FIVEberry Hardware Manual

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CONTENTS:

CHAPTER

ONE

ABOUT THIS MANUAL

1.1 Imprint

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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	18.11.2022	dk	Initial creation
1.1	09.01.2023	aw	**added** • schematics • PCB outline
1.2	11.05.2023	wa	• Updated the FIVEberry picture • New marketing information

CHAPTER

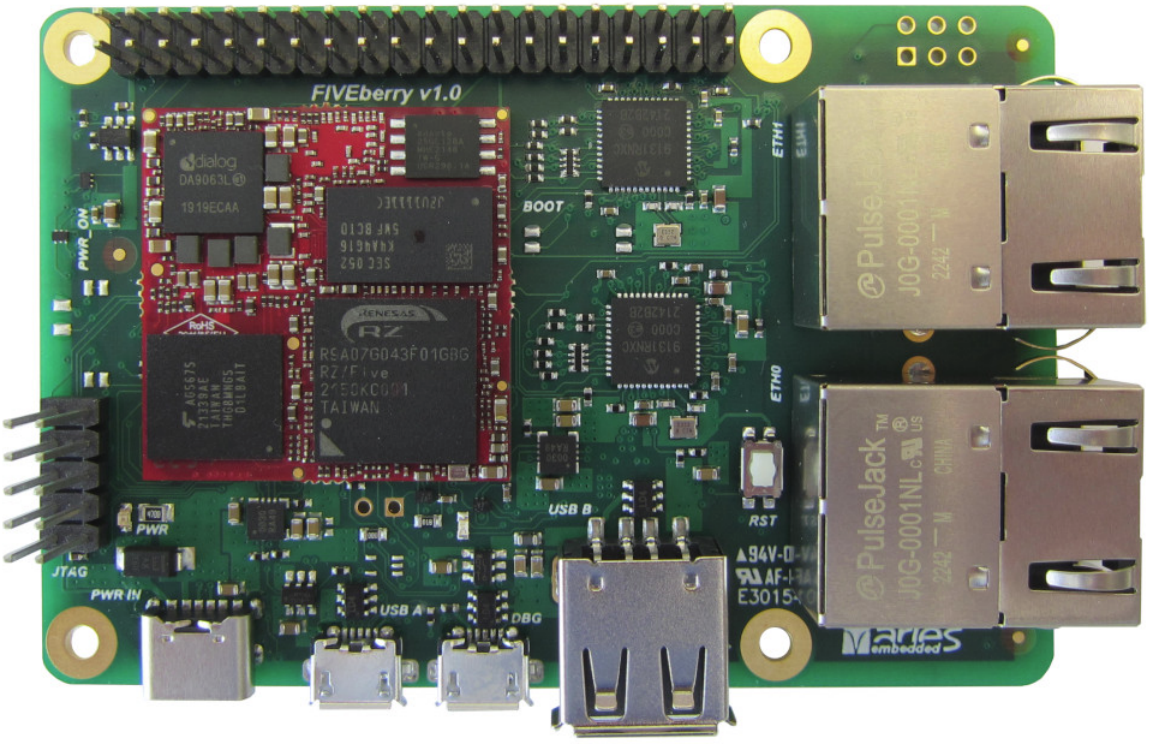
TWO

OVERVIEW

2.1 FIVEberry Evaluation Kit

This is an evaluation board that is made to provide developers and engineers an easy-to use platform for developing and evaluating applications.The FIVEberry Evaluation Kit is a compact and cost effective board that has an easy access to various interfaces and peripherals of RZ/Five microcontroller. This includes Ethernet interface, USB Type-C interface, SD cards slot and a variety of sensors and actuators.

The FIVEberry contains the MSRZFive - the Open Standard Module compliant System-In-Package based on Renesas RZ Family architecture offering high-performance 64-bit RISC-V core.This evaluation board offers flexibility thus making it suitable for applications used in industrial automation, IoT and robotics.



2.2 Feature Set

- **FIVEberry EVK**
  - RZ/Five general-purpose microprocessor unit
  - Single core RISC-V, up to 1GHz
  - 512MB – 4GB DDR4 RAM
  - 4GB eMMC NAND Flash
  - dual 10/100/1000MBit Ethernet
  - size S, 30x30mm^2
  - pin count: 332
- 2x PHY Ethernet
- 2x USB
- SD Card
- USB to UART bridge
- compliant to the SGET OSM standard
- 0°C..+70°C commercial temperature range
- -40°C..+85°C industrial temperature range

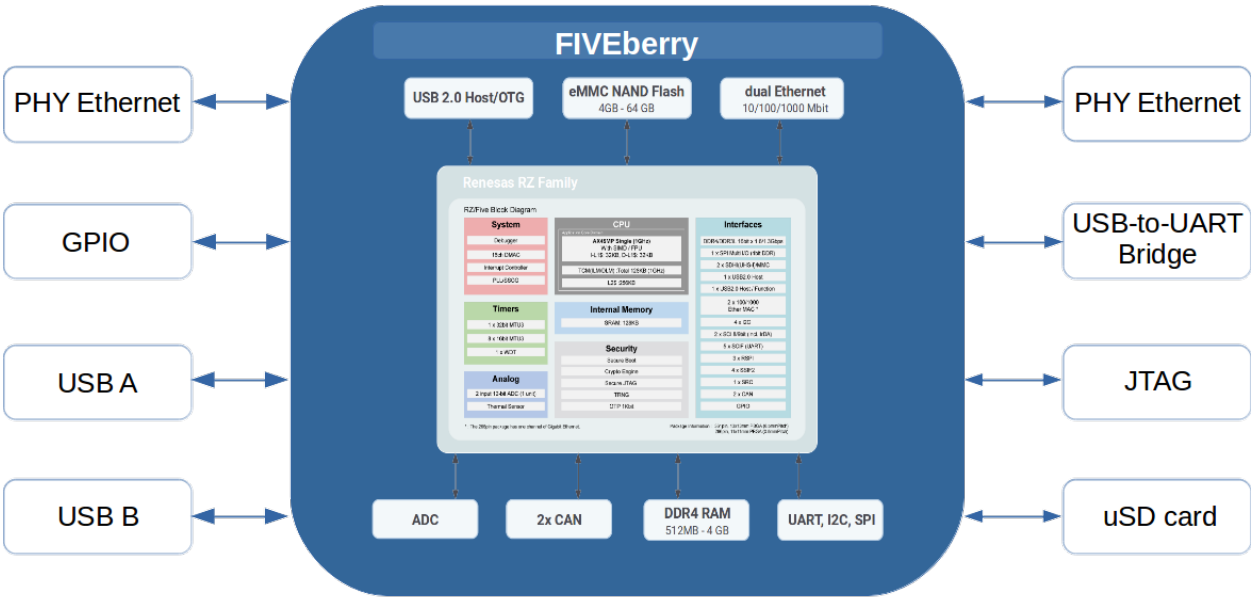
2.3 Order Codes

The FIVEberry EVK is available in the following standard configurations:

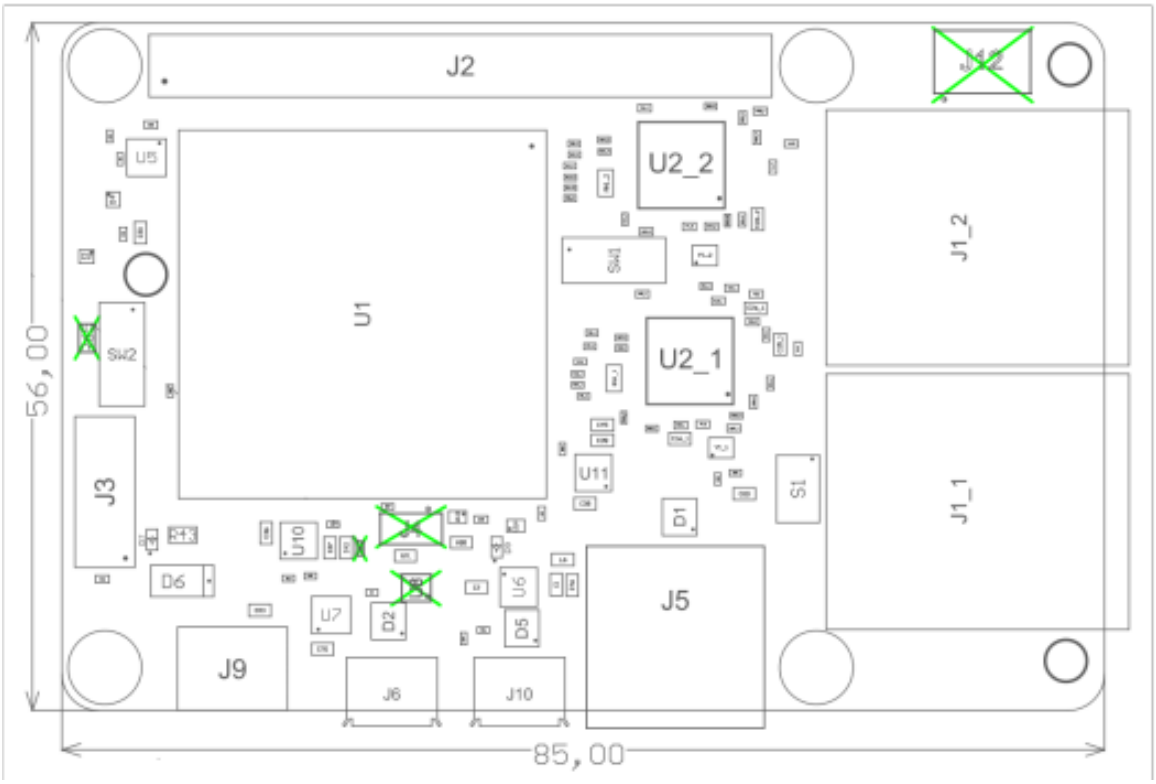
- **MSRZFive-AAE**
  - Single core RISC-V
  - 512MB DDR4 RAM
  - 4GB eMMC
  - -25...+85°C

Please contact ARIES Embedded for more information about the availability of other standard products of MSRZFive or custom configurations.

2.4 Block Diagram

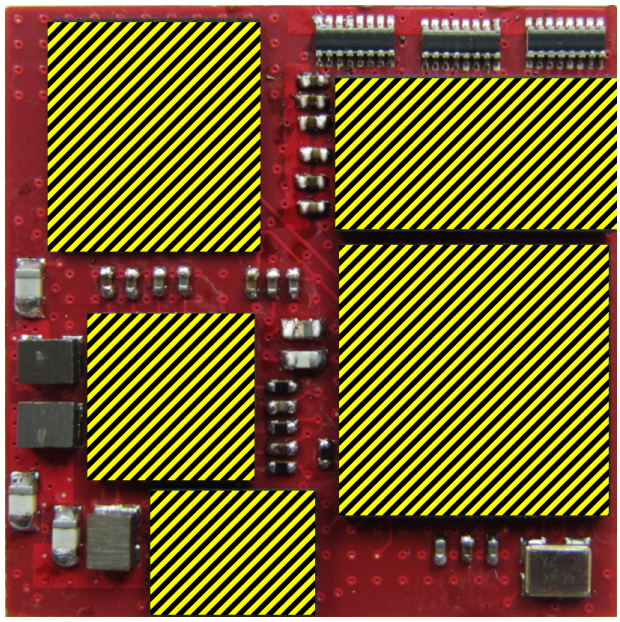


2.5 Dimensions / Part Overview



2.6 Handling Recommendations

To avoid mechanical damage to the components populated on MSRZFive 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:



CHAPTER

THREE

RESOURCES

3.1 Ethernet

FIVEberry offers the ETH0 and ETH1 Ethernet Ports. These ports can be accessed via the RJ45 connectors P1 1 and P1 2 supported by Microchip KSZ9131RNXC Ethernet physical-layer transceivers.

3.1.1 HPS Gigabit Ethernet Phy 0 (U2 1)

FIVEberry Function	U2_1 Pin	U1 Connector Pads	MSRZFive Pin
ET0.TXD0	19	H15	L1
ET0.TXD1	20	G15	L2
ET0.TXD2	21	H16	K1
ET0.TXD3	22	G16	K2
ET0_TX.CTL	25	K16	M1
ET0.TXC	24	J15	M2
ET0.RXD0	32	K15	P2
ET0.RXD1	31	L15	R3
ET0.RXD2	28	N15	R2
ET0.RXD3	27	P15	R1
ET0.RX.CTL	33	M15	N1
ET0.RXC	35	R15	N3
ET0.MDIO	36	T15	T2
ET0.MDC	37	T16	T3

3.1.2 HPS Gigabit Ethernet Phy 1 (U2 2)

This is a physical layer transceiver that is designed for high-speed Ethernet communication. In addition, it offers low power consumption and reliability. It also has advanced error detection and correction capabilities thus ensuring reliable data transfer. The PHY1 transceiver is compatible with RZ/Five microcontroller, which makes it easy for the design process used by developers and engineers who work on embedded systems. This mode of communication can be used in the automotive,IoT and industrial automation.

FIVEberry Function	U2_2 Pin	U1 Connector Pads	MSRZFive Pin
ET1.TXD0	19	G1	AD16
ET1.TXD1	20	F1	AE16
ET1.TXD2	21	G2	AD15
ET1.TXD3	22	F2	AE15
ET1_TX.CTL	25	J2	AD17
ET1.TXC	24	H1	AE18
ET1.RXD0	32	J1	AE19
ET1.RXD1	31	K1	AD19
ET1.RXD2	28	M1	AE20
ET1.RXD3	27	N1	AD20
ET1.RX.CTL	33	L1	AC18
ET1.RXC	35	P1	AC17
ET1.MDIO	37	C7	AE21
ET1.MDC	36	C6	AC20

3.2 GPIO

GPIOs allow digital signals to be received ans sent by the microcontroller thus allowing it to interface with a wide range of sensors and external devices. GPIOs are easy to use, flexible and are able to support a wide range of applications.Also it allows developers and engineers to quickly make prototypes and develop applications that require any interface with external devices as well as sensors. FIVEberry offers GPIO on a J2 2x20 pin Header.

FIVEberry Function	J2 Pin	U1 Connector Pads	MSRZFive Pin
I2C_A.SCL	5	AA15	B19
I2C_A.SDA	3	AA16	B20
I2C_B.SCL	10	AA20	A19
I2C_B.SDA	8	AA21	A20
GPIO.0	33	Y7	–
GPIO.1	32	AA6	–
GPIO.2	26	Y6	–
GPIO.3	24	AA5	–
GPIO.4	15	Y5	–
GPIO.5	12	Y4	–
GPIO.6	11	W4	–
GPIO.7	7	V3	–
GPIO.8	13	V4	–
GPIO.9	16	U3	–
GPIO.10	19	T3	–
GPIO.11	18	T4	–
GPIO.12	21	R4	–
GPIO.13	36	R3	–
GPIO.14	22	P3	–
GPIO.15	28	N3	–
GPIO.16	23	N4	–
GPIO.17	29	M3	–
GPIO.18	27	M4	–
GPIO.19	31	L3	–
GPIO.20	38	K3	–
GPIO.21	37	K4	–
GPIO.22	35	J4	–
GPIO.23	40	J3	–

3.3 USB Host Micro

FIVEberry offers one USB A 2.0 Host-interface on a J5 connector.

FIVEberry Function	J5 Pin	U1 Connector Pads	MSRZFive Pin
USB_B.D_N	2	AB23	AE5
USB_B.D_P	3	AC22	AD5
USB_B.OC#	–	AC21	AE2
USB_B.EN	–	AC20	AD1
USB_HOST_VBUS	10	–	–

3.4 USB OTG A

FIVEberry offers one micro USB-OTG interface on a J6 connector.

FIVEberry Function	J6 Pin	U1 Connector Pads	MSRZFive Pin
USB_A.D_N	2	AB13	AE6
USB_A.D_P	3	AC14	AD6
USB_A.ID	4	AB14	AD2
USB_A.OC#	–	AC15	AE3
USB_A.EN	–	AC16	AD3
USB_OTG_VBUS	10	–	–
USB_A_VBUS_IN	–	AB16	AD8

3.5 JTAG

FIVEberry includes one JTAG interface on a 2x5 pin header J3.

FIVEberry Function	J8 Pin	U1 Connector Pads	MSRZFive Pin
JTAG.TCK	4	N17	U2
JTAG.TMS	2	N19	U1
JTAG.TDI	8	P17	W1
JTAG.TDO	6	R17	V2
JTAG.TRST	9	R19	V1
JTAG.DBG	–	AC18	–

3.6 USB-to-UART Bridge

These highly-integrated USB-to-UART bridge controllers provide a simple solution forupdating RS-232 designs to USB using a minimum of components and PCB space. CP2102N includes a USB 2.0 full-speed function controller, USB transceiver, oscillator,and Universal Asynchronous Receiver/Transmitter (UART) in packages as small as 3mm x 3 mm.

3.6.1 Connector U4

FIVEberry Function	J8 Pin	U1 Connector Pads	MSRZFive Pin
USB_DBG_RST_N	9	–	–
USB_DBG_P	3	–	–
USB_DBG_N	4	–	–
UART CONS.RX	21	D22	AC1
UART CONS.TX	20	D23	AC2

3.7 SDIO

3.7.1 Connector J8

FIVEberry Function	J8 Pin	U1 Connector Pads	MSRZFive Pin
SDIO.CLK	P5	F21	G2
SDIO.CMD	P3	E20	H6
SDIO.DAT0	P7	G20	H2
SDIO.DAT1	P8	G21	J3
SDIO.DAT2	P1	H20	J1
SDIO.DAT3	P2	H21	J2
SDIO.PWR_EN	P4	D21	–
SDIO.CD#	DSW2	J21	D3

3.8 MSRZFive MPU

3.8.1 Connector U1

MSRZFive Pin	MSRZFive Function	U1 Pads	FIVEberry Function
U1A			
–	–	M19	–
C4	MD_BOOT2	B22	–
–	–	Y16	–
–	PMIC_SCL	C16	PMIC_SCL
–	–	Y20	–
–	PMIC_SDA	P16	PMIC_SDA
–	3.3V	Y17	5V
–	–	V21	–
–	3.3V	Y19	–
–	–	W21	–
–	–	AA18	–
–	–	V19	–
–	–	AB18	–
–	–	W19	–
–	OSM_SYS_RST#	U17	SYS_RST#
–	–	V18	–
–	CARRIER_PWR_EN	V17	CARRIER_PWR_EN
–	–	W18	–
–	–	U18	–
–	–	W20	–
–	–	W17	–
AD6	USB_A_D_P	AC14	USB_A.D_P
C5	MD_BOOT1	U19	BOOT_SEL0#
AE6	USB_A_D_N	AB13	USB_A.D_N
C4	MD_BOOT2	R18	BOOT_SEL1#
AD2	USB_A_ID	AB14	USB_A.ID
–	–	T17	–

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Table 1 – continued from previous page

MSRZFive Pin	MSRZFive Function	U1 Pads	FIVEberry Function
AE3	USB_A_OC#	AC15	USB_A.OC#
–	–	U15	–
AD8	USB_A_VBUS_IN	AB16	USB_A_VBUS_IN
–	–	V15	–
AD3	USB_A_EN	AC16	USB_A.EN
–	–	W16	–
AD5	USB_B_D_P	AC22	USB_B.D_P
–	–	W15	–
AE5	USB_B_D_N	AB23	USB_B.D_N
–	–	Y15	–
–	–	AB22	–
–	–	U16	–
AE2	USB_B_OC#	AC21	USB_B.OC#
–	–	Y22	–
–	–	AB20	–
–	–	Y23	–
AD1	USB_B_EN	AC20	USB_B.EN
–	–	AA23	–
B19	I2C_A_SCL	AA15	I2C_A.SCL
–	–	Y21	–
B20	I2C_A_SDA	AA16	I2C_A.SDA
H6	SDIO_A_CMD	E20	SDIO.CMD
A19	I2C_B_SCL	AA20	I2C_B.SCL
G2	SDIO_A_CLK	F21	SDIO.CLK
A20	I2C_B_SDA	AA21	I2C_B.SDA
H2	SDIO_A_D0	G20	SDIO.DAT0
–	–	AC17	–
J3	SDIO_A_D1	G21	SDIO.DAT1
–	–	AB17	–
J1	SDIO_A_D2	H20	SDIO.DAT2
–	–	AC19	–
J2	SDIO_A_D3	H21	SDIO.DAT3
–	–	AB19	–
D3	SDIO_A_CD#	J21	SDIO.CD#
B18	ADC0	M18	–
C3	SDIO_A_WP	D20	–
A18	ADC1	N18	–
–	–	D21	SDIO.PWR_EN
–	–	E18	–
–	VCC_SD	C20	VCC_SD
–	–	F18	–
–	–	K20	–
–	–	G18	–
–	–	K21	–
–	–	H18	–
–	–	L20	–
–	–	J18	–
–	–	L21	–
–	–	K18	–

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Table 1 – continued from previous page

MSRZFive Pin	MSRZFive Function	U1 Pads	FIVEberry Function
–	–	M21	–
M3	ET0_CRS	E16	–
–	–	N20	–
M6	ET0_COL	F15	–
–	–	N21	–
L1	ET0_TXD0	H15	ET0.TXD0
–	–	P20	–
L2	ET0_TXD1	G15	ET0.TXD1
–	–	P21	–
K1	ET0_TXD2	H16	ET0.TXD2
–	–	R21	–
K2	ET0_TXD3	G16	ET0.TXD3
–	–	T21	–
M1	ET0_TX_CTL	K16	ET0.CTL
–	–	U20	–
M2	ET0_TXC	J15	ET0.TXC
–	–	U21	–
P2	ET0_RXD0	K15	ET0.RXD0
–	–	T20	–
R3	ET0_RXD1	L15	ET0.RXD1
AC1	UART_CONS_RX	D22	UART CONS.RX
R2	ET0_RXD2	N15	ET0.RXD2
AC2	UART_CONS_TX	D23	UART CONS.TX
R1	ET0_RXD3	P15	ET0_RXD3
–	–	C22	–
N2	ET0_RX_ERR	L16	–
–	–	C23	–
N1	ET0_RX_CTL	M15	ET0.RX.CTL
–	–	A22	–
N3	ET0_RXC	R15	ET0.RXC
–	–	B23	–
–	–	N16	–
–	–	D14	–
T2	ET0_MDIO	T15	ET0.MDIO
–	–	D13	–
T3	ET0_MDC	T16	ET0.MDC
–	–	D15	–
–	PVDD18	M17	–
–	–	D16	–
U2	JTAG_TCK/SWDCLK	N17	JTAG.TCK
B22	UART_A_RX	A14	–
U1	JTAG_TMS/SWDIO	N19	JTAG.TMS
A21	UART_A_TX	B13	–
W1	JTAG_TDI	P17	JTAG.TDI
–	–	C13	–
–	–	P19	–
–	–	C14	–
V2	JTAG_TDO	R17	JTAG.TDO
–	–	D17	SDIO.PWR_EN

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Table 1 – continued from previous page

MSRZFive Pin	MSRZFive Function	U1 Pads	FIVEberry Function
V1	JTAG_TRST#	R19	JTAG.TRST
–	–	E17	GPIO.21
–	DEBUGEN	AC18	JTAG.DBG
–	–	F17	–
–	–	C18	–
–	–	G17	–
–	GND	D18	GND
–	–	H17	–
–	GND	E15	GND
–	–	J17	GPIO.23
–	GND	E21	GND
AE17	ET1_TX_ERR	K17	–
–	GND	F16	GND
AC3	GPIO_A_7	L17	–
–	GND	F20	GND
P1	ET0_LINKSTA	D19	–
–	GND	J16	GND
AC19	ET1_LINKSTA	E19	–
–	GND	J20	GND
B1	GPIO_B_2	F19	–
–	GND	L18	GND
C2	GPIO_B_3	G19	–
–	GND	M16	GND
AB2	GPIO_B_4	H19	–
–	GND	M20	GND
AB3	GPIO_B_5	J19	–
–	GND	P18	GND
K6	ET0_TX_ERR	K19	–
–	GND	R16	GND
–	–	L19	–
–	GND	R20	GND
–	–	V16	GND
–	GND	V20	GND
–	GND	Y18	GND
–	GND	AA14	GND
–	GND	AA17	GND
–	GND	AA19	GND
–	GND	AA22	GND
–	GND	AB15	GND
–	GND	AB21	GND
–	–	–	–
U1B			
–	–	A16	–
–	–	A20	–
–	–	C15	–
–	–	C17	–
–	–	C19	–
–	–	C21	–
–	–	A15	–

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Table 1 – continued from previous page

MSRZFive Pin	MSRZFive Function	U1 Pads	FIVEberry Function
–	–	A17	–
–	–	A18	–
–	–	A19	–
–	–	A21	–
–	–	B15	–
–	–	B16	–
–	–	B17	–
–	–	B18	–
–	–	B19	–
–	–	B20	–
–	–	B21	–
U1C			
–	5V	Y8	VCC_IN_5V0
–	PMIC_TP	D6	PMIC_TP
–	5V	Y9	VCC_IN_5V0
–	AUDIO_CLK	D7	GND
–	5V	Y10	VCC_IN_5V0
–	–	AB1	–
–	5V	Y11	VCC_IN_5V0
–	–	AB2	–
–	PWR_BTN#	AA9	PWR_BTN#
–	–	AC2	–
–	–	Y3	–
–	–	AC3	–
–	–	C5	–
–	–	W2	–
AC15	ET1_CRS	D2	–
–	–	V2	–
AC16	ET1_COL	E1	–
–	–	W1	–
AD16	ET1_TXD0	G1	ET1.TXD0
–	–	Y1	–
AE16	ET1_TXD1	F1	ET1.TXD1
–	–	T2	–
AD15	ET1_TXD2	G2	ET1.TXD2
–	–	U1	–
AE15	ET1_TXD3	F2	ET1.TXD3
–	–	T1	–
AD17	ET1_TX_CTL	J2	ET1.CTL
–	–	R2	–
AE18	ET1_TXC	H1	ET1.TXC
–	–	D3	–
AE19	ET1_RXD0	J1	ET1.RXD0
–	–	D4	–
AD19	ET1_RXD1	K1	ET1.RXD1
–	–	E3	–
AE20	ET1_RXD2	M1	ET1.RXD2
–	–	E4	–
AD20	ET1_RXD3	N1	ET1.RXD3

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Table 1 – continued from previous page

MSRZFive Pin	MSRZFive Function	U1 Pads	FIVEberry Function
–	–	F3	–
AD18	ET1_RX_ERR	K2	–
–	–	F4	–
AC18	ET1_RX_CTL	L1	ET1_RX.CTL
–	–	G3	–
AC17	ET1_RXC	P1	ET1.RXC
–	–	G4	–
–	–	M2	–
–	–	AB10	–
AE21	ET1_MDIO	C7	ET1.MDIO
–	–	AB11	–
AC20	ET1_MDC	C6	ET1.MDC
–	–	AC8	–
–	–	B1	–
–	–	AC9	–
–	–	C1	–
–	–	AC5	–
–	–	A3	–
–	–	AC6	–
–	–	A2	–
–	–	AB4	–
–	–	A6	GND
–	–	AB5	–
–	–	A5	GND
–	–	AB7	–
–	–	B7	–
–	–	AB8	–
–	–	B6	–
–	–	AA3	–
–	–	B4	–
–	–	Y7	GPIO.0
–	–	B3	–
–	–	AA6	GPIO.1
–	–	C2	–
–	–	Y6	GPIO.2
–	–	C3	–
–	–	AA5	GPIO.3
–	–	C4	–
–	–	Y5	GPIO.4
–	GND	A4	GND
–	–	Y4	GPIO.5
–	GND	A7	GND
–	–	W4	GPIO.6
–	GND	A10	GND
–	–	V3	GPIO.7
–	GND	B2	GND
–	–	V4	GPIO.8
–	GND	B5	GND
–	–	U3	GPIO.9

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Table 1 – continued from previous page

MSRZFive Pin	MSRZFive Function	U1 Pads	FIVEberry Function
–	GND	B8	GND
–	–	T3	GPIO.10
–	GND	B9	GND
–	–	T4	GPIO.11
–	GND	C11	GND
–	–	R4	GPIO.12
–	GND	D1	GND
–	–	R3	GPIO.13
–	GND	D5	GND
–	–	P3	GPIO.14
–	GND	D8	GND
–	–	N3	GPIO.15
–	GND	E2	GND
–	–	N4	GPIO.16
–	GND	H2	GND
–	–	M3	GPIO.17
–	GND	H4	GND
–	–	M4	GPIO.18
–	GND	L2	GND
–	–	L3	GPIO.19
–	GND	L4	GND
–	–	K3	GPIO.20
–	GND	P2	GND
–	–	K4	GPIO.21
–	GND	P4	GND
–	–	J4	GPIO.22
–	GND	R1	GND
–	–	J3	GPIO.23
–	GND	U2	GND
–	–	H3	–
–	GND	U4	GND
–	–	D10	–
–	GND	V1	GND
–	–	D11	–
–	GND	W3	GND
–	–	D9	–
–	GND	Y2	GND
–	–	C8	–
–	GND	AA1	GND
–	–	C10	–
–	GND	AA4	GND
–	–	A9	–
–	GND	AA7	GND
–	–	A8	–
–	GND	AA8	GND
–	–	B11	–
–	GND	AA10	GND
–	–	B10	–
–	GND	AA11	GND

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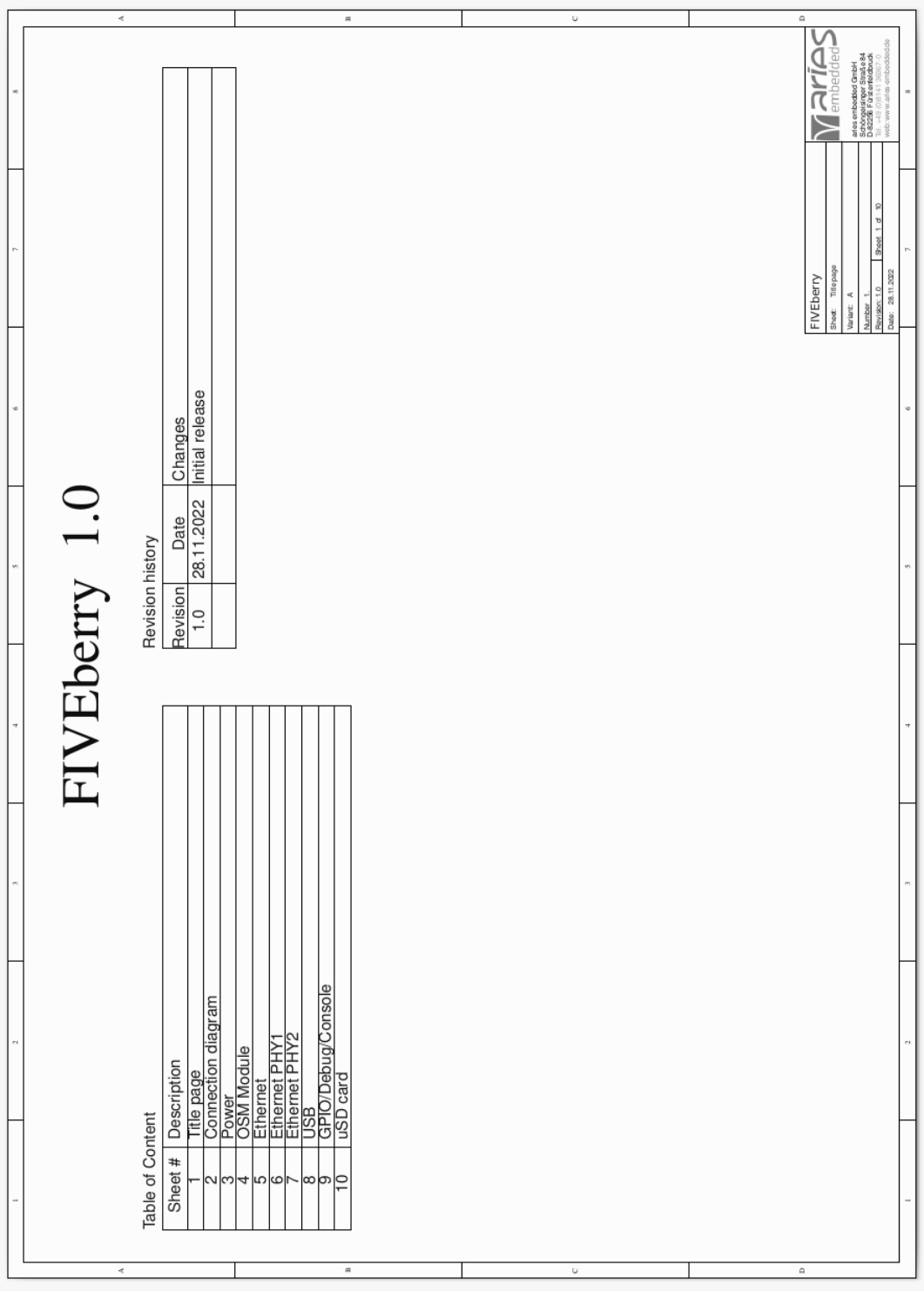
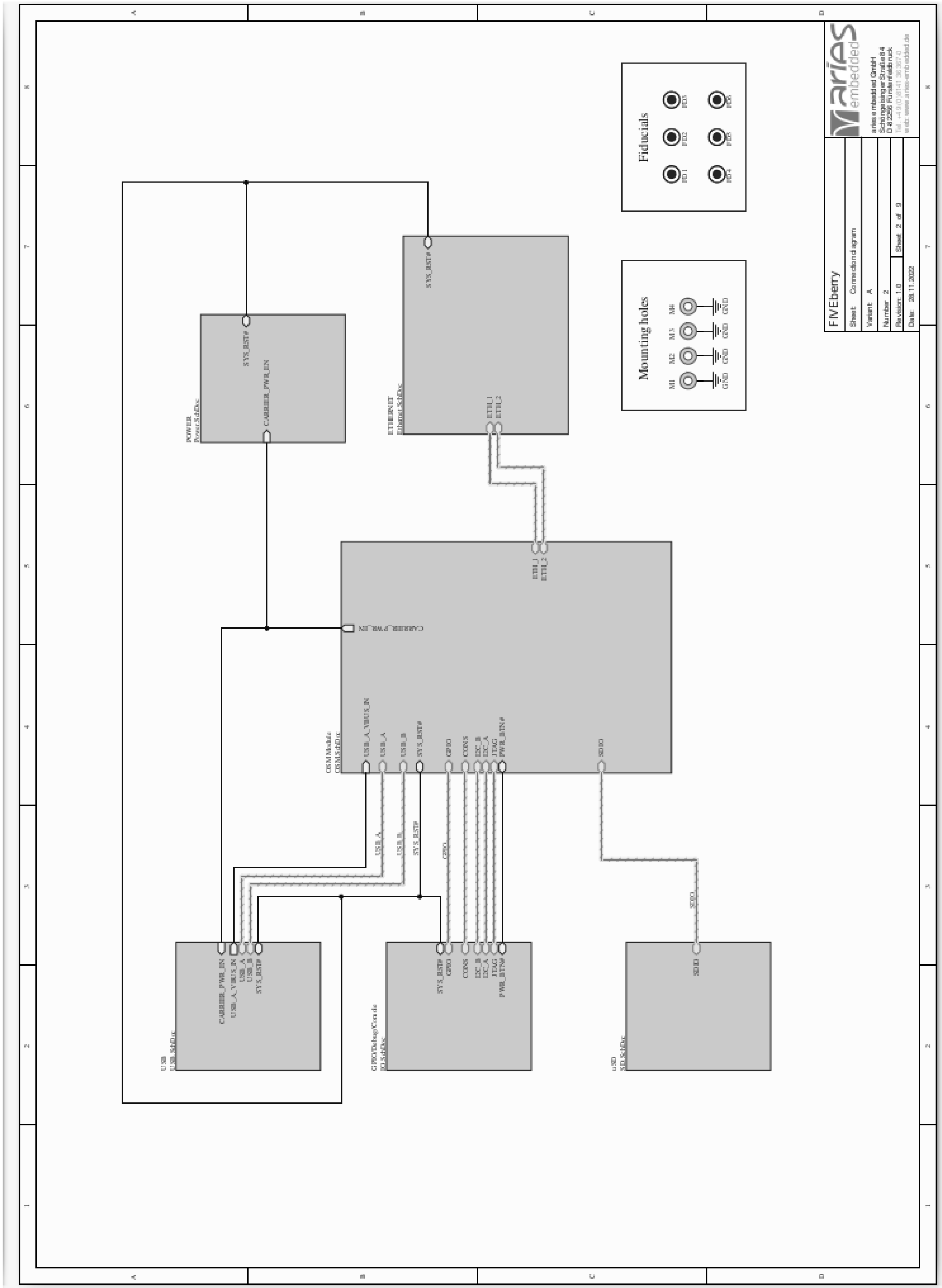
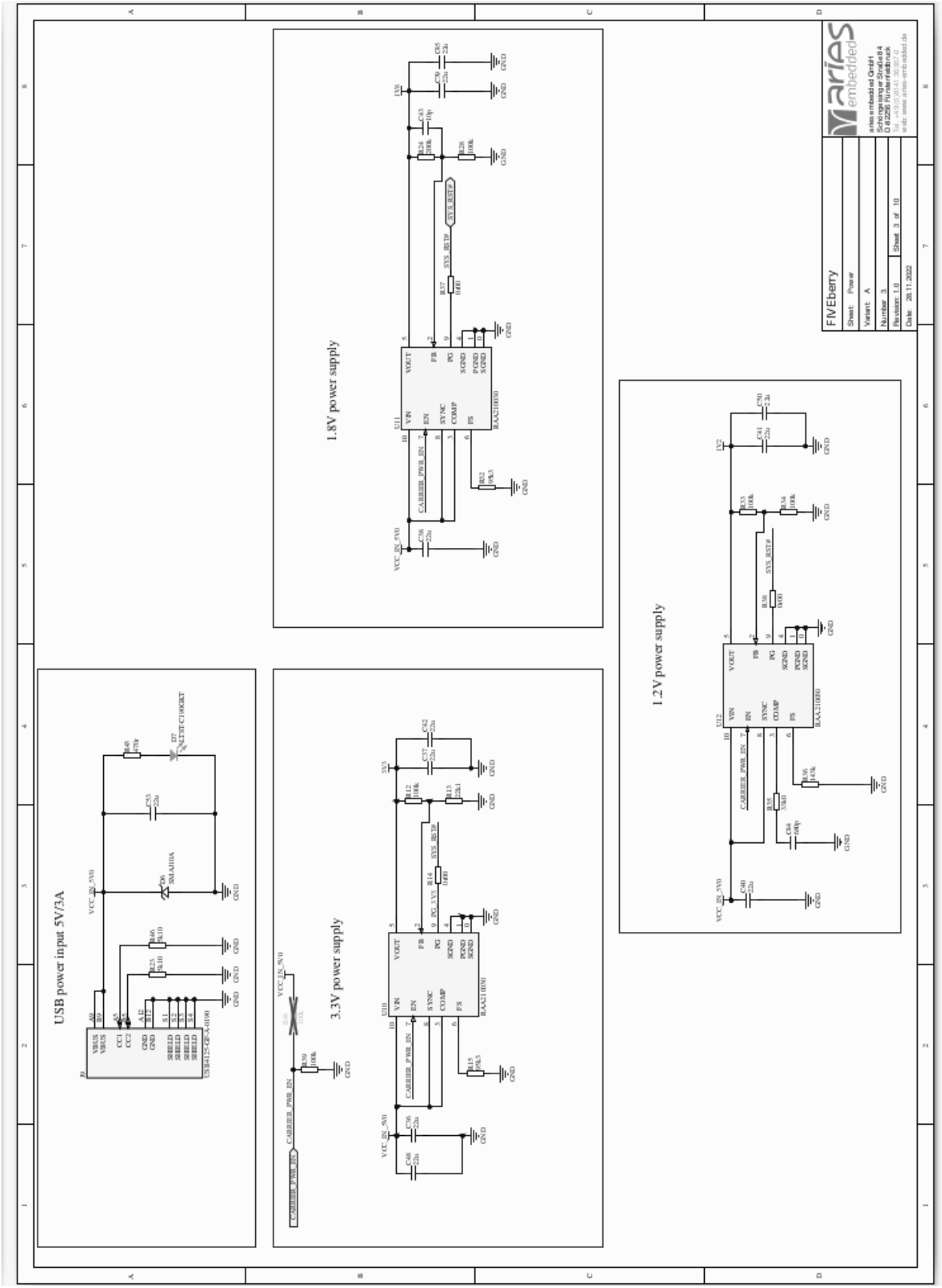
Table 1 – continued from previous page

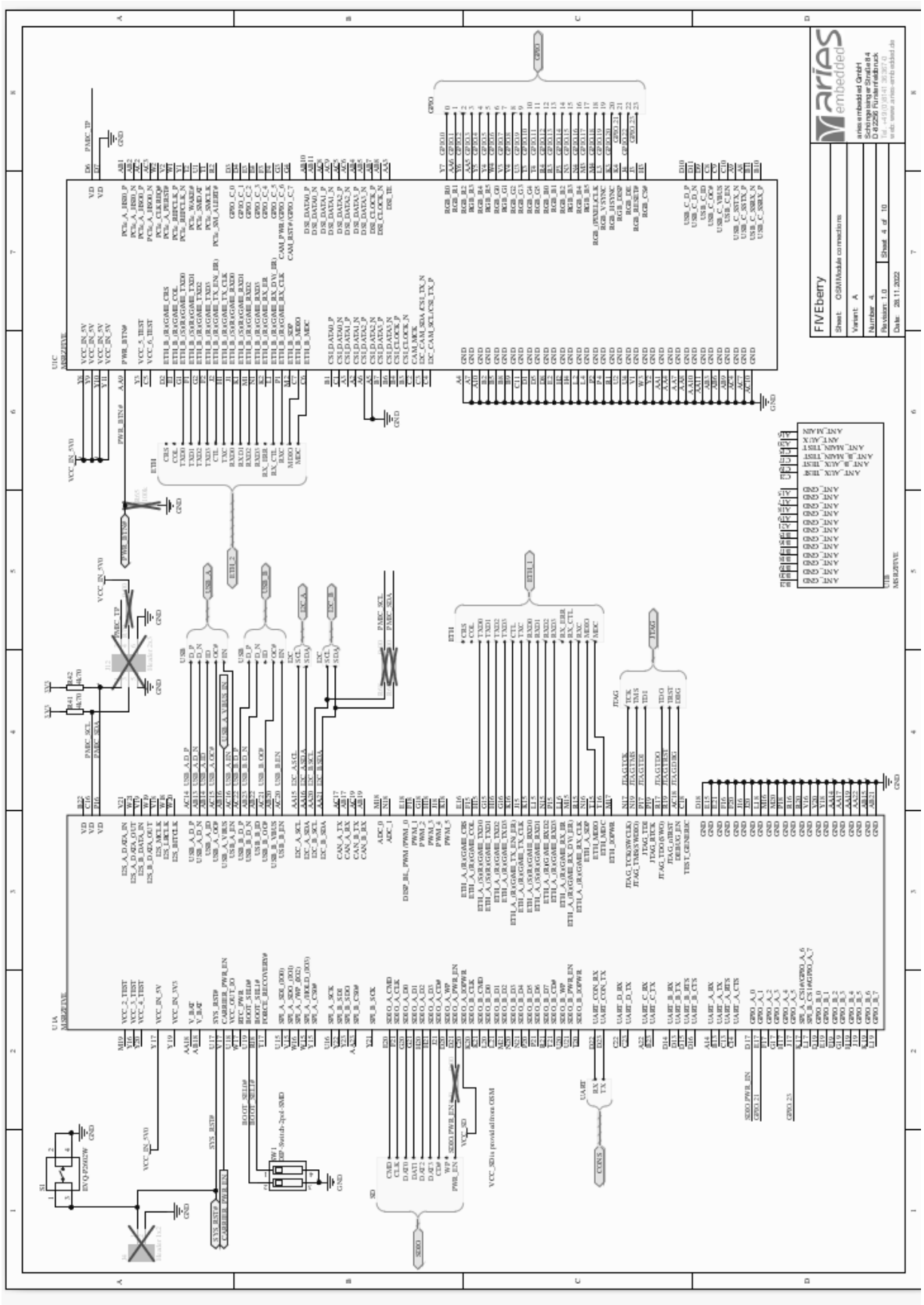
MSRZFive Pin	MSRZFive Function	U1 Pads	FIVEberry Function
–	GND	AB3	GND
–	GND	AB6	GND
–	GND	AB9	GND
–	GND	AC4	GND
–	GND	AC7	GND
–	GND	AC10	GND
–	–	–	–

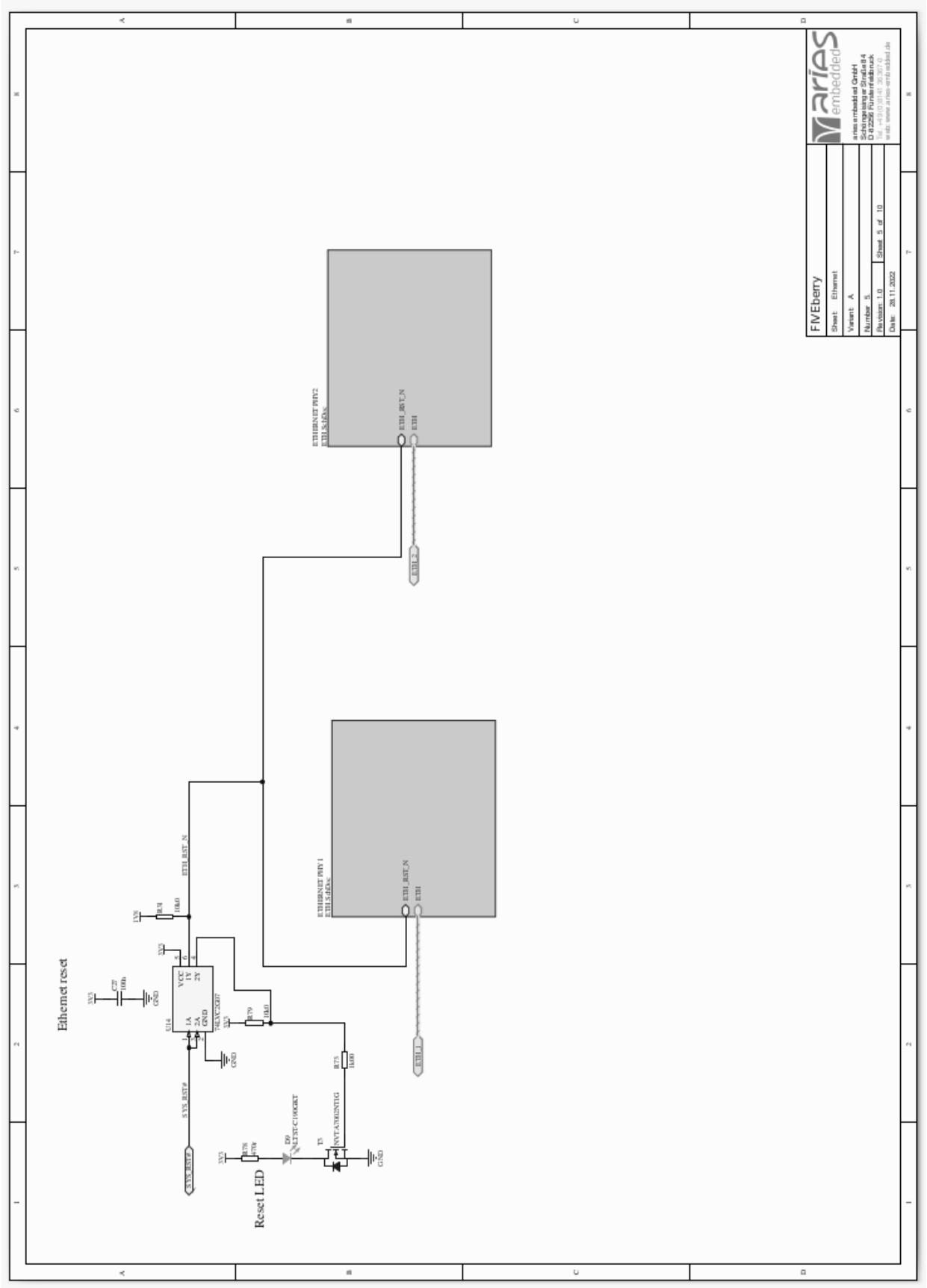
3.9 Schematics

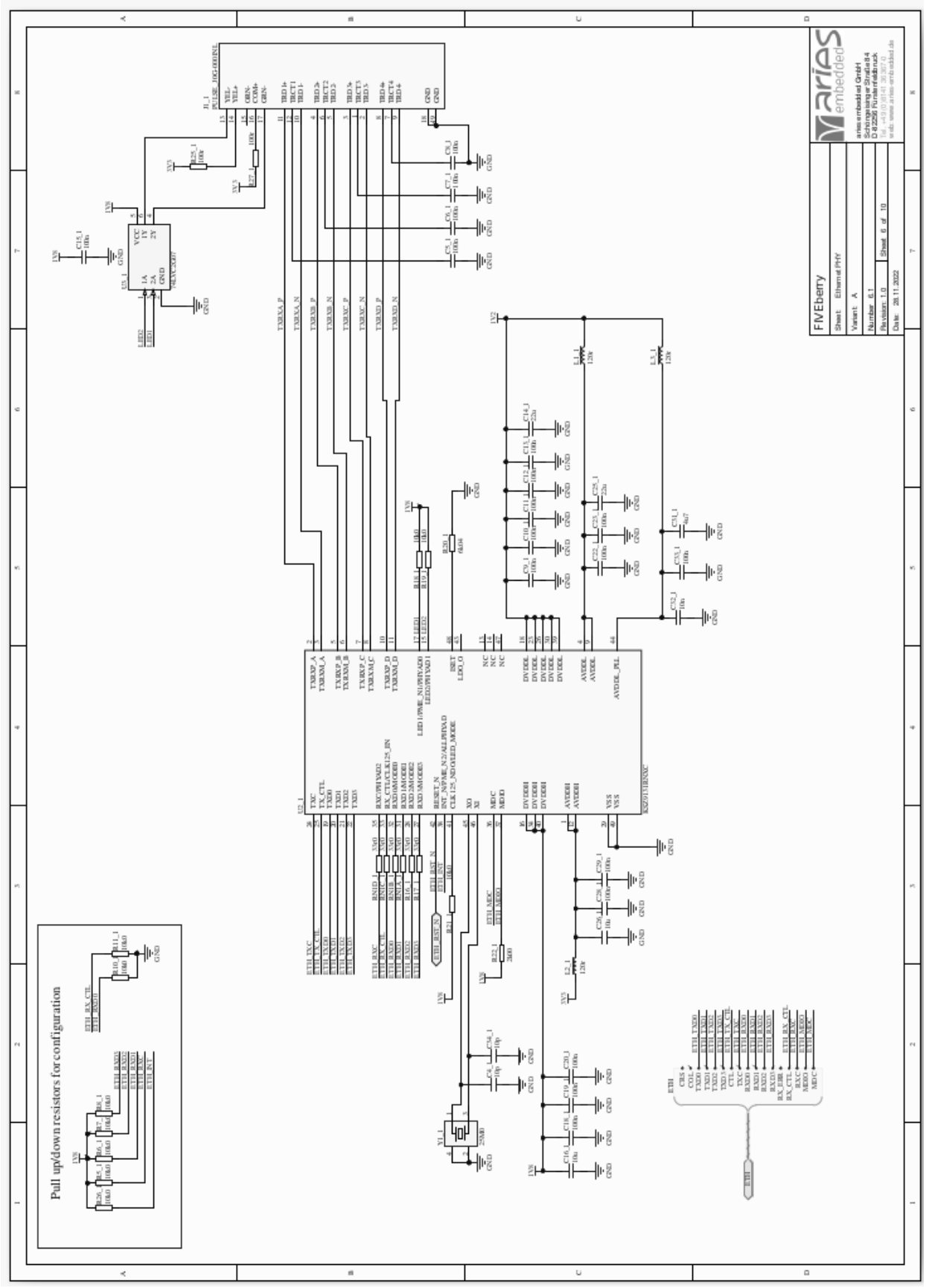


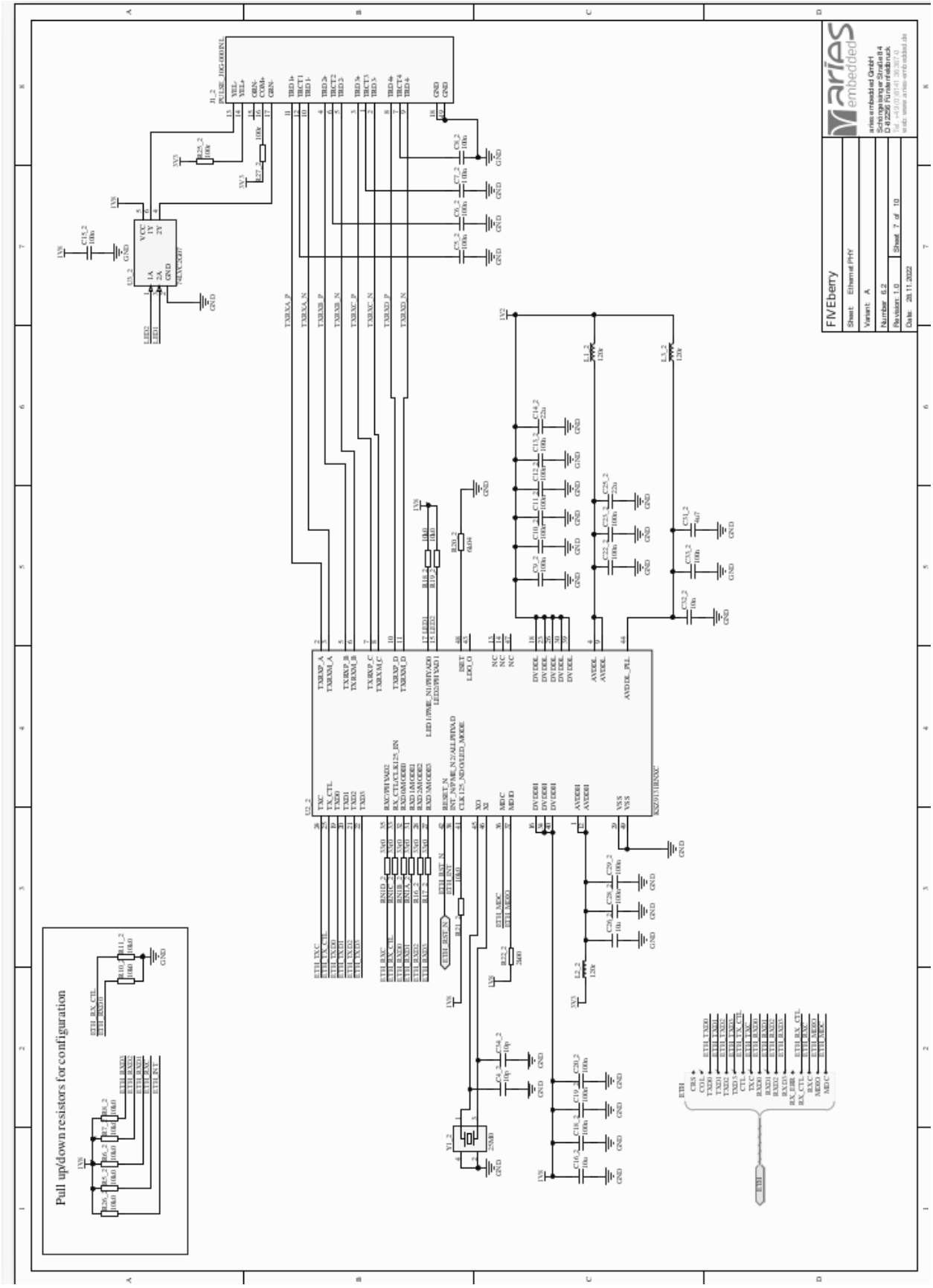

Fiducials
Mounting holes
FIVEberry
Connection diagram

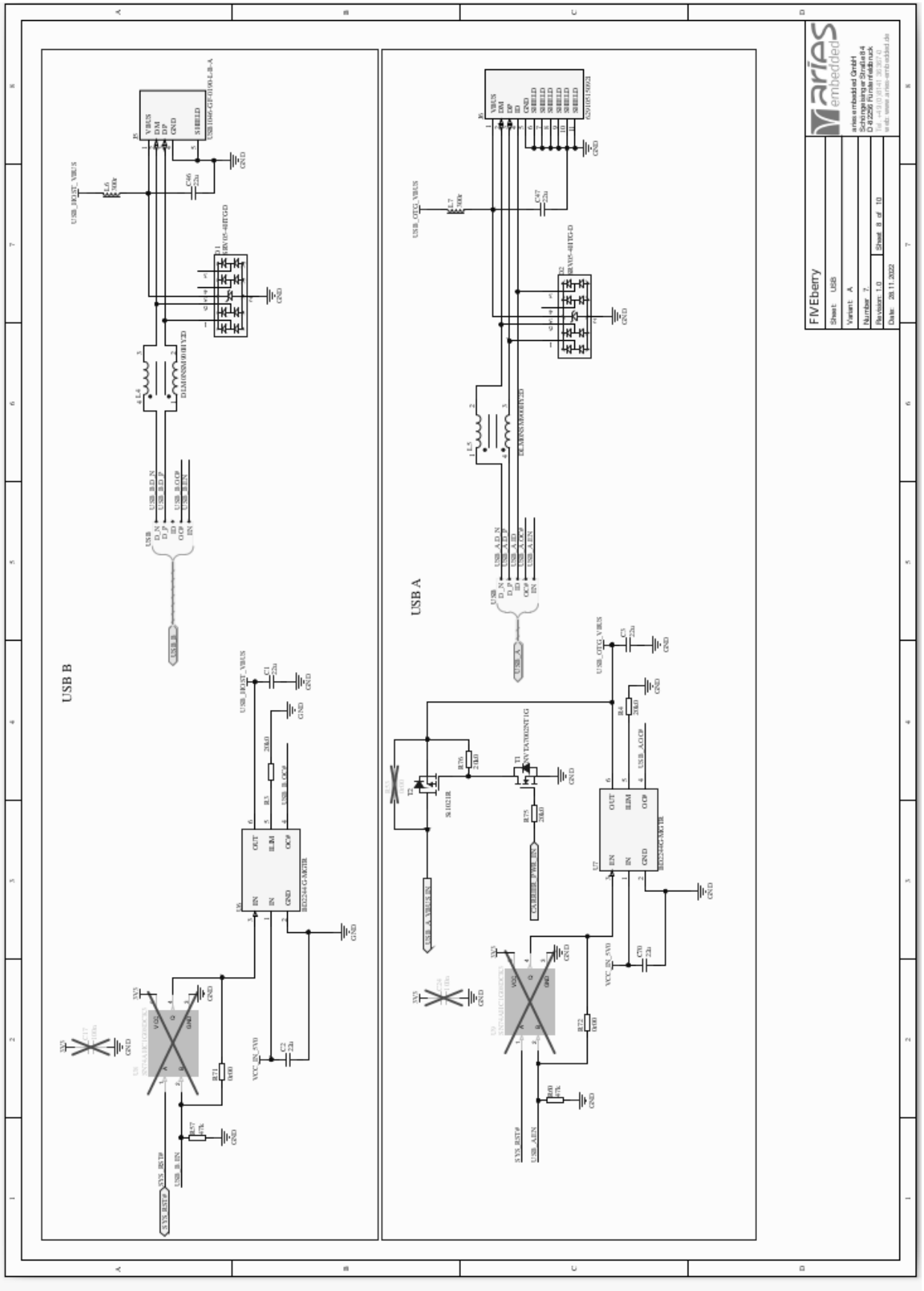

1.8V power supply
1.2V power supply
3.3V power supply
USB power input 5V/3A
FIVEberry
aries embedded GmbH

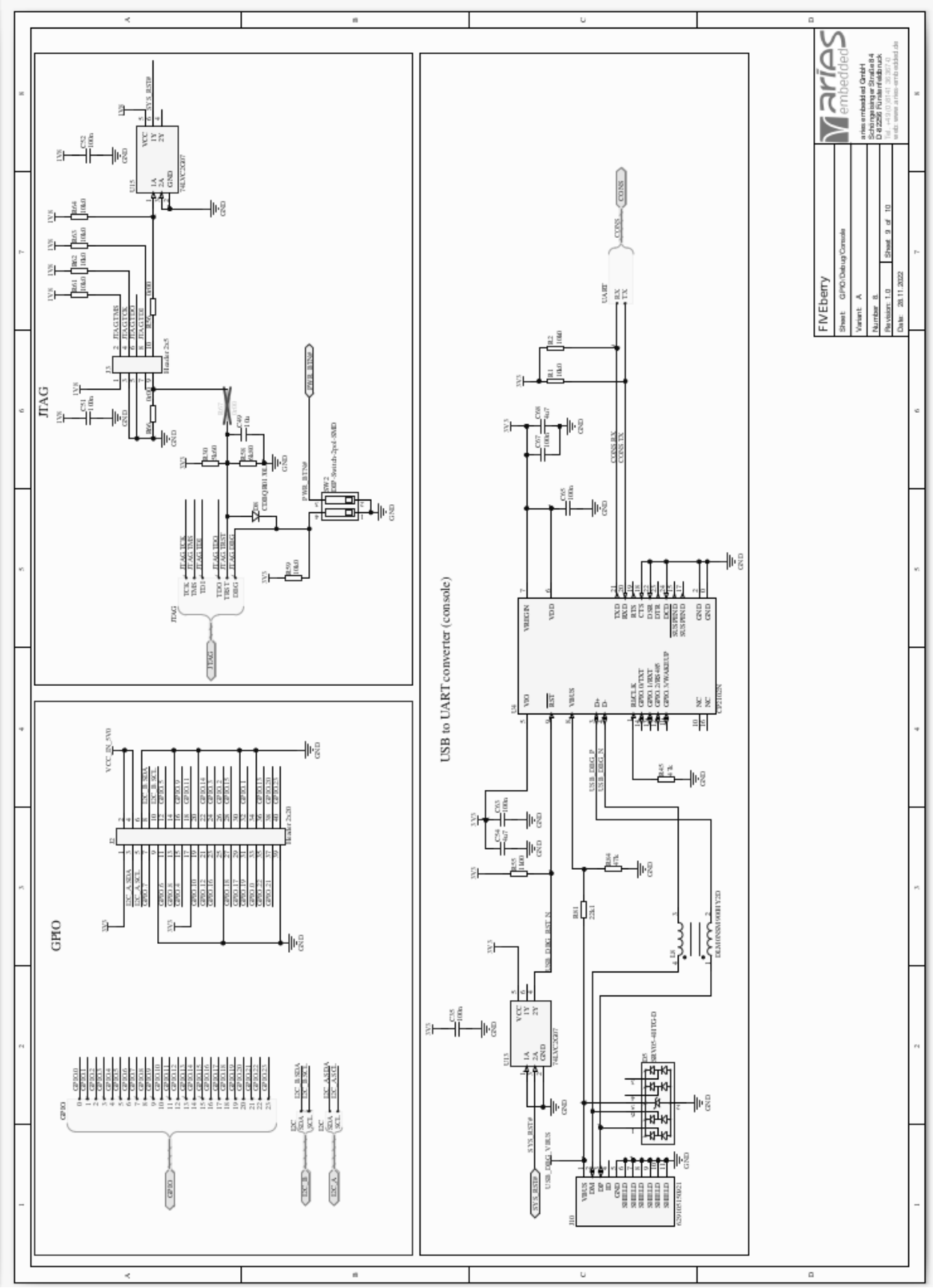



FIVEberry
Sheet: Ethernet
Variant: A
Number: 5
Revision: 1.0
Sheet 5 of 18
Date: 28.11.2022
aries embedded GmbH
Schorndorfer Straße 64
D-82256 Fürstenfeldbruck
ETHERNET PHY2
ETHERNET PHY 1
ETH_RST_N
Ethernet reset
Reset LED
SYS_RST#
3V3
GND


FIVEberry
Sheet: Ethernet PHY
Variant: A
Number: 6.1
Revision: 1.0
Sheet 6 of 10
Date: 28.11.2022
aries embedded GmbH
Pull up/down resistors for configuration


FIVEberry
Sheet: Ethernet PHY
Variant: A
Number: 6.2
Revision: 1.0
Sheet 7 of 10
Date: 28.11.2022
aries embedded GmbH
Pull up/down resistors for configuration


USB B
USB A
FIVEberry
Sheet: USB
Variant: A
Number: 7
Revision: 1.0
Sheet 8 of 10
Date: 28.11.2022


JTAG
GPIO
USB to UART converter (console)
FIVEberry
Sheet: GPIO/Debug Console
Variant: A
Number: B
Revision: 1.0
Sheet 9 of 10
Date: 28.11.2022
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Ritterstr. 2
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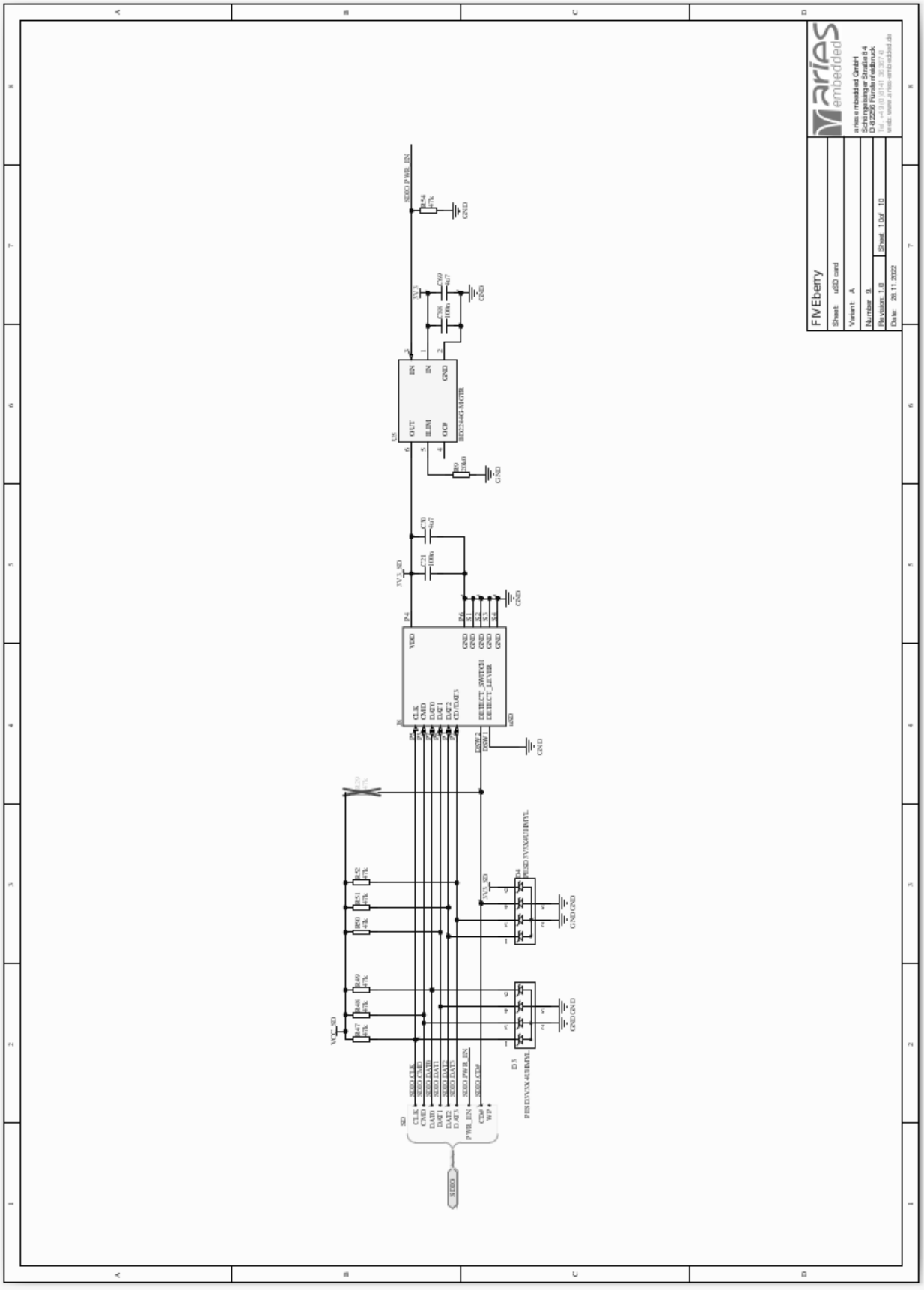
FIVEberry
Sheet: uSD card
Variant: A
Number: 3
Revision: 1.0
Sheet: 1.0of 10
Date: 28.11.2022
aries embedded GmbH
Schlingplatzer Straße 84
D-82256 Fürstenfeldbruck
Tel.: +49 (0) 8141 36367-0
web: www.aries-embedded.de
SDIO_PWR_EN
GND
3V3
3V3_SD
VCC_SD
SDIO_CLK
SDIO_CMD
SDIO_DAT0
SDIO_DAT1
SDIO_DAT2
SDIO_DAT3
SDIO_CD#
SD
CLK
CMD
DAT0
DAT1
DAT2
DAT3
PWR_EN
CD#
WP#
SDIO