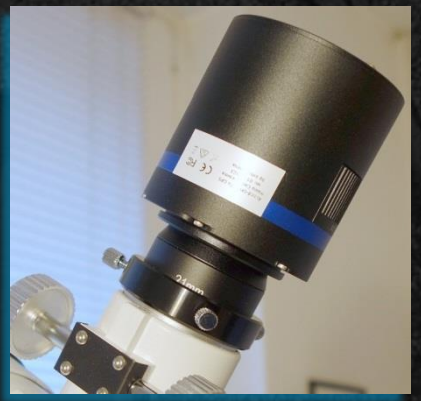
ESOP XXXIX

QHY 174 GPS

Firmware Upgrade - Implementation and Benefits

Christian Weber, IOTA/ES | 2020 August 30

QHY174GPS firmware upgrade



1 The QHY174GPS camera

2 Firmware upgrade
- Introduction
- Implementation
- Test and benefits

3 GPS status temporal behavior

4 Summary

1 The QHY174GPS camera

QHY174GPS:

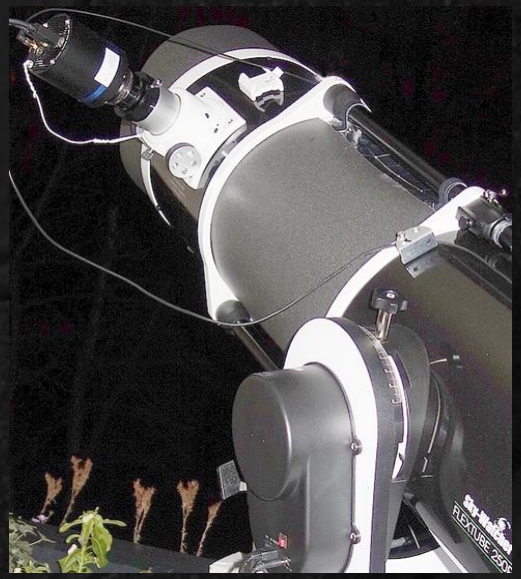
- So far the only commercial digital camera with integrated GPS-controlled shutter/timestamping
- Same sensor IMX174 like the Swiss DVTI-camera*, but very different in some relevant points:
  - Is equipped with a Peltier cooling system, (external power required)
  - Sufficient controllable with SharpCap** only
  - Requires a “Calibration” for precise timing
  - This calibration also depends on the camera’s GPS status
- Up to now the QHY delivered QHY174GPS cameras came with a limited GPS data output. This is improved with the described firmware upgrade. (There are hints that latest QHY174GPS cameras could be upgraded ex works.)

* https://groups.io/g/d-vti-cam/

** http://www.sharpcap.co.uk/

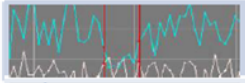
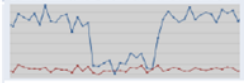
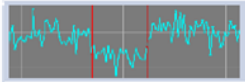
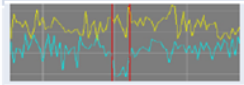
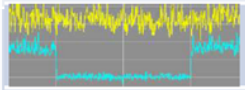
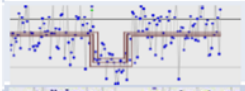
1 The QHY174GPS camera

QHY174GPS parts:



1 The QHY174GPS camera

QHY174GPS 2019 positive events:

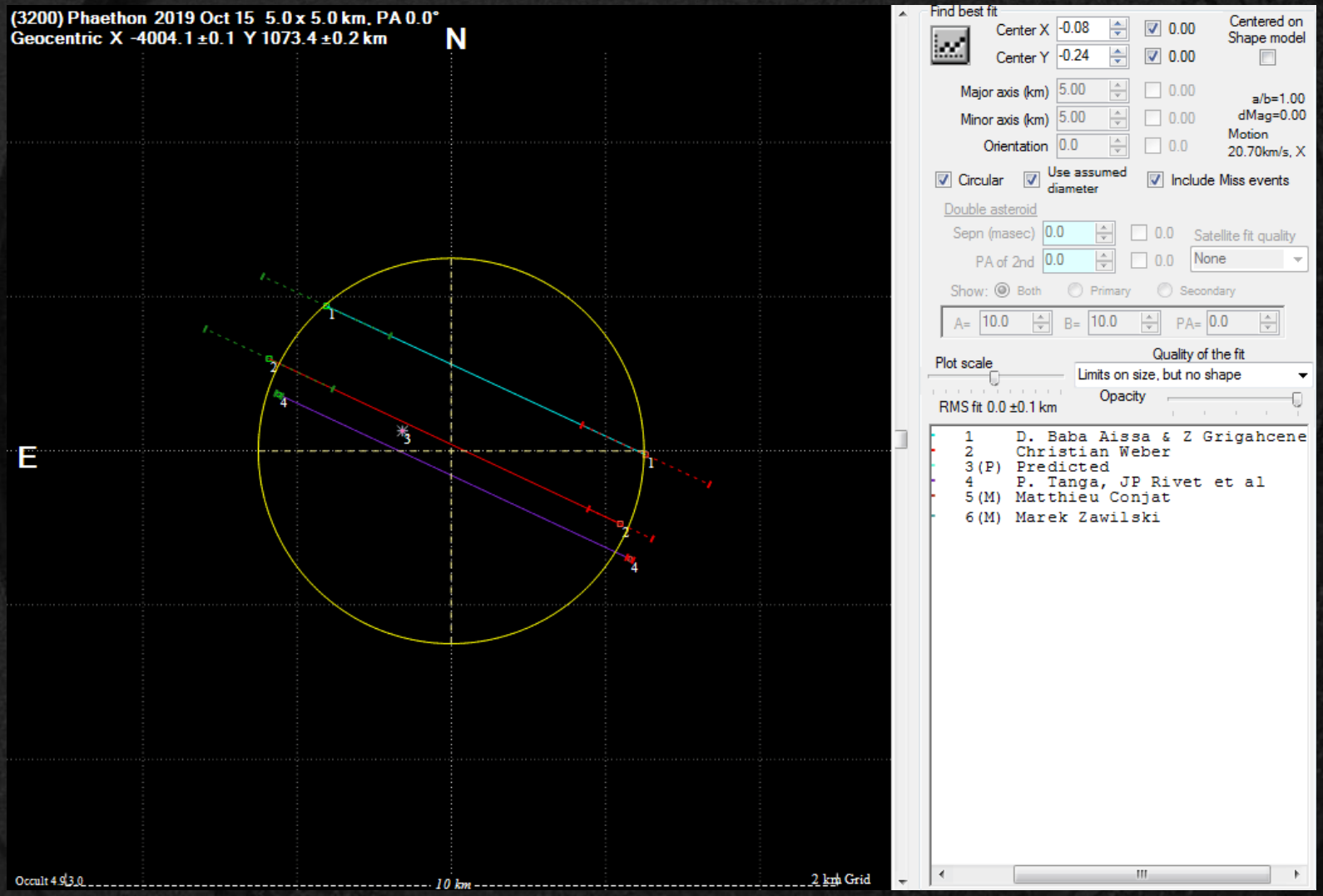
Asteroid	2019 (UT)	Star	Star (m)	Dur. (s)	Drp. (m)	Scp. (“)	Exp. (ms)	Gain	Offs.	ROI	T (°C)	USB Tr.	SC 3.2…	Data Reduction
(308) Polyxo	13 May; 01:36:15	4UC-402-056901	13.0	12.7	0.3	6 M	250	460	50	640 x 480	13	4	5994	
(734) Benda	14 Sep; 03:09:08	TYC 1891-01348-1	11.4	2.8	4.2	6 M	150	450	0	800 x 600	-25	4	6086	
(675) Ludmilla	14 Sep; 21:52:57	4UC-597-007906	11.9	11.1	0.7	6 M	300	480	0	640 x 480	-20	0	6086	
(3200) Phaethon	15 Oct; 19:46:28	4UC-707-014626	11.3	0.2	5.6	10 M	40	480	0	480 x 300	-12	4	6109	
(87) Sylvia	29 Oct; 23:39:33	TYC 1932-00469-1	10.1	23	3.3	6 M	75	460	400	480 x 300	-20	4	6109	
(140) Siwa	18 Nov; 21:50:48	4UC-550-012450	13.3	8.4	0.7	6 M	275	460	264	640 x 480	-20	4	6109	
(786) Bredichina	05 Dec; 00:13:13	4UC-562-024846	13.5	7.4	1.1	10 M	250	470	228	480 x 300	-31	4	6109	

1 The QHY174GPS camera

2019 Oct 15 Phaethon event positive recorded with QHY174GPS:

1 The QHY174GPS camera

2019 Oct 15 Phaethon event positive recorded with QHY174GPS:



http://www.euraster.net/results/2019/20191015-Phaethon_crd.gif

2 Firmware upgrade | Introduction

FW upgrade source:

- Marc Buie (https://www.boulder.swri.edu) from SWRI and Robin Glover, developer of SharpCap, kindly made a firmware upgrade available which allows the output of the enhanced GPS data set: (https://forums.sharpcap.co.uk/viewtopic.php?f=28&t=3012#p14581)

Prerequisites:

- Have a stable and recent SC installation and a working QHY174GPS including calibration and GPS status. (See e.g. IOTA QHY174GPS Workshop, SC QHY sub-forum and K. Getrost's two lectures at the IOTA 2020 annual meeting:

  https://www.iota-es.de/qhy174gps_workshop.html

  https://forums.sharpcap.co.uk/viewforum.php?f=28&sid=bd9f48c10b285b16879b410bf7ba95ff

  http://occultations.org/community/meetingsconferences/na/2020-iota-annual-meeting/)

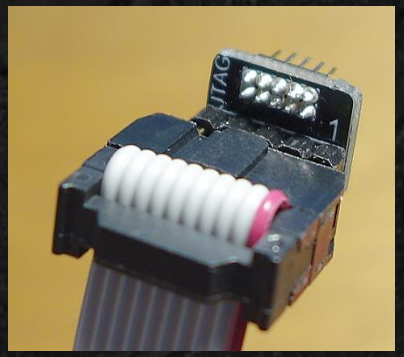
- There is some risk of short circuit and ESD. Generally spoken, it is a bit tricky, you will need some experience in electronics. Not every step is documented here, you may contact me personally (see last page).

Prerequisites continued:

- The *„Notes on Upgrading QHY174 Firmware.pdf”* https://forums.sharpcap.co.uk/download/file.php?id=3191 are a good and recommended guideline - but be creative with your own situation.
- For the actual transfer of the new firmware the camera must by powered: by USB - not by the 12 V.
- Avoid any USB interruptions during FW transfer.
- There is no way to save and replay the original (old) firmware.

!!! You will likely violate your camera’s warranty. Everything you do is at your own risk !!!

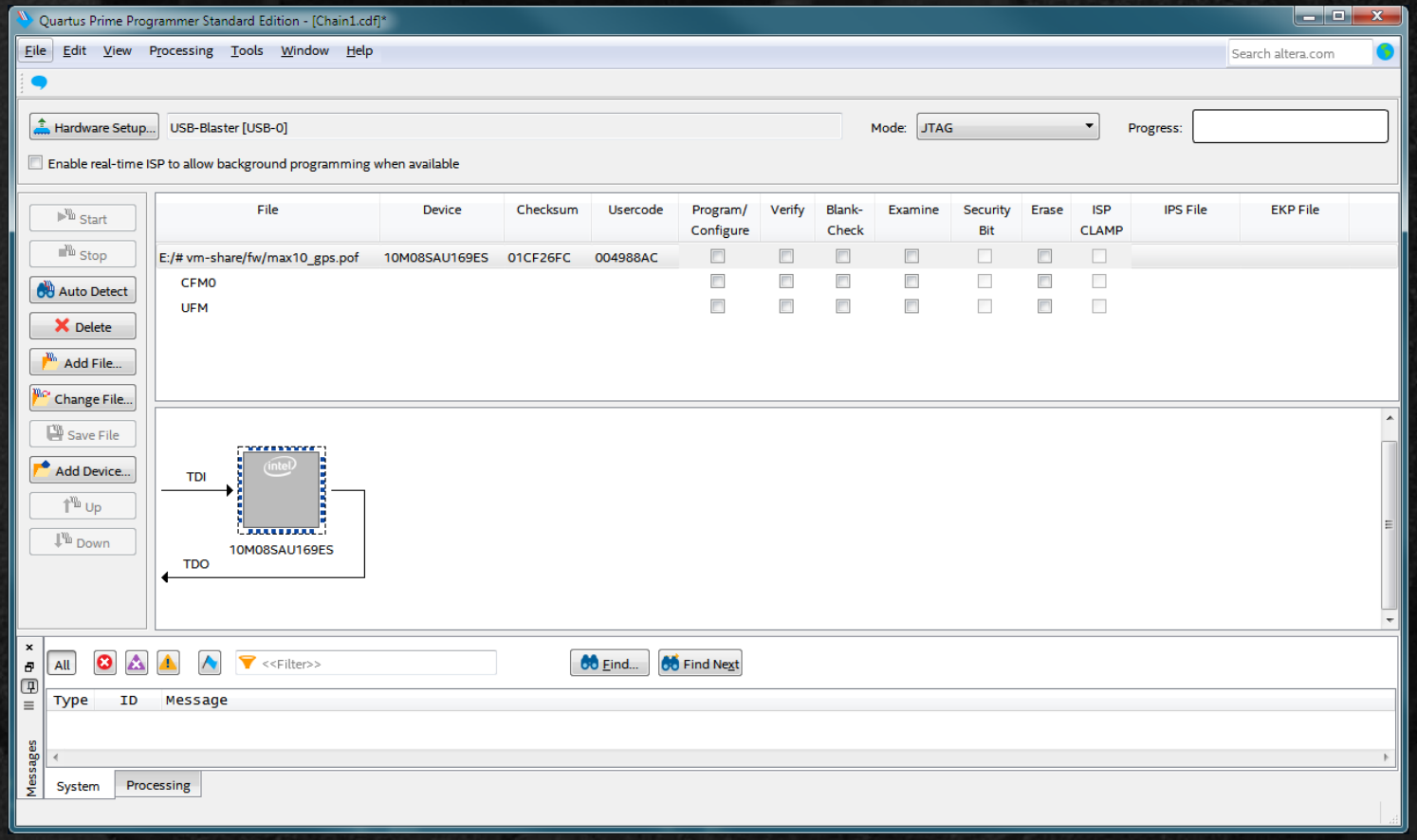
USB blaster and JTAG connector:
You need these with the camera delivered parts. Be aware to connect them in the right direction as shown.



2 Firmware upgrade | Implementation 2

FPGA software:

To upgrade, you need to install Intel's *„Quartus Prime Lite Edition“* https://fpgasoftware.intel.com/?edition=lite . This SW is free but for download you must register.



Remove the housing as far as possible. Maybe there are some glue sealed connections. You will need to expose both the USB and GPS boards. They will be connected by the USB blaster.

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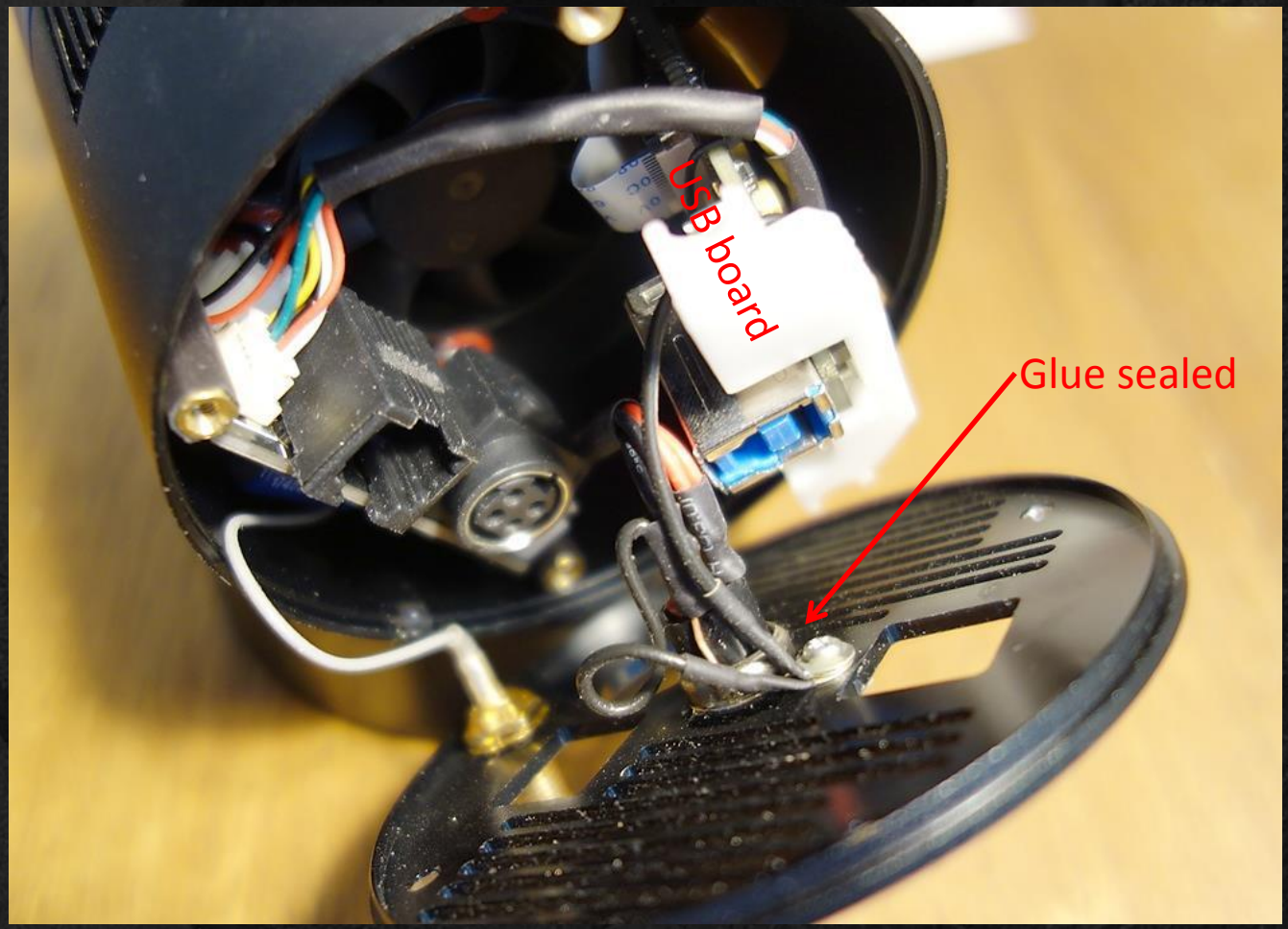
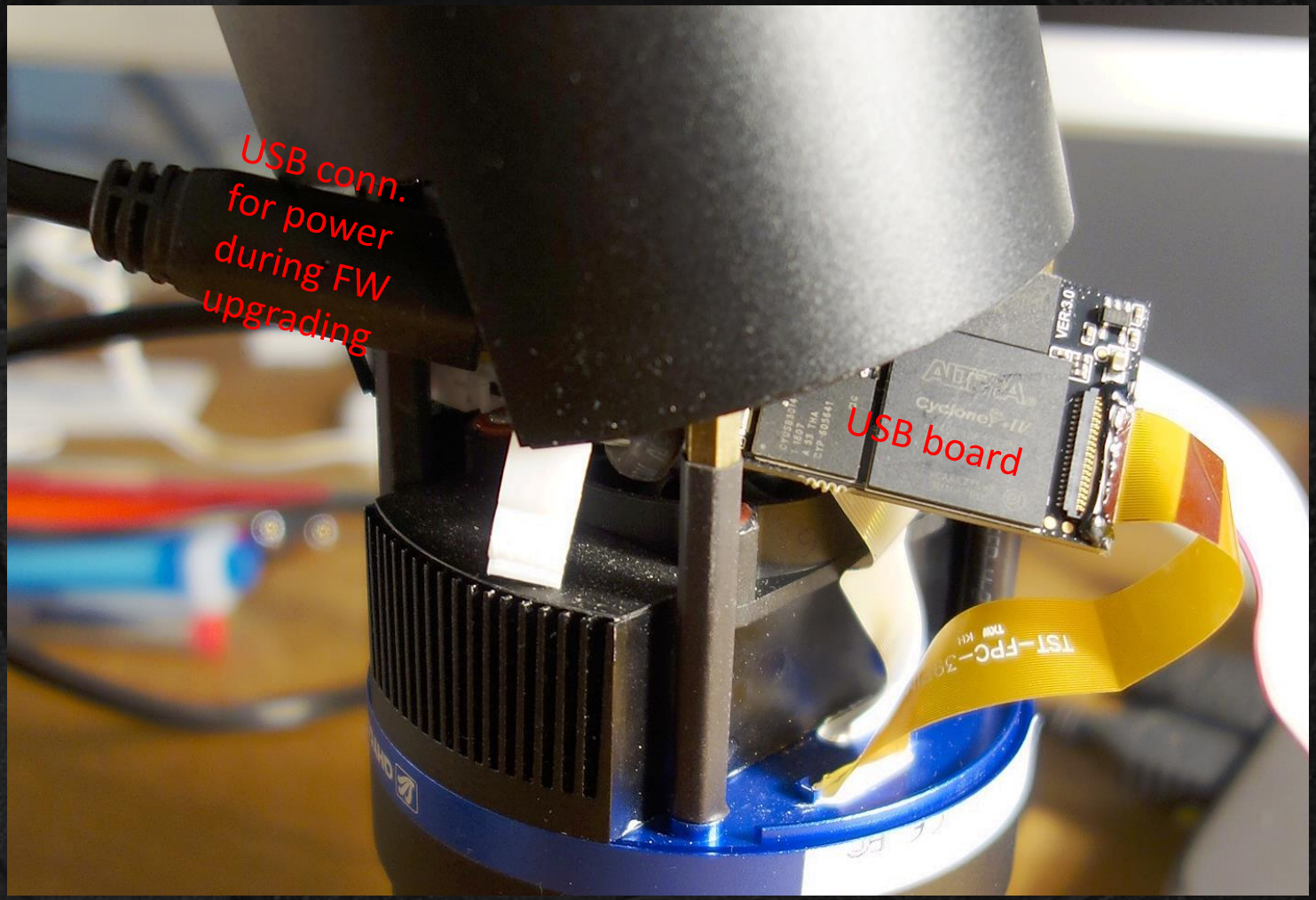


USB board (During FW upgrade of both FPGAs it must be connected with USB to power the chips.):



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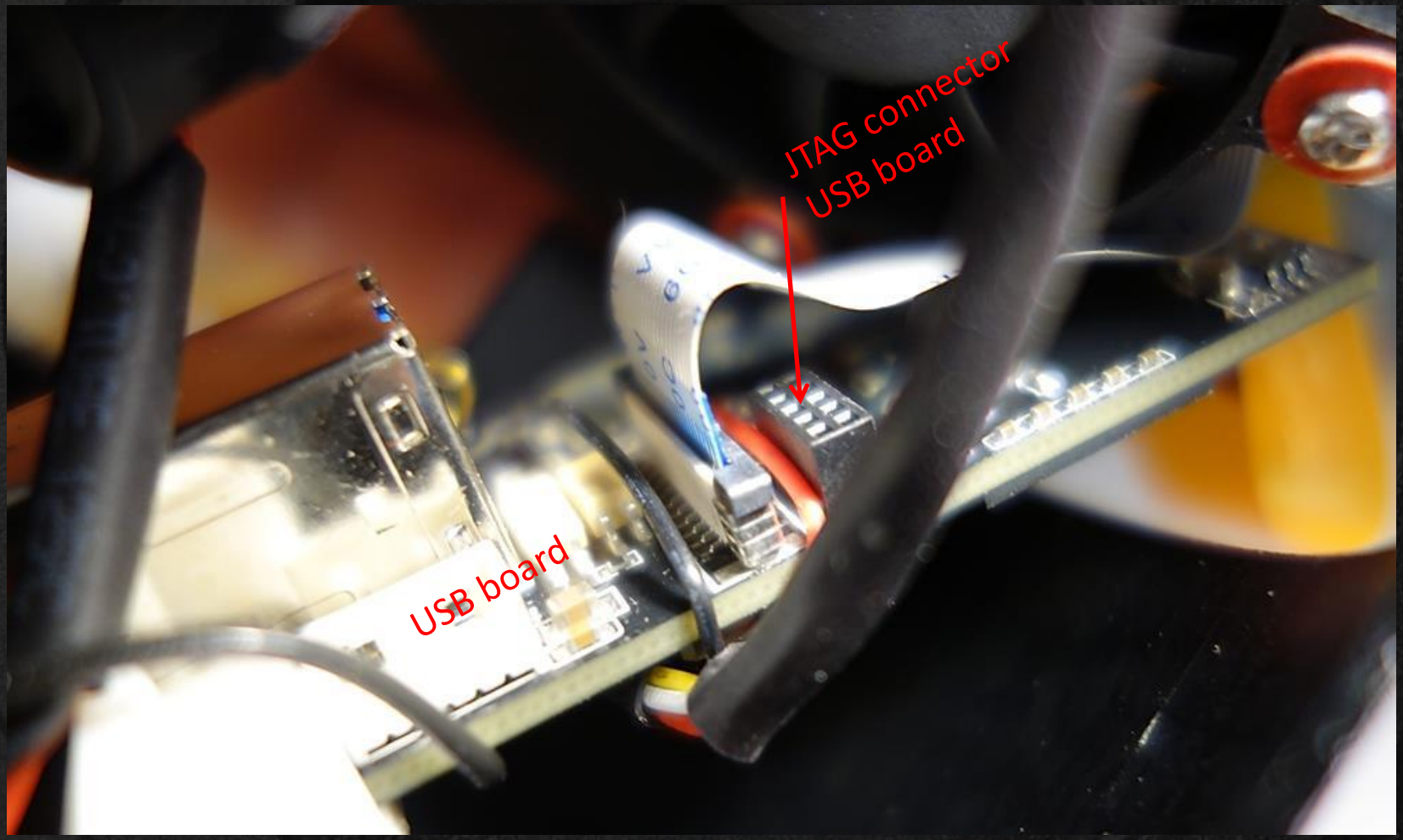

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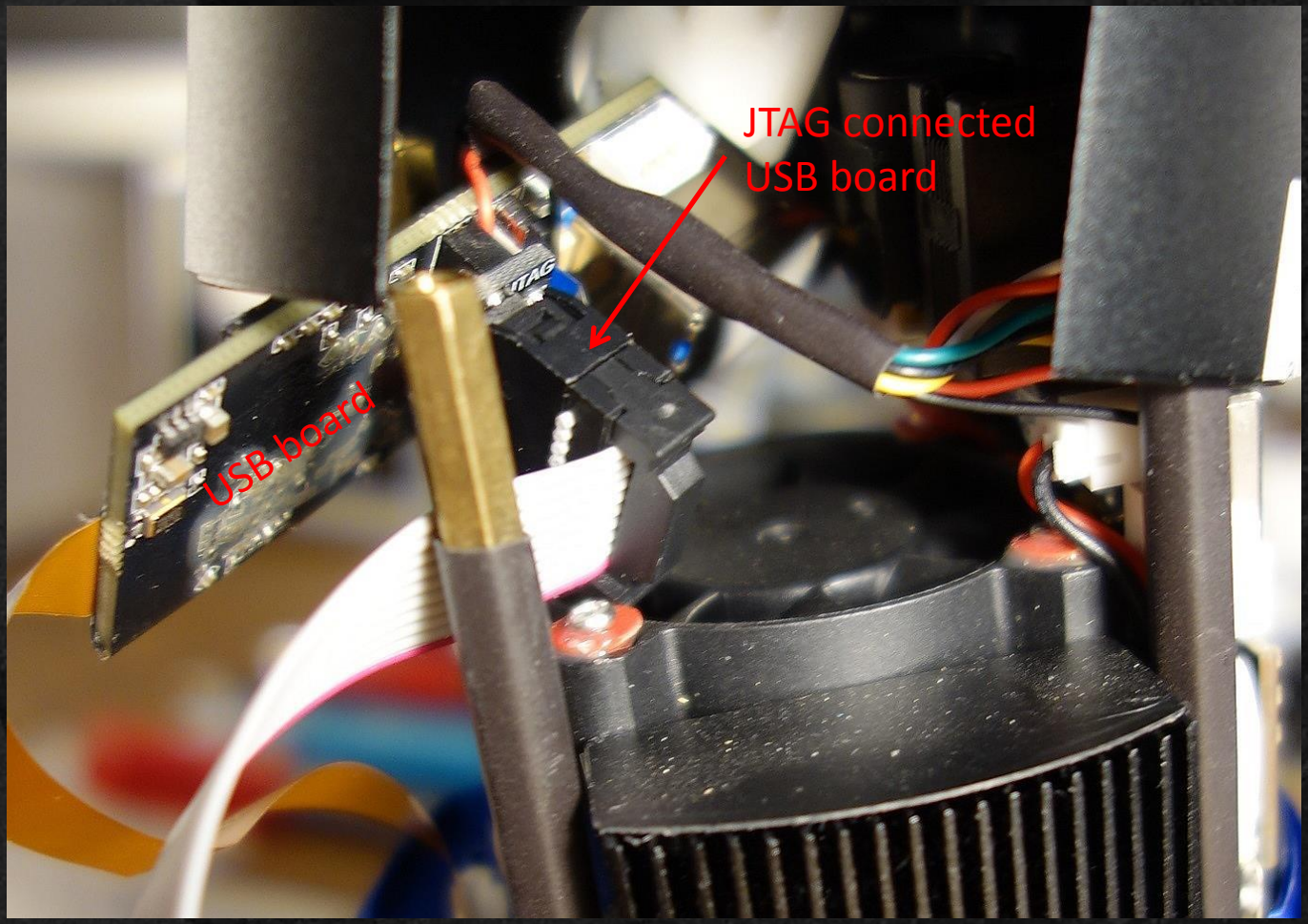
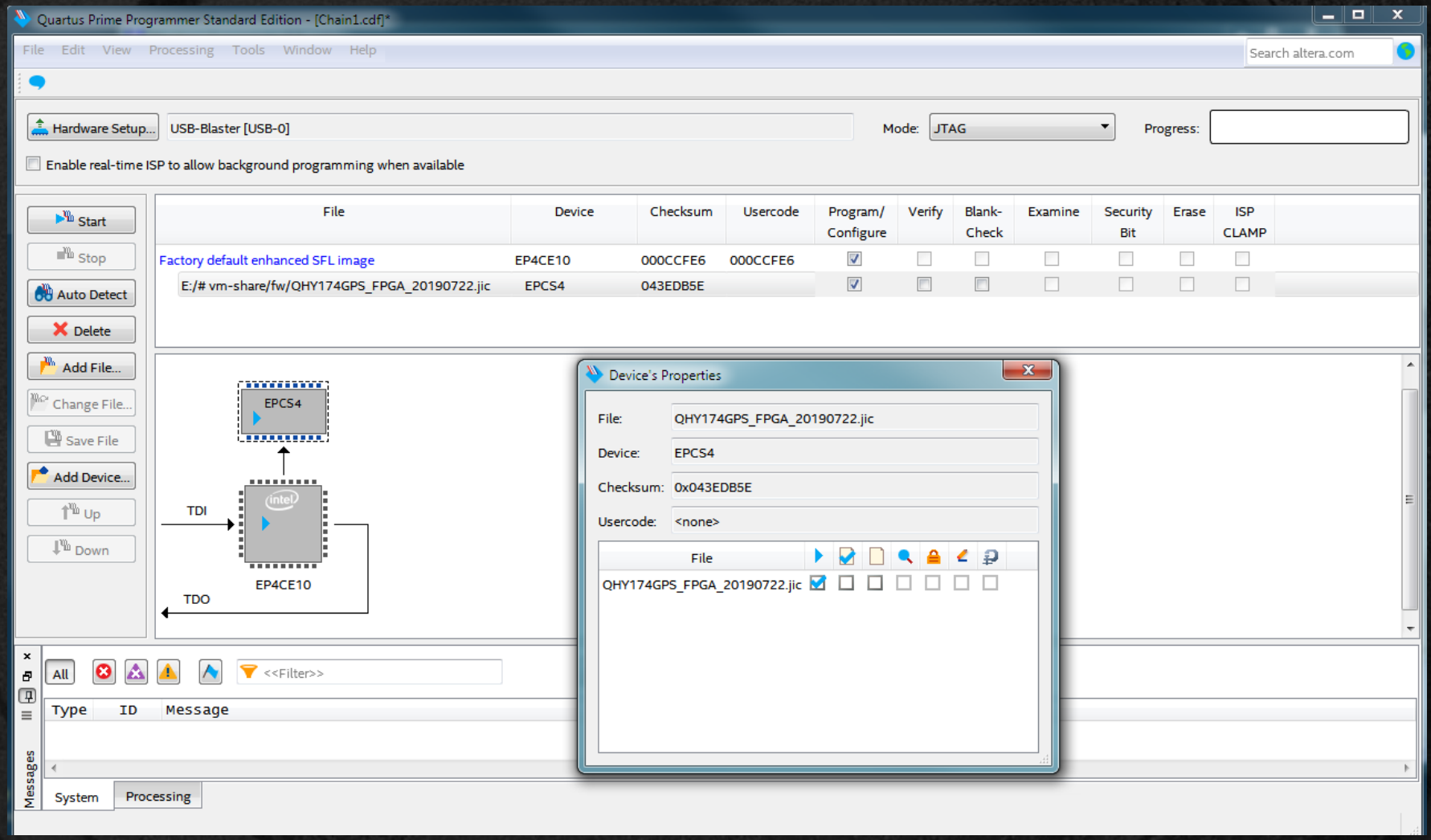
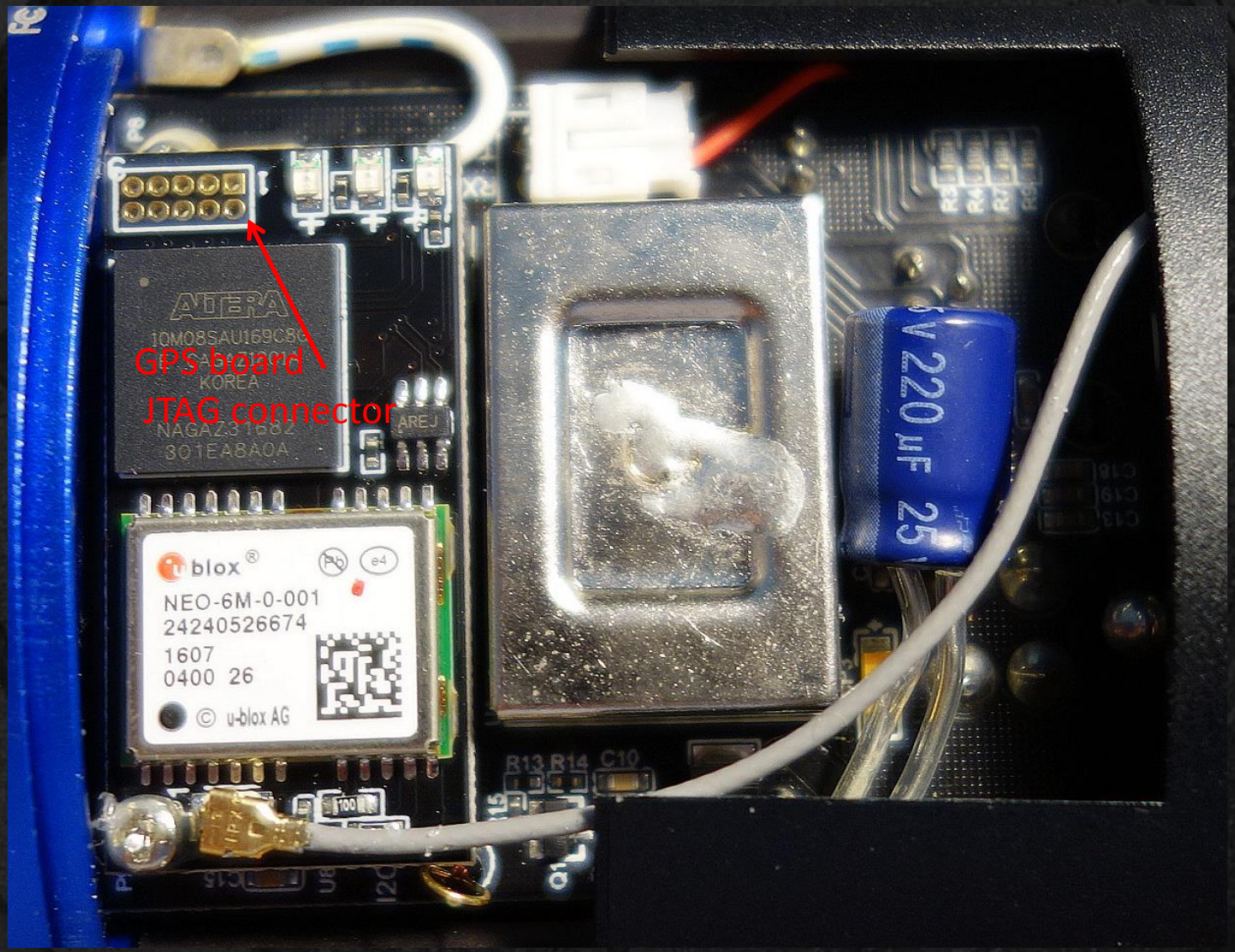


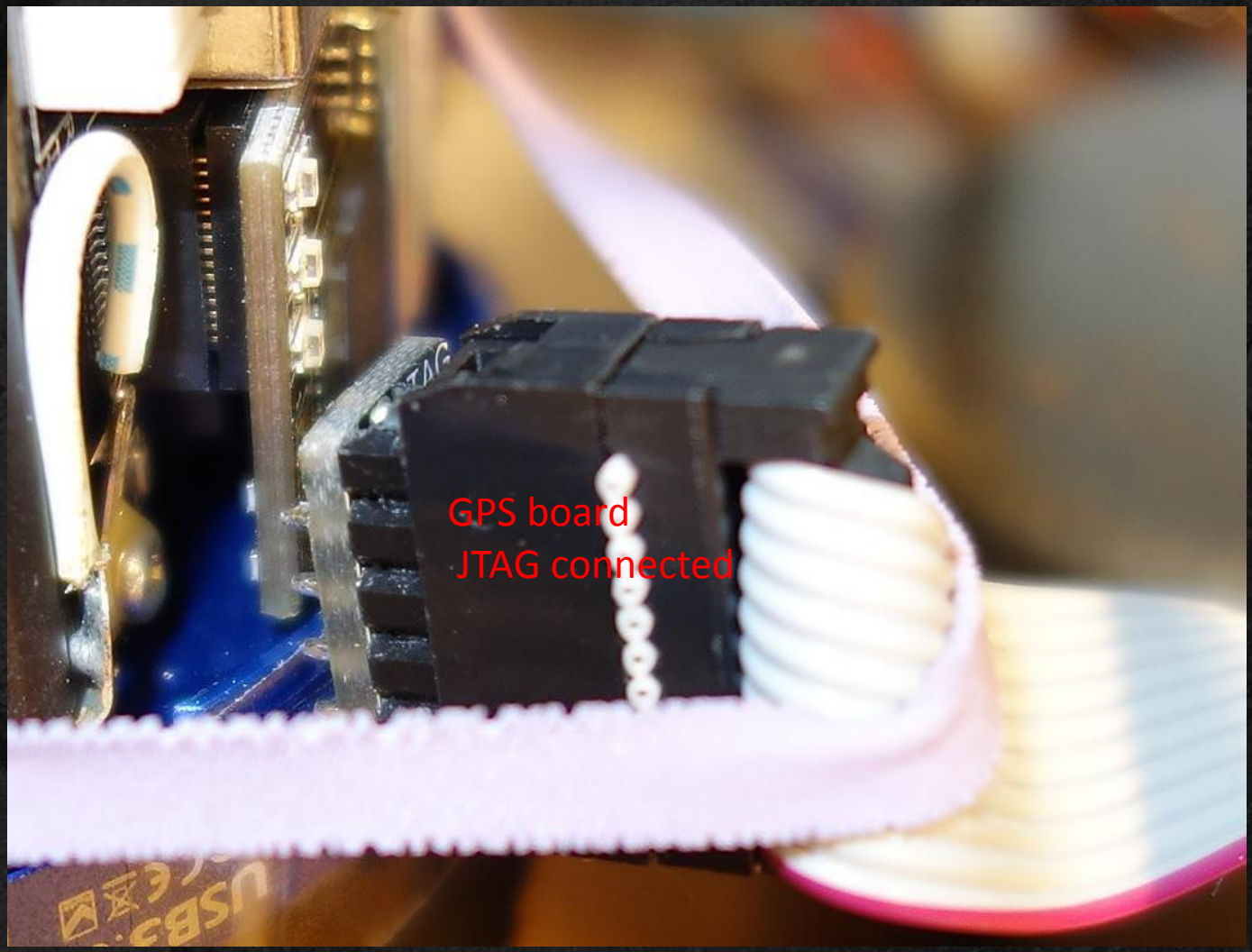
FW upgrading of the USB board:



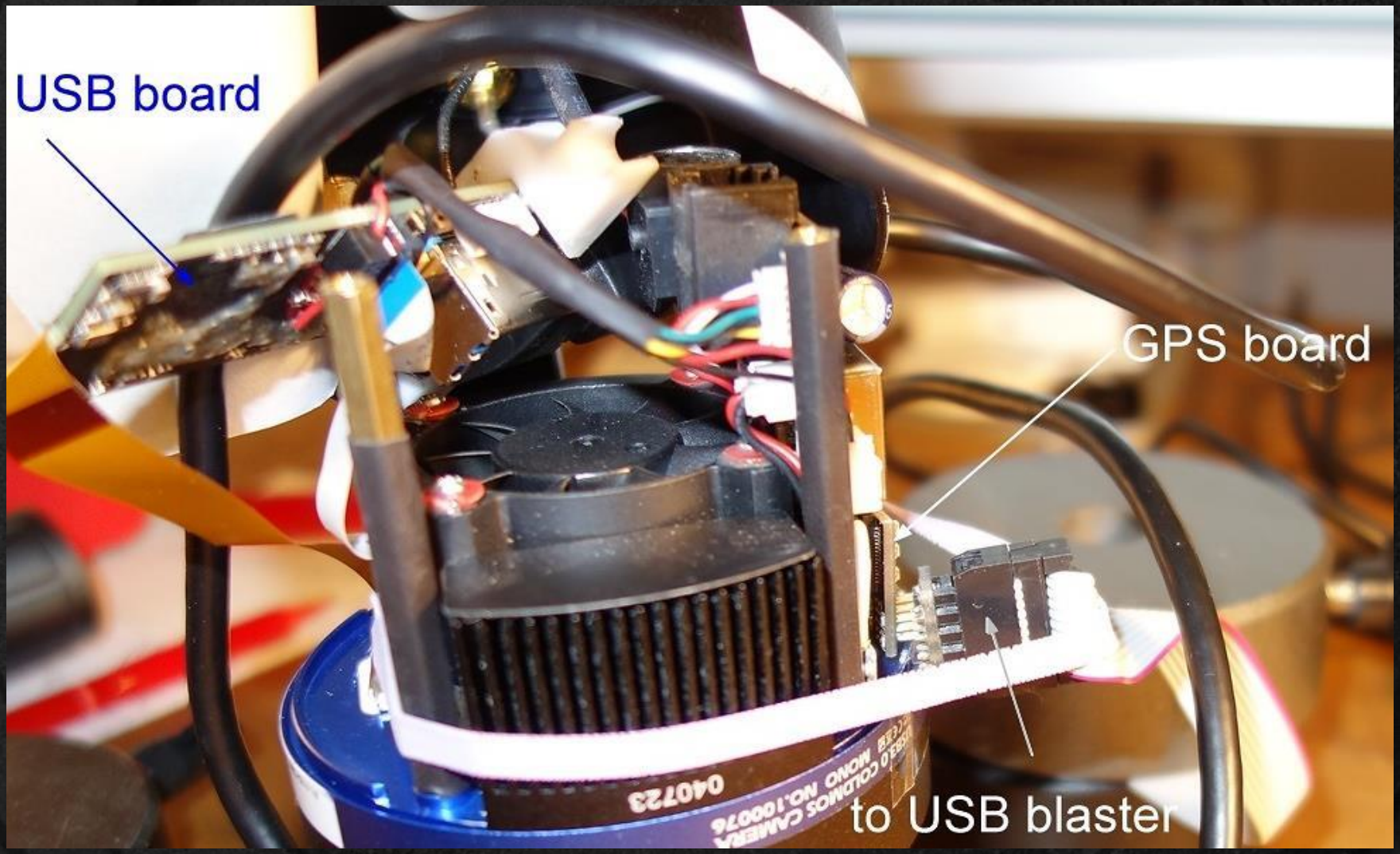
GPS board:


GPS board
JTAG connector
ALTERA
KOREA
blox
NEO-6M-0-001
24240526674
1607
0400 26
u-blox AG
220 µF 25

GPS board, JTAG connector:



FW upgrade of the GPS board:



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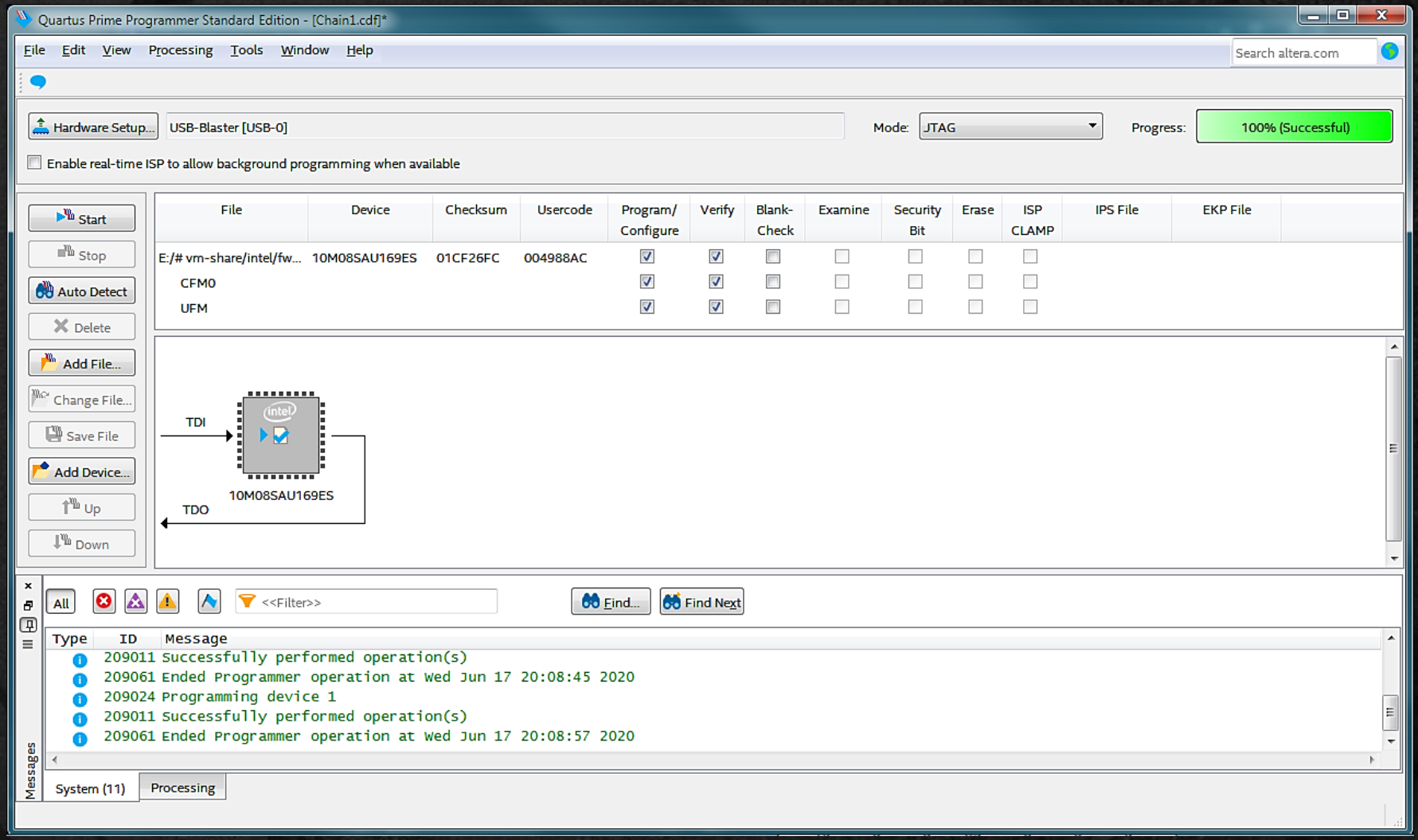
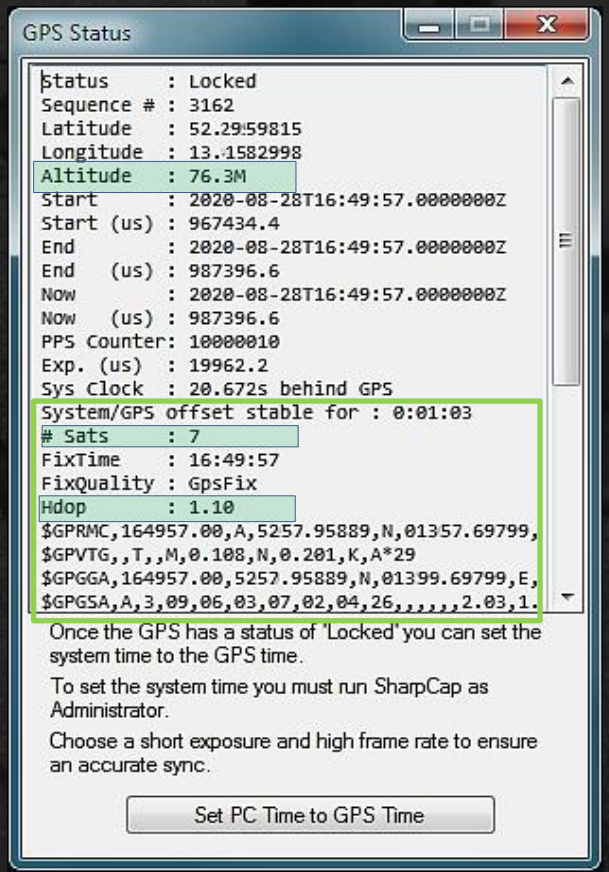


After the FW upgrades of both the boards disconnect everything. Carefully rebuild parts and housing. Double check if there are any short circuits, especially between boards and housing.
Connect the GPS antenna and start SharpCap, wait for GPS lock. Calibrate as usual.
If the upgrade was successful, you should see at least some additional information in the GPS status window (and in the GPS logfile too).



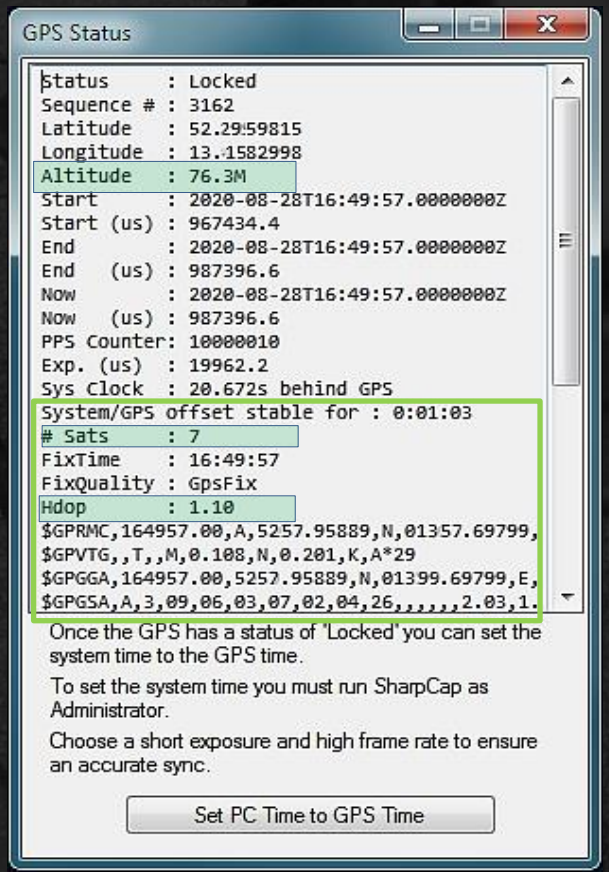
The Altitude is also written to the FITS header.

But no indicator of almanac status.

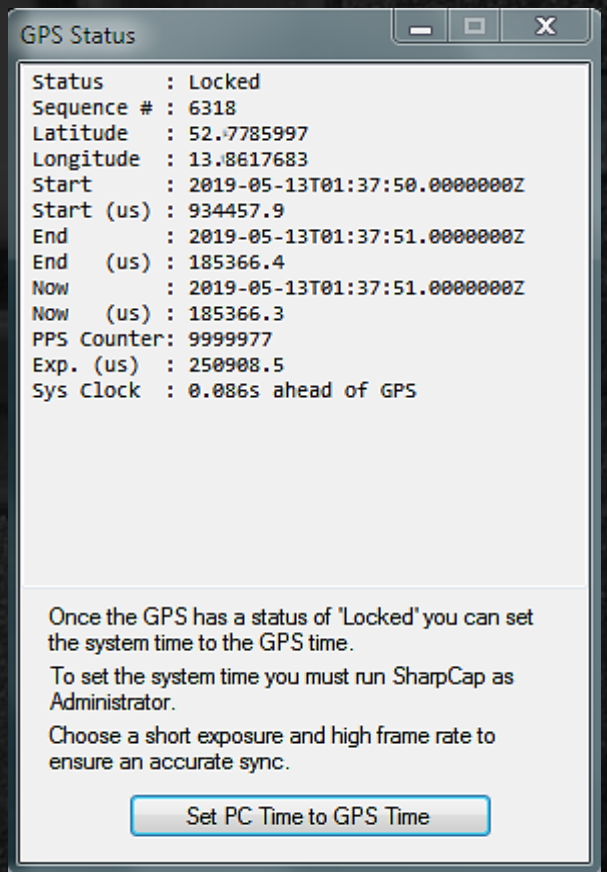
The additional data will help to establish a stable GPS status and to avoid the notorious “Bad calibration” state.

Comparison GPS status window …

… after FW upgrade

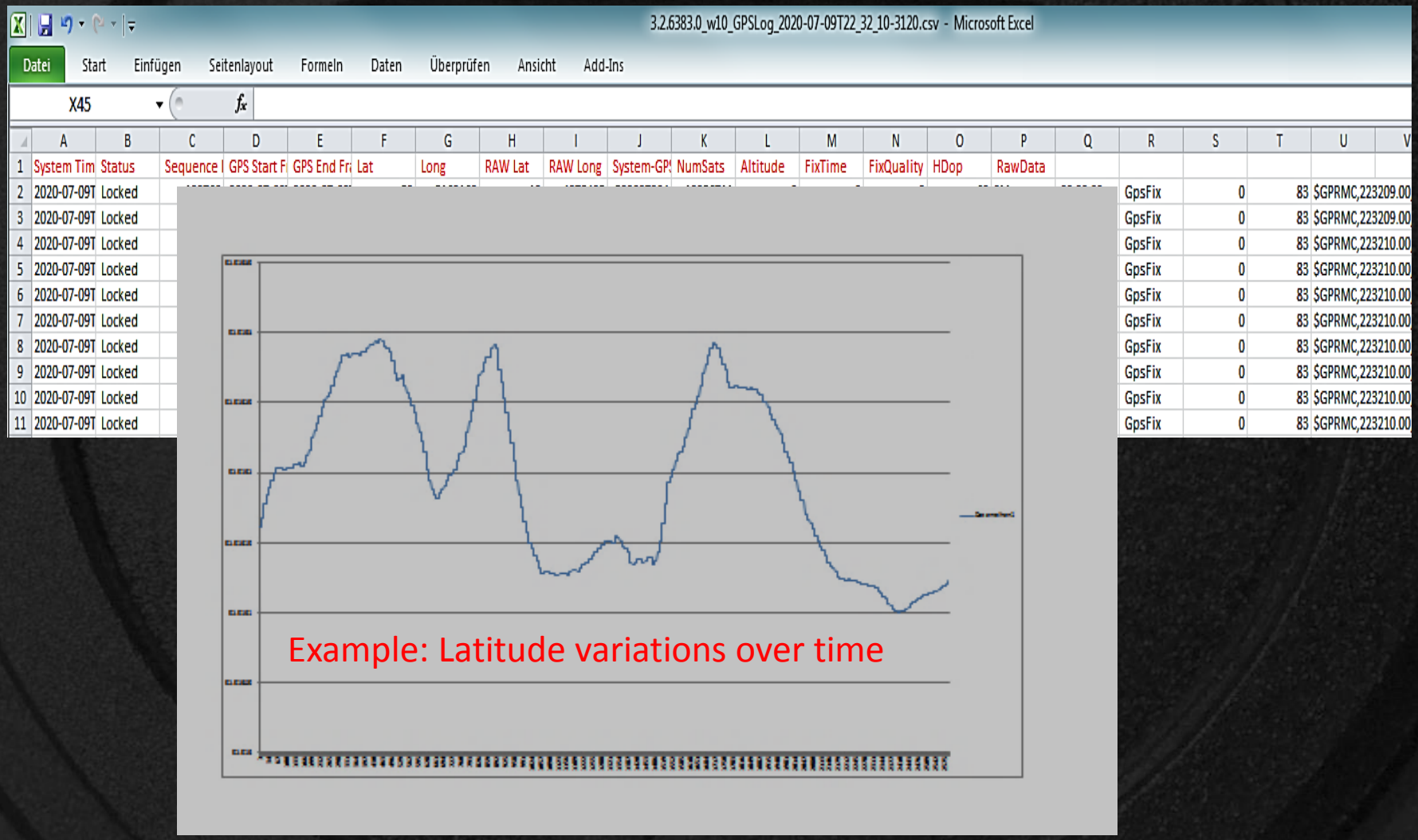


… before FW upgrade



3 GPS status temporal behavior

From the GPS logfile the GPS status temporal behavior can be studied.



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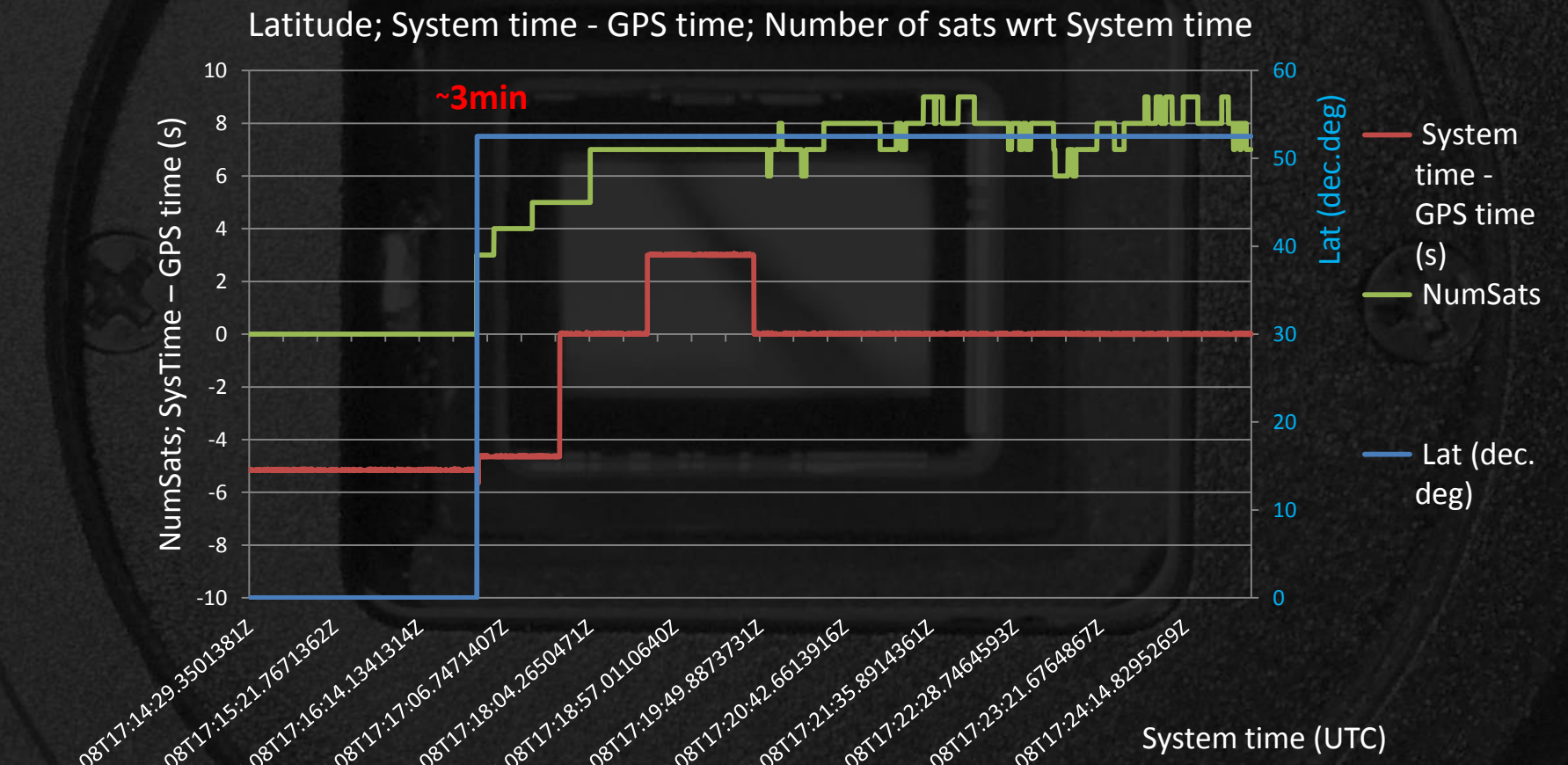
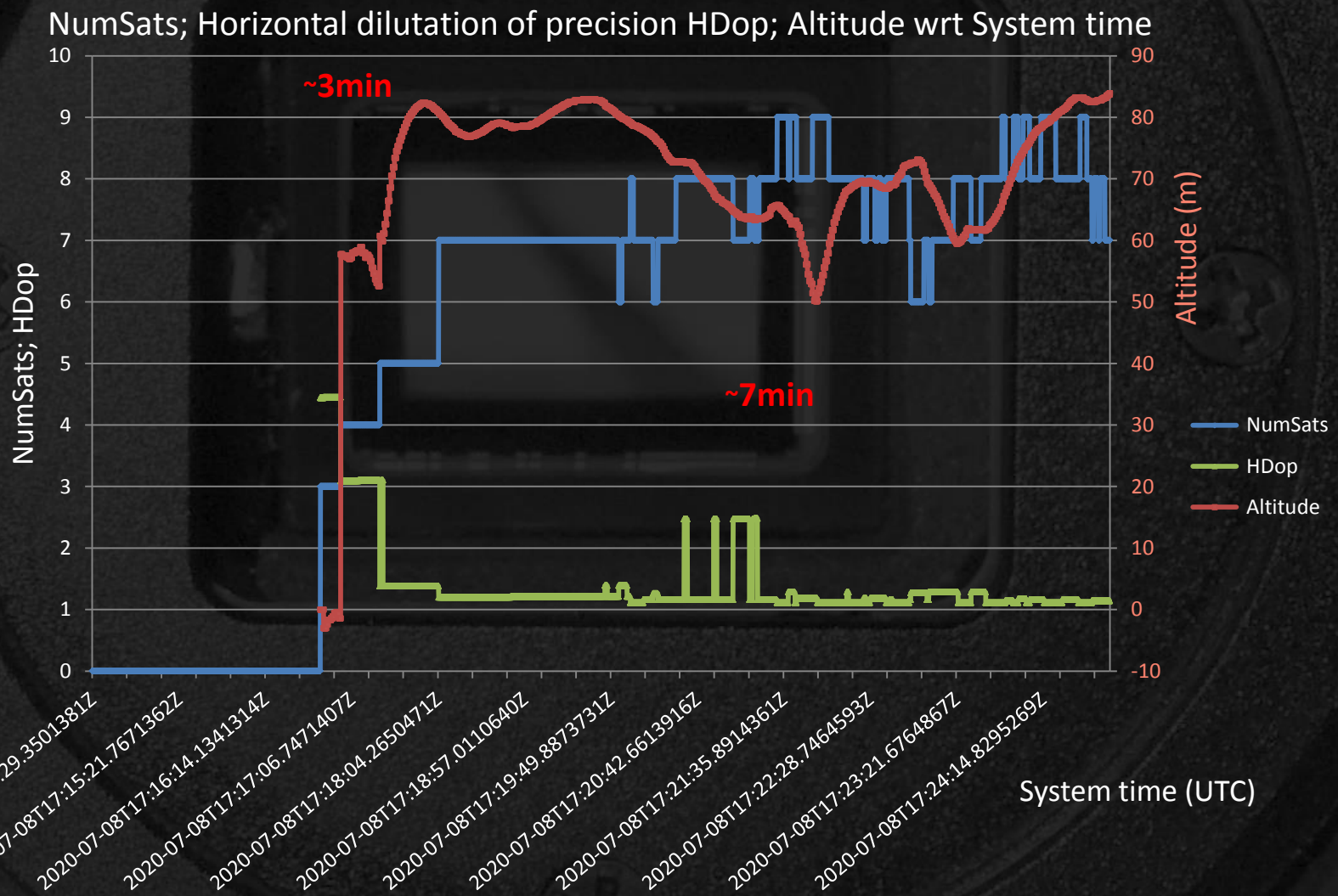


3 GPS status temporal behavior

From the GPS logfile the GPS status temporal behavior can be studied. The example shows a stabilisation after about 7min.



4 Summary

The QHY174GPS firmware upgrade:

- Is not essential to observe occultation events
- There is a certain risk of destroying something
- Not only is it nice to have, but it also helps in getting and maintaining a stable calibration and a recording with no dropped frames
- It is recommended to wait at least 15 – 20min before recording to guarantee a stabilised GPS system

QHY174GPS firmware upgrade

Many thanks to:

Marc Buie, SWRI,
Robin Glover, SC developer,
for providing the firmware upgrade.

Colleagues of the worldwide community for suggestions and valuable discussions.

© Dr. Christian Weber, ESOP XXXIX, 2020 Aug 30
Web Version 2020 Sep 02
Contact: planoccult mailing list or
camera@iota-es.de

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Thank You Very Much

Christian Weber, IOTA/ES | 2020 August 30