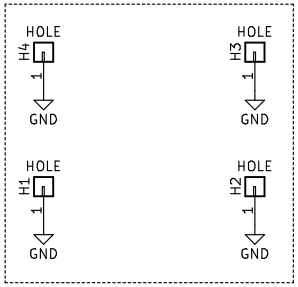


click on mouse pointer arrow on top of right toolbar
and double-click on sheet to open

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

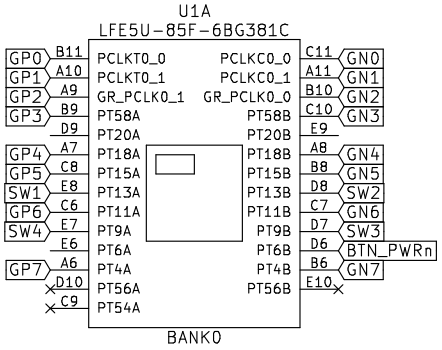
Root sheet
EMARD

Sheet: /
File: ulx3s.sch

Title: ULX3S

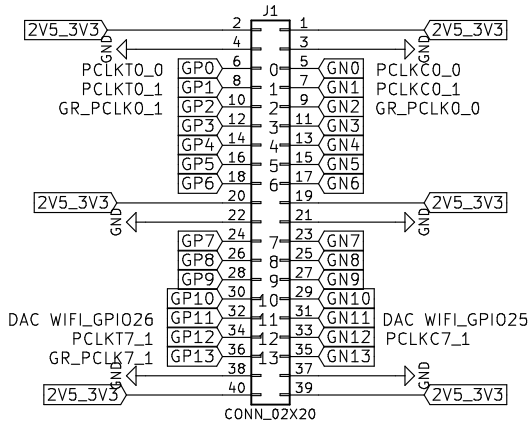
Size: A4	Date:	**Rev: 3.1.1**
KiCad E.D.A. kicad 5.1.6+dfsg1-1		Id: 1/11

NC v1.7

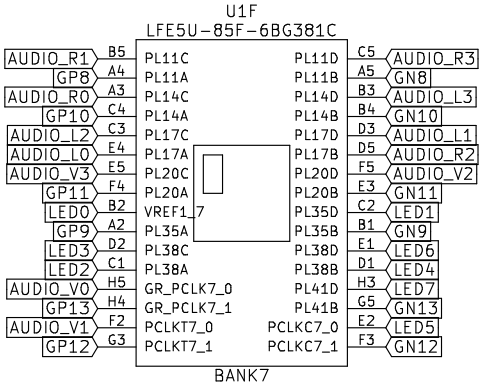


NC v1.7

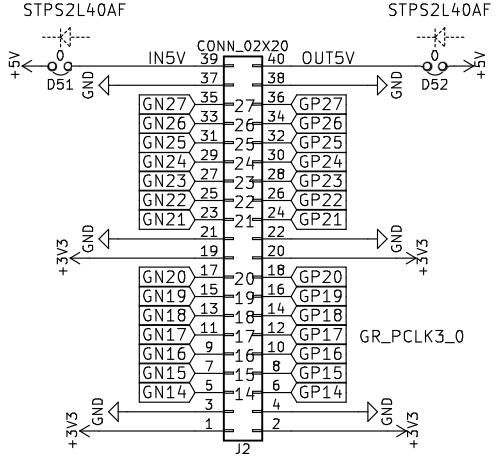
J1 J2 PIN numbering 1-40 is for FEMALE 90° ANGLED header.
For MALE VERTICAL header, SWAP EVEN and ODD pin numbers.



GP,GN 0-7 single-ended connected to BANK0
GP,GN 8-13 differential bidirectional connected to BANK7



J1 J2 PIN numbering 1-40 is for FEMALE 90° ANGLED header.
For MALE VERTICAL header, SWAP EVEN and ODD pin numbers.



GP,GN 14-21 differential bidirectional connected to BANK2,3 on "ram" sheet
GP,GN 22-27 single-ended connected to BANK1 on "gpdi" sheet

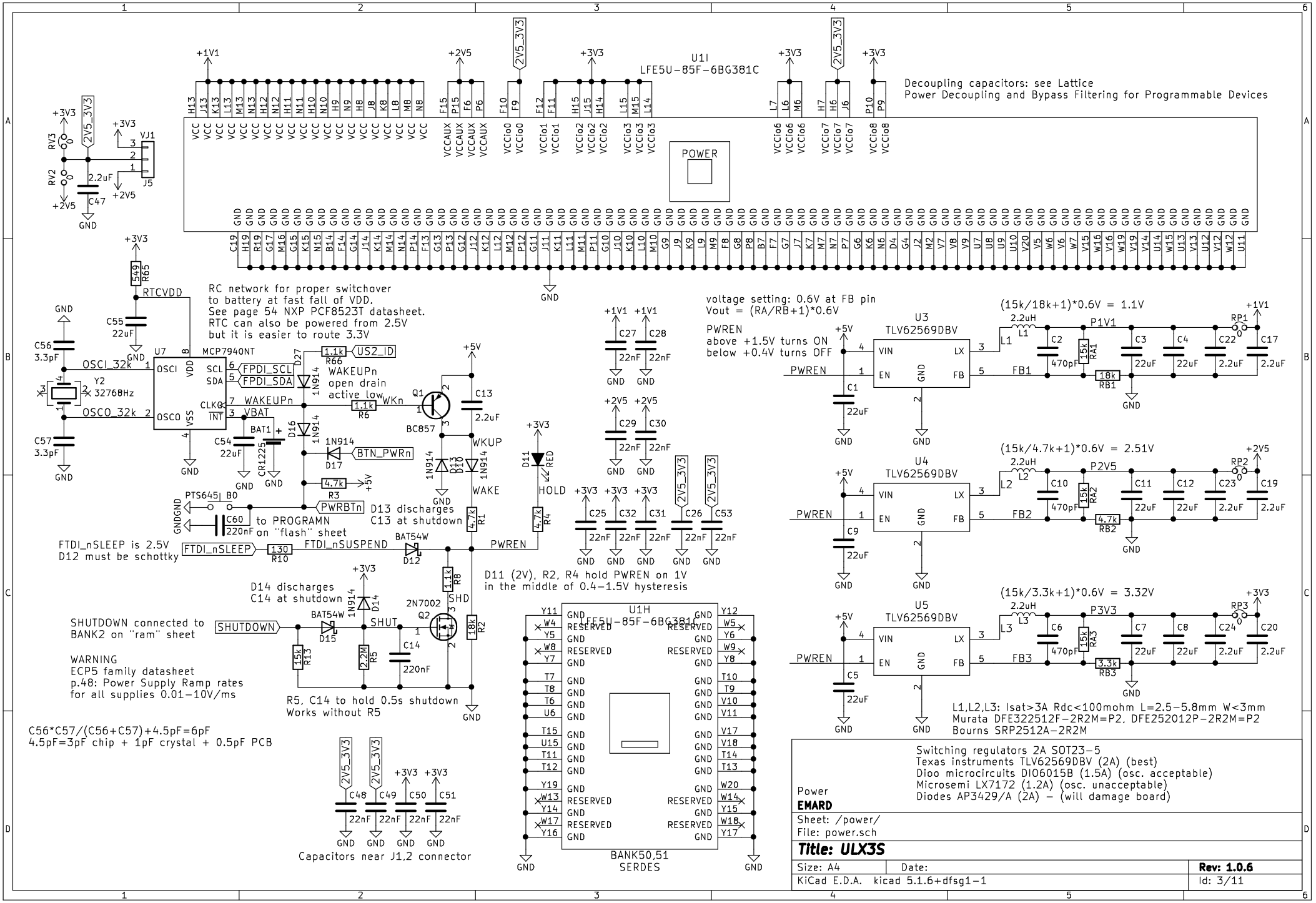
GPIO route only A/B pairs as those are differential bidirectional
don't route C/D pairs to GPIO as those can be differential input only
BANK0,1 are single-ended (non-differential)

GPIO 2.54 mm connectors
EMARD

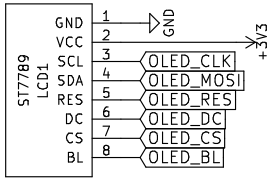
Sheet: /gpio/
File: gpio.sch

Title: ULX3S

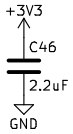
Size: A4	Date:	**Rev: 1.0.1**
KiCad E.D.A. kicad 5.1.6+dfsg1-1		Id: 2/11

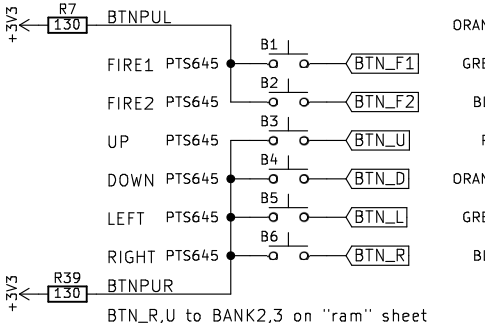

U1I
LFE5U-85F-6BG381C
Decoupling capacitors: see Lattice
Power Decoupling and Bypass Filtering for Programmable Devices
POWER
RC network for proper switchover
to battery at fast fall of VDD.
See page 54 NXP PCF8523T datasheet.
RTC can also be powered from 2.5V
but it is easier to route 3.3V
WAKEUPn
open drain
active low
D13 discharges
C13 at shutdown
to PROGRAMN
on "flash" sheet
FTDI_nSLEEP is 2.5V
D12 must be schottky
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
D11 (2V), R2, R4 hold PWREN on 1V
in the middle of 0.4-1.5V hysteresis
C56*C57/(C56+C57)+4.5pF=6pF
4.5pF=3pF chip + 1pF crystal + 0.5pF PCB
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: 1.0.6
KiCad E.D.A. kicad 5.1.6+dfsg1-1
Id: 3/11

ST7789/SSD1331/SSD1351/SSD1306
compatible LCD/OLED 0.96/1.3/1.54" PCB
14x14 units
1 unit = 2.54 mm

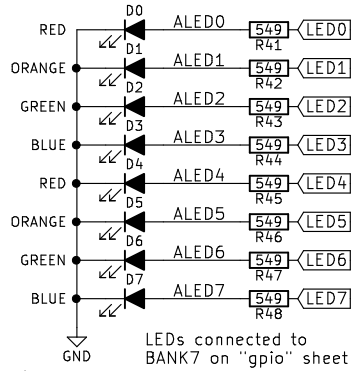


OLED connected to
BANK6 on "usb" sheet

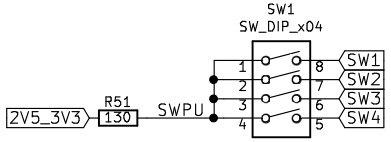




BTN_R,U to BANK2,3 on "ram" sheet
BTN_F1,F2,D,L to BANK8 on "flash" sheet

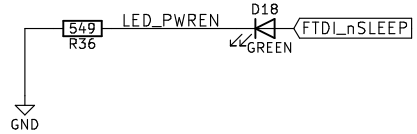


LEDs connected to
BANK7 on "gpio" sheet



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

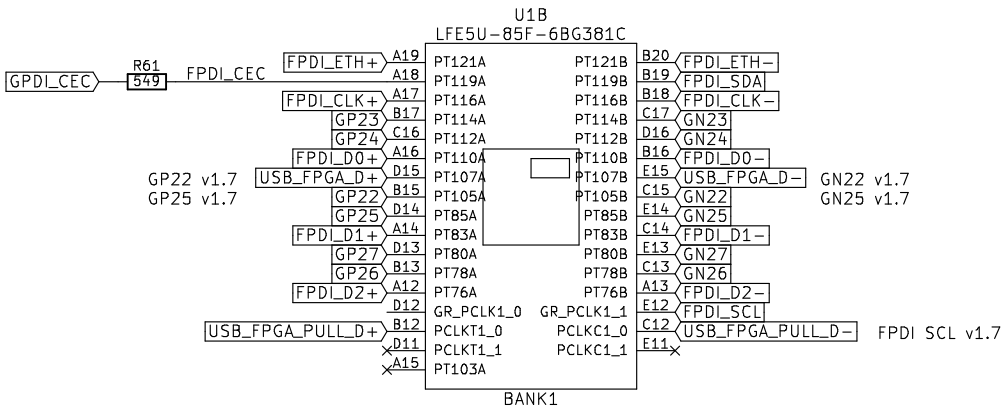


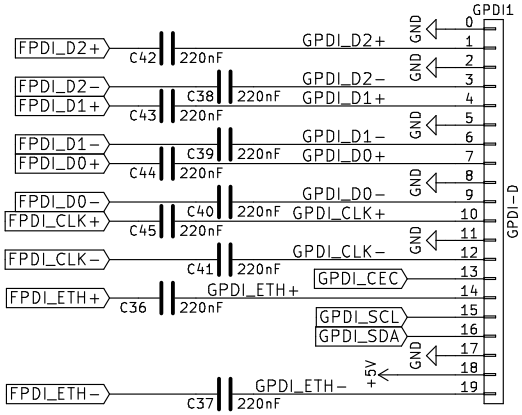
TXLED blinks when FPGA sends data to FTDI

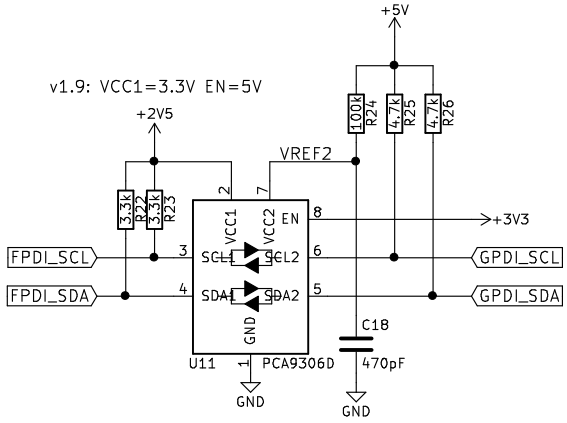
WIFI_GPIO2 v1.7, WIFI_GPIO5 <v3.1

Buttons, LEDs, OLED display
EMARD

Sheet: /blinkey/ File: blinkey.sch		
Title: ULX3S		
Size: A4	Date:	**Rev: 1.0.3**
KiCad E.D.A. kicad 5.1.6+dfsg1-1		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

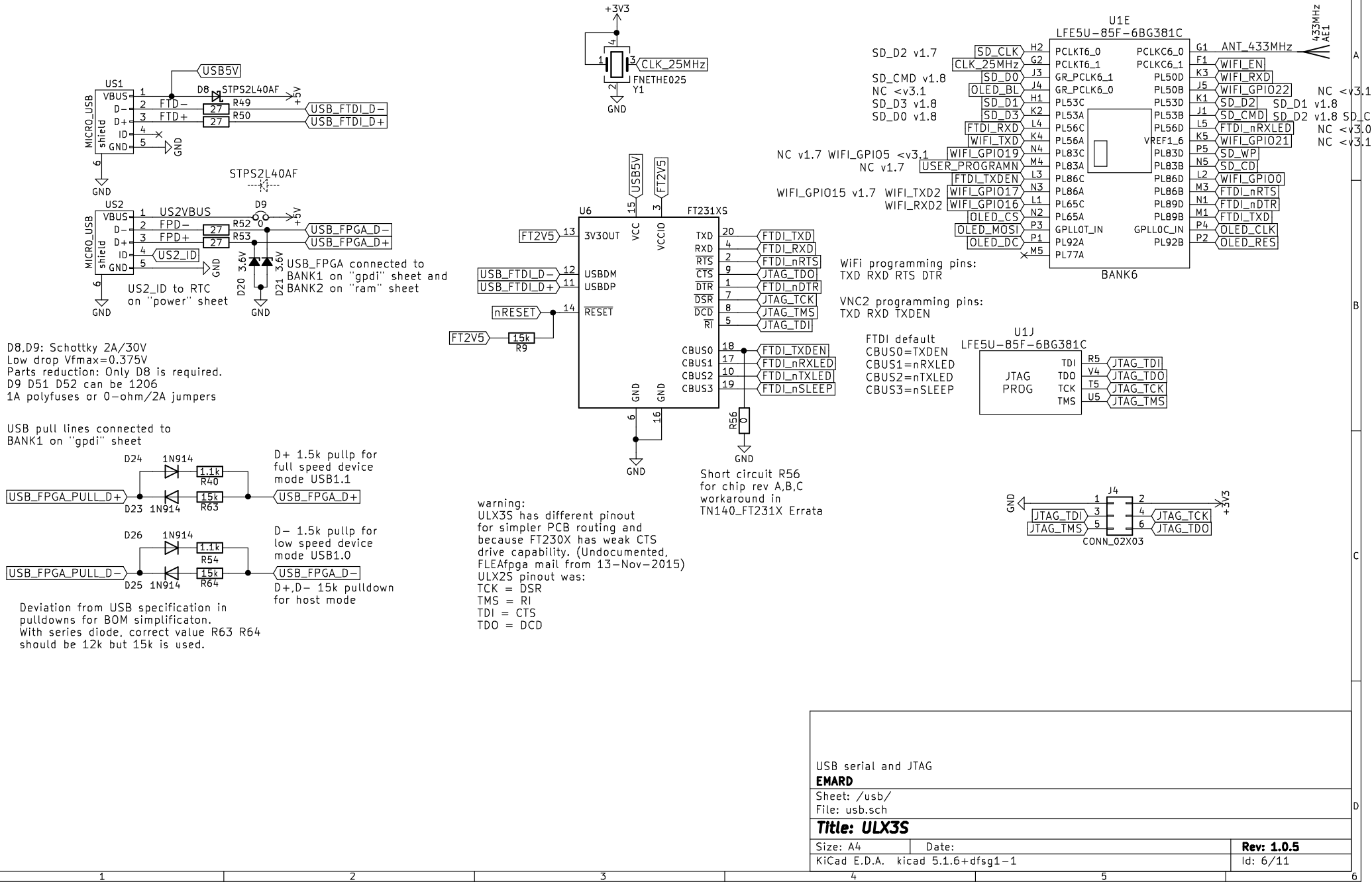
PCB v1.7 and v1.8 accept
mouser PN: 538-47151-1001 (Molex)
https://www.molex.com/pdm_docs/sd/471511001_sd.pdf
mouser PN: 710-685119134923 (Wurth)
https://katalog.we-online.com/em/datasheet/685119134923.pdf

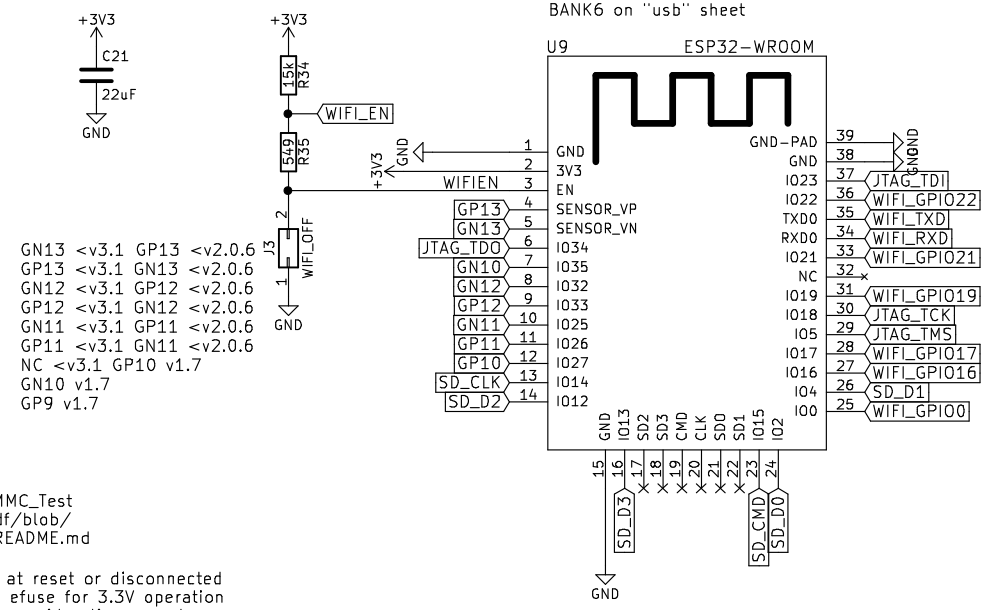
Digital Video and Ethernet
General Purpose Differential Interface
EMARD

Sheet: /gpdi/
File: gpdi.sch

Title: ULX3S

Size: A4	Date:	**Rev: 1.0.2**
KiCad E.D.A. kicad 5.1.6+dfsg1-1		Id: 5/11


US1
MICRO_USB
VBUS
D−
D+
ID
GND
shield
USB5V
D8
STPS2L40AF
+5V
R49
R50
27
FTD−
FTD+
USB_FTDI_D−
USB_FTDI_D+
US2
US2VBUS
FPD−
FPD+
US2_ID
R52
R53
0
D9
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
BANK1 on "gpdi" sheet
D24
1N914
1.1k
R40
15k
R63
USB_FPGA_PULL_D+
D+ 1.5k pullp for
full speed device
mode USB1.1
D26
R54
R64
USB_FPGA_PULL_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
GND
U6
FT231XS
USB5V
FT2V5
3V3OUT
VCC
VCCIO
USBDM
USBDP
RESET
nRESET
R9
TXD
RXD
RTS
CTS
DTR
DSR
DCD
RI
JTAG_TDO
JTAG_TCK
JTAG_TMS
JTAG_TDI
CBUS0
CBUS1
CBUS2
CBUS3
FTDI_TXDEN
FTDI_nRXLED
FTDI_nTXLED
FTDI_nSLEEP
R56
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
Short circuit R56
for chip rev A,B,C
workaround in
TN140_FT231X Errata
U1E
LFE5U−85F−6BG381C
BANK6
SD_D2 v1.7
SD_CMD v1.8
NC <v3.1
SD_D3 v1.8
SD_D0 v1.8
NC v1.7 WIFI_GPIO5 <v3.1
NC v1.7
WIFI_GPIO15 v1.7
WIFI_TXD2
WIFI_RXD2
SD_CLK
CLK_25MHz
SD_D0
OLED_BL
SD_D1
SD_D3
FTDI_RXD
WIFI_TXD
WIFI_GPIO19
USER_PROGRAMN
FTDI_TXDEN
WIFI_GPIO17
WIFI_GPIO16
OLED_CS
OLED_MOSI
OLED_DC
ANT_433MHz
433MHz
AE1
WIFI_EN
WIFI_RXD
WIFI_GPIO22
SD_D2
SD_CMD
FTDI_nRXLED
WIFI_GPIO21
SD_WP
SD_CD
WIFI_GPIO0
FTDI_nRTS
FTDI_nDTR
FTDI_TXD
OLED_CLK
OLED_RES
NC <v3.1
SD_D1 v1.8
SD_D2 v1.8 SD_C
NC <v3.0
NC <v3.1
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
+3V3
USB serial and JTAG
EMARD
Sheet: /usb/
File: usb.sch
Title: ULX3S
Size: A4
Date:
Rev: 1.0.5
KiCad E.D.A. kicad 5.1.6+dfsg1−1
Id: 6/11



GN13 <v3.1 GP13 <v2.0.6
GP13 <v3.1 GN13 <v2.0.6
GN12 <v3.1 GP12 <v2.0.6
GP12 <v3.1 GN12 <v2.0.6
GN11 <v3.1 GP11 <v2.0.6
GP11 <v3.1 GN11 <v2.0.6
NC <v3.1 GP10 v1.7
GN10 v1.7
GP9 v1.7

TDO <v3.1

NC v1.7, WIFI_GPIO5 <v3.1
NC v1.7

NC v1.7

Programming pins:
TXD RXD EN GPIO0

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

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

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/espressif/esp-idf/tree/master/examples/storage/sd_card

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

GN9 v1.7

WIFI_GPIO15 v1.7
WIFI_LED v1.7

LED and WIFI_GPIO17
to solder pads of PCB

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 HSPI pins
GPIO12: MISO
GPIO13: MOSI
GPIO14: SCK
GPIO15: SS

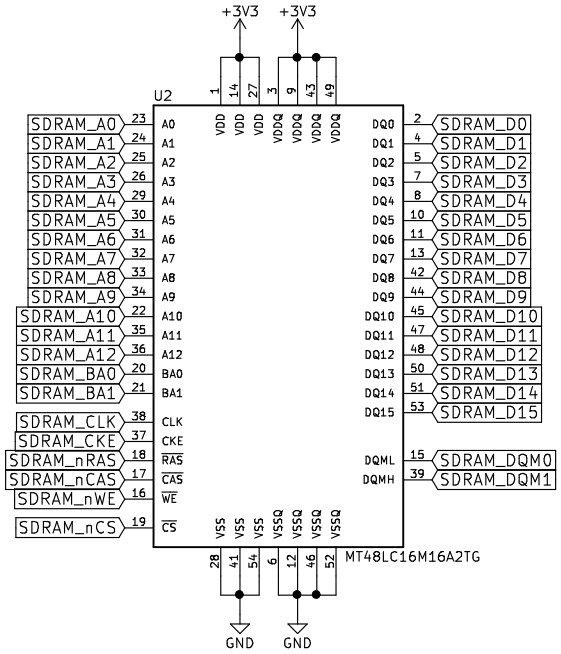
ESP32 JTAG slave interface
EN: TRST_N
GPIO15: TDO
GPIO12: TDI
GPIO13: TCK
GPIO14: TMS
FLASH over JTAG
not yet supported.

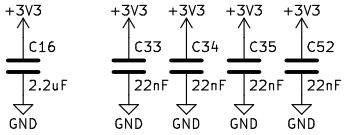
WIFI module ESP32
EMARD

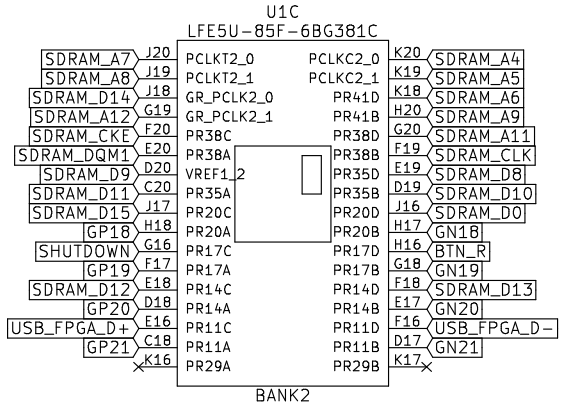
Sheet: /wifi/
File: wifi.sch

Title: ULX3S

Size: A4	Date:	**Rev: 1.0.3**
KiCad E.D.A. kicad 5.1.6+dfsg1-1		Id: 7/11







SDRAM memory

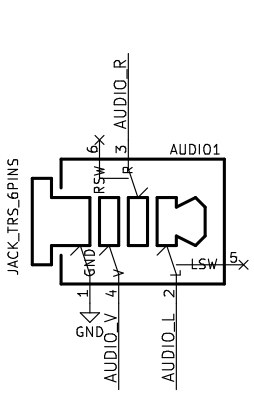
EMARD

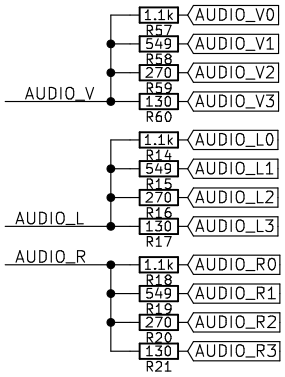
Sheet: /ram/

File: ram.sch

Title: ULX3S

Size: A4	Date:	**Rev: 1.0.0**
KiCad E.D.A. kicad 5.1.6+dfsg1-1		Id: 8/11

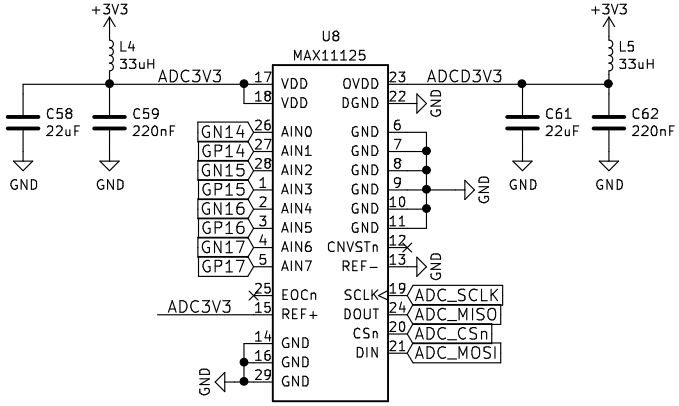




JACK pinout for SJ-43516-SMT-TR
http://www.cui.com/product/resource/sj-4351x-smt-series.pdf
pin 1 - sleeve (GND)
pin 2 - tip (left channel)
pin 3 - ring1 (right channel)
pin 4 - ring2 (video)
pin 5 - tip switch
pin 6 - ring1 switch

Audio connected to
BANK7 on "gpio" sheet

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



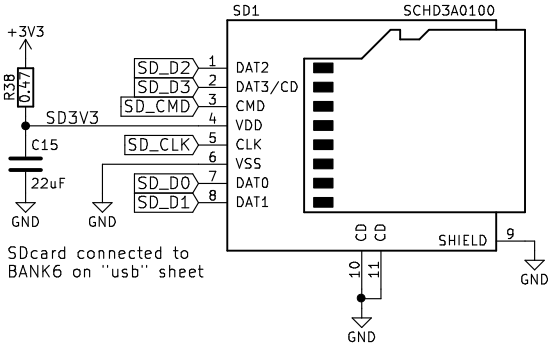
ADC SPI connected to
BANK3 of "ram" sheet

Analog audio and video
EMARD

Sheet: /analog/
File: analog.sch

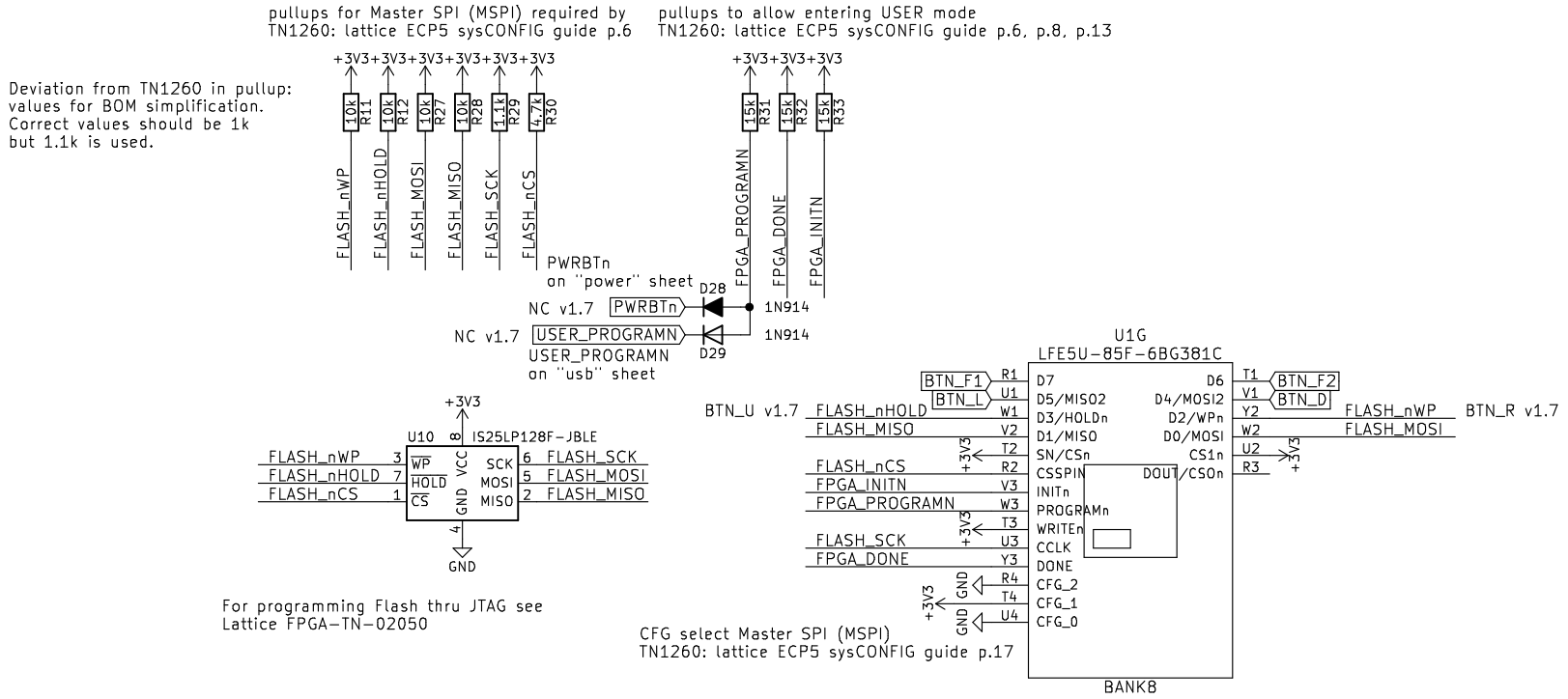
Title: ULX3S

Size: A4	Date:	**Rev: 1.0.4**
KiCad E.D.A. kicad 5.1.6+dfsg1-1		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 5.1.6+dfsg1-1		Id: 10/11



SPI flash

EMARD

Sheet: /flash/
File: flash.sch

Title: ULX3S

Size: A4	Date:	**Rev: 1.0.6**
KiCad E.D.A. kicad 5.1.6+dfsg1-1		Id: 11/11