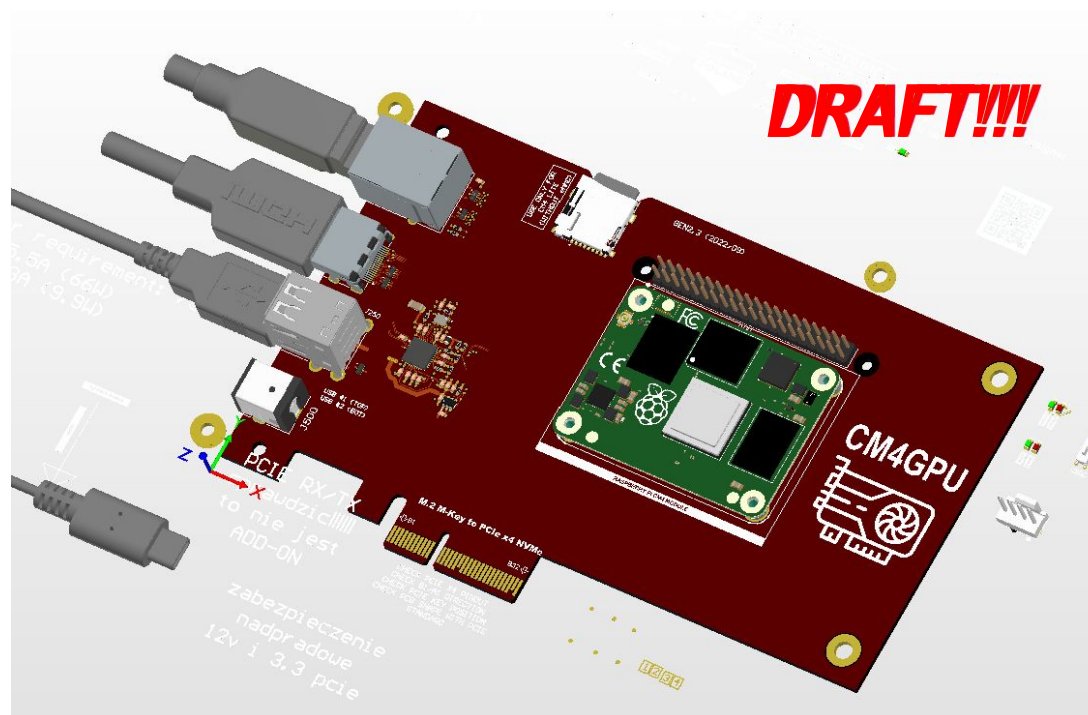


CM4 Module -> GPU card

PCB Project: CM4GPU
Version: V1
Revision: R1
Project State: DRAFT
Variant: FULL
Print date: 03.11.2022

TOP VIEW

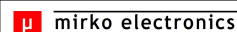


Page	Index
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01	Cover page
02	Block diagram
03	Top schematic
04	CM4 module - part #1
05	CM4 module - part #2
06	USB C interface
07	USB Hub
08	PCIe x4 slot
09	HDMI
10	100/1000M Ethernet
11	MicroSD card
12	MISC
13	Power supply
14	PCB marking and mechnics
15	Hardware changelog

[02]Block_diagram.SchDoc

[03]Top.SchDoc

PCB
PCB BARE BOARD

		Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland	Size A3
Title CM4GPU		Project CM4 Module -> GPU card	Version V1
Variant FULL		RefDes: -	Revision R1
Designer M. Folejewski		Sheet 1 / 15	
File Name [01] Cover page.SchDoc		Printed 03.11.2022	

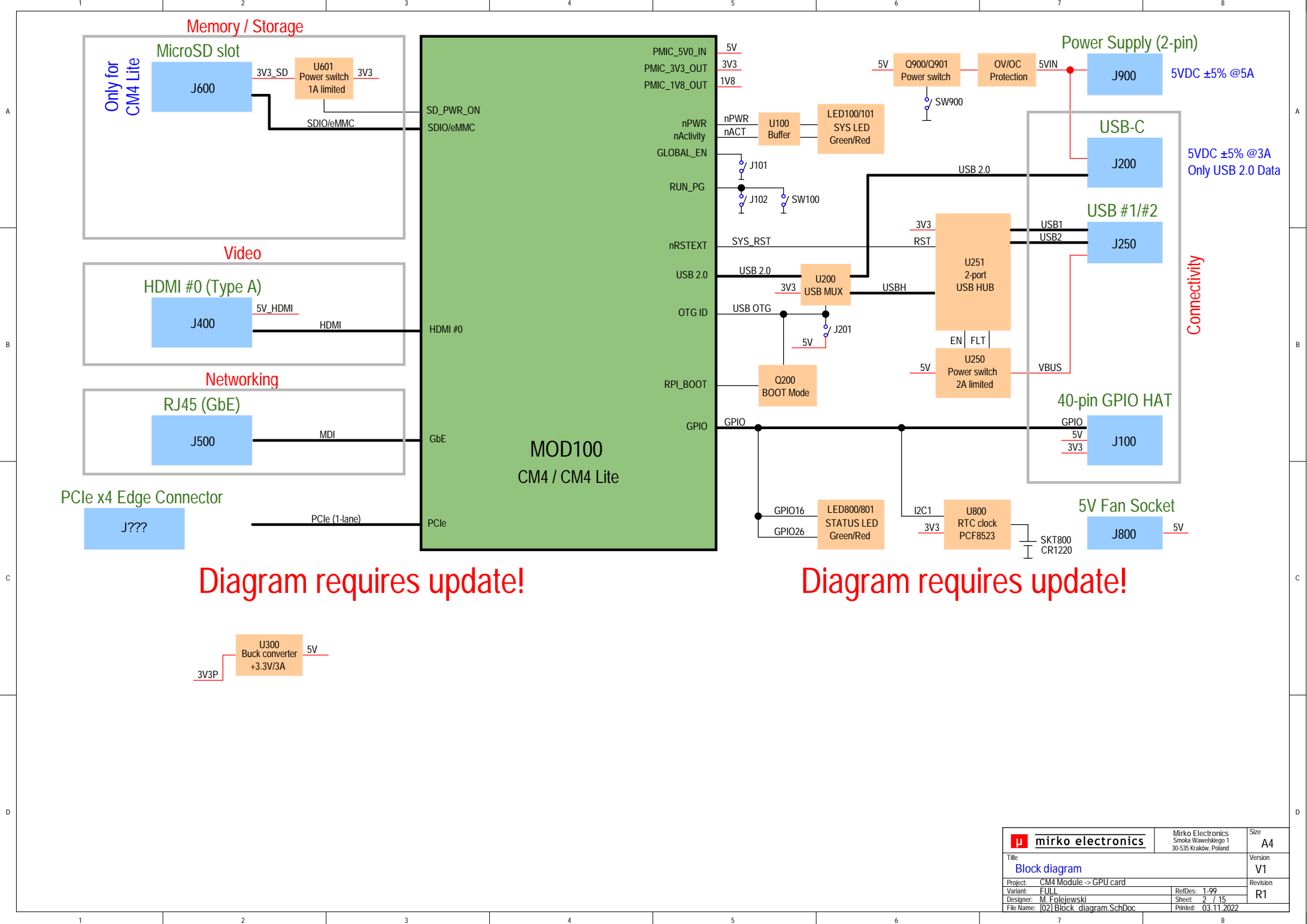



Diagram requires update!

Diagram requires update!

 mirko electronics		Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland	Size A4
Title Block diagram		Version V1	
Project: CM4 Module -> GPU card		Revision R1	
Variant: FULL		RefDes: 1-99	
Designer: M. Folejewski		Sheet: 2 / 15	
File Name: 021 Block diagram.SchDoc		Printed: 03.11.2022	

1

2

3

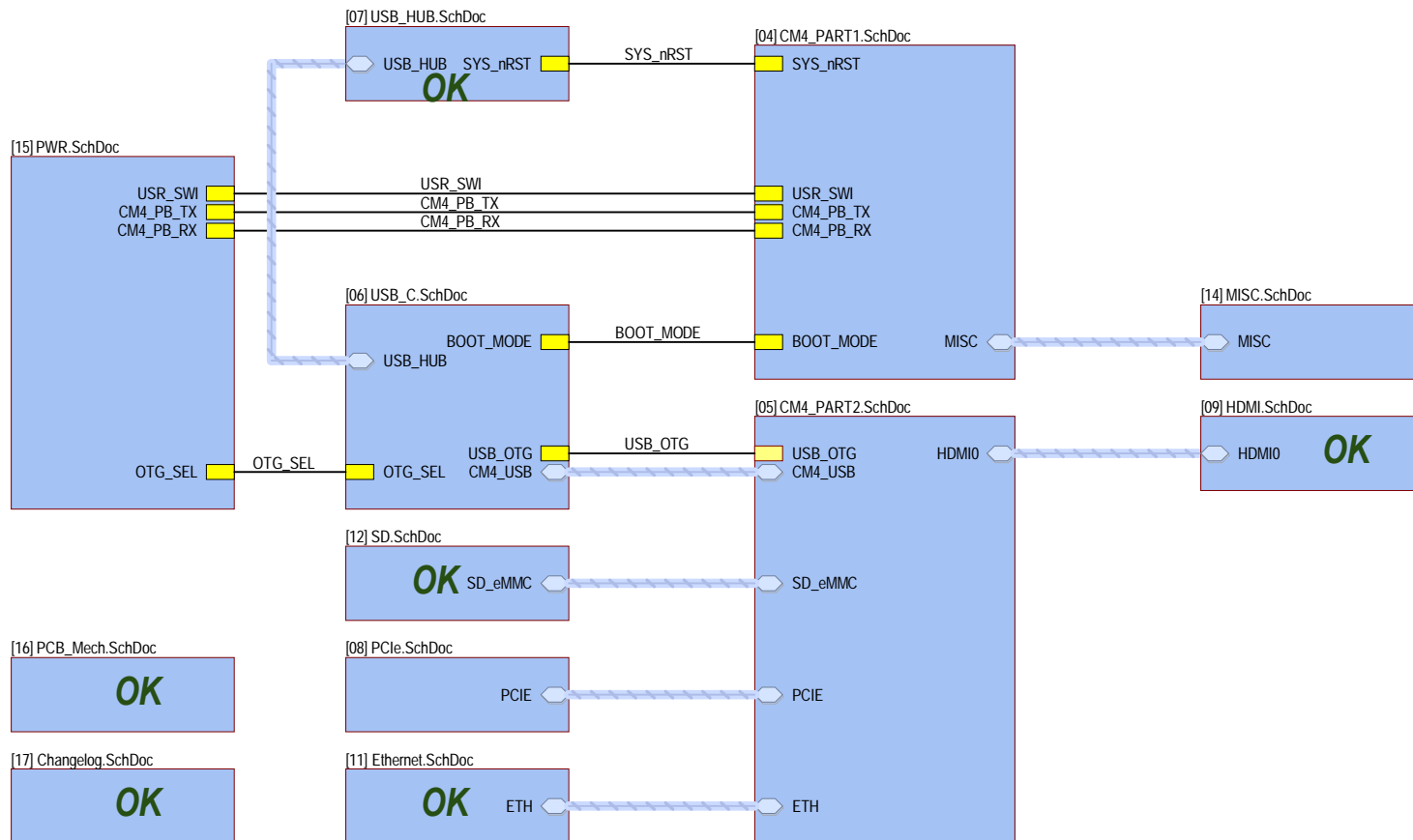
4

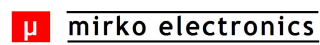
A

B

C

D



		Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland		Size A4
Title Top schematic				Version V1
Project: CM4 Module -> GPU card				Revision R1
Variant: FULL		RefDes: 1-99		
Designer: M. Folejewski		Sheet: 3 / 15		
File Name: [03] TOP.SchDoc		Printed: 03.11.2022		

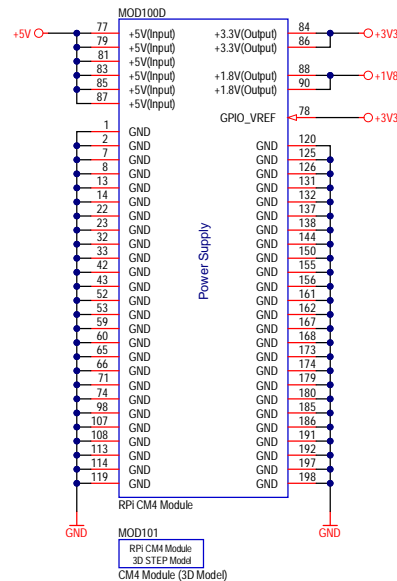
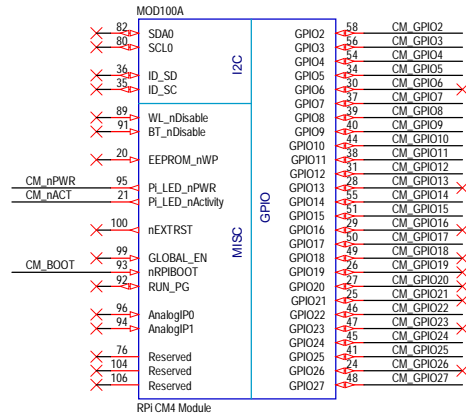
1

2

3

4

CM4 MODULE (PART #1)



SCH:

I2C0 Interface: SCL0 pin (GPIO45) and SDA0 pin (GPIO44) typically are used for Camera and Displays and have internal 1.8k pull up to CM4_3.3V. ID Interface (ID_SD/ID_SC): CM4 datasheet does not mention about pull-up resistors on ID_SD and ID_SC pins.

I2C1 (GPIO2/GPIO3) have 1.8k pull-up resistors added on CM4 module.

SCH:

I2C (ID_SD/ID_SC): This I2C bus is normally used for identifying HATS (HAT ID EEPROM) and controlling CSIO and DSIO devices. At boot time this I2C interface will be interrogated to look for an EEPROM that identifies the attached board and allows automatic setup of the GPIOs (and optionally, Linux drivers).

DO NOT USE these pins for anything other than attaching an I2C ID EEPROM. Leave unconnected if ID EEPROM not required.

SCH:

nRPIBOOT: A low on this pin force booting from an RPI server. If not used leave floating. Internally pulled via 10K to +3.3V.

SCH:

EEPROM_nWP pin: Leaving floating NB internally pulled up to CM4_3.3V via 100K (VIL < 0.8V) but can be grounded to prevent writing to the on board EEPROM which stores the bootcode.

SCH:

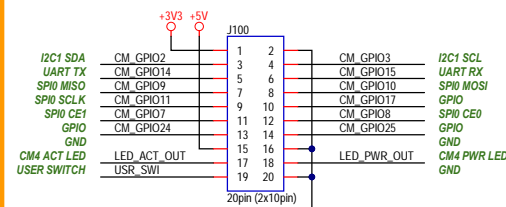
1.8V and 3.3V Outputs +/-2.5%. Power Output max 300mA per pin for a total of 600mA. This will be powered down during power off or GLOBAL_EN being set low.

SCH:

GLOBAL_EN: Drive low to power off CM4. Internally pulled up with a 100K to +5V.

16-PIN GPIO HEADER

reserved for future use



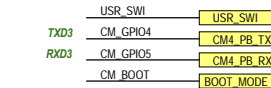
TESTPOINTS (DEBUG)

+3V3

+1V8

TP119

TP120



GPIO pins - connect to specific devices

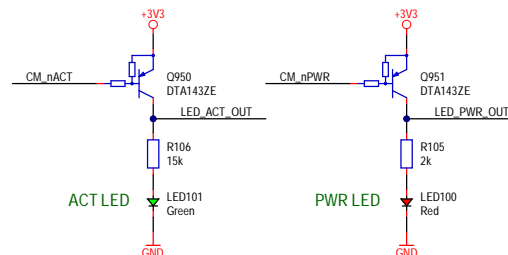
components - display 4 parameters: val/tol/pwr rating/package

power rail nets - use Google convention (e.g. PP3300)



3v3 Power	1	2	5v Power
GPIO 2 (I2C1 SDA)	3	4	5v Power
GPIO 3 (I2C1 SCL)	5	6	Ground
GPIO 4 (GPCLK0)	7	8	GPIO 14 (UART TX)
Ground	9	10	GPIO 15 (UART RX)
GPIO 17	11	12	GPIO 18 (PCM CLK)
GPIO 27	13	14	Ground
GPIO 22	15	16	GPIO 23
3v3 Power	17	18	GPIO 24
GPIO 10 (SPI0 MOSI)	19	20	Ground
GPIO 9 (SPI0 MISO)	21	22	GPIO 25
GPIO 11 (SPI0 SCLK)	23	24	GPIO 8 (SPI0 CE0)
Ground	25	26	GPIO 7 (SPI0 CE1)
GPIO 0 (EEPROM SDA)	27	28	GPIO 1 (EEPROM SCL)
GPIO 5	29	30	Ground
GPIO 6	31	32	GPIO 12 (PWM0)
GPIO 13 (PWM1)	33	34	Ground
GPIO 19 (PCM FS)	35	36	GPIO 16
GPIO 26	37	38	GPIO 20 (PCM DIN)
Ground	39	40	GPIO 21 (PCM DOUT)

SYS LEDs



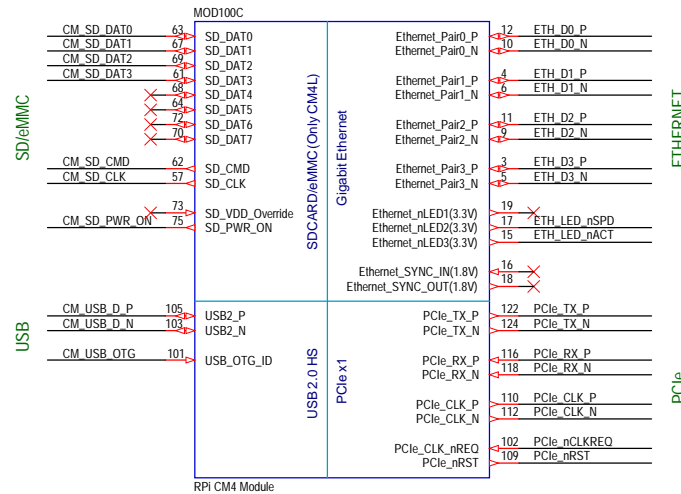
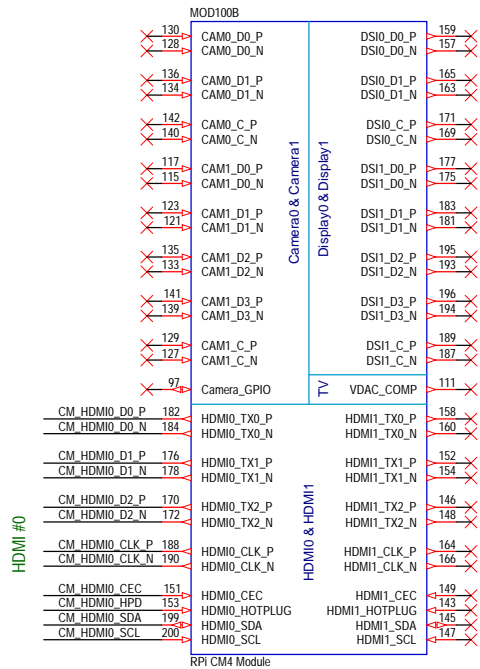
3V3 LOAD

SCH:

Extra load on the 3V3 power rail to fix the HDMI issue with 5V LED.

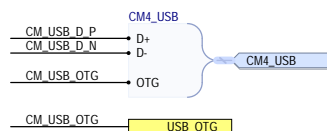
mirko electronics	Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland	Size A3
Title Compute Module 4 (Part #1)	Version V1	Revision R1
Project: CM4 Module -> GPU card	RefDes: 100-199	
Variant: FULL	Sheet: 4 / 15	
Designer: M. Folejewski	Printed: 03.11.2022	
File Name: 1041CM4_PART1.SchDoc		

CM4 MODULE (PART #2)

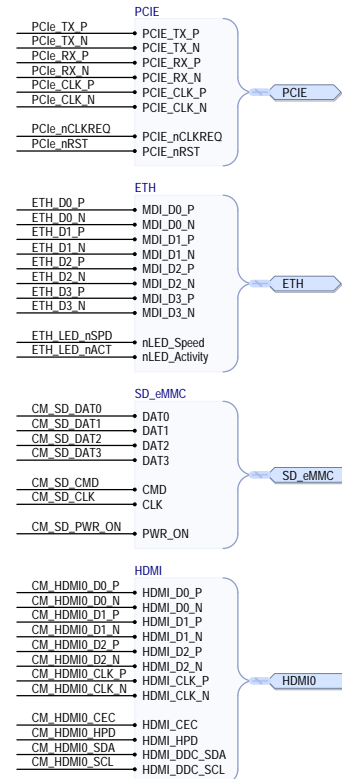


SCH:

USB_OTG_ID: Input (3.3V signal) USB OTG Pin. Internal pulled up. The USB_OTG pin is used to select between USB host and device that is typically wired to the ID pin of a Micro usb connector. To use this functionality it must be enabled in the OS that is used. If using either as a fixed slave or fixed master, please tie the USB OTGID pin to ground.



MEZZANINE CONNECTORS



LAYOUT:

Route MIPI signals as matched length 100 Ohm differential pairs, each signal within a pair should ideally be matched to better than 0.15mm.

Route USB signals as matched length 90 Ohm differential pairs. The P N signals should ideally be matched to 0.15mm.

Route HDMI signals as matched length 100 Ohm differential pairs, each signal within a pair should ideally be matched to better than 0.15mm. Pairs don't typically need any extra matching as they only have to be matched to 25mm.

LAYOUT:

Route Ethernet signals as matched length 100 Ohm differential pairs with suitable clearances. Length matching between pairs should be better than 50mm, so in the typical case no length matching is required. However the signals within a pair need to be length matched, ideally to better than 0.15mm.

Route PCIe signals as matched length 90 Ohm differential pairs with suitable clearances. There is no need to match the lengths between pairs, only the signals within a pair need to be length matched ideally to better than 0.1mm.

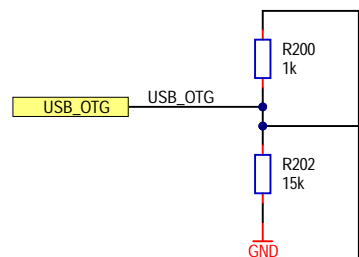
LAYOUT:

Impedance matching:
90 Ohm → PCIe, USB
100 Ohm → HDMI, Ethernet, MIPI (CSI, DSI)

	Mirko Electronics Smoka Wawelskiego 1 30-535 Krakow, Poland		Size B
	Title Compute Module 4 (Part #2)		Version V1
Project:	CM4 Module -> GPU card	RefDes:	100-199
Variant:	FULL	Sheet:	5 / 15
Designer:	M. Folejewski	Revision	R1
File Name:	[05] CM4 PART2.SchDoc		
		Printed: 03.11.2022	

USER:

USB_OTG line: if USB-C cable is connected and SW200 jumper has shorted 2-3 pins then the CM4 becomes a USB Device.

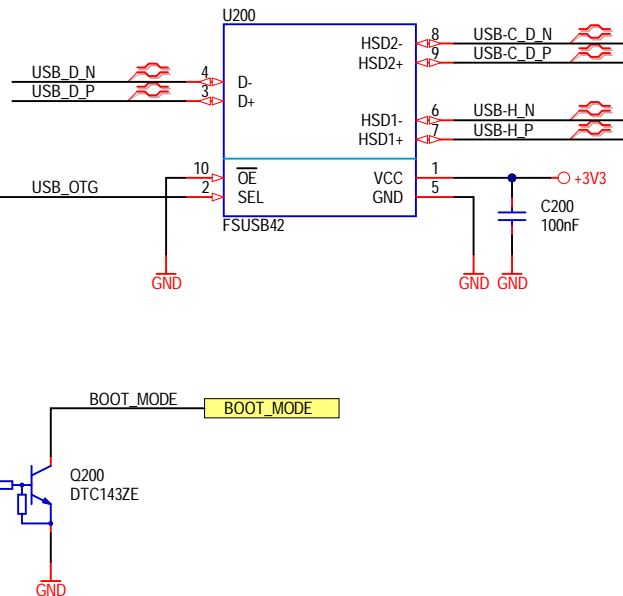


USB DEVICE MODE

USER:

USB DEVICE MODE JUMPER:
1-2 = USB Device disabled (OS BOOT).
2-3 = CM4 connected as USB Device to USB-C cable.

USB SWITCH



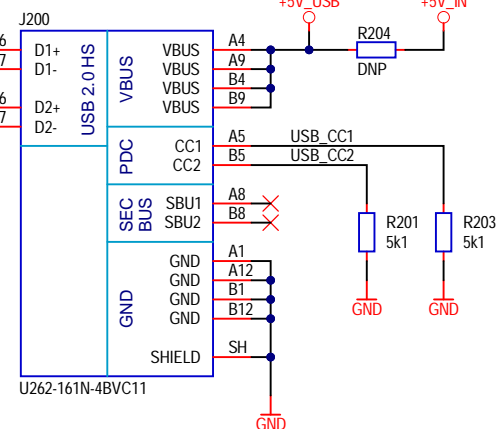
LAYOUT:

connect the IO1A - IO4A on the connector side.

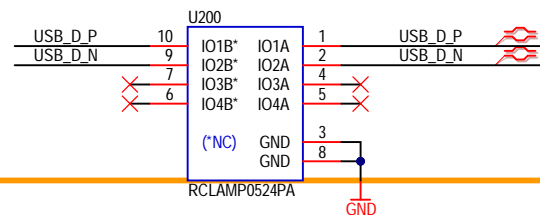
LAYOUT:

Place the TVS array diodes as close as possible to the USB-C connector.

USB TYPE C



ESD PROTECTION



BOM:

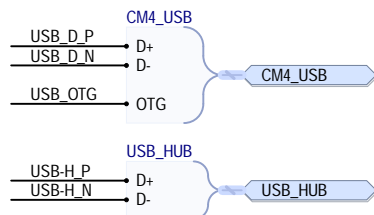
USB 3.1 Type C:
Use XKB Connectivity, MPN = U262-161N-4BVC11.
Description: vertical connector, 16 pins, USB 2.0 only, SMD version.

LAYOUT:

Route USB signals as matched length 90 Ohm differential pairs. The P N signals should ideally be matched to 0.15mm.

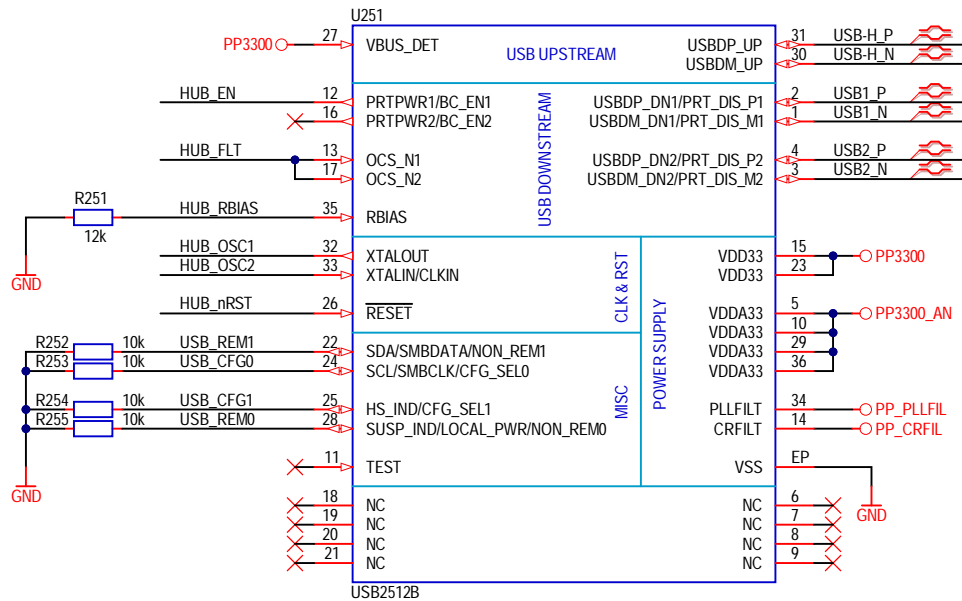
TESTPOINTS (DEBUG)

USB_OTG	TP200
OTG_SEL	TP201
USB_CC1	TP203
USB_CC2	TP204

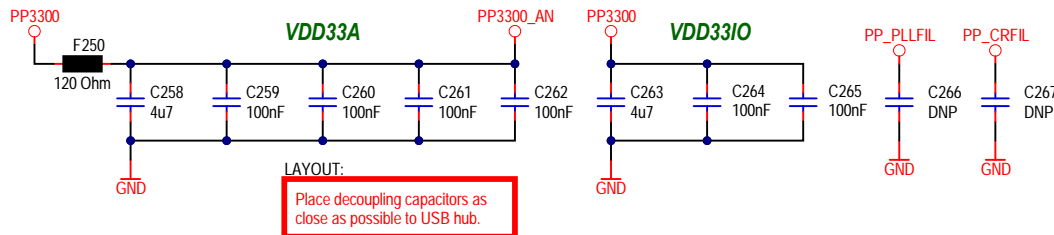


		Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland	Size A4
Title USB-C interface and USB switch		Project: CM4 Module -> GPU card Variant: FULL Designer: M. Folejewski File Name: [06] USB_C.SchDoc	Version V1
		RefDes: 200-249 Sheet: 6 / 15 Printed: 03.11.2022	Revision R1

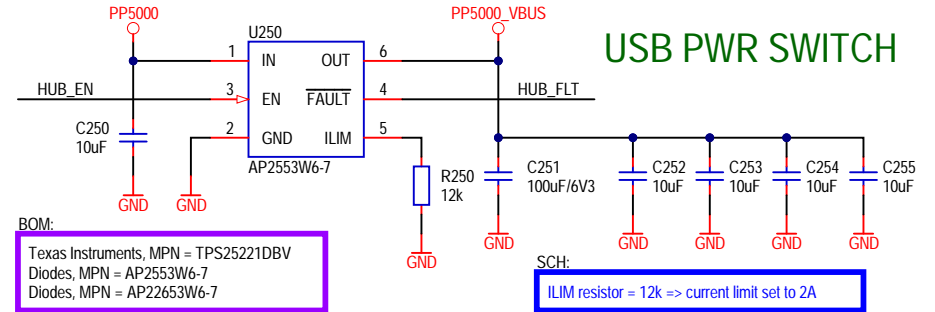
2-PORT USB HUB



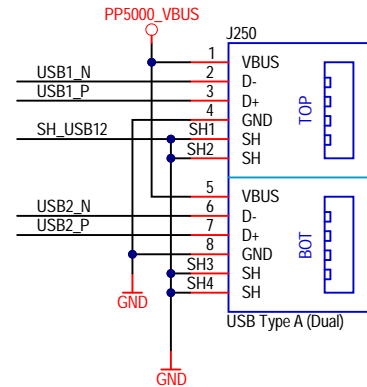
DECOUPLING CAPACITORS



USB PWR SWITCH

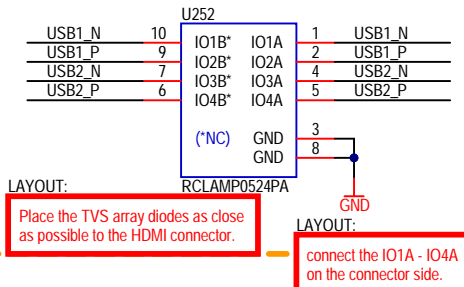


USB #1/#2

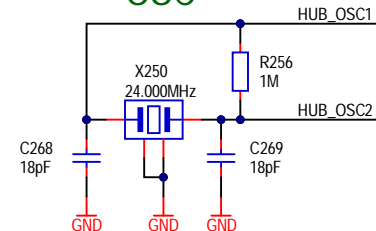


LAYOUT:
Route USB signals as matched length 90 Ohm differential pairs. The P N signals should ideally be matched to 0.15mm.

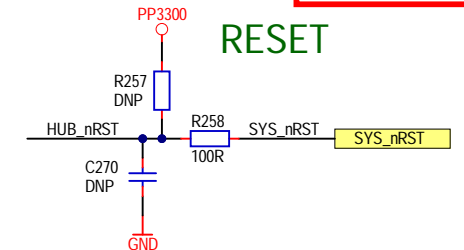
ESD PROTECTION



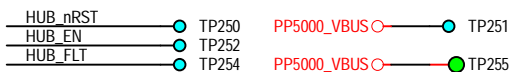
OSC



RESET

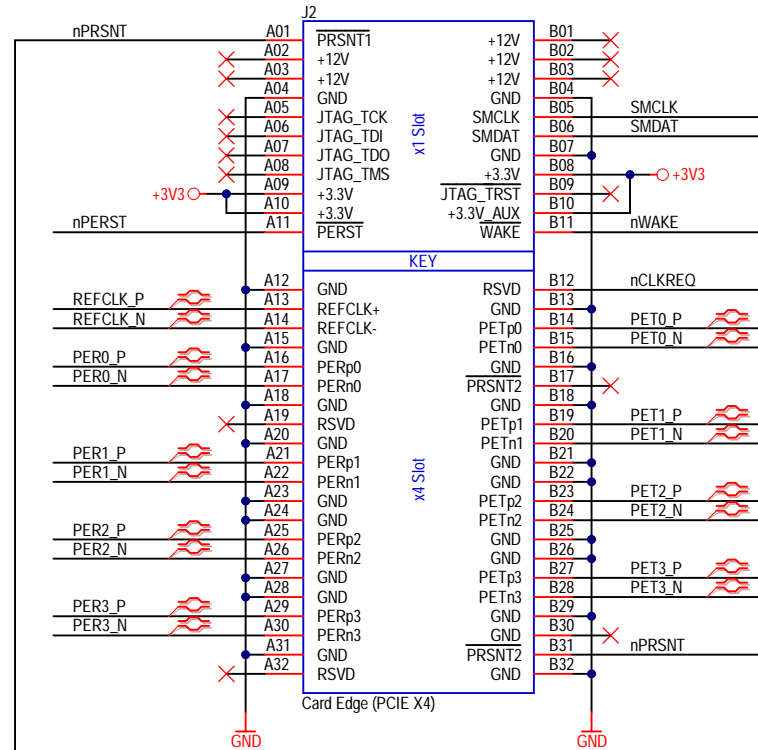


TESTPOINTS (DEBUG)



		Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland		Size A4
Title 4-port USB 2.0 hub		Version V1		Revision R1
Project: CM4 Module -> GPU card		RefDes: 250-299		
Variant: FULL		Sheet: 7 / 15		
Designer: M. Folejewski		Printed: 03.11.2022		
File Name: I071 USB_HUB.SchDoc				

PCI Express x4

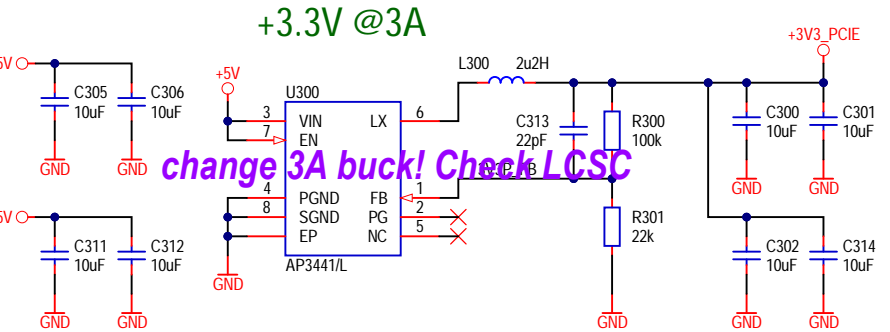
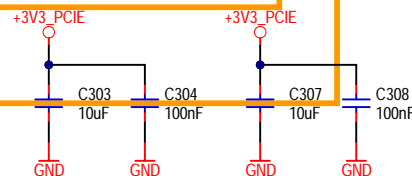


SCH:

PCIe x4 reference board: PINE64 -ROCKPro64
https://files.pine64.org/doc/rockpro64/rockpro64_v21-SCH.pdf

AYOUT:

Route PCIe signals as matched length 90 Ohm differential pairs with suitable clearances. There is no need to match the lengths between pairs, only the signals within a pair need to be length matched ideally to better than 0.1mm.



LAYOUT:

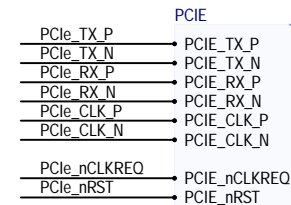
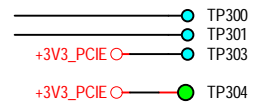
Place decoupling capacitors as close as possible to the Buck converter.

BOM:

2.2uH -> compatible components (7.3x6.6x2.4mm):
 Changjiang Microelectronics Tech, MPN = FXL0624-2R2-M
 Sumida, MPN = 0624CDMCCDS-2R2MC
 AVX, MPN = LMLP07B7M2R2DTAS



TESTPOINTS (DEBUG)

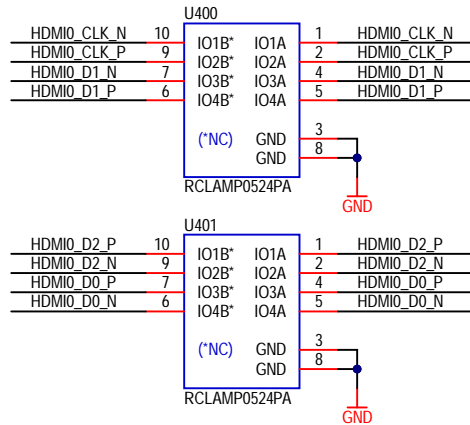


LAYOUT:

Place decoupling capacitors as close as possible to M.2 connector.

		Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland	Size A4
Title M.2 PCIe x1 Socket		Variant: FULL Designer: M. Folejewski File Name: 1081 PCIe.SchDoc	Version V1
Project: CM4 Module -> GPU card RefDes: 300-399 Sheet: 8 / 15 Printed: 03.11.2022		Revision R1	

ESD PROTECTION



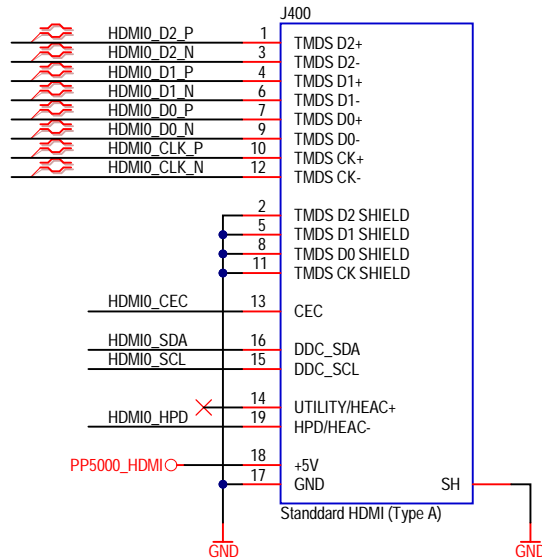
LAYOUT:

Place the TVS array diodes as close as possible to the HDMI connector.

LAYOUT:

connect the IO1A - IO4A on the connector side.

HDMI #0 (TYPE A)



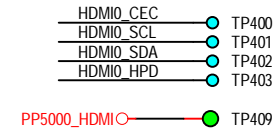
BOM:

HDMI #0 connector:
Wurth Elektronik, MPN = 685 119 134 923
BOOMELE, MPN = HDMI-001
Description: Type A (Standard), 19 pins, 0.50mm pitch, horizontal, SMD.

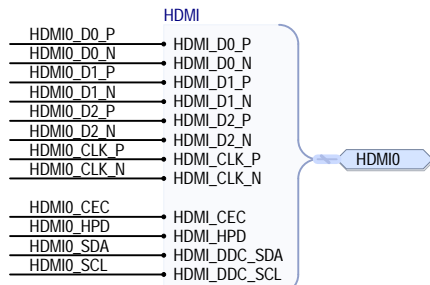
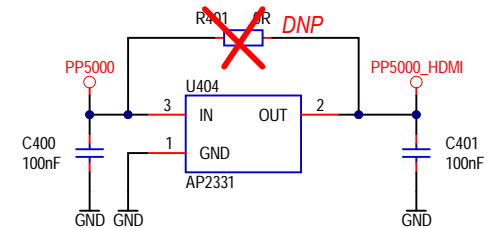
LAYOUT:

Route HDMI signals as matched length 100 Ohm differential pairs, each signal within a pair should ideally be matched to better than 0.15mm. Pairs don't typically need any extra matching as they only have to be matched to 25mm.

TESTPOINTS (DEBUG)

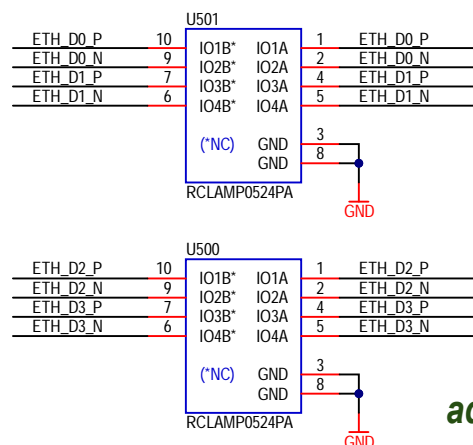


5V POWER SWITCH



		Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland		Size A4
Title HDMI Interface		Version V1		Revision R1
Project: CM4 Module -> GPU card		RefDes: 400-449		
Variant: FULL		Sheet: 9 / 15		
Designer: M. Folejewski		Printed: 03.11.2022		
File Name: [09] HDMI.SchDoc				

ESD PROTECTION



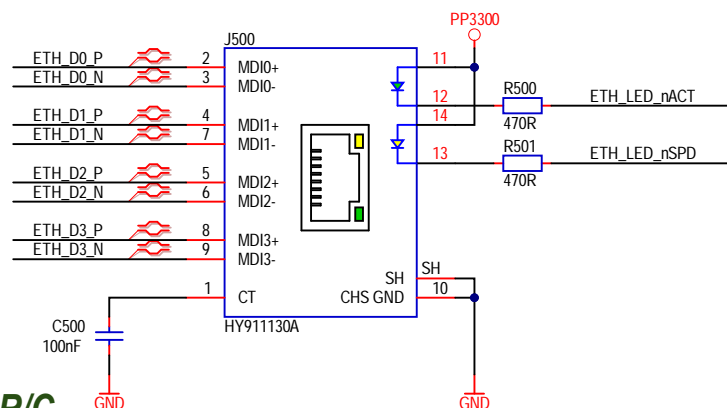
LAYOUT:

connect IO1A - IO4A on the connector side.

LAYOUT:

Place TVS array diodes as close as possible to RJ45 connector.

100/1000M ETHERNET



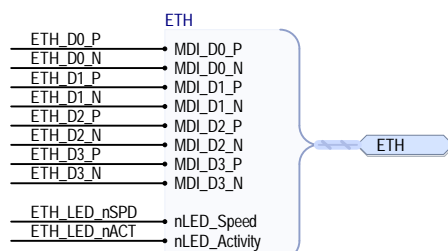
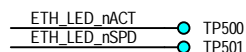
LAYOUT:

Route Ethernet signals as matched length 100 Ohm differential pairs with suitable clearances. Length matching between pairs should be better than 50mm, so in the typical case no length matching is required. However the signals within a pair need to be length matched, ideally to better than 0.15mm.

BOM:

RJ45 -> compatible connectors:
HanRun, MPN = HR911130A (HY911130A)
Link-PP, MPN = LPJG0806FBNL
Description: 100/1000M RJ45, Tab-down, G/Y LEDs

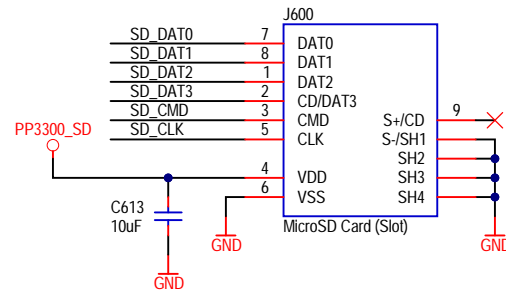
TESTPOINTS (DEBUG)



		Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland	Size A4
Title 100/1000M Ethernet interface		Version V1	
Project: CM4 Module -> GPU card Variant: FULL Designer: M. Folejewski File Name: [11] Ethernet.SchDoc		RefDes: 500-599 Sheet: 10 / 15 Printed: 03.11.2022	
		Revision R1	

add 4 parameters R/C

MICRO SD CARD



SCH:

Used MicroSD card slot: Hmax = 2.00 mm

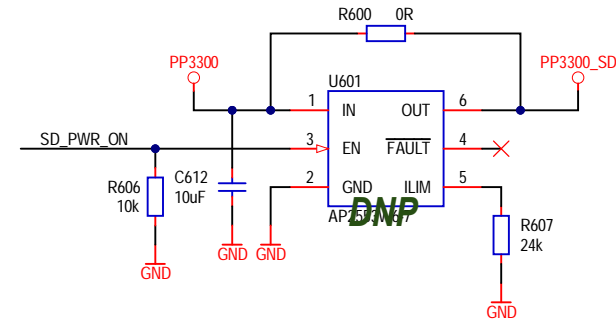
USER:

SD Card only for CM4 Lite module with no on-board Flash memory chip (eMMC).

BOM:

MicroSD slot -> compatible components:
GCT, MPN = MEM2055-00-190-01-A
SOFNG, MPN = TF-015
HOAUC, MPN = HYC77-TF09-200
XUNPU, MPN = TF-115

PWR SWITCH



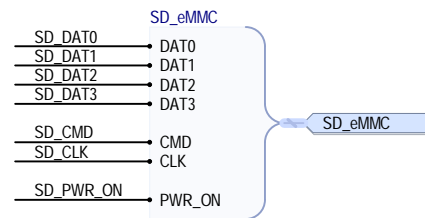
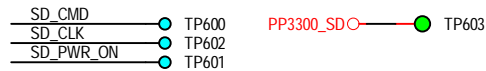
BOM:


Texas Instruments, MPN = TPS25221DBV
Diodes, MPN = AP2553W6-7
Diodes, MPN = AP22653W6-7

SCH:

ILIM resistor = 24k => current limit set to 1.05A

TESTPOINTS (DEBUG)

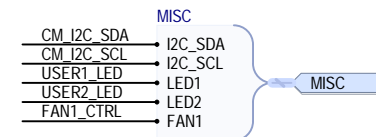


 mirko electronics		Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland	Size A4
Title MicroSD slot		Variant: FULL	Version V1
Project: CM4 Module -> GPU card		RefDes: 600-699	Revision R1
Designer: M. Folejewski		Sheet: 11 / 15	
File Name: [12]SD.SchDoc		Printed: 03.11.2022	

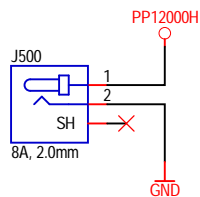
FAN1 can be controlled by FAN1_CTRL line (by static GPIO level or by using PWM mode). FAN1 control can be disabled (always on) by assembly R802 jumper.

BOM:

4-pin connector (2.54mm pitch):
Molex, MPN = 47053-1000.
PINREX, MPN = 744-81-04TW30.




+5V MAIN POWER SUPPLY



MCU ISP (UPDI)

3.3V/300mA LDO

TESTPOINTS (DEBUG)

 mirko electronics		Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland		Size A4
Title Power supply				Version V1
Project: CM4 Module -> GPU card				Revision R1
Variant: FULL		RefDes: 900-949		
Designer: M. Folejewski		Sheet: 13 / 15		
File Name: [15] PWR.SchDoc		Printed: 03.11.2022		

PCB MOUNTING HOLES

add mech holes

M2.5 STEEL SPACERS

MECH950
M2.5, L = 3.0mm

MECH951
M2.5, L = 3.0mm

SCR950
M2.5

SCR951
M2.5

MECH952
M2.5, L = 3.0mm

MECH953
M2.5, L = 3.0mm

SCR952
M2.5

SCR953
M2.5

BOM:

SMT Steel Spacer with internal Thread M2.5, L = 3.0mm:
Use Wurth Elektronik, MPN = 977 403 015 1.

PCB MARKING

FID950
Fiducial

FID951
Fiducial

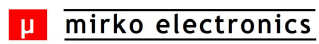
FID952
Fiducial

PCB950
LAYER INDICATOR
PCB_LAYER_STACKUP

FID953
Fiducial

FID954
Fiducial

FID955
Fiducial

		Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland	Size A4
Title PCB marking & mechanical parts		Version V1	Revision R1
Project: CM4 Module -> GPU card	Variant: FULL	RefDes: 950-999	
Designer: M. Folejewski	Sheet: 14 / 15	Printed: 03.11.2022	
File Name: [16] PCB_Mech.SchDoc			

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A

B

C

D

A

B

C

D

Hardware changelog

2022.10.27:

- project has started;
- imported schematics from existing designs;

2022.10.29:

- schematic update, minor changes;

2022.10.31:


- PCB shape according to PCIe standard;
- initial component placement of the front connectors;
- minor changes;

2022.01.02:

- added DC barrel jack;
- schematic: power supply update;

2022.01.03:

- component placement of the front connectors;
- microsd card: updated PCB edge;
- RefDes updated;

 mirko electronics		Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland	Size A4
Title Hardware changelog			Version V1
Project: CM4 Module -> GPU card			Revision R1
Variant: FULL		RefDes: -	
Designer: M. Folejewski		Sheet: 15 / 15	
File Name: [17] Changelog.SchDoc		Printed: 03.11.2022	

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