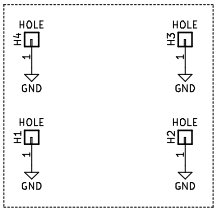


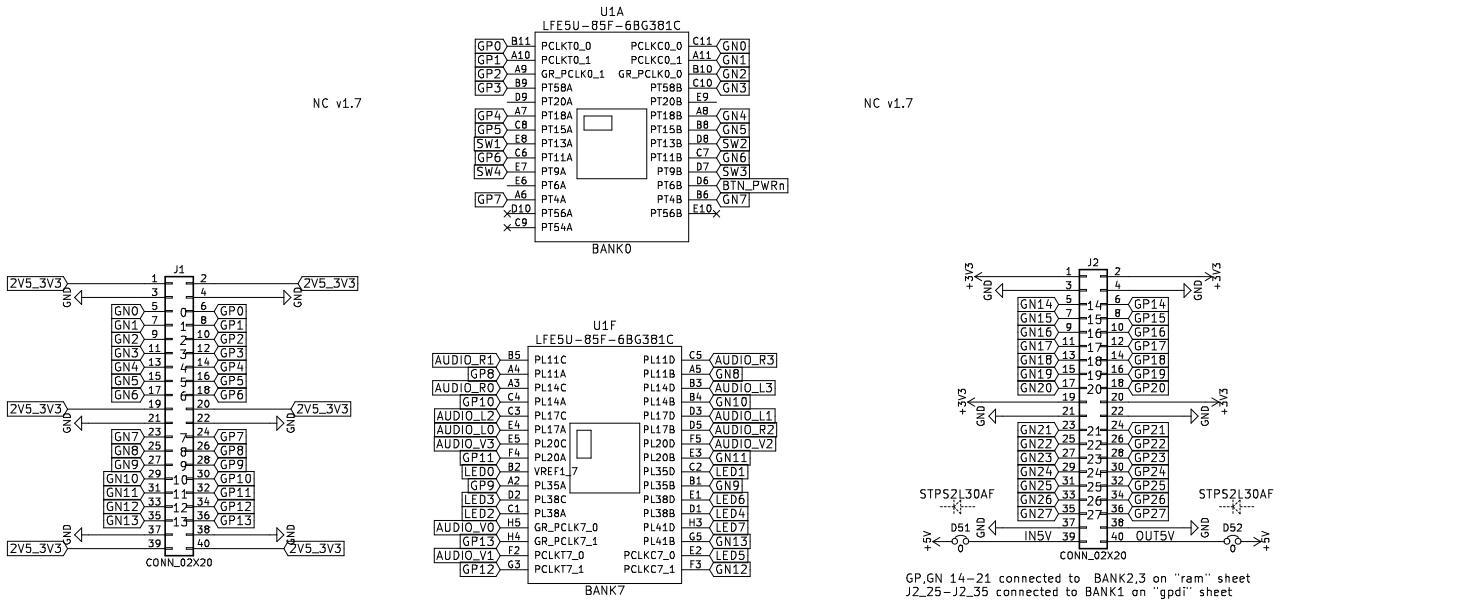
click on mouse pointer arrow on top of right toolbar
and double-click on sheet to open

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 5.0.1+dfsg1-3		Id: 1/11



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

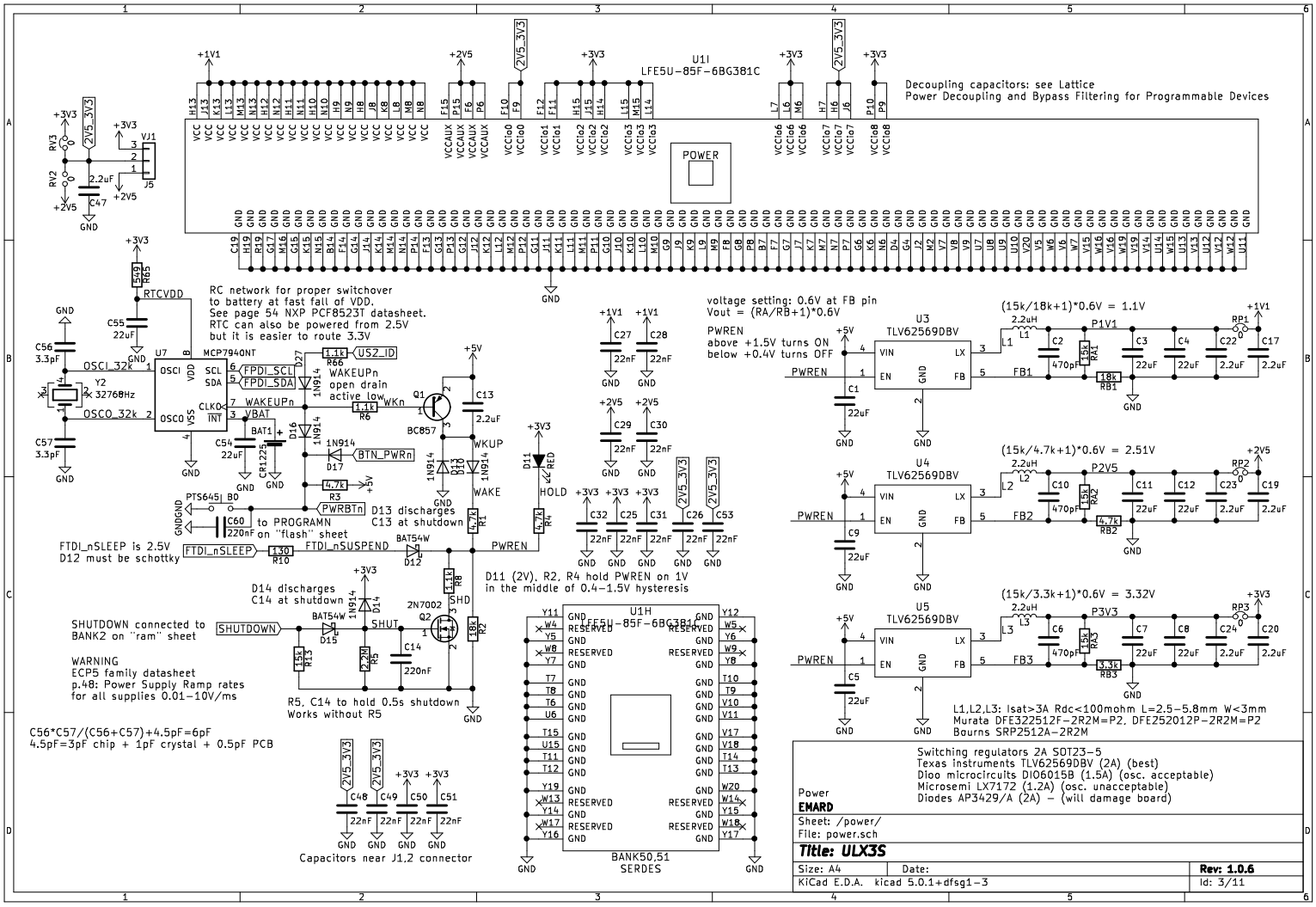
GPIO 2.54 mm connectors

EMARD

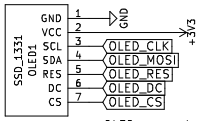
Sheet: /gpio/
File: gpio.sch

Title: ULX3S

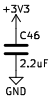
Size: A4	Date:	**Rev: 1.0.0**
KiCad E.D.A. kicad 5.0.1+dfsg1-3		Id: 2/11

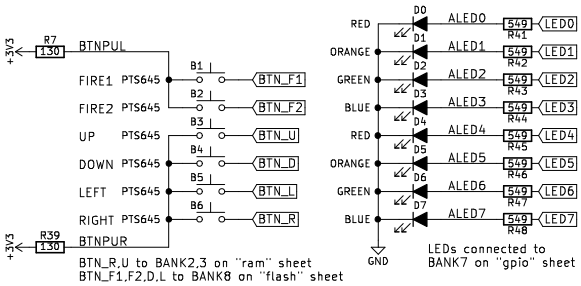

U1I
LFE5U-85F-6BG381C
Decoupling capacitors: see Lattice
Power Decoupling and Bypass Filtering for Programmable Devices
POWER
RC network for proper switchover
to battery at fast fall of VDD.
See page 54 NXP PCF8523T datasheet.
RTC can also be powered from 2.5V
but it is easier to route 3.3V
MCP7940NT
WAKEUPn
open drain
active low
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
C56*C57/(C56+C57)+4.5pF=6pF
4.5pF=3pF chip + 1pF crystal + 0.5pF PCB
Capacitors near J1,2 connector
U1H
LFE5U-85F-6BG381C
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
U3
TLV62569DBV
(15k/18k+1)*0.6V = 1.1V
U4
TLV62569DBV
(15k/4.7k+1)*0.6V = 2.51V
U5
TLV62569DBV
(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 5.0.1+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



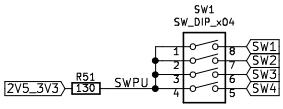
OLED connected to
BANK6 on "usb" sheet





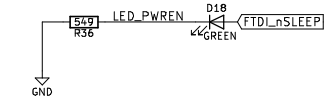
BTN_R,U to BANK2,3 on "ram" sheet
BTN_F1,F2,D,L to BANK8 on "flash" sheet

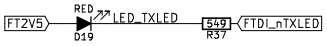
LEDs connected to
BANK7 on "gpio" sheet



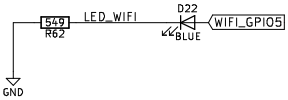
DIP switch connected to
BANK0 on 'gpio' sheet

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





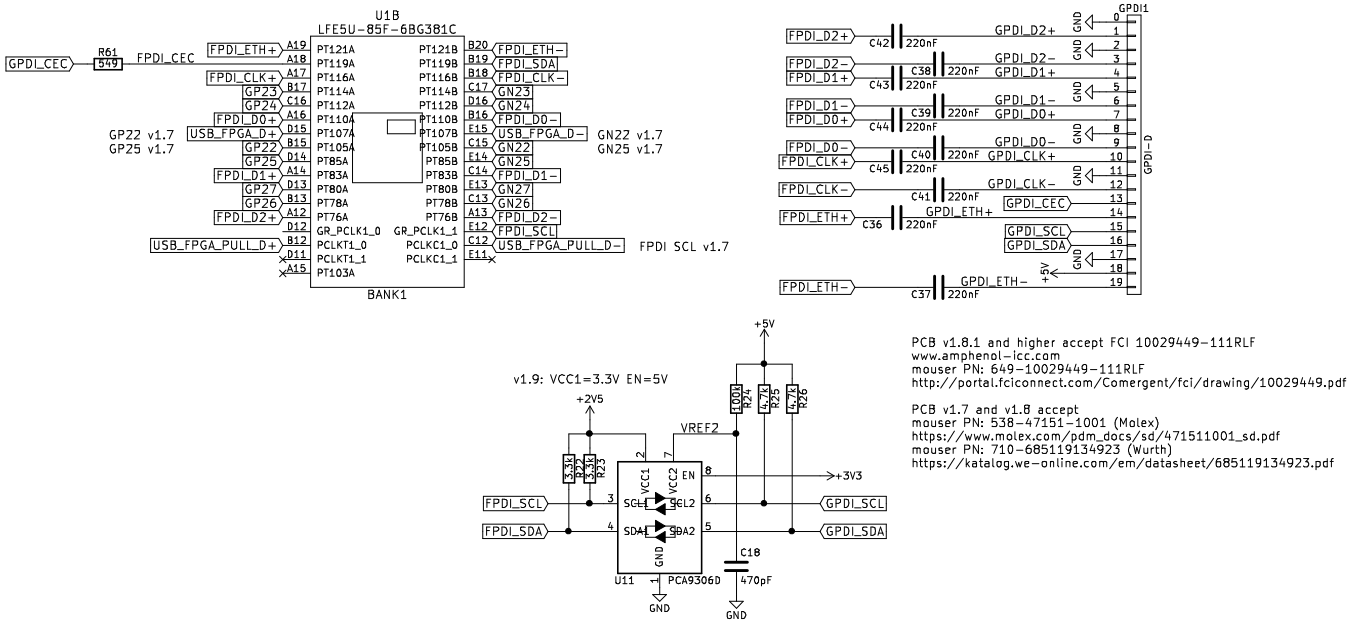
TXLED blinks when FPGA sends data to FTDI

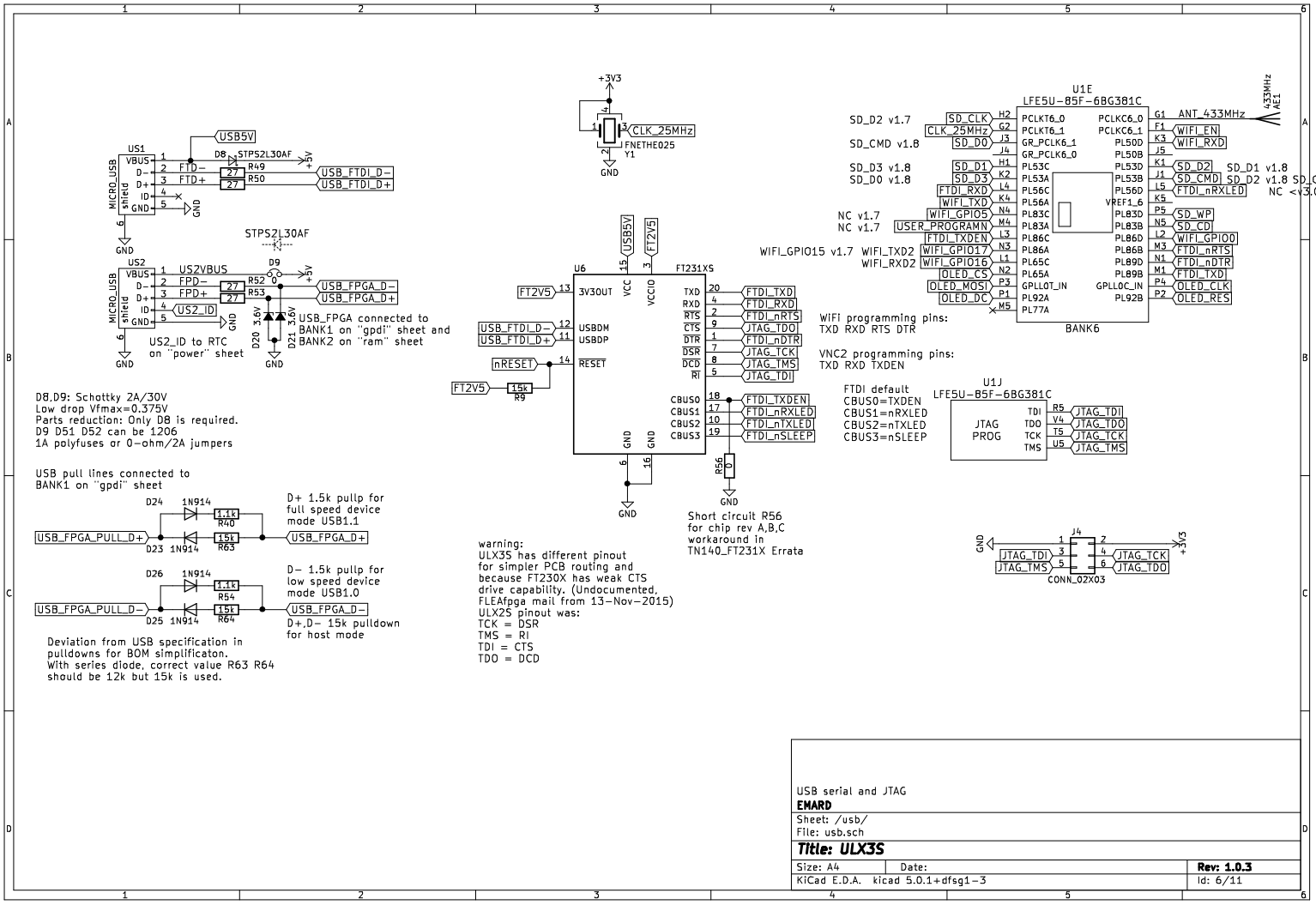


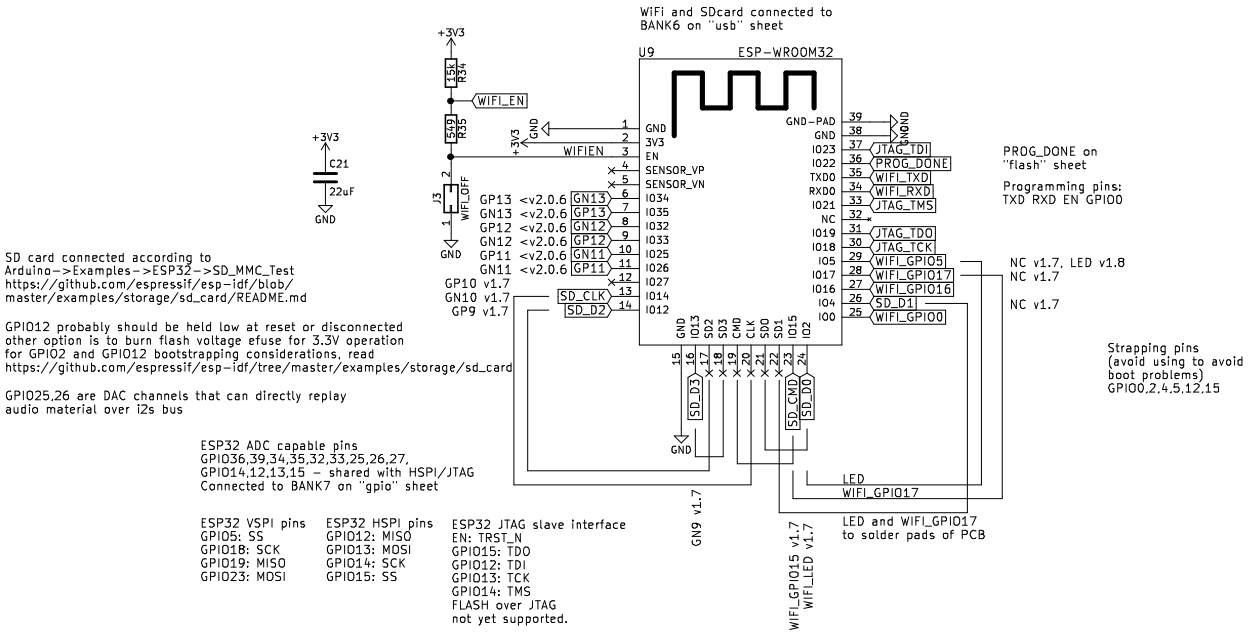
GPIO2 on PCB v1.7

Buttons, LEDs, OLED display
EMARD

Sheet: /blinkey/		
File: blinkey.sch		
Title: ULX3S		
Size: A4	Date:	**Rev: 1.0.0**
KiCad E.D.A. kicad 5.0.1+dfsg1-3		Id: 4/11


U1B
LFE5U-85F-6BG381C
BANK1
GPDI_CEC
R61
549
FPDI_CEC
FPDI_ETH+
FPDI_CLK+
GP23
GP24
FPDI_D0+
USB_FPGA_D+
GP22
GP25
FPDI_D1+
GP27
GP26
FPDI_D2+
USB_FPGA_PULL_D+
GP22 v1.7
GP25 v1.7
FPDI_ETH-
FPDI_SDA
FPDI_CLK-
GN23
GN24
FPDI_D0-
USB_FPGA_D-
GN22
GN25
FPDI_D1-
GN27
GN26
FPDI_D2-
FPDI_SCL
USB_FPGA_PULL_D-
GN22 v1.7
GN25 v1.7
FPDI SCL v1.7
GPDI1
GPDI-D
FPDI_D2+
C42
220nF
GPDI_D2+
FPDI_D2-
FPDI_D1+
C43
C38
GPDI_D2-
GPDI_D1+
FPDI_D1-
FPDI_D0+
C44
C39
GPDI_D1-
GPDI_D0+
FPDI_D0-
FPDI_CLK+
C45
C40
GPDI_D0-
GPDI_CLK+
FPDI_CLK-
C41
GPDI_CLK-
FPDI_ETH+
C36
GPDI_ETH+
GPDI_CEC
GPDI_SCL
GPDI_SDA
FPDI_ETH-
C37
GPDI_ETH-
GND
+5V
v1.9: VCC1=3.3V EN=5V
+2V5
VREF2
3.3k
R22
3.3k
R23
100k
R24
4.7k
R25
4.7k
R26
VCC1
VCC2
EN
SCL1
SCL2
SDA1
SDA2
GND
+3V3
FPDI_SCL
FPDI_SDA
GPDI_SCL
GPDI_SDA
U11
PCA9306D
C18
470pF
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 5.0.1+dfsg1-3
Id: 5/11


USB5V
US1
MICRO_USB
VBUS
D-
D+
ID
GND
shield
FTD-
FTD+
D8
STPS2L30AF
+5V
R49
R50
27
USB_FTDI_D-
USB_FTDI_D+
GND
STPS2L30AF
US2
US2VBUS
FPD-
FPD+
US2_ID
R52
R53
0
D9
USB_FPGA_D-
USB_FPGA_D+
US2_ID to RTC
on "power" sheet
D20
D21
3.6V
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
3V3OUT
VCC
VCCIO
USBDM
USBDP
RESET
nRESET
FT2V5
15k
R9
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
R56
0
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
SD_D3 v1.8
SD_D0 v1.8
NC v1.7
NC v1.7
WIFI_GPIO15 v1.7
WIFI_TXD2
WIFI_RXD2
SD_CLK
CLK_25MHz
SD_D0
SD_D1
SD_D3
FTDI_RXD
WIFI_TXD
WIFI_GPIO5
USER_PROGRAMN
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
GPLL0T_IN
PL92A
PL77A
PCLKC6_0
PCLKC6_1
PL50D
PL50B
PL53D
PL53B
PL56D
VREF1_6
PL83D
PL83B
PL86D
PL86B
PL89D
PL89B
GPLL0C_IN
PL92B
ANT_433MHz
433MHz
WIFI_EN
WIFI_RXD
SD_D2
SD_CMD
FTDI_nRXLED
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
NC <v3.0.5
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
J4
CONN_02X03
+3V3
USB serial and JTAG
EMARD
Sheet: /usb/
File: usb.sch
Title: ULX3S
Size: A4
Date:
Rev: 1.0.3
KiCad E.D.A. kicad 5.0.1+dfsg1-3
Id: 6/11



WIFI module ESP32

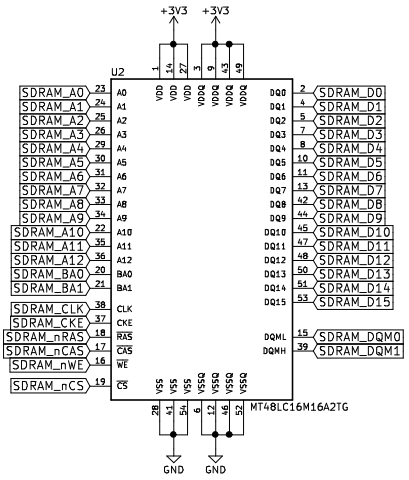
EMARD

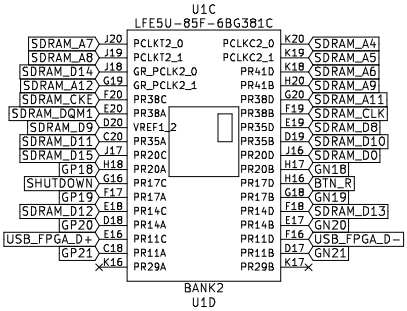
Sheet: /wifi/

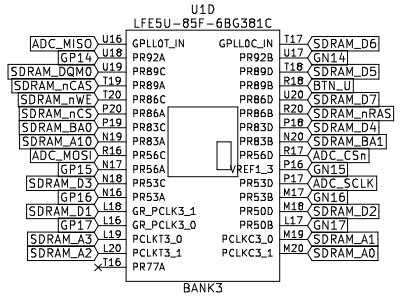
File: wifi.sch

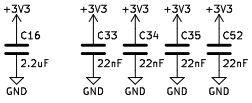
Title: ULX3S

Size: A4	Date:	**Rev: 1.0.1**
KiCad E.D.A. kicad 5.0.1+dfsg1-3		Id: 7/11









SDRAM memory

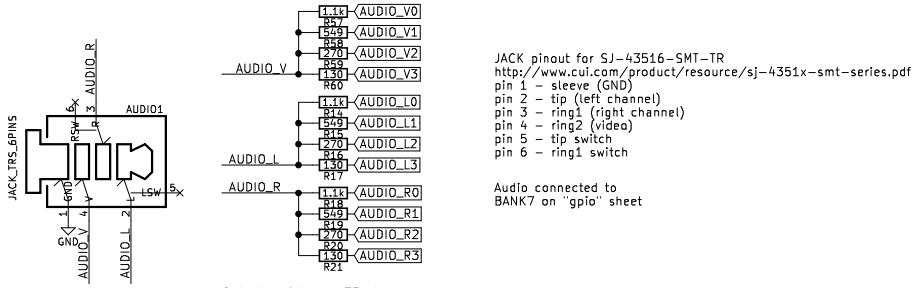
EMARD

Sheet: /ram/

File: ram.sch

Title: ULX3S

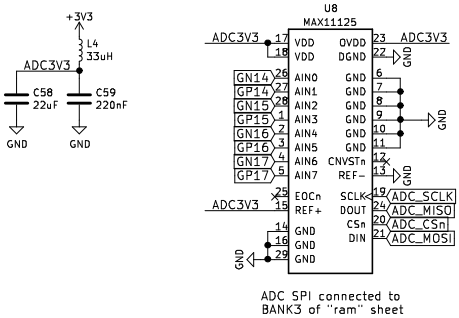
Size: A4	Date:	**Rev: 1.0.0**
KiCad E.D.A. kicad 5.0.1+dfsg1-3		Id: 8/11



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

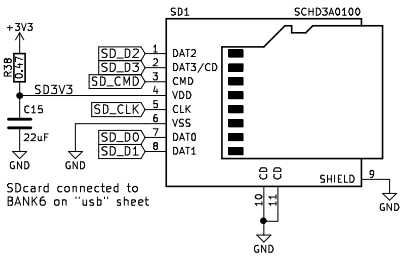
Output resistance: 75 ohm
Internal resistance of FPGA pin: 10 ohm
1/(1/(130+10)+1/(270+10)+1/(549+10)+1/(1100+10))=74.6



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 5.0.1+dfsg1-3		Id: 9/11



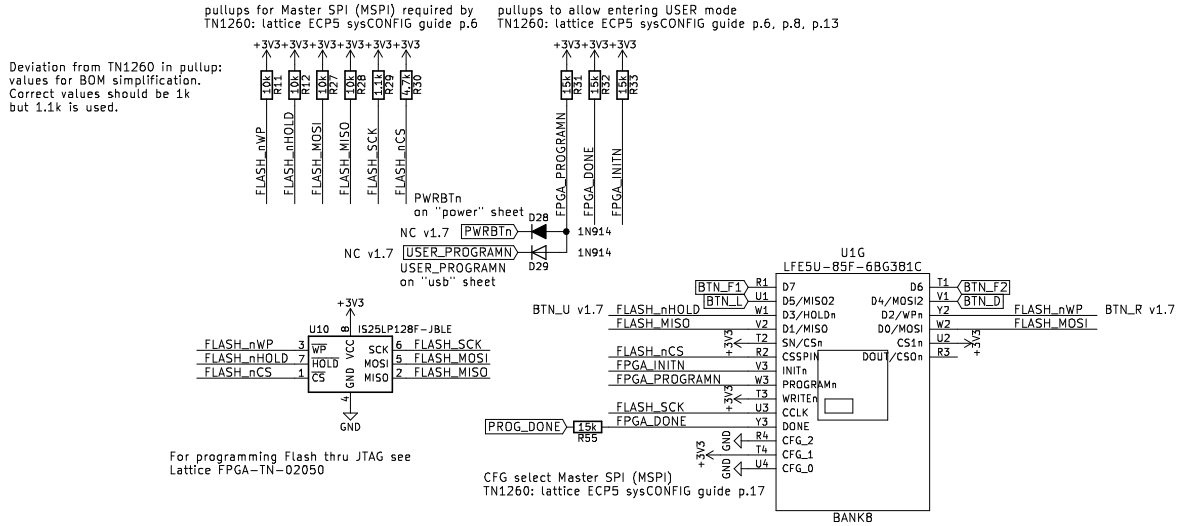
minimum pins for compatible mode
SD_CLK, SD_CMD, SD_D0, SD_D3

SD card
EMARD

Sheet: /sdcard/
File: sdcard.sch

Title: ULX3S

Size: A4	Date:	**Rev: 1.0.0**
KiCad E.D.A. kicad 5.0.1+dfsg1-3		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 5.0.1+dfsg1-3		Id: 11/11