FPGA

iCE40-HX8k-BG121 U1B

	D6	VCCIO_0
	A11	IOT_168
	A10	IOT_170
	C9	IOT_172
	B9	IOT_174
	B8	IOT_177
	A9	IOT_178
	C8	IOT_179
	D7	IOT_181
FPGA_HEARTBEAT	A8	IOT_190
FPGA_UART_RX	C7	IOT_191
FPGA_UART_TX	A7	IOT_192
GPIO_SW0	A6	IOT_206
GPIO_SW1	A5	IOT_207
GPIO_SW2	B5	IOT_208
GPIO_SW3	A4	IOT_211
GPIO_SW4	D5	IOT_212
GPIO_SW5	B4	IOT_219
GPIO_SW6	B3	IOT_221
GPIO_SW7	A2	IOT_222
GPIO_SW8	A3	IOT_223
GPIO_SW9	A1	IOT_225
	B7	IOT_197_GBIN1
	B6	IOT_198_GBIN0

iCE40-HX8k-BG121 U1D

	H6	VCCIO_2
SRAM_A17	L1	IOB_56
	J3	IOB_57
SRAM_DQ6	L2	IOB_61
SRAM_DQ7	K3	IOB_63
SRAM_DQ2	J4	IOB_64
SRAM_DQ8	L3	IOB_71
SRAM_A15	L4	IOB_72
SRAM_WE	K4	IOB_73
SRAM_DQ3	J5	IOB_78
SRAM_A14	K5	IOB_79
SRAM_DQ5	J7	IOB_86
SRAM_DQ4	H7	IOB_87
SRAM_A13	K7	IOB_89
	J8	IOB_91
SRAM_A12	L7	IOB_94
SRAM_A16	L8	IOB_103_CBSEL0
	H9	IOB_104_CBSEL1
CLK_OSC	L5	IOB_81_GBIN5
	K6	IOB_82_GBIN4

VPP_FAST for NVCM programming only.
Do not connect.
VPP_2V5 can be tied to 3V3 when
not programming NVCM.

iCE40-HX8k-BG121 U1A

	H4	VCC
	H8	VCC
	D4	VCC
	D8	VCC
	C10	VPP_2V5
	B10	VPP_FAST
VCCPLL1	C6	VCCPLL1
VCCPLL0	J6	VCCPLL0
	C5	GNDPLL1
	L6	GNDPLL0
	H5	GND
	G7	GND
	G6	GND
	G5	GND
	F7	GND
	F6	GND
	F5	GND
	E7	GND
	E6	GND
	E5	GND

R7 10 R8 10

C3 1u C5 1u

DC Connection
GNDPLL <-> GND
is made internally

FPGA decoupling

C6 0.1u C8 0.1u C10 0.1u C12 0.1u

C7 0.1u C9 0.1u C11 0.1u C13 0.1u

VCCPLL1 PWR_FLAG

VCCPLL0 PWR_FLAG

Separate nets from 1V2
due to RC filter. Must
explicitly mark as powered.

iCE40-HX8k-BG121 U1C

	F8	VCCIO_1
LCD_CS	J11	IOR_114
LCD_DC	K11	IOR_115
LCD_SDA	H10	IOR_116
LCD_SCL	J10	IOR_117
LCD_RESET	G8	IOR_118
LCD_SDO	H11	IOR_119
LCD_PWM	G10	IOR_120
AUDIO_PWM	G9	IOR_128
	G11	IOR_129
	F10	IOR_136
	F9	IOR_137
	E9	IOR_144
	E8	IOR_146
uSD_DAT0	D9	IOR_147
uSD_DAT1	E11	IOR_148
uSD_DAT2	D11	IOR_152
uSD_DAT3	D10	IOR_154
uSD_CMD	C11	IOR_160
uSD_CLK	B11	IOR_161
	E11	IOR_140_GBIN3
	E10	IOR_141_GBIN2

iCE40-HX8k-BG121 U1E

	E4	VCCIO_3
	G4	VCCIO_3
SRAM_A5	B1	IOL_2A
SRAM_A4	B2	IOL_2B
SRAM_A3	C4	IOL_4A
SRAM_A2	C3	IOL_4B
SRAM_A6	C2	IOL_5A
SRAM_A7	C1	IOL_5B
SRAM_DQ16	E1	IOL_8A
SRAM_UB	D1	IOL_8B
SRAM_OE	D2	IOL_9A
SRAM_A1	D3	IOL_9B
SRAM_LB	E2	IOL_10A
SRAM_A0	E3	IOL_10B
SRAM_DQ14	F1	IOL_12A
SRAM_DQ15	F2	IOL_12B
SRAM_CE	F4	IOL_13A
SRAM_DQ13	G2	IOL_14B
SRAM_DQ1	G3	IOLB_17A
SRAM_A11	H3	IOL_17B
SRAM_DQ10	H1	IOL_18A
SRAM_DQ11	H2	IOL_18B
SRAM_A8	J1	IOL_23A
SRAM_A10	K1	IOL_23B
SRAM_A9	K2	IOL_25A
SRAM_DQ9	J2	IOL_25B
	F3	IOL_13B_GBIN7
SRAM_DQ12	G1	IOL_14A_GBIN6

Note there is extensive scrambling here
to decongest FPGA->SRAM routing

RN4 10k

iCE40-HX8k-BG121 U1F

	L11	VCC_SPI
FPGA_CFG_DONE	K8	CDONE
FPGA_CFG_RST	L9	CRESET_B
	K9	IOB_105_SDO
FPGA_CFG_SI	J9	IOB_106_SDI
FPGA_CFG_SCK	L10	IOB_107_SCK
FPGA_CFG_SS	K10	IOB_108_SS

12MHz MEMS oscillator

DSC60XX U2

	1	STBY
	2	GND
	4	VCC
CLK_OSC	3	OUT

C4 0.1u

Charger

U4 BQ21040

	6	VIN
	5	GND
	2	OUT
	3	CHG
	4	ISET
	1	TS

P2 CONN_01X02

C14 1u

10k R9 680 R10 680 R11 D2 LED CHARGE

Dual Buck Converter

U5 NCP1532

	3	VIN
	5	GND
	2	EN1
	6	SYNC
	9	EN2
	4	SW1
	1	FB1
uC_RST	8	POR
	7	SW2
	10	FB2

C20 1u

SWITCH_SPST SW1

10k R12

2u2 L1 450k R17 100k R18

C24 18p C26 10u C28 1u

2u2 L2 100k R19 100k R20

C25 18p C27 10u C29 1u

TP11 TestPoint
TP12 TestPoint
TP13 TestPoint

TP14 Tie_point

Inductors:
490-15987-1-ND
or similar

SRAM

GS74116AGP/ U3

	33	VDD
	11	VDD
SRAM_A0	5	A0
SRAM_A1	4	A1
SRAM_A2	3	A2
SRAM_A3	2	A3
SRAM_A4	1	A4
SRAM_A5	44	A5
SRAM_A6	43	A6
SRAM_A7	42	A7
SRAM_A8	27	A8
SRAM_A9	26	A9
SRAM_A10	25	A10
SRAM_A11	24	A11
SRAM_A12	21	A12
SRAM_A13	20	A13
SRAM_A14	19	A14
SRAM_A15	18	A15
SRAM_A16	22	A16
SRAM_A17	23	A17
	34	VSS
	12	VSS
	7	DQ1
	8	DQ2
	9	DQ3
	10	DQ4
	13	DQ5
	14	DQ6
	15	DQ7
	16	DQ8
	29	DQ9
	30	DQ10
	31	DQ11
	32	DQ12
	35	DQ13
	36	DQ14
	37	DQ15
	38	DQ16
	6	CE
	17	WE
	41	OE
	40	UB
	39	LB
	28	NC

SRAM_DQ1 SRAM_DQ2 SRAM_DQ3 SRAM_DQ4 SRAM_DQ5 SRAM_DQ6 SRAM_DQ7 SRAM_DQ8 SRAM_DQ9 SRAM_DQ10 SRAM_DQ11 SRAM_DQ12 SRAM_DQ13 SRAM_DQ14 SRAM_DQ15 SRAM_DQ16

SRAM_CE SRAM_WE SRAM_OE SRAM_UB SRAM_LB

C15 1u C16 0.1u

Micro USB B connector

C23 10u

USB_DM USB_DP

R16 NF

J3 USB_OTG

	1	VBUS
	2	D-
	3	D+
	4	ID
	5	GND
	6	shield

Microcontroller
Provides:
- FPGA configuration image stored in flash
- USB <-> UART
- USB <-> SD Card

U6 SAML22G18A

	44	VDDIO
	36	VDDIO
	17	VDDIO
	19	VLCD
	6	VDDANA
	43	VDDOUT
	41	VDDCORE
	1	PA00
	2	PA01
	3	PA02
	4	PA03
uSD_CMD	9	SC0P0/PA04
uSD_CLK	10	SC0P1/PA05
uSD_DAT3	11	SC0P2/PA06
uSD_DAT0	12	SC0P3/PA07
	13	PA08
	14	PA09
	15	PA10
	16	PA11
	21	PA12
	22	PA13
FPGA_CFG_DONE	23	PA14
FPGA_CFG_RST	24	PA15
FPGA_CFG_SI	25	SC1P0/PA16
FPGA_CFG_SCK	26	SC1P1/PA17
FPGA_CFG_SS	27	SC1P2/PA18
	28	SC1P3/PA19
	29	SC2P2/PA20
	30	SC2P3/PA21
	31	SC2P0/PA22
	32	SC2P1/PA23
USB_DM	33	USBDM/PA24
USB_DP	34	USBDP/PA25
	39	PA27
	47	PB02
	48	PB03
FPGA_UART_TX	7	SC3P0/PB08
FPGA_UART_RX	8	SC3P1/PB09
	20	PB22
	37	PB23
	45	PA30/SWCLK
	46	PA31/SWDIO
	40	RST
	35	GND
	18	GND
	5	GND
	42	GNDANA
	49	GNDPAD

SPI Mode:
CMD -> MOSI
CLK -> SCLK
DAT3 -> SS
DAT0 -> MISO

C18 1u C19 0.1u

C21 1u C22 0.1u

RN3 10k

uC_SWCLK uC_SWD uC_RST

AUDIO_PWM

parallel resistors are just to
avoid more unique values

680 R13 680 R15 220 R14 C30 0.1u P4 CONN_01X02

Display Connector

ILI9341 P1

	1	GND
LCD_RESET	2	RESET
LCD_SDO	3	SCL
LCD_SDA	4	D/C
LCD_CS	5	CS
LCD_DC	6	SDA
LCD_SCL	7	SDO
	8	GND
	9	VCC
	10	LEDA
	11	LEDK1
	12	LEDK2
	13	LEDK3
	14	LEDK4
	15	XL
	16	YU
	17	XR
	18	YD

220 R2 220 R3 220 R4 220 R5

Q1 BSS816NW

10k R1

C1 1u C2 1u

Multiple resistors helps
backlight uniformity

LCD_RESET TP15 TestPoint
LCD_SCL TP1 TestPoint
LCD_DC TP2 TestPoint
LCD_CS TP3 TestPoint
LCD_SDA TP4 TestPoint

Any small signal NMOS is fine.
This one was just cheap in small qty

FPGA_HEARTBEAT D1 LED 680 R6

Debug/Chicken Connector

J1 Conn_01x12

	12	
FPGA_CFG_SI	11	
FPGA_CFG_SCK	10	
FPGA_CFG_SS	9	
FPGA_CFG_DONE	8	
FPGA_CFG_RST	7	
uC_RST	6	
uC_SWCLK	5	
uC_SWD	4	
FPGA_UART_TX	3	
FPGA_UART_RX	2	
	1	

Buttons
(use internal pullups
in iCE40 pads)

J2 Conn_01x06

GPIO_SW0	1
GPIO_SW1	2
GPIO_SW2	3
GPIO_SW3	4
GPIO_SW4	5
	6

J4 Conn_01x06

GPIO_SW5	1
GPIO_SW6	2
GPIO_SW7	3
GPIO_SW8	4
GPIO_SW9	5
	6

RN1 10k RN2 10k

Micro SD Card Socket

SPI Mode:
DAT3 -> SS
CLK -> SCLK
CMD -> MOSI
DAT0 -> MISO

J3 Micro_SD_Card_Det

TP5	1	DAT2
TP6	2	DAT3/CD
TP7	3	CMD
	4	VDD
TP8	5	CLK
	6	VSS
TP9	7	DAT0
TP10	8	DAT1
	10	DET_A
	9	DET_B
	11	SHIELD

uSD_DAT2 uSD_DAT3 uSD_CMD uSD_CLK uSD_DAT0 uSD_DAT1

C17 0.1u

FPGA_UART_TX FPGA_UART_RX

Luke Wren

Sheet: /
File: fpgaboy.sch

Title: FPGABoy Logic Board

Size: A3	Date: 2018-02-11	**Rev: A**
KiCad E.D.A. kicad 5.0.1-33cea8e68ubuntu18.10.1		Id: 1/1