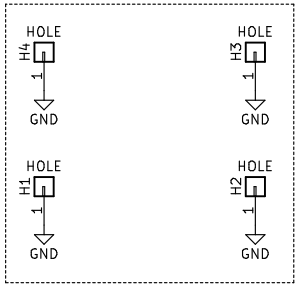


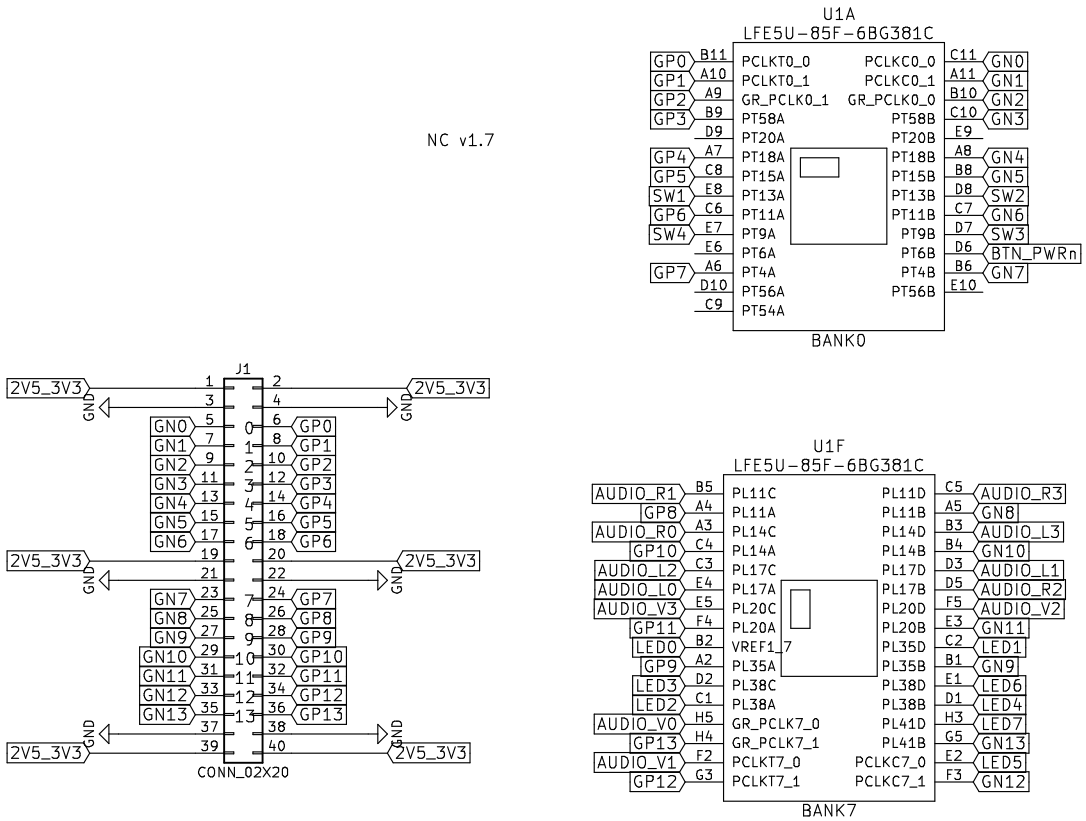
click on mouse pointer arrow on top of right toolbar
and double-click on sheet to open

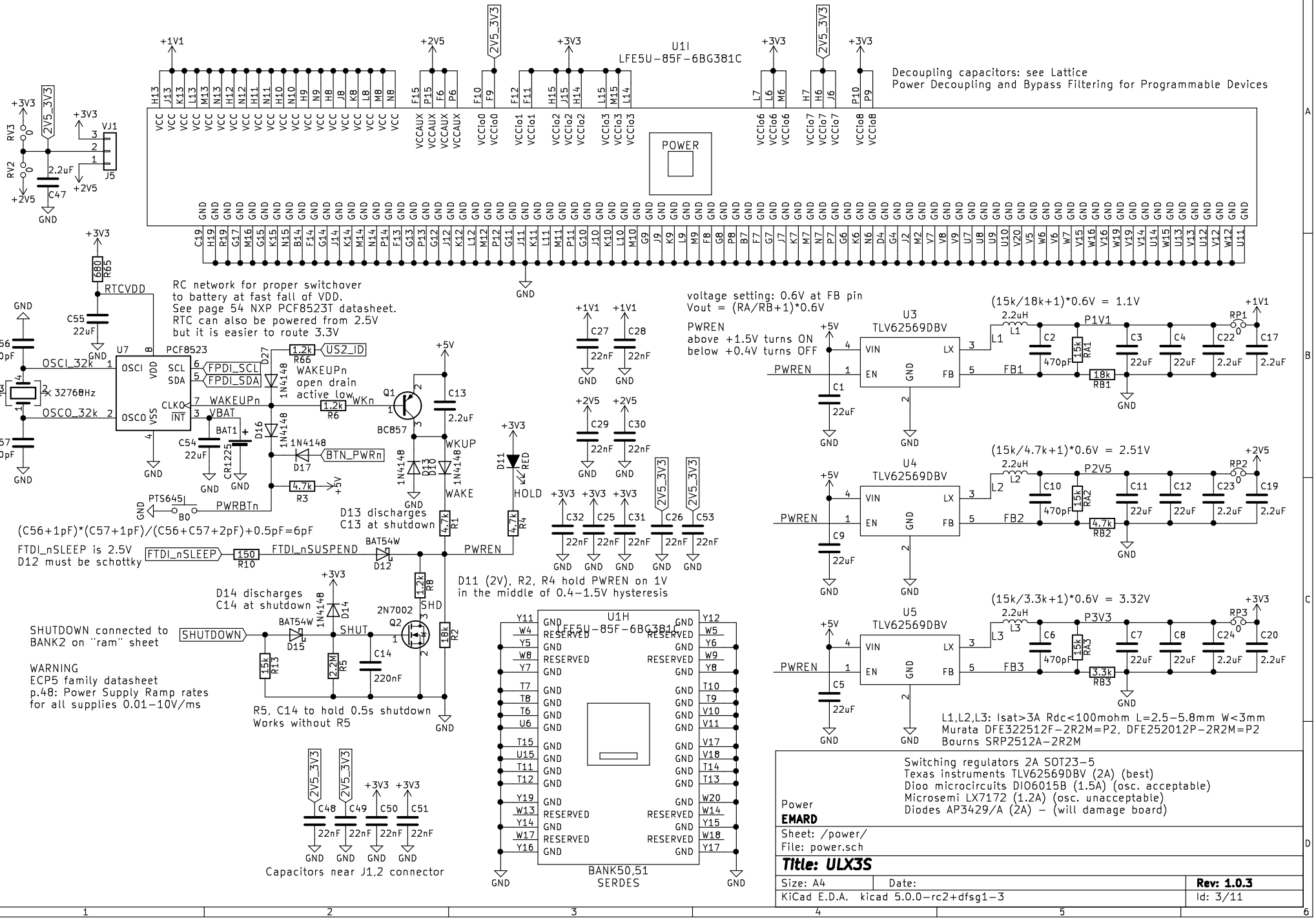
Sheet: power	Sheet: usb	Sheet: blinkey	Sheet: ram	Sheet: sdcard
File: power.sch	File: usb.sch	File: blinkey.sch	File: ram.sch	File: sdcard.sch
Sheet: gpio	**Sheet: gpdi**	**Sheet: analog**	**Sheet: wifi**	**Sheet: flash**
File: gpio.sch	File: gpdi.sch	File: analog.sch	File: wifi.sch	File: flash.sch

Root sheet
EMARD
Sheet: /
File: ulx3s.sch

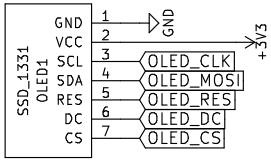
Title: ULX3S

Size: A4	Date:	**Rev: 2.0**
KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3		Id: 1/11

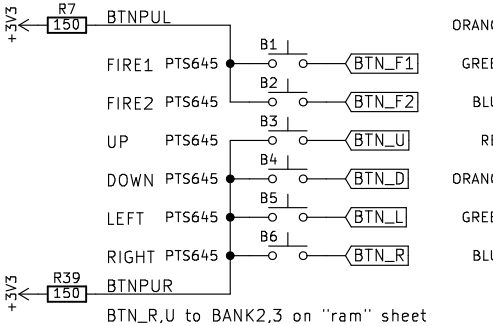

U1A
LFE5U-85F-6BG381C
GP0 B11 PCLKT0_0
GP1 A10 PCLKT0_1
GP2 A9 GR_PCLK0_1
GP3 B9 PT58A
D9 PT20A
GP4 A7 PT18A
GP5 C8 PT15A
SW1 E8 PT13A
GP6 C6 PT11A
SW4 E7 PT9A
E6 PT6A
GP7 A6 PT4A
D10 PT56A
C9 PT54A
PCLKC0_0 C11 GN0
PCLKC0_1 A11 GN1
GR_PCLK0_0 B10 GN2
PT58B C10 GN3
PT20B E9
PT18B A8 GN4
PT15B B8 GN5
PT13B D8 SW2
PT11B C7 GN6
PT9B D7 SW3
PT6B D6 BTN_PWRn
PT4B B6 GN7
PT56B E10
BANK0
NC v1.7
NC v1.7
J1
2V5_3V3
GND
GN0 GN1 GN2 GN3 GN4 GN5 GN6
GP0 GP1 GP2 GP3 GP4 GP5 GP6
GN7 GN8 GN9 GN10 GN11 GN12 GN13
GP7 GP8 GP9 GP10 GP11 GP12 GP13
CONN_02X20
U1F
LFE5U-85F-6BG381C
AUDIO_R1 B5 PL11C
GP8 A4 PL11A
AUDIO_R0 A3 PL14C
GP10 C4 PL14A
AUDIO_L2 C3 PL17C
AUDIO_L0 E4 PL17A
AUDIO_V3 E5 PL20C
GP11 F4 PL20A
LED0 B2 VREF1_7
GP9 A2 PL35A
LED3 D2 PL38C
LED2 C1 PL38A
AUDIO_V0 H5 GR_PCLK7_0
GP13 H4 GR_PCLK7_1
AUDIO_V1 F2 PCLKT7_0
GP12 G3 PCLKT7_1
PL11D C5 AUDIO_R3
PL11B A5 GN8
PL14D B3 AUDIO_L3
PL14B B4 GN10
PL17D D3 AUDIO_L1
PL17B D5 AUDIO_R2
PL20D F5 AUDIO_V2
PL20B E3 GN11
PL35D C2 LED1
PL35B B1 GN9
PL38D E1 LED6
PL38B D1 LED4
PL41D H3 LED7
PL41B G5 GN13
PCLKC7_0 E2 LED5
PCLKC7_1 F3 GN12
BANK7
J2
+3V3
GND
GN14 GN15 GN16 GN17 GN18 GN19 GN20
GP14 GP15 GP16 GP17 GP18 GP19 GP20
GN21 GN22 GN23 GN24 GN25 GN26 GN27
GP21 GP22 GP23 GP24 GP25 GP26 GP27
STPS2L30AF
RD51
RD52
IN5V
OUT5V
+5V
CONN_02X20
GP,GN 14-21 connected to BANK2,3 on "ram" sheet
J2_25-J2_35 connected to BANK1 on "gpdi" sheet
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:
Rev: 1.0.0
KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3
Id: 2/11


U1I
LFE5U-85F-6BG381C
POWER
Decoupling capacitors: see Lattice
Power Decoupling and Bypass Filtering for Programmable Devices
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
WAKEUPn
open drain
active low
D13 discharges
C13 at shutdown
(C56+1pF)*(C57+1pF)/(C56+C57+2pF)+0.5pF=6pF
FTDI_nSLEEP is 2.5V
D12 must be schottky
D11 (2V). R2, R4 hold PWREN on 1V
in the middle of 0.4–1.5V hysteresis
D14 discharges
C14 at shutdown
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
Capacitors near J1,2 connector
BANK50,51
SERDES
voltage setting: 0.6V at FB pin
Vout = (RA/RB+1)*0.6V
PWREN
above +1.5V turns ON
below +0.4V turns OFF
(15k/18k+1)*0.6V = 1.1V
(15k/4.7k+1)*0.6V = 2.51V
(15k/3.3k+1)*0.6V = 3.32V
L1,L2,L3: Isat>3A Rdc<100mohm L=2.5–5.8mm W<3mm
Murata DFE322512F-2R2M=P2, DFE252012P-2R2M=P2
Bourns SRP2512A-2R2M
Switching regulators 2A SOT23-5
Texas instruments TLV62569DBV (2A) (best)
Dioo microcircuits DIO6015B (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:
Rev: 1.0.3
KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3
Id: 3/11

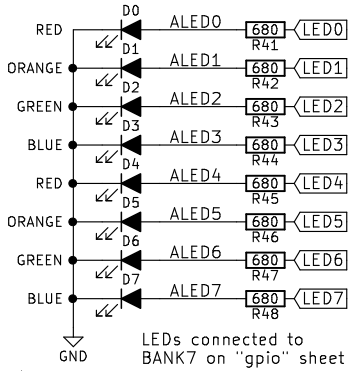
SSD1306 B/W or SSD1331 COLOR
compatible OLED 0.96" or 1.3" PCB
14x14 units
1 unit = 2.54 mm



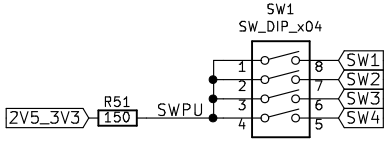
OLED connected to
BANK6 on "usb" sheet



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

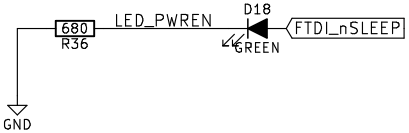


LEDs connected to
BANK7 on "gpio" sheet

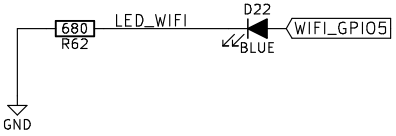


DIP switch connected to
BANK0 on 'gpio' sheet

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



TXLED blinks when FPGA sends data to FTDI

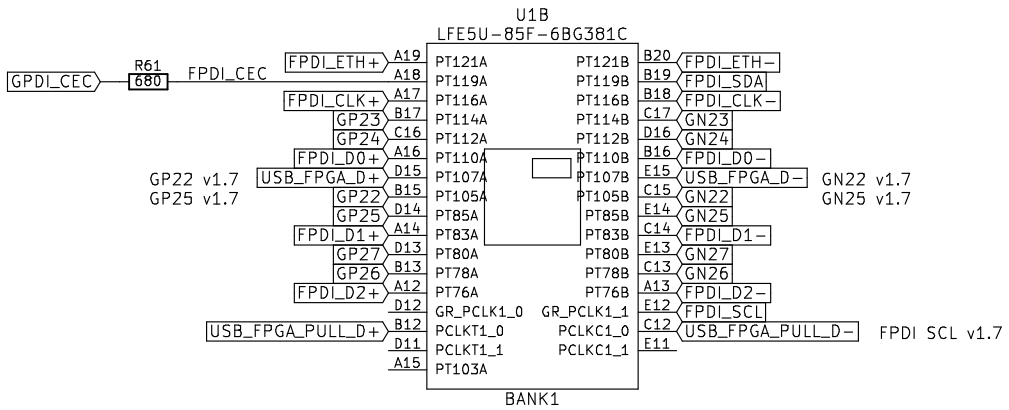


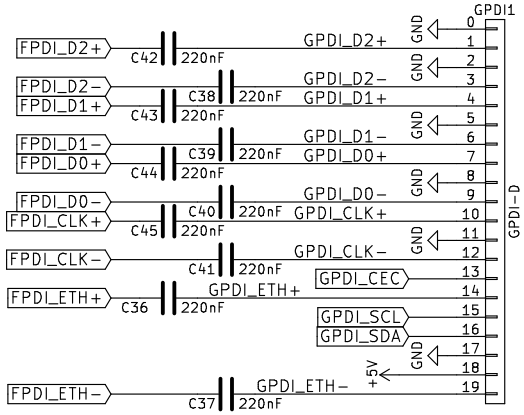
GPIO2 on PCB v1.7

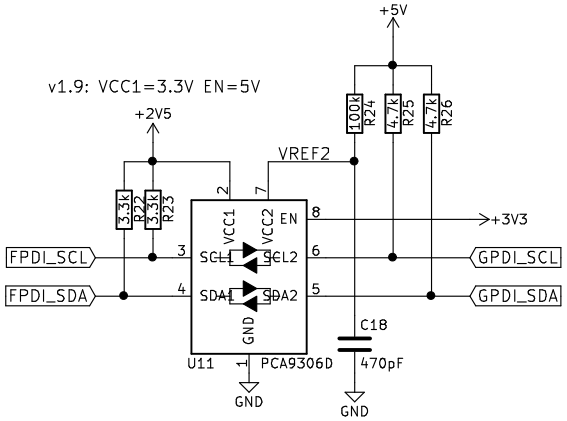
Buttons, LEDs, OLED display
EMARD
Sheet: /blinkey/
File: blinkey.sch

Title: ULX3S

Size: A4	Date:	**Rev: 1.0.0**
KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3		Id: 4/11







i2c shared with RTC
on "power" sheet

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

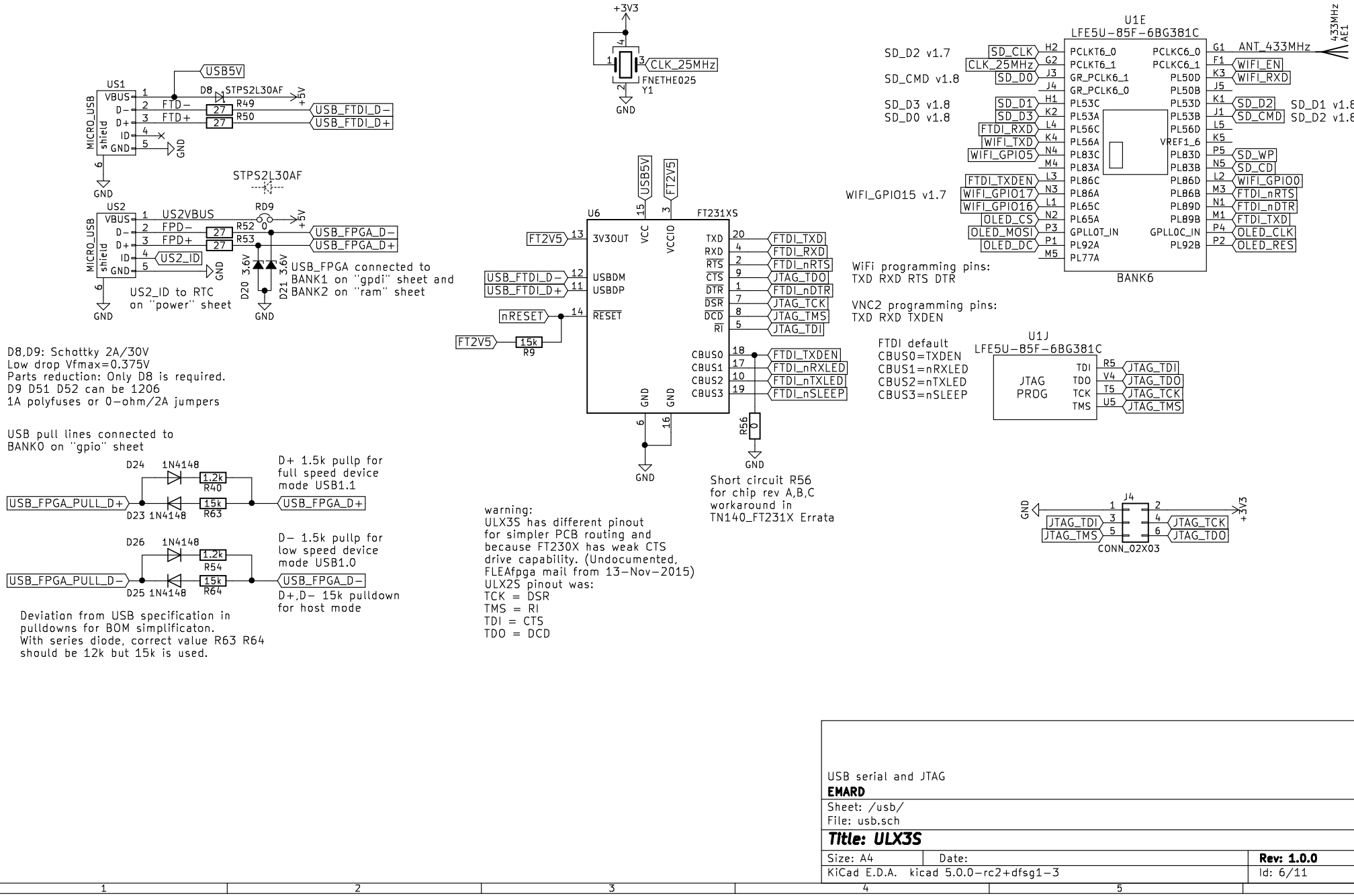
PCB v1.7 and v1.8 accept
mouser PN: 538-47151-1001 (Molex)
https://www.molex.com/pdm_docs/sd/471511001_sd.pdf
mouser PN: 710-685119134923 (Wurth)
https://katalog.we-online.com/em/datasheet/685119134923.pdf

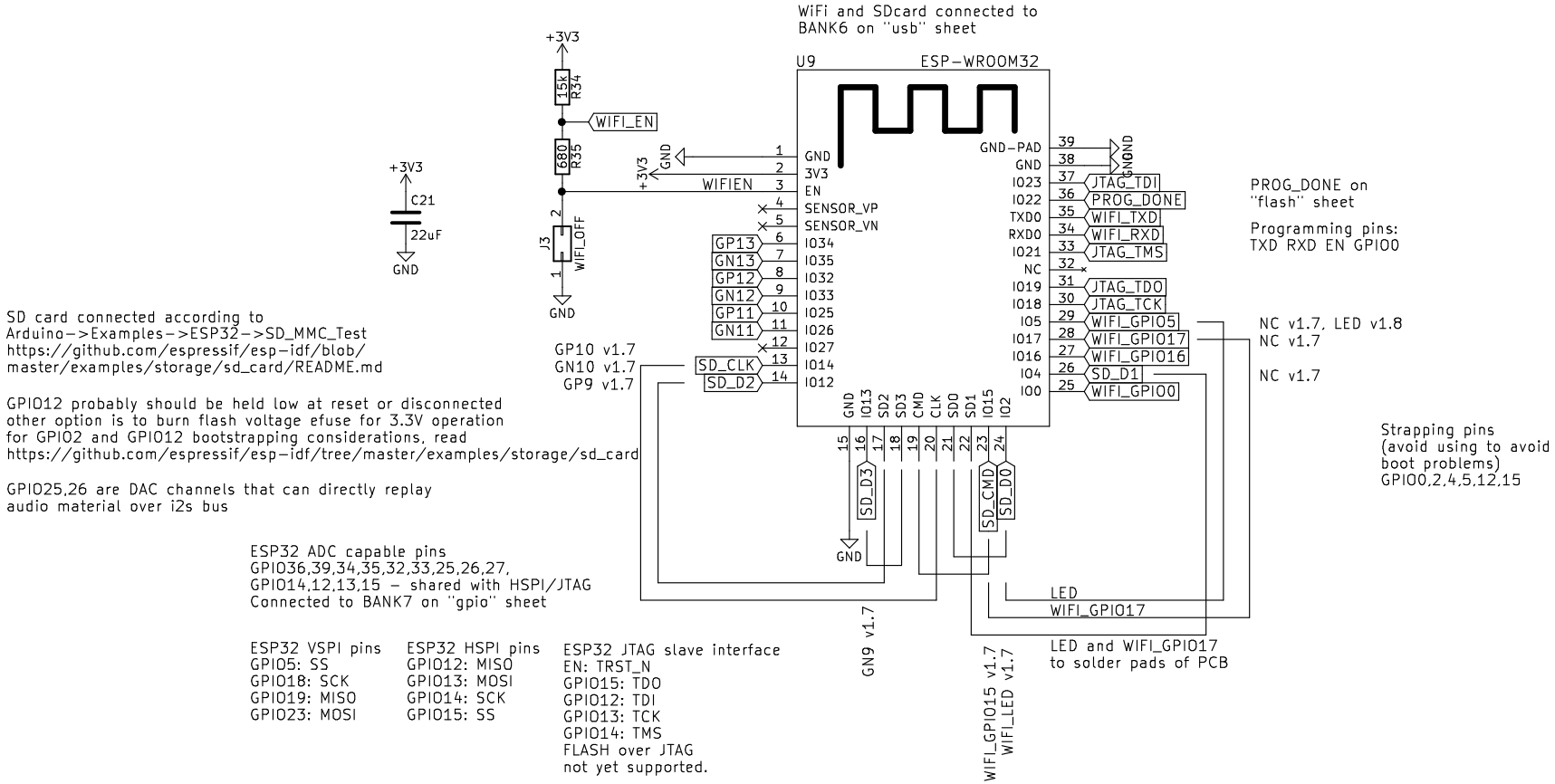
Digital Video and Ethernet
General Purpose Differential Interface
EMARD

Sheet: /gpdi/
File: gpdi.sch

Title: ULX3S

Size: A4	Date:	**Rev: 1.0.1**
KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3		Id: 5/11


USB5V
US1
MICRO_USB
shield
VBUS
D−
D+
ID
GND
FTD−
FTD+
D8
STPS2L30AF
+5V
R49
R50
27
USB_FTDI_D−
USB_FTDI_D+
STPS2L30AF
US2
US2VBUS
FPD−
FPD+
US2_ID
RD9
R52
R53
0
USB_FPGA_D−
USB_FPGA_D+
D20 3.6V
D21 3.6V
US2_ID to RTC
on "power" sheet
USB_FPGA connected to
BANK1 on "gpdi" sheet and
BANK2 on "ram" sheet
D8,D9: Schottky 2A/30V
Low drop Vfmax=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
BANK0 on "gpio" sheet
D24
1N4148
1.2k
R40
15k
R63
USB_FPGA_PULL_D+
USB_FPGA_D+
D+ 1.5k pullp for
full speed device
mode USB1.1
D26
R54
R64
USB_FPGA_PULL_D−
USB_FPGA_D−
D− 1.5k pullp for
low speed device
mode USB1.0
D+,D− 15k pulldown
for host mode
Deviation from USB specification in
pulldowns for BOM simplificaton.
With series diode, correct value R63 R64
should be 12k but 15k is used.
+3V3
CLK_25MHz
FNETHE025
Y1
U6
FT231XS
3V3OUT
VCC
VCCIO
USBDM
USBDP
RESET
TXD
RXD
RTS
CTS
DTR
DSR
DCD
RI
CBUS0
CBUS1
CBUS2
CBUS3
FTDI_TXD
FTDI_RXD
FTDI_nRTS
JTAG_TDO
FTDI_nDTR
JTAG_TCK
JTAG_TMS
JTAG_TDI
FTDI_TXDEN
FTDI_nRXLED
FTDI_nTXLED
FTDI_nSLEEP
nRESET
R9
R56
Short circuit R56
for chip rev A,B,C
workaround in
TN140_FT231X Errata
warning:
ULX3S has different pinout
for simpler PCB routing and
because FT230X has weak CTS
drive capability. (Undocumented,
FLEAfpga mail from 13−Nov−2015)
ULX2S pinout was:
TCK = DSR
TMS = RI
TDI = CTS
TDO = DCD
U1E
LFE5U−85F−6BG381C
BANK6
SD_D2 v1.7
SD_CMD v1.8
SD_D3 v1.8
SD_D0 v1.8
WIFI_GPIO15 v1.7
SD_CLK
CLK_25MHz
SD_D0
SD_D1
SD_D3
FTDI_RXD
WIFI_TXD
WIFI_GPIO5
FTDI_TXDEN
WIFI_GPIO17
WIFI_GPIO16
OLED_CS
OLED_MOSI
OLED_DC
PCLKT6_0
PCLKT6_1
GR_PCLK6_1
GR_PCLK6_0
PL53C
PL53A
PL56C
PL56A
PL83C
PL83A
PL86C
PL86A
PL65C
PL65A
GPLLOT_IN
PL92A
PL77A
PCLKC6_0
PCLKC6_1
PL50D
PL50B
PL53D
PL53B
PL56D
VREF1_6
PL83D
PL83B
PL86D
PL86B
PL89D
PL89B
GPLLOC_IN
PL92B
ANT_433MHz
433MHz
AE1
WIFI_EN
WIFI_RXD
SD_D2
SD_CMD
SD_WP
SD_CD
WIFI_GPIO0
FTDI_nRTS
FTDI_nDTR
FTDI_TXD
OLED_CLK
OLED_RES
SD_D1 v1.8
SD_D2 v1.8 SD_CLK v1.7
WiFi programming pins:
TXD RXD RTS DTR
VNC2 programming pins:
TXD RXD TXDEN
FTDI default
CBUS0=TXDEN
CBUS1=nRXLED
CBUS2=nTXLED
CBUS3=nSLEEP
U1J
LFE5U−85F−6BG381C
JTAG
PROG
TDI
TDO
TCK
TMS
R5
V4
T5
U5
J4
CONN_02X03
USB serial and JTAG
EMARD
Sheet: /usb/
File: usb.sch
Title: ULX3S
Size: A4
Date:
Rev: 1.0.0
KiCad E.D.A. kicad 5.0.0−rc2+dfsg1−3
Id: 6/11



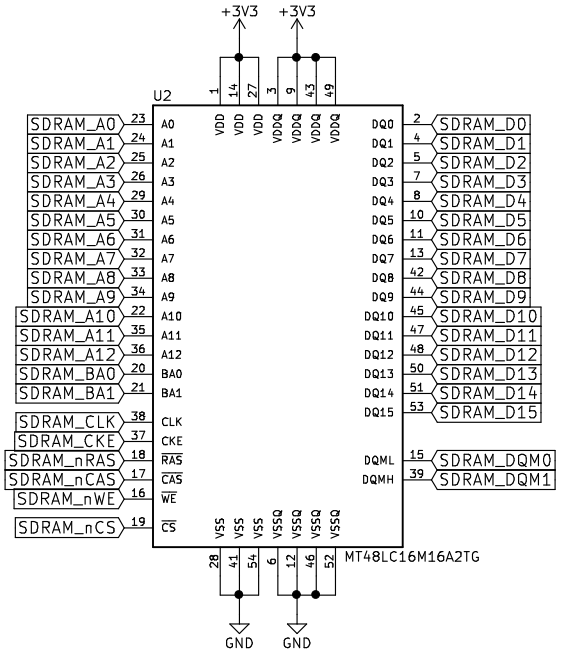
WIFI module ESP32

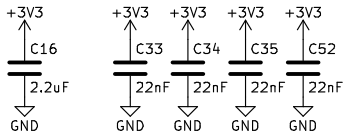
EMARD

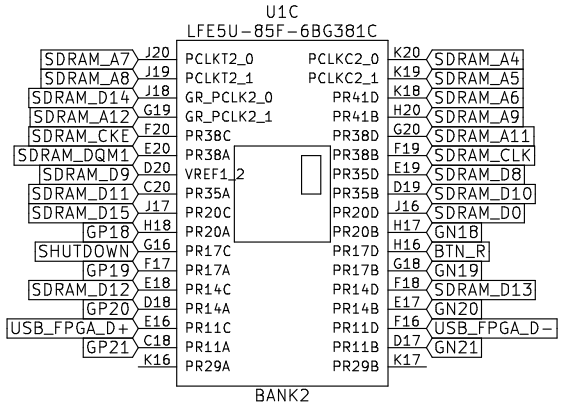
Sheet: /wifi/
File: wifi.sch

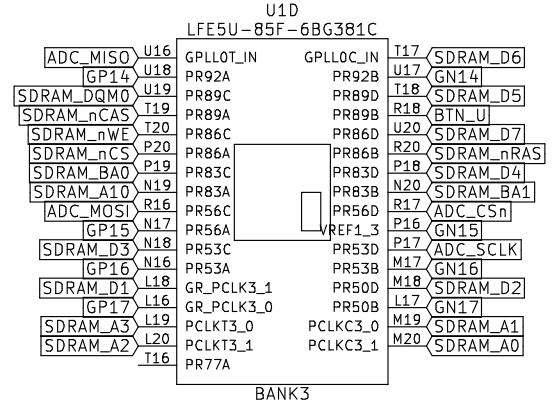
Title: ULX3S

Size: A4	Date:	**Rev: 1.0.0**
KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3		Id: 7/11









SDRAM memory

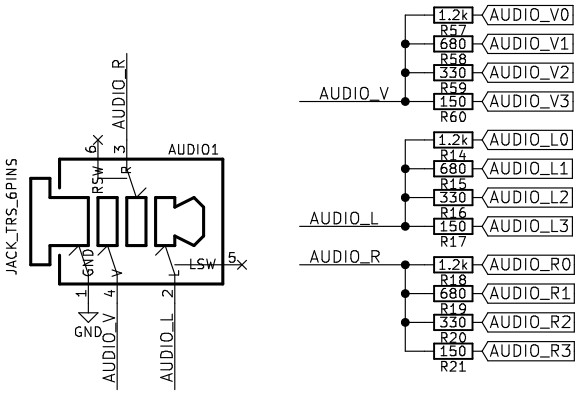
EMARD

Sheet: /ram/

File: ram.sch

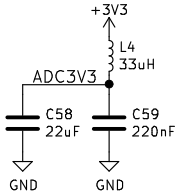
Title: ULX3S

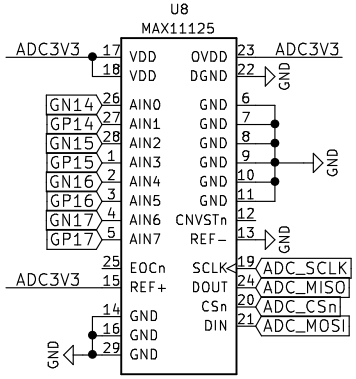
Size: A4	Date:	**Rev: 1.0.0**
KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3		Id: 8/11



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





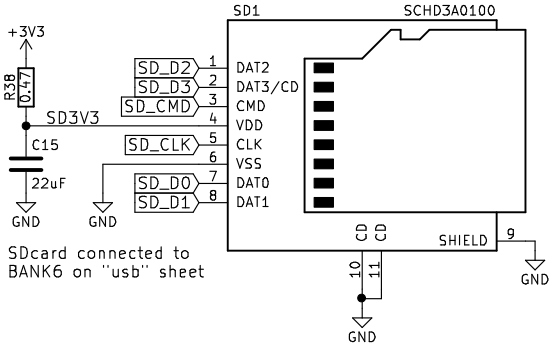
ADC SPI connected to
BANK3 of "ram" sheet

Analog audio and video
EMARD

Sheet: /analog/
File: analog.sch

Title: ULX3S

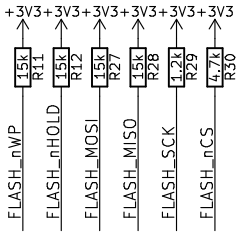
Size: A4	Date:	**Rev: 1.0.2**
KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3		Id: 9/11



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

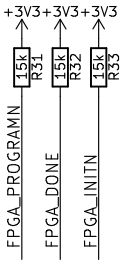
SD card **EMARD**		
Sheet: /sdcard/ File: sdcard.sch		
Title: ULX3S		
Size: A4	Date:	**Rev: 1.0.0**
KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3		Id: 10/11

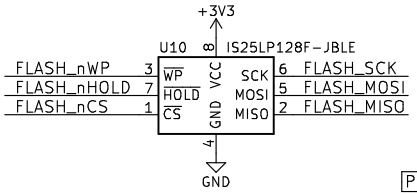
pullups for Master SPI (MSPI) required by
TN1260: lattice ECP5 sysCONFIG guide p.6



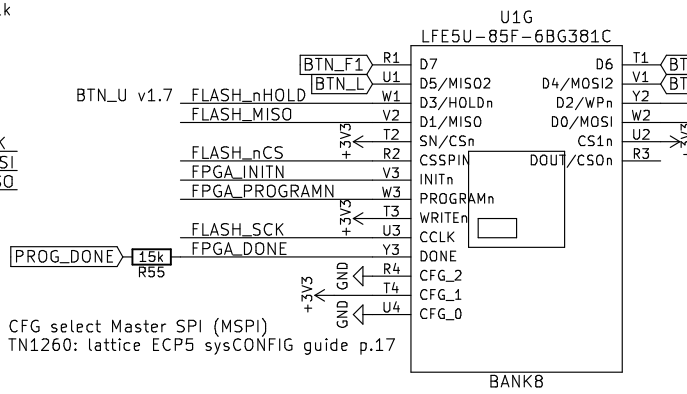
Deviation from TN1260 in pullup:
values for BOM simplification.
Correct values should be 10k and 1k
but 15k and 1.2k are used.

pullups to allow entering USER mode
TN1260: lattice ECP5 sysCONFIG guide p.6, p.8, p.13





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: | **Rev: 1.0.0**
KiCad E.D.A. kicad 5.0.0-rc2+dfsg1-3 | Id: 11/11