

DigiSnap Pro

Product Guide

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Overview

The DigiSnap Pro is an advanced controller for long-term time-lapse photography systems. All of the functions normally required for a long-term time-lapse system using high quality cameras are integrated into this single small device. Both autonomous and networked applications are supported.

- Camera interfaces: Power, Shutter Release, USB Picture Transfer Protocol (PTP)
- Internal charge controller for dual hot-swappable battery packs
- Two battery chemistries are supported (12.1V LiIon, 14.8V LiIon)
- Compatible with a wide range of charge power sources: solar panels, battery backup banks, AC/DC adapters
- USB host for external mass storage (memory stick / hard-drive), USB cellular modem, or other specialty needs
- Configuration via Bluetooth LE to Android smart phone or tablet.
- Status reports via email
- Image transfer via WiFi, Ethernet, Cellular* and satellite terminal*.
- Carefully developed for absolutely minimum power use, for extended battery / solar powered applications
- Designed with an auxiliary interface to support sensors, motion control, and other application specific devices.

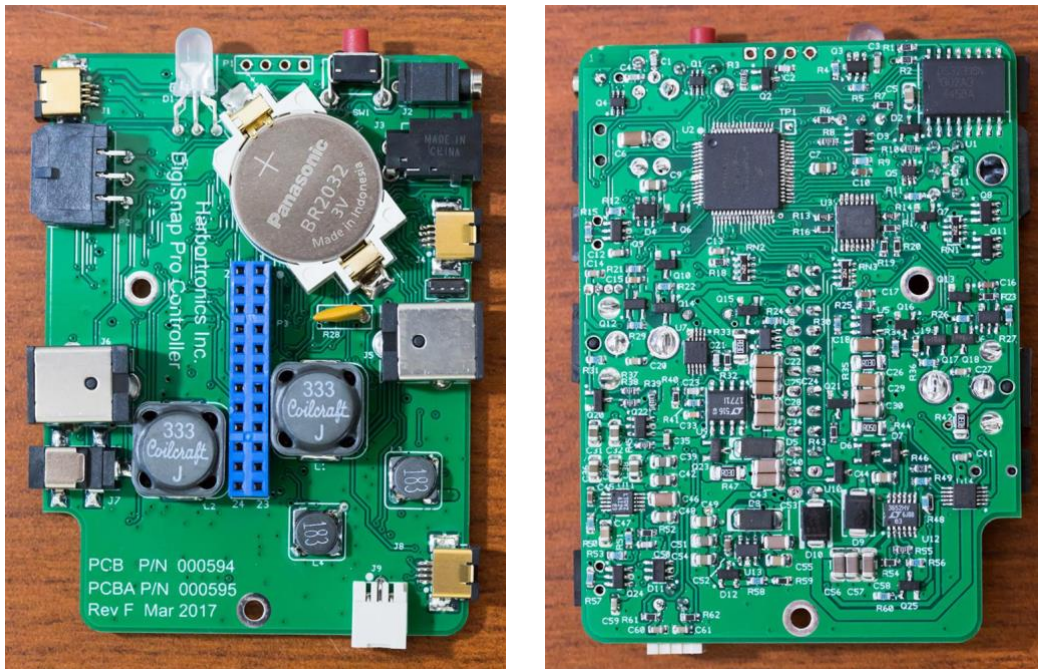
**Sold separately; not provided by Harbortronics*

DigiSnap Pro Hardware Overview

The DigiSnap Pro incorporates multiple hardware modules, each with its own functionality and means to communicate with other modules. Some devices are hard-wired, and others are hot-plug-able.

DigiSnap Pro Controller Board

The DigiSnap Pro Controller (DSPC) board is the main circuit board. The DSPC forms the base for a complete time-lapse system, including power management features, camera control, and typical time-lapse functions. While the DSPC can operate autonomously, its features are expanded greatly by the addition of the Network Board, and Accessory Modules.



Real-Time Clock

The DSPC includes an internal high-accuracy Real-Time clock, with battery backup. The coin cell battery should maintain time for many years and is user-replaceable. The time and date may be set via the DigiSnap Pro user interfaces and may be automatically corrected if the Network Board is attached to the DSPC and connected to the Internet.

Status indications

A bi-color (Red & Green) LED is visible on the DigiSnap Pro housing to display the status of the system and may be disabled if desired. When the DigiSnap Pro is initially powered on, there will be an 8 flash Green sequence to confirm that the Controller Board is working.

DigiSnap Pro

When the system is operating properly, there will be a periodic green blink. If there is a detected fault within the DigiSnap Pro, with communications, the power source or camera, a blinking sequence will be displayed instead of a simple green flash. The blink sequence is described in Appendix 1, but a short video of the blinking sequence can be submitted to Harbortronics for interpretation as well.

While the built-in LED is useful during setup and testing, in typical use the DigiSnap Pro will be installed inside a housing as part of a larger system. An external LED can be connected to the DigiSnap Pro, allowing view of status through the wall of a housing or at some remote distance.

User Switch

The DigiSnap Pro Controller includes a simple push-button switch. This switch performs various functions depending on how long it is pressed before being released.

Duration	Function
< 1 sec	Take picture now (Green LED during this period)
2-4 sec	Display LED Status sequence (Amber LED during this period)
10-15 sec	Reset the DigiSnap Pro. (Red LED During this period)
10-15 sec	If the switch is held for this duration at power-up (power unplugged/restored), the DigiSnap Pro Controller Board is reset to Factory Defaults. There will be a blinking Red LED During this period. The DigiSnap Pro password and other critical parameters are not changed. If reset, the LED will flash Amber briefly.

Temperature Sensor

The DSPC includes multiple on-board temperature sensors, used to monitor the ambient temperature, as well as check for high-temperature conditions on the circuit board. Temperature information is used to control charging to the battery pack, and may be used by the Network board in status reports, or logged with pictures.

The reported Ambient temperature is from a sensor in the air between the circuit boards. This temperature may be slightly higher than the actual air temperature in the housing, and it will be slow to respond to temperature changes. When the internal battery charger is in use, this temperature will naturally rise.

The Bluetooth Module also has a temperature sensor, and there is essentially no internal heating in that module. When connected to the DigiSnap Pro, the temperature reading from the Bluetooth Module is used for the Ambient temperature.

Humidity Sensor

An on-board humidity sensor can be used to detect moisture build-up, such as from a housing leak. By monitoring the humidity reported in emails, the operator can be warned early enough to prevent condensation on the optics.

Scheduled Time-Lapse

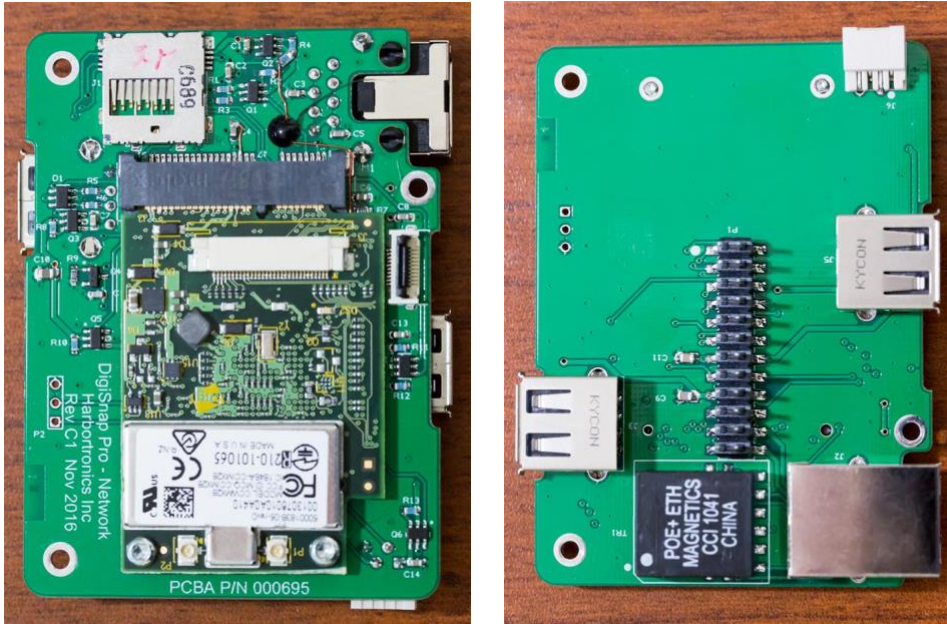
The DSPC includes a scheduled time-lapse process, where up to four time-lapse sequences may be defined. Each sequence has a number of configurable parameters:

- Start & Stop times: Operate during portions of the day, or set equal to each other to operate all day.
- Interval between pictures (i.e. every 5 minutes)
- Days of the Week: Operate every day, or only during selected days
- Months of the Year: Operate year round, or only selected months.

DigiSnap Pro Network Board

The Network Board mates with the DSPC and includes an embedded computer running a Linux operating system. The embedded computer was selected for its low power, wealth of resources, and small form factor. The addition of the Network Board enhances the DSPC tremendously, adding USB host ports, connector for GPS module, Ethernet, and WiFi communications. The Network Board allows for transfer of images and notification messaging.

One particularly difficult aspect of providing a camera system with networking is minimizing the power draw. The DigiSnap Pro handles this by controlling the power to the network board, leaving it powered down the majority of the time. When images are ready to transmit individually or in a queue, the network board is powered on and off again later when completed.



Networking

A 10/100 Mbps Ethernet connection is provided on the DigiSnap Pro.

The Ethernet connection may be used for direct wired connection to a local area network, or for connection to a satellite terminal.

A WiFi radio is built into the DigiSnap Pro Network Board, and an optional antenna with a short cable is available. This short extension is perfect for use in the Cyclapse Housing, raising the antenna to a position inside the fiberglass dome lid where it has much better coverage. The DigiSnap Pro can be ordered with an installed antenna, but it may also be installed at a later date. The cable to the antenna has a small connector, which should be routed through the hole in the DigiSnap Pro housing, and connected to the mating connector on the circuit board. This requires the DigiSnap Pro housing to be disassembled, but this is straightforward.

The USB Host ports may be used to communicate with USB cellular modems. The power is electronically controlled as needed to save power. When using a USB cellular modem 'dongle', we recommend using a short USB cable to locate it for best radio coverage.

The DSPC provides switched power outputs which can be used to power WiFi routers, cellular modems, and satellite terminals. In normal operation the network connection and power to external radios will be established only as long as needed for image transfer and status reports, saving power.

USB Host

The DigiSnap Pro Network Board includes a pair of USB 2.0 host ports, which may be used to connect to a camera USB port for camera control and image download. The USB connection is also perfect for use with a hard drive or flash memory device. Consider a camera system mounted out of reach on a pole. A flash memory stick can be connected to the end of a long USB cable routed down from the camera system for easy collection of the images. Configure the system to copy the images to the external memory, and simply swap the memory stick with a new one to collect the images.

DigiSnap Pro Accessory Modules

BLEM: Bluetooth Low Energy Module

The BLEM is designed to leverage the most user friendly and ubiquitous electronic interfaces ever developed... smart phones. The BLEM is a small micro-powered radio transceiver providing a wireless connection to smart phones, tablets, and other Bluetooth enabled computers. An Android app has been developed to configure and control the DigiSnap Pro via smartphones and tablets.

The BLEM is normally purchased with each DigiSnap Pro as the primary method to configure the system. Android tablets are an excellent low-cost way to get started with the DigiSnap Pro, if an Android smartphone is not already available. Bluetooth 4.0 or greater is required to communicate with the DigiSnap Pro.

Android 6 and 7 are currently supported by the DigiSnap Pro App, which can be acquired through the Google Play store, or the Amazon App store.

Debug Module

The Debug Module is a cable (containing electronics) which connects the DigiSnap Pro FM Port to a USB port on a standard computer. A Windows-based computer program is included which allow the operator to configure and control the DigiSnap Pro. Mac users can run the Debug program with Boot Camp or virtualization software such as Parallels or VMware Fusion.

The Debug Module is an optional accessory for the DigiSnap Pro. It was developed to aid in testing the DigiSnap Pro, and was not intended for normal use by customers, but can be a valuable resource to customers who require access to all features.

GPS Module

The GPS module provides collection of time and position information. GPS positioning is not necessary for most time-lapse projects, but can be essential for some projects. Consider a time-lapse camera on an iceberg transmitting images and position via satellite. Imagine a camera attached to an animal in the field... there are many potential applications that could make use of position data in addition to images.

Design Considerations

Power

- Solar, battery, or AC Mains adapters can be used to Charge Battery Pack(s)

One particularly difficult aspect of long term time-lapse projects is finding a way to power the equipment.

AC mains power is great it is available, and if it's reliable. The longer the project, the more likely it is that the power will drop out sometime during the shoot. If you are on a construction site, you can be assured that someone is going to unplug your power cord, "just for a minute" to use their drill or intentionally disable the camera system. AC/battery/inverter backup systems are available, but are bulky, expensive, very inefficient, and small commercial units only last for a few hours. Then there's the matter of finding a place for the large the backup unit, protecting it from the elements, etc. Dedicated AC power requires electricians, conduit, digging, and other expensive resources.

If you don't have reliable AC power handy, rechargeable battery power is essential. There are various ways to gather energy, such as solar or wind (or even AC) power, but these sort of energy sources are never constant and are unreliable. These intermittent power sources are however quite useful for charging batteries, which then power the equipment. In some short/medium term projects, enough battery power can be supplied to eliminate the need for charging, but most applications will benefit from charging in the field.

The DigiSnap Pro is designed specifically for use with battery power. There are connections for two battery packs, which may be hot-swapped as needed. The DigiSnap Pro takes in energy from an external power source and maintains the charge on one or two connected battery packs. The charger can work from any DC voltage from 18 to 30 VDC, connected either via network cabling or the charge port connector. An efficient technique is used to optimally extract power from solar panels or variable output power sources.

In order to work properly, the charger input voltage must be about 3V higher than the battery under charge. Harbortronics has a 16.8V 'indoor' battery charger kit (000716) often used with the Cyclapse Classic system. This battery charger is not sufficient to charge the standard Cyclapse battery pack (14.8V, 92WH, 000457) when used through the DigiSnap Pro. We can provide a weatherproof AC power supply if AC power is required for your DigiSnap Pro or Cyclapse Pro.

The DigiSnap Pro battery port can also be connected directly to a 12V AC/DC adapter in place of using batteries.

Camera Control

- Industry standard Half/Full contacts, and USB

On modern digital cameras, there are three interfaces of interest when considering time-lapse applications. Power, shutter release, and computer connections. The DigiSnap Pro provides all of these connections.

Internal batteries in a camera are insufficient for anything beyond a short time-lapse project. The DigiSnap Pro has an efficient switching supply to convert the power from an external battery pack to the correct voltage needed by the camera. Most cameras will shut down to a low power state (sleep) between pictures, which is normally adequate to reduce the power consumption of the system. With some camera models, the camera does not conserve power automatically, and the power to the camera can be controlled dynamically by the DigiSnap Pro, completely shutting the power off when not needed.

The DigiSnap Pro monitors the current drawn by a camera in order to detect a camera failure or a full memory card. This information can be used to stimulate a message to the operator via networking.

Most digital SLR cameras have an electronic shutter release connection, which is essentially the same as pressing the shutter button manually. In most time-lapse projects the camera will fall to a sleep state between pictures. Activating this interface will wake the camera from a sleep state. The dwell time for the half and full press states can be individually configured within the DigiSnap Pro.

Almost all cameras have a USB interface, compatible with the USB 2.0 provided on the DigiSnap Pro. As with most computer equipment, just because it has a USB port doesn't guarantee compatibility! The DigiSnap Pro has been proven to work fully with most Canon and Nikon cameras, and has limited compatibility with some Pentax, Panasonic and Sony cameras. In normal operation, pictures may be scheduled to be taken at the same time images are being extracted from the camera. Not all cameras have this capability, so we recommend the use of Canon or Nikon cameras. We'd be happy to suggest particular models.

Image Storage / Transfer

- Camera Memory Card, Local USB Stick, or Remote Image Transfer to the 'cloud'

The DigiSnap Pro was designed from the outset to be network-able via the Network Board. Images (full size or thumbnails) can be automatically transferred to internet servers as they are taken or in scheduled queued bursts to optimize power use.

Historically, Harbortronics equipment have been designed for autonomous operation, where the images were simply stored on the camera's internal memory card, and periodically swapped in the field. This mode of operation is still preferred in many applications, as the system power is hugely reduced and there is no requirement for wireless and network services and their attendant fees. In many remote locations, networking may not be possible. The DigiSnap Pro can be operated as an autonomous controller, where images are simply left on the memory card for periodic gathering.

A USB port on the DigiSnap Pro can be used with extended cables to connect to a remote storage device. This could be as simple as a USB memory stick on the end of cable at the bottom of the mounting pole. Other mass storage devices such as a huge USB hard-drives can be accommodated easily. Power is disconnected when not needed.

When configured for use with a network via WiFi, Ethernet, or cellular modem, the DigiSnap Pro can automatically transfer images via FTP to a networked storage location, which could be the operator's own server or a managed time-lapse photo service.

Unlike many other companies, the Harbortronics DigiSnap Pro uses open, industry standard communication protocols to allow images to be transferred with no service fees / monthly contracts to Harbortronics!

Connections

One major goal for the DigiSnap Pro was to integrate all of the pieces typically needed for a long term time-lapse project into a single device. This means that there are a lot of ways to use the DigiSnap Pro, and a lot of connections! Not all connections are required for every installation. Harbortronics can assist in configuring the optimum cable solution for your application. The connectors on the DigiSnap Pro are unique to their use, so there is no concern for mis-connecting the cables.

Charger

The DigiSnap Pro is almost always powered from a local battery pack(s). External power sources, such as a solar panel, windmill, AC power supply, battery bank, etc., are used to keep the battery pack(s) charged. Power is drawn from external power sources only as needed to recharge the connected battery pack(s). The charge current to the battery packs is limited to 2 Amps, and the maximum power drawn from any power source is approximately 32 watts. In addition to charge control, the DigiSnap Pro uses an energy harvesting algorithm that optimizes power extraction from any DC power source, at whatever power level they are able to supply.

Solar Panel Size

Given that the DigiSnap Pro has an efficient energy harvesting process, you can use small panels (i.e., 5 watts) for projects that will take a limited number of pictures per day (i.e. under 100), and infrequent networking use. You may also use large solar panels without fear of overcharging the battery packs or drawing excessive current. The DigiSnap Pro will only draw a maximum of 32 watts, so a large panel may not be fully utilized, but there is still an advantage as there will be a greater amount of power available for more hours in the day.

The charge power connections are not DC isolated from the main circuit. This is not at all unusual, but it is advisable to use an isolated charge power source. Solar panels, AC / DC power supplies, and external batteries are all normally isolated from earth ground, and may be used without concern.

Connector: DC Power Jack, 1.3/3.5mm

Mating Connector: 1.3/3.5mm barrel plug.

Function: Power Source for charging internal and external battery packs

Typical Use: Solar Panels, AC/DC Power Supplies, 24VDC Battery Banks

Pin	Name	Description
1	Center	Positive power, 18-30 Volts DC
2	Outside	Power return

Battery Packs (2 jacks provided)

The DigiSnap Pro is always powered from one or two battery packs. When AC power is available, a standard AC/DC power supply may be used as a charge power source, and a low capacity battery pack may be sufficient. For long term unattended applications, larger battery packs are advisable to keep the system operating during the inevitable periods where the charge power may drop out. Harbortronics has been using these sort of battery packs for many years and would be happy to recommend or supply battery packs for your project.

Compatible Battery Packs:

- Internally-protected 4 Cell Lithium-Ion (14.8V nominal). This is typically supplied with the Cyclapse Housing.
- Internally-protected 3 Cell Lithium-Ion (11.1V nominal).

The battery connections are designed to allow connection of battery packs of different charge states and capacities. Capacities of 3-15 AH are well suited for this system. The peak charging current is 2 Amps. Hot-swap capability is built into the DigiSnap Pro, allowing the battery packs to be connected or disconnected without having to match their charge state. When two battery packs are used, they must be the same type (i.e. 14.8V cell Lithium Ion), but they can have different capacity ratings.

Connector: DC Power Jack, 2.1/5.5mm

Mating Connector: 2.1/5.5mm barrel plug.

Function: Connection to external battery pack(s)

Pin	Name	Description
1	Center	Positive terminal of battery pack (17VDC absolute maximum)
2	Outside	Power return, circuit ground

Camera Shutter Release

The DigiSnap Pro is designed for compatibility with a wide range of commercial digital stills cameras. Compatible cameras will have a connection for a 'wired remote' shutter release cable. There are a variety of connectors used in the industry, and every few years a

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new format is introduced. The DigiSnap Pro uses a shutter release control technique which will work with the majority of them. All Canon SLR cameras use either an N3 or E3 connector, Nikon SLR cameras may use a 10Pin, DC1 or DC2 connector, Pentax SLR cameras may use the E3 style connection, Panasonic, Sony, etc., may use different designs. Harbortronics can provide cables to connect between the DigiSnap Pro and your camera.

Connector: 2.5mm stereo jack (Canon E3 style)

Mating Connector: 2.5mm stereo plug

Function: Digital Camera Shutter Release

Pin	Name	Description
Tip	Full Press	Switched to common to take a picture.
Center Ring	Half Press	Switched to common to activate metering and focus.
Base Ring	Return	Returned to circuit common

Camera Power

In short term applications, for instance time-lapse photography of clouds, fireworks, etc., the internal battery of the camera may be sufficient. For long term time-lapse applications (months or years), providing reliable power to the camera is an essential component of time-lapse equipment. The DigiSnap Pro is designed to provide power for a digital camera, simplifying the design of the overall system. The camera power voltage can be configured for any voltage from 3V to 10V, which is sufficient range to cover all digital cameras on the market.

The vast majority of compatible cameras are designed for use with two cell lithium ion battery packs, whose voltage may range from 6.0 to 8.4V depending on the state of charge. The DigiSnap Pro is pre-configured to provide 8V to the camera power adapter, to simulate a near fully charged battery pack.

Cameras typically use one of two means of connecting to external power: via the battery compartment using a 'dummy battery', or through a dedicated connector on the camera. Most manufacturers have moved to the use of dummy battery packs, with a cable entering the battery compartment. Harbortronics can supply dummy battery packs with appropriate cabling for the DigiSnap Pro, as well as cables to connect to dedicated power connectors on cameras.

The current drawn by the camera is monitored by the DigiSnap Pro to confirm camera function. For instance, if the camera does not seem to draw current when triggered, there is likely a problem with the camera, and the operator may optionally be notified via an Email status message.

Connector: DC Power Jack, 1.7/4.75mm

Mating Connector: 1.7/4.75mm barrel plug.

Function: Power supply for digital camera

Typical Use: External power for camera

Rating: 3.5 Amps capability, please limit to 1 Amp average current. Most SLR cameras draw 1.5 - 2.5A for a short time when taking a picture, and draw very little the rest of the time.

Pin	Name	Description
1	Center	Positive voltage to camera, configurable for 3-10 volts DC
2	Outside	Power return, circuit ground

Input / Output Signaling

Over the many years Harbortronics has been designing and supplying time-lapse equipment, an amazing variety of applications have been addressed. Some of these applications involved responding to events, such as motion detectors, remote triggering via radio, and response to a variety of environmental parameters, such as rock fall, temperature changes, water depth, remote switches, etc. Essentially all of these 'real world' triggering sensor/mechanisms can be adapted to output a 'dry contact closure' type of signal. The DigiSnap Pro has an input connection which is compatible with this standard type of trigger signal.

In addition to having an input signal connection, the DigiSnap Pro has an output signal which can be used for a number of applications. There are a variety of external devices that may need activation in conjunction with taking pictures. For instance, a window wiper, external mechanical cover, power for lighting, and simple motion control devices can all be synchronized to the camera via the output signal.

The DigiSnap Pro could potentially be used with other networking devices. Two power outlets are provided to power such devices. One output is essentially a switched connection to the battery power, which can be perfect for powering a satellite terminal, and the other is a switched 5V output source which may be useful for a router or cellular modem.

The switched battery output can also be used to power a heater. The DigiSnap Pro includes an algorithm to power a heater on/off as needed to keep the temperature above freezing, which can be useful in some applications. In the majority of applications, even in the Arctic, a heater isn't required.

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The DigiSnap Pro can be directly connected to many RC Servo devices, to be used as a window wiper or as an auxiliary window cover/shutter. The starting and ending positions can be configured for these applications.

Connector: Molex Micro-Fit 3.0, 6 pins, 43045-0600

Mating Connector: Molex part number 43025-0600

Function: Simple signaling to/from external devices, and switched power.

Pin	Name	Description
1	Batt Out	Switched Battery Voltage, positive, 10-16.8 Volts (depends on battery type and state of charge). Maximum 5 Amp capacity, may also be limited by the particular battery pack.
2	Input	Connect to ground to trigger the DigiSnap. Internally pulled up to 3.6 Volts with 220K resistor.
3	Ground	Common to circuit ground
4	Ground	Common to circuit ground
5	5V Out	Switched 5V voltage, 1.2A total capacity, shared with other devices.
6	Output	Open Drain Output, 200mA capacity. Internally pulled up to 3.6 Volts with 33K resistor. Normally open/high.

Visual Status Monitor -External

Connector: TE Connectivity 292206-3

Mating Connector: TE Connectivity 353908-3 or 353253-3

Function: Status indication

Typical Use: LED attached through environmental housing wall, visible outside

Pin	Name	Description
1	Red	3.6V signal, 33 ohm source resistance, to power a Red LED (10mA typical)
2	Ground	Receive input to DigiSnap Pro
3	Green	3.6V power, 33 ohm source resistance, to power a Green LED (10mA typical)

The LEDs are used to periodically display the status of the system, and may be configured to be enabled or disabled. Please refer to Appendix 1 for more description of the LED blink sequence.

Accessory Port (3 independent ports provided)

Connector: Hirose MQ172X4

Mating Connector: Hirose MQ172X4 Plug

Function: Connection to accessory module

Potential Uses: Motion Control, Ambient Light, Motion Sensor, Water Level, Temperature, etc.

Pin	Name	Description
1	FM Power	Switched Battery Voltage, positive, 10-16.8 Volts (depends on battery type and state of charge). Maximum 5 Amp capacity, may also be limited by the particular battery pack.
2	TxD	Transmit from DigiSnap Pro
3	RxD	Receive input to DigiSnap Pro
4	Ground	Common to circuit ground

The Accessory Modules and their connection/communication protocol are described in a separate document.

USB Host (2 provided) [Network Board]

Connector: Industry standard USB A jack

Mating Connector: Industry standard USB A Plug

Function: USB 2.0 Specification, High-Speed

Typical Use: Camera USB/PTP

Note: The USB port power is switched by the DigiSnap Pro. You may need to configure the system before it will apply power to, and recognize your USB device.

Pin	Name	Description
1	USB Power	+5 Volts Power when enabled, 1.2A total capacity, shared with other devices.
2	USB D-	Bi-direction data twisted pair with pin 3
3	USB D+	Bi-direction data twisted pair with pin 2
4	Ground	Common to circuit ground

Ethernet [Network Board]

Connector: RJ45

Mating Connector : Industry standard network cabling

Function: 10/100 Mbps Ethernet

Note: The Ethernet signals are not DC isolated from the circuit ground. The RJ45 shield is connected to circuit ground.

Pin	Name	Description
1	TX+	Transmit from DigiSnap Pro, twisted pair with pin 2
2	TX-	Transmit from DigiSnap Pro, twisted pair with pin 1
3	RX+	Receive input to DigiSnap Pro, twisted pair with pin 6
4	PoE +	Common with Pin 5, positive PoE voltage (18-30VDC)
5	PoE +	Common with Pin 4, positive PoE voltage (18-30VDC)
6	RX-	Receive input to DigiSnap Pro, twisted pair with pin 3
7	PoE Return	Common with Pin 8, PoE supply return [Low value sense resistor to ground]
8	PoE Return	Common with Pin 7, PoE supply return [Low value sense resistor to ground]

GPS [Network Board]

Connector: TE Connectivity 292206-4

Mating Connector: TE Connectivity 353908-4 or 353253-4

Function: Asynchronous Serial Data, 3 Volt logic levels.

Typical Use: GPS Receiver Module

Pin	Name	Description
1	Serial Power	3.6 Volts Power when enabled (please limit to 100 mAmps)
2	Serial Rx	Receive input to DigiSnap Pro
3	Serial Tx	Transmit from DigiSnap Pro
4	Ground	Common to circuit ground

WiFi [Network Board]

Connector: U.FL miniature coax

Function: 802.11 a/b/g/n WiFi

Typical Use: Cable connection to remote antenna. Harbortronics can provide an antenna on a short cable which has been pre-certified for use with the WiFi module inside the DigiSnap Pro.

Configuration

There is a big list of configurable settings in the DigiSnap Pro. This can seem overwhelming at first! It can be very helpful to just consider one piece of the system at a time and work through the configuration slowly. In the vast majority of applications, there are only a few items that will need to be adjusted.

The DigiSnap Pro may be configured in the office or in the field via an Android smartphone or tablet using a Bluetooth LE radio link. The DigiSnap Pro App is available for free in the Google Play store, or if using an Amazon specific Android device via the Amazon App store. The optional Bluetooth LE Module accessory must be connected to one of the Accessory ports of the DigiSnap Pro for this configuration method.

A direct connection to a Windows PC or Mac computer with virtualized Windows installation can be established using the Debug Module cable and the Debug Module software. This connection method allows control over all of the DigiSnap Pro configurable settings, as well as factory test and setup.

Camera

The DigiSnap Pro can be used with a wide range of cameras, from small point-and-shoot cameras, to high-end Medium Format cameras. The vast majority of long term time-lapse projects make use of SLR cameras, so the DigiSnap Pro is optimized for the interfaces generally provided on these cameras. We would be happy to recommend cables and configuration settings for your camera.

Power Supply Voltage

Digital cameras will use a range of battery types, but generally they use lithium-ion chemistry, and are single or dual cells. The DigiSnap Pro is often used with a 'DC Coupler' or 'battery substitute' cable assembly, which plugs into the battery compartment in place of the battery pack.

The vast majority of SLR cameras use battery packs made with two cylindrical battery cells, and often this is obvious from the shape of the battery pack. These are all rated at 7.4V, and will range from 6.0V to 8.4V depending on the state of the charge. We suggest setting the camera power supply voltage to 8.0 volts.

Some cameras such as the Panasonic Lumix for instance, will detect the difference between using a DC coupler and a normal battery pack, and require the voltage to be 8.4V or higher.

Some cameras may use a single cell battery pack, and for these we recommend using a 4.0V setting.

Some cameras may provide a dedicated jack for external power. In all of these cameras, the voltage is specified on the camera body next to the connector making it easy to set up the DigiSnap Pro.

In addition to setting the camera's power supply voltage, the timing when the power is applied may be configured. Most modern cameras do a very good job of minimizing power within the camera and don't require additional control. For instance, many cameras will switch to a low power 'sleep' state 10 or 30 seconds after a picture has been taken, and this sleep state is generally low enough as to be negligible. For these cameras, the power may be left 'always on'. It's often a good idea to periodically remove power from even these cameras, just in case the camera were to experience an internal issue or 'lock-up'. Removing and re-applying power can often allow the camera to recover from these rare issues. Our recommended configuration is the 'Reset Power Daily' setting. Some cameras may draw significant power during their 'sleep' state, or may not even fall into a sleep state between pictures. For these cameras you may wish to turn the power to the camera on before the picture, and off a short time after the picture, to save power.

Shutter Release Timing

Triggering a digital camera via the standard shutter release connection is a two-step process. If you manually activate a camera you have done this without even thinking about it. Lightly pressing the shutter release button wakes the camera and sets the focus and exposure. Once these processes have finished, pressing the shutter release button fully triggers the camera to take the image.

The DigiSnap Pro controls the timing of both of these signals to the camera, the Half-Press and Full-Press. When the camera is awake, and the lens is set to manual focus, the camera can be triggered very quickly. On the other hand, if the camera is asleep between pictures in a time-lapse sequence, or if the lens is set to auto-focus, it can take much longer.

The Half-Press duration may be set to about 2 seconds for a typical Canon or Nikon SLR whose lens is set to manual focus. This is long enough to wake the camera from sleep, and set the exposure. Other cameras, such as the Sony A7 series require a longer time, about 4 seconds to reliably perform these operations. If the lens is set to auto-focus (which we never recommend), you may need to increase this time to 10 seconds or more, but even then the camera might not focus on the subject you desire. The configuration range is from 1/16th second to 16 seconds.

Once the camera has been awoken and is ready, it only takes a very brief period of activating the Full-Press signal to trigger the camera to take the picture. We typically suggest setting to 1/8 second.

The DigiSnap Pro has the ability to activate the Full-Press signal for as short as 10mS and as long as 6 hrs, with a 1/12th stop resolution. This capability is useful when the camera is set to BULB mode, and attempting to perform a 'Holy-Grail' time-lapse, from day to night.

Time-Lapse Sequences

The DigiSnap Pro allows up to four independent time-lapse sequences to be configured, which will work even when the scheduled times overlap. A time-lapse sequence has several configuration parameters.

- **Enable/Disable**
Most projects may only require one time-lapse sequence, so the others would be disabled.
- **Start / Stop Time**
The DigiSnap Pro handles time-lapse on a daily basis, which works well for projects where the activity is limited to certain times during the day, such as construction projects, daylight scenes, etc. If you set the Start and Stop times to the same time, the time-lapse will be active all of the time (24 hours / day).
- **Days of the Week**
In addition to selecting daily windows of time to take pictures, you may also select the days of the week. This is particularly useful for human work related projects, like construction.
- **Months of the Year**
In some applications, such as work in the polar regions, there may be a need to only take pictures during certain months of the year.

Burst Sequence

There are many possible projects where the event to be captured with photography may be sporadic. Animal/trail photography is a good example. The DigiSnap Pro has an input signal that can be configured to start a limited (Burst) time-lapse sequence when triggered. A Burst sequence is configured by the interval between pictures, and the number of pictures to take.

Battery Type

When used in the Cyclapse housing, Harbortronics will supply one or two 14.8V Lithium Ion battery pack(s). Other systems with sealed housings may be built using 11.1V Lithium Ion, or 12.8V Lithium Iron Phosphate (LiFePO4) battery packs. Internally protected battery packs must be used!

If the battery pack is external to the housing (connected through a SHORT) cable, 12V Lead Acid batteries may also be used. Lead Acid batteries must never be recharged inside a sealed housing!

Please take care to select the correct battery type when configuring the system! If the setting is wrong, the battery could be overcharged which could destroy the battery pack and possibly be a safety hazard! Alternatively, a wrong setting could undercharge the battery pack leading to very poor performance.

The battery type can also be set to 'No Charging', which would permit use with primary (non-rechargeable) batteries, or directly from a 12V AC/DC power supply (not recommended for a long term application).

Image Storage

When pictures are taken, the images are saved on the memory card in the camera. The DigiSnap Pro can be configured to connect to the camera via USB, extract and move those images. There are two general locations that the DigiSnap Pro can use to transfer the images: USB storage and remote storage. If the storage media isn't connected, the images are simply left on the camera.

USB storage would consist of a USB hard-drive or memory stick. Consider a Cyclapse camera system with the DigiSnap Pro mounted on a utility pole overlooking a construction site. Accessing the camera would require climbing the pole, a tall ladder, or a bucket-truck. Alternatively, a USB cable could be connected to the DigiSnap Pro, routed to the base of the pole, and a USB memory stick connected. Images could be collected instantly by swapping memory sticks.

Remote storage is any location on a network or the internet. The DigiSnap Pro can connect to the internet and transfer images to a designated server for instance. The network location may be anywhere you designate.

When connecting to a network or internet site, additional settings are required to specify the location, and login.

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A major consideration for networking is power consumption. The Network Board, Camera, and storage media must all be powered on and active during image transfer. It can take a fair amount of time to power everything up and establish communication. If the system is solar powered, the power consumption can be optimized by transferring multiple images at a time, rather than each time a new picture is taken. Image transfer can be enabled to occur every time a picture is taken, after multiple (30) pictures, once per day, once per week or never.

The image files will be placed on the local or remote storage, in daily folders. The date and time come from the camera's clock, and the format is:

YYYYMMDD/YYYYMMDD_HHMMSS.jpg

When processing images, it may be useful to move all images to the same folder. There are utilities to do this on most servers (, as well as Mac and Windows PCs.

Server: <https://unix.stackexchange.com/questions/52814/flattening-a-nested-directory/52816#52816>

If you set your camera's clock to UTC then it will be in UTC. If you use the "push time" button in the app, it will set the camera to local time according to the network board. This is based on its timezone setting, which defaults to UTC. If you want another timezone, make sure to set the timezone before hitting "push time".

Networking

In order to save power, the DigiSnap Network Board will be inactive most of the time. When it is powered on to perform a task such as image transfer, it will automatically check the various ports to find a connection to a network. Connection may be made via WiFi, Ethernet, USB cellular modem, or even satellite terminal.

Once the connection path has been found, there may be a log-in for that path, such as a WiFi password. When connected to a network, there may be other log-in processes required for connection to a remote storage location. All of these locations and log-ins may be configured and retained in the DigiSnap Pro.

- Email address, for sending status messages.
- Network URL, Login, and Password, to connect to a remote storage folder, typically on the internet.
- Email require several configuration settings: SMTP server address, SMTP port, SMTP user name. Harbortronics has pre-loaded our own email server info into the DigiSnap Pro, so you can get started more quickly.
- WiFi connection password, to connect to a local router.

Networking numerous and large image files via radio can be problematic. For instance, consider a system taking a picture every 5 minutes during a 10 hour work day, 5 days per week. This works out to about 2400 pictures per month. A typical 18MP JPEG image is on the order of 8MB. A 20GB cellular data plan would be required to transfer all images, which might be expensive or perhaps not even available in some locations. A satellite terminal installed in the wilderness might only be able to transfer 20MB per month!

The DigiSnap Pro can be configured to send a reduced set of images (one of N) to reduce the information transmitted. All of the images in this case would be retained on the memory card or local storage for later (manual) collection.

Instead of transmitting full sized images (RAW or JPEG), much smaller thumbnail image files can be selected for transmission via networking. While limiting the amount of data sent can reduce the utility of the transmitted images, they can give peace of mind that the system is working, while not requiring a great deal of radio time and expense.

Signaling

The DigiSnap Pro has an input signal, and 3 outputs. The functions associated with each of these signals may be configured by the operator for specific applications.

The operation in response to the Input trigger signal may be configured within the DigiSnap Pro. The Burst mode is useful for a number of applications, such as animal motion sensing.

Mode	Input Trigger Function
0	Do Nothing
1	Take picture now
2	Take a burst of pictures. The delay, number of pictures in the burst, and the interval may also be defined.
3	Enable all DigiSnap Pro Controller time-lapse sequences, if disabled.
4	Gated Burst. Take pictures at burst interval while the input signal is active.
5	Shutter Sense. The center pin of an SLR camera hot shoe is active while the shutter is open. This signal may be connected to the DigiSnap Pro to provide timing for specific operations, such as to minimize the time that a lamp is on.

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The three output signals (Battery Out, 5V Out, Output) may be activated synchronously with taking pictures. For instance the 5V Out may be used to power a WiFi router, turning it on a few seconds before taking a picture, and leaving it on for a few minutes afterward to allow a WiFi memory card to transmit the image to a network. There are a variety of applications which can make use of these signals, and the timing may be configured within the DigiSnap Pro. The Before and After times can be independently configured.

Mode	Output Function
0	Do Nothing
1	Before: Activate the signal for a period of time before the picture is taken (charge a strobe for instance)
2	After: Activate the signal for a period of time after the picture (reposition the camera for instance)
3	Before & After: The signal is active for a period of time both before and after a picture. (Router...)
4	Always: The signal is always active. Useful to provide a constant Battery or 5V power source.
5	Heater Control. When external charge power is available, and the temperature is below freezing, the output is applied, which can be used to control or power a small heater inside the system housing.
6	Active when the Network hardware is powered on. This may be useful to power external networking equipment, such as a router, modem, or satellite terminal.
7	Wiper Control. The Signal Out and 5V Out lines can be used to drive an RC Servo Motor to wipe the window before taking a picture.
8	Cover Control. The Signal Out and 5V Out lines can be used to drive an RC Servo Motor to move a window cover/shutter away from the window to take a picture, and back again after the picture has been taken.
9	Lamp Control. Optimum timing for a lamp can be achieved using this control mode.

Heater Control

The DigiSnap Pro can also act as a thermostat to control power to a heater, to warm battery packs, or to clear frost from a window.

The algorithm for the heater control is as follows:

Heater control is active if all of the following are true:

- Ambient temperature is less than or equal to -5C
- Battery voltage is not low (25% or higher)
- Charge power is detected.

Once activated, the heater control is deactivated when any of the following is true:

- Ambient temperature is greater than or equal to +5C
- Battery voltage is low (25% or less)
- Charge power is removed.

The three outputs (Signal, 5V Power, Battery Power) can be configured for heater control.

- The Signal or 5V outputs could be used to control a power relay, to apply power to a heater from the external charge power source. This would prevent the heater from draining the battery pack.
- The Battery Output can be used to drive a heater directly. There are some risks to consider when using the battery output to power a heater. Some battery types cannot be charged when below freezing, just when the heater is needed! When the heater is activated and the connection is via the battery output, the internal charger is turned on regardless of the temperature. While this will help supply power to the heater, it may also provide charge power to a 'cold' battery pack, which could do some damage to the battery. If charge power is always applied, the heater will come on at -5C, and the heater may increase the battery pack temperature, so this might not be a problem. If however, the system is at a very low temperature, and charge power is applied (sunny day following a cold night), the battery packs could be damaged from charging. If the charger is sized to match the expected amount of power from the charger, there would not be any excess to charge the battery pack. A 20W heater might work well with a 20W battery pack. When the temperature rises in the housing enough to shut the heater off, the battery pack temperature may have risen enough to accept a charge with less damage.

Please choose a heater according to the voltage of the battery pack, and the amount of heat required.

Wiper Control / Cover Control

An RC servo motor can be used to move a wiper blade or brush to clear the window before taking a picture, or to move an external shutter / cover out of the way. The Signal Out line can provide the pulse-width modulated signal needed for RC (radio control) servos, and the 5V Out line can be used to provide power to the servo.

We recommend a 'Digital' RC Servo Motor, as the Signal Output may not be sufficient to drive some of the "Analog" devices. The servo must be compatible with 5V power to use the DigiSnap Pro 5V Out signal for power. One model that we recommend for compact size, great strength, and compatibility is the HD-1207TG servo.

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The Wiper Control or Cover Control selections are only applicable for the Signal Output, and the 5V Outputs, not the Battery Output.

There are other configuration parameters associated with servo control, such as the pulse width timing used at the home and final positions of the wiper, the number of wipes to perform before each picture, and the amount of time it takes for the servo to move from one position to another. These parameters depend on the servo selected, the geometry of the mechanics, and the application.

In Wiper Control operation, the wiper is moved from the home position to the final position, and then immediately swept back again to home, before the camera is activated. The time before activation is the greater of the configured Before time, or twice the Wiper Dwell time.

In Cover Control, the arm will move from the home position (covered) to the final position (open), before the camera takes the pictures, and returns to the home position after the picture has been taken.

Lamp Control

The Battery Output signal can provide up to about 2.4A of output current, when used with a 14.8V battery can supply about 35 watts of power. This is enough to drive a rather substantial LED light array! Consider a standalone operation in a cave, or underwater. The camera may be set to program or aperture priority mode, to let the camera set the exposure to suit the scene and lighting. To maximize the battery life, the lamp should be turned on for the least amount of time.

The lamp should be turned on when the camera 'half-press' is activated, to allow the camera to set the exposure, and then left on while the camera shutter is open. The lamp is left on for the amount of time indicated by the 'After' time setting. For most applications where the illumination is good, the After time may be set to 1 second to minimize power. For applications that have no movement in the scene, a less intense lamp can be used (drawing less power), and the shutter time may be extended to accumulate enough light. The After time may need to be increased to suit the worst case scenario on the site.

A further optimization of lamp timing can be achieved by connecting the camera hot shoe to the Signal input line. The center contact of an SLR hot shoe is active while the camera shutter is open, so sensing this signal can be used to shut the lamp off when the shutter closes. The After time still provides a maximum for this operation, to save the battery in case the hot shoe connection comes loose.

The only output signal used for Lamp Control is the Battery Output. Please note that it is a switched connection to the battery pack, and a separate constant current converter may be required to directly drive LEDs.

Specifications

Size: 2.3" wide, 3.5" long, 1.0" Tall (easily fits in shirt pocket)
Weight: 156 grams, 5.5 oz
Power Consumption: Approximately 100mW at idle, approximately 2 watts while networking

Power:

- Rechargeable battery pack (2 connections, hot-swap safe, 10-17V range)
- 18-30 VDC Input Charge Power Source
 - Power-Over-Ethernet (24V passive) via Network connector, and AC mains power source
 - Dedicated connector (solar panel, battery bank)
- Camera Power: 3-10 VDC output, 3.5 Amp peak capacity. Current monitored to validate camera operation.
- 5V accessory power output, 3A capacity
- Switched 5V and Battery outputs

Signaling:

- Trigger Input (configurable, such as Burst Time-Lapse triggered from motion detector)
- Contact Output (configurable, such as triggering Shoot-Move-Shoot motion controllers)
- Switched 5V Output (configurable, such as powering a network router, or LED illumination)
- Switched Battery Output (configurable, such as powering a heater when temperature is below freezing)
- Remote LED (status indicator)
- Camera Shutter Release (Half/Full Press controls)

Other Connections:

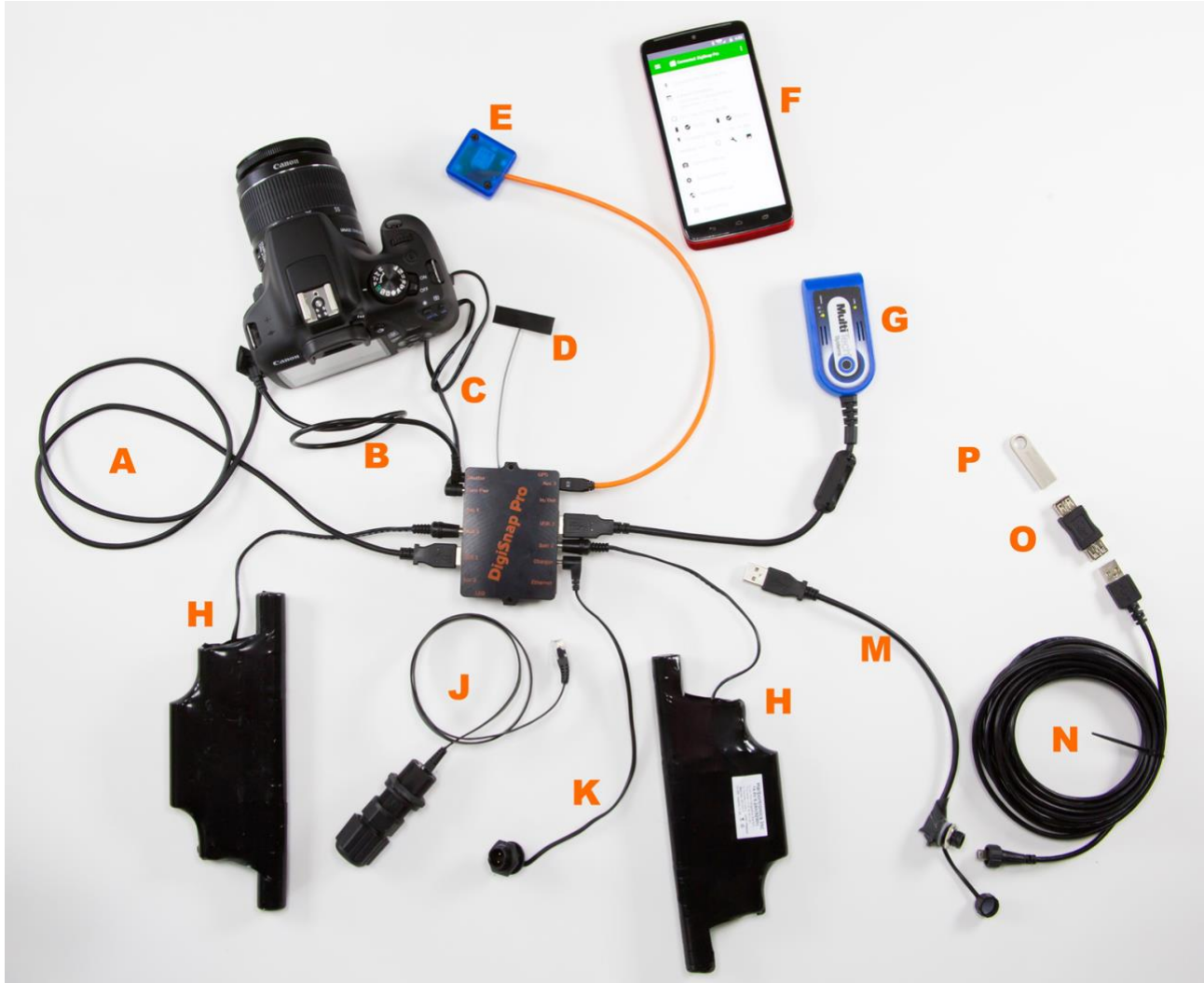
- USB Host (USB 2.0, 2 ports. Camera PTP, Memory Stick, cellular modem)
- MicroSD card (Software Updates, and internal functions)
- UART (GPS, Satellite Terminals)
- Network (10/100 Ethernet)
- DigiSnap Pro Accessory Ports (3x, for additional functions)
- WiFi (802.11a/b/g/n, external antenna)

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The DigiSnap Pro was designed at Harbortronics in Fort Collins, Colorado, USA.

The DigiSnap and Cyclapse names are trademarks of Harbortronics.

DigiSnap Pro Optional Accessories



The cables and accessories shown here and listed below cover a huge range of requirements, and may not be required for your particular application. Some of these are intended for use with a weatherproof housing such as the Cyclapse.

- A. USB Cable to Camera**
A USB cable normally comes with the camera, however we sometimes will provide a right/angle cable to reduce the space the cable takes inside the Cyclapse housing. This of course depends on the camera model used in the system.
- B. Shutter Release Cable to Camera**
SLR cameras are easily triggered to take a photo using their remote shutter release port. There are a number of connector types used by the camera manufacturers, but Harbortronics can supply cables for all of these types,
- C. Power Cable to Camera**
Most SLR cameras use a 'dummy battery' also called a DC coupler for external power. Other cameras may have a dedicated connector on the camera body. Each camera model may have a specific coupler or connector, but Harbortronics can provide a cable assembly to provide power to all of these cameras.
- D. WiFi Antenna (Harbortronics p/n 001004)**
The DigiSnap Pro includes the ability to communicate via WiFi, but this is a short range technique, so is not commonly used to connect to a network. The DigiSnap Pro housing is made from machined aluminum in order to provide shielding against high electric field events (such as nearby lightning), so an external antenna will be required to use WiFi. This antenna uses a short cable, and is perfect for use inside a housing such as the Cyclapse. It does not need to be attached to anything... it can be left standing up unsupported.
- E. Bluetooth LE Module (Harbortronics p/n 001005)**
This device includes a Bluetooth LE module, allowing communication to a smartphone or tablet. The DigiSnap Pro

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housing is made from machined aluminum in order to provide shielding against high electric field events (such as nearby lightning), so this external device is needed for radio communication. The Bluetooth LE Module can be connected to any of the three Acc ports.

- **F. Android App**
The DigiSnap Pro App is provided free of charge, and may be acquired through Google Play, or Amazon App Store. The App is currently for Android only. This App is the primary user interface to the DigiSnap Pro, allowing configuration from a short distance away! If you do not currently own a compatible Android device, we encourage you to purchase a low cost tablet. There are good Android tablets available for as little as USD \$60.
- **G. USB Cellular Modem (discontinued)**
- **H. Battery Pack**
The DigiSnap Pro is designed to always operate with an attached battery pack. Multiple battery pack chemistries are supported. The DigiSnap Pro has two connections for battery packs, allowing battery hot-swapping, or simply to increase the total battery capacity. The battery packs shown are designed for the Cyclapse housing.
- **I. Debug Module Cable (not shown) (Harbortronics p/n 001000)**
The Debug Module is a combination of a custom USB/Serial cable (not shown), and a custom program running on a Windows computer. The Debug Module is normally used for development purposes, but can be used by a customer for configuration, if the Bluetooth LE process is not permitted. The Debug Module cable can be connected to any of the three Acc ports.
- **J. Ethernet Cable Assembly, Watertight Connection (Harbortronics p/n 001030)**
When a local area network is available, a direct connection to the Ethernet port on the DigiSnap Pro provides the optimum network connection. This cable and watertight connector extend the Ethernet connection through the wall of a housing, such as the Cyclapse.
- **K. Charge Power Port, Watertight Connection (Harbortronics p/n 000453)**
A charge power source, such as a solar panel or AC adapter is normally used to keep the attached battery pack charged. This cable assembly extends the charge port connection on the DigiSnap Pro through the wall of a housing, such as the Cyclapse. Mating connectors, solar panels, extension cables, AC power sources, etc., are also available from Harbortronics.
- **L. Signaling Cable (not shown)**
The DigiSnap Pro has a connection designed to work with external trigger sources, and to control external devices. These are not normally used in a long term time-lapse application, so the cable assembly will be customized as needed, to suit your application.

Long term time-lapse projects may use networking to transfer images, but this is not always necessary, practical, or desirable. In these cases, local collection of the images may be needed. While the camera memory card could be accessed by opening the housing, the most practical way to do extract images manually using the DigiSnap Pro is to connect a USB flash drive (memory stick), through a cable attached to the housing!

- **M. USB Port, Watertight Connection (Harbortronics p/n 001029)**
This cable assembly extends a USB port on the DigiSnap Pro through the wall of a housing, such as the Cyclapse. A watertight cap is provided, for those times that a mating cable is not attached.
- **N. USB Extension Cable, Outdoor, 15ft (5M) (Harbortronics p/n 000943)**
This cable mates with the USB port on the housing, providing a watertight cable that may be routed to a convenient location for access.
- **O. USB Adapter, Female-Female Type A (Harbortronics p/n 001007)**
This adapter simply changes the gender of the cable to allow connection to a local storage device, or to an active repeater cable.
- **P. Local Storage Media**
A flash drive (memory stick), or even a USB hard-drive may be attached, to receive the images transferred from the camera by the DigiSnap Pro. Harbortronics does not normally provide this device.

Appendix 1: LED Blinking Sequence

Summary Status

During initial power-up, the internal and External LEDs will blink green 8 times to indicate that it is operating. If the DigiSnap is reset to factory default conditions, they will blink amber 8 times.

In normal operation, the LEDs will flash periodically to indicate the status of the system, as well as the time to the next picture. The internal and external LED be disabled if needed. The LEDs will be off during the periods of time that the shutter is open.

The flash color indicates the status of the system. Green indicates that no issues have been detected. Amber indicates that the system is operating, but there is no charge power source, or that the battery voltage is somewhat low. Red indicates that there is a problem that needs to be addressed, such as a camera failure, a very low or over charged battery, or a power supply failure.

Green: OK

Amber: An issue has been detected, but the system may still be operating.

Red: A problem has been detected, which needs to be addressed.

Time between flashes depends on the estimated time to the next scheduled picture:

Time between sequences	Time to next Picture
10 sec	Less than 2 min
20 sec	2.. 5 min
30 sec	5..10 min
40 sec	10..20 min
50 sec	20..40 min
60 sec	40..90 min
70 sec	90..180 min
80 sec	180..360 min
90 sec	More than 360 min

Detailed Status

A special status sequence will be displayed when the user push button is used to request more detailed information (held for 2-4 sec, or until the Amber color is displayed).

Blink:

- Standard blink per item: 200mS on, 1S off
- Extended blink: 1S on, 1S off

Status Sequence

1. Overall for all items below.
If all OK/Normal, Extended Green, and skip all of the rest of the status items
If any significant failures below, Extended Red, otherwise Extended Amber.
2. Camera:
If last picture is suspected to have failed, Extended Red.
If power is not supplied by the DigiSnap Pro, Extended Amber.
If power is supplied by DigiSnap Pro, and no failure of last pic detected, Extended Green.
3. Battery Voltage.
12.6-14.5V: Amber
14.5-16.1V: Green
16.1-16.8V: Amber
Otherwise: Red
4. Battery Charger:
Extended Green if all sub-items are OK, Extended Amber if not
 1. Input Voltage:
16-30V: Green
5-16V: Amber
Otherwise: Red
 2. Charger Electronics: Green if OK, Red if fault

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5. Controller Board:
Extended Green if all sub-items are OK, Extended Red if not
 1. Power Supplies: Green/Red
 2. Real time clock: Green/Red
6. Network Board:
Extended Green if all sub-items are OK, Extended Amber if a problem detected.
Note: If the Network Board is not installed, there will be no status shown.
 1. Camera Memory Full: Green/Red
 2. External Memory Full: Green/Red
 3. Network Availability: Green/Red
 4. Image Transfer: Green if successful or not enabled, Red if failure

If you need to contact Harbortronics to interpret the status display, you can record the external led display on your cell phone video camera and send to Harbortronics for review.