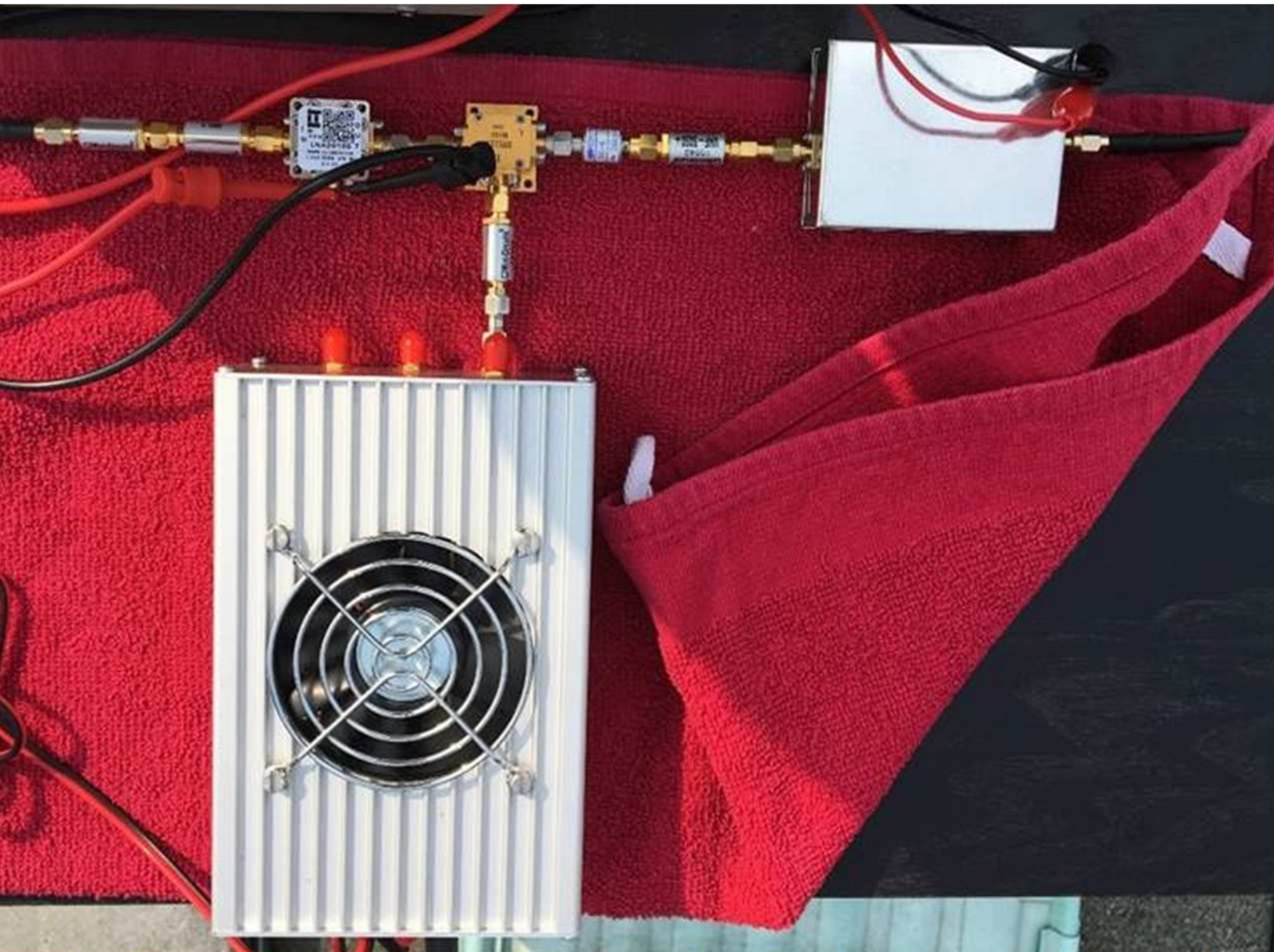




# DE KUNSTMAAN

September 2020 – 47e jaargang nr. 3

Uitgave van de Werkgroep Kunstmanen



In dit nummer o.a.  
Sweeper voor 8GHz met logaritmische detector  
Meteosat zonder antenne  
Etsen van printplaten  
en nog veel meer

Dear member,

This pdf contains translated articles of our Dutch magazine “De Kunstmaan”.

Translation for each article is normally done by the author, using Google Translate (and manual corrections afterwards). But for sure these translations are not perfect! If something isn't clear please let us know.

Formatting is not as perfect as the paper magazine, but figures are all added.

Internet links mentioned in the articles can be found at our website; see under menu 'Weblinks' at: [www.kunstmanen.net](http://www.kunstmanen.net)

Older magazines, from 2014 to 2018, are now also available in English; see menu “De Kunstmaan”, “Archief”.

I hope these translations will help you to understand the Dutch articles.

Rob Alblas  
werkgroep Kunstmanen  
[kunstmanen@alblas.demon.nl](mailto:kunstmanen@alblas.demon.nl)

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Photo front page:

Downconverter of Fred Jansen for receiving at 8GHz X-band. Next time more about this.

## **Preface**

### **Online meetings**

Last September 12 we had a digital meeting / ALV for a second time . That with software , such as eg. Please , can hold a remote meeting is fantastic. Five years ago this was unthinkable. Now that we have had a digital meeting twice , I want to share some findings. I would also like to hear your findings!

#### *Benefits*

The sound quality for presentations is much better than with the Nimeto. The blinds do not have to go down and you are not staring at a poorly visible screen. Showing your crafts goes very well with the video camera. You can record the presentation and play it later.

For some members it saves an incredible amount of travel time. For example, if you come from the far north or the south / Belgium, it will take you two hours and you also have to return.

You don't have to pay a parking fee if you couldn't find free parking. Furthermore, you have no fuel costs.

Members who cannot attend, for example because they are abroad or have difficulty walking, can now still attend the meeting.

#### *Cons*

The most important drawback is that small group or 1-on-1 conversations are not possible. Looking at a printout or a schedule together and talking about it is impossible . We remain people and want to keep meeting each other.

You must have a computer with sound and a camera , not everyone has this. There are also cases where Zoom, or other conferencing software, does not work. By the way, if you have a computer with sound only, you can of course only listen and watch!

It is sometimes a hassle. If you don't do this every day, it can be tricky. But for members concerned with receiving weather satellites, it should be a piece of cake.

#### *Ask*

Which program should we use for the digital meetings? We have now used Zoom twice. You sometimes read stories that online meetings are unsafe, but with a number of precautions (which we take) it is easy to oversee. We do not have the ability to review and test all conferencing software . We are a working group for the reception of weather satellites!

With more than 17 million virologists in the Netherlands, it is difficult to predict how our November meeting will take place. If the corona misery continues, perhaps we should include a manual in the Kunstmaan.

## 8 GHz

Fred Jansen gave a very nice presentation about 8 GHz reception. With a 150cm mesh dish it is possible to receive a picture from the Aqua satellite . If SDR-receiver , the is LimeSDR used. Now it is important to optimize everything. Nice that the beginning is here. Add n we had started QPSK it first only in software and now we can (with the latest version of WSAT ) real-time in receiving color! An extensive article will be published in the next Kunstmaan.



*Detailed view of the AQUA satellite*

## Mini-Circuits at Mouser

Ordering from Mini-Circuits always gave you the feeling that you were working on an important project. For example, you had to declare that the parts are not used in nuclear weapons or cruise missiles and indicate where the parts are located. In addition, you got a delivery time of 3 weeks and a minimum order cost of 20 Euro.

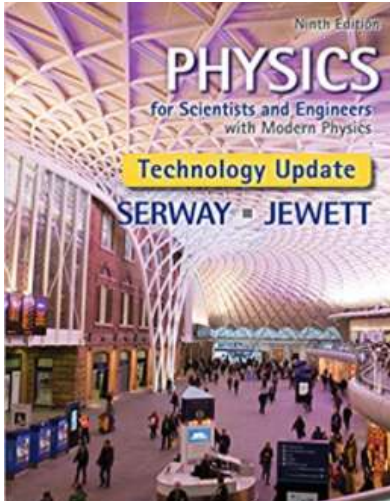


Now Mini-Circuits is available from Mouser . This summer it was not delivered to the Netherlands, but now it seems that they it do so. I haven't tried it yet .

Then they might have listened to my evaluation of the free samples: or I request free samples or I buy them from Mouser ....

## Physics

For a more robust re foundation for my electronics knowledge to explain I'm picking my physics knowledge. What could be better than such an American textbook with many pictures. The book I had in mind costs 170 Euro new. But at Bookmatch , a second-hand marketplace for study books, available for 35 Euro! After receiving the book, one drawback became clear: the book weighs 3.5 kg. So no light food. Our librarian Paul continues to write about this.



*3.5 kg reading pleasure*

## The Kunstmaan

Ger has written a nice article about the Raspberry Pi with which he retrieves images from the Meteosat via FTP and makes animations with it. We have to do more with the Raspberry Pi!

The report of the digital meeting is from Rob and Paul has searched the UKWberichte and written a nice UdB for those who want to know more about physics.

Rob in xrit2pic support hdf5 file format created .

I wrote an article about how to sweep an 8-GHz filter with easily available modules. My other article is about lighting and etching prints, but very differently. PCB etching by myself is necessary again since I have some RF printing material lying around.

Enjoy reading this Kunstmaan and hopefully just maybe we can together in November in living n see firsthand.

## **Sweeper for the 8 GHz with logarithmic detector**

### **Preface**

For example, when sweeping filters a spectrum analyzer (SA) having tracking generator (TG), a useful tool. My DSA815 goes up to 1500 MHz and with the band converter [1] it goes up to 2 GHz. Nowadays all affordable SAs of Siglent obtainable that hacked can measure up to 3.2 GHz. The higher the frequency, the more expensive the models. A good guideline is 1000 Euro per GHz.

Also in the corner of vector network analyzer s (VNA) are much developments. The NanoVNA version 2, for example, goes up to 3 GHz and costs only 60 Euro [2] .

Nice, but what if you want to measure up to 9 GHz? An SA with TG is very useful for sweeping filters , but we are not interested in the spectrum. A VNA with which you can measure the phase, and thus determine whether your DUT is inductive or capacitive, is not necessary.

That is why I looked to buy / make a signal generator that, in combination with a logarithmic detector, can measure the passage curve of a filter.

### **The intended setup**

My starting point was to work with ready-to-use modules. The necessary parts are so small that DIY is very difficult.

As a signal generator I use the ADF5355. There are not that many alternatives, which are also cheaper. The ADF5355 goes up to 13.6 GHz, which is sufficient for our purpose. On Amazon or eBay you still spend about 100 Euro for a small development print.

The detector also comes from Analog Devices (AD) and is the AD8317 which can measure up to 10 GHz and costs around 20 Euro. The detector provides an analog voltage that goes to the microcontroller with ADC.



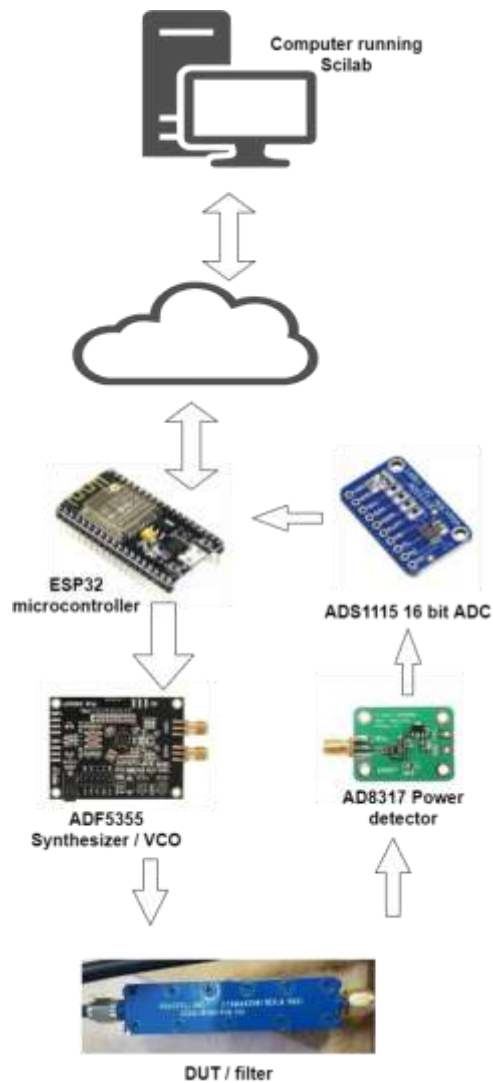


Fig 1 Block diagram of the different parts

### Microcontroller

To control the ADF5355 and the AD8317 I use the ESP8266 that supports WiFi and can be programmed from an Arduino environment .

### Software

I could have programmed everything in the ESP8266. But this has its limitations. It is difficult to save measurement results, make graphs, etc. That is why I have chosen to control / read out the ESP8266 only the ADF5355 and the AD8317 and do the rest in a Scilab program .

### The ADF5355



The ADF5355 has a VCO running from 3400 to 6800 MHz. The frequency on the RFout-A output can be reduced to 54 MHz by means of dividers. On the RFout-B output state the VCO-signal after a doubler. This output has a signal that can run from 6.8 to 13.6 GHz. Want eg oorbeeld a range of 2 to 10 GHz sweep you should combine both outputs. Incidentally, no SMA connector is soldered to RFout-B on the development PCB, you still have to do this.

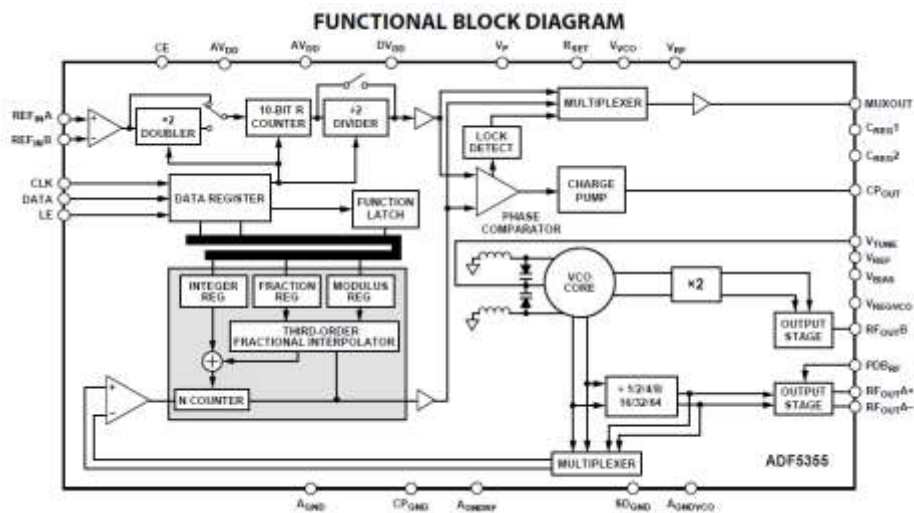


Figure 1,

Fig 2 Functional block diagram of the ADF5355

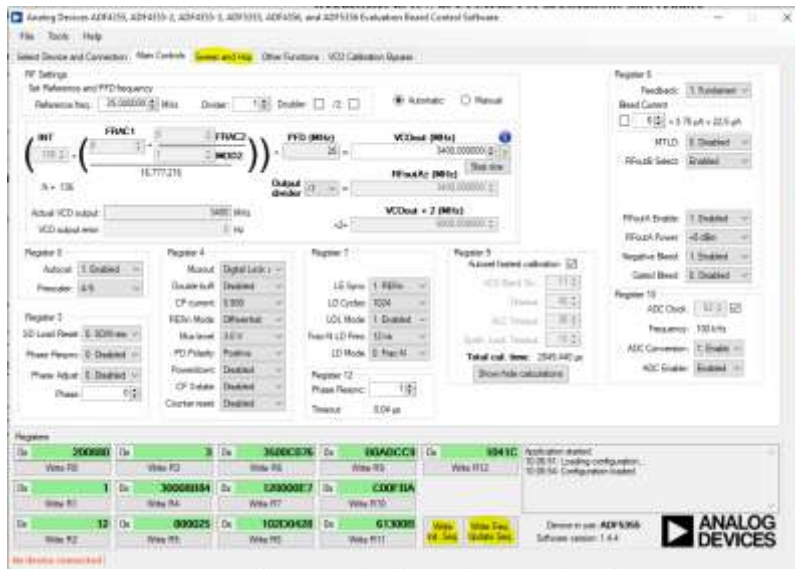


Fig 3 The development PCB of the ADF5355

Connecting the ADF5355 to the ESP8266 is similar to what I had already selected for the ADF4351 [ 3 ]. The CY7C68013A module from eBay can also be used to simulate the development board of AD. In AD's software comes a warning that the CY7C68013A cannot be used, you can ignore this, it just works.

Software from Analog Devices was the starting point for the sweeper [4]. In this software you can also measure sweeping and power (if you have a power meter with a GPIB connection).

My first test was a sweep that used a frequency meter and 2000 divider to see if the ADF5355 worked.



*Fig 4 AD software settings for the 6800 MHz. By pressing the buttons with "Write ..." you can see which data is sent to the ADF5355. You can set the sweeping on a separate tab .*

The print needs 6V and does consume some power, the ADF5355 gets hot. Maybe I'll stick a little heat sink on this. I closed the unused **RFout-A** outputs with 50-Ohm terminators.

## Detector AD8317

This logarithmic detector has a range of 1 MHz to 10 GHz, with a dynamic range of 55dB (this applies up to 8 GHz).

In itself this is not an exciting part. The power is converted to a voltage between 0 and 1.75 V. The voltage stabilizer is a 78L05, supply voltage of around 8V.

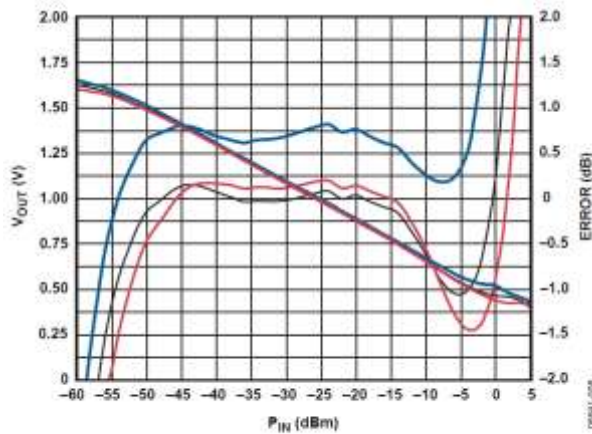


Figure 8.  $V_{OUT}$  and Log Conformance vs. Input Amplitude at 8.0 GHz,  $R_{TADJ}$  = Open, Error Calculated from  $P_{IN} = -34$  dBm to  $P_{IN} = -16$  dBm

Fig 5 Output voltage and error . Between -50 and -15 dBm the error is around 0dB. The output voltage then varies between 1.5 and 0.75V.



Fig 6 PCB of the AD8317

With the ADS1115, which is a 16 bit 4-channel ADC that is connected to the ESP8266 via I2C , the output voltage of the AD8317 is converted to a digital signal. Incidentally, the ESP8266 also has a single channel 10-bit ADC. Due to the lower resolution, I have decided not to use it.

### Microcontroller

At first I thought of the ATmega328 / Arduino to control the whole thing. My biggest problem was the USB interface you need to communicate with the PC. Both Arduino and Scilab have simple serial communication. You will have to do a lot of programming to get this right.

I had already done wireless experiments with the ESP8266 and this in itself was very simple. So why not try this?

### ESP8266

The ESP8266 is a microcontroller with WiFi and a full TCP / IP stack, so it talks "internet". It is a Chinese chip from Espressif Systems.



## Software

The software used can be divided into two parts: the program in the ESP8266 and the Scilab program.

Message traffic is via JSON, short for JavaScript Object Notation . JSON is widely used to request data from the web browser and then get it back in JSON format.

Below is a very simple example of a JSON message:

```
{  
  "sensor": "gps",  
  "time": 1351824120,  
  "data": [  
    48.756080,  
    2.302038  
  ]  
}
```

Both Scilab and Arduino support JSON and this makes the programs a lot simpler. For the Arduino, a very good library is ArduinoJSON . The author of this has also written a very good book [6].

## Program for the ESP8266

The total program is 150 lines. I will further explain some points below.

WifiServer , lines 22-24

The ESP8266 will behave like a web server in the network . You send a request to it and you get an answer.

In your home network you must use an IP number that is free.

Connecting to the server, lines 61-73

In the setup routine, the server boots up and tries to connect to the network.

Reinforcement of the ADS1115, line 85

The ADS1115 contains Programmable Gain Amplifiers (PGA). With these PGAs you can set the measuring range between  $\pm 256\text{mV}$  and  $\pm 6.144$ .

Waiting for a Client connection, lines 90-100

You then enter the main loop where you first wait for a connection to a client

Skipping the HTTP header, lines 102-107

Every JSON message has so-called HTTP headers. We do not need these and are skipped here.

Create a JSON data object, lines 110-116

The JSON message is a text stream and have a data structure converted so this via which it can access / query program.

Read out all values and send them to the ADF5355, lines 118-125

With the command "JsonPair" all "key-value" combinations are retrieved. The key here is the registry code and the value to which the register should be written. In a for loop is sent to the ADF5355. The order in the JSON message is also the order in which it is written. By the way, nothing is done with the key value here.

The subroutine "sendCommand", lines 28-49 sends the bits out one-by-one, this is the so-called bit-banging.

Reading the ADC, lines 127-129

On line 129 the ADC is read and put in the 16-bit variable adc0. The 5 mS delay was necessary because otherwise the ADF5355 would not have finished the frequency change.

The answer, lines 131-133

The response is also a JSON message and has the following format:

```
{"ADC0: 1452"}
```

Sending the message, lines 139-145

Here you see the structure of an HTTP header. The JSON message is sent on line 145.

## **Scilab**

So much for the program in the ESP8266, it is fairly simple in design, the real work is done in Scilab.

Fixed data, lines 3-11

In the Sweeprange you indicate the range of the VCO. The VCO runs from 3400 to 6800 MHz. On line 6, we show that we doubler using the ADF5355.

In the processing we can use a reference file, this is for a baseline measurement. You connect the ADF5355 directly to the AD8317 and you take a measurement. We subtract the values from this from the measurement results of the filter measurement. That way we only get to see the characteristics of the filter.

SWEEPDATA, line 15

The data is stored in the SWEEPDATA matrix:

1st column: frequency

2nd column: reference value

3rd column: the measurement, not corrected for reference file

Opening the reference file, lines 17-27

It is checked whether the reference file exists , if so , it is read.

Calculation of the INT value for the ADF5355

Here I am following the datasheet from the ADF5355, page 16. In this sweeper, I do nothing with the FRAC, MOD and R. This means that the step size we use to go through the sweep range must be a multiple of the reference frequency (in our case 25 MHz .

ADF5355 data object, lines 37-50



Here is a data object created, this involves the ADF5355 initialization. The values literally come from the AD software. The hex2dec function converts the decimal value to a number. In the ESP8266 we also need a number.

Send to the ESP8266, line 51

With one command you send the data to the ESP8266.

Performing the sweep , lines 53-64

In line 54 the INT is calculated for the selected frequency.

In line 57 the object is emptied because otherwise we will throw all registers back over the line. This is allowed, but is not necessary.

See page 22 of the datasheet how to put the value INT in Register0, line 58.

The answer will be in the struct return\_message.

Write data, line 66

SWEEPDATA is written to disk as a CSV file.

Beginning of the chart, lines 68-69

We make the graph by opening the CSV file and using it to do the calculations. So I could develop graphics without constant measurements homestead n do.

Calculation of dB, line 71

The reference value is subtracted from the reading and divided by 22. This should give the attenuation in dB.

To show the graph, lines 73-78

With " rect = [...]" we indicate that we only want to show part of the graph.

I wanted the labels on the horizontal axis to be easier to read, it said 3.4D + 09. With a so-called "handle" you can access and adjust the graph data of the horizontal axis (in line 78).

3dB points, lines 80-89

Also useful for calculating the 3dB points. This is always an approximation because you only do a limited number of calculations and the 3dB points will almost certainly not be included. So you have to see which segment they are in, lines 83-84.

The statement " find (dB> dB3point)" returns all positions in the vector that give less than 3dB attenuation. With "(1)" and "(\$)", I select the left and right starting point.

The associated frequency is interpolated with the instruction " interppl ".

Supplementary text, lines 91-104

In itself this is self-explanatory. In the variable xloc \_ text I calculate the position on the x-axis based on the sweep range . The intention is that the text ends up slightly in the middle.

To adjust the text size and font, you use a "handle" which is created with the " gce ()" function.



*Fig 9 Reactel 's filter , where 8150 is the center frequency and 700 is the bandwidth in MHz.*

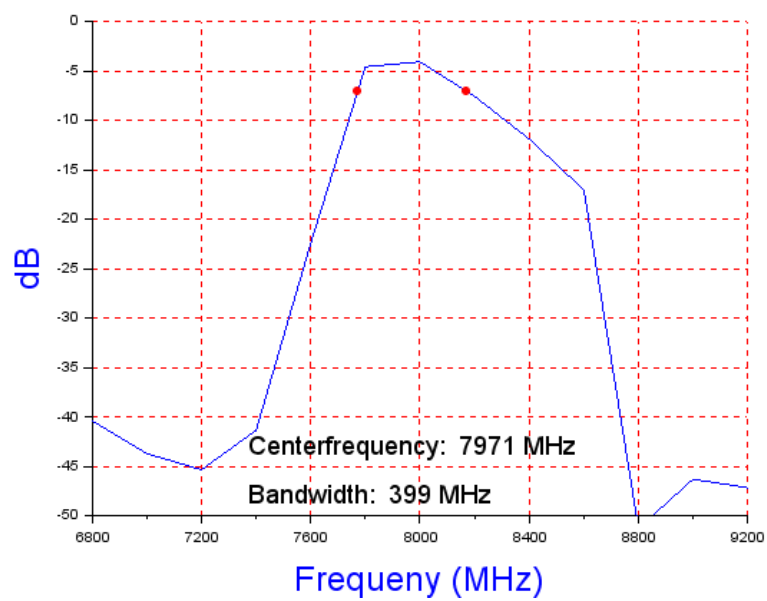


Fig 10 The result of the measurement of the filter from figure 8

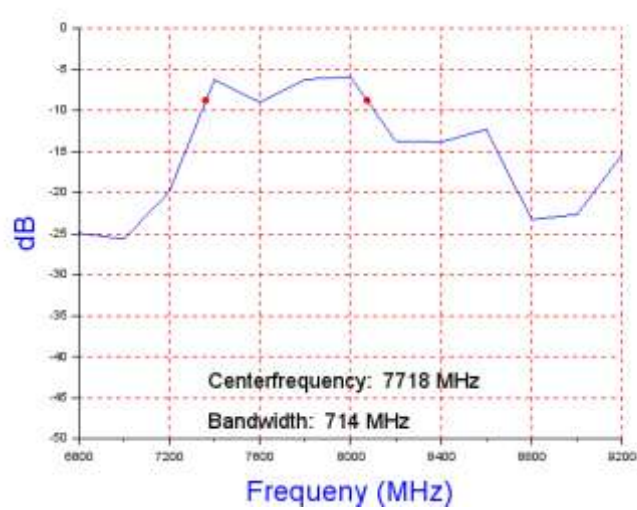


Fig 1 1 A measurement of the BFCN-8000 + from Mini Circuits

## Comments

### Heat up

Let everything warm up for half an hour before you can get reproducible measurements.

### *SWR measurements*

You could take SWR measurements with a directional coupler . The problem is that the reflected signal is quite attenuated and is no longer picked up by the detector. The signal will have to be amplified and (DIY) 8 GHz amplifiers is a story in itself [ 7 ].

### *22 mV per dB*

The datasheet of the AD8317 states that every dB gives a change of 22mV on the output. However, if you look at the graphs, it seems to be frequency dependent.

If you want to 10 GHz measure than measurements currently difficult.

### *Dynamic range*

The dynamic range of 40dB is not great. With an SA you can measure up to -150dBm.

### *50 ohms*

Probably parts of the system are not perfect 50 ohms. This will cause reflections and thus loss. I cannot judge to what extent this is visible in the measurements. But there is something. You see this in the reference measurements that sometimes a weird jump verto sources .

### **Improvements**

The current Scilab program only makes one sweep . For adjustment it is more convenient if there is constant sweeping . I need to find out what the maximum speed the sweeps can run at. There are a number of bottlenecks: the wireless communication and the settle time of the ADF5355.

Now think t feedback from the ESP8266 via the serial ð le port instead. If it wants to be completely wireless, I have to do something with status LEDs or with a display.

### **Conclusion**

It has become quite a story again, but with fairly simple means you can perform measurements up to 10 GHz. The quality of the measurements is a different story. If you want to do it really well, you will have to calibrate the entire system (also according to temperature) . Furthermore, you will probably need to use development boards from Analog Devices . The development board for the ADF5356 is cheaper than that for the ADF5355. The ADF5356 is an improved version of the ADF5355. But you can still manage with the aforementioned limitations.

You can send data in a very flexible way via JSON messages. You do not need to change the structure of the program if several ADC channels or other sensors are added. Because the communication is via HTTP, you could also do this via the mobile phone. Instead of Scilab, a web page where the calculations are done will be added.

**References (for links see [www.kunstmanen.net](http://www.kunstmanen.net), menu Weblinks )**

[1] The tape converter described in the Kunstmaan 201 8 June , page 16

[2] NanoVNA version 2

[3] ADF4351 described in the Kunstmaan September 2017, page 17

[4] Software for controlling the development print of AD

[5] Installation ESP8266 in the Arduino environment

[6] ArduinoJSON

[ 7 ] Gali-2 described in the Kunstmaan June 2020, page 14

# The HDF5 format

## Preface.

There are many file formats that are used for data from weather satellite data. Eumetcast often uses the XRIT (HRIT / LRIT) format: High / Low Rate Information Transmission. This format consists of a number of header blocks containing specific information about resolution, relationship of pixels with location, calibration, etc. The image information is then in the same file behind the headers. In America this format is also used for the older GOES satellites. For more information about the H / LRIT format, see [1].

The data transfer from newer satellites uses a different format: HDF5: Hierarchical Data Format version 5. This format is also used in other branches of industry, such as in the aircraft industry, automation, finance, etc. See [2].

Thanks to a set of useful functions, available as an API, working with HDF5 is relatively easy. This article hopes to give an impression of how to extract the needed data from a hdf5 – formatted file.

## Structure

Broadly speaking, this format consists of only two types of things:

- a group; may contain other groups
- data set: contains the actual data; this is the lowest layer in the hierarchical structure

The structure is very similar to directories (folders) and files on a PC: a group is like a folder (directory), a data set is similar to a file on a PC.

The names of groups and data are in plain language, in contrast to XRIT, where codes are used.

Data from GOES16, and later also from the third generation Meteosat satellites is/will be offered via Eumetcast in HDF5 format.

Fortunately, extensive knowledge of HDF5 is not always necessary. There is an API (Application Programming Interface), consisting of a number of functions with which the desired information easily can be pulled out of a hdf5 file. I compiled this API (as C) and put it on my website, both as Linux-lib and Windows-dll: [3]. With these functions, a program looks like this:

- H5Fopen (): Open an HDF5 file
- H5Gopen2 (): Open a group within this file
- H5Dopen (): open a dataset within the group
- H5Dget\_space () ,
- H5Sget\_simple\_extent\_dims (): determine the dimensions (width / height of image)
- H5Dread (): read the data in an array that must first be reserved using the dimensions defined above.

After this, one can do the desired processing of the data, for example, translate to jpeg. By the way, HDF5 is also supported through other languages, such as Python, Matlab and Scilab.

There now follows A more elaborate description now follows, using GOES- and MTG data.

## GOES16

A set hdf5 files (e.g. provided via EUMETCast) derived from GOES16 , belonging to a certain time slot, is made up of a plurality of hdf5 files, for each channel one, eg .: M6C01, M6C02 ... M6C16. Some information can be extracted from the file name, e.g .:

OR\_ABI-L1b-RadF-M6C01\_G16\_s20201831800209\_e201831809517\_c20201831809575.nc :

- OR: Operational system real-time data
- ABI: name of the sensor
- L1b: processing level (indicates the degree to which the data has already been processed; L0 = raw data, with L1b a relationship has already been established between pixels on the one hand and place and time on the other.)
- Rad: radiance
- F: Full Disk
- M6C01 : channel no., Here channel 1 (vis\_04)
- G16: satellite, GOES 16
- start time, end time and creation time
- .nc : extension, NetCDF.

The extension indicates that it is a NetCDF file. NetCDF (see [4]) is a set of data formats, including HDF5. So in this case the file contains HDF5.

There is a convenient tool: H5dump which outputs the hdf5 file entirely as ASCII. Mind you, HDF5 itself is not in ASCII! Using H5dump the above file results in:

```
GROUP "/"
  DATASET "Rad" {
    DATA {
      (0,0): 1023, 1023, 1023, 1023, .....
      .....
    }
  }
}
```

Here we see the top group "/", a dataset called "Rad" (from Radiance), and below it a series of numbers indicating the "brightness" of the pixels. Normally you don't use the output of H5dump; instead, get the desired information directly from the original file.

Some sample code now follows. Due to the limited length of lines, a number of pieces that are not important for understanding the code have been replaced by dots.



The piece of code with HDF5-API , to extract the "Rad" data, then looks like this: (filename shortened to M6C01.nc )

```
// Declaration
hid_t file, dset, dataspace; // Handles
hsize_t dims [2] = {0.0}; // storage dimensions
int * rdata;

// Open file, search dataset "Rad"
file = H5Fopen ("M6C01.nc", H5F_ACC_RDONLY, ...);
dset = H5Dopen (file, "Rad", H5P_DEFAULT);
dataspace = H5Dget_space (dset);

// define dimensions (width / height image)
// and reserve space
H5Sget_simple_extent_dims (dataspace, dims, NULL);
rdata = malloc (dims [0] * dims [1] * sizeof (int));

// put image data in array 'rdata'
H5Dread (dset, ..., H5S_ALL, H5S_ALL, ..., rdata);

// Exit HDF5
H5Sclose (dataset);
H5Dclose (dset);
H5Fclose (file);
```

That's all; the entire image is now in array 'rdata'.

What is striking is that no groups are defined here (apart from the top group) . For GOES a fairly flat construction is used, with a top level and otherwise only datasets. This can be compared to if you have all files under \$HOME or C:\ on your PC.

## MTG

While Meteosat Third Generation satellites have not yet launched there are already dummy data files available so programs can be tested in advance. With MTG the HDF files are "really" hierarchical built. H5Dump will return something like this:

```
GROUP "/" {
  GROUP "data" {
    GROUP "ir_105" {
      GROUP "measured" {
        DATASET "start_position_row" {
          DATATYPE H5T_STD_U16LE
          DATASPACE SCALAR
```

```

        DATA {
            (0): 10541
        }
    }
    DATASET "effective_radiance" {
        DATATYPE H5T_STD_U16LE
        DATASPACE SIMPLE ...
        DATA {
            (0.0): 65535, ...
            .....
        }
    }
}
GROUP "vis_04" {
    GROUP "measured" {
        DATASET "start_position_row" {
            ...
        }
        DATASET "effective_radiance" {
            ...
        }
    }
}
....
}
}

```

We see here that several channels (in fact all 16 channels) are in a single HDF file. But then only from one segment; 70 files are needed for a complete picture. Hence, information is also needed about the position of a particular segment: "start\_position\_row".

A piece of program to extract eg the ir\_105 channel is

```

// Declaration
hid_t file, dset, dataspace, row; // Handles
hsize_t dims [2] = {0.0}; // for storage dimensions
int * rdata;

// Open file, search group for channel ir_105
file = H5Fopen (" xxx. nc", H5F_ACC_RDONLY, ...);
grp1 = H5Gopen2 (file, "data/ir_105", ...);

// Search group "measured"
grp2 = H5Gopen2 (grp1, "measured", H5P_DEFAULT);

```

```

// Search dataset " start_position_row "
dset = H5Dopen (grp2, "start_position_row", ...);
// start position is in 'row'
H5Dread (dset, ..., H5S_ALL, H5S_ALL, ..., & row);
H5Dclose (dset);

// Search dataset "effective_radiance"
dset = H5Dopen (grp2, "effective_radiance", ...);
dataspace = H5Dget_space (dset);

// determine dimensions (w / h image); reserve space
H5Sget_simple_extent_dims (dataspace, dims, NULL);
rdata = malloc (dims [0] * dims [1] * sizeof (int));

// put image data in array ' rdata '
H5Dread (dset, ..., H5S_ALL, H5S_ALL, ..., rdata);

// Exit HDF5
H5Sclose (dataset);
H5Dclose (dset);
H5Gclose ( grp2 );
H5Gclose ( grp1 );
H5Fclose (file);

```

We see that if the hierarchy is known it is a matter of simply go down to the desired level where the data can be extracted. If desired, multiple levels can be descended directly with a single command, see here e.g. with "data/ir\_105 "

In this case, the starting position of the segment must also be determined; see the part with: " start\_position\_row "

The division into (horizontal) segments is similar to MSG, but the number of lines per segment is variable. For the top and bottom, for example for the channel vis\_04 there are 198 lines per segment; around the equator there are only 40. Apparently this was done to make all files about the same size; around the poles there is a lot of black ("universe" ) in the picture and little earth, so that easily compresses into something small; around the equator, there is more information so are more bytes per line required.

## Resolution; problems with small computers

The resolution of the images from this new generation of satellites is considerably higher than that of older generation satellites such as MSG. For GOES this could be 21696x21696, so 470 Mpixels. With 2 bytes per pixel, that goes quite a bit to 1 Gbyte. This can sometimes cause problems with older PCs. The APIs of HDF5 provide a solution for this; a part of the image data can be extracted from the hdf5 file, without first having to read in the whole. This is done with the function H5Sselect\_hyperslab ():

```

// original dimensions
H5Sget_simple_extent_dims (dataspace, dims1, ...);

resol = 2; // make resolution factor 2 lower
// new dimensions
dimso [0] = dims1 [0] / resol;
dimso [1] = dims1 [1] / resol;

offset [0] = 0;
offset [1] = 0;
stride [0] = resol;
stride [1] = resol;

H5Sselect_hyperslab (dataspace, H5S_SELECT_SET, offset, stride, dim 50 , NULL);
// define memoryspace
memspace = H5Screate_simple (2, dimso, NULL);
H5Sselect_hyperslab (memspace, H5S_SELECT_SET, offset, NULL, dim 50, NULL);

// reserve space, factor 2x2 = 4 lower than would be needed for original
rdata [0] = (int) malloc (dims0[0] * dims0 [1] * sizeof (int));

// load data into array
H5Dread (dset, ..., memspace, dataspace, ..., rdata [0]);

```

Naturally this results in a lower resolution. In this way, it is also possible to extract a part of the image, with full resolution.

## xrit2pic

Xrit2pic now supports HDF5, from version 2020.3 on. An upper limit can be specified with regard to image size, so that older PCs do not have problems with the high-resolution data. Currently only the basic translation to plates and combination of channels in a color plate is supported. With GOES a combination of channels can be used which results in close to "true color" pictures. GOES, however, does not have the appropriate sensors for blue / green / red (no green!), so there needs to be some tricked [5].

With MTG true colour should be possible, using channels VIS\_04, VIS\_05 and VIS\_06.

Links: See website "<http://www.kunstmanen.net/>", menu 'Weblinks'.

- [1] Decoding of MSG. Kunstmaan nr. 1, 3 and 4; 2003
- [2] hdfgroup
- [3] API libs
- [4] NetCDF
- [5] True color with GOES16

# Meteosat without antenna

Ger Smit

## Summary

This article describes how to setup a system to process Eumetcast-data downloaded from internet, using a Raspberry Pi, a Python script and xrit2pic for processing.

## Taken from life

The enthusiasm has always been there to see the world from above. It was in the eighties of the last century that I bought a 137 MHz receiver and tried with a simple antenna on the shed to receive the nice beeping signals from the coming satellites.

I heard them but could not get nice pictures with the MSX-pc because the antenna could not be placed optimally. Also, the time between the satellites coming over was very long. The purchase of equipment to receive and view the signals from Meteosat was very expensive at the time, and that's it really.

Now that I have reached the age of not having to work anymore, I have picked up the weather satellite as a hobby again, I will now be able to shoot beautiful pictures. But now also a problem that presents itself, because it is not allowed to place dishes or antennas other than dishes at or on the apartment where I live. So it's over.

Since I have been experimenting for a long time with various Raspberry Pi's (RPI), a computer no larger than a pack of cigarettes that can continue to run day and night, I searched the internet to obtain weather satellite data. It did not seem unthinkable to me that someone who can receive the signals live would want to share them. I ended up at Eumetsat and after submitting an application to them, I obtained a license to download the data via FTP. Perfect, almost real-time, what could be better.

Okay RPI, get to work. During my search for software for RPI, to convert from MSG to jpg, I came to the program Xrit2pic of Rob Alblas. It's great how that works and still gives me the feeling that I am receiving live images.

## The set-up.

What is necessary:

- Raspberry Pi with Linux OS, Python and xrit2pic program (Python may already be part of the Linux distribution) RPI version 4 is used, but earlier versions should work too.
- internet connection
- login to Eumetsat for the FTP service

What have I done:

First I wrote a piece of Python (program language) to get the data from the FTP server. There are a lot of data in the folder on the server, I first made a routine which selects the most recent files and save them in the receivermap known by Xrit2pic. After this we will process the data stored in the receiver folder with a shell script via the program xrit2pic\_cmd (the command version of xrit2pic) and then put it back in another folder as a jpg file.

The python script calls the Shell Script containing xrit2pic with all needed options to process the images with brightness, colour and more. The whole can then be automated through the Linux crontab setting.

I myself use multiple folders to store different jpg's , such as black / white, black / white with coastline, color and thermal images.

The colours fascinate me the most to give clear visibility in the activities that arise in downloaded images. Now that the photos are ready, they can possibly be processed into a moving film by means of a movie maker present in the Xrit2pic software. It is also possible to adjust the colours as desired with a piece of Python script.

Of course, everyone remains free to decide what to do after taking the photos: save, delete.

The use of the program xrit2pic\_cmd is described in detail in various web pages. I can tell, there is a lot to do with it, also for the amateur.

I believe that there are enough people who experience the same as me, the interest and the will is there, but not being able to perform is sometimes at the forefront.

That is why we are going to start building a system ourselves and enjoy the beautiful images from above.

## The scripts.

And then, how are we going to achieve this with the Raspberry Pi and Python3?

First of all we create a folder in the directory "/home/pi" with in my case called xrit2pic and a folder from\_msg. In the latter, we create two folders named eumetsat\_foto containing a folder 'bw' and 'received'. The folder names are in fact used in the Python script and shell. In the first folder comes the xrit2pic\_cmd executable and libraries that are required for xrit2pic and in the second folder are the generated JPG files and the storage of raw data. So:

Location	content
/home/pi/xrit2pic/	xrit2pic program
/home/pi/from_msg/eumetsat_foto/received/	raw data received
/home/pi/from_msg/eumetsat_foto/bw/	edited data (jpeg)

And now for the Python script, let's get started quickly:

Lines 1 to 5 are loading the various modules that are required for the implementation. If a module is missing, install it using PIP3 INSTALL <module>. Why PIP3, because we also do the implementation in Python3.

```
1. import time
2. import os, re
3. import glob
4. from ftplib import FTP
5. from datetime import datetime
```

From line 6 to 27 the definitions are placed (subroutines)

```
6. def get_files (): # get file from server
7.     global x
8.     x = 0
9.     for file in files:
10.        if last in file:
11.            x = x + 1
12.            print ("Downloading ..." + file)
13.            ftp.retrbinary ("RETR" + file, \
                open ("/home/pi/from_msg/received/" + file, 'wb'). write)
14.
15. def picture_only ():
16.     print ("explore pictures black and white")
17.     os.system ('./ start_xrit2pic_bw.sh')
18.     print ('- done -')
19.
20. def delete_files ():
21.     for f in files:
22.         os.remove (f)
23.
24. def delete_received_files ():
25.     files = glob.glob ('/ home / pi / from_msg / received / *')
26.     for f in files:
27.         os.remove (f)
```

From lines 28 to 44 a short menu to:

1. Reload the photos from the raw data data available (ideal for experimenting with colors, etc.)
2. retrieve the data from the server again removing all raw data and jpg files.

```
28. # - START MENU ----- START -----
```



```

29. print ("Pick an option")
30. Menu = 0
31. Menu = input ('' '
32. 1. Photo only
33. 2. Get data, take picture
34. 3. Quit
35. '' ')
36. if (int (Menu)) == 1:
37.     picture_only ()
38. if (int (Menu)) == 2:
39.     #Delete files in photo folder
40.     files=glob.glob('/home/pi/from_msg/eumetsat_foto/bw/*. Jpg')
41.     delete_files ()
42.     print ("files deleted")
43.     #Delete files in receive folder
44.     delete_received_files ()

```

Lines 45 to 50 generate the current time, after completion it shows the total download time (not necessary but is interesting to see how this works)

```

45. # start time
46. start = datetime.now ()
47. current_time = start.strftime ("% H:% M:% S")
48.
49. print ("Current time =", current_time)
50.

```

Lines 51 to 73 show the FTP routine with an error correction in lines 52 and 71-72-73, this and "while x <42:" ensure that if the data is not downloaded at once, multiple attempts are possible. The login FTP starts line 56, line 59 refers to the directory, line 63 give most recent file in server folder, line 65 gets the most recent time from the file names and in line 66 makes it a search string. Then we go with this data in line 68 to the subroutine get\_files() and look there for the requested files. For the good build in Xrit2pic, 42 out of 4032 files are needed: each image is made up of 8 segments and this time 5 is 40 files. There are 2 files PRO and EPI, which makes a total of 42 required files.

Based on the above is that you have the same FTP account at Eumetsat. But the script can also serve for other FTP servers, but then the data must be adjusted.

```

51. # Open FTP
52. try:
53.     x = 0
54.     while x <42:
55.         # Get All Files
56.         ftp = FTP ( "oisftp.eumetsat. Org ")
57.         ftp.login ('<user>', '<password>')
58.         ftp.set_pasv (False)
59.         ftp.cwd ('lrit30m')
60.         files = ftp.nlst ()
61.         data = []
62.         ftp.dir ('- t', data.append)
63.         filename = data [0]
64.         print ('filename (data [0]:', filename)
65.         print ('filename [100: 11 4 ] =', filename [100: 11 4 ])
66.         last = filename [100: 11 4 ]
67.         # --GET DATA -
68.         get_files ()
69.         print (x)
70.         ftp.close ()
71. except:
72.     ftp.close ()
73.     print ("THERE WAS AN EXCEPTION")
       quit ()

```

Line 74 makes a short pause and lines 75 to 77 indicate the difference in time it took to download the data.

Then in line 78 the routine `picture_only()` is called which will call the shell file containing `xrit2pic` and specify all necessary options for the output and result via `xrit2pic`.

```

74. time.sleep (5)
75. end = datetime.now ()
76. diff = end - start
77. print ('All files downloaded in' + str (diff.seconds) + 's')
78. picture_only ()

```

After this, the processing of the jpg files is possible and this is entirely in the hands of the user.

Since this concerns 30-min images, I recommend starting the next download session 15 minutes after broadcast. We hope that 15-min footage can be downloaded soon as well. The various print commands and timers do not apply to the proper functioning of the script. They are just control assignments.

```
----- SHELL FILE -----
START_XRIT2PIC_BW.sh --- -----
This file is a separate .sh file.
The options that are used can be found on the url:
http://www.alblas.demon.nl/wsats/software/soft_msg.html
```

```
1. #! / Bin / bash
2.
3. export LD_LIBRARY_PATH = $ LD_LIBRARY_PATH: $ HOME / xrit2pic
4.
5. ./xrit2pic_cmd \
6.     -overwrite \
7.     -src /home/pi/from_msg/eumetsat_foto/received \
8.     -dest /home/pi/from_msg/eumetsat_foto/bw \
9.     -area 1 \
10.    -ol=256 cou \
11.    -ltimestamp@[0,20]s2 \
12.    -add_text@[0,0]s2 "Black and White coastlines images" \
13.    -lmin 10 \
14.    -lmax 100 \
15.    -gamma 1
```

Note, this script requires manual input through a menu. This must be adjusted for automatic processing; only option 2 is relevant.

Output from the above script gives:

Pick an option

```
1. Photo only
2. Get data, take picture
3. Quit
```

2

files deleted

Current time = 10:31:45

```
filename (data[0]: -rw-r - r-- 1 kunstmaan psacln 425551 Sep 17 08:41 L-000-MSG4__-MSG4_____-WV_062____-000001____-202009020815-C_')
```

```
Downloading... L-000-MSG4__-MSG4_____-IR_039____-000007____202009020815-C_
```

```
Downloading... L-000-MSG4__-MSG4_____-IR_108____-000007____-202009020815C_
```

...

```
Downloading... L-000-MSG4__-MSG4_____-WV_062____-000001____-202009020815C_
```

42

All files downloaded in 24s

explore pictures black and white

- ready -

## **Etching circuit board**

### **Summary**

In this article we use photo resist dry film to make PCBs . The required negative film is created using an analog SLR camera which is photographing the layout shown at an pc monitor.

### **Preface**

It turned out to be necessary again to get the etching tray from the attic. I have been ordering my prints in China for over four years. It is no longer worth the effort to etch a printed circuit board yourself that you can order in China for a few Euros. This includes metallization , text imprint, solder mask, etc.

Unfortunately, the Chinese use FR4 and this material is not suitable for high frequencies. There are very few PCB manufacturers , offering affordable prints e.g. Rogers can make. So it's time to see if we can take the etching of prints to a higher level .

This article describes how you can make a film with a 35mm camera with which you can expose a photosensitive print. The maximum print size is 24x36mm.

### **Isola**

In my search for PCB manufacturers, Job pointed out OSH park that have material that is suitable for high frequencies. The disadvantage of their material is that it is incredibly thin and the track width becomes very narrow (to keep 50 Ohm impedance) and you have to use very small SMD parts . I preferred to avoid this. The material OSH park uses , comes from Isola . I 've contacted them and explained the situation. After that I studied their data sheets of various print materials had gone through , I thought the IS680 was most suitable. They kindly sent me a sample that I could use.

### **Apply layout to the print**

However, the print material I received does not have a photosensitive layer. I tired s t so think of something to the printed circuit board lay - get out on the circuit board etching.

There are a number of methods, each with its advantages and disadvantages:

- Toner transfer. You print the layout with a laser printer on glossy paper and with a hot iron you melt the toner on the copper. You have to invest quite a bit of time before you get the hang of this properly. I have tried , but you have to do a lot of experiments before you get good results.



## Processing process

Below are the steps to make a printout .

### Lay - out Printing

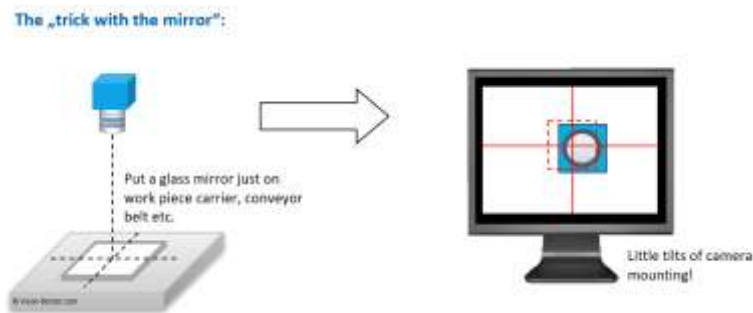
In the first instance I lay - out on 80 gram transparent film Schoellershammer printed. Because the blackening was insufficient , I made two prints and overlaid them. Another problem is the laser , which by the heat the paper (and the lay - out) is deformed. This is a problem especially with large double-sided prints.

Other n for use n inkjet printers. Problems are: ink that runs out, paper that gets too wet due to the ink , etc.

This part of the whole process is real ... (fill in a word of your choice). A solution to this problem , which I otherwise not have found on the internet , the use of negative-mm film.

### 35mm film

My idea was to to monitor the printed circuit board lay - show this and shoot out with analog film camera. It turned out , which it more simply is , than done. At first I tried with a tripod and camera recording to get and . For me it was impossible to get horizontal and vertical lines in the picture, everything went flat and crooked. In an ith ale arrangement the center of the print is to be on the optical axis of the recording . Then horizontal lines run horizontally and vertical lines run vertically.



*Fig 2 Aligning the camera with a mirror [3]*

### Some sort of optical bench

This had to work. Thus , I have about 30 kilograms of aluminum profiles at Motedis [2] purchased in order to make a construction in which at I a monitor perfect right angles k o confirm n, and a camera can be positioned relatively easily. To align the camera it is useful to stick a mirror on the monitor and make sure that the lens (in the mirror) is perfectly in the center of the image.



*Fig 3 Aluminium construction with camera and monitor . On the left the laptop to which the monitor is connected*

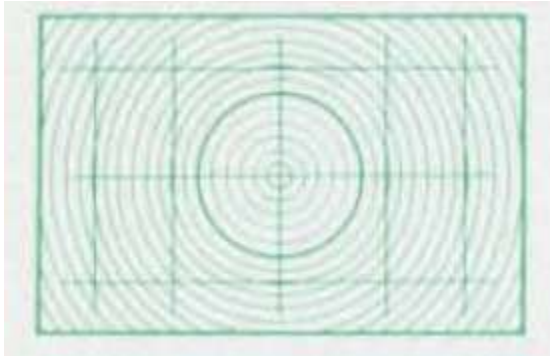
### **The camera**

The miniature camera , which I use , is an icon of the last century: the Nikon F3. It is equipped with a DW-4 magnifier and a screen with a square pattern. The lens is a Micro-Nikkor 55mm / f2.8. The magnifying glass finder was really necessary, you can focus very critically and you don't have to bend over backwards because you look at the top of the camera. A very big advantage is that a circle of 12mm is present in the viewfinder, with which you can determine the distance to the monitor very precisely (where you temporarily show a circle of 12mm on the print).



*Fig 4 Nikon F4 with magnifier*





*Fig 5 A special frosted glass with a circle of 12mm with which you can determine the distance to the monitor very precisely.*

### **Film / developer**

Amazing what you can still buy nowadays . As a film I use the Ilford Ortho . With test shots I came to 1/8 of a second at aperture 5.6. Develop in ID-11 stock solution for 15 minutes . Stop bath and fix as standard according to Ilford.



*Fig 6 The print layout on a 35mm negative . The film size is 24x36mm. Because you are making a contact print, the maximum print size is also 24x36mm.*

### **Prepare the PCB**

Make the PCB slightly larger than necessary because any problems are on the edge. You can easily cut the 0.51mm PCB with scissors. Bend it straight again after cutting. Make the corners and edges a bit rounder with sandpaper. This is to prevent damage to the etching pouch .

The copper must be spotless. Remove the last grease with acetone and polish the copper completely shiny with a seno sanding block . Just before applying the foil I blow away any dust with " Dust off ".

### **Cut the foil to size**

According to the documentation k you n you do this in yellow light or in a darkened room. It is certainly not allowed in sunlight because the film is already exposed after a few seconds of sunlight. I processed the film in a dark garage. Cut or cut (on a cutting mat ) the foil slightly larger than the printed circuit board. This makes sticking easier.

### **Application of the foil**

First, the inner protective layer (this is the layer that is on the inside of the curl) must be removed from the foil. You can do this easily with two pieces of tape on either side of the film, which you then remove the protective t . Do this slowly and make sure that there is no kink in the film. Mist the film and circuit board with distilled water.

Place the film on an angle and press the film against the copper with a hard roll. Make sure all the water is gone and the foil is tight on the print.

### **To dry**

Let the film air dry (in the dark) for a few hours. I did that for at least six hours. An oven would also be possible, but I have no experience with that.

The print then passes through a laminator three times. This must be suitable for 0.6mm, not all models are. Let it heat up well in advance. Do you have small prints , hold then the laminator inclined . This way you don't have to push the PCBs through with an accessory and they just fall out. Let the prints dry / cool for another hour.

### **Expose**

I have a UV exposure is made from a print by Elmar 96 UV LEDs . In the first instance you have to make experiments to see what the ideal exposure time is. In my case I'm at 30 seconds. The film is not sensitive to overexposure. For example, at 15 seconds I had nice prints, but at 30 seconds it was better.

After exposure can vaguely see all the contours of the lay - out.

### **Curing**

Then let the print harden (in the dark). I have an hour wait .

## Develop

By developing are the non-removed exposed areas. It is recommended a 1% solution (10 grams in 1 liter of water). Because I had some problems with oil that wouldn't really go away, I increased the concentration to 2%. For a print of 25 cm<sup>2</sup> I made 100 ml.

Remove the last protective layer with an adhesive tape. Don't do this sooner because oxygen corrodes the polymer layer. Don't forget this, otherwise development won't do much!

You help the development process by rubbing a sponge over the print.

The development is finished after two minutes. I don't think over-development does not happen quickly.

## Harden

Expose the printed circuit board for 5 to 10 minutes under UV light to further harden the polymer layer. The layout is now bright purple.



*Fig 7 The print after exposure*

## Etching

Now the print can be etched. Use your favorite etchant for this. In the past I used iron III chloride but this no longer worked. Now I have made an etching fluid with 23% hydrochloric acid and 3% hydrogen peroxide (from the Kruidvat). The ratio is 1: 2. For the PCB I made 30 ml.

Put the etchant and the PCB in a zip-lock bag in a large bowl. Move a roller over the print and after about 7 minutes the print is etched. The advantage of etching with hydrochloric acid over iron III chloride is that the liquid is transparent and that you can follow the etching process well.

On the internet you can also see the sponge method, where you apply the iron III chloride on the print with a sponge. But this does not work, the gloves will leak, with all the consequences that entails.

## **Remove foil**

The last remnants of the film can you with a 3% aqueous sodium hydroxide solution of 55 ° C to remove . Wear safety glasses.

## **Improvements**

With this film story you can a number of sides still on:

- Expose on 6x6 film, in order to make larger prints .
- Put the negative in an enlarger as described above and expose a very large film. You have films up to 20x25cm .
- Control the exposure time by turning the monitor on and off. This prevents blur that can occur when you touch the camera .
- I display the gerber files with gerbv , but this is time-consuming and error-prone. I am looking for an alternative. Prefer that you lay - out on the monitor can move minimally.
- My monitor has a resolution of 1920x1200 pixels. A 4K monitor has a resolution of 3840x2160 pixels.
- The used Micro-Nikkor change to an enlarger lens as it is optimal for the plane and close-ups are corrected .

## **Conclusion**

It is a hassle to make a print , but we succeeded and that is fun. Once you have the setup, you will get reproducible results. You do need some space for it.

## **Links**

[1] Mungolux , supplier of photo-resist film

<https://mungolux.com/>

[2] Motedis , supplier of aluminum profiles

<https://www.motedis.nl/shop/>

[3] Aligning the camera

<https://www.vision-doctor.com/en/perfect-alignment-of-cameras.html>

# UKW-BERICHTE

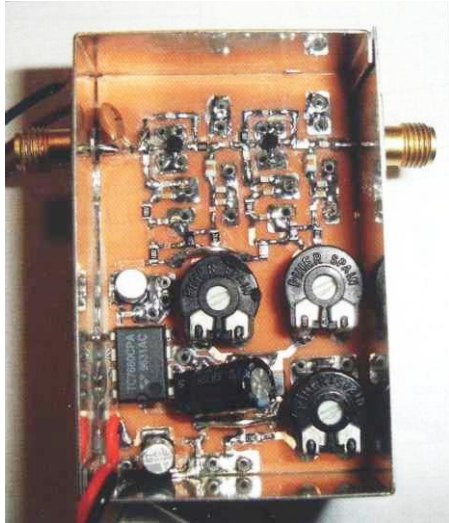
Paul Baak

## Summary

In this article a concise review of articles published in the 2th edition of 2020 of the German magazine UKW-Berichte. We have a subscription to this magazine.



Here is an overview of UKW reports 2020 Heft 2. This appeared not until in August this year, so there is a slight backlog in publication. We find 5 articles, plus the regular overview with internet links. Our club has a subscription to this magazine. Please indicate if you appreciate this subscription! Positive or negative, it doesn't matter, as long as your board hears something. The latest editions are available for inspection at meetings on the library table.



Heiko Leutbecher describes VHF-UHF broadband amplifiers with GaAs-FETs and MMICs. The first design uses the proven transistor types CLY5 and CLY10 (which have an SOT223 housing and cost about 5 euros). In a reverse phase design, a flat gain of approximately 16 dB to 1 GHz is achieved. The counter phase is realized with baluns. The author describes the adjustments necessary for stability. The noise figure is 3 dB and the output power approx. 1 Watt. It may therefore have been conceived for controlling a transmitter. Furthermore, the adaptation of a 75 ohm MMIC, the ABA3100 for 50 ohm and a feedback FET amplifier up to 2500 MHz with the ATF21186. Here, too, simulation took place with the Ansoft Designer [1] program.

Wolfgang Schneider describes power measurement up to 200 Watt for the 13 and 23 cm tires. Two directional couplers, diode detectors HP33331E and measuring amplifiers OP200 and an Arduino behind it are used to determine SWR and power. The calculation is described in general; the software can be requested from the author.

Michael Margraf describes the simulation of the EM field with the free program QucsStudio. With this, circuits could first be calculated; now simulations of EM fields have been added. A 5-pole band-pass filter is considered as an example. The software can be found at [2].

Günthard Kraus describes the NanoVNA as a vectorial network analyzer with a range from 50 KHz to (in the first instance) 900MHz. In addition, many considerations about the correct purchase (especially the aids) and practical use. The article can almost be read as a concise course. A low-pass filter of 110 MHz and a loop antenna at 435 MHz are the test objects. The H2 (2.8 inch, with housing) version is also discussed, which runs up to 1500 MHz. There is also a 4.5 inch H4 version. The judgment above 600 MHz regarding the H2 version is critical; people are more positive about the H4. The price has dropped below \$ 70. I also add: many manufacturers are now making the NanoVNA. There is no doubt quality difference between them.

In Fundstelle Internet we find internet links. I mention here: antenna design calculators [3] and the measurement of quartz crystals [4].

Under the heading Ultrakurz we find the Weinheim 2020 and Dortmund amateur fairs listed; unfortunately both are canceled.

UKW-Berichte [5] is a German-language publication, now without an English version, which previously existed under the name VHF communications. The magazine costs EUR 33.20 per year, including shipping from Germany, as per in 2020.

**Links on [www.kunstmanen.net](http://www.kunstmanen.net), menu Weblinks:**

- [1] Ansoft Designer
- [2] QucsStudio
- [3] antenne design calculators
- [4] measuring quartz crystals
- [5] UKW-Berichte

From the Library

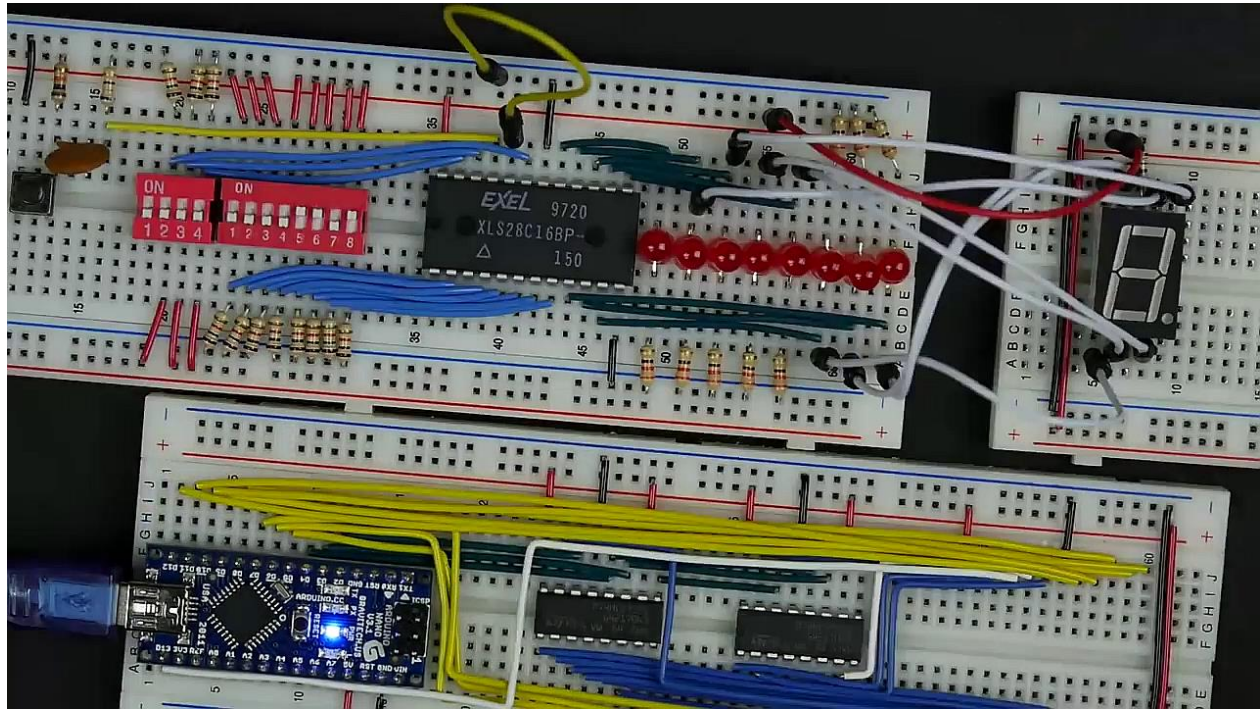
Dear people,

Great unrest came over me in recent weeks. Why are the High People in our society heroically pulling the virus to themselves by cuddling with a restaurant owner or even their mother-in-law? In the meantime, why do they so tenderly and caringly, with their threats, punishments and crooked rules, want to ensure that the virus stays outside of society for others? After careful contemplation it became clear to me: they want to prevent that we, members of Werkgroep Kunstmanen, would eventually be affected. It touches me somehow, their selfless care for our association. It gives me the strength to support you with the following Generosity and Grace (mocking the inconsistent Dutch government here - can't fully translate that, sorry).

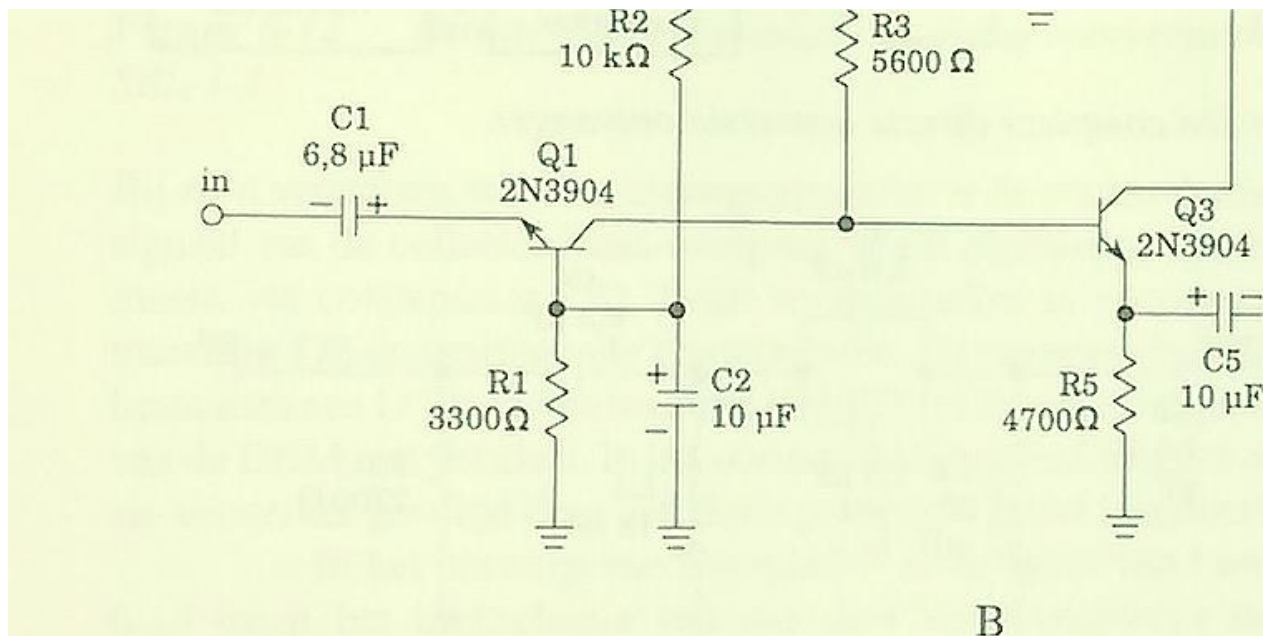
That endless stream of internet stuff from China just doesn't stop. Until recently, customs did not care when another package came along. At least not under the limit of 22 euros. In the spring this will come to an end. The VAT exemption for cheap equipment will be abolished [1]. Instead, everything has to be declared. That is allowed for material under 150 euros with a new and simpler clearance procedure, otherwise they cannot deal with it. A new procedure to simplify the implementation of the many procedures, and so done under the leadership of the EU. There is a possible additional caveat: the VAT must be paid by the recipient and that could mean that the customs service for the onward shipment will use a courier service that will charge 10 to 20 euros in addition to the VAT to be collected at the door. There is no certainty yet. Another plan is that the EU will force all Chinese companies to collect and pass on VAT to the EU [2]. All geniuses together! I have to smile for a moment.

It is the way of working nowadays: no schematic or block diagram is supplied with an electronics design, but a drawing of "Fritzing". This is a free program that can create a picture of the wiring on a breadboard. However, it does not provide insight into the operation of a circuit. Even better I found this aerial photo of the wiring in an otherwise very nice story about the use of eeproms on Youtube. Modern information continues to be a struggle. Look at the picture and find the wire.





The library in our village no longer houses technical books. Years ago these were removed during an "improvement campaign" and replaced by countless books with self-realization (what the heck is that) and spirituality (doesn't even exist) and long-distance travelling (I wouldn't do it for a while). When I just walked around the library in The Hague last week, I did see rows of books about technology. A feast of recognition! I immediately became a member and took along: HF technique Without Mysticism (1997) in two volumes by Joseph Carr. I spent hours reading what seemed to me like a refresher course for anyone who thinks they already know it all. Everything comes along: filters, mixers, components, from VLF (admittedly - a bit less interesting for us) to cavities, MMICs, handy formulas. What I did notice with a diagram is the following input stage. It must be a drawing error.



Hardware must not be discarded, that is immoral and, moreover, still a crime, I think. I have a spare König Satellite Finder from an old household, and I will not be using it for now myself. Anyone interested, by email or at the next meeting, can have it.



In this September's Elektor magazine, a story about photographing electronic equipment. To be honest, I must admit that my own work could use some improvement. My photos accompanying the articles are sometimes dark or show a visible flash. Elektor naturally has the same problem with its contributors, hence they issued their article that may also be helpful to you. Soldering is also discussed in this magazine: it is said that fighting lead in solder is a nice idea, but it might be better to do something about the large amount of discarded electronics. My idea!

The VERON department in Zoetermeer has a free monthly PDF magazine. I have already mentioned it because of the issues that are sometimes also relevant to us: the Swedish Electrical Safety Bureau is threatening to ban the sale of optimizers used in solar panel installations because of the high level of HF pollution they produce [3]. Good that the issue progressively is being taken care of. If there are no regulations, a manufacturer is happy to save on a few suppressor C's and coils. Saves another dime.

Two ladies in England have built a receiving station for the reception of APT / NOAA / 137 MHz satellite images using software defined radio on Windows or MacOS. They shared their enthusiasm through a comprehensive guide. Catching. Read the manual on [4].

The radio amateur association DARU, successor of the DAKARS foundation, publishes a free PDF magazine. In issue 8, September 2020 [5], Peter Gouweleeuw describes a SAW filter for 434 MHz and he also mentions the free e-book RF Filter Technologies for Dummies. Not really a Dummies book, more of an advertisement for the Qorzo company. Even then a good explanation of SAW filters [6].

The European Microwave Organization presents itself as a non-profit organization in the field. Their European Microwave Week (EuMW) [7] will be held after a delay, from January 10-15, 2021 in Utrecht. There is a free and a paid part, resp. the exhibition and the conferences / workshops. Unfortunately, the sign up site is a mess. It is unclear what you will get for what entrance fee. For example, registering as an early pensioner is impossible, because you are still considered to have a job. I regret to advise against visiting, even the part suggested as free, to avoid paying a hefty sum for something you don't want.

For some unknown reason I had the wish to delve into the theoretical background of electromagnetism that is the basis for our hobby. I found a very nice book on the border of tricky theory and comprehensibility: A Student's Guide to Maxwell's Equations by Daniel Fleisch. It strikes a good balance between theory, which remains tough, and the explanation in words of what is meant by it. Don't let the multiple integrals and differentials in this world scare you too much: complicated situations with irregular shapes cannot be calculated (we have simulation programs for that nowadays!) and more simple situations with spheres, circles and straight lines come down to fairly simple calculations. In the meantime, the miracle remains unexplained: if an electron moves somewhere, another electron at a great distance also feels obliged to move.

Turning to theoretical mathematics: on youtube I saw a campaign [8] to replace the number pi with tau. Or rather: replace  $2\pi$  with tau. It has been going on for some time [9]. One Mr. Bob Palais (mathematics professor, that too..) is an advocate. The idea is that many formulas contain  $2\pi$  and that it can be replaced by another Greek letter. The disadvantage is that formulas with pi must contain  $\tau / 2$ . You don't get any better with it. All maths and physics books, yes even some articles in the Kunstmaan should be adapted. The youth, who often already have difficulty with mathematics, are now going to lose track already completely in primary school. But there is a much more fundamental problem. Some texts, especially in the corner of Fourier transforms (to put it quickly: a kind of mathematical spectrum analyzer), already contain both pi and tau. The latter as a time-bound parameter. You see the trouble coming. I am mostly in favor of free speech, but this is where I get my reservations.

With all this I dare to send you into the fall. No real meetings in Utrecht yet. Too bad, because by now I long to cuddle a receiver disk again. I now just go to the countryside for a few days and do take the binoculars and the laptop with me for the satellite passings [10]. It is very dark at night. It's in a very quiet part of the Netherlands and they don't even have any decent robberies and shootings there yet. That will be quite a change for

your librarian

Links on [www.kunstmanen.net](http://www.kunstmanen.net), menu Weblinks:

- [1] New customs rules
- [2] Customs Procedures
- [3] Controversial optimizers for solar panels
- [4] Construction of satellite earth station
- [5] Daru magazines
- [6] RF filter technologies for Dummies
- [7] European Microwave Week
- [8] Tau instead of Pi
- [9] Tau on wikipedia
- [10] Satellite tracking

## **Report of the members meeting 12 September 2020.**

### **Summary**

Report of our meeting at September 12 .

### **Opening by the chairman.**

Welcome; unfortunately this meeting is again via zoom. In principle, we could have access to Nimeto, but after a brief survey, interest seemed to be low, due to the risk of mutual contamination. This meeting is a postponed GMM; postponed in the hope that we could have a normal meeting again in September. Not so ...

### **Explanation of the 2019 figures + statement of the Audit Committee**

There is not much special to say about the 2019 figures; there is still a loss, but there are still plenty of reserves.

Things will be different for 2020; see below, under 'Budget'.

There are no further questions / comments.

Discharge is granted.

### **Discharge of the management board for 2019 policy**

Discharge is granted.

### **Budget 2020**

The treasurer provides an explanation. Part of the costs for Nimeto, called "Administrator Nimeto", will now be canceled, which is why the budget shows 0.00 on this item.

Because of the Corona virus the Radio Flea Market in Rosmalen was canceled. This means a godsend of around 265 euro's for 2020, assuming that we will have a 'real' meeting in November. In the figures published in "de Kunstmaan" no. 1, the "corona godsend" are not included.

Furthermore, by introducing a PDF subscription for the Netherlands more will change for 2021.

### **Board affairs: PDF membership**

There is already an English "Kunstmaan" in pdf; foreign members for pdf-only pay less dues.

The chairman was somewhat cautious about the release of a PDF, due to possible uncontrolled distribution and therefore less interest in being a member. Release of the "paper Kunstmaan" takes time and money, and it can all go wrong in the delivery (such as "wet magazines"). Post delivery by Sandd would be an outcome but because Sandd now been taken over by KPN this is no longer the case.

So we are thinking of introducing a PDF membership, also for Dutch members. Possibly there will be a yearbook containing "timeless" articles from the past year (so no preface, satellite status and so on). The attendees are asked who is in favor of entering a PDF subscription.

Job (the editor) is for it, it saves him a lot of work in terms of mail.

Fred Jansen also thinks it's a good idea. Paul (the librarian) : calls the transition to PDF inevitable. Rob (treasurer / member administration) indicates that 9 of the 24 foreign

members have an English subscription. The current cost of 10 euros does not seem to be a problem.

Fred vd Bosch is "crazy about paper", a yearbook would be great.

Arne is also in favor, but indicates that paper must also remain available .

Elmar Bögels, Wim bravenboer and Peter Kuiper are also for pdf.

### **Satellite status (Arne)**

There is not much to report. The GEO newsletter [1] also contains a satellite overview.

Elektro-L2 can be received on X-band, but a large dish is needed to separate the signal

from a neighboring military satellite. Elektro-L2 is very suitable for adjusting the position, but because the polarization is "reverse-circular" it is not suitable for adjusting the helical.

The signal is so strong that in spite of the inverted polarization receiving for the mentioned purpose is possible.

### **Any other business**

Fred Jansen gives a talk about his 8 GHz reception; there will be an article about it in the Kunstmaan.

Paul: No specifics; the proposed reorganization of the cabinets in Nimeto has been postponed due to Corona.

Arne: Question to Fred Jansen on the use of mesh for a dish: a massive dish would give more signal. Fred indicates that a massive dish suffers more from windage than it benefits . The construction of a mesh dish is a "bad job", but it can be done. Wim Bravenboer indicates he uses alu/mosquito netting used for his dish. Ben also has experience with mesh, see "de Kunstmaan" no. 3, September 2019, page 24 (English edition), in which he described this.

Ben: Is experimenting with the self-etching of pcb's, by making a photograph of the screen and then use the negative as a mask . It is not easy, partly in connection with the alignment of camera and monitor. See elsewhere in this KM.

Peter Smits indicates that he uses a printer to print the layout. That does cause problems in connection with the limited blackening. The density on a negative is very good, so the exposure is not critical.

Ben also shows a self-made "sweeper" at 8 GHz; for a description see elsewhere in this "Kunstmaan".

### **Closure**

This was another succesfull meeting, but it would be nice if we could have a "real" one in the Nimeto in November. Whether that will work is the big question ...

Rob Alblas (secretary AI)

[1] GEO newsletter, <http://www.geo-web.org.uk/>



Arne van Belle, september 26 2020

2020

POLAIR	APT (MHz)	HRPT (MHz)	Overkomst
NOAA 15	137.620	1702.5	Morning/evening, HRPT weak + sync problems
NOAA 18	137.9125	1707.0	Early morning/afternoon
NOAA 19	137.100	1698.0	noon/night
FengYun 3A	-	1704.5	AHRPT 2.80 Msym/s
FengYun 3B	-	1704.5	AHRPT 2.80 Msym/s
FengYun 3C	-	1701.3	AHRPT 2.60 Msym/s, off at the moment
FengYun 3D	-	7820.0 X-band	noon MPT 30 Msym/s
Metop-A	off(137.100 LRPT)	1701.3	LRPT/AHRPT 2.33 Msym/s
Metop-B	-	1701.3	Alleen AHRPT 2.33 Msym/s
Metop-C	-	1701.3	Alleen AHRPT 2.33 Msym/s
METEOR M N2	137.100 LRPT	1700.0	LRPT QPSK 72k /MHRPT
METEOR M N2-2	off(137.900 LRPT)	1700.0	LRPT OQPSK 72k /MHRPT
NPP	geen	7812.0 X-band	HRD 15 Mbps
JPSS-1/NOAA 20	geen	7812.0 X-band	HRD 15 Msym/s

NOAA 15, 18 and 19 are the last satellites that still broadcast APT.

METEOR M N2-2 has been hit, most likely by a micro-meteorite. It changed orbit suddenly en is depressurized. They have control back but due to overheating of the batteries they had to switch off LRPT. MHRPT is only on when solar panels are lit

NPP (NPOESS Preparatory Project) and JPSS-1 (NOAA-20) only broadcast on the X-band at 15 Mbit/s. A tracking dish with a diameter of 2.4 meters is recommended! [2]

FengYun 3A, 3B and 3C broadcast AHRPT, this can only be received with the new QPSK receiver from

Harrie and Ben. This AHRPT is not entirely according to the standard so that even a Metop AHRPT receiver is not suitable for the FY-3 series!

FengYun 3C also has a different data rate than 3A and 3B and broadcast on X-band with LHCP. Rob Alblas has expanded his GODIL decoder and can now demodulate HRPT, Meteor HRPT, METOP and FY3A / B and FY3C in the 1700 MHz band!

Recently FY-3C does not transmit on 1701.3 MHz. Like NPP and JPSS-1, FY-3D only broadcasts on the X-band!

GEOSTATIONAIR	APT (MHz)	(SDUS)/PDUS (MHz)	Baanpositie
MET-11 (MSG-4)	no LRIT	1695.15 HRIT	0 degree, operational
MET-10	no LRIT	1695.15 HRIT	9.5 degree E, RSS
MET-9	no LRIT	1695.15 HRIT	3.5 degree E, RSS parallel operation
MET-8	no LRIT	1695.15 HRIT	41.5° degree E, IODC
GOES-E (no. 16)	1686.6 GRB	1694.1 HRIT	75.2 degree W via Eumetcast
GOES-W (no. 17)	1686.6 GRB	1694.1 HRIT	137.2 degree W via Eumetcast
GOES 14	1691 LRIT	1685,7 GVAR	105 degree W, Backup
GOES 13	1691 LRIT	1685,7 GVAR	60 degree W, Backup
GOES 15	1691 LRIT	1685,7 GVAR	128 degree W parallel with GOES 17
Elektro-L2	1691 LRIT	1693 HRIT	14.5 Degree W, via Eumetcast
Elektro-L3	LRIT	HRIT	76 degree E, Operational
MTSAT-1R	1691 LRIT	1687.1 HRIT	140 degree E, Backup for MTSAT2
MTSAT-2	1691 LRIT	1687.1 HRIT	145 degree E, via Eumetcast
Himawari-8	no LRIT	no HRIT	140.7 degree E, via HimawariCast
Himawari-9	no LRIT	no HRIT	140.7 degree E, Backup for 8
Feng Yun 2E	-	-	86.5 degree E, Backup
Feng Yun 2F	-	-	112.5 degree E, Backup

Feng Yun 2G	-	-	99.5 degree E
Feng Yun 2H	-	-	79 degree E
Feng Yun 4A	1697 LRIT	1681HRIT	99.5 degree E, Operational

## Launches

Meteor-M2-3                      expected August 2021

Now that Elektro-L3 is operational, L2 has been moved to 14 degrees West and is visible in Europe now. Oleg and Fred Jansen report reception on X-band 7500 MHz, BPSK 30.72MS/s RHCP. According to WMO Oscar L2 can also transmit LHCP on 8195 MHz and RHCP HRIT of LRIT on 1691/1693 MHz but there is no fixed schedule.

Unfortunately, DVB-S and most "DVB-S2 without VCM" receivers are no longer usable for EUMETCast. With a special driver, some recent DVB-S2 receivers can still be made suitable for Basic Service Only. (only the TBS-5980 and Skystar 2 eXpress HD, unfortunately this does not apply to the Skystar HD USB box)

The signal at 10 degrees east has a larger bandwidth and is therefore weaker than before.

Recommended dish diameter is 80-90 cm for Basic Service and at least 120 cm for High Volume Service 1 and 2

The 2nd EUMETCast TP2 transponder is set to 11387.500 MHz Horizontal and broadcasts HVS-2. The Symbol Rate and mode is the same as HVS-1 (33000 kSym/s DVB-S2, CCM mode, MODCOD 16APSK2 / 3).

For good reception the same applies as for HVS-1, in good weather a 90 cm dish is sufficient, but a 120 cm is recommended.

After requesting, users can receive live GOES 16 and 17 data on TP1 / HVS-1. Unfortunately this is in NetCDF format. In addition to SNAP, EUMETCastView by Hugo van Ruys can also display this. [3]

David Taylor has written the excellent GOES ABI Manager for Goes 16 and 17 NetCDF data. [4]

Due to "congestion" in the TV satellite world, we see that more and more transponders are being used on Eutelsat 10A. For optimum signal quality (SNR) you must rotate (Skew) the LNB in such a way that vertical transmitters are weakened as much as possible. A moderate or poor quality LNB can suddenly cause problems if it has poor attenuation for the vertical signals. This is called Cross-polarization. This value should be better than 22 dB and indicates how much a vertical transmitter is weakened if the LNB receives horizontally.

Dishes smaller than 120 cm have a larger opening angle and may experience more interference from neighboring satellites.

Eumetsat recommends repeating the fine alignment of your dish every year and paying attention to the

correct rotation (Skew) of the LNB. If possible, also check the focus (sliding in and out towards the dish). If the old SNR values are no longer achievable, it may be necessary to replace the LNB with one with better "Cross-polarization Isolation". [5]

With a splitter you can connect a second receiver to the same dish / LNB and receive Transponder 2 at the same time. The same PC runs 3 instances of Tellicast, for BAS, for HVS-1 and for HVS-2. If you also want to save all data then you must use a ram disk and multiple hard disks or a fast SSD.

The TBS dual or quad tuner cards are able to receive both transponders at the same time and have a built-in splitter/switch. Unfortunately the Ayecka SR1 cannot decode both TP1 and TP2 although it has dual tuners.

Eumetsat has released an update for Tellicast, TC 2.14.5. In addition to improvements, the license can handle up to 500 Mbit/s instead of 200. The channel files are also completely revised. Make a backup of your old ini and channels file in advance! The software update arrives 2x every day on Eumetcast on "Info-Channel-1"

This update is only necessary if you have problems with the reception of HVS-1 or 2.

If you have problems with Tellicast, Eumetsat advises you to upgrade first.

Himawari-8 images are now broadcast every 10 minutes via EUMETCast. Because this concerns all 16 spectral channels with a resolution of 2 km, these are transmitted via HVS-1 under channel E1H-TPG-2. Unfortunately, this stopped the half-hourly Himawari-8 images on the Basic Service on 10 October.

GOES 16 channel B01 is now available so that you can make "real" RGB images.

With effect from 15 January 2019, a license is no longer required for the hourly Meteosat data.

For the more frequent data and that of many other satellites, however, a license (including 3 annual renewal) is required. You still need your ECU for this.

EUMETCast users be warned for the fall "solar outage" ! From October 9<sup>th</sup> to 14<sup>th</sup> between 10:59 and 11:09 UTC the sun will be right behind Eutelsat 10A causing interference or signal loss. A glimmering wet dish might cause your LNB cap to melt or burst. It is recommended to check your LNB cap for damage after October 14<sup>th</sup>. A broken cover can be repaired using plexiglas and transparent silicone.



- [1] Meteorontvangst met RTL dongle
- [2] Info van NOAA20
- [3] EUMETCastView
- [4] GOES ABI Manager
- [5] EUMETCast Europe Link Margins Explained.



De werkgroep is opgericht in 1973 en stelt zich tot doel:  
*Het bevorderen van het waarnemen van kunstmanen  
m.b.v. visuele, radiofrequente en andere middelen*

**[www.kunstmanen.net](http://www.kunstmanen.net)**

