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E4407B restoration project: EEPROMs

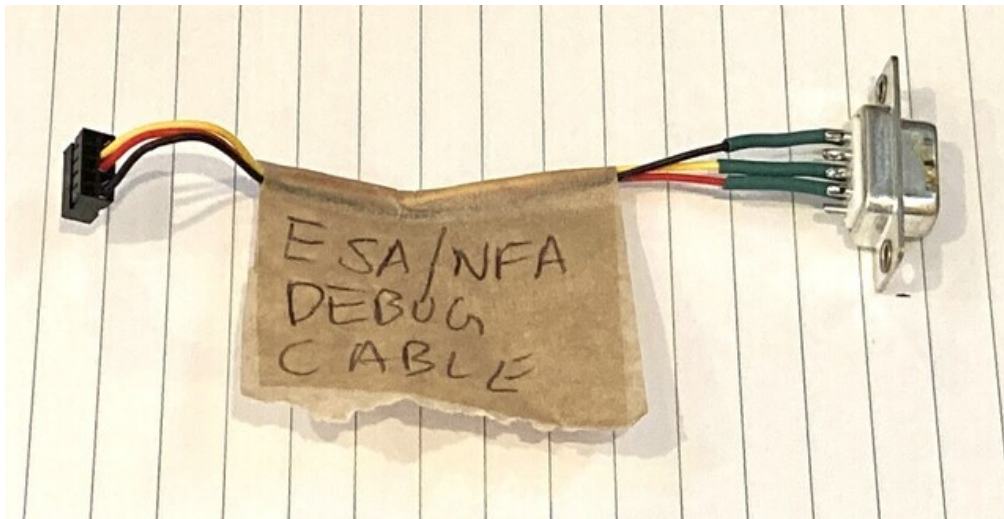
Date ▾ (<https://groups.io/g/HP-Agilent-Keysight-equipment/topic/32215745?p=Created%2C%2C%2C20%2C1%2C0%2C0>)



Techfreakz

Oct 23 (<https://groups.io/g/HP-Agilent-Keysight-equipment/message/119577>)

P.P.S. Here's a photo of the serial debug cable.



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Techfreakz

Oct 23 (<https://groups.io/g/HP-Agilent-Keysight-equipment/message/119576>)

P.S. If anyone needs to work on the NFA "uWave Front End" module, here's the "chip & wire" and DC PCB reverse engineered!

Sorry for the slow reply, I don't check this group very often.

I put about a month in to learning how the look-up is performed, reverse engineering the EEPROM contents and re-generating the correct contents - quite a feat of engineering!

My most important discovery (late in the process) was that there is a serial (RS232) debug port on the CPU card (its the pin header you can see on the rear panel). During the YTF alignment process, there is lots of information written out this port. I made a little cable to convert from the 2mm(?) pitch header to a 9-way D-type.

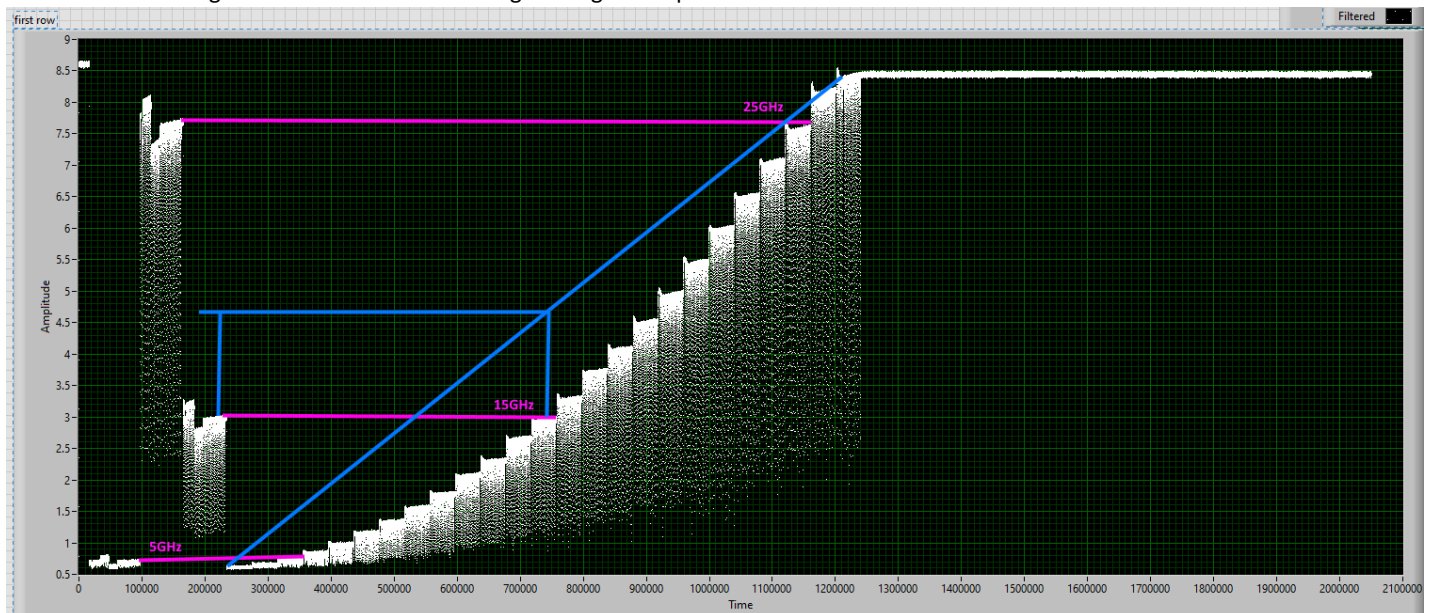
Attached are some captures of the debug output (for the NFA) during boot and (failed) alignment and a successful alignment.

So, what I found (for the NFA), was that the instrument uses a polynomial to perform the look-up of frequency -> YTF tuning voltage.

If I recall correctly, the alignment process does something along the following lines during "YTF Align":

1. It uses the current polynomial constants to set the YTF at the bottom, top and middle of the band, seeing the LO to detect the noise-peak in the receivers pass band.
2. It then steps through many frequency points, performing peaking of the noise (by tuning the YTF) at each frequency.
3. Upon successful completion of the calibration sweep, the polynomial is re-calculated and programmed to the EEPROM (when you click Save, I think).

Here's the YTF voltage monitored over time during the alignment process.



There is actually a significant loop-hole in the YTF alignment process. If the instrument has a fault and the YTF alignment process is run and saved, then the (very) incorrect YTF polynomial values are stored to memory. If the unrelated instrument fault is fixed, the instrument will still never be able to align itself back to a corrected state!

NOTE: Calibration data actually spans the two EEPROMs on instruments with a wide frequency range (e.g. those that go up to 26.5GHz, may the 6 & 13GHz models too). The YTF polynomial only actually has a few coefficients. The majority of the data on the EEPROM is the amplitude correction & mixer bias settings across the band. For the NFA, this data isn't important, as it corrects itself during its measurement process, but for the ESAs this may be more important for accurate measurements. If you just have incorrect YTF coefficients, then you will not need to touch the other EEPROM contents. If this is the case, I would strongly encourage you to back-up the contents of these EEPROMs before making any changes!!

BTW, each section in the EEPROM is checksum'd (I never did determine the CRC calculation used), but I seem to recall the instrument doesn't check this anyway!

The following data is stored in the first (of two) EEPROMs:

```

Model, serial, description and revision
3367 4534 3430 3436 3030 3031 0000 3233
3131 3437 3030 3031 3600 3939 0000 0041
4672 6571 7565 6E63 7920 4578 7465 6E73
696F 6E00 0000 0000 0000 0000 0000 9D3D

```

```

ALC reference level = 8 bits (written with address = 0xD, register = 0xC)
82CA 003F 0087 006F 006F 0093 0080 008F

```

```

YTF DAC Polynomial (double polynomial in 64bits, X^0, X^1, X^2, X^3)
4090 6B3B A000 0000 3E87 BF3E A000 0000
3C8E CD38 C000 0000 BA1C A744 A000 0000
0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000
4088

```

```

Unknown. Likely Mixer bias level is in here
26FB E76C 8B44 410D EE80 0000 0000 3F19
06E2 1C6A 43EC 3EE0 D12A F7C7 C49D C083
2922 D0E5 6042 BCDA C05A 8E88 2CA3 3E20
42C0 4307 107A BC55 8119 4633 00EF 3FE7
CED9 1687 2B02 BAD0 18E6 0000 0276
BF20 25E7 F115 8171 3EFA 6C92 D051 BC8B
0000 0000 0000 0000 0000 0000 0000 0000
BE60 5A63 F94C A62C 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000
3DC4 2D10 D9C0 A872 0000 0000 0000 0000
4034 1B08 AAC9 6CC6 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000
000F 0055 0000 0000 0001
000F 0055 0000 0000 0001
0D48 0000 0244
0D48 0000 02A8
0D48 0000 02DA

```

Of interest is the "YTF DAC Polynomial". This data is stored as a double precision floating point number (8 x 8 bytes = 64 bits).

If I recall correctly, the short answer to what I did was to connect the YTF to my Network Analyser to perform an S21 measurement. I connected an external power supply to the YTF control input and swept the control voltage whilst noting the centre frequency of the pass band. A polynomial was fitted to the curve and these coefficients were programmed in to the EEPROM as a more sensible starting point for the YTF Align. I think I only needed the first one or two terms as its very linear. I then re-ran the YTF alignment process several times. Each time, it would get closer to the final characteristic and finally the alignment completed successfully at every frequency.

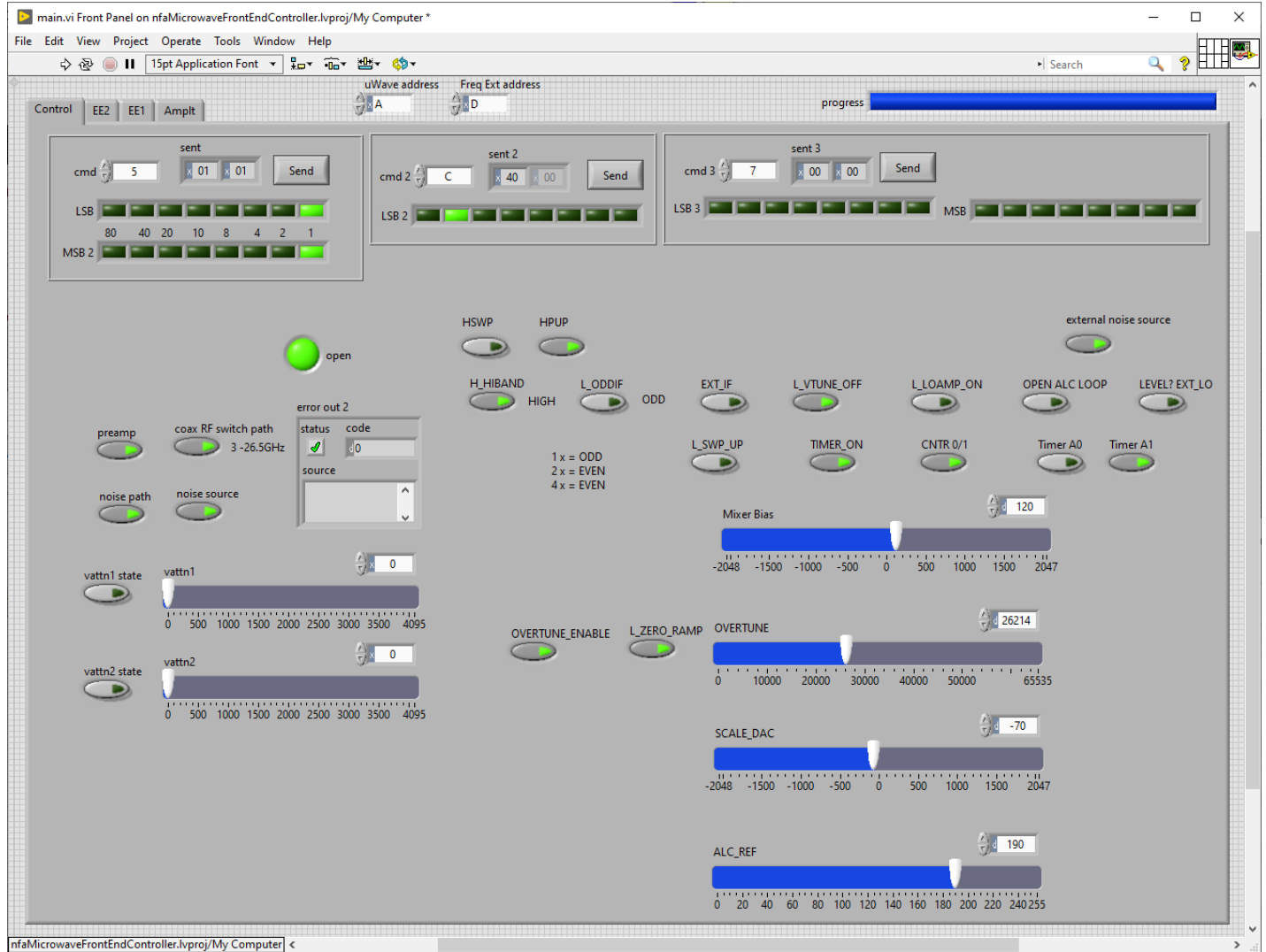
You can run the calibration (even if it fails), note the polynomial generated at the end. Read back the EEPROM and verify what was programmed matches what was computed and shown in the debug log. You can then adjust these coefficient values, as shown above, to bring the alignment back to a correct state.

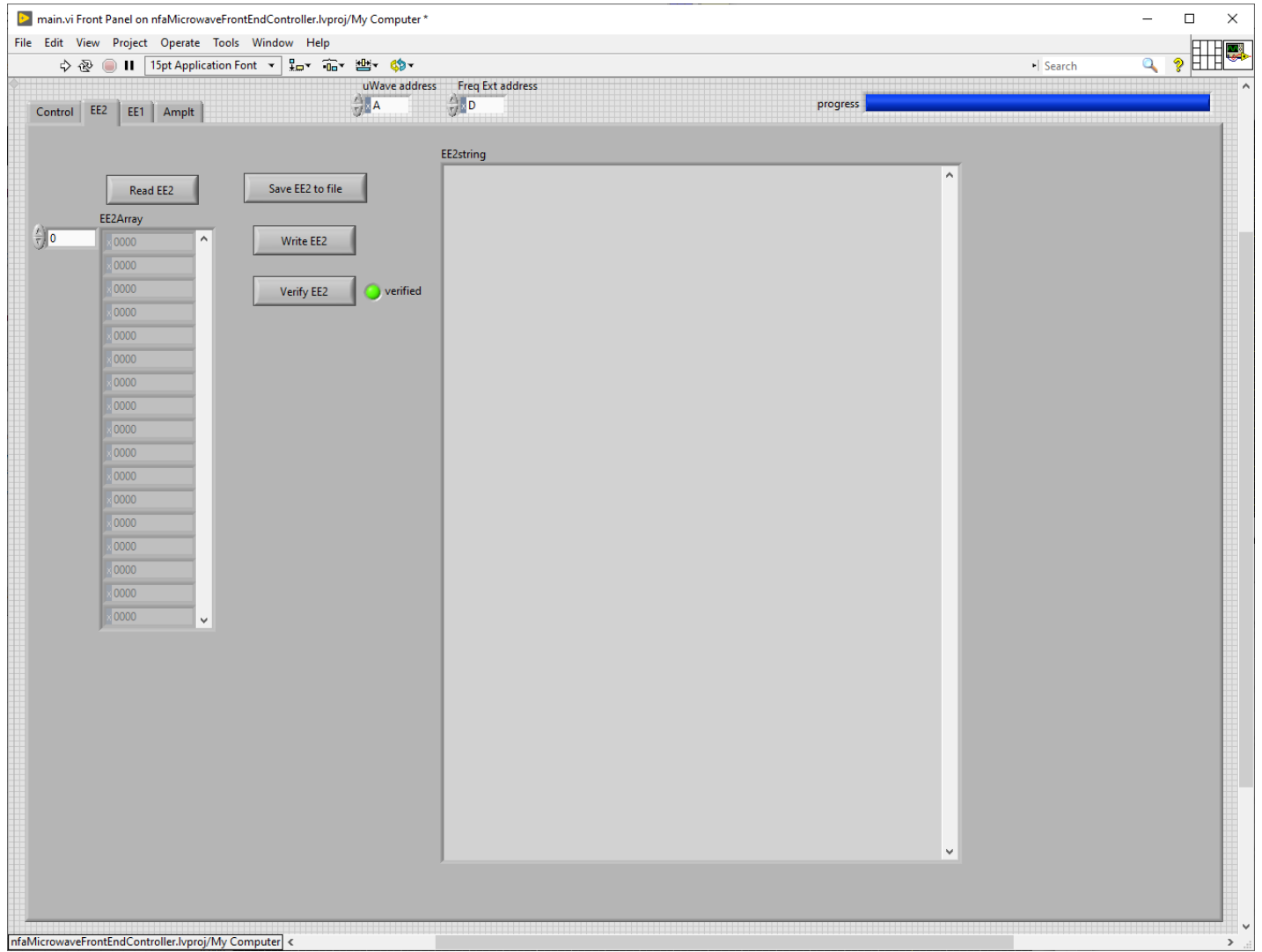
As an aside, I reverse engineered the pseudo-SPI bus that the CPU card uses to talk to all the other cards across the backplane. I then wrote a LabVIEW application with buttons and sliders to control some elements of the operation of the instrument. To do this, I pulled out the CPU card, and made connections to the pseudo-SPI bus on one of the plug-in cards.

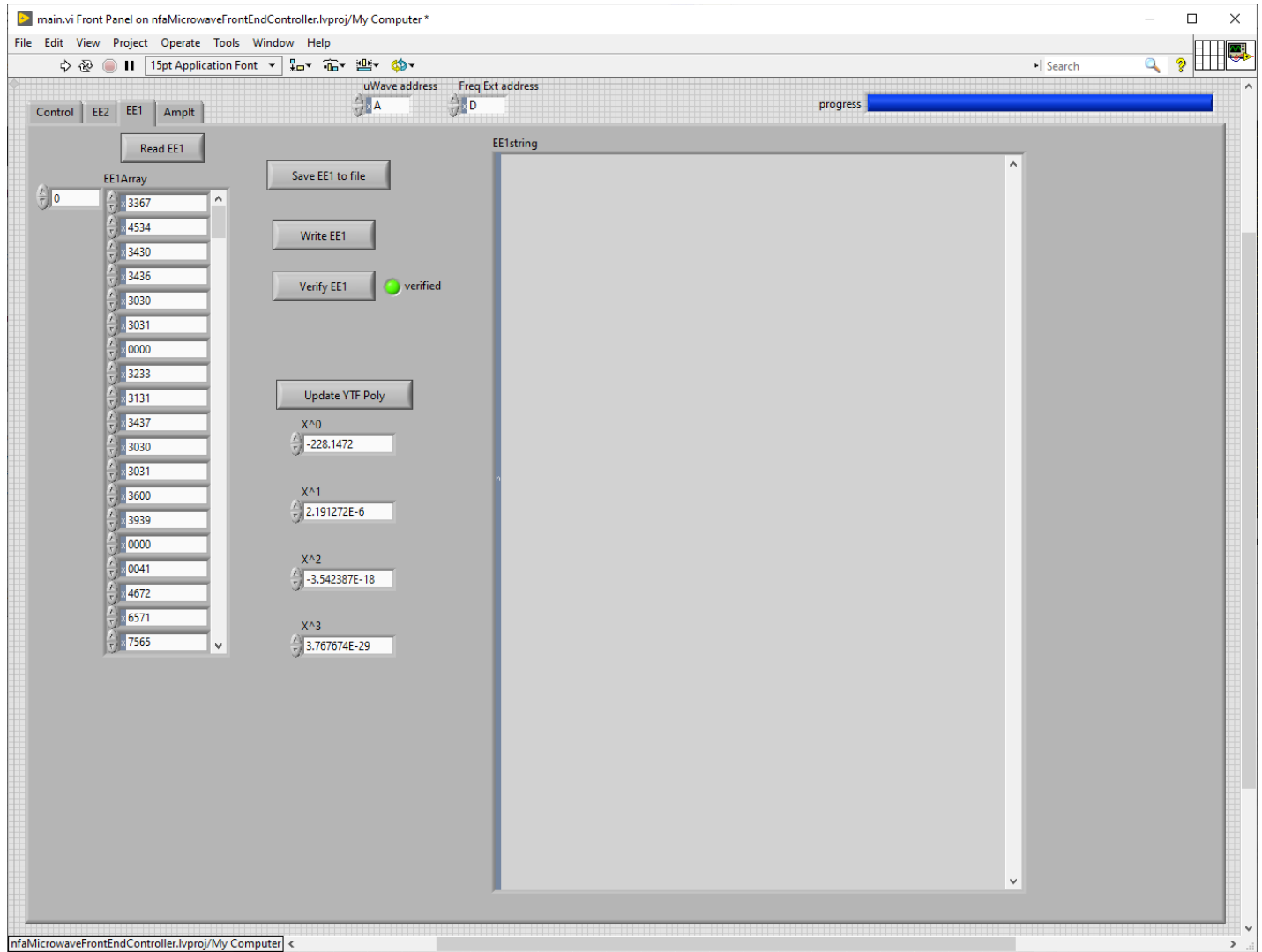
FTDI	ADBUS	Mask	Direction	Value	A7A4 pins
Black	-				90
Grey	4	0x10	1		89
Orange	0	0x01	1		88
White	6	0x40	1		87
Yellow	1	0x02	1		86

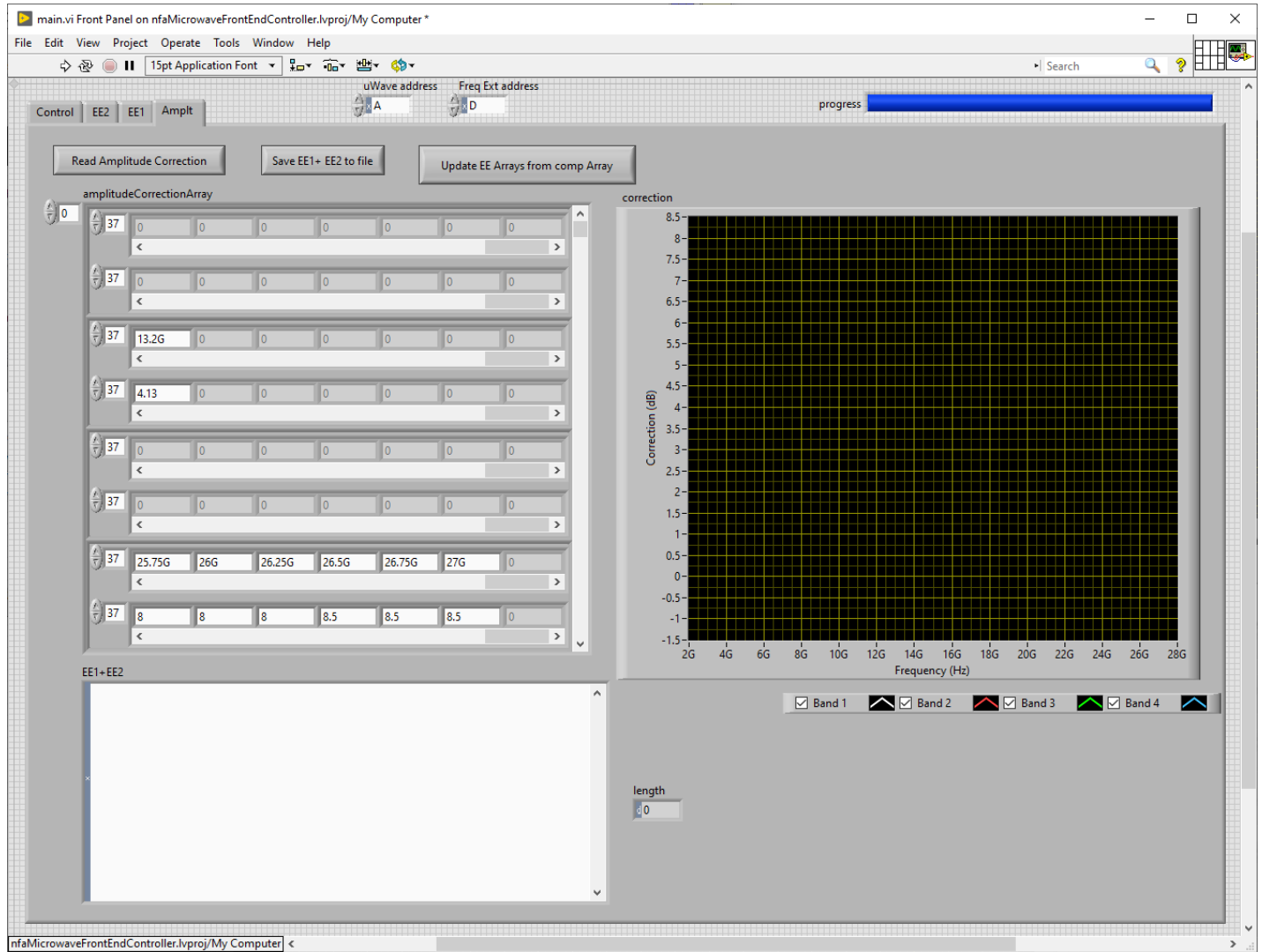
Purple	5	0x20	1	85
Green	2	0x04	0	84
Brown	3	0x08	0	34
Blue	7	0x80	0	81

I think the cable I used was one of these: <https://ftdichip.com/products/c232hm-ddhsl-0-2> (<https://ftdichip.com/products/c232hm-ddhsl-0-2/>)









Amazing what you can do when you put your mind to it 😊

Best regards,
A

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boot and ytf align log.txt

([https://groups.io/g/HP-Agilent-Keysight-equipment/attachment/119574/6/boot and ytf align log.txt](https://groups.io/g/HP-Agilent-Keysight-equipment/attachment/119574/6/boot%20and%20ytf%20align%20log.txt))



_completely Successful calibration.txt

([https://groups.io/g/HP-Agilent-Keysight-equipment/attachment/119574/7/_completely Successful calibration.txt](https://groups.io/g/HP-Agilent-Keysight-equipment/attachment/119574/7/_completely%20Successful%20calibration.txt))

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Zack Smith

Jun 1 [🔗 \(https://groups.io/g/HP-Agilent-Keysight-equipment/message/116239\)](https://groups.io/g/HP-Agilent-Keysight-equipment/message/116239)

Hi Alex,

Were you able to regenerate the YTF alignment/correction data? I am in the need to do the same for my ESA where the YTF needs to be re-adjusted. Did you find out the format of the values stored for that on the freq. extension board, and the best way to regenerate the correct values?

Thanks,

--zs

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Sandra Carroll

Apr 25 [🔗 \(https://groups.io/g/HP-Agilent-Keysight-equipment/message/115279\)](https://groups.io/g/HP-Agilent-Keysight-equipment/message/115279)

@Techfreakz, sounds interesting what you're doing. would love to see it in action sometime.

Something I would love to see is this the Tacking Generator. HP/Agilent/Keysight (take your pic) all say the TG is not alienable which makes no sense but it does have 5 multi turn pots onboard but it should still be doable.

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Techfreakz

Apr 25 [🔗 \(https://groups.io/g/HP-Agilent-Keysight-equipment/message/115276\)](https://groups.io/g/HP-Agilent-Keysight-equipment/message/115276)

Hello Amirb,

Well lets just say I like a challenge.

If the data grouped as per the patent outlines, I can at least regenerate the YTF frequency correction and gain correction data. There are only so many ways of packing floating point & integer data!

Bear in mind that I've already written a GUI that controls a good portion of the instrument without the main processor board being installed in the instrument! So I'm committed.....or is that should be committed!!

Best regards,
Alex

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amirb

Apr 25 [🔗 \(https://groups.io/g/HP-Agilent-Keysight-equipment/message/115275\)](https://groups.io/g/HP-Agilent-Keysight-equipment/message/115275)

maybe I am missing something but let's say you did get a copy of this EEPROM from another instrument what is it useful for? it's a bunch of binary garbage, it's not like you can read nice table of decimal numbers in there and besides, it won't be useful for another instrument so I am wondering what is it useful for to have an image of this EEPROM

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Techfreakz

Apr 25 (<https://groups.io/g/HP-Agilent-Keysight-equipment/message/115274>)

Hello Mark,

Understood. No problem. Thank you anyway.

For the benefit of anyone else with this issue, on the Freq Ext board, there is an additional EEPROM NM93C86, that holds the YTF alignment data and, by the looks of it, the frequency flatness data.

I suspect it is stored as per this patent: <https://patents.google.com/patent/US8112238> (<https://patents.google.com/patent/US8112238>)

Best regards,
Alex

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Mark Bielman (</g/HP-Agilent-Keysight-equipment/profile/502679>)Apr 25 (<https://groups.io/g/HP-Agilent-Keysight-equipment/message/115273>)

Alex - That sounds risky. I finally got mine working and hate to tear into it again. I presume the EEPROM is soldered.

From my limited experience with these (front panel and processor EEPROMs) they hold the part #, serial #, rev, etc and not much else.

Mark

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Techfreakz

Apr 25 (<https://groups.io/g/HP-Agilent-Keysight-equipment/message/115272>)

Hello again Mark,

I would be happy to pay for your time if you could read out U41.....

BTW, I'm developing a LabVIEW utility that allows you to use an FTDI cable to control all the boards on the pseudo-SPI in the ESA/NFA series.

At present it supports most of functions on the Frequency Extension (Freq Ext) board (common across the ESA series), controls the noise on/off on the Noise SIB and controls nearly everything on the NFA uWave Front End Module.

I've been using this to exercise all the components used to align the YTF automatically.

Best regards,
Alex

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Techfreakz

Apr 25 (<https://groups.io/g/HP-Agilent-Keysight-equipment/message/115271>)

Hello Mark,

Thank you anyway!

I'm busy repairing an N8975A (based on the same platform) and the YTF alignment is failing.

Best regards,
Alex

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Sandra Carroll

Apr 25 (<https://groups.io/g/HP-Agilent-Keysight-equipment/message/115270>)

Hi Mark,

you might check out eevblog in these threads, we did alot of work around licensing in them and reading out the processor EEPROM
<https://www.eevblog.com/forum/testgear/enabling-options-on-agilent-esa-series-e4402b-e4404b-e4405b-e4407b/new/?topicseen#new>
(<https://www.eevblog.com/forum/testgear/enabling-options-on-agilent-esa-series-e4402b-e4404b-e4405b-e4407b/new/?topicseen#new>)

also I did a processor board repair there (ended up being a bricked unit) has my E4407B processor EPROM read out in the thread.
<https://www.eevblog.com/forum/repair/agilent-e4407b-repair-no-video/> (<https://www.eevblog.com/forum/repair/agilent-e4407b-repair-no-video/>)
I have datasheets for all the memory components in that thread as well as images of the processor board (looks to be same as yours 60059)

The processor board EEPROM does not contain any licensing information. from what we were able to tell is all on the FLASH SIMM.
this is why a main processor board loses its licenses. replacing the board and keeping the simm does not keep licenses either. Licenses are Node Locked + Serial
Serial is on the processor board. never did find out there the HW ID is kept.

Keep up the good work, love to hear more

Sandra

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Mark Bielman (</g/HP-Agilent-Keysight-equipment/profile/502679>)

Apr 25 (<https://groups.io/g/HP-Agilent-Keysight-equipment/message/115268>)

Hi Alex,

I did not. Sorry.

Mark

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Techfreakz

Apr 25 (<https://groups.io/g/HP-Agilent-Keysight-equipment/message/115267>)

Hello Mark,

Whilst you were reading out the EEPROMs, did you happen to read out the YTF calibration EEPROM (U41) on the frequency extension board?

Best regards,
Alex

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Mark Bielman (</g/HP-Agilent-Keysight-equipment/profile/502679>)

2019-06-28 (<https://groups.io/g/HP-Agilent-Keysight-equipment/message/97532>)

(ST Micro) M93C66. Readily available (and cheap) from Digi-Key.
I might be bold and pull the one from my working front panel and copy it into a new one.
At least my old front panel (although still dirty, etc) would be totally functional.

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mosaicmerc

2019-06-28 (<https://groups.io/g/HP-Agilent-Keysight-equipment/message/97528>)

What type of EEPROMs does it use?

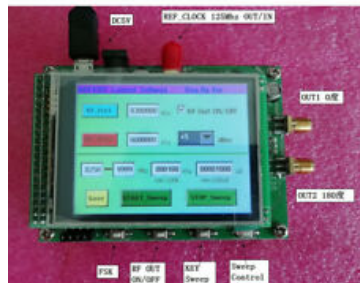
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Mark Bielman (/g/HP-Agilent-Keysight-equipment/profile/502679)

2019-06-27 [🔗 \(https://groups.io/g/HP-Agilent-Keysight-equipment/message/97524\)](https://groups.io/g/HP-Agilent-Keysight-equipment/message/97524)

I picked up one of the Chinese units based on the ADF5355 (I think). Bought it specifically to test the E4407B!
So the fundamental (6.8 MHz) is large, goes through a doubler, and the sum (13.6 + 6.8) comes through too.

Like one of these:



Needs better filters :-)

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Burt K6OQK (/g/HP-Agilent-Keysight-equipment/profile/245586)

2019-06-27 [🔗 \(https://groups.io/g/HP-Agilent-Keysight-equipment/message/97523\)](https://groups.io/g/HP-Agilent-Keysight-equipment/message/97523)

It looks like an intermod product between the 13.6 GHz signal and the lower freq signal. They appear to be pretty symmetrical. What are the frequencies of each displayed signal? If you attenuate the 13.6 GHz by 10 dB, do the others go down by 10 dB?

Burt, K6OQK

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--

Burt I. Weiner Associates
Broadcast Technical Services
Glendale, CA 91201 U.S.A.
K6OQK

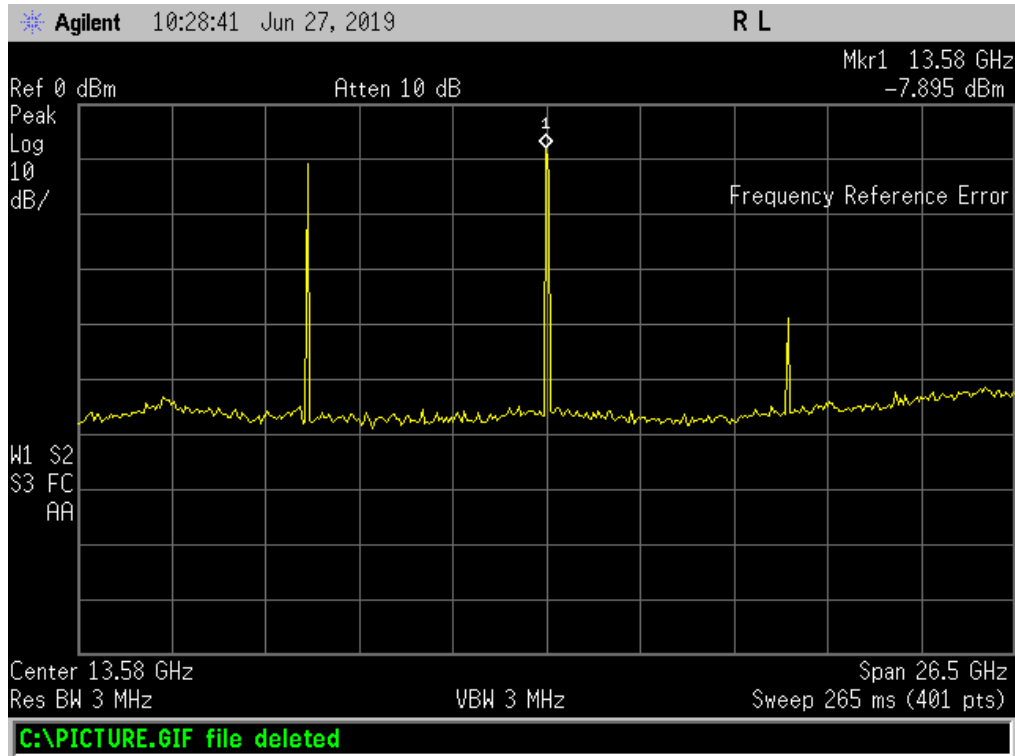
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Mark Bielman (/g/HP-Agilent-Keysight-equipment/profile/502679)

2019-06-27 (https://groups.io/g/HP-Agilent-Keysight-equipment/message/97521)

Thank you, Burt. Here I'm looking at a 13.6 GHz signal with a spur around 20 GHz. The unit seems to work fine. Just have to fix that pesky error!



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Burt K6OQK (/g/HP-Agilent-Keysight-equipment/profile/245586)

2019-06-27 (https://groups.io/g/HP-Agilent-Keysight-equipment/message/97520)

Mark,

Beautiful job!

Burt, K6OQK

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--
Burt I. Weiner Associates
Broadcast Technical Services
Glendale, CA 91201 U.S.A.
K6OQK

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32 > (https://groups.io/g/HP-Agilent-Keysight-equipment/topic/e4407b_restoration_project/32215745?p=Created%2C%2C%2C20%2C2%2C20%2C0&next=1)

← (<https://groups.io/g/HP-Agilent-Keysight-equipment/topic/86274179?p=,,,20,0,0,0::,,,0,0,0,86274179>)

→ (<https://groups.io/g/HP-Agilent-Keysight-equipment/topic/86539732?p=,,,20,0,0,0::,,,0,0,0,86539732>)