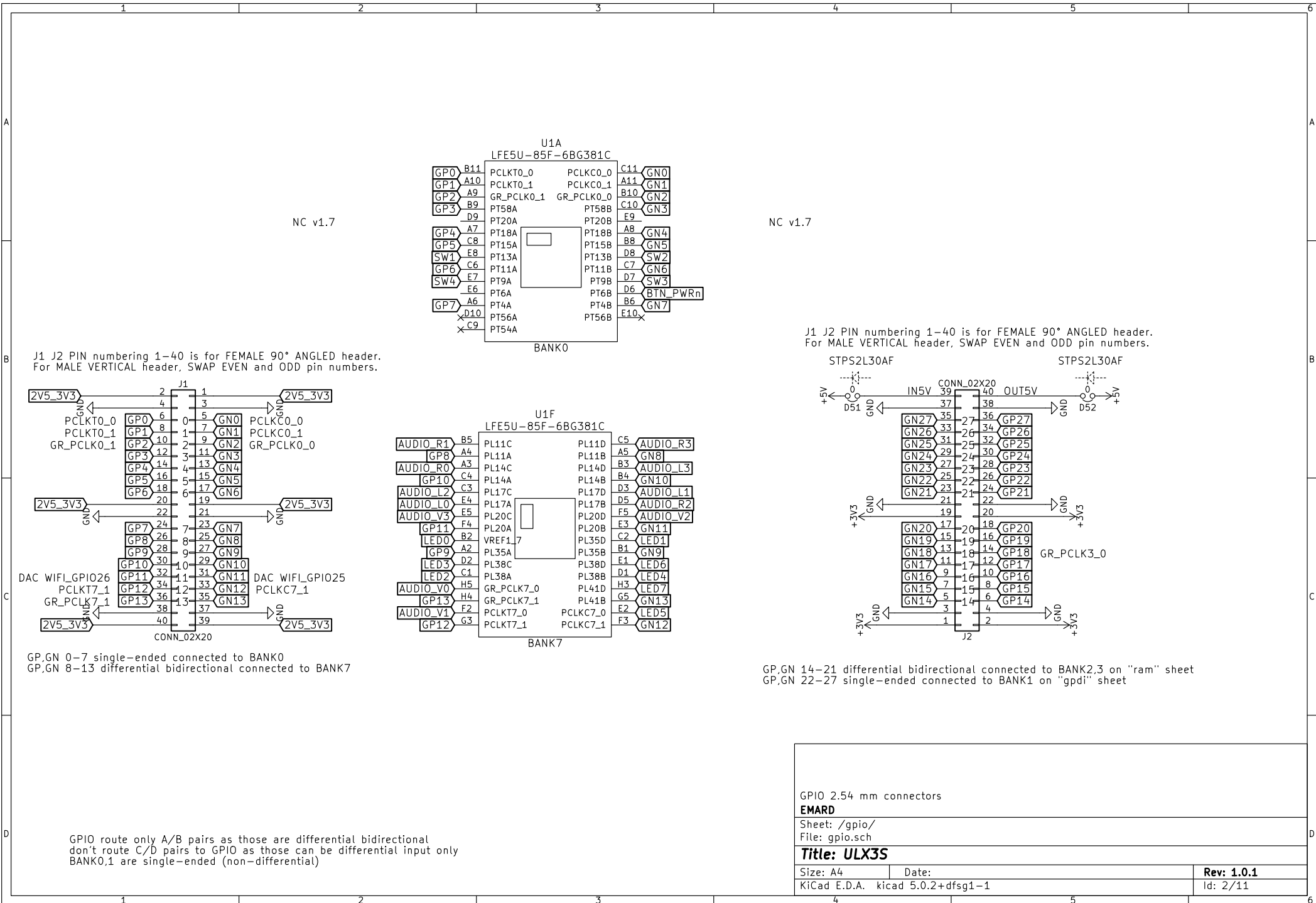


click on mouse pointer arrow on top of right toolbar
and double-click on sheet to open

power	usb	blinky	ram	sdcard
power.sch	usb.sch	blinky.sch	ram.sch	sdcard.sch
gpio	gpd	analog	wifi	flash
gpio.sch	gpd.sch	analog.sch	wifi.sch	flash.sch

Root sheet	
EMARD	
Sheet: /	
File: ulx3s.sch	
Title: ULX3S	
Size: A4	Date:
KiCad E.D.A. kicad 5.0.2+dfsg1-1	Rev: 3.0.5
	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.

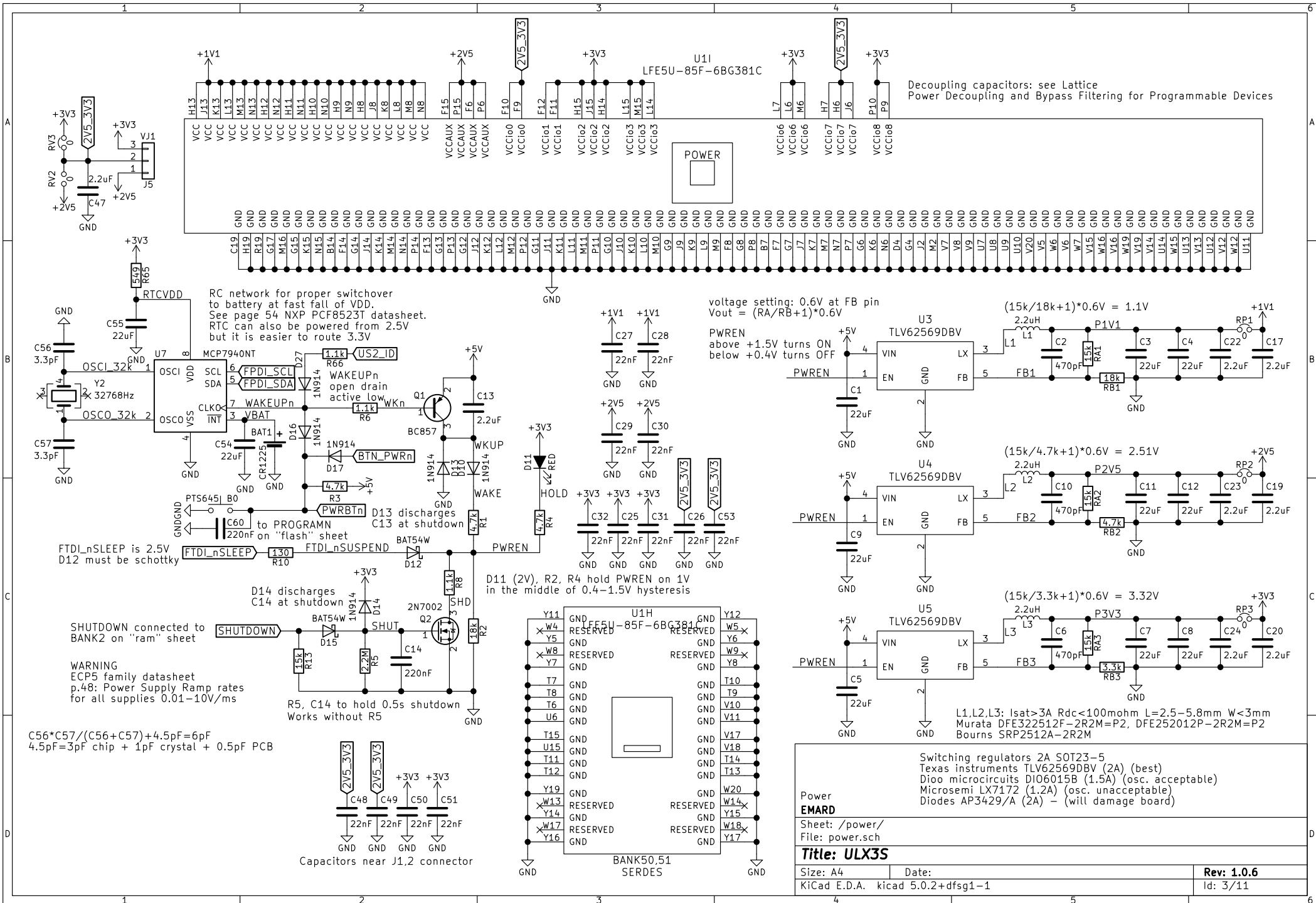
J1 J2 PIN numbering 1-40 is for FEMALE 90° ANGLED header. For MALE VERTICAL header, SWAP EVEN and ODD pin numbers.

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

GP,GN 14-21 differential bidirectional connected to BANK2,3 on "ram" sheet
 GP,GN 22-27 single-ended connected to BANK1 on "gpi" 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:
KiCad E.D.A. kicad 5.0.2+dfsg1-1	Rev: 1.0.1
	Id: 2/11



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

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

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)
 Dico 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 5.0.2+dfsg1-1		Id: 3/11

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

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

D14 discharges C14 at shutdown

SHUTDOWN connected to BANK2 on "ram" sheet

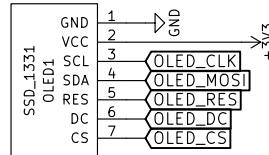
WARNING ECP5 family datasheet p.48: Power Supply Ramp rates for all supplies 0.01-10V/ms

FTDI_nSLEEP is 2.5V D12 must be schottky
 to PROGRAMM
 220nF on "flash" sheet

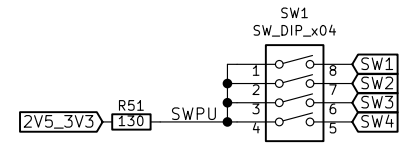
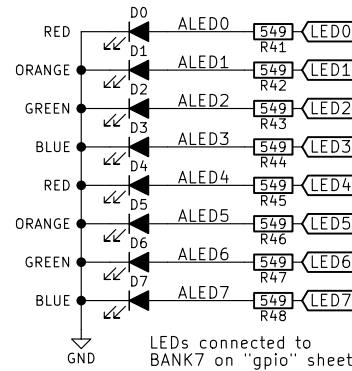
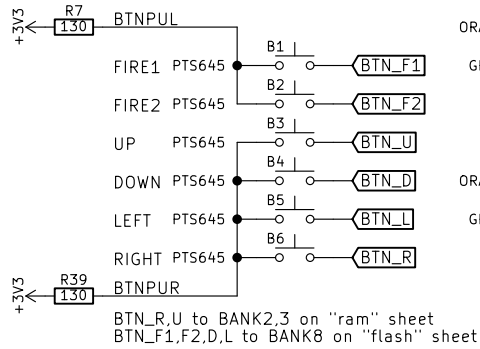
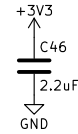
WAKEUPn open drain active low WKn

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

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

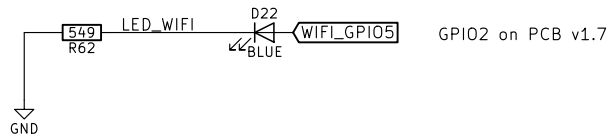
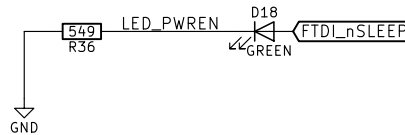


OLED connected to BANK6 on "usb" sheet



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

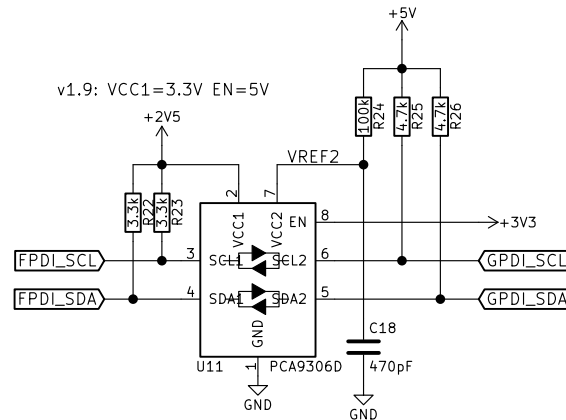
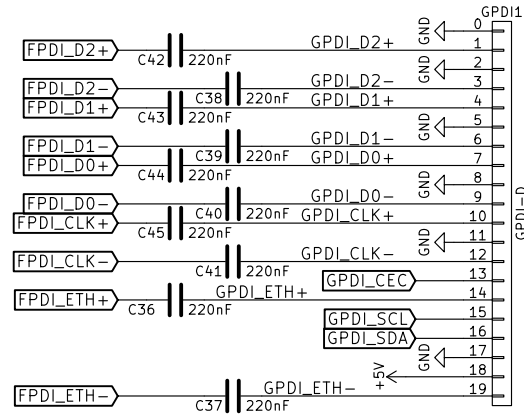
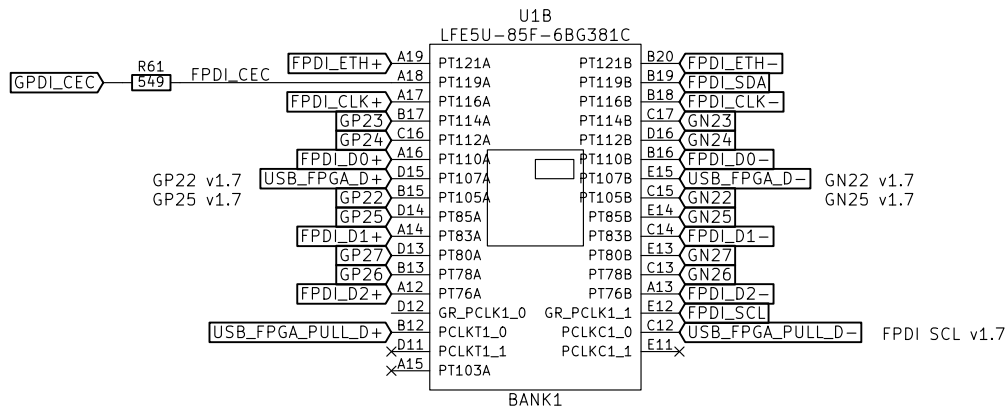
EMARD

Sheet: /blinky/
File: blinky.sch

Title: ULX3S

Size: A4 Date:
KiCad E.D.A. kicad 5.0.2+dfsg1-1

Rev: 1.0.0
Id: 4/11



i2c shared with RTC on "power" sheet

PCB v1.8.1 and higher accept FCI 10029449-111RLF
[www.amphenol-icc.com](http://portal.fciconnect.com/Comergent/fci/drawing/10029449.pdf)
 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>

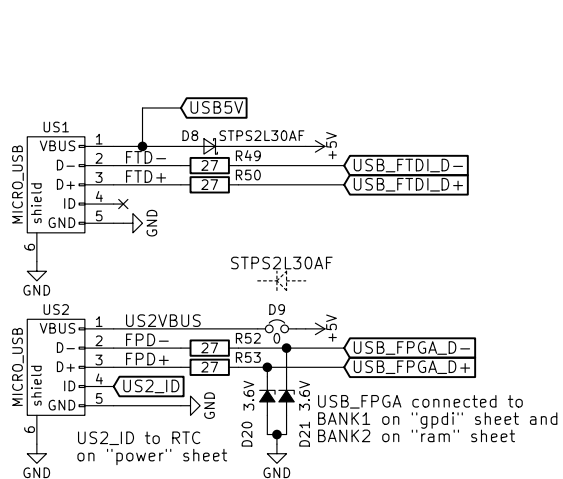
Digital Video and Ethernet
 General Purpose Differential Interface
EMARD

Sheet: /gpd1/
 File: gpd1.sch

Title: ULX3S

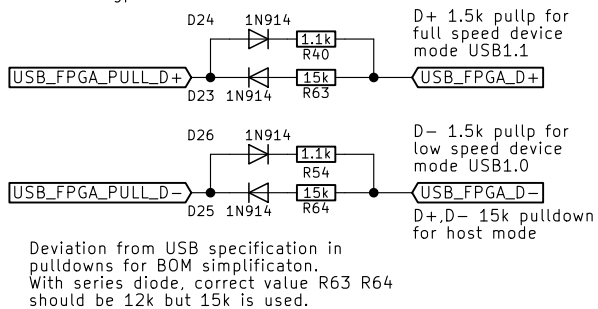
Size: A4 Date:
 KiCad E.D.A. kicad 5.0.2+dfsg1-1

Rev: 1.0.2
 Id: 5/11

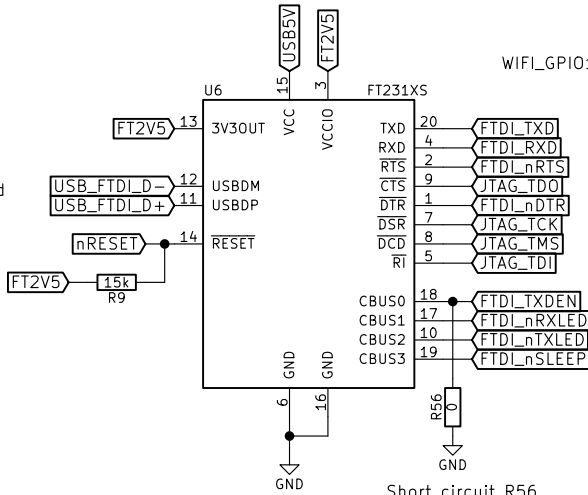
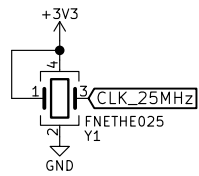


D8,D9: Schottky 2A/30V
 Low drop Vfmax=0.375V
 Parts reduction: Only D8 is required.
 D9 D51 D52 can be 1206
 1A polyfuses or 0-ohm/2A jumpers

USB pull lines connected to BANK1 on "gpd1" sheet

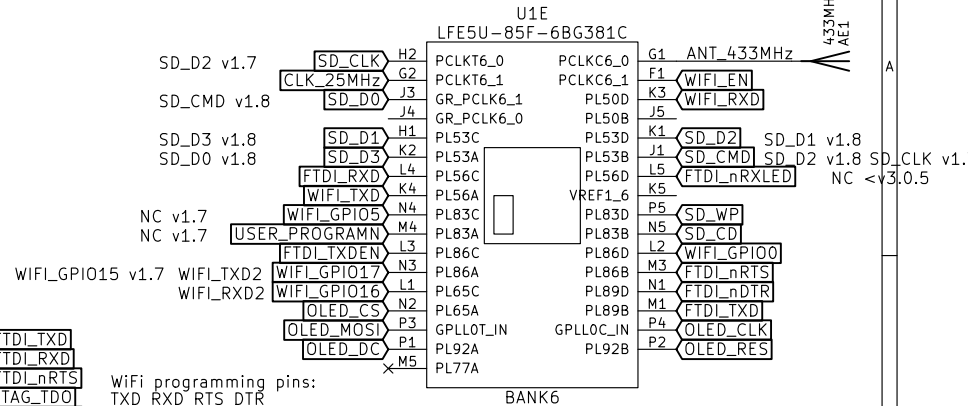


Deviation from USB specification in pulldowns for BOM simplification. With series diode, correct value R63 R64 should be 12k but 15k is used.



warning:
 UXL35 has different pinout for simpler PCB routing and because FT230X has weak CTS drive capability. (Undocumented, FLEAfpga mail from 13-Nov-2015)
 UXL25 pinout was:
 TCK = DSR
 TMS = RI
 TDI = CTS
 TDO = DCD

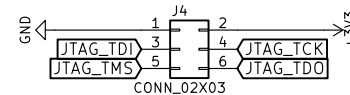
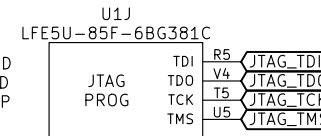
Short circuit R56 for chip rev A,B,C workaround in TN140_FT231X Errata



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: UXL35	
Size: A4	Date:
KiCad E.D.A. kicad 5.0.2+dfsg1-1	
Rev: 1.0.3 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

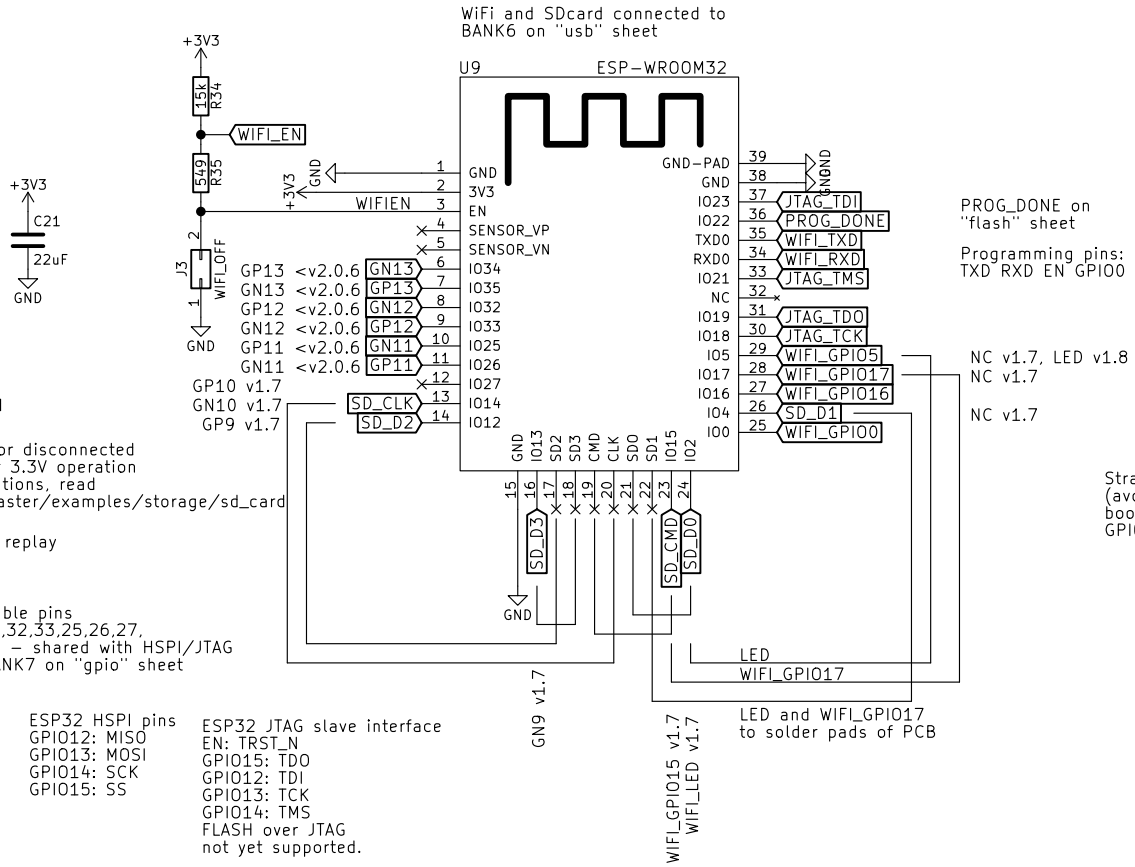
GPIO12 probably should be held low at reset or disconnected
 other option is to burn flash voltage efuse for 3.3V operation
 for GPIO2 and GPIO12 bootstrapping considerations, read
https://github.com/espressif/esp-idf/tree/master/examples/storage/sd_card

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 ESP32 HSPI pins
 GPIO5: SS GPIO12: MISO
 GPIO18: SCK GPIO13: MOSI
 GPIO19: MISO GPIO14: SCK
 GPIO23: MOSI GPIO15: SS

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

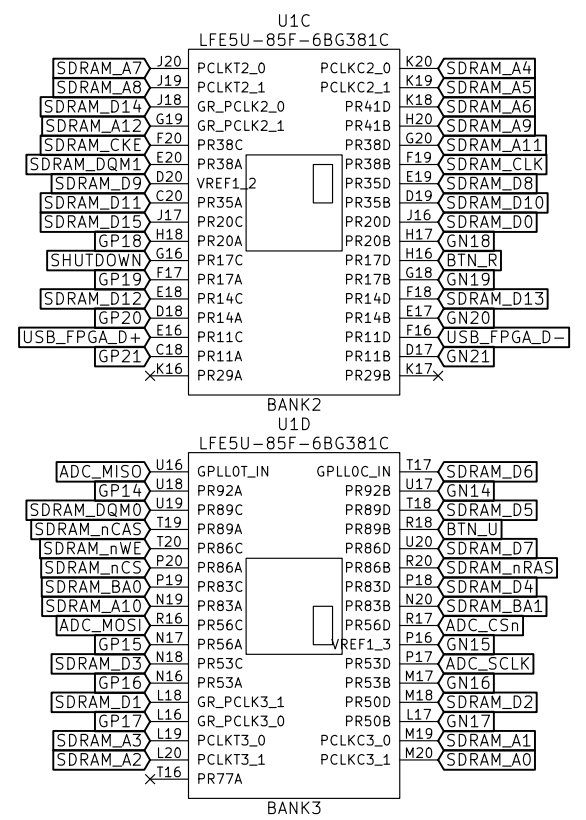
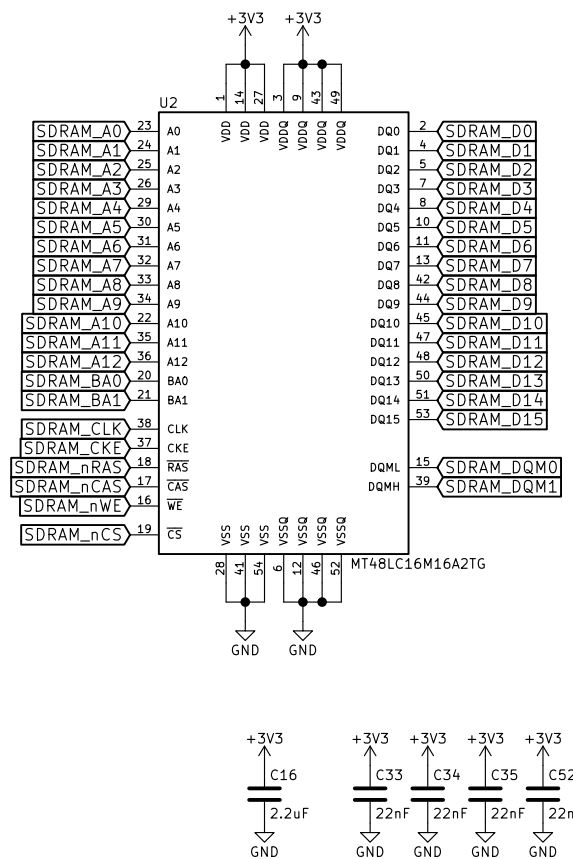


PROG_DONE on
 "flash" sheet
 Programming pins:
 TXD RXD EN GPIO0

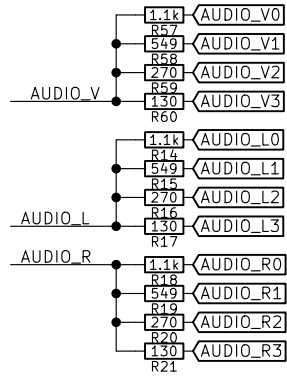
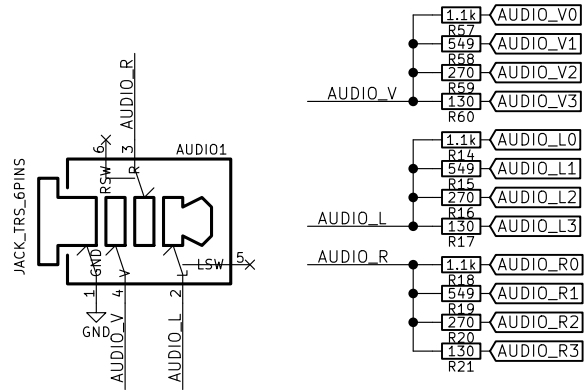
NC v1.7, LED v1.8
 NC v1.7
 NC v1.7

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

WiFi module ESP32	
EMARD	
Sheet: /wifi/ File: wifi.sch	
Title: ULX3S	
Size: A4	Date:
KiCad E.D.A. kicad 5.0.2+dfsg1-1	Rev: 1.0.1 Id: 7/11



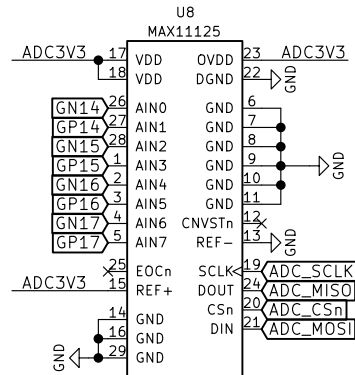
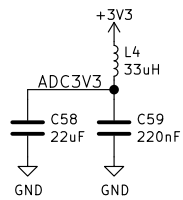
SDRAM memory	
EMARD	
Sheet: /ram/ File: ram.sch	
Title: ULX3S	
Size: A4	Date:
KiCad E.D.A. kicad 5.0.2+dfsg1-1	
Rev: 1.0.0	
Id: 8/11	



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

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

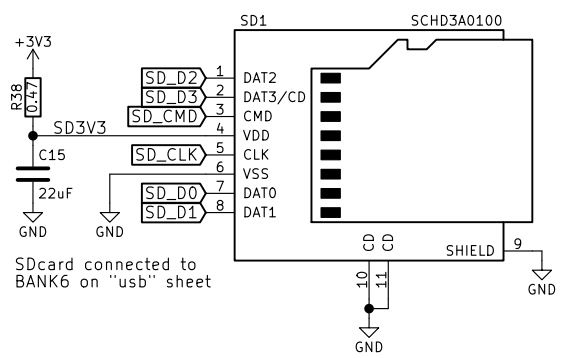
Size: A4

Date:

KiCad E.D.A. kicad 5.0.2+dfsg1-1

Rev: 1.0.3

Id: 9/11



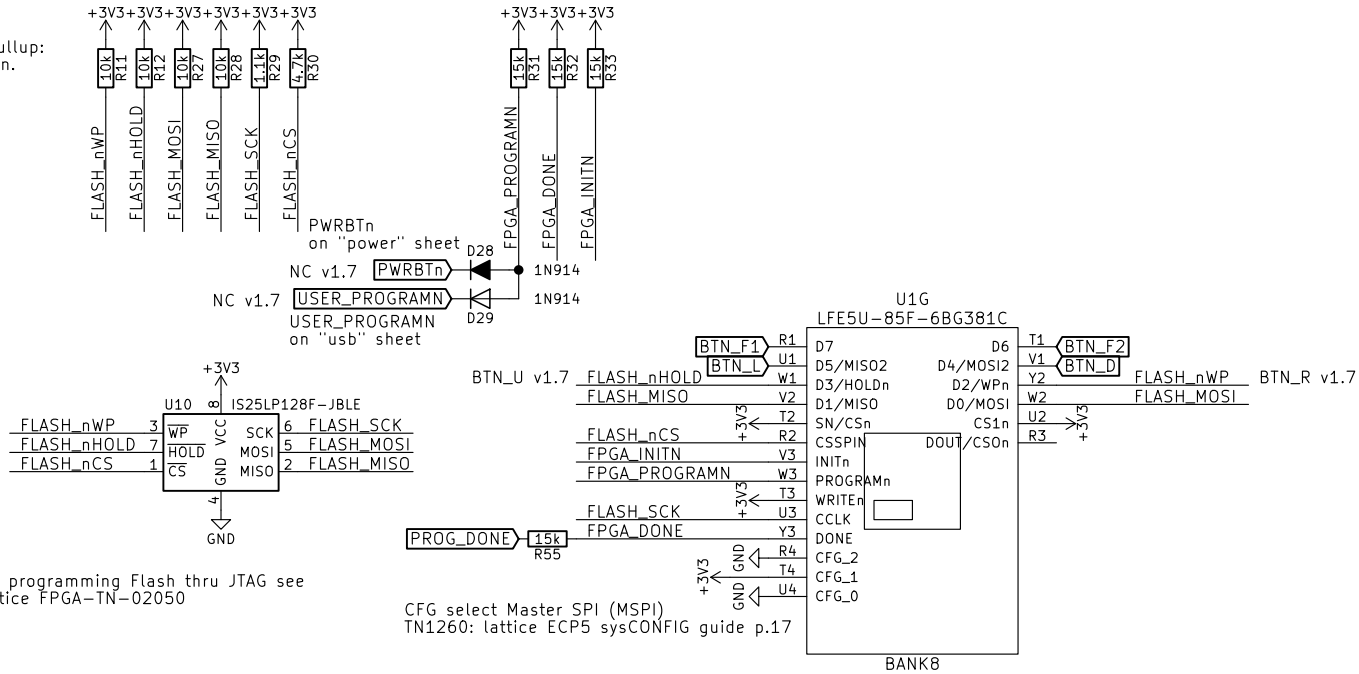
minimum pins for compatible mode
SD_CLK, SD_CMD, SD_D0, SD_D3

SD card	
EMARD	
Sheet: /sdcards/ File: sdcards.sch	
Title: ULX3S	
Size: A4	Date:
KiCad E.D.A. kicad 5.0.2+dfsg1-1	Rev: 1.0.0 Id: 10/11

Deviation from TN1260 in pullup values for BOM simplification. Correct values should be 1k but 1.1k is used.

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



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 5.0.2+dfsg1-1

Rev: 1.0.5
Id: 11/11