

INCUBATOR MONITORING



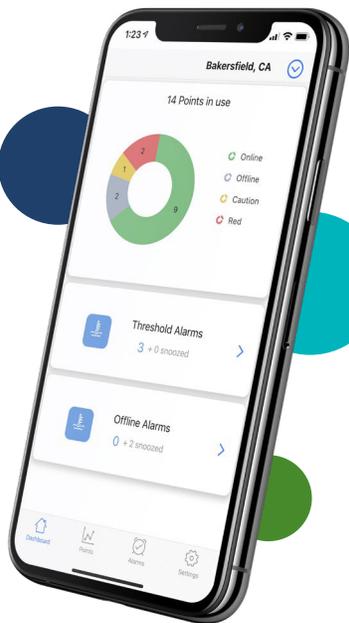
The increasing interest in biological therapies and stem cell research has sparked a rise in biological research. Specialized cells like immortalized and stem cells are vital in these studies and require meticulous care, including the use of CO2 incubators. Scientists assign and monitor several parameters in these incubators to ensure optimal cell growth and proliferation.

Many CO2 incubators already have built-in monitoring functions that measure temperature, humidity, CO2 and O2 concentrations as well as shaker speeds. Audible alarms are triggered when incubator conditions deviate from the user's set points, alerting laboratory staff to check the conditions. Some incubators also feature built-in data loggers that record environmental parameters for approximately 72 hours.





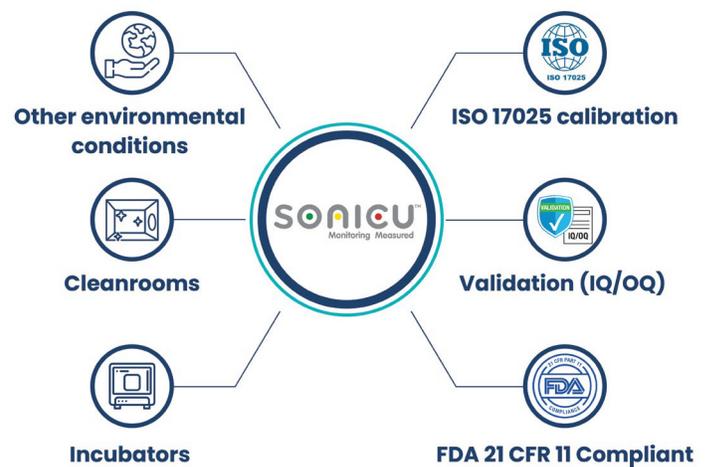
While current incubator models provide some utility in monitoring environmental parameters, they have shortcomings in detecting and alerting staff for out-of-spec conditions. Audible alarms are ineffective during off-hours when staff is less likely to be present, resulting in delayed awareness of issues.



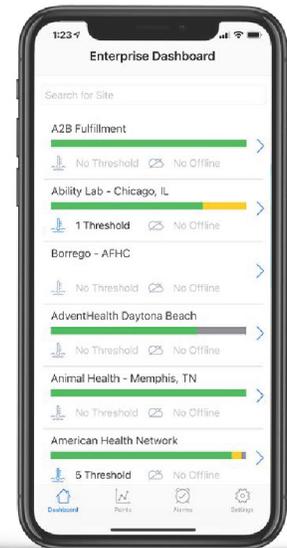
Additionally, built-in monitoring functions fail to capture out-of-spec incubator conditions caused by power outages, which can disrupt cellular incubation cycles due to inclement weather. Furthermore,

these systems may not allow for data export of environmental conditions during a cellular incubation cycle, which is valuable for troubleshooting and compliance purposes.

To overcome these limitations, incubator monitoring through the Internet of Things (IoT) is recommended. There are two options for data collection and incubator monitoring. The first option is using primary sensors placed inside the incubator to monitor crucial variables like temperature, humidity, light, CO₂, and O₂. Cloud-connected IoT sensors such as Sonicu can capture and transmit this critical data to the SoniCloud for secure storage. The choice of sensors depends on the importance of each variable.



One of the several reasons researchers select Sonicu is our flexibility to transmit data from an incubator, -80 freezer or ambient conditions monitoring device. Sonicu offers Wi-Fi, cellular and LoRaWAN transmission options, translating to increased flexibility and security for researchers depending on their unique requirements. The power and network redundancy engineered into the Duo communicating meter is also a powerful feature for researchers focused on compliance reporting.



The Duo features a backup battery and data storage that will continue to capture data and then sync it to SoniCloud upon reconnection, meaning even a power outage or network disruption will not disrupt your lab's ability to collect critical compliance data.

The second option for leveraging incubator performance indicators involves capturing data from the incubator's internal sensors. Data collection devices, like Sonicu's universal 4-20mA adapter, connect directly to the incubator's data port to gather operational set points and conditions.

Parameters such as temperature, humidity, CO₂ concentration, O₂ concentration, and shaker speeds can be monitored using these devices. Similar to the primary sensors, data collected by Sonicu is continuously streamed to SoniCloud. Users can configure customized alerts for each incubator asset on their dashboard, receiving notifications via email or SMS and even phone calls when conditions go beyond the specified range.

Monitoring incubators through sensors like Sonicu's offers many advantages over traditional built-in functions. Data is no longer restricted to a specific incubator but is remotely accessible for real-time monitoring, allowing prompt responses to alerts even when off-site. IoT provides broader coverage of failure modes, including power outages, thanks to connection and power alerts integrated into IoT devices.

For instance, battery-powered Sonicu sensors can transmit environmental data even when the incubator is not powered. This enables tracking of environmental drift within the incubator, helping assess potential compromises to the samples. Setting up IoT monitoring for incubators is a straightforward process, with the Sonicu platform designed as a plug-and-play solution. Simply connect the necessary devices, and the system is ready to use.

Primary Data Collection-Independent Monitor

-ET, EA, ED/EC



- Get independent data
- Backup in case of incubator sensor malfunction
- Automated data collection
- Real-time alerts



- More hardware - more plug points, more calibrated equipment to maintain
- More expensive-need to procure more hardware

Direct Incubator Connection via Data Port/Comm Board

-ED/EC



- Utilize built-in functionality and increased ability to capture more variables
- Less hardware to maintain
- Cheaper because you don't need extra sensors
- Automated data-collections
- Real-time alerts



- Calibrations and accuracy must be maintained per SOP
- No secondary reading