

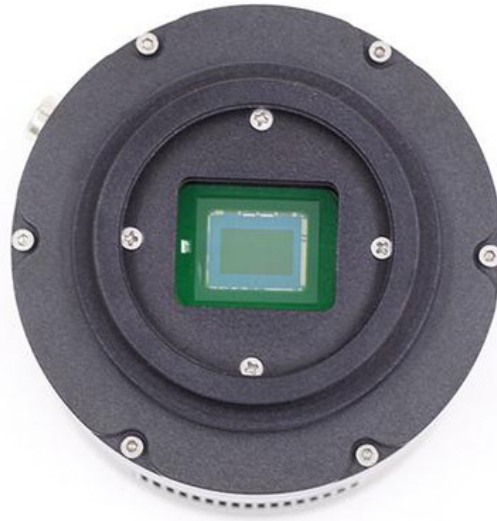
# QHY174GPS Design

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QHYCCD

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# 01



## QHY174GPS

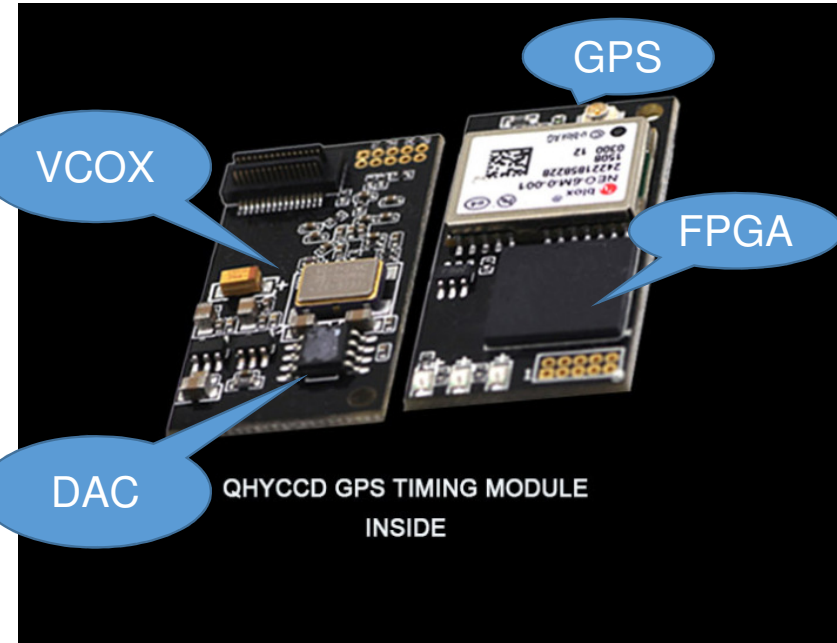
### 1. GPS Module Inside in the Camera

Design Target : Accurate 1 us    Resolution 0.1us

### 2. Sony Global Shutter CMOS

1920\*1200 UP TO 138FPS , 78% QE

2e to 5e readout noise    12/8bit output



Major Component	Feature
GPS module	Standard
FPGA	6000 gates, fully programmable
VCOX	10MHz Voltage Controlled Crystal
DAC	Digital to Analog Converter for VCOX frequency control

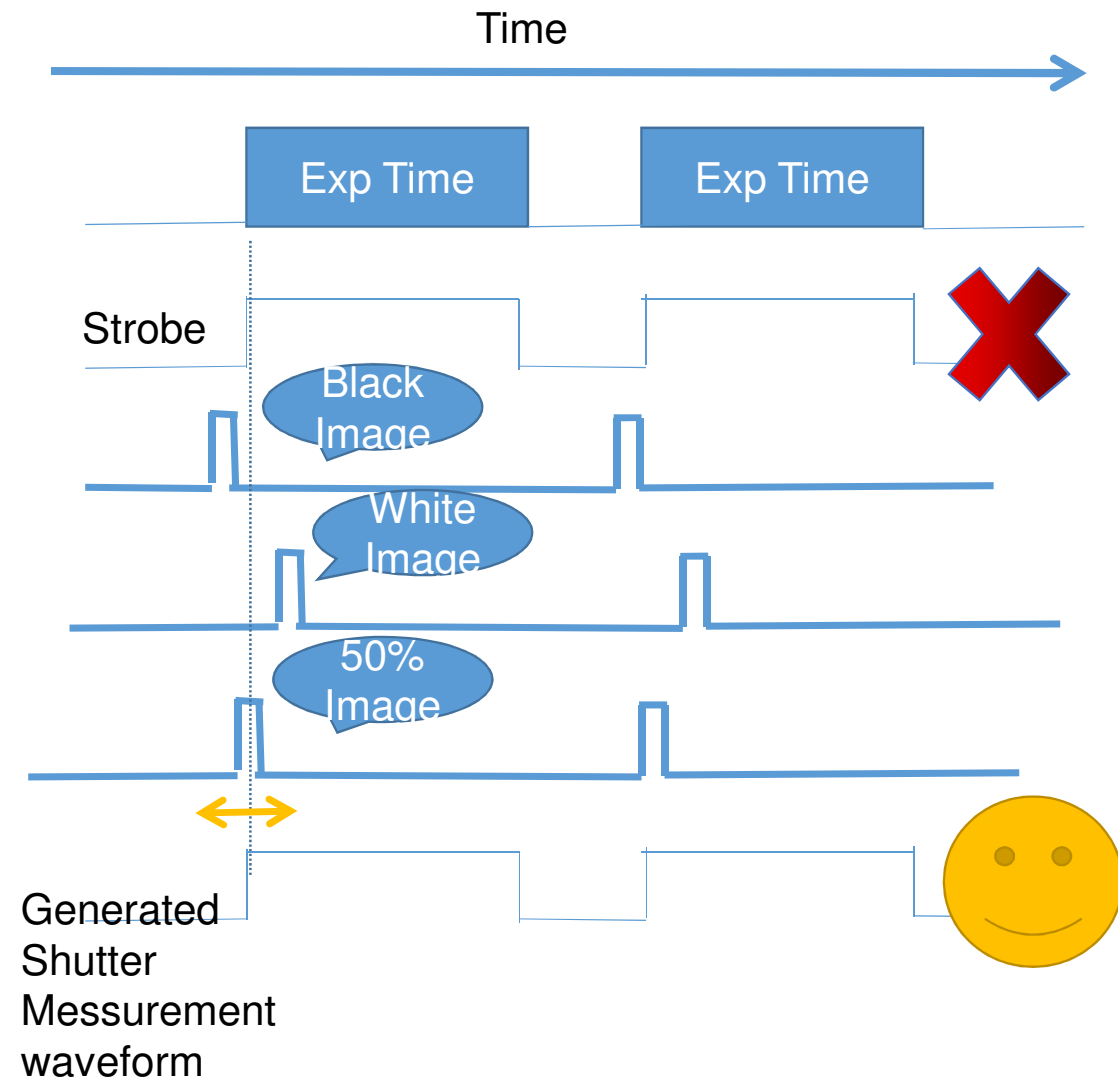
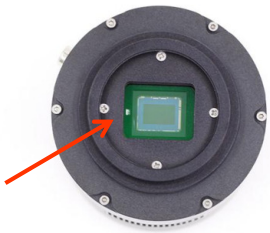
# LED Calibration Method

## ① Build in LED on front of sensor

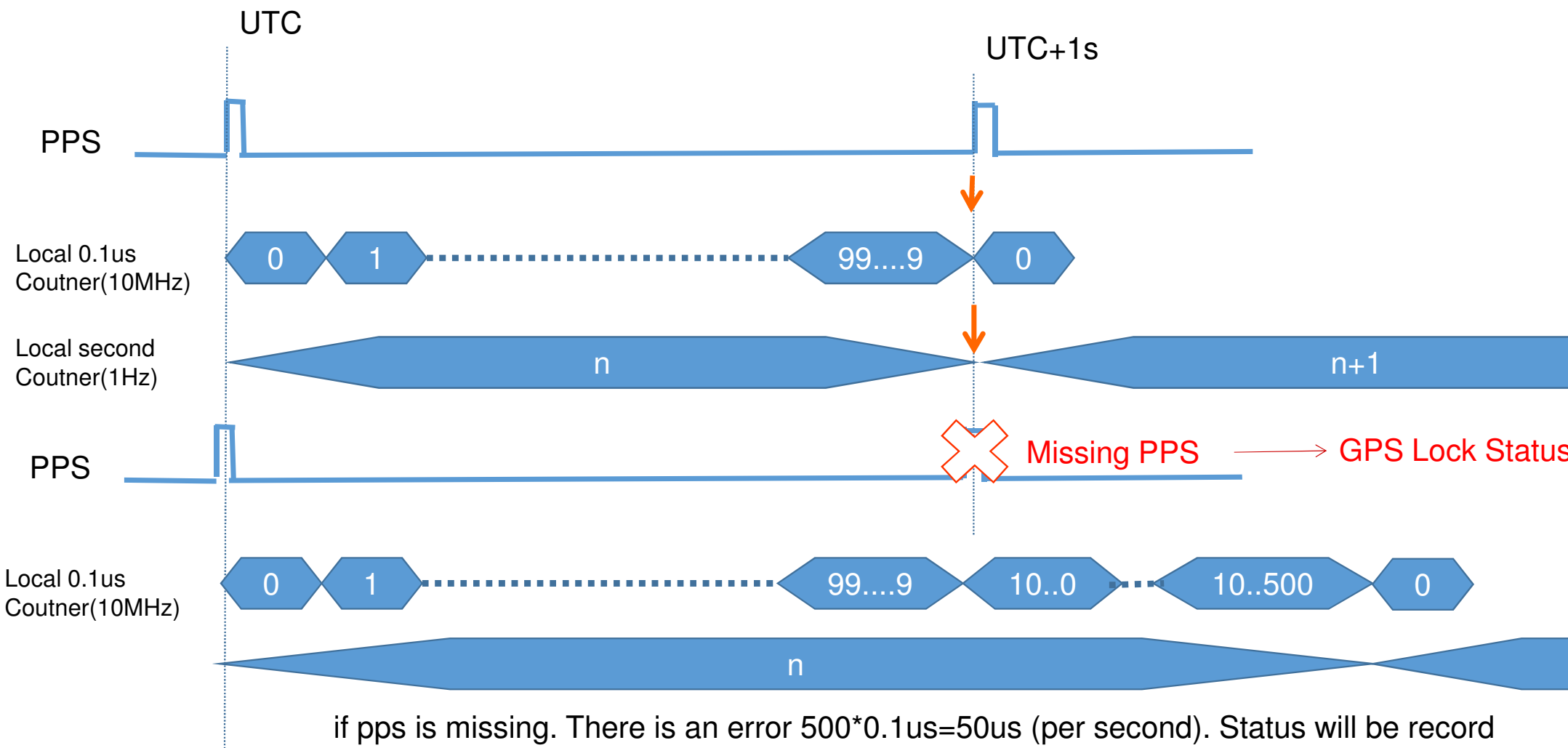
Strobe Signal is not so precise . QHYCCD has a build-in LED emitter to flash a short pulse .By adjusting position of this pulse we can find the begin and end of the exposure edges.

## ② Need to be Calibrated before using

This needs to be calibrated only once for each different exposure time. Data can be stored in software (dependent on software) and can be reused in future.

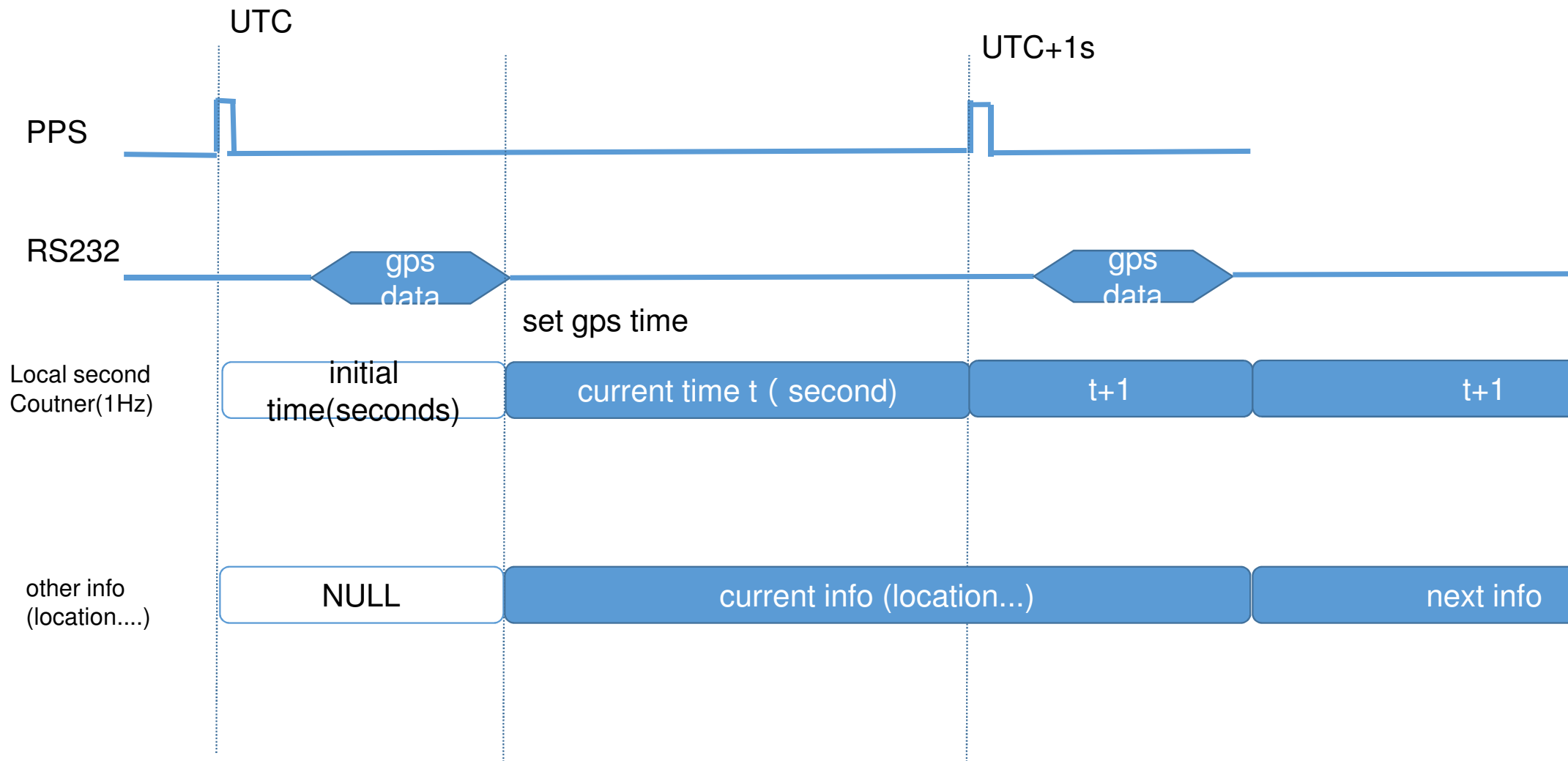


# PPS Synchronized Timer / Missing Handle



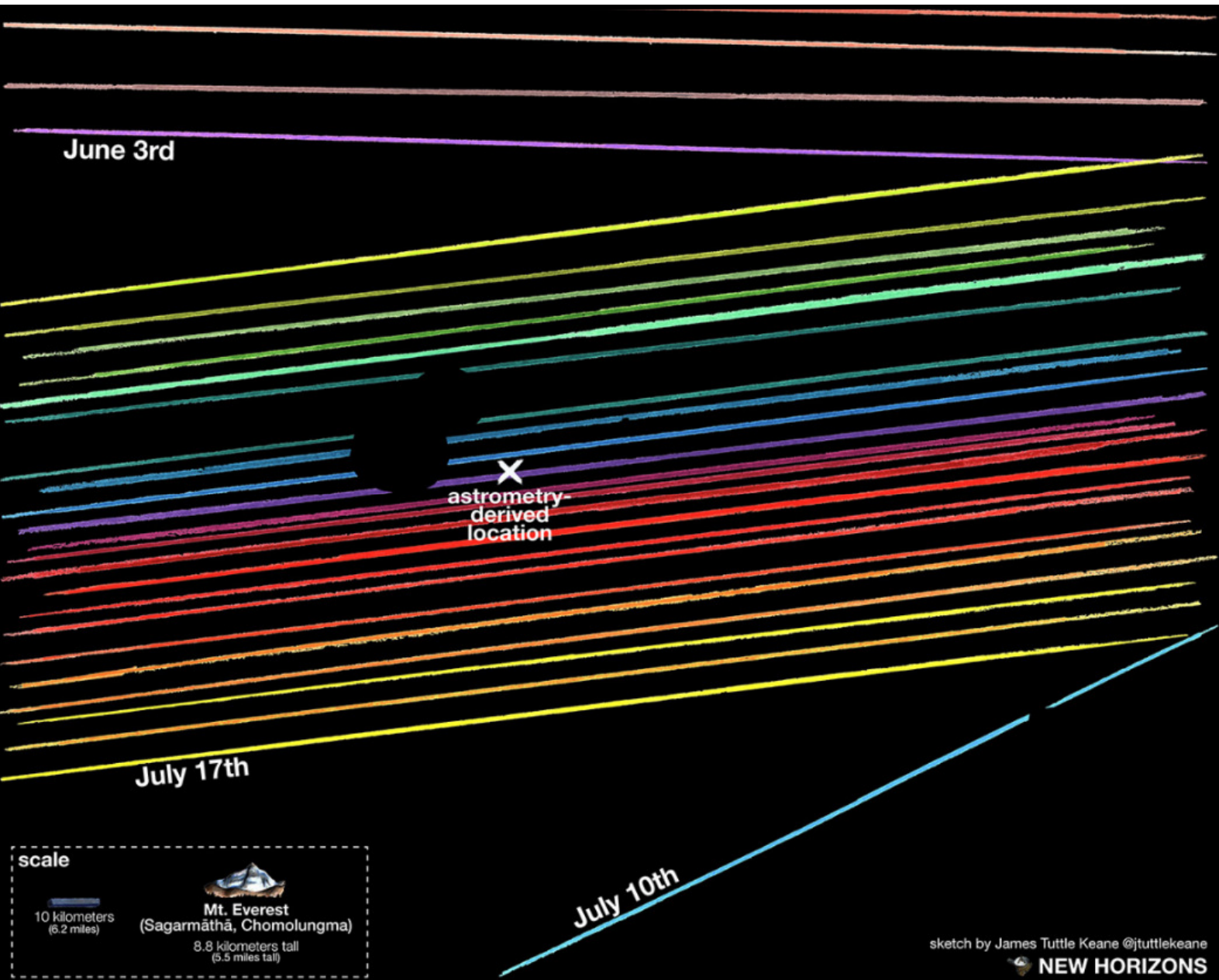
if pps is missing. There is an error  $500 \times 0.1 \mu s = 50 \mu s$  (per second). Status will be record

# GPS year/month...../sec/positions initial timing



# Hardware TimeStamp in image head pixels

0 Sequence Number MSB	22 Start micro second MSB
1 Sequence Number	23 Start micro second
2 Sequence Number	24 Start micro second LSB
3 Sequence Number LSB	25 End flag (GPS STATUS)
4 temporary Sequence Number (Normally no use)	Shutter end time (JS)
5 Image Width MSB	26 End Second MSB
6 Image Width LSB	27 End Second
7 Image Height MSB	28 End Second
8 Image Height LSB	29 End Second LSB
Latitude is the current latitude report by GPS.	30 End micro second MSB
9 latitude MSB	31 End micro second
10 latitude	32 End micro second LSB
11 latitude	33 now flag: this can be used for the GPS statu indicator bit[7..4] is the
12 latitude LSB	The now time is the time that of the vertical sync of the CMOS sensor. It does not the precision time of shutter open or close
Longitude is the current longitude report by GPS.	34 now second MSB
13 longitude MSB	35 now second
14 longitude	36 now second
15 longitude	37 now second LSB
16 longitude LSB	38 now micro second MSB
17 Start_Flag (GPS STATUS)	39 now micro second
Shutter start time (JS)	40 now micro second LSB
18 Start Second MSB	The counter value of two PPS. it should be about 10,000,000. But since the temperature of the crystal. It is not exactly the 10,000,000. You can adjust the VCXO to let it close to it. And when the PPS signal lost, it will become 10,000,500. When exceed this value, FPGA will generate a second to instead of the GPS PPS signal to avoid the second counter lost one second.
19 Start Second	41 count of PPS MSB
20 Start Second	42 count of PPS
21 Start Second LSB	43 count of PPS LSB



A successful Project using QHY174GPS

MU69 Occultation Observing by NASA New Horizons Team

2017.7.17 in Argentina

Using more than 20 QHY174GPS, 400mm Dob.

Five Signals has been Recorded

sketch by James Tuttle Keane @jtuttlekeane

 NEW HORIZONS

2019 08 31 17:05:52-0178414

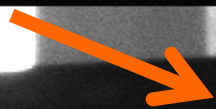


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16:54:18

## Future Development / Products

Standalone GPS BOX with the support for the most QHYCCD CMOS cameras.

Support GPS signal or GPS/BD dual mode signal.

Most QHY CMOS Camera is FPGA based . Can be re-programed to support GPS sync and hardware time stamp on image

We can add the support based on user's requirements. Currently we have QHY163 added. The QHY4040,2020,6060, 411, 461, 600 etc. are under development plan.

The major challenge is that the most CMOS cameras have rolling shutters. For rolling shutter cmos each row does not begin/ends its exposure at the same time. Image based re-calculation is required. Data processing is more complex.

The QHY174GPS using global shutter IMX174 cmos sensor. QHYCCD is developing more global shutter based cmos camera, like IMX342(APS-C), IMX432(1.1inch), Gense0806(APS-C) etc.

Other low cost global sensor is under considering for low cost solution.

