Report on an amp-off mod for a Mintron 12V-C-Ex

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Disclaimer
This report describes the steps I made for the amp-off modification. It can be used as guidance, but only at your own full risk!

Introduction

This report describes the subsequent steps I have undertaken to make an amp-off modification on the Mintron 12V-C-Ex. It gives also the points of attention and difficulties I encountered. I build the circuit into the Mintron and using the 12V power supply at the Mintron. So no additional batteries are needed. Only the switch for amp-off/on is located outside the Mintron (see image 1).

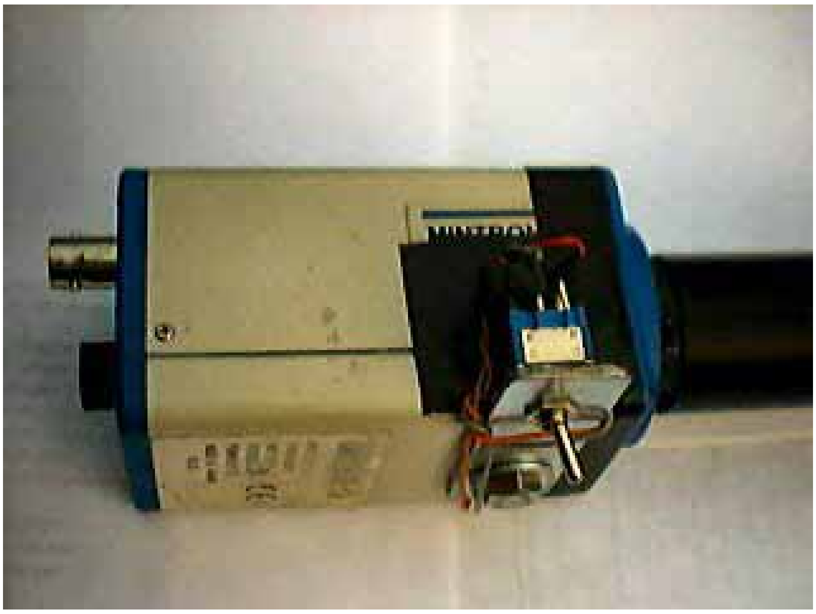


Image 1 Modified Mintron (the orange and grey wires are used for my light-on modification)

I copied the circuit that was designed by Dan Otlowski (I recommend strongly to read his document as well on the amp-off mod for background and additional information in the document :
XMinron_Amp_Off.pdf at:
http://groups.yahoo.com/group/videoastro/files/Amp%20Off%20Mods/

During the modification Dan assisted me through email, for which I am very grateful. He could supply me of additional information and hints, which are incorporated this document.

Most difficult steps

I found the following steps the most difficult in the amp-off mod:

- soldering the wires from the amp-off circuit to the timing circuit at the Mintron (see the image in the Otlowski document). There is a very tiny capacitor to which a wire needs to be soldered. There is a potential danger of damaging the capacitor or short-circuit the capacitor by too much solder. Also soldering the other wire to pin 19 at the Mintron board was hard, as I could not make a good soldering connection at first. I needed a fixed high magnifying lens in order to see what and where I was soldering. Also I needed to file my soldering iron to a sharp and tiny tip.
- cutting pin 9 of the CCD.
  I did this with a tiny jigsaw blade. That went really easy until the very last stroke. During cutting through the last piece of metal one tooth of the jigsaw got stuck behind the pin and with the last stroke I almost broke off the pin. It bent a little bit, but I did not bend it back in order not to break it off. So I think cutting with a jigsaw blade is easy until the very last piece of metal left. Next time I would cut off the very last part by other means.

The circuit

As earlier stated I copied the circuit from Dan Otlowski. Dan Otlowski used a 4 x 1.5V = 6V battery power supply for the circuit. Instead I used a 12V-to-5V-power regulator, so I could use the 12V power supply to the camera. Furthermore Dan Otlowski added some dipswitches to test with different zener diodes. I made the circuit with only one zener diode and one switch.

The circuit is given in appendix I.

The electronic components

For the circuit the following components are needed:

<u>Wires (thin)</u>

I used wires with a diameter of about 1 mm (including insulation). For the wire connecting to Pin 9 I needed a wire with an even smaller diameter in order to feed the wire through the tiny hole in the CCD printed circuit. For the Pin 9 wire I used one of the tiny wires in a telephone cable.

<u>Resistors</u>

Quality: 1% or 5%

1 x 5 kΩ (R1)

2 x 47 kΩ (R2 and R3)

Linear trim pot's: 2 x 2 MΩ (R7 and R8)

1 x 1,5 MΩ (R4)
1 x 500 kΩ (R5)
1 x 500 Ω (R6)

Capacitors

Quality: non-polarized hi-quality, dipped types
1 x 0,68 µF (C2)
4 x 0,1 µF (C3, C5, C6 and C7)
1 x 0,22 µF (C4)

Quality: electrolyte
1 x 1µF (C1)

IC's

1 x 6N137 (Input – opto IC1)
1 x LMC555CN (Delay timer IC2)
1 x LM555CN (Pulse duration IC3)
1 x 4N35 (Output opto IC4)

4 x corresponding IC-sockets

Other items

- 1 x 7805 (12V to 5V Power regulator 1 A, IC5).
- *Note: The circuit draws about 20 mA. I tried to use one with smaller rating, but that one exploded.*

- 1 x 1N5237 (8,2V Zener diode)

- 1 x high quality switch single poled or double poled.

I used a double-poled switch, as I wanted to switch off the 12V power supply to the circuit during amp-on. But now I don't think it is really necessary to switch of the 12V. I am now considering implementing a relay to switch amp-on/off. With this relay the length of the wires inside the Mintron can be kept short.

- 1 x breadboard

- a test LED any colour with a limiting resistor (600 Ω.). I bought a red LED with an additional limiting resistor of 10 k Ω (or 100 k Ω), which I used to replace the green led and limiting resistor at the back of the Mintron camera (see details at the end of this document).

Physical layout of the circuit and location in the Mintron

Size

As I wanted to implement the circuit inside the Mintron, I had to place the components on a breadboard with a size of almost 4 x 4 cm (1,6 “ x 1,6 “).

Physical layout of the components

The physical layout of the components and connections is shown in appendix II. For the wiring of the components at the other side of the circuit board, I used the mirror image.

Soldering and testing of connections

After soldering all the components (the zener not yet soldered and the IC’s not yet placed in their sockets!) I tested with an Ohmmeter if all connections were made according to the circuit diagram in appendix I, and if there were no false short-circuited connections.

Location in the Mintron

I wanted to place the switch for amp-on/off on the location of the auto-iris plug. This plug can be removed without any problem. After building and testing the circuit I placed the circuit inside the Mintron and I came to the discovery that the switch did not fit in the Mintron anymore. Also the screw nut inside the metal casing did not fit in the hole in the support structure. So the circuit had to be placed rather at the rear end of the camera. For this purpose I had to turn the remote control printed circuit 180 degree, so I could use one of the free screw holes. I attached the breadboard to the Mintron by means of the metal strip and hole of the 5V power regulator (see image 2).

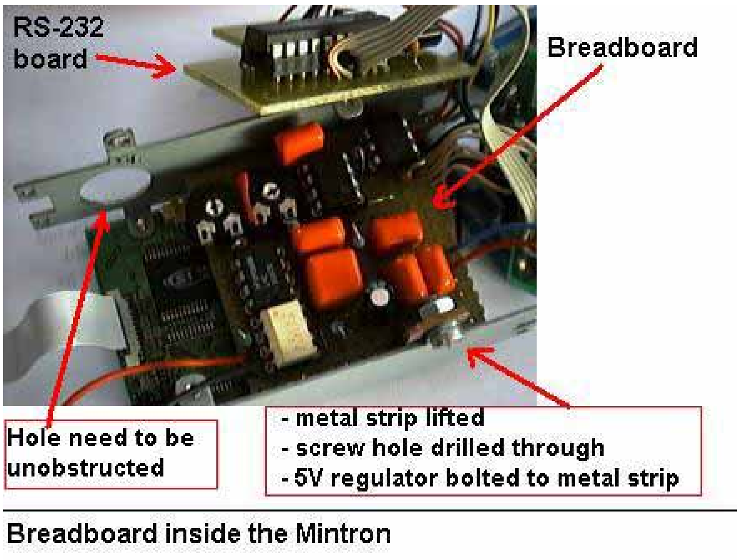


Image 2 Breadboard mounted inside the Mintron

After this construction the switch still did not fit in the former auto-iris plughole. So I attached it otherwise (see image 1 at the first page).

Note: In the case of modification of a new camera I would rethink/reconstruct the layout, so that I don't have to rotate the RS-232 board and could place the switch at the location of the auto-iris plug.

Testing the circuit

Testing of the circuit was done in the following described order.

Checking connections

Before any other tests I retested the connection wiring according to the circuit diagram in appendix I (IC's not yet placed in their sockets!).

Voltage regulator

First I tested the voltage regulator by applying 12V and checking for 5V output voltage.

Timers

Checking delay time

For the correct delay time I checked the refresh rate of the Mintron at Sense x128. For this purpose I put the Mintron in full darkness, set the Sense at x128 and waited the amp-glow to appear. After looking at the screen and waiting after the refreshing occurred roughly every 2-3 seconds I started to count the number of refreshings during 2 minutes and redoing this several times. For my camera (a CCIR/PAL) I counted 46 to 47 refreshings per 2 minutes. So the refresh rate is 2,61 to 2,55 seconds. According to Dan Otlowski the refresh rate for an EIA/NTSC camera is around 2,1 seconds.

The pulse width timer will be set at about 400 ms. As the amplifier must be on some time before read-out, a value of about 200 ms is reasonable. So I came to a delay time of 2,55 – 0,2 (200 ms) = 2,35 seconds (for a EIA camera this value is around 1,9 seconds).

Delay timer LMC555CN

I first placed the delay timer in its socket (power supply off!!).

An oscilloscope was attached to test point 2 at (pin 3 of the delay timer). I generated a pulse by applying just simply a digital voltmeter to test point 1 (pin 2 of the delay timer) and the other pin of the voltmeter connected to ground. After some trial and error I managed to time the delay and set it to 2,4 s +/- 50 ms with the trim pot R7.

Pulse width timer LM555CN

After placing the LM555CN IC in its socket (power supply off) I attached the oscilloscope at test point 3 (pin 3 of the pulse width timer). After fiddling with the timing and triggering level of the oscilloscope I was able to measure the pulse width (after a delay of 2,4 seconds). The input pulse was generated in the same way and at the same point as described at the delay timer. The pulse width was set at 400 ms +/- 20 ms with R8.

Opto-couplers

Input opto 6N137

Next I tested the input opto by leaving the oscilloscope at test point 3 and applying 12 V to the input of the opto-coupler (intermittent and manually). +12V was connected to the red wire, which is connected to the 5K resistor at pin 2 of 6N137 (the 5k resistor must be present) and ground to the black wire (pin 3 of 6N137). Every time I applied a short +12V I saw the oscilloscope showing the short pulse.

Output opto 4N35

The output opto was connected with a red LED with limiting resistor to pin 5 (in such a direction that it would give light) and pin 4 to ground. Next I connected permanently 12 V to the LED. The LED was off in this case.

Then I applied 12 V again to red wire of the input opto. Now the red LED lighted ~ 2,5 seconds later.

The last step was to add the zener diode. After adding the zener, I redid the last test and it showed that the LED was constantly burning at a low light level, but after adding a pulse at the input opto the LED burned at a higher light level during the 400 ms pulse, as it should.

These tests confirmed that the circuit was working well.

Connecting the circuit to the Mintron

Cutting pin 9 of the CCD.

First I studied carefully the images of Dan Otlowski (see his document) in order to locate the correct pin on the CCD to be cut. I checked, checked and rechecked to confirm myself that I had the correct pin.

The cutting I did with a tiny jigsaw blade. That went really easy until the very last stroke. Only I had to take care not to damage the printed circuit board underneath the CCD. During cutting through the last piece of metal one tooth of the jigsaw got stuck behind the pin and with the last stroke I almost broke off the pin. It bent a little bit, but I did not bend it back in order not to break it off. So I think cutting with a jigsaw blade is easy until the very last piece of metal left. Next time I would cut off the very last part by other means.

Soldering

As earlier described this is the most difficult part of the modification. Soldering the two wires (black and red from the input opto) to the timing circuit at the Mintron are the most difficult ones. Soldering the two others to Pin 9 points of the CCD is easy. Refer to the Dan Otlowski document images to see where exactly the wires have to be connected.

Soldering iron

I used a small soldering iron of which I filed the tip to a long sharp point and then filed under an angle of about 45 degree a small flat part at the tip for the solder (just filing with one or two strokes to make this flat part at the tip).

Magnifying lens

I needed a high magnifying lens in order to see where I was soldering. I used a 50 mm camera lens and made a temporary construction to have the lens in a fixed position and my hands free. I needed also enough daylight and some additional artificial light.

Fixation/securing the wires

I found it rather important to secure each individual wire immediate after soldering. At first I secured the wires with insulation tape, but it showed that this is far too unstable. The two wires broke off after one day after manipulating with the printed circuit CCD board. The wires exerted quite some of strain on the components. I discovered that the tiny capacitor to which the red wire was connected was quite loose and I feared that it was broken. Luckily it turned out not to be the case. After considering several methods I found that using cyanoacrylic glue (2-seond glue) is easy, dries quickly and can withstand strain within a few minutes.

Connection to the timing circuit of the Mintron

The red wire from the opto input IC is connected to the tiny capacitor. There is a potential danger of damaging the capacitor or short-circuit the capacitor by too much solder. I found the best way to proceed was as follows: presoldering the red wire, cutting the soldered end to a small end, making a bend in the wire, positioning it exactly on top of the capacitor and pre-aligning the rest of the wire on the CCD board, so that I could secure the wire immediately with glue after soldering.

Soldering was done quick and short by pressing the soldering iron against the wire, which is on top of the capacitor until the solder is liquid.

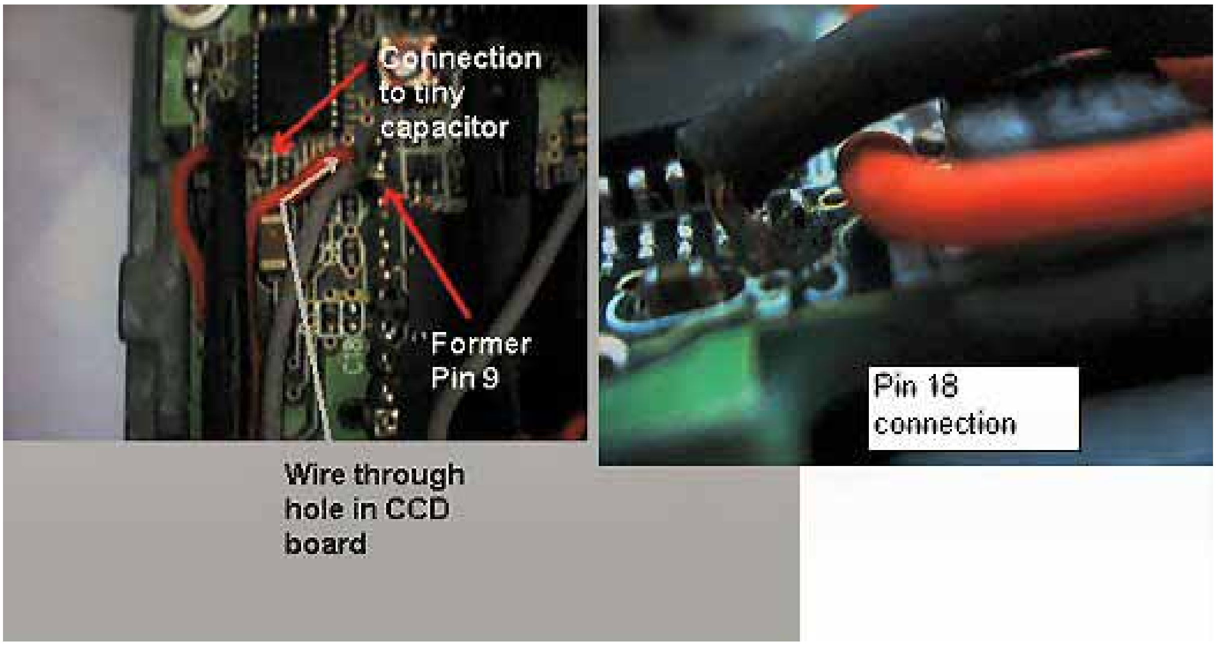


Image 3 Wiring connections at the CCD board

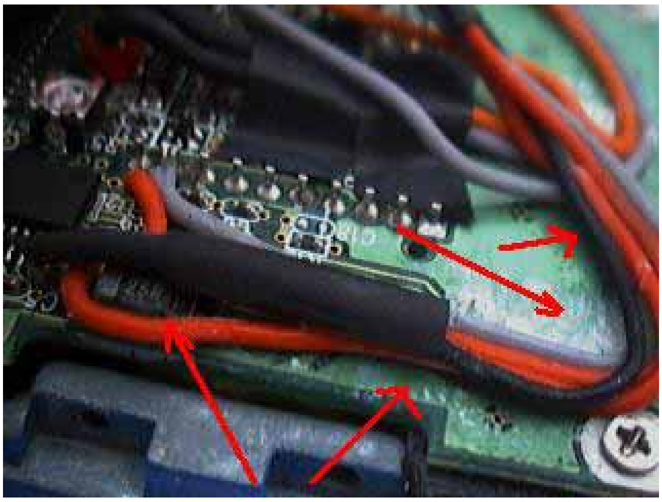


Image 4 Glue points at the CCD board

The black wire from the opto input IC is connected to a connection point on the CCD board. I had troubles getting this point soldered. After numerous attempts I found the following solution: taking out some individual twisted strings from the wire leaving three to four individual strings, soldering the end of these strings and adding a little bit of soldering resin to the soldered end of the wire. The amount of soldering resin should really be minimal in order not to have the circuit board flooded with solder.

Soldering to the pin 9 connection points

At the Dan Otlowski images can be seen to which points the connection should be made. The tiny and small wire connecting to pin 9 of the CCD can be put through the hole in the CCD board.

Soldering to the 12V power supply

At the printed circuit board at the rear end of the camera there are a few points to which the 12V connection and grounding can be made. I checked the 12V connector and the points rear-end board with an ohmmeter.

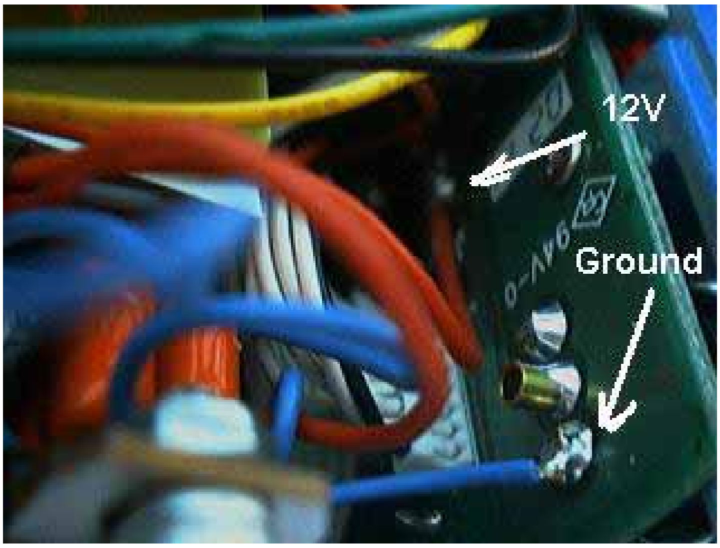


Image 5 Connection points for 12V and grounding

Testing

After the soldering the most exiting moment started. Covering the camera with a thick black cloth and applying 12V I waited until the amp-glow started (with the switch in amp-on mode). After the screen refreshings decreased to about 3 seconds and were stable I pulled the switch. Then nothing happened! It took about 5 seconds until the screen popped “live” with virtually no amp-glow! Only the warm and hot pixels were visible as a starry night sky (it was quite warm weather during testing). Then I said, “YES!” it works! Thanks to Dan Otlowski!

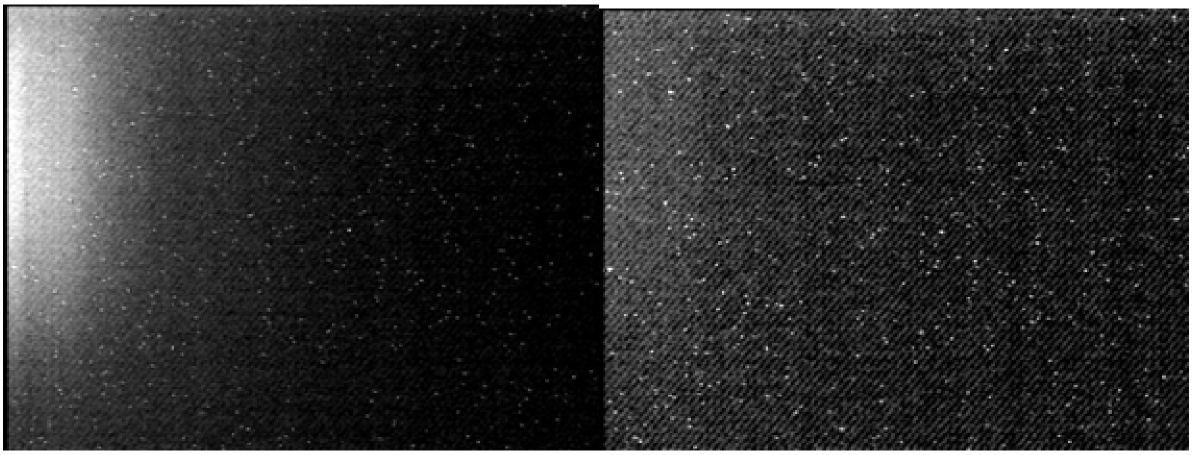


Image 6 Full darkness amp-on (left) and amp-off (right): everything is working!

Final mounting of the mod circuit board

The mod circuit was mounted into the Mintron. I needed to rotate the RS-232 board 180 horizontally degrees before mounting. As insulation between the bottom-side of the RS-232 board and the top of the mod circuit board, I cut a piece of plastic sheet and placed it just under the RS-232 and attached it with the same screws as for the RS-232 board.

I closed the Mintron carefully and attached the switch. Then I redid a test and saw on the screen steady diagonal lines! The lines are also already visible in the previous image.

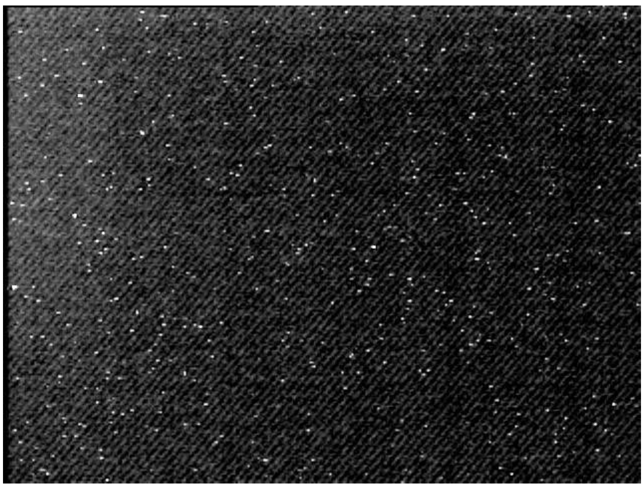


Image 7 Amp-off and showing diagonal lines

After opening the Mintron and checking with an oscilloscope at the several test points I could not find the culprit! Then I simply rearranged the wires connecting the CCD-board to the mod circuit board inside the Mintron slightly. And gone were the diagonal lines with amp-on and amp-off. Apparently there was some signal pick-up.

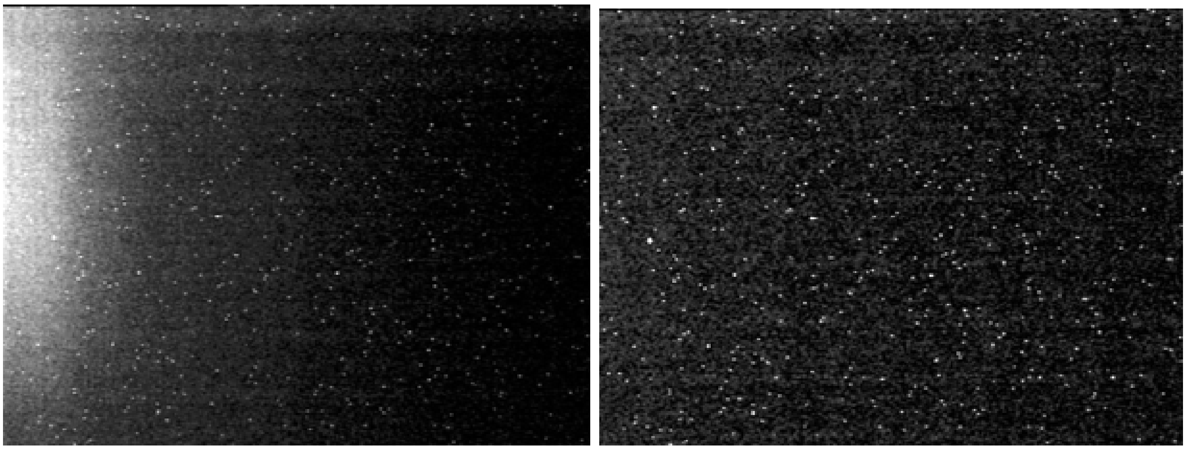


Image 8 Amp-on and amp-off after rearranging the wires: No more diagonal lines!

Specific other issues I experienced

Guarantee

It should be obvious that making modifications to the Mintron will cancel any warranties.

Soldering

I found soldering the wires of the amp-off circuit to the Mintron the most difficult part (see the chapter with difficulties). Also fixation/securing of the wires to the board is a point of serious concern and should not be underestimated.

Switch

I changed amp-off/on switches four (!) times. I now have a high quality switch which works perfect. All the other mini-switches were poor of construction. Pushing side wards against the lever of the switch gave already interruptions of the read-out and noise on the TV-screen.

Assembling / flat cable

I have disassembled the Mintron quite a number of times for other modifications. I removed the flat cable every time from the connector. The end result now is that the connectors don't grip on the flat cable tight enough anymore, with the result of a "dead" Mintron. After numerous attempts to put the cable in its place again, I have got the Mintron working again, although the shutter function does not work anymore (I cannot use the Mintron anymore during high light levels). So my advice is to remove the flat cable only when really, really necessary.

Time

I took ample of time to finish this project. It took me about one day designing the physical layout of the circuit board. About two evenings of soldering the components to board. Testing the circuit wiring and the timers about one day. Cutting the CCD and soldering the wires to the Mintron one day. Soldering the circuit to the Mintron two wires took me FOUR hours (!). Redoing this again (after breaking off the wires) about THREE hours. It takes time to make the soldering iron OK.

Changing the green LED

During the soldering to the 12V power supply connection, I also changed the green LED by a red LED and a more limiting resistor (for me a 10 kΩ resistor was sufficient to bring the light level down. Others on the Internet make use of a 100 kΩ resistor for lower light levels). During exchanging the LED it is of course important to check polarity of the LED.

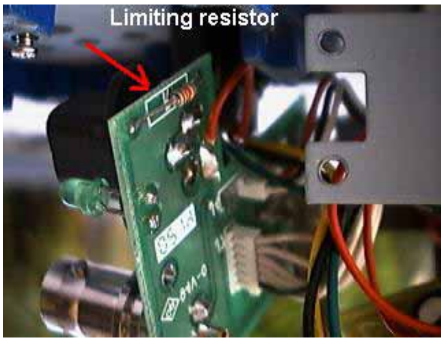
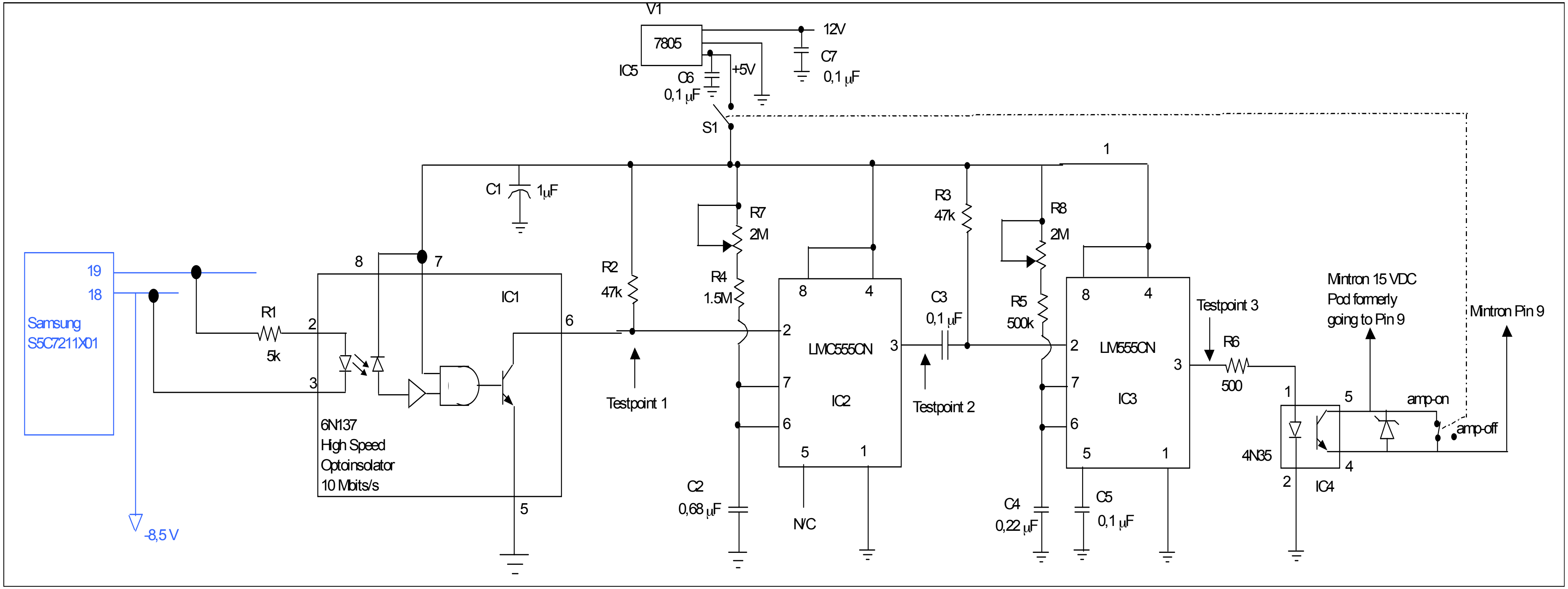


Image 9 Location of the LED and limiting resistor

APPENDIX I CIRCUIT DIAGRAM (ORIGINAL DESIGN BY DAN OTLOWSKI)



APPENDIX II PHYSICAL LAYOUT OF THE CIRCUIT AND COMPONENTS (TOP VIEW)