
MAXEVK Hardwaremanual

Release 1

ARIES Embedded GmbH

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ABOUT THIS MANUAL

1.1 Imprint

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1.2 Disclaimer

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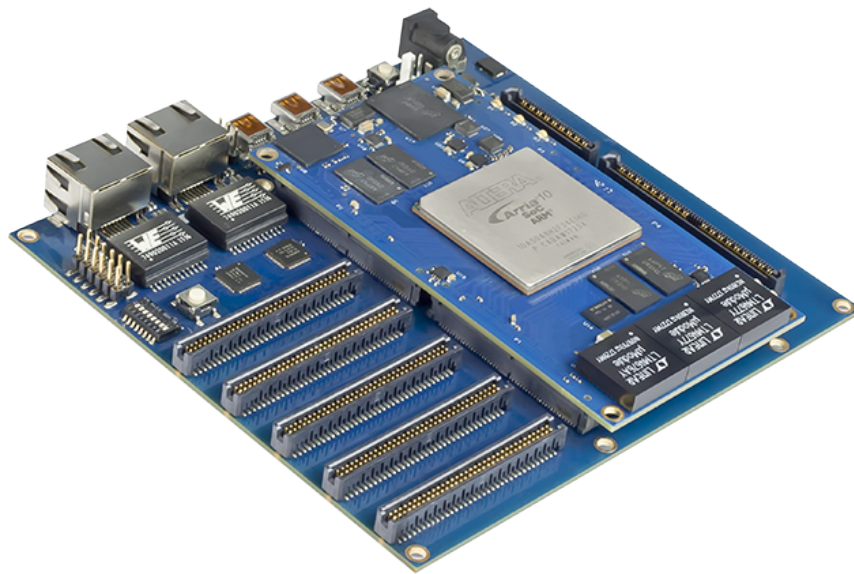
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1.5 Care and Maintenance

- Keep the device dry. Precipitation, humidity, and all types of liquids or moisture can contain minerals that will corrode electronic circuits. If your device does get wet, allow it to dry completely.
- Do not use or store the device in dusty, dirty areas. Its moving parts and electronic components can be damaged.
- Do not store the device in hot areas. High temperatures can shorten the life of electronic devices, damage batteries, and warp or melt certain plastics.
- Do not store the device in cold areas. When the device returns to its normal temperature, moisture can form inside the device and damage electronic circuit boards.
- Do not attempt to open the device.
- Do not drop, knock, or shake the device. Rough handling can break internal circuit boards and fine mechanics.
- Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the device.
- Do not paint the device. Paint can clog the moving parts and prevent proper operation.
- Unauthorized modifications or attachments could damage the device and may violate regulations governing radio devices.

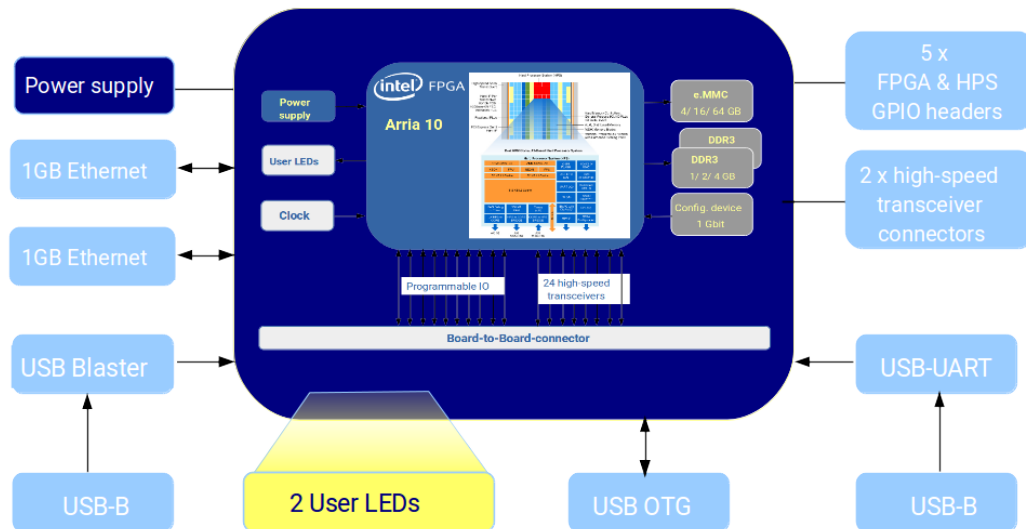
1.6 Change Log

Revision	Date	Revised	Comment
1.0	28.05.2020	js, aw	Initial creation

OVERVIEW

The MAXEVK was developed to serve the MAX System on Modul, based on Arria 10 SoC-FPGA devices. It offers most interfaces of the HPS Subsystem and all FPGA I/O pins on to a 1,27mm pin header. 24 transceiver channels are available at two Samtec high-speed connectors. The HPS supports two Gigabit Ethernet interfaces, one USB OTG interface as well as a UART/USB converter. For in-system-programming a USB-Blaster II is implemented.

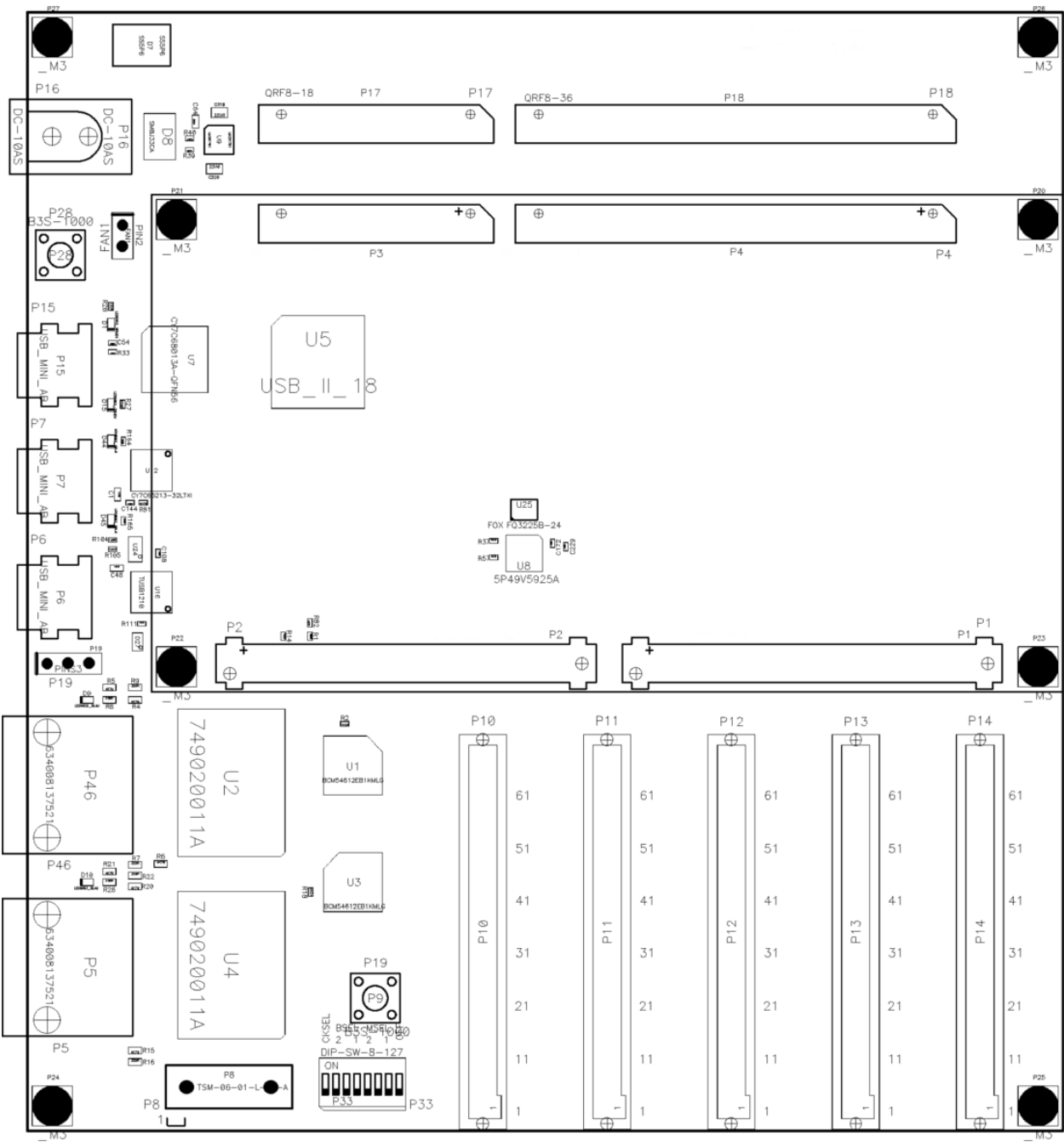
2.1 Block Diagram



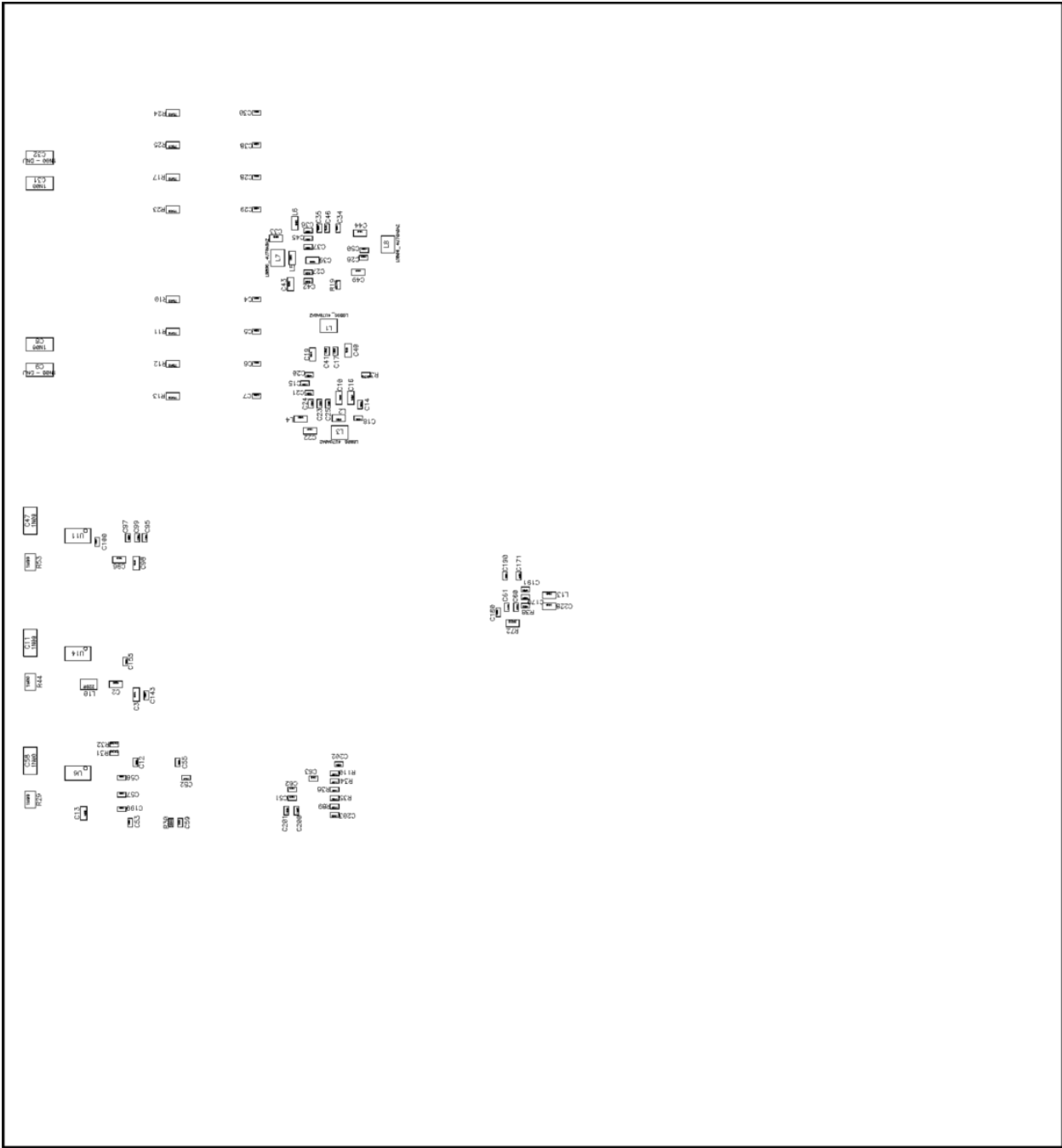
2.2 Feature Set

The MAXEVK provides the following features

- 2 x Gigabit Ethernet
- USB-OTG
- UART / USB converter
- embedded USB-Blaster II
- 5 x pinheader for FPGA / HPS signals
- 2 x high-speed connectors for 24 transceiver
- 12V power supply
- clock generation for Ethernet / USB
- wall plug power supply
- size: 180 x 180mm

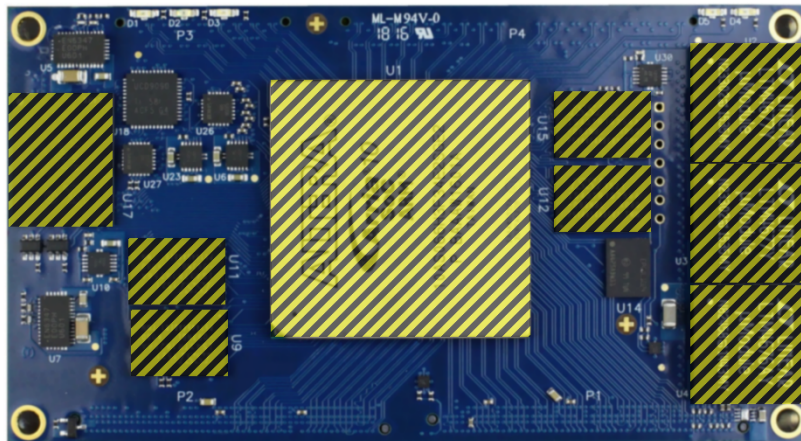


2.3.2 Components Bottom Side



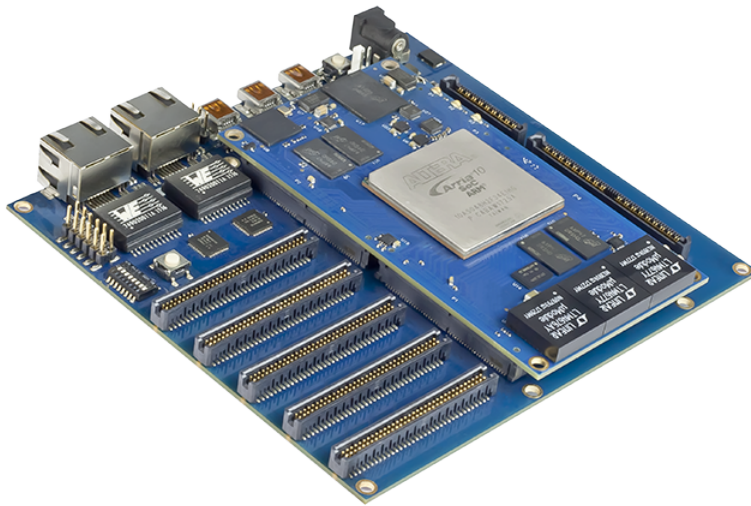
2.4 Handling Recommendations

The populated Samtec connectors require certain mechanical force to insert the SoM into its mating baseboard connectors. To avoid mechanical damage to the components populated on MAX it is strongly recommended not to apply mechanical force on the Ball Grid Array (BGA) components. The BGA components are marked as shaded in the figure below:



MAXEVK

The MAXEVK was designed for board bring-up and board testing of the MAX Arria 10 SoM. It provides several interfaces for all the on-module functions.



HPS:

- Dual Gigabit Ethernet
- USB OTG
- UART / USB Interface

FPGA:

- Pinheader for all I/O Pins
- Transceiver

Miscellaneous:

- Fan header
- Embedded USB Blaster
- JTAG connection to MAX10
- Power Supply

3.1 DIP-Switch (P33)

The DIP Switch is used to configure the modules. It contains the *MSEL*, *BSEL* Signals and the *IDT Clock Select* signal. The last switch can be used to switch the board on and off. The default setting is *OFF*.

MSEL Pins default setting: **AS standard**

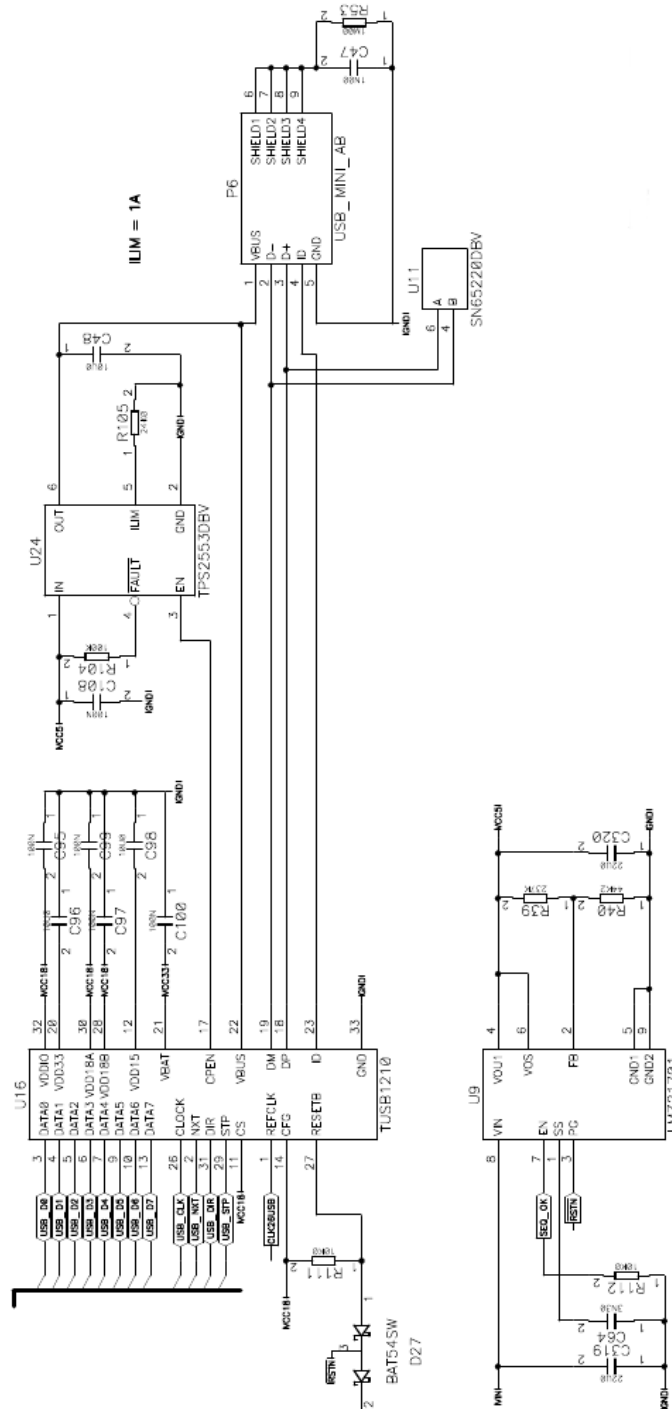
BSEL Pins default setting: **eMMC boot**

Nr.	Function
1	IDT Clock Select for Transceiver Clocks ON: external Clock from P3 OFF: internal Crystal (25 MHz)
2	BSEL2 ON: 0 OFF: 1
3	BSEL1 ON: 1 OFF: 0
4	BSEL0 ON: 0 OFF: 1
5	MSEL2 ON: 1 OFF: 0
6	MSEL1 ON: 0 OFF: 1
7	MSEL0 ON: 0 OFF: 1
8	EXT_OFF ON: Switch Module OFF OFF: Power up Module

[illegible]

3.3 USB - OTG

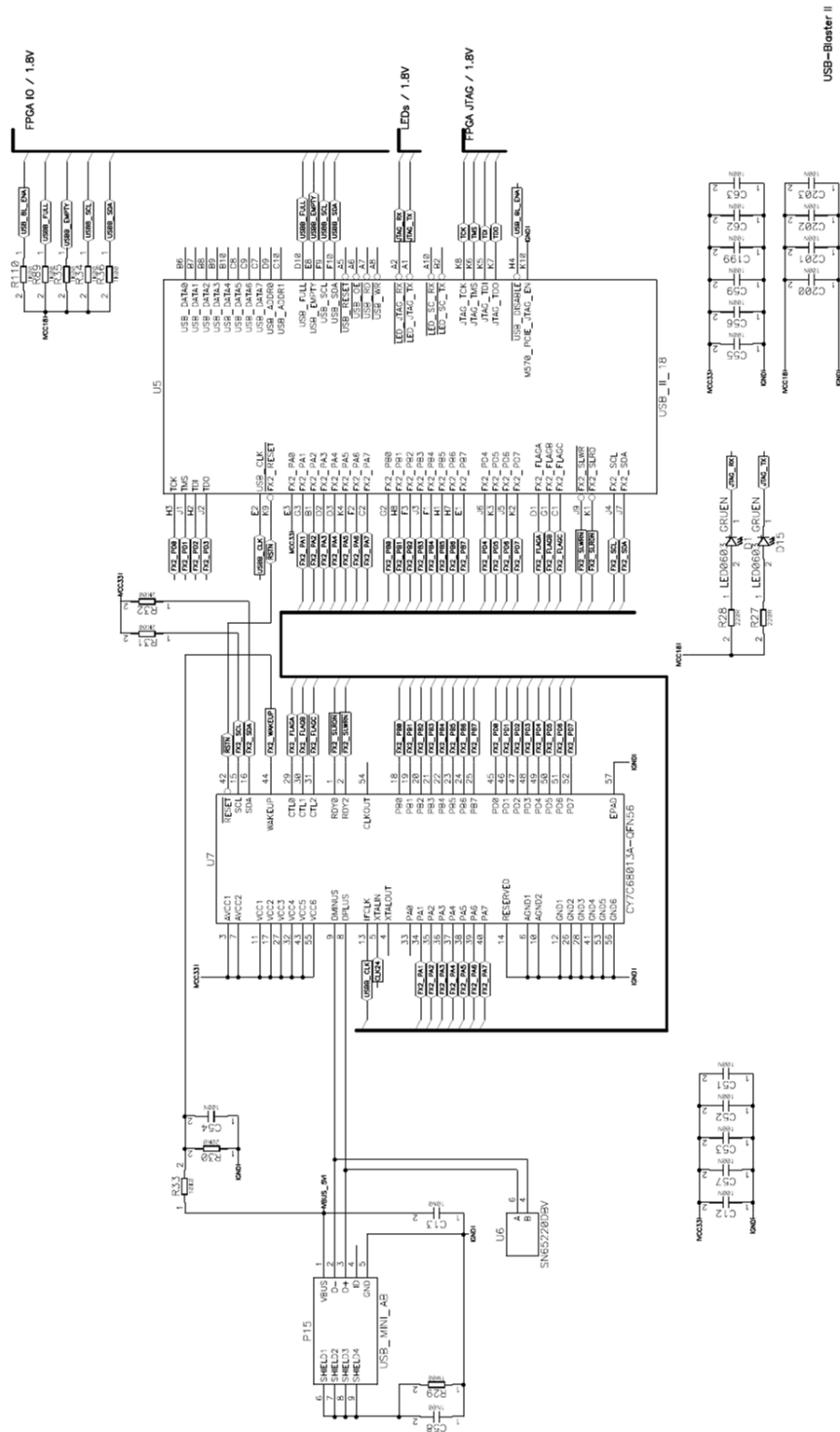
A **TUSB1210** USB OTG Phy is implemented on the board, together with a 5V power switch and the mini USB connector P6.



3.4 USB-Blaster II

The MAXEVK base board is equipped with an on-board USB-Blaster-II, which can be used as programming and debugging interface for the MAX module.

The module provides one JTAG port, where the FPGA and the HPS are chained together.

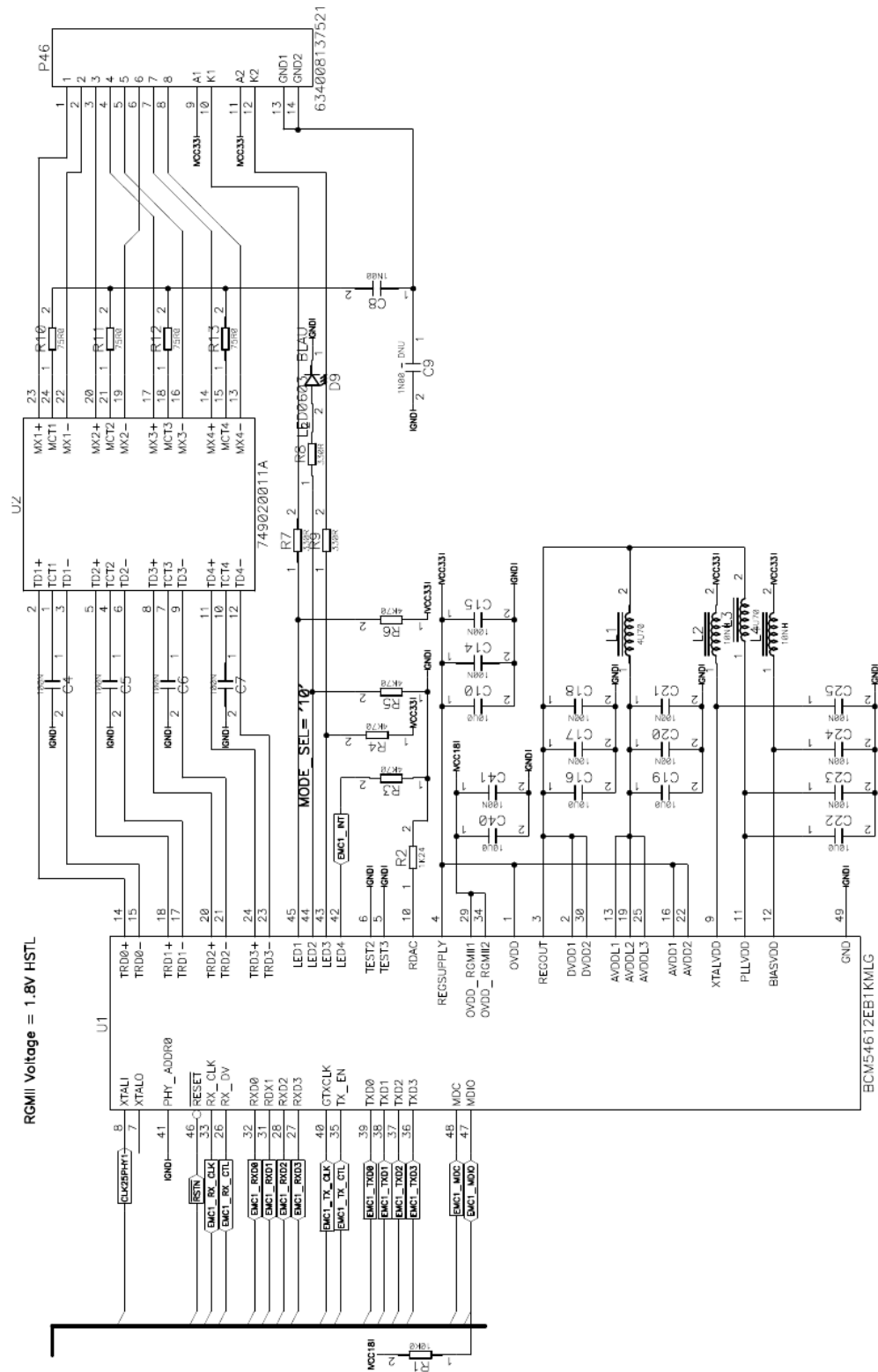


3.5 Gigabit Ethernet

The base board provides two Broadcom BCM54612 Gigabit Ethernet Phys, the Gigabit Ethernet transformer and the RJ45 connector. The two PHY LEDs are also connected to the RJ45 LEDs. A third LED on the board shows the Gigabit Link status.

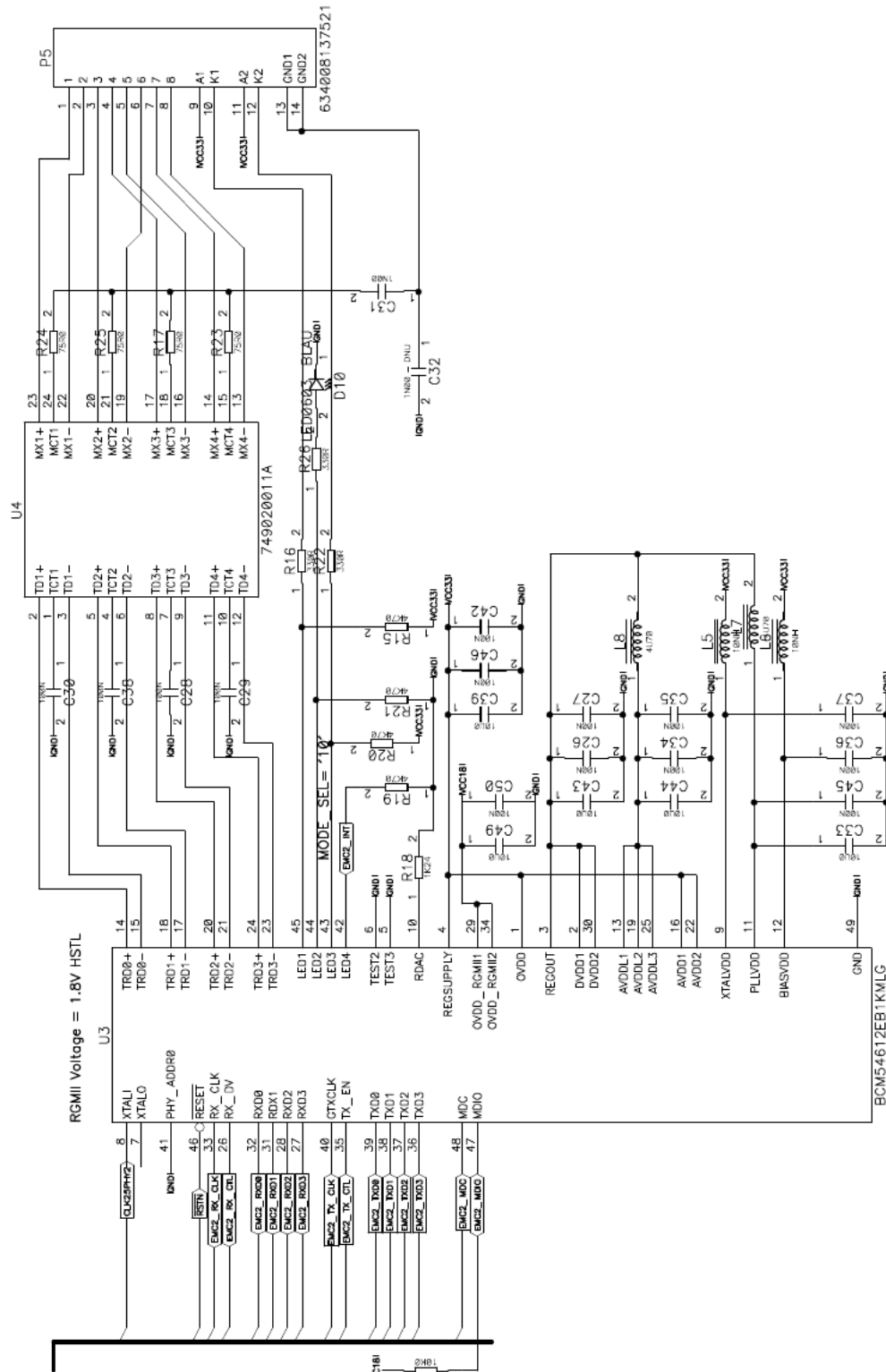
3.6 Gigabit Ethernet 1

Phy Address: 00000 Connector: P46 Connector type: TJ45



3.7 Gigabit Ethernet 2

Phy Address: 00000 Connector: P5 Connector type: TJ45



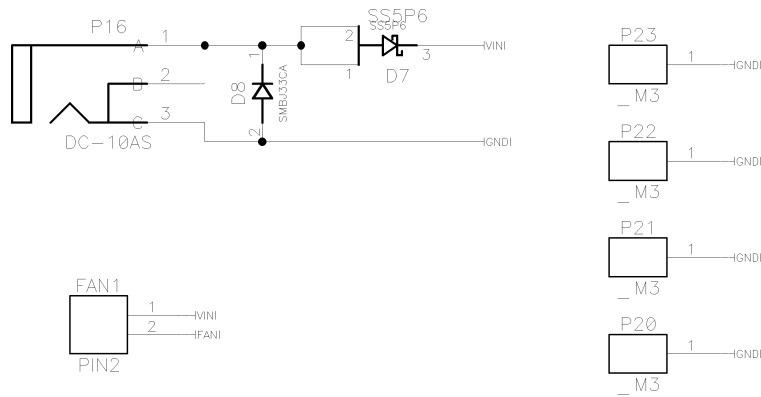
3.8 Power Supply

The power stage is build for an input voltage of 12V. The 12V is provided to the MAX-SoC module and is used for a 5V rail on the baseboard - mainly for the USB-OTG supply. The power plug is a DC10 connector.

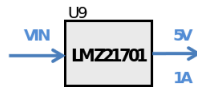
Out: GND

IN: 12V

Power Supply:



5V Rail:



3.9 Reset Buttons

The button P9 activates the HPS_RSTN signal, which is connected to the HPS warm reset input.

P28 is the power good reset button.

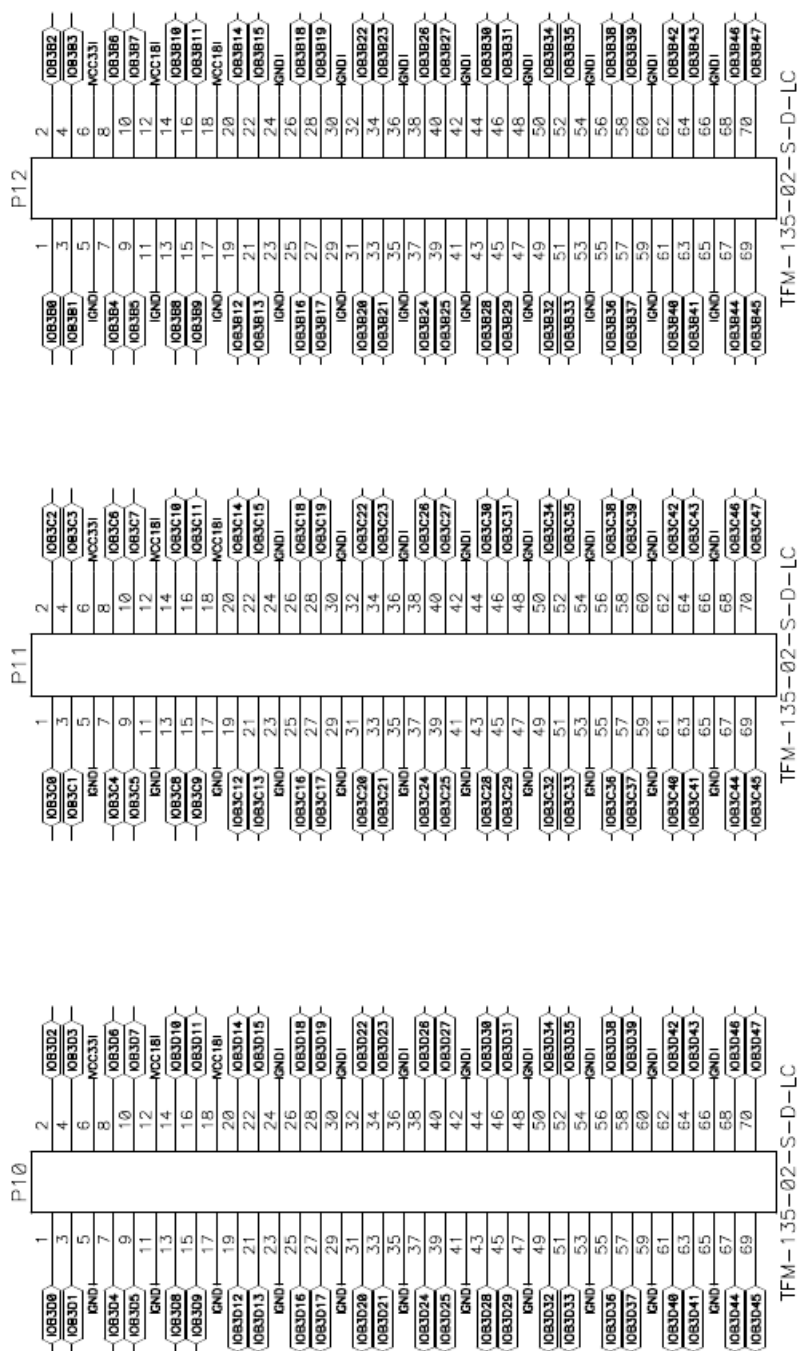
3.10 FAN header

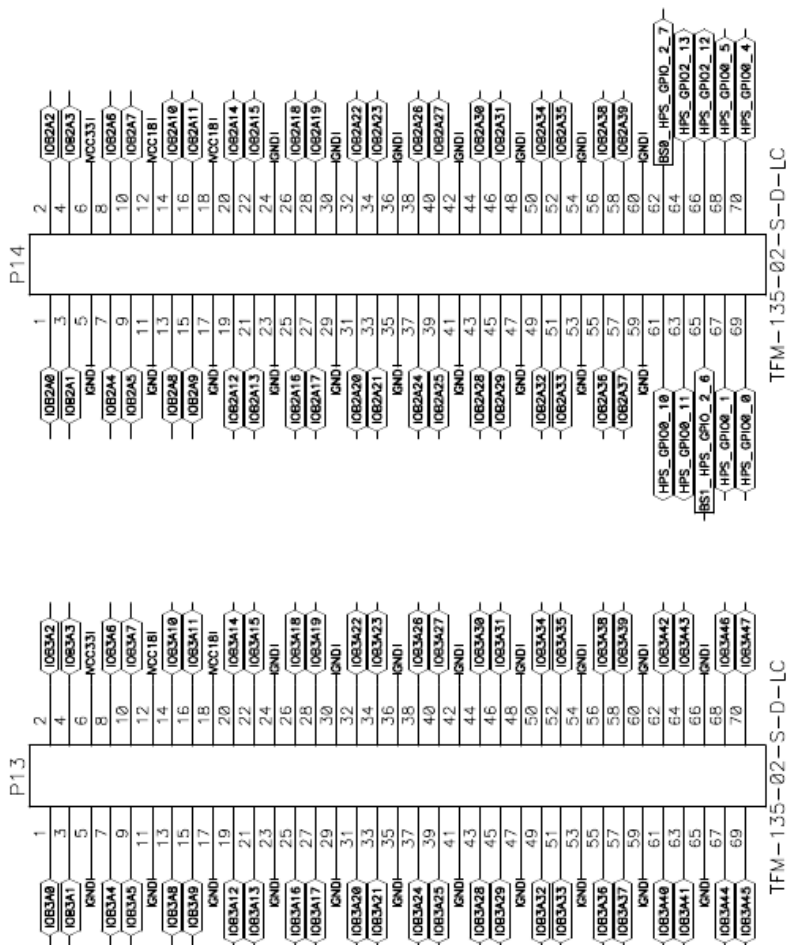
The FAN1 header provides the connection to the FAN of the module.

Pin	Function
1	VIN
2	FAN signal from module

3.11 IO Header

The following section describes the availability of IO signals on different pin headers.





3.12 IOBANK 2A - P14

Function	FPGA	#	#	FPGA	Function
IOB2A0	AK14	1	2	AK13	IOB2A2
IOB2A1	AL14	3	4	AL13	IOB2A3
GND		5	6		VCC33
IOB2A4	AL15	7	8	AP12	IOB2A6
IOB2A5	AM15	9	10	AN12	IOB2A7
GND		11	12		VCC18
IOB2A8	AH15	13	14	AH14	IOB2A10
IOB2A9	AJ15	15	16	AJ14	IOB2A11
GND		17	18		VCC18
IOB2A12	AM16	19	20	AM13	IOB2A14
IOB2A13	AL16	21	22	AN13	IOB2A15
GND		23	24		GND
IOB2A16	AK17	25	26	AF16	IOB2A18
IOB2A17	AJ17	27	28	AG16	IOB2A19
GND		29	30		GND
IOB2A20	AG18	31	32	AP14	IOB2A22
IOB2A21	AF18	33	34	AN14	IOB2A23
GND		35	36		GND
IOB2A24	AP17	37	38	AN17	IOB2A26
IOB2A25	AP16	39	40	AM17	IOB2A27
GND		41	42		GND
IOB2A28	AN18	43	44	AP15	IOB2A30
IOB2A29	AM18	45	46	AN15	IOB2A31
GND		47	48		GND
IOB2A32	AH17	49	50	AL18	IOB2A34
IOB2A33	AG17	51	52	AK18	IOB2A35
GND		53	54		GND
IOB2A36	AE19	55	56	AE17	IOB2A38
IOB2A37	AF19	57	58	AE16	IOB2A39
GND		59	60		GND
HPS_GPIO0_10	L20	61	62	E16	BSEL0_HPS_GPIO2_7
HPS_GPIO0_11	M20	63	64	H15	HPS_GPIO2_13
BSEL1_HPS_GPIO2_6	G15	65	66	F15	HPS_GPIO2_12
HPS_GPIO0_1	M18	67	68	L21	HPS_GPIO0_5
HPS_GPIO0_0	M17	69	70	M21	HPS_GPIO0_4

3.13 IOBANK 3A - P13

Function	FPGA	#	#	FPGA	Function
IOB3A0	AJ6	1	2	AG7	IOB3A2
IOB3A1	AJ7	3	4	AH7	IOB3A3
GND		5	6		VCC33
IOB3A4	AL4	7	8	AM2	IOB3A6
IOB3A5	AL5	9	10	AM1	IOB3A7
GND		11	12		VCC18
IOB3A8	AE8	13	14	AH5	IOB3A10
IOB3A9	AF8	15	16	AJ5	IOB3A11
GND		17	18		VCC18
IOB3A12	AM5	19	20	AL3	IOB3A14
IOB3A13	AM6	21	22	AM3	IOB3A15
GND		23	24		GND
IOB3A16	AG8	25	26	AK8	IOB3A18
IOB3A17	AH8	27	28	AK7	IOB3A19
GND		29	30		GND
IOB3A20	AK6	31	32	AN4	IOB3A22
IOB3A21	AL6	33	34	AP4	IOB3A23
GND		35	36		GND
IOB3A24	AE9	37	38	AK9	IOB3A26
IOB3A25	AF9	39	40	AJ9	IOB3A27
GND		41	42		GND
IOB3A28	AM7	43	44	AN5	IOB3A30
IOB3A29	AN7	45	46	AP5	IOB3A31
GND		47	48		GND
IOB3A32	AF10	49	50	AG9	IOB3A34
IOB3A33	AG10	51	52	AH10	IOB3A35
GND		53	54		GND
IOB3A36	AG11	55	56	AP6	IOB3A38
IOB3A37	AF11	57	58	AP7	IOB3A39
GND		59	60		GND
IOB3A40	AE11	61	62	AL8	IOB3A42
IOB3A41	AE12	63	64	AL9	IOB3A43
GND		65	66		GND
IOB3A44	AN9	67	68	AM8	IOB3A46
IOB3A45	AP9	69	70	AN8	IOB3A47

3.14 IOBANK 3B – P12

Function	FPGA	#	#	FPGA	Function
IOB3B0	AB7	1	2	AC5	IOB3B2
IOB3B1	AB8	3	4	AC4	IOB3B3
GND		5	6		VCC33
IOB3B4	AE3	7	8	AD1	IOB3B6
IOB3B5	AE2	9	10	AD2	IOB3B7
GND		11	12		VCC18
IOB3B8	AB11	13	14	AD4	IOB3B10
IOB3B9	AB10	15	16	AE4	IOB3B11
GND		17	18		VCC18
IOB3B12	AF4	19	20	AB5	IOB3B14
IOB3B13	AF3	21	22	AB6	IOB3B15
GND		23	24		GND
IOB3B16	AE7	25	26	AC7	IOB3B18
IOB3B17	AE6	27	28	AD7	IOB3B19
GND		29	30		GND
IOB3B20	AG3	31	32	AE1	IOB3B22
IOB3B21	AH3	33	34	AF1	IOB3B23
GND		35	36		GND
IOB3B24	AC10	37	38	AD6	IOB3B26
IOB3B25	AC9	39	40	AD5	IOB3B27
GND		41	42		GND
IOB3B28	AH4	43	44	AG2	IOB3B30
IOB3B29	AJ4	45	46	AG1	IOB3B31
GND		47	48		GND
IOB3B32	AD9	49	50	AF6	IOB3B34
IOB3B33	AC8	51	52	AG6	IOB3B35
GND		53	54		GND
IOB3B36	AJ2	55	56	AH2	IOB3B38
IOB3B37	AK2	57	58	AJ1	IOB3B39
GND		59	60		GND
IOB3B40	AD11	61	62	AF5	IOB3B42
IOB3B41	AD10	63	64	AG5	IOB3B43
GND		65	66		GND
IOB3B44	AK3	67	68	AK1	IOB3B46
IOB3B45	AK4	69	70	AL1	IOB3B47

3.15 IOBANK 3C – P11

Function	FPGA	#	#	FPGA	Function
IOB3C0	R4	1	2	P5	IOB3C2
IOB3C1	T4	3	4	P4	IOB3C3
GND		5	6		VCC33
IOB3C4	R3	7	8	R2	IOB3C6
IOB3C5	T3	9	10	P2	IOB3C7
GND		11	12		VCC18
IOB3C8	Y9	13	14	T6	IOB3C10
IOB3C9	Y8	15	16	T5	IOB3C11
GND		17	18		VCC18
IOB3C12	V4	19	20	P1	IOB3C14
IOB3C13	V5	21	22	R1	IOB3C15
GND		23	24		GND
IOB3C16	AA9	25	26	U5	IOB3C18
IOB3C17	AA8	27	28	U6	IOB3C19
GND		29	30		GND
IOB3C20	V3	31	32	T1	IOB3C22
IOB3C21	U3	33	34	U1	IOB3C23
GND		35	36		GND
IOB3C24	W7	37	38	W5	IOB3C26
IOB3C25	W6	39	40	W4	IOB3C27
GND		41	42		GND
IOB3C28	Y7	43	44	U2	IOB3C30
IOB3C29	Y6	45	46	V2	IOB3C31
GND		47	48		GND
IOB3C32	AA6	49	50	Y4	IOB3C34
IOB3C33	AA5	51	52	Y3	IOB3C35
GND		53	54		GND
IOB3C36	Y2	55	56	W2	IOB3C38
IOB3C37	Y1	57	58	W1	IOB3C39
GND		59	60		GND
IOB3C40	AB3	61	62	AA4	IOB3C42
IOB3C41	AB2	63	64	AA3	IOB3C43
GND		65	66		GND
IOB3C44	AA1	67	68	AC2	IOB3C46
IOB3C45	AB1	69	70	AC3	IOB3C47

3.16 IOBANK 3D - P10

Function	FPGA	#	#	FPGA	Function
IOB3D0	T10	1	2	P9	IOB3D2
IOB3D1	U10	3	4	N9	IOB3D3
GND		5	6		VCC33
IOB3D4	R7	7	8	L8	IOB3D6
IOB3D5	R8	9	10	K7	IOB3D7
GND		11	12		VCC18
IOB3D8	M8	13	14	R9	IOB3D10
IOB3D9	N8	15	16	T9	IOB3D11
GND		17	18		VCC18
IOB3D12	J5	19	20	L6	IOB3D14
IOB3D13	J4	21	22	K6	IOB3D15
GND		23	24		GND
IOB3D16	P7	25	26	L5	IOB3D18
IOB3D17	N7	27	28	M4	IOB3D19
GND		29	30		GND
IOB3D20	K4	31	32	J2	IOB3D22
IOB3D21	L4	33	34	J1	IOB3D23
GND		35	36		GND
IOB3D24	T8	37	38	M7	IOB3D26
IOB3D25	U8	39	40	M6	IOB3D27
GND		41	42		GND
IOB3D28	K3	43	44	K2	IOB3D30
IOB3D29	L3	45	46	K1	IOB3D31
GND		47	48		GND
IOB3D32	V8	49	50	P6	IOB3D34
IOB3D33	V9	51	52	R6	IOB3D35
GND		53	54		GND
IOB3D36	M3	55	56	L1	IOB3D38
IOB3D37	M2	57	58	M1	IOB3D39
GND		59	60		GND
IOB3D40	U7	61	62	W9	IOB3D42
IOB3D41	V7	63	64	W10	IOB3D43
GND		65	66		GND
IOB3D44	N5	67	68	N3	IOB3D46
IOB3D45	N4	69	70	N2	IOB3D47

3.17 Transceiver P7 / P18

P18				P17			
QNH	77	P1	P5	79	QNH	QNH	QNH
QNH	78	P2	P6	80	QNH	QNH	QNH
1	QNH	1	A1	B1	2	QNH	2
2	QNH	2	A2	B2	3	QNH	3
3	QNH	3	A3	B3	4	QNH	4
4	QNH	4	A4	B4	5	QNH	5
5	QNH	5	A5	B5	6	QNH	6
6	QNH	6	A6	B6	7	QNH	7
7	QNH	7	A7	B7	8	QNH	8
8	QNH	8	A8	B8	9	QNH	9
9	QNH	9	A9	B9	10	QNH	10
10	QNH	10	A10	B10	11	QNH	11
11	QNH	11	A11	B11	12	QNH	12
12	QNH	12	A12	B12	13	QNH	13
13	QNH	13	A13	B13	14	QNH	14
14	QNH	14	A14	B14	15	QNH	15
15	QNH	15	A15	B15	16	QNH	16
16	QNH	16	A16	B16	17	QNH	17
17	QNH	17	A17	B17	18	QNH	18
18	QNH	18	A18	B18	19	QNH	19
19	QNH	19	A19	B19	20	QNH	20
20	QNH	20	A20	B20	21	QNH	21
21	QNH	21	A21	B21	22	QNH	22
22	QNH	22	A22	B22	23	QNH	23
23	QNH	23	A23	B23	24	QNH	24
24	QNH	24	A24	B24	25	QNH	25
25	QNH	25	A25	B25	26	QNH	26
26	QNH	26	A26	B26	27	QNH	27
27	QNH	27	A27	B27	28	QNH	28
28	QNH	28	A28	B28	29	QNH	29
29	QNH	29	A29	B29	30	QNH	30
30	QNH	30	A30	B30	31	QNH	31
31	QNH	31	A31	B31	32	QNH	32
32	QNH	32	A32	B32	33	QNH	33
33	QNH	33	A33	B33	34	QNH	34
34	QNH	34	A34	B34	35	QNH	35
35	QNH	35	A35	B35	36	QNH	36
36	QNH	36	A36	B36	37	QNH	37
37	QNH	37	A37	B37	38	QNH	38
38	QNH	38	A38	B38	39	QNH	39
39	QNH	39	A39	B39	40	QNH	40
40	QNH	40	A40	B40	41	QNH	41
41	QNH	41	A41	B41	42	QNH	42
42	QNH	42	A42	B42	43	QNH	43
43	QNH	43	A43	B43	44	QNH	44
44	QNH	44	A44	B44	45	QNH	45
45	QNH	45	A45	B45	46	QNH	46
46	QNH	46	A46	B46	47	QNH	47
47	QNH	47	A47	B47	48	QNH	48
48	QNH	48	A48	B48	49	QNH	49
49	QNH	49	A49	B49	50	QNH	50
50	QNH	50	A50	B50	51	QNH	51
51	QNH	51	A51	B51	52	QNH	52
52	QNH	52	A52	B52	53	QNH	53
53	QNH	53	A53	B53	54	QNH	54
54	QNH	54	A54	B54	55	QNH	55
55	QNH	55	A55	B55	56	QNH	56
56	QNH	56	A56	B56	57	QNH	57
57	QNH	57	A57	B57	58	QNH	58
58	QNH	58	A58	B58	59	QNH	59
59	QNH	59	A59	B59	60	QNH	60
60	QNH	60	A60	B60	61	QNH	61
61	QNH	61	A61	B61	62	QNH	62
62	QNH	62	A62	B62	63	QNH	63
63	QNH	63	A63	B63	64	QNH	64
64	QNH	64	A64	B64	65	QNH	65
65	QNH	65	A65	B65	66	QNH	66
66	QNH	66	A66	B66	67	QNH	67
67	QNH	67	A67	B67	68	QNH	68
68	QNH	68	A68	B68	69	QNH	69
69	QNH	69	A69	B69	70	QNH	70
70	QNH	70	A70	B70	71	QNH	71
71	QNH	71	A71	B71	72	QNH	72
72	QNH	72	A72	B72	73	QNH	73
73	QNH	73	A73	B73	74	QNH	74
74	QNH	74	A74	B74	75	QNH	75
75	QNH	75	A75	B75	76	QNH	76
76	QNH	76	A76	B76	77	QNH	77
77	QNH	77	A77	B77	78	QNH	78
78	QNH	78	A78	B78	79	QNH	79
79	QNH	79	A79	B79	80	QNH	80
80	QNH	80	A80	B80	81	QNH	81
81	QNH	81	A81	B81	82	QNH	82
82	QNH	82	A82	B82	83	QNH	83
83	QNH	83	A83	B83	84	QNH	84
84	QNH	84	A84	B84	85	QNH	85
85	QNH	85	A85	B85	86	QNH	86
86	QNH	86	A86	B86	87	QNH	87
87	QNH	87	A87	B87	88	QNH	88
88	QNH	88	A88	B88	89	QNH	89
89	QNH	89	A89	B89	90	QNH	90
90	QNH	90	A90	B90	91	QNH	91
91	QNH	91	A91	B91	92	QNH	92
92	QNH	92	A92	B92	93	QNH	93
93	QNH	93	A93	B93	94	QNH	94
94	QNH	94	A94	B94	95	QNH	95
95	QNH	95	A95	B95	96	QNH	96
96	QNH	96	A96	B96	97	QNH	97
97	QNH	97	A97	B97	98	QNH	98
98	QNH	98	A98	B98	99	QNH	99
99	QNH	99	A99	B99	100	QNH	100
100	QNH	100	A100	B100	101	QNH	101
101	QNH	101	A101	B101	102	QNH	102
102	QNH	102	A102	B102	103	QNH	103
103	QNH	103	A103	B103	104	QNH	104
104	QNH	104	A104	B104	105	QNH	105
105	QNH	105	A105	B105	106	QNH	106
106	QNH	106	A106	B106	107	QNH	107
107	QNH	107	A107	B107	108	QNH	108
108	QNH	108	A108	B108	109	QNH	109
109	QNH	109	A109	B109	110	QNH	110
110	QNH	110	A110	B110	111	QNH	111
111	QNH	111	A111	B111	112	QNH	112
112	QNH	112	A112	B112	113	QNH	113
113	QNH	113	A113	B113	114	QNH	114
114	QNH	114	A114	B114	115	QNH	115
115	QNH	115	A115	B115	116	QNH	116
116	QNH	116	A116	B116	117	QNH	117
117	QNH	117	A117	B117	118	QNH	118
118	QNH	118	A118	B118	119	QNH	119
119	QNH	119	A119	B119	120	QNH	120
120	QNH	120	A120	B120	121	QNH	121
121	QNH	121	A121	B121	122	QNH	122
122	QNH	122	A122	B122	123	QNH	123
123	QNH	123	A123	B123	124	QNH	124
124	QNH	124	A124	B124	125	QNH	125
125	QNH	125	A125	B125	126	QNH	126
126	QNH	126	A126	B126	127	QNH	127
127	QNH	127	A127	B127	128	QNH	128
128	QNH	128	A128	B128	129	QNH	129
129	QNH	129	A129	B129	130	QNH	130
130	QNH	130	A130	B130	131	QNH	131
131	QNH	131	A131	B131	132	QNH	132
132	QNH	132	A132	B132	133	QNH	133
133	QNH	133	A133	B133	134	QNH	134
134	QNH	134	A134	B134	135	QNH	135
135	QNH	135	A135	B135	136	QNH	136
136	QNH	136	A136	B136	137	QNH	137
137	QNH	137	A137	B137	138	QNH	138
138	QNH	138	A138	B138	139	QNH	139
139	QNH	139	A139	B139	140	QNH	140
140	QNH	140	A140	B140	141	QNH	141
141	QNH	141	A141	B141	142	QNH	142
142	QNH	142	A142	B142	143	QNH	143
143	QNH	143	A143	B143	144	QNH	144
144	QNH	144	A144	B144	145	QNH	145
145	QNH	145	A145	B145	146	QNH	146
146	QNH	146	A146	B146	147	QNH	147
147	QNH	147	A147	B147	148	QNH	148
148	QNH	148	A148	B148	149	QNH	149
149	QNH	149	A149	B149	150	QNH	150
150	QNH	150	A150	B150	151	QNH	151
151	QNH	151	A151	B151	152	QNH	152
152	QNH	152	A152	B152	153	QNH	153
153	QNH	153	A153	B153	154	QNH	154
154	QNH	154	A154	B154	155	QNH	155
155	QNH	155	A155	B155	156	QNH	156
156	QNH	156	A156	B156	157	QNH	157
157	QNH	157	A157	B157	158	QNH	158
158	QNH	158	A158	B158	159	QNH	159
159	QNH	159	A159	B159	160	QNH	160
160	QNH	160	A160	B160	161	QNH	161
161	QNH	161	A161	B161	162	QNH	162
162	QNH	162	A162	B162	163	QNH	163
163	QNH	163	A163	B163	164	QNH	164
164	QNH	164	A164	B164	165	QNH	165
165	QNH	165	A165	B165	166	QNH	166
166	QNH	166	A166	B166	167	QNH	167
167	QNH	167	A167	B167	168	QNH	168
168	QNH	168	A168	B168	169	QNH	169
169	QNH	169	A169	B169	170	QNH	170
170	QNH	170	A170	B170	171	QNH	171
171	QNH	171	A171	B171	172	QNH	172
172	QNH	172	A172	B172	173	QNH	173
173	QNH	173	A173	B173	174	QNH	174
174	QNH	174	A174	B174	175	QNH	175
175	QNH	175	A175	B175	176	QNH	176
176	QNH	176	A176	B176	177	QNH	177
177	QNH	177	A177	B177	178	QNH	178
178	QNH	178	A178	B178	179	QNH	179
179	QNH	179	A179	B179	180	QNH	180
180	QNH	180	A180	B180	181	QNH	181
181	QNH	181	A181	B181	182	QNH	182
182	QNH	182	A182	B182	183	QNH	183
183	QNH	183	A183	B183	184	QNH	184
184	QNH	184	A184	B184	185	QNH	185
185	QNH	185	A185	B185	186	QNH	186
186	QNH	186	A186	B186	187	QNH	187
187	QNH	187	A187	B187	188		

3.18 Clocking

