



Codes 345x

HEADnodes

Node-Based Wireless Measurement System

OVERVIEW

Node-Based Wireless Measurement System

A common requirement for measuring and monitoring sound and vibration of large vehicles, machines, or buildings is to be as unintrusive as possible. In addition, covering long distances between sensors and the recording device is challenging.

HEADnodes addresses these challenges: it is a system of nodes connected via a wireless network, which is designed for improved reliability, stability, and efficiency. Due to its unintrusive characteristics, compact node dimensions, and simple installation, HEADnodes can be set up and taken down very quickly. The system consists of different node types each of which fulfills a dedicated task:

Acq-Nodes (Code 3450) acquire measurement data. The sensors used for the measurement are each connected to an Acq-Node. If necessary, the connected sensor can be supplied by the Acq-Node.

The Cen-Node (Code 3452) wirelessly controls and configures the whole system, collects and stores the measurement data from all Acq-Nodes in its internal storage, and transfers this data to a then connected storage device once the measurement is finalized. This can be, for example, a mobile storage device such as an external SSD or a computer. Cen-Nodes can also be used to expand the range of the WiFi network via a specific repeater mode so that larger structures can be covered.

All nodes are supplied via Bat-Nodes (Codes 3453 and 3454) which are available with two different capacities of 40 Wh and 55 Wh respectively. Bat-Node 40 offers up to 20 hours of operating time including up to 500 hours of standby time for an Acq-Node. The long standby time allows for repeated recordings with longer time intervals in between. Configuration, monitoring of an ongoing measurement, and downloading of the measurement data are performed via a web interface that can be accessed via any web browser on any device.

HEADnodes comes in the transport case HN-Case (Code 3455). HN-case can be connected to a power supply and powers the nodes during configuration and charges the battery packs respectively.

KEY FEATURES

Wireless connectivity for configuration and data transfer

Compact and sturdy

Power supply via Bat-Node 40 or Bat-Node 55

Easy and unintrusive setup options

Ready-to-go storing and transportation options

Central access to the stored measurement data

Measurement configuration and system monitoring via an intuitive web interface on a mobile device or a computer

APPLICATIONS

Replacement of complex wired measurement systems with wireless technology

- › Distributed sound measurements in trains, ships, and aircrafts
- › Structural analysis of wind turbines, machinery, bridges, and buildings
- › Advanced noise measurements in urban areas

DETAILS

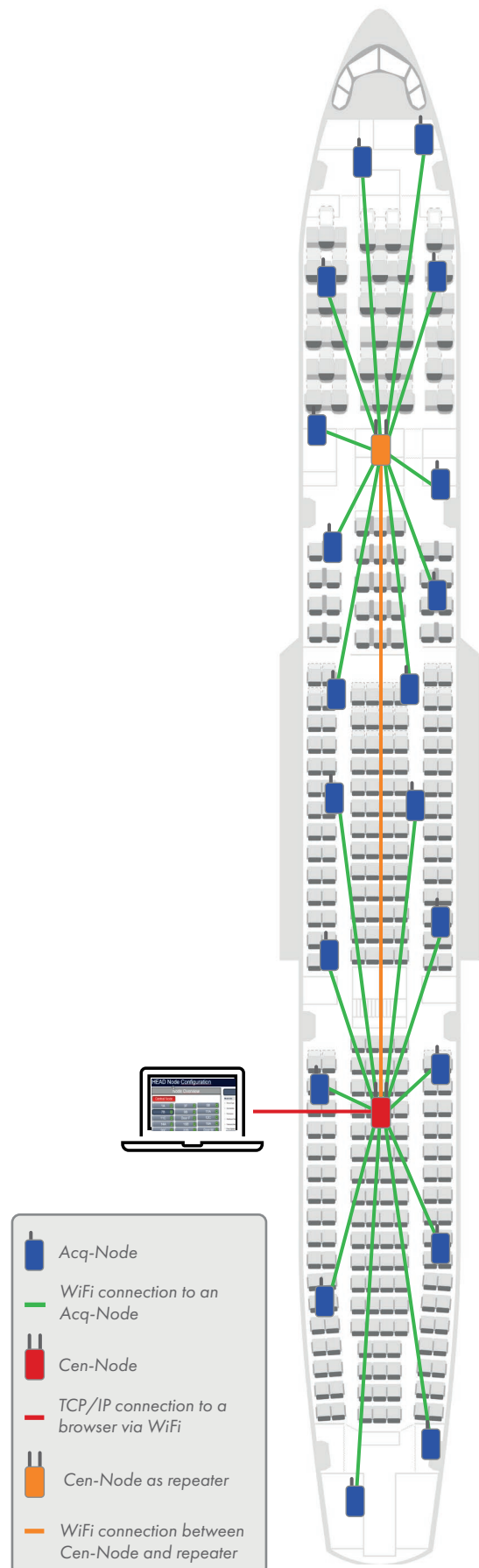
The application example to the right shows the usage of HEADnodes with 20 Acq-Nodes, a Cen-Node in repeater mode, and a Cen-Node in default mode in an aircraft cabin to measure sound and vibration during a test flight scenario.

The nodes are connected to a WiFi network that is used to transfer configuration data and commands from the Cen-Node to the other nodes and recorded data from the Acq-Nodes to the Cen-Node. The Cen-Node establishes the WiFi network and the connections to the Acq-Nodes in range and the Cen-Node in repeater mode. The Cen-Node in repeater mode extends the WiFi network's range thus ensuring a stable and reliable WiFi network connection for all Acq-Nodes (green in the figure to the right).

The system is managed via a web interface that can be accessed using a browser on a mobile device or a computer. With the web interface, recordings can be started and stopped and channels can be muted and unmuted. It also provides configuration access to all connected nodes, node status information (e.g., idle, ready, recording, ...), battery levels, overall storage capacity information, upload status, and TEDS information of connected sensors. It is also used to trigger the data download from the Cen-Node's internal storage to a connected mobile storage device.

While HEADnodes is in standby, Acq-nodes and Cen-Nodes are switched off to reduce power consumption. Supervisor components in each Bat-Node monitor the network, power up the nodes, and switch the system to normal operation if an action is triggered by the user via any Bat-Node. For example, the start of a measurement. HEADnodes then switches to normal operation and performs the configured measurement.

In systems with many nodes or for long recordings, the Cen-Node is able to download measurement data from the Acq-Nodes already during the measurement to ensure a fast finalization of the measurement. When the measurement is stopped via the web interface, the remaining measurement data is being downloaded to the internal storage of the Cen-Node and can then be transferred to a connected mobile storage device or computer by the user. After that, the measurement data is complete and can be processed further, for example, with ArtemiS SUITE.



HARDWARE COMPONENTS

Acq-Node (Code 3450)

- › Internal storage for acquired data
- › WiFi connection to the Cen-Node or to a Cen-Node in repeater mode
- › Connection to a sensor via an SMB connector
- › External WiFi antenna
- › ePaper display
- › Buttons and LEDs for on-device operation and status display
- › Power supply via a Bat-Node (Nodelink connection)

WiFi Antenna

Antenna to connect to the WiFi network which is used to receive configuration data and upload measurement data to the Cen-Node.

Nodelink connector

Nodelink connector for power supply and to send/receive configuration and status information to/from the connected Bat-Node.

Sensor Connector

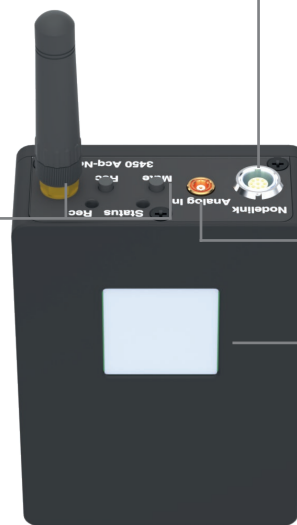
Measuring sensors such as microphones, acceleration sensors, or strain gauges are connected to this connector. The connector provides a switchable supply voltage for IEPE/ICP sensors.

Buttons and LEDs

Two buttons for on-device operation and LEDs to display different states such as idle, active, or recording.

ePaper Display

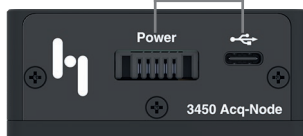
ePaper display to display details of the connected sensor and user defined text.



Acq-Node frontside

Power and USB connectors

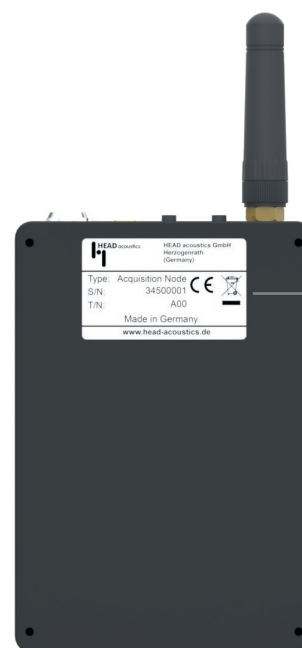
Connectors to the power supply of the transport case HN-Case (left) or for power supply and for service and maintenance access via USB-C (right).



Acq-Node underside

Type Plate

Type plate with device specific information such as product type, serial number, and product code.



Acq-Node backside

Cen-Node (Code 3452)

- › Internal storage for measurement data collected from all connected Acq-Nodes
- › Configurable repeater mode in which a central node is used to extend the WiFi network range
- › External WiFi antennas
- › ePaper display

WiFi Antennas

Two WiFi antennas to provide the node WiFi network in order to transfer configuration data to the nodes, receive measurement data from the nodes, and connect a mobile device/computer.

Buttons and LEDs

Two buttons for on-device operation and LEDs to display different states such as idle, active, or recording.

Nodelink connector

Nodelink connector for power supply and to send/receive configuration and status information to/from the connected Bat-Node.

USB-C connector

USB-C connector to connect the central node to a mobile device, an external storage, or a computer. This connection is then used to configure the system and to download measurement data. Via this connector, Cen-Node can also be supplied with power.

ePaper Display

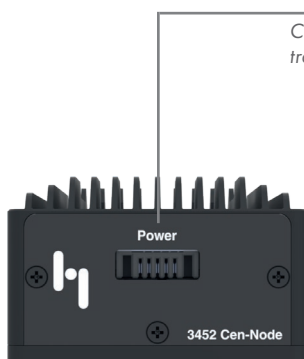
ePaper display to display selected system information and a user defined text.



Cen-Node frontside

Power connector

Connector to the power supply of the transport case HN-Case.



Cen-Node underside

Type Plate

Type plate with device specific information such as product type, serial number, and product code.



Cen-Node backside

Bat-Node 40 (Code 3453) / Bat-Node 55 (Code 3454) (images show Bat-Node 40)

- › Battery node for supplying Acq-Nodes and Cen-Nodes
- › Available with 40 Wh (Bat-Node 40) or 55 Wh capacity (Bat-Node 55)
- › Status LEDs for charge status display
- › Can be charged when stored in the Transport Case
- › External WiFi antenna for Bat-Node wake-up

Nodelink connector

Nodelink connector to supply power to and to send/receive status and configuration information to/from the connected node.

WiFi Antenna

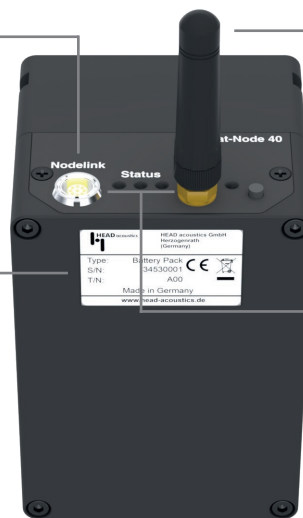
WiFi antenna to connect to the WiFi network in order to receive the wake-up instruction when the system is activated.

Type Plate

Type plate with device specific information such as product type, serial number, and product code.

Status LEDs

LEDs to display the charge status.



Bat-Node 40 backside



Bat-Node 40 underside

Power and USB connectors

Connectors to the power supply of the transport case HN-Case (left) and for service and maintenance access via USB-C (right).

POWER SUPPLY

Acq-Nodes and Cen-Nodes can be powered by Bat-Nodes or via the USB connector.

The power from Bat-Node is supplied via the Battery Cable (Code 3457) using push-pull connectors on both the Acq-Node and the Bat-Node. Acq-Nodes require less than 2 W in operation. A fully charged Bat-Node allows for the following operation times:

- › Acq-Node: ~20 h operation plus ~500 h standby (Bat-Node 40)
- › Cen-Node: ~6 h operation plus ~500 h standby (Bat-Node 55)

The two available battery packs Bat-Node 40 (Code 3453) and Bat-Node 55 (Code 3454) provide 40 Wh and 55 Wh respectively. In addition, Bat-Nodes can be charged when stored in the transport case HN-Case (Code 3455).



Bat-Nodes can be connected directly to an Acq-Node or to a Cen-Node. Bat-Node and the other node can be attached separately restricted only by the length of the power cable.

STORAGE AND TRANSPORT

Nodes are stored and transported in the robust transport case HN-Case (Code 3455) that also enables power supply for the nodes during configuration and charging of Bat-Nodes respectively. HN-Case is equipped with pull-out handles and wheels and can be handled by one or two persons.

Nodes can be powered on and off simultaneously by connecting an external power source to a designated Power In connector inside HN-Case. If HN-Case is powered, the Battery Packs are charged if necessary and the individual charge levels of the Battery Packs can be monitored via the respective status LEDs.

Transport Case HN-Case (Code 3455)

- › Fits one Cen-Node, up to five Acq-Nodes, up to five Bat-Nodes 40, and two Bat-Nodes 55
- › Power supply with a HEAD Power Supply Unit (150 W)
- › Current limit of 1 A for each node
- › Charging of Bat-Nodes 40 and Bat-Nodes 55
- › Central Power On/Off
- › Lid with lockable hinges
- › Total weight approx. 16 kg
- › Size approx. 55 cm x 36 cm x 23 cm



HN-Case (Code 3455)

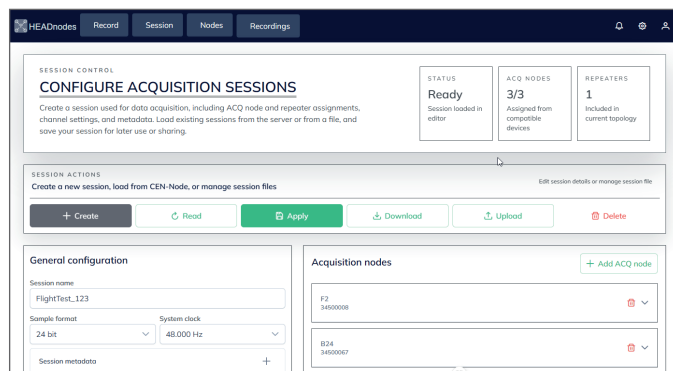
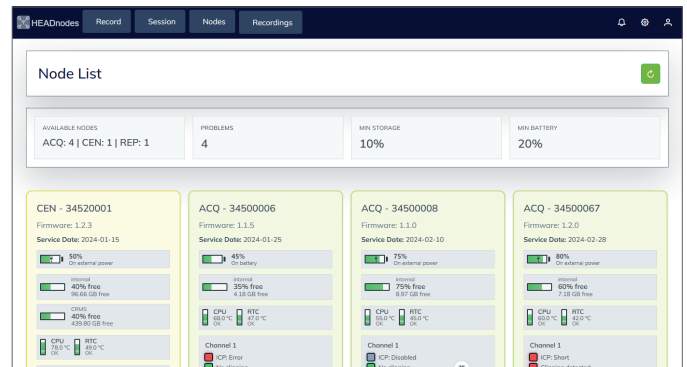


Schematic layout of HN-Case

NODE CONFIGURATION AND MONITORING

Node configuration and monitoring during a measurement is done via a web interface that can be used with any web browser on a mobile device or a computer. The web interface allows for monitoring the whole system or individual nodes and control the measurement.

The node management view allows for a detailed overview of the complete system status and detailed information about each available node in the system. For each node listed, the respective parameters are displayed. Functions like identifying nodes with low battery or storage levels, or resetting the complete system can be performed. Furthermore, node information such as battery level, power supply status, and available recording storage is displayed.

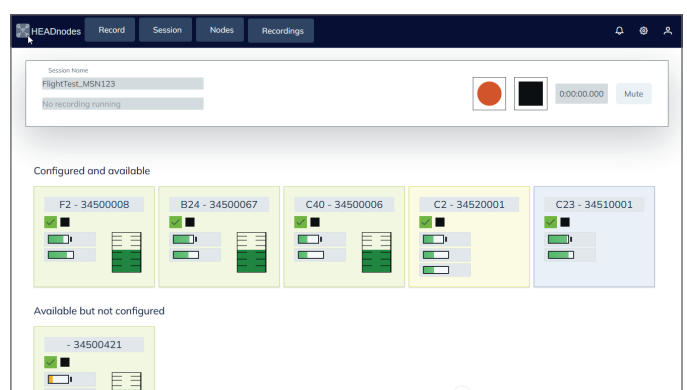


The session configuration view allows you to set up all required measurement session parameters for the complete system. You can define recording parameters like the measurement name or the system sampling rate.

The session configuration view also lets you configure the sensors connected to the nodes or define a short text for each node to be displayed on the integrated ePaper display.

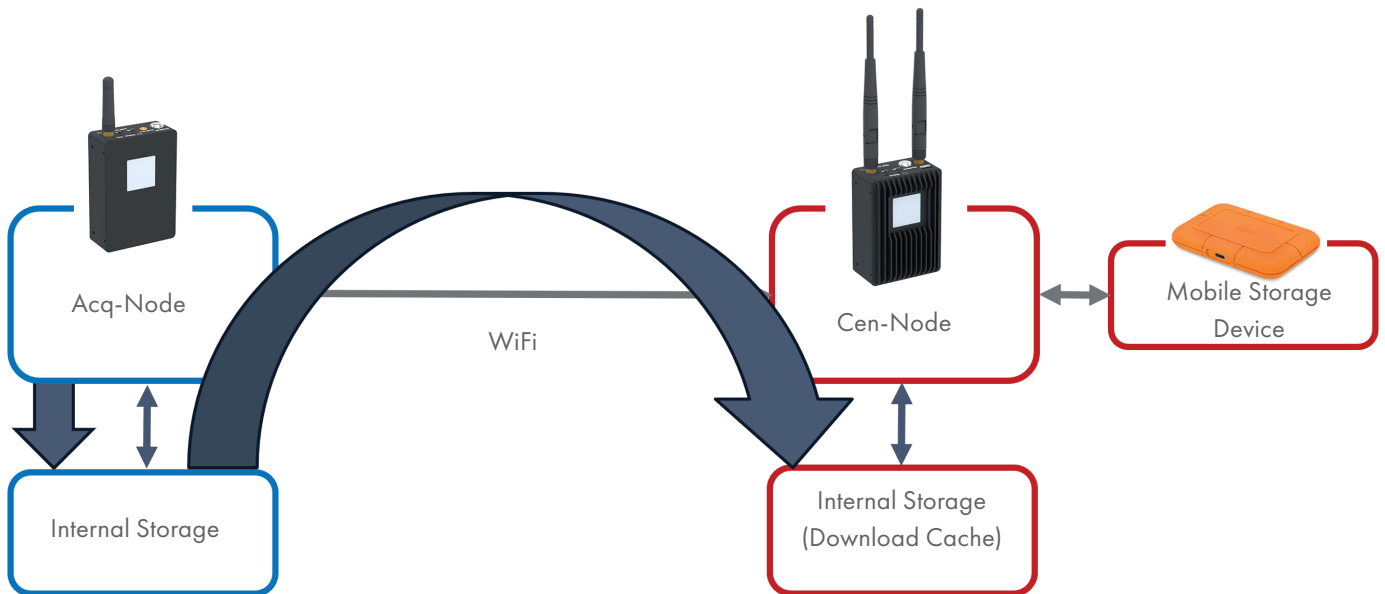
During measurement, level indicators for all nodes are displayed to monitor the incoming signals and ensure that the recorded signals are not overloaded. Additionally, the system continuously monitors each node in order to notify you of, for example, low battery levels or sensor issues.

With the recorder control you can start and stop recording for all nodes and monitor the recording duration. An event log displays incident information in case of an error or a problem.

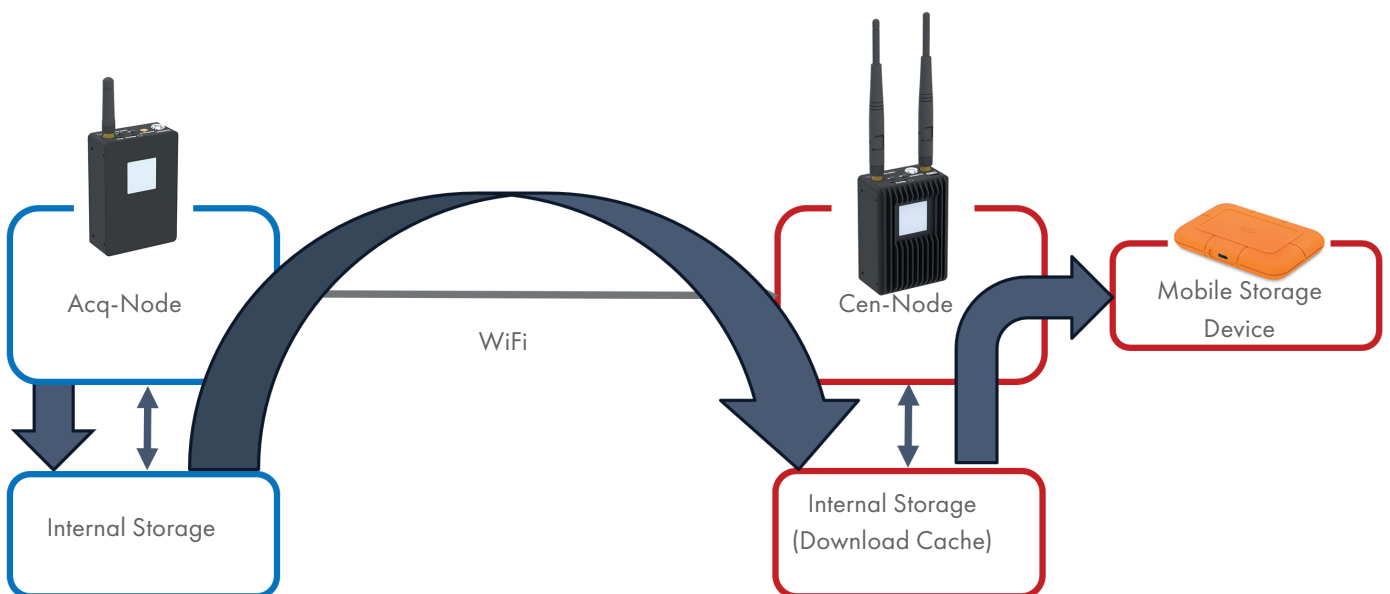


RECORDING – DATA FLOW

During measurement, Acq-Nodes store measurement data in their internal storage. Simultaneously, data is already transferred from the Acq-Nodes to the Cen-Node's internal storage (download cache).



After the measurement is finished, any remaining recorded data still stored on the Acq-Nodes is transferred to the internal storage of the Cen-Node. When all recorded data is transferred, the now completed measurement data set can be downloaded from the Cen-Node's internal storage (download cache) to a connected mobile storage device or to another storage location via the browser running the web interface.



HEADnodes PRODUCT FAMILY

Code	Name	Description	
3450	Acq-Node	Acquisition node	
3452	Cen-Node	Central node	
3453	Bat-Node 40	Battery pack with 40 Wh for supplying nodes	
3454	Bat-Node 55	Battery pack with 55 Wh for supplying nodes	
3455	HN-Case	Robust transport case with power supply for nodes	
3457	CLL-Node	Cable to supply connected nodes with power	
3449	CRMS	Removable storage	

TECHNICAL DATA

Acq-Node (Code 3450)

General

Connectors data acquisition/generation	1 x voltage/IEPE/ICP input
Communication interfaces	1 x USB OTG, 1 x Nodelink, 1 x WLAN
Supply connector	1 x push-pull connector 9-pin, 1 x HN-Case connector, 1 x USB Type-C
Supply voltage Push-pull connector 9-pin HN-Case connector USB Type-C	8 V _{DC} – 32 V _{DC} 8 V _{DC} – 32 V _{DC} 5 V _{DC}
Reverse polarity protection	Yes
Max. power consumption Device alone incl. connected sensor	1.7 W 1.85 W
Sampling rates	32.768 kHz (2 ⁿ), 48 kHz
Synchronisation	internal external via WLAN
Max. sampling rate	48 kHz
Cooling	Convection, fanless
Temperature Operation Storage	-15 °C – +55 °C (5 °F – 131 °F) -55 °C – +85 °C (-67 °F – 185 °F)
Relative humidity	0% – 90%, non-condensing
Shock (acc. to EN 60068-2-27)	Sawtooth, 26 g (260 m/s ²), 11 ms, 18 shocks (3 in each direction of the X, Y, Z axis)
Vibration (acc. to EN 60068-2-27)	Sinus, 4.5 g (45 m/s ²), 10 Hz – 500 Hz
Dimensions (WxHxD)	70 mm x 100 mm x 31 mm (without antennas)
Weight	210 g
Storage capacity	16 GB

Display

Type	EPD a-Si TFT active matrix (ePaper)
Touch capable	No
Resolution	200 x 200 pixels
Dimensions	27 mm x 27 mm
Color depth	B/W
Backlighting	No

USB Device

Connectors	1 x USB Type-C
Number of interfaces	1
USB specification	USB 2.0
Electrical isolation	No

Wireless Network (WLAN)

WLAN standard	802.11 a/b/g/n/ac/ax
Frequency bands	2.4 GHz
Number of antennas	1
Encryption	WPA3 SAE
Multiple-Input and Multiple-Output (MIMO)	1T1R

Analog Inputs (Voltage/IEPE/ICP)

Connectors	1 x SMB
Number of channels	1
Measured quantity	Voltage
Measurement ranges	1 V _p
S/N	105 dB(A)
THD+N	-100 dB
Input impedance	1 MΩ
Coupling	AC, IEPE/ICP
Analog high-pass filter	0.4 Hz
Electric strength	±24 V
IEPE/ICP voltage	24 V
IEPE/ ICP current	4 mA (-7.5% / +25%)
Cable breakage and short circuit detection for IEPE/ICP sensors	Yes
TEDS (IEEE 1451.4) read	TEDS Class 1, shared return wire (Version 0.9 und 1.0)

Cen-Node (Code 3452)

General

Communication interfaces	1 x USB OTG, 1 x Nodelink, 1 x WLAN
Supply connector	1 x push-pull connector 9-pin, 1 x HN-Case connector, 1 x USB Type-C
Supply voltage Nodelink HN-Case connector USB Type-C	8 V _{DC} – 32 V _{DC} 8 V _{DC} – 32 V _{DC} 5 V _{DC}
Max. power consumption in operation (device only)	8 W
Cooling	Convection, fanless
Temperatures Operation Storage	-15 °C – +55 °C (5 °F – 131 °F) -55 °C – +85 °C (-67 °F – 185 °F)
Relative humidity	0% – 90%, non-condensing
Shock (acc. to EN 60068-2-27)	Sawtooth, 26 g (260 m/s²), 11 ms, 18 shocks (3 in each direction of the X, Y, Z axis)
Vibration (acc. to EN 60068-2-27)	Sinus, 4.5 g (45 m/s²), 10 Hz – 500 Hz
Dimensions (WxHxD)	70 mm x 100 mm x 46 mm (without antennas)
Weight	350 g
Processor	ARM Cortex i.MX8MP Quad 1.6 GHz
Storage capacity	256 GB

Display

Type	EPD a-Si TFT active matrix (ePaper)
Touch capable	No
Resolution	200 x 200 pixels
Dimensions	27 mm x 27 mm
Color depth	B/W
Backlighting	No

USB Host

Connectors	1 x USB Type-C
Number of interfaces	1
USB specification	USB 3.1 Gen1
Output voltage	5 V _{DC}
Total output current	0.9 A
Max. output power	4.5 W
Electrical isolation	No

USB Device

Connectors	1 x USB Type-C
Number of interface	1
USB specification	USB 3.1 Gen1

Wireless Network (WLAN)

WLAN standard	802.11 a/b/g/n/ac/ax
Frequency bands	2.4 GHz / 5 GHz dual-band dual-concurrent (DBDC)
Number of antennas	2
Encryption	WPA3 SAE
Multiple-Input and Multiple-Output (MIMO)	2T2R

Bat-Node 40 (Code 3453)

General

Communication interfaces	1 x USB 2.0, 1 x Nodelink, 1 x WLAN
Supply connector	1 x HN-Case connector, 1 x USB Type-C
Supply voltage HN-Case connector USB Type-C	20 V _{DC} – 32 V _{DC} 5 V _{DC} (for operation only, no charging)
Reverse polarity protection	Yes
Max. power consumption in operation (device only)	28 W
Output voltage	9 V _{DC} – 12.6 V _{DC}
Cooling	Convection, fanless
Operating temperature Charging Discharging	0 °C – +40 °C (32 °F – 104 °F) -15 °C – +55 °C (5 °F – 131 °F)
Storage temperature	-20 °C – +65 °C (-4 °F – 149 °F)
Relative humidity	0% –90%, non-condensing

Shock (acc. to EN 60068-2-27)	Sawtooth, 26 g (260 m/s ²), 11 ms, 18 shocks (3 in each direction of the X, Y, Z axis)
Vibration (acc. to EN 60068-2-27)	Sinus, 4.5 g (45 m/s ²), 10 Hz – 500 Hz
Dimensions (WxHxD)	70 mm x 100 mm x 64.5 mm (without antennas)
Weight	840 g

Battery

Max. power consumption incl. charging	28 W
Max. output power	13.5 W
Electrical isolation input/output	No
Type	NiMH
Capacity	4.8 Ah
Voltage	10.8 V
Energy	51 Wh
Charging time with ext. power supply (device switched on)	2.5 h
Charging cycles	500
Battery charge status display	LEDs
Battery charge status software query	Yes, in 1% increments

USB Device (for Maintenance/Service Purposes Only)

Connector	1 x USB Type-C
Number of interfaces	1
USB specification	USB 2.0

WLAN

WLAN standard	802.11 b/g/n
Frequency band	2.4 GHz
Number of antennas	1

Bat-Node 55 (Code 3454)

General

Communication interfaces	1 x USB 2.0, 1 x Nodelink, 1 x WLAN
Supply connector	1 x HN-Case connector, 1 x USB Type-C
Supply voltage HN-Case connector USB Type-C	20 V _{DC} – 32 V _{DC} 5 V _{DC} (for operation only, no charging)
Reverse polarity protection	Yes
Max. power consumption in operation (device only)	28 W
Output voltage	9 V _{DC} – 16.8 V _{DC}
Cooling	Convection fanless
Operating temperature Charging Discharging	0 °C – +40 °C (32 °F – 104 °F) -15 °C – +55 °C (5 °F – 131 °F)
Storage temperature	-20 °C – +65 °C (-4 °F – 149 °F)
Relative humidity	0% – 90%, non-condensing

Shock (acc. to EN 60068-2-27)	Sawtooth, 26 g (260 m/s ²), 11 ms, 18 shocks (3 in each direction of the X, Y, Z axis)
Vibration (acc. to EN 60068-2-27)	Sinus, 4.5 g (45 m/s ²), 10 Hz – 500 Hz
Dimensions (WxHxD)	70 mm x 100 mm x 71.4 mm (without antennas)
Weight	1050 g

Battery

Max. power consumption incl. charging	35 W
Max. output power	13.5 W
Electrical isolation input/output	No
Type	NiMH
Capacity	4.8 Ah
Voltage	14.4 V
Energy	69 Wh
Charging time with ext. power supply (device switched on)	2.5 h
Charging cycles	500
Battery charge status display	LEDs
Battery charge status software query	Yes, in 1% increments

USB Device (for Maintenance/Service Purposes Only)

Connector	USB Type-C
Number of interfaces	1
USB specification	USB 2.0

WLAN

WLAN standard	802.11 b/g/n
Frequency band	2.4 GHz
Number of antennas	1

USB-C® a registered trademark of *USB Implementers Forum, Inc.*

IEPE/ICP® a registered trademark of *PCB Group*.

IEPE denotes an industry standard for piezoelectric sensors with integrated impedance-converting electronics. Comparable technologies are marketed by individual manufacturers under proprietary names such as ICP, CCLD, IsoTron, or DeltaTron. In this document, the term IEPE/ICP is used as a generic designation representing the corresponding manufacturer-specific product and trademark names.



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