

AcSense-Mini-OEM

User Manual

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Software Version: 2.2.0 +

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System Overview

The AcSense-Mini-OEM is the OEM version of single-channel hydrophone, IMU, internal pressure/temperature, and RTC recorder for use in underwater sensing application. Based on the AcSense-Digital board, this system provides comes with one or two endcap-integrated hydrophones for collection of acoustic data sampled at up to 100 kHz with 12 bit resolution, as well as an arducam that can sample at up to 20 frames/s (camera resolution automatically adjusts based on sample rate; lower sample rate = higher resolution). Standard features include one HTI-96-MIN broadband hydrophone, internal IMU, and RTC.

Expected battery life is 9 hours with a 9V lithium primary battery, 5 hours with a 9V lithium rechargeable or 9V alkaline battery.

Input Voltage:

Connector Number	Cable End Description	Voltage (VDC_
J1	USBC	5 V
J22	Molex Microfit 3.0 1x2 M shell F pins	3.7 to 17 V

Console: A console cable is provided; see console section below.

SD Card: The system is configured via a file called DefaultConfig.cfg on the SD card. We provide a micro SD card with a default configuration, with that same config available in the customer share google drive.

Typical System Overview

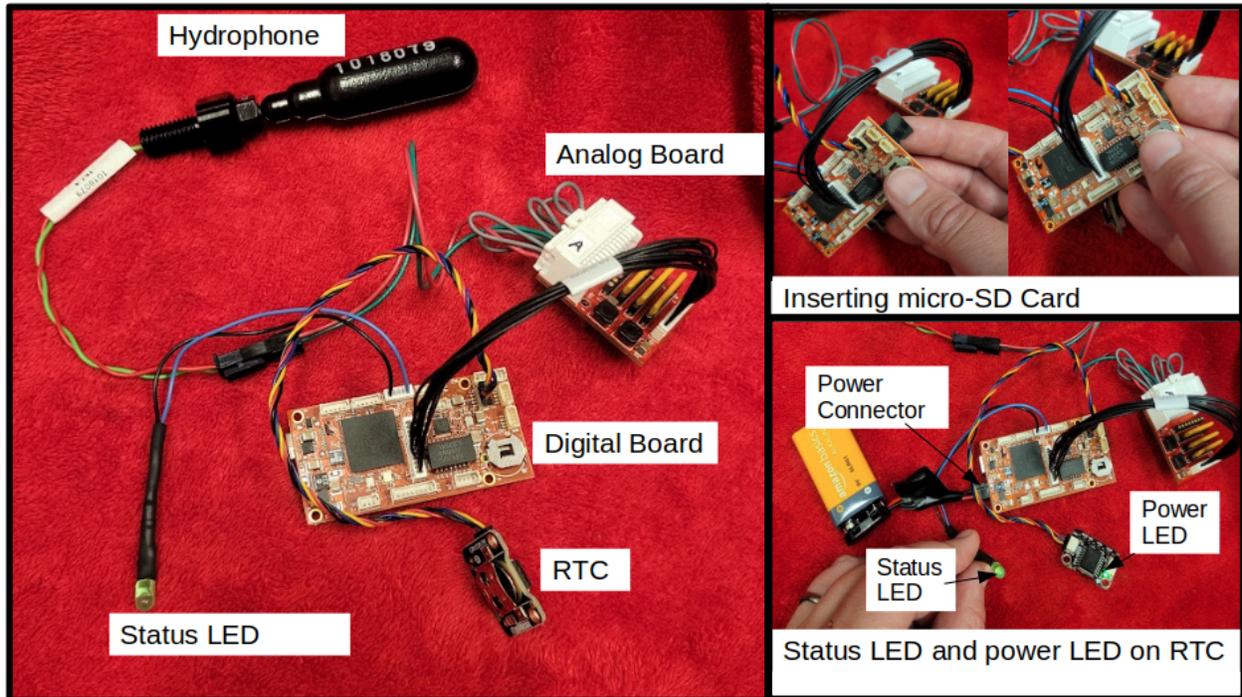


FIG 1: Key components of the AcSense-Mini-OEM with hydrophone recorder

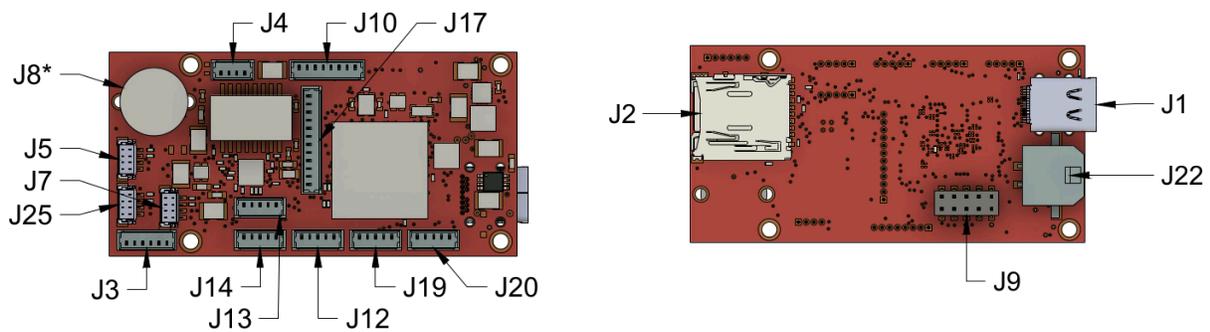


FIG 2: Connector Labels. For this build, important connectors are J17 -> Analog board, J20 -> Console Cable, J12 -> Status LED, J7 -> RTC, J1 (USBC) or J22 can be used to power the system with 5-17 V, Micro SD card slots into J2.

Typical Use

The typical use of this system includes turning the system on, configuring the system, confirming system state, and data offload. The system on startup will begin logging to an SD card automatically.

Powering On

To power the system on, power via one of the power connectors:

Connector Number	Cable End Description	Voltage (VDC_
J1	USBC	5 V
J22	Molex Microfit 3.0 1x2 M shell F pins	3.7 to 17 V

Observing Logging State

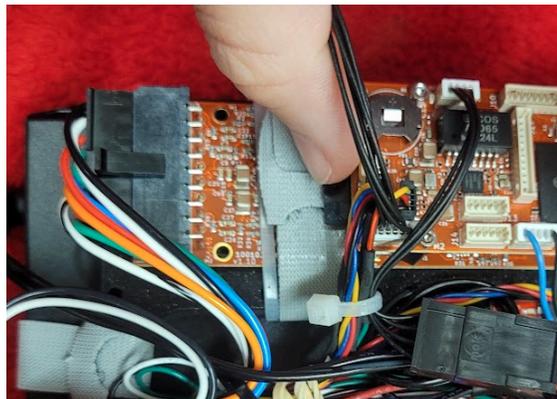
There are two LEDs, one on the RTC and the other a cabled status LED. The RTC LED will be on so long as the system is powered; the green status LED on the hydrophone board has three states:

- OFF: AcSense system is not running/logging data
- AcSense is logging but not logging: solid blue LED
- Recording: flashing blue LED, 2 s on, blink off, 2 s on

If the light is ON but not blinking, that indicates the system is configured but the SD card is missing. If the light is OFF it indicates the AcSense is not running. Check that the SD card is full inserted; this can also indicate that the config file contains an error. Open the config file in ghex and ensure each config line starts at the beginning of the line.

Offloading Data

The AcSense firmware creates a series of folders; every time the system turns on, it writes to the next sequential folder. The most recent folder with data in it contains the most recent run; occasionally a file system refresh is required to have the new files show up. Note that if files are initially created before the GPS RTC is set, the dates of creation on the folders will reflect that rather than the correct time.



SD Card location: to remove, push in and then gently extract. Tweezers can be helpful!

1. Open the housing as described above
2. Locate SD card on end of the electronics rack away from the sensor endcap under the Digital board.
3. Press the SD card to “pop” out, remove SD card
4. Put SD card into reader, connected to a computer, copy data to known location
5. Run parser as described below, in “Data Parsing”.

NOTE: a pair of tweezers can be useful for inserting/removing the SD card if you are struggling with it.

Note: The last directory will contain the latest data; in general, data should be contained within a single directory but it sometimes gets split either due to too many files being created in a single directory or due to system reset due to an overflow state. A new directory is entered on longer runs every 5-6 hours. We suggest you use the timestamps and expected duration to check, and clear the SD card of D* directories prior to each use.

Logged data Parser and Plotter

Parsing and plotting is handled via an open-source GUI provided by Acbotics Research. For the most up to date public repo and use instructions, see:

https://github.com/Acbotics-Public/AcSense_utils.git

Make sure when using the parser that you select the “Internal ADC” radio button on the GUI.

Streamed Data: ROS Application

The ROS application for ethernet streaming is available open-source; for the most up to date public repo and use instructions, see:

https://github.com/Acbotics-Public/AcSense_ROS.git

Streamed Data: UDP Interface

Open source UDP interface code is available here:

https://github.com/Acbotics-Public/acbotics_interface.git

microSD Card Config

The provided microSD card should have a file called “DefaultConfig.cfg”. This file sets which data streams are turned on and off, what is logged, and what is used as the clock for the system.

An example configuration file is below, with annotations:

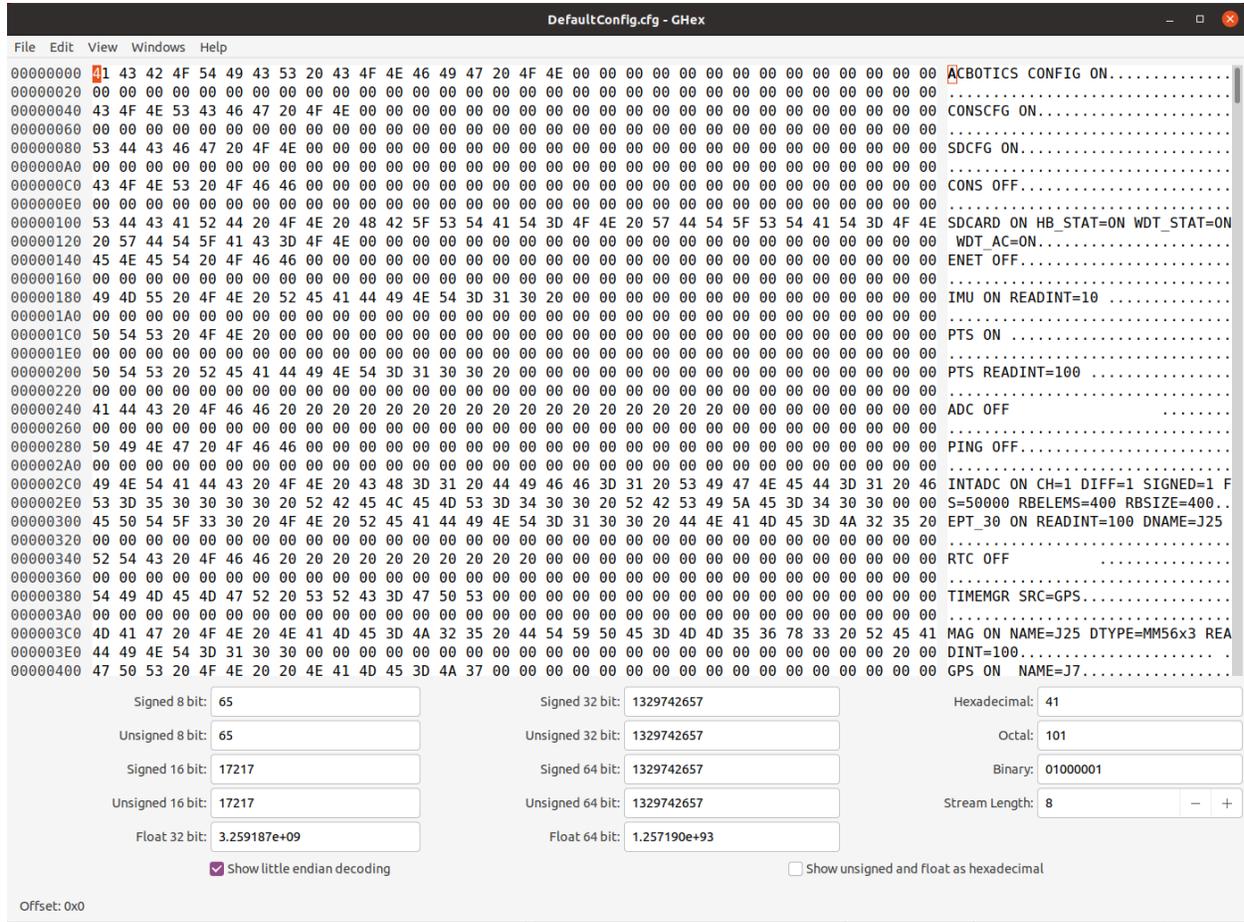
```
ACBOTICS CONFIG ON.....
CONSCFG ON.....
SDCFG ON.....
CONS OFF.....
SDCARD ON HB_STAT=ON WDT_STAT=ON WDT_AC=ON.....
ENET OFF.....
IMU ON READINT=50 .....
PTS ON .....
PTS READINT=500 .....
ADC OFF .....
PING OFF.....
INTADC ON CH=1 DIFF=1 SIGNED=1 FS=30000 RBSIZE=400 RBELEMS=400..
EPT_30 ON READINT=500 DNAME=J25 .....
RTC OFF .....
TIMEMGR SRC=GPS.....
MAG OFF NAME=J25 DTYPE=MM56x3 READINT=200.....
GPS ON DNAME=J7.....
SDCARD ACH=INTADC1 CH=GPS CH=EPT CH=IMU CH=PTS ..
STAT ON SD_GPI0=B10 WDT=ON .....
CAM OFF .....
```

To change the default config, do the following:

1. Locate and remove SD card. Plug into computer.
2. Find binary .cfg file on SD card, DefaultConfig.cfg



3. Open file in ghex or other binary file editor (HxD works for windows). (instructions below are for ghex) (for ghex, it is really helpful to stretch the screen horizontally until the lines all start where the hex ends as shown below before attempting to edit)



4. Edit as needed
5. Save file
6. Eject card, put back into AcSense-Digital board

Install ghex on linux:

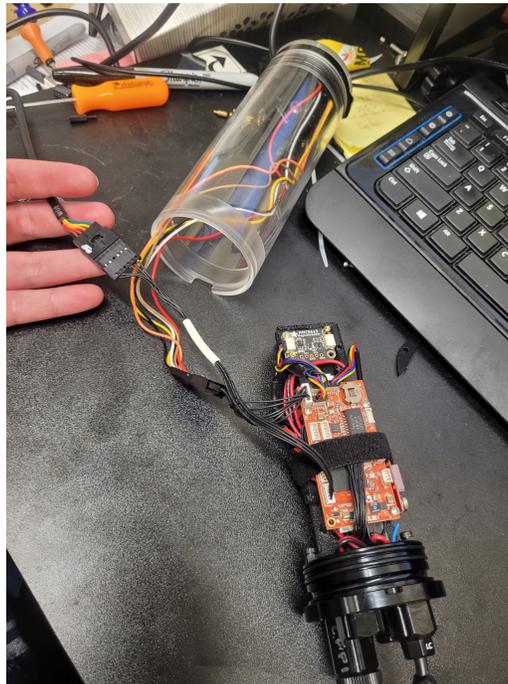
```
> sudo apt-get install ghex
```

For windows machines, HxD is a good option.

For more information on config file customization, see **Configuration Setup** document:

<https://drive.google.com/drive/folders/1NAreHchK1WEcRs49j4L7UmqwYeII3E1I?usp=sharing>

Console Service



Plugging in the console cable to the AcSense-Mini-Cam system

The cable kit includes a console cable to plug into J20; this cable mates to a USB to serial converter (avail on digikey:

<https://www.digikey.com/en/products/detail/ftdi-future-technology-devices-international-ltd/TTL-232R-3V3/1836393>). Using a console is useful if you need to debug the system, but may not be

required during general use.

1. Connect console cable to USB to serial converter cable (provided)
2. Power ON using switch: Green LED should be lit
3. Log in via Minicom or other terminal (Baud rate 115200, flow control off):
> minicom -D /dev/ttyUSB0
(Navigate menus to adjust baud rate, flow control)

To Verify sensor values using serial console:

→ ?

The system will begin giving you heartbeats. To enable internal pressure/temperature streamed logging:

→ PTS+

To stop streaming PTS over serial or to get a single data entry:

→ PTS

In general, a command and + will stream; a command without plus will give a single return and stop. The options for data queries for the default config are:

LOG STS CFG ADC EPT_30 GPS PTS IMU
SDCARD

Setting the RTC:

To manually set the RTC, in the serial console:

- > ?
- > CFG
- >> RTC
- >> RTC MM/DD/YY HH:MM:SS
- >> EXIT
- To confirm: (it may take a few seconds to update)
- > RTC

To enter FTP mode using serial console:

On boot, the console service provides an option to select alternate config files or to initiate file transfer:

```
Version: acsense_v2.1.1

ACBOTICS Initialization (RCON=0x40), enter '?' for Config
Press 1 to enter data offload mode
  2: 2_Hydrophone_Stream.cfg
  3: 3_Geophone_Stream.cfg
```

Multiple .cfg files may be loaded onto the SD card of the AcSense system; by default DefaultConfig.cfg will run, but on boot or reset you can select a different config via the command line. To go into FTP mode for file transfer, press “1” (you can press it multiple times until it enables FTP mode. If you don’t press anything, it will use DefaultConfig.cfg as before.

Detailed software documentation on UDP, console service, and configuration is available here:

<https://drive.google.com/drive/folders/1NAreHchK1WECrs49j4L7UmqwYeI13E1I?usp=sharing>

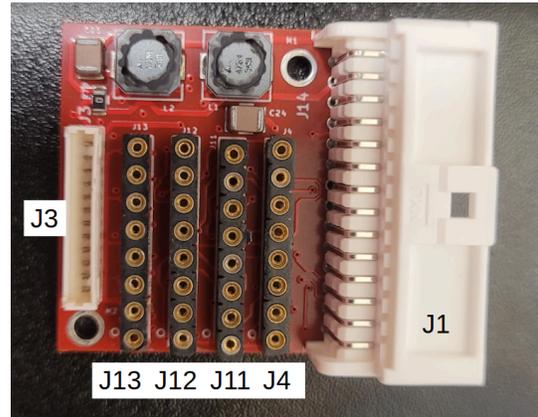
Software Documentation and Further Reading:

Detailed software documentation on UDP, FTP, console service, and configuration is available here:

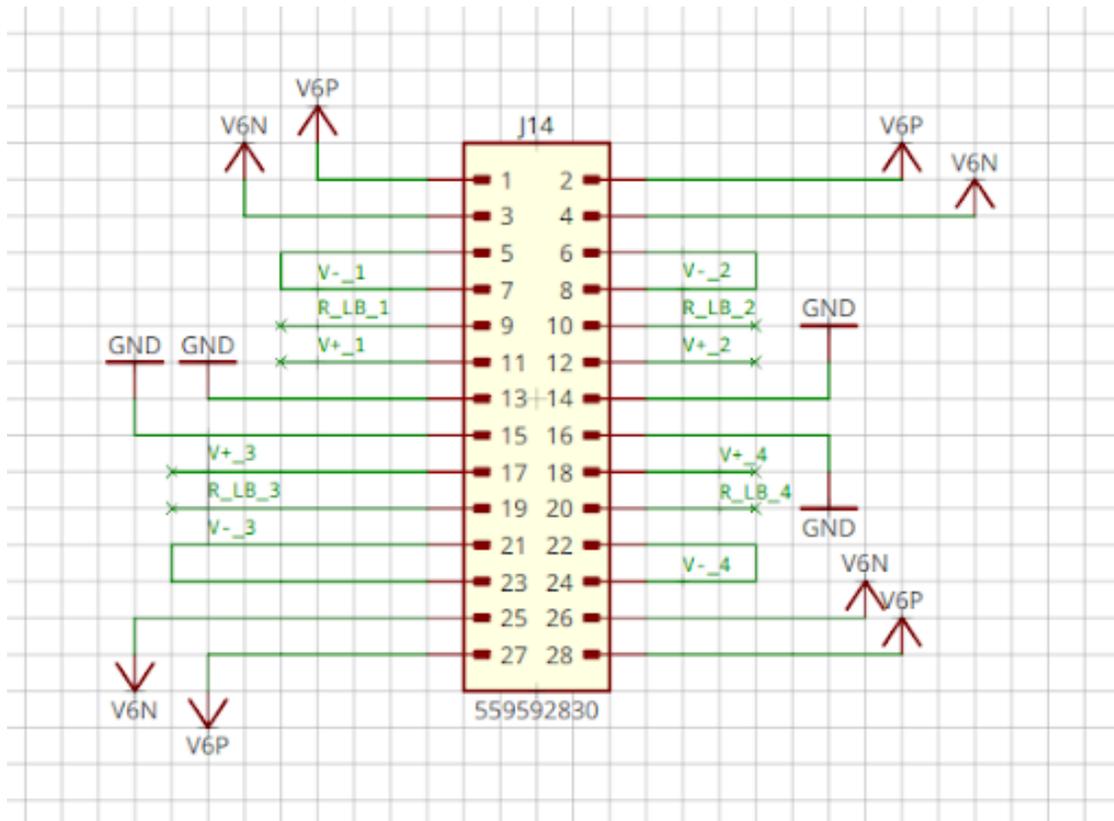
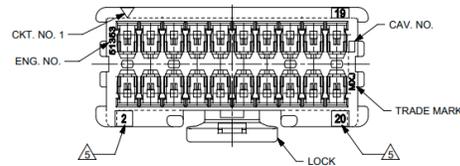
<https://drive.google.com/drive/folders/1NAreHchK1WECrs49j4L7UmqwYeI13E1I?usp=sharing>

Selecting Gain and Filter options

For systems sold with adjustable analog front end, including AcSense-Mini-Soundscape 2.0, AcSense-Mini-OEM with cable kit, and AcSense-Mini-* systems sold after November 2024. These systems include a 4-channel amp and filter board for the AcSense-Mini with 4 generic input acoustic channels with customer-adjustable gain and filters. Filters and gains are set via resistor packs. Adjustable Front End Part number: 100638



Settings via loopbacks: The hydrophone connector allows for four different options: current mode 12V, voltage mode (single ended 6V), voltage mode (differential 6 V) or an electret microphone. Settings are determined by loopbacks selected on J1.



increment of 1 equivalent to 10 ns (i.e. 10^{-8} s). This ensures that regardless of whether the global time is incorrect or variable in accuracy, the data integrity is guaranteed.

To go from timestamp to seconds into the log with no global time offset, simply multiply the timestamp value by 10^{-8} :

```
time_seconds = (  
    data["timestamp"].to_numpy() * 10**-8  
)
```

To get a global timestamp, the plotter code uses the .csv associated with the RTC or GPS RTC, finds the first valid global time in the file, and uses that value to map the timestamps in all other sensor csv files to a global time in seconds:

```
offset = 0  
if RTC_data is not None:  
  
    # use RTC data to look up timestamps:  
    # print(RTC_data[0])  
    try:  
        rtc_start = RTC_data.iloc[0]["timestr"]  
        offset = RTC_data.iloc[0]["timestamp"]  
    except:  
        rtc_start = ""  
        offset = 0  
  
    xlabeln = "s since " + rtc_start  
  
else:  
    print("RTC data is None?")  
    xlabeln = "s"  
if type(sensor_data["timestamp"]) == type([]) or type(  
    sensor_data["timestamp"]  
) == type(np.array([])):  
    tstamp_array = np.array(sensor_data["timestamp"]) - offset  
  
else:  
    try:  
        tstamp_array = sensor_data["timestamp"].to_numpy() - offset  
    except:  
        tstamp_array = np.array([sensor_data["timestamp"]]) - offset  
tstamps = tstamp_array * TICK  
return [tstamps, xlabeln]
```

Files and Folders

The system automatically creates a series of directories, D1 -> D31, in the SD card. On boot, the system will write to SD card in those directories; for long logging intervals, new directories will be entered approximately every 5-6 hours. It is highly recommended to copy off and then remove all directories from the SD card for each extended run.



Folders created on the SD card

Within a given directory, e.g. D1/, there will be the following files and folders:

1. Image directories: e.g. IMG1_0/, IMG1_1/ etc.
2. SENS file(s): e.g. SENS_1_1.dat
3. Acoustic files: e.g. AC1_0.dat, AC1_1.dat etc.
4. Config files stored for reference (binary and text): CC_1_1.cfg, CC_1_1.txt

The image directories are indexed to the acoustic files, such that IMG1_0/ contains the images collected during the acoustic file AC1_0.dat.

Image metadata is stored in the SENS file as well, and exported to .csv with the other SENS data structures; this makes it easy to reference specific images to timestamps.