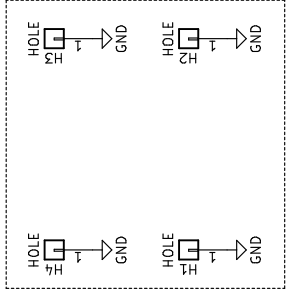
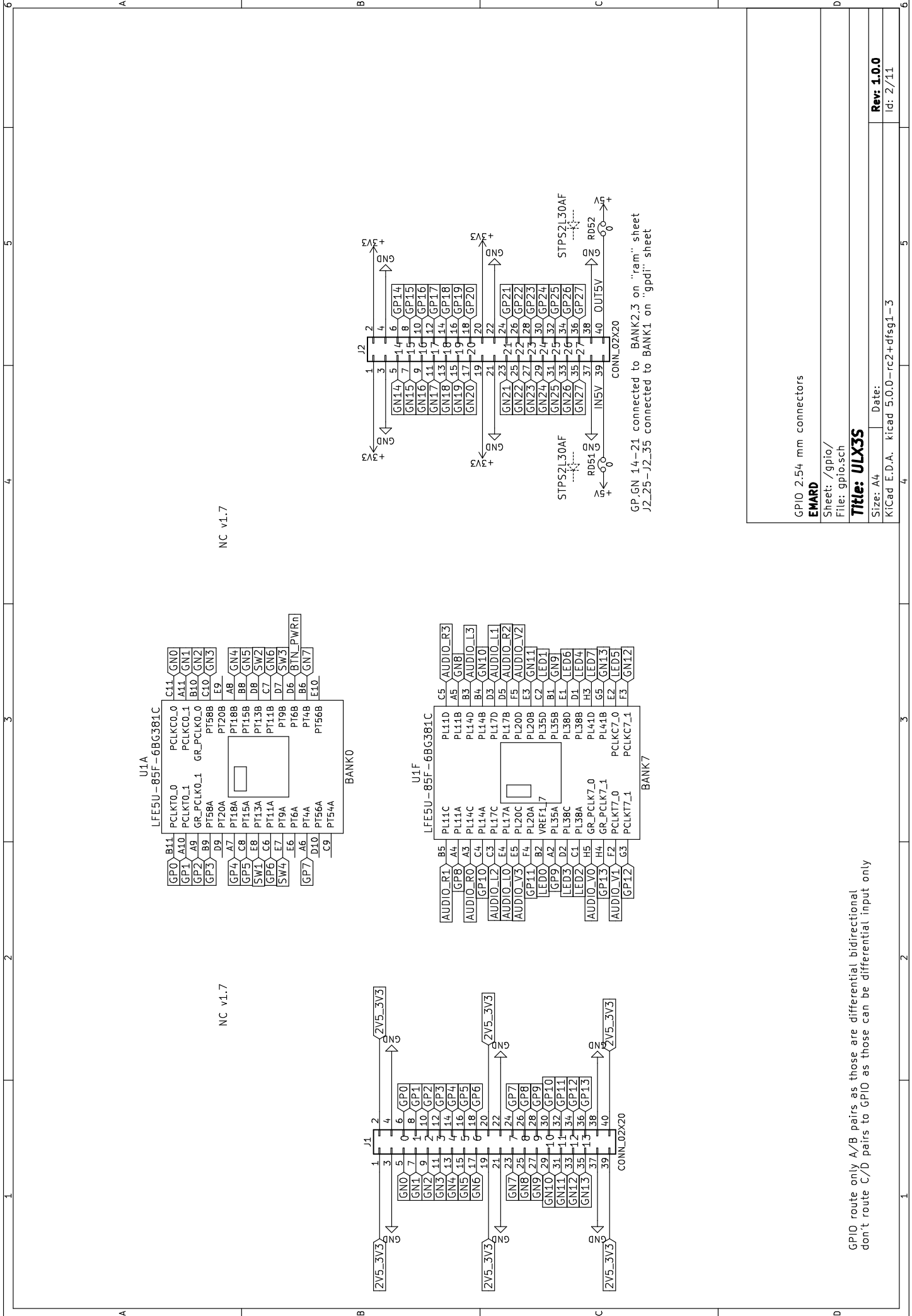


1	A	B	C	D																				
			<p>click on mouse pointer arrow on top of right toolbar and double-click on sheet to open</p> <table border="1"> <tr> <td>Sheet: power</td> <td>Sheet: usb</td> <td>Sheet: blinky</td> <td>Sheet: ram</td> <td>Sheet: sdcard</td> </tr> <tr> <td>File: power.sch</td> <td>File: usb.sch</td> <td>File: blinky.sch</td> <td>File: ram.sch</td> <td>File: sdcard.sch</td> </tr> <tr> <td>Sheet: gpio</td> <td>Sheet: gpi</td> <td>Sheet: analog</td> <td>Sheet: wifi</td> <td>Sheet: flash</td> </tr> <tr> <td>File: gpio.sch</td> <td>File: gpi.sch</td> <td>File: analog.sch</td> <td>File: wifi.sch</td> <td>File: flash.sch</td> </tr> </table>	Sheet: power	Sheet: usb	Sheet: blinky	Sheet: ram	Sheet: sdcard	File: power.sch	File: usb.sch	File: blinky.sch	File: ram.sch	File: sdcard.sch	Sheet: gpio	Sheet: gpi	Sheet: analog	Sheet: wifi	Sheet: flash	File: gpio.sch	File: gpi.sch	File: analog.sch	File: wifi.sch	File: flash.sch	
Sheet: power	Sheet: usb	Sheet: blinky	Sheet: ram	Sheet: sdcard																				
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File: gpio.sch	File: gpi.sch	File: analog.sch	File: wifi.sch	File: flash.sch																				
				<p>Root sheet EMARD Sheet: / File: ulx3s.sch</p>																				
				<p>Title: ULX3S</p>																				
				<table border="1"> <tr> <td>Size: A4</td> <td>Date:</td> </tr> <tr> <td>KiCad E.D.A.</td> <td>kicad 5.0.0-rc2+dfsg1-3</td> </tr> </table>	Size: A4	Date:	KiCad E.D.A.	kicad 5.0.0-rc2+dfsg1-3																
Size: A4	Date:																							
KiCad E.D.A.	kicad 5.0.0-rc2+dfsg1-3																							
6	A	B	C	D																				





NC v1.7

NC v1.7

GPIO route only A/B pairs as those are differential bidirectional
don't route C/D pairs to GPIO as those can be differential input only

GPIO 2.54 mm connectors

EMARD

Sheet: /gpio/
File: gpio.sch

Title: ULX3S

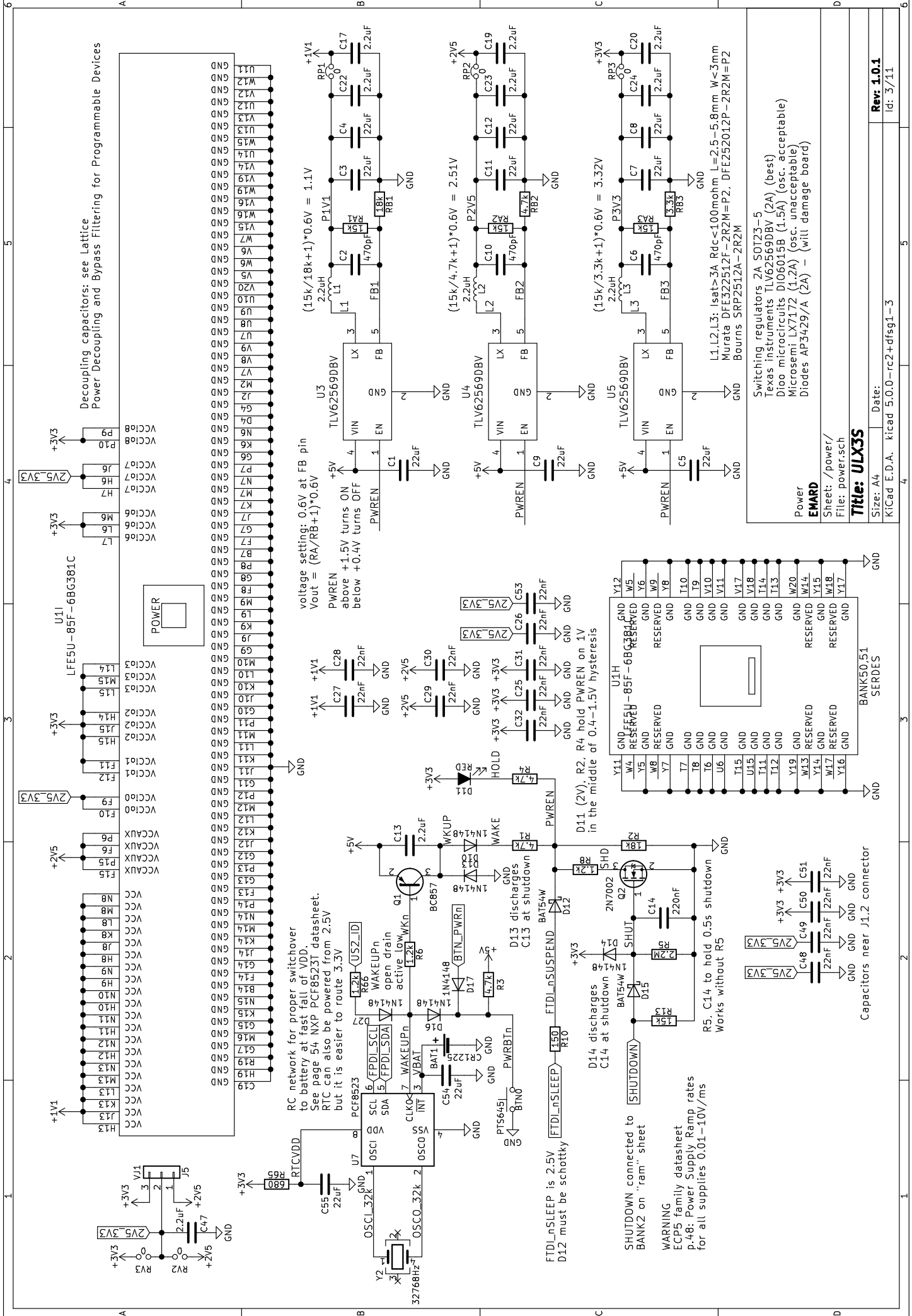
Size: A4 Date:

KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3

Rev: 1.0.0

Id: 2/11

GPIO route only A/B pairs as those are differential bidirectional
don't route C/D pairs to GPIO as those can be differential input only



Decoupling capacitors: see Lattice Power Decoupling and Bypass Filtering for Programmable Devices

voltage setting: 0.6V at FB pin
 $V_{out} = (R_A/R_B + 1) * 0.6V$

$$V_{out} = (15k/18k + 1) * 0.6V = 1.1V$$

$$V_{out} = (15k/4.7k + 1) * 0.6V = 2.51V$$

$$V_{out} = (15k/3.3k + 1) * 0.6V = 3.32V$$

Switching regulators 2A_S0T23-5
 Texas Instruments TLV62569DBV (2A) (best)
 Dileo microcircuits D106015B (1.5A) (osc. unacceptable)
 Microsemi LX7172 (1.2A) (osc. unacceptable)
 Diodes AP3429/A (2A) - (will damage board)

Power **EMARD**
 Sheet: /power/
 File: power.sch

Title: ULX3S

Size: A4 Date: Rev: 1.0.1
 KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3 Id: 3/11

RC network for proper switchover to battery at fast fall of VDD.
 See page 54 NXP PCF8523T datasheet.
 RTC can also be powered from 2.5V but it is easier to route 3.3V

FTDI_nSLEEP is 2.5V
 D12 must be schottky

SHUTDOWN connected to BANK2 on "ram" sheet

WARNING
 ECP5 family datasheet p.48: Power Supply Ramp rates for all supplies 0.01-10V/ms

R5, C14 to hold 0.5s shutdown Works without R5

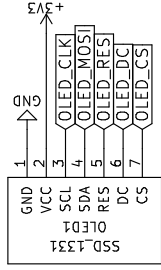
D14 discharges C14 at shutdown

D13 discharges C13 at shutdown

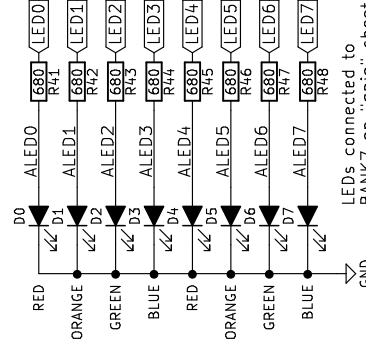
D11 (2V), R2, R4 hold PWREN on 1V in the middle of 0.4-1.5V hysteresis

Capacitors near J1.2 connector

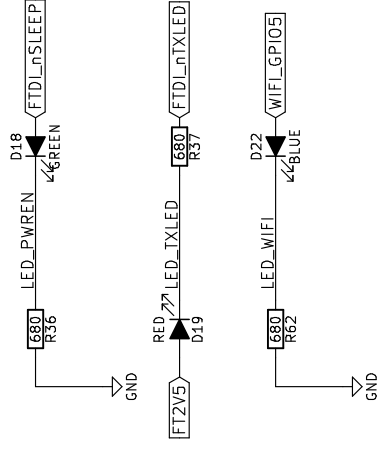
SSD1306 B/W or SSD1331 COLOR compatible OLED 0.96" or 1.3" PCB 1.4x1.4 units 1 unit = 2.54 mm



OLED connected to BANK6 on "usb" sheet

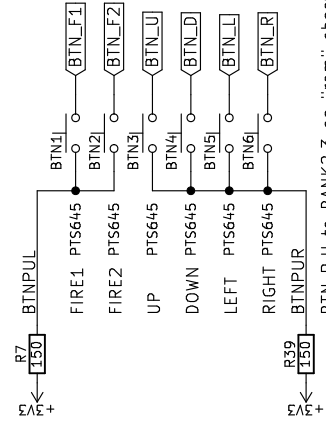


LEDs connected to BANK7 on "gpio" sheet

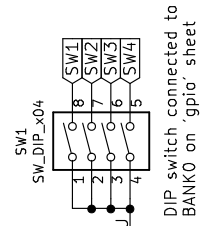


TXLED blinks when FPGA sends data to FTDI

GPIO2 on PCB v1.7



BTN_R,U to BANK2,3 on "ram" sheet
BTN_F1,F2,D,L to BANK8 on "flash" sheet



DIP switch connected to BANK0 on "gpio" sheet

To fix issues with FT231XS rev A,B,C Short-circuit D18 LED, but then board cannot keep awake by USB. chip rev D works properly See TN140_FT231X Errata

Buttons, LEDs, OLED display

EMARD

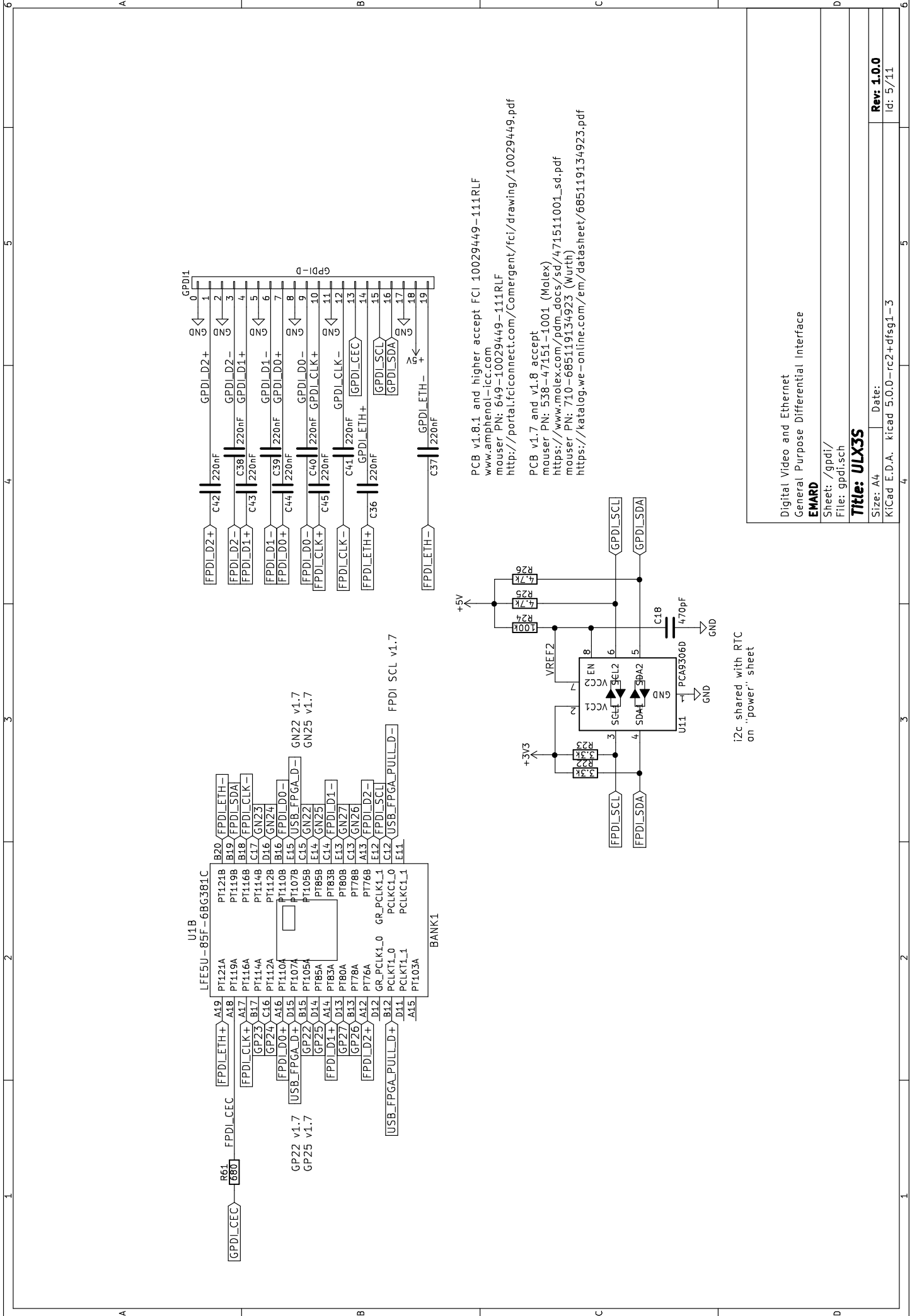
Sheet: /blinky/
File: blinky.sch

Title: ULX3S

Size: A4 Date:

KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3

Rev: 1.0.0
Id: 4/11



PCB v1.8.1 and higher accept FCI 10029449-111RLF
 www.amphenol-icc.com
 mouser PN: 649-10029449-111RLF
 http://portal.fciconnect.com/Comergent/fci/drawing/10029449.pdf

PCB v1.7 and v1.8 accept
 mouser PN: 538-47151-1001 (Molex)
 https://www.molex.com/pdm_docs/sd/471511001_sd.pdf
 mouser PN: 710-685119134923 (Würth)
 https://katalog.wg-online.com/em/datasheet/685119134923.pdf

Digital Video and Ethernet
 General Purpose Differential Interface

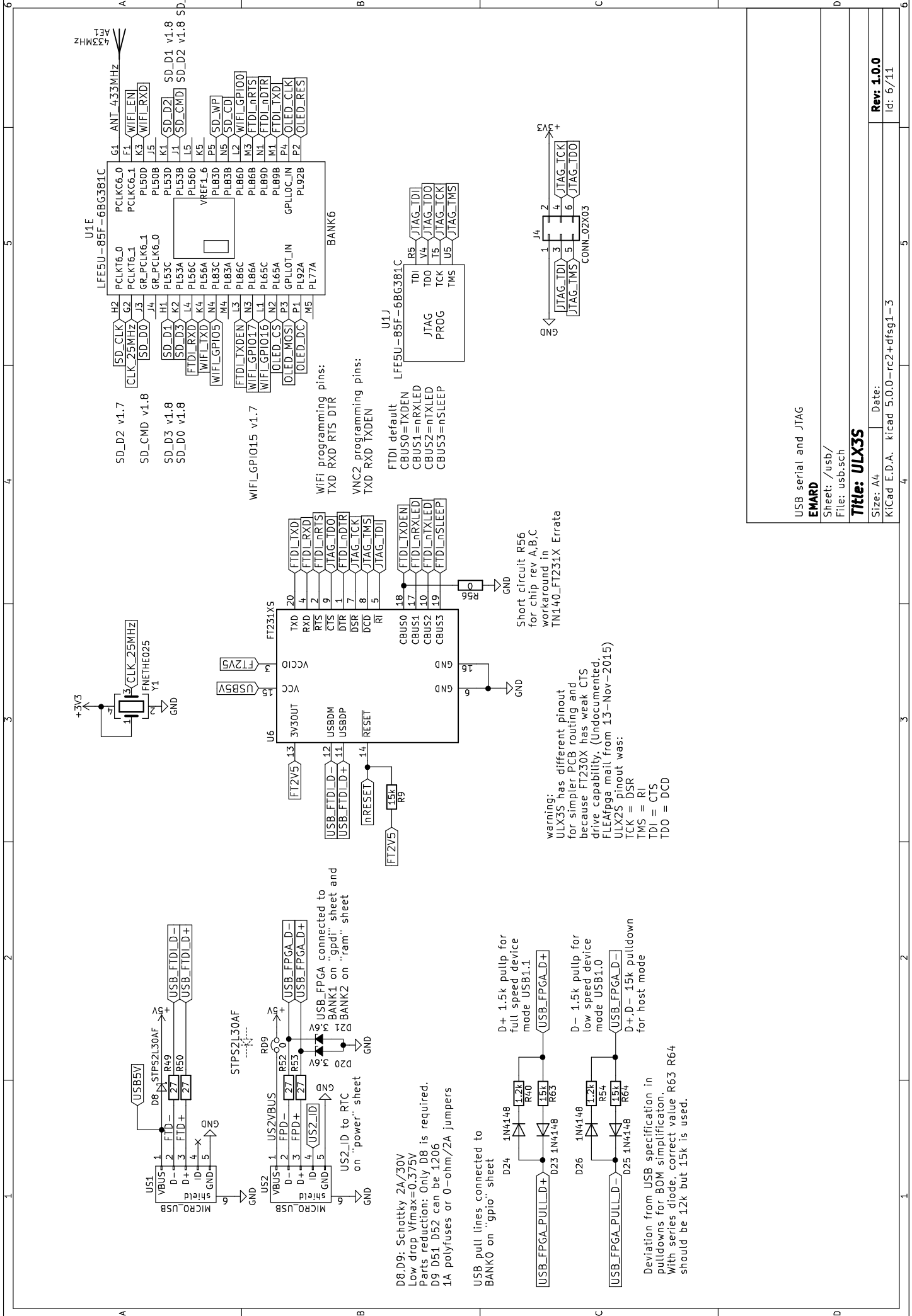
EMARD

Sheet: /gpd/
 File: gpd1.sch

Title: ULX3S

Size: A4 Date:
 KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3
 Rev: 1.0.0
 Id: 5/11

i2c shared with RTC
 on "power" sheet



Warning: ULX3S has different pinout for simpler PCB routing and because FT230X has weak CTS drive capability. (Undocumented. FLEApiga mail from 13-Nov-2015)

TCK = DSR
TMS = RI
TDI = CTS
TDO = DCD

Short circuit R56 for chip rev A,B,C workaround in TN140_FT231X Errata

FTDI default
CBUS0=TXDEN
CBUS1=nRXLED
CBUS2=nTXLED
CBUS3=nSLEEP

FTDI TXDEN
TXD RXD TXDEN

WiFi programming pins:
TXD RTS TXD DTR

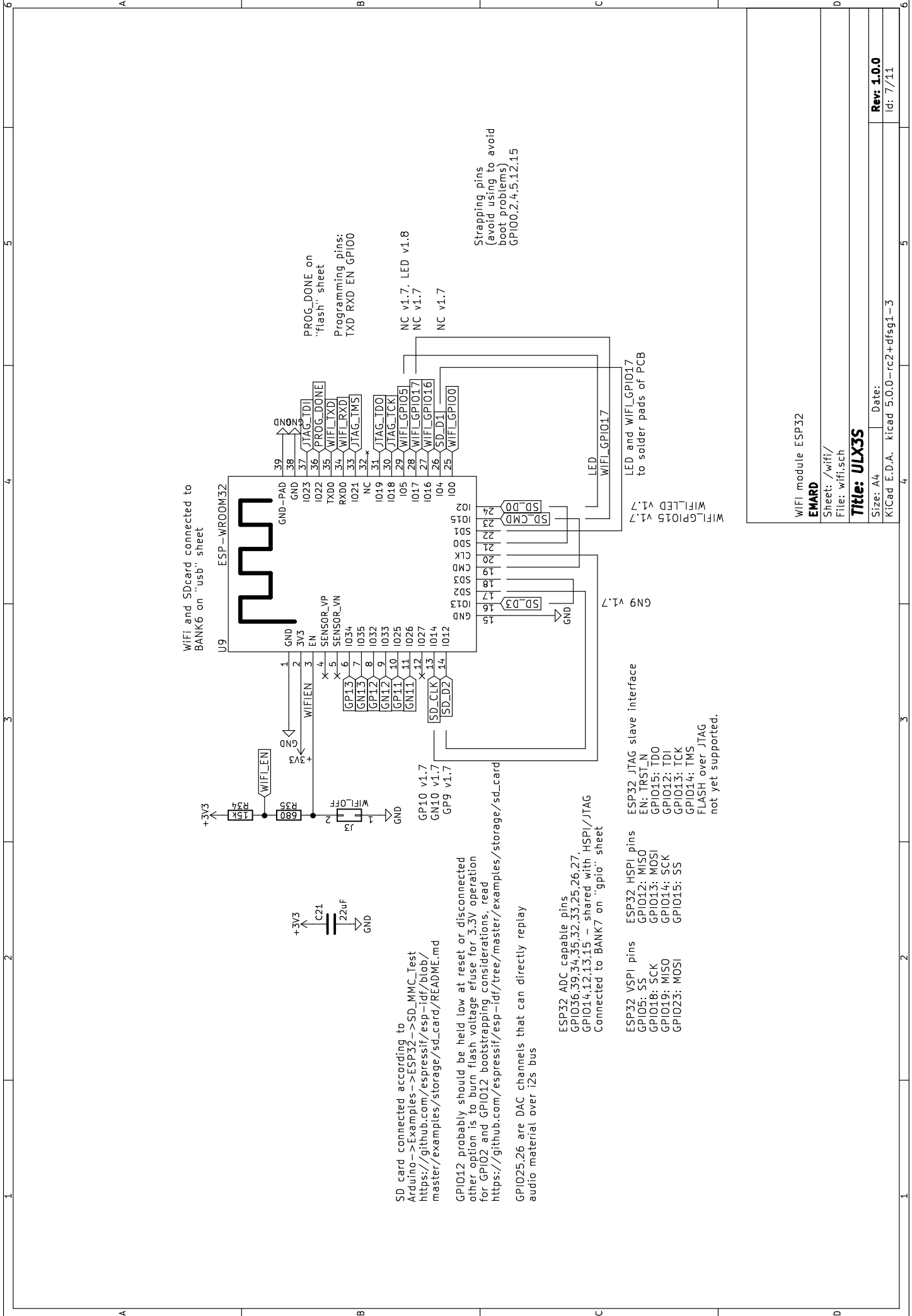
VNC2 programming pins:
TXD RXD TXDEN

USB serial and JTAG
EMARD
Sheet: /usb/
File: usb.sch

Title: ULX3S

Size: A4 Date:
KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3

Rev: 1.0.0
Id: 6/7/11



SD card connected according to Arduino -> Examples -> ESP32 -> SD_MMC_Test
https://github.com/esp8266/arduino-esp32-examples/tree/master/examples/storage/sd_card/README.md

GPIO12 probably should be held low at reset or disconnected other option is to burn flash voltage efuse for 3.3v operation for GPIO2 and GPIO12 bootstrapping considerations, read https://github.com/esp8266/arduino-esp32-examples/tree/master/examples/storage/sd_card/README.md

GPIO25,26 are DAC channels that can directly replay audio material over i2s bus

ESP32 ADC capable pins
 GPIO36,39,34,35,32,33,25,26,27,
 GPIO14,12,13,15 - shared with HSPi/JTAG
 Connected to BANK7 on 'gpio' sheet

ESP32 VSPi pins
 GPIO5: SS
 GPIO18: SCK
 GPIO19: MISO
 GPIO23: MOSI

ESP32 JTAG slave interface
 EN: TRST_N
 GPIO15: TDO
 GPIO12: TDI
 GPIO13: TCK
 GPIO14: TMS
 FLASH over JTAG
 not yet supported.

PROG_DONE on "flash" sheet
 Programming pins:
 TXD RXD EN GPIO0

NC v1.7 LED v1.8
 NC v1.7
 NC v1.7

Strapping pins (avoid using to avoid boot problems)
 GPIO0,2,4,5,12,15

LED and WIFL_GPIO17
 to solder pads of PCB

WiFi module ESP32

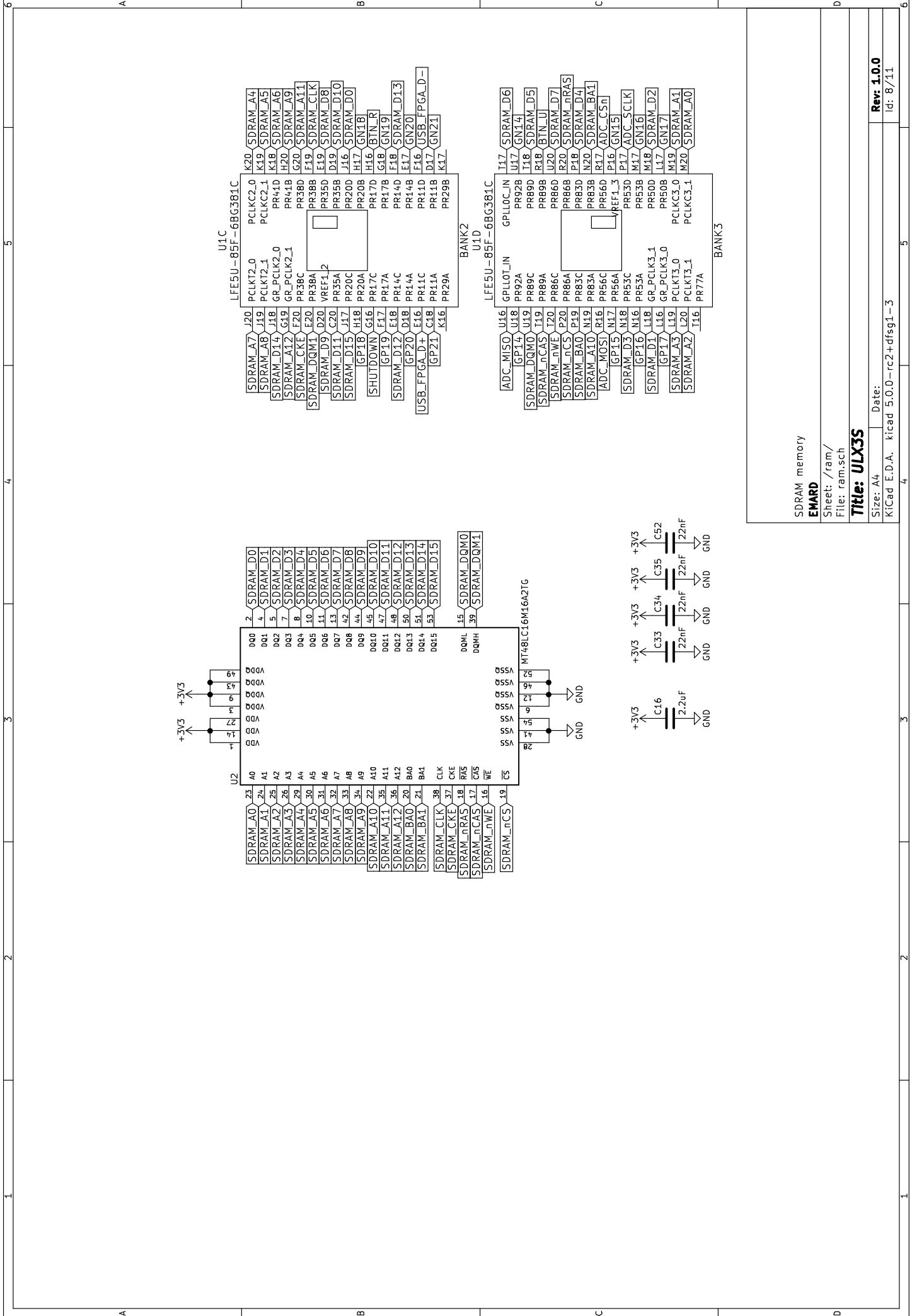
EMARD

Sheet: /wifi/
 File: wifi.sch

Title: **ULX3S**

Size: A4
 Date:
 KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3

Rev: **1.0.0**
 Id: 77/11

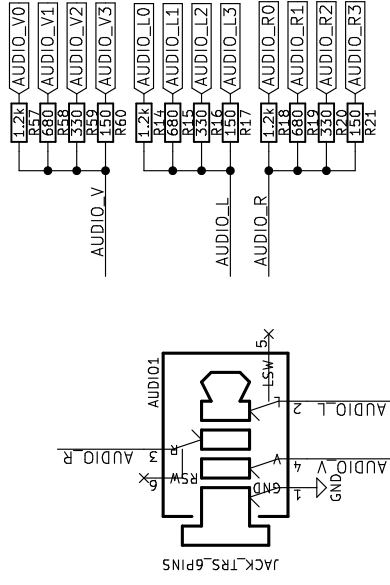


SDRAM memory
EMARD
 Sheet: /ram/
 File: ram.sch

Title: ULX3S

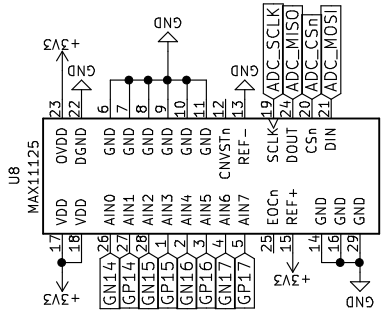
Size: A4 Date:
 KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3

Rev: 1.0.0
 Id: 8/11



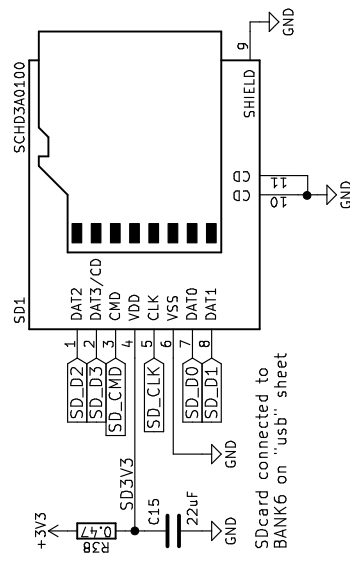
JACK pinout for SJ-43516-SMT-TR
<http://www.cui.com/product/resource/sj-4351x-smt-series.pdf>
 pin 1 - sleeve (GND)
 pin 2 - tip (left channel)
 pin 3 - ring1 (right channel)
 pin 4 - ring2 (video)
 pin 5 - tip switch
 pin 6 - ring1 switch

Audio connected to BANK7 on "gpio" sheet



ADC SPI connected to BANK3 of "ram" sheet

Analog audio and video
EMARD
 Sheet: /analog/
 File: analog.sch
Title: ULX3S
 Size: A4 Date:
 KICad: E.D.A. kicad 5.0.0-rc2+dfsg1-3
 Id: 9/11



minimum pins for compatible mode
SD_CLK, SD_CMD, SD_D0, SD_D3

SD card
EMARD
Sheet: /sdcard/
File: sdcard.sch
Title: ULX3S

Size: A4 Date:
KICad: E.D.A. kicad 5.0.0-rc2+dfsg1-3
Rev. 1.0.0
Id: 10/11



pullups for Master SPI (MSPI) required by TN1260: lattice ECP5 sysCONFIG guide p.6
 pullups to allow entering USER mode TN1260: lattice ECP5 sysCONFIG guide p.6, p.8, p.13

Deviation from TN1260 in pullup: values for BOM simplification. Correct values should be 10k and 1k but 15k and 1.2k are used.

For programming Flash thru JTAG see Lattice FPGA-TN-02050

CFG select Master SPI (MSPI) TN1260: lattice ECP5 sysCONFIG guide p.17

SPI flash
EMARD

Sheet: /flash/
 File: flash.sch

Title: ULX3S

Size: A4 Date:
 KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3

Rev. 1.0.0
 Id: 11/11