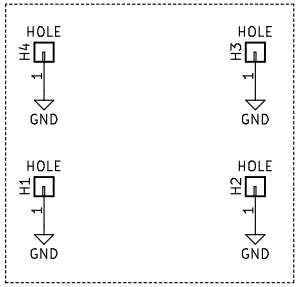


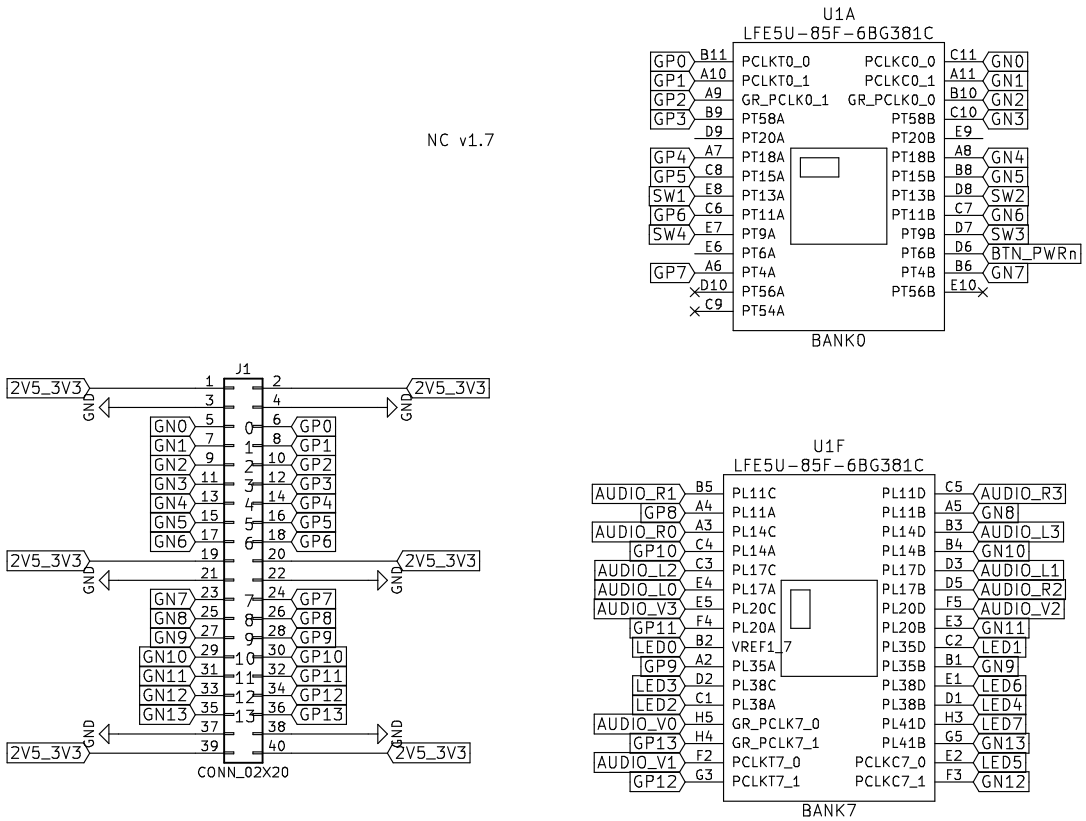
click on mouse pointer arrow on top of right toolbar
and double-click on sheet to open

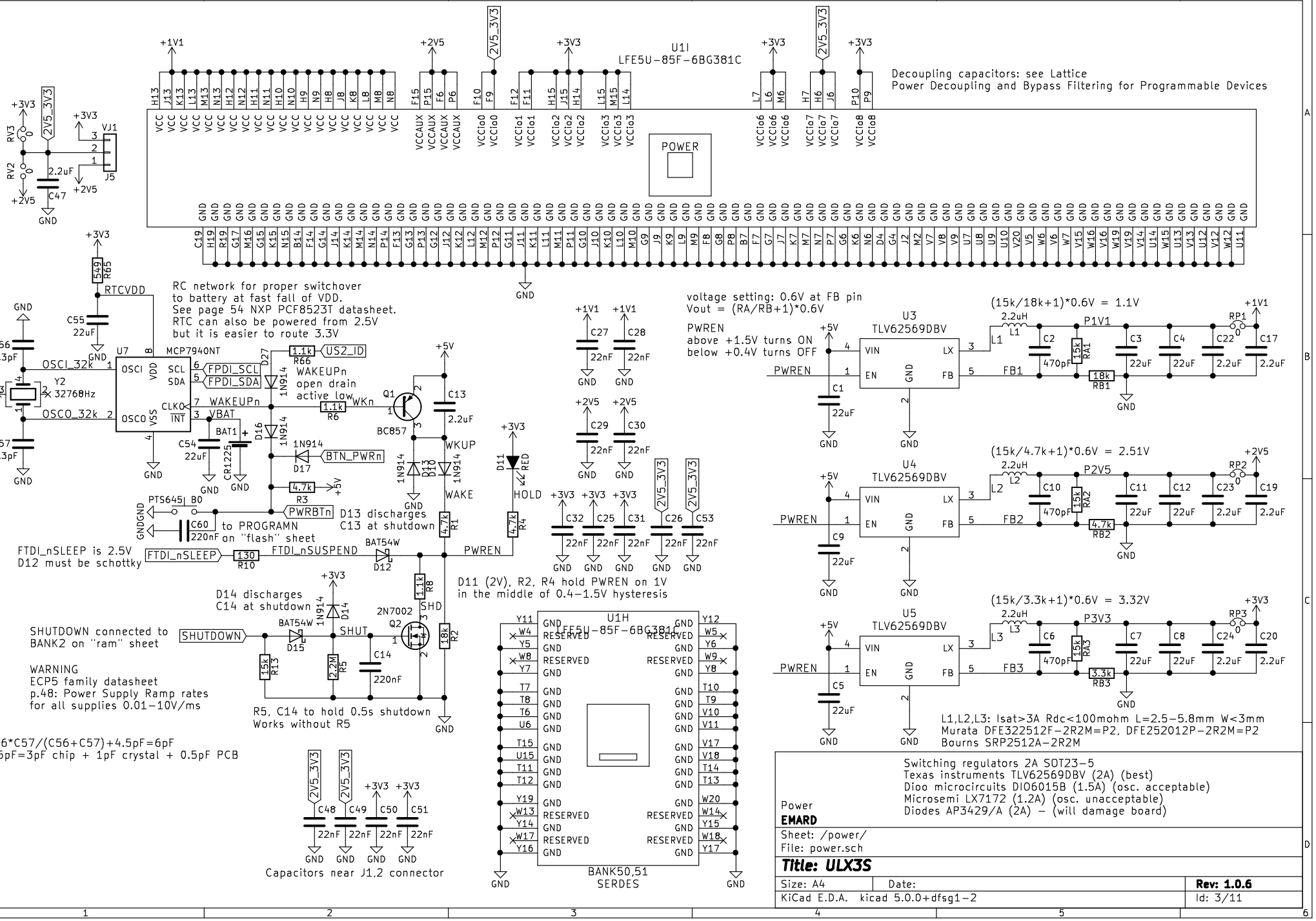
Sheet: power	Sheet: usb	Sheet: blinkey	Sheet: ram	Sheet: sdcard
File: power.sch	File: usb.sch	File: blinkey.sch	File: ram.sch	File: sdcard.sch
Sheet: gpio	**Sheet: gpdi**	**Sheet: analog**	**Sheet: wifi**	**Sheet: flash**
File: gpio.sch	File: gpdi.sch	File: analog.sch	File: wifi.sch	File: flash.sch

Root sheet
EMARD
Sheet: /
File: ulx3s.sch

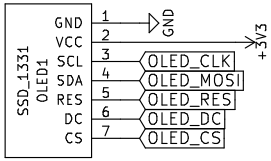
Title: ULX3S

Size: A4	Date:	**Rev: 3.0.5**
KiCad E.D.A. kicad 5.0.0+dfsg1-2		Id: 1/11

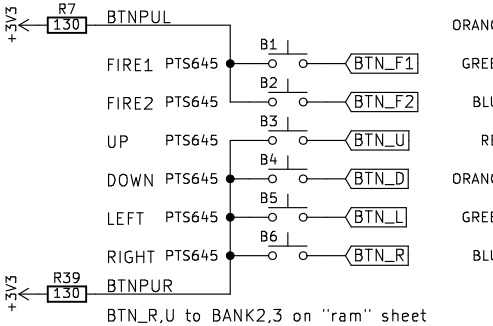

U1A
LFE5U-85F-6BG381C
PCLKT0_0
PCLKT0_1
GR_PCLK0_1
PT58A
PT20A
PT18A
PT15A
PT13A
PT11A
PT9A
PT6A
PT4A
PT56A
PT54A
PCLKC0_0
PCLKC0_1
GR_PCLK0_0
PT58B
PT20B
PT18B
PT15B
PT13B
PT11B
PT9B
PT6B
PT4B
PT56B
BANK0
NC v1.7
NC v1.7
J1
CONN_02X20
2V5_3V3
GND
U1F
LFE5U-85F-6BG381C
PL11C
PL11A
PL14C
PL14A
PL17C
PL17A
PL20C
PL20A
VREF1_7
PL35A
PL38C
PL38A
GR_PCLK7_0
GR_PCLK7_1
PCLKT7_0
PCLKT7_1
PL11D
PL11B
PL14D
PL14B
PL17D
PL17B
PL20D
PL20B
PL35D
PL35B
PL38D
PL38B
PL41D
PL41B
PCLKC7_0
PCLKC7_1
BANK7
J2
CONN_02X20
+3V3
GND
STPS2L30AF
D51
D52
IN5V
OUT5V
+5V
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+dfsg1-2
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
MCP7940NT
WAKEUPn
open drain
active low
D13 discharges
C13 at shutdown
to PROGRAMN
on "flash" sheet
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
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 5.0.0+dfsg1-2
Id: 3/11

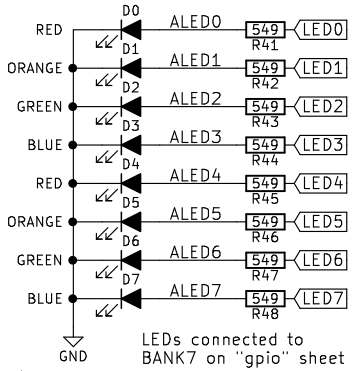
SSD1306 B/W or SSD1331 COLOR
compatible OLED 0.96" or 1.3" PCB
14x14 units
1 unit = 2.54 mm



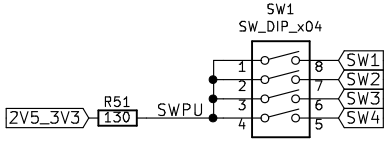
OLED connected to
BANK6 on "usb" sheet



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

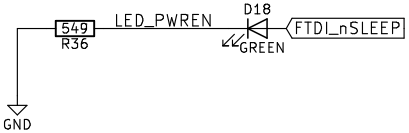


LEDs connected to
BANK7 on "gpio" sheet

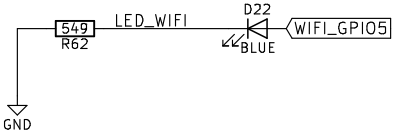


DIP switch connected to
BANK0 on 'gpio' sheet

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

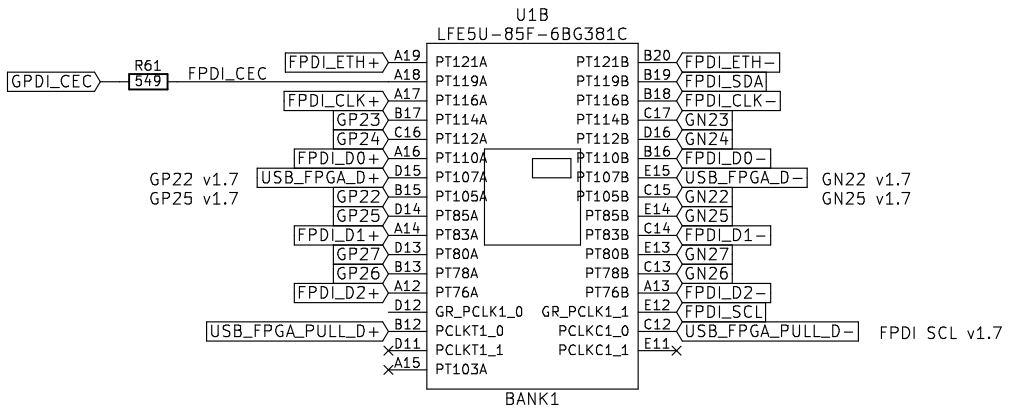


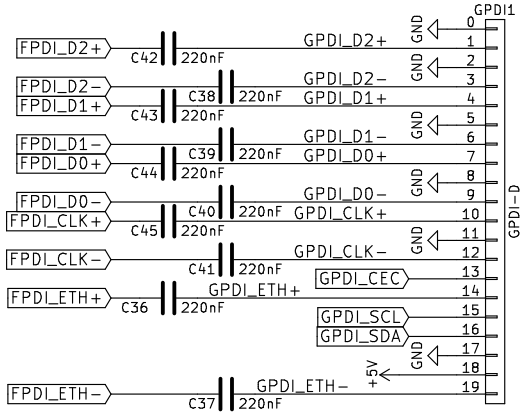
GPIO2 on PCB v1.7

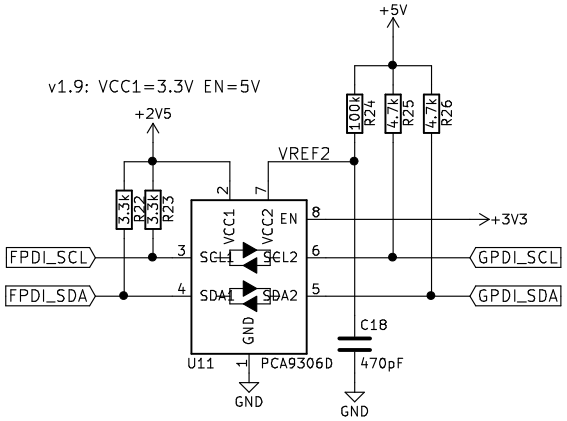
Buttons, LEDs, OLED display
EMARD
Sheet: /blinkey/
File: blinkey.sch

Title: ULX3S

Size: A4	Date:	**Rev: 1.0.0**
KiCad E.D.A. kicad 5.0.0+dfsg1-2		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

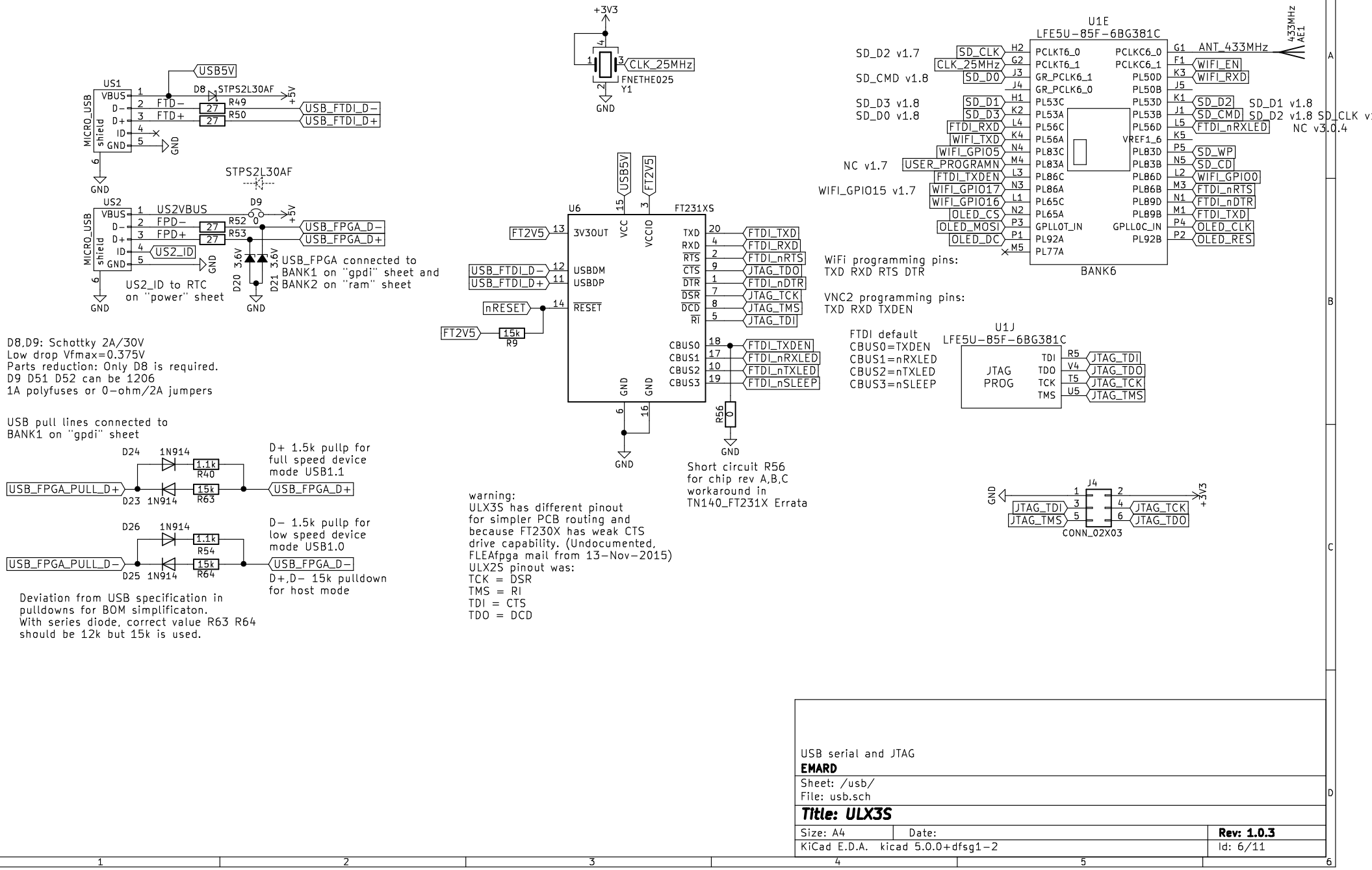
PCB v1.7 and v1.8 accept
mouser PN: 538-47151-1001 (Molex)
https://www.molex.com/pdm_docs/sd/471511001_sd.pdf
mouser PN: 710-685119134923 (Wurth)
https://katalog.we-online.com/em/datasheet/685119134923.pdf

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 5.0.0+dfsg1-2		Id: 5/11



USB serial and JTAG

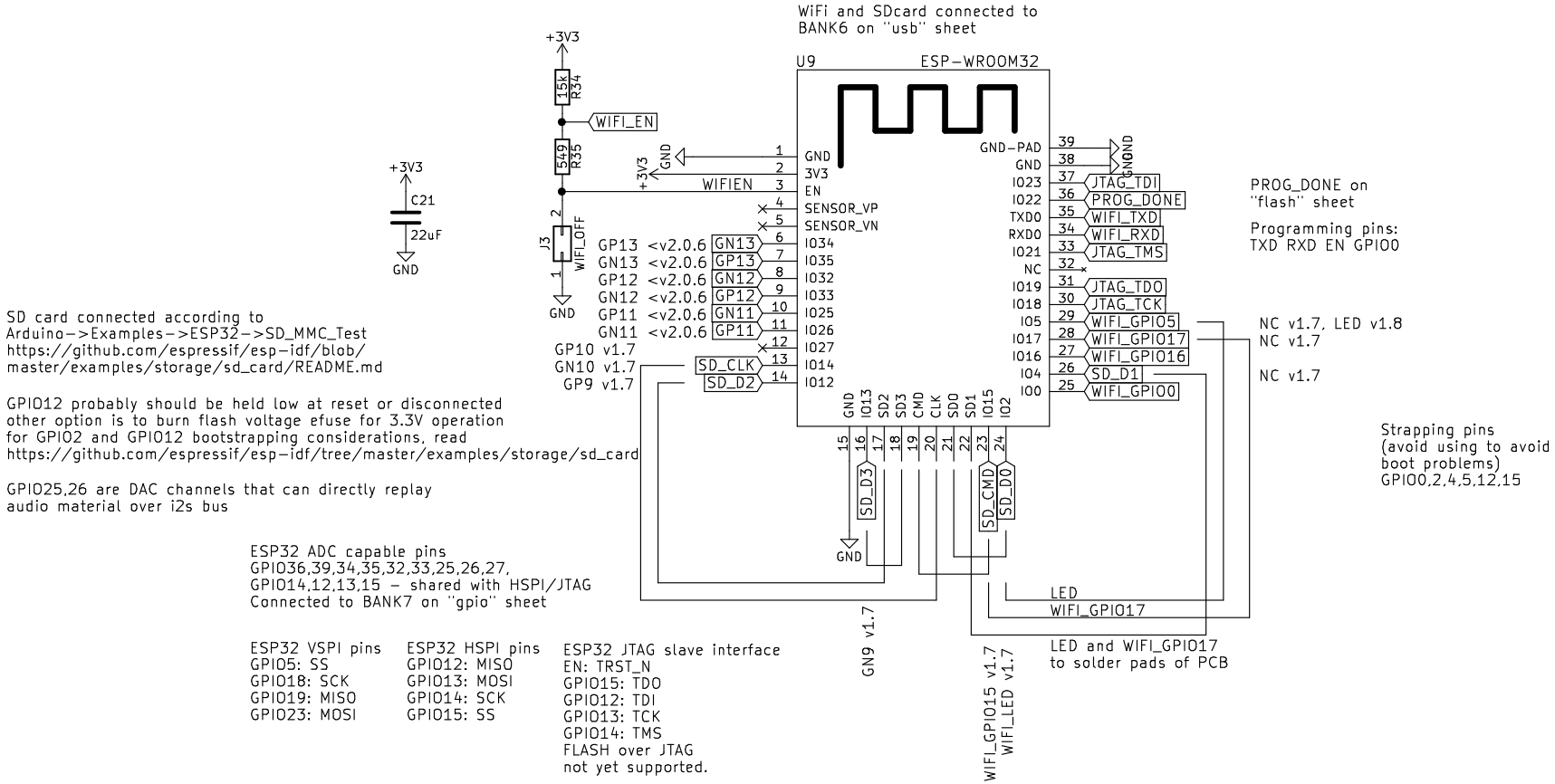
EMARD

Sheet: /usb/

File: usb.sch

Title: ULX3S

Size: A4	Date:	**Rev: 1.0.3**
KiCad E.D.A. kicad 5.0.0+dfsg1−2		Id: 6/11



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

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

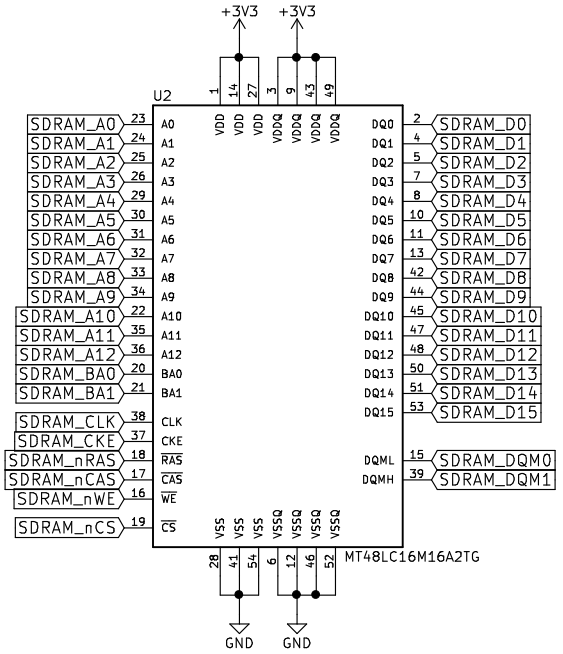
ESP32 HSPI pins
GPIO12: MISO
GPIO13: MOSI
GPIO14: SCK
GPIO15: SS

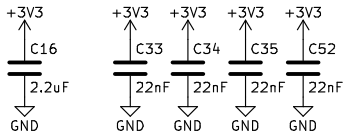
ESP32 JTAG slave interface
EN: TRST_N
GPIO15: TDO
GPIO12: TDI
GPIO13: TCK
GPIO14: TMS
FLASH over JTAG
not yet supported.

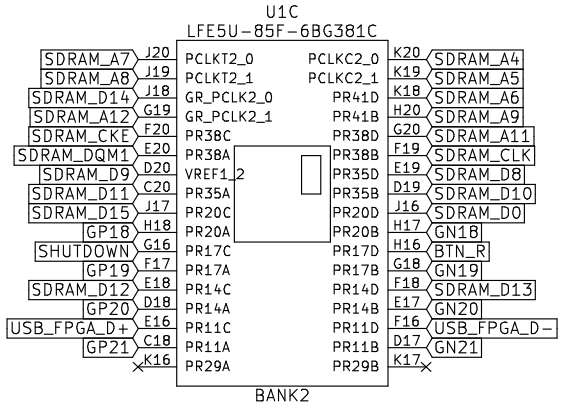
WIFI module ESP32
EMARD
Sheet: /wifi/
File: wifi.sch

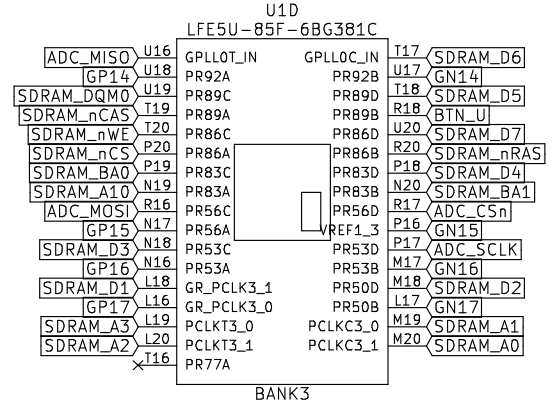
Title: ULX3S

Size: A4	Date:	**Rev: 1.0.1**
KiCad E.D.A. kicad 5.0.0+dfsg1-2		Id: 7/11









SDRAM memory

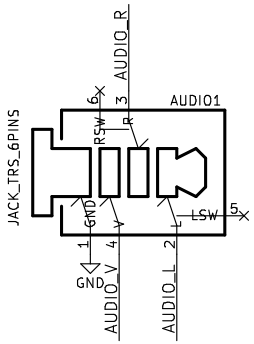
EMARD

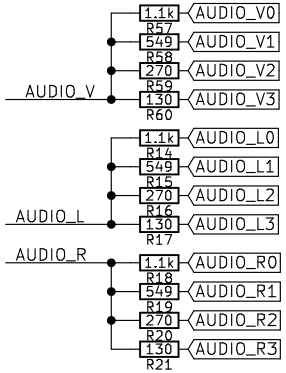
Sheet: /ram/

File: ram.sch

Title: ULX3S

Size: A4	Date:	**Rev: 1.0.0**
KiCad E.D.A. kicad 5.0.0+dfsg1-2		Id: 8/11

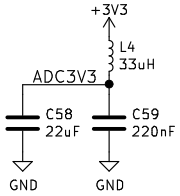


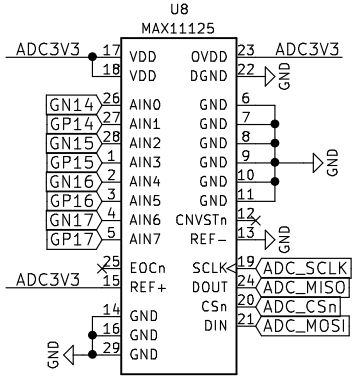


JACK pinout for SJ-43516-SMT-TR
http://www.cui.com/product/resource/sj-4351x-smt-series.pdf
pin 1 - sleeve (GND)
pin 2 - tip (left channel)
pin 3 - ring1 (right channel)
pin 4 - ring2 (video)
pin 5 - tip switch
pin 6 - ring1 switch

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





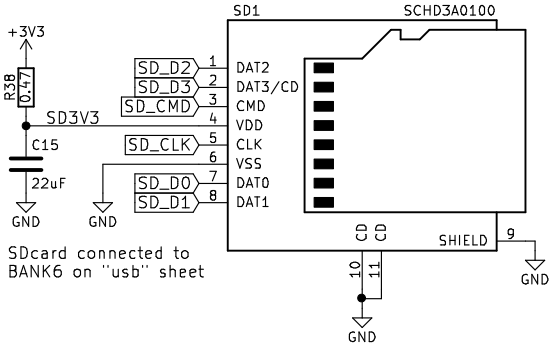
ADC SPI connected to
BANK3 of "ram" sheet

Analog audio and video
EMARD

Sheet: /analog/
File: analog.sch

Title: ULX3S

Size: A4	Date:	**Rev: 1.0.3**
KiCad E.D.A. kicad 5.0.0+dfsg1-2		Id: 9/11



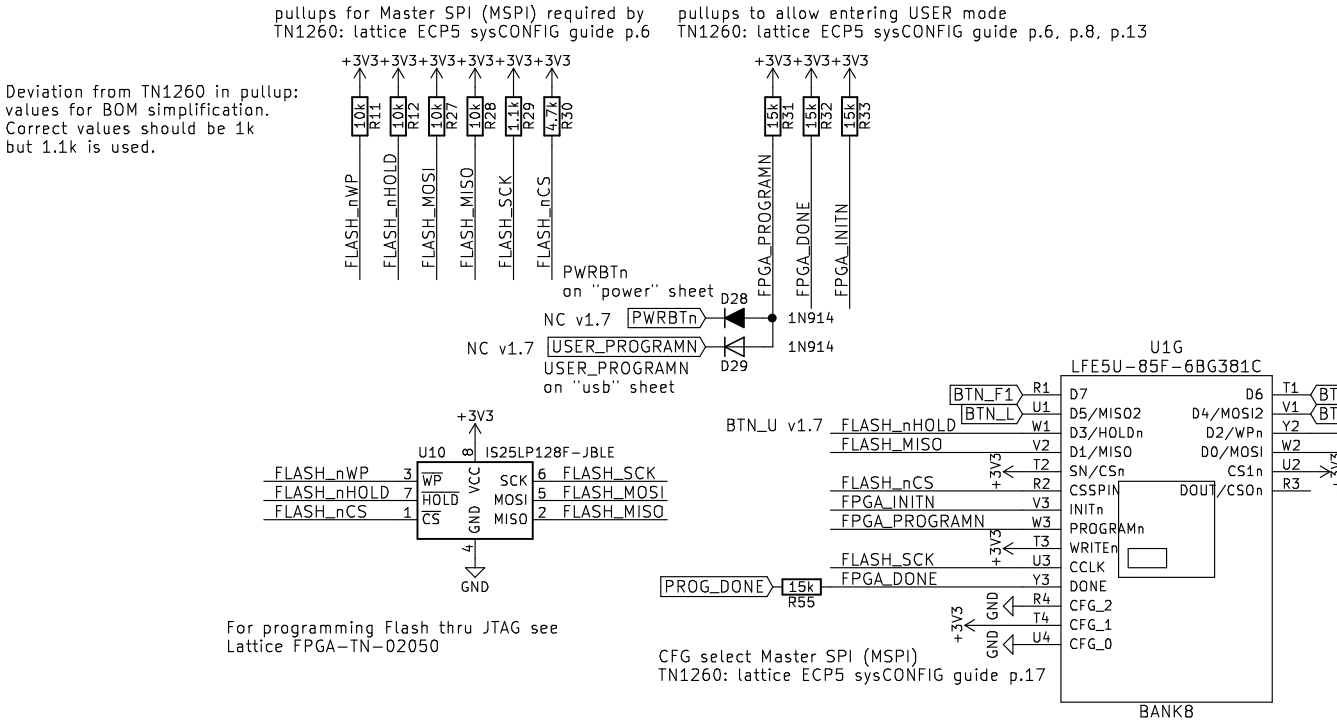
minimum pins for compatible mode
SD_CLK, SD_CMD, SD_D0, SD_D3

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+dfsg1-2		Id: 10/11



SPI flash

EMARD

Sheet: /flash/
File: flash.sch

Title: ULX3S

Size: A4	Date:	**Rev: 1.0.5**
KiCad E.D.A. kicad 5.0.0+dfsg1-2		Id: 11/11