

**Title: i-SPEED 7 HEALTH MONITORING SYSTEM****Date written: June 10, 2017****Author: Patrick Hope****Keywords: i-SPEED 7, health monitoring, battery, fan speed, temperature, voltage****Overview**

The i-SPEED health monitoring system is accessible through the Connect panel within i-SPEED Control and i-SPEED Control Multi-DAQ by clicking *Show Camera Health Information* within the *Camera Information* panel typically docked in the lower left hand corner.



The i-SPEED health monitoring system is the means by which the i-SPEED 7 monitors the internal functioning of the camera. The health monitoring system is essentially a grouping of dozens of independently operating systems and sensors which measure various settings and conditions throughout the camera to ensure its smooth operation grouped into a single location. While the data output can be very informative as to the conditions and status of the camera, the interactions from the user are limited. Many of the functions performed by the camera occur automatically, with the health monitoring systems outputting the results of those functions, not demanding interaction with those functions.

Within the health monitoring system, a highlighted green box indicates that the item is present, or the condition is engaged, while a black box with greyed out text means that the item is not present or the condition is disengaged. A black box with white text indicates a measurable value.

Battery

Unlike other high-speed cameras which have detached external batteries, the i-SPEED 7 has a dedicated internal battery directly connected and controlled by the camera itself. The health monitoring system monitors the AC lead presence as well as the battery status. This represents the general system which allows the i-SPEED 7 to automatically switch from AC lead power directly to battery power without interruption simply by plugging and unplugging the unit.



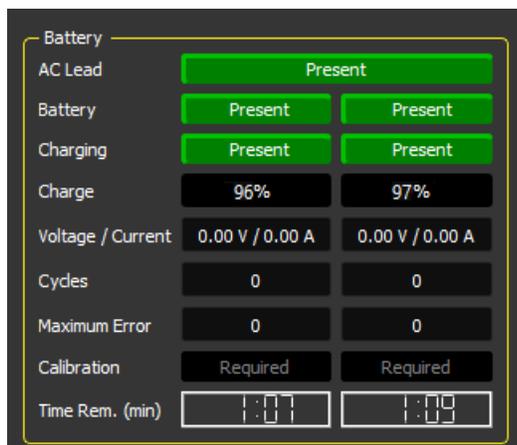
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The i-SPEED 7 is powered by two removable Lithium Ion smart batteries. The camera charges the batteries when the DC input voltage rises above 14v. These batteries each contain integrated fuel-gauge electronics which accurately measure the charge remaining on the battery by integrating the input and output current with the camera and using coulomb counting to accurately track the available capacity of the attached battery. Each battery maintains a dual chemical and digital charging capacity, the latter of which is used to determine the charge values of the former and power the indicators on the back of the batteries as well as within the camera itself.

The battery can directly display the capacity information. The battery capacity is displayed as the relative state of charge. Each LCD segment represents 20 percent of the full charge capacity. The LCD pattern definition is given in the table below. If the battery voltage is low, there will be no LCD indication. During charge, the most significant segment will blink.

Capacity	LCD Segments				
	1	2	3	4	5
Below 1%					
1%-20%					
21%-40%					
41%-60%					
61%-80%					
81%-100%					



Within the battery section, you can check on the charge of each battery, read the expected charge remaining within the current cycle, and get a good idea of the long-term life of the battery in general.

The health monitoring system controls system components to maximize the life of the batteries and to allow the batteries to charge in the quickest manner possible.

The i-SPEED health monitoring system also monitors the health and lifespan of your batteries. All lithium Ion batteries have a



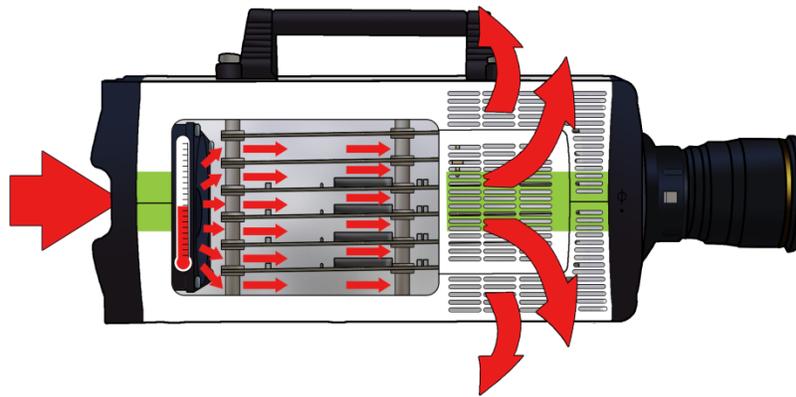
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finite lifespan measured in discharge cycles. Within the i-SPEED 7, a discharge cycle is measured when a fully charged battery goes to a completely discharged state in a single session. The cycles give a good indication of the general life of a battery, with a typical Lithium Ion battery's lifespan being roughly 300 complete cycles, at which point the available battery capacity has reached about 45% of full. As the number of cycles increases, so too does the discrepancy between the digitally monitored parameter values & the actual values of the chemical cells.

Periodic battery calibration may be necessary to re-sync these two values, as the drifting represents a relative margin of error between measured battery life and actual battery life and results in a battery dying with 2-10% of a charge remaining unused. Battery recalibration will increase the useable charge available on the battery and extend the life of the battery. Contact iX Cameras support for recalibration instructions.

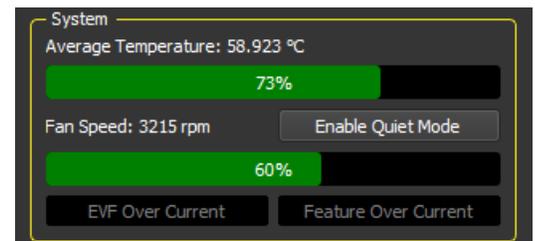
System

The system menu of the i-SPEED health monitoring system measures and averages the internal camera temperatures. A number of temperature sensors exist within the camera, but the main one displayed is the Average Temperature. This is an average value of all of the temperature readings available and is displayed as both a value in degrees Celsius as well as a percentage of maximum. Directly below the Average Temperature is the Fan Speed. This represents the speed in rotations per minute of the internal fan, and is also listed as a percentage of maximum. The fan speed is directly linked to the average temperature.



As the average temperature rises, so does the fan speed. If the average temperature rises above 90% of maximum, the user receives a cautionary alert. If the average temperature continues to rise above this point, the camera begins a safe shutdown, securing the camera and data from any damage.

The health monitoring system also allows you to access and enable Quiet mode within the camera. Quiet mode is designed for broadcast situations where you need to silence the camera fan for short periods of time. Once enabled, Quiet mode causes the camera to run silently for the duration of both a capture and





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save. The health monitoring system tracks the temperature of the camera and re-engages the fan before any overheating can occur, automatically reverting the camera to normal operation. The length of time that the camera can remain in quiet mode depends upon the temperature of the sensor.

Within the system menu is an on/off notification which monitors external feature connector output overcurrent. Overcurrent through this port could potentially cause excessive heat generation and possible damage to the external device.

Information

The health monitoring system also contains a section listing values which may be of interest to the user. Input voltage and current are important if the camera is being powered by a non-traditional source, such as a potentially unstable power grid, or a gas or solar power generator. Further information and descriptions for these values are given below.

Information	
Sensor Temperature [°C]	62.187
Input Voltage [V]	23.992
Input Current [A]	5.769
Accessory Voltage [V]	12.081
Overall Accessory Current [A]	0
System Bus Voltage [V]	12.077
System Bus Current A [A]	5.57
System Bus Current B [A]	5.541

Descriptions

AC Lead

A green button labeled 'Present' indicates if the power lead is plugged in and present in the back of the camera. The i-SPEED 7 power supply produces 24V and connects via a 6 pin LEMO connection into the back of the camera.

Battery

A green button labeled 'Present' indicates if a single battery is present in the camera. Two green 'present' buttons indicate both batteries are correctly installed and recognized by the camera. The camera will only run on battery power if both batteries are 'present' & run-time will be determined by the state of charge of the weaker of the two batteries. iX Cameras recommends inserting batteries with a capacity mismatch of no more than one segment, as indicated on the LCD window viewed through the camera's battery cover.

Charging

A green button labeled 'Charging' indicates that the battery is currently charging. A greyed out box indicates that the battery is not charging. The batteries will be charged inside the camera when the DC input voltage rises above 14V.

Charge

The current percentage value which each battery is charged.

Voltage/Current

Lists the voltage (in Volts) and current (in Amps) each battery is outputting. Each battery contains a maximum of 9A continuous discharge.

Cycles

A cycle count which counts the number of times the battery has been completely discharged and then recharged in a single cycle. This value indicates the lifespan



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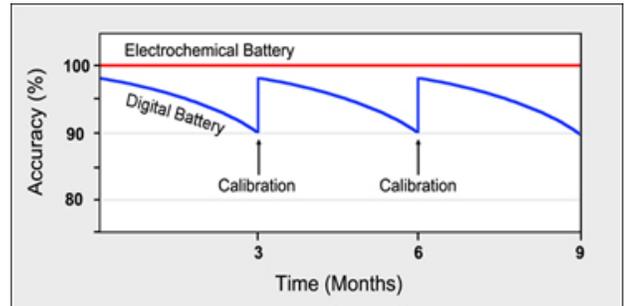
of the battery, the likelihood that the battery will need a calibration performed, as well as the max error accuracy. Partial discharging/recharging does not count as a cycle.

Maximum Error

Max Error represents the accuracy between the theoretical and actual output of the battery and is represented by a percentage of misalignment value. A max error of 0% means that the battery is outputting its full potential, while a max error of 8-10% means that the battery needs recalibration. Max error increases from partial discharges.

Calibration

All smart battery Lithium Ion batteries contain two essential components, the electrochemical battery which powers the camera, and the digital management electronics which controls the functioning of the battery.



Over time, the accuracy of the digital battery monitoring drifts off of that of the electrochemical battery and needs to be recalibrated. Typically our support department performs this calibration in-house, and it can significantly increase the life of your batteries.

Time Remaining (min)

The camera run-time to empty remaining in minutes and hours.

Average System Temp

The average temperature recorded from all of the internal sensors, as well as the percentage of maximum operational temperature.

Enable Quiet Mode

Enabling Quiet mode reduces the fan speed of the camera to the point where it is no longer audible. The camera will automatically exit quiet mode when the internal sensor temperature reaches dangerous temperatures.

Fan Speed

The number of rotations per minute at which the internal fan is spinning, as well as a percentage of maximum fan speed.

Feature Over Current

Feature cable 12V accessory device over current.

Sensor Temperature

The temperature of the image sensor.

Input Voltage

The input voltage (measured in Volts) provided to the camera. The camera requires 12V minimum to operate and a minimum of 14-V over external lead to charge the batteries.



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Input Current	The input current (measured in Amps) provided to the camera.
Accessory Voltage	The accessory voltage (measured in Volts) provided by the camera.
Overall Acc. Current	The total accessory current (measured in Amps) provided by the camera.
System Bus Voltage	The camera's internally distributed system power supply voltage.
System Bus Current A	System bus current provided by 'phase A' supply. Note that the total System Bus current is equal to the sum of 'phase A' & 'phase B', as they are connected in parallel.
System Bus Current B	System bus current provided by 'phase B' supply. Note that the total System Bus current is equal to the sum of 'phase A' & 'phase B', as they are connected in parallel.