Phase One Cameras and GPS/IMU Systems

Installation Guide

Phase One

Aerial Camera Systems

PHASEONE INDUSTRIAL

1. Introduction

1.1 Phase One Aerial Cameras and GPS/IMU

Phase One aerial cameras are easy to integrate into new or existing setups and offer compatibility with popular flight management systems, global navigation satellite systems and Inertial Measurement Units.

This guide is meant to assist you in connecting your Phase One aerial camera with a GPS/IMU. To understand the exposure sequence, read the appropriate instructions in the camera installation guide.

1.2 Getting Started

Connecting a Phase One camera to a GPS/IMU involves three steps:

- Physical connection of the camera to the GPS
- Configuring the camera
- Configuring the GPS/IMU

In order to facilitate communication between your Phase One aerial camera and a GPS receiver, the parameters in your GPS receiver and camera must match.

Note: The GPS receiver must use the same baud rate as the camera (115200).

Ensure that your iXA camera is using the latest firmware.

Current firmware is available from http://industrial.phaseone.com/downloads.

1.3 Multi-Camera Setup

Phase One iXA cameras can be connected to form an array. By following the instructions for a multi-camera setup, you can ensure that the cameras are synchronized and that the GPS data is transferred to all cameras that are connected to each other.

If you are using a multi-camera setup, each camera must be configured for GPS use. All multi-synced cameras share the GPS data, which is written to each image.

Phase One iXU

2. Configuration of GPS/IMU

2.1 Connecting an iXU Camera to a GPS/IMU

To connect an iXU camera to a GPS/IMU:

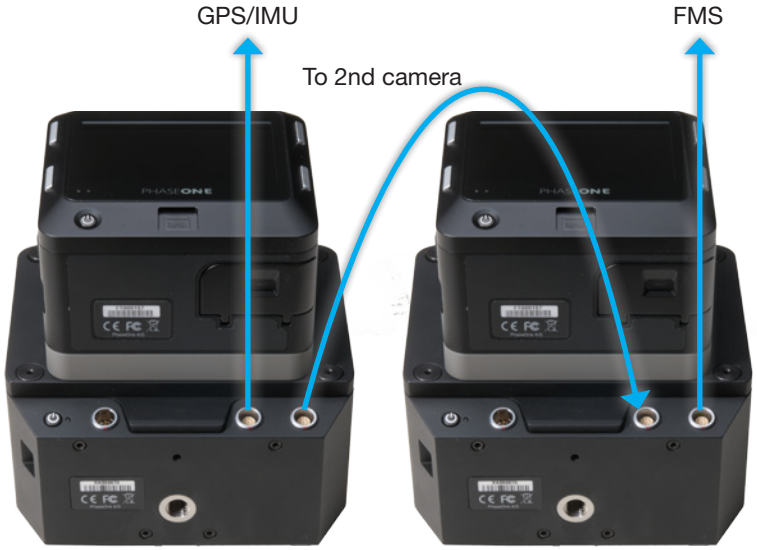
1. Using a Phase One control cable, connect your GPS receiver to data terminal A (left data terminal) on the iXU camera.
2. If using a flight management system (FMS) or a controller using iX Link, connect another Phase One control cable from data terminal B (right terminal) to the FMS or controller using iX Link.
3. Ensure that both the camera and GPS receiver are connected to a power source.

Phase One iXA

2.2 Connecting an iXA Camera to a GPS/IMU

To connect an iXA camera to a GPS/IMU:

1. Using a Phase One control cable, connect your GPS receiver to data terminal A on the iXA camera (the left terminal of the two).
2. If using an FMS, connect another Phase One control cable from data terminal B to the FMS.
3. Ensure that both the camera and GPS receiver are connected to a power source.



2.3 Connecting Two iXA Cameras to a GPS/IMU

To connect two iXA cameras to a GPS/IMU:

1. Using a Phase One control cable, connect your GPS receiver to data terminal A on the iXA camera (left data terminal).
2. Connect a Phase One multi-sync cable from the B data terminal (right data terminal) of the first camera to the A data terminal (left data terminal) of the additional iXA camera.
3. Repeat for additional cameras.
4. If using a flight management system (FMS), connect another Phase One control cable from the last camera's B data terminal (right data terminal) to the FMS.

2.4 About Communication Modes

There are two possible ways a GPS sends data to a Phase One camera:

- Event driven — the data is generated at the exact time of the mid-exposure pulse.
- Continuous data stream — the GPS sends the data in a continuous stream based on the output frequency of the receiver. The camera uses the closest relevant data.

When using event driven data, the following data is written to the image file:

- NovAtel
  - MARKTIME sentence
    - Event ID
    - Time
    - Date
  - MARKPOS sentence
    - Event ID
    - Position
- Applanix
  - PAPLEVT1 sentence
    - Event ID
    - Time
    - Position
    - Dynamics

When using continuous data stream, the following data is written to the image file:

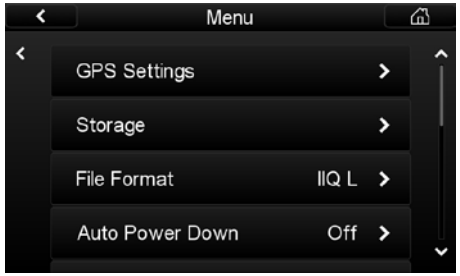
- NMEA GGA sentence
  - Time
  - Position
- NMEA ZDA sentence
  - Time
  - Date
- NMEA VTG sentence
  - Speed
- NMEA GLL sentence
  - Time
  - Position
- NMEA GST sentence
  - Time
- NMEA PASHR sentence
  - Time
  - Dynamics

When using a NovAtel or Applanix receiver, you can use either event driven communication or continuous data stream.

By selecting NovAtel when using a Novatel receiver or by selecting Applanix, when using an Applanix receiver, the communication mode is event driven.

By selecting NMEA Device when using a Novatel or Applanix receiver, the communication mode is continuous data stream.

Device	Selection in Camera or iX Capture	Communication Mode
NMEA	NMEA Device	Continuous
NovAtel	Novatel	Event driven
NovAtel	NMEA Device	Continuous
Applanix	Applanix	Event driven
Applanix	NMEA Device	Continuous

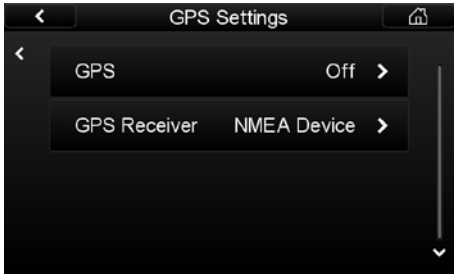


2.5 Configuring a Camera for GPS/IMU Recording

Your camera can be configured for connectivity to a GPS/IMU via the camera or via iX Capture. If using iX Capture, refer to the iX Capture User Guide.

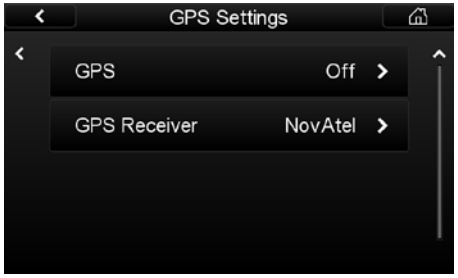
To configure your camera to work with your GPS receiver, do the following:

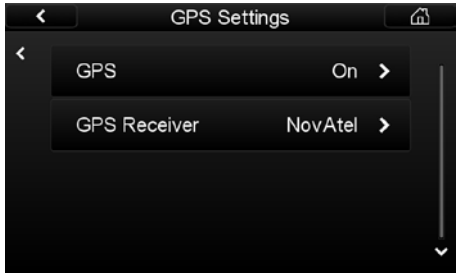
1. From the Home screen, select Menu > GPS Settings.
   The GPS Settings screen appears.



2. From the GPS Settings screen, select GPS Receiver.
   The GPS Receiver screen appears.
3. From the GPS Receiver screen, select the GPS receiver you are using:
   - NMEA Device
   - NovAtel
   - Applanix

The GPS Settings screen appears with your selected device displayed.





4. From the GPS Settings screen, tap GPS.
   The GPS screen appears.
5. From the GPS screen, select either:
   - On
   - Off

The GPS Settings screen appears with your selection displayed.

2.6 Configuring a GPS/IMU Device

To configure your external device's serial port:

1. Set the external device as follows:
    - Baud rate:115200 bps
    - Data: 8 bit data
    - Parity: none
    - Stop: 1 bit
2. Set the appropriate sentences that you want written to the image according to the receiver you have selected.

If you are using an Applanix receiver:

- PAPLEVT1 (Applanix) mandatory

If you are using a NovAtel receiver, we support two sentences.

Select at least one sentence:

- MARKTIME (NovAtel)
- MARKPOS (NovAtel)

The following sentences are supported by the camera in NMEA devices.

Select at least one of the following sentences:

- NMEA GGA sentence
- NMEA ZDA sentence
- NMEA VTG sentence
- NMEA GLL sentence
- NMEA GST sentence
- NMEA PASHR sentence

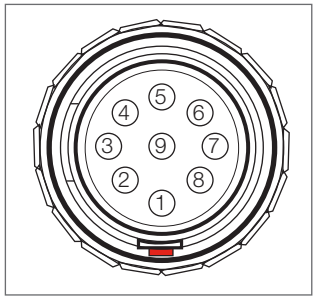


Figure 1: Communication Connector Cable Plug Pinout

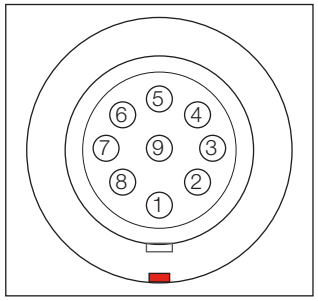


Figure 2: Camera Socket Pinout

2.7 Wiring a Camera Control Cable

The GPS/IMU is connected to the camera with a Phase One control cable (supplied with the camera kit). This cable has a LEMO-secured connector on one side for the camera and an open side with nine (28 AWG) wires for connection to your system.

The table below describes the functionality of the wires in the camera control cable for connection to a GPS/IMU.

Table 1 – Camera Control Cable Description

Connector Pin	Color	Name	Description	Direction	Level	Notes	Connect to
4	Purple	Trigger In	Trigger the camera for new capture cycle	In	VIH, min = 2.4 V VIL, max = 0.8 V tiF, tiR < 1uSec	Isolated Activate by short to common signal, otherwise leave floating	FMS
5	Blue	RS232 RX	External system can send specific information (GPS) to camera	In	VIT+ max=2.4V VIT-min=0.8V	Isolated 115200 Baud, 8 data bits, parity: none, stop bit: 1	GPS
7	White	Mid-exposure pulse	Midpoint of the exposure time	Out	VOH, min = 4.0 V (Io= -4mA) VOL, max = 0.8 V (Io= 4mA)	Isolated 5 Volt Level	GPS
8	Gray	Common		Common			
9	Black	Common		Common			

2.8 GPS Data in Image Files

The camera system extracts GPS data received from the GPS receiver and stores them in the image metadata section. Only parameters provided by the GPS/IMU device based on the selected sentences are stored. GPS event ID is always stored with a value of 0 in case of no GPS data at all or in the case a synchronization event did not occur.

2.9 Viewing GPS Data in Image Files

You can use an XMP viewer to see the GPS data in processed files. Partial data can also be viewed with Capture One in the Metadata tab.

The data is located in the image XMP block (XML packet containing XMP metadata), which is TIFF extension tag number 700 (0x2BC) with the name "XMP".

Parameters are stored in two sections:

- 'exif' (for parameters that comply with Exif standard)
- 'aerialgps'

The GPS data parameters are: (XML parameter tag is shown in brackets):

- Event ID (GPSEventID) — a unique number for matching image with GPS mark output sentence
- Position:
  - ◊ Latitude (GPSLatitude) — in format of degrees, minutes and decimal minutes and direction (N/S)
  - ◊ Longitude (GPSLongitude) — in format of degrees, minutes and decimal minutes and direction (W/E)
  - ◊ Altitude (GPSAltitude) — numerator, '/' and denominator in meter
  - ◊ Altitude reference (GPSAltitudeRef) — an integer value 0 for above sea level and 1 for below sea level
- Time (GPSTimeStamp) — GPS time in format hh:mm:ss.sss

Note: If time is UTC time (rather than GPS time) additional UTC offset is added and it is formatted as ±hh:mm

- Date (GPSDateStamp) – in format yyyy-mm-dd
- Speed:
  - ◊ Speed (GPSSpeed) — numerator, ‘/ ’ and denominator
  - ◊ Speed reference (GPSSpeedRef) — ‘K’ for km/h, ‘M’ for mph and ‘N’ for knots
  - ◊ Track (GPSTrack) — degrees in format of numerator, ‘/ ’ and denominator
  - ◊ Track reference (GPSTrackRef) — ‘M’ for magnetic north and ‘T’ for true north
- Dynamics:
  - ◊ Pitch (GPSIMUPitch) — numerator, ‘/’ and denominator where positive number for nose up and negative for nose down
  - ◊ Roll (GPSIMURoll) — numerator, ‘/’ and denominator where positive number for right wing down and negative for right wing up
  - ◊ Yaw (GPSIMUYaw) — degrees in format of numerator, ‘/’ and denominator
  - ◊ Yaw reference (GPSIMUYawRef) — ‘M’ for magnetic north and ‘T’ for true north