiFi modem for the User Port of the Commodore C64. It is based on the project "Build your own 9600 Baud C64 WiFi Modem For $10" of "1200BAUD" (https://1200baud.wordpress.com/2017/03/04/build-your-own-9600-baud-c64-wifi-modem-for-20/).

The WiFi functionality is implemented in the NODEMCU V3 development board/module, which contains an Espressive ESP8266, a WiFi and RISC processor. This module can be programmed with free software via a micro USB cable.

The board contains status and activity LEDs and connects to the User Port of the Commodore C64.

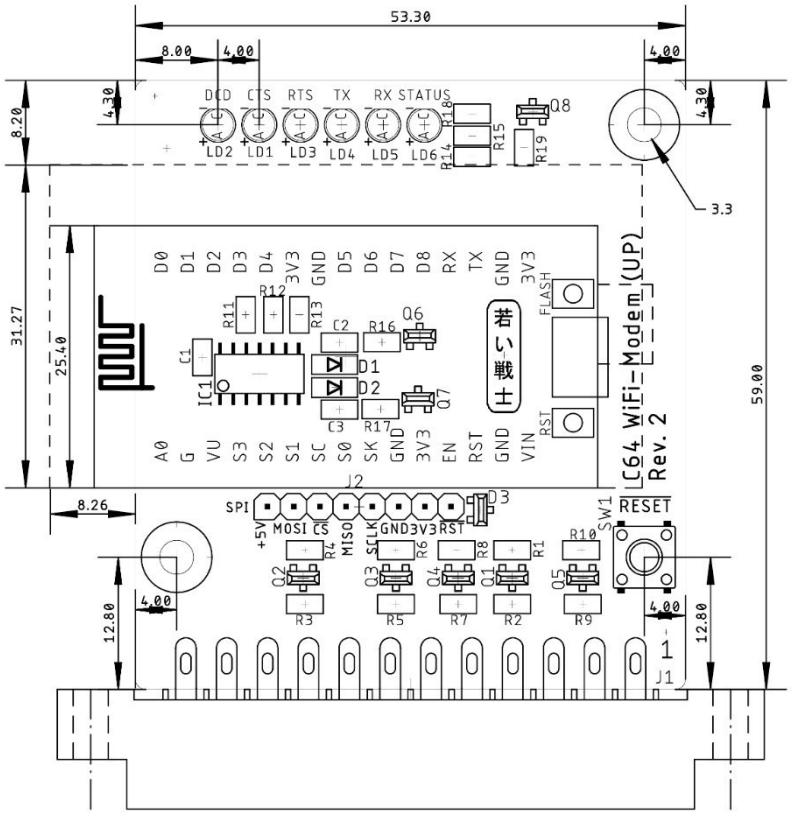


Figure 1: Dimensions of the WiFi modem board

For the NodeMCU V3 programming and the required C64 software, refer to the article mentioned before.

The board contains level shifters, that translate between the NodeMCU 3.3V level and the User Port 5V level. According to the data sheet, the ESP8266 is not 5V-level tolerant. Its protection diodes might limit the HIGH level to below 4V. Without the level shifters, the User Port/6526 CIA might be stressed by the HIGH level being pulled to this level.

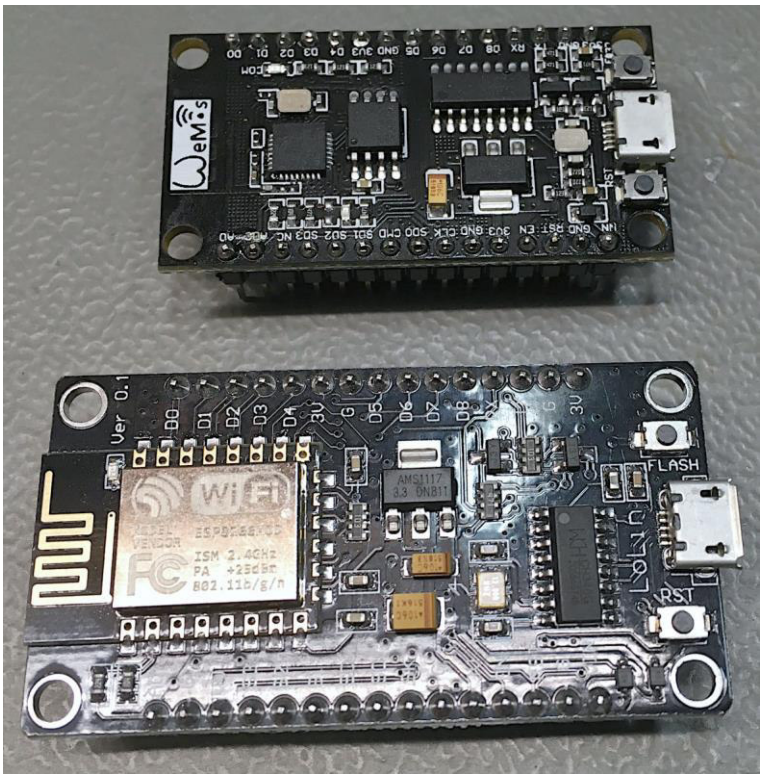


Figure 2: The narrow and the wide NodeMCU

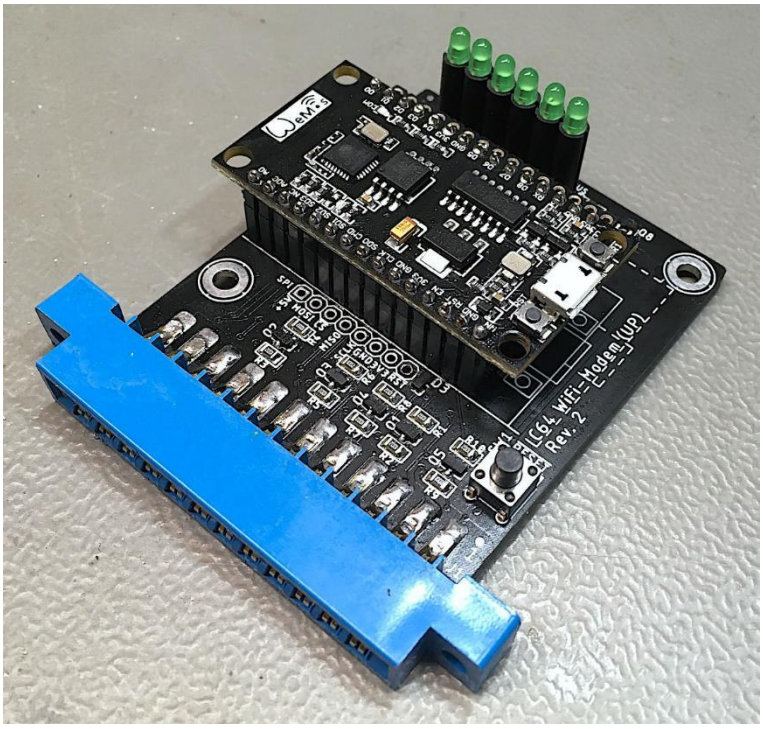


Figure 3: WiFi Modem with narrow NodeMCU v3

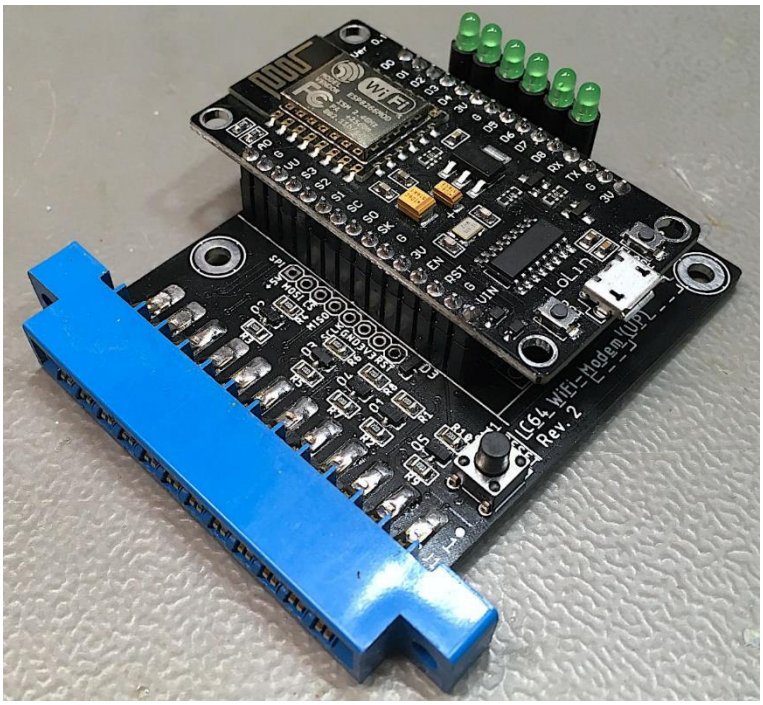


Figure 4: WiFi modem with the wide NodeMCU

Logic connections

3.3V level			5V level	
Pin	NodeMCU V3	Signal	User Port	Pin
29	GPIO5 (D1)	RTS	PB1	D
28	GPIO4 (D2)	CTS	PB6	K
26	GPIO2 (D4)	DCD	PB4	H
22	GPIO12 (D6)	Status-LED	-	-
19	RXD0 (RX)	RXD	PA2, SP1	M, 5
18	TXD0 (TX)	TXD	/FLAG2, PB0, SP2	B, C, 7
-	-		PB7, CNT2	L, 6

Connectors

User Port

2 x 12 edge connector, pitch 3.96mm

Pin	Signal	Pin	Signal
1	GND	A	GBD
2	+5V	B, C	TXD
3	$\overline{\text{RESET}}$	D	RTS
5	RXD	H	DCD
6	CNT2	K	CTS
7	TXD	L	CNT2
12	GND	M	RXD
		N	GND

SPI (spare)

8p. pin header, pitch 2.54mm. The function of the SPI-Bus is not implemented in the NodeMCU software. The signals have a 3.3V level. 3.3V, 5V and GND are connected to this pin header.

Pin	Signal
1	+5V
2	MOSI
3	$\overline{CS}$
4	MISO
5	SCLK
6	GND
7	+3.3V
8	$\overline{RST}$ (Reset Signal NodeMCU)

Revision History

Rev. 0

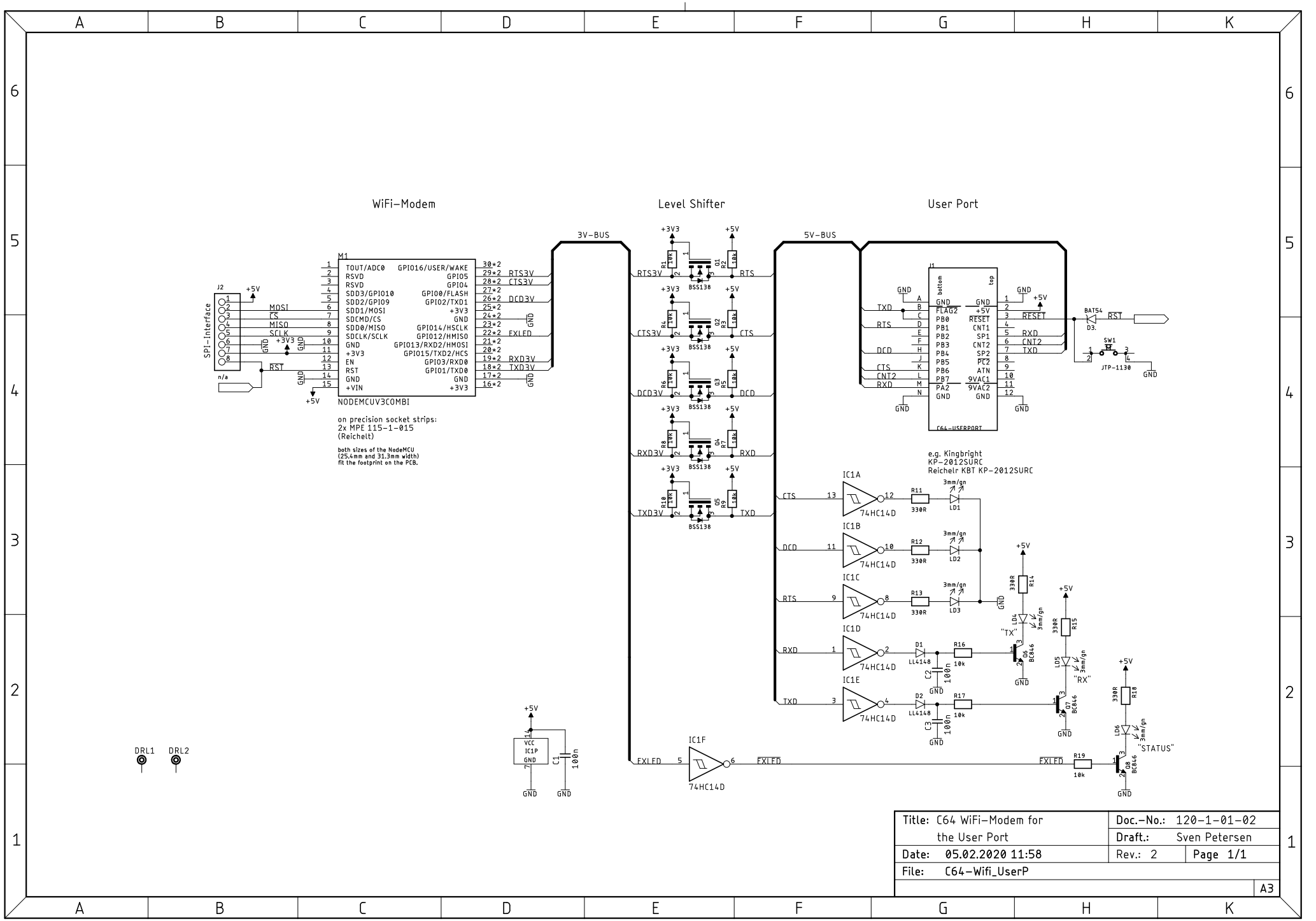
Prototype, functional. Labeling of the LEDs was not perfect, the Status LED was inverted.

Rev. 0 → Rev. 1

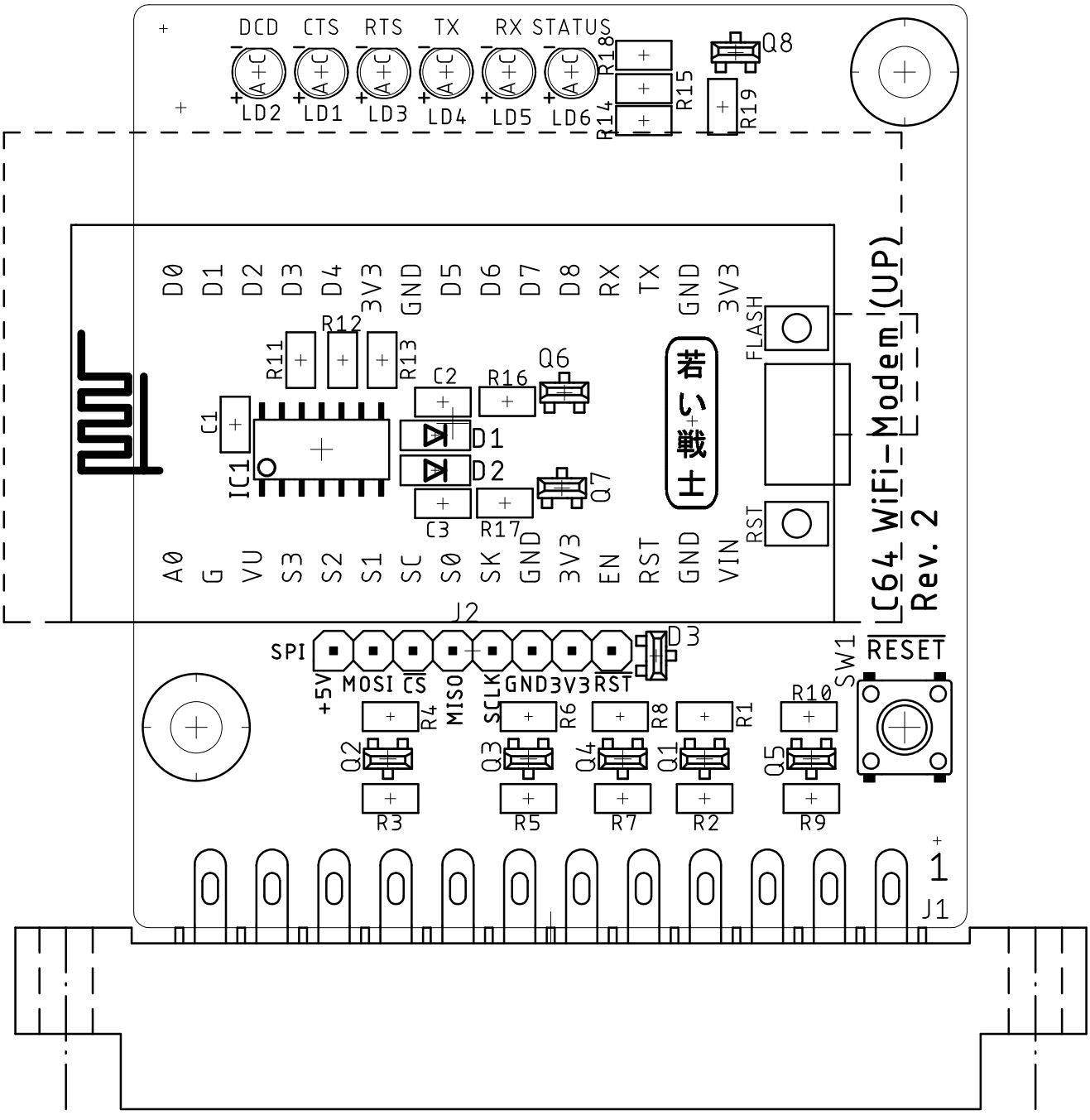
- Board Revision
- LEDs changed to 3mm standard LEDs
- The "WiFi" LED is now named "Status" and it is inverted
- The Labeling from RX and TX was swapped, since before it was labeled from the perspective of the NodeMCU
- Positions of LEDs have moved
- A pin header for a spare SPI-Bus connection is added
- Two mounting holes for a not yet designed enclosure are added
- A $\overline{RESET}$ -Button is added
- The C64 Reset affects the NodeMCU

Rev. 1 → Rev. 2

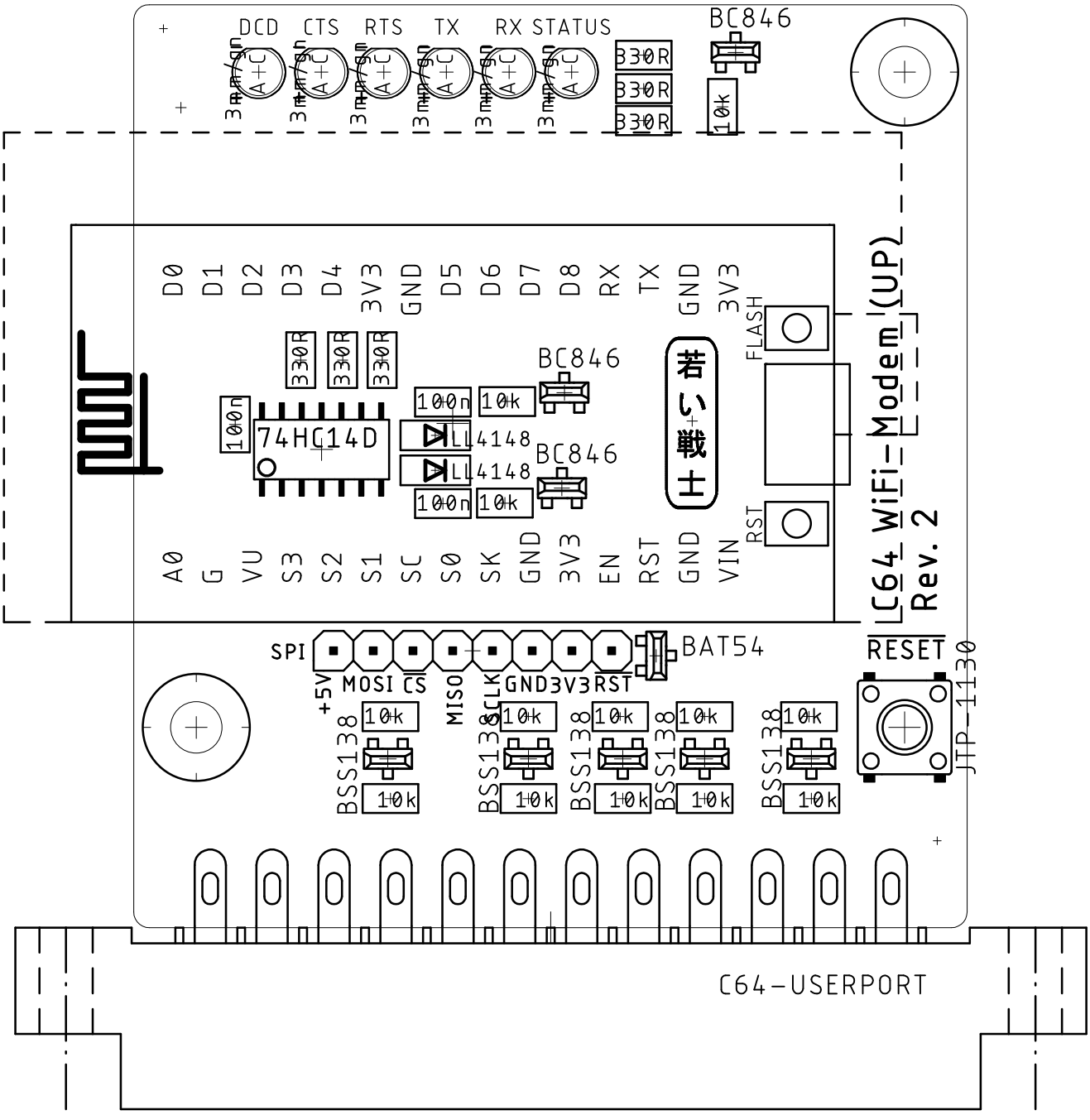
- Board Revision
- The original WeMos NodeMCU footprint and the wider footprint of other vendors both fit the PCB
- The case Rev. 2 is required


WiFi-Modem
Level Shifter
User Port
3V-BUS
5V-BUS
M1
NODEMCUV3COMBI
on precision socket strips:
2x MPE 115-1-015
(Reichelt)
both sizes of the NodeMCU
(25.4mm and 31.3mm width)
fit the footprint on the PCB.
J2
SPI-Interface
MOSI
CS
MISO
SCLK
RST
n/a
J1
C64-USERPORT
BAT54
D3.
SW1
JTP-1130
BSS138
74HC14D
IC1A
IC1B
IC1C
IC1D
IC1E
IC1F
LL4148
BC846
e.g. Kingbright
KP-2012SURC
Reichelr KBT KP-2012SURC
"TX"
"RX"
"STATUS"
DRL1
DRL2
C1
100n
C2
C3
Title: C64 WiFi-Modem for the User Port
Doc.-No.: 120-1-01-02
Draft.: Sven Petersen
Date: 05.02.2020 11:58
Rev.: 2
Page 1/1
File: C64-Wifi_UserP
A3

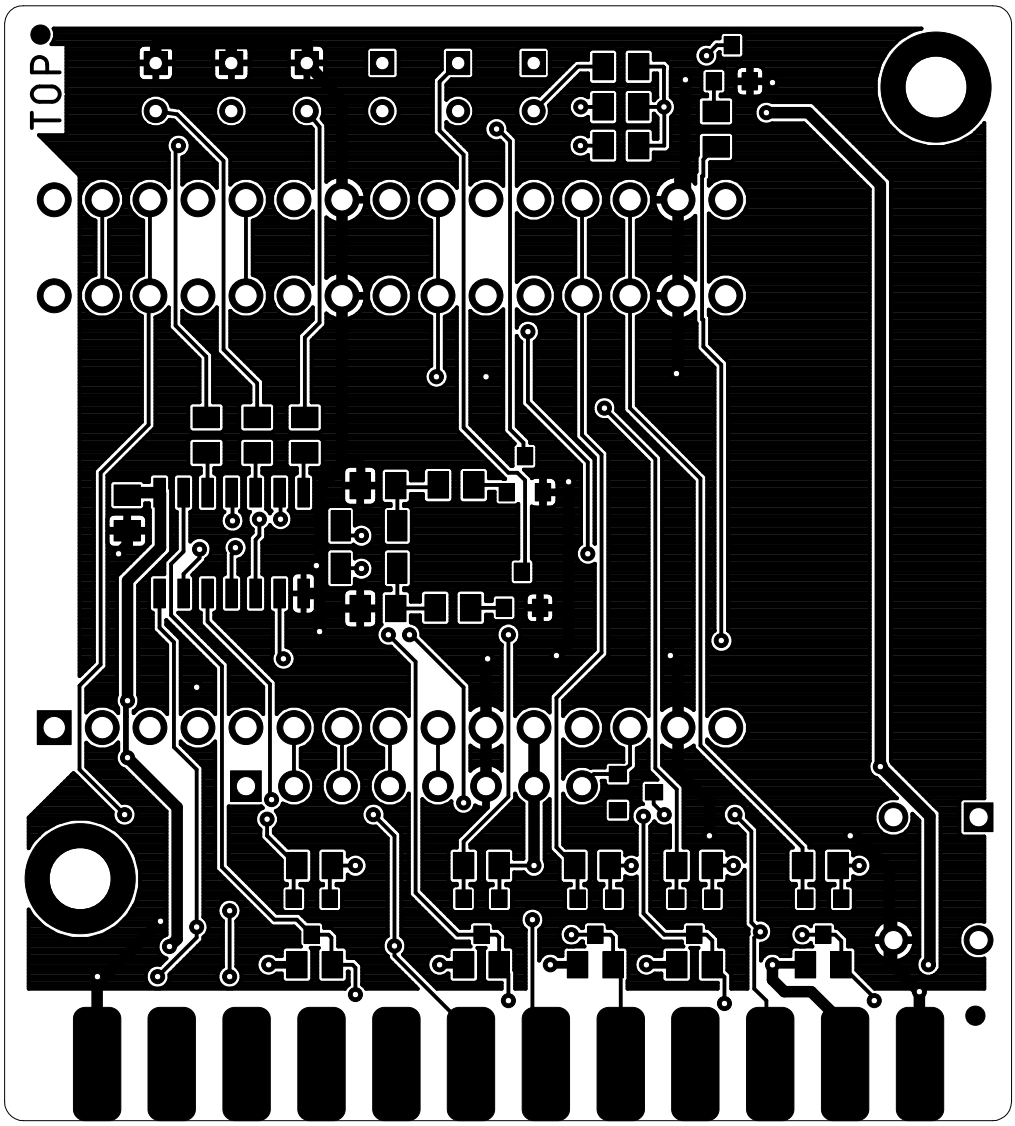
Sven Petersen 2020	Doc.-No.: 120-2-01-02	
	Cu: 35µm	Cu-Layers: 2
C64-Wifi_UserP		
05.02.2020 12:00		Rev.: 2
placement component side		



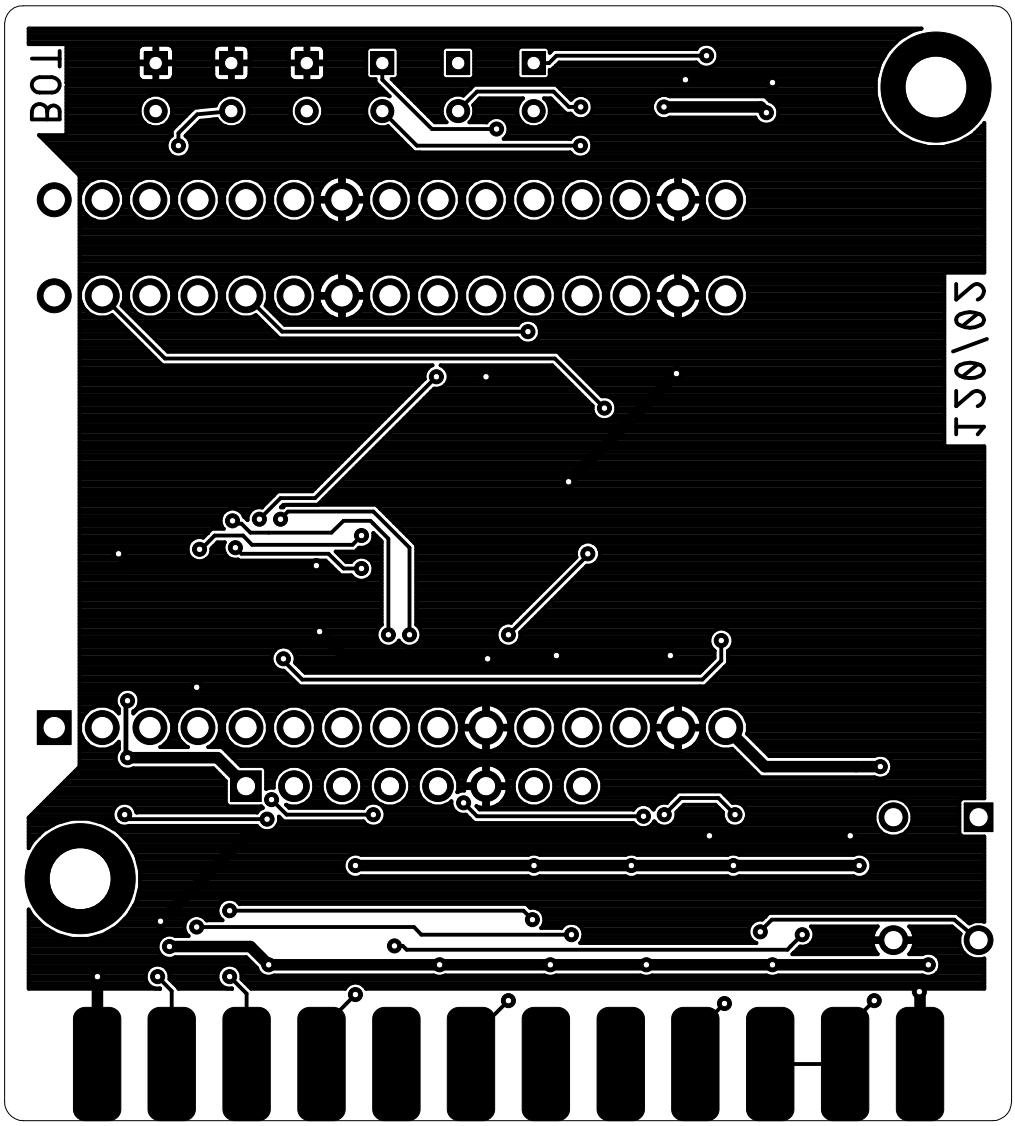
Sven Petersen 2020	Doc.-No.: 120-2-01-02	
	Cu: 35µm	Cu-Layers: 2
C64-Wifi_UserP		
05.02.2020 12:00		Rev.: 2
placement component side		



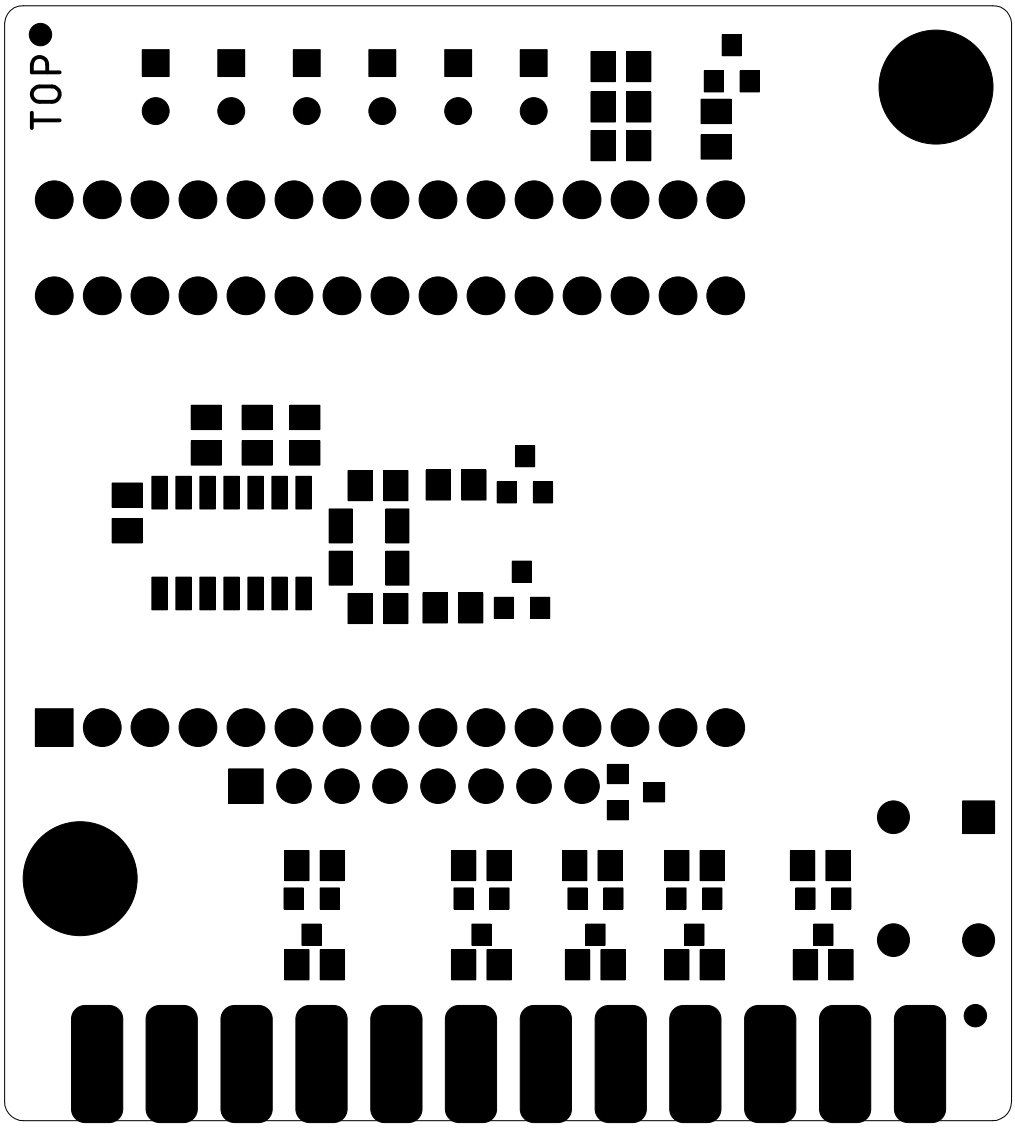
Sven Petersen 2020	Doc.-No.: 120-2-01-02	
	Cu: 35µm	Cu-Layers: 2
C64-Wifi_UserP		
05.02.2020 12:00		Rev.: 2
top		



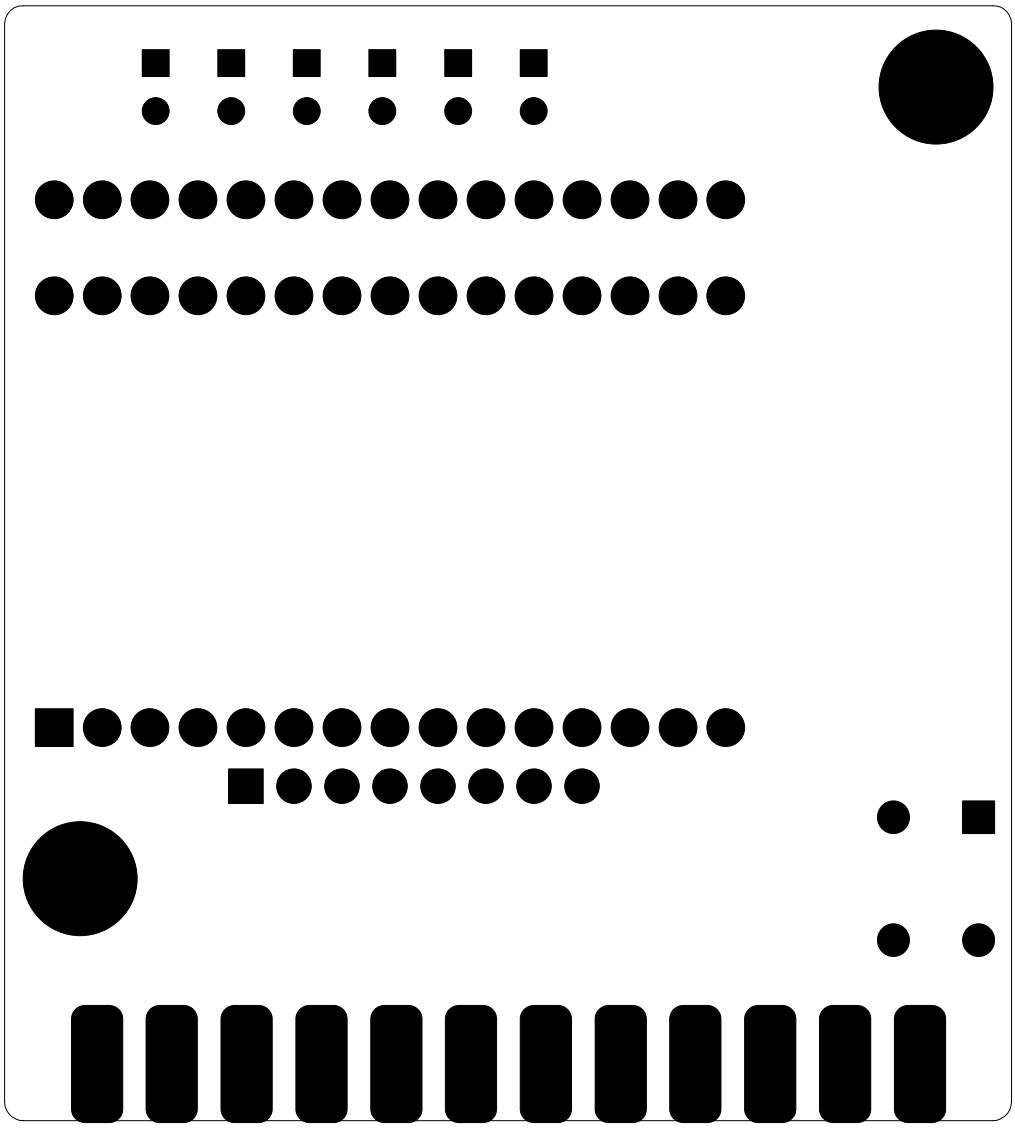
Sven Petersen 2020	Doc.-No.: 120-2-01-02	
	Cu: 35µm	Cu-Layers: 2
C64-Wifi_UserP		
05.02.2020 12:00		Rev.: 2
bottom		



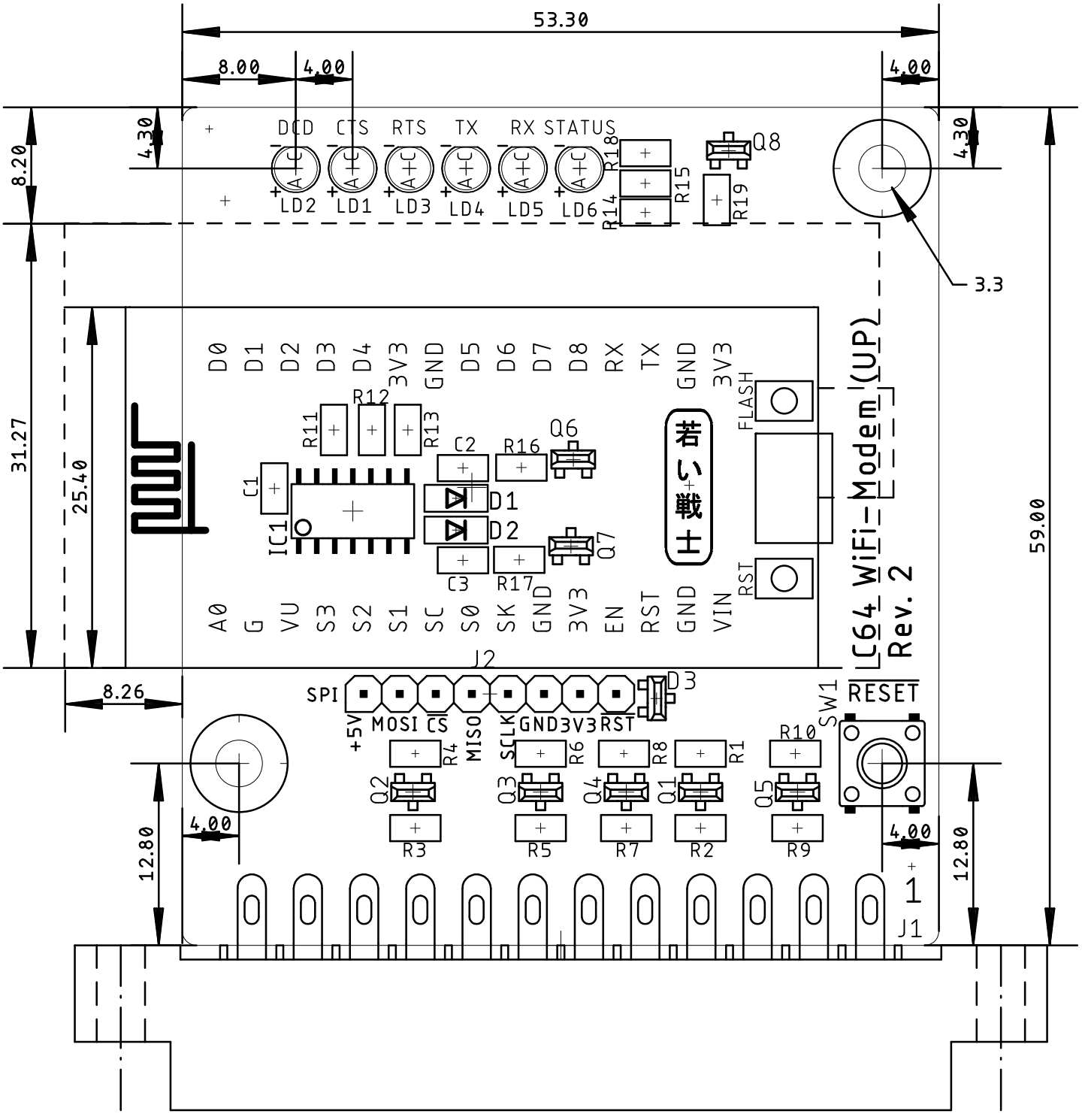
Sven Petersen 2020	Doc.-No.: 120-2-01-02	
	Cu: 35µm	Cu-Layers: 2
C64-Wifi_UserP		
05.02.2020 12:00		Rev.: 2
stopmask component side		



Sven Petersen 2020	Doc.-No.: 120-2-01-02	
	Cu: 35µm	Cu-Layers: 2
C64-Wifi_UserP		
05.02.2020 12:00		Rev.: 2
stopmask solder side		



Sven Petersen 2020	Doc.-No.: 120-2-01-02	
	Cu: 35µm	Cu-Layers: 2
C64-Wifi_UserP		
05.02.2020 12:00		Rev.: 2
placement component side measures		



C64 WiFi-Modem for User Port Rev. 2

Functional Description

J1 is connecting to the C64 user port. The logic levels are TTL (5V)-levels. The NodeMCU v3 (M1) contains all functionality, WiFi included. Its signal level is 3.3V, so level shifters are required. Those are implemented in the MOSFETs (Q1 – Q5).

The modem signals are active low. The inverters (IC1) are used to drive LEDs. The RxD and TxD lines might toggle often. To obtain a good LED brightness, the output of the inverters IC1D and IC1E are buffered in a capacitor, which is charged via a diode and discharged via the base resistor and the base of a transistor, which is then driving an LED.

The last LED (LD6) is driven by the signal EXLED from the NodeMCU. It serves as a status LED for the NodeMCU software. According to the comments in the software, a LOW on this output should switch the Status-LED on, thus the inverter IC1F is required.

J2 is a spare SPI bus connection. The functionality is not implemented in the software, the pin header may stay not populated.

SW1 serves as a RESET switch for the C64. It is a standard 6mm tact switch.

A LOW level on the C64's $\overline{\text{RESET}}$ signal pulls the NodeMCU's $\overline{\text{RST}}$ LOW via the Schottky diode D3. This way, the NodeMCU is reset together with the C64.

C64 WIFI Modem (User Port) Rev. 2

Testing v2

Setup

The C64 WiFi Modem (Rev. 1) is driven by a C64 (Mainboard: ASSY250469 with ARMSID), which also connects to an Ultimate II+.

Current consumption

The current is measured with a Fluke 89 IV multimeter, which is connected between the power supply and the Power jack of the C64.

First the maximum current of the C64 setup mentioned before is determined without the DUT being connected to the user port. CCGMS 2017 v6 was loaded from the Ultimate II+.

The measured result I_{MAX} is 998.7mA.

In the next step, the DUT was connected and the measurement was repeated. This time, the result is 1095.5mA.

The current consumption of the Modem board might vary depending on the operations/state. It can eb assumed, that is it approximately 100mA.

Connection Test

With the CCGMS software, the Modem was set up, three different WiFi connections were established:

- An iPad Pro acting as an access point
- A WAP (wireless access point)
- A Router

The connections to the WiFi networks could be established, repeatedly. The WAP did not connect anymore after a few days. Since the WAP was far away and all other connections continued working, it was assumed, that either the settings or the distance of the WAP were causing the problem.

After setting up the dialer with several BBS connections and Port numbers, the WiFi-Modem and CCGMS software could connect to those BBSes and exchange data and hold the connection in a stable behavior.

Conclusion

The functionality of **Rev. 0** is given, the labeling of the LEDs needs to be changed. The Status LED needs to be inverted. Refer to document 120-6-03-00: Testing Rev. 0.

Rev. 1 was built and tested. The LEDs cab be viewed properly, their behavior is ok. The reset button resets both, the C64 and the modem. The modem does not reset the C64. The designed 3D printed case (for PCB Rev. 1) fits well. The modem connects to WiFi and is able to dial in a variety of BBSes.

Rev. 2 was built and tested. The designed 3D printed case (for PCB Rev. 2) fits well. The tests were conducted with both, the narrow NodeMCU and the wide NodeMCU. The modem connects to WiFi and is able to dial in a variety of BBSes.

C64 WiFi-Modem for User Port Rev. 2
Bill of Material Rev. 2.0

Pos.	Qty	Value	Footprint	Ref.-No.	Comment
1	1	120-2-01-01	2 Layer	PCB Rev. 1	2 layer, Cu 35µ, HASL, 54.0 x 53.3, 1.6mm FR4
2	6	3mm/gn	3mm LED	LD1, LD2, LD3, LD4, LD5, LD6	Standard 3mm green LEDs
3	3	100n	0805	C1, C2, C3	ceramic cap, 0805, 25V or better
4	13	10k	0805	R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R16, R17, R19	chip resistor, 0805, 5% or better
5	6	330R	0805	R11, R12, R13, R14, R15, R18	chip resistor, 0805, 5% or better
6	1	74HC14D	SO-14	IC1	ST micro, NXP, TI etc. e.g. Reichelt SMD HC 14
7	3	BC846B	SOT23	Q6, Q7, Q8	SMD NPN transistor, e.g. Reichelt BC 846B NXP
8	5	BSS138	SOT23	Q1, Q2, Q3, Q4, Q5	SMD MOSFET, e.g. Reichelt BSS 138 SMD
9	1	2x12, 3.96mm pitch	USERPORT	J1	edge connector for C64 user port, ebay or online shops
10	2	LL4148	SOD80C	D1, D2	diode SMD, e.g. Reichelt LL4148
11	1	NodeMCU V3	NODEMCUV3	M1	e.g. WeMOS NodeMCU v3. ebay or online shops or Reichelt DEBO JT ESP8266, either the origial narror footprint or the 31.1mm wide footprint of other vendors.
12	2	socket strip 15p. 2.54mm pitch		(M1)	e.g. MPE Garry 115-1-015, Reichelt MPE 115-1-015
13	1	8p, 2.54mm pin header		J2	not populated
14	1	BAT54	SOT23	D3	schottky diode
15	1	JTP-1130	6mm tact switch	SW1	Namea Electronics. Or standard 6x6mm tact switch