Video surveillance
Camera Server Hardware

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Contents

1 Abstract

We describe the design and implementation of camera servers, including housing and power delivery. Several versions have been put together and tested in real life situations.

2 Introduction

We have for a long time worked on video and still image transfer from remotely placed camera servers. Our main focus has been to provide reasonably priced observation stations that send video streams through the use of the open source mjpg-streamer [MJPEG streamer]. The computing part is Single Board Computers (SBC) either the Raspberry PI [Raspberry PI] or some of the many NanoPI models from FriendlyELEC [Friendly]. Currently we consentrate on Raspberry Pi and the Pi camera.

Naturally such devices need some sort of power. For long time running powering through cable from a mains power outlet. Long unprotected cabling carrying main voltage is not safe so we must use low voltage for power delivery. This solution does suffer from voltage loss through the cable - if the cable is not of large diameter. We implement another design, viz. powering at 12 V and use a voltage regulator placed at the observation station itself.

No matter what camera and SBC we choose to use it will have to be placed in some sort of enclosure and this has to be weatherproofed when the camera server is to be placed outdoors. We are working on enclosures based on plastic sewer pipes. Here we find short tubes with inspection ports. To dimensons are of interest, viz. a 4 inch tube and a 3 inch tube. The 4 inch version are somewhat lage and bulky, while the 3 inch version is cramped inside. A benefit with the larger housing is that it allows for placing some sort of battery inside for a truely remote observation station.

We have completed a number of 4 inch camera houses that are now in production and are working on getting a Raspberry Pi 4 with camera to fit inside the 3 inch tube. For this latter assembly we will most likely have to loose the option of placing a battery inside the housing.

3 Computer and camera combinations

There are a plentitude of SBCs and cameraes available on the market, and it follows that the number of combinations are large. We are still in the process of finding combinations that are optimal for different uses and also within our budget. Two different manufacturers have been considered, viz. Raspberry Pi foundation and the chineese FriendlyElec. The first one offers the well known series of Raspberry Pi computers and companion cameraes. The FriendlyElec produces a large series of SBCs called NanoPi and several cameraes to go with them.

3.1 Raspberry Pi and cameraes

We have been using Pi Zero, Pi Zero W, Pi 1 Model B, and lately P1 4 Model B. The Pi Zero has a narrow camera connector, but adapters exist for conversion both ways. For the Raspberry Pis a number of cameras has been and are currently available. Initially we had the the camera module v1 with 2592 x 1944 pixels on an Omnivision OV5647 detector. Later this was replaced with the camera module v2.1 with 3280 x 2464 pixels on a Sony IMX219 detector. as of 2020-08-12 the V2.1 had a price of £ 24. Following that the High Quality (HQ) Camera was made available. The HQ camera is a 12 megapixels where each pixel is 50 % larger than the ones of the V2.1. This HQ version does not have a fixed lens rather uses C/CS mount lenses and bears a price tag of £ 49.50 - when in stock.

3.2 The NanoPIs and the CAM500B camera

The NanoPIs are a large family of SBCs built and sold by the Chinese FriendlyElec [Friendly]. Observe that the home page address is www.friendlyarm.com. We have been using two different SBCs. These are the NanoPI NEO Air and the NanoPI M1 plus. There also used to be an attractively priced M1, but this is as a rule out of stock. When available it sold at a price of $ 14.99. The NanoPI Air has both a built in embedded MultiMediaCard (eMMC) storage as well as WiFi hardware, but not Ethernet. The Air sell at a price of $ 19.99 with 8 GB eMMC, but 32 GB costs $ 11 more. The ManoPI M1 plus may also boot and run from a built in 8 GB eMMC. In addition to WiFi there is also an Ethernet connection. The M1 Plus sell at a price of $ 38. This SBC has to date always been available. Special images for copying the operating system to the built in eMMC are avaliable from Friendlyelec for M1 Plus and Air.

The CAM500B is a 5MP (2592 x 1944) 1080p Camera Module with an OmniVision [OmniVision] OV5640 detector chip. The pixel size is 1.4 μm times 1.4 μm. And the detector image area dimension is 3673.6 μm times 2738.4 μm. The CAM500B sell at $ 19.99. Althoug the NanoPI NEO Air is a possible SBC we have consentrated on the M1 plus due to its interfaces and availability.

4 Power draw of Computer and camera assemblies

4.1 Raspberry Pi and Pi camera power draw

Our oldest Raspberry PI is the old model 1 with Raspberry PI camera. Running steadily it takes about 0.5 A at 5 V, i.e. 2.5 W. The power connector is a micro-USB receptacle. The more resent Pi 4 are supposed to be more power hungry, but when running from a laboratory power supply we read off a the same current consumption of 0.5 A with user pi logged in. There were no workload on the machine when this measurement was done. The power draw during boot peaked at 0.7 A as did also the current during a "ls -lR /". After shutdown the current draw was 0.28 A.

4.2 NanoPI M1 plus and CAM500B power draw

With nanopi-m1-plus_eflasher_3.4.39_20171102.img and the CAM 500B connected. Also the mjpg-streamer was streaming one stream. Through the 12 V to 5 V regulator, described in section 5.3, the current was 0.5 A.

5 Connecting power to PIs and NanoPIs

For both the Raspberry- as well as the Nano-PIs we may apply power either through the μUSB connector or through connections to the pin headers,

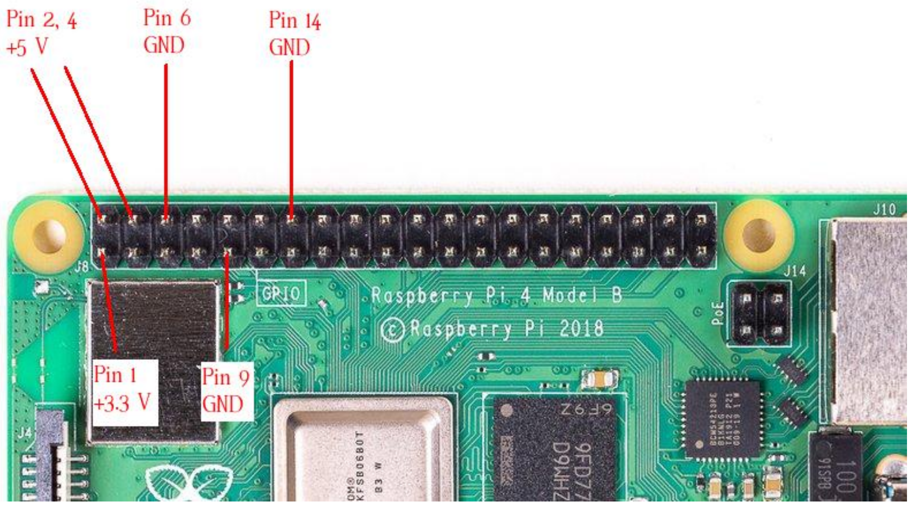

Figure 1: The 20 times 2 pin-header of the Raspberry Pis

nut not both at the same time. The header pins on the Raspberry Pis are shown in Figure 1. The most relevant pins for power input (+5 V) and output (+3.3 V) are annotated. The +5 V is input for powering the Raspberry Pi itself while the 3.3 V is from the built in regulator and may be used for powering pheripherals. The NanoPi models have very very different layouts and pinouts so one should consult the manufacturers information on this topic. For the NanoPI M1 plus we connected the +5 V to pin 2 and ground to pin 6.

We measured the voltage at the power supply and at the Raspberry Pi pin header when the current draw was 0.5 A. The connecting leads were dual 0.22 mm^2 stranded wire of length 20 cm soldered onto a header. The voltage at the power supply was 5.05 V and the voltage at the Pi header was 5.04 V. Both referred to ground at the power supply. This voltage drop is negligible.

5.1 Power from charger or 5 V supply

This is the obvious solution and has been proven on many occations. Still it should be tested before put into service as we have observed that with some mobile chargers the Pis does not start after a mains power loss. This method can only be used where mains power is avaliable. Bringing mains power through cabling to remote locations could be unsafe unless the cable is very robust.

5.2 Power from a battery or accumulator

There is also the possibility to power the PI from a so called power bank. This is a battery intended to be used for charging mobile phones, but we tested one with the PI and it worked like a charm.

5.3 Power from 12 V to 5 V linear voltage regulator

Even with such a small current as 0.5 A the voltage drop through a long cable may bring the end voltage below the operating range of the computers. To circumvent this potential problem we have designed a 12 V to 5 V regulator based on the L78S05CV linear voltage regulator. This circuit delivers 5 V from an input range of 8 V to 35 V and can handle 2 A. Although without very good cooling the 35 V is mostly academic. The thermal resistance from junction to case is 4°C/W, while junction to ambient is 35°C/W. Maximum junction temperature is 150°C. If we say 3 W dissipation the junction to ambient temperature drop is 35°C/W * 3 W that equals 105°C. For an ambient emperatur of 20°C this is dangerously close to the maximum 150°C so a heat-sink must be used. Our design uses a cooler that allows running at an input of 12 V for indefinite period.

Actually the plan is that the excess power shall heat the housing to avoid icing during cold periods. At 12 V input the L78S05CV takes 7 V and therefore emits a heat output of 3.5 W in addition to the 2.5 W dissipated by the Raspberry PI. With this scheme one may use long and thin wires to supply the remotely placed camera, as long as the voltage drop is less than say 4 V. We tried this out with a 25 m long 2x0.75 mm^2 mains cable. With the supply at 12 V the voltage at the regulator was 11.43 V. This indicates that we may possibly use up to 200 m power leads.

Later we obtained voltage down-converters of the buck converter (integrated switch) type. These are more efficient than the linear converter described above. We cannot expect that such a converter will contribute to the heating of the camera enclosure.

5.4 Part list and schematic for 12 V to 5 V regulator

As mentions the regulator itself is the L78S05CV. This one of a family of three terminal, 2 A, fixed voltage regulators from STMicroelectronics [ST]. According to the data sheet one should use a 0.33 μF capacitor on the input side and a 0.1 μF capacitor on the output. This will ensure stable operation even with long leads. We place a fuse on the input and also a diode to protect against accidental reversing the polarity of the 12 V supply line. There is also a resistor on the output to make sure the LS78 has some

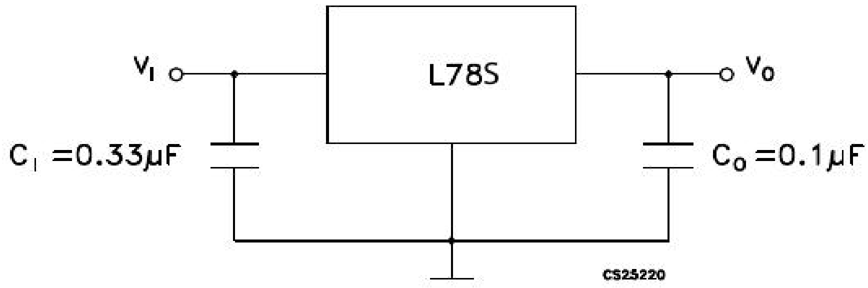

Figure 2: Central part of the 12 V to 5 V regulator

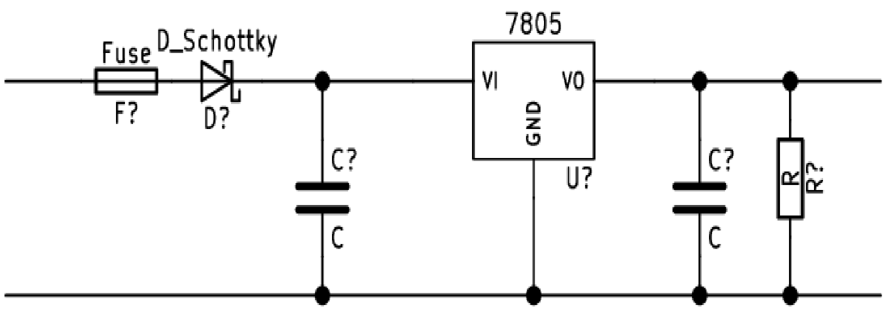

Figure 3: Regulator model II schematic

current even without any other load. The load regulation for the L78S05CV is 100 mV in the range 20 mA to 1.5 A. We select a resitor value of 200 Ω that will draw 25 mA at 5 V. This resistor will have to be of at least 0.125 W size. The schematic for the regulator is shown in Figure 2. The parts we use are:
L78S05CV, 5 V, 2 A, In 8..35 V, TO-220, ST, Elfa 173-09-560
100 nF, 50 V, 5.08 mm, Elfa 165-71-681, Kr 2.14 /pcs
330 nF, 50 V, Elfa 165-77-295
200 Ω, 1 W
Schottky diode 5 A, 50 V, DO-201, SB550, Diotec, Elfa 300-31-486
Fuse holder and fuse
Input side connector block
Actually for the two first regulators we did not have the Schottky diode so we used two ordinary silicon diodes instead. Two models were made - the model I for the Raspberry PI in its large housing and model II that is a smaller design intended for NanoPI solutions. The model I used an USB connetor on the output side. The schematic for the regulator model II is shown in Figure 3. This regulator model I mounted in the housing is shown in Figure 4. The other design is a smaller outline and is intended to be used together with the NanoPI M1 or M1 plus based camera servers. The PCB with components is shown in Figure 5.

As the model II do not have the USB output it connects to the NanoPI's pin header directly. If one intend to power the NanoPI through the μUSB connector one must remove the pin header connection. The 12 V to 5 V power converters are not protected against back voltages on the oputput.

We did some testing of the regulator version II powering the NanoPI M1 plus. The current draw at the 12 V side were a steady 0.4 A. This is without camera and with the processor more or less in idle. Using only the heat sink, this became so hot that it was uncomfortable to touch. This is probably way below 100°C, but indicates that one should mount the regulator with the heat sink in thermal contact to a larger metal plate. This is done in the Raspberry PI housings with the regulator model I. Later we connected the camera CAM500B and with the mjpg-streanmer working the current rose to 0.6 A. The heat sink of the regulator II quickly became hot to touch. Even later we mounted the heatsink on a 60 x 80 mm^2 aluminum plate that again was mounted to a larger plate. With this combination we let the server mjpg-streamer run for one hour in an about 20°C ambient. The heatsink is still quite warm, but not hot.

5.5 Switchmode 12 V to 5 V converter

We could also consider using a switchmode regulator. This would not heat up and consequently need no heatsink. It would also be much more efficient

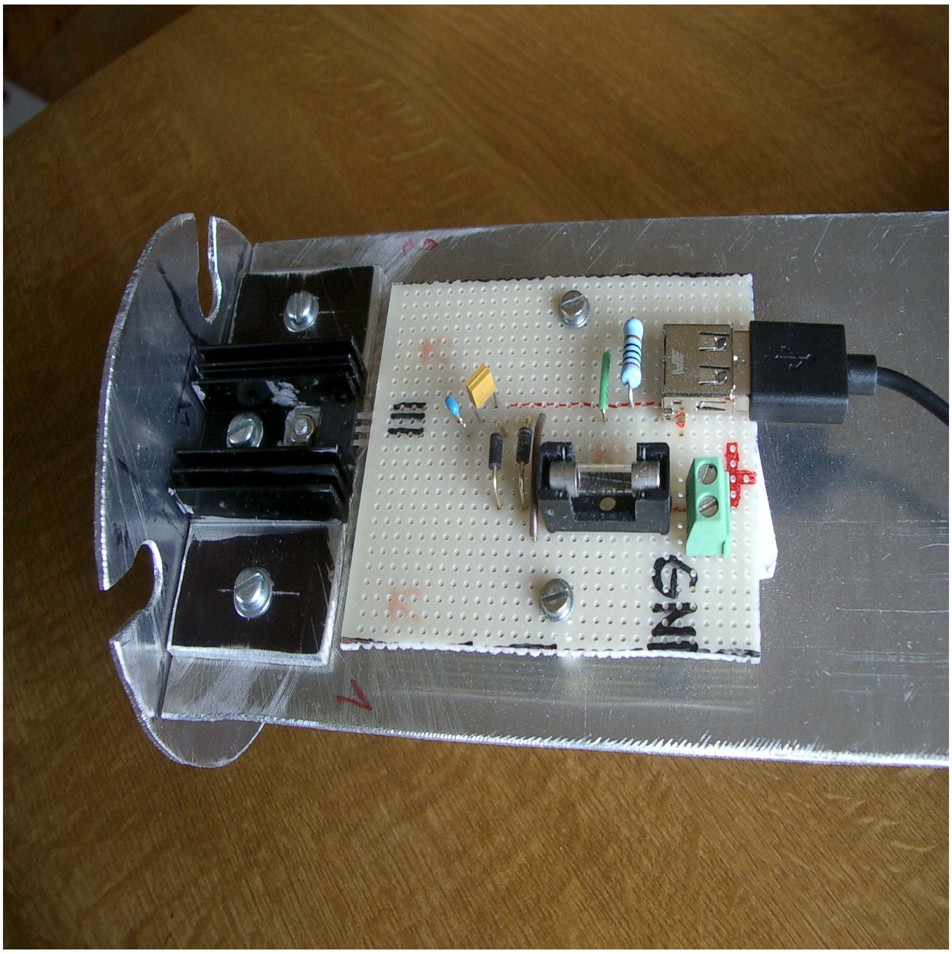

Figure 4: Regulator model I mounted in housing

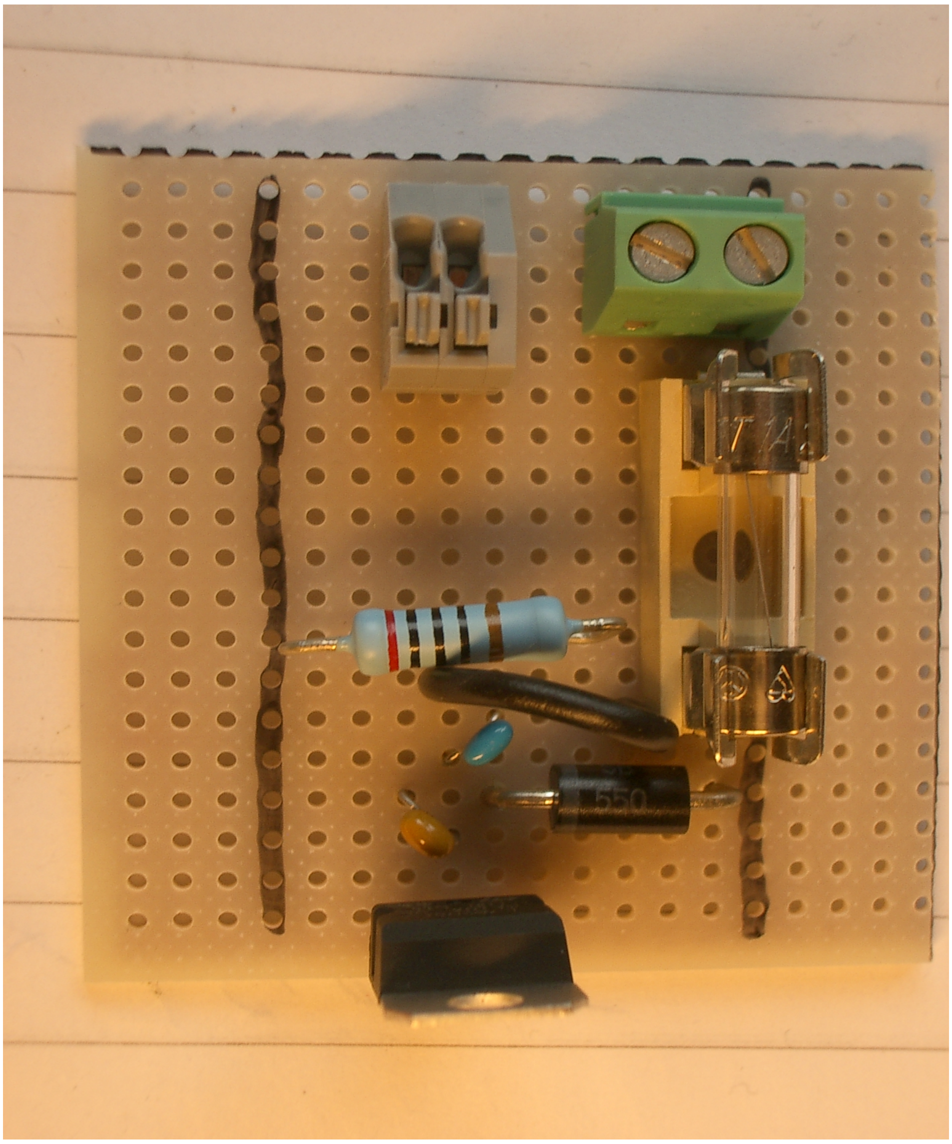

Figure 5: Regulator model II PCB with components

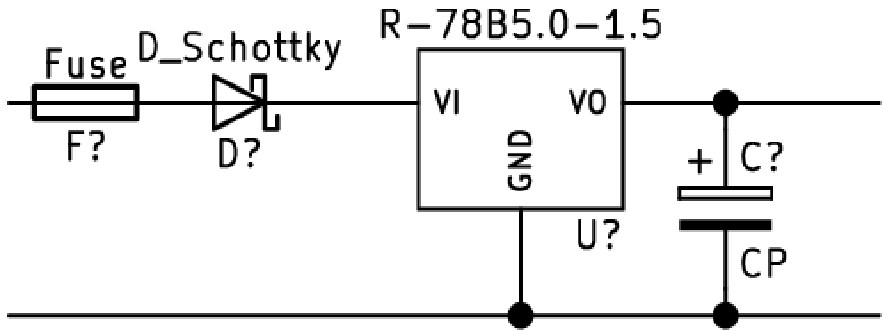

Figure 6: Switchmode 12 V to 5 V regulator schematic

in cases where power consumption is important. The shematic for one such regulator, based on the Recom R-78B5.0-1.5, is shown in Figure 6. We have not yet built any regulator of this type.

5.6 Step down 12 V to 5 V buck converter

We are testing several versions of these. One from Droking bought via Amazon.co.uk. We have not been able to find what parts these are based on. What seems to be an SMT IC bears the marking "IAGCK". The other is from eBay seller elec-module58. This converter is based on the MP1584EN high frequency step-down switching regulator. Both claims the same specifications, viz. 3 A at 5 V. At this maximum power one may need additional cooling. Finally we also tested the Velleman VMA404 that seems to work properly.

5.6.1 Parts from eBay and Amazon

When testing the eBay part seemed quite unstable and the voltage out varied when the load of 8 Ω were disconnected and connected. The Droking were set at 5 V out with the potmeter and output voltage were quite stable with an input of 12 V, 0.31 A. Neither converted was hot to touch when delivering into 8 Ω. When we followed the instructions for setting fixed output on the Droking converter we found it gave 4.75 V when 5 V output was selected. With this converter it seems like we will need to use the adjustable setting and will use this to our benefit and isolate the converter from back flowing current by inserting a schottky diode and adjusting the output voltage to reach 5 V at the PI header. This makes it possible to power the Pi through the USB-C connector or otherwise without disconnecting the converter. The setting of the very small potemtiometer is difficult.

5.6.2 Step down regulator from Velleman

As a last try we obtained a few step-down converters from Kjell & Company. These vere Velleman VMA404 at a price of Kr 100 each. They will take an input voltage range of 3 V to 40 V and deliver an output voltage range of 1.25 V to 35 V. The current capability is 2.5 A and the regulator is built around the LM2596S. We tried out one of these with a 12 V power as input and into an 8 Ω resistor. The current draw from the 12 V supply was about 0.3 A. The converted was hardly warm, seemd to be stable, and the adjustment of the output voltage was easy to get correct. Although higer in price this is our best candidate.

We protect the step down regulator with both a fuse and a diode on the 12 V input. We also allow for directly powering the Pi from a 5 V supply that without any protection would connect directly to the regulator 5 V output. As we do not know wether the regulator can handle this we provide a diode on the regulator output and connect the 5 V and the Pi to this side. The diodes are 5 A, 50 V Schottky diodes SB550, Elfa part number 300-31-486.

5.7 12 V cabling color coding and connectors

One final point is the colour coding of the 12 V distribution cable. In normal alternating current distribution the Neutral (N) conductor is blue and the Live conductor shall be brown. For direct current the positive conductor is usually red and the neutral (ground) conductor is black. We use 0.75 mm^2 mains cables that are usually blue and brown so we use **blue for the negative** conductor and **brown for the positive** conductor.

12 V power may be connected internally, as we originally intended, or by using an external power socket. The latter will make it much easier to move the camera enclosures around, but will most likely also require some sort of external connector for the Ethernet cabling.

We have previously used a 5 pin connector for power connections. Both the panel and the cable part are obtain ed from elfa. The panel part was a male connector while the cable was female. Looking into the male panel mounted part the pin numbering is in clockwise order 5, 4, 3, 2, 1, with pin number 3 center and upper. We connect the 12 V leads with ground to pin 3 and 12 V to pin number 1. When soldering in the blue-brown mains lead, used for 12 V supply, the **brown lead goes to pin 1** while the **blue lead goes to pin 3**.

Actually the 5 pin connector may be used for delivering more voltages and our convention is that pin 5 is -12 V, pin 4 is -5 V, pin 3 is common ground, pin 2 is +5 V, and pin 1 is +12 V. For lead colors on this connector we choose black for the ground lead, red for 5 V, and yellow for 12 V.

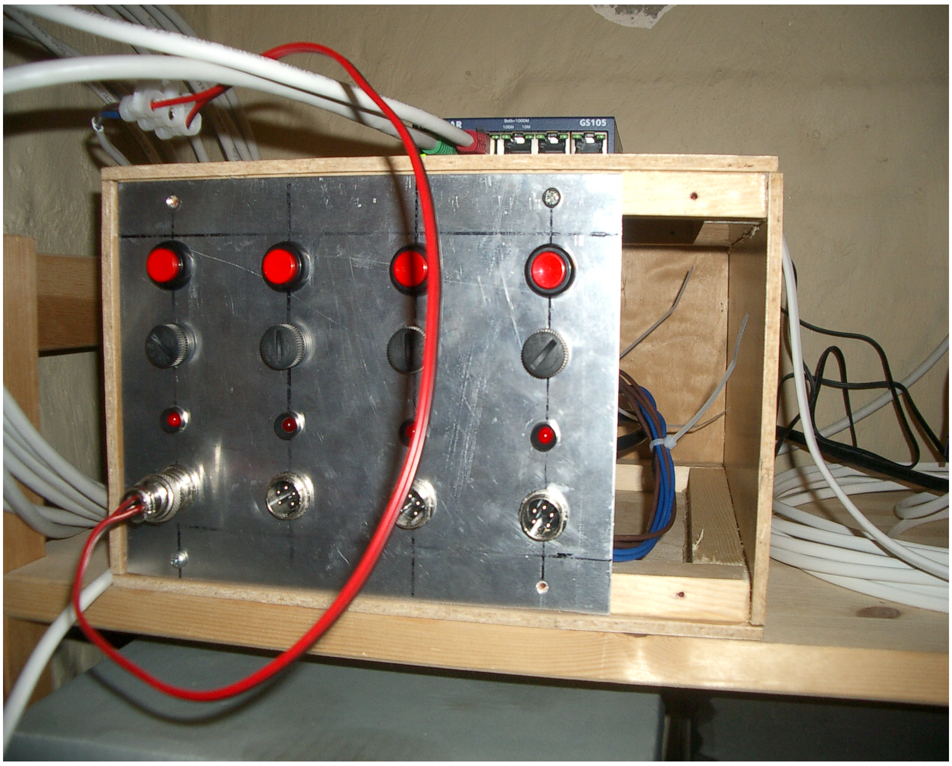

Figure 7: Four channel 12 V power supply

5.8 Multipple output 12 V power supply

When several observation stations all connects to one and same Ethernet switch one may as well use a power supply with several outputs. We put together one of these with four separate outputs. All outputs are feed from one mains powered 12 V supply. For each output there is a switch, a fuse, a Light Emitting Diode (LED), and one 5 pole connector. The central part is a switchmode power supply from Kjell & Company [Kjell & Co.], viz. the Strømforsyning for innebygging 12 V, 6 A Art. 44478, Modell nr: LRS-75-12, at a price of Kr 229. The half-finished 4-channel power supply is shown in Figure 7. The connector is the "M001-5 - Panel Plug Nickel - Plated 5P - Tsay-E" mentioned in section 5.7. The total current of this multipple output power supply is 5 A. Power on each output is indicated with a red LED connected in series with a 3.3 kΩ resistor.

6 Heat sinks for the SBC processors

For most of the processors we use a simple heatsink that is glued with thermal pads onto the processor. Such heat sinks are usually supplied by

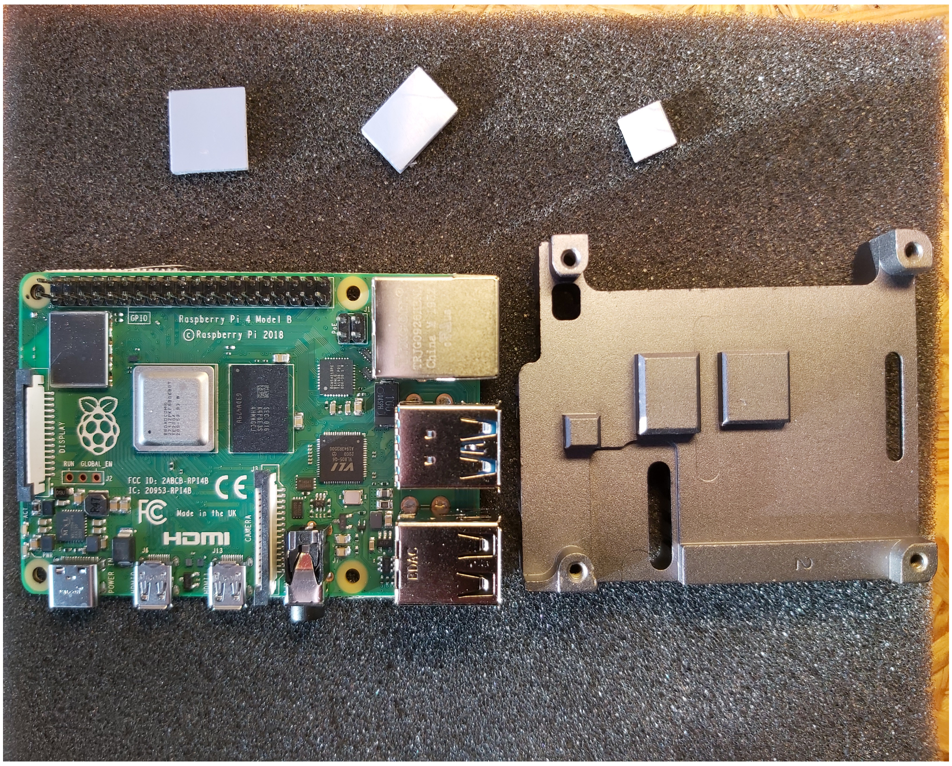

Figure 8: Raspberry pi 4 and the heat sink case

the SBC manufacturer. For the Raspberry Pi 4 there is a special case called heatsink case that is mounted around the SBC. This case consists of a bottom part and a top part. The heatsink case is held together with 4 M 2.5 unbrako screws. For our purpose we use just the top part and mounts this to the plate holding the SBC. The case has a cutout for the camera cable and connecting the cable after the heat sink is in place is not possible. Figure 8 show the heat sink case alojngside the Raspberry pi 4 and the three thermal pads. In mounting of this heat sink with the camera connector inserted is quite demanding. Our best proposal is to attach the heat sink thermal pads as shown in Figure 9 then connect the camera cable. Remember that it must be threaded through the hole in the heat sink. Now fixate the heat sink with the screws and put a rubber band around heatsink and the pi SBC. The original screws is to short when they shall reach through the basplate and a plastic distance. We found that Bossard M 2.5 x 12 mm is long enough, but we could possibly use somawhat longer. Remove the screws and place the assembly on the plate that will hold the computer in the complete assembly. Afterwards the rubber band can be removed by cutting.

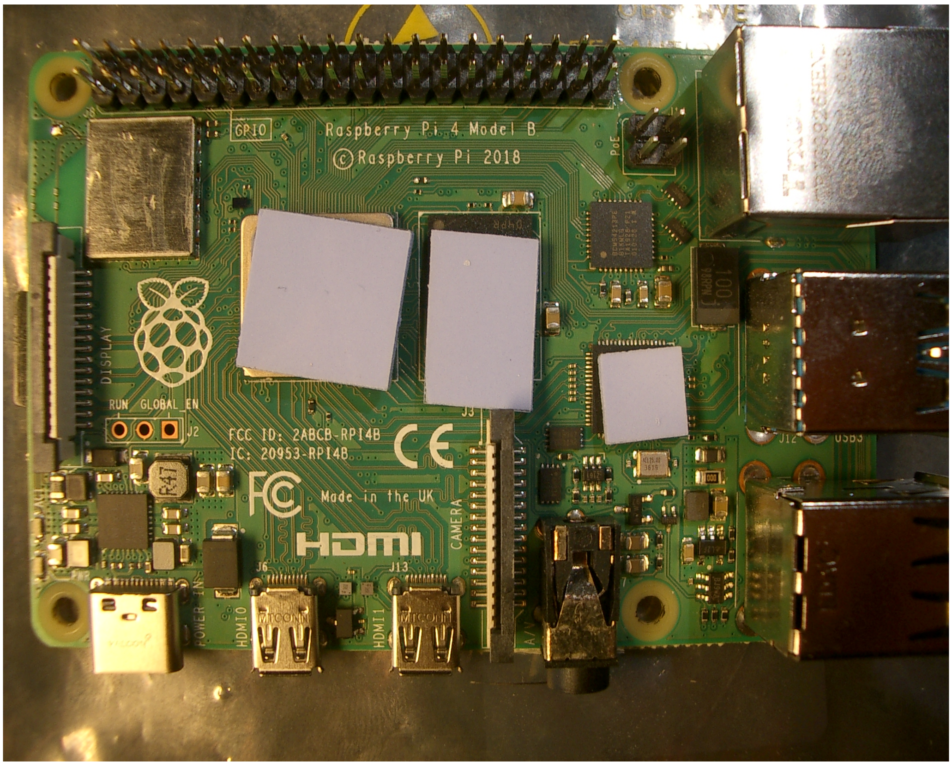

Figure 9: Placement of the thermal pads on the pi 4

Figure 10: 3 and 4 inch camera housing

7 Weather protected enclosures

We started out with the idea that weatherproof enclosures can be made out of short sewer pipe with inspection window. Our first attempts were based on 4” pipe and these assemblies ended up as unreasonably large. Althoug at that time we also intended to use battery power with the battery inside the housing. Later we obtained some 3” pipe with inspection windows and it seems like we will be able to fit the computer, the camera, and a power converter inside this pipe. Both the 4” and the unfinished 3” housing are shown in Figure 10.

7.1 Enclosure based on 4” sewer pipe

Is an older construction that has not been documented

7.2 Enclosure based on 3” sewer pipe

For this smaller enclosure we abandoned the idea of placing a battery inside. If battery power is to be used we will place the battery in another housing

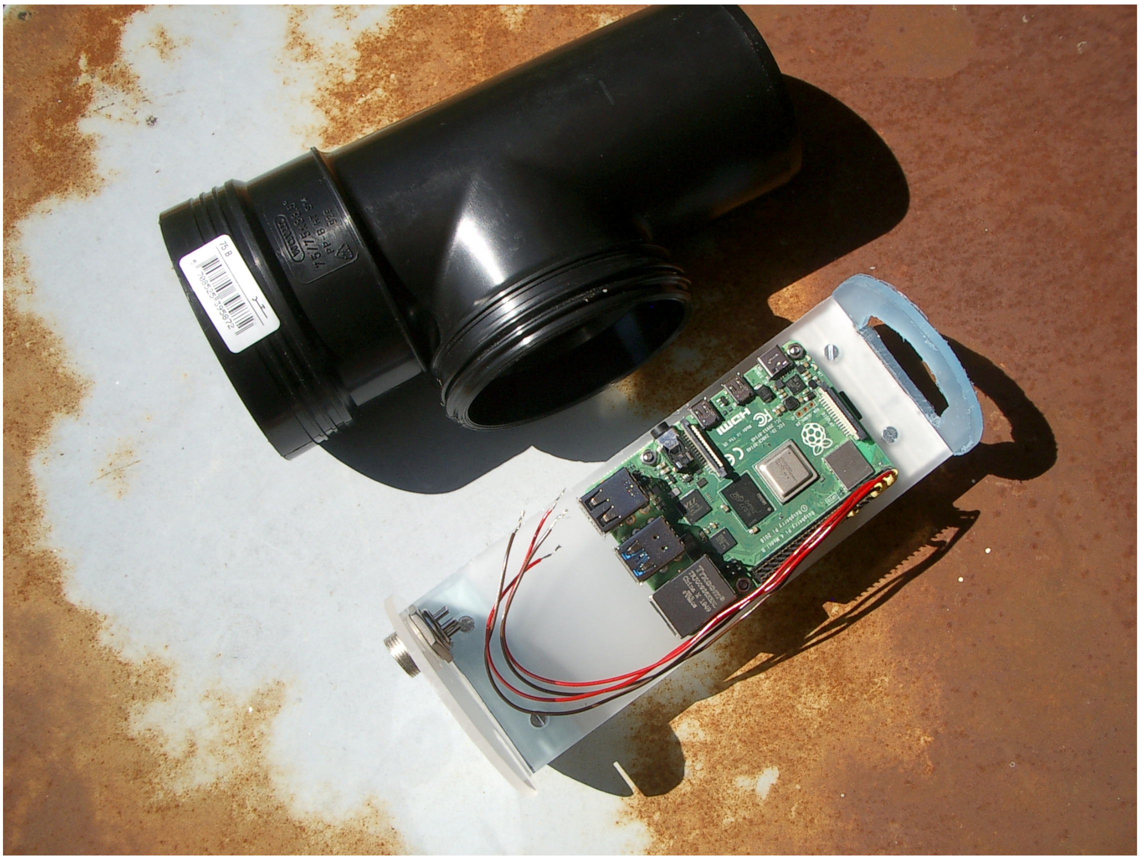

Figure 11: Insert for 3 inch camera housing, with PI 4

close by. Also the we do not have the space for heatsink and will use a more efficient voltage regulator for stepping down the 12 V delivery to the 5 V expected by SBC. The housing and the unfinished insert is shown in Figure 11. For connecting to the headers we use Female GPIO Hammer Headers, COM1105 from PIMORONI. These are intended for mounting into drilled PCBs, but we have found it easy to solder onto the pins as well. The unconnected leads from the header will be run through a hole in the Pi-plate and to the screw terminals of the step down voltage converter assembly. These leads are about 0.22 mm^2 built up from about 7 strands. We solder them to the header in lengths of 25 cm and later cut to correct length for reaching the voltage converter connection board. The feed-through holes in the Pi-plate has not been drilled in the image.

Figure 12 show the nearly finished insert for the 3 inch camera housing. The connection leads from the 5-pin connector to the voltage converter is 1 mm in diameter multistrand wire. Probably 0.75 mm^2 cross section. We solder these to the 5-pin connector in lenghts of 15 cm. The red black and yellow

Figure 12: Insert for 3 inch camera housing, nearly complete

Figure 13: Fully operational 3 inch camera housing

lead are the 12 V input, while the red lead may be used for supplying the Pi directly with 5 V. Once mounted we cut the leads to suitable length for reaching the input connectors of the voltage converter.

Warning:
The camera assembly is very close to the inside of the casing. In some cases the camera has been displaced during withdrawal of the SBC and camera holder assembly from the tubing. Be sure to avoid tilting the SBC holder in a way that the camera may hit the plastic tube.

At about july 2021 we started deplying the new 3 inch camera housings and Figure 13 shows one such camera mounted on the south-east corner of Leiv Eirikssons vei 9, overlooking the parking area.

8 Where to obtain parts

8.1 Computers and cameraes

Computers were bought from PIMORONI for the Rapsberry Pis and from FriendlyElec for ther NanoPis.

8.2 Aluminum and plastic sheets

Aluminum sheet from Norwegian Modellers up to 3 mm thick. Pexiplas from Biltema of thickness 3 mm as "PLEXIGLAS 300*300*3 OPAL" Biltema part number: 26-2113, price Kr 64.90.

Material for the window could be polycabonate that should be avaliable at Biltema in sheets of 1200 x 800 x 3 mm, at a price of Kr 369.00. "polykarbonatplater", Biltema part number: 26-2119 Another source for the window could be Elfa Distrelec. "PC TRANSPARENT 500X500X3 - Plate i polykarbonat, 500 mm, 1200 kg/m^2, 2300 N/mm^2, No Brand", Elfa part number: 148-21-652, available at Kr 218. The current windows for the 3" tubing has been cut out of 2 mm polycabonate. I believe I obtained a plate from Elfa Distrelec.

Also some corner protectors out of aluminum is handy for making construction details. Like angles for fixing the plates. We have used "Aluminiumsprofil til case og kasser", Art: 41-2683 from Clas Ohlson.

8.3 Bolts and nuts

Mosly we use M3 bolts that are avaliable at Clas Ohlson and Biltema at reasonable prices. The M 2.5 bolts used for the PI 4, heatsink case, and assembly base plate are available et Elfa Distrelec at Kr 62 / 100 pieces.

8.4 Sewer pipe with inspection window

Plastic waste water tubing either from Biltema and many others for the 4 inch variant. The 3 inch insperction door pipe was found at Vvskupp.no as: "75 MM WAFIX PP STAKERØR M/LOKK" at a price of kr 170 a piece. Vvskupp also provides a 50 mm pipe with inspection door, but I do not think this will be of any use. During a visit to MegaFlis I also found a 3 inch inspection door pipe.

The top of the pipe will have to waterproofed with some sort of cap. There were prviously rubber caps for sale at Biltema, but these seems not to be available anymore. For the 3 inch pipe a possible cap is found at Ebay:

"Fernco Schedule 40 3 in. Hub x 0 in. Dia. Hub Flexible PVC Cap" from the seller "pens_n_more" located in Hickory Hills, Illinois, United States. The unit price is $ 7.41, but freight and VAT must be added.

In the end I found that a similar, if not same, part could be purchased from Amazon.co.uk. **Flexseal (Fernco) REC76 EPDM Rubber Stop End Cap - 67-76mm, each 16.49**. The sale was arranged through Amazon and the seller was UnisealShop. Next time I tried to purcase this part through Amazon the purchase was cancelled by the seller and from that on the part was not deliverable to Norway. Still when searching eBay I found the part from the same seller and here shipping to Norway seemed to be possible. At this time I had resigned and found the alternative below.

As a last resort I loked elsewhere and found that "Englamark økologisk honning" as traded by the norwegian Coop was packaged in plastic cans that fit onto the sewer pipe. This relates to the 425 g can. The hony is good as well.

At 2021-07-18 I found out that UnisealShop had an eBay salse place. I found the Flexseal (Fernco) REC76 and ordered two of those. There were a lot of links to tracking, but I found that the results that seemed to be most reliable was to use the "order history" on my eBay. The package was sent through the "Global Shipping Program" that also handles cusoms clearance. estimated arraival was 28 of july to 02 of august and the package arrived at Fjellhamar Kiosk on wednesday 28 of july.

8.5 Connection wire

Internal wiring from the 5-pole connector to the voltage converter is abpout 0.75 mm^2 cross section. We cannot remember where we obtained this cable, but the "4160204 - Stranded Wire PVC 0.75 mm^2 Tinned Copper Red H07V-K 100m, Lapp", Distrelec Article Number: 301-80-493 will most likely do the trick.

The thin wire for running power from the voltage converter to the Pi-header is "3250 BK005 - Stranded Wire PVC 0.23 mm^2 Tinned Copper Black 3250 30.5m, Alpha Wire" We obtained this from Elfa Distrelec. The black version has Distrelec Article Number: 301-51-335.

8.6 Power connectors

The housing that takes a 12 V input uses a 5-pole panel plug that we obtained from Elfa as part number 300-20-642 with description "Panel Plug nickel-plated 5P M001-5". Brand: Tsay-E. As of 2020-06-17 they were still available, but no longer stocked. The price was Kr 12.40. The alternatives are much more expencive. More description: "Microphone connector with thread locking", "Fits most communication radios", "Panel hole: Diameter 16 mm".

We also found a part that looks exactly same at amazon.co.uk. The description is: "5 Pin Microphone Male Chassis Socket CB/Ham Radio". The price at Amazon was £ 2.79

The mating part for the power cable is "Female cable connector nickel-plated 5P M002-5", Elfa part 300-20-266, at NOK 9,36 (exc. VAT). Further decription is: "Microphone connector with thread locking", "Fits most communication radios", "Panel hole: ø 16 mm". Manufactorer: Tsay-E.

References

[Elfa] Elfa distrelec AS
https://www.elfadistrelec.no/

[Friendly] FriendlyElec, FriendlyARM
www.friendlyelec.com

[Kjell & Co.] Kjell & Company
https://www.kjell.com/no

[MJPEG streamer] Mjpg-streamer
WARNING: ABANDONED as 2018-02-18
https://sourceforge.net/projects/mjpg-streamer/

[OmniVision] OmniVision

[PuTTY] PuTTY
www.putty.org

[Raspberry PI] The Raspberry Pi Foundation
www.raspberrypi.org

[ST] STMicroelectonics
http://www.st.com