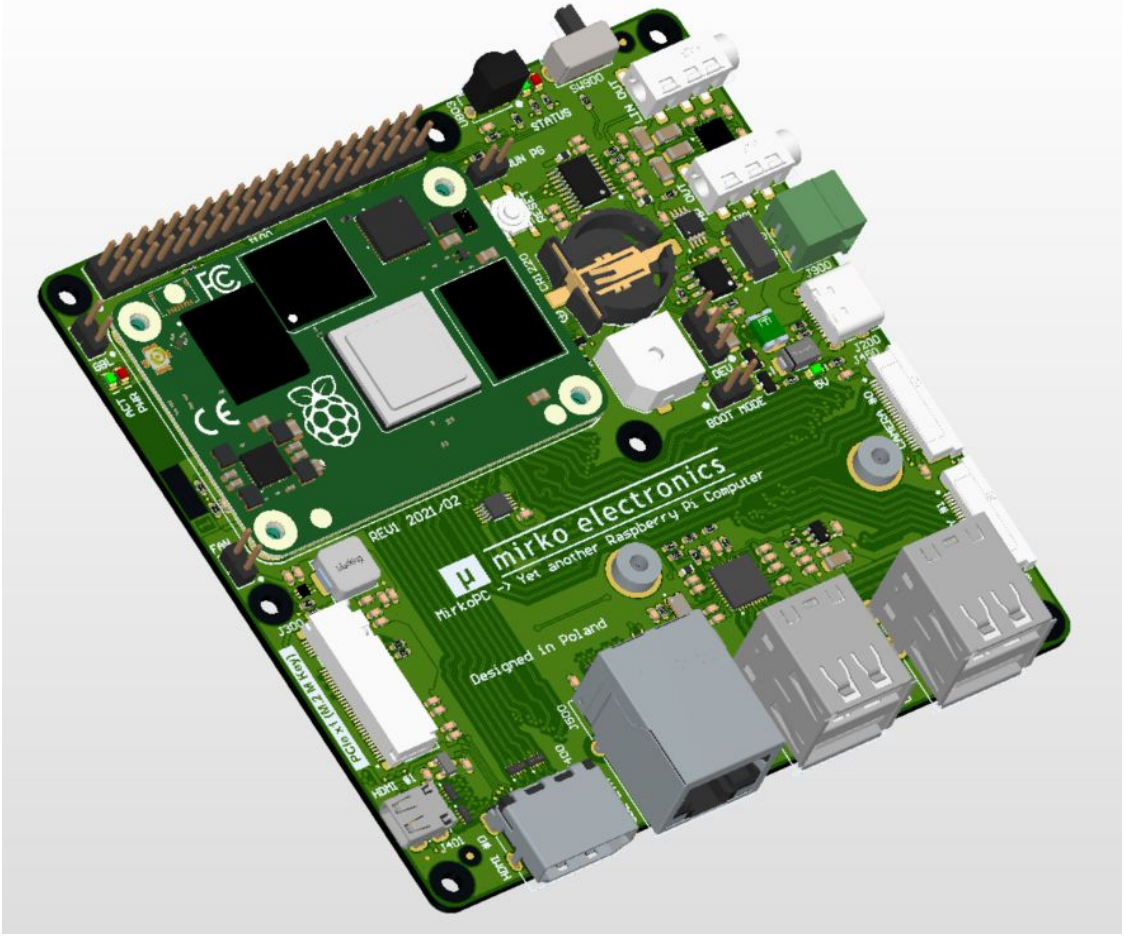
Raspberry Pi MiniPC (CM4 carrier board)

PCB Project:	MirkoPC
Version:	VER1
Revision:	REV1
Project State:	Released (2021-02-09)
Variant:	STD
Print date:	2021-03-17

TOP VIEW



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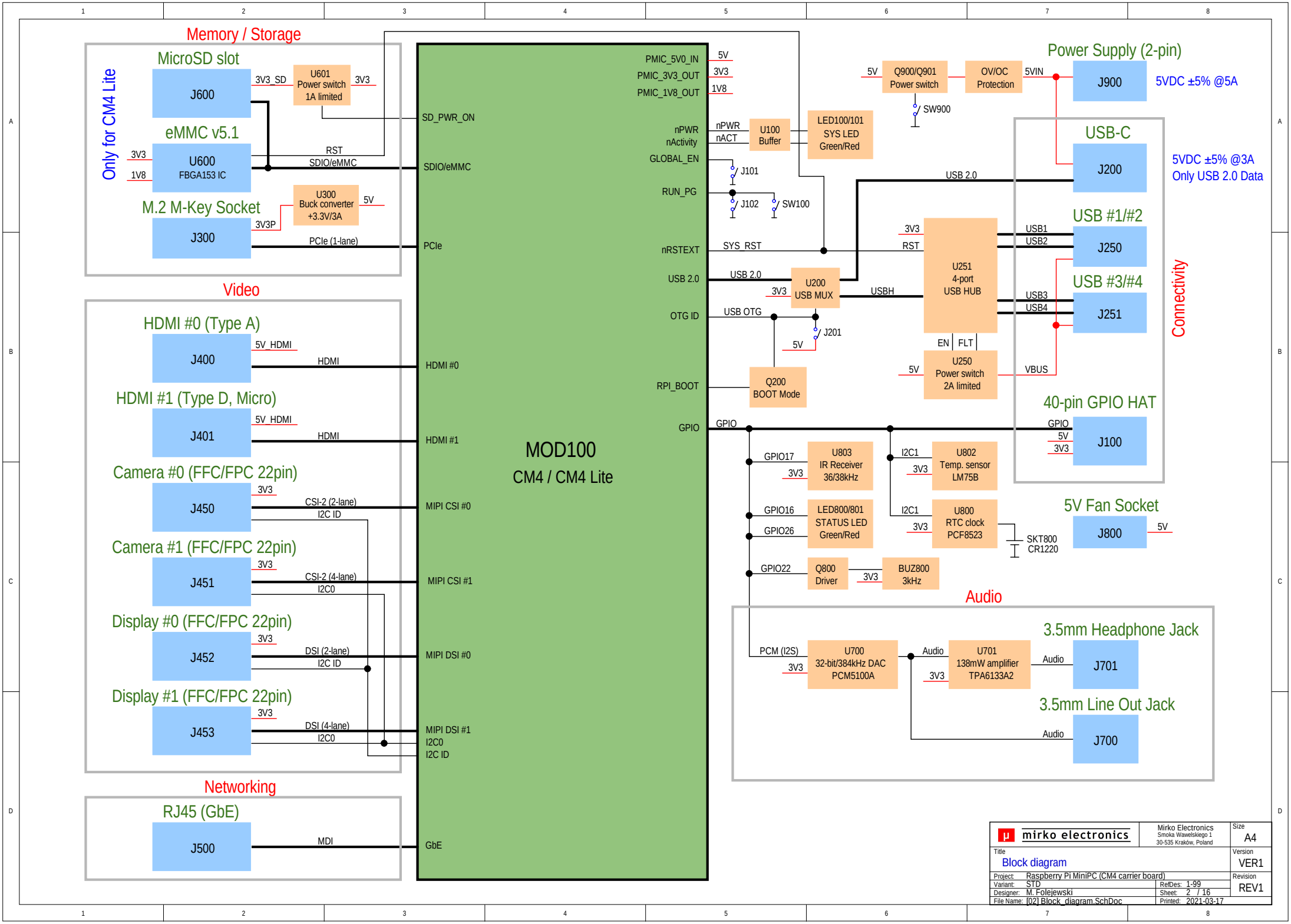
[02] Block_diagram.SchDoc

[03] Top.SchDoc

PCB
PCB BARE BOARD

mirko electronics	Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland	Size: A3
Title: MirkoPC - Board		Version: VER1
Project: Raspberry Pi MiniPC (CM4 carrier board)		Revision: REV1
Variant: STD	RefDes: -	
Designer: M. Folejewski	Sheet: 1 / 16	
File Name: [01] Cover_page.SchDoc	Printed: 2021-03-17	


Memory / Storage
Only for CM4 Lite
MicroSD slot
J600
3V3_SD
U601
Power switch
1A limited
3V3
SD_PWR_ON
eMMC v5.1
3V3
1V8
U600
FBGA153 IC
RST
SDIO/eMMC
SDIO/eMMC
M.2 M-Key Socket
J300
3V3P
U300
Buck converter
+3.3V/3A
5V
PCIe (1-lane)
PCIe
Video
HDMI #0 (Type A)
J400
5V_HDMI
HDMI
HDMI #0
HDMI #1 (Type D, Micro)
J401
5V_HDMI
HDMI
HDMI #1
Camera #0 (FFC/FPC 22pin)
J450
3V3
CSI-2 (2-lane)
I2C ID
MIPI CSI #0
Camera #1 (FFC/FPC 22pin)
J451
3V3
CSI-2 (4-lane)
I2C0
MIPI CSI #1
Display #0 (FFC/FPC 22pin)
J452
3V3
DSI (2-lane)
I2C ID
MIPI DSI #0
Display #1 (FFC/FPC 22pin)
J453
3V3
DSI (4-lane)
I2C0
MIPI DSI #1
I2C0
I2C ID
Networking
RJ45 (GbE)
J500
MDI
GbE
MOD100
CM4 / CM4 Lite
PMIC_5V0_IN
5V
PMIC_3V3_OUT
3V3
PMIC_1V8_OUT
1V8
nPWR
nActivity
nPWR
nACT
U100
Buffer
LED100/101
SYS LED
Green/Red
GLOBAL_EN
J101
RUN_PG
J102
SW100
nRSTEXT
SYS_RST
USB 2.0
USB 2.0
U200
USB MUX
3V3
USBH
OTG ID
USB OTG
J201
5V
RPI_BOOT
Q200
BOOT Mode
GPIO
Power Supply (2-pin)
5V
Q900/Q901
Power switch
SW900
OV/OC
Protection
5VIN
J900
5VDC ±5% @5A
Connectivity
USB-C
J200
5VDC ±5% @3A
Only USB 2.0 Data
USB 2.0
USB #1/#2
3V3
RST
U251
4-port
USB HUB
USB1
USB2
J250
USB #3/#4
USB3
USB4
J251
EN
FLT
5V
U250
Power switch
2A limited
VBUS
40-pin GPIO HAT
GPIO
5V
3V3
J100
GPIO17
3V3
U803
IR Receiver
36/38kHz
I2C1
3V3
U802
Temp. sensor
LM75B
GPIO16
GPIO26
LED800/801
STATUS LED
Green/Red
I2C1
3V3
U800
RTC clock
PCF8523
SKT800
CR1220
5V Fan Socket
J800
5V
GPIO22
Q800
Driver
3V3
BUZ800
3kHz
Audio
PCM (I2S)
3V3
U700
32-bit/384kHz DAC
PCM5100A
Audio
3V3
U701
138mW amplifier
TPA6133A2
Audio
3.5mm Headphone Jack
J701
3.5mm Line Out Jack
Audio
J700
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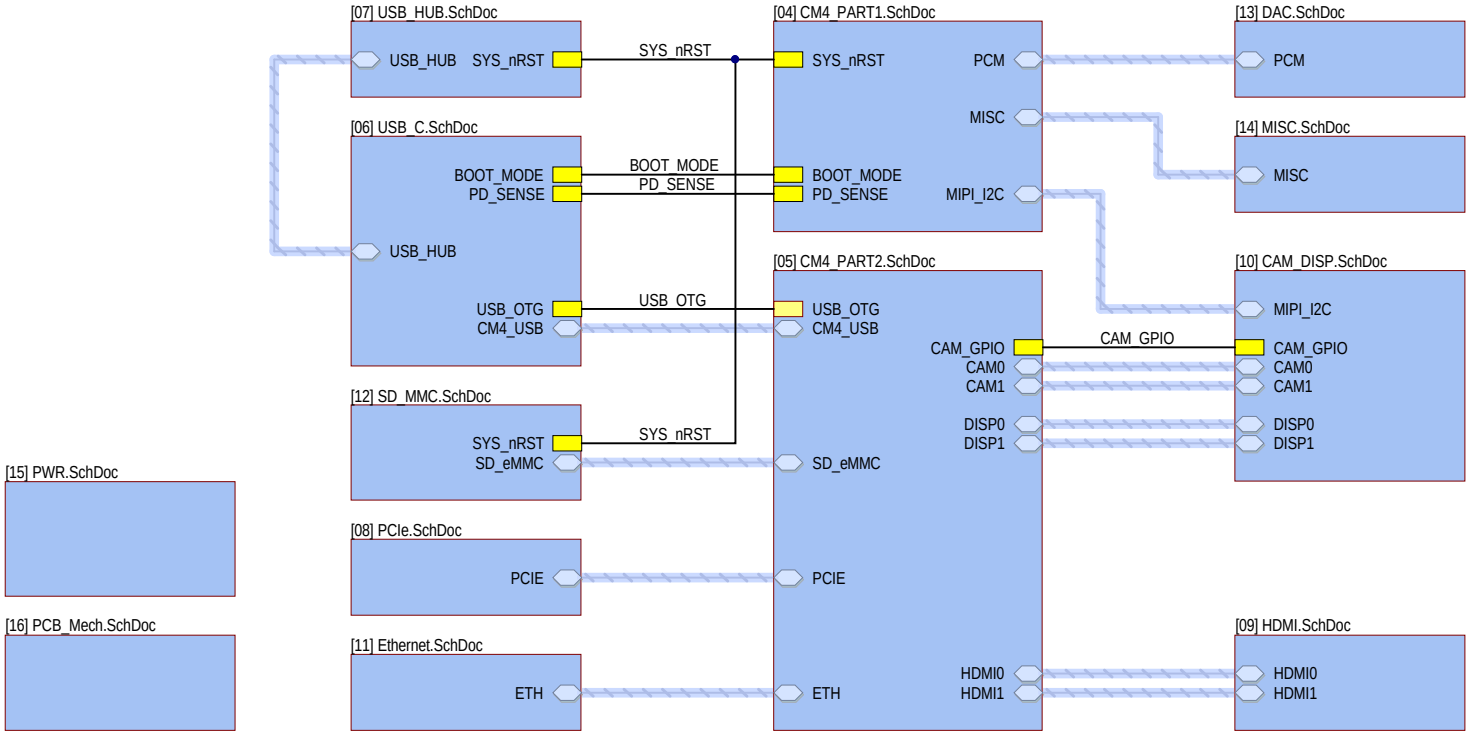
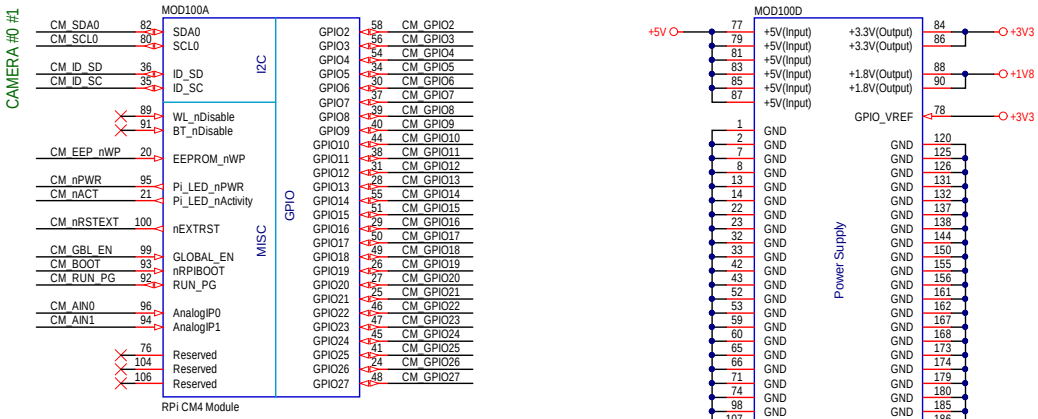
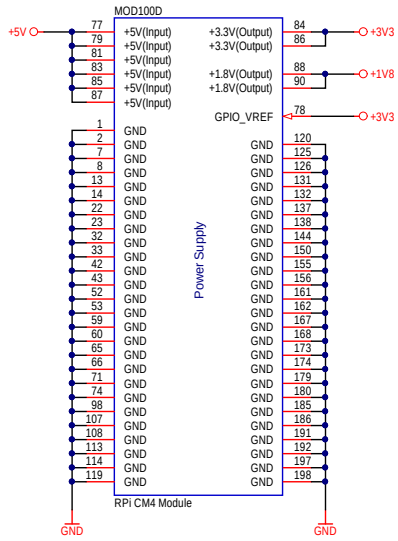
Mirko Electronics
Smoka Wawelskiego 1
30-535 Kraków, Poland
Size
A4
Title
Block diagram
Version
VER1
Project: Raspberry Pi MiniPC (CM4 carrier board)
Revision
REV1
Variant: STD
RefDes: 1-99
Designer: M. Folejewski
Sheet: 2 / 16
File Name: [02] Block_diagram.SchDoc
Printed: 2021-03-17



mirko electronics	Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland	Size A4
Title Top schematic		Version VER1
Project: Raspberry Pi MiniPC (CM4 carrier board)		Revision REV1
Variant: STD	RefDes: 1-99	
Designer: M. Folejewski	Sheet: 3 / 16	
File Name: [03] TOP.SchDoc	Printed: 2021-03-17	

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:
I2C0 (SDA0/SCL0): This internal I2C bus is normally allocated to the CSI1 and DSI1 as these devices are controlled by the firmware.

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:
I2C (ID_SD/ID_SC): This I2C bus is normally used for identifying HATs (HAT ID EEPROM) and controlling CSI0 and DSI0 devices.

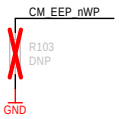
At boot time this I2C interface will beinterrogated to look for an EEPROM that identifes the attached board andallows automagic setup of the GPIOs (and optionally, Linux drivers).

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

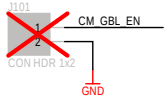
SCH:
EEPROM_nWP pin: Leaving floating NB internally pulled up to CM4_3.3V via 100k (VIL <0.8V) but can be grounded to prevent writing to the on board EEPROM which stores the bootcode.

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.

EEP WP



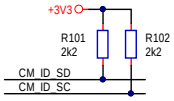
GLOBAL EN



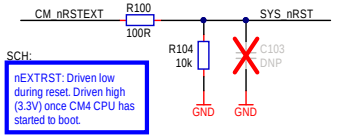
SCH:
GLOBAL_EN: Drive low to power off CM4. Internally pulled up with a 100K to +5V.

USER:
Power Down jumper 1-2 = CM4 Power Down enabled

ID I2C

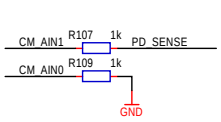


GLOBAL RESET



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

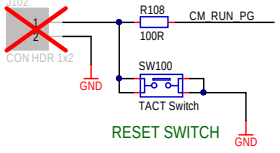
AIN0/AIN1



SCH:
AIN0, AIN1: Analogue inputs of the MAX7704. Typically connected to CC pin of Type C power connector.

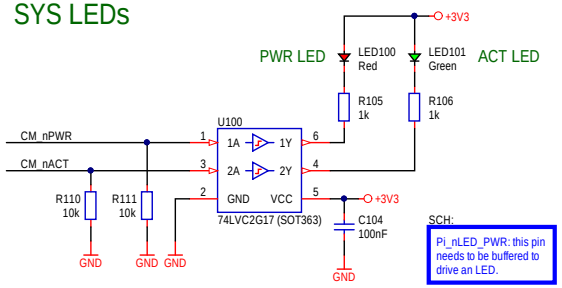
SCH:
AIN0 and AIN1 pins connected according to Raspberry Pi 4B schematic.

RUN PG



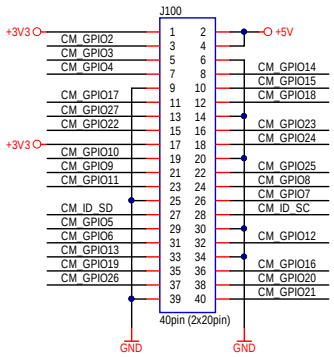
USER:
RUN_PG pin: This pin when high signals that the CM4 has started. Driving this pin low resets the module, this should be done with caution as if files on a filesystem are open they will not be closed.

SYS LEDs

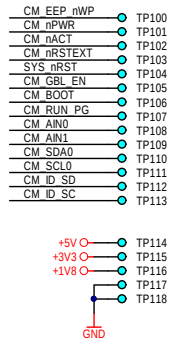


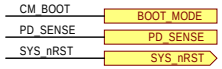
SCH:
Pi_nLED_PWR: this pin needs to be buffered to drive an LED.

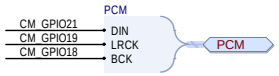
40-PIN GPIO HEADER

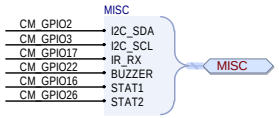


TESTPOINTS (DEBUG)









Used GPIOs:

GPIO2 - I2C1 SDA
GPIO3 - I2C1 SCL

GPIO18 - PCM CLK (BCK)
GPIO19 - PCM FS (LRCK)
GPIO21 - PCM DOUT (DAT)

GPIO17 - IR RX

GPIO22 - BUZZER

GPIO16 - STATUS1 LED (Green)
GPIO26 - STATUS2 LED (Red)

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 (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)

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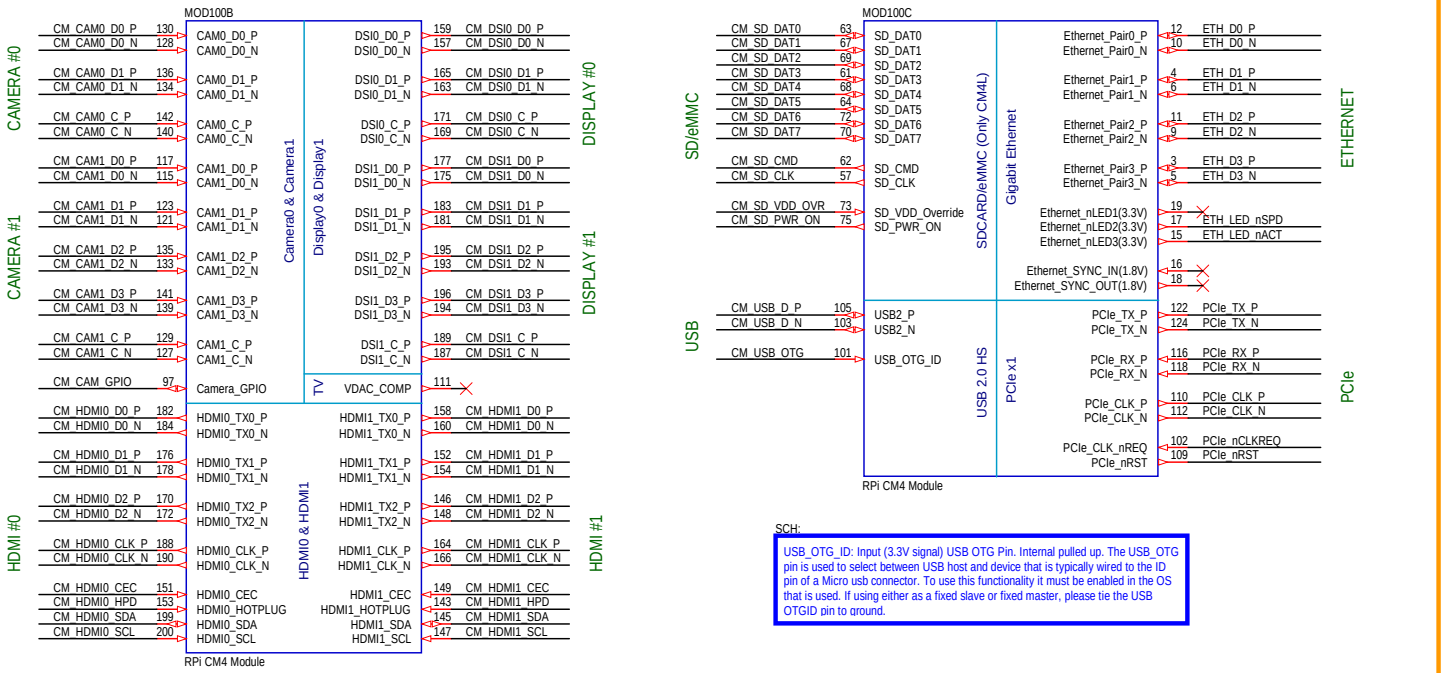
30-535 Kraków, Poland

Title: Compute Module 4 (Part #1)
Size: A3
Version: VER1
Revision: REV1
Project: Raspberry Pi MiniPC (CM4 carrier board)
Variant: STD
Designer: M. Folejewski
File Name: [04] CM4_PART1.SchDoc
RefDes: 1-99
Sheet: 4 / 16
Printed: 2021-03-17

CM4 MODULE (PART #2)



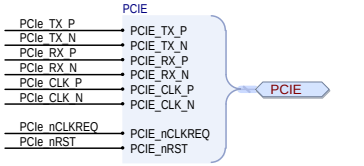
SCH:

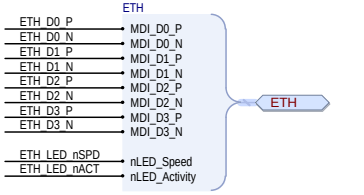
USB_OTG_ID: Input (3.3V signal) USB OTG Pin. Internal pulled up. The USB_OTG pin is used to select between USB host and device that is typically wired to the ID pin of a Micro usb connector. To use this functionality it must be enabled in the OS that is used. If using either as a fixed slave or fixed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

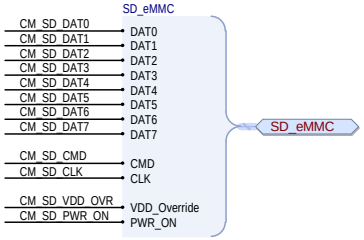
MEZZANINE CONNECTORS

J103 — CONNECTOR — Mezzanine, 100pin, 1.5mm

J104 — CONNECTOR — Mezzanine, 100pin, 1.5mm







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.

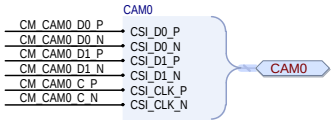
LAYOUT:

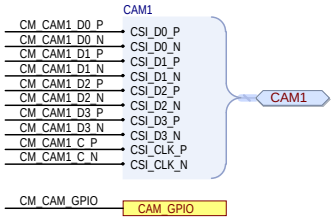
Route Ethernet signals as matched length 100 Ohm differential pairs with suitable clearances. Length matching between pairs should be better than 50mm, so in the typical case no length matching is required. However the signals within a pair need to be length matched, ideally to better than 0.15mm.

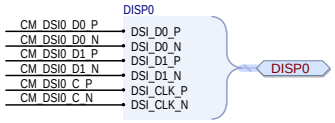
Route PCIe signals as matched length 90 Ohm differential pairs with suitable clearances. There is no need to match the lengths between pairs, only the signals within a pair need to be length matched ideally to better than 0.1mm.

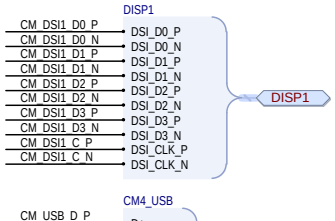
LAYOUT:

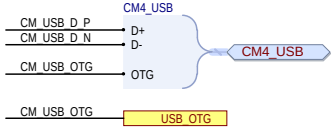
Impedance matching:
90 Ohm -> PCIe, USB
100 Ohm -> HDMI, Ethernet, MIPI (CSI, DSI)

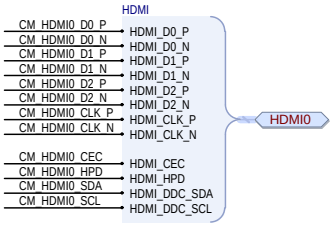


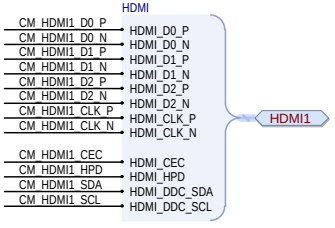




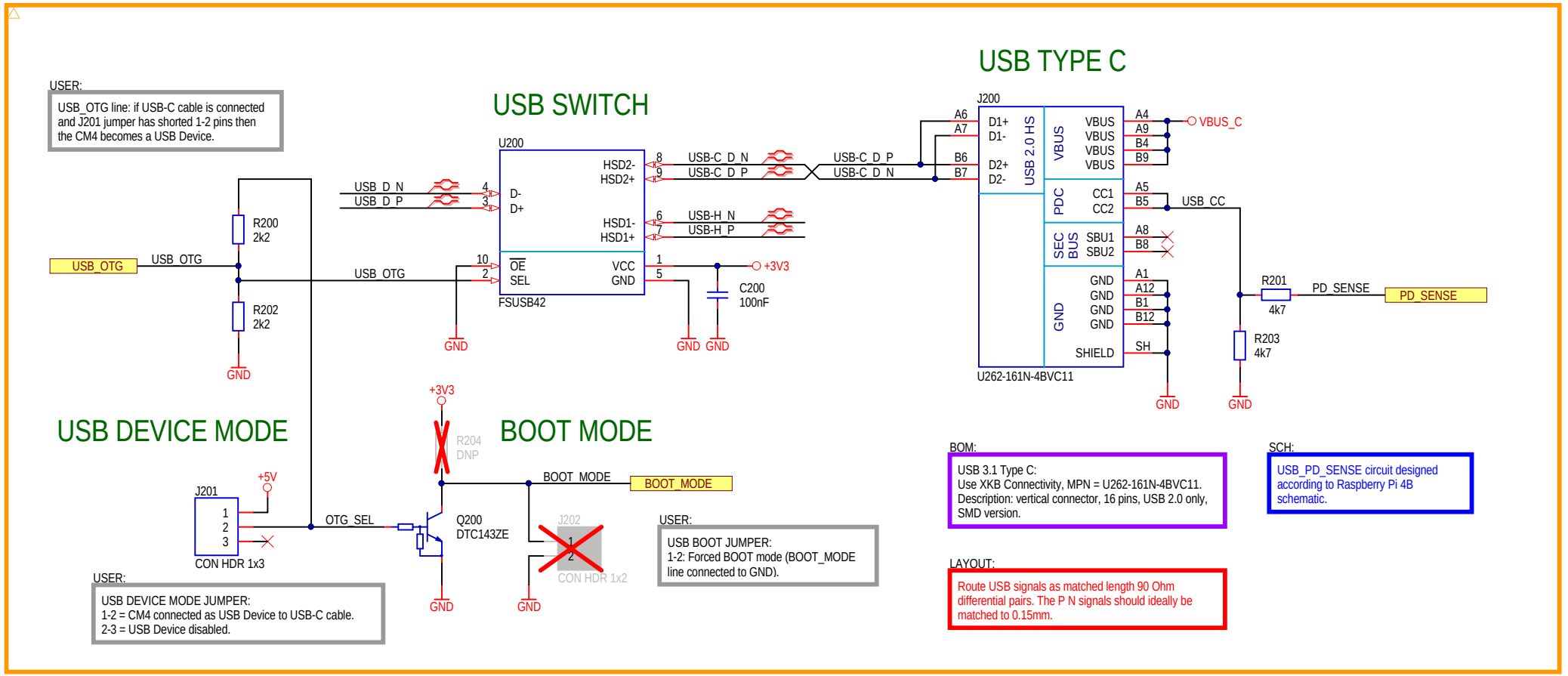






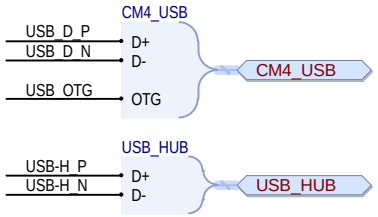


mirko electronics	Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland	Size	B
Title	Compute Module 4 (Part #2)	Version	VER1
Project:	Raspberry Pi MiniPC (CM4 carrier board)	Revision	REV1
Variant:	STD	RefDes:	1-99
Designer:	M. Folejewski	Sheet:	5 / 16
File Name:	[05] CM4_PART2.SchDoc	Printed:	2021-03-17



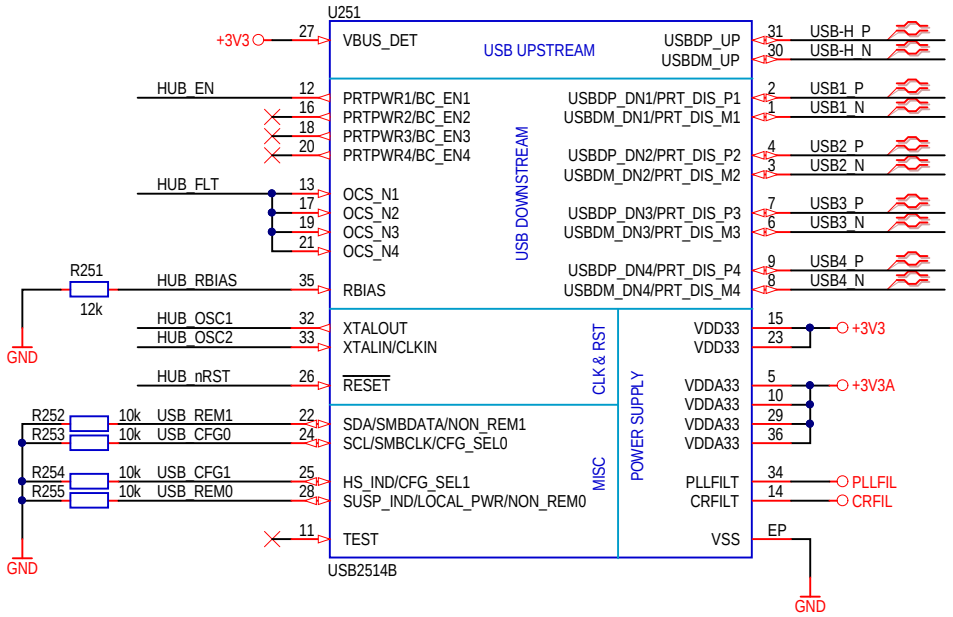
TESTPOINTS (DEBUG)

USB_OTG	TP200
OTG_SEL	TP201
BOOT_MODE	TP202
USB_CC	TP203
PD_SENSE	TP204

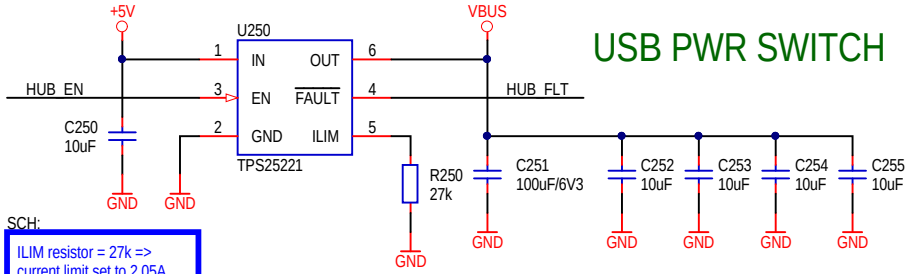


mirko electronics	Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland	Size	A4
Title: USB-C interface and USB switch		Version	VER1
Project: Raspberry Pi MiniPC (CM4 carrier board)		Revision	REV1
Variant: STD	RefDes: 1-99		
Designer: M. Folejewski	Sheet: 6 / 16		
File Name: [06] USB_C.SchDoc	Printed: 2021-03-17		

4-PORT USB HUB



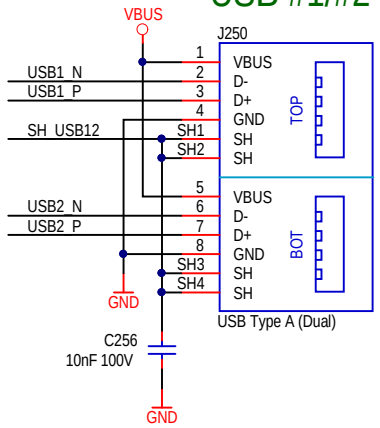
USB PWR SWITCH



SCH:

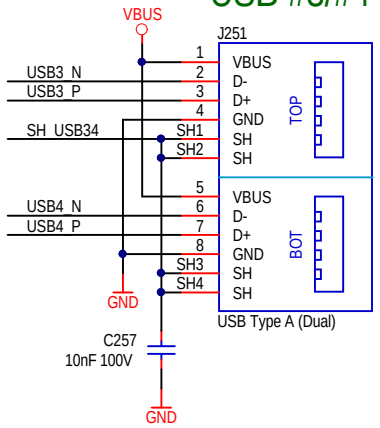
ILIM resistor = 27k =>
current limit set to 2.05A

USB #1/#2



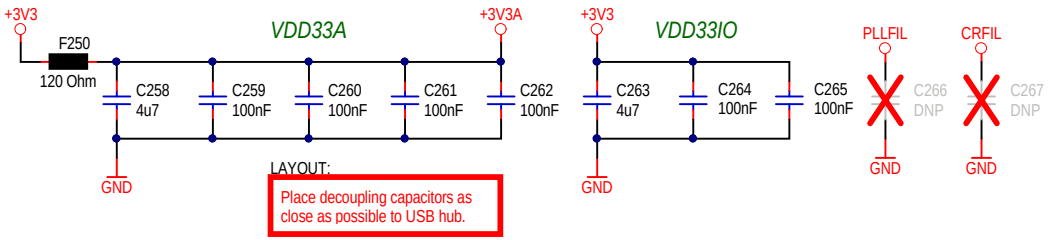
USB Type A (Dual)

USB #3/#4



USB Type A (Dual)

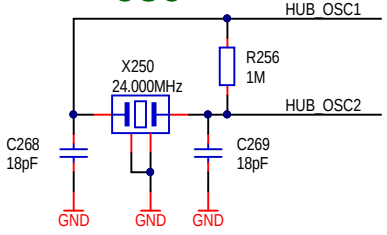
DECOUPLING CAPACITORS



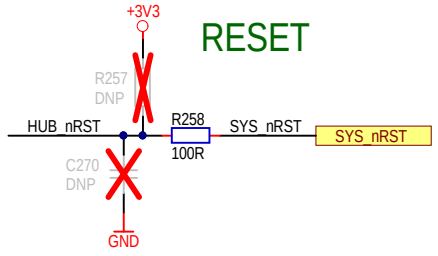
LAYOUT:

Place decoupling capacitors as close as possible to USB hub.

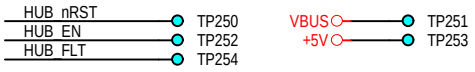
OSC



RESET



TESTPOINTS (DEBUG)

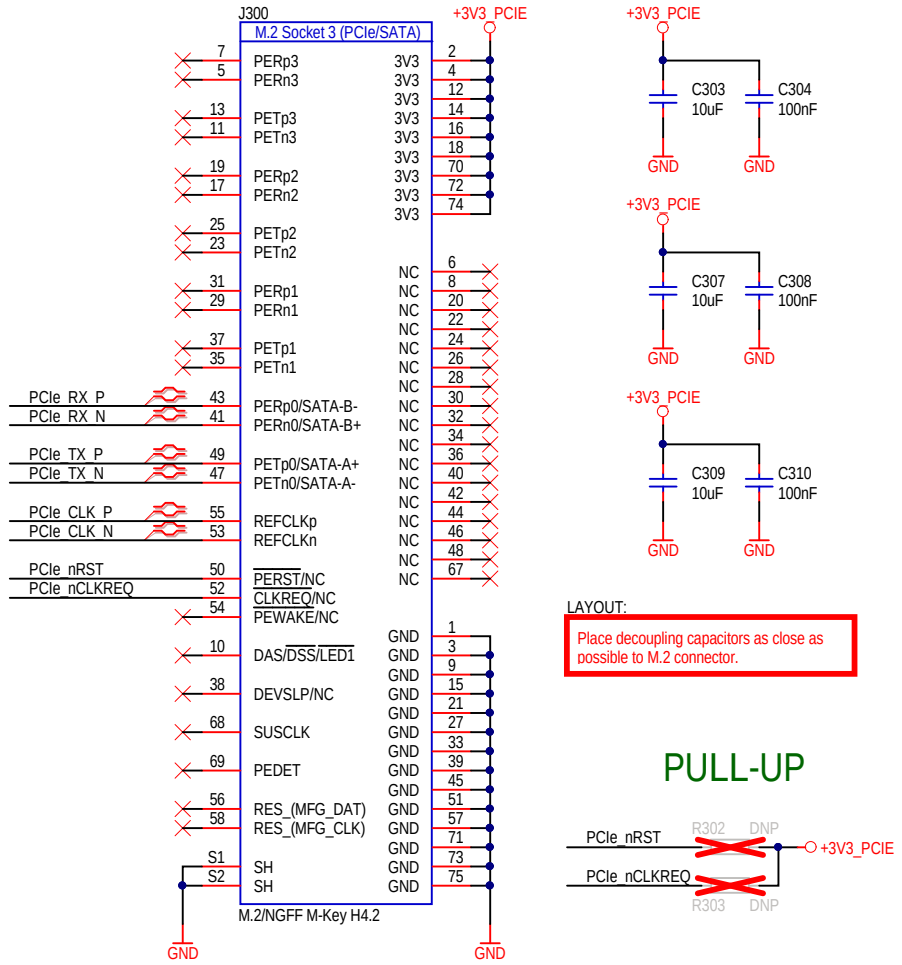


LAYOUT:

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

mirko electronics	Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland	Size	A4
Title: 4-port USB 2.0 hub		Version	VER1
Project: Raspberry Pi MiniPC (CM4 carrier board)		Revision	REV1
Variant: STD	RefDes: 1-99		
Designer: M. Folejewski	Sheet: 7 / 16		
File Name: [07] USB_HUB.SchDoc	Printed: 2021-03-17		

M.2 Socket 3 (M-Key) PCIe x1



LAYOUT:

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

PULL-UP

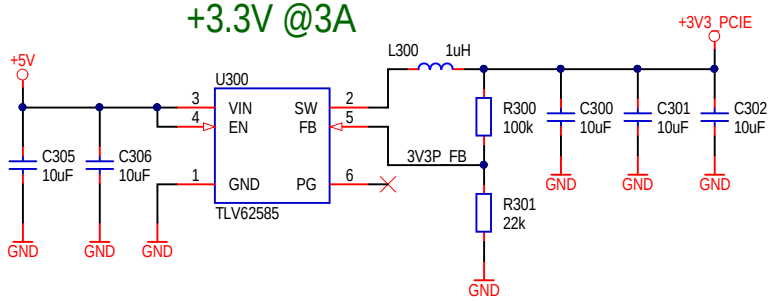
LAYOUT:

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.

BOM:

NGFF connector:
Description: M.2 (NGFF), M-Key, H4.2.
Lotes, MPN = APCI0107-P001A.
TE Connectivity, MPN = 1-2199230-5.

+3.3V @3A



LAYOUT:

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

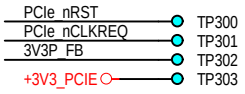
BOM:

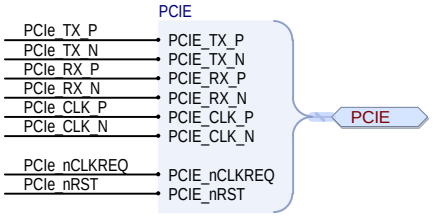
1.0uH -> compatible components:
PSA (Prosperity Dielectrics), MPN = MCS0630-1R0MN2
Wurth Elektronik, MPN = 744 373 460 10 (WE-LHMI, 7030 Series)

STAND-OFF HEIGHT TABLE

Connector Height Descriptor	L1
H2.3	0.35 ± 0.03
H2.5	0.55 ± 0.03
H2.8	0.80 ± 0.03
H3.2	1.45 ± 0.03
H4.2	2.45 ± 0.03

TESTPOINTS (DEBUG)

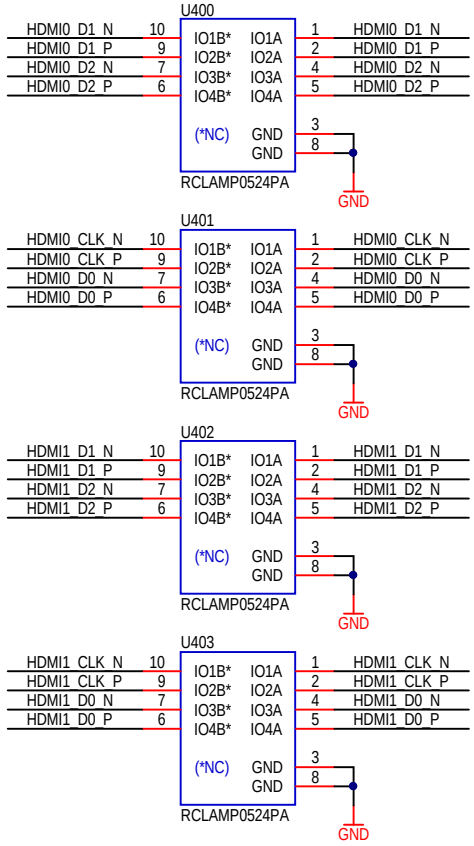




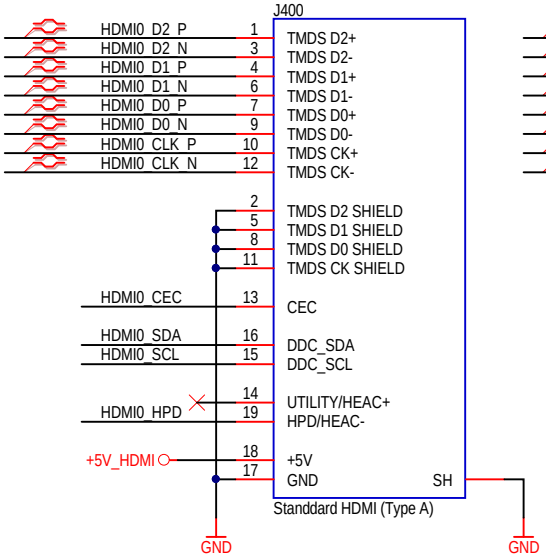
MOD300
SSD HDD
NGFF M.2
MOD_SSD_NGFF

mirko electronics	Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland	Size	A4
Title: M.2 PCIe x1 Socket		Version	VER1
Project: Raspberry Pi MiniPC (CM4 carrier board)		Revision	REV1
Variant: STD	RefDes: 1-99		
Designer: M. Folejewski	Sheet: 8 / 16		
File Name: [08] PCIe.SchDoc	Printed: 2021-03-17		

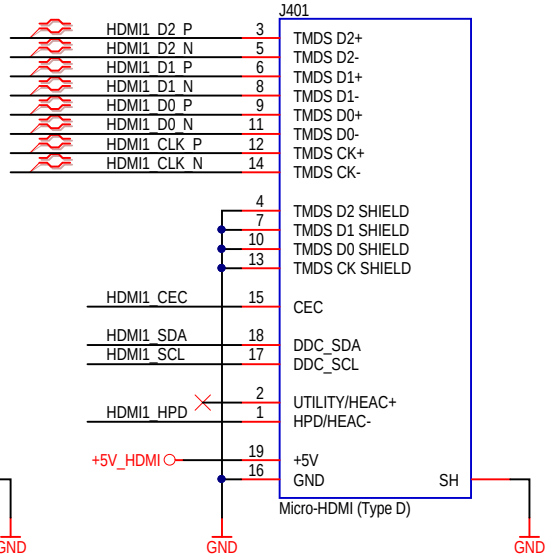
ESD PROTECTION



HDMI #0 (TYPE A)



HDMI #1 (TYPE D)



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.

BOM:

HDMI #1 connector:
Wurth Elektronik, MPN = 685 119 248 123
HOAUC, MPN = HYC23-HDMID19-650
Description: Type D (Micro-HDMI), 19 pins, 0.40mm pitch, horizontal, SMD.

LAYOUT:

connect IO1A - IO4A on the connector side.

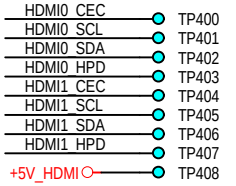
LAYOUT:

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

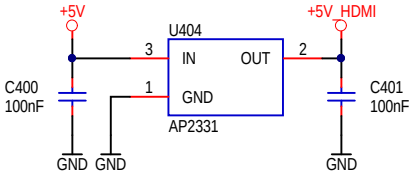
LAYOUT:

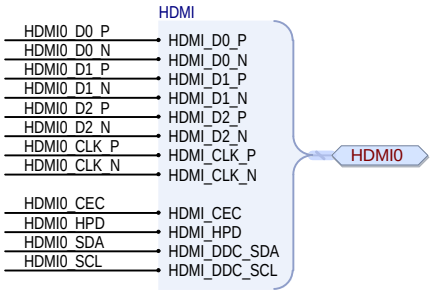
Route HDMI signals as matched length 100 Ohm differential pairs, each signal within a pair should ideally be matched to better than 0.15mm. Pairs don't typically need any extra matching as they only have to be matched to 25mm.

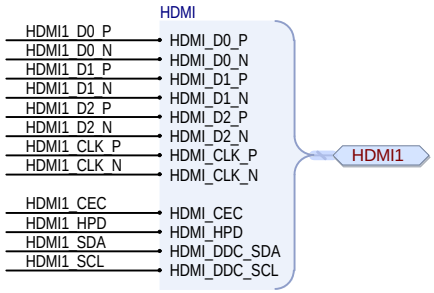
TESTPOINTS (DEBUG)



5V POWER SWITCH







mirko electronics

Mirko Electronics
Smoka Wawelskiego 1
30-535 Kraków, Poland

Size: A4

Title: HDMI Interfaces

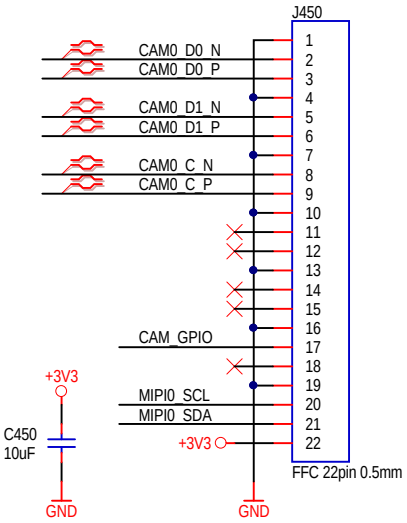
Version: VER1

Project: Raspberry Pi MiniPC (CM4 carrier board)
Variant: STD
Designer: M. Folejewski
File Name: [09] HDMI.SchDoc

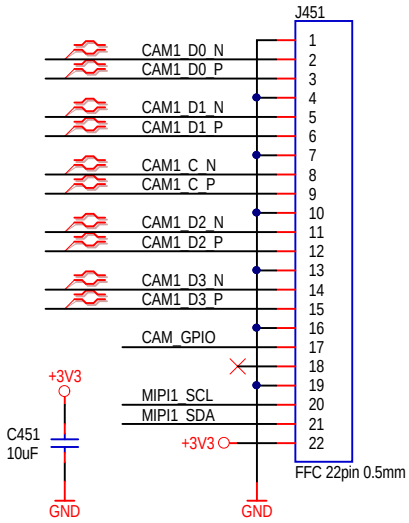
RefDes: 1-99
Sheet: 9 / 16
Printed: 2021-03-17

Revision: REV1

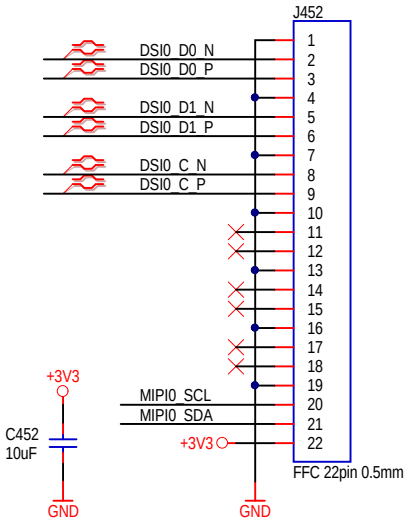
CAMERA #0



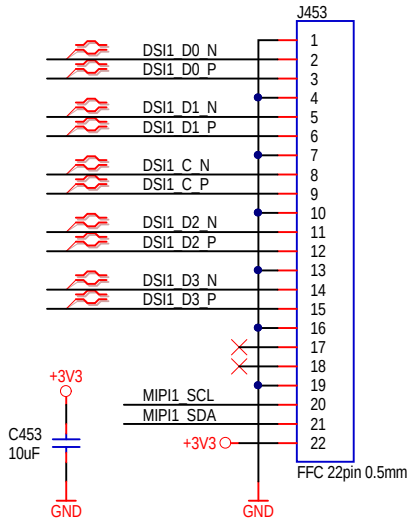
CAMERA #1



DISPLAY #0



DISPLAY #1



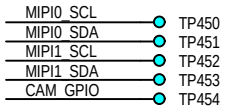
LAYOUT:

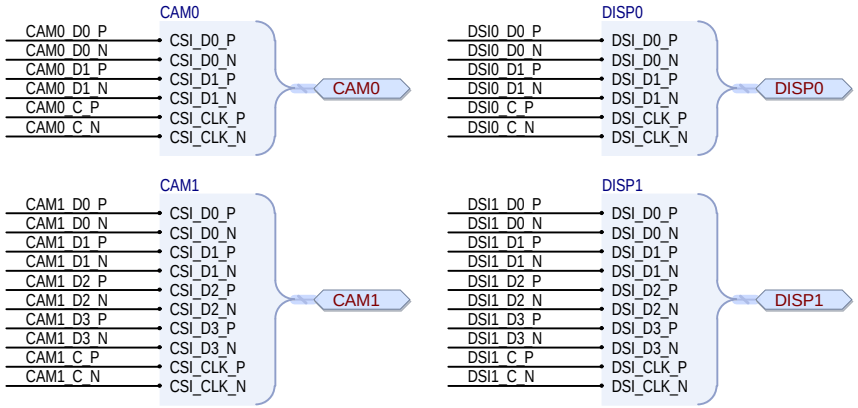
MIPI CSI and DSI signals should be routed as 100 Ohm differential pairs, each signal within a pair should ideally be matched to better than 0.15mm.

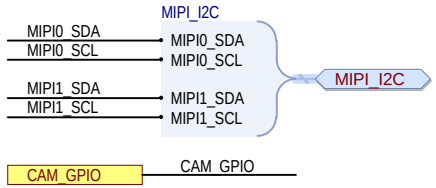
BOM:

FFC/FPC connector for Camera inteface:
Use XKB Connectivity, MPN = X05B20L22T.
Description: 22 pins, 0.50mm pitch, horizontal, bottom contact.

TESTPOINTS (DEBUG)

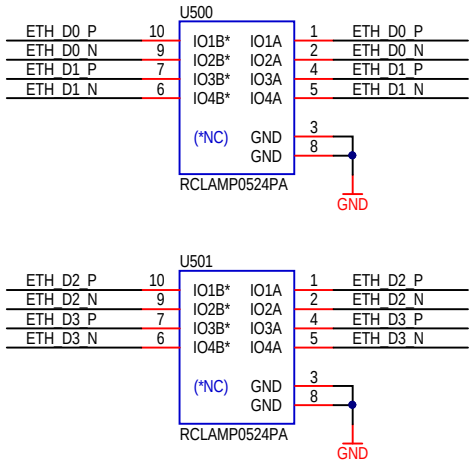






mirko electronics	Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland		Size A4
Title MIPI CSI & DSI (camera and display interfaces)			Version VER1
Project: Raspberry Pi MiniPC (CM4 carrier board)			Revision REV1
Variant: STD		RefDes: 1-99	
Designer: M. Folejewski		Sheet: 10 / 16	
File Name: [10] CAM_DISP.SchDoc		Printed: 2021-03-17	

ESD PROTECTION



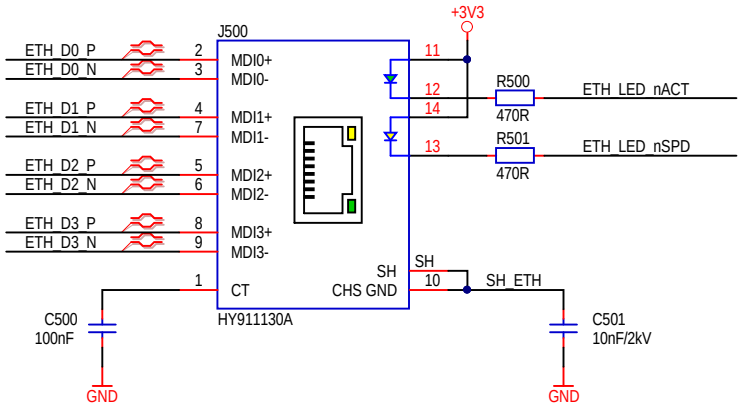
LAYOUT:

connect IO1A - IO4A on the connector side.

LAYOUT:

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

100/1000M ETHERNET



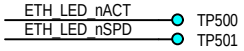
LAYOUT:

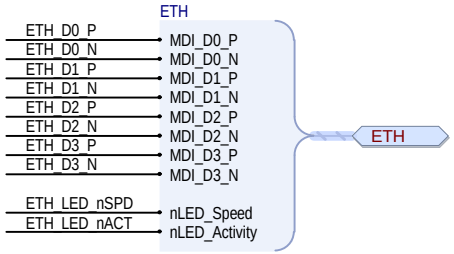
Route Ethernet signals as matched length 100 Ohm differential pairs with suitable clearances. Length matching between pairs should be better than 50mm, so in the typical case no length matching is required. However the signals within a pair need to be length matched, ideally to better than 0.15mm.

BOM:

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

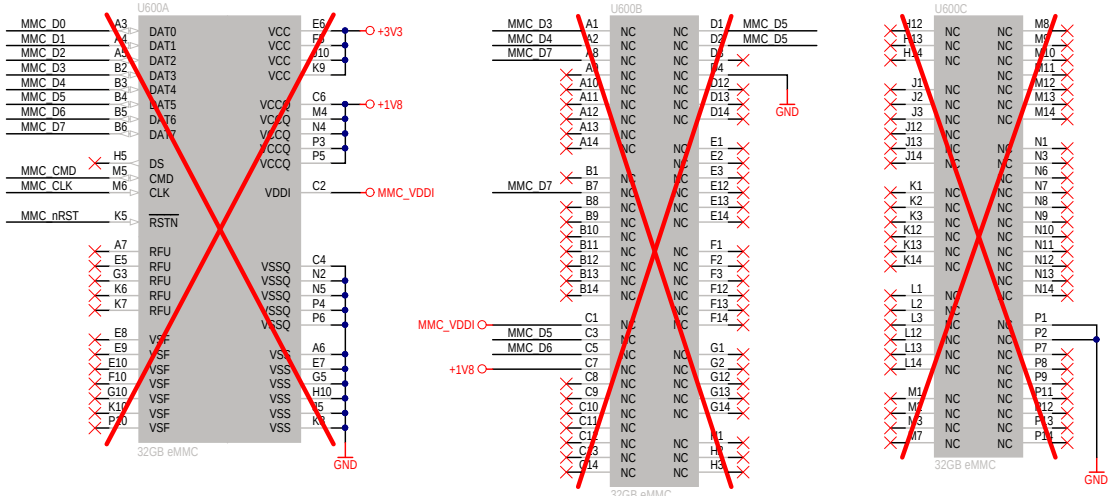
TESTPOINTS (DEBUG)



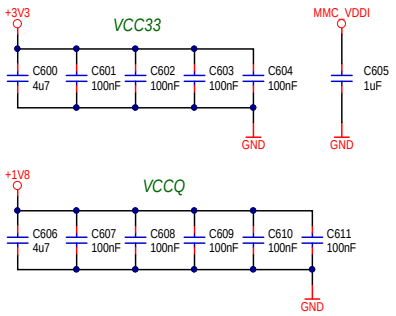


mirko electronics	Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland		Size A4
Title 100/1000M Ethernet interface			Version VER1
Project: Raspberry Pi MiniPC (CM4 carrier board)			Revision REV1
Variant: STD		RefDes: 1-99	
Designer: M. Folejewski		Sheet: 11 / 16	
File Name: [11] Ethernet.SchDoc		Printed: 2021-03-17	

eMMC v5.1



DECOUPLING CAPACITORS



SCH:

VCCQ is the power supply line for host interface, have two power mode:
High power mode: 2.7V3.6V,
Lower power mode: 1.7V1.95V.

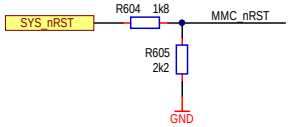
VCC is the power supply line for internal flash memory, its power voltage range is: 2.7V3.6V.

VDDI is internal power node, not the power supply.

LAYOUT:

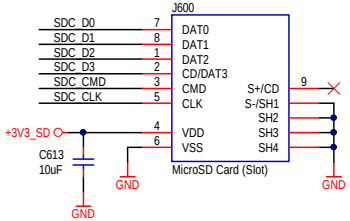
Place decoupling capacitors as close as possible to eMMC memory.

MMC_RST - level conversion 3.3V -> 1.8V



Force eMMC interface to 1.8V signalling

MICRO SD CARD



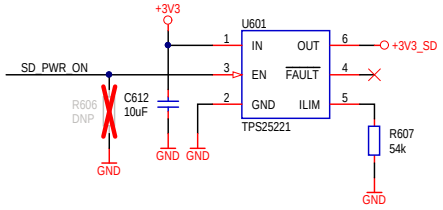
USER:

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

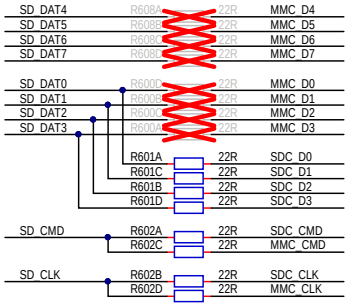
PWR SWITCH



SCH:

ILIM resistor = 54k => current limit set to 1.02A

SD INTERFACE MUX



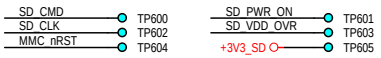
BOM:

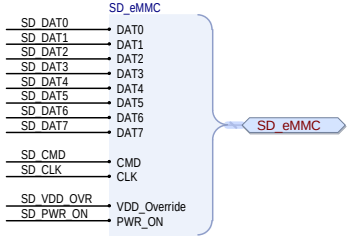
Place only series resistors only for SD Card interface or for eMMC memory.

LAYOUT:

Place series resistors as close as possible to CM4 module.

TESTPOINTS (DEBUG)

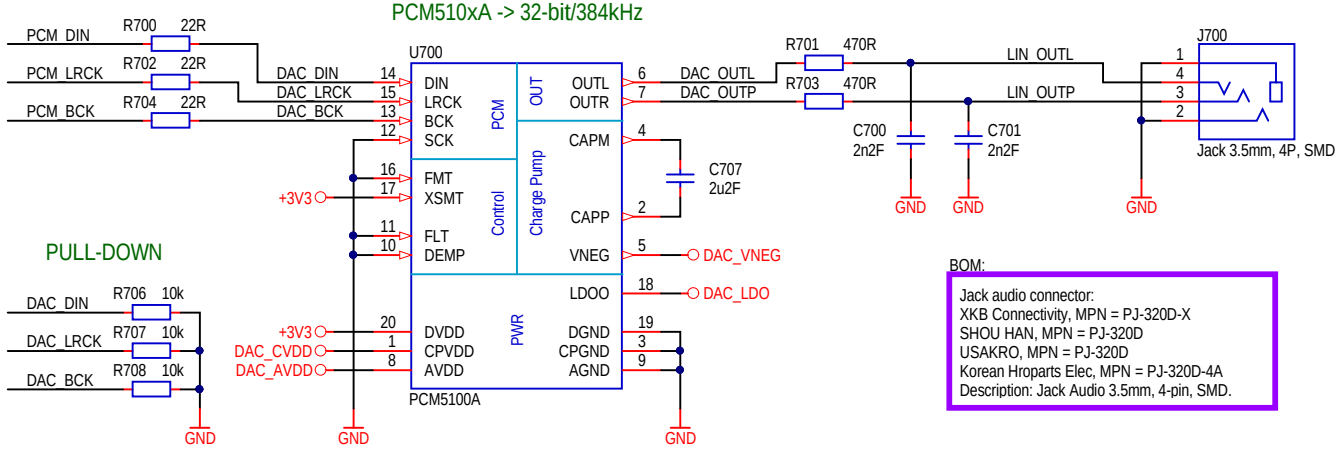




mirko electronics	Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland		Size: B
Title: MicroSD slot and eMMC memory			Version: VER1
Project: Raspberry Pi MiniPC (CM4 carrier board)			Revision: REV1
Variant: STD		RefDes: 1-99	
Designer: M. Folejewski		Sheet: 12 / 16	
File Name: [12] SD_MMC.SchDoc		Printed: 2021-03-17	

DAC Audio

PCM510xA -> 32-bit/384kHz

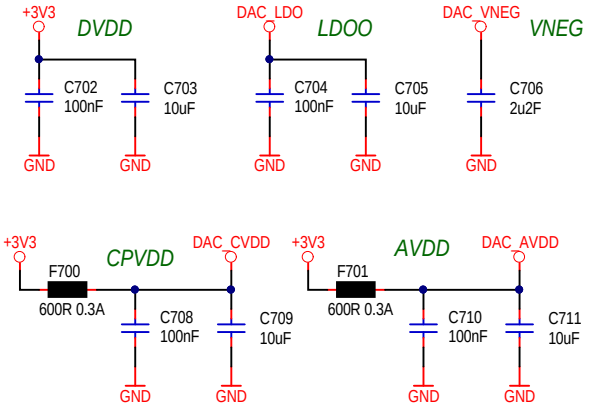


PULL-DOWN

BOM:

Jack audio connector:
XKB Connectivity, MPN = PJ-320D-X
SHOU HAN, MPN = PJ-320D
USAKRO, MPN = PJ-320D
Korean Hroparts Elec, MPN = PJ-320D-4A
Description: Jack Audio 3.5mm, 4-pin, SMD.

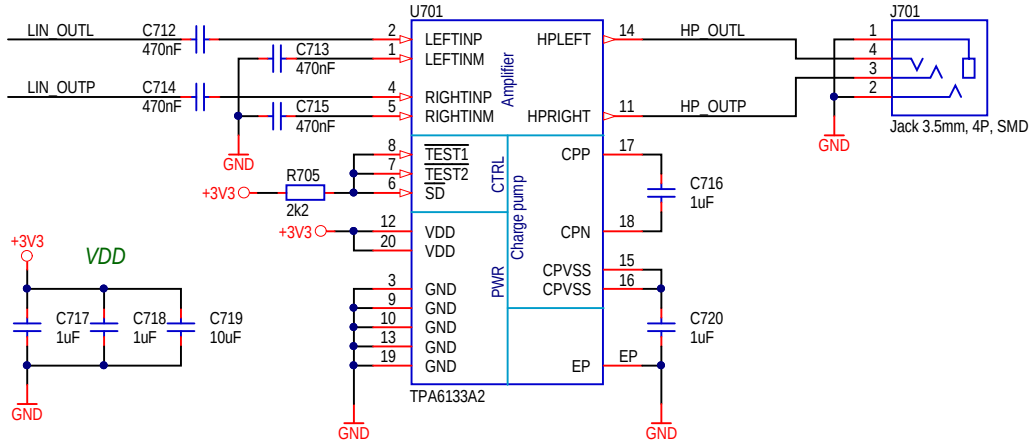
DECOUPLING CAPACITORS



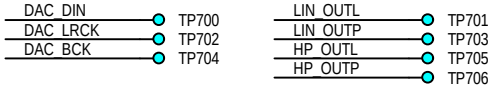
Headphone Amplifier

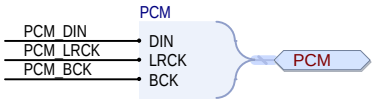
BOM:

470nF -> use film capacitor
Cornell Dubilier, MPN = FCA1206C474M-H3

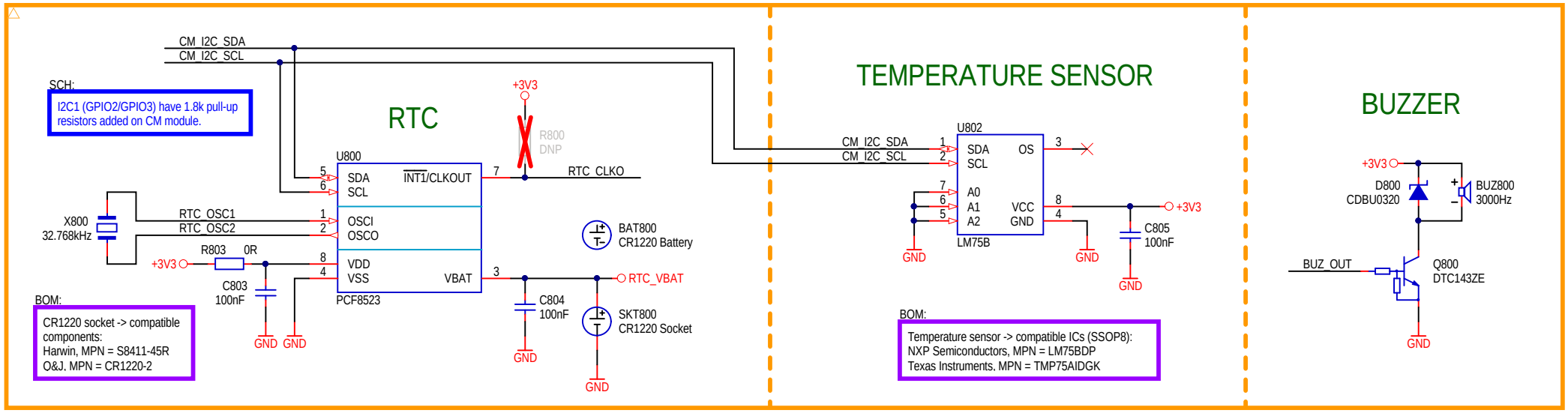


TESTPOINTS (DEBUG)



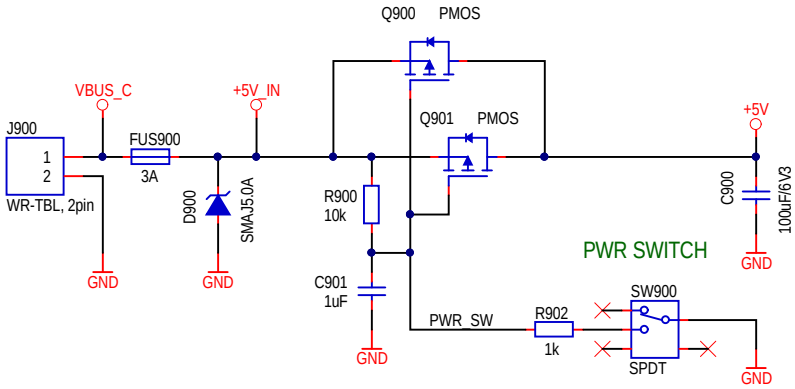


mirko electronics	Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland		Size A4
Title DAC audio output			Version VER1
Project: Raspberry Pi MiniPC (CM4 carrier board)			Revision REV1
Variant: STD		RefDes: 1-99	
Designer: M. Folejewski		Sheet: 13 / 16	
File Name: [13] DAC.SchDoc		Printed: 2021-03-17	



mirko electronics	Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland		Size A4
Title MISC			Version VER1
Project: Raspberry Pi MiniPC (CM4 carrier board)			Revision REV1
Variant: STD		RefDes: 1-99	
Designer: M. Folejewski		Sheet: 14 / 16	
File Name: [14] MISC.SchDoc		Printed: 2021-03-17	

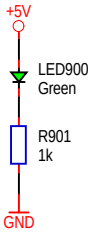
+5V MAIN POWER SUPPLY



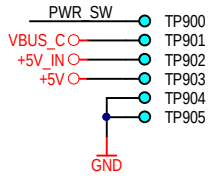
BOM:

P-MOS -> compatible transistors:
LGE, MPN = LGE2305
HUASHUO, MPN = HSS2307

PWR LED

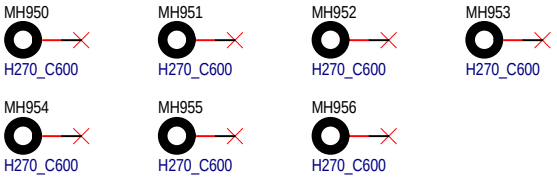


TESTPOINTS (DEBUG)

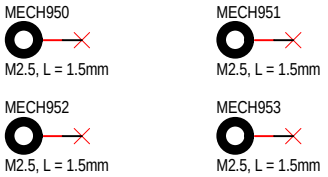


mirko electronics	Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland		Size: A4
Title: +5V power supply			Version: VER1
Project: Raspberry Pi MiniPC (CM4 carrier board)			Revision: REV1
Variant: STD		RefDes: 1-99	
Designer: M. Folejewski		Sheet: 15 / 16	
File Name: [15] PWR.SchDoc		Printed: 2021-03-17	

PCB MOUNTING HOLES



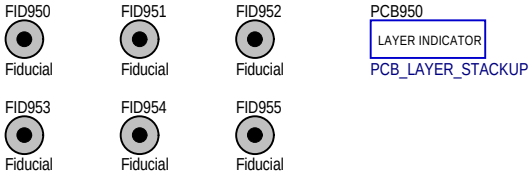
M2.5 STEEL SPACERS



BOM:

SMT Steel Spacer with internal Thread M2.5, L = 1.5mm:
Use Wurth Elektronik, MPN = 977 401 515 1.

PCB MARKING



mirko electronics	Mirko Electronics Smoka Wawelskiego 1 30-535 Kraków, Poland		Size: A4
Title: PCB marking & mechanical parts			Version: VER1
Project: Raspberry Pi MiniPC (CM4 carrier board)			Revision: REV1
Variant: STD		RefDes: 1-99	
Designer: M. Folejewski		Sheet: 16 / 16	
File Name: [16] PCB_Mech.SchDoc		Printed: 2021-03-17	