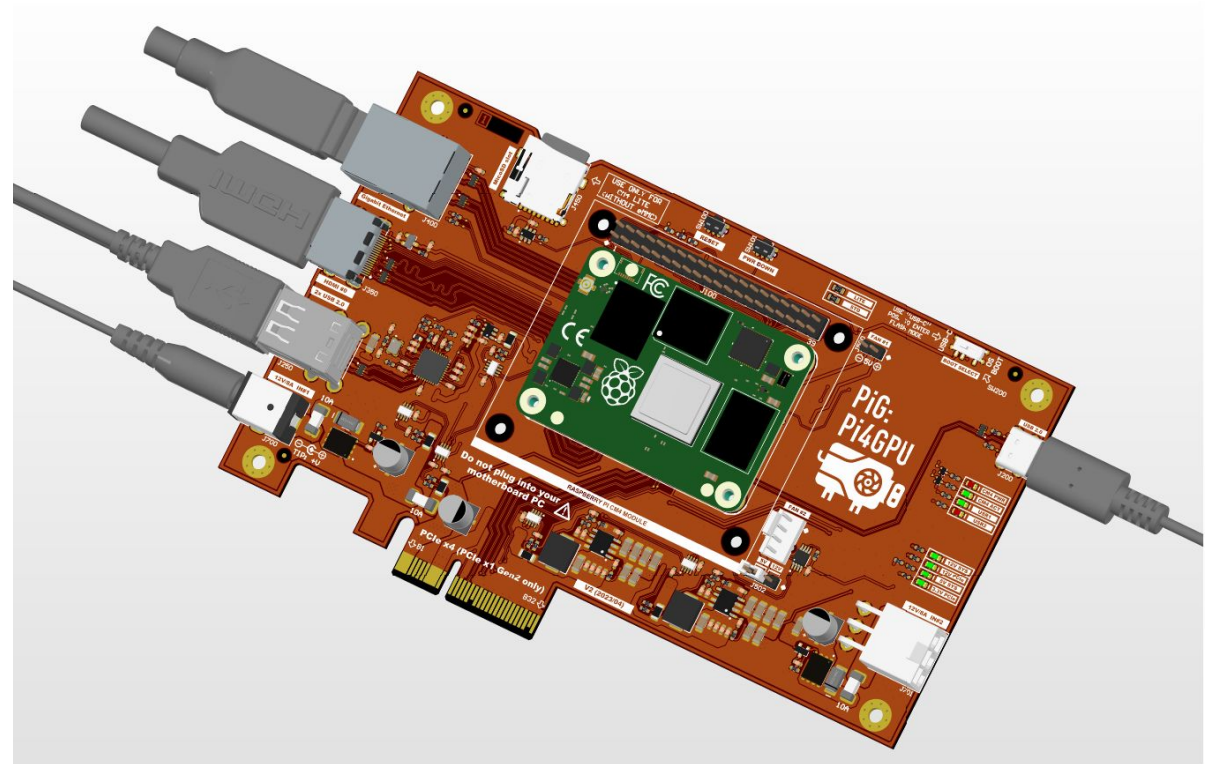


Pi4GPU (PiG)

TOP VIEW

PCB Project: Pi4GPU (PiG)
Version: V2
Revision: R1
Project State: Released (2023-04-12)
Variant: LITE
Print date: 12.04.2023



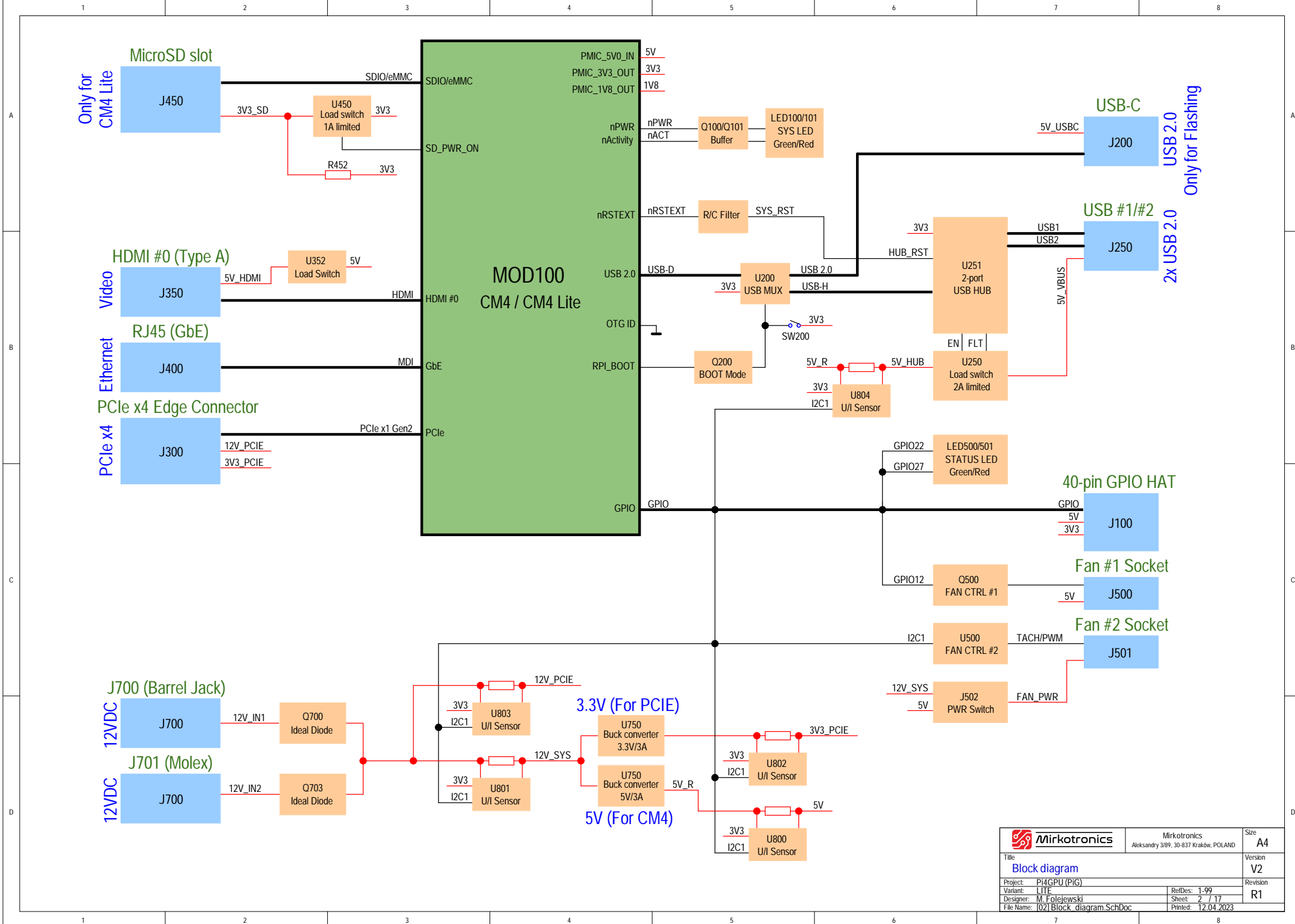
Page	Index
---	-----
01	Cover page
02	Block diagram
03	Top schematic
04	CM4 module - part #1
05	CM4 module - part #2
06	USB C interface
07	USB Hub
08	PCIe x4 slot
09	HDMI
10	100/1000M Ethernet
11	MicroSD card
12	MISC
13	Power supply #1
14	Power supply #2
15	Sensors
16	PCB marking and mechnics
17	Hardware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

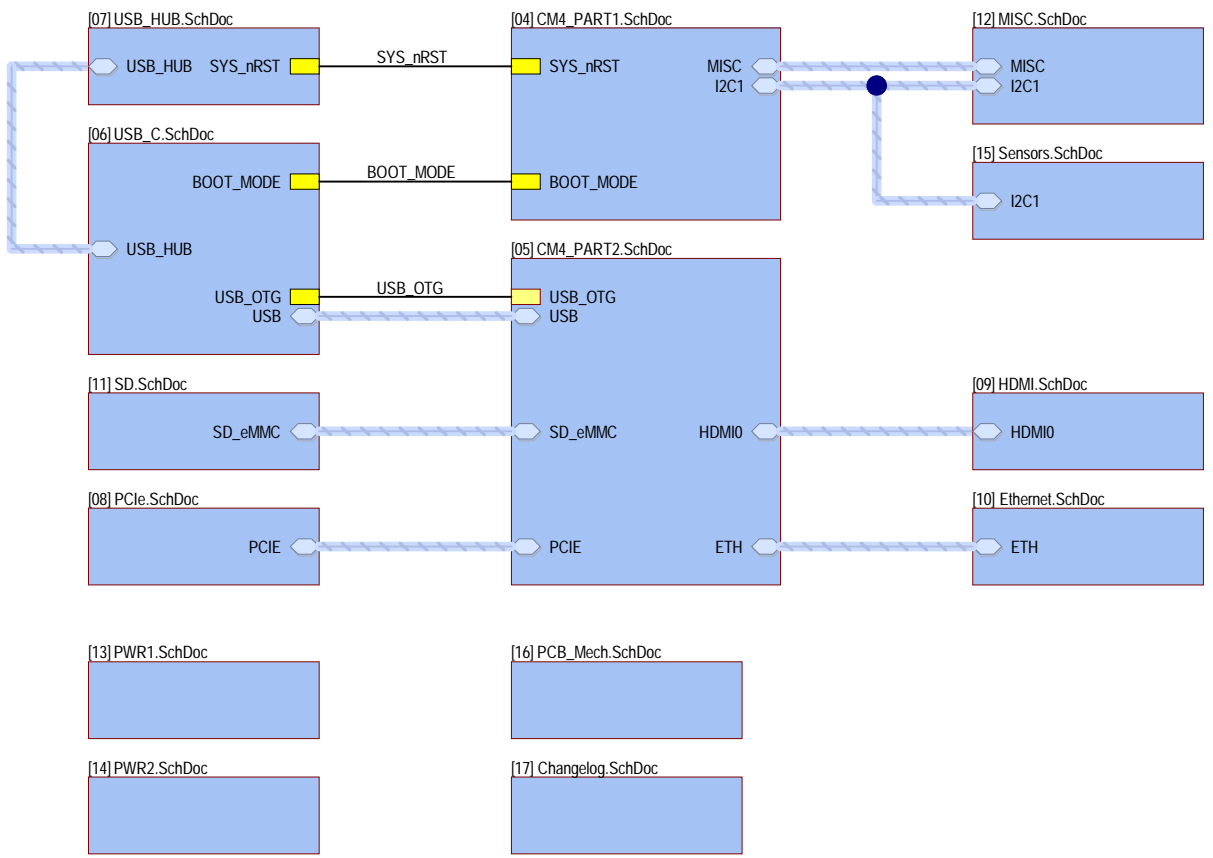
[02] Block diagram.SchDoc


[03] Top.SchDoc

PCB
PCB BARE BOARD

 Mirkotronics		Mirkotronics Aleksandry 3/89, 30-837 Kraków, POLAND	Size A3
Title Pi4GPU (PiG)		Version V2	Revision R1
Project: Pi4GPU (PiG)		RefDes: -	
Variant: LITE		Sheet: 1 / 17	
Designer: M. Folejewski		Printed: 12.04.2023	
File Name: [01] Cover page.SchDoc			





 Mirkotronics		Mirkotronics Aleksandry 3/89, 30-837 Kraków, POLAND		Size A4
Title Top schematic				Version V2
Project: Pi4GPU (PiG)		RefDes: 1-99		Revision R1
Variant: LITE		Sheet: 3 / 17		
Designer: M. Folejewski		Printed: 12.04.2023		
File Name: [03] TOP.SchDoc				

[illegible]

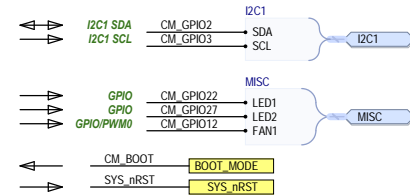
40-PIN GPIO HEADER

The diagram shows a 40-pin header with the following labels:

- Power Pins:** PP3300 (pin 1), PP5000 (pin 2), PP3300 (pin 19).
- GPIO Pins:**
 - CM_GPIO2 (pin 3)
 - CM_GPIO3 (pin 4)
 - CM_GPIO4 (pin 5)
 - CM_GPIO17 (pin 9)
 - CM_GPIO27 (pin 13)
 - CM_GPIO22 (pin 14)
 - CM_GPIO10 (pin 19)
 - CM_GPIO9 (pin 20)
 - CM_GPIO11 (pin 21)
 - CM_ID_SD (pin 25)
 - CM_GPIO5 (pin 29)
 - CM_GPIO6 (pin 30)
 - CM_GPIO13 (pin 31)
 - CM_GPIO19 (pin 33)
 - CM_GPIO19 (pin 35)
 - CM_GPIO26 (pin 36)
- Other Pins:**
 - CM_GPIO14 (pin 6)
 - CM_GPIO15 (pin 7)
 - CM_GPIO18 (pin 11)
 - CM_GPIO23 (pin 15)
 - CM_GPIO24 (pin 16)
 - CM_GPIO25 (pin 17)
 - CM_GPIO8 (pin 22)
 - CM_GPIO7 (pin 23)
 - CM_ID_SC (pin 26)
 - CM_GPIO12 (pin 32)
 - CM_GPIO16 (pin 34)
 - CM_GPIO20 (pin 37)
 - CM_GPIO21 (pin 38)
- Ground Pins:** GND (pin 40), GND (pin 41).

The header is labeled "40pin (2x20pin)" at the bottom.

TESTPOINTS (DEBUG)



Raspberry Pi
Pinout

3v3 Power	1		2	5v Power
GPIO 2 (I2C1 SDA)	3		4	5v Power
GPIO 3 (I2C1 SCL)	5		6	Ground
GPIO 4 (GPICLK0)	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)

GLOBAL RESET

SCH:
nEXTRST: Driven low during reset. Driven high (3.3V) once CM4 CPU has started to boot.

ID I2C

RESET SWITCHES

BOM:
SMD switch:
APLS, MPN = SKRTLAE010
XUNPU, MPN = TS-1084-AR03526
DGBZ, MPN = VTS4020B0341204B
Würth Elektronik, MPN = 436 333 033 816

SYS LEDs

3V3 LOAD

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

ID I2C

RESET SWITCHES

The image contains two circuit diagrams for reset switches, SW100 and SW101. Both switches are SPST (Single Pole Single Throw) and are connected to ground (GND) on one side. The other side of the switch is connected to a pull-up resistor (R107 for SW100, R109 for SW101) which is connected to a signal line (CM_RUN_PG for SW100, CM_GBL_EN for SW101). The signal lines are shown as red lines.

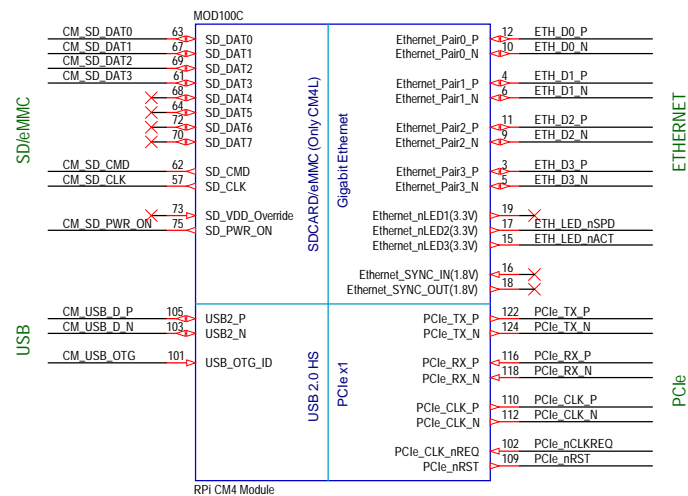
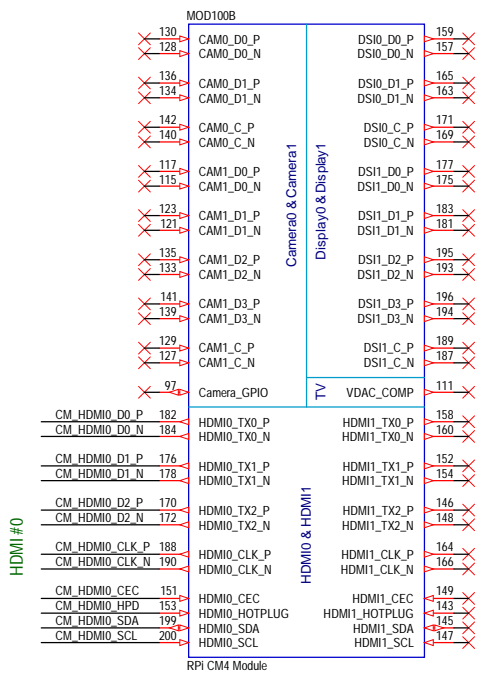
SW100: A SPST switch with one terminal connected to GND and the other terminal connected to a pull-up resistor R107 (100R). The other end of R107 is connected to the CM_RUN_PG signal line.

SW101: A SPST switch with one terminal connected to GND and the other terminal connected to a pull-up resistor R109 (100R). The other end of R109 is connected to the CM_GBL_EN signal line.

BOM:

- SMD switch:
 - APLS, MPN = SKRTLAE010
 - XUNPU, MPN = TS-1084-AR03526
 - DGBZ, MPN = YTS4020B0341206B
- Wurth Elektronik, MPN = 436 333 033 816

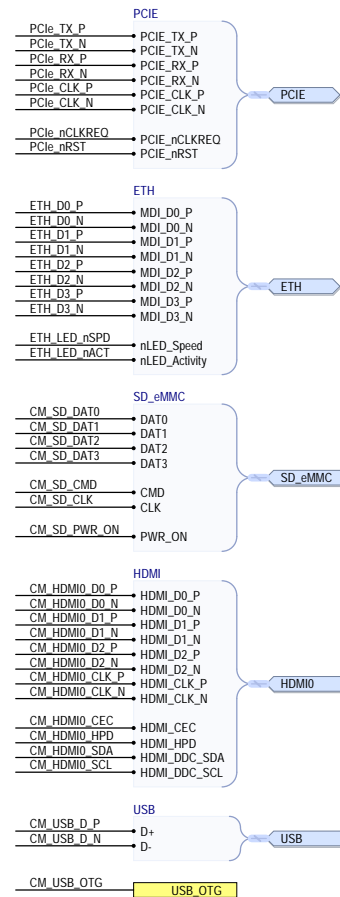
CM4 MODULE (PART #2)



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:

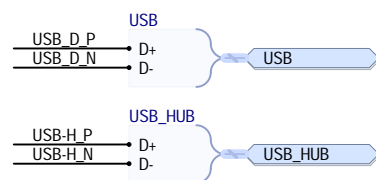
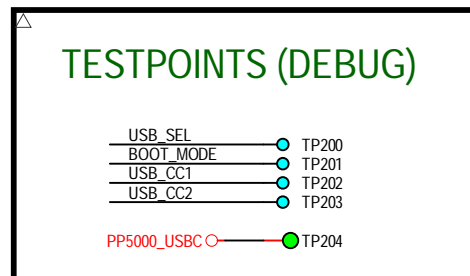
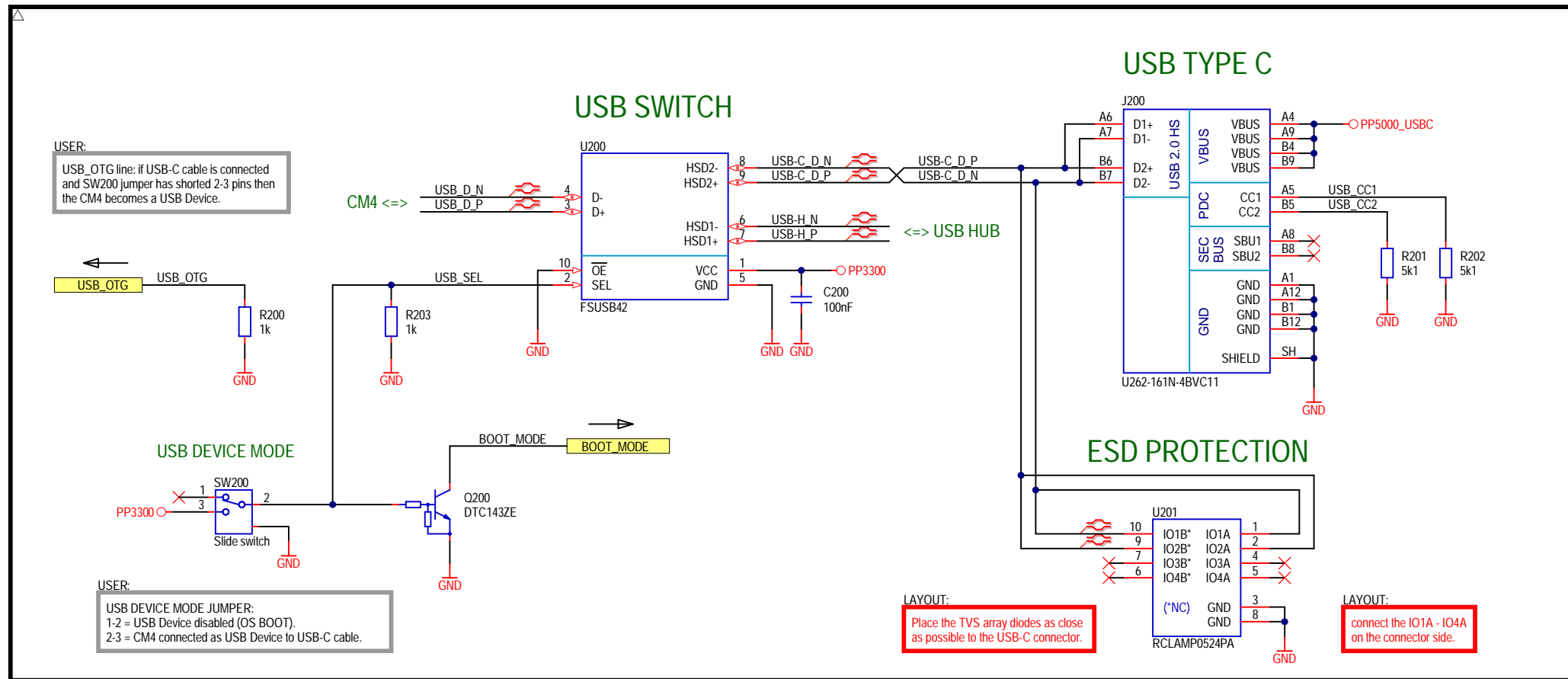
Route Ethernet signals as matched length 100 Ohm differential pairs with suitable clearances. Length matching between pairs should be better than 50mm, so in the typical case no length matching is required. However the signals within a pair need to be length matched, ideally to better than 0.15mm.

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)

 Mirkotronics		Mirkotronics Aleksandry 3/89, 30-837 Kraków, POLAND		Size B
Title Compute Module 4 (Part #2)				Version V2
Project:	Pi4GPU (PiG)			Revision R1
Variant:	LITE	RefDes:	100-199	
Designer:	M. Folejewski	Sheet:	5 / 17	
File Name:	[05] CM4_PART2.SchDoc	Printed:	12.04.2023	




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:

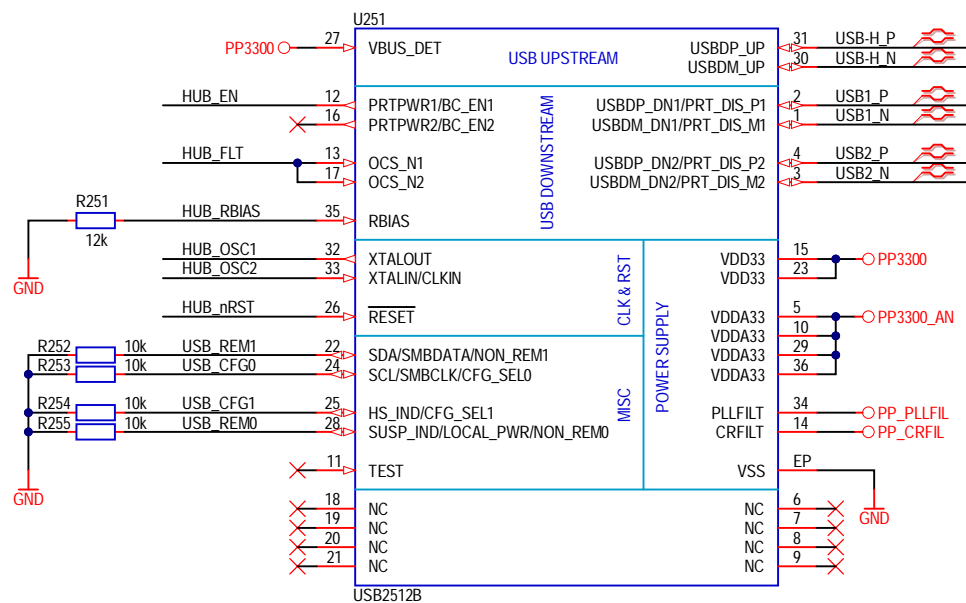
Route USB signals as matched length 90 Ohm differential pairs. The P N signals should ideally be matched to 0.15mm.

 <div>Mirkotronics</div>		Mirkotronics Aleksandry 3/89, 30-837 Kraków, POLAND	Size A4
Title USB-C interface and USB mux			Version V2
Project: Pi4GPU (PiG)		RefDes: 200-249	Revision R1
Variant: LITE			
Designer: M. Folejewski		Sheet: 6 / 17	
File Name: [06] USB_C.SchDoc		Printed: 12.04.2023	

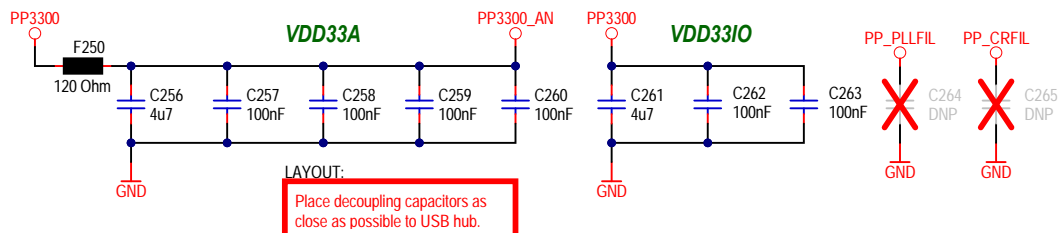
LAYOUT:

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

2-PORT USB HUB



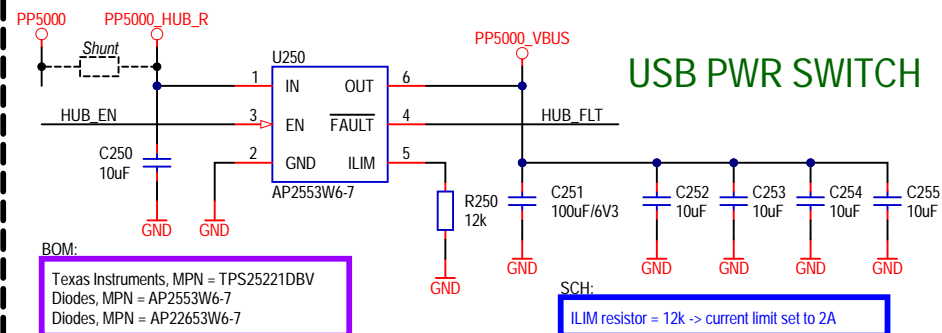
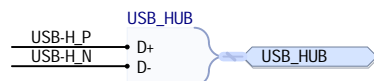
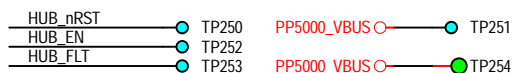
DECOUPLING CAPACITORS



LAYOUT:

Place decoupling capacitors as close as possible to USB hub.

TESTPOINTS (DEBUG)



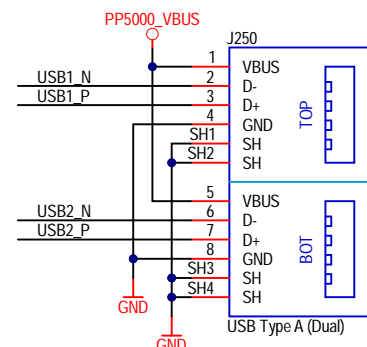
BOM:

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

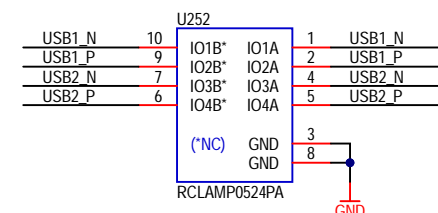
SCH:

ILIM resistor = 12k -> current limit set to 2A

USB #1/#2



ESD PROTECTION



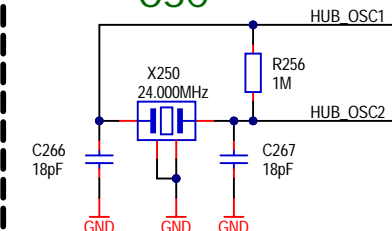
LAYOUT:

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

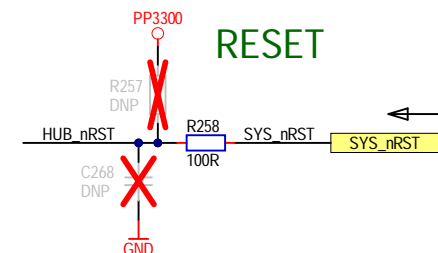
LAYOUT:

connect the IO1A - IO4A on the connector side.

OSC



RESET



Mirkotronics
Aleksandry 3/89, 30-837 Kraków, POLAND

Size
A4

Title
2-port USB 2.0 hub

Version
V2

Project: Pi4GPU (PiG)

Variant: LITE

Designer: M. Folejewski

File Name: [07] USB_HUB.SchDoc

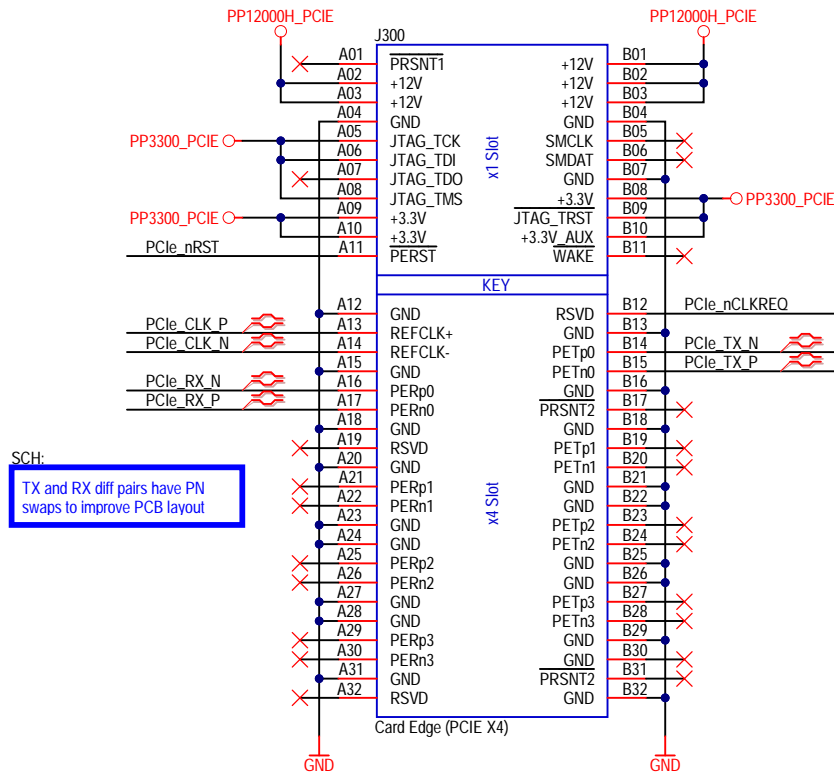
RefDes: 250-299

Sheet: 7 / 17

Printed: 12.04.2023

Revision
R1

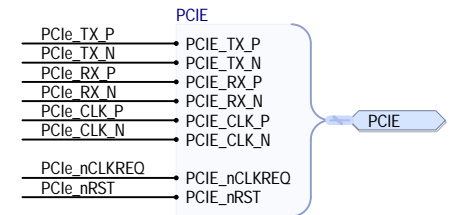
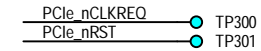
PCI Express x4 Edge Connector




SCH:
TX and RX diff pairs have PN swaps to improve PCB layout

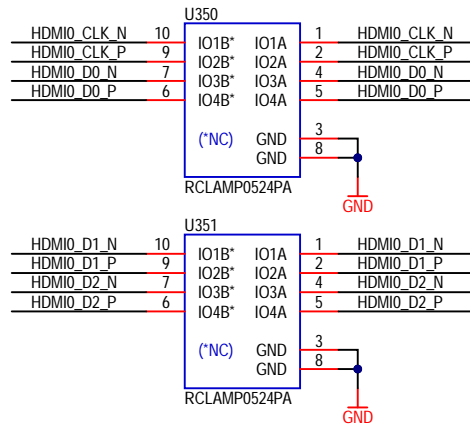
LAYOUT:
Route PCIe signals as matched length 90 Ohm differential pairs with suitable clearances. There is no need to match the lengths between pairs, only the signals within a pair need to be length matched ideally to better than 0.1mm.

TESTPOINTS (DEBUG)



 Mirkotronics		Mirkotronics Aleksandry 3/89, 30-837 Kraków, POLAND		Size A4
Title PCIe x4 edge connector (PCIe x1 only)				Version V2
Project: Pi4GPU (PiG)		RefDes: 300-399		Revision R1
Variant: LITE		Sheet: 8 / 17		
Designer: M. Folejewski		Printed: 12.04.2023		
File Name: [08] PCIe.SchDoc				

ESD PROTECTION



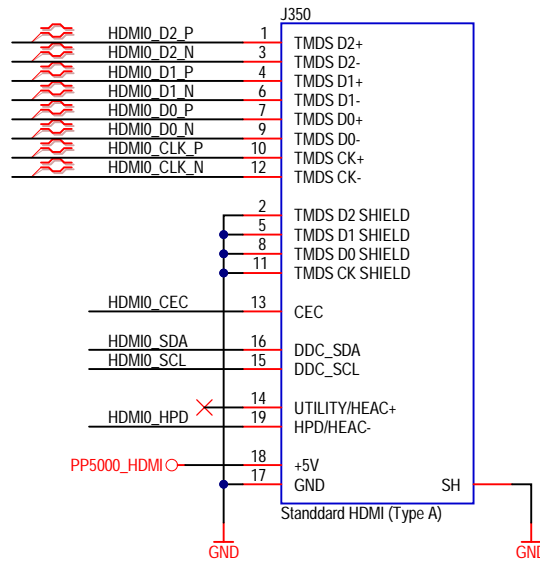
LAYOUT:

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)



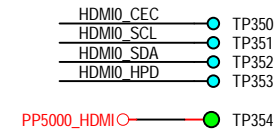
BOM:

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.

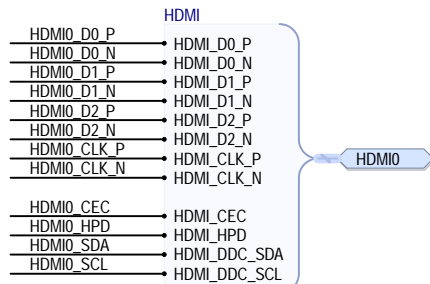
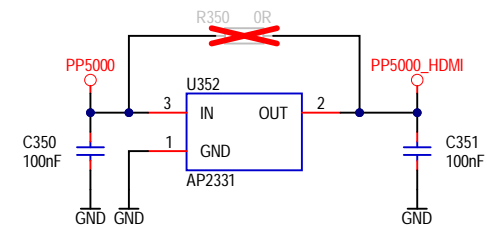
LAYOUT:

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)

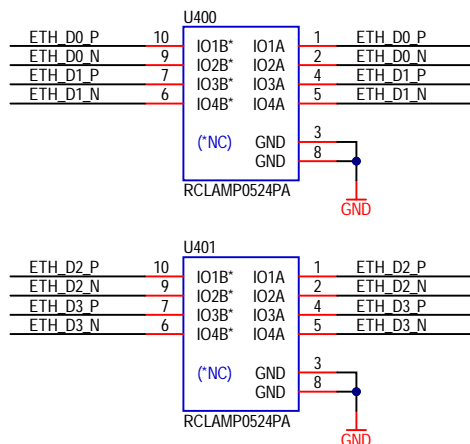


5V POWER SWITCH



		Mirkotronics Aleksandry 3/89, 30-837 Kraków, POLAND		Size A4
Title HDMI Interface		Version V2		Revision R1
Project: Pi4GPU (PiG)		RefDes: 400-449		
Variant: LITE		Sheet: 9 / 17		
Designer: M. Folejewski		Printed: 12.04.2023		
File Name: [09] HDMI.SchDoc				

ESD PROTECTION



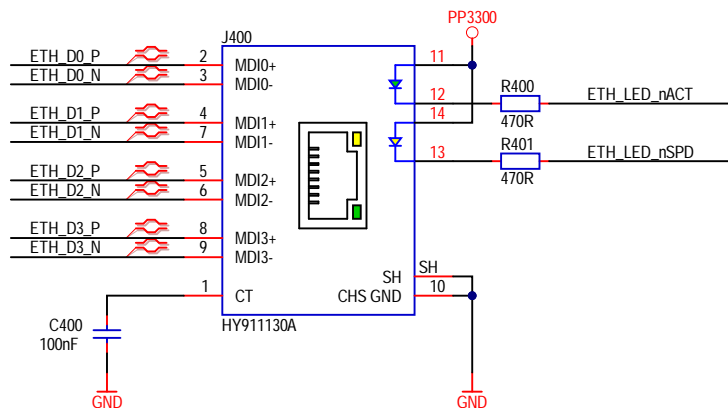
LAYOUT:

connect IO1A - IO4A on the connector side.

LAYOUT:

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

100/1000M ETHERNET



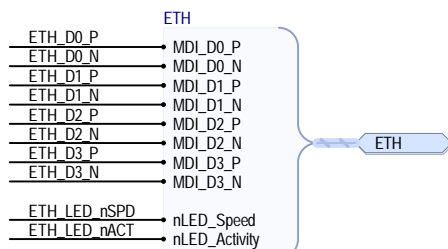
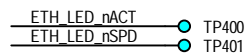
LAYOUT:

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.

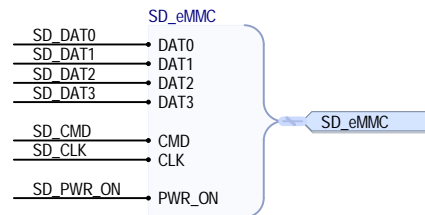
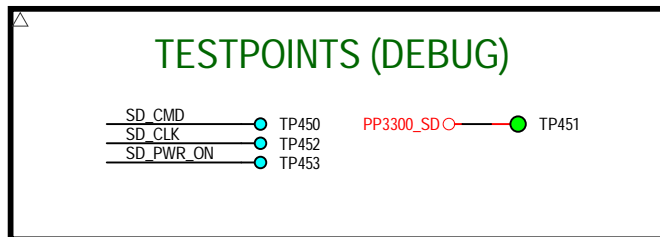
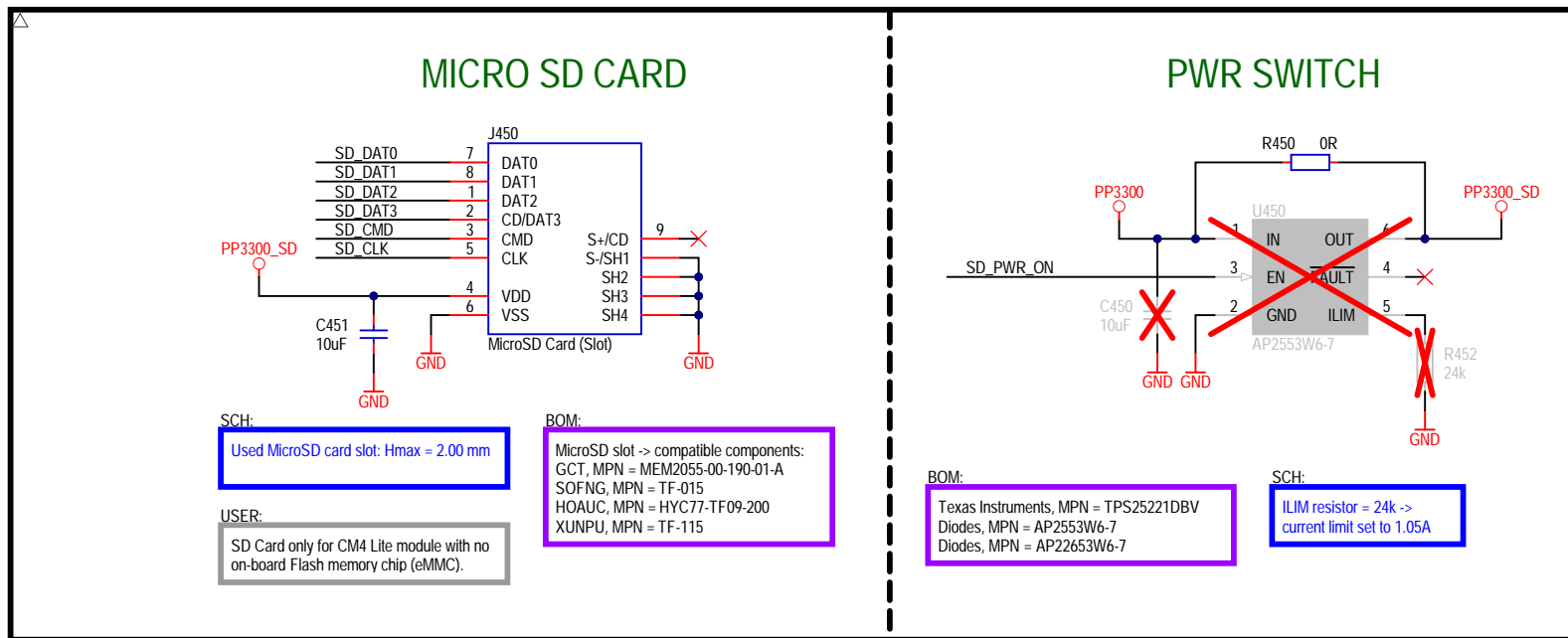
BOM:

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

TESTPOINTS (DEBUG)

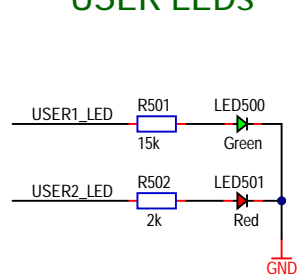


 Mirkotronics		Mirkotronics Aleksandry 3/89, 30-837 Kraków, POLAND	Size A4
Title 100/1000M Ethernet interface			Version V2
Project: Pi4GPU (PiG)			Revision R1
Variant: LITE		RefDes: 500-599	
Designer: M. Folejewski		Sheet: 10 / 17	
File Name: [10] Ethernet.SchDoc		Printed: 12.04.2023	

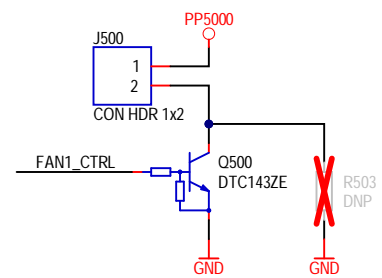


		Mirkotronics Aleksandry 3/89, 30-837 Kraków, POLAND		Size A4
Title MicroSD slot		Version V2		Revision R1
Project: Pi4GPU (PiG)		RefDes: 600-699		
Variant: LITE		Sheet: 11 / 17		
Designer: M. Folejewski		Printed: 12.04.2023		
File Name: [11] SD.SchDoc				

USER LEDs

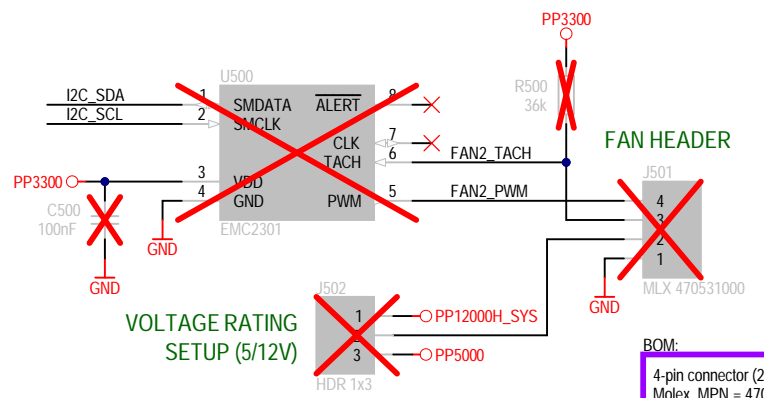


FAN1 (5V, ON/OFF)



USER:
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.

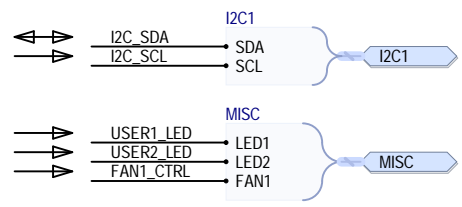
FAN2 (5V/12V PWM CTRL IC)



VOLTAGE RATING
SETUP (5/12V)

FAN HEADER

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



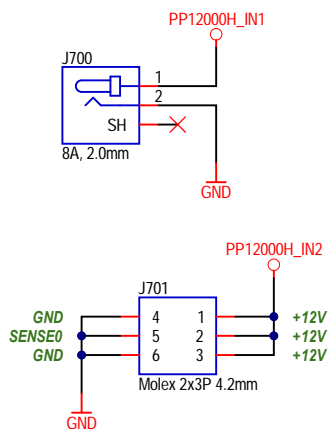
		Mirkotronics Aleksandry 3/89, 30-837 Kraków, POLAND		Size A4
Title MISC		Version V2		Revision R1
Project: Pi4GPU (PiG)		RefDes: 800-899		
Variant: LITE		Sheet: 12 / 17		
Designer: M. Folejewski		Printed: 12.04.2023		
File Name: I121MISC.SchDoc				

7.5V - 12V INPUT
12V NOMINAL

IDEAL DIODE

LEDs

TESTPOINTS



USER:
Use only one of the two power
supply connectors: J700 or J701.

12V PCIe POWER RAIL: $\pm 8\%$ (75W)
12V $\pm 8\%$ = 11.04V - 12.96V

PCIe Gen3 power requirement: 75W
12V -> 5.5A (66W)
3.3V -> 3A (9.9W)

IDEAL DIODE

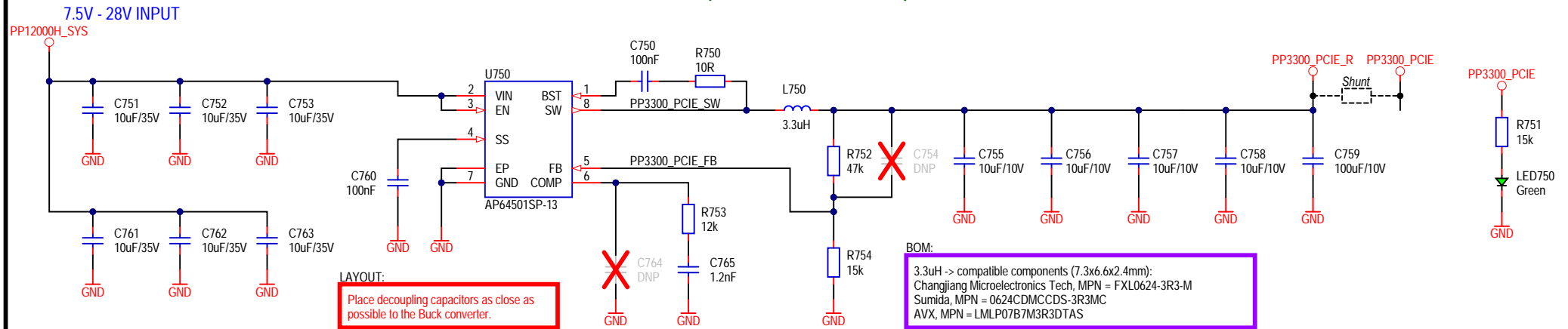
TP700
TP701
TP702
TP703
TP704
TP705
TP706
TP707
TP708
TP709
TP710
TP711

BOM:

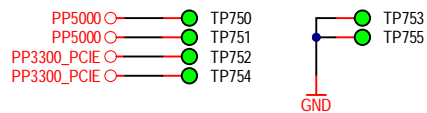
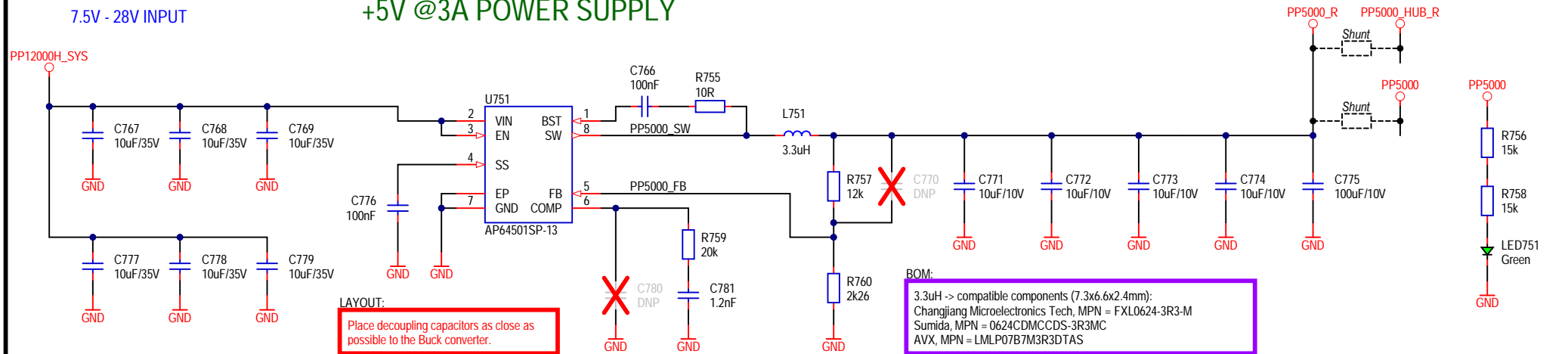
Fuse: 10A/125V
Bel Fuse, MPN = 0679L9100-01
KOA Speer, MPN = CCF1F10TTE
Bourns, MPN = SF-2410FP1000T-2
Littelfuse, MPN = 0453010.NR


 Mirkotronics		Mirkotronics Aleksandry 3/89, 30-837 Kraków, POLAND		Size A4
Title Power supply				Version V2
Project: Pi4GPU (PiG)				Revision R1
Variant: LITE		RefDes: 900-949		
Designer: M. Folejewski		Sheet: 13 / 17		
File Name: [13] PWR1.SchDoc		Printed: 12.04.2023		

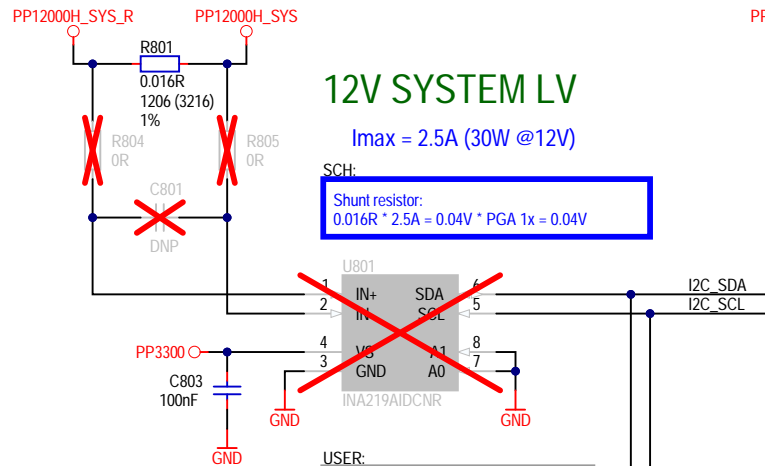
+3.3V @3A POWER SUPPLY (FOR PCIE ONLY)



+5V @3A POWER SUPPLY



 Mirkotronics		Mirkotronics Aleksandry 3/89, 30-837 Kraków, POLAND	Size A4
Title Power supply			Version V2
Project: Pi4GPU (PiG)		RefDes: 900-949 Sheet: 14 / 17 Printed: 12.04.2023	Revision R1
Variant: LITE			
Designer: M. Folejewski File Name: [14] PWR2.SchDoc			

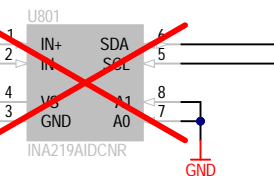


12V SYSTEM LV

$I_{max} = 2.5A$ (30W @12V)

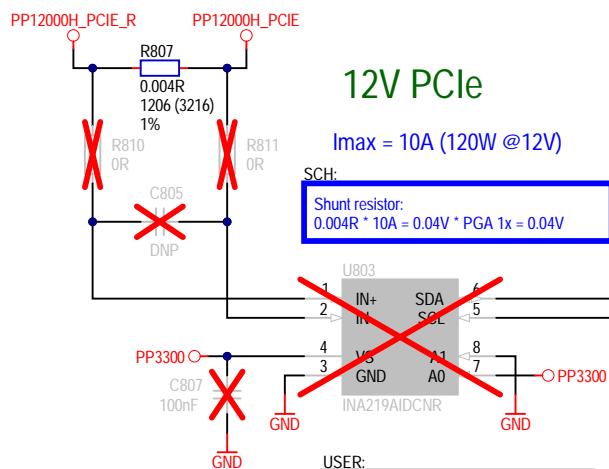
SCH:

Shunt resistor:
 $0.016R \cdot 2.5A = 0.04V \cdot PGA \cdot 1x = 0.04V$



USER:

7-bit I2C address: 1000000 (0x40)

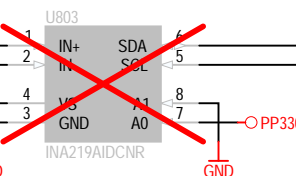


12V PCIe

$I_{max} = 10A$ (120W @12V)

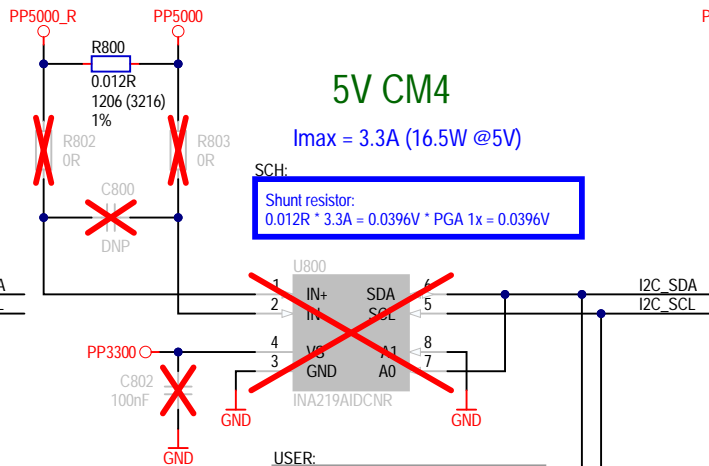
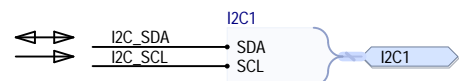
SCH:

Shunt resistor:
 $0.004R \cdot 10A = 0.04V \cdot PGA \cdot 1x = 0.04V$



USER:

7-bit I2C address: 1000001 (0x41)

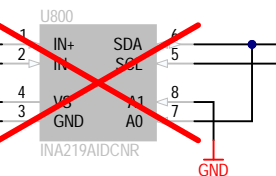


5V CM4

$I_{max} = 3.3A$ (16.5W @5V)

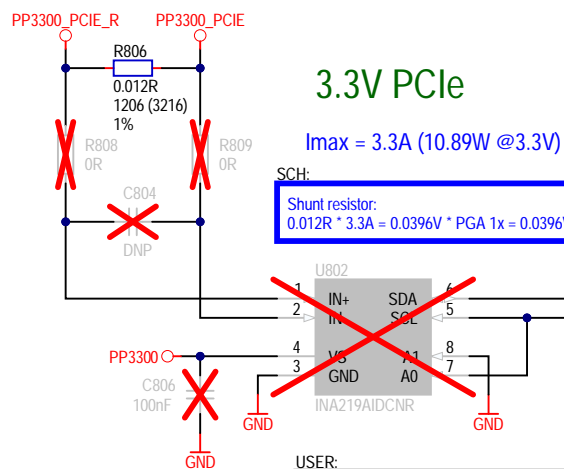
SCH:

Shunt resistor:
 $0.012R \cdot 3.3A = 0.0396V \cdot PGA \cdot 1x = 0.0396V$



USER:

7-bit I2C address: 1000010 (0x42)

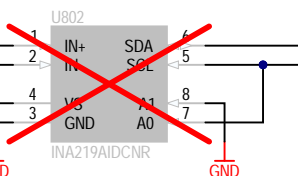


3.3V PCIe

$I_{max} = 3.3A$ (10.89W @3.3V)

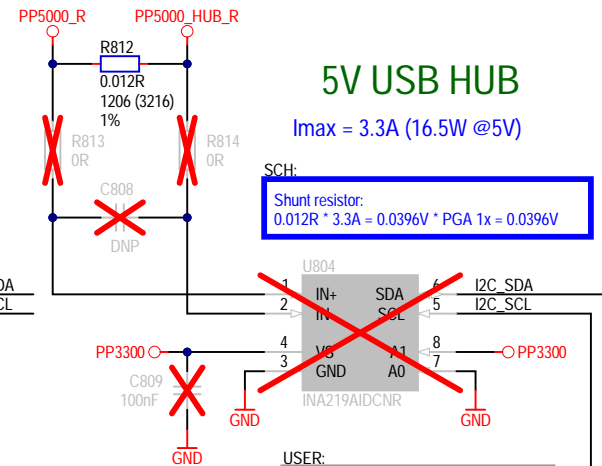
SCH:

Shunt resistor:
 $0.012R \cdot 3.3A = 0.0396V \cdot PGA \cdot 1x = 0.0396V$



USER:

7-bit I2C address: 1000011 (0x43)

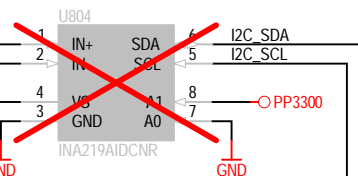


5V USB HUB

$I_{max} = 3.3A$ (16.5W @5V)

SCH:

Shunt resistor:
 $0.012R \cdot 3.3A = 0.0396V \cdot PGA \cdot 1x = 0.0396V$



USER:

7-bit I2C address: 1000100 (0x44)

Table 1. INA219 Address Pins and Slave Addresses

A1	A0	SLAVE ADDRESS
GND	GND	1000000
GND	V _{S+}	1000001
GND	SDA	1000010
GND	SCL	1000011
V _{S+}	GND	1000100
V _{S+}	V _{S+}	1000101
V _{S+}	SDA	1000110
V _{S+}	SCL	1000111
SDA	GND	1001000
SDA	V _{S+}	1001001
SDA	SDA	1001010
SDA	SCL	1001011
SCL	GND	1001100
SCL	V _{S+}	1001101
SCL	SDA	1001110
SCL	SCL	1001111



Mirkotronics
 Aleksandry 3/89, 30-837 Kraków, POLAND

Size
A4

Title
Measurement sensors

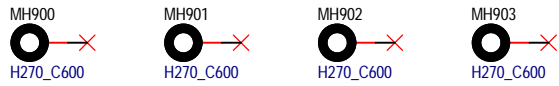
Version
V2

Project: Pi4GPU (PiG)
 Variant: LITE
 Designer: M. Folejewski
 File Name: [15] Sensors.SchDoc

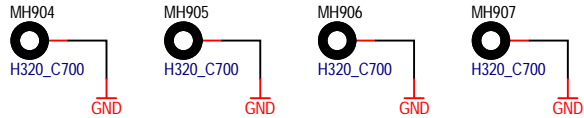
RefDes: 900-949
 Sheet: 15 / 17
 Printed: 12.04.2023

Revision
R1

CM4 MOUNTING HOLES



PCB MOUNTING HOLES



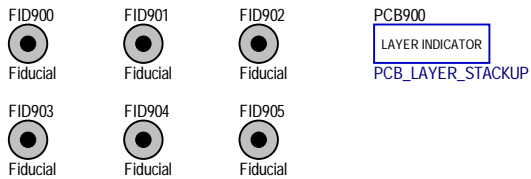
M2.5 STEEL SPACERS



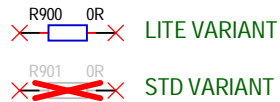
BOM:

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

PCB MARKING



ASSEMBLY VARIANT INDICATOR



 Mirkotronics		Mirkotronics Aleksandry 3/89, 30-837 Kraków, POLAND		Size A4
Title PCB marking & mechanical parts		Version V2		Revision R1
Project:	Pi4GPU (PiG)	RefDes:	950-999	
Variant:	LITE	Sheet:	16 / 17	
Designer:	M. Folejewski	Printed:	12.04.2023	
File Name:	[16] PCB_Mech.SchDoc			

Hardware changelog

2023.04.11:

- project has started;
- power supply circuit: R702, R703, R704, R708, Q701, Q702 removed;
- power supply circuit: R706, R707, LED702, LED703 removed;
- PCB silkscreen updated (new company logo);
- mounting holes updated (hole vias increased);
- microSD card circuit: Q450, Q451, R451 removed;
- USB OTG circuit: R200/R203 redesigned;
- CM4 module: added: SW100, SW101, R107, R108, R109;

2023.04.12:

- PCB layout;
- project released;

 Mirkotronics		Mirkotronics Aleksandry 3/89, 30-837 Kraków, POLAND		Size A4
Title Hardware changelog				Version V2
Project: Pi4GPU (PiG)				Revision R1
Variant: LITE		RefDes: -		
Designer: M. Folejewski		Sheet: 17 / 17		
File Name: [17] Changelog.SchDoc		Printed: 12.04.2023		