

# Seagull #MAP-X2

User Manual



Product: Seagull #MAP-X2  
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FW: 1.1

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# GENERAL INFORMATION

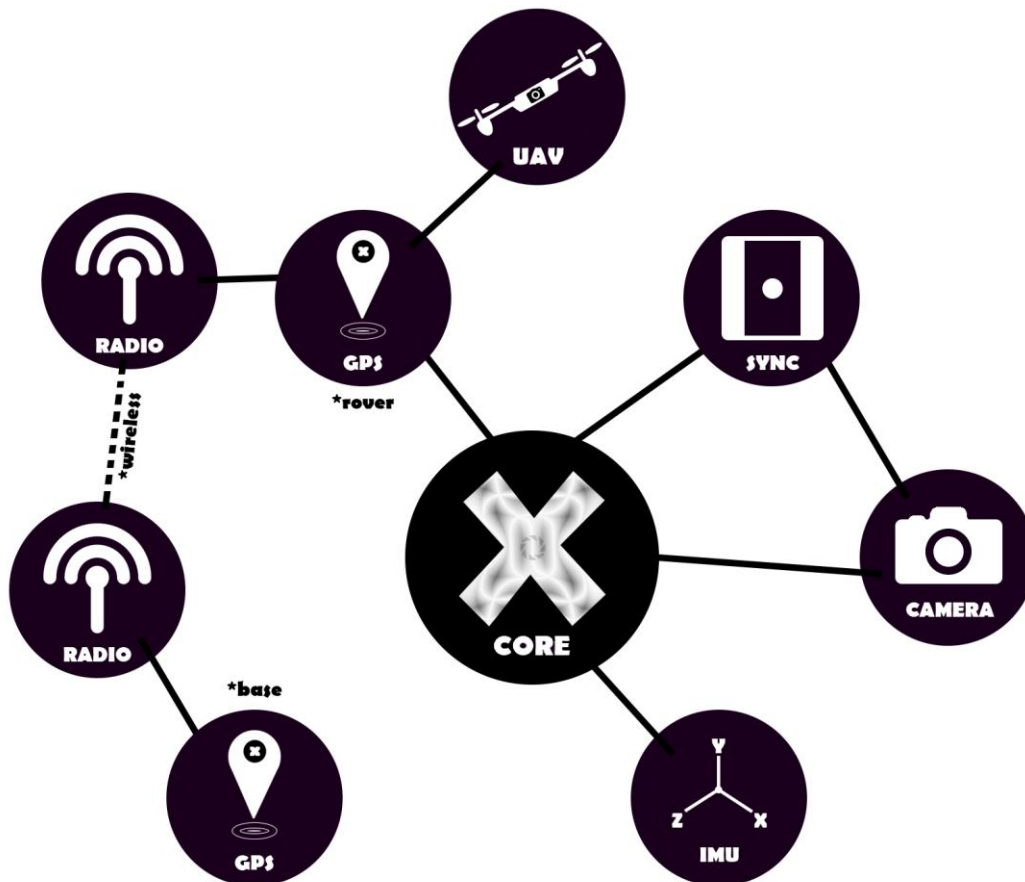
**\*\*\* Please read this manual thoroughly before connecting and configuring Seagull #MAP-X2 \*\*\***

Seagull #MAP-X2 is a precision camera trigger controller and logger. #MAP-X2 uses your cameras' hotshoe/event pin for feedback and GNSS data to log exact coordinates of when the photo was captured, resulting in a 1:1 ratio between coordinates and photos. #MAP-X2 can receive GNSS data via Seagull UAVs' GNSS receiver products or other GNSS receivers capable of providing necessary messages, that are recognized by #MAP-X2 for data logging.

**NOTE:** #MAP-X2 can also log GNSS data without a SYNC event feedback.

## #MAP-X2 features:

- High data rate sampling – 4Hz MB, 5Hz RTK, 10Hz RAW, 10Hz GNSS
- Various trigger modes – SST, ACT, PWM, BUTTON, TIMELAPSE
- Trigger and Log – with or without SYNC feedback
- Easy geotagging – Pix4D, EXIF
- IMU compatible – improves ORTOPHOTO and 3D Model processing
- GNSS receiver messages supported – UBX-RAW, PVT



# TRIGGER MODES & COMMANDS

## SST

*(Shoe Sync Trigger)*

When operating in SST mode, #MAP-X2 will wait for a SYNC event (hotshoe/event feedback) and will log the data when supplying a LOW (0 volt) condition to the SYNC pin.

SST mode is designed for a scenario where the user is triggering a camera by pressing the shutter button to capture a photo, then the SYNC signal is sent to #MAP-X2, telling that there was a shutter event on the camera, and #MAP-X2 will write coordinates and other data to the log files.

**NOTE:** This mode is not only limited to a MANUAL TRIGGERING scenario. For example, if you wish to have control functionalities from Seagull #REC and the precision of #MAP-X2 for logging, then you may do so by using #MAP-X2 in SST mode to handle the logging, and simply use Seagull #REC to handle the triggering of the camera.

## ACT-PWM

*(Autofocus Custom Trigger - Pulse Width Modulation)*

This is the default trigger mode for #MAP-X2. When operating in this mode #MAP-X2 enables ACT mode on HIGHER and PWM mode on LOWER end of signals for CH1 input.

ACT mode is meant for use to trigger cameras that are connected to a camera port on the #MAP-X2, that are listed on the: [#MAP-series cable finder](#)

PWM mode is meant to trigger cameras that use PWM signal as a command for triggering, such as the FLIR VUE Pro thermal camera.

## ACT+PWM

*(Autofocus Custom Trigger + Pulse Width Modulation)*

When operating in this mode it enables both modes ACT and PWM to trigger either on HIGH or LOW end of signal for CH1 input.

ACT mode is meant for use to trigger cameras that are connected to a camera port on the #MAP-X2, that are listed on the: [#MAP-series cable finder](#)

PWM mode is meant to trigger cameras that use PWM signal as a command for trigger, such as FLIR VUE Pro thermal camera.

**NOTE:** When operating in this dual trigger mode, #X2 will wait out until all trigger conditions that are set in the CONFIG.txt are met. For example, in a case when SYNC is enabled for AC-T mode and PWM DURATION set to 0.5(seconds): if ACT SYNC event happens before PWM DURATION is over – then #MAP-X2 will log coordinates and wait the remaining time of PWM DURATION before allowing next user input.

## TIMELAPSE

*(Interval trigger)*

Timelapse will only be active when there is a value present in the CONFIG.txt of #MAP-X2 and will work with the user input interval value for the following trigger modes: ACT – PWM, ACT + PWM and BUTTON mode.

If the value is set as 0, only a single photo will be captured.

If value is set for example 0.5(seconds) #MAP-X2 will keep taking photos as long as the selected trigger mode is kept in its activation value (PWM input value).

## BUTTON

*(Support for an external button for triggering)*

BUTTON mode is activated by providing a LOW state (0 volt) to the signal pin of BUTTON channel. When signal is present it will execute a trigger mode that is setup in the CONFIG.txt the following trigger modes are compatible ACT – PWM, ACT + PWM and TIMELAPSE.

This mode is very useful in a scenario where the user wishes to log and execute triggering commands by a push of a button or simply supplying constant LOW state and using with TIMELPASE setout INTERVAL for continuous photo triggering.

## CAMERA ON/OFF

*(Feature to control power on/off)*

CAMERA ON/OFF command is very useful in scenarios where you have retractable lenses or wish to protect from dust before takeoff or during landing scenarios.

**NOTE:** Only available with camera cables listed as "Sony S2 w. on/off" for Sony "MULTI" enabled cameras.

## LOG START/END

This command must be executed in order for #X2 to generate log files. #X2 will only start log generation once the command LOG START/END has been executed. The LOG START/END can be executed via the following options:

Sending "1800" $\mu$ S signal to #MAP-X2 via CH2.

Clicking the "LOG" button on #MAP-X2.

Setting "Logging activation" setting in the CONFIG.txt to "AUTO"

## CH1 & CH2 COMMAND TABLE

CHANNEL	STATE / MODE	ACTIVATION VALUES	SCOPE
CH1	PWM / ACT+PWM	1200 $\mu$ S	1000 <> 1400 $\mu$ S
CH1	AC-T / ACT+PWM	1800 $\mu$ S	1600 <> 2000 $\mu$ S
CH2	CAMERA ON / OFF *	1200 $\mu$ S	1000 <> 1400 $\mu$ S
CH2	LOG START / END	1800 $\mu$ S	1600 <> 2000 $\mu$ S
CH1, CH2	NEUTRAL	1500 $\mu$ S	1400 <> 1600 $\mu$ S
CH1 / CH2	SIGNAL NOT IN RANGE **	n/a	1 <> 1000 $\mu$ S $\mu$ S / 2000 <> $\infty$ $\mu$ S
CH1 & CH2	NO SIGNAL ***	n/a	0 $\mu$ S

\* ON/OFF only for Sony "Multi" cameras with SMAP-3009/3010 cable!

\*\* Signal not in range will occur when there is signal present, but it is not within any operational modes.

\*\*\* There is no input signal detected.

# CONFIG FILE

## GENERAL

The CONFIG.txt is located on the SD card within the #MAP-X2. This file is used to configure the modes, settings and parameters for the specific needs with its application or use case.

To edit the CONFIG.txt file, simply insert it to a PC/Mac and edit the values after the ":" (comma) in the file.

## EDITING

Please note that when saving the changes, please keep the text format in "ANSI" – other formats might lead to corruption of the CONFIG.txt file.

Also, don't insert any spaces or other characters than listed within the brackets – doing so will corrupt the file, so it can't be read by #MAP-X2.

**NOTE:** In a case that the CONFIG.txt file becomes corrupt or deleted, it will be re-created if an empty card is inserted, during the powerup of #MAP-X2 and will be initiated with DEFAULT values.

*Example of default #MAP-X2 - CONFIG.txt file:*

```
##### MAP-X2 CORE SETTINGS #####
Baud rate :115200

##### TRIGGER SETTINGS #####
Trigger mode (SST/ACT-PWM/ACT+PWM) :ACT-PWM
Button trigger (DISABLE/ACT/PWM/ACT+PWM) :DISABLE

##### ACT #####
Focus time (seconds) :0

##### PWM #####
Pre-output delay (seconds) :0
Trigger value :1800
Trigger duration (seconds) :0.5
Neutral value :1500

##### TIMELAPSE SETTINGS #####
Timelapse interval (seconds) :1

##### LOGGING SETTINGS #####
Logging activation (MANUAL/AUTO) :MANUAL
Logging type (X2/PPK/X2+PPK) :X2
IMU logging (ENABLE/DISABLE) :DISABLE
Altitude tag source (GPS/IMU/EXT) :GPS
Image filename prefix (etc. 'DSC') :DSC
GPS logging delay (seconds) :0

##### HOTSHOE #####
SYNC feedback (ENABLE/DISABLE) :ENABLE
Trigger mode ACT+PWM SYNC (ACT/PWM) :ACT

#####
##### FW 1.1 #####
```

# SETTINGS AND VALUES TABLE

SETTING NAME	SETTINGS	RANGE	DEFAULT	DESCRIPTION
<b>MAP-X2 CORE</b>				
Baud rate	Value	1200 - 960000	115200	Baud rate setting used for communicating with GNSS receiver connected to #MAP-X2 – <b>MUST BE SAME VALUE AS GNSS RECEIVER BAUD RATE</b>
<b>TRIGGER SETTINGS</b>				
Trigger mode	SST / ACT-PWM / ACT+PWM	n/a	ACT-PWM	Selection of which trigger mode #MAP-X2 should work in. Read section "TRIGGER MODES & COMMANDS" for description of each individual mode
<b>ACT</b>				
ACT Focus time	Value in seconds	0 <> *alot (9e+15)	0	ACT pre-focus time will focus the camera for a period of time and then activate shutter release. Its best to keep it at 0 and use MANUAL focus on the cameras' settings.
<b>PWM</b>				
PWM Pre-output delay	Value in seconds	0 <> *alot (9e+15)	0	A delay before executing PWM output commands for triggering the camera.
PWM Trigger value	Value in µS	550 <> 2400 µS	1800 µS	Trigger value in microseconds that is accepted by your PWM signal driven camera for shutter or other mode activations.
PWM Trigger duration	Value in seconds	0 <> *alot (9e+15)	0.5	How long the PWM trigger value should be outputted before returning to NEUTRAL mode. <b>NOTE:</b> If SYNC is enabled and event occurs, PWM NEUTRAL is executed and PWM duration ends.
PWM Neutral value	Value in µS	550 <> 2400 µS	1500	NEUTRAL value for your PWM camera, meaning that when set in this value it will not execute anything and wait for trigger value to occur again.
<b>TIMELAPSE SETTINGS</b>				
Timelapse interval	Value in seconds	0 – to disable 0.1 <> *alot (9e+15)	0.5	When set to 0 TIMELAPSE mode is disabled. If value is higher than 0 and within range, #MAP-X2 will keep triggering until the Trigger mode is exited. Following modes are supported: ACT-PWM, ACT+PWM and BUTTON.
<b>LOGGING SETTINGS</b>				
Logging activation	MANUAL / AUTO	n/a	MANUAL	Can be enabled to AUTO logging start and end. When there is a signal present on CH1 which is above 999 µS and below 2001 µS, #MAP-X2 will start log generation. When the signal is out of these ranges it will end log and write the data to the microSD card.
Logging type	X2 / PPK / X2+PPK	n/a	X2	<b>X2:</b> Pix4D, X2, KML, SUM <b>PPK:</b> PPK, SUM <b>X2+PPK:</b> All the above logs generated
IMU logging	ENABLE / DISABLE	n/a	DISABLE	If IMU is present and enabled, #MAP-X2 will log extra fields in Pix4D and X2 logs with roll, pitch and yaw.
Altitude tag source	GPS / IMU / EXT	n/a	GPS	Setting to use which altitude source should be used and written in the Pix4D and #MAP-X2 logs. If set to GPS it will use GNSS' altitude reading. When set to IMU it will use onboard barometer for altitude logging. EXT is an external altitude sensor input and is currently disabled. <b>NOTE:</b> When set to IMU altitude tagging, at the start of IMU the altitude is read and set to be at 0 (ground level).
Image filename prefix	USER INPUT etc. "DSC"	n/a	DSC	Input the filename prefix used on photos by your camera. #MAP-X2 will log image filename with the following: filename + confirmed photo count etc. Example: "DSC00001.JPG"
GPS logging delay	Value in seconds	0 <> *alot (9e+15)	0	GPS logging delay is set to delaying logging of the coordinate after the camera has been triggered. Very useful in scenarios where there is no SYNC feedback, so you can

				time approximately how long it takes for camera to capture photo and then execute to log coordinate by #MAP-X2.
<b>HOTSHOE</b>				
SYNC feedback	ENABLE / DISABLE	n/a	ENABLE	ENABLE or DISABLE SYNC feedback for precise logging. <b>NOTE:</b> LOW (0 volt) state indicates a SYNC event.
Trigger mode ACT+PWM SYNC	ACT / PWM	n/a	ACT	When using trigger mode ACT+PWM and SYNC is ENABLED, indicate which mode your SYNC should react to - ACT driven or PWM driven camera.

## FLIGHT CONTROLLER INTEGRATION

### PIXHAWK

#MAP-X2 can be powered via its rails – so when connecting to Pixhawk rails, make sure there is sufficient power to supply #X2. Maximum power that can be applied on Pixhawk 1 rails is 5.7V, follow documentation of the ArduPilot controller that you have. Its recommended to use 5V UBEC to provide power to the rails.

### COMPATIBLE PORTS RC5 TO RC11



### DJI A3

Connect the CHANNEL that you wish to control from #MAP-X2 to the "F port" that you wish to use. DJI A3 can't provide power to the #MAP-X2 through its rails, therefore connect only BLACK – and WHITE signal to the "F port" and power #MAP-X2 via UBEC or such that is within power range limits for #MAP-X2.

### PORTS F1 TO F8





# R/C TRANSMITTER INTEGRATION

#MAP-X2 is compatible with all R/C equipment that can supply a PWM/SERVO signal operating at 50Hz and that meets the ranges set out for #MAP-X2 modes. For the modes please refer to CH1 & CH2 COMMAND TABLE in the manual. As well check the conversion table for RC transmitters when adjusting the channel to activate #MAP-X2 modes.



# FLIGHT PLANNER SOFTWARE INTEGRATION

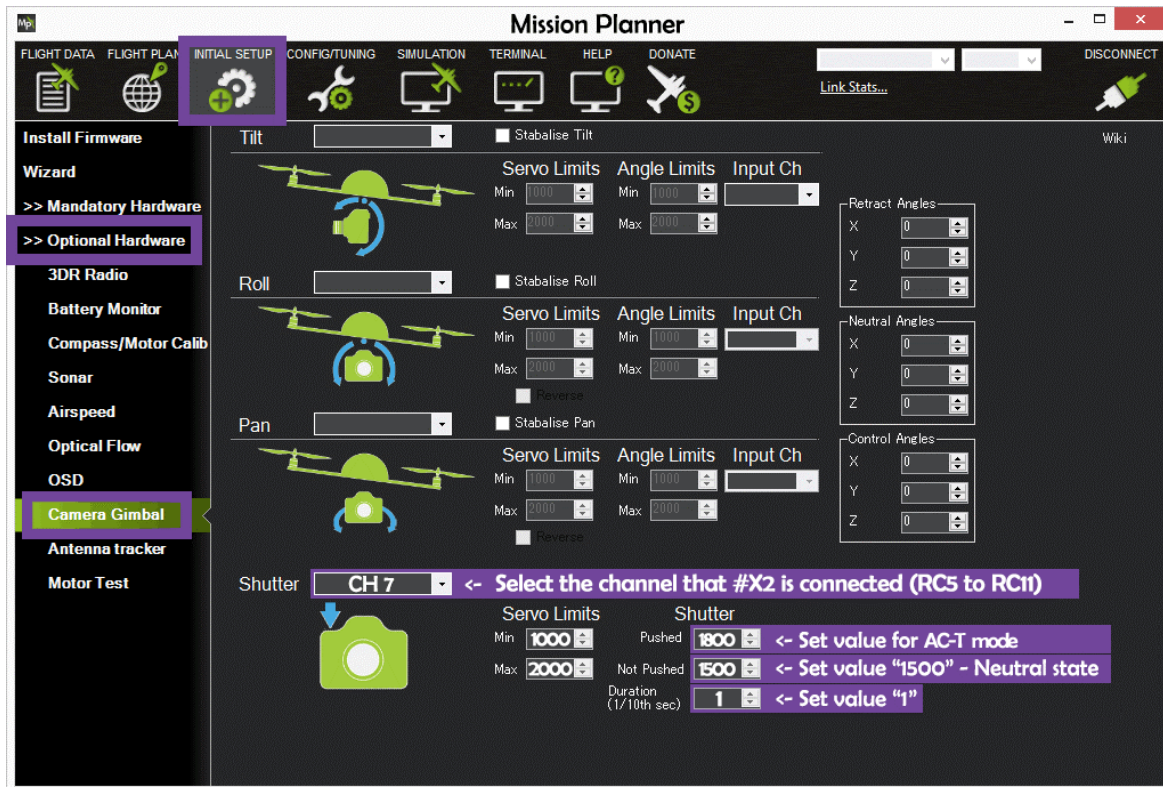
## MISSION PLANNER

The following example is for setup where automated flight is being executed with the do\_digicam\_control command.

When a channel is setup via "Camera Gimbal" menu, that channel is occupied by Pixhawk and you will not be able to pass manual trigger commands via R/C transmitter. If you wish to control the channel manually you will need to setup the RC channel as pass through in the Mission Planner.

1. Click on INITIAL SETUP >> OPTIONAL HARDWARE >> CAMERA GIMBAL
2. "SHUTTER" - in the drop-down list, chose the channel that Seagull #MAP-X2 is connected to.
3. "PUSHED" - Set the "VALUE" for the trigger mode ([CH1 & CH2 COMMAND TABLE](#))
4. "NOT PUSHED" – Set the value "1500" (NEUTRAL STATE)
5. "DURATION" – Set the value "1"

*Example from Mission Planner:*

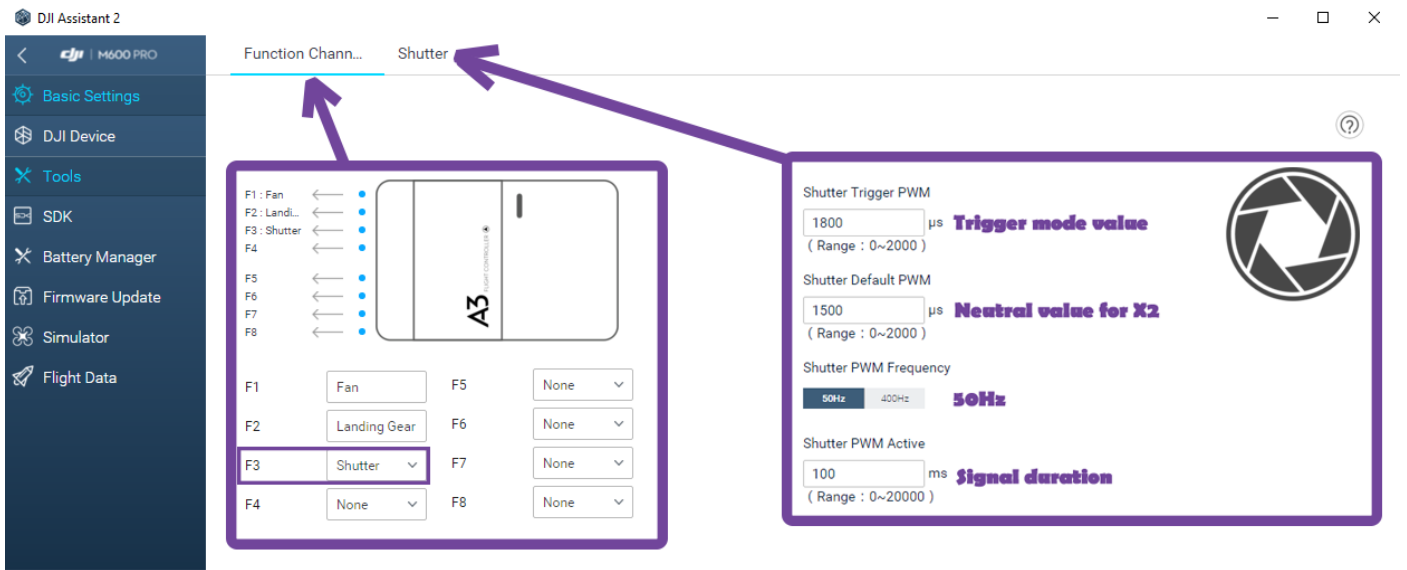


**NOTE:** "Servo Limits" needs to be set to Min: "1000" and Max: "2000" for Pixhawk to react to the entered values!

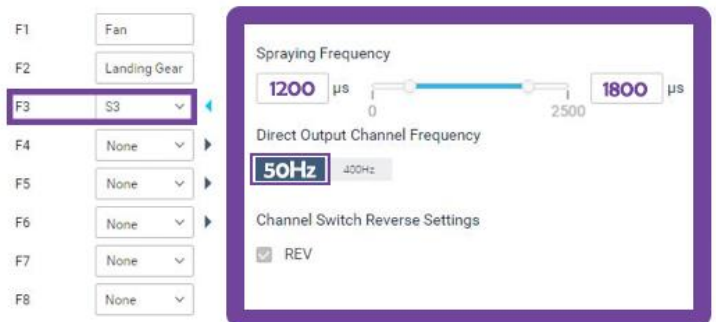
# DJI ASSISTANT 2

The following example sets up DJI A3 controller through DJI Assistant 2 for shutter control automated flights.





1. "SHUTTER" - in the drop-down list on the "F port" that #MAP-X2 is connected to
2. "SHUTTER TRIGGER PWM" - Set the "VALUE" for the trigger mode ([CH1 & CH2 COMMAND TABLE](#))
3. "SHUTTER DEFAULT PWM" – Set the value "1500" (NEUTRAL STATE)
4. "SHUTTER PWM FREQUENCY " – Select "50Hz" option
5. "SHUTTER PWM ACTIVE " – Set the value to "100"

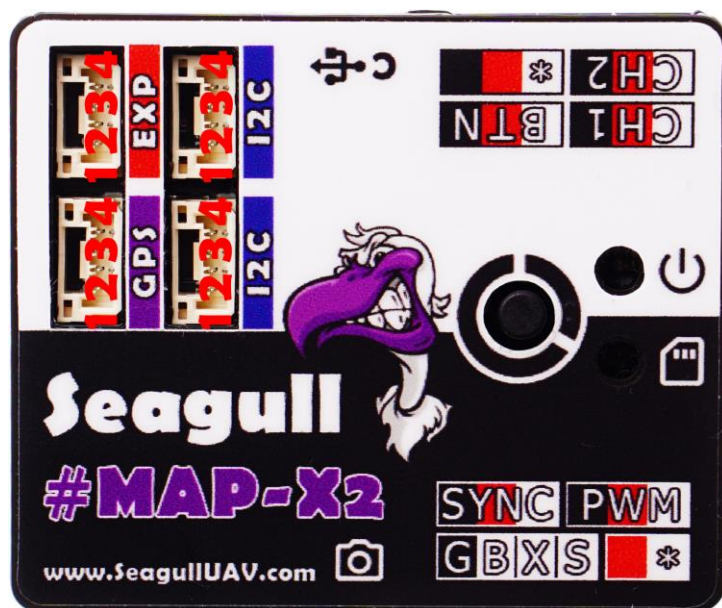


It is also possible to map a switch to have manual triggering option, this can be done when selecting the port to operate as "Sx" and inputting the value in LOW and HIGH range. To achieve a NEUTRAL value for the switch it is calculated  $(LOW+HIGH)/2$ , in the below example it is set to use "1800" (ACT mode) and value for NEUTRAL is "1500".





## PORT / PIN DEFINITIONS

PORT	DEFINITION	PINS			
GPS	GNSS communication port	1: VIN (3.9 -12V)	2: RX (3.3V)	3: TX (3.3V)	4: GND
EXP	Expansion port	1: VIN (3.9 -12V)	2: RX (3.3V)	3: TX (3.3V)	4: GND
I2C	Interface for I2C modules	1: VIN (3.9 -12V)	2: SCL (3.3V)	3: SDA (3.3V)	4: GND
I2C	Interface for I2C modules	1: VIN (3.9 -12V)	2: SCL (3.3V)	3: SDA (3.3V)	4: GND
CH1	CHANNEL 1 INPUT	SIGNAL	VIN 3.9 – 12V	GND	
CH2	CHANNEL 2 INPUT	SIGNAL	VIN 3.9 – 12V	GND	
BTN	BUTTON TRIGGER INPUT	SIGNAL	VIN 3.9 – 12V	GND	
SYNC	SYNC FEEDBACK	SIGNAL	X2 – 3.3V OUT	GND	
PWM	PWM TRIGGER OUTPUT	SIGNAL	VIN 3.9 – 12V	GND	
GBXS	ACCESSORY PORT	S: SD LED	X: X STATE LED	B: LOG BUTTON	G: GND
	LOG START/END BUTTON				
	Controller USB and firmware update port. The unit can be powered via USB as well with following ranges 4.4 – 12V				
*	N/C				
	VIN 3.9 – 12V				
	GND				



## TROUBLESHOOTING

To determine what Seagull #MAP-X2 is currently doing - simply read the output of the "X STATE" and "SD CARD" LEDs, then match it with the "Action" in the table below.

 X STATE	ACTION
Off	There is no signal
Blinking	Signal is present but out of range
Fading	In "Neutral" and Ready - waiting for next command
Faded	Active in a trigger mode – return to "Neutral" before next command
 SD CARD	ACTION
Blinking	Micro SD card - is not present
Flashing rapidly	Micro SD card initialization error – please check format!
Fading	Micro SD card has been initialized and waiting for log to start
Solid on	Micro SD card – logging has been activated

# TECHNICAL SPECIFICATIONS

- Supply voltage: 3.9 – 12V (5v recommended – do **NOT** exceed 12V!)
- Current draw: Min: 17mA, Average: 43mA, Max: 55mA
- Input signal: 3.3V standard R/C PWM between 1000 – 2000µS
- Dimensions: 48mm x 40mm x 11mm
- Weight: 20g (without misc. cables)

## GEOTAGGING

### GENERAL

Please note that image filename generated in the LOG files starts from 1 onwards, therefore you might need to batch rename all of the photos that have been captured in order to recognize for the geotagging software. Useful tool to name photos in batches is Adobe Lightroom.

### X2 LOG

1. DOWNLOAD GEOTAG TOOL. – [DOWNLOAD LINK](#)
2. EXTRACT FILES TO WINDOWS FOLDER.
3. MOVE X2.TXT LOG FILE TO LOCATION WHERE PHOTOS ARE LOCATED.
4. OPEN COMMAND PROMPT AND CHANGE DIRECTORY TO WHERE LOG FILE AND PHOTOS ARE LOCATED.
5. EXECUTE THE FOLLOWING IN COMMAND PROMPT:

```
exiftool -csv=X2.csv -gpslatituderef=N -gpslongituderef=W -gpsaltituderef=above -gpstrackref=T .
```

After the photos have been geotagged you can review the EXIF data to ensure that all the tags have been written by executing the following command in the command prompt:

```
exiftool example.jpg
```

To change directories in command prompt, do the following command:

```
cd C:\ImageFolder
```

# PIX4D

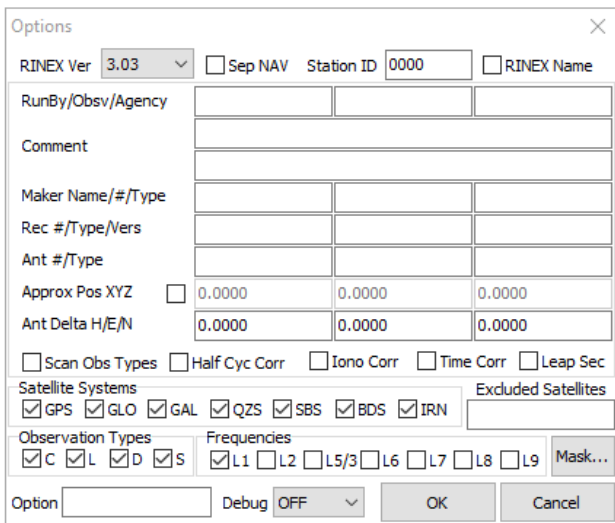
Simply input the .CSV file into Pix4D with your images, and you are good to go! If you have purchased and enabled **Seagull #IMU** then the Pix4D LOG file will contain extra data such as ROLL, PITCH, YAW, HORIZONTAL ACCURACY and VERTICAL ACCURACY.

# PPK PROCESSING

Generated LOG is in u-blox UBX format, in order to do the post processing please use RTKLIB conv to convert the PPK UBX file to RINEX 3.03.

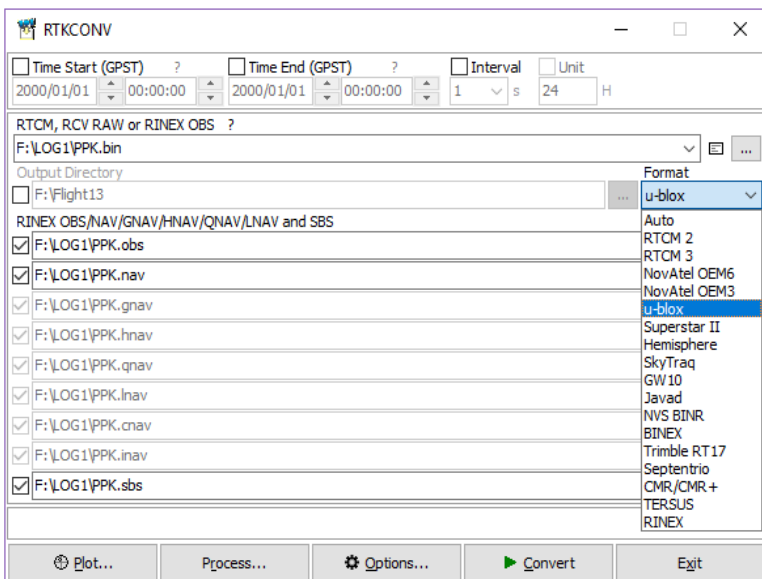
\*\*\* Download RTKLIBv2.4.3.zip from [HERE](#) \*\*\*

**STEP 1:** Open "RTKLIB CONV" and select the following options.

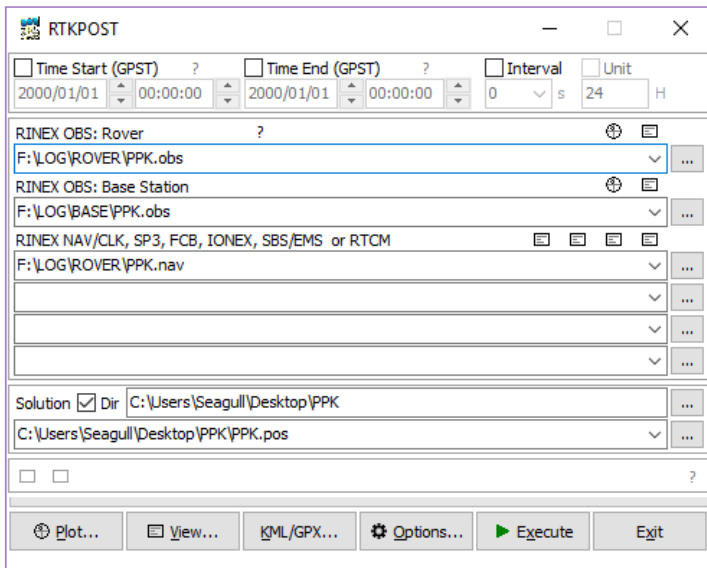


**STEP 2:** Add "PPK.bin" file and choose format "u-blox".

**STEP 3:** Click "Convert" for the LOGS generated from #MAP-X2 and the #GPK units.



**STEP 4:** Open "RTKPOST" and input "BASE.obs" file, "ROVER.obs" and "ROVER.nav" files.



**STEP 5:** Click "Options" and set the following settings:

"SETTINGS 1" tab

Positioning mode: **Kinematic/Static**

Elevation Mask / SNR Mask: **20**

REC Dynamics: **ON**

"SETTINGS 2" tab

Integer Ambiguity Res: **Fix and Hold**

Max Pos Var for AR / AR Filter: **ON**

"POSITIONS" tab

Base Station: **RINEX Header Position**

**STEP 6:** Click "EXECUTE" and wait until process is complete.

# PWM TO TRANSMITTER VALUES CONVERSION TABLES

## FUTABA SG14

PWM	Futaba	PWM	Futaba
1000	-100	1520	4
1020	-96	1540	8
1040	-92	1560	12
1060	-88	1580	16
1080	-84	1600	20
1100	-80	1620	24
1120	-76	1640	28
1140	-72	1660	32
1160	-68	1680	36
1180	-64	1700	40
1200	-60	1720	44
1220	-56	1740	48
1240	-52	1760	52
1260	-48	1780	56
1280	-44	1800	60
1300	-40	1820	64
1320	-36	1840	68
1340	-32	1860	72
1360	-28	1880	76
1380	-24	1900	80
1400	-20	1920	84
1420	-16	1940	88
1440	-12	1960	92
1460	-8	1980	96
1480	-4	2000	100
1500	0		

## DJI A2

PWM	DJI A2
1000	-10000
1025	-9500
1050	-9000
1075	-8500
1100	-8000
1125	-7500
1150	-7000
1175	-6500
1200	-6000
1225	-5500
1250	-5000
1275	-4500
1300	-4000
1325	-3500
1350	-3000
1375	-2500
1400	-2000
1425	-1500
1450	-1000
1475	-500
1500	0

PWM	DJI A2
1525	500
1550	1000
1575	1500
1600	2000
1625	2500
1650	3000
1675	3500
1700	4000
1725	4500
1750	5000
1775	5500
1800	6000
1825	6500
1850	7000
1875	7500
1900	8000
1925	8500
1950	9000
1975	9500
2000	10000

## DJI WK-M

PWM	DJI WK-M
1000	-1000
1025	-950
1050	-900
1075	-850
1100	-800
1125	-750
1150	-700
1175	-650
1200	-600
1225	-550
1250	-500
1275	-450
1300	-400
1325	-350
1350	-300
1375	-250
1400	-200
1425	-150
1450	-100
1475	-50
1500	0

PWM	DJI wk-M
1525	50
1550	100
1575	150
1600	200
1625	250
1650	300
1675	350
1700	400
1725	450
1750	500
1775	550
1800	600
1825	650
1850	700
1875	750
1900	800
1925	850
1950	900
1975	950
2000	1000

## FUTABA

PWM	Futaba	PWM	Futaba	PWM	Futaba
1000	0	1330	33	1660	66
1010	1	1340	34	1670	67
1020	2	1350	35	1680	68
1030	3	1360	36	1690	69
1040	4	1370	37	1700	70
1050	5	1380	38	1710	71
1060	6	1390	39	1720	72
1070	7	1400	40	1730	73
1080	8	1410	41	1740	74
1090	9	1420	42	1750	75
1100	10	1430	43	1760	76
1110	11	1440	44	1770	77
1120	12	1450	45	1780	78
1130	13	1460	46	1790	79
1140	14	1470	47	1800	80
1150	15	1480	48	1810	81
1160	16	1490	49	1820	82
1170	17	1500	50	1830	83
1180	18	1510	51	1840	84
1190	19	1520	52	1850	85
1200	20	1530	53	1860	86
1210	21	1540	54	1870	87
1220	22	1550	55	1880	88
1230	23	1560	56	1890	89
1240	24	1570	57	1900	90
1250	25	1580	58	1910	91
1260	26	1590	59	1920	92
1270	27	1600	60	1930	93
1280	28	1610	61	1940	94
1290	29	1620	62	1950	95
1300	30	1630	63	1960	96
1310	31	1640	64	1970	97
1320	32	1650	65	1980	98
				1990	99
				2000	100

## SPKTRUM

PWM	Spektrum	PWM	Spektrum	PWM	Spektrum
1000	-50	1333	17	1667	83
1010	-48	1343	19	1677	85
1020	-46	1354	21	1687	87
1030	-44	1364	23	1697	89
1040	-42	1374	25	1707	91
1051	-40	1384	27	1717	93
1061	-38	1394	29	1727	95
1071	-36	1404	31	1737	97
1081	-34	1414	33	1747	99
1091	-32	1424	35	1758	102
1101	-30	1434	37	1768	104
1111	-28	1444	39	1778	106
1121	-26	1455	41	1788	108
1131	-24	1465	43	1798	110
1141	-22	1475	45	1808	112
1152	-20	1485	47	1818	114
1162	-18	1495	49	1828	116
1172	-16	1505	51	1838	118
1182	-14	1515	53	1848	120
1192	-12	1525	55	1859	122
1202	-10	1535	57	1869	124
1212	-8	1545	59	1879	126
1222	-6	1556	61	1889	128
1232	-4	1566	63	1899	130
1242	-2	1576	65	1909	132
1253	1	1586	67	1919	134
1263	3	1596	69	1929	136
1273	5	1606	71	1939	138
1283	7	1616	73	1949	140
1293	9	1626	75	1960	142
1303	11	1636	77	1970	144
1313	13	1646	79	1980	146
1323	15	1657	81	1990	148
				2000	150

## TARANIS

PWM	Taranis	PWM	Taranis	PWM	Taranis
1000	-100	1340	-32	1680	36
1010	-98	1350	-30	1690	38
1020	-96	1360	-28	1700	40
1030	-94	1370	-26	1710	42
1040	-92	1380	-24	1720	44
1050	-90	1390	-22	1730	46
1060	-88	1400	-20	1740	48
1070	-86	1410	-18	1750	50
1080	-84	1420	-16	1760	52
1090	-82	1430	-14	1770	54
1100	-80	1440	-12	1780	56
1110	-78	1450	-10	1790	58
1120	-76	1460	-8	1800	60
1130	-74	1470	-6	1810	62
1140	-72	1480	-4	1820	64
1150	-70	1490	-2	1830	66
1160	-68	1500	0	1840	68
1170	-66	1510	2	1850	70
1180	-64	1520	4	1860	72
1190	-62	1530	6	1870	74
1200	-60	1540	8	1880	76
1210	-58	1550	10	1890	78
1220	-56	1560	12	1900	80
1230	-54	1570	14	1910	82
1240	-52	1580	16	1920	84
1250	-50	1590	18	1930	86
1260	-48	1600	20	1940	88
1270	-46	1610	22	1950	90
1280	-44	1620	24	1960	92
1290	-42	1630	26	1970	94
1300	-40	1640	28	1980	96
1310	-38	1650	30	1990	98
1320	-36	1660	32	2000	100
1330	-34	1670	34		