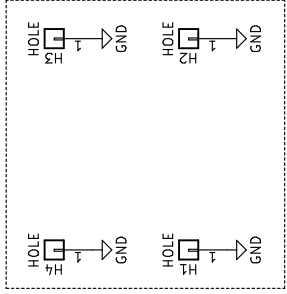
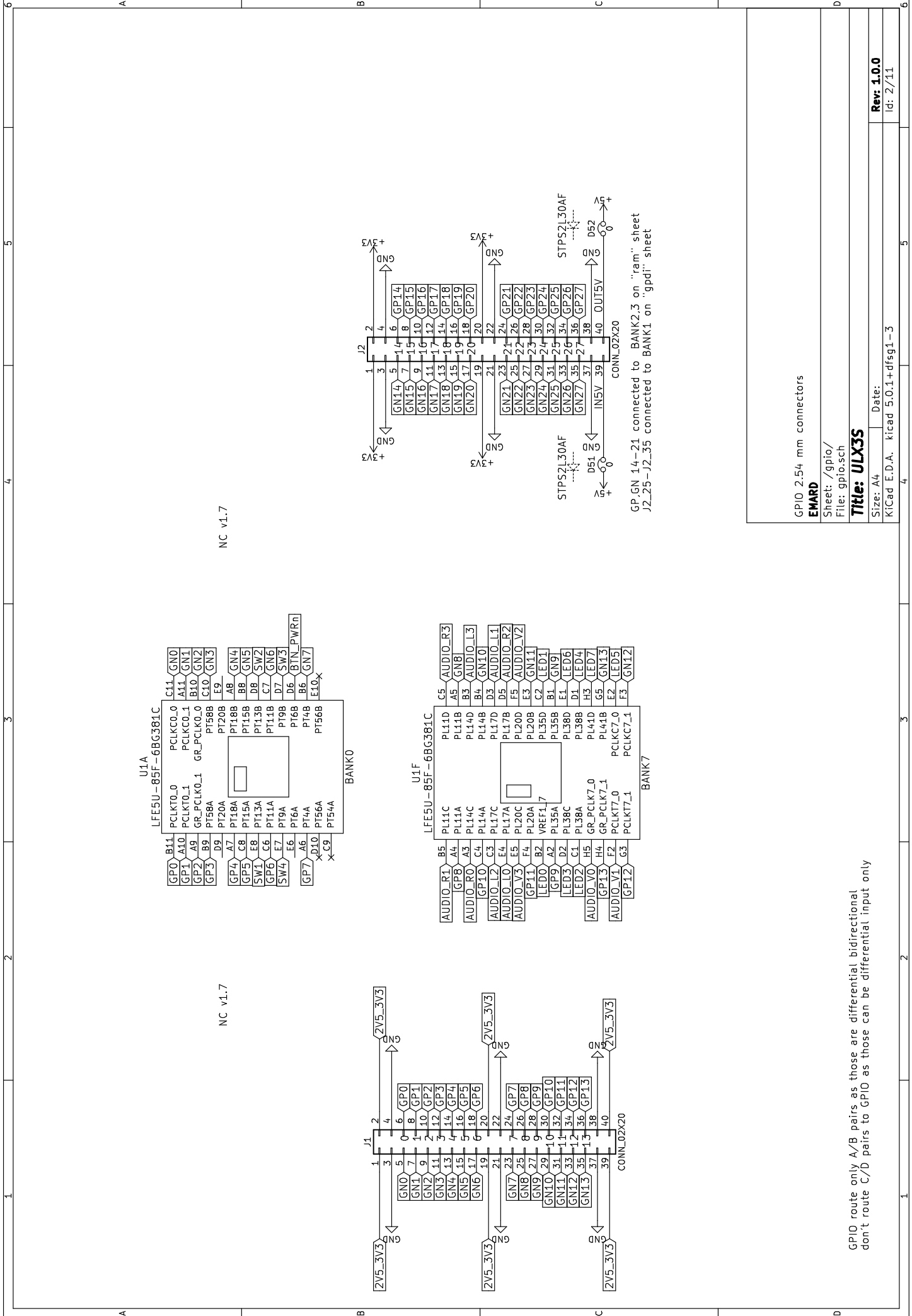


1	2	3	4	5	6																				
A	A	B	B	C	C																				
<p>click on mouse pointer arrow on top of right toolbar and double-click on sheet to open</p> <table border="1" data-bbox="989 78 1244 896"> <tr> <td>Sheet: power</td> <td>Sheet: usb</td> <td>Sheet: blinky</td> <td>Sheet: ram</td> <td>Sheet: 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: gpdi</td> <td>Sheet: analog</td> <td>Sheet: wifi</td> <td>Sheet: flash</td> </tr> <tr> <td>File: gpio.sch</td> <td>File: gpdi.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: gpdi	Sheet: analog	Sheet: wifi	Sheet: flash	File: gpio.sch	File: gpdi.sch	File: analog.sch	File: wifi.sch	File: flash.sch
Sheet: power	Sheet: usb	Sheet: blinky	Sheet: ram	Sheet: sdcard																					
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Sheet: gpio	Sheet: gpdi	Sheet: analog	Sheet: wifi	Sheet: flash																					
File: gpio.sch	File: gpdi.sch	File: analog.sch	File: wifi.sch	File: flash.sch																					
<table border="1" data-bbox="989 1377 1524 2161"> <tr> <td colspan="2">Root sheet</td> </tr> <tr> <td colspan="2"><b>EMARD</b></td> </tr> <tr> <td>Sheet: /</td> <td>File: ulx3s.sch</td> </tr> <tr> <td colspan="2"><b>Title: ULX3S</b></td> </tr> <tr> <td>Size: A4</td> <td>Date:</td> </tr> <tr> <td colspan="2">KiCad E.D.A. kicad 5.0.1+dfsg1-3</td> </tr> </table>						Root sheet		<b>EMARD</b>		Sheet: /	File: ulx3s.sch	<b>Title: ULX3S</b>		Size: A4	Date:	KiCad E.D.A. kicad 5.0.1+dfsg1-3									
Root sheet																									
<b>EMARD</b>																									
Sheet: /	File: ulx3s.sch																								
<b>Title: ULX3S</b>																									
Size: A4	Date:																								
KiCad E.D.A. kicad 5.0.1+dfsg1-3																									
A	A	B	B	C	C																				
1	2	3	4	5	6																				





NC v1.7

NC v1.7

GP,GN 14-21 connected to BANK2,3 on "ram" sheet  
 J2\_25-J2\_35 connected to BANK1 on "gpd1" sheet

GPIO 2.54 mm connectors

**EMARD**

Sheet: /gpio/  
 File: gpio.sch

**Title: ULX3S**

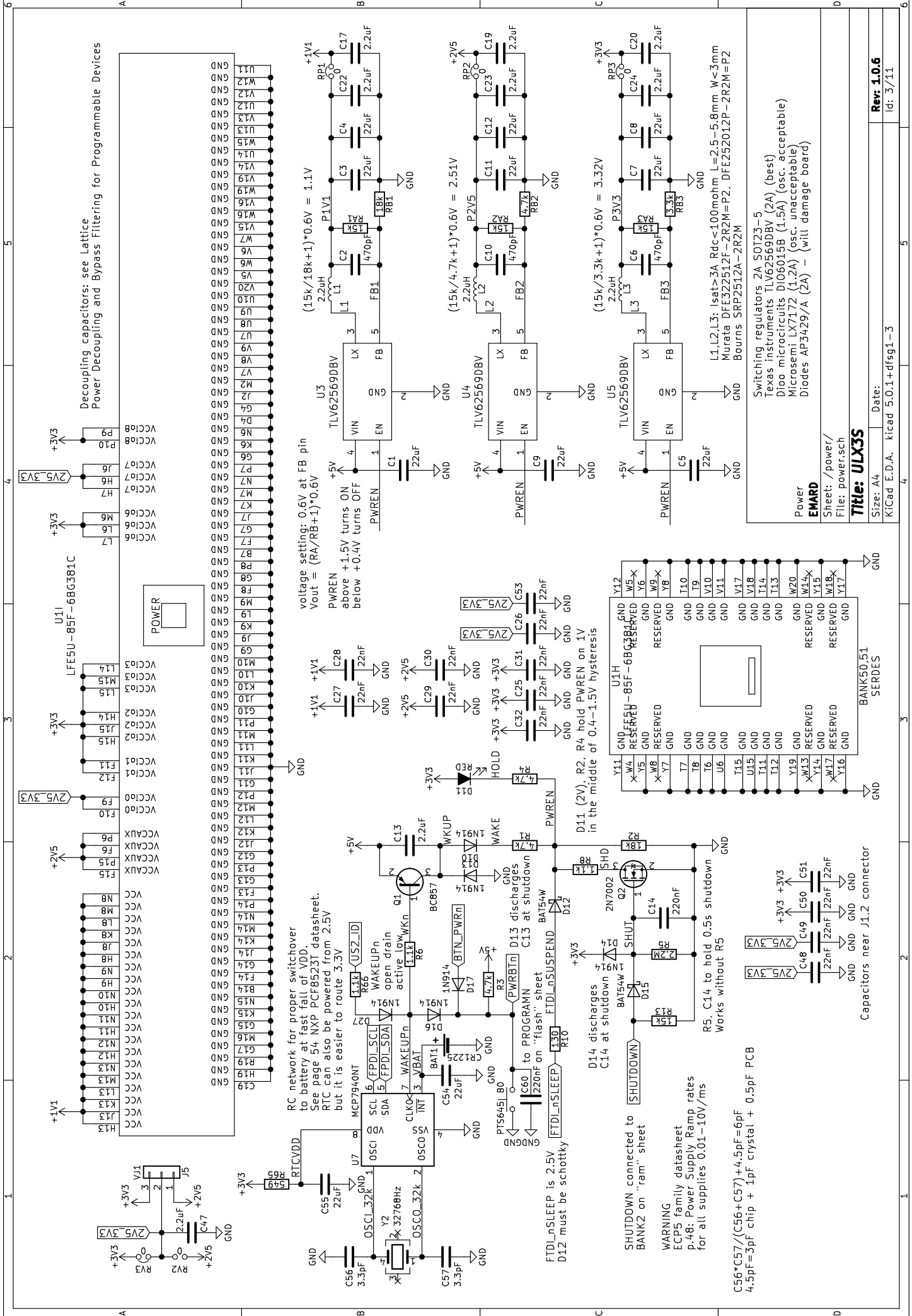
Size: A4 Date:

KiCad E.D.A. kicad 5.0.1+dfsg1-3

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

**Rev: 1.0.0**

Id: 2/11



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

voltage setting:  $0.6V$  at FB pin  
 $V_{out} = (R_A/R_B + 1) \cdot 0.6V$   
PWREN above  $+1.5V$  turns ON  
below  $+0.4V$  turns OFF

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

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

SHUTDOWN connected to  
BANK2 on "ram" sheet

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

$C56 * C57 / (C56 + C57) + 4.5pF = 6pF$   
 $4.5pF = 3pF$  chip +  $1pF$  crystal +  $0.5pF$  PCB

Capacitors near J1.2 connector

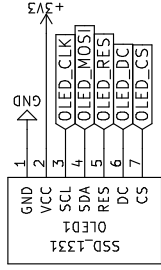
Switching regulators 2A\_S0123-5  
Texas Instruments TLV62569DBV (2A) (best)  
Dioo microcircuits D106015B (1.5A) (osc. acceptable)  
Microsemi LX7172 (1.2A) (osc. unacceptable)  
Diodes AP3429/A (2A) - (will damage board)

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

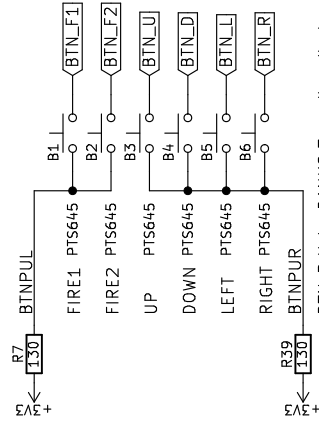
**Title: ULX3S**

Size: A4 Date:  
KiCad E.D.A. kicad 5.0.1+dfsg1-3  
Rev: 1.0.6  
Id: 3/11

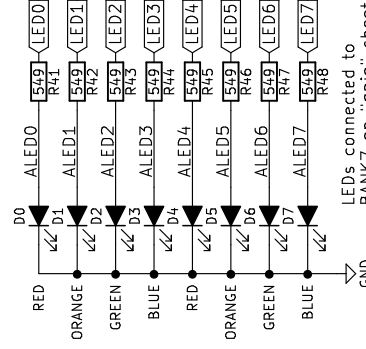
SSD1306 B/W or SSD1331 COLOR compatible OLED 0.96" or 1.3" PCB 14x14 units 1 unit = 2.54 mm



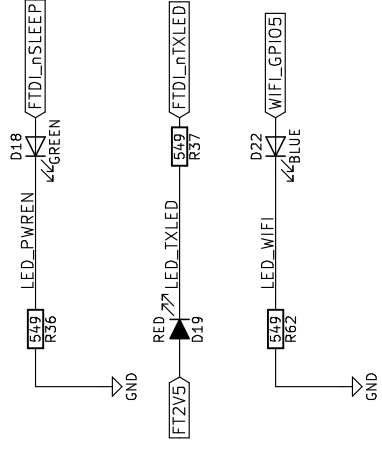
OLED connected to BANK6 on "usb" sheet



BTN\_R,U to BANK2,3 on "ram" sheet  
BTN\_F1,F2,D,L to BANK8 on "flash" sheet

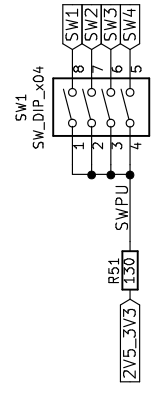


LEDs connected to BANK7 on "gpio" sheet



TXLED blinks when FPGA sends data to FTDI

GPIO2 on PCB v1.7



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

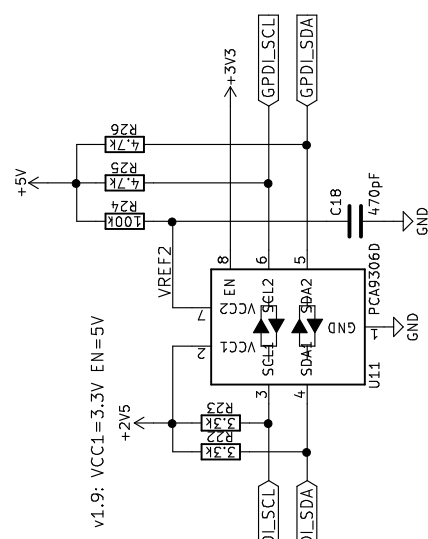
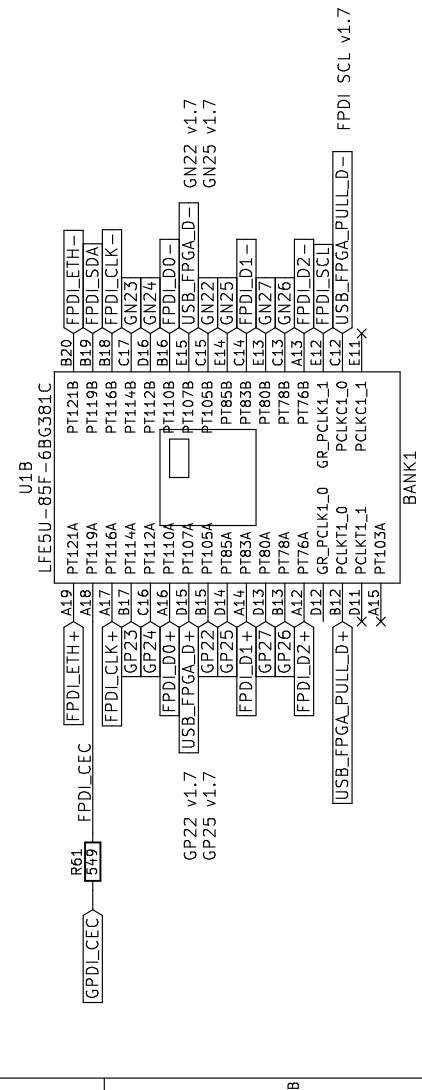
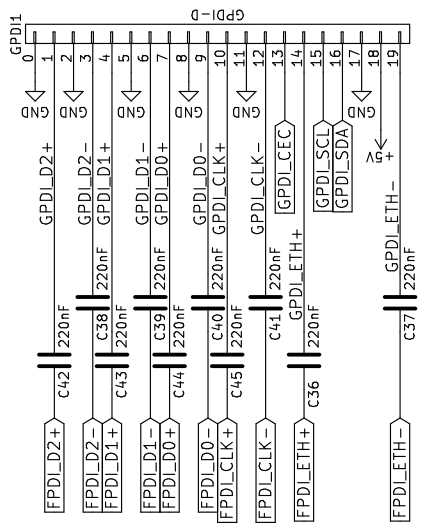
Sheet: /blinky/  
File: blinky.sch

Title: ULX3S

Size: A4 Date:

KiCad E.D.A. kicad 5.0.1+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.we-online.com/em/datasheet/685119134923.pdf

i2c shared with RTC  
 on "power" sheet

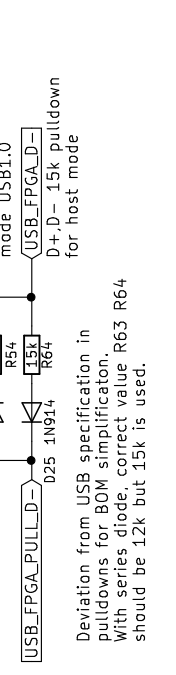
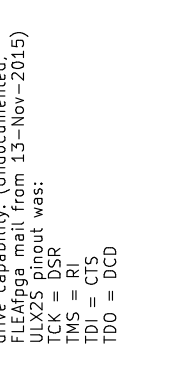
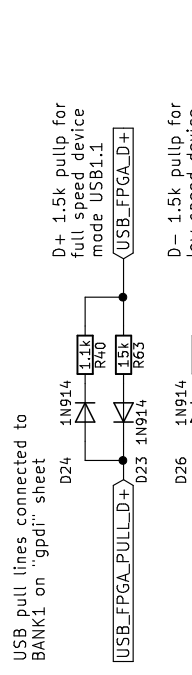
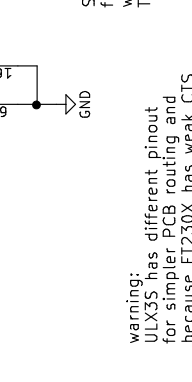
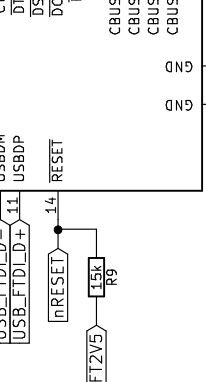
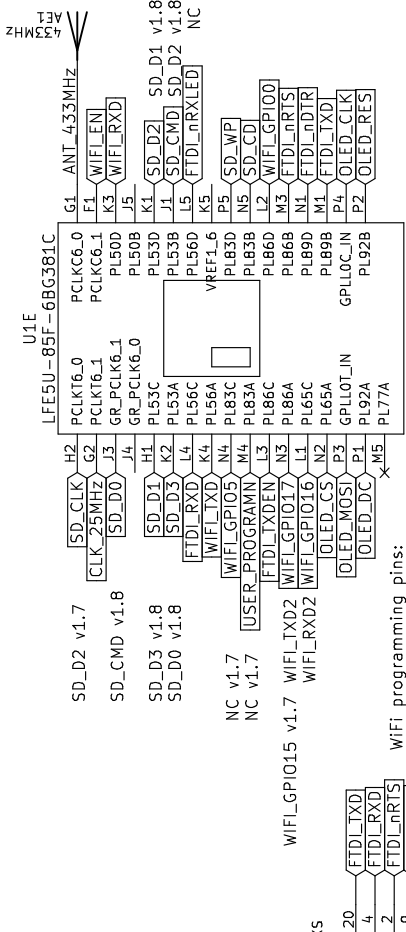
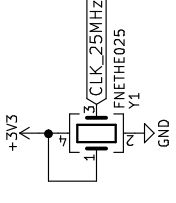
Digital Video and Ethernet  
 General Purpose Differential Interface  
**EMARD**

Sheet: /gpdi/  
 File: gpdi.sch

**Title: ULX3S**

Size: A4 Date:  
 KiCad E.D.A. kicad 5.0.1+dfsg1-3

**Rev: 1.0.2**  
 Id: 5/11



D8,D9: Schottky 2A/30V  
 Low drop V<sub>fmax</sub>=0.375V  
 Parts reduction: Only D8 is required.  
 D9 D51,D52 can be 1206  
 1A polyfuses or 0-ohm/2A jumpers

USB pull lines connected to BANK1 on "gpi1" sheet

Deviation from USB specification in pull-downs for BOM simplification. With series diode, correct value R63 R64 should be 12k but 15k is used.

warning:  
 ULX35 has different pinout for simpler PCB routing and because FT230X has weak CTS drive capability. (Undocumented. FLEAPga 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

WiFi programming pins:  
 TXD RXD RTS DTR  
 VNC2 programming pins:  
 TXD RXD TXDEN

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

USB serial and JTAG

EMARD

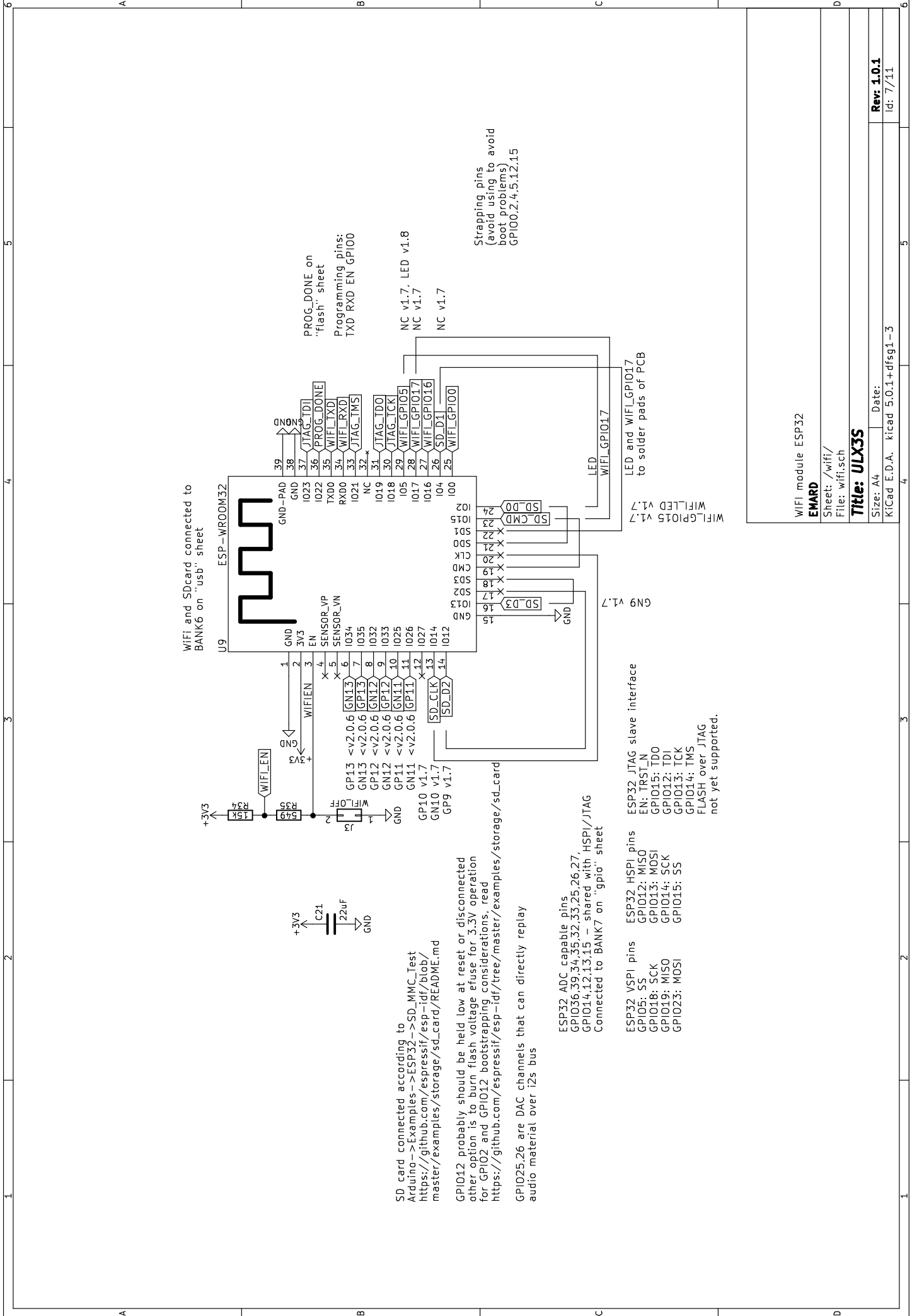
Sheet: /usb/  
 File: usb.sch

Title: ULX35

Size: A4 Date:

KiCad E.D.A. kicad 5.0.1+dfsg1-3

Rev: 1.0.3  
 Id: 6/7/11



WiFi and SDcard connected to BANK6 on "usb" sheet

PROG\_DONE on "flash" sheet  
Programming pins:  
TXD RXD EN GPIO0

SD card connected according to Arduino -> Examples -> ESP32 -> SD\_MMC\_Test  
[https://github.com/espressif/esp-idf/blob/master/examples/storage/sd\\_card/README.md](https://github.com/espressif/esp-idf/blob/master/examples/storage/sd_card/README.md)

GPIO12 probably should be held low at reset or disconnected other option is to burn flash voltage fuse for 3.3v operation for GPIO2 and GPIO12 bootstrapping considerations, read [https://github.com/espressif/esp-idf/tree/master/examples/storage/sd\\_card](https://github.com/espressif/esp-idf/tree/master/examples/storage/sd_card)

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.

LED and WIFI\_GPIO17  
to solder pads of PCB

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

WiFi module ESP32

EMARD

Sheet: /wifi/  
File: wifi.sch

Title: ULX3S

Size: A4 Date:

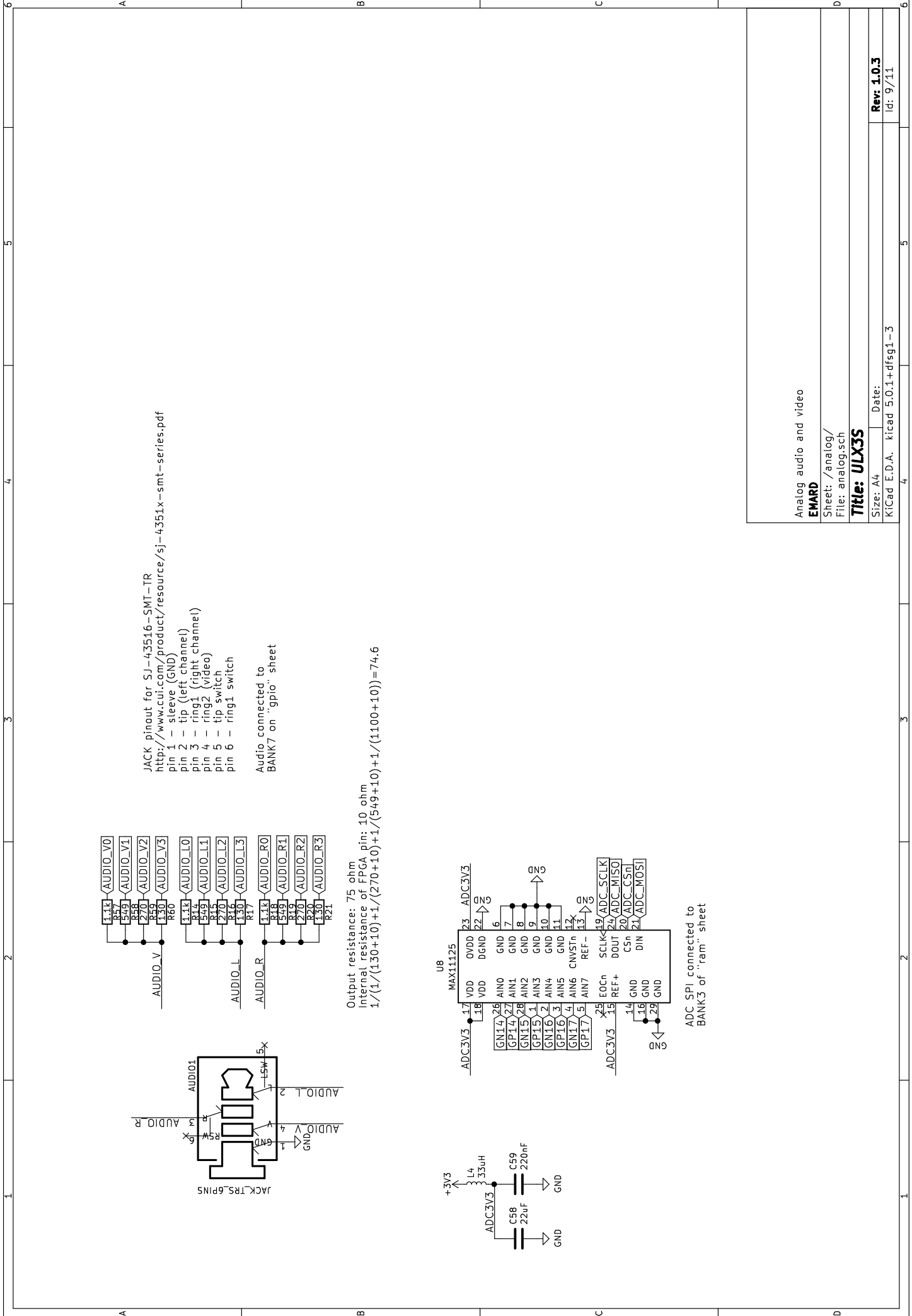
KiCad E.D.A. kicad 5.0.1+dfsg1-3

Rev: 1.0.1

Id: 7/7/11







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

Output resistance: 75 ohm  
 Internal resistance of FPGA pin: 10 ohm  
 $1/(1/(130+10)+1/(270+10)+1/(549+10)+1/(1100+10))=74.6$

ADC SPI connected to BANK3 of "ram" sheet

Analog audio and video

EMARD

Sheet: /analog/

File: analog.sch

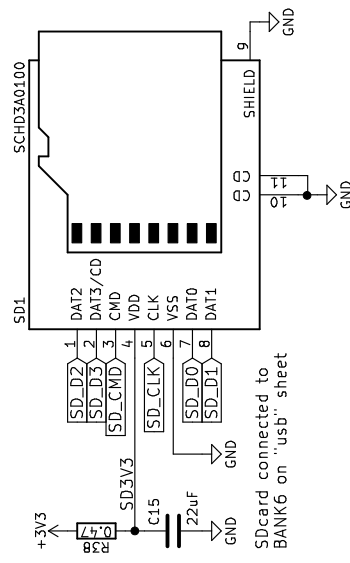
Title: ULX3S

Size: A4 Date:

KiCad E.D.A. kicad 5.0.1+dfsg1-3

Rev: 1.0.3

Id: 9/11

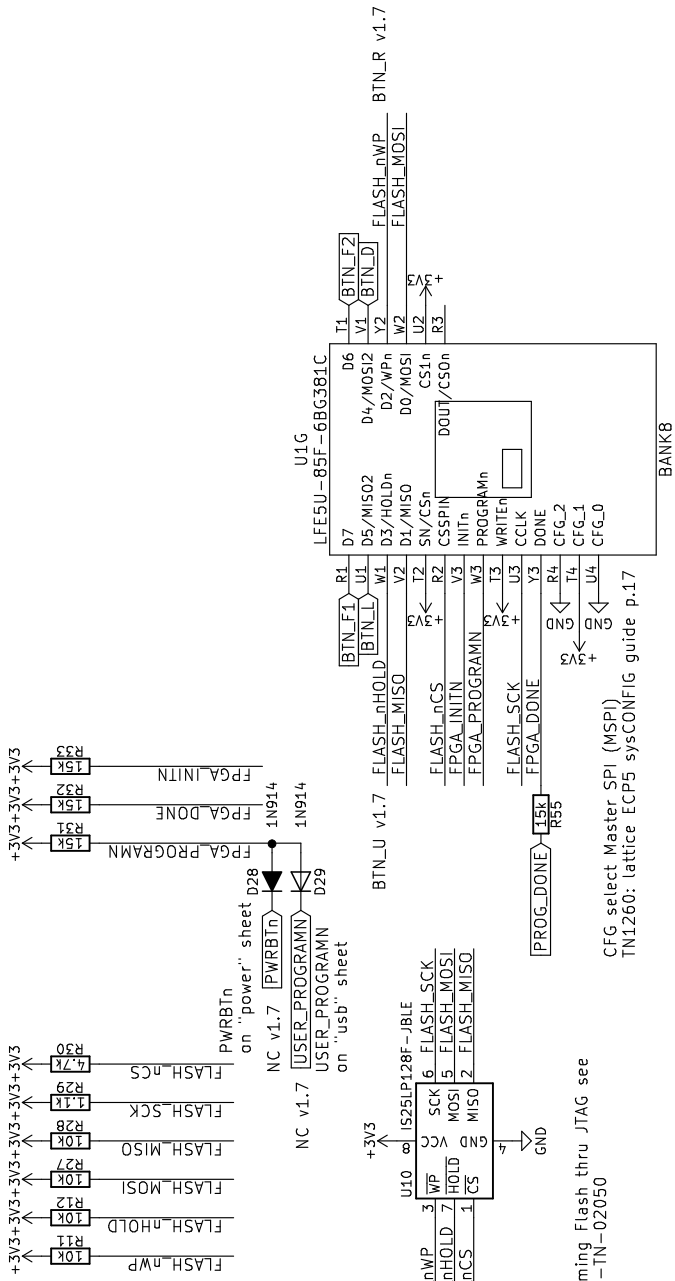


minimum pins for compatible mode  
SD\_CLK, SD\_CMD, SD\_D0, SD\_D3

SD card  
**EMARD**  
 Sheet: /sdcard/  
 File: sdcard.sch  
**Title: ULX3S**  
 Size: A4 Date:  
 KiCad E.D.A. kicad 5.0.1+dfsg1-3  
 Id: 10/11

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

Deviation from TN1260 in pullup:  
 values for BOM simplification.  
 Correct values should be 1k  
 but 1.1k is 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 5.0.1+dfsg1-3